EXHIBIT 1

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 • (217) 782-3397
PAT QUINN, GOVERNOR JOHN J. KIM, DIRECTOR

217/524-3301

March 11, 2013

Certified Mail
7012 0470 0001 2997 1464

Caterpillar, Inc.
Mapleton Plant
Attn: G.L. Bevilacqua
8826 W. Route 24
Mapleton, Illinois 61547-9799

Re: 1438050004 -- Peoria County
Caterpillar Inc Mapleton Plant
Permit No. 1995-154-LFM
Modification No. 20
Log No. 2013-024
Expiration Date: May 1, 2017
Permit Landfill 810-817 File
Permit Approval

Dear Mr. Bevilacqua:

Permit has been granted to Caterpillar, Inc. as owner and operator, approving development and operation of an existing foundry waste landfill all in accordance with the application and plans identified as Log No. 1995-154. Final plans, specifications, application, and supporting documents, as submitted and approved, shall constitute part of this permit and are identified in the records of the Illinois Environmental Protection Agency ("Illinois EPA"), Bureau of Land, Division of Land Pollution Control by the permit number designated in the heading above.

Permit No. 1995-154-LFM, issued April 30, 1997 approved:

a. The Significant Modification of the development and operation of this landfill so as to comply with the applicable requirements of Title 35, Illinois Administrative Code (hereinafter 35 IAC), Subtitle G, Parts 811 through 814, and Part 817. This facility consists of a single disposal unit of approximately 80 acres and is permitted to dispose of potentially usable waste foundry wastes generated within this site (Mapleton Plant).

b. Vertical expansion of the 80 acre disposal area. The total disposal capacity of the vertical expansion is approximately 4,800,000 cubic yards, excluding daily, intermediate, and final cover soils.

The total disposal capacity of this landfill, including the vertical expansion is approximately 7,300,000 cubic yards, excluding daily, intermediate, and final cover soils and its maximum final elevation is 590 feet above mean sea level.

Permit Modification No. 20 is hereby granted to Caterpillar, Inc. as owner and operator, allowing modification of an existing foundry waste landfill all in accordance with application signed and sealed by Brian E. Linne, P.E. of Caterpillar, Inc. on January 14, 2013 and identified in the Illinois EPA records as Log No. 2013-024.

The permit application approved by the Modification No. 20 consists of the following document:

DOCUMENT	DATED	DATE RECEIVED
Application Log No. 2013-024	January 14, 2013	January 17, 2013

Modification No. 20 to Permit No. 1995-154-LFM approves a revision of Special Condition VII.7.g.

Except for the differences described below, the special conditions of the permit letter for Modification No. 20 are identical to the special conditions of the Permit No. 1995-154-LFM, Modification No. 19, issued on August 31, 2012.

Special Condition Number in Modification No. 19	Special Condition Number in Modification No. 20	Description of Change
VII.7.g	VII.7.g	Replaced 2012 with 2013.

Final plans, specifications, application, and supporting documents as submitted and approved shall constitute part of this permit and are identified on the records of the Illinois EPA, Bureau of Land, Division of Land Pollution Control by the permit number and log number designated in the heading above.

Pursuant to Section 39(a) of the Illinois Environmental Protection Act (Act) [415 ILCS 5/39(a)] this permit is issued subject to the development, operating and reporting requirements for non-hazardous waste landfills in 35 IAC, Parts 810, 811, 813, 814, and 817, the standard conditions attached hereto, and the following special conditions. In case of conflict between the permit application and these conditions (both standard and special), the conditions of this permit shall govern.

I. CONSTRUCTION QUALITY ASSURANCE

1. All necessary surface drainage control facilities shall be constructed prior to other disturbance in any area.

2. No part of the unit shall be placed into service or accept waste until an acceptance report for all the activities listed below (as applicable) has been submitted to and approved by this Illinois EPA as a significant modification pursuant to 35 IAC, Sections 811.505(d) and 813.203.

   a. Installation of the leachate sampling system;

   b. Construction of the surface water control system including sedimentation basins/ponds; and

   c. Placement of final cover.

3. The permittee shall designate an independent third party contractor as the Construction Quality Assurance (CQA) Officer(s). The CQA Officer(s) shall be an Illinois Certified Professional Engineer who is independent from and not under the control or influence of the operator, any employee of the operator, or any other corporation, company or legal entity that is a subsidiary, affiliate, parent corporation or holding corporation associated with the operator.

4. The CQA Officer(s) designated pursuant to Special Condition No. I.3 shall personally be present during all construction and testing is subject to CQA certification pursuant to 35 IAC, Section 811.503(a). If the CQA Officer(s) is unable to be present as required, then the CQA officer(s) shall comply with the requirements of 35 IAC, Section 811.503(b).

5. Pursuant to 35 IAC, Section 811.505(d), upon completion of construction of each major phase, the CQA Officer(s) shall submit an acceptance report to the Illinois EPA. The acceptance report shall be submitted before the structure is placed into service and shall contain the following:

   a. A certification by the CQA Officer(s) that the construction has been prepared and constructed in accordance with the engineering design;

   b. As-built drawings; and

   c. All daily summary reports.

6. All stakes and monuments marking property boundaries and the permit area shall be maintained, inspected annually and surveyed no less frequently than once in five years by a professional land surveyor. Any missing or damaged stakes or monuments discovered shall be replaced and resurveyed.

7. All standards for testing the characteristics and performance of materials, products, systems, and services shall be established by the American Society for Testing and Materials (ASTM) unless otherwise stated in the permit application.

II. OPERATING CONDITIONS

1. Pursuant to 35 IAC, Sections 811.107(a) and 811.107(b), throughout the operating life of this landfill, waste shall not be placed in a manner or at a rate which results in unstable internal or external slopes or interference with construction, operation or monitoring activities.

2. The operator of this solid waste facility shall not conduct the operation in a manner which results in any of the following:

   a. refuse in standing or flowing waters;

   b. leachate flows entering waters of the State;

   c. leachate flows exiting the landfill confines (i.e., the facility boundaries established for the landfill in a permit or permits issued by the Illinois EPA);

   d. open burning of refuse in violation of Section 9 of the Act;

   e. failure to provide final cover within time limits established by Board regulations;

   f. acceptance of wastes without necessary permits;

   g. scavenging as defined by Board regulations;

   h. deposition of refuse (waste) in any unpermitted (i.e., without an Illinois EPA approved significant modification authorizing operation) portion of the landfill;

   i. acceptance of a special waste without a required manifest and identification record, if required;

   j. failure to submit reports required by permits or Board regulations;

   k. failure to collect and contain litter (waste) from the site by the end of each operating day.

   l. failure to submit any cost estimate or any financial assurance mechanism for the facility as required by the Act or Board regulations.

3. No later than 60 days after placement of the final lift of waste in any area, the area shall receive a final cover system meeting the design specifications approved in this permit application (Log No. 1995-154). The final cover shall consist of a layer of two (2) feet

of compacted, selected foundry sand from mold pit with a maximum hydraulic conductivity of 1 x 10^{-7} cm/sec overlain by two inches (2") of topsoil roto-tilled with four (4) inches of select foundry material, for a total vegetative layer of six (6) inches capable of supporting vegetation.

4. Operating hours are those hours during which waste may be accepted. For this facility the operating hours shall be twenty four (24) hours a day, Monday through Sunday.

5. Adequate lighting shall be provided for outdoor activities at the landfill occurring before sunrise or after sunset.

6. Equipment shall be maintained and available for use at the facility during all hours of operation to allow proper operation of the landfill. If breakdowns occur that would prevent proper facility operation, back-up equipment shall be brought into the site.

7. All utilities, including but not limited to heat, lights, power, communications equipment and sanitary facilities necessary for safe, efficient and proper operation of the landfill shall be available at the facility at all times.

8. Waste shall be deposited at the fill face and compacted upward into the fill face unless precluded by extreme weather conditions or for reasons of safety.

9. The operator shall implement methods for controlling dust so as to prevent wind dispersal of particulate matter off-site.

10. The facility shall be constructed and operated to minimize the level of equipment noise audible outside the facility. The facility shall not cause or contribute to a violation of 35 IAC, Parts 900 through 905.

11. The operator shall institute fire protection measures in accordance with the proposed fire safety plan.

12. The operator shall implement methods to prevent tracking of mud by hauling vehicles onto public roadways.

13. Access to the active area and all other areas within the boundaries of the facility shall be controlled by use of fences, gates and natural barriers to prevent unauthorized entry at all times.

14. A permanent sign shall be maintained at the facility entrance containing the information required under 35 IAC, Section 811.109(b)(1) through (5).

15. The operator shall implement load checking program detailed in Permit Application Log No. 1995-154 so as to prevent disposal of an unauthorized waste in accordance with 35 IAC, Section 817.306. Furthermore, the operator shall not accept wastes for disposal at this facility unless the wastes are accompanied by documentation that they are potentially usable based on testing of the leachate from such a waste performed in accordance with the requirements of 35 IAC, Part 817, Subpart A.

16. The following potentially usable wastes generated by Caterpillar, Inc., Mapleton Plant are permitted for disposal at the on-site landfill:

    a. Dust collector wastewater treatment sludge;
    b. *Dry dust collector "super saks";
    c. Core pit waste;
    d. Mold pit waste;
    e. 3500 area waste;
    f. 3600 series waste;
    g. Finishing waste;
    h. Metallics waste;
    i. +Metal pieces mixed with sand;
    j. Used Refractory; and
    k. Foundry Slag

    Notes: *The sacks/bags in which the dust is collected shall constitute no more than 0.1% by volume of the total amount of waste disposed during the lifetime of the landfill.

    +Shall constitute no more than 1.0% by volume of the total amount of waste disposed during the lifetime of the landfill.

III. <u>RECORDKEEPING</u>

1. Information developed by the operator but not yet forwarded to the Illinois EPA in a semi-annual or annual report shall be kept at or near the facility for inspection by the Illinois EPA upon request during normal working hours.

2. Information and observations derived from load checking inspections shall be recorded in writing and retained at the facility for at least three (3) years.

3. The permittee shall retain copies of any certifications of representative samples, laboratory analyses, waste analysis plans, and any waivers of requirements, at the facility until the end of the closure period and thereafter at the site office until the end of the post-closure care period.

4. Inspections of the closed landfill shall be conducted in accordance with the approved post-closure care plan. Records of field investigations, inspections, sampling and

corrective action taken are to be maintained at the site and made available to Illinois EPA personnel. During the post-closure care period, those records are to be maintained at the office of the site operator.

5. The permittee shall record and retain near the facility in an operating record or in some alternative location specified by the Illinois EPA, the information submitted to the Illinois EPA pursuant to 35 IAC, Parts 811, 813, and 817, as it becomes available. At a minimum, the operating record shall contain the following information, even if such information is not required by 35 IAC, Parts 811, 813, and 817:

    a. Any location restriction demonstration required by 35 IAC, Sections 811.102 and 817.309;

    b. Inspection records, training procedures, and notification procedures required by 35 IAC, Section 817.306;

    c. Any demonstration, certification, monitoring results, testing, or analytical data relating to the leachate monitoring program required by 35 IAC, Sections 813.501 and 817.305;

    d. Closure and post-closure care plans and any monitoring, testing, or analytical data required by 35 IAC, Sections 811.110, 811.111, and 817.303; and

    e. Any cost estimates and financial assurance documentation required by 35 IAC Part 811, Subpart G and Section 21.1 of the Act.

V. GENERAL CONDITIONS

1. This permit is issued with the expressed understanding that no process discharge to Waters of the State or to a sanitary sewer will occur from these facilities except as authorized by a permit issued by the Bureau of Water.

2. Site surface drainage, during development, during operation and after the site is closed, shall be managed in accordance with the approved drainage control plan.

3. If changes occur which modify any of the information the permittee has used in obtaining a permit for this facility, the permittee shall notify the Illinois EPA. Such changes would include but not be limited to any changes in the names or addresses of both beneficial and legal titleholders to the herein-permitted site. The notification shall be submitted to the Illinois EPA within fifteen (15) days of the change and shall include the name or names of any parties in interest and the address of their place of abode; or, if a corporation, the name and address of its registered agent.

4. Pursuant to 35 IAC, Section 813.201(a), any modifications to this permit shall be proposed in the form of a permit application and submitted to the Illinois EPA.

5. Pursuant to 35 IAC, Section 813.301, an application for permit renewal shall be filed with the Illinois EPA at least ninety (90) days prior to the expiration date of this permit.

6. The attachments and enclosures referenced in Permit No. 1995-154-LFM, issued on April 30, 1997 have not been changed by this permit modification and they remain valid.

7. The permittee(s) shall submit a 39(i) certification and supporting documentation within 30 days of any of the following events:

   a. The owner or officer of the owner, or operator, or any employee who has control over operating decisions regarding the facility has violated federal, State, or local laws, regulations, standards, or ordinances in the operation of waste management facilities or sites; or

   b. The owner or operator or officer of the owner, or operator, or any employee who has control over operating decisions regarding the facility has been convicted in this or another State of any crime which is a felony under the laws of this State, or conviction of a felony in a federal court; or

   c. The owner or operator or officer of the owner, or operator, or any employee who has control over operating decisions regarding this facility has committed an act of gross carelessness or incompetence in handling, storing, processing, transporting, or disposing of waste.

   d. A new person is associated with the owner or operator who can sign the application form(s) or who has control over operating decisions regarding the facility, such as corporate officer or a delegated employee.

VI. SURFACE WATER CONTROL

1. Runoff from disturbed areas to waters of the State shall be permitted by the Illinois EPA in accordance with 35 IAC, Part 309, and meet the requirements of 35 IAC 304 unless permitted otherwise.

2. All surface water control structures other than temporary diversions for intermediate phases shall be operated until the final cover is placed and erosional stability is provided by the final protective layer of the final cover system.

3. Runoff from undisturbed areas resulting from precipitation events less than or equal to the 25-year, 24-hour precipitation event shall be diverted around disturbed areas where possible and not commingled with runoff from disturbed areas.

4. Site surface drainage, during development, during operation and after the site is closed, shall be managed in accordance with the approved drainage control plan detailed in Permit Application Log No. 1995-154. Stormwater management structures consisting of perimeter ditches and sediment basins shall be constructed prior to disturbing any portion of a drainage area identified in Application Log No. 1995-154.

VII. LEACHATE SAMPLING

1. This permit authorizes installation of a leachate sampling system as outlined in Permit Application Log Nos. 1995-154 and 1999-128 which proposes that piezometers are to be installed to comply with the requirement of 35 IAC, Section 817.305(a). Any modification to the leachate sampling system, such as, a change in the sampling point(s) design (piezometer, lysimeter, etc.) or sampling location shall be approved by the Illinois EPA via a submittal of a significant modification of permit application.

2. Leachate from this landfill shall be sampled and tested beginning as soon as it is first produced and continuing throughout the operating period and post-closure care period of this facility in accordance with the plans proposed in Permit Application Log No. 1995-154.

3. The following sampling points are to be used in the Leachate Sampling Program for this facility:

Leachate Sampling Points

Applicant Designation	Illinois EPA Designation
L301	L301
L302	L302
L303R	L03R
L304	L304
L305	L305

4. Pursuant to 35 IAC, Sections 817.305(b), leachate monitoring (i.e., sampling, measurements and analysis) must be implemented at each leachate sampling point when that device accumulates a measurable quantity of leachate for the first time. The concentrations or values for the parameters contained in List L1 (below) shall be determined on a semi-annual basis for each "producing" sampling point using the statistical procedures outlined in 35 IAC, Sections 817.106 and 817.305 and submitted in accordance with the sampling, testing, and reporting schedules in Special Condition No. VII.5.

LIST L1

Routine Leachate Monitoring Parameters	STORET
Temp. Of Leachate Sample (^{0}F)	00011
Specific Conductance	00094
pH	00400
Elevation Leachate Surface	71993
BTM of Well Elevation	72020
Leachate Level from Measuring Point ft.	72109
1,1,1-Trichloroethane	34506
1,1-Dichloroethylene	34501
1,2-Dichloroethane	34531
1,2-Dichloropropane	34541
Arsenic (total)	01002
Barium	01007
Benzene	34030
Cadmium (total)	01027
Carbon Tetrachloride	32101
Chloride	00940
Chromium	01034
cis-1,2-Dichloroethylene	77093
Copper (total)	01042
Ethylbenzene	78113
Fluoride	00951
Iron	01045
Lead	01051
Manganese	01055
Monochlorobenzene	34301
Nitrate-Nitrogen	00620
Selenium	01147
Styrene	77128
Sulfates	00945
Tetrachloroethylene	34475
Toluene	34010
Total Dissolved Solids (TDS)	70300
trans-1,2-Dichloroethylene	34546
Trichloroethylene	39180
Trihalomethanes (total in water, by summation ug/l)	82080
Vinyl Chloride	39175
Xylene	81551
Zinc	01092

Notes for all leachate sampling parameters:

a. The test methods for leachate analysis shall be those approved in the USEPA's Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846), Third Edition or the equivalent thereof.

b. All parameters shall be determined from unfiltered samples.

c. The monitoring results should be reported in ug/l units unless otherwise indicated.

5. The schedule for leachate sample collection and submission of semi-annual monitoring results is as follows:

Sampling Event	Sampling List	Report Due Date
April-May (2^{nd})	All leachate points List L1	July 15
Oct-Nov (4^{th})	All leachate points List L1	January 15

List L1 - Routine Leachate Parameters

The leachate monitoring data must be submitted in an electronic format. The information is to be submitted as fixed-width text files formatted as found at http://www.epa.state.il.us/land/waste-mgmt/groundwater-monitoring.html.

6. Pursuant to 35 IAC, Section 817.305(c), if the results of testing of leachate samples indicate that the organic Maximum Allowable Leachate Concentration (MALC) for potentially usable waste as defined in 35 IAC, Section 817.106 have not been exceeded for any of the chemical constituents in List L1 for four (4) consecutive sampling periods, the sampling frequency for the organic parameters shall be reduced to once every two (2) years. All changes to the leachate sampling frequency and leachate sampling list must be approved by the Illinois EPA through the permit modification process.

The procedure described in the application addenda dated April 20, 2001 and June 25, 2001 of Log No. 2000-482 shall be used to evaluate leachate sampling data.

Each year, no later than June 1 of that year, the permittee shall submit a leachate data evaluation report in the form of an application for significant modification of permit. The report shall contain all data and statistical calculations used in the previous two (2) sampling and evaluation periods.

7. Pursuant to 35 IAC, Section 817.305(d), if the results of testing of leachate samples confirm that the MALCs for potentially usable waste as identified in 35 IAC, Section 817.106 have been exceeded for any of the chemical constituents in List L1, the permittee shall:

a. Notify the Illinois EPA in writing of the finding within ten (10) days following the finding;

b. Verify the exceedence by taking additional samples within forty five (45) days after the initial observation;

c. Report the results of the verification sampling to the Illinois EPA within sixty (60) days after the initial observation;

d. Determine the cause of the exceedence which may include, but not be limited to, the waste itself, natural phenomena, sampling or analysis errors, or an offsite source. The determination shall be completed within thirty (30) days after reporting the verification results to the Illinois EPA;

e. Notify the Illinois EPA in writing of a confirmed exceedence and provide the rationale used in such a determination in the form of significant modification of permit application within ten (10) days after the determination.

f. If an exceedance(s) is attributable to the landfill, the operator shall undertake quarterly sampling and analysis for the organic parameters in List L1 of Special Condition No. VII.4 in accordance with the following schedule:

Sampling Quarter	Sampling List	Report Due Date
Jan-Feb (1st)	All leachate points	April 15
April -May (2nd)	All leachate points	July 15
July-Aug (3rd)	All leachate points	October 15
Oct-Nov (4th)	All leachate points	January 15

Quarterly sampling and analysis for the organic parameters shall continue until the exceedance(s) cease.

g. TDS shall not be subject to the requirements of items a through f above during the 2nd and 4th quarters of 2010 through 2013 leachate sampling and evaluation events.

8. If, as a result of further testing of the leachate pursuant to Special Condition VII.7.b of this permit and statistical analysis of the results in accordance with 35 IAC, Section 811.320(e), it is determined that the facility leachate exceeds the MALC limits for a potentially usable waste provided in 35 IAC, Section 817.106, but does not exceed the MALC limits for a low risk waste, the facility shall:

   a. No longer be subject to the potentially usable waste landfill requirements at 35 IAC, Part 817, Subpart C; and

   b. Immediately be subject to the requirements for low risk waste landfills of 35 IAC, Section 814.602.

9. If the results of the retesting completed pursuant to Special Condition VII.7.b indicate the leachate exceeds the MALC limits for a low risk waste provided in 35 IAC, Section 817.106, the facility shall:

   a. No longer be subject to the potentially usable waste landfill requirements at 35 IAC, Part 817, Subpart C;

   b. Immediately cease accepting waste;

   c. Within sixty (60) days, develop closure and post-closure care plans that incorporate the requirements of 35 IAC, Part 811, Subpart C and Parts 812 and 813, as applicable; and

   d. Initiate closure within ninety (90) days pursuant to a closure plan and complete closure within one (1) year or pursuant to an alternate closure schedule that has been approved in writing by the Illinois EPA.

10. Should any well become consistently dry or unserviceable, a replacement well shall be provided within ten (10) feet of the existing well. This well shall monitor the same zone as the existing well and constructed in accordance with the current Illinois EPA well construction standards at the time that the wells are replaced. A replacement well which is more than ten (10) feet from the existing well or which does not monitor the same zone must be approved via a Significant Modification of the permit and designated as a new well.

    Within sixty (60) days of installation of any leachate monitoring well, boring logs compiled by a qualified geologist, well development data and as-built diagrams shall be submitted to the Illinois EPA utilizing "Well Completion Report" form. For each well installed pursuant to this permit one form must be completed. As-built diagrams, for each monitoring point installed, shall include the horizontal location to the nearest 0.1 foot (grid coordinates), the type and inner diameter of casing material used, type and length of screen packing material used, type and length of seals used, type of backfill used, finishing details, groundwater levels, elevation of stick-up (top of casing), ground surface elevation, bottom elevation, interval screened and screen slot size and depth. All elevations or levels are to be measured and reported to the nearest 0.01 foot MSL.

VIII. <u>GROUNDWATER</u>

1. The operator has demonstrated that this facility meets the requirements of 35 IAC, Section 817.309(b)(2) for a potentially useable waste facility. Furthermore, no additional groundwater monitoring, at this time, is required at this facility.

2. Existing upgradient wells G01S, G02S, G03S, G04S, and G04D and downgradient wells G05S, G06S, P06S, P06D, R07S, and G08S shall be maintained in accordance with the requirements of 77 IAC, Part 920 of the Illinois Department of Public Health Water Well Construction Code.

IX. CLOSURE/POST CLOSURE CARE AND FINANCIAL ASSURANCE

1. The facility shall be closed in accordance with the closure plan in Application Log No. 1995-154. Upon completion of closure activities, the operator shall notify the Illinois EPA that the site has been closed in accordance with the approved closure plan utilizing the Illinois EPA's "Affidavit for Certification of Closure of Solid Waste Landfills permitted under 35 Ill. Adm. Code Parts 813 and 814."

2. Inspections of the closed landfill shall be conducted in accordance with the approved post-closure care plan in Application Log No. 1995-154. Records of field investigations, inspections, sampling and corrective action taken are to be maintained at the site and made available to Illinois EPA personnel. During the post-closure care period, these records are to be maintained at the office of the site operator.

3. If necessary, the soil over the entire planting area shall be amended with lime, fertilizer and/or organic matter. On sideslopes, mulch or some other form of stabilizing material is to be provided to hold seed in place and conserve moisture.

4. When the post-closure care period has been completed, the operator shall notify the Illinois EPA utilizing the Illinois EPA's LPC-PA1 application form entitled "General Application for Permit."

5. The operator shall provide financial assurance for closure and post-closure care pursuant to 35 IAC, Part 811, Subpart G and Section 21.1 of the Act. Financial assurance for closure and post-closure care shall be required only for those areas for which authorization to operate has been issued and for those areas expected to be operated during the current five (5) year permit term.

6. The total cost estimate for premature closure and post-closure care for this facility approved by Modification No. 18 is $2,527,088.00 as contained in application Log No. 2012-024. The owner and operator shall maintain financial assurance equal to or greater than current cost estimate at all times in accordance with 35 IAC, Section 811.701(a).

X. REPORTING REQUIREMENTS

1. The annual report for each calendar year shall be submitted to the Illinois EPA by May 1, of the following year pursuant to 35 Ill. Adm. Code 813.504. The annual report shall include:

a. Information relating to monitoring data from the leachate collection system, groundwater monitoring network, gas monitoring system and any other monitoring data specified in this permit, including:

   1) Summary of monitoring data for the calendar year;

   2) Dates of submittal of comprehensive monitoring data to the Illinois EPA during the calendar year;

   3) Statistical summaries and analysis of trends;

   4) Changes to the monitoring program; and

   5) Discussion of error analysis, detection limits and observed trends.

b. Proposed activities:

   1) Amount of waste expected in the next year;

   2) Structures to be built within the next year; and

   3) New monitoring stations to be installed within the next year.

c. Any modification or significant modification affecting operation of the facility; and

d. The signature of the operator or duly authorized agent as specified in 35 Ill. Adm. Code 815.102.

2. In addition to the annual report, the semi-annual reports on leachate sampling shall be submitted to the Illinois EPA in accordance with the schedule described in Special Condition VII.5, pursuant to 35 IAC, Section 813.502.

3. The original and two (2) copies of all certifications, logs, reports (including annual reports) and plan sheets and three (3) copies of monitoring and analysis data which are required to be submitted to the Illinois EPA by the permittee should be mailed to the following address:

   Illinois Environmental Protection Agency
   Bureau of Land -- #33
   Permit Section
   1021 North Grand Avenue East
   Post Office Box 19276
   Springfield, Illinois 62794-9276

The applicant may appeal this final decision to the Illinois Pollution Control Board pursuant to Section 40 of the Act by filing a petition for a hearing within 35 days after the date of issuance of the final decision. However, the 35-day period may be extended for a period of time not to exceed 90 days by written notice from the applicant and the Illinois EPA within the initial 35-day appeal period. If the owner or operator wishes to receive a 90-day extension, a written request that includes a statement of the date the final decision was received, along with a copy of this decision, must be sent to the Illinois EPA as soon as possible.

For information regarding the request for an extension, please contact:

Illinois Environmental Protection Agency
Division of Legal Counsel
1021 North Grand Avenue East
Post Office Box 19276
Springfield, IL 62794-9276
217/782-5544

For information regarding the filing of an appeal, please contact:

Illinois Pollution Control Board, Clerk
State of Illinois Center
100 West Randolph, Suite 11-500
Chicago, IL 60601
312/814-3620

Work required by this permit, your application or the regulations may also be subject to other laws governing professional services, such as the Illinois Professional Land Surveyor Act of 1989, the Professional Engineering Practice Act of 1989, the Professional Geologist Licensing Act, and the Structural Engineering Licensing Act of 1989. This permit does not relieve anyone from compliance with these laws and the regulations adopted pursuant to these laws. All work that falls within the scope and definitions of these laws must be performed in compliance with them. The Illinois EPA may refer any discovered violation of these laws to the appropriate regulating authority.

Sincerely,

Stephen F. Nightingale, P.E.
Manager, Permit Section
Bureau of Land

KES
SFN:KES/1438050004-811LF-SM20-2013024-Approval.doc
CJL

Attachment: Standard Conditions

cc: Brian E. Linne, P.E., Caterpillar, Inc.

bcc: Bureau File
Peoria Region
Bur Filson
Ellen Robinson, Bob Mathis & Nancy Moore
Kenn Smith

STANDARD CONDITIONS FOR CONSTRUCTION/DEVELOPMENT PERMITS ISSUED BY THE ILLINOIS ENVIRONMENTAL PROTECTION AGENCY BUREAU OF LAND

August 22, 2001

The Illinois Environmental Protection Act (Illinois Revised Statutes, Chapter 111-1/2, Section 1039) grants the Environmental Protection Agency authority to impose conditions on permits which it issues.

These standard conditions shall apply to all permits which the Agency issues for construction or development projects which require permits under the Bureau of Land. Special conditions may also be imposed in addition to these standard conditions.

1. Unless this permit has been extended or it has been voided by a newly issued permit, this permit will expire two years after date of issuance unless construction or development on this project has started on or prior to that date.

2. The construction or development of facilities covered by this permit shall be done in compliance with applicable provisions of Federal laws and regulations, the Illinois Environmental Protection Act, and Rules and Regulations adopted by the Illinois Pollution Control Board.

3. There shall be no deviations from the approved plans and specifications unless a written request for modification of the project, along with plans and specifications as required, shall have been submitted to the Agency and a supplemental written permit issued.

4. The permittee shall allow any agent duly authorized by the Agency upon the presentation of credentials:

   a. to enter at reasonable times the permittee's premises where actual or potential effluent, emissions or noise sources are located or where any activity is to be conducted pursuant to this permit.

   b. to have access to and copy at reasonable times any records required to be kept under the terms and conditions of this permit.

   c. to inspect at reasonable times, including during any hours of operation of equipment constructed or operated under this permit, such equipment or monitoring methodology or equipment required to be kept, used, operated, calibrated and maintained under this permit.

   d. to obtain and remove at reasonable times samples of any discharge or emission of pollutants.

e. to enter at reasonable times and utilize any photographic, recording, testing, monitoring or other equipment for the purpose of preserving, testing, monitoring, or recording any activity, discharge, or emission authorized by this permit.

5. The issuance of this permit:

   a. shall not be considered as in any manner affecting the title of the premises upon which the permitted facilities are to be located;

   b. does not release the permittee from any liability for damage to person or property caused by or resulting from the construction, maintenance, or operation of the proposed facilities;

   c. does not release the permittee from compliance with other applicable statutes and regulations of the United States, of the State of Illinois, or with applicable local laws, ordinances and regulations;

   d. does not take into consideration or attest to the structural stability of any units or parts of the project;

   e. in no manner implies or suggests that the Agency (or its officers, agents or employees) assumes any liability, directly or indirectly, for any loss due to damage, installation, maintenance, or operation of the proposed equipment or facility.

6. Unless a joint construction/operation permit has been issued, a permit for operating shall be obtained from the Agency before the facility or equipment covered by this permit is placed into operation.

7. These standard conditions shall prevail unless modified by special conditions.

8. The Agency may file a complaint with the Board for modification, suspension or revocation of a permit:

   a. upon discovery that the permit application contained misrepresentations, misinformation or false statements or that all relevant facts were not disclosed; or

   b. upon finding that any standard or special conditions have been violated; or

   c. upon any violation of the Environmental Protection Act or any Rule or Regulation effective thereunder as a result of the construction or development authorized by this permit.

SFN\STANDARD CONDITIONS

EXHIBIT 2

Exhibit 2

HYDROGEOLOGICAL INVESTIGATION REPORT

CATERPILLAR PART 817 LANDFILL
MAPLETON, ILLINOIS

Prepared for:
CATERPILLAR INC.

Prepared by:
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JUNE 26, 2012 (REVISED MAY 28, 2013)
REF. NO. 070102 (2)

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1.0 INTRODUCTION

1.1 BACKGROUND

Caterpillar Inc. (Caterpillar) operates a gray iron foundry on a property consisting of approximately 350 acres located immediately south of the Village of Mapleton in Hollis Township, Peoria County, Illinois (Site). The physical address of the Site is 8826 West Route 24, Mapleton, Illinois. The Site is located approximately 4 miles west of Pekin, and approximately 11 miles southwest of downtown Peoria (Figure 1.1). Caterpillar manufactures engine blocks, cylinder heads, liners, and crankshafts at the Site, which Caterpillar uses in its equipment and offers for sale to other companies. The plant property and features are shown on Figure 1.2.

As part of its foundry operations, Caterpillar operates an approximately 80-acre foundry waste landfill on the southeastern portion of the Site under permit No. 1995-154-LFM (hereinafter the Permit) issued by the Illinois Environmental Protection Agency (IEPA). Caterpillar operates the foundry waste landfill (hereinafter the Landfill) under Title 35 Ill. Adm. Code Part 817 (Part 817) as a potentially usable waste landfill, and does not accept any material from off-Site sources. Under the Permit, Caterpillar is obligated to monitor leachate for a number of chemical parameters, including total dissolved solids (TDS).

As explained more fully herein, TDS concentrations in the Landfill leachate above the Maximum Allowable Leaching Concentration (MALC) for potentially usable waste of 1,200 milligrams per liter (mg/L) have been a recurring issue for Caterpillar since issuance of the Permit in 1995, although, at least up until 2009, Caterpillar had been successful in maintaining compliance for TDS through the statistical analysis specified by the Permit. However, beginning with the October 2009 leachate monitoring event, the concentrations of TDS in leachate wells monitored at the Site have caused exceedances of the MALC even with the statistical analysis. Therefore, Caterpillar completed a hydrogeological investigation of the Landfill and surroundings to evaluate its options for seeking relief from the TDS MALC from the Illinois Pollution Control Board (IPCB).

1.2 PURPOSE

This Hydrogeological Investigation Report, which summarizes and interprets the results of investigation activities completed to date at the Site, is prepared in support of

Caterpillar's petition before the IPCB for an adjusted standard for TDS as authorized under the IPCB regulations.

2.0 SITE BACKGROUND

2.1 SITE DESCRIPTION AND FEATURES

The Site consists of approximately 350 acres and is located south of the Village of Mapleton, between U.S. Highway 24/Illinois Highway 9 and the Illinois River. The Site is in Peoria County in Sections 29 and 30, Township 7 North, Range 5 West of the Third Principal Meridian. The Site is located at River Mile 147, which is approximately 11 river miles downstream of the Peoria Lock and Dam.

The foundry manufactures engine blocks, cylinder heads, liners, and crankshafts used in Caterpillar equipment and for sale to other companies. Caterpillar acquired and began to develop the property in the middle 1960s. Currently, Caterpillar conducts foundry operations in Building D, which is located west of Little LaMarsh Creek and north of the Toledo, Peoria, and Western Railroad (TP&W) rail easement. From approximately 1967 until the late 1980s, Caterpillar also conducted foundry operations in Building B, which was located on the northeastern portion of the Site, east of Little LaMarsh Creek. Caterpillar subsequently demolished Building B in 2008/2009. A paved road connects the active western portion of the plant with the eastern portion.

The Landfill is an 80-acre foundry waste landfill on land located south of the TP&W rail easement and east of Little LaMarsh Creek, between the rail easement and the Illinois River. Caterpillar operates the Landfill pursuant to the Permit under Part 817 as a potentially usable waste landfill and does not accept any material from off-Site sources.

2.2 PHYSICAL SETTING

2.2.1 LAND USE

There are no major population centers within a 3-mile radius of the Site. Land use surrounding the Site is a mixture of industrial, agricultural, and open space. Land use south of U.S. Highway 24/Illinois Highway 9, a four lane divided highway, is primarily industrial and agricultural. The Site abuts industrial property to the east, and this industrial land use extends approximately 1.7 miles to the east, upstream along the Illinois River. Except for an industrial operation adjacent to the southwestern portion of the Site, the adjacent property to the west of the Site is in agricultural use and fallow ground. North of Highway 24/9, land use is primarily sparse residential, agricultural, and fallow ground. Much of the land immediately north of the Site is undeveloped and wooded, especially in the deeply incised drainage valleys. The Village of Mapleton, population approximately 200, lies across Highway 24/9 from the eastern portion of the Site.

To the south of the Illinois River, land use is primarily agricultural, with widely scattered residences. On the opposite side of the Illinois River to the southeast of the Site is Powerton Lake, a large cooling water reservoir serving the Powerton electrical generating plant. A figure depicting surrounding land use is provided as Figure 2.1.

2.2.2 TOPOGRAPHY AND DRAINAGE

Between the north bank of the Illinois River and Highway 24/9, surface topography is relatively flat to gently sloping towards the Illinois River. The normal pool elevation of the Illinois River adjacent to the Site is approximately 431 to 435 feet above average mean sea level (AMSL). At the shore of the Illinois River, the elevation is approximately 435 feet AMSL. Surface elevations inland of the Illinois River generally range from approximately 440 feet to 460 feet AMSL. To the north of Highway 24/9, the elevation increases relatively steeply, forming bluffs that rise to an elevation of over 600 feet AMSL (see Figure 1.1). These bluffs are incised by deep, steeply sloped, generally wooded drainage valleys associated with perennial and intermittent tributaries that drain towards the Illinois River.

The most significant of the drainage tributaries is Little LaMarsh Creek, which bisects the western portion of the Site from north to south, and drains most of the land north of the plant property into the Illinois River. The central portion of the Site is unpaved, and surface water runoff is directed towards Little LaMarsh Creek. Areas surrounding the Site structures are covered with impervious surfaces (concrete, asphalt, or compacted gravel). Surface water runoff from these areas and the roofs is directed to subsurface storm sewers that discharge to tributaries to the Illinois River.

South of the TP&W rail easement, surface water is routed by overland flow, ditches, and channels towards the Illinois River. According to a review of Illinois River flow data for the period of 1980 to 2010 (see Table 2.1), the monthly mean discharge near Mapleton (Kingston Mines) has ranged from approximately 3,676 cubic feet per second (cfs) in November 2003 to 55,630 cfs in April 1983. According to the Illinois State Water Survey (ISWS), the 7-day, 10-year annual (7Q10) low flow for the Illinois River near Mapleton is 3,050 cfs (see Figure 2.2).

2.2.3 ECOLOGY

The most prominent ecological feature near the Site is the Illinois River and its associated tributaries and wetlands. CRA completed a review of the available data for the Site, as well as its physical characteristics and nearby natural features to determine whether sensitive ecological receptors might occur near the Site. CRA reviewed information sources such as aerial photographs, Site-specific groundwater contour maps, the National Wetland Inventory (NWI) map, and the IEPA and Illinois Department of Natural Resources (IDNR) data for the Illinois River.

According to the NWI map for the Site, freshwater forested wetlands and freshwater emergent wetlands are located east, west and south of the landfill area within the floodplain of the Illinois River (see Figure 2.3). Pond Lily Lake exists on the adjacent property to the east of the landfill and is managed by Illinois Department of Natural Resources (IDNR) for waterfowl migration[1].

Wetlands and surface waters generally are considered sensitive ecological receptors. However, based on CRA's review of available records, these wetland and surface waters do not appear to be to serve as habitat for unusually sensitive threatened or endangered species. An Illinois Natural Heritage Database search using the IDNR's Ecological Compliance Assessment Tool (EcoCAT) did not identify any records of State-listed threatened or endangered species, Illinois Natural Area Inventory sites, dedicated Illinois Nature Preserves, or registered Land and Water Reserves in the vicinity of the Site. A 2003 study of the distribution and relative abundance of mussels in the Illinois River indicated that 19 mussel species occur in the Peoria navigation pool. However, none of these species were listed as threatened or endangered.

A 401 Water Quality Certification to discharge into waters of the State, was posted by IEPA for an upstream site at River Mile 159.4 (approximately 12 miles upstream). According to the 2008 IDNR Publication "*Integrating Multiple Taxa in a Biological Stream Rating System*", the Illinois River, at the location of the Site, is not listed as a biologically significant stream nor has it received an integrity rating. CRA's review of water quality data indicates that IEPA lists the segment of the Illinois River at the location of the Site (IL_D-31) as impaired in the Illinois Integrated Water Quality Report and 2010 Section 303(d) List. The impairment is attributable to fish consumption advisories due to mercury and PCBs, and primary contact recreation advisories due to fecal coliform bacteria. However, according to the current Illinois fish consumption advisory, mercury

[1] Illinois Department of Natural Resources. 2012. Rice Lake – State Fish and Wildlife Area. http://www.dnr.state.il.us/lands/landmgt/parks/r1/Rice.htm.

is not listed as being problematic. The mercury impairment is apparently due to a statewide advisory for mercury applicable to all Illinois waters[2].

Illinois currently has no surface water criterion for TDS. Until the mid-2000s, it had a general use standard of 1,000 mg/L[3]. However, Illinois abandoned this standard in favor of chloride and sulfate standards to address more reliably the causal agents of the problems that might be associated with high TDS concentrations. The IEPA asserts that TDS concentrations cannot predict the threshold of adverse effects to aquatic life and that the adoption of revised sulfate and chloride standards would adequately address the toxicity of dissolved salts[4].

2.3 REGIONAL GEOLOGY

The Site is located on the Galesburg Ridge Plain area of the Till Plains Section in the Central Lowland Province (Figure 2.4). Regionally, this area has prominent glacial topography characteristics of the Illinoian Glaciation Stage (Figure 2.5). However, within the Illinois River Valley near the Site, deposits from the Illinoian Glaciation have been eroded, and outwash deposits from the more recent Wisconsinan Glaciation and recent alluvium sediments are present.

Published literature regarding the regional stratigraphy beneath the Site indicates that it is comprised of a layer of unconsolidated alluvium consisting of clay, silt, sand, and gravel, which overlies bedrock. The area of the Site has been mapped as A2 and B2 for the northern half of the property on Plates 1 and 2 of the Berg Circular, respectively, and as AX on both Plates 1 and 2 for the southern half of the property (Figures 2.6A and 2.6B).[5] Areas mapped as A2 on Plate 1 are described as "Thick, permeable sand and gravel within 20 feet of land surface". Areas mapped as B2 on Plate 2 are described as "Permeable bedrock between 5 and 20 feet of surface, overlain by silty or clayey till and loess; relatively impermeable weathered zone in till". Areas mapped as AX are described as "Alluvium, a mixture of gravel, sand, silt, and clay along streams, variable in composition and thickness".

[2] Illinois River Coordinating Council. May 10, 2006 Meeting Minutes. http://www2.illinois.gov/ltgov/Documents/IRCCMinutes/2006-05-10%20IRCC.pdf.
[3] USEPA. 2009. USEPA approval for amendments to the existing Illinois Control Board regulations. May 18, 2009, http://www.epa.gov/r5water/wqs5/pdfs/IL-Sulfate%20Rationale%20of%20Decision.pdf.
[4] See also Iowa Department of Natural Resources, Environmental Protection Commission. Notice of Intended Action – Chapter 61 Water Quality Standards- Chloride, Sulfate and Total Dissolved Solids. April 27, 2009. Available at http://www.iowadnr.gov/portals/idnr/uploads/water/standards/tds_noia.pdf.
[5] R.C. Berg, Kempton, J.P. and Cartwright, K., Potential for Contamination of Shallow Aquifers in Illinois, Illinois Department of Energy and Natural Resources, Circular 532, 1984.

On the Stack-Unit Map of Illinois (Figure 2.7)[6] the northern half of the Site is shown as overlying at least 20 feet of the Henry Formation, and the southern half of the Site is shown as overlying at least 20 feet of the Cahokia Alluvium and at least 20 feet of the Henry Formation. The Henry Formation consists of glacial outwash of sand and gravel[7]. The Cahokia Alluvium includes the deposits in the floodplains and channels of present rivers and consists mainly of poorly sorted silt, clay, and silty sand, but locally contains lenses of sand and gravel[8].

Bedrock beneath the Site is identified as Pennsylvanian-age strata of the Carbondale and Modesto Formations (Figure 2.8)[9]. The Pennsylvanian System is approximately 200 feet in thickness beneath the area (Figure 2.9)[10]. The Carbondale and Modesto Formations are comprised primarily of shale with interbedded limestone, coal, and sandstone[11].

2.4 REGIONAL HYDROGEOLOGY

Regionally, the alluvial sand and gravel deposits adjacent to the Illinois River are known as the Sankoty Aquifer.[12] The Sankoty Aquifer has a relatively wide distribution and potentially large groundwater yields. Regional flow in the Sankoty Aquifer is towards the Illinois River. The Sankoty Aquifer is hydraulically connected to the river and contributes to its base flow.

The hydrogeology of the areas adjacent to the Illinois River has been well studied by the Illinois State Water Survey. As documented in previous reports submitted to the IEPA in support of the 817 Landfill permitting effort, these studies conclude that the Illinois River is a major regional discharge point for groundwater.[13]

[6] R.C. Berg, Kempton, J.P., Stack-Unit Mapping of Geologic Materials in Illinois to a Depth of 15 Meters, Illinois State Geologic Survey, Circular 542.
[7] H.B. William et al., Handbook of Illinois Stratigraphy, Illinois State Geological Survey, Bulletin 95, 1975, p 164.
[8] IBID.
[9] IBID.
[10] IBID.
[11] IBID.
[12] S.L. Burch and Kelly, D.J., Peoria-Pekin Regional Groundwater Quality Assessment, Illinois Department of Energy and Natural Resources, Illinois State Water Survey Division, Research Report 124, 1993.
[13] Groundwater Assessment Report, RMT, Inc., October 1996, pp. 4, 11.

Additionally, the Illinois State Water Survey (ISWS) has studied the regional groundwater flow adjacent to the Illinois River in the Peoria-Pekin Region.

The study concluded:

> "*The general groundwater pattern of ground-water movement is towards the Illinois River, which represents a discharge boundary and receives ground water from both sides. Consequently, the ground-water system plays a role in maintaining baseflow in the Illinois River. Smaller flow systems exist but the main impetus of flow-direction is towards the river.*"[14]

Figure 2.10 provides a map from the ISWS research report depicting potentiometric surface elevations and the direction of groundwater. Except where municipal well pumping fields are present near Peoria and Pekin that alter flow locally, groundwater flow is towards the Illinois River. Given the above information and he lack of high-capacity municipal wells in the area, the expected natural groundwater flow at the Site is from north to south (i.e., from the uplands to the north towards the Illinois River regional discharge feature to the south).

2.5 SITE GEOLOGY AND HYDROGEOLOGY

Prior to development, Caterpillar undertook extensive geotechnical investigations of the Site. During the period of October 1964 through February 1965, Walter E. Hanson Company (Hanson) advanced numerous geotechnical soil borings. General subsurface stratigraphy included clays and silts to depths ranging from 2 to 13 feet below ground surface (bgs). Underlying the clays and silts, Hanson identified a granular deposit consisting of sand, gravel, and some small boulders. The thickness of the granular deposit was variable and extended to the top of the bedrock surface. Bedrock identified beneath the Site consisted of brown to gray shale and fine-grained gray sandstone. Soil boring logs indicate that the unconsolidated stratigraphic units at the Site range in thickness from approximately 20 feet in the northern portion of the Site to greater than 70 feet in the southern portion of the Site and are underlain by shale bedrock. The stratigraphic information indicates that the depth to the bedrock surface increases to the south towards the Illinois River.

RMT, Inc. of Madison, Wisconsin (RMT) completed additional geological investigations at the Site in the early to mid-1990s, in connection with Caterpillar's application for the

[14] Illinois State Water Survey, Peoria-Pekin Regional Ground-Water Quality Assessment, Research Report 124, 1993, p.10.

Permit. Principally, RMT's investigation activities were focused on land occupied by and immediately surrounding the 80-acre parcel upon which the Landfill is located. RMT described the stratigraphy beneath the Site as consisting of valley fill and outwash deposits that overlie shale bedrock[15].

During its investigations, RMT described the local stratigraphic units as summarized below. (As a point of clarification, note that RMT focused its investigations around the Landfill principally south of the TP&W easement. Therefore, the term "*site*" as used below, refers to the area of RMT's investigations at and surrounding the Landfill and not the larger plant "*Site*", which consists of the entire 350-acre plant property as defined earlier.)

Upper Sand Unit

RMT described the Upper Sand Unit as a light yellowish-brown poorly graded sand present beneath the southeastern portion of the site. The upper sand unit pinches out towards the north and is not present north of the TP&W rail easement.

Intermediate Clay Aquitard

The Intermediate Clay Aquitard underlies approximately the southern two-thirds of the site. In this unit, deeper groundwater flow appears to be unaffected by the groundwater mounding observed in the shallow groundwater beneath the Landfill. RMT observed the unit to range from 12 feet to 56 feet in thickness and reported a hydraulic conductivity in the range of 10^{-7} to 10^{-9} centimeters per second (cm/s). At depth, the unit becomes gray and/or brown in color, and the silt and sand content increases. This unit extends from the south side of Building B to the Illinois River. In the central third of the site, the intermediate clay aquitard overlies bedrock, and in the southern third the unit overlies the lower clay unit.

Lower Sand Unit

The Lower Sand Unit appears to be present only beneath the southern third of the site and underlies the Intermediate Clay Aquitard and the Illinois River. The Lower Sand Unit appears to be typical channel sand and lag sediment deposited in a fluvial environment. RMT described the unit as a well to poorly graded, loose to medium

[15] RMT, Inc., Additional Information for Significant Modification Application, Log #1995-154, 35 IAC Part 817.309 Facility Location Demonstration, March 1997, p 8.

dense sand with some to no gravel. The Lower Sand Unit pinches out toward the north against the shale bedrock surface.

Lower Clay Aquitard

RMT described this unit as a lean to silty, loose to medium stiff/stiff gray clay. The upper portion of the Lower Clay Aquitard is believed to represent more recent deposition of fine-grained low-energy river sediments and contains organic matter, wood fragments, and shells. In some places, the lower portion of the unit becomes greenish gray in color and is believed to represent weathered shale bedrock, based on the amount of shale fragments present in soil samples. The Lower Clay Aquitard appears to be present only in the southern third of the site and underlies the Lower Sand Unit and overlies bedrock.

Bedrock

Stratigraphic logs from deep geotechnical and investigative soil borings indicate that the depth to bedrock beneath the plant property ranges from approximately 10 feet to greater than 70 feet. The depth to the bedrock surface increases to the south towards the Illinois River. RMT described the bedrock as blue/gray or brown shale with traces of sandstone. RMT noted that the shale bedrock is highly mineralized, and contains elevated concentrations of sodium and chloride[16].

Appendix A contains a stratigraphic log from a test well drilled to a depth of 310 feet bgs. The stratigraphy for the test well indicated that the bedrock underlying the Site is comprised primarily of shale with interbedded limestone, coal, and sandstone units. This stratigraphy is consistent with the published bedrock geologic description of the area that shows the bedrock beneath the Site to be Carbondale Formation (Pennsylvanian Age).

2.6 LOCAL GROUNDWATER USE

Caterpillar does not use the groundwater at the Site for either potable or non-potable purposes. Caterpillar tested the water before the Site was developed and determined the groundwater quality to be poor because of elevated TDS content and chose to use surface water from the Illinois River for potable and industrial water supply at the Site.

[16] RMT, Inc., Groundwater Assessment Report, October 1996, P.17.

In order to determine whether there are any water wells in use in proximity to the Site, CRA searched the Illinois State Geological Survey (ISGS) Water and Related Wells Database that is available online.[17] Specifically, CRA searched near Mapleton Site in Sections 29 and 30, Township 7 North, Range 5 West of the Third Principal Meridian in Peoria County, Illinois, which provided sufficient coverage to the east, west, and north of the area occupied by the Part 817 Landfill to assess groundwater usage. Appendix B provides the water well records obtained from the ISWS database.

In general, the ISWS database identified a number of engineering borings located on and off Site, and existing monitoring wells associated with the Part 817 Landfill. However, the database did identify three water wells on the adjacent Evonik Industries property (formerly Goldschmidt Chemical) located east of the Site and two water wells located on the adjacent property to the west of the Site owned by Growmark Industries (formerly C.F. Industries).

Caterpillar contacted Evonik and Growmark to confirm the presence and location of the water wells identified in the ISGS database. Figure 2.1 depicts the approximate locations of the three Evonik wells and the two Growmark wells per the information obtained from the respective representatives. As noted in Figure 2.1, the closest Evonik water well is located approximately 4,000 feet east of the Part 817 Landfill to the south of Pond Lily Lake. According to Evonik representatives, the three wells are between 65 and 80 feet in depth and are used for domestic water (showers, sinks, kitchen) not specifically for drinking. The closest Growmark water well is located approximately 1,600 feet west of the Part 817 Landfill, and the two wells have reported depths of 36 and 51 feet. The Growmark Industries representative stated that neither of the two wells are used for drinking water.

The Mapleton municipal well (identified as location #1641 in the figure showing the Section 29 search results in Appendix B and shown just below the "E" in "MAPLETON" on Figure 2.1) is located approximately 3,000 feet north-northeast (upgradient) of the Landfill. One other private wells was reported in Section 29 but is located over a mile northwest of the Landfill in the upland area not associated with the Sankoty Aquifer.

[17] http://isgs-ablation.isgs.uiuc.edu/website/ilwater/viewer.htm

2.7 LANDFILL OPERATION AND LEACHATE MONITORING

2.7.1 LANDFILL OPERATION AND HISTORY

Caterpillar operates the Landfill under Permit No. 1995-154-LFM issued by the IEPA. The Landfill began operating in 1977. Following promulgation of Part 817 in 1994, Caterpillar submitted an application for a permit to operate the Landfill as a potentially usable waste landfill pursuant to Part 817 and subsequently received the Permit from the IEPA. The Landfill is permitted to dispose of a variety of potentially usable waste generated at the Site and does not accept any material from off-Site sources. Potentially usable wastes placed in the Landfill primarily consist of spent foundry sands from the foundry casting production process, as well as varying amounts of other foundry wastes, including finishing waste (foundry sand mixed with metallics and metal pieces), metallics waste (steel shot, metal fines), metal pieces mixed with sand (less than 1%), foundry slag, dust collector wastewater treatment sludge, full dry dust collector super sacks, and used furnace refractory from the foundry casting production process, as well as varying amounts of other foundry wastes, including finishing waste (foundry sand mixed with metallics and metal pieces), metallics waste (steel shot, metal fines), metal pieces mixed with sand (less than 1%), foundry slag, dust collector wastewater treatment sludge, full dry dust collector super sacks, and used furnace refractory.

2.7.2 LEACHATE MONITORING

The Permit requires collection and analysis of leachate from five leachate monitoring wells (L301, L302, L303R, L304R, and L305) for a number of parameters including TDS. Appendix C summarizes the leachate analytical data during the period of December 1997 through January 2012. Figure 2.11 provides a graphical display of the leachate concentrations for this same period.

The Landfill began operating in 1977, long before the promulgation of Part 817 in 1994. When the Landfill was permitted under Part 817 in 1995, the MALCs were applied as the leachate standards. The first leachate wells were installed in November 1997 (L310, L302, and L303) and the initial set of leachate samples were collected in December 1997. Thereafter, leachate wells have been sampled semiannually since February 1998.

As shown on the concentrations versus time plot in Figure 2.11, TDS concentrations at individual leachate wells have exceeded the MALC since the initiation of leachate monitoring in 1997. TDS concentrations measured at leachate well L302 have exceeded the MALC in every monitoring round beginning with the first monitoring round in

1997, ranging in concentration from 1,900 to 3,200 mg/L. Concentrations of TDS above the MALC at other leachate wells during monitoring events are not uncommon. TDS concentrations above the MALC have been observed at every leachate well and, historically, TDS concentrations at or above the MALC occur in at least two leachate wells during each monitoring event.

In accordance with Permit Condition VII.4, compliance with the MALC is determined using a procedure where a statistical confidence interval is constructed around a mean compliance well concentration (with a 90 percent confidence interval). The individual leachate concentrations are pooled, and cumulative statistics calculated for the four most recent sampling rounds. If the MALC for an analyte lies within or is above this statistical confidence interval, the Landfill is in compliance. The TDS exceedance reported for the October 2009 monitoring round occurred as TDS concentrations at leachate well L303 began an increasing trend with the November 2008 monitoring round.

Recent fluctuations in the leachate TDS data have been noted during leachate monitoring. For example, between the November 2008 and the May 2009 monitoring rounds, the TDS concentration at leachate well L303 increased from 1,500 mg/L to 2,400 mg/L. The TDS concentrations at L303 increased through the May 2009 monitoring round, peaking at 2,400 mg/L. Beginning with the October 2009 monitoring round, TDS concentrations at leachate well L303 began to decrease but were still high compared to concentrations observed historically. Due to well integrity and biofouling concerns, in coordination with IEPA, Caterpillar replaced leachate well L303 with leachate well L303R prior to the May 2010 leachate monitoring round. Between the sampling conducted at L303 in October 2009 and the sampling conducted in May 2011, the TDS concentration in L303R leachate samples dropped from 2,200 mg/L to 1,400 mg/L. In November 2010, the TDS concentration in the L303R leachate sample was 940 mg/L, over 2.5 time lower than in May 2009, and has remained below the MALC during subsequent monitoring events (through October 2011).

A more recent example of data fluctuation was the spike in TDS concentration observed at leachate well L304 in November 2010. Historically, the TDS concentrations in the samples collected from leachate well L304 were predominantly below the MALC. However, in November 2010, the TDS concentration in the L304 leachate sample spiked to 4,800 mg/L. In response, Caterpillar replaced leachate well L304 with leachate well L304R, and the leachate sample obtained from leachate well L304R in December 2010 was 1,200 mg/L, four times lower than in November 2010.

As can be seen in Figure 2.11, the leachate concentrations in all of the leachate wells are close to the MALC, meaning that fluctuations in the leachate TDS data, such as the examples discussed above, result in difficulty in meeting the TDS MALC. Moderate fluctuations in leachate concentrations in one leachate well can result in a MALC exceedance such as that observed in October 2009. Given the fluctuations in leachate concentrations noted above, and historically in the data set, Caterpillar likely will have ongoing compliance challenges with achieving the TDS MALC in the future.

2.7.3 LEACHATE WELL TDS DATA DISCUSSION

TDS is a non-specific parameter that is a measurement of the aggregate weight of all constituents in an aqueous sample remaining after being filtered and dried as specified by an analytical method. Therefore, TDS is not a direct measurement of any specific constituent present in a sample. Rather, TDS is the residue that remains after a water sample is filtered through a 0.2 µm (nominal) pore-diameter glass fiber filter, and the filtrate is evaporated to dryness in a pre-weighed dish to a constant weight at a 180 °C. The weight increase from the non-filterable residue in the dish after drying represents the mass of total dissolved solids in the sample. Individual constituents dissolved in the groundwater that comprise TDS can occur naturally in background groundwater; through dissolution from soil and rock that comprise the aquifer matrix and from anthropogenic sources. Potential anthropogenic TDS sources include nitrates from agricultural fields and salt storage or application of salt on a highway during winter.

In May and August 2010, expanded lists of parameters were analyzed in an effort to determine the source of TDS in the leachate wells (see Table 2.2). Well L302 was of particular interest as this well historically has exhibited elevated TDS concentrations. The expanded list of parameters included cations (metallic constituents), anions (e.g., chloride, fluoride, sulfate), and general water chemistry constituents, including TDS. The results from the analysis of these constituents were used to determine the correlation between the sum of cations and anions present in the leachate to the laboratory-measured TDS concentrations.

The laboratory-measured TDS concentration is expected to be equal to, or marginally greater than, the TDS concentration calculated from the individual anions and cations. In general, laboratory-measured TDS concentrations less than the calculated concentrations indicate a problem with the analyses, and the samples should be reanalyzed. The correlation between the laboratory-measured and calculated TDS concentrations were within the acceptable range for all leachate well samples, indicating the laboratory was conducting the TDS method properly.

In addition to determining the accuracy of the laboratory-measured TDS concentrations, the expanded parameter lists included certain analytes that allowed the geochemistry of the leachate to be evaluated. In particular, the results of the nitrogen-containing anions (nitrate, nitrite, ammonia) and the sulfur-containing anions (sulfate, sulfite, sulfide) analyzed during the May 2010 sampling event allowed for an assessment of the oxidation-reduction (redox) conditions within and in the vicinity of each leachate well. Redox conditions can be determined from the oxidation state of the nitrogen-containing and the sulfur-containing anions. Nitrate and sulfate will be the predominant forms of these anion series under oxidizing conditions, whereas sulfide and ammonia will predominate under reducing conditions. Nitrite and sulfite are intermediate oxidation states of these anion series.

The May and August 2010 leachate sample results indicate the geochemistry at well L302 is dissimilar from the other leachate wells. The highest concentrations of alkalinity and ammonia were detected in this leachate well, and sulfate was detected at every leachate well location except L302. The oxidized forms of nitrogen and sulfur, nitrate and sulfate, respectively, were not detected in the samples collected. However, the reduced forms of nitrogen and sulfur, ammonia and sulfide, respectively, were detected in samples collected at L302 during one or both of the sampling events. In addition, the field data sheets completed for well L302 during these sampling events includes a note that the sample odor was "sulfur", which typical denotes the presence of sulfide in its gas phase (i.e., hydrogen sulfide). These results clearly indicate reducing redox conditions exist at leachate well L302. Also, as discussed in Section 2.7.2, field observations of biofouling (bacterial growth on the well screen, significant particulate matter in the well) were noted at leachate well L303 prior to its replacement in May 2010.

The reducing conditions at well L302 likely are the result of biological activity within the well and the immediate vicinity. The geochemistry of the samples collected from this location suggests the biological activity may be in the form of a microorganism that utilizes sulfur in its metabolism. Sulfur-utilizing microorganisms, such as the sulfate-reducing bacteria group, grow anaerobically and reduce sulfate to hydrogen sulfide, which is evident at well L302.

In addition to well biofouling, reducing conditions alter the subsurface environmental conditions and cause certain cations that exist as insoluble metal compounds or are adsorbed to particulate matter under oxidizing conditions to become soluble, thus detectable as TDS. Examples of redox-sensitive cations that may become soluble when redox conditions change from oxidizing to reducing include barium, iron, and manganese, which are common earth elements. These metal cations were detected at well L302 during the May and August 2010 sampling events, and the highest iron concentrations were detected at well L302.

It is noted that the samples collected for metals analysis were not filtered prior to being chemically preserved with nitric acid, which is added to prevent cations from precipitating out of solution or adsorbing to interior surfaces of sample containers. Therefore, the physical state (i.e., filterable or non-filterable) of barium, iron, and manganese at L302 cannot be determined from the metals results. However, when converted to their soluble form by reducing conditions, these cations are non-filterable and are included in the TDS concentration measured in the sample. Consequently, the microbial activity changing the redox conditions in and around well L302, which increases the solubility of constituents that comprise TDS, is the source of elevated TDS concentrations historically detected at this location.

3.0 HYDROGEOLOGICAL INVESTIGATION SUMMARY

3.1 INVESTIGATION RATIONALE

As part of an effective monitoring program, it is important to distinguish background sources (both anthropogenic and natural) from the regulated source such as the Landfill. Additionally, an effective monitoring program is necessary to determine whether the Landfill contributes TDS to the groundwater at levels that exceed the background TDS levels in groundwater. Determining whether an analyte is attributable to background groundwater quality typically involves collecting samples for analysis from upgradient monitoring wells. However, all of the monitoring wells installed prior to the investigation described herein were located in close proximity to the Landfill and not well situated for the purpose of determining background groundwater quality. Because the monitoring wells were not well situated for determining background quality, a robust database of background groundwater quality did not exist.

Due to a lack of background data on TDS, Caterpillar completed the hydrogeological investigation described in this section primarily to better define background groundwater quality with respect to TDS and understand the potential source and causes of high TDS detections dating back to the initiation of leachate sampling in 1997, and as experienced more acutely in recent sampling events. The objectives of the hydrogeological investigation were to provide information required to assess leachate quality (unaffected by mixing with groundwater), background groundwater quality, and hydrogeological conditions at the Site, in order to determine if an adjusted standard for TDS is appropriate and, if so, determine the appropriate adjusted standard. In addition to the existing monitoring well network, the hydrogeological investigation included seven new groundwater monitoring wells in four nested pairs located in areas to the north and southwest of the Landfill. These new monitoring wells combined with the network of ten existing monitoring wells were sufficient to evaluate groundwater flow patterns at the Site consistent with recognized industry practices.

The hydrogeological investigation completed at the Site effectively evaluated groundwater flow and TDS concentrations over an area in excess of 250 acres. The hydrogeological investigation completed by Caterpillar included groundwater, leachate, and surface water investigation tasks as described in this section.

3.2 GROUNDWATER INVESTIGATION

The groundwater investigation included installation of new shallow and deep groundwater monitoring wells, surveying of new and existing monitoring wells for horizontal and vertical control, gauging of the water levels in the monitoring wells, and collection of groundwater samples for chemical analysis. Table 3.1 summarizes the construction details and screened units for monitoring wells in the groundwater monitoring network. Figure 3.1 shows the monitoring well locations where shallow monitoring wells are designated with an "S" suffix and deep monitoring wells are designated with a "D" suffix. Appendix D provides a description of the groundwater monitoring well installation and development procedures. Appendix E contains the stratigraphic and instrumentation logs for the monitoring wells installed at the Site.

3.2.1 EXISTING MONITORING WELLS

CRA utilized ten existing groundwater monitoring wells during the groundwater investigation. The existing network consists of eight shallow monitoring wells (G101S, G102S, G103S, G104S, G105S, G016S, G108S, and G112S) and two deep monitoring wells (G103D and G104D). RMT installed nine of the existing wells utilized during the investigation in the late-1990s as part of the investigation work it completed on behalf of Caterpillar for permitting the Landfill. CRA installed the other existing monitoring well (G112S) in 2009, in connection with an unrelated due diligence investigation.

3.2.2 NEW MONITORING WELLS

In order to establish an adequate upgradient monitoring well network to obtain sufficient data to determine background TDS levels in groundwater, CRA designed an upgradient monitoring network that consisted of seven new groundwater monitoring wells, including three shallow monitoring wells and four deep monitoring wells (monitoring wells G110S, G110D, G111S, G111D, G112D, G113S, and G113D).

CRA selected the locations of the background monitoring wells to be a sufficient distance upgradient so as not to be influenced by radial flow from the Landfill. To the east of the Landfill, no additional monitoring wells were deemed to be necessary due to the presence of Pond Lily Lake, which lies a few hundred feet east of the Landfill and extends to the east more than a mile. The land between the east boundary of the Landfill and Pond Lily Lake is undeveloped riverine bottomland that is heavily vegetated and periodically inundated.

Similarly, the land west of the Landfill located between the Landfill and the adjacent property owned by Growmark is largely undeveloped and heavily vegetated riverine bottomland and flood plain associated with Little LaMarsh Creek, which flows from north to south to the west of the Landfill and discharges to the Illinois River. A lagoon associated with Caterpillar's mill water intake system is located adjacent to the southwestern portion of the Landfill as shown on Figure 2.1. A north-south trending drainage feature known as West Ditch lies between the mill water intake lagoon and Little LaMarsh Creek. Near the Site's western boundary lies an unused harbor that extends over 1,000 feet north from the Illinois River, which historically facilitated the delivery of materials to the Site by barge.

Boart Longyear of Indianapolis, Indiana (Boart) provided drilling services under the oversight of a CRA geologist. Boart constructed the shallow monitoring wells so that the screened intervals were set near the water-table interface. Boart constructed the deep monitoring wells such that the bottom of each well was set at and elevation ranging from approximately 405 to 430 feet.

3.2.3 SINGLE-WELL RESPONSE TESTS

CRA completed single well response tests (slug tests) at six shallow monitoring wells (G103S, G104S, G110S, G111S, G112S, and G113S) and three deep monitoring wells (G103D, G104D, and G111D). The intent was to obtain estimates of hydraulic conductivity from shallow and deep monitoring wells located upgradient and downgradient of the Landfill. As none of the monitoring well screens partially penetrated the water-bearing zone, three slug-in and three slug-out tests were performed at each location. CRA monitored water-level recovery using an electronic data logger. CRA evaluated the slug test data using AQTESOLV™ Version 4.01 aquifer test analysis software. Appendix F provides the response test data reports for each monitoring well.

3.3 LEACHATE INVESTIGATION

3.3.1 EXISTING LEACHATE WELLS

There are five existing leachate wells (designated L301 through L305) installed within the footprint of the Landfill. Caterpillar regularly samples these leachate wells to meet the requirements of the Permit. A sixth leachate well, L306, is not used in the Landfill monitoring program. An "R" suffix (e.g., L303R and L304R) designates a leachate well that was replaced sometime after the original leachate well was installed. Replacement occurred because the well was breached or damaged and, consistent with the requirements of the Permit, the replacement well was installed within a 10-foot radius of the prior well.

The leachate wells are installed through the Landfill and screened in the saturated zone beneath the Landfill. As such, samples obtained from the leachate wells are a mixture of leachate that percolates through the Landfill and the groundwater underlying the Landfill. Table 3.2 summarizes the leachate well construction details. Appendix E contains the stratigraphic and instrumentation logs for the leachate wells installed at the Site. Figure 3.1 shows the leachate well locations.

3.3.2 LYSIMETERS

To obtain representative samples of the leachate percolating through the Landfill for comparison to the leachate well data set, CRA installed five lysimeters (designated as LS301 through LS305) in the Landfill. The purpose of this effort was to determine whether the two datasets were comparable or if more complex interactions in the saturated zone beneath the Landfill (such as commingling with the high TDS background groundwater or biofouling) affected the samples obtained from the leachate wells. CRA installed Campbell Monoflex™ porous cup, deep-sampling lysimeters designed for obtaining water samples from the vadose zone from depths greater than 20 feet. The lysimeters consist of a ceramic porous filter cup at the base, which is approximately 2 inches in diameter and 27 inches in length. The porous cup is threaded to a 2-inch diameter PVC outer casing that extends to the surface. The lysimeters are equipped with two ports that extend from the surface to the cup inside the outer casing. One port allows for an application of a vacuum to draw the soil pore water into the cup and the other allows for the collection of a water sample using a suction pump. Figure 3.1 shows the lysimeter locations. Figure 3.2 provides the typical detail for the porous cup lysimeters installed at the Site. Table 3.3 summarizes the lysimeter construction details.

CRA installed the lysimeters within 10 feet of the corresponding existing leachate monitoring wells in order to meet the requirements of the Permit and to obtain leachate data reasonably comparable to the data obtained from the adjacent leachate wells. CRA designated the lysimeters with an "LS" prefix and the same number as the adjacent leachate well. So, for example, lysimeter LS301 lies adjacent to and within 10 feet of leachate well L301. In order to select the depth of lysimeter installation, CRA examined the leachate levels recorded historically and installed the lysimeters at an elevation of between approximately 5 and 10 feet above the recorded high leachate level observed in the adjacent leachate well. This ensured that the lysimeters drew leachate from an elevation above the water table and the capillary fringe zone. Generally, CRA installed the lysimeters at depths of 20 to 25 feet below the top of the Landfill surface.

Boart installed the lysimeters using a rotary sonic drilling rig. Boart advanced each borehole to its target depth and installed the lysimeter into the borehole through the drill casing. Once the lysimeter was in place, Boart removed the outer casing while backfilling the borehole with foundry sand cuttings obtained during borehole advancement. Boart installed a seal consisting of hydrated bentonite chips approximately halfway up the borehole annulus and again at the surface to seal the borehole annulus. Boart fitted each lysimeter with a locking aluminum protective surface casing. Appendix E contains the stratigraphic and instrumentation logs for the lysimeters installed at the Site.

3.4 SURFACE WATER

CRA installed two staff gauges at the bank of the Illinois River, one upstream location near the east property boundary (SG-1) and a second downstream location to the west (SG-2) as shown in Figure 3.1. CRA used these as gauging stations and surface water sampling points during the investigation.

3.5 GROUNDWATER, LEACHATE, AND SURFACE WATER SAMPLING

3.5.1 GROUNDWATER SAMPLING

CRA collected groundwater samples from the full monitoring well network during the weeks of April 4 and May 23, 2011. CRA obtained groundwater samples during the April 2011 sampling round that the project laboratory analyzed for List L1 routine leachate monitoring parameters identified in Section VII.4 of the Permit. This list includes volatile organic compounds (VOCs), ten metals (arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, selenium, and zinc), and five general chemistry analytes (chloride, fluoride, nitrate as nitrogen, sulfate, and TDS). During the May 2011 sampling round, CRA dropped VOCs from the list of analytes because of the lack of any VOC detections in the groundwater samples during the April 2011 round.

In addition, to supplement the background TDS data set, groundwater samples were collected from the upgradient monitoring well set (G110S/D, G112S/D, and G113S/D) during three additional quarterly sampling events on September 21, 2011, November 29, 2011, and on January 10 and 11, 2012.

3.5.2 LEACHATE SAMPLING

CRA collected two rounds of leachate samples from the lysimeters for TDS analysis. CRA completed the first round of sampling on May 25 and May 31, 2011. (Three of the lysimeters produced leachate rapidly and CRA sampled these on May 25 and the remaining two produced leachate more slowly and CRA sampled these on May 31.) CRA collected the second round of leachate samples from the lysimeters on June 22, 2011. However, lysimeter LS305 did not yield a sufficient sample volume during the second event to permit analysis.

Caterpillar collected samples from the leachate wells for semiannual List L1 routine leachate parameters analysis on May 16 and 17, and October 10 and 11, 2011.

3.5.3 SURFACE WATER SAMPLING

Coincident with the April and May 2011 groundwater sampling events, CRA obtained surface water samples from the Illinois River at the two staff gauge locations for TDS analysis.

3.6 SURVEYING AND GAUGING

Zumwalt & Associates, Inc. of Peoria, Illinois (ZAI) surveyed the new and existing groundwater monitoring wells, leachate wells, and lysimeters for horizontal and vertical control. In addition to the horizontal coordinates, ZAI provided a ground surface and top of casing elevation for each monitoring well and leachate well and ground surface elevations at each new lysimeter.

During the groundwater sampling rounds, CRA and Caterpillar obtained concurrent depth-to-water measurements from the groundwater monitoring well and leachate well network. Using the survey data from ZAI, CRA compiled groundwater elevations at each location. Tables 3.4 through 3.6 summarize the water elevation data for the shallow monitoring wells, deep monitoring wells, and leachate wells, respectively.

4.0 SUMMARY OF FINDINGS

4.1 SITE GEOLOGY

Using the data and information obtained during this investigation, CRA prepared several cross-sections to depict the geology underlying the Site (Appendix G). The geology is variable from north to south. As shown in the two north-south cross-sections (A-A' and B-B'), to the north of the Landfill and the TP&W rail easement, overburden geology consists of fill materials (ranging in composition from silty clay to sand) overlying native silty clays containing interbedded silt, sand, and gravel. The depth to bedrock is in the range of 15 to 20 feet below ground surface. The bedrock consists of shale of the Carbondale Formation, weathered and greenish-gray near the surface grading to black.

To the south, at or near the TP&W rail easement, the depth to bedrock increases towards the south and the thickness of the unconsolidated overburden deposits increases. This feature represents an eroded bedrock valley that has been backfilled with channel and overbank deposits. Underlying the Landfill is a relatively thick clay unit, which corresponds to the Intermediate Clay Aquitard described by RMT (see Section 2.5). The Intermediate Clay Aquitard associated with the alluvial deposits beneath the Landfill is a separate and distinct geologic unit from the clay/native fill deposits north of the Landfill and the TP&W rail easement. A poorly graded sand unit underlies the clay and corresponds to the Lower Sand Unit described by RMT. In the southeastern portion of the Site, a lower clay unit overlying bedrock was identified by RMT. However, as shown in cross-section C-C' in Appendix G, no other borings to the west of G104D were drilled deep enough to encounter the lower clay so it is unclear whether this unit is laterally continuous.

4.2 SITE HYDROGEOLOGY

4.2.1 GROUNDWATER FLOW

CRA used the groundwater elevation data for the shallow and the deep monitoring wells summarized in Tables 3.4 through 3.6 to generate groundwater contour plots for the Site as depicted in Figures 4.1 through 4.9. CRA used the groundwater elevation data from the leachate wells to generate the shallow groundwater contours across the Site (Figures 4.1, 4.2, 4.4, 4.6, and 4.8). Figures 4.3, 4.5, 4.7, and 4.9 depict the groundwater contours across the Site drawn using the deep monitoring wells. No contours were drawn for the deep wells using the April 2011 groundwater elevation data because the groundwater elevation at G113D had not reached equilibrium on that date.

Consistent with previous observations by RMT, the shallow groundwater contours reveal a groundwater mound is present beneath the Landfill resulting in radial flow from the Landfill towards the west, east, and south. Based on the observed groundwater flow pattern in the shallow groundwater, monitoring wells G110S, G112S, and G113S are not affected by radial flow from the Landfill and serve as background wells. In the deeper wells, the observed groundwater flow is generally from north to south towards the Illinois River. Additional investigation of the groundwater mounding to the east and west of the Landfill was not deemed necessary due to the adjacent features present and proximity of these wells to these features. To the east, Pond Lily Lake and associated heavily vegetated bottomland occupy the property directly adjacent to the Landfill. Pond Lily Lake encompasses nearly 300 acres and extends eastward over a mile from the east boundary of the Caterpillar property. As discussed in Section 2.6, the nearest water supply well east of the Landfill is located 4,000 feet away. Given this situation, it is not possible to install monitoring wells to the east of the Landfill nor is it necessary or relevant to define groundwater flow in the area east of the Landfill.

The land to the west of the Landfill for a distance of over 1,500 feet is property owned by Caterpillar that is largely undeveloped heavily vegetated bottomland. A mill water intake pond, a drainage ditch (West Ditch), Little LaMarsh Creek, and an unused harbor associated with the Illinois River lie between the Landfill and the adjacent property to the west. Shallow groundwater mounding from the Landfill is a local effect that will diminish laterally within a few hundred feet of the landfill due to the effect of the regional hydrogeological gradient towards the Illinois River. Therefore, it is highly unlikely that groundwater mounding would divert groundwater flow off site to the west.

Deeper groundwater flow does not appear to be affected by the groundwater mounding observed in the shallow groundwater. Based on the observed groundwater flow pattern, monitoring wells G110D, G112D, and G113D are positioned hydraulically upgradient of the Landfill and serve as background wells.

There is vertical and lateral compositional variability between groundwater-bearing zones at the Site, which was previously described by RMT. Laterally, generally to the south of the TP&W rail easement and beneath the Landfill, shallow and deeper groundwater is present in an alluvial water-bearing zone consisting of interbedded sands and clays that overlie bedrock (reported to be present at a depth of 70 feet below ground surface near the Illinois River). This alluvial water-bearing zone is hydraulically connected to the Illinois River.

Upgradient of the Landfill (generally to the north of the TP&W rail easement), the shallow groundwater is present in overburden deposits comprised predominantly of clay and silty clay, both fill and native. However, deep upgradient monitoring wells in this area are screened in dark-gray shale of the Carbondale Formation, which generally is present at a depth of approximately 20 feet bgs. The shallow and deep groundwater upgradient of the Landfill flow south towards the Illinois River and discharge into the alluvial water-bearing units present beneath the Landfill (the Upper Sand Unit, the Lower Sand Unit, and the Intermediate Clay Aquitard described in Section 2.5) and commingle with groundwater in the alluvial system. The groundwater in the alluvial system then discharges to the Illinois River.

4.2.2 HYDRAULIC CONDUCTIVITY

Table 4.1 summarizes the hydraulic conductivity values calculated for the Site monitoring wells. The calculated hydraulic conductivity values for the shallow monitoring wells ranged from approximately 4.2E-02 cm/s to 1.9E-04 cm/s with a geometric mean of 1.2E-03 cm/s. The calculated hydraulic conductivity for the three deep wells ranged from approximately 1.1E-03 to 1.0E-04 cm/s with a geometric mean of 2.9E-04 cm/s. CRA notes that the three deep wells tested were installed in the lower sand unit. Monitoring wells G110D, G112D, and G113D were installed in the underlying shale unit and likely have hydraulic conductivities that are at least an order of magnitude lower than the three wells that were tested.

4.3 HYDROGEOLOGICAL INVESTIGATION ANALYTICAL DATA

Caterpillar commissioned a hydrogeological investigation that included, among other things, collection of groundwater samples, leachate samples from existing leachate wells, leachate samples from newly installed lysimeters, and surface water samples obtained from the Illinois River. Appendix H provides the analytical reports from the project laboratory for the hydrogeological investigation.

4.3.1 GROUNDWATER ANALYTICAL DATA

4.3.1.1 SHALLOW GROUNDWATER DATA

Table 4.2 summarizes the analytical data for the shallow groundwater samples obtained during the April and May 2011 sampling rounds and compares the data to the MALCs for potentially usable wastes. Figure 4.10 provides a summary of analytes detected in shallow groundwater samples at concentrations above the MALC.

VOCs were not detected in any of the groundwater samples collected from the shallow monitoring wells.

Metals detected at concentrations above the MALC in the groundwater samples collected from the shallow monitoring wells included cadmium, chromium, iron, lead, and manganese. Of these, cadmium, chromium, and lead were detected above the MALC only in the sample obtained from G110S during the April sampling round, and were not detected above the MALC at this location in the subsequent May sampling round. Iron was detected in shallow groundwater at concentrations ranging from 0.1J mg/L (estimated concentration) to 138 mg/L, and concentrations were above the MALC during at least one round in all of the shallow monitoring wells except G102S, G106S, and G112S. Manganese was detected in shallow groundwater at concentrations ranging from 0.24 mg/L to 2.8 mg/L, and was above the MALC in every shallow groundwater sample.

General chemistry analytes detected in shallow groundwater at concentrations above the MALC included chloride, fluoride, and TDS. Chloride concentrations in shallow groundwater ranged from 5.9 mg/L to 710 mg/L. Chloride was detected above the MALC in the groundwater samples collected from G102S and G103S. Fluoride concentrations in shallow groundwater ranged from non-detect to 5.4 mg/L. Fluoride was detected above the MALC only in the groundwater samples collected from G104S. TDS concentrations in shallow groundwater ranged from 319 mg/L to 1,600 mg/L. TDS was detected at concentrations above the MALC at G102S, G103S, and G111S (April 2011 only).

4.3.1.2 DEEP GROUNDWATER DATA

Table 4.3 summarizes the analytical data for the deep groundwater samples obtained during the April and May 2011 sampling rounds and compares the data to the MALCs for potentially usable wastes. Figure 4.10 depicts the analytes detected in deep groundwater samples at concentrations above the MALC.

VOCs were not detected in any of the groundwater samples collected from the deep monitoring wells.

Metals detected at concentrations above the MALC in the groundwater samples collected from the deep monitoring wells included chromium, iron, and manganese. Chromium was detected above the MALC in the groundwater sample collected from G110D (during the April round only) and G113D. Iron concentrations ranged from 0.52 to 187 mg/L, and concentrations were above the MALC during at least one round in all of the deep monitoring wells except G110D. Manganese concentrations ranged from 0.014 to 2.78 mg/L, and concentrations were above the MALC during both sampling rounds in all of the deep monitoring wells except G110D and G112D.

Chloride and TDS were the only general chemistry analytes detected in deep groundwater at concentrations above the MALC. Chloride concentrations in deep groundwater ranged from 29.1 mg/L to 350 mg/L. Chloride was detected above the MALC only in the groundwater samples collected from G110D. TDS concentrations in deep groundwater ranged from 400 mg/L to 3,050 mg/L. TDS was detected at concentrations above the MALC at G103D (April 2011 only), G110D, G112D, and G113D (April only).

4.3.2 LEACHATE WELL ANALYTICAL DATA

Table 4.4 summarizes the analytical data for the samples obtained from the five leachate wells in May and October 2011 and compares the data to the MALCs for potentially usable wastes.

The only VOC detected in samples obtained from the leachate wells was benzene at L302 at a concentration of 0.013 mg/L in May and 0.029 mg/L in October 2011, as compared to the MALC of 0.005 mg/L. No other VOCs were detected at L302 and no VOCs were detected in the samples from the other four leachate wells.

Of the 10 metals analyzed, six metals were detected in the samples collected from the leachate wells including arsenic, barium, cadmium, iron, lead, and manganese. Of these, cadmium and lead were detected only in the sample obtained from leachate well L304 at concentrations well below the MALC for potentially usable wastes. Of the remaining metals, manganese was the only analyte detected at a concentration above the MALC at locations L301 and L303R.

The general chemistry analytes including nitrate as nitrogen, nitrite as nitrogen, and nitrite as nitrite were not detected in the samples collected from the leachate wells. General chemistry analytes detected at concentrations above the MALC included chloride in the samples from L302 and L305 (October 2011 only), fluoride in the samples from L304, sulfate in the sample from L303R (May 2011 only) and TDS in the samples from L301 (May 2011 only), L302, and L305. Chloride concentrations in the leachate well samples ranged from 15 mg/L to 510 mg/L. Fluoride concentrations in the leachate well samples ranged from 2.4 mg/L to 8.2 mg/L. TDS concentrations in the leachate well samples ranged from non-detect to 2,200 mg/L.

4.3.3 LYSIMETER ANALYTICAL DATA

Table 4.5 summarizes the analytical data for leachate samples collected from the five lysimeters during the two sampling rounds completed in May and June 2011 and compares the data to the MALC for potentially usable wastes. TDS concentrations in the lysimeter samples ranged from 730 to 1,500 mg/L. TDS concentrations exceeded the MALC for potentially usable waste at only one location, LS304, during both sampling rounds. The TDS concentrations were at or below the MALC in the samples collected from the four other lysimeters. As is often an issue with lysimeter sampling, it is noted that lysimeter LS305 did not produce a sufficient volume of leachate during the June sampling round to permit sample analysis.

4.3.4 SURFACE WATER ANALYTICAL DATA

Table 4.6 summarizes the surface water analytical data for the samples obtained during the April and May 2011 sampling rounds. In April 2011, the TDS concentrations were 524 mg/L at staff gauge SG-2 (downstream) and 527 mg/L at staff gauge SG-1 (upstream). In May 2011, the TDS concentrations were 430 mg/L at staff gauge SG-2 (downstream) and 410 mg/L at staff gauge SG-1 (upstream).

5.0 DISCUSSION OF STATISTICAL METHODS

5.1 OVERVIEW

As discussed in Section 2.7.3, TDS is a non chemical-specific parameter, generally comprised of inorganic salts and small amounts of organic matter dissolved in water, and not a direct measurement of any specific constituent present in a sample. The U.S. EPA set a national secondary drinking water standard of 500 mg/L for TDS. The U.S. EPA's secondary drinking water standards are non-enforceable guidelines regulating analytes that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water but that are not considered to present a risk to human health. With respect to TDS, at higher concentrations aesthetic effects, mineral deposition, and corrosion of water systems may occur. The IEPA enforces a TDS objective of 1,200 mg/L for Class I and Class II groundwater per 35 Ill. Adm. Code Part 620. Additionally, IEPA enforces a TDS MALC of 1,200 mg/L for potentially usable wastes under Part 817.

Metals and general chemistry analytes, such as those that appear on the L-1 leachate sampling constituents list in the Permit, also occur naturally in groundwater. Therefore, in order to determine whether leaching of constituents from the Landfill has any significant effect on groundwater quality, it is necessary to determine the background concentrations of these analytes in upgradient groundwater unaffected by the Landfill and compare these concentrations to the concentrations of constituents in the groundwater downgradient of the Landfill.

CRA completed a number of statistical comparisons of the groundwater, leachate well, and lysimeter analytical data collected during this hydrogeological investigation to determine the expected range of naturally occurring background concentrations and what effect, if any, the leaching of foundry waste-related constituents might have on the groundwater beneath and downgradient of the Landfill.

In order to complete these concentration data set comparisons, CRA used a number of statistical techniques, as described in Section 5.2 below.

5.2 STATISTICAL METHODS UTILIZED

The statistical testing carried out focused on the following elements:

i) Establishing *background threshold values* (BTVs), which are statistical upper tolerance limits (UTLs) on an upper percentile of the background population. The BTVs were calculated for each analyte using monitoring data generated from sampling at upgradient/reference wells.

ii) Performing *inter-group comparisons*, directly contrasting analyte concentrations between location groups (i.e., upgradient, downgradient, lysimeter or leachate wells) using statistical hypothesis tests.

The methods employed were selected from relevant U.S. EPA and United States Naval Facilities Engineering Control (NAVFAC) guidance. The specific procedures used include:

a) BTV calculations using the methods and decision templates found in U.S. EPA's ProUCL Version 4.1 Technical Guide (U.S. EPA 2010)[18]

b) Inter-group comparisons using the Mann-Whitney/Wilcoxon Rank-Sum (WRS) Test and the Quantile Test recommended for use in U.S. EPA's Data Quality Assessment (QA-G9/S) Guidance (2006), CERCLA soil background comparison guidance (U.S. EPA 2002) and NAVFAC's groundwater background comparison guidance (NAVFAC, 2002).

For statistical UTL calculations to use as BTVs, CRA considered the 95th percentile of background. The UTL was calculated using a 99 percent confidence level (i.e., a statistical significance of $\alpha=0.01$, consistent with the minimum level for individual comparisons under Federal RCRA regulations)[19]. Therefore, each BTV is a value which is expected, with 99 percent confidence, to be exceeded by no more than 1 in 20 background samples. Any sampling result that exceeds the BTV would represent either

[18] It is noted that the ProUCL Technical Guide (U.S. EPA, 2010) recommends a minimum sample size of 8-10 observations, which was met and exceeded for all the data sets considered (i.e., there were 12 background data for all parameters excepting TDS, which had 24 background data).

[19] See 40 CFR 264.97(i)(2). Note that this Federal regulation is referred to indirectly in Illinois RCRA Closure Guidance (on page D-18 of the July 2003 guidance), which refers to EPA's "Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities" (EPA/530-R-93-001), which in turn (on page 2-3) refers to EPA's "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities – Interim Final Guidance (1989, which has subsequently been replaced by a Final Unified Guidance document in 2009). EPA's statistical guidance is based on the 40CFR 264 regulation.

a rare background value (i.e., expected to occur only 5 percent of the time with 99 percent confidence) or an indication that contributions from other sources are occurring and further investigation may be warranted.

The inter-group tests examine each group of data and compare the data sets directly. In the case of the data available for the present investigation, the groups considered included:

- Upgradient wells (shallow and deep groundwater)
- Downgradient wells (shallow and deep groundwater)
- Lysimeters (leachate)
- Leachate wells (leachate)

The WRS Test compares the central value (median) of two groups of data. The Quantile Test compares the upper and/or lower values (distribution tails) of the two groups of data. Using these two tests in conjunction allows for a more sensitive comparison, as either type of difference (central value or tails) can trigger a statistically significant result.

In performing the inter-group comparisons, a 95 percent confidence level was used, except in cases where a smaller number of samples (5 or less) was available in one of the test groups, in which case a 90 percent confidence level (significance of α=0.10) was used. This reduction of confidence is necessary for small data sets, as the power of the statistical tests (WRS and Quantile tests) is reduced, and using a lower confidence level compensates by providing a protective assessment (i.e., is more likely to find a difference, at the expense of potentially having more "false positive" results).

In the inter-group comparisons, one-sided tests (e.g., testing to see downgradient conditions exceed upgradient, but not vice-versa) were carried out. The exception to this was when comparing shallow and deep groundwater, in which case two-sided tests (i.e., to see if either shallow is greater than deep or shallow is less than deep) were used. The choice of one-sided vs. two-sided testing was determined by investigation goals, e.g., it was not of interest to test if analyte concentrations were lower downgradient than upgradient, but within the downgradient wells it was of interest to test if concentrations in shallow groundwater were higher or lower than in deep groundwater.

The statistical tests employed were carried out using U.S. EPA's ProUCL (Version 4.1.01) software, with the exception of the Quantile Test (an inter-group comparison method), which was carried out using spreadsheet calculations due to software limitations in

ProUCL Version 4.1.01 for some of the data sets encountered. U.S. EPA commissioned the ProUCL software to provide capabilities for carrying out environmental statistics analyses required by Federal and State regulations.

In the statistical tests, ProUCL handled the treatment of non-detects by applying the methodologies built into the software[20]. Where field sample duplicate results were present, the original investigative sample was retained (and field duplicate result excluded) in order that these points did not have undue influence (i.e., double that of measurements at other locations) on the statistical test results.

For information purposes, the following table provides the details of the three cases in which field duplicate results are present in the background dataset for TDS.

Well	*Sampling Event*	*Original*	*Duplicate*	*RPD*	*Retained*
G110S	January 2012	790	800	1.3%	790
G113D	September 2011	870	920	5.6%	870
G113D	November 2011	1100	1000	9.5%	1100

Note: units are mg/L

The column labeled "original" is the original investigative sample result from the well and the column labeled "Duplicate" is the duplicate sample result from the same well. The column labeled "RPD" represents the relative percent difference between the sample result and duplicate sample result. The retained value is the concentration used in the statistical dataset.

5.3 SCOPE OF ANALYTICAL DATA

The available groundwater, landfill leachate, and lysimeter water sample analytical data represent the following sampling events completed at the Site:

- April 2011 (groundwater monitoring wells)
- mid-May 2011 (leachate wells)
- late-May/early-June 2011 (groundwater monitoring wells and lysimeters)
- late-June 2011 (lysimeters)

[20] The only exception was for a single fluoride measurement in a sample collected at deep upgradient well G113D on April 7, 2011, which yielded a non-detect with an elevated detection limit above all other fluoride data (both detects and non-detects). In this case, the data point could not be meaningfully ranked as higher or lower than the other data, and needed to be excluded from the inter-group comparison tests in order to obtain valid results.

- September 2011 (upgradient groundwater monitoring wells)
- October 2011 (leachate wells)
- November 2011 (upgradient groundwater monitoring wells)
- January 2012 (upgradient groundwater monitoring wells).

5.4 STATISTICAL REFERENCE CITATIONS

- NAVFAC, 2004. Guidance for Environmental Background Analysis. Volume III: Groundwater. Naval Facilities Engineering Command. User's Guide UG-2059-ENV. Port Hueneme, California.
- U.S. EPA, September 2002. Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites (OSWER 9285.7-41). Office of Emergency and Remedial Response, United States Environmental Protection Agency, Washington D.C. EPA/540/R-01/003.
- U.S. EPA, February 2006. Data Quality Assessment: Statistical Methods for Practitioners (EPA QA/G-9S). Office of Environmental Information, United States Environmental Protection Agency, Washington D.C. EPA/240/B-06/003. [Available at http://www.epa.gov/QUALITY/qs-docs/g9s-final.pdf].
- U.S. EPA, May 2010. ProUCL Version 4.1.00 Technical Guide (Draft). United States Environmental Protection Agency, Office of Research and Development, Washington DC. EPA/600/R-07/041.

6.0 ANALYTICAL DATA EVALUATION

6.1 LEACHATE WELLS/LYSIMETERS TDS ANALYTICAL DATA EVALUATION

As discussed throughout this report, given the location and history of Landfill operations, Caterpillar has been concerned about influences from high TDS background concentrations in the vicinity of the Landfill on leachate well data. In an effort to provide some additional perspective on this issue, Caterpillar commissioned the installation of lysimeters adjacent to the leachate wells and collected limited additional data for assessment as part of its sampling and analysis. By design, lysimeters draw samples of leachate percolating through the Landfill in the vadose zone above the water-table interface, and are not subject to the complex interaction of groundwater and leachate beneath the Landfill or the effects of biofouling observed in the leachate well network.

In order to evaluate the comparability of the leachate data obtained from the leachate wells and lysimeters, CRA completed an inter-group statistical comparison of the TDS concentrations between the lysimeter data set and the leachate well data set as summarized in Table 6.1. The inter-group statistical comparison demonstrates that the lysimeters TDS data set exhibits a lower concentration than the leachate well TDS data set.

The fact that the statistical evaluation demonstrates that the limited lysimeter data set exhibits a lower TDS concentration than the leachate well data set warranted further evaluation. Therefore, CRA used the groundwater analytical data from the investigation to determine whether leaching from the Landfill has resulted in any substantive impact on the TDS concentration in the groundwater. This was accomplished by completing a statistical comparison of the groundwater analytical data upgradient and downgradient of the Landfill as described in the following sections.

6.2 BACKGROUND GROUNDWATER QUALITY

6.2.1 UPGRADIENT/DOWNGRADIENT MONITORING WELL SETS

In order to assess the potential TDS impacts to the groundwater from the Landfill, it is critical to understand the background TDS concentrations in the upgradient groundwater that is unimpacted by the Landfill. As discussed in Sections 2.4 and 2.5, groundwater flow is from the north towards the south across the Site towards the

Illinois River, which is the major regional discharge body for groundwater. However, as noted in Section 3.1, the monitoring wells that existed prior to this investigation were not well located for a background quality determination so a robust database of background groundwater quality did not exist.

As part of this investigation, Caterpillar commissioned installation of new monitoring wells G110S, G110D, G112S, G112D, G113S, and G113D upgradient of the Landfill. As noted in Section 4.2.1, the shallow and deep groundwater upgradient of the Landfill flows south towards the Illinois River and discharge into the alluvial water-bearing units present beneath the Landfill and commingle with groundwater in the alluvial system.

As shown in Table 3.5, there is a downward vertical gradient between the shallow and deep wells at every nested cluster (both north of the Landfill and beneath the Landfill), which demonstrates a downward flow from the shallow to the deeper groundwater. While there may be lateral and vertical compositional variability between the strata north of the Landfill, a confining unit is not present north of the Landfill and groundwater flows freely between the overburden and the underlying shale bedrock unit. Because the shallow and deep groundwater upgradient of the Landfill are not hydraulically separate units and upgradient groundwater discharges to and mixes with the groundwater present in the alluvial deposits beneath the Landfill, it is appropriate to consider both shallow and deep upgradient groundwater when calculating a background TDS concentration.

There is natural variability in TDS concentrations expected between the shallower groundwater present in the overburden and the deeper groundwater that is present in the shale. This is because the bedrock in this area is comprised of dark-colored, highly mineralized shale that acts as an abundant source of the dissolved anions and cations (i.e., calcium, magnesium, sulfate, chloride, etc.) that comprise TDS.[21] Additionally, deeper groundwater will have more residence time in this strata resulting in more dissolution of TDS components and higher concentrations of TDS in the groundwater. By contrast, shallower groundwater that has a lower residence time in the overburden unit, a deposit that does not contain as much of the anions and cations that comprise TDS, thus exhibits a lower TDS than the bedrock.

Further, as documented in previous reports submitted to the IEPA, a 43 foot deep test well drilled into the alluvial deposits adjacent to the Illinois River by Caterpillar in 1964

[21] RMT October 1996, pg. 4, and Additional Information for Significant Modification Application, Log #1995-154, RMT, Inc. March 1997, pg. 7.

exhibited TDS concentrations between 982 and 1,667 parts per million.[22] Caterpillar obtained these data long before the existence of the Landfill, and these prior data exhibit the same type of variability in TDS concentrations observed during the recent investigation. Based on the previous data, Caterpillar chose not to use the groundwater for plant water supply.

The six monitoring wells mentioned earlier in this section (G110S, G110D, G112S, G112D, G113S, and G113D) are considered the upgradient monitoring well set. The concentrations of analytes in groundwater samples from these monitoring wells (whether shallow or deep) are indicative of background levels of naturally occurring analytes in the groundwater unaffected by leaching from the Landfill. Conversely, monitoring wells G103D, G104S, G104D, G105S, G106S, G111S, and G111D are located hydraulically downgradient of and in relatively close proximity to the Landfill, and are considered the downgradient monitoring well set.

Applying the statistical techniques discussed in Section 5.2, CRA used the available monitoring data to perform inter-group comparisons between groundwater quality parameters in downgradient wells and upgradient wells. The data used for inter-group comparisons are presented in Tables 4.2 (shallow wells) and 4.3 (deep wells). Similarly, for the purposes of BTV calculations, the available groundwater quality data for the upgradient wells (G110S, G110D, G112S, G112D, G113S, and G113D) were used (again see Tables 4.2 and 4.3). For TDS only, the May 2011 sample analytical results for the upgradient wells were excluded from the statistical calculations, since two rounds of TDS data are available for the second quarter of 2011 (i.e., April and May). The May 2011 samples were excluded so that the TDS data during this quarter did not have undue influence (i.e., double that of the measurements from other quarters) on the statistical test results, and to incorporate four consecutive quarters of data representing the maximum time period spread available (i.e., April 2011, September 2011, November 2011 and January 2012). The May 2011 data for all other parameters and TDS in the downgradient wells were retained in the statistical analyses, since no additional sampling occurred for these analytes.

6.2.2 UPGRADIENT GROUNDWATER BTV DETERMINATION

In order to characterize background groundwater quality upgradient of the Landfill, CRA calculated BTVs from the upgradient monitoring well data set to compare to the

[22] Additional Information for Significant Modification Application, Log #1995-154, RMT, Inc. March 1997, p. 14

MALCs. As part of this, CRA calculated a BTV for TDS to determine whether the background groundwater contains TDS at concentrations exceeding the MALC, thus warranting an adjusted standard per Section 817.416(b)(2). Table 6.2 summarizes the BTVs calculated from the upgradient well data set and compares the BTVs to the MALCs for potentially usable waste.

A total of 12 samples were collected in shallow and deep upgradient wells during April and May 2011 and analyzed for metals and general chemistry parameters. The data from these 12 samples were used for BTV calculations for all parameters but TDS. As noted previously, additional samples were collected and analyzed for TDS only in the upgradient wells during September 2011, November 2011, and January 2012. Consequently, the May 2011 TDS results were excluded from the BTV calculations, in order to incorporate four consecutive quarters of data representing the maximum time period spread available (24 results total).

As indicated in Table 6.2, the BTV calculated from the upgradient TDS data set is 2,539 mg/L. As discussed in Section 5.2, the BTV provides a statistical representation of upgradient conditions based on existing sampling data such that there is high level of confidence that 95 percent of the upgradient groundwater population should not exceed the BTV. For TDS, and six other analytes (cadmium, chromium, iron, lead, manganese, and chloride) which all contribute to the TDS concentrations measured in the groundwater, the proportion of detected concentrations that were below the associated MALC was less than 95 percent in upgradient monitoring well samples (ranging from 33 percent for manganese to 92 percent for cadmium). Of particular interest, for TDS the percentage of detections below the MALC of 1,200 mg/L was only 63 percent (15 out of 24 samples).

The statistical evaluation demonstrates that many of the inorganic and general chemistry analytes that occur naturally in the background groundwater, including TDS, are expected to frequently exceed the MALC, as indicated by their calculated BTVs exceeding the MALC. Therefore, it would be difficult, if not impossible, for Caterpillar to demonstrate that the concentrations of TDS in groundwater in the zone of attenuation downgradient of the Landfill meet the Part 620 groundwater quality standards upon which the MALCs are based, as allowed under Section 817.106(b). Given this, since the TDS BTV concentration exceeds the MALC, a more appropriate compliance benchmark for TDS would be the calculated BTV of 2,539 mg/L.

6.3 GROUNDWATER DATA SET COMPARISONS

6.3.1 UPGRADIENT/SHALLOW DOWNGRADIENT GROUNDWATER DATA SET COMPARISON

In order to provide an indication of whether leaching from the Landfill is resulting in any significant impact to the downgradient groundwater, CRA completed an inter-group statistical comparison between the upgradient groundwater data set and the shallow downgradient groundwater data set. CRA believes this comparison is particularly relevant because any Landfill-related leachate impacts to groundwater quality would be observed first and would be most pronounced in the shallow downgradient groundwater data set. This is because the shallow groundwater is spatially located closest to the Landfill where effects from leaching would be most prominent.

As summarized in Table 6.3, the results of the inter-group statistical comparison of the analyte concentrations in the upgradient groundwater data set and the shallow downgradient groundwater data set yielded no statistical difference in the concentrations of TDS and 13 of the other analytes evaluated. Additionally, the highest TDS concentration observed in the shallow downgradient wells of 1,210 mg/L is well below the BTV for TDS of 2,539 mg/L.

These comparisons demonstrate that the TDS concentrations in shallow groundwater immediately downgradient of the Landfill are similar to the background concentrations in upgradient groundwater; thus any potential Landfill-related TDS impact to the shallow downgradient groundwater is negligible.

6.3.2 UPGRADIENT/DEEP DOWNGRADIENT GROUNDWATER DATA SET COMPARISON

Due to the presence of a significant aquitard between the Upper and Lower Sand Units as documented in Section 2.5, leachate-related impacts to the deep downgradient groundwater would not be expected. Nevertheless, CRA performed an evaluation of upgradient and downgradient analyte concentrations in the deep monitoring wells to complete the upgradient/downgradient comparison.

As summarized in Table 6.4, the inter-group statistical evaluations between the upgradient groundwater data set and the deep downgradient data set yielded no statistical difference in the concentrations of TDS and 13 of the other analytes evaluated.

Additionally, the highest TDS concentration in the deep downgradient wells of 1,380 mg/L is well below the BTV for TDS of 2,539 mg/L.

These comparisons demonstrate that the TDS concentrations in deep groundwater immediately downgradient of the Landfill are similar to the background concentrations in upgradient groundwater; thus any potential Landfill-related TDS impact to the deep downgradient groundwater is negligible.

6.4 SUMMARY OF STATISTICAL OBSERVATIONS

CRA completed a statistical evaluation of the various data sets and compared the data sets to each other in a number of ways in order to determine whether there are potential TDS impacts to the groundwater beneath the Site that are attributable to the Landfill. The following sections provide a summary of the conclusions of the statistical evaluations.

6.4.1 SUMMARY OF LEACHATE DATA SET EVALUATIONS

- Due to a concern about the representativeness of the leachate samples collected from the leachate wells and the observed TDS concentrations, Caterpillar commissioned installation of lysimeters adjacent to the leachate wells to facilitate collection of TDS analytical data for comparison.
- The comparability of the leachate data obtained from the leachate wells and lysimeters was tested by performing statistical inter-group comparisons of TDS concentrations between the lysimeter data set and the leachate well data set.
- The inter-group statistical comparison between the lysimeter and leachate well TDS data sets demonstrates that the lysimeters TDS data set exhibits a lower concentration than the leachate well TDS data set.

6.4.2 SUMMARY OF GROUNDWATER DATA SET EVALUATIONS

Upgradient Groundwater Quality

- The concentrations of many of the inorganic and general chemistry analytes that occur naturally in the background groundwater including TDS are expected to frequently exceed the MALC.

- Recent lysimeter data support the conclusion that the TDS concentrations in the background groundwater are a contributing factor to the TDS concentrations observed in leachate wells.
- It would be difficult, if not impossible, for Caterpillar to demonstrate that the concentrations of TDS in groundwater in the zone of attenuation downgradient of the Landfill meet the Class I groundwater quality standards upon which the MALCs are based, as allowed under Section 817.106(b).
- The appropriate concentration to use as a compliance benchmark for TDS is the BTV concentration of 2,539 mg/L, based on TDS concentrations observed in wells upgradient of the Site.

Upgradient/Downgradient Groundwater Comparisons

- In order to provide an indication of whether leaching from the Landfill is resulting in any significant impact to the downgradient groundwater; CRA completed an inter-group statistical comparison between the upgradient groundwater data set and the shallow and deep downgradient groundwater data sets.
- These comparisons demonstrate that the shallow and deep groundwater downgradient of the Landfill do not exhibit statistically significant differences in TDS concentrations as compared to the upgradient groundwater data set.
- The highest TDS concentration in the shallow downgradient wells of 1,210 mg/L and the deep downgradient wells of 1,380 mg/L are well below the BTV for TDS of 2,539 mg/L.
- The TDS concentrations in shallow and deep groundwater immediately downgradient of the Landfill are similar to the background concentrations in upgradient groundwater; thus any potential Landfill-related TDS impacts to the shallow and deep downgradient groundwater are negligible.

7.0 POTENTIAL IMPACTS TO THE ILLINOIS RIVER

7.1 POTENTIAL GROUNDWATER DISCHARGE TO THE ILLINOIS RIVER

The Illinois River is the regional discharge point for groundwater. CRA calculated the shallow groundwater flux for the Landfill frontage along the Illinois River. This evaluation was confined to the shallow groundwater because, as discussed in Section 5.3.3, if the leachate from the Landfill were to affect the groundwater quality beneath the Landfill to levels above background (a fact not borne out by the statistical evaluations), this most likely would be observed first and be most pronounced in the shallow groundwater downgradient of the Landfill.

CRA calculated the estimated shallow groundwater discharge to the Illinois River by the using the following formula:

Equation 1:

$$Q = KiA$$

where:

Q	=	the discharge to the Illinois River in cfs (ft^3/sec)
K	=	the hydraulic conductivity of the aquifer in feet per second (ft/sec)
i	=	the hydraulic gradient (dimensionless)
A	=	the cross-sectional area across which groundwater discharge occurs in square feet (ft^2)

CRA estimated the hydraulic conductivity (K) of the alluvial water-bearing zone using the geometric mean of all of the hydraulic conductivity values for the shallow wells in Table 4.1 (1.25E-03 cm/s or 4.10E-05 ft/sec). The hydraulic gradient (i) was estimated by averaging the change in head between leachate well L301 and monitoring well G106S (a distance of 600 feet) over the five monitoring rounds, which was approximately 0.036. This is a very conservative estimate of the groundwater gradient as it represents an area where the leachate to shallow groundwater gradient is steepest, not an average condition across the entire length of the Landfill frontage along the Illinois River. The use of the steepest gradient will provide a high bias and over predict the volume of groundwater flux to the Illinois River.

The cross-sectional area of the groundwater discharge to the Illinois River, 27,500 ft^2, was determined based on the distance along the Illinois River between the north property line on the north and the West Ditch discharge point on the south, a distance of approximately 2,750 feet multiplied by the saturated thickness of the shallow alluvial water-bearing zone above the intermediate clay unit (estimated to be approximately 10 feet based on water levels observed in the shallow downgradient wells).

Substitution of variables into Equation 1 yields the equation and result below:

$$Q = 4.10\text{E-05 ft/sec} \bullet 0.036 \bullet 27{,}500\ \text{ft}^2$$

$$Q = 4.06\text{E-02 cfs}$$

7.2 POTENTIAL TDS LOADING TO THE ILLINOIS RIVER

CRA examined the potential loadings of TDS to the Illinois River, the regional discharge point for groundwater beneath the Site. CRA researched information pertaining to discharge of the Illinois River in the area near the Site. As discussed in Section 2.2.2, since 1980, the monthly mean discharge of the Illinois River near Mapleton has ranged from approximately 3,676 cfs in November 2003 to 55,630 cfs in April 1983. According to the Illinois State Water Survey (ISWS), the 7-day, 10-year annual (7Q10) low flow for the Illinois River near Mapleton is 3,050 cfs.

Dividing the 7Q10 low flow by the shallow water-bearing zone cross-sectional discharge yields a dilution factor of over 75,000. Therefore, based on the current TDS concentrations in the groundwater downgradient of the Landfill, the expected impact on the TDS concentration in the Illinois River would be 1.33E-05 mg/L, which is not measurable using modern laboratory testing protocols. Stated another way, the concentration of a constituent in the shallow groundwater discharging to the Illinois River would need to be increased by 75,000 mg/L for the concentration of the same constituent in the Illinois River to rise by 1 mg/L based on estimates of groundwater flux that are biased high. To put this in perspective, this discharge would represent water that contained over twice the TDS content of seawater, which is typically 35,000 mg/L[23].

[23] Brackish Water FAQs, Texas Water Development Board, http://www.twdb.state.tx.us/innovativewater/desal/faqbrackish.asp

Based on the calculated dilution factor and the concentrations of analytes noted in the groundwater and leachate samples, the groundwater downgradient of the Landfill will have no impact to the Illinois River. Any TDS loadings from the Landfill to the groundwater and subsequently to Illinois River are negligible, are not distinguishable from background, and do not affect surface water quality. As discussed in Section 2.2.3, Illinois abandoned the TDS general use standard recently in favor of chloride and sulfate standards to address more reliably the causal agents of the problems that are associated with TDS. CRA examined the upgradient/downgradient relationship between chloride and sulfate concentrations in groundwater and found no significant differences between these data sets. Additionally, similar to TDS, any sulfate and chloride loadings from the Landfill to the groundwater and subsequently to Illinois River are negligible, are not distinguishable from background, and do not affect surface water quality.

8.0 POTENTIAL ENVIRONMENTAL RECEPTORS

CRA performed an assessment of potential ecological receptors and a qualitative risk assessment for potential human receptors associated with the groundwater TDS concentrations associated with the Landfill at the Site.

8.1 POTENTIAL ECOLOGICAL RECEPTORS

CRA performed an assessment for sensitive ecological receptors and threatened and endangered species and their habitats. The most significant ecological features near the Site are the Illinois River and its associated tributaries and wetlands. As stated in Section 2.2.3, based on CRA's review, no unusually sensitive species (i.e., threatened or endangered species) or their habitat were identified near the Site. The absence of threatened and endangered species in adjacent habitats reduces the potential for significant ecological effects. However, the lack of any significant loading to the Illinois River above background levels already precludes the potential for significant ecological effects.

As stated in Section 2.2.3, Illinois currently has no surface water criterion for TDS. Until the mid-2000s, Illinois had a general use standard of 1,000 mg/L for TDS but abandoned the general use standard recently in favor of chloride and sulfate standards to address more reliably the causal agents of the problems that are associated with TDS. Given this, CRA examined the upgradient/downgradient relationship in groundwater between chloride and sulfate concentrations in groundwater and found no significant differences between these data sets (see Tables 6.3 and 6.4). This demonstrates the lack of any significant loadings from the Landfill to the Illinois River for these constituents and, accordingly, the absence of impact to environmental receptors.

8.2 POTENTIAL HUMAN RECEPTORS

The potential human receptors for groundwater at the Site include industrial workers, construction workers, and occasional trespassers. With respect to the potential human receptors, there is a limited number of potential exposure pathways present at the Site. There is no current usage of groundwater at the Site for either potable or non-potable purposes (such as industrial process water). Caterpillar tested the water before the Site was developed and determined the groundwater quality to be poor because of elevated TDS content and chose to use surface water from the Illinois River for potable and industrial water supply at the Site.

As discussed in Section 2.6, the ISWS database identified three water wells on the adjacent Evonik Industries property (formerly Goldschmidt Chemical) located east of the Site and two water wells located on the adjacent property to the west of the Site owned by Growmark Industries (formerly C.F. Industries). The closest Evonik water well is located approximately 4,000 feet east of the Part 817 Landfill to the south of Pond Lily Lake. According to Evonik representatives, the three wells are between 65 and 80 feet in depth and are used for domestic water (showers, sinks, kitchen) not specifically for drinking. The closest Growmark water well is located approximately 1,600 feet west of the Part 817 Landfill, and the two wells have reported depths of 36 and 51 feet. The Growmark Industries representative stated that neither of the two wells are used for drinking water. One other private wells was reported in Section 29 but is located over a mile northwest of the Part 817 Landfill in the upland area not associated with the Sankoty Aquifer.

It is highly unlikely that TDS impacts from the Landfill extend to the water wells located to the east and west of the Landfill. To the east, the nearest water supply well is located 4,000 feet away from the Landfill. Although no stratigraphic records were available, the owner reported these wells to be between 65 and 80 feet deep, thus likely screened in alluvium associated with the Illinois River. As discussed in Section 4.2.1, deeper groundwater flow does not appear to be affected by the groundwater mounding observed in the shallow groundwater.

The land to the west of the Landfill for a distance of over 1,500 feet is property owned by Caterpillar that is largely undeveloped, heavily vegetated bottomland. A mill water intake pond, a drainage ditch (West Ditch), Little LaMarsh Creek, and an unused harbor associated with the Illinois River lie between the Landfill and the adjacent property to the west. Shallow groundwater mounding related to the Landfill is a local effect that will diminish laterally within a few hundred feet of the landfill due to the effect of the regional hydrogeological gradient towards the Illinois River especially given the features present west of the Landfill such as the mill water holding pond, Little LaMarsh Creek, and the unoccupied harbor. Therefore, it is highly unlikely that shallow groundwater mounding would divert groundwater flow off site to the west. Well to the north of the Site, including the Mapleton municipal well, lay well upgradient of the Site and thus not affected by Landfill.

TDS and the other analytes tested do not represent a direct contact threat to humans so this is not an exposure pathway of concern. Therefore, human exposure to groundwater is not of concern at the Site. The data evaluations in this report document the absence of any significant Landfill-related loadings of TDS to the Illinois River above background levels and thus demonstrates the lack of potential impact to surface water quality. Based on the TDS background groundwater concentrations (see the discussion in Section 6.2.2) and the fact that Caterpillar has other potable water supply infrastructure in place, it is highly unlikely that groundwater would be used at the Site in the future so groundwater ingestion is not an exposure pathway of concern at the Site.

9.0 817.413 GROUNDWATER IMPACT ASSESSMENT

9.1 BACKGROUND

The waste classification rules at 817.106(b) state that the Agency, upon application by an owner or operator, may allow an exceedance of any secondary standard provided an adequate demonstration using the groundwater impact assessment procedures of 817.413 showing that the limit increase will not result in an exceedance of the groundwater quality standards in Section 817.416.

The Section 817.416 groundwater quality standards include:

A) The Board established standard

B) The Board established adjusted standard

C) Background, for constituents where no Board established standards exists

The Board-established standard is the concentration adopted as a groundwater quality standard under 35 Ill. Adm. Code 620.

As TDS is the only analyte noted to have exceeded a MALC in sampling required under the Permit, this discussion focuses on TDS. TDS is a secondary standard per Section 817.106. Therefore, the use of the groundwater impact assessment procedures in Section 817.413 is appropriate.

The analysis below uses the groundwater impact assessment procedures to demonstrate that the limit increase in the MALC for TDS will not result in an exceedance of the proposed adjusted groundwater quality standard of 2,539 mg/L, which is based on the BTV calculated using the upgradient groundwater data set.

9.2 GROUNDWATER IMPACT ASSESSMENT PROCEDURE

The procedure for the groundwater impact assessment is summarized at 817.413(a)(3)(A) through (F).

(A) Determine The Aquifer Hydraulic Conductivity. If the Aquifer Conductivity Is 1E-05 cm/s or Less, No Further Assessment Is Required

The hydraulic conductivity of the water-bearing units beneath and downgradient of the Landfill exceeds 1E-05 cm/s. However, although the hydraulic conductivity is greater than 1E-05 cm/s, much of the groundwater present in the Upper Sand Unit downgradient of the Landfill does not meet the criteria of a Class I aquifer because the groundwater occurs in a sandy zone that is less than 10 feet below ground surface. Examination of the stratigraphic logs indicates that the uppermost permeable saturated zone at the shallow downgradient monitoring wells (G104S, G105S, G106S, and G107SR) is less than 10 feet below ground surface and underlying these units is a clay unit (the Intermediate Clay Aquitard) of variable thickness. By definition, groundwater in these zones would not be considered Class I because it is less than 10 feet below ground surface. However, the stratigraphy at G111S indicates the shallow groundwater below 10 feet may be Class I groundwater but the extent of this Class I groundwater downgradient of the Landfill clearly is limited. The hydraulic conductivity of the Lower Sand Unit exceeds 1E-05 cm/s.

(B) Develop a Conceptual Flow Model of the Site to Determine the Soil Units Through Which the Leachate Constituents May Migrate

Section 4 of this document discusses the Site Conceptual Model (CSM). In its natural condition, groundwater would flow north to south and discharge to the Illinois River. The shallow and deep groundwater upgradient of the Landfill flows south towards the Illinois River and discharges into the alluvial water-bearing units present beneath the Landfill and commingles with groundwater in the alluvial system. Landfill leachate flows downwards and commingles with the groundwater present in the shallow alluvial water-bearing unit beneath the Landfill. The alluvial water-bearing unit consists of a shallow and deeper sand unit separated by an aquitard (the Upper Sand Unit, the Intermediate Clay Aquitard, and the Lower Sand Unit). In turn, these units overlie bedrock present at approximately 70 feet below ground surface downgradient of the Landfill. The groundwater in the alluvial system then discharges to the Illinois River. The Upper Sand Unit beneath and downgradient of the Landfill is the water-bearing unit that is expected to exhibit the greatest potential effects from the leachate.

(C) Determine the Organic Carbon Content for Soil Units Through Which Leachate Constituents May Migrate

During hydrogeological investigations completed at the Site, the organic carbon content of the soil at the Site ranged from 2 to 4.5 percent, with an average of 3.2 percent[24].

[24] Residual Management Technology, Inc., Hydrogeologic Investigation Report, Caterpillar – Mapleton Plant Landfill, Peoria, Illinois, March 1993, Table 3.

(D) Determine the Retardation Factor for Constituents of Interest

Retardation of TDS in the permeable sand units during advection is not expected to be significant and was assumed to be zero.

(E) Determine MALC Values of Constituents of Interest Required to Achieve Compliance with Applicable Groundwater Quality Standards

The Board-established standard for TDS adopted as a groundwater quality standard under 35 Ill. Adm. Code 620 is 1,200 mg/L. As stated in Section 817.416(b)(1), the operator may petition the Board for an adjusted groundwater quality standard. Caterpillar is seeking an adjusted standard for TDS pursuant to 817.106(b) because the upgradient background BTV for TDS exceeds the MALC of 1,200 mg/L and the compliance challenged posed by the leachate data from the Landfill leachate wells. The proposed adjusted standard of 2,539 mg/L for leachate is based on the statistical TDS BTV calculated using the upgradient groundwater data set. Assuming that the Board grants the adjusted groundwater quality standard of 2,539 mg/L, this concentration would become the MALC for TDS required to achieve compliance.

(F) Compare the Calculated MALC Values to the Leachate Values for the Waste Streams to Determine Whether Compliance with the Groundwater Standards Can Be Met

As discussed above, the BTV of 2,539 mg/L is the appropriate standard under Section 817.416(b)(2) for leachate because groundwater beneath the Site contains naturally occurring TDS that does not meet the groundwater quality standard under 35 Ill. Adm. Code 620 and would not be used for public water supply. The BTV is the value for which there is 99 percent confidence that 95 percent of new data will not exceed if they are representative of background conditions. The highest TDS concentration observed in the shallow downgradient wells of 1,210 mg/L is well below the BTV for TDS of 2,539 mg/L. This demonstrates that the TDS concentrations in shallow groundwater immediately downgradient of the Landfill are similar to the background concentrations in upgradient groundwater. The highest TDS concentration observed in leachate during the study was 2,200 mg/L, which is below the calculated MALC of 2,539 mg/L. Historically, although there have been individual detections of TDS in the leachate wells at concentrations above the calculated MALC, the leachate will meet the adjusted TDS standard of 2,539 mg/L using the statistical procedure to determine compliance noted in the Permit.

10.0 CONCLUSIONS

The following provides a summary of conclusion from the hydrogeological investigation that supports the adoption of Site-specific objectives for groundwater at the Site.

1. Elevated TDS Concentrations Have Been a Historical Challenge at the Landfill Since Operations Commenced under the Part 817 Permit

The Landfill began operating in 1977 long before the promulgation of Part 817. When the Landfill was permitted under Part 817 in 1995, the MALCs were applied as the leachate standards. TDS concentrations at individual leachate wells have exceeded the MALC since the initiation of leachate monitoring in 1997. TDS concentrations measured at one leachate well, L302, have exceeded the MALC in every monitoring round beginning with the first monitoring round in 1997. TDS concentrations above the MALC have been observed at every leachate well and, historically, TDS concentrations at or above the MALC occur in at least two leachate wells during each monitoring event. Well integrity and biofouling concerns are suspected to be significant causes of elevated TDS concentration in the leachate well network and will continue to be of concern in the future and represent a compliance challenge for Caterpillar.

Given that compliance is based on pooling of individual leachate concentrations to calculated cumulative statistics, historically the high TDS concentrations at individual wells had not resulted in non-compliance under the Permit prior to 2009. More recently the TDS concentrations at individual leachate wells have been high enough to present a compliance challenge for Caterpillar under the Permit. Because the leachate concentrations are close to the MALC, fluctuations in the leachate TDS data result in difficulty in meeting the TDS MALC. Moderate fluctuations in leachate concentrations in one leachate well can result in a MALC exceedance such as that observed reported in October 2009. Given the fluctuations in leachate concentrations noted above and historically in the data set, Caterpillar likely will have ongoing compliance challenges with achieving the TDS MALC in the future. This justifies a change in the TDS MALC.

2. The Background Groundwater Contains TDS at Concentrations Exceeding the MALC

The statistical evaluations of the upgradient groundwater data sets completed by CRA demonstrate that the upgradient background groundwater quality, which is unaffected by the Landfill, contains naturally occurring constituents, including TDS, at concentrations above the MALC. The BTV for TDS in background groundwater is 2,539 mg/L, which is well above the TDS MALC of 1,200 mg/L. Therefore, it would be appropriate and justified to set both an adjusted groundwater quality standard for TDS and a corresponding MALC for TDS at 2,539 mg/L.

3. The Lysimeters TDS Data Set Exhibits a Lower Concentration than the Leachate Well TDS Data Set

CRA completed an inter-group statistical comparison of the TDS concentrations between the lysimeter data set and the leachate well data set to evaluate the comparability of the leachate data obtained from the leachate wells and lysimeters. The inter-group statistical comparison demonstrates that the lysimeters TDS data set exhibits a lower concentration than the leachate well TDS data set. The fact that the statistical evaluation demonstrates that the limited lysimeter data set exhibits a lower TDS concentration than the leachate well data set warranted further evaluation. The lysimeter data supported the conclusion that the TDS concentrations in the background groundwater are a contributing factor to the TDS concentrations observed in leachate wells. Therefore, CRA evaluated the groundwater analytical data from the investigation to determine whether leaching from the Landfill has resulted in any substantive impact on the TDS concentration in the groundwater.

4. The BTV Based on Background Upgradient Groundwater TDS Concentrations Would Be a More Appropriate Compliance Benchmark than the MALC

The statistical evaluation demonstrates that the concentrations of many of the inorganic and general chemistry analytes that occur naturally in the background groundwater, including TDS, are expected to frequently exceed the MALC. Therefore, it would be difficult, if not impossible, for Caterpillar to demonstrate that the concentrations of TDS in groundwater in the zone of attenuation downgradient of the Landfill meet the Part 620 groundwater quality standards upon which the MALCs are based, as allowed under Section 817.106(b). Given this, for the analytes for which the BTV concentration exceeds the MALC, a more appropriate compliance benchmark would be the calculated BTV concentration. The BTV calculated from the upgradient TDS data set is 2,539 mg/L.

5. Potential Impacts to Shallow Downgradient Groundwater Related to Dissolved TDS Leaching from the Landfill are Negligible

In order to provide an indication of whether leaching from the Landfill is resulting in any significant impact to the downgradient groundwater; CRA completed an inter-group statistical comparison between the upgradient groundwater data set and the shallow and deep downgradient groundwater data sets. These comparisons demonstrate that the TDS concentrations in shallow and deep groundwater immediately downgradient of the Landfill are similar to the background concentrations in upgradient groundwater; thus any potential Landfill-related TDS impacts to the shallow and deep downgradient groundwater are negligible.

6. The Landfill Leachate Will Have No Impact on the Illinois River Water Quality

A conservative estimate of shallow groundwater discharge and the 7Q10 low flow rate of the Illinois River yields a dilution factor of over 75,000. Therefore, the concentration of a constituent in the shallow groundwater discharging to the Illinois River would need to be over 75,000 mg/L higher, twice that of typical seawater, in order to increase the concentration of that constituent in the river by 1 ppm. No such extreme concentration differences are observed at the Site, nor is it reasonable to expect these to occur. Therefore, it is reasonable to conclude that the Landfill will have no impact on the water quality in the Illinois River even using conservative assumptions.

7. Potential Human Exposure to Groundwater Analytes Is Not of Concern at the Site

There is no current usage of groundwater at the Site for either potable or non-potable purposes (such as industrial process water). Caterpillar tested the water before the Site was developed and determined the groundwater quality to be poor because of elevated TDS content and chose to use surface water from the Illinois River for potable and industrial water supply at the Site. Based on the TDS background groundwater concentrations and the fact that Caterpillar has other potable water supply infrastructure in place, it is highly unlikely that groundwater would be used at the Site in the future so groundwater ingestion is not an exposure pathway of concern at the Site.

TDS and the other analytes tested do not represent a direct contact threat to humans so this is not an exposure pathway of concern. Therefore, human exposure to groundwater is not of concern at the Site.

8. There Are No Significant Impacts to Potential Ecological Receptors in the Illinois River

The most significant ecological features near the Site are the Illinois River and its associated tributaries and wetlands. Based on CRA's review, no unusually sensitive species (i.e., threatened or endangered species) or their habitat were identified near the

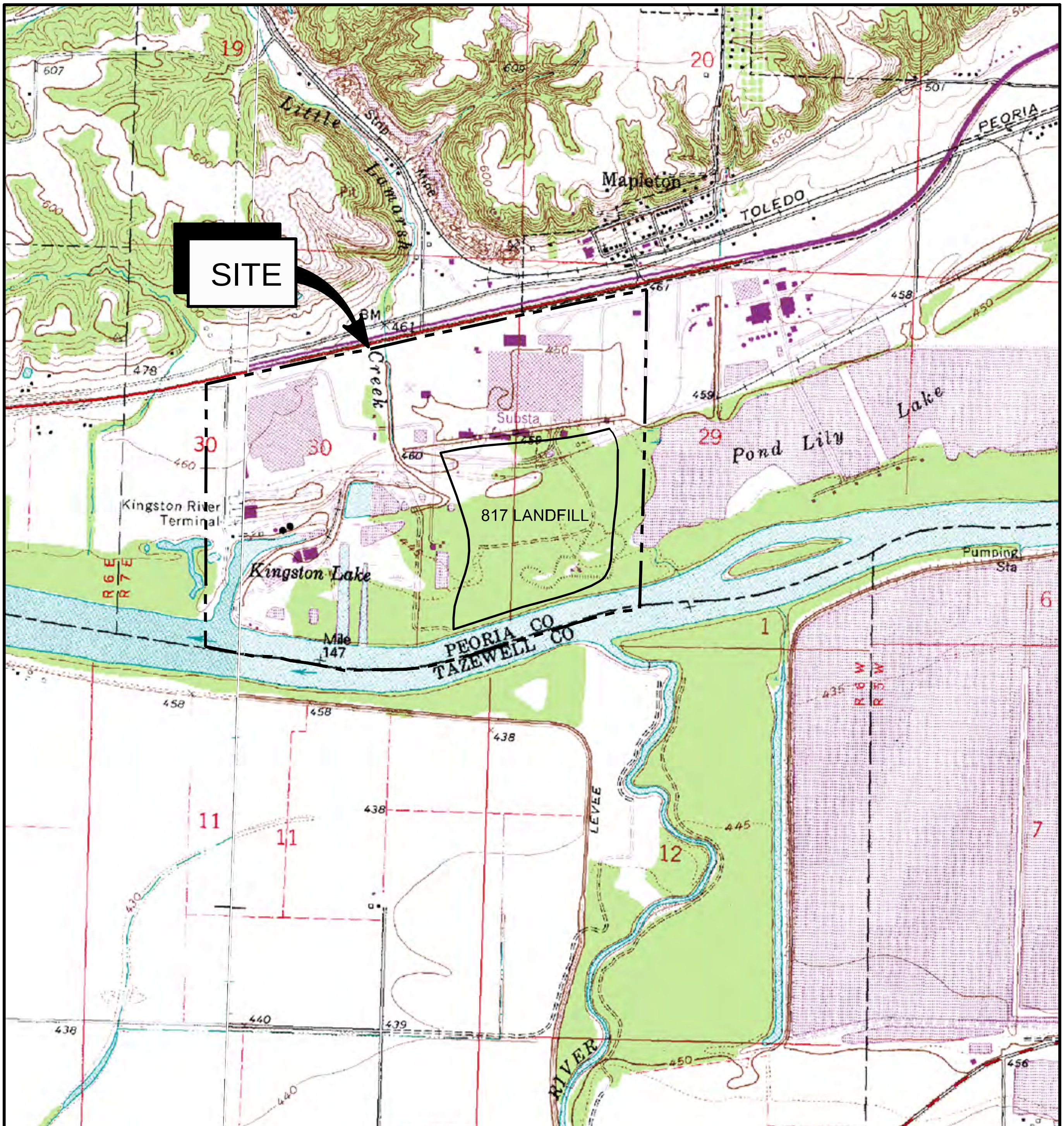
Site. The absence of threatened and endangered species in adjacent habitats reduces the potential for significant ecological effects. However, the lack of any significant loading to the Illinois River above background levels already precludes the potential for significant ecological effects.

Illinois abandoned the TDS general use standard recently in favor of chloride and sulfate standards to address more reliably the causal agents of the problems that are associated with TDS. CRA examined the upgradient/downgradient relationship between chloride and sulfate concentrations in groundwater and found no significant differences between these data sets. This demonstrates the lack of any significant loadings from the Landfill to the Illinois River for these constituents and, accordingly, the absence of impact to environmental receptors.

9. The Leachate from the Landfill Will Meet an Adjusted Groundwater Quality Standard Based on Background Groundwater Quality

The TDS BTV of 2,539 mg/L calculated from upgradient groundwater data is justified as the appropriate adjusted standard because upgradient groundwater contains naturally occurring TDS that exceeds the MALC of 1,200 mg/L. The highest TDS concentration observed in the leachate well data set is lower than the BTV for the upgradient well data set. Therefore, the leachate from the Landfill will meet an adjusted standard of 2,539 mg/L based on background groundwater quality.

FIGURES



BASE SOURCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE;
GLASFORD AND PEKIN, IL 1996

0 1000 2000ft

figure 1.1

SITE LOCATION
CATERPILLAR INC.
Mapleton, Illinois

CRA

70102-00(002)GN-WI001 MAY 24/2012

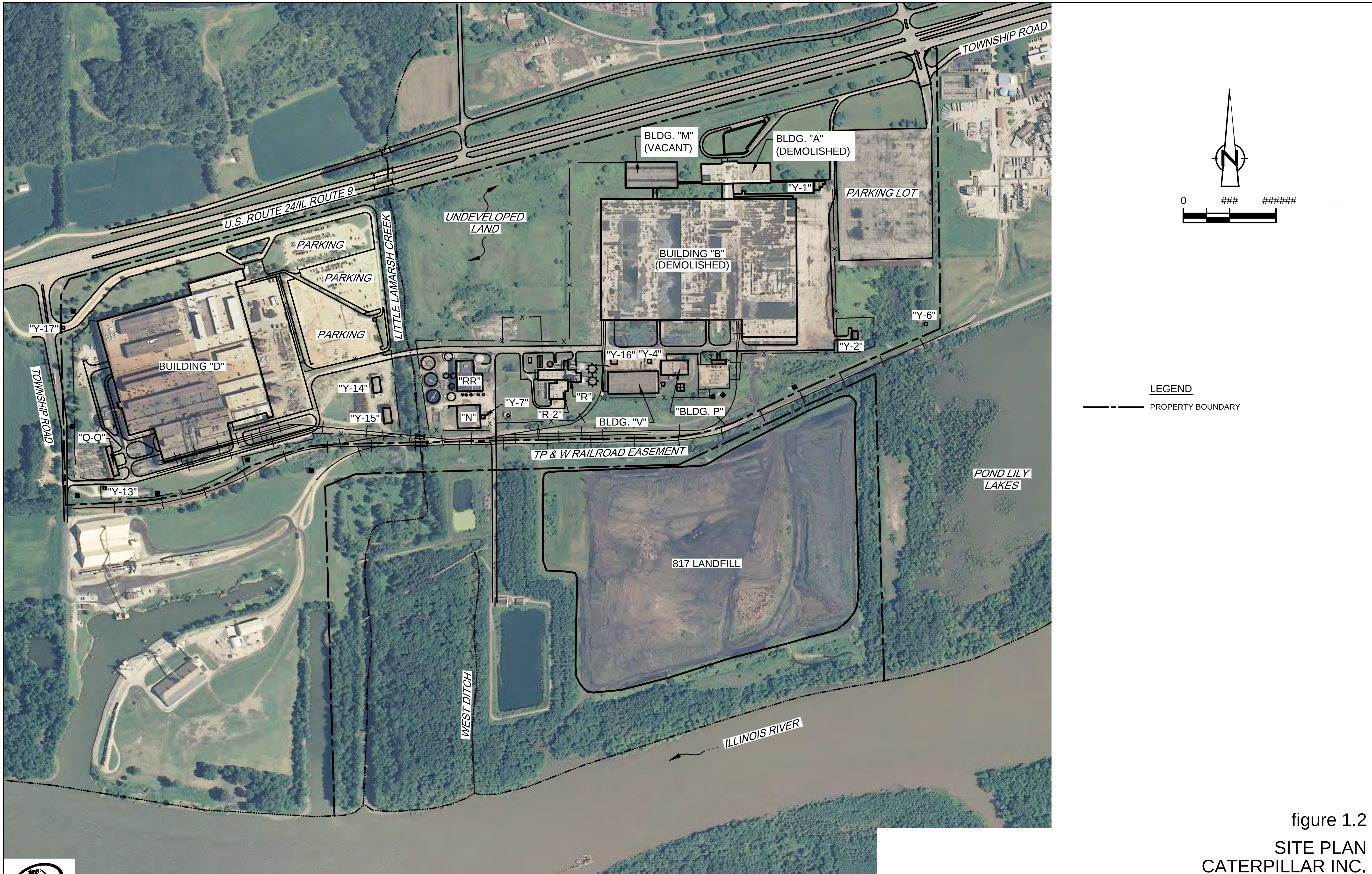


figure 1.2

SITE PLAN
CATERPILLAR INC.
Mapleton, Illinois

SOURCE: SAMPLE LOCATIONS SURVEYED BY ZUMWALT & ASSOC, INC. JUNE 2011; ILLINOIS SP WEST, NAD83.
AERIAL: USGS NAIP, 2010.

70102-00(002)GN-WA001 AUG 12/2011

Source: Image courtesy of USGS © 2012 Microsoft Corporation
Coordinate System: NAD 1983 StatePlane Illinois West FIPS 1202 Feet

Legend

● Approximate Private Well Location

figure 2.1

SURROUNDING LAND-USE MAP
CATERPILLAR INC.
Mapleton, Illinois

70102-00(002)GIS-WA001 January 04, 2013

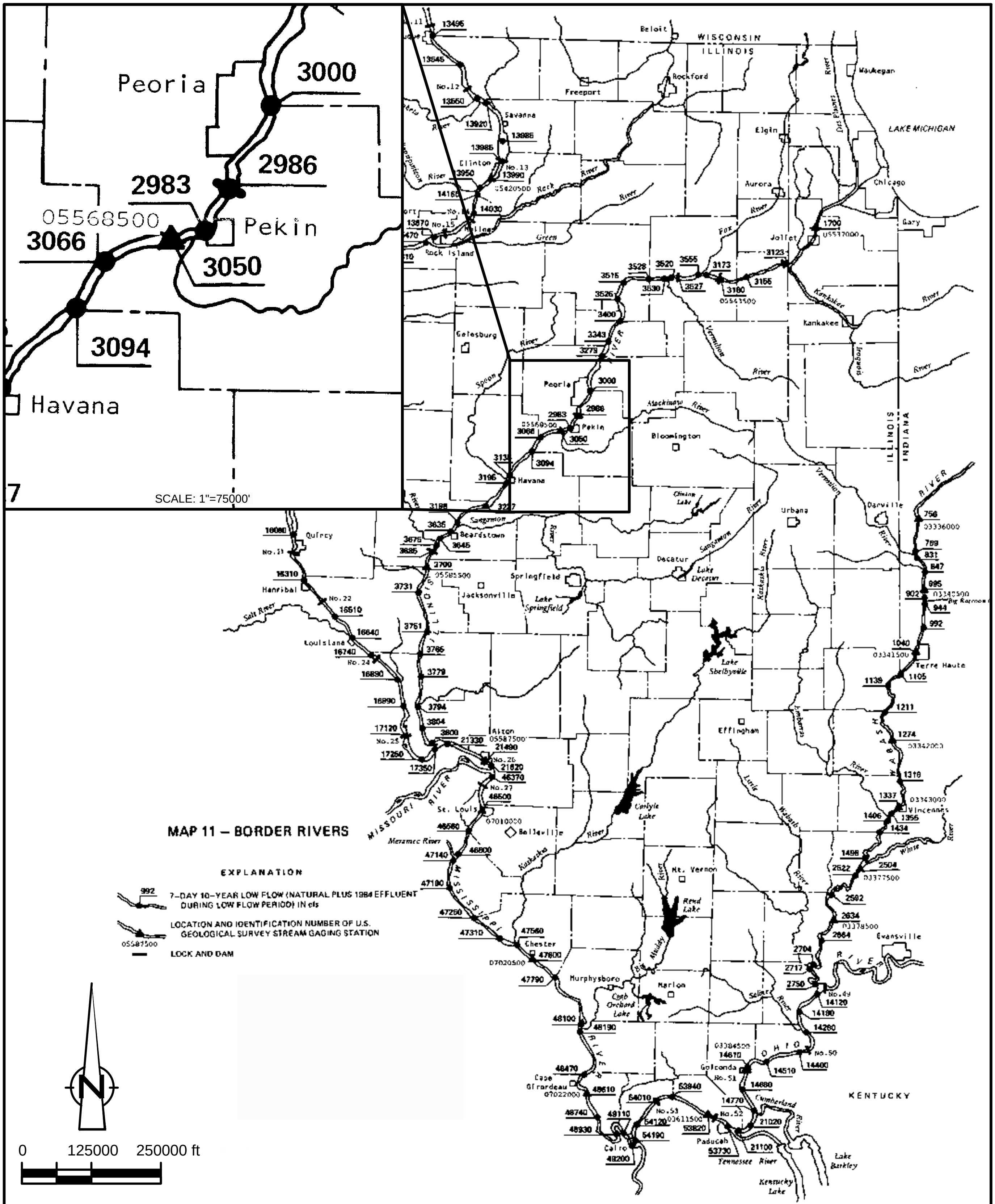
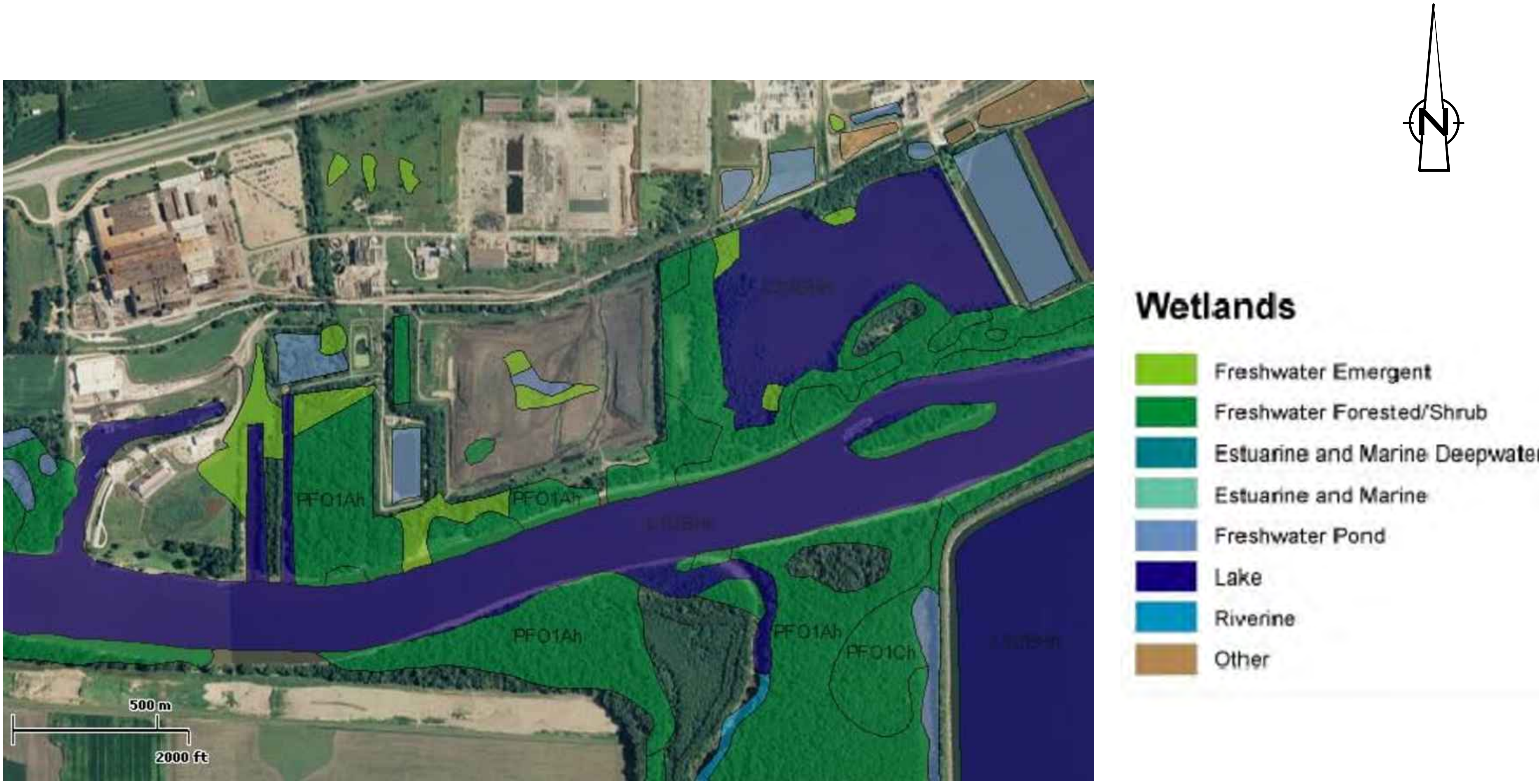


figure 2.2

ILLINOIS STATE WATER SURVEY 7Q10 FLOW DATA
CATERPILLAR INC.
Mapleton, Illinois

SOURCE: ILLINOIS STATE WATER SURVEY, MAP 11 BORDER RIVERS.

70102-00(002)GN-WA017 AUG 12/2011



THIS MAP IS FOR GENERAL USE ONLY. THE US FISH AND WILDLIFE SERVICE IS NOT RESPONSIBLE FOR THE ACCURACY OR CURRENTNESS OF THE BASE DATA SHOWN ON THIS MAP. ALL WETLANDS RELATED DATA SHOULD BE USED IN ACCORDANCE WITH THE LAYER METADATA FOUND ON THE WETLANDS MAPPER WEB SITE.

figure 2.3

NATIONAL WETLANDS INVENTORY MAP
CATERPILLAR INC.
Mapleton, Illinois

CRA

SOURCE: US FISH AND WILDLIFE SERVICE, JUNE 24, 2011

70102-00(002)GN-WI009 AUG 12/2011

SOURCE: ILLINOIS STATE GEOLOGICAL SURVEY DEPARTMENT OF REGISTRATION AND EDUCATION BULLETIN 95, 1975

figure 2.4

PHYSIOGRAPHIC DIVISIONS OF ILLINOIS
CATERPILLAR INC.
Mapleton, Illinois

70102-00(002)GN-WI002 AUG 12/2011

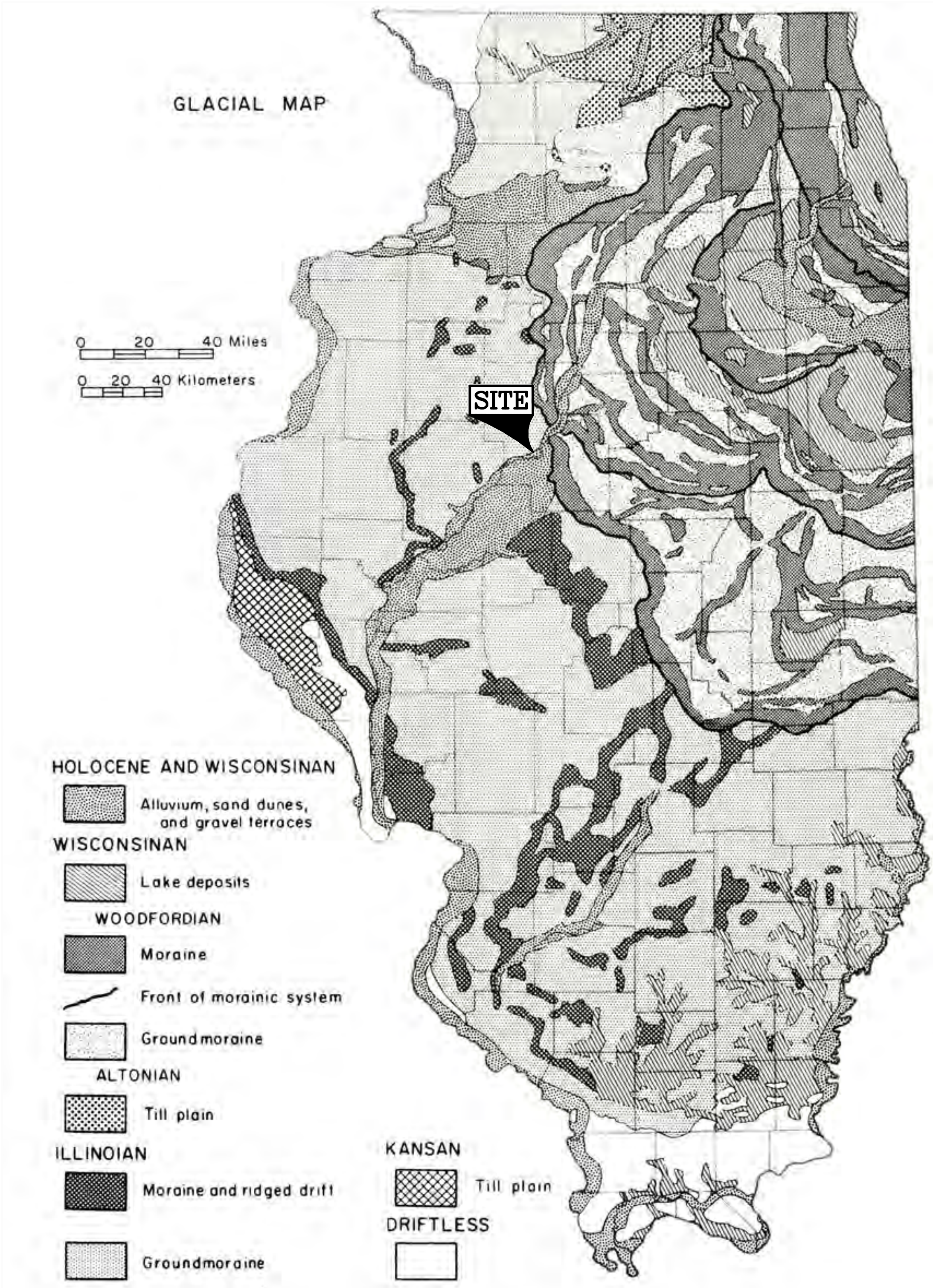
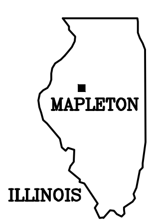


Fig. Q-2—Glacial map of Illinois (after Willman and Frye, 1970).

figure 2.5

GLACIAL MAP OF ILLINOIS
AFTER WILLMAN AND FRYE, 1970
CATERPILLAR INC.
Mapleton, Illinois

CRA



0 2.5 5 10 20 mi

BASE SOURCE: RICHARD C. BERG 1984
JOHN P. KEMPTON
ROBERT C. VAIDEN
AMY N. STECYK

figure 2.6A

BERG CIRCULAR MAP
PLATE 1
CATERPILLAR INC.
Mapleton, Illinois

70102-00(002)GN-WI004 AUG 12/2011

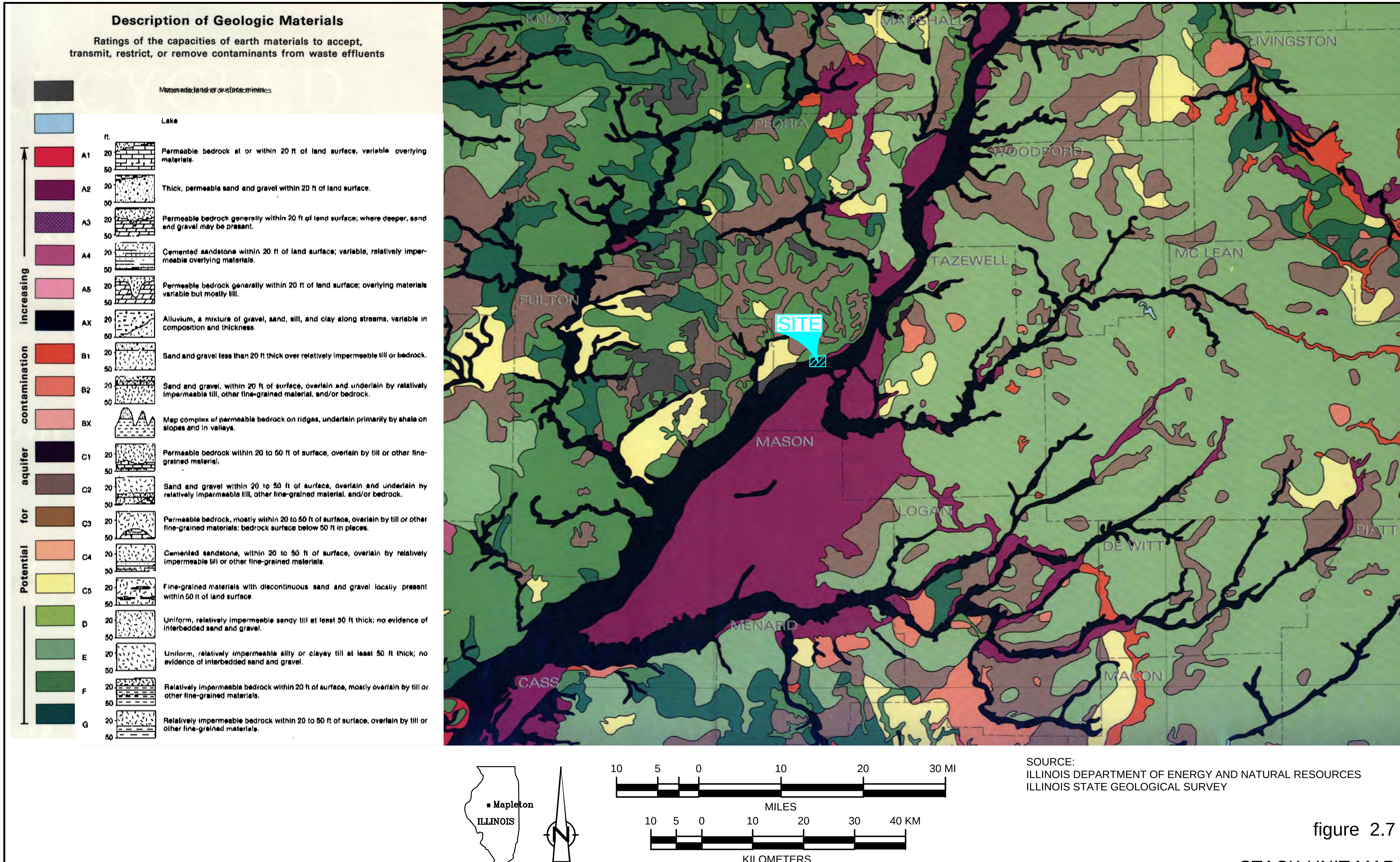
BASE SOURCE: RICHARD C. BERG 1984
JOHN P. KEMPTON
ROBERT C. VAIDEN
AMY N. STECYK

0 2.5 5 10 20 mi

figure 2.6B

BERG CIRCULAR MAP
PLATE 2
CATERPILLAR INC.
Mapleton, Illinois

70102-00(002)GN-WI005 AUG 12/2011



SOURCE:
ILLINOIS DEPARTMENT OF ENERGY AND NATURAL RESOURCES
ILLINOIS STATE GEOLOGICAL SURVEY

figure 2.7

STACK-UNIT MAP
CATERPILLAR INC.
Mapleton, Illinois

70102-00(002)GN-WI008 AUG 12/2011

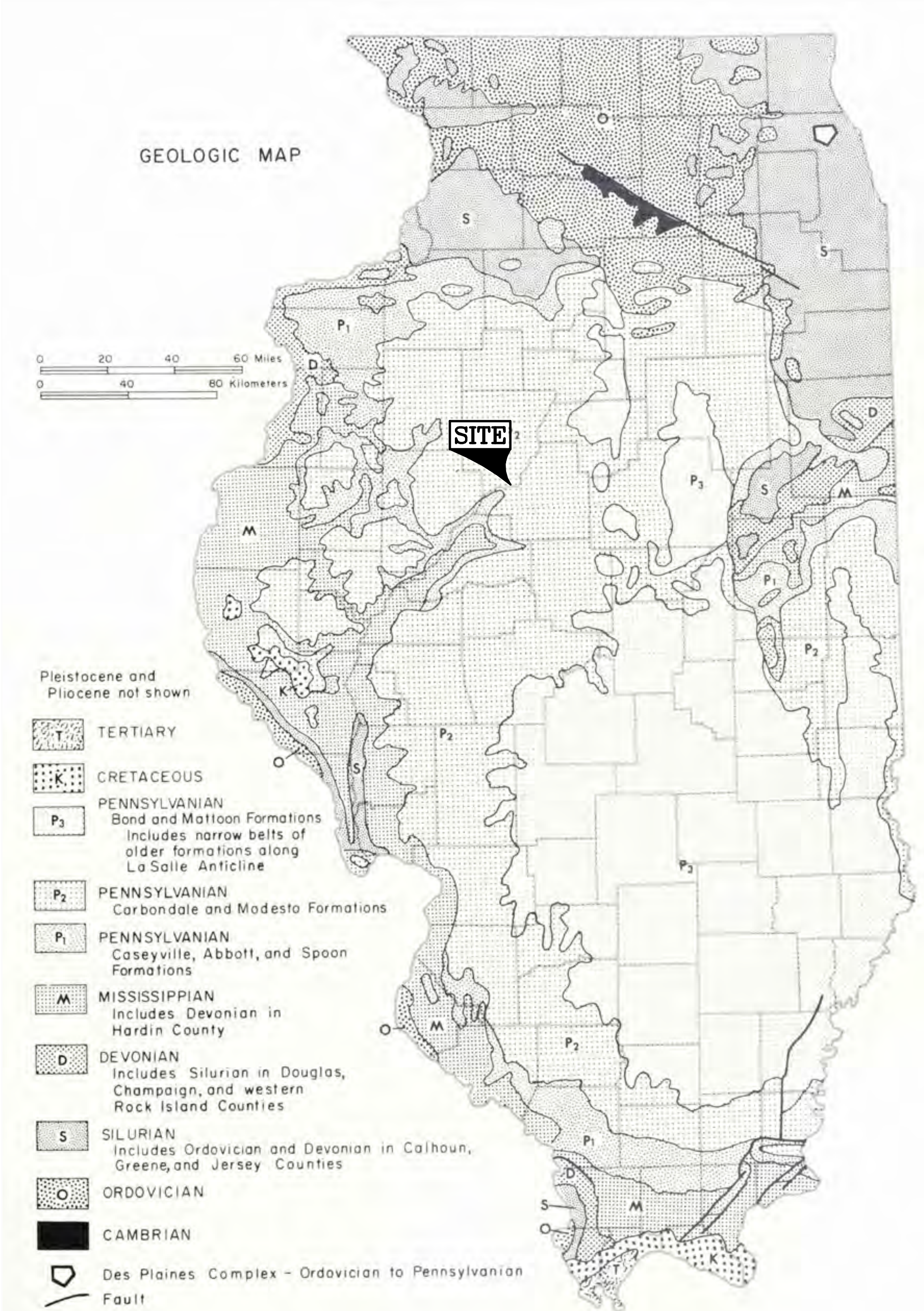


figure 2.8

GENERALIZED AREAL GEOLOGY OF THE BEDROCK SURFACE
WILLMAN AND FRYE, 1970
CATERPILLAR INC.
Mapleton, Illinois

70102-00(002)GN-WI006 AUG 12/2011

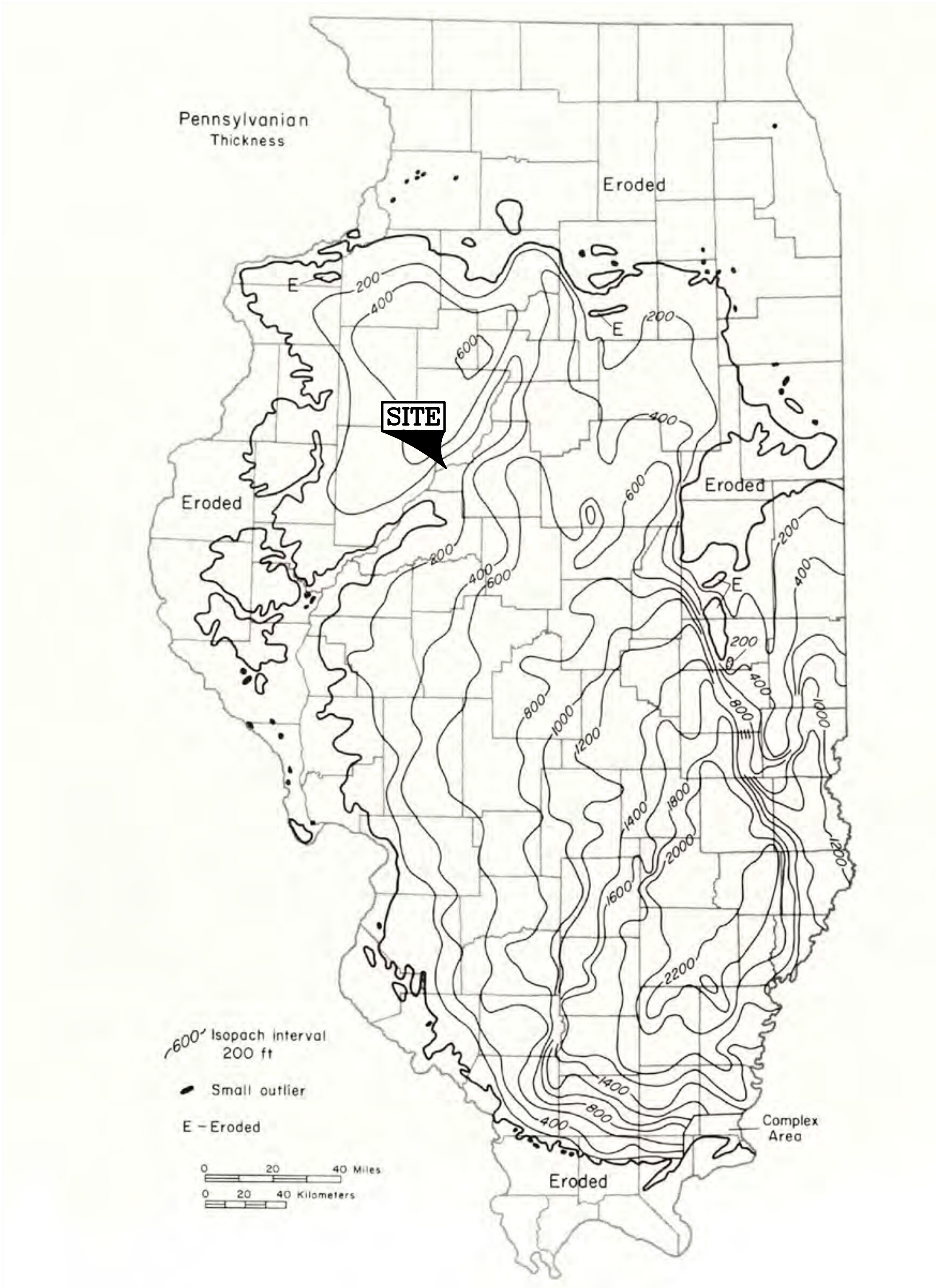
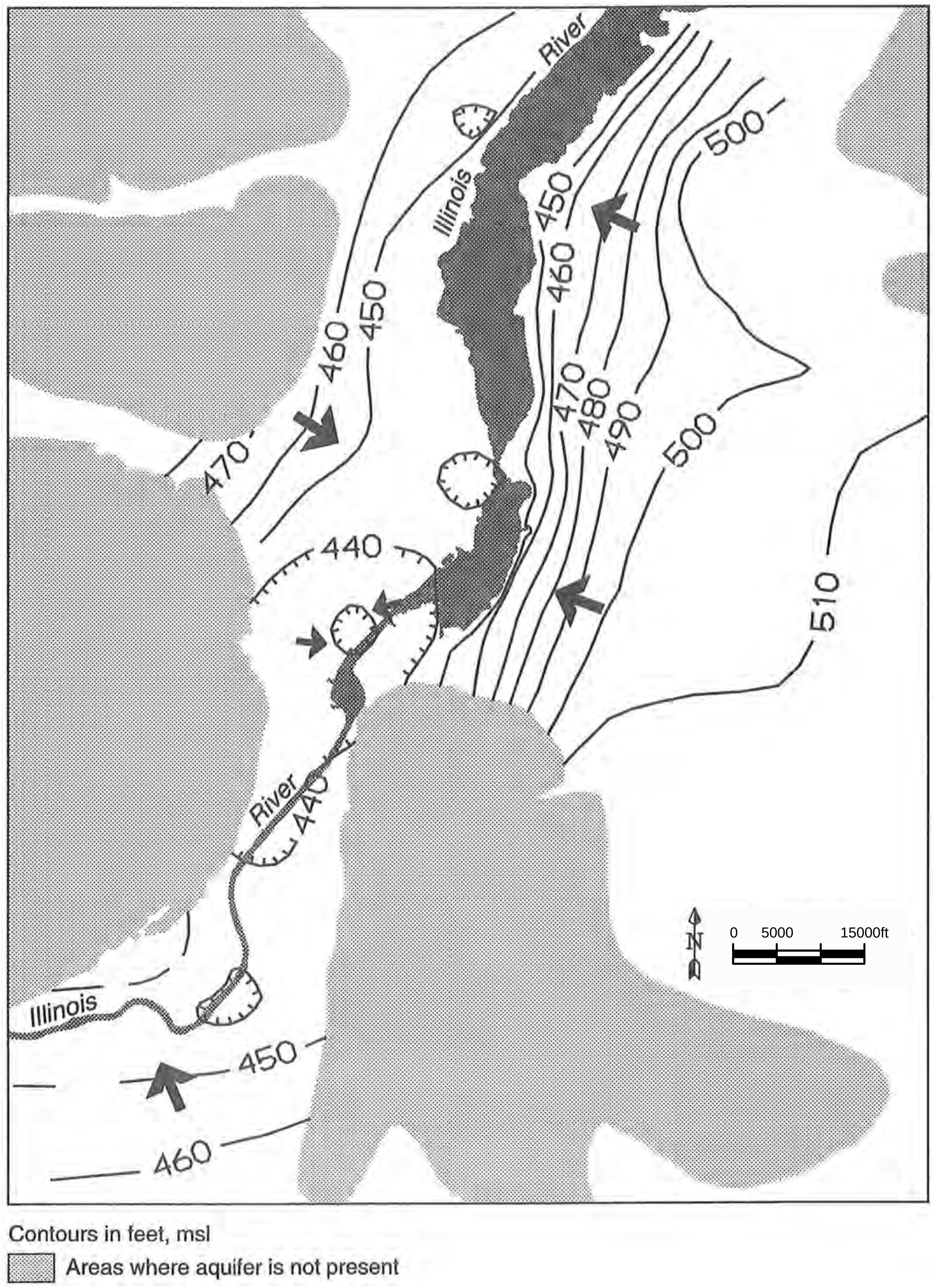


figure 2.9

THICKNESS OF THE PENNSYLVANIAN SYSTEM
CATERPILLAR INC.
Mapleton, Illinois



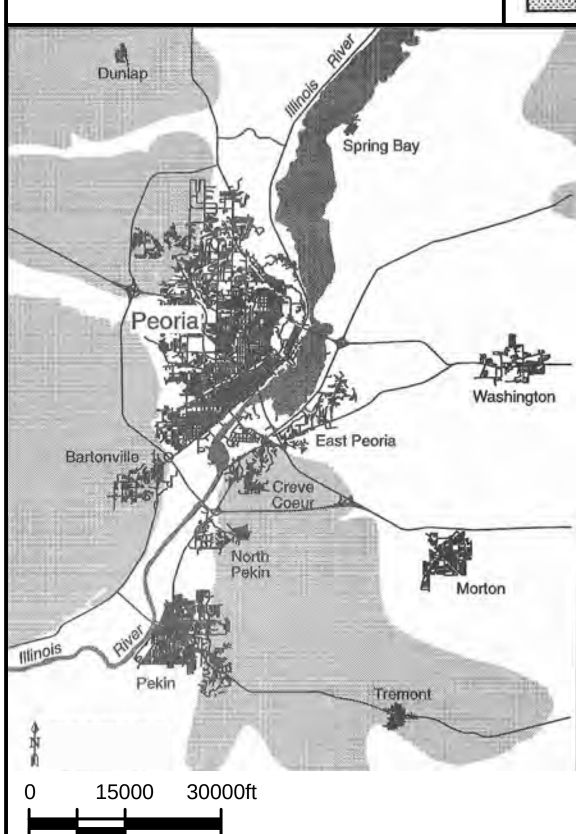


figure 2.10

ELEVATION OF POTENTIOMETRIC SURFACE AND DIRECTION OF REGIONAL GROUND-WATER FLOW FOR THE PEORIA-PEKIN REGION: 1990-1991 DATA
CATERPILLAR INC.
Mapleton, Illinois

SOURCE: ILLINOIS STATE WATER SURVEY: PEORIA-PEKIN GROUND-WATER QUALITY ASSESSMENT, RESEARCH REPORT 124, 1993

70102-00(002)GN-WA027 OCT 15/2012

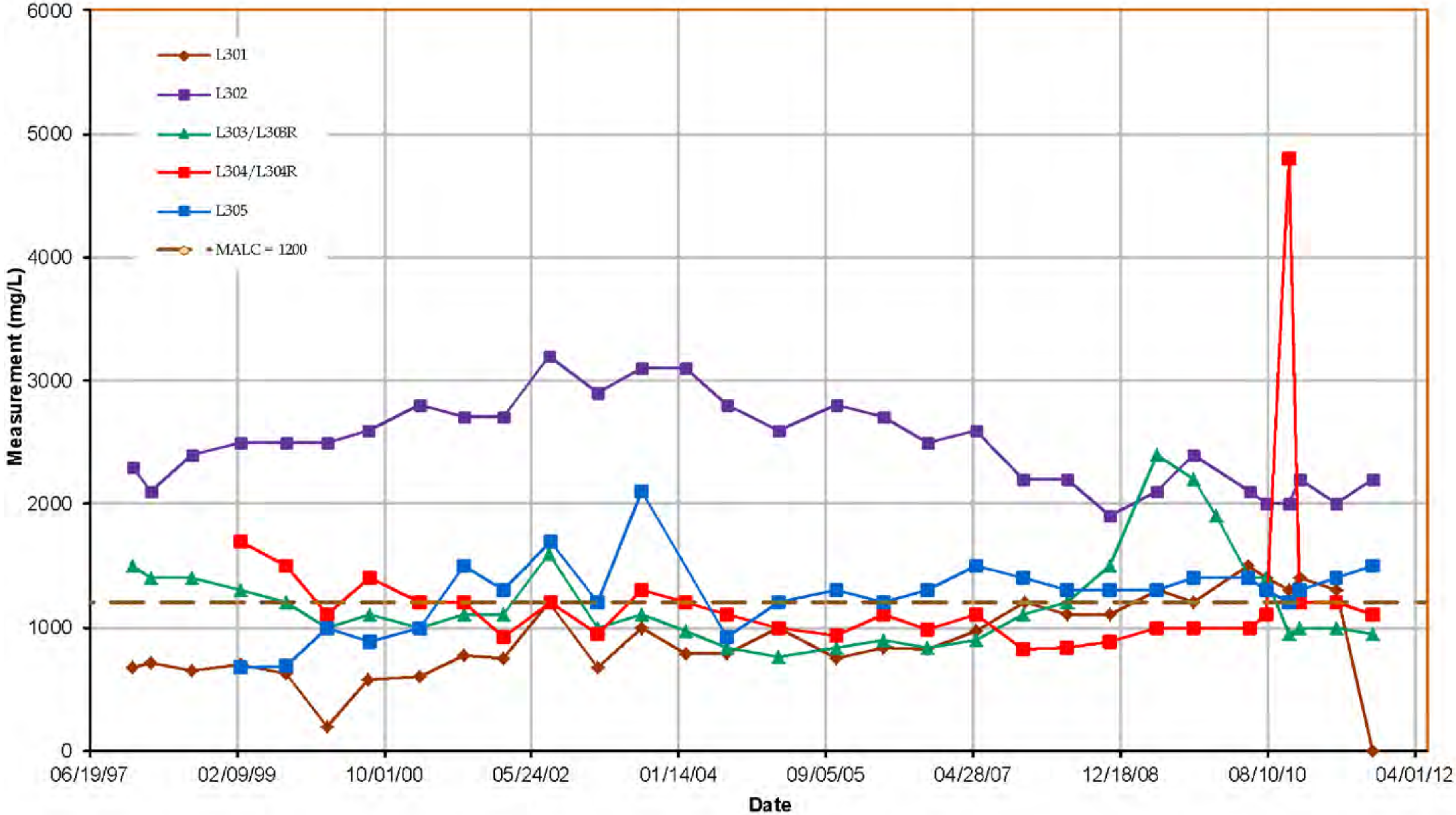


figure 2.11

TDS CONCENTRATION VS. TIME IN LANDFILL MONITORING WELLS
CATERPILLAR INC.
Mapleton, Illinois

SOURCE: TRC AUGUST 18, 2011.

70102-00(002)GN-WA020 JAN 11/2013

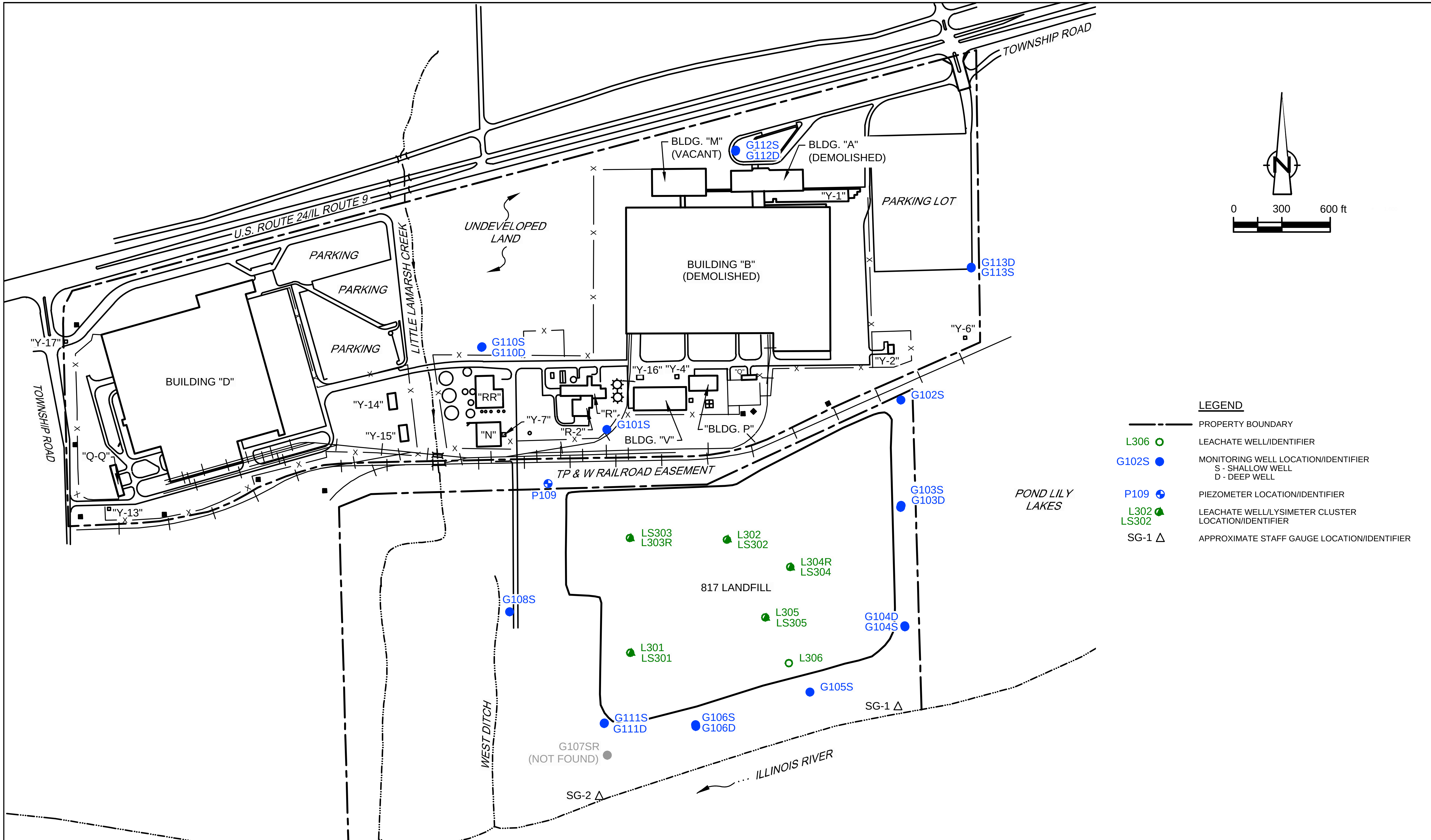


figure 3.1

MONITORING WELL, LEACHATE WELL, LYSIMETER, AND STAFF GAUGE LOCATION MAP
CATERPILLAR INC.
Mapleton, Illinois

SOURCE: SAMPLE LOCATIONS SURVEYED BY ZUMWALT & ASSOC, INC. JUNE 2011; ILLINOIS SP WEST, NAD83.

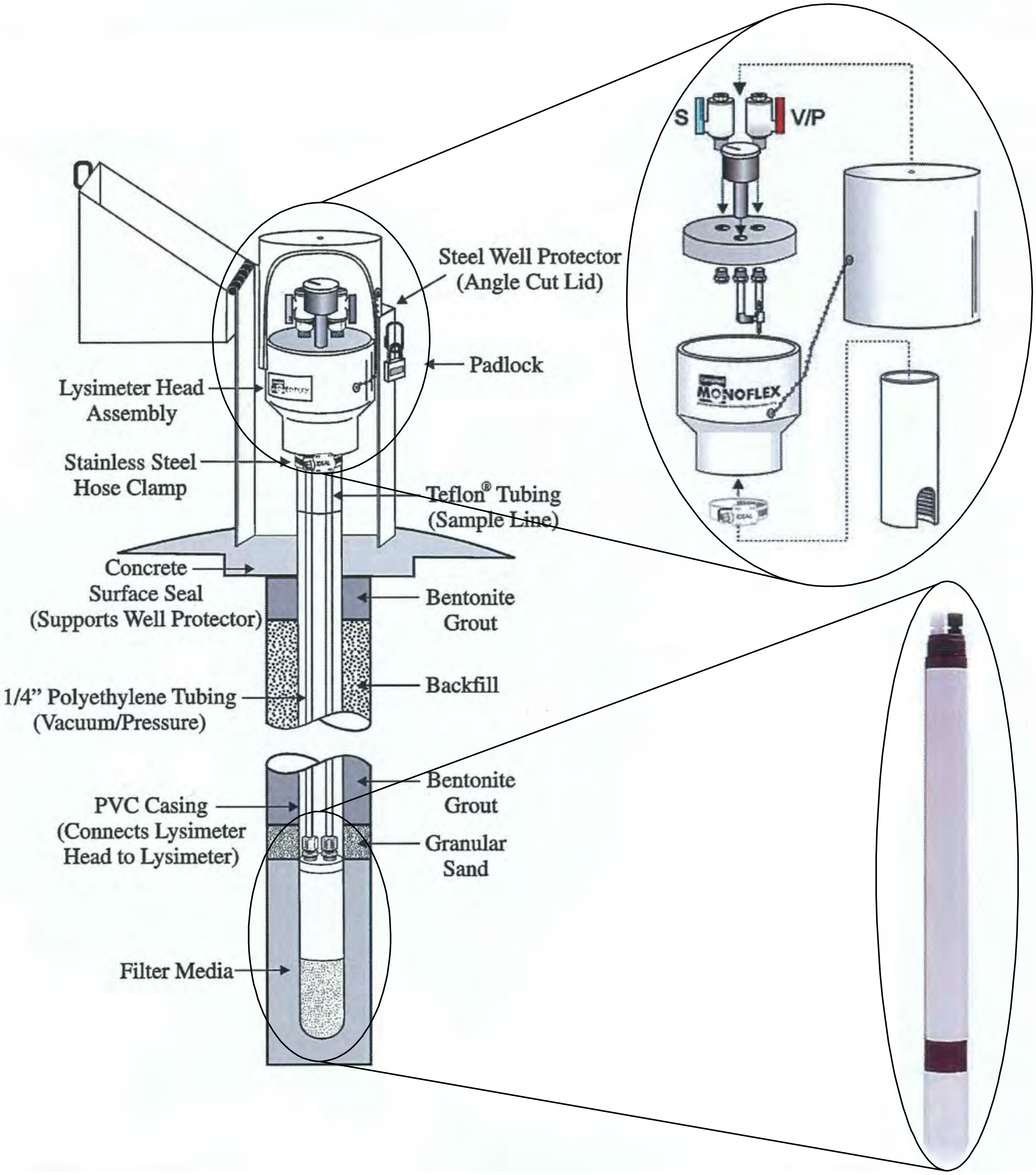


figure 3.2

TYPICAL POROUS CUP LYSIMETER DETAIL
CATERPILLAR INC.
Mapleton, Illinois

SOURCE: MONOFLEX DIVISION OF CAMPBELL MANUFACTURING, INC.

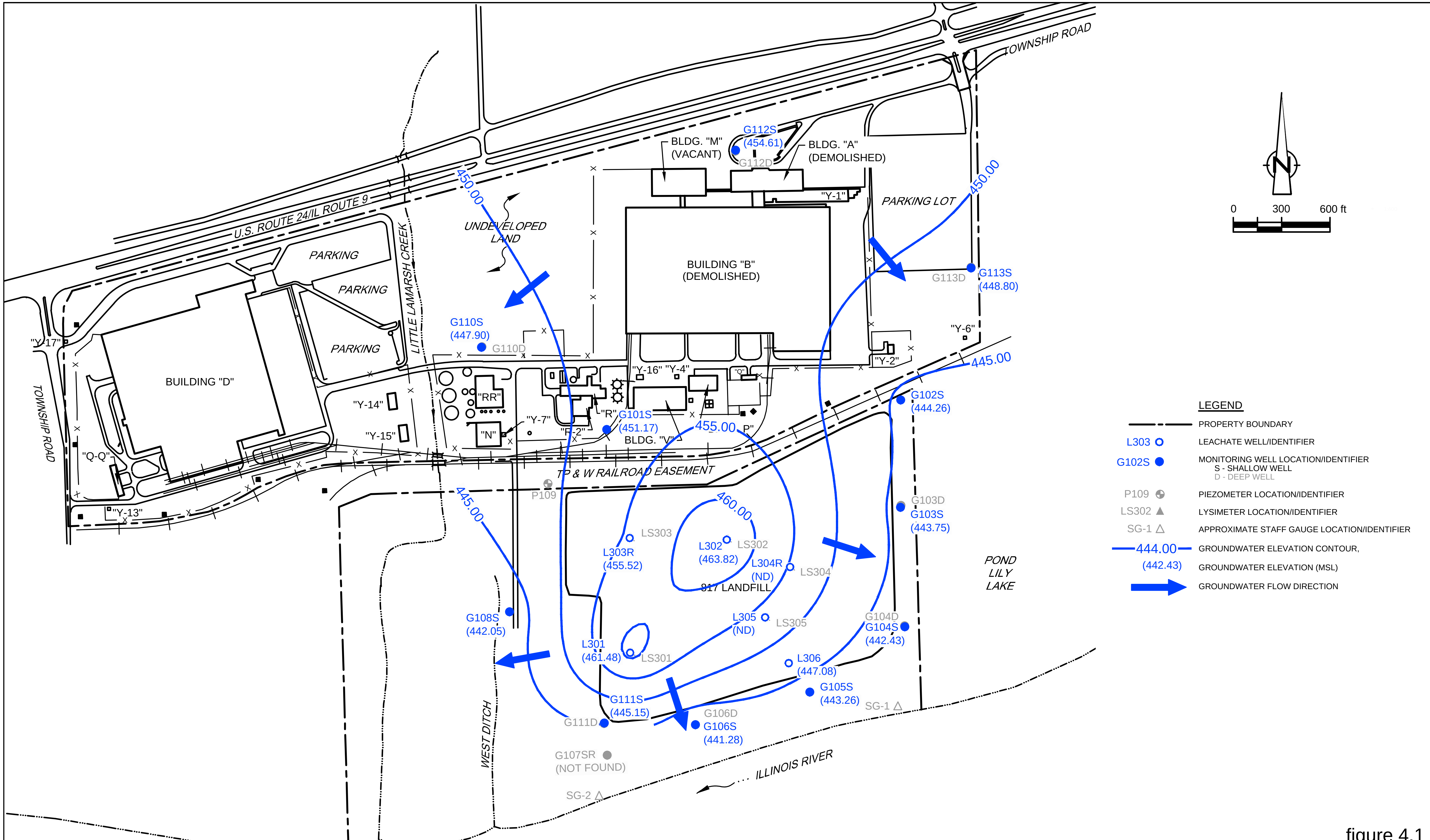


figure 4.1

GROUNDWATER CONTOURS - APRIL 5, 2011
SHALLOW MONITORING WELLS AND LEACHATE WELLS
CATERPILLAR INC.
Mapleton, Illinois

SOURCE: SAMPLE LOCATIONS SURVEYED BY ZUMWALT & ASSOC, INC. JUNE 2011; ILLINOIS SP WEST, NAD83.

70102-00(002)GN-WA002 JAN 11/2013

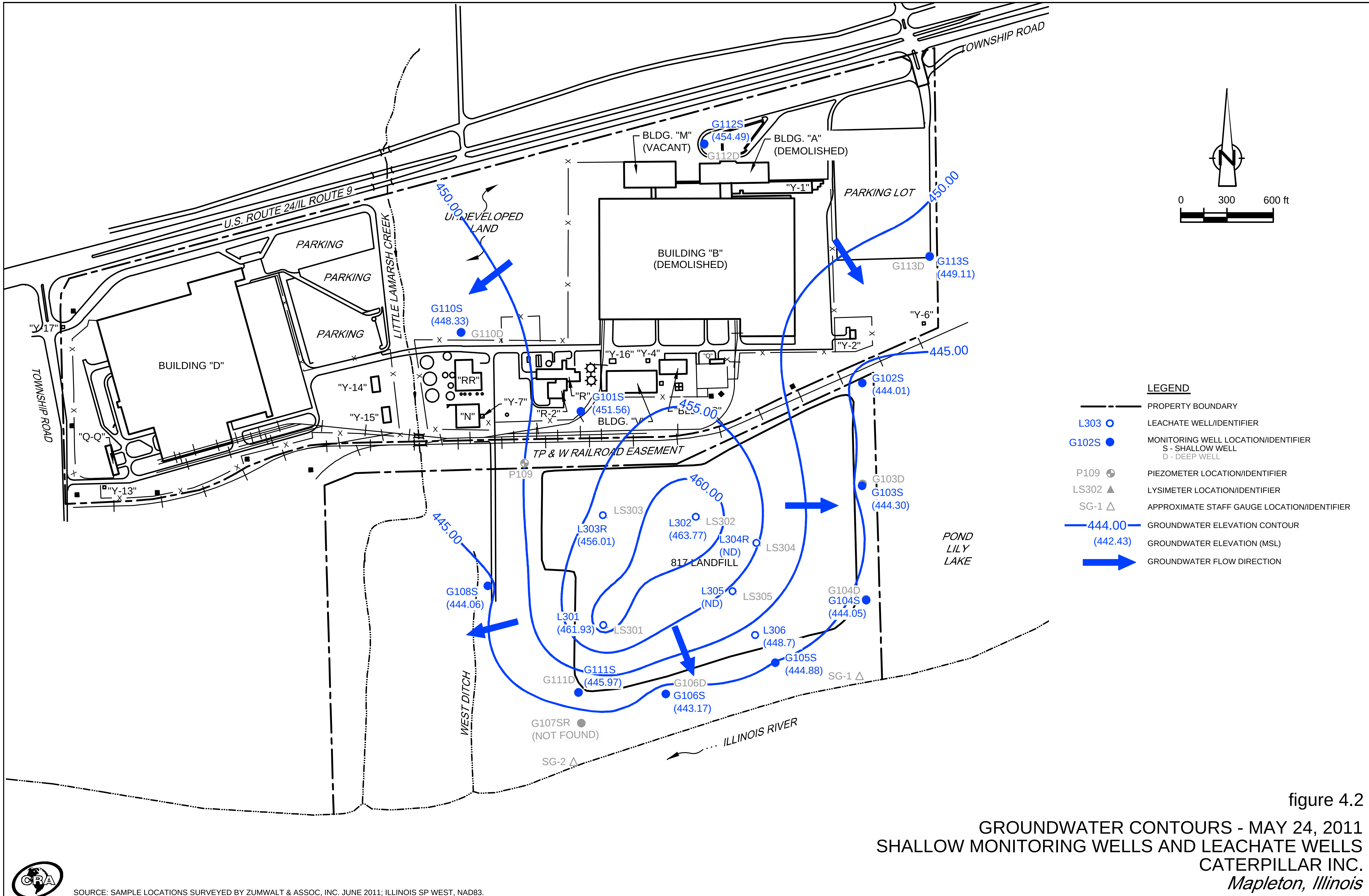


figure 4.2

GROUNDWATER CONTOURS - MAY 24, 2011
SHALLOW MONITORING WELLS AND LEACHATE WELLS
CATERPILLAR INC.
Mapleton, Illinois

SOURCE: SAMPLE LOCATIONS SURVEYED BY ZUMWALT & ASSOC, INC. JUNE 2011; ILLINOIS SP WEST, NAD83.

70102-00(002)GN-WA003 JAN 11/2013

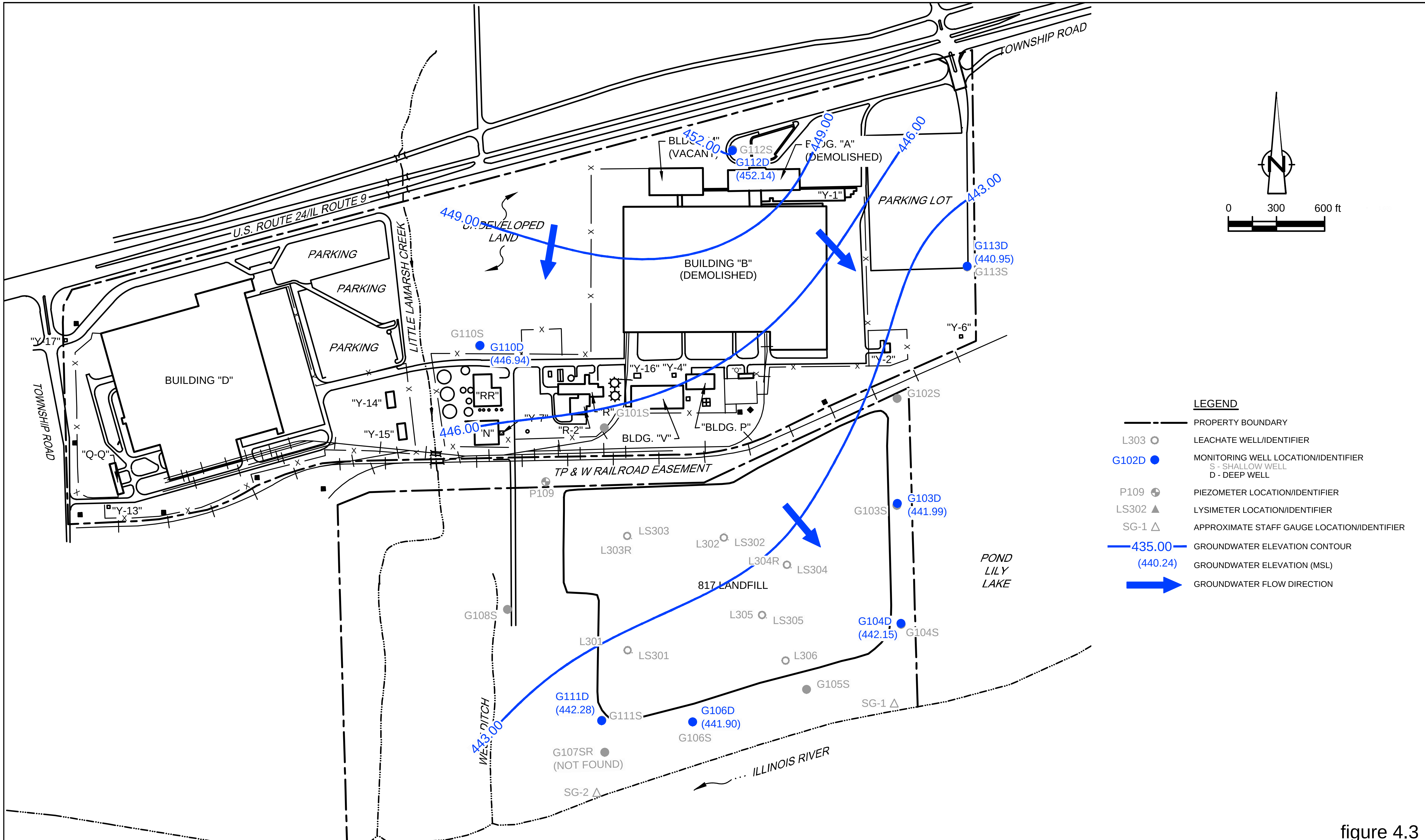


figure 4.3

GROUNDWATER CONTOURS - MAY 24, 2011
DEEP MONITORING WELLS
CATERPILLAR INC.
Mapleton, Illinois

SOURCE: SAMPLE LOCATIONS SURVEYED BY ZUMWALT & ASSOC, INC. JUNE 2011; ILLINOIS SP WEST, NAD83.

70102-00(002)GN-WA005 JAN 11/2013

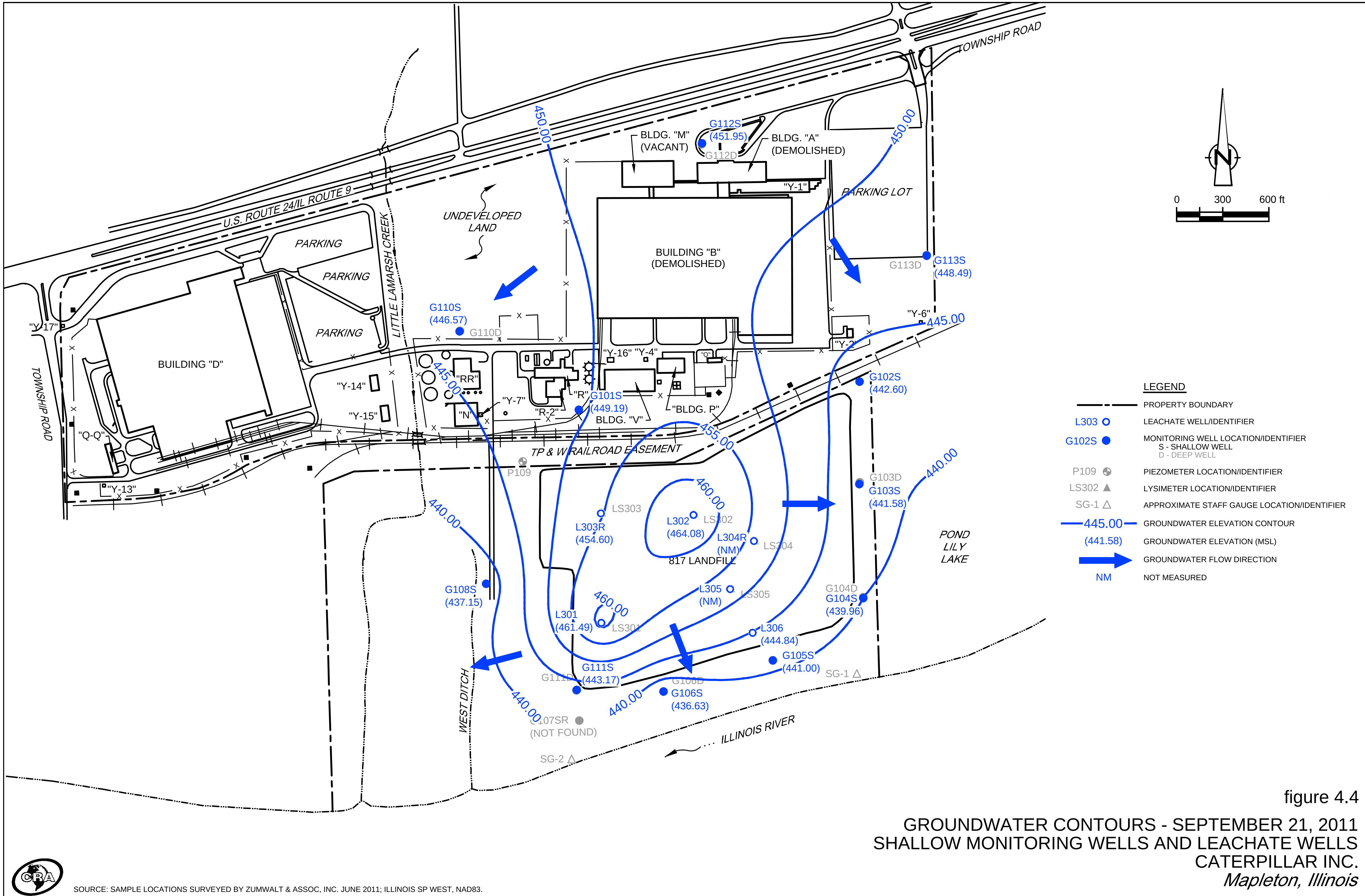


figure 4.4

GROUNDWATER CONTOURS - SEPTEMBER 21, 2011
SHALLOW MONITORING WELLS AND LEACHATE WELLS
CATERPILLAR INC.
Mapleton, Illinois

70102-00(002)GN-WA021 JAN 11/2013

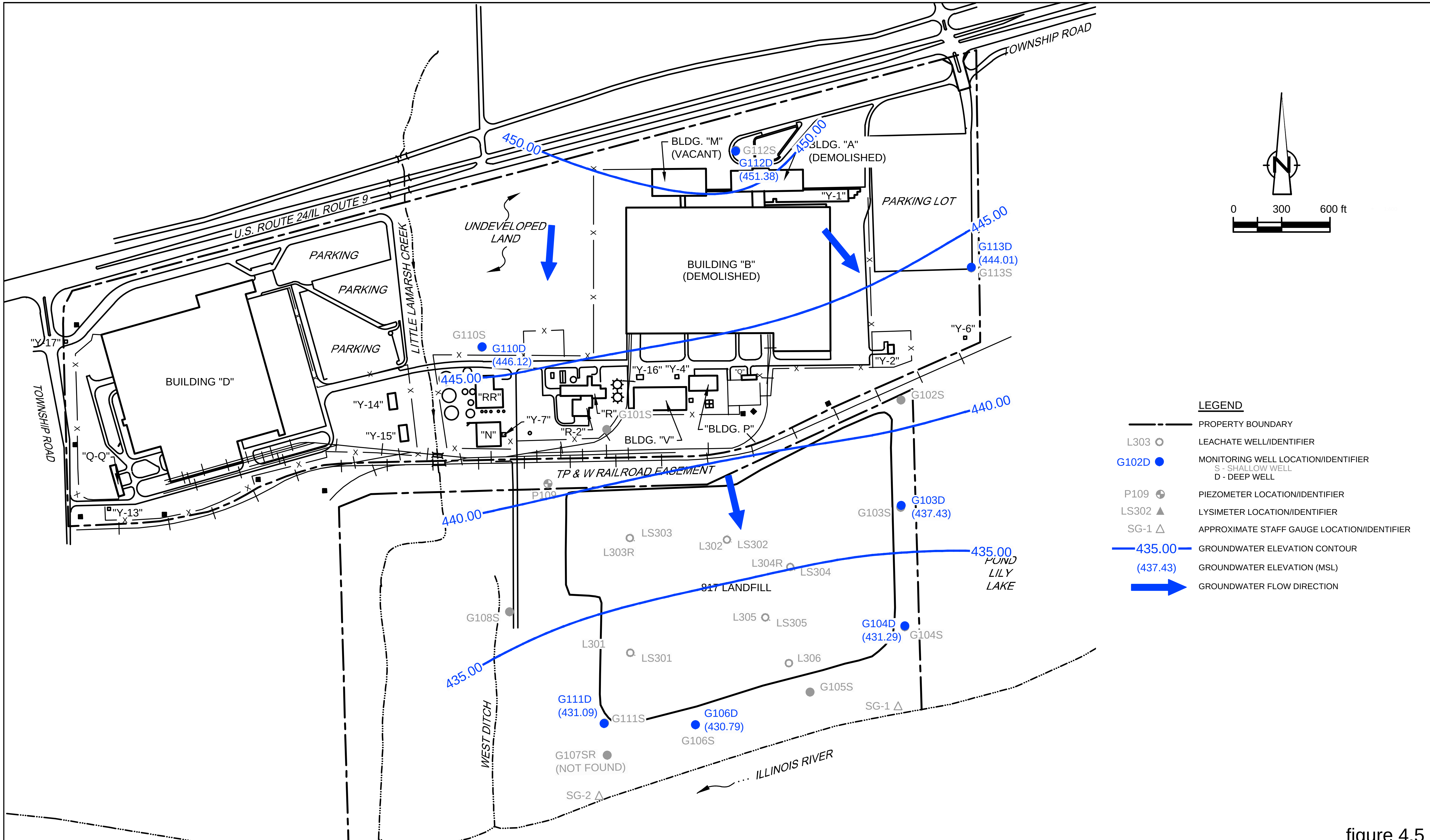


figure 4.5

GROUNDWATER CONTOURS - SEPTEMBER 21, 2011
DEEP MONITORING WELLS
CATERPILLAR INC.
Mapleton, Illinois

SOURCE: SAMPLE LOCATIONS SURVEYED BY ZUMWALT & ASSOC, INC. JUNE 2011; ILLINOIS SP WEST, NAD83.

70102-00(002)GN-WA024 JAN 11/2013

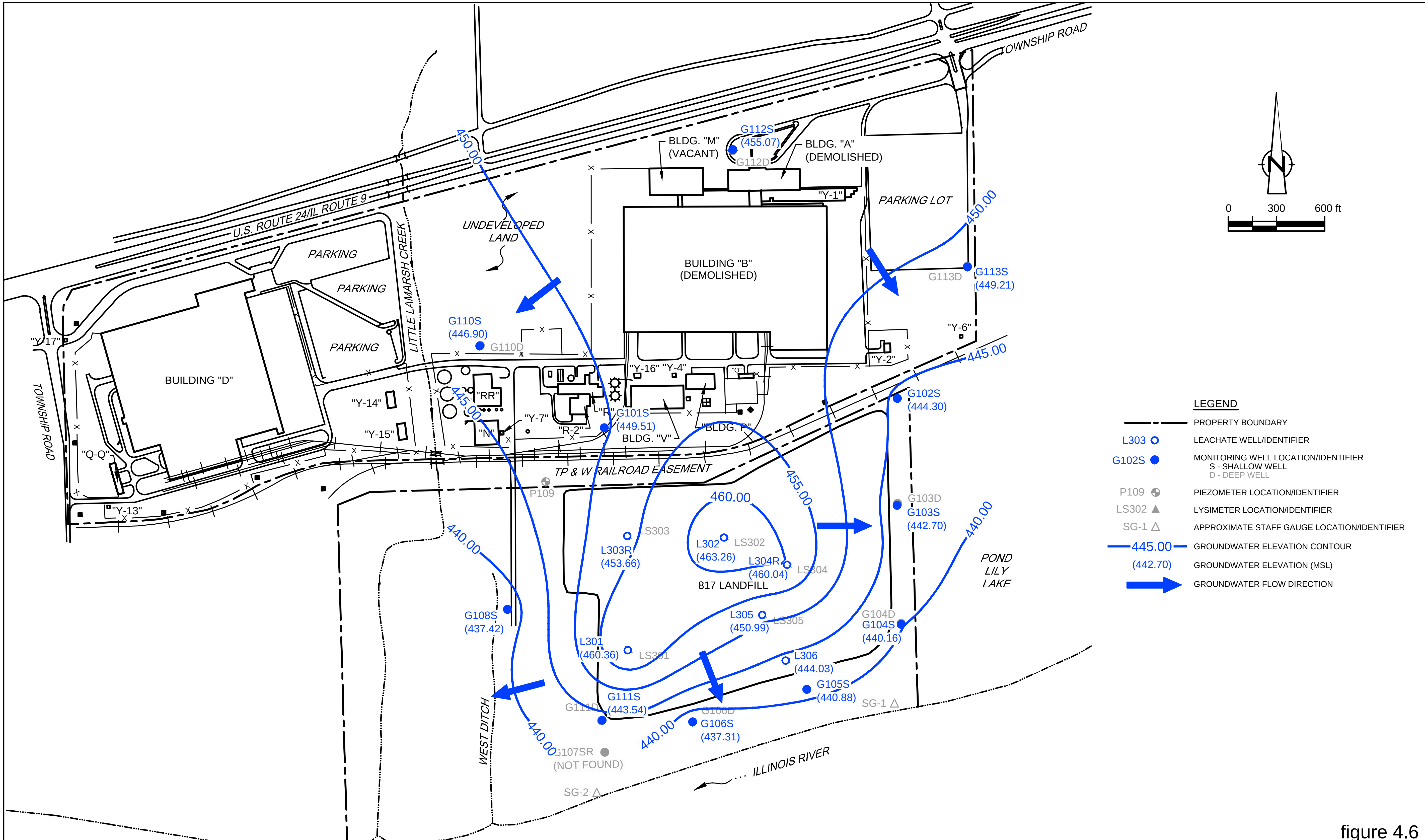


figure 4.6

GROUNDWATER CONTOURS - NOVEMBER 29, 2011
SHALLOW MONITORING WELLS AND LEACHATE WELLS
CATERPILLAR INC.
Mapleton, Illinois

SOURCE: SAMPLE LOCATIONS SURVEYED BY ZUMWALT & ASSOC, INC. JUNE 2011; ILLINOIS SP WEST, NAD83.

70102-00(002)GN-WA022 JAN 11/2013

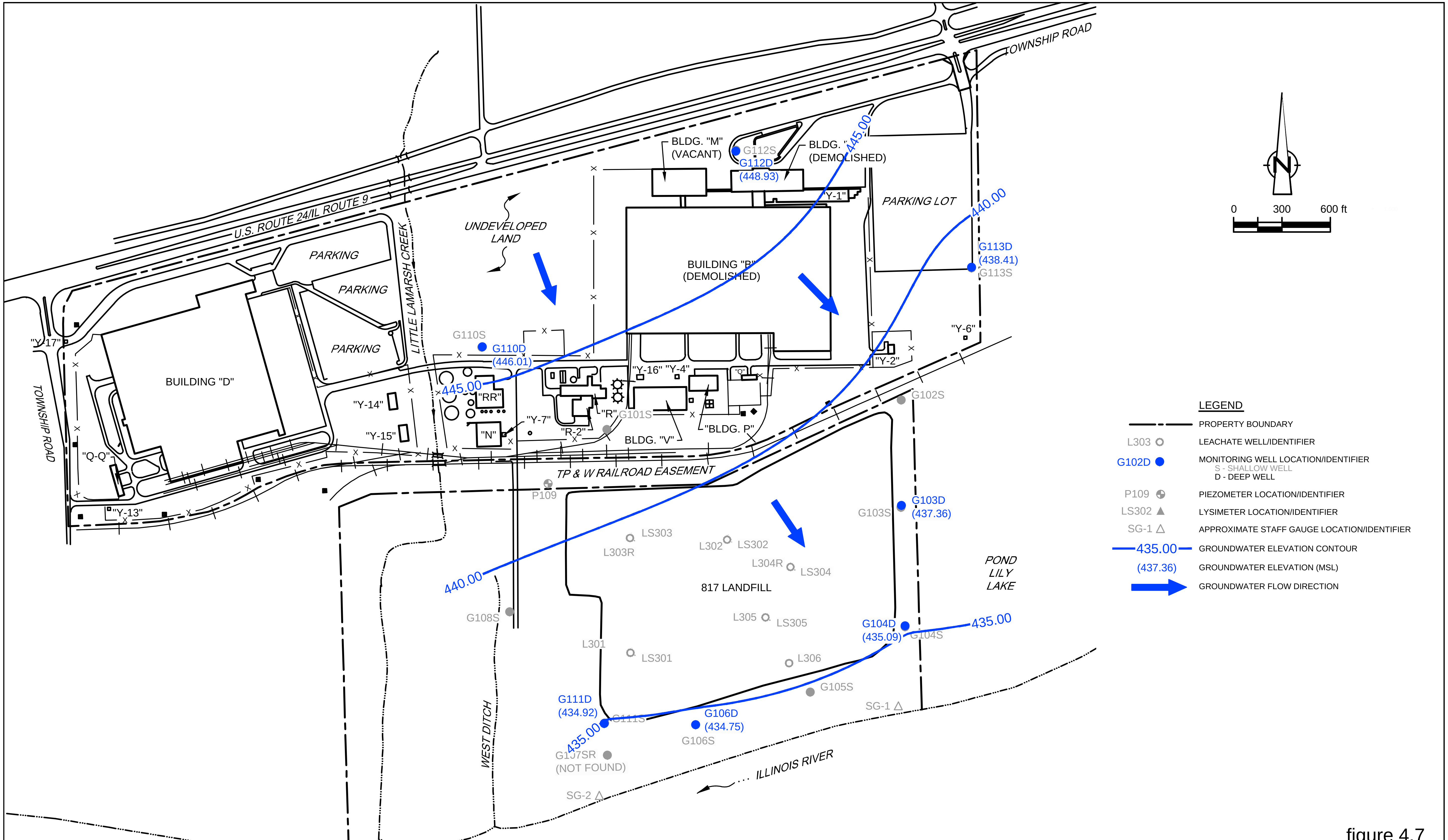


figure 4.7

GROUNDWATER CONTOURS - NOVEMBER 29, 2011
DEEP MONITORING WELLS
CATERPILLAR INC.
Mapleton, Illinois

SOURCE: SAMPLE LOCATIONS SURVEYED BY ZUMWALT & ASSOC, INC. JUNE 2011; ILLINOIS SP WEST, NAD83.

70102-00(002)GN-WA025 JAN 11/2013

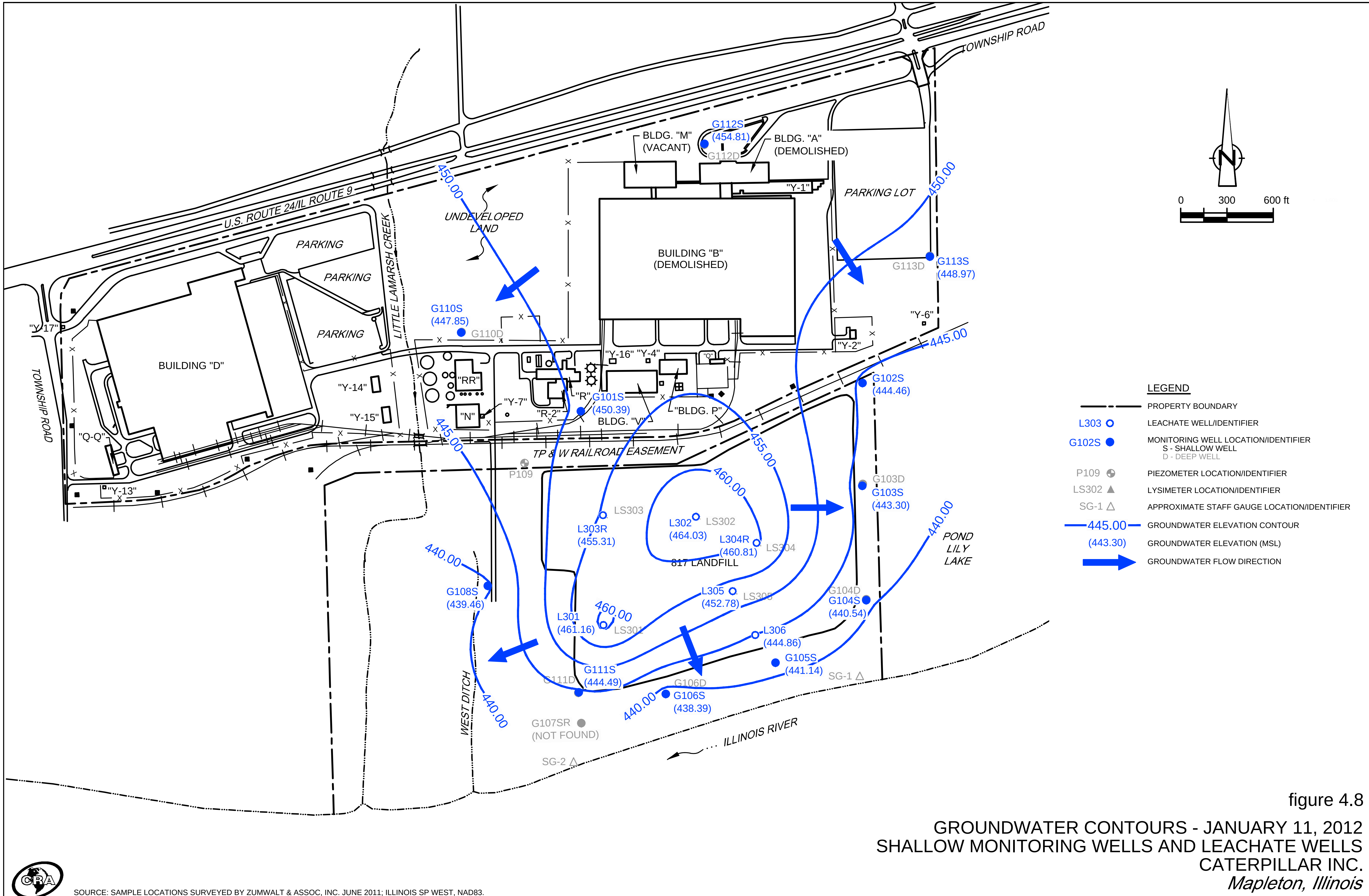


figure 4.8

GROUNDWATER CONTOURS - JANUARY 11, 2012
SHALLOW MONITORING WELLS AND LEACHATE WELLS
CATERPILLAR INC.
Mapleton, Illinois

70102-00(002)GN-WA023 JAN 11/2013

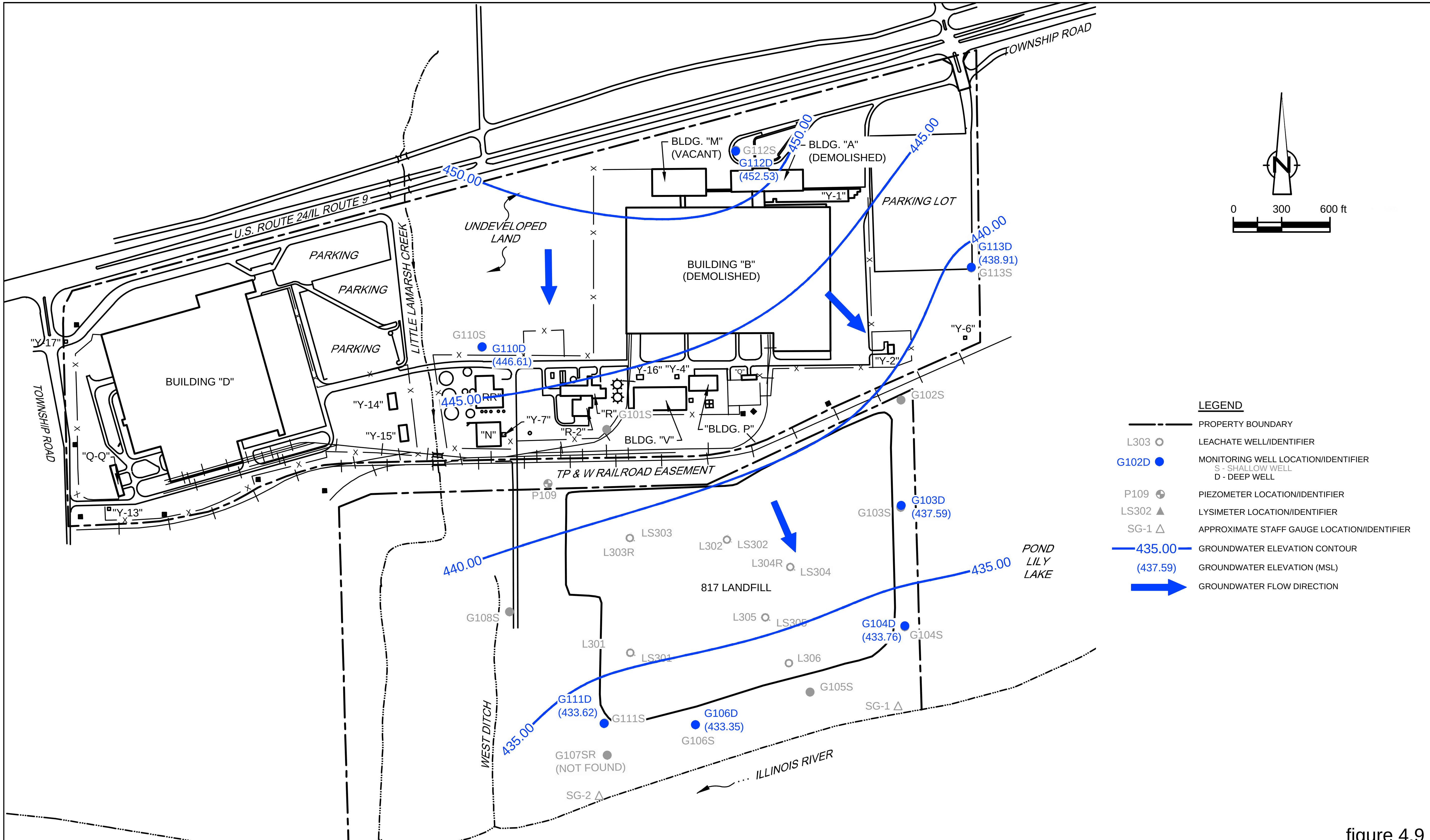
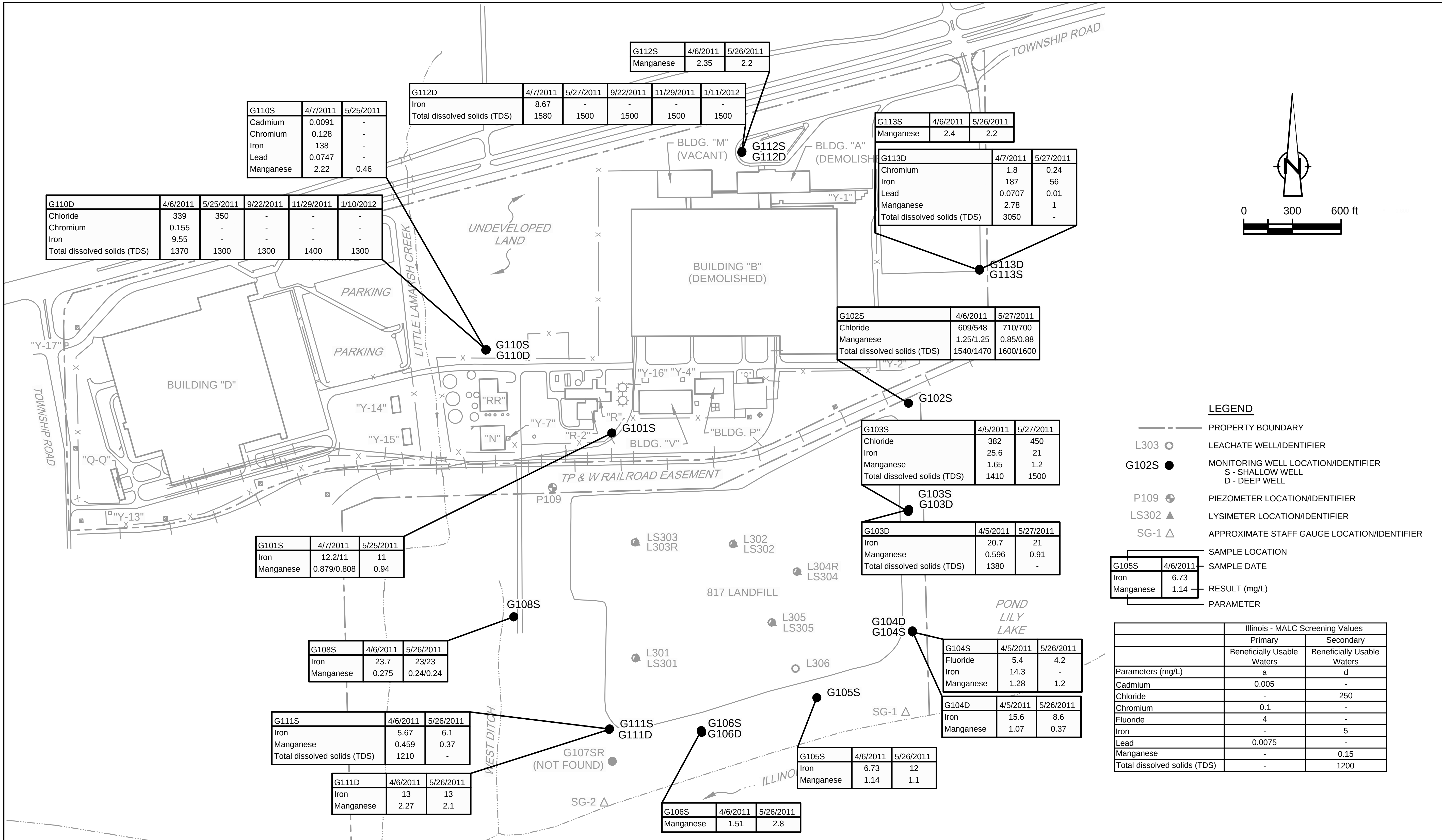


figure 4.9

GROUNDWATER CONTOURS - JANUARY 11, 2012
DEEP MONITORING WELLS
CATERPILLAR INC.
Mapleton, Illinois

SOURCE: SAMPLE LOCATIONS SURVEYED BY ZUMWALT & ASSOC, INC. JUNE 2011; ILLINOIS SP WEST, NAD83.

70102-00(002)GN-WA026 JAN 11/2013



G112S	4/6/2011	5/26/2011
Manganese	2.35	2.2

G112D	4/7/2011	5/27/2011	9/22/2011	11/29/2011	1/11/2012
Iron	8.67	-	-	-	-
Total dissolved solids (TDS)	1580	1500	1500	1500	1500

G110S	4/7/2011	5/25/2011
Cadmium	0.0091	-
Chromium	0.128	-
Iron	138	-
Lead	0.0747	-
Manganese	2.22	0.46

G113S	4/6/2011	5/26/2011
Manganese	2.4	2.2

G113D	4/7/2011	5/27/2011
Chromium	1.8	0.24
Iron	187	56
Lead	0.0707	0.01
Manganese	2.78	1
Total dissolved solids (TDS)	3050	-

G110D	4/6/2011	5/25/2011	9/22/2011	11/29/2011	1/10/2012
Chloride	339	350	-	-	-
Chromium	0.155	-	-	-	-
Iron	9.55	-	-	-	-
Total dissolved solids (TDS)	1370	1300	1300	1400	1300

G102S	4/6/2011	5/27/2011
Chloride	609/548	710/700
Manganese	1.25/1.25	0.85/0.88
Total dissolved solids (TDS)	1540/1470	1600/1600

G103S	4/5/2011	5/27/2011
Chloride	382	450
Iron	25.6	21
Manganese	1.65	1.2
Total dissolved solids (TDS)	1410	1500

G103D	4/5/2011	5/27/2011
Iron	20.7	21
Manganese	0.596	0.91
Total dissolved solids (TDS)	1380	-

G101S	4/7/2011	5/25/2011
Iron	12.2/11	11
Manganese	0.879/0.808	0.94

G108S	4/6/2011	5/26/2011
Iron	23.7	23/23
Manganese	0.275	0.24/0.24

G104S	4/5/2011	5/26/2011
Fluoride	5.4	4.2
Iron	14.3	-
Manganese	1.28	1.2

G104D	4/5/2011	5/26/2011
Iron	15.6	8.6
Manganese	1.07	0.37

G111S	4/6/2011	5/26/2011
Iron	5.67	6.1
Manganese	0.459	0.37
Total dissolved solids (TDS)	1210	-

G111D	4/6/2011	5/26/2011
Iron	13	13
Manganese	2.27	2.1

G105S	4/6/2011	5/26/2011
Iron	6.73	12
Manganese	1.14	1.1

G106S	4/6/2011	5/26/2011
Manganese	1.51	2.8

LEGEND

- PROPERTY BOUNDARY
- L303 — LEACHATE WELL/IDENTIFIER
- G102S — MONITORING WELL LOCATION/IDENTIFIER
  - S - SHALLOW WELL
  - D - DEEP WELL
- P109 — PIEZOMETER LOCATION/IDENTIFIER
- LS302 — LYSIMETER LOCATION/IDENTIFIER
- SG-1 — APPROXIMATE STAFF GAUGE LOCATION/IDENTIFIER

G105S	4/6/2011
Iron	6.73
Manganese	1.14

SAMPLE LOCATION (G105S); SAMPLE DATE (4/6/2011); RESULT (mg/L); PARAMETER

	Illinois - MALC Screening Values	
	Primary	Secondary
	Beneficially Usable Waters	Beneficially Usable Waters
Parameters (mg/L)	a	d
Cadmium	0.005	-
Chloride	-	250
Chromium	0.1	-
Fluoride	4	-
Iron	-	5
Lead	0.0075	-
Manganese	-	0.15
Total dissolved solids (TDS)	-	1200

figure 4.10

SUMMARY OF MALC EXCEEDANCES, SHALLOW AND DEEP MONITORING WELLS
CATERPILLAR INC.
Mapleton, Illinois

SOURCE: SAMPLE LOCATIONS SURVEYED BY ZUMWALT & ASSOC, INC. JUNE 2011; ILLINOIS SP WEST, NAD83.

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