BEFORE THE
ILLINOIS POLLUTION CONTROL BOARD

DYNEGY MIDWEST GENERATION, LLC Petitioner **v.** **ILLINOIS ENVIRONMENTAL PROTECTION AGENCY** Respondent.	**PCB 2024-________**

NOTICE OF FILING

To: Pollution Control Board, Attn: Clerk
100 West Randolph Street
James R. Thompson Center
Suite 11-500
Chicago, Illinois 60601-3218
PCB.Clerks@illinois.gov

Division of Legal Counsel
Illinois Environmental Protection Agency
1021 N. Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276
epa.dlc@illinois.gov

PLEASE TAKE NOTICE that I have today filed with the Office of the Clerk of the Pollution Control Board the attached **PETITION FOR REVIEW OF ILLINOIS ENVIRONMENTAL PROTECTION AGENCY'S NON-CONCURRENCE WITH ALTERNATIVE SOURCE DEMONSTRATION UNDER 35 ILL. ADM. CODE PART 845 AND MOTION FOR STAY**; **APPEARANCES OF JOSHUA MORE, BINA JOSHI, AND SAMUEL RASCHE**; and a **CERTIFICATE OF SERVICE**, copies of which are herewith served upon you.

/s/ *Samuel A. Rasche*
Dated: September 30, 2024

Joshua R. More
Bina Joshi
Samuel A. Rasche
233 South Wacker Drive, Suite 7100
Chicago, Illinois 60606
(312) 258-5500
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Attorneys for Dynegy Midwest Generation, LLC

BEFORE THE
ILLINOIS POLLUTION CONTROL BOARD

DYNEGY MIDWEST GENERATING, LLC Petitioner **v.** **ILLINOIS ENVIRONMENTAL PROTECTION AGENCY** Respondent.	**PCB 2024-________**

CERTIFICATE OF SERVICE

I, the undersigned, certify that on this 30th day of September, 2024:

I have electronically served a true and correct copy of the attached Petition for Review of Illinois Environmental Protection Agency's Non-Concurrence with Alternative Source Demonstration Under 35 Ill. Admin. Code Part 845 and Motion for Stay and Appearances of Joshua R. More, Bina Joshi, and Samuel A. Rasche by electronically filing with the Clerk of the Illinois Pollution Control Board and by e-mail upon the following persons:

Pollution Control Board, Attn: Clerk
100 West Randolph Street
James R. Thompson Center
Suite 11-500
Chicago, Illinois 60601-3218
PCB.Clerks@illinois.gov

Division of Legal Counsel
Illinois Environmental Protection Agency
1021 N. Grand Avenue East
P.O. Box 19276
Springfield, Illinois 62794-9276
epa.dlc@illinois.gov

My e-mail address is sam.rasche@afslaw.com

The number of pages in the e-mail transmission is 540.

The e-mail transmission took place before 5:00 p.m.

/s/ Samuel A. Rasche
Samuel A. Rasche

Dated: September 30, 2024

ARENTFOX SCHIFF LLP
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Attorneys for Dynegy Midwest Generating, LLC

BEFORE THE
ILLINOIS POLLUTION CONTROL BOARD

DYNEGY MIDWEST GENERATION, LLC	
Petitioner	**PCB 2024-________**
v.	
ILLINOIS ENVIRONMENTAL PROTECTION AGENCY	
Respondent.	

APPEARANCE OF JOSHUA R. MORE
AND CONSENT TO E-MAIL SERVICE

I, Joshua R. More, hereby enter my appearance on behalf of DYNEGY MIDWEST GENERATION, LLC and authorize the service of documents on me by email in lieu of receiving paper documents in the above-captioned proceeding. My email address to receive service is as follows:

Joshua.More@afslaw.com

/s/ *Joshua R. More*
Joshua R. More

Dated: September 30, 2024

Joshua R. More
233 South Wacker Drive, Suite 7100
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(312) 258-5500
Joshua.More@afslaw.com

Attorney for Dynegy Midwest Generation, LLC

BEFORE THE
ILLINOIS POLLUTION CONTROL BOARD

DYNEGY MIDWEST GENERATION, LLC Petitioner **v.** **ILLINOIS ENVIRONMENTAL PROTECTION AGENCY** Respondent.	**PCB 2024-________**

APPEARANCE OF BINA JOSHI
AND CONSENT TO E-MAIL SERVICE

I, Bina Joshi, hereby enter my appearance on behalf of DYNEGY MIDWEST GENERATION, LLC and authorize the service of documents on me by email in lieu of receiving paper documents in the above-captioned proceeding. My email address to receive service is as follows:

Bina.Joshi@afslaw.com

/s/ *Bina Joshi*
Bina Joshi

Dated: September 30, 2024

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Bina.Joshi@afslaw.com

Attorney for Dynegy Midwest Generation, LLC

BEFORE THE
ILLINOIS POLLUTION CONTROL BOARD

DYNEGY MIDWEST GENERATION, LLC Petitioner **v.** **ILLINOIS ENVIRONMENTAL PROTECTION AGENCY** Respondent.	**PCB 2024-________**

APPEARANCE OF SAMUEL A. RASCHE
AND CONSENT TO E-MAIL SERVICE

I, Samuel A. Rasche, hereby enter my appearance on behalf of DYNEGY MIDWEST GENERATION, LLC and authorize the service of documents on me by email in lieu of receiving paper documents in the above-captioned proceeding. My email address to receive service is as follows:

Sam.Rasche@afslaw.com

/s/ *Samuel A. Rasche*
Samuel A. Rasche

Dated: September 30, 2024

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Attorney for Dynegy Midwest Generation, LLC

BEFORE THE
ILLINOIS POLLUTION CONTROL BOARD

DYNEGY MIDWEST GENERATION, LLC Petitioner **v.** **ILLINOIS ENVIRONMENTAL PROTECTION AGENCY** Respondent.	**PCB 2024-________**

PETITION FOR REVIEW OF ILLINOIS ENVIRONMENTAL PROTECTION AGENCY'S NON-CONCURRENCE WITH ALTERNATIVE SOURCE DEMONSTRATION UNDER 35 ILL. ADM. CODE PART 845 AND MOTION FOR STAY

Petitioner Dynegy Midwest Generation, LLC ("DMG" or "Petitioner"), pursuant to Sections 105.200 *et seq.* and 845.650(e) of Title 35 of the Illinois Administrative Code, 35 Ill. Adm. Code §§ 105.200 *et seq.* and § 845.650(e), appeals the final decision of the Illinois Environmental Protection Agency ("IEPA" or the "Agency") that did not concur with the Alternative Source Demonstration for the Vermilion Power Plant New East Ash Pond submitted to the Agency on July 24, 2024 (the "Vermilion ASD"). IEPA's non-concurrence is stated in a letter from IEPA Bureau of Water Permit Section Manager Darin LeCrone to DMG dated August 22, 2024, and served upon DMG on August 26, 2024, via U.S. Mail, which is attached as **Exhibit A** (the "IEPA Denial"). As detailed in Section II below, IEPA's Denial is contrary to the applicable regulations, unsupported and unjustified.

In support of this Petition and Motion for Stay, DMG states as follows:

I. BACKGROUND

A. Regulatory Background

1. IEPA regulates coal combustion residuals ("CCR") surface impoundments under 35 Ill. Adm. Code. Part 845 ("Part 845").[1] Part 845 includes requirements for regular groundwater monitoring. 35 Ill. Adm. Code § 845.650.

2. If, during groundwater monitoring, one or more constituents are detected and confirmed to be in exceedance of the groundwater protection standards in Section 845.600 ("GWPS"), a series of additional steps are triggered.

3. Within 60 days after detecting an exceedance of a GWPS, an owner or operator may submit an Alternative Source Demonstration ("ASD") to IEPA demonstrating "that a source other than the CCR surface impoundment caused the contamination and the CCR surface impoundment did not contribute to the contamination, or that the exceedance of the GWPS resulted from error in sampling, analysis, statistical evaluation, natural variation in groundwater quality, or a change in the potentiometric surface and groundwater flow direction." 35 Ill. Adm. Code § 845.650(e).

4. The ASD must "include a report that contains the factual or evidentiary basis for any conclusions and a certification of accuracy by a qualified professional engineer." *Id.*

5. IEPA must send a public notice of the ASD, and members of the public may submit written comments to IEPA within 14 days of the notice. *Id.*

6. Within 30 days after receiving an ASD, IEPA must provide a written response to the owner or operator of the CCR surface impoundment either concurring or not with the ASD. If IEPA concurs, the owner or operator must continue groundwater monitoring, but is not required to take additional actions in connection with the identified exceedance, including initiating an

[1] Subsequent references in this petition to "Section 845.xxx" or "§ 845.xxx" shall be to 35 Ill. Adm. Code, Part 845, unless otherwise specified.

assessment of corrective measures. If IEPA does not concur, the owner or operator may petition the Board for review of the non-concurrence. *Id.*

7. Other requirements are prompted in the absence of an ASD, or in the event an ASD is denied and a stay is not granted. For example, within 90 days after detecting an exceedance of a GWPS, the owner or operator of the CCR surface impoundment must initiate an assessment of corrective measures. 35 Ill. Adm. Code § 845.660(a). The owner or operator must, within 90 days of initiating its assessment of corrective measures (or up to 60 days longer if an extension is requested and granted), submit to the Agency an assessment of corrective measures. *Id.* at § 845.660(a)(2). Within a year of completing the assessment of corrective measures, an owner or operator must submit a construction permit application and corrective action plan to IEPA identifying the selected remedy. *Id* at § 845.670(b).

B. DMG's Alternative Source Demonstration

8. DMG owns and operated the now retired Vermilion Power Plant ("Vermilion") located in Vermilion County, Illinois, approximately 4 miles northeast of the Village of Oakwood. Vermilion includes the New East Ash Pond ("NEAP"), a CCR surface impoundment regulated under Part 845.

9. On May 25, 2024, groundwater monitoring at the NEAP identified several GWPS exceedances at multiple wells. The majority of the detected exceedances are similar to exceedances identified during previous quarterly monitoring periods and for which DMG submitted ASDs ("Previous ASD Exceedances"). IEPA did not concur with DMG's previous ASDs, and IEPA's nonconcurrence is currently pending review before the Board in docket no. PCB 24-53. However, DMG also identified one new exceedance for total dissolved solids ("TDS") at well 70D (the "TDS Exceedance").

10. DMG notified IEPA of its groundwater monitoring results, including the TDS Exceedance, placed the information in its operating record, and contracted with an environmental consultant to further investigate the cause of the TDS Exceedance. Vermilion Power Plant New East Ash Pond; IEPA ID # W1838000002-04, Groundwater Monitoring Data and Detected Exceedances, Quarter 1, 2024 (May 25, 2024), available at https://www.luminant.com/documents/ccr/il-ccr/Vermilion/2024/2024-VE%20NEAP%202024%201st%20qtr%2035%20IAC%20845%20GW%20report-Vermilion-New%20East%20Ash%20Pond-W1838000002%E2%80%9004.pdf (attached as **Exhibit E**).

11. On July 24, 2024, DMG submitted the Vermilion ASD to IEPA. The Vermilion ASD concluded that neither the NEAP nor the two other CCR surface impoundments located at the Vermilion site—the Old East Ash Pond ("OEAP") and the North Ash Pond ("NAP")—are the source of the TDS exceedance, and that the TDS exceedance was caused by groundwater interactions with bedrock. The Vermilion ASD is attached as **Exhibit B**. The Vermilion ASD also explained that the facts and evidence presented in the ASD applied and continued to apply to the Previous ASD Exceedances.

12. The Vermilion ASD identified four lines of evidence to demonstrate that the NEAP, OEAP, and NAP (collectively, the "Ash Ponds") are not the cause of or contributing to the TDS Exceedance and that the TDS Exceedance is due to natural groundwater interactions with bedrock. First, the Vermilion ASD demonstrated that the ionic composition of bedrock groundwater is consistent with published observations for Pennsylvanian Bedrock in the area and different from the ionic composition of porewater from the Ash Ponds. **Exhibit B** at 16-17. The Vermilion ASD explained that porewater from the Ash Ponds has a calcium-sulfate dominant hydrochemical composition, whereas well 70D (as well as nearby well 35D) are sodium-chloride dominant. *Id.* at

17. Additionally, wells 35D and 70D are screened at lower elevations, and "[g]roundwater from deeper in Pennsylvanian aquifers tends to be more dominant in chloride, and groundwater may change from a sodium-bicarbonate to a sodium chloride facies over small changes in depth." *Id.* The Vermilion ASD concluded that "compliance groundwater samples have a different ionic composition than NEAP, OEAP, and NAP porewater and a composition relative to background that is consistent with expected changes due to screed depth, indicating that NEAP, OEAP, and NAP porewater is not the source of CCR constituents detected in 70D" *Id.*

13. Second, the Vermilion ASD demonstrated that "[c]oncentrations of chloride in the NEAP, OEAP, and NAP porewater are lower than those observed in groundwater from compliance well 70D."[2] *Id.* at 18. Because the "maximum concentration of chloride detected in NEAP, OEAP, and NAP porewater . . . is lower than the minimum concentration of chloride in 70D" and "the median concentration of chloride in well 70D is 31, 224, and 84 times greater, than the median concentration of chloride . . . in NEAP, OEAP, and NAP porewater, respectively[,]" the Vermilion ASD concluded that "the NEAP, OEAP, and NAP cannot be the source of the elevated chloride, and thus TDS, concentrations observed in 70D." *Id.*

14. Third, the Vermilion ASD included evidence from a bedrock solids and geochemical evaluation, described in a technical memorandum included with the ASD, which included an "evaluation of site-specific solid phase compositions, geochemical conditions through multivariate statistical analyses, and literature review of Pennsylvanian-aged shale bedrock groundwaters[.]" *Id.* at 18-19; Appendix C. The technical memorandum identified naturally

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[2] The technical memorandum attached to the ASD explained that "TDS is the summation of all dissolved constituents in a water sample" and "does not have a singular source but rather is influenced by concentrations of individual components of groundwater composition." **Exhibit B** at Appendix C, p. 3. For well 70D at Vermilion, "chloride comprises the largest component of the TDS value." *Id.*

occurring chloride associated with shales as the alternative source of chloride (and by extension the TSD exceedance) at well 70D. *Id.* This conclusion was based on three observations: (1) detection in the bedrock of "considerable quantities of clay and mica materials that retain dissolved ions (*i.e.*, chloride) from marine water trapped in the pore space"; (2) "[g]roundwater chloride concentrations observed in Pennsylvanian-age shale bedrock aquifers are comparable to or higher than those observed at well 70D"; and (3) a principal component analysis of groundwater and porewater samples collected from the Ash Ponds and surrounding area "shows that [bedrock confining unit] groundwater is distinct from NEAP, OEAP, and NAP porewater." *Id.*

15. Fourth, the Vermilion ASD demonstrated that bedrock groundwater in the vicinity of the Ash Ponds "is only slightly connected or completely isolated from the groundwater in the quaternary deposits based on isotopic analysis, observed hydraulic conditions, and hydraulic conductivity of associated hydrostratigraphic units." *Id* at 19. Prior sampling and isotopic analysis conducted by ISGS and DMG in 2002 showed that tritium concentrations in groundwater indicated that bedrock groundwater was much older than groundwater in the quaternary deposits. *Id.* These results were consistent with carbon dating which showed "[g]roundwater collected from wells screened in shallow bedrock in the vicinity of the NEAP . . . had estimated ages ranging from 13,920 to 34,610 years . . . in contrast to groundwater collected [from the Quaternary deposits] which had estimated ages of less than 210 years." *Id.* at 19-20. ISGS concluded then that "the wells that draw water from the bedrock are either only slightly connected to or completely isolated from the local groundwater flow system." *Id.* (internal quotations omitted).

16. The Vermilion ASD also presented "more recent observations of site conditions [which] support the ISGS' 2002 conclusion." *Id.* First, data obtained from pressure transducers installed in monitoring wells shows "a lack of groundwater elevation response in [bedrock] wells

to precipitation and short-term changes in Middle Fork River stage" which suggests "a lack of hydraulic connection" between the bedrock and local groundwater flow system. *Id.* at 20. Second, "groundwater in the [bedrock] is at the end of its flow path as it migrates upward . . . , preventing the downward migration into the shale of water in contact with CCR materials contained with the NEAP." *Id.* Additional data from a 2021 hydrogeologic characterization report further "indicat[es] the presence of upward gradients in the bedrock." *Id.* at 21. Finally, the ASD demonstrated that "significant differences in both horizontal and vertical hydraulic conductivities between the [bedrock] and the [uppermost unit] hydrostratigraphic units, as well as the primarily upward vertical gradients identified downgradient of the NEAP, indicate the preferred flow path of groundwater in the [uppermost unit] would be laterally east and discharging into the Middle Fork [river] rather than vertically down into the low permeability [bedrock], further supporting that groundwater in the [bedrock] is hydraulically isolated from and not influenced by the local groundwater flow system in the [uppermost unit]." *Id.*

17. For the above reasons, the Vermilion ASD concluded that the evidence demonstrated "that the [Ash Ponds] are not the source of the TDS GWPS exceedance in well 70D" and that the "TDS exceedance is due to groundwater interactions with bedrock." *Id.* at 22.

C. The IEPA Denial

18. On August 26, 2024, DMG received a letter from IEPA notifying DMG of IEPA's non-concurrence with the Vermilion ASD (the "IEPA Denial"). The IEPA Denial states that IEPA "does not concur" due to a single "data gap." **Exhibit A**. IEPA's stated "data gap" is as follows:

> "Lack of analysis of Chloride from the Coal Combustion Residuals in the New East Ash Pond. Source characterization of the CCR at New East Ash Pond must include total solids leachate [synthetic precipitation leaching procedure (SPLP)] sampling in accordance with the waste characterization and/or fate and transport characterization required in 35 Ill. Adm. Code 845 and analyzed in accordance with SW846."

19. IEPA did not provide any further explanation or otherwise respond to the lines of evidence presented in the Vermilion ASD.

II. Discussion

20. IEPA's basis for its non-concurrence, the stated "data gap," is not supported by IEPA's regulatory authority or the requirement set forth under Section 845.650, technically unsound, and unjustly requests an impossibility.

A. There is no data gap in the Vermilion ASD

21. IEPA's Denial unreasonably demands data and analysis that is not required by Section 845.650. The regulation requires only that DMG submit a "demonstration . . . that a source other than the CCR surface impoundment caused the contamination and the CCR surface impoundment did not contribute to the contamination." 35 Ill. Adm. Code § 845.650(e). In support of the demonstration, the regulations require that an ASD "include a report that contains the factual or evidentiary basis for any conclusions and a certification of accuracy by a qualified professional engineer." *Id.* The Vermilion ASD report does just that through a scientifically supported analysis that contains multiple lines of evidence and is certified by a qualified professional engineer. **Exhibit B.** *See also*, Declaration of Mindy Hahn at 2-3 (September 30, 2024), attached as **Exhibit C**. The information identified by IEPA's "data gap" is not necessary to form a "factual and evidentiary basis" for the conclusions reached in an ASD, nor would it otherwise prove helpful in supporting the ASD. The information would not lead to a different result, and the fact the data was not submitted is inadequate to support the Agency's nonconcurrence with the Vermilion ASD.

22. IEPA's "data gap demands that the Vermilion ASD should have included an "analysis of Chloride from the [CCR] in the New East Ash Pond." **Exhibit A.** Specifically, IEPA demands that the "[s]ource characterization of the CCR at [NEAP] must include total solids . . . leachate testing" using synthetic precipitation leaching procedure ("SPLP"). However, there is no

requirement in Part 845 that source characterization of CCR for an ASD include such an analysis, and IEPA's Denial provides no justification for its demand. IEPA asserts that SPLP testing is required "in accordance with the waste characterization and/or fate and transport characterization required in 35 Ill. Adm. Code 845 and analyzed in accordance with SW846." *Id.* But, as stated above, Part 845 does not indicate that any specific testing or characterization method must be utilized for an ASD, and SPLP testing is not referred to, directly or indirectly, anywhere within the text of Part 845.

23. Nor is there any legal requirement that a source characterization for purposes of an ASD conducted under Section 845.650(e) utilize SW846. Method SW846 is incorporated by reference into Part 845 by Section 845.150. However, inclusion in the general "incorporations by reference" section of Part 845 does not create an affirmative obligation to use SW846 in all circumstances. The Board has explained that where Illinois rules incorporate analytical methods by reference via a "centralized listing of incorporations by reference" such as Section 845.150, "Illinois rules further indicate where each method is used *in the body of the substantive provisions*." *See In the Matter of: SDWA Update, USEPA Amendments (January 1, 2013 through June 30, 2013)*, R 14-8, slip op. at 24-25 (Jan. 23, 2014) (emphasis added). Further, Chapter 2 of SW846 states that the methods in that document are not "mandatory" unless specifically specified as such by regulation. United States Environmental Protection Agency ("USEPA"), *SW-846 Update V*, (July 2014) at 1.[3] USEPA guidance also makes clear that SW846 is only legally required where "explicitly specified" in a regulation. USEPA, *Disclaimer for Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846)*, (July 2014), at 1.[4] The only substantive provision

[3] Available at https://www.epa.gov/sites/default/files/2015-10/documents/chap2_1.pdf.
[4] Available at https://www.epa.gov/sites/default/files/2015-10/documents/disclaim.pdf.

of Part 845 specifically requiring analysis using SW846 is Section 845.640(j), which applies to analyzing groundwater monitoring samples under a groundwater monitoring program and is not at issue here. 35 Ill. Adm. Code § 845.640(e). There is no requirement to use SW846 under Section 845.650(e). The plain language of the rules does not require the utilization of SW846 for purposes of source characterization for an ASD, and IEPA has provided no justification for any alternative interpretation.

24. Further, from a technical basis, the porewater analysis conducted in the Vermilion ASD is a more appropriate and accurate method to characterize the NEAP source material's impact on groundwater than a SPLP analysis. **Exhibit C** at 6-9**.** Source characterization of the NEAP was conducted using the best scientifically available procedure, porewater sampling. CCR porewater most accurately represents the mobile constituents associated with waste management activity within the NEAP, and is representative of the waters that could potentially be contributors to groundwater observed in compliance monitoring wells. *Id.*

25. IEPA does not provide any citation or other explanation for why it believes only an SPLP analysis should be used for source characterization in an ASD under Part 845. **Exhibit A**. However, *no* method would have been preferable to or provide more appropriate information than the source characterization methodology utilized for the Vermilion ASD. **Exhibit C** at 6-7. An SPLP analysis would require laboratory simulations that are less direct and less appropriate for understanding the potential impact of a release because, unlike porewater, they are not representative of the actual water quality from a CCR surface impoundment that would mix with groundwater. **Exhibit C** at 6-9. The characterization data utilized for the Vermilion ASD included an analysis of actual and direct measurements of field porewater and leachate quality at the NEAP. *Id.* at 4-5.

26. If source characterization of CCR at the NEAP did include an SPLP analysis, it would not be expected to change the results of the Vermilion ASD. *Id.* at 8-9.

27. IEPA's denial of the Vermilion ASD based on the stated "data gap" is accordingly absurd and unreasonable.

B. IEPA's Denial imposes practically infeasible requirements.

28. IEPA's interpretation of Section 845.650(e) is further unreasonable because the alleged "data gap" demands complex sampling and analysis that cannot feasibly be completed within the timeframes contemplated by the regulations. Section 845.650(e) requires owners and operators to submit an ASD within 60 days after detecting a GWPS exceedance. The regulations further require IEPA to reach a final decision within 30 days after receiving an ASD. 35 Ill Adm. Code § 845.650(e)(4).

29. IEPA's alleged "data gap" requires an analysis of leachable chloride from the CCR in the NEAP using SPLP testing. **Exhibit A.** Such a demonstration, which contains scientific limitations, could take approximately 12 to 15 weeks. **Exhibit D**, Declaration of Cynthia Vodopivec at X.[5] Again, there is no ongoing regulatory requirement that DMG conduct such analysis, and thus there would have been no reason for DMG to begin any such assessment until a GWPS exceedance is detected. Once again, even if DMG had fully anticipated IEPA's request, it would not have been able to complete the analysis until months past the deadline to submit an ASD.

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[5] Undertaking the steps required to provide the information IEPA seeks through IEPA's "data gap would also be costly: collecting the information requested by IEPA's "data gap" would cost approximately $$65,000 to $80,000. **Exhibit D**. While cost is not a driver of actions taken for completing an ASD, as Dr. Hahn explains, accepted scientific practice is to not develop costly additional lines of evidence when sufficient evidence exists from other, better lines of evidence to support a conclusion. **Exhibit C** at 2-3.

30. The data collection the IEPA Denial categorizes as a "gap" in the Vermilion ASD could not feasibly be completed before the prescribed deadline for submitting an ASD. IEPA's interpretation that Section 845.650 requires the information in the "data gap" would thus make the entire ASD provision meaningless, as it would be impossible for any owner or operator to submit a sufficient ASD.

31. Furthermore, even if the data requested was required to be collected elsewhere under Part 845 (which it is not), there is no requirement in Section 845.650 that such data be used in connection with an ASD. Here, qualified professionals used best available information to develop an ASD within the regulatory deadline and in conformance with regulatory requirements. Certainly, additional lines of evidence could be added to the ASD analysis; however, professional judgment and practicality dictate that every possible line of evidence need not and cannot be developed. **Exhibit C** at 2-3. Doing so would take an unreasonable amount of time. Additionally, doing so is unnecessary when existing information is sufficient to support the conclusion that an alternative source caused the contamination detected and that the CCR surface impoundment at issue did not contribute to that contamination. *Id.* at 9.

32. IEPA's denial is therefore not supported by law, unjust, and technically unsupported.

III. CONCLUSION

33. For the above reasons, DMG respectfully requests that the Board stay the requirements of Sections 845.650(d), 845.660, 845.670, and 845.680 relating to the TDS Exceedance at issue in this Petition until the later of (a) the Board's final resolution of this Petition, or (b) if this Petition is granted, IEPA's issuance of a concurrence. Moreover, DMG respectfully requests that the Board grant this Petition for Review and remand to IEPA to issue a new final written response concurring with the Vermilion ASD.

Respectfully submitted,

/s/ Joshua R. More
Joshua R. More

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Attorneys for Dynegy Midwest Generating, LLC

BEFORE THE
ILLINOIS POLLUTION CONTROL BOARD

DYNEGY MIDWEST GENERATING, LLC Petitioner **v.** **ILLINOIS ENVIRONMENTAL PROTECTION AGENCY** Respondent.	**PCB 2024-________**

INDEX OF EXHIBITS

Exhibit A	Letter from Darin LeCrone, Permit Section Manager, Division of Water Pollution Control, Bureau of Water, Illinois Environmental Protection Agency to Dianna Tickner, Dynegy Midwest Generation, LLC (August 22, 2024)
Exhibit B	Ramboll, 35 I.A.C. § 845.650(E): Alternative Source Demonstration, New East Ash Pond, Vermilion Power Plant, Oakwood, Illinois, IEPA ID: W1838000002-04 (July 24, 2024)
Exhibit C	Declaration of Melinda W. Hahn, PhD (September 30, 2024)
Exhibit D	Declaration of Cynthia Vodopivec on behalf of Dynegy Midwest Generation, LLC (February 2, 2024)
Exhibit E	Ramboll, Vermilion Power Plant New East Ash Pond; IEPA ID # W1838000002-04, Groundwater Monitoring Data and Detected Exceedances, Quarter 1, 2024 (May 25, 2024)

Exhibit A

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 · (217) 782-3397
JB PRITZKER, GOVERNOR **JAMES JENNINGS**, INTERIM DIRECTOR

217-782-1020

August 22, 2024

Dianna Tickner
Dynegy Midwest Generation, LLC
1500 Eastport Plaza Drive
Collinsville, Illinois 62234

Re: Vermilion Power Plant East Power Plant New East Ash Pond; W1838000002-4
Alternate Source Demonstration (ASD) Submittal

Dear Mrs. Tickner:

The purpose of this correspondence is to notify you that the Illinois Environmental Protection Agency (Illinois EPA) does not concur with the Vermilion New East Ash Pond System Alternative Source Demonstration (ASD) dated July 24, 2024.

The Illinois EPA does not concur due to the following data gap:

- Lack of analysis of Chloride from the Coal Combustion Residuals in the New East Ash Pond. Source characterization of the CCR at New East Ash Pond must include total solids leachate [synthetic precipitation leaching procedure (SPLP)] sampling in accordance with the waste characterization and/or fate and transport characterization required in 35 Ill. Adm. Code 845 and analyzed in accordance with SW846.

If you have any questions, please contact: **Justin Bierwagen** Illinois EPA, Bureau of Water, Groundwater Section DPWS #13, P.O. Box 19276, Springfield, Illinois 62794-9276. If you have any questions concerning the investigation described above, please call 217-782-1020.

Sincerely,

Darin LeCrone
Permit Section Manager
Division of Water Pollution Control
Bureau of Water

cc: Justin Bierwagen
Lauren Hunt
Keegan MacDonna
Records 06M

Exhibit B

Luminant

Dynegy Midwest Generation, LLC
1500 Eastport Plaza Drive
Collinsville, IL 62234

July 24, 2024

Illinois Environmental Protection Agency
DWPC – Permits MC#15
Attn: 35 I.A.C. § 845.650(e) Alternative Source Demonstration Submittal
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

Re: Vermilion Power Plant New East Ash Pond; IEPA ID # W1838000002-04

Dear Mr. LeCrone:

In accordance with Title 35 of the Illinois Administrative Code (35 I.A.C.) Section (§) 845.650(e), Dynegy Midwest Generation, LLC (DMG) is submitting this Alternative Source Demonstration (ASD) for exceedances observed from the Quarter 1 2024 sampling event at the Vermilion Power Plant New East Ash Pond, identified by Illinois Environmental Protection Agency (IEPA) ID No. W1838000002-04.

As allowed in 35 I.A.C. § 845.650(e), previous ASDs were submitted for GWPS exceedances at the New East Ash Pond. This ASD is being submitted within 60 days from the date of determination of an exceedance of a groundwater protection standard (GWPS) for constituents listed in 35 I.A.C. § 845.600. As required by 35 I.A.C. § 845.650 (e)(1), the ASD was placed on the facility's website within 24 hours of submittal to the agency.

One hard copy is provided with this submittal.

Sincerely,

Dianna Tickner

Dianna Tickner
Sr. Director – Decommission and Demolition

Enclosures

Alternate Source Demonstration, Quarter 1 2024, New East Ash Pond Vermilion Power Plant

Intended for
Dynegy Midwest Generation, LLC

Date
July 24, 2024

Project No.
1940103584-009

35 I.A.C. § 845.650(E): ALTERNATIVE SOURCE DEMONSTRATION

NEW EAST ASH POND
VERMILION POWER PLANT
OAKWOOD, ILLINOIS
IEPA ID: W1838000002-04

RAMBOLL Bright ideas. Sustainable change.

CERTIFICATIONS

I, Eric J. Tlachac, a qualified professional engineer in good standing in the State of Illinois, certify that the information in this report is accurate as of the date of my signature below. The content of this report is not to be used other than for its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

____
Eric J. Tlachac
Qualified Professional Engineer
062-063091
Illinois
Ramboll Americas Engineering Solutions, Inc.
Date: July 24, 2024

LICENSED PROFESSIONAL ENGINEER
ERIC J. TLACHAC
062-063091
STATE OF ILLINOIS

I, Brian G. Hennings, a professional geologist in good standing in the State of Illinois, certify that the information in this report is accurate as of the date of my signature below. The content of this report is not to be used other than for its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

____
Brian G. Hennings
Professional Geologist
196-001482
Illinois
Ramboll Americas Engineering Solutions, Inc.
Date: July 24, 2024

LICENSED PROFESSIONAL GEOLOGIST
BRIAN G. HENNINGS
196.001482
ILLINOIS

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APPENDICES

ACRONYMS AND ABBREVIATIONS

35 I.A.C.	Title 35 of the Illinois Administrative Code
^{14}C	carbon-14
ASD	Alternative Source Demonstration
BCU	Bedrock Confining Unit
CCR	coal combustion residuals
CMA	Corrective Measures Assessment
cm/s	centimeters per second
DMG	Dynegy Midwest Generation, LLC
E001	Event 1, Quarter 2, 2023
E003	Event 3, Quarter 4, 2023
E004	Event 4, Quarter 1, 2024
EPRI	Electric Power Research Institute
GMP	Groundwater Monitoring Plan
GWPS	groundwater protection standard
HCR	Hydrogeologic Site Characterization Report
IEPA	Illinois Environmental Protection Agency
ISGS	Illinois State Geological Survey
IPCB	Illinois Pollution Control Board
IQR	Interquartile Range
LGU	Lower Groundwater Unit
LOE(s)	line(s) of evidence
mg/L	milligrams per liter
MGU	Middle Groundwater Unit
Middle Fork	Middle Fork of the Vermilion River
NAP	North Ash Pond
NAVD88	North American Vertical Datum of 1988
NEAP	New East Ash Pond
NGVD	National Geodetic Vertical Datum of 1929
OEAP	Old East Ash Pond
PCA	principal component analysis
PMP	Potential Migration Pathway
Ramboll	Ramboll Americas Engineering Solutions, Inc.
RYBP	Radiocarbon Years Before Present
SEP	Sequential Extraction Procedure
SI	surface impoundment
TDS	total dissolved solids
TU	tritium units
UCU	Upper Confining Unit
USEPA	United States Environmental Protection Agency
UU	Upper Unit
VPP	Vermilion Power Plant

EXECUTIVE SUMMARY

Groundwater samples collected at the Vermilion Power Plant (VPP) New East Ash Pond (NEAP) during February 2024 for the Quarter 1, 2024 compliance sampling event (Event 4 [E004]) were evaluated for exceedances of the groundwater protection standards (GWPS) described in Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845.600. Exceedances were identified in the following hydrostratigraphic units and wells:

Bedrock confining unit (BCU) (potential migration pathway [PMP]) exceedances:

- Chloride at wells 35D and 70D
- Lithium at wells 35D and 70D
- Sulfate at well 35D
- Total dissolved solids (TDS) at wells 35D and 70D

Upper unit (UU; PMP) exceedances:

- Sulfate at well 70S
- TDS at well 70S

These are similar to GWPS exceedances determined during previous quarterly sampling events, with the exception of the TDS exceedance at well 70D, which was a new exceedance determined after the E004 sampling event. As a result of the newly identified E004 exceedance, this Alternative Source Demonstration (ASD) has been prepared to provide pertinent information pursuant to 35 I.A.C. § 845.650(e) for the VPP NEAP.

Two previous ASDs were submitted for the GWPS exceedances referenced above (except for the new TDS exceedance at well 70D addressed by this ASD) and a GWPS exceedance of chloride identified at well 71D during the Quarter 4, 2023 (E003) groundwater sampling event (Ramboll, 2023 and 2024a). The Illinois Environmental Protection Agency (IEPA) communicated in written correspondence (IEPA, 2023 and 2024) that they did not concur with these ASDs due to the following data gaps:

- Characterization that the draw water from the bedrock is completely isolated from local groundwater flow system.
- No assessment of the interaction between bedrock groundwater and the Old East Ash Pond (OEAP). Based on Fig. 1 shows to be upgradient of the NEAP. The Agency (IEPA) is unable to review for fate and transport or related concepts without source characterization of total CCR solids.
- Lack of analysis of the leachable metals from the CCR in the NEAP. Source characterization of the CCR at NEAP must include total solids sampling in accordance with the waste characterization and/or fate and transport characterization required in 35 Ill. Adm. Code 845 and analyzed in accordance with SW846.

As allowed in 35 I.A.C. § 845.650(e), DMG subsequently filed a petition on February 2, 2024 asking the Illinois Pollution Control Board (IPCB) to review the IEPA's denial (dated December 28, 2023) of the ASD for chloride, lithium, sulfate, and TDS at well 35D and chloride and lithium at well 70D. The IPCB accepted the petition for appeal on February 15, 2024 and on April 18, 2024 approved a partial stay, with no objections by the IEPA, of the requirements of 35 I.A.C. § 845.650(d), 35 I.A.C. § 845.660, 35 I.A.C. § 845.670, and 35 I.A.C. § 845.680, which pertain to corrective actions for the parameters with exceedances, pending final action by the Board.

This ASD provides additional information in response to concerns raised by IEPA in the prior denials:

- In response to IEPA's denial point regarding no characterization that draw water from the bedrock is completely isolated from the local groundwater flow system, additional hydrogeologic information is provided in Sections 2.3.1 and 3.4 demonstrating the lack of a hydraulic connection between the bedrock and overlying shallow, unlithified soils that comprise the local groundwater flow system in the vicinity of the NEAP.
- In response to the IEPA's denial point regarding no assessment of the interaction of bedrock groundwater and the OEAP, additional hydrogeologic information is provided in Section 2.3.1 regarding groundwater flow in the vicinity of the OEAP; and, the ionic composition of porewater collected from both the OEAP and NAP is included in the comparison of the ionic composition of CCR porewater to that of bedrock groundwater collected from the monitoring wells in the vicinity of the NEAP presented in Sections 3.1 and 3.2.
- In response to the IEPA's denial point regarding the lack of analysis of the leachable metals from the CCR in the NEAP, additional information is provided in Section 2.4 demonstrating that analysis of available CCR source water collected from porewater wells screened near the base of ash within the unit is considered the primary CCR source term for the purpose of alternative source evaluation.

The four LOEs listed below, with elaboration provided herein, demonstrate that the NEAP, OEAP, and North Ash Pond (NAP) are not the source of the TDS GWPS exceedance in well 70D. The TDS exceedance is due to groundwater interactions with the bedrock, with chloride being the major contributor to TDS.

1. The ionic composition of bedrock groundwater is different than the ionic composition of NEAP, OEAP, and NAP porewater and consistent with published observations for Pennsylvanian Bedrock.
2. Concentrations of Chloride in the NEAP, OEAP, and NAP Porewater are Lower than Those Observed in Groundwater from Compliance Well 70D.
3. A Bedrock Solids and Geochemical Evaluation Identified Naturally Occurring Shales as the Source of Chloride, and thus the TDS Exceedance at Compliance Well 70D.
4. Bedrock Groundwater is Only Slightly Connected or Completely Isolated from the Groundwater in the Quaternary Deposits Based on Isotopic Analysis, Observed Hydraulic Conditions, and Hydraulic Conductivity of Associated Hydrostratigraphic Units.

This information serves as the written ASD prepared in accordance with 35 I.A.C. § 845.650(e), demonstrating that the TDS exceedance observed at well 70D during the Quarter 1, 2024 sampling event (E004) was not due to the NEAP and is attributable to natural groundwater interactions with bedrock. Therefore, assessment of corrective measures is not required for this TDS exceedance at the NEAP.

Sulfate and TDS GWPS exceedances at well 70S will be addressed in accordance with 35 I.A.C. § 845.660, and an associated Corrective Measures Assessment (CMA) was initiated on December

31, 2023. A request to extend the 90-day CMA completion deadline specified in 35 I.A.C. § 845.660(a)(2) by 60 days was submitted to IEPA on January 2, 2024 and approved in a written response from IEPA dated January 3, 2024. The CMA was completed and submitted to IEPA on May 29, 2024.

1. INTRODUCTION

Under 35 I.A.C. § 845.650(e), within 60 days from the date of determination of an exceedance of a GWPS for constituents listed in 35 I.A.C. § 845.600, an owner or operator of a coal combustion residuals (CCR) surface impoundment (SI) may complete a written demonstration that a source other than the CCR SI caused the contamination and the CCR SI did not contribute to the contamination, or that the exceedance of the GWPS resulted from error in sampling, analysis, statistical evaluation, natural variation in groundwater quality, or a change in the potentiometric surface and groundwater flow direction (ASD).

This ASD has been prepared on behalf of Dynegy Midwest Generation, LLC (DMG) by Ramboll Americas Engineering Solutions, Inc (Ramboll), to provide pertinent information pursuant to 35 I.A.C. § 845.650(e) for the VPP NEAP (*i.e.,* Site) located near Oakwood, Illinois.

The Quarter 1, 2024 sampling event (E004) was completed on February 21, 2024, and analytical data were received on March 26, 2024. In accordance with 35 I.A.C. § 845.610(b)(3)(C), comparison of statistically derived values with the GWPSs described in 35 I.A.C. § 845.600 to determine exceedances of the GWPS was completed by May 25, 2024, within 60 days of receipt of the analytical data (Ramboll, 2024a). The statistical comparison identified the following GWPS exceedances at compliance groundwater monitoring wells:

- Chloride at wells 35D and 70D
- Lithium at wells 35D and 70D
- Sulfate at wells 35D and 70S
- TDS at wells 35D, 70D, and 70S

These are similar to GWPS exceedances determined during previous quarterly sampling events, with the exception of the TDS exceedance at well 70D, which was a new exceedance determined after the E004 sampling event.

As allowed in 35 I.A.C. § 845.650(e), an ASD was submitted on December 1, 2023 for GWPS exceedances determined after the Quarter 2, 2023 sampling event (E001), including chloride, lithium, sulfate, and TDS exceedances at wells 35D and 70D (Ramboll, 2023). The IEPA communicated in a written response dated December 28, 2023 (IEPA, 2023) that it did not concur with the E001 ASD due to the following data gaps:

- Characterization that the draw water from the bedrock is completely isolated from local groundwater flow system.
- No assessment of the interaction between bedrock groundwater and the OEAP. Based on Fig. 1 shows to be upgradient of the NEAP.
- Lack of analysis of the leachable metals from the CCR in the NEAP.

DMG subsequently filed a petition asking the IPCB to review the IEPA's ASD denial. The petition included a motion for a partial stay of the 35 I.A.C. § 845 requirements as they apply to the exceedance of the chloride, lithium, sulfate, and TDS GWPS in BCU wells 35D and 70D. The IEPA had no objection to the requested stay, which was granted by the IPCB on April 18, 2024.

A second ASD was submitted on May 8, 2024, for a new GWPS exceedance of chloride at well 71D during the Quarter 4, 2023 sampling event (E003) (Ramboll, 2024a). This ASD referenced similar lines of evidence (LOEs) as the E001 ASD and included additional hydrogeologic information regarding groundwater flow in the area of the OEAP and demonstrating the lack of a hydraulic connection between the bedrock and overlying shallow, unlithified soils that comprise the local groundwater flow system in the area of the NEAP. The IEPA communicated in a written response dated June 5, 2024 (IEPA, 2024) that it did not concur with the E003 ASD due to the following data gaps:

- No assessment of the interaction between bedrock groundwater and the OEAP. Based on Fig. 1 shows to be up gradient of the NEAP. The IEPA is unable to review for fate and transport or related concepts without source characterization of total CCR solids.
- Lack of analysis of the leachable metals from the Coal Combustion Residuals in the NEAP. Source characterization of the CCR at NEAP must include total solids sampling in accordance with the waste characterization and/or fate and transport characterization required in 35 Ill. Adm. Code 845 and analyzed in accordance with SW846.

This ASD provides additional information in response to IEPA's denial points for the previous two ASDs:

- In response to IEPA's denial point regarding no characterization that draw water from the bedrock is completely isolated from the local groundwater flow system, additional hydrogeologic information is provided in Sections 2.3.1 and 3.4 demonstrating the lack of a hydraulic connection between the bedrock and overlying shallow, unlithified soils that comprise the local groundwater flow system in the vicinity of the NEAP.
- In response to the IEPA's denial point regarding no assessment of the interaction of bedrock groundwater and the OEAP, additional hydrogeologic information is provided in Section 2.3.1 regarding groundwater flow in the vicinity of the OEAP and the ionic composition of porewater collected from both the OEAP and NAP is included in the comparison of the ionic composition of CCR porewater to that of bedrock groundwater collected from the monitoring wells in the vicinity of the NEAP in Sections 3.1 and 3.2.
- In response to the IEPA's denial point regarding the lack of analysis of the leachable metals from the CCR in the NEAP, additional information is provided in Section 2.4 demonstrating that analysis of available CCR source water collected from porewater wells screened near the base of ash within the unit is considered the primary CCR source term for the purpose of alternative source evaluation.

Pursuant to 35 I.A.C. § 845.650(e), the LOEs presented in Section 3 demonstrate that <u>sources other than the NEAP, OEAP, and NAP are the cause of the new TDS GWPS exceedance at well 70D</u> listed above and the NEAP, OEAP, and NAP have not contributed to the exceedance.

This ASD was completed by July 24, 2024, within 60 days of determination of the exceedance (May 25, 2024), as required by 35 I.A.C. § 845.650(e). This ASD has been completed in conformance with guidance provided in the Electric Power Research Institute (EPRI) guidance for development of ASDs at CCR sites (EPRI, 2017), and the United States Environmental Protection Agency (USEPA)'s Solid Waste Disposal Facility Criteria: Technical Manual (USEPA, 1993).

Sulfate and TDS GWPS exceedances at well 70S will be addressed in accordance with 35 I.A.C. § 845.660, and an associated CMA was initiated on December 31, 2023. A request to extend the 90-day CMA completion deadline specified in 35 I.A.C. § 845.660(a)(2) by 60 days was submitted to IEPA on January 2, 2024, and approved in a written response from IEPA dated January 3, 2024. The CMA was completed and submitted to IEPA on May 29, 2024.

2. BACKGROUND

2.1 Site Location and Description

The former VPP is located four miles northeast of the Village of Oakwood in Vermilion County. The NEAP lies in the bottomlands of the Middle Fork and is bordered to the west by bluffs, to the south by unimproved DMG land, and to the north and east by the Middle Fork. Several underground coal mines and one surface mine were historically operated both beneath the NEAP and in the vicinity of the VPP.

2.2 Description of New East Ash Pond CCR Unit

The NEAP is a 29-acre inactive, unlined CCR SI constructed overtop a thick shale formation using berms constructed with a low-permeability clay core and cutoff walls keyed into the underlying shale formation.

The original East Ash Pond (1989 pond footprint) was constructed in 1989 and expanded in 2002 to form the present-day NEAP. The 1989 pond footprint was built overtop a thick shale formation which is greater than 80 feet thick in the vicinity of the ash ponds. The earthen berms on the north, east, and south sides of the 1989 pond footprint were constructed with a low-permeability clay core and cutoff walls keyed into the underlying shale formation. The cutoff walls extended approximately 8 feet into the underlying shale. A natural earthen bluff composed of low-permeability native clays formed the west side of the 1989 pond footprint.

New berms were constructed in 2002 to expand the capacity of the 1989 pond footprint, forming the footprint of the present-day NEAP. The new berms raised the height of the original berms and were constructed with clay liners keyed into the underlying clay core. A cutoff trench backfilled with low permeability fill was placed along the western side slope of the enlarged NEAP. The low-permeability materials surrounding the footprint of the present-day NEAP form the existing containment system. The secondary pond was not expanded or modified as part of the 2002 NEAP expansion. The VPP ceased operations in 2011 when the power plant was retired.

2.3 Geology and Hydrogeology

2.3.1 Site Hydrogeology

Significant site investigation has been completed at the VPP to fully characterize the geology, hydrogeology, and groundwater quality as provided in the October 2021 operating permit application (Geosyntec Consultants, 2021), the January 2022 construction permit application (Geosyntec Consultants, 2022a), and the HCR (Ramboll, 2021a). A site conceptual model has been developed and is summarized below.

In addition to the CCRs present in the NEAP, there are two different types of unlithified material present above the lithified bedrock, which were categorized into three hydrostratigraphic units in this report as follows:

- Upper Unit (UU): includes mixed Quaternary alluvial deposits of the Cahokia Alluvium described as sand with occasional layers of silty clay. The alluvial sand is generally a fine to medium sand that contains silts, clays, and gravels in varying amounts. This unit is present outside of the NEAP and in the bottomlands of the Middle Fork.

- Upper Confining Unit (UCU): consists of predominantly low permeability silty and clayey diamictons (glacial till) of the Wedron Formation with intermittent sand layers and lenses. This unit is present outside of the NEAP and along the western bluff of the Middle Fork.
- Bedrock Confining Unit (BCU): lowermost unit identified at the site and underlies all unlithified deposits. This unit occurs within Pennsylvanian shale which is the uppermost lithified unit at the Site.

None of the hydrostratigraphic units described above have been identified as an aquifer. However, the UU and BCU have been identified as PMPs.

The groundwater present in the unlithified and lithified materials present around the NEAP is isolated from the groundwater present in the vicinity of the NAP and OEAP. Interpreted groundwater flow direction and gradients toward the Middle Fork have not changed significantly since the hydrogeologic study of the NEAP was completed in 2003 (Ramboll, 2021a; Kelron, 2003), and recent data supports the existing conceptual site model. A groundwater elevation map for the BCU for February 19, 2024 is presented in Figure 1, but it was not possible to develop potentiometric surface contours because groundwater elevations in BCU monitoring wells 70D and 71D were observed to be consistently increasing before and after the E004 sampling event based upon data obtained from pressure transducers deployed in those wells (Appendix A). Groundwater elevations in those monitoring wells have not reached static equilibrium following the E003 sampling event, thus yielding groundwater elevations that are not representative of the potentiometric surface at these locations. However, groundwater elevations at wells 10 and 22 are screened within the UU and BCU, respectively and are considerably higher than groundwater elevations at or near the OEAP, therefore the NEAP bedrock wells are not downgradient of the OEAP.

No BCU groundwater elevation data is collected and available to complete a potentiometric surface map for the BCU in the area of the NAP and OEAP. However, a calibrated groundwater flow model was completed as part of the January 2022 construction permit application (Geosyntec Consultants, 2022b) for the NAP and OEAP, which included the BCU within the model domain. The simulated potentiometric surface map, which includes the area of the NAP and OEAP, for the BCU from the calibrated groundwater model is provided in Appendix B. Simulated groundwater elevations in the shale are highest in the topographically highest areas, such as in the vicinity of the NEAP, and the lowest groundwater elevations occur at wells located adjacent to the Middle Fork, consistent with the HCRs for the NAP/OEAP and NEAP (Ramboll, 2021a; Ramboll, 2021c) and as previously reported by Kelron (2003) for the NEAP. The simulated potentiometric surface indicates groundwater in the BCU does not flow from the OEAP to the area of the NEAP. The Middle Fork is the receiving body of water in the region, including for both the NAP and OEAP via a different hydrostratigraphic unit, referred to as the Middle Groundwater Unit (MGU) and described further below, and NEAP via the underlying BCU, consistent with the conceptual site model.

As described in the HCR for the NAP and OEAP (Ramboll, 2021c), groundwater flows into the Middle Fork through the unlithified MGU (alluvial deposits of coarser grained material encountered at the base of the Cahokia Alluvium and designated as the uppermost aquifer in the area of the NAP and OEAP) and Lower Groundwater Unit (LGU; glacial outwash and re-worked glacial deposits of the Henry Formation in the area of the NAP and OEAP) which are the primary pathways that contaminant migration could occur in the area of the NAP and OEAP. Water level elevations collected from ND3 (a porewater well placed in the NAP) indicate the phreatic surface is above the water levels observed in the uppermost aquifer; however, the potentiometric surface of the uppermost aquifer (MGU) for February 19, 2024 (Figure 2) illustrate flow toward the Middle Fork with no observable radial component of flow outward along the perimeter of the NAP and OEAP (and toward the upland bluff and NEAP, both areas where the MGU does not exist and materials at similar elevations as the MGU along the perimeter of the NAP and OEAP consist of low permeability tills [with exception to bottomland areas north of the NAP]). The absence of a radial component of flow indicates the NAP and OEAP do not significantly impact regional groundwater flow direction toward the Middle Fork. As indicated by groundwater potentiometric surfaces, groundwater flows from beneath the NAP and OEAP toward the Middle Fork through the MGU, not toward the NEAP. Groundwater flow in the LGU beneath the bluff and Company Lake appears to reflect the topography, flowing from the VPP toward the NAP, OEAP and Middle Fork to the north, and toward Company Lake to the south, which results in localized groundwater divides (Figure 3). Company Lake is not downgradient of the NAP and OEAP. Neither the MGU nor the LGU are present in the upland area immediately southeast of the OEAP or in the area of the NEAP. Low permeability tills of the UCU and LCU occur at similar elevations as the MGU and LGU in the upland area immediately southeast of the OEAP between the OEAP and NEAP areas creating a localized groundwater flow divide. Consequently, groundwater does not flow through the low permeability till units between the OEAP area to the NEAP area, but instead preferentially flows along a direct path to the Middle Fork through the MGU and LGU. Thus, the NAP and OEAP areas are hydraulically isolated from the NEAP in the shallow, unlithified soils overlying the bedrock.

2.3.2 Regional Bedrock Geology

Regional investigations of the Illinois Basin have identified bedrock (specifically brines within the bedrock formations) as a source of chloride in groundwater (Kelley et al, 2012; Panno et al, 2018). Studies by Cartwright (1970) and Siegel (1989) indicate that groundwater migrates toward the center of the Illinois Basin and discharges upward through overlying confining units. The “Saline groundwater and brines can be brought near or to the land surface by natural conditions, such as migrating up prominent fractures and/or faults in bedrock, or by anthropogenic activities, such as exploration for and exploitation of petroleum. The mixing of upward-migrating saline groundwater with fresh groundwater from shallow aquifers can make groundwater from private wells undrinkable and can present a very expensive problem for municipalities (Panno and Hackley, 2010). Illinois State Geological Survey (ISGS) reporting includes 31 chloride results from available water samples (including some samples from VPP) which range from 2.1 to 30,269 milligrams per liter (mg/L) with mean value of 1,689 mg/L and median of 13 mg/L (ISGS, 2002). The report also concludes that water from the wells completed in shale contained higher concentrations of aluminum, barium, bromide, boron, chloride, fluoride, iron, lithium, potassium, sodium, and strontium. Tritium and carbon-14 (^{14}C) age dating has demonstrated that groundwater from the bedrock is significantly older than that from the shallow Quaternary deposits (Kelron, 2003; ISGS, 2002).

2.4 Groundwater and NEAP Monitoring

The monitoring system for the NEAP was established in the Groundwater Monitoring Plan (GMP; Ramboll, 2021b) and consists of monitoring wells installed in the UU, UCU, and BCU, including background monitoring wells 10 and 22, located west of the NEAP, and compliance monitoring wells 16A, 16B, 35S, 35D, 70S, 70D, 71S and 71D (Figure 1). NED1 (installed in CCR) is used to collect porewater samples and monitor water levels within the NEAP. CCR porewater is water "collected from the interstitial water between waste particles in surface impoundments as it occurs in the field" (USEPA, 2014) and represents the material potentially leached from impoundments. The CCR materials are the primary source of constituent loading to the CCR porewater. Over an extended period (*e.g.,* months to years), the CCR porewater (*i.e.,* water) reaches equilibrium with the CCR materials. The concentrations within the porewater are "the most representative data available for impoundments because these data are field-measured concentrations of leachate" (USEPA, 2014). CCR source water collected from porewater wells screened near the base of ash within the unit is considered as the primary CCR source term for the purpose of alternative source evaluation.

3. LINES OF EVIDENCE THAT GROUNDWATER PROTECTION STANDARD EXCEEDANCES ARE NOT RELATED TO THE NEAP, OEAP, OR NAP

As allowed by 35 I.A.C. § 845.650(e), this ASD demonstrates that sources other than the NEAP (the CCR unit) caused the TDS exceedance at compliance groundwater monitoring well 70D and the NEAP did not contribute to the exceedance. Specifically, the following LOEs conclude that the TDS exceedance is due to groundwater interactions with the bedrock.

1. The ionic composition of bedrock groundwater is different than the ionic composition of NEAP, OEAP, and NAP porewater and consistent with published observations for Pennsylvanian Bedrock.
2. Concentrations of Chloride in the NEAP, OEAP, and NAP Porewater are Lower than Those Observed in Groundwater from Compliance Well 70D.
3. A Bedrock Solids and Geochemical Evaluation Identified Naturally Occurring Shales as the Source of Chloride, and thus the TDS Exceedance, at Compliance Well 70D.
4. Bedrock Groundwater is Only Slightly Connected or Completely Isolated from the Groundwater in the Quaternary Deposits Based on Isotopic Analysis, Observed Hydraulic Conditions, and Hydraulic Conductivity of Associated Hydrostratigraphic Units.

These LOEs are described and supported in greater detail below.

Figure A (on the following page) shows boxplots summarizing the relative contribution of each major ion to TDS in groundwater from well 70D since 2021. Box plots graphically represent the range of a given dataset using lines to construct a box where the lower line, midline, and upper line of the box represent the values of the first quartile, median, and third quartile values, respectively. The minimum and maximum values of the dataset (excluding outliers) are illustrated by whisker lines extending beyond the first and third quartiles of (*i.e.,* below and above) the box plot. Outliers (values that are at least 1.5 times the IQR away from the edges of the box) are represented by single points plotted outside of the range of the whiskers. Figure A shows that chloride has the greatest contribution to TDS concentrations at 70D (median of 41 percent).

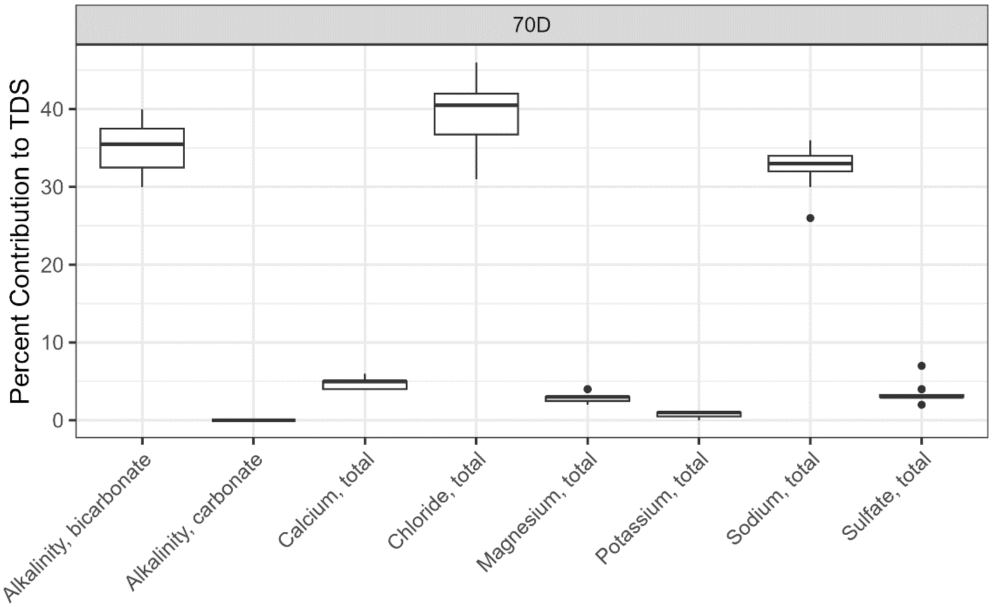

Figure A. Contribution of each major ion to TDS at well 70D.

3.1 LOE #1: The Ionic Composition of Bedrock Groundwater is Different Than the Ionic Composition of NEAP, OEAP, and NAP Porewater and Consistent with Published Observations for Pennsylvanian Bedrock

Piper diagrams graphically represent ionic composition of aqueous solutions. A Piper diagram displays the position of water samples with respect to their major cation and anion content on the two lower triangular portions of the diagram, providing the information which, when combined on the central, diamond-shaped portion of the diagram, identify composition categories or groupings (hydrochemical facies). Figure B on the following page is a Piper diagram that displays the ionic composition of samples collected from the bedrock background and bedrock compliance wells associated with the NEAP (sampled February 20 and 21, 2024), porewater sampling location associated with the NAP (sampled February 20, 2024), porewater sampling location associated with the NEAP (sampled February 21, 2024), and porewater sampling location associated with the OEAP (sampled June 20, 2023).

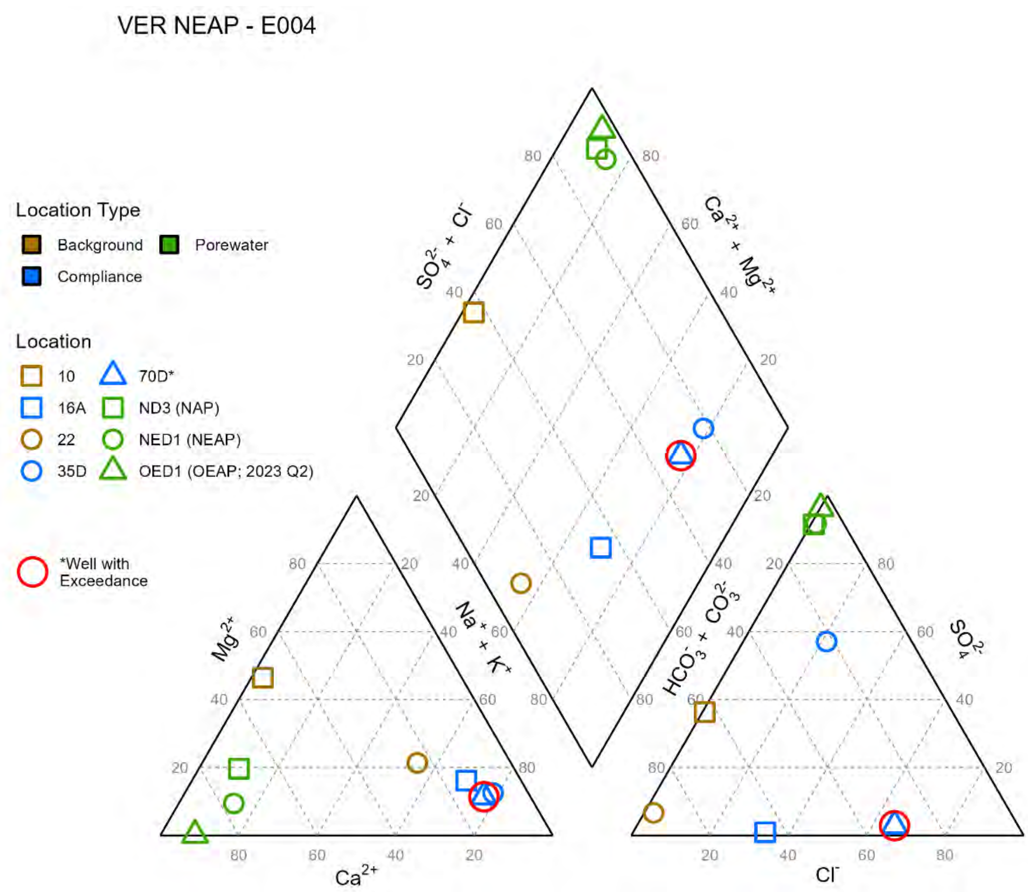

Figure B. Piper Diagram. Shows ionic composition of bedrock groundwater (February 20 and 21, 2024), porewater associated with the NAP (February 20, 2024), porewater associated with the NEAP (February 21, 2024), and porewater associated with the OEAP (June 20, 2023).

It is evident from the piper diagram (Figure B) that porewater from the NEAP (green circle symbol), OEAP (green triangle symbol), and NAP (green square symbol) are primarily in the calcium-sulfate hydrochemical facies, while the bedrock groundwater from wells 35D and 70D near the NEAP (blue triangle and blue circle symbols, respectively) are in the sodium-chloride hydrochemical facies. The background BCU sample (brown circle symbol) is in the sodium-bicarbonate hydrochemical facies. The background BCU sample is collected from well 22, which is screened at from 556 to 576 feet[1], and wells 35D and 70D are screened at lower elevations (536 to 546 feet and 541 to 551 feet, respectively). Groundwater from deeper in Pennsylvanian aquifers tends to be more dominant in chloride, and groundwater may change from a sodium-bicarbonate to a sodium-chloride facies over small changes in depth (Lloyd and Lyke, 1995). Therefore, compliance groundwater samples have a different ionic composition than NEAP, OEAP, and NAP porewater and a composition relative to background that is consistent with expected changes due to screen depth, indicating that NEAP, OEAP, and NAP porewater is not the source of CCR constituents detected in 70D.

[1] All elevations in this report are referenced to North American Vertical Datum 1988 (NAVD88) unless otherwise noted.

3.2 LOE #2: Concentrations of Chloride in the NEAP, OEAP, and NAP Porewater are Lower than Those Observed in Groundwater from Compliance Well 70D

A box plot of chloride concentrations in compliance monitoring well 70D and NEAP, OEAP, and NAP porewater wells NED1, OED1, and ND3, respectively, is provided in Figure C below. The chloride data ranges are April 2021 to February 2024 for 70D and NED1, June 2021 to June 2023 for OED1, and March 2021 to February 2024 for ND3. Chloride concentrations are significantly lower in the NEAP, OEAP, and NAP porewater samples than in compliance groundwater samples collected from well 70D. The maximum concentration of chloride detected in NEAP, OEAP, and NAP porewater (44 mg/L, 5 mg/L, and 10 mg/L, respectively) is lower than the minimum concentration of chloride in 70D (317 mg/L). In addition, the median concentration of chloride in well 70D (672.5 mg/L) is 31, 224, and 84 times greater than the median concentration of chloride (21.5 mg/L, 3 mg/L, and 8 mg/L) in NEAP, OEAP, and NAP porewater, respectively. Therefore, the porewater from the NEAP, OEAP, and NAP cannot be the source of the elevated chloride, and thus TDS, concentrations observed in 70D.

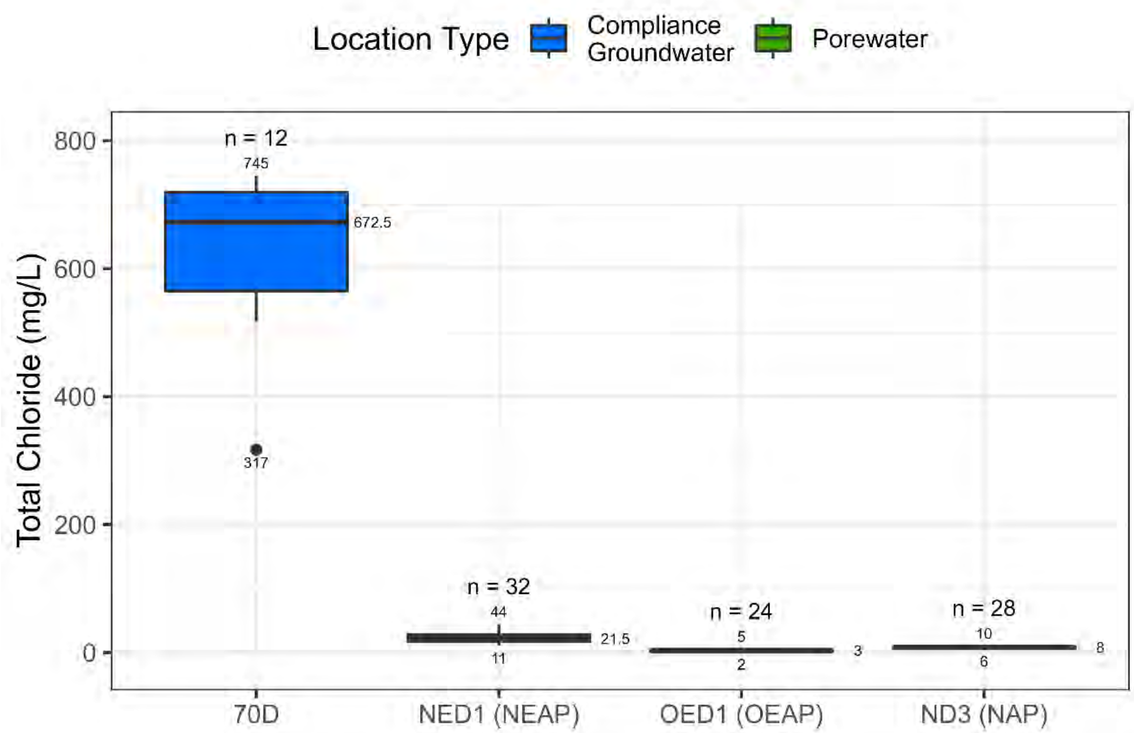

Figure C. Chloride Box Plot. The sample size (n), maximum, median, and minimum values are noted.

3.3 LOE #3: A Bedrock Solids and Geochemical Evaluation Identified Naturally Occurring Shales as the Source of Chloride, and thus the TDS Exceedance, at Compliance Well 70D

Appendix C presents an evaluation of site-specific solid phase compositions, geochemical conditions through multivariate statistical analyses, and literature review of Pennsylvanian-aged shale bedrock groundwaters that identifies naturally occurring chloride associated with shales as the alternative source of this constituent and related TDS exceedance in the groundwater at 70D based on the following observations:

- Mineralogy of bedrock samples collected from the site consists of considerable quantities of clay and mica materials that retain dissolved ions (*i.e.,* chloride) from marine water trapped in the pore space at the time of deposition of these materials.
- Groundwater chloride concentrations observed in Pennsylvanian-age shale bedrock aquifers are comparable to or higher than those observed at well 70D.
- Principal component analysis (PCA) shows that BCU well groundwater is distinct from NEAP, OEAP, and NAP porewater.

3.4 LOE #4: Bedrock Groundwater is Only Slightly Connected or Completely Isolated from the Groundwater in the Quaternary Deposits Based on Isotopic Analysis, Observed Hydraulic Conditions, and Hydraulic Conductivity of Associated Hydrostratigraphic Units

In 2002, ISGS and DMG collected groundwater samples from eight monitoring wells and tested the samples for ^{14}C and hydrogen-3 (tritium) (ISGS, 2002). Six of the monitoring wells (25, 26, 27, 28, 29, and 30) were located adjacent to the NEAP (Figure 7, Appendix D). Wells 26 and 28 had well screens that intersected Quaternary deposits of the UU and the remaining wells were screened in shallow shale bedrock (BCU). Results of the testing are presented in Figure 7 included in Appendix D, and in Table 11 of the ISGS report (2002) included below as Table A.

Table A. Isotopic Data from ISGS Sampled Wells (Table 11 from ISGS, 2002)

Table 11. Isotopic data for ISGS sampled wells

Parameter	Units	Well Number							
		1349	25531	KELRON 25	KELRON 26	KELRON 27	KELRON 28	KELRON 29	KELRON 30
^{14}C	RYBP	2,180	21,160	13,920	210	19,400	modern	34,610	20,850
	% modern carbon	76	7.2	18	97	8.9	102	1.4	7.5
Tritium	TU	7.8	<0.43	<0.43	5.3	<0.43	5.8	<0.52	<0.43

^{14}C = carbon-14

RYBP = Radiocarbon Years Before Present

TU = tritium units

Tritium is generated in the atmosphere and decays in the isolated subsurface. Water with tritium concentrations greater than 5 TU is considered to be recent, while water with nondetectable tritium concentrations is considered to be greater than 50 years old (ISGS, 2002). Groundwater collected from shallow Quaternary deposits is recent (TU > 5), while groundwater from the shallow bedrock is older (no tritium detected). The tritium results are consistent with the ^{14}C results, which indicate that the shallow bedrock wells contain an inorganic carbon signature substantially older than that from wells screened in the Quaternary deposits. Groundwater collected from wells screened in shallow bedrock in the vicinity of the NEAP (wells 25, 27, 29, and 30) had estimated ages ranging from 13,920 to 34,610 years based on ^{14}C age dating. This is in contrast to groundwater collected from wells 26 and 28 (screened in the Quaternary deposits) which had estimated ages of less than 210 years. These results indicated to ISGS that the wells that "draw water from the bedrock are either only slightly connected to or completely isolated from the local groundwater flow system [overlying Quaternary deposits]" (ISGS, 2002).

More recent observations of site conditions support the ISGS' 2002 conclusion, including the following described in further detail below:

- The lack of groundwater elevation response in BCU wells to precipitation and short-term changes in Middle Fork River stage
- Mostly upward vertical hydraulic gradients in the BCU (and observed artesian conditions in the BCU)
- Differences in vertical hydraulic conductivities between UU and BCU units

Groundwater elevation in the alluvial deposits (UU) typically conforms to ground surface topography and fluctuates in response to changes in river stage and variations in precipitation (Kelron, 2003). Recent data available from pressure transducers installed in the NEAP monitoring wells screened in the UU indicate relatively quick responses (increases and decreases in a period of one month) to changes in river stage and variations in precipitation as illustrated in the hydrograph for wells 70S and 70D (Appendix A; note transducer data for other NEAP monitoring wells screened in the UU are not available as these wells are frequently dry). Recent transducer data available from NEAP monitoring wells screened in the BCU did not indicate a response to changes in river stage and variations in precipitation like those in NEAP monitoring wells screened in the UU, only steady increases in a period of one month as illustrated in the hydrograph for wells 22, 70D, and 71D (Appendix A; note transducer data is not available for BCU wells 16A and 35D). The lack of increases and decreases in the hydrographs for the BCU wells support a lack of hydraulic connection to the local groundwater flow system in the UU.

The progressively slow steady increase of water levels in the BCU as illustrated in the hydrographs for the BCU wells likely also indicates that groundwater elevations in these wells did not reach static equilibrium following sampling events when groundwater levels were drawn down during purging as a result of the low permeability of the shale. Further, wells 70D and 71D may not have fully recovered from installation and initial well development. Downgradient shallow UU wells 16B (nested with BCU well 16A) and 35S (nested with BCU well 35D) are frequently dry, and downgradient BCU wells 70D (nested with UU well 70S) and 71D (nested with UU well 71S) may not represent static groundwater elevations as previously described; therefore, the following discussion on vertical hydraulic gradient downgradient of the NEAP focuses on data collected by Kelron (2003) as recent data is not sufficient to evaluate vertical hydraulic gradients.

Further, as presented by Kelron (2003), groundwater in the shale (BCU) is at the end of its flow path as it migrates upward into the overlying alluvium (UU) and directly into the Middle Fork in some locations, as illustrated in the cross-section in Figure 28 from Kelron, 2003 and provided in Appendix D, preventing the downward migration into the shale of water in contact with CCR materials contained within the NEAP. In 2002, upward vertical gradients were observed between the shale and alluvial deposits at all of the nested wells within the bottomlands of the Middle Fork during at least part of the monitoring period, with the exception of nested wells 23/24 (these evaluations included alluvial deposit and shale wells nests 13B/13A, 16B/16A, 23/24, 26/27, and 28/29). The greatest upward gradients were observed between shallow shale well 13A and nested deep shale well 32. Deep shale well 32 was also reported to be flowing under artesian conditions during the investigation completed for the 2003 Report. Note that well 35D (installed in March 2017) replaced well 13A, where the greatest upward gradients within the bedrock were observed and reported in the Kelron 2003 report; it is expected that vertical gradients are upward at well nest 35S/35D under normal conditions (static conditions). According to the Kelron 2003 report, high hydraulic heads and artesian groundwater flow conditions were also observed when the coal seam and overlying fractured shale in close proximity to the mined areas were intercepted at exploratory borings B201 and B202 (boring locations shown in Figure 7 of Appendix D). Nested wells 16B/16A experienced upward vertical gradients in only one of the eight groundwater level monitoring events in 2002 and the overall eight-month average vertical gradient was downward. As reported in the HCR (Ramboll, 2021a), groundwater elevations measured at BCU well 16A in 2021 ranged from 568.28 to 571.32 feet, which were consistently greater than the elevation of the top of bedrock at location 16A (approximately 566 feet National Geodetic Vertical Datum of 1929 [NGVD]) indicating the presence of upward gradients in the bedrock (nested well 16B was dry in eight monitoring events from March to August 2021). The upward vertical gradients discussed in Kelron, 2003 and the 2021 HCR (Ramboll, 2021a) support that BCU groundwater is hydraulically isolated from the overlying local groundwater flow system in the UU downgradient of the NEAP; groundwater does not flow from the UU downward into the BCU downgradient of the NEAP.

As described in the 2021 HCR (Ramboll, 2021a), the UU and the BCU are distinct water-bearing units based on stratigraphic relationships and hydrogeologic characteristics as described in Section 2.3. Field hydraulic conductivity tests indicated that the horizontal hydraulic conductivity for the UU ranged from 7.4×10^{-4} to 1.1×10^{0} centimeters per second (cm/s), with a geometric mean of 1.1×10^{-2} cm/s (Ramboll, 2021a). Based on field hydraulic conductivity testing, the horizontal hydraulic conductivity for the BCU ranged from 1.1×10^{-6} to 2.3×10^{-5} cm/s, with a geometric mean of 7.1×10^{-6} cm/s (Ramboll, 2021a). Wells 70D and 71D were installed in 2021 in the BCU, where the hydraulic conductivity of the BCU is relatively low with a geometric mean of 7.09×10^{-6} cm/s. As described previously, water levels at wells 70D and 71D did not likely equilibrate to static water levels following installation and initial well development in 2021 as a result of the low permeability of the shale. Two samples were collected from the UU at two locations (70S and 71S) in the vicinity of the NEAP as part of the 2021 field investigation and the resulting vertical hydraulic conductivities for the samples ranged from 5.2×10^{-4} to 1.3×10^{-3} cm/s. The vertical hydraulic conductivity calculated from tests performed in the laboratory on one shale core ranged from 1×10^{-8} to 5×10^{-8} cm/s (Kelron, 2003). The geometric mean of field hydraulic conductivity tests were four orders of magnitude lower in the BCU when compared to the UU. The laboratory vertical hydraulic conductivity tests were a minimum of four orders of magnitude lower in the BCU when compared to the UU. The significant difference in both horizontal and vertical hydraulic conductivities between the BCU and overlying UU hydrostratigraphic units, as well as the primarily upward vertical gradients identified downgradient of the NEAP, indicate the preferred flow path of groundwater in the UU would be laterally east and discharging into the Middle Fork rather than vertically down into the low permeability BCU, further supporting that groundwater in the BCU is hydraulically isolated from and not influenced by the local groundwater flow system in the UU.

In addition to the spatial location of the wells tested for ^{14}C and tritium relative to the NEAP, the elevations of the well screens and lithology of the age dated wells overlap with the well screen elevation and lithology of well 70D, which contains the TDS exceedance (Table B below), with the exception of MW30, which is screened at a lower elevation than all of the other wells.

Table B. Summary of Bedrock Well Screen Elevations and Lithology

Well ID	Screen Elevation (feet)	Lithology
MW70D – exceedance well	550 to 540	shale bedrock
MW25	560 to 540	shale bedrock
MW27	557 to 537	shale bedrock
MW29	558 to 538	shale bedrock
MW30	519 to 499	shale bedrock

This data demonstrates that bedrock groundwater in the vicinity of the NEAP is only slightly connected or completely isolated from the groundwater in the quaternary deposits and the NEAP is not the source of the TDS exceedance at well 70D.

4. CONCLUSIONS

Based on these four LOEs, it has been demonstrated that the NEAP, OEAP, and NAP are not the source of the TDS GWPS exceedance in well 70D. The TDS exceedance is due to groundwater interactions with the bedrock. The major contributor to TDS in well 70D is chloride.

1. The ionic composition of bedrock groundwater is different than the ionic composition of NEAP, OEAP, and NAP porewater and consistent with published observations for Pennsylvanian Bedrock.
2. Concentrations of Chloride in the NEAP, OEAP, and NAP Porewater are Lower than Those Observed in Groundwater from Compliance Well 70D.
3. A Bedrock Solids and Geochemical Evaluation Identified Naturally Occurring Shales as the Source of Chloride, and thus the TDS Exceedance, at Compliance Well 70D.
4. Bedrock Groundwater is Only Slightly Connected or Completely Isolated from the Groundwater in the Quaternary Deposits Based on Isotopic Analysis, Observed Hydraulic Conditions, and Hydraulic Conductivity of Associated Hydrostratigraphic Units.

This information serves as the written ASD prepared in accordance with 35 I.A.C. § 845.650(e), demonstrating that the TDS exceedance observed at well 70D during the Quarter 1, 2024 sampling event was not due to the NEAP and is attributable to natural groundwater interactions with bedrock. Therefore, assessment of corrective measures is not required for this TDS exceedance at the NEAP.

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FIGURES

COMPLIANCE MONITORING WELL
BACKGROUND MONITORING WELL
PORE WATER WELL
MONITORING WELL
REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

NOTES:
1. ELEVATIONS IN PARENTHESES MAY HAVE NOT REACHED STATIC EQUILIBRIUM.
2. GROUNDWATER ELEVATIONS SHOWN IN FEET, NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

0 150 300 Feet

NEW EAST ASH POND GROUNDWATER ELEVATIONS FEBRUARY 19, 2024

ALTERNATIVE SOURCE DEMONSTRATION
NEW EAST ASH POND
VERMILION POWER PLANT
OAKWOOD, ILLINOIS

FIGURE 1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

PROJECT: 169000XXXX | DATED: 7/10/2024 | DESIGNER: GALARNMC

Y:\Mapping\Projects\22\2285\MXD\Alt_Source_Dem\Vermilion\NEAP_912\E004\ASD_E004.aprx\Figure 2. VER 910 911 NAPS OEAP Pot Surface 20240219

PROJECT: 169000XXXX | DATED: 6/25/2024 | DESIGNER: GALARNMC

COMPLIANCE MONITORING WELL
BACKGROUND MONITORING WELL
PORE WATER WELL
MONITORING WELL
GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)
INFERRED GROUNDWATER ELEVATION CONTOUR
GROUNDWATER FLOW DIRECTION
REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

NOTES:
1. ELEVATIONS IN PARENTHESES WERE NOT USED FOR CONTOURING.
2. ELEVATION CONTOURS SHOWN IN FEET, NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

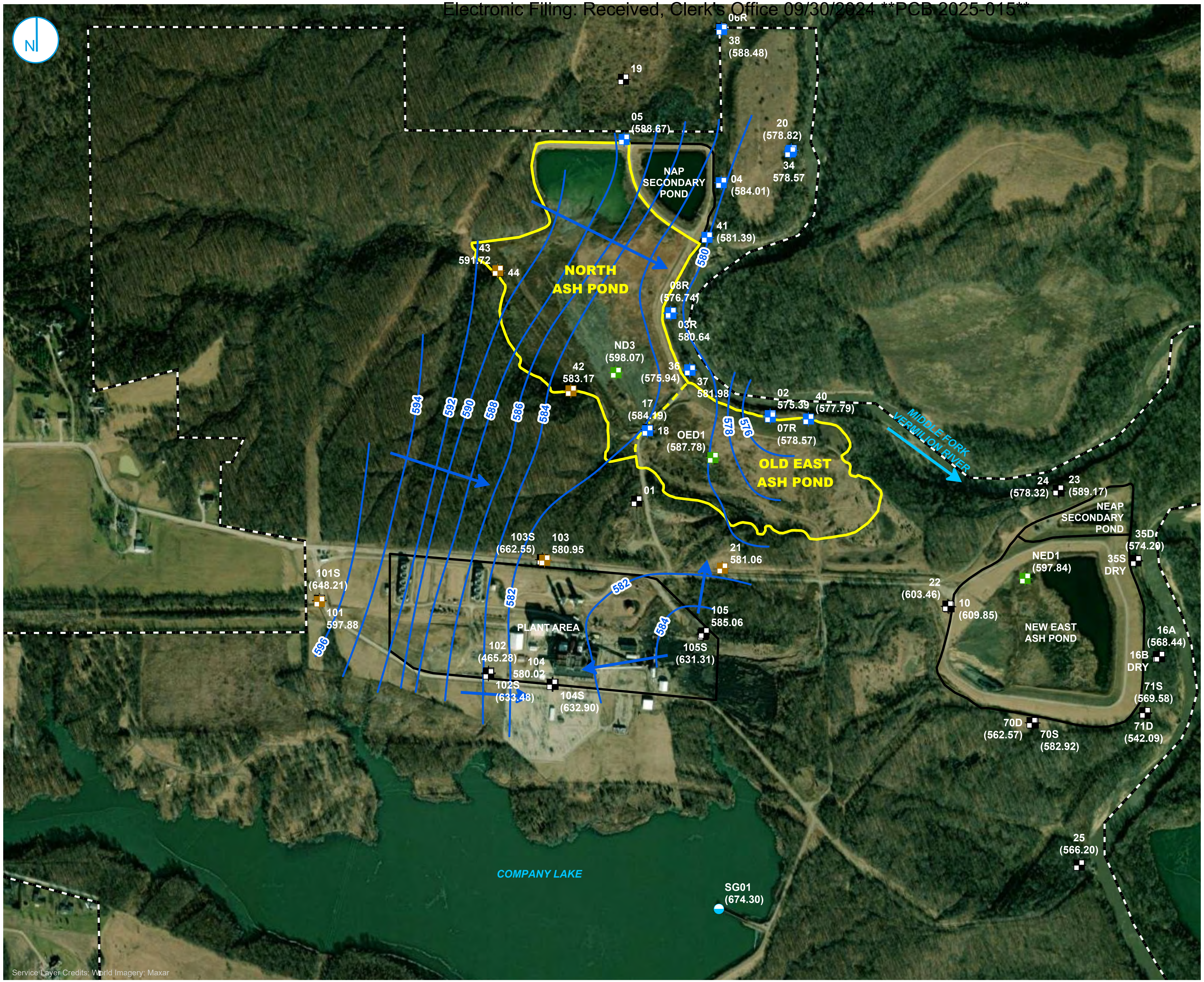
0 200 400
Feet

NORTH ASH POND AND OLD EAST ASH POND POTENTIOMETRIC SURFACE MAP FEBRUARY 19, 2024

ALTERNATIVE SOURCE DEMONSTRATION
NEW EAST ASH POND
VERMILION POWER PLANT
OAKWOOD, ILLINOIS

FIGURE 2

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.



- COMPLIANCE MONITORING WELL
- BACKGROUND MONITORING WELL
- PORE WATER WELL
- STAFF GAGE, RIVER
- MONITORING WELL
- GROUNDWATER ELEVATION CONTOUR (2-FT CONTOUR INTERVAL, NAVD88)
- GROUNDWATER FLOW DIRECTION
- REGULATED UNIT (SUBJECT UNIT)
- SITE FEATURE
- PROPERTY BOUNDARY

NOTES:
1. ELEVATIONS IN PARENTHESES WERE NOT USED FOR CONTOURING.
2. ELEVATION CONTOURS SHOWN IN FEET, NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

0 300 600 Feet

POTENTIAL MIGRATION PATHWAY LOWER GROUNDWATER UNIT POTENTIOMETRIC SURFACE MAP FEBRUARY 19, 2024

ALTERNATIVE SOURCE DEMONSTRATION
NEW EAST ASH POND
VERMILION POWER PLANT
OAKWOOD, ILLINOIS

FIGURE 3

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL

Y:\Mapping\Projects\22\2285\MXD\Alt_Source_Dem\Vermilion\NEAP_912\E004\ASD_E004.aprx\Figure 3. VER 910 911 NAPS OEAP PMP Pot Surface 20240219

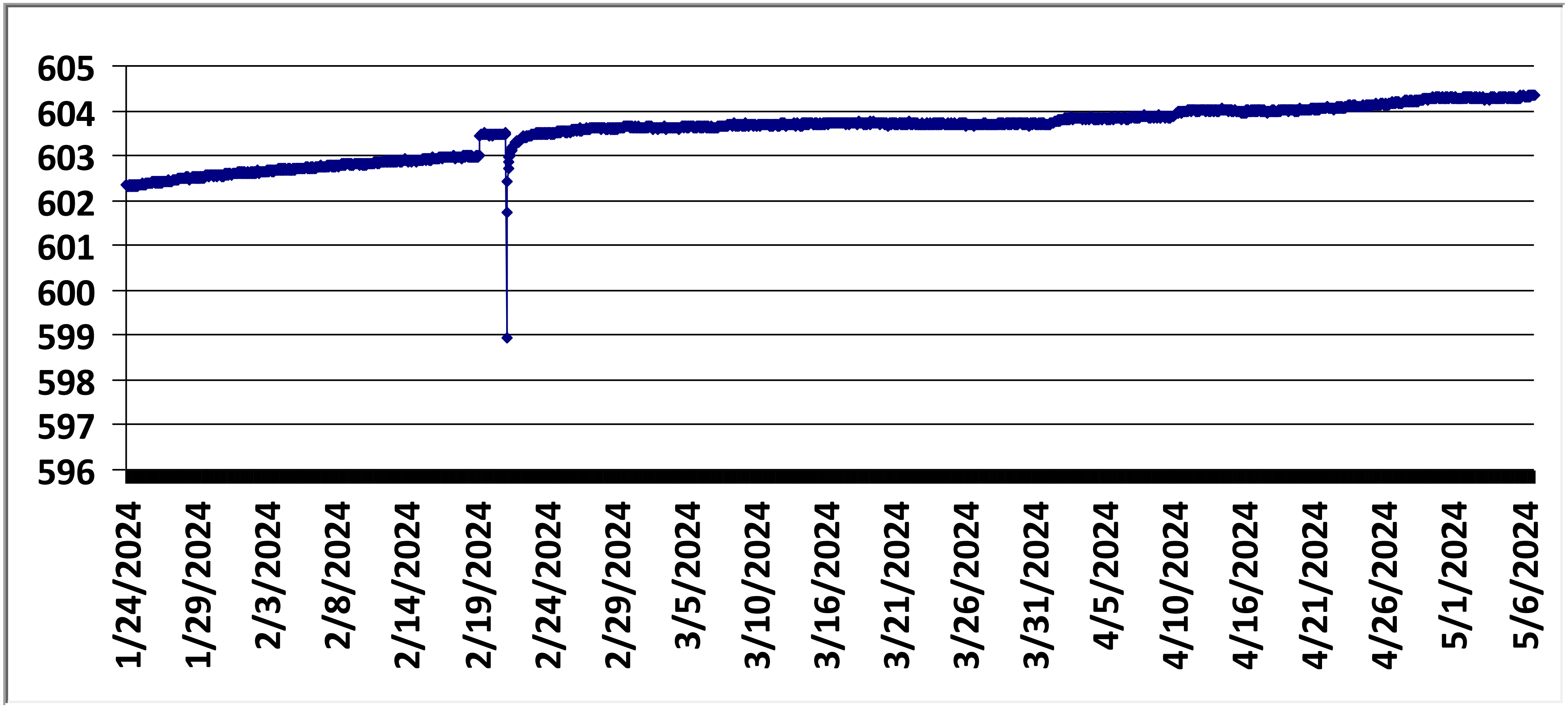
PROJECT: 169000XXXX | DATED: 7/8/2024 | DESIGNER: GALARNMC

APPENDICES

APPENDIX A
PLOTS OF GROUNDWATER ELEVATION DATA FROM PRESSURE TRANSDUCERS INSTALLED IN MONITORING WELLS 22, 70S, 70D, 71S, AND 71D

VER_022

21739726



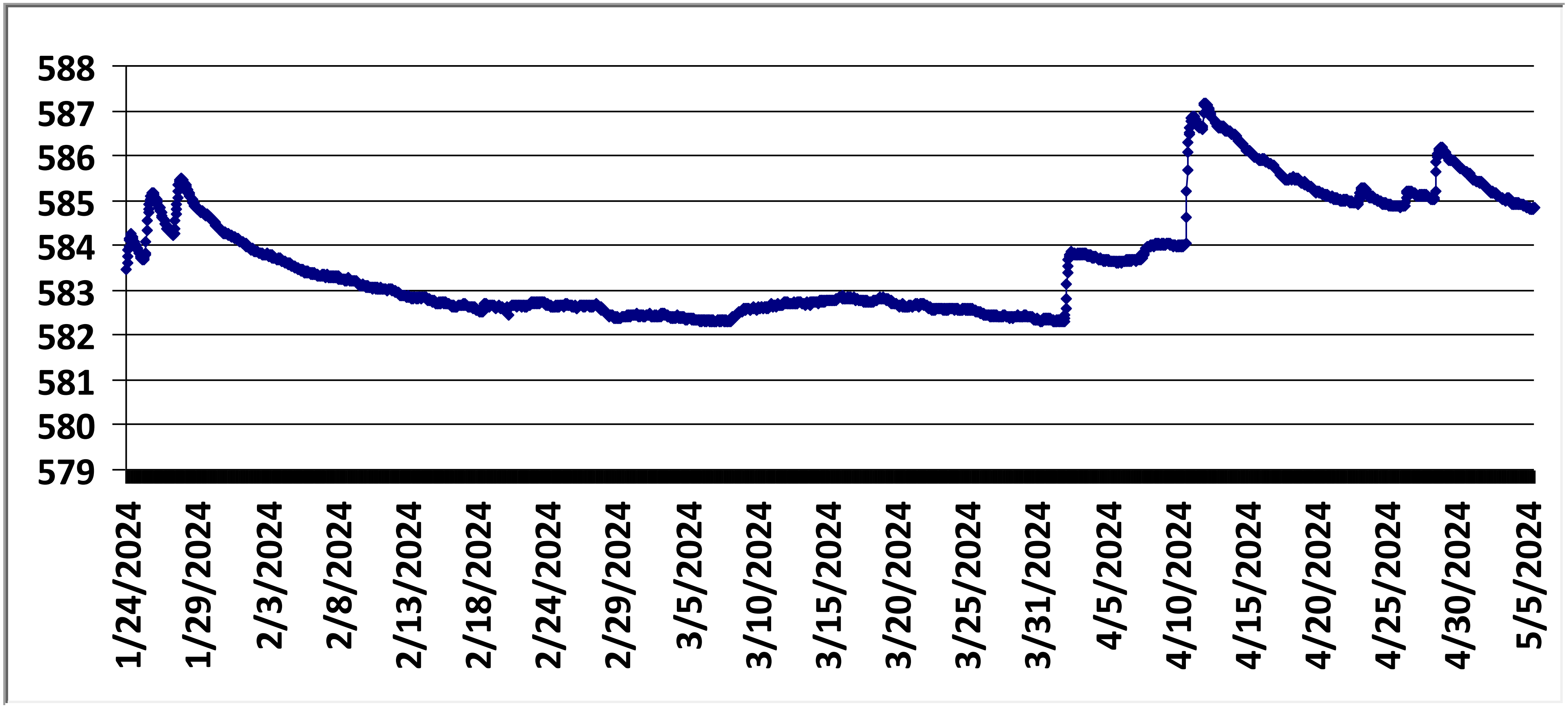
RAMBOLL

Groundwater Level Data

TIME SERIES

VER_S70#S

21615597

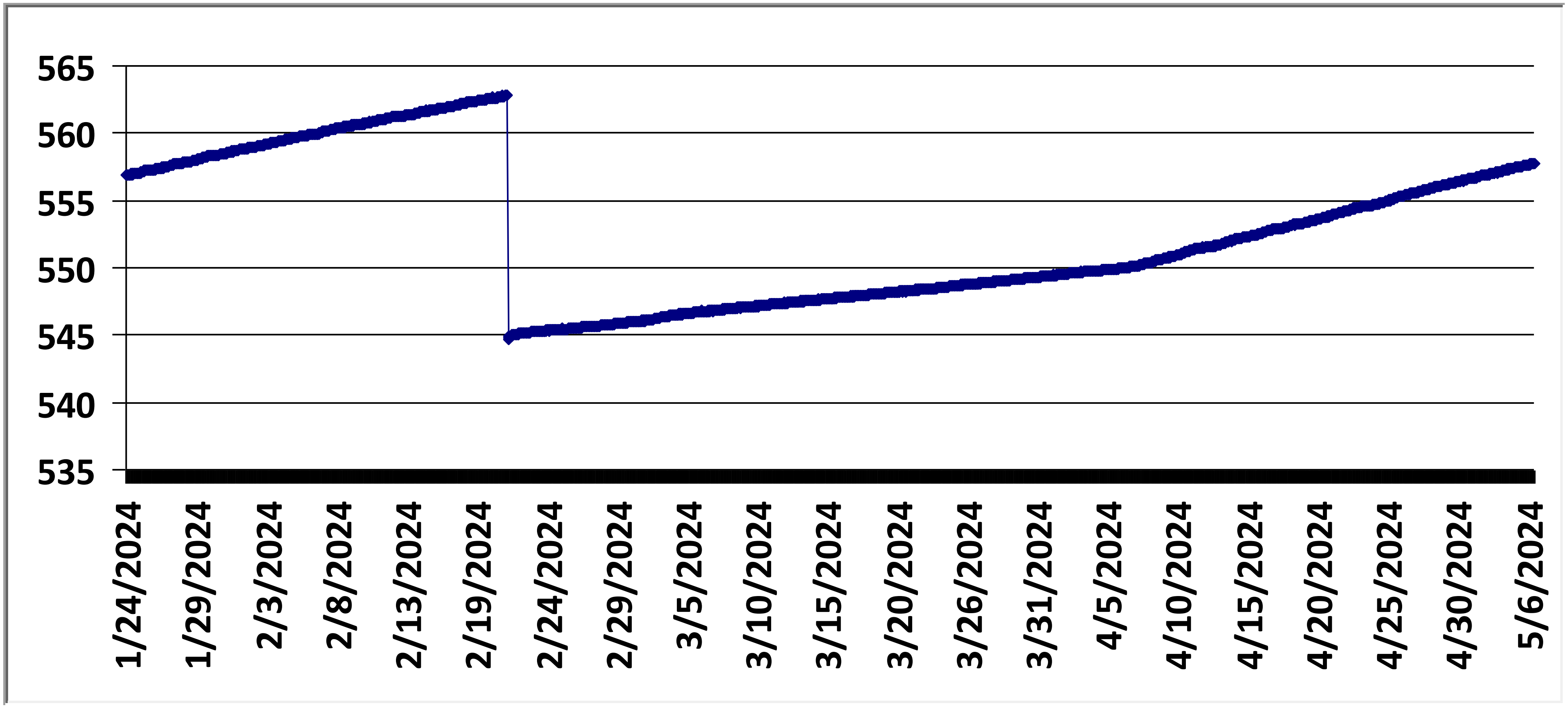


RAMBOLL

Groundwater Level Data

TIME SERIES

VER_070&D
21615620



Groundwater Level Data

TIME SERIES

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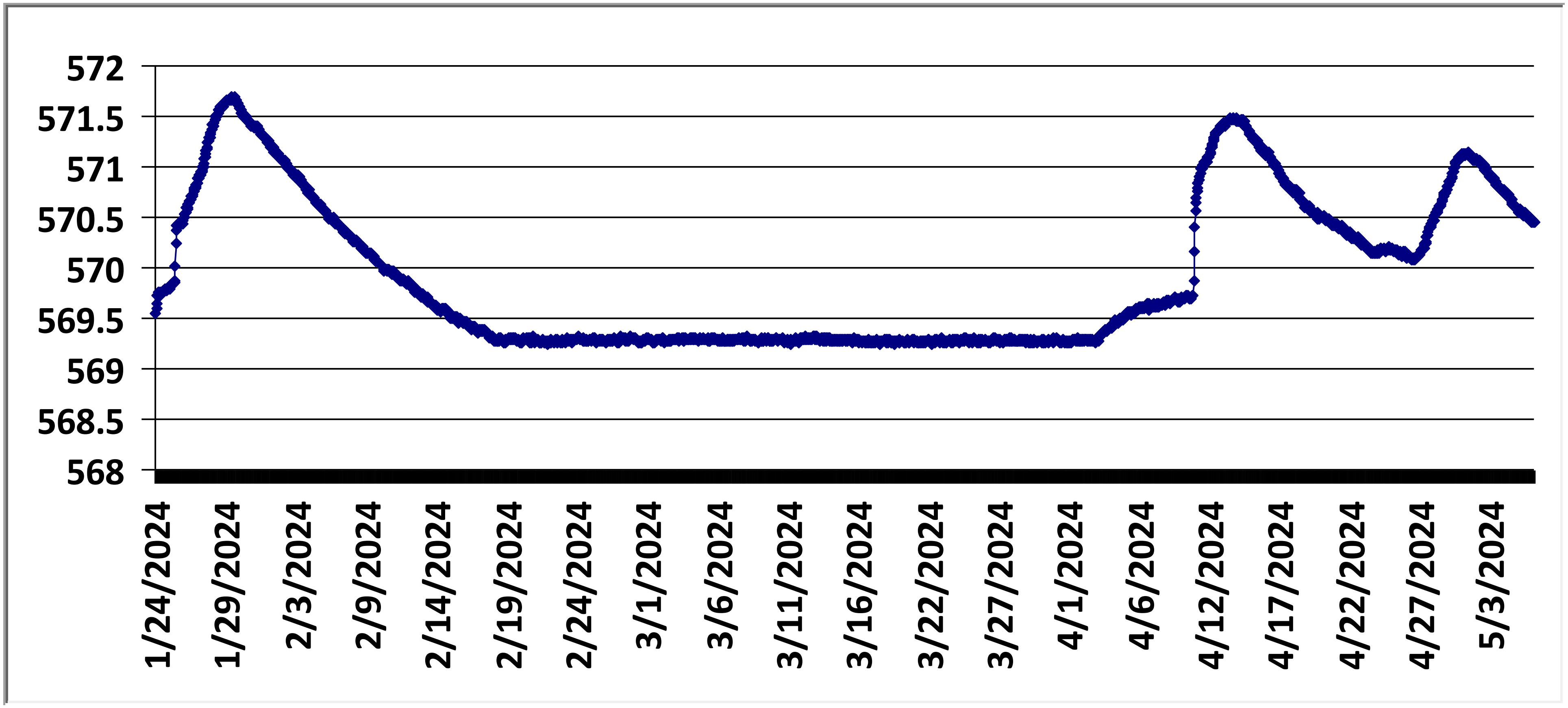


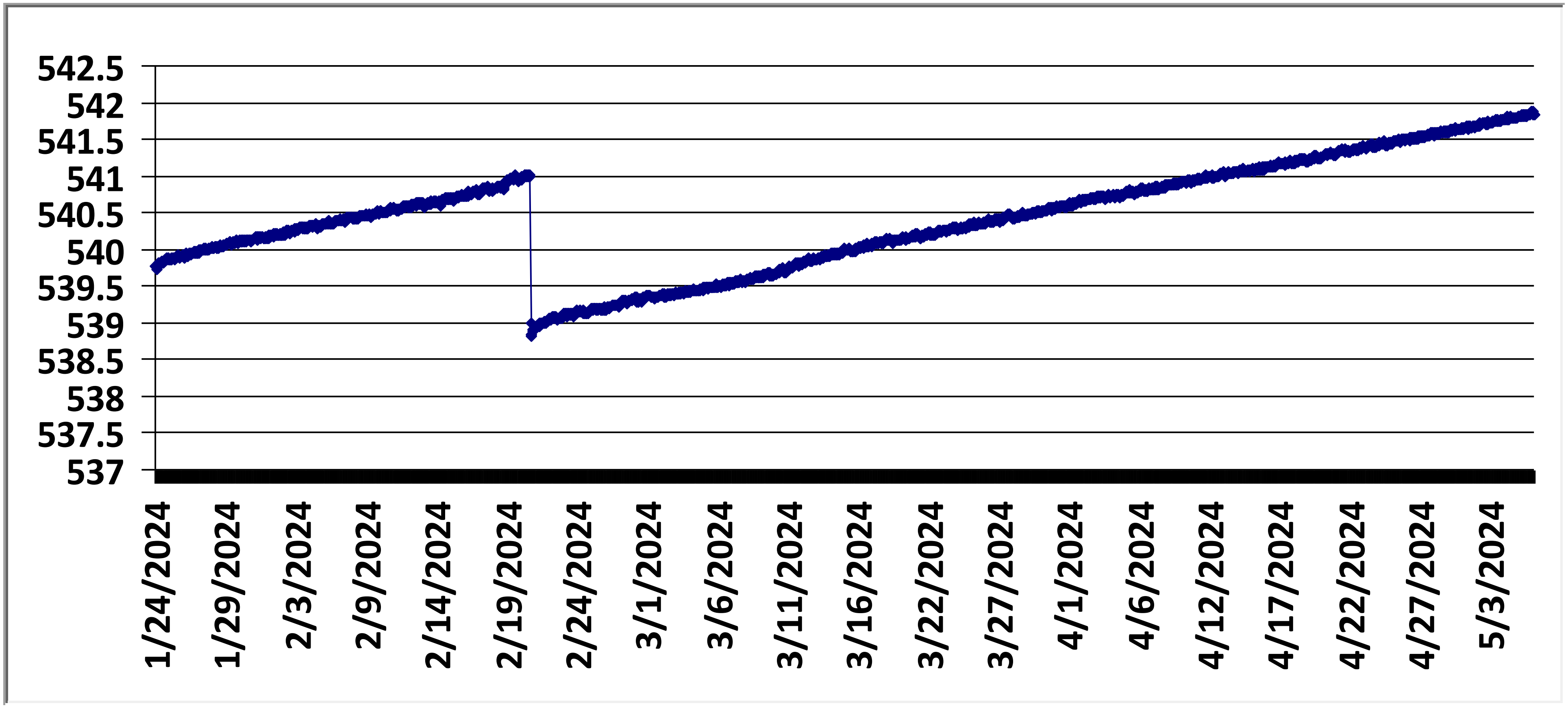
RAMBOLL

Groundwater Level Data

TIME SERIES

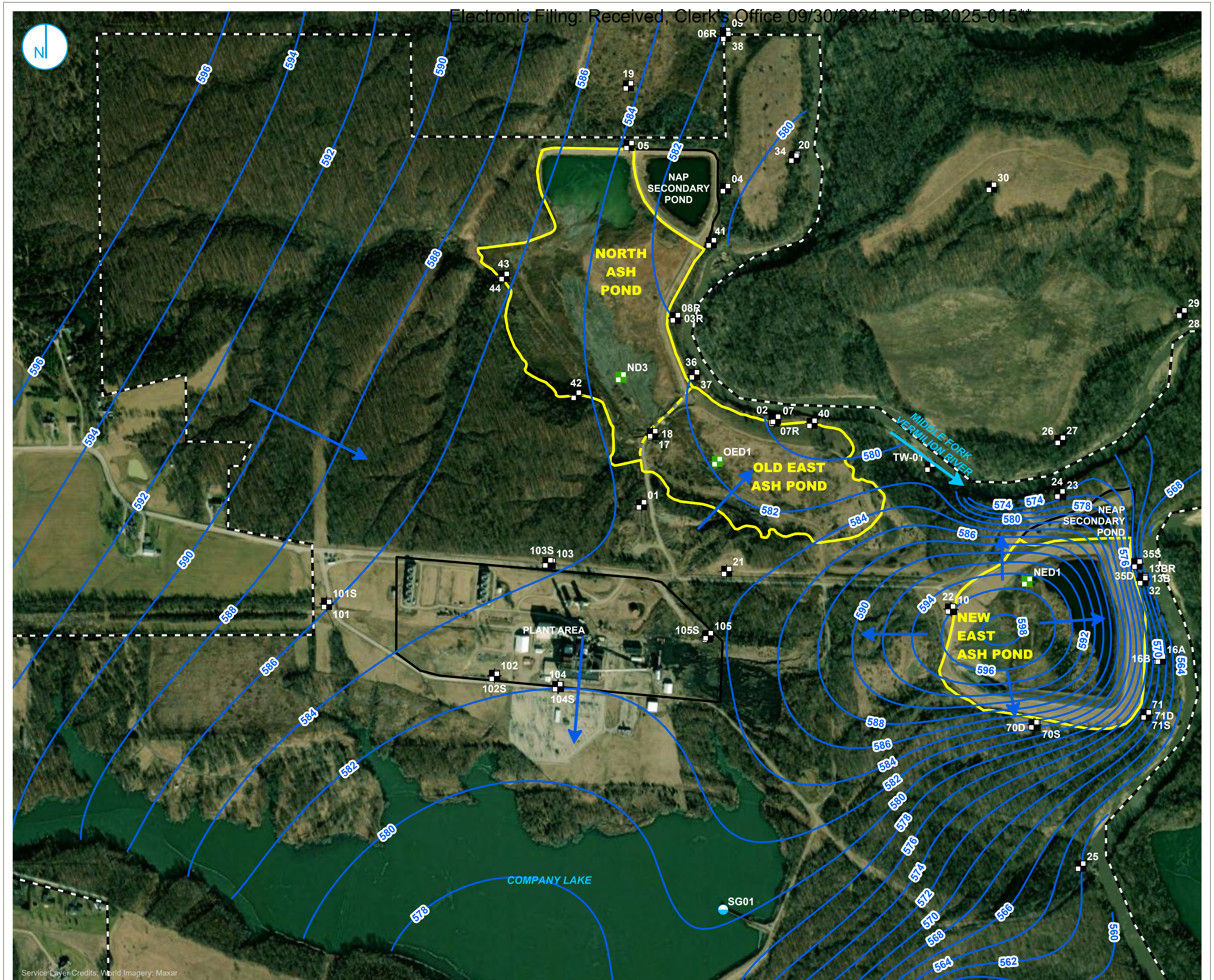
VER_07I&D

21863675



RAMBOLL	Groundwater Level Data
	TIME SERIES

APPENDIX B
SIMULATED BEDROCK CONFINING UNIT POTENTIOMETRIC SURFACE CONTOURS FROM THE JANUARY 2022 CONSTRUCTION PERMIT APPLICATION FOR THE NORTH ASH POND AND OLD EAST ASH POND



MONITORING WELL
PORE WATER WELL
STAFF GAGE, LAKE
SIMULATED POTENTIOMETRIC SURFACE ELEVATION (FEET)
GROUNDWATER FLOW DIRECTION
REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

NOTES:
1. ELEVATION CONTOURS SHOWN IN FEET, NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

0 300 600 Feet

SIMULATED BEDROCK CONFINING UNIT POTENTIOMETRIC SURFACE CONTOURS FROM THE CONSTRUCTION PERMIT APPLICATION FOR THE NORTH ASH POND AND OLD EAST ASH POND

ALTERNATIVE SOURCE DEMONSTRATION
NEW EAST ASH POND
VERMILION POWER PLANT
OAKWOOD, ILLINOIS

APPENDIX B

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

Y:\Mapping\Projects\22\2285\MXD\Alt_Source_Dem\Vermilion\NEAP_912\E004\ASD_E004.aprx\Appendix A. Simulated BCU Contours VER NAP OEAP GMR

PROJECT: 169000XXXX | DATED: 7/8/2024 | DESIGNER: GALARNMC

APPENDIX C

GEOSYNTEC CONSULTANTS, 2024. TECHNICAL MEMORANDUM: EVALUATION OF ALTERNATIVE SOURCES FOR TOTAL DISSOLVED SOLIDS WITHIN BEDROCK AQUIFER SOLIDS, VERMILION POWER PLANT - NEW EAST ASH POND. JULY 10, 2024.

Geosyntec consultants

500 W. Wilson Bridge Road, Suite 250
Worthington, Ohio 43085
PH 614.468.0421
FAX 614.468.0416
www.geosyntec.com

TECHNICAL MEMORANDUM

Date:	July 18, 2024
To:	Brian Voelker, Dynegy Midwest Generation, LLC
Copies to:	Stu Cravens and Phil Morris, Dynegy Midwest Generation, LLC Eric Tlachac and Brian Hennings, Ramboll
From:	Allison Kreinberg, Geosyntec Consultants
Subject:	Evaluation of Alternative Sources for Total Dissolved Solids within Bedrock Solids Vermilion Power Plant – New East Ash Pond

This document serves as an Appendix to the July 24, 2024, Alternative Source Demonstration (ASD) for the Vermilion Power Plant New East Ash Pond (NEAP) (Site) for the Quarter 1 2024 sampling event completed to fulfill the requirements of Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845.650(e) (VER NEAP E004 ASD).

The Q1 2024 sampling event identified an exceedance of the GWPS for TDS at monitoring well 70D (Ramboll 2024a). The statistical result for TDS at well 70D was calculated to be 1,270 mg/L, which exceeds the GWPS of 1,200 mg/L. Geosyntec Consultants, Inc. (Geosyntec) has completed a review of geochemical and geologic conditions at the Site to evaluate the elevated TDS values observed in groundwater at compliance monitoring well 70D. Using evidence from laboratory analyses, statistical evaluations, and the depositional history of the geologic units at the Site, this technical memorandum demonstrates that naturally occurring major ion concentrations associated with bedrock underlying the Site are the likely source of the TDS statistical exceedance in Site groundwater.

SITE CONDITIONS

Site geology consists primarily of unlithified alluvial and glacial deposits overlying shale bedrock that contains a major coal seam mined in the region. The alluvial deposits consist of the Cahokia Alluvium composed primarily of sand with occasional layers of silty clay and the Upper Till Unit (Wedron Formation and Glasford Formation Till) consisting of clay and silty clay with occasional sand lenses. The Cahokia Alluvium comprises the Upper Unit (UU) at the NEAP and is generally 10 to 25 feet thick. Below this unit is the Upper Confining Unit (UCU) that is comprised of the lower permeability Wedron and Glasford Formations. The UCU is of variable thickness, ranging from up to 100 feet west of the NEAP and absent east of the NEAP (Ramboll 2021).

The Bedrock Confining Unit (BCU), which is typically greater than 80 feet thick, consists of the Pennsylvanian-age Shelburn Formation, which is primarily a low permeability shale with thin limestone, sandstone, and coal beds. The top of the shale unit in the vicinity of the NEAP is described as highly weathered and decomposed. This unit contains the Danville (No. 7) Coal, which was encountered near the NEAP at approximately 80 to 100 feet below ground surface (ft bgs). Well 70D is screened within the BCU.

Additional information regarding Site hydrogeology and stratigraphy is provided in the ASD prepared by Ramboll.

NATURAL VARIABILITY OF TOTAL DISSOLVED SOLIDS

Aquifer solids samples were collected from soil borings VER-35 and VER-70 advanced in June 2023 near compliance wells 35D and 70D (**Figure 1**). Field boring logs for these soil borings are provided in **Attachment 1** and boring logs for monitoring wells 35D and 70D are provided in **Attachment 2**. Due to access limitations and health and safety considerations at the Site, the boring locations were adjusted in the field and are approximately 200-250 feet offset from the well locations. Differences in ground surface elevations and bedrock dip were considered during drilling and sample selection so that the sampled intervals correspond with the well screen interval for wells 35D and 70D. Boring locations and well screen intervals are shown in the cross sections provided in **Attachment 3**. Two samples were collected from the boring near well 35D (VER-35), and three samples were collected from the boring near well 70D (VER-70) at various depths.

Samples were submitted for analysis of mineralogy via X-ray diffraction (XRD) to determine the mineralogical components of shale samples.[1] Whole rock mineralogy results are provided in **Table 1** and **Attachment 4**. Sample mineralogy consists of quartz, mica (muscovite), feldspars (albite and microcline), iron-carbonate mineral siderite, and clay minerals (illite, chlorite, and kaolinite) (**Table 1**). Shale samples were found to contain between 43.0 to 47.4 percent (%) phyllosilicate (clay and mica) minerals by weight.

[1] Two samples from the unlithified units from VER-70 (30-40 ft bgs) and (41-42 ft bgs) are excluded from subsequent results tables and discussion to emphasize findings associated with shale lithologies in support of an assessment of naturally occurring chloride in bedrock.

Monitoring well 70D is screened within shale of the Shelburn formation. The Shelburn formation, like many of the Pennsylvanian-age deposits within the Illinois Basin, represents marine cyclic depositional sequences which feature transgressive and regressive periods that cause the deposition of interbedded sequences of sandstone, shale, and limestone (Weller 1930; Weller 1931). In such depositional environments, fine grained shales are deposited and cyclically exposed to high ionic strength marine waters which are concentrated in major cations and anions. Fine-grained marine shales specifically are known to retain these aqueous parameters for long periods, resulting in elevated concentrations of major ions in formation water (Hem 1985).

Transgression-regression cycling creates sequences in which saline marine waters saturate open pore space in these sediments, which are then retained due to the subsequent deposition of and burial by additional fine-grained sediment, trapping the marine water at the time of deposition. While the original water within the pore space is typically replaced by meteoric recharge early after deposition, the dissolved ions in the water are typically retained by membrane filtration as an effect of the phyllosilicate (clay/mica) mineralogy of the shales (Drever 1988). These clay and mica minerals are observed in all shale samples from the Site at notable quantities of 43.0 through 47.4 weight % (**Table 1**), suggesting this mechanism is applicable to groundwater at the Site. In addition to the retention of marine water within the pore space of fine-grained sedimentary rocks, deposited sediment in cyclic marine environments also may become impregnated with soluble salts like halite (crystalline sodium chloride, NaCl), sylvite (crystalline potassium chloride, KCl), or anhydrite/gypsum (crystalline calcium sulfate $CaSO_4$). These evaporites are known to be highly soluble and subject to dissolution during pore fluid evolution. Dissolution of these salts results in further increases in the concentrations of aqueous ions in pore fluid from rocks of coastal marine origin, regardless of whether the evaporite minerals are still present currently.

Well 70D contains TDS concentrations exceeding the GWPS. TDS is the summation of all dissolved constituents in a water sample, with major ions comprising the majority of TDS in most natural waters (Boyd 2019). Unlike specific parameters, TDS does not have a singular source but rather is influenced by concentrations of individual components of groundwater composition. At well 70D, chloride comprises the largest component of the TDS value, with chloride comprising 41% of TDS for well 70D (Figure A of the Ramboll ASD document).

Seeps with high naturally occurring salinity (i.e., brines) are known to occur in southern Illinois. These seeps contain relatively high concentrations of major ions such as chloride, which comprises large portions of TDS concentrations in NEAP groundwater. These seeps are known to be of geogenic origin and demonstrate the degree of variability associated with major ion chemistry in the region. Samples of seeps and shallow wells affected by brine in Illinois had highly variable chloride concentrations ranging from ~100 mg/L up to more than 30,000 mg/L at the Vermilion Salines in Kickapoo Creek State Park (Kelly et al. 2012). These observed concentrations further support the prominence of elevated naturally occurring chloride, and thus TDS, within groundwater from Pennsylvanian aquifer units in the region due to the depositional history of these units. Additional studies have documented the connection between basin brine movement along geologic structures and through permeable strata to saline seeps in alluvial material throughout the Illinois Basin, with seeps containing highly saline chemistry with TDS values in excess of 60,000 mg/L driven primarily from sodium, chloride, and sulfate concentrations (Panno et al. 2022). These studies demonstrate the degree of connectivity between highly saline basin formation waters and surficial material such as the Cahokia Alluvium. In these instances, the TDS concentrations of both Illinois Basin groundwater and water within alluvial material (which combined comprise the groundwater beneath the NEAP) in the area contain elevated TDS values that are associated with natural salinity derived from the depositional history of strata in the region.

STATISTICAL EVALUATION OF GROUNDWATER COMPOSITION

Advanced statistical analyses were employed to evaluate the similarity or dissimilarity among different groundwater samples or groups based on a broad suite of analytes. Dimensional reduction techniques, such as principal component analysis (PCA), are especially effective in identifying the analytes responsible for statistical differences between samples and revealing underlying patterns related to environmental factors, contamination sources, or other natural characteristics of the Site. Clustering methods were further utilized to group samples based on their combined chemical composition through maximizing intra-group similarity.

PCA is often used to simplify large datasets with multiple variables by creating new uncorrelated variables known as principal components (PCs). The PCs are linear combinations of the original variables; the first few PCs typically capture most of the variation within the dataset. Factor loadings are calculated based on the correlation between PCs and the original variables. As such, variables with notably higher positive or negative factor loadings are main drivers of similarity or dissimilarity and clustering of samples. Factor scores are calculated based on the correlation between the chemical composition of each sample and the PCs. Samples with similar chemical compositions show similar factor scores and tend to cluster together on a PCA plot.

In this study, the dataset used for PCA included 90 groundwater samples collected in 2021, 2023 and 2024 from upgradient wells (10 and 22), downgradient wells (70S, 71S, 70D, 71D, 16A, and 35D), and a NEAP porewater wells (NED1), ND3 and OED1).[2] Samples were also included from two porewater wells associated with the Old East Ash Pond/North Ash Pond (OEAP/NAP) CCR unit (ND3, OED1) to evaluate the potential influence of the OEAP/NAP on groundwater

[2] Analytes included in this PCA include alkalinity, boron, calcium, pH, barium, chloride, and fluoride. The complete dataset used for PCA analysis is provided with this submission as **Attachment 5**.

composition at NEAP downgradient well 70D. The CCR porewater chemistry from both the NEAP and OEAP/NAP is significantly different from that of the monitoring wells (e.g., boron concentration in porewater was 28.73 ± 12.19 mg/L compared to 2.02 ± 4.24 mg/L in the rest of the wells). Therefore, the total variability in the dataset is expected to be dominated by the greater variance of CCR signatures between pore water and the rest of the wells, potentially obscuring the variabilities in samples from monitoring wells. As such, two parallel scenarios – one with and one without porewater samples - were evaluated.

The results from the evaluation with porewater are discussed first and shown in **Figures 2 to 4**. PCA requires that input variables have similar scales of measurement and variances. As such, data were standardized by mean-centering and scaling to unit variance prior to performing PCA. Data were further square transformed to reduce the skewness of dataset. The fraction of total variation explained by each PC is shown in **Figure 2a**, with the first two PCs accounting for approximately 85% of the total variation in the datasets. Additionally, the quality of representation of each variable by the first two PCs is presented in **Figure 2b**. As illustrated in the figure, the first dimension is dominated by calcium, bicarbonate alkalinity, and boron, while the second dimension is dominated by chloride and barium.

PCA results are often visualized using biplots where samples are projected on the first two PCs (i.e., factor scores), and factor loadings are represented as vectors. The closer the data points are on the graph, the greater the similarity in their chemical composition. The result from this study is shown on **Figure 3**, where the samples acquired from the BCU are orange, UCU and UU samples are shades of blue, and the porewater samples are gray. The biplot suggests that porewater samples cluster separately from the groundwater samples in all hydrostratigraphic units (i.e., BCU, UCU, and UU samples). The factor loadings, represented as vectors on the biplot, suggest that constituents such as boron and calcium are responsible for the chemical signature of the porewater cluster.

Clustering was further explored using Ward's hierarchical clustering method, a distance measure employed in agglomerative algorithms and commonly applied in hydrogeochemical studies. The analysis was performed on a scaled and centered dataset. The results from clustering (**Figure 4**), align with findings from the PCA (**Figure 3**). Both PCA and clustering analysis supported the distinction between porewater samples and groundwater samples from both downgradient and upgradient locations.

The results of the evaluation without porewater samples included are shown in **Figures 5 to 7**. In this scenario, the first two principal components captured approximately 76% of total variance (**Figure 5a**), with fluoride and chloride dominating the first dimension and bicarbonate alkalinity dominating the second dimension (**Figure 5b**). The biplot is presented on **Figure 6**, which shows that the BCU samples are clustered separately from the combined UCU and UU samples. Clustering was also performed for this second analysis, as shown in **Figure 7**, with the results indicating upgradient and downgradient samples from the BCU cluster separately from the combined UCU and UU samples. This PCA analysis and clustering suggested that lithology is the main driver for the chemistry of groundwater samples. Overall, the results of the PCA and clustering analyses from different scenarios support the conclusion that the TDS exceedance at 70D is not attributed to the CCR unit and instead the groundwater geochemistry is influenced primarily by the native lithology.

Due to anomalously high sulfate concentrations in well 35D (Ramboll 2023), sulfate and TDS were excluded from both multivariate analyses described above. Two additional scenarios which included sulfate and TDS but exclude 35D samples are presented in **Attachment 6**. As before, the evaluation included one analysis with porewater samples and one without porewater samples included. The findings were consistent with the multivariate analyses described, in that groundwater composition is influenced by native lithology.

CONCLUSION

TDS concentrations at well 70D were determined to be the result of naturally occurring chloride. The TDS and chloride concentrations are likely from original formation water in the aquifer unit which contains notable major ion concentrations sourced from the depositional conditions of the BCU. XRD analysis of solid phase samples collected near BCU wells 35D and 70D identified abundant micas and clay minerals hosted in the shale bedrock that facilitate the retention of elevated concentrations of major ions resulting from depositional conditions, such as chloride. Advanced statistical methods demonstrate that groundwater geochemical signatures from the BCU, the UCU, and the UU are distinctly different from that of the porewater based on a combination of parameters.

This information serves as the written ASD demonstrating that the GWPS exceedance of TDS at well 70D is not due to the NEAP CCR unit.

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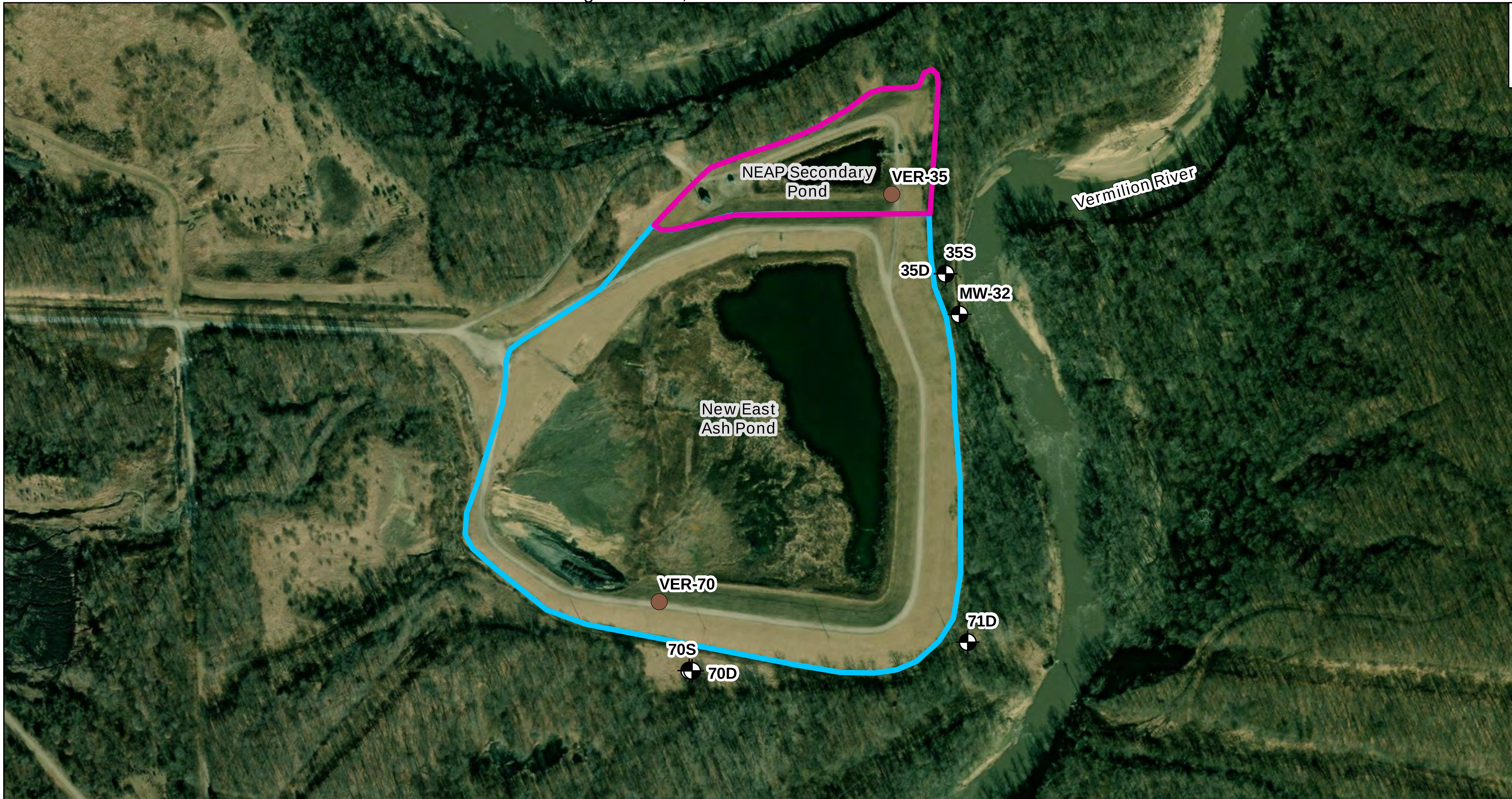
TABLES

Table 1 - Summary of X-Ray Diffraction Analysis
Vermillion Power Plant - New East Ash Pond

Field Boring Location			**VER-35**	**VER-35**	**VER-70**
Sample Depth (ft bgs)			**(55-60)**	**(60-63)**	**(75-80)**
Location			**Downgradient**	**Downgradient**	**Downgradient**
Field Boring Log Description			**Weathered Shale**	**Highly Weathered Shale**	**Highly Weathered Shale**
Mineral/Compound	**Formula**	**Mineral Type**	**(wt %)**	**(wt %)**	**(wt %)**
Quartz	SiO_2	Silicate	38.5	38.1	35.0
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	Mica	23.4	23.0	27.0
Albite	$NaAlSi_3O_8$	Feldspar	12.6	12.6	11.5
Illite	$K(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH)_2$	Clay	7.1	8.0	5.2
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$	Clay	6.9	6.8	7.7
Kaolinite	$Al_2Si_2O_5(OH)_4$	Clay	5.6	5.4	7.5
Siderite	$FeCO_3$	Carbonate	4.9	5.0	5.4
Microcline	$KAlSi_3O_8$	Feldspar	1.0	1.1	0.70
Clay Minerals Total			19.6	20.2	20.4
Clays + Muscovite Total			43.0	43.2	47.4

Notes
Sample depth is shown in feet below ground surface (ft bgs).
wt %: percentage by weight

FIGURES



Legend
- Monitoring Well
- Boring Location
- New East Ash Pond (NEAP)
- NEAP Secondary Pond

Notes
- Soil boring locations are approximate.
- Only select monitoring well locations are shown.
- Ash pond boundaries are approximate.

250 125 0 250 Feet

Boring Locations

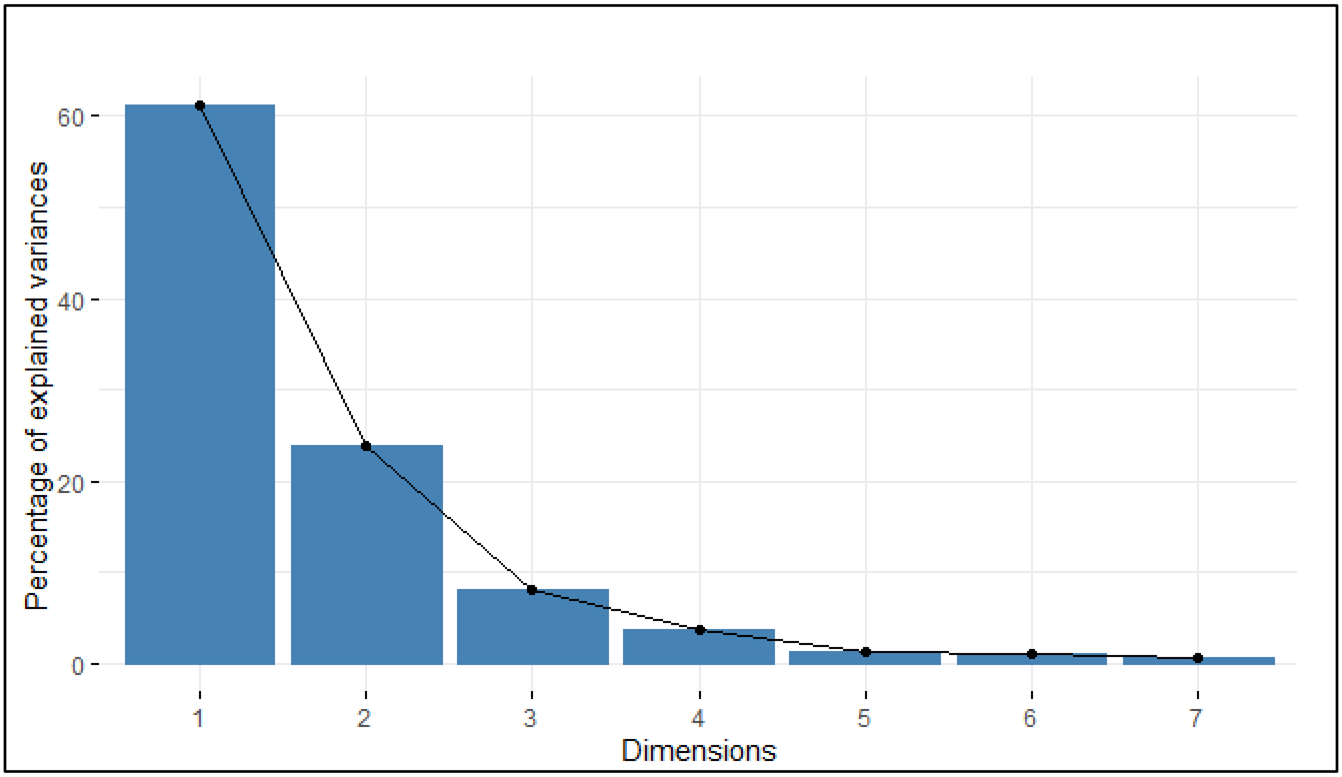
Dynegy Midwest Generation
Vermilion Site
Oakwood, Illinois

Geosyntec consultants

Columbus, Ohio | April 2024

Figure 1

Y:\Company\Projects_post_2014\CHE8404_VPS_Closure_RIA_Sprt\500 - Technical\572 - MNA and GSI Evaluation\GIS\MXDs\20231020_Figure 1-Boring_Locations.mxd. ASoltero. 4/16/2024. Project/Phase/Task.



Notes:
1. Samples collected from upgradient wells 10 and 22, downgradient wells 70S, 71S, 16A, 35D, 70D, and 71D, and porewater wells NED1, ND3 and OED1 were included in the evaluation.

PCA Analysis - Quality of Representation of Principal Components
Vermilion Power Plant – New East Ash Pond

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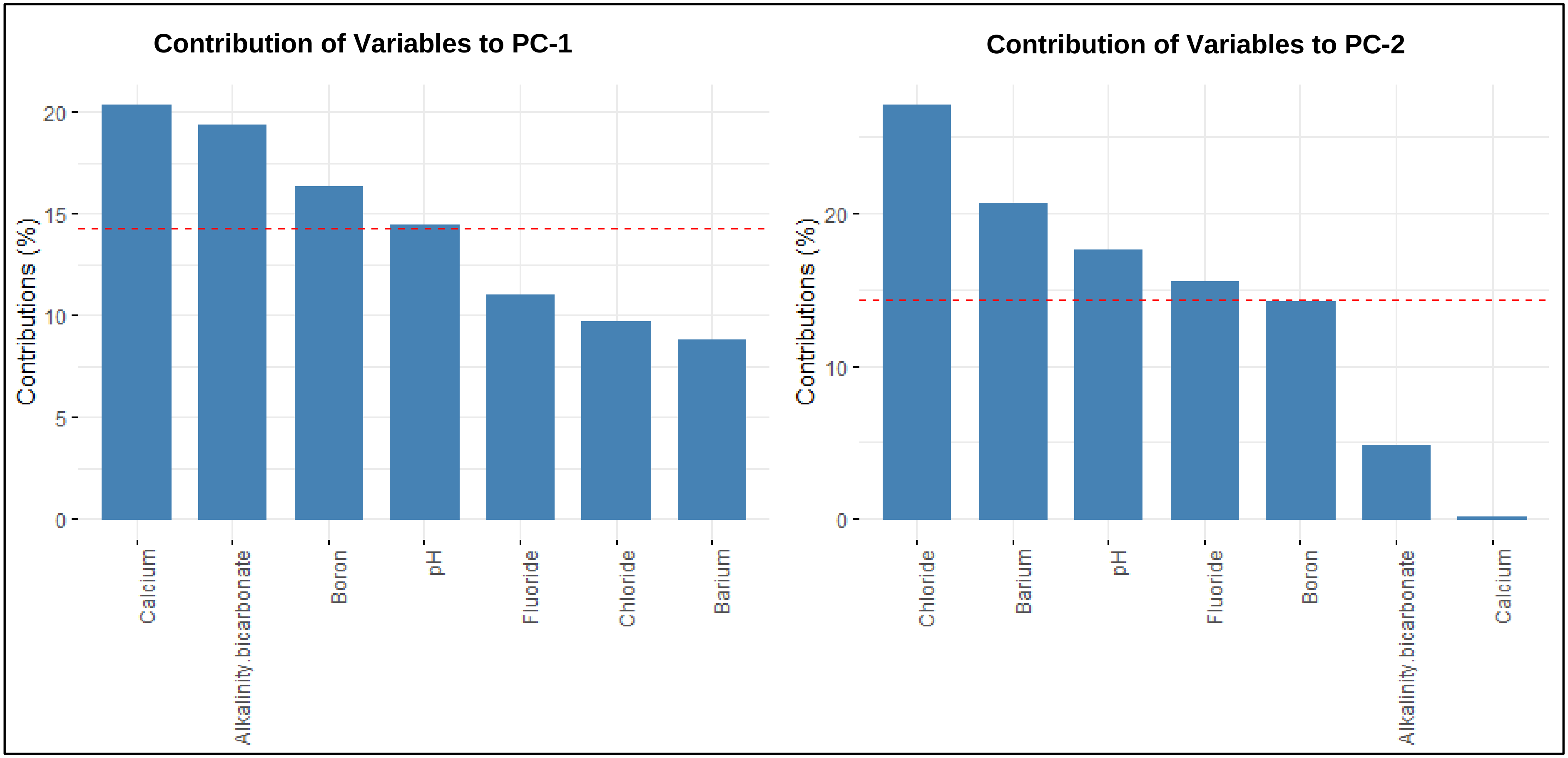
Columbus, Ohio | July 2024

Figure **2a**



Notes:
1. The dashed red line represents the anticipated value for uniform contribution. The constituents with a contribution exceeding the reference line are considered significant in its contribution to each PC (principal component).

Contribution of Variables to First Two Principal Components

Vermilion Power Plant – New East Ash Pond

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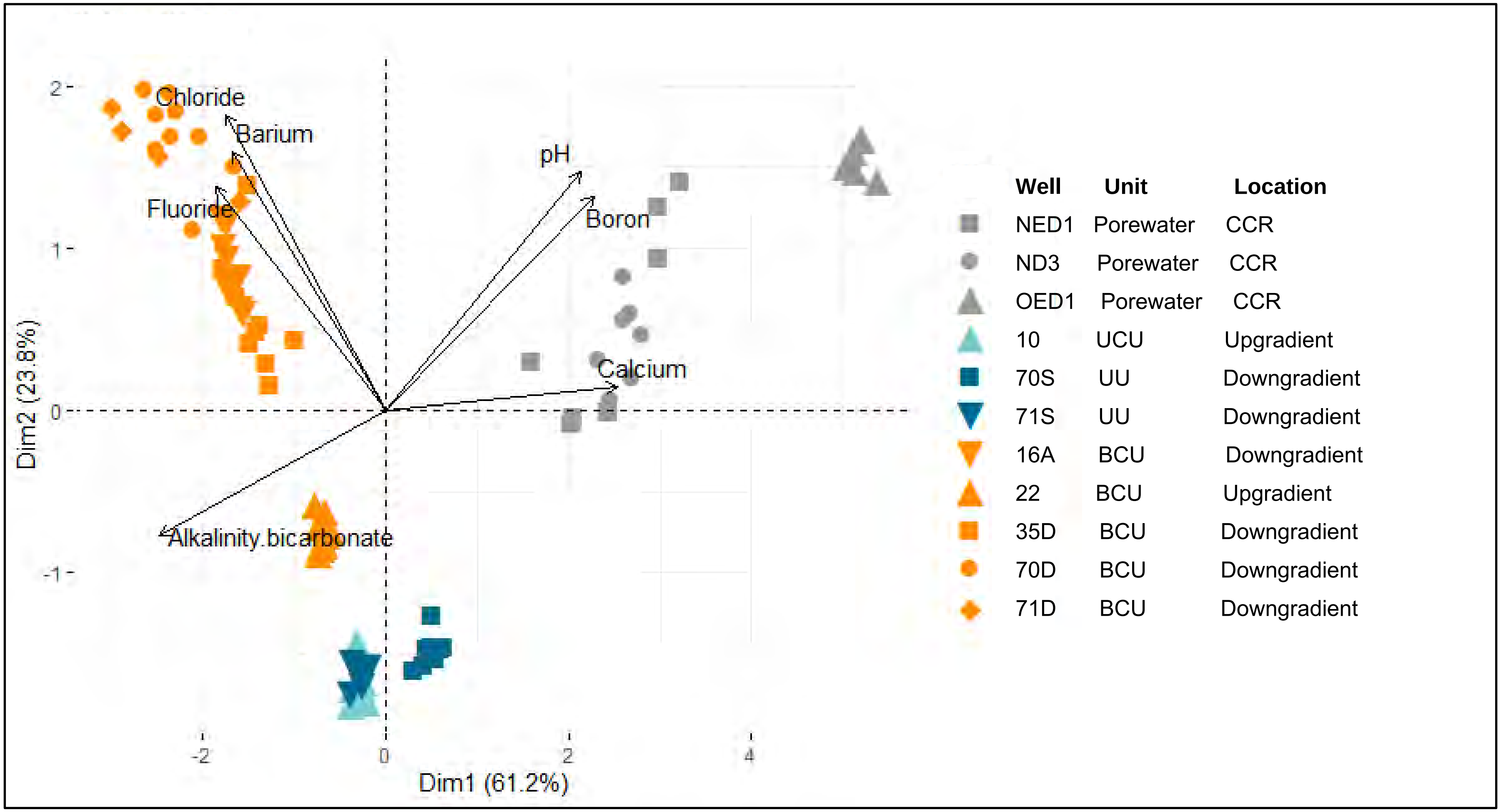
Figure **2b**

Columbus, Ohio	July 2024



Notes:
1. The arrows signify the correlations between the constituents and the principal components.
2. Datapoints are colored based on hydrostratigraphic unit of sampling locations as follows:
   - Bedrock Confining Unit (BCU) wells: 16A, 22, 35D, 70D, 71D.
   - Upper Confining Unit (UCU) well: 10.
   - Upper Unit (UU) wells: 70S, 71S.
   - Coal Combustion Residual (CCR) wells: NED1, ND3, OED1.

Principal Components Analysis Biplot

Vermilion Power Plant – New East Ash Pond

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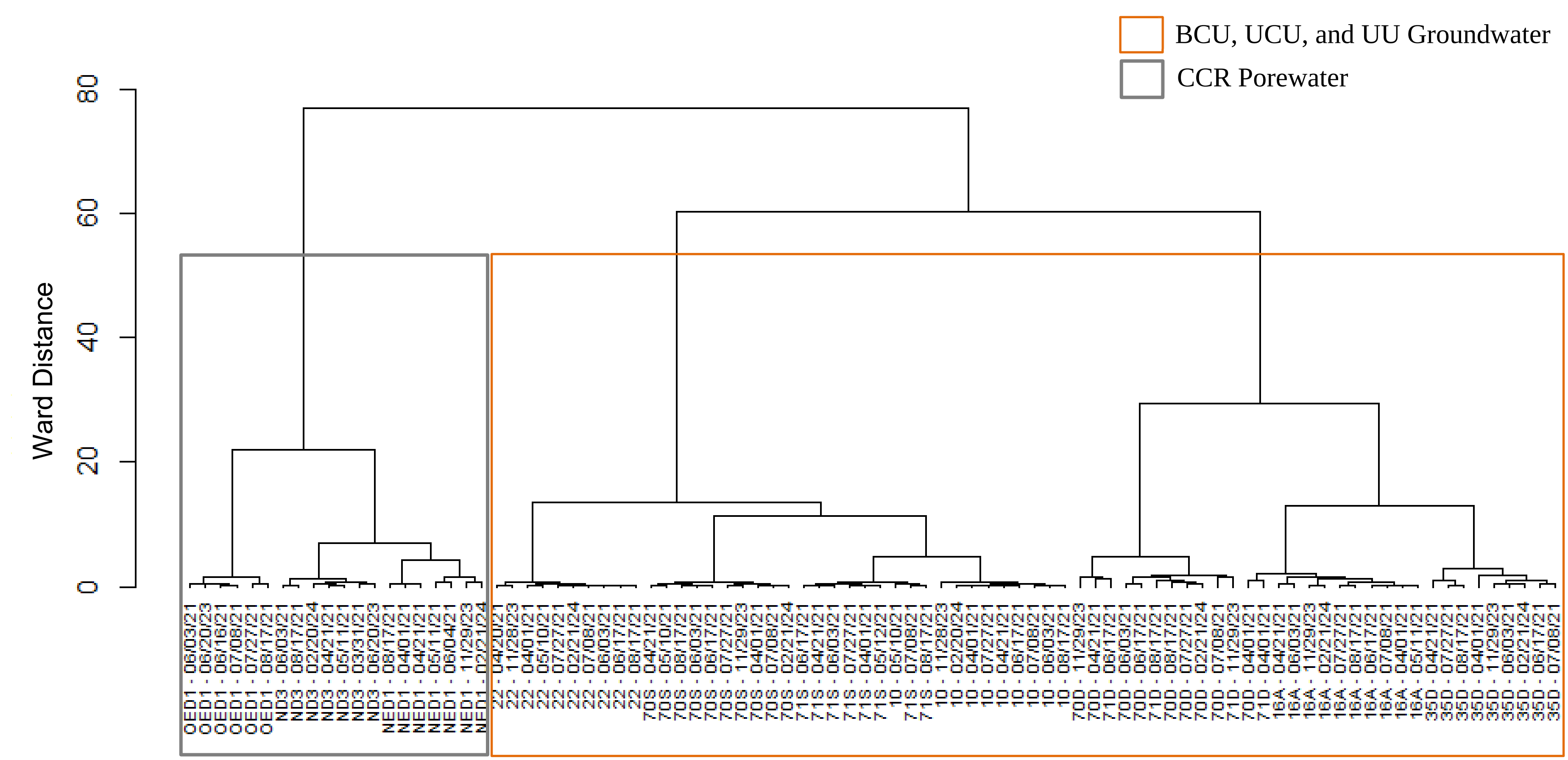
Figure 3



Notes:
1. The cluster analysis used Euclidean distances, and Ward's method as the clustering algorithm.
2. In the dendrogram, samples on the same branch are more similar to each other. The samples with the highest similarity are on the closest branches.
3. The boxes around the branches represent the two clusters into which samples from each source grouped.
4. BCU, CCR, UCU and UU refer to Bedrock Confining Unit, Coal Combustion Residual, Upper Confining Unit, and Upper Unit, respectively.

Dendrogram Graph from Cluster Analysis
MW-35 Excluded

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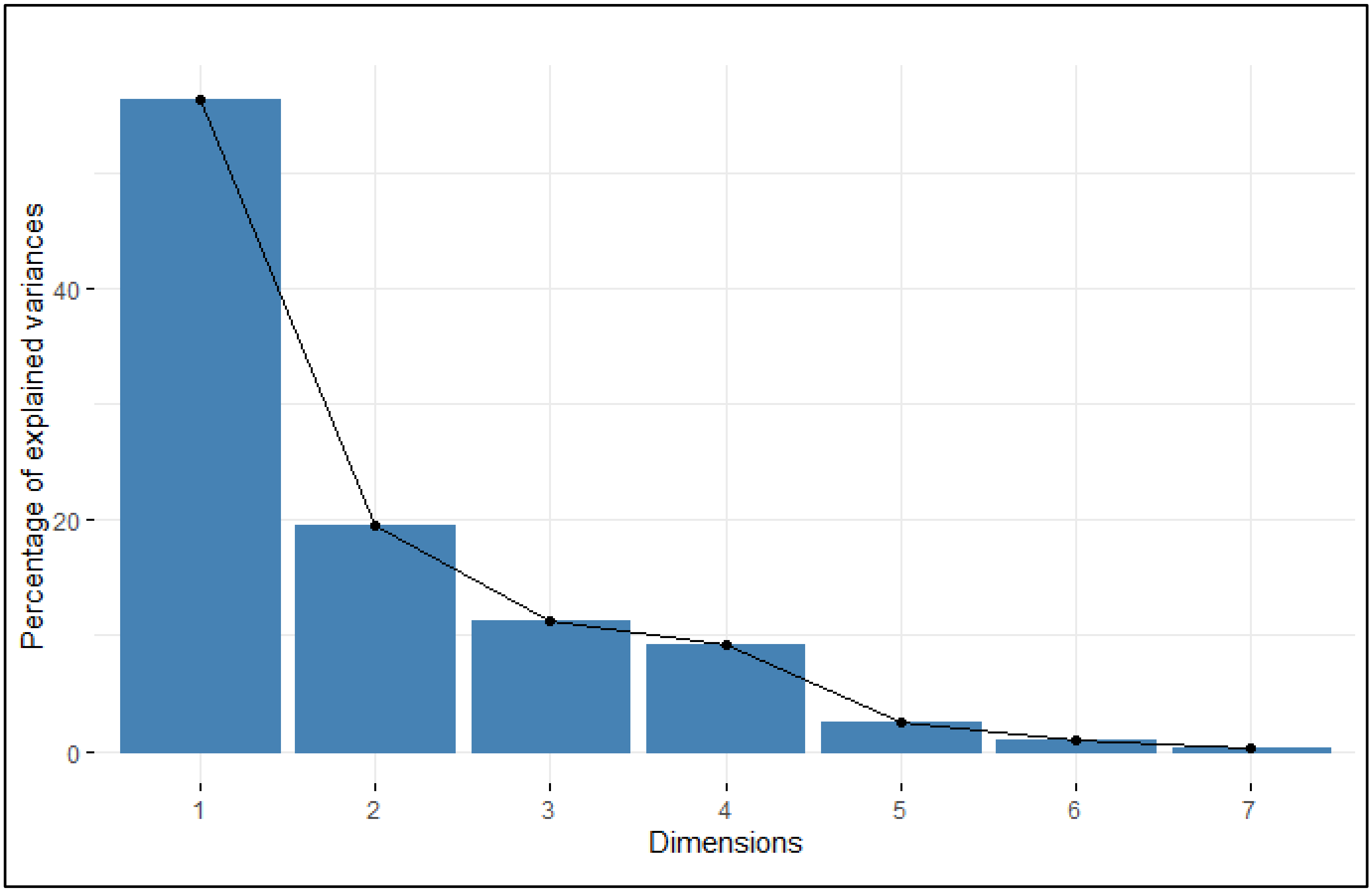
Figure **4**



Notes:
1. Samples collected from upgradient wells 10 and 22 and downgradient wells 70S, 71S, 16, 35D, 70D, and 71D were included in the evaluation.

PCA Analysis - Quality of Representation of Principal Components (Porewater Excluded)
Vermilion Power Plant – New East Ash Pond

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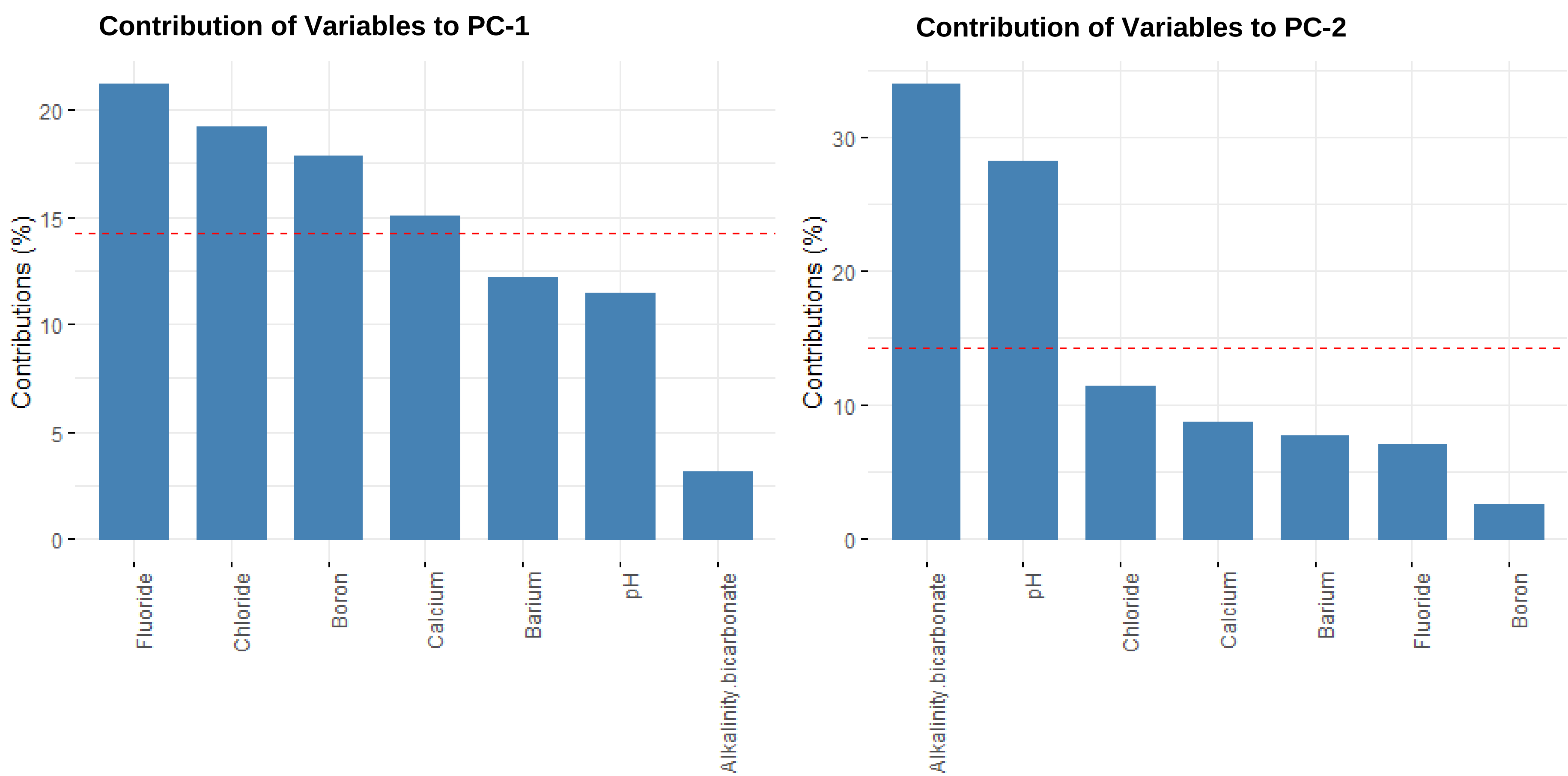
Figure 5a



Notes:
1. The dashed red line represents the anticipated value for uniform contribution. The constituents with a contribution exceeding the reference line are considered significant in its contribution to each PC (principal component).

Contribution of Variables to First Two Principal Components (Porewater Excluded)
Vermilion Power Plant – New East Ash Pond

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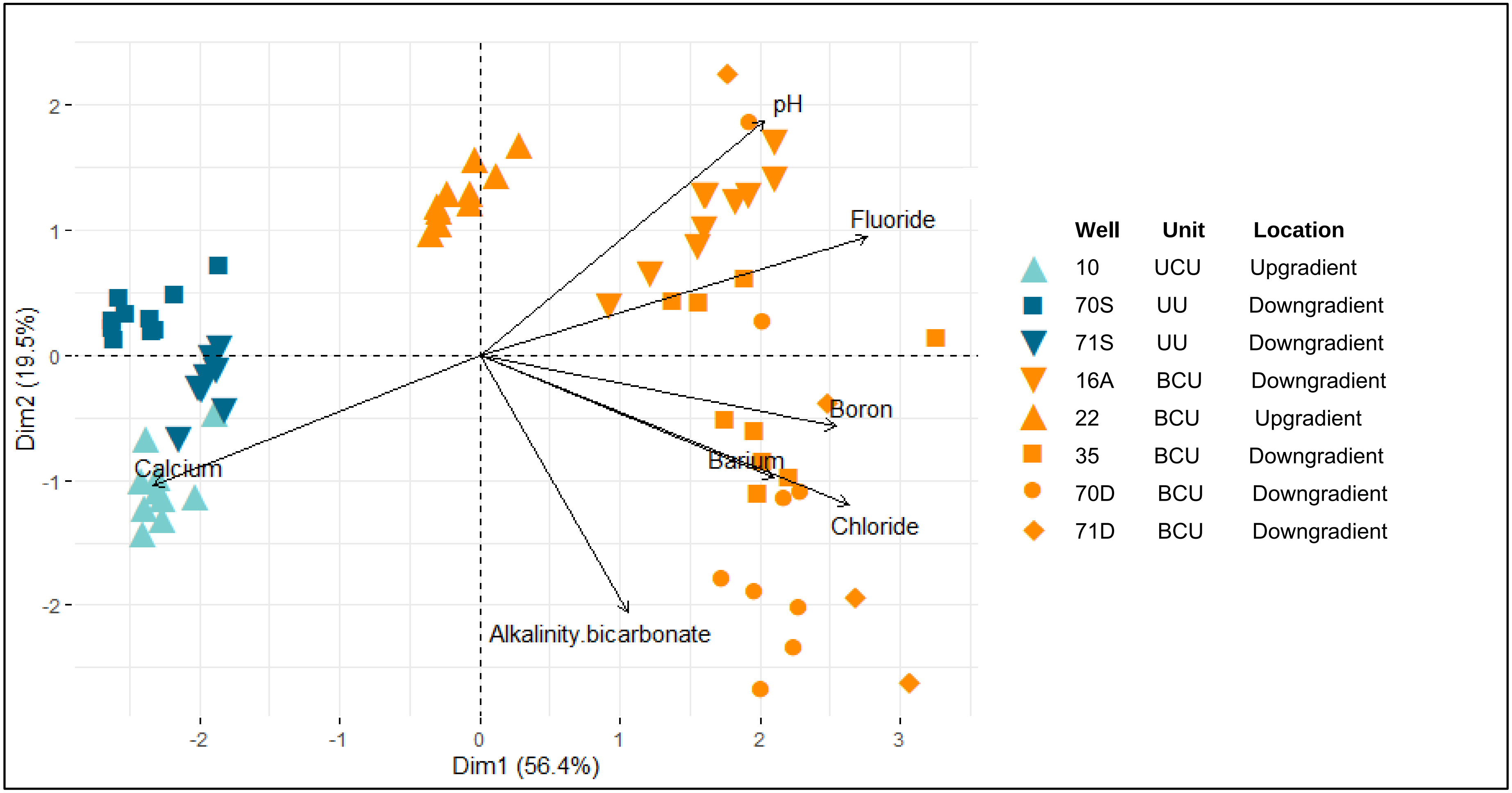
Figure
5b



Notes:
1. The arrows signify the correlations between the constituents and the principal components.
2. Datapoints are colored based on hydrostratigraphic unit of sampling locations as follows:
   - Bedrock Confining Unit (BCU) wells: 16A, 22, 35D, 70D, 71D.
   - Upper Confining Unit (UCU) well: 10.
   - Upper Unit (UU) wells: 70S, 71S.

Principal Components Analysis Biplot
(Porewater Excluded)
Vermilion Power Plant – New East Ash Pond

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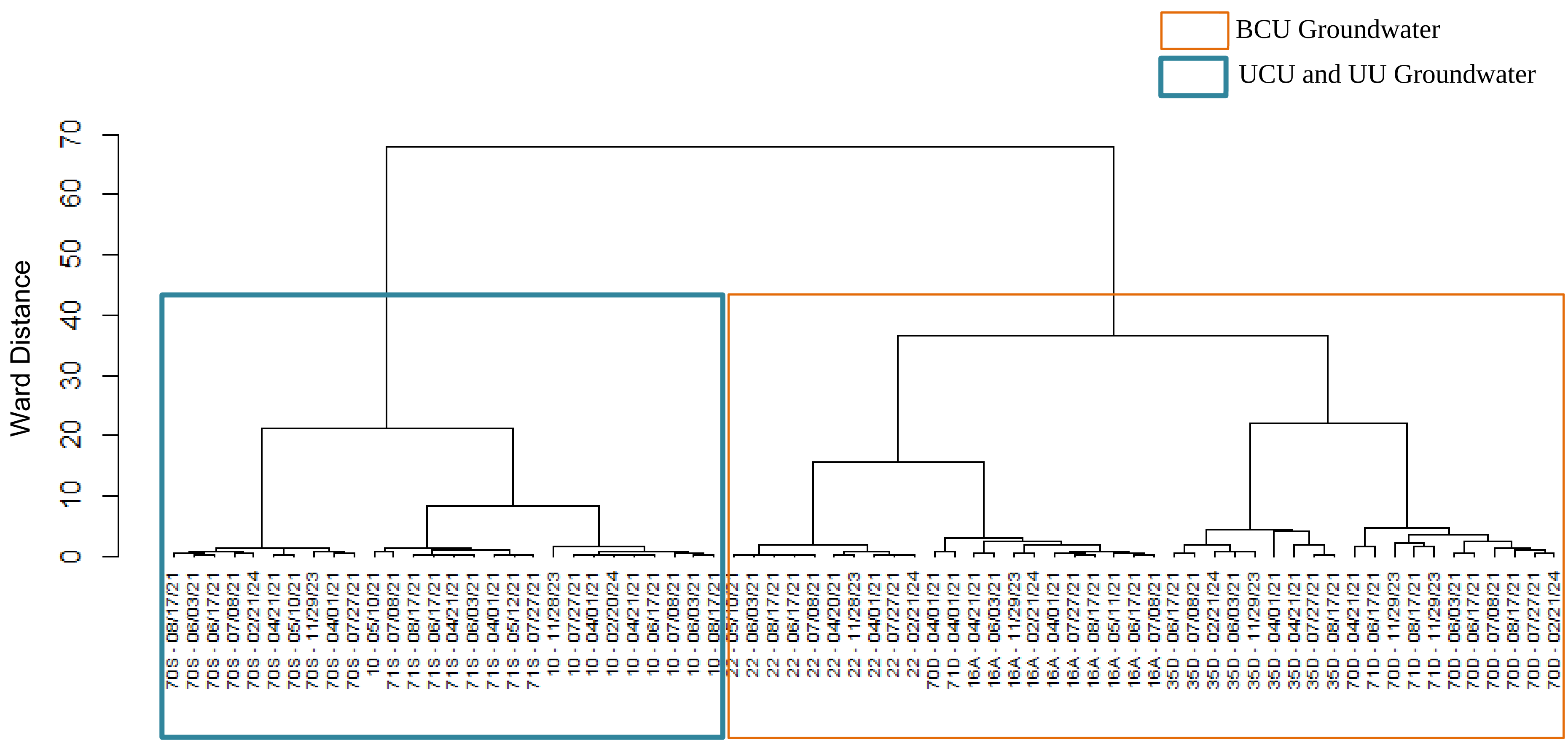
Figure **6**

Columbus, Ohio | July 2024



Notes:
1. The cluster analysis used Euclidean distances, and Ward's method as the clustering algorithm.
2. In the dendrogram, samples on the same branch are more similar to each other. The samples with the highest similarity are on the closest branches.
3. The boxes around the branches represent the two clusters into which samples from each source grouped.
4. BCU, UCU and UU refer to Bedrock Confining Unit, Upper Confining Unit, and Upper Unit, respectively.

Dendrogram Graph from Cluster Analysis (Porewater Excluded)
Vermilion Power Plant – New East Ash Pond

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Figure **7**

Columbus, Ohio | July 2024

ATTACHMENT 1

Field Boring Logs

Geosyntec consultants — engineers | scientists | innovators	Client: Vistra Project: Vermilion Power Plant New East Ash Pond Address: 10188 East 2150 North Road, Oakwood, IL	**BORING LOG** Boring No. VER-35 Page: 1 of 4

Drilling Start Date:	**06/24/2023**	Boring Depth (ft):	**63**
Drilling End Date:	**06/24/2023**	Boring Diameter (in):	**6**
Drilling Company:	**Cascade Drilling**	Ground Surface Elev. (ft):	**Not surveyed**
Drilling Method:	**Sonic**	Boring was advanced adjacent to well 35D. Samples collected from 55-60 ft bgs and 60-63 ft bgs	
Drilling Equipment:	**Geoprobe**		
Driller:	**Jeff Jehn**		
Logged By:	**Andrew Kelley**		

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	Date & Time	Blow Counts	Recovery (ft)	SOIL/ROCK VISUAL DESCRIPTION
0					10:35	NA	5.1/10	(0') GRAVELLY SILT (ML); light gray to brown (darkens downward), dry, loose, little sand, minor concretions.
3								(3') CLAYEY SILT (ML); dark reddish brown, moist, firm, some black organics staining, few gravel, minor iron oxide stains.
10					10:45		2.5/10	(10') As above.
10.6								(10.6') GRAVELLY SILT (ML); light gray to brown, moist, loose, fine to coarse gravel, little sand.
11.6								(11.6') SILTY CLAY (CL); dark grayish brown, moist, stiff, medium plasticity.
20								

NOTES:

Geosyntec consultants	Client: Vistra	BORING LOG
engineers | scientists | innovators	Project: Vermilion Power Plant New East Ash Pond	Boring No. VER-35
	Address: 10188 East 2150 North Road, Oakwood, IL	Page: 2 of 4

Drilling Start Date:	**06/24/2023**	Boring Depth (ft):	**63**
Drilling End Date:	**06/24/2023**	Boring Diameter (in):	**6**
Drilling Company:	**Cascade Drilling**	Ground Surface Elev. (ft):	**Not surveyed**
Drilling Method:	**Sonic**	Boring was advanced adjacent to well 35D. Samples collected from 55-60 ft bgs and 60-63 ft bgs	
Drilling Equipment:	**Geoprobe**		
Driller:	**Jeff Jehn**		
Logged By:	**Andrew Kelley**		

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	SOIL/ROCK VISUAL DESCRIPTION
20					10:55	NA	8/8	(20') CLAY (CL); gray to light brown, moist, very soft, trace coarse gravel, high plasticity.
								(22.3') WEATHERED SHALE, gray, moist, highly decomposed, moderately disintegrated.
25								
							2/2	(28') As above.
30					11:55		8/10	(30') SHALE, gray, wet, highly decomposed, slightly disintegrated.
35								(35.3') WEATHERED SHALE, gray, moist, highly decomposed, highly disintegrated.
40								

NOTES:

Client:	Vistra
Project:	Vermilion Power Plant New East Ash Pond
Address:	10188 East 2150 North Road, Oakwood, IL

BORING LOG
Boring No. VER-35

Drilling Start Date:	**06/24/2023**
Drilling End Date:	**06/24/2023**
Drilling Company:	**Cascade Drilling**
Drilling Method:	**Sonic**
Drilling Equipment:	**Geoprobe**
Driller:	**Jeff Jehn**
Logged By:	**Andrew Kelley**

Boring Depth (ft):	**63**
Boring Diameter (in):	**6**
Ground Surface Elev. (ft):	**Not surveyed**

Boring was advanced adjacent to well 35D.
Samples collected from 55-60 ft bgs and 60-63 ft bgs

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	SOIL/ROCK VISUAL DESCRIPTION
40					12:10	NA	2/2	(40') As above.
					13:20		4/5	(42') WEATHERED SHALE, gray, moist, highly decomposed, highly disintegrated.
45								
					13:40		3.3/4	(47') As above.
50								
					14:05		3/4	(51') As above: slightly decomposed, competent at 1.5-1.6 ft.
55					14:20		4/5	(55') As above: slightly less weathered.
60								

NOTES:

Geosyntec consultants
engineers | scientists | innovators

Client:	Vistra
Project:	Vermilion Power Plant New East Ash Pond
Address:	10188 East 2150 North Road, Oakwood, IL

BORING LOG
Boring No. VER-35

Drilling Start Date:	**06/24/2023**
Drilling End Date:	**06/24/2023**
Drilling Company:	**Cascade Drilling**
Drilling Method:	**Sonic**
Drilling Equipment:	**Geoprobe**
Driller:	**Jeff Jehn**
Logged By:	**Andrew Kelley**
Boring Depth (ft):	**63**
Boring Diameter (in):	**6**
Ground Surface Elev. (ft):	**Not surveyed**

Boring was advanced adjacent to well 35D.
Samples collected from 55-60 ft bgs and 60-63 ft bgs

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	SOIL/ROCK VISUAL DESCRIPTION
60					14:50	NA	2/3	(60') As above: gray, moist, highly decomposed, highly disintegrated, few fragments are slightly more competent.
								(63') End of Boring.
65								

NOTES:

Drilling Start Date:	**06/23/2023**	Boring Depth (ft):	**80**
Drilling End Date:	**06/23/2023**	Boring Diameter (in):	**6**
Drilling Company:	**Cascade Drilling**	Ground Surface Elev. (ft):	**Not surveyed**
Drilling Method:	**Sonic**		
Drilling Equipment:	**Geoprobe**		
Driller:	**Jeff Jehn**		
Logged By:	**Andrew Kelley**		

Boring was advanced adjacent to well 70D.
Samples collected from 30-40 ft bgs, 41-42 ft bgs and 75-80 ft bgs

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	Sample Type	Date & Time	Blow Counts	Recovery (ft)	SOIL/ROCK VISUAL DESCRIPTION
0					10:40	NA	6/10	(0') SILT WITH GRAVEL (ML); light brown, dry, loose, fine to coarse gravel.
								(1') SILT (ML); brown to tan, dry, firm, moderate concretions, little gravel, few clay.
								(3.6') SILT (ML); gray to dark gray with little brown, dry, firm, few fine sand, few fine gravel, coarsens downwards, moderate concretions.
5								
10					10:55		4/10	(10') SILTY GRAVEL (GM); gray to dark gray, moist, loose, some fine to coarse sand.
								(10.5') SILTY GRAVEL (GM); light gray, moist, loose, fines downward.
								(12') SANDY SILT (ML); brown, moist, medium dense, firm, little clay, little fine gravel.
15								
20								

NOTES:

Geosyntec consultants
engineers | scientists | innovators

Client: Vistra
Project: Vermilion Power Plant New East Ash Pond
Address: 10188 East 2150 North Road, Oakwood, IL

BORING LOG
Boring No. VER-70

Drilling Start Date:	**06/23/2023**	Boring Depth (ft):	**80**
Drilling End Date:	**06/23/2023**	Boring Diameter (in):	**6**
Drilling Company:	**Cascade Drilling**	Ground Surface Elev. (ft):	**Not surveyed**
Drilling Method:	**Sonic**		
Drilling Equipment:	**Geoprobe**		
Driller:	**Jeff Jehn**		
Logged By:	**Andrew Kelley**		

Boring was advanced adjacent to well 70D.
Samples collected from 30-40 ft bgs, 41-42 ft bgs and 75-80 ft bgs

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	Sample Type	Date & Time	Blow Counts	Recovery (ft)	SOIL/ROCK VISUAL DESCRIPTION
20					13:00	NA	3/10	(20') CLAY WITH SILT (CL); grayish brown, wet, stiff, little sand, little fine to coarse gravel.
								(21') SILTY CLAY (CL); grayish brown, wet, soft, little fine gravel, few sand.
								(21.3') SANDY CLAY (CL); grayish brown, wet, very stiff, some gravel.
25								
30							3/10	(30') GRAVELLY CLAY WITH SAND (CL); grayish brown, wet, firm, sand coarsens downward.
								(31.8') CLAY (CL); dark gray to black, wet, firm, little gravel, few roots observed, dark organics.
35								
40								

NOTES:

Drilling Start Date:	**06/23/2023**	Boring Depth (ft):	**80**
Drilling End Date:	**06/23/2023**	Boring Diameter (in):	**6**
Drilling Company:	**Cascade Drilling**	Ground Surface Elev. (ft):	**Not surveyed**
Drilling Method:	**Sonic**		
Drilling Equipment:	**Geoprobe**		
Driller:	**Jeff Jehn**		
Logged By:	**Andrew Kelley**		

Boring was advanced adjacent to well 70D.
Samples collected from 30-40 ft bgs, 41-42 ft bgs and 75-80 ft bgs

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	COLLECT: Date & Time	COLLECT: Blow Counts	COLLECT: Recovery (ft)	SOIL/ROCK VISUAL DESCRIPTION
40					13:50	NA	8/10	(40') POORLY GRADED SAND (SP); brown with hint of gray, wet, medium dense, fine grained.
								(41.7') CLAY (CL); brownish gray, moist, very stiff, few coarse gravel, some sand.
								(42.4') SHALE, gray, moist, laminated, highly decomposed, moderately disintegrated.
45								
50					14:30		5/10	(50') As above.
55								
60								

NOTES:

Geosyntec consultants
engineers | scientists | innovators

Client: Vistra
Project: Vermilion Power Plant New East Ash Pond
Address: 10188 East 2150 North Road, Oakwood, IL

BORING LOG

Boring No. VER-70

Drilling Start Date:	**06/23/2023**	Boring Depth (ft):	**80**
Drilling End Date:	**06/23/2023**	Boring Diameter (in):	**6**
Drilling Company:	**Cascade Drilling**	Ground Surface Elev. (ft):	**Not surveyed**
Drilling Method:	**Sonic**		
Drilling Equipment:	**Geoprobe**		
Driller:	**Jeff Jehn**		
Logged By:	**Andrew Kelley**		

Boring was advanced adjacent to well 70D.
Samples collected from 30-40 ft bgs, 41-42 ft bgs and 75-80 ft bgs

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	COLLECT: Sample Type	Date & Time	Blow Counts	Recovery (ft)	SOIL/ROCK VISUAL DESCRIPTION
60					15:15	NA	1/10	(60') SHALE, gray to dark gray, wet (driller water), foliated, highly decomposed, slightly disintegrated, weaker and more highly disintegrated shale likely washed out by driller fluids.
65								
70					17:00		10/10	(70') SHALE, gray to dark gray, wet, highly decomposed, moderately disintegrated, coated in wet clay (likely slough).
75								(75') SHALE, gray to dark gray, moist, highly decomposed, slightly disintegrated.
80								(80') End of Boring.

NOTES:

ATTACHMENT 2

Boring Logs and Well Construction Logs

SOIL BORING LOG INFORMATION

NATURAL RESOURCE TECHNOLOGY

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Vermilion Power Station		MW35D

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Bruno Williamson Ramsey Geotechnical Engineering	3/1/2017	3/3/2017	rotary/auger

Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
MW35D	Feet (NAVD88)	581.25 Feet (NAVD88)	7.3 inches

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 1,279,955.58 N, 1,151,276.17 E Ⓔ/W
1/4 of 1/4 of Section , T N, R

Lat 40° 10' 47.14212"
Long 87° 44' 8.06652"

Local Grid Location ☐ N ☐ E
Feet ☐ S Feet ☐ W

Facility ID	County	State	Civil Town/City/ or Village
	Vermilion	IL	Danville

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 SS	24 16.5	2 2 3 3		0 - 2.5' **FILL, SILT:** ML, very dark grayish brown (10YR 3/2), 15-30% silt, trace wood and roots, cohesive, low plasticity, moist.	(FILL) ML								
2 SS	24 19	1 3 3 3		2.5 - 4.3' **SANDY LEAN CLAY:** s(CL), weak red (2.5YR 4/2), 5-15% fine sand, sand content increasing with depth, low plasticity, moist.	s(CL)								
3 SS	24 21	2 3 4 3		4.3 - 8' **POORLY-GRADED SAND:** SP, yellowish brown (10YR 5/6), fine sand, 15-30% clay, moist. 5.1' trace clay.	SP								
4 SS	24 18	3 3 3 3		7.5' trace gravel and cobbles.									Auger bringing up cobbles on flights.
5 SS	24 10	3 4 4 22		8 - 8.5' **FAT CLAY:** CH, very dark grayish brown (10YR 3/2), trace silt, high plasticity, moist.	CH			0.5					
				8.5 - 10' **Weathered SHALE Bedrock** BDX (SH), very dark grayish brown (10YR 3/2) to very dark greenish gray (GLEY 1 3/10Y), highly weathered, red (7.5YR 4/6) discoloration, fissile, moist.	BDX (SH)								
6 SS	15 15	20 34 50 for 3"		10 - 15.6' **Weathered SHALE Bedrock** to **SHALE:** BDX (SH), gray (GLEY 1 6/N), weak, fissile, intensely fractured, red (7.5YR 4/6) discoloration, dry.	BDX (SH)								

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature [signature]

Firm Natural Resource Technology
234 W. Florida St., Fifth Floor, Milwaukee, WI 53204
Tel: (414) 837-3607
Fax: (414) 837-3608

SOIL BORING LOG INFORMATION SUPPLEMENT

NATURAL RESOURCE TECHNOLOGY

Boring Number MW35D

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
7 SS	8 9	45 50 for 2"	13	10 - 15.6' **Weathered SHALE Bedrock** to **SHALE:** BDX (SH), gray (GLEY 1 6/N), weak, fissile, intensely fractured, red (7.5YR 4/6) discoloration, dry. *(continued)*	BDX (SH)									
8 SS	9 7	31 50 for 3"	14, 15											
9 CORE	120 120		16–25	15.6 - 45.8' **SHALE:** BDX (SH), dark reddish gray (10YR 4/1) to gray (2.5Y 5/1), microcrystalline, thinly bedded to laminated, weak, slightly decomposed (very dark gray (10YR 3/1) to black (10YR 2/1) discoloration in partly healed fractures), competent, dry to moist in fractures.	BDX (SH)									Core 9, RQD = 89%. Light brown gray return water. 4" diameter outer casing set from 0-16 ft bgs.
10 CORE	131.3 120		26–32	25.6' partly to totally healed fractures.										Core 10, RQD = 89%. Light gray return water.

NATURAL RESOURCE TECHNOLOGY

Boring Number MW35D

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram		Soil Properties: Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			33–36	15.6 - 45.8' **SHALE:** BDX (SH), dark reddish gray (10YR 4/1) to gray (2.5Y 5/1), microcrystalline, thinly bedded to laminated, weak, slightly decomposed (very dark gray (10YR 3/1) to black (10YR 2/1) discoloration in partly healed fractures), competent, dry to moist in fractures. *(continued)*										
11 CORE	111.1 120		37–41		BDX (SH)									Core 11, RQD = 93%. Gray return water.
			42	41.9' - 43' crossbedding.										
			43–45											
				45.8' End of Boring.										

Facility/Project Name	Local Grid Location of Well	Well Name
Vermilion Power Station	___ft. ☐ N. ☐ S. ___ft. ☐ E. ☐ W.	
Facility License, Permit or Monitoring No.	Local Grid Origin ☐ (estimated: ☐) or Well Location ☒ Lat. 40° 10' 47.142" Long. 87° 44' 8.067" or	MW35D
Facility ID	St. Plane 1,279,955.58 ft. N, 1,151,276.17 ft. E. (E)/W	Date Well Installed 03/03/2017
Type of Well: mw	Section Location of Waste/Source ___1/4 of ___ 1/4 of Sec. ___, T. ___ N, R. ___ ☐ E ☐ W	Well Installed By: (Person's Name and Firm) Bruno Williamson Ramsey Geotechnical Engineering
Distance from Waste/Source ___ ft. / State: IL	Location of Well Relative to Waste/Source u ☐ Upgradient s ☐ Sidegradient d ☐ Downgradient n ☐ Not Known Gov. Lot Number	

A. Protective pipe, top elevation ___ ft. MSL

B. Well casing, top elevation 584.15 ft. MSL

C. Land surface elevation 581.25 ft. MSL

D. Surface seal, bottom 579.3 ft. MSL or 2.0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☒

13. Sieve analysis attached? ☐ Yes ☒ No

14. Drilling method used: Rotary ☐
Hollow Stem Auger ☐
HSA / Rotary Other ☒

15. Drilling fluid used: Water ☒ 0 2 Air ☐
Drilling Mud ☐ 0 3 None ☐

16. Drilling additives used? ☐ Yes ☒ No

Describe ___

17. Source of water (attach analysis, if required):
City of Champaign

E. Bentonite seal, top 551.3 ft. MSL or 30.0 ft.

F. Fine sand, top ___ ft. MSL or ___ ft.

G. Filter pack, top 548.3 ft. MSL or 33.0 ft.

H. Screen joint, top 546.3 ft. MSL or 35.0 ft.

I. Well bottom 536.3 ft. MSL or 45.0 ft.

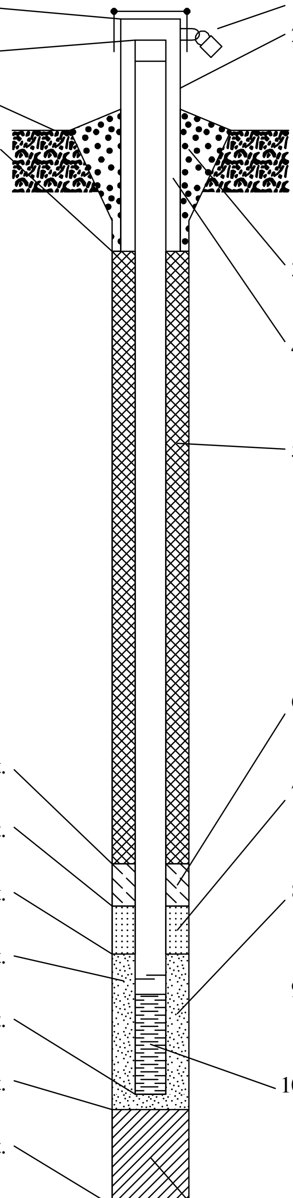
J. Filter pack, bottom 535.5 ft. MSL or 45.8 ft.

K. Borehole, bottom 535.5 ft. MSL or 45.8 ft.

L. Borehole, diameter 7.3 in.

M. O.D. well casing 2.38 in.

N. I.D. well casing 1.99 in.



1. Cap and lock? ☒ Yes ☐ No
2. Protective cover pipe:
   a. Inside diameter: 6.0 in.
   b. Length: 6.0 ft.
   c. Material: Steel ☒ Other ☐
   d. Additional protection? ☒ Yes ☐ No
   If yes, describe: 4" diameter protective PVC casing
3. Surface seal: Bentonite ☐ Concrete ☒ Other ☐
4. Material between well casing and protective pipe: Bentonite ☒
   Sand Other ☒
5. Annular space seal: a. Granular/Chipped Bentonite ☐
   b. ___Lbs/gal mud weight . . . Bentonite-sand slurry ☐
   c. ___Lbs/gal mud weight . . . Bentonite slurry ☐
   d. 30 % Bentonite . . . Bentonite-cement grout ☒
   e. ___Ft^3 volume added for any of the above
   f. How installed: Tremie ☒ Tremie pumped ☐ Gravity ☐
6. Bentonite seal: a. Bentonite granules ☐
   b. ☐ 1/4 in. ☒ 3/8 in. ☐ 1/2 in. Bentonite chips ☒
   c. ___ Other ☐
7. Fine sand material: Manufacturer, product name & mesh size
   a. ___
   b. Volume added ___ ft^3
8. Filter pack material: Manufacturer, product name & mesh size
   a. NSF Quartz Sand #10-20
   b. Volume added ___ ft^3
9. Well casing: Flush threaded PVC schedule 40 ☒
   Flush threaded PVC schedule 80 ☐
   Other ☐
10. Screen material: Schedule 40 PVC
    a. Screen Type: Factory cut ☒ Continuous slot ☐ Other ☐
    b. Manufacturer ___
    c. Slot size: 0.100 in.
    d. Slotted length: 10.0 ft.
11. Backfill material (below filter pack): None ☒ Other ☐

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Date Modified: 4/6/2017

Signature [signature]

Firm: Natural Resource Technology
234 W. Florida Street, Floor 5, Milwaukee, WI 53204
Tel: (414) 837-3607
Fax: (414) 837-3608

SOIL BORING LOG INFORMATION

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Vermilion Power Station		70D

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
Jason Greer Cascade Drilling	3/4/2021	3/4/2021	Mini Sonic

Common Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
70D	Feet (NAVD88)	591.90 Feet (NAVD88)	6.0 inches

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☐
State Plane 1,278,929.46 N, 1,150,617.15 E Ⓔ/ W
1/4 of 1/4 of Section , T N, R

Lat ° ' "
Long ° ' "

Local Grid Location
Feet ☐ N ☐ S Feet ☐ E ☐ W

Facility ID	County	State	Civil Town/City/ or Village
	Vermilion	Illinois	Oakwood

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID 10.6 eV Lamp	Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
1 CS	60 47		0–6.3	0 - 6.3' **SILT:** ML, dark brown (10YR 3/3) to brown (10YR 4/3), clay (15-25%), sand, (0-5%), roots (0-5%), stiff, slow dilatancy, low toughness, low plasticity, moist.	ML				1.5 1.5 1.5					CS= Core Sample
2 CS	60 60													
			6.3–11.3	6.3 - 11.3' **SILTY CLAY:** CL/ML, brown (10YR 4/3), sand (0-10%), gravel (0-5%), firm, slow dilatancy, low toughness, medium plasticity, moist. 9.4' color change to yellowish brown (10YR 5/4).	CL/ML				0.75 0.75					
3 CS	120 120													
			11.3–14.7	11.3 - 14.7' **CLAYEY SAND:** SC, yellowish brown (10YR 5/6), rounded fine sand, silt (5-10%), gravel (0-5%), loose, wet.	SC									

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm
[signature]	Ramboll 234 W. Florida Street, Milwaukee, WI 53204 Tel: (414) 837-3607 Fax: (414) 837-3608

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID 10.6 eV Lamp	Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				14.7 - 15' **SILTY CLAY:** CL/ML, yellowish brown (10YR 5/6), soft, slow dilatancy, low toughness, medium plasticity.	CL/ML									
			16		SC									
				15 - 16.2' **CLAYEY SAND:** SC, yellowish brown (10YR 5/6), rounded fine sand, silt (5-10%), gravel (0-5%), loose, wet.										
			17											
			18	16.2 - 18.8' **POORLY-GRADED SAND WITH CLAY:** SP-SC, ???, subrounded to rounded, fine to medium sand, loose, wet.	SP-SC									
			19	18.8 - 19.6' **LEAN CLAY:** CL, dark gray (10YR 4/1), gravel, (0-5%), sand (0-5%), stiff, no dilatancy, low toughness, medium plasticity, moist.	CL				2.5					
4 CS	120 97		20	19.6 - 20.3' **Weathered SHALE Bedrock** BDX (SH), gray (10YR 5/1), dry.	BDX (SH)									
			21	20.3 - 52' **SHALE:** BDX (SH), gray (10YR 5/1).										
			22											
			23											
			24											
			25											
			26											
			27											
			28											
			29											
5 CS	132 132		30		BDX (SH)									
			31											
			32											
			33											
			34											
			35											
			36											
			37											
			38											
			39											
			40											

Boring Number 70D

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID 10.6 eV Lamp	Compressive Strength (tsf)	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				20.3 - 52' **SHALE:** BDX (SH), gray (10YR 5/1). *(continued)*										
6 CS	132 132		41–51		BDX (SH)									
			52	52' End of Boring.										

MONITORING WELL CONSTRUCTION

Facility/Project Name: Vermilion Power Station	Local Grid Location of Well: ____ft. ☐ N. ☐ S. ____ft. ☐ E. ☐ W.	Well Name: 70D
Facility License, Permit or Monitoring No.	Local Grid Origin ☐ (estimated: ☐) or Well Location ☐ Lat. ___° ___' ___" Long. ___° ___' ___" or	
Facility ID	St. Plane 1,278,929 ft. N, 1,150,617 ft. E. (E)/W	Date Well Installed: 03/04/2021
Type of Well: Well Code 12/pz	Section Location of Waste/Source: ____1/4 of ____ 1/4 of Sec. ____, T. ____ N, R. ____ ☐ E ☐ W	Well Installed By: (Person's Name and Firm): Jason Greer, Cascade Drilling
Distance from Waste/Source ft. | State: Illinois	Location of Well Relative to Waste/Source: u ☐ Upgradient, s ☐ Sidegradient, d ☒ Downgradient, n ☐ Not Known | Gov. Lot Number	

A. Protective pipe, top elevation 595.10 ft. MSL

B. Well casing, top elevation 594.52 ft. MSL

C. Land surface elevation 591.9 ft. MSL

D. Surface seal, bottom 590.9 ft. MSL or 1.0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☒

13. Sieve analysis attached? ☐ Yes ☒ No

14. Drilling method used: Rotary ☐; Hollow Stem Auger ☐; Sonic Other ☒

15. Drilling fluid used: Water ☒ 0 2 Air ☐; Drilling Mud ☐ 0 3 None ☐

16. Drilling additives used? ☐ Yes ☒ No

Describe ____

17. Source of water (attach analysis, if required): Potable City Water

E. Bentonite seal, top 557.9 ft. MSL or 34.0 ft.

F. Fine sand, top ____ ft. MSL or ____ ft.

G. Filter pack, top 552.9 ft. MSL or 39.0 ft.

H. Screen joint, top 550.9 ft. MSL or 41.0 ft.

I. Well bottom 540.9 ft. MSL or 51.0 ft.

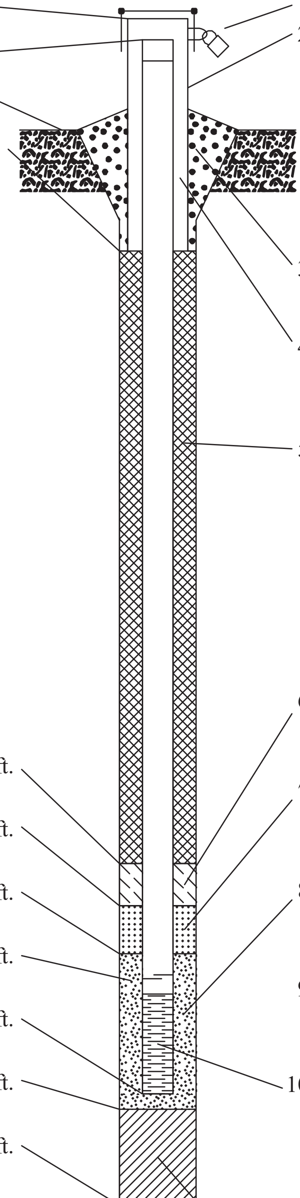
J. Filter pack, bottom 540.9 ft. MSL or 51.0 ft.

K. Borehole, bottom 539.9 ft. MSL or 52.0 ft.

L. Borehole, diameter 6.0 in.

M. O.D. well casing 2.38 in.

N. I.D. well casing 2.07 in.



1. Cap and lock? ☒ Yes ☐ No
2. Protective cover pipe:
   a. Inside diameter: 4.0 in.
   b. Length: 5.0 ft.
   c. Material: Steel ☒; Other ☐
   d. Additional protection? ☒ Yes ☐ No
   If yes, describe: 4 Steel Bollards
3. Surface seal: Bentonite ☐; Concrete ☒; Other ☐
4. Material between well casing and protective pipe: Bentonite ☐; Sand Other ☒
5. Annular space seal: a. Granular/Chipped Bentonite ☐
   b. ____Lbs/gal mud weight . . . Bentonite-sand slurry ☐
   c. 9.2 Lbs/gal mud weight . . . Bentonite slurry ☒
   d. ____% Bentonite . . . Bentonite-cement grout ☐
   e. ____Ft^3 volume added for any of the above
   f. How installed: Tremie ☐; Tremie pumped ☒; Gravity ☐
6. Bentonite seal: a. Bentonite granules ☐
   b. ☐ 1/4 in. ☒ 3/8 in. ☐ 1/2 in. Bentonite chips ☒
   c. ____ Other ☐
7. Fine sand material: Manufacturer, product name & mesh size
   a. NA
   b. Volume added 0 ft^3
8. Filter pack material: Manufacturer, product name & mesh size
   a. FILTERSIL 0.85
   b. Volume added ____ ft^3
9. Well casing: Flush threaded PVC schedule 40 ☒; Flush threaded PVC schedule 80 ☐; Other ☐
10. Screen material: Schedule 40 PVC
    a. Screen Type: Factory cut ☒; Continuous slot ☐; Other ☐
    b. Manufacturer Johnson Screens
    c. Slot size: 0.010 in.
    d. Slotted length: 10.0 ft.
11. Backfill material (below filter pack): None ☐; Formation Materials Other ☒

I hereby certify that the information on this form is true and correct to the best of my knowledge.

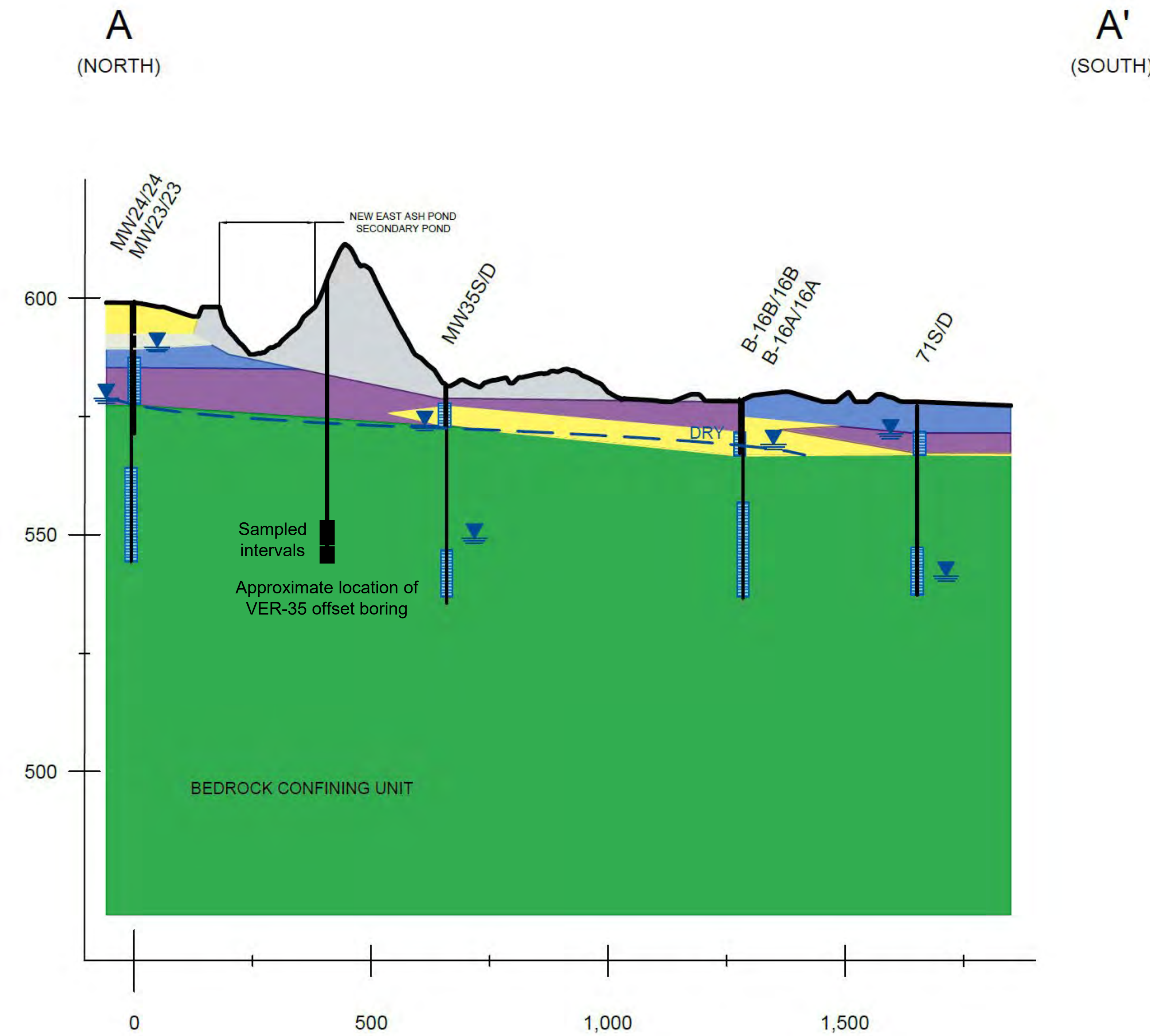
Date Modified: 3/31/2021

Signature	Firm	
[signature]	Ramboll 234 W. Florida Street, Milwaukee, WI 53204	Tel: (414) 837-3607 Fax: (414) 837-3608

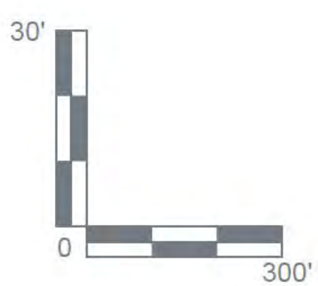
ATTACHMENT 3

Cross Sections

Electronic Filing: Received, Clerk's Office 09/30/2024 **PCB 2025-015**



NOTES
1. This profile was developed by interpolation between widely spaced boreholes. Only at the borehole location should it be considered as an approximately accurate representation and then only to the degree implied by the notes on the borehole logs.
2. Scale is approximate.
3. Vertical scale is exaggerated 10X.
4. Groundwater elevations measured on March 29, 2021.
5. PMP = Potential Migration Pathway



LEGEND
- FILL
- CLAY (CL/CH)
- TILL (CL/CH)
- SILT (ML)
- SAND (SP/SM/SW)
- GRAVEL (GP/GW)
- BEDROCK / WEATHERED BEDROCK (INTERBEDDED SHALE, LIMESTONE, SANDSTONE, V. LITTLE SS)
- WELL SCREEN INTERVAL
- BEDROCK CONFINING UNT POTENTIOMETRIC SURFACE
- BEDROCK CONFINING UNIT / PMP GROUNDWATER / OTHER GROUNDWATER / SURFACE WATER ELEVATION(S)

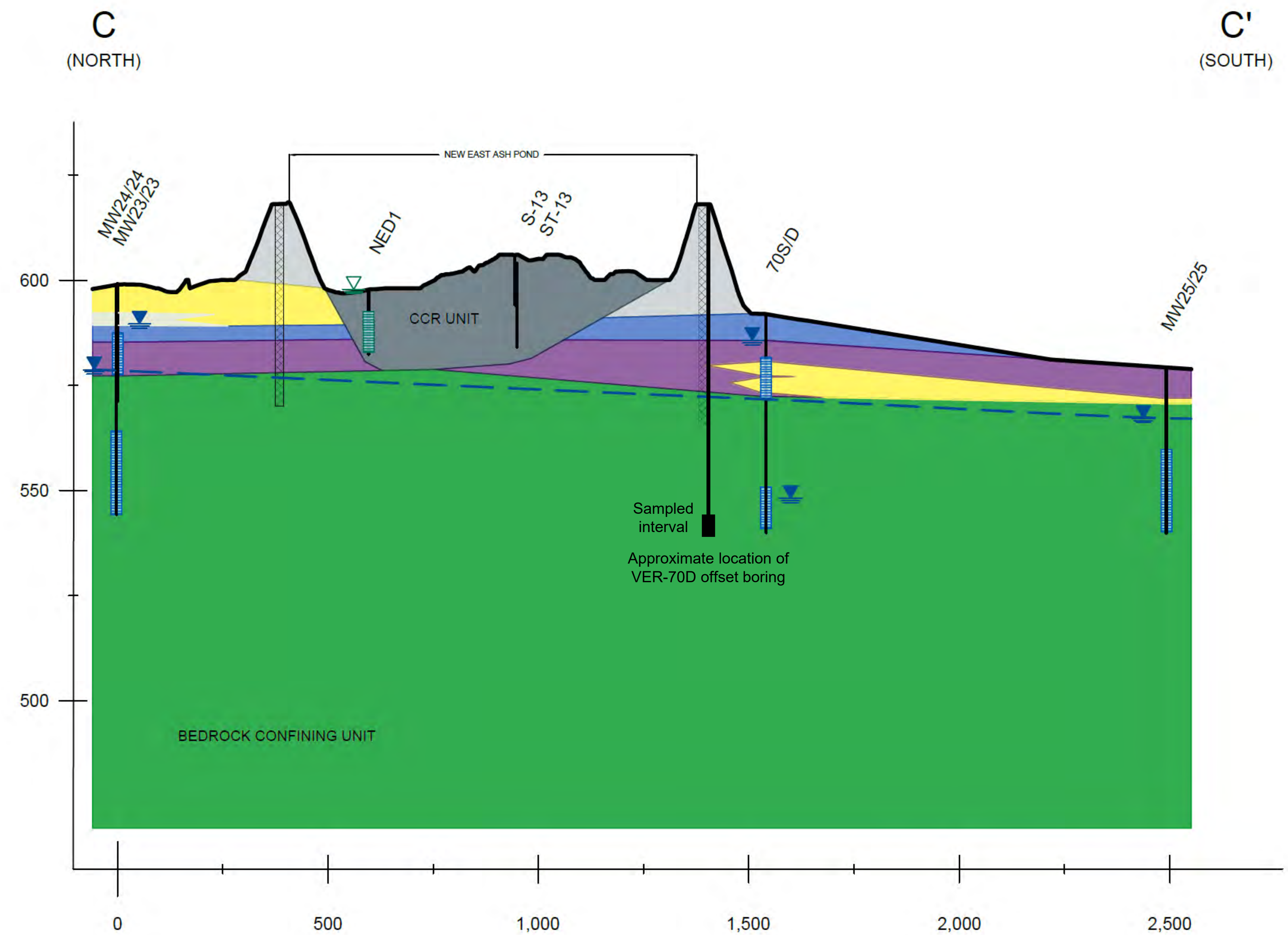
GEOLOGIC CROSS SECTION
A-A'

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
NEW EAST ASH POND
VERMILION POWER PLANT
OAKWOOD, ILLINOIS

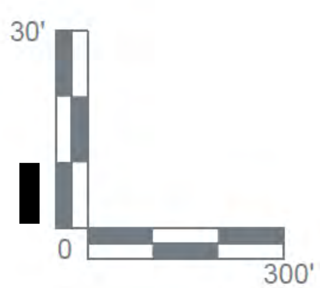
FIGURE 2-9

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

RAMBOLL



NOTES
1. This profile was developed by interpolation between widely spaced boreholes. Only at the borehole location should it be considered as an approximately accurate representation and then only to the degree implied by the notes on the borehole logs.
2. Scale is approximate.
3. Vertical scale is exaggerated 10X.
4. Groundwater elevations measured on March 29, 2021.
5. PMP = Potential Migration Pathway



LEGEND
- COAL COMBUSTION RESIDUALS (CCR)
- FILL
- CLAY (CL/CH)
- TILL (CL/CH)
- SILT (ML)
- SAND (SP/SM/SW)
- GRAVEL (GP/GW)
- BEDROCK / WEATHERED BEDROCK (INTERBEDDED SHALE, LIMESTONE, SANDSTONE, V. LITTLE SS)
- WELL SCREEN INTERVAL
- BEDROCK CONFINING UNT POTENTIOMETRIC SURFACE
- POREWATER ELEVATION
- BEDROCK CONFINING UNIT / PMP GROUNDWATER / OTHER GROUNDWATER / SURFACE WATER ELEVATION(S)
- CLAY CORE KEYED 8-FT INTO BEDROCK

GEOLOGIC CROSS SECTION
C-C'

HYDROGEOLOGIC SITE CHARACTERIZATION REPORT
NEW EAST ASH POND
VERMILION POWER PLANT
OAKWOOD, ILLINOIS

FIGURE 2-11

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.

RAMBOLL

ATTACHMENT 4
X-Ray Diffraction
Laboratory Analytical Report

SGS

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*Environmental Services*
Project Number/ LIMS No.	*Custom XRD/MI4526-AUG23*
Sample Receipt:	*August 10, 2023*
Sample Analysis:	*August 31, 2023*
Reporting Date:	*September 13, 2023*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 35 kV, 40 mA; Detector: LYNXEYE Regular Scanning: Step: 0.02°, Step time: 0.75s, 2θ range: 6-80° Clay Section Scanning: Step: 0.01°, Step time:0.2s, 2θ range: 3-40°
Interpretations :	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva and Topas software.
Detection Limit :	0.5-2%. Strongly dependent on crystallinity.

Contents:

1) Method Summary
2) Quantitative XRD Results
3) XRD Pattern(s)

Zhihai (Adrian) Zhang, Ph.D
Mineralogist

Kim Gibbs, H.B.Sc., P.Geo.
Senior Mineralogist

ACCREDITATION: SGS Natural Resources Lakefield is accredited to the requirements of ISO/IEC 17025 for specific tests as listed on our scope of accreditation, including geochemical, mineralogical and trade mineral tests. To view a list of the accredited methods, please visit the following website and search SGS Canada Inc. - Minerals: https://www.scc.ca/en/search/palcan.

Method Summary

The Rietveld Method of Mineral Identification by XRD (ME-LR-MIN-MET-MN-D05) method used by SGS Natural Resources is accredited to the requirements of ISO/IEC 17025.

Mineral Identification and Interpretation:

Mineral identification and interpretation involves matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards have been added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Mineral or compound identification and quantitative analysis results should be accompanied by supporting chemical assay data or other additional tests.

Clay Mineral Separation and Identification:

Clay minerals are typically fine-grained (<2 µm) phyllosilicates in sedimentary rock. Due to the poor crystallinity and fine size of clay minerals, separation of the clay fraction from bulk samples by centrifuge is required. A slide of the oriented clay fraction is prepared and scanned followed by a series of procedures (the addition of ethylene glycol and high temperature heating). Clay minerals are identified by their individual diffraction patterns and changes in their diffraction pattern after different treatments. Clay speciation and mineral identification of the bulk sample are performed using DIFFRACplus EVA (Bruker AXS).

Quantitative Rietveld Analysis:

Quantitative Rietveld Analysis is performed by using Topas 4.2 (Bruker AXS), a graphics based profile analysis program built around a non-linear least squares fitting system, to determine the amount of different phases present in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental and specimen factors. Unlike other peak intensity-based methods, the Rietveld method uses a least squares approach to refine a theoretical line profile until it matches the obtained experimental patterns.

Rietveld refinement is completed with a set of minerals specifically identified for the sample. Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

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Member of the SGS Group (SGS SA)

SGS

Environmental Services
Custom XRD/MI4526-AUG23
13-Sep-23

Summary of Rietveld Quantitative Analysis X-Ray Diffraction Results

Mineral/Compound	VER-35 55-60 20230624 AUG4526-01 (wt %)	VER-35 60-63 20230624 AUG4526-02 (wt %)	VER-70 30-40 20230623 AUG4526-03 (wt %)	VER-70 41-42 20230623 AUG4526-04 (wt %)	VER-70 75-80 20230623 AUG4526-05 (wt %)
Quartz	38.5	38.1	48.6	48.2	35.0
Chlorite	6.9	6.8	1.2	3.6	7.7
Muscovite	23.4	23.0	13.5	15.2	27.0
Albite	12.6	12.6	10.6	10.8	11.5
Microcline	1.0	1.1	1.3	1.1	0.7
Siderite	4.9	5.0	0.9	0.1	5.4
Actinolite	-	-	0.8	-	-
Dolomite	-	-	11.7	11.7	-
Clays					
Illite	7.1	8.0	7.4	5.6	5.2
Kaolinite	5.6	5.4	3.2	3.7	7.5
Montmorillonite	-	-	0.8	-	-
TOTAL	100	100	100	100	100

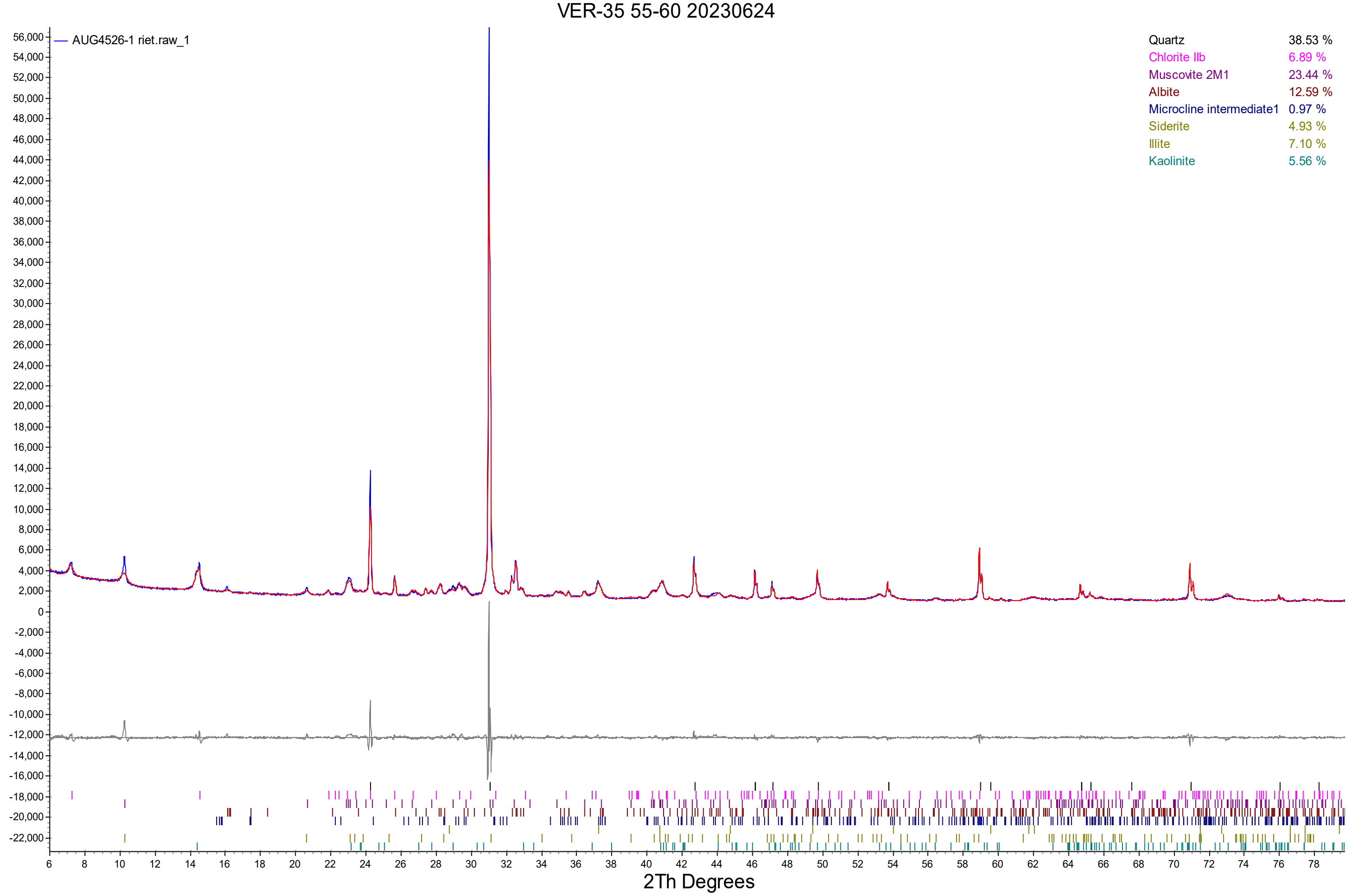
Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

Dashes indicate that the mineral was not identified by the analyst and not included in the refinement calculation for the sample.

The weight percent quantities indicated have been normalized to a sum of 100%. The quantity of amorphous material has not been determined.

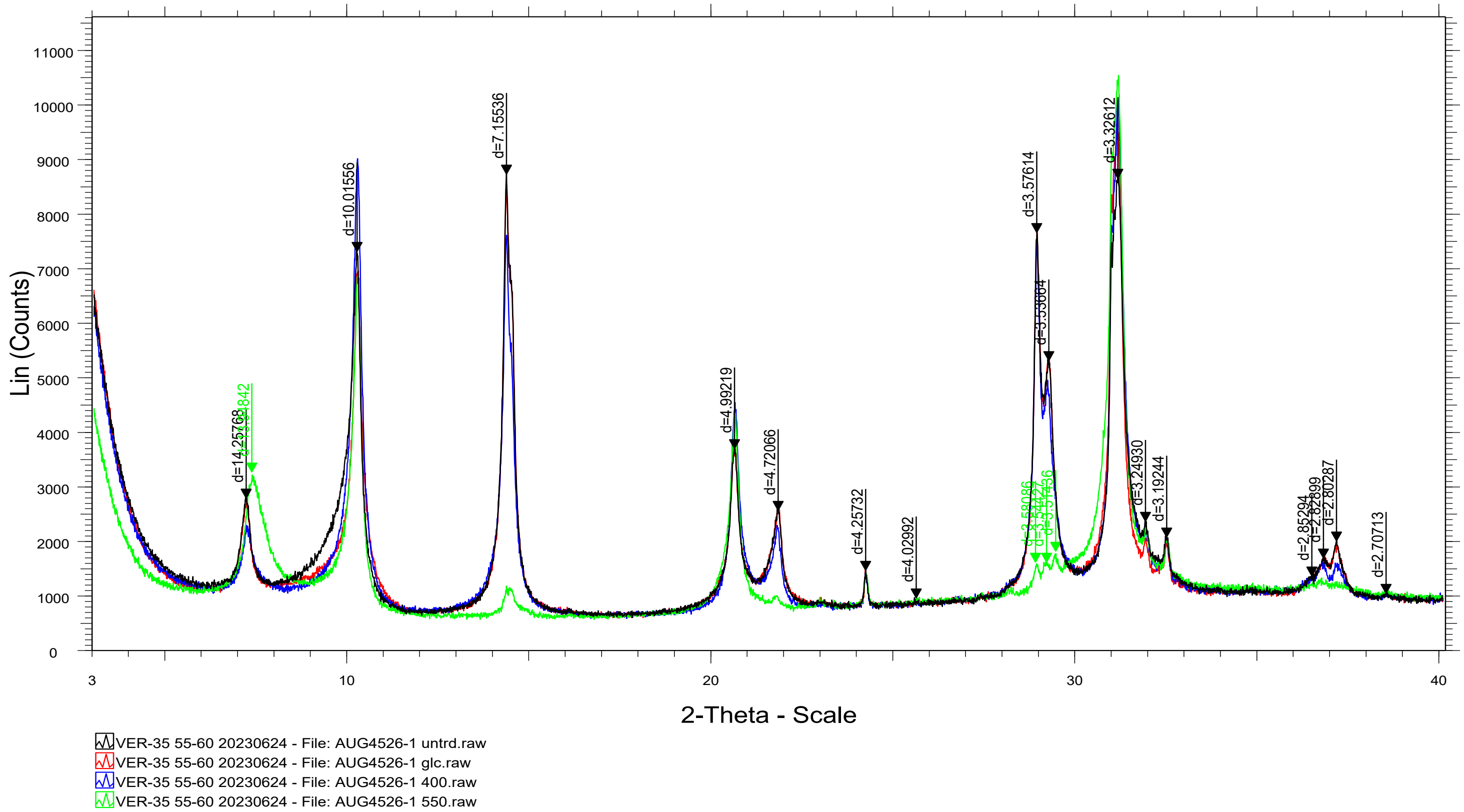
Mineral/Compound	Formula
Quartz	SiO_2
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Albite	$NaAlSi_3O_8$
Microcline	$KAlSi_3O_8$
Siderite	$FeCO_3$
Illite	$(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}[(OH)_2,(H_2O)]$
Kaolinite	$Al_2Si_2O_5(OH)_4$
Actinolite	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$
Dolomite	$CaMg(CO_3)_2$
Montmorillonite	$(Na,Ca)_{0.3}(Al,Mg)_2Si_4O_{10}(OH)_2 \cdot 10H_2O$

Environmental Services
Custom XRD/MI4526-AUG23
13-Sep-23



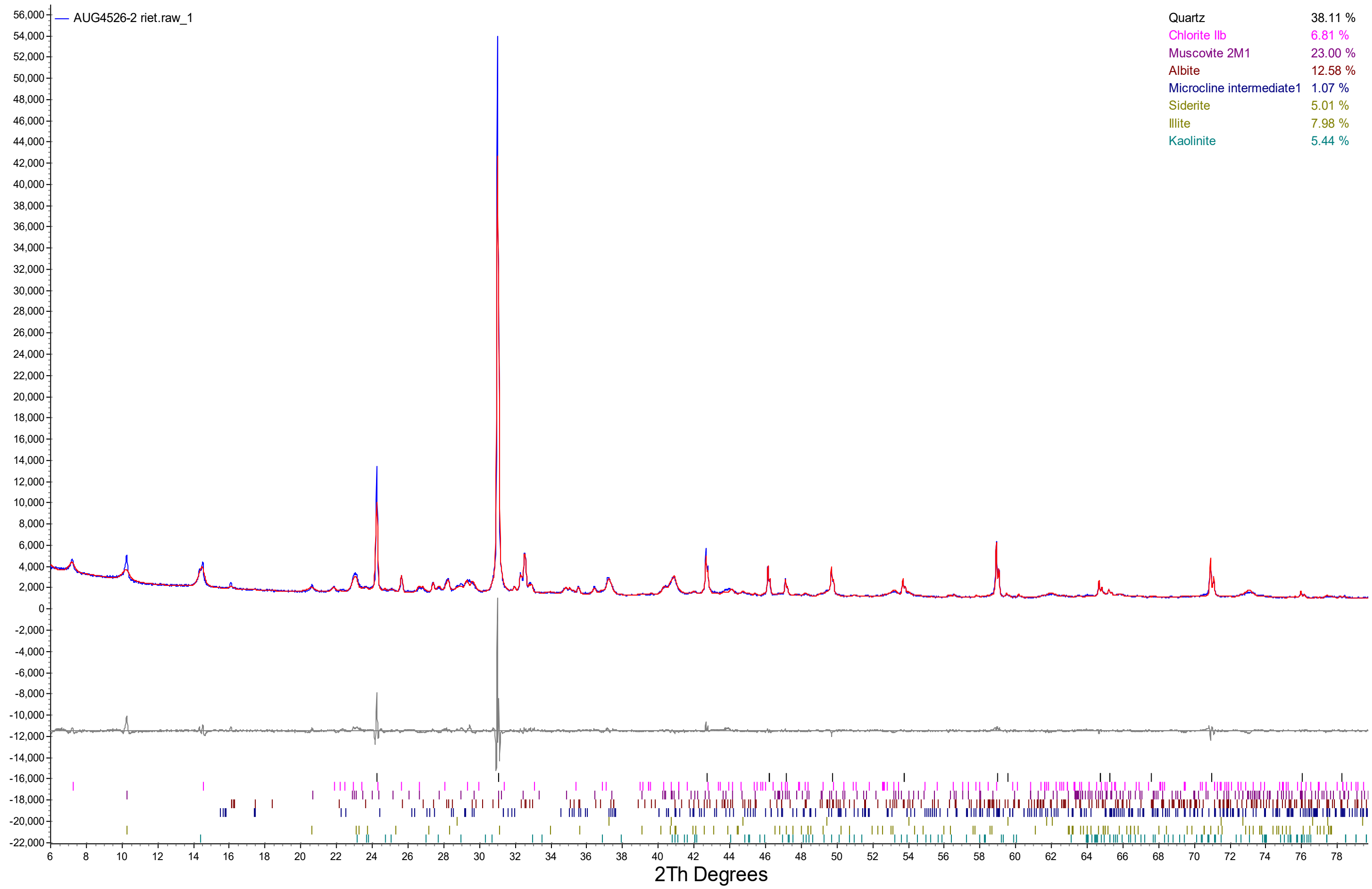
Environmental Services
Custom XRD/MI4526-AUG23
13-Sep-23

VER-35 55-60 20230624

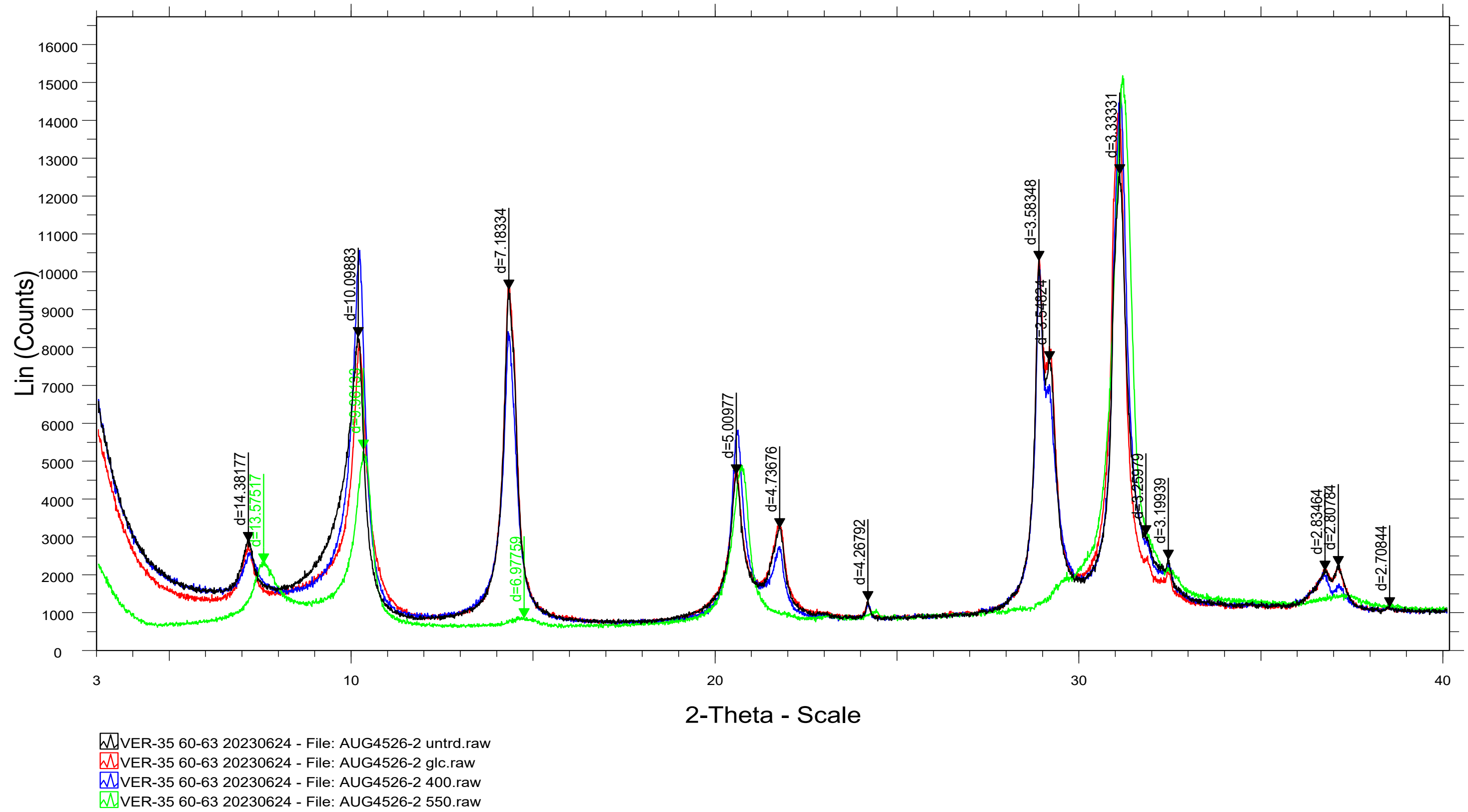


Environmental Services
Custom XRD/MI4526-AUG23
13-Sep-23

VER-35 60-63 20230624

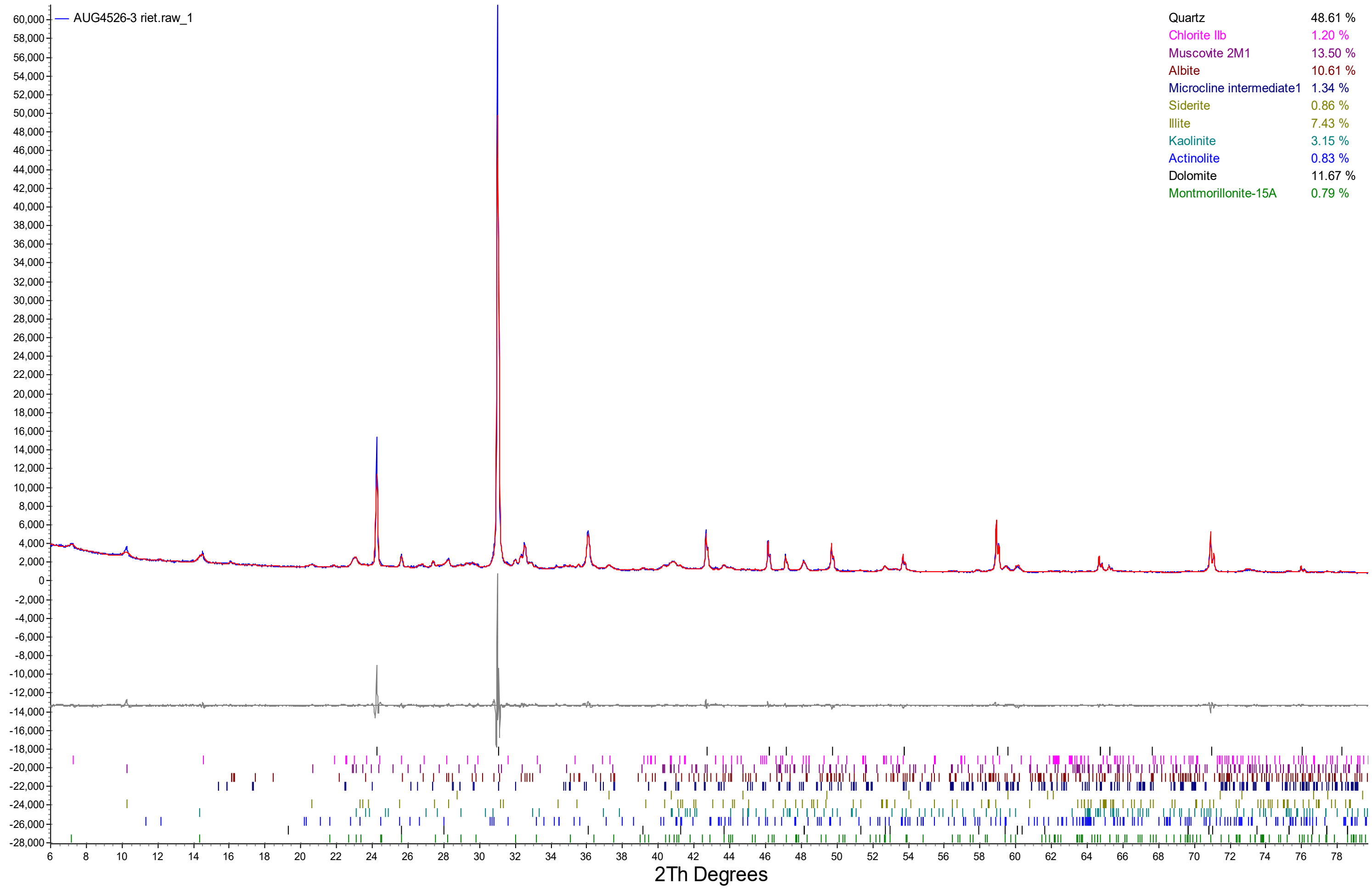


VER-35 60-63 20230624



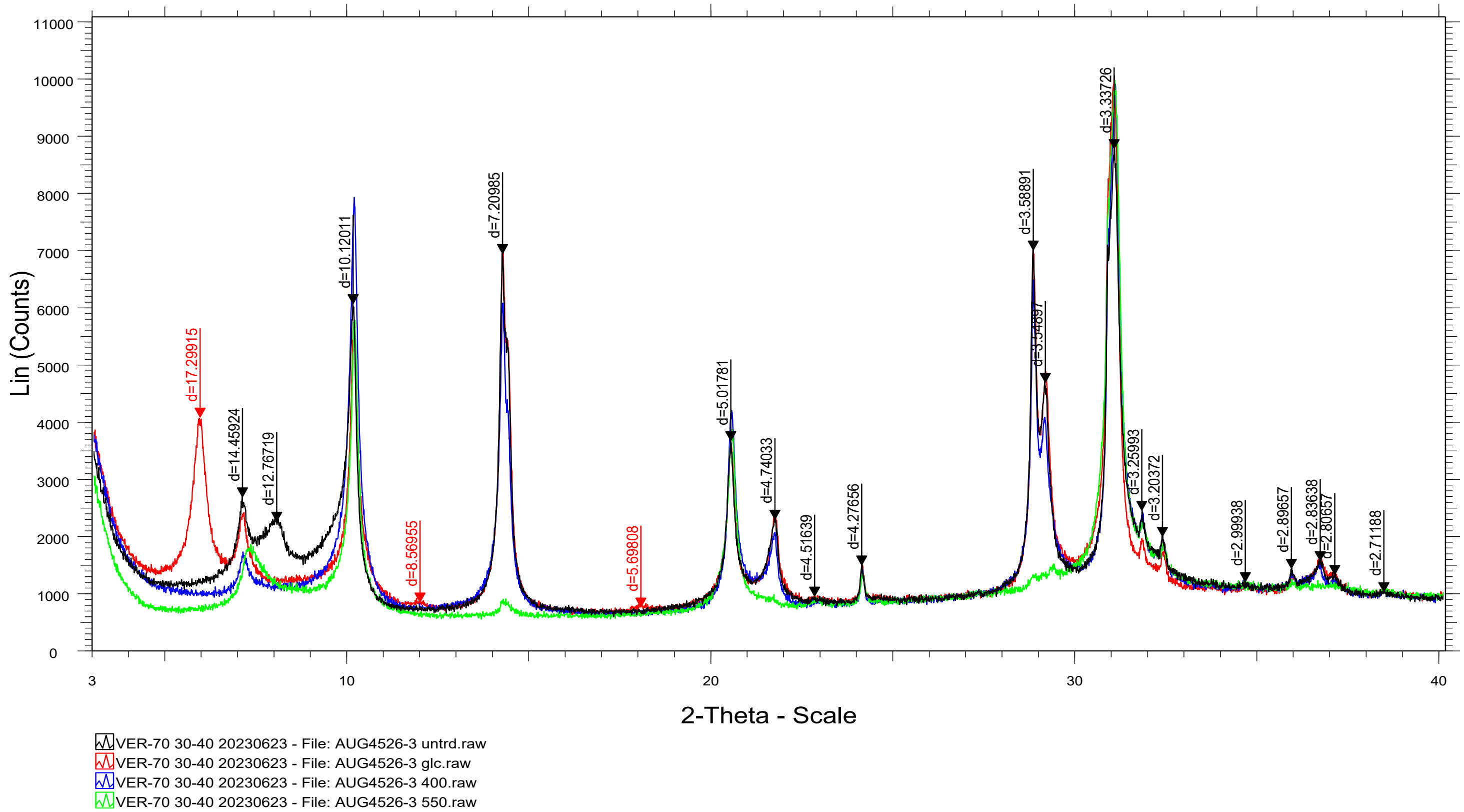
Environmental Services
Custom XRD/MI4526-AUG23
13-Sep-23

VER-70 30-40 20230623



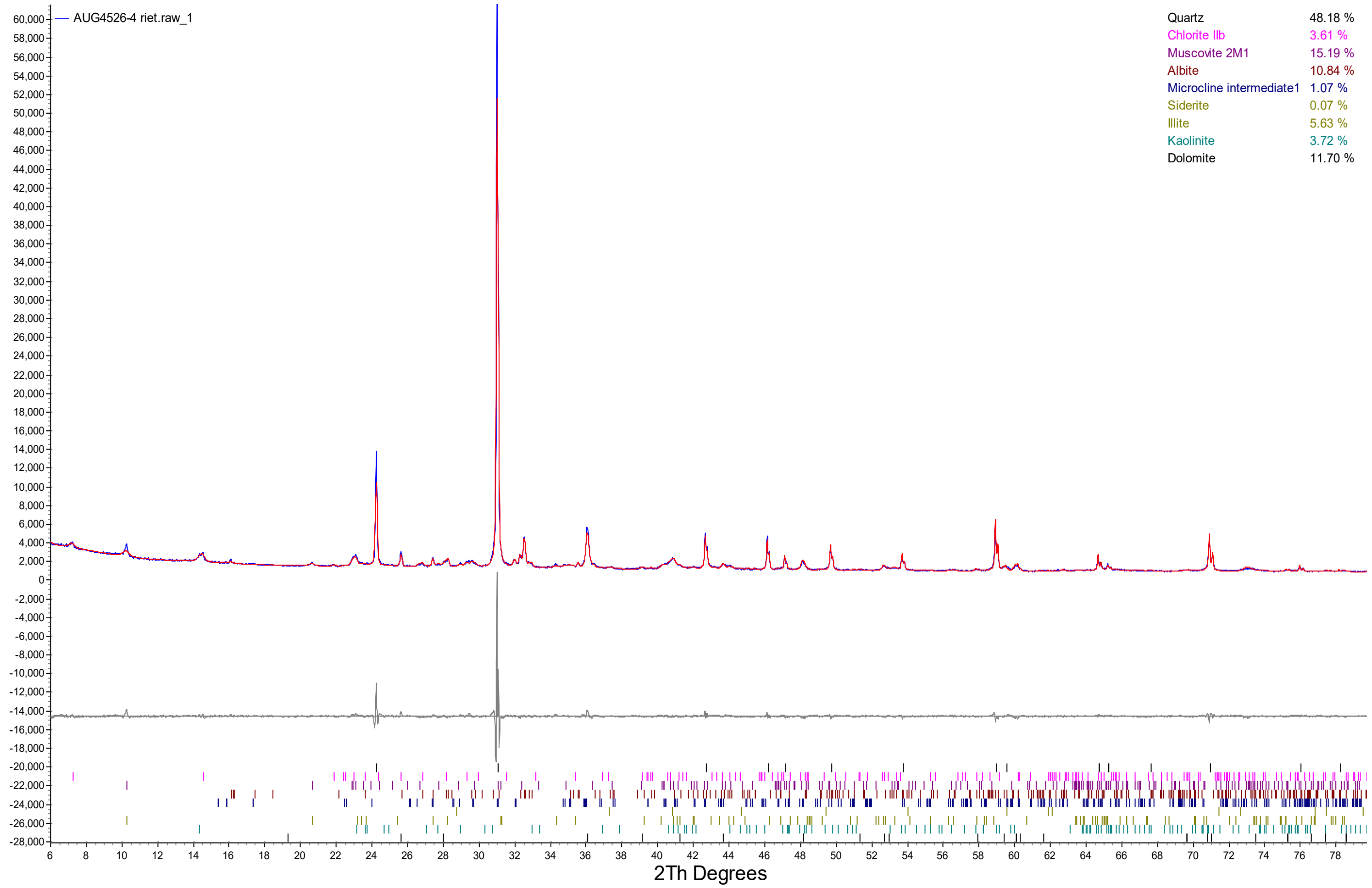
Environmental Services
Custom XRD/MI4526-AUG23
13-Sep-23

VER-70 30-40 20230623



Environmental Services
Custom XRD/MI4526-AUG23
13-Sep-23

VER-70 41-42 20230623



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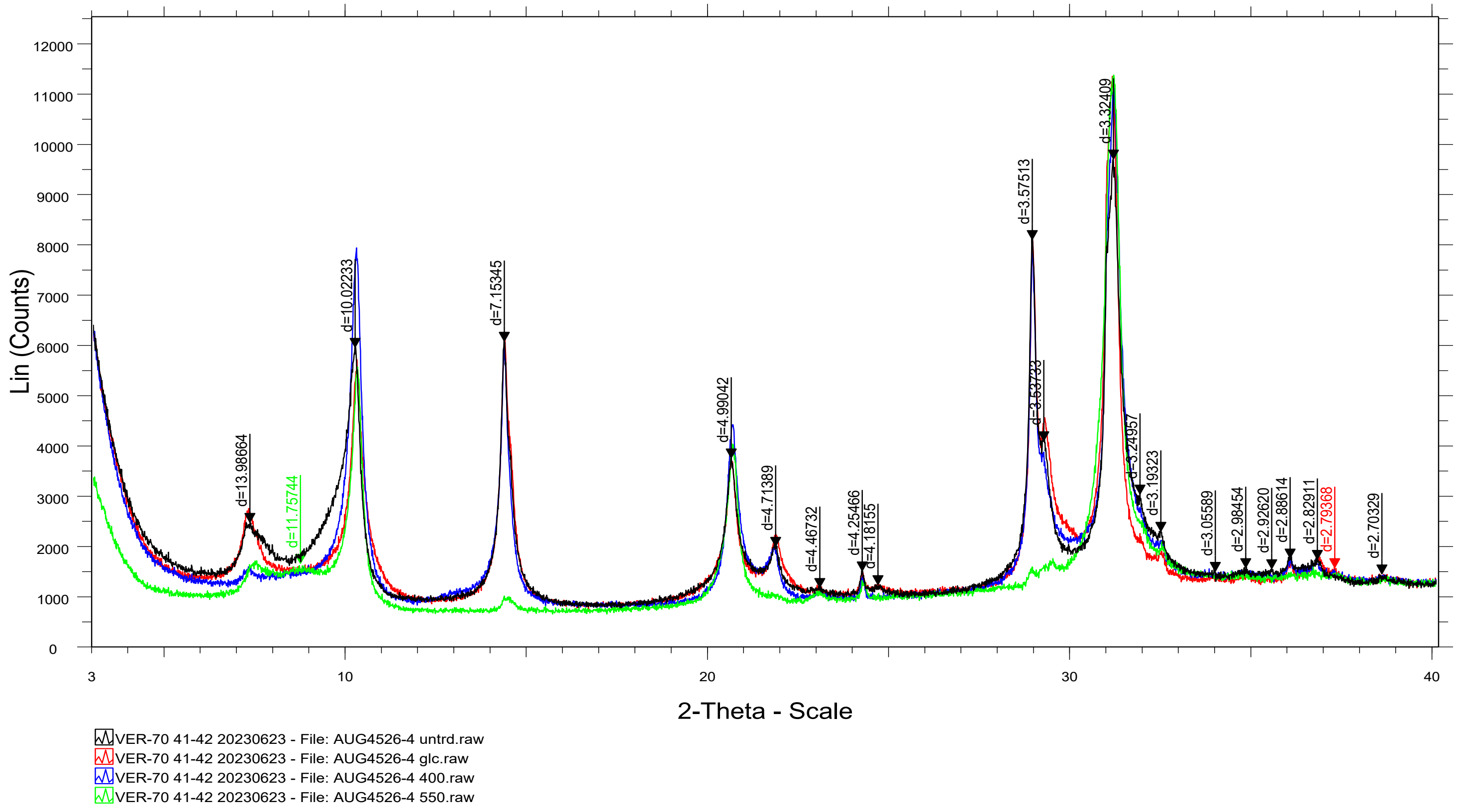
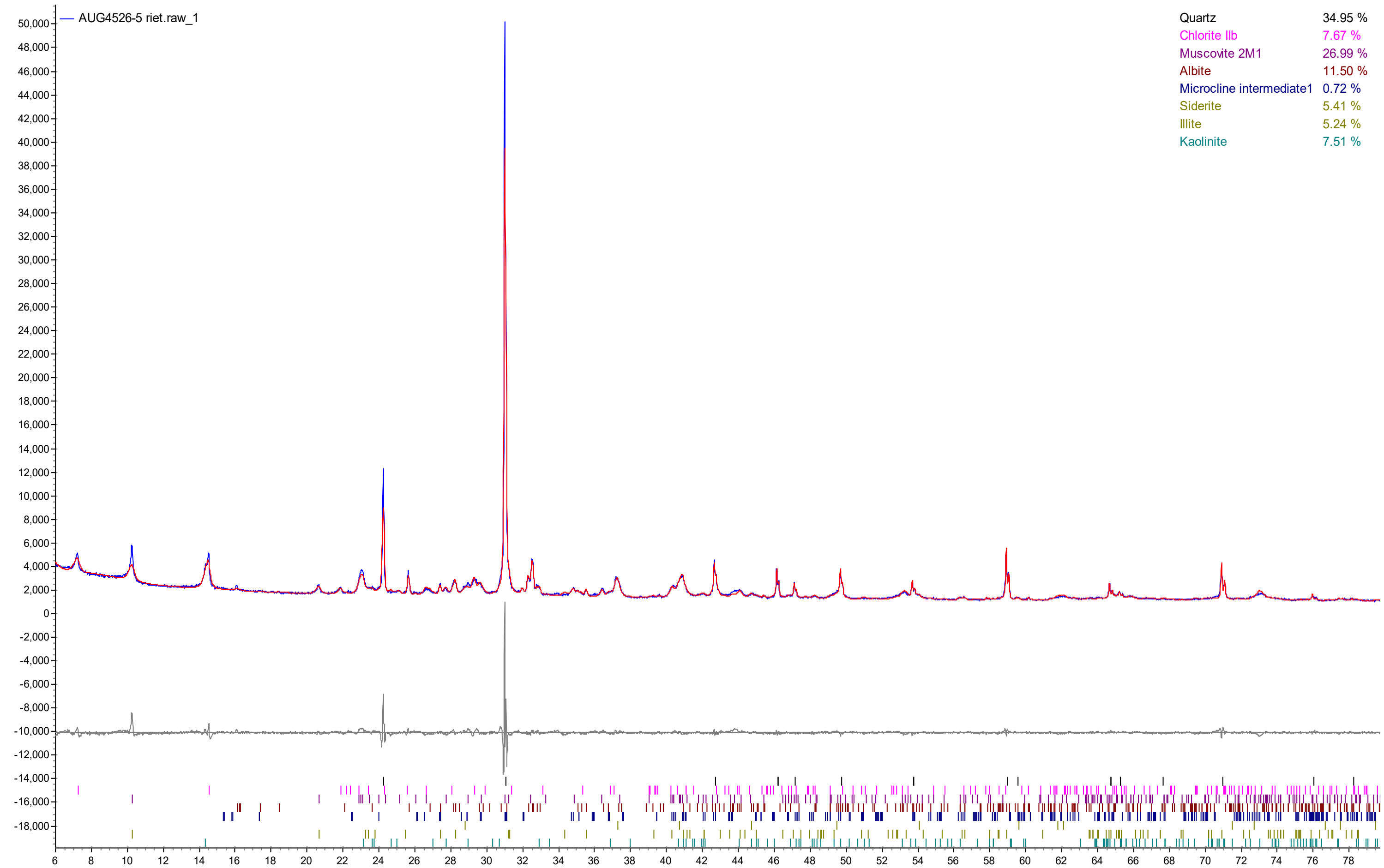


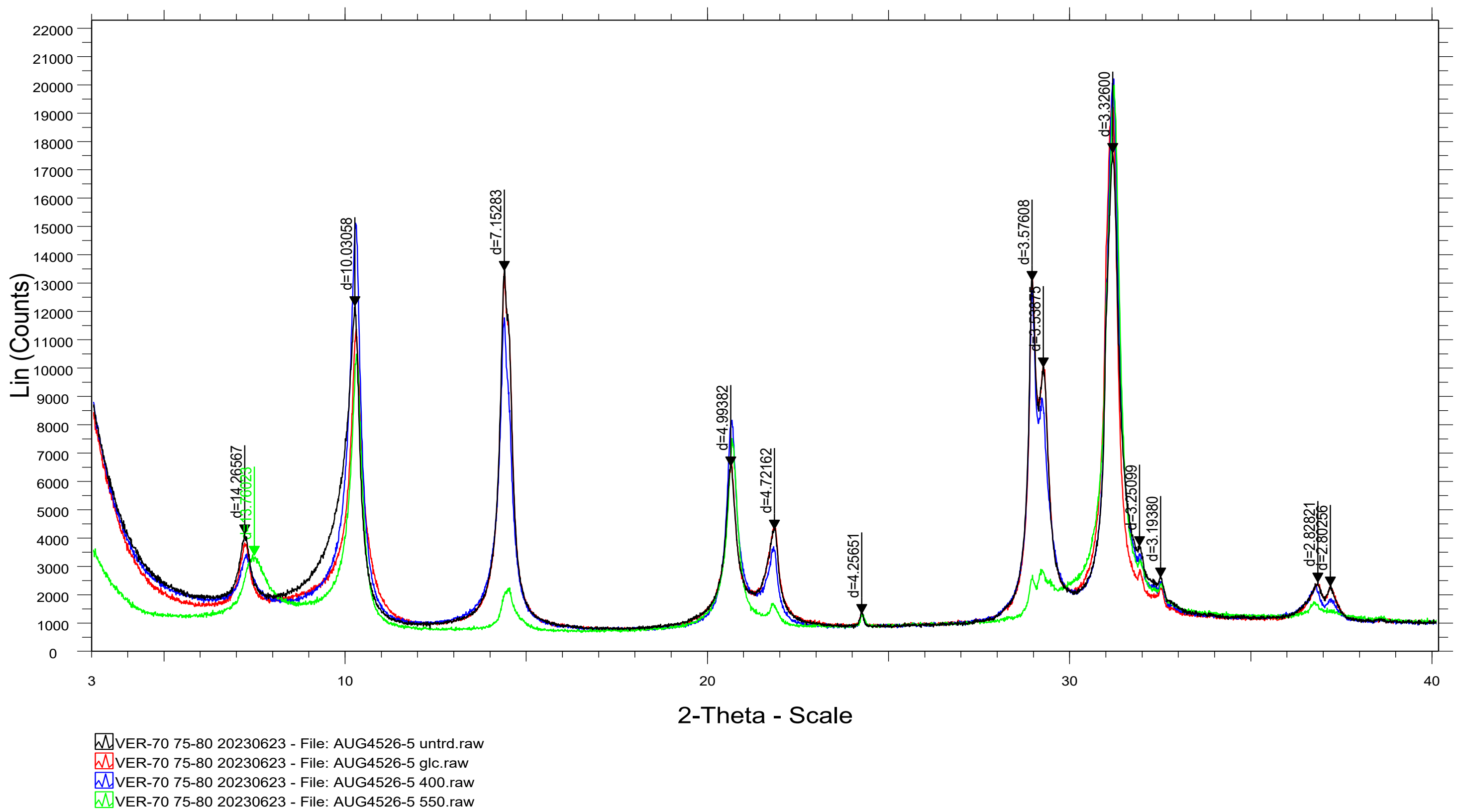
Environmental Services
Custom XRD/MI4526-AUG23
13-Sep-23

VER-70 75-80 20230623



Environmental Services
Custom XRD/MI4526-AUG23
13-Sep-23

VER-70 75-80 20230623



ATTACHMENT 5

PCA Data Input Summary

ELECTRONIC PCA DATA FOR ATTACHMENT 4
35 I.A.C. § 845: ALTERNATIVE SOURCE DEMONSTRATION
VERMILION POWER PLANT
NEW EAST ASH POND
OAKWOOD, IL

Well	HSU	Date	Well Type	pH (SU)	Alkalinity, bicarbonate (mg/L)	Barium (mg/L)	Boron (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Sulfate (mg/L)	TDS (mg/L)
16A	BCU	04/01/2021	Downgradient	7.50	390	0.261	0.675	40.8	131	0.77	31	662
16A	BCU	04/21/2021	Downgradient	7.20	407	0.335	0.613	71.1	106	0.64	78	692
16A	BCU	05/11/2021	Downgradient	7.40	361	0.245	0.807	36.6	139	0.78	16	582
16A	BCU	06/03/2021	Downgradient	7.26	405	0.272	0.716	51.6	128	0.68	47	680
16A	BCU	06/17/2021	Downgradient	7.40	406	0.251	0.746	42.2	144	0.78	30	630
16A	BCU	07/08/2021	Downgradient	7.31	404	0.249	0.768	38	151	0.77	24	688
16A	BCU	07/27/2021	Downgradient	7.45	390	0.248	0.794	35.3	163	0.84	16	662
16A	BCU	08/17/2021	Downgradient	7.50	393	0.261	0.755	33.3	176	0.84	11	654
16A	BCU	11/29/2023	Downgradient	7.66	400	0.33	0.76	37	160	0.82	4.1	770
16A	BCU	02/21/2024	Downgradient	7.68	380	0.34	0.62	30	140	0.87	5.2	650
35D	BCU	04/01/2021	Downgradient	8.20	707	0.111	2.0	112	529	0.76	1640	3830
35D	BCU	04/21/2021	Downgradient	7.76	533	0.0294	1.8	93.6	281	0.65	1220	2920
35D	BCU	06/03/2021	Downgradient	7.25	637	0.0546	2.5	98.1	461	0.75	1300	3240
35D	BCU	06/17/2021	Downgradient	7.25	603	0.1400	1.8	99.4	393	0.75	1320	3170
35D	BCU	07/08/2021	Downgradient	7.22	582	0.0297	1.9	86	372	0.74	1230	2910
35D	BCU	07/27/2021	Downgradient	7.37	507	0.0263	1.5	70.4	234	0.79	981	2320
35D	BCU	08/17/2021	Downgradient	7.30	491	0.0269	1.41	65.7	199	0.76	895	2090
35D	BCU	11/29/2023	Downgradient	7.34	680	0.029	2.4	120	470	0.65	1700	4300
35D	BCU	02/21/2024	Downgradient	7.42	630	0.026	2.1	110	440	0.7	1600	3900
70D	BCU	04/01/2021	Downgradient	7.60	262	0.336	0.712	39.6	317	0.76	53	792
70D	BCU	04/21/2021	Downgradient	7.28	334	0.5210	1.01	48.1	517	0.57	48	1150
70D	BCU	06/03/2021	Downgradient	7.03	416	0.687	1.56	68.6	665	0.47	48	1570
70D	BCU	06/17/2021	Downgradient	7.14	443	0.726	1.33	73.1	680	0.5	49	1600
70D	BCU	07/08/2021	Downgradient	6.85	527	0.954	1.58	82.5	735	0.41	49	1770
70D	BCU	07/27/2021	Downgradient	6.96	540	0.734	1.54	78.1	745	0.44	48	1830
70D	BCU	08/17/2021	Downgradient	6.84	610	0.761	1.54	91.5	716	0.36	50	1940
70D	BCU	11/29/2023	Downgradient	6.98	580	0.42	1.4	84	550	0.43	47	1800
70D	BCU	02/21/2024	Downgradient	6.91	490	0.68	1.5	84	730	0.4	43	1900
71D	BCU	04/01/2021	Downgradient	7.60	258	0.299	0.58	37.7	172	0.92	44	896
71D	BCU	06/17/2021	Downgradient	7.15	475	0.4	1.1	28.7	563	0.73	72	1640
71D	BCU	08/17/2021	Downgradient	6.95	628	0.677	1.3	34.9	674	0.56	63	1900
71D	BCU	11/29/2023	Downgradient	7.09	770	0.7800	1.5	45.0	800	0.47	53	2400
22	BCU	04/01/2021	Upgradient	7.40	390	0.0723	0.41	41.5	23	0.43	34	484
22	BCU	04/20/2021	Upgradient	7.58	407	0.0798	0.418	37.5	11	0.4	27	476
22	BCU	05/10/2021	Upgradient	7.29	395	0.0795	0.433	45.7	11	0.42	30	494
22	BCU	06/03/2021	Upgradient	7.26	390	0.0787	0.361	48.3	7	0.38	29	450
22	BCU	06/17/2021	Upgradient	7.23	406	0.079	0.377	50.3	7	0.39	30	468
22	BCU	07/08/2021	Upgradient	7.20	412	0.082	0.3	47.7	7	0.37	30	476
22	BCU	07/27/2021	Upgradient	7.34	401	0.0795	0.311	48.2	7	0.39	30	486
22	BCU	08/17/2021	Upgradient	7.26	402	0.0785	0.34	47.1	7	0.38	29	474
22	BCU	11/28/2023	Upgradient	7.51	400	0.084	0.3	44	6.4	0.36	26	490
22	BCU	02/21/2024	Upgradient	7.40	410	0.084	0.4	46	7.7	0.37	29	490
10	UCU	04/01/2021	Upgradient	6.80	550	0.079	0.0587	182	6	0.13	292	942
10	UCU	04/21/2021	Upgradient	6.80	546	0.047	0.0587	193	6	0.14	309	1080
10	UCU	05/10/2021	Upgradient	6.76	476	0.068	0.053	160	4	0.14	224	850
10	UCU	06/03/2021	Upgradient	6.74	579	0.0795	0.0835	186	5	0.14	317	980
10	UCU	06/17/2021	Upgradient	6.76	550	0.0625	0.111	186	6	0.14	272	946
10	UCU	07/08/2021	Upgradient	6.69	561	0.068	0.0499	166	5	0.13	328	988
10	UCU	07/27/2021	Upgradient	6.80	550	0.0712	0.237	182	4	0.14	338	1010
10	UCU	08/17/2021	Upgradient	6.69	582	0.0772	0.0695	192	5	0.13	296	970
10	UCU	11/28/2023	Upgradient	7.03	510	0.11	0.059	160	4.6	0.15	230	890
10	UCU	02/20/2024	Upgradient	6.82	540	0.076	0.068	180	3.5	0.13	300	1100
70S	UU	04/01/2021	Downgradient	7.00	310	0.02	0.457	253	19	0.14	760	1450
70S	UU	04/21/2021	Downgradient	6.94	270	0.0205	0.403	281	17	0.14	840	1580
70S	UU	05/10/2021	Downgradient	6.99	262	0.0185	0.382	270	16	0.14	779	1480
70S	UU	06/03/2021	Downgradient	6.91	272	0.0165	0.424	245	15	0.14	673	1350
70S	UU	06/17/2021	Downgradient	6.85	278	0.0187	0.363	250	15	0.15	730	1340
70S	UU	07/08/2021	Downgradient	6.80	305	0.0172	0.253	220	14	0.16	589	1220
70S	UU	07/27/2021	Downgradient	7.01	287	0.0148	0.556	229	11	0.17	541	1140
70S	UU	08/17/2021	Downgradient	6.87	272	0.0195	0.538	232	15	0.16	638	1250
70S	UU	11/29/2023	Downgradient	7.16	280	0.02	0.63	220	20	0.17	670	1500
70S	UU	02/21/2024	Downgradient	6.93	310	0.024	0.43	210	11	0.13	600	1200
71S	UU	04/01/2021	Downgradient	6.90	422	0.05	0.18	115	2	0.18	68	486
71S	UU	04/21/2021	Downgradient	6.73	419	0.05	0.22	116	3	0.17	68	500
71S	UU	05/12/2021	Downgradient	6.84	403	0.05	0.23	124	3	0.18	69	474
71S	UU	06/03/2021	Downgradient	6.71	419	0.04	0.23	116	2	0.18	60	484
71S	UU	06/17/2021	Downgradient	6.76	422	0.04	0.22	117	2	0.19	65	502
71S	UU	07/08/2021	Downgradient	6.60	462	0.05	0.17	128	2	0.19	46	490
71S	UU	07/27/2021	Downgradient	6.83	421	0.05	0.25	132	2	0.20	60	538
71S	UU	08/17/2021	Downgradient	6.73	442	0.07	0.27	122	3	0.19	69	534
NED1	CCR	04/01/2021	CCR	9.20	1.5	0.0324	18.6	497	44	0.32	1340	2340
NED1	CCR	04/21/2021	CCR	8.86	4	0.029	19.3	472	32	0.38	1230	2130
NED1	CCR	05/11/2021	CCR	7.88	132	0.029	14	674	18	0.2	1300	2170
NED1	CCR	06/04/2021	CCR	7.55	117	0.0319	13.5	532	18	0.24	1400	2340
NED1	CCR	08/17/2021	CCR	8.73	18	0.0314	18.3	531	25	0.29	1510	2350
NED1	CCR	11/29/2023	CCR	8.04	210	0.230	10	470	11	0.15	1300	2500
NED1	CCR	02/21/2024	CCR	7.78	100	0.130	10	470	13	0.099	1300	2200
ND3	CCR	03/31/2021	CCR	8.70	99	0.060	32	291	10	0.2	953	1680
ND3	CCR	04/21/2021	CCR	8.38	65	0.059	30.3	310	9	0.16	984	1740
ND3	CCR	05/11/2021	CCR	8.35	68	0.038	31	332	8	0.15	970	1720
ND3	CCR	06/03/2021	CCR	7.93	115	0.027	28.5	333	7	0.15	1040	1790
ND3	CCR	08/17/2021	CCR	7.94	120	0.064	29.4	344	6	0.17	1050	1680
ND3	CCR	06/20/2023	CCR	8.40	71	0.023	29	303	9	0.24	933	1500
ND3	CCR	02/20/2024	CCR	8.25	93	0.025	28	330	6.5	0.14	1100	1700
OED1	CCR	06/03/2021	CCR	10.00	1.5	0.039	45.5	886	5	0.1	1890	3240
OED1	CCR	06/16/2021	CCR	10.20	1.5	0.034	46.7	838	4	0.1	1930	3170
OED1	CCR	07/08/2021	CCR	10.30	1.5	0.031	46.7	810	3	0.1	1960	3170
OED1	CCR	07/27/2021	CCR	10.30	1.5	0.026	35	886	3	0.1	1950	3220
OED1	CCR	08/17/2021	CCR	10.10	1.5	0.039	39.5	828	2	0.1	1910	3060
OED1	CCR	06/20/2023	CCR	10.10	1.5	0.038	49.2	834	2	0.04	1860	3130

Notes:
mg/L = milligrams per liter
TDS= Total Dissolved Solids
SU= standard units
HSU = hydrostratigraphic unit
CCR = coal combustion residual
BCU = Bedrock Confining Unit
UCU = Upper Confining Unit
UU = Upper Unit
Non-detect values were replaced with half of detection limit.

ATTACHMENT 6

PCA Analyses - Well 35D Results Excluded

ATTACHMENT 6 – ADDITIONAL PCA ANALYSES

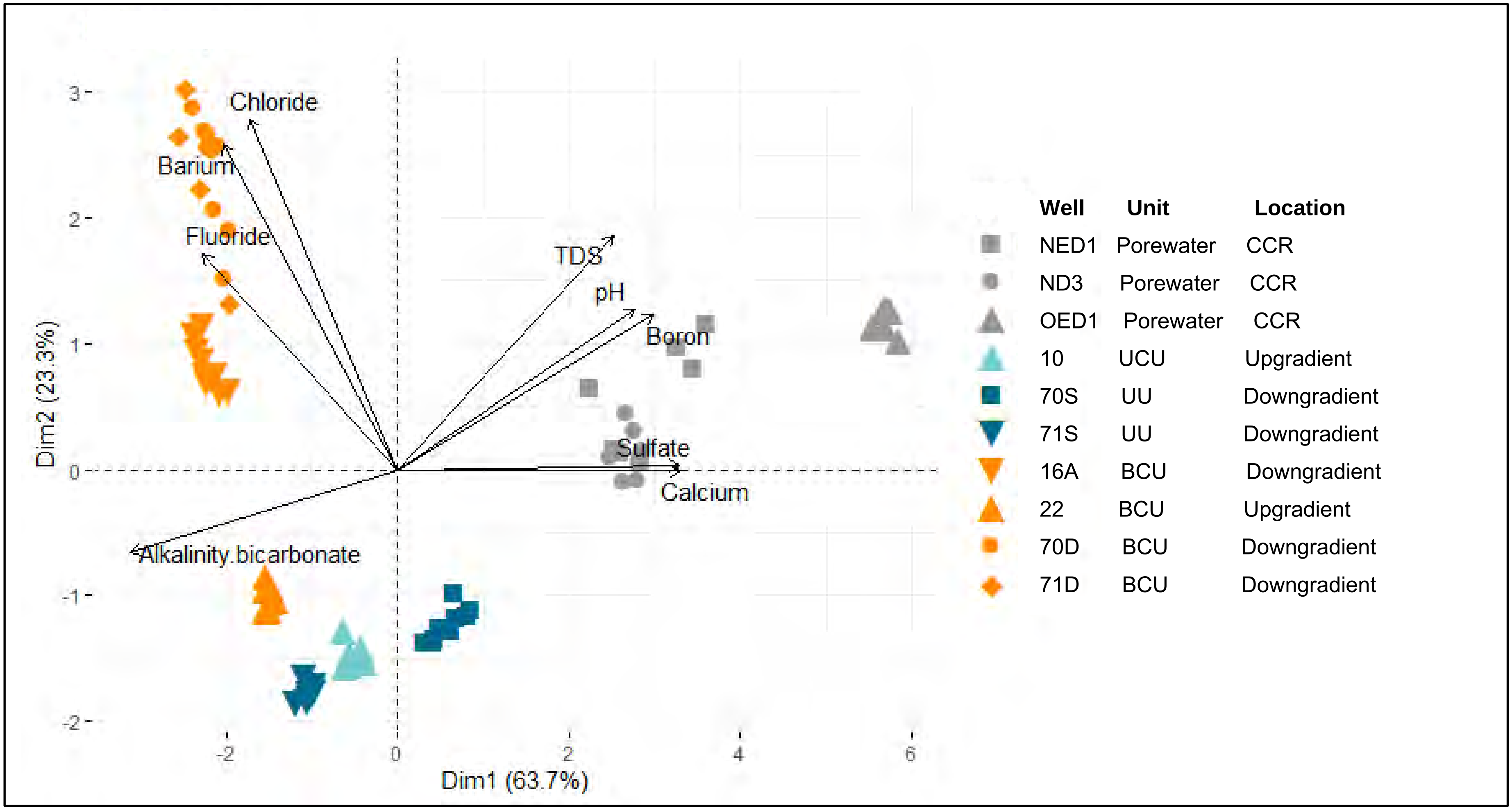
Due to anomalously high sulfate concentrations in well 35D[1], sulfate and TDS were excluded from both multivariate analyses described in the July 2024 *Evaluation of Alternative Sources for Total Dissolved Solids within Bedrock Solids* technical memorandum prepared by Geosyntec. Two additional scenarios which included sulfate and TDS but exclude 35D samples are presented herein. The evaluation included one analysis with porewater samples and one without porewater samples included.

The biplot for the scenario with porewater samples included is shown on **Attachment 6a** indicating that the porewater samples are clustered separately from the BCU, UCU, and UU samples. This finding is consistent with the scenario where both 35D and porewater samples were included (**Figure 3** of main text). As before, constituents such as boron and sulfate are responsible for the chemical signature of the porewater samples. The results of clustering analysis confirmed one cluster of porewater samples distinct from the combined BCU, UCU and UU groundwater sample cluster (**Attachment 6b**).

The biplot for the scenario without porewater samples is shown on **Attachment 6c** indicating that BCU samples cluster separately from the combined UCU and UU samples. This finding is consistent with the previous scenario where 35D samples were included and porewater was excluded (**Figure 6** of main text). Clustering, as shown in **Attachment 6d**, also confirmed distinct clustering of BCU samples from the UCU and UU samples.

These findings are consistent with the scenarios described in the main document, in which lithology is the main driver for the chemistry of the groundwater samples.

[1] Ramboll. 2023. *35 I.A.C. § 845.650(E): Alternative Source Demonstration – New East Ash Pond*. Vermilion Power Plant, Oakwood, Illinois. Ramboll Americas Engineering Solutions, Inc. December.



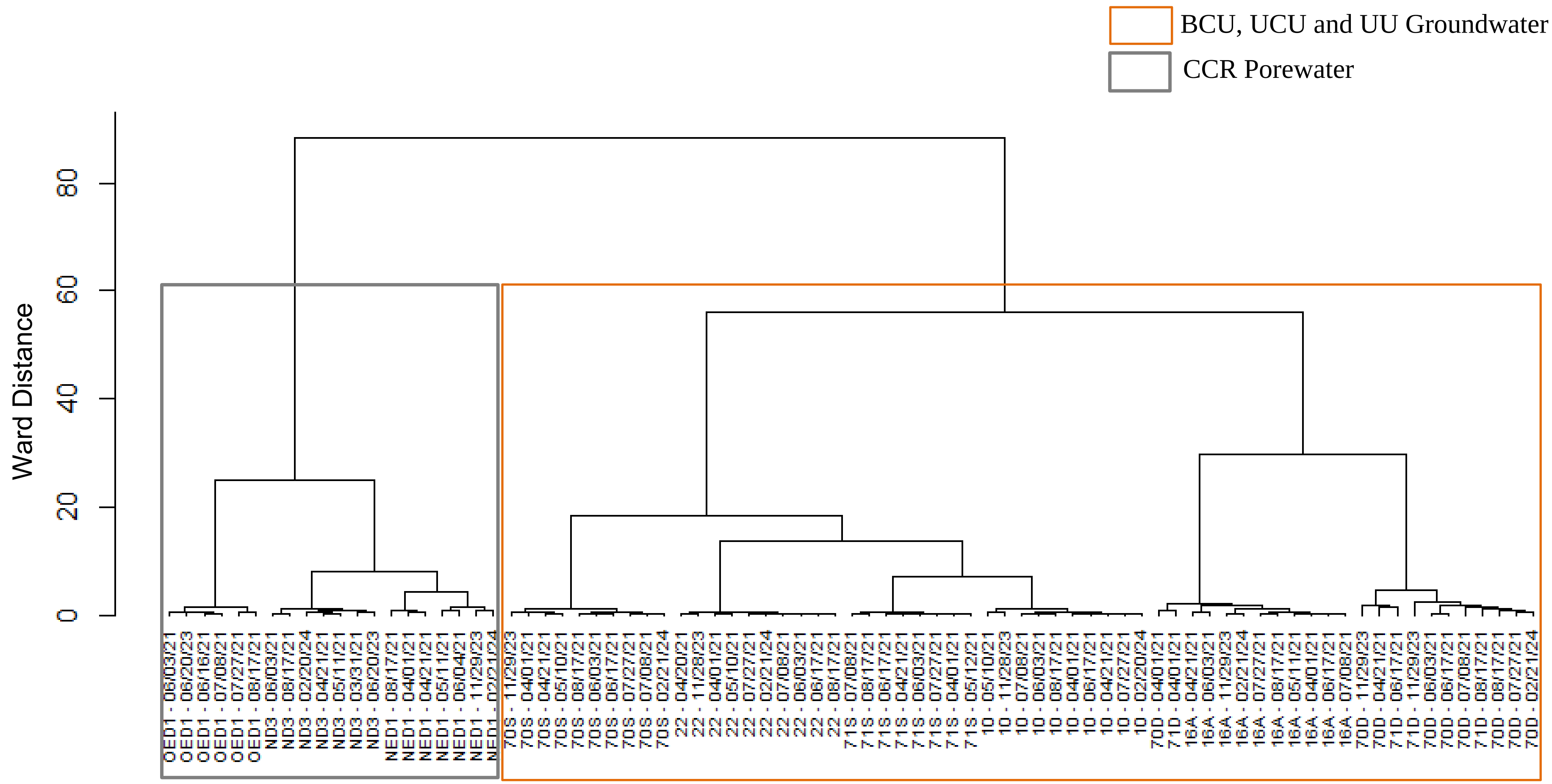
Notes:
1. The arrows signify the correlations between the constituents and the principal components.
2. Datapoints are colored based on hydrostratigraphic unit of sampling locations as follows:
   - Bedrock Confining Unit (BCU) wells: 16A, 22, 70D, 71D.
   - Upper Confining Unit (UCU) well: 10.
   - Upper Unit (UU) wells: 70S, 71S.
   - Coal Combustion Residual (CCR) well: NED1, ND3, OED1.

Principal Components Analysis Biplot
(35D Excluded)
Vermilion Power Plant – New East Ash Pond

Geosyntec consultants

Attachment **6a**

Columbus, Ohio | July 2024



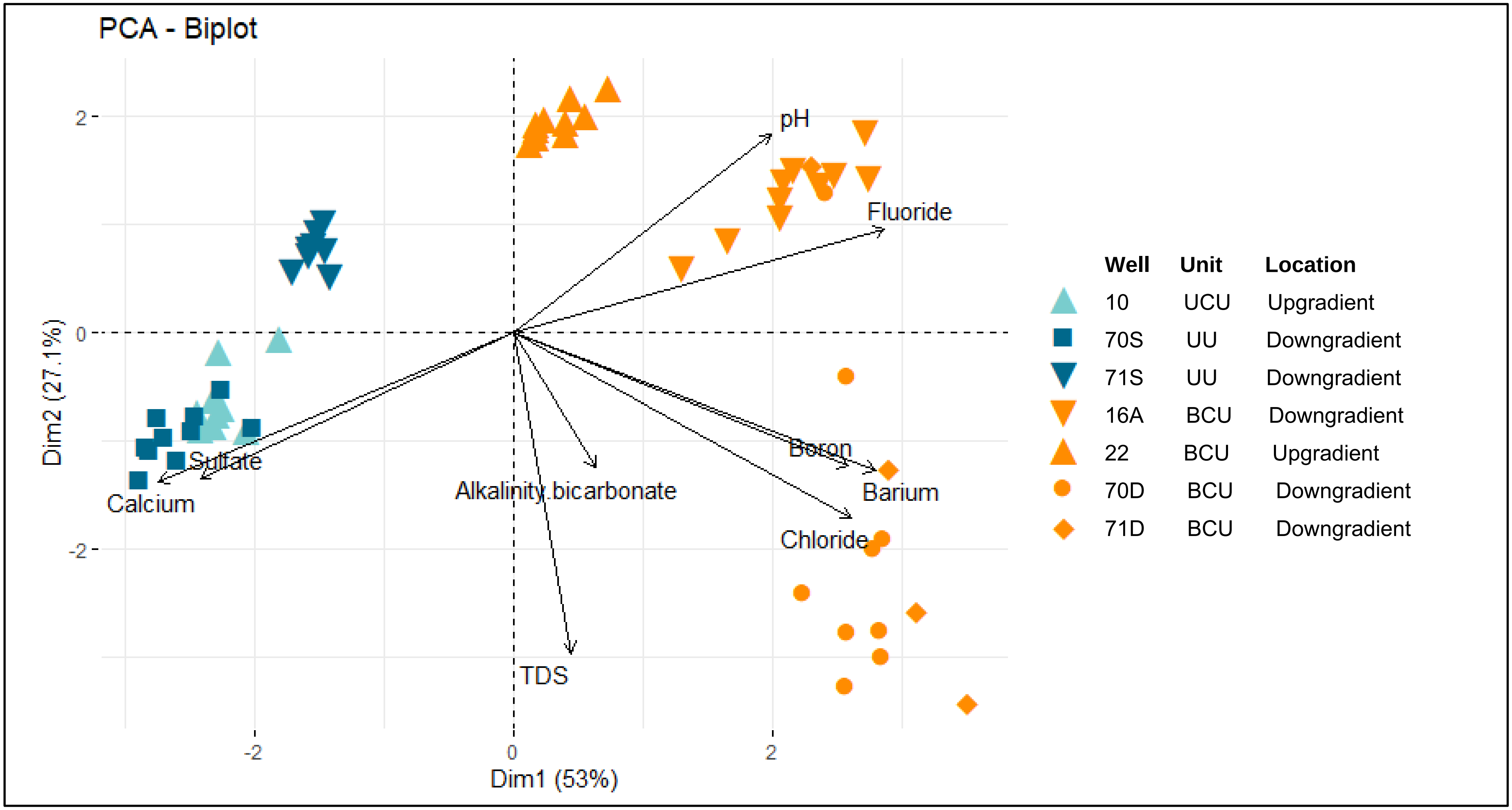
Notes:
1. The cluster analysis used Euclidean distances, and Ward's method as the clustering algorithm.
2. In the dendrogram, samples on the same branch are more similar to each other. The samples with the highest similarity are on the closest branches.
3. The boxes around the branches represent the two clusters into which samples from each source grouped.
4. BCU, UCU, UU and CCR refer to Bedrock Confining Unit, Upper Confining Unit, Upper Unit, and Coal Combustion Residual, respectively.

Dendrogram Graph from Cluster Analysis (35D Excluded)
Vermilion Power Plant – New East Ash Pond

Geosyntec consultants

Attachment
6b

Columbus, Ohio | July 2024



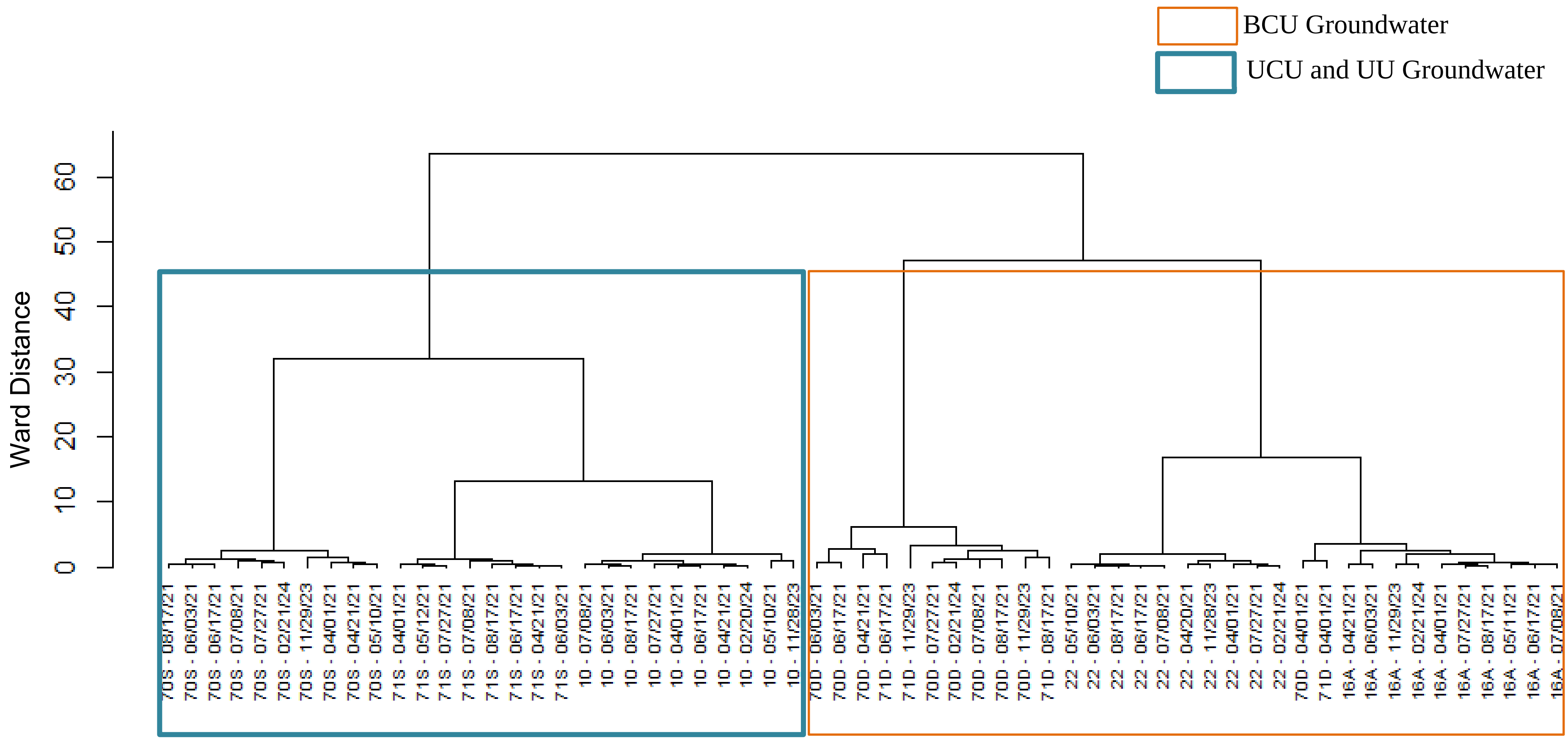
Notes:
1. The arrows signify the correlations between the constituents and the principal components.
2. Datapoints are colored based on hydrostratigraphic unit of sampling locations as follows:
   - Bedrock Confining Unit (BCU) wells: 16A, 22, 70D, 71D.
   - Upper Confining Unit (UCU) well: 10.
   - Upper Unit (UU) wells: 70S, 71S.

Principal Components Analysis Biplot
(Porewater Wells and 35D are Excluded)
Vermilion Power Plant – New East Ash Pond

Geosyntec consultants

Columbus, Ohio | July 2024

Attachment
6c



Notes:
1. The cluster analysis used Euclidean distances, and Ward's method as the clustering algorithm.
2. In the dendrogram, samples on the same branch are more similar to each other. The samples with the highest similarity are on the closest branches.
3. The boxes around the branches represent the two clusters into which samples from each source grouped.
4. BCU, UCU and UU refer to Bedrock Confining Unit, Upper Confining Unit, and Upper Unit, respectively.

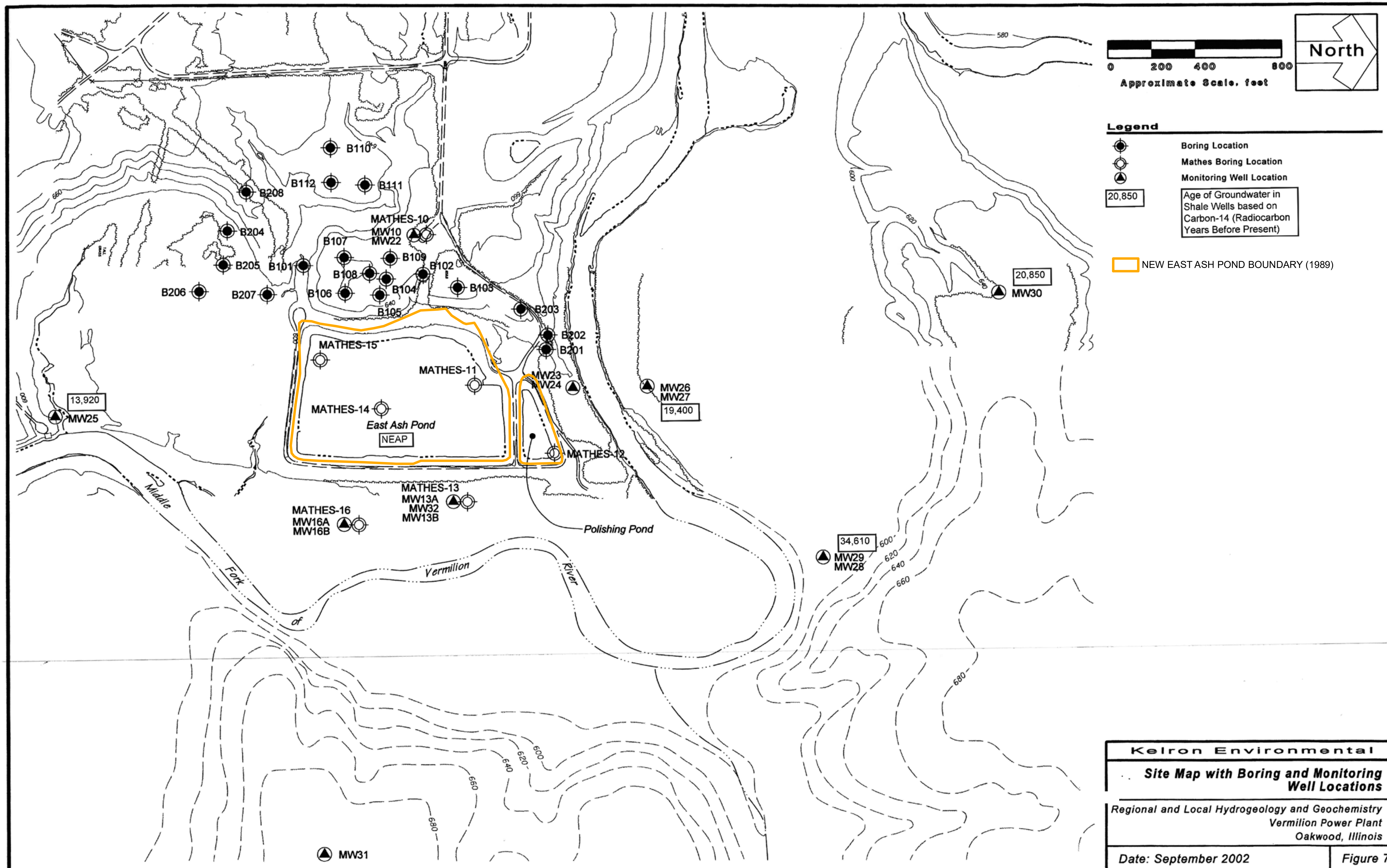
Dendrogram Graph from Cluster Analysis (Porewater Wells and 35D Excluded)
Vermilion Power Plant – New East Ash Pond

Geosyntec consultants

Columbus, Ohio | July 2024

Attachment **6d**

APPENDIX D
FIGURES 7, 9, AND 28 AND TABLE 6 FROM KELRON, 2003



Kelron Environmental

Site Map with Boring and Monitoring Well Locations

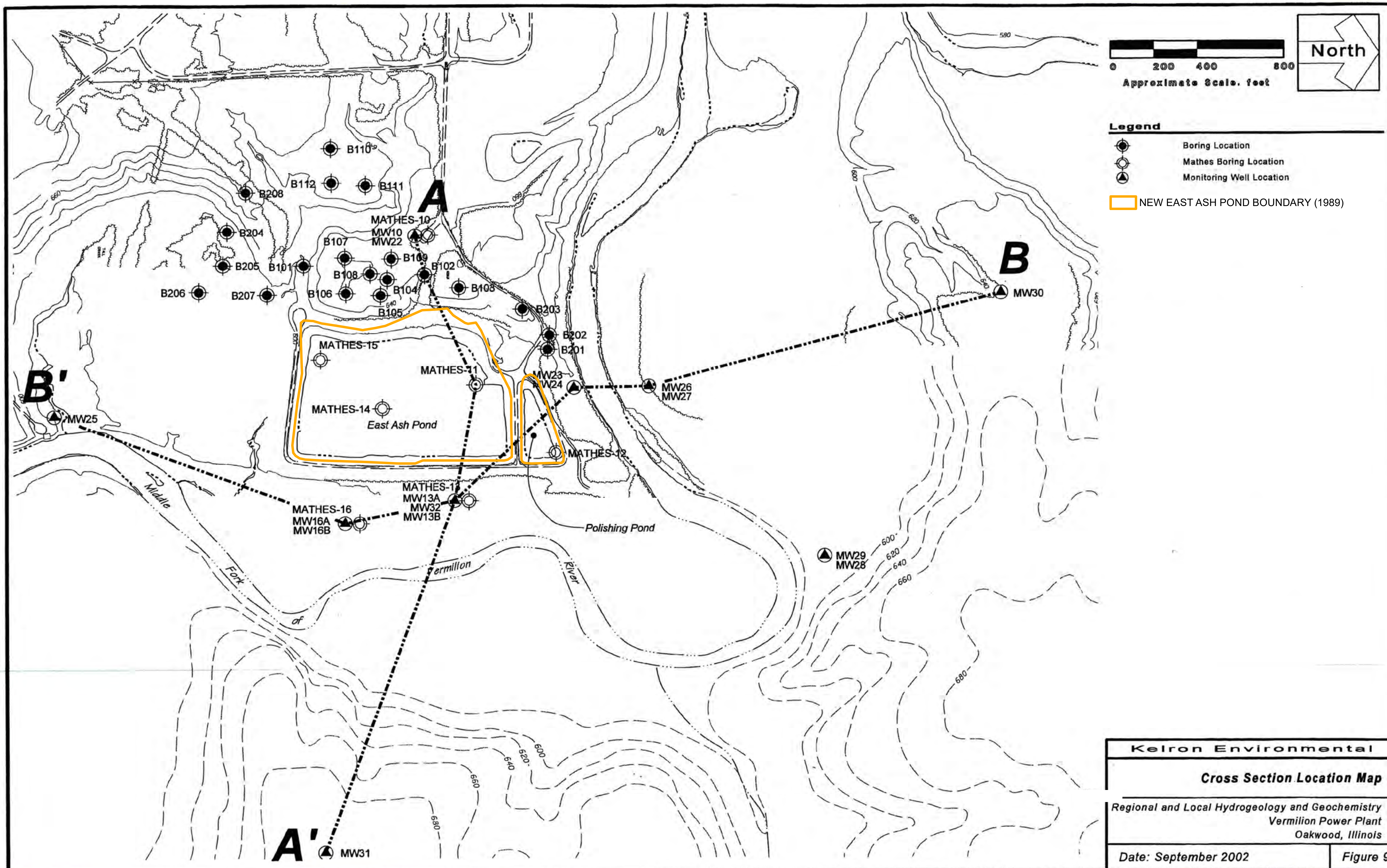
Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002 | Figure 7

Y:\Mapping\Projects\22\2285\MXD\Alt_Source_Dem\Vermilion\NEAP_912\E003\appendix\AppD Figure 7. Monitoring Well Location Map Carbon14.mxd

PROJECT: 169000XXXX | DATED: 5/2/2024 | DESIGNER: galarnmc

Service Layer Credits:



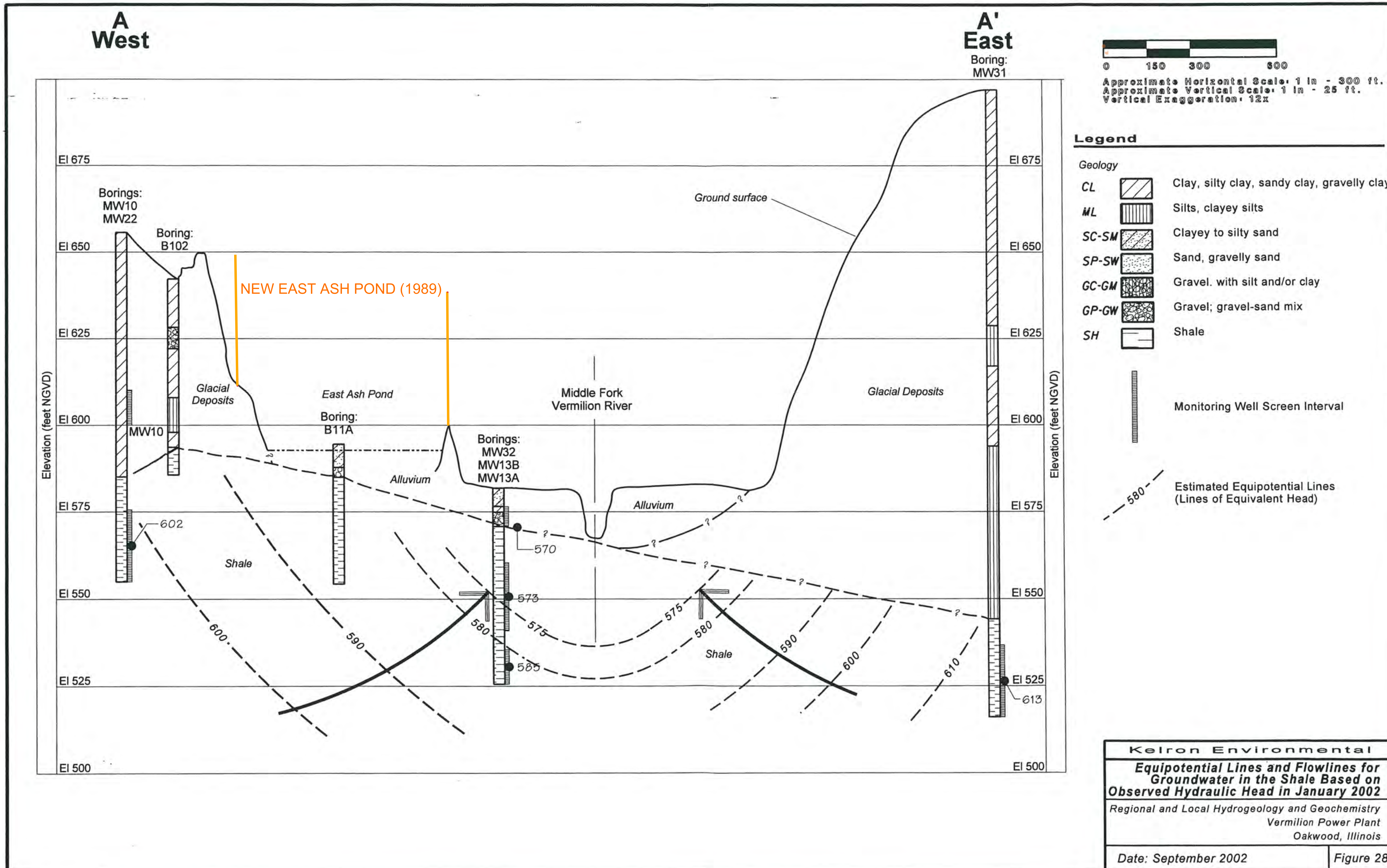
Kelron Environmental

Cross Section Location Map

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002

Figure 9



A
West
A'
East
Boring:
MW31
0 150 300 600
Approximate Horizontal Scale: 1 in = 300 ft.
Approximate Vertical Scale: 1 in = 25 ft.
Vertical Exaggeration: 12x
Legend
Geology
CL Clay, silty clay, sandy clay, gravelly clay
ML Silts, clayey silts
SC-SM Clayey to silty sand
SP-SW Sand, gravelly sand
GC-GM Gravel. with silt and/or clay
GP-GW Gravel; gravel-sand mix
SH Shale
Monitoring Well Screen Interval
580
Estimated Equipotential Lines (Lines of Equivalent Head)
Elevation (feet NGVD)
El 675
El 650
El 625
El 600
El 575
El 550
El 525
El 500
Borings:
MW10
MW22
Boring:
B102
NEW EAST ASH POND (1989)
Ground surface
Glacial Deposits
East Ash Pond
Boring:
B11A
Middle Fork
Vermilion River
Glacial Deposits
MW10
Alluvium
Borings:
MW32
MW13B
MW13A
Alluvium
602
570
Shale
573
575
585
580
600
590
575
580
590
600
610
Shale
613
Kelron Environmental
Equipotential Lines and Flowlines for Groundwater in the Shale Based on Observed Hydraulic Head in January 2002
Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois
Date: September 2002
Figure 28

Table 6. Vertical Groundwater Gradients in Shale and Between Shale and Alluvium

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

Monitoring Wells for Gradient Calculations with Screened Formations		Groundwater Level Measurement Date During 2002								8-month Average
		22-23 Jan	18-Feb	19-21 March	16-17 April	22-May	18-Jun	16-Jul	27-Aug	
MW13B alluvial	MW13A shale	alluvial dry	**-0.048**	**-0.048**	**-0.041**	0.003	**-0.044**	**-0.061**	**-0.064**	**-0.043**
MW13A shale	MW32 shale	**-0.615**	**-0.605**	**-0.598**	**-0.612**	**-0.588**	**-0.619**	**-0.524**	**-0.523**	**-0.585**
MW16B alluvial	MW16A shale	alluvial dry	alluvial dry	0.031	0.040	alluvial dry	**-0.012**	alluvial dry	alluvial dry	0.020
MW23 alluvial	MW24 shale	0.317	0.386	0.351	0.355	0.346	0.294	0.284	0.275	0.326
MW26 alluvial	MW27 shale	**-0.053**	**-0.020**	0.001	0.008	0.032	**-0.010**	**-0.048**	**-0.052**	**-0.018**
MW28 alluvial	MW29 shale	**-0.240**	**-0.231**	**-0.222**	**-0.223**	**-0.213**	**-0.240**	**-0.251**	**-0.204**	**-0.228**

Notes:
-0.615 Vertical gradient is upwards between the screened well intervals and formations indicated.
0.386 Vertical gradient is downwards between the screened well intervals and formations indicated.
alluvial dry Shallow alluvial monitoring well did not have a measurable water level on the date indicated.

Exhibit C

DECLARATION OF MELINDA W. HAHN, PhD

In support of Dynegy Midwest Generation, LLC's (DMG's) Petition for Review of IEPA's Non-concurrence with the Vermilion Alternative Source Demonstration dated September 30, 2024.

I, Dr. Melinda W. Hahn, declare and state as follows:

Introduction

1. I am an Environmental Engineer and Principal with BBJ Group LLC. Attachment A is a true and accurate copy of my Curriculum Vitae.

2. I hold a PhD in Environmental Engineering from Johns Hopkins University. The focus of my research for my PhD dissertation was contaminant transport in porous media (e.g., groundwater).

3. My practice over my 25-year career includes site investigation and remediation in multiple state and federal programs, such as voluntary remediation, Resource Conservation and Recovery Act (RCRA) corrective action, and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response action. My work in these programs includes contaminant fate and transport modelling, site investigation and remediation, and statistics and forensic

analysis of environmental contamination data. I have evaluated sites from many different industrial sectors with many different contaminants of concern, including volatile organic compounds (VOCs), which includes chlorinated volatile organic compounds (CVOCs), semivolatile organic compounds (SVOCs), metals, polychlorinated biphenyls (PCBs), and dioxins/furans.

4. To prepare this Declaration, I reviewed the DMG December 1, 2023 Alternative Source Demonstration (ASD) Report for lithium, chloride, sulfate and total dissolved solids (TDS) observed in groundwater from bedrock wells 35D and 70D at the Vermilion Power Plant (VPP) New East Ash Pond (NEAP); the December 28, 2023 IEPA denial of the December 2023 ASD; the July 24, 2024 ASD Report for TDS in NEAP bedrock well 70D; the August 22, 2024 IEPA denial of the July 2024 ASD; and supporting information for both ASDs. I reviewed the documents submitted by DMG independently and was not personally involved in their preparation.

5. The July 2024 ASD report addresses a new exceedance of TDS above its Groundwater Protection Standard (GWPS) observed in groundwater in compliance bedrock well 70D in the 1st quarter of 2024.[1] The ASD report relies on a multiple lines of evidence (MLE) approach that is standard practice in causal

[1] Ramboll, Groundwater Monitoring Data and Exceedances Report, 1st Quarter 2024, New East Ash Pond, Vermilion Power Plant May 25, 2024, Table 2.

determinations in environmental forensic analysis, risk assessment, and site investigation.[2,3,4,5,6] The MLE approach involves analysis of multiple independent sets of data to test whether an identified source can explain observed data. Information to consider can be site-specific, regional, or from the literature.[7,8] These independent lines of evidence are developed until sufficient confidence is achieved to either confirm or rule out a source.[9] The lines of evidence (LOE) presented in the July 2024 Vermilion ASD demonstrate that a source other than the NEAP is causing the TDS exceedance in bedrock well 70D, and the NEAP is not the source of or contributing to the observed exceedance. The presented LOEs include the following:[10]

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2 Miller, J. Methods and Advances in the Forensic Analysis of Contaminated Rivers, E3S Web of Conferences Vol. 125, 2019, p. 3.

3 U.S. EPA, U.S. Navy SPAWAR Systems Center, GeoChem Metrix Inc., and Battelle Memorial Institute, A Handbook for Determining the Sources of PCB Contamination in Sediments, Technical Report, TR-NAVFAC EXWC-EV-1302, October 2012, p. 13.

4 U.S. EPA, Office of the Science Advisor, Risk Assessment Forum, Weight of Evidence in Ecological Assessment, EPA/100/R-16/001, December 2016.

5 U.S. EPA, Office of Solid Waste and Emergency Response, OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor in Indoor Air, June 2015, pp. xv-xvii, 17-18, 38-40, 60-61, 117-123.

6 EPRI, Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites, 2017 Technical Report, p. viii.

7 U.S. EPA, Office of the Science Advisor, Risk Assessment Forum, Weight of Evidence in Ecological Assessment, EPA/100/R-16/001, December 2016, p. 20 et seq.

8 U.S. EPA, U.S. Navy SPAWAR Systems Center, GeoChem Metrix Inc., and Battelle Memorial Institute, A Handbook for Determining the Sources of PCB Contamination in Sediments, Technical Report, TR-NAVFAC EXWC-EV-1302, October 2012, p. 30.

9 Miller, J. Methods and Advances in the Forensic Analysis of Contaminated Rivers, E3S Web of Conferences Vol. 125, 2019, p. 3.

10 Ramboll, Alternative Source Demonstration Report, New East Ash Pond, Vermilion, December 1, 2023, p. 8.

LOE 1 – The ionic composition of bedrock groundwater is different than the ionic composition of NEAP, OEAP, and NAP porewater and consistent with published observations for Pennsylvanian Bedrock.

LOE 2 – Concentrations of chloride in the NEAP, OEAP, and NAP porewater are lower than those observed in the groundwater from compliance well 70D.

LOE 3 – A bedrock solids and geochemical evaluation identified naturally occurring shales as the source chloride, and thus the TDS exceedance, at compliance well 70D.

LOE 4 – Bedrock groundwater is only slightly connected or completely isolated from the groundwater in the quaternary deposits based on isotopic analysis, observed hydraulic gradients, and hydraulic conductivity of associated hydrostratigraphic units.

6. These lines of evidence are the same that were presented in the December 2023 ASD report for chloride exceedances in compliance wells 35D and 70D. However, the July 2024 ASD presents additional data that further demonstrate the lack of hydraulic connection, and consequently lack of a migration pathway, from the NEAP to the bedrock confining unit (the BCU) including:

a) Additional observations of upward gradients in the BCU measured by the ISGS (Kelron, 2003);

b) A lack of BCU groundwater elevation change in response to precipitation events and changes in the Middle Fork River stage, whereas upper unit (UU) alluvial deposit water levels vary with this activity (Kelron 2003); and

c) Measured BCU vertical hydraulic conductivity values that are four orders of magnitude lower (10,000 times lower) than those in the UU alluvial deposits, indicating a preferential flow path horizontally through the UU rather than vertically to and through the BCU (Kelron 2003 and Ramboll 2021).

7. My February 2, 2024 Declaration (provided as Attachment B) in support of the December 2023 ASD lines of evidence that demonstrate that the NEAP was not the source of and did not contribute to chloride exceedances in the BCU also applies to the current TDS exceedance in BCU well 70D because chloride is the major contributor to TDS in the BCU groundwater.[11] The December 2023 ASD relied on a comparison of the geochemistry of the BCU groundwater and the NEAP porewater to show that the chemical signatures are distinct and unrelated. Further, the chloride concentrations in the BCU were significantly higher than those observed in the NEAP porewater, ruling out the NEAP as the source due to the principle of conservation of mass (solute concentrations necessarily decrease moving downgradient). Tritium isotopic analysis revealed that the BCU

[11] Ramboll, Alternative Source Demonstration Report, New East Ash Pond, Vermilion, December 1, 2023, Figure A.

groundwater is much older than the UU, which further supports the hydraulic separation of the units. Finally, the December 2023 ASD identified the naturally occurring shale bedrock as the source of chloride, and hence, TDS at well 70D.

IEPA Denial

8. In its August 22, 2024 letter, the IEPA denied the July 2024 Vermilion ASD due to the following perceived data gap:

a) Lack of analysis of chloride from the coal combustion residuals in the NEAP. Source characterization of the CCR at NEAP must include total solids leachate [synthetic precipitation leaching procedure (SPLP)] sampling in accordance with the waste characterization and/or fate and transport characterization required in 35 Ill. Adm. Code 845 and analyzed in accordance with SW846.

9. In its stated data gap, IEPA is requesting laboratory leach testing of solid CCR samples by Synthetic Precipitation Leaching Procedure (SPLP). Neither total solids leachate testing in general nor total solids leachate testing specifically by SPLP is required by 35 Ill. Adm. Code 845 for any purpose, including development of an ASD. Leach testing by SPLP is a one-day batch test that allows 100 g of solid sample to be in contact with a larger volume of water at a slightly acidic pH to simulate natural rainwater.[12] The liquid-to-solid ratio used is approximately 20:1.

[12] The Florida Center for Solid and Hazardous Waste Management, A Guide to the Use of Leaching Tests in Solid Waste Management Decision Making, March 2003.

The resulting leachate is filtered using a 0.6 to 0.8 um glass fiber filter. These conditions differ from those in a CCR surface impoundment where the CCR is in contact with less water and the leachate can be more acidic or also caustic. NEAP porewater samples are collected from the interstitial water (at much lower liquid-to-solid ratio) within the CCR near the base of the surface impoundment from a monitoring well using the low-flow sampling technique. The sampled water is not filtered prior to analysis. The lower liquid-to-solid ratio (less dilution), the longer contact time, the likelihood of more extreme pH driving metal solubility, and the lack of filtration will result in higher porewater constituent concentrations relative to SPLP results. Porewater sample results are more reflective of actual conditions, and result in more conservative (higher) leachate estimates, so they are the best representation of CCR leachate at field scale available to DMG.

10. The landfill literature also reflects the conclusion that SPLP testing is not a good substitute for field-scale data. Synthetic laboratory leach tests on a solid sample (such as SPLP) aim to simulate a landfill environment in order to predict leachate quality from a solid sample. Synthetic leach test results are compared to actual field leachate data for fly ash and slag in order to evaluate the representativeness of their results, i.e., field verification.[13] U.S. EPA advises that

[13] Tiwari, M.K., et al, Suitability of Leaching Test Methods for Fly Ash and Slag: A Review, Journal of Radiation Research and Applied Sciences, Vol.8, 2015. pp. 523-537.

these "batch" 1-day laboratory tests on a relatively small sample do not account for the long-term climatic and meteorological influences on a full-scale landfill operation.[14] These tests often yield high initial concentrations that are not typical of a full-scale operation.[15] Other researchers evaluating the utility of the synthetic precipitation leaching procedure (SPLP) to assess the risk of groundwater contamination posed by the land application of granular solid waste report that the use of a total pollutant concentration (mg/kg) in conjunction with SPLP concentrations (milligrams per liter [mg/L]) to estimate pore water concentration was unreliable as this method underestimates the measured porewater concentrations.[16] For the NEAP, lower estimated leachate concentrations of chloride would make the likelihood that the NEAP is the source of the TDS exceedance at well 70D even more remote.

11. Clearly, directly measuring CCR analyte concentrations in actual porewater samples from the actual disposal environment is a more accurate basis for an impact analysis/ASD than using laboratory predictions of those values. The Vermilion NEAP CCR, leachate, and adjacent groundwater quality have been adequately characterized for performing an ASD. Data from the NEAP, OEAP, and

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[14] U.S. EPA Office of Solid Waste and Emergency Response, Solid Waste Disposal Criteria, Technical Manual, EPA530-R-93-017, p. 125.

[15] *Ibid.*

[16] Townsend, T, et al, Interpretation of Synthetic Precipitation Leaching Procedure (SPLP) Results for Assessing Risk to Groundwater from Land-Applied Granular Waste, Environmental Engineering Science, Vol. 23, No. 1, 2005.

NAP porewater samples relied upon in the July 2024 ASD Report[17] are sufficient to define the strength and variability of source water for this assessment. Collection of additional CCR source characterization data suggested in IEPA's August 22, 2024 letter is not required for the ASD by Part 845 or Part 257 and would not change the conclusion of the ASD that the CCR in the NEAP did not cause or contribute to the noted exceedance. In fact, SPLP data would reinforce the conclusion of the ASD report because they would indicate that the NEAP is even more unlikely to have caused the exceedance at well 70D.

I declare under penalty of perjury that the foregoing is true and correct.

Dated: September 30, 2024

____

Melinda W. Hahn, PhD

[17] Ramboll, Alternative Source Demonstration Report, New East Ash Pond, Vermilion Power Plant, July 24, 2024.

ATTACHMENT A

Curriculum Vitae of Melinda Hahn, PhD

MELINDA HAHN, PhD
PRINCIPAL SCIENTIST

Education

B.S., Mathematics, Department of Natural Science, The University of Texas at Austin, 1990

B.S., Physics, Department of Natural Science, The University of Texas at Austin, 1990

Ph.D., Environmental Engineering, Department of Geography and Environmental Engineering, The Johns Hopkins University, 1995

Academic Honors

National Science Foundation Graduate Fellow (1992 – 1995)

Most Distinguished Environmental Engineering Dissertation, American Association of Environmental Engineering Professionals

Professional Training

OSHA 40-Hour Health and Safety Course for Hazardous Waste Sites

Operations and Annual 8-Hr Refresher course (HAZWOPER)

GENERAL CAREER BACKGROUND

Dr. Hahn joined BBJ Group in 2024, where she currently serves as a Principal Scientist, working on site investigation, remediation, and litigation projects involving soil, groundwater and sediment contamination. Prior to that, she was a Senior Manager for ENVIRON and Ramboll Americas Engineering Solutions. Dr. Hahn started her career at ERM North Central in Deerfield, Illinois, and has served Midwest and national clients for more than 25 years.

REPRESENTATIVE CLIENT EXPERIENCE

Dr. Hahn's practice areas include site investigation and remediation, contaminant fate and transport modelling, statistics of environmental data, forensic analysis, and litigation support, including primarily toxic tort, environmental liability and cost allocation. Regulatory areas include RCRA, CERCLA, TSCA, Coal Combustion Residuals and Voluntary Cleanup/Risk-Based Corrective Action. Dr. Hahn has experience in the following industry categories: energy (electric utilities, petroleum dispensing, pipeline operations, former manufactured gas plant sites), industrial equipment manufacturing, metal working and metal recycling, automobile manufacturing, ink and chemical manufacturing, wood treating, mining, cement manufacturing, milling and smelting operations, secondary aluminum production, and dry cleaning.

GEOGRAPHICAL AREAS OF EXPERTISE

Dr. Hahn has completed projects in many states, including Alabama, California, Connecticut, Delaware, Louisiana, Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Oregon, Tennessee, Texas, and Wisconsin, Europe and the British Virgin Islands.

EXAMPLE PROJECTS

- Provided technical litigation support for over 50 matters regarding extent, severity, timing, and source of soil, sediment, air and ground water contamination, necessity for and costs of remediation, toxic tort liability, Superfund cost allocation (including consistency with the NCP), insurance cost recovery, and the siting and monitoring of a hazardous waste landfill. The regulatory frameworks included Illinois Voluntary Cleanup Program, Illinois Leaking Underground Storage Tank Program, RCRA, CERCLA, TSCA, NCP, and California Proposition 65. Contaminants of concern included chlorinated solvents, metals, PCBs, pesticides, dioxins/furans and PFAS. Completed projects in more than twenty states, with a focus in the Midwest.

- Provided expert testimony in matters involving Superfund cost allocation, statistics of environmental data, and contaminant fate and transport.
- Provided strategic support for sites undergoing investigation and remediation where multiple on- and off-site sources are in play.
- Provided litigation support for environmental liability/cost allocation mediation and litigation at several large sediment sites. Evaluated historical information on industrial processes and discharges, and conducted forensic/statistical analysis to estimate the relative contribution of contaminants to sediments.
- Provided litigation support for a number of insurance cost recovery projects, including a former wood treating facility, a jewelry manufacturer, metal plating facility, machine shop and dry cleaner. Tasks included the identification of likely sources and timing of contamination.
- Provided litigation support to a PRP for a municipal wellfield with chlorinated solvent contamination, including analysis of source areas and migration pathways. Completed an estimate of relative cost allocation between sources based on soil and groundwater data, and groundwater flow and contaminant transport modeling.
- Provided strategic support to a PRP responding to a release of chlorinated solvents and PFAS at a manufacturing site and off-site disposal area.
- Provided strategic support to a PRP in responding to a release of chlorinated solvent in an area with complex hydreogeology and deep municipal water supply wells contaminated with coal tar compounds, chlorinated solvents, 1,4-dioxane and PFAS.
- Evaluated claims of residents living near a scrap metal facility of transport and deposition of lead-containing particles in their homes using statistical analysis of plaintiffs' chemical data. Provided expert testimony based on this analysis.
- Evaluated the hydrogeological setting of a proposed petroleum pipeline pumping station and estimated the likelihood of a release and groundwater contamination. Provided expert testimony based on this analysis.
- Provided expert testimony on proposed coal ash impoundment closure regulations and proposed new state groundwater standards in Illinois.
- Retained as an expert on environmental fate and transport and environmental liability for arsenic at an urban inorganic pesticide manufacturing site.
- Conducted environmental forensic evaluations to determine sources of observed environmental contamination in soil, groundwater, sediment and sub-slab/indoor air for sites in litigation and pre-litigation phases.
- Performed multivariate statistical analyses of data for forensic analysis, for contaminant ecological impact analysis, to determine appropriate remedial objectives, and as part of human health and ecological risk assessments.

- Lead RCRA Corrective Action at a former manufacturing facility.
- Directed and assisted in the closure of a number of sites in the Illinois Voluntary Cleanup Program and the Illinois Leaking Underground Storage Tank Program.
- Evaluated the potential contribution of urban industrial sources of heavy metals to urban soil and sediments using both simple data comparisons and multivariate statistical techniques.
- Performed ground water and contaminant fate and transport modeling using MODFLOW and MT3D for use as a Superfund cost allocation tool in support of expert testimony. Relative mass of TCE from two PRP's properties was used as a basis for cost allocation. A Monte Carlo analysis was also performed to evaluate the sensitivity of the proposed allocation to changes in key variables.
- Performed Monte Carlo analysis of risk to ground water posed by a proposed petroleum pipeline in support of expert testimony. The analysis examined the likelihood of the exceedance of the Illinois Class I ground water standard for benzene per mile of proposed pipeline.
- Performed Monte Carlo cost allocation among four PRPs for a Superfund Site in support of expert testimony. Total volume, volume of hazardous substances, and volume of drummed materials were considered.
- Performed research and analysis of remedial activities and associated costs to determine compliance with the NCP for cost recovery matters for a number of sites.

PUBLICATIONS AND PRESENTATIONS

1993
Stochastic Models of Particle Deposition in Porous Media
Paper presented at the 1993 Midwest Regional Conference on Environmental Chemistry, University of Notre Dame
Authors: Hahn, M.W., and C. F. O'Melia

1994
Deposition and Reentrainment of Particles in Porous Media
Poster presented at the 1994 Gordon Research Conference on Environmental Science, Water, New Hampshire
Authors: Hahn, M.W., D. Abadzic, and C. R. O'Melia

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Presented at the 1994 ASCE National Conference, Boulder, Colorado
Authors: Hahn, M.W., D. Abadzic, and C. R. O'Melia

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Authors: Hahn, M.W., D. Abadzic, and C. R. O'Melia

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Deposition and Reentrainment of Brownian Particles under Unfavorable Chemical Conditions
Doctoral Dissertation, Johns Hopkins University
Author: Hahn, M.W.

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Some Effects of Particles Size in Separation Processes Involving Colloids
Wat. Sci. Tech. Vol. 36, No. 4 pp. 119–126
Authors: O'Melia, C.R., M.W. Hahn, and C. Chen

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Authors: Millano E.F. and M.W. Hahn

1998
The Statistics of Small Data Sets
Accepted for publication, Superfund Risk Assessment in Soil Contamination Studies: Third Volume, ASTM STP 1338, K.B. Hoddinott Ed., American Society for Testing and Materials
Authors: Ball, R.O., and M.W. Hahn

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Battelle Conference Proceedings, Remediation of Chlorinated and Recalcitrant Compounds: Risk, Resource and Regulatory Issues
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Authors: Hahn, M.W., A.E. Sevcik, and R.O.Ball

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Authors: Ball, R.O., M.W. Hahn, and A.E. Sevcik1998

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Authors: Sheahan, J.W., R.O. Ball, and M.W. Hahn

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Environmental Science & Technology, Vol. 38, pp 210-220
Authors: Hahn, M.W. and C.R. O'Melia

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Environmental Law Reporter, News & Analysis, July 2010, pp. 10638-10641
Authors: More, J.R. and M.W. Hahn

ATTACHMENT B

February 2, 2024 Declaration of Melinda Hahn, PhD

DECLARATION OF MELINDA W. HAHN, PhD

In support of Dynegy Midwest Generation, LLC's (DMG's) Petition for Review of IEPA's Non-concurrence with the Vermilion Alternative Source Demonstration and Request for Stay

I, Dr. Melinda W. Hahn, declare and state as follows:

Introduction

1) I am an Environmental Engineer and Senior Managing Consultant with Ramboll Americas Engineering Solutions, Inc. Attachment A is a true and accurate copy of my Curriculum Vitae.

2) I hold a PhD in Environmental Engineering from Johns Hopkins University. The focus of my research for my PhD dissertation was contaminant transport in porous media (e.g., groundwater).

3) My practice over my 25-year career includes site investigation and remediation in multiple state and federal programs, such as voluntary remediation, Resource Conservation and Recovery Act (RCRA) corrective action, and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response action. My work in these programs includes contaminant fate

and transport modelling, site investigation and remediation, and statistics and forensic analysis of environmental contamination data. I have evaluated sites from many different industrial sectors with many different contaminants of concern, including volatile organic compounds (VOCs), which includes chlorinated volatile organic compounds (CVOCs), semivolatile organic compounds (SVOCs), metals, polychlorinated biphenyls (PCBs), and dioxins/furans.

4) To prepare this Declaration, I reviewed the DMG December 1, 2023 Alternative Source Demonstration (ASD) Report for lithium, chloride, sulfate and total dissolved solids (TDS) observed in groundwater from bedrock wells 35D and 70D at the Vermilion Power Plant (VPP) New East Ash Pond (NEAP), the December 28, 2023 IEPA denial of the ASD, and supporting information for the ASD. I reviewed the documents submitted by DMG independently and was not personally involved in their preparation.

5) The ASD report addresses exceedances of lithium, chloride, sulfate and TDS above their respective Groundwater Protection Standards (GPS) observed in groundwater in bedrock wells 35D (lithium, chloride, sulfate and TDS) and 70D (lithium, chloride and TDS) at the VPP NEAP in the 2nd quarter of 2023.[1] The ASD report relies on a multiple lines of evidence (MLE) approach that is standard practice

[1] Ramboll, Groundwater Monitoring Data and Exceedances Report, 2nd Quarter 2023, New East Ash Pond, Vermilion Power Plant, October 2, 2023, Table 2.

in causal determinations in environmental forensic analysis, risk assessment, and site investigation.[2,3,4,5,6] The MLE approach involves analysis of multiple independent sets of data to test whether an identified source can explain observed data. Information to consider can be site-specific, regional, or from the literature.[7,8] These independent lines of evidence are developed until sufficient confidence is achieved to either confirm or rule out a source.[9] The lines of evidence (LOE) presented in the Vermilion ASD that demonstrate that a source other than the NEAP is causing the exceedances and the NEAP is not the source of or contributing to the observed exceedances are the following:[10]

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2 Miller, J. Methods and Advances in the Forensic Analysis of Contaminated Rivers, E3S Web of Conferences Vol. 125, 2019, p. 3.

3 U.S. EPA, U.S. Navy SPAWAR Systems Center, GeoChem Metrix Inc., and Battelle Memorial Institute, A Handbook for Determining the Sources of PCB Contamination in Sediments, Technical Report, TR-NAVFAC EXWC-EV-1302, October 2012, p. 13.

4 U.S. EPA, Office of the Science Advisor, Risk Assessment Forum, Weight of Evidence in Ecological Assessment, EPA/100/R-16/001, December 2016.

5 U.S. EPA, Office of Solid Waste and Emergency Response, OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor in Indoor Air, June 2015, pp. xv-xvii, 17-18, 38-40, 60-61, 117-123.

6 EPRI, Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites, 2017 Technical Report, p. viii.

7 U.S. EPA, Office of the Science Advisor, Risk Assessment Forum, Weight of Evidence in Ecological Assessment, EPA/100/R-16/001, December 2016, p. 20 et seq.

8 U.S. EPA, U.S. Navy SPAWAR Systems Center, GeoChem Metrix Inc., and Battelle Memorial Institute, A Handbook for Determining the Sources of PCB Contamination in Sediments, Technical Report, TR-NAVFAC EXWC-EV-1302, October 2012, p. 30.

9 Miller, J. Methods and Advances in the Forensic Analysis of Contaminated Rivers, E3S Web of Conferences Vol. 125, 2019, p. 3.

10 Ramboll, Alternative Source Demonstration Report, New East Ash Pond, Vermilion, December 1, 2023, p. 8.

LOE 1 – The ionic composition of bedrock groundwater is different than the ionic composition of porewater and consistent with published observations for Pennsylvanian Bedrock.

LOE 2 – Concentrations of chloride in the NEAP porewater are lower than those observed in the groundwater.

LOE 3 – A bedrock solids and geochemical evaluation identified naturally occurring shales as the source of lithium and chloride exceedances at 35D and 70D.

LOE 4 – A bedrock solids and geochemical evaluation identified naturally occurring coal seams as the source of the sulfate exceedance at 35D due to regional upward vertical hydraulic gradients in the shale bedrock.

LOE 5 – Isotopic analysis of groundwater from the bedrock and overlying Quaternary deposits indicate that bedrock groundwater is between 13,000 and 35,000 years older than groundwater in the Quaternary deposits; and bedrock groundwater is isolated from the groundwater in the Quaternary deposits.

Background

6) The Vermilion Power Plant (VPP) property and nearby properties were historically used for coal mining. The coal seam, where present typically between approximately 80 and 100 feet below grade, is contained within the bedrock unit and can influence bedrock geochemistry above the seams due to the local and regional

upward hydraulic gradient within the bedrock unit. Coal mining leaves behind voids that can collapse and disturb the overlying rock and soil, causing fracturing (that changes the hydraulic properties of the bedrock by creating preferential flow pathways) and soil subsidence. A test boring on-site at the VPP during the Kelron investigation in 2002 hit one such location that caused an above-ground geyser of sulfur-rich water from the coal seam.[11] This example indicates the presence of a strong upward hydraulic gradient within the bedrock aquifer.

7) The regional and local geology, hydrogeology and groundwater geochemistry at the VPP, and near the Old East Ash Pond (OEAP) area in particular, were extensively studied by Kelron Environmental in collaboration with the Illinois State Geological Survey (ISGS) in 2003 (the report for this investigation in provided as Attachment B to this Declaration). This investigation included a review of historical mining activity and seismic investigation of on-site historic mine sites, review of regional groundwater quality in the alluvial deposits and the bedrock, installation of 40 soil borings and 11 new monitoring wells (for a total of 16), collection of groundwater data in the bedrock and alluvial sediments monthly for six consecutive months (including background and monitoring data for inorganic parameters for the Old East Ash Pond), collection and analysis of soil and coal

[11] Ramboll, Alternative Source Demonstration Report for New East Ash Pond, Vermilion Power Plant, December 1, 2023. P. 7, Appendix A pp. 2, 8.; Kelron Environmental, Regional and Local Hydrogeology and Geochemistry, Vermilion Power Plant, Vol. 1. p. 26 (The report for this investigation was referenced and relied upon in the preparation of the Vermilion ASD and is included as Attachment B to this Declaration).

samples, permeability testing, downhole geophysical logging by ISGS, laboratory analysis of rock samples by ISGS, isotopic analysis for tritium and carbon-14 of groundwater samples, and significant data analysis including extensive mapping of data, cross section preparation, summary statistics, geochemical analysis of groundwater data in Piper, Stiff, Box Whiskers, and Cation plots, and multivariate components and cluster analysis. The analysis is presented in a 2003 report, and the primary conclusions of the report are:[12]

a) The top of the Danville Coal or the void remaining where the coal was removed through mining is located at depths between 80 and 102.5 feet in the floodplain east of the Old East Ash Pond within the Pennsylvanian bedrock.

b) The Middle Fork of the Vermilion River is a zone of discharge for the bedrock aquifer due to the upward vertical hydraulic gradients measured within the shale.

c) The former coal mines in the vicinity of the East Ash Pond System have significant collapse features, resulting in fracturing of the overlying bedrock and in some cases, surface subsidence.

d) The isotopic, geochemical, and hydraulic data support the conclusion that groundwater within the bedrock has upward hydraulic gradients,

[12] Kelron Environmental, Regional and Local Hydrogeology and Geochemistry, Vermilion Power Plant, pp. viii – x.

high dissolved mineral content, and is thousands of years older than recent groundwater in the overlying unlithified deposits.

e) Multiple bedrock background and monitoring wells at the Old East Ash Pond regularly exceeded contemporaneous groundwater standards for chloride, sulfate and TDS (note that lithium in these wells also exceeded the current groundwater protection standard). The occurrence of these parameters within the bedrock at concentrations higher than groundwater standards can be attributed to three sources: natural geochemistry, natural geochemistry associated with coal deposits, and impacts from the former coal mining activities.

8) For the Vermilion ASD, the independent lines of evidence supporting its conclusions include hydrogeological data to establish the direction of groundwater flow (groundwater flows horizontally generally from northwest to southeast toward the Vermilion River at the VPP, but the bedrock aquifer has a significant upward vertical component), chemical porewater data from a well set in the NEAP to characterize source concentrations, chemical groundwater data from upgradient and compliance wells, empirical observations of geologic layers from boring logs, and geochemical and multivariate analysis of chemical data. The lines of evidence also rely on the principles of geochemistry and the fundamental concept of contaminant migration: that contaminant concentrations decrease in the downgradient direction due to the successive dilution of dispersion and diffusion

(i.e., downgradient concentrations cannot be higher than steady source concentrations). In a coal combustion residual (CCR) surface impoundment release scenario, leachate is subject to physical processes that dilute solute concentrations including mixing, dispersion and dilution.[13]

9) The porewater well source concentrations in the NEAP have been characterized through the collection of porewater samples. The source porewater data for the NEAP are consistent with literature values for CCR leachate,[14,15,16] and define the maximum concentrations for CCR groundwater impact outside of the NEAP. NEAP source porewater is characterized by elevated levels of boron, calcium, and molybdenum relative to background bedrock groundwater concentrations as described in the Kelron/ISGS investigation report.[17]

10) Background bedrock well 22 at the NEAP is more shallow than all of the other bedrock background and compliance wells for the OEAP and the NEAP.[18,19] This single well is not representative of all bedrock background

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13 U.S. EPA Office of Solid Waste and Emergency Response, Solid Waste Disposal Criteria, Technical Manual, EPA530-R-93-017, p. 126.

14 U.S. EPA, Industrial Environmental Research Laboratory, Chemical and Biological Characterization of Leachates from Coal Solid Wastes, EPA-600/7-80-039, March 1980.

15 U.S. EPA and TVA, Effects of Coal-ash Leachate on Ground Water Quality, EPA-600/7-80-066, March 1980.

16 U.S. EPA, Office of Research and Development, Characterization of Coal Combustion Residues from Electric Utilities – Leaching and Characterization Data, EPA-600/R-09/151, December 2009.

17 Kelron, Regional and Local Hydrogeology and Geochemistry Report, Vermilion Power Plant, November 30, 2003, Table 11.

18 Kelron, Regional and Local Hydrogeology and Geochemistry Report, Vermilion Power Plant, November 30, 2003, Table 2

19 Ramboll, Hydrogeologic Characterization Report, New East Ash Pond, Vermilion Power Plant, October 25, 2021, Table 3-1.

groundwater quality throughout the VPP because there is dramatic variability in natural bedrock groundwater chemistry onsite due to the presence of coal, the changes in chemistry with depth, and the upward vertical gradient in the bedrock aquifer. Samples from the multiple background wells identified in the Kelron/ISGS investigation with varying screen depths and proximities to a coal seam provide a more fulsome picture.

11) The Kelron/ISGS investigation identified significant variability among the background bedrock well chemistry, particularly for sulfate. The background bedrock sulfate concentrations ranged over almost two orders of magnitude among the tested wells,[20] likely due to the natural variability and random nature of the location of coal seams and mine voids, and preferential vertical pathways that move groundwater upward.

Chloride, Lithium, Sulfate and TDS Exceedances

12) A key LOE that the NEAP did not cause the GPS exceedances at 35D and 70D is that samples from these wells contain more chloride than the NEAP source porewater, and are consistent with established background concentrations in the upgradient bedrock aquifer and regional literature values. The measured chloride

[20] Kelron, Regional and Local Hydrogeology and Geochemistry Report, Vermilion Power Plant, November 30, 2003, Table 11.

concentrations at 35D and 70D in 2nd Quarter 2023 were 493 and 573 mg/L,[21] respectively. The mean chloride concentration in the porewater is more than one order of magnitude lower at 27 mg/L, and the maximum reported value is 44 mg/L.[22] Due to advection and dilution, groundwater concentrations decrease moving away from the source, so downgradient areas necessarily have lower concentrations than constant strength source areas. For comparison to upgradient site background, the range of mean chloride concentrations in OEAP bedrock background wells is 60 to 1,233 mg/L.[23] The highest mean chloride concentration reported in the Kelron/ISGS study was observed at the deepest bedrock well (MW30). The mean reported concentration by the ISGS for the regional bedrock aquifer is 1,689 mg/L.[24] This evidence supports the conclusion that the NEAP is not the source of GPS exceedances at 35D and 70D.

13) Another key LOE is that upward hydraulic gradients exist within the bedrock. This fact demonstrates that the bedrock aquifer is not downgradient from the NEAP. As described above, groundwater contaminant fate and transport must be considered in three dimensions at the VPP. Water coming from the sampled

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[21] Ramboll, Groundwater Monitoring Data and Exceedances Report, 2nd Quarter 2023, New East Ash Pond, Vermilion Power Plant, October 2, 2023, Table 1.

[22] Ramboll, Hydrogeologic Characterization Report, New East Ash Pond, Vermilion Power Plant, October 25, 2021, Table 2-2.

[23] Kelron, Regional and Local Hydrogeology and Geochemistry Report, Vermilion Power Plant, November 30, 2003, Table 11.

[24] Kelron, Regional and Local Hydrogeology and Geochemistry Report, Vermilion Power Plant, November 30, 2003, Table 11.

bedrock intervals is coming from deeper within the bedrock. This concept is supported by the chemical isotope data (carbon-14) that indicates that VPP bedrock groundwater is tens of thousands of years old, whereas groundwater in the overburden (the alluvial sediments above the bedrock) has detectable tritium isotopes indicating a “young” groundwater that has recently been in contact with the atmosphere.[25] These results indicate that there is no or very little mixing of groundwater between the bedrock and the overburden. If a small amount of mixing is occurring, it is most likely migration from the bedrock to the overburden due to the observed upward hydraulic gradients within the bedrock.

14) Concentrations of lithium and TDS in 35D and 70D are also consistent with those observed in bedrock background wells identified in the Kelron/ISGS hydrogeologic investigation. Second quarter 2023 lithium concentrations in 35D and 70D were 0.144 and 0.085 mg/L respectively[26], versus a measured site-specific range of means of 0.04 to 0.11 mg/L and a maximum of 0.4 mg/L in background bedrock wells.[27] Second quarter TDS concentrations in 35D and 70D were 3,370 and 1,590 mg/L respectively,[28] versus a reported site-specific range of means of 863

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25 Kelron, Regional and Local Hydrogeology and Geochemistry Report, Vermilion Power Plant, November 30, 2003, p. ix.

26 Ramboll, Groundwater Monitoring Data and Exceedances Report, 2nd Quarter 2023, New East Ash Pond, Vermilion Power Plant, October 2, 2023, Table 1.

27 Kelron, Regional and Local Hydrogeology and Geochemistry Report, Vermilion Power Plant, November 30, 2003, Table 11.

28 Ramboll, Groundwater Monitoring Data and Exceedances Report, 2nd Quarter 2023, New East Ash Pond, Vermilion Power Plant, October 2, 2023, Table 1.

to 2,433 mg/L, and a reported regional mean of 3,540 mg/L in background bedrock wells.[29]

15) The ASD presented the results of multiple geochemical data analyses (Piper diagram), multivariate analysis including Principal Components Analysis (PCA) and Hierarchical Clustering Analysis (HCA) of NEAP background wells in bedrock and overburden, compliance wells in bedrock and overburden, and porewater.[30] The results indicated that the porewater chemical signature is dominated by boron and carbonate alkalinity, whereas the bedrock groundwater chemical signature is dominated, in part, by chloride. Compliance groundwater samples have a different ionic composition compared to porewater, and a composition relative to background that is consistent with expected changes due to screen depth. The clustering results show that the chemical composition of groundwater samples is primarily influenced by their lithography (aquifer solids) rather than their relative location with respect to the CCR unit. These results provide an independent LOE to support the conclusion that the lithium and chloride exceedances in 35D and 70D are not driven by the CCR unit, but rather by the native lithology.

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[29] Kelron, Regional and Local Hydrogeology and Geochemistry Report, Vermilion Power Plant, November 30, 2003, Table 11

[30] Ramboll, Alternative Source Demonstration Report, New East Ash Pond, Vermilion, December 1, 2023, Appendix A, pp. 6-7.

16) Geochemical analysis of site-specific bedrock and coal solids samples was completed in 2002 and 2023,[31] and the results confirm that native lithology drives the detection of lithium and sulfate in NEAP bedrock groundwater. Sequential extraction procedure (SEP) and X-ray diffraction conducted on bedrock solid samples in 2023 demonstrated the presence of micas and clay minerals that contain lithium. Geochemical conditions in the groundwater support the desorption or dissolution of the sulfide and iron oxide mineral phases that host lithium. Similarly, chemical analysis of coal seam solids collected and analyzed by Kelron/ISGS indicates that the coal contains up to 10% iron sulfide that readily undergoes oxidation to iron and sulfate. These analyses provide another LOE and demonstrate that aquifer solids within the bedrock contain and release lithium and sulfate. The underlying coal seam is the likely alternative source of the sulfate exceedance at 35D. The well construction log for this well indicates significant fracturing in the bedrock. The fractures are likely present due to underlying mining voids and also likely serve as preferential pathways for coal-impacted water from below to reach the sampled interval.

17) The major contributors to TDS are chloride and sulfate in groundwater observed at 35D and 70D.[32] All LOEs that apply to chloride and sulfate, therefore

[31] Ramboll, Alternative Source Demonstration Report, New East Ash Pond, Vermilion, December 1, 2023, Appendix A, pp. 3, 8.

[32] Ramboll, Alternative Source Demonstration Report, New East Ash Pond, Vermilion, December 1, 2023, Figure A.

also apply to TDS. The presented lines of evidence demonstrate that the NEAP is not the source of and does not contribute to the observed GPS exceedances of lithium, chloride, sulfate and TDS in 35D and 70D.

IEPA Denial

18) In its December 28, 2023 letter, the IEPA denied the Vermilion ASD due to perceived "data gaps" that included the following:

a) Characterization that the draw water from the bedrock is completely isolated from local groundwater system.

b) No assessment of the interaction between bedrock groundwater and the old east ash pond. Based on Fig. 1 shows to be upgradient of the New East Ash Pond.

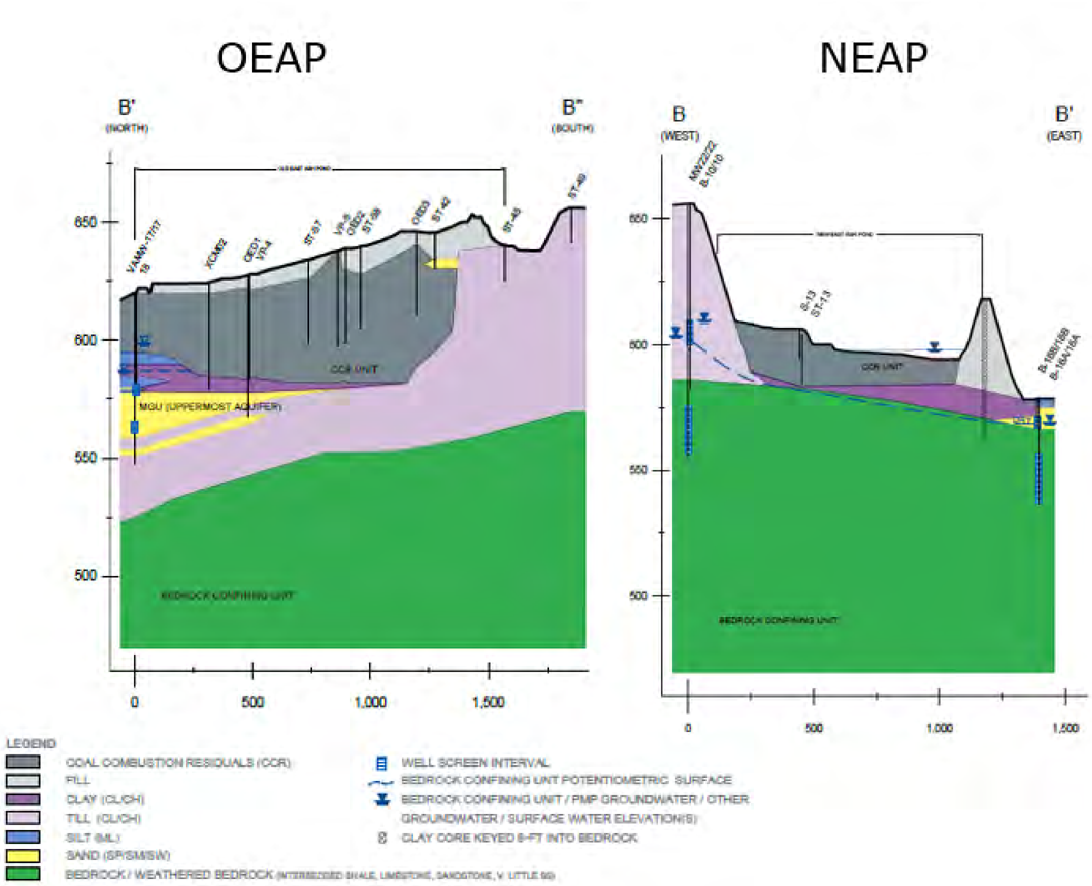
c) Lack of analysis of the leachable metals from the CCR to the New East Ash Pond.

19) The first identified data gap is confusing as the bedrock is necessarily part of the "local groundwater system". However, if the IEPA is referring to the isolation of the bedrock from the CCR unit or the overlying alluvial sediments, the ASD presented several facts that support the conclusion that there is no or very little mixing between the bedrock aquifer and the overburden. The chemical isotopic analysis that shows that the bedrock groundwater and the alluvial groundwater have very different ages (tens of thousands of years for the bedrock versus very recent for

the alluvial sediments) and are therefore not subject to mixing. Further, the strong upward vertical hydraulic gradients observed within the bedrock indicate that the origin of the sampled bedrock groundwater is deeper within the bedrock, and that if a small amount of mixing does occur, it is most likely bedrock groundwater moving into the overburden. Thus, based on available evidence any further evaluation of the isolation of the bedrock from the NEAP or overlying alluvial sediments is unnecessary and would not change the conclusions of the ASD.

20) In its second stated data gap, the IEPA points out the OEAP is located hydraulically upgradient of the NEAP and the ASD does not assess the interaction between the OEAP and the bedrock aquifer. The groundwater flow at the VPP must be understood in three dimensions. Figure 1 of the ASD may suggest that the OEAP is upgradient of shallow groundwater at the NEAP, but it does not suggest that contaminants from the OEAP could potentially migrate to the bedrock aquifer. This Declaration has demonstrated, through the discussion above, the lack of a migration pathway for NEAP contaminants to the bedrock. The OEAP is even further removed than the NEAP from the bedrock due to its higher elevation and additional till layer between the CCR unit and the bedrock. The following cross sections show the vertical relationship between the respective ash ponds and the bedrock aquifer. The cross sections from the respective Hydrogeologic Characterization reports for the

CCR units run from northwest to southeast through the OEAP, then the NEAP with very little gap in between.[33]



33 Ramboll, Hydrogeologic Characterization Report, Vermilion Power Plant, North Ash Pond and Old East Ash Pond, October 25, 2021, Fig. 2-10. Ramboll, Hydrogeologic Characterization Report, Vermilion Power Plant, New East Ash Pond, October 25, 2021, Fig. 2-10.

The juxtaposed cross sections show that the OEAP is separated from the bedrock with an additional layer of till. The bedrock was not considered to be a potential migration pathway for evaluation of the OEAP. Also, the background wells 10 and 22 for the NEAP, located on the left hand (west) side of the NEAP cross section, do not exhibit exceedances of the GPS as one might expect if a plume was migrating from the OEAP. This evidence demonstrates that the OEAP is not a source of exceedances observed in NEAP bedrock wells 35D and 70D and thus any further evaluation of the interaction between the OEAP and the bedrock aquifer is unnecessary and would not result in any change to the ASD's conclusions.

21) In its third stated data gap, the IEPA suggests that there is insufficient analysis of leachable metals from the CCR in the NEAP. The IEPA does not specify what type of analysis is requested. If the IEPA is requesting laboratory leach testing of solid CCR samples either by Toxicity Characteristic leaching procedure (TCLP), Synthetic Precipitation Leaching Procedure (SPLP), or Leaching Environmental Assessment Framework (LEAF), that information would not be more appropriate for a source impact analysis than the actual porewater data collected from the CCR presented in the Vermilion ASD. All of the synthetic laboratory leach tests on a solid sample aim to simulate a landfill environment in order to predict leachate quality from a solid sample. Synthetic leach test results are compared to actual field leachate data for fly ash and slag in order to evaluate the representativeness of their results,

i.e., field verification.[34] U.S. EPA advises that these "batch" 1-day laboratory tests on a relatively small sample do not account for the long-term climatic and meteorological influences on a full-scale landfill operation.[35] These tests often yield high initial concentrations that are not typical of a full-scale operation.[36] Other researchers evaluating the utility of the synthetic precipitation leaching procedure (SPLP) to assess the risk of groundwater contamination posed by the land application of granular solid waste report that the use of a total pollutant concentration (mg/kg) in conjunction with SPLP concentrations (milligrams per liter [mg/L]) to estimate pore water concentration was unreliable as this method underestimates the measured porewater concentrations.[37]

22) Clearly, directly measuring CCR analyte concentrations in actual porewater samples from the actual disposal environment is a more accurate basis for an impact analysis than using laboratory predictions of those values. The Vermilion NEAP CCR and adjacent groundwater quality have been adequately characterized for performing an alternative source demonstration. Data from the NEAP porewater

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[34] Tiwari, M.K., et al, Suitability of Leaching Test Methods for Fly Ash and Slag: A Review, Journal of Radiation Research and Applied Sciences, Vol.8, 2015. pp. 523-537.

[35] U.S. EPA Office of Solid Waste and Emergency Response, Solid Waste Disposal Criteria, Technical Manual, EPA530-R-93-017, p. 125.

[36] *Ibid.*

[37] Townsend, T, et al, Interpretation of Synthetic Precipitation Leaching Procedure (SPLP) Results for Assessing Risk to Groundwater from Land-Applied Granular Waste, Environmental Engineering Science, Vol. 23, No. 1, 2005.

samples relied upon in the ASD Report[38] are sufficient to define the strength and variability of source water for this assessment. Collection of additional CCR source characterization data suggested in IEPA's December 28, 2023 letter is not required for the ASD by Part 845 or Part 257 and would not change the conclusion of the ASD that the CCR in the NEAP did not cause or contribute to the noted exceedances.

I declare under penalty of perjury that the foregoing is true and correct.

Dated: February 2, 2024

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Melinda W. Hahn, PhD

[38] Ramboll, Alternative Source Demonstration Report, New East Ash Pond, Vermilion Power Plant, December 1, 2023. Appendix A, Attachment 5.

ATTACHMENT A

Curriculum Vitae of Melinda Hahn, PhD

ENVIRONMENT
& HEALTH

RAMBOLL

MELINDA W. HAHN, PH.D.

Senior Managing Consultant

Dr. Hahn's practice areas include site investigation and remediation, contaminant fate and transport modelling, statistics of environmental data, forensic analysis, and litigation support, including primarily environmental liability and cost allocation. Regulatory areas include RCRA, CERCLA, TSCA, and Voluntary Cleanup/Risk-Based Corrective Action. Dr. Hahn has experience in the following industry categories: energy (electric utilities, petroleum dispensing, pipeline operations, former manufactured gas plant sites), industrial equipment manufacturing, metal working and metal recycling, automobile manufacturing, ink and chemical manufacturing, wood treating, mining, cement manufacturing, milling and smelting operations, secondary aluminum production, and dry cleaning.

EDUCATION

1995
PhD, Environmental Engineering
The Johns Hopkins University

1990
BS, Physics
The University of Texas at Austin

1990
BS, Mathematics
The University of Texas at Austin

ACADEMIC HONORS

1992-1995
Graduate Fellow, National Science Foundation

1995
Most Distinguished Environmental Engineering Dissertation, Association of Environmental Engineering Professors

CAREER

1998-Present
Senior Managing Consultant, ENVIRON/Ramboll

1997-1998
Consultant, Roy Ball, PC

1995-1997
Senior Project Engineer, Environmental Resources Management-North Central, Inc.

CONTACT INFORMATION

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United States of America

PROJECTS

- Provided technical litigation support for over 50 matters regarding extent, severity, timing, and source of soil and ground water contamination and vapor intrusion, necessity for and costs of remediation, human health risk assessment, toxic tort liability, Superfund cost allocation (including consistency with the NCP), insurance cost recovery, and the siting and monitoring of a hazardous waste landfill. The regulatory frameworks included Illinois Voluntary Cleanup Program, Illinois Leaking Underground Storage Tank Program, RCRA, CERCLA, TSCA, NCP, and California Proposition 65. Completed projects in more than twenty states, with a focus in the Midwest.
- Provided expert testimony in matters involving Superfund cost allocation, statistics of environmental data, and contaminant fate and transport.
- Retained as an expert witness and provided litigation/mediation support for a number of cost allocation cases involving remediation of contaminated soil, groundwater, and sediment.
- Provided litigation support for environmental liability/cost allocation mediation and litigation at several large sediment sites. Evaluated historical information on industrial processes and discharges, and conducted forensic/statistical analysis to estimate the relative contribution of contaminants to sediments.
- Provided litigation support for a number of insurance cost recovery projects, including a former wood treating facility, a jewelry manufacturer, metal plating facility, machine shop and dry cleaner. Tasks included the identification of likely sources and timing of contamination.
- Evaluated claims of residents living near a scrap metal facility of transport and deposition of lead-containing particles in their homes using statistical analysis of plaintiffs' chemical data. Provided expert testimony based on this analysis.
- Evaluated the hydrogeological setting of a proposed petroleum pipeline pumping station and estimated the likelihood of a release and groundwater contamination. Provided expert testimony based on this analysis.
- Provided expert testimony on proposed coal ash impoundment closure regulations and proposed new state groundwater standards in Illinois.
- Conducted environmental forensic evaluations to determine sources of observed environmental contamination in soil, groundwater, sediment and sub-slab/indoor air for sites in litigation and pre-litigation phases.
- Performed multivariate statistical analyses of data for forensic analysis, for contaminant ecological impact analysis, to determine appropriate remedial objectives, and as part of human health and ecological risk assessments.
- Lead RCRA Corrective Action at a former manufacturing facility.
- Directed and assisted in the closure of a number of sites in the Illinois Voluntary Cleanup Program and the Illinois Leaking Underground Storage Tank Program.
- Evaluated the potential contribution of urban industrial sources of heavy metals to urban soil and sediments using both simple data comparisons and multivariate statistical techniques.
- Performed ground water and contaminant fate and transport modeling using MODFLOW and MT3D for use as a Superfund cost allocation tool in support of expert testimony. Relative mass of TCE entering the Superfund Site from sources on two PRP's properties was used as a basis for cost allocation. A Monte Carlo analysis was also performed to evaluate the sensitivity of the proposed allocation to changes in key variables.

- Performed Monte Carlo analysis of risk to ground water posed by a proposed petroleum pipeline in support of expert testimony. The analysis examined the likelihood of the exceedance of the Illinois Class I ground water standard for benzene per mile of proposed pipeline.
- Performed Monte Carlo cost allocation among four PRPs for a Superfund Site in support of expert testimony. Total volume, volume of hazardous substances, and volume of drummed materials were considered.
- Utilized 3-D geostatistical interpolation techniques to visualize environmental data, to estimate excavation volumes for remediation, and to identify and distinguish source areas and potential preferential pathways of migration for a number of contaminated sites.
- Performed research and analysis of remedial activities and associated costs to determine compliance with the NCP for cost recovery matters for a number of sites.

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ATTACHMENT B

Kelron/ISGS Investigation Report: Regional and Local Hydrogeology and Geochemistry, Vermilion Power Plant, Illinois, 2003

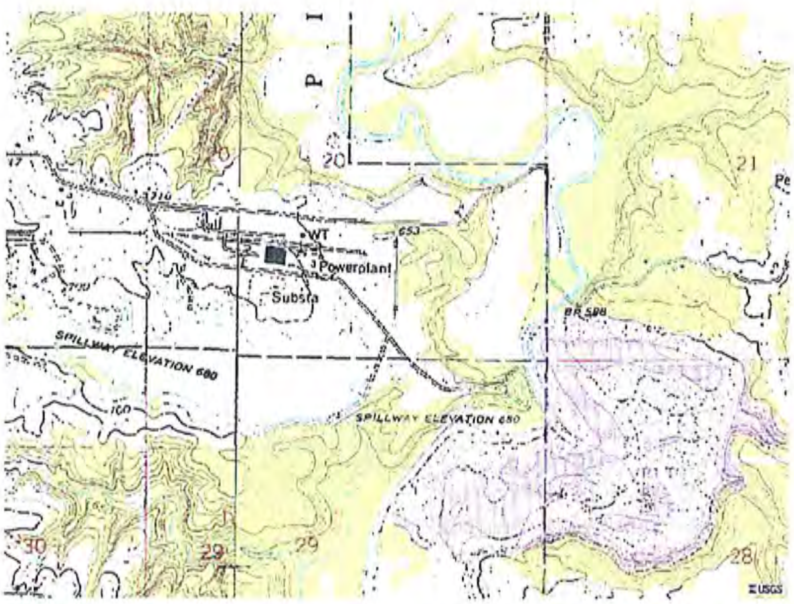
REGIONAL AND LOCAL HYDROGEOLOGY AND GEOCHEMISTRY VERMILION POWER PLANT, ILLINOIS

VOLUME 1 OF 2

November 30, 2003

Prepared for:

Dynegy Midwest Generation, Inc.
Decatur, Illinois



KELRON ENVIRONMENTAL
CHAMPAIGN, ILLINOIS

REGIONAL AND LOCAL HYDROGEOLOGY AND GEOCHEMISTRY VERMILION POWER PLANT, ILLINOIS

VOLUME 1 OF 2

November 30, 2003

Prepared for:
Dynegy Midwest Generation, Inc.
Decatur, Illinois

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EXECUTIVE SUMMARY

Background and Objectives

The East Ash Pond System (East Ash Pond) of the Vermilion Power Plant is owned and operated by Dynegy Midwest Generation, Inc. (DMG). The Vermilion Power Plant is located in Vermilion County, Illinois. Following a hydrogeologic investigation by Mathes Geotechnical Services, Inc. in 1987, the primary and secondary cells of the East Ash Pond were constructed in 1989. A planned expansion of the primary cell of the East Ash Pond beginning in 2002 prompted DMG to authorize in October 2001 a comprehensive regional and local hydrogeologic and geochemical investigation. Secondary objectives of the study were:

- To determine if the East Ash Pond was causing any changes to groundwater quality in the alluvial deposits or underlying bedrock;
- To assess the impacts of nearby coal mines on the hydrology and groundwater quality; and,
- To determine the appropriate groundwater classification for the East Ash Pond.

Due to the large scope of work involved and the need to establish the background geochemistry both in the vicinity of the study site (see Figures 1, 2, 3) and within the larger region, the Illinois State Geological Survey (ISGS) was contracted by Kelron Environmental (Kelron) to provide technical assistance in determining the background geochemistry of the bedrock deposits in the vicinity of the study site. The results of the ISGS investigation have been incorporated into this report.

Investigation Methods

In order to characterize both the geology and groundwater quality in the vicinity of the study site, a total of 40 borings and 16 monitoring wells were utilized. Groundwater and surface-water quality data were collected monthly over a six-month period for 19 inorganic parameters and four field parameters. In addition, as part of their separate study the ISGS collected groundwater samples from both DMG wells and private wells for inorganic and isotopic (tritium and Carbon-14) chemical analysis.

Other data collection activities employed during the study included:

- field permeability testing and analysis of the geologic materials by Kelron;
- seismic investigation of bedrock and coal mines near the East Ash Pond by URS Corp.;
- downhole geophysical logging of borings by the ISGS; and,
- laboratory analysis of rock-core samples by the ISGS.

The field and laboratory data collected during 2001 and 2002 were used to create a variety of products, including topographic maps, geologic maps, potentiometric surface maps, geologic cross-sections, hydrographs, and geochemical tables and figures.

Results

Geology

The deposits covering the bedrock in the study site are derived from recent river deposition (alluvial sediments) in the river valleys and glacial drift deposits occurring below the alluvial sediments and in the upland areas. Thickness of these deposits in the region range from zero thickness along portions of the Middle Fork of the Vermilion River (Middle Fork) where bedrock is exposed, to over 200 feet in the upland areas. The unlithified alluvial and glacial deposits in the vicinity of the East Ash Pond and within the floodplain generally range in thickness from 10 to 25 feet.

Rocks of Pennsylvanian age form the bedrock surface in the region surrounding the site. The Danville area is located on the northeast flank of the Illinois basin. Regionally, the Pennsylvanian bedrock consists of mainly shale with thin limestone, sandstone, and coal beds. The upper 75 feet of bedrock at the study site typically consists of the Shelburn Formation, which is composed of non-marine and marine, silty and micaceous shales. The Shelburn Formation contains a major coal seam mined in the region, the Danville Coal, also called the No. 7 Coal.

The top of the Danville Coal, or the void remaining where the coal was removed through mining, was intercepted at depths of 80 to 102.5 feet on the floodplain adjacent to the East Ash Pond. The thickness of the coal seam ranged from four to seven feet with an average thickness of 5.4 feet.

Hydrogeology

Groundwater within the alluvial and, where present, the glacial (till) deposits within the floodplain generally conforms to the ground surface topography. Groundwater elevations in the glacial and alluvial deposits demonstrate that groundwater elevations in the unlithified materials are higher than those in the adjacent Middle Fork through much of the year. The groundwater surface in the alluvial deposits fluctuates in response to changes in river stage and variations in precipitation. The groundwater surface is not affected by water levels in the East Ash Pond, which has been hydraulically isolated from both the shale and alluvial deposits by soil/bentonite slurry walls and a compacted clay core. Changes in pond elevation do not result in any corresponding changes in the shallow groundwater levels.

Groundwater elevations in the bedrock shale are highest in the topographically highest areas to the west and east of the Middle Fork of the Vermilion River. The lowest groundwater elevations occur at wells located adjacent to the Middle Fork. **Flow lines derived from the potentiometric surface maps indicate that the Middle Fork of the Vermilion in this area is a zone of discharge for the shale. The occurrence of the Middle Fork in this area as a regional discharge zone for the shallow bedrock is supported by the upward vertical hydraulic gradients measured within the shale. The shale outcrops along the banks of the Middle Fork and groundwater moving**

upward through the shale discharges into both the alluvium and directly into the Middle Fork.

The coal mines in the vicinity of the East Ash Pond System have been shown to have significant collapse features where the overlying shale has collapsed or partially collapsed downward into the void or mined coal seam. The collapse of the shale into the void translates upward through the shale, resulting in fracturing and in some cases surface subsidence.

Groundwater Chemistry

Based on the groundwater and surface water quality data collected in 2002, the affects of the East Ash Pond on groundwater quality are either negligible or not present. Groundwater quality data for most major ions and trace constituents is similar to background groundwater quality. In cases where elevated concentrations of a parameter were found to occur in groundwater near the East Ash Pond there were also elevated concentrations in background wells screened within coal deposits or in the proximity of abandoned coal mines.

Trace metal concentrations in groundwater were compared to East Ash Pond water samples and there was no commonality between the two water types. The deficiency of trace metals such as molybdenum, selenium, and vanadium in groundwater within both the alluvial deposits and the Pennsylvanian age bedrock at both background and East Ash Pond wells, as compared to their ubiquitous presence within waters of the East Ash Pond, suggests that **based on trace water quality data there is no impact to unlithified or bedrock groundwater quality by the East Ash Pond**.

The results of the isotopic analyses of groundwater samples from the background bedrock wells by the ISGS resulted in Carbon-14 ages ranging from 13,000 to 35,000 RYBP (radiocarbon years before present). In support of the Carbon-14 results, tritium concentrations for the same set of bedrock groundwater samples were all below detection limits ranging from 0.43 to 0.52 TU (tritium units). Water with non-detectable tritium concentrations is considered to be greater than 50 years old (Mehnert and Dreher, 2002).

The isotopic and other geochemical data from background monitoring wells supports the hydrogeologic conceptualization that **the Middle Fork of the Vermilion River is a regional discharge area for the bedrock.** Groundwater within the bedrock is at the end of its flow path and has upward hydraulic gradients, high dissolved mineral content, and is thousands of years older than recent groundwater in the overlying unlithified deposits.

Groundwater Classification

No groundwater parameters measured in the unlithified (i.e., alluvium and till) deposits of the study site exceeded Class I or II groundwater standards during March through August 2002. However, background well MW28 (see Figures 7, 8) exceeded the sulfate and TDS standards of 400 and 1,200 mg/L, respectively, during January and February 2002. Three bedrock monitoring wells at the East Ash Pond and four background wells regularly exceeded standards for at least one of the parameters of chloride, sulfate, and TDS.

The occurrence of parameters within the bedrock at sufficiently high concentrations to exceed groundwater standards can be attributed to three sources: natural geochemistry; natural geochemistry associated with coal deposits; and, anthropogenic (man-made) affects on geochemistry associated with former coal mines and mine spoil. Similarly, high concentrations of inorganic parameters within the unlithified deposits can be attributed to natural geochemistry and the impacts of former coal mines and mine spoil.

Based on the hydrogeology and geochemistry established for the vicinity of the East Ash Pond and surrounding region, and given the influence of former coal mines documented at the study site on the geochemistry of groundwater, it appears that the groundwater designation is Class IV – Other Groundwater, in accordance with Section 620.201 of Part 620 (IAC Title 35, Subtitle F, Chapter I). Class IV groundwater is defined as groundwater within a previously mined area that cannot meet the standards of Class I or II groundwater.

1.0 INTRODUCTION

1.1 PURPOSE

The East Ash Pond System (East Ash Pond) of the Vermilion Power Plant, which is owned and operated by Dynegy Midwest Generation, Inc. (DMG), is located in Vermilion County, Illinois (Figures 1, 2, 3). Following a hydrogeologic investigation by Mathes Geotechnical Services, Inc. (Mathes) in 1987, the primary and secondary cells of the East Ash Pond were constructed in 1989. A planned expansion of the primary cell of the East Ash Pond beginning in 2002 prompted DMG to authorize in October 2001 a comprehensive regional and local hydrogeologic and geochemical investigation by Kelron Environmental (Kelron). The secondary purpose of the investigation was to determine if the East Ash Pond was impacting groundwater quality in the surficial and underlying bedrock deposits.

1.2 APPROACH

In order to characterize both the regional and local groundwater quality, the existing groundwater data collected from five monitoring wells from the earlier Mathes investigation had to be supplemented with new data from an expanded network of downgradient and background wells. Eleven new monitoring wells were installed to expand the existing network from 5 to 16 wells (Figures 7, 8). The larger network of wells and new boring data were used to re-define and expand upon the earlier hydrogeologic conceptualization by Mathes. In addition, the new groundwater quality data were combined with surface-water quality data collected from the East Ash Pond and the Middle Fork of the Vermilion River to determine potential interactions between natural and man-made surface water bodies with the shallow and deeper groundwater systems.

Due to the large scope of work involved and the need to establish the background geochemistry both in the vicinity of the study site and within the larger region, the Illinois State Geological Survey (ISGS) was contracted by Kelron to conduct an independent research investigation. The ISGS research and approach is discussed in the following section.

1.2.1 Illinois State Geological Survey Research

Kelron Environmental contracted with the ISGS to provide technical assistance in determining the background geochemistry of the bedrock deposits in the vicinity of the study site. As part of their independent study of background geochemistry, the ISGS performed the following tasks.

- Literature search, including unpublished data sources, for information pertaining to groundwater geochemistry of shale and coal. The search focused on the groundwater quality of Pennsylvanian-age shale and coal in Illinois and the Midwest. Unpublished data sources included the ISGS and Illinois State Water Survey (ISWS) databases.

- Reviewed geologic data from bedrock cores obtained during drilling of monitoring wells by Kelron and also reviewed geophysical logs recorded by the ISGS scientists.
- Reviewed and incorporated groundwater chemistry data for samples collected from background monitoring wells by Kelron and Dynegy.
- Provided advice on the list of analytes for groundwater sampling of monitoring wells by Kelron.
- Analyzed rock samples from bedrock cores for mineralogy.
- Collected groundwater samples from four private wells, two in the vicinity of the study site, and analyzed samples for anions, cations, pH, and alkalinity.
- Collected groundwater samples from two private wells and analyzed for the isotopes tritium [^{3}H] and Carbon-14 [^{14}C].
- Collected groundwater samples from six background monitoring wells installed by Kelron and analyzed for anions, cations, pH, alkalinity, and selected isotopes (^{3}H and ^{14}C).
- Prepared a final report that included pertinent literature and data on the geochemistry of shale and coal, discussion of the geochemistry of shallow bedrock groundwater in background wells based on the data collected as part of the study, and conclusions on the geochemistry of shallow bedrock groundwater in background wells in the region surrounding Dynegy's Vermilion Power Plant.

The results of the ISGS study have been incorporated into this report. The full ISGS study report is included as Appendix A.

1.3 SITE DESCRIPTION

The East Ash Pond is located in Vermilion County, primarily in the east half of the northeast quarter of the southeast quarter of Section 20, Township 20 North, Range 12 West (Figure 1). The entire study site, encompassing both the East Ash Pond and background wells, is located in the east half of Section 20 and the west half of Section 21. The Middle Fork of the Vermilion River (Middle Fork) borders the East Ash Pond along its north and east edges. The East Ash Pond lies in the flood plain of the Middle Fork and is bordered by bluffs to the west.

A topographic map (Figure 2) and aerial photograph (Figure 3) show the topographic and natural features in the vicinity of the East Ash Pond. The V-shaped lake in the lower right hand corner of the aerial photograph is a remnant of strip mining activity southeast of the East Ash Pond on the east side of the Middle Fork.

1.4 SITE HISTORY

1.4.1 Previous Investigations

A hydrogeological investigation was performed by Mathes in 1987 in the vicinity of the current East Ash Pond. The purpose of the 1987 study was to obtain sufficient information concerning subsurface conditions at the site to make recommendations concerning location and construction of a new ash pond system for the Vermilion Power Plant.

Information from the 1987 Mathes investigation was incorporated into the current study. In addition, several monitoring wells from the Mathes study, which were not destroyed during construction of the East Ash Pond in 1989, were incorporated into the current investigation.

1.4.2 East Ash Pond Construction and Expansion

The East Ash Pond consists of two cells: an 11-acre primary (main) pond and a 0.8-acre secondary (polishing) pond. Ash in the main pond settles out of the sluice water, is decanted to the secondary pond, and then discharged to the Middle Fork in accordance with the effluent limits and monitoring requirements of an NPDES permit.

The original primary and secondary cells of the East Ash Pond System were constructed in 1989. The entire East Ash Pond was built directly overtop a thick shale formation which is greater than 80 feet thick in the vicinity of the ash ponds. The alluvial deposits overlying the shale formation were excavated so that the shale surface was exposed. The earthen berms on the north, east, and south sides of the primary cell are "keyed" into the underlying shale formation with two four-foot thick soil/bentonite slurry walls. Bentonite is an absorbent aluminum silicate clay formed from volcanic ash. These walls extend approximately 8 feet down into the shale and approximately 12 feet above the shale surface into the clay-core center of the earthen berms (see Figure 4). A natural earthen bluff composed of low permeability native clays forms the west side of the primary cell. The maximum permeability of the soil/bentonite slurry wall was specified not to exceed 1×10^{-8} cm/s.

The earthen berms built on top of the soil/bentonite slurry walls are approximately 18 feet tall, 80 to 120 feet wide at the base, and 15 feet wide at the top. The outside portion of the berms is constructed of locally excavated sand and clay. The center of these berms is constructed with a compacted clay core ranging in thickness from 15 feet at the top to 30 feet near the base. The permeability of the clay core is approximately 10^{-7} cm/s.

The new berms constructed to expand the capacity of the primary cell of the East Ash Pond System in 2002 raised the height of the original berms by approximately 20 feet. The new berms are constructed with 8-foot clay liners keyed into the underlying clay core. The 8-foot clay liners are on the wetted-side of the berm surrounding the expanded ash pond. The clay liners are placed within berms constructed of local clay and silty clay materials. The permeabilities of these materials are within the same specification range as for the original ash pond. A natural earthen bluff wall forms the west side of the enlarged primary cell.

The secondary pond is not being expanded or modified as part of the East Ash Pond System expansion.

1.4.3 Coal Mines

The vicinity of the Vermilion Power Plant has seen extensive coal-mining activity from 1893 to 1970. Two coal mines, called the Crawford Mine (ISGS Mine Index No. 3889) and Fletcher's Middlefork Mine (ISGS Mine Index No. 3888), are located beneath the East Ash Pond and vicinity (Figure 5). Based on data and maps obtained from the ISGS, the former entrances to the two coal mines beneath the site are located just north of the secondary cell of the East Ash Pond (Mine 3889) and 600 hundred feet southwest of the primary cell (Mine 3888) (ISGS, 1996). Information pertaining to both these mines and other mines in the vicinity of the Site are provided in Appendix B.

The entrance to the Crawford Mine was field located. It is a slope shaft mine with the main coal seam (the Danville, or No. 7 Coal) located between the depths of 80 and 92 feet below land surface (BLS). The average thickness of the main coal seam is approximately 5 ½ feet. Several borings were advanced in order to locate both this mine and the Middlefork Mine. The procedures and data gathered during the coal-mine investigation, in addition to the subsequent geophysical investigation, are discussed later in the report. The Middlefork Mine operated between 1939 and 1949 using the room-and-pillar method, whereby the coal is removed in 'rooms' with 'pillars' of coal left in place to support the roof. During the course of the investigation of this mine both mined and un-mined areas were intercepted during exploratory borings. Mined areas were identified based on the drill bit dropping through voids where the coal had been removed. In addition to locating the mined interval, the slope shaft descending to the coal seam was intercepted near the mine entrance at a depth of 28 to 37 feet BLS.

The exact entrance to Middlefork Mine was not located, although based on mine tailings, topography, and historic records it is somewhere between the north end of the secondary cell and the Middle Fork of the Vermilion River. This mine is a vertical shaft mine with the main seam of the Danville Coal located between the depths of 102 and 115 feet BLS. The average thickness of the seam in this area is estimated at five to six feet. This mine operated between 1905 and 1919 using the room-and-pillar method. Three borings were advanced to locate this mine and two of them intercepted mined-out coal seams, one of which had collapsed. The coal mine collapse and subsidence at the Middlefork Mine caused some fracturing of the overlying shale and also changed the groundwater hydraulics in the vicinity of the mine. The potential effect of the coal mine on the groundwater hydrology is discussed in Section 5.

Other mines, both shaft and strip, are located south and southeast of the Crawford and Middlefork mines discussed above (Appendix B). Some of these mines are located within or adjoining the property of the Vermilion Power Plant. The Danville Coal has been extensively mined using both subsurface and strip methods in the vicinity of the Site. To varying degrees, these mining activities have altered the natural topography, hydrology, surface water chemistry, and groundwater chemistry that existed in the area before mining began.

A geophysical study was conducted by URS Corp. in early 2002 to further investigate and locate the coal mines in the vicinity of the East Ash Pond. The results of this investigation are presented in Section 4.2.1.2.

2.0 STUDY METHODS AND PROCEDURES

The objective of the investigation was to conduct a full hydrogeologic and groundwater geochemical characterization in the vicinity of the East Ash Pond of the Vermilion Power Plant and compare the investigation results to the regional background hydrogeology and geochemistry. Secondary objectives of the study were:

- To determine if the East Ash Pond was causing any changes to groundwater quality in the alluvial deposits or underlying bedrock;
- To assess the impacts of nearby coal mines on the hydrology and groundwater quality; and,
- To determine the appropriate groundwater classification for the site.

Data collected from the previous investigation at the site (Mathes, 1987) and quarterly groundwater quality data collected since 1994 were incorporated into the study. The methods used to conduct the study and procedures used for obtaining the necessary geologic, hydrologic, and chemical data are presented in this section.

2.1 METHODS

2.1.1 Previous Data

As mentioned earlier, the prior investigation by Mathes (1987) was incorporated into the study, both as background data for developing an initial conceptual understanding of the hydrogeology and for inclusion of pertinent hydrogeologic data directly into the current investigation. Five wells installed by Mathes in 1987 that were not destroyed by the subsequent construction of the East Ash Pond were incorporated into the study. These five wells include the alluvial wells MW13B and MW16B, which were nested with the shale bedrock wells MW13A and MW16A, respectively, and the till well MW10 (Figures 6, 7, 8). In addition to the existing wells, the Mathes study provided borehole geologic data and hydraulic conductivity data.

Supplementing the geologic data available for the site, inorganic groundwater quality data and water-level data were available for the five monitoring wells for the period of 1994 to the present. Quarterly groundwater monitoring for selected inorganic parameters was instituted beginning in 1994.

Site topographic maps, as-built diagrams of the East Ash Pond, and aerial photographs were used to develop base maps, locate wells, and develop geologic cross-sections.

2.1.2 Geologic Data

The geology presented in this report is primarily based on the geotechnical and monitoring well borings listed in Table 1 and summarized below.

- Nine borings drilled by Mathes (1987) as part of a hydrogeologic investigation for construction of the East Ash Pond.

- Eleven borings drilled in 2001 as part of the current investigation. Four borings were drilled at locations near the East Ash Pond and seven were placed at locations to the south, east, and north.
- Twelve borings drilled in 2001 for geotechnical characterization for expansion of the East Ash Pond; and,
- Eight exploratory borings drilled in 2002 for locating and characterizing the coal mines in the vicinity of the East Ash Pond.

Detailed geologic logs are provided for all of the borings in Appendix C.

Other information incorporated into the study for characterizing the geology was provided by the ISGS. The ISGS performed downhole geophysical logging of three of the deepest borings, logged three bedrock cores, and provided geologic logs and well construction data for a one-mile radius around the study site. The ISGS also provided information for coal mines and coal seams in the vicinity of the site.

In addition to the above geologic information, the results of the geophysical investigation into coal mine locations at the East Ash Pond, conducted in early 2002 by URS Corp., have also been incorporated into this report.

The assembled geologic data were used to develop the following:

- thickness maps of the unlithified deposits;
- bedrock elevation map;
- coal seam elevation map; and,
- coal mine location maps.

2.1.3 Hydrologic Data

The hydrology of the unlithified deposits and underlying bedrock presented in this report was based on the data obtained from a network of 16 monitoring wells installed at the site: five from the 1987 Mathes study and 11 installed in 2001 (Table 2 and Figure 6). Six monitoring wells are installed in the unlithified deposits, with four located near the East Ash Pond and two background wells located north of the Middle Fork (Figure 7). Ten monitoring wells are installed in the bedrock, with five installed near the East Ash Pond, four background wells located to the north and east of the Middle Fork, and one background well located south near the river pump station. Water-level measurements were made monthly for the eight months from January through August 2002 (Table 3 and Figure 8).

In addition to the hydrologic data collected from the monitoring wells, surface water measurements were obtained from the Middle Fork upriver from the East Ash Pond near nested wells MW26/MW27, downriver at MW25, and from the primary and secondary cells of the East Ash Pond. Surface water measurements of the East Ash Pond were not conducted after May 22 because the primary and secondary ponds were drained during construction activities. The last discharge from the East Ash Pond outfall to the Middle

Fork during 2002 was on May 26. Discharging from the East Ash Pond System resumed in January 2003 after construction of the enlarged primary cell was completed.

The groundwater and surface water measurements were used to develop the following:

- potentiometric surface maps;
- groundwater and surface water hydrographs showing temporal variations in water levels;
- horizontal groundwater flow directions and velocities;
- vertical hydraulic gradients between the alluvial deposits and underlying bedrock;
- hydraulic connection between groundwater in the alluvium and bedrock with surface water in the Middle Fork; and,
- impact assessment of the East Ash Pond on alluvium and bedrock groundwater levels.

2.1.4 Groundwater and Surface Water Chemical Data

The groundwater chemistry data presented in this report is based on six months (March through August 2002) of field and laboratory data collected from 16 monitoring wells. Three of the wells (MW13B, MW16B, and MW22) were typically dry or had insufficient water for groundwater sampling. In addition to the above samples, inorganic and isotopic chemistry data analyzed by the ISGS for the five background bedrock wells (MW25, MW27, MW29, MW30 and MW31) sampled in June 2002 were also incorporated into this report. The surface water chemistry data are based on five months of data collected from the East Ash Pond primary cell (January through May 2002) and six months (March through August 2002) of data collected upriver on the Middle Fork at the Higginsville Bridge. No East Ash Pond samples were collected after May 2002 because the pond was drained and no further effluents were being discharged into the impoundment during construction activities.

The chemical data presented in this report for the monitoring wells includes the field parameters temperature, pH, and conductivity and the following laboratory analytical parameters:

Alkalinity	Aluminum	Barium	Boron	Calcium
Chloride	Iron	Lithium	Magnesium	Manganese
Molybdenum	Phosphorus	Potassium	Selenium	Sodium
Strontium	Sulfate	TDS	Vanadium	

The above parameters, with the exception of the field parameters, were also analyzed in the surface water samples. However, all of the inorganic parameters in groundwater were analyzed as dissolved while those in surface water were analyzed as totals.

In addition to the samples collected and analyzed monthly from March through August 2002, the background monitoring wells MW25 through MW31 and the East Ash Pond primary cell were sampled in February 2002 for the same inorganic constituents listed above plus cadmium, chromium, and zinc. Based on this first round of sampling in February, the analytes cadmium, chromium, and zinc were dropped from the study because they were below their respective method detection limits (1, 1, and 5 micrograms per liter [ug/L], respectively) in almost all of the samples analyzed.

2.2 TECHNICAL PROCEDURES

2.2.1 Borehole Drilling

Eleven boreholes drilled for the installation of monitoring wells were numbered sequentially from MW22 to MW32. Borehole logs are provided in Appendix C for both the current and prior studies at the Site. The eight boreholes drilled for the coal mine investigation were numbered sequentially from B201 through B208. Boreholes were drilled using a Diedrich D-120 rig equipped with hollow-stem augers and rock coring equipment. Drilling through the unlithified deposits was performed utilizing hollow-stem augers. Samples were obtained using a 24-inch long by two-inch outside diameter (O.D.) split-spoon sampler. The sampler was mechanically driven using a 140-pound hammer with a 30-inch drop. Soil samples were collected continuously in unlithified deposits less than 25 feet thick and at intervals of five to ten feet in deposits greater than 100 feet thick.

All soil samples were logged in the field for sample interval and soil recovery, stratum thickness and depth, visual soil classification by the Unified Soil Classification System [(USCS); ASTM D 2487 and 2488], moisture content and presence of water, soil stiffness, and horizontal compressive strength using a pocket penetrometer.

For those boreholes cored into the underlying bedrock, 4.5-inch O.D. steel surface casing was installed to the top of the bedrock. The outer casing was left permanently in place for all of the bedrock holes with the exception of MW25, MW30, MW31, and the coal mine boreholes. Following installation of the outer casing, continuous sampling of the bedrock was performed using an HQ-core (2.25-inch I.D.) for the monitoring well locations and NQ-core (1.88-inch I.D.) for coal mine borings. Wireline coring, which is a type of rotary drilling, was used to obtain continuous samples of consolidated (i.e., bedrock) formations. A hollow coring bit was used to cut the rock and the samples of rock were removed at designated intervals, in the case of this study every 10 feet. Clean water was used as the drilling fluid.

All core samples were logged in the field for sample interval and soil recovery, stratum thickness and depth, and visual soil classification by the USCS System. In addition, the cores obtained from boreholes MW25, MW30, and MW31 were delivered to the ISGS for more detailed classification and analysis (Appendix A).

2.2.2 Monitoring Well Installation and Development

Groundwater monitoring wells were constructed of two-inch diameter, flush-threaded (Schedule 40) polyvinyl chloride (PVC) screens and risers. Well screens were 0.010-inch slot size machine cut. Screen lengths (Table 2) were 20 feet for all of the bedrock wells except MW32, which had a 10-foot screen. Screen lengths for new wells installed in the unlithified deposits were five feet for MW26 and MW28 and 10 feet for MW23.

Following placement of the screen and riser, the annular space between the well screen and borehole wall was backfilled with well-sorted quartz sand. The sand filter was placed from the bottom of the borehole to approximately 2-feet above the top of the well screen. A minimum two-foot thick bentonite seal (bentonite chips, pellets, or grout) was placed above the sand pack. The remainder of the borehole annulus was filled to the surface with bentonite grout using a 1.25-inch ID PVC tremie pipe which was placed down the inside of the augers as they were removed from the ground. Monitoring wells were completed with steel well protectors extending approximately 2 ½ to 3 feet above ground surface and set in a cement pad. Monitoring well construction forms and diagrams are provided in Appendix C. In addition, the Well Completion Reports and Well Construction Reports required by the Illinois Environmental Protection Agency and the Illinois Department of Public Health, respectively, are provided in Appendix D.

At least 48-hours following well completion, all monitoring wells were developed to attempt to restore the natural hydraulic conductivity of the monitored formation and remove all drilling-induced sediment to provide turbidity-free groundwater samples. Development was performed using air-lift displacement and submersible pumps. The wells were developed until a minimum three to five well volumes were removed from each well. However, some of the wells installed into the shale did not produce sufficient groundwater before being pumped dry (i.e., MW25, MW31 and MW32); in those cases the wells were developed on more than one occasion in order to remove at least two to three well volumes. Water samples collected during well development were monitored for the field parameters pH, temperature, and conductivity. Development was considered complete when the field parameters had stabilized. Well development data sheets are provided in Appendix E.

2.2.3 Site Surveying

Monitoring well locations were surveyed by an Illinois Professional Land Surveyor to an accuracy of 0.1-foot horizontal and 0.01-foot vertical relative to the state planar horizontal datum NAD83 and vertical datum NAVD88 Geoid 96, respectively. Borehole locations were surveyed to a minimum accuracy of 1-foot horizontal and 0.1-foot vertical. Boring and monitoring well locations are shown in Figure 7 and elevations are provided in Table 1.

2.2.4 Water-Level Measurement Collection

Prior to collecting groundwater samples, static water depth was measured to an accuracy of 0.01 foot in each monitoring well using a Solinst-101 electronic water-level indicator. The groundwater depths were measured relative to the top of the PVC riser and subsequently subtracted from the measuring point elevation to determine the groundwater elevation within the well. In addition to groundwater elevation at all of the monitoring wells, surface water elevation measurements were obtained from the following locations:

- Middle Fork of Vermilion River adjacent to wells MW26/MW27;
- Middle Fork of Vermilion River adjacent to well MW25 at the downriver pump station;

- Primary cell of the East Ash Pond; and,
- Secondary cell (i.e., Polishing Pond) of the East Ash Pond.

Groundwater and surface water level measurements were conducted on a monthly basis from January through August 2002. The measurements were used to develop hydrographs, potentiometric surface maps, vertical gradients between formations, and evaluate hydrologic interactions between the unlithified deposits, bedrock, Middle Fork, and East Ash Pond. Water levels and elevations for the period of investigation are provided in Table 3.

2.2.5 Groundwater and Surface Water Sampling and Chemical Analyses

Water samples were collected from the background wells MW25 through MW31 and the primary cell of the East Ash Pond on a monthly basis by the DMG Environmental Laboratory beginning in January 2002. The remaining monitoring wells in the vicinity of the East Ash Pond, and upriver samples from the Middle Fork at the Higginsville Bridge, were sampled monthly beginning in March 2002. Samples from all wells and surface-water collection points were obtained within a period of one to two days each month with the exception of the March sampling event, when poor weather and equipment problems extended the sampling period to three days.

Groundwater samples were collected using a low-flow sampling technique with Well Wizard® bladder pumps and MicroPurge® equipment. The bladder pumps prevent contact between the pump drive air and the sample, and the downhole equipment is permanently dedicated to each well, preventing cross-contamination caused by transporting pumps between wells. The specification sheets for each of the bladder pumps placed in monitoring wells at the Site are provided in Appendix F. The bladder pumps were placed within the screened interval of each well so that groundwater being pumped would come from the formation pore water and minimize pumping of the overlying static water within the well casing. The only wells that did not have bladder pumps installed were MW10, MW13B, and MW16B. These three wells are typically dry or have insufficient groundwater for sampling. In those cases where there was sufficient groundwater to be sampled from these wells it was removed using dedicated bailers or a peristaltic pump.

The low-flow ground water sampling procedures followed for this study are based on the sampling protocol provided by the United States Environmental Protection Agency (USEPA) in a document authored by Puls and Barcelona (1995). This document has been incorporated into the report as Appendix G. Due to the extremely low permeability of the shale formation from which many of the groundwater samples were obtained, passive sample collection techniques were utilized. Passive sample collection was conducted at the bedrock wells by setting the pump rate at less than 0.2 Liters per minute (L/m), pumping sufficient water to clear the tubing and bladder pump of stagnant water, and collection of samples for laboratory analysis. Three sets of measurements for the field parameters of temperature, pH, and conductivity were collected and documented as follows: at the start of pumping, prior to sample collection, and at the conclusion of sample collection. Sampling of the higher permeability wells installed within the unlithified deposits was conducted at higher flow rates of 0.2 to 0.5 L/m.

Analysis of field parameters (pH, specific conductivity, and temperature) were conducted using either a Hydrolab® Minisonde Model 4a or a Hydrolab Surveyor Model 4a water quality analyzer connected directly to the discharge tubing from the bladder pump. Samples for laboratory chemical analysis were collected using in-line filtration (0.45 micron filter size) that prevented contract with air prior to collection. Water samples were collected in new or acid-washed polypropylene bottles and subsequently stored at 4° C for transport back to the laboratory.

Surface water samples were collected from the East Ash Pond primary cell and the Middle Fork upriver by submerging the sample bottles directly into the water and, where possible, capping under water to minimize air contact. Surface water samples were collected for analysis of total inorganic parameters and were not field filtered. No field parameters were analyzed for the surface water samples.

Chemical analyses were performed by the DMG laboratory. Inorganic analyses were performed in accordance with U.S. EPA SW-846 and Standard Methods for the Examination of Water and Wastewater, 19th Edition. The following parameters and analytical methods were analyzed by DMG for the groundwater and surface water samples:

- Total Alkalinity: EPA Method 310.1 (Titremetric Method);
- Total Dissolved Solids (TDS): EPA Method 160.1 (Gravimetric Method);
- Chloride: Standard Methods, Method 4500-Cl (Potentiomeric Method);
- Sulfate: EPA Method 375.4 (Turbidimetric Method);
- Phosphorus: EPA SW-846 Method 365.2 (ascorbic-acid Colorometric Method); and,
- Boron, Manganese, Magnesium, Calcium, Potassium, Iron, Aluminum, Lithium, Molybdenum, Selenium, Strontium, Vanadium, Barium: EPA Method 200.7 (ICP).

2.2.6 Illinois State Geological Survey Sampling and Chemical Analyses

The ISGS accompanied DMG laboratory personnel on June 18, 2002 in order to obtain split samples for analysis. The ISGS returned to the study site on June 25 and 26 along with Kelron to obtain groundwater for isotope analyses. The methods by which samples were collected and analyzed by the ISGS for their background water quality study are presented in detail in the ISGS report (Appendix A).

2.2.7 Field Permeability Tests

In-situ hydraulic conductivity tests were performed on seven of the newly installed shale monitoring wells (MW24, MW25, MW27, MW29, MW30, MW 31, and MW32) and two of the newly installed alluvial monitoring wells (MW26 and MW28) during September 2002. The monitoring wells were tested by the variable head ("slug") test method.

Most of the slug tests were conducted using three and four foot long by 1-1/4 inch diameter PVC slugs with rope and recorded using In-Situ® Troll 8000 datalogger with 15 pounds per square inch (psi) transducer. The Troll 8000 is a combination downhole transducer and datalogger. Due to the slow recharge of some of the shale monitoring wells, a few tests were conducted without the Troll 8000 by measuring water levels using the Solinst 101 electronic water-level meter and recording the measurements by hand. In some cases only rising head tests were performed and in others both rising and falling head tests were performed.

A laptop computer was used to download the data from the datalogger and analyze the data with the use of AQTESOLV™ for Windows (Version 2.5), an aquifer test analysis software package by HYDROSOLVE. All of the analytical solutions used the Bouwer-Rice method (1980). The AQTESOLV™ for Windows output is included in Appendix H.

2.2.8 Data Management

Field data were recorded on pre-printed forms including:

- Daily field reports;
- Boring logs;
- Monitoring well completion reports;
- Well development reports; and,
- Water sampling forms.

Groundwater and surface water sample data, including water levels, field parameter analyses, and laboratory chemical analyses, were entered and stored on a proprietary groundwater data management software package (MANAGES™ Version 2.7, Electric Power Research Institute). Data collected from wells MW10, MW13A/13B, and MW16A/16B beginning in 1994 were already incorporated into the database prior to the beginning of the current study.

3.0 REGIONAL GEOLOGY AND HYDROLOGY

3.1 TOPOGRAPHY

The uplands are fairly uniform in elevation. They generally occur between the elevations of 650 and 700 feet National Geodetic Vertical Datum (NGVD) in the vicinity of the study site. The lowland areas (floodplains) along the Middle Fork lie between elevations of 550 and 600 feet NGVD. The natural surface topography within the floodplain is relatively flat with drainage toward the river.

3.2 BEDROCK GEOLOGY

The Danville area is located on the northeast flank of the Illinois basin. The bedrock strata are of Pennsylvanian age and in general dip gently southwestward toward the center of the basin.

The study site lies approximately 3 miles west of the central axis of the Danville Bedrock Valley, which is oriented northwest to southeast and midway between the Middle Fork and North Fork of the Vermilion River (Selkregg and Kempton, 1958).

Regionally, the Pennsylvanian bedrock consists of mainly shale with thin limestone, sandstone, and coal beds (Selkregg and Kempton, 1958). The bedrock surface elevation in the vicinity of the study site is between 500 and 600 feet NGVD (Willman et al., 1967). The rocks were originally deposited as unlithified sediments in coastal marshes or in shallow seas that repeatedly formed in the area. The shale was originally deposited as clay, while coal was formed from plants buried in the coastal swamps. Sandstone was deposited as sand and the limestone was formed by precipitation of carbonates and by accumulation of seashells on the sea floor (Selkregg and Kempton, 1958).

After the Pennsylvanian sediments were deposited, the seas retreated and the upper part of the bedrock was deeply eroded. During the Pleistocene epoch, continental glaciers advanced from the north and overrode the eroded bedrock surface (Selkregg and Kempton, 1958), leaving the glacial deposits that mantle the area today.

The principal formations within the Pennsylvanian bedrock in the region are, from upper to lower, the Bond, Shelburn, and Carbondale Formations. In the vicinity of the Site the principal formation is the Shelburn, which contains a major coal seam mined in the region, the Danville (No. 7). The Danville coal has been mined extensively in the region both as surface (strip) mines and underground mines. The northernmost mines identified by the ISGS (ISGS, 1996) are located in the immediate vicinity of the Site (Figure 5) within Township 20 North and Range 12 West. Additional information pertaining to coal seams and mines in the vicinity of the Site is provided in Section 4.2.1.1.

Several geologic logs obtained from the ISGS files (ISGS, 2001) were for exploratory borings for coal seams in 1910 and 1911 (Appendix I). In the vicinity of the site (Sections 20 and 21), the deepest borings were to depths of 166 and 131 feet BLS with bedrock intercepted at depths of 105 and 26 feet BLS, respectively. The formations intercepted by the two borings consisted of shale containing the following two coal seams:

- Danville (No. 7) coal at depths of 113 to 120 feet BLS and 79 to 83 feet BLS; and,
- Herrin (No. 6) coal at depths of 144 to 148 feet BLS and 110 to 114 feet BLS.

No limestone or sand layers were identified on these borings. However, further to the south in Section 28, a 1910 boring for the Big Four Railroad was progressed to 312 feet BLS. The Danville and Herrin coal seams were intercepted at depths of 72 and 96 feet BLS, respectively. Several other layers of coal, less than two feet in thickness, were intercepted. Five limestone layers ranging in thickness from one to eight feet were intercepted between 99 and 257 feet BLS. One sandstone layer was intercepted at 211 to 213 feet BLS. The entire bedrock interval cored was 247 feet, of which 220 feet was shale, 11 feet coal, 14 feet limestone, and 2 feet sandstone.

3.3 UNLITHIFIED DEPOSITS GEOLOGY

The deposits covering the bedrock in the region surrounding the study site are derived from recent river deposition (alluvial sediments) in the river valleys and glacial drift deposits occurring below the alluvial sediments and in the upland areas. The glacial and interglacial geologic events that shaped the topography seen today occurred during the Pleistocene Epoch, about two million to 12,000 years ago (ISWPTF, 1997). Thickness of these deposits in the region range from zero thickness along portions of the Middle Fork where bedrock is exposed to over 200 feet in the upland areas (Piskin and Bergstrom, 1975).

Although there were several major glaciations – pre-Illinoisan, Illinoisan, and Wisconsin – glaciers of only the last three are known to have entered the east-central Illinois region (Selkregg and Kempton, 1958). Each glaciation was followed by an interglacial period in which the climate warmed and the ice front moved back. The surficial features seen in the upland areas are part of the Gifford Moraine, which was formed during the Woodfordian Substage of the Wisconsinan Stage of glaciation (Willman and Frye, 1970).

Based on stack-unit maps of geologic materials to a depth of 15 meters (49.3 feet) prepared by Berg and Kempton (1988), the lowlands (floodplains) adjacent to the Middle Fork are characterized by the following downward sequence of unlithified deposits:

- Less than six meters (19.7 feet) of Cahokia Alluvium (i.e., alluvial sediments deposited by streams and rivers);
- Less than six meters of Henry Formation deposits of Wisconsinan age, which consist of glacial outwash dominated by sand and gravel; and,
- Less than six meters of Glasford Formation deposits of Illinoian age, which consist of silty and clayey diamictons.

Diamicton is unsorted, nonstratified sediment with a wide range of particle sizes (i.e., clay, silt, sand, gravel, cobbles, and boulders). When diamicton is due to glacial deposition it is known as till. The diamictons in the vicinity of the study site are till deposits characterized by a clay matrix containing variable percentages of silt, sand, gravel, cobbles, and boulders.

The unlithified deposits of the upland areas bordering the Middle Fork are characterized by the following downward sequence:

- Greater than six meters (19.7 feet) of Wedron Formation deposits of Wisconsinan age, which consist of silty and clayey diamictons; and
- Less than six meters of Glasford Formation silty and clayey diamictons (Berg and Kempton, 1988).

Unlithified deposits below 15 meters (49.3 feet) are not identified in the stack-unit maps, but based on published literature the Glasford Formation deposits either extend to the top of bedrock or are underlain by the Banner Formation of pre-Illinoisan age (i.e., greater than 500,000 years of age). The Banner Formation, which consists of till and intercalcated outwash where present, is draped over the bedrock surface and is generally deepest where the bedrock is deepest.

3.4 BEDROCK HYDROLOGY

The Pennsylvanian rocks generally have low porosities and permeabilities. The porosity of shale typically ranges from 1 to 20 percent (Walton, 1988). Representative horizontal field hydraulic conductivity (permeability) for shale typically ranges from $5x10^{-6}$ to $5x10^{-10}$ centimeters per second (cm/s). Representative aquitard field permeability ranges for shale, which is defined as the rate of vertical flow of water through a unit horizontal cross-sectional area of the aquitard, are $5x10^{-8}$ to $5x10^{-12}$ cm/s. In contrast to the low permeability of shale, coal deposits have horizontal permeability ranging from $5x10^{-2}$ to $5x10^{-5}$ cm/s (Walton, 1988).

The Pennsylvanian rocks in the region yield small amounts of water to wells from interconnected pores, cracks, fractures, crevices, joints, and bedding planes. Water-bearing openings are variable from place to place and are best developed near the surface in thin limestones and sandstones, when present, within the predominantly shale formation. Shallow sandstone and creviced limestone may yield small supplies in some areas, but water quality becomes poorer with increasing depth. The Pennsylvanian bedrock is not a reliable source of groundwater and the quality varies considerably. Small domestic supplies have been obtained from creviced limestone, permeable sandstone, or cracked shale and coal in the upper part of the bedrock (Selkregg and Kempton, 1958).

Water in the Pennsylvanian rocks becomes highly mineralized with increasing depth. Recharge to the Pennsylvanian rocks is derived locally from vertical leakage through the glacial drift and other unlithified materials that are in turn recharged from precipitation.

Water occurs in these rocks mainly under artesian and leaky-artesian conditions (Csallany, 1966).

3.5 UNLITHIFIED DEPOSITS HYDROLOGY

Alluvial deposits along the Middle Fork valley contain a wide variety of sediments ranging from clay to sand, gravel, and cobbles. The effective porosities for the types of sediments found in the vicinity of the study site range from 20 to 35 percent for poorly sorted sand and gravel alluvial deposits to 10 to 20 percent for the diamictons found in the upland areas (Fetter, 1980). Effective porosity, which is a measure of the pore space thorough which saturated flow can occur, typically ranges from 10 to 30 percent for poorly sorted sand and gravel deposits to 5 to 20 percent for diamictons (Walton, 1988).

Horizontal hydraulic conductivity for the alluvial deposits as measured by field tests can vary greatly depending on the percentage of fine-grained materials within those deposits. Deposits with materials ranging from sand to gravel typically have horizontal permeability ranging from 10^{-1} to 10^{-4} cm/s. Silt, clay, and mixtures of sand, silt, and clay typically have horizontal permeability ranging from 10^{-4} to 10^{-7} cm/s (USDI, 1981; Fetter, 1980).

Groundwater in the alluvial deposits discharges into the Middle Fork during most of the year with the exception of flood events, when localized flow-reversals may occur. No published information is available concerning the hydrology of the shallow deposits in the vicinity of the study site.

Permeable deposits capable of supplying sufficient groundwater for domestic use are scattered and discontinuous, with aquifers varying in permeability (Selkregg and Kempton, 1958). Water-well logs and a well location map were obtained from the ISGS during October 2001 (Appendix I; ISGS, 2001) for a four square mile area surrounding the study site. Ten water wells installed between 1967 and 1999 in upland areas were screened across permeable formations ranging in depth from 40 to 160 feet BLS. Eight of the ten wells were screened at depths greater than 100 feet BLS and had an average depth of 132 feet BLS. Groundwater was obtained primarily from sand and gravel deposits within the drift. The sand and gravel layers ranged from 3 to 13 feet in thickness. However, one well obtained groundwater from gravelly clay at 135 to 160 feet BLS and another well, drilled in 1999, was a dry hole.

4.0 STUDY SITE GEOLOGY AND HYDROLOGY

Characterization of the geology and hydrogeology at the study site is based on previous investigations conducted prior to construction of the East Ash Pond in 1989 and on new boring and monitoring well data from the current 2001-2002 investigation. Mathes Geotechnical Services, Inc. conducted a hydrogeologic investigation in a portion of the current study site (Mathes, 1987) prior to construction of the original East Ash Pond. The information used to describe the study site geology and hydrogeology is based on the borings and monitoring wells summarized in Table 1 and provided in Appendix C in addition to all of the field data collected during the course of the study in 2001 and 2002.

The two types of materials present at the study site consist of unlithified deposits (alluvium and glacial deposits) and bedrock. Each of these materials will be discussed in detail in order to establish a framework with which to understand the hydrogeology, and in later sections the geochemistry, of the site. Figure 7 shows the locations of all of the borings used in describing the geology of the site. Figure 9 shows the locations of the east-west (Figure 10) and north-south (Figure 11) geologic cross-sections through the study site.

4.1 UNLITHIFIED DEPOSITS

4.1.1 Alluvial and Glacial Geology

The cross-sections across the Site (Figures 9, 10, and 11) best demonstrate the correlation between topography and stratigraphy of the unlithified deposits. The other variable that affects the thickness and composition of the unlithified deposits is the bedrock surface topography. Glacial deposits are thickest (greater than 100 feet) where the shale bedrock decreases in elevation. The glacial materials consist primarily of low plasticity silty to sandy clays with occasional layers of silt, sand, and gravel.

The unlithified alluvial and glacial deposits in the vicinity of the East Ash Pond and within the floodplain generally range in thickness from 10 to 25 feet (Figure 12). Thickness of the alluvial deposits immediately adjacent to the Middle Fork is generally 10 to 15 feet. The unlithified deposits increase in thickness towards the uplands as the alluvial deposits pinch out and are supplanted by glacial deposits at higher topographic elevations.

Along the western portion of the study site, to the west of the East Ash Pond, the thickest glacial deposits range from 71 feet at Well MW22 to the north to 103 feet at Boring B208 to the south. North and east of the Middle Fork the thickness of the glacial deposits are 116 feet at Well MW30 and 155 feet at Well MW31, respectively.

The uppermost unlithified deposits in the floodplain consist of alluvium composed primarily of sand with occasional layers of silty clay. The sand is generally a fine to medium sand that contains silts, clays, and gravels in varying amounts. The sand in some areas may be overlain by silty to sandy clay. In places where the unlithified deposits in the floodplain become thicker, the alluvium may be underlain by glacial deposits consisting of outwash sand and gravel or diamictons. The shallow geology at Boring MW23, located within 25 feet of the south bank of the Middle Fork, has approximately 14 feet of alluvial deposits ranging from silt to gravel overlying eight feet of glacial deposits consisting of sandy clay with gravel.

4.1.2 Alluvial and Glacial Hydrology

Groundwater elevation within the alluvial and, where present, the glacial deposits within the floodplain generally conform to the ground surface topography. Prior to construction of the East Ash Pond, groundwater elevations documented by Mathes (1987) in the alluvial deposits generally ranged from five to six feet below ground surface in most of the alluvial wells where the East Ash Pond was constructed.

The only alluvial wells remaining from the 1987 study are MW13B and MW16B, located between the East Ash Pond and the Middle Fork. Hydrographs of groundwater levels in these two wells for 2002 are provided in Figures 13 and 14. Groundwater elevations measured in Well MW13B in 2002 have ranged from dry (no groundwater) in January and July to 573.44 feet NGVD in May, which is approximately 1.9 feet above the bottom of the screen and two feet above the bedrock surface. Groundwater elevations in Well MW16B were dry (no groundwater) in January, February, May, July, and August and were approximately 570 feet NGVD in March, April and June. The bottom of the well screen and the bedrock surface are at elevations of 566.5 and 566 feet NGVD, respectively.

Figure 15 shows the relationship of groundwater-levels in the alluvial wells MW26 and MW28 versus the Middle Fork of the Vermilion River elevations during 2002. During the period of measurement in 2002 groundwater levels in both these wells were above river elevation, demonstrating the potential for shallow groundwater discharge to the Middle Fork.

Groundwater elevations in the till and alluvial deposits in January 2002 (Figure 16) and hydrographs (Figure 15) demonstrate that groundwater elevations in the unlithified materials are higher than those in the adjacent Middle Fork through much of the year. The groundwater surface in the alluvial deposits fluctuates in response to changes in river stage and variations in precipitation. Based on the groundwater levels measured in wells MW13B and MW16B during 2002 and earlier years, groundwater elevations within the alluvial deposits in the vicinity of the East Ash Pond have not been elevated since the East Ash Pond was constructed. Groundwater levels are frequently measured at or near the base of the well screens of MW13B and MW16B, suggesting that the East Ash Pond has been hydraulically isolated from both the shale and alluvial deposits by soil/bentonite slurry walls and a compacted clay core.

Groundwater-level contour maps of the unlithified deposits could not be prepared due to the limited number and distribution of shallow wells. All of the shallow wells with the exception of Well MW10, which is installed in till, are adjacent to the Middle Fork. The presence of the East Ash Pond prevented the installation of upgradient wells within the alluvial deposits.

Groundwater gradients in the alluvial deposits prior to pond construction were determined by Mathes (1987). During the period of April to July 1987, horizontal gradients between downgradient wells MW13B and MW16B and upgradient alluvial wells ranged from 0.014 to 0.028 ft/ft and flow direction was towards the Middle Fork.

The hydraulic conductivity of the alluvium was estimated by Mathes (1987) by conducting field permeability (slug) tests. The horizontal hydraulic conductivity ranged from 1×10^{-3} to 7×10^{-3} cm/s. Field hydraulic conductivities determined during September 2002 for the alluvial deposits at monitoring wells MW26 and MW28, located on the north side of the Middle Fork across from the East Ash Pond, resulted in a computed geometric mean hydraulic conductivity of 1.5×10^{-2} cm/s (Table 4). The higher permeabilities calculated at wells MW26 and MW28 during 2002 relative to the lower values calculated by Mathes (1987) could be either from actual permeability differences of the alluvial deposits (i.e., coarser-grained or better sorted alluvium at MW26 and MW28 relative to the Mathes well locations) or systematic differences due to differences in analysis methods.

4.2 BEDROCK

The bedrock at the study site has been investigated using the following sources of data:

- Six borings from the 1987 Mathes hydrogeologic investigation;
- Two monitoring wells (MW13A and MW16A) remaining from the 1987 Mathes investigation;
- Eight borings and monitoring wells installed in 2001 as part of the current hydrogeologic investigation;
- Eight borings from the 2001 geotechnical investigation for expansion of the East Ash Pond;
- Eight borings from the 2002 coal mine investigation at the East Ash Pond;
- Geophysical logging of three boreholes by the Illinois State Geological Survey in 2001 (Appendix A);
- Geophysical investigation for location of coal mines by URS Corp in 2002;
- Bedrock core logs prepared by the ISGS (Appendix A); and,
- Mineralogical analyses of 19 rock samples (from three bedrock cores) by the ISGS in addition to geochemical modeling (Appendix A).

Based on the above sources of information a comprehensive evaluation of the bedrock geology and hydrology is presented below.

4.2.1 Bedrock Geology

The upper 75 feet of bedrock was cored at the study site and consists of non-marine and marine, silty and micaceous shales of the Pennsylvanian Age Shelburn Formation. The Shelburn Formation contains a major coal seam mined in the region, the Danville Coal, also called the No. 7 Coal. Geologic logs of selected cores (from borings for Wells MW25, MW30, and MW31) were prepared by the ISGS (Appendix A). Based on these logs, the shale has been described as medium to dark gray, massive, and with blocky fracture. Some intervals have thin interbeds of light gray shale.

The shale cores at Well MW25, located to the south of the East Ash Pond, are non-marine and contain abundant carbonized plant material. The shale cores at Well MW30, a background well located at the north end of the study area, have been identified as non-marine from 116 to 135 feet BLS and marine from 135 to 144 feet BLS, with abundant fossils, including brachiopods, gastropods, and bivalves. The Danville Coal was intercepted at 145 feet BLS before the coring was discontinued at 148 feet BLS. The coal contained abundant pyrite along cleats. The shale cores at Well MW31, located at the east end of the study site, also consist of a non-marine shale overlying a fossiliferous marine shale.

The upper zone of the shale is often weathered so that it appears as a greenish-gray to bluish-gray silty clay. Determination of the interval at which weathered shale turns into an unlithified silty clay is often based on the presence of fissility.

Based on the mineralogical analyses of 19 samples from three cores (from the borings for MW29, MW30, and MW31) conducted by the ISGS (Appendix A), the shale is composed principally of clay minerals and quartz with minor amounts of potassium feldspar, plagioclase feldspar, siderite, and marcasite or pyrite. The most abundant clay minerals in the cores were illite, kaolinite, and chlorite, with minor amounts of illite/smectite mixed-layer clay.

The depth to the top of the bedrock (i.e., shale), bedrock surface elevation, and depth/elevation of the Danville Coal are provided in Table 5. Figure 12, which shows the thickness of the unlithified deposits, also provides the depth to bedrock. Generally, the top of the shale occurs within 10 to 25 feet of ground surface in the vicinity of the East Ash Pond and rapidly increases in depth toward the western upland bordering the Site. The depth to bedrock is greatest towards the east, where it exceeds 150 feet.

Another way to view the shale bedrock is by looking at a bedrock elevation map, which can also be called a bedrock topography map. Figure 17 shows that the bedrock high within the study area occurs directly west of the East Ash Pond and the higher elevations trend toward the northeast. The lowest bedrock elevations occur to the north (530 feet NGVD at Well MW30) and the east (544 feet NGVD at Well MW31). The slope of the bedrock surface between the bedrock high and the eastern low at MW31 is approximately 0.018 foot per foot (95 feet per mile), which is a relatively mild slope when compared to the greater relief of the glacially-carved Middle Fork valley.

4.2.1.1 Danville (No. 7) Coal

The Danville (No. 7) Coal is found within the Shelburn Formation (ISGS, 1996) and was intercepted at eight locations (Table 5) in the vicinity of the East Ash Pond (Borings B201 to B208) and one location to the north of the Middle Fork (Boring MW30). Most of the borings advanced during both this and prior studies did not penetrate deep enough into the bedrock to intercept the coal seam. The top of the Danville Coal was intercepted at depths of 80 to 102.5 feet BLS on the floodplain adjacent to the East Ash Pond. Greater boring depths were required to intercept the coal seam in the upland areas. Borings B203, B208, and MW30 intercepted the coal seam at depths of 127, 152, and 144 feet BLS, respectively.

The top of the Danville Coal, or the void remaining where the coal was removed through mining, was intercepted at elevations between 496 and 509 feet NGVD. The thickness of the coal seam ranged from four to seven feet with an average thickness of 5.4 feet. Thin layers of coal interlayered with shale occurred above or below the main coal seam; these were not included in calculating the main seam thickness. The elevation of the top of the Danville Coal has been mapped on Figure 18. The Danville Coal generally decreases in elevation northward under the East Ash Pond at a gradient of 0.004 ft/ft (22 feet per mile). The coal increases in elevation from north of the East Ash Pond (493 to 496.6 feet NGVD at B201 and B202) to 501.5 feet NGVD at Well MW30 at a gradient of 0.0024 ft/ft (12.8 feet per mile).

Further information about the occurrence and mining of the Danville Coal in the vicinity of the East Ash Pond and other portions of the Vermilion Power Plant is provided in Section 1.4.3. Coal mine maps prepared by the ISGS, and other historical information pertaining to coal mining at the site is discussed. The potential effects of coal mines on subsurface geology, groundwater hydraulics, and water quality are discussed in greater detail in Sections 4.2.1.2, 4.2.2.5, and 5.2, respectively.

4.2.1.2 Geophysical Investigation of East Ash Pond

A geophysical investigation was conducted by URS Corp. in April 2002 (URS, 2002) to determine if mining occurred below the East Ash Pond, and if so to determine its lateral extent. The investigation was conducted by running five separate high-resolution seismic lines (Figure 19): three along the south, east, and north dikes (Lines A, B, and C, respectively), one calibration line (Line D) over an area of known mine voids based on test borings, and a final Line E over an area of suspected mine collapse features north of the secondary pond.

Based on the data obtained from the geophysics investigation, the findings are summarized below.

- The survey confirmed that mining occurred in the vicinity of the East Ash Pond; however, the mining appeared to be sporadic and of limited extent along the lines of seismic investigation.
- The surface depressions north of the secondary (polishing) pond (along Line E of Figure 19) are most likely mine collapse features. The largest of these features is about 100 feet across and shows 4 to 5 feet of vertical displacement. These features are pit-type collapses consistent with mining depths less than about 150 feet below grade.

- The survey detected 12 anomalies judged to be mine-related voids, collapse features, or partial collapse features along the five lines A through E. The mine-related voids are locations where the coal has been mined, leaving a void in the bedrock. The voids may eventually work to the surface resulting in settlement (surface depressions) similar to the collapse features north of the secondary pond.

4.2.2 Bedrock Hydrology

Hydrologic data have been incorporated from data collected from both the current investigation and from the previous hydrogeologic study completed in 1987 (Mathes, 1987). Both observed and predicted effects of coal mines on the hydrology of the bedrock are discussed at the conclusion of this section.

4.2.2.1 Hydraulic Conductivity

The upper zone of the shale is moderately weathered at the surface at most of the boring locations. Generally, the shale is massive with very few horizontal joints or partings. Some near vertical joints were observed near the surface, but these were typically irregular and closed.

The horizontal hydraulic conductivity of the shale was determined by Mathes (1987) from field permeability tests. Seven wells screened in the shale were tested and the computed hydraulic conductivity ranged from $4x10^{-10}$ to $1x10^{-8}$ cm/s. The geometric mean hydraulic conductivity of the shale based on the seven wells tested was $4.3x10^{-9}$ cm/s. The vertical hydraulic conductivity calculated from tests performed in the laboratory on one shale core ranged from $1x10^{-8}$ to $5x10^{-8}$ cm/s. The field and laboratory values for hydraulic conductivity of the shale all fall within the range of $5x10^{-6}$ to $5x10^{-10}$ cm/s reported by Walton (1988).

Field hydraulic conductivity tests conducted by Kelron in 2002 (Table 4) on seven monitoring wells screened within the Pennsylvanian Shale at the Site resulted in a higher estimate of permeability than Mathes (1987). The geometric mean hydraulic conductivity for all seven shale wells was $3x10^{-6}$ cm/s and the range was $1.04x10^{-4}$ to $1.45x10^{-7}$ cm/s.

The higher permeabilities calculated by Kelron during 2002 relative to the lower values calculated by Mathes (1987) could be either from actual permeability differences of the bedrock deposits or systematic differences due to differences in analysis methods.

4.2.2.2 Potentiometric Surface Maps

Potentiometric surface maps of the upper shale were prepared using groundwater-elevation data from January and May 2002 for the nine shale monitoring wells located at the study site (Figures 20 and 21). Groundwater elevations in the shale are highest in the topographically highest areas to the west and east of the Middle Fork. The lowest groundwater elevations occur at wells located adjacent to the Middle Fork. Flow lines derived from the potentiometric surface maps indicate that the Middle Fork of the Vermilion River in this area is a zone of discharge for the shale.

Horizontal hydraulic gradients in the shallow shale range from 0.026 to 0.038 ft/ft and are towards the Middle Fork. However, the upland wells are screened at shallower (MW22) or deeper (MW30 and MW31) elevations then most of the shale wells along the Middle Fork, possibly resulting in lower or higher gradient calculations then actually exist.

The occurrence of the Middle Fork in this area as a regional discharge zone for the shallow bedrock is supported by the upward vertical hydraulic gradients measured within the shale and the upward vertical hydraulic gradients observed during various periods and at multiple locations between the shale and the alluvium. The shale outcrops along the banks of the Middle Fork in this area and groundwater moving upward through the shale discharges into both the alluvium and directly into the Middle Fork.

The east-west and north-south cross sections shown on Figures 22 and 23, respectively, show the groundwater elevations at the monitoring wells relative to the geology

4.2.2.3 Vertical Hydraulic Gradients

Vertical hydraulic gradients are a measure of the change in total head with a change in vertical distance. The vertical hydraulic gradient measures the potential for groundwater to move upward or downward. Vertical gradients were calculated using the monthly groundwater data for the five paired (nested) well sets within the shale and alluvium and at one nested set within the shale. Gradients were computed by dividing the difference in the potentiometric head in the nested wells (i.e., dh) by the difference in the midpoint of the screened elevations (i.e., dl). A positive vertical gradient indicates a downward potential for groundwater movement and a negative gradient indicates an upward potential for groundwater movement.

All of the nested wells within the floodplain of the Middle Fork, with the exception of MW23/MW24, had an upward gradient from the shale to the overlying unlithified deposits during part of the eight months of monitoring (Table 6). Two sets of nested wells, MW13A/MW13B/MW32 and MW28/MW29, had large upward gradients during the entire study period with only one exception during May.

Nested wells MW13A/MW13B/MW32, located between the East Ash Pond and the Middle Fork, had an average upward gradient of 0.043 ft/ft between the shale well MW13B and alluvial well MW13A. The average upward gradient within the shale, between wells MW32 and MW13A, was even greater at 0.585 ft/ft. The only time that the gradient was measured as downward instead of upward between the alluvium and shale (MW13A and MW13B) was during May, when a slight downward gradient of 0.003 ft/ft was measured. However, during this same time the gradient within the shale was upward at 0.588 ft/ft. Figure 24 shows the relationship between water levels in the shale and alluvial wells relative to the land surface. The upward gradient within the shale is so great that groundwater at the deepest shale well (MW32) was under flowing artesian conditions during the study.

Nested wells MW16B and MW16A, also located between the East Ash Pond and Middle Fork, had an upward gradient during one of the three months during which the alluvial well (MW16B) was not dry (Figure 25). The vertical gradient at this location was downward during the March and April measurements and upward in June.

Nested wells MW28 and MW29, located northeast of the East Ash Pond on the north side of the Middle Fork, had an average upward gradient of 0.228 ft/ft between the shale and alluvium (Figure 26). The upward gradient over the eight months study period was very consistent, ranging from 0.204 to 0.251. Similarly, nested wells MW26 and MW27, located west of MW28/MW29, had an upward gradient of 0.01 to 0.053 ft/ft during five of the eight months (Figure 26). During March, April, and May the gradient at this location was downward from the alluvium to the shale at 0.001 to 0.032 ft/ft.

The only location within the floodplain where the gradient between the unlithified deposits and the shale was downward throughout the study was at nested wells MW23 and MW24, located north of the East Ash Pond. The unlithified deposits are thicker at this location and consist of finer grained alluvial deposits overlying glacial sediments. The 8-month average downward gradient at this location was 0.018 ft/ft. This is most likely a very localized flow cell where groundwater moves downward from the unlithified deposits to the shale. However, groundwater elevations in the shale during the study were still higher then river elevations, meaning that groundwater was discharging from the shale into the river.

Unlike the lowlands along the Middle Fork where groundwater within the shale is typically discharging upward into the unlithified deposits and the river, vertical groundwater movement in the uplands to the east, west, and north is downward. Figure 27 shows groundwater levels within the diamicton and shale wells MW10 and MW22, respectively. Groundwater levels in the glacial deposits are consistently higher than those in the underlying shale.

4.2.2.4 Groundwater-Flow Direction and Velocity

In upland areas bordering the Middle Fork valley the groundwater within the glacial deposits flows downward into the shale bedrock and along the top of the shale. Groundwater within the shale moves from upland areas and discharges into the regional discharge area of the Middle Fork (Figure 28). Groundwater generally moves upward from the shale deposits into the overlying alluvial (and glacial) sediments within the Middle Fork valley. Groundwater from the shale also discharges into the Middle Fork either through the overlying alluvium or, where bedrock is exposed, directly into the river. The groundwater elevations measured in the shale monitoring wells and shown on Figure 28 support this conceptualization of groundwater movement within the Pennsylvanian bedrock.

Groundwater flow velocity within the shale bedrock, computed based on a horizontal gradient of 0.027 ft/ft, hydraulic conductivity of 3×10^{-6} cm/s, and an effective porosity of 0.10, was 0.26 meters per year (0.85 feet per year), or 10.2 inches per year. The calculated velocity is based on the geometric mean hydraulic conductivity determined by Kelron in 2002.

4.2.2.5 Coal Mine Effects on Hydrology

The presence of a coal mine beneath portions of the East Ash Pond and study area has been documented based on exploratory borings, geophysics, and historic data acquired from the ISGS. The coal mine has been shown to have significant collapse features where the overlying bedrock (shale) has collapsed or partially collapsed downward into the void or mined coal seam. The collapse of the shale into the void translates upward through the shale, resulting in fracturing and in some cases surface subsidence. Both surface depressions from subsidence and fractured shale within bedrock cores were observed during coal mine investigation activities.

A hydrologic feature noted during the exploratory boring phase of the coal mine investigation was the presence of substantial hydraulic head within the coal and overlying fractured shale in proximity to mined areas. Borings B201 and B202 (Figure 18 and Appendix C), located northwest of the East Ash Pond and secondary pond, both intercepted groundwater under high hydraulic head that resulted in temporary suspension of drilling. Upon intercepting fractured shale above the coal mines during coring, the groundwater, which had accumulated within the fractured shale and underlying coal seam and voids, rose to over 30 feet above ground surface at an estimated flow volume of greater than 100 gallons per minute. The flow rate slowly subsided, but groundwater continued to flow above the ground surface for several hours following penetration of the fractured (collapsed) shale.

The high hydraulic head that developed in the coal mine and overlying shale would be expected based on the strong upward gradient measured within the shale in monitoring wells located along the Middle Fork of the Vermilion River (see Section 4.2.2.3). Since groundwater within the shallow Pennsylvanian bedrock at the study site discharges upward into the Middle Fork, the buildup of groundwater with high hydraulic head within a more permeable confined unit of coal and fractured shale would be expected.

In addition to the high hydraulic head associated with the mined area at borings B201 and B202, hydrogen sulfide gas (developed within the reducing environment of the sulfur-rich coal beds) vented at a high rate and continued to vent until the borings were sealed over 12 hours later.

A major concern at the study site is the affects of abandoned mines on the water quality of the overlying shale, alluvial deposits and the Middle Fork. Groundwater quality issues related to coal mines are discussed further in Sections 5.2.1.3 and 6.4.

5.0 WATER QUALITY

Water quality of the groundwater and surface water at the East Ash Pond and in the surrounding region has been extensively assessed during 2002. Kelron has assessed groundwater quality at background and site wells for 22 parameters. The ISGS has evaluated background groundwater quality for 40 parameters, including the carbon and hydrogen (tritium) isotopes. In addition, the ISGS evaluated the background bedrock groundwater quality for 31 samples acquired from databases from the ISGS, ISWS, IEPA, and Indiana Geological Survey.

DMG collected groundwater samples from all of the site and background wells, both in the unlithified and bedrock deposits, monthly from March through August of 2002. Various wells were also sampled during January and February 2002, but that data was not used in statistical analyses because it was only a subset of all wells used in the study, the wells were still being developed and uniform sampling equipment had not been put into all the wells.

During June 2002 the ISGS split samples with DMG at background wells MW25 through MW 30 (ISGS designation KELRON 25 to KELRON 30) for separate analysis by the ISGS laboratory. In addition to groundwater samples, surface water samples were collected by DMG from the East Ash Pond monthly from January through May of 2002 and from upriver on the Middle Fork from March through August 2002. No East Ash Pond water samples were collected after May 2002 because of construction activities associated with expansion of the East Ash Pond. All effluent discharges to the East Ash Pond were halted and the remaining water was pumped to the secondary pond for discharge to the Middle Fork, resulting in almost no standing water within the East Ash Pond. The last discharge from the East Ash Pond outfall into the Middle Fork of the Vermilion River during the study period was May 26, 2002. Discharging from the East Ash Pond System did not resume until January 2003.

Water quality analytical results for both groundwater and surface water are provided in Appendix J for analyses conducted by DMG. All analytical results for ISGS samples are included with their report in Appendix A.

5.1 GROUNDWATER QUALITY OF THE UNLITHIFIED DEPOSITS

Water quality in the unlithified deposits at the East Ash Pond was evaluated by looking at groundwater in background wells MW26 and MW28 and comparing to East Ash Pond well MW23, located north of the secondary (polishing) pond. Groundwater quality was also compared to surface water quality upgradient on the Middle Fork and in the East Ash Pond. In addition, isotopic data collected and evaluated by the ISGS are included for the background wells MW26 and MW28 (ISGS designation's KELRON 26 and KELRON 28). No water quality data were available for East Ash Pond wells MW10, MW13B, and MW16B due to the lack of water in the wells. Wells MW13B and MW16B are typically dry or have insufficient water-column depth to obtain groundwater samples.

5.1.1 Summary of Groundwater and Surface Water Quality

5.1.1.1 Major Anions and Cations

Groundwater compositions can be grouped into identifiable categories to assist in interpreting the distribution of principal types of groundwater. A hydrochemical facies diagram, also called a Piper diagram, displays the position of water samples with respect to their major cation and anions so that composition categories can be defined (Walton, 1998). Figure 29 shows the position of groundwater samples obtained in June 2002 from East Ash Pond well MW23 and background wells MW26 and MW28. Also shown on the diagram are the surface water samples from the East Ash Pond and from the Middle Fork (labeled as "Upstream River" on the diagram).

The principal anion in background wells MW26 and MW28 and in the Middle Fork sample is bicarbonate. Well MW23 has no dominant type of anion, but is dominated by both bicarbonate and sulfate. In contrast is the East Ash Pond water sample, which has sulfate as the dominant anion. The cation portion of the diagram is much more definitive in grouping the data. All three of the wells and the Middle Fork sample cluster together between calcium and magnesium while the East Ash Pond sample is clearly dominated by calcium. Based on the observed cations and anions, and looking at the upper portion of the diagram, the hydrochemical facies of the water samples can be defined as follows: wells MW26, and MW28 and the Middle Fork of the Vermilion River are calcium-magnesium and bicarbonate type waters; the East Ash Pond is a calcium-sulfate dominated water; and, MW23 falls in-between.

The above categorizations of water types based on principal anions and cations are further demonstrated by the Stiff diagrams shown on Figure 30. The Stiff diagram for the June 2002 water samples shows the similarity between all three of the wells. The higher sulfate in well MW23 relative to bicarbonate is again demonstrated, but all other cations and anions in MW23 are similar to the background wells. The East Ash Pond water is clearly dominated by the cation calcium and the anion sulfate.

The correlation between parameters in groundwater within the unlithified materials is displayed on Table 7. The cations calcium and magnesium have a high correlation of 0.84, which indicates that these parameters vary proportionately within groundwater adjacent to the Middle Fork. The bicarbonate anion has a very high correlation of 0.94 with magnesium and the sulfate anion has a very high correlation of 0.92 with calcium. TDS concentrations in the shallow groundwater are principally controlled by the cations calcium and magnesium (correlation coefficients with TDS of 0.97 and 0.89, respectively) and the anions bicarbonate and sulfate (correlation coefficients with TDS of 0.72 and 0.89, respectively).

5.1.1.2 Statistical Analyses

In order to summarize all of the water quality data generated during 2002 so that some clear observations can be made about both the major and minor ions, including trace elements, several types of tables and figures were prepared. Each of the forms of analysis is discussed below with a summary of all the inorganic data and statistical analyses provided in Section 5.1.1.3.

Detailed Statistical Tables

A summary of groundwater quality data for the unlithified wells, East Ash Pond, and Middle Fork of the Vermilion River (Table 8) lists the mean, median, minimum, and maximum concentration for each chemical parameter. The comments under each parameter include the results of a non-parametric test called the Wilcoxon Rank-Sum Test for Comparison of Means. This statistical test, which has no distributional assumptions, was used to compare the data collected for each parameter at East Ash Pond well MW23 versus the pooled background data from wells MW26 and MW28 to determine if there was any significant difference between their means at a 95 percent confidence level. The detailed test results (Appendix K) were used to make one of three statements for each individual parameter: (1) groundwater from the East Ash Pond well MW23 comes from the same population as the background wells; (2) groundwater from the East Ash Pond well has a statistically significant lower concentration than the background wells; or, (3) groundwater from the East Ash Pond well has a statistically significant higher concentration than the background wells.

Box-and-Whisker Plots

The box-and-whisker plots in Figure 31 provide a visual representation of some of the statistical data presented on Table 8. The rectangular part of the plot extends from the lower quartile to the upper quartile, covering the center half of each sample. The center lines within each box show the sample medians and the plus signs the sample means. The whiskers extend from the box to the minimum and maximum values in each sample, except for any outside or far outside points, which are plotted separately. Outside points are points that lie more than 1.5 times the interquartile range above or below the box and are shown as small squares. Far outside points, more than 3 times the interquartile range above or below the box, are shown as small squares with plus signs through them. Far outside points may indicate outliers or a highly skewed distribution.

Cluster Analysis

Cluster analysis is a descriptive statistical method used to identify groupings (i.e., clusters) of samples or variables. Cluster analysis is used to reveal the latent structure within a data set and is an exploratory tool only. The data from the East Ash Pond study were analyzed using cluster analysis to demonstrate the following:

- grouping of samples from wells and the Middle Fork into clusters based on water quality as defined by absolute concentrations of the major cations and anions (alkalinity, calcium, chloride, potassium, magnesium, sodium, and sulfate);
- grouping of samples from wells and the Middle Fork into clusters based on water quality as defined by absolute concentrations of minor and trace metals (aluminum, boron, barium, iron, lithium, manganese, selenium, and strontium);
- grouping of major cations and anions into clusters with common characteristics; and,
- grouping of minor and trace metals into clusters with common characteristics.

The cluster analysis results can be presented in several ways. In order to visually interpret how the data have been categorized, a graphical depiction of the clusters is shown with a dendrogram. The dendrogram is a linkage tree which first links those samples or parameters that have the greatest similarity (i.e., highest correlation). Each subsequent linkage (or cluster) is less similar than earlier linkages. The greater the distance on the y-axis between linkages, the lower the significance between the linked samples or variables.

The dendrograms of major and minor/trace ions (Figure 32) both show that the first sets of clusters are within each sample location (i.e., samples from each monitoring point cluster together first since they are most similar). The next set of clusters occurs between some of the samples from background well MW26 and samples from the Middle Fork. Although the major ions do not result in any significant linkages after well MW26 and the Middle Fork are grouped together, the minor/trace metals in the water samples result in clustering of East Ash Pond well MW23 with MW26 and the Middle Fork. The final cluster, based on minor/trace metals, is the samples from background well MW28. Based on these dendrograms, the samples from well MW28 are the least similar to samples from the other locations.

The dendrograms formed by looking only at the parameters irrespective of the specific sample locations (Figure 33) used the same data as for Figure 32. The most similar major ions (i.e., the first linkages) were calcium and sulfate followed by: magnesium, alkalinity, sodium, chloride, and finally potassium. The relationship between the parameters clustered together in the dendrograms is partially quantified by the correlation coefficients listed in Table 7. The correlation coefficient between calcium and sulfate was very high at 0.92. The correlation between calcium and magnesium was 0.84 and between sulfate and magnesium was 0.97. Alkalinity had a correlation with magnesium of 0.94. The least similar parameter to the other major ions was potassium, which had a negative (i.e., inverse) correlation with magnesium of –0.69.

The dendrogram for the minor/trace metal parameters (Figure 33) has the first clusters between iron and manganese (correlation coefficient {R} = 0.82 [Table 7]) and lithium and strontium (R = 0.89). These two clusters are then clustered with selenium. Later linkages with boron, barium, and aluminum are much less significant as the similarities between parameters in all of the groundwater and Middle Fork river samples markedly decrease.

5.1.1.2 <u>Summary of Data</u>

All of the statistical analyses and observations listed on Table 8 and graphically presented in Figures 29 to 33 are summarized and consolidated onto Table 9 so that all of the parameters can be assessed together. Based on the Wilcoxon Rank-Sum tests presented in Table 8, the only parameters that have statistically significant greater concentrations in East Ash Pond well MW23 relative to background groundwater concentrations are boron, chloride, potassium, sodium, and sulfate. Each of these parameters will be discussed in detail below along with other trace parameters.

Boron
The box-and-whisker diagram for boron on Figure 31 shows the relative concentrations of boron in the East Ash Pond versus the background wells, well MW23, and the Middle Fork of the Vermilion River. The median boron concentration of 0.27 milligrams per liter (mg/L) in MW23 is 0.15 mg/L above background concentrations, but is 38 times lower than the 10 mg/L median concentration in the East Ash Pond samples. Figure 34a shows the trend in boron concentrations in shallow groundwater versus the river during 2002. Boron concentrations in groundwater at MW23 trend independently from wells MW26 and MW28 and the river. Boron in wells MW26 and MW28 has a parallel trend. Boron concentrations in the river generally lay between those observed in MW26 and MW28.

Boron concentrations in MW23 are due to either natural variation as a result of geologic and hydrologic differences at MW23 relative to the background wells or may be partly affected by the presence of the former coal mine, mine spoil, or the presence of the East Ash Pond. Any impact by the East Ash Pond on shallow groundwater quality is uncertain due to the similarity between groundwater quality impacts from coal ash disposal, coal mine spoil, and coal mine drainage.

Chloride
Chloride concentrations on the box-and-whisker diagram (Figure 31) are similar between the East Ash Pond well MW23 and the Middle Fork of the Vermilion River. Well MW23 has a median chloride concentration of 38.5 mg/L, which is only 9 mg/L above the median Middle Fork concentration. Chloride in MW23 is 5.2 times lower than the median East Ash Pond concentration of 200 mg/L. Chloride has a high correlation of 0.89 (Table 7) with boron based on data from both background wells and MW23. The natural correlation between boron and chloride makes it difficult to distinguish the co-variance of these parameters in groundwater versus potential impacts from the East Ash Pond water, which also has a high correlation between boron and chloride.

The trend in chloride concentrations (Figure 34b) are very different between groundwater sampled from well MW23 versus wells 26, 28, and the river. Wells 26 and 28 have similar chloride trends but are markedly different from chloride concentration changes in the Middle Fork.

The chloride concentrations observed in MW23 are most likely due to either natural variation as a result of geologic and hydrologic differences at MW23 relative to the background wells or may be partly affected by the presence of the former coal mine and mine spoil. Impact by the East Ash Pond on shallow groundwater quality is uncertain due to the similarity between groundwater quality impacts from coal ash disposal, coal mine spoil, and coal mine drainage.

Potassium
Potassium concentrations are similar between East Ash Pond wells MW23, background wells, and the Middle Fork. Median concentrations of 3.25 mg/L in MW23 are 0.9 mg/L above background. Potassium in MW23 is 7.7 times lower than the median East Ash

Pond concentration of 25 mg/L. The trend in potassium concentrations (Figure 34c) demonstrate the similarity between background wells MW26 and MW28, although concentrations in MW23 and the river also have similar trends to the background wells.

The potassium concentrations observed in MW23 are most likely due to either natural variation as a result of geologic and hydrologic differences at MW23 relative to the background wells or may be partly affected by the presence of the former coal mine or associated mine spoils. Impact by the East Ash Pond on potassium concentrations is uncertain due to the similarity between groundwater quality impacts from coal ash disposal, coal mine spoil, and coal mine drainage. However, the similarity between potassium concentration trends in well MW23 and background wells suggests that the East Ash Pond has negligible impact on shallow groundwater concentrations of potassium.

Sodium

Median sodium concentration of 19.5 mg/L in well MW23 is 2.5 mg/l above the median in the background well MW28 and 10.3 mg/L above the median concentration in the Middle Fork of the Vermilion River. Sodium in MW23 is 7.2 times lower than the median East Ash Pond concentration of 140 mg/L. Maximum observed sodium concentrations in 2002 at MW23 and the East Ash Pond were 26 and 240 mg/L, respectively. Similar to chloride trends, the trend in sodium concentrations (Figure 34d) are very different between groundwater sampled from well MW23 versus wells 26, 28, and the river.

The sodium concentrations observed in MW23 are most likely due to either natural variation as a result of geologic and hydrologic differences at MW23 relative to the background wells or may be partly affected by the presence of the former coal mine and mine spoil. Impact by the East Ash Pond on shallow groundwater quality is uncertain due to the similarity between groundwater quality impacts from coal ash disposal, coal mine spoil, and coal mine drainage.

Sulfate

Sulfate concentrations in East Ash Pond well MW23 in 2002 ranged from 280 to 380 mg/L with a median concentration of 320 mg/L. Concentrations in surface water at the East Ash Pond ranged from 440 to 1,500 mg/L with a median concentration of 780 mg/L, or approximately 2.4 times higher than observed in groundwater at MW23. Sulfate concentrations in the shallow unlithified deposits at MW23 and MW28 have a high variability, as seen by the box-and-whisker diagram for sulfate (Figure 31). Sulfate also has a very high correlation of 0.92 with calcium (Table 7) and these two parameters are within the first (most similar) cluster in the dendrogram discussed earlier (Figure 33).

Trends in sulfate concentration (Figure 34e) at well MW23 and background well MW28 are very similar. Sulfate concentrations at wells MW23 and MW28 are above those observed in background well MW26 and the river, which also trend closely together.

The concentrations observed for sulfate in well MW23 can partly be attributed to natural groundwater variations in conjunction with changes observed for calcium. Calcium in groundwater at MW23 is statistically from the same population as background groundwater concentrations and the high correlation between calcium and sulfate in groundwater suggests that the sulfate concentrations at MW23 are also partly natural. Impacts by the East Ash Pond, coal mine, or mine spoils on sulfate concentrations are uncertain.

Aluminum, Barium, Lithium, Molybdenum, Selenium, Strontium, and Vanadium
Concentrations of the trace metals aluminum, barium, lithium, molybdenum, selenium, strontium, and vanadium in the East Ash Pond during 2002 were all significantly higher than those in groundwater within the unlithified deposits (background and on-site). Lithium, molybdenum, selenium, and vanadium concentrations in all shallow groundwater samples were typically below or near their detection limits compared to significantly higher concentrations in the East Ash Pond surface water samples.

Statistically, the trace metal groundwater parameters sampled at well MW23 near the East Ash Pond are from the same population as the background groundwater (exception is barium, which has lower concentrations than background). The deficiency of all the trace metals in shallow groundwater near the East Ash Pond, as compared to their ubiquity in the surface water of the pond itself, suggests there is no impact on shallow groundwater by the East Ash Pond.

5.1.2 Exceedances of Groundwater Quality Standards

During March through August 2002 no groundwater samples collected from the unlithified deposits at the East Ash Pond or from the background monitoring wells exceeded any of the Class I or II groundwater standards (Illinois Administrative Code [IAC] Title 35, Part 620, Section 620.410 and 620.420) for inorganic parameters. However, background well MW28 did exceed the sulfate and TDS standards of 400 and 1,200 mg/L, respectively, during January and February 2002.

5.2 GROUNDWATER QUALITY OF THE BEDROCK DEPOSITS

Water quality in the bedrock was evaluated by comparing background wells to the East Ash Pond wells. Both the ISGS and Kelron investigated background groundwater quality through independent investigations. The ISGS investigated background groundwater quality of the Pennsylvanian age bedrock in two ways: literature and database search, including unpublished data sources, for information pertaining to groundwater geochemistry of shale and coal in Illinois and the Midwest; and, groundwater sampling and analysis during June 2002 using four private wells in Vermilion County and four of the site background wells (MW25, MW27, MW29, and MW30). Kelron investigated the background groundwater quality of the bedrock by utilizing the same four Site wells as the ISGS in addition to well MW31 and had the wells sampled by DMG for 6 consecutive months from March through August 2002.

Utilizing the data collected and analyzed by both the ISGS and DMG, the groundwater quality data from the background wells was grouped according to the source of the data and compared to the East Ash Pond bedrock wells (MW13A, MW16A, MW22, MW24, and MW32) using a variety of statistical and graphical methods.

5.2.1 Summary of Groundwater Quality

5.2.1.1 Major Anions and Cations

The major anions and cations of background and East Ash Pond wells are graphically displayed on the hydrochemical facies (Piper) diagram of Figure 35 and the Stiff diagrams of Figure 36. The principal cations in groundwater from the background wells are typically sodium and potassium, although a few wells have groundwater with higher concentrations of calcium and magnesium. The median value derived from the ISGS literature and database search, which is weighted heavily by groundwater samples from coal-bearing deposits, is dominated by calcium. A ternary plot of the cation data for background bedrock wells (Figure 37; modified from ISGS Figure 13, Appendix A) displays the linear nature of the data points. The ISGS (Mehnert and Dreher, 2002) hypothesized that "groundwater with greater concentrations of sodium plus potassium (Na+K, e.g., KELRON 27 or KELRON 29) migrated over a longer distance from the recharge area to the respective well than samples with lower concentrations of Na+K (e.g., well 23343). During migration, the groundwater dissolved increasingly greater amounts of sodium from the aquifer rocks and increasing amounts of calcium and magnesium were removed from the water, probably by adsorption of clay minerals in the aquifer rocks."

Cation data for groundwater sampled from the East Ash Pond wells plots along the same line as the background wells. Most of the East Ash Pond wells are dominated by sodium and potassium relative to calcium and magnesium. Conversely, surface water sampled from the East Ash Pond is dominated by calcium.

The principal anion in groundwater from background wells and East Ash Pond wells in the vicinity of the Site is chloride. The median value from the ISGS database is dominated by bicarbonate. Surface water from the East Ash Pond is also dominated by sulfate.

The correlation between parameters in groundwater sampled from background and East Ash Pond bedrock wells at the Site is displayed on Table 10. The cations calcium and magnesium have a very high correlation of 0.98, which reflects the data shown on the Piper and Stiff diagrams that calcium and magnesium have been removed from the groundwater by clay minerals in the shale during migration. Sodium and chloride, the principal cations and anions in bedrock groundwater at the Site, are also highly correlated with a coefficient of 0.94. These two parameters, as will be discussed later, account for much of the variability observed in groundwater from the bedrock. In addition, sodium and chloride have correlation coefficients of 0.88 and 0.93, respectively, with TDS. A large amount of the TDS observed in groundwater from the bedrock wells, both background and at the East Ash Pond, is directly correlated to changes in sodium and chloride concentrations.

As observed by the ISGS (Mehnert and Dreher, 2002) for samples from bedrock wells, "sodium and chloride concentrations apparently increase at the expense of calcium, magnesium, and other high valence cations due to adsorption as groundwater moves away from recharge areas."

5.2.1.2 Statistical Analyses

Several types of tables and figures were prepared to summarize the groundwater quality data for the bedrock. Each of the forms of analysis is discussed in the following sections. A summary of all the anlyses for each of the major ions and minor ions, including trace metals, is provided in Section 5.2.1.3

Detailed Statistical Tables

A summary of groundwater quality data is presented in Table 11 for the following groupings of data:

- Background bedrock wells at the Site using all results from the 6 monthly samplings from March through August 2002: wells MW25, MW27, MW29, MW30, and MW30;
- ISGS background data for 27 wells derived from the scientific literature and state databases (see Appendix A);
- ISGS background data for 4 wells sampled and analyzed by the ISGS in Vermilion County: wells 1349, 21903, 23343, and 25531;
- East Ash Pond bedrock wells using all results from the 6 monthly samplings in 2002: MW13A, MW16A, MW22, MW24, and MW32; and,
- East Ash Pond surface water samples from the 5 monthly samplings from January to May 2002.

The statistical summary lists the mean, median, minimum, and maximum concentration for each parameter. The comments under each parameter include the results of a non-parametric test called the Wilcoxon Rank-Sum Test for Comparison of Means. This statistical test, which has no distributional assumptions, was used to compare the data collected for each parameter at each individual East Ash Pond bedrock well (MW13A, MW16A, MW22, MW24, and MW32) versus the pooled background data from the Site background wells (MW25, MW27, MW29, MW30, and MW31) to determine if there was any significant difference between their means at a 95 percent confidence level. The detailed test results (Appendix K) were used to make one of three statements for each individual parameter: (1) groundwater from the East Ash Pond well(s) comes from the same population as the background wells; (2) groundwater from the East Ash Pond well(s) has a statistically significant lower concentration than the background wells; or, (3) groundwater from the East Ash Pond well(s) has a statistically significant higher concentration than the background wells.

Box-and-Whisker Plots

The box-and-whisker plots in Figure 38 provide a visual representation of some of the statistical data presented in Table 11. The rectangular part of the plot extends from the lower quartile to the upper quartile, covering the center half of each sample. The center-lines within each box show the sample medians and the plus signs the sample means. The whiskers extend from the box to the minimum and maximum values in each sample, except for any outside or far outside points, which are plotted separately. Outside points are points that lie more than 1.5 times the interquartile range above or below the box and are shown as small squares. Far outside points, more than 3 times the interquartile range above or below the box, are shown as small squares with plus signs through them. Far outside points may indicate outliers or a highly skewed distribution.

Cluster Analysis

Cluster analysis is a descriptive statistical method used to identify groupings (i.e., clusters) of samples or variables. Cluster analysis is used to reveal the latent structure within a data set and is an exploratory tool only. The data from the East Ash Pond study was analyzed using cluster analysis to demonstrate the following:

- grouping of samples from background wells and East Ash Pond wells at the Site into clusters based on water quality as defined by the major cations and anions (alkalinity, calcium, chloride, potassium, magnesium, sodium, and sulfate);
- grouping of samples from background wells and East Ash Pond wells at the Site into clusters based on water quality as defined by minor and trace metals (aluminum, boron, barium, iron, lithium, manganese, and strontium);
- grouping of major cations and anions into clusters with common characteristics; and,
- grouping of minor and trace metals into clusters with common characteristics.

The cluster analysis results can be presented in several ways. In order to visually interpret how the data have been categorized, a graphical depiction of the clusters is shown with a dendrogram. The dendrogram is a linkage tree which first links those samples or parameters that have the greatest similarity. Each subsequent linkage (or cluster) is less similar than earlier linkages. The greater the distance on the y-axis between linkages, the lower the significance between the linked samples or variables.

The dendrogram of major ions (Figure 39 top) shows that the first sets of clusters are typically within each sample location (i.e., groundwater sample data from each monitoring point cluster together first since they are most similar). The next set of clusters occur between East Ash Pond well MW32 and background well MW30, followed by a cluster with East Ash Pond well MW13A. Wells MW13A and MW32, located immediately east of the East Ash Pond, are nested within the bedrock; well MW32 is the screened at a lower elevation than well MW13A. Another separate clustering occurs between East Ash Pond wells MW22 and MW24 with background wells MW27 and MW29, located on the other side of the Middle Fork of the Vermilion River. The clusterings of background wells with East Ash Pond wells based on major ion composition is indicative of strong similarities between the overall groundwater composition at these locations and depths within the Pennsylvanian bedrock.

The dendrogram of minor ions and trace metals (Figure 39 bottom) has a slightly different set of clusters than that of the major ions above. The first sets of clusters following those within each sample location are between wells MW13A - MW32, MW27 - MW29, and MW22 - MW24. Wells MW13A and MW32 are the nested wells that clustered together for the major ions, but well MW30 no long clusters with these wells due to the differences in the trace element composition of the groundwater. This may be due to the presence of coal within the screened interval of well MW30. The next level of clusters occurs between all of the wells listed above: MW13A, MW32, MW27, MW29, MW22, and MW24; four of these wells are at the East Ash Pond and two (MW27 and MW29) are background wells. The next set of clusters in order of distance along the dendrogram incorporates background wells MW25 and MW31 followed by East Ash Pond well MW16A. The trace metal data from MW30 is very dissimilar from all other wells and is clustered last.

The dendrograms formed by looking only at the parameters irrespective of the specific sample locations (Figure 40 used the same data as for Figure 39. The most similar major ions (i.e., the first linkages) were calcium-magnesium and sodium-chloride followed by: calcium-magnesium and sulfate, sodium-chloride and alkalinity, and sodium-chloride-alkalinity and potassium. The relationship between the parameters clustered together in the dendrograms is partially quantified by the correlation coefficients listed in Table 10. The correlation coefficients between calcium-magnesium and sodium-chloride were very high at 0.98 and 0.94, respectively. The correlations between calcium and magnesium with sulfate were both 0.86. The correlations between sodium and chloride with alkalinity were 0.70 and 0.46, respectively.

The dendrogram for the minor/trace metal parameters (Figure 40, bottom) has the first clusters between barium and iron (correlation coefficient {R} = 0.87 [Table 10]) and aluminum and lithium (R = 0.63). Next, barium-iron is clustered with strontium (R = 0.54 and 0.56, respectively) and aluminum-lithium is clustered with boron (R= -0.02 and 0.47, respectively). Manganese concentrations in groundwater at the study site are very poorly correlated with all the other minor/trace metals and there is no cluster formed with any other parameters.

5.2.1.3 <u>Summary of Data</u>

All of the statistical analyses and observations listed on Table 11 and graphically presented in figures 35 to 40 are summarized on Table 12 so that all of the parameters can be assessed together. Based on the Wilcoxon Rank-Sum tests presented in Table 11, the only parameters that have statistically significant greater concentrations in any of the East Ash Pond wells relative to background groundwater quality in the bedrock are the following:

- Boron at wells MW13A and MW32;
- Calcium at well MW16A;

- Lithium at wells MW13A and MW16A;
- Magnesium at well MW16A;
- Manganese at wells MW13A and MW16A;
- Phosphorus at well MW24;
- Sodium at wells MW13A and MW32;
- Sulfate at wells MW16A, MW22, and MW24; and,
- TDS at wells MW13A and MW32.

Each of these parameters and wells listed above will be discussed in detail below. Other parameters measured in groundwater samples from the bedrock and East Ash Pond will also be discussed.

Boron

The box-and-whisker diagram for boron on Figure 38 shows the relative concentrations of boron in the East Ash Pond wells relative to background wells and the East Ash Pond. The range of boron concentrations in the Site background wells during 2002 was between 0.20 and 1.30 mg/L versus a range for the East Ash Pond wells of 0.30 to 1.60 mg/L. Median boron concentrations at East Ash Pond wells MW13A and MW32 were 1.40 and 1.50 mg/L, respectively. These median boron concentrations are approximately 7 times lower than those observed in the East Ash Pond sluice water.

Wells MW13A and MW32 are both at a location where groundwater has a large upward vertical gradient as it discharges into the alluvial deposits and the Middle Fork of the Vermilion River. The similarity of boron concentrations at this nested well location, along with the upward gradient, indicates that the occurrence of boron is either naturally occurring or may be influenced by the occurrence of past coal mining activities as discussed earlier in Section 4.2.2.5.

Calcium

Calcium concentrations in all of the East Ash Pond wells with the exception of MW16A are either equal to or below background concentrations based on the Wilcoxon Rank-Sum Test. Well MW16A has a median calcium concentration of 135 mg/L, which is above the range of values observed at the Site background wells (median values of 29.5 to 85.5 mg/L). However, the concentrations measured for calcium at well MW16A in 2002 are well above the historical median of 33 mg/L for the period of 1993 through 2001. Calcium concentrations at well MW16A have historically been similar to those at well MW13A and the Site background wells. East Ash Pond surface water samples had calcium concentrations ranging from 150 to 450 mg/L and a median concentration of 350 mg/L.

It is uncertain what factors may have resulted in higher calcium concentrations at well MW16A during 2002. However, well MW16A also had historically high concentrations of magnesium, sulfate, and TDS during 2002. Calcium and magnesium are very highly correlated (R = 0.98, Table 10) in groundwater at the Site and the higher observed concentrations of both these parameters at only one location may be due to the affects of the former coal mine on groundwater geochemistry.

Chloride

Chloride concentrations at the East Ash Pond wells are generally below those observed at Site background wells (Figure 38). The highest chloride concentrations at the East Ash Pond are found in groundwater at nested wells MW13A and MW32, with median concentrations of 570 and 845 mg/L, respectively. These concentrations are below the median chloride concentrations of 840 and 1,200 mg/L measured in groundwater at Site background wells MW25 and MW30, respectively. It is of interest that the highest chloride concentrations occur at well MW30, which is partially screened across coal deposits, and at wells MW25, MW13A, and MW32, all of which occur near (and may be impacted by) former coal mines.

The median chloride concentration in surface water at the East Ash Pond ranged from 100 to 240 mg/L with a median value of 200 mg/L during the study period, or approximately 3 to 4 times lower than the median chloride concentrations observed at wells MW13A and MW32. Chloride in groundwater at the Site is naturally occurring at most bedrock well locations, including the elevated concentrations observed at well MW30 due to coal deposits. However, elevated concentrations observed in some bedrock wells may occur due to former coal mines located nearby.

Lithium

Although lithium concentrations in groundwater at East Ash Pond wells MW13A and MW32 were identified by the Wilcoxon Rank-Sum Test as being above site background, a closer look at the data on the box-and-whisker diagrams (Figure 38) and on Table11 show that the relative concentrations of lithium in wells MW13A and MW32 are within the range of data at Site background wells MW25 and MW30. Lithium concentrations in all of the East Ash Pond wells range from non-detect at 0.005 mg/L to 0.19 mg/L versus a range of non-detect to 0.40 mg/L in the Site background wells.

Similar to observed chloride concentrations, the lithium concentrations in groundwater at wells MW13A and MW32 are higher than other East Ash Pond wells but within the range of values observed in background wells MW25 and MW30. As discussed for chloride, the higher lithium concentration at well MW30 may be caused by the presence of coal in the screened interval. Similarly, higher lithium concentrations in wells MW13A, MW32, and MW25 may be related to the presence of former coal mines.

Lithium concentrations in the East Ash Pond ranged from non-detect to 0.30 mg/L with a median concentration of 0.27 mg/L, or approximately 3 to 14 times greater than the median concentrations observed in the East Ash Pond wells.

Magnesium

Magnesium concentrations in all of the East Ash Pond wells with the exception of MW16A are either equal to or below background concentrations based on the Wilcoxon Rank-Sum Test. Well MW16A has a median manganese concentration of 72.5 mg/L, which is above the range of values observed at the Site background wells. However, the concentrations measured for magnesium at well MW16A in 2002 are well above the historical median of 20 mg/L for the period of 1993 through 2001. Magnesium concentrations at well MW16A have historically been similar to those at well MW13A and the Site background wells. East Ash Pond surface water samples had magnesium concentrations ranging from 8.4 to 42 mg/L and a median concentration of 30 mg/L.

It is uncertain what factors may have resulted in higher magnesium concentrations at well MW16A during 2002. However, well MW16A also had historically high concentrations of calcium, sulfate, and TDS during 2002. Magnesium and calcium are very highly correlated (R = 0.98, Table 10) in groundwater at the Site and the higher observed concentrations of both these parameters at only one location may be attributed to impacts from the former coal mine.

Manganese

As with magnesium, manganese concentrations in well MW16A are statistically above Site background concentrations. The highest manganese concentrations observed in any of the East Ash Pond or background wells occurs in groundwater at well MW16A. The median manganese concentration at well MW16A during the study was 14 times greater than the median in surface water from the East Ash Pond. Since manganese is highly correlated with magnesium concentrations in groundwater at the Site (R = 0.86, Table 10), the higher manganese concentrations observed at well MW16A would be expected based on the high magnesium concentrations also observed in groundwater at this location.

Manganese concentrations at Well MW13A were also above Site background, but were similar to the concentrations observed at background well MW31. The concentrations at MW13A were also within the range documented by the ISGS from the scientific literature and state databases (Table 11).

The degree to which manganese concentrations at MW13A and MW16A might be impacted by the presence of former coal mines is unknown, although any decrease in pH values or presence of reducing conditions associated with former mines would result in increased manganese concentrations in groundwater.

Phosphorus

Phosphorus concentrations in all of the East Ash Pond wells with the exception of MW24 are either equal to or below background concentrations based on the Wilcoxon Rank-Sum Test. Well MW24 has a median phosphorus concentration of 0.047 mg/L, which is within the range observed in groundwater at wells MW16A and MW31. Phosphorus concentrations at well MW24 are most likely naturally occurring based on concentrations observed in the East Ash Pond, other East Ash Pond wells, and Site background wells.

Sodium

Sodium concentrations at the East Ash Pond wells are generally within the same range as those observed at Site background wells (Figure 38). The highest sodium concentrations mg/L). The highest TDS concentrations observed in groundwater in 2002, ranging from 2,400 to 2,500 mg/L, occurred at background well MW30. Well MW30 is partially screened across a coal seam. The median TDS concentration of 1,400 mg/L in groundwater at well MW16A is statistically from the same population as the background bedrock wells using the Wilcoxon Rank-Sum Test and 1,000 mg/L below the median TDS concentration in groundwater at background well MW30.

The high TDS concentrations observed at wells MW13A and MW32 can be attributed to the high sodium and chloride concentrations in groundwater at this nested well location. TDS is most highly correlated with sodium (R = 0.93) and chloride (R = 0.88). As discussed earlier, high sodium and chloride concentrations in groundwater at the Site are a function of naturally occurring conditions at most bedrock wells. Naturally elevated concentrations of these major ions are reflected by similarly high TDS concentrations. However, the highest elevated concentrations of TDS (as with sodium and chloride) may occur in some bedrock wells due to coal deposits (i.e., at well MW30) or former coal mines located nearby (MW25, MW13A, and MW16A).

The median TDS concentration of 1,400 mg/L in groundwater at well MW16A in 2002 is significantly higher than the historical median of 760 mg/L for the period 1993 through 2001. The high TDS concentrations observed at well MW16A in 2002 are attributed primarily to calcium, magnesium, and sulfate, all of which were elevated in groundwater at well MW16A relative to other bedrock wells.

Factors contributing to the higher concentrations of these parameters at well MW16A are difficult to determine since this is the only well with elevated calcium, magnesium, and sulfate concentrations relative to background. However, based on an upward hydraulic gradient within the bedrock and the presence of former coal mines in the vicinity of the well, it is surmised that the occurrence of high TDS in groundwater in this area may be impacted by the former coal mines.

Barium

Barium concentrations in the East Ash Pond wells are at statistically significant lower concentrations than observed in the background bedrock wells based on the Wilcoxon Rank-Sum Test. The lowest mean and median concentrations of barium are found in surface water of the East Ash Pond. The highest barium concentrations are found in the background bedrock wells and the nested East Ash Pond bedrock wells MW13A and MW32.

The nested bedrock wells MW13A and MW32 may have higher barium concentrations than other East Ash Pond wells due to either naturally higher concentrations or may be affected by the former coal mines. The influence of former coal mines on groundwater quality of the bedrock at MW13A and MW32 is hypothesized based on the higher barium concentrations observed in background bedrock wells MW25 and MW30. Wells MW25 and MW30 have elevated barium concentrations relative to the other background wells. Well MW25 is located near a former coal mine and well MW30 is partially screened across a coal seam.

Strontium
Strontium concentrations in the East Ash Pond bedrock wells are at statistically significant lower concentrations or from the same population as the background bedrock wells based on the Wilcoxon Rank-Sum Test. Concentrations of strontium in the East Ash Pond water samples are within the range of both background wells and East Ash Pond wells. Based on the data collected, strontium is not a useful parameter for distinguishing groundwater types or the potential influence of anthropogenic sources.

Aluminum, Molybdenum, Selenium, and Vanadium
Concentrations of the trace metals aluminum, molybdenum, selenium, and vanadium in the East Ash Pond during 2002 were all significantly higher than observed in groundwater within the bedrock deposits (background and on-site). Concentrations of aluminum, molybdenum, selenium, and vanadium in groundwater samples from all bedrock wells were typically below or near their detection limits compared to significantly higher concentrations in the East Ash Pond surface water samples. All of the East Ash Pond bedrock well samples for these four trace metals are statistically from the same population as the background samples using the Wilcoxon Rank-Sum Test for comparison of means.

The deficiency of these four trace metals in groundwater within the Pennsylvanian age bedrock at both background and East Ash Pond wells, as compared to their presence within waters of the East Ash Pond, suggests there is no impact to bedrock groundwater quality by the East Ash Pond.

5.2.2 Exceedances of Groundwater Quality Standards

Groundwater samples collected from bedrock wells at the East Ash Pond and background locations in 2002 (Appendix J) exceeded several Class II groundwater standards (IAC Title 35, Part 620.420) for inorganic parameters. The parameters exceeded by one or more groundwater samples from the bedrock wells at the Site include chloride, sulfate, and TDS. As discussed in Section 5.2.1.3 and displayed on Table 11, many parameters detected at elevated concentrations in groundwater were elevated in both background wells and the East Ash Pond wells.

As seen on the following table, the chloride standard was exceeded at four background wells and two East Ash Pond wells, the sulfate standard at one East Ash Pond well, and the TDS standard at two background wells and three East Ash Pond wells.

Parameter	Class II Groundwater Standard (mg/L)	Background Bedrock Wells Exceeding Class II Standard in 2002	East Ash Pond Bedrock Wells Exceeding Class II Standard in 2002
Chloride	200	MW25, MW27, MW29, MW30	MW13A, MW32
Sulfate	400	none	MW16A
TDS	1,200	MW25, MW30	MW13A, MW16A, MW32

The occurrence of parameters in groundwater at sufficiently high concentrations to exceed groundwater standards can be attributed to three sources: natural geochemistry of the shale bedrock; natural geochemistry associated with coal deposits, particularly at MW30; and, anthropogenic affects on geochemistry associated with former coal mines in the vicinity of background well MW25 and the East Ash Pond wells, particularly wells MW13A, MW16A, and MW32.

5.3 ISOTOPE RESEARCH RESULTS

The carbon and hydrogen (tritium) isotopic data analyzed by the ISGS for groundwater "reveal that some wells produce recent water, while others yield much older water" (Mehnert and Dreher, 2002; Appendix A). Groundwater sampled from the alluvial deposits at wells MW26 and MW28 is indicative of recent water. Tritium values in Illinois precipitation as reported by the ISGS (Appendix A, Table 11) typically range from 3 to 10 tritium units (TU). In the subsurface, tritium has a half-life of 12.3 years and water with tritium concentrations greater than 5 TU is considered recent water. Tritium concentrations in groundwater from the unlithified deposits at wells MW26 and MW28 were 5.3 and 5.8 TU, respectively. Conversely, tritium concentrations in groundwater from the bedrock deposits at wells MW25, MW27, MW29, and MW30 were all below detection limits ranging from 0.43 to 0.52 TU. Water with non-detectable tritium concentrations is considered to be greater than 50 years old.

The Carbon-14 (^{14}C) data for groundwater from the alluvial deposits was consistent with the tritium data. ^{14}C, which has a much longer half-life than tritium, is presented by the ISGS (Appendix A, Table 11) as radiocarbon years before present (RYBP) and as percent (%) modern carbon, both of which provide relative ages. Groundwater from the shallow alluvial wells (MW26 and MW28) had % modern carbon values of 97 and 102 and RYBP values of 210 and "modern", respectively. Based on the tritium and ^{14}C data for groundwater from MW26 and MW28, it is apparent that wells completed in Quaternary geologic materials (i.e., alluvial deposits) "appear to draw water from the local groundwater flow system" (Mehnert and Dreher, 2002).

In contrast to water sampled from the alluvial wells, ^{14}C data from the bedrock wells indicates that the groundwater is significantly older. The ^{14}C data for the background wells installed in the Pennsylvanian bedrock is listed below.

Well Number	Radiocarbon Years Before Present (RYBP)	% Modern Carbon
MW25 (Kelron 25)	13,920	18
MW27 (Kelron 27)	19,400	8.9
MW29 (Kelron 29)	34,610	1.4
MW30 (Kelron 30)	20,850	7.5

The conclusions of the ISGS concerning the four bedrock wells sampled for ^{14}C analysis were that they "apparently draw water from the bedrock and are either only slightly connected to or completely isolated from the local groundwater flow system".

The results of the isotopic analyses of groundwater samples from the background bedrock wells support the hydrogeologic data and conceptualization established earlier. Namely, the Middle Fork of the Vermilion River is a regional discharge area for the bedrock and groundwater within the bedrock is at the end of its flow path, with upward hydraulic gradients, high dissolved mineral content, and significantly older by 13,000 to 35,000 RYBP than groundwater in the overlying unlithified deposits.

6.0 CONCLUSIONS

A comprehensive hydrogeologic and geochemical study of the East Ash Pond System and surrounding region at DMG's Vermilion Power Plant was conducted during 2001-2002. Background geochemical data on the bedrock and groundwater was collected and evaluated by the ISGS for comparison to site-specific data. The collected body of data has been summarized below for the geology, hydrogeology and groundwater chemistry. Utilizing all the available data from the study site and surrounding region, a final section provides the proposed groundwater classification for groundwater at the Vermilion Power Plant and East Ash Pond System.

6.1 GEOLOGY

The deposits covering the bedrock in the region surrounding the study site are derived from recent river deposition (alluvial sediments) in the river valleys and glacial drift deposits occurring below the alluvial sediments and in the upland areas. The glacial and interglacial geologic events that shaped the topography seen today occurred during the Pleistocene Epoch, about 2 million to 12,000 years ago. Thickness of these deposits in the region range from zero thickness along portions of the Middle Fork where bedrock is exposed to over 200 feet in the upland areas.

The unlithified alluvial and glacial deposits in the vicinity of the East Ash Pond and within the floodplain generally range in thickness from 10 to 25 feet. The unlithified deposits increase in thickness as the alluvial deposits pinch out and are supplanted by glacial deposits at higher topographic elevations. Along the western portion of the study site, to the west of the East Ash Pond, the thickest glacial deposits range from 71 feet to the north to 103 feet in the south.

Rocks of Pennsylvanian age form the bedrock surface in the region surrounding the study site. The Danville area is located on the northeast flank of the Illinois basin. Regionally, the Pennsylvanian bedrock consists of mainly shale with thin limestone, sandstone, and coal beds. The upper 75 feet of bedrock at the Site consists of non-marine and marine, silty and micaceous shales of the Pennsylvanian Age Shelburn Formation. The Shelburn Formation contains a major coal seam mined in the region, the Danville Coal, also called the No. 7 Coal.

The top of the Danville Coal, or the void remaining where the coal was removed through mining, was intercepted at depths of 80 to 102.5 feet BLS on the floodplain adjacent to the East Ash Pond. The thickness of the coal seam ranged from 4 to 7 feet with an average thickness of 5.4 feet. A geophysical survey by URS Corp. along 5 lines in 2002 detected 12 anomalies judged to be mine-related voids, collapse features, or partial collapse features in the vicinity of the East Ash Pond System.

The region surrounding the Vermilion Power Plant, including portions of the plant property, has seen extensive coal-mining activity from 1893 to 1970. Two coal mines are located within the vicinity of the East Ash Pond System. Based on data and maps obtained from the ISGS, the former entrances to the two coal mines beneath the site are located just north of the secondary cell of the East Ash Pond and 600 feet southwest of the primary cell.

6.2 HYDROGEOLOGY

Groundwater within the alluvial and, where present, the glacial (till) deposits within the floodplain generally conforms to the ground surface topography. Groundwater elevations in the till and alluvial deposits demonstrate that groundwater elevations in the unlithified materials are higher than those in the adjacent Middle Fork through much of the year. The groundwater surface in the alluvial deposits fluctuates in response to changes in river stage and variations in precipitation. The groundwater surface is not affected by water levels in the East Ash Pond, which has been hydraulically isolated from both the shale and alluvial deposits by soil/bentonite slurry walls and a compacted clay core. Changes in pond elevation do not result in any corresponding changes in the shallow groundwater levels.

Groundwater elevations in the shale are highest in the topographically highest areas to the west and east of the Middle Fork of the Vermilion River. The lowest groundwater elevations occur at wells located adjacent to the Middle Fork. Flow lines derived from the potentiometric surface maps indicate that the Middle Fork in this area is a zone of discharge for the shale. The occurrence of the Middle Fork in this area as a regional discharge zone for the shallow bedrock is supported by the upward vertical hydraulic gradients measured within the shale and the upward vertical hydraulic gradients observed during various periods and at multiple locations between the shale and the alluvium. The shale outcrops along the banks of the Middle Fork and groundwater moving upward through the shale discharges into both the alluvium and directly into the Middle Fork.

The coal mines in the vicinity of the East Ash Pond System have been shown to have significant collapse features where the overlying shale has collapsed or partially collapsed downward into the void or mined coal seam. The collapse of the shale into the void translates upward through the shale, resulting in fracturing and in some cases surface subsidence. A hydrologic feature noted during the exploratory boring phase of the coal mine investigation was the presence of substantial hydraulic head within the coal and overlying fractured shale in proximity to mined areas. Borings located northwest of the East Ash Pond intercepted groundwater under flowing artesian conditions that resulted in temporary suspension of drilling.

6.3 GROUNDWATER CHEMISTRY

Based on all of the groundwater and surface water quality data collected in 2002, the affects of the East Ash Pond on groundwater quality are either negligible or not present. Groundwater quality data for most major ions and trace constituents is similar to background groundwater quality. In cases where elevated concentrations of a parameter were found to occur in groundwater near the East Ash Pond there were also elevated concentrations in background wells screened within coal deposits or in the proximity of abandoned coal mines.

Trace metal concentrations in groundwater were compared to East Ash Pond water samples and there was no commonality between the two water types. The deficiency of trace metals such as molybdenum, selenium, and vanadium in groundwater within both the alluvial deposits and the Pennsylvanian age bedrock at both background and East Ash Pond wells, as compared to their ubiquitous presence within waters of the East Ash Pond, suggests that based on trace water quality data there is no impact to unlithified or bedrock groundwater quality by the East Ash Pond.

Finally, the results of the isotopic analyses of groundwater samples from the background bedrock wells by the ISGS resulted in Carbon-14 ages ranging from 13,000 to 35,000 RYBP (radiocarbon years before present). In support of the Carbon-14 results, tritium concentrations for the same set of bedrock groundwater samples were all below detection limits ranging from 0.43 to 0.52 TU (tritium units). Water with non-detectable tritium concentrations is considered to be greater than 50 years old (Mehnert and Dreher, 2002).

The isotopic and other geochemical data supports the hydrogeologic conceptualization established earlier. Namely, the Middle Fork of the Vermilion River is a regional discharge area for the bedrock and groundwater within the bedrock is at the end of its flow path, with upward hydraulic gradients, high dissolved mineral content, and significantly older by 13,000 to 35,000 RYBP than recent groundwater in the overlying unlithified deposits.

6.4 GROUNDWATER CLASSIFICATION

During March through August 2002, no groundwater parameters measured in shallow monitoring wells in the unlithified deposits exceeded Class I or II groundwater standards. However, background well MW28 exceeded the sulfate and TDS standards of 400 and 1,200 mg/L, respectively, during January and February 2002.

Three bedrock monitoring wells at the East Ash Pond and four background wells regularly exceeded standards for at least one of the parameters of chloride, sulfate, and TDS. The occurrence of parameters within the bedrock at sufficiently high concentrations to exceed groundwater standards can be attributed to three sources: natural geochemistry of the shale bedrock; natural geochemistry associated with coal deposits; and, anthropogenic (man-made) affects on geochemistry associated with former coal mines.

Based on the hydrogeology and geochemistry established for the vicinity of the East Ash Pond and surrounding region, and given the influence of former coal mines documented at the Site on the geochemistry of groundwater within the unlithified and bedrock deposits, it is proposed that the groundwater designation in accordance with Section 620.201 of Part 620 (IAC Title 35, Subtitle F, Chapter I) be Class IV – Other Groundwater, as documented by the following excerpt from Section 620.240:

"g) Groundwater within a previously mined area, unless monitoring demonstrates that the groundwater is capable of consistently meeting the standards of Sections 620.410 or 620.420. If such capability is determined, groundwater within the previously mined area shall not be Class IV."

The groundwater quality established at the East Ash Pond is within a previously mined area and has been documented to be influenced by both natural geochemistry and the influences of abandoned coal mines and mine spoils. Groundwater quality at the Vermilion Power Plant and in background wells have consistently not met the Class I and II standards for chloride, sulfate, and TDS as documented in Sections 620.410 and 620.420, respectively, of the IAC. Therefore, groundwater in the unlithified deposits and bedrock at the East Ash Pond and surrounding area of the DMG property at the Vermilion Power Plant should be designated Class IV.

7.0 REFERENCES

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Tables

Table 1. Boring and Monitoring Well Summary

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

Boring or Monitoring Well	Drilling / Installation Date	Status / Purpose as of November 2002	Land Surface Elevation (feet) 2001 Survey	State Planar X-Coord (feet)	State Planar Y-Coord (feet)
MW10	1987	Quarterly Monitoring Well	656.3	1,150,091	1,279,665
MW13A	1987	Quarterly Monitoring Well	581.9	1,151,313	1,279,859
MW13B	1987	Quarterly Monitoring Well	582.0	1,151,313	1,279,865
MW16A	1987	Quarterly Monitoring Well	578.3	1,151,425	1,279,349
MW16B	1987	Quarterly Monitoring Well	578.5	1,151,418	1,279,347
MW-11A	1987	destroyed - E.Ash Pond construction	594.7	1,150,764	1,279,956
MW-12A	1987	destroyed - E.Ash Pond construction	590.0	1,151,082	1,280,323
MW-14A	1987	destroyed - E.Ash Pond construction	586.1	1,150,877	1,279,520
MW-15A	1987	destroyed - E.Ash Pond construction	589.0	1,150,650	1,279,242
MW22	2001	2001-2002 Hydrogeologic Investigation / In Use	655.6	1,150,083	1,279,669
MW23	2001	2001-2002 Hydrogeologic Investigation / In Use	599.1	1,150,788	1,280,399
MW24	2001	2001-2002 Hydrogeologic Investigation / In Use	598.8	1,150,783	1,280,404
MW25	2001	2001-2002 Hydrogeologic Investigation / In Use	578.8	1,150,916	1,278,027
MW26	2001	2001-2002 Hydrogeologic Investigation / In Use	580.5	1,150,782	1,280,741
MW27	2001	2001-2002 Hydrogeologic Investigation / In Use	580.4	1,150,787	1,280,744
MW28	2001	2001-2002 Hydrogeologic Investigation / In Use	581.0	1,151,565	1,281,552
MW29	2001	2001-2002 Hydrogeologic Investigation / In Use	580.9	1,151,564	1,281,557
MW30	2001	2001-2002 Hydrogeologic Investigation / In Use	645.7	1,150,347	1,282,360
MW31	2001	2001-2002 Hydrogeologic Investigation / In Use	698.2	1,152,932	1,279,256
MW32	2001	2001-2002 Hydrogeologic Investigation / In Use	581.9	1,151,312	1,279,850
B101	2001	Geotechnical Boring - E.Ash Pond Expansion	604.0	1,150,224	1,279,157
B102	2001	Geotechnical Boring - E.Ash Pond Expansion	642.0	1,150,264	1,279,708
B103	2001	Geotechnical Boring - E.Ash Pond Expansion	653.9	1,150,323	1,279,872
B104	2001	Geotechnical Boring - E.Ash Pond Expansion	652.4	1,150,287	1,279,540
B105	2001	Geotechnical Boring - E.Ash Pond Expansion	652.4	1,150,360	1,279,510
B106	2001	Geotechnical Boring - E.Ash Pond Expansion	659.2	1,150,353	1,279,348
B107	2001	Geotechnical Boring - E.Ash Pond Expansion	658.6	1,150,188	1,279,346
B108	2001	Geotechnical Boring - E.Ash Pond Expansion	658.0	1,150,259	1,279,463
B109	2001	Geotechnical Boring - E.Ash Pond Expansion	655.8	1,150,194	1,279,559
B110	2001	Geotechnical Boring - E.Ash Pond Expansion	654.6	1,149,682	1,279,283
B111	2001	Geotechnical Boring - E.Ash Pond Expansion	653.7	1,149,852	1,279,443
B112	2001	Geotechnical Boring - E.Ash Pond Expansion	652.7	1,149,843	1,279,285
B201	2002	Exploratory Boring - Coal Mine Investigation	599.1	1,150,614	1,280,277
B202	2002	Exploratory Boring - Coal Mine Investigation	606.0	1,150,547	1,280,287
B203	2002	Exploratory Boring - Coal Mine Investigation	627.1	1,150,427	1,280,159
B204	2002	Exploratory Boring - Coal Mine Investigation	588.0	1,150,065	1,278,812
B205	2002	Exploratory Boring - Coal Mine Investigation	589.6	1,150,223	1,278,791
B206	2002	Exploratory Boring - Coal Mine Investigation	589.0	1,150,345	1,278,682
B207	2002	Exploratory Boring - Coal Mine Investigation	595.6	1,150,358	1,278,992
B208	2002	Exploratory Boring - Coal Mine Investigation	657.6	1,149,885	1,278,897

Table 2. Monitoring Well Depths and Screened Elevations

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

Monitoring Well	TOC/MP Elevation (feet)	Land Surface Elevation (feet)	Well Stickup (feet)	Screen Top from LS (feet)	Screen Bot from LS (feet)	Screen Length (feet)	Screen Elevation Top (feet)	Screen Elevation Bottom (feet)	Total Well Depth from LS (feet)	Total Well Depth from TOC/MP (feet)
MW10	659.10	656.3	2.8	46.60	56.60	10.00	609.70	599.70	56.6	59.4
MW13A	583.47	581.9	1.6	21.00	41.00	20.00	560.90	540.90	41.0	42.6
MW13B	583.84	582.0	1.8	5.50	10.50	5.00	576.50	571.50	10.5	12.3
MW16A	580.17	578.3	1.9	21.80	41.80	20.00	556.50	536.50	41.8	43.7
MW16B	580.56	578.5	2.1	7.00	12.00	5.00	571.50	566.50	12.0	14.1
MW22	658.60	655.6	3.0	80.00	100.00	20.00	575.60	555.60	100.0	103.0
MW23	601.89	599.2	2.7	11.80	21.80	10.00	587.40	577.40	22.0	24.7
MW24	601.81	598.8	3.0	34.80	54.80	20.00	564.00	544.00	54.8	57.8
MW25	581.65	578.8	2.9	19.10	39.10	20.00	559.70	539.70	39.1	42.0
MW26	583.52	580.5	3.0	7.75	12.75	5.00	572.75	567.75	13.0	16.0
MW27	583.39	580.4	3.0	23.00	43.00	20.00	557.40	537.40	43.0	46.0
MW28	583.79	581.0	2.8	8.00	13.00	5.00	573.00	568.00	13.0	15.8
MW29	583.90	580.9	3.0	23.00	43.00	20.00	557.90	537.90	43.0	46.0
MW30	648.71	645.7	3.0	127.00	147.04	20.04	518.70	498.66	147.0	150.1
MW31	701.21	698.2	3.0	162.00	182.00	20.00	536.20	516.20	182.0	185.0
MW32	585.00	581.9	3.1	45.80	55.80	10.00	536.10	526.10	55.8	58.9

Notes:

Shale
Till or Alluvial

All elevations measured during December 2001 except MW13A,B; and, MW16A,B from 1999 survey.

Table 3. Groundwater and Surface-Water Levels and Elevations: 2002

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

Monitoring Well or Surface Water Point	Measuring Point Elevation[1] (feet NGVD)	Groundwater Depth (feet below MP)								Groundwater Elevation (feet NGVD)							
		1 1/22-23/02	2 2/18/2002	3 3/19-21/02	4 4/16-17/02	5 5/22/2002	6 6/18/2002	7 7/16/2002	8 8/27/2002	1 1/22-23/02	2 2/18/2002	3 3/19-21/02	4 4/16-17/02	5 5/22/2002	6 6/18/2002	7 7/16/2002	8 8/27/2002
MW10	659.10	52.99	52.41	51.89	51.62	52.63	51.62	51.81	52.26	606.11	606.69	607.21	607.48	606.47	607.48	607.29	606.84
MW13A	583.47	10.73	10.56	10.32	10.59	10.11	10.73	10.82	8.82	572.74	572.91	573.15	572.88	573.36	572.74	572.65	574.65
MW13B	583.84	dry	12.03	11.79	11.90	10.40	12.12	12.61	10.67	dry	571.81	572.05	571.94	573.44	571.72	571.23	573.17
MW16A	580.17	10.34	10.60	10.36	10.74	9.65	9.86	9.99	6.6	569.83	569.57	569.81	569.43	570.52	570.31	570.18	573.57
MW16B	580.56	dry	dry	10.05	10.22	dry	10.51	dry	9.63	dry	dry	570.51	570.34	dry	570.05	dry	dry
MW22	658.60	56.61	56.52	56.60	58.54	57.42	58.78	59.10	60.35	601.99	602.08	602.00	600.06	601.18	599.82	599.50	598.25
MW23	601.89	13.79	12.98	12.00	12.39	12.06	13.80	14.49	13.46	588.10	588.91	589.89	589.50	589.83	588.09	587.40	588.43
MW24	601.81	22.71	23.86	21.90	22.39	21.80	22.06	22.48	21.20	579.10	577.95	579.91	579.42	580.01	579.75	579.33	580.61
MW25	581.65	16.02	15.89	15.39	15.46	14.82	15.25	15.84	13.97	565.63	565.76	566.26	566.19	566.83	566.40	565.81	567.68
MW26	583.52	10.03	9.11	7.91	7.83	6.40	8.13	9.83	8.86	573.49	574.41	575.61	575.69	577.12	575.39	573.69	574.66
MW27	583.39	8.70	8.52	7.80	7.88	7.00	7.77	8.60	7.54	574.69	574.87	575.59	575.51	576.39	575.62	574.79	575.85
MW28	583.79	9.36	8.53	7.95	7.77	7.42	8.70	10.09	8.44	574.43	575.26	575.84	576.02	576.37	575.09	573.70	575.35
MW29	583.90	4.04	3.42	3.04	2.83	2.71	3.38	4.52	3.95	579.86	580.48	580.86	581.07	581.19	580.52	579.38	579.95
MW30	648.71	63.94	63.18	62.57	62.57	62.34	62.26	62.83	62.70	584.77	585.53	586.14	586.14	586.37	586.45	585.88	586.01
MW31	701.21	88.12	87.94	87.55	87.30	87.00	87.41	87.89	86.06	613.09	613.27	613.66	613.91	614.21	613.80	613.32	615.15
MW32	585.00	0.09	0.12	0.00	0.00	0.00	0.00	1.98	0.00	584.91	584.88	585.00	585.00	585.00	585.00	583.02	585.00
River at MW26/MW27[2]	580.81	na	na	na	na	na	na	na	na	572.01	572.14	573.47	572.86	573.26	573.31	nm	573.83
River at MW25[3]	573.00	12.71	12.33	11.93	11.91	11.60	11.78	nm	11.20	560.29	560.67	561.07	561.09	561.40	561.22	nm	561.80
Secondary Ash Pond[4]	599.43	na	nm	7.20	7.56	7.21	nm	nm	nm	593.17	nm	592.23	591.87	592.22	nm	nm	nm
Primary Ash Pond[5]	599.77	na	nm	6.11	12.8	nm	nm	nm	nm	592.66	nm	593.66	586.97	586.65	nm	nm	nm

Notes:

1 As measured at top of riser pipe for wells and surveyed or measured for surface water points.
2 Control Monument 0109 adjacent to Wells MW26 and MW27.
3 Control Point is scribe mark on lower deck of Pump House.
4 Control Point is scribe mark on concrete base of east catwalk.
5 Control Point is scribe mark on concrete base of north catwalk.

MP Measuring point.
MW Monitoring well.
NGVD National Geodetic Vertical Datum.
MW27 Shale Monitoring Wells
MW26 Till or Alluvial Monitoring Wells
na not applicable
nm not measured

Table 4. Field Hydraulic Conductivity Results

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

Monitoring Well	Formation	Analytical Solution	Number of Field Tests	Average Hydraulic Conductivity (cm/sec)
MW24	Pennsylvanian Shale	Bouwer-Rice (confined)	1	3.85×10^{-5}
MW25	Pennsylvanian Shale	Bouwer-Rice (confined)	1	2.47×10^{-6}
MW27	Pennsylvanian Shale	Bouwer-Rice (confined)	2	1.04×10^{-4}
MW29	Pennsylvanian Shale	Bouwer-Rice (confined)	1	5.76×10^{-7}
MW30	Pennsylvanian Shale and Coal	Bouwer-Rice (confined)	1	1.80×10^{-6}
MW31	Pennsylvanian Shale	Bouwer-Rice (confined)	1	1.45×10^{-7}
MW32	Pennsylvanian Shale	Bouwer-Rice (confined)	1	1.49×10^{-6}
Geometric Mean Hydraulic Conductivity (all shale wells)				**3.0×10^{-6}**
MW26	Recent Alluvium (sand and gravel)	Bouwer-Rice (unconfined)	2	2.16×10^{-2}
MW28	Recent Alluvium (silt, some sand)	Bouwer-Rice (unconfined)	2	1.02×10^{-2}
Geometric Mean Hydraulic Conductivity (alluvial wells only)				**1.5×10^{-2}**

Table 5. Depths and Elevations of Pennsylvanian Shale Bedrock and Danville Coal

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

Boring or Monitoring Well	Land Surface Elevation	Pennsylvanian Shale		Danville (No. 6) Coal			
				Top of Coal Seam		Bottom of Coal Seam	
		Depth (feet)	Elevation (feet)	Depth (feet)	Elevation (feet)	Depth (feet)	Elevation (feet)
MW13A	581.9	11	571	- -	- -	- -	- -
MW16A	578.3	12	566	- -	- -	- -	- -
MW22	655.6	71	585	- -	- -	- -	- -
MW24	598.8	22	577	- -	- -	- -	- -
MW25	578.8	10	569	- -	- -	- -	- -
MW27	580.4	13	567	- -	- -	- -	- -
MW29	580.9	18	566	- -	- -	- -	- -
MW30	645.7	116	530	144.2	501.5	Borehole terminated above base of unit.	
MW31	698.2	155	545	- -	- -	- -	- -
MW32	581.9	11	571	- -	- -	- -	- -
B-11A	594.7	10	585	- -	- -	- -	- -
B-12A	590.0	12	578	- -	- -	- -	- -
B-14A	586.1	10	576	- -	- -	- -	- -
B-15A	589.0	12	578	- -	- -	- -	- -
B101	604.0	29	575	- -	- -	- -	- -
B102	642.0	49	594	- -	- -	- -	- -
B103	653.9	69	585	- -	- -	- -	- -
B104	652.4	64	588	- -	- -	- -	- -
B105	652.4	64	588	- -	- -	- -	- -
B106	659.2	69	590	- -	- -	- -	- -
B107	658.6	70	589	- -	- -	- -	- -
B108	658.0	67	591	- -	- -	- -	- -
B109	655.8	>71	na	- -	- -	- -	- -
B110	654.6	>86	na	- -	- -	- -	- -
B111	653.7	>76	na	- -	- -	- -	- -
B112	652.7	>76	na	- -	- -	- -	- -
B201	599.1	41	559	102.5	496.6	107.5	491.6
				Mined Out Coal Seam. Mine Void Intercepted - Coal Seam Removed.			
B202	606.0	48	558	*Mined Out Coal Seam. Collapsed Mine.*		114.7	491.3
B203	627.1	66	561	127.0	500.1	132.3	494.8
B204	588.0	15	574	83.0	505.0	88.9	499.1
				Sloped Mineshaft (Void) Intercepted from 28 to 37 feet below ground surface.			
B205	589.6	22	568	86.3	503.3	91.8	497.8
B206	589.0	16	573	80.4	508.6	84.4	504.6
				Mined Out Coal Seam. Mine Void Intercepted - Coal Seam Removed.			
B207	595.6	22	574	90.0	505.6	95.5	500.1
B208	657.6	103	554	152.0	505.6	159.0	498.6

Notes:

\- - Borehole terminated at a depth shallower than the Danville (No. 6) Coal.

Table 6. Vertical Groundwater Gradients in Shale and Between Shale and Alluvium

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

Monitoring Wells for Gradient Calculations with Screened Formations		Groundwater Level Measurement Date During 2002								8-month Average
		22-23 Jan	18-Feb	19-21 March	16-17 April	22-May	18-Jun	16-Jul	27-Aug	
MW13B alluvial	MW13A shale	alluvial dry	**-0.048**	**-0.048**	**-0.041**	0.003	**-0.044**	**-0.061**	**-0.064**	**-0.043**
MW13A shale	MW32 shale	**-0.615**	**-0.605**	**-0.598**	**-0.612**	**-0.588**	**-0.619**	**-0.524**	**-0.523**	**-0.585**
MW16B alluvial	MW16A shale	alluvial dry	alluvial dry	0.031	0.040	alluvial dry	**-0.012**	alluvial dry	alluvial dry	0.020
MW23 alluvial	MW24 shale	0.317	0.386	0.351	0.355	0.346	0.294	0.284	0.275	0.326
MW26 alluvial	MW27 shale	**-0.053**	**-0.020**	0.001	0.008	0.032	**-0.010**	**-0.048**	**-0.052**	**-0.018**
MW28 alluvial	MW29 shale	**-0.240**	**-0.231**	**-0.222**	**-0.223**	**-0.213**	**-0.240**	**-0.251**	**-0.204**	**-0.228**

Notes:
-0.615 Vertical gradient is upwards between the screened well intervals and formations indicated.
0.386 Vertical gradient is downwards between the screened well intervals and formations indicated.
alluvial dry Shallow alluvial monitoring well did not have a measurable water level on the date indicated.

Table 7. Correlation Between Groundwater Quality Parameters in Unlithified Deposits

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

	Aluminum	Alkalinity	Boron	Barium	Calcium	Chloride	Iron	Potassium	Lithium	Magnesium	Manganese	Sodium	Selenium	Sulfate	Strontium	TDS
Aluminum		-0.38	-0.53	0.10	-0.80	-0.28	-0.03	0.07	-0.47	-0.59	-0.20	-0.50	-0.35	-0.80	-0.55	-0.73
Alkalinity			-0.16	0.66	0.63	-0.30	0.49	-0.83	**0.92**	**0.94**	**0.82**	0.42	0.36	0.38	**0.96**	0.72
Boron				-0.51	0.61	**0.89**	-0.11	0.58	-0.15	0.12	-0.18	0.72	-0.01	0.79	0.06	0.53
Barium					0.05	-0.47	0.45	-0.59	0.49	0.47	0.53	-0.06	0.22	-0.09	0.59	0.20
Calcium						0.36	0.18	-0.24	0.66	**0.84**	0.38	0.79	0.36	**0.92**	0.77	**0.97**
Chloride							-0.21	0.66	-0.27	-0.08	-0.32	0.68	-0.08	0.55	-0.11	0.29
Iron								-0.41	0.33	0.37	**0.82**	0.13	-0.13	0.09	0.51	0.28
Potassium									**-0.81**	-0.69	-0.67	0.03	-0.39	0.09	-0.69	-0.33
Lithium										**0.91**	0.59	0.36	0.54	0.40	**0.89**	0.71
Magnesium											0.69	0.59	0.47	0.63	**0.97**	**0.89**
Manganese												0.29	-0.01	0.21	**0.81**	0.49
Sodium													0.07	0.78	0.56	0.78
Selenium														0.26	0.33	0.39
Sulfate															0.57	**0.89**
Strontium																**0.83**
TDS																

Notes:

between the variables. The number of pairs of data values used to compute each coefficient was 18 (6 observations of each chemical parameter in groundwater per well for wells MW23, MW26, and MW28). Generally, correlations greater than 0.50 or less than -0.50 indicate statistically significant non-zero correlations at the 95% confidence level.

Data for determination of correlations are the 6 monthly samples collected from March to August 2002 at unconsolidated wells MW23 at the East Ash Pond and background wells MW26 and MW28.

0.89 Bold-face numbers highlighted in boxes indicate a high level of correlation between two parameters. Positive numbers indicate that the parameters are directly proportional and negative numbers indicate the parameters are inversely proportional.

Table 8. Summary of Groundwater Quality Data in Unlithified Deposits, East Ash Pond, and Middle Fork River

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

Parameter: Aluminum, diss (mg/L)	Samples per Location	Mean*	Median*	Minimum**	Maximum
Background Alluvial Wells (2002 Kelron Study)					
MW26	6	0.013	0.013	0.010	0.017
MW28	6	0.007	0.008	<0.005	0.010
East Ash Pond Alluvial Wells (2002 Kelron Study)					
MW23	6	0.007	0.008	<0.005	0.010
Upstream Middle Fork at Higginsville Bridge (2002 Kelron Study)	6	0.015	0.013	<0.005	0.030
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002)	5	**0.124**	**0.140**	0.011	0.25

Comments:
1. East Ash Pond alluvial well MW23 comes from same population as Background alluvial wells MW26 and MW28 based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.
2. Median Aluminum concentrations in East Ash Pond Surface Water Samples are 10 to 18 times greater than in Background and East Ash Pond alluvial wells.
3. Median Aluminum concentrations upstream on the Middle Fork are equivalent to or slightly greater than the Background Alluvial Wells.

Parameter: Barium, diss (mg/L)	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Alluvial Wells (2002 Kelron Study)					
MW26	6	0.030	0.029	0.028	0.031
MW28	6	0.033	0.033	0.028	0.041
East Ash Pond Alluvial Wells (2002 Kelron Study)					
MW23	6	0.025	0.025	0.023	0.027
Upstream Middle Fork at Higginsville Bridge (2002 Kelron Study)	6	0.041	0.039	0.036	0.054
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002) not applicable	5	**0.14**	**0.13**	0.03	0.28

Comments:
1. East Ash Pond alluvial well MW23 has a statistically significant lower concentration than Background alluvial wells MW26 and MW28 based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.
2. Median Barium concentrations in East Ash Pond Surface Water Samples are 4 to 5 times greater than in Background and East Ash Pond alluvial wells.
3. Median Barium concentrations upstream on the Middle Fork are slightly greater than (within 35 percent) the Background Alluvial Wells.

Parameter: Boron, diss (mg/L)	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Alluvial Wells (2002 Kelron Study)					
MW26	6	0.038	0.025	<0.05	0.076
MW28	6	0.122	0.120	0.110	0.140
East Ash Pond Alluvial Wells (2002 Kelron Study)					
MW23	6	**0.265**	**0.265**	0.20	0.32
Upstream Middle Fork at Higginsville Bridge (2002 Kelron Study)	6	0.057	0.065	<0.05	0.091
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002) not applicable	5	**10.88**	**10.00**	5.1	18.0

Comments:
1. East Ash Pond alluvial well MW23 has a statistically significant higher concentration than Background alluvial wells MW26 and MW28 based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.
2. Median Boron concentrations in East Ash Pond Surface Water Samples are 38 times greater than those in East Ash Pond alluvial well MW23.
3. Median Boron concentrations upstream on the Middle Fork are within the range of the Background Alluvial Wells.

Notes:
* Less than points were replaced by one-half the detection limit.
** Some parameters had multiple detection limits. Lowest detection limit is reported.
Highest mean and median concentrations of parameter are shown in boldface.

Table 8. Summary of Groundwater Quality Data in Unlithified Deposits, East Ash Pond, and Middle Fork River

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

Parameter: Calcium, diss (mg/L)	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Alluvial Wells (2002 Kelron Study)					
MW26	6	89	92	75	100
MW28	6	203	195	180	250
East Ash Pond Alluvial Wells (2002 Kelron Study)					
MW23	6	185	185	180	190
Upstream Middle Fork at Higginsville Bridge (2002 Kelron Study)	6	77	82	60	93
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002) not applicable	5	**322**	**350**	150	450

Comments:

1. East Ash Pond alluvial well MW23 comes from same population as Background alluvial wells MW26 and MW28 based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.
2. Median Calcium concentrations in East Ash Pond Surface Water Samples are 1.9 times greater than those in East Ash Pond alluvial well MW23.
3. Median Calcium concentrations upstream on the Middle Fork are slighly lower than the Background Alluvial Wells.

Parameter: Chloride, total (mg/L)	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Alluvial Wells (2002 Kelron Study)					
MW26	6	11.1	12.0	7.3	13
MW28	6	13	12.5	11	18
East Ash Pond Alluvial Wells (2002 Kelron Study)					
MW23	6	35.2	38.5	10	54
Upstream Middle Fork at Higginsville Bridge (2002 Kelron Study)	6	28.8	29.5	18	41
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002)	5	**172**	**200**	100	240

Comments:

1. East Ash Pond alluvial well MW23 has a statistically significant higher concentration than Background alluvial wells MW26 and MW28 based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.
2. Median Chloride concentrations in East Ash Pond Surface Water Samples are 5.2 times greater than those in East Ash Pond alluvial well MW23.
3. Median Chloride concentrations upstream on the Middle Fork are about 2.5 times higher than the Background Alluvial Wells.

Parameter: Iron, diss (mg/L)	Samples per Location	Mean*	Median*	Minimum**	Maximum
Background Alluvial Wells (2002 Kelron Study)					
MW26	6	**0.015**	**0.013**	<0.025	0.025
MW28	6	**0.040**	**0.029**	<0.025	0.11
East Ash Pond Alluvial Wells (2002 Kelron Study)					
MW23	6	nd	nd	<0.025	<0.025
Upstream Middle Fork at Higginsville Bridge (2002 Kelron Study)	6	nd	nd	<0.025	<0.025
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002)	5	nd	nd	<0.025	<0.025

Comments:

1. East Ash Pond alluvial well MW23 comes from same population as Background alluvial wells MW26 and MW28 based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.
2. The only detected iron concentrations were in the Background Alluvial Wells; all other locations were below the method detection limit of 0.025 mg/L.

Notes:
* Less than points were replaced by one-half the detection limit.
** Some parameters had multiple detection limits. Lowest detection limit is reported.
nd No samples were above method detection limit.
Highest mean and median concentrations of parameter are shown in boldface.

Table 8. Summary of Groundwater Quality Data in Unlithified Deposits, East Ash Pond, and Middle Fork River

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

Parameter: Lithium, diss (mg/L)	Samples per Location	Mean*	Median*	Minimum**	Maximum
Background Alluvial Wells (2002 Kelron Study)					
MW26	6	0.004	0.003	<0.005	0.007
MW28	6	nd	nd	<0.005	<0.005
East Ash Pond Alluvial Wells (2002 Kelron Study)					
MW23	6	0.004	0.003	<0.005	0.007
Upstream Middle Fork at Higginsville Bridge (2002 Kelron Study)	6	0.004	0.003	<0.005	0.007
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002)	5	**0.19**	**0.27**	<0.005	0.30

Comments:

1. East Ash Pond alluvial well MW23 comes from same population as Background alluvial wells MW26 and MW28 based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.
2. Median Lithium concentrations in East Ash Pond Surface Water Samples are over 90 times greater than in Background and East Ash Pond alluvial wells.
3. Median Lithium concentrations upstream on the Middle Fork are equivalent to the Background Alluvial Wells.

Parameter: Magnesium, diss (mg/L)	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Alluvial Wells (2002 Kelron Study)					
MW26	6	34	35	28	42
MW28	6	**98**	**100**	90	110
East Ash Pond Alluvial Wells (2002 Kelron Study)					
MW23	6	56	55	53	62
Upstream Middle Fork at Higginsville Bridge (2002 Kelron Study)	6	35.3	36	24	41
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002)	5	26.5	30	8.4	42

Comments:

1. East Ash Pond alluvial well MW23 comes from same population as Background alluvial wells MW26 and MW28 based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.
2. Median Magnesium concentrations in East Ash Pond Surface Water Samples are lower than those observed in East Ash Pond alluvial well MW23 and the Middle Fork.
3. Median Magnesium concentrations upstream on the Middle Fork are within the range of the Background Alluvial Wells.

Parameter: Manganese, diss (mg/L)	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Alluvial Wells (2002 Kelron Study)					
MW26	6	nd	nd	<0.005	<0.005
MW28	6	**0.062**	**0.065**	0.019	0.11
East Ash Pond Alluvial Wells (2002 Kelron Study)					
MW23	6	nd	nd	<0.005	<0.005
Upstream Middle Fork at Higginsville Bridge (2002 Kelron Study)	6	0.011	0.010	0.005	0.019
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002)	5	0.025	0.024	0.003	0.057

Comments:

1. Background alluvial wells MW26 and MW28 have a statistically significant higher concentration than East Ash Pond alluvial well MW23 based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.
2. Median Manganese concentrations upstream on the Middle Fork are within the range of the Background Alluvial Wells.

Notes:

* Less than points were replaced by one-half the detection limit.
** Some parameters had multiple detection limits. Lowest detection limit is reported.
*** Sample data contained censored values, did not compute means.
nd No samples were above method detection limit.
Highest mean and median concentrations of parameter are shown in boldface.

Table 8. Summary of Groundwater Quality Data in Unlithified Deposits, East Ash Pond, and Middle Fork River

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

Parameter: Molybdenum, diss (mg/L)	Samples per Location	Mean*	Median*	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)					
MW26	6	nd	nd	<0.010	<0.010
MW28	6	nd	nd	<0.010	<0.010
East Ash Pond Bedrock Wells (2002 Kelron Study)					
MW23	6	nd	nd	<0.010	<0.010
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002)	5	**0.22**	**0.24**	0.130	0.298

Comments:
1. All Bedrock Wells (Background and East Ash Pond wells) had no detectable concentrations of Molybdenum.
2. East Ash Pond Surface Water Samples had Molybdenum in all samples, ranging from 0.13 to 0.298 mg/L.

Parameter: Phosphorus, diss (mg/L)	Samples per Location	Mean*	Median*	Minimum**	Maximum
Background Alluvial Wells (2002 Kelron Study)					
MW26	6	0.060	0.057	0.018	0.095
MW28	6	0.019	0.022	<0.010	0.029
East Ash Pond Alluvial Wells (2002 Kelron Study)					
MW23	6	0.011	0.010	<0.010	0.017
Upstream Middle Fork at Higginsville Bridge (2002 Kelron Study)	6	**0.104**	**0.063**	0.014	0.310
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002)	5	0.071	0.031	0.010	0.23

Comments:
1. Background alluvial wells MW26 and MW28 have a statistically significant higher concentration than East Ash Pond alluvial well MW23 based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.
2. Median Phosphorus concentrations upstream on the Middle Fork are two times greater than those observed in the East Ash Pond Surface Water Samples.
3. East Ash Pond alluvial well MW23 has the lowest phosphorus concentrations compared to all other locations.

Parameter: Potassium, diss (mg/L)	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Alluvial Wells (2002 Kelron Study)					
MW26	6	2.35	2.35	2.2	2.5
MW28	6	0.97	0.82	0.7	1.8
East Ash Pond Alluvial Wells (2002 Kelron Study)					
MW23	6	3.32	3.25	2.8	4.0
Upstream Middle Fork at Higginsville Bridge (2002 Kelron Study)	6	1.60	1.20	1.1	3.0
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002)	5	**24.0**	**25.0**	17	31

Comments:
1. East Ash Pond alluvial well MW23 has a statistically significant higher concentration than Background alluvial wells MW26 and MW28 based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.
2. Median Potassium concentrations in East Ash Pond Surface Water Samples are 7.7 times greater than those in East Ash Pond alluvial well MW23.
3. Median Potassium concentrations upstream on the Middle Fork are within the range of the Background Alluvial Wells.

Notes:
* Less than points were replaced by one-half the detection limit.
** Some parameters had multiple detection limits. Lowest detection limit is reported.
*** Sample data contained censored values, did not compute means.
nd No samples were above method detection limit.
Highest mean and median concentrations of parameter are shown in boldface.

Table 8. Summary of Groundwater Quality Data in Unlithified Deposits, East Ash Pond, and Middle Fork River

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

Parameter: Selenium, diss (mg/L)	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)					
MW26	6	nd	nd	<0.005	<0.005
MW28	6	0.004	0.003	<0.005	0.005
East Ash Pond Bedrock Wells (2002 Kelron Study)					
MW23	6	***	0.003	<0.005	0.006
Upstream Middle Fork at Higginsville Bridge (2002 Kelron Study)	6	***	0.003	<0.005	0.005
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002)	5	***	**0.022**	<0.005	0.043

Comments:
1. All Alluvial Wells (Background and East Ash Pond wells) had Selenium concentrations equal to or less than 0.006 milligrams per Liter.
2. East Ash Pond Surface Water Samples had median Selenium concentrations at least 7 times greater than in Background Wells or East Ash Pond alluvial well MW23.

Parameter: Sodium (mg/L)	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Alluvial Wells (2002 Kelron Study)					
MW26	6	4.2	4.2	3.1	5.1
MW28	6	17.0	17.0	15.0	19.0
East Ash Pond Alluvial Wells (2002 Kelron Study)					
MW23	6	17.7	19.5	8.4	26
Upstream Middle Fork at Higginsville Bridge (2002 Kelron Study)	6	9.4	9.2	7	14
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002)	5	**160**	**140**	100	240

Comments:
1. East Ash Pond alluvial well MW23 has a statistically significant higher concentration than Background alluvial wells MW26 and MW28 based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.
2. Median Sodium concentrations in East Ash Pond Surface Water Samples are 7.2 times greater than those in East Ash Pond alluvial well MW23.
3. Median Sodium concentrations upstream on the Middle Fork are within the range of the Background Alluvial Wells.

Parameter: Strontium, diss (mg/L)	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Alluvial Wells (2002 Kelron Study)					
MW26	6	0.07	0.07	0.067	0.076
MW28	6	0.33	0.32	0.300	0.390
East Ash Pond Alluvial Wells (2002 Kelron Study)					
MW23	6	0.14	0.14	0.128	0.160
Upstream Middle Fork at Higginsville Bridge (2002 Kelron Study)	6	0.12	0.12	0.094	0.160
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002) not applicable	5	**0.51**	**0.57**	0.27	0.65

Comments:
1. East Ash Pond alluvial well MW23 comes from same population as Background alluvial wells MW26 and MW28 based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.
2. Median Strontium concentrations in East Ash Pond Surface Water Samples are 4 times greater than those in East Ash Pond alluvial well MW23.
3. Median Strontium concentrations upstream on the Middle Fork are within the range of the Background Alluvial Wells.

Notes:
* Less than points were replaced by one-half the detection limit.
** Some parameters had multiple detection limits. Lowest detection limit is reported.
*** Sample data contained censored values, did not compute means.
nd No samples were above method detection limit.
Highest mean and median concentrations of parameter are shown in boldface.

Table 8. Summary of Groundwater Quality Data in Unlithified Deposits, East Ash Pond, and Middle Fork River

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

Parameter: Sulfate (mg/L)	**Samples per Location**	**Mean***	**Median***	**Minimum****	**Maximum**
Background Alluvial Wells (2002 Kelron Study)					
MW26	6	23.8	23.5	18	30
MW28	6	273	270	170	360
East Ash Pond Alluvial Wells (2002 Kelron Study)					
MW23	6	327	320	280	380
Upstream Middle Fork at Higginsville Bridge (2002 Kelron Study)	6	40	41.5	26	52
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002)	5	**808**	**780**	440	1,500

Comments:

1. East Ash Pond alluvial well MW23 has a statistically significant higher concentration than Background alluvial wells MW26 and MW28 based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.
2. Median Sulfate concentrations in East Ash Pond Surface Water Samples are 2.4 times greater than those in East Ash Pond alluvial well MW23.
3. Median Sulfate concentrations upstream on the Middle Fork are within the range of the Background Alluvial Wells.

Parameter: TDS (mg/L)	**Samples per Location**	**Mean***	**Median**	**Minimum****	**Maximum**
Background Alluvial Wells (2002 Kelron Study)					
MW26	6	403	395	290	520
MW28	6	1,038	1,040	900	1,200
East Ash Pond Alluvial Wells (2002 Kelron Study)					
MW23	6	868	860	810	970
Upstream Middle Fork at Higginsville Bridge (2002 Kelron Study)	6	382	385	290	430
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002)	5	**1,650**	**1,800**	950	2,100

Comments:

1. East Ash Pond alluvial well MW23 comes from same population as Background alluvial wells MW26 and MW28 based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.
2. Median TDS concentrations in East Ash Pond Surface Water Samples are 2 times greater than those in East Ash Pond alluvial well MW23.
3. Median TDS concentrations upstream on the Middle Fork are slighly lower than the Background Alluvial Wells.

Parameter: Vanadium (mg/L)	**Samples per Location**	**Mean***	**Median***	**Minimum****	**Maximum**
Background Bedrock Wells (2002 Kelron Study)					
MW26	6	nd	nd	<0.010	<0.010
MW28	6	nd	nd	<0.010	<0.010
East Ash Pond Bedrock Wells (2002 Kelron Study)					
MW23	6	nd	nd	<0.010	<0.010
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002)	5	**0.04**	**0.03**	<0.010	0.078

Comments:

1. All Alluvial Wells (Background and East Ash Pond wells) had Vanadium concentrations below 0.01 milligrams per Liter.
2. East Ash Pond Surface Water Samples had median Vanadium concentrations at least 3 times greater than in Background Wells or East Ash Pond Alluvial Wells.

Notes:

* Less than points were replaced by one-half the detection limit.
** Some parameters had multiple detection limits. Lowest detection limit is reported.
*** Sample data contained censored values, did not compute means.
na Not analyzed.
nd No samples were above method detection limit.
Highest mean and median concentrations of parameter are shown in boldface.

Table 9. Summary of Impacts on Groundwater Quality in Unlithified Deposits

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

Parameter	COLUMN 2 Mean Groundwater Concentrations in Alluvial Wells[1] at East Ash Pond Compared to Background Alluvial Wells[2]	COLUMN 3 Groundwater Quality in East Ash Pond Alluvial Wells[1] Compared to East Ash Pond Surface Water	Impact by East Ash Pond on Groundwater Quality in Alluvial Deposits	Other Conclusions
Aluminum	**0**	LT	No impact	
Barium	**LT**	LT	No impact	
Boron	GT	LT	**Uncertain**	Median B in MW23 is above background by 0.15 mg/L, but at 0.27 mg/L the source of impact, if any, is uncertain. Slightly higher B may be from natural variation, presence of former coal mine, or East Ash Pond.
Calcium	**0**	LT	No impact	
Chloride	GT	LT	**Uncertain**	Median Cl in MW23 is above background by 26 mg/L and only 9 mg/L above Middle Fork. Slighly higher Cl may be due to natural variation, presence of former coal mine, or East Ash Pond.
Iron	**0**	**All non-detect**	No impact	
Lithium	**0**	LT	No impact	
Magnesium	**0**	GT	No impact	
Manganese	**LT**	LT	No impact	
Molybdenum	**All wells non-detect**	LT	No impact	
Phosphorus	**LT**	LT	No impact	
Potassium	GT	LT	**Uncertain**	Median K in MW23 is above background by 0.9 mg/L, but at 3.25 mg/L may be due to either natural variation or impacts from former coal mine. Concentrations are similar to bedrock.
Selenium	**0**	LT	No impact	
Sodium	GT	LT	**Uncertain**	Median Na in MW23 is above background by 2.5 mg/L, but at 19.5 mg/L the source of impact, if any, is uncertain. Slightly higher Na may be from natural variation, presence of former coal mine, or East Ash Pond.
Strontium	**0**	LT	No impact	
Sulfate	GT	LT	**Uncertain**	Median sulfate in MW23 is above background by 50 mg/L. Higher concentrations are most likely from natural variation. Impacts by East Ash Pond or nearby coal mine are relatively minor or negligible.
TDS	**0**	LT	No impact	
Vanadium	**0**	LT	No impact	

Key to Symbols

COLUMN 2

0 Groundwater quality for given parameter in East Ash Pond wells is statistically from the same population as Background Wells (26 and 28) based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.

LT Groundwater quality for given parameter in East Ash Pond wells has a statistically significant lower mean concentration compared to Background Wells (26 and 28) based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.

GT Groundwater quality for given paramter in East Ash Pond wells has a statistically significant higher mean concentration compared to Background Wells (26 and 28) based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.

COLUMN 3

LT Groundwater concentrations in East Ash Pond Alluvial Wells are less than East Ash Pond surface water for given parameter.

GT Groundwater concentrations in East Ash Pond Alluvial Wells are greater than East Ash Pond surface water for given parameter.

[1] Alluvial wells at East Ash Pond include MW13B, MW16B, and MW23. Only MW23 had sufficient water for sampling in 2002.

[2] Background alluvial wells used for statistical comparison to East Ash Pond wells using Wilcoxon Rank-Sum Test include the following: MW26 and MW28.

Table 10. Correlation Between Groundwater Quality Parameters in Bedrock

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

	Aluminum	Alkalinity	Boron	Barium	Calcium	Chloride	Iron	Potassium	Lithium	Magnesium	Manganese	Sodium	Selenium	Sulfate	Strontium	TDS
Aluminum		-0.17	-0.02	-0.01	0.16	-0.09	0.06	0.68	0.63	0.10	0.05	-0.05	0.65	0.09	0.27	-0.03
Alkalinity			0.39	0.39	-0.14	0.46	0.46	0.56	0.42	-0.07	0.05	0.70	0.21	0.01	0.46	0.67
Boron				0.13	-0.20	0.65	-0.02	0.25	0.47	-0.10	-0.04	0.63	-0.02	-0.19	0.17	0.61
Barium					-0.11	0.77	**0.87**	0.38	0.28	-0.04	-0.16	0.73	-0.06	-0.23	0.54	0.72
Calcium						-0.30	0.06	0.18	0.01	**0.98**	**0.81**	-0.34	0.51	**0.86**	0.57	0.00
Chloride							0.55	0.32	0.48	-0.17	-0.23	**0.94**	-0.17	-0.37	0.33	**0.88**
Iron								0.40	0.31	0.11	0.10	0.58	0.22	0.06	0.56	0.62
Potassium									0.67	0.15	0.07	0.37	0.50	0.06	0.73	0.42
Lithium										0.05	0.08	0.45	0.48	-0.08	0.38	0.47
Magnesium											**0.86**	-0.21	0.46	**0.86**	0.58	0.14
Manganese												-0.18	0.52	**0.91**	0.38	0.15
Sodium													-0.08	-0.29	0.33	**0.93**
Selenium														0.63	0.36	0.06
Sulfate															0.36	0.01
Strontium																0.54
TDS																

Notes:

between the variables. The number of pairs of data values used to compute each coefficient was 60 (6 observations of each chemical parameter in groundwater per well for wells MW13A, MW16A, MW22, MW24, MW25, MW27, MW29, MW30, MW31, and MW32.
Generally, correlations greater than 0.50 or less than -0.50 indicate statistically significant non-zero correlations at the 95% confidence level.

Data for determination of correlations are the 6 monthly samples collected from March to August 2002 at bedrock wells MW13A, MW16A, MW22, MW24, MW25, MW27, MW29, MW30, MW31, and MW32.

0.89 Bold-face numbers highlighted in boxes indicate a high level of correlation between two parameters. Positive numbers indicate that the parameters are directly proportional and negative numbers indicate the parameters are inversely proportional.

Table 11. Summary of Groundwater Quality Data in Bedrock and East Ash Pond
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Parameter: Aluminum, diss (mg/L)	Number of Wells	Samples per Location	Mean*	Median*	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)						
MW25	1	6	0.006	0.007	<0.005	0.009
MW27	1	6	0.011	0.011	0.010	0.013
MW29	1	6	0.006	0.007	<0.005	0.009
MW30	1	6	0.016	0.010	0.009	0.044
MW31	1	5	0.006	0.009	<0.005	0.009
ISGS Background Wells (Scientific Literature and State Databases) see Appendix A						
	27	1	***	**0.20**	<0.02	8.47
ISGS Background Wells (2002 ISGS Study) see Appendix A						
(wells 1349,21903,23343,25531)	4	1	<0.1	<0.1	<0.1	<0.1
East Ash Pond Bedrock Wells (2002 Kelron Study)						
MW13A	1	6	0.008	0.007	<0.005	0.017
MW16A	1	6	0.008	0.008	0.005	0.013
MW22	1	6	0.008	0.007	0.005	0.013
MW24	1	6	0.016	0.010	0.007	0.040
MW32	1	6	0.036	0.042	<0.005	0.047
East Ash Pond Surface Water Samples (2002 Kelron Study)						
(monthly samples from Jan-May 2002)	not applicable	5	**0.124**	**0.140**	0.011	0.25

Comments:
1. All East Ash Pond Bedrock Wells except MW32 come from same population as Background Bedrock Wells (2002 Kelron Study) based on Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.
2. East Ash Pond Bedrock Well MW32 has a higher mean and median concentration than the Background Bedrock Wells (2002 Kelron Study) and other shallower East Ash Pond Bedrock Wells.
3. Highest mean and median concentrations of Aluminum are found in East Ash Pond water samples and in ISGS Background Wells (Scientific Literature and State Databases).
4. Median Aluminum concentrations in East Ash Pond Surface Water Samples are 12 to 20 times greater than in Background Bedrock Wells (2002 Kelron Study) and 3 to 20 times greater than in East Ash Pond Bedrock Wells (2002 Kelron Study).

Parameter: Barium, diss (mg/L)	Number of Wells	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)						
MW25	1	6	**1.66**	**1.60**	1.6	1.7
MW27	1	6	**0.66**	**0.67**	0.63	0.69
MW29	1	6	**0.47**	**0.47**	0.45	0.49
MW30	1	6	**4.57**	**4.30**	4.2	5.3
MW31	1	6	**0.57**	**0.67**	0.052	0.71
ISGS Background Wells (Scientific Literature and State Databases) see Appendix A						
	27	1	***	0.28	0.02	2.44
ISGS Background Wells (2002 ISGS Study) see Appendix A						
(wells 1349,21903,23343,25531)	4	1	**0.46**	**0.37**	0.14	0.98
East Ash Pond Bedrock Wells (2002 Kelron Study)						
MW13A	1	6	**0.41**	**0.41**	0.39	0.43
MW16A	1	6	0.07	0.04	0.04	0.18
MW22	1	6	0.06	0.06	0.06	0.071
MW24	1	6	0.16	0.14	0.13	0.25
MW32	1	6	**0.48**	**0.49**	0.45	0.50
East Ash Pond Surface Water Samples (2002 Kelron Study)						
(monthly samples from Jan-May 2002)	not applicable	5	0.14	0.13	0.03	0.28

Comments:
1. Each of the East Ash Pond Bedrock Wells have a statistically significant lower mean concentration than the Background Bedrock Wells (2002 Kelron Study) based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.
2. Lowest mean and median concentrations of Barium are found in East Ash Pond water samples. Highest Barium concentrations are found in the Background Bedrock Wells (2002 Kelron Study) and in the East Ash Pond Bedrock Wells MW13A and MW32.

Notes:
* Less than points were replaced by one-half the detection limit.
** Some parameters had multiple detection limits. Lowest detection limit is reported.
*** Sample data contained censored values, did not compute means.
Highest mean and median concentrations of parameter are shown in boldface.

Table 11. Summary of Groundwater Quality Data in Bedrock and East Ash Pond
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Parameter: Boron, diss (mg/L)	Number of Wells	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)						
MW25	1	6	1.17	1.15	1.10	1.30
MW27	1	6	0.83	0.83	0.79	0.87
MW29	1	6	1.12	1.10	1.10	1.20
MW30	1	6	0.90	0.99	0.85	0.96
MW31	1	6	0.68	0.77	0.20	0.82
ISGS Background Wells (Scientific Literature and State Databases) see Appendix A						
	30	1	***	0.28	ND	2.08
ISGS Background Wells (2002 ISGS Study) see Appendix A						
(wells 1349,21903,23343,25531)	4	1	0.85	0.85	0.29	1.4
East Ash Pond Bedrock Wells (2002 Kelron Study)						
MW13A	1	6	**1.40**	**1.40**	1.30	1.60
MW16A	1	6	0.79	0.77	0.70	0.92
MW22	1	6	0.33	0.32	0.30	0.38
MW24	1	6	0.55	0.47	0.43	0.86
MW32	1	6	**1.45**	**1.50**	1.30	1.50
East Ash Pond Surface Water Samples (2002 Kelron Study)						
(monthly samples from Jan-May 2002)	not applicable	5	**10.88**	**10.00**	5.1	18.0

Comments:

1. East Ash Pond Bedrock Wells MW16A, MW22, and MW24 have statistically significant lower concentrations than Background Wells (2002 Kelron Study) based on Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level. Bedrock Wells MW13A and MW32 have statistically significant higher concentrations than Background Wells (2002 Kelron Study).
2. Median Boron concentrations in East Ash Pond Surface Water Samples are 9 to 13 times greater than in Background Bedrock Wells (2002 Kelron Study) and 7 to 31 times greater than in East Ash Pond Bedrock Wells.

Parameter: Calcium, diss (mg/L)	Number of Wells	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)						
MW25	1	6	84.7	85.0	80	89
MW27	1	6	31.8	32.0	30	33
MW29	1	6	28.7	29.5	26	30
MW30	1	6	34.5	34.0	31	38
MW31	1	6	79.3	85.5	13	110
ISGS Background Wells (Scientific Literature and State Databases) see Appendix A						
	31	1	***	83	<1	951
ISGS Background Wells (2002 ISGS Study) see Appendix A						
(wells 1349,21903,23343,25531)	4	1	69.9	55.8	36.8	131
East Ash Pond Bedrock Wells (2002 Kelron Study)						
MW13A	1	6	19.8	20.0	18	21
MW16A	1	6	**149.3**	**135.0**	96	210
MW22	1	6	48.7	49.0	45	51
MW24	1	6	34.0	35.5	25	38
MW32	1	6	15.2	16.0	13	17
East Ash Pond Surface Water Samples (2002 Kelron Study)						
(monthly samples from Jan-May 2002)	not applicable	5	**322**	**350**	150	450

Comments:

1. East Ash Pond Bedrock Wells MW13A and MW32 have a statistically significant lower mean concentration than the Background Bedrock Wells (2002 Kelron Study) based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level. East Ash Pond Bedrock Wells MW22 and MW24 are statistically from the same population as the Background Bedrock Wells. East Ash Pond Bedrock Well MW16A is has a statistically significant higher mean concentration than the Background Bedrock Wells.
2. Highest mean and median concentrations of Calcium are found in East Ash Pond water samples.
3. Median Calcium concentrations in East Ash Pond Surface Water Samples are 4 to 11 times greater than in Background Bedrock Wells (2002 Kelron Study) and 2.6 to 22 times greater than in East Ash Pond Bedrock Wells.

Notes:

* Less than points were replaced by one-half the detection limit.
** Some parameters had multiple detection limits. Lowest detection limit is reported.
*** Sample data contained censored values, did not compute means.
Highest mean and median concentrations of parameter are shown in boldface.

Table 11. Summary of Groundwater Quality Data in Bedrock and East Ash Pond
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Parameter: Chloride, total (mg/L)	Number of Wells	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)						
MW25	1	6	**820**	**840**	720	910
MW27	1	6	353	370	290	390
MW29	1	6	333	285	270	570
MW30	1	6	**1,233**	**1,200**	1,100	1,400
MW31	1	6	60	69	19	79
ISGS Background Wells (Scientific Literature and State Databases) see Appendix A						
	31	1	1,689	13	2.1	30,269
ISGS Background Wells (2002 ISGS Study) see Appendix A						
(wells 1349,21903,23343,25531)	4	1	244	165	5	640
East Ash Pond Bedrock Wells (2002 Kelron Study)						
MW13A	1	6	**630**	**570**	500	1000
MW16A	1	6	90	71	45	170
MW22	1	6	11	11	9.9	13
MW24	1	6	65	40	31	190
MW32	1	6	**860**	**845**	830	930
East Ash Pond Surface Water Samples (2002 Kelron Study)						
(monthly samples from Jan-May 2002)	not applicable	5	172	200	100	240

Comments:
1. East Ash Pond Bedrock Wells MW16A, MW22, and MW24 have statistically significant lower concentrations than Background Wells (2002 Kelron Study) based on Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level. Wells MW13A and MW32 are statistically from the same population as the Background Wells (2002 Kelron Study).
2. Median Chloride concentrations in East Ash Pond Surface Water Samples are 3 to 18 times greater than in East Ash Pond Bedrock Wells MW16A, MW22, and MW24 (2002 Kelron Study). East Ash Pond Bedrock Wells MW13A and MW32 are 3 to 4 times greater than the East Ash Pond Surface Water Samples.

Parameter: Iron, diss (mg/L)	Number of Wells	Samples per Location	Mean*	Median*	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)						
MW25	1	6	0.13	0.05	<0.025	0.27
MW27	1	6	0.19	0.18	0.10	0.22
MW29	1	6	0.22	0.23	<0.025	0.40
MW30	1	6	**1.66**	**1.70**	0.83	2.20
MW31	1	6	0.37	0.33	0.26	0.55
ISGS Background Wells (Scientific Literature and State Databases) see Appendix A						
	31	1	***	**0.69**	<0.006	26.8
ISGS Background Wells (2002 ISGS Study) see Appendix A						
(wells 1349,21903,23343,25531)	4	1	**1.95**	**2.00**	<0.01	3.8
East Ash Pond Bedrock Wells (2002 Kelron Study)						
MW13A	1	6	0.15	0.16	0.067	0.25
MW16A	1	6	0.34	0.33	0.063	0.79
MW22	1	6	0.12	0.13	0.096	0.15
MW24	1	6	0.036	0.013	<0.025	0.11
MW32	1	6	0.037	0.024	<0.025	0.11
East Ash Pond Surface Water Samples (2002 Kelron Study)						
(monthly samples from Jan-May 2002)	not applicable	5	0.013	0.013	0.013	0.013

Comments:
1. All East Ash Pond Bedrock Wells have a statistically significant lower mean concentration than the Background Bedrock Wells (2002 Kelron Study) or are statistically from the same population based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.
2. Highest mean and median concentrations of Iron are found in ISGS Background Wells (2002 ISGS Study and Scientific Literature and State Databases), and in Background Bedrock Well MW30 (Kelron Study).

Notes:
* Less than points were replaced by one-half the detection limit.
** Some parameters had multiple detection limits. Lowest detection limit is reported.
*** Sample data contained censored values, did not compute means.
Highest mean and median concentrations of parameter are shown in boldface.

Table 11. Summary of Groundwater Quality Data in Bedrock and East Ash Pond
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Parameter: Lithium, diss (mg/L)	Number of Wells	Samples per Location	Mean*	Median*	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)						
MW25	1	6	**0.11**	**0.08**	0.071	0.18
MW27	1	6	0.04	0.04	<0.005	0.086
MW29	1	6	0.04	0.04	<0.005	0.089
MW30	1	6	**0.11**	**0.10**	0.010	0.26
MW31	1	6	0.09	0.05	<0.005	0.40
ISGS Background Wells (Scientific Literature and State Databases) see Appendix A						
	31	1	na	na	na	na
ISGS Background Wells (2002 ISGS Study) see Appendix A						
(wells 1349,21903,23343,25531)	4	1	0.025	0.015	0.01	0.07
East Ash Pond Bedrock Wells (2002 Kelron Study)						
MW13A	1	6	**0.11**	**0.08**	0.070	0.19
MW16A	1	6	0.04	0.04	0.022	0.069
MW22	1	6	0.04	0.03	<0.005	0.089
MW24	1	6	0.02	0.02	<0.005	0.070
MW32	1	6	**0.12**	**0.09**	<0.087	0.23
East Ash Pond Surface Water Samples (2002 Kelron Study)						
(monthly samples from Jan-May 2002)	not applicable	5	**0.19**	**0.27**	<0.005	0.30

Comments:
1. East Ash Pond Bedrock Wells MW16A, MW22, and MW24 have statistically significant lower concentrations than Background Wells (2002 Kelron Study) or are statistically from the same population based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level. Wells MW13A and MW32 have a statistically significant higher mean concentration than the Background Bedrock Wells.
2. Median Lithium concentrations in East Ash Pond Surface Water Samples are 3 to 14 times greater than in East Ash Pond Bedrock Wells (2002 Kelron Study) and IGSG Background Wells (2002 ISGS Study).

Parameter: Magnesium, diss (mg/L)	Number of Wells	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)						
MW25	1	6	44.7	44.5	44	46
MW27	1	6	19.5	19.5	19	20
MW29	1	6	15.0	15.0	14	16
MW30	1	6	25.2	25.0	24	27
MW31	1	6	33.7	37.0	4.1	46
ISGS Background Wells (Scientific Literature and State Databases) see Appendix A						
	31	1	***	31.1	<0.5	454
ISGS Background Wells (2002 ISGS Study) see Appendix A						
(wells 1349,21903,23343,25531)	4	1	39.3	37.0	27	56
East Ash Pond Bedrock Wells (2002 Kelron Study)						
MW13A	1	6	18.2	18.0	18	19
MW16A	1	6	**77.0**	**72.5**	53	100
MW22	1	6	26.3	26.0	26	27
MW24	1	6	16.2	16.5	14	17
MW32	1	6	15.5	16.0	14	16
East Ash Pond Surface Water Samples (2002 Kelron Study)						
(monthly samples from Jan-May 2002)	not applicable	5	26.5	30.0	8.4	42

Comments:
1. East Ash Pond Bedrock Wells MW13A , MW24, and MW32 have a statistically significant lower mean concentration than the Background Bedrock Wells (2002 Kelron Study) based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level. East Ash Pond Bedrock Well MW22 is statistically from the same population as the Background Bedrock Wells. East Ash Pond Bedrock Well MW16A is has a statistically significant higher mean concentration than the Background Bedrock Wells.
2. Highest median concentrations of Magnesium are found in ISGS Background Wells (Scientific Literature and State Databases) and in East Ash Pond Bedrock Well MW16A.

Notes:
* Less than points were replaced by one-half the detection limit.
** Some parameters had multiple detection limits. Lowest detection limit is reported.
*** Sample data contained censored values, did not compute means.
na Not analyzed.
Highest mean and median concentrations of parameter are shown in boldface.

Table 11. Summary of Groundwater Quality Data in Bedrock and East Ash Pond
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Parameter: Manganese, diss (mg/L)	Number of Wells	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)						
MW25	1	6	**0.041**	**0.041**	0.028	0.053
MW27	1	6	0.023	0.022	0.018	0.029
MW29	1	6	0.015	0.016	0.010	0.020
MW30	1	6	**0.043**	**0.041**	0.034	0.059
MW31	1	6	**0.085**	**0.081**	0.072	0.110
ISGS Background Wells (Scientific Literature and State Databases) see Appendix A						
	31	1	***	**0.100**	0.015	1.47
ISGS Background Wells (2002 ISGS Study) see Appendix A						
(wells 1349,21903,23343,25531)	4	1	**0.057**	**0.041**	0.035	0.11
East Ash Pond Bedrock Wells (2002 Kelron Study)						
MW13A	1	6	**0.082**	**0.087**	0.018	0.120
MW16A	1	6	**0.330**	**0.345**	0.200	0.390
MW22	1	6	0.017	0.017	0.014	0.019
MW24	1	6	0.012	0.012	0.010	0.012
MW32	1	6	0.014	0.013	0.011	0.022
East Ash Pond Surface Water Samples (2002 Kelron Study)						
(monthly samples from Jan-May 2002)	not applicable	5	0.025	0.024	0.003	0.057

Comments:
1. East Ash Pond Bedrock Wells MW22, MW24, and MW32 have statistically significant lower concentrations than Background Wells (2002 Kelron Study) based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level. Wells MW13A and MW16A have a statistically significant higher mean concentration than the Background Bedrock Wells.
2. Median Manganese concentrations in Background Bedrock Wells MW25, MW30, and MW31 (2002 Kelron Study), ISGS Background Wells (ScientificLiterature and State Databases), and ISGS Background Wells (2002 ISGS Study) are significantly greater than in East Ash Pond Surface Water Samples and East Ash Pond Bedrock Wells MW22, MW24, and MW32 (2002 Kelron Study).
3. Median Manganese concentrations in East Ash Pond Bedrock Well MW16A is 14 times greater than median concentrations for the East Ash Pond Surface Water Samples.

Parameter: Molybdenum, diss (mg/L)	Number of Wells	Samples per Location	Mean*	Median*	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)						
MW25	1	6	nd	nd	<0.010	<0.010
MW27	1	6	nd	nd	<0.010	<0.010
MW29	1	6	nd	nd	<0.005	<0.010
MW30	1	6	nd	nd	<0.010	<0.010
MW31	1	6	nd	nd	<0.010	<0.010
ISGS Background Wells (Scientific Literature and State Databases) see Appendix A						
	31	1	na	na	na	na
ISGS Background Wells (2002 ISGS Study) see Appendix A						
(wells 1349,21903,23343,25531)	4	1	nd	nd	<0.01	<0.01
East Ash Pond Bedrock Wells (2002 Kelron Study)						
MW13A	1	6	nd	nd	<0.010	<0.010
MW16A	1	6	nd	nd	<0.010	<0.010
MW22	1	6	nd	nd	<0.010	<0.010
MW24	1	6	nd	nd	<0.010	<0.010
MW32	1	6	nd	nd	<0.010	<0.010
East Ash Pond Surface Water Samples (2002 Kelron Study)						
(monthly samples from Jan-May 2002)	not applicable	5	**0.22**	**0.24**	0.130	0.298

Comments:
1. All Bedrock Wells (Background and East Ash Pond wells) had no detectable concentrations of Molybdenum.
2. East Ash Pond Surface Water Samples had Molybdenum in all samples, ranging from 0.13 to 0.298 mg/L.

Notes:
* Less than points were replaced by one-half the detection limit.
** Some parameters had multiple detection limits. Lowest detection limit is reported.
*** Sample data contained censored values, did not compute means.
na Not analyzed.
nd No samples were above method detection limit.
Highest mean and median concentrations of parameter are shown in boldface.

Table 11. Summary of Groundwater Quality Data in Bedrock and East Ash Pond
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Parameter: Phosphorus, diss (mg/L)	Number of Wells	Samples per Location	Mean*	Median*	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)						
MW25	1	6	0.012	0.008	<0.010	0.031
MW27	1	6	0.028	0.027	0.019	0.038
MW29	1	6	0.023	0.024	<0.010	0.036
MW30	1	6	0.037	0.036	0.027	0.053
MW31	1	6	0.067	0.041	0.032	0.19
ISGS Background Wells (Scientific Literature and State Databases) see Appendix A						
	31	1	na	na	na	na
ISGS Background Wells (2002 ISGS Study) see Appendix A						
(wells 1349,21903,23343,25531)	4	1	na	na	na	na
East Ash Pond Bedrock Wells (2002 Kelron Study)						
MW13A	1	6	0.038	0.033	0.022	0.070
MW16A	1	6	0.069	0.093	<0.010	0.110
MW22	1	6	0.015	0.017	<0.010	0.022
MW24	1	6	0.048	0.047	0.023	0.081
MW32	1	6	0.027	0.023	0.016	0.045
East Ash Pond Surface Water Samples (2002 Kelron Study)						
(monthly samples from Jan-May 2002)	not applicable	5	0.071	0.031	0.010	0.23

Comments:
1. East Ash Pond Bedrock Wells MW13A, MW16A, MW22, and MW32 are statistically from the same population or have statistically significant lower concentrations than Background Wells (2002 Kelron Study) based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level. Well MW24 has a statistically significant higher mean concentration than Background Wells (2002 Kelron Study).

Parameter: Potassium, diss (mg/L)	Number of Wells	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)						
MW25	1	6	5.2	5.2	4.9	5.4
MW27	1	6	3.3	3.4	3.1	3.6
MW29	1	6	3.2	3.2	3.1	3.4
MW30	1	6	6.6	6.6	6.2	7.4
MW31	1	6	9.4	8.2	6.6	17
ISGS Background Wells (Scientific Literature and State Databases) see Appendix A						
	30	1	7.4	2.1	0.67	63
ISGS Background Wells (2002 ISGS Study) see Appendix A						
(wells 1349,21903,23343,25531)	4	1	4.5	4.25	3.0	5.0
East Ash Pond Bedrock Wells (2002 Kelron Study)						
MW13A	1	6	4.8	4.9	4.5	5.2
MW16A	1	6	3.5	3.6	2.5	4.6
MW22	1	6	2.6	2.6	2.5	2.7
MW24	1	6	2.0	1.8	1.8	2.5
MW32	1	6	5.4	5.4	5.1	6.0
East Ash Pond Surface Water Samples (2002 Kelron Study)						
(monthly samples from Jan-May 2002)	not applicable	5	**24.0**	**25.0**	17	31

Comments:
1. East Ash Pond Bedrock Wells MW16A, MW22, and MW24 have a statistically significant lower mean concentration than the Background Bedrock Wells (2002 Kelron Study) based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level. East Ash Pond Bedrock Well MW13A and MW32 are statistically from the same population as the Background Bedrock Wells.
2. Median Potassium concentrations in the East Ash Pond Surface Water Samples are 3 to 12 times greater than median concentrations in Background Bedrock Wells (2002 Kelron Study), ISGS Background Wells (Scientific Literature and State Databases), or ISGS Background Wells (2002 ISGS Study).

Notes:
* Less than points were replaced by one-half the detection limit.
** Some parameters had multiple detection limits. Lowest detection limit is reported.
*** Sample data contained censored values, did not compute means.
na Not analyzed.
nd No samples were above method detection limit.
Highest mean and median concentrations of parameter are shown in boldface.

Table 11. Summary of Groundwater Quality Data in Bedrock and East Ash Pond
Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

Parameter: Selenium, diss (mg/L)	Number of Wells	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)						
MW25	1	6	nd	nd	<0.005	<0.005
MW27	1	6	***	***	0.005	<0.005
MW29	1	6	nd	nd	<0.005	<0.005
MW30	1	6	***	***	0.005	<0.005
MW31	1	6	***	***	0.005	<0.005
ISGS Background Wells (Scientific Literature and State Databases) see Appendix A						
	30	1	***	0.001	<0.001	0.002
ISGS Background Wells (2002 ISGS Study) see Appendix A						
(wells 1349,21903,23343,25531)	4	1	nd	nd	<0.1	<0.1
East Ash Pond Bedrock Wells (2002 Kelron Study)						
MW13A	1	6	nd	nd	<0.005	<0.005
MW16A	1	6	nd	nd	<0.005	<0.005
MW22	1	6	nd	nd	<0.005	<0.005
MW24	1	6	nd	nd	<0.005	<0.005
MW32	1	6	nd	nd	<0.005	<0.005
East Ash Pond Surface Water Samples (2002 Kelron Study)						
(monthly samples from Jan-May 2002)	not applicable	5	***	**0.022**	<0.005	0.043

Comments:
1. All Bedrock Wells (Background and East Ash Pond wells) had Selenium concentrations equal to or less than 0.005 milligrams per Liter.
2. East Ash Pond Surface Water Samples had median Selenium concentrations 22 times greater than in Background Wells or East Ash Pond Bedrock Wells.

Parameter: Sodium (mg/L)	Number of Wells	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)						
MW25	1	6	385	390	360	400
MW27	1	6	267	270	250	280
MW29	1	6	257	250	250	280
MW30	1	6	**887**	**890**	850	910
MW31	1	6	176	195	88	210
ISGS Background Wells (Scientific Literature and State Databases) see Appendix A						
	31	1	1,083	28.7	6	18,078
ISGS Background Wells (2002 ISGS Study) see Appendix A						
(wells 1349,21903,23343,25531)	4	1	241	154	67	590
East Ash Pond Bedrock Wells (2002 Kelron Study)						
MW13A	1	6	**507**	**505**	490	520
MW16A	1	6	180	185	120	240
MW22	1	6	102	100	100	110
MW24	1	6	130	110	100	210
MW32	1	6	**730**	**735**	680	760
East Ash Pond Surface Water Samples (2002 Kelron Study)						
(monthly samples from Jan-May 2002)	not applicable	5	160	140	100	240

Comments:
1. East Ash Pond Bedrock Wells MW16A, MW22, and MW24 have a statistically significant lower mean concentration than the Background Bedrock Wells (2002 Kelron Study) based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level. East Ash Pond Bedrock Well MW13A and MW32 have a statistically significant higher mean concentration than the Background Bedrock Wells.
2. Median Sodium concentrations in Background Bedrock Wells (2002 Kelron Study) are 1.4 to 6.4 times greater than the median East Ash Pond Surface Water Samples.
3. Median Sodium concentrations in East Ash Pond Bedrock Wells MW13A and MW32 are a 3.6 and 5.3 times greater, respectively, than the median concentration in the East Ash Pond Surface Water Samples and 6.4 times greater than East Ash Pond samples.

Notes:
* Less than points were replaced by one-half the detection limit.
** Some parameters had multiple detection limits. Lowest detection limit is reported.
*** Sample data contained censored values, did not compute means or medians.
na Not analyzed.
nd No samples were above method detection limit.
Highest mean and median concentrations of parameter are shown in boldface.

Table 11. Summary of Groundwater Quality Data in Bedrock and East Ash Pond
Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

Parameter: Strontium, diss (mg/L)	Number of Wells	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)						
MW25	1	6	0.57	0.56	0.54	0.60
MW27	1	6	0.36	0.36	0.34	0.38
MW29	1	6	0.33	0.33	0.31	0.35
MW30	1	6	0.65	0.64	0.61	0.70
MW31	1	6	0.67	0.78	0.14	0.79
ISGS Background Wells (Scientific Literature and State Databases) see Appendix A	30	1	na	na	na	na
ISGS Background Wells (2002 ISGS Study) see Appendix A (wells 1349,21903,23343,25531)	4	1	0.71	0.55	0.23	1.5
East Ash Pond Bedrock Wells (2002 Kelron Study)						
MW13A	1	6	0.35	0.38	<0.366	0.39
MW16A	1	6	0.55	0.54	0.44	0.67
MW22	1	6	0.32	0.31	0.30	0.34
MW24	1	6	0.22	0.22	0.21	0.23
MW32	1	6	0.38	0.38	0.36	0.40
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002)	not applicable	5	0.51	0.57	0.27	0.65

Comments:
1. East Ash Pond Bedrock Wells MW22 and MW24 have a statistically significant lower mean concentration than the Background Bedrock Wells (2002 Kelron Study) based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level. East Ash Pond Bedrock Wells MW13A, MW16A, and MW32 are statistically from the same population as the Background Bedrock Wells.

Parameter: Sulfate (mg/L)	Number of Wells	Samples per Location	Mean*	Median*	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)						
MW25	1	6	***	2.5	<5.0	7
MW27	1	6	nd	nd	<5.0	<5.0
MW29	1	6	nd	nd	<5.0	<5.0
MW30	1	6	4.5	4.3	<5.0	7
MW31	1	6	**123**	**125**	58	160
ISGS Background Wells (Scientific Literature and State Databases) see Appendix A	31	1	***	31	<1	847
ISGS Background Wells (2002 ISGS Study) see Appendix A (wells 1349,21903,23343,25531)	4	1	38	5.8	<0.1	140
East Ash Pond Bedrock Wells (2002 Kelron Study)						
MW13A	1	6	nd	nd	<5.0	<5.0
MW16A	1	6	**415**	**510**	120	620
MW22	1	6	30	31	27	32
MW24	1	6	35	34	30	41
MW32	1	6	nd	nd	<5.0	<5.0
East Ash Pond Surface Water Samples (2002 Kelron Study) (monthly samples from Jan-May 2002)	not applicable	5	**808**	**780**	440	1,500

Comments:
1. East Ash Pond Bedrock Wells MW16A, MW22, and MW24 have a statistically significant higher mean concentration than the Background Bedrock Wells (2002 Kelron Study) based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level. East Ash Pond Bedrock Wells MW13A and MW32 are statistically from the same population as the Background Bedrock Wells.
2. Mean and median Sulfate concentrations in East Ash Pon Bedrock Wells MW13A, MW22, MW24, and MW32 are within range of Background Bedrock Wells (2002 Kelron Study), ISGS Background Wells (Scientific Literature and State Databases), and ISGS Background Wells (2002 ISGS Study).
3. Median Sulfate concentration in East Ash Pond Bedrock Well MW16A is 4 times greater than highest concentration in Background Bedrock Wells (i.e., Well MW31).
4. Median Sulfate concentration in East Ash Pond Surface Water Samples is 1.5 times greater than in East Ash Pond Bedrock Well MW16A.

Notes:
* Less than points were replaced by one-half the detection limit.
** Some parameters had multiple detection limits. Lowest detection limit is reported.
*** Sample data contained censored values, did not compute means.
na Not analyzed. nd No samples were above method detection limit.
Highest mean and median concentrations of parameter are shown in boldface.

Table 11. Summary of Groundwater Quality Data in Bedrock and East Ash Pond
Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

Parameter: TDS (mg/L)	Number of Wells	Samples per Location	Mean*	Median	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)						
MW25	1	6	**1,450**	**1,400**	1,400	1,600
MW27	1	6	910	905	850	980
MW29	1	6	838	825	800	900
MW30	1	6	**2,433**	**2,400**	2,400	2,500
MW31	1	6	863	940	410	1,000
ISGS Background Wells (Scientific Literature and State Databases) see Appendix A						
	28	1	3,540	426	280	52,100
ISGS Background Wells (2002 ISGS Study) see Appendix A						
(wells 1349,21903,23343,25531)	4	1	633	510	210	1,300
East Ash Pond Bedrock Wells (2002 Kelron Study)						
MW13A	1	6	**1,467**	**1,450**	1,400	1,600
MW16A	1	6	**1,383**	**1,400**	1,200	1,600
MW22	1	6	532	525	470	620
MW24	1	6	532	495	410	750
MW32	1	6	**1,933**	**1,900**	1,900	2,000
East Ash Pond Surface Water Samples (2002 Kelron Study)						
(monthly samples from Jan-May 2002)	not applicable	5	**1,650**	**1,800**	950	2,100

Comments:
1. East Ash Pond Bedrock Wells MW13A and MW32 have a statistically significant higher mean concentration than the Background Bedrock Wells (2002 Kelron Study) based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level. East Ash Pond Bedrock Well MW16A is statistically from the same population as the Background Bedrock Wells. Wells MW22 and MW24 have a statistically significant lower mean concentration than the Background Wells (2002 Kelron Study).
2. Median TDS concentrations in the East Ash Pond Surface Water Samples are within the same range of values as Background Bedrock Wells (2002 Kelron Study) MW25 and MW30 and East Ash Pond Bedrock Wells MW13A, MW16A, and MW32.

Parameter: Vanadium (mg/L)	Number of Wells	Samples per Location	Mean*	Median*	Minimum**	Maximum
Background Bedrock Wells (2002 Kelron Study)						
MW25	1	6	nd	nd	<0.010	<0.010
MW27	1	6	nd	nd	<0.010	<0.010
MW29	1	6	nd	nd	<0.010	<0.010
MW30	1	6	nd	nd	<0.010	<0.010
MW31	1	6	nd	nd	<0.010	<0.010
ISGS Background Wells (Scientific Literature and State Databases) see Appendix A						
	31	1	na	na	na	na
ISGS Background Wells (2002 ISGS Study) see Appendix A						
(wells 1349,21903,23343,25531)	4	1	nd	nd	<0.01	<0.01
East Ash Pond Bedrock Wells (2002 Kelron Study)						
MW13A	1	6	nd	nd	<0.010	<0.010
MW16A	1	6	nd	nd	<0.010	<0.010
MW22	1	6	nd	nd	<0.010	<0.010
MW24	1	6	nd	nd	<0.010	<0.010
MW32	1	6	nd	nd	<0.010	<0.010
East Ash Pond Surface Water Samples (2002 Kelron Study)						
(monthly samples from Jan-May 2002)	not applicable	5	**0.04**	**0.03**	<0.010	0.078

Comments:
1. All Bedrock Wells (Background and East Ash Pond wells) had Vanadium concentrations below 0.01 milligrams per Liter.
2. East Ash Pond Surface Water Samples had median Vanadium concentrations at least 3 times greater than in Background Wells or East Ash Pond Bedrock Wells.

Notes:
* Less than points were replaced by one-half the detection limit.
** Some parameters had multiple detection limits. Lowest detection limit is reported.
*** Sample data contained censored values, did not compute means.
na Not analyzed.
nd No samples were above method detection limit.
Highest mean and median concentrations of parameter are shown in boldface.

Table 12. Summary of Impacts on Groundwater Quality in Bedrock
Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant, Illinois

Parameter	COLUMN 2 Mean Groundwater Concentrations in Bedrock Wells[1] at East Ash Pond Compared to Background Bedrock Wells[2]		COLUMN 3 Groundwater Quality in East Ash Pond Bedrock Wells[1] Compared to East Ash Pond Surface Water	Impact by East Ash Pond on Groundwater Quality in Bedrock	Other Conclusions
Aluminum	0	all wells	LT	No impact	
Barium	LT	all wells	GT	No impact	Wells 13A and 32 may be affected by past coal mining activities.
Boron	LT GT	16A,22,24 13A,32	LT	No impact	Wells 13A and 32 may be affected by past coal mining activities.
Calcium	0 LT GT	22,24 13A,32 16A	LT	No impact	Well 16A has higher Ca concentrations than background wells. Ca is higly correlated with Mg at 0.98. Ca is either naturally occurring or influenced by former coal mines.
Chloride	0 LT	13A,32 16A,22,24	LT (16A,22,24) GT (13A,32)	No impact	Wells 13A and 32 may be affected by past coal mining activities. Background well 25 may also be affected by coal mining. Background well 30 is in coal and shale and has highest Cl concentrations at study site.
Iron	0 LT	16A 13A,22,24,32	GT	No impact	Well 30, background well installed in coal and shale, has the highest Fe concentration at the study site.
Lithium	0 LT GT	16A 22,24 13A,32	LT	No impact	Wells 13A and 32 may be affected by past coal mining activities. Background well 25 may also be affected by coal mining. Background well 30 is in coal and shale and has similar Li concentrations to 13A, 32, and 25.
Magnesium	0 LT GT	22 13A,24,32 16A	LT (13A,22,24,32) GT (16A)	No impact	Well 16A has higher Mg concentrations than background wells and East Ash Pond and is not impacted by surface water from East Ash Pond. All other East Ash Pond wells are either equal to or below background concentrations.
Manganese	LT GT	22,24,32 13A,16A	LT (22,24,32) GT (13A,16A)	No impact	Wells 13A and 16A may be affected by past coal mining activities. These wells have higher concentrations than most background wells and East Ash Pond water.
Molybdenum	0	all wells	LT	No impact	All background wells and East Ash Pond wells have no detectable concentrations of Mo. Only East Ash Pond water samples have detected concentrations of Mo.
Phosphorus	0 LT GT	13A,16A,32 22 24	Variable (no determination)	No impact	
Potassium	0 LT	13A,32 16A,22,24	LT	No impact	
Selenium	0	all wells	LT	No impact	Almost all samples from background wells and East Ash Pond wells have no detectable concentrations of Se. Only East Ash Pond water samples have detectable Se levels.
Sodium	LT GT	16A,22,24 13A,32	Variable (no determination)	No impact	Wells 13A and 32 may be affected by past coal mining activities. Background well 30 is in coal and shale and has similar high Na concentrations as wells 13A and 32.
Strontium	0 LT	13A,16A,32 22,24	LT	No impact	
Sulfate	0 GT	13A,32 16A,22,24	LT	No impact	Well 16A is the only bedrock well in the vicinity of East Ash Pond with elevated sulfate relative to background. Water quality is most likely affected by past coal mining.
Total Dissolved Solids	0 LT GT	16A 22,24 13A,32	Variable (no determination)	No impact	Wells 13A, 16A and 32 may be affected by past coal mining activities. Background well 25 may also be affected by coal mining. Background well 30 is in coal and shale and has the highest mean and median TDS concentrations.
Vanadium	0	all wells	LT	No impact	All samples from background wells and East Ash Pond wells were below detection limits for Vanadium. Only East Ash Pond water samples have detectable Vanadium.

Key to Symbols

COLUMN 2

0 Groundwater quality for given parameter in East Ash Pond wells is statistically from the same population as Background Wells (25,27,29,30, and 31) based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.

LT Groundwater quality for given parameter in East Ash Pond wells has a statistically significant lower mean concentration compared to Background Wells (25,27,29,30, and 31) based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.

GT Groundwater quality for given parameter in East Ash Pond wells has a statistically significant higher mean concentration compared to Background Wells (25,27,29,30, and 31) based on the Wilcoxon Rank-Sum Test for Comparison of Means, 95 % confidence level.

COLUMN 3

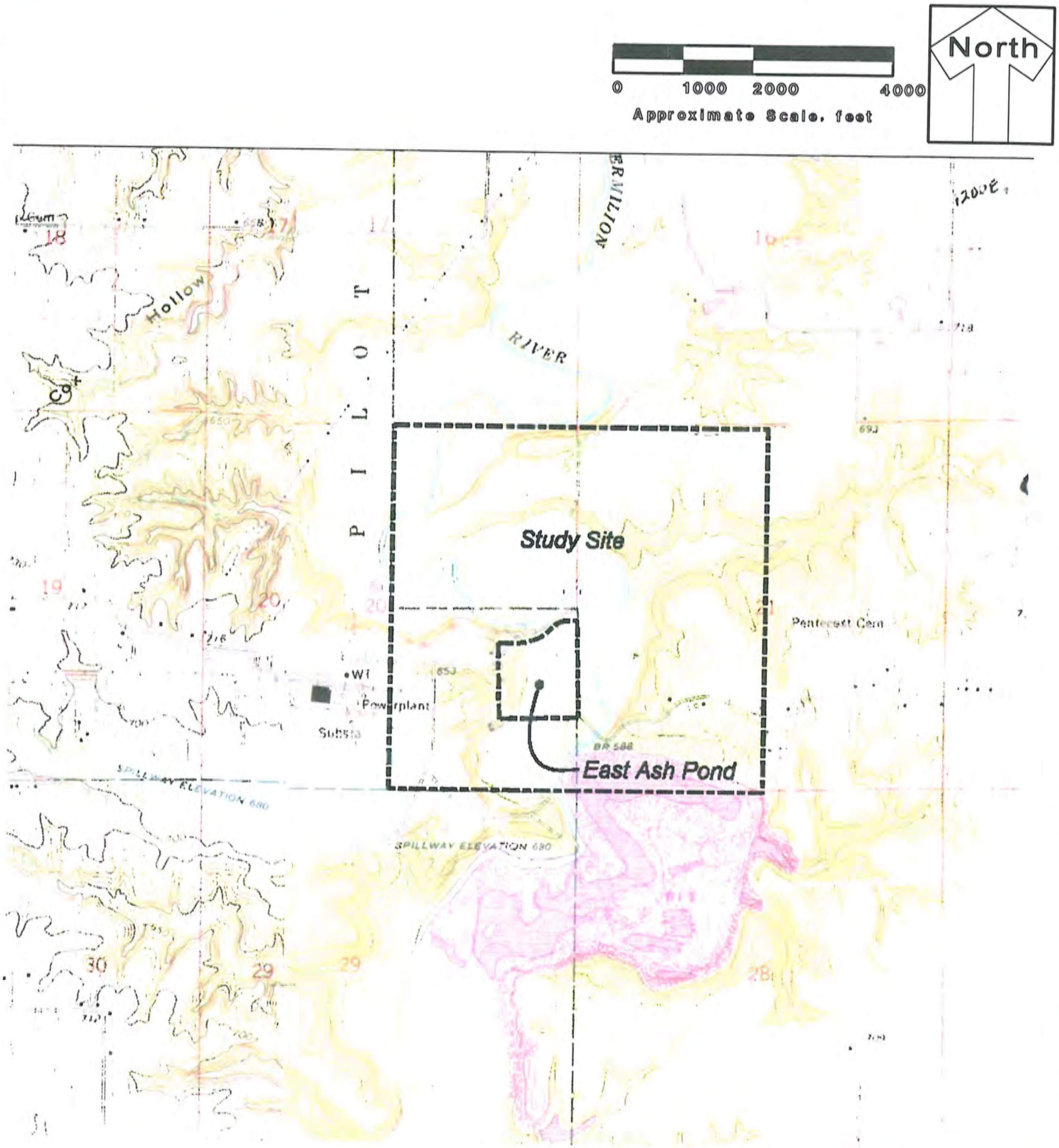
LT Groundwater concentrations in East Ash Pond Bedrock Wells are less than East Ash Pond surface water for given parameter.

GT Groundwater concentrations in East Ash Pond Bedrock Wells are greater than East Ash Pond surface water for given parameter.

1 Bedrock wells at East Ash Pond include MW13A (13A), MW16A (16A), MW22 (22), MW24 (24), and MW32 (32).

2 Background bedrock wells used for statistical comparison to East Ash Pond wells using Wilcoxon Rank-Sum Test include the following: MW25 (25), MW27 (27), MW29 (29), MW30 (30), and MW31 (31).

Figures



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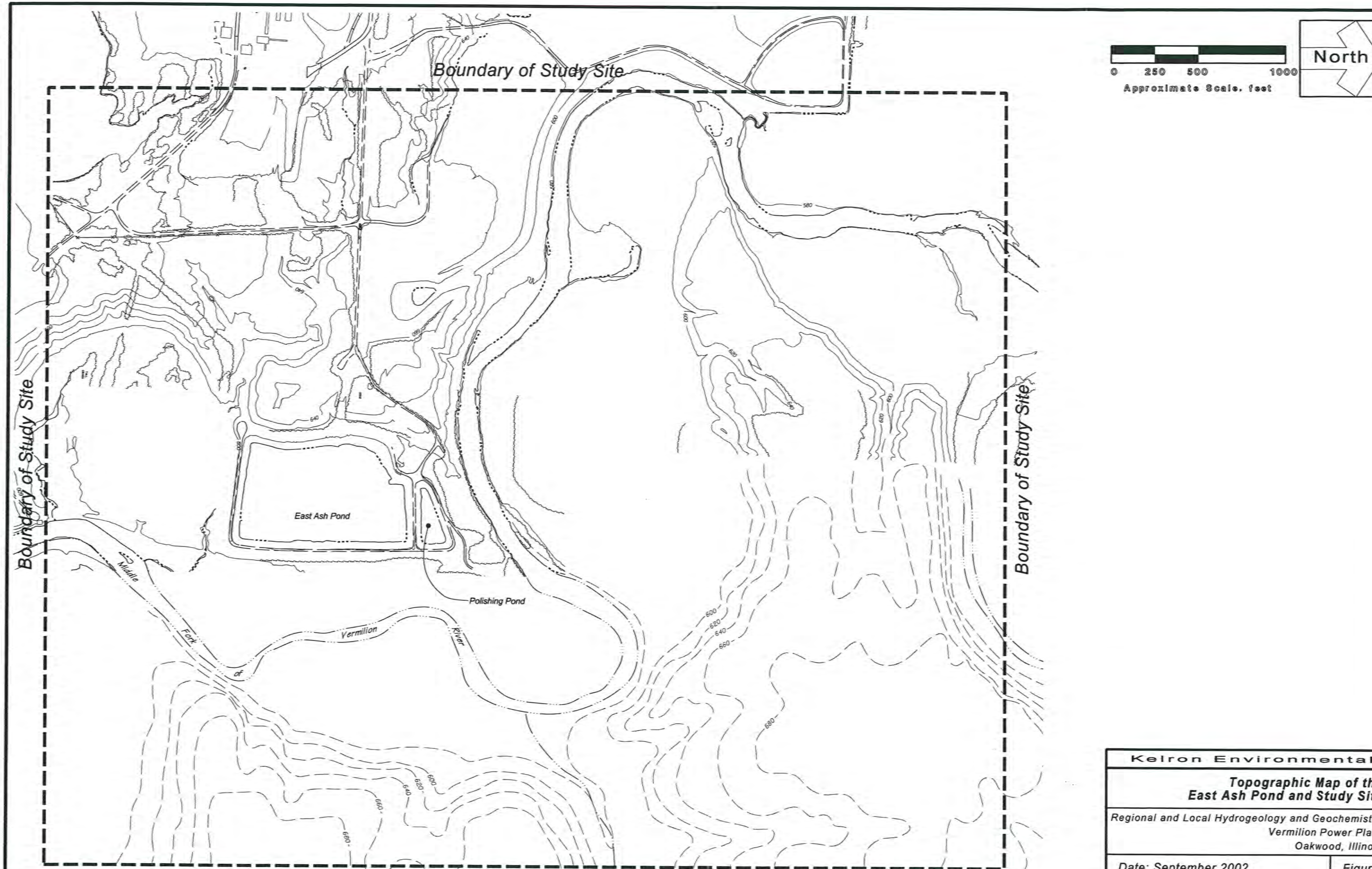
Site Location Map of the Vermilion Power Station and East Ash Pond

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002 | *Figure 1*



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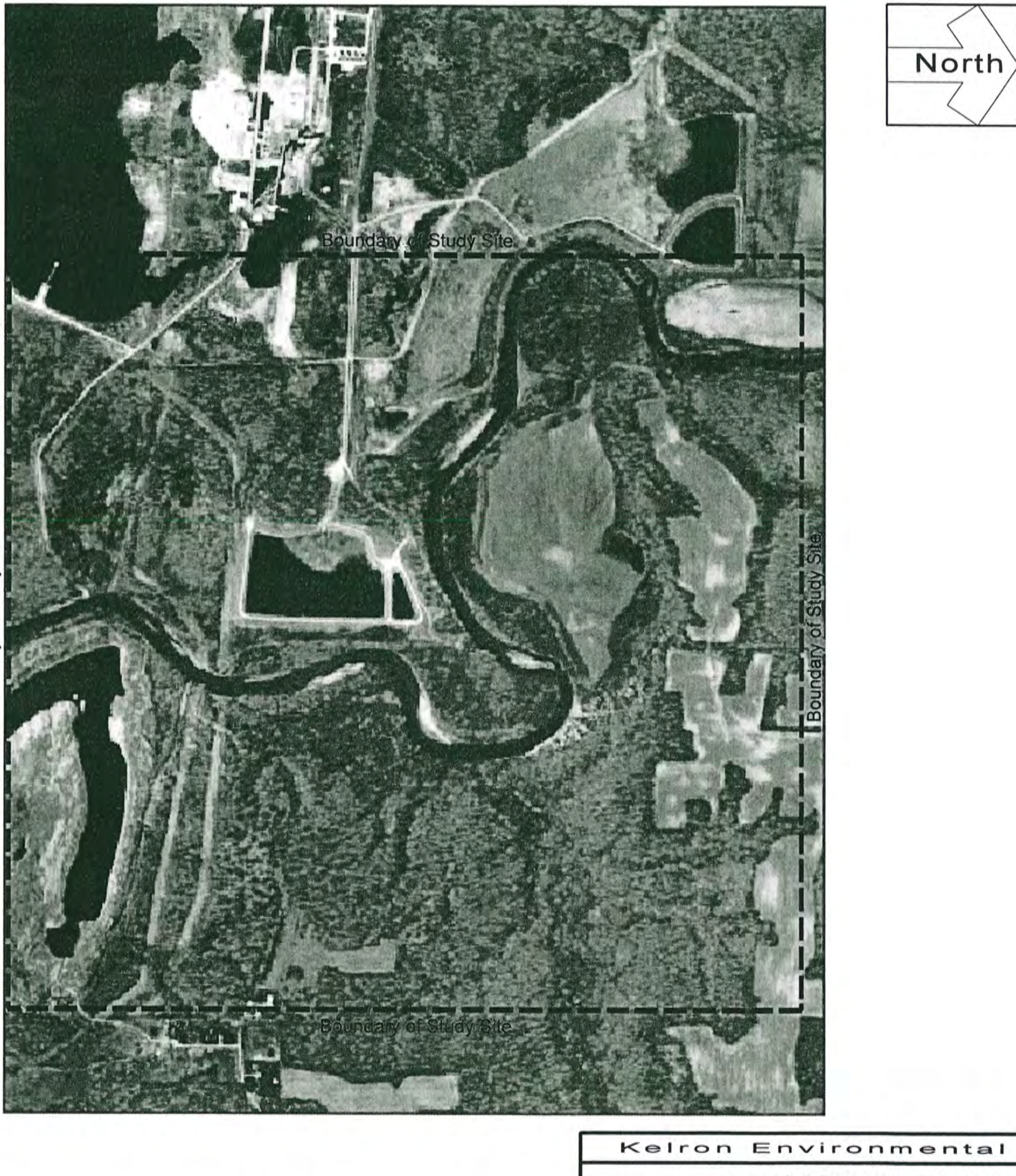
Topographic Map of the East Ash Pond and Study Site

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002

Figure 2



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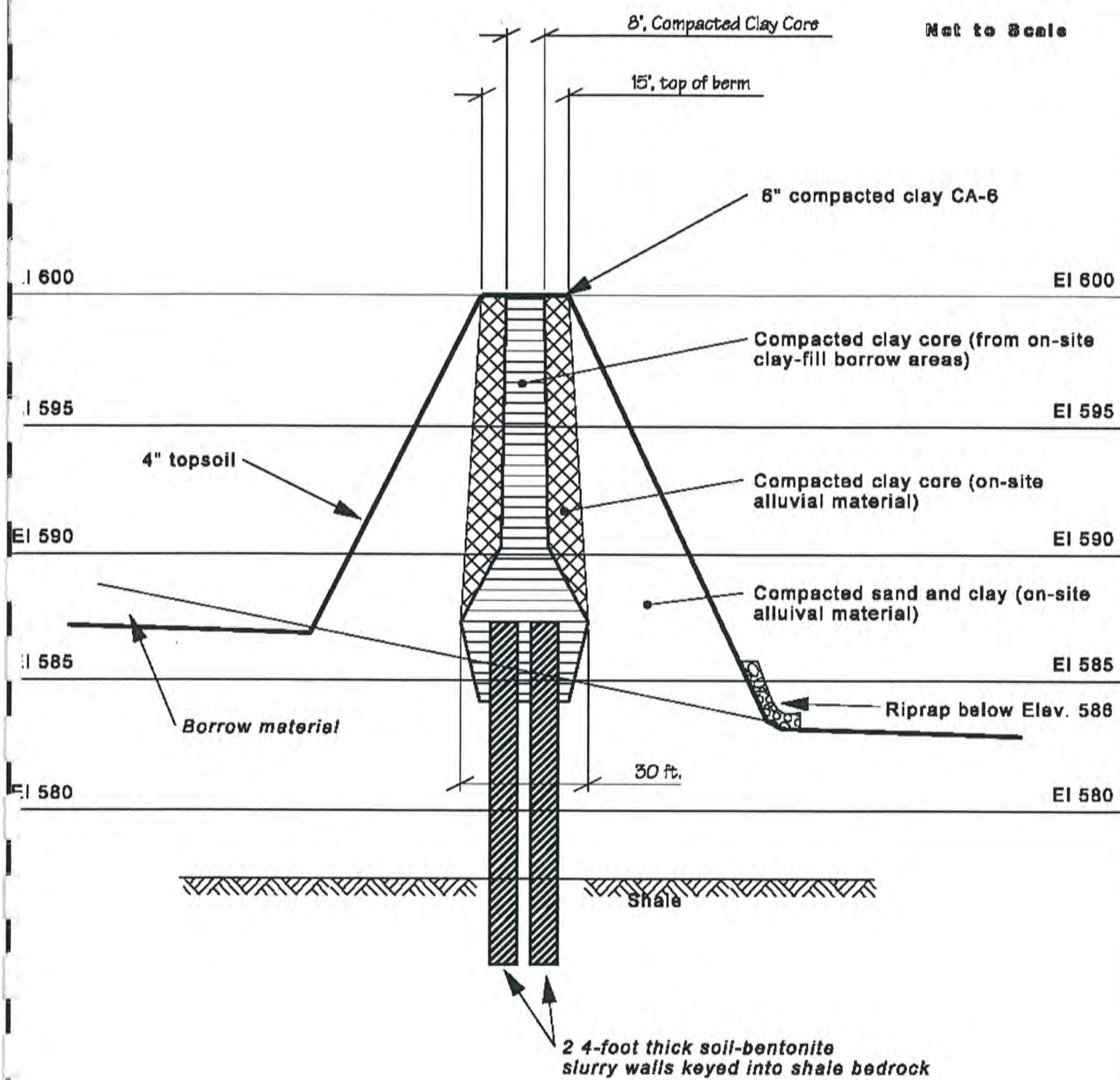
Aerial Photograph of the East Ash Pond and Study Site

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002	*Figure 3*



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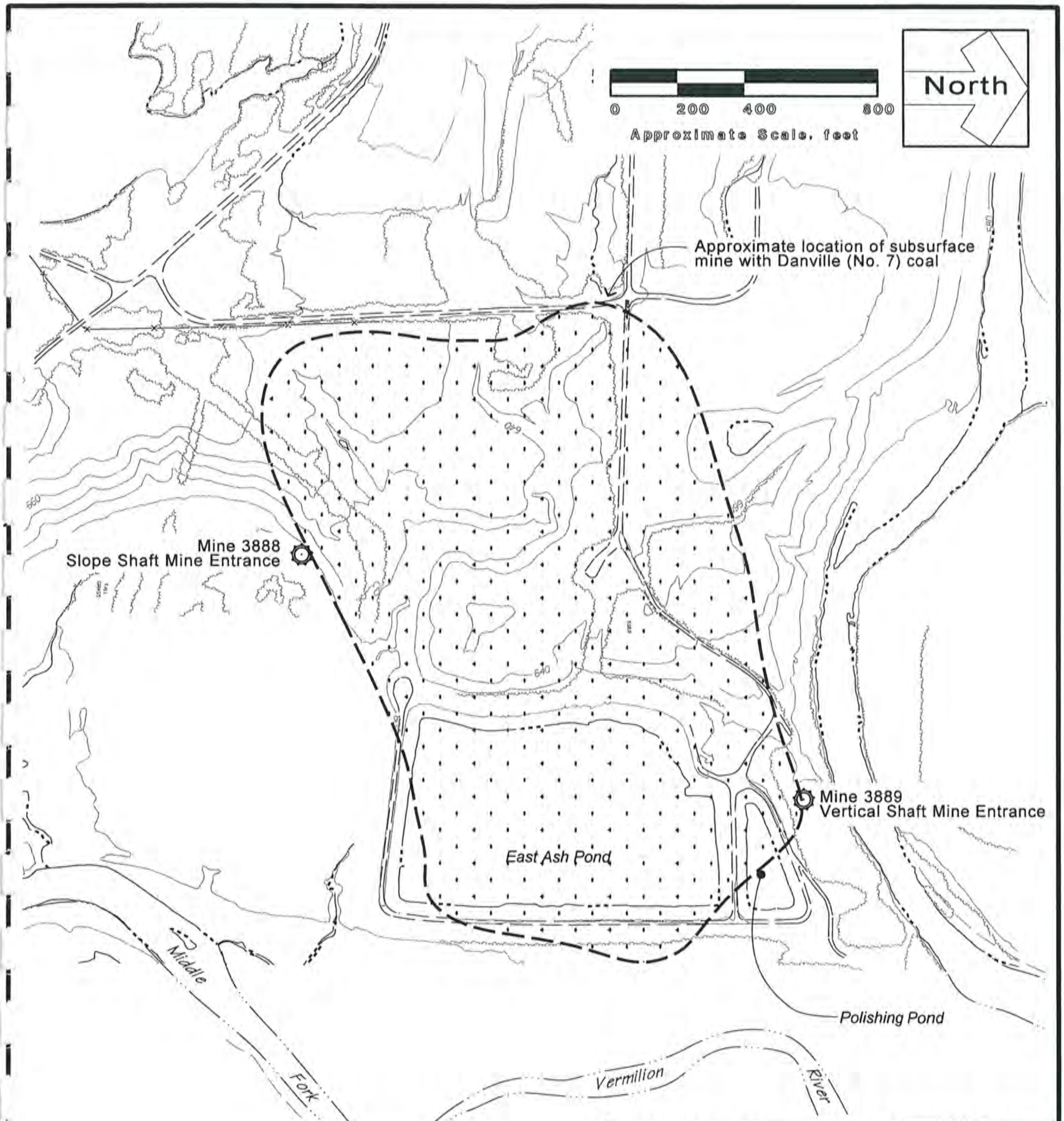
Typical Cross-Section of Original East Ash Pond Berm

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002 | *Figure 4*



Legend

Location of Mine Entrance

Note: Modified after " Directory of Coal Mines in Illinois - Vermilion County "; ISGS 1996.

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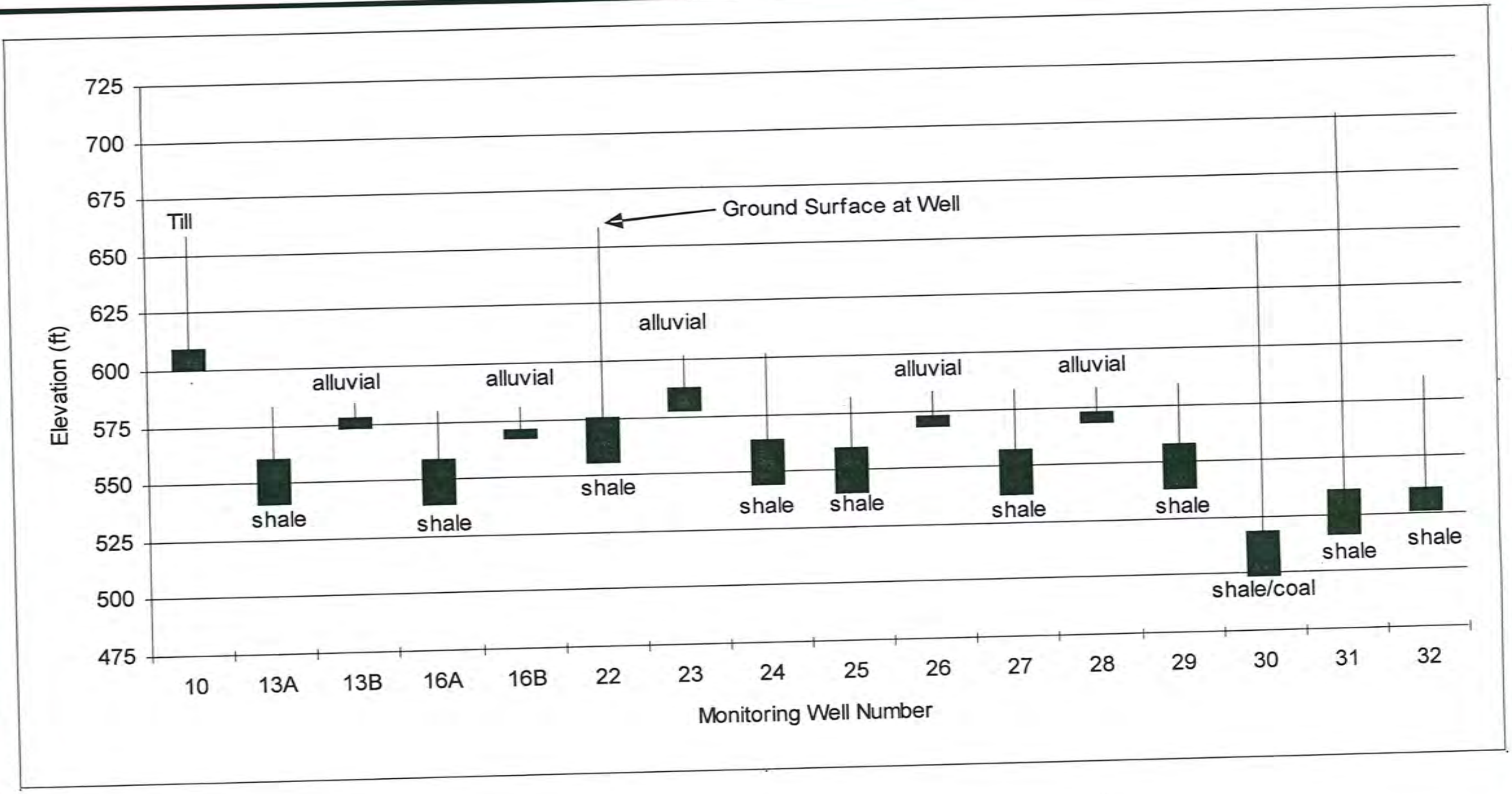
Map of Coal Mines in the Vicinity of the East Ash Pond - Illinois State Geological Survey

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002	*Figure 5*



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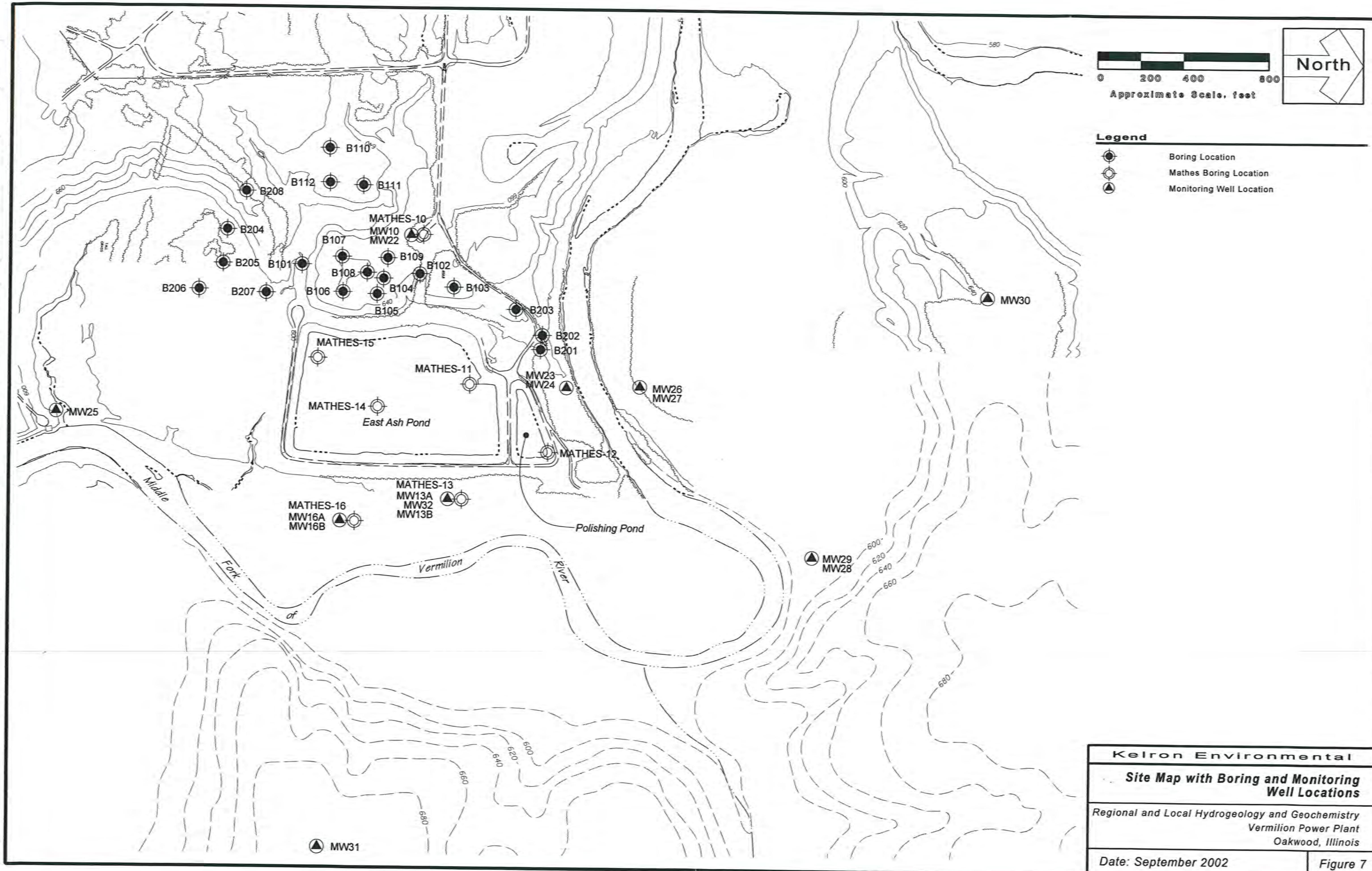
Monitoring Well Screen Intervals

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002 | *Figure 6*



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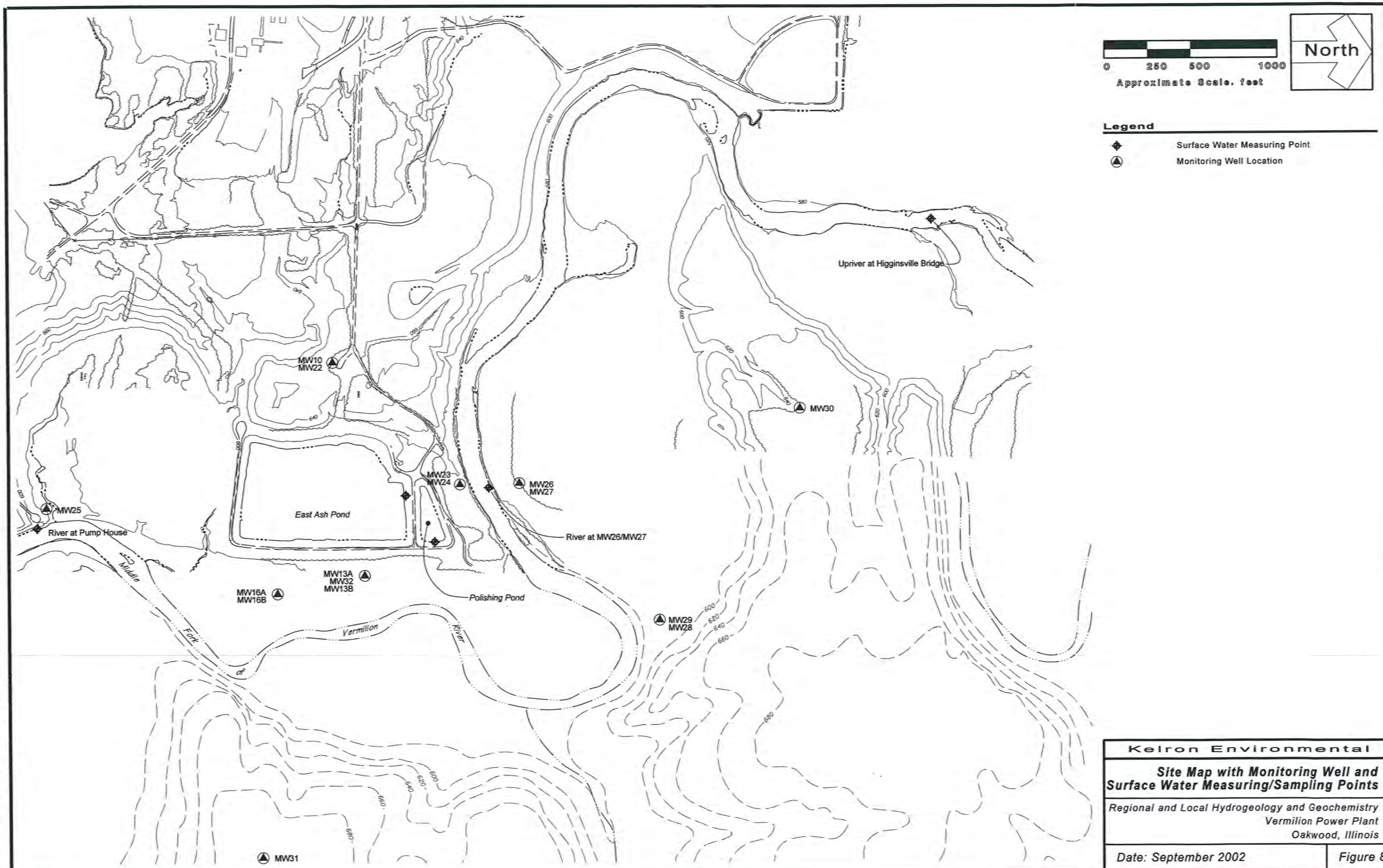
Site Map with Boring and Monitoring Well Locations

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002

Figure 7



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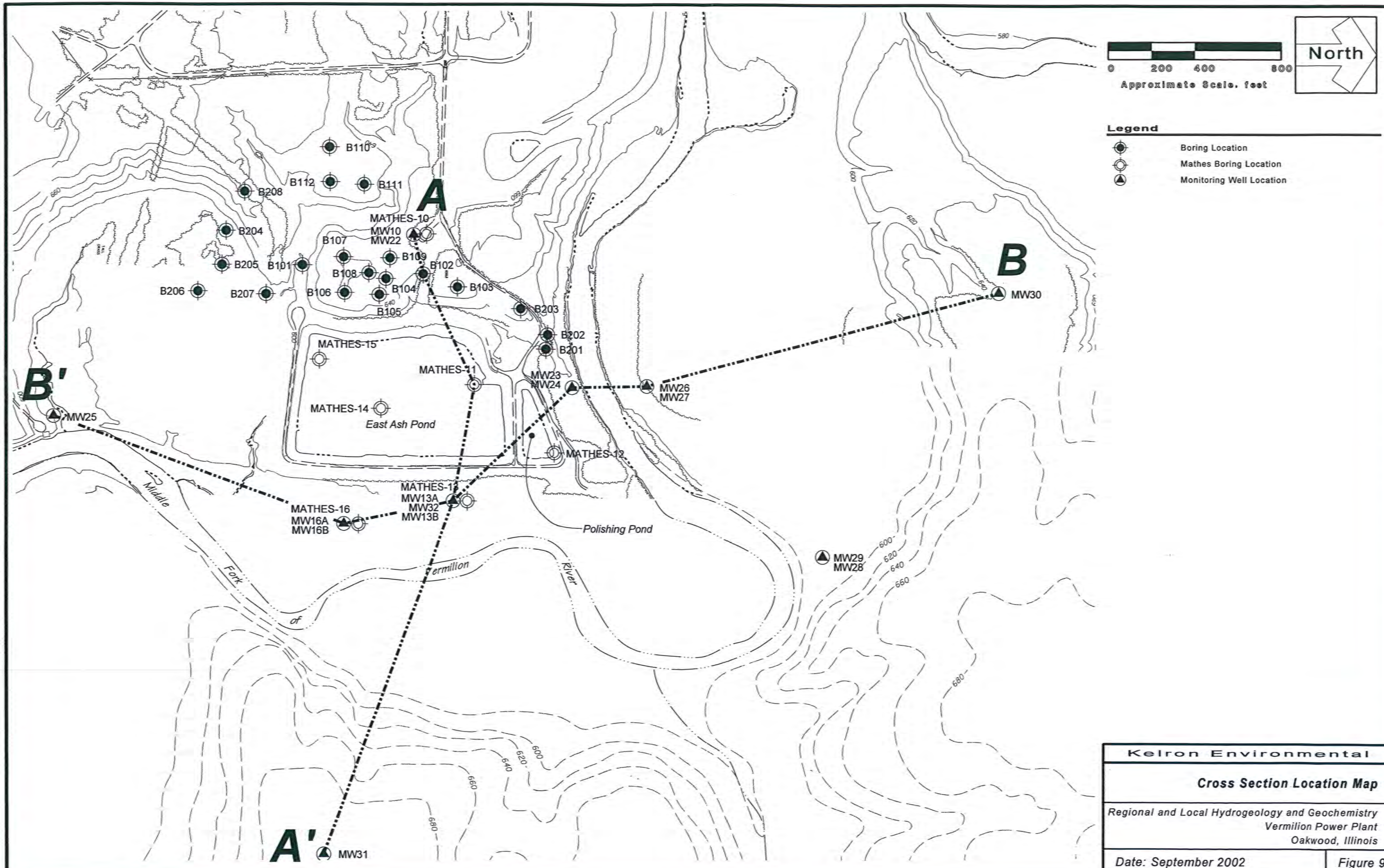
Site Map with Monitoring Well and Surface Water Measuring/Sampling Points

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002 | Figure 8



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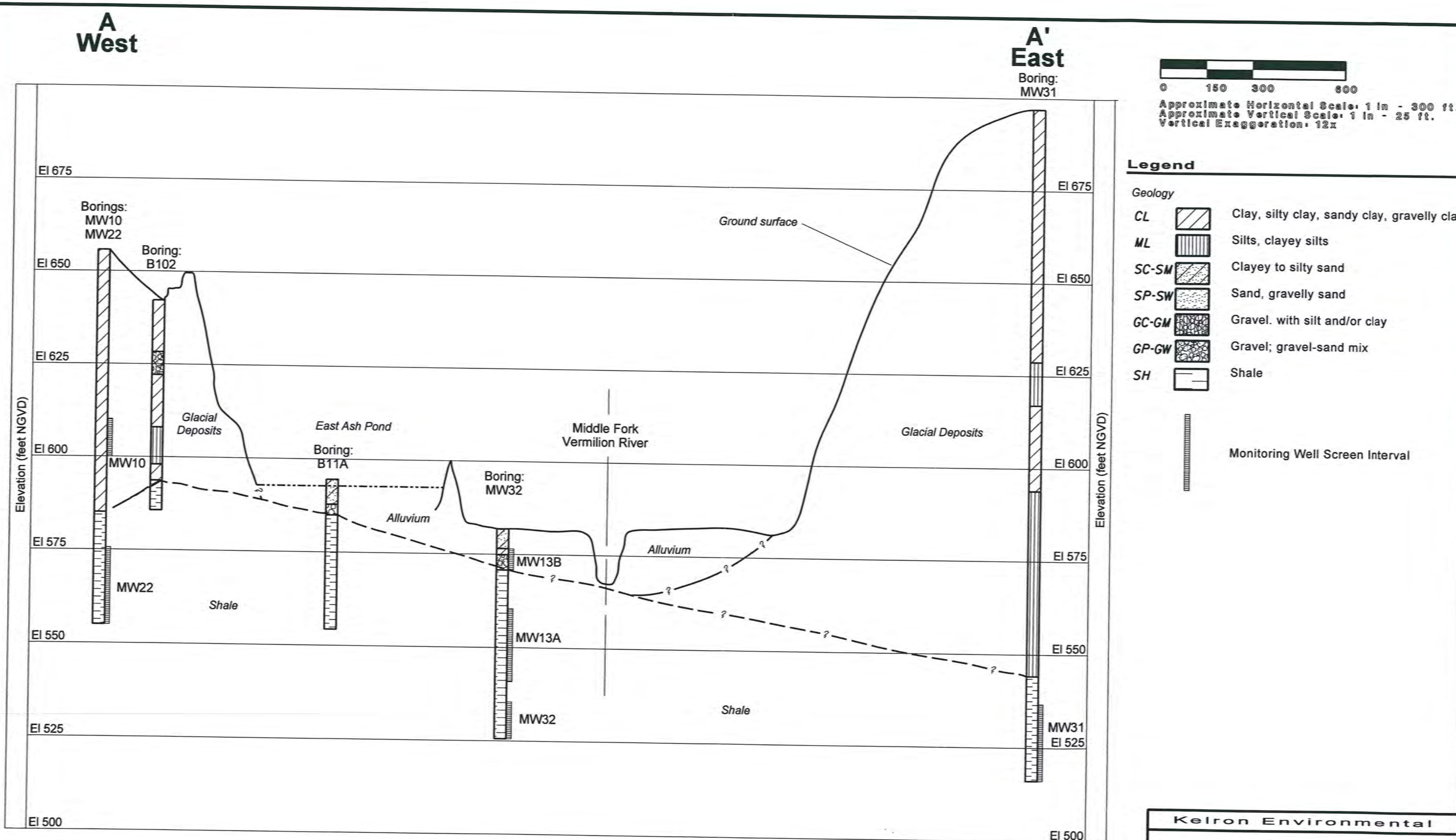
Cross Section Location Map

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002 | *Figure 9*



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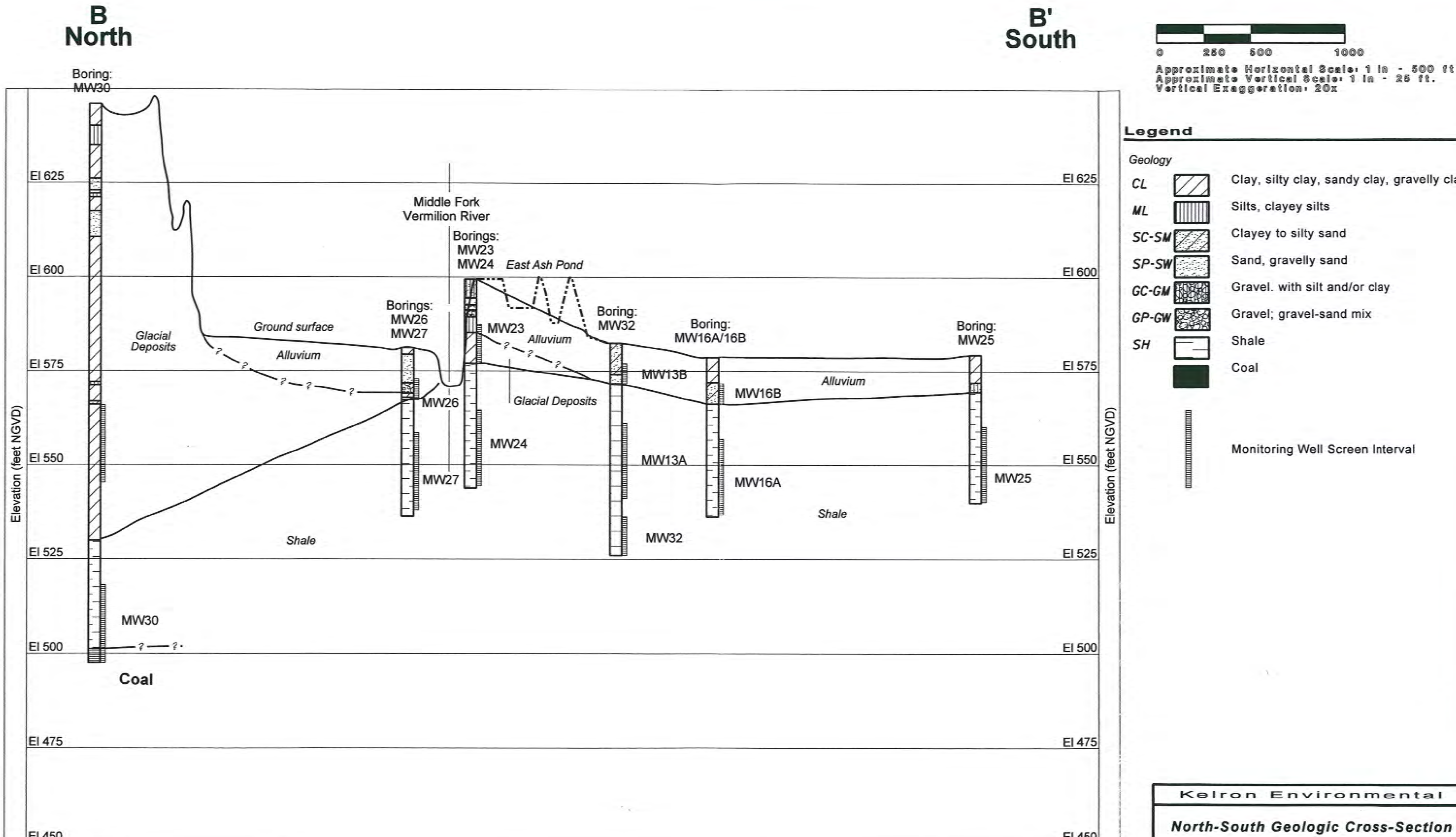
East-West Geologic Cross-Section

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002	Figure 10



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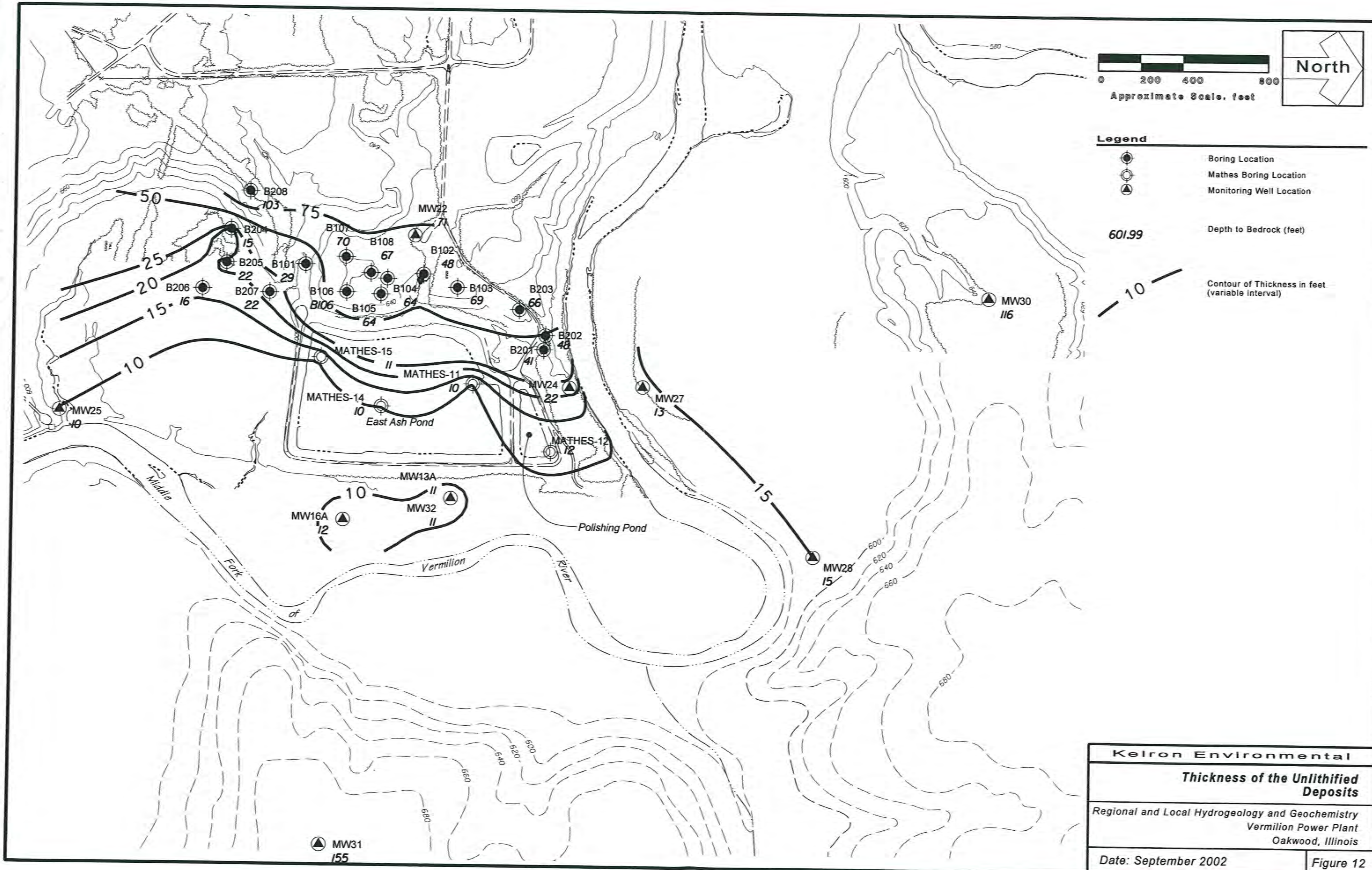
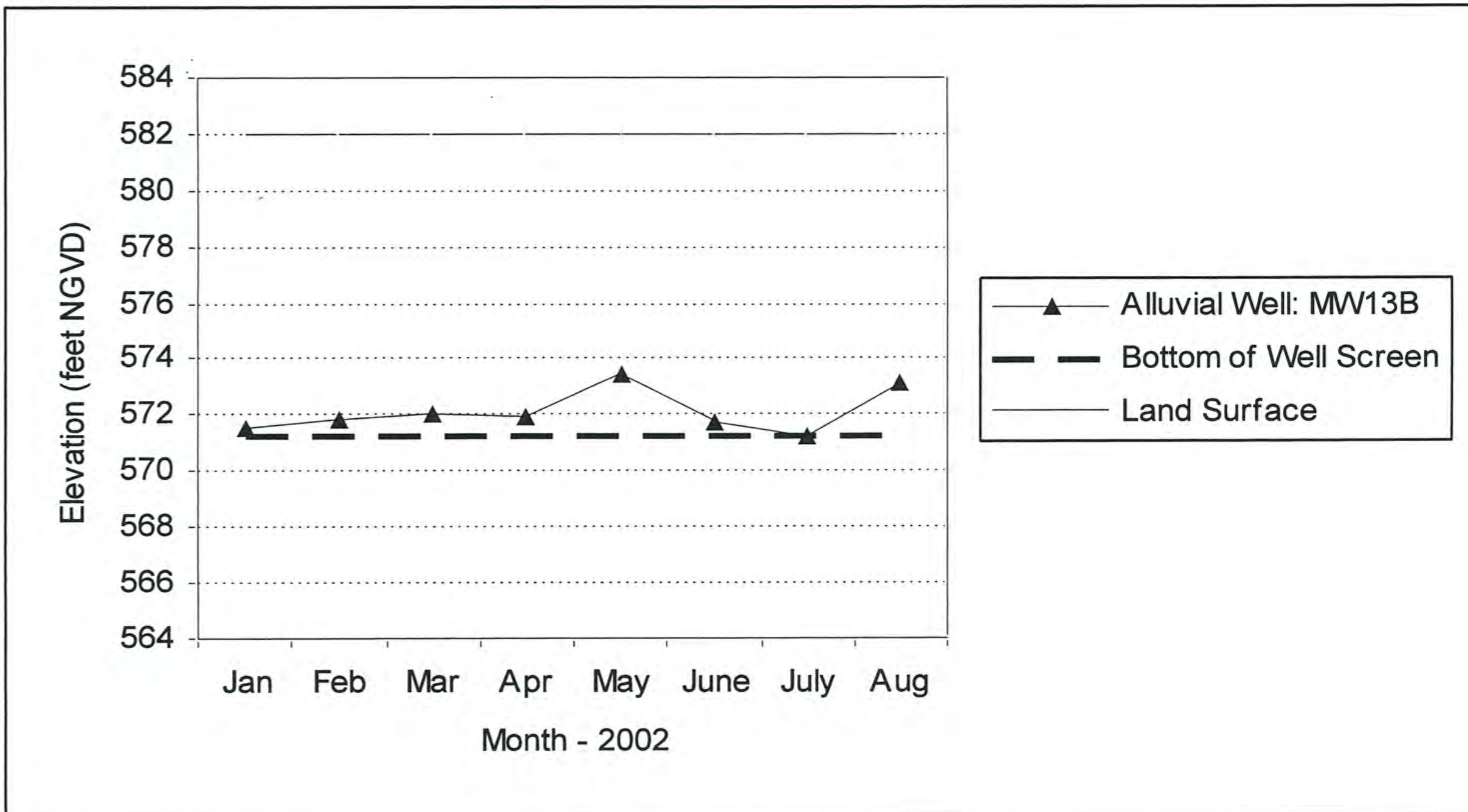
North-South Geologic Cross-Section

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002

Figure 11


North
0 200 400 800
Approximate Scale, feet
Legend
Boring Location
Mathes Boring Location
Monitoring Well Location
601.99 Depth to Bedrock (feet)
10 Contour of Thickness in feet (variable interval)
B208 103
B204 15
B205 22
B206 16
B207 22
B101 29
B107 70
B108 67
B106 B106
B105 64
B104 64
B102 48
B103 69
B203 66
B202 48
B201 41
MW22 71
MW24 22
MW25 10
MW27 13
MW28 15
MW30 116
MW31 155
MW13A 11
MW32 11
MW16A 12
MATHES-15 11
MATHES-11 10
MATHES-14 10
MATHES-12 12
East Ash Pond
Polishing Pond
Middle Fork of Vermilion River
Kelron Environmental
Thickness of the Unlithified Deposits
Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois
Date: September 2002
Figure 12



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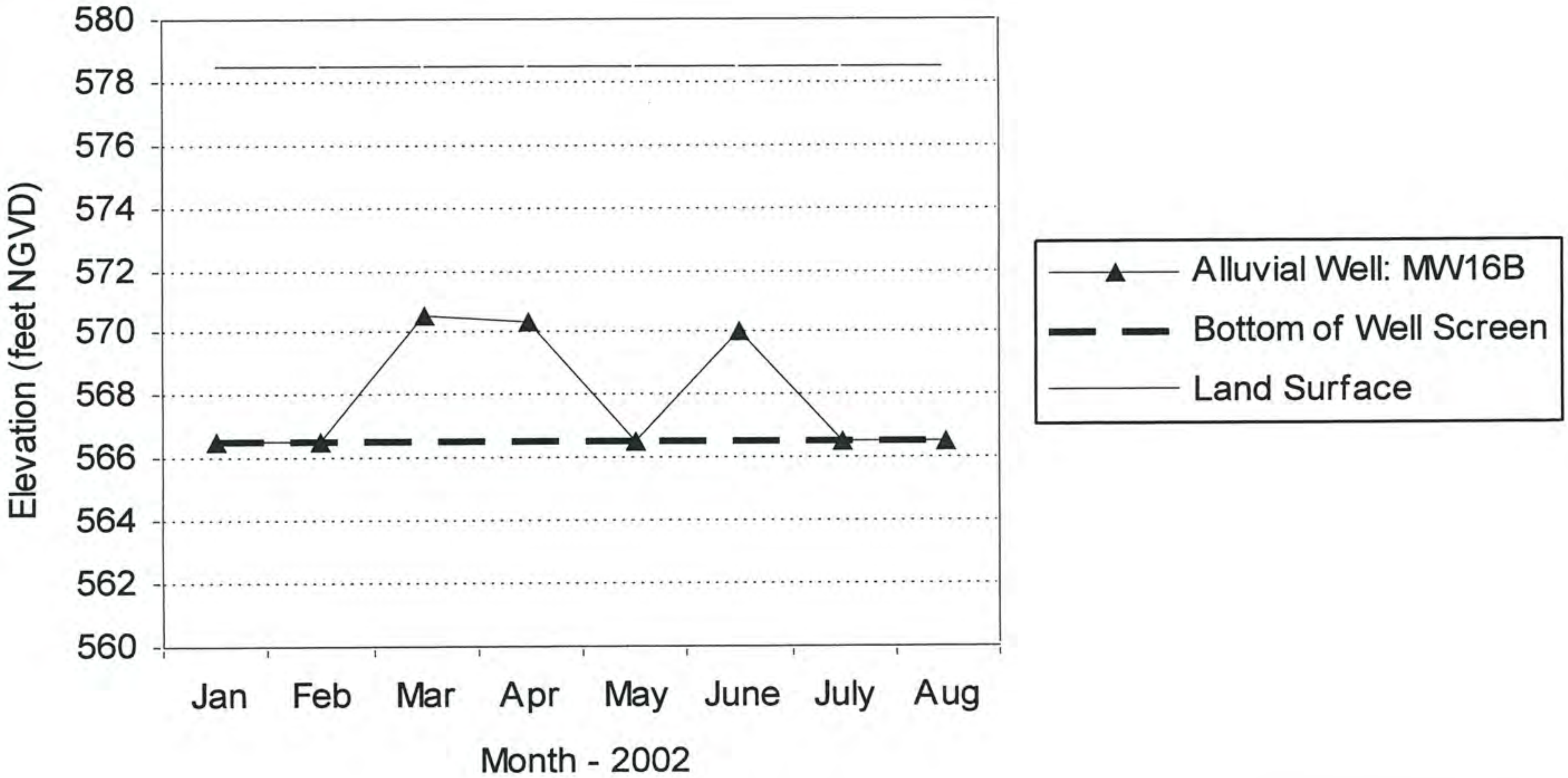
Groundwater Hydrograph of Alluvial Well MW13B

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002	*Figure 13*



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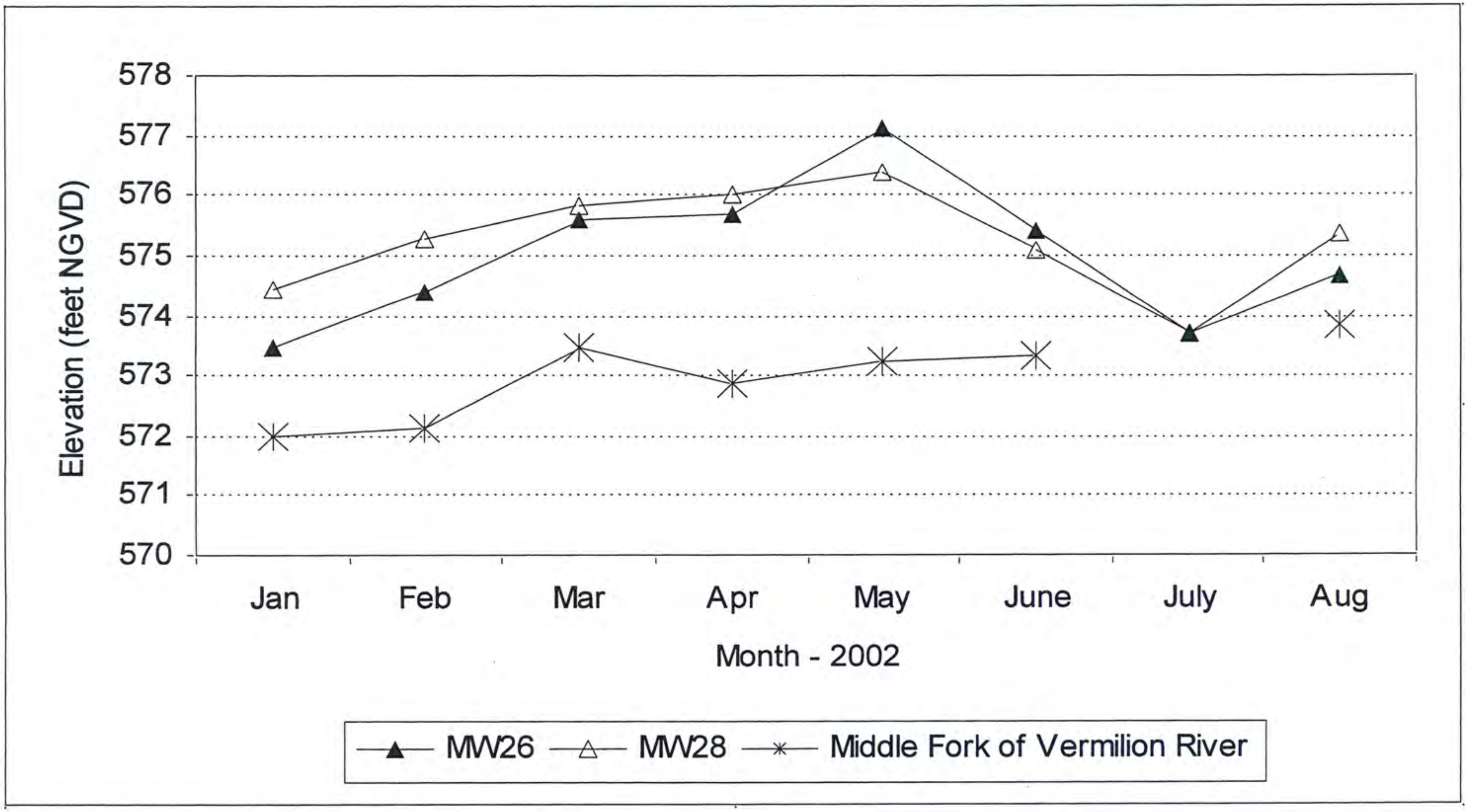
Groundwater Hydrograph of Alluvial Well MW16B

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002	*Figure 14*



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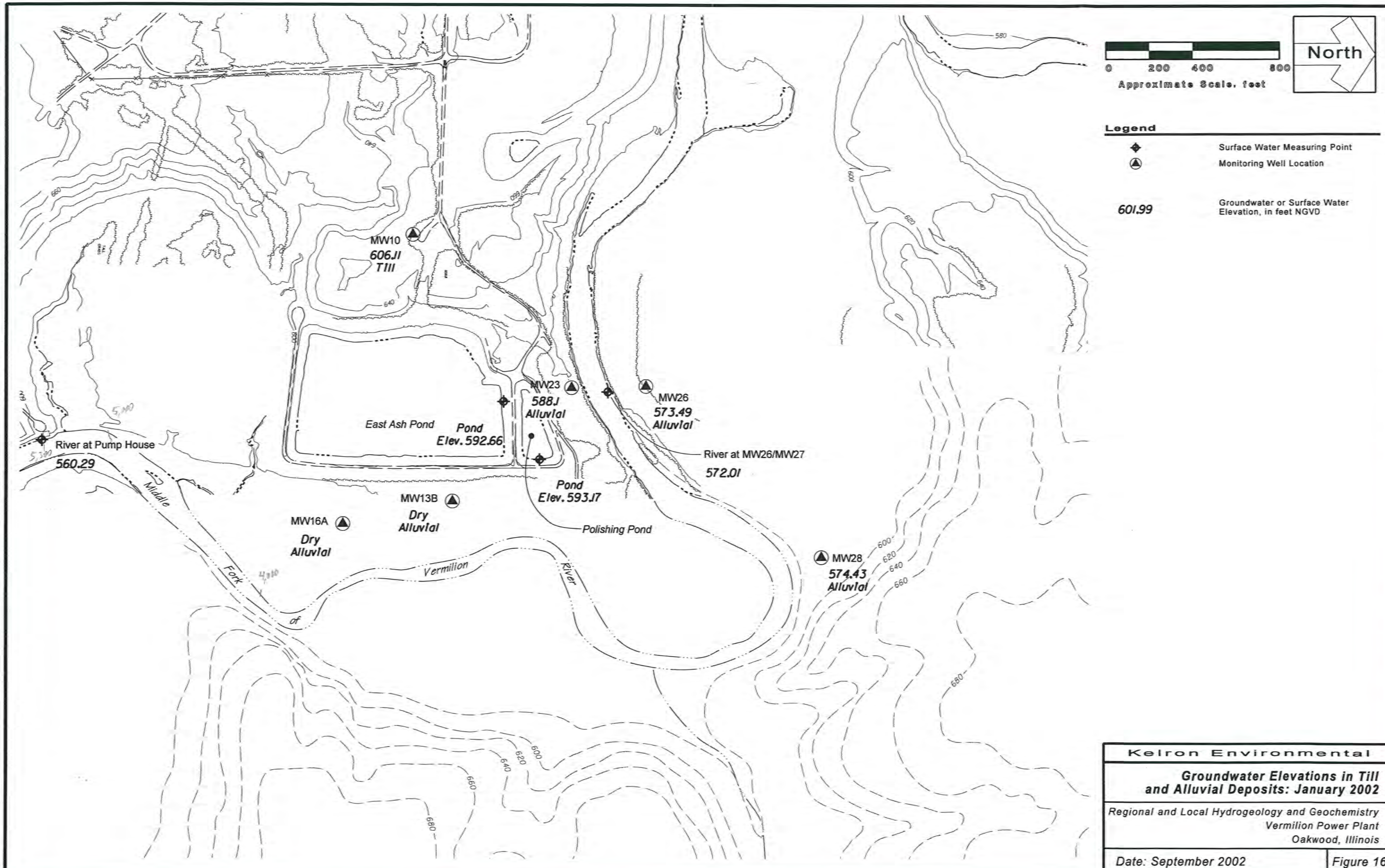
Hydrographs of Alluvial Wells MW26, MW28, and Middle Fork of Vermilion River

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002	*Figure 15*



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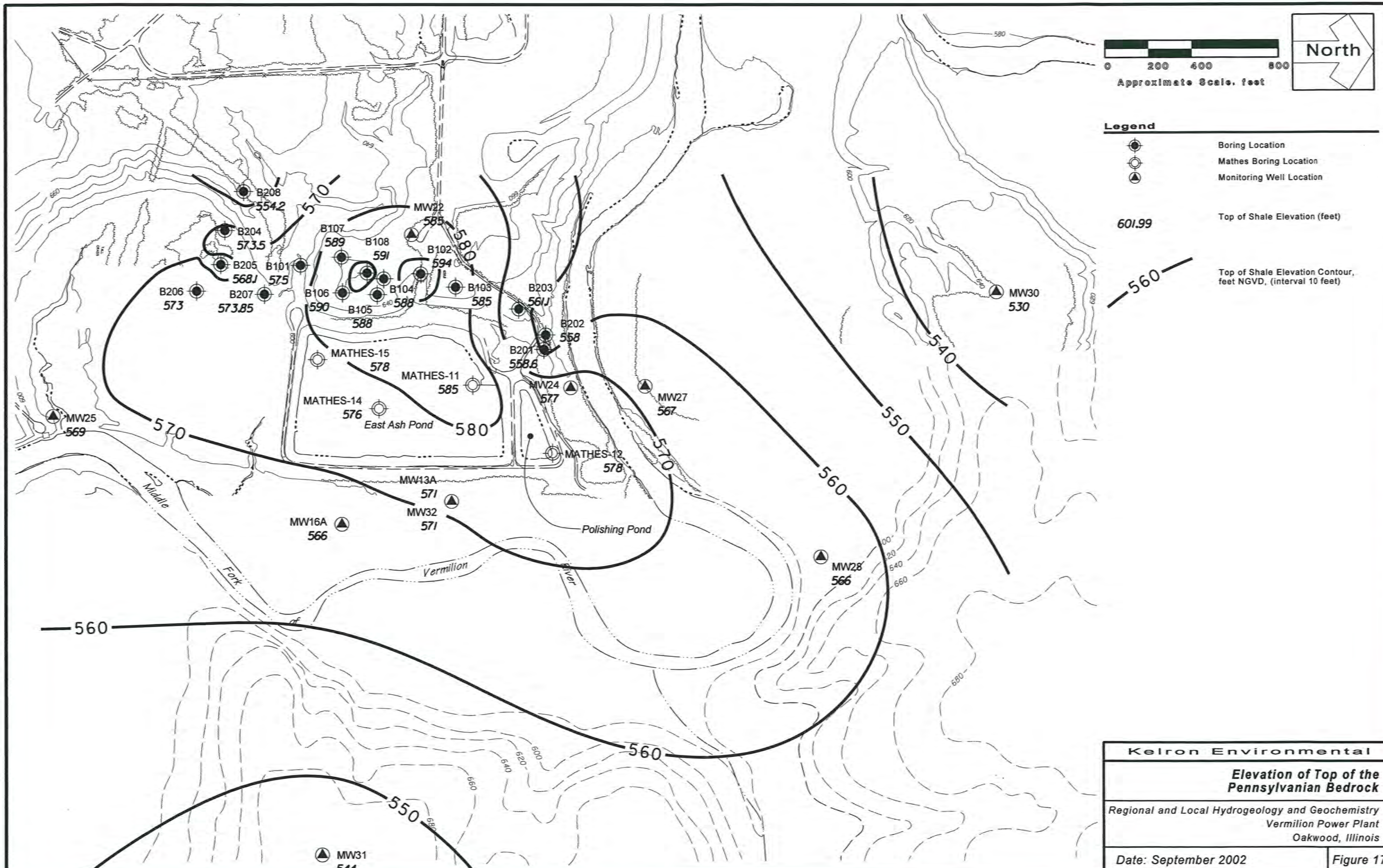
Groundwater Elevations in Till and Alluvial Deposits: January 2002

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002 | Figure 16



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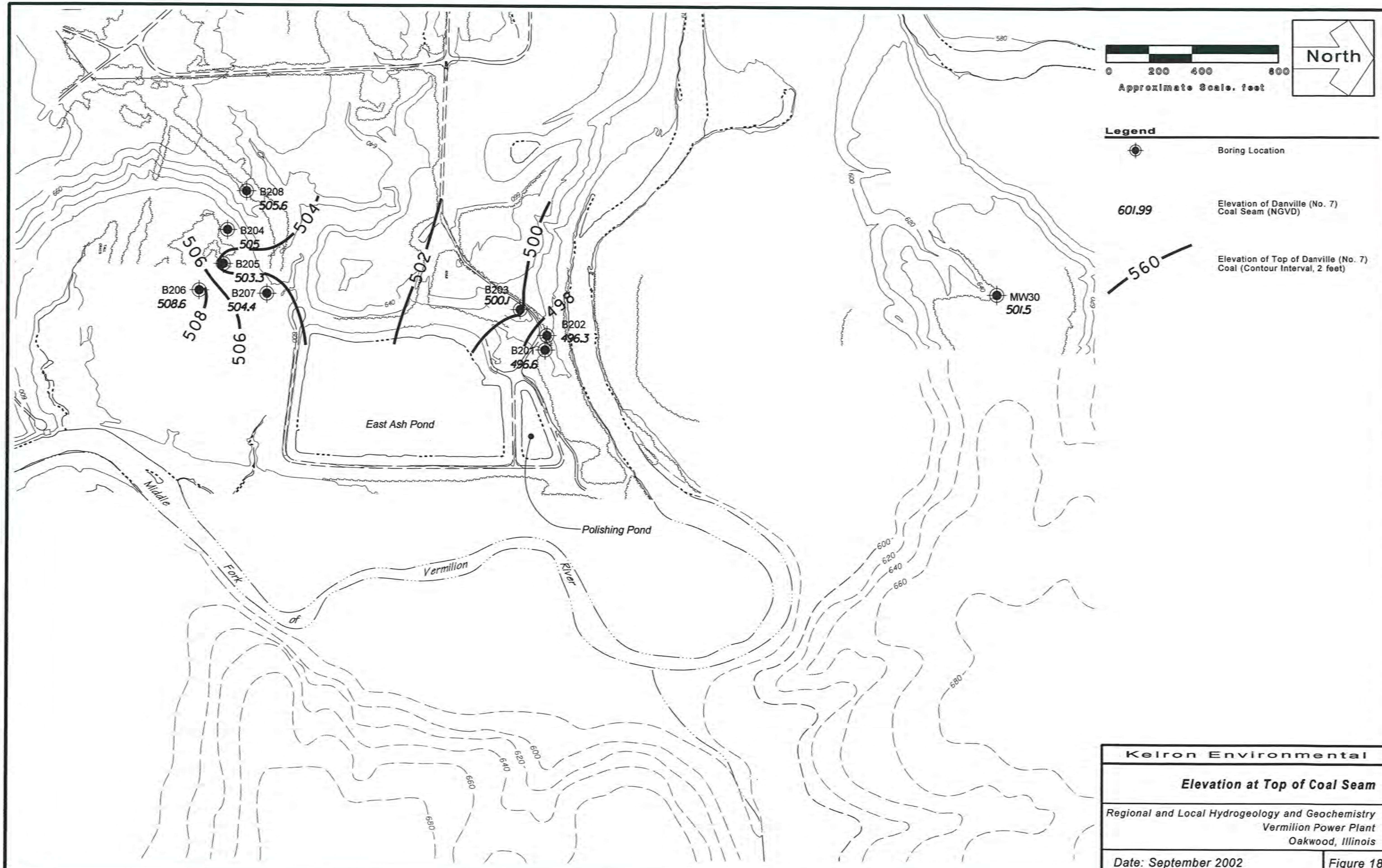
Elevation of Top of the Pennsylvanian Bedrock

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002 | *Figure 17*



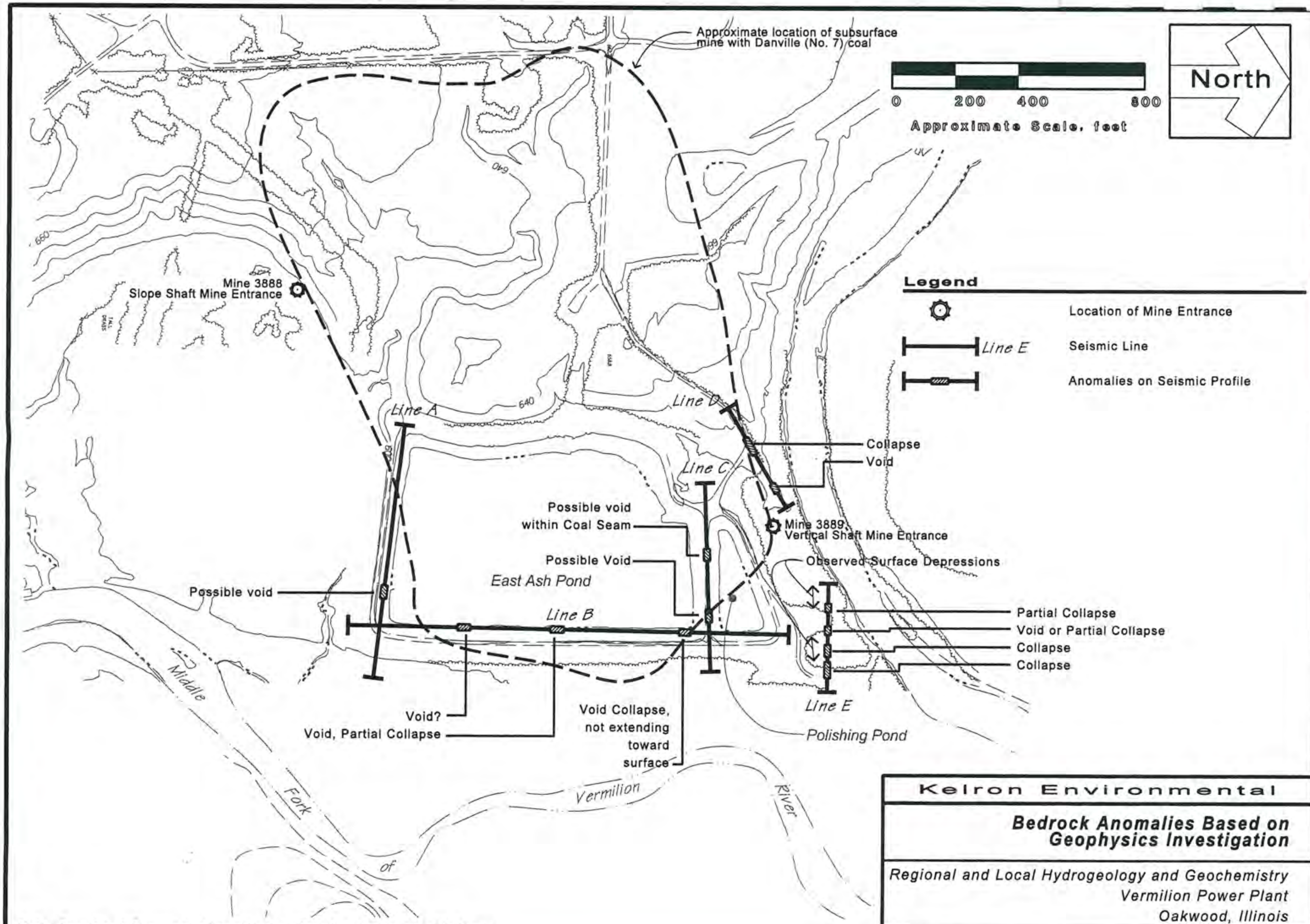
Kelron Environmental

Elevation at Top of Coal Seam

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

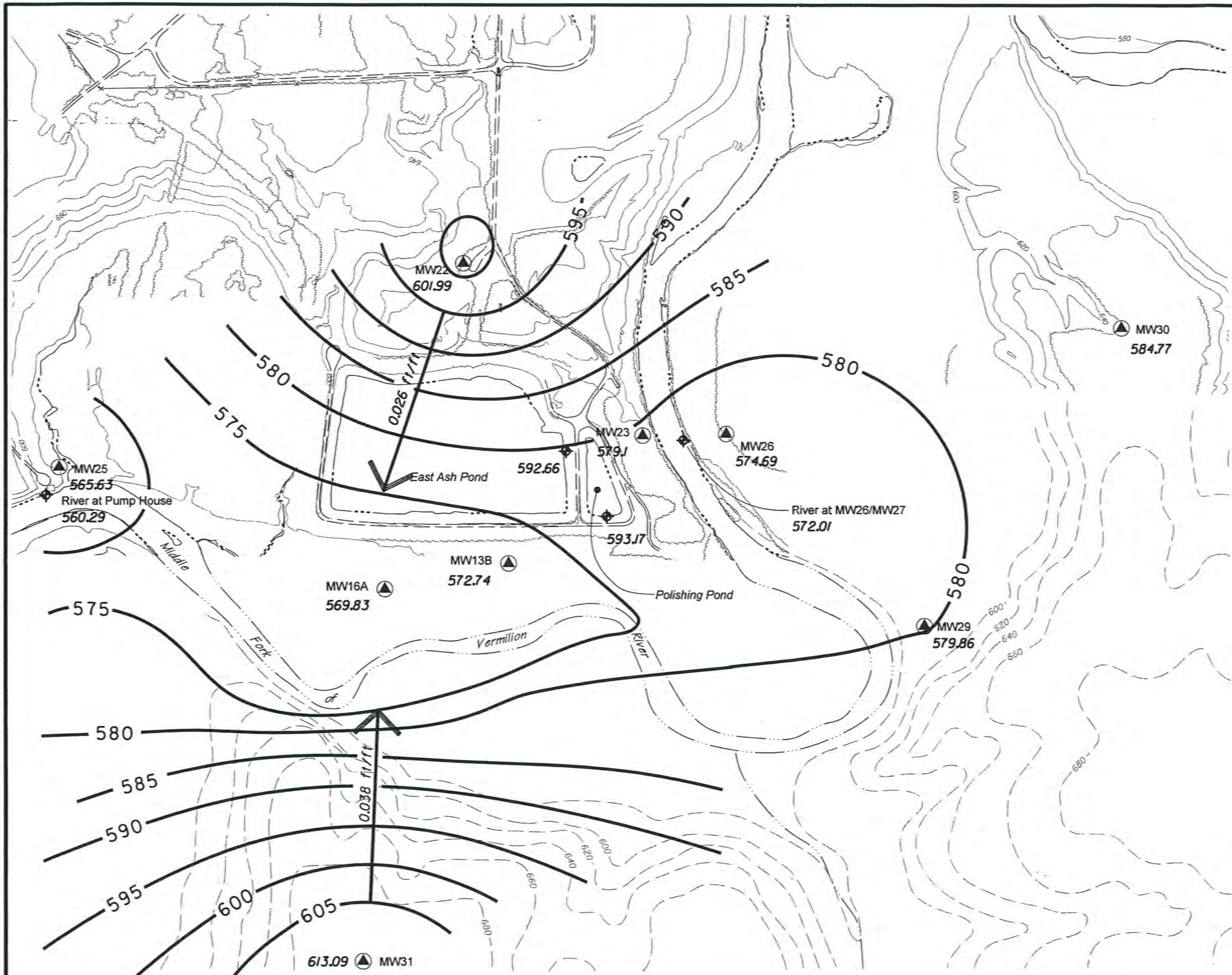
Date: September 2002

Figure 18



Note: Based on " Geophysical Investigation, East Ash Pond, " by URS Corp.; October 11, 2002 (URS, 2002)

Kelron Environmental	
Bedrock Anomalies Based on Geophysics Investigation	
Regional and Local Hydrogeology and Geochemistry Vermilion Power Plant Oakwood, Illinois	
Date: September 2002	*Figure 19*

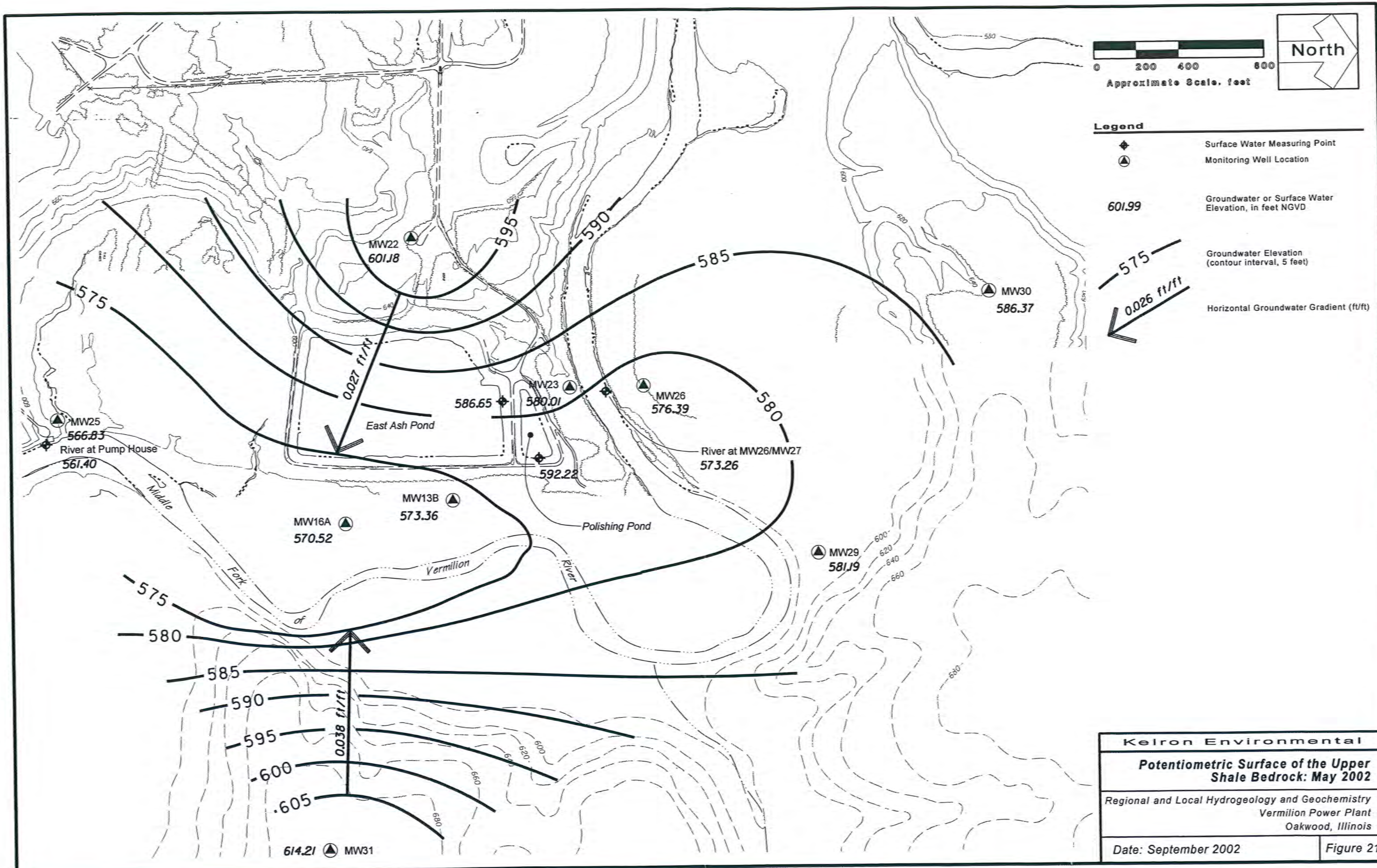


Kelron Environmental

Potentiometric Surface of the Upper Shale Bedrock: January 2002

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002	Figure 20

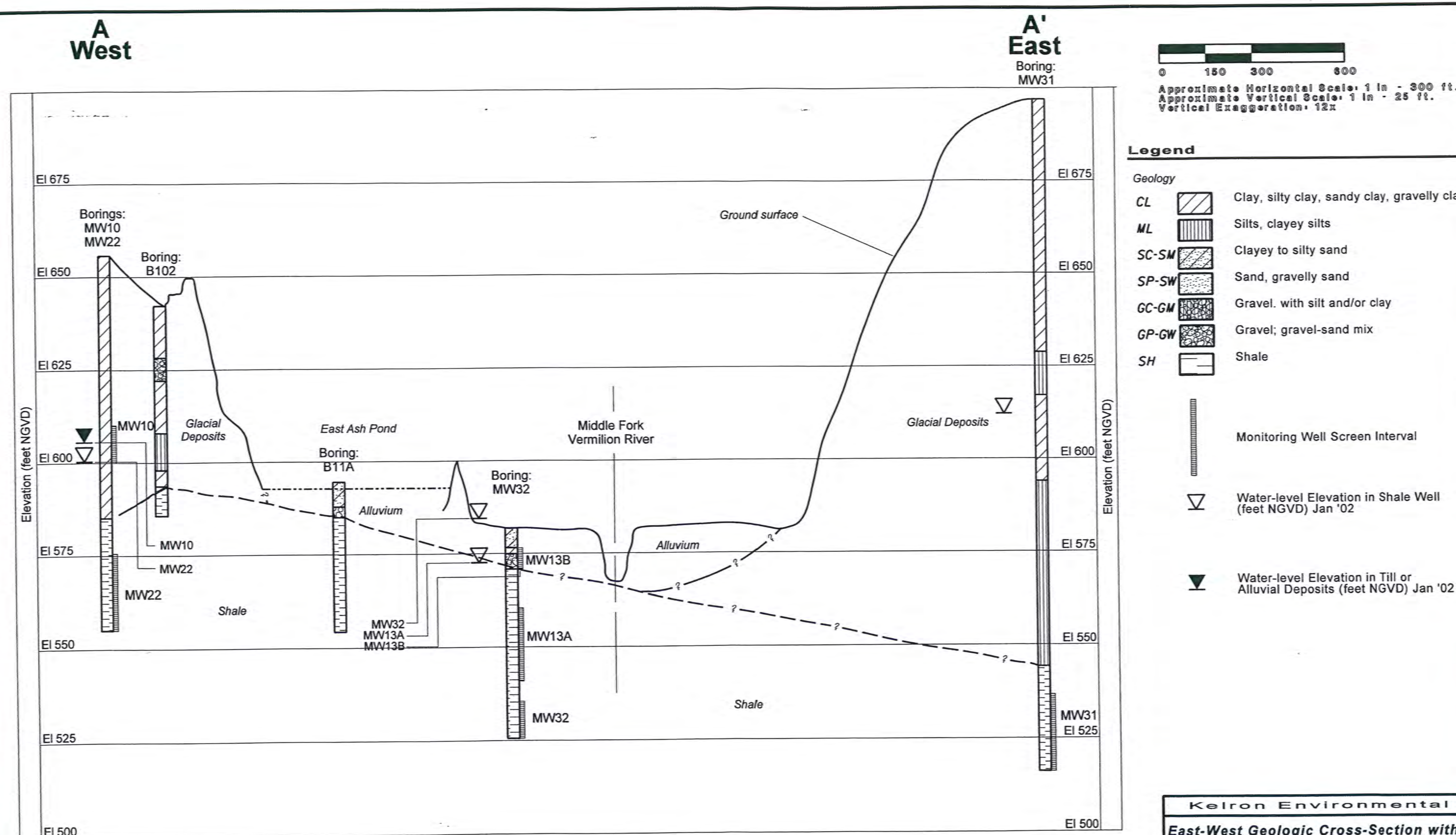


Kelron Environmental

Potentiometric Surface of the Upper Shale Bedrock: May 2002

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002 | Figure 21

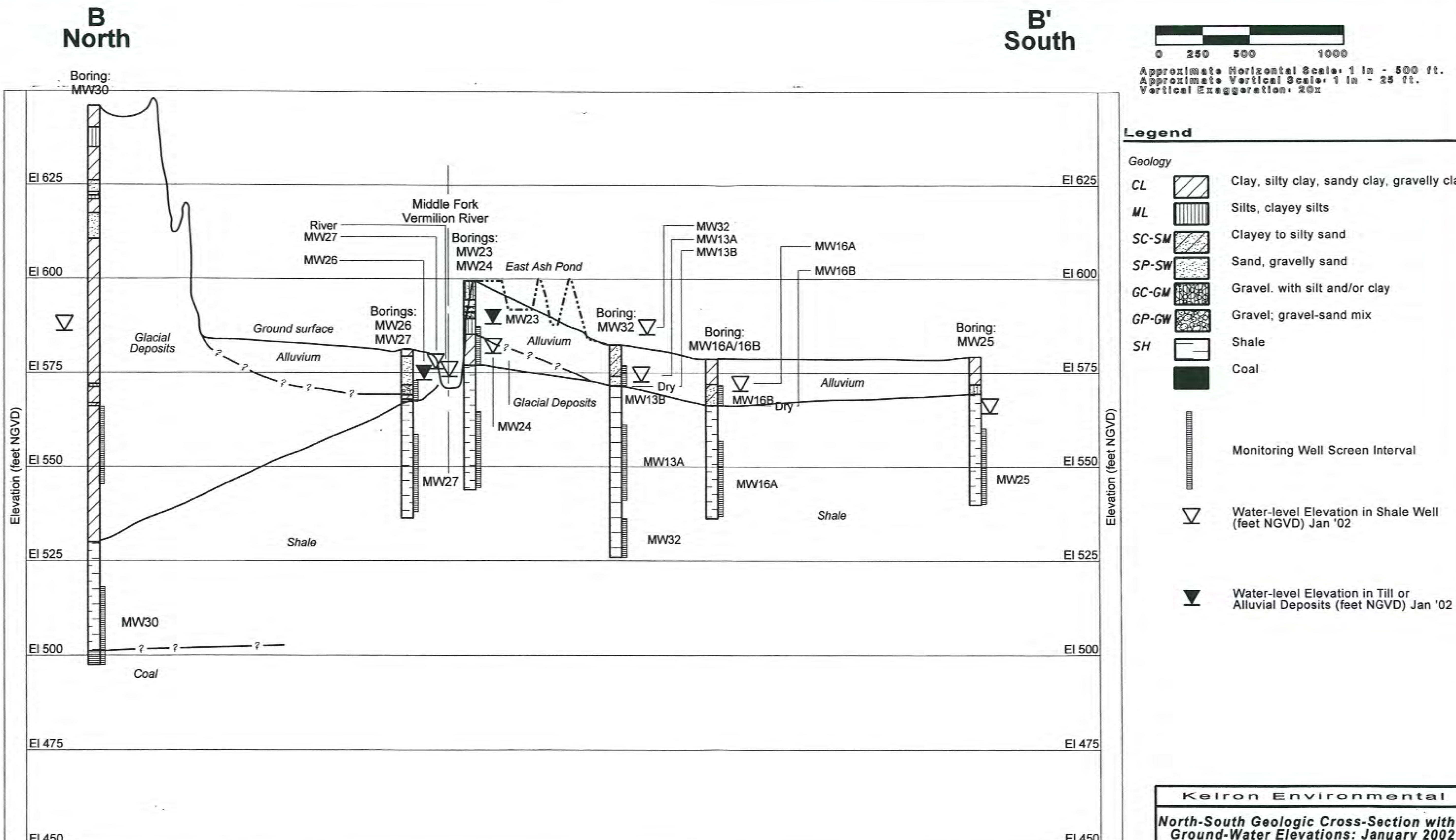


Kelron Environmental

East-West Geologic Cross-Section with Ground-Water Elevations: January 2002

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002	*Figure 22*

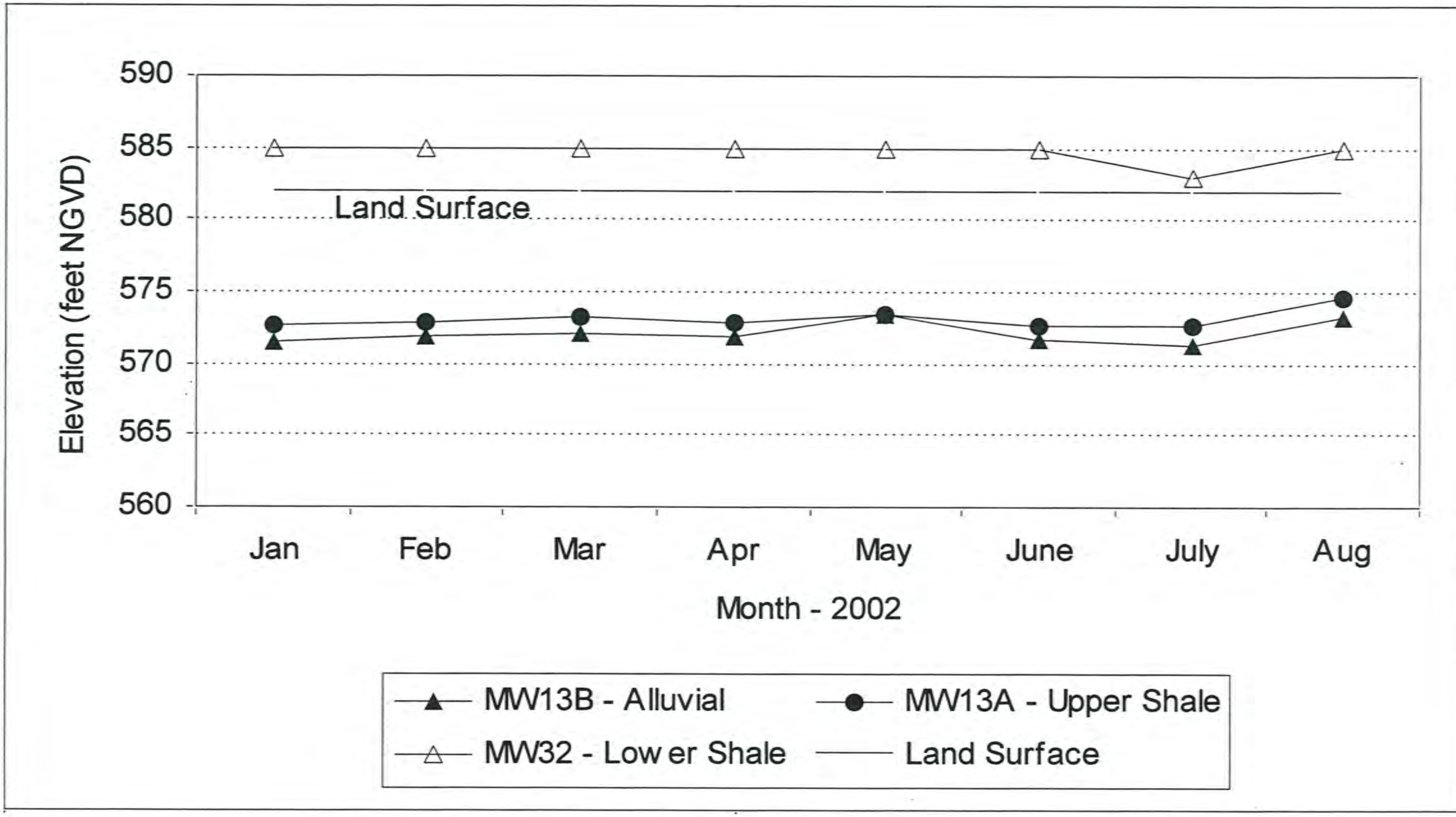


Kelron Environmental

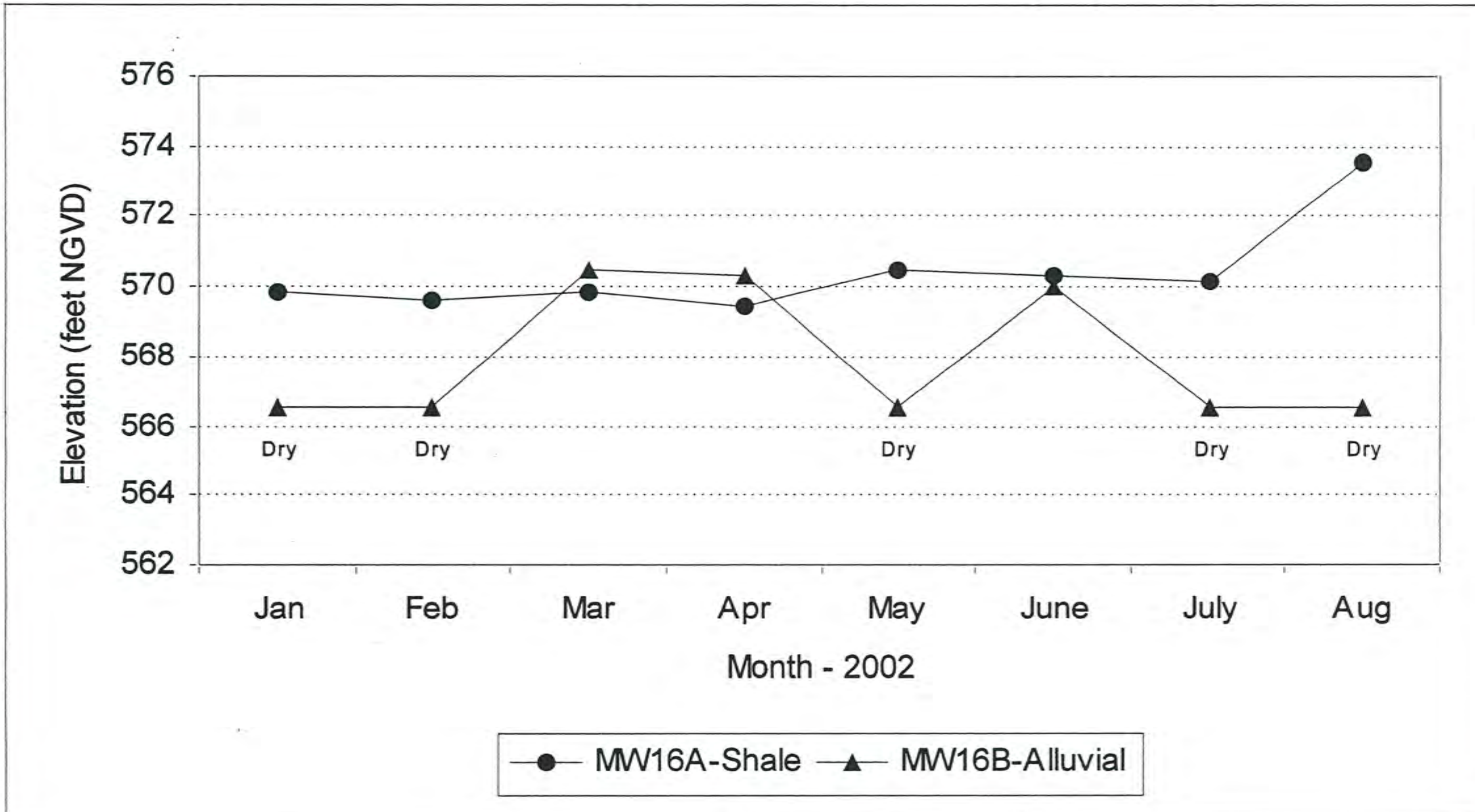
North-South Geologic Cross-Section with Ground-Water Elevations: January 2002

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

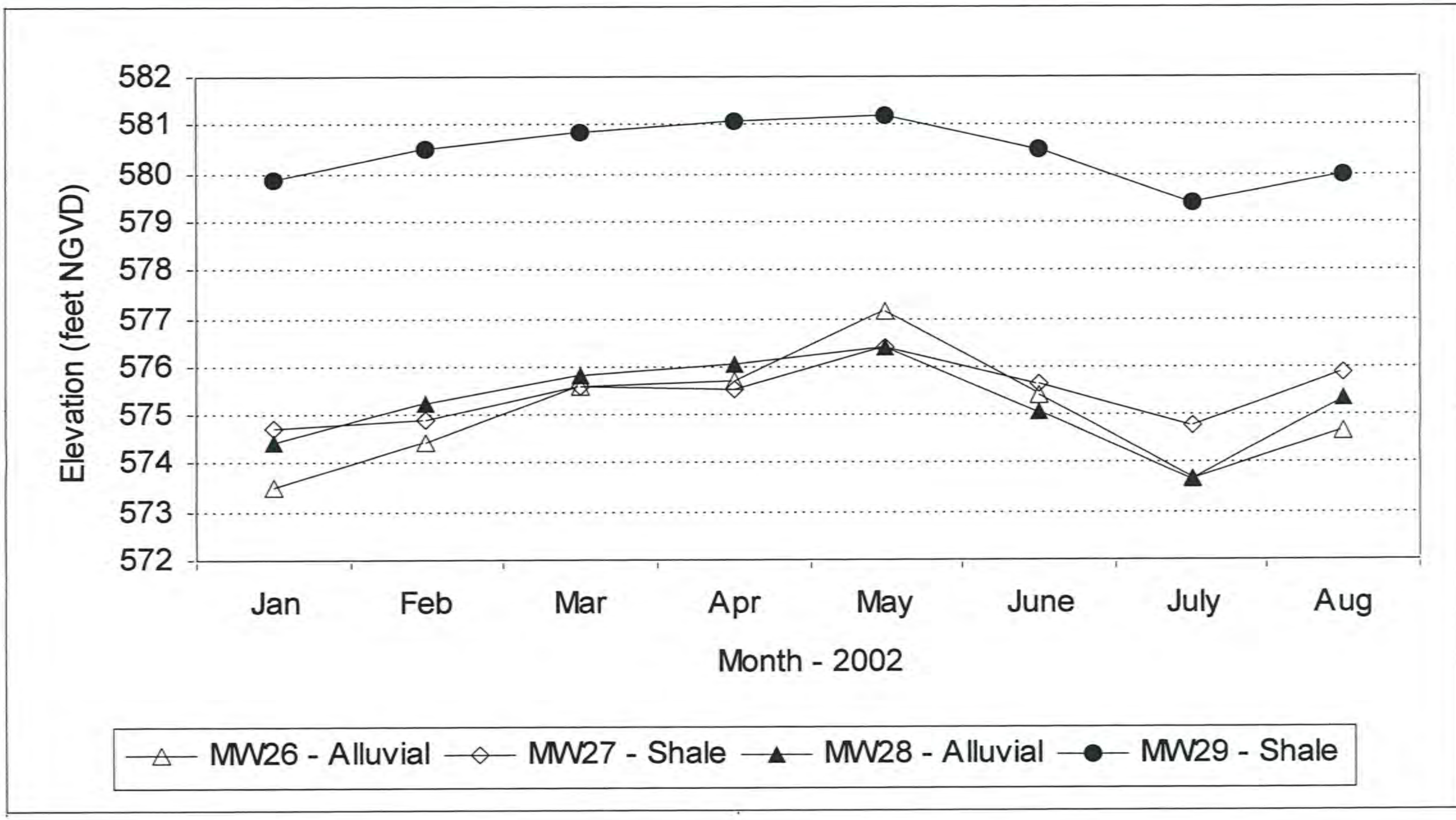
Date: September 2002	Figure 23



Kelron Environmental	
Groundwater Hydrographs of Nested Wells MW13A, MW13B and MW32	
Regional and Local Hydrogeology and Geochemistry Vermilion Power Plant Oakwood, Illinois	
Date: September 2002	*Figure 24*



Kelron Environmental	
Groundwater Hydrographs of Nested Wells MW16A and MW16B	
Regional and Local Hydrogeology and Geochemistry Vermilion Power Plant Oakwood, Illinois	
Date: September 2002	*Figure 25*



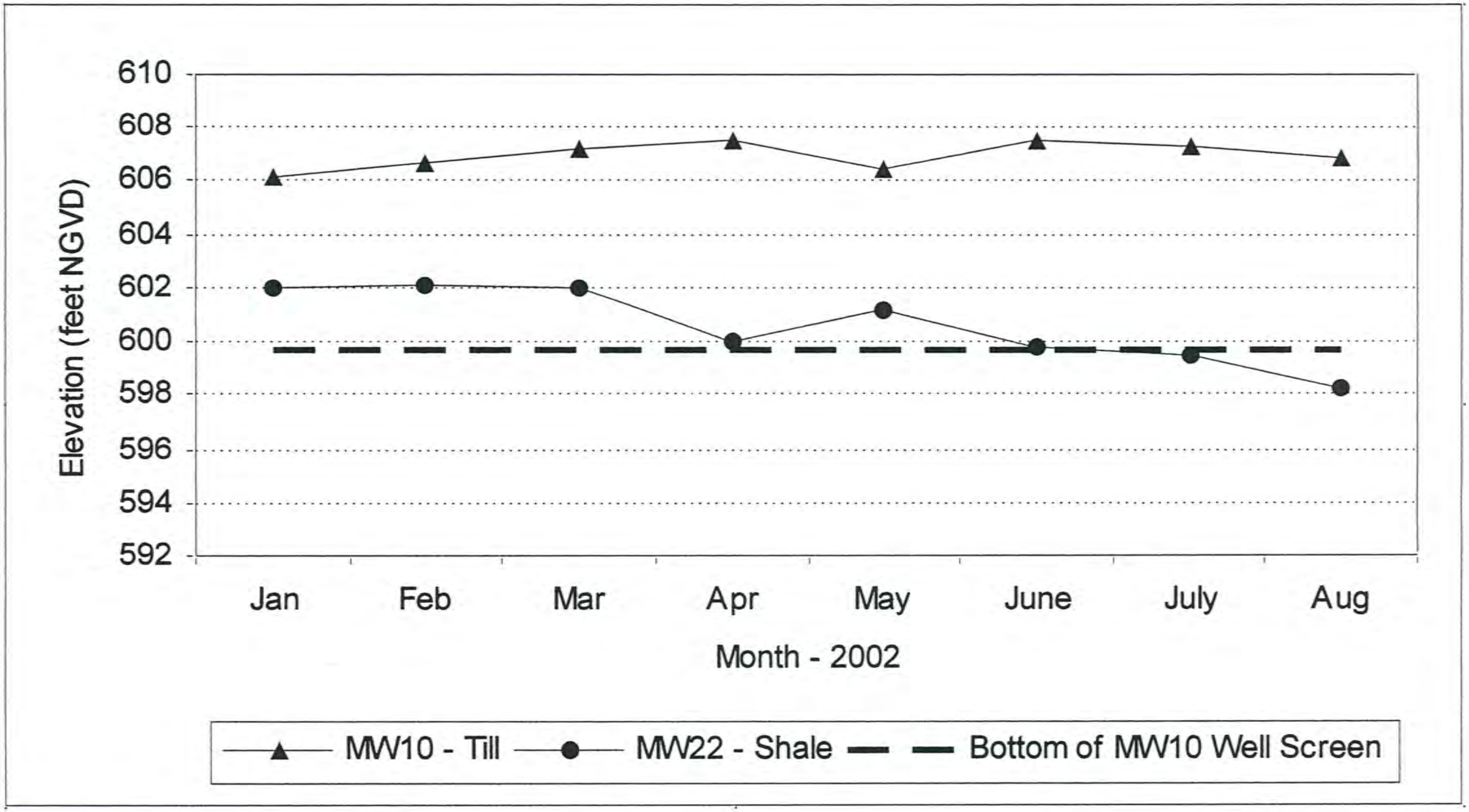
Kelron Environmental

Groundwater Hydrographs of Nested Wells
MW26 / MW27 and MW28 / MW29

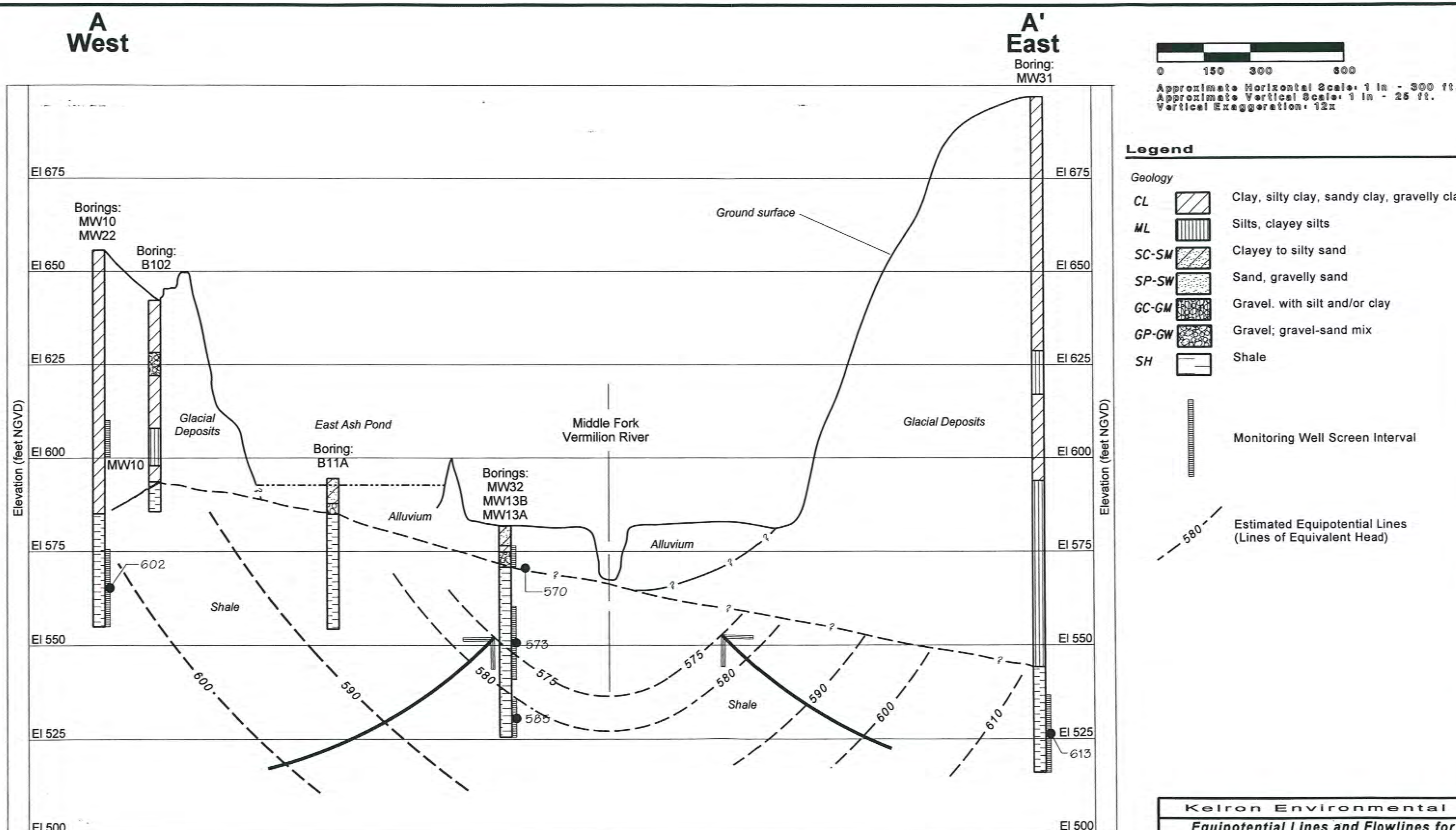
Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002

Figure 26



Kelron Environmental	
Groundwater Hydrographs of Nested Wells MW10 and MW22	
Regional and Local Hydrogeology and Geochemistry Vermilion Power Plant Oakwood, Illinois	
Date: September 2002	*Figure 27*

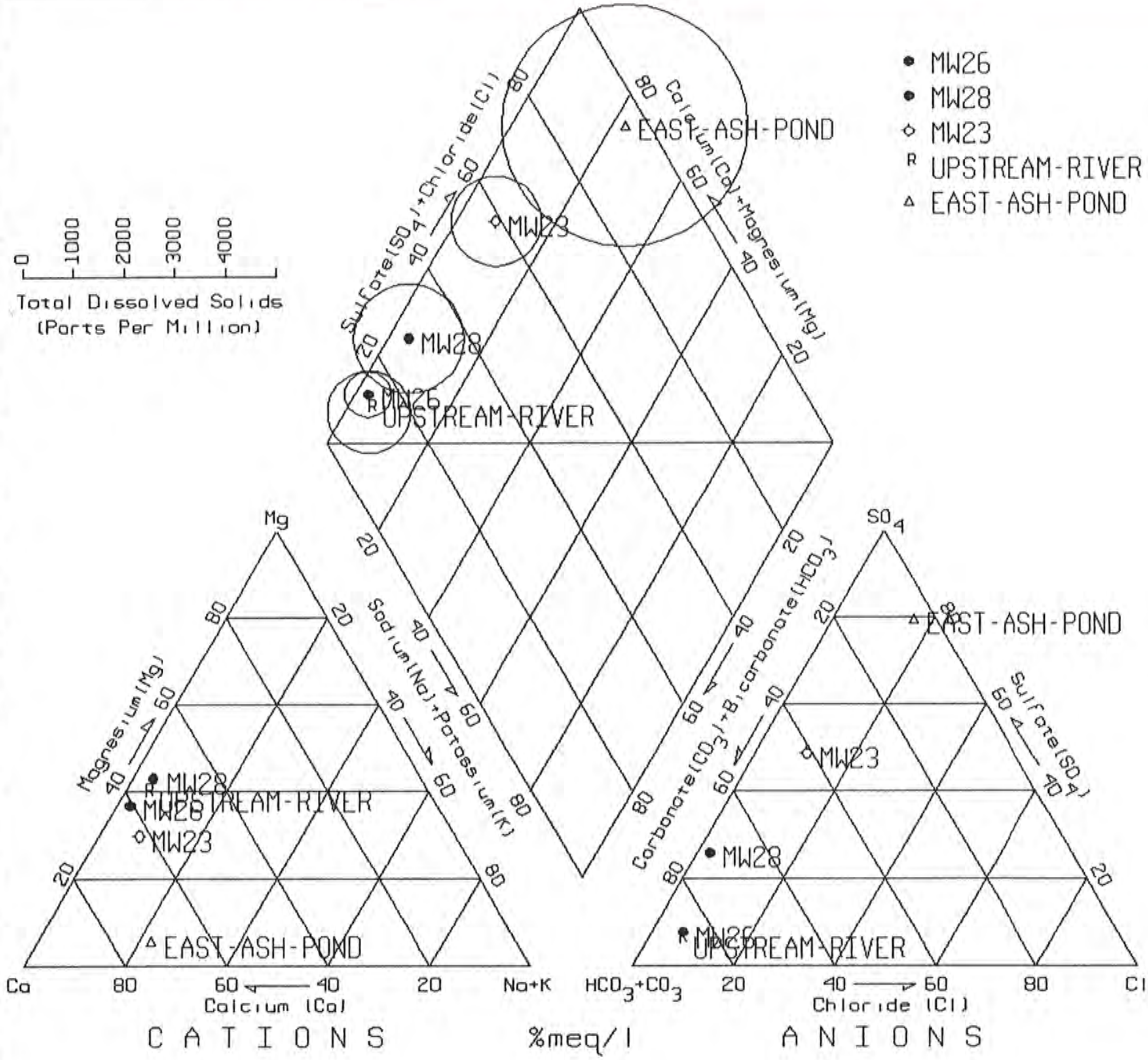


Kelron Environmental

Equipotential Lines and Flowlines for Groundwater in the Shale Based on Observed Hydraulic Head in January 2002

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002 | *Figure 28*



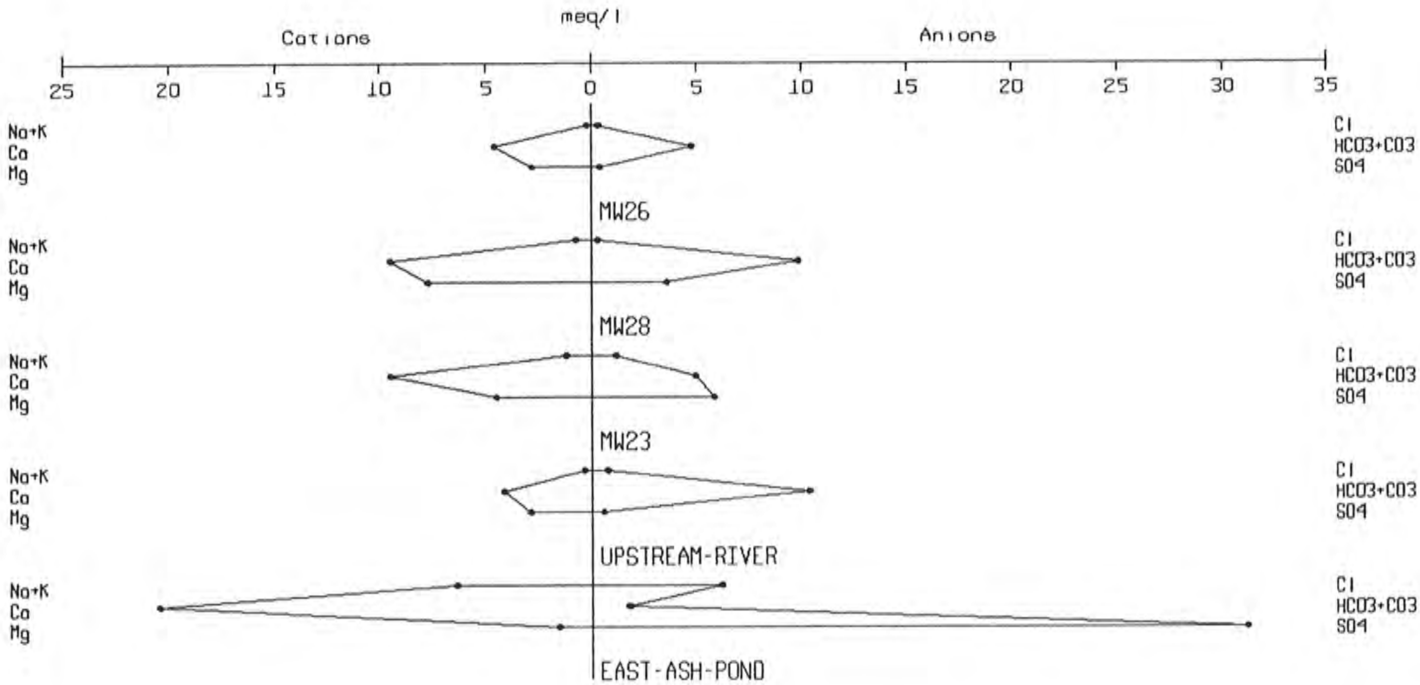
Kelron Environmental

Piper Diagram of Water Samples from Unlithified Deposits, Middle Fork River, and East Ash Pond

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002 | *Figure 29*

Note: Groundwater samples and Middle Fork River Sample are from June 2002; East Ash Pond sample is from March 2002



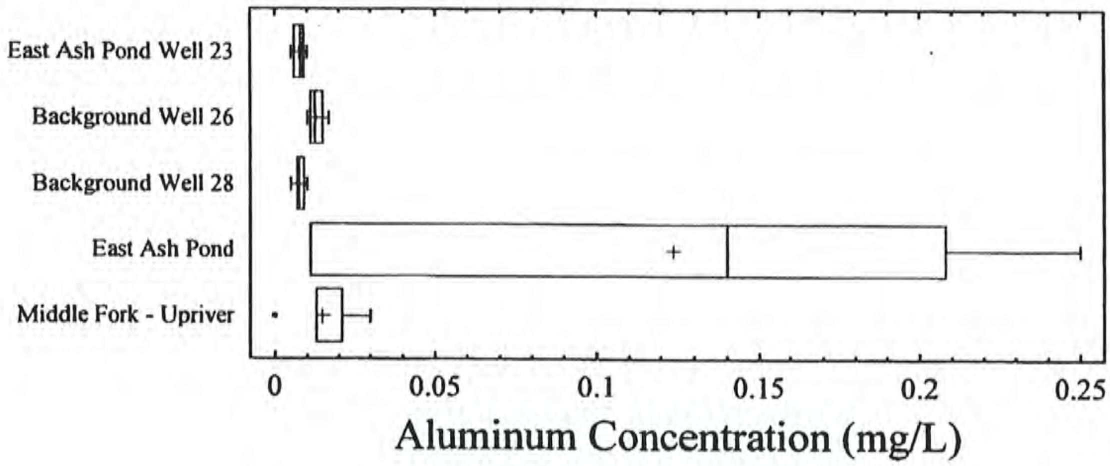
Note: Groundwater samples and Middle Fork River Sample are from June 2002; East Ash Pond sample is from March 2002

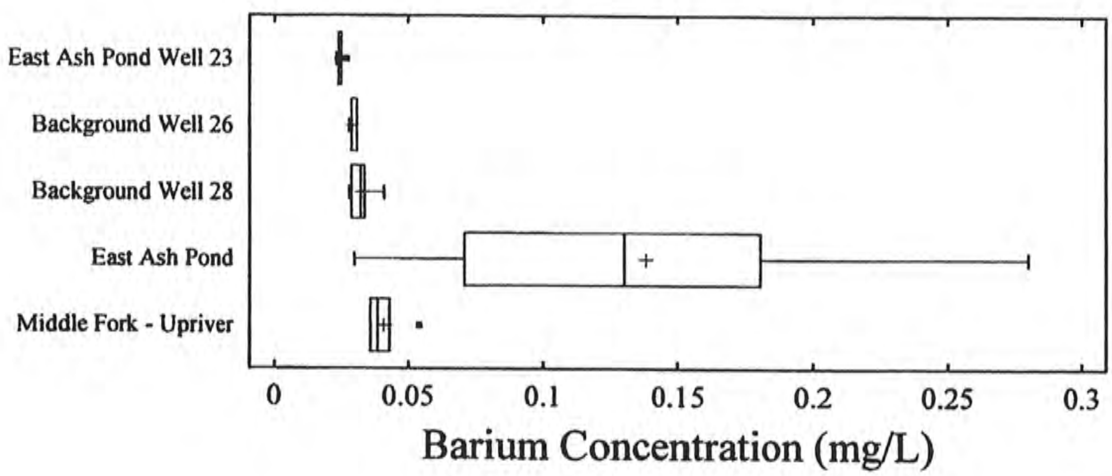
Kelron Environmental

Stiff Diagrams of Water Samples from Unlithified Deposits, Middle Fork River, and East Ash Pond

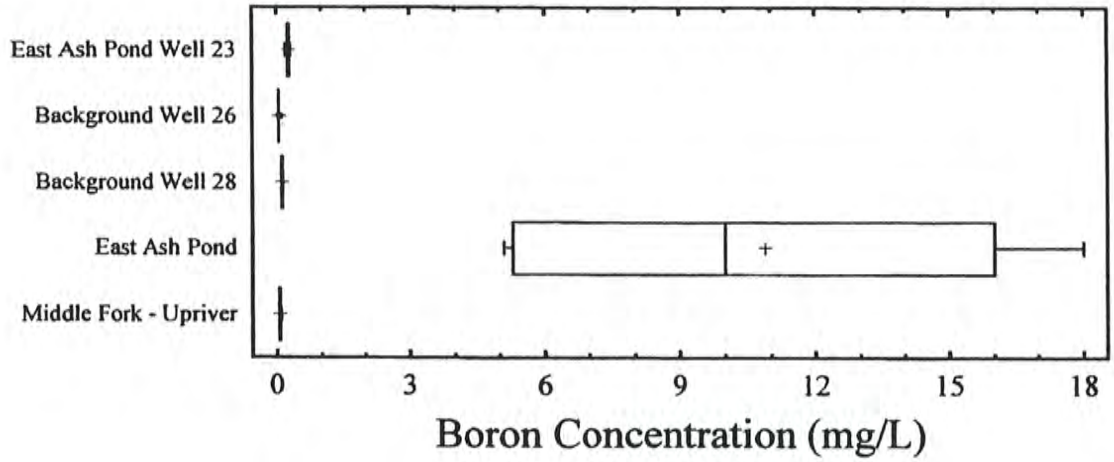
Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

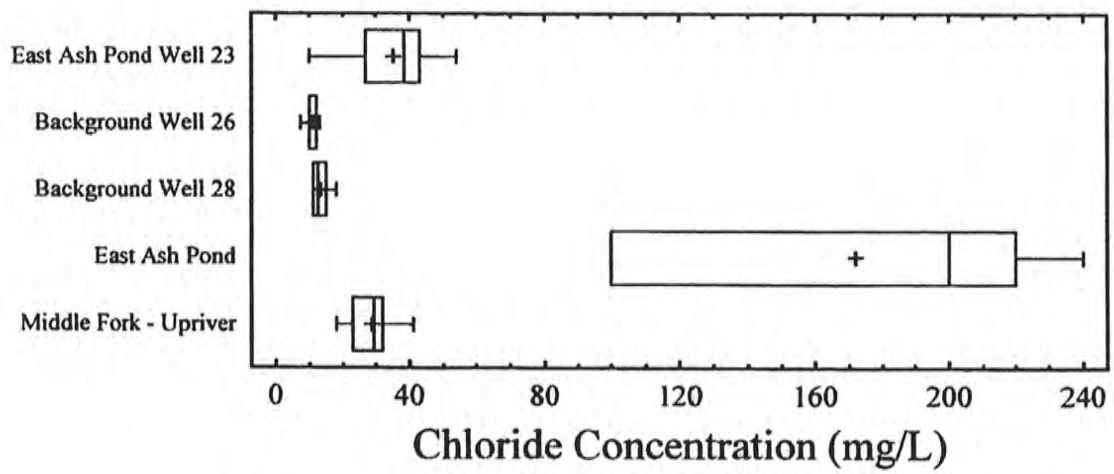
Date: September 2002	*Figure 30*





Kelron Environmental	
Box-and-Whisker Diagrams for Water Samples from Unlithified Deposits, Middle Fork River, and East Ash Pond in 2002	
Regional and Local Hydrogeology and Geochemistry Vermilion Power Plant Oakwood, Illinois	
Date: September 2002	*Figure 31a*



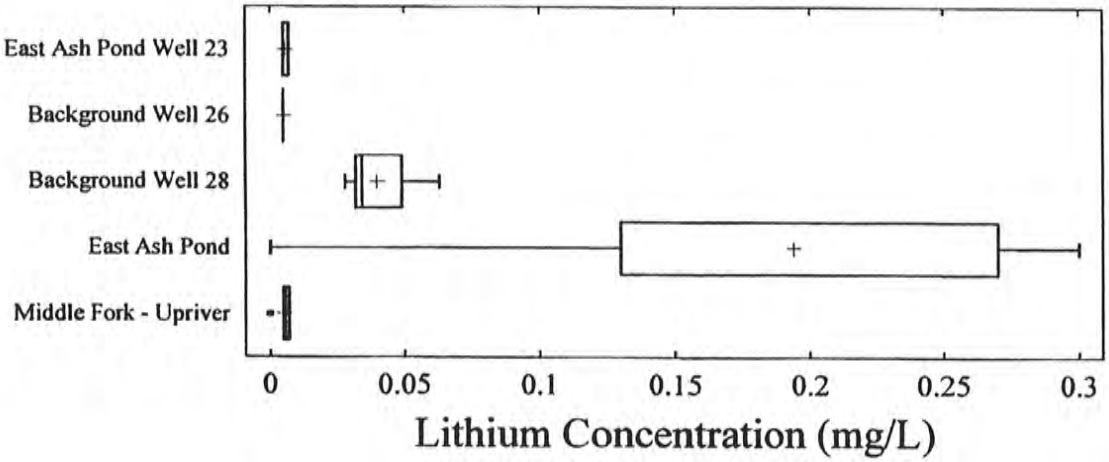


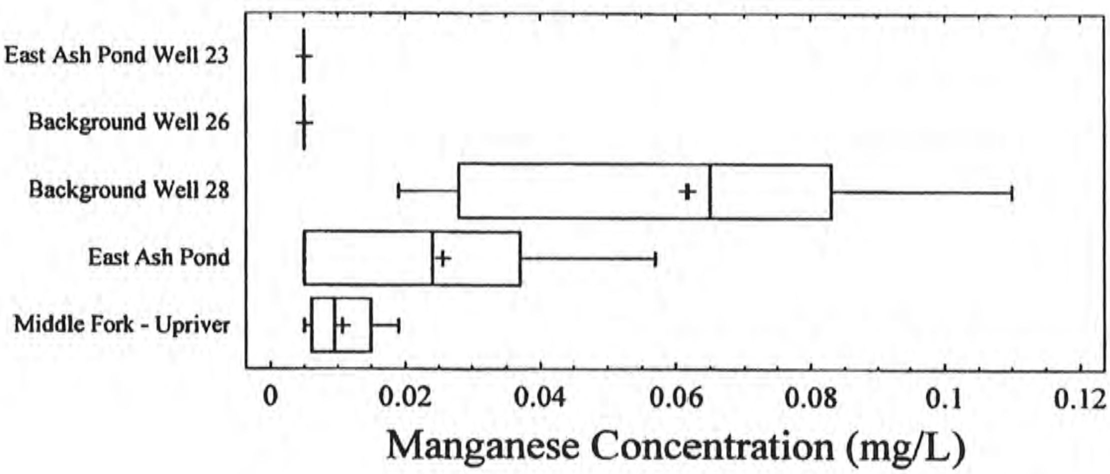
Kelron Environmental

Box-and-Whisker Diagrams for Water Samples from Unlithified Deposits, Middle Fork River, and East Ash Pond in 2002

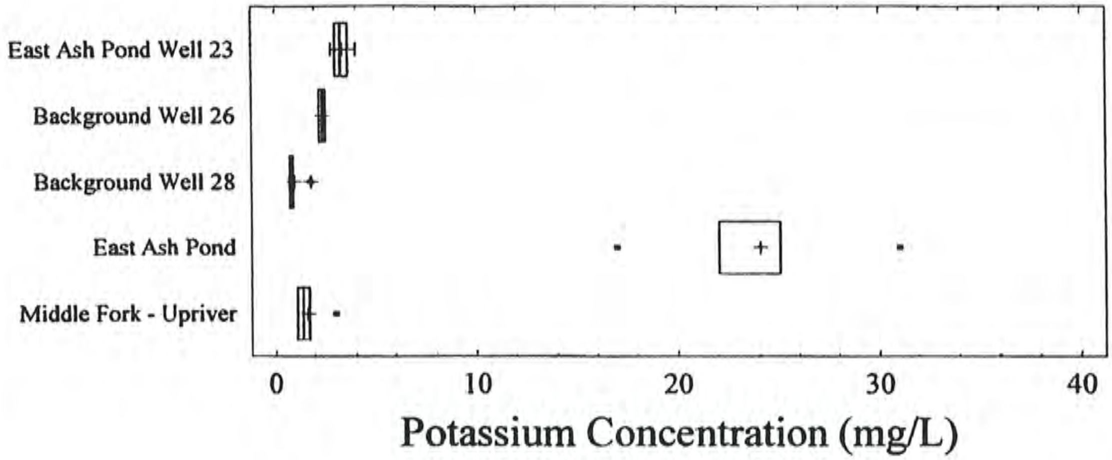
Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

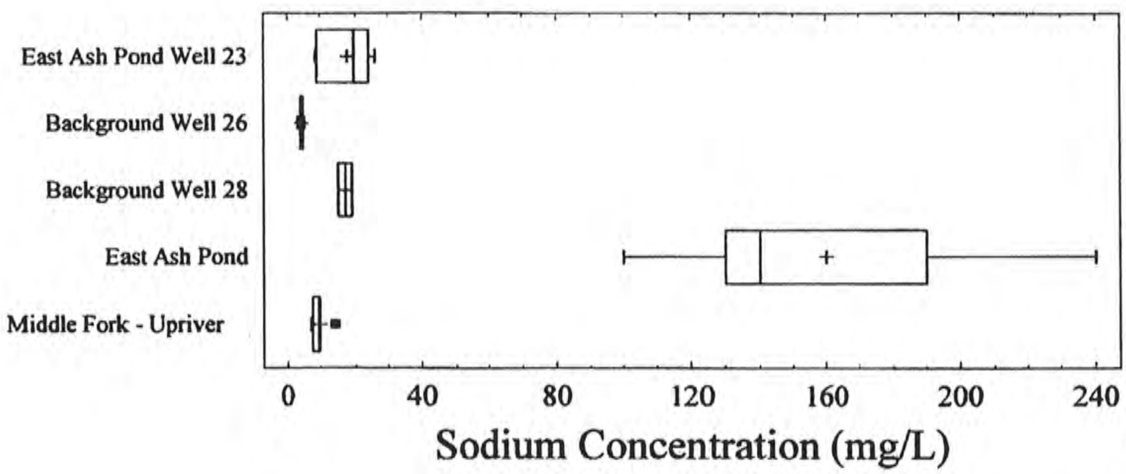
Date: September 2002 | *Figure 31b*





Kelron Environmental	
Box-and-Whisker Diagrams for Water Samples from Unlithified Deposits, Middle Fork River, and East Ash Pond in 2002	
Regional and Local Hydrogeology and Geochemistry *Vermilion Power Plant* *Oakwood, Illinois*	
Date: September 2002	*Figure 31c*



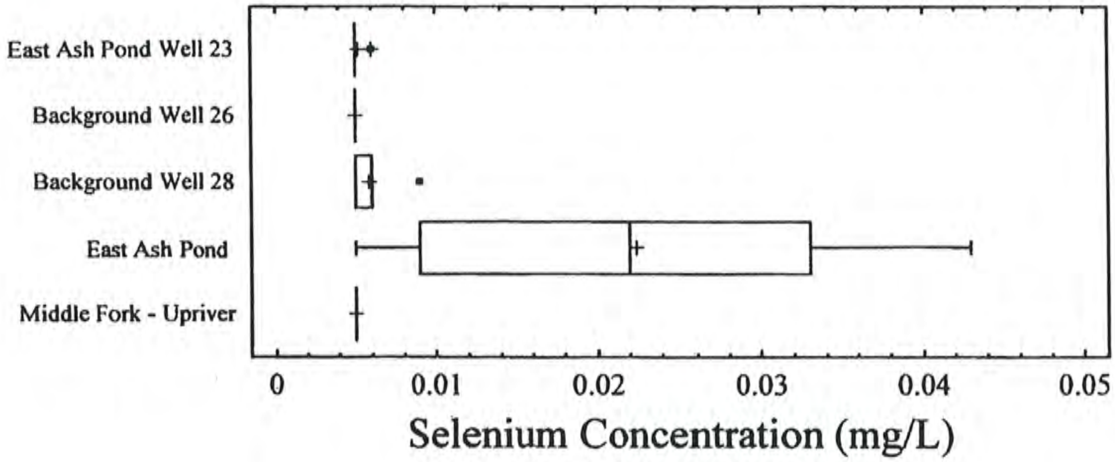


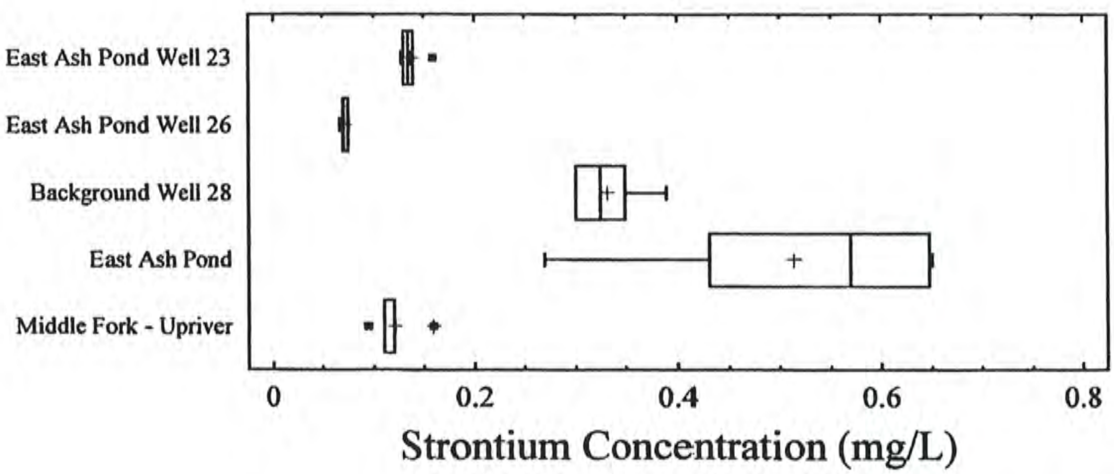
Kelron Environmental

Box-and-Whisker Diagrams for Water Samples from Unlithified Deposits, Middle Fork River, and East Ash Pond in 2002

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002	*Figure 31d*



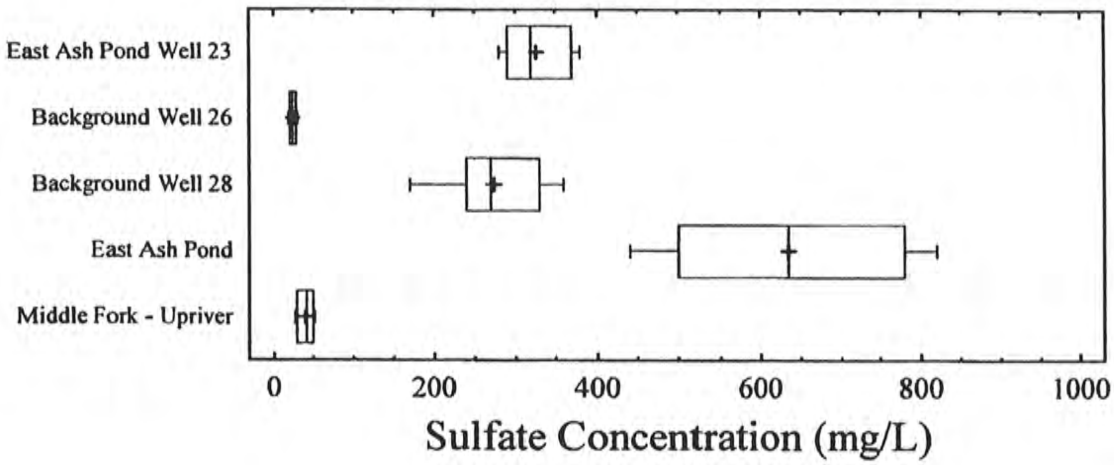


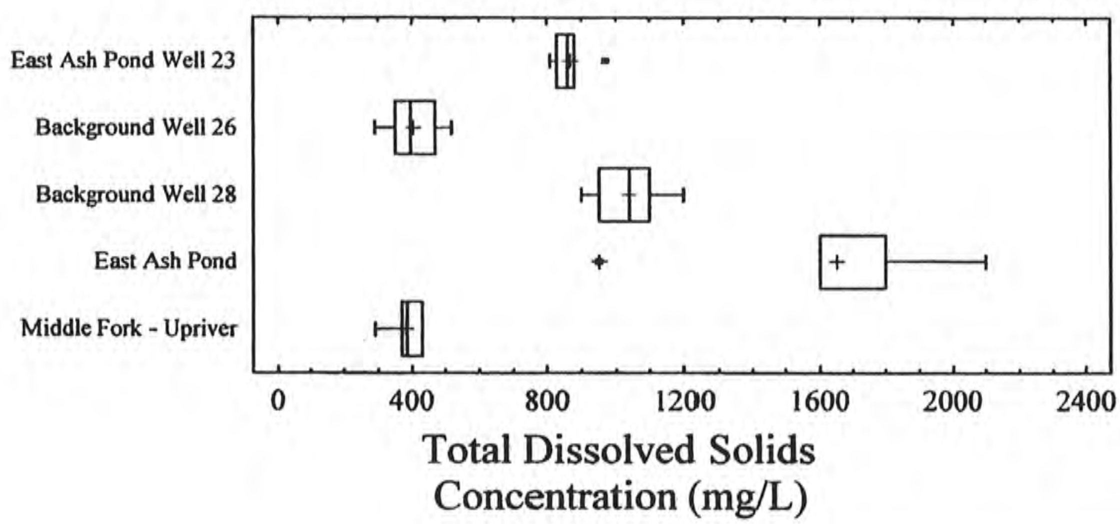
Kelron Environmental

Box-and-Whisker Diagrams for Water Samples from Unlithified Deposits, Middle Fork River, and East Ash Pond in 2002

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

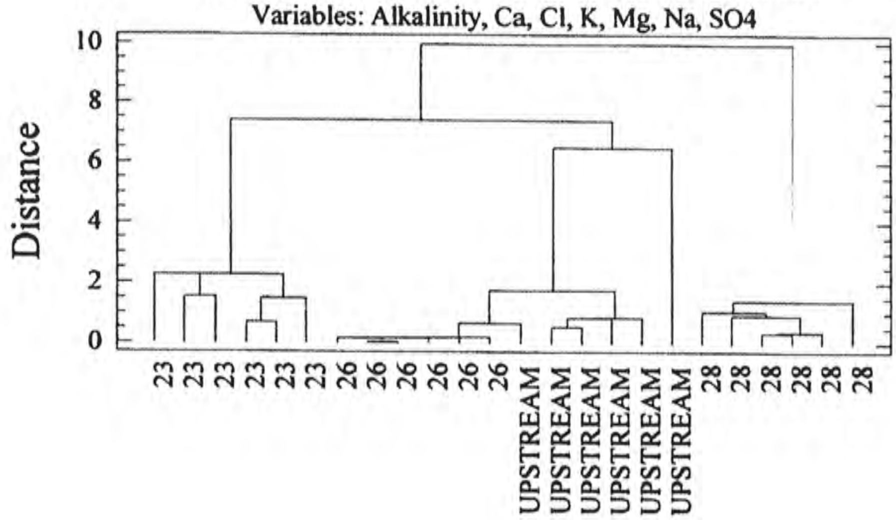
Date: September 2002 | *Figure 31e*



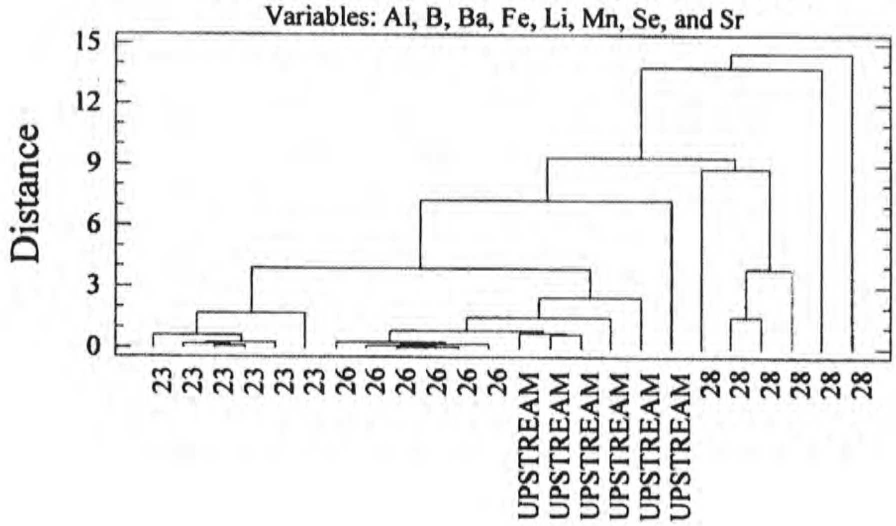


Kelron Environmental	
Box-and-Whisker Diagrams for Water Samples from Unlithified Deposits, Middle Fork River, and East Ash Pond in 2002	
Regional and Local Hydrogeology and Geochemistry *Vermilion Power Plant* *Oakwood, Illinois*	
Date: September 2002	*Figure 31f*

Dendrogram: Nearest Neighbor, Squared Euclidean
Variables: Alkalinity, Ca, Cl, K, Mg, Na, SO4



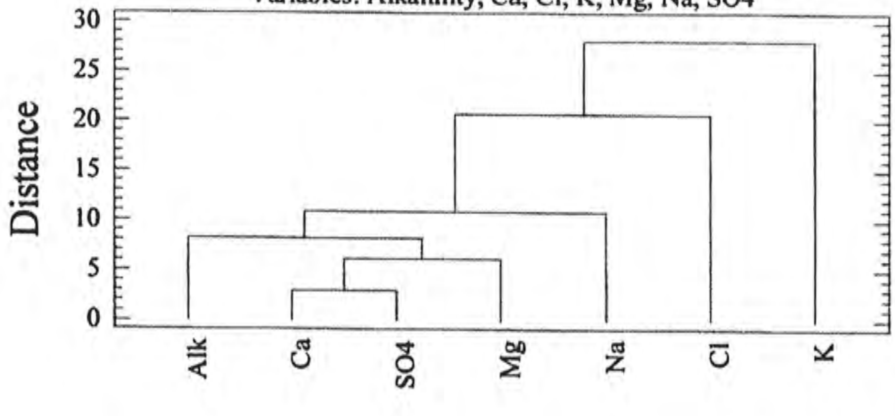
Dendrogram: Nearest Neighbor, Squared Euclidean
Variables: Al, B, Ba, Fe, Li, Mn, Se, and Sr



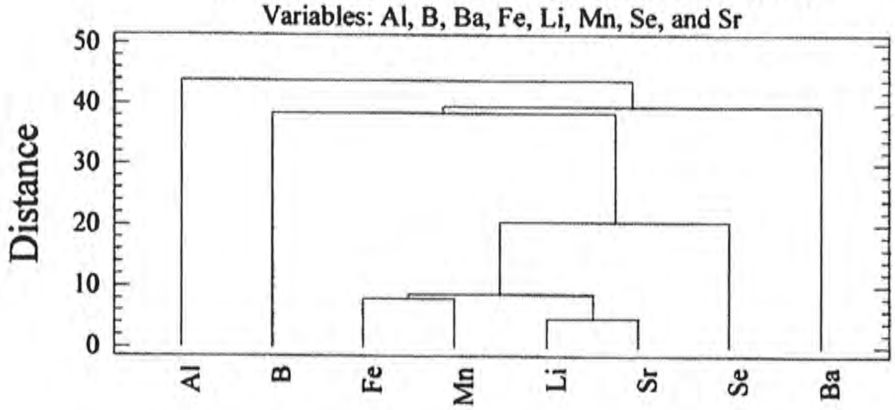
Note: Wells used in dendograms are: background wells MW26 and MW28; and, East Ash Pond well MW23. Upstream surface water quality is from Middle Fork of Vermilion River)

Kelron Environmental	
Dendrograms of Monthly Water Chemistry Data in Unlithified Deposits and Middle Fork River Based on Major Ions and Trace Metals	
Regional and Local Hydrogeology and Geochemistry *Vermilion Power Plant* *Oakwood, Illinois*	
Date: September 2002	*Figure 32*

Dendrogram: Nearest Neighbor, Squared Euclidean
Variables: Alkalinity, Ca, Cl, K, Mg, Na, SO4

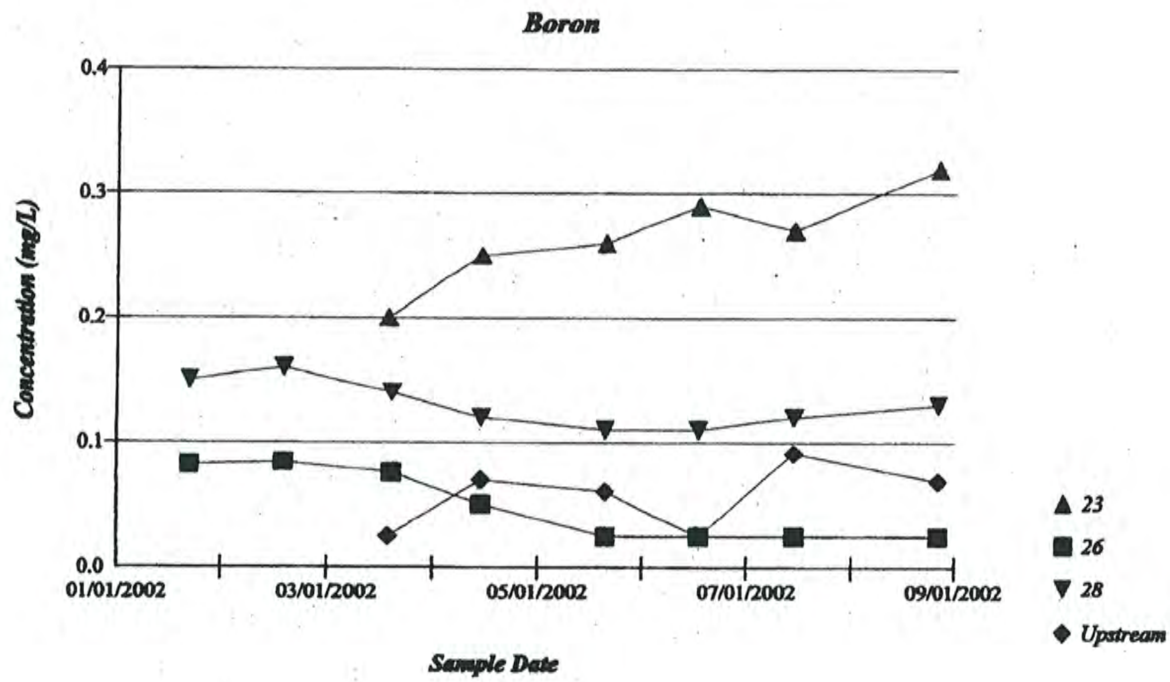


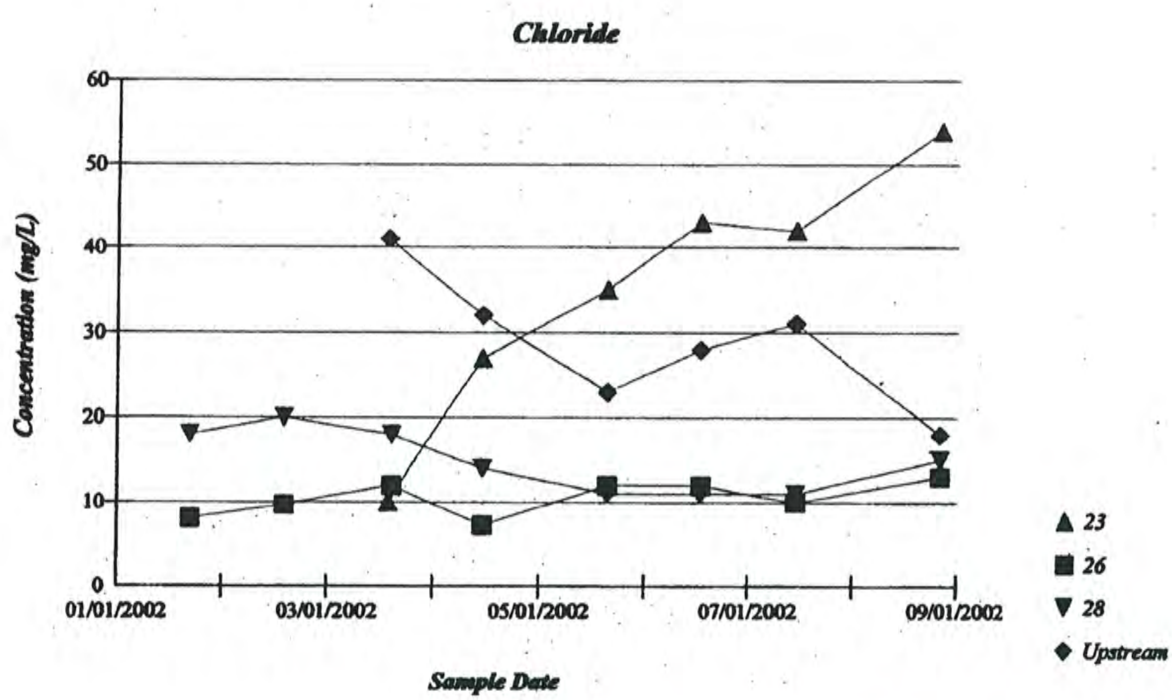
Dendrogram: Nearest Neighbor, Squared Euclidean
Variables: Al, B, Ba, Fe, Li, Mn, Se, and Sr



Note: Data used in dendograms are for background wells MW26 and MW28, East Ash Pond well MW23, and upstream surface water from the Middle Fork of Vermilion River)

Kelron Environmental	
Dendrograms of Major Ions and Trace Metals in Water from Unconsolidated Deposits and Middle Fork River	
Regional and Local Hydrogeology and Geochemistry Vermilion Power Plant Oakwood, Illinois	
Date: September 2002	Figure 33



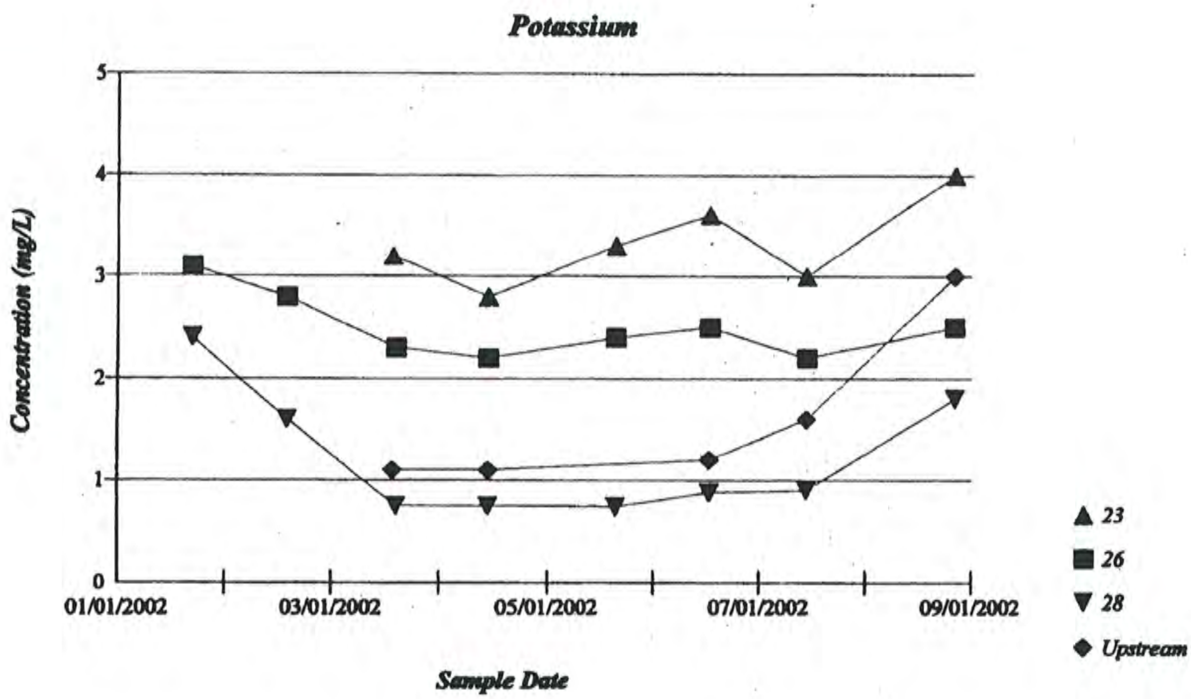


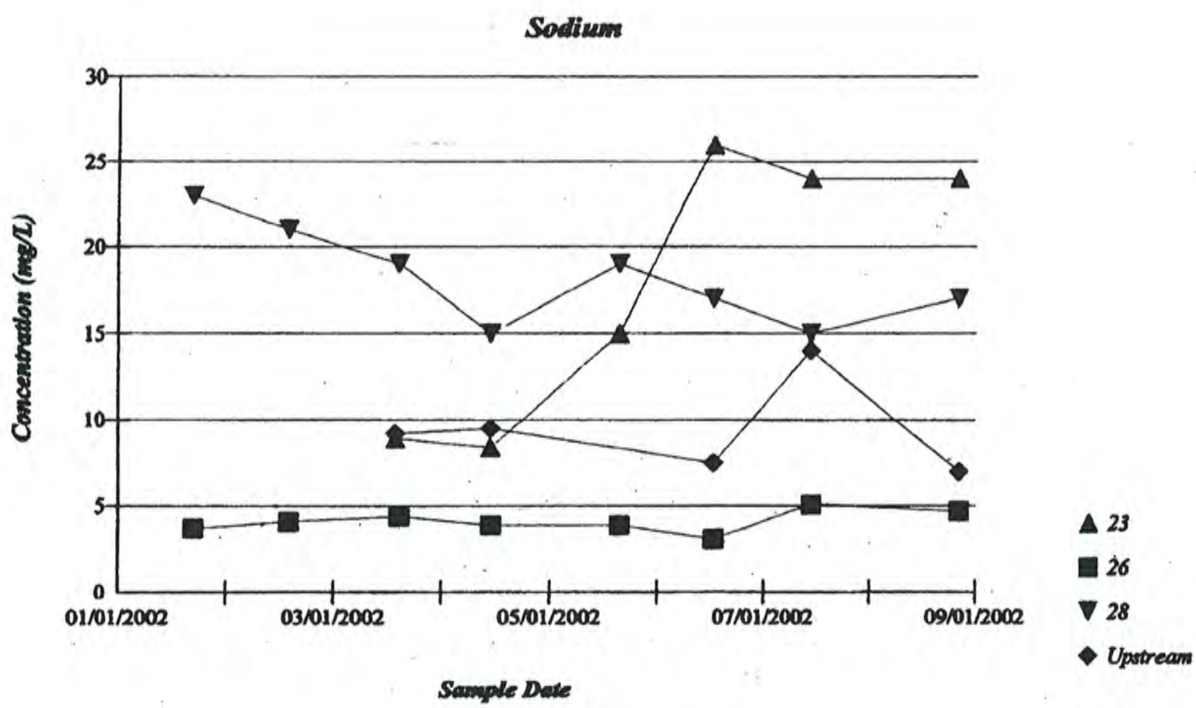
Kelron Environmental

Chloride Trends in Unlithified Deposits and Upstream on Middle Fork River

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002	*Figure 34A*



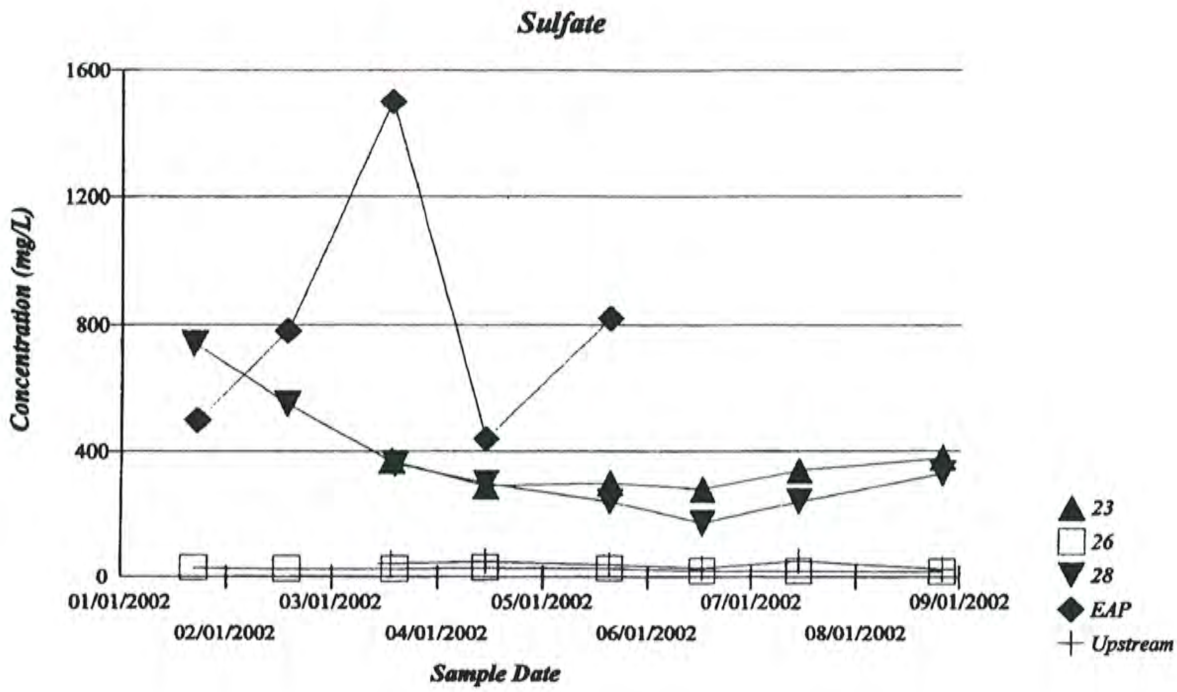


Kelron Environmental

Potassium and Sodium Trends in Unlithified Deposits and Upstream on Middle Fork River

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002	*Figure 34B*

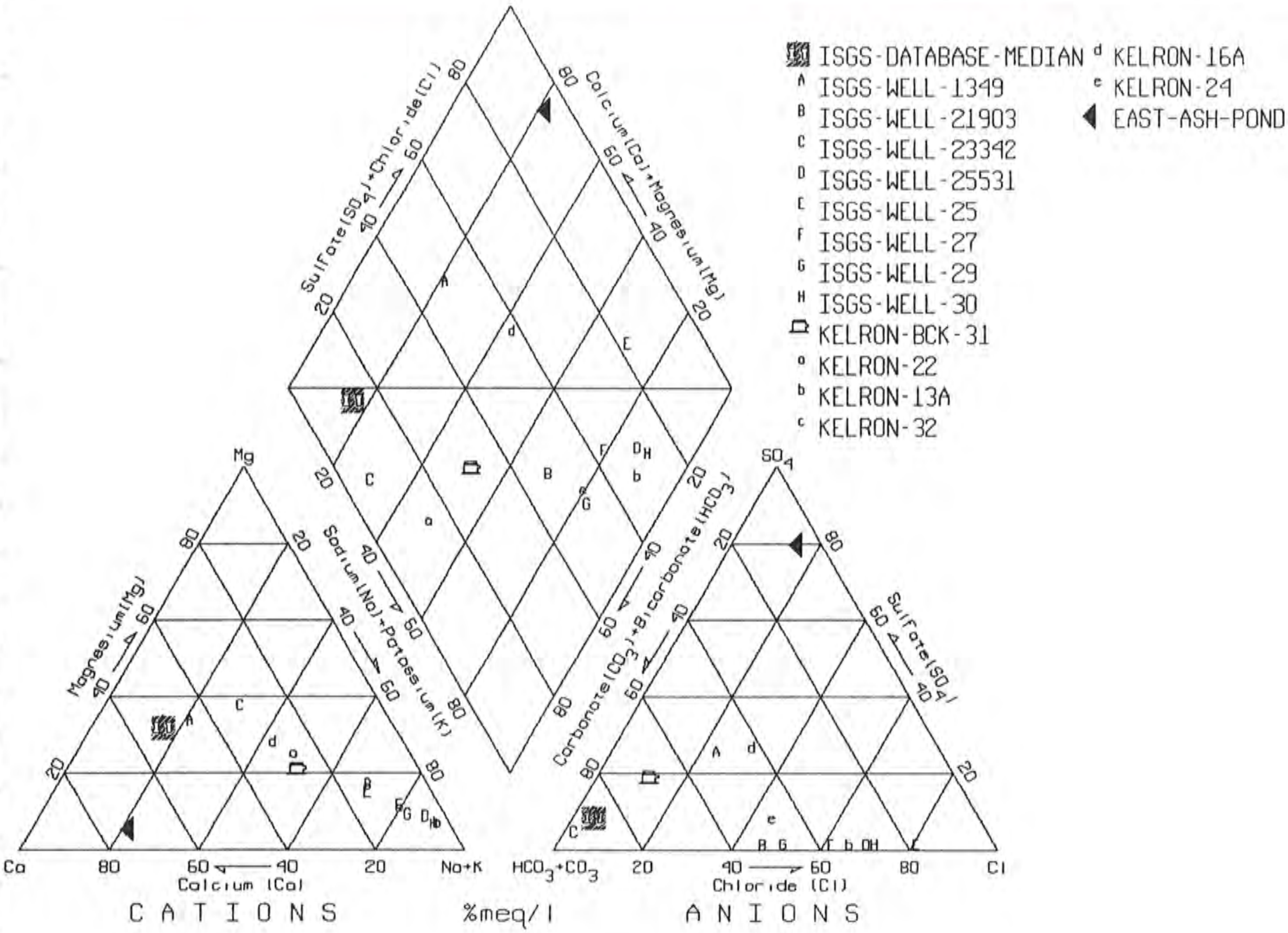


Kelron Environmental

Sulfate Trends in Unlithified Deposits, Upstream on Middle Fork River, and East Ash Pond

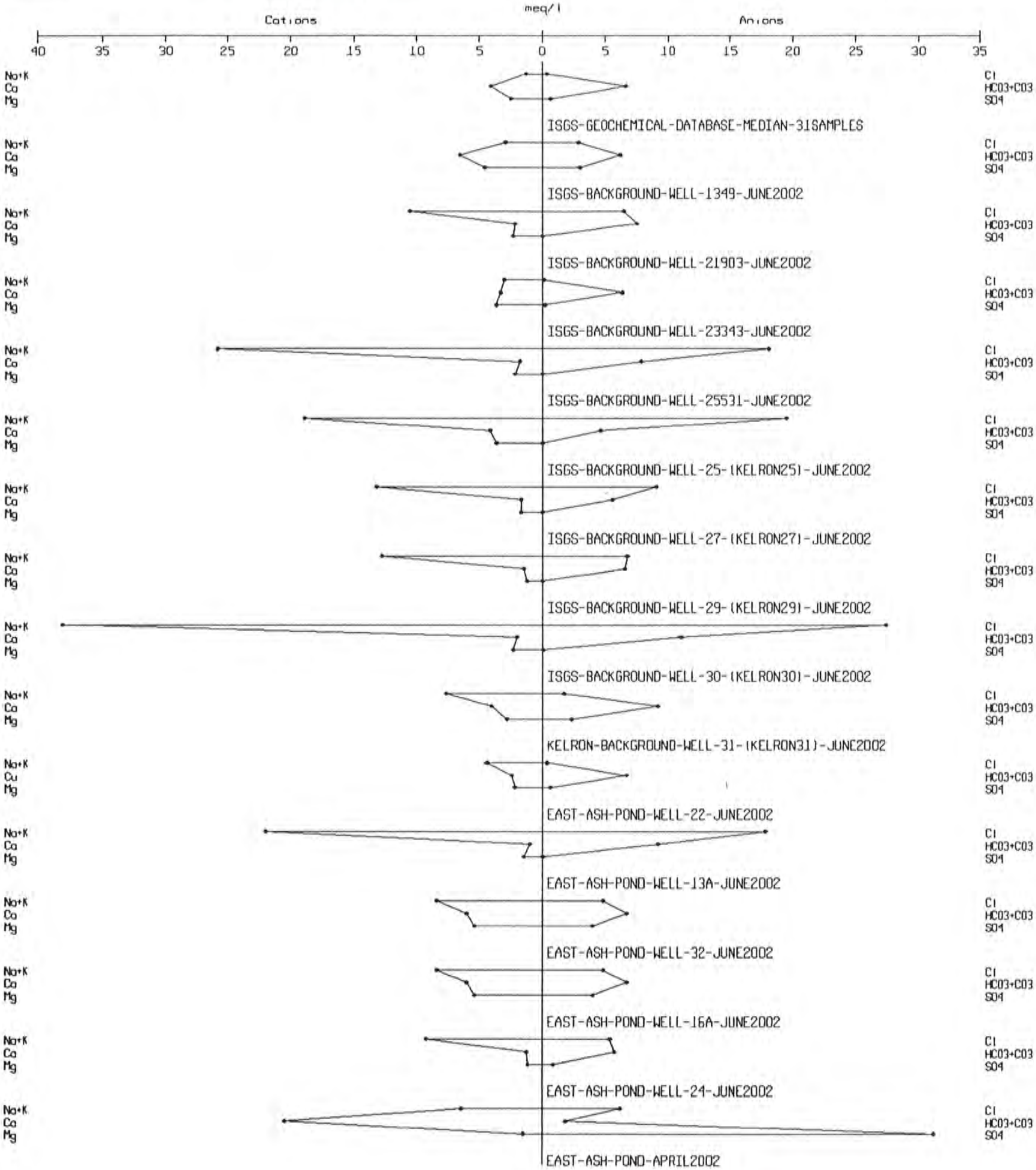
Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002	Figure 34C



Note: Groundwater samples are from June 2002; East Ash Pond sample is from March 2002)

Kelron Environmental	
Piper Diagram of Groundwater Samples from Bedrock and Surface Water Samples from East Ash Pond	
Regional and Local Hydrogeology and Geochemistry *Vermilion Power Plant* *Oakwood, Illinois*	
Date: September 2002	*Figure 35*



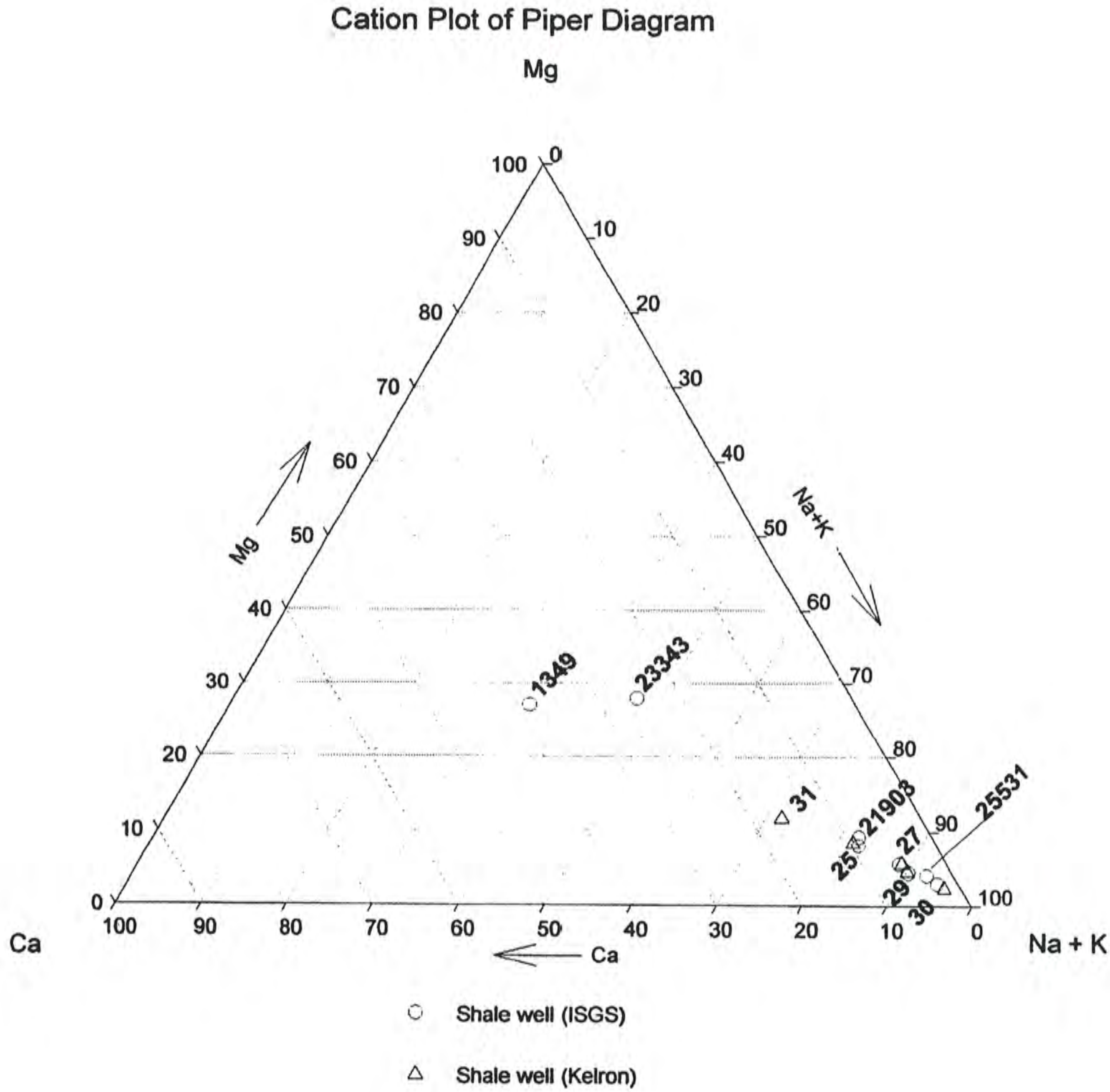
Note: Groundwater samples are from June 2002; East Ash Pond sample is from March 2002)

Kelron Environmental

Stiff Diagrams of Groundwater Samples from Bedrock and Surface Water Samples from East Ash Pond

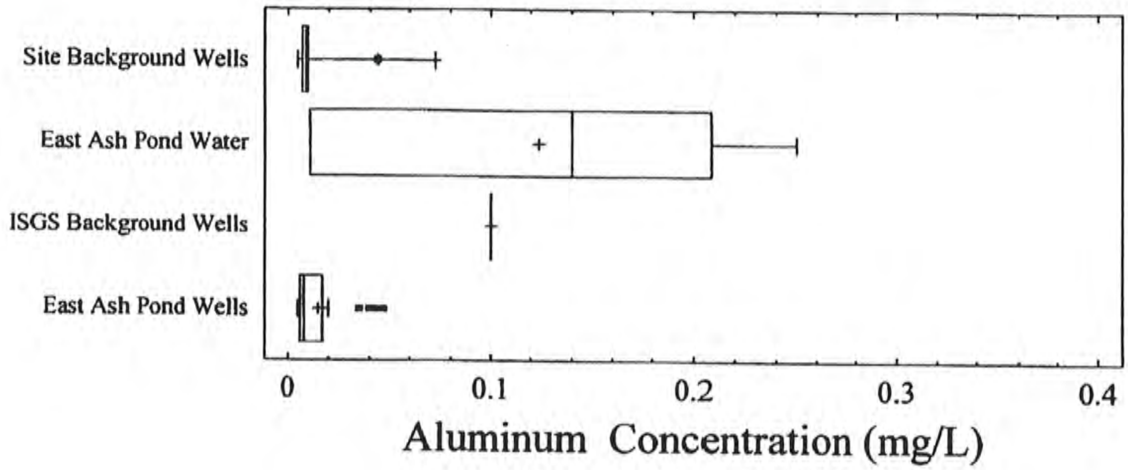
Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

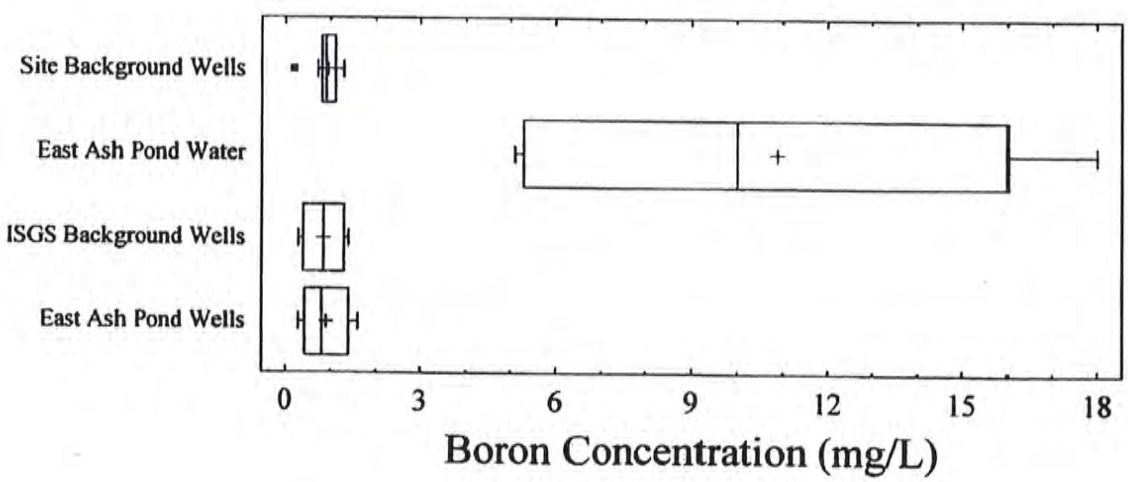
Date: September 2002	*Figure 36*



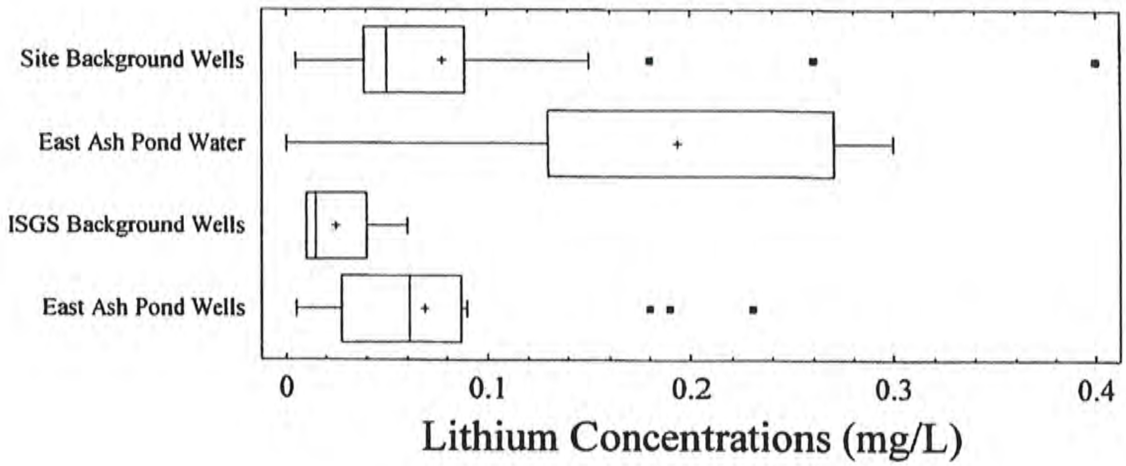
Kelron Environmental	
Cation Plot of Piper Diagram for June 2002 Groundwater Samples Collected by the ISGS and Kelron	
Regional and Local Hydrogeology and Geochemistry *Vermilion Power Plant* *Oakwood, Illinois*	
Date: September 2002	*Figure 37*

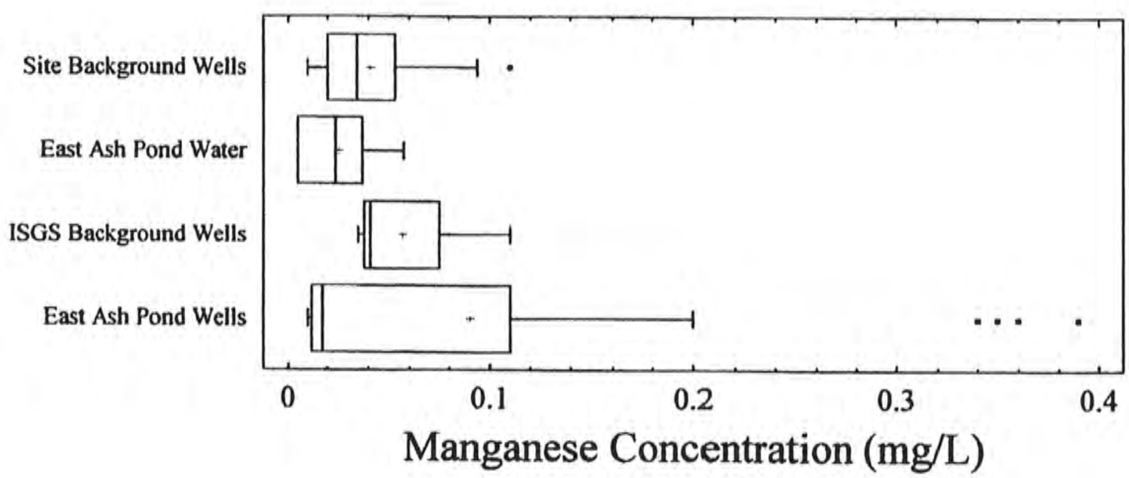
Note: modified after Figure 13, Appendix A (Mehnert and Dreher, 2002)



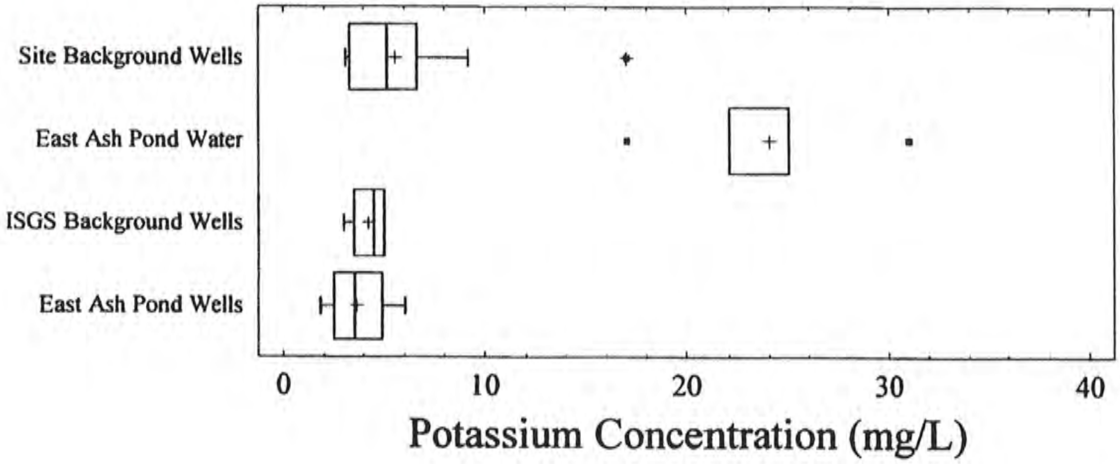


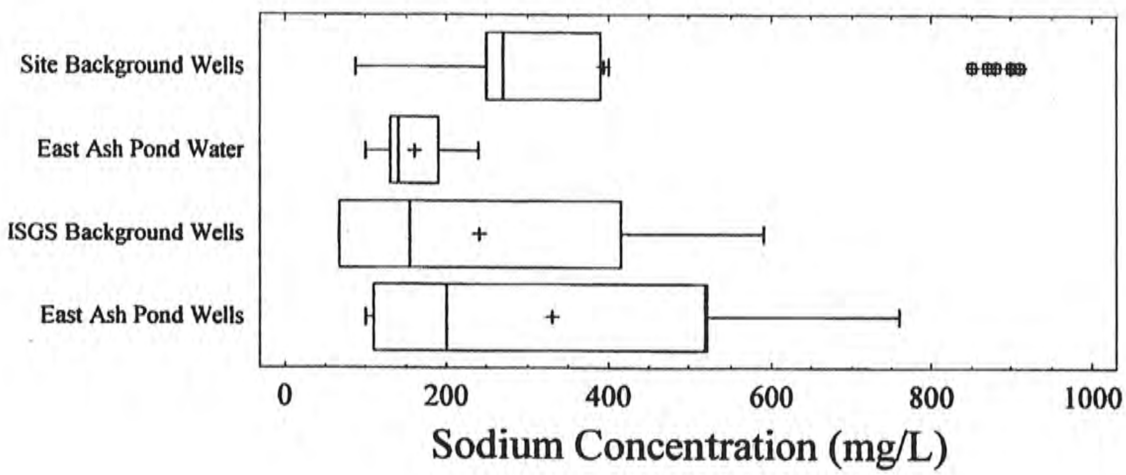
Kelron Environmental	
Box-and-Whisker Diagrams for Groundwater Samples from Bedrock and Surface Water Samples from East Ash Pond in 2002	
Regional and Local Hydrogeology and Geochemistry *Vermilion Power Plant* *Oakwood, Illinois*	
Date: September 2002	*Figure 38A*



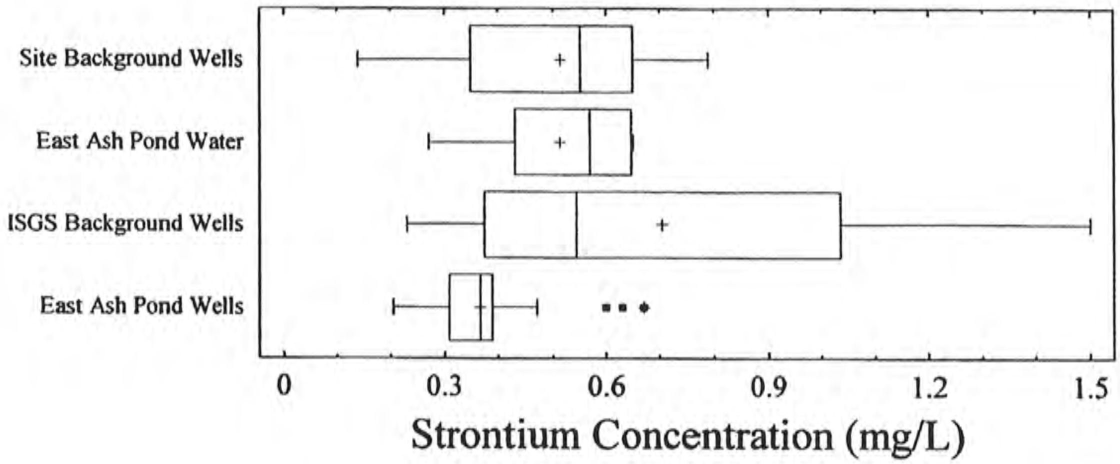


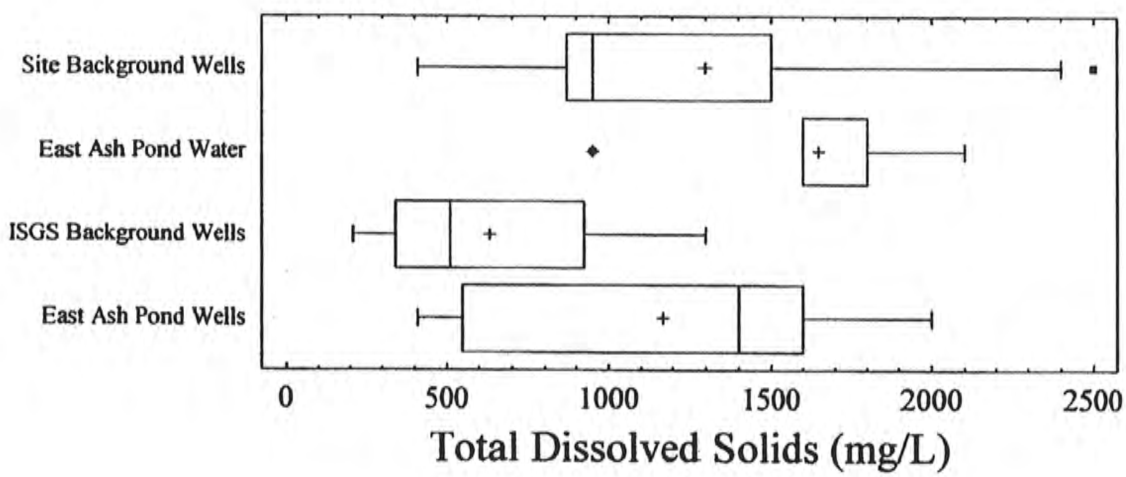
Kelron Environmental	
Box-and-Whisker Diagrams for Groundwater Samples from Bedrock and Surface Water Samples from East Ash Pond in 2002	
Regional and Local Hydrogeology and Geochemistry *Vermilion Power Plant* *Oakwood, Illinois*	
Date: September 2002	*Figure 38C*





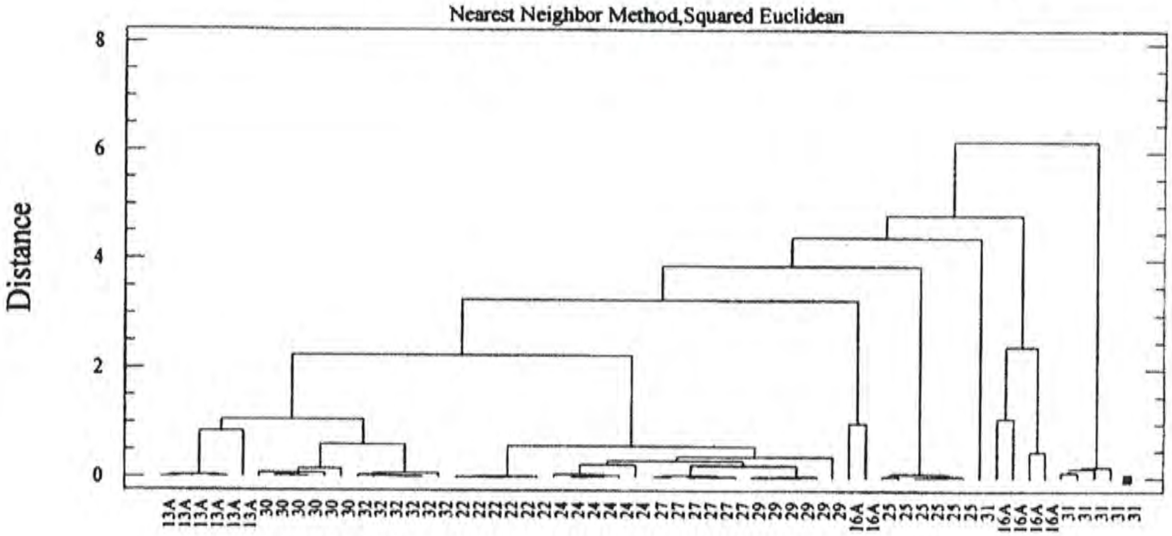
Kelron Environmental	
Box-and-Whisker Diagrams for Groundwater Samples from Bedrock and Surface Water Samples from East Ash Pond in 2002	
Regional and Local Hydrogeology and Geochemistry *Vermilion Power Plant* *Oakwood, Illinois*	
Date: September 2002	*Figure 38D*



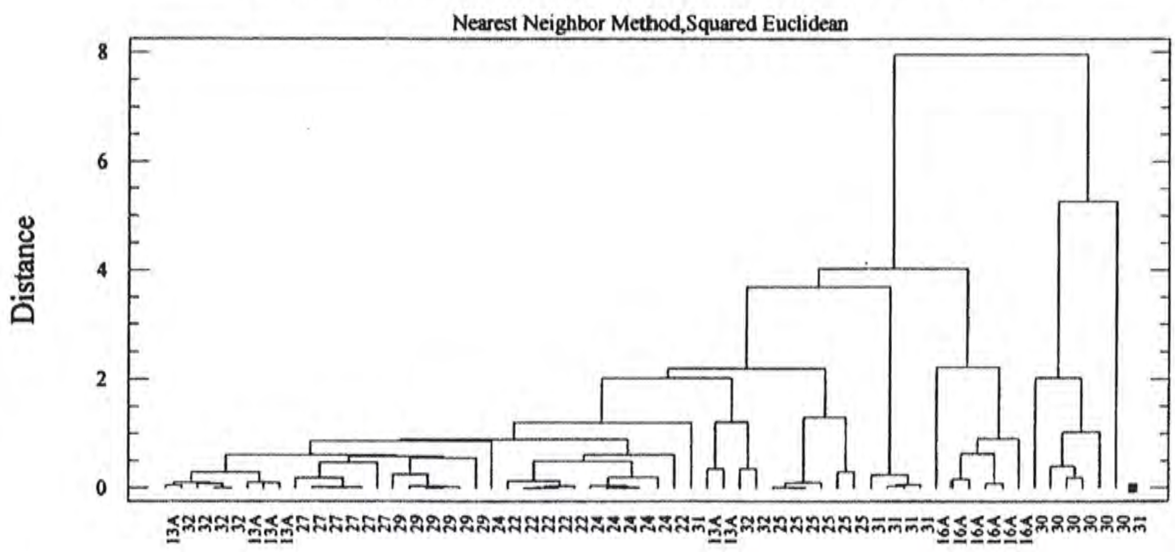


Kelron Environmental	
Box-and-Whisker Diagrams for Groundwater Samples from Bedrock and Surface Water Samples from East Ash Pond in 2002	
Regional and Local Hydrogeology and Geochemistry *Vermilion Power Plant* *Oakwood, Illinois*	
Date: September 2002	*Figure 38E*

Dendrogram: Variables - Na, K, Ca, Mg, Cl, SO4, Alkalinity



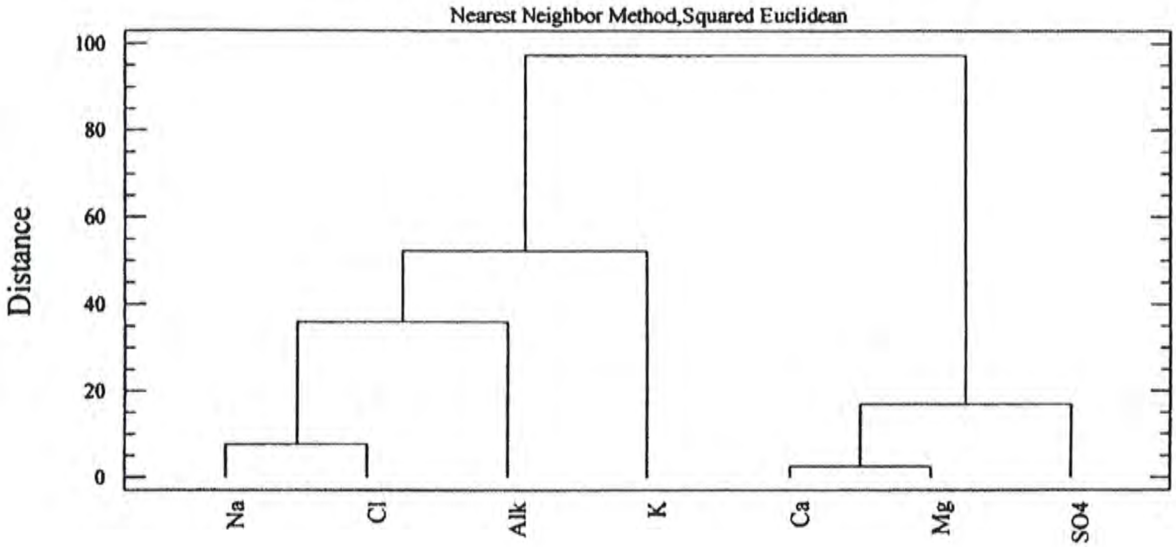
Dendrogram: Variables - Trace Metals (Al, B, Ba, Fe, Li, Mn, Sr)



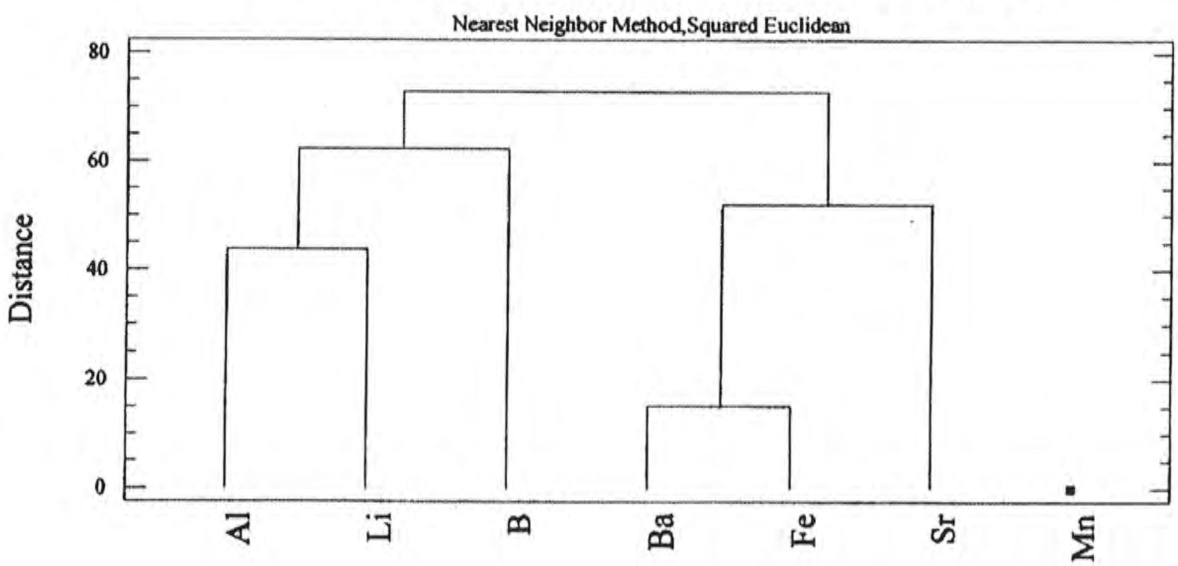
Note: Wells used in dendogram are background and East Ash Pond wells: MW13A, MW16A, MW22, MW24, MW25, MW27, MW29, MW30, and MW31)

Kelron Environmental	
Dendrograms of Monthly Groundwater Chemistry Data in Bedrock Deposits Based on Major Ions and Trace Metals	
Regional and Local Hydrogeology and Geochemistry *Vermilion Power Plant* *Oakwood, Illinois*	
Date: September 2002	*Figure 39*

Dendrogram Variables: Na, K, Ca, Mg, Cl, SO4, Alkalinity



Dendrogram: Variables - Trace Metals (Al, B, Ba, Fe, Li, Mn, Sr)



Kelron Environmental

Dendrograms of Major Ions and Trace Metals in Groundwater of Bedrock Deposits

Regional and Local Hydrogeology and Geochemistry
Vermilion Power Plant
Oakwood, Illinois

Date: September 2002 | *Figure 40*

Note: Data used in dendogram are for background and East Ash Pond wells: MW13A, MW16A, MW22, MW24, MW25, MW27, MW29, MW30, and MW31)

Appendix A Volume 1

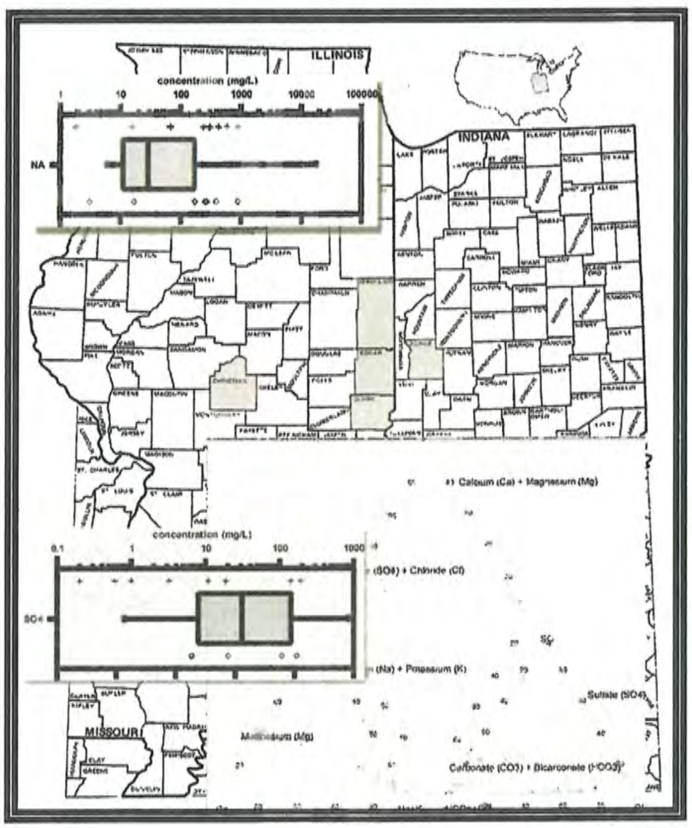
Geochemistry of Groundwater from the Shallow Bedrock in Central Vermilion County, Illinois.

Edward Mehnert and Gary B. Dreher, Illinois State Geological Survey. Illinois State Geological Survey Open-File Series Report 2002-4.

The Geochemistry of Groundwater from the Shallow Bedrock in Central Vermilion County, Illinois

Edward Mehnert and Gary B. Dreher
Illinois State Geological Survey

Illinois State Geological Survey
Open-File Series Report 2002-4



Illinois State Geological Survey

ILLINOIS
DEPARTMENT OF
NATURAL
RESOURCES

The Geochemistry of Groundwater from the Shallow Bedrock in Central Vermilion County, Illinois

ABSTRACT

The background groundwater conditions in the shallow bedrock of central Vermilion County, Illinois, were assessed by reviewing available geochemical data and by analyzing a limited number of water and rock samples. Water samples were collected from monitoring wells and water-supply wells and were analyzed for anions, cations, and carbon and hydrogen isotopes. Rock samples were obtained from cores collected by KELRON and were analyzed using a portable infrared mineral analyzer and x-ray diffraction.

Great variability was observed in the geochemical data for the Pennsylvanian bedrock, Pennsylvanian groundwater, and other data collected for this project. Some of this variability is due to the different lithologies which included sandstone, shale, coal, limestone, and sand and gravel. Some of this variability is also due to the depth of the sample. For example, groundwater samples from KELRON 26 and 28 are significantly different from other samples because they were from shallow wells and are completely connected to the local groundwater system, whereas water samples from deeper wells were largely isolated from the local groundwater flow system. Overall, the geochemical data collected for this project are similar to the available data from Vermilion and surrounding counties.

1. INTRODUCTION

Using available data and limited sampling, we sought to define the background groundwater conditions in the shallow bedrock of central Vermilion County. Most of the wells sampled for this study were concentrated around the Middle Fork of the Vermilion River, as shown in figures 1 and 2. We had access to and sampled monitoring wells on land owned by Dynegy, Inc. as well as private and public water supply wells (figure 2) . Because of the limited number of Vermilion County wells completed in the bedrock, we sought and used available data from surrounding counties in Illinois and Indiana.

2. GEOLOGY

The surficial bedrock geology in Vermilion County is variable. The youngest formation, the Pennsylvanian-aged Bond Formation, is found beneath southwestern Vermilion County (figure 3). Pennsylvanian-aged bedrock underlies most of Vermilion County, except in the northern portion of the county where Mississippian and Devonian rocks are present. Older units can be found at the bedrock surface to the west and north, which reflects the erosional surface of the Mahomet Bedrock Valley and the structure of the Illinois Basin. In Vermilion County, the thickness of the Pennsylvanian bedrock varies from 0 feet in the

Figure 1. Map showing sampling locations in Illinois and Indiana

Figure 2. Map showing sampling locations in Vermilion County, Illinois

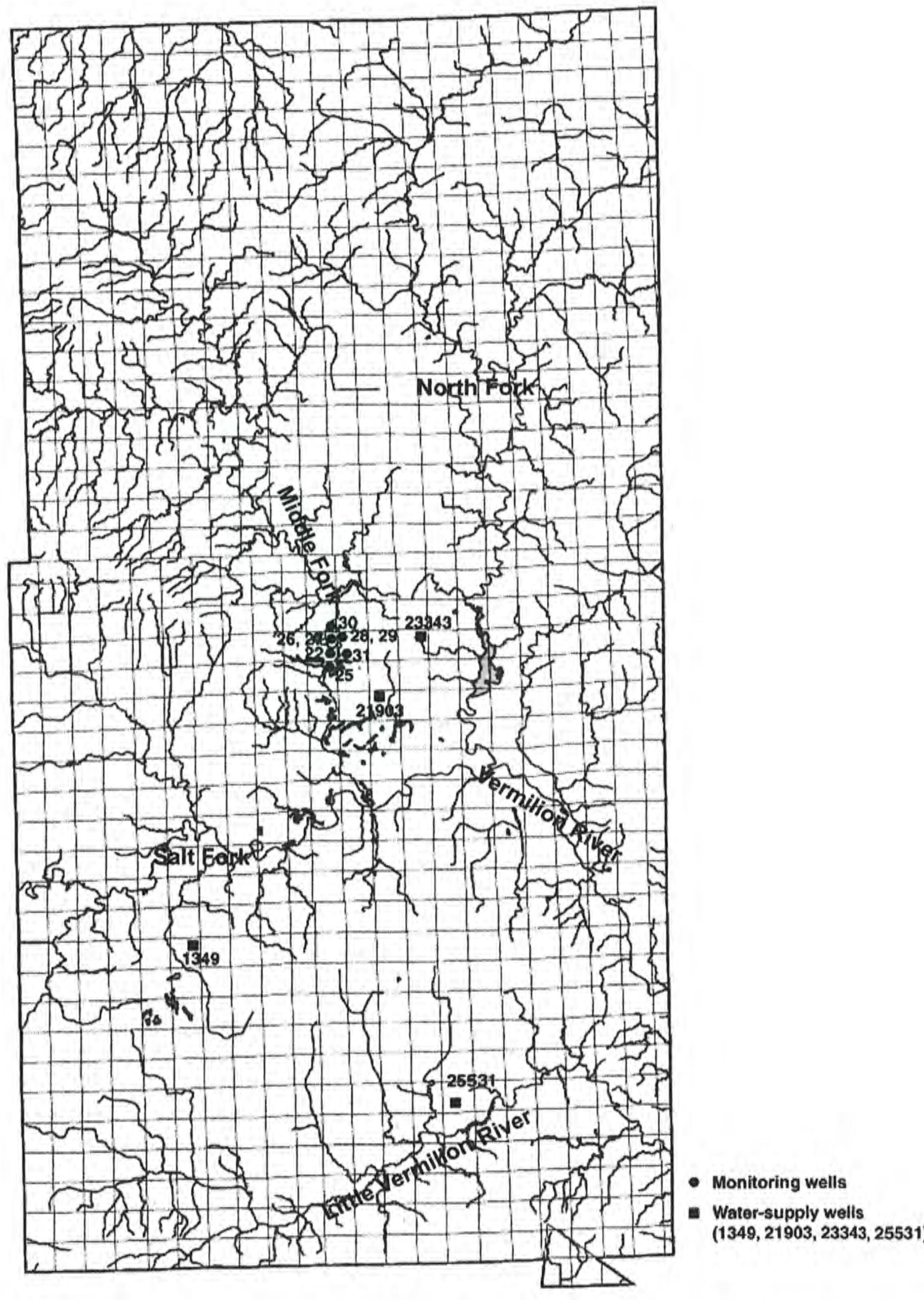
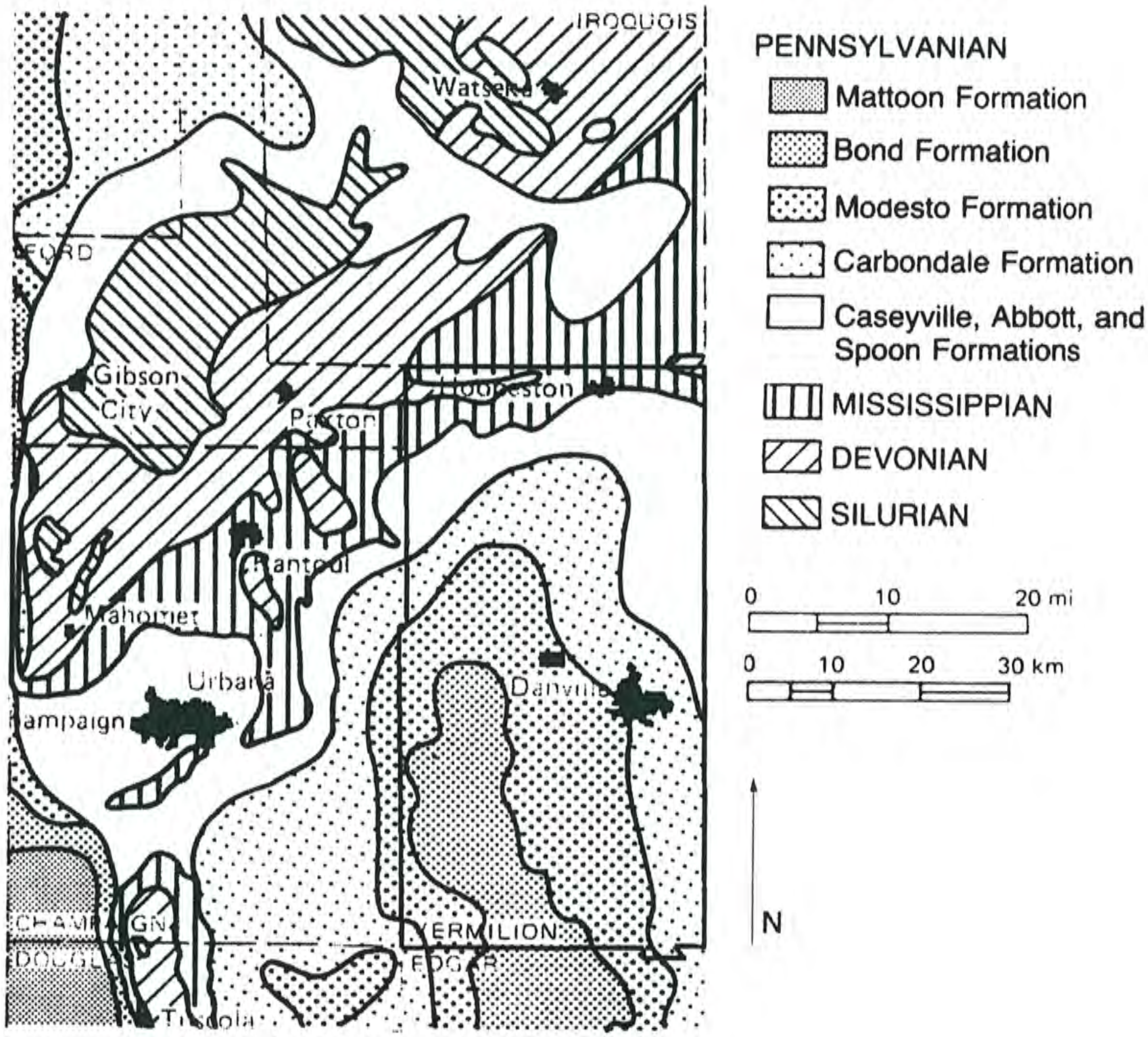


Figure 3. Surficial Bedrock Geology in Vermilion County (adapted from Kempton et al., 1982)



north to greater than 400 feet in the southeast (Willman et al., 1975).

The location of the Mahomet Bedrock Valley can be seen in the drift thickness map (figure 4). The thalweg of the valley, defined by the 400-foot thickness contour, runs east-west through the northern tier of townships in Vermilion County. In addition, a northwest-southeast trending tributary underlies parts of T23N R13W, T22N R13W, T22N R12W, and T21N R12W. The drift thickness also exceeds 200 feet in the southwest portion of the county. However, in the central portion of the county, the drift is generally less than 100 feet thick and bedrock outcrops are common in the river valleys (Piskin and Bergstrom, 1975).

KELRON collected core at 3 locations in T20N R12W (KELRON 25, KELRON 30, and KELRON 31). Descriptions of these cores appear in Appendices A and B. At this location, the uppermost bedrock was mapped as the Pennsylvanian-aged, Modesto Formation by Willman et al. (1975). The core from KELRON 30 penetrated 3 feet into the Danville (No. 7) Coal Member, which was considered the uppermost member of the Carbondale Formation. The stratigraphic nomenclature of the Pennsylvanian system was recently revised by the Tri-State Committee (2001). Using this new nomenclature, the bedrock from the three cores collected by KELRON (KELRON 25, KELRON 30, and KELRON 31) was assigned to the Shelburn Formation (Appendix A). Natural gamma logs for these wells, collected by the ISGS, appear in Appendix B.

In west-central Indiana, the surficial bedrock is Pennsylvanian-age along the IL-IN state line and Mississippian-age to the east (figure 5).

3. GEOCHEMISTRY

We reviewed the available geochemical data for both groundwater and bedrock from Vermilion County and surrounding counties in Illinois and Indiana. In addition, during June 2002, we collected groundwater samples from several monitoring wells and water wells. We also analyzed samples from core collected from three KELRON monitoring wells. To determine the geochemistry of the groundwater in chemical equilibrium with the host rock, equilibrium geochemical modeling was conducted.

3.1 Review of Available Data

To obtain data on the geochemistry of groundwater from Pennsylvanian bedrock and the Pennsylvanian
bedrock itself, we searched the scientific literature and databases at the Illinois State Geological Survey, Illinois State Water Survey, Illinois Environmental Protection Agency, and the Indiana Geological Survey. These data are summarized in tables 1 through 5. The locations for available groundwater samples are summarized by county in table 1. The geochemical data for these 31 samples are presented in table 2. The lithologies of the Pennsylvanian bedrock samples are summarized in table 3. We obtained data for 56 bedrock samples– 35 coal and 21 non-coal samples. The geochemistry of the non-coal samples (table 4) and the coal samples (table 5) has been summarized. Table 5 includes 1 sample from the Springfield (No.

Figure 4. Drift Thickness in Vermilion County (adapted from Piskin and Bergstrom, 1975)

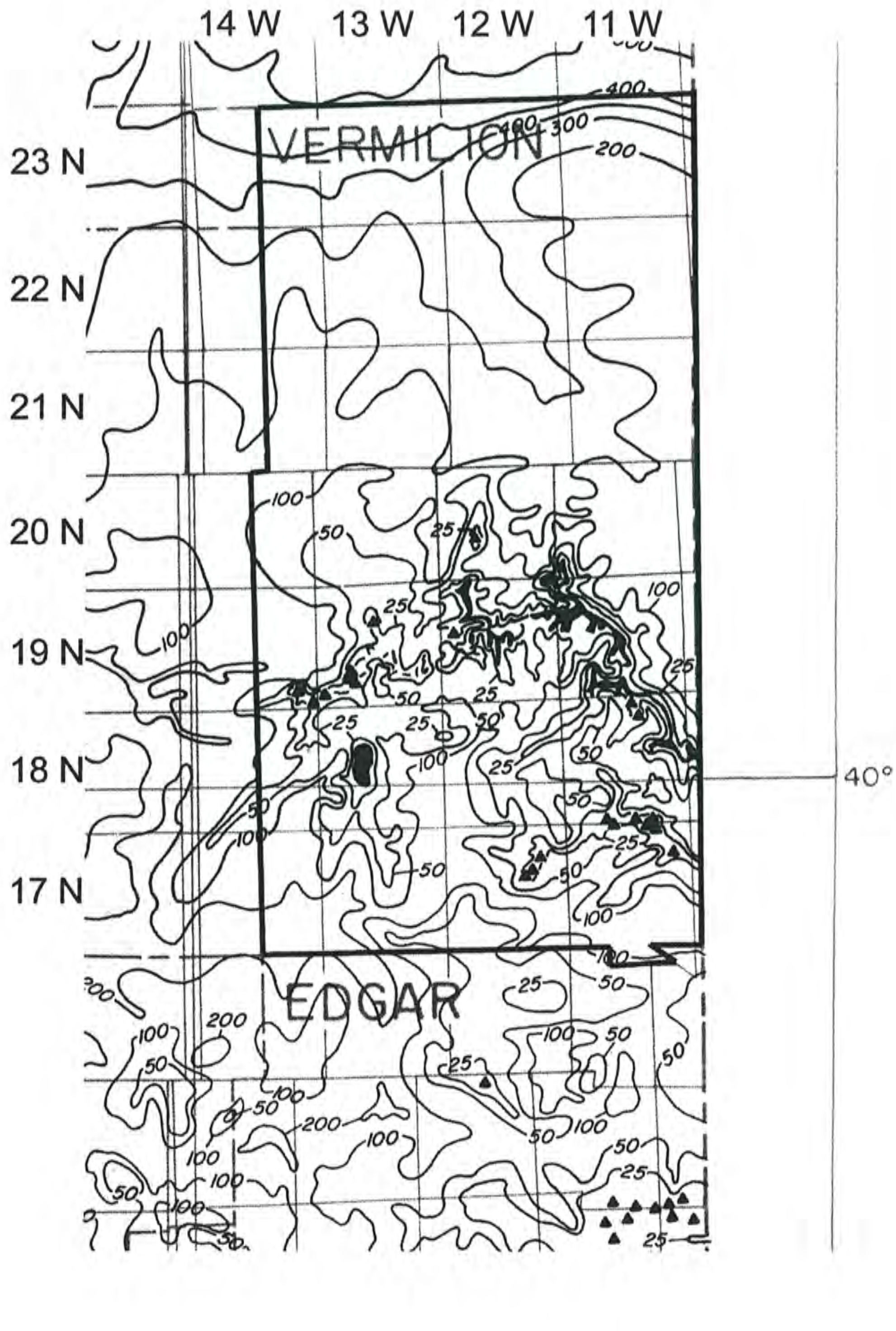


Figure 5. Surficial Bedrock Geology of west-central Indiana including Parke County (from Indiana Geological Survey, 1970) The dashed line shows the limit of the Wisconsin Episode glacial sediments.

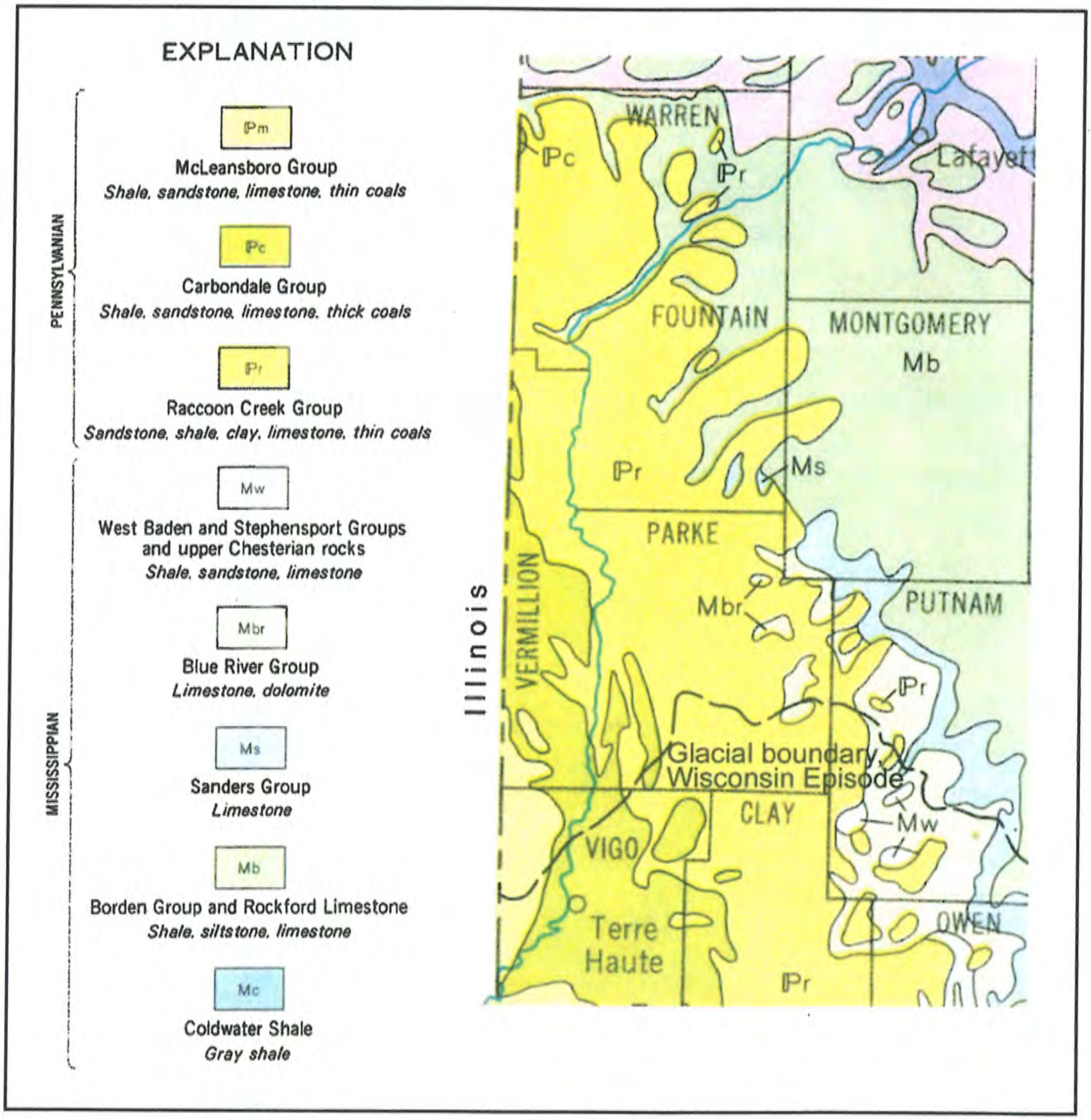


Table 1: Summary of available well data

County	# of Wells	Sampling Dates	Well Depths (ft)
Vermilion	6	10/9/74 - 11/9/93	72 - 220
Clark	1	6/3/99	155
Edgar	1	8/7/48	422
Christian	4	1/22/97 - 2/20/97	276 - 344
Parke (IN)	19	7/10/95 - 7/20/95	100 - 307
TOTAL	31	10/9/74 - 2/20/97	72 - 422

Table 2: Geochemical summary for available water samples
(Sources: Chugh et al., 1997; ISGS Geochemical Database, Meents et al., 1952)

	Units	# of Records	Minimum*	Maximum	Mean	Median
TDS	ppm	28	280	52100	3540	426
Alkalinity	mg/L as $CaCO_3$	30	56	485	321	335
pH	--	27	6.5	10.0	7.5	7.3
Temperature	°C	23	11.0	22.8	15.5	14.8
Bicarbonate	mg/L	31	63	591	389	407
Chloride	mg/L	31	2.1	30269	1689	13
Fluoride	mg/L	26	0.09	1.06	0.49	0.47
Nitrate	mg/L	31	<0.01	29.0	***	2.95
Sulfate	mg/L	31	<1	847	***	31
Aluminum	mg/L	27	<0.02	8.47	***	0.20
Arsenic	mg/L	30	<0.001	0.023	***	0.0050
Barium	mg/L	30	0.02	2.44	***	0.28
Boron	mg/L	30	ND**	2.08	***	0.0047
Cadmium	mg/L	30	<0.0002	0.0044	***	0.00020
Calcium	mg/L	31	<1	951	***	83
Chromium	mg/L	30	<0.001	0.005	***	0.0015
Iron	mg/L	31	<0.006	26.8	***	0.69
Lead	mg/L	29	<0.001	0.018	***	0.003
Magnesium	mg/L	31	<0.5	454	***	31.1
Manganese	mg/L	31	0.015	1.47	***	0.10
Mercury	mg/L	30	<0.00005	1.0	***	0.000025
Potassium	mg/L	30	0.67	63	7.4	2.1
Selenium	mg/L	30	<0.001	0.002	***	0.001
Silicon	mg/L	31	0.69	10.0	6.51	7.12
Sodium	mg/L	31	6	18078	1083	28.7
Zinc	mg/L	30	<0.01	1.43	***	0.21

* Some parameters had multiple detection levels. The lowest detection level is reported.

** Not detected, detection limit was not reported.

*** Sample data contain censored values, did not compute mean.

Table 3: Lithology of the available Pennsylvanian bedrock samples

Lithology	Number of Samples
Sandstone	2
Limestone	2
Shale	4
Carbonaceous Shale	13
Coal	35
TOTAL	56

Table 4: Geochemical summary for available non-coal solid samples
(Sources: Bradbury et al., 1962; Chugh et al., 1997; Schultz and Coveney, 1992)

Analyte	Units	# of Records	Minimum	Maximum	Mean	Median
Al_2O_3	wt. %	21	0.42	20.8	11.7	11.1
CaO	wt. %	21	0.15	54.1	7.57	1.27
Fe_2O_3	wt. %	21	0.63	21.4	8.65	7.02
K_2O	wt. %	21	0.09	4.20	2.51	2.61
MgO	wt. %	21	0.36	2.17	1.44	1.63
MnO	wt. %	18	0.017	1.83	0.20	0.045
Na_2O	wt. %	21	0.030	1.68	0.59	0.58
P_2O_5	wt. %	17	0.030	18.4	2.31	0.53
SiO_2	wt. %	21	2.09	85.7	37.0	33.8
TiO_2	wt. %	21	<0.1	0.92	***	0.51
As	mg/kg	18	19.8	119	57.7	53.8
B	mg/kg	18	31	385	123	112
Ba	mg/kg	18	122	543	***	333
Be	mg/kg	16	<1	4.8	***	2.0
Ce	mg/kg	18	52	233	134	125
Co	mg/kg	18	15.9	68.5	28.3	24.6
Cr	mg/kg	18	68.5	643	289	281
Cs	mg/kg	18	<2	13.4	***	7.0
Cu	mg/kg	16	9.0	192.3	94.3	84.3
Ga	mg/kg	18	6.5	29.3	18.7	17.9

Analyte	Units	# of Records	Minimum	Maximum	Mean	Median
Hg	mg/kg	6	<0.5	5.4	***	2.8
La	mg/kg	18	16.4	99.2	50.8	44
Li	mg/kg	16	11	130.	51.2	37.0
Ni	mg/kg	18	50.	530.	288	280
Pb	mg/kg	16	32	812	167	79
Rb	mg/kg	18	<3.	201	***	127
Sb	mg/kg	18	1.9	56.0	27.2	29.7
Sc	mg/kg	18	9.3	23.6	15.5	14.9
Se	mg/kg	18	4.0	260	104	97
Sr	mg/kg	18	<80	699	210	147
V	mg/kg	18	80.	5600	1770	790
Zn	mg/kg	18	30.3	3350	1000	522
Zr	mg/kg	16	20.8	103	***	49.3
Cl	mg/kg	7	240	698	532	563
Total Carbon	wt. %	17	0.91	>33	***	6.0
Inorganic Carbon	wt. %	17	0.02	11.7	1.7	0.49
Organic Carbon	wt. %	16	0.48	>33	***	3.7

*** Sample data contain censored values, did not compute mean.

Table 5: Geochemical summary for available coal samples
(Sources: Bradbury et al., 1962; Chugh et al., 1997; Schultz and Coveney, 1992; Yates, 1984)

	Sample Data						Illinois Basin Coals*		
	Units	# of Records	Min.	Max.	Mean	Median	Min.	Max.	Mean
Al	mg/kg	34	2300	16800	10400	10400	4300	30000	12000
As	mg/kg	35	0.4	52	***	5.1	1	120	14
B	mg/kg	32	37	149	97.3	99.0	12	230	110
Ba	mg/kg	33	8.9	231	64.6	38.8	5	750	100
Be	mg/kg	35	<0.12	2.5	***	1.5	0.5	4	1.7
Ca	mg/kg	34	1500	21300	8740	8100	100	27000	6700
Ce	mg/kg	33	2.0	30	10.0	8.0	4.4	46	14
Co	mg/kg	35	0.9	23.9	5.1	4.0	2	34	7.3
Cr	mg/kg	35	4.0	32	14.7	13.0	4	60	18
Cs	mg/kg	33	<0.3	3.2	***	0.9	0.5	3.6	1.4
Cu	mg/kg	35	2.0	39	10.6	9.0	5	44	14
Fe	mg/kg	35	4300	57900	19500	18600	4500	41000	20000
Ga	mg/kg	35	1.7	5.55	3.4	3.3	0.8	10	3.2
Hg	mg/kg	34	0.07	0.52	0.14	0.11	0.03	1.6	0.2
K	mg/kg	35	300	3800	1610	1500	400	5600	1700
La	mg/kg	33	1.2	12.7	***	4.2	2.7	20	6.8
Li	mg/kg	30	2.0	39.7	13.7	12.5	Not determined		
Mg	mg/kg	34	<100	2200	***	600	100	1700	500
Na	mg/kg	35	400	2300	989	1000	40	2000	500
Ni	mg/kg	35	2.0	93	15.7	9.0	7.6	68	21
Pb	mg/kg	35	2.0	191	***	8.0	0.8	220	32
Rb	mg/kg	33	1.6	44	13.1	11.5	2	46	19
Sb	mg/kg	35	0.06	3.3	1.0	0.8	0.1	8.9	1.3
Sc	mg/kg	33	0.8	5.2	2.7	2.6	1.2	7.7	2.7
Se	mg/kg	35	0.7	12.3	2.2	1.8	0.4	7.7	2.2
Si	mg/kg	34	3300	37800	21200	20700	5800	47000	24000
Sr	mg/kg	33	9	127	***	20.6	10	130	35
Ti	mg/kg	34	100	1000	550	500	200	1500	600
V	mg/kg	35	3.3	59	14.2	11	11	90	32
Zn	mg/kg	35	7.0	318	***	51.5	10	5300	250

	Sample Data						Illinois Basin Coals*		
	Units	# of Records	Min.	Max.	Mean	Median	Min.	Max.	Mean
Zr	mg/kg	33	3.1	42	20.3	18.0	12	130	47
Cl	mg/kg	22	400	4600	1700	1600	100	5400	1400
Org. S	wt. %	33	0.6	2.04	1.6	1.7	0.37	3.2	1.6
Pyr. S	wt. %	33	0.36	4.18	1.8	1.8	0.29	4.6	2
Su. S	wt. %	33	0.01	0.42	0.1	0.1	0.01	1.1	0.1
Tot. S	wt. %	33	1.68	6.01	3.5	3.5	0.56	6.4	3.6
Ash	wt. %	34	3.71	19.7	12.1	11.5	4.6	20	11

* Gluskoter et al.,1977

*** Sample data contain censored values, did not compute mean.

5) coal, 23 samples from the Herrin (No. 6) coal, 10 samples from the Danville (No. 7) coal, and one other sample whose stratigraphic source is unknown.

For the liquid samples, the available data have been plotted on box plots and a Piper diagram. A box plot shows the distribution of concentrations. The left side of the box shows the 25th percentile. The center of the box shows the 50th percentile or the median. The right side of the box shows the 75th percentile. The difference between the 75th percentile and 25th percentile is the Hspread, which is used to define outliers. The whiskers on the box show approximately the 5th percentile (left) and the 95th percentile (right). Additional data outside these ranges are shown with asterisks (points between 1.5*Hspread and 3*Hspread) and circles (points >3*Hspread). Box plots were constructed for major cations (figure 6) and anions (figure 7) using SYSTAT version 9. A Piper diagram (figure 8) was constructed for the water samples using RockWorks (Rockware Inc.).

Of the major cation concentrations, sodium (Na) had the greatest variability and calcium (Ca) and magnesium (Mg) had the least variability. Of the major anion concentrations, chloride (Cl) had the greatest
variability and bicarbonate (HCO_3) had the least variability. The Piper diagram will be discussed later in this report.

3.2 Summary of New Chemical and Mineralogical Data
New chemical and mineralogical data were obtained from samples of cores previously collected by KELRON (KELRON 25, KELRON 30, and KELRON 31). In addition, we collected groundwater samples from 6 KELRON wells and 4 water-supply wells in central Vermilion County. KELRON provided geochemical data for 7 wells.

Figure 6. Box plot of major cations for the available groundwater samples

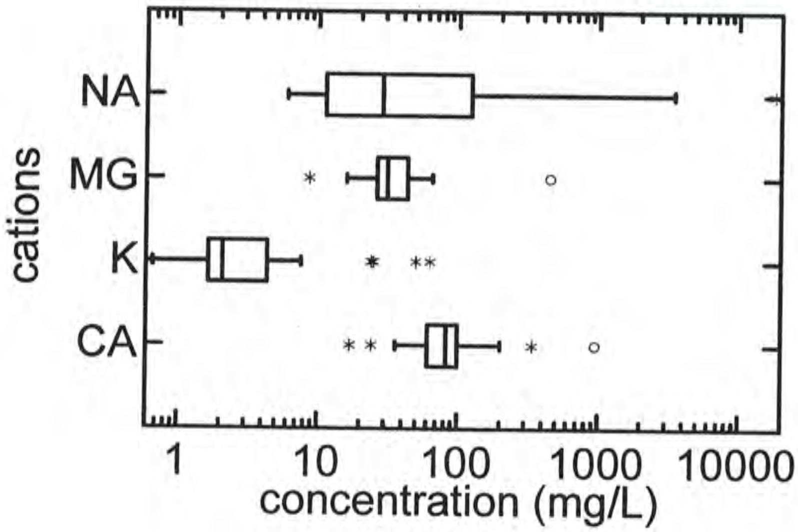


Figure 7. Box plot of major anions for the available groundwater samples

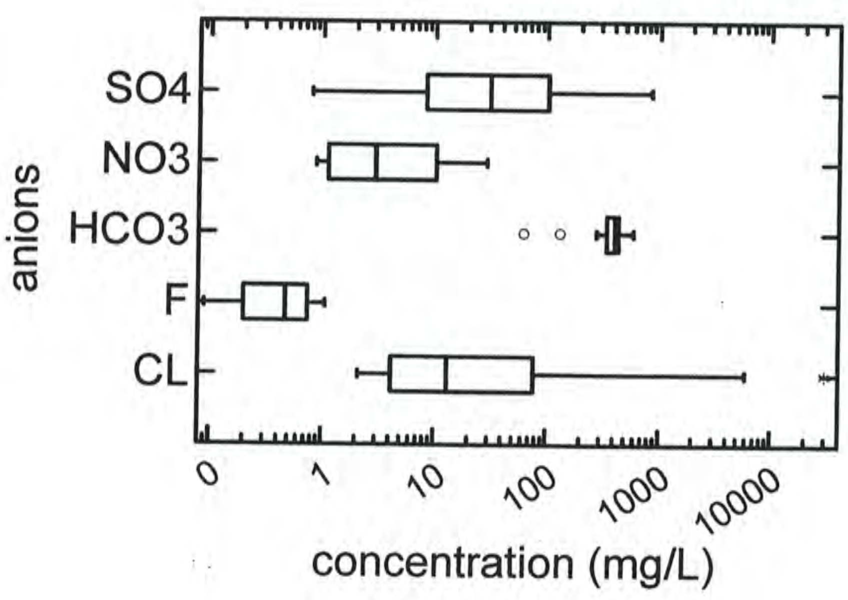
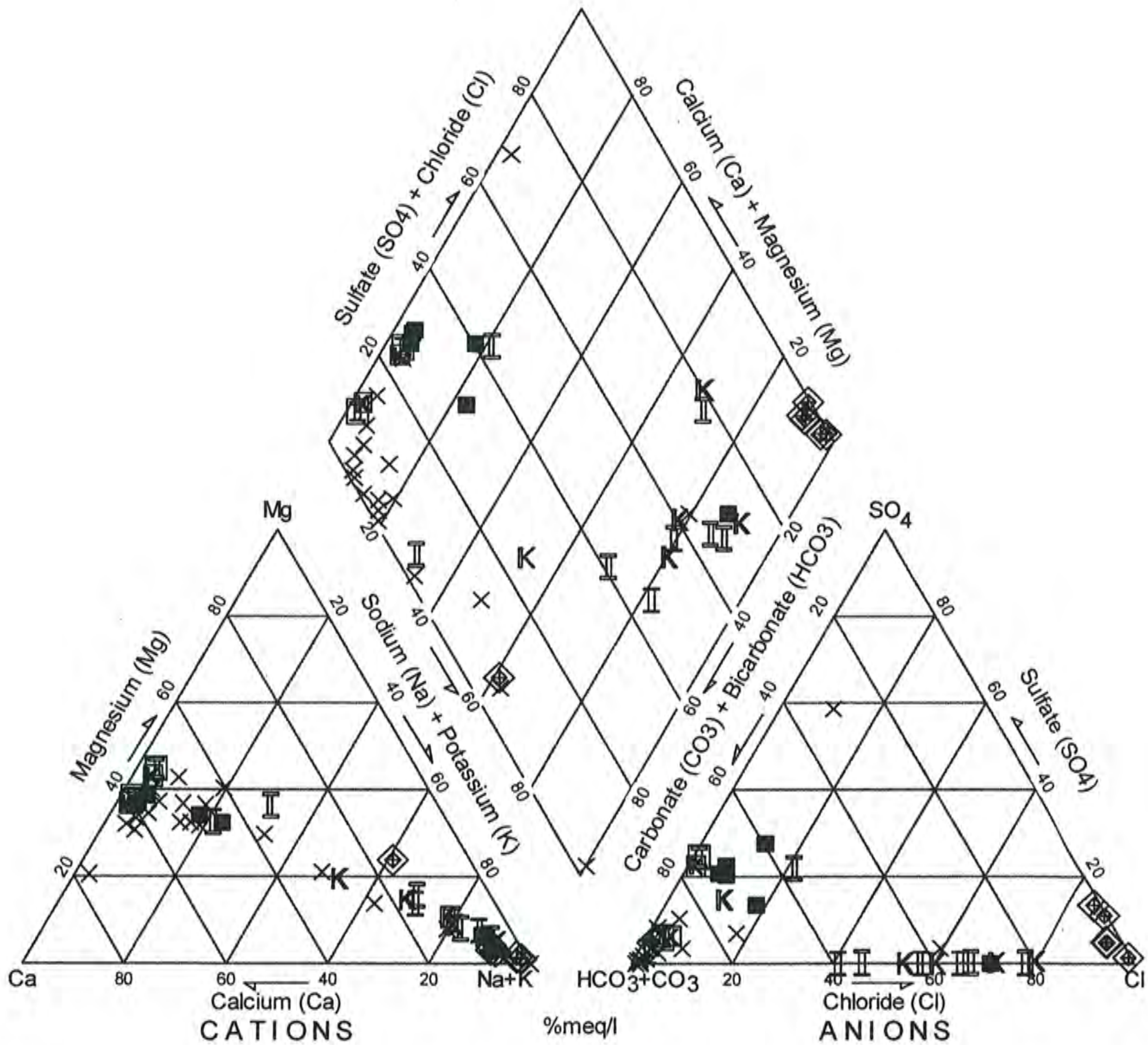


Figure 8. A Piper diagram of the groundwater samples (Vermilion Co., IL= squares, other IL counties= diamond, Parke Co., IN= x, ISGS samples= I and KELRON samples= K, non-bedrock samples from ISGS & KELRON are boxed.)



Analytical Methods

PIMA and X-ray diffraction (XRD) analyses. Core samples were analyzed using a portable infrared mineral analyzer (PIMA), manufactured by Integrated Spectronics Pty. Ltd. (Baulkham Hills, New South Wales, Australia). The PIMA-SP™ reflectance spectrometer (figure 9) provided analyses as quickly as one per minute, portability, and good data from irregular, round or flat core- or hand-specimen samples. The instrument's 1.25 cm-diameter window allowed close-interval core logging and determinations on small features in samples. In the analysis mode, the PIMA's 1300 to 2500 nm spectra were matched with reference spectra to determine percentages for up to six minerals. Quartz and feldspar produce no PIMA spectra, thus PIMA sees through these grains to give better-than-expected spectra for minerals that are usually of primary concern, e.g., clay minerals, iron hydroxides, and carbonates. Custom reference spectra can be created for the specific minerals of concern, and the spectral processing programs provide several methods for analyzing spectra, including instantaneous display of calculated features in each spectrum in a "special stack" from outcrop or borehole samples (figure 10).

For six geochemical-PIMA-XRD samples, the core was sawed and about a 15-cm-thick composite of half of the core was crushed and split. The other 13 samples of the three cores were removed, either by drilling perpendicular to bedding with a ¼ inch carbide drill bit, or, for core segments that broke into thin bedding layers, by breaking a 5 to10 g fragment of the layer. For PIMA and XRD analyses, all 19 samples were hand ground with a mortar and pestle, and packed into end-loading XRD sample holders. The samples were x-rayed using standard operating procedures (SOPs) on file at the ISGS. The same sample surface was later inverted into a calibrated petri dish for PIMA analyses. Hughes and Warren (1989) Hughes et al. (1994) and Hughes et al. (2002) summarize the methods used. Demir et al. (2001), Hughes et al. (1987), Hughes et al. (1989), Hughes et al. (1992), Hughes (1993), Hughes et al. (1994), and Hughes et al. (2002) summarize the range of composition normally found for these types of
sediments.

Smear samples. Smears of the particles with diameters <8µm were prepared by placing 1 to 3 g of sample in a 150 mL beaker, adding 100 mL of deionized H_2O, dispersing the slurry with an ultrasonic probe for 60 seconds, and allowing the samples to soak overnight. For samples that flocculated and had clear supernates, the clear water was decanted and the beakers refilled with deionized water. Five drops of dispersant solution were added to each of the beakers, each beaker was stirred for 30 seconds, and the samples were allowed to settle 3 minutes per cm of slurry depth. After settling, the fine fractions were poured into 400 mL glass beakers and flocculated with $CaCl_2 \cdot nH_2O$. The glass beakers were refilled, two drops of dispersant were added, the mixtures were stirred, allowed to settle, and the fine fractions were added to the glass beakers containing the first settlings. A third settling was completed, and the >8 µm fractions were allowed to dry, after which, the sample and beaker were weighed, to estimate the weights of the coarse and fine fractions. The <8 µm fractions were flocculated and allowed to settle overnight, the clear supernate was decanted, the fines were transferred to 40 mL centrifuge tubes, and after centrifuging 20 minutes @ 2000 RPM, the clear supernates were decanted, the sediment plugs were thoroughly mixed with a microspatula, and the paste was smeared on a round, glass XRD slide. After the smear dried in air, the slides were x-rayed using ISGS SOPs.

Figure 9. A typical laboratory setup for PIMA showing the power supply at left, a limestone sample on the PIMA's analysis window on the tabletop, and a laptop computer with a spectrum for pure calcite from a limestone sample.

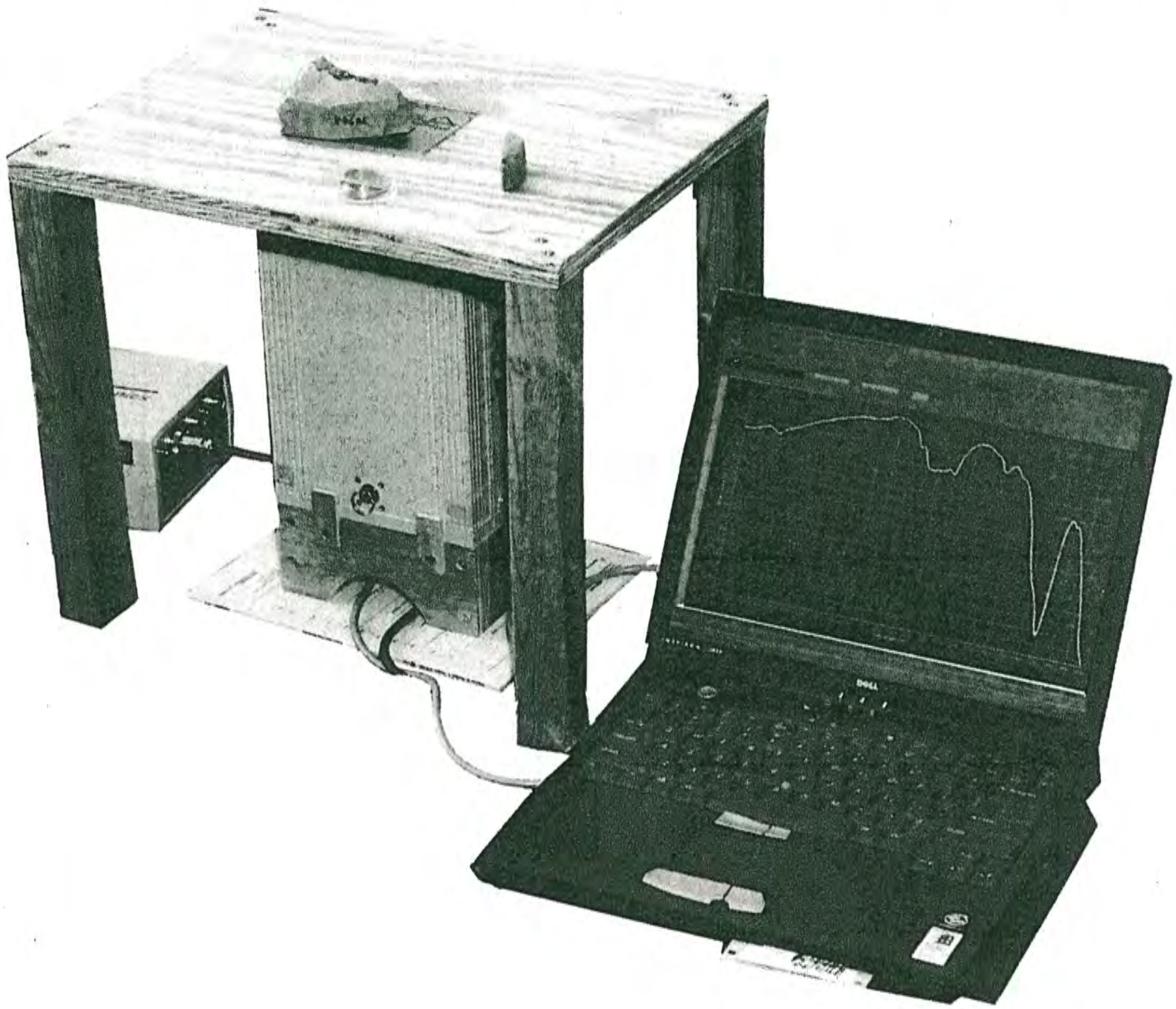
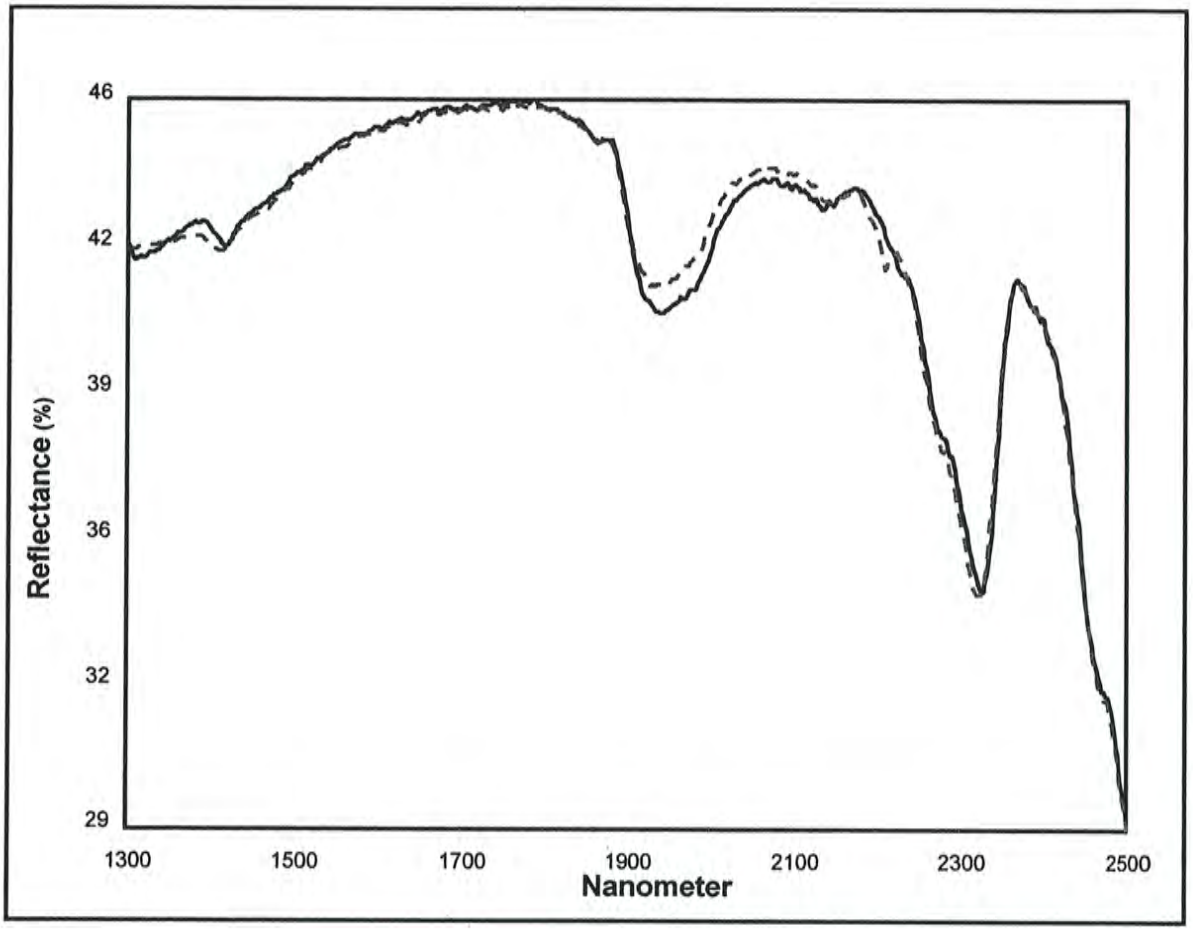


Figure 10. Overlay of the spectrum for western Illinois dolomite (dark trace) and a calculated spectrum (light, dashed trace) for 100% dolomite (PIMA's MinIDB reference standards library).



Water samples. Water samples were collected from monitoring and water-supply wells. Groundwater samples from the KELRON monitoring wells were collected using Dynegy-owned equipment including dedicated, low-flow sampling pumps. The June 18, 2002 samples were collected as split samples during Dynegy's regular sampling. Groundwater samples from water-supply wells were collected using the installed pumps, from taps prior to any water treatment such as water softeners. Prior to sample collection, field parameters (temperature, dissolved oxygen, pH, Eh, and specific conductance) were monitored and were allowed to stabilize, unless the well appeared to be running out of water. Water samples were transported on ice and stored at 4°C until analyzed.

Water samples collected by the ISGS were analyzed for anions and cations by the ISGS Geochemistry Laboratory. Anions were determined using a Dionex DX-120 Ion Chromatograph with Ionpac AG14 Guard Column, Ionpac AS14 Analytical Column, and ASRS-ULTRA (4mm) suppressor module. Analytes were measured with a CDM-3 conductivity detector cell with a DS4 detection stabilizer. The eluent was 3.5mM sodium carbonate and 1.0 mM sodium bicarbonate. The following were approximate retention times in minutes: fluoride, 2.9; chloride, 4.0; bromide, 5.6; nitrate, 6.4; phosphate, 8.0; and sulfate, 9.5. Instrument operation and data collection were controlled using PeakNet 5.01 software. A calibration check standard and blank were run with each analysis set.

Cations were determined with a Thermo Jarrell-Ash Model ICAP 61e inductively coupled plasma spectrometer. The list of elements and their wavelengths in nanometers are: Al(308.2), As(193.6), B(249.6), Ba(493.4), Be(313.0), Ca(393.3, 317.9), Cd(228.8), Co(228.6), Cr(267.7), Cu(324.7), Fe(259.9, 271.4), K(766.4), Li(670.7), Mg(279.5, 383.2), Mn(257.6), Mo(202.0), Na(588.9, 330.2), Ni(231.6), P(214.9), Pb(220.3), S(182.0), Sb(206.8), Sc(361.3), Se(196.0), Si(288.1), Sr(421.5), Te(214.2), Ti(334.9), Tl(190.8), V(292.4), and Zn(213.8). Instrument operation, inter-element interference correction, background correction, and data collection were controlled using ThermoSPEC/AE 6.20 software. Blanks, calibration check standards, and reference standards were run with each analysis set.

For tritium analyses, water samples were collected in 1L HDPE bottles. Tritium was determined with 200 mL of water using the enrichment technique (Ostlund and Dorsey, 1977). The tritium enriched samples were purified by vacuum distillation, mixed with a scintillation cocktail, and counted in a low-level scintillation counter (Packard 2000 CA/LL). The tritium results are reported in tritium units (TU), which is defined as one tritium atom per 10^{18} hydrogen atoms.

The dissolved inorganic carbon (DIC) in water was analyzed at the ISGS for carbon-14 activity using conventional techniques (Hackley, 2002). The DIC is extracted from water samples by the addition of acid. The carbon dioxide released from water samples is quantitatively collected and cryogenically purified on a vacuum line. The purified carbon dioxide is converted to high-purity benzene following the technique described in Coleman (1976). The carbon-14 activity is measured using the liquid scintillation spectrometry method developed by Noakes et al. (1965, 1967).
Groundwater samples from the KELRON wells also were collected and analyzed by Dynegy. Prior

to sample collection, Dynegy monitored several field parameters (temperature, dissolved oxygen, pH, Eh, and specific conductance) using a calibrated Hydrolab Minisonde. Cations were determined by inductively coupled plasma emission spectroscopy (ICP) (USEPA method 200.7). Alkalinity was determined by a titrimetric method (USEPA method 310.1). Total dissolved solids were determined by a gravimetric method (USEPA method 160.1). Sulfate was determined using a turbidimetric method (USEPA method 375.4). Total phosphorus was determined using an ascorbic acid/colorimetric method (USEPA 365.2). Finally, chloride was determined using a potentiometric method (Standard method 4500-Cl).

Solid Samples

Detailed descriptive logs (see DeMaris logs, Appendix A) were compiled for three new holes drilled by KELRON and used to select 19 samples for PIMA-SP™ and XRD analyses. Table 6 gives the lab number, core number, depth, and material type for the 19 samples. The coal in core KELRON 30 had been sealed, and a sample of the white oxidation product on top of the coal was analyzed by PIMA and XRD. Separately, one or two siderite nodules were analyzed, and 19 PIMA and XRD samples were chosen to contrast the mineralogical composition of silt- and clay-rich zones. Over 90 PIMA analyses were run for this project, 54 on the cores, and 39 on bulk and <8μm smear samples. The results from the PIMA analyses of the cores were quite uniform, suggesting that little mineralogical variation was present. Table 6 gives the XRD analysis results for bulk sample preparations that show: a) 10 to 60% clay minerals, b) 35 to 75% quartz, 0 to 3% K-feldspar, 2 to 13% plagioclase feldspar, and 0 to 10% siderite. Samples 3955S and T also contained 2.3 and 10% pyrite/marcasite, respectively. The iron sulfide in both samples is mostly marcasite, a form of the compound that oxidizes very quickly. The needle-like white precipitate above the coal in core KELRON 30 is undoubtedly the result of this rapid oxidation. In general, silt-rich samples had lower clay mineral contents and higher quartz and feldspar contents than shaly zones.

The XRD analyses of the <8μm smear samples (table 7) showed that the clay mineral suites were composed mostly of illite, kaolinite, chlorite, and small amounts of mixed-layered illite/smectite (I/S). Coarser, more permeable zones normally have higher fluid flow rates and this results in higher kaolinite contents, and so as expected, the silt-rich samples in this set contained relatively more kaolinite, a higher kaolinite:chlorite ratio, and less illite, I/S, and chlorite. Table 8 gives the ranges of the clay mineral contents from the smear slides- 50 to 65% illite, 12 to 32% kaolinite, 9 to 22% chlorite, and 3 to 7% I/S (atypical sample 3955T had 19% I/S).

PIMA analyses of core, hand specimen, bulk powder, and smear samples confirmed the generally uniform composition of these strata, but showed significant differences in the compositions of the silty and shaly samples. These results also are qualitatively consistent with the XRD results. Finally, the PIMA analyses of the core required only a few minutes each, and these results confirmed the value of the PIMA to identify compositional changes and refine the sample selection process.

Table 6. PIMA-XRD sample description and mineral percentages from XRD analysis

Well	Sample No.	Depth (ft)	Material	% Clay minerals	% Quartz	%K-Feldspar	%Plagiclase feldspar	% Siderite
KELRON 25	3955A1	18.17	siltstone	14	72	2.3	10	1.2
	3955A2	18.13	siltstone	14	69	0.9	12	3.6
	3955A3	18.10	shale	25	61	0.8	8.8	4.5
	3955B	28.17	shale	11	74	0.0	12	2.6
	3955C	36.0	shale	26	59	1.1	8.1	5.8
	3955E	12.55-12.75	silty-shale	21	63	1.8	11	3.6
	3955G	32.0-32.25	shale	23	61	0.0	9.0	6.5
KELRON 31	3955I	156.6-156.8	shale	24	60	1.5	10	3.8
	3955J1	154.22	shale	27	56	1.2	11	4.5
	3955J2	162.0	shale	22	55	0.0	13	10
	3955K	165.7-165.95	shale	26	60	1.5	8.4	4.0
	3955L	178.18	shale	36	53	0.0	7.8	2.8
	3955M	174.4-174.62	shale	34	53	0.0	7.4	5.0
KELRON 30	3955N	120.3	shale	24	67	0.0	9.1	0.0
	3955O	127.2-127.45	shale	34	52	1.4	8.8	4.2
	3955P	132.5	shale	36	55	0.0	7.2	2.6
	3955Q	136.25-136.43	shale	40	51	0.0	5.1	3.2
	3955S	141.15-141.4	shale	39	49	0.0	6.2	3.1
	3955T	144.0	C-Py-shale	56	30	2.5	2.0	0.0

Key: C = carbonaceous; Py = pyritic (pyrite or marcasite)

Samples 3955S and T had pyrite/marcasite, which was mostly marcasite; percentages = 2.3 and 6.7%, respectively.

Table 7. Percentages of mixed-layered illite/smectite, illite, kaolinite, and chlorite from X-ray diffraction data based on 8μm smear samples. The ratio of kaolinite:chlorite (K:C), the clay index (CI), and %<8μm also are given.

Sample	%I/S	%I	%K	%C	K:C	CI	%<8μm
3955A1	3.6	48	32	16	0.67	0.73	35
3955A2	3.9	48	30	18	0.63	0.78	49
3955A3	4.0	62	15	19	0.44	0.87	54
3955B	3.3	51	29	16	0.64	0.81	38
3955C	4.5	62	16	17	0.48	0.84	59
3955E	5.0	59	17	18	0.49	0.91	31
3955G	4.5	60	17	19	0.47	0.89	39
3955I	5.8	58	15	21	0.42	0.88	40
3955J1	5.8	60	16	18	0.47	0.90	44
3955J2	4.9	60	17	18	0.49	0.83	57
3955K	4.3	64	13	19	0.40	0.89	47
3955L	5.0	60	13	22	0.36	0.86	79
3955M	5.1	60	14	21	0.39	0.85	72
3955N	4.8	57	18	20	0.48	0.88	47
3955O	5.4	62	13	20	0.41	0.88	75
3955P	6.0	59	14	21	0.39	0.85	75
3955Q	6.4	58	13	22	0.38	0.85	91
3955S	6.6	61	12	20	0.39	0.86	88
3955T	19	60	13	8.6	0.60	0.81	62

Key: I/S = mixed-layered illite/smectite; I = illite; K = kaolinite; C = chlorite; K:C = the ratio of the kaolinite 002 peak to the chlorite 004 peak; CI = the clay index, which equals the corrected sum of the peaks for the clay minerals divided by the sum of the corrected intensities of the clay and nonclay minerals; the higher the ratio, the higher the clay mineral content; the %<8μm was estimated from the initial weight of the sample minus the final weight of the >8μm.

Water Samples

The ISGS sampled the wells described in table 8 in mid- to late June 2002. These wells included 6 monitoring wells and 4 water-supply wells located in Vermilion County. All but two wells were completed in shallow bedrock. Two monitoring wells (KELRON 26 & 28), completed in shallow Quaternary materials, were sampled to provide data on shallow groundwater. The chemical data for the ISGS samples are summarized in table 9. Dynegy sampled numerous monitoring wells from February through August 2002 (table 10). Some of these data are reported here. On June 18th, split samples were collected from 6 KELRON wells and sent to ISGS and Dynegy laboratories. The results for these split samples were within 20%, except for a few samples for chloride, iron, and potassium.

Table 8. Description of wells sampled by the ISGS and/or Dynegy

Well #	Location	Total Depth (ft)	Lithology @ screen
1349	T18N, R13W, Sec 9	72	sandstone & shale
21903	T20N, R12W, Sec 34	147	sandstone & shale
23343	T20N, R12W, Sec 23	175	sandstone & shale
25531	T17N, R12W, Sec 1	140	rock & shale
KELRON 25	T20N, R12W, Sec 29	39	shale
KELRON 26	T20N, R12W, Sec 20	16	sand & shale
KELRON 27	T20N, R12W, Sec 20	44	shale
KELRON 28	T20N, R12W, Sec 21	15	sand & silt
KELRON 29	T20N, R12W, Sec 21	45	shale
KELRON 30	T20N, R12W, Sec 20	148	shale & coal
KELRON 31	T20N, R12W, Sec 21	184	shale

The range of concentrations of major anions (figure 11) and major cations (figure 12) for the samples collected for this study (by the ISGS and Dynegy) are shown by the dots, while the box plots display the available data. These box plots were generated using GRAPHER version 3. The whiskers cover the entire range of data, which differs from the whiskers for the SYSTAT box plots (e.g., figure 6).

The dot and box plots are similar; thus, the data collected from the sampled wells are similar to the available data, which cover a broader geographic area. Only 2 sampled wells (well 23343 and KELRON 26) had TDS values below 250 mg/L. Well 23343 is a 175-foot, domestic well completed in bedrock. KELRON 26 is a 16-foot monitoring well completed in Quaternary geologic materials. Another shallow monitoring well, KELRON 28, had a TDS similar to the bedrock wells.

Some of the concentration data can be explained by the lithology of the aquifer materials (table 8). KELRON 30 was completed in shale and coal, wells 1349, 21903 and 23343 in sandstone and shale, well
25531 in rock and shale, KELRON 26 and 28 in sand, while the remaining wells were completed in shale. For example, a groundwater sample from KELRON 30 (the only well completed in coal) had the highest concentration of Ba, Li, Na, and Cl. Data from tables 4 and 5 show that coal generally has higher concentrations of Cl than other geologic materials.

Table 9. Geochemical data for ISGS sampled wells

	Well Number									
	1349	21903	23343	25531	KELRON 25	KELRON 26	KELRON 27	KELRON 28	KELRON 29	KELRON 30
n*	1	1	1	1	2	2	2	2	2	2
Al	<0.1**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
As	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
B	0.29	0.50	1.4	1.2	1.14	.055	.086	0.09	1.2	0.93
Ba	0.14	0.98	0.26	0.47	2.0	0.031	0.77	0.034	0.55	5.3
Be	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ca	131	44.2	67.4	36.8	84.4	87.3	34.8	186	30.4	42.0
Cd	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Co	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cr	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cu	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fe	2.4	<0.01	1.6	3.8	0.06	<0.01	0.20	0.04	0.22	1.9
K	3.0	4.0	5.0	5.0	6.5	3.5	4.5	<1	4.0	7.0
Li	0.01	0.02	0.01	0.06	0.07	<0.01	0.04	0.03	0.04	0.10
Mg	56	29	45	27	45	34	21	98	15	29
Mn	0.11	0.041	0.035	0.041	0.057	<0.001	0.020	0.081	0.015	0.047
Mo	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Na	67	240	68	590	430	1.9	300	16	290	870
Ni	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.005	0.005	<0.01
Pb	<0.02	<0.02	<0.02	<0.02	<0.02	0.015	0.015	<0.02	<0.02	<0.02
S	49	0.03	5.4	0.38	0.46	7.9	0.19	72	0.3	1.5
Sb	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sc	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Se	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Si	8.0	3.4	7.5	3.3	5.4	4.4	6.1	6.2	5.8	4.7
Sr	0.23	0.52	1.5	0.57	0.7	0.1	0.4	0.3	0.4	0.8
Ti	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tl	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
V	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

	1349	21903	23343	25531	KELRON 25	KELRON 26	KELRON 27	KELRON 28	KELRON 29	KELRON 30
Zn	0.055	<0.001	0.018	0.074	<0.001	<0.001	<0.001	0.004	<0.001	0.003
F	0.2	0.2	0.5	0.5	0.5	0.1	0.7	0.1	0.8	0.7
Cl	100	230	5.0	640	690	7.0	320	7.0	240	970
Br	<0.05	<0.05	<0.05	0.72	1.3	<0.05	0.61	<0.05	0.51	2.5
NO_3-N	<0.02	<0.02	<0.02	<0.02	<0.02	6.7	<0.02	<0.02	<0.02	0.15
PO_4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
SO_4	140	<0.1	11	0.6	1.0	19	0.2	190	0.6	3.2
Total Alk	380	460	390	480	280	280	340	600	400	670
pH	7.7	7.8	8.2	8.0	7.8	7.9	8.0	7.9	8.1	8.2
TDS	470	550	210	1300	1300	150	700	450	590	1900

* n= number of samples. For n>1, average values are reported.

**: All values are reported in units of mg/L except pH.

Table 10. Geochemical data from KELRON well samples

Parameter	Units	Well Number						
		KELRON 25	KELRON 26	KELRON 27	KELRON 28	KELRON 29	KELRON 30	KELRON 31
n*	–	7	1	7	1	7	7	7
pH	--	7.3	7.2	7.6	7.0	7.5	7.4	7.2
Temperature	°C	12.5	11.6	12.0	13.6	13.0	14.5	12.4
TDS	mg/L	1500	350	900	900	830	2400	860
Alkalinity	mg/L	280	290	330	600	390	670	560
B	mg/L	1.2	<0.05	0.83	0.11	1.1	0.9	0.7
Ba	mg/L	1.6	0.03	0.7	0.03	0.47	4.6	0.58
Ca	mg/L	85	92	32	190	29	34	82
Fe	mg/L	0.15	<0.025	0.18	0.05	0.26	1.8	0.40
K	mg/L	5.8	2.2	3.7	0.88	3.7	7.7	9.5
Li	mg/L	0.11	<0.005	0.04	0.03	0.05	0.12	0.10
Mg	mg/L	45	34	20	94	15	25	35
Mn	mg/L	0.05	<0.005	0.02	0.07	0.01	0.04	0.08
Na	mg/L	390	3.1	270	17	260	890	170
Sr	mg/L	0.57	0.07	0.4	0.3	0.3	0.7	0.7
Cl	mg/L	820	12	360	11	320	1200	59
PO_4	mg/L	0.03	0.10	0.02	0.01	0.03	0.04	0.06
SO_4	mg/L	6.6	20	<5	170	<5	6.5	110

* n= number of samples. For n>1, average values are reported.

Figure 11. Major anions: box plot for the available wells along with dot plots of the ISGS (+) and Dynegy (◇) samples

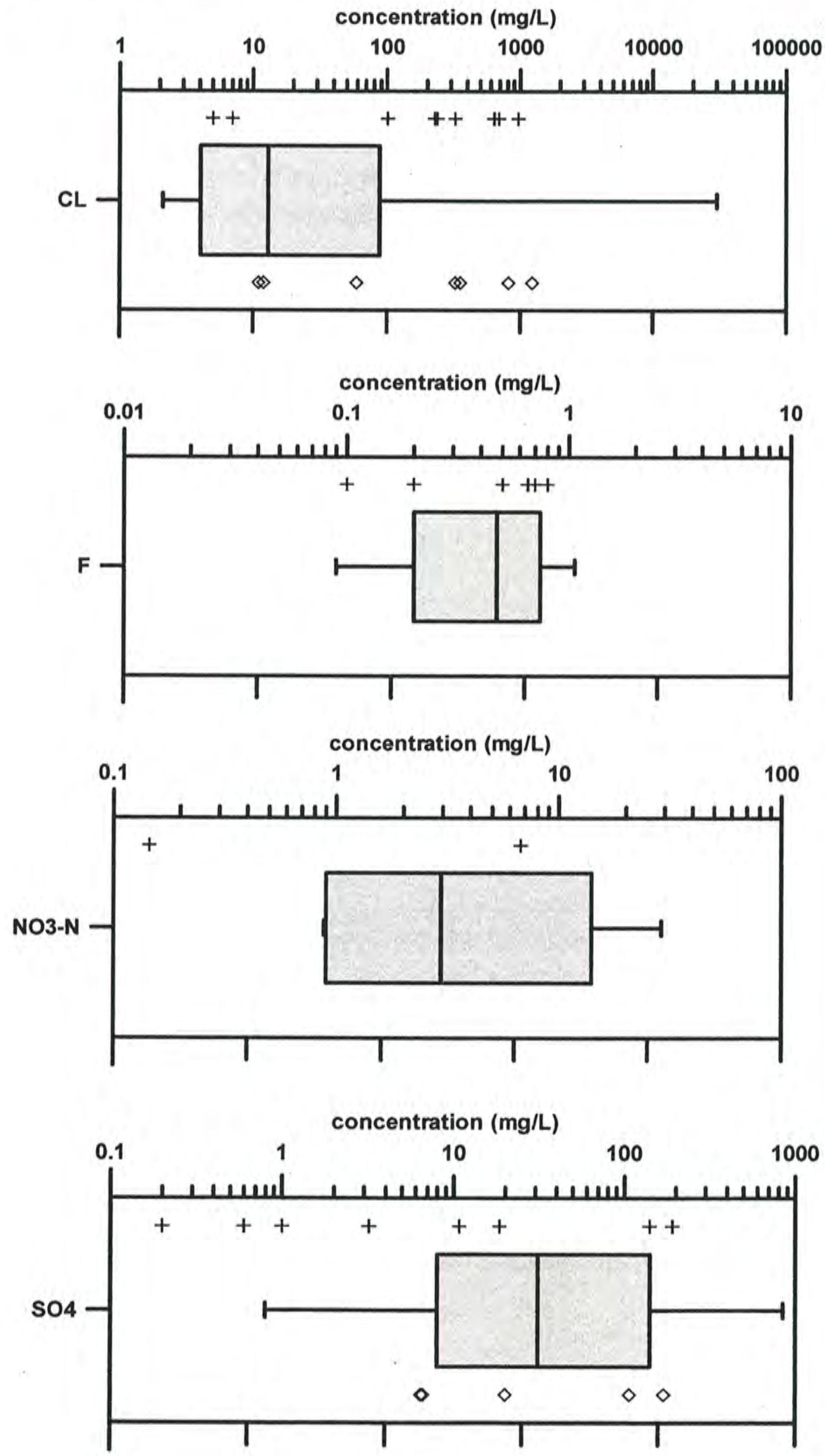
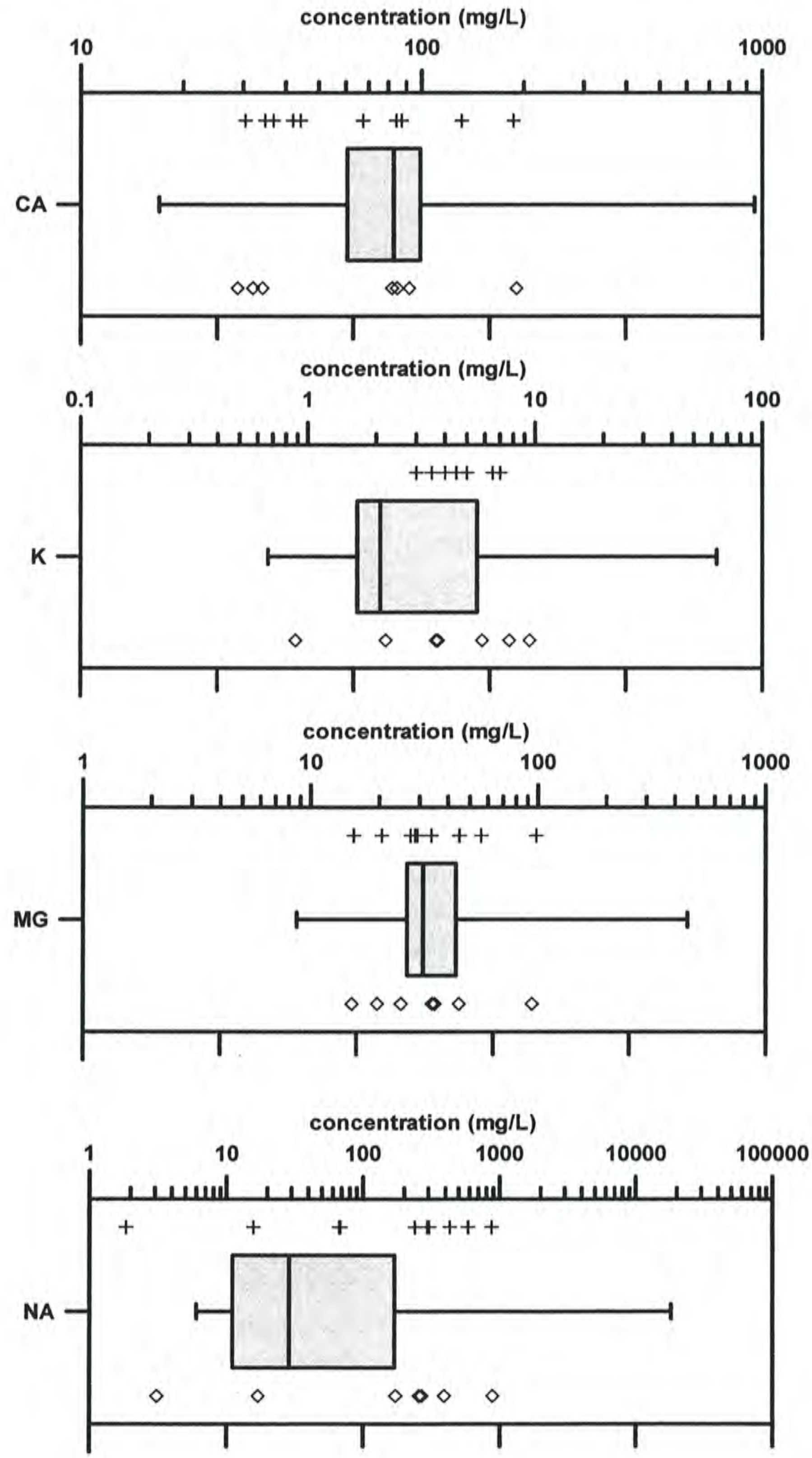


Figure 12. Major cations: box plot for the available wells along with dot plots of the ISGS (+) and Dynegy (◇) samples



The concentration data for the ISGS and Dynegy groundwater samples were also plotted on a Piper diagram (figure 8). The major cation concentrations for these groundwater samples appear in the left-hand ternary plot of the Piper diagram (figures 8 & 13). The linear nature of the data points leads to the hypothesis that groundwater with the greater concentrations of sodium plus potassium (Na+K, e.g., KELRON 27 or KELRON 29) migrated over a longer distance from the recharge area to the respective well than samples with lower concentrations of Na+K (e.g., well 23343). During migration, the groundwater dissolved increasingly greater amounts of sodium from the aquifer rocks and increasing amounts of calcium and magnesium were removed from the water, probably by adsorption by clay minerals in the aquifer rocks. In general, the chemistry of the water samples tends to cluster based on the lithology of the geologic materials in which they are screened. For example, the two wells completed in Quaternary materials plot to the far left in figure 13, and wells 1349 and 23343 (sandstone and shale) in the center of the plot. Well 25531 is the only well that does not fit this pattern.

The diamond-shaped plot in the Piper diagram (figure 8) indicates that for the water samples collected in June 2002, 35% displayed temporary hardness (moderate amounts of Mg, Ca, and HCO_3^-); 41% of these samples are classified as saline (contained relatively large amounts of Na and Cl); the remaining samples were of intermediate classification between temporary hardness and saline.

The position of water quality results plotted on a Piper diagram can be misleading, however, because the Piper diagram is based on the mole percent of four major cations and four major anions. For a given water sample, the number of moles of each of the eight major ions is calculated, then the mole percent is calculated on the basis of the total moles of either cations or anions, respectively. The mole percent of sodium, for example, in a water sample that contains low concentrations of the major cations and anions can be the same as in a water sample that contains high concentrations of major anions and cations. A water that is classified as temporarily hard might not be hard at all, according to the accepted definition of hard water. The hardness of water is defined by the concentration of calcium carbonate in the water. Water containing 0 to 60 mg $CaCO_3$/L is defined as "soft," whereas water that contains 121 to 180 mg $CaCO_3$/L is defined as "hard" (Hem, 1970).

The carbon and hydrogen (tritium) isotopic data (table 11) reveal that some wells produce recent water, while others yield much older water. Tritium values in Illinois precipitation typically range from 3 to 10 tritium units (TU) (Hackley et al., 1996; Hackley, personal communication, 2002). Tritium is generated in the atmosphere. In the subsurface, tritium decays exponentially with a half-life of 12.3 years (Freeze and Cherry, 1979). Thus, water with tritium concentrations greater than 5 TU is considered recent water (wells 1349, KELRON 26, and KELRON 28), while water with nondetectable tritium concentrations is considered to be >50 years old. ^{14}C has a longer half-life than tritium and is expressed as radiocarbon years before present (RYBP) and as % modern carbon. Both units provide relative ages. Due to the complexities of carbon chemistry, a great deal of additional analysis is needed to obtain definitive dates. The ^{14}C data are consistent with the tritium data, showing that three wells (wells 1349, KELRON 26 and KELRON 28) yield recent water and the others yield much older water. Two wells (KELRON 26 and

Figure 13. Cation plot of the Piper diagram for ISGS and Dynegy samples

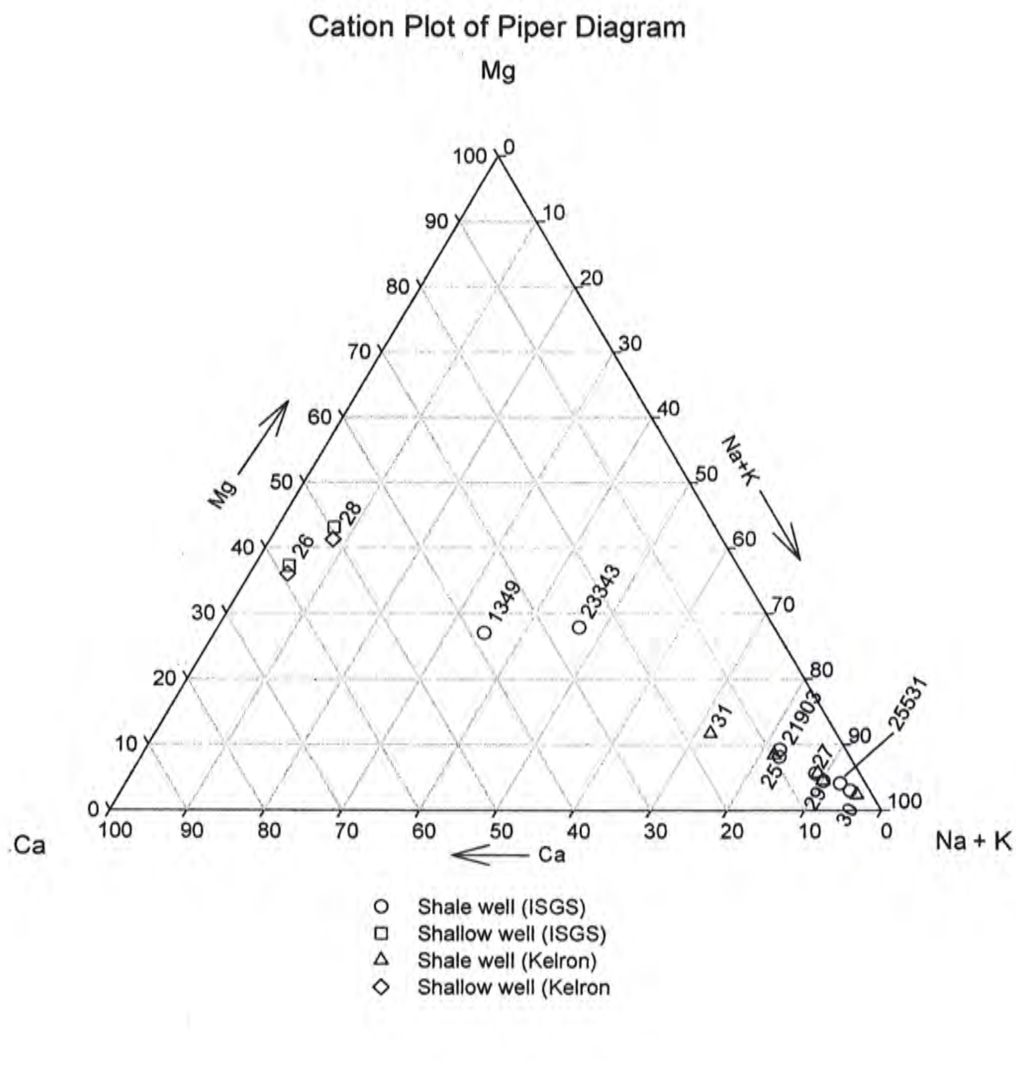


Table 11. Isotopic data for ISGS sampled wells

Parameter	Units	Well Number							
		1349	25531	KELRON 25	KELRON 26	KELRON 27	KELRON 28	KELRON 29	KELRON 30
^{14}C	RYBP	2,180	21,160	13,920	210	19,400	modern	34,610	20,850
	% modern carbon	76	7.2	18	97	8.9	102	1.4	7.5
Tritium	TU	7.8	<0.43	<0.43	5.3	<0.43	5.8	<0.52	<0.43

KELRON 28) were completed in Quaternary geologic materials and appear to draw water from the local groundwater flow system. The third well (well 1349) is completed in the shallow bedrock, but apparently draws some recent water from the overlying Quaternary geologic materials. The remaining wells (KELRON 25, KELRON 27, KELRON 29, KELRON 30, and KELRON 31) apparently draw water from the bedrock and are either only slightly connected to or completely isolated from the local groundwater flow system.

When expressing ^{14}C as % modern carbon, ^{14}C has an inverse linear relationship with TDS, sodium, and chloride and a positive linear relationship with calcium. These relationships were determined using linear regression and had coefficients of determination or R^2 ranging from 0.46 (for TDS) to 0.73 (for Ca).

3.3 Equilibrium Geochemical Modeling

The geochemical model, MINTEQA2 (Allison et al., 1990), is an equilibrium geochemical model used to calculate the theoretical composition of an aqueous solution at equilibrium, with or without contacting solids (minerals). Because they are in dynamic relationships with their environment, most groundwater systems are not at equilibrium. The use of a geochemical equilibrium model, however, provides an approximation of the geochemical reactions that might occur in a groundwater system.

Input data for MINTEQA2 from the two KELRON wells screened in Pennsylvanian shale (KELRON 25 and KELRON 30) included major element water chemistry and selected mineral components of the shale in the screened interval of the wells. The aqueous components input to the model were carbonate (from alkalinity determinations), calcium, iron (as Fe^{2+}), magnesium, potassium, sodium, silicon (as H_4SiO_4), chloride, sulfate, Eh, and pH. Trace elements were not used because of their negligible influence on the water chemistry. The only minerals included in the model were kaolinite, quartz, and siderite. Thermodynamic data for other minerals present in the shale, such as illite, K-feldspar, plagioclase feldspar, and chlorite, were not available in the model's database. Kaolinite, quartz, and siderite were set as infinitely available, i.e., they were assumed to never completely dissolve from the rock.

In operation, MINTEQA2 initially calculates the charge balance of the input solution. The errors for the charge balances between anions and cations were 2% and 6% for KELRON 25 and KELRON 30, respectively, using data derived by the ISGS for the aqueous composition. After the initial calculation of the charge balance, the model determines which minerals in its database could potentially precipitate, due to the components in the aqueous phase. For example, if manganese were not present as an aqueous component, then rhodochrosite ($MnCO_3$) would not be among the potential precipitates. The model then calculates which of the potential solid phases is most supersaturated according to a comparison of the mineral's solubility product (K_{sp}) with the activity product of the relevant components of the aqueous phase. For example, if calcite ($CaCO_3$) is the most supersaturated mineral, MINTEQA2 calculates the activity product of $(Ca^{2+})(CO_3^{2-})$ and compares this product with the K_{sp} for calcite. Sufficient Ca^{2+} and CO_3^{2-} are subtracted from the aqueous phase and added to the solid phase so that the resulting aqueous activity product equals the K_{sp}. At this point, the solid and aqueous phases are in equilibrium with respect to calcite. MINTEQA2 then calculates the next most supersaturated solid phase and repeats the above procedure. Dissolution of minerals is also accomplished in an iterative manner, by addition of solutes from the solid phase to the aqueous phase.

The modeling results for KELRON 25 and KELRON 30 were that calcite ($CaCO_3$) and wustite (FeO) are allowed to precipitate from the water in both wells. In addition, magnesite ($MgCO_3$) is allowed to precipitate from the water in KELRON 30. The mass of minerals that were calculated to precipitate per liter of water were small: 0.1 to 0.2 g calcite, 0.08 to 0.4 g wustite, and approximately 0.09 g magnesite. The calculated equilibrium pH values for the water in KELRON 25 and KELRON 30 were 8.55 and 9.20 while the mean observed pH values at the time of collection were 7.78 and 8.24, respectively.

When the mean observed pH values were imposed as the equilibrium values, then only about 0.09 g of calcite was calculated to precipitate per liter of water in both wells, with neither wustite nor magnesite precipitating. This is the most likely scenario. Given sufficient time, calcite will probably precipitate in the wells screened in the Pennsylvanian shale. If water were removed from the wells and stored (e.g., in a tank), then calcite and siderite ($FeCO_3$) were calculated to precipitate when the observed pH was imposed as the equilibrium pH.

4. SUMMARY & CONCLUSIONS

Great variability was observed in the geochemical data for the Pennsylvanian bedrock, Pennsylvanian groundwater, and other data collected for this project. Some of this variability is due to the different lithologies which includes sandstone, shale, coal, limestone, and sand and gravel. Some of this variability is also due to the depth of the sample. For example, groundwater samples from KELRON 26 and 28 are significantly different from other samples because they were from shallow wells and are completely connected to the local groundwater system, whereas water samples from deeper wells were largely isolated from the local groundwater flow system. Although little data are available regarding the hydraulic connection between the Vermilion River and the shallow bedrock which crops out locally, we suspect that a well's position relative to recharge and discharge areas affects the concentrations of major cations and anions in the groundwater samples.

Some general observations can be made regarding the groundwater compositions, although exceptions can be found for most of these observations.

> The samples collected for this study have a similar range in the concentrations of major anions and cations as those from available groundwater samples collected over a broader geographic area.

> The average concentrations of calcium, magnesium, sulfate, and alkalinity were higher in water from two shallow wells (KELRON 26 and 28) than in the wells developed in shale (KELRON 25, 27, 29, 30, and 31). This indicates a possibility that the aquifer rocks of the shallow wells contained greater contents of calcite/dolomite and gypsum or magnesite than the wells completed in shale. Water from the wells completed in shale contained higher concentrations of aluminum, barium, bromide, boron, chloride, fluoride, iron, lithium, potassium, sodium, and strontium. The greater aluminum concentration in the water suggests greater clay contents in the shale aquifer rocks than in the shallow wells.

> For samples from bedrock wells, sodium and chloride concentrations apparently increase at the expense of calcium, magnesium, and other higher valence cations due to adsorption as groundwater moves away from recharge areas.

> Compared to samples from the deeper bedrock wells, samples from shallow wells generally have higher tritium and % modern carbon, suggesting the addition of recent water.

> Equilibrium modeling showed that calcite is expected to precipitate from water derived from the shale wells, given enough time for equilibrium to become established. The calcite might eventually plug well screens. If water is pumped from the shale aquifer and stored in a tank, calcite is expected to precipitate in the tank and accumulate slowly on the tank walls and bottom.

The mineralogy of an aquifer governs the chemical composition of the associated groundwater. Mineralogical analyses were conducted to aid in understanding the chemical composition of the groundwater, and to provide information for geochemical modeling. The mineralogical analyses showed that three cores collected during this project (KELRON 29, KELRON 30, and KELRON 31) consisted principally of shale, composed of clay minerals and quartz with minor amounts of K-feldspar, plagioclase feldspar, siderite, and marcasite or pyrite. Coal was penetrated while drilling KELRON 30, and a small amount was recovered at the bottom of that core. The most abundant clay minerals in the cores were illite, kaolinite, and chlorite, with minor amounts of illite/smectite mixed-layer clay.

ACKNOWLEDGMENTS

This study was partially funded by a grant from KELRON Environmental, Inc. of Champaign, IL. We gratefully acknowledge the well owners who allowed us to sample their wells. In addition, we received technical assistance with sampling from Gina Eversole, Dynegy, Inc., Lindsay Hagemeyer, Dynegy, Inc. and Stuart Cravens, KELRON.

Chris Stohr, ISGS, collected the natural gamma logs from 3 wells.

Randy Hughes, Phil DeMaris, Makiko Otao, and Mary Hynes of the ISGS conducted the PIMA and XRD analyses.

The ISGS Isotope Geochemistry Lab ran the tritium and ^{14}C analyses. Keith Hackley, ISGS, assisted with the interpretation of the isotopic data.

Alec M. Davis, ISGS, compiled much of the geochemical data and prepared some of the figures for this report.

Mike Knapp, ISGS, drafted figures 1 & 2 for this report.

Tracy D. Branam, Indiana Geological Survey, provided data for the Indiana wells included in this report.

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Appendix A. Geologic Logs of Selected Bedrock Core

The core descriptions by Kolata and Jacobson include a stratigraphic interpretation of the core and appear first. The core descriptions by DeMaris emphasize lithologic and structural features of the core.

Kelron Environmental MW 25

Vermilion Power Station
Danville, Vermilion County, IL
(NW, NW, NW, Sec. 29, T. 20 N., R. 12 W.)
Description by Dennis R. Kolata and Russell J. Jacobson, March 14, 2002

Pennsylvanian System
Shelburn Formation
Unnamed Shale above the Danville Coal

9' to at 39' (TD)
Shale, light to medium gray, massive beds, blocky fracture, silty, micaceous, abundant carbonized plant material, bioturbated; interbeds of very light gray shale between 1 mm and 30 mm thick.

Kelron Environmental MW 30

Vermilion Power Station
Danville, Vermilion County, IL
(SW, NE, NE, Sec. 20, T. 20 N., R. 12 W.)
Description by Dennis R. Kolata and Russell J. Jacobson, March 14, 2002

Pennsylvanian System
Shelburn Formation

Farmington Shale
116' to 135'
Shale, medium gray, massive beds, blocky fractures, silty, micaceous; 1-2 " thick brownish-gray siderite nodules beginning a 128', non-marine.

135' to 144'
Shale, medium to dark gray, somewhat less silty than above, brownish-gray siderite nodules mostly 1 cm thick; first appearance of marine fossils 135.5' (strophomenid brachiopods, gastropods, and bivalves increase in abundance downward).

144' to 145'
Shale, dark gray to black, organic-rich, contains white needle-like crystals.

Danville Coal
145' to 148'
Coal, abundant pyrite along cleats

Kelron Environmental MW 31
Vermilion Power Station
Danville, Vermilion County, IL
(SW, NE, NE, Sec. 20, T. 20 N., R. 12 W.)
Description by Dennis R. Kolata and Russell J. Jacobson, March 14, 2002

Pennsylvanian System
Shelburn Formation?

Unnamed Shale above the Danville Coal
154' to 173'
Shale, medium gray, massive beds, blocky fractures, bioturbated, silty, micaceous, not fossiliferous.

173' to 183' (TD)
Shale, medium to dark gray, siderite nodules up to 3 cm thick, bioturbated, silty, micaceous; small bivalves suggest that this is a marine shale.

Boring: **KELRON 25** (HQ or 2.5 inch core)
Location: NW/4 of NW/4 of NW/4, Sec 29, T20N, R12W, Vermilion County, IL

Total Depth= 39 feet, Surface Elevation= 578.8 feet
Description by Philip J. DeMaris, June 2002

Interval (ft)			**Description**
Top	Bottom	Thickness	
9.00	11.25	2.25	Shale– light to medium gray, slightly silty, especially as silt lenses from 10.35 to 11.25', slightly micaeous, horizontal bedding, slightly weathered at top
11.25	30.60	19.35	Shale– medium gray, silty, slightly micaeous and finely carbonaceous, multiple siltstone bands in interval from 18.10 to 30.60', planar bedding
30.60	36.87	6.27	Shale– medium gray, slightly silty, some pyrite, predominantly planar bedding
36.87	38.82	1.95	Shale– medium gray, very slightly silty, some clay lenses, silt lenses and carbonaceous debris rare, faint planar bedding with some bioturbation
			total core= 29.82'

Boring: **KELRON 30** (HQ or 2.5 inch core)
Location: SW/4 of NE/4 of NE/4, Sec 20, T20N, R12W, Vermilion County, IL

Total Depth= 148 feet, Surface Elevation= 645.7 feet
Description by Philip J. DeMaris, June 2002

Interval (ft)			**Description**
Top	Bottom	Thickness	
119.00	126.92	7.92	Shale– light to medium gray, slightly silty, sparsely micaeous above 123', slightly weathered at top, fractured on multiple low-angle planes in top 1.5', generally planar bedding throughout, two medium-angle faults from 121.1 to 121.7'
126.92	131.20	4.28	Shale– medium gray, nonmicaeous, multiple siderite bands/nodules

Interval (ft)			Description
Top	Bottom	Thickness	
131.20	138.68	7.48	Shale– medium gray, finely carbonaceous, many siderite bands/ nodules throughout, scattered marine fossils in interval 136-138'
138.68	144.38	5.70	Shale– dark gray, becoming more carbonaceous and pyritic downward, siderite nodules present in top 1.3', sulfide-rich carb. claystone at base, strongly weathered
144.38	148.00	3.62	Coal (Danville Coal)– normally bright banded, well cleated, pyritic, calcite and kaolinite on cleat, some fusain present throughout
			total core= 29.0'

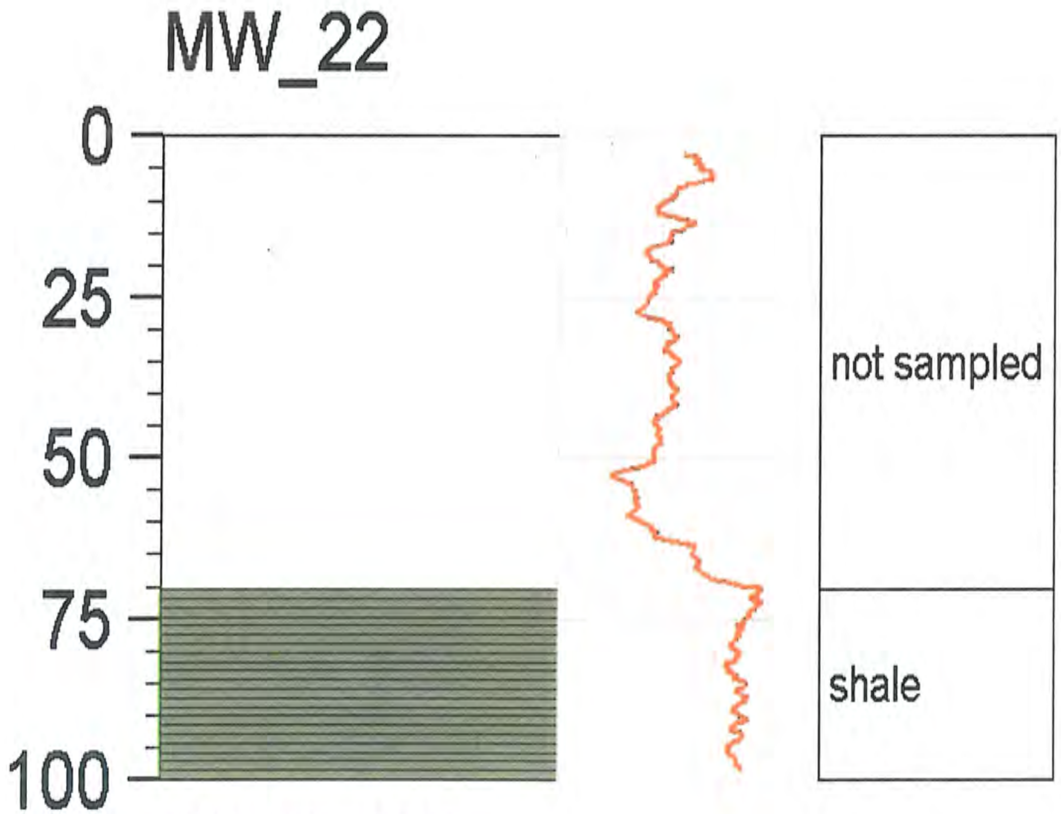
Boring: **KELRON 31** (HQ or 2.5 inch core)
Location: NE/4 of SW/4 of SW/4, Sec 21, T20N, R12W, Vermilion County, IL

Total Depth= 184 feet, Surface Elevation= 698.2 feet
Description by Philip J. DeMaris, June 2002

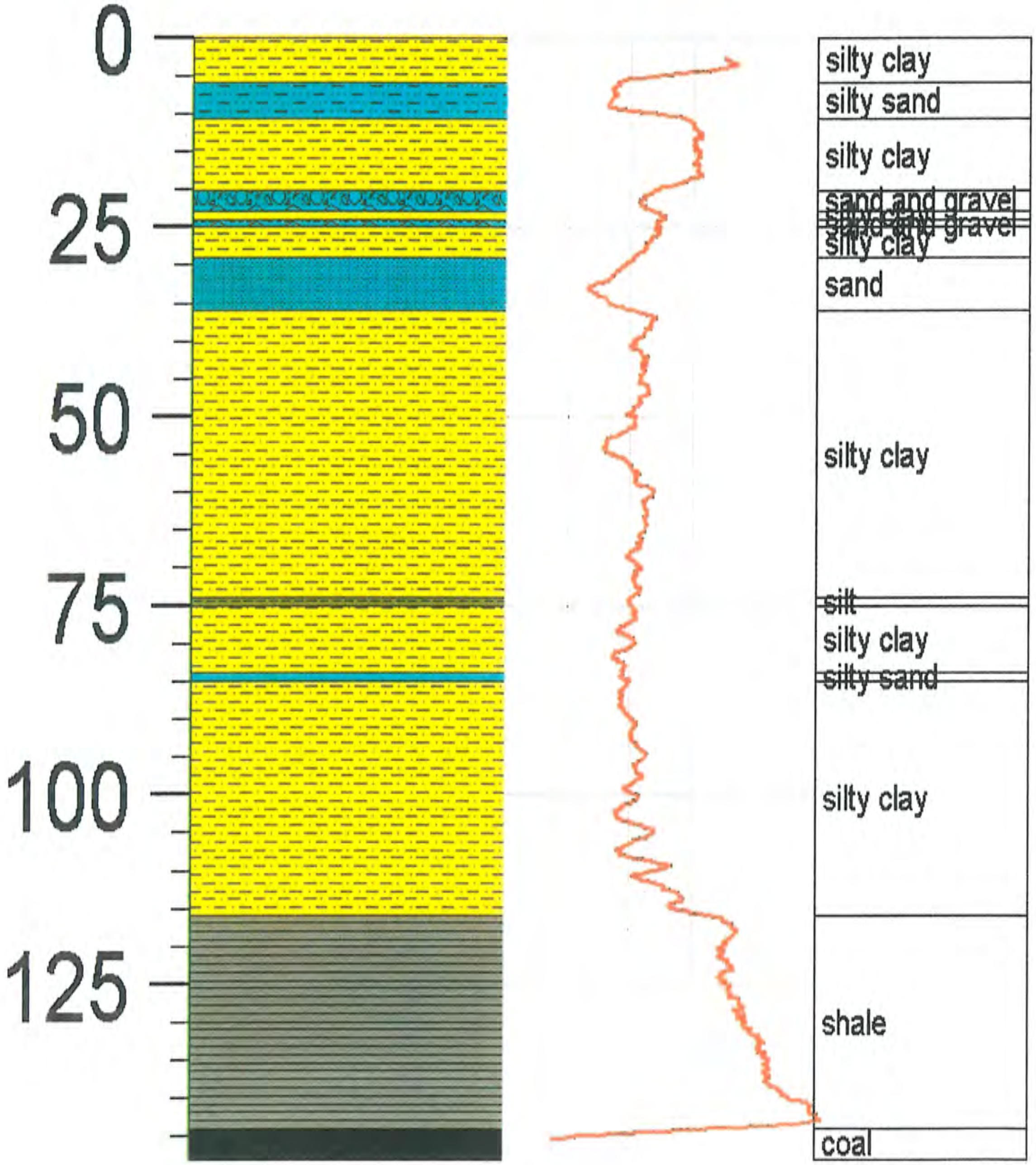
Interval (ft)			Description
Top	Bottom	Thickness	
153.00	157.55	4.55	Shale– light to medium gray, slightly silty, well weathered in top 1.2', carbonaceous debris rare, several low angle faults
157.55	170.30	12.75	Shale– light to medium gray, silty, slightly micaeous, unweathered, competent, uniformly faintly laminated, less silty below 164', very faintly horizontally bedded, planar fault (59° dip) centered at 168.8'
170.30	180.80	10.50	Shale– medium gray, slightly silty at top, minor sideritized banding near top of interval, many siderite bands and nodules from 173.7' to base
180.80	182.82	2.02	Shale– dark gray, with multiple siderite bands, very finely carbonaceous
			total core= 29.82'

Appendix B. Natural Gamma Logs of Selected KELRON Wells

Natural gamma logs for three KELRON wells (KELRON 22, KELRON 30, and KELRON 32) were collected by Chris Stohr of the ISGS in May 2002. The natural gamma logs shown in this appendix are scaled from 0 to 100 cps. In general, higher gamma counts reflect geologic materials with higher clay content such as shales and clayey diamictons.



MW_30



0
25
50
75
100
125
silty clay
silty sand
silty clay
sand and gravel
silty clay
sand
silty clay
silt
silty clay
silty sand
silty clay
shale
coal

Exhibit D

DECLARATION OF CYNTHIA VODOPIVEC
ON BEHALF OF ELECTRIC ENERGY INC.

I, Cynthia Vodopivec, affirm and declare as follows:

1. I present this Declaration on behalf of Dynegy Midwest Generation, LLC (hereinafter "DMG"). I am Senior Vice President, Environmental Health and Safety at Vistra Corp., the indirect corporate parent of DMG. As part of my duties, I oversee permitting, regulatory development, compliance (air, water, and waste issues), and health and safety at the Company, including DMG's Vermilion Power Plant in Vermilion County, Illinois. I received a Bachelor's Degree in Engineering from Dartmouth College in 1998 and an MBA from Rensselaer in 2009. I state the following in support of DMG's Petition for Review of Illinois Environmental Protection Agency's Non-Concurrence with Alternative Source Demonstration under 35 Ill. Adm. Code Part 845 and Motion for Stay ("Petition").

2. DMG received IEPA's letter dated August 22, 2024, notifying DMG of IEPA's nonconcurrence with the Vermilion Power Plant New East Ash Pond ("NEAP") Alternative Source Demonstration via U.S. Mail on August 26, 2024. This letter is attached as Exhibit A of the Petition.

3. Assuming conducting an analysis of leachable chloride from CCR in the NEAP using synthetic precipitation leaching procedure (SPLP) testing would involve drilling into the NEAP with 10 borings using specialized equipment to collect 30 samples, followed by laboratory analysis, data evaluation and reporting for those samples (and assuming a driller is readily available, which is not always the case), this process would likely take approximately 12 - 15 weeks, and would likely cost approximately $65,000 - $80,000.

FURTHER, the Declarant sayeth not.

Dated: September 27, 2024

Cynthia E Vodopivec
____

Exhibit E

Dynegy Midwest Generation, LLC
1500 Eastport Plaza Drive
Collinsville, IL 62234

May 25, 2024

Illinois Environmental Protection Agency
DWPC – Permits MC#15
Attn: Part 845 Coal Combustion Residual Rule Submittal
1021 North Grand Avenue East
Springfield, IL 62794

Re: Vermilion Power Plant New East Ash Pond; IEPA ID # W1838000002-04

Dear Mr. LeCrone:

In accordance with Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845.610(b)(3)(D), Dynegy Midwest Generation, LLC is submitting groundwater monitoring data for the Quarter 1, 2024 sampling event at the Vermilion Power Plant New East Ash Pond, identified by Illinois Environmental Protection Agency (IEPA) ID No. W1838000002-04. This data is being submitted and placed in the facility's operating record as required by 35 I.A.C. § 845.800(d)(15) within 60 days of receiving final laboratory analytical data. Results were compared with the groundwater protection standards (GWPSs) described in 35 I.A.C. § 845.600 to determine statistical exceedances of the GWPS.

The date of this submittal is considered to be the date that exceedances of the GWPSs were detected. This notification of exceedances of the GWPSs in 35 I.A.C. § 845.600 will be placed in the facility's operating record within 30 days as required by 35 I.A.C. § 845.800(d)(16).

As allowed in 35 I.A.C. § 845.650(e), an Alternative Source Demonstration (ASD) was submitted on December 1, 2023 for the GWPS exceedances of chloride, lithium, sulfate, and total dissolved solids (TDS) detected at compliance monitoring wells 35D and 70D during the Quarter 2, 2023 sampling event. The Illinois IEPA provided a written response on December 11, 2023 that did not concur with the ASD. A second ASD was submitted on May 8, 2024 for the GWPS exceedance of chloride at well 71D during the Quarter 4, 2023 sampling event. Exceedances of chloride, lithium, sulfate, and TDS were detected during the Quarter 1, 2024 sampling event in the same monitoring wells identified in the December 1, 2023 ASD.

A Corrective Measures Assessment (CMA) for the remaining GWPS exceedances of sulfate and TDS at compliance monitoring well 70S was initiated on December 10, 2023 in accordance with 35 I.A.C. § 845.660. GWPS exceedances for subsequent events will be incorporated into the CMA on a case-by-case basis, as opposed to generating a new CMA. As allowed in 35 I.A.C. § 845.650(e), an ASD will be evaluated for new detected exceedances of the GWPS and, if successfully completed, the ASD will be submitted to IEPA within 60 days of this transmittal.

Sincerely,

Dianna Tickner

Dianna Tickner, PE, PMP
Senior Director, Demolition and Decommission

Enclosures

Groundwater Monitoring Data and Detected Exceedances, Quarter 1, 2024, New East Ash Pond (NEAP), Vermilion Power Plant, Oakwood, Illinois

RAMBOLL

ENVIRONMENT
& HEALTH

35 I.A.C. § 845.610(b)(3)(D)
GROUNDWATER MONITORING DATA AND DETECTED EXCEEDANCES
QUARTER 1, 2024
NEW EAST ASH POND (NEAP), VERMILION POWER PLANT, OAKWOOD, ILLINOIS

May 25, 2024

Samples were collected on February 20 and 21, 2024, and analyzed for the parameters listed in Title 35 of the Illinois Administrative Code (35 I.A.C.) § 845.600(a), calcium, and turbidity. Final laboratory analytical data was received on March 26, 2024.

The monitoring well locations are included in Figure 1. Attachment A summarizes the groundwater elevation data for the Quarter 1, 2024 sampling event. Table 1 is a summary of the field parameters and analytical results. Attachment B contains the associated laboratory analytical reports and field data sheets for the Quarter 1, 2024 sampling event. Monitoring well 71S had insufficient water to sample for this sampling event. Monitoring well 71D purged dry during sample collection. Monitoring wells 16B and 35S were dry; therefore, groundwater elevation data were not recorded and groundwater samples were not collected for this sampling event.

Statistical procedures used to evaluate groundwater results are provided in Appendix A of the Groundwater Monitoring Plan[1] provided in the operating permit application. In accordance with 35 I.A.C. § 845.610(b)(3)(B), the Quarter 1, 2024 groundwater monitoring data were evaluated for statistical exceedances over background levels for the constituents listed in 35 I.A.C. § 845.600. Attachment C shows the statistically derived values compared to background levels.

In accordance with 35 I.A.C. § 845.610(b)(3)(C), the statistically derived values identified as Statistical Results in Table 2 were compared with the groundwater protection standards (GWPSs) described in 35 I.A.C. § 845.600 to determine statistical exceedances of the GWPS, as shown in Table 2. The date of this submittal is considered to be the date that the exceedances were detected.

As allowed in 35 I.A.C. § 845.650(e), an Alternative Source Demonstration[2] (ASD) was submitted on December 1, 2023 for the GWPS exceedances of chloride, lithium, sulfate, and total dissolved solids (TDS) detected at compliance monitoring wells 35D and 70D during the Quarter 2, 2023 sampling event. The Illinois Environmental Protection Agency (IEPA) provided a written response on December 11, 2023 that did not concur with the ASD[3]. A second ASD[4] was submitted on May 8, 2024 for the GWPS exceedance of chloride at well 71D during the Quarter 4, 2023 sampling event. Exceedances of chloride, lithium, sulfate, and TDS were detected during the Quarter 1, 2024 sampling event in the same monitoring wells identified in the December 1, 2023 ASD.

[1] Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2021. Groundwater Monitoring Plan. New East Ash Pond. Vermilion Power Plant. Oakwood, Illinois. October 25, 2021.

[2] Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2023. *35 I.A.C. § 845.650(E): Alternative Source Demonstration, New East Ash Pond, Oakwood, Illinois, IEPA ID: W1838000002-04*. December 1, 2023.

[3] Illinois Environmental Protection Agency (IEPA), 2023. *Letter from Michael Summers (IEPA) to Dianna Tickner (Dynegy Midwest Generation, LLC): Re: Vermilion Power Plant New East Ash Pond– W1838000002-04, Alternative Soruce Demonstration (ASD) Submittal*. December 28, 2023.

[4] Ramboll Americas Engineering Solutions, Inc. (Ramboll), 2024. *35 I.A.C. § 845.650(E): Alternative Source Demonstration, New East Ash Pond, Oakwood, Illinois, IEPA ID: W1838000002-04*. May 8, 2024.

A Corrective Measures Assessment (CMA) for the remaining GWPS exceedances of sulfate and TDS at compliance monitoring well 70S was initiated on December 10, 2023 in accordance with 35 I.A.C. § 845.660. GWPS exceedances for subsequent events will be incorporated into the CMA on a case-by-case basis, as opposed to generating a new CMA. As allowed in 35 I.A.C. § 845.650(e), an ASD will be evaluated for new detected exceedances of the GWPS and, if successfully completed, the ASD will be submitted to IEPA within 60 days of this transmittal.

TABLES

FIGURES

ATTACHMENTS

TABLES

TABLE 1.
FIELD PARAMETERS AND ANALYTICAL RESULTS - QUARTER 1, 2024
845 QUARTERLY REPORT
VERMILION POWER PLANT
NEW EAST ASH POND
OAKWOOD, IL

Well ID	Well Type	Event	Date	Parameter	Result	Unit
10	Background	E004	02/20/2024	Antimony, total	0.0013 U	mg/L
10	Background	E004	02/20/2024	Arsenic, total	0.00023 U	mg/L
10	Background	E004	02/20/2024	Barium, total	0.0760	mg/L
10	Background	E004	02/20/2024	Beryllium, total	0.00053 U	mg/L
10	Background	E004	02/20/2024	Boron, total	0.0680 J+	mg/L
10	Background	E004	02/20/2024	Cadmium, total	0.00017 U	mg/L
10	Background	E004	02/20/2024	Calcium, total	180	mg/L
10	Background	E004	02/20/2024	Chloride, total	3.50	mg/L
10	Background	E004	02/20/2024	Chromium, total	0.0024 J	mg/L
10	Background	E004	02/20/2024	Cobalt, total	0.00320	mg/L
10	Background	E004	02/20/2024	Dissolved Oxygen	3.11	mg/L
10	Background	E004	02/20/2024	Fluoride, total	0.130	mg/L
10	Background	E004	02/20/2024	Lead, total	0.00019 U	mg/L
10	Background	E004	02/20/2024	Lithium, total	0.0140	mg/L
10	Background	E004	02/20/2024	Mercury, total	0.000079 U	mg/L
10	Background	E004	02/20/2024	Molybdenum, total	0.0025 U	mg/L
10	Background	E004	02/20/2024	Oxidation Reduction Potential	28.8	mV
10	Background	E004	02/20/2024	pH (field)	6.8	SU
10	Background	E004	02/20/2024	Radium 226 + Radium 228, total	2.51	pCi/L
10	Background	E004	02/20/2024	Selenium, total	0.0013 J	mg/L
10	Background	E004	02/20/2024	Specific Conductance @ 25C (field)	1,099	micromhos/cm
10	Background	E004	02/20/2024	Sulfate, total	300	mg/L
10	Background	E004	02/20/2024	Temperature	12.7	degrees C
10	Background	E004	02/20/2024	Thallium, total	0.00057 U	mg/L
10	Background	E004	02/20/2024	Total Dissolved Solids	1,100	mg/L
10	Background	E004	02/20/2024	Turbidity, field	8.45	NTU
22	Background	E004	02/21/2024	Antimony, total	0.0013 U	mg/L
22	Background	E004	02/21/2024	Arsenic, total	0.00023 U	mg/L
22	Background	E004	02/21/2024	Barium, total	0.0840	mg/L
22	Background	E004	02/21/2024	Beryllium, total	0.00053 U	mg/L
22	Background	E004	02/21/2024	Boron, total	0.400 J+	mg/L
22	Background	E004	02/21/2024	Cadmium, total	0.00017 U	mg/L
22	Background	E004	02/21/2024	Calcium, total	46.0	mg/L
22	Background	E004	02/21/2024	Chloride, total	7.70	mg/L
22	Background	E004	02/21/2024	Chromium, total	0.0011 U	mg/L
22	Background	E004	02/21/2024	Cobalt, total	0.0004 U	mg/L
22	Background	E004	02/21/2024	Dissolved Oxygen	0.120	mg/L
22	Background	E004	02/21/2024	Fluoride, total	0.370	mg/L
22	Background	E004	02/21/2024	Lead, total	0.0005 UJ	mg/L
22	Background	E004	02/21/2024	Lithium, total	0.0280	mg/L
22	Background	E004	02/21/2024	Mercury, total	0.000079 U	mg/L
22	Background	E004	02/21/2024	Molybdenum, total	0.0025 U	mg/L
22	Background	E004	02/21/2024	Oxidation Reduction Potential	-73.5	mV
22	Background	E004	02/21/2024	pH (field)	7.4	SU
22	Background	E004	02/21/2024	Radium 226 + Radium 228, total	0.724	pCi/L
22	Background	E004	02/21/2024	Selenium, total	0.00098 U	mg/L

TABLE 1.
FIELD PARAMETERS AND ANALYTICAL RESULTS - QUARTER 1, 2024
845 QUARTERLY REPORT
VERMILION POWER PLANT
NEW EAST ASH POND
OAKWOOD, IL

Well ID	Well Type	Event	Date	Parameter	Result	Unit
22	Background	E004	02/21/2024	Specific Conductance @ 25C (field)	623	micromhos/cm
22	Background	E004	02/21/2024	Sulfate, total	29.0	mg/L
22	Background	E004	02/21/2024	Temperature	13.2	degrees C
22	Background	E004	02/21/2024	Thallium, total	0.00057 U	mg/L
22	Background	E004	02/21/2024	Total Dissolved Solids	490	mg/L
22	Background	E004	02/21/2024	Turbidity, field	6.40	NTU
16B	Compliance	E004	--	Antimony, total	--	mg/L
16B	Compliance	E004	--	Arsenic, total	--	mg/L
16B	Compliance	E004	--	Barium, total	--	mg/L
16B	Compliance	E004	--	Beryllium, total	--	mg/L
16B	Compliance	E004	--	Boron, total	--	mg/L
16B	Compliance	E004	--	Cadmium, total	--	mg/L
16B	Compliance	E004	--	Calcium, total	--	mg/L
16B	Compliance	E004	--	Chloride, total	--	mg/L
16B	Compliance	E004	--	Chromium, total	--	mg/L
16B	Compliance	E004	--	Cobalt, total	--	mg/L
16B	Compliance	E004	--	Dissolved Oxygen	--	mg/L
16B	Compliance	E004	--	Fluoride, total	--	mg/L
16B	Compliance	E004	--	Lead, total	--	mg/L
16B	Compliance	E004	--	Lithium, total	--	mg/L
16B	Compliance	E004	--	Mercury, total	--	mg/L
16B	Compliance	E004	--	Molybdenum, total	--	mg/L
16B	Compliance	E004	--	Oxidation Reduction Potential	--	mV
16B	Compliance	E004	--	pH (field)	--	SU
16B	Compliance	E004	--	Radium 226 + Radium 228, total	--	pCi/L
16B	Compliance	E004	--	Selenium, total	--	mg/L
16B	Compliance	E004	--	Specific Conductance @ 25C (field)	--	micromhos/cm
16B	Compliance	E004	--	Sulfate, total	--	mg/L
16B	Compliance	E004	--	Temperature	--	degrees C
16B	Compliance	E004	--	Thallium, total	--	mg/L
16B	Compliance	E004	--	Total Dissolved Solids	--	mg/L
16B	Compliance	E004	--	Turbidity, field	--	NTU
16A	Compliance	E004	02/21/2024	Antimony, total	0.0013 U	mg/L
16A	Compliance	E004	02/21/2024	Arsenic, total	0.00530	mg/L
16A	Compliance	E004	02/21/2024	Barium, total	0.340	mg/L
16A	Compliance	E004	02/21/2024	Beryllium, total	0.00061 J	mg/L
16A	Compliance	E004	02/21/2024	Boron, total	0.620 J+	mg/L
16A	Compliance	E004	02/21/2024	Cadmium, total	0.00017 U	mg/L
16A	Compliance	E004	02/21/2024	Calcium, total	30.0	mg/L
16A	Compliance	E004	02/21/2024	Chloride, total	140	mg/L
16A	Compliance	E004	02/21/2024	Chromium, total	0.0140	mg/L
16A	Compliance	E004	02/21/2024	Cobalt, total	0.0110	mg/L
16A	Compliance	E004	02/21/2024	Dissolved Oxygen	2.86	mg/L
16A	Compliance	E004	02/21/2024	Fluoride, total	0.870	mg/L
16A	Compliance	E004	02/21/2024	Lead, total	0.00810 J+	mg/L
16A	Compliance	E004	02/21/2024	Lithium, total	0.0460	mg/L

TABLE 1.
FIELD PARAMETERS AND ANALYTICAL RESULTS - QUARTER 1, 2024
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VERMILION POWER PLANT
NEW EAST ASH POND
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Well ID	Well Type	Event	Date	Parameter	Result	Unit
16A	Compliance	E004	02/21/2024	Mercury, total	0.000079 U	mg/L
16A	Compliance	E004	02/21/2024	Molybdenum, total	0.0025 U	mg/L
16A	Compliance	E004	02/21/2024	Oxidation Reduction Potential	-102	mV
16A	Compliance	E004	02/21/2024	pH (field)	7.7	SU
16A	Compliance	E004	02/21/2024	Radium 226 + Radium 228, total	1.77	pCi/L
16A	Compliance	E004	02/21/2024	Selenium, total	0.00098 U	mg/L
16A	Compliance	E004	02/21/2024	Specific Conductance @ 25C (field)	1,032	micromhos/cm
16A	Compliance	E004	02/21/2024	Sulfate, total	5.20	mg/L
16A	Compliance	E004	02/21/2024	Temperature	12.1	degrees C
16A	Compliance	E004	02/21/2024	Thallium, total	0.00057 U	mg/L
16A	Compliance	E004	02/21/2024	Total Dissolved Solids	650	mg/L
16A	Compliance	E004	02/21/2024	Turbidity, field	136	NTU
35S	Compliance	E004	--	Antimony, total	--	mg/L
35S	Compliance	E004	--	Arsenic, total	--	mg/L
35S	Compliance	E004	--	Barium, total	--	mg/L
35S	Compliance	E004	--	Beryllium, total	--	mg/L
35S	Compliance	E004	--	Boron, total	--	mg/L
35S	Compliance	E004	--	Cadmium, total	--	mg/L
35S	Compliance	E004	--	Calcium, total	--	mg/L
35S	Compliance	E004	--	Chloride, total	--	mg/L
35S	Compliance	E004	--	Chromium, total	--	mg/L
35S	Compliance	E004	--	Cobalt, total	--	mg/L
35S	Compliance	E004	--	Dissolved Oxygen	--	mg/L
35S	Compliance	E004	--	Fluoride, total	--	mg/L
35S	Compliance	E004	--	Lead, total	--	mg/L
35S	Compliance	E004	--	Lithium, total	--	mg/L
35S	Compliance	E004	--	Mercury, total	--	mg/L
35S	Compliance	E004	--	Molybdenum, total	--	mg/L
35S	Compliance	E004	--	Oxidation Reduction Potential	--	mV
35S	Compliance	E004	--	pH (field)	--	SU
35S	Compliance	E004	--	Radium 226 + Radium 228, total	--	pCi/L
35S	Compliance	E004	--	Selenium, total	--	mg/L
35S	Compliance	E004	--	Specific Conductance @ 25C (field)	--	micromhos/cm
35S	Compliance	E004	--	Sulfate, total	--	mg/L
35S	Compliance	E004	--	Temperature	--	degrees C
35S	Compliance	E004	--	Thallium, total	--	mg/L
35S	Compliance	E004	--	Total Dissolved Solids	--	mg/L
35S	Compliance	E004	--	Turbidity, field	--	NTU
35D	Compliance	E004	02/21/2024	Antimony, total	0.0013 U	mg/L
35D	Compliance	E004	02/21/2024	Arsenic, total	0.0023 J	mg/L
35D	Compliance	E004	02/21/2024	Barium, total	0.0260	mg/L
35D	Compliance	E004	02/21/2024	Beryllium, total	0.00053 U	mg/L
35D	Compliance	E004	02/21/2024	Boron, total	2.10	mg/L
35D	Compliance	E004	02/21/2024	Cadmium, total	0.00017 U	mg/L
35D	Compliance	E004	02/21/2024	Calcium, total	110	mg/L
35D	Compliance	E004	02/21/2024	Chloride, total	440	mg/L

TABLE 1.
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Well ID	Well Type	Event	Date	Parameter	Result	Unit
35D	Compliance	E004	02/21/2024	Chromium, total	0.0011 U	mg/L
35D	Compliance	E004	02/21/2024	Cobalt, total	0.0004 U	mg/L
35D	Compliance	E004	02/21/2024	Dissolved Oxygen	0.140	mg/L
35D	Compliance	E004	02/21/2024	Fluoride, total	0.700	mg/L
35D	Compliance	E004	02/21/2024	Lead, total	0.0005 UJ	mg/L
35D	Compliance	E004	02/21/2024	Lithium, total	0.130	mg/L
35D	Compliance	E004	02/21/2024	Mercury, total	0.000079 U	mg/L
35D	Compliance	E004	02/21/2024	Molybdenum, total	0.0035 J	mg/L
35D	Compliance	E004	02/21/2024	Oxidation Reduction Potential	-16.2	mV
35D	Compliance	E004	02/21/2024	pH (field)	7.4	SU
35D	Compliance	E004	02/21/2024	Radium 226 + Radium 228, total	0.558	pCi/L
35D	Compliance	E004	02/21/2024	Selenium, total	0.00098 U	mg/L
35D	Compliance	E004	02/21/2024	Specific Conductance @ 25C (field)	4,000	micromhos/cm
35D	Compliance	E004	02/21/2024	Sulfate, total	1,600	mg/L
35D	Compliance	E004	02/21/2024	Temperature	12.5	degrees C
35D	Compliance	E004	02/21/2024	Thallium, total	0.00057 U	mg/L
35D	Compliance	E004	02/21/2024	Total Dissolved Solids	3,900	mg/L
35D	Compliance	E004	02/21/2024	Turbidity, field	31.0	NTU
70S	Compliance	E004	02/21/2024	Antimony, total	0.0013 U	mg/L
70S	Compliance	E004	02/21/2024	Arsenic, total	0.00032 J	mg/L
70S	Compliance	E004	02/21/2024	Barium, total	0.0240	mg/L
70S	Compliance	E004	02/21/2024	Beryllium, total	0.00053 U	mg/L
70S	Compliance	E004	02/21/2024	Boron, total	0.430 J+	mg/L
70S	Compliance	E004	02/21/2024	Cadmium, total	0.00026 J	mg/L
70S	Compliance	E004	02/21/2024	Calcium, total	210	mg/L
70S	Compliance	E004	02/21/2024	Chloride, total	11.0	mg/L
70S	Compliance	E004	02/21/2024	Chromium, total	0.0011 U	mg/L
70S	Compliance	E004	02/21/2024	Cobalt, total	0.0004 U	mg/L
70S	Compliance	E004	02/21/2024	Dissolved Oxygen	0.220	mg/L
70S	Compliance	E004	02/21/2024	Fluoride, total	0.130	mg/L
70S	Compliance	E004	02/21/2024	Lead, total	0.00019 U	mg/L
70S	Compliance	E004	02/21/2024	Lithium, total	0.00930	mg/L
70S	Compliance	E004	02/21/2024	Mercury, total	0.000079 U	mg/L
70S	Compliance	E004	02/21/2024	Molybdenum, total	0.0034 J	mg/L
70S	Compliance	E004	02/21/2024	Oxidation Reduction Potential	68.4	mV
70S	Compliance	E004	02/21/2024	pH (field)	6.9	SU
70S	Compliance	E004	02/21/2024	Radium 226 + Radium 228, total	0.325	pCi/L
70S	Compliance	E004	02/21/2024	Selenium, total	0.00098 U	mg/L
70S	Compliance	E004	02/21/2024	Specific Conductance @ 25C (field)	1,298	micromhos/cm
70S	Compliance	E004	02/21/2024	Sulfate, total	600	mg/L
70S	Compliance	E004	02/21/2024	Temperature	11.0	degrees C
70S	Compliance	E004	02/21/2024	Thallium, total	0.00057 U	mg/L
70S	Compliance	E004	02/21/2024	Total Dissolved Solids	1,200	mg/L
70S	Compliance	E004	02/21/2024	Turbidity, field	6.82	NTU
70D	Compliance	E004	02/21/2024	Antimony, total	0.0013 U	mg/L
70D	Compliance	E004	02/21/2024	Arsenic, total	0.00058 J	mg/L

TABLE 1.
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Well ID	Well Type	Event	Date	Parameter	Result	Unit
70D	Compliance	E004	02/21/2024	Barium, total	0.680	mg/L
70D	Compliance	E004	02/21/2024	Beryllium, total	0.00053 U	mg/L
70D	Compliance	E004	02/21/2024	Boron, total	1.50	mg/L
70D	Compliance	E004	02/21/2024	Cadmium, total	0.00017 U	mg/L
70D	Compliance	E004	02/21/2024	Calcium, total	84.0	mg/L
70D	Compliance	E004	02/21/2024	Chloride, total	730	mg/L
70D	Compliance	E004	02/21/2024	Chromium, total	0.0035 J	mg/L
70D	Compliance	E004	02/21/2024	Cobalt, total	0.00270	mg/L
70D	Compliance	E004	02/21/2024	Dissolved Oxygen	0.300	mg/L
70D	Compliance	E004	02/21/2024	Fluoride, total	0.400	mg/L
70D	Compliance	E004	02/21/2024	Lead, total	0.00200 J+	mg/L
70D	Compliance	E004	02/21/2024	Lithium, total	0.0970	mg/L
70D	Compliance	E004	02/21/2024	Mercury, total	0.000079 U	mg/L
70D	Compliance	E004	02/21/2024	Molybdenum, total	0.0025 U	mg/L
70D	Compliance	E004	02/21/2024	Oxidation Reduction Potential	26.7	mV
70D	Compliance	E004	02/21/2024	pH (field)	6.9	SU
70D	Compliance	E004	02/21/2024	Radium 226 + Radium 228, total	1.94	pCi/L
70D	Compliance	E004	02/21/2024	Selenium, total	0.00098 U	mg/L
70D	Compliance	E004	02/21/2024	Specific Conductance @ 25C (field)	2,781	micromhos/cm
70D	Compliance	E004	02/21/2024	Sulfate, total	43.0	mg/L
70D	Compliance	E004	02/21/2024	Temperature	11.7	degrees C
70D	Compliance	E004	02/21/2024	Thallium, total	0.00057 U	mg/L
70D	Compliance	E004	02/21/2024	Total Dissolved Solids	1,900	mg/L
70D	Compliance	E004	02/21/2024	Turbidity, field	19.6	NTU
71S	Compliance	E004	--	Antimony, total	--	mg/L
71S	Compliance	E004	--	Arsenic, total	--	mg/L
71S	Compliance	E004	--	Barium, total	--	mg/L
71S	Compliance	E004	--	Beryllium, total	--	mg/L
71S	Compliance	E004	--	Boron, total	--	mg/L
71S	Compliance	E004	--	Cadmium, total	--	mg/L
71S	Compliance	E004	--	Calcium, total	--	mg/L
71S	Compliance	E004	--	Chloride, total	--	mg/L
71S	Compliance	E004	--	Chromium, total	--	mg/L
71S	Compliance	E004	--	Cobalt, total	--	mg/L
71S	Compliance	E004	--	Dissolved Oxygen	--	mg/L
71S	Compliance	E004	--	Fluoride, total	--	mg/L
71S	Compliance	E004	--	Lead, total	--	mg/L
71S	Compliance	E004	--	Lithium, total	--	mg/L
71S	Compliance	E004	--	Mercury, total	--	mg/L
71S	Compliance	E004	--	Molybdenum, total	--	mg/L
71S	Compliance	E004	--	Oxidation Reduction Potential	--	mV
71S	Compliance	E004	--	pH (field)	--	SU
71S	Compliance	E004	--	Radium 226 + Radium 228, total	--	pCi/L
71S	Compliance	E004	--	Selenium, total	--	mg/L
71S	Compliance	E004	--	Specific Conductance @ 25C (field)	--	micromhos/cm
71S	Compliance	E004	--	Sulfate, total	--	mg/L

TABLE 1.
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Well ID	Well Type	Event	Date	Parameter	Result	Unit
71S	Compliance	E004	--	Temperature	--	degrees C
71S	Compliance	E004	--	Thallium, total	--	mg/L
71S	Compliance	E004	--	Total Dissolved Solids	--	mg/L
71S	Compliance	E004	--	Turbidity, field	--	NTU
71D	Compliance	E004	--	Antimony, total	--	mg/L
71D	Compliance	E004	--	Arsenic, total	--	mg/L
71D	Compliance	E004	--	Barium, total	--	mg/L
71D	Compliance	E004	--	Beryllium, total	--	mg/L
71D	Compliance	E004	--	Boron, total	--	mg/L
71D	Compliance	E004	--	Cadmium, total	--	mg/L
71D	Compliance	E004	--	Calcium, total	--	mg/L
71D	Compliance	E004	--	Chloride, total	--	mg/L
71D	Compliance	E004	--	Chromium, total	--	mg/L
71D	Compliance	E004	--	Cobalt, total	--	mg/L
71D	Compliance	E004	--	Dissolved Oxygen	--	mg/L
71D	Compliance	E004	--	Fluoride, total	--	mg/L
71D	Compliance	E004	--	Lead, total	--	mg/L
71D	Compliance	E004	--	Lithium, total	--	mg/L
71D	Compliance	E004	--	Mercury, total	--	mg/L
71D	Compliance	E004	--	Molybdenum, total	--	mg/L
71D	Compliance	E004	--	Oxidation Reduction Potential	--	mV
71D	Compliance	E004	--	pH (field)	--	SU
71D	Compliance	E004	--	Radium 226 + Radium 228, total	--	pCi/L
71D	Compliance	E004	--	Selenium, total	--	mg/L
71D	Compliance	E004	--	Specific Conductance @ 25C (field)	--	micromhos/cm
71D	Compliance	E004	--	Sulfate, total	--	mg/L
71D	Compliance	E004	--	Temperature	--	degrees C
71D	Compliance	E004	--	Thallium, total	--	mg/L
71D	Compliance	E004	--	Total Dissolved Solids	--	mg/L
71D	Compliance	E004	--	Turbidity, field	--	NTU

Notes:
− = no data available
C = Celsius
cm = centimeter
mg/L = milligrams per liter
mV = millivolts
NTU = Nephelometric Turbidity Units
pCi/L = picocuries per liter
SU = Standard Units
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
J+ = The result is an estimated quantity, but the result may be biased high.
U = The analyte was analyzed for, but was not detected above the level of the adjusted detection limit or quantitation limit, as appropriate.
UJ = The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

TABLE 2.
COMPARISON OF STATISTICAL RESULTS TO GWPS - QUARTER 1, 2024
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NEW EAST ASH POND
OAKWOOD, IL

Well ID	HSU	Event	Parameter	Units	Date Range	Sample Count	Percent ND	Statistical Calculation	Statistical Result	GWPS	GWPS Source	Compliance Result
16B	UU	E004	Antimony, total	mg/L	--	--	--	--	--	0.006	Standard	--
16B	UU	E004	Arsenic, total	mg/L	--	--	--	--	--	0.010	Standard	--
16B	UU	E004	Barium, total	mg/L	--	--	--	--	--	2.0	Standard	--
16B	UU	E004	Beryllium, total	mg/L	--	--	--	--	--	0.004	Standard	--
16B	UU	E004	Boron, total	mg/L	--	--	--	--	--	2	Standard	--
16B	UU	E004	Cadmium, total	mg/L	--	--	--	--	--	0.005	Standard	--
16B	UU	E004	Chloride, total	mg/L	--	--	--	--	--	200	Standard	--
16B	UU	E004	Chromium, total	mg/L	--	--	--	--	--	0.1	Standard	--
16B	UU	E004	Cobalt, total	mg/L	--	--	--	--	--	0.0900	Background	--
16B	UU	E004	Fluoride, total	mg/L	--	--	--	--	--	4.0	Standard	--
16B	UU	E004	Lead, total	mg/L	--	--	--	--	--	0.0075	Standard	--
16B	UU	E004	Lithium, total	mg/L	--	--	--	--	--	0.04	Standard	--
16B	UU	E004	Mercury, total	mg/L	--	--	--	--	--	0.002	Standard	--
16B	UU	E004	Molybdenum, total	mg/L	--	--	--	--	--	0.1	Standard	--
16B	UU	E004	pH (field)	SU	--	--	--	--	--	6.3/9.0	Background/Standard	--
16B	UU	E004	Radium 226 + Radium 228, total	pCi/L	--	--	--	--	--	7.00	Background	--
16B	UU	E004	Selenium, total	mg/L	--	--	--	--	--	0.05	Standard	--
16B	UU	E004	Sulfate, total	mg/L	--	--	--	--	--	400	Standard	--
16B	UU	E004	Thallium, total	mg/L	--	--	--	--	--	0.002	Standard	--
16B	UU	E004	Total Dissolved Solids	mg/L	--	--	--	--	--	1,200	Standard	--
16A	BCU	E004	Antimony, total	mg/L	04/01/21 - 02/21/24	11	91	CI around median	0.001	0.006	Standard	No Exceedance
16A	BCU	E004	Arsenic, total	mg/L	04/01/21 - 02/21/24	11	0	CI around geomean	0.00117	0.010	Standard	No Exceedance
16A	BCU	E004	Barium, total	mg/L	04/01/21 - 02/21/24	11	0	CI around mean	0.25	2.0	Standard	No Exceedance
16A	BCU	E004	Beryllium, total	mg/L	04/01/21 - 02/21/24	11	100	All ND - Last	0.001	0.004	Standard	No Exceedance
16A	BCU	E004	Boron, total	mg/L	04/01/21 - 02/21/24	11	0	CI around mean	0.674	2	Standard	No Exceedance
16A	BCU	E004	Cadmium, total	mg/L	04/01/21 - 02/21/24	11	100	All ND - Last	0.0005	0.005	Standard	No Exceedance
16A	BCU	E004	Chloride, total	mg/L	04/01/21 - 02/21/24	11	0	CI around mean	126	200	Standard	No Exceedance

TABLE 2.
COMPARISON OF STATISTICAL RESULTS TO GWPS - QUARTER 1, 2024
845 QUARTERLY REPORT
VERMILION POWER PLANT
NEW EAST ASH POND
OAKWOOD, IL

Well ID	HSU	Event	Parameter	Units	Date Range	Sample Count	Percent ND	Statistical Calculation	Statistical Result	GWPS	GWPS Source	Compliance Result
16A	BCU	E004	Chromium, total	mg/L	04/01/21 - 02/21/24	11	91	CB around T-S line	0.0015	0.1	Standard	No Exceedance
16A	BCU	E004	Cobalt, total	mg/L	04/01/21 - 02/21/24	11	91	CI around median	0.001	0.0900	Background	No Exceedance
16A	BCU	E004	Fluoride, total	mg/L	04/01/21 - 02/21/24	11	9	CI around mean	0.663	4.0	Standard	No Exceedance
16A	BCU	E004	Lead, total	mg/L	04/01/21 - 02/21/24	11	91	CI around median	0.0005	0.0075	Standard	No Exceedance
16A	BCU	E004	Lithium, total	mg/L	04/01/21 - 02/21/24	11	0	CB around linear reg	0.0289	0.04	Standard	No Exceedance
16A	BCU	E004	Mercury, total	mg/L	04/01/21 - 02/21/24	11	100	All ND - Last	0.0002	0.002	Standard	No Exceedance
16A	BCU	E004	Molybdenum, total	mg/L	04/01/21 - 02/21/24	11	100	All ND - Last	0.005	0.1	Standard	No Exceedance
16A	BCU	E004	pH (field)	SU	04/01/21 - 02/21/24	16	0	CI around mean	7.2/7.5	6.3/9.0	Background/Standard	No Exceedance
16A	BCU	E004	Radium 226 + Radium 228, total	pCi/L	04/01/21 - 02/21/24	10	0	CI around mean	0.465	7.00	Background	No Exceedance
16A	BCU	E004	Selenium, total	mg/L	04/01/21 - 02/21/24	11	100	All ND - Last	0.0025	0.05	Standard	No Exceedance
16A	BCU	E004	Sulfate, total	mg/L	04/01/21 - 02/21/24	16	5	CB around linear reg	-24	400	Standard	No Exceedance
16A	BCU	E004	Thallium, total	mg/L	04/01/21 - 02/21/24	11	100	All ND - Last	0.002	0.002	Standard	No Exceedance
16A	BCU	E004	Total Dissolved Solids	mg/L	04/01/21 - 02/21/24	16	0	CI around mean	646	1,200	Standard	No Exceedance
35S	UU	E004	Antimony, total	mg/L	--	--	--	--	--	0.006	Standard	--
35S	UU	E004	Arsenic, total	mg/L	--	--	--	--	--	0.010	Standard	--
35S	UU	E004	Barium, total	mg/L	--	--	--	--	--	2.0	Standard	--
35S	UU	E004	Beryllium, total	mg/L	--	--	--	--	--	0.004	Standard	--
35S	UU	E004	Boron, total	mg/L	--	--	--	--	--	2	Standard	--
35S	UU	E004	Cadmium, total	mg/L	--	--	--	--	--	0.005	Standard	--
35S	UU	E004	Chloride, total	mg/L	--	--	--	--	--	200	Standard	--
35S	UU	E004	Chromium, total	mg/L	--	--	--	--	--	0.1	Standard	--
35S	UU	E004	Cobalt, total	mg/L	--	--	--	--	--	0.0900	Background	--
35S	UU	E004	Fluoride, total	mg/L	--	--	--	--	--	4.0	Standard	--
35S	UU	E004	Lead, total	mg/L	--	--	--	--	--	0.0075	Standard	--
35S	UU	E004	Lithium, total	mg/L	--	--	--	--	--	0.04	Standard	--
35S	UU	E004	Mercury, total	mg/L	--	--	--	--	--	0.002	Standard	--
35S	UU	E004	Molybdenum, total	mg/L	--	--	--	--	--	0.1	Standard	--

TABLE 2.
COMPARISON OF STATISTICAL RESULTS TO GWPS - QUARTER 1, 2024
845 QUARTERLY REPORT
VERMILION POWER PLANT
NEW EAST ASH POND
OAKWOOD, IL

Well ID	HSU	Event	Parameter	Units	Date Range	Sample Count	Percent ND	Statistical Calculation	Statistical Result	GWPS	GWPS Source	Compliance Result
35S	UU	E004	pH (field)	SU	--	--	--	--	--	6.3/9.0	Background/Standard	--
35S	UU	E004	Radium 226 + Radium 228, total	pCi/L	--	--	--	--	--	7.00	Background	--
35S	UU	E004	Selenium, total	mg/L	--	--	--	--	--	0.05	Standard	--
35S	UU	E004	Sulfate, total	mg/L	--	--	--	--	--	400	Standard	--
35S	UU	E004	Thallium, total	mg/L	--	--	--	--	--	0.002	Standard	--
35S	UU	E004	Total Dissolved Solids	mg/L	--	--	--	--	--	1,200	Standard	--
35D	BCU	E004	Antimony, total	mg/L	04/01/21 - 02/21/24	12	75	CI around median	0.001	0.006	Standard	No Exceedance
35D	BCU	E004	Arsenic, total	mg/L	04/01/21 - 02/21/24	12	17	CI around geomean	0.00164	0.010	Standard	No Exceedance
35D	BCU	E004	Barium, total	mg/L	04/01/21 - 02/21/24	12	0	CI around median	0.026	2.0	Standard	No Exceedance
35D	BCU	E004	Beryllium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.001	0.004	Standard	No Exceedance
35D	BCU	E004	Boron, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	1.64	2	Standard	No Exceedance
35D	BCU	E004	Cadmium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.0005	0.005	Standard	No Exceedance
35D	BCU	E004	Chloride, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	302	200	Standard	Exceedance
35D	BCU	E004	Chromium, total	mg/L	04/01/21 - 02/21/24	12	75	CI around median	0.0015	0.1	Standard	No Exceedance
35D	BCU	E004	Cobalt, total	mg/L	04/01/21 - 02/21/24	12	42	CI around median	0.001	0.0900	Background	No Exceedance
35D	BCU	E004	Fluoride, total	mg/L	04/01/21 - 02/21/24	12	8	CI around mean	0.642	4.0	Standard	No Exceedance
35D	BCU	E004	Lead, total	mg/L	04/01/21 - 02/21/24	12	50	CI around geomean	0.000579	0.0075	Standard	No Exceedance
35D	BCU	E004	Lithium, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	0.112	0.04	Standard	Exceedance
35D	BCU	E004	Mercury, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.0002	0.002	Standard	No Exceedance
35D	BCU	E004	Molybdenum, total	mg/L	04/01/21 - 02/21/24	12	25	CB around linear reg	-0.00104	0.1	Standard	No Exceedance
35D	BCU	E004	pH (field)	SU	04/01/21 - 02/21/24	16	0	CI around median	7.3/7.4	6.3/9.0	Background/Standard	No Exceedance
35D	BCU	E004	Radium 226 + Radium 228, total	pCi/L	04/01/21 - 02/21/24	11	0	CI around mean	0.333	7.00	Background	No Exceedance
35D	BCU	E004	Selenium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.0025	0.05	Standard	No Exceedance
35D	BCU	E004	Sulfate, total	mg/L	04/01/21 - 02/21/24	17	0	CI around mean	1,100	400	Standard	Exceedance
35D	BCU	E004	Thallium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.002	0.002	Standard	No Exceedance
35D	BCU	E004	Total Dissolved Solids	mg/L	04/01/21 - 02/21/24	17	0	CI around mean	2,710	1,200	Standard	Exceedance
70S	UU	E004	Antimony, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.003	0.006	Standard	No Exceedance

TABLE 2.
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845 QUARTERLY REPORT
VERMILION POWER PLANT
NEW EAST ASH POND
OAKWOOD, IL

Well ID	HSU	Event	Parameter	Units	Date Range	Sample Count	Percent ND	Statistical Calculation	Statistical Result	GWPS	GWPS Source	Compliance Result
70S	UU	E004	Arsenic, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.001	0.010	Standard	No Exceedance
70S	UU	E004	Barium, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	0.0166	2.0	Standard	No Exceedance
70S	UU	E004	Beryllium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.001	0.004	Standard	No Exceedance
70S	UU	E004	Boron, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	0.366	2	Standard	No Exceedance
70S	UU	E004	Cadmium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.0005	0.005	Standard	No Exceedance
70S	UU	E004	Chloride, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	13.2	200	Standard	No Exceedance
70S	UU	E004	Chromium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.005	0.1	Standard	No Exceedance
70S	UU	E004	Cobalt, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.001	0.0900	Background	No Exceedance
70S	UU	E004	Fluoride, total	mg/L	04/01/21 - 02/21/24	12	8	CI around median	0.14	4.0	Standard	No Exceedance
70S	UU	E004	Lead, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.0005	0.0075	Standard	No Exceedance
70S	UU	E004	Lithium, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	0.0112	0.04	Standard	No Exceedance
70S	UU	E004	Mercury, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.0002	0.002	Standard	No Exceedance
70S	UU	E004	Molybdenum, total	mg/L	04/01/21 - 02/21/24	12	25	CI around median	0.005	0.1	Standard	No Exceedance
70S	UU	E004	pH (field)	SU	04/01/21 - 02/21/24	12	0	CI around mean	6.9/7.0	6.3/9.0	Background/Standard	No Exceedance
70S	UU	E004	Radium 226 + Radium 228, total	pCi/L	04/01/21 - 02/21/24	11	0	CI around geomean	0.0972	7.00	Background	No Exceedance
70S	UU	E004	Selenium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.0025	0.05	Standard	No Exceedance
70S	UU	E004	Sulfate, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	605	400	Standard	Exceedance
70S	UU	E004	Thallium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.002	0.002	Standard	No Exceedance
70S	UU	E004	Total Dissolved Solids	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	1,230	1,200	Standard	Exceedance
70D	BCU	E004	Antimony, total	mg/L	04/01/21 - 02/21/24	12	83	CI around median	0.001	0.006	Standard	No Exceedance
70D	BCU	E004	Arsenic, total	mg/L	04/01/21 - 02/21/24	12	58	CI around median	0.001	0.010	Standard	No Exceedance
70D	BCU	E004	Barium, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	0.461	2.0	Standard	No Exceedance
70D	BCU	E004	Beryllium, total	mg/L	04/01/21 - 02/21/24	12	75	CI around median	0.001	0.004	Standard	No Exceedance
70D	BCU	E004	Boron, total	mg/L	04/01/21 - 02/21/24	12	0	CI around median	1.01	2	Standard	No Exceedance
70D	BCU	E004	Cadmium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.0005	0.005	Standard	No Exceedance
70D	BCU	E004	Chloride, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	525	200	Standard	Exceedance
70D	BCU	E004	Chromium, total	mg/L	04/01/21 - 02/21/24	12	33	CI around geomean	0.00292	0.1	Standard	No Exceedance

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845 QUARTERLY REPORT
VERMILION POWER PLANT
NEW EAST ASH POND
OAKWOOD, IL

Well ID	HSU	Event	Parameter	Units	Date Range	Sample Count	Percent ND	Statistical Calculation	Statistical Result	GWPS	GWPS Source	Compliance Result
70D	BCU	E004	Cobalt, total	mg/L	04/01/21 - 02/21/24	12	8	CI around geomean	0.00161	0.0900	Background	No Exceedance
70D	BCU	E004	Fluoride, total	mg/L	04/01/21 - 02/21/24	12	8	CB around linear reg	0.234	4.0	Standard	No Exceedance
70D	BCU	E004	Lead, total	mg/L	04/01/21 - 02/21/24	12	17	CI around geomean	0.00137	0.0075	Standard	No Exceedance
70D	BCU	E004	Lithium, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	0.0761	0.04	Standard	Exceedance
70D	BCU	E004	Mercury, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.0002	0.002	Standard	No Exceedance
70D	BCU	E004	Molybdenum, total	mg/L	04/01/21 - 02/21/24	12	33	CB around linear reg	-0.0201	0.1	Standard	No Exceedance
70D	BCU	E004	pH (field)	SU	04/01/21 - 02/21/24	12	0	CI around mean	6.9/7.2	6.3/9.0	Background/Standard	No Exceedance
70D	BCU	E004	Radium 226 + Radium 228, total	pCi/L	04/01/21 - 02/21/24	11	0	CI around mean	0.993	7.00	Background	No Exceedance
70D	BCU	E004	Selenium, total	mg/L	04/01/21 - 02/21/24	12	83	CI around median	0.001	0.05	Standard	No Exceedance
70D	BCU	E004	Sulfate, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	46.5	400	Standard	No Exceedance
70D	BCU	E004	Thallium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.002	0.002	Standard	No Exceedance
70D	BCU	E004	Total Dissolved Solids	mg/L	04/01/21 - 02/21/24	12	0	CB around linear reg	1,270	1,200	Standard	Exceedance
71S	UU	E004	Antimony, total	mg/L	--	--	--	--	--	0.006	Standard	--
71S	UU	E004	Arsenic, total	mg/L	--	--	--	--	--	0.010	Standard	--
71S	UU	E004	Barium, total	mg/L	--	--	--	--	--	2.0	Standard	--
71S	UU	E004	Beryllium, total	mg/L	--	--	--	--	--	0.004	Standard	--
71S	UU	E004	Boron, total	mg/L	--	--	--	--	--	2	Standard	--
71S	UU	E004	Cadmium, total	mg/L	--	--	--	--	--	0.005	Standard	--
71S	UU	E004	Chloride, total	mg/L	--	--	--	--	--	200	Standard	--
71S	UU	E004	Chromium, total	mg/L	--	--	--	--	--	0.1	Standard	--
71S	UU	E004	Cobalt, total	mg/L	--	--	--	--	--	0.0900	Background	--
71S	UU	E004	Fluoride, total	mg/L	--	--	--	--	--	4.0	Standard	--
71S	UU	E004	Lead, total	mg/L	--	--	--	--	--	0.0075	Standard	--
71S	UU	E004	Lithium, total	mg/L	--	--	--	--	--	0.04	Standard	--
71S	UU	E004	Mercury, total	mg/L	--	--	--	--	--	0.002	Standard	--
71S	UU	E004	Molybdenum, total	mg/L	--	--	--	--	--	0.1	Standard	--
71S	UU	E004	pH (field)	SU	--	--	--	--	--	6.3/9.0	Background/Standard	--

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845 QUARTERLY REPORT
VERMILION POWER PLANT
NEW EAST ASH POND
OAKWOOD, IL

Well ID	HSU	Event	Parameter	Units	Date Range	Sample Count	Percent ND	Statistical Calculation	Statistical Result	GWPS	GWPS Source	Compliance Result
71S	UU	E004	Radium 226 + Radium 228, total	pCi/L	--	--	--	--	--	7.00	Background	--
71S	UU	E004	Selenium, total	mg/L	--	--	--	--	--	0.05	Standard	--
71S	UU	E004	Sulfate, total	mg/L	--	--	--	--	--	400	Standard	--
71S	UU	E004	Thallium, total	mg/L	--	--	--	--	--	0.002	Standard	--
71S	UU	E004	Total Dissolved Solids	mg/L	--	--	--	--	--	1,200	Standard	--
71D	BCU	E004	Antimony, total	mg/L	--	--	--	--	--	0.006	Standard	--
71D	BCU	E004	Arsenic, total	mg/L	--	--	--	--	--	0.010	Standard	--
71D	BCU	E004	Barium, total	mg/L	--	--	--	--	--	2.0	Standard	--
71D	BCU	E004	Beryllium, total	mg/L	--	--	--	--	--	0.004	Standard	--
71D	BCU	E004	Boron, total	mg/L	--	--	--	--	--	2	Standard	--
71D	BCU	E004	Cadmium, total	mg/L	--	--	--	--	--	0.005	Standard	--
71D	BCU	E004	Chloride, total	mg/L	--	--	--	--	--	200	Standard	--
71D	BCU	E004	Chromium, total	mg/L	--	--	--	--	--	0.1	Standard	--
71D	BCU	E004	Cobalt, total	mg/L	--	--	--	--	--	0.0900	Background	--
71D	BCU	E004	Fluoride, total	mg/L	--	--	--	--	--	4.0	Standard	--
71D	BCU	E004	Lead, total	mg/L	--	--	--	--	--	0.0075	Standard	--
71D	BCU	E004	Lithium, total	mg/L	--	--	--	--	--	0.04	Standard	--
71D	BCU	E004	Mercury, total	mg/L	--	--	--	--	--	0.002	Standard	--
71D	BCU	E004	Molybdenum, total	mg/L	--	--	--	--	--	0.1	Standard	--
71D	BCU	E004	pH (field)	SU	--	--	--	--	--	6.3/9.0	Background/Standard	--
71D	BCU	E004	Radium 226 + Radium 228, total	pCi/L	--	--	--	--	--	7.00	Background	--
71D	BCU	E004	Selenium, total	mg/L	--	--	--	--	--	0.05	Standard	--
71D	BCU	E004	Sulfate, total	mg/L	--	--	--	--	--	400	Standard	--
71D	BCU	E004	Thallium, total	mg/L	--	--	--	--	--	0.002	Standard	--
71D	BCU	E004	Total Dissolved Solids	mg/L	--	--	--	--	--	1,200	Standard	--

TABLE 2.
COMPARISON OF STATISTICAL RESULTS TO GWPS - QUARTER 1, 2024
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VERMILION POWER PLANT
NEW EAST ASH POND
OAKWOOD, IL

Notes:
− = no data available
Compliance Result:

No Exceedance: the statistical result did not exceed the GWPS.

Exceedance: The statistical result exceeded the GWPS.

HSU = hydrostratigraphic unit:

BCU = Bedrock Confining Unit

UU = Upper Unit

mg/L = milligrams per liter
ND = non-detect
pCi/L = picocuries per liter
SU = standard units
Sample Count = number of samples from Sampled Date Range used to calculate the Statistical Result
Statistical Calculation = method used to calculate the statistical result:

All ND - Last = All results were below the reporting limit, and the last determined reporting limit is shown

CB around T-S line = Confidence band around Thiel-Sen line

CB around linear reg = Confidence band around linear regression

CI around geomean = Confidence interval around the geometric mean

CI around mean = Confidence interval around the mean

CI around median = Confidence interval around the median

Statistical Result = calculated in accordance with the Statistical Analysis Plan using constituent concentrations observed at each monitoring well during all sampling events within the specified date range
For pH, the values presented are the lower / upper limits
GWPS = Groundwater Protection Standard
GWPS Source:

Standard = standard specified in 35 I.A.C. § 845.600(a)(1)

Background = background concentration (see cover page for additional information)

FIGURES

Y:\Mapping\Projects\22\2285\MXD\845_Operating_Permit\Vermilion\NAP_OEAP\GMP\gmp_aprx.aprx

PROJECT: 169000XXXX | DATED: 9/7/2023 | DESIGNER: egreaves

COMPLIANCE WELL
BACKGROUND WELL
SOURCE SAMPLE LOCATION
REGULATED UNIT (SUBJECT UNIT)
SITE FEATURE
PROPERTY BOUNDARY

0 150 300 Feet

MONITORING WELL LOCATION MAP

NEW EAST ASH POND
VERMILION POWER PLANT
OAKWOOD, ILLINOIS

FIGURE 1

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.

ATTACHMENTS

ATTACHMENT A
SUMMARY OF GROUNDWATER ELEVATION DATA
QUARTER 1, 2024

ATTACHMENT A.
GROUNDWATER ELEVATION DATA - QUARTER 1, 2024
845 QUARTERLY REPORT
VERMILION POWER PLANT
NEW EAST ASH POND
OAKWOOD, IL

Well ID	Well Type	Date	Depth to Groundwater (feet BMP)	Groundwater Elevation (feet NAVD88)
10	Background	02/19/2024	49.41	609.85
16B	Compliance	02/19/2024	Dry	
16A	Compliance	02/19/2024	12.05	568.44
22	Background	02/19/2024	55.33	603.46
35S	Compliance	02/19/2024	Dry	
35D	Compliance	02/19/2024	10.11	574.20
70S	Compliance	02/19/2024	10.99	582.92
70D	Compliance	02/19/2024	32.12	562.57
71S	Compliance	02/19/2024	10.15	569.58
71D	Compliance	02/19/2024	37.97	542.09
NED1	Water Level	02/19/2024	2.40	597.84

Notes:
BMP = below measuring point
NAVD88 = North American Vertical Datum of 1988

ATTACHMENT B
LABORATORY REPORTS AND FIELD DATA SHEETS
QUARTER 1, 2024

Environment Testing

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2
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4
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6
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ANALYTICAL REPORT

PREPARED FOR

Attn: Brian Voelker
Vistra Energy Corp
133 S 4th, Suite 206
Springfield, Illinois 62701

Generated 03/26/24 16:02:20

JOB DESCRIPTION

VER-24Q1
VER_845_912

JOB NUMBER

500-246480-5

Eurofins Chicago
2417 Bond Street
University Park IL 60484

See page two for job notes and contact information.

Eurofins Chicago

Job Notes

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Authorization

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Table of Contents

Case Narrative

Job Narrative
500-246480-5

Receipt
The samples were received on 02/21/24 11:20. Unless otherwise noted below, the samples arrived in good condition, and where required, properly preserved and on ice. The temperatures of the 10 coolers at receipt time were 1.5º C, 2.5º C, 2.6º C, 2.7º C, 3.6º C, 3.9º C, 4.1º C, 4.1º C, 5.1º C and 5.3º C.

Receipt Exceptions
Received 7 bottles for sample 5, COC has 6. Received Rad bottles for sample 20, not marked on COC. VER_010 (500-246480-5) and VER_ND3 (500-246480-20)
VER_ND3 (Sample 20) not requesting Rad analysis on client SARs and confirmed via email, not logged for Rad.

Metals
Method 6020B: The method blank for preparation batch 500-757078 and analytical batch 500-758475 contained Boron above the method detection limit. This target analyte concentration was less than the reporting limit (RL) in the method blank; therefore, re-extraction and/or re-analysis of samples was not performed.

Method 6020B: The method blank for preparation batch 500-756958 and analytical batch 500-758475 contained Boron and Calcium above the method detection limit. This target analyte concentration was less than the reporting limit (RL) in the method blank; therefore, re-extraction and/or re-analysis of samples was not performed.

Method 6020B: The initial low level calibration verification (ICVL) result for batch 500-758529 was above the upper control limit. The affected analyte is: Be. Sample results were below the reporting limit, and have been reported as qualified data.

Method 6020B: The continuing calibration verification (CCV) at lines 161 and 203 associated with batch 500-757459 recovered above the upper control limit for Antimony. The samples associated with these CCVs were non-detects for the affected analyte; therefore, the data have been reported.

Method 6020B: The continuing calibration blank (CCB) at lines 161 and 203 for analytical batch 500-757459 contained Antimony greater than the reporting limit (RL). The samples associated with these CCBs were non-detects for the affected analyte; therefore, the data have been reported.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

General Chemistry
Method SM 2320B: The method blank for analytical batch 500-757067 contained Alkalinity and Bicarbonate Alkalinity as CaCO3 above the reporting limit (RL). Associated sample(s) were not re-extracted and/or re-analyzed because results were greater than 10X the value found in the method blank. The following samples were affected:VER_010 (500-246480-5), VER_016A (500-246480-25), VER_022 (500-246480-26), VER_035&D (500-246480-27), VER_070#S (500-246480-29), VER_070&D (500-246480-30), VER_NED1 (500-246480-31), (500-246480-B-10), (500-246480-B-15), (500-246480-B-15 DU) and (500-246480-B-25 DU)

Method 300.0: The laboratory control sample (LCS) for analytical batch 500-757150 recovered outside control limits for the following analyte: Chloride. These analytes were biased high in the LCS and were the associated samples recovered below the reporting limit(RL); therefore, the data have been reported.

Method 300.0: The method blank for analytical batch 500-757150 contained Sulfate above the method detection limit. This target analyte concentration was less than the reporting limit (RL) in the method blank; therefore, re-extraction and/or re-analysis of samples was not performed.

Method 300.0: The method blank for analytical batch 500-757868 contained Chloride above the method detection limit. This target analyte concentration was less than the reporting limit (RL) in the method blank; therefore, re-extraction and/or re-analysis of samples was not performed.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Detection Summary

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-5
SDG: VER_845_912

Client Sample ID: VER_010 — Lab Sample ID: 500-246480-5

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Lithium	0.014		0.0050	0.0020	mg/L	1		200.7 Rev 4.4	Total Recoverable
Barium	0.076		0.0025	0.00073	mg/L	1		6020B	Total Recoverable
Boron	0.068	B	0.050	0.013	mg/L	1		6020B	Total Recoverable
Calcium	180	B	0.20	0.044	mg/L	1		6020B	Total Recoverable
Chromium	0.0024	J	0.0050	0.0011	mg/L	1		6020B	Total Recoverable
Cobalt	0.0032		0.0010	0.00040	mg/L	1		6020B	Total Recoverable
Magnesium	100		0.20	0.049	mg/L	1		6020B	Total Recoverable
Potassium	1.6		0.50	0.11	mg/L	1		6020B	Total Recoverable
Selenium	0.0013	J	0.0025	0.00098	mg/L	1		6020B	Total Recoverable
Sodium	11		0.20	0.077	mg/L	1		6020B	Total Recoverable
Chloride	3.5		1.0	0.12	mg/L	1		300.0	Total/NA
Sulfate	300		10	2.1	mg/L	10		300.0	Total/NA
Bicarbonate Alkalinity as CaCO3	540	B	5.0	3.7	mg/L	1		SM 2320B	Total/NA
Total Dissolved Solids	1100		10	4.3	mg/L	1		SM 2540C	Total/NA
Fluoride	0.13		0.10	0.056	mg/L	1		SM 4500 F C	Total/NA
Depth to Water (ft from MP)	49.31				ft	1		Field Sampling	Total/NA
Field pH	6.82				SU	1		Field Sampling	Total/NA
Field Temperature	12.7				Degrees C	1		Field Sampling	Total/NA
Oxidation Reduction Potential	28.8				millivolts	1		Field Sampling	Total/NA
Oxygen, Dissolved	3.11				mg/L	1		Field Sampling	Total/NA
Specific Conductance	1099				umhos/cm	1		Field Sampling	Total/NA
Turbidity	8.45				NTU	1		Field Sampling	Total/NA

Client Sample ID: VER_EB1 — Lab Sample ID: 500-246480-21

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Boron	0.020	J B	0.050	0.013	mg/L	1		6020B	Total Recoverable
Lead	0.00045	J	0.00050	0.00019	mg/L	1		6020B	Total Recoverable
Bicarbonate Alkalinity as CaCO3	6.3		5.0	3.7	mg/L	1		SM 2320B	Total/NA

Client Sample ID: VER_016A — Lab Sample ID: 500-246480-25

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Lithium	0.046		0.0050	0.0020	mg/L	1		200.7 Rev 4.4	Total Recoverable
Arsenic	0.0053		0.0010	0.00023	mg/L	1		6020B	Total Recoverable
Barium	0.34		0.0025	0.00073	mg/L	1		6020B	Total Recoverable
Beryllium	0.00061	J	0.0010	0.00053	mg/L	1		6020B	Total Recoverable
Boron	0.62	B	0.050	0.013	mg/L	1		6020B	Total Recoverable

This Detection Summary does not include radiochemical test results.

Detection Summary

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-5
SDG: VER_845_912

Client Sample ID: VER_016A (Continued)

Lab Sample ID: 500-246480-25

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Calcium	30		0.20	0.044	mg/L	1		6020B	Total Recoverable
Chromium	0.014		0.0050	0.0011	mg/L	1		6020B	Total Recoverable
Cobalt	0.011		0.0010	0.00040	mg/L	1		6020B	Total Recoverable
Lead	0.0081		0.00050	0.00019	mg/L	1		6020B	Total Recoverable
Magnesium	21		0.20	0.049	mg/L	1		6020B	Total Recoverable
Potassium	3.8		0.50	0.11	mg/L	1		6020B	Total Recoverable
Sodium	170		0.20	0.077	mg/L	1		6020B	Total Recoverable
Chloride	140	B	10	1.2	mg/L	10		300.0	Total/NA
Sulfate	5.2		1.0	0.21	mg/L	1		300.0	Total/NA
Bicarbonate Alkalinity as CaCO3	380		5.0	3.7	mg/L	1		SM 2320B	Total/NA
Total Dissolved Solids	650		10	4.3	mg/L	1		SM 2540C	Total/NA
Fluoride	0.87		0.10	0.056	mg/L	1		SM 4500 F C	Total/NA
Depth to Water (ft from MP)	12.13				ft	1		Field Sampling	Total/NA
Field pH	7.68				SU	1		Field Sampling	Total/NA
Field Temperature	12.1				Degrees C	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-101.8				millivolts	1		Field Sampling	Total/NA
Oxygen, Dissolved	2.86				mg/L	1		Field Sampling	Total/NA
Specific Conductance	1032				umhos/cm	1		Field Sampling	Total/NA
Turbidity	135.54				NTU	1		Field Sampling	Total/NA

Client Sample ID: VER_022

Lab Sample ID: 500-246480-26

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Lithium	0.028		0.0050	0.0020	mg/L	1		200.7 Rev 4.4	Total Recoverable
Barium	0.084		0.0025	0.00073	mg/L	1		6020B	Total Recoverable
Boron	0.40	B	0.050	0.013	mg/L	1		6020B	Total Recoverable
Calcium	46		0.20	0.044	mg/L	1		6020B	Total Recoverable
Lead	0.00019	J	0.00050	0.00019	mg/L	1		6020B	Total Recoverable
Magnesium	25		0.20	0.049	mg/L	1		6020B	Total Recoverable
Potassium	2.5		0.50	0.11	mg/L	1		6020B	Total Recoverable
Sodium	120		0.20	0.077	mg/L	1		6020B	Total Recoverable
Chloride	7.7		1.0	0.12	mg/L	1		300.0	Total/NA
Sulfate	29		1.0	0.21	mg/L	1		300.0	Total/NA
Bicarbonate Alkalinity as CaCO3	410		5.0	3.7	mg/L	1		SM 2320B	Total/NA
Total Dissolved Solids	490		10	4.3	mg/L	1		SM 2540C	Total/NA
Fluoride	0.37		0.10	0.056	mg/L	1		SM 4500 F C	Total/NA
Depth to Water (ft from MP)	55.29				ft	1		Field Sampling	Total/NA
Field pH	7.40				SU	1		Field Sampling	Total/NA
Field Temperature	13.2				Degrees C	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-73.5				millivolts	1		Field Sampling	Total/NA

This Detection Summary does not include radiochemical test results.

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Detection Summary

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-5
SDG: VER_845_912

Client Sample ID: VER_022 (Continued) — Lab Sample ID: 500-246480-26

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Oxygen, Dissolved	0.12				mg/L	1		Field Sampling	Total/NA
Specific Conductance	623				umhos/cm	1		Field Sampling	Total/NA
Turbidity	6.4				NTU	1		Field Sampling	Total/NA

Client Sample ID: VER_035&D — Lab Sample ID: 500-246480-27

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Lithium	0.13		0.0050	0.0020	mg/L	1		200.7 Rev 4.4	Total Recoverable
Arsenic	0.0023	J	0.010	0.0023	mg/L	10		6020B	Total Recoverable
Barium	0.026		0.0025	0.00073	mg/L	1		6020B	Total Recoverable
Boron	2.1	B	0.50	0.13	mg/L	10		6020B	Total Recoverable
Calcium	110		2.0	0.44	mg/L	10		6020B	Total Recoverable
Lead	0.00029	J	0.00050	0.00019	mg/L	1		6020B	Total Recoverable
Magnesium	93		0.20	0.049	mg/L	1		6020B	Total Recoverable
Molybdenum	0.0035	J	0.0050	0.0025	mg/L	1		6020B	Total Recoverable
Potassium	8.8		5.0	1.1	mg/L	10		6020B	Total Recoverable
Sodium	1100		2.0	0.77	mg/L	10		6020B	Total Recoverable
Chloride	440	B	100	12	mg/L	100		300.0	Total/NA
Sulfate	1600		100	21	mg/L	100		300.0	Total/NA
Bicarbonate Alkalinity as CaCO3	630	B	5.0	3.7	mg/L	1		SM 2320B	Total/NA
Total Dissolved Solids	3900		10	4.3	mg/L	1		SM 2540C	Total/NA
Fluoride	0.70		0.10	0.056	mg/L	1		SM 4500 F C	Total/NA
Depth to Water (ft from MP)	10.15				ft	1		Field Sampling	Total/NA
Field pH	7.42				SU	1		Field Sampling	Total/NA
Field Temperature	12.5				Degrees C	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-16.2				millivolts	1		Field Sampling	Total/NA
Oxygen, Dissolved	0.14				mg/L	1		Field Sampling	Total/NA
Specific Conductance	4000				umhos/cm	1		Field Sampling	Total/NA
Turbidity	31.0				NTU	1		Field Sampling	Total/NA

Client Sample ID: VER_070#S — Lab Sample ID: 500-246480-29

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Lithium	0.0093		0.0050	0.0020	mg/L	1		200.7 Rev 4.4	Total Recoverable
Arsenic	0.00032	J	0.0010	0.00023	mg/L	1		6020B	Total Recoverable
Barium	0.024		0.0025	0.00073	mg/L	1		6020B	Total Recoverable
Boron	0.43	B	0.050	0.013	mg/L	1		6020B	Total Recoverable
Cadmium	0.00026	J	0.00050	0.00017	mg/L	1		6020B	Total Recoverable
Calcium	210		0.20	0.044	mg/L	1		6020B	Total Recoverable

This Detection Summary does not include radiochemical test results.

Client Sample ID: VER_070#S (Continued) — Lab Sample ID: 500-246480-29

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Magnesium	90		0.20	0.049	mg/L	1		6020B	Total Recoverable
Molybdenum	0.0034	J	0.0050	0.0025	mg/L	1		6020B	Total Recoverable
Potassium	1.8		0.50	0.11	mg/L	1		6020B	Total Recoverable
Sodium	19		0.20	0.077	mg/L	1		6020B	Total Recoverable
Chloride	11		1.0	0.12	mg/L	1		300.0	Total/NA
Sulfate	600		50	10	mg/L	50		300.0	Total/NA
Bicarbonate Alkalinity as CaCO3	310	B	5.0	3.7	mg/L	1		SM 2320B	Total/NA
Total Dissolved Solids	1200		10	4.3	mg/L	1		SM 2540C	Total/NA
Fluoride	0.13		0.10	0.056	mg/L	1		SM 4500 F C	Total/NA
Depth to Water (ft from MP)	11.12				ft	1		Field Sampling	Total/NA
Field pH	6.93				SU	1		Field Sampling	Total/NA
Field Temperature	11.0				Degrees C	1		Field Sampling	Total/NA
Oxidation Reduction Potential	68.4				millivolts	1		Field Sampling	Total/NA
Oxygen, Dissolved	0.22				mg/L	1		Field Sampling	Total/NA
Specific Conductance	1298				umhos/cm	1		Field Sampling	Total/NA
Turbidity	6.82				NTU	1		Field Sampling	Total/NA

Client Sample ID: VER_070&D — Lab Sample ID: 500-246480-30

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Lithium	0.097		0.0050	0.0020	mg/L	1		200.7 Rev 4.4	Total Recoverable
Arsenic	0.00058	J	0.0010	0.00023	mg/L	1		6020B	Total Recoverable
Barium	0.68		0.0025	0.00073	mg/L	1		6020B	Total Recoverable
Boron	1.5	B	0.050	0.013	mg/L	1		6020B	Total Recoverable
Calcium	84		0.20	0.044	mg/L	1		6020B	Total Recoverable
Chromium	0.0035	J	0.0050	0.0011	mg/L	1		6020B	Total Recoverable
Cobalt	0.0027		0.0010	0.00040	mg/L	1		6020B	Total Recoverable
Lead	0.0020		0.00050	0.00019	mg/L	1		6020B	Total Recoverable
Magnesium	49		0.20	0.049	mg/L	1		6020B	Total Recoverable
Potassium	7.4		0.50	0.11	mg/L	1		6020B	Total Recoverable
Sodium	620		0.20	0.077	mg/L	1		6020B	Total Recoverable
Chloride	730	B	100	12	mg/L	100		300.0	Total/NA
Sulfate	43		1.0	0.21	mg/L	1		300.0	Total/NA
Bicarbonate Alkalinity as CaCO3	490	B	5.0	3.7	mg/L	1		SM 2320B	Total/NA
Total Dissolved Solids	1900		10	4.3	mg/L	1		SM 2540C	Total/NA
Fluoride	0.40		0.10	0.056	mg/L	1		SM 4500 F C	Total/NA
Depth to Water (ft from MP)	31.83				ft	1		Field Sampling	Total/NA
Field pH	6.91				SU	1		Field Sampling	Total/NA
Field Temperature	11.7				Degrees C	1		Field Sampling	Total/NA
Oxidation Reduction Potential	26.7				millivolts	1		Field Sampling	Total/NA

This Detection Summary does not include radiochemical test results.

Detection Summary

Client Sample ID: VER_070&D (Continued) — Lab Sample ID: 500-246480-30

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Oxygen, Dissolved	0.30				mg/L	1		Field Sampling	Total/NA
Specific Conductance	2781				umhos/cm	1		Field Sampling	Total/NA
Turbidity	19.56				NTU	1		Field Sampling	Total/NA

Client Sample ID: VER_NED1 — Lab Sample ID: 500-246480-31

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Lithium	0.24		0.0050	0.0020	mg/L	1		200.7 Rev 4.4	Total Recoverable
Arsenic	0.040		0.010	0.0023	mg/L	10		6020B	Total Recoverable
Barium	0.13		0.0025	0.00073	mg/L	1		6020B	Total Recoverable
Boron	10	B	0.50	0.13	mg/L	10		6020B	Total Recoverable
Calcium	470		2.0	0.44	mg/L	10		6020B	Total Recoverable
Lead	0.00034	J	0.00050	0.00019	mg/L	1		6020B	Total Recoverable
Magnesium	35		0.20	0.049	mg/L	1		6020B	Total Recoverable
Molybdenum	0.054		0.0050	0.0025	mg/L	1		6020B	Total Recoverable
Potassium	25		5.0	1.1	mg/L	10		6020B	Total Recoverable
Sodium	84		2.0	0.77	mg/L	10		6020B	Total Recoverable
Chloride	13		1.0	0.12	mg/L	1		300.0	Total/NA
Sulfate	1300		100	21	mg/L	100		300.0	Total/NA
Bicarbonate Alkalinity as CaCO3	100	B	5.0	3.7	mg/L	1		SM 2320B	Total/NA
Total Dissolved Solids	2200		10	4.3	mg/L	1		SM 2540C	Total/NA
Fluoride	0.099	J	0.10	0.056	mg/L	1		SM 4500 F C	Total/NA
Depth to Water (ft from MP)	2.32				ft	1		Field Sampling	Total/NA
Field pH	7.78				SU	1		Field Sampling	Total/NA
Field Temperature	10.6				Degrees C	1		Field Sampling	Total/NA
Oxidation Reduction Potential	-194.1				millivolts	1		Field Sampling	Total/NA
Oxygen, Dissolved	0.00				mg/L	1		Field Sampling	Total/NA
Specific Conductance	1721				umhos/cm	1		Field Sampling	Total/NA
Turbidity	4.63				NTU	1		Field Sampling	Total/NA

Client Sample ID: VER_FB — Lab Sample ID: 500-246480-32

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Boron	0.063	B	0.050	0.013	mg/L	1		6020B	Total Recoverable
Calcium	0.057	J	0.20	0.044	mg/L	1		6020B	Total Recoverable
Lead	0.0011		0.00050	0.00019	mg/L	1		6020B	Total Recoverable
Sodium	0.11	J	0.20	0.077	mg/L	1		6020B	Total Recoverable
Chloride	0.21	J	1.0	0.12	mg/L	1		300.0	Total/NA
Sulfate	0.40	J	1.0	0.21	mg/L	1		300.0	Total/NA
Bicarbonate Alkalinity as CaCO3	4.0	J	5.0	3.7	mg/L	1		SM 2320B	Total/NA
Total Dissolved Solids	12		10	4.3	mg/L	1		SM 2540C	Total/NA

This Detection Summary does not include radiochemical test results.

Detection Summary

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-5
SDG: VER_845_912

Client Sample ID: VER_EB2

Lab Sample ID: 500-246480-33

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Boron	0.049	J B	0.050	0.013	mg/L	1		6020B	Total Recoverable
Calcium	0.044	J	0.20	0.044	mg/L	1		6020B	Total Recoverable
Lead	0.00040	J	0.00050	0.00019	mg/L	1		6020B	Total Recoverable
Chloride	0.21	J *+	1.0	0.12	mg/L	1		300.0	Total/NA
Sulfate	0.34	J B	1.0	0.21	mg/L	1		300.0	Total/NA
Bicarbonate Alkalinity as CaCO3	8.7		5.0	3.7	mg/L	1		SM 2320B	Total/NA
Total Dissolved Solids	36		10	4.3	mg/L	1		SM 2540C	Total/NA

This Detection Summary does not include radiochemical test results.

Method Summary

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-5
SDG: VER_845_912

Method	Method Description	Protocol	Laboratory
200.7 Rev 4.4	Metals (ICP)	EPA	EET CHI
6020B	Metals (ICP/MS)	SW846	EET CHI
7470A	Mercury (CVAA)	SW846	EET CHI
300.0	Anions, Ion Chromatography	EPA	EET CHI
SM 2320B	Alkalinity	SM	EET CHI
SM 2540C	Solids, Total Dissolved (TDS)	SM	EET CHI
SM 4500 F C	Fluoride	SM	EET CHI
Field Sampling	Field Sampling	EPA	EET CHI
200.7	Preparation, Total Recoverable Metals	EPA	EET CHI
3005A	Preparation, Total Recoverable or Dissolved Metals	SW846	EET CHI
7470A	Preparation, Mercury	SW846	EET CHI

Protocol References:

EPA = US Environmental Protection Agency

SM = "Standard Methods For The Examination Of Water And Wastewater"

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

EET CHI = Eurofins Chicago, 2417 Bond Street, University Park, IL 60484, TEL (708)534-5200

Sample Summary

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-5
SDG: VER_845_912

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
500-246480-5	VER_010	Water	02/20/24 17:55	02/21/24 11:20
500-246480-21	VER_EB1	Water	02/20/24 17:50	02/21/24 11:20
500-246480-25	VER_016A	Water	02/21/24 13:15	02/22/24 11:18
500-246480-26	VER_022	Water	02/21/24 11:10	02/22/24 11:18
500-246480-27	VER_035&D	Water	02/21/24 13:05	02/22/24 11:18
500-246480-29	VER_070#S	Water	02/21/24 09:20	02/22/24 11:18
500-246480-30	VER_070&D	Water	02/21/24 08:45	02/22/24 11:18
500-246480-31	VER_NED1	Water	02/21/24 15:00	02/22/24 11:18
500-246480-32	VER_FB	Water	02/21/24 15:20	02/22/24 11:18
500-246480-33	VER_EB2	Water	02/21/24 15:50	02/22/24 11:18

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-5
SDG: VER_845_912

Client Sample ID: VER_010

Date Collected: 02/20/24 17:55
Date Received: 02/21/24 11:20

Lab Sample ID: 500-246480-5
Matrix: Water

Method: EPA 200.7 Rev 4.4 - Metals (ICP) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Lithium	**0.014**		0.0050	0.0020	mg/L		03/05/24 08:58	03/06/24 21:12	1

Method: SW846 6020B - Metals (ICP/MS) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.0030		0.0030	0.0013	mg/L		03/05/24 17:38	03/11/24 17:54	1
Arsenic	<0.0010		0.0010	0.00023	mg/L		03/05/24 17:38	03/11/24 17:54	1
Barium	**0.076**		0.0025	0.00073	mg/L		03/05/24 17:38	03/11/24 17:54	1
Beryllium	<0.0010		0.0010	0.00053	mg/L		03/05/24 17:38	03/14/24 17:43	1
Boron	**0.068**	**B**	0.050	0.013	mg/L		03/05/24 17:38	03/14/24 17:43	1
Cadmium	<0.00050		0.00050	0.00017	mg/L		03/05/24 17:38	03/11/24 17:54	1
Calcium	**180**	**B**	0.20	0.044	mg/L		03/05/24 17:38	03/14/24 17:43	1
Chromium	**0.0024**	**J**	0.0050	0.0011	mg/L		03/05/24 17:38	03/11/24 17:54	1
Cobalt	**0.0032**		0.0010	0.00040	mg/L		03/05/24 17:38	03/14/24 17:43	1
Lead	<0.00050		0.00050	0.00019	mg/L		03/05/24 17:38	03/08/24 00:44	1
Magnesium	**100**		0.20	0.049	mg/L		03/05/24 17:38	03/08/24 00:44	1
Molybdenum	<0.0050		0.0050	0.0025	mg/L		03/05/24 17:38	03/08/24 00:44	1
Potassium	**1.6**		0.50	0.11	mg/L		03/05/24 17:38	03/08/24 00:44	1
Selenium	**0.0013**	**J**	0.0025	0.00098	mg/L		03/05/24 17:38	03/11/24 17:54	1
Sodium	**11**		0.20	0.077	mg/L		03/05/24 17:38	03/14/24 17:43	1
Thallium	<0.0020		0.0020	0.00057	mg/L		03/05/24 17:38	03/08/24 00:44	1

Method: SW846 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.00020		0.00020	0.000079	mg/L		03/05/24 10:40	03/06/24 07:25	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride (EPA 300.0)	**3.5**		1.0	0.12	mg/L			03/02/24 15:34	1
Sulfate (EPA 300.0)	**300**		10	2.1	mg/L			03/02/24 15:49	10
Bicarbonate Alkalinity as CaCO3 (SM 2320B)	**540**	**B**	5.0	3.7	mg/L			03/05/24 16:37	1
Carbonate Alkalinity as CaCO3 (SM 2320B)	<5.0		5.0	3.7	mg/L			03/05/24 16:37	1
Total Dissolved Solids (SM 2540C)	**1100**		10	4.3	mg/L			02/23/24 00:19	1
Fluoride (SM 4500 F C)	**0.13**		0.10	0.056	mg/L			03/07/24 15:33	1

Method: EPA Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Depth to Water (ft from MP)	**49.31**				ft			02/20/24 17:55	1
Field pH	**6.82**				SU			02/20/24 17:55	1
Field Temperature	**12.7**				Degrees C			02/20/24 17:55	1
Oxidation Reduction Potential	**28.8**				millivolts			02/20/24 17:55	1
Oxygen, Dissolved	**3.11**				mg/L			02/20/24 17:55	1
Specific Conductance	**1099**				umhos/cm			02/20/24 17:55	1
Turbidity	**8.45**				NTU			02/20/24 17:55	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-5
SDG: VER_845_912

Client Sample ID: VER_EB1

Date Collected: 02/20/24 17:50
Date Received: 02/21/24 11:20

Lab Sample ID: 500-246480-21
Matrix: Water

Method: EPA 200.7 Rev 4.4 - Metals (ICP) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Lithium	<0.0050		0.0050	0.0020	mg/L		03/05/24 09:00	03/06/24 23:53	1

Method: SW846 6020B - Metals (ICP/MS) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.0030		0.0030	0.0013	mg/L		03/06/24 09:08	03/08/24 02:39	1
Arsenic	<0.0010	^+	0.0010	0.00023	mg/L		03/06/24 09:08	03/11/24 20:36	1
Barium	<0.0025		0.0025	0.00073	mg/L		03/06/24 09:08	03/08/24 02:39	1
Beryllium	<0.0010		0.0010	0.00053	mg/L		03/06/24 09:08	03/14/24 16:22	1
Boron	**0.020**	**J B**	0.050	0.013	mg/L		03/06/24 09:08	03/14/24 16:22	1
Cadmium	<0.00050		0.00050	0.00017	mg/L		03/06/24 09:08	03/11/24 20:36	1
Calcium	<0.20		0.20	0.044	mg/L		03/06/24 09:08	03/14/24 16:22	1
Chromium	<0.0050		0.0050	0.0011	mg/L		03/06/24 09:08	03/14/24 16:22	1
Cobalt	<0.0010		0.0010	0.00040	mg/L		03/06/24 09:08	03/08/24 02:39	1
Lead	**0.00045**	**J**	0.00050	0.00019	mg/L		03/06/24 09:08	03/08/24 02:39	1
Magnesium	<0.20		0.20	0.049	mg/L		03/06/24 09:08	03/08/24 02:39	1
Molybdenum	<0.0050		0.0050	0.0025	mg/L		03/06/24 09:08	03/08/24 02:39	1
Potassium	<0.50		0.50	0.11	mg/L		03/06/24 09:08	03/08/24 02:39	1
Selenium	<0.0025		0.0025	0.00098	mg/L		03/06/24 09:08	03/14/24 16:22	1
Sodium	<0.20		0.20	0.077	mg/L		03/06/24 09:08	03/14/24 16:22	1
Thallium	<0.0020		0.0020	0.00057	mg/L		03/06/24 09:08	03/08/24 02:39	1

Method: SW846 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.00020		0.00020	0.000079	mg/L		03/06/24 10:55	03/07/24 08:37	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride (EPA 300.0)	<1.0		1.0	0.12	mg/L			03/06/24 11:27	1
Sulfate (EPA 300.0)	<1.0		1.0	0.21	mg/L			03/06/24 11:27	1
Bicarbonate Alkalinity as CaCO3 (SM 2320B)	**6.3**		5.0	3.7	mg/L			03/05/24 19:47	1
Carbonate Alkalinity as CaCO3 (SM 2320B)	<5.0		5.0	3.7	mg/L			03/05/24 19:47	1
Total Dissolved Solids (SM 2540C)	<10		10	4.3	mg/L			02/26/24 22:53	1
Fluoride (SM 4500 F C)	<0.10		0.10	0.056	mg/L			03/07/24 17:18	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-5
SDG: VER_845_912

Client Sample ID: VER_016A

Lab Sample ID: 500-246480-25

Date Collected: 02/21/24 13:15
Date Received: 02/22/24 11:18

Matrix: Water

Method: EPA 200.7 Rev 4.4 - Metals (ICP) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Lithium	**0.046**		0.0050	0.0020	mg/L		03/05/24 09:00	03/07/24 00:20	1

Method: SW846 6020B - Metals (ICP/MS) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.0030		0.0030	0.0013	mg/L		03/06/24 09:08	03/08/24 02:53	1
Arsenic	**0.0053**		0.0010	0.00023	mg/L		03/06/24 09:08	03/15/24 14:12	1
Barium	**0.34**		0.0025	0.00073	mg/L		03/06/24 09:08	03/08/24 02:53	1
Beryllium	**0.00061**	**J**	0.0010	0.00053	mg/L		03/06/24 09:08	03/14/24 16:46	1
Boron	**0.62**	**B**	0.050	0.013	mg/L		03/06/24 09:08	03/14/24 16:46	1
Cadmium	<0.00050		0.00050	0.00017	mg/L		03/06/24 09:08	03/11/24 21:06	1
Calcium	**30**		0.20	0.044	mg/L		03/06/24 09:08	03/14/24 16:46	1
Chromium	**0.014**		0.0050	0.0011	mg/L		03/06/24 09:08	03/14/24 16:46	1
Cobalt	**0.011**		0.0010	0.00040	mg/L		03/06/24 09:08	03/08/24 02:53	1
Lead	**0.0081**		0.00050	0.00019	mg/L		03/06/24 09:08	03/08/24 02:53	1
Magnesium	**21**		0.20	0.049	mg/L		03/06/24 09:08	03/08/24 02:53	1
Molybdenum	<0.0050		0.0050	0.0025	mg/L		03/06/24 09:08	03/08/24 02:53	1
Potassium	**3.8**		0.50	0.11	mg/L		03/06/24 09:08	03/08/24 02:53	1
Selenium	<0.0025		0.0025	0.00098	mg/L		03/06/24 09:08	03/15/24 14:12	1
Sodium	**170**		0.20	0.077	mg/L		03/06/24 09:08	03/14/24 16:46	1
Thallium	<0.0020		0.0020	0.00057	mg/L		03/06/24 09:08	03/08/24 02:53	1

Method: SW846 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.00020		0.00020	0.000079	mg/L		03/06/24 10:55	03/07/24 08:50	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride (EPA 300.0)	**140**	**B**	10	1.2	mg/L			03/12/24 12:32	10
Sulfate (EPA 300.0)	**5.2**		1.0	0.21	mg/L			03/06/24 12:27	1
Bicarbonate Alkalinity as CaCO3 (SM 2320B)	**380**		5.0	3.7	mg/L			03/05/24 21:25	1
Carbonate Alkalinity as CaCO3 (SM 2320B)	<5.0		5.0	3.7	mg/L			03/05/24 21:25	1
Total Dissolved Solids (SM 2540C)	**650**		10	4.3	mg/L			02/26/24 23:03	1
Fluoride (SM 4500 F C)	**0.87**		0.10	0.056	mg/L			03/07/24 17:46	1

Method: EPA Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Depth to Water (ft from MP)	**12.13**				ft			02/21/24 13:15	1
Field pH	**7.68**				SU			02/21/24 13:15	1
Field Temperature	**12.1**				Degrees C			02/21/24 13:15	1
Oxidation Reduction Potential	**-101.8**				millivolts			02/21/24 13:15	1
Oxygen, Dissolved	**2.86**				mg/L			02/21/24 13:15	1
Specific Conductance	**1032**				umhos/cm			02/21/24 13:15	1
Turbidity	**135.54**				NTU			02/21/24 13:15	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-5
SDG: VER_845_912

Client Sample ID: VER_022

Lab Sample ID: 500-246480-26
Date Collected: 02/21/24 11:10
Date Received: 02/22/24 11:18
Matrix: Water

Method: EPA 200.7 Rev 4.4 - Metals (ICP) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Lithium	**0.028**		0.0050	0.0020	mg/L		03/05/24 09:00	03/07/24 00:24	1

Method: SW846 6020B - Metals (ICP/MS) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.0030		0.0030	0.0013	mg/L		03/06/24 09:08	03/08/24 02:56	1
Arsenic	<0.0010	^+	0.0010	0.00023	mg/L		03/06/24 09:08	03/11/24 21:10	1
Barium	**0.084**		0.0025	0.00073	mg/L		03/06/24 09:08	03/08/24 02:56	1
Beryllium	<0.0010		0.0010	0.00053	mg/L		03/06/24 09:08	03/14/24 16:50	1
Boron	**0.40**	**B**	0.050	0.013	mg/L		03/06/24 09:08	03/14/24 16:50	1
Cadmium	<0.00050		0.00050	0.00017	mg/L		03/06/24 09:08	03/11/24 21:10	1
Calcium	**46**		0.20	0.044	mg/L		03/06/24 09:08	03/14/24 16:50	1
Chromium	<0.0050		0.0050	0.0011	mg/L		03/06/24 09:08	03/14/24 16:50	1
Cobalt	<0.0010		0.0010	0.00040	mg/L		03/06/24 09:08	03/08/24 02:56	1
Lead	**0.00019**	**J**	0.00050	0.00019	mg/L		03/06/24 09:08	03/08/24 02:56	1
Magnesium	**25**		0.20	0.049	mg/L		03/06/24 09:08	03/08/24 02:56	1
Molybdenum	<0.0050		0.0050	0.0025	mg/L		03/06/24 09:08	03/08/24 02:56	1
Potassium	**2.5**		0.50	0.11	mg/L		03/06/24 09:08	03/08/24 02:56	1
Selenium	<0.0025		0.0025	0.00098	mg/L		03/06/24 09:08	03/14/24 16:50	1
Sodium	**120**		0.20	0.077	mg/L		03/06/24 09:08	03/14/24 16:50	1
Thallium	<0.0020		0.0020	0.00057	mg/L		03/06/24 09:08	03/08/24 02:56	1

Method: SW846 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.00020		0.00020	0.000079	mg/L		03/06/24 10:55	03/07/24 08:52	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride (EPA 300.0)	**7.7**		1.0	0.12	mg/L			03/06/24 12:42	1
Sulfate (EPA 300.0)	**29**		1.0	0.21	mg/L			03/06/24 12:42	1
Bicarbonate Alkalinity as CaCO3 (SM 2320B)	**410**		5.0	3.7	mg/L			03/05/24 21:45	1
Carbonate Alkalinity as CaCO3 (SM 2320B)	<5.0		5.0	3.7	mg/L			03/05/24 21:45	1
Total Dissolved Solids (SM 2540C)	**490**		10	4.3	mg/L			02/26/24 23:06	1
Fluoride (SM 4500 F C)	**0.37**		0.10	0.056	mg/L			03/07/24 18:03	1

Method: EPA Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Depth to Water (ft from MP)	**55.29**				ft			02/21/24 11:10	1
Field pH	**7.40**				SU			02/21/24 11:10	1
Field Temperature	**13.2**				Degrees C			02/21/24 11:10	1
Oxidation Reduction Potential	**-73.5**				millivolts			02/21/24 11:10	1
Oxygen, Dissolved	**0.12**				mg/L			02/21/24 11:10	1
Specific Conductance	**623**				umhos/cm			02/21/24 11:10	1
Turbidity	**6.4**				NTU			02/21/24 11:10	1

Client Sample Results

Client Sample ID: VER_035&D

Date Collected: 02/21/24 13:05
Date Received: 02/22/24 11:18

Lab Sample ID: 500-246480-27
Matrix: Water

Method: EPA 200.7 Rev 4.4 - Metals (ICP) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Lithium	**0.13**		0.0050	0.0020	mg/L		03/05/24 09:00	03/07/24 00:28	1

Method: SW846 6020B - Metals (ICP/MS) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.0030	^+	0.0030	0.0013	mg/L		03/06/24 09:08	03/08/24 03:10	1
Arsenic	**0.0023**	**J**	0.010	0.0023	mg/L		03/06/24 09:08	03/14/24 16:53	10
Barium	**0.026**		0.0025	0.00073	mg/L		03/06/24 09:08	03/11/24 21:13	1
Beryllium	<0.0010	^1+	0.0010	0.00053	mg/L		03/06/24 09:08	03/15/24 14:16	1
Boron	**2.1**	**B**	0.50	0.13	mg/L		03/06/24 09:08	03/14/24 16:53	10
Cadmium	<0.00050		0.00050	0.00017	mg/L		03/06/24 09:08	03/11/24 21:13	1
Calcium	**110**		2.0	0.44	mg/L		03/06/24 09:08	03/14/24 16:53	10
Chromium	<0.0050		0.0050	0.0011	mg/L		03/06/24 09:08	03/15/24 14:16	1
Cobalt	<0.0010	^+	0.0010	0.00040	mg/L		03/06/24 09:08	03/08/24 03:10	1
Lead	**0.00029**	**J**	0.00050	0.00019	mg/L		03/06/24 09:08	03/08/24 03:10	1
Magnesium	**93**		0.20	0.049	mg/L		03/06/24 09:08	03/08/24 03:10	1
Molybdenum	**0.0035**	**J**	0.0050	0.0025	mg/L		03/06/24 09:08	03/08/24 03:10	1
Potassium	**8.8**		5.0	1.1	mg/L		03/06/24 09:08	03/14/24 16:53	10
Selenium	<0.0025		0.0025	0.00098	mg/L		03/06/24 09:08	03/15/24 14:16	1
Sodium	**1100**		2.0	0.77	mg/L		03/06/24 09:08	03/14/24 16:53	10
Thallium	<0.0020		0.0020	0.00057	mg/L		03/06/24 09:08	03/08/24 03:10	1

Method: SW846 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.00020		0.00020	0.000079	mg/L		03/06/24 10:55	03/07/24 08:54	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride (EPA 300.0)	**440**	**B**	100	12	mg/L			03/12/24 12:47	100
Sulfate (EPA 300.0)	**1600**		100	21	mg/L			03/09/24 23:51	100
Bicarbonate Alkalinity as CaCO3 (SM 2320B)	**630**	**B**	5.0	3.7	mg/L			03/05/24 22:11	1
Carbonate Alkalinity as CaCO3 (SM 2320B)	<5.0		5.0	3.7	mg/L			03/05/24 22:11	1
Total Dissolved Solids (SM 2540C)	**3900**		10	4.3	mg/L			02/26/24 23:08	1
Fluoride (SM 4500 F C)	**0.70**		0.10	0.056	mg/L			03/07/24 18:23	1

Method: EPA Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Depth to Water (ft from MP)	**10.15**				ft			02/21/24 13:05	1
Field pH	**7.42**				SU			02/21/24 13:05	1
Field Temperature	**12.5**				Degrees C			02/21/24 13:05	1
Oxidation Reduction Potential	**-16.2**				millivolts			02/21/24 13:05	1
Oxygen, Dissolved	**0.14**				mg/L			02/21/24 13:05	1
Specific Conductance	**4000**				umhos/cm			02/21/24 13:05	1
Turbidity	**31.0**				NTU			02/21/24 13:05	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-5
SDG: VER_845_912

Client Sample ID: VER_070#S

Lab Sample ID: 500-246480-29
Date Collected: 02/21/24 09:20
Date Received: 02/22/24 11:18
Matrix: Water

Method: EPA 200.7 Rev 4.4 - Metals (ICP) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Lithium	0.0093		0.0050	0.0020	mg/L		03/05/24 09:00	03/07/24 00:37	1

Method: SW846 6020B - Metals (ICP/MS) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.0030	^+	0.0030	0.0013	mg/L		03/06/24 09:08	03/08/24 03:17	1
Arsenic	0.00032	J	0.0010	0.00023	mg/L		03/06/24 09:08	03/14/24 17:00	1
Barium	0.024		0.0025	0.00073	mg/L		03/06/24 09:08	03/11/24 21:34	1
Beryllium	<0.0010		0.0010	0.00053	mg/L		03/06/24 09:08	03/14/24 17:00	1
Boron	0.43	B	0.050	0.013	mg/L		03/06/24 09:08	03/14/24 17:00	1
Cadmium	0.00026	J	0.00050	0.00017	mg/L		03/06/24 09:08	03/11/24 21:34	1
Calcium	210		0.20	0.044	mg/L		03/06/24 09:08	03/14/24 17:00	1
Chromium	<0.0050		0.0050	0.0011	mg/L		03/06/24 09:08	03/14/24 17:00	1
Cobalt	<0.0010	^+	0.0010	0.00040	mg/L		03/06/24 09:08	03/08/24 03:17	1
Lead	<0.00050		0.00050	0.00019	mg/L		03/06/24 09:08	03/08/24 03:17	1
Magnesium	90		0.20	0.049	mg/L		03/06/24 09:08	03/08/24 03:17	1
Molybdenum	0.0034	J	0.0050	0.0025	mg/L		03/06/24 09:08	03/08/24 03:17	1
Potassium	1.8		0.50	0.11	mg/L		03/06/24 09:08	03/14/24 17:00	1
Selenium	<0.0025		0.0025	0.00098	mg/L		03/06/24 09:08	03/14/24 17:00	1
Sodium	19		0.20	0.077	mg/L		03/06/24 09:08	03/14/24 17:00	1
Thallium	<0.0020		0.0020	0.00057	mg/L		03/06/24 09:08	03/08/24 03:17	1

Method: SW846 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.00020		0.00020	0.000079	mg/L		03/06/24 10:55	03/07/24 08:58	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride (EPA 300.0)	11		1.0	0.12	mg/L			03/06/24 13:58	1
Sulfate (EPA 300.0)	600		50	10	mg/L			03/10/24 00:21	50
Bicarbonate Alkalinity as CaCO3 (SM 2320B)	310	B	5.0	3.7	mg/L			03/05/24 22:32	1
Carbonate Alkalinity as CaCO3 (SM 2320B)	<5.0		5.0	3.7	mg/L			03/05/24 22:32	1
Total Dissolved Solids (SM 2540C)	1200		10	4.3	mg/L			02/26/24 23:14	1
Fluoride (SM 4500 F C)	0.13		0.10	0.056	mg/L			03/07/24 18:32	1

Method: EPA Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Depth to Water (ft from MP)	11.12				ft			02/21/24 09:20	1
Field pH	6.93				SU			02/21/24 09:20	1
Field Temperature	11.0				Degrees C			02/21/24 09:20	1
Oxidation Reduction Potential	68.4				millivolts			02/21/24 09:20	1
Oxygen, Dissolved	0.22				mg/L			02/21/24 09:20	1
Specific Conductance	1298				umhos/cm			02/21/24 09:20	1
Turbidity	6.82				NTU			02/21/24 09:20	1

Client Sample Results

Client Sample ID: VER_070&D

Lab Sample ID: 500-246480-30

Date Collected: 02/21/24 08:45
Matrix: Water
Date Received: 02/22/24 11:18

Method: EPA 200.7 Rev 4.4 - Metals (ICP) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Lithium	**0.097**		0.0050	0.0020	mg/L		03/05/24 09:00	03/07/24 00:41	1

Method: SW846 6020B - Metals (ICP/MS) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.0030	^+	0.0030	0.0013	mg/L		03/06/24 09:08	03/08/24 03:20	1
Arsenic	**0.00058**	**J**	0.0010	0.00023	mg/L		03/06/24 09:08	03/14/24 17:03	1
Barium	**0.68**		0.0025	0.00073	mg/L		03/06/24 09:08	03/11/24 21:37	1
Beryllium	<0.0010		0.0010	0.00053	mg/L		03/06/24 09:08	03/14/24 17:03	1
Boron	**1.5**	**B**	0.050	0.013	mg/L		03/06/24 09:08	03/14/24 17:03	1
Cadmium	<0.00050		0.00050	0.00017	mg/L		03/06/24 09:08	03/11/24 21:37	1
Calcium	**84**		0.20	0.044	mg/L		03/06/24 09:08	03/14/24 17:03	1
Chromium	**0.0035**	**J**	0.0050	0.0011	mg/L		03/06/24 09:08	03/14/24 17:03	1
Cobalt	**0.0027**		0.0010	0.00040	mg/L		03/06/24 09:08	03/14/24 17:03	1
Lead	**0.0020**		0.00050	0.00019	mg/L		03/06/24 09:08	03/08/24 03:20	1
Magnesium	**49**		0.20	0.049	mg/L		03/06/24 09:08	03/08/24 03:20	1
Molybdenum	<0.0050		0.0050	0.0025	mg/L		03/06/24 09:08	03/08/24 03:20	1
Potassium	**7.4**		0.50	0.11	mg/L		03/06/24 09:08	03/14/24 17:03	1
Selenium	<0.0025	^+	0.0025	0.00098	mg/L		03/06/24 09:08	03/08/24 03:20	1
Sodium	**620**		0.20	0.077	mg/L		03/06/24 09:08	03/14/24 17:03	1
Thallium	<0.0020		0.0020	0.00057	mg/L		03/06/24 09:08	03/08/24 03:20	1

Method: SW846 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.00020		0.00020	0.000079	mg/L		03/06/24 10:55	03/07/24 09:00	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride (EPA 300.0)	**730**	**B**	100	12	mg/L			03/12/24 13:17	100
Sulfate (EPA 300.0)	**43**		1.0	0.21	mg/L			03/06/24 14:13	1
Bicarbonate Alkalinity as CaCO3 (SM 2320B)	**490**	**B**	5.0	3.7	mg/L			03/05/24 22:41	1
Carbonate Alkalinity as CaCO3 (SM 2320B)	<5.0		5.0	3.7	mg/L			03/05/24 22:41	1
Total Dissolved Solids (SM 2540C)	**1900**		10	4.3	mg/L			02/26/24 23:16	1
Fluoride (SM 4500 F C)	**0.40**		0.10	0.056	mg/L			03/07/24 18:37	1

Method: EPA Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Depth to Water (ft from MP)	**31.83**				ft			02/21/24 08:45	1
Field pH	**6.91**				SU			02/21/24 08:45	1
Field Temperature	**11.7**				Degrees C			02/21/24 08:45	1
Oxidation Reduction Potential	**26.7**				millivolts			02/21/24 08:45	1
Oxygen, Dissolved	**0.30**				mg/L			02/21/24 08:45	1
Specific Conductance	**2781**				umhos/cm			02/21/24 08:45	1
Turbidity	**19.56**				NTU			02/21/24 08:45	1

Client Sample Results

Client Sample ID: VER_NED1

Lab Sample ID: 500-246480-31
Date Collected: 02/21/24 15:00
Date Received: 02/22/24 11:18
Matrix: Water

Method: EPA 200.7 Rev 4.4 - Metals (ICP) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Lithium	0.24		0.0050	0.0020	mg/L		03/05/24 09:00	03/07/24 00:46	1

Method: SW846 6020B - Metals (ICP/MS) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.0030	^+	0.0030	0.0013	mg/L		03/06/24 09:08	03/08/24 03:24	1
Arsenic	0.040		0.010	0.0023	mg/L		03/06/24 09:08	03/14/24 17:07	10
Barium	0.13		0.0025	0.00073	mg/L		03/06/24 09:08	03/11/24 21:41	1
Beryllium	<0.0010	^1+	0.0010	0.00053	mg/L		03/06/24 09:08	03/15/24 14:23	1
Boron	10	B	0.50	0.13	mg/L		03/06/24 09:08	03/14/24 17:07	10
Cadmium	<0.00050		0.00050	0.00017	mg/L		03/06/24 09:08	03/11/24 21:41	1
Calcium	470		2.0	0.44	mg/L		03/06/24 09:08	03/14/24 17:07	10
Chromium	<0.0050		0.0050	0.0011	mg/L		03/06/24 09:08	03/15/24 14:23	1
Cobalt	<0.0010	^+	0.0010	0.00040	mg/L		03/06/24 09:08	03/08/24 03:24	1
Lead	0.00034	J	0.00050	0.00019	mg/L		03/06/24 09:08	03/08/24 03:24	1
Magnesium	35		0.20	0.049	mg/L		03/06/24 09:08	03/08/24 03:24	1
Molybdenum	0.054		0.0050	0.0025	mg/L		03/06/24 09:08	03/08/24 03:24	1
Potassium	25		5.0	1.1	mg/L		03/06/24 09:08	03/14/24 17:07	10
Selenium	<0.0025		0.0025	0.00098	mg/L		03/06/24 09:08	03/15/24 14:23	1
Sodium	84		2.0	0.77	mg/L		03/06/24 09:08	03/14/24 17:07	10
Thallium	<0.0020		0.0020	0.00057	mg/L		03/06/24 09:08	03/08/24 03:24	1

Method: SW846 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.00020		0.00020	0.000079	mg/L		03/06/24 10:55	03/07/24 09:02	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride (EPA 300.0)	13		1.0	0.12	mg/L			03/06/24 14:28	1
Sulfate (EPA 300.0)	1300		100	21	mg/L			03/10/24 00:51	100
Bicarbonate Alkalinity as CaCO3 (SM 2320B)	100	B	5.0	3.7	mg/L			03/05/24 22:51	1
Carbonate Alkalinity as CaCO3 (SM 2320B)	<5.0		5.0	3.7	mg/L			03/05/24 22:51	1
Total Dissolved Solids (SM 2540C)	2200		10	4.3	mg/L			02/26/24 23:19	1
Fluoride (SM 4500 F C)	0.099	J	0.10	0.056	mg/L			03/07/24 18:41	1

Method: EPA Field Sampling - Field Sampling

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Depth to Water (ft from MP)	2.32				ft			02/21/24 15:00	1
Field pH	7.78				SU			02/21/24 15:00	1
Field Temperature	10.6				Degrees C			02/21/24 15:00	1
Oxidation Reduction Potential	-194.1				millivolts			02/21/24 15:00	1
Oxygen, Dissolved	0.00				mg/L			02/21/24 15:00	1
Specific Conductance	1721				umhos/cm			02/21/24 15:00	1
Turbidity	4.63				NTU			02/21/24 15:00	1

Client Sample Results

Client Sample ID: VER_FB
Date Collected: 02/21/24 15:20
Date Received: 02/22/24 11:18

Lab Sample ID: 500-246480-32
Matrix: Water

Method: EPA 200.7 Rev 4.4 - Metals (ICP) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Lithium	<0.0050		0.0050	0.0020	mg/L		03/05/24 09:00	03/07/24 00:50	1

Method: SW846 6020B - Metals (ICP/MS) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.0030	^+	0.0030	0.0013	mg/L		03/06/24 09:08	03/08/24 03:27	1
Arsenic	<0.0010	^+	0.0010	0.00023	mg/L		03/06/24 09:08	03/11/24 21:48	1
Barium	<0.0025	^+	0.0025	0.00073	mg/L		03/06/24 09:08	03/08/24 03:27	1
Beryllium	<0.0010		0.0010	0.00053	mg/L		03/06/24 09:08	03/14/24 17:10	1
Boron	**0.063**	**B**	0.050	0.013	mg/L		03/06/24 09:08	03/14/24 17:10	1
Cadmium	<0.00050		0.00050	0.00017	mg/L		03/06/24 09:08	03/11/24 21:48	1
Calcium	**0.057**	**J**	0.20	0.044	mg/L		03/06/24 09:08	03/14/24 17:10	1
Chromium	<0.0050		0.0050	0.0011	mg/L		03/06/24 09:08	03/14/24 17:10	1
Cobalt	<0.0010	^+	0.0010	0.00040	mg/L		03/06/24 09:08	03/08/24 03:27	1
Lead	**0.0011**		0.00050	0.00019	mg/L		03/06/24 09:08	03/08/24 03:27	1
Magnesium	<0.20		0.20	0.049	mg/L		03/06/24 09:08	03/08/24 03:27	1
Molybdenum	<0.0050		0.0050	0.0025	mg/L		03/06/24 09:08	03/08/24 03:27	1
Potassium	<0.50		0.50	0.11	mg/L		03/06/24 09:08	03/14/24 17:10	1
Selenium	<0.0025		0.0025	0.00098	mg/L		03/06/24 09:08	03/14/24 17:10	1
Sodium	**0.11**	**J**	0.20	0.077	mg/L		03/06/24 09:08	03/14/24 17:10	1
Thallium	<0.0020		0.0020	0.00057	mg/L		03/06/24 09:08	03/08/24 03:27	1

Method: SW846 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.00020		0.00020	0.000079	mg/L		03/06/24 10:55	03/07/24 07:08	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride (EPA 300.0)	**0.21**	**J**	1.0	0.12	mg/L			03/06/24 14:44	1
Sulfate (EPA 300.0)	**0.40**	**J**	1.0	0.21	mg/L			03/06/24 14:44	1
Bicarbonate Alkalinity as CaCO3 (SM 2320B)	**4.0**	**J**	5.0	3.7	mg/L			03/06/24 17:26	1
Carbonate Alkalinity as CaCO3 (SM 2320B)	<5.0		5.0	3.7	mg/L			03/06/24 17:26	1
Total Dissolved Solids (SM 2540C)	**12**		10	4.3	mg/L			02/26/24 23:21	1
Fluoride (SM 4500 F C)	<0.10		0.10	0.056	mg/L			03/07/24 18:46	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-5
SDG: VER_845_912

Client Sample ID: VER_EB2

Lab Sample ID: 500-246480-33

Date Collected: 02/21/24 15:50
Date Received: 02/22/24 11:18

Matrix: Water

Method: EPA 200.7 Rev 4.4 - Metals (ICP) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Lithium	<0.0050		0.0050	0.0020	mg/L		03/05/24 09:00	03/07/24 00:54	1

Method: SW846 6020B - Metals (ICP/MS) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.0030	^+	0.0030	0.0013	mg/L		03/06/24 09:08	03/08/24 03:31	1
Arsenic	<0.0010	^+	0.0010	0.00023	mg/L		03/06/24 09:08	03/11/24 21:51	1
Barium	<0.0025	^+	0.0025	0.00073	mg/L		03/06/24 09:08	03/08/24 03:31	1
Beryllium	<0.0010		0.0010	0.00053	mg/L		03/06/24 09:08	03/14/24 17:14	1
Boron	**0.049**	**J B**	0.050	0.013	mg/L		03/06/24 09:08	03/14/24 17:14	1
Cadmium	<0.00050		0.00050	0.00017	mg/L		03/06/24 09:08	03/11/24 21:51	1
Calcium	**0.044**	**J**	0.20	0.044	mg/L		03/06/24 09:08	03/14/24 17:14	1
Chromium	<0.0050		0.0050	0.0011	mg/L		03/06/24 09:08	03/14/24 17:14	1
Cobalt	<0.0010	^+	0.0010	0.00040	mg/L		03/06/24 09:08	03/08/24 03:31	1
Lead	**0.00040**	**J**	0.00050	0.00019	mg/L		03/06/24 09:08	03/08/24 03:31	1
Magnesium	<0.20		0.20	0.049	mg/L		03/06/24 09:08	03/08/24 03:31	1
Molybdenum	<0.0050		0.0050	0.0025	mg/L		03/06/24 09:08	03/08/24 03:31	1
Potassium	<0.50		0.50	0.11	mg/L		03/06/24 09:08	03/14/24 17:14	1
Selenium	<0.0025		0.0025	0.00098	mg/L		03/06/24 09:08	03/14/24 17:14	1
Sodium	<0.20		0.20	0.077	mg/L		03/06/24 09:08	03/14/24 17:14	1
Thallium	<0.0020		0.0020	0.00057	mg/L		03/06/24 09:08	03/08/24 03:31	1

Method: SW846 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.00020		0.00020	0.000079	mg/L		03/06/24 10:55	03/07/24 07:10	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride (EPA 300.0)	**0.21**	**J *+**	1.0	0.12	mg/L			03/07/24 08:10	1
Sulfate (EPA 300.0)	**0.34**	**J B**	1.0	0.21	mg/L			03/07/24 08:10	1
Bicarbonate Alkalinity as CaCO3 (SM 2320B)	**8.7**		5.0	3.7	mg/L			03/06/24 17:33	1
Carbonate Alkalinity as CaCO3 (SM 2320B)	<5.0		5.0	3.7	mg/L			03/06/24 17:33	1
Total Dissolved Solids (SM 2540C)	**36**		10	4.3	mg/L			02/26/24 23:24	1
Fluoride (SM 4500 F C)	<0.10		0.10	0.056	mg/L			03/07/24 19:02	1

Definitions/Glossary

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-5
SDG: VER_845_912

Qualifiers

Metals

Qualifier	Qualifier Description
^+	Continuing Calibration Verification (CCV) is outside acceptance limits, high biased.
^1+	Initial Calibration Verification (ICV) is outside acceptance limits, high biased.
B	Compound was found in the blank and sample.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

General Chemistry

Qualifier	Qualifier Description
*+	LCS and/or LCSD is outside acceptance limits, high biased.
B	Compound was found in the blank and sample.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

QC Association Summary

Metals

Prep Batch: 756864

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-5	VER_010	Total Recoverable	Water	200.7	
MB 500-756864/1-A	Method Blank	Total Recoverable	Water	200.7	
LCS 500-756864/2-A	Lab Control Sample	Total Recoverable	Water	200.7	

Prep Batch: 756867

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-21	VER_EB1	Total Recoverable	Water	200.7	
500-246480-25	VER_016A	Total Recoverable	Water	200.7	
500-246480-26	VER_022	Total Recoverable	Water	200.7	
500-246480-27	VER_035&D	Total Recoverable	Water	200.7	
500-246480-29	VER_070#S	Total Recoverable	Water	200.7	
500-246480-30	VER_070&D	Total Recoverable	Water	200.7	
500-246480-31	VER_NED1	Total Recoverable	Water	200.7	
500-246480-32	VER_FB	Total Recoverable	Water	200.7	
500-246480-33	VER_EB2	Total Recoverable	Water	200.7	
MB 500-756867/1-A	Method Blank	Total Recoverable	Water	200.7	
LCS 500-756867/2-A	Lab Control Sample	Total Recoverable	Water	200.7	

Prep Batch: 756906

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-5	VER_010	Total/NA	Water	7470A	
MB 500-756906/12-A	Method Blank	Total/NA	Water	7470A	
LCS 500-756906/13-A	Lab Control Sample	Total/NA	Water	7470A	

Prep Batch: 756958

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-5	VER_010	Total Recoverable	Water	3005A	
MB 500-756958/1-A	Method Blank	Total Recoverable	Water	3005A	
LCS 500-756958/2-A	Lab Control Sample	Total Recoverable	Water	3005A	

Prep Batch: 757078

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-21	VER_EB1	Total Recoverable	Water	3005A	
500-246480-25	VER_016A	Total Recoverable	Water	3005A	
500-246480-26	VER_022	Total Recoverable	Water	3005A	
500-246480-27	VER_035&D	Total Recoverable	Water	3005A	
500-246480-29	VER_070#S	Total Recoverable	Water	3005A	
500-246480-30	VER_070&D	Total Recoverable	Water	3005A	
500-246480-31	VER_NED1	Total Recoverable	Water	3005A	
500-246480-32	VER_FB	Total Recoverable	Water	3005A	
500-246480-33	VER_EB2	Total Recoverable	Water	3005A	
MB 500-757078/1-A	Method Blank	Total Recoverable	Water	3005A	
LCS 500-757078/2-A	Lab Control Sample	Total Recoverable	Water	3005A	

Prep Batch: 757117

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-21	VER_EB1	Total/NA	Water	7470A	
500-246480-25	VER_016A	Total/NA	Water	7470A	
500-246480-26	VER_022	Total/NA	Water	7470A	
500-246480-27	VER_035&D	Total/NA	Water	7470A	
500-246480-29	VER_070#S	Total/NA	Water	7470A	

Metals (Continued)

Prep Batch: 757117 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-30	VER_070&D	Total/NA	Water	7470A	
500-246480-31	VER_NED1	Total/NA	Water	7470A	
MB 500-757117/12-A	Method Blank	Total/NA	Water	7470A	
LCS 500-757117/13-A	Lab Control Sample	Total/NA	Water	7470A	

Prep Batch: 757118

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-32	VER_FB	Total/NA	Water	7470A	
500-246480-33	VER_EB2	Total/NA	Water	7470A	
MB 500-757118/12-A	Method Blank	Total/NA	Water	7470A	
LCS 500-757118/13-A	Lab Control Sample	Total/NA	Water	7470A	

Analysis Batch: 757131

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-5	VER_010	Total/NA	Water	7470A	756906
MB 500-756906/12-A	Method Blank	Total/NA	Water	7470A	756906
LCS 500-756906/13-A	Lab Control Sample	Total/NA	Water	7470A	756906

Analysis Batch: 757263

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-5	VER_010	Total Recoverable	Water	200.7 Rev 4.4	756864
500-246480-21	VER_EB1	Total Recoverable	Water	200.7 Rev 4.4	756867
500-246480-25	VER_016A	Total Recoverable	Water	200.7 Rev 4.4	756867
500-246480-26	VER_022	Total Recoverable	Water	200.7 Rev 4.4	756867
500-246480-27	VER_035&D	Total Recoverable	Water	200.7 Rev 4.4	756867
500-246480-29	VER_070#S	Total Recoverable	Water	200.7 Rev 4.4	756867
500-246480-30	VER_070&D	Total Recoverable	Water	200.7 Rev 4.4	756867
500-246480-31	VER_NED1	Total Recoverable	Water	200.7 Rev 4.4	756867
500-246480-32	VER_FB	Total Recoverable	Water	200.7 Rev 4.4	756867
500-246480-33	VER_EB2	Total Recoverable	Water	200.7 Rev 4.4	756867
MB 500-756864/1-A	Method Blank	Total Recoverable	Water	200.7 Rev 4.4	756864
MB 500-756867/1-A	Method Blank	Total Recoverable	Water	200.7 Rev 4.4	756867
LCS 500-756864/2-A	Lab Control Sample	Total Recoverable	Water	200.7 Rev 4.4	756864
LCS 500-756867/2-A	Lab Control Sample	Total Recoverable	Water	200.7 Rev 4.4	756867

Analysis Batch: 757337

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-21	VER_EB1	Total/NA	Water	7470A	757117
500-246480-25	VER_016A	Total/NA	Water	7470A	757117
500-246480-26	VER_022	Total/NA	Water	7470A	757117
500-246480-27	VER_035&D	Total/NA	Water	7470A	757117
500-246480-29	VER_070#S	Total/NA	Water	7470A	757117
500-246480-30	VER_070&D	Total/NA	Water	7470A	757117
500-246480-31	VER_NED1	Total/NA	Water	7470A	757117
500-246480-32	VER_FB	Total/NA	Water	7470A	757118
500-246480-33	VER_EB2	Total/NA	Water	7470A	757118
MB 500-757117/12-A	Method Blank	Total/NA	Water	7470A	757117
MB 500-757118/12-A	Method Blank	Total/NA	Water	7470A	757118
LCS 500-757117/13-A	Lab Control Sample	Total/NA	Water	7470A	757117
LCS 500-757118/13-A	Lab Control Sample	Total/NA	Water	7470A	757118

QC Association Summary

Metals

Analysis Batch: 757459

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-5	VER_010	Total Recoverable	Water	6020B	756958
500-246480-21	VER_EB1	Total Recoverable	Water	6020B	757078
500-246480-25	VER_016A	Total Recoverable	Water	6020B	757078
500-246480-26	VER_022	Total Recoverable	Water	6020B	757078
500-246480-27	VER_035&D	Total Recoverable	Water	6020B	757078
500-246480-29	VER_070#S	Total Recoverable	Water	6020B	757078
500-246480-30	VER_070&D	Total Recoverable	Water	6020B	757078
500-246480-31	VER_NED1	Total Recoverable	Water	6020B	757078
500-246480-32	VER_FB	Total Recoverable	Water	6020B	757078
500-246480-33	VER_EB2	Total Recoverable	Water	6020B	757078
MB 500-756958/1-A	Method Blank	Total Recoverable	Water	6020B	756958
MB 500-757078/1-A	Method Blank	Total Recoverable	Water	6020B	757078
LCS 500-756958/2-A	Lab Control Sample	Total Recoverable	Water	6020B	756958
LCS 500-757078/2-A	Lab Control Sample	Total Recoverable	Water	6020B	757078

Analysis Batch: 757847

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-5	VER_010	Total Recoverable	Water	6020B	756958
500-246480-21	VER_EB1	Total Recoverable	Water	6020B	757078
500-246480-25	VER_016A	Total Recoverable	Water	6020B	757078
500-246480-26	VER_022	Total Recoverable	Water	6020B	757078
500-246480-27	VER_035&D	Total Recoverable	Water	6020B	757078
500-246480-29	VER_070#S	Total Recoverable	Water	6020B	757078
500-246480-30	VER_070&D	Total Recoverable	Water	6020B	757078
500-246480-31	VER_NED1	Total Recoverable	Water	6020B	757078
500-246480-32	VER_FB	Total Recoverable	Water	6020B	757078
500-246480-33	VER_EB2	Total Recoverable	Water	6020B	757078
MB 500-756958/1-A	Method Blank	Total Recoverable	Water	6020B	756958
MB 500-757078/1-A	Method Blank	Total Recoverable	Water	6020B	757078
LCS 500-756958/2-A	Lab Control Sample	Total Recoverable	Water	6020B	756958
LCS 500-757078/2-A	Lab Control Sample	Total Recoverable	Water	6020B	757078

Analysis Batch: 758475

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-5	VER_010	Total Recoverable	Water	6020B	756958
500-246480-21	VER_EB1	Total Recoverable	Water	6020B	757078
500-246480-25	VER_016A	Total Recoverable	Water	6020B	757078
500-246480-26	VER_022	Total Recoverable	Water	6020B	757078
500-246480-27	VER_035&D	Total Recoverable	Water	6020B	757078
500-246480-29	VER_070#S	Total Recoverable	Water	6020B	757078
500-246480-30	VER_070&D	Total Recoverable	Water	6020B	757078
500-246480-31	VER_NED1	Total Recoverable	Water	6020B	757078
500-246480-32	VER_FB	Total Recoverable	Water	6020B	757078
500-246480-33	VER_EB2	Total Recoverable	Water	6020B	757078
MB 500-756958/1-A	Method Blank	Total Recoverable	Water	6020B	756958
MB 500-757078/1-A	Method Blank	Total Recoverable	Water	6020B	757078
LCS 500-756958/2-A	Lab Control Sample	Total Recoverable	Water	6020B	756958
LCS 500-757078/2-A	Lab Control Sample	Total Recoverable	Water	6020B	757078

QC Association Summary

Metals

Analysis Batch: 758529

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-25	VER_016A	Total Recoverable	Water	6020B	757078
500-246480-27	VER_035&D	Total Recoverable	Water	6020B	757078
500-246480-31	VER_NED1	Total Recoverable	Water	6020B	757078

General Chemistry

Analysis Batch: 755368

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-5	VER_010	Total/NA	Water	SM 2540C	
MB 500-755368/1	Method Blank	Total/NA	Water	SM 2540C	
LCS 500-755368/2	Lab Control Sample	Total/NA	Water	SM 2540C	

Analysis Batch: 755755

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-21	VER_EB1	Total/NA	Water	SM 2540C	
500-246480-25	VER_016A	Total/NA	Water	SM 2540C	
500-246480-26	VER_022	Total/NA	Water	SM 2540C	
500-246480-27	VER_035&D	Total/NA	Water	SM 2540C	
500-246480-29	VER_070#S	Total/NA	Water	SM 2540C	
500-246480-30	VER_070&D	Total/NA	Water	SM 2540C	
500-246480-31	VER_NED1	Total/NA	Water	SM 2540C	
500-246480-32	VER_FB	Total/NA	Water	SM 2540C	
500-246480-33	VER_EB2	Total/NA	Water	SM 2540C	
MB 500-755755/1	Method Blank	Total/NA	Water	SM 2540C	
LCS 500-755755/2	Lab Control Sample	Total/NA	Water	SM 2540C	

Analysis Batch: 756576

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-5	VER_010	Total/NA	Water	300.0	
500-246480-5	VER_010	Total/NA	Water	300.0	
MB 500-756576/3	Method Blank	Total/NA	Water	300.0	
LCS 500-756576/4	Lab Control Sample	Total/NA	Water	300.0	

Analysis Batch: 756942

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-21	VER_EB1	Total/NA	Water	300.0	
500-246480-25	VER_016A	Total/NA	Water	300.0	
500-246480-26	VER_022	Total/NA	Water	300.0	
500-246480-29	VER_070#S	Total/NA	Water	300.0	
500-246480-30	VER_070&D	Total/NA	Water	300.0	
500-246480-31	VER_NED1	Total/NA	Water	300.0	
500-246480-32	VER_FB	Total/NA	Water	300.0	
MB 500-756942/3	Method Blank	Total/NA	Water	300.0	
LCS 500-756942/4	Lab Control Sample	Total/NA	Water	300.0	

Analysis Batch: 757067

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-5	VER_010	Total/NA	Water	SM 2320B	
500-246480-21	VER_EB1	Total/NA	Water	SM 2320B	
500-246480-25	VER_016A	Total/NA	Water	SM 2320B	
500-246480-26	VER_022	Total/NA	Water	SM 2320B	

QC Association Summary

General Chemistry (Continued)

Analysis Batch: 757067 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-27	VER_035&D	Total/NA	Water	SM 2320B	
500-246480-29	VER_070#S	Total/NA	Water	SM 2320B	
500-246480-30	VER_070&D	Total/NA	Water	SM 2320B	
500-246480-31	VER_NED1	Total/NA	Water	SM 2320B	
MB 500-757067/11	Method Blank	Total/NA	Water	SM 2320B	
MB 500-757067/32	Method Blank	Total/NA	Water	SM 2320B	
MB 500-757067/57	Method Blank	Total/NA	Water	SM 2320B	
LCS 500-757067/33	Lab Control Sample	Total/NA	Water	SM 2320B	
LCS 500-757067/58	Lab Control Sample	Total/NA	Water	SM 2320B	
LCS 500-757067/7	Lab Control Sample	Total/NA	Water	SM 2320B	
500-246480-25 DU	VER_016A	Total/NA	Water	SM 2320B	

Analysis Batch: 757150

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-33	VER_EB2	Total/NA	Water	300.0	
MB 500-757150/3	Method Blank	Total/NA	Water	300.0	
LCS 500-757150/4	Lab Control Sample	Total/NA	Water	300.0	

Analysis Batch: 757258

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-32	VER_FB	Total/NA	Water	SM 2320B	
500-246480-33	VER_EB2	Total/NA	Water	SM 2320B	
MB 500-757258/12	Method Blank	Total/NA	Water	SM 2320B	
LCS 500-757258/8	Lab Control Sample	Total/NA	Water	SM 2320B	

Analysis Batch: 757486

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-27	VER_035&D	Total/NA	Water	300.0	
500-246480-29	VER_070#S	Total/NA	Water	300.0	
500-246480-31	VER_NED1	Total/NA	Water	300.0	
MB 500-757486/3	Method Blank	Total/NA	Water	300.0	
LCS 500-757486/4	Lab Control Sample	Total/NA	Water	300.0	

Analysis Batch: 757490

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-5	VER_010	Total/NA	Water	SM 4500 F C	
500-246480-21	VER_EB1	Total/NA	Water	SM 4500 F C	
500-246480-25	VER_016A	Total/NA	Water	SM 4500 F C	
500-246480-26	VER_022	Total/NA	Water	SM 4500 F C	
500-246480-27	VER_035&D	Total/NA	Water	SM 4500 F C	
500-246480-29	VER_070#S	Total/NA	Water	SM 4500 F C	
500-246480-30	VER_070&D	Total/NA	Water	SM 4500 F C	
500-246480-31	VER_NED1	Total/NA	Water	SM 4500 F C	
500-246480-32	VER_FB	Total/NA	Water	SM 4500 F C	
500-246480-33	VER_EB2	Total/NA	Water	SM 4500 F C	
MB 500-757490/3	Method Blank	Total/NA	Water	SM 4500 F C	
MB 500-757490/31	Method Blank	Total/NA	Water	SM 4500 F C	
LCS 500-757490/32	Lab Control Sample	Total/NA	Water	SM 4500 F C	
LCS 500-757490/4	Lab Control Sample	Total/NA	Water	SM 4500 F C	

QC Association Summary

General Chemistry

Analysis Batch: 757868

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-25	VER_016A	Total/NA	Water	300.0	
500-246480-27	VER_035&D	Total/NA	Water	300.0	
500-246480-30	VER_070&D	Total/NA	Water	300.0	
MB 500-757868/9	Method Blank	Total/NA	Water	300.0	
LCS 500-757868/10	Lab Control Sample	Total/NA	Water	300.0	

Field Service / Mobile Lab

Analysis Batch: 755860

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-5	VER_010	Total/NA	Water	Field Sampling	
500-246480-25	VER_016A	Total/NA	Water	Field Sampling	
500-246480-26	VER_022	Total/NA	Water	Field Sampling	
500-246480-27	VER_035&D	Total/NA	Water	Field Sampling	
500-246480-29	VER_070#S	Total/NA	Water	Field Sampling	
500-246480-30	VER_070&D	Total/NA	Water	Field Sampling	
500-246480-31	VER_NED1	Total/NA	Water	Field Sampling	

QC Sample Results

Method: 200.7 Rev 4.4 - Metals (ICP)

Lab Sample ID: MB 500-756864/1-A
Matrix: Water
Analysis Batch: 757263

Client Sample ID: Method Blank
Prep Type: Total Recoverable
Prep Batch: 756864

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Lithium	<0.0050		0.0050	0.0020	mg/L		03/05/24 08:58	03/06/24 20:46	1

Lab Sample ID: LCS 500-756864/2-A
Matrix: Water
Analysis Batch: 757263

Client Sample ID: Lab Control Sample
Prep Type: Total Recoverable
Prep Batch: 756864

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Lithium	0.250	0.234		mg/L		94	85 - 115

Lab Sample ID: MB 500-756867/1-A
Matrix: Water
Analysis Batch: 757263

Client Sample ID: Method Blank
Prep Type: Total Recoverable
Prep Batch: 756867

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Lithium	<0.0050		0.0050	0.0020	mg/L		03/05/24 09:00	03/06/24 23:24	1

Lab Sample ID: LCS 500-756867/2-A
Matrix: Water
Analysis Batch: 757263

Client Sample ID: Lab Control Sample
Prep Type: Total Recoverable
Prep Batch: 756867

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Lithium	0.250	0.230		mg/L		92	85 - 115

Method: 6020B - Metals (ICP/MS)

Lab Sample ID: MB 500-756958/1-A
Matrix: Water
Analysis Batch: 757459

Client Sample ID: Method Blank
Prep Type: Total Recoverable
Prep Batch: 756958

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Lead	<0.00050		0.00050	0.00019	mg/L		03/05/24 17:38	03/08/24 00:16	1
Molybdenum	<0.0050		0.0050	0.0025	mg/L		03/05/24 17:38	03/08/24 00:16	1
Thallium	<0.0020		0.0020	0.00057	mg/L		03/05/24 17:38	03/08/24 00:16	1

Lab Sample ID: MB 500-756958/1-A
Matrix: Water
Analysis Batch: 757847

Client Sample ID: Method Blank
Prep Type: Total Recoverable
Prep Batch: 756958

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.0030		0.0030	0.0013	mg/L		03/05/24 17:38	03/11/24 17:23	1
Arsenic	<0.0010		0.0010	0.00023	mg/L		03/05/24 17:38	03/11/24 17:23	1
Barium	<0.0025		0.0025	0.00073	mg/L		03/05/24 17:38	03/11/24 17:23	1
Cadmium	<0.00050		0.00050	0.00017	mg/L		03/05/24 17:38	03/11/24 17:23	1
Chromium	<0.0050		0.0050	0.0011	mg/L		03/05/24 17:38	03/11/24 17:23	1
Selenium	<0.0025		0.0025	0.00098	mg/L		03/05/24 17:38	03/11/24 17:23	1

Method: 6020B - Metals (ICP/MS) (Continued)

Lab Sample ID: MB 500-756958/1-A
Matrix: Water
Analysis Batch: 758475

Client Sample ID: Method Blank
Prep Type: Total Recoverable
Prep Batch: 756958

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Beryllium	<0.0010		0.0010	0.00053	mg/L		03/05/24 17:38	03/14/24 17:17	1
Boron	0.0135	J	0.050	0.013	mg/L		03/05/24 17:38	03/14/24 17:17	1
Calcium	0.0492	J	0.20	0.044	mg/L		03/05/24 17:38	03/14/24 17:17	1
Cobalt	<0.0010		0.0010	0.00040	mg/L		03/05/24 17:38	03/14/24 17:17	1
Magnesium	<0.20		0.20	0.049	mg/L		03/05/24 17:38	03/14/24 17:17	1
Potassium	<0.50		0.50	0.11	mg/L		03/05/24 17:38	03/14/24 17:17	1
Sodium	<0.20		0.20	0.077	mg/L		03/05/24 17:38	03/14/24 17:17	1

Lab Sample ID: LCS 500-756958/2-A
Matrix: Water
Analysis Batch: 757459

Client Sample ID: Lab Control Sample
Prep Type: Total Recoverable
Prep Batch: 756958

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Lead	0.100	0.0916		mg/L		92	80 - 120
Molybdenum	1.00	0.976		mg/L		98	80 - 120
Thallium	0.100	0.0920		mg/L		92	80 - 120

Lab Sample ID: LCS 500-756958/2-A
Matrix: Water
Analysis Batch: 757847

Client Sample ID: Lab Control Sample
Prep Type: Total Recoverable
Prep Batch: 756958

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Antimony	0.500	0.533		mg/L		107	80 - 120
Arsenic	0.100	0.0959		mg/L		96	80 - 120
Barium	0.500	0.484		mg/L		97	80 - 120
Cadmium	0.0500	0.0477		mg/L		95	80 - 120
Chromium	0.200	0.188		mg/L		94	80 - 120
Selenium	0.100	0.0985		mg/L		99	80 - 120

Lab Sample ID: LCS 500-756958/2-A
Matrix: Water
Analysis Batch: 758475

Client Sample ID: Lab Control Sample
Prep Type: Total Recoverable
Prep Batch: 756958

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Beryllium	0.0500	0.0469		mg/L		94	80 - 120
Boron	1.00	0.932		mg/L		93	80 - 120
Calcium	10.0	10.5		mg/L		105	80 - 120
Cobalt	0.500	0.493		mg/L		99	80 - 120
Magnesium	10.0	9.91		mg/L		99	80 - 120
Potassium	10.0	9.61		mg/L		96	80 - 120
Sodium	10.0	9.57		mg/L		96	80 - 120

Lab Sample ID: MB 500-757078/1-A
Matrix: Water
Analysis Batch: 757459

Client Sample ID: Method Blank
Prep Type: Total Recoverable
Prep Batch: 757078

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.0030		0.0030	0.0013	mg/L		03/06/24 09:08	03/08/24 01:53	1
Barium	<0.0025		0.0025	0.00073	mg/L		03/06/24 09:08	03/08/24 01:53	1

QC Sample Results

Method: 6020B - Metals (ICP/MS) (Continued)

Lab Sample ID: MB 500-757078/1-A
Matrix: Water
Analysis Batch: 757459
Client Sample ID: Method Blank
Prep Type: Total Recoverable
Prep Batch: 757078

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Cobalt	<0.0010		0.0010	0.00040	mg/L		03/06/24 09:08	03/08/24 01:53	1
Lead	<0.00050		0.00050	0.00019	mg/L		03/06/24 09:08	03/08/24 01:53	1
Magnesium	<0.20		0.20	0.049	mg/L		03/06/24 09:08	03/08/24 01:53	1
Molybdenum	<0.0050		0.0050	0.0025	mg/L		03/06/24 09:08	03/08/24 01:53	1
Potassium	<0.50		0.50	0.11	mg/L		03/06/24 09:08	03/08/24 01:53	1
Thallium	<0.0020		0.0020	0.00057	mg/L		03/06/24 09:08	03/08/24 01:53	1

Lab Sample ID: MB 500-757078/1-A
Matrix: Water
Analysis Batch: 757847
Client Sample ID: Method Blank
Prep Type: Total Recoverable
Prep Batch: 757078

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	<0.0010		0.0010	0.00023	mg/L		03/06/24 09:08	03/11/24 19:44	1
Cadmium	<0.00050		0.00050	0.00017	mg/L		03/06/24 09:08	03/11/24 19:44	1
Chromium	0.00183	J	0.0050	0.0011	mg/L		03/06/24 09:08	03/11/24 19:44	1

Lab Sample ID: MB 500-757078/1-A
Matrix: Water
Analysis Batch: 758475
Client Sample ID: Method Blank
Prep Type: Total Recoverable
Prep Batch: 757078

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Beryllium	<0.0010		0.0010	0.00053	mg/L		03/06/24 09:08	03/14/24 15:39	1
Boron	0.0281	J	0.050	0.013	mg/L		03/06/24 09:08	03/14/24 15:39	1
Calcium	<0.20		0.20	0.044	mg/L		03/06/24 09:08	03/14/24 15:39	1
Selenium	<0.0025		0.0025	0.00098	mg/L		03/06/24 09:08	03/14/24 15:39	1
Sodium	<0.20		0.20	0.077	mg/L		03/06/24 09:08	03/14/24 15:39	1

Lab Sample ID: LCS 500-757078/2-A
Matrix: Water
Analysis Batch: 757459
Client Sample ID: Lab Control Sample
Prep Type: Total Recoverable
Prep Batch: 757078

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Antimony	0.500	0.575		mg/L		115	80 - 120
Barium	0.500	0.506		mg/L		101	80 - 120
Cobalt	0.500	0.534		mg/L		107	80 - 120
Lead	0.100	0.0962		mg/L		96	80 - 120
Magnesium	10.0	9.34		mg/L		93	80 - 120
Molybdenum	1.00	0.946		mg/L		95	80 - 120
Potassium	10.0	9.70		mg/L		97	80 - 120
Thallium	0.100	0.0959		mg/L		96	80 - 120

Lab Sample ID: LCS 500-757078/2-A
Matrix: Water
Analysis Batch: 757847
Client Sample ID: Lab Control Sample
Prep Type: Total Recoverable
Prep Batch: 757078

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Arsenic	0.100	0.104		mg/L		104	80 - 120
Cadmium	0.0500	0.0463		mg/L		93	80 - 120
Chromium	0.200	0.195		mg/L		97	80 - 120

QC Sample Results

Method: 6020B - Metals (ICP/MS) (Continued)

Lab Sample ID: LCS 500-757078/2-A
Matrix: Water
Analysis Batch: 758475
Client Sample ID: Lab Control Sample
Prep Type: Total Recoverable
Prep Batch: 757078

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Beryllium	0.0500	0.0442		mg/L		88	80 - 120
Boron	1.00	0.881		mg/L		88	80 - 120
Calcium	10.0	10.3		mg/L		103	80 - 120
Selenium	0.100	0.0924		mg/L		92	80 - 120
Sodium	10.0	9.32		mg/L		93	80 - 120

Method: 7470A - Mercury (CVAA)

Lab Sample ID: MB 500-756906/12-A
Matrix: Water
Analysis Batch: 757131
Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 756906

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.00020		0.00020	0.000079	mg/L		03/05/24 10:40	03/06/24 07:12	1

Lab Sample ID: LCS 500-756906/13-A
Matrix: Water
Analysis Batch: 757131
Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 756906

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Mercury	0.00201	0.00178		mg/L		89	80 - 120

Lab Sample ID: MB 500-757117/12-A
Matrix: Water
Analysis Batch: 757337
Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 757117

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.00020		0.00020	0.000079	mg/L		03/06/24 10:55	03/07/24 08:03	1

Lab Sample ID: LCS 500-757117/13-A
Matrix: Water
Analysis Batch: 757337
Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 757117

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Mercury	0.00201	0.00188		mg/L		94	80 - 120

Lab Sample ID: MB 500-757118/12-A
Matrix: Water
Analysis Batch: 757337
Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 757118

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.00020		0.00020	0.000079	mg/L		03/06/24 10:55	03/07/24 07:04	1

Lab Sample ID: LCS 500-757118/13-A
Matrix: Water
Analysis Batch: 757337
Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 757118

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Mercury	0.00201	0.00185		mg/L		92	80 - 120

QC Sample Results

Method: 300.0 - Anions, Ion Chromatography

Lab Sample ID: MB 500-756576/3
Matrix: Water
Analysis Batch: 756576
Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	<1.0		1.0	0.12	mg/L			03/02/24 13:32	1
Sulfate	<1.0		1.0	0.21	mg/L			03/02/24 13:32	1

Lab Sample ID: LCS 500-756576/4
Matrix: Water
Analysis Batch: 756576
Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Chloride	20.0	22.0		mg/L		110	90 - 110
Sulfate	20.0	21.0		mg/L		105	90 - 110

Lab Sample ID: MB 500-756942/3
Matrix: Water
Analysis Batch: 756942
Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	<1.0		1.0	0.12	mg/L			03/06/24 07:24	1
Sulfate	<1.0		1.0	0.21	mg/L			03/06/24 07:24	1

Lab Sample ID: LCS 500-756942/4
Matrix: Water
Analysis Batch: 756942
Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Chloride	20.0	22.0		mg/L		110	90 - 110
Sulfate	20.0	21.1		mg/L		105	90 - 110

Lab Sample ID: MB 500-757150/3
Matrix: Water
Analysis Batch: 757150
Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	<1.0		1.0	0.12	mg/L			03/07/24 00:50	1
Sulfate	0.328	J	1.0	0.21	mg/L			03/07/24 00:50	1

Lab Sample ID: LCS 500-757150/4
Matrix: Water
Analysis Batch: 757150
Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Chloride	20.0	22.2	*+	mg/L		111	90 - 110
Sulfate	20.0	22.0		mg/L		110	90 - 110

Lab Sample ID: MB 500-757486/3
Matrix: Water
Analysis Batch: 757486
Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Sulfate	<1.0		1.0	0.21	mg/L			03/09/24 19:48	1

QC Sample Results

Method: 300.0 - Anions, Ion Chromatography (Continued)

Lab Sample ID: LCS 500-757486/4
Matrix: Water
Analysis Batch: 757486
Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Sulfate	20.0	21.8		mg/L		109	90 - 110

Lab Sample ID: MB 500-757868/9
Matrix: Water
Analysis Batch: 757868
Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	0.145	J	1.0	0.12	mg/L			03/12/24 12:02	1
Sulfate	<1.0		1.0	0.21	mg/L			03/12/24 12:02	1

Lab Sample ID: LCS 500-757868/10
Matrix: Water
Analysis Batch: 757868
Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Chloride	20.0	20.3		mg/L		101	90 - 110
Sulfate	20.0	19.9		mg/L		100	90 - 110

Method: SM 2320B - Alkalinity

Lab Sample ID: MB 500-757067/11
Matrix: Water
Analysis Batch: 757067
Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Bicarbonate Alkalinity as CaCO3	5.01		5.0	3.7	mg/L			03/05/24 15:27	1
Carbonate Alkalinity as CaCO3	<5.0		5.0	3.7	mg/L			03/05/24 15:27	1

Lab Sample ID: MB 500-757067/32
Matrix: Water
Analysis Batch: 757067
Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Bicarbonate Alkalinity as CaCO3	<5.0		5.0	3.7	mg/L			03/05/24 18:20	1
Carbonate Alkalinity as CaCO3	<5.0		5.0	3.7	mg/L			03/05/24 18:20	1

Lab Sample ID: MB 500-757067/57
Matrix: Water
Analysis Batch: 757067
Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Bicarbonate Alkalinity as CaCO3	5.84		5.0	3.7	mg/L			03/05/24 21:55	1
Carbonate Alkalinity as CaCO3	<5.0		5.0	3.7	mg/L			03/05/24 21:55	1

Lab Sample ID: LCS 500-757067/33
Matrix: Water
Analysis Batch: 757067
Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Alkalinity	100	107		mg/L		107	95 - 121

QC Sample Results

Method: SM 2320B - Alkalinity (Continued)

Lab Sample ID: LCS 500-757067/58
Matrix: Water
Analysis Batch: 757067
Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Alkalinity	100	113		mg/L		113	95 - 121

Lab Sample ID: LCS 500-757067/7
Matrix: Water
Analysis Batch: 757067
Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Alkalinity	100	116		mg/L		116	95 - 121

Lab Sample ID: 500-246480-25 DU
Matrix: Water
Analysis Batch: 757067
Client Sample ID: VER_016A
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Bicarbonate Alkalinity as CaCO3	380		369		mg/L		3	20
Carbonate Alkalinity as CaCO3	<5.0		<5.0		mg/L		NC	20

Lab Sample ID: MB 500-757258/12
Matrix: Water
Analysis Batch: 757258
Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Bicarbonate Alkalinity as CaCO3	<5.0		5.0	3.7	mg/L			03/06/24 17:07	1
Carbonate Alkalinity as CaCO3	<5.0		5.0	3.7	mg/L			03/06/24 17:07	1

Lab Sample ID: LCS 500-757258/8
Matrix: Water
Analysis Batch: 757258
Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Alkalinity	100	113		mg/L		113	95 - 121

Method: SM 2540C - Solids, Total Dissolved (TDS)

Lab Sample ID: MB 500-755368/1
Matrix: Water
Analysis Batch: 755368
Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	<10		10	4.3	mg/L			02/22/24 23:41	1

Lab Sample ID: LCS 500-755368/2
Matrix: Water
Analysis Batch: 755368
Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Total Dissolved Solids	250	242		mg/L		97	80 - 120

Method: SM 2540C - Solids, Total Dissolved (TDS) (Continued)

Lab Sample ID: MB 500-755755/1
Matrix: Water
Analysis Batch: 755755

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	<10		10	4.3	mg/L			02/26/24 22:25	1

Lab Sample ID: LCS 500-755755/2
Matrix: Water
Analysis Batch: 755755

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Total Dissolved Solids	250	242		mg/L		97	80 - 120

Method: SM 4500 F C - Fluoride

Lab Sample ID: MB 500-757490/3
Matrix: Water
Analysis Batch: 757490

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	<0.10		0.10	0.056	mg/L			03/07/24 15:02	1

Lab Sample ID: MB 500-757490/31
Matrix: Water
Analysis Batch: 757490

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	<0.10		0.10	0.056	mg/L			03/07/24 17:22	1

Lab Sample ID: LCS 500-757490/32
Matrix: Water
Analysis Batch: 757490

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Fluoride	10.0	9.98		mg/L		100	90 - 119

Lab Sample ID: LCS 500-757490/4
Matrix: Water
Analysis Batch: 757490

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Fluoride	10.0	9.87		mg/L		99	90 - 119

Lab Chronicle

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-5
SDG: VER_845_912

Client Sample ID: VER_010

Lab Sample ID: 500-246480-5
Date Collected: 02/20/24 17:55
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total Recoverable	Prep	200.7			756864	BDE	EET CHI	03/05/24 08:58 - 03/05/24 14:58 [1]
Total Recoverable	Analysis	200.7 Rev 4.4		1	757263	SJ	EET CHI	03/06/24 21:12
Total Recoverable	Prep	3005A			756958	MC	EET CHI	03/05/24 17:38 - 03/05/24 22:38 [1]
Total Recoverable	Analysis	6020B		1	757459	RN	EET CHI	03/08/24 00:44
Total Recoverable	Prep	3005A			756958	MC	EET CHI	03/05/24 17:38 - 03/05/24 22:38 [1]
Total Recoverable	Analysis	6020B		1	757847	RN	EET CHI	03/11/24 17:54
Total Recoverable	Prep	3005A			756958	MC	EET CHI	03/05/24 17:38 - 03/05/24 22:38 [1]
Total Recoverable	Analysis	6020B		1	758475	RN	EET CHI	03/14/24 17:43
Total/NA	Prep	7470A			756906	MJG	EET CHI	03/05/24 10:40 - 03/05/24 12:40 [1]
Total/NA	Analysis	7470A		1	757131	MJG	EET CHI	03/06/24 07:25
Total/NA	Analysis	300.0		1	756576	W1T	EET CHI	03/02/24 15:34
Total/NA	Analysis	300.0		10	756576	W1T	EET CHI	03/02/24 15:49
Total/NA	Analysis	SM 2320B		1	757067	LEG	EET CHI	03/05/24 16:37
Total/NA	Analysis	SM 2540C		1	755368	CLB	EET CHI	02/23/24 00:19
Total/NA	Analysis	SM 4500 F C		1	757490	LEG	EET CHI	03/07/24 15:33
Total/NA	Analysis	Field Sampling		1	755860	DN	EET CHI	02/20/24 17:55

Client Sample ID: VER_EB1

Lab Sample ID: 500-246480-21
Date Collected: 02/20/24 17:50
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total Recoverable	Prep	200.7			756867	BDE	EET CHI	03/05/24 09:00 - 03/05/24 15:00 [1]
Total Recoverable	Analysis	200.7 Rev 4.4		1	757263	SJ	EET CHI	03/06/24 23:53
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	757459	RN	EET CHI	03/08/24 02:39
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	757847	RN	EET CHI	03/11/24 20:36
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	758475	RN	EET CHI	03/14/24 16:22
Total/NA	Prep	7470A			757117	MJG	EET CHI	03/06/24 10:55 - 03/06/24 12:55 [1]
Total/NA	Analysis	7470A		1	757337	MJG	EET CHI	03/07/24 08:37
Total/NA	Analysis	300.0		1	756942	W1T	EET CHI	03/06/24 11:27
Total/NA	Analysis	SM 2320B		1	757067	LEG	EET CHI	03/05/24 19:47
Total/NA	Analysis	SM 2540C		1	755755	CLB	EET CHI	02/26/24 22:53
Total/NA	Analysis	SM 4500 F C		1	757490	LEG	EET CHI	03/07/24 17:18

Client Sample ID: VER_016A

Lab Sample ID: 500-246480-25
Date Collected: 02/21/24 13:15
Matrix: Water
Date Received: 02/22/24 11:18

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total Recoverable	Prep	200.7			756867	BDE	EET CHI	03/05/24 09:00 - 03/05/24 15:00 [1]
Total Recoverable	Analysis	200.7 Rev 4.4		1	757263	SJ	EET CHI	03/07/24 00:20

Lab Chronicle

Client Sample ID: VER_016A

Lab Sample ID: 500-246480-25

Date Collected: 02/21/24 13:15

Matrix: Water

Date Received: 02/22/24 11:18

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	757459	RN	EET CHI	03/08/24 02:53
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	757847	RN	EET CHI	03/11/24 21:06
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	758475	RN	EET CHI	03/14/24 16:46
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	758529	RN	EET CHI	03/15/24 14:12
Total/NA	Prep	7470A			757117	MJG	EET CHI	03/06/24 10:55 - 03/06/24 12:55 [1]
Total/NA	Analysis	7470A		1	757337	MJG	EET CHI	03/07/24 08:50
Total/NA	Analysis	300.0		1	756942	W1T	EET CHI	03/06/24 12:27
Total/NA	Analysis	300.0		10	757868	MB	EET CHI	03/12/24 12:32
Total/NA	Analysis	SM 2320B		1	757067	LEG	EET CHI	03/05/24 21:25
Total/NA	Analysis	SM 2540C		1	755755	CLB	EET CHI	02/26/24 23:03
Total/NA	Analysis	SM 4500 F C		1	757490	LEG	EET CHI	03/07/24 17:46
Total/NA	Analysis	Field Sampling		1	755860	DN	EET CHI	02/21/24 13:15

Client Sample ID: VER_022

Lab Sample ID: 500-246480-26

Date Collected: 02/21/24 11:10

Matrix: Water

Date Received: 02/22/24 11:18

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total Recoverable	Prep	200.7			756867	BDE	EET CHI	03/05/24 09:00 - 03/05/24 15:00 [1]
Total Recoverable	Analysis	200.7 Rev 4.4		1	757263	SJ	EET CHI	03/07/24 00:24
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	757459	RN	EET CHI	03/08/24 02:56
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	757847	RN	EET CHI	03/11/24 21:10
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	758475	RN	EET CHI	03/14/24 16:50
Total/NA	Prep	7470A			757117	MJG	EET CHI	03/06/24 10:55 - 03/06/24 12:55 [1]
Total/NA	Analysis	7470A		1	757337	MJG	EET CHI	03/07/24 08:52
Total/NA	Analysis	300.0		1	756942	W1T	EET CHI	03/06/24 12:42
Total/NA	Analysis	SM 2320B		1	757067	LEG	EET CHI	03/05/24 21:45
Total/NA	Analysis	SM 2540C		1	755755	CLB	EET CHI	02/26/24 23:06
Total/NA	Analysis	SM 4500 F C		1	757490	LEG	EET CHI	03/07/24 18:03
Total/NA	Analysis	Field Sampling		1	755860	DN	EET CHI	02/21/24 11:10

Lab Chronicle

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-5
SDG: VER_845_912

Client Sample ID: VER_035&D

Lab Sample ID: 500-246480-27

Date Collected: 02/21/24 13:05
Date Received: 02/22/24 11:18

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total Recoverable	Prep	200.7			756867	BDE	EET CHI	03/05/24 09:00 - 03/05/24 15:00 [1]
Total Recoverable	Analysis	200.7 Rev 4.4		1	757263	SJ	EET CHI	03/07/24 00:28
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	757459	RN	EET CHI	03/08/24 03:10
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	757847	RN	EET CHI	03/11/24 21:13
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		10	758475	RN	EET CHI	03/14/24 16:53
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	758529	RN	EET CHI	03/15/24 14:16
Total/NA	Prep	7470A			757117	MJG	EET CHI	03/06/24 10:55 - 03/06/24 12:55 [1]
Total/NA	Analysis	7470A		1	757337	MJG	EET CHI	03/07/24 08:54
Total/NA	Analysis	300.0		100	757486	W1T	EET CHI	03/09/24 23:51
Total/NA	Analysis	300.0		100	757868	MB	EET CHI	03/12/24 12:47
Total/NA	Analysis	SM 2320B		1	757067	LEG	EET CHI	03/05/24 22:11
Total/NA	Analysis	SM 2540C		1	755755	CLB	EET CHI	02/26/24 23:08
Total/NA	Analysis	SM 4500 F C		1	757490	LEG	EET CHI	03/07/24 18:23
Total/NA	Analysis	Field Sampling		1	755860	DN	EET CHI	02/21/24 13:05

Client Sample ID: VER_070#S

Lab Sample ID: 500-246480-29

Date Collected: 02/21/24 09:20
Date Received: 02/22/24 11:18

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total Recoverable	Prep	200.7			756867	BDE	EET CHI	03/05/24 09:00 - 03/05/24 15:00 [1]
Total Recoverable	Analysis	200.7 Rev 4.4		1	757263	SJ	EET CHI	03/07/24 00:37
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	757459	RN	EET CHI	03/08/24 03:17
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	757847	RN	EET CHI	03/11/24 21:34
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	758475	RN	EET CHI	03/14/24 17:00
Total/NA	Prep	7470A			757117	MJG	EET CHI	03/06/24 10:55 - 03/06/24 12:55 [1]
Total/NA	Analysis	7470A		1	757337	MJG	EET CHI	03/07/24 08:58
Total/NA	Analysis	300.0		1	756942	W1T	EET CHI	03/06/24 13:58
Total/NA	Analysis	300.0		50	757486	W1T	EET CHI	03/10/24 00:21
Total/NA	Analysis	SM 2320B		1	757067	LEG	EET CHI	03/05/24 22:32
Total/NA	Analysis	SM 2540C		1	755755	CLB	EET CHI	02/26/24 23:14
Total/NA	Analysis	SM 4500 F C		1	757490	LEG	EET CHI	03/07/24 18:32
Total/NA	Analysis	Field Sampling		1	755860	DN	EET CHI	02/21/24 09:20

Lab Chronicle

Client Sample ID: VER_070&D

Lab Sample ID: 500-246480-30

Date Collected: 02/21/24 08:45

Matrix: Water

Date Received: 02/22/24 11:18

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total Recoverable	Prep	200.7			756867	BDE	EET CHI	03/05/24 09:00 - 03/05/24 15:00 [1]
Total Recoverable	Analysis	200.7 Rev 4.4		1	757263	SJ	EET CHI	03/07/24 00:41
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	757459	RN	EET CHI	03/08/24 03:20
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	757847	RN	EET CHI	03/11/24 21:37
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	758475	RN	EET CHI	03/14/24 17:03
Total/NA	Prep	7470A			757117	MJG	EET CHI	03/06/24 10:55 - 03/06/24 12:55 [1]
Total/NA	Analysis	7470A		1	757337	MJG	EET CHI	03/07/24 09:00
Total/NA	Analysis	300.0		1	756942	W1T	EET CHI	03/06/24 14:13
Total/NA	Analysis	300.0		100	757868	MB	EET CHI	03/12/24 13:17
Total/NA	Analysis	SM 2320B		1	757067	LEG	EET CHI	03/05/24 22:41
Total/NA	Analysis	SM 2540C		1	755755	CLB	EET CHI	02/26/24 23:16
Total/NA	Analysis	SM 4500 F C		1	757490	LEG	EET CHI	03/07/24 18:37
Total/NA	Analysis	Field Sampling		1	755860	DN	EET CHI	02/21/24 08:45

Client Sample ID: VER_NED1

Lab Sample ID: 500-246480-31

Date Collected: 02/21/24 15:00

Matrix: Water

Date Received: 02/22/24 11:18

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total Recoverable	Prep	200.7			756867	BDE	EET CHI	03/05/24 09:00 - 03/05/24 15:00 [1]
Total Recoverable	Analysis	200.7 Rev 4.4		1	757263	SJ	EET CHI	03/07/24 00:46
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	757459	RN	EET CHI	03/08/24 03:24
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	757847	RN	EET CHI	03/11/24 21:41
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		10	758475	RN	EET CHI	03/14/24 17:07
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	758529	RN	EET CHI	03/15/24 14:23
Total/NA	Prep	7470A			757117	MJG	EET CHI	03/06/24 10:55 - 03/06/24 12:55 [1]
Total/NA	Analysis	7470A		1	757337	MJG	EET CHI	03/07/24 09:02
Total/NA	Analysis	300.0		1	756942	W1T	EET CHI	03/06/24 14:28
Total/NA	Analysis	300.0		100	757486	W1T	EET CHI	03/10/24 00:51
Total/NA	Analysis	SM 2320B		1	757067	LEG	EET CHI	03/05/24 22:51
Total/NA	Analysis	SM 2540C		1	755755	CLB	EET CHI	02/26/24 23:19
Total/NA	Analysis	SM 4500 F C		1	757490	LEG	EET CHI	03/07/24 18:41
Total/NA	Analysis	Field Sampling		1	755860	DN	EET CHI	02/21/24 15:00

Lab Chronicle

Client Sample ID: VER_FB

Lab Sample ID: 500-246480-32

Date Collected: 02/21/24 15:20

Matrix: Water

Date Received: 02/22/24 11:18

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total Recoverable	Prep	200.7			756867	BDE	EET CHI	03/05/24 09:00 - 03/05/24 15:00 [1]
Total Recoverable	Analysis	200.7 Rev 4.4		1	757263	SJ	EET CHI	03/07/24 00:50
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	757459	RN	EET CHI	03/08/24 03:27
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	757847	RN	EET CHI	03/11/24 21:48
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	758475	RN	EET CHI	03/14/24 17:10
Total/NA	Prep	7470A			757118	MJG	EET CHI	03/06/24 10:55 - 03/06/24 12:55 [1]
Total/NA	Analysis	7470A		1	757337	MJG	EET CHI	03/07/24 07:08
Total/NA	Analysis	300.0		1	756942	W1T	EET CHI	03/06/24 14:44
Total/NA	Analysis	SM 2320B		1	757258	LEG	EET CHI	03/06/24 17:26
Total/NA	Analysis	SM 2540C		1	755755	CLB	EET CHI	02/26/24 23:21
Total/NA	Analysis	SM 4500 F C		1	757490	LEG	EET CHI	03/07/24 18:46

Client Sample ID: VER_EB2

Lab Sample ID: 500-246480-33

Date Collected: 02/21/24 15:50

Matrix: Water

Date Received: 02/22/24 11:18

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total Recoverable	Prep	200.7			756867	BDE	EET CHI	03/05/24 09:00 - 03/05/24 15:00 [1]
Total Recoverable	Analysis	200.7 Rev 4.4		1	757263	SJ	EET CHI	03/07/24 00:54
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	757459	RN	EET CHI	03/08/24 03:31
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	757847	RN	EET CHI	03/11/24 21:51
Total Recoverable	Prep	3005A			757078	BDE	EET CHI	03/06/24 09:08 - 03/06/24 15:08 [1]
Total Recoverable	Analysis	6020B		1	758475	RN	EET CHI	03/14/24 17:14
Total/NA	Prep	7470A			757118	MJG	EET CHI	03/06/24 10:55 - 03/06/24 12:55 [1]
Total/NA	Analysis	7470A		1	757337	MJG	EET CHI	03/07/24 07:10
Total/NA	Analysis	300.0		1	757150	NMB	EET CHI	03/07/24 08:10
Total/NA	Analysis	SM 2320B		1	757258	LEG	EET CHI	03/06/24 17:33
Total/NA	Analysis	SM 2540C		1	755755	CLB	EET CHI	02/26/24 23:24
Total/NA	Analysis	SM 4500 F C		1	757490	LEG	EET CHI	03/07/24 19:02

[1] This procedure uses a method stipulated length of time for the process. Both start and end times are displayed.

Laboratory References:

EET CHI = Eurofins Chicago, 2417 Bond Street, University Park, IL 60484, TEL (708)534-5200

Accreditation/Certification Summary

Laboratory: Eurofins Chicago

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
Illinois	NELAP	IL00035	04-29-24

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
200.7 Rev 4.4	200.7	Water	Lithium
Field Sampling		Water	Depth to Water (ft from MP)
Field Sampling		Water	Field pH
Field Sampling		Water	Field Temperature
Field Sampling		Water	Oxidation Reduction Potential
Field Sampling		Water	Oxygen, Dissolved
Field Sampling		Water	Specific Conductance
Field Sampling		Water	Turbidity
SM 2320B		Water	Bicarbonate Alkalinity as CaCO3
SM 2320B		Water	Carbonate Alkalinity as CaCO3

500-246480

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT All relevant fields must be completed accurately

500-246480 COC

Page 1 of 3

Section A Required Client Information

Company:	Vistra Corp-Vermilion
Address	10188 E 2150 North Rd, Danville, IL 61834
Email To	Brian.Voelker@VistraCorp.com
Phone	(217) 753-8911
Fax:	
Requested Due Date/TAT	10 day

Section B Required Project Information

Report To	Brian Voelker
Copy To.	Sam Davies samantha.davies@vistracorp.com; Dianna Tickner - Dianna Tickner@vistracorp com
Purchase Order No	
Project Name	VER-24Q1
Project Number:	50022750

Section C Invoice Information:

Attention:	Dave McCoy
Company Name	A3 Environmental
Address	3030 Warrenville Rd, Lisle, IL 60532
Quote Reference	
Project Manager:	Donna Campbell & Dirk Nelson
Profile #:	

REGULATORY AGENCY

NPDES | GROUND WATER | DRINKING WATER
UST | RCRA | OTHER

Site Location STATE: IL

Section D Required Client Information

Valid Matrix Codes (MATRIX / CODE): DRINKING WATER DW; WATER WT; WASTE WATER WW; PRODUCT P; SOIL/SOLID SL; OIL OL; WIPE WP; AIR AR; OTHER OT; TISSUE TS

SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test (Y/N)	VER-845-910-911	VER-845-912	VER-NPDES-912	VER_000_A	VER_000_B	VER_000_RAD	Residual Chlorine (Y/N)	Project No./ Lab I.D.
1	VER_002			2/20/24	12:20	[illegible]	6										X				X	X		
2	VER_003R			2/20/24	16:40		6										X				X	X		
3	VER_003R_FD			2/20/24	16:40		6										X				X	X		
	~~VER_004~~																~~X~~				~~X~~	~~X~~		
	~~VER_005~~																~~X~~				~~X~~	~~X~~		
	~~VER_007R~~																~~X~~				~~X~~	~~X~~		
4	VER_008R			2/20/24	17:25		6										X				X	X		
5	VER_010			2/20/24	17:53		6											X	X	X		X		
	~~VER_016IB~~																	~~X~~	~~X~~	~~X~~		~~X~~		
	~~VER_016A~~																	~~X~~	~~X~~	~~X~~		~~X~~		
	~~VER_017~~																~~X~~				~~X~~	~~X~~		
6	VER_020			2/20/24	9:25		18										X				X	X		MS/MSD
7	VER_021			2/20/24	10:30		6										X				X	X		
	~~VER_022~~																	~~X~~			~~X~~	~~X~~		
8	VER_034			2/20/24	0935		6										X				X	X		
	~~VER_035#S~~																	~~X~~	~~X~~	~~X~~		~~X~~		

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
VER-24Q1 Rev 1	[illegible] A3E	2-21-24	930	Taylor Blanchard	2/21/24	09:30	
	[illegible]	2/21/24	1120	Shae Scott	2/21/24	1120	

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: David McCoy / Taylor Olsen - Allison Beckett

SIGNATURE of SAMPLER: [signature] DATE Signed (MM/DD/YY): 2/20/24

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

5.8→5.3, 4.6→4.1, 3.1→2.6, 4.4→3.9, 5.6→5.1, 4.1→3.6

500-240480

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT All relevant fields must be completed accurately

Page 2 of 3

Section A Required Client Information		Section B Required Project Information		Section C Invoice Information	
Company	Vistra Corp-Vermilion	Report To	Brian Voelker	Attention	Dave McCoy
Address	10188 E 2150 North Rd	Copy To	Sam Davies. samantha.davies@vistracorp com	Company Name	A3 Environmental
	Danville, IL 61834		Dianna Tickner - Dianna Tickner@vistracorp com	Address	3030 Warrenville Rd, Lisle, IL 60532
Email To	Brian.Voelker@VistraCorp.com	Purchase Order No		Quote Reference	
Phone	(217) 753-8911 Fax.	Project Name	VER-24Q1	Project Manager	Donna Campbell & Dirk Nelson
Requested Due Date/TAT	10 day	Project Number	50022750	Profile #	

REGULATORY AGENCY		
NPDES	GROUND WATER	DRINKING WATER
UST	RCRA	OTHER
Site Location STATE	IL	

Section D Required Client Information

SAMPLE ID (A-Z, 0-9 /) Sample IDs MUST BE UNIQUE

Valid Matrix Codes MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
WIPE	WP
AIR	AR
OTHER	OT
TISSUE	TS

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	VER-845-910-911	VER-845-912	VER-NPDES-912	VER_000_A	VER_000_B	VER_000_RAD	Residual Chlorine (Y/N)	Project No./Lab I.D.
	~~VER_035&D~~																	X	X	X		X		
9	VER_036			2/20/24	15:15		6										X				X	X		
10	VER_036_FD			2/20/24	15:15		6										X				X	X		
11	VER_037			2/20/24	14:25												X				X	X		
12	VER_038			2/20/24	10:30												X				X	X		
13	VER_040			2/20/24	11:20												X				X	X		
14	VER_040_FD			2/20/24	11:20												X				X	X		
	~~VER_041~~																X				X	X		
15	VER_042			2/20/24	12:17												X				X	X		MS/MSD
16	VER_043			2/20/24	11:30												X				X	X		
17	VER_043_FD			2/20/24	11:30												X				X	X		
	~~VER_070#S~~																	X			X	X		
	~~VER_070&D~~																	X			X	X		
	~~VER_071#S~~																	X			X	X		
	~~VER_071&D~~																	X			X	X		
18	VER_101&			2/20/24	13:45												X				X	X		

	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
VER-24Q1 Rev 1	Dave Mc / A3E	2-21-24	0930	[signature]	2/21/24	09:30	
	[signature]	2/21/24	1120	[signature]	2/21/24	1120	

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Dave Mc / Taylor Clark

SIGNATURE of SAMPLER: [signature]

DATE Signed (MM/DD/YY): 2/20/24

Temp in °C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

500-246480

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT All relevant fields must be completed accurately

Page 3 of 3

Section A Required Client Information.		Section B Required Project Information:		Section C Invoice Information	
Company:	Vistra Corp-Vermilion	Report To	Brian Voelker	Attention	Dave McCoy
Address	10188 E 2150 North Rd	Copy To	Sam Davies samantha.davies@vistracorp com	Company Name	A3 Environmental
	Danville, IL 61834		Dianna Tickner - Dianna Tickner@vistracorp com	Address	3030 Warrenville Rd, Lisle, IL 60532
Email To	Brian.Voelker@VistraCorp.com	Purchase Order No		Quote Reference	
Phone	(217) 753-8911 Fax:	Project Name	VER-24Q1	Project Manager:	Donna Campbell & Dirk Nelson
Requested Due Date/TAT	10 day	Project Number:	50022750	Profile #:	

REGULATORY AGENCY		
NPDES	GROUND WATER	DRINKING WATER
UST	RCRA	OTHER
Site Location STATE	IL	

Section D Required Client Information

Valid Matrix Codes: MATRIX / CODE — DRINKING WATER DW; WATER WT; WASTE WATER WW; PRODUCT P; SOIL/SOLID SL; OIL OL; WIPE WP; AIR AR; OTHER OT; TISSUE TS

SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE

Preservatives: Unpreserved, H_2SO_4, HNO_3, HCl, NaOH, $Na_2S_2O_3$, Methanol, Other

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	VER-845-910-911	VER-845-912	VER-NPDES-912	VER_000_A	VER_000_B	VER_000_RAD	Residual Chlorine (Y/N)	Project No./ Lab I.D.
19	VER_103&			2/24/24	15:15		6										X				X	X		
20	VER_ND3			2/20/24	13:40		6										X				X			No RAD Analysis
	~~VER_NED1~~																	~~X~~			~~X~~			~~No RAD Analysis~~
	~~VER_OED1~~																~~X~~				~~X~~			~~No RAD Analysis~~
	~~VER_FB~~																	~~X~~	~~X~~	~~X~~		~~X~~		
21	VER_EB1			2/20/24	14:50		7											X	X	X		X		
	~~VER_EB2~~																	~~X~~	~~X~~	~~X~~		~~X~~		
	~~VER_EB3~~																	~~X~~	~~X~~	~~X~~		~~X~~		

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
VER-24Q1 Rev 1	Dave Ng A3E	2-21-24	0930	Alyssa Scholl [signature]	2/21/24	0930	
	Alyssa Scholl [signature]	2/21/24	1120	[signature]	2/21/24	1120	

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Dave Ng Taylor Clark

SIGNATURE of SAMPLER: [signature] DATE Signed (MM/DD/YY): 2/20/24

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT All relevant fields must be completed accurately.

500-246480

Page: 1 of 3

Section A Required Client Information:

Company:	Vistra Corp-Vermilion
Address:	10188 E 2150 North Rd, Danville, IL 61834
Email To:	Brian.Voelker@VistraCorp.com
Phone:	(217) 753-8911
Fax:	
Requested Due Date/TAT:	10 day

Section B Required Project Information:

Report To:	Brian Voelker
Copy To:	Sam Davies: samantha.davies@vistracorp.com; Dianna Tickner Dianna.Tickner@vistracorp.com
Purchase Order No.	
Project Name:	VER-24Q1
Project Number:	50022750

Section C Invoice Information:

Attention:	Dave McCoy
Company Name:	A3 Environmental
Address:	3030 Warrenville Rd, Lisle, IL 60532
Quote Reference:	
Project Manager	Donna Campbell & Dirk Nelson
Profile #:	

REGULATORY AGENCY: NPDES, GROUND WATER, DRINKING WATER, UST, RCRA, OTHER

Site Location STATE: IL

500-246480 COC

Section D Required Client Information

Valid Matrix Codes: DRINKING WATER DW; WATER WT; WASTE WATER W; PRODUCT P; SOIL/SOLID SL; OIL OL; WIPE WP; AIR AR; OTHER OT; TISSUE S

SAMPLE ID (A-Z, 0-9 / -) Sample IDs MUST BE UNIQUE

Preservatives: Unpreserved, H_2SO_4, HNO_3, HCl, NaOH, $Na_2S_2O_3$, Methanol, Other

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	VER-845-910-911	VER-845-912	VER-NPDES-912	VER_000_A	VER_000_B	VER_000_RAD	Residual Chlorine (Y/N)	Project No./ Lab I.D.
	~~VER_002~~							X				X	X		
	~~VER_003R~~							X				X	X		
	~~VER_003R_FD~~							X				X	X		
22	VER_004			2.21.24	0845			X				X	X		
23	VER_005			2 21.24	09.40			X				X	X		
24	VER_007R			2.21.24	11:20		6	X				X	X		
	~~VER_008R~~							X				X	X		
	~~VER_010~~								X	X	X		X		
	~~VER_016IB~~								X	X	X		X		
25	VER_016A			2 21.24	13 15		7		X	X	X		X		
	~~VER_017~~							X				X	X		
	~~VER_020~~							X				X	X		MS/MSD
	~~VER_021~~							X				X	X		
26	VER_022			2 21.24	11:10		6		X			X	X		
	~~VER_034~~							X				X	X		
	~~VER_035#S~~								X	X	X		X		

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME
VER-24Q1 Rev 1	Dave Mc	2.21.24	1630	Jason Blenell	2/22/24	0923
	Jason Blenell	2/22/24 2.21.24	1118	Stephanie Hernandez EETA	2/22/24	1118

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Dave McCoy

SIGNATURE of SAMPLER: [signature]

DATE Signed (MM/DD/YY): 2.21.24

SAMPLE CONDITIONS: Temp in °C; Received on Ice (Y/N); Custody Sealed Cooler (Y/N); Samples Intact (Y/N)

2/21/24

4.6+4.1, 3.2+2.7, 1.0+1.5, 3.0+2.5

DM

Confidential

500-246480

CHAIN-OF-CUSTODY / Analytical Request Document

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Page: 2 of 3

Section A Required Client Information:		Section B Required Project Information:		Section C Invoice Information:	
Company:	Vistra Corp-Vermilion	Report To:	Brian Voelker	Attention:	Dave McCoy
Address:	10188 E 2150 North Rd	Copy To:	Sam Davies: samantha.davies@vistracorp.com	Company Name:	A3 Environmental
	Danville, IL 61834		Dianna Tickner Dianna.Tickner@vistracorp.com	Address:	3030 Warrenville Rd, Lisle, IL 60532
Email To:	Brian.Voelker@VistraCorp.com	Purchase Order No.		Quote Reference:	
Phone:	(217) 753-8911 Fax:	Project Name:	VER-24Q1	Project Manager	Donna Campbell & Dirk Nelson
Requested Due Date/TAT:	10 day	Project Number:	50022750	Profile #:	

REGULATORY AGENCY		
NPDES	GROUND WATER	DRINKING WATER
UST	RCRA	OTHER
Site Location STATE:	IL	

Section D Required Client Information

Valid Matrix Codes: MATRIX / CODE — DRINKING WATER DW; WATER WT; WASTE WATER WW; PRODUCT P; SOIL/SOLID SL; OIL OL; WIPE WP; AIR AR; OTHER OT; TISSUE TS

SAMPLE ID (A-Z, 0-9 / -) Sample IDs MUST BE UNIQUE

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	VER-845-910-911	VER-845-912	VER-NPDES-912	VER_000_A	VER_000_B	VER_000_RAD	Residual Chlorine (Y/N)	Project No./ Lab I.D.
27 26	VER_035&D			2 21 24	13:05		6											X	X	X		X		
	~~VER_036~~																X				X	X		
	~~VER_036_FD~~																X				X	X		
	~~VER_037~~																X				X	X		
	~~VER_038~~																X				X	X		
	~~VER_040~~																X				X	X		
	~~VER_040_FD~~																X				X	X		
28 27	VER_041			2.21.24	12:05												X				X	X		
	~~VER_042~~																X				X	X		MS/MSD
	~~VER_043~~																X				X	X		
	~~VER_043_FD~~																X				X	X		
29 28	VER_070#S			2.21.24	0920		6											X			X	X		
30 29	VER_070&D			2.21.24	0845		6											X			X	X		
	~~VER_071#S~~																	X			X	X		
	~~VER_071&D~~																	X			X	X		
	~~VER_101&~~																X				X	X		

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
VER-24Q1 Rev 1	[signature]	2.22.24	16:30	[signature]	2/22/24	0923	
	[signature]	2/22/24	1116	Stephanie Hemond / EEFH	2/22/24	1118	

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Dave McCoy

SIGNATURE of SAMPLER: [signature] DATE Signed (MM/DD/YY): 2.21.24

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

2/21/24 DM

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

500 146480

Page: 3 of 3

Section A Required Client Information:		Section B Required Project Information:		Section C Invoice Information:	
Company:	Vistra Corp-Vermilion	Report To:	Brian Voelker	Attention:	Dave McCoy
Address:	10188 E 2150 North Rd	Copy To:	Sam Davies: samantha.davies@vistracorp.com	Company Name:	A3 Environmental
	Danville, IL 61834		Dianna Tickner Dianna.Tickner@vistracorp.com	Address:	3030 Warrenville Rd, Lisle, IL 60532
Email To:	Brian.Voelker@VistraCorp.com	Purchase Order No.		Quote Reference:	
Phone: (217) 753-8911	Fax:	Project Name:	VER-24Q1	Project Manager	Donna Campbell & Dirk Nelson
Requested Due Date/TAT:	10 day	Project Number:	50022750	Profile #:	

REGULATORY AGENCY

NPDES | GROUND WATER | DRINKING WATER
UST | RCRA | OTHER

Site Location STATE: IL

Section D Required Client Information

Valid Matrix Codes: MATRIX / CODE — DRINKING WATER DW, WATER, WASTE WATER WW, PRODUCT P, SOIL/SOLID SL, OIL OL, WIPE WP, AIR AR, OTHER OT, TISSUE TS

SAMPLE ID (A-Z, 0-9 / -) Sample IDs MUST BE UNIQUE

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	VER-845-910-911	VER-845-912	VER-NPDES-912	VER_000_A	VER_000_B	VER_000_RAD	Residual Chlorine (Y/N)	Project No./ Lab I.D.
	~~VER_103&~~																X				X	X		
	~~VER_ND3~~																X				X			No RAD Analysis
31 ~~30~~	VER_NED1			2 21.24	1500		6											X			X			No RAD Analysis
	~~VER_OED1~~																X				X			No RAD Analysis
32 ~~31~~	VER_FB			2 21.24	15:20		7											X	X	X		X		
	~~VER_EB1~~																	X	X	X		X		
33 ~~32~~	VER_EB2			2 21 24	15:50		7											X	X	X		X		
	~~VER_EB3~~																	X	X	X		X		

2/21/24 CH

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
VER-24Q1 Rev 1	[signature]	2/22/24	1630	[signature]	2/22/24	0923	
	[signature]	2/22/24	1118	Stephanie Hernandez EETA	2/22/24	1118	

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Dave my

SIGNATURE of SAMPLER: [signature]

DATE Signed (MM/DD/YY): 2 21.24

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

2/21/24
DM

Login Sample Receipt Checklist

Client: Vistra Energy Corp

Job Number: 500-246480-5
SDG Number: VER_845_912

Login Number: 246480
List Number: 1
Creator: Scott, Sherri L

List Source: Eurofins Chicago

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	5.3,4.1,2.6,3.9,5.1,3.6,4.1,2.7,1.5,2.5
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	False	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion Client: Vistra

Project Number: Task #: Start Date: 2 / /2024 Time: 11:48 02 - 1220

Field Personnel: A. Beckett / T. Closen / D. McCoy Finish Date: 2.20.24 Time: 1423

WELL INFORMATION

Well ID: 02

Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp. (°C) 3%	pH (SU) ±.1	SEC or Cond. (µs/cm) 3%	Dissolved Oxygen (mg/L) 10%	Turbidity (NTU) 10%	ORP (mV) 10%	Visual Clarity
	11:48		17.89		~~18.5~~						
	11:53	0.75	20.97	3.08	13.3	7.85	863	1.08	3.00	-153.94	turbid
	11:58	2.5	22.21	4.32	13.3	7.87	858	1.28	4.15	-168.6	" "
	12:03	3	22.92	5.03	13.3	7.88	857	0.99	4.78	-179.2	" "
	12:08	3.5	23.41	5.52	13.3	7.87	856	1.14	3.99	-183.1	Clear
	12:13	4.0	23.99	6.10	13.3	7.86	847	1.21	4.04	-189.1	Clear
	12:18		24.40		13.36	7.85	846	1.23	4.26	-186.1	Clear

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity
FT BTOC - Feet Below Top of Casing
na -
ORP - Oxidation-Reduction Potential
SEC - Specific Electrical Conductance
SU - Standard Units

Low-Flow Sampling Form Page

02@ 1220

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion
Client: Vistra
Project Number:
Task #:
Start Date: 2 / /2024
Time: 16:05
Field Personnel: A. Beckett / T. Closen / D. McCoy
Finish Date: 2.28.24
Time:
1423

WELL INFORMATION

Well ID: 3R
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp (°C)	pH (SU)	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity
	16:05		7.85								
	16:07	0.25	8.31	0.46	12.5	7.36	1347	2.04	145.46	-53.2	Clear
	16:12	1.0	8.08	0.23	12.4	7.41	1365	1.44	104.14	-110.7	Clear
	16:17	1.75	8.52	0.67	12.5	7.40	1376	0.42	117.20	-137.6	Clear
	16:23	2.25	8.39	0.54	12.5	7.39	1369	0.15	111.65	-142.4	Clear
	16:27	3.0	8.62	0.77	12.5	7.39	1372	0.17	104.82	-147.2	Clear
	16:32	5.0	8.49	0.65	12.5	7.39	1369	0.16	100.97	-149.8	Clear
	16:37	5.5	8.52	0.67	12.5	7.39	1368	0.15	108.61	-150.1	Clear

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity
FT BTOC - Feet Below Top of Casing
na -
ORP - Oxidation-Reduction Potential
SEC - Specific Electrical Conductance
SU - Standard Units

Low-Flow Sampling Form

Page

☐
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3R @ > 16:40
3R FD

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion
Client: Vistra
Project Number:
Task #:
Start Date: 2/21/2024
Time: ~~[illegible]~~ 8:10
Field Personnel: A. Beckett / T. Closen / D. McCoy
Finish Date: 2/21/24
Time: 8:45
1423

WELL INFORMATION

Well ID: 04
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp. (°C)	pH (SU)	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity
initial	8:15		7.02								
purge	8:20		7.35		9.7	7.79	417.3	0.76	35.7	-135.4	clear
purge	8:25		7.36		9.8	7.82	422.6	0.27	9.08	-162.5	clear
purge	8:30		7.34		9.8	7.79	434.9	0.17	6.80	-164.9	clear
purge	8:35		7.36		9.8	7.76	449.8	0.10	4.10	-163.3	clear
purge	8:40	4 gal	7.35		9.7	7.75	451.1	0.09	4.08	-162.4	clear

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity ORP - Oxidation-Reduction Potential SEC - Specific Electrical
FT BTOC - Feet Below Top of Casing na - Conductance SU - Standard Units

Low-Flow Sampling Form

Page

VER_004

Sample @ 8:45

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion
Client: Vistra
Project Number:
Task #:
Start Date: 2/2' /2024 Time: 9:05
Field Personnel: A. Beckett / T. Closen / D. McCoy
Finish Date: 2/21/24 Time: 9:15
1423

WELL INFORMATION

Well ID: 05
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp. (°C)	pH (SU)	SEC or Cond (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity
initial	9:05		7.13								
purge	9:10		7.61		10.8	7.80	555	0.33	34.1	0.5	clear
purge	9:15		7.62		10.8	7.60	553	0.13	10.05	-2.4	clear
purge	9:20		7.59		10.9	7.59	553	0.09	6.05	-4.0	clear
purge	9:25		7.62		11.0	7.59	553	0.06	4.30	-6.2	clear
purge	9:30		7.62		11.0	7.59	553	0.04	3.20	-6.8	clear
purge	9:35	4.5 gal	7.61		11.0	7.59	553	0.04	3.18	-6.9	clear

NOTES (continued)

Bladder Pump / Clear / No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity
FT BTOC - Feet Below Top of Casing na -
ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units

Low-Flow Sampling Form

Page

VER_005 9:40

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion | Client: Vistra
Project Number: | Task #: | Start Date: 2 / /2024 | Time: 10:40
Field Personnel: A. Beckett / T. Closen / D. McCoy | Finish Date: 2.21.24 | Time: 1423

WELL INFORMATION

Well ID: 007R
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp (°C) 3%	pH (SU) .1	SEC or Cond (µs/cm) 3%	Dissolved Oxygen (mg/L) 10	Turbidity (NTU) 10	ORP (mV) 10	Visual Clarity
	10:40	—	16.11								
	10:45	0.25	16.25	.14	12.1	7.56	2551	1.82	50.68	1.79	Clear
	10:50	0.5	16.28	.17	12.3	7.63	2546	1.26	87.40	-122.1	Clear
	10:55	0.75	16.26	.15	12.4	7.65	2535	1.18	129.82	-128.5	Clear
	11:00	1.25	16.26	.15	12.4	7.65	2549	1.02	134.37	-128.7	Clear
	11:05	2.25	16.26	.15	12.4	7.66	2554	0.93	122.04	-135.8	Clear
	11:10	3.0	16.26	.15	12.4	7.69	2525	0.89	125.57	-140.7	Clear
	11:15	3.5	16.26	.15	12.6	7.68	2551	0.87	131.63	-141.1	Clear

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond - Actual Conductivity ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units
FT BTOC - Feet Below Top of Casing na -

Low-Flow Sampling Form Page

007R @ 11:20
6 Bottles

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion
Client: Vistra
Project Number:
Task #:
Start Date: 2 / /2024 Time: 16:52
Field Personnel: A. Beckett / T. Closen / D. McCoy
Finish Date: 2-20-24 Time: 1423

WELL INFORMATION

Well ID:
Casing ID: 8R inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp (°C)	pH (SU)	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity
	16:52		13.31								
	16:57	0.25	13.52	.21	10.3	6.91	1305	1.96	22.00	-32.3	Clear
	17:02	0.5	13.86	.55	10.4	6.93	1348	0.34	12.25	-35.7	Clear
	17:07	0.75	13.88	.57	10.6	7.05	1364	-0.11	6.24	-54.2	Clear
	17:12	1.0	13.94	.63	10.6	7.06	1363	-0.10	5.25	-58.3	Clear
	17:17	1.25	13.87	.56	10.7	7.07	1361	-0.09	5.49	-58.9	Clear
	17:22	1.5	13.91	.60	10.5	7.08	1358	-0.07	5.35	-59.1	Clear

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity
FT BTOC - Feet Below Top of Casing na -
ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units

Low-Flow Sampling Form

Page

8R 17:25

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion
Client: Vistra
Project Number:
Task #:
Start Date: 2/20/2024 Time: 1645
Field Personnel: A. Beckett / T. Closen / D. McCoy
Finish Date: 2/20/24 Time: 1755
1423

WELL INFORMATION

Well ID: VER-010
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp. (°C)	pH (SU)	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity
pre	1647		49.31								
purge	1650		49.90		12.1	6.96	937	8.38	8.29	13.2	murky
	1655		50.40		12.8	6.82	1101	3.14	7.39	28.9	"
	1700		50.91		12.7	6.82	1097	3.15	7.51	28.9	"
	1705	1	51.21		12.7	6.82	1099	3.11	8.45	28.8	"

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond - Actual Conductivity ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units
FT BTOC - Feet Below Top of Casing na -

Sampled @ 1710

Low-Flow Sampling Form

Page

☐ ☐
☐ ☐

7 bottles → went dry after filling 2 1L bottle & the 250 mL FF bottle
Nitric acid

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion Client: Vistra
Project Number: Task #: Start Date: 2 / /2024 Time: 12:35
Field Personnel: A. Beckett / T. Closen / D. McCoy Finish Date: 2.21.24 Time: 1423

WELL INFORMATION

Well ID: 16A
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp. (°C) 3%	pH (SU) ±.1	SEC or Cond. (µs/cm) 3%	Dissolved Oxygen (mg/L) 10%	Turbidity (NTU) 10%	ORP (mV) 10%	Visual Clarity
	12:35		12.13								
	12:38	0.25	14.68	2.55	12.0	7.67	1301	1.42	53.42	1.34	Clear
	12:43	1.25	19.79	7.66	11.8	7.60	1053	1.41	29.80	1.41	Clear
	12:48	2.50	23.[illegible]	10.98	11.7	7.60	1037	1.45	34.21	2.05	Clear
	12:53	2.75	24.05	11.92	11.8	7.62	1041	2.56	111.82	-81.8	Clear
	12:58	3.0	24.94	12.81	11.8	7.63	1039	2.64	114.68	-86.1	Clear
	1303	3.5	24.81	12.68	12.1	7.65	1041	2.68	121.11	-89.9	Clear
	1308	4.0	25.30	13.17	12.1	7.67	1037	2.71	128.73	-96.5	Clear
	1313	4.5	25.46	13.33	12.1	7.68	1032	2.86	135.54	-101.8	Clear

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units
FT BTOC - Feet Below Top of Casing na -

Low-Flow Sampling Form Page

16A @ 13:15
7 Bottles
FF

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion | Client: Vistra

Project Number: | Task #: | Start Date: 2/23/2024 | Time: 0830

Field Personnel: A. Beckett / T. Closen / D. McCoy | Finish Date: 2/20/24 | Time: 0945

1423

WELL INFORMATION

Well ID: VER-620
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp (°C) ± 1.0	pH (SU) ± 0.1	SEC or Cond. (µs/cm) 3%	Dissolved Oxygen (mg/L)	Turbidity (NTU) 10% or ± 10	ORP (mV) ± 10	Visual Clarity
Pre	0845		13.67								
purge	0852		13.85		10.3	7.16	520	2.36	119.55	-8.9	orange
	0857	1	13.76		10.4	7.14	530	1.80	38.97	-26.8	clear
	0902		13.74		10.3	7.13	534	1.61	25.23	-30.1	" "
	0907	2	13.74		10.4	7.13	543	1.23	12.73	-36.5	" "
	0912		13.76		10.4	7.12	547	1.14	7.78	-38.6	" "
	0917	3	13.76		10.4	7.12	550	1.13	5.37	-39.5	" "
	0922	>4	13.76		10.5	7.12	554	1.12	3.99	-40.0	" "

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond - Actual Conductivity
FT BTOC - Feet Below Top of Casing na
ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units

Sampled @ 0925

Low-Flow Sampling Form

Page

nitric acid

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion Client: Vistra
Project Number: Task #: Start Date: 2/20/2024 Time: 1551
Field Personnel: A. Beckett / T. Closen / D. McCoy Finish Date: 2/20/24 Time: 1638 1423

WELL INFORMATION

Well ID: VER-021
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp. (°C)	pH (SU)	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity
pre	1555		91.82								
purge	1600		93.41		11.5	7.66	522	10.13	7.70	84.1	clear
	1605		95.68		12.3	7.28	969	1.60	23.98	-93.3	greenish
	1610		97.82		12.3	7.37	926	0.41	24.98	-121.2	" "
	1615		98.62		12.3	7.40	890	0.28	24.64	-134.0	" "
	1620		99.56		12.3	7.41	884	0.27	22.93	-140.2	" "
	1625	3.5	99.95		12.2	7.41	886	0.26	23.11	-143.2	" "

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity
FT BTOC - Feet Below Top of Casing na -
ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units

Sampled @ 1630

Low-Flow Sampling Form

Page

6 bottles

Nitric acid

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion Client: Vistra
Project Number: Task #: Start Date: 2/24/2024 Time:
Field Personnel: A. Beckett / T. Closen / D. McCoy Finish Date: Time: 1423

WELL INFORMATION

Well ID: 22
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp. (°C)	pH (SU)	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity
initial	10:30		55.29								
purge	10:35		58.30		12.9	7.39	615	.32	11.4	-45.6	clear
purge	10:40		58.95		12.9	7.40	616	.20	7.7	-53.6	clear
purge	10:45		59.35		12.9	7.40	617	.16	14.2	-60.2	clear
purge	10:50		59.42		13.1	7.40	619	.13	13.6	-66.9	clear
purge	10:55		59.39		13.2	7.40	621	.12	8.6	-71.2	clear
purge	11:00		59.46		13.2	7.41	622	.11	6.5	-73.4	clear
purge	11:05	4.5 gal	59.42		13.2	7.40	623	.12	6.4	-73.5	clear

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond - Actual Conductivity
FT BTOC - Feet Below Top of Casing
na -
ORP - Oxidation-Reduction Potential
SEC - Specific Electrical Conductance
SU - Standard Units

Low-Flow Sampling Form Page

VER_022 Sample @ 11:10

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion
Client: Vistra
Project Number:
Task #:
Start Date: 2 / /2024
Time:
Field Personnel: A. Beckett / T. Closen / D. McCoy
Finish Date: 2/20/24
Time: Sample @ 0935
1423

WELL INFORMATION

Well ID: 34
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp. (°C) ±3%	pH (SU) ±0.1	SEC or Cond. (µs/cm) ±3%	Dissolved Oxygen (mg/L) ±10%	Turbidity (NTU) ±10%	ORP (mV) ±10	Visual Clarity
	0843	—	14.09								
	0910	—	14.09		11.1	7.21	810	1.77	319.82	74.8	Clear
	0915	0.5	14.39	0.3	11.3	7.18	812	0.17	175.74	79	Clear
	0920	1.0	14.42	0.33	11.4	7.18	808	0.08	243.30	80.7	Clear
	0925	1.5	14.47	0.38	11.4	7.17	820	0.10	268.43	82.3	Clear
	0930	2.5	15.04	0.95	11.5	7.16	829	0.11	241.22	78.7	Clear

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units
FT BTOC - Feet Below Top of Casing na -

Low-Flow Sampling Form

Page

34 @ 0935

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion
Client: Vistra
Project Number:
Task #:
Start Date: 2 / /2024
Time:
Field Personnel: A. Beckett / T. Closen / D. McCoy
Finish Date:
Time: 1423

WELL INFORMATION

Well ID: 35 & D
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp. (°C)	pH (SU)	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity
initial	12:15		10.15								
purge	12:20		10.81		13.0	7.40	3992	2.87	8.86	-12.9	Clear
purge	12:25		12.85		12.6	7.42	4011	.39	35.2	-56.5	clear
purge	12:30		14.57		12.7	7.42	4003	.21	48.6	-55.7	clear
purge	12:35		16.12		12.7	7.42	4005	.14	78.9	-49.5	slcar
purge	12:40		17.32		12.6	7.41	4011	.12	24.5	-42.5	clear
purge	12:45		18.42		12.5	7.42	3999	.12	26.5	-34.8	clear
purge	12:50		19.56		12.5	7.42	4001	.13	26.2	-33.5	clear
purge	12:55		21.50		12.3	7.42	4023	.13	30.9	-17.1	clear
purge	13:00	2.5 gal	23.09		12.5	7.42	4000	.14	31.0	-16.2	clear

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

No Bladder, sampled w/ geo pump

ABBREVIATIONS

Cond - Actual Conductivity
FT BTOC - Feet Below Top of Casing na -
ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units

Low-Flow Sampling Form

Page

VER_035 & D

Sample @ ~~[illegible]~~ 13:05

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion
Client: Vistra
Project Number:
Task #:
Start Date: 2 / /2024 Time: 14:45
Field Personnel: A. Beckett / T. Closen / D. McCoy
Finish Date: 2-20-24 Time: 15:15
1423

WELL INFORMATION

Well ID:
Casing ID: 36 inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp. (°C) 3%	pH (SU) 0.1	SEC or Cond (µs/cm) 3%	Dissolved Oxygen (mg/L) 10%	Turbidity (NTU) 10%	ORP (mV) 10 mV	Visual Clarity
	14:45		14.21								
	14:47	—	14.31	[illegible]	12.2	7.18	1630	0.27	244.31	-106.2	Turbid
	14:52	0.5	14.28	0.07	12.1	7.23	1712	0.11	58.20	-107.8	Turbid
	14:57	1.0	14.41	0.20	12.1	7.27	1737	0.18	47.43	-112.1	clear
	15:02	1.75	14.40	.19	12.1	7.30	1750	0.20	14.04	-115.4	Clear
	15:07	2.25	14.31	0.10	12.1	7.32	1756	0.21	13.52	-117.4	clear
	15:12	3.0	14.31	0.10	12.1	7.33	1761	0.22	12.49	-119.0	clear

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units
FT BTOC - Feet Below Top of Casing na -

Low-Flow Sampling Form

Page

36
36FD @ 15:15

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion　Client: Vistra
Project Number:　Task #:　Start Date: 2 / /2024　Time: 14:05
Field Personnel: A. Beckett / T. Closen / D. McCoy　Finish Date: 2-20-24　Time:　1423

WELL INFORMATION

Well ID: 37
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp. (°C) ±3%	pH (SU) ±.1	SEC or Cond (µs/cm) ±3%	Dissolved Oxygen (mg/L) ±10%	Turbidity (NTU) ±10%	ORP (mV) ±10%	Visual Clarity
	14:05		7.96								
	14:07	0.25	9.86	1.1	12.6	7.10	1249	0.36	73.92	-154.6	Turbid
	14:13	3.0	9.20	1.24	12.6	7.09	1231	0.18	211.92	-168.9	Turbid
	14:18	5.0	9.20	0.0	12.6	7.09	1234	0.22	96.30	-169.2	Clear
	14:23	7.0	8.80	.84	12.6	7.08	1237	0.24	101.4	-170.9	Clear
	14:28	8.0	8.41	0.45	12.6	7.08	1238	0.25	98.54	-171.7	Clear
	~~14:33~~										

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity　ORP - Oxidation-Reduction Potential SEC - Specific Electrical
FT BTOC - Feet Below Top of Casing na -　Conductance SU - Standard Units

Low-Flow Sampling Form　Page

37 @ 14:35

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion Client: Vistra
Project Number: Task #: Start Date: 2/20/2024 Time: 0955
Field Personnel: A Beckett / T Closen / D McCoy Finish Date: 2/20/24 Time: 1030 1423

WELL INFORMATION

Well ID: VER_038
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp. (°C) 3%	pH (SU) ±.1	SEC or Cond. (µs/cm) 3%	Dissolved Oxygen (mg/L) 10%	Turbidity (NTU) 10%	ORP (mV) 10 mV	Visual Clarity
pre	1000		3.51								
purge	1002		3.55		11.1	7.10	758	0.36	42.61	-130.4	clear
purge	1007		3.52		11.4	7.10	759	0.23	40.63	-138.9	clear
purge	1012		3.52		11.6	7.10	760	0.18	44.35	-141.7	clear
purge	1017		3.52		11.6	7.10	753	0.03	43.46	-150.9	clear
purge	1023		3.52		11.6	7.10	752	0.02	41.23	-152.3	"
purge	1027	4	3.60		11.0	7.10	753	0.03	44.36	-151.2	"

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units
FT BTOC - Feet Below Top of Casing na -

Sampled @ 1030

38

Nitric acid

6 bottles

Low-Flow Sampling Form

Page

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion
Client: Vistra
Project Number:
Task #:
Start Date: 2 / /2024
Time: 10:45
Well_40
Field Personnel: A. Beckett / T. Closen / D. McCoy
Finish Date: 2/22/24
Time: 11:15
1423

WELL INFORMATION

Well ID: 40
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other (Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp. (°C) 3%	pH (SU) ±.1	SEC or Cond. (µs/cm) 3%	Dissolved Oxygen (mg/L) 10%	Turbidity (NTU) 10%	ORP (mV) 10%	Visual Clarity
	10:45	—	14.64								
	10:50	0.75	14.78	.14	12.5	6.47	3817	0.05	68.11	-113.5	clear
	10:55	1.5	14.80	.16	12.4	6.47	3805	0.07	127.28	-116.3	clear
	11:00	2.0	14.80	.00	12.5	6.48	3803	0.14	192.75	-120.1	clear
	11:05	2.5	14.80	.00	12.5	6.48	3799	0.17	208.67	-121.5	clear
	11:10	3.5	14.80	.00	12.5	6.48	3785	0.19	211.13	-123.2	clear
	11:15	4.0	14.80	.00	12.5	6.48	3787	0.20	215.73	-123.6	

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units
FT BTOC - Feet Below Top of Casing na -

Low-Flow Sampling Form

40 — @ 11:20
40 FD — @ 11:20

Page

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion
Client: Vistra
Project Number:
Task #:
Start Date: 2 / /2024
Time: 11:40
Field Personnel: A. Beckett / T. Closen / D. McCoy
Finish Date:
Time:
1423

WELL INFORMATION

Well ID:
Casing ID: 0041 inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp (°C) 3%	pH (SU) ±.1	SEC or Cond. (µs/cm) 3%	Dissolved Oxygen (mg/L) 10%	Turbidity (NTU) 10%	ORP (mV) 10%	Visual Clarity
			5.87 11:35								
	11:40	0.25	6.02	.15	12.5	7.26	1039	0.62	63.21	-126.5	clear
	11:45	3.0	6.22	.35	12.5	7.25	1038	-.18	27.32	-148.6	clear
	11:50	4.5	6.02	.15	12.6	7.25	1038	-0.21	25.10	-152.3	clear
	11:55	7.5	6.02	.15	12.6	7.25	1038	-.24	26.92	-154.7	clear
	12:00	9.0	6.02	.15	12.6	7.24	1038	-.20	25.74	-156.5	clear
	12:05	11.0	6.02	.15	12.6	7.24	1039	-.24	27.17	-156.5	

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units
FT BTOC - Feet Below Top of Casing na -

Low-Flow Sampling Form

Page

0041 @ 12:05
6 Bottles

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion
Client: Vistra
Project Number:
Task #:
Start Date: 2/20/2024
Time: 1145
Field Personnel: A. Beckett / T. Closen / D. McCoy
Finish Date: 2/20/24
Time: 1234
1423

WELL INFORMATION

Well ID: VER 042
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp (°C)	pH (SU)	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity
pre	11:52		25.71								
purge	11:57		25.79		10.8	7.59	810	1.21	105	-143.1	clear
	12:02		25.82		10.4	7.50	813	1.22	88	-152.5	clear
	12:07		25.84		10.5	7.50	806	1.29	86	-155.5	clear
	12:12		25.84		10.5	7.60	805	1.21	74	-156.0	clear
	12:17		25.84		10.5	7.51	802	1.25	82	-156.0	

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity
FT BTOC - Feet Below Top of Casing na -
ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units

Sampled @ 1217

Low-Flow Sampling Form

Page

MS/MSD

nitric acid

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion | Client: Vistra
Project Number: | Task #: | Start Date: 2/20/2024 | Time: 1055
Field Personnel: A. Beckett / T. Closen / D. McCoy | Finish Date: 2/20/24 | Time: 1140 | 1423

WELL INFORMATION

Well ID: VER_043
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp. (°C)	pH (SU)	SEC or Cond (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity
pre	1100		16.38		~~11.3~~	~~7.05~~	~~1100~~	~~1.84~~	~~40.34~~	~~-83.7~~	~~clear~~
	1103		18.71		11.3	7.05	1100	1.84	40.34	-83.7	clear
	1108		17.75		11.6	7.06	1265	0.19	50.61	-109.3	murky
	1113		17.75		11.6	7.10	1260	0.15	57.08	-112.9	"
	1118	2.0	18.12		11.0	7.10	1262	0.15	50.92	-122.5	"
	1123		17.76		11.0	7.09	1251	0.18	53.18	-124.4	"
	1128		17.75		11.1	7.10	1253	0.16	51.99	-128.9	"

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity
FT BTOC - Feet Below Top of Casing
na -
ORP - Oxidation-Reduction Potential
SEC - Specific Electrical Conductance
SU - Standard Units

Sampled @ 1130

Low-Flow Sampling Form

Page

FD

12 bottles total

YSI was not registering turbidity "++++"
↳had to hit low flow sampling on ground

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion
Client: Vistra
Project Number:
Task #:
Start Date: 2 / /2024
Time: 0835
Field Personnel: A. Beckett / T. Closen / D. McCoy
Finish Date: 2.21.24
Time:
1423

WELL INFORMATION

Well ID:
Casing ID: 7DD inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp (°C) 3%	pH (SU) ±.1	SEC or Cond. (µs/cm) 3%	Dissolved Oxygen (mg/L) 10%	Turbidity (NTU) 10%	ORP (mV) 10%	Visual Clarity
	0805	0	31.83		11.6	7.16	3320	0.50	26.20	-8.9	clear
	0810	0.25	32.68	0.85	11.6	7.17	3310	0.47	26.58	-7.2	" "
	0815	0.5	33.59	1.76	11.6	7.17	3302	0.40	25.14	-4.4	" "
	0820	0.75	34.31	2.48	11.6	7.16	3290	0.40	24.43	-0.8	" "
	0825	1.25	37.33	5.5	11.6	7.00	2985	0.22	17.6	18.3	" "
	0830	1.75	41.64	9.81	11.6	6.98	2867	0.26	28.21	22.3	" "
	0835	2.25	45.10	13.77	11.6	6.91	2817	0.29	19.81	24.1	" "
	0840	3.25	46.28	14.45	11.6	6.92	2798	0.31	20.78	25.2	" "
	0845	3.75	47.44		11.7	6.91	2781	0.30	19.56	26.7	" "

NOTES (continued)

Bladder Pump / Clear / No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity
FT BTOC - Feet Below Top of Casing
na -
ORP - Oxidation-Reduction Potential
SEC - Specific Electrical Conductance
SU - Standard Units

Low-Flow Sampling Form

Page

Draw-start 31.83

7DD
7DD @ 845
6 Bottles
Remove pump

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion Client: Vistra
Project Number: Task #: Start Date: 2 / /2024 Time: 0855
Field Personnel: A Beckett / T Closen / D McCoy Finish Date: 2.21.24 Time: 0920 1423

WELL INFORMATION

Well ID: 705
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp. (°C) ±3%	pH (SU) ±.1	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity
	0855		11.12								
	0858	0.1	11.34	0.22	11.1	7.09	1340	2.30	51.82	68.0	
	0903	0.35	11.27	0.15	10.9	6.94	1298	0.14	6.09	69	
	0908	1.25	11.25	0.13	11.0	6.93	1299	0.19	8.14	68.6	
	0913	1.5	11.25	0.13	11.0	6.93	1299	0.21	7.96	68.4	
	0918	2.0	11.25	0.12	11.0	6.93	1298	0.22	6.82	68.4	
	[illegible]										
	[illegible]										

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity FT BTOC - Feet Below Top of Casing na - ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units

Low-Flow Sampling Form Page

705 @ 0920
6 Bottles

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion   Client: Vistra
Project Number: Task #:   Start Date: 2 / /2024   Time: 0955
Field Personnel: A. Beckett / T. Closen / D. McCoy   Finish Date: 2.21.24   Time: 1423

WELL INFORMATION

Well ID: 71D
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp (°C)	pH (SU)	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity
	0958		37.98								
	0955	.25	38.50	.52	11.9	7.62	3426	2.01	19.13	143.6	Clear
	10:00	.5	—	—	12.0	6.97	3334	0.73	11.10	133.5	clear
				DRY							

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity
FT BTOC - Feet Below Top of Casing na -
ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units

Low-Flow Sampling Form   Page

71D

- Dry During Purge

71S – No water

Both pumps removed

71D
71S > No sample

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion Client: Vistra
Project Number: Task #: Start Date: 2/20/2024 Time: 1300
Field Personnel: A. Beckett / T. Closen / D. McCoy Finish Date: 2/20/24 Time: 1415 1423

WELL INFORMATION
Well ID: VER - 101R
Casing ID: inches

EVENT TYPE
Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp. (°C)	pH (SU)	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity
Pre	1300		109.05								
purge	1305		110.45		12.9	7.23	936	2.96		-74.8	clear
purge	1310		110.61		13.1	7.37	932	.45		-139.0	clear
purge	1315		110.86		13.1	7.39	944	.34		-140.0	clear
purge	1320		111.31		13.0	7.40	942	.26		-142.8	clear
purge	1325		111.85		13.0	7.40	933	.20		-144.6	clear
purge	1330		112.35		13.00	7.40	927	.18	36	-146.4	"
purge	1335		113.03		13.00	7.41	910	0.15	22.94	-149.4	"
purge	1340	2.5	113.34		13.00	7.42	911	0.14	22.7	-152.1	clear

NOTES (continued)

Bladder Pump / Clear / No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units
FT BTOC - Feet Below Top of Casing na -

Sampled @ 13:45
1018

Low-Flow Sampling Form Page

deep well

4250 psi

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion Client: Vistra
Project Number: Task #: Start Date: 2 / 20/2024 Time: 1420
Field Personnel: A. Beckett / T. Closen / D. McCoy Finish Date: 2/20/24 Time: 1545

1423

WELL INFORMATION

Well ID: VER-103[illegible]
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp (°C)	pH (SU)	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity
pre	1425		130.23								
purge	1440		131.71		13.3	7.02	1747	6.83	122.00	70.1	clearish
	1445		132.60		13.3	7.01	1733	6.05	120.75	77.4	"
	1450		133.51		13.3	7.00	1732	5.93	81.44	77.4	"
	1455		134.53		13.2	7.00	1730	5.83	46.16	77.7	"
	1500		134.99		13.1	7.00	1731	5.87	46.81	81.9	"
	1505		135.69		13.0	7.00	1733	5.88	40.20	84.3	"
	1510	2.5	136.98		13.1	7.00	1732	5.8	39.51	85.2	

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units
FT BTOC - Feet Below Top of Casing na -

Sampled @ 1515

Low-Flow Sampling Form Page

6 bottles
Nitric acid

deep!

4250 psi – 300 psi

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion Client: Vistra
Project Number: Task #: Start Date: 2/21/2024 Time:
Field Personnel: A. Beckett (T. Closen) D. McCoy Finish Date: Time: 1423

WELL INFORMATION

Well ID: NED-1
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp (°C)	pH (SU)	SEC or Cond. (µs/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	ORP (mV)	Visual Clarity
initial	14:10		2.32								
purge	14:20		2.72		10.8	7.80	1663	0.12	19.52	-178.3	clear
purge	14:25		2.74		10.8	7.74	1684	0.08	14.70	-157.5	clear
purge	14:30		2.76		10.8	7.69	1712	0.03	9.60	-167.0	clear
purge	14:35		2.73		10.6	7.69	1719	0.01	8.26	-175.1	clear
purge	14:40		2.74		10.6	7.70	1720	0.00	6.05	-180.6	clear
purge	14:45		2.79		10.6	7.75	1717	0.00	5.20	-187.6	clear
purge	14:50		2.76		10.6	7.77	1719	0.00	4.65	-193.9	clear
purge	14:55		2.74		10.6	7.78	1721	0.03	4.63	-194.1	clear

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond. - Actual Conductivity ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units
FT BTOC - Feet Below Top of Casing na -

Low-Flow Sampling Form

Page

☐ ☐

☐ ☐

VER_NED1 Sample @ 15:00

WELL DEVELOPMENT AND GROUNDWATER SAMPLING FIELD FORM

PROJECT INFORMATION

Site: Vermillion
Client: Vistra
Project Number:
Task #:
Start Date: 2 / /2024 Time: 13:05
Field Personnel: A. Beckett / T. Closen / D. McCoy
Finish Date: 2-20-24 Time: 1423

WELL INFORMATION

Well ID: N D3
Casing ID: inches

EVENT TYPE

Well Development
Well Volume Approach Sampling
Low-Flow / Low Stress Sampling Other
(Specify): Low Flow

WATER QUALITY INDICATOR PARAMETERS (continued)

Sampling Stage	Time (military)	Volume Removed (gallons)	Depth to Water (Feet)	Drawdown (Feet)	Temp (°C) 3%	pH (SU) ±.1	SEC or Cond (µs/cm) 3%	Dissolved Oxygen (mg/L) 10%	Turbidity (NTU) 10%	ORP (mV) 10%	Visual Clarity
	13:05	–	16.64								
	13:10	0.5	17.61	0.97	13.0	8.09	1551	2.03	73.03	0.1	clear
	13:15	1.0	18.24	1.6	13.0	8.24	1557	0.86	129.81	0.8	clear
	13:20	1.5	18.83	2.19	13.1	8.34	1603	0.77	69.33	0.8	clear
	13:25	2.0	19.07	2.43	13.1	8.31	1597	0.84	71.47	0.86	clear
	13:30	2.5	19.23	2.59	13.1	8.27	1589	0.90	75.94	0.93	clear
	13:35	3.0			13.0	8.25	1586	0.93	73.25	0.93	clear

NOTES (continued)

Bladder Pump / Clear /No Color / No odor

ABBREVIATIONS

Cond - Actual Conductivity
FT BTOC - Feet Below Top of Casing na -
ORP - Oxidation-Reduction Potential SEC - Specific Electrical Conductance SU - Standard Units

Low-Flow Sampling Form

Page

ND3 @ 13:40

eurofins Environment Testing

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

ANALYTICAL REPORT

PREPARED FOR

Attn: Brian Voelker
Vistra Energy Corp
133 S 4th, Suite 206
Springfield, Illinois 62701

Generated 03/25/24 11:49:42

JOB DESCRIPTION

VER-24Q1
VER_000_RAD

JOB NUMBER

500-246480-2

Eurofins Chicago
2417 Bond Street
University Park IL 60484

See page two for job notes and contact information.

myEOL

Eurofins Chicago

Job Notes

This report may not be reproduced except in full, and with written approval from the laboratory. The results relate only to the samples tested. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

The test results in this report relate only to the samples as received by the laboratory and will meet all requirements of the methodology, with any exceptions noted. This report shall not be reproduced except in full, without the express written approval of the laboratory. All questions should be directed to the Eurofins Chicago Project Manager.

Authorization

Generated
03/25/24 11:49:42

Authorized for release by
Dirk Nelson, Project Management Assistant II
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Designee for
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(217)519-2114

Table of Contents

Case Narrative

Job ID: 500-246480-2 Eurofins Chicago

Job Narrative
500-246480-2

Receipt
The samples were received on 02/21/24 11:20. Unless otherwise noted below, the samples arrived in good condition, and where required, properly preserved and on ice. The temperatures of the 10 coolers at receipt time were 1.5º C, 2.5º C, 2.6º C, 2.7º C, 3.6º C, 3.9º C, 4.1º C, 4.1º C, 5.1º C and 5.3º C.

Receipt Exceptions
Received 7 bottles for sample 5, COC has 6. Received Rad bottles for sample 20, not marked on COC. VER_010 (500-246480-5) and VER_ND3 (500-246480-20)
VER_ND3 (Sample 20) not requesting Rad analysis on client SARs and confirmed via email, not logged for Rad.

RAD
Method 904.0: Radium-228 batch 649789
The detection goal was not met for the following sample due to the reduced sample volume attributed to the presence of matrix interferences: VER_070&D (500-246480-30). Analytical results are reported with the detection limit achieved.

Methods 904.0: Radium-228 prep batch 160-649394:
The detection goal was not met for the following samples due to the reduced sample volume attributed to the presence of matrix interferences: VER_034 (500-246480-8), VER_038 (500-246480-12) and VER_042 (500-246480-15) . Analytical results are reported with the detection limit achieved.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Detection Summary

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_002 — Lab Sample ID: 500-246480-1

No Detections.

Client Sample ID: VER_003R — Lab Sample ID: 500-246480-2

No Detections.

Client Sample ID: VER_003R_FD — Lab Sample ID: 500-246480-3

No Detections.

Client Sample ID: VER_008R — Lab Sample ID: 500-246480-4

No Detections.

Client Sample ID: VER_010 — Lab Sample ID: 500-246480-5

No Detections.

Client Sample ID: VER_020 — Lab Sample ID: 500-246480-6

No Detections.

Client Sample ID: VER_021 — Lab Sample ID: 500-246480-7

No Detections.

Client Sample ID: VER_034 — Lab Sample ID: 500-246480-8

No Detections.

Client Sample ID: VER_036 — Lab Sample ID: 500-246480-9

No Detections.

Client Sample ID: VER_036_FD — Lab Sample ID: 500-246480-10

No Detections.

Client Sample ID: VER_037 — Lab Sample ID: 500-246480-11

No Detections.

Client Sample ID: VER_038 — Lab Sample ID: 500-246480-12

No Detections.

Client Sample ID: VER_040 — Lab Sample ID: 500-246480-13

No Detections.

Client Sample ID: VER_040_FD — Lab Sample ID: 500-246480-14

No Detections.

Client Sample ID: VER_042 — Lab Sample ID: 500-246480-15

No Detections.

Client Sample ID: VER_043 — Lab Sample ID: 500-246480-16

No Detections.

This Detection Summary does not include radiochemical test results.

Detection Summary

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_043_FD — Lab Sample ID: 500-246480-17

No Detections.

Client Sample ID: VER_101& — Lab Sample ID: 500-246480-18

No Detections.

Client Sample ID: VER_103& — Lab Sample ID: 500-246480-19

No Detections.

Client Sample ID: VER_EB1 — Lab Sample ID: 500-246480-21

No Detections.

Client Sample ID: VER_004 — Lab Sample ID: 500-246480-22

No Detections.

Client Sample ID: VER_005 — Lab Sample ID: 500-246480-23

No Detections.

Client Sample ID: VER_007R — Lab Sample ID: 500-246480-24

No Detections.

Client Sample ID: VER_016A — Lab Sample ID: 500-246480-25

No Detections.

Client Sample ID: VER_022 — Lab Sample ID: 500-246480-26

No Detections.

Client Sample ID: VER_035&D — Lab Sample ID: 500-246480-27

No Detections.

Client Sample ID: VER_041 — Lab Sample ID: 500-246480-28

No Detections.

Client Sample ID: VER_070#S — Lab Sample ID: 500-246480-29

No Detections.

Client Sample ID: VER_070&D — Lab Sample ID: 500-246480-30

No Detections.

Client Sample ID: VER_FB — Lab Sample ID: 500-246480-32

No Detections.

Client Sample ID: VER_EB2 — Lab Sample ID: 500-246480-33

No Detections.

This Detection Summary does not include radiochemical test results.

Method Summary

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Method	Method Description	Protocol	Laboratory
903.0	Radium-226 (GFPC)	EPA	EET SL
904.0	Radium-228 (GFPC)	EPA	EET SL
Ra226_Ra228 Pos	Combined Radium-226 and Radium-228	TAL-STL	EET SL
PrecSep_0	Preparation, Precipitate Separation	None	EET SL
PrecSep-21	Preparation, Precipitate Separation (21-Day In-Growth)	None	EET SL

Protocol References:

EPA = US Environmental Protection Agency

None = None

TAL-STL = TestAmerica Laboratories, St. Louis, Facility Standard Operating Procedure.

Laboratory References:

EET SL = Eurofins St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

Sample Summary

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
500-246480-1	VER_002	Water	02/20/24 12:20	02/21/24 11:20
500-246480-2	VER_003R	Water	02/20/24 16:40	02/21/24 11:20
500-246480-3	VER_003R_FD	Water	02/20/24 16:40	02/21/24 11:20
500-246480-4	VER_008R	Water	02/20/24 17:25	02/21/24 11:20
500-246480-5	VER_010	Water	02/20/24 17:55	02/21/24 11:20
500-246480-6	VER_020	Water	02/20/24 09:25	02/21/24 11:20
500-246480-7	VER_021	Water	02/20/24 16:30	02/21/24 11:20
500-246480-8	VER_034	Water	02/20/24 09:35	02/21/24 11:20
500-246480-9	VER_036	Water	02/20/24 15:15	02/21/24 11:20
500-246480-10	VER_036_FD	Water	02/20/24 15:15	02/21/24 11:20
500-246480-11	VER_037	Water	02/20/24 14:35	02/21/24 11:20
500-246480-12	VER_038	Water	02/20/24 10:30	02/21/24 11:20
500-246480-13	VER_040	Water	02/20/24 11:20	02/21/24 11:20
500-246480-14	VER_040_FD	Water	02/20/24 11:20	02/21/24 11:20
500-246480-15	VER_042	Water	02/20/24 12:17	02/21/24 11:20
500-246480-16	VER_043	Water	02/20/24 11:30	02/21/24 11:20
500-246480-17	VER_043_FD	Water	02/20/24 11:30	02/21/24 11:20
500-246480-18	VER_101&	Water	02/20/24 13:45	02/21/24 11:20
500-246480-19	VER_103&	Water	02/20/24 15:15	02/21/24 11:20
500-246480-21	VER_EB1	Water	02/20/24 17:50	02/21/24 11:20
500-246480-22	VER_004	Water	02/21/24 08:45	02/22/24 11:18
500-246480-23	VER_005	Water	02/21/24 09:40	02/22/24 11:18
500-246480-24	VER_007R	Water	02/21/24 11:20	02/22/24 11:18
500-246480-25	VER_016A	Water	02/21/24 13:15	02/22/24 11:18
500-246480-26	VER_022	Water	02/21/24 11:10	02/22/24 11:18
500-246480-27	VER_035&D	Water	02/21/24 13:05	02/22/24 11:18
500-246480-28	VER_041	Water	02/21/24 12:05	02/22/24 11:18
500-246480-29	VER_070#S	Water	02/21/24 09:20	02/22/24 11:18
500-246480-30	VER_070&D	Water	02/21/24 08:45	02/22/24 11:18
500-246480-32	VER_FB	Water	02/21/24 15:20	02/22/24 11:18
500-246480-33	VER_EB2	Water	02/21/24 15:50	02/22/24 11:18

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_002

Date Collected: 02/20/24 12:20
Date Received: 02/21/24 11:20

Lab Sample ID: 500-246480-1

Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.286		0.138	0.140	1.00	0.165	pCi/L	02/23/24 09:44	03/18/24 16:30	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*102*		*30 - 110*	*02/23/24 09:44*	*03/18/24 16:30*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.802		0.427	0.434	1.00	0.594	pCi/L	02/23/24 09:49	03/13/24 12:09	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*102*		*30 - 110*	*02/23/24 09:49*	*03/13/24 12:09*	*1*
Y Carrier	*85.2*		*30 - 110*	*02/23/24 09:49*	*03/13/24 12:09*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	1.09		0.449	0.456	5.00	0.594	pCi/L		03/22/24 19:14	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_003R

Lab Sample ID: 500-246480-2

Date Collected: 02/20/24 16:40
Matrix: Water
Date Received: 02/21/24 11:20

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.611		0.180	0.188	1.00	0.150	pCi/L	02/23/24 09:44	03/18/24 16:31	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*103*		*30 - 110*	*02/23/24 09:44*	*03/18/24 16:31*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.695		0.454	0.459	1.00	0.678	pCi/L	02/23/24 09:49	03/13/24 12:10	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*103*		*30 - 110*	*02/23/24 09:49*	*03/13/24 12:10*	*1*
Y Carrier	*84.5*		*30 - 110*	*02/23/24 09:49*	*03/13/24 12:10*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	1.31		0.488	0.496	5.00	0.678	pCi/L		03/22/24 19:14	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_003R_FD

Lab Sample ID: 500-246480-3

Date Collected: 02/20/24 16:40
Date Received: 02/21/24 11:20

Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.432		0.152	0.157	1.00	0.142	pCi/L	02/23/24 09:44	03/18/24 16:31	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*104*		*30 - 110*	*02/23/24 09:44*	*03/18/24 16:31*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	2.22		0.579	0.614	1.00	0.598	pCi/L	02/23/24 09:49	03/13/24 12:10	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*104*		*30 - 110*	*02/23/24 09:49*	*03/13/24 12:10*	*1*
Y Carrier	*84.9*		*30 - 110*	*02/23/24 09:49*	*03/13/24 12:10*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	2.66		0.599	0.634	5.00	0.598	pCi/L		03/22/24 19:14	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_008R

Lab Sample ID: 500-246480-4

Date Collected: 02/20/24 17:25
Date Received: 02/21/24 11:20
Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.120	U	0.0890	0.0897	1.00	0.126	pCi/L	02/23/24 09:44	03/18/24 16:31	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*94.4*		*30 - 110*	*02/23/24 09:44*	*03/18/24 16:31*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	**0.742**		0.362	0.368	1.00	0.487	pCi/L	02/23/24 09:49	03/13/24 12:10	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*94.4*		*30 - 110*	*02/23/24 09:49*	*03/13/24 12:10*	*1*
Y Carrier	*84.9*		*30 - 110*	*02/23/24 09:49*	*03/13/24 12:10*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**0.862**		0.373	0.379	5.00	0.487	pCi/L		03/22/24 19:14	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_010

Lab Sample ID: 500-246480-5

Date Collected: 02/20/24 17:55
Matrix: Water
Date Received: 02/21/24 11:20

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.574		0.192	0.199	1.00	0.200	pCi/L	02/23/24 09:44	03/18/24 16:31	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*95.7*		*30 - 110*	*02/23/24 09:44*	*03/18/24 16:31*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	1.94		0.593	0.619	1.00	0.674	pCi/L	02/23/24 09:49	03/13/24 12:10	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*95.7*		*30 - 110*	*02/23/24 09:49*	*03/13/24 12:10*	*1*
Y Carrier	*86.0*		*30 - 110*	*02/23/24 09:49*	*03/13/24 12:10*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	2.51		0.623	0.650	5.00	0.674	pCi/L		03/22/24 19:14	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_020

Date Collected: 02/20/24 09:25
Date Received: 02/21/24 11:20

Lab Sample ID: 500-246480-6
Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.0997	U	0.108	0.108	1.00	0.174	pCi/L	02/23/24 09:44	03/18/24 16:32	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*88.3*		*30 - 110*	*02/23/24 09:44*	*03/18/24 16:32*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.310	U	0.385	0.386	1.00	0.637	pCi/L	02/23/24 09:49	03/13/24 12:49	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*88.3*		*30 - 110*	*02/23/24 09:49*	*03/13/24 12:49*	*1*
Y Carrier	*86.4*		*30 - 110*	*02/23/24 09:49*	*03/13/24 12:49*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	0.410	U	0.400	0.401	5.00	0.637	pCi/L		03/22/24 19:14	1

Client Sample Results

Client Sample ID: VER_021

Lab Sample ID: 500-246480-7

Date Collected: 02/20/24 16:30

Matrix: Water

Date Received: 02/21/24 11:20

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	**0.355**		0.245	0.247	1.00	0.315	pCi/L	02/23/24 10:00	03/20/24 17:50	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*92.6*		*30 - 110*	*02/23/24 10:00*	*03/20/24 17:50*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.253	U	0.430	0.431	1.00	0.738	pCi/L	02/23/24 10:04	03/20/24 11:54	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*92.6*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:54*	*1*
Y Carrier	*78.5*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:54*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	0.608	U	0.495	0.497	5.00	0.738	pCi/L		03/22/24 19:03	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_034

Date Collected: 02/20/24 09:35
Date Received: 02/21/24 11:20

Lab Sample ID: 500-246480-8
Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.216	U	0.469	0.469	1.00	0.861	pCi/L	02/23/24 10:00	03/20/24 17:50	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*36.5*		*30 - 110*	*02/23/24 10:00*	*03/20/24 17:50*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	1.62	U G	1.25	1.26	1.00	1.94	pCi/L	02/23/24 10:04	03/20/24 11:54	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*36.5*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:54*	*1*
Y Carrier	*81.1*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:54*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	1.84	U	1.34	1.34	5.00	1.94	pCi/L		03/22/24 19:03	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_036

Date Collected: 02/20/24 15:15
Date Received: 02/21/24 11:20

Lab Sample ID: 500-246480-9
Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.221	U	0.199	0.200	1.00	0.302	pCi/L	02/23/24 10:00	03/20/24 17:51	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*101*		*30 - 110*	*02/23/24 10:00*	*03/20/24 17:51*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.245	U	0.342	0.343	1.00	0.573	pCi/L	02/23/24 10:04	03/20/24 11:54	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*101*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:54*	*1*
Y Carrier	*84.5*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:54*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	0.466	U	0.396	0.397	5.00	0.573	pCi/L		03/22/24 19:03	1

Client Sample Results

Client Sample ID: VER_036_FD

Lab Sample ID: 500-246480-10

Date Collected: 02/20/24 15:15

Matrix: Water

Date Received: 02/21/24 11:20

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.194	U	0.172	0.173	1.00	0.254	pCi/L	02/23/24 10:00	03/20/24 17:51	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*101*		*30 - 110*	*02/23/24 10:00*	*03/20/24 17:51*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.337	U	0.328	0.329	1.00	0.526	pCi/L	02/23/24 10:04	03/20/24 11:54	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*101*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:54*	*1*
Y Carrier	*84.5*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:54*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**0.531**		0.370	0.372	5.00	0.526	pCi/L		03/22/24 19:03	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_037

Date Collected: 02/20/24 14:35
Date Received: 02/21/24 11:20

Lab Sample ID: 500-246480-11
Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.597		0.349	0.353	1.00	0.426	pCi/L	02/23/24 10:00	03/20/24 17:51	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*74.6*		*30 - 110*	*02/23/24 10:00*	*03/20/24 17:51*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	1.24		0.620	0.631	1.00	0.848	pCi/L	02/23/24 10:04	03/20/24 11:54	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*74.6*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:54*	*1*
Y Carrier	*82.6*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:54*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	1.84		0.711	0.723	5.00	0.848	pCi/L		03/22/24 19:03	1

Client Sample Results

Client Sample ID: VER_038

Date Collected: 02/20/24 10:30
Date Received: 02/21/24 11:20

Lab Sample ID: 500-246480-12
Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.489	U	0.439	0.442	1.00	0.667	pCi/L	02/23/24 10:00	03/20/24 18:01	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*86.5*		*30 - 110*	*02/23/24 10:00*	*03/20/24 18:01*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	1.16	U G	0.781	0.788	1.00	1.17	pCi/L	02/23/24 10:04	03/20/24 11:55	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*86.5*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:55*	*1*
Y Carrier	*83.4*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:55*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**1.65**		0.896	0.903	5.00	1.17	pCi/L		03/22/24 19:03	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_040

Date Collected: 02/20/24 11:20
Date Received: 02/21/24 11:20

Lab Sample ID: 500-246480-13
Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.0605	U	0.162	0.162	1.00	0.302	pCi/L	02/23/24 10:00	03/20/24 18:02	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*103*		*30 - 110*	*02/23/24 10:00*	*03/20/24 18:02*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	**0.976**		0.380	0.390	1.00	0.481	pCi/L	02/23/24 10:04	03/20/24 11:55	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*103*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:55*	*1*
Y Carrier	*82.6*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:55*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**1.04**		0.413	0.422	5.00	0.481	pCi/L		03/22/24 19:03	1

Client Sample Results

Client Sample ID: VER_040_FD

Lab Sample ID: 500-246480-14

Date Collected: 02/20/24 11:20

Matrix: Water

Date Received: 02/21/24 11:20

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.309		0.214	0.216	1.00	0.301	pCi/L	02/23/24 10:00	03/20/24 18:02	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*108*		*30 - 110*	*02/23/24 10:00*	*03/20/24 18:02*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.701		0.336	0.342	1.00	0.453	pCi/L	02/23/24 10:04	03/20/24 11:55	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*108*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:55*	*1*
Y Carrier	*80.4*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:55*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	1.01		0.398	0.404	5.00	0.453	pCi/L		03/22/24 19:03	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_042

Date Collected: 02/20/24 12:17
Date Received: 02/21/24 11:20

Lab Sample ID: 500-246480-15
Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.616	U	0.464	0.467	1.00	0.678	pCi/L	02/23/24 10:00	03/20/24 18:02	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*63.5*		*30 - 110*	*02/23/24 10:00*	*03/20/24 18:02*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.612	U G	0.638	0.641	1.00	1.03	pCi/L	02/23/24 10:04	03/20/24 11:55	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*63.5*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:55*	*1*
Y Carrier	*80.0*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:55*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**1.23**		0.789	0.793	5.00	1.03	pCi/L		03/22/24 19:03	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_043

Date Collected: 02/20/24 11:30
Date Received: 02/21/24 11:20

Lab Sample ID: 500-246480-16
Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.000	U	0.293	0.293	1.00	0.581	pCi/L	02/23/24 10:00	03/20/24 18:02	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*80.5*		*30 - 110*	*02/23/24 10:00*	*03/20/24 18:02*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	**0.917**		0.572	0.578	1.00	0.839	pCi/L	02/23/24 10:04	03/20/24 11:56	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*80.5*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:56*	*1*
Y Carrier	*82.2*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:56*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**0.917**		0.643	0.648	5.00	0.839	pCi/L		03/22/24 19:03	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_043_FD

Lab Sample ID: 500-246480-17

Date Collected: 02/20/24 11:30
Date Received: 02/21/24 11:20

Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	**0.643**		0.338	0.343	1.00	0.408	pCi/L	02/23/24 10:00	03/20/24 18:02	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*88.8*		*30 - 110*	*02/23/24 10:00*	*03/20/24 18:02*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.554	U	0.470	0.472	1.00	0.730	pCi/L	02/23/24 10:04	03/20/24 11:56	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*88.8*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:56*	*1*
Y Carrier	*76.6*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:56*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**1.20**		0.579	0.583	5.00	0.730	pCi/L		03/22/24 19:03	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_101&

Date Collected: 02/20/24 13:45
Date Received: 02/21/24 11:20

Lab Sample ID: 500-246480-18

Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.153	U	0.246	0.246	1.00	0.429	pCi/L	02/23/24 10:00	03/20/24 18:03	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*84.8*		*30 - 110*	*02/23/24 10:00*	*03/20/24 18:03*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.211	U	0.399	0.399	1.00	0.694	pCi/L	02/23/24 10:04	03/20/24 11:56	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*84.8*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:56*	*1*
Y Carrier	*83.0*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:56*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	0.363	U	0.469	0.469	5.00	0.694	pCi/L		03/22/24 19:03	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_103&

Date Collected: 02/20/24 15:15
Date Received: 02/21/24 11:20

Lab Sample ID: 500-246480-19
Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.0907	U	0.203	0.204	1.00	0.375	pCi/L	02/23/24 10:00	03/20/24 18:03	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*95.2*		*30 - 110*	*02/23/24 10:00*	*03/20/24 18:03*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.511	U	0.445	0.447	1.00	0.698	pCi/L	02/23/24 10:04	03/20/24 11:56	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*95.2*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:56*	*1*
Y Carrier	*82.2*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:56*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	0.602	U	0.489	0.491	5.00	0.698	pCi/L		03/22/24 19:03	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_EB1

Date Collected: 02/20/24 17:50
Date Received: 02/21/24 11:20

Lab Sample ID: 500-246480-21
Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.0850	U	0.208	0.208	1.00	0.376	pCi/L	02/23/24 10:00	03/20/24 18:03	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*103*		*30 - 110*	*02/23/24 10:00*	*03/20/24 18:03*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.154	U	0.283	0.283	1.00	0.489	pCi/L	02/23/24 10:04	03/20/24 12:07	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*103*		*30 - 110*	*02/23/24 10:04*	*03/20/24 12:07*	*1*
Y Carrier	*81.5*		*30 - 110*	*02/23/24 10:04*	*03/20/24 12:07*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	0.239	U	0.351	0.351	5.00	0.489	pCi/L		03/22/24 19:03	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_004

Lab Sample ID: 500-246480-22

Date Collected: 02/21/24 08:45
Matrix: Water
Date Received: 02/22/24 11:18

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	**0.419**		0.137	0.142	1.00	0.147	pCi/L	02/26/24 10:15	03/19/24 09:18	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*94.9*		*30 - 110*	*02/26/24 10:15*	*03/19/24 09:18*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.392	U	0.303	0.305	1.00	0.478	pCi/L	02/26/24 10:27	03/12/24 12:17	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*94.9*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:17*	*1*
Y Carrier	*76.3*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:17*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**0.812**		0.333	0.336	5.00	0.478	pCi/L		03/22/24 19:14	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Client Sample ID: VER_005
Date Collected: 02/21/24 09:40
Date Received: 02/22/24 11:18

Lab Sample ID: 500-246480-23
Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.0682	U	0.0708	0.0711	1.00	0.112	pCi/L	02/26/24 10:15	03/19/24 09:18	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*103*		*30 - 110*	*02/26/24 10:15*	*03/19/24 09:18*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.199	U	0.280	0.281	1.00	0.467	pCi/L	02/26/24 10:27	03/12/24 12:18	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*103*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:18*	*1*
Y Carrier	*80.0*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:18*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	0.267	U	0.289	0.290	5.00	0.467	pCi/L		03/22/24 19:14	1

Client Sample Results

Client Sample ID: VER_007R

Lab Sample ID: 500-246480-24

Date Collected: 02/21/24 11:20

Matrix: Water

Date Received: 02/22/24 11:18

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.116		0.0750	0.0757	1.00	0.0996	pCi/L	02/26/24 10:15	03/19/24 09:19	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*101*		*30 - 110*	*02/26/24 10:15*	*03/19/24 09:19*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.463		0.285	0.288	1.00	0.436	pCi/L	02/26/24 10:27	03/12/24 12:18	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*101*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:18*	*1*
Y Carrier	*81.5*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:18*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	0.579		0.295	0.298	5.00	0.436	pCi/L		03/22/24 19:14	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_016A

Lab Sample ID: 500-246480-25

Date Collected: 02/21/24 13:15

Matrix: Water

Date Received: 02/22/24 11:18

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	**0.989**		0.260	0.275	1.00	0.182	pCi/L	02/26/24 10:15	03/19/24 09:19	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*93.9*		*30 - 110*	*02/26/24 10:15*	*03/19/24 09:19*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.780	U	0.576	0.581	1.00	0.898	pCi/L	02/26/24 10:27	03/12/24 12:18	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*93.9*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:18*	*1*
Y Carrier	*73.6*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:18*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**1.77**		0.632	0.643	5.00	0.898	pCi/L		03/22/24 19:14	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_022

Lab Sample ID: 500-246480-26

Date Collected: 02/21/24 11:10
Matrix: Water
Date Received: 02/22/24 11:18

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	**0.519**		0.134	0.142	1.00	0.103	pCi/L	02/26/24 10:15	03/19/24 09:19	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*99.2*		*30 - 110*	*02/26/24 10:15*	*03/19/24 09:19*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.206	U	0.251	0.252	1.00	0.415	pCi/L	02/26/24 10:27	03/12/24 12:18	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*99.2*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:18*	*1*
Y Carrier	*78.9*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:18*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**0.724**		0.285	0.289	5.00	0.415	pCi/L		03/22/24 19:14	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_035&D

Date Collected: 02/21/24 13:05
Date Received: 02/22/24 11:18

Lab Sample ID: 500-246480-27
Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.0542	U	0.0625	0.0627	1.00	0.101	pCi/L	02/26/24 10:15	03/19/24 09:19	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*94.9*		*30 - 110*	*02/26/24 10:15*	*03/19/24 09:19*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.504	U	0.358	0.361	1.00	0.538	pCi/L	02/26/24 10:27	03/12/24 12:18	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*94.9*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:18*	*1*
Y Carrier	*78.9*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:18*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**0.558**		0.363	0.366	5.00	0.538	pCi/L		03/22/24 19:14	1

Client Sample Results

Client Sample ID: VER_041

Lab Sample ID: 500-246480-28
Date Collected: 02/21/24 12:05
Matrix: Water
Date Received: 02/22/24 11:18

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	**0.472**		0.156	0.162	1.00	0.127	pCi/L	02/26/24 10:15	03/19/24 09:20	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*87.1*		*30 - 110*	*02/26/24 10:15*	*03/19/24 09:20*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.648	U	0.518	0.521	1.00	0.799	pCi/L	02/26/24 10:27	03/12/24 12:18	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*87.1*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:18*	*1*
Y Carrier	*77.0*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:18*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	**1.12**		0.541	0.546	5.00	0.799	pCi/L		03/22/24 19:14	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_070#S

Date Collected: 02/21/24 09:20
Date Received: 02/22/24 11:18

Lab Sample ID: 500-246480-29
Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.0859	U	0.0700	0.0704	1.00	0.0983	pCi/L	02/26/24 10:15	03/19/24 09:20	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*87.6*		*30 - 110*	*02/26/24 10:15*	*03/19/24 09:20*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.239	U	0.341	0.342	1.00	0.576	pCi/L	02/26/24 10:27	03/12/24 12:19	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*87.6*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:19*	*1*
Y Carrier	*77.8*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:19*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	0.325	U	0.348	0.349	5.00	0.576	pCi/L		03/22/24 19:14	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_070&D

Lab Sample ID: 500-246480-30

Date Collected: 02/21/24 08:45
Date Received: 02/22/24 11:18

Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.527		0.205	0.211	1.00	0.186	pCi/L	02/26/24 10:15	03/19/24 09:20	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*86.3*		*30 - 110*	*02/26/24 10:15*	*03/19/24 09:20*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	1.41	G	0.892	0.901	1.00	1.33	pCi/L	02/26/24 10:27	03/12/24 12:19	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*86.3*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:19*	*1*
Y Carrier	*78.1*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:19*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	1.94		0.915	0.925	5.00	1.33	pCi/L		03/22/24 19:14	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_FB

Date Collected: 02/21/24 15:20
Date Received: 02/22/24 11:18

Lab Sample ID: 500-246480-32
Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	-0.0238	U	0.0436	0.0437	1.00	0.105	pCi/L	02/26/24 10:15	03/19/24 09:20	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*108*		*30 - 110*	*02/26/24 10:15*	*03/19/24 09:20*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.394	U	0.331	0.333	1.00	0.517	pCi/L	02/26/24 10:27	03/12/24 12:19	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*108*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:19*	*1*
Y Carrier	*77.0*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:19*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	0.394	U	0.334	0.336	5.00	0.517	pCi/L		03/22/24 19:14	1

Client Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_EB2
Date Collected: 02/21/24 15:50
Date Received: 02/22/24 11:18

Lab Sample ID: 500-246480-33
Matrix: Water

Method: EPA 903.0 - Radium-226 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.0198	U	0.0493	0.0493	1.00	0.0916	pCi/L	02/26/24 10:15	03/22/24 06:39	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*103*		*30 - 110*	*02/26/24 10:15*	*03/22/24 06:39*	*1*

Method: EPA 904.0 - Radium-228 (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.307	U	0.289	0.290	1.00	0.459	pCi/L	02/26/24 10:27	03/12/24 12:19	1

Carrier	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*103*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:19*	*1*
Y Carrier	*81.9*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:19*	*1*

Method: TAL-STL Ra226_Ra228 Pos - Combined Radium-226 and Radium-228

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium 226 and 228	0.326	U	0.293	0.294	5.00	0.459	pCi/L		03/22/24 19:14	1

Definitions/Glossary

Qualifiers

Rad

Qualifier	Qualifier Description
G	The Sample MDC is greater than the requested RL.
U	Result is less than the sample detection limit.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

QC Association Summary

Rad

Prep Batch: 649386

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-1	VER_002	Total/NA	Water	PrecSep-21	
500-246480-2	VER_003R	Total/NA	Water	PrecSep-21	
500-246480-3	VER_003R_FD	Total/NA	Water	PrecSep-21	
500-246480-4	VER_008R	Total/NA	Water	PrecSep-21	
500-246480-5	VER_010	Total/NA	Water	PrecSep-21	
500-246480-6	VER_020	Total/NA	Water	PrecSep-21	
MB 160-649386/1-A	Method Blank	Total/NA	Water	PrecSep-21	
LCS 160-649386/2-A	Lab Control Sample	Total/NA	Water	PrecSep-21	
500-246480-6 MS	VER_020	Total/NA	Water	PrecSep-21	
500-246480-6 MSD	VER_020	Total/NA	Water	PrecSep-21	

Prep Batch: 649387

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-1	VER_002	Total/NA	Water	PrecSep_0	
500-246480-2	VER_003R	Total/NA	Water	PrecSep_0	
500-246480-3	VER_003R_FD	Total/NA	Water	PrecSep_0	
500-246480-4	VER_008R	Total/NA	Water	PrecSep_0	
500-246480-5	VER_010	Total/NA	Water	PrecSep_0	
500-246480-6	VER_020	Total/NA	Water	PrecSep_0	
MB 160-649387/1-A	Method Blank	Total/NA	Water	PrecSep_0	
LCS 160-649387/2-A	Lab Control Sample	Total/NA	Water	PrecSep_0	
500-246480-6 MS	VER_020	Total/NA	Water	PrecSep_0	
500-246480-6 MSD	VER_020	Total/NA	Water	PrecSep_0	

Prep Batch: 649393

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-7	VER_021	Total/NA	Water	PrecSep-21	
500-246480-8	VER_034	Total/NA	Water	PrecSep-21	
500-246480-9	VER_036	Total/NA	Water	PrecSep-21	
500-246480-10	VER_036_FD	Total/NA	Water	PrecSep-21	
500-246480-11	VER_037	Total/NA	Water	PrecSep-21	
500-246480-12	VER_038	Total/NA	Water	PrecSep-21	
500-246480-13	VER_040	Total/NA	Water	PrecSep-21	
500-246480-14	VER_040_FD	Total/NA	Water	PrecSep-21	
500-246480-15	VER_042	Total/NA	Water	PrecSep-21	
500-246480-16	VER_043	Total/NA	Water	PrecSep-21	
500-246480-17	VER_043_FD	Total/NA	Water	PrecSep-21	
500-246480-18	VER_101&	Total/NA	Water	PrecSep-21	
500-246480-19	VER_103&	Total/NA	Water	PrecSep-21	
500-246480-21	VER_EB1	Total/NA	Water	PrecSep-21	
MB 160-649393/1-A	Method Blank	Total/NA	Water	PrecSep-21	
LCS 160-649393/2-A	Lab Control Sample	Total/NA	Water	PrecSep-21	
500-246480-15 MS	VER_042	Total/NA	Water	PrecSep-21	
500-246480-15 MSD	VER_042	Total/NA	Water	PrecSep-21	

Prep Batch: 649394

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-7	VER_021	Total/NA	Water	PrecSep_0	
500-246480-8	VER_034	Total/NA	Water	PrecSep_0	
500-246480-9	VER_036	Total/NA	Water	PrecSep_0	
500-246480-10	VER_036_FD	Total/NA	Water	PrecSep_0	

QC Association Summary

Rad (Continued)

Prep Batch: 649394 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-11	VER_037	Total/NA	Water	PrecSep_0	
500-246480-12	VER_038	Total/NA	Water	PrecSep_0	
500-246480-13	VER_040	Total/NA	Water	PrecSep_0	
500-246480-14	VER_040_FD	Total/NA	Water	PrecSep_0	
500-246480-15	VER_042	Total/NA	Water	PrecSep_0	
500-246480-16	VER_043	Total/NA	Water	PrecSep_0	
500-246480-17	VER_043_FD	Total/NA	Water	PrecSep_0	
500-246480-18	VER_101&	Total/NA	Water	PrecSep_0	
500-246480-19	VER_103&	Total/NA	Water	PrecSep_0	
500-246480-21	VER_EB1	Total/NA	Water	PrecSep_0	
MB 160-649394/1-A	Method Blank	Total/NA	Water	PrecSep_0	
LCS 160-649394/2-A	Lab Control Sample	Total/NA	Water	PrecSep_0	
500-246480-15 MS	VER_042	Total/NA	Water	PrecSep_0	
500-246480-15 MSD	VER_042	Total/NA	Water	PrecSep_0	

Prep Batch: 649787

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-22	VER_004	Total/NA	Water	PrecSep-21	
500-246480-23	VER_005	Total/NA	Water	PrecSep-21	
500-246480-24	VER_007R	Total/NA	Water	PrecSep-21	
500-246480-25	VER_016A	Total/NA	Water	PrecSep-21	
500-246480-26	VER_022	Total/NA	Water	PrecSep-21	
500-246480-27	VER_035&D	Total/NA	Water	PrecSep-21	
500-246480-28	VER_041	Total/NA	Water	PrecSep-21	
500-246480-29	VER_070#S	Total/NA	Water	PrecSep-21	
500-246480-30	VER_070&D	Total/NA	Water	PrecSep-21	
500-246480-32	VER_FB	Total/NA	Water	PrecSep-21	
500-246480-33	VER_EB2	Total/NA	Water	PrecSep-21	
MB 160-649787/1-A	Method Blank	Total/NA	Water	PrecSep-21	
LCS 160-649787/2-A	Lab Control Sample	Total/NA	Water	PrecSep-21	
500-246480-33 DU	VER_EB2	Total/NA	Water	PrecSep-21	

Prep Batch: 649789

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
500-246480-22	VER_004	Total/NA	Water	PrecSep_0	
500-246480-23	VER_005	Total/NA	Water	PrecSep_0	
500-246480-24	VER_007R	Total/NA	Water	PrecSep_0	
500-246480-25	VER_016A	Total/NA	Water	PrecSep_0	
500-246480-26	VER_022	Total/NA	Water	PrecSep_0	
500-246480-27	VER_035&D	Total/NA	Water	PrecSep_0	
500-246480-28	VER_041	Total/NA	Water	PrecSep_0	
500-246480-29	VER_070#S	Total/NA	Water	PrecSep_0	
500-246480-30	VER_070&D	Total/NA	Water	PrecSep_0	
500-246480-32	VER_FB	Total/NA	Water	PrecSep_0	
500-246480-33	VER_EB2	Total/NA	Water	PrecSep_0	
MB 160-649789/1-A	Method Blank	Total/NA	Water	PrecSep_0	
LCS 160-649789/2-A	Lab Control Sample	Total/NA	Water	PrecSep_0	
500-246480-33 DU	VER_EB2	Total/NA	Water	PrecSep_0	

QC Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Method: 903.0 - Radium-226 (GFPC)

Lab Sample ID: MB 160-649386/1-A
Matrix: Water
Analysis Batch: 652964

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 649386

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.01482	U	0.0578	0.0578	1.00	0.115	pCi/L	02/23/24 09:44	03/18/24 14:36	1

Carrier	*MB %Yield*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*88.6*		*30 - 110*	*02/23/24 09:44*	*03/18/24 14:36*	*1*

Lab Sample ID: LCS 160-649386/2-A
Matrix: Water
Analysis Batch: 653503

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 649386

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec Limits
Radium-226	11.3	10.33		1.07	1.00	0.115	pCi/L	91	75 - 125

Carrier	*LCS %Yield*	*LCS Qualifier*	*Limits*
Ba Carrier	*103*		*30 - 110*

Lab Sample ID: 500-246480-6 MS
Matrix: Water
Analysis Batch: 652964

Client Sample ID: VER_020
Prep Type: Total/NA
Prep Batch: 649386

Analyte	Sample Result	Sample Qual	Spike Added	MS Result	MS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec Limits
Radium-226	0.0997	U	11.4	10.39		1.11	1.00	0.114	pCi/L	90	60 - 140

Carrier	*MS %Yield*	*MS Qualifier*	*Limits*
Ba Carrier	*97.5*		*30 - 110*

Lab Sample ID: 500-246480-6 MSD
Matrix: Water
Analysis Batch: 652964

Client Sample ID: VER_020
Prep Type: Total/NA
Prep Batch: 649386

Analyte	Sample Result	Sample Qual	Spike Added	MSD Result	MSD Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec Limits	RER	RER Limit
Radium-226	0.0997	U	11.4	10.77		1.17	1.00	0.149	pCi/L	94	60 - 140	0.17	1

Carrier	*MSD %Yield*	*MSD Qualifier*	*Limits*
Ba Carrier	*90.9*		*30 - 110*

Lab Sample ID: MB 160-649393/1-A
Matrix: Water
Analysis Batch: 653196

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 649393

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	-0.08645	U	0.112	0.112	1.00	0.294	pCi/L	02/23/24 10:00	03/20/24 17:50	1

QC Sample Results

Method: 903.0 - Radium-226 (GFPC) (Continued)

Lab Sample ID: MB 160-649393/1-A
Matrix: Water
Analysis Batch: 653196
Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 649393

Carrier	MB %Yield	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
Ba Carrier	94.4		30 - 110	02/23/24 10:00	03/20/24 17:50	1

Lab Sample ID: LCS 160-649393/2-A
Matrix: Water
Analysis Batch: 653196
Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 649393

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec Limits
Radium-226	11.3	8.889		1.17	1.00	0.230	pCi/L	78	75 - 125

Carrier	LCS %Yield	LCS Qualifier	Limits
Ba Carrier	105		30 - 110

Lab Sample ID: 500-246480-15 MS
Matrix: Water
Analysis Batch: 653266
Client Sample ID: VER_042
Prep Type: Total/NA
Prep Batch: 649393

Analyte	Sample Result	Sample Qual	Spike Added	MS Result	MS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec Limits
Radium-226	0.616	U	15.2	13.31		1.71	1.00	0.442	pCi/L	84	60 - 140

Carrier	MS %Yield	MS Qualifier	Limits
Ba Carrier	104		30 - 110

Lab Sample ID: 500-246480-15 MSD
Matrix: Water
Analysis Batch: 653266
Client Sample ID: VER_042
Prep Type: Total/NA
Prep Batch: 649393

Analyte	Sample Result	Sample Qual	Spike Added	MSD Result	MSD Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec Limits	RER	RER Limit
Radium-226	0.616	U	15.1	16.15		2.24	1.00	0.726	pCi/L	103	60 - 140	0.72	1

Carrier	MSD %Yield	MSD Qualifier	Limits
Ba Carrier	58.4		30 - 110

Lab Sample ID: MB 160-649787/1-A
Matrix: Water
Analysis Batch: 653003
Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 649787

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.007234	U	0.0501	0.0501	1.00	0.101	pCi/L	02/26/24 10:15	03/19/24 09:18	1

Carrier	MB %Yield	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
Ba Carrier	104		30 - 110	02/26/24 10:15	03/19/24 09:18	1

QC Sample Results

Method: 903.0 - Radium-226 (GFPC) (Continued)

Lab Sample ID: LCS 160-649787/2-A
Matrix: Water
Analysis Batch: 653003
Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 649787

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec Limits
Radium-226	11.3	9.894		1.04	1.00	0.0965	pCi/L	87	75 - 125

Carrier	*LCS %Yield*	*LCS Qualifier*	*Limits*
Ba Carrier	*102*		*30 - 110*

Lab Sample ID: 500-246480-33 DU
Matrix: Water
Analysis Batch: 653597
Client Sample ID: VER_EB2
Prep Type: Total/NA
Prep Batch: 649787

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Radium-226	0.0198	U	0.01669	U	0.0479	1.00	0.0913	pCi/L	0.03	1

Carrier	*DU %Yield*	*DU Qualifier*	*Limits*
Ba Carrier	*95.7*		*30 - 110*

Method: 904.0 - Radium-228 (GFPC)

Lab Sample ID: MB 160-649387/1-A
Matrix: Water
Analysis Batch: 652361
Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 649387

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	-0.02476	U	0.285	0.285	1.00	0.550	pCi/L	02/23/24 09:49	03/13/24 12:48	1

Carrier	*MB %Yield*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*88.6*		*30 - 110*	*02/23/24 09:49*	*03/13/24 12:48*	*1*
Y Carrier	*85.6*		*30 - 110*	*02/23/24 09:49*	*03/13/24 12:48*	*1*

Lab Sample ID: LCS 160-649387/2-A
Matrix: Water
Analysis Batch: 652361
Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 649387

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec Limits
Radium-228	9.13	8.618		1.17	1.00	0.454	pCi/L	94	75 - 125

Carrier	*LCS %Yield*	*LCS Qualifier*	*Limits*
Ba Carrier	*105*		*30 - 110*
Y Carrier	*90.5*		*30 - 110*

QC Sample Results

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Method: 904.0 - Radium-228 (GFPC) (Continued)

Lab Sample ID: 500-246480-6 MS
Matrix: Water
Analysis Batch: 652315

Client Sample ID: VER_020
Prep Type: Total/NA
Prep Batch: 649387

Analyte	Sample Result	Sample Qual	Spike Added	MS Result	MS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec Limits
Radium-228	0.310	U	9.19	10.23		1.38	1.00	0.522	pCi/L	108	60 - 140

Carrier	*MS %Yield*	*MS Qualifier*	*Limits*
Ba Carrier	*97.5*		*30 - 110*
Y Carrier	*84.1*		*30 - 110*

Lab Sample ID: 500-246480-6 MSD
Matrix: Water
Analysis Batch: 652315

Client Sample ID: VER_020
Prep Type: Total/NA
Prep Batch: 649387

Analyte	Sample Result	Sample Qual	Spike Added	MSD Result	MSD Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec Limits	RER	RER Limit
Radium-228	0.310	U	9.16	9.672		1.35	1.00	0.511	pCi/L	102	60 - 140	0.20	1

Carrier	*MSD %Yield*	*MSD Qualifier*	*Limits*
Ba Carrier	*90.9*		*30 - 110*
Y Carrier	*85.2*		*30 - 110*

Lab Sample ID: MB 160-649394/1-A
Matrix: Water
Analysis Batch: 653196

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 649394

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.4215	U	0.303	0.305	1.00	0.451	pCi/L	02/23/24 10:04	03/20/24 11:53	1

Carrier	*MB %Yield*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*94.4*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:53*	*1*
Y Carrier	*83.7*		*30 - 110*	*02/23/24 10:04*	*03/20/24 11:53*	*1*

Lab Sample ID: LCS 160-649394/2-A
Matrix: Water
Analysis Batch: 653196

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 649394

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec Limits
Radium-228	9.11	9.820		1.28	1.00	0.431	pCi/L	108	75 - 125

Carrier	*LCS %Yield*	*LCS Qualifier*	*Limits*
Ba Carrier	*105*		*30 - 110*
Y Carrier	*81.9*		*30 - 110*

QC Sample Results

Method: 904.0 - Radium-228 (GFPC) (Continued)

Lab Sample ID: 500-246480-15 MS
Matrix: Water
Analysis Batch: 653196

Client Sample ID: VER_042
Prep Type: Total/NA
Prep Batch: 649394

Analyte	Sample Result	Sample Qual	Spike Added	MS Result	MS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec Limits
Radium-228	0.612	U G	12.2	13.24		1.73	1.00	0.596	pCi/L	104	60 - 140

Carrier	*MS %Yield*	*MS Qualifier*	*Limits*
Ba Carrier	*104*		*30 - 110*
Y Carrier	*82.6*		*30 - 110*

Lab Sample ID: 500-246480-15 MSD
Matrix: Water
Analysis Batch: 653196

Client Sample ID: VER_042
Prep Type: Total/NA
Prep Batch: 649394

Analyte	Sample Result	Sample Qual	Spike Added	MSD Result	MSD Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec Limits	RER	RER Limit
Radium-228	0.612	U G	12.1	15.27		2.32	1.00	1.26	pCi/L	121	60 - 140	0.50	1

Carrier	*MSD %Yield*	*MSD Qualifier*	*Limits*
Ba Carrier	*58.4*		*30 - 110*
Y Carrier	*78.9*		*30 - 110*

Lab Sample ID: MB 160-649789/1-A
Matrix: Water
Analysis Batch: 652066

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 649789

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-228	0.08858	U	0.251	0.251	1.00	0.449	pCi/L	02/26/24 10:27	03/12/24 12:17	1

Carrier	*MB %Yield*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Ba Carrier	*104*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:17*	*1*
Y Carrier	*81.5*		*30 - 110*	*02/26/24 10:27*	*03/12/24 12:17*	*1*

Lab Sample ID: LCS 160-649789/2-A
Matrix: Water
Analysis Batch: 652066

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 649789

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec Limits
Radium-228	9.13	9.482		1.12	1.00	0.402	pCi/L	104	75 - 125

Carrier	*LCS %Yield*	*LCS Qualifier*	*Limits*
Ba Carrier	*102*		*30 - 110*
Y Carrier	*78.9*		*30 - 110*

QC Sample Results

Method: 904.0 - Radium-228 (GFPC) (Continued)

Lab Sample ID: 500-246480-33 DU
Matrix: Water
Analysis Batch: 652066

Client Sample ID: VER_EB2
Prep Type: Total/NA
Prep Batch: 649789

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Radium-228	0.307	U	0.3580	U	0.336	1.00	0.529	pCi/L	0.08	1

Carrier	*DU %Yield*	*DU Qualifier*	*Limits*
Ba Carrier	*95.7*		*30 - 110*
Y Carrier	*73.6*		*30 - 110*

Lab Chronicle

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_002
Lab Sample ID: 500-246480-1
Date Collected: 02/20/24 12:20
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649386	KAC	EET SL	02/23/24 09:44
Total/NA	Analysis	903.0		1	652964	SCB	EET SL	03/18/24 16:30
Total/NA	Prep	PrecSep_0			649387	KAC	EET SL	02/23/24 09:49
Total/NA	Analysis	904.0		1	652361	FLC	EET SL	03/13/24 12:09
Total/NA	Analysis	Ra226_Ra228 Pos		1	653736	EMH	EET SL	03/22/24 19:14

Client Sample ID: VER_003R
Lab Sample ID: 500-246480-2
Date Collected: 02/20/24 16:40
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649386	KAC	EET SL	02/23/24 09:44
Total/NA	Analysis	903.0		1	652964	SCB	EET SL	03/18/24 16:31
Total/NA	Prep	PrecSep_0			649387	KAC	EET SL	02/23/24 09:49
Total/NA	Analysis	904.0		1	652315	SWS	EET SL	03/13/24 12:10
Total/NA	Analysis	Ra226_Ra228 Pos		1	653736	EMH	EET SL	03/22/24 19:14

Client Sample ID: VER_003R_FD
Lab Sample ID: 500-246480-3
Date Collected: 02/20/24 16:40
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649386	KAC	EET SL	02/23/24 09:44
Total/NA	Analysis	903.0		1	652964	SCB	EET SL	03/18/24 16:31
Total/NA	Prep	PrecSep_0			649387	KAC	EET SL	02/23/24 09:49
Total/NA	Analysis	904.0		1	652315	SWS	EET SL	03/13/24 12:10
Total/NA	Analysis	Ra226_Ra228 Pos		1	653736	EMH	EET SL	03/22/24 19:14

Client Sample ID: VER_008R
Lab Sample ID: 500-246480-4
Date Collected: 02/20/24 17:25
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649386	KAC	EET SL	02/23/24 09:44
Total/NA	Analysis	903.0		1	652964	SCB	EET SL	03/18/24 16:31
Total/NA	Prep	PrecSep_0			649387	KAC	EET SL	02/23/24 09:49
Total/NA	Analysis	904.0		1	652315	SWS	EET SL	03/13/24 12:10
Total/NA	Analysis	Ra226_Ra228 Pos		1	653736	EMH	EET SL	03/22/24 19:14

Lab Chronicle

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_010
Lab Sample ID: 500-246480-5
Date Collected: 02/20/24 17:55
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649386	KAC	EET SL	02/23/24 09:44
Total/NA	Analysis	903.0		1	652964	SCB	EET SL	03/18/24 16:31
Total/NA	Prep	PrecSep_0			649387	KAC	EET SL	02/23/24 09:49
Total/NA	Analysis	904.0		1	652315	SWS	EET SL	03/13/24 12:10
Total/NA	Analysis	Ra226_Ra228 Pos		1	653736	EMH	EET SL	03/22/24 19:14

Client Sample ID: VER_020
Lab Sample ID: 500-246480-6
Date Collected: 02/20/24 09:25
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649386	KAC	EET SL	02/23/24 09:44
Total/NA	Analysis	903.0		1	652964	SCB	EET SL	03/18/24 16:32
Total/NA	Prep	PrecSep_0			649387	KAC	EET SL	02/23/24 09:49
Total/NA	Analysis	904.0		1	652315	SWS	EET SL	03/13/24 12:49
Total/NA	Analysis	Ra226_Ra228 Pos		1	653736	EMH	EET SL	03/22/24 19:14

Client Sample ID: VER_021
Lab Sample ID: 500-246480-7
Date Collected: 02/20/24 16:30
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649393	KAC	EET SL	02/23/24 10:00
Total/NA	Analysis	903.0		1	653196	SCB	EET SL	03/20/24 17:50
Total/NA	Prep	PrecSep_0			649394	KAC	EET SL	02/23/24 10:04
Total/NA	Analysis	904.0		1	653196	SCB	EET SL	03/20/24 11:54
Total/NA	Analysis	Ra226_Ra228 Pos		1	653735	EMH	EET SL	03/22/24 19:03

Client Sample ID: VER_034
Lab Sample ID: 500-246480-8
Date Collected: 02/20/24 09:35
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649393	KAC	EET SL	02/23/24 10:00
Total/NA	Analysis	903.0		1	653196	SCB	EET SL	03/20/24 17:50
Total/NA	Prep	PrecSep_0			649394	KAC	EET SL	02/23/24 10:04
Total/NA	Analysis	904.0		1	653196	SCB	EET SL	03/20/24 11:54
Total/NA	Analysis	Ra226_Ra228 Pos		1	653735	EMH	EET SL	03/22/24 19:03

Lab Chronicle

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_036
Lab Sample ID: 500-246480-9
Date Collected: 02/20/24 15:15
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649393	KAC	EET SL	02/23/24 10:00
Total/NA	Analysis	903.0		1	653196	SCB	EET SL	03/20/24 17:51
Total/NA	Prep	PrecSep_0			649394	KAC	EET SL	02/23/24 10:04
Total/NA	Analysis	904.0		1	653196	SCB	EET SL	03/20/24 11:54
Total/NA	Analysis	Ra226_Ra228 Pos		1	653735	EMH	EET SL	03/22/24 19:03

Client Sample ID: VER_036_FD
Lab Sample ID: 500-246480-10
Date Collected: 02/20/24 15:15
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649393	KAC	EET SL	02/23/24 10:00
Total/NA	Analysis	903.0		1	653196	SCB	EET SL	03/20/24 17:51
Total/NA	Prep	PrecSep_0			649394	KAC	EET SL	02/23/24 10:04
Total/NA	Analysis	904.0		1	653196	SCB	EET SL	03/20/24 11:54
Total/NA	Analysis	Ra226_Ra228 Pos		1	653735	EMH	EET SL	03/22/24 19:03

Client Sample ID: VER_037
Lab Sample ID: 500-246480-11
Date Collected: 02/20/24 14:35
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649393	KAC	EET SL	02/23/24 10:00
Total/NA	Analysis	903.0		1	653196	SCB	EET SL	03/20/24 17:51
Total/NA	Prep	PrecSep_0			649394	KAC	EET SL	02/23/24 10:04
Total/NA	Analysis	904.0		1	653196	SCB	EET SL	03/20/24 11:54
Total/NA	Analysis	Ra226_Ra228 Pos		1	653735	EMH	EET SL	03/22/24 19:03

Client Sample ID: VER_038
Lab Sample ID: 500-246480-12
Date Collected: 02/20/24 10:30
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649393	KAC	EET SL	02/23/24 10:00
Total/NA	Analysis	903.0		1	653266	SWS	EET SL	03/20/24 18:01
Total/NA	Prep	PrecSep_0			649394	KAC	EET SL	02/23/24 10:04
Total/NA	Analysis	904.0		1	653196	SCB	EET SL	03/20/24 11:55
Total/NA	Analysis	Ra226_Ra228 Pos		1	653735	EMH	EET SL	03/22/24 19:03

Lab Chronicle

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_040
Lab Sample ID: 500-246480-13
Date Collected: 02/20/24 11:20
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649393	KAC	EET SL	02/23/24 10:00
Total/NA	Analysis	903.0		1	653266	SWS	EET SL	03/20/24 18:02
Total/NA	Prep	PrecSep_0			649394	KAC	EET SL	02/23/24 10:04
Total/NA	Analysis	904.0		1	653196	SCB	EET SL	03/20/24 11:55
Total/NA	Analysis	Ra226_Ra228 Pos		1	653735	EMH	EET SL	03/22/24 19:03

Client Sample ID: VER_040_FD
Lab Sample ID: 500-246480-14
Date Collected: 02/20/24 11:20
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649393	KAC	EET SL	02/23/24 10:00
Total/NA	Analysis	903.0		1	653266	SWS	EET SL	03/20/24 18:02
Total/NA	Prep	PrecSep_0			649394	KAC	EET SL	02/23/24 10:04
Total/NA	Analysis	904.0		1	653196	SCB	EET SL	03/20/24 11:55
Total/NA	Analysis	Ra226_Ra228 Pos		1	653735	EMH	EET SL	03/22/24 19:03

Client Sample ID: VER_042
Lab Sample ID: 500-246480-15
Date Collected: 02/20/24 12:17
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649393	KAC	EET SL	02/23/24 10:00
Total/NA	Analysis	903.0		1	653266	SWS	EET SL	03/20/24 18:02
Total/NA	Prep	PrecSep_0			649394	KAC	EET SL	02/23/24 10:04
Total/NA	Analysis	904.0		1	653196	SCB	EET SL	03/20/24 11:55
Total/NA	Analysis	Ra226_Ra228 Pos		1	653735	EMH	EET SL	03/22/24 19:03

Client Sample ID: VER_043
Lab Sample ID: 500-246480-16
Date Collected: 02/20/24 11:30
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649393	KAC	EET SL	02/23/24 10:00
Total/NA	Analysis	903.0		1	653266	SWS	EET SL	03/20/24 18:02
Total/NA	Prep	PrecSep_0			649394	KAC	EET SL	02/23/24 10:04
Total/NA	Analysis	904.0		1	653196	SCB	EET SL	03/20/24 11:56
Total/NA	Analysis	Ra226_Ra228 Pos		1	653735	EMH	EET SL	03/22/24 19:03

Lab Chronicle

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_043_FD

Lab Sample ID: 500-246480-17
Date Collected: 02/20/24 11:30
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649393	KAC	EET SL	02/23/24 10:00
Total/NA	Analysis	903.0		1	653266	SWS	EET SL	03/20/24 18:02
Total/NA	Prep	PrecSep_0			649394	KAC	EET SL	02/23/24 10:04
Total/NA	Analysis	904.0		1	653196	SCB	EET SL	03/20/24 11:56
Total/NA	Analysis	Ra226_Ra228 Pos		1	653735	EMH	EET SL	03/22/24 19:03

Client Sample ID: VER_101&

Lab Sample ID: 500-246480-18
Date Collected: 02/20/24 13:45
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649393	KAC	EET SL	02/23/24 10:00
Total/NA	Analysis	903.0		1	653266	SWS	EET SL	03/20/24 18:03
Total/NA	Prep	PrecSep_0			649394	KAC	EET SL	02/23/24 10:04
Total/NA	Analysis	904.0		1	653196	SCB	EET SL	03/20/24 11:56
Total/NA	Analysis	Ra226_Ra228 Pos		1	653735	EMH	EET SL	03/22/24 19:03

Client Sample ID: VER_103&

Lab Sample ID: 500-246480-19
Date Collected: 02/20/24 15:15
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649393	KAC	EET SL	02/23/24 10:00
Total/NA	Analysis	903.0		1	653266	SWS	EET SL	03/20/24 18:03
Total/NA	Prep	PrecSep_0			649394	KAC	EET SL	02/23/24 10:04
Total/NA	Analysis	904.0		1	653196	SCB	EET SL	03/20/24 11:56
Total/NA	Analysis	Ra226_Ra228 Pos		1	653735	EMH	EET SL	03/22/24 19:03

Client Sample ID: VER_EB1

Lab Sample ID: 500-246480-21
Date Collected: 02/20/24 17:50
Matrix: Water
Date Received: 02/21/24 11:20

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649393	KAC	EET SL	02/23/24 10:00
Total/NA	Analysis	903.0		1	653266	SWS	EET SL	03/20/24 18:03
Total/NA	Prep	PrecSep_0			649394	KAC	EET SL	02/23/24 10:04
Total/NA	Analysis	904.0		1	653266	SWS	EET SL	03/20/24 12:07
Total/NA	Analysis	Ra226_Ra228 Pos		1	653735	EMH	EET SL	03/22/24 19:03

Lab Chronicle

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_004

Lab Sample ID: 500-246480-22
Date Collected: 02/21/24 08:45
Matrix: Water
Date Received: 02/22/24 11:18

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649787	KAC	EET SL	02/26/24 10:15
Total/NA	Analysis	903.0		1	653003	SWS	EET SL	03/19/24 09:18
Total/NA	Prep	PrecSep_0			649789	KAC	EET SL	02/26/24 10:27
Total/NA	Analysis	904.0		1	652066	FLC	EET SL	03/12/24 12:17
Total/NA	Analysis	Ra226_Ra228 Pos		1	653736	EMH	EET SL	03/22/24 19:14

Client Sample ID: VER_005

Lab Sample ID: 500-246480-23
Date Collected: 02/21/24 09:40
Matrix: Water
Date Received: 02/22/24 11:18

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649787	KAC	EET SL	02/26/24 10:15
Total/NA	Analysis	903.0		1	653003	SWS	EET SL	03/19/24 09:18
Total/NA	Prep	PrecSep_0			649789	KAC	EET SL	02/26/24 10:27
Total/NA	Analysis	904.0		1	652066	FLC	EET SL	03/12/24 12:18
Total/NA	Analysis	Ra226_Ra228 Pos		1	653736	EMH	EET SL	03/22/24 19:14

Client Sample ID: VER_007R

Lab Sample ID: 500-246480-24
Date Collected: 02/21/24 11:20
Matrix: Water
Date Received: 02/22/24 11:18

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649787	KAC	EET SL	02/26/24 10:15
Total/NA	Analysis	903.0		1	653003	SWS	EET SL	03/19/24 09:19
Total/NA	Prep	PrecSep_0			649789	KAC	EET SL	02/26/24 10:27
Total/NA	Analysis	904.0		1	652066	FLC	EET SL	03/12/24 12:18
Total/NA	Analysis	Ra226_Ra228 Pos		1	653736	EMH	EET SL	03/22/24 19:14

Client Sample ID: VER_016A

Lab Sample ID: 500-246480-25
Date Collected: 02/21/24 13:15
Matrix: Water
Date Received: 02/22/24 11:18

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649787	KAC	EET SL	02/26/24 10:15
Total/NA	Analysis	903.0		1	653003	SWS	EET SL	03/19/24 09:19
Total/NA	Prep	PrecSep_0			649789	KAC	EET SL	02/26/24 10:27
Total/NA	Analysis	904.0		1	652066	FLC	EET SL	03/12/24 12:18
Total/NA	Analysis	Ra226_Ra228 Pos		1	653736	EMH	EET SL	03/22/24 19:14

Lab Chronicle

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_022

Lab Sample ID: 500-246480-26
Date Collected: 02/21/24 11:10
Matrix: Water
Date Received: 02/22/24 11:18

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649787	KAC	EET SL	02/26/24 10:15
Total/NA	Analysis	903.0		1	653003	SWS	EET SL	03/19/24 09:19
Total/NA	Prep	PrecSep_0			649789	KAC	EET SL	02/26/24 10:27
Total/NA	Analysis	904.0		1	652066	FLC	EET SL	03/12/24 12:18
Total/NA	Analysis	Ra226_Ra228 Pos		1	653736	EMH	EET SL	03/22/24 19:14

Client Sample ID: VER_035&D

Lab Sample ID: 500-246480-27
Date Collected: 02/21/24 13:05
Matrix: Water
Date Received: 02/22/24 11:18

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649787	KAC	EET SL	02/26/24 10:15
Total/NA	Analysis	903.0		1	653003	SWS	EET SL	03/19/24 09:19
Total/NA	Prep	PrecSep_0			649789	KAC	EET SL	02/26/24 10:27
Total/NA	Analysis	904.0		1	652066	FLC	EET SL	03/12/24 12:18
Total/NA	Analysis	Ra226_Ra228 Pos		1	653736	EMH	EET SL	03/22/24 19:14

Client Sample ID: VER_041

Lab Sample ID: 500-246480-28
Date Collected: 02/21/24 12:05
Matrix: Water
Date Received: 02/22/24 11:18

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649787	KAC	EET SL	02/26/24 10:15
Total/NA	Analysis	903.0		1	653003	SWS	EET SL	03/19/24 09:20
Total/NA	Prep	PrecSep_0			649789	KAC	EET SL	02/26/24 10:27
Total/NA	Analysis	904.0		1	652066	FLC	EET SL	03/12/24 12:18
Total/NA	Analysis	Ra226_Ra228 Pos		1	653736	EMH	EET SL	03/22/24 19:14

Client Sample ID: VER_070#S

Lab Sample ID: 500-246480-29
Date Collected: 02/21/24 09:20
Matrix: Water
Date Received: 02/22/24 11:18

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649787	KAC	EET SL	02/26/24 10:15
Total/NA	Analysis	903.0		1	653003	SWS	EET SL	03/19/24 09:20
Total/NA	Prep	PrecSep_0			649789	KAC	EET SL	02/26/24 10:27
Total/NA	Analysis	904.0		1	652066	FLC	EET SL	03/12/24 12:19
Total/NA	Analysis	Ra226_Ra228 Pos		1	653736	EMH	EET SL	03/22/24 19:14

Lab Chronicle

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Client Sample ID: VER_070&D
Date Collected: 02/21/24 08:45
Date Received: 02/22/24 11:18

Lab Sample ID: 500-246480-30
Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649787	KAC	EET SL	02/26/24 10:15
Total/NA	Analysis	903.0		1	653003	SWS	EET SL	03/19/24 09:20
Total/NA	Prep	PrecSep_0			649789	KAC	EET SL	02/26/24 10:27
Total/NA	Analysis	904.0		1	652066	FLC	EET SL	03/12/24 12:19
Total/NA	Analysis	Ra226_Ra228 Pos		1	653736	EMH	EET SL	03/22/24 19:14

Client Sample ID: VER_FB
Date Collected: 02/21/24 15:20
Date Received: 02/22/24 11:18

Lab Sample ID: 500-246480-32
Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649787	KAC	EET SL	02/26/24 10:15
Total/NA	Analysis	903.0		1	653003	SWS	EET SL	03/19/24 09:20
Total/NA	Prep	PrecSep_0			649789	KAC	EET SL	02/26/24 10:27
Total/NA	Analysis	904.0		1	652066	FLC	EET SL	03/12/24 12:19
Total/NA	Analysis	Ra226_Ra228 Pos		1	653736	EMH	EET SL	03/22/24 19:14

Client Sample ID: VER_EB2
Date Collected: 02/21/24 15:50
Date Received: 02/22/24 11:18

Lab Sample ID: 500-246480-33
Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	PrecSep-21			649787	KAC	EET SL	02/26/24 10:15
Total/NA	Analysis	903.0		1	653597	SCB	EET SL	03/22/24 06:39
Total/NA	Prep	PrecSep_0			649789	KAC	EET SL	02/26/24 10:27
Total/NA	Analysis	904.0		1	652066	FLC	EET SL	03/12/24 12:19
Total/NA	Analysis	Ra226_Ra228 Pos		1	653736	EMH	EET SL	03/22/24 19:14

Laboratory References:

EET SL = Eurofins St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

Accreditation/Certification Summary

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Laboratory: Eurofins St. Louis

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
Illinois	NELAP	200023	11-30-24

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
903.0	PrecSep-21	Water	Radium-226
904.0	PrecSep_0	Water	Radium-228
Ra226_Ra228 Pos		Water	Radium 226 and 228

500-246480

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT All relevant fields must be completed accurately

500-246480 COC

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Section A Required Client Information		Section B Required Project Information		Section C Invoice Information	
Company	Vistra Corp-Vermilion	Report To	Brian Voelker	Attention:	Dave McCoy
Address	10188 E 2150 North Rd	Copy To.	Sam Davies samantha.davies@vistracorp.com	Company Name	A3 Environmental
	Danville, IL 61834		Dianna Tickner - Dianna Tickner@vistracorp com	Address	3030 Warrenville Rd, Lisle, IL 60532
Email To	Brian.Voelker@VistraCorp.com	Purchase Order No		Quote Reference	
Phone	(217) 753-8911 Fax:	Project Name	VER-24Q1	Project Manager	Donna Campbell & Dirk Nelson
Requested Due Date/TAT	10 day	Project Number	50022750	Profile #	

REGULATORY AGENCY		
NPDES	**GROUND WATER**	DRINKING WATER
UST	RCRA	OTHER
Site Location STATE:	IL	

Section D Required Client Information

Valid Matrix Codes: MATRIX / CODE — DRINKING WATER DW; WATER WT; WASTE WATER WW; PRODUCT P; SOIL/SOLID SL; OIL OL; WIPE WP; AIR AR; OTHER OT; TISSUE TS

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test	VER-845-910-911	VER-845-912	VER-NPDES-912	VER_000_A	VER_000_B	VER_000_RAD	Residual Chlorine (Y/N)	Project No./ Lab I.D.
1	VER_002			2/20/24	12:20		6										X				X	X		
2	VER_003R			2/20/24	16:40		6										X				X	X		
3	VER_003R_FD			2/20/24	16:40		6										X				X	X		
	~~VER_004~~																X				X	X		
	~~VER_005~~																X				X	X		
	~~VER_007R~~																X				X	X		
4	VER_008R			2/20/24	17:25		6										X				X	X		
5	VER_010			2/20/24	17:55		6											X	X	X		X		
	~~VER_016IB~~																	X	X	X		X		
	~~VER_016A~~																	X	X	X		X		
	~~VER_017~~																X				X	X		
6	VER_020			2/20/24	9:25		18										X				X	X		MS/MSD
7	VER_021			2/20/24	10:30		6										X				X	X		
	~~VER_022~~																	X			X	X		
8	VER_034			2/20/24	0935		6										X				X	X		
	~~VER_035#S~~																	X	X	X		X		

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
VER-24Q1 Rev 1	Dave A3E	2-21-24	930	Taylor Blohm	2/21/24	09:30	
	Taylor Blohm	2/21/24	1120	[illegible] Scott	2/21/24	1120	

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: David McCoy / Taylor Olsen - Allison Beckett

SIGNATURE of SAMPLER: [signature] DATE Signed (MM/DD/YY): 2/20/24

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

5.8→5.3, 4.6→4.1, 3.1→2.6, 4.4→3.9, 5.6→5.1, 4.1→3.6

500-240480

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT All relevant fields must be completed accurately

Page 2 of 3

Section A Required Client Information		Section B Required Project Information		Section C Invoice Information	
Company	Vistra Corp-Vermilion	Report To	Brian Voelker	Attention	Dave McCoy
Address	10188 E 2150 North Rd	Copy To	Sam Davies. samantha.davies@vistracorp com	Company Name	A3 Environmental
	Danville, IL 61834		Dianna Tickner - Dianna Tickner@vistracorp com	Address	3030 Warrenville Rd, Lisle, IL 60532
Email To	Brian.Voelker@VistraCorp.com	Purchase Order No		Quote Reference	
Phone	(217) 753-8911 Fax.	Project Name	VER-24Q1	Project Manager	Donna Campbell & Dirk Nelson
Requested Due Date/TAT	10 day	Project Number	50022750	Profile #	

REGULATORY AGENCY: NPDES, **GROUND WATER**, DRINKING WATER, UST, RCRA, OTHER

Site Location STATE: IL

Section D Required Client Information — SAMPLE ID (A-Z, 0-9 /) Sample IDs MUST BE UNIQUE

Valid Matrix Codes: DRINKING WATER DW, WATER WT, WASTE WATER WW, PRODUCT P, SOIL/SOLID SL, OIL OL, WIPE WP, AIR AR, OTHER OT, TISSUE TS

Preservatives: Unpreserved, H_2SO_4, HNO_3, HCl, NaOH, $Na_2S_2O_3$, Methanol, Other

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE	SAMPLE TYPE	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	VER-845-910-911	VER-845-912	VER-NPDES-912	VER_000_A	VER_000_B	VER_000_RAD	Residual Chlorine (Y/N)	Project No./ Lab I.D.
	~~VER_035&D~~								X	X	X		X		
9	VER_036			2/20/24	15:15		6	X				X	X		
10	VER_036_FD			2/20/24	15:15		6	X				X	X		
11	VER_037			2/20/24	14:25			X				X	X		
12	VER_038			2/20/24	10:30			X				X	X		
13	VER_040			2/20/24	11:20			X				X	X		
14	VER_040_FD			2/20/24	11:20			X				X	X		
	~~VER_041~~							X				X	X		
15	VER_042			2/20/24	12:17			X				X	X		MS/MSD
16	VER_043			2/20/24	11:30			X				X	X		
17	VER_043_FD			2/20/24	11:30			X				X	X		
	~~VER_070#S~~								X			X	X		
	~~VER_070&D~~								X			X	X		
	~~VER_071#S~~								X			X	X		
	~~VER_071&D~~								X			X	X		
18	VER_101&			2/20/24	13:45			X				X	X		

	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
VER-24Q1 Rev 1	Dave Mc / A3E	2-21-24	0930	[signature]	2/21/24	09:30	
	[signature]	2/21/24	1120	[signature]	2/21/24	1120	

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Dave Mc, Taylor Clark

SIGNATURE of SAMPLER: [signature] DATE Signed (MM/DD/YY): 2/20/24

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

500-246480

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT All relevant fields must be completed accurately

Page 3 of 3

Section A Required Client Information.		Section B Required Project Information		Section C Invoice Information	
Company	Vistra Corp-Vermilion	Report To	Brian Voelker	Attention	Dave McCoy
Address	10188 E 2150 North Rd	Copy To	Sam Davies samantha.davies@vistracorp com	Company Name	A3 Environmental
	Danville, IL 61834		Dianna Tickner - Dianna Tickner@vistracorp com	Address	3030 Warrenville Rd, Lisle, IL 60532
Email To	Brian.Voelker@VistraCorp.com	Purchase Order No		Quote Reference	
Phone	(217) 753-8911 Fax:	Project Name	VER-24Q1	Project Manager	Donna Campbell & Dirk Nelson
Requested Due Date/TAT	10 day	Project Number	50022750	Profile #:	

REGULATORY AGENCY		
NPDES	GROUND WATER	DRINKING WATER
UST	RCRA	OTHER
Site Location STATE	IL	

Section D Required Client Information

Valid Matrix Codes

MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
WIPE	WP
AIR	AR
OTHER	OT
TISSUE	TS

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	VER-845-910-911	VER-845-912	VER-NPDES-912	VER_000_A	VER_000_B	VER_000_RAD	Residual Chlorine (Y/N)	Project No./ Lab I.D.
19	VER_103&			2/24/24	15:15		6										X				X	X		
20	VER_ND3			2/20/24	13:40		6										X				X			No RAD Analysis
	~~VER_NED1~~																	X			X			~~No RAD Analysis~~
	~~VER_OED1~~																X				X			~~No RAD Analysis~~
	~~VER_FB~~																	X	X	X		X		
21	VER_EB1			2/20/24	14:50		7											X	X	X		X		
	~~VER_EB2~~																	X	X	X		X		
	~~VER_EB3~~																	X	X	X		X		

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
VER-24Q1 Rev 1	Dave Ng A3E	2-21-24	0930	[illegible signature]	2/21/24	0930	
	[illegible signature]	2/21/24	1120	[illegible signature]	2/21/24	1120	

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Dave Ng Taylor Cline

SIGNATURE of SAMPLER: [illegible signature] DATE Signed (MM/DD/YY): 2/20/24

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

500-246480

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT All relevant fields must be completed accurately.

Page: 1 of 3

Section A Required Client Information:
Company: Vistra Corp-Vermilion
Address: 10188 E 2150 North Rd
Danville, IL 61834
Email To: Brian.Voelker@VistraCorp.com
Phone: (217) 753-8911 Fax:
Requested Due Date/TAT: 10 day

Section B Required Project Information:
Report To: Brian Voelker
Copy To: Sam Davies: samantha.davies@vistracorp.com
Dianna Tickner Dianna.Tickner@vistracorp.com
Purchase Order No.
Project Name: VER-24Q1
Project Number: 50022750

Section C Invoice Information:
Attention: Dave McCoy
Company Name: A3 Environmental
Address: 3030 Warrenville Rd, Lisle, IL 60532
Quote Reference:
Project Manager: Donna Campbell & Dirk Nelson
Profile #:

REGULATORY AGENCY
NPDES GROUND WATER DRINKING WATER
UST RCRA OTHER
Site Location STATE: IL

500-246480 COC

Section D Required Client Information

Valid Matrix Codes — MATRIX / CODE: DRINKING WATER DW; WATER WT; WASTE WATER WW; PRODUCT P; SOIL/SOLID SL; OIL OL; WIPE WP; AIR AR; OTHER OT; TISSUE TS

SAMPLE ID (A-Z, 0-9 / -) Sample IDs MUST BE UNIQUE

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	VER-845-910-911	VER-845-912	VER-NPDES-912	VER_000_A	VER_000_B	VER_000_RAD	Residual Chlorine (Y/N)	Project No./ Lab I.D.
	~~VER_002~~																X				X	X		
	~~VER_003R~~																X				X	X		
	~~VER_003R_FD~~																X				X	X		
22	VER_004			2.21.24	0845												X				X	X		
23	VER_005			2 21.24	09.40												X				X	X		
24	VER_007R			2.21.24	11:20		6										X				X	X		
	~~VER_008R~~																X				X	X		
	~~VER_010~~																	X	X	X		X		
	~~VER_016IB~~																	X	X	X		X		
25	VER_016A			2 21.24	1315		7											X	X	X		X		
	~~VER_017~~																X				X	X		
	~~VER_020~~																X				X	X		MS/MSD
	~~VER_021~~																X				X	X		
26	VER_022			2 21.24	11:10		6											X			X	X		
	~~VER_034~~																X				X	X		
	~~VER_035#S~~																	X	X	X		X		

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
VER-24Q1 Rev 1	Dave McCoy	2.21.24	1630	[signature]	2/22/24	0923	
	[signature] 2/22/24	2.21.24	1118	Stephanie Hernandez EETA	2/22/24	1118	

SAMPLER NAME AND SIGNATURE
PRINT Name of SAMPLER: Dave McCoy
SIGNATURE of SAMPLER: [signature] DATE Signed (MM/DD/YY): 2.21.24

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

2/21/24

4.6+4.1, 3.2+2.7, 1.0+1.5, 3.0+2.5

DM

500-246480

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: 2 of 3

Section A Required Client Information:		Section B Required Project Information:		Section C Invoice Information:	
Company:	Vistra Corp-Vermilion	Report To:	Brian Voelker	Attention:	Dave McCoy
Address:	10188 E 2150 North Rd	Copy To:	Sam Davies: samantha.davies@vistracorp.com	Company Name:	A3 Environmental
	Danville, IL 61834		Dianna Tickner Dianna.Tickner@vistracorp.com	Address:	3030 Warrenville Rd, Lisle, IL 60532
Email To:	Brian.Voelker@VistraCorp.com	Purchase Order No.		Quote Reference:	
Phone: (217) 753-8911	Fax:	Project Name:	VER-24Q1	Project Manager	Donna Campbell & Dirk Nelson
Requested Due Date/TAT:	10 day	Project Number:	50022750	Profile #:	

REGULATORY AGENCY		
NPDES	GROUND WATER	DRINKING WATER
UST	RCRA	OTHER
Site Location STATE:	IL	

Section D Required Client Information

SAMPLE ID (A-Z, 0-9 / -) Sample IDs MUST BE UNIQUE

Valid Matrix Codes MATRIX	CODE
DRINKING WATER	DW
WATER	WT
WASTE WATER	WW
PRODUCT	P
SOIL/SOLID	SL
OIL	OL
WIPE	WP
AIR	AR
OTHER	OT
TISSUE	TS

Requested Analysis Filtered (Y/N)

	ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	VER-845-910-911	VER-845-912	VER-NPDES-912	VER_000_A	VER_000_B	VER_000_RAD	Residual Chlorine (Y/N)	Project No./ Lab I.D.
27	26	VER_035&D			2.21.24	13:05		6											X	X	X		X		
		~~VER_036~~																X				X	X		
		~~VER_036_FD~~																X				X	X		
		~~VER_037~~																X				X	X		
		~~VER_038~~																X				X	X		
		~~VER_040~~																X				X	X		
		~~VER_040_FD~~																X				X	X		
28	27	VER_041			2.21.24	12:05												X				X	X		
		~~VER_042~~																X				X	X		MS/MSD
		~~VER_043~~																X				X	X		
		~~VER_043_FD~~																X				X	X		
29	28	VER_070#S			2.21.24	0920		6											X			X	X		
30	29	VER_070&D			2.21.24	0845		6											X			X	X		
		~~VER_071#S~~																	X			X	X		
		~~VER_071&D~~																	X			X	X		
		~~VER_101&~~																X				X	X		

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
VER-24Q1 Rev 1	[signature]	2.22.24	16:30	[signature]	2/22/24	0923	
	[signature]	2/22/24	1118	Stephanie Hermond / EEIA	2/22/24	1118	

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Dave McCoy

SIGNATURE of SAMPLER: DM

DATE Signed (MM/DD/YY): 2.21.24

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

2/21/24

DM

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT All relevant fields must be completed accurately.

500 146480

Page: 3 of 3

Section A Required Client Information:

Company:	Vistra Corp-Vermilion
Address:	10188 E 2150 North Rd, Danville, IL 61834
Email To:	Brian.Voelker@VistraCorp.com
Phone:	(217) 753-8911 Fax:
Requested Due Date/TAT:	10 day

Section B Required Project Information:

Report To:	Brian Voelker
Copy To:	Sam Davies: samantha.davies@vistracorp.com; Dianna Tickner Dianna.Tickner@vistracorp.com
Purchase Order No.	
Project Name:	VER-24Q1
Project Number:	50022750

Section C Invoice Information:

Attention:	Dave McCoy
Company Name:	A3 Environmental
Address:	3030 Warrenville Rd, Lisle, IL 60532
Quote Reference:	
Project Manager	Donna Campbell & Dirk Nelson
Profile #:	

REGULATORY AGENCY

NPDES, GROUND WATER, DRINKING WATER, UST, RCRA, OTHER

Site Location STATE: IL

Section D Required Client Information

Valid Matrix Codes: DRINKING WATER DW, WATER WT, WASTE WATER WW, PRODUCT P, SOIL/SOLID SL, OIL OL, WIPE WP, AIR AR, OTHER OT, TISSUE TS

SAMPLE ID (A-Z, 0-9 / -) Sample IDs MUST BE UNIQUE

Requested Analysis Filtered (Y/N)

ITEM #	SAMPLE ID	MATRIX CODE	SAMPLE TYPE	COLLECTED DATE	COLLECTED TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test	VER-845-910-911	VER-845-912	VER-NPDES-912	VER_000_A	VER_000_B	VER_000_RAD	Residual Chlorine (Y/N)	Project No./ Lab I.D.
	~~VER_103&~~																X				X	X		
	~~VER_ND3~~																X				X			No RAD Analysis
31 ~~30~~	VER_NED1			2 21.24	1500		6											X			X			No RAD Analysis
	~~VER_OED1~~																X				X			No RAD Analysis
32 ~~31~~	VER_FB			2 21.24	15:20		7											X	X	X		X		
	~~VER_EB1~~																	X	X	X		X		
33 ~~32~~	VER_EB2			2 21 24	15:50		7											X	X	X		X		
	~~VER_EB3~~																	X	X	X		X		

2/21/24 DM

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
VER-24Q1 Rev 1	D	2/22/24	1630	[signature]	2/22/24	0923	
	[signature]	2/22/24	1118	Stephanie Hernandez EETIA	2/22/24	1118	

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER: Dave Mc

SIGNATURE of SAMPLER: D

DATE Signed (MM/DD/YY): 2 21.24

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

2/21/24

DM

Eurofins Chicago
2417 Bond Street
University Park, IL 60484
Phone: 708-534-5200 Fax: 708-534-5211

Chain of Custody Record

eurofins | Environment Testing

Client Information (Sub Contract Lab)	Sampler:	Lab PM: Campbell, Donna L	Carrier Tracking No(s):	COC No: 500-184995.1
Client Contact: Shipping/Receiving	Phone:	E-Mail: Donna.Campbell@et.eurofinsus.com	State of Origin: Illinois	Page: Page 1 of 3
Company: TestAmerica Laboratories, Inc.		Accreditations Required (See note): NELAP - Illinois		Job #: 500-246480-2
Address: 13715 Rider Trail North, ,	Due Date Requested: 3/21/2024			
City: Earth City	TAT Requested (days):			
State, Zip: MO, 63045				
Phone: 314-298-8566(Tel) 314-298-8757(Fax)	PO #:			
Email:	WO #:			
Project Name: VER-24Q1	Project #: 50022750			
Site:	SSOW#:			

Analysis Requested

Sample Identification - Client ID (Lab ID)	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	903.0/PrecSep_21 BL	904.0/PrecSep_0 BL	Ra226_228GFPC_P/ BL	Total Number of containers	Special Instructions/Note:
			Preservation Code:								
VER_002 (500-246480-1)	2/20/24	12:20 Central		Water			X	X	X	2	
VER_003R (500-246480-2)	2/20/24	16:40 Central		Water			X	X	X	2	
VER_003R_FD (500-246480-3)	2/20/24	16:40 Central		Water			X	X	X	2	
VER_008R (500-246480-4)	2/20/24	17:25 Central		Water			X	X	X	2	
VER_010 (500-246480-5)	2/20/24	17:55 Central		Water			X	X	X	2	
VER_020 (500-246480-6)	2/20/24	09:25 Central		Water			X	X	X	2	
VER_020 (500-246480-6MS)	2/20/24	09:25 Central	MS	Water			X	X	X	2	
VER_020 (500-246480-6MSD)	2/20/24	09:25 Central	MSD	Water			X	X	X	2	
VER_021 (500-246480-7)	2/20/24	10:30 Central		Water			X	X	X	2	

Preservation Codes:

A - HCL	M - Hexane
B - NaOH	N - None
C - Zn Acetate	O - AsNaO2
D - Nitric Acid	P - Na2O4S
E - NaHSO4	Q - Na2SO3
F - MeOH	R - Na2S2O3
G - Amchlor	S - H2SO4
H - Ascorbic Acid	T - TSP Dodecahydrate
I - Ice	U - Acetone
J - DI Water	V - MCAA
K - EDTA	W - pH 4-5
L - EDA	Y - Trizma
	Z - other (specify)

Other:

Note: Since laboratory accreditations are subject to change, Eurofins Chicago places the ownership of method, analyte & accreditation compliance upon our subcontract laboratories. This sample shipment is forwarded under chain-of-custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analysis/tests/matrix being analyzed, the samples must be shipped back to the Eurofins Chicago laboratory or other instructions will be provided. Any changes to accreditation status should be brought to Eurofins Chicago attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said compliance to Eurofins Chicago.

Possible Hazard Identification
Unconfirmed

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For* ______ *Months*

Deliverable Requested: I, II, III, IV, Other (specify) Primary Deliverable Rank: 2

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:		
Relinquished by: Stephanie Hernandez	Date/Time: 2/21/24 1630	Company: EETA	Received by: Richard Thornley	Date/Time: FEB 22 2024	Company: ETA STL
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:		Cooler Temperature(s) °C and Other Remarks:		

Ver: 06/08/2021

Eurofins Chicago
2417 Bond Street
University Park, IL 60484
Phone: 708-534-5200 Fax: 708-534-5211

Chain of Custody Record

eurofins | Environment Testing

Client Information (Sub Contract Lab)	Sampler:	Lab PM: Campbell, Donna L	Carrier Tracking No(s):	COC No: 500-184995.2
Client Contact: Shipping/Receiving	Phone:	E-Mail: Donna.Campbell@et.eurofinsus.com	State of Origin: Illinois	Page: Page 2 of 3
Company: TestAmerica Laboratories, Inc.		Accreditations Required (See note): NELAP - Illinois		Job #: 500-246480-2
Address: 13715 Rider Trail North,	Due Date Requested: 3/21/2024			
City: Earth City	TAT Requested (days):			
State, Zip: MO, 63045				
Phone: 314-298-8566(Tel) 314-298-8757(Fax)	PO #:			
Email:	WO #:			
Project Name: VER-24Q1	Project #: 50022750			
Site:	SSOW#:			

Analysis Requested

Sample Identification - Client ID (Lab ID)	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	903.0/PrecSep_21 BL	904.0/PrecSep_0 BL	Ra226_228GFPC_P/ BL	Total Number of containers	Special Instructions/Note:
			Preservation Code:								
VER_034 (500-246480-8)	2/20/24	09:35 Central		Water			X	X	X	2	
VER_036 (500-246480-9)	2/20/24	15:15 Central		Water			X	X	X	2	
VER_036_FD (500-246480-10)	2/20/24	15:15 Central		Water			X	X	X	2	
VER_037 (500-246480-11)	2/20/24	14:35 Central		Water			X	X	X	2	
VER_038 (500-246480-12)	2/20/24	10:30 Central		Water			X	X	X	2	
VER_040 (500-246480-13)	2/20/24	11:20 Central		Water			X	X	X	2	
VER_040_FD (500-246480-14)	2/20/24	11:20 Central		Water			X	X	X	2	
VER_042 (500-246480-15)	2/20/24	12:17 Central		Water			X	X	X	2	
VER_042 (500-246480-15MS)	2/20/24	12:17 Central	MS	Water			X	X	X	2	

Preservation Codes:
A - HCL
B - NaOH
C - Zn Acetate
D - Nitric Acid
E - NaHSO4
F - MeOH
G - Amchlor
H - Ascorbic Acid
I - Ice
J - DI Water
K - EDTA
L - EDA
M - Hexane
N - None
O - AsNaO2
P - Na2O4S
Q - Na2SO3
R - Na2S2O3
S - H2SO4
T - TSP Dodecahydrate
U - Acetone
V - MCAA
W - pH 4-5
Y - Trizma
Z - other (specify)
Other:

Note: Since laboratory accreditations are subject to change, Eurofins Chicago places the ownership of method, analyte & accreditation compliance upon our subcontract laboratories. This sample shipment is forwarded under chain-of-custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analysis/tests/matrix being analyzed, the samples must be shipped back to the Eurofins Chicago laboratory or other instructions will be provided. Any changes to accreditation status should be brought to Eurofins Chicago attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said compliance to Eurofins Chicago.

Possible Hazard Identification *Unconfirmed*	***Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)*** ☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For ____ Months*
Deliverable Requested: I, II, III, IV, Other (specify) — Primary Deliverable Rank: 2	Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:		
Relinquished by: Stephanie Hemandez	Date/Time: 2/21/24 1630	Company: EETA	Received by: Richard Thornley	Date/Time: FEB 22 2024	Company: ETA STL
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:		Cooler Temperature(s) °C and Other Remarks:		

Ver: 06/08/2021

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Eurofins Chicago
2417 Bond Street
University Park, IL 60484
Phone: 708-534-5200 Fax: 708-534-5211

Chain of Custody Record

eurofins | Environment Testing

Client Information (Sub Contract Lab)	Sampler:	Lab PM: Campbell, Donna L	Carrier Tracking No(s):	COC No: 500-184995.3
Client Contact: Shipping/Receiving	Phone:	E-Mail: Donna.Campbell@et.eurofinsus.com	State of Origin: Illinois	Page: Page 3 of 3
Company: TestAmerica Laboratories, Inc.		Accreditations Required (See note): NELAP - Illinois		Job #: 500-246480-2
Address: 13715 Rider Trail North,	Due Date Requested: 3/21/2024			
City: Earth City	TAT Requested (days):			
State, Zip: MO, 63045				
Phone: 314-298-8566(Tel) 314-298-8757(Fax)	PO #:			
Email:	WO #:			
Project Name: VER-24Q1	Project #: 50022750			
Site:	SSOW#:			

Analysis Requested

Sample Identification - Client ID (Lab ID)	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	903.0/PrecSep_21 BL	904.0/PrecSep_0 BL	Ra226_228GFPC_P/ BL	Total Number of containers	Special Instructions/Note:
			Preservation Code:								
VER_042 (500-246480-15MSD)	2/20/24	12:17 Central	MSD	Water			X	X	X	2	
VER_043 (500-246480-16)	2/20/24	11:30 Central		Water			X	X	X	2	
VER_043_FD (500-246480-17)	2/20/24	11:30 Central		Water			X	X	X	2	
VER_101& (500-246480-18)	2/20/24	13:45 Central		Water			X	X	X	2	
VER_103& (500-246480-19)	2/20/24	15:15 Central		Water			X	X	X	2	
VER_EB1 (500-246480-21)	2/20/24	17:50 Central		Water			X	X	X	2	

Preservation Codes:

A - HCL
B - NaOH
C - Zn Acetate
D - Nitric Acid
E - NaHSO4
F - MeOH
G - Amchlor
H - Ascorbic Acid
I - Ice
J - DI Water
K - EDTA
L - EDA
M - Hexane
N - None
O - AsNaO2
P - Na2O4S
Q - Na2SO3
R - Na2S2O3
S - H2SO4
T - TSP Dodecahydrate
U - Acetone
V - MCAA
W - pH 4-5
Y - Trizma
Z - other (specify)

Other:

Note: Since laboratory accreditations are subject to change, Eurofins Chicago places the ownership of method, analyte & accreditation compliance upon our subcontract laboratories. This sample shipment is forwarded under chain-of-custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analysis/tests/matrix being analyzed, the samples must be shipped back to the Eurofins Chicago laboratory or other instructions will be provided. Any changes to accreditation status should be brought to Eurofins Chicago attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said compliance to Eurofins Chicago.

Possible Hazard Identification
Unconfirmed

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For* ______ *Months*

Deliverable Requested: I, II, III, IV, Other (specify)   Primary Deliverable Rank: 2

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:		Time:	Method of Shipment:	
Relinquished by: Stephanie Hemmond	Date/Time: 2/21/24 1630	Company: EETA	Received by: Richard Thornley	Date/Time: FEB 22 2024	Company: ETA STL
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:

Custody Seals Intact: Δ Yes Δ No   Custody Seal No.:

Cooler Temperature(s) °C and Other Remarks:

Ver: 06/08/2021

Eurofins Chicago
2417 Bond Street
University Park, IL 60484
Phone: 708-534-5200 Fax: 708-534-5211

Chain of Custody Record

eurofins | Environment Testing

Client Information (Sub Contract Lab)	Sampler:	Lab PM: Campbell, Donna L	Carrier Tracking No(s):
Client Contact: Shipping/Receiving	Phone:	E-Mail: Donna.Campbell@et.eurofinsus.com	State of Origin: Illinois
Company: TestAmerica Laboratories, Inc		Accreditations Required (See note): NELAP - Illinois	
Address: 13715 Rider Trail North,	Due Date Requested: 3/5/2024		
City: Earth City	TAT Requested (days):		
State, Zip: MO, 63045			
Phone: 314-298-8566(Tel) 314-298-8757(Fax)	PO #:		
Email:	WO #:		
Project Name: VER-24Q1	Project #: 50022750		
Site:	SSOW#:		

COC No: 500-185017.1
Page: Page 1 of 2
Job #: 500-246480-1

Analysis Requested

Sample Identification - Client ID (Lab ID)	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	903.0/PrecSep_21 BF	904.0/PrecSep_0 BF	Ra226_228GFPC_P/ BF	903.0/PrecSep_21 BL	904.0/PrecSep_0 BL	Ra226_228GFPC_P/ BL	903.0/PrecSep_21 BH	904.0/PrecSep_0 BH	Ra226_228GFPC_P/ BH	Total Number of containers	Special Instructions/Note:
			Preservation Code:														
VER_004 (500-246480-22)	2/21/24	08:45 Central		Water			X	X	X	X	X	X				2	
VER_005 (500-246480-23)	2/21/24	09:40 Central		Water			X	X	X	X	X	X				2	
VER_007R (500-246480-24)	2/21/24	11:20 Central		Water			X	X	X	X	X	X				2	
VER_016A (500-246480-25)	2/21/24	13:15 Central		Water						X	X	X	X	X	X	2	
VER_022 (500-246480-26)	2/21/24	11:10 Central		Water						X	X	X	X	X	X	2	
VER_035&D (500-246480-27)	2/21/24	13:05 Central		Water						X	X	X	X	X	X	2	
VER_041 (500-246480-28)	2/21/24	12:05 Central		Water			X	X	X	X	X	X				2	
VER_070#S (500-246480-29)	2/21/24	09:20 Central		Water						X	X	X	X	X	X	2	
VER_070&D (500-246480-30)	2/21/24	08:45 Central		Water						X	X	X	X	X	X	2	

Preservation Codes:
A - HCL; B - NaOH; C - Zn Acetate; D - Nitric Acid; E - NaHSO4; F - MeOH; G - Amchlor; H - Ascorbic Acid; I - Ice; J - DI Water; K - EDTA; L - EDA
M - Hexane; N - None; O - AsNaO2; P - Na2O4S; Q - Na2SO3; R - Na2S2O3; S - H2SO4; T - TSP Dodecahydrate; U - Acetone; V - MCAA; W - pH 4-5; Y - Trizma; Z - other (specify)
Other:

Note: Since laboratory accreditations are subject to change, Eurofins Chicago places the ownership of method, analyte & accreditation compliance upon our subcontract laboratories. This sample shipment is forwarded under chain-of-custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analysis/tests/matrix being analyzed, the samples must be shipped back to the Eurofins Chicago laboratory or other instructions will be provided. Any changes to accreditation status should be brought to Eurofins Chicago attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said compliance to Eurofins Chicago.

Possible Hazard Identification
Unconfirmed

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For* ____ *Months*

Deliverable Requested: I, II, III, IV, Other (specify) | Primary Deliverable Rank: 2 | Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:		
Relinquished by: [signature]	Date/Time: 2/22/24 1300	Company:	Received by: [signature]	Date/Time: 2/23/24 0830	Company: EASR
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Relinquished by:	Date/Time:	Company:	Received by:	Date/Time:	Company:
Custody Seals Intact: Δ Yes Δ No	Custody Seal No.:		Cooler Temperature(s) °C and Other Remarks:		

Eurofins Chicago
2417 Bond Street
University Park, IL 60484
Phone 708-534-5200 Fax 708-534-5211

Chain of Custody Record

eurofins | Environment Testing

Client Information (Sub Contract Lab)

Client Contact	Shipping/Receiving
Company	TestAmerica Laboratories, Inc
Address	13715 Rider Trail North
City	Earth City
State Zip	MO, 63045
Phone	314-298-8566(Tel) 314-298-8757(Fax)
Email	
Project Name	VER-24Q1
Site	
Sampler	
Phone	
Due Date Requested	3/5/2024
TAT Requested (days)	
PO #	
WO #	
Project #	50022750
SSOW#	
Lab PM	Campbell, Donna L
E-Mail	Donna.Campbell@et.eurofinsus.com
Accreditations Required (See note)	NELAP - Illinois
Carrier Tracking No(s)	
State of Origin	Illinois
COC No	500-185017.2
Page	Page 2 of 2
Job #	500-246480-1

Analysis Requested

Sample Identification - Client ID (Lab ID)	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water, S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	903.0/PrecSep_21 BF	904.0/PrecSep_0 BF	Ra226_228GFPC_P/ BF	903.0/PrecSep_21 BL	904.0/PrecSep_0 BL	Ra226_228GFPC_P/ BL	903.0/PrecSep_21 BH	904.0/PrecSep_0 BH	Ra226_228GFPC_P/ BH	Total Number of containers	Special Instructions/Note:
			Preservation Code:														
VER_EB1 (500-246480-32)	2/21/24	15:20 Central		Water						X	X	X	X	X	X	2	
VER EB2 (500-246480-33)	2/21/24	15:50 Central		Water						X	X	X	X	X	X	2	

Preservation Codes:
A - HCL, B - NaOH, C - Zn Acetate, D - Nitric Acid, E - NaHSO4, F - MeOH, G - Amchlor, H - Ascorbic Acid, I - Ice, J - DI Water, K - EDTA, L - EDA
M - Hexane, N - None, O - AsNaO2, P - Na2O4S, Q - Na2SO3, R - Na2S2O3, S - H2SO4, T - TSP Dodecahydrate, U - Acetone, V - MCAA, W - pH 4-5, Y - Trizma, Z - other (specify)
Other:

Note Since laboratory accreditations are subject to change, Eurofins Chicago places the ownership of method, analyte & accreditation compliance upon our subcontract laboratories. This sample shipment is forwarded under chain-of-custody. If the laboratory does not currently maintain accreditation in the State of Origin listed above for analysis/tests/matrix being analyzed, the samples must be shipped back to the Eurofins Chicago laboratory or other instructions will be provided. Any changes to accreditation status should be brought to Eurofins Chicago attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said compliance to Eurofins Chicago.

Possible Hazard Identification
Unconfirmed

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For* ____ *Months*

Deliverable Requested: I, II, III, IV, Other (specify) | Primary Deliverable Rank: 2

Special Instructions/QC Requirements:

Empty Kit Relinquished by:	Date:	Time:	Method of Shipment:

Relinquished by	Date/Time	Company	Received by	Date/Time	Company
	2/22/24 1300			2/23/24 0830	EMSN

Custody Seals Intact:	Custody Seal No.:	Cooler Temperature(s) °C and Other Remarks:
Δ Yes Δ No		

Login Sample Receipt Checklist

Client: Vistra Energy Corp

Job Number: 500-246480-2
SDG Number: VER_000_RAD

Login Number: 246480
List Number: 1
Creator: Scott, Sherri L

List Source: Eurofins Chicago

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	5.3,4.1,2.6,3.9,5.1,3.6,4.1,2.7,1.5,2.5
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	False	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Login Sample Receipt Checklist

Client: Vistra Energy Corp

Job Number: 500-246480-2
SDG Number: VER_000_RAD

Login Number: 246480
List Number: 2
Creator: Thornley, Richard W

List Source: Eurofins St. Louis
List Creation: 02/22/24 01:34 PM

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	N/A	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	N/A	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Login Sample Receipt Checklist

Client: Vistra Energy Corp

Job Number: 500-246480-2
SDG Number: VER_000_RAD

Login Number: 246480
List Number: 3
Creator: Thornley, Richard W

List Source: Eurofins St. Louis
List Creation: 02/23/24 03:47 PM

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	N/A	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	N/A	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Tracer/Carrier Summary

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Method: 903.0 - Radium-226 (GFPC)

Matrix: Water **Prep Type: Total/NA**

Lab Sample ID	Client Sample ID	Percent Yield (Acceptance Limits) Ba (30-110)
500-246480-1	VER_002	102
500-246480-2	VER_003R	103
500-246480-3	VER_003R_FD	104
500-246480-4	VER_008R	94.4
500-246480-5	VER_010	95.7
500-246480-6	VER_020	88.3
500-246480-6 MS	VER_020	97.5
500-246480-6 MSD	VER_020	90.9
500-246480-7	VER_021	92.6
500-246480-8	VER_034	36.5
500-246480-9	VER_036	101
500-246480-10	VER_036_FD	101
500-246480-11	VER_037	74.6
500-246480-12	VER_038	86.5
500-246480-13	VER_040	103
500-246480-14	VER_040_FD	108
500-246480-15	VER_042	63.5
500-246480-15 MS	VER_042	104
500-246480-15 MSD	VER_042	58.4
500-246480-16	VER_043	80.5
500-246480-17	VER_043_FD	88.8
500-246480-18	VER_101&	84.8
500-246480-19	VER_103&	95.2
500-246480-21	VER_EB1	103
500-246480-22	VER_004	94.9
500-246480-23	VER_005	103
500-246480-24	VER_007R	101
500-246480-25	VER_016A	93.9
500-246480-26	VER_022	99.2
500-246480-27	VER_035&D	94.9
500-246480-28	VER_041	87.1
500-246480-29	VER_070#S	87.6
500-246480-30	VER_070&D	86.3
500-246480-32	VER_FB	108
500-246480-33	VER_EB2	103
500-246480-33 DU	VER_EB2	95.7
LCS 160-649386/2-A	Lab Control Sample	103
LCS 160-649393/2-A	Lab Control Sample	105
LCS 160-649787/2-A	Lab Control Sample	102
MB 160-649386/1-A	Method Blank	88.6
MB 160-649393/1-A	Method Blank	94.4
MB 160-649787/1-A	Method Blank	104

Tracer/Carrier Legend

Ba = Ba Carrier

Tracer/Carrier Summary

Client: Vistra Energy Corp
Project/Site: VER-24Q1

Job ID: 500-246480-2
SDG: VER_000_RAD

Method: 904.0 - Radium-228 (GFPC)

Matrix: Water

Prep Type: Total/NA

		Percent Yield (Acceptance Limits)	
		Ba	Y
Lab Sample ID	Client Sample ID	(30-110)	(30-110)
500-246480-1	VER_002	102	85.2
500-246480-2	VER_003R	103	84.5
500-246480-3	VER_003R_FD	104	84.9
500-246480-4	VER_008R	94.4	84.9
500-246480-5	VER_010	95.7	86.0
500-246480-6	VER_020	88.3	86.4
500-246480-6 MS	VER_020	97.5	84.1
500-246480-6 MSD	VER_020	90.9	85.2
500-246480-7	VER_021	92.6	78.5
500-246480-8	VER_034	36.5	81.1
500-246480-9	VER_036	101	84.5
500-246480-10	VER_036_FD	101	84.5
500-246480-11	VER_037	74.6	82.6
500-246480-12	VER_038	86.5	83.4
500-246480-13	VER_040	103	82.6
500-246480-14	VER_040_FD	108	80.4
500-246480-15	VER_042	63.5	80.0
500-246480-15 MS	VER_042	104	82.6
500-246480-15 MSD	VER_042	58.4	78.9
500-246480-16	VER_043	80.5	82.2
500-246480-17	VER_043_FD	88.8	76.6
500-246480-18	VER_101&	84.8	83.0
500-246480-19	VER_103&	95.2	82.2
500-246480-21	VER_EB1	103	81.5
500-246480-22	VER_004	94.9	76.3
500-246480-23	VER_005	103	80.0
500-246480-24	VER_007R	101	81.5
500-246480-25	VER_016A	93.9	73.6
500-246480-26	VER_022	99.2	78.9
500-246480-27	VER_035&D	94.9	78.9
500-246480-28	VER_041	87.1	77.0
500-246480-29	VER_070#S	87.6	77.8
500-246480-30	VER_070&D	86.3	78.1
500-246480-32	VER_FB	108	77.0
500-246480-33	VER_EB2	103	81.9
500-246480-33 DU	VER_EB2	95.7	73.6
LCS 160-649387/2-A	Lab Control Sample	105	90.5
LCS 160-649394/2-A	Lab Control Sample	105	81.9
LCS 160-649789/2-A	Lab Control Sample	102	78.9
MB 160-649387/1-A	Method Blank	88.6	85.6
MB 160-649394/1-A	Method Blank	94.4	83.7
MB 160-649789/1-A	Method Blank	104	81.5

Tracer/Carrier Legend

Ba = Ba Carrier
Y = Y Carrier

ATTACHMENT C
COMPARISON OF STATISTICAL RESULTS TO BACKGROUND
QUARTER 1, 2024

ATTACHMENT C.
COMPARISON OF STATISTICAL RESULTS TO BACKGROUND - QUARTER 1, 2024
845 QUARTERLY REPORT
VERMILION POWER PLANT
NEW EAST ASH POND
OAKWOOD, IL

Well ID	HSU	Event	Parameter	Units	Date Range	Sample Count	Percent ND	Statistical Calculation	Statistical Result	Background
16B	UU	E004	Antimony, total	mg/L	--	--	--	--	--	0.00500
16B	UU	E004	Arsenic, total	mg/L	--	--	--	--	--	0.001
16B	UU	E004	Barium, total	mg/L	--	--	--	--	--	0.0820
16B	UU	E004	Beryllium, total	mg/L	--	--	--	--	--	0.001
16B	UU	E004	Boron, total	mg/L	--	--	--	--	--	0.430
16B	UU	E004	Cadmium, total	mg/L	--	--	--	--	--	0.001
16B	UU	E004	Chloride, total	mg/L	--	--	--	--	--	20.4
16B	UU	E004	Chromium, total	mg/L	--	--	--	--	--	0.00400
16B	UU	E004	Cobalt, total	mg/L	--	--	--	--	--	0.0900
16B	UU	E004	Fluoride, total	mg/L	--	--	--	--	--	0.430
16B	UU	E004	Lead, total	mg/L	--	--	--	--	--	0.001
16B	UU	E004	Lithium, total	mg/L	--	--	--	--	--	0.0300
16B	UU	E004	Mercury, total	mg/L	--	--	--	--	--	0.0002
16B	UU	E004	Molybdenum, total	mg/L	--	--	--	--	--	0.00400
16B	UU	E004	pH (field)	SU	--	--	--	--	--	6.3/7.8
16B	UU	E004	Radium 226 + Radium 228, total	pCi/L	--	--	--	--	--	7.00
16B	UU	E004	Selenium, total	mg/L	--	--	--	--	--	0.001
16B	UU	E004	Sulfate, total	mg/L	--	--	--	--	--	338
16B	UU	E004	Thallium, total	mg/L	--	--	--	--	--	0.002
16B	UU	E004	Total Dissolved Solids	mg/L	--	--	--	--	--	1,080
16A	BCU	E004	Antimony, total	mg/L	04/01/21 - 02/21/24	11	91	CI around median	0.001	0.00500
16A	BCU	E004	Arsenic, total	mg/L	04/01/21 - 02/21/24	11	0	CI around geomean	0.00117	0.001
16A	BCU	E004	Barium, total	mg/L	04/01/21 - 02/21/24	11	0	CI around mean	0.25	0.0820
16A	BCU	E004	Beryllium, total	mg/L	04/01/21 - 02/21/24	11	100	All ND - Last	0.001	0.001
16A	BCU	E004	Boron, total	mg/L	04/01/21 - 02/21/24	11	0	CI around mean	0.674	0.430
16A	BCU	E004	Cadmium, total	mg/L	04/01/21 - 02/21/24	11	100	All ND - Last	0.0005	0.001
16A	BCU	E004	Chloride, total	mg/L	04/01/21 - 02/21/24	11	0	CI around mean	126	20.4

Well ID	HSU	Event	Parameter	Units	Date Range	Sample Count	Percent ND	Statistical Calculation	Statistical Result	Background
16A	BCU	E004	Chromium, total	mg/L	04/01/21 - 02/21/24	11	91	CB around T-S line	0.0015	0.00400
16A	BCU	E004	Cobalt, total	mg/L	04/01/21 - 02/21/24	11	91	CI around median	0.001	0.0900
16A	BCU	E004	Fluoride, total	mg/L	04/01/21 - 02/21/24	11	9	CI around mean	0.663	0.430
16A	BCU	E004	Lead, total	mg/L	04/01/21 - 02/21/24	11	91	CI around median	0.0005	0.001
16A	BCU	E004	Lithium, total	mg/L	04/01/21 - 02/21/24	11	0	CB around linear reg	0.0289	0.0300
16A	BCU	E004	Mercury, total	mg/L	04/01/21 - 02/21/24	11	100	All ND - Last	0.0002	0.0002
16A	BCU	E004	Molybdenum, total	mg/L	04/01/21 - 02/21/24	11	100	All ND - Last	0.005	0.00400
16A	BCU	E004	pH (field)	SU	04/01/21 - 02/21/24	16	0	CI around mean	7.2/7.5	6.3/7.8
16A	BCU	E004	Radium 226 + Radium 228, total	pCi/L	04/01/21 - 02/21/24	10	0	CI around mean	0.465	7.00
16A	BCU	E004	Selenium, total	mg/L	04/01/21 - 02/21/24	11	100	All ND - Last	0.0025	0.001
16A	BCU	E004	Sulfate, total	mg/L	04/01/21 - 02/21/24	16	5	CB around linear reg	-24	338
16A	BCU	E004	Thallium, total	mg/L	04/01/21 - 02/21/24	11	100	All ND - Last	0.002	0.002
16A	BCU	E004	Total Dissolved Solids	mg/L	04/01/21 - 02/21/24	16	0	CI around mean	646	1,080
35S	UU	E004	Antimony, total	mg/L	--	--	--	--	--	0.00500
35S	UU	E004	Arsenic, total	mg/L	--	--	--	--	--	0.001
35S	UU	E004	Barium, total	mg/L	--	--	--	--	--	0.0820
35S	UU	E004	Beryllium, total	mg/L	--	--	--	--	--	0.001
35S	UU	E004	Boron, total	mg/L	--	--	--	--	--	0.430
35S	UU	E004	Cadmium, total	mg/L	--	--	--	--	--	0.001
35S	UU	E004	Chloride, total	mg/L	--	--	--	--	--	20.4
35S	UU	E004	Chromium, total	mg/L	--	--	--	--	--	0.00400
35S	UU	E004	Cobalt, total	mg/L	--	--	--	--	--	0.0900
35S	UU	E004	Fluoride, total	mg/L	--	--	--	--	--	0.430
35S	UU	E004	Lead, total	mg/L	--	--	--	--	--	0.001
35S	UU	E004	Lithium, total	mg/L	--	--	--	--	--	0.0300
35S	UU	E004	Mercury, total	mg/L	--	--	--	--	--	0.0002
35S	UU	E004	Molybdenum, total	mg/L	--	--	--	--	--	0.00400

ATTACHMENT C.
COMPARISON OF STATISTICAL RESULTS TO BACKGROUND - QUARTER 1, 2024
845 QUARTERLY REPORT
VERMILION POWER PLANT
NEW EAST ASH POND
OAKWOOD, IL

Well ID	HSU	Event	Parameter	Units	Date Range	Sample Count	Percent ND	Statistical Calculation	Statistical Result	Background
35S	UU	E004	pH (field)	SU	--	--	--	--	--	6.3/7.8
35S	UU	E004	Radium 226 + Radium 228, total	pCi/L	--	--	--	--	--	7.00
35S	UU	E004	Selenium, total	mg/L	--	--	--	--	--	0.001
35S	UU	E004	Sulfate, total	mg/L	--	--	--	--	--	338
35S	UU	E004	Thallium, total	mg/L	--	--	--	--	--	0.002
35S	UU	E004	Total Dissolved Solids	mg/L	--	--	--	--	--	1,080
35D	BCU	E004	Antimony, total	mg/L	04/01/21 - 02/21/24	12	75	CI around median	0.001	0.00500
35D	BCU	E004	Arsenic, total	mg/L	04/01/21 - 02/21/24	12	17	CI around geomean	0.00164	0.001
35D	BCU	E004	Barium, total	mg/L	04/01/21 - 02/21/24	12	0	CI around median	0.026	0.0820
35D	BCU	E004	Beryllium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.001	0.001
35D	BCU	E004	Boron, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	1.64	0.430
35D	BCU	E004	Cadmium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.0005	0.001
35D	BCU	E004	Chloride, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	302	20.4
35D	BCU	E004	Chromium, total	mg/L	04/01/21 - 02/21/24	12	75	CI around median	0.0015	0.00400
35D	BCU	E004	Cobalt, total	mg/L	04/01/21 - 02/21/24	12	42	CI around median	0.001	0.0900
35D	BCU	E004	Fluoride, total	mg/L	04/01/21 - 02/21/24	12	8	CI around mean	0.642	0.430
35D	BCU	E004	Lead, total	mg/L	04/01/21 - 02/21/24	12	50	CI around geomean	0.000579	0.001
35D	BCU	E004	Lithium, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	0.112	0.0300
35D	BCU	E004	Mercury, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.0002	0.0002
35D	BCU	E004	Molybdenum, total	mg/L	04/01/21 - 02/21/24	12	25	CB around linear reg	-0.00104	0.00400
35D	BCU	E004	pH (field)	SU	04/01/21 - 02/21/24	16	0	CI around median	7.3/7.4	6.3/7.8
35D	BCU	E004	Radium 226 + Radium 228, total	pCi/L	04/01/21 - 02/21/24	11	0	CI around mean	0.333	7.00
35D	BCU	E004	Selenium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.0025	0.001
35D	BCU	E004	Sulfate, total	mg/L	04/01/21 - 02/21/24	17	0	CI around mean	1,100	338
35D	BCU	E004	Thallium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.002	0.002
35D	BCU	E004	Total Dissolved Solids	mg/L	04/01/21 - 02/21/24	17	0	CI around mean	2,710	1,080
70S	UU	E004	Antimony, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.003	0.00500

ATTACHMENT C.
COMPARISON OF STATISTICAL RESULTS TO BACKGROUND - QUARTER 1, 2024
845 QUARTERLY REPORT
VERMILION POWER PLANT
NEW EAST ASH POND
OAKWOOD, IL

Well ID	HSU	Event	Parameter	Units	Date Range	Sample Count	Percent ND	Statistical Calculation	Statistical Result	Background
70S	UU	E004	Arsenic, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.001	0.001
70S	UU	E004	Barium, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	0.0166	0.0820
70S	UU	E004	Beryllium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.001	0.001
70S	UU	E004	Boron, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	0.366	0.430
70S	UU	E004	Cadmium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.0005	0.001
70S	UU	E004	Chloride, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	13.2	20.4
70S	UU	E004	Chromium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.005	0.00400
70S	UU	E004	Cobalt, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.001	0.0900
70S	UU	E004	Fluoride, total	mg/L	04/01/21 - 02/21/24	12	8	CI around median	0.14	0.430
70S	UU	E004	Lead, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.0005	0.001
70S	UU	E004	Lithium, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	0.0112	0.0300
70S	UU	E004	Mercury, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.0002	0.0002
70S	UU	E004	Molybdenum, total	mg/L	04/01/21 - 02/21/24	12	25	CI around median	0.005	0.00400
70S	UU	E004	pH (field)	SU	04/01/21 - 02/21/24	12	0	CI around mean	6.9/7.0	6.3/7.8
70S	UU	E004	Radium 226 + Radium 228, total	pCi/L	04/01/21 - 02/21/24	11	0	CI around geomean	0.0972	7.00
70S	UU	E004	Selenium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.0025	0.001
70S	UU	E004	Sulfate, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	605	338
70S	UU	E004	Thallium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.002	0.002
70S	UU	E004	Total Dissolved Solids	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	1,230	1,080
70D	BCU	E004	Antimony, total	mg/L	04/01/21 - 02/21/24	12	83	CI around median	0.001	0.00500
70D	BCU	E004	Arsenic, total	mg/L	04/01/21 - 02/21/24	12	58	CI around median	0.001	0.001
70D	BCU	E004	Barium, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	0.461	0.0820
70D	BCU	E004	Beryllium, total	mg/L	04/01/21 - 02/21/24	12	75	CI around median	0.001	0.001
70D	BCU	E004	Boron, total	mg/L	04/01/21 - 02/21/24	12	0	CI around median	1.01	0.430
70D	BCU	E004	Cadmium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.0005	0.001
70D	BCU	E004	Chloride, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	525	20.4
70D	BCU	E004	Chromium, total	mg/L	04/01/21 - 02/21/24	12	33	CI around geomean	0.00292	0.00400

Well ID	HSU	Event	Parameter	Units	Date Range	Sample Count	Percent ND	Statistical Calculation	Statistical Result	Background
70D	BCU	E004	Cobalt, total	mg/L	04/01/21 - 02/21/24	12	8	CI around geomean	0.00161	0.0900
70D	BCU	E004	Fluoride, total	mg/L	04/01/21 - 02/21/24	12	8	CB around linear reg	0.234	0.430
70D	BCU	E004	Lead, total	mg/L	04/01/21 - 02/21/24	12	17	CI around geomean	0.00137	0.001
70D	BCU	E004	Lithium, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	0.0761	0.0300
70D	BCU	E004	Mercury, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.0002	0.0002
70D	BCU	E004	Molybdenum, total	mg/L	04/01/21 - 02/21/24	12	33	CB around linear reg	-0.0201	0.00400
70D	BCU	E004	pH (field)	SU	04/01/21 - 02/21/24	12	0	CI around mean	6.9/7.2	6.3/7.8
70D	BCU	E004	Radium 226 + Radium 228, total	pCi/L	04/01/21 - 02/21/24	11	0	CI around mean	0.993	7.00
70D	BCU	E004	Selenium, total	mg/L	04/01/21 - 02/21/24	12	83	CI around median	0.001	0.001
70D	BCU	E004	Sulfate, total	mg/L	04/01/21 - 02/21/24	12	0	CI around mean	46.5	338
70D	BCU	E004	Thallium, total	mg/L	04/01/21 - 02/21/24	12	100	All ND - Last	0.002	0.002
70D	BCU	E004	Total Dissolved Solids	mg/L	04/01/21 - 02/21/24	12	0	CB around linear reg	1,270	1,080
71S	UU	E004	Antimony, total	mg/L	--	--	--	--	--	0.00500
71S	UU	E004	Arsenic, total	mg/L	--	--	--	--	--	0.001
71S	UU	E004	Barium, total	mg/L	--	--	--	--	--	0.0820
71S	UU	E004	Beryllium, total	mg/L	--	--	--	--	--	0.001
71S	UU	E004	Boron, total	mg/L	--	--	--	--	--	0.430
71S	UU	E004	Cadmium, total	mg/L	--	--	--	--	--	0.001
71S	UU	E004	Chloride, total	mg/L	--	--	--	--	--	20.4
71S	UU	E004	Chromium, total	mg/L	--	--	--	--	--	0.00400
71S	UU	E004	Cobalt, total	mg/L	--	--	--	--	--	0.0900
71S	UU	E004	Fluoride, total	mg/L	--	--	--	--	--	0.430
71S	UU	E004	Lead, total	mg/L	--	--	--	--	--	0.001
71S	UU	E004	Lithium, total	mg/L	--	--	--	--	--	0.0300
71S	UU	E004	Mercury, total	mg/L	--	--	--	--	--	0.0002
71S	UU	E004	Molybdenum, total	mg/L	--	--	--	--	--	0.00400
71S	UU	E004	pH (field)	SU	--	--	--	--	--	6.3/7.8

Well ID	HSU	Event	Parameter	Units	Date Range	Sample Count	Percent ND	Statistical Calculation	Statistical Result	Background
71S	UU	E004	Radium 226 + Radium 228, total	pCi/L	--	--	--	--	--	7.00
71S	UU	E004	Selenium, total	mg/L	--	--	--	--	--	0.001
71S	UU	E004	Sulfate, total	mg/L	--	--	--	--	--	338
71S	UU	E004	Thallium, total	mg/L	--	--	--	--	--	0.002
71S	UU	E004	Total Dissolved Solids	mg/L	--	--	--	--	--	1,080
71D	BCU	E004	Antimony, total	mg/L	--	--	--	--	--	0.00500
71D	BCU	E004	Arsenic, total	mg/L	--	--	--	--	--	0.001
71D	BCU	E004	Barium, total	mg/L	--	--	--	--	--	0.0820
71D	BCU	E004	Beryllium, total	mg/L	--	--	--	--	--	0.001
71D	BCU	E004	Boron, total	mg/L	--	--	--	--	--	0.430
71D	BCU	E004	Cadmium, total	mg/L	--	--	--	--	--	0.001
71D	BCU	E004	Chloride, total	mg/L	--	--	--	--	--	20.4
71D	BCU	E004	Chromium, total	mg/L	--	--	--	--	--	0.00400
71D	BCU	E004	Cobalt, total	mg/L	--	--	--	--	--	0.0900
71D	BCU	E004	Fluoride, total	mg/L	--	--	--	--	--	0.430
71D	BCU	E004	Lead, total	mg/L	--	--	--	--	--	0.001
71D	BCU	E004	Lithium, total	mg/L	--	--	--	--	--	0.0300
71D	BCU	E004	Mercury, total	mg/L	--	--	--	--	--	0.0002
71D	BCU	E004	Molybdenum, total	mg/L	--	--	--	--	--	0.00400
71D	BCU	E004	pH (field)	SU	--	--	--	--	--	6.3/7.8
71D	BCU	E004	Radium 226 + Radium 228, total	pCi/L	--	--	--	--	--	7.00
71D	BCU	E004	Selenium, total	mg/L	--	--	--	--	--	0.001
71D	BCU	E004	Sulfate, total	mg/L	--	--	--	--	--	338
71D	BCU	E004	Thallium, total	mg/L	--	--	--	--	--	0.002
71D	BCU	E004	Total Dissolved Solids	mg/L	--	--	--	--	--	1,080

ATTACHMENT C.
COMPARISON OF STATISTICAL RESULTS TO BACKGROUND - QUARTER 1, 2024
845 QUARTERLY REPORT
VERMILION POWER PLANT
NEW EAST ASH POND
OAKWOOD, IL

Notes:
– = no data available
Lower Confidence Limit (LCL) or Upper Confidence Limit (UCL) exceeded the statistical background value
HSU = hydrostratigraphic unit:

- BCU = Bedrock Confining Unit
- UU = Upper Unit

mg/L = milligrams per liter
ND = non-detect
pCi/L = picocuries per liter
SU = standard units
Sample Count = number of samples from Sampled Date Range used to calculate the Statistical Result
Statistical Calculation = method used to calculate the statistical result:

- All ND - Last = All results were below the reporting limit, and the last determined reporting limit is shown
- CB around T-S line = Confidence band around Thiel-Sen line
- CB around linear reg = Confidence band around linear regression
- CI around geomean = Confidence interval around the geometric mean
- CI around mean = Confidence interval around the mean
- CI around median = Confidence interval around the median

Statistical Result = calculated in accordance with the Statistical Analysis Plan using constituent concentrations observed at each monitoring well during all sampling events within the specified date range
For pH, the values presented are the lower / upper limits of the background determination