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November 25, 2020

Sent electronically via File Transfer

Mr. Andrew Wheeler
Administrator, US EPA
1200 Pennsylvania Avenue, N.W.
Mail Code: 5304-P
Washington, D.C. 20460

Subject: Request for Site-Specific Alternative Deadline to Initiate Closure of CCR Surface Impoundment
Development of Alternative Capacity is Technically Infeasible Demonstration
SIGECO A.B. Brown Generating Station, Mount Vernon, Posey County, Indiana

Dear Mr. Wheeler:

Southern Indiana Gas and Electric Company, Inc. (SIGECO) hereby submits this request for an extension to the "cease receipt" deadline for the A.B. Brown Generating Station (A.B. Brown) Ash Pond pursuant to the *Development of Alternative Capacity is Technically Infeasible* criteria under 40 CFR § 257.103(f)(1).

The attached report has been prepared in accordance with the requirements of 40 CFR 257.103(f)(1) to demonstrate that obtaining alternative capacity for the CCR and non-CCR flows at the SIGECO A.B. Brown Ash Pond is infeasible before the April 11, 2021 "cease receipt" deadline provided in 40 CFR § 257.101(a)(1). Accordingly, SIGECO is respectfully requesting an extension of the "cease receipt" deadline to October 15, 2023 for the Ash Pond. The basis for this request is detailed in the attached document. To aid in your verification of completeness, a regulatory checklist summarizing where each regulatory requirement has been included in the report, immediately following the Table of Contents.

We trust this provides the information you need to process this application. As allowed and preferred by the agency, in lieu of hard copies of the demonstration packet, the submittal format is via email with a file transfer link to Kirsten Hillyer, Frank Behan, and Richard Huggins. Should you need additional information on this submittal, please don't hesitate to contact me at 812-491-4787 or Angela.Casbon-Scheller@centerpointenergy.com.

Sincerely,

Angela Casbon-Scheller
Manager, Environmental Operations
Power Generation

cc: Kirsten Hillyer (Hillyer.Kirsten@epa.gov)
Frank Behan (Behan.Frank@epa.gov)
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AECOM Imagine it. Delivered.

Submitted to
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November 25, 2020

Request for Site-Specific Alternative Deadline to Initiate Closure of CCR Surface Impoundment

Development of Alternative Capacity is Technically Infeasible Demonstration (40 CFR § 257.103(f)(1)) for the Ash Pond at the A.B. Brown Generating Station

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Regulatory Checklist

Regulatory Reference	Description of Requirement	Report Section
257.103 (f)(1)(iv)(A)(1)	*A written narrative discussing the options considered both on and off-site to obtain alternative capacity for each CCR and/or non-CCR wastestreams, the technical infeasibility of obtaining alternative capacity prior to April 11, 2021, and the option selected and justification for the alternative capacity selected. The narrative must also include all of the following:*	**5.0**
257.103 (f)(1)(iv)(A)(1)(i)	*An in-depth analysis of the site and any site-specific conditions that led to the decision to select the alternative capacity being developed;*	**5.1.3**
257.103 (f)(1)(iv)(A)(1)(ii)	*An analysis of the adverse impact to plant operations if the CCR surface impoundment in question were to no longer be available for use; and*	**5.1.4**
257.103 (f)(1)(iv)(A)(1)(iii)	*A detailed explanation and justification for the amount of time being requested and how it is the fastest technically feasible time to complete the development of the alternative capacity;*	**5.1.5**
257.103 (f)(1)(iv)(A)(2)	*A detailed schedule of the fastest technically feasible time to complete the measures necessary for alternative capacity to be available including a visual timeline representation. The visual timeline must clearly show all of the following:*	**5.2**
257.103 (f)(1)(iv)(A)(2)(i)	*How each phase and the steps within that phase interact with or are dependent on each other and the other phases;*	**5.2**
257.103 (f)(1)(iv)(A)(2)(ii)	*All of the steps and phases that can be completed concurrently;*	**5.2**
257.103 (f)(1)(iv)(A)(2)(iii)	*The total time needed to obtain the alternative capacity and how long each phase and step within each phase will take; and*	**5.2**
257.103 (f)(1)(iv)(A)(2)(iv)	*At a minimum, the following phases: Engineering and design, contractor selection, equipment fabrication and delivery, construction, and start up and implementation.;*	**5.2**
257.103 (f)(1)(iv)(A)(3)	*A narrative discussion of the schedule and visual timeline representation, which must discuss all of the following:*	**5.2**
257.103 (f)(1)(iv)(A)(3)(i)	*Why the length of time for each phase and step is needed and a discussion of the tasks that occur during the specific step;*	**5.2**
257.103 (f)(1)(iv)(A)(3)(ii)	*Why each phase and step shown on the chart must happen in the order it is occurring;*	**5.2**
257.103 (f)(1)(iv)(A)(3)(iii)	*The tasks that occur during each of the steps within the phase; and*	**5.2.2**
257.103 (f)(1)(iv)(A)(3)(iv)	*Anticipated worker schedules*	**5.2.3**
257.103 (f)(1)(iv)(A)(4)	*A narrative discussion of the progress the owner or operator has made to obtain alternative capacity for the CCR and/or non-CCR wastestreams. The narrative must discuss all the steps taken, starting from when the owner or operator initiated the design phase up to the steps occurring when the demonstration is being compiled. It must discuss where the facility currently is on the timeline and the efforts that are currently being undertaken to develop alternative capacity.*	**5.3**
257.103 (f)(1)(iv)(B)	*To demonstrate that the criteria in paragraph (f)(1)(iii) of this section have been met, the owner or operator must submit all of the following:*	**6.0**

Regulatory Reference	Description of Requirement	Report Section
257.103 (f)(1)(iv)(B)(1)	*A certification signed by the owner or operator that the facility is in compliance with all of the requirements of this subpart;*	**6.1**
257.103 (f)(1)(iv)(B)(2)	*Visual representation of hydrogeologic information at and around the CCR unit(s) that supports the design, construction and installation of the groundwater monitoring system. This includes all of the following:*	**6.2**
257.103 (f)(1)(iv)(B)(2)(i)	*Map(s) of groundwater monitoring well locations in relation to the CCR unit(s);*	**6.2.1**
257.103 (f)(1)(iv)(B)(2)(ii)	*Well construction diagrams and drilling logs for all groundwater monitoring wells; and*	**6.2.2**
257.103 (f)(1)(iv)(B)(2)(iii)	*Maps that characterize the direction of groundwater flow accounting for seasonal variations;*	**6.2.3**
257.103 (f)(1)(iv)(B)(3)	*Constituent concentrations, summarized in table form, at each groundwater monitoring well monitored during each sampling event;*	**6.3**
257.103 (f)(1)(iv)(B)(4)	*A description of site hydrogeology including stratigraphic cross-sections;*	**6.4**
257.103 (f)(1)(iv)(B)(5)	*Any corrective measures assessment conducted as required at 257.96*	**6.5**
257.103 (f)(1)(iv)(B)(6)	*Any progress reports on corrective action remedy selection and design and the report of final remedy at selection required a 257.97 (a)*	**6.6**
257.103 (f)(1)(iv)(B)(7)	*The most recent structural stability assessment required at 257.73 (d)*	**6.7**
257.103 (f)(1)(iv)(B)(8)	*The most recent safety factor assessment required at 257.73 (e)*	**6.8**

Acronyms

A.B. Brown	A.B. Brown Generating Station
Acre-ft	Acre-feet
ARO	After receipt of order
CCGT	Combined Cycle Gas Turbine
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
CPCN	Certificate of Public Convenience and Necessity
CT	Combustion Turbine
EPA	United States Environmental Protection Agency
FGD	Flue Gas Desulfurization
GAs	General Arrangements
GPM	Gallons per Minute
GWPS	Groundwater Protection Standards
H:V	Horizontal: Vertical
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
IFC	Issue for Construction
IRP	Integrated Resource Plan
IURC	Indiana Utility Regulatory Commission
MCC	Motor Control Centers
MGD	Million Gallons per Day
MM	Million
MSL	Mean Sea Level
MW	Megawatt
NPDES	National Pollutant Discharge Elimination System
PD	Pressure discharge
PDC	Power Distribution Centers
P&IDs	Piping and Instrument Diagrams
PLCs	Programmable Logic Controllers
POTW	Publicly Owned Treatment Works
RFP	Request for Proposal
SCC	Submerged Chain Conveyor

SIGECO	Southern Indiana Gas and Electric Company
SSLs	Statistically Significant Levels
TSS	Total Suspended Solids
USWAG	Utility Solid Waste Activities Group
Westside WWTP	Westside Wastewater Treatment Plant
WWTF	Wastewater Treatment Facility
ZLD	Zero-Liquid discharge

Executive Summary

Southern Indiana Gas and Electric Company (SIGECO) owns and operates the A.B. Brown Generating Station (A.B. Brown) surface impoundment (Ash Pond). The Ash Pond is a currently operating surface impoundment that is planning for closure in accordance with the requirements of the United States Environmental Protection Agency's (EPA) Final Coal Combustion Residuals (CCR) Rule (40 Code of Federal Regulations (CFR) 257, Subpart D or Federal CCR Rule). The Ash Pond will be closed by removal, with the majority of CCR materials being recycled for beneficial use within the cement kiln industry[1] (a portion of material will not conform to cement kiln specifications and will be subject to disposal in an onsite landfill). The CCR Rule (following the Part A updates) requires SIGECO to cease placing CCR and non-CCR wastestreams into the Ash Pond as soon as technically feasible, but no later than April 11, 2021 or seek appropriate extensions under 40 CFR § 257.103 to continue operating. As described in this document, SIGECO is requesting an extension of the April 11, 2021 "cease flow" deadline for operation of the Ash Pond until October 15, 2023 due to it being technically infeasible to eliminate all flows to the Ash Pond prior to this date. As discussed herein, alternative capacity is actively being pursued for those CCR and non-CCR flows for which it is technically feasible to redirect the flows to alternative capacity.

SIGECO is subject to a regulatory process required under rules promulgated by the Indiana Utility Regulatory Commission (IURC), called Integrated Resource Planning, which requires periodic evaluation and definition of its future generation portfolio, including the continued operation of the A.B. Brown coal-fired units. This process involved significant planning and evaluation, including a series of public stakeholder meetings held in 2019 and 2020 culminating in the most recent (June 2020) update of SIGECO's Integrated Resource Plan (IRP). The most recent IRP concluded with a preferred portfolio that retires coal-generation assets (Unit 1 and 2) at A.B. Brown, and replaces the A.B. Brown units with a mix of renewable energy sources and two new simple-cycle gas turbines that are planned for construction at the A.B. Brown site. Throughout this regulatory planning process, SIGECO has been actively working on identifying alternative capacity for management of its CCR and non-CCR wastestreams. However, SIGECO's plan to retire coal-generation assets at A.B. Brown has affected this strategy. Nevertheless, plans have been adjusted to match the current scenario and a preferred alternative for future flow management of certain CCR and non-CCR flows has been selected and is being actively pursued.

For continued operation of the Ash Pond beyond April 11, 2021, two extension mechanisms are available under the final Part A: (1) *Development of Alternative Capacity is Technically Infeasible* (40 CFR § 257.103(f)(1)) or (2) *Permanent Cessation of a Coal-Fired Boiler(s) by a Date Certain* (40 CFR § 257.103(f)(2)). SIGECO has prepared this document to demonstrate that obtaining alternative capacity for the CCR and non-CCR flows managed by the A.B. Brown Ash Pond is infeasible before the April 11, 2021 deadline. This extension mechanism has been selected in lieu of the "*boiler cessation*" alternative due to the regulatory criteria within the "*boiler cessation*" alternative that requires that closure also be completed by October 17, 2028 (for units greater than 40 acres). This closure completion date is not technically feasible due to the closure method selected (closure by removal for beneficial use[2]), current contractual obligations, and production limitations by the end user. For this reason, the "*Development of Alternative Capacity is Technically Infeasible*" extension mechanism has been selected.

As discussed in this document, eight flow management alternatives were identified and evaluated based on feasibility and schedule. Following evaluation of these alternatives in consideration of the decision to retire the coal-fired boilers at A.B. Brown, SIGECO has decided to construct a new lined CCR Pond for alternative capacity to allow the cessation of certain non-CCR and CCR flows to the Ash Pond (remaining CCR flows to the Ash Pond

[1] It should be noted that the majority of fly ash generated by SIGECO's coal-fired generating facilities has been recycled for beneficial reuse within the cement kiln industry, dating back to 2010.

[2] Capital investments necessary to complete the beneficial reuse and closure project were approved by the IURC on May 13, 2020. Moreover, as necessitated by the beneficial reuse pond closure project, current loading of dry fly ash generated at the Brown units will be handled by a new loading silo being constructed in an adjacent county.

will cease on or before October 15, 2023 with accepted early plant retirement as described in the June 2020 IRP report). Conceptual engineering and design of the new pond (and associated flow redirection) has been initiated, and the project schedule for completion is expected to be 31 months from December 2020. Based on the considerations provided within this report, SIGECO is eliminating certain CCR and non-CCR flows to the Ash Pond on or before July 1, 2023 and is requesting approval of extension of Ash Pond operations for only certain identified remaining flows until October 15, 2023 to allow for use of the Ash Pond during the remaining life of the coal-fired boilers. It should be noted that the SIGECO coal-fired units at Brown are slated for retirement. But for the time constraints imposed by the excavation and beneficial reuse of up to 6 million tons of ponded ash, SIGECO would qualify for the boiler cessation extension up to October 2028.

2 Demonstration Purpose and Objectives

This document has been prepared in accordance with the requirements 40 CFR § 257.103(f)(1) to demonstrate that obtaining alternative capacity for the CCR and non-CCR flows at the SIGECO A.B. Brown Ash Pond is infeasible before the April 11, 2021 “cease receipt” deadline provided in 40 CFR § 257.101(a)(1). Accordingly, SIGECO is respectfully requesting an extension to the deadline for Ash Pond operations pursuant to the *Development of Alternative Capacity is Technically Infeasible* criteria under 40 CFR § 257.103(f)(1). This document provides the requested information to support this demonstration.

3 Organization of the Demonstration

For ease of review and verification of completeness, this demonstration has been structured consistent with the specific requirements and criteria under 40 CFR § 257.103(f)(1)(iv). The document structure and contents of each section are as follows:

Section 1 – Executive Summary – The section provides an overview of the document.

Section 2 - Demonstration Purpose and Objectives – The section provides a brief discussion of the document purpose.

Section 3 – Organization of the Demonstration – This section provides a discussion of the document outline and organization, indicating where the various regulatory criteria are addressed.

Section 4 – Facility and CCR Unit Background and Description – This section provides background information associated with the generating station, its current operating scenario, and the CCR unit.

Section 5 – Work Plan for Alternative Capacity – This section addresses the requirements for a work plan described in 40 CFR § 257.103(f)(1)(iv)(A), and includes the following key subsections:

Section 5.1 – Evaluation of On-site and Off-site Options for Alternative Capacity – This section provides a detailed Work Plan for obtaining Alternative Capacity consisting of a narrative discussion of options considered, technical infeasibility demonstrations, and a justification of the option selected (40 CFR § 257.103(f)(1)(iv)(A)(1)).

Section 5.2 – Detailed Schedule and Narrative Discussion – This section provides a detailed schedule of the fastest technically feasible time to complete the measures necessary and a narrative discussion describing the schedule and timeline considerations (40 CFR § 257.103(f)(1)(iv)(A)(2 and 3)).

Section 5.3 – Progress Toward Alternative Capacity - This provides a narrative discussion of the progress made to obtain alternative capacity thus far (40 CFR § 257.103(f)(1)(iv)(A)(4)).

Section 6 – Compliance Certification and Additional Information – This section provides a signed certification that the facility is operating in compliance with this subpart and a narrative summary of the requested hydrogeologic and other information (40 CFR § 257.103(f)(1)(iv)(B)).

The recent “A Holistic Approach to Closure Part A: Deadline to Initiate Closure” (Part A) revision to the Federal CCR Rule requires that demonstrations be submitted to EPA for approval no later than November 30, 2020. Following the submission of this demonstration, SIGECO will place a Notice of Intent to apply for a site-specific alternative to initiation of closure due to development of alternative capacity infeasible, along with a copy of the demonstration, into its operating record and onto the company’s CCR Compliance website (https://www.vectren.com/reporting/ccr) as required by 40 CFR 257.105(i)(14) and 40 CFR 257.106(i)(14), respectively.

4 Facility and CCR Unit Background and Description

A discussion of the facility, operational scenario, and CCR unit background is provided in the following sections.

4.1 Facility Description and Future Operations

SIGECO owns and operates the A.B. Brown Generating Station located at 8511 Welborn Road near Evansville, Indiana (see attached **Figure 1**). The coal-fired power plant is located approximately 10 miles east of Mount Vernon in Posey County, Indiana. SIGECO currently operates two coal burning units (245 megawatt (MW) each) at A.B. Brown. The units were placed in service in 1979 (Unit 1) and 1986 (Unit 2). Over the past several years, significant consideration and evaluation has been given to the future of coal-fired generation at A.B. Brown and SIGECO's forward-looking generation portfolio. This process was initiated after an application for a Certificate of Public Convenience and Necessity (CPCN) was denied by the Indiana Utility Regulatory Commission (IURC) and based on feedback received from the IURC in which the IURC approved SIGECO's CCR and ELG compliance projects at Culley but disapproved the plans for the A.B. Brown units. Specifically, the IURC requested that SIGECO go back and model additional compliance pathways at A.B. Brown, including retrofitting new scrubbers and repowering options. A copy of the order (Cause No. 45052) is provided in **Appendix A**. To this end, SIGECO has been involved in a regulatory process involving an update of the IRP, which was recently finalized in June 2020 after an effort of significant modelling and a series of public stakeholder meetings. With evaluation of options and input from stakeholder groups culminating in the June 2020 update of the IRP, it is SIGECO's intention to pursue retirement of the coal-fired generation assets at A.B. Brown by December 31, 2023. As discussed in the June 2020 IRP report, this generating capacity is expected to be replaced with a mix of generation sources including two new simple-cycle Combustion Turbine (CT) gas units, new solar generation, and wind generation.

The process to reach this critical decision (as documented in the IRP and discussed in this demonstration) has taken considerable effort over the last several years, making this demonstration somewhat unique as compared to the considerations for other facilities as many of the future plant water management decisions have been connected to outcomes and resolutions regarding future generation and water balance planning at A.B. Brown. As such, this process and the corresponding technical considerations and schedule interactions have been referenced and discussed throughout this demonstration, as appropriate.

4.2 CCR Unit Description

A.B. Brown operates an unlined CCR surface impoundment which is referred to as the Ash Pond (see attached **Figure 2**). The Ash Pond was commissioned in 1978 and currently receives and manages bottom ash and fly ash transport water flows, scrubber and truck bay wash waters from the flue gas desulphurization (FGD) system, as well as non-CCR flows including the Capital Pond discharge, treated sanitary wastewater, plant floor drains, coal pile runoff and stormwater. Under normal operations, solids are settled within the unit and treated water is returned to the plant for use in the process. A portion of the discharge, when discharge is necessary for purposes of maintaining the pond operating level, is also treated through a second-stage wastewater mercury treatment system, then through a lined settling pond, and ultimately discharged through NPDES-permitted Outfall 001. Under high rainfall scenarios occurring on an infrequent basis, treated emergency overflow water is discharged through NPDES-permitted Outfall 004. It is worth noting that as a result of active water management and weather forecast monitoring, discharge through Outfall 004 has not occurred since February 2018.

The Ash Pond comprises a surface area of approximately 164 acres and is considered a "valley fill" unit as an earthen dam was originally constructed to form the unit. In 2003, a second dam, referred to as the "upper dam," was constructed east of the original dam and further up the valley to increase storage capacity. This temporarily

created an upper pond and lower pond. The upper and lower ponds were operated separately until 2016 when the upper dam was decommissioned. An approximately 10-foot wide breach was installed in the upper dam and the normal pool elevation was lowered. Currently, the upper pool and the lower pool hydraulically act as one unit. The Ash Pond is estimated to contain approximately 5.9 million cubic yards of CCR materials.

Following promulgation of the Federal CCR Rule, SIGECO began working with consultants (AECOM and Haley & Aldrich) to evaluate the Ash Pond's compliance with the new Federal CCR Rule requirements. Following construction of an earthen buttress in 2016, the Ash Pond was certified to be compliant with Federal CCR Rule stability and safety factor criteria. The Ash Pond is also compliant with the wetlands, fault area, seismic impact zone, and unstable area location restrictions. However, the Ash Pond did not achieve the uppermost aquifer separation criteria. In addition, groundwater monitoring results associated with the Ash Pond indicate statistically significant levels (SSLs) of molybdenum and lithium above Groundwater Protection Standards (GWPS). Given that the unit is unlined, the Ash Pond is required to cease CCR and non-CCR flows by April 11, 2021 (under the provisions of the recently effective Part A) and either initiate closure or seek appropriate extensions for continued short-term operation.

Following extensive planning, analysis of alternatives and efforts to determine and finalize arrangements for beneficial use of the ponded CCR material, the decision has been made to close the Ash Pond by removal and recycle the majority of the CCR in a cement kiln (a portion of material will not achieve cement kiln specification and will require disposal). It should be noted that the majority of fly ash generated by SIGECO's coal-fired generating facilities (approximately 70 percent) has been recycled for beneficial reuse within the cement kiln industry, dating back to 2010. This closure process will involve excavation and beneficial reuse of the majority of CCR materials from the Ash Pond and has received agency and public support due to its environmental benefit. Planning, engineering, and construction are currently underway to implement this project, with excavation activities planning to commence in the upper portions of the Ash Pond in 2021. Capital investments necessary to complete the beneficial reuse and closure project were approved by the IURC on May 13, 2020 (Cause No. 45280, provided in **Appendix B**). Moreover, as necessitated by the beneficial reuse pond closure project, current loading of dry fly ash generated at the A.B. Brown units will be handled by a new loading silo being constructed in an adjacent county. However, in order to continue to manage CCR and non-CCR flows until coal-fired boiler retirement, the lower portions of the Ash Pond will need to continue to operate and manage a portion of overall flows until October 2023 because no alternative capacity exists, either on-site or off-site, and it is infeasible to obtain alternative capacity prior to October 2023. As discussed in this demonstration, CCR and non-CCR flows that can be feasibly eliminated from the Ash Pond will be managed in a new Federal CCR Rule-compliant surface impoundment. Other flows will continue to the Ash Pond unit until the planned plant retirement in October 2023 in accordance with the Part A provisions discussed below. At this time of coal-fired boiler retirement, the remaining flows to the pond will cease and the Ash Pond will formally initiate the closure process under the Federal CCR Rule.

4.3 Extension Mechanism Selection

As indicated above, SIGECO will seek alternative capacity where technically feasible and will eliminate these associated flows on the fastest feasible timeline as discussed in this demonstration. SIGECO intends to operate the Ash Pond with the remaining reduced flows until October 15, 2023 (planned coal-fired boiler retirement as stated in the June 2020 IRP report) for continued management of these flows because no alternative capacity currently exists (either on or off-site) and it is infeasible to obtain alternative capacity prior to the April 11, 2021 "cease flow" deadline and the accepted October 2023 plant retirement. For continued operation of the Ash Pond beyond April 11, 2021, two extension mechanisms are available under the final Part A: (1) *Development of Alternative Capacity is Technically Infeasible* (40 CFR § 257.103(f)(1)) or (2) *Permanent Cessation of a Coal-Fired Boiler(s) by a Date Certain* (40 CFR § 257.103(f)(2)). Key considerations for each of these provisions and the basis for extension selection are outlined below.

1) *Development of Alternative Capacity is Technically Infeasible*: Under this provision, Owner/Operators are required to demonstrate to EPA that no alternative capacity currently exists (either on or off-site) and that obtaining alternative capacity prior to April 11, 2021 is infeasible. Therefore, additional time is needed to secure this alternative capacity. In summary, the demonstration must provide information and technical

justification that no alternative capacity exists on-site or off-site, must provide a detailed workplan and schedule that includes technical and narrative discussions of how A.B. Brown will obtain alternative capacity as soon as technically feasible. Following public comment and EPA approval, this provision may allow for an operational extension up to October 15th, 2023 (for non-eligible unlined CCR surface impoundments) or October 15th, 2024 (for eligible unlined CCR surface impoundments). Under the provisions of Part A, the A.B. Brown Ash Pond is a non-eligible unlined CCR surface impoundment.

2) *Permanent Cessation of a Coal-Fired Boiler(s) by a Date Certain*: Under this provision, a CCR unit may continue to receive flows in the event it also commits to coal-fired boiler retirement. As discussed in Part A, the facility must commit to coal-fired boiler retirement and cease flows/complete CCR unit closure by October 17th, 2028 (for units over 40 acres). While in typical cases this would be the default demonstration mechanism for the scenario at the A.B. Brown Generating Station, this extension mechanism is not a viable and technically feasible option in this scenario due to the closure method decision, contractual and regulatory (IURC) commitments, and timetables required to complete closure. As mentioned previously, closure of the Ash Pond will be performed by excavation of the contents and recycling of the majority of the CCR material within a cement kiln. This recycling process is limited by the production needs and feedstock consumption rates of the end-user. Based on these production constraints by the end user, it is estimated to take approximately 12 years to complete closure of the Ash Pond. SIGECO has commenced construction activities and capital investment necessary to beneficially reuse the ponded material. However, because the Ash Pond recycling and closure activities cannot be completed by October 17, 2028, the unit is not eligible for the *Permanent Cessation of a Coal-Fired Boiler by a Date Certain* extension under 40 CFR § 257.103(f)(2) even though it is SIGECO's intention to cease burning coal at the A.B. Brown generating units in 2023.

Based on the considerations above, SIGECO has prepared this extension based on the requirements for the *Development of Alternative Capacity is Technically Infeasible* extension provision of Part A. As discussed throughout this demonstration, this selection meets the following criteria for *Development of Alternative Capacity is Technical Infeasible* as referenced in 40 CFR § 257.103(f)(1):

- No alternative disposal capacity is available on or off-site (40 CFR § 257.103(f)(1)(i))
- CCR and non-CCR waste streams must continue to be managed in the CCR surface impoundment because it is technically infeasible to complete the measures necessary to obtain alternative disposal capacity either on or off-site of the facility by April 11, 2020 (40 CFR § 257.103(f)(1)(ii)).

The basis and technical justification for this demonstration is provided in the following sections.

5 Work Plan for Alternative Capacity (40 CFR § 257.103(f)(1)(iv)(A)(1))

The Part A demonstration criteria presented in 40 CFR § 257.103(f)(1)(iv)(A)(1) requires a written narrative discussing the options considered both on and off-site to obtain alternative capacity for each CCR and/or non-CCR waste stream, the technical infeasibility of obtaining alternative capacity prior to April 11, 2021, and the option selection and justification for the alternative capacity selected. While A.B. Brown has been actively and aggressively pursuing alternative capacity since the Utility Solid Waste Activities Group (USWAG) decision in August 2018, much of this effort has also been associated with the evaluation of future energy generation mix associated with the two most recent IRP cycles leading to the recent study result to retire coal-fired boilers at the site. As this decision has a direct impact on the nature, characteristics, and magnitude of the flows to be managed, detailed evaluation and final engineering could not be commenced prior to completion of the IRP process as required by the State of Indiana. Ultimately, the IRP planning process resulted in a recommendation to retire the A.B. Brown coal-fired units, which is currently being evaluated by the IURC. This process and the options considered are further discussed in the following sections.

5.1 Evaluation of On-site and Off-site Options for Alternative Capacity

As currently operating, the Ash Pond receives an average of approximately 8.8 million gallons per day (MGD) of influent from various plant sources. The flows to the Ash Pond are generally comingled, and the flowrates of the primary streams are listed in **Table 1**.

Table 1. Ash Pond Inflows

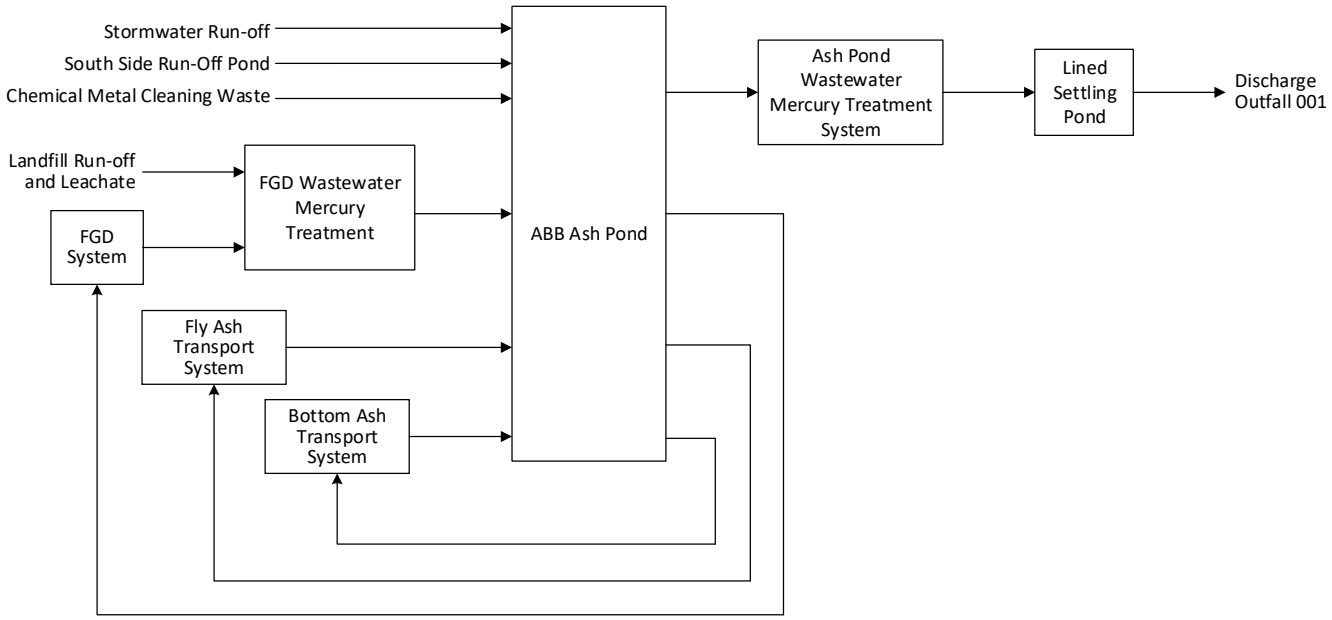
CCR Flows			
Source	**MGD**	**Current management**	**Future management**
Bottom Ash Transport Water	0.316	Ash Pond	No production
Fly Ash Transport Water	6.02	Ash Pond	No production
Treated Flue Gas Desulfurization (FGD) Wastewater [3]	0.622	Ash Pond	No production
Non-CCR Flows[4]			
Source	**MGD**	**Current management**	**Future management**
Stormwater Runoff	0.675	Ash Pond	New Lined CCR Pond
Landfill Runoff and Leachate[2]	0.048	Wastewater treatment	New Lined CCR Pond
South Side Runoff Pond[1]	1.137	Ash Pond	New Lined CCR Pond
Total	**8.818**		

Notes:
1. Plant Wastewater and treated sanitary wastewater included in South Side Run-Off Pond. A portion of this will be discontinued, but the remainder will need to be routed to the new lined CCR Pond
2. Landfill Runoff and Leachate will continue to be processed in the Wastewater Mercury Treatment System prior to discharging to the new lined CCR Pond.
3. FGD Wastewater (CCR flow) is currently treated in the Wastewater Mercury Treatment System with the Landfill Runoff and Leachate (non-CCR flow) prior to discharging to the Ash Pond.
4. Chemical Metal Cleaning Waste not accounted for, occurs for 2 days every 6 to 7 years for average flow rate of 0.045 MGD. This flow is not expected to occur again prior to the anticipated unit retirement, but is included here for completeness.

Most of the flow into the Ash Pond is recycled back to the plant for reuse by either the fly ash handling system, bottom ash handling system, or FGD system. However, a portion of the flow is treated by the Ash Pond Wastewater Mercury Treatment System, conveyed to a smaller lined settling pond, and discharged through Outfall 001 in accordance with the facilities NPDES permit.

A block flow diagram of the current flows to and from the Ash Pond is shown in **Figure 3**.

Figure 3. Flow Diagram of Current Flows to/from Ash Pond



As mentioned previously, the Ash Pond is unlined and thus will require closure under the provisions of the recent Part A rule. As discussed in this demonstration, closure of the Ash Pond will begin with the planned retirement of coal-fired Units 1 and 2 and their concurrent replacement by wind and solar electric power generation. The proposed plan as discussed in the recently issued IRP report also includes construction of two (2) simple-cycle gas turbines with a currently proposed in-service date in 2024.

Both closure-by-removal and closure-in-place methodologies were considered to close the Ash Pond. However, Indiana Department of Environmental Management (IDEM) interpretations regarding the Federal CCR Rule render obtaining closure-in-place approval technically infeasible given the groundwater levels in the vicinity of the Ash Pond. Due in part to this consideration, a decision was made to excavate and beneficially reuse a majority of the CCR materials within the Ash Pond. In support of this excavation, a pipe conveyor is currently being constructed to transport CCR material from a receiving hopper, located adjacent to the Ash Pond, to a barge loading facility on the Ohio River. Infrastructure design and construction work and the excavation/closure plan for the Ash Pond are currently in development, with material excavation and beneficial reuse planned to be initiated in 2021. Due to receiving facility throughput limitations and contractual obligations, closure by removal activities will be performed over approximately 12 years at which time closure of the Ash Pond will be complete.

As mentioned previously, no current alternatives exist for management of the current CCR and non-CCR flows managed by the Ash Pond. As part of the overall planning effort, various on-site and off-site alternatives were evaluated to assess the feasibility of alternative capacity for management and treatment of CCR and non-CCR

flows at A.B. Brown. As this effort has been ongoing since 2019, it should be noted that these alternatives presumed that coal-fired boiler operations would continue past 2023. This was the overriding assumption and was also considered a "worse-case scenario" for planning purposes. If another scenario would be selected, the plan would be adjusted to address this more-manageable scenario. However, with the recent IRP preferred portfolio announcement in June 2020 to retire coal-burning assets in October 2023, these alternatives are not fully applicable to the current scenario. Nevertheless, and in the interest of demonstration completeness, this discussion has been provided to illustrate the efforts and options considered, and to demonstrate that it is technically infeasible to obtain alternative CCR flow capacity for all CCR flows prior to the October 15, 2023 plant retirement date. These options (including feasibility, schedules, and environmental regulatory constraints) were among many considerations in the announced intention to retire coal-fired boiler operations.

The following sections detail this evaluation of the options considered, the technical feasibility of each option, and justification for the alternative capacity ultimately selected.

5.1.1 Alternative Capacity – On-Site Alternatives

As alternative capacity does not currently exist at A.B. Brown, the cessation of CCR and non-CCR flows to the Ash Pond requires alternative capacity to replace the operational functions of the Ash Pond, or the plant must be modified to operate without the Ash Pond. Primary functions of the Ash Pond include removal of solids by settlement and hydraulic storage and water re-use. Due to the large flowrate with multiple commingled individual streams, this increases the scope and complexity of the alternative capacity options. The following six on-site alternatives were evaluated to manage CCR and non-CCR flows:

- Alternative 1 - Repurposing Existing Lined Facilities
- Alternative 2 – Construction of a New Settling Pond
- Alternative 3 – Construction of a Lined Pond for Management of Certain CCR and Non-CCR flows
- Alternative 4 - Temporary Wastewater Treatment Facility
- Alternative 5 - Converting the Bottom Ash, Fly Ash and FGD System Wastewater to Dry Handling
- Alternative 6 - Constructing Temporary Storage

The following is a summary of the technical evaluation for each of these alternatives:

Alternative 1 – Repurposing Existing Lined Facilities

The existing facilities evaluated for repurposing include the Capital Pond and the Sedimentation Pond. A layout of the plant site with the location of these facilities is shown in **Figure 4**.

Figure 4. Existing Facility Layout and Potential Site for New Pond

The Sedimentation Pond is an H-shaped, lined CCR-regulated pond that receives leachate and runoff from the FGD Landfill located to the east. From the Sedimentation Pond, supernatant is conveyed to the Capital Pond located to the immediate north.

As a basis for comparison of alternatives, settling capacity of the lower pool of the existing Ash Pond was first evaluated. The lower pool of the Ash Pond was dredged in January of 2020 to expand its settling capacity. Material removed from the lower pool was moved to the upper pool. A bathymetry survey performed February 26, 2020, provides a volume of approximately 48 million gallons of storage and settling capacity within the lower pool, from the bottom to a water surface elevation of 442.08 feet above mean sea level (MSL). Given the inflows previously described, the approximate retention and settling time provided by the lower pool of the pond is 5.4 days. This is the pond volume and settling time that will need to be replaced by alternative capacity.

After determining the existing volume and settling time provided by the lower pool of the Ash Pond, the existing facilities, previously mentioned, were reviewed to evaluate feasibility of repurposing for managing CCR and non-CCR flows. Of the existing facilities other than the Ash Pond, the Capital Pond, which is also lined with a bentonite-based liner system, has the largest capacity with a volume of approximately 6.96 million gallons. The Sedimentation Pond located just to the south is a Federal CCR Rule-regulated surface impoundment lined with a composite liner system (meeting the requirements of the Federal CCR Rule). The Sedimentation Pond has a capacity of 1.01 million gallons. The combined capacity of the Capital Pond and Sedimentation Pond is less than 17% of the capacity provided by the lower pool of the Ash Pond. A significant expansion of these ponds would therefore be required to provide an additional 40 million gallons of capacity for settling and hydraulic storage. An expansion of these Ponds

would be constrained by the landfill's stormwater basin to the north, the FGD Landfill to the east, and the plant railway to the south. Limited expansion to the west may be possible to a certain extent but would require realignment of the stormwater features and other infrastructure. However, such an expansion would also not be able to provide enough capacity due to space constraints between the Capital Pond and West Franklin Road and/or would result in a pond depth that is not feasible. Also, alternative capacity for the Settling Pond and Capital Pond would be required during construction of the expanded pond which would result in significant engineering complications.

The significant distance of the Capital Pond and Sedimentation Pond from the Lower Ash Pool also poses technical challenges. Re-routing the wastestreams that currently discharge to the Ash Pond to the Capital Pond area would require significant modifications and additions to the existing plant infrastructure. New pumping systems to transfer the wastestreams to the Capital Pond and then return of wastewater to the plant for re-use would be required.

As this pond would be a Federal CCR-Rule compliant pond, implementation of this option would also require obtaining a permit from IDEM Office of Land Quality (OLQ) for operation of the CCR Pond (as well as a NPDES permit modification). Recent discussions with IDEM OLQ indicate that a 12-month permit review and approval period should be expected. A NPDES Permit Modification would also be required, but this could be performed in parallel to IDEM OLQ permitting. Given the various complications described above, the anticipated schedule for implementation of this alternative, if it was a physically viable option, is provided below.

Table 2. Anticipated Schedule for Repurposing Existing Lined Facilities

Activity	Estimated Duration
Geotechnical Investigation/Groundwater Monitoring/Preliminary Design	9 months
Permitting Review (IDEM OLQ and NDPES)	12 months
Bidding and Contractor Selection (performed in parallel to permitting review)	3 months
Pond Construction and Flow Reroute	18 months
Total	**39 months**

Due to these considerations, converting existing facilities to manage CCR and non-CCR flows is considered technically infeasible as the completion date would exceed October 15, 2023 (estimated February 2024).

Alternative 2 – Construction of a New Lined Settling Pond

Construction of a new lined settling pond on plant property was also considered for this analysis. There are three on-site locations with potentially sufficient area and acceptable topography for a new settling pond. The three candidate locations were identified for evaluation.

Settling Pond Area 1 - The largest area on-site that is not currently utilized for plant operations is the wooded area southwest of the existing Ash Pond to West Franklin Road and Smith Diamond Road. Prior to the 2019 - 2020 IRP, a conceptual pond design with equivalent settling capacity to the lower pool of the existing Ash Pond was considered for this area. The new pond would manage CCR and non-CCR flows discharged to the existing Ash Pond for the period between the CCR cease flow deadline and the retirement of coal-fired boilers in late 2023. The evaluation established that this wooded area with steep hill slopes and no existing access roads would be difficult to develop. It would likely require a significant permitting effort (i.e., Section 401/404 for stream impacts with stream mitigation, etc.) to site a new settling pond in this location. Based on recent Indiana and U.S. Army Corps of Engineers permitting experience, an individual Section 401/404 permit would likely be required as a result of aquatic and other environmental features in this wooded area and would necessitate a typical 12-month review and approval duration. Furthermore, the conveyor transporting material for beneficial reuse will bisect this area rendering much of the area unusable for pond development. Based on these considerations, this area was determined to be not suitable for a new settling pond.

Settling Pond Area 2 - The area of the existing South Side Runoff Pond represents another candidate area for a new lined settling pond. The existing South Side Runoff Pond and the area available for expansion to the north are shown in **Figure 4**. Approximately 3.4 acres would currently be available for a pond in this area but would require coal pile run-off, treated sanitary wastewaters, and multiple plant wastewater sources (including reverse osmosis reject, water treatment filter and softener backwash, boiler blowdown, floor drains, occasional discharges of the lime storage tank, and yard drainage) to be rerouted during construction if a pond in this area were to be reused for a new larger lined pond. To create approximately the same settling capacity (approximately 48 million gallons) as the lower pool of the Ash Pond, the volume of a square pond was calculated and compared to the available area in the South Side Runoff Pond and its vicinity. This pond was assumed to have the shape of an upside-down square truncated pyramid, with 3:1 H:V (horizontal : vertical) interior side slopes, and a depth of 8 feet. The outer boundary of the pond would be 920 feet by 920 feet, sloping down to a flat square bottom 872 feet on each side. These dimensions would provide a total settling volume of approximately 48 million gallons. However, the concept is infeasible for several reasons:

- The proposed pond would occupy an area of approximately 19 acres, not including access roads or other necessary features. Approximately 3.4 acres are currently available in the footprint of the South Side Runoff Pond and the area to the north. This is insufficient compared to the 19 acres required.

- The proposed pond will likely not be able to be incised into the topography as it must meet aquifer separation requirements of the CCR Rule. The proposed pond will then likely require dam permitting with the Indiana Department of Natural Resources (IDNR) based on storage volume since 48 million gallons is equal to 147 acre-feet (acre-ft), exceeding the 100 acre-ft threshold for regulation (IC 14-27-7.5-1). Design, permitting, and construction of a new impoundment meeting the requirements of the CCR Rule is not feasible in the remaining time before plant retirement.

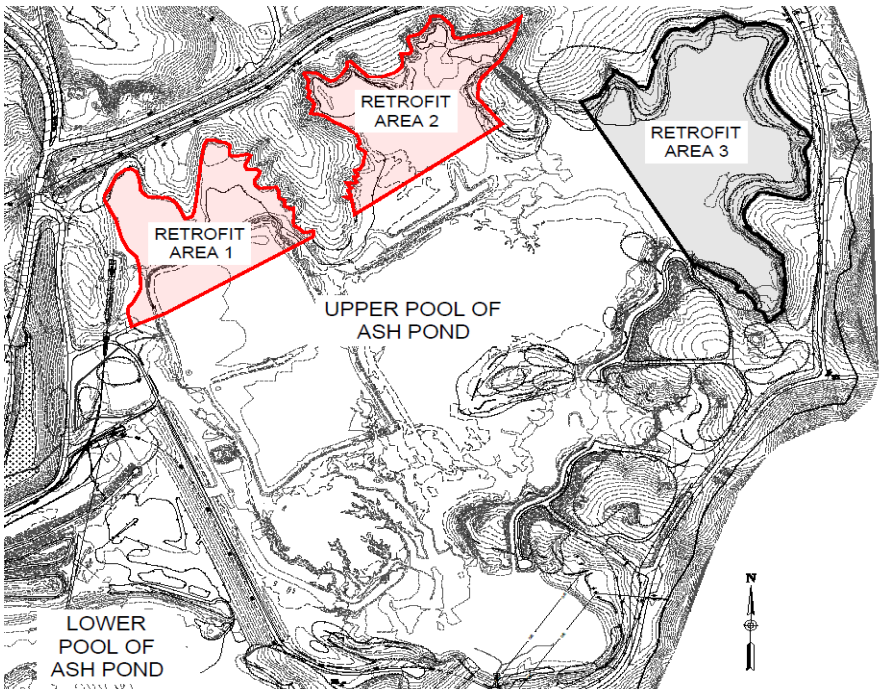
- The coal pile will remain in use by the plant until the coal-fired units retire in October 2023. No feasible alternative location exists for the coal pile. Construction of a small new pond may be able to begin (and is currently planned for) as the coal stockpile is used and becomes smaller. Coal is delivered to the plant by way of rail cars and unloaded via a coal trestle just to the North of the existing coal pile. Changing the location of the coal pile would also involve significant modifications to the railway and relocation of the coal unloading trestle. Due to the complexity involved it is not be feasible to change the location of the plant's coal pile to allow a larger pond to be constructed earlier.

Settling Pond Area 3 – Settling Pond Area 3 represents a potential Ash Pond retrofit option. This scenario would involve construction of a new lined pond within one of the "fingers" of the Upper Pool of the Ash Pond. It is technically infeasible to perform a retrofit in the Lower Pool of the Ash Pond due to the fact that a pool elevation of 440' must be maintained at all times during plant operation (while the plant remains in operation). The complications associated with deep excavation in the Lower Pool and constant recharge of groundwater from the base and sides of this area would prevent effective dewatering necessary to remove CCR within the necessary footprint, confirm removal of CCR and any contaminated subgrade, and construct the new lined pond separately within the operating pool.

Locating the pond within a "finger" of the Upper Pool would reduce dewatering challenges in relation to a location in the Lower Pool, but would still require significant dewatering due to the necessity of maintaining the Lower Pool elevation at 440' in elevation until closure of the plant. Three of the "finger" areas were evaluated in order to assess a location for the proposed retrofit. These areas are shown on the figure below. Retrofit Areas 1 and 2 were first evaluated due to their proximity to the plant, which would minimize the distance of pumping flows to and from the proposed pond. However, the bottom elevation of the ash in these two areas is approximately 415' as determined from the valley grades prior to ash placement. As the bottom of the grades prior to ash placement in Retrofit Area 3 is approximately 425', construction of a pond in Retrofit Areas 1 or 2 would require 10 additional feet of excavation in saturated ash in relation to Retrofit Area 3. Additionally, the southeastern border of Retrofit Areas 1 and 2 open into the portion of the pond with the greatest amount of ash. Excavation of this part of the pond would require an extensive laying back of slopes (or other shoring method) to enable excavation of the deepest ash, which would increase the quantity of ash to be excavated and therefore would increase the time to dewater, excavate, and

construct the lined pond. Retrofit Area 3, in contrast, is wider and shallower with a natural bottleneck in the underlying topography, which would reduce the proposed dam embankment size as well as lessen the amount of ash that must be excavated. While Retrofit Area 3 is farther from the plant, increasing the distance over which flows must be pumped, this distance would potentially make dewatering of this area easier since it is also farther away from the Lower Pool of the Ash Pond and its recharge. Based on these considerations, Retrofit Area 3 was selected as the location of the retrofit concept.

Figure 5. Potential Retrofit Areas within the Upper Pool of the Ash Pond



Consistent with the other pond options, the lined pond envisioned for the retrofit would have a capacity of approximately 48 million gallons. In addition, the proposed pond will require an embankment dam to be constructed across the valley, likely requiring dam permitting with the IDNR based on storage volume as the design volume equates to 147 acre-feet (acre-ft), exceeding the 100 acre-ft threshold for regulation (IC 14-27-7.5-1). For the purposes of this analysis, it is assumed that the phreatic surface of the pond within the Upper Pool is approximately 445'. The proposed lined pond must meet aquifer separation requirements of the CCR Rule. To meet the aquifer separation requirements of the CCR rule, the bottom of the proposed pond would be approximately at 450' in elevation. Given this configuration, such a pond would have a footprint of approximately 14 acres, requiring removal of approximately 270,000 CY of CCR material, 50,000 CY of underlying subgrade (assuming 2 feet of removal), and installation of 160,000 CY of clean fill to raise the bottom of the pond 5 feet above the assumed groundwater level and build the dam embankment. To implement this alternative, the following steps would be conducted:

- Geotechnical Investigation of Proposed Dam Location
- Design and Installation of Groundwater Monitoring System
- Conceptual Design
- Preliminary Design
- Detailed Design
- Review by IDNR/IDEM of:
  - Dam permit application/modification (IDNR)
  - Written retrofit plan for retrofit of impoundment (IDEM)
- Contractor Bid, Selection, and Award
- Procurement
- Construction
  - Begin Dewatering/Excavation
  - Complete removal of all CCR/contaminated soils from proposed pond footprint
  - Construct embankment dam and place fill to 5 feet above groundwater surface
  - Construct Composite Pond Liner
  - Construct pump stations for flow redirection (concurrently with other features)
  - Internally reroute process flows to new pump stations

The approximate durations of the critical path activities are summarized in the following table. For reference, the permitting review period is included as 18 months (IDNR, IDEM OLQ, and NPDES). This duration has been established based on SIGECO's experience required for Culley West Ash Pond Closure/Post-Closure Plan approval, which realized a review period of approximately 20 months. Because this project would involve a retrofit under the Federal CCR Rule, IDEM would have additional involvement (as compared to a new pond) as this option would involve CCR removal and verification methods subject to approval by IDEM. IDEM OLQ would also review and approve operation of the new retrofit pond as it would be a regulated CCR Unit. As such, the permitting effort is considered to be equally extensive as compared to the Culley West Ash Pond Closure/Post-Closure Plan approval, as a new dam must be permitted in addition to the approval of the retrofit plan for the Ash Pond.

Table 3. Estimated Simplified Schedule for Partial Retrofit

Anticipated Schedule for the Partial Retrofit of the Upper Pool of the Ash Pond	
Activity	**Estimated Duration**
Geotechnical Investigation/Engineering Design	9 months
Permitting Review (IDEM and IDNR)	18 months
Bidding and Contractor Selection (in parallel with permitting review)	3 months
Retrofit Construction (Dewatering, Excavation of CCR and Subgrade, Dam/Pump Station Construction, Pond Lining)	16 months
Total	**43 months**

The timeframe to complete these efforts would be on the order of 43 months from December 2020, with an estimated completion date of July of 2024, exceeding the maximum extension date of October 15, 2023.

Based upon the constraints associated with repurposing existing facilities as well as constructing a new settling pond, no options for alternative on-site capacity exist on site for management of all CCR and non-CCR flows described previously. In addition, it is technically infeasible to construct a new lined settling pond for all Ash Pond flows prior to the maximum extension date of October 15, 2023.

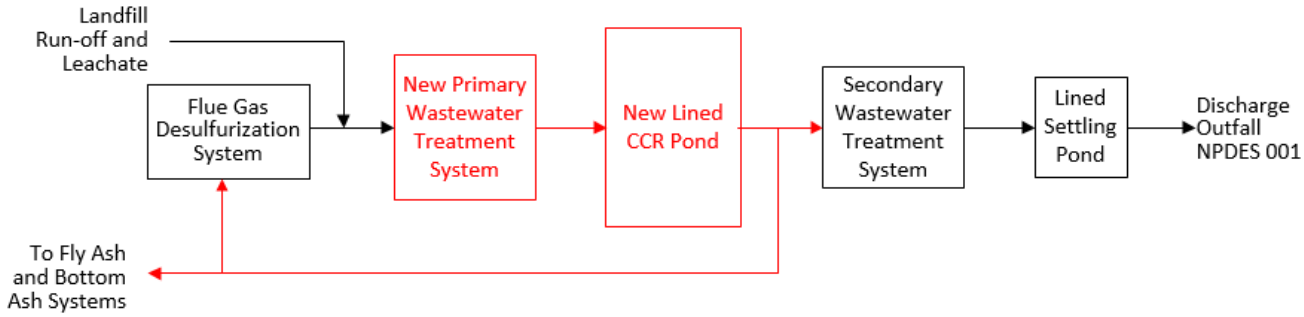
Alternative 3 - Lined Pond for Management of Certain CCR and Non-CCR Flows

In an effort to identify the fastest feasible alternative for elimination of flows from the Ash Pond, an alternative was evaluated which would expand the capacity available for treatment of some CCR flows as well as non-CCR flows utilizing available area in the vicinity of the South Side Runoff Pond (also known as the Coal Pile Runoff Pond). For this alternative, the existing South Side Runoff Pond would be expanded to the north and to the west of the South Side Runoff Pond, sited as to avoid the branch of the unnamed Ohio River tributary that flows to the south (presumed to be a Water of the US and/or state). An illustration of the areas of the proposed pond expansion is shown in **Figure 6**. The existing access road to the South Side Runoff Pond from the north is shown to remain in place in this illustration; however, it may be relocated as the design is refined in order to maximize the storage capacity of the expanded pond.

Figure 6. Expansion Areas for South Side Runoff Pond

In concept, the additional flows managed by this proposed expanded pond would include the combined FGD wastewater and landfill runoff leachate that is currently managed within the Ash Pond. This new pond would also manage and redirect stormwater and coal pile runoff, which is currently pumped to the Ash Pond. As part of this alternative, the existing wastewater treatment system (Metclear mercury removal system) would be either relocated or replaced at a location adjacent to the proposed expanded pond such that water is able to flow into the pond by gravity. Flows treated within the pond would be returned to the plant for re-use or to the secondary wastewater treatment system and Lined Settling Pond on the north side of the plant, then ultimately discharged through NPDES Outfall 001. A simplified flow diagram of the of the new lined CCR Pond is provided in **Figure 7**.

Figure 7. Flow Diagram of New Lined CCR Pond



The proposed expansion would add approximately 4.2 acres of area to the South Side Runoff Pond. The existing portion of the pond would be cleaned and reconstructed with a composite liner system compliant with the CCR Rule as this proposed unit would also manage some CCR flow (FDG-related wastewater). The composite liner system will consist of a geomembrane underlain by low hydraulic conductivity soil (or geosynthetic clay layer) in accordance with 40 CFR. § 257.70. As a rough estimate, the bottom of these ponds would be located at an approximate elevation of 382'. Preliminary review of existing geotechnical data within the vicinity of the pond expansion indicates favorable bedrock conditions that would allow the construction of a pond within the proposed area. Similar to the concept detailed in the discussion of Alternative 2's Settling Pond Area 2, the new pond/pond expansion in this area would be approximately 8 feet deep, with a total of 8 million additional gallons of capacity added to the existing capacity. This additional capacity is believed sufficient to manage the non-CCR flows and FGD wastewater providing adequate residence time for settling. However, it would not be of sufficient size to permit effective hydraulic capacity and/or settling for the additional CCR bottom ash and fly ash flows currently entering the Ash Pond. With the management of FGD wastewater and non-CCR wastestreams, the flows which would be managed by this pond represent approximately 0.67 MGD of flow based on the plant's water balance. The expansion of the pond would allow for more than 10 days of settling capacity within the expanded pond for these flows, which is to manage the solids within the wastestream. The pond would need to be periodically dredged to prevent excess solids buildup and the design would include provisions for this concept

Groundwater data is not currently available for this area. However, based on the survey conducted in January 2020, the stream elevation south of the proposed pond expansion is lower than the 377' contour, indicating it may be possible for the bottom of the expanded pond to be 5' above the groundwater table. If groundwater elevations are found to be higher within the footprint of the proposed pond expansion, it is likely possible to raise the pond elevations higher without exceeding the embankment height permitting threshold of 20 feet. Pursuant to 40 CFR § 257.60(a), new CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must be constructed with a base that is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high water table). Because some CCR wastestreams will be treated within the pond, the proposed pond will either comply with the 5-foot location restriction or be designed such that it will be possible to demonstrate that there will be no intermittent, recurring, or sustained hydraulic connection between any portion of the base of the unit and the uppermost aquifer.

One advantage of this option is that the total storage of the pond plus its expansions will be below the 100 acre-ft storage threshold and the 20-foot embankment height threshold for IDNR regulation, and as such will not have to undergo the process for dam permitting. Modification of the NPDES permit will also be required and is assumed to occur concurrently with IDEM OLQ review and the detailed design engineering.

To implement this alternative, the following steps would be conducted:

- Groundwater Monitoring – Design, Installation, Data Collection and Evaluation
- Conceptual & Preliminary Design
- Permitting
  - IDEM OLQ CCR Pond Operations Permit
  - NPDES Major Modification
- Detailed Design
- Engineered Equipment Procurement
  - Pumps – Transfer Feed Pumps and Return Water Pumps
  - Power Distribution Center (PDC), Transformers
  - Distributed Control System (DCS) Integration
- Structural, Mechanical, Electrical and Controls Contractor Bid, Selection and Award
- Structural, Mechanical, Electrical and Controls Construction
  - Reroute of Landfill Leachate and FGD wastewater lines to new pond area
  - Installation of new or relocated FGD wastewater treatment system
  - Pond Discharge pumping system and ancillary components
  - Electrical, controls and balance of plant scope
- Civil Earthworks Contractor Bid, Selection, and Award
- Procurement
- Civil & Earthworks Construction
  - Dewatering/Excavation
  - Construct pond embankment
  - Subgrade Preparation
  - Construct composite CCR Pond Liner
  - Construct lines and/or pump stations for flow redirection (concurrently with other features)
- Start-up and Commissioning
- Initial Operation

The approximate durations of the critical path activities are summarized in the following table.

Table 4. Estimated Simplified Schedule for Lined Pond for Management of Some CCR/Non-CCR Flows

Anticipated Schedule for the Coal Pile Runoff Pond Expansion	
Activity	**Estimated Duration**
Initial Design/Geotechnical Investigation/Groundwater Monitoring System Design and Installation	4 months
Permitting Review (IDEM/NPDES) (concurrent with Detailed Design)	12 months
Project Award	1 month
Construction (Dewatering, Excavation of CCR and Subgrade, Pond Liner Construction, Flow Reroute Construction)	12 months
Construction Certification/Startup and Commissioning	2 months
Total	**31 months**

The timeframe to complete these efforts would be on the order of 31 months from December 2020, with an estimated completion date of July 1, 2023.

Alternative 4 – Temporary Wastewater Treatment Facility

To replace the operational functions of the Ash Pond, a temporary wastewater treatment facility (WWTF) requires a significant amount of storage capacity and the capability to remove and dewater the suspended solids in these waste streams. The WWTF consists of the following primary components:

- Equalization Storage Tanks – to receive and store the influent flows.
- Primary Dewatering Clarifier/Thickeners – to remove suspended solids from the liquid.
- Filter Feed Storage Tanks – to receive the clarifier/thickener underflow and store until fed to the secondary dewatering filter presses
- Secondary Dewatering Filter Presses – to remove liquid from the solids so that they can be disposed in a landfill.
- Treated Water Storage Tanks – to store the water that is returned to the system or discharged.

Equalization tanks balance the flow to the downstream clarifiers and blend the wastestreams to reduce fluctuations in temperature and composition. The equalization tanks are sized for 24 hours of wastestream production to address upset conditions in the WWTF and influent peak flow events such as stormwater runoff. The 8.8 MGD (6,100 gpm) of combined CCR and non-CCR flows require 9 million gallons of capacity in the equalization tanks. The system has 9 – 10 tanks, each 62’ in diameter and 60’ in height with one or more mixers to prevent the solids from settling.

From the equalization tanks, the untreated wastestreams will be transferred to one of four clarifier/thickeners. Clarifier/thickeners are large quiescent circular tanks that removes the suspended solids by settlement. For these streams, each clarifier is approximately 75’ diameter by 15’ high. A coagulant and polymer are added to the feed stream to promote settling and produce a low suspended solids stream. A rotating rake assembly moves the settled solids to the center of the clarifier/thickeners where they are discharged to the filter feed storage tanks. The overflow from the clarifier/thickeners is collected in a sump and pumped to one of the treated water storage tanks. Any water discharged must meet the total suspended solids (TSS) requirements of the NPDES permit.

The treated water tanks would store the water for re-use by the system. Return water pumps would send water back to the system for re-use for bottom ash transport, fly ash transport, and FGD system make-up. The treated water tanks would be sized for a 5 million gallons of capacity in 5 tanks of 1 million gallons each. Each tank would be approximately 62’ in diameter by 62’ height and agitator would not be required.

The filter press is a batch operation. Because solids must be purged from the clarifier/thickeners on a continuous basis, filter feed storage tanks are required. Filter press performance is highly dependent on the characteristics of the solids. Fly ash and FGD solids are among the more difficult to dewater and a filter press cycle time of 3 to 8 hours is expected for this material. To accommodate batch operation, 2 million gallons of filter feed storage capacity is required. Due to the higher solids content, 4 tanks of 500,000 gallons, approximately 45’ x 45’ each, would be installed.

The filter press units would be fed from the filter feed tank with high-pressure diaphragm pumps. The fill cycle for a filter press varies dependent on the characteristics of the material. Based on the throughput, four or more filter press units are required. Dewatered solids would drop from the filter press units to the roll away bin and taken to a landfill. The filtrate would be collected and returned to the clarifier/thickeners. Solids that are disposed in the landfill must meet the requirements for free liquids.

The project scope for this WWTF includes field-erected tanks, engineered equipment, structural steel, buildings, piping, electrical, and controls. A significant amount of engineering design is required including:

- Major Engineered Equipment – The system included the following engineered equipment: pumps, agitators, clarifiers, filter presses, power distribution systems and distributed control systems. The design and manufacturing duration for this equipment ranges from 6 – 12 months after receipt of order.

- Foundations – The WWTF has 15 tanks of 1,000,000 gallons each and four of 500,000 each. Each tank will require deep foundations, typically 30' to 60' piles, a mat and containment walls. The four clarifier/thickeners, each 75' in diameter also require deep foundations. The filter press unit must be elevated to discharge to the bins. These structural support members and enclosure will also require deep foundations.

- Field Erected Tanks – The tanks would all be knockdown field erected. Panel sections would be fabricated, then assembled in the field.

- Electrical and Controls – The new WWTF will require a new electrical service for the pumps, agitators, clarifiers, filter press, freeze protection, heating, ventilation, and lighting. New instrumentation and controls are required to operate this system.

In addition to the WWTF, the existing wastestreams must be re-directed from the Ash Pond to the new facility. New pipe runs are required, and the existing systems will require upgrade and modification to transport these wastestreams to the new WWTF.

The following table summarizes the fastest schedule for implementation of a WWTF to treat the wastestream flows to the Ash Pond.

Table 5: Anticipated Schedule Wastewater Treatment Facility

Activity	Estimated Duration
Conceptual Design and Investigations	3 months
Major Equipment Vendor Selection and Award	2 months
Detailed Design	12 months
Construction Contractor Selection and Award	2 months
Construction	18 months
Start-up and Commissioning	3 months
Initial Operation	2 months
Total	**42 months**

The fastest feasible duration to construct a WWTF is 42 months from December 1, 2020. The estimated completion for the system is June 2024 and is therefore not a technically feasible option.

Alternative 5 - Converting the Bottom Ash, Fly Ash, and FGD System to Dry Handling

Multiple options to convert the bottom ash, fly ash, and the FGD system to dry handling were evaluated as part of the effort to identify alternative capacity. These wet to dry conversions require significant modification and/or retrofit of the boilers, fly ash handling system, and air quality control system. The following sections summarize the various options evaluated for each of these wastestreams.

Bottom Ash Wet to Dry Conversion

For the conversion of the boiler bottom ash from wet to dry handling, the following three options were evaluated:

1. Dewatering Bunker and Settling Tank
2. Remote Submerged Chain Conveyor
3. Retrofit Submerged Chain Conveyor

The first two options are high recycle rate systems with the dewatering equipment located remotely. The bottom ash is sluiced to the remote system and treated water is returned to the system. The third option is a retrofit of the boiler with a new submerged chain conveyor (SCC) installed underneath the boiler. The new SCC replaces the existing boiler bottom ash hopper.

- **Dewatering Bunker and Settling Tank**

  The dewatering bunker system employs a large concrete bunker to separate the larger particles followed by a settling tank to separate the fine solids. This system requires a large footprint, approximately 20,000 ft^2, and therefore cannot be located near the units. Relative to the other bottom ash handing alternatives, this system is complex with many pumps, long pipe runs and large concrete bunkers. Operation of this system is labor intensive and requires the on-going removal of settled ash from the dewatering bunker with front-end loaders. This system requires a duration of 38 – 42 months from concept development to operation.

- **Remote Submerged Chain Conveyor**

  Remote SCCs have been used at numerous plants for bottom ash conversions. This alternative combines established SCC technology with conventional high flow bottom ash sluice recirculation systems. Typical recycle flows to the SCC range between 2,500 and 3,500 gpm. As with the dewatering bunker, recycle piping run must be extended to the remote SCC location. Although not as large as the Dewatering Bunker and Settling Tank system, the SCC requires approximately 6,000 ft^2 and therefore cannot be located near the units. The SCC consists of a water filled lower trough with a submerged drag chain. Flights attached to two chains move the ash through the trough and up an inclined conveyor section. The ash is dewatered as it travels up the inclined section and is then discharges directly into the ash bunker. The dewatered ash is then loaded in trucks to hauled to a location for beneficial reuse or disposal. A typical remote SCC is shown in **Figure 8**. The typical schedule duration to design and install a remote SCC system is 38 to 42 months.

Figure 8 – Remote Submerged Chain Conveyor

- **Boiler Retrofit Submerged Chain Conveyor**

  The third option evaluated for dry handling of the bottom ash is a retrofit SCC located under the existing boiler. The retrofit SCC is a custom-designed unit that is located under the bottom ash trough and clinker grinders. The design concept is similar to the remote SCC, with design modifications to reduce the height so that it will fit under the existing boiler. Like the remote SCC, the design consists of a water filled lower trough with a submerged drag chain. Flights attached to two chains move the ash through the trough and up an inclined conveyor section. The ash is dewatered as it travels up the inclined section and is then discharged directly into a dump truck or an ash bunker. The dewatered ash is then hauled by truck for beneficial reuse or disposal. The SCC operates continuously and can be designed with a dry seal configuration that eliminates the need for cooling water. An elevation view of typical modified SCC retrofit under an existing boiler is shown in **Figure 9**.

Figure 9 – Typical Bottom Ash Submerged Chain Conveyor Retrofit

A boiler retrofit SCC typically requires a shorter duration to install than a remote SCC. This is because it is a less complex without a need for the high flow recycle system. The remote SCC also requires a separate foundation, electrical power for the recycle pumps and lengthy sluice lines.

A retrofit SCC project for boilers similar to the Units at A.B. Brown was recently completed at the SIGECO F.B. Culley Unit 3. The project duration was 34 months from kickoff to initial operation. A similar project to retrofit Unit 1 and 2 at A. B. Brown would require an additional 3 to 5 months because the installation must be performed in series within limited available space under the boilers. Also, the outage duration required for installation of the retrofit SCC at A.B. Brown is expected to be longer to address foundation modifications that were not required for the installation at F.B. Culley. These modifications to the boiler foundation can only be made during installation of the retrofit SCC are expected increase the length of the outage. For A.B. Brown the timeframe to complete these efforts for Units 1 and 2 would be on the order of 38 months from December 2020, with an estimated completion date of February 2024. While this alternative is the fastest technically feasible option for dry bottom ash conversion, it's schedule of February 2024 completion exceeds the maximum Part A extension date of October 15, 2023.

Fly Ash Wet to Dry Conversion

Converting the existing wet fly ash handling system to dry handling requires the retrofit of several system components and a new dry ash silo. The existing handling system uses a jet pump (Hydroveyor®) to generate a high vacuum, high volume conveying air flow. To convert to dry handling, the jet pumps would be replaced with mechanical exhausters. Three exhauster packages would be required, one for each unit and a common spare. Each exhauster package includes a 125 hp exhauster, sound enclosures, piping, valves, and instrumentation. In addition to the mechanical exhausters, a new 500-ton day bin silo is required to receive the dry ash. The silo will be equipped with a mixer/unloader to condition the fly ash as it is unloaded into transport trucks. Both the mechanical

exhausters and new silo require new foundations, electrical, and controls. The estimated duration for conversion of the fly ash handling system from wet to dry is estimated to be 20 months.

FGD System Wet to Dry Conversion

Three options were evaluated for wet to dry conversion of the FGD system:

- Brine concentrator with encapsulation and disposal of the brine
- Membrane separation
- Wastewater spray dryer

For the brine concentrator and membrane separation, the raw FGD wastewater be must pretreated to remove suspended solids. The pretreatment system includes clarifier/thickeners, and sand filters to remove the solids.

- **Brine Concentrator**

  A brine concentrator is a thermal system that concentrates dissolved species in the wastestream and produces a distillate that can be re-used by the system. The concentrated brine is blended with fly ash and lime for disposal in a landfill. Brine concentrators have had limited use for treating FGD wastewaters. Relative to other options, the brine concentrator was assessed to have a higher technical risk and higher operating cost

  Due to the size of system, the brine concentrators would need to be located remotely. The overall duration for design, procurement and installation of a brine concentrator system, with fly ash blending of the concentrated brine is 42 months.

- **Membrane Treatment**

  Membrane treatment including microfiltration, ultrafiltration, nanofiltration, forward osmosis (FO), and reverse osmosis (RO) systems, are all essentially specialized filtration systems. A pump is used to convey a high-pressure stream of FGD wastewater across a polymeric membrane. For an FGD wastewater application, the wastewater salts are concentrated on one side of the membrane while a clean permeate (product stream) stream is discharged from the opposite side. The permeate can be discharged or returned to the FGD system as makeup water. The concentrated brine stream can be encapsulated with fly ash and lime, then landfilled.

  The application of membrane technologies for FGD wastewater treatment is an emerging technology. It is considered developmental and not yet ready for commercial applications. Further demonstration of this technology is required before it can be considered for commercial applications.

- **Wastewater Spray Dryer**

  A wastewater spray dryer system uses hot flue gas to evaporate the FGD wastewater stream upstream of a particulate collection device. A slip stream of flue gas is diverted to the spray dryer vessel where a rotary atomizer distributes wastewater into the flue gas stream. Dissolved solids in the wastewater are flash dried and entrained in the flue gas exiting the spray dryer. The flue gas can either be returned to the bulk flue gas stream where the solids are collected with ash and other particulate in the existing baghouse or a new small particulate collection device can be installed to treat the slip stream. Particulate collected in a new collection device can be trucked to a landfill for disposal. A recent wastewater spray dryer retrofit project in the United States was complete in 36 months. This duration is consistent with the overall schedule for a new system that is being planned by SIGECO at the F.B. Culley Generating Station.

  The shortest feasible schedule for the overall wet to dry conversion of the bottom ash, fly ash and FGD wastestreams is 38 months (schedule controlled by dry bottom ash conversion). Wet to dry conversion of these streams does not address the other plant streams that discharge to the Ash Pond nor streams associated with Ash Pond closure activities. As such, Alternative 3 (Lined CCR Pond) would still be required with implementation

of any of these options. In addition, airspace within the onsite landfill at A.B. Brown is limited and there would be insufficient space to accommodate additional dry CCR materials for disposal. Additionally, the landfill is not designed to accept Type I restricted waste (fly ash), thereby further rendering use of the on-site landfill for disposal of fly ash as infeasible. While this consideration does not render dry conversion infeasible, it does add to the technical considerations and schedule length associated with pursuit of this concept. Due to the duration required to implement these multiple technologies, wet to dry conversion of the bottom ash, fly ash, and FGD system is not a technically feasible alternative.

Alternative 6 – Constructing Temporary Storage

The use of temporary tanks in lieu of the Ash Pond was evaluated. In order to replace the capacity of the Ash Pond, 48 million gallons of storage capacity is required. Temporary tanks range in size from 21,000-gallon frac tanks to 2.6 million-gallon modular tanks. Modular tanks are field erected structures with a bolted steel frame and a geosynthetic membrane liner. To replace the capacity of the Ash Pond, 2,400 frac tanks or 19 of the largest modular tanks would be required. These temporary modular tanks require a flat area with secondary containment to address spills, solids removal, and the potential for tank failure. Solids that settle in the tank must be periodically removed and then dewatered before they can be landfilled.

A 2.6 million-gallon modular tank with 12-foot panels has a diameter of 193 feet. An area of 30 acres is required to site theses temporary tanks and allow space to remove and dewater the settled solids. There is no area of this size available near the lower pool of the Ash Pond. Locating the temporary tanks further away requires redesign and replacement of multiple systems that transfer the wastestreams to and from the Ash Pond.

Temporary tanks are considered high risk for this application. The geomembrane liners would likely be damaged during removal of the settled solids from the tanks resulting in leaks. The wastewater would have to be contained to avoid the potential of an uncontrolled discharge and violation of the plant water discharge permit. Solids removed from the tanks require dewatering and drying before they can be landfilled. Runoff from dewatering operations must be contained and returned to the process.

Due to the environmental risks and space constraints associated with temporary tanks for this application, they are not a feasible alternative.

5.1.2 Alternative Capacity – Off-Site Alternatives

Off-Site Wastewater Treatment Facilities

As required by Part A, alternatives for off-site treatment of the flows discharged to the Ash Pond were also evaluated. For this alternative the CCR and non-CCR flows would be transported to either a publicly owned treatment works (POTW) or a private facility capable of managing the waste. Any off-site treatment facilities must achieve the same level of treatment as required for direct discharge of FGD wastewater, bottom ash transport water and fly ash transport water. In addition to these discharge limitations, POTWs have their own limits on the constituents they can accept in the raw wastewater. For example, the Evansville wastewater treatment facilities limit the TSS of any incoming wastewater stream to less than 0.21%. The TSS of the Ash Pond wastestreams varies considerably but is consistently greater than this value, with averages of 3% for fly ash and 8% for bottom ash wastestreams. If the wastestreams are transported by truck to the off-site facility, there are also limits on the settleable solids that can be handled by a conventional tanker truck.

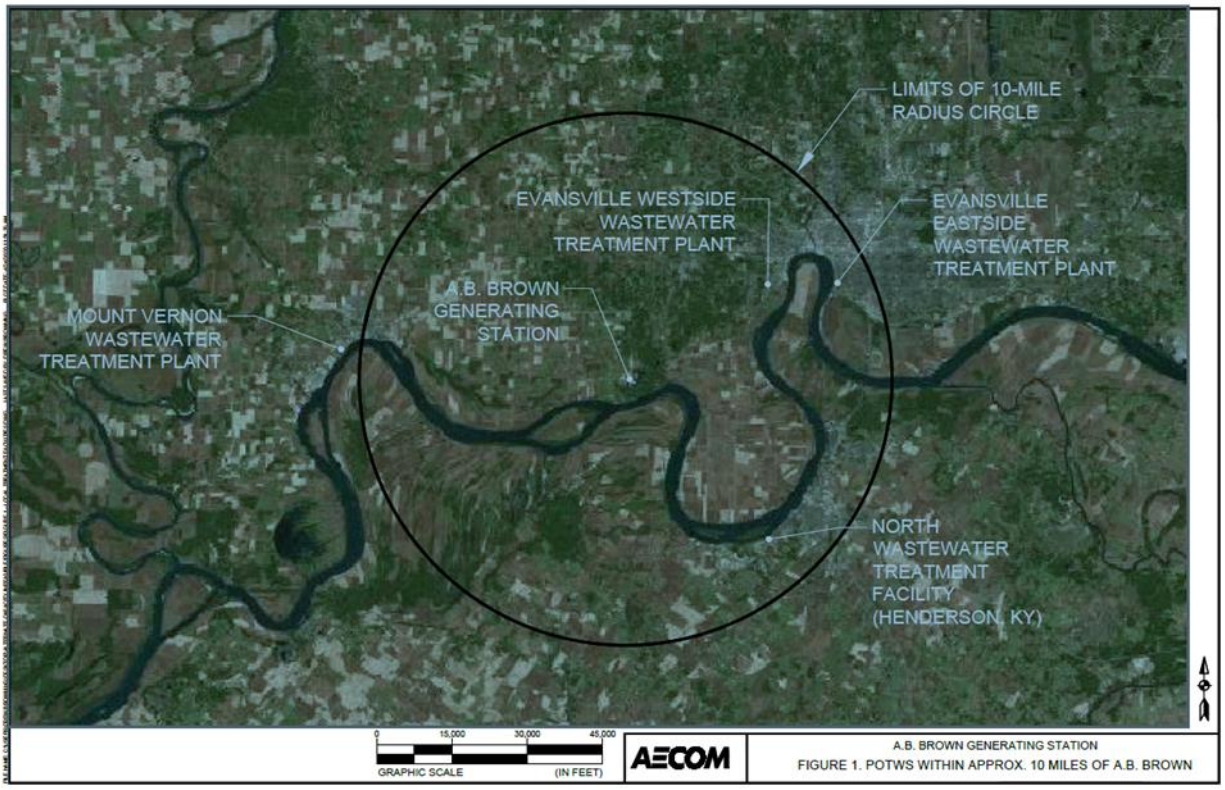
To address these constraints, on-site pretreatment of the wastestreams is required. At minimum, pretreatment would consist of reduction of the TSS to acceptable levels of transport and off-site treatment. A pretreatment system similar to the temporary WWTF described in Alternative 3 with clarifier/thickeners, filter presses, and storage tanks is required. Additional pretreatment may be required to remove dissolved metals (e.g., arsenic, mercury, selenium, nitrate) to meet the off-site facilities standards based on their process and permits. In addition to pretreatment, if the waste is trucked to the off-site facility, a loading/unloading station with adequate storage capacity is required

both at the plant and off-site facility. These facilities primarily receive sanitary wastestreams and it is not uncommon for them not have the capability to receive wastewater by truck.

As detailed in Alternative 4, the duration required to construct a temporary WWTF for pretreatment of the wastestreams is 42 months. The WWTF for pretreatment of the wastestreams would not be operational till June 2024, and therefore off-site treatment is not technically feasible. Notwithstanding the pretreatment requirements that make this alternative technically infeasible, an evaluation was performed to identify facilities in the area that could potentially treat these wastestreams.

A 20-mile radius from A.B. Brown was surveyed for POTWs or private facilities that may be capable of treating the wastestreams. No private commercial treatment facilities were identified during this search. The POTWs of Evansville and Mt. Vernon, Indiana, and Henderson, Kentucky are located approximately within this radius, as shown in **Figure 10**.

Figure 10. POTWs Within 10 Miles of A. B. Brown Station



Two options were evaluated for transport of the wastestreams to the off-site waste treatment facilities:

- Alternative 7 - Transporting Waste Streams to Area Treatment Facilities
- Alternative 8 - Pumping Waste Streams to Area Treatment Facilities

Alternative 7 – Transporting Waste Streams to Area Treatment Facilities

These POTWs primarily treat municipal wastewater and their processes are incompatible with treatment of the CCR and non-CCR flows from A.B. Brown. For example, the primary clarification tank at Evansville's Westside Wastewater Treatment Plant (Westside WWTP) has a volume of 280,000 gallons. The residence time of wastewater at this tank is approximately 10 minutes at the maximum treatment rate of 39 MGD. This is not sufficient time to settle out the remaining fine particles (e.g. fly ash) present in the CCR waste stream. As previously stated, Evansville's Westside and Eastside treatment plant are unable to accept any influent with a TSS of great than 0.21%

(or 2,114 mg/L), and even the minimum of the average TSS values of the bottom ash, fly ash, and FGD wastestreams exceed this value. Furthermore, the addition of CCR materials to the waste treatment facility sludge products may change the classification of this material and it may no longer be suitable for disposal in the facility's landfill or for re-use.

As a simplification in evaluation of this alternative, it is assumed that this facility could treat the wastewater. Several further significant assumptions are also necessary for consideration of this scenario:

- It is assumed that following pretreatment the non-CCR and CCR flows would be held in storage tanks at A.B. Brown with multiple filling stations that would permit truck traffic to enter and leave the site with minimal delays.
- It is assumed that tanker trucks used to transport CCR and non-CCR liquids are 5,000-gallon capacity, with a filling and dumping rate of 400 gallons per minute (gpm). Large capacity (10,000 gallon) trucks would not meet the local road weight limits of 80,000 pounds or less, per Indiana Code Title 9, Article 20. Trucks are assumed to be in operation 10 hours per day.
- Westside WWTP is the closest POTW to the site. It takes approximately 28 minutes to travel to this plant from A.B. Brown and back.

The following table presents the calculated trucks required based on these assumptions:

Table 6. Estimated Trucking Calculations

Quantity	Units/Description
8,818,000	Gallons that must be treated per day
5,000	Capacity, gallons per truck
1,764	Truck loads required per day
14	Minutes from site to Westside Treatment Plant
28	Total round trip time (minutes)
13	Truck filling time at 400 gpm (minutes)
13	Truck unloading time (minutes)
53	Total time to deliver one load and return (minutes)
600	Length of shift (minutes)
11	Trips per shift per truck
156	Number of trucks required to transport CCR/non-CCR flows

Given the assumptions and calculations presented above, 156 trucks would be required to make approximately 11 trips each per day to transport the waste to the closest POTW, Westside WWTP. This POTW is not capable of accepting and treating these waste streams, so this estimate serves as a minimum estimated number of trucks that are required, more trucks would be required to transport waste to a facility farther away that is capable of treating the waste.

If trucking of the waste were to be implemented, it is likely that 1,764 total truckloads per day would strain traffic patterns at the site, at the POTW, and in the local community. It would also mount a significant logistics challenge for A.B. Brown, as three trucks would have to leave A.B. Brown every minute for 10 hours per day. With three trucks leaving every minute, approximately 39 filling stations would be required to keep trucks coming and going with a 13-minute loading time. Based on experience of SIGECO staff and managing truck traffic within the site, the approximate maximum truckloads per day that can be effectively accommodated is estimated to be approximately

100. Based on all of the considerations discussed in this section, transporting waste via truck to the nearest POTW is considered technically infeasible.

Alternative 8 - Pumping Waste Streams to Area Treatment Facilities

Alternative 8 would involve the pumping of CCR and non-CCR flows directly to a POTW or private treatment facility from the site. The straight-line distance for such a pipeline to the nearest POTW would be approximately 6.9 miles. As with trucking waste to a POTW, this alternative also assumes that the POTW would be able to treat the waste. Furthermore, this alternative would require several key items to be completed rapidly to be successful:

- Selection of pipeline route. Completion of any environmental studies required and environmental permitting from regulatory agencies.
- Application for any federal and/or state permitting required, and timely receipt of approval.
- Acquisition of easements for pipeline right of-way.
- Design of pipeline and any necessary pumping stations.
- Construction of pipeline and pumping stations.
- Final testing.

Given the length of pipeline required, the volume of flows required to be conveyed, and the significant regulatory and design obstacles, construction of a pipeline to a POTW before the October 15, 2023 cease flow extension deadline is not feasible. Further, this effort would require multiple lift stations (given the distance) with significant required time for acquisition of property rights and design. The timeframe to complete these efforts would be on the order of 60 months.

In consideration of the volume of wastestreams, pretreatment requirements, and the logistics of transportation or pumping via pipeline, off-site treatment is technically infeasible.

5.1.3 Alternative Selected and Analysis of the Site and any Site-Specific Conditions that Led to the Alternative Selected (40 CFR § 257.103(f)(1)(iv)(A)(1)(i))

As discussed throughout this document, SIGECO has been involved in an integrated resource planning process required every three years by the IURC to determine the best future generation mix for SIGECO's ratepayers. During the evaluation of CCR and non-CCR flow management alternatives, it was announced, at a June 15, 2020 public stakeholder meeting, that it is SIGECO's intention to pursue retirement of the coal-fired generation assets at A.B. Brown and replace this generation capacity with a mix of renewables (solar and wind) and two simple-cycle gas turbines. This strategy is further addressed in SIGECO's IRP report and impacted the scope and trajectory of flow-management alternatives at the facility.

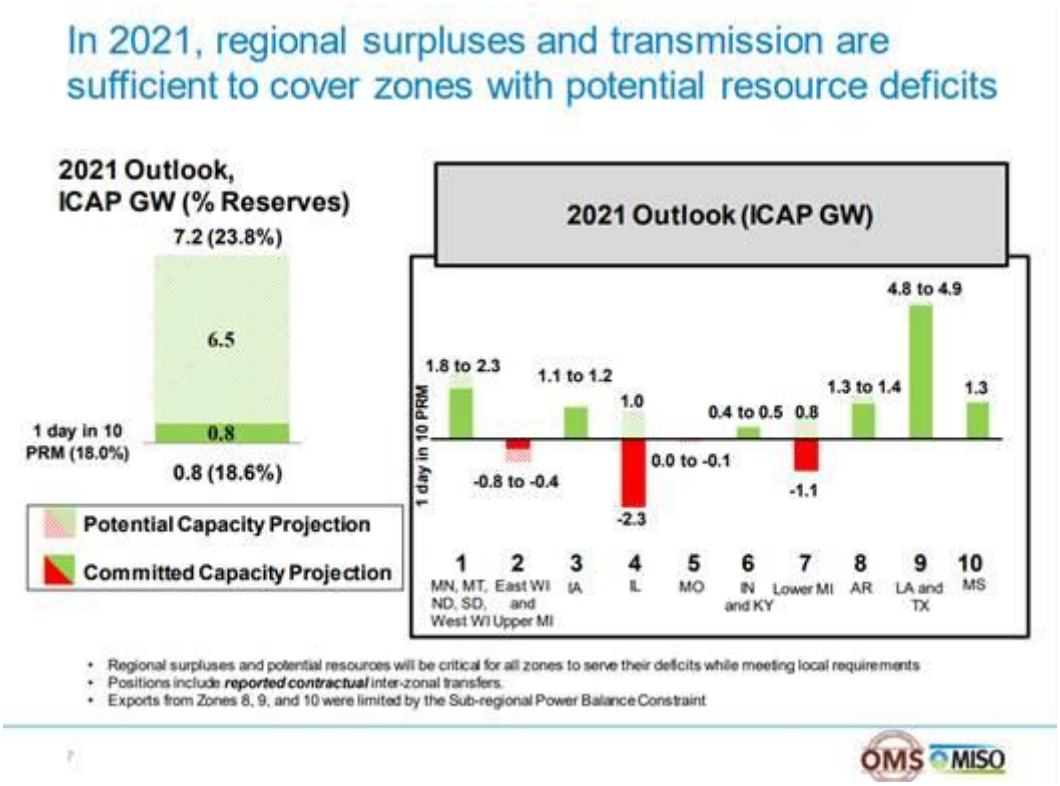
In summary, none of the alternative capacity options evaluated can feasibly address all CCR and non-CCR flows managed by the Ash Pond and be implemented and completed prior to the October 15, 2023 maximum extension deadline. Based on this current scenario of retirement of coal-fired boilers and consideration of available options, the selected alternative is to construct a new lined CCR Pond to expand the capacity available for treatment of some CCR flows as well as non-CCR flows utilizing available area in the vicinity of the South Side Runoff Pond. In concept, the additional flows managed by this proposed expanded pond would include the combined FGD wastewater and non-CCR flows (primarily stormwater, landfill runoff, and landfill leachate) that is currently managed within the Ash Pond. This new pond would also manage and redirect stormwater and coal pile runoff, which is currently pumped to the Ash Pond. As part of this alternative, the existing Metclear mercury removal system would be either moved or duplicated at a location adjacent to the proposed expanded pond such that water is able to flow into the pond by gravity. This alternative utilizes available space and maximizes the number of flows that can be eliminated from the Ash Pond. Implementation of this alternative will result in elimination of the FGD wastewater and non-CCR flows to the Ash Pond by July 1, 2023.

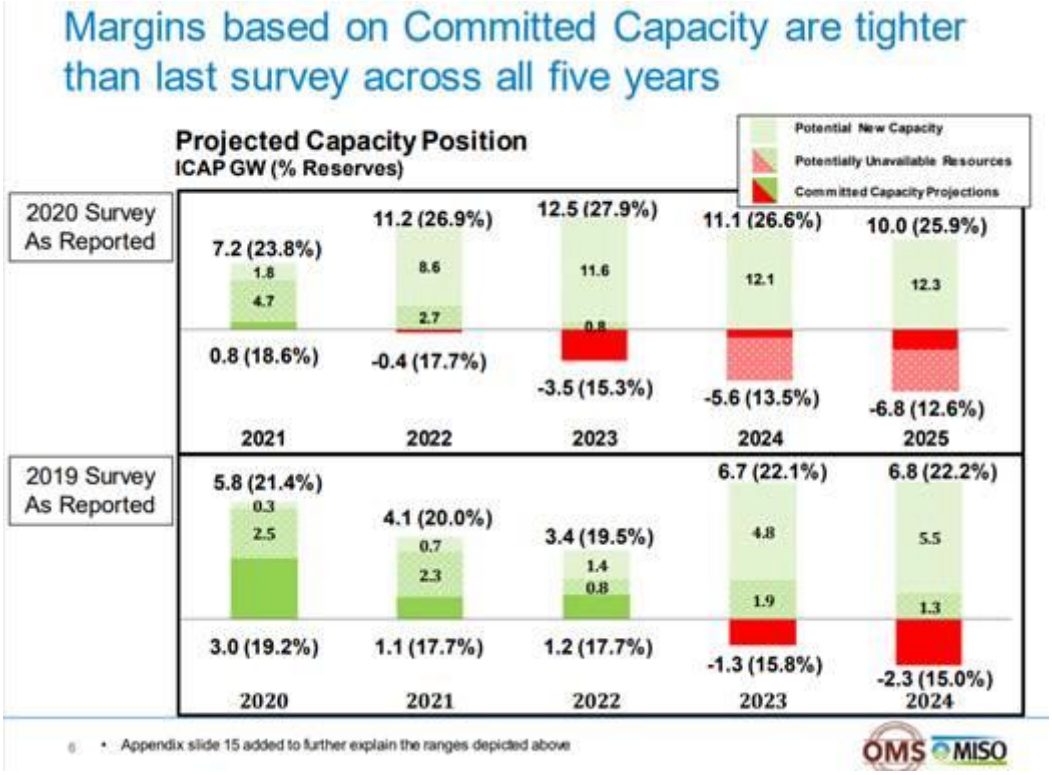
As the fastest feasible time for dry bottom ash conversion (with use of a boiler retrofit SCC) is 38 months, this modification would be complete in February 2024 which would exceed the maximum pond operation extension date of October 15, 2023. Due to absence of a technically feasible alternative to address all remaining flows to the Ash Pond (fly ash and bottom ash), these remaining flows which cannot be accommodated in the new CCR Pond will continue to the Ash Pond until retirement of coal-fired boilers and a retirement date of October 15, 2023 will be accepted by SIGECO in order to comply with the Part A CCR rule.

5.1.4 Adverse Impact on Plant Operation if the Ash Pond Were No Longer Available (40 CFR § 257.103(f)(1)(iv)(A)(1)(ii))

Given the lack of current alternative capacity and a technically feasible option to address all current flows to the Ash Pond, continued operation of A.B. Brown Units 1 and 2 is wholly dependent on the continued operation of the Ash Pond until currently planned plant retirement in October 2023. If the CCR and non-CCR flows to the Ash Pond were to cease on April 11, 2021 without alternative capacity available, Units 1 and 2 will not be able to continue operation. As mentioned previously, some non-CCR flows to the Ash Pond will continue independent of the operating status of the units. These streams (as well as FGD-related wastewaters) will be directed to alternative capacity under implementation of the preferred alternative.

A.B. Brown Units 1 and 2 haves a combined capacity of 490 MW and currently comprise a significant portion of SIGECO's generating units. A.B. Brown Units 1 and 2 are an essential part of the generation capacity within the fleet and the region. The results of the 2020 MISO Organization of MISO states survey projects a slight capacity surplus for zone 6 in 2021 and a potential shortfall in 2025. The survey shows that the MISO system in its entirety could experience a shortfall as early as 2022.





The source for the charts shown above:
https://cdn.misoenergy.org/20200708%20RASC%20Item%2004a%202021%20OMS-MISO%20Survey456786.pdf

5.1.5 Explanation and Justification for the Amount of Time being Requested and How it is the Fastest Technically Feasible Time to Complete the Development of Alternative Capacity

Flows which can be managed through constructed alternative capacity (FGD-related wastewater and non-CCR flows) will be redirected to a new CCR Pond on or before July 1, 2023 under implementation of the preferred alternative. As stated above, continued operation of the Ash Pond is needed until the intended retirement of A.B. Brown Units 1 and 2 which will be accepted to be on or before October 15, 2023. As demonstrated throughout this demonstration, there are no technically feasible options for obtaining alternative capacity for all CCR and non-CCR flows prior to October 15, 2023. Therefore, the Ash Pond must remain operational throughout the remaining life of coal-burning generation at the facility. For this reason, extension of Ash Pond operation until October 15, 2023 is requested in this demonstration.

The selected alternative for management of FGD-related wastewaters and non-CCR flows represents the fastest technically feasible time to obtain alternative capacity for these flows. These schedule considerations are provided in the following sections.

5.2 Detailed Schedule and Narrative Discussion (40 CFR § 257.103(f)(1)(iv)(A)(2) and (3))

The provisions of 40 CFR § 257.103(f)(1)(iv)(A)(2) and (3) requires that a detailed schedule be provided illustrating the fastest technically feasible time to complete the measures necessary for alternative capacity to be available including a visual timeline representation. The visual timeline must clearly show the following:

- How each phase and the steps within that phase interact with or are dependent on each other and the other phases (40 CFR §257.103(f)(1)(iv)(A)(2)(i)),
- All of the steps and phases that can be completed concurrently (40 CFR §257.103(f)(1)(iv)(A)(2)(ii)),
- The total time needed to obtain the alternative capacity and how long each phase and step within each phase will take (40 CFR §257.103(f)(1)(iv)(A)(2)(iii)), and
- At a minimum, the following phases: engineering and design, contractor selection, equipment fabrication and delivery, construction, and start-up and implementation (40 CFR §257.103(f)(1)(iv)(A)(2)(iv)).

In addition, 40 CFR §257.103(f)(1)(iv)(A)(3) requires a narrative discussion of the schedule and visual timeline representation which must discuss all of the following:

- Why the length of time for each phase and step is needed and a discussion of the tasks that occur during the specific step (40 CFR §257.103(f)(1)(iv)(A)(3)(i)),
- Why each phase and step shown on the chart must happen in the order it is occurring (40 CFR §257.103(f)(1)(iv)(A)(3)(ii)),
- The task that occurs during each of the steps within the phase (40 CFR §257.103(f)(1)(iv)(A)(3)(iii)), and
- Anticipated worker schedules ((40 CFR §257.103(f)(1)(iv)(A)(3)(iv)).

These items are provided and discussed in the following sections.

5.2.1 Regulatory and Other Considerations Associated with Overall Project Schedule

The scenario at A.B. Brown is complex and involves a series of interrelated regulatory and technical milestones. In order to address the requirements of this section, two detailed schedule representations have been provided. The first, provided in **Appendix C**, provides a representation of the overall schedule for A.B. Brown, which includes sections for the regulatory process to select future generation technology, CCR-related activities, and alternative pond capacity development activities. This schedule is intended to represent the overall scenario at A.B. Brown and illustrates the interrelationships of the various activities.

In order to understand the schedule for alternative capacity development, the overall context of activities at A.B. Brown also must be understood.

SIGECO has been involved in an integrated resource planning process required every three years by the IURC to determine the best future generation mix for SIGECO's ratepayers. Significant capital expenditures that arise out of the planning process must be approved by the IURC as reasonable and prudent. On February 20, 2018, SIGECO filed an application with the IURC for a CPCN to construct a proposed 850 MW Combined Cycle Gas Turbine (CCGT) at A.B. Brown to replace the current coal-fired generation units. Following a required process involving review of the application and a series of hearings, IURC issued an order of denial of the CPCN on April 24, 2019 (see Cause No. 45052 in **Appendix A**). The IURC provided feedback on this denial and recommendations for proceeding which involved a robust process of evaluating and modelling potential generation scenarios, implementing an all-source Request for Proposal (RFP) process, evaluating all potential future generation scenarios, and holding a series of stakeholder meetings. These activities and milestones are depicted on the overall schedule provided in **Appendix C**.

The All-Source RFP bid process was conducted between June and August 2019, and a series of four stakeholder meetings held in 2019 and 2020. The receipt of the order of denial and the subsequent all-options open evaluation process for the 2019-2020 IRP study culminated in a final stakeholder meeting and filing of an updated IRP in June 2020. This process resulted in significant changes to the scope of water management as well as the overall schedule of activities at A.B. Brown.

In summary, the current preferred IRP portfolio involves replacement of 730 MWs of coal-fired generation (490 MW to be retired at A.B. Brown) with renewables by the end of 2023, but the steps along the way are subject to some variation. In addition, the preferred IRP portfolio also involves development and construction of two (2) simple-cycle gas turbines at A.B. Brown. While the issuance of the IRP provides a framework for planning and engineering activities, the process is still very much dynamic and subject to adjustment. SIGECO will continue to monitor developments with the State of Indiana's Energy Policy Task Force and the wholesale energy market for potential changes that could alter the plan.

Once attractive renewable projects from the All-Source RFP are selected, SIGECO will seek approval from IURC by issuing a CPCN. Around this time, SIGECO will also issue another RFP for combustion turbines. The results of that RFP are expected within the last quarter of 2020/first quarter of 2021, and following this RFP process the CPCN for the combustion turbines will also be submitted to IURC (anticipated sometime in 2021). Engineering, design work, and development of cost estimates will occur as soon as possible after the RFPs are completed and will take place during mid-2021.

Related to and in parallel with the above activities, SIGECO has been evaluating the plans for closure of the A.B. Brown Ash Pond. This process has been ongoing since 2016 and culminated in the decision to close the Ash Pond by removal with the majority of the Ash Pond contents being beneficially used within the cement market. This concept was addressed by SIGECO in a press release dated August 14, 2019. Since 2016, significant Ash Pond closure planning and engineering efforts have been ongoing, and construction of a pipe conveyor system to convey the excavated ash to a barge loading system is currently underway. It is currently anticipated that excavation of the Ash Pond for beneficial use will commence in June 2021. Schedule activities and milestones related to closure of the Ash Pond is provided on the overall schedule in **Appendix C**.

In addition to and in parallel with the above activities, SIGECO has also been involved with planning and evaluation of CCR and non-CCR flow management options and alternative capacity. In 2019 (following the IURC denial of the CCGT CPCN application) and the first half of 2020, these planning activities were focused on continued operation of the coal-fired assets (as discussed in Section 4.1 of this report). However, following selection and public announcement of the preferred generation portfolio in June 2020, efforts have been made to revise the concepts to accommodate the scenario of retirement of coal-fired generation assets in 2023. This process has resulted in the alternative selected for alternative capacity (new lined CCR Pond) discussed in Section 5.1.3 of this report.

The sections below focus on the development schedule for this alternative capacity.

5.2.2 Schedule for Development of Alternative Capacity (New Lined CCR Pond)

The construction of a new lined CCR Pond to receive a FGD wastewater, landfill leachate wastestreams, and non-CCR flows (Alternative 3) is the selected option. A detailed schedule for development of alternative capacity is provided in **Appendix D**.

As shown in **Appendix D**, the overall project duration for the selected Alternative is estimated to be 31 months from conceptual design to initial operation. The project schedule for the selected alternative can be broken down to the following segments:

a. Conceptual & Preliminary Design
b. Permitting
c. Detailed Design
d. Equipment Procurement and Manufacture
e. Construction Bid and Award
f. Construction
g. Construction Certification / Start-up and Commissioning
h. Initial Operation

A discussion of the considerations related to each phase of the project is provided below.

5.2.2.1 Conceptual and Preliminary Design

Work on this phase for alternative capacity will initiate in December 2020 with project kick-off and the beginning-of-project definition and preliminary design. This phase will include various field investigations and information gathering to support the preliminary design and operating permit application. Groundwater monitoring wells will be installed to address CCR Rule requirements (as needed) and establish the groundwater levels to provide a minimum elevation for the base of the future CCR pond liner system. Key deliverables from this phase include:

a) Design Basis
b) Plant Water Balances and Process Flow Diagrams
c) Overall Site Plan
d) Install Groundwater Monitoring Wells
e) Preliminary Pond Design Drawings and Specifications
f) Permit Application Package
g) Permit Applications (i.e. IDEM OLQ Submittal and NPDES Major Modification)
h) Cost Estimate
i) Detailed Project Schedule

The new lined CCR Pond will be sized based on the expected flows and available area. A candidate location has been identified to the north and to the west of the South Side Runoff Pond (also known as the Coal Pile Runoff Pond). A key objective of the preliminary design phase is to develop the permit package for submittal to IDEM OLQ. This task along with the installation of groundwater monitoring wells are on the critical path.

Other objectives of this phase include detailed information regarding the FGD wastewater, landfill leachate, and non-CCR streams. This includes verification of the flowrates, composition, temperature, pressure, and operating requirements. Activities to gather this information may include flow measurements, sampling and analysis, review of plant operating data, and the collection of design information. Once all the streams have been defined and characterized, a conceptual design will be developed to redirect the flows to the new lined CCR Pond. This may include the modification of existing plant facilities, re-grading to redirect stormwater, and new facilities to transport the flows to the new lined CCR Pond. Four months are planned for the conceptual and preliminary design phase.

5.2.2.2 Permitting

A number of permitting requirements are associated with the selected alternative for alternative capacity. The two primary required permits are summarized below:

1. CCR Surface Impoundment Operations Permit from IDEM OLQ – Indiana is very involved in the surface impoundment operations approval and closure approval process as surface impoundments are regulated by the state as land disposal units and Indiana has adopted reference to the Federal CCR Rule within their state regulations (329 IAC 10). While approval is not required for construction of a CCR surface impoundment, approval by IDEM OLQ is required for operation of a CCR surface impoundment. This process consists of submission of design materials, flows, and associated calculations and analyses. SIGECO representatives recently contacted IDEM to discuss the review time for this CCR surface impoundment operations approval, and IDEM indicated that 365 days (from submission) is the typical timeframe for approval. This review period has been factored into project schedules and will involve preparation of a permit-level design package for IDEM review and approval early in the design process (first four months), and detailed design will be continued during IDEM review of this package. During the review process, the permit-level design package will need to be supplemented with data demonstrating compliance with the aquifer separation criteria of 40 CFR 257.60.

2. NPDES Major Modification – In order to address the proposed CCR flow treatment changes, a Major Modification to A.B. Brown's NPDES permit will be required. Based on recent IDEM experience and discussions with IDEM, 6 months is required from package submission to approval. Again, this has been factored into the schedule and this activity occurs in parallel with other activities (such as detailed design

and OLQ review of the CCR surface impoundment application). It should be noted that there is schedule float associated this permit approval process, and it lags in schedule by approximately 6 months if needed without affecting the overall project timeline.

There will be a number of other approvals requires such as permit coverage for Stormwater Associated with Construction Activities (Rule 5 in Indiana). However, these are typically shorter lead time permits and are not near the critical path.

Finally, it should be noted that the permitting timelines assume that a Section 401/404 permit will not be required and that any Waters of the US and/or any special aquatic sites, if present, can be avoided. This consideration will be addressed through implementing a site ecological evaluation early in the conceptual design process.

5.2.2.3 Detailed Engineering

The detailed design phase will commence following the conceptual and preliminary design and will occur in parallel to IDEM permit reviews. The key objective of the detailed design phase is to develop a design package and specifications for the equipment procurement and construction packages. Work from the conceptual and preliminary design will be used to develop drawings and specifications. Key deliverables from this phase include:

a) Final Pond Site Plan, Sections and Details Drawings
b) Final Pond Grading Plans and Calculations (geotechnical, stormwater management, pond capacity, etc.)
c) Liner and Earthwork Specifications
d) Piping and Instrument Diagrams (P&IDs)
e) General Arrangements (GA's)
f) Pipe Routing and Lists
g) Electrical One Lines, Circuit Drawings, Cable Routing Drawings, Schedules
h) Control System Logic, Input Output Lists, Connection Diagrams
i) Construction and Equipment Specifications

Detailed design will be executed concurrently with on-going groundwater monitoring activities and permitting support. The pond design will not be finalized until all required design information has been received and permitting authorities have completed their reviews. Design tasks associated with the redirected flows include hydraulic calculations, pipe support design, electrical and control cable routing and termination diagrams, electrical load studies, and control logic development. It may be necessary proceed with the procurement of specific engineered equipment in order to meet project schedules. This information may include electrical and controls circuits diagrams and equipment interface connections. Construction phasing will be an important consideration of the design as the current South Side Runoff Pond is currently operating and management of flows will need to continue through construction. Based on these considerations, a total of 9 months is planned for detailed engineering and design. During this phase, Issue for Bid (IFB) packages will be completed. Issue for Construction (IFC) packages will be developed following contractor award and completion of review/approval by the permitting authorities.

5.2.2.4 Engineered Equipment Procurement and Manufacture

Mechanical Engineered procurements are expected to include pumps or pump upgrades. A duration of 1 month is expected to receive vendor bids with 2 months to evaluate and award each package. Based on previously solicited vendor bids for similar equipment pumps are expected to have a 6-month lead time after receipt of order (ARO) for manufacturing and delivery, resulting in a total duration of 9 months for mechanical procurements.

Electrical procurements are expected to include transformers, motor control centers (MCC), power distribution center (PDC), and distributed control system components. As with the mechanical procurements, a duration of 1 month is expected to receive vendor bids and a 2-month period for evaluation and vendor award. The long lead items associated with electrical procurements have been identified as the PDCs with an expected lead time of 9 months ARO for manufacturing and delivery, resulting in a total duration of 12 months for mechanical procurements.

Mechanical and Electrical procurements occur in parallel for a total procurement cycle of 12 months. These activities follow completion of the mechanical detailed design and runs in parallel with completion of the electrical detailed design. The manufacturing and delivery of these components will occur in parallel with construction of the new pond. Other procurements are piping, structural steel, pond liner, valves, and instrumentation. These items have been identified to have a short lead time and will be purchased by the construction contractor. They do not impact the overall project schedule and will occur in parallel with the mechanical and electrical procurements.

5.2.2.5 Contractor Bid, Selection and Award

In this phase, a Request for Proposal (RFP) will be issued to contractors to construct the system. The project scope may be bid and awarded in 2 separate packages:

- Package 1 - mechanical, structural, electrical and control scope that is not associated with the pond
- Package 2 - civil earthworks associated with the new CCR Pond

The decision to award the construction in 1 or 2 packages will be based on achieving the shortest duration for construction.

The bid, selection, and award phase will require 3 months from issuance of the RFP. This includes 1.5 months for the bidders to prepare proposals and 1.5 months for evaluation and contract negotiations. Evaluation of the proposals includes a review of the means and methods of construction proposed by the bidders and any alternates that may improve the design or reduce the project schedule. The duration of the evaluation period is dependent on the quality of the proposals received, responsiveness of the bidders to questions and complexity of the alternates considered. These activities occur concurrently with completion of detailed design and equipment fabrication and delivery.

5.2.2.6 Construction and Start-up

The candidate location for the new lined CCR Pond is north and to the west of the South Side Runoff Pond, sited as to avoid the branch of the unnamed Ohio River tributary that flows to the south (presumed to be a Water of the US and/or state). The new lined CCR Pond will meet the requirements for a composite liner system under the Federal CCR Rule (40 CFR § 257.72) as well as the location restrictions of 40 CFR § 257.60-64. The successful completion of groundwater monitoring and completion of review by the regulatory agencies is required before the pond design can be finalized.

The available area for the new lined CCR Pond is approximately 4 acres. Construction is planned to require 12 months including site prep and cleaning, cut and fill, and liner installation.

The project scope will include modifications to reroute various wastestreams to the new lined CCR Pond. The two CCR wastestreams are pumped by transfer systems. New lines will be routed to the pond using existing pipe runs where available. The existing system treating the FGD wastewater prior to discharge to the Ash Pond will be replaced or relocated to an area adjacent to the new lined pond. Tie-ins for the electrical supply and other utilities must be planned and coordinated with plant operations and it may be necessary to perform this work during an outage.

Following completion of construction, the system will undergo start-up and commissioning. This project phase will require 2 months and involves instrument loop checks, motor meggering, electrical system settings, overall system hydrostatic testing, mechanical operation of all rotating equipment, and various other tasks to prepare the system for operation. Issues discovered during this period may require support from the equipment vendor to repair or replace damaged components. At the conclusion of this phase, a package with all checkout records will be produced.

Following pond construction and prior to operation, the pond must be certified to IDEM by a registered engineer. Certification requires record drawings of the final construction and various records verifying the installed pond meets

the required standards. Two months is planned for assembly of this packet and IDEM review and release for operation.

A period of 1 month is allocated for initial operation, during which the process control loops will be tuned and setpoints adjusted. A key objective of the run-in period is to verify the reliability of the system over a range of operating conditions. Issues that are identified during this phase may require support from the equipment vendor or modification of the system. At the completion of initial operation period, non-CCR flows and FGD wastewater flow to the Ash Pond will cease and be redirected to the new pond.

5.2.2.7 Schedule Summary

Based on the schedule provided in **Appendix D**, planning and conceptual design activities for the new lined CCR Pond and redirection of flows are currently underway. The path to alternative capacity will involve conceptual design, preliminary design, contractor selection, detailed design, procurement, and construction. It is currently projected that operation of the new lined CCR Pond will begin on or before July 1, 2023. Throughout the design process, efforts will be made to identify schedule improvements.

5.2.3 Anticipated Worker Schedules (40 CFR 257.103(f)(1)((iv)(A)(3)(iv)

During construction of the new lined CCR Pond and infrastructure to redirect flows, the anticipated worker schedules will consist of 50-hour weeks. This will involve work 5 days per week, working approximately 10 hours per day. If weather or other delays are encountered, the worker schedule may be adjusted (increased) to address this lost time in order to meet project schedules resulting in alternative capacity by July 1, 2023.

5.3 Progress Toward Alternate Capacity (40 CFR 257.103(f)(1)(iv)(A)(4))

Part A (40 CFR 257.103(f)(1)(iv)(A)(4)) requires a narrative discussion of the progress the Owner/Operator has made to obtain alternative capacity for the CCR and/or non-CCR wastestreams. The narrative must discuss all the steps taken, starting from when the Owner/Operator initiated the design phase up to the steps occurring when the demonstration is being compiled. It must discuss where the facility currently is on the timeline and the efforts that are currently being undertaken to development alternative capacity.

As discussed throughout this document, decisions regarding the future generation for SIGECO were absolutely critical to the process of obtaining alternative capacity. Over the past several years, significant efforts have been expended toward this goal. During this process, options for alternative capacity were developed and evaluated, and the preferred alternative is currently within the conceptual design phase.

Below is a summary of the progress made toward the goal of alternative capacity:

- Evaluation and Decision on Future Energy Generation Mix
    - Following an involved process, SIGECO announced in June 2020 the result of the IRP study, which is to replace the coal-fired generation at A.B. Brown and one coal-fired unit at F.B. Culley with a mix of solar generation, wind generation, and simple-cycle Combustion Turbine gas units
- Evaluation of On-Site and Off-Site Options for Alternative Capacity
    - During the future generation evaluation process, eight alternative options were evaluated for schedule and feasibility and included the following options:
        - Repurposing Existing Lined Facilities
        - Construction of New Settling Pond
        - Lined Pond for Management of Certain CCR and Non-CCR Flows
        - Construction of New Wastewater Treatment Facility
        - Converting Bottom Ash, Fly Ash, and FGD System to Dry Handling
        - Transporting Wastestreams to Area Treatment Facilities
        - Pumping Wastestreams to Area Treatment Facilities
    - Following the decision on future generation, options were again reevaluated based on the scenario of retirement of coal-fired boilers
- Selection of Alternative Capacity Option
    - The selected option is the construction of a new lined pond to accommodate non-CCR flows and certain CCR flows (currently entering the Ash Pond)
- Conceptual Design (current phase)
    - Initiated identification and evaluation of individual flows to be accommodated in the new lined CCR pond
    - Initiated work on design basis for the new lined CCR Pond
    - Candidate pond location has been identified and is being further evaluated for any fatal flaws

Work toward alternative capacity will continue in general accordance with the schedule provided in **Appendix D**.

6 Compliance Certification and Additional Information (40 CFR § 257.103(f)(1)(iv)(B))

In accordance with *40 CFR § 257.103 (f)(1)(iv)(B),* the following information and attachments have been assembled to demonstrate that the A.B. Brown Generating Station is in compliance with the Federal CCR Rule.

As required by the Federal CCR Rule, groundwater monitoring wells were installed to evaluate the groundwater quality in the vicinity of the A.B. Brown Ash Pond, A.B. Brown Landfill, and Sedimentation Basin. The analytical results from this monitoring have identified two constituents, lithium and molybdenum, that were found to have concentrations at SSLs that exceeded GWPS at the Ash Pond. In response, Haley & Aldrich prepared a Corrective Measures Assessment (Appendix K) for the A.B. Brown Ash Pond on behalf of SIGECO. The Corrective Measures Assessment evaluated the risk related to the lithium and molybdenum exceedances and determined there are “no adverse effects on human health or the environment currently or under reasonably anticipated future uses” from groundwater at the Ash Pond.

The analytical results from the groundwater monitoring at the A.B. Brown Landfill identified three constituents, cobalt, lithium, and arsenic, that were found to have concentrations at SSLs that exceeded GWPS. However, all of the constituents were subsequently addressed by a successful Alternate Source Demonstration (ASD).

Haley & Aldrich continues to evaluate the nature and extent of groundwater impact. Additional piezometers and wells have been installed and semiannual groundwater sampling has been implemented to continue to monitor and evaluate groundwater through the closure and post-closure processes. This information will be used for the future groundwater remedy selection.

Compliance data required by Part A associated with the Ash Pond is referenced in the sections below and provided in Appendices to this report. Supplemental data and information related to the Landfill and Sedimentation Pond are included in an addendum to this report (**Landfill and Sedimentation Pond Supplemental Attachments).**

6.1 Certification of Compliance (40 CFR § 257.103 (f)(1)(iv)(B)(1))

The A.B. Brown Generating Station is in compliance with the requirements of the CCR Rule. SIGECO manages the company website for the A.B. Brown Generating Station and it is kept up to date and contains all the necessary documentation. **Appendix E** provides the certification of compliance.

6.2 Visual Representation of Hydrogeologic Information (40 CFR § 257.103 (f)(1)(iv)(B)(2))

Part A requires a representation of hydrogeologic information at and around the CCR unit(s) be provided that supports the design, construction and installation of the groundwater monitoring system. This includes all of the following:

6.2.1 Groundwater Monitoring Well Locations (40 CFR § 257.103 (f)(1)(iv)(B)(2)(i))

Figures detailing the location of the groundwater monitoring wells in relation to the Ash Pond at A.B. Brown are attached **(Appendix F**).

Figures detailing the location of the groundwater monitoring wells in relation to the Landfill and Sedimentation Pond at A.B. Brown are included in the addendum (**Landfill and Sedimentation Pond Supplemental Attachments**).

The figures were prepared by Haley & Aldrich.

6.2.2 Well Construction Diagrams and Drilling Logs (*40 CFR § 257.103 (f)(1)(iv)(B)(2)(ii)*

Well construction diagrams and boring logs including stratigraphic cross-sections for the Ash Pond are attached (**Appendix G)**.

Well construction diagrams and boring logs including stratigraphic cross-sections for the Landfill and Sedimentation Pond are included in the addendum (**Landfill and Sedimentation Pond Supplemental Attachments)**.

The well construction diagrams were prepared by Haley & Aldrich.

6.2.3 Groundwater Flow Direction Maps (*40 CFR § 257.103 (f)(1)(iv)(B)(2)(iii))*

Figures detailing the groundwater elevation contours of November 2016 and June 2017 for the Ash Pond to account for seasonal variations are attached (**Appendix H)**.

Figures detailing the groundwater elevation contours of June 2016, June 2017, November 2017, and December 2017 for the Landfill are included in the addendum (**Landfill and Sedimentation Pond Supplemental Attachments)**. Figures detailing the groundwater elevation contours of June 2016 and December 2017 for the Sedimentation Pond are included in the addendum (**Landfill and Sedimentation Pond Supplemental Attachments)**.

Figures detailing the groundwater elevation contours of November 2016 and June 2017 for the Landfill and Sedimentation Pond are depicted with the Ash Pond contours in **Appendix H**.

6.3 Groundwater Monitoring Analytical Results (*40 CFR § 257.103 (f)(1)(iv)(B)(3)*)

Tables summarizing the constituent concentrations of each groundwater monitoring well sampled at the Ash Pond between 2016 and 2020 are attached (**Appendix I**). The January 2020 Groundwater Monitoring Report (prepared by Haley & Aldrich) is also included in **Appendix I**.

Tables summarizing the constituent concentrations of each groundwater monitoring well sampled at the Landfill and Sedimentation Pond between 2016 and 2020 are included in the addendum (**Landfill and Sedimentation Pond Supplemental Attachments**). The Annual Groundwater Monitoring Reports (prepared by Haley & Aldrich) including the ASD efforts are also included in the addendum (**Landfill and Sedimentation Pond Supplemental Attachments).**

The tables were prepared by Haley & Aldrich.

6.4 Description of Site Hydrogeology (*40 CFR § 257.103 (f)(1)(iv)(B)(4))*

A description of the site hydrogeology at the A.B. Brown Generating Station is attached (**Appendix J**). The description was prepared by Haley & Aldrich.

6.5 Corrective Measures Assessment (*40 CFR § 257.103 (f)(1)(iv)(B)(5)*)

The Corrective Measures Assessment report for the Ash Pond (prepared by Haley & Aldrich) is attached (**Appendix K**). The report is also located on A.B. Brown's CCR Compliance website. (https://www.vectren.com/assets/downloads/planning/ccr/Brown-Ash-Pond-Corrective-Measures-Assessment-Report.pdf)

Groundwater sampling at A.B. Brown Ash Pond identified two Appendix IV constituents, lithium and molybdenum, in exceedance of Groundwater Protection Standards, and the Corrective Measures Assessment was prepared in response to those results. The Corrective Measures Assessment evaluated the potential risk these constituents posed and potential corrective measures to prevent further releases. Groundwater flow was evaluated and found in the vicinity of the Ash Pond to flow predominantly to the west with a component of flow to the northwest from the northern portion of the Ash Pond. There are no groundwater supply wells within one-half mile to the west or northwest of the Ash Pond. The nearby Ohio River is to the south of the Ash Pond and groundwater does not flow in that direction. The risk assessment demonstrated no adverse effects on human or ecological health from groundwater. Potential corrective measures to prevent further releases were identified and evaluated. These measures are based on Closure by Removal with Beneficial Use and include Monitored Natural Attenuation, Hydraulic Containment with No Treatment, and Hydraulic Containment with Treatment. These evaluations are further discussed and compared in the Corrective Measures Assessment.

Groundwater sampling at A.B. Brown Landfill and Sedimentation Pond identified Appendix III constituents with SSI's observed above background. An ASD was prepared for both the A.B. Brown Landfill and A.B. Brown Sedimentation Pond to address these samples and is included in the addendum (**Landfill and Sedimentation Pond Supplemental Attachments)**. The ASD's did not identify a contributing source that could serve as an ASD for the SSI's; therefore, a CMA was not been prepared to address these concerns.

6.6 Progress Reports (*40 CFR § 257.103 (f)(1)(iv)(B)(6)*)

The progress reports for the Ash Pond on corrective action remedy selection dated March 2020 and September 2020 are attached (**Appendix L**). The reports were prepared by Haley & Aldrich. The reports are also located on A.B. Brown's CCR Compliance website.

March 2020 Progress Report (https://www.vectren.com/assets/downloads/planning/ccr/Brown-Ash-Pond-Semi-Annual-Selection-of-Remedy-Progress-Report_2020March.pdf)

September 2020 Progress Report (https://www.vectren.com/assets/downloads/planning/ccr/Brown-Ash-Pond-Semi-Annual-Selection-of-Remedy-Progress-Report_2020September.pdf)

As GWPS exceedances have been addressed by a successful ASD, a CMA is not required for the A.B. Brown Landfill. An SSL has not been identified at the Sedimentation Pond. Therefore, there have not been progress reports prepared for the A.B. Brown Landfill and Sedimentation Pond.

6.7 Structural Stability Assessment (*40 CFR § 257.103 (f)(1)(iv)(B)(7)*)

The structural stability assessment report for the Ash Pond is attached (**Appendix M**). The report was prepared by AECOM. The report is also located on A.B. Brown's CCR Compliance website. (https://www.vectren.com/assets/downloads/planning/ccr/Brown-Pond-Structural-Stability-Assessment.pdf)

The structural stability assessment reports for the Landfill and Sedimentation Pond are not required as this evaluation is not required for landfills and incised surface impoundments.

6.8 Safety Factor Assessment (*40 CFR § 257.103 (f)(1)(iv)(B)(8)*)

The factor of safety assessment report for the Ash Pond is attached (**Appendix N**). The report was prepared by AECOM. The report is also located on A.B. Brown's CCR Compliance website. (https://www.vectren.com/assets/downloads/planning/ccr/Brown-Pond-Safety-Factor-Assessment.pdf)

The factor of safety assessment reports for the Landfill and Sedimentation Pond are not required as this assessment is not required for landfills and incised surface impoundments.

Figures

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A.B. BROWN GENERATING STATION
MT. VERNON, IN

DEVELOPMENT OF ALTERNATIVE CAPACITY INFEASIBLE DEMOSTRATION

ISSUED FOR CERTIFICATION

	DATE	BY
ISSUED FOR BIDDING		
ISSUED FOR CONSTRUCTION		

REVISIONS

NO.	DESCRIPTION	DATE
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AECOM PROJECT NO:	60442676
DRAWN BY:	MJC
DESIGNED BY:	MJC
CHECKED BY:	TLE
DATE CREATED:	
PLOT DATE:	4/22/2016
SCALE:	AS SHOWN
ACAD VER:	2014

SHEET TITLE

LOCATION MAP

FIGURE 1

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ISSUED FOR BIDDING - - (DATE BY)

ISSUED FOR CONSTRUCTION (DATE BY)

REVISIONS

NO.	DESCRIPTION	DATE
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AECOM PROJECT NO:	60442676
DRAWN BY:	MSR/MAW
DESIGNED BY:	MSR
CHECKED BY:	RJB
DATE CREATED:	5/1/2017
PLOT DATE:	5/1/2017
SCALE:	AS SHOWN
ACAD VER:	CIVIL 3D 2016

SHEET TITLE

SITE MAP

FIGURE 2

SHEET 4 OF 22

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Appendices

Appendix A
IURC Cause No. 45052

ORIGINAL

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STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

VERIFIED PETITION OF SOUTHERN INDIANA GAS AND ELECTRIC COMPANY d/b/a VECTREN ENERGY DELIVERY OF INDIANA, INC. ("VECTREN SOUTH") FOR (1) ISSUANCE OF A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY FOR THE CONSTRUCTION OF A COMBINED CYCLE GAS TURBINE GENERATION FACILITY ("CCGT"); (2) APPROVAL OF ASSOCIATED RATEMAKING AND ACCOUNTING TREATMENT; (3) ISSUANCE OF A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY FOR COMPLIANCE PROJECTS TO MEET FEDERALLY MANDATED REQUIREMENTS ("CULLEY 3 COMPLIANCE PROJECT"); (4) AUTHORITY TO TIMELY RECOVER 80% OF THE COSTS INCURRED DURING CONSTRUCTION AND OPERATION OF THE CULLEY 3 COMPLIANCE PROJECTS THROUGH VECTREN SOUTH'S ENVIRONMENTAL COST ADJUSTMENT MECHANISM; (5) AUTHORITY TO CREATE REGULATORY ASSETS TO RECORD (A) 20% OF THE REVENUE REQUIREMENT FOR COSTS, INCLUDING CAPITAL, OPERATING, MAINTENANCE, DEPRECIATION, TAX AND FINANCING COSTS ON THE CULLEY 3 COMPLIANCE PROJECT WITH CARRYING COSTS AND (B) POST-IN-SERVICE ALLOWANCE FOR FUNDS USED DURING CONSTRUCTION, BOTH DEBT AND EQUITY, AND DEFERRED DEPRECIATION ASSOCIATED WITH THE CCGT AND CULLEY 3 COMPLIANCE PROJECT UNTIL SUCH COSTS ARE REFLECTED IN RETAIL ELECTRIC RATES; (6) ONGOING REVIEW OF THE CCGT; (7) AUTHORITY TO IMPLEMENT A PERIODIC RATE ADJUSTMENT MECHANISM FOR RECOVERY OF COSTS DEFERRED IN ACCORDANCE WITH THE ORDER IN CAUSE NO. 44446; AND (8) AUTHORITY TO ESTABLISH DEPRECIATION RATES FOR THE CCGT AND CULLEY 3 COMPLIANCE PROJECT ALL UNDER IND. CODE §§ 8-1-2-6.7, 8-1-2-23, 8-1-8.4-1 *ET SEQ*, 8-1-8.5-1 *ET SEQ.*, AND 8-1-8.8 - 1 *ET SEQ.*	)	**CAUSE NO. 45052** **APPROVED:** APR 24 2019

ORDER OF THE COMMISSION

Presiding Officers:
David E. Ziegner, Commissioner
David E. Veleta, Senior Administrative Law Judge

On February 20, 2018, Southern Indiana Gas & Electric Company d/b/a Vectren Energy Delivery of Indiana, Inc. ("Vectren South") filed its verified petition in this Cause seeking, among other relief, certificates of public convenience and necessity for a new duct-fired F-class 2x1 combined cycle gas turbine ("CCGT") providing 700 MW of baseload and 150 MW of peaking capacity pursuant to Ind. Code ch. 8-1-8.5 and for certain environmental projects at its Culley Unit 3 generating station pursuant to Ind. Code ch. 8-1-8.4. Petitions to intervene were filed by the Vectren Industrial Group; Valley Watch, Inc., the Citizens Action Coalition of Indiana, Inc., and the Sierra Club ("Joint Intervenors"); the Indiana Coal Council, Inc. ("ICC"), Sunrise Coal, and Alliance Coal, LLC (the "Coal Parties"); SABIC Innovative Plastics Mt. Vernon, LLC; St. Joseph Energy Center, LLP; St. Joseph Phase II LLC; and Evansville Western Railway. All of these petitions to intervene were subsequently granted. A public field hearing was held in Evansville on July 11, 2018, at which time members of the public presented testimony. The Indiana Utility Regulatory Commission ("Commission") held an evidentiary hearing at 9:30 a.m. on October 9, 2018, in Room 222, PNC Center, 101 West Washington Street, Indianapolis, Indiana.

Based upon the applicable law and the evidence presented, the Commission finds:

1. **Notice and Jurisdiction.** Notice of the hearings in this Cause was given and published as required by law. Vectren South is a "public utility" as defined in Ind. Code § 8-1-2-1(a) and Ind. Code § 8-1-8.5-1, an "energy utility" as defined in Ind. Code § 8-1-8.4-3, and an "eligible business" as defined in Ind. Code § 8-1-8.8-6. Vectren South is subject to the jurisdiction of this Commission in the manner and to the extent provided by Indiana law. Pursuant to Ind. Code chs. 8-1-8.5 and 8-1-8.4, Vectren South may seek Commission approval of Certificates of Public Convenience and Necessity. Accordingly, the Commission has jurisdiction over Vectren South and the subject matter of this proceeding.

2. **Vectren South's Characteristics.** Vectren South is an operating public utility incorporated under the laws of the State of Indiana, with its principal office and place of business in the City of Evansville. Vectren South provides electric and gas utility service to the public in Indiana and is subject to the regulation by this Commission in the manner and to the extent provided by the laws of the State of Indiana. This proceeding pertains to Vectren South's electric utility business. Vectren South renders retail electric utility service to approximately 145,000 customers in seven counties in southwestern Indiana, and owns, operates, manages and controls electric generating, transmission and distribution plant, property and equipment and related facilities which are used and useful for the convenience of the public in the production, transmission, delivery and furnishing of electric energy, heat, light and power for residential, commercial, industrial and municipal uses. Vectren South furnishes such electric utility service to retail customers located in Vanderburgh, Posey, Gibson, Pike, Warrick, Dubois and Spencer Counties, with a major portion of such customers residing in and around the City of Evansville, Indiana. Vectren South owns and operates 1,248 megawatts ("MW") of total net generating capacity. This generation capacity is primarily derived from the following five coal-fired baseload units providing a total of approximately 1,000 MW: A.B. Brown 1 (245 MW), A.B. Brown 2 (245 MW), F.B. Culley 2 (90 MW), F.B. Culley 3 (270 MW) and Warrick Unit 4 (150 MW[1]). Vectren South procures 100% of its coal supply from mines located in Indiana.

[1] Represents Vectren South's ½ interest in Warrick Unit 4, a 300 MW unit.

Vectren South's operations are subject to federal, state and local rules promulgated and/or implemented by, among others, the federal Environmental Protection Agency ("EPA"), the Indiana Department of Environmental Management ("IDEM") and by the Environmental Rules Board of the State of Indiana. Such rules establish environmental compliance standards that govern emissions and discharges from Vectren South's electric generating units.

3. Overview of the Evidence.

A. Condition of Current Fleet.

i. Vectren South. The main drivers behind Vectren South's proposal are the age and operating characteristics of Vectren South's existing baseload capacity and the upcoming deadlines for significant capital investments to address environmental regulations. Mr. Wayne D. Games, Vice President of Power Supply at Vectren South, testified regarding the condition of Vectren South's current generation fleet and the challenges facing the fleet. He testified Vectren South's fleet consists of five coal-fired baseload units totaling 1,000 MW. Mr. Games further testified that growth of renewable energy sources and low natural gas prices have negatively affected MISO's dispatch of Vectren South's coal-fired units. Instead of running continuously, Vectren South's units are now cycled up and down throughout the day, or are shut down altogether, decreasing unit efficiency and increasing wear and tear on the units. Mr. Games testified that because the units were not designed to cycle in this manner, the units cannot effectively compete with gas units in particular, which have far better operating flexibility. Continued market reforms are exacerbating this issue and jeopardizing unit availability and reliability.

Mr. Games also explained that the individual units face additional operating challenges. In particular, the A.B. Brown Units rely on scrubbers that utilize a technology that has been abandoned by the industry because of its high variable costs and the vapor it emits which causes corrosion of the unit structure. The scrubbers are already past their expected 30 year design life and present a significant risk to reliability and maintenance costs. He explained that Culley Unit 2 is Vectren South's oldest and smallest unit and that it has the worst heat rate of any coal unit in the state. Finally, he explained the unique circumstances related to the joint operation of the Warrick Unit which creates uncertainty as to the duration of its operation.

Ms. Angila Retherford, Vice President of Environmental Affairs and Corporate Sustainability, testified regarding two new major federal regulatory initiatives – Effluent Limitations Guidelines ("ELG") and Coal Combustion Residuals ("CCR") - impacting Vectren South's coal-generating units. Absent substantial investment at all of Vectren South's coal plants, they must cease operations by December 31, 2023. Ms. Retherford described Vectren South's environmental compliance strategy for the A.B. Brown and Culley units and testified future compliance costs were modeled in Vectren South's 2016 Integrated Resource Plan ("IRP") under the business as usual scenario. Ms. Retherford testified these rules and other existing federal regulatory requirements will require Vectren South to make significant further investment at the A.B. Brown and Culley generating facilities to continue their operation.

ii. Non-Utility Parties.

(1) OUCC. OUCC witnesses Lauren M. Aguilar – Utility Analyst, Anthony A. Alvarez – Utility Analyst and Peter M. Boerger – Senior Utility Analyst testified regarding Vectren South's request for a CPCN to construct the CCGT. These OUCC witnesses testified Vectren South's decision to construct the CCGT is premature because Vectren South has not explored all practical alternatives to extend the life of the A.B. Brown units. OUCC Witness Aguilar ultimately recommended that the decision to build the CCGT be delayed until the end of the 2019 IRP process, in order to allow Vectren South the opportunity to evaluate additional alternatives. The OUCC offered no alternative resource proposal, but argued for a "blended approach" with the possible continued use of existing assets, and suggested that the necessary expenditures to continue use of these assets could be viewed as buying an "option on the future." The OUCC witnesses asserted that deferring any decision until the conclusion of the 2019 IRP process would still allow sufficient time to take action without affecting reliability.

(2) Coal Parties. The Coal Parties' witnesses generally testified that Vectren South should wait to transition its baseload generation from coal to natural gas because the environmental regulations driving the transition, the ELG and CCR rules, are in flux and not yet final. Specifically, the Coal Parties' witnesses testified that recent and anticipated EPA reconsiderations of the ELG and CCR regulations, as well as the potential stay or replacement of the Clean Power Plan ("CPP"), create the potential scenario where Vectren South could operate the A.B. Brown and Culley units beyond 2023 without the need to make material investments in compliance measures. Coal Parties witness Michael J. Nasi – Partner with the law firm of Jackson Walker L.L.P. – further testified that Vectren South's decision to retire its coal plants is premature. He recommended that the decision be delayed until the environmental regulations driving the decision are better understood. With respect to the A.B. Brown units, the Coal Parties suggested that Vectren should investigate an alternative scrubber technology marketed by a Chinese firm to replace the existing dual alkali scrubbers. This technology which uses ammonia creates material that can be sold as fertilizer with revenues used to offset variable operating costs of the scrubber.

iii. Vectren South Rebuttal. Ms. Retherford, who is also a licensed attorney, testified regarding the risks associated with continuing to operate Vectren South's coal-fired fleet and delaying the decision to construct the proposed CCGT. Ms. Retherford testified that recent legal developments related to the CCR rule have made it impossible for Vectren South to continue operating its coal-fired fleet beyond 2023 without significant capital investment. She testified that the current water discharge permits require, and the groundwater monitoring results at the A.B. Brown and Culley ash ponds confirm, that Vectren South must cease discharging coal ash by December 31, 2023, pursuant to the ELG and CCR rules. She also testified that *Utility Solid Waste Activities Group v. Environmental Protection Agency*, 901 F.3d 414 (D.C. Cir. 2018), 2018 U.S. App. LEXIS 23547, confirms that the CCR Rule is final, including the final compliance deadlines at issue in this proceeding. Ms. Retherford testified that pond retirement delay is not an option, and therefore Vectren South must either make investments to comply with the CCR rule or retire the plants before 2024.

In response to the Coal Parties' position that the current administration could alleviate environmental carbon regulations applicable to the coal units, Ms. Retherford testified that the Administration's proposed replacement for CPP does not alleviate the problems. On August 31, 2018, the EPA published its proposed Affordable Clean Energy ("ACE") rule in lieu of CPP. She explained

that ACE would increase uncertainty and could actually increase the cost of compliance. For units with high heat rates – such as A.B. Brown – ACE would cause significant future compliance costs.

Vectren South also presented the testimony of Richard McMahon from Edison Electric Institute ("EEI") regarding the growing importance of Environmental, Sustainability and Governance ("ESG") reporting and metrics to the financial community, and the focus of all public electric utilities on being responsive to these topics and establishing explicit carbon reduction targets as part of their public disclosures. Mr. McMahon described the coordinated electric industry response to the demands for ESG reporting, and provided specific examples of lenders and large institutional investors who are putting pressure on companies to transition from dependence on coal units. He explained that Vectren South's 60% carbon emission reduction was in line with similar targets publicly disclosed by its electric utility peers. He also presented information regarding the industry transition from reliance on coal to use of gas as part of the ability to reduce carbon emissions.

As to the potential for alternative scrubbers, Vectren South witness Paul Farber – Principal of P. Farber & Associates, LLC – testified regarding the shortcomings of the technologies presented by Sunrise Coal witness Dombrowski and OUCC witness Aguilar and explained why, from an operational and financial perspective, it would not be prudent for Vectren South to adopt those technologies. With respect to the ammonia based scrubber technology presented by witness Dombrowski, Mr. Farber testified the technology has very limited deployment in the United States and would present a number of operational challenges if installed at baseload coal-fired units like A.B. Brown. These uncertainties and risks posed by adoption of this technology include its cost, its impact on operation of the units (including that it might cause Vectren South to be out of compliance with regulations for other constituents such as mercury and particulate matter absent further types of investments), the unknown ability to sell fertilizer output, and the complications associated with dealing with vendors with no domestic history. He discussed in depth the substantial operational burden and health and Homeland Security risk associated with handling the large amount of ammonia required by such a scrubber. Mr. Farber concluded that the Coal Parties had failed to provide any evidence that the capital costs of this scrubber technology would be any less than the scrubber modeled in Vectren South's 2017 IRP Update. In rebuttal testimony, Jon K. Luttrell, Senior Vice President, Utility Operations and President of Vectren Utility Holdings, Inc., also discussed the cyber security complications and risks posed by adoption of Chinese scrubber technology.

Mr. Farber also responded to OUCC witness Aguilar's criticism that Vectren South "only" evaluated wet limestone and her presentation of potential costs for other technologies. Mr. Farber testified that dry scrubbing is not an applicable technology at A.B. Brown for technical and economic reasons, and therefore it was logical for Vectren South to evaluate wet limestone technology at A.B. Brown. He also testified the cost estimates presented by Ms. Aguilar are not comparable cost estimates to replace the existing scrubbers at A.B. Brown Units 1 and 2.

Mr. Games testified on rebuttal that there simply is no time to delay a decision and await the outcome of another IRP. The Vectren South coal units must be retired or retrofitted by December 31, 2023. Given that there has been nothing to suggest more delay would change the overall economics that the F-class 2x1 CCGT is part of the lowest cost solution under every scenario, there is no reason to believe that modeling in the next IRP would change that result. Mr. Games provided an exhibit setting forth a timeline showing that a delay to allow the next IRP to proceed would leave Vectren South with essentially no baseload capacity for almost three years. During that entire period, Vectren

South customers would be completely exposed to the market for capacity and energy. Per the redirect examination of Justin M. Joiner, Director of Regulatory Policy and MISO Affairs for Vectren Utility Holdsings, Inc. ("VUHI"), this would be during the period when MISO is projecting its largest capacity shortfall for Zone 6 (Indiana). The Commission's Director's Report states "[a]n appropriate planning aspiration is to maintain flexibility while also waiting as long as reasonably possible to commit to a resource." Mr. Games testified on cross-examination that Vectren South has waited as long as reasonably possible.

B. Modeling and Results. Only two parties presented modeling evidence and results. Vectren South presented the modeling from the 2017 IRP Update and the 2016 IRP. Sunrise Coal Witness Philip Hayet presented alternative modeling whereby Vectren South's Preferred Portfolio was delayed by seven years in order to allow existing coal units to continue to operate beyond 2023. Other parties offered criticism of Vectren South's modeling but presented no alternative modeling.

i. 2016 IRP. Vectren South's case was filed in the context of a proposed new rule to govern the IRP process. While our new rule was not effective during the 2016 IRPs, all participating electric utilities complied. This new process is significantly more transparent. It includes the participation of stakeholders, the convening of public meetings, and the submission of and response to comments. Mr. Matt Rice, Director – Research and Energy Technologies, testified regarding Vectren South's IRP process and the results of that process. Mr. Rice described Vectren's approach to its 2016 IRP process and testified Vectren South engaged several industry experts, including Burns & McDonnell and Pace Global, to conduct technical modeling. Mr. Rice testified Vectren South worked with these experts and IRP stakeholders to conduct scenario analysis to evaluate 15 portfolios, each representing a different mix of supply and demand side resources to meet customer load over a 20-year time horizon. He further testified Vectren South worked with Pace Global to conduct a risk analysis and evaluate the 15 portfolios using a balanced scorecard approach. From this analysis, Vectren South identified the "preferred portfolio" which consisted of replacing all existing coal fired generation other than Culley Unit 3 as well as gas peaking units Northeast 1 and 2 and Broadway 1 by 2024 with an F-class .05 Fired CCGT. Mr. Rice testified Vectren South incorporated stakeholder input throughout the process and described the steps Vectren South took to engage stakeholders both before and during the process. This engagement included having stakeholders develop two portfolios which were then modeled and included in the risk analysis.

Mr. Matthew Lind – Associate Project Manager, Burns & McDonnell – described the modeling Burns & McDonnell conducted in the 2016 IRP on behalf of Vectren South to evaluate its resource needs over the next 20 years. He testified the results of Burns & McDonnell's modeling identified a low-cost portfolio that ceased coal operations at Vectren South's coal fired facilities (A.B. Brown Units 1 and 2, F.B. Culley Units 2 and 3, and Warrick Unit 4) and replaced this capacity and energy with the combined cycle facility proposed here along with a simple cycle facility. Mr. Gary Vicinus – Managing Director for Utilities at Pace Global – described Pace Global's role in identifying and defining the objectives, metrics and risks in order to select the preferred portfolio among the many options. He testified Pace Global used a balanced scorecard approach to apply a risk analysis to a selection of portfolios ultimately to recommend a preferred portfolio. Mr. Vicinus further testified regarding revisions Pace Global made to its risk analysis and explained that, even with these revisions, the risk analysis indicated the preferred portfolio was the best approach.

Mr. Rice described the preferred portfolio and explained why it ranked the best on the balanced scorecard. He testified it performed the best because the portfolio is diversified as it contemplates keeping FB Culley 3 (a coal unit) and existing wind contracts, building a CCGT and introducing solar and continuing to offer energy efficiency. He further testified it is among the lower cost portfolios (within 4% of the predominantly gas lowest cost portfolio) and ultimately performed best overall when viewed across multiple measures on the balanced scorecard. Because the all-gas portfolio represented the lowest cost portfolio, it is the retention of Culley Unit 3 and the accelerated addition of the 50 MW solar project that increases the costs of the Preferred Portfolio over the lowest cost all-gas portfolio. Retention of coal and the addition of solar are essential to diversity.

ii. 2017 IRP Update. Mr. Lind testified Vectren South requested Burns & McDonnell to update the 2016 IRP modeling and the re-evaluated low-cost portfolio was consistent with the low-cost portfolio identified in the 2016 IRP. He explained that several modeling inputs were updated, including the capital cost for solar resources, variable production costs and revenue requirements for existing units, an assumed operation of Warrick Unit 4 through 2023, and updated cost assumptions for capacity, energy, natural gas, coal, and energy efficiency.

OUCC witness Peter Boerger testified regarding Vectren South's 2017 IRP Update economic modeling. Mr. Boerger testified that Vectren South's 2017 IRP Update did not adequately consider viable options for serving its customers—including making use of existing resources and adequately considering the addition of a smaller CCGT unit rather than the 2x1 unit being proposed. Mr. Boerger also testified Vectren South's modeling of the proposed CCGT understated its capital cost by $200 million, an error which disadvantaged other options in Vectren South's modeling. Mr. Boerger ultimately recommended Vectren South reevaluate its future needs and model additional alternatives.

CAC witness Tyler Comings – Senior Researcher at Applied Economics Clinic – testified on behalf of the Joint Intervenors. Mr. Comings criticized Vectren South's modeling, testifying it was too convoluted to yield a sufficiently transparent or credible result. He testified Vectren South used too many models in the selection of the preferred portfolio and that the use of many models created ample opportunity for flawed and/or inconsistent input assumptions and other settings that could create bias in favor of the preferred plan. Mr. Comings ultimately recommended Vectren South's petition be denied because, in his view, Vectren South did not provide sufficient justification for its choice to build the CCGT and continue the operation of Culley 3.

Indiana Coal Council witness Emily Medine – Principal in the consulting firm of Energy Venture Analysis, Inc. – also testified regarding Vectren South's modeling. Witness Medine testified Vectren South should have fully updated its 2016 IRP analysis, including its scenario analysis, in order to confirm its preferred resource portfolio. She further testified that such an update should include a broader analysis (including sensitivity analyses) of the relevant assumptions and factors as of a time as close to Vectren South filing its Petition as possible. Ms. Medine attributed the decision to build a CCGT to financial motivations and also opined that approval of the CCGT might be a condition to closing the Vectren South merger transaction.[2] Ms. Medine recommended that Vectren South's Petition be rejected because Vectren South has failed to show that proceeding with building the CCGT at this time is prudent, less risky, and a better decision for both customers and the environment.

[2] While this case was pending, it was announced publicly that Vectren South's holding company was the subject of an acquisition at the holding company level, which was the subject of Cause No. 45109.

Mr. Lind responded to Mr. Boerger's testimony about an alleged $200 million "error." He explained that approximately $67 million of the alleged error identified by Mr. Boerger was due to Mr. Boerger's mistaken assumption about whether modeled option costs are stated in 2017 dollars or nominal dollars in the year of incurrence. The remainder is due to Mr. Boerger's efforts to compare apples and oranges. As Mr. Lind explained, the modeling was done prior to the more refined cost estimates for the CCGT that were developed for this case. Rather than based on a design level accuracy of plus/minus 50%, the CCGT design has been refined to a plus/minus 10%. All of the other portfolios were still at plus/minus 50%. As Mr. Lind explained, to compare the other less refined portfolios to the more refined CCGT would require some additional risk factor for the other portfolios. But even if one includes the updated cost estimate, Mr. Lind testified that it doesn't change that the lowest cost portfolios still include the CCGT. Mr. Lind prepared additional modeling involving coal-to-gas conversion (which we will describe later) and which did include the more refined CCGT cost estimate. While this additional modeling used the more precise CCGT cost and therefore impacted every portfolio that included the CCGT by increasing the overall net present value ("NPV") by $54 million, the portfolios that included the CCGT were still the lowest cost portfolios compared to portfolios that did not include the CCGT. Regarding the use of the models, witnesses Lind and Vicinus confirmed that the process and modeling for Vectren South's IRP and risk analysis were consistent with the resource planning approach Pace and Burns & McDonnell have used for numerous other utilities.

(iii) Size of the Proposed CCGT. Joint Intervenors' witness Tyler Comings testified regarding the size of the proposed CCGT. Witness Comings testified that Vectren South has not provided a sufficient justification to build a CCGT of the size included in its proposal. Witness Comings also criticized Vectren South's Request for Proposals ("RFP") (which we will describe in greater detail later) which sought resources between 600 and 800 MW, because he believed Vectren South could have considered combinations of small resources that added up to 600 MW. He further testified that considering smaller options would limit the market risk exposure for ratepayers, as well as permit a combination of bids to make up a least cost alternative. Mr. Comings testified that in order to reduce ratepayers' risk, Vectren South should explore cost effective alternatives that do not require intensive capitalization, but still provide benefits to ratepayers.

OUCC witness Anthony Alvarez also testified regarding the size Vectren South is proposing for the CCGT. Mr. Alvarez testified that Vectren South currently has excess supply, and there is no resource shortfall or inadequacy that supports Vectren's proposed 850 MW CCGT. He also questioned the load forecast used in the IRP and testified Vectren South has excess supply after serving its peak load and therefore has excess capacity to offer into the market and serve new customers.

Industrial Group witness Michael Gorman also testified regarding the size of Vectren South's proposed CCGT. Mr. Gorman testified Vectren South's proposal to build an 850 MW CCGT will result in excess capacity and have a compound impact on Vectren South's cost of service because the plan increases the costs of new generation resources and results in unrecovered stranded costs from the retired resources. Mr. Gorman recommended the Commission implement mitigation measures to reduce the cost burden on customers related to stranded costs and the cost of the new CCGT. He also recommended the Commission modify the off-system sales margin treatment so that 100% of future wholesale revenues be provided to customers to offset the cost of the proposed resource plan.

Vectren South witness Carl Chapman testified on rebuttal regarding Vectren South's decision to construct an 850 MW CCGT. Mr. Chapman explained the CCGT is essentially two units -- a 700 MW baseload unit to replace 730 MWs of retiring coal unit capacity and 150 MWs of duct fired peaking capacity to replace older peaking units and provide available low cost capacity for growth and wholesale sales opportunity. The additional peaking capacity is provided by the decision to duct-fire the CCGT. The incremental cost of duct-firing the CCGT is $15 million, and that decision must be made at the time the CCGT is constructed (i.e., it cannot be added at a later time.) Mr. Chapman testified that if only the unfired 700 MW baseload CCGT is built, then by 2025, Vectren South has a projected surplus above MISO's Planning Reserve Margin ("PRM") (which fluctuates) of only 51 MW. He further testified that by 2030, the surplus is only 5 MWs and by 2031 Vectren South will fail to meet its PRM. He testified that by 2036, Vectren South will be short 39 MWs, and all of this assumes Vectren South will not add significant new load. Mr. Chapman testified that with its low capital cost, firing makes sense from a customer perspective. For an incremental cost of 2%, the firing provides a 21% increase in capacity. Nevertheless, if the Commission approves the baseload 700 MW CCGT without firing, Vectren South will proceed to construct the unfired CCGT to replace its baseload coal units. He stated that Vectren South would also consider investing the incremental $15 million to duct-fire the unit and be at risk to recoup its investment via retention of the wholesale revenue produced by that peaking capacity.

Mr. Chapman also testified regarding Industrial Group witness Gorman's recommendation that Vectren South pass off-system sales margins on to retail customers. Mr. Chapman testified that Vectren South has decided to commit to provide 100% of wholesale sales revenue from the CCGT (baseload and peaking) to customers. Mr. Chapman explained that once the CCGT is placed in rate base, the benefits from the wholesale revenue produced by the unit will go to reduce customer costs. Mr. Chapman testified that providing 100% of wholesale revenue to customers further improves the NPV of the CCGT, will provide a larger offset to customer costs in general, and adds even more support to the $15 million incremental investment to duct fire the unit.

C. <u>Coal Parties' Modeling</u>. Indiana Coal Council, Inc. witness Philip Hayet – Vice President of J. Kennedy and Associates, Inc. – testified regarding Vectren South's 2016 IRP modeling and the 2017 IRP Update. Mr. Hayet testified that Vectren South's modeling analyses were flawed due to errors, inconsistencies, and a lack of consideration of important factors. Mr. Hayet performed his own analysis and testified that using the same model with certain corrections, including a deferral of a decision to add a CCGT, produced a slightly lower cost result on a NPV basis. He predicated his modeling on the assumption that the A.B. Brown 2 scrubber will continue to operate reliably through 2030. He ultimately recommended that Vectren South defer its decision to construct the CCGT.

On rebuttal, Vectren South witness Matthew Lind testified regarding Indiana Coal Council witness Hayet's alternative modeling. Mr. Lind testified that when Mr. Hayet's modeling is corrected for obvious errors, it reaches the same preferred portfolio conclusion as Vectren South's modeling. Mr. Lind provided corrections to Mr. Hayet's modeling in the form of an updated Strategist model and spreadsheets documenting the corrections. Mr. Lind outlined each of the errors he identified in Mr. Hayet's modeling and the impact of the individual errors on his analysis. The first of several errors he identified was that Mr. Hayet failed to include cost escalation during the seven years of delay that he was urging and that correcting this error alone would change Mr. Hayet's overall conclusion that delay would be less costly. Mr. Lind also testified regarding the cumulative effect of

addressing all of the errors. As part of this analysis, Mr. Lind testified that he included the increased cost of the CCGT to reflect the more recent cost estimates based on a plus or minus 10% confidence level. He testified that when correcting Mr. Hayet's modeling for all of these errors and inconsistencies, the NPV favors Vectren South's preferred portfolio, even under Mr. Hayet's no carbon regulation scenario. Witness Hayet corrected his testimony after Mr. Lind filed his rebuttal to add the escalation during the period of delay he was urging, and this correction changed his original conclusion that delay was less expensive. Mr. Hayet did not address the other modeling issues raised by Mr. Lind.

Mr. Games' rebuttal testimony also addressed witness Hayet's assumption that the A.B. Brown 2 unit and scrubber could be operated without added cost and reliability risk through 2030. Apart from the reliability issues created by the frequent cycling of the unit, he explained the structural damage resulting from the corrosive environment created by the unique characteristics of these scrubbers, and based on his direct experience with this equipment, Mr. Games concluded that he could not agree that it would be prudent to continue to operate the A.B. Brown 2 scrubber for another 12 years beyond 2018.

D. <u>Renewables and All-Source RFP</u>. Joint Intervenor witness Tyler Comings criticized the costs assumed in Vectren South's modeling for most renewable energy sources. Mr. Comings testified that Vectren South's forecast of the capital costs of future wind resources is higher than he would have recommended for the type of planning analysis and its forecast of the fixed O&M costs are lower. Mr. Comings recommended the use of the National Renewable Energy Laboratory's Annual Technology Baseline ("ATB") to develop the forecasts. With respect to future solar resources, Mr. Comings testified Vectren South's forecasts are too high for both the capital and fixed O&M costs. Mr. Comings recommended the reliance on the ATB to develop wind and solar price forecasts. For utility-scale PV, he testified that the ATB midpoint projection would be appropriate. As part of his discussion of renewable costs, he noted that Northern Indiana Public Service Company ("NIPSCO") had recently conducted an RFP and obtained solar and wind bids. Mr. Comings testified that Vectren South's overestimation of renewable costs compared to the ATB data biased the modeling results against renewable resources in favor of non-renewable resources, such as natural gas.

On rebuttal, Mr. Lind responded to Mr. Comings' testimony related to the cost of renewables included in Vectren South's modeling. With respect to wind resources, Mr. Lind noted that prior to revising his testimony, Mr. Comings' originally filed testimony included an inaccurate and inappropriate comparison of assumed capital cost for wind resources between Vectren South and ATB because Mr. Comings failed to account for the declining cost curve over time utilized by Vectren South. Mr. Lind testified that when Mr. Comings updated his testimony to reflect this decline, he recognized that Vectren South's wind costs are only "slightly higher" than what Mr. Comings recommends. Mr. Lind further testified that even with this correction, Mr. Comings' comparison to the ATB figures is incorrect because the ATB figure excludes a 2.1% construction finance factor and is thus understated. Mr. Lind testified that when the 2.1% construction finance factor is included, the ATB capital cost will exceed Vectren South's modeled capital cost for wind over more than half of the planning period. Mr. Lind pointed out that Vectren South assumed a higher capacity factor than the ATB survey and also assumed lower O&M costs compared to the ATB survey, and as a result, it is likely that the wind prices recommended by Mr. Comings are actually higher than those modeled by Vectren South.

With respect to Mr. Comings' criticisms of Vectren South's solar costs, Mr. Lind testified Mr. Comings again failed to account for the declining cost curve over time in the original version of his testimony. Mr. Lind further testified that while Mr. Comings did update his comparison to reflect the decline, he did not update it to include the 2.1% construction finance factor in the ATB comparison. Moreover, Mr. Lind explained that the national survey costs relied upon by Mr. Comings were presented on a direct current (DC) basis, whereas the 2017 IRP Update stated cost in terms of alternating current (AC), thus requiring that Comings' costs be converted to AC to allow for a valid comparison to be made. When correcting for these additional errors, Mr. Lind testified the solar costs used by Mr. Comings and Vectren South are nearly consistent over the last half of the study period and fairly similar from 2024 onward, which is the point at which capacity is needed.

Mr. Lind also testified regarding the impact of network upgrades and congestion costs on a portfolio that would rely more heavily on renewables. Mr. Lind testified that a portfolio which would rely heavily on renewables to supply power to Vectren South's customers is more likely to source some or all of these resources remote to Vectren South's service territory given the acreage required for such projects, the grid issues that can be encountered, and the enhanced production that can be obtained in certain locations (e.g., northern Indiana). Mr. Lind explained that when significant amounts of power are sourced from off-system resources, congestion costs to Vectren South's customers increase substantially. Because such costs were not part of the 2017 IRP Update assumptions, Mr. Lind concluded that any small differences between the solar costs presented by Mr. Comings and those modeled by Vectren South would be more than offset by the congestion costs associated with greater reliance on such resources. Finally, Mr. Lind noted that even assuming lower renewable costs could be achieved, such resources would likely displace Culley Unit 3's 270 MWs of capacity because that could be done incrementally to reduce the effects of network upgrades and congestion, whereas the CCGT would remain the optimal low cost choice to replace the remaining 730 MWs of retiring coal capacity in 2023. Further, wind and solar are intermittent sources of power; given that Culley Unit 3 would be Vectren South's only baseload capacity under its preferred portfolio, dispatchable baseload generation from a CCGT provides greater flexibility to respond to intermittent resources.

E. <u>Capacity Price Forecasts</u>. Mr. Comings testified regarding Vectren South's ability to purchase future needed capacity from the MISO market. Mr. Comings testified that Vectren South overestimated future capacity prices in MISO in its modeling, and in reality, the MISO market has had an oversupply of resources and tempered demand, leading to low capacity prices. He testified Vectren South's assumption of higher capacity prices is critical, because it makes the economics of building a new resource more attractive. He concluded that Vectren South was placing risk on its customers if the price of capacity is lower. To reach his conclusion, he relied on the MISO auction clearing results for Zone 6 (Indiana) for the past five years. Indiana Coal Council witness Hayet had a similar criticism of Vectren South's modeled capacity prices. He agreed that the cost of new entry ("CONE") served as the upper end of future capacity prices but that, also based on MISO historic auction clearing prices, it was inappropriate for future assumed capacity prices to approximate CONE. Instead, witness Hayet proposed to use 75% of CONE.

On rebuttal, Vectren South witness Joiner responded to Mr. Comings' testimony related to Vectren South's alleged overestimation of MISO capacity prices. Mr. Joiner testified he disagreed with Mr. Comings' contention that Vectren South should assume it will be able to purchase capacity and energy from the MISO market at low prices based upon recent market conditions. Mr. Joiner explained that the MISO market has been volatile in recent years and is experiencing shrinking

capacity, and such factors have prompted MISO to evaluate changes to its market structure. Mr. Joiner testified that MISO's recent and pending market reform initiatives, including MISO's Resource Availability and Need ("RAN"), are aimed at increasing capacity and energy prices to incentivize new generation development and are thus leading to higher prices as capacity tightens. As such, Mr. Joiner testified that while MISO's historical capacity and energy prices are indicators of recent trends, contrary to Mr. Comings' MISO auction clearing price testimony, they are not good indicators of expected, long-term future pricing. Moreover, the reported potential for a capacity shortfall by 2024 shows the risk of increased market prices.

F. Refueling Options. OUCC witness Boerger recommended that Vectren model a smaller 440 MW CCGT option in conjunction with gas refueling of one or both A.B. Brown units in order to consider a lower capital cost alternative. This option, which replaces retired coal units with a smaller gas baseload unit, was consistent with his stated concern that implementation of large quantities of intermittent renewables could create grid difficulties and that the extension of the life of small coal units is not common in the industry.

Mr. Lind's rebuttal presented the results of additional modeling in response to the OUCC's interest in further analysis related to resource plan options including coal-to-gas conversion that would make use of the A.B. Brown unit boilers. Burns & McDonnell performed that modeling and analyzed four additional portfolios, each where the conversion of one or more units to natural gas was considered. Mr. Lind testified that this updated rebuttal modeling used the more refined cost estimates (at the plus/minus 10% confidence level) for the CCGT for comparison with the coal-to-gas conversion portfolios (which were stated at plus/minus 50% accuracy.) Mr. Lind described the results of the updated analysis and testified that when compared with the coal-to-gas conversion portfolios, the preferred portfolio still produces a lower NPV and projected customer cost. Witness Games explained that this is due in part to the high heat rates of refueled units which result in very poor dispatch rates and resulting reliance on the market for energy needs. He explained that such a portfolio would result in customers significantly depending on market purchases for energy. Witness Games testified the fuel cost per MWhr from a converted gas plant is roughly $20 more expensive than the cost from the proposed CCGT when gas price is $4.000/dkt. He showed the much higher heat rates and lower capacity factors at converted plants that were completed between 2013 through the first quarter of 2018. Mr. Games testified during the hearing that the problem of high heat rates means that the refueled units continue to cycle and ramp up and down when dispatched, leading to wear and tear and the risk of additional maintenance costs.

G. Docket Entry Question & Response. As a follow-up to the additional modeling performed by Vectren South on rebuttal of gas conversion options, we issued a Docket Entry requesting further iterations of gas conversion portfolios. These included refurbishment of Broadway Unit 2 coupled with delays of removal of Warrick Unit 4 and installation of either a simple cycle or combined cycle gas turbine. Vectren South's response included the more refined cost estimate of the CCGT at plus/minus 10%, excluded additional environmental compliance costs at Warrick Unit 4 that would allow for the delay, and were presented with and without the commitment by Vectren South on rebuttal to pass 100% of wholesale revenues to customers if the CCGT is approved. All of the additional modeling requested by our docket entry produced a higher NPV than the lowest cost refueling portfolio presented on rebuttal (to convert A.B. Brown and instill a simple cycle gas turbine). With the sharing of 100% of wholesale revenues, all of the additional modeling produced a higher NPV when compared to the preferred portfolio ranging from 3.5% to 7.0%. Given that the preferred portfolio was within 4% of the lowest cost 2016 IRP portfolio (CCGT, an additional

simple cycle turbine, and delayed renewables), that means the gas conversion portfolios ranged anywhere from 8-12% higher than the lowest cost portfolio.

H. Estimated Cost of CCGT and RFP Process.

i. Vectren South. Mr. Games testified that, consistent with the 2016 IRP results, the 2017 IRP Update, and the Pace risk analysis, Vectren South is proposing to build a CCGT with 700 MW of baseload capacity and 150 MW of peaking capacity to replace retiring coal-fired capacity. Mr. Games testified Vectren South is proposing to build a unit with an output of approximately 850 MWs in order to hold some additional capacity to meet its obligations as a public utility, as well as to serve potential new customers and foster economic development. The 850 MW replaces 865 MW of retiring capacity (730 MW of baseload and 135 MW of peaking capacity, including Broadway Unit 2 in 2025). Mr. Games further testified the estimated cost of the CCGT is $781 million (+/-10%). The estimate includes owner's costs and allowance for funds used during construction ("AFUDC"). This figure was based on cost estimates developed by witness Diane M. Fischer, Central Regional Area Director and Associate Vice President with Black & Veatch. Those estimates were derived from a request for proposals for all equipment comprising the CCGT as well as construction. Mr. Games testified Vectren South is proposing to construct the new CCGT on its existing A.B. Brown generating site which will provide a conservative cost savings of $50 million resulting from reusing the existing site, facilities and equipment. He explained the critical timing of the in-service date of the CCGT which will be operational for the 2023/2024 MISO capacity year in order to retire the Culley 2 and A.B. Brown units and thereby avoid material capital investments otherwise required to operate those units beyond 2023. Similarly, the Warrick Unit 4 joint operating agreement will terminate at the end of 2023. To continue to operate Warrick would also require further investment to comply with environmental regulations.

Mr. Luttrell testified regarding the other replacement generation options Vectren South considered. He described the solicitation of competitive bids for either purchased power or ownership of all or a portion of a new CCGT unit. Mr. Luttrell explained Vectren South engaged Burns & McDonnell to manage the entire power supply RFP process, and testified this process allowed Vectren South to compare the best competitive offers for dispatchable baseload capacity to several self-build alternatives, including a partnership alternative. Mr. Luttrell testified that based on this economic and qualitative comparison, Vectren South made the decision to pursue building the duct-fired version of the proposed CCGT at the existing A.B. Brown site.

Mr. Lind testified in greater depth regarding Burns & McDonnell's role in developing and managing the RFP process to address Vectren South's power supply needs. He testified Vectren South received 11 unique proposals from six different developers. He further testified each of the conforming proposals was ranked and the top two proposals were compared with Vectren South's self-build proposals. Mr. Lind testified that based on NPV cost and qualitative risk factors, including a congestion analysis related to an off-system generation project developed by a third party, Vectren South determined that the self-build option was the best resource for reliable, long term service.

ii. OUCC. Witness Alvarez testified that, while Vectren South conducted an RFP, Vectren South did not competitively bid the actual CCGT it seeks to build in this case. OUCC witness Aguilar testified that Vectren South has not yet identified a manufacturer, chosen an exact type of CCGT, or issued any bids for the project.

iii. Coal Parties. ICC witness Medine criticized Vectren South's RFP process for a number of reasons, including the contention that Vectren South was involved in the process and the self-build project did not submit a bid as part of the RFP process. ICC witness Hayet stated a similar concern. Ms. Medine also disagreed with the position that self-build projects represent less risk than merchant projects. Ms. Medine further testified regarding the risks associated with self-builds, including cost over-runs. She testified that most if not all new Indiana plants have experienced cost over-runs that utilities look to customers to recover, and unless Vectren South is willing to guarantee costs, this is a risk that should be considered.

iv. Joint Intervenors. Witness Comings testified Vectren South did not facilitate a competitive bidding process, which limited resources and discouraged bidders from offering purchased power agreements ("PPAs"). He further testified the RFP should not have been limited to MISO Zone 6 and should have been similar to other investor-owned utility solicitations.

v. Vectren South Rebuttal. Mr. Luttrell responded to the Intervenors' criticisms of Vectren South's RFP process. With respect to Mr. Comings' criticisms that Vectren South did not facilitate a competitive bidding process, including limiting resources and discouraging bidders from offering PPAs, Mr. Luttrell testified Vectren South is retiring over 70% of its baseload capacity and the RFP was specifically designed to fill that deficiency with reliable cost-effective supply identified by the IRP. Mr. Luttrell further testified PPAs were not discouraged and all four of the responsive bidders offered a PPA. Mr. Luttrell also responded to Ms. Medine's criticisms that Vectren South was involved in many aspects of the solicitation and that Vectren South did not submit a bid as part of the RFP Process. Mr. Luttrell testified Vectren South used two separate teams—one focused on the RFP and evaluation and one focused on developing the cost estimate for the Vectren South-build CCGT—and each of these teams were separate and walled off from the other. He testified Vectren South's involvement in the RFP process was critical to help ensure the RFP would meet the needs its modeling indicated was necessary. He further testified he did not believe the RFP process was negatively impacted as a result of the self-build alternative being developed parallel to the evaluation of the RFP bids, and Ms. Medine acknowledges "there is no evidence that there was inappropriate information transfer." Mr. Luttrell explained that ultimately, an evaluation of congestion costs associated with the off-system resource proposal was the driver of selecting the CCGT project at A.B. Brown as the best option.

Mr. Luttrell also responded to Ms. Medine's position that a PPA does not pose a greater risk than having a regulated utility own the generation facility. Mr. Luttrell testified that Vectren South believes that an on-system project at an existing utility site subject to regulatory oversight and financed by a public utility, is less risky than relying on a developer. He further testified that when 70% of baseload capacity is at stake, a utility should consider all risks to project completion and to ongoing service in the long term. Mr. Luttrell provided a real-life, recent example of the risks associated with relying on a developer to construct a project. Further, Mr. Luttrell testified that a PPA does represent greater risk compared to a self-build option because the financing, construction, operation, and future financial stability of the seller is not in control of either the regulated public utility or the Commission. Mr. Lind also explained that while the cost estimate for the CCGT is stated at plus/minus 10%, the risk is actually higher (plus/minus 50%) for all portfolios that do not include the CCGT.

I. Construction of Gas Lateral to Serve CCGT.

i. Vectren South. Mr. Perry Pergola – Director, Gas Supply – testified regarding Vectren South's decision to secure the interstate pipeline services of Texas Gas Transmission ("TGT") to provide natural gas service to the proposed CCGT. He testified Vectren South selected TGT because it was the least cost pipeline option to serve the CCGT at the A.B. Brown location. Mr. Pergola further testified Vectren South will build and operate a new gas lateral to interconnect with TGT and serve the CCGT.

Mr. Steve Hoover – Director of Engineering – testified regarding the 23 mile gas lateral Vectren South will construct to connect the CCGT with TGT. He testified Vectren South will construct the pipeline itself because, by virtue of its experience building, operating and maintaining new or existing gas facilities in the Vectren South service area, Vectren South is uniquely qualified and positioned to construct the new pipeline. Mr. Hoover further testified the estimated cost to construct the gas pipeline is approximately $87 million. This is not included in the estimated cost of the CCGT as presented by witnesses Fischer and Games, as it is expected the costs of the gas pipeline will be reflected in the delivered cost of the gas.

ii. OUCC. OUCC witness Alvarez testified regarding Vectren South's proposal to build the gas lateral to serve the CCGT. He testified Vectren South did not include the costs necessary to build the gas lateral in the $781 million CCGT cost estimate and should have.

iii. Industrial Group. Industrial Group witness Gorman also testified regarding Vectren South's proposal to construct a gas lateral to serve the proposed CCGT. Mr. Gorman testified Vectren South's proposal to self-build the gas lateral is not consistent with protecting the public interest and is anti-competitive. He testified that Vectren South should have considered a third party or TGT to develop the gas lateral. Mr. Gorman testified that to the extent TGT can construct a gas lateral at a lower cost than the Vectren South self-build option, then this option should be adopted. Mr. Gorman further testified that Vectren South's proposal to recover the pipeline costs as part of the fuel costs for the CCGT is not reasonable because the fixed cost to build the gas lateral will not vary with energy generation or volume of gas delivered to the CCGT. He testified instead it would be appropriate to allocate the gas lateral cost as part of the CCGT fixed capital cost of the facility and allocate it on a capacity basis.

iv. Coal Parties. ICC witness Medine testified regarding Vectren South's proposal to construct the gas lateral. Ms. Medine characterized Vectren South's proposal as a proposal to build the lateral using an affiliate without competitive bidding. She also criticized Vectren South's decision to self-build the gas lateral instead of soliciting bids from third parties. Ms. Medine testified that Vectren South did not solicit bids for the lateral from third parties, and, therefore, it cannot represent that it was the lowest cost option for the construction of the lateral.

v. Vectren South Rebuttal. Vectren South witness Steve Hoover responded to criticisms raised by the Intervenors related to Vectren South's proposal to construct the gas lateral. Mr. Hoover testified that Ms. Medine's characterization of the proposal as an "affiliate transaction" has no bearing on the overall substance of the proposed transaction because there are many reasons why it is advantageous for Vectren South to construct the gas lateral. He reiterated that the Vectren South engineering, land services, and construction management teams have already

successfully completed two similar projects to deliver gas to Duke Edwardsport and IPL Eagle Valley generating units. He testified it is therefore in the best interest of Vectren South's customers for it to enlist the experience and expertise of its gas utility in the pipeline construction and operations. Mr. Hoover also responded to criticisms raised by witnesses Gorman and Medine that the lateral project is anti-competitive and being conducted without competitive bidding. Mr. Hoover testified that Vectren South requested TGT to provide a cost estimate to construct the lateral early in the process, and TGT's cost estimate was 10-15% higher than Vectren South's estimate. He further testified that Vectren South will complete a competitive procurement process to select a contractor to construct the lateral. Mr. Hoover testified that during the course of bidding and the evaluation process, Vectren South will also incorporate cost protections and performance incentives to ensure both competitive and fair pricing.

Mr. Hoover also responded to Mr. Gorman's preference that the lateral be placed in Vectren South's rate base as opposed to the costs being recovered via the Fuel Adjustment Clause ("FAC"). Mr. Hoover testified that like IPL and Duke, Vectren South has chosen to have a qualified local distribution company ("LDC") own and operate its gas delivery pipeline. Therefore, the pipeline will not be an electric utility asset and the costs associated with it will be recovered through gas rates.

As to the allegation that Vectren South's owning the gas pipeline as a gas utility asset is anti-competitive, witness Pergola testified on cross-examination that nearly all of the pipeline (more than 22 of the 23 miles of length) is located in Kentucky and therefore presents no opportunity for bypass, because Vectren South does not possess the right to serve customers in Kentucky.

J. Warrick Unit 4.

i. Vectren South. Mr. Wayne Games testified regarding the uncertain future of Warrick Unit 4. Mr. Games explained that Vectren South and Alcoa co-own the unit pursuant to a Joint Operating Agreement ("JOA") whereby each has 50% ownership in the unit. Mr. Games testified that while Warrick Unit 4 will continue to operate in the near term, the long term outlook for the unit is uncertain. He testified the future of the unit is tied to the Alcoa industrial site, and at any time Alcoa could decide to close the smelter unit, which utilizes significant quantities of electricity produced by Warrick Unit 4, based on price volatility in the aluminum market. He testified that the decision to shut down the smelter unit would jeopardize the future of Warrick Unit 4 and this uncertainty makes it difficult to justify investment in the unit or to depend upon it in the long run.

Vectren South witness Carl Chapman also testified regarding the future of Warrick Unit 4. Mr. Chapman testified that Vectren South has agreed to retain its involvement in the unit through 2023 to support the re-opening of the Alcoa smelter. However, he testified beyond 2023 it does not makes sense to continue to invest in a unit that could be subject to shut down if Alcoa decides it has no continuing need for the capacity.

ii. OUCC. OUCC witness Aguilar testified regarding Warrick Unit 4. Ms. Aguilar testified she does not agree with Vectren South's assessments of the risk of continuing to operate Warrick Unit 4 under the JOA and she disagrees with Vectren South's "presentation of the agreement." She further testified that Vectren South could continue to operate Warrick Unit 4 beyond 2023 with environmental compliance updates.

iii. Vectren South Rebuttal. Mr. Games responded to OUCC witness Aguilar's contention that Vectren South could continue to operate Warrick Unit 4 beyond 2023. He testified that due to compliance requirements coming in Alcoa's next National Pollutant Discharge Elimination System ("NPDES") permit, it is anticipated that the unit will require significant capital investment to meet environmental standards in the future. He testified that these investments coupled with the uncertainty related to whether Alcoa will continue to operate Warrick Unit 4[3] under the JOA and performance issues at the unit, warn against continued reliance on Warrick Unit 4.

Mr. Chapman also testified regarding the continued operation of Warrick Unit 4. He testified that the partnership with Alcoa jointly to operate Warrick Unit 4 has become highly uncertain in terms of duration and no longer represents a viable long-term resource option. Mr. Chapman further testified that while Vectren South's IRP recommended retirement of Warrick Unit 4 well before 2023, Vectren South examined each of the coal units to determine whether such units should be retained. He testified that while Culley 3 and Warrick Unit 4 had better profiles in terms of environmental equipment as compared to Vectren South's other units, Culley 3 ultimately had a better operating history based on cost, availability and heat rate. Mr. Chapman reiterated that a strike against continued operation of Warrick Unit 4 is the uncertainty surrounding the longevity of the Alcoa partnership. He reiterated the continued operation of Warrick Unit 4 is dependent on the aluminum market, and if Alcoa's industrial operations cease at the site, the environmental requirements facing Warrick Unit 4 will become significantly more stringent. Mr. Chapman ultimately testified the bottom line is assuming Warrick Unit 4 can continue on post-2023 presents great risk.

As noted previously, in response to our Docket Entry question seeking additional modeling of a portfolio with delayed retirement of Warrick Unit 4, Vectren South indicated that an additional capital investment cost of as much as $50 million may be required to retain the unit if IDEM determines not to renew a variance in the unit's current NPDES permit that allows water discharge at a higher temperature. The new draft renewal NPDES permit allows IDEM to terminate this variance at any time, which will likely require the construction of a cooling tower. Coupled with both Alcoa's and Vectren South's ability to terminate the joint operating agreement, this even further increases the risk of reliance on Warrick Unit 4 beyond 2023.

K. Culley Unit 3. While making investments to preserve some coal-fired generation is not part of the lowest NPV under the 2016 IRP modeling, Vectren South proposes to make investments at Culley Unit 3, its most efficient plant, in order that it may continue to operate beyond 2023. This decision became part of the preferred portfolio as a result of the risk assessment in the 2016 IRP. Preserving Culley Unit 3 promotes greater diversity in fuel sources and it also lessens the impact on the local coal industry. Witness Retherford described the environmental controls that are needed as a result of CCR and ELG. The Culley 3 Compliance Projects consist of (1) conversion of the current wet bottom ash collection system to a dry handling bottom ash system; (2) installation of a spray dryer evaporator system; and (3) the closure of the Culley West ash pond and construction of a new lined process water and storm water retention pond in its place. This new retention pond will be constructed on the location of the existing ash pond due to space limitations. Witness Fischer developed the cost estimates for the former two and Ms. Retherford provided the cost estimate for the latter. Recovery of the associated costs through a rate adjustment mechanism under Ind. Code ch. 8-1-8.4 was opposed by OUCC witness Aguilar and Industrial Group witness Gorman.

[3] With proper notice, Alcoa can also terminate the JOA.

4. <u>Pending Summary Judgment Motion and Motion to Dismiss under T.R. 41(B)</u>. On July 19, 2018, the Coal Parties, Joint Intervenors, Evansville Western Railway, the OUCC, and the Industrial Group filed a Motion for Summary Judgment asking the Commission to vacate the schedule, arguing that we cannot grant Vectren South's request for authority to construct facilities until we have completed a "final" statewide analysis pursuant to Ind. Code § 8-1-8.5-3(a). Alternatively, the Movants asked us to grant them an extension of time to file their pre-filed testimony until at least 45 days after we post a "final" statewide analysis. We took the matter under advisement. At the conclusion of Vectren South's case-in-chief, Alliance Coal made an oral motion to dismiss under T.R. 41(B) on the same grounds. The T.R. 41(B) motion was joined by the OUCC and all of the other Movants except the Industrial Group and Evansville Railway.

In construing a statute, we start with its plain language and "attempt[] to give words their plain and ordinary meanings." *Indiana Wholesale Wine & Liquor Co., Inc. v. State ex rel. Indiana Alcoholic Beverage Com'n*, 695 N.E.2d 99, 103 (Ind., 1998) (citations omitted). "[I]n seeking to give effect to the legislature's intent, [the court] read[s] an act's sections as a whole and strive[s] to give effect to all of the provisions so that no part is held meaningless if it can be reconciled with the rest of the statute." *Fort Wayne Patrolmen's Benev. Ass'n, Inc. v. City of Fort Wayne*, 903 N.E.2d 493, 497 (Ind. Ct. App., 2009) (citation omitted).

The Motion is based primarily on Section 3(a) of Ind. Code § 8-1-8.5, which provides that "[t]he Commission shall develop, publicize, and keep current an analysis of the long range needs for expansion of facilities for generation of electricity," and Section 3(c), which provides that "[t]he commission shall consider the analysis in acting upon any petition by any utility for consideration." The Movants interpret these provisions to mean that we cannot consider a certificate of public convenience and necessity ("CPCN") request absent a "final" statewide analysis. We disagree.

Neither provision requires or implies there must be a "final" or conclusive statewide analysis. Nor does any other provision in Chapter 8.5. Section 3 directs us to undertake an "analysis" that is subject to ongoing review and revision. An analysis that must remain "current" cannot possibly remain static or culminate in a finished product. We find that the analysis detailed in the draft and final versions of the Statewide Analysis meets the requirements of the statute.

To the extent the Movants argue that we cannot grant Vectren South's Petition until we complete our annual report on the analysis, their Motion also fails.

Section 3(h) requires us "[e]ach year" to "submit to the governor and to the appropriate committees of the general assembly a report of its analysis regarding the future requirements of electricity for Indiana or this region." Ind. Code § 8-1-8.5-3(h). Section 5(b)(2) provides that a certificate may be granted if the Commission finds the project (A) "will be consistent with the Commission's analysis (or such part of the analysis as may then be developed, if any)"; or (B) is "consistent with a utility's specific proposal submitted under Section 3(e)(1) of this chapter and approved under subsection (d)." Ind. Code § 8-1-8.5-5(b)(2)(A) and (B).

This unambiguous language reflects the Legislature's understanding that new generation needs may arise at a time while the analysis or even the annual report is being developed or under revision. The Legislature granted the Commission authority to issue a CPCN rather than hold the request in abeyance until the annual report is issued.

It must be presumed that "'the legislature intended the language used in the statute be applied logically and not to bring about an unjust or absurd result.'" *D.B. v. Review Bd. of Indiana Dept. of Workforce Development*, 2 N.E.3d 705, 710 (Ind. Ct. App., 2013) (quoting *Penny v. Review Bd. of Ind. Dep't of Workforce Dev.*, 852 N.E.2d 954, 960 (Ind. Ct. App., 2006), trans. denied). Reviewing bodies also avoid "interpreting a statute in such a manner as to render its provisions mere surplusage." *Id.* (citing *In re Adoption of D.C.*, 887 N.E.2d 950, 959 (Ind. Ct. App., 2008). The Legislature cannot have meant for the Commission to hold off assessing petitions until its analysis becomes "final" (which will never occur), or even until its annual report is submitted. Thus, the statute is clear that in considering a CPCN request, pursuant to Section 5(b)(2) we can rely on whatever current statewide analysis exists or simply determine whether the proposal is consistent with the utility's own plan and reports.

In sum, the Commission retains authority to review a project at any time. Ind. Code § 8-1-8.5-5.5 expressly allows us to "commence a review of any certificate granted under this chapter" when, "in the opinion of the commission, changes in the estimate of the probable future growth of the use of electricity" call for such review. Further, "[i]f the commission finds that completion of the facility under construction is no longer in the public interest, the commission may modify or revoke the certificate." Id.

For all of the foregoing reasons, and each of them, the Motions for Summary Judgment and for Dismissal under T.R. 41(B) are denied.

5. <u>Commission Discussion and Findings</u>.

A. <u>Vectren South's Request for a CPCN for a CCGT</u>. Vectren South requests a CPCN for a proposed CCGT (approximately 850 MW) to be constructed at the current site of the A.B. Brown power plant in Posey County. Under Chapter 8.5, a public utility may not begin the construction, purchase or lease of any steam, water, or other facility for the generation of electricity to be directly or indirectly used for the furnishing of public utility service without first obtaining from the Commission a certificate that public convenience and necessity requires, or will require, such construction, purchase or lease.

In considering a CPCN request, Chapter 8.5 requires the Commission to consider options other than the construction, purchase, or lease of an electric generating facility. *See* Ind. Code § 8-1-8.5-4.

Further, Ind. Code § 8-1-8.5-5 sets forth specific findings the Commission must make in order to approve and grant the requested CPCN. First, the Commission must make a finding, based on the evidence of the record, as to the best estimate of construction costs. Second, the Commission must find that either (a) construction will be consistent with the Commission's Statewide Analysis, if any, for the expansion of electric generation facilities, or (b) the proposed construction is consistent with a utility-specific proposal as to the future needs of consumers in the State of Indiana or in the petitioning public utility's service area [i.e., the utility's IRP]. Third, the Commission must find that public convenience and necessity require the facilities for which the CPCN is requested.[4]

[4] A fourth finding relating to coal-consuming facilities, pursuant to Ind. Code § 8-1-8.5-5(b)(4), does not apply to the proposed natural gas facilities.

"We have indicated in previous CPCN cases that 'least-cost planning' is an essential component of our [CPCN] law." *Joint Petition of PSI Energy, Inc. and CINCAP VII, LLC*, Cause No. 42145, at 4 (IURC Dec. 29, 2002), *quoting Southern Indiana Gas & Electric Co.*, Cause No. 38738, at 5 (IURC Oct. 25, 1989). "We have defined 'least-cost planning' as a 'planning approach' which will find the set of options most likely to provide utility services at the lowest cost once appropriate service and reliability levels are determined." *Id.* "However, we have emphasized that the [CPCN] statute does not require the utility to automatically select the least cost alternative. Nor does the statute require the utility to ignore its obligation to provide reliable service or to disregard its exercise of reasonable judgment as to how best to meet its obligation to serve." *Id.* As this Commission has previously ruled: "[i]f an Indiana utility reasonably considers and evaluates the statutorily required options for providing reliable, efficient, and economic service, then the utility should, in recognition that it bears the service obligations of IC 8-1-2-4, be given some discretion to exercise its reasonable judgment in selecting the option or options to implement which minimize the cost of providing such service." *PSI Energy, Inc.*, Cause No. 39175, at 14 (IURC May 13, 1992); *see also Joint Petition of PSI Energy, Inc. and CINCAP VII, LLC*, Cause No. 42145, at 4.

The pre-approval of long-lived power plant investment and the concurrent regulatory assurance of that investment's recovery is, at its base, the creation of fixed costs that customers will be required to pay several years into the future, perhaps as long as 30 years or more into the future. Accordingly, our consideration in this and other pre-approval requests, especially in periods of seemingly quickening technological change, must not ignore the risk that any such investment may become uneconomic over the long-term. We must acknowledge that the economic forces at work may come from other supply side options or even demand side opportunities. The supply side and demand side certificating statutes implicate this by recognizing that an optimal balance of energy resources should consider both aspects in meeting customer needs.[5] A complication in the optimizing effort is the often disparate time horizons of the supply and demand sides of the balance. The inability to adjust the long-lasting nature of the supply side of the equation in the event market conditions or demand side expectations change in a lesser time horizon introduces a risk that some measure of the supply side investment may become uneconomic within its lifetime.[6] Demand side efforts by customers as a result of the uncontroverted improving economics of customer-scale generation resources may further compound the challenge of the optimal balancing act. Reducing demand in the near term does not necessarily correspond with reduced assured supply side investment cost recovery.[7] Because unwinding assured cost recovery should an asset become uneconomic is not a commonly employed regulatory option, it is prudent to ensure during the pre-approval process that we understand and consider the risk that customers could sometime in the future be saddled with an uneconomic investment. Outcomes that reasonably minimize such potential risk and serve to foster utility and customer flexibility in an environment of rapid technological innovation on both the utility and customer side of the meter are, therefore, a lens through which we will review Vectren South's request.

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[5] Indiana Code §§ 8-1-8.5-4 and -10(c)(3).

[6] This effect can be see through the recovery of lost revenues a statutory component of utility DSM programs, which is in part a function of investment, of fixed cost, that is not being consumed at the expected rate.

[7] This timing inconsistency can reduce the value of demand side efforts because they are not avoiding long-lived fixed costs previously approved and included in rates. The full incremental impacts of demand side actions which occur after the approval of long-lived fixed costs are only affected over longer periods of time when future resources must be acquired and the timing and type of resource might change as a result of cumulative demand side activities.

i. Ind. Code §§ 8-1-8.5-4.

(1) Ind. Code § 8-1-8.5-4(1). In evaluating a utility application for approval to construct new generation, the Legislature has directed us to take into account the utility's "current and potential arrangements with other electric utilities for (A) the interchange of power; (B) the pooling of facilities; (C) the purchase of power; and (D) joint ownership of facilities."

As a member of MISO, Vectren South interchanges power on a daily basis, and Vectren South's modeling considered and factored this arrangement into its decision to seek a CPCN. In addition, early in its resource selection process Vectren South identified a potential partner for a joint generation project. Witness Luttrell explained that this partner was interested in owning a minority share of a larger CCGT, and agreed to study locating such a unit on Vectren South's system. As studies ensued, the partnership appeared to be a viable resource option. As a result, the parties studied this joint ownership opportunity throughout 2017, but ultimately in January 2018 the potential partner provided notice that it would not proceed with such a project. Both Vectren South and the Commission have considered the interchange of power and pooling of facilities.

When assessing a CPCN petition, the Commission also considers the potential purchase of power by Vectren South. On June 20, 2017, Vectren South issued a RFP for dispatchable resources located in MISO Zone 6. Vectren South explained that its RFP specified this location requirement in order to satisfy MISO's requirement that a load serving entity have at least 67% of its resources located within its zone. The RFP sought dispatchable resources based upon the 2016 IRP analysis, which recommended that Vectren South retire nearly all of its baseload coal-fired capacity by the end of 2023. As a result, the RFP was designed to solicit baseload capacity to replace the 730 MWs provided by the retiring coal units. In response, Vectren South received nine qualified bids offering both PPAs and offers to build a CCGT and sell that unit or a partial interest in that unit to Vectren South. Using the expertise of Burns & McDonnell ("BMC"), Vectren South evaluated both quantitative and qualitative aspects of the competing bids. Based on BMC's analysis of the levelized cost of energy ("LCOE") of the bids, Vectren South selected the bid with the most favorable LCOE to compare to a self-build option. BMC's analysis was that Vectren South's self-build option had a better net present value than this best bid, and also exposed Vectren South to less risk versus long-term reliance on a merchant developer. Vectren South's rebuttal testimony noted that the merchant developer in question had in fact, even prior to its bid submission, withdrawn its project from the MISO queue without informing Vectren South.

The Commission acknowledges Vectren South's issuance of an RFP but believes the RFP was unduly restrictive given the rapid changes in technology and costs being seen in the market, especially regarding renewable energy. The narrow RFP with its focus on a large baseload dispatchable resource limited the options Vectren South evaluated to those larger than 600 MW. As a result, Vectren South foreclosed consideration of combinations of smaller resources that might have offered greater resource diversity, flexibility and cost efficiencies than reliance on the acquisition of a single large natural-gas facility. As discussed further below, expansion of the RFP to consider a broader spectrum of resource options would have also gone a long way to improve the metrics to limit risks from exposure to changes in market conditions and technologies.

Based on Vectren South's unduly restrictive RFP the Commission cannot conclude that Vectren South thoroughly evaluated the purchase of power in connection with Vectren South's request.

(2). Ind. Code § 8-1-8.5-4(2).

(a) The Refurbishment of Existing Facilities. In acting upon a petition for the construction of an electric generation facility, we must consider other methods for providing reliable, efficient, and economical electric service, including the refurbishment of existing facilities. Ind. Code § 8-1-8.5-4(2). Ms. Aguilar summarized the following alternatives that Vectren South failed to fully analyze: (1) Retain Coal at Vectren South's existing plants and invest in refurbishments; (2) Retain the agreement with Alcoa for Warrick Unit 4; (3) Refuel the A.B. Brown unit(s) with gas; (4) A blended option, such as refueling one or more A.B. Brown units to gas and building a smaller CCGT; (5) Enter into a PPA with one of the bidders who responded to Vectren South's RFP; and (6) Retain its Broadway Avenue Unit 2. Pub. Ex 1, p. 8. Ms. Aguilar argued that Vectren South unfairly screened out these alternatives during the IRP process.

We agree with Ms. Aguilar and Dr. Boerger that Vectren South did not fully consider options to extend the life, or refurbish, existing units as required by Ind. Code § 8-1-8.5-4(1). *Id.* and Pub. Ex. 3, p. 6. This failure began during Vectren South's IRP process, when Vectren South screened out, without further study, viable refurbishment options. Pub. Ex. 1, p. 11. Vectren South's stated reason for shutting down the A.B. Brown units is premised on the need to replace the flue-gas desulfurization ("FGD") units at a cost of approximately $350 million. Pub. Ex. 3, p. 7. Dr. Boerger stated that with the exception of the current FGDs, the units operate quite well and are sized appropriately for a small utility like Vectren South. But as noted by Ms. Aguilar and Dr. Boerger, Vectren South's chosen FGD replacement technology was the most expensive and only technology reviewed. *Id.,* Pub. Ex. 3. Dr. Boerger pointed out that Vectren South did not consider lower-cost FGD replacement options, even though such options were available. He said that this decision made the continued use of the A.B. Brown units look less attractive in modeling than if those options had been included. A reasonable alternative would have been the refurbishment of these units through refueling. Pub. Ex. 3, p. 7. Refueling is viable, proven technology that could be accomplished at a fraction of the price of the CCGT – approximately $45 million for both A.B. Brown units.

Vectren South considered a smaller 440 MW CCGT option in its last IRP, but Vectren South did not include it as part of any refueling options. Pub. Ex. 3, p. 9. Further, when Vectren South issued its RFP, it did so for 600-800 MW of dispatchable power, precluding smaller units that might have combined with refurbishment of other Vectren South units. Tr. B-25 - B-26. Vectren South did not fully model the conversion of one of the A.B. Brown units in its rebuttal testimony. Tr. E-45 – E-46.

On cross-examination, Vectren South witness Mr. Swiz estimated that the value of the stranded assets at the A.B. Brown unit alone will equal $220 million and that the system-wide total will be $270 million. While Vectren South argues that the CCGT option is the lowest cost, we find for the many reasons stated throughout this Order, including Vectren South's failure to sufficiently consider the refurbishment and continued operation of its existing facilities, we are not able to verify this claim. Through the lens of minimizing risk and providing future flexibility the refurbishment option would seem to provide a potential bridge to the future, providing system capacity value that was not sufficiently evaluated. This conservative solution and risk avoidance strategy stands in stark contrast to proposed CCGT. Vectren South plans to submit a new IRP in 2019. We instruct Vectren South to closely consider our analysis in this Order and the Director's Report on the 2016 IRP of the flaws in their modeling for the 2016 IRP and the 2017 IRP Update and to present a more thorough

analysis that fully evaluates all possible options for continuing to provide reliable, efficient, and economical electric service.

(b) Conservation and Load Management. The evidence demonstrates that Vectren South has evaluated the CCGT against other reasonable generation alternatives, and included demand side management and energy efficiency ("DSM/EE") levels consistent with the targets approved in Cause No. 44927. Vectren South's modeling concludes that, even when the cost of energy efficiency has been significantly lowered, the CCGT is still the least cost reliable resource alternative to meet Vectren South's customers' future energy resource needs.

The Joint Intervenors criticize the assumptions used by Vectren South to model the cost of DSM/EE, arguing that the assumptions used by Vectren South were too high resulting in a higher cost of DSM/EE. Ms. Harris stated in her rebuttal that for purposes of this proceeding, Vectren South opted only to update its growth factors in its revised cost analysis in order to show the impact lower DSM/EE costs would have on the energy resources selected in its IRP. Ms. Harris explained that limiting the updates to the growth factors preserved the integrity of Vectren South's 2016 IRP. Petitioner's Exhibit No. 8-R, p. 3. We find that while some of the cost assumptions used by Vectren South could have been updated, on the whole it does not render Vectren South's analysis of DSM/EE unreasonable.

(c) Cogeneration and Renewable Energy Sources. Vectren South's IRP modeling process considered the potential for cogeneration facilities to serve its customers and adjusted its load forecast to reflect the potential for cogeneration facilities. Petitioner's Exhibit No. 5, Attachment MAR-1, pp. 99-103. Consequently, the potential for customer-owned generation resources, including renewable generation, to reduce Vectren South's load was evaluated as part of the IRP process that concluded the CCGT was necessary as part of least-cost planning. Nonetheless, while Vectren South may have considered renewable energy in the IRP, there is a lack of evidence that Vectren South made a serious effort to determine the price and availability of renewables. In addition, the economics of customer-scale renewable and cogeneration facilities appears likely to continue to improve and we anticipate that additional well-developed efforts to understand their customers' interest would serve to provide clarity to the lens of risk avoidance by minimizing the potential for unexpected demand side efforts. Therefore, we would expect Vectren South to ensure an enhanced consideration of renewable energy and customer-generator opportunities in future IRPs.

(3) Ind. Code § 8-1-8.5-5. A certificate may be granted only if the Commission makes the followings findings:

(a) Best estimate of construction, purchase, or lease costs based on the evidence of record. The cost estimates for Vectren South's proposed CCGT were developed and presented by witness Diane Fischer. Black & Veatch developed a design basis and conceptual design and thereafter developed a cost estimate. Several conceptual designs were first developed. From that, ten plant alternatives for purposes of estimating costs were identified. This was later narrowed to seven alternatives for which detailed costs were developed. Competitive bids were obtained for the equipment and materials. Based upon Black & Veatch's experience as an engineering, procurement and construction ("EPC") contractor, Black & Veatch was able to estimate indirect costs, contingency, overhead, and profit for the EPC contractor. Bids were also received for construction. Ultimately, Ms. Fischer testified that the cost estimate for the proposed CCGT had been refined to +/- 10%. The total estimated project cost (excluding owner's costs) was $582,000,000. The owner's

costs were then provided by witness Games, including insurance, contingency, study, and AFUDC. The total cost estimate was $781,000,000.

(b) Consistency of the CCGT with Vectren South's Utility-Specific IRP and the Statewide Analysis. Ind. Code § 8-1-8.5-5(b)(2)(A) directs the Commission to determine whether Vectren South's proposed construction of a new CCGT will be consistent with the Commission's 2018 Statewide Analysis. The final version of that report was issued after the parties' pre-filing deadline, but before the evidentiary hearing and was admitted into evidence as Pet. Admin. Not. Ex. 2. Included in that report is a synopsis of information taken from the most recent IRP projects of Indiana utilities, including Vectren South.

In Appendix 12 of the Statewide Analysis, the concept of Resource Diversity is explained:

> In an electric system, resource diversity may be characterized as utilizing multiple resource types to meet demand. A more diversified system is intuitively expected to have increased flexibility and adaptability to: 1) mitigate risk associated with equipment design issues or common modes of failure in similar resource types, 2) address fuel price volatility, and 3) reliably mitigate instabilities caused by weather and other unforeseen system shocks. In this way, resource diversity can be considered a system-wide tool to ensure a stable and reliable supply of electricity. Resource diversity itself, however, is not a measure of reliability. Relying too heavily on any one fuel type may create a fuel security or resilience issue because the level of resource mix diversity does not correlate directly with a resource portfolio's ability to provide sufficient generator reliability attributes.

Vectren South's proposal to concentrate its base load capacity from five different generating units located at three different sites down to just three generating units (one of them constituting 70% of Vectren South's baseload capacity) located at two sites appears to be contrary to the concept of resource diversity.

On page 5 of the 2018 Statewide Analysis it says:

> A key consideration in long-term resource planning is the need to retain maximum flexibility in utility resource decisions to minimize risks. An IRP developed by a utility should be regarded as illustrative and not a commitment for the utility to undertake.

In explaining the importance of sound long-range planning on page 56 of the 2018 Statewide Analysis, it says, "[t]he credibility of the analysis is critical to the efforts of Indiana utilities to maintain as many options as possible, which includes off ramps, to react quickly to changing circumstances and make appropriate changes in the resources." However, we find nothing in Vectren South's evidence convinces us that its proposal provides any off ramps that would allow Vectren South to react to changing circumstances and make appropriate changes in resources. To the contrary, Vectren South's proposal seems to close most off ramps for the foreseeable future.

The parties offered diametrically opposed views on the modeling offered to support the CPCN, with Vectren South pointing to its CCGT conclusion as consistent with its IRP. But that conclusion is but one part of the analysis. We have criticized utilities in the past for modeling infirmities and even penalized a utility for analysis we found lacking. In IPL's MATS case, we ordered a $10 million credit to customers to "send[] an appropriate message" to the utility. *Indianapolis Pwr. & Light Co.*, Cause No. 44242, 2013 WL 4479081 *38, 307 P.U.R.4th 311, Order p. 36 (IURC Aug. 14, 2013). We found IPL's cost/benefit study "disappointing" and noted our own "responsibility to insure that the regulatory process involves the presentation of the best evidence possible, given the facts and circumstances of a particular case." *Id.* at 35.

At the outset, Mr. Games testified that Vectren South sent a request for information ("RFI") to original equipment manufacturers ("OEM") for CCGT pricing information before Vectren South's 2016 IRP. Tr. E-89 – E-91. Mr. Chapman stated that under any of the IRP models, the CCGT is the least expensive. Tr. A-27 - A-28.

Dr. Boerger testified that Vectren South did not consider other viable options such as refueling and smaller combinations of generation assets to meet its needs, Pub. Ex. 3, p. 1 – p. 2, which would be more prudent for a small utility like Vectren South. Pub. Ex. 3, p. 5. Vectren South excluded possible options such as maintaining Culley 2, Pub. Ex. 3, pp. 11-12, and did not allow the refueling of the A.B. Brown units to be included in any of its model runs. *Id.* Vectren South kept a smaller, 440 MW CCGT from being combined with a refueled A.B. Brown unit. Pub. Ex. 3, p. 13. Mr. Games admitted that Vectren "never [ran] a risk analysis of portfolios including a 1 X 1 CCGT instead of a 2 X 1[.]" Tr. E-50. Vectren South also did not allow for proposals of joint projects to be built at it's A.B. Brown site, which would eliminate the potential for congestion problems Vectren South identified as a problem in its RFP responses. Vectren South's Strategist model limited the amount of capacity purchases that a given portfolio could make. Tr. D-73. This had the effect of automatically screening out PPAs that could have been combined with other resources to meet Vectren South's capacity needs. The Director's Report on Vectren South's 2016 IRP noted that Vectren South failed to model a wide range of gas prices, making the "range of fuel price projections… unduly limited[,]" Tr. D-85, and Vectren South's re-run of gas costs did not model higher prices in a wide enough range. Tr. D-86. As noted by Mr. Alvarez, Vectren South's model retired the BAGS 2 unit in 2024 without evidence of any engineering reason to do so. Pub. Ex. 2, pp. 13-14.

Dr. Boerger also found that Vectren South modeled the cost of its proposed CCGT to be $200 million less than the cost of the project presented in the testimony of Vectren South witness Games. Pub. Ex. 3, p. 2. The consequence of excluding $200 million in Vectren South's NPV calculation had the effect of making the CCGT option look more favorable. Pub. Ex. 3, p. 14. Without adding the $200 million back into the model runs, Vectren South's analysis is skewed. Pub. Ex. 3, p. 18 – p. 19. Mr. Games admitted that his testimony about the estimates was confusing, stating "[w]e started off with 2017 dollars, and those were -- then overheads were added, anticipated profit with the EPC, contingency for EPC, and escalation was added to get to the 582 million." Tr. E-15 – E-16. Mr. Lind took issue with Dr. Boerger's analysis, but admitted that Vectren South did not include $130 million in owner's costs when it compared its self-built CCGT to other options offered in the RFP and otherwise. Tr. A-36 – A-38; Tr. D-7 – D-8. When questioned why BMC did not use the $781 million figure, Mr. Lind stated that the $630 million estimate used for modeling was a +/- 50% estimate; the $781 million had a more certain +/- 10% range of accuracy. Tr. A-35; Tr. C-61 - C-62, C-74. BMC's projected cost of $580 - $650 million was used to weigh the economics of potential projects. Tr. A-

36 – A-38. And Vectren South witness Mr. Vicinus ran his "low regulatory" model using the $630 million estimate. Tr. D-98.

In response to the OUCC's criticism of its modeling, Vectren South's rebuttal included a new model run that refueled one of the A.B. Brown units, and added 200 MW of solar. Tr. D-12 – D-13. Vectren South used this rebuttal modeling to try to reinforce its original request for a 850 MW CCGT. Both Mr. Lind and Mr. Games acknowledged, however, that the addition of 200 MW of solar was not the best choice to meet MISO's PRM, because MISO would only give Vectren 100 MW of credit for the 200 MW of solar. Tr. E-15. The revised model also did not take into account the fact that solar costs between $1,200 - $1,800 per MW, Tr. D-16 – D-17, and Vectren South did not model any storage to counter the inherent intermittency of solar resources. Tr. D-14.

While we find Vectren South's request is "consistent" with its 2016 IRP, the subsequent modeling for this case effectively screened out multiple less-expensive alternatives. Vectren South did not allow its models to choose refueling or smaller units in combination. While Vectren South's rebuttal modeling runs included refueling of the A.B. Brown units in various configurations, the rebuttal modeling was not used to make Vectren South's decision of what generation form to choose. Tr. D-14. We view the rebuttal modeling as an after-thought used to buttress Vectren South's initial request.

Vectren South had sufficient time to conduct its analysis in a way more open to smaller-scale options that would correct the modeling deficiencies that have been identified. It seems straight-forward to suggest that smaller-scale options, especially for a relatively small electric utility, serve to minimize the risk should a challenge arise at any one option. As noted above, minimizing supply side long-term investment risk in an environment of rapid technological innovation is an attractive characteristic in a utility resource proposal. Vectren South should use its scheduled 2019 IRP process to address problems in its modeling, incorporate more options for partnering with other entities and competitive inquiries into smaller-scale options that can be acted upon swiftly to meet the end-of-2023 date upon which additional capacity may be needed.

(c) Public Convenience and Necessity. Ind. Code § 8-1-8.5-5(b)(2) requires that we find that public convenience and necessity requires or will require the proposed CCGT. Such consideration of the public interest is not only a statutory requirement at the outset but would become a continuing obligation should the Commission grant a CPCN. Ind. Code § 8-1-8.5-5.5 provides that if, after granting a CPCN for construction of a new generator, "the commission finds that completion of the facility under construction is no longer in the public interest, the commission may modify or revoke the certificate."

"[P]ublic interest may be taken to encompass a wide range of considerations, from environmental, health, and safety concerns, to the financial concerns of employers, employees, and ratepayers." *General Motors Corp. v. Indianapolis Power & Light Co.*, 654 N.E.2d 752, 762 (Ind. Ct. App., 1995). In *General Motors*, the court approved the Commission's consideration of the impact on employment in the coal industry in its public interest determination. *Id.*

The parties dispute whether Vectren South accurately and adequately evaluated risk in its analysis of alternative portfolios and selection of the proposed CCGT. As noted earlier, under Ind. Code § 8-1-8.5-4, we are required to take into account other methods for providing reliable, efficient,

and economical service, and we find utility risk analyses play an important role in comparing alternative portfolios.

Joint Intervenors argued that Vectren South's risk analysis is inadequate for multiple reasons. Joint Intervenors note that the risk analysis has not been updated since the 2016 IRP, despite Vectren South having updated inputs available for several inputs, including the estimated cost of its preferred build, and adequate time to re-run the model. Joint Intervenors complain that Vectren South ignored known material risks in a manner that biased results in favor of its preferred portfolio, including taking a one-sided view of capacity purchase and market purchase risks and failing to consider the potential for future methane regulations. Joint Intervenors further argue that Vectren South arbitrarily scored several metrics and designed others to conceal rather than measure obvious risks of the preferred portfolio.

We find merit in several of Joint Intervenor's critiques and are further concerned that Vectren South has not fully responded to critiques in the Final Director's Report on the 2016 IRPs. We agree that Vectren South had adequate time and opportunity to update its risk analysis modeling prior to this filing, and that it has sufficient time to do so now before moving forward. Vectren South updated inputs in its possession for multiple factors, including: solar capital costs; variable production costs and revenue requirement assumptions for existing units; forecasted cost for wholesale market capacity and energy; delivered fuel prices for gas and coal; and costs associated with new energy efficiency programs. Pet. Ex. 6 at 9-10. Vectren South also had a higher capital cost estimate for its preferred build. We know Vectren South had time to use these inputs to re-run the model because (a) it did just that with some of its Strategist modeling and (b) Mr. Vicinus testified that it would have taken just three months to re-run the risk analysis modeling. Tr. p. D-66. Mr. Vicinus opined that updated risk modeling would not change the result, but we are skeptical given the number and import of the updated inputs and the significance of the proposed portfolio changes. *See Indianapolis Pwr. & Light,* Cause No. 44339, 2014 WL 2091348, Order p. 27 (IURC May 14, 2014) ("[W]e believe that IPL could have reasonably updated the [model] given the extent of changes in data inputs and assumptions and provided a more robust analysis."). Before proposing a portfolio change of this magnitude, Vectren South should have taken the three months necessary to update its risk analysis modeling. Updated risk modeling may not be necessary in all cases, but it is warranted here given the size and cost of the proposed CCGT.

We are further concerned that Vectren South appears not to have accounted for material risks associated with its preferred portfolio. As we have previously stated, "it is appropriate that modeling take into consideration reasonable risks and unknowns." *Indianapolis Pwr. & Light Co.*, Cause No. 44794, 2017 WL 1632316, Order p. 28 (IURC Apr. 26, 2017). Joint Intervenors point out that Vectren South's risk analysis took a one-sided view of capacity purchase and market purchase risks. *See* JI Ex. 2 at 43; Vicinus Rebuttal. Vectren South offered no rebuttal explaining its one-sided view of market risk, which assumed surplus capacity and generation offers only benefits to ratepayers. JI Ex. 2 at 20-21. That view of market purchases is only true when market prices and/or load are high. JI Ex. 2 at 21. Further, Vectren South's Docket Entry response of October 5, 2018, presents portfolio results that suggest the material weight at which opportunity sales influences the analysis.[8] Heavy dependence on market revenues to support a regulated investment choice is a speculative influence that we find must be materially discounted to limit the risk of customers being saddled with

[8] The submitted table indicates that the advantage of the Preferred Portfolio in comparison to (1) BAU to Gas Conversion escalates from 1.3% to 3.5% when the opportunity sales sharing moves from 50% to 100%.

uneconomic options should such speculation unfold differently than forecasted. A metric biased in favor of portfolios with surplus generation is speculation we decline to embrace.

Vectren South's own witnesses and others acknowledged risks related to relying on gas generation, but Vectren South only considered carbon dioxide emission reductions when it evaluated environmental risk. We agree that was too narrow an approach to environmental risk and one that biased the analysis in favor of gas-fired generation.

The Commission appreciates the metrics developed and used by Vectren South in the 2016 IRP, but we agree with the Joint Intervenors that the use of these particular metrics also obscured critical characteristics of the preferred portfolio. One of Vectren South's IRP objectives was to develop a plan with flexibility to adapt to market conditions and technological change to minimize risks to shareholders and customers. Specific metrics to measure resource portfolio balance and flexibility included concentration on one technology, the number of technologies and having resources remote from Vectren South's load. A critical piece of information these metrics overlook is that the acquisition of an 850 MW resource must be evaluated relative to the load to be served. Vectren South's 2016 IRP Base peak load forecast is for the summer peak to increase from 1,109 MW in 2019 to 1,198 MW in 2036. The acquisition of an 850 MW generation facility represents approximately 77 percent of the 2019 peak load and just under 71 percent of the summer peak load for 2036. We are hard pressed to see how reliance on one facility for so much of the Vectren South system requirements is consistent with maintaining flexibility to respond to changing market conditions and technological change.

Therefore, we conclude that Vectren South's risk analysis does not adequately consider the relative risk of other methods for providing reliable, efficient, and economical electric service. The proposed large scale single resource investment for a utility of Vectren South's size does not present an outcome which reasonably minimizes the potential risk that customers could sometime in the future be saddled with an uneconomic investment or serve to foster utility and customer flexibility in an environment of rapid technological innovation. As a result, we find that Vectren South has not demonstrated through the evidence of record that the public convenience and necessity require the building of an 850 MW CCGT. Therefore, Vectren South's request for a CPCN to construct a 850 MW CCGT is denied.

B. <u>Vectren South's Request for a CPCN for Culley compliance projects and related relief</u>. Vectren South's preferred portfolio also includes the construction of various environmental projects that Vectren South contends are needed so that Culley Unit 3 can continue to operate beyond 2023. Vectren South's petition seeks relief for these projects under Ind. Code ch. 8-1-8.4 as "federally mandated" projects.

i. <u>Ind. Code ch. § 8-1-8.4 ("Chapter 8.4")</u>.

(1) <u>Federally Mandated Requirements (Ind. Code §§ 8-1-8.4-5 and 8-1-8.4-6(b)(1)(A) and 8-1-8.4-7(b)(3))</u>. Ind. Code § 8-1-8.4-5 defines a federally mandated requirement to include "a requirement that the commission determines is imposed on an energy utility by the federal government in connection with any of the following: (2) The federal Water Pollution Control Act (33 U.S.C. 1251 *et seq.*)" and also includes "(7) Any other law, order, or regulation administered or issued by the United States Environmental Protection Agency, the United States

Department of Transportation, the Federal Energy Regulatory Commission, or the United States Department of Energy."

The description of the Culley 3 Compliance Projects was set forth in the direct testimonies of Ms. Fischer and Ms. Retherford. The Culley 3 Compliance Projects consist of (1) conversion of the current wet bottom ash collection system to a dry handling bottom ash system; (2) installation of a spray dryer evaporator system; and (3) the closure of the Culley West ash pond and construction of a new lined process water and storm water retention pond in its place. This new retention pond will be constructed on the location of the existing ash pond due to space limitations. No party disputed that the dry handling bottom ash conversion or spray dryer evaporator system qualify as compliance projects to meet federally mandated requirements. The OUCC challenged whether the closure of the existing pond qualified for relief but did not contend that it was not federally mandated. For the reasons described below, we find that these projects all constitute compliance projects to meet federally mandated requirements as those terms are defined in Ind. Code §§ 8-1-8.4-2 and -5.

Vectren South witness Retherford testified that the dry handling bottom ash system is required to comply with the ELG Rule, which was promulgated under the federal Water Pollution Control Act. Petitioner's Exhibit No. 9, p. 11. The ELG rule prohibits further wet handling of fly and bottom ash. This system will enable ash from Culley Unit 3 to be disposed of in a landfill, hauled back to a surface mine in accordance with applicable surface mining regulation or recycled rather than being washed into the ash pond as part of a water discharge.

Ms. Retherford further explained that the spray dryer evaporator system was necessary to ensure compliance with ELG-imposed limits on FGD wastewater discharge. She noted that this system functions effectively as a ZLD system and enables Vectren South to utilize the alternative ELG-imposed compliance date of December 31, 2023, and to meet future more stringent ELG wastewater discharge limits.

Ms. Retherford testified that construction of a new, lined process and storm water retention pond is required to comply with the ELG Rule. As we have already noted, projects necessary to comply with the ELG Rule, promulgated pursuant to the federal Water Pollution Control Act (33 U.S.C. 1251 *et seq.*), constitute a federally mandated requirement. The only dispute, raised by OUCC witness Aguilar, pertains to Vectren South's plans to close the existing Culley West pond so that the new lined pond can be built at the site. Witness Retherford testified that there are two reasons the Culley West pond is closing: (1) the pond was taken out of service prior to the 2015 deadline and the CCR rule requires that it be closed by 2020; and (2) the current space limitations require that the new stormwater retention and process water pond be constructed on the current location. Thus, there is no dispute that costs associated with the construction of the new lined pond are incurred pursuant to a federally mandated requirement. The dispute is whether the costs to close the Culley West pond so that the new pond can be built on top of that location, also qualify as federally mandated costs.

The OUCC identifies three reasons closure costs for the Culley West pond should not be considered federally mandated costs. First, OUCC witness Aguilar contends that Vectren South has been collecting depreciation and asset retirement costs in base rates, which include the closure of ash ponds. Public's Exhibit No. 1, p. 28. However, Vectren South witness Retherford responded that finalization of the CCR rule on April 17, 2015 imposed more stringent requirements to close the ash pond. The CCR rule imposed an obligation to dewater, cap and/or remove ponded ash. Petitioner's Exhibit No. 9-R, pp. 24-25.

On rebuttal, Mr. Swiz stated Vectren South's existing depreciation rates include an estimated level of cost of removal that was designed well before the implementation of requirements to close the ponds in accordance with the environmental regulations described by Ms. Retherford. The assumed removal costs in the demolition study provided in Cause No. 43839 (Vectren South's most recent general rate case), estimated $1.1 million to close both of the Culley Ash Ponds based on cost of backfill, grading and seeding. By comparison, the estimate for closure of one ash pond in this proceeding is $19.969 million. Petitioner's Exhibit No. 13-R, pp. 6-7; Petitioner's Administrative Notice 1.

Consequently, we find that costs associated with CCR closure have not been included in Vectren South's depreciation rates, which were last updated prior to finalization of the CCR Rule.

Second, the OUCC contends that other utilities are not tracking pond closure costs as Federally-Mandated CCR Projects. Public's Exhibit No. 1, p. 28. Vectren South witness Swiz noted that no utility had proposed such recovery yet but that one utility specifically indicated that it would present closure related activities as recoverable under the Federal Mandate Statute. Petitioner's Exhibit No. 13-R, pp. 6-7. Mr. Swiz explained that Duke, IPL and NIPSCO did not ask for recovery of their pond closure costs in the proceedings Ms. Aguilar cited, and in fact the order in Cause No. 44765 specifically notes that Duke anticipates presenting closure related activities of existing surface impoundments and their associated costs in a future proceeding. Petitioner's Exhibit No. 13-R, p. 6, citing *Duke Energy Indiana*, Cause No. 44765, at *7 (IURC May 24, 2017). Each of the cases Ms. Aguilar cited were settled cases containing non-precedential language. Nevertheless, Mr. Swiz pointed out that the NIPSCO Order in Cause No. 44872, suggests that the OUCC agreed that closure costs can be recovered as federally mandated costs. Petitioner's Exhibit No. 13-R, p. 7.

Third, the OUCC contends that Vectren South should have presented alternative suitable locations to the West Pond for consideration. However, Ms. Retherford testified that the location was chosen because there was limited space at the Culley generating station. In other words, there was not an alternate location to explore. The statutory requirement to consider options does not require a utility to present alternatives that are not practical or feasible. Accordingly, we find the Culley 3 Compliance Projects are all federally mandated requirements and that Vectren South described them in its application.

(2) Energy utilities seeking recovery of Federally Mandated Costs must establish that the costs are incurred in connection with a compliance project, including capital, operating, maintenance, depreciation, tax or financing costs and describe the costs to be recovered. Ind. Code §§ 8-1-8.4-4 and -6(b)(1)(B). We have already found that the Culley 3 Compliance Projects constitute projects required by federally mandated requirements. Consequently, the costs associated with these projects constitute Federally Mandated Costs. These costs will consist of capital, operating, maintenance, depreciation, tax and financing costs. Vectren South identified the estimated costs to be recovered as Federally Mandated Costs. Costs associated with the dry handling bottom ash handling system and spray dryer evaporator system were identified by Vectren South witness Fischer. Petitioner's Exhibit No. 6, pp. 16-18, 26-28. Costs associated with the construction of a new lined process water and storm water retention pond were identified in Ms. Retherford's testimony. Petitioner's Exhibit No. 9, Attachment AMR-1. No party disputed the cost estimates for the Culley 3 Compliance Projects. Based on the evidence presented, we find that Vectren South has identified

federally mandated costs and reasonably described those costs. Those total costs are $95 million, and they are hereby approved. Petitioner's Exhibit No. 4, p. 26.

(3) Compliance with Federally Mandated Requirements (Ind. Code §§ 8-1-8.4-6(b)(1)(C)) and 8-1-8.4-7(b)(3)). No party disputed that the Culley 3 Compliance Projects will allow Vectren South to comply with ELG and CCR or that ELG and CCR are federally mandated. We previously addressed the OUCC's objections related to appropriateness of recovery. We have already found that the ELGs and CCR Rule are federally mandated requirements within the meaning of Ind. Code §§ 8-1-8.4-5 and 8-1-8.4-6(b)(1)(A) and 8-1-8.4-7(b)(3). Based on the evidence presented, we find that Vectren South's Culley 3 Compliance Projects, will allow the utility to comply with the ELGs and the CCR Rule. Therefore, we find that Vectren South has satisfied the requirements of Ind. Code § 8-1-8.4-6(b)(1)(C).

(4) Alternative Plans for Compliance (Ind. Code §§ 8-1-8.4-6(b)(1)(D) and 8-1-8.4-7(b)(3)). Ind. Code § 8-1-8.4-6(b)(1)(D) requires the Commission to examine "[a]lternative plan that demonstrate that the proposed compliance project is reasonable and necessary." Vectren South witness Diane Fischer testified about Black & Veatch's evaluation of the ELG Compliance Program for Culley to identify potential FGD discharge water treatment alternatives and ash transport water alternatives that could be implemented to comply with the ELGs. She sponsored two written reports setting forth Black & Veatch's analyses of the alternatives. Ms. Fischer testified that each of the potential discharge treatment technology alternatives assessed by Black & Veatch were screened for design concept feasibility, capital expense and operating expense.

With respect to FGD discharge water treatment, two main treatment alternatives were considered: (1) FGD treatment and discharge; and (2) zero liquid discharge ("ZLD"). Three technology types were evaluated within these two treatment alternatives: (1) for FGD treatment and discharge, physical/chemical pretreatment with biological treatment technology, (2) for ZLD, spray dryer evaporator technology, and (3) also for ZLD, brine concentrator/crystallizer technology. Ms. Fischer testified that multiple vendors providing such technologies were evaluated. A sensitivity analysis was then performed for each technology and vendor. Ms. Fischer's Discharge Treatment Report also included a cost assessment of all alternatives considered. Petitioner's Exhibit No. 10, p. 7. Ms. Fischer testified that Black & Veatch provided Vectren South with a final overall assessment of each technology and vendor offering based on Black & Veatch's analysis and the following attributes: (1) start-up/ramp up reliability; (2) technology readiness risk; (3) adaptability to sensitivity analysis scenarios; (4) operation and control risk; (5) heat rate impact risk; (6) number of operators; (7) capital and annual O&M costs; (8) susceptibility to future environmental regulations; (9) overall financial stability and credit rating. Black & Veatch ultimately recommended that Vectren move forward to a detailed engineering phase with Stochastic Differential Equation ("SDE") type technology if the maximum FGD wastewater flow rate of between 50 and 80 gpm is achieved through future testing and operations. Ms. Fischer explained the SDE solution ranks the highest among all technologies based on the attributes discussed above and the solution is economically viable and provides a zero discharge solution if the minimum FGD wastewater flow rate of between 50 and 80 gpm is achieved. The conceptual design evaluation indicated the SDE can be feasibly located and tied into the existing equipment at Culley. In addition, Ms. Fischer stated the ZLD solution provides certainty that any future change in EPA regulations would not apply at Culley since there would be no discharge of FGD wastewater.

With respect to ash transport, Ms. Fischer described Black & Veatch's analysis to identify alternative ash transport solutions that could be implemented at Culley to comply with ELG requirements, focused specifically on identifying options for removal and dewatering of bottom ash from the Culley Unit 3 boiler with truck transport and disposal of the dry material at an off-site location. Black & Veatch evaluated two categories of technologies: (1) dry conversion of the bottom ash system and (2) closed loop wet sluicing system. For dry conversion system, Black & Veatch evaluated a submerged chain conveyor under the existing bottom ash hopper. For the closed loop wet sluicing system, Black & Veatch evaluated both a dewatering bunker and a remote submerged chain conveyor. In comparing all technologies, Black & Veatch used the following quality attributes to select the preferred treatment: technical feasibility; total installed cost, O&M cost, estimated additional manpower ("FTE"), estimated footprint, major equipment, advantage, disadvantages and reliability. Ms. Fischer's testimony discussed in detail the advantages and disadvantage of each alternative. Black & Veatch prepared cost estimates for all technologies considered for addressing ash transport water. Black & Veatch ultimately recommended the submerged chain conveyor for Culley 3 compliance with ELG requirements, due to the complexity of design and comparatively higher installed cost of the other alternatives.

The only evidence offered in opposition as being an alternative plan was the OUCC's conclusory statement about possible alternative locations for the new lined pond. As we have previously found, the chosen site was selected because there are no alternative locations.

While the Commission gives significant weight to cost-effective planning and decision making when considering alternatives, the Federal Mandate Statute does not require that a utility demonstrate that the chosen compliance plan is the least cost option. Consistent with the Commission's finding in Indianapolis Power and Light's recent proceeding, Cause No. 44794 (IURC 4/26/2017), p. 30, 2017 Ind. PUC LEXIS 114, *92, (finding "it is important that the Petersburg Station is able to continue to operate on coal and protect customers from potential price volatility in the gas markets"), a reasonable alternative can be, and often is, a solution that includes risk balancing through a diversified portfolio.

Based on the evidence presented, we find that Vectren South considered alternative plans for compliance with the ELGs and the CCR Rule. The evidence shows that the Culley 3 Compliance Projects are reasonable and necessary.

(5) Useful Life of the Facility (Ind. Code §§ 8-1-8.4-6(b)(1)(E) and 8-1-8.4-7(b)(3)). Mr. Games testified that the investments in the Culley 3 Compliance Projects will allow for the continued operation of Vectren South's most efficient coal fired unit. Ms. Retherford described the environmental regulations requiring the Culley 3 Compliance Projects in order for Culley Unit 3 to continue operating. Ms. Retherford explained how closure of the Culley West pond will extend the useful life of Culley 3, because closure of the Culley West pond is necessary to provide a suitable location to construct a new pond that can continue to take non-CCR process water discharged from Culley Unit 3 and plant stormwater (i.e. surface water) which flows into the West Pond. Without this new lined process and stormwater pond, continued operation consistent with applicable regulations would be impossible after the Culley East pond commences closure.

No party disputes that issuance of a CPCN for the Culley 3 Compliance Projects will extend the useful life of Vectren South's Culley 3 unit or that Culley 3 would be required to retire in the near future if the Culley 3 Compliance Projects are not completed.

Based on the evidence presented, we find that Vectren South has satisfied the requirements of Ind. Code § 8-1-8.4-6(b)(1)(E).

(6) Conclusion. We find that the Culley 3 Compliance Projects will allow Vectren South to comply directly or indirectly with one or more federally mandated requirements and that public convenience and necessity will be served by the Culley 3 Compliance Projects.

ii. Accounting and Ratemaking Issues Associated with Culley Compliance Projects. Ind. Code § 8-1-8.4-7(c) states:

> If the commission approves under subsection (b) a proposed compliance project and the projected federally mandated costs associated with the proposed compliance project, the following apply:
> (1) Eighty percent (80%) of the approved federally mandated costs shall be recovered by the energy utility through a periodic retail rate adjustment mechanism that allows the timely recovery of the approved federally mandated costs. The Commission shall adjust the energy utility's authorized net operating income to reflect any approved earnings for purposes of IC 8-1-2-42(d)(3)and IC 8-1-2-42(g)(3).
> (2) Twenty percent (20%) of the approved federally mandated costs, including depreciation, allowance for funds used during construction, and post in service carrying costs, based on the overall cost of capital most recently approved by the commission, shall be deferred and recovered by the energy utility as part of the next general rate case filed by the energy utility with the commission.
> (3) Actual costs that exceed the projected federally mandated costs of the approved compliance project by more than twenty-five percent (25%) shall require specific justification by the energy utility and specific approval by the commission before being authorized in the next general rate case filed by the energy utility with the commission.

(1) Accounting and Ratemaking Treatment for ECA. Vectren South requests authority to implement a new annual rate adjustment mechanism ("ECA") pursuant to Ind. Code § 8-1-8.4-7 for the timely and periodic recovery of 80% of the federally mandated costs. Vectren South also requests approval of proposed changes to its electric service tariff relating to the proposed ECA mechanism, including the proposed Appendix E. Ind. Code §8-1-8.4-8 provides that an energy utility may, in a timely manner, recover 80% of all federally mandated costs through a periodic rate adjustment mechanism. Ind. Code §§ 8-1-8.4-4 and 8-1-8.4-7 provide that such costs include capital, AFUDC, O&M, depreciation, tax, and financing costs.

Vectren South witness Swiz described how the eligible costs associated with the Culley 3 Compliance Projects will be incorporated into the proposed ECA mechanism. He testified Vectren South will prepare in each annual filing a revenue requirement calculation accumulating all eligible costs incurred through December 31 of the previous calendar year. To provide for timely recovery, Mr. Swiz testified the proposed ECA will project an annualized level of expense related to the approved projects for the 12-month effective period. Mr. Swiz stated the annual revenue requirements

will capture eligible new capital investments (both in service and Construction Work in Progress) related to the Culley 3 Compliance Projects, multiplied by the applicable rate of return, with depreciation, O&M and property tax expenses associated with the projects, and recovery of the regulatory assets recorded through interim deferral of depreciation expense, plan development expense, and PISCC, added to the resulting total. The revenue requirement for those projects will be the basis for the recovery of 80% of the eligible revenue requirement amounts in each annual ECA filing.

Mr. Swiz also described Vectren South's proposal to defer and subsequently recover depreciation expense as well as costs associated with development of the Culley 3 Compliance Projects through the ECA. The cumulative deferred balances of the regulatory assets recorded through interim deferral of such depreciation expenses would be amortized over the remaining life of the assets (20 years) and the amortization amount would be included in the ECA revenue requirements. Mr. Swiz stated the costs of development of the projects would be included for recovery within the ECA, with the balance amortized over a period of three years.

Vectren South proposes the pre-tax return on the new capital investment will be calculated by multiplying the pre-tax rate of return, based on the weighted average cost of capital ("WACC"), by total new capital investment related to the approved projects. Mr. Swiz testified Vectren South proposes to use a WACC in the ECA based upon the most recent approved WACC within Vectren South's TDSIC mechanism under Cause No. 44910, which is based on a return on equity ("ROE") of 10.4% as approved in Cause Nos. 43111 and 43839, Vectren South's two most recent base rate cases. Mr. Swiz stated the equity component of the rate used in the ECA revenue requirement calculation will be grossed up for recovery of income taxes, both state and federal, at then current rates.

Mr. Swiz testified that approved recoveries within each ECA filing will be calculated by taking the billing determinants by month multiplied by the applicable rates and charges for the ECA period. Any under recoveries resulting from instances in which ECA rates and charges are not in place for a full month will be recovered as an under-recovery variance in a subsequent ECA proceeding. Vectren South proposes to allocate ECA costs pursuant to the four-coincident peak allocation percentages for Vectren South utilized in its Cause No. 43406 RCRA15 and 43405 DSMA15 rate mechanisms.

With respect to the treatment of operating income, Mr. Swiz testified Vectren South will adjust its statutory earnings test under Ind. Code § 8-1-2-42(d)(3) to include the incremental earnings from approved ECA filings.

Mr. Swiz testified Vectren South proposes to file its ECA petitions and cases in chief annually, on May 1 of each year, with new ECA rates and charges becoming effective August 1 of each year. Each filing will be based on capital investments and expenses through the twelve months ended December of the prior calendar year. Variances will be reconciled in each ECA filing and recovered over the subsequent 12 month rate effective period. Vectren South seeks approval of its proposed Sheet No. 69, Appendix E, Environmental Cost Adjustment. Additional changes to Vectren South's rate schedules in its tariff are needed to reflect that the ECA will be applied monthly.

Industrial Group witness Gorman recommended that the ELG costs associated with the Culley 3 Compliance Projects be recovered within a base rate proceeding and not through the proposed ECA. He cited Vectren South's overall rate of return and stated Vectren South's costs have declined since

the last base rate case. He also suggested that Vectren South should be permitted to recover a return on investment of no more than 9.8%.

Mr. Swiz explained on rebuttal that under the statutory test under Ind. Code § 8-1-2-42(d) and -42.3, performed in Vectren South's most recent FAC proceedings as of the time his rebuttal testimony was filed (Cause No. 38708 FAC 120), Vectren South's comprehensive earnings compared to authorized levels, including both changes in expenses and revenues, show that Vectren South is currently under-earning by approximately $6.5 million of net operating income and has been under-earning since February 2017. Mr. Swiz explained that depreciation and operating expense are driving much of these results, and Mr. Gorman does not capture those expenses in his calculation.

Eligibility for recovery through Ind. Code ch. 8-1-8.4 is not contingent on whether other costs have declined to offset the new federally mandated costs. Once we have made the required findings, 80% of the federally mandated costs "shall be recovered by the energy utility through a periodic retail rate adjustment mechanism." Ind. Code § 8-1-8.4-7(c)(1). In any event, we find that Mr. Swiz has adequately explained why Mr. Gorman's position is incorrect.

Mr. Swiz testified that pursuant to Ind. Code § 8-1-8.4-7, Vectren South seeks ratemaking treatment for 80% of the costs associated with the Culley 3 Compliance Projects through its proposed ECA mechanism. Specifically, Vectren South seeks timely recovery of all federally mandated costs associated with the Culley 3 Compliance Projects, including capital costs, AFUDC, post-in-service carrying cost charges ("PISCC"), O&M, depreciation expense, property tax expense, and other taxes, with 80% recovered through the ECA and the balance deferred for recovery in Vectren South's next rate case.

Vectren South proposes to implement construction work in progress ("CWIP") ratemaking treatment related to the recovery of financing costs incurred during construction of the Culley 3 Compliance Projects. In connection with CWIP ratemaking treatment, Vectren South will remove from the AFUDC-eligible balance the amount of investment included for recovery in the ECA, so that only the amount of the Culley 3 Compliance Projects investment not currently being recovered in the ECA would be eligible for AFUDC.

Mr. Swiz testified that Vectren South proposes to accrue post-in-service carrying charges on all eligible new capital investment from the date it is placed in service until the date it is included in rates. He explained the PISCC balances will be multiplied by the pre-tax rate of return within the ECA revenue requirement, at the WACC rate described herein. Unlike other utilities who have been granted such authority, Vectren South is not seeking to accrue and subsequently recover in the next base rate case PISCC on the 20% deferred balance discussed below.

OUCC witness Aguilar opposed Vectren South's request to recover pond closure costs for the Culley 3 Compliance Projects as part of the ECA because the OUCC's position is that Vectren South is already collecting pond closure costs within its depreciation rates. Ms. Aguilar also testified that neither Duke, IPL, nor NIPSCO are tracking pond closure costs. We have already addressed these positions and rejected them.

Based on the evidence presented, we find that the proposed ECA mechanism should allow for the timely and periodic recovery of 80% of Vectren South's approved federally mandated costs. We further find that Vectren South's request for approval to adjust its authorized net operating income to

reflect an approved earnings associated with the Culley 3 Compliance Project for purposes of Ind. Code §§ 8-1-2-42(d)(3) and 8-1-2-42(g)(3) is consistent with Ind. Code § 8-1-8.4-7(c)(1).

Vectren South is authorized to defer (until captured within the ECA mechanism) and recover 80% of the approved federally mandated costs incurred in connection with the Culley 3 Compliance Projects through the approved ECA Mechanism pursuant to Ind. Code § 8-1-8.4-7, including capital, O&M, depreciation, taxes, financing, and carrying costs based on the current overall WACC and AFUDC. Vectren South is authorized to utilize CWIP ratemaking treatment for the Culley 3 Compliance Projects through the proposed ECA mechanism. Vectren South is authorized to defer post-in service costs of the Culley 3 Compliance Projects, including carrying costs based on the current overall WACC, depreciation, taxes and operating and maintenance expenses on an interim basis until such costs are recognized for ratemaking purposes through Vectren South's ECA mechanism or otherwise included for recovery in Vectren South's base rates in its next general rate case. Vectren South is authorized to defer and recover through the ECA mechanism 80% of its federally mandated costs, including but not limited to federally mandated costs incurred prior to and after approval of a final order in this proceeding to the extent that such costs are reasonable and consistent with the scope of the Culley 3 Compliance Projects described in Vectren South's evidence. Vectren South's proposed cost allocation factors are also approved.

(2) Accounting and Ratemaking Treatment for Deferred Costs. Indiana Code § 8-1-8.4-8 provides that 20% of the approved federally mandated costs, including depreciation, AFUDC, and PISCC, based on the overall cost of capital most recently approved by the Commission, shall be deferred and recovered by the energy utility as part of the next general rate case filed by the energy utility with the Commission. Vectren South proposes to defer as a regulatory asset 20% of all federally mandated costs incurred in connection with these projects.

Based on the evidence presented, the Commission finds Vectren South is authorized to defer 20% of the federally mandated costs incurred in connection with the Culley 3 Compliance Projects, and Vectren South may recover the deferred costs in its next general rate case as allowed by Ind. Code § 8-1-8.4-7(c)(2).

(3) Depreciation Treatment. Vectren South proposes to utilize a depreciation rate of 5%, representing a 20-year life on these investments. Mr. Swiz testified the proposed depreciation rate for the investments aligns with the estimated remaining life of Culley Unit 3.

No party opposed Vectren South's proposed depreciation rate for the investments required for the Culley 3 Compliance Projects.

Based on the evidence presented, we find that Vectren South's proposal to depreciate the individual projects included in the Culley 3 Compliance Projects based on a 5% depreciation rate is reasonable and is approved.

C. Recovery of Prior Pollution Control Investments. Our January 28, 2015 and June 22, 2016 Orders in Cause No. 44446 (the "44446 Orders") (1) granted Vectren South a CPCN for A.B. Brown Unit 1 and 2, Culley Unit 3 and Warrick Unit 3 clean coal technology projects and (2) authorized Vectren South to recover federally mandated costs associated with federally mandated requirements at A.B. Brown Units 1 and 2 (collectively the "MATS Projects"). Rather than recovering

the costs of the MATS Projects through a tracking mechanism as authorized by Ind. Code § 8-1-8.4-7, Vectren South sought, and we granted, authority to defer these costs for recovery in a future proceeding. Vectren South now seeks to commence recovery of the MATS Projects' costs through the ECA pursuant to Ind. Code § 8-1-8.4-7.

Vectren South witness Swiz described the proposed recovery through the ECA in more detail. He indicated that Vectren South proposes recovery of the MATS Projects to begin on January 1, 2019 with the approval of ECA rates and charges recovering the specified revenue requirement. In accordance with applicable statutory requirements, Vectren South proposes to recover the 80% of eligible revenue requirements amounts for post-in-service carrying costs, incremental depreciation and property taxes and financing costs that Vectren South incurred to construct the MATS Projects and deferral of the remaining 20% of these costs for subsequent recovery in a base rate case. Vectren South will prepare an annual revenue requirement as part of the ECA to capture eligible capital investments in plant related to the MATS Projects, multiplied by the applicable rate of return, with depreciation, O&M, and property tax expenses associated with the MATS Projects added to the resulting total. To provide for timely recovery, Vectren South's proposed ECA will project an annualized level of expense related to these approved projects for the 12-month effective period.

Depreciation associated with the MATS Projects will be based on the currently approved depreciation rates applicable to the assets, as approved in Vectren South's last electric base rate case (Cause No. 43839). The pre-tax return on the new capital investment will be calculated by multiplying the pre-tax rate of return, based on the WACC, by total new capital investment related to the approved projects. Vectren South proposes to use a WACC in the ECA based upon the most recent approved WACC within Vectren South's TDSIC mechanism, Cause No. 44910. This WACC, approved by the Commission, represents an updated actual capital structure as of the cut-off date of each TDSIC filing, and includes the typical items captured in Vectren South's base rate case capital structure. This rate will be used in the ECA revenue requirement calculation, and the equity component will be grossed up for recovery of income taxes, both state and federal, at then current rates. O&M expense included for recovery in the ECA will reflect an annualized level of expense related to the MATS Projects. This O&M expense represents incremental chemical costs and other expenses associated only with the MATS Projects.

No party objected to Vectren South's proposal to commence recovery of the MATS Projects' costs, currently being deferred, through the ECA. We previously found the MATS Projects costs qualify as federally mandated costs in the 44446 Orders. While Vectren South proposed, and we approved of, deferral of these costs in lieu of the recovery through a periodic retail rate adjustment mechanism, Vectren South now seeks to recover the costs in accordance with Ind. Code § 8-1-8.4-7(c). We find that Vectren South shall be authorized to commence recovery of these MATS Projects' costs pursuant to Ind. Code § 8-1-8.4-7 through the ECA in accordance with the procedures outlined in Mr. Swiz's testimony.

6. <u>Confidentiality</u>. Vectren South filed motions for protection and nondisclosure of confidential and proprietary information on March 20, 2018, August 21, 2018, and September 10, 2018, respectively. In its motions, Vectren South states certain information redacted in the evidence is confidential, proprietary, competitively sensitive, and/or trade secrets. Docket entries were issued on March 29, August 27, and October 4, 2018 finding such information to be preliminarily confidential and protected from disclosure under Ind. Code §§ 8-1-2-29 and 5-14-3-4. The confidential information was subsequently submitted under seal. The Commission finds the

information for which Vectren South seeks confidential treatment is confidential trade secret information pursuant to Ind. Code § 8-1-2-29 and Ind. Code ch. 5-14-3, is exempt from public access and disclosure by Indiana law, and shall continue to be held by the Commission as confidential and protected from public access and disclosure.

IT IS THEREFORE ORDERED BY THE INDIANA UTILITY REGULATORY COMMISSION that:

1. Vectren South's request for a certificate of public convenience and necessity under Ind. Code ch. 8-1- 8.5 to construct an 850 MW CCGT and all associated relief requested is denied.

2. Vectren South's request for a certificate of public convenience and necessity for the Culley 3 Compliance Projects pursuant to Ind. Code ch. 8-1-8.4 and all associated relief requested is approved.

3. Vectren South's proposed recovery of federally mandated costs approved in connection with Cause No. 44446 through the ECA is approved as described in this Order.

4. Vectren South's proposed ECA, and Vectren South's proposed Sheet No. 69, Appendix E of its tariff to implement such ECA is approved.

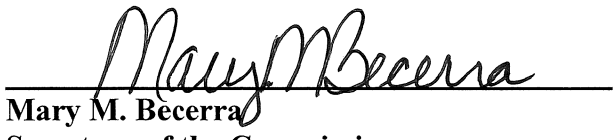
5. The Confidential Information submitted under seal in this Cause pursuant to Vectren South's requests for confidential treatment is determined to be confidential trade secret information as defined in Ind. Code § 24-2-3-2 and shall continue to be held as confidential and exempt from public access and disclosure under Ind. Code §§ 8-1-2-29 and 5-14-3-4.

6. This Order shall be effective on and after the date of its approval.

HUSTON, KREVDA, OBER, AND ZIEGNER CONCUR; FREEMAN ABSENT:

APPROVED: APR 2 4 2019

I hereby certify that the above is a true and correct copy of the Order as approved.



Mary M. Becerra
Secretary of the Commission

Appendix B
IURC Cause No. 45280

ORIGINAL

Commissioner	Yes	No	Not Participating
Huston	✓		
Freeman	✓		
Krevda	✓		
Ober	✓		
Ziegner	✓		

STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

VERIFIED PETITION OF SOUTHERN INDIANA GAS AND ELECTRIC COMPANY d/b/a VECTREN ENERGY DELIVERY OF INDIANA, INC. ("VECTREN SOUTH") FOR: (1) ISSUANCE OF A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY FOR A COMPLIANCE PROJECT TO MEET FEDERALLY MANDATED REQUIREMENTS TO CLOSE ITS A. B. BROWN POND (THE "BROWN POND COMPLIANCE PROJECT"); (2) AUTHORITY TO TIMELY RECOVER 80% OF THE APPROVED FEDERALLY MANDATED COSTS INCURRED DURING CONSTRUCTION AND OPERATION OF THE BROWN POND COMPLIANCE PROJECT INCLUDING POST-IN SERVICE CARRYING CHARGES (BOTH DEBT AND EQUITY) ("PISCC') AND DEFERRED DEPRECIATION THROUGH VECTREN SOUTH'S ENVIRONMENTAL COST ADJUSTMENT MECHANISM; (3) AUTHORITY TO DEFER FOR RECOVERY IN VECTREN SOUTH'S ENSUING GENERAL RATE CASE 20% OF SUCH APPROVED FEDERALLY MANDATED COSTS; AND (4) IN THE ALTERNATIVE, APPROVAL TO INCLUDE THE BROWN POND COMPLIANCE PROJECT IN RATE BASE PURSUANT TO IC 8-1-2-23.	)	**CAUSE NO. 45280** **APPROVED:** MAY 13 2020

ORDER OF THE COMMISSION

Presiding Officers:
Stefanie N. Krevda, Commissioner
Brad J. Pope, Administrative Law Judge

On August 14, 2019, Southern Indiana Gas and Electric Company d/b/a Vectren Energy Delivery of Indiana, Inc., a CenterPoint Energy Company ("Petitioner" or "Vectren South") filed its Verified Petition with the Indiana Utility Regulatory Commission ("Commission") seeking: (1) a Certificate of Public Convenience and Necessity ("CPCN") pursuant to Ind. Code ch. 8-1-8.4 for the compliance project to close the Brown Ash Pond in compliance with the Environmental Protection Agency's ("EPA") Coal Combustion Residual ("CCR") rule (the "Brown Pond Compliance Project" or "Project"); (2) authority to timely recover 80% of the approved federally mandated costs incurred during construction and operation of the Project, including post-in-service carrying costs ("PISCC"), both debt and equity, and deferred depreciation expense associated with the Project through Petitioner's environmental cost adjustment ("ECA") mechanism; and (3)

authority to defer for recovery in Petitioner's ensuing general rate case 20% of such approved federally mandated costs.

On August 15, 2019, Petitioner filed the direct testimony and attachments of the following witnesses in support of its Verified Petition:

- Wayne D. Games, Vice President Power Generation Operations, for Petitioner;
- Angila M. Retherford, Vice President, Environmental and Corporate Responsibility, for Petitioner;
- Jay D. Mokotoff, Senior Engineer Group Manager, Civil and Environmental Engineering, AECOM Technical Services, Inc. ("AECOM");
- Claire Schmit, Principal Process Engineer, AECOM;
- David M. Bowler, Director, Accounting, for Petitioner; and
- J. Cas Swiz, Director, Rates and Regulatory Portfolio Management, for Petitioner.

On October 4, 2019, Petitioner filed a Notice of Substitution of Witness indicating that Mr. Keith Benton, Senior Project Engineer, AECOM is being substituted for and is adopting the direct testimony previously filed by Vectren South witness Claire Schmit.

Also on August 15, 2019, Petitioner filed a Motion for Protection of Confidential and Proprietary Information ("Motion"). In the Motion, Petitioner indicated certain information ("Confidential Information") that it intended to submit in this matter contains trade secrets as that term is defined under Ind. Code § 24-2-3-2. The Presiding Officers granted the Motion by docket entry dated September 10, 2019, and Petitioner submitted the Confidential Information on September 11, 2019.

On September 19, 2019, Citizens Action Coalition of Indiana, Inc. ("CAC") filed a Petition to Intervene, which was granted by docket entry dated September 30, 2019.

On December 19, 2019, Petitioner and the Indiana Office of Utility Consumer Counselor ("OUCC") jointly submitted a Stipulation and Settlement Agreement resolving all matters raised in this proceeding as among Petitioner and OUCC (the "December Settlement Agreement"). Petitioner also filed the supplemental testimony of David M. Bowler, Director, Accounting, for Petitioner, in support of the December Settlement Agreement. In addition, the OUCC filed the Settlement Testimony of Cynthia M. Armstrong, Senior Utility Analyst, Electric Division, for the OUCC, in support of the December Settlement Agreement.

On January 10, 2020, Petitioner, the OUCC, and CAC (collectively, the "Settling Parties") jointly submitted a Stipulation and Settlement Agreement pursuant to which CAC joined in the December Settlement Agreement and the Settling Parties agreed to additional terms pertaining to the Brown Ash Pond Compliance Project (the "Joint Settlement Agreement"), thereby resolving all matters raised in this proceeding as among the Settling Parties. Petitioner also filed supplemental testimony of Angila M. Retherford in support of the Joint Settlement Agreement.

On February 11, 2020, the Presiding Officers issued a docket entry requesting updates of certain information related to the settlements. On February 13, 2020, Petitioner filed its Second Motion for Protection of Confidential and Proprietary Information ("Second Motion"), seeking

confidential treatment for certain information related to Petitioner's response to the February 11, 2020 Docket Entry (also referred to as "Confidential Information"). The Second Motion was granted that same day, and Petitioner filed its Response on February 14, 2020.

The Commission held an Evidentiary Hearing in this Cause on February 18, 2020, at 9:30 a.m. in Room 222 of the PNC Center, 101 West Washington Street, Indianapolis, Indiana. Petitioner, the OUCC, and CAC appeared at and participated in the hearing, and their respective evidence was admitted into the record without objection.

Based on the applicable law and the evidence presented, the Commission now finds:

1. Notice and Commission Jurisdiction. Notice of the Evidentiary Hearing in this Cause was given and published by the Commission as required by law. Petitioner is a "public utility" as defined in Ind. Code § 8-1-2-1(a) and an "energy utility" as defined in Ind. Code § 8-1-8.4-3. Petitioner is subject to the jurisdiction of this Commission in the manner and to the extent provided by Indiana law. Pursuant to Ind. Code ch. 8-1-8.4, Petitioner may apply to the Commission for CPCNs and recovery of federally mandated costs. Accordingly, the Commission has jurisdiction over Petitioner and the subject matter of this proceeding.

2. Petitioner's Characteristics. Vectren South is a public utility incorporated under the laws of the State of Indiana with its principal office at One Vectren Square, Evansville, Indiana. Petitioner is engaged in rendering electric utility service to the public and owns, operates, manages, and controls, among other things, plants, property, equipment, and facilities that are used and useful for the production, storage, transmission, distribution, delivery, and furnishing of electric utility service to approximately 145,000 customers in southwestern Indiana.

3. Relief Requested. Petitioner requests: (1) a finding that public convenience and necessity will be served by the proposed Project; (2) granting Petitioner a CPCN for the Project pursuant to Ind. Code ch. 8-1-8.4; (3) a finding that the Project constitutes a compliance project that will allow Petitioner to comply directly or indirectly with "federally mandated requirements" under Ind. Code § 8-1-8.4-5 and a finding that the associated costs are "federally mandated costs" under Ind. Code § 8-1-8.4-4 and therefore eligible for cost recovery set forth in Ind. Code § 8-1-8.4-7; (4) making the required findings under each of the factors set forth in Ind. Code § 8-1-8.4-6(b); (5) authorizing Petitioner to timely recover 80% of the stipulated federally mandated costs incurred during construction and operation of the Project, including PISCC, both debt and equity, and deferred depreciation expense associated with the Project through Petitioner's ECA mechanism; (6) authorizing Petitioner to defer for recovery in Petitioner's ensuing general rate case 20% of such approved federally mandated costs until such costs are reflected in Petitioner's retail electric rates pursuant to Ind. Code § 8-1-8.4-7(c)(2); (7) authorizing Petitioner to accrue PISCC, both debt and equity, related to the Project after its in-service date using the overall cost of capital approved in Petitioner's TDSIC cases; (8) authorizing Petitioner to defer depreciation and operation and maintenance ("O&M) expenses relating to the Project until such expenses are recovered through either a rate adjustment mechanism or in base rates; and (9) approving depreciation rates for the Project.

4. Petitioner's Case-in-Chief. Wayne Games, Petitioner's Vice President Power Generation Operations, described the Brown Ash Pond, the evaluation that led to the selection of Closure by Removal ("CBR") for the Project, the overall benefits of the Project and its estimated cost, and how that compliance cost compares to other pond closure options. Mr. Games also provided support for the request that the Commission issue Petitioner a CPCN for the Project.

Mr. Games testified the Brown Ash Pond was placed in service in 1979 and remains in use. He explained that while all bottom ash produced by the Brown plant is deposited in the Brown Ash Pond, since 2009, most of the dry ash produced by the plant has been provided to a manufacturer for beneficial reuse. He explained that Petitioner's consistent supply of local Indiana coal coupled with its operating practices and procedures has allowed Petitioner to ship over 1.4 million tons of fly ash for reuse, all of which has met acceptable specifications and never been rejected. Mr. Games testified the manufacturer has not paid Petitioner for the fly ash and that providing it for beneficial reuse has benefited both Petitioner and its customers by providing a more environmentally friendly solution, avoiding costs for disposal, extending the life of the Brown and F.B. Culley ash ponds, and eliminating the expense of excavating ash and transporting it to other locations for disposal.

Mr. Games testified the CCR Rule requires that the Brown Ash Pond be closed, explaining Petitioner must cease ash disposal by October 2020 and commence closure of the Brown Ash Pond within six months of cessation of disposal as discussed in greater detail in the testimony of Petitioner's witness Angila Retherford. Mr. Games explained challenges associated with closing the Brown Ash Pond include the ravine's irregular shape and varying depth of up to 70 feet deep; the very fine and saturated nature of the ash material causing it to be unstable, absent dewatering; and the fact the Ash Pond continues to accept water from higher groundwater around the edges. Mr. Games then described the selection process for identifying AECOM as the engineering firm to assist Petitioner in evaluating its compliance options as well as the work performed by AECOM related to CCR compliance, such as its assessing the structural stability of the ponds to continue to accept CCR material and development of alternative plans for closing the Brown Ash Pond. Mr. Games explained while internally evaluating Petitioner's compliance options for the Brown Ash Pond under the CCR Rule, an entity approached Petitioner expressing interest in the reuse of the ash, yielding another opportunity for Petitioner to explore.

Next, Mr. Games described the compliance options presented by AECOM. First, he described the Cap (or Close) in Place ("CIP") option, explaining it requires dewatering the pond, leaving the CCR material in place, constructing a synthetic membrane cap, installing a system to drain all surface water away from the cap, adding topsoil, and establishing a vegetative cover. Mr. Games testified the CIP option requires long-term groundwater monitoring and cap maintenance. Next, he described two CBR options, which involve dewatering the pond and removing the CCR material for disposal or beneficial reuse. Mr. Games testified while the CIP approach, at first, would appear to be less expensive than the CBR approaches, there are multiple reasons to select CBR over CIP. First, as further explained by Ms. Retherford, he testified that the Indiana Department of Environmental Management ("IDEM") has been unwilling to approve a CIP approach where significant amounts of ash remain in contact with groundwater and other states are moving to require CBR. He added if required to remove the ash from the groundwater under a CIP approach, Petitioner's upfront costs for CIP would no longer be lower. Mr. Games

continued by explaining the CIP (even if a viable option), poses risk for future groundwater contamination and associated remediation due to CCR material being left in the closed pond. Mr. Games stated that the CBR options, on the other hand, remove the requirement for 30 years of groundwater monitoring, mitigate groundwater issues, and eliminate the potential future requirement for CCR material to be excavated and placed in a lined landfill because of future regulations, more stringent groundwater standards, and/or changes in interpretations of existing regulations or standards.

With respect to the CBR options, Mr. Games explained the advantages for selecting beneficial reuse of CCR material over disposal in a landfill include eliminating the requirement to design and permit a new landfill since the one at Brown is nearly out of space and cannot accommodate the ash from the Project, as well as eliminate the ongoing expense of monitoring and maintaining a landfill in future years. He added that an off-site landfill would dramatically increase compliance costs further. Mr. Games explained if the majority or all of CCR material can be beneficially reused, the liability associated with the CCR material would be removed from the site, greatly increasing certainty and reducing risk to Petitioner and customers over time.

Mr. Games testified that in order to comply with the CCR Regulations and complete a closure of the Brown Ash Pond, the Project contains three major components: (1) building infrastructure to transport and load ash material to the barges on the Ohio River; (2) excavation and blending of the ash to acceptable specifications for reuse; and (3) encapsulating non-conforming CCR material with an impermeable cap that meets EPA and IDEM requirements.

Mr. Games explained that Petitioner entered into a confidential agreement (the "CBR Project Agreement") with an Ash Reuser to excavate CCR material from the Brown Ash Pond and deliver acceptable material (ponded ash) to the Ash Reuser by loading it on a barge at the Brown loading facility on the Ohio River. Mr. Games confirmed the Ash Reuser will pay Petitioner for the Brown fly ash it accepts and that the Ash Reuser agreed to accept a specified minimum required amount of ash each year, which will ensure timely removal of the ash material from the Brown Ash Pond. Mr. Games confirmed the CBR Project Agreement also contains security provisions to protect Petitioner financially in the case of default by the Ash Reuser. He continued by explaining the Ash Reuser accepts ownership once the material is on the barge and transports it to its manufacturing site. Mr. Games described acceptable material is defined as material that meets or exceeds the CBR Project Agreement quality specifications, or non-conforming material that is off-spec but accepted by the Ash Reuser prior to its loading on a barge for shipment. Mr. Games testified Petitioner will test the ash quality in an on-site laboratory and will oversee blending of the ash as necessary to meet the specifications.

To effectuate the Project, Mr. Games explained Petitioner entered in to a confidential agreement with AECOM as the Engineering, Procurement, and Construction Management ("EPCM") entity. He testified that Petitioner selected AECOM based on its impressive expertise and the initial compliance work AECOM completed on Petitioner's behalf. Per Mr. Games, the scope of work for AECOM services includes: (1) engineering and design; (2) procurement; (3) project management and controls; (4) construction and construction management; (5) technical support during construction and start-up; (6) operator training; and (7) proper disposal of non-conforming material.

Regarding infrastructure investments, Mr. Games explained the Ash Reuser, and not Petitioner, is responsible for any infrastructure investments required at the Ash Reuser's manufacturing facility. He testified that Petitioner will need to make several infrastructure investments to move the ash from the Brown Ash Pond to the barges on the Ohio River, such as dewatering the ash to a moisture content level specified in the CBR Project Agreement; constructing an above-ground conveyor system to move the ponded ash one mile to the existing tube conveyor; and modifying the current dry handling barge loading system to allow for handling of ponded ash. Mr. Games explained the EPCM Agreement provides that AECOM will design, procure, and install the infrastructure required to convey and then handle or load the ponded ash on the barge, and then turn over the infrastructure equipment to Petitioner to own, operate, and maintain while AECOM excavates the ash pond by removing the ponded material from the Brown Ash Pond and loading conforming material into the new conveying system. Mr. Games testified the estimated cost for the infrastructure construction and dry ash handling modifications is $47 million in 2018 dollars. He explained that AECOM provided the estimate and will execute the construction project, as the EPCM entity, for that target price. Mr. Games added, however, that the cost of obtaining permits, clearing trees, and providing electrical feed, along with Petitioner's overhead and allowance for funds used during construction ("AFUDC"), must be added to the estimate to arrive at the total cost.

While the terms of the agreement are confidential, Mr. Games explained the EPCM Agreement offers Petitioner cost risk protections. He explained the agreement allows AECOM to pass actual project costs on to Petitioner with a predetermined profit margin. Mr. Games testified a fixed price alternative was not viable given uncertainties related to volume, quantity, and quality of ash as well as project duration due to the unpredictable amount to be accepted annually by the Ash Reuser. Mr. Games added, however, that AECOM agreed to a Performance Cost Model with a Target Price that includes sharing in cost-savings and protections for cost overruns to mitigate Petitioner's cost risk and incentivize AECOM to minimize costs. Specifically, Mr. Games explained the performance components of the project related to infrastructure, excavation, and blending build up to a target price that includes a cost of work estimate, contractor's fees and contingency. Per Mr. Games, specific benefits to the Performance Cost Model include the avoidance of contingencies associated with a fixed price; the incentive for AECOM to blend and ship as much as possible to the Ash Reuser thereby maximizing revenue received by Petitioner and minimizing the amount of non-conforming ash to be encapsulated; and the incentive for AECOM to identify cost reduction opportunities and control costs thereby avoiding loss of profit margin and forfeit fees. Mr. Games confirmed Petitioner has used a Performance Cost Model with a Target Price in the past, citing both large power plant projects where scope is difficult to define and the Brown dam stabilizing project, the latter of which came in below the target price resulting in shared savings.

Mr. Games then testified regarding the capital and O&M costs for the Project. He indicated Table 1 to his testimony (Petitioner's Exhibit No. 1) provided the estimated total capital and O&M costs, which represents the federally mandated costs, totaling $164,539,000, adjusted for inflation. Mr. Games explained the ash will be supplied over several years and will generate revenue from the Ash Reuser that will be used to offset Project costs. Mr. Games presented a comparison of those total costs to total project costs adjusted for inflation of the CIP option ($137,509,000) and the CBR and Landfill option ($225,526,351). He explained that because the CIP option assumes

that ash would be left in contact with groundwater, it is not a viable option because IDEM has been unwilling to permit such an approach. He also noted that the CIP option has the risks of future groundwater contamination and associated remediation obligations due to CCR material being left in the closed pond. He noted the costs of CIP compare very differently to the total federally mandated costs of the Project when consideration is given to the fact that a portion of the cost will be offset by payments from the Ash Reuser.

Regarding the estimated 1.25 million tons of ponded material that may not be able to be blended to meet Ash Reuser contract specifications or be accepted by the Ash Reuser, Mr. Games explained that as Ms. Retherford testified, Petitioner is in discussions with IDEM to allow placement of CCR material in the current Brown landfill, which if approved and provided space is available, will be Petitioner's first option. If not approved or space is not available, the excavated CCR material will be placed in an area within the footprint of the Brown Ash Pond that is a minimum of five feet above the uppermost aquifer, encapsulated, and covered with an impermeable cap that prevents water infiltration.

Angila Retherford, Petitioner's Vice President of Environmental and Corporate Sustainability, testified regarding the CCR Rule, how the CCR Rule applies to the Brown Ash Pond, and Petitioner's planned closure and remediation of the Brown Ash Pond to achieve compliance with the CCR Rule. In addition, Ms. Retherford's testimony provided support for the request for the Commission to issue Petitioner a CPCN for the Compliance Project. Ms. Retherford described the requirements under the CCR Rule to continue to use an existing ash pond beyond October 2020. She described Petitioner's Ash Ponds and current ash handling practices. She then explained that the closure of the Brown Ash Pond was triggered under the CCR Rule for not only violating the location restrictions enumerated in the CCR Rule but also due to detection of lithium and molybdenum in groundwater above acceptable levels. She explained that removing ash from the pond means Vectren South will be removing all ash out of the groundwater and capping any remaining non-spec ash (i.e., ash that cannot be recycled) under an impermeable cap. In addition to describing IDEM's authority under the CCR Rule, Ms. Retherford explained how the costs associated with the closure of the Brown Ash Pond qualify as federally mandated costs. Specifically, Ms. Retherford testified the CCR Rule requiring closure satisfies the requirements of a federally mandated requirement in Ind. Code § 8-1-8.4-5 because it is a requirement imposed on Petitioner by the federal government in connection with the Resource Conservation and Recovery Act ("RCRA") by virtue of being an energy utility that generates electricity. She added the Project is directly related to Petitioner's compliance with applicable federally mandated requirements. As such, the costs associated with closure of the Brown Ash Pond qualify as federally mandated costs.

Ms. Retherford also testified as to whether the Project would extend the life of an existing utility facility. She explained while the compliance project will not extend the overall life of the nearby Brown Generating Station, the CCR Rule applies regardless of when coal generation ceases at that site. Ms. Retherford explained that remediation of the Brown Ash Pond to achieve compliance with the CCR Rule allows Petitioner to retain a compliant brownfield generation site that can continue to be used in the future.

David M. Bowler, Petitioner's Director of Accounting, testified regarding the accounting and ratemaking treatment for the Project pursuant to the Federal Mandate Statute. Mr. Bowler

noted that the Brown plant depreciation rates never contemplated a cost of removal associated with the ash pond since the rates were set prior to adoption of CCR regulations, and thus no funds have been collected for pond closure activities. He described the capital and O&M costs of the Project, as well as the cash proceeds from potential insurance recoveries and the Ash Reuser that would be used to offset O&M costs. Relying on the Federal Mandate Statute, he discussed the manner in which eligible Project costs would be recovered over time, including the treatment of construction work in progress and AFUDC. He noted that once capital investments were placed in-service, the accumulated depreciation would be included as a reduction to gross plant. He also explained that until such time as investments are included for recovery in rates, they would be eligible for PISCC.

Mr. Bowler described the method for calculation of depreciation expense as well as the cost of capital that would be used for this investment. He presented Vectren South's proposal to use a depreciation rate of 7.69%, representing a 13-year life, coincident with the life of the Project. He stated a smaller ash impoundment to be constructed toward the end of the Project would obtain a 3.33% depreciation rate, representing a 30-year life, which coincides with the length of time the impoundment must be operated and managed pursuant to regulatory guidelines discussed by Ms. Retherford. Regarding the cost of capital, Mr. Bowler testified that, as was approved in Cause No. 45052, the weighted average cost of capital ("WACC") proposed to be utilized in the ECA is the most recent approved WACC from Petitioner's TDSIC mechanism (Cause No. 44910). Based on the terms of the Federal Mandate Statute, Mr. Bowler described how 20% of the Project investment would be deferred until Petitioner's next base rate proceeding. He also covered the recovery of O&M costs related to the Project. Finally, Mr. Bowler reviewed how the revenue requirement for the Project would be calculated for purposes of recovery in the ECA mechanism. He attached illustrative ECA schedules to his testimony to demonstrate how the ECA filings would be prepared to reflect inclusion of the Project. He also discussed the proposed adjustment to Vectren South's authorized return amount used in its Fuel Adjustment Clause net operating income earnings tests under Ind. Code §§ 8-1-2-42(d) and -42.3 because of the proposed ECA, consistent with the Federal Mandate Statute.

J. Cas Swiz, Petitioner's Director, Rates and Regulatory Portfolio Management, testified regarding use of the ECA to recover Project costs pursuant to the Federal Mandate Statute. He explained that consistent with the Federal Mandate Statute, 80% of the Project costs will be recovered via the ECA mechanism, with the remaining 20% deferred and recovered in a future base rate case. Mr. Swiz described how the revenue requirement related to the Project will be calculated for purposes of ECA filings, and he discussed the illustrative ECA schedules that will be submitted to the Commission once costs have been incurred. He provided the cost allocation percentages that will be applied in the ECA and discussed the timing of annual ECA filings. Mr. Swiz presented a revised ECA tariff to be used once the Project is approved and proposed that the tariff be approved. He concluded by providing a schedule of projected bill impacts resulting from recovery of Project costs.

Jay D. Mokotoff, Senior Engineer Group Manager, Civil and Environmental Engineering at AECOM, and Mr. Keith Benton, Senior Project Engineer in the Process Development and Consulting Department of the Process Technologies Organization of AECOM, testified about the process of option development and the evaluation and engineering work completed by AECOM related to closure of the Brown Ash Pond consistent with applicable federal and state regulations.

Mr. Mokotoff described AECOM's qualification and experience related to CCR projects. He defined AECOM's role in evaluating closure options for the Brown Ash Pond. He described the ABB Evaluation of Options for Pond Closure Report (the "Report") with a description of the various options and how those options were compared and evaluated. He then described the work performed by AECOM in order to prepare the Report including the development of option concepts and the application of design and regulatory criteria to each option. He then explained how the two main options, CIP and CBR, were further analyzed by evaluating alternatives related to the six main components of the closure process: Pond Closure, Excavation, Dewatering, Handling, Processing, and Storage. He then described how each of these options were analyzed including the formulation of conceptual engineering designs.

Mr. Mokotoff testified as to how the Report documents the analysis process and that CBR with Beneficial Reuse was ultimately selected. He described the CBR with Beneficial Reuse process including stormwater control and how the ash material will be loaded onto barges on the Ohio River. Lastly, he testified as to how the public convenience and necessity will be served by the chosen approach. Specifically, he testified that CBR with Beneficial Reuse represents the preferred alternative in terms of compliance, risk, and cost and how it provides the best approach for this site in terms of balancing upfront project cost, cost certainty, and long-term risk.

Mr. Keith Benton adopted the prefiled testimony of Claire Schmit, Principal Process Engineer at AECOM, and described the preparation of the Report, specifically the elements related to the infrastructure to support CBR with Beneficial Reuse, including loading, storage, handling, and transport of CCR materials. He then provided an overview of the Report including the description of a separate study to determine the market value of the reclaimed ponded ash and an evaluation of the infrastructure required for a CBR option in which the CCR material is transported off-site for beneficial reuse. He described the process used for evaluating CCR pond closure and infrastructure options including, but not limited to, the development and comparison of estimates of the capital cost of the infrastructure equipment, anticipated operating cost, anticipated revenue from ash reclaimed for beneficial use, and total project duration for each option.

Mr. Benton's testimony described Section 4 of the Report, which defines the phases of the closure process including how the CCR material will be processed and then transported to the upgraded barge loading system. The processed ponded ash will then transfer onto river barges for transport to the third party for beneficial reuse. He explained what other options were considered and how AECOM evaluated the cost of each alternative as part of its analysis. He described how AECOM prepared the capital cost estimates for the selected pond closure and infrastructure options with a specific discussion of the bidding process. He also explained how AECOM developed lifecycle cost estimates for the pond closure and ash handling systems. He stated that lifecycle costs are a combination of utility costs, O&M costs, replacement parts, and for the CIP option, post-closure maintenance.

Mr. Benton then testified regarding the design basis for the cost estimates for the pond closure and ash handling systems including the costs (services, equipment, construction, lifecycle, fee, and contingency) included in the cost estimates. He stated that the estimate set forth in the Report was accurate within a range of -20% to +30%, and the final project costs (as provided in

Mr. Games' testimony) should have an accuracy range of -10% to +20%. Mr. Benton concluded by stating that AECOM supports Petitioner's conclusions with respect to the selection of CBR with Beneficial Reuse.

5. **Settlement Agreements.** After the filing of Petitioner's case-in-chief and before the submissions of any responsive testimony, two Settlement Agreements were submitted to the Commission supporting the proposed Project and resolving all issues in the proceeding. Initially, the OUCC and Petitioner entered into the December Settlement Agreement, and subsequently CAC, the OUCC, and Petitioner entered into the Joint Settlement Agreement wherein CAC also joined in the December Settlement Agreement. The two Settlement Agreements provide for approval of the relief requested in this proceeding by Petitioner and add additional customer safeguards that the Settlement Parties agreed upon after good faith negotiations. The terms of the two Settlement Agreements comprise the complete agreement of the Settling Parties and will be considered together and referred to hereafter as the Settlement Agreements. The key provisions are set forth below.

A. **Agreement that a CPCN Should Be Granted for the Project.** The Settling Parties have entered into the Settlement Agreements in which they agreed that the Commission should grant Petitioner a CPCN pursuant to Ind. Code ch. 8-1-8.4 for the Project in order to close the Brown Ash Pond in compliance with CCR regulations, as described in Petitioner's case-in-chief.

B. **Recovery of Federally Mandated Costs.** The Settling Parties agree that the Commission should find that the Project constitutes a compliance project that will allow Petitioner to comply with "federally mandated requirements" under Ind. Code § 8-1-8.4-5 and that the associated costs, as modified herein, are "federally mandated costs" under Ind. Code § 8-1-8.4-4 and therefore eligible for cost recovery set forth in Ind. Code § 8-1-8.4-7. The Settling Parties agree that the total estimated federally mandated costs of $156,200,000 are reasonable and should be approved. This agreed-upon amount reflects the Settling Parties' agreement that, in light of Ind. Code § 8-1-8.4-7(c)(3) and without waiver of the rights provided to the parties thereunder, Petitioner shall remove the contingency of $8.33 million from the federally mandated costs.

C. **Agreement on a Project Cost Credit Based upon Cash Proceeds Received by Petitioner.** The Settling Parties agree that the total federally mandated costs will be offset by total cash proceeds to be received from the Ash Reuser ("Ash Payments" in Table 1 of Petitioner's Exhibit No. 1-C, p. 20) and insurance proceeds (Petitioner's Exhibit No. 5, p. 6, lines 1-5) and that these proceeds will be at least $25 million. These cash proceeds will be used to offset incurred O&M costs to excavate and convey the ash to the loading facility.

D. **Agreement for Timely Cost Recovery through ECA Mechanism.** The Settling Parties agree that the Commission should grant Petitioner's request to timely recover 80% of the approved federally mandated costs incurred during construction and after placement in service and operation of the Project, including PISCC, both debt and equity, and deferred depreciation expense associated with the Project through Petitioner's ECA mechanism, as described in Petitioner's Exhibit No. 5, p. 6.

E. Agreement Regarding Treatment of Cost of Removal. The Settling Parties agree that the costs of removal associated with retirements of existing or future capital assets in connection with the Project are not reflected in the total projected federally mandated costs and they will not be reflected in the ECA mechanism in future proceedings. The Settling Parties agree that such costs of removal, if incurred, will be addressed in future general base rate cases to the extent of their effect on net original cost rate base. In the event the Project results in a retirement of existing assets, Petitioner will offset the incremental depreciation expense included in the revenue requirement calculation with the impact of the retired assets, as stated in Petitioner's Exhibit No. 5, p. 8.

F. Agreement to Deferral Authority. The Settling Parties agree the Commission should grant Petitioner's request to defer 20% of the approved federally mandated costs until such costs are reflected in Petitioner's retail electric rates pursuant to Ind. Code § 8-1-8.4-7(c)(2), as presented in Petitioner's Exhibit No. 5, p. 6.

G. Agreement on Other Accounting and Ratemaking Treatment. The Settling Parties agree that the Commission should grant Petitioner's requested accounting and ratemaking treatment.

H. Agreement on Preservation of Rights Regarding Effect of Environmental Liability on Rates. The Settling Parties agree in the event Petitioner is held liable for damages or made subject to enforcement action with respect to the handling of the ash from the Brown Ash Pond, the Settling Parties reserve their respective positions with respect to any request for rate recovery related thereto and preserve their rights to defend such positions in future proceedings.

I. Agreement to Submit Plans and Notice Regarding Dewatering. The Settling Parties agree that, prior to commencing dewatering of the Brown Ash Pond, for purposes of closing the Brown Ash Pond, Petitioner shall submit the dewatering plans to IDEM for approval. Petitioner shall provide a copy of the dewatering plans and the notice to IDEM of the commencement of dewatering to the Settling Parties.

J. Agreement on Closure Activities. The Settling Parties agree that, prior to commencing any closure-in-place of CCR at the Brown Ash Pond, Petitioner shall submit and receive IDEM approval of a closure plan for the Brown Ash Pond pursuant to applicable IDEM regulations. Petitioner shall include a revised Fugitive Dust Plan for the Brown Ash Pond as part of the closure plan application. The full closure plan for the Brown Ash Pond shall be made publicly available.

K. Agreement to Worker Protections. The Settling Parties agree that Petitioner shall work with its contractors to include worker protection provisions in the revised Fugitive Dust Plan submitted as part of Petitioner's closure plan for the Ash Pond. Those worker protection provisions should include protections for workers engaged in the removal of CCR from the Brown Ash Pond, onsite processing of the CCR, and conveying of the CCR from the Brown Ash Pond to any barge that will transport it to off-site locations.

L. Additional Terms. The Settling Parties agree that the Settlement Agreements are a complete, interrelated package and should be accepted or rejected in their entirety without modifications or conditions that may be unacceptable to any Settling Party. If not approved in their entirety, the Settlement Agreements shall be null and void to the extent a Settling Party issues notice within 15 business days of the date of the Final Order in this proceeding that the modifications made by the Commission are unacceptable.

6. Evidence Supporting the Settlement Agreement.

A. Petitioner's Testimony in Support of the Settlement Agreement. Mr. Bowler testified in support of the December Settlement Agreement with the OUCC, which was later joined by the CAC. He explained that the Settlement Agreement supports the relief requested regarding the Project, including agreement that a CPCN pursuant to the Federal Mandate Statute should be granted, and that the Settlement Agreement adds certain customer safeguards that further support a finding that the Project is in the public interest. Mr. Bowler described the following customer protections set forth in the Settlement Agreement: (1) removal of a contingency of over $8 million from the Project costs, thereby reducing the approved federally mandated costs to $156,200,000; (2) setting a $25 million minimum offset of Project O&M costs based on projected cash proceeds to be received from both the Ash Reuser and insurance policies; and (3) to the extent Petitioner is found liable for damages or faces an enforcement action related to handling of fly ash, the parties reserve their rights as to any request for recovery of such costs. Mr. Bowler noted that the Settlement Agreement also clarifies how costs of removal will be handled once existing assets are retired. He stated that the Settlement Agreement represents a negotiated compromise that produces a fair and balanced outcome and asked the Commission to issue an order approving the terms of the Settlement Agreement in its entirety.

Ms. Retherford testified in support of the Joint Settlement Agreement and explained the conditions related to Petitioner's dewatering plans, closure plans, fugitive dust plan, and worker protections with respect to fugitive dust. She testified that Petitioner's commitment to provide copies to the OUCC and CAC of the dewatering plans and the notice to IDEM regarding commencement of dewatering activities does not change Vectren South's obligations under applicable regulations or its communications with IDEM. However, it does allow the other parties to remain aware of Petitioner's interactions with IDEM related to dewatering at the Project.

Ms. Retherford further testified as to conditions imposed with respect to Petitioner's closure plan under the Joint Settlement Agreement. She explained that Vectren South will submit and receive IDEM approval of its closure plan for the Brown Ash Pond, pursuant to applicable IDEM regulations, prior to commencing any CIP for materials that do not meet the specifications for reuse by the Ash Reuser. Additionally, she explained that Petitioner commits to provide the revised Fugitive Dust Plan (as required under the CCR Rule) as part of its closure plan application to IDEM and to make the full closure plan publicly available.

She also testified that the worker protections Vectren South has committed to include in the closure plan to be submitted to IDEM are already contemplated in the anticipated contractor and subcontractor agreements to be utilized to complete the Project. She concluded by stating that the Joint Settlement Agreement is in the public interest due in part to the fact that it provides a

reasonable resolution without the time and expense that would be incurred in connection with litigation.

B. <u>The OUCC's Testimony in Support of the Settlement Agreement</u>. Cynthia M. Armstrong, Senior Utility Analyst, Electric Division testified in support of the December Settlement Agreement. Ms. Armstrong summarized the primary components of the December Settlement Agreement, explaining that it is in the public interest for many reasons. First, she stated that the Settlement Agreement mitigates the impact on consumers of potential cost overruns by removing the contingency Vectren South originally proposed in its application for a Federally Mandated CPCN. She explained that under Ind. Code § 8-1-8.4-7(c)(3), actual costs that exceed the projected federally mandated costs of the approved compliance project by more than 25% require specific justification by the energy utility and specific approval by the Commission before being authorized in the next general rate case filed by the energy utility with the Commission. She concluded that a utility does not have to receive specific Commission approval for cost overruns until the project costs exceed 25% of the approved amount, so the Federally Mandated Requirements statute naturally allows a utility a reasonable level of contingency for a federally mandated project.

Second, she testified that the Settlement Agreement further mitigates the rate impact of the project on ratepayers by offsetting O&M costs with the cash proceeds received from the ash re-user and insurance proceeds. She also noted that if the Brown Ash Pond Compliance Project results in a retirement of existing assets, Vectren South will offset the incremental depreciation expense included in the revenue requirement calculation for the ECA with the impact of the retired assets.

Third, Ms. Armstrong stated the Settlement Agreement allows for the closure of the Brown Ash Pond in a manner that is more protective of public health and the environment (i.e., CBR) than the complete closure in-place of the pond. She explained that by removing the ash and allowing it to be beneficially re-used in a manner that will encapsulate it, Vectren South is minimizing the likelihood that dangerous constituents within the ash will leak into local groundwater supplies. She testified that beneficially re-using the ash also mitigates Vectren South's future liability associated with remediation and decreases costs that could potentially be passed onto ratepayers. She noted that the OUCC does not necessarily agree that such remediation costs are appropriate to pass onto ratepayers, but stated that the project minimized the risk of a future conflict between Vectren South and the OUCC on additional remediation costs.

Finally, she stated that public policy supports the Settlement Agreement. She explained that by collaborating to resolve the issues in this proceeding, the Settlement Agreement also serves the public interest by avoiding contentious and costly litigation. She affirmed that the Settlement Agreement provides ratepayer benefits and a reasonable compromise among the Settling Parties and recommended its approval.

Ms. Armstrong also addressed the OUCC's opposition to recovery under the Federal Mandate Statute in other cases before the Commission and explained the OUCC's differing position in this case. She testified that after reviewing Vectren South's CCR Compliance Plan, the OUCC found Vectren South put forth an approvable plan that met the requirements of Ind. Code § 8-1-8.4-6(b). She stated that Vectren South developed an innovative plan for dealing with its

legacy ash waste and that it was clear to the OUCC that Vectren South investigated reasonable alternatives to closing the ash pond in a manner that mitigated the costs passed onto ratepayers. She noted that although that a CCR Compliance Plan similar to Vectren South's may not be possible for other utilities to implement, a utility should show that it reasonably considered and investigated the possibility of re-using its ash when submitting an application for rate recovery before the Commission. She further explained that Vectren South appears to be taking all actions possible to further reduce the costs of closure beyond selling the ash for re-use by actively pursuing compensation under its insurance policies and providing an offset to costs recovered in the ECA tracker to account for the retirement of the ash ponds.

7. **Commission Discussion and Findings.**

A. **Overview of the Brown Ash Pond and Vectren South's CCR Compliance Analysis.** In 1978, the Brown Ash Pond was commissioned in order to dispose of CCR material including fly ash, bottom ash, and scrubber byproduct from Vectren South's nearby A. B. Brown Generating Station in Posey County, Indiana. The unlined Brown Ash Pond was created by constructing an earthen dam across an existing valley and remains in operation today. In 2005, a second earthen dam was constructed across the middle of the pond on top of the existing ash to increase the storage capacity. This created upper and lower pools that together comprise the Brown Ash Pond. The lower pool, which is approximately 57 acres, holds process water for the A. B. Brown Generating Station, while the upper pool, which is approximately 107 acres, continues to collect fly ash and bottom ash. In total, both ponds can hold approximately 5.9 million cubic yards or 6.2 million tons of CCR material.

Pursuant to the CCR Rule, Vectren South commenced groundwater monitoring at the Brown site in June 2016. Vectren South published the results of that testing on its website as required by the CCR Rule. The groundwater monitoring results indicated statistically significant groundwater impacts above acceptable levels, which triggered closure under the CCR Rule. The CCR Rule requires that Vectren South cease disposal of ash in the Brown Ash Pond by October 2020 and commence closure activities within six months thereafter, or April 2021.

In order to achieve the CCR Rule compliance objectives, Vectren South selected AECOM as the engineering firm to assist in evaluating its CCR compliance options, assessing the structural stability of the ponds to continue accepting CCR material, and developing alternative plans for the potential closure of the Brown Ash Pond. During Vectren South's internal compliance evaluation for the Brown Ash Pond, an entity expressed interest in the reuse of the ash. After extensive consideration of its compliance options as documented in the AECOM Report, Vectren South ultimately selected CBR with Beneficial Reuse and executed a contract with the Ash Reuser.

B. **Consideration of Settlement Agreements.** In previous Orders, we have discussed our policy with respect to settlements:

> Indiana law strongly favors settlement as a means of resolving contested proceedings. *See, e.g., Manns v. State Department of Highways,* (1989), Ind., 541 N.E.2d 929, 932; *Klebes v. Forest Lake Corp.,* (1993), Ind. App. 607 N.E.2d 978, 982; *Harding v. State,* (1992), Ind. App., 603 N.E.2d 176, 179. A settlement

> agreement "may be adopted as a resolution on the merits if [the Commission] makes an independent finding, supported by substantial evidence on the record as a whole, that the proposal will establish 'just and reasonable' rates." *Mobil Oil Corp. v. FPC,* (1974), 417 U.S. 283, 314.

Indianapolis Power & Light Co., Cause No. 39936, p. 7 (IURC 9/24/95); *see also Commission Investigation of Northern Ind. Pub. Serv. Co.,* Cause No. 41746, p. 23 (IURC 9/23/02). This policy is consistent with expressions to the same effect by the Supreme Court of Indiana. *See, e.g., Mendenhall v. Skinner & Broadbent Co.,* 728 N.E.2d 140, 145 (Ind. 2000) ("The policy of the law generally is to discourage litigation and encourage negotiation and settlement of disputes"); *In re Assignment of Courtrooms, Judge's Offices and Other Facilities of St. Joseph Superior Court,* 715 N.E.2d 372, 376 (Ind. 1999) ("Without question, state judicial policy strongly favors settlement of disputes over litigation").

Nevertheless, pursuant to the Commission's procedural rules and prior determinations by this Commission, a settlement agreement will not be approved by the Commission unless it is supported by probative evidence. 170 Ind. Admin. Code 1-1.1-17. Settlements presented to the Commission are not ordinary contracts between private parties. *U.S. Gypsum, Inc. v. Indiana Gas Co.,* 73 5 N.E.2d 790, 803 (Ind. 2000). Any settlement agreement approved by the Commission "loses its status as a strictly private contract and takes on a public interest gloss." *Id.* (quoting *Citizens Action Coalition v. PSI Energy, Inc.,* 664 N.E.2d 401, 406 (Ind. Ct. App. 1996)). Thus, the Commission "may not accept a settlement merely because the private parties are satisfied; rather [the Commission] must consider whether the public interest will be served by accepting the settlement." *Citizens Action Coalition,* 664 N.E.2d at 406. Furthermore, a Commission decision, ruling or order must be supported by specific findings of fact and sufficient evidence. *U.S. Gypsum,* 735 N.E.2d at 795 (citing *Citizens Action Coalition v. Public Service Co.,* 582 N.E.2d 330, 331 (Ind. 1991)). Therefore, before the Commission can approve the Settlement Agreement, we must determine whether the evidence in this Cause sufficiently supports the conclusion that the Settlement Agreements are reasonable, just, and consistent with the purpose of the governing statutory provisions, and that such agreements serve the public interest.

In this case, the Commission has before it a considerable body of evidence with which to judge the reasonableness of the terms of the Settlement Agreements, including the Settling Parties' agreement that the Commission should grant Petitioner a CPCN pursuant to Ind. Code ch. 8-1-8.4 for the Project. We are also mindful that settlements represent the product of negotiations, and modifications to the terms can result in nullification of the entire settlement.

As we will discuss below, the record includes substantial evidence supporting each element of the Federal Mandate Statute. The evidence also supports the Settling Parties' agreement that the Project constitutes a compliance project that will allow Petitioner to comply directly or indirectly with "federally mandated requirements" under Ind. Code § 8-1-8.4-5 and that the associated costs, as modified herein, are "federally mandated costs" under Ind. Code § 8-1-8.4-4 and, therefore, eligible for cost recovery as set forth in Ind. Code § 8-1-8.4-7.

C. <u>Certificate of Public Convenience and Necessity</u>. Before approving the Settlement Agreements, and thus granting Petitioner a CPCN under Ind. Code ch. 8-1-8.4, we

must: (1) find that public convenience and necessity will be served by the proposed Project; (2) approve the projected costs associated with the Compliance Project; and (3) make a finding on each of the factors in Ind. Code § 8-1-8.4-6(b). Those factors include:

> (A) A description of the federally mandated requirements that the energy utility seeks to comply with through the proposed compliance project.
>
> (B) A description of the projected federally mandated costs associated with the proposed compliance project.
>
> (C) A description of how the proposed compliance project allows the energy utility to comply with the federally mandated requirements described by the energy utility under clause (A).
>
> (D) Evaluation of alternative plans that demonstrate that the proposed compliance project is reasonable and necessary.
>
> (E) Information as to whether the proposed compliance project will extend the useful life of an existing energy utility facility and, if so, the value of that extension.

Ind. Code § 8-1-8.4-6(b)(1).

i. Federally Mandated Requirements and Petitioner's Compliance with the Mandate. Ind. Code § 8-1-8.4-5 defines a federally mandated requirement to include a "requirement that the commission determines is imposed on an energy utility by the federal government in connection with . . . [a]ny other law, order, or regulation administered or issued by the United States Environmental Protection Agency[.]" EPA promulgated the CCR Rule under RCRA, which is one of the federal mandates explicitly listed in Ind. Code § 8-1-8.4-5. As discussed by Ms. Retherford, the CCR Rule requires groundwater testing at the Brown Ash Pond. The testing results indicated statistically significant groundwater impacts above acceptable levels, which triggered the mandate that Vectren South commence closure of the Brown Ash Pond. As such, the Project is being undertaken to comply with these federally mandated requirements under Ind. Code § 8-1-8.4-5.

Mr. Games and Ms. Retherford both explained how the proposed Project allows Petitioner to comply with the CCR Rule. Additionally, the Settling Parties agree that the proposed Project is reasonable and necessary to meet a federally mandated requirement. Based on the evidence presented, we find that Petitioner's Project will allow it to comply with EPA's CCR Rule, which is a "federally mandated requirement" under Ind. Code § 8-1-8.4-5.

ii. Federally Mandated Project Costs. Ind. Code § 8-1-8.4-4 defines federally mandated costs, in part, as "costs that an energy utility incurs in connection with a compliance project, including capital, operating, maintenance, depreciation, tax, or financing costs." Based on Petitioner's direct testimony, the Project has a total cost of $164,539,000. Under the Settlement Agreements, Petitioner agreed to remove a contingency cost, thereby reducing the total federally mandated cost to $156,200,000. The Settling Parties agree that this cost estimate constitutes a reasonable estimate of the costs for the Project. Under the Settlement Agreements, Petitioner has agreed to a minimum amount of cash proceeds from the Ash Reuser and insurance

policy recoveries of $25 million to offset the O&M Project Costs to be recovered. Actual recoveries in excess of this minimum will also be applied to offset O&M costs.

Petitioner explained in detail the unique aspects of the Project whereby beneficial reuse of the excavated ash results in the ash being safely removed from the pond and transported off site to the Ash Reuser. Project costs are offset by the proceeds from the Ash Reuser and the insurance recoveries to the point that the Project costs are comparable to the estimated total inflated CIP project cost of $137.5 million. We recognize the economic and environmental advantages of the CBR approach to achieving CCR compliance. The record sets forth the many benefits of CBR with Beneficial Reuse in this particular circumstance compared to a CIP project, including long-term mitigation of risk to the extent a CIP approach would expose Petitioner to future additional remediation requirements at the pond.

The evidence sufficiently describes the projected federally mandated costs and expenses associated with the Project and demonstrates that Petitioner used sufficient rigor to develop its estimates, including the testimony of AECOM, an expert engineering firm that frequently engages in such remediation projects. The Commission agrees that the stipulated eligible project cost of $156,200,000 represents a reasonable estimate of the federally mandated costs for the Project. We further commend Vectren South for identifying a beneficial re-use of its CCR material and finalizing its agreement with the Ash Reuser in order to offset overall project costs. While each CCR project has its own unique challenges, we encourage all jurisdictional utilities facing similar CCR Rule compliance obligations to explore potential beneficial re-use and other cost mitigation options. Therefore, we approve the stipulated project cost as federally mandated costs and expenses associated with the Project.

iii. Alternative Plans. Through its partnership with AECOM, Vectren South presented detailed and comprehensive options for closing the Brown Ash Pond in compliance with the CCR Rule. The two general approaches that Vectren South evaluated are CIP and CBR. As detailed in the AECOM Report and Mr. Mokotoff's direct testimony, these two options were analyzed by evaluating engineering alternatives related to the six main components of the closure process: pond closure, excavation, dewatering, handling, processing, and storage. As such, the alternative evaluation included the following scenarios:

1. Pond Closure Options
    a. Closure-in-Place (CIP)
    b. Closure-by-Removal (CBR)
    c. Partial Removal Option 1: 50% CBR / 50% CIP
    d. Partial Removal Option 2: 75% CBR / 25% CIP
2. Excavation
    a. Hydraulic Dredging
    b. Drag Line
    c. Conventional
3. Dewatering Options
    a. Gravity Dewatering
    b. Positive Dewatering
    c. Combination of Gravity and Positive Dewatering

4. Handling Options
    a. Trucking
    b. Conveyor
5. Processing Options
    a. Screening
    b. Blending
    c. Drying
6. Storage Options
    a. Eurosilo
    b. Dome Structure

AECOM reviewed each scenario by using experience based on similar pond closure and infrastructure projects, by conducting research specific to the various possible technologies, and by discussing the potential options with construction contractors and equipment vendors. In addition, AECOM observed current CCR handling operations at the Brown Ash Pond and at ash ponds and CCR landfills owned by other electric utilities to gain further insight into what might be the most appropriate and effective CCR management methods for the Brown Ash Pond. AECOM then developed conceptual engineering designs to approximately a 60% of final level of detail for each of the pond closure options.

The CIP option involves dewatering the pond, leaving the CCR material in place, constructing a synthetic membrane cap, installing a system to drain all surface water away from the cap, adding topsoil, and establishing a vegetative cover. As such, the CIP option requires long-term groundwater monitoring and ongoing cap maintenance. Alternatively, the CBR option entails dewatering the pond and removing the CCR material for disposal or beneficial reuse.

Initially, the CIP approach appeared to be less expensive and resource intensive than the CBR approaches. In his direct testimony, Mr. Games presented the estimated total federally mandated costs for CBR with Beneficial Reuse at $164,539,000, adjusted for inflation. However, based on the Settling Parties' agreement, this projected cost estimate was offset by: 1.) removing the inflated contingency of $8.33 million; and 2.) applying cash proceeds from the Ash Reuser and insurance proceeds of at least $25 million. Applying the $25 million offset to the total federally mandated costs of $156,200,000 agreed to by the Settling Parties results in at most $131,200,000 for CBR with Beneficial Reuse compared to AECOM's estimates of $137,509,000 for the CIP option and $225,526,351 for the CBR and Landfill option.

Additionally, Vectren South identified multiple reasons to select CBR over CIP prior to negotiating these cost reductions. First, IDEM has been unwilling to approve a CIP approach where significant amounts of ash remain in contact with groundwater, and other states are starting to require CBR. Second, if required to remove ash from groundwater under a CIP approach, the upfront costs would no longer be lower. Third, the CIP poses risk for future groundwater contamination and associated remediation due to CCR material being left in the closed pond. The CBR options, on the other hand, remove the requirement for 30 years of groundwater monitoring and mitigate groundwater issues. The CBR options also avoid the potential scenario wherein CCR material is required to be excavated and placed in a lined landfill as a result of future regulations. Given these considerations as detailed in AECOM's comprehensive engineering analysis and the

evidence of record, we find that Petitioner properly considered alternative plans for compliance with the CCR Rule and that the Project as presented is reasonable and necessary.

iv. Useful Life of the Facilities. In her testimony, Ms. Retherford explained that the Project will extend the useful life of the existing A.B. Brown Generating Station, which is a brownfield site with infrastructure to be used for existing and possible future generation resources. We find that the Project will benefit the continued and future use of the Brown site as a location for generation resources.

v. Conclusion. The evidence presented demonstrates that the proposed Project will allow Petitioner to comply with the requirements of the CCR Rule. As discussed above, we have made a finding on each of the factors described in Ind. Code § 8-1-8.4-6(b), and we have approved the projected federally mandated costs associated with this Compliance Project. Therefore, we find that public convenience and necessity will be served by the Project, and we approve the proposed Project and issue Petitioner a CPCN for the Project under Ind. Code § 8-1-8.4-7(b), consistent with the Settlement Agreements negotiated by the Settling Parties.

D. Cost Recovery. Ind. Code § 8-l-8.4-7(c) states:

> If the commission approves under subsection (b) a proposed compliance project, including approval of the projected federally mandated costs associated with the compliance project, the following apply:
>
> (1) Eighty percent (80%) of the approved federally mandated costs shall be recovered by the energy utility through a periodic retail rate adjustment mechanism that allows the timely recovery of the approved federally mandated costs. The commission shall adjust the energy utility's authorized net operating income to reflect any approved earnings for purposes of IC 8-l-2-42(d)(3) and IC 8-1-2-42(g)(3).
>
> (2) Twenty percent (20%) of the approved federally mandated costs, including depreciation, allowance for funds used during construction, and post in service carrying costs, based on the overall cost of capital most recently approved by the commission, shall be deferred and recovered by the energy utility as part of the next general rate case filed by the energy utility with the commission.
>
> (3) Actual costs that exceed the projected federally mandated costs of the approved compliance project by more than twenty-five percent (25%) shall require specific justification by the energy utility and specific approval by the commission before being authorized in the next general rate case filed by the energy utility with the commission.

Pursuant to the Settlement Agreements, the Settling Parties have agreed that Petitioner should be authorized to: (1) recover 80% of the federally mandated costs for the Project, including PISCC, both debt and equity using the overall cost of capital approved in Petitioner's TDSIC cases, and deferred depreciation expense associated with the Project, through Petitioner's ECA Rider; (2) defer 20% of the federally mandated costs for the Project for subsequent recovery in a base rate case; and (3) defer depreciation and O&M expenses relating to the Project until such expenses

are recovered through either a rate adjustment mechanism or in base rates, all as described in Petitioner's Exhibit No. 5, p. 6. The Settling Parties further agreed that Vectren South's requested accounting and ratemaking treatment should be granted except as expressly modified in the Settlement Agreements (as we have described above). The Settling Parties' agreement on the total federally mandated costs is without waiver of the rights provided to the parties under Ind. Code § 8-1-8.4-7(c)(3). The Settling Parties further agree that in the event the Project results in a retirement of existing assets, Vectren South will offset the incremental depreciation expense included in the revenue requirement calculation with the impact of the retired assets.

We find that the stipulated accounting and ratemaking treatment set forth in the Settlement Agreements as described above are reasonable and are hereby approved. Additionally, we find the proposed ECA tariff changes described by Mr. Cas Swiz are reasonable and are approved.

8. Conclusion. The evidence presented provides substantive support demonstrating that the Settlement Agreements are reasonable and in the public interest. We find the Settlement Agreements contain reasonable customer safeguards in terms of the project costs to be recovered and represent a reasonable resolution of the issues. Based on the evidence presented, we find that the Settlement Agreements should be approved in their entirety. Petitioner is authorized to proceed with the Project, which it has demonstrated is reasonable and necessary for compliance with the CCR Rule.

The Settling Parties agree that the Settlement Agreements should not be used as precedent in any other proceeding or for any other purpose, except to the extent necessary to implement or enforce their terms. Consequently, with regard to future citation of the Settlement Agreements, we find our approval herein should be construed in a manner consistent with our finding in *Richmond Power & Light*, Cause No. 40434, 1997 WL 34880849, at *7-8 (IURC March 19, 1997).

We commend Vectren South for developing an innovative plan for addressing its legacy ash waste at the Brown Ash Pond. We likewise agree with the OUCC and CAC that Vectren South investigated reasonable alternatives to closing the pond in a manner that mitigated the costs passed onto ratepayers and diminished the potential of future liability. While we recognize that each ash pond subject to the CCR Rule has unique geographic, structural, and environmental characteristics, jurisdictional utilities should show that they reasonably examined all realistic closure options and pursued all avenues to reduce costs to ratepayers when submitting an application for rate recovery before the Commission. We also recognize CAC's efforts in securing worker safety provisions for workers engaged in the removal, onsite processing, and conveying of CCR material from the Brown Ash Pond without attributing additional costs to ratepayers.

9. Confidential Information. Petitioner filed motions for protective order on August 15, 2019, and February 13, 2020, all of which were supported by affidavits showing documents to be submitted to the Commission were trade secret information within the scope of Ind. Code §§ 5-14-3-4(a)(4) and (9) and Ind. Code § 24-2-3-2. The Presiding Officers issued docket entries finding all of the information described in the motions to be preliminarily confidential, after which such information was submitted under seal. We find all such information is confidential pursuant to Ind. Code § 5-14-3-4 and Ind. Code § 24-2-3-2, is exempt from public access and disclosure by Indiana

law and shall be held confidential and protected from public access and disclosure by the Commission.

IT IS THEREFORE ORDERED BY THE INDIANA UTILITY REGULATORY COMMISSION that:

1. The Settlement Agreements attached hereto are approved in their entirety as set forth above.

2. Petitioner is issued a Certificate of Public Convenience and Necessity for the Project pursuant to Ind. Code §§ 8-1-8.4-6 and -7. This Order constitutes the Certificate.

3. Petitioner is authorized to timely recover 80% of the stipulated federally mandated costs incurred during construction and operation of the Project, including post-in-service carrying costs, both debt and equity, and deferred depreciation expense associated with the Project through Petitioner's ECA mechanism. Petitioner's authorized return amount utilized in its Fuel Adjustment Clause net operating income earnings tests under Ind. Code § 8-1-2-42(d) and Ind. Code § 8-1-2-42.3 shall be adjusted accordingly.

4. Petitioner is authorized to defer for recovery 20% of such approved federally mandated costs until such costs are reflected in Petitioner's retail electric rates pursuant to Ind. Code § 8-1-8.4-7(c)(2).

5. Petitioner is authorized to accrue post-in-service carrying costs, both debt and equity, related to the Project after its in-service date using the overall cost of capital approved in Petitioner's TDSIC cases.

6. Petitioner is authorized to defer depreciation and operating and maintenance expenses relating to the Project until such expenses are recovered through either a rate adjustment mechanism or in base rates.

7. Petitioner is authorized to utilize the depreciation rates set forth in Petitioner's Exhibit No. 5, p. 8 with respect to the Project.

8. Petitioner is authorized to revise its ECA Rider tariffs as shown in Petitioner's Exhibit No. 6, Attachment JCS-2.

9. Petitioner shall file with the Commission as a compliance filing under this Cause its dewatering plans upon submission to IDEM.

10. The Commission's approval of Petitioner's request in this Cause is contingent on IDEM's final approval of the Project.

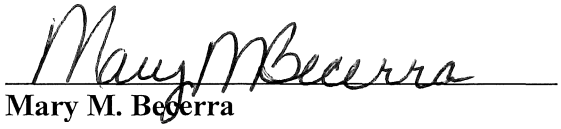
11. The Confidential Information is deemed confidential under Ind. Code §§ 8-1-2-29 and 5-14-3-4, is exempt from public access and disclosure by Indiana law, and shall be held confidential and protected from public access and disclosure by the Commission.

12. This Order shall be effective on and after the date of its approval.

HUSTON, FREEMAN, KREVDA, OBER, AND ZIEGNER CONCUR:

APPROVED: MAY 13 2020

I hereby certify that the above is a true and correct copy of the Order as approved.



Mary M. Becerra
Secretary of the Commission

FILED
December 19, 2019
INDIANA UTILITY
REGULATORY COMMISSION

STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

VERIFIED PETITION OF SOUTHERN INDIANA GAS AND ELECTRIC COMPANY d/b/a VECTREN ENERGY DELIVERY OF INDIANA, INC. ("VECTREN SOUTH") FOR (1) ISSUANCE OF A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY FOR A COMPLIANCE PROJECT TO MEET FEDERALLY MANDATED REQUIREMENTS TO CLOSE ITS A. B. BROWN POND (THE "BROWN POND COMPLIANCE PROJECT"); (2) AUTHORITY TO TIMELY RECOVER 80% OF THE APPROVED FEDERALLY MANDATED COSTS INCURRED DURING CONSTRUCTION AND OPERATION OF THE BROWN POND COMPLIANCE PROJECT INCLUDING POST-IN SERVICE CARRYING CHARGES (BOTH DEBT AND EQUITY) ("PISCC") AND DEFERRED DEPRECIATION THROUGH VECTREN SOUTH'S ENVIRONMENTAL COST ADJUSTMENT MECHANISM; (3) AUTHORITY TO DEFER FOR RECOVERY IN VECTREN SOUTH'S ENSUING GENERAL RATE CASE 20% OF SUCH APPROVED FEDERALLY MANDATED COSTS; AND (4) IN THE ALTERNATIVE, APPROVAL TO INCLUDE THE BROWN POND COMPLIANCE PROJECT IN RATE BASE PURSUANT TO IC 8-1-2-23.	)	**CAUSE NO. 45280**

STIPULATION AND SETTLEMENT AGREEMENT

This Stipulation and Settlement Agreement (the "Settlement Agreement") is entered into by and among Southern Indiana Gas and Electric Company d/b/a Vectren Energy Delivery of Indiana, Inc. ("Vectren South" or the "Company") and the Indiana Office of Utility Consumer Counselor ("OUCC"). Vectren South and the OUCC are collectively referred to herein as the "Settling Parties." The Settling Parties, solely for

purposes of compromise and settlement, stipulate and agree that the terms and conditions set forth in this Settlement Agreement represent a fair, just and reasonable resolution of all matters raised in this proceeding, subject to their incorporation by the Indiana Utility Regulatory Commission ("Commission") into a final, non-appealable order without modification or further condition that is unacceptable to any Settling Party. The Settling Parties agree that this Settlement Agreement resolves all disputes, claims and issues arising from the Commission proceeding currently pending in Cause No. 45280 as between the Settling Parties. The Settling Parties agree that Vectren South's requested relief in this Cause should be granted in its entirety except as expressly modified herein.

1. Certificate of Public Convenience and Necessity. The Settling Parties agree the Commission should find that public convenience and necessity will be served by the compliance project to close the Brown Ash Pond in compliance with the Environmental Protection Agency's ("EPA") Coal Combustion Residual ("CCR") rule (the "Brown Ash Pond Compliance Project") and grant Vectren South a certificate of public convenience and necessity ("CPCN") pursuant to Ind. Code ch. 8-1-8.4 for the Brown Ash Pond Compliance Project.

2. Federally Mandated Costs. The Settling Parties agree that, in light of Ind. Code 8-1-8.4-7(c)(3) and without waiver of the rights provided to the parties thereunder, Vectren South shall remove the inflated contingency of $8.33 million ($7.49 million prior to inflation)[1] from the total federally mandated costs. As a result, the Settling Parties agree that the total projected (inflated) federally mandated costs of $156,200,000 are reasonable and should be approved. The Settling Parties agree that the Commission

[1] Petitioner's Exhibit No. 1, p. 22, lines 2-7.

should find that the Brown Ash Pond Compliance Project constitutes a compliance project that will allow Vectren South to comply directly or indirectly with "federally mandated requirements" under Ind. Code § 8-1-8.4-5 and that the associated costs, as modified herein, are "federally mandated costs" under Ind. Code § 8-1-8.4-4 and therefore eligible for cost recovery set forth in Ind. Code § 8-1-8.4-7.

3. Credit for Cash Proceeds and Insurance Proceeds. The Settling Parties agree that total federally mandated costs will be offset by total cash proceeds to be received from the ash reuser ("Ash Payments" in Table 1 of Petitioner's Exhibit No. 1, p. 20) plus total insurance proceeds to be received (Petitioner's Exhibit No. 5, p. 5, lines 1-5) of at least $25 million. These cash proceeds will be used to offset incurred operations and maintenance ("O&M") Costs to excavate and convey the ash to the loading facility, as described in Vectren South's direct testimony.

4. Timely Recovery Through ECA Mechanism. The Settling Parties agree that Vectren South should be authorized to timely recover 80% of the approved federally mandated costs incurred during construction and after placement in service and operation of the Brown Pond Compliance Project, including post-in-service carrying costs, both debt and equity, and deferred depreciation expense associated with the Brown Ash Pond Compliance Project through Vectren South's Environmental Cost Adjustment ("ECA") mechanism, as described in Petitioner's Exhibit No. 5, p. 6.

5. Cost of Removal. The Settling Parties agree that the costs of removal associated with retirements of existing or future capital assets in connection with the Brown Ash Pond Compliance Project are not reflected in the total projected federally mandated costs and they will not be reflected in the ECA mechanism in future

proceedings. Such costs of removal, if incurred, will be addressed in future general base rate cases to the extent of their effect on net original cost rate base. In the event the Brown Ash Pond Compliance Project results in a retirement of existing assets, Vectren South will offset the incremental depreciation expense included in the revenue requirement calculation with the impact of the retired assets. (Petitioner's Exhibit No. 5, p. 8.)

6. Deferral Authority. The Settling Parties agree that Vectren South should be authorized to defer 20% of the approved federally mandated costs until such costs are reflected in Vectren South's retail electric rates pursuant to Ind. Code § 8-1-8.4-7(c)(2), as presented in Petitioner's Exhibit No. 5, p. 6.

7. Other Accounting and Ratemaking Treatment. The Settling Parties agree that the Commission should grant Vectren South's requested accounting and ratemaking treatment except as expressly modified herein.

8. Preservation of Rights Regarding Effect of Environmental Liability on Rates. In the event Vectren South is held liable for damages or made subject to enforcement action with respect to the handling of the ash from the Brown Ash Pond, the Settling Parties reserve their respective positions with respect to rate recovery related thereto and preserve their rights to defend such positions in future proceedings.

9. Scope and Effect of Settlement.

a. Neither the making of this Settlement Agreement nor any of its provisions shall constitute in any respect an admission by any Settling Party in this or any other litigation or proceeding. Neither the making of this Settlement Agreement, nor the provisions thereof, nor the entry by the Commission of

a Final Order approving this Settlement Agreement, shall establish any principles or legal precedent applicable to Commission proceedings other than those resolved herein.

b. This Settlement Agreement shall not constitute nor be cited as precedent by any person or deemed an admission by any Settling Party in any other proceeding except as necessary to enforce its terms before the Commission, or any tribunal of competent jurisdiction. This Settlement Agreement is solely the result of compromise in the settlement process and, except as provided herein, is without prejudice to and shall not constitute a waiver of any position that any of the Settling Parties may take with respect to any or all of the issues resolved herein in any future regulatory or other proceedings.

c. The Settling Parties' entry into this Settlement Agreement shall not be construed as a limitation on any position they may take or relief they may seek in other pending or future Commission proceedings not specifically addressed in this Settlement Agreement.

10. Authority to Enter Settlement. The undersigned have represented and agreed that they are fully authorized to execute this Settlement Agreement on behalf of their designated clients, and their successors and assigns, who will be bound thereby, subject to the agreement of the Settling Parties on the provisions contained herein.

11. Privileged Settlement Communications. The communications and discussions during the negotiations and conferences have been conducted based on the explicit understanding that said communications and discussions are or relate to offers of

settlement and therefore are privileged. All prior drafts of this Settlement Agreement and any settlement proposals and counterproposals also are or relate to offers of settlement and are privileged.

12. Conditions of Settlement. This Settlement Agreement is conditioned upon and subject to Commission acceptance and approval of its terms in their entirety, without any change or condition that is unacceptable to any Settling Party.

13. Evidence in Support of Settlement. Vectren South and the OUCC shall offer supplemental testimony supporting the Commission's approval of this Settlement Agreement and will request that the Commission issue a Final Order incorporating the agreed proposed language of the Settling Parties and accepting and approving the same in accordance with its terms without any modification. Such supportive testimony will be agreed-upon by the Settling Parties and offered into evidence without objection by any Settling Party. The Settling Parties hereby waive cross-examination of each other's witnesses.

14. Commission Approval. The Settling Parties will support this Settlement Agreement before the Commission and request that the Commission accept and approve the Settlement Agreement. This Settlement Agreement is a complete, interrelated package and is not severable, and shall be accepted or rejected in its entirety without modification or further condition(s) that may be unacceptable to any Settling Party. If the Commission does not approve the Settlement Agreement in its entirety, the Settlement Agreement shall be null and void and deemed withdrawn, upon notice in writing by any Settling Party within fifteen (15) business days after the date of the Final Order that any modifications made by the Commission are unacceptable to it. In the event the Settlement

Agreement is withdrawn, the Settling Parties will request that an Attorneys' Conference be convened to establish a procedural schedule for the continued litigation of this proceeding.

15. Proposed Order. The Settling Parties will work together to prepare an agreed upon proposed order to be submitted in this Cause. The Settling Parties will request Commission acceptance and approval of this Settlement Agreement in its entirety, without any change or condition that is unacceptable to any party to this Settlement Agreement.

16. Publicity. The Settling Parties also will work cooperatively on news releases or other announcements to the public about this Settlement Agreement.

17. Waiver of Opposition. The Settling Parties shall not appeal or seek rehearing, reconsideration or a stay of any Final Order entered by the Commission approving the Settlement Agreement in its entirety without changes or condition(s) unacceptable to any Settling Party (or related orders to the extent such orders are specifically and exclusively implementing the provisions hereof) and shall not oppose this Settlement Agreement in the event of any appeal or a request for rehearing, reconsideration or a stay by any person not a party hereto.

Accepted and Agreed on this 19th day of December, 2019.

(signature page follows)

Southern Indiana Gas and Electric Company
d/b/a Vectren Energy Delivery of Indiana, Inc.

By: _____

Indiana Office of Utility Consumer Counselor

By: _____

DMS 15900098v1

STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

VERIFIED PETITION OF SOUTHERN INDIANA GAS AND ELECTRIC COMPANY d/b/a VECTREN ENERGY DELIVERY OF INDIANA, INC. ("VECTREN SOUTH") FOR (1) ISSUANCE OF A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY FOR A COMPLIANCE PROJECT TO MEET FEDERALLY MANDATED REQUIREMENTS TO CLOSE ITS A. B. BROWN POND (THE "BROWN POND COMPLIANCE PROJECT"); (2) AUTHORITY TO TIMELY RECOVER 80% OF THE APPROVED FEDERALLY MANDATED COSTS INCURRED DURING CONSTRUCTION AND OPERATION OF THE BROWN POND COMPLIANCE PROJECT INCLUDING POST-IN SERVICE CARRYING CHARGES (BOTH DEBT AND EQUITY) ("PISCC") AND DEFERRED DEPRECIATION THROUGH VECTREN SOUTH'S ENVIRONMENTAL COST ADJUSTMENT MECHANISM; (3) AUTHORITY TO DEFER FOR RECOVERY IN VECTREN SOUTH'S ENSUING GENERAL RATE CASE 20% OF SUCH APPROVED FEDERALLY MANDATED COSTS; AND (4) IN THE ALTERNATIVE, APPROVAL TO INCLUDE THE BROWN POND COMPLIANCE PROJECT IN RATE BASE PURSUANT TO IC 8-1-2-23.	)	CAUSE NO. 45280

FILED
January 10, 2020
INDIANA UTILITY
REGULATORY COMMISSION

STIPULATION AND SETTLEMENT AGREEMENT

This Stipulation and Settlement Agreement (the "Settlement Agreement") is entered into by and among Southern Indiana Gas and Electric Company d/b/a Vectren Energy Delivery of Indiana, Inc. ("Vectren South" or the "Company"), the Indiana Office of Utility Consumer Counselor ("OUCC") and the Citizens Action Coalition of Indiana, Inc. ("CAC"). Vectren South, the OUCC and the CAC are collectively referred to herein as the

"Settling Parties." The Settling Parties, solely for purposes of compromise and settlement, stipulate and agree that the terms and conditions set forth in this Settlement Agreement represent a fair, just and reasonable resolution of concerns raised by the CAC related to the compliance project to close the Brown Ash Pond in compliance with the Environmental Protection Agency's ("EPA") Coal Combustion Residual ("CCR") rule (the "Brown Ash Pond Compliance Project"), subject to their incorporation by the Indiana Utility Regulatory Commission ("Commission") into a final, non-appealable order without modification or further condition that is unacceptable to any Settling Party. The Settling Parties agree that this Settlement Agreement resolves all disputes, claims and issues arising from the Commission proceeding currently pending in Cause No. 45280 as between the Settling Parties. The Settling Parties agree that Vectren South's requested relief in this Cause should be granted in its entirety subject to the conditions stated herein.

1. Stipulation and Settlement Agreement between Vectren South and OUCC dated December 19, 2019. CAC agrees with and joins the Stipulation and Settlement Agreement between Vectren South and the OUCC dated December 19, 2019 (the "December 19 Settlement Agreement"), subject to the additional conditions stated in this Settlement Agreement.

2. Submission of Plans and Notice Regarding Dewatering. The Settling Parties agree that, prior to commencing dewatering of the Brown Ash Pond, for purposes of closing the Brown Ash Pond, Vectren South shall submit the dewatering plans to the Indiana Department of Environmental Management ("IDEM") for approval. Vectren shall provide a copy of the dewatering plans and shall also provide the notice to IDEM of the commencement of dewatering to the Settling Parties.

3. Closure Activities. The Settling Parties agree that, prior to commencing any closure-in-place of CCR at the Brown Ash Pond, Vectren South shall submit, and receive IDEM approval of, a closure plan for the Brown Ash Pond pursuant to applicable IDEM regulations. Vectren South shall include a revised Fugitive Dust Plan for the Brown Ash Pond as part of that closure plan application. The full closure plan for the Brown Ash Pond shall be made publicly available.

4. Worker Protections. The Settling Parties agree that Vectren South shall work with its contractors to include worker protection provisions in the revised Fugitive Dust Plan submitted as part of Vectren South's closure plan for the Ash Pond. Those worker protection provisions should include protections for workers engaged in the removal of CCR from the Brown Ash Pond, onsite processing of the CCR, and conveying of the CCR from the Brown Ash Pond to any barge that will transport it to off-site locations.

5. Scope and Effect of Settlement.

a. Neither the making of this Settlement Agreement nor any of its provisions shall constitute in any respect an admission by any Settling Party in this or any other litigation or proceeding. Neither the making of this Settlement Agreement, nor the provisions thereof, nor the entry by the Commission of a Final Order approving this Settlement Agreement, shall establish any principles or legal precedent applicable to Commission proceedings other than those resolved herein.

b. This Settlement Agreement shall not constitute nor be cited as precedent by any person or deemed an admission by any Settling Party in any other proceeding except as necessary to enforce its terms before the

Commission, or any tribunal of competent jurisdiction. This Settlement Agreement is solely the result of compromise in the settlement process and, except as provided herein, is without prejudice to and shall not constitute a waiver of any position that any of the Settling Parties may take with respect to any or all of the issues resolved herein in any future regulatory or other proceedings.

c. The Settling Parties' entry into this Settlement Agreement shall not be construed as a limitation on any position they may take or relief they may seek in other pending or future Commission proceedings not specifically addressed in this Settlement Agreement or the December 19 Settlement Agreement.

6. Authority to Enter Settlement. The undersigned have represented and agreed that they are fully authorized to execute this Settlement Agreement on behalf of their designated clients, and their successors and assigns, who will be bound thereby, subject to the agreement of the Settling Parties on the provisions contained herein.

7. Privileged Settlement Communications. The communications and discussions during the negotiations and conferences have been conducted based on the explicit understanding that said communications and discussions are or relate to offers of settlement and therefore are privileged. All prior drafts of this Settlement Agreement and any settlement proposals and counterproposals also are or relate to offers of settlement and are privileged.

8. Conditions of Settlement. This Settlement Agreement is conditioned upon and subject to Commission acceptance and approval of its terms in their entirety, without any change or condition that is unacceptable to any Settling Party.

9. Evidence in Support of Settlement. Vectren South shall offer supplemental testimony supporting the Commission's approval of this Settlement Agreement and will request that the Commission issue a Final Order incorporating the agreed proposed language of the Settling Parties and accepting and approving the same in accordance with its terms without any modification. Such supportive testimony will be agreed-upon by the Settling Parties and offered into evidence without objection by any Settling Party. The Settling Parties hereby waive cross-examination of each other's witnesses.

10. Commission Approval. The Settling Parties will support this Settlement Agreement before the Commission and request that the Commission accept and approve the Settlement Agreement. The terms of this Settlement Agreement constitute an interrelated package and are not severable, and shall be accepted or rejected in their entirety without modification or further condition(s) that may be unacceptable to any Settling Party. If the Commission does not approve this Settlement Agreement in its entirety, this Settlement Agreement shall be null and void and deemed withdrawn, upon notice in writing by any Settling Party within fifteen (15) business days after the date of the Final Order that any modifications made by the Commission are unacceptable to it. In the event this Settlement Agreement is withdrawn, the Settling Parties will request that an Attorneys' Conference be convened to establish a procedural schedule for the continued litigation of this proceeding.

11. Proposed Order. The Settling Parties will work together to prepare an agreed upon proposed order to be submitted in this Cause. The Settling Parties will request Commission acceptance and approval of this Settlement Agreement and the December 19 Settlement Agreement in their entirety, without any change or condition that is unacceptable to any party to this Settlement Agreement.

12. Publicity. The Settling Parties also will work cooperatively on news releases or other announcements to the public about this Settlement Agreement.

13. Waiver of Opposition. The Settling Parties shall not appeal or seek rehearing, reconsideration or a stay of any Final Order entered by the Commission approving this Settlement Agreement in its entirety without changes or condition(s) unacceptable to any Settling Party (or related orders to the extent such orders are specifically and exclusively implementing the provisions hereof) and shall not oppose this Settlement Agreement in the event of any appeal or a request for rehearing, reconsideration or a stay by any person not a party hereto.

Accepted and Agreed on this 9th day of January, 2020.

(signature page follows)

Southern Indiana Gas and Electric Company
d/b/a Vectren Energy Delivery of Indiana, Inc.

By:_____

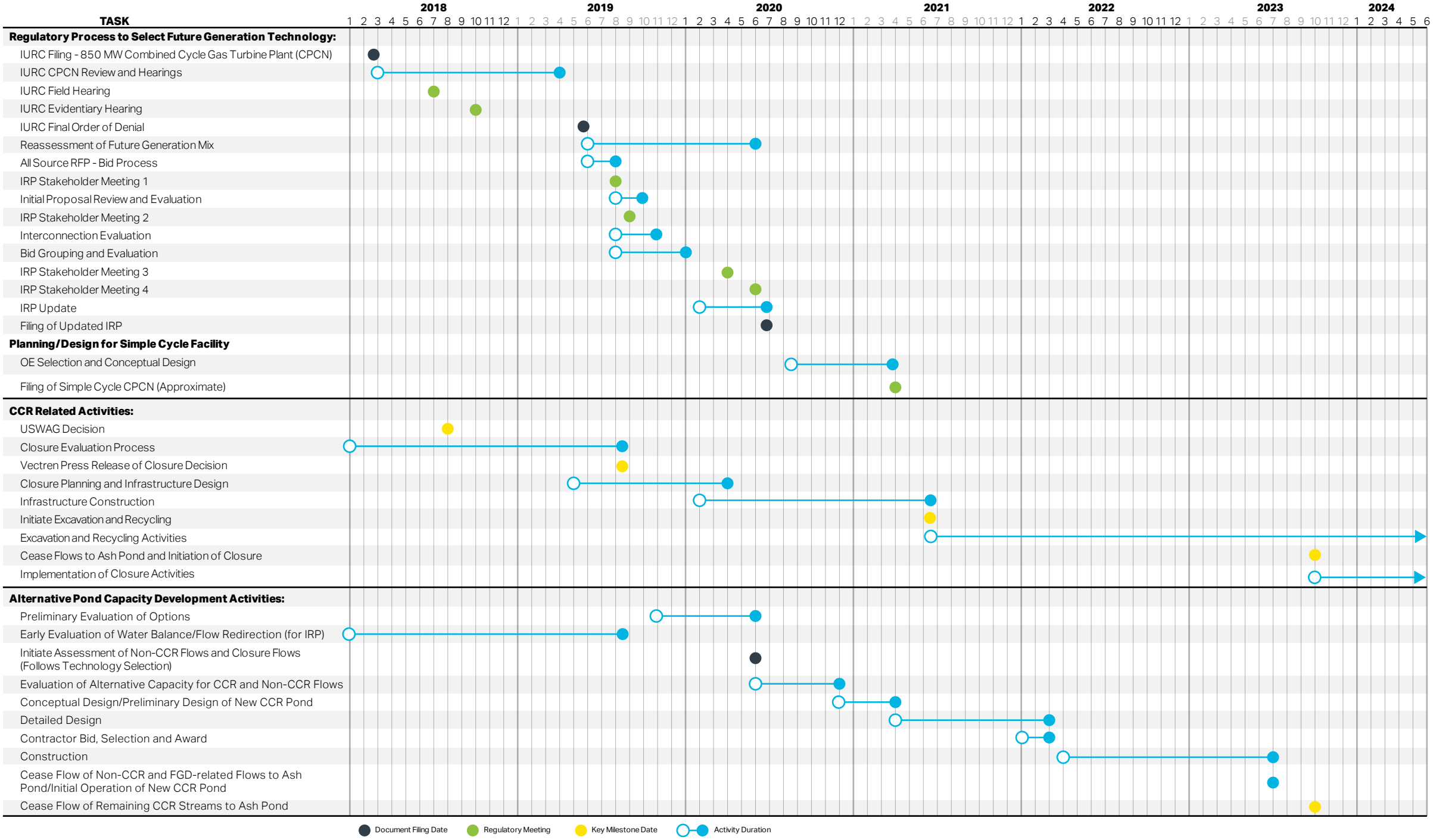
Citizens Action Coalition of Indiana, Inc.

By:_____
Kerwin L. Olson, Executive Director

Indiana Office of Utility Consumer Counselor

By: Lorraine Hitz-Bradley

Appendix C
Schedule Activities and Milestone


TASK
2018
2019
2020
2021
2022
2023
2024
Regulatory Process to Select Future Generation Technology:
IURC Filing - 850 MW Combined Cycle Gas Turbine Plant (CPCN)
IURC CPCN Review and Hearings
IURC Field Hearing
IURC Evidentiary Hearing
IURC Final Order of Denial
Reassessment of Future Generation Mix
All Source RFP - Bid Process
IRP Stakeholder Meeting 1
Initial Proposal Review and Evaluation
IRP Stakeholder Meeting 2
Interconnection Evaluation
Bid Grouping and Evaluation
IRP Stakeholder Meeting 3
IRP Stakeholder Meeting 4
IRP Update
Filing of Updated IRP
Planning/Design for Simple Cycle Facility
OE Selection and Conceptual Design
Filing of Simple Cycle CPCN (Approximate)
CCR Related Activities:
USWAG Decision
Closure Evaluation Process
Vectren Press Release of Closure Decision
Closure Planning and Infrastructure Design
Infrastructure Construction
Initiate Excavation and Recycling
Excavation and Recycling Activities
Cease Flows to Ash Pond and Initiation of Closure
Implementation of Closure Activities
Alternative Pond Capacity Development Activities:
Preliminary Evaluation of Options
Early Evaluation of Water Balance/Flow Redirection (for IRP)
Initiate Assessment of Non-CCR Flows and Closure Flows (Follows Technology Selection)
Evaluation of Alternative Capacity for CCR and Non-CCR Flows
Conceptual Design/Preliminary Design of New CCR Pond
Detailed Design
Contractor Bid, Selection and Award
Construction
Cease Flow of Non-CCR and FGD-related Flows to Ash Pond/Initial Operation of New CCR Pond
Cease Flow of Remaining CCR Streams to Ash Pond
Document Filing Date
Regulatory Meeting
Key Milestone Date
Activity Duration

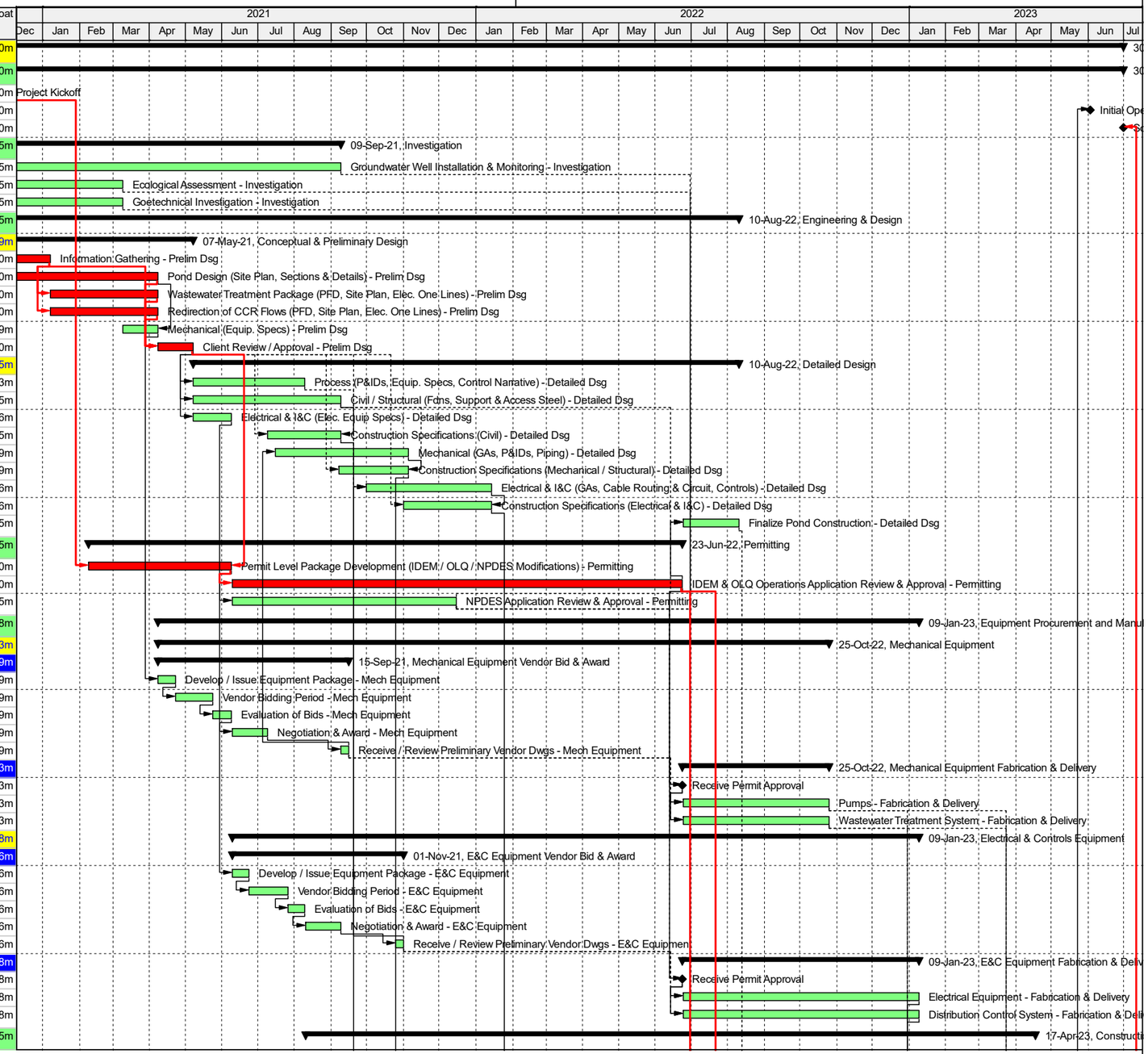
Appendix D
Detailed Schedule for Development of Alternative Capacity

ABB Southside Runoff Pond West Exp._RevC

RevC

Data Date: 30-Nov-20

Activity ID	Activity Name	Duration	Start	Finish	Total Float
ABB Southside Runoff Pond West Exp._RevC		29.7m	01-Dec-20	30-Jun-23	0.0m
Milestones		29.7m	01-Dec-20	30-Jun-23	0.0m
A1350	Project Kickoff	0.0m	01-Dec-20*		0.0m
A1360	Initial Operation	0.0m	02-Jun-23		1.0m
A1640	South Side Runoff Pond - West Expansion Complete	0.0m		30-Jun-23*	0.0m
Investigation		9.0m	01-Dec-20	09-Sep-21	9.5m
A1010	Groundwater Well Installation & Monitoring - Investigation	9.0m	01-Dec-20	09-Sep-21	9.5m
A1330	Ecological Assessment - Investigation	3.0m	01-Dec-20	09-Mar-21	15.5m
A1730	Goetechnical Investigation - Investigation	3.0m	01-Dec-20	09-Mar-21	15.5m
Engineering & Design		19.5m	01-Dec-20	10-Aug-22	0.5m
Conceptual & Preliminary Design		5.0m	01-Dec-20	07-May-21	3.9m
A1000	Information Gathering - Prelim Dsg	1.0m	01-Dec-20	07-Jan-21	0.0m
A1020	Pond Design (Site Plan, Sections & Details) - Prelim Dsg	4.0m	01-Dec-20	07-Apr-21	0.0m
A1040	Wastewater Treatment Package (PFD, Site Plan, Elec. One Lines) - Prelim	3.0m	07-Jan-21	07-Apr-21	0.0m
A1430	Redirection of CCR Flows (PFD, Site Plan, Elec. One Lines) - Prelim Dsg	3.0m	07-Jan-21	07-Apr-21	0.0m
A1540	Mechanical (Equip. Specs) - Prelim Dsg	1.0m	09-Mar-21	07-Apr-21	4.9m
A1450	Client Review / Approval - Prelim Dsg	1.0m	08-Apr-21	07-May-21	0.0m
Detailed Design		14.5m	07-May-21	10-Aug-22	0.5m
A1050	Process (P&IDs, Equip. Specs, Control Narrative) - Detailed Dsg	3.0m	07-May-21	09-Aug-21	9.3m
A1070	Civil / Structural (Fdns, Support & Access Steel) - Detailed Dsg	4.0m	07-May-21	09-Sep-21	6.5m
A1560	Electrical & I&C (Elec. Equip Specs) - Detailed Dsg	1.0m	07-May-21	08-Jun-21	6.6m
A1090	Construction Specifications (Civil) - Detailed Dsg	2.0m	09-Jul-21	09-Sep-21	6.5m
A1060	Mechanical (GAs, P&IDs, Piping) - Detailed Dsg	3.7m	15-Jul-21	05-Nov-21	4.9m
A1610	Construction Specifications (Mechanical / Structural) - Detailed Dsg	2.0m	07-Sep-21	05-Nov-21	4.9m
A1080	Electrical & I&C (GAs, Cable Routing & Circuit, Controls) - Detailed Dsg	3.0m	30-Sep-21	14-Jan-22	6.6m
A1440	Construction Specifications (Electrical & I&C) - Detailed Dsg	2.0m	01-Nov-21	14-Jan-22	6.6m
A1270	Finalize Pond Construction - Detailed Dsg	1.5m	24-Jun-22	10-Aug-22	0.5m
Permitting		16.0m	08-Feb-21	23-Jun-22	0.5m
A1030	Permit Level Package Development (IDEM / OLQ / NPDES Modifications)	4.0m	08-Feb-21	08-Jun-21	0.0m
A1100	IDEM & OLQ Operations Application Review & Approval - Permitting	12.0m	09-Jun-21	23-Jun-22	0.0m
A1110	NPDES Application Review & Approval - Permitting	6.0m	09-Jun-21	15-Dec-21	6.5m
Equipment Procurement and Manufacture		20.0m	08-Apr-21	09-Jan-23	1.8m
Mechanical Equipment		18.0m	08-Apr-21	25-Oct-22	3.3m
Mechanical Equipment Vendor Bid & Award		5.2m	08-Apr-21	15-Sep-21	4.9m
A1120	Develop / Issue Equipment Package - Mech Equipment	0.5m	08-Apr-21	22-Apr-21	4.9m
A1130	Vendor Bidding Period - Mech Equipment	1.0m	22-Apr-21	24-May-21	4.9m
A1140	Evaluation of Bids - Mech Equipment	0.5m	24-May-21	08-Jun-21	4.9m
A1150	Negotiation & Award - Mech Equipment	1.0m	09-Jun-21	09-Jul-21	4.9m
A1550	Receive / Review Preliminary Vendor Dwgs - Mech Equipment	0.2m	09-Sep-21	15-Sep-21	4.9m
Mechanical Equipment Fabrication & Delivery		4.0m	23-Jun-22	25-Oct-22	3.3m
A1310	Receive Permit Approval	0.0m		23-Jun-22	3.3m
A1160	Pumps - Fabrication & Delivery	4.0m	24-Jun-22	25-Oct-22	3.3m
A1170	Wastewater Treatment System - Fabrication & Delivery	4.0m	24-Jun-22	25-Oct-22	3.3m
Electrical & Controls Equipment		18.0m	09-Jun-21	09-Jan-23	1.8m
E&C Equipment Vendor Bid & Award		4.7m	09-Jun-21	01-Nov-21	6.6m
A1490	Develop / Issue Equipment Package - E&C Equipment	0.5m	09-Jun-21	23-Jun-21	6.6m
A1500	Vendor Bidding Period - E&C Equipment	1.0m	23-Jun-21	26-Jul-21	6.6m
A1510	Evaluation of Bids - E&C Equipment	0.5m	26-Jul-21	09-Aug-21	6.6m
A1520	Negotiation & Award - E&C Equipment	1.0m	10-Aug-21	09-Sep-21	6.6m
A1530	Receive / Review Preliminary Vendor Dwgs - E&C Equipment	0.2m	25-Oct-21	01-Nov-21	6.6m
E&C Equipment Fabrication & Delivery		6.0m	23-Jun-22	09-Jan-23	1.8m
A1720	Receive Permit Approval	0.0m		23-Jun-22	1.8m
A1180	Electrical Equipment - Fabrication & Delivery	6.0m	24-Jun-22	09-Jan-23	1.8m
A1190	Distribution Control System - Fabrication & Delivery	6.0m	24-Jun-22	09-Jan-23	1.8m
Construction		19.3m	10-Aug-21	17-Apr-23	2.5m



Actual Work | Critical Remaining Work | Summary
Remaining Work | Milestone

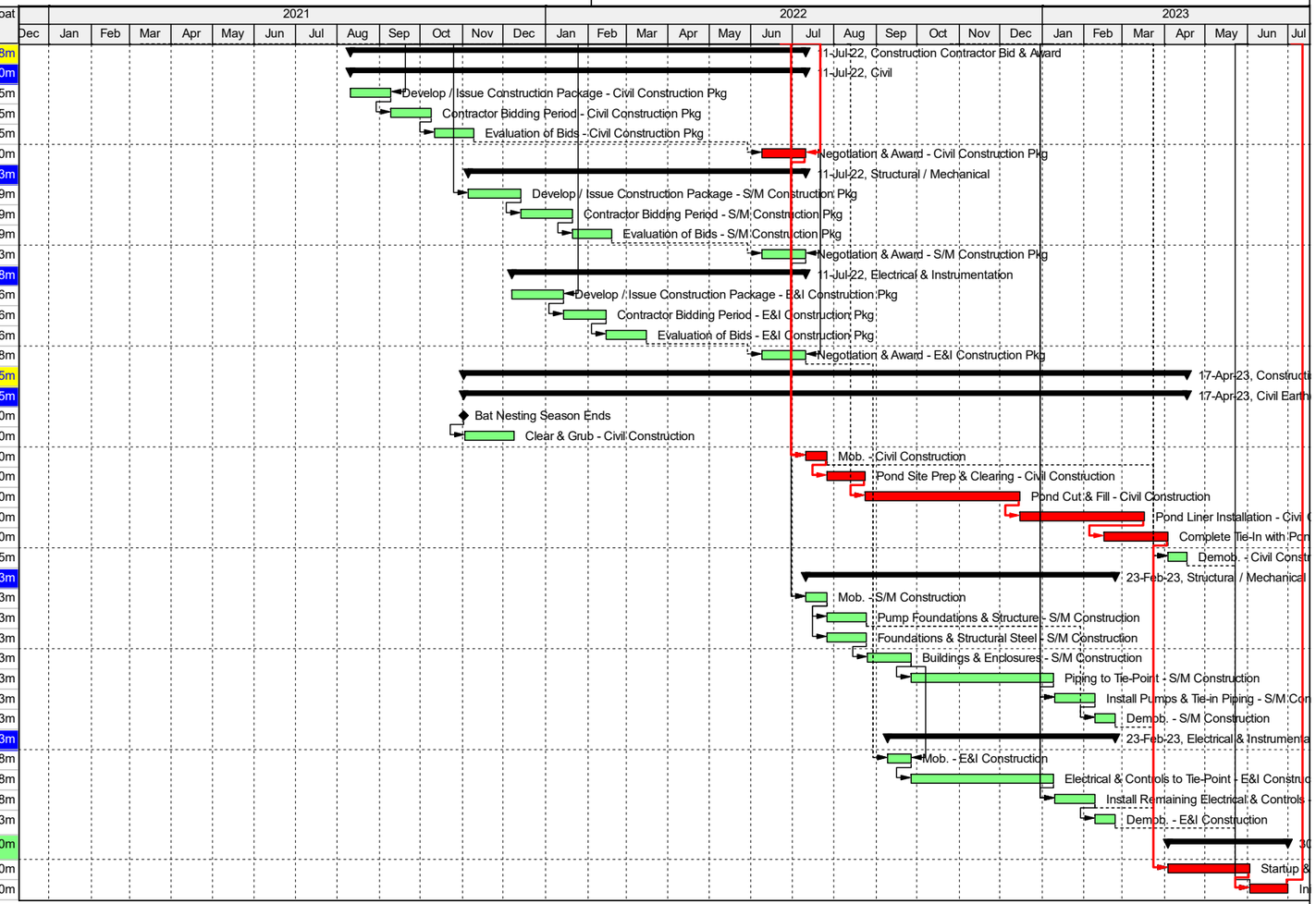
AECOM

ABB Southside Runoff Pond West Exp._RevC

RevC

Data Date: 30-Nov-20

Activity ID	Activity Name	Duration	Start	Finish	Total Float
Construction Contractor Bid & Award		10.5m	10-Aug-21	11-Jul-22	3.8m
Civil		10.5m	10-Aug-21	11-Jul-22	0.0m
A1200	Develop / Issue Construction Package - Civil Construction Pkg	1.0m	10-Aug-21	09-Sep-21	6.5m
A1210	Contractor Bidding Period - Civil Construction Pkg	1.0m	09-Sep-21	08-Oct-21	6.5m
A1220	Evaluation of Bids - Civil Construction Pkg	1.0m	11-Oct-21	09-Nov-21	6.5m
A1230	Negotiation & Award - Civil Construction Pkg	1.0m	09-Jun-22	11-Jul-22	0.0m
Structural / Mechanical		7.6m	05-Nov-21	11-Jul-22	1.3m
A1570	Develop / Issue Construction Package - S/M Construction Pkg	1.0m	05-Nov-21	13-Dec-21	4.9m
A1580	Contractor Bidding Period - S/M Construction Pkg	1.0m	13-Dec-21	20-Jan-22	4.9m
A1590	Evaluation of Bids - S/M Construction Pkg	1.0m	20-Jan-22	18-Feb-22	4.9m
A1600	Negotiation & Award - S/M Construction Pkg	1.0m	09-Jun-22	11-Jul-22	1.3m
Electrical & Instrumentation		6.8m	07-Dec-21	11-Jul-22	3.8m
A1390	Develop / Issue Construction Package - E&I Construction Pkg	1.0m	07-Dec-21	14-Jan-22	6.6m
A1400	Contractor Bidding Period - E&I Construction Pkg	1.0m	14-Jan-22	14-Feb-22	6.6m
A1410	Evaluation of Bids - E&I Construction Pkg	1.0m	14-Feb-22	16-Mar-22	6.6m
A1420	Negotiation & Award - E&I Construction Pkg	1.0m	09-Jun-22	11-Jul-22	3.8m
Construction		16.5m	01-Nov-21	17-Apr-23	2.5m
Civil Earthworks		16.5m	01-Nov-21	17-Apr-23	2.5m
A1290	Bat Nesting Season Ends	0.0m		01-Nov-21*	0.0m
A1300	Clear & Grub - Civil Construction	1.0m	02-Nov-21	08-Dec-21	18.0m
A1240	Mob. - Civil Construction	0.5m	11-Jul-22	26-Jul-22	0.0m
A1250	Pond Site Prep & Clearing - Civil Construction	1.0m	26-Jul-22	23-Aug-22	0.0m
A1260	Pond Cut & Fill - Civil Construction	3.5m	23-Aug-22	15-Dec-22	0.0m
A1280	Pond Liner Installation - Civil Construction	2.8m	15-Dec-22	17-Mar-23	0.0m
A1630	Complete Tie-In with Pond & Install Pond Pumps - Civil Construction	1.5m	15-Feb-23	03-Apr-23	0.0m
A1470	Demob. - Civil Construction	0.5m	03-Apr-23	17-Apr-23	1.5m
Structural / Mechanical		7.0m	11-Jul-22	23-Feb-23	1.3m
A1620	Mob. - S/M Construction	0.5m	11-Jul-22	26-Jul-22	1.3m
A1650	Pump Foundations & Structure - S/M Construction	1.0m	26-Jul-22	24-Aug-22	5.3m
A1670	Foundations & Structural Steel - S/M Construction	1.0m	26-Jul-22	24-Aug-22	1.3m
A1680	Buildings & Enclosures - S/M Construction	1.0m	25-Aug-22	26-Sep-22	1.3m
A1690	Piping to Tie-Point - S/M Construction	3.0m	26-Sep-22	09-Jan-23	1.3m
A1700	Install Pumps & Tie-in Piping - S/M Construction	1.0m	10-Jan-23	08-Feb-23	1.3m
A1710	Demob. - S/M Construction	0.5m	08-Feb-23	23-Feb-23	1.3m
Electrical & Instrumentation		5.0m	09-Sep-22	23-Feb-23	3.3m
A1340	Mob. - E&I Construction	0.5m	09-Sep-22	26-Sep-22	1.8m
A1320	Electrical & Controls to Tie-Point - E&I Construction	3.0m	26-Sep-22	09-Jan-23	1.8m
A1480	Install Remaining Electrical & Controls - E&I Construction	1.0m	10-Jan-23	08-Feb-23	1.8m
A1460	Demob. - E&I Construction	0.5m	08-Feb-23	23-Feb-23	3.3m
Start-Up & Commissioning		3.0m	03-Apr-23	30-Jun-23	0.0m
A1370	Startup & Commissioning	2.0m	03-Apr-23	02-Jun-23	0.0m
A1380	Initial Operation	1.0m	02-Jun-23	30-Jun-23	0.0m



Actual Work | Critical Remaining Work | Summary
Remaining Work | Milestone

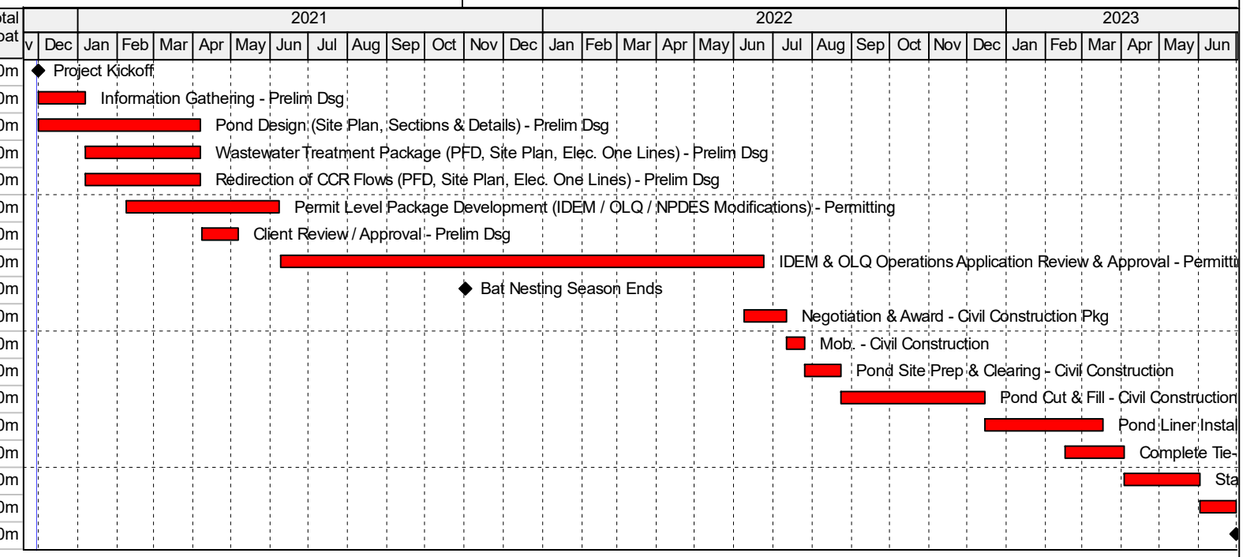
AECOM

ABB Southside Runoff Pond West Exp._RevC

RevC

Data Date: 30-Nov-20

Activity ID	Activity Name	Orig. Dur.	Start	Finish	Total Float
A1350	Project Kickoff	0.0m	01-Dec-20*		0.0m
A1000	Information Gathering - Prelim Dsg	1.0m	01-Dec-20	07-Jan-21	0.0m
A1020	Pond Design (Site Plan, Sections & Details) - Prelim Dsg	4.0m	01-Dec-20	07-Apr-21	0.0m
A1040	Wastewater Treatment Package (PFD, Site Plan, Elec. One Lines) - Prelim Dsg	3.0m	07-Jan-21	07-Apr-21	0.0m
A1430	Redirection of CCR Flows (PFD, Site Plan, Elec. One Lines) - Prelim Dsg	3.0m	07-Jan-21	07-Apr-21	0.0m
A1030	Permit Level Package Development (IDEM / OLQ / NPDES Modifications) - Permitting	4.0m	08-Feb-21	08-Jun-21	0.0m
A1450	Client Review / Approval - Prelim Dsg	1.0m	08-Apr-21	07-May-21	0.0m
A1100	IDEM & OLQ Operations Application Review & Approval - Permitting	12.0m	09-Jun-21	23-Jun-22	0.0m
A1290	Bat Nesting Season Ends	0.0m		01-Nov-21*	0.0m
A1230	Negotiation & Award - Civil Construction Pkg	1.0m	09-Jun-22	11-Jul-22	0.0m
A1240	Mob. - Civil Construction	0.5m	11-Jul-22	26-Jul-22	0.0m
A1250	Pond Site Prep & Clearing - Civil Construction	1.0m	26-Jul-22	23-Aug-22	0.0m
A1260	Pond Cut & Fill - Civil Construction	3.5m	23-Aug-22	15-Dec-22	0.0m
A1280	Pond Liner Installation - Civil Construction	2.8m	15-Dec-22	17-Mar-23	0.0m
A1630	Complete Tie-In with Pond & Install Pond Pumps - Civil Construction	1.5m	15-Feb-23	03-Apr-23	0.0m
A1370	Startup & Commissioning	2.0m	03-Apr-23	02-Jun-23	0.0m
A1380	Initial Operation	1.0m	02-Jun-23	30-Jun-23	0.0m
A1640	South Side Runoff Pond - West Expansion Complete	0.0m		30-Jun-23*	0.0m



Actual Work
Critical Remaining Work
Summary
Remaining Work
Milestone

AECOM

Appendix E
Certification of Compliance

Certification of Compliance

In accordance with 40 CFR §257.103(f)(1)(iv)(B)(1), I, Angila Retherford, being a qualified representative of Southern Industrial Gas & Electric Company, do hereby certify, to the best of my knowledge, information, and belief, that the A.B. Brown Generating Station is in compliance with all of the requirements of 40 CFR 257 Subpart D – Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments. A.B. Brown's CCR Compliance website is up-to-date and contains all the necessary documentation and notification postings.

Angila Retherford

Signed

Angila Retherford

Printed Name

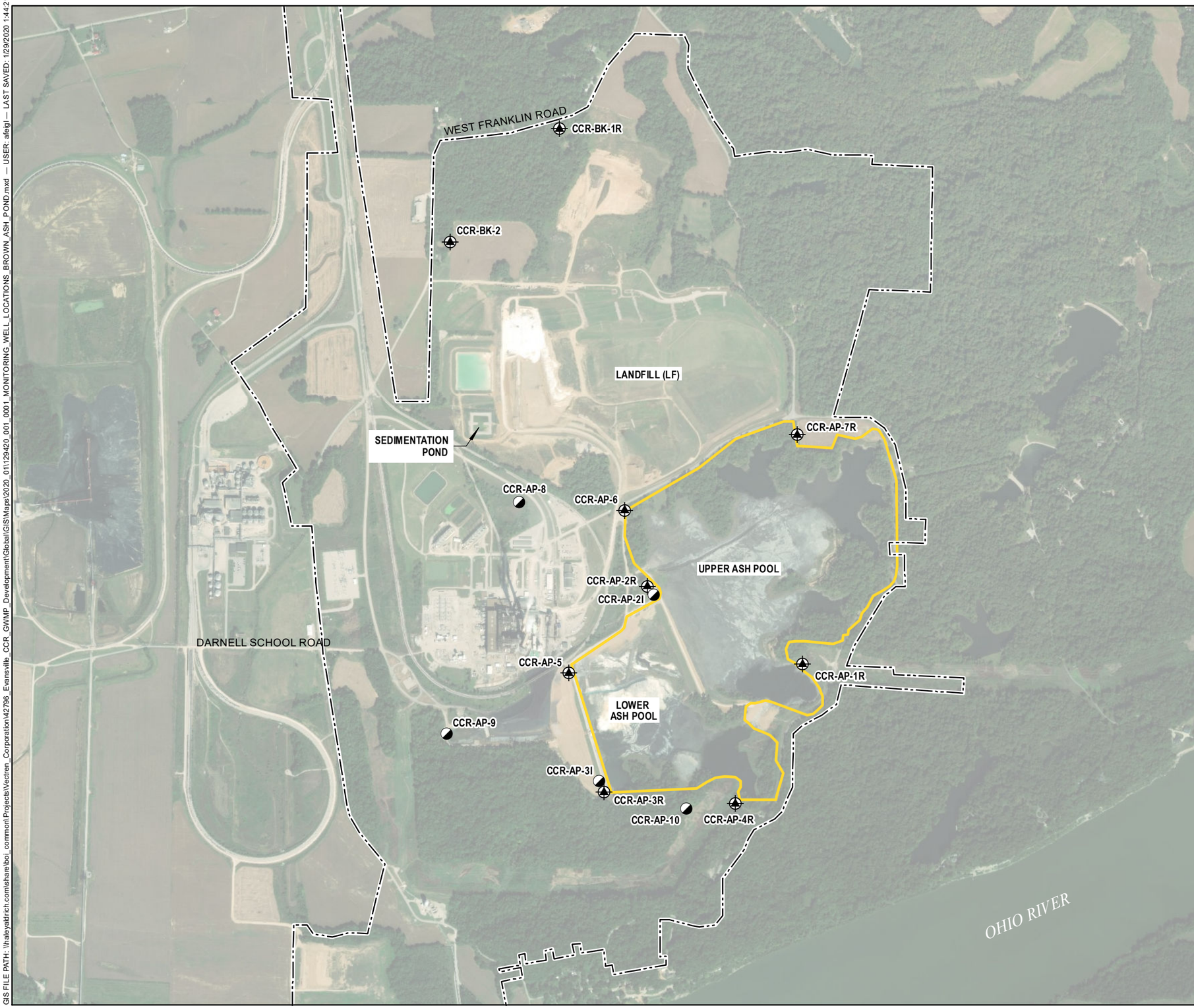
VP Environmental & Corp Resp.

Title

11/23/20

Date

Appendix F
Groundwater Monitoring Well Location



LEGEND

- CCR MONITORING WELL
- NATURE AND EXTENT MONITORING WELL
- CCR PIEZOMETER WELL
- ASH POND UNIT BOUNDARY

NOTES

1. AERIAL IMAGERY SOURCE: ESRI
2. LOCATIONS DERIVED FROM THREE I DESIGN DATA.

N

0 1,100 2,200
SCALE IN FEET

HALEY ALDRICH

SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

GROUNDWATER MONITORING WELL LOCATIONS - ASH POND

JANAURY 2020

FIGURE 1

GIS FILE PATH: \\haleyaldrich.com\share\boi_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2020_01\129420_001_0001_MONITORING_WELL_LOCATIONS_BROWN_ASH_POND.mxd — USER: afeigl — LAST SAVED: 1/29/2020 1:44:21 PM

Appendix G
Well Construction Diagrams

TEST BORING REPORT

Boring No. CCR-AP-1

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 1
Start	18 December 2015
Finish	18 December 2015
Driller	B. Marshall
H&A Rep.	T. Vanage
Elevation	465.7 (est.)
Datum	
Location	See Plan N 968260.82 E 2773560.71

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	Sonic	-	Steel	Rig Make & Model: Track Geoprobe 8140LS
Inside Diameter (in.)	6	-	6.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	-	-	Drill Mud: None
Hammer Fall (in.)		-	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 38	0.0 5.0	CL		Soft brown lean CLAY (CL), mps 20 mm, no odor, moist, roots throughout -OVERBURDEN-	-	5	-	-	5	90				
5		U2 58	5.0 10.0	ML	460.0 5.8	Soft brown SILT (ML), no odor, wet -OVERBURDEN-	-	-	-	-	5	95				
10		U3 108	10.0 20.0													
15					447.7 18.0	Moderately weathered red-brown medium-grained SANDSTONE -BEDROCK-										
20					445.7 20.0	BOTTOM OF EXPLORATION 20.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/20/15	-	-	-	-	4.87

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	18.0
Rock Cored (ft)	2.0
Samples	3U

Boring No. CCR-AP-1

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-1R

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	26 July 2016
Finish	26 July 2016
Driller	J. Gryska
H&A Rep.	C. Toscano
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel
Type	HSA	S	Steel
Inside Diameter (in.)	4.25	1 3/8	9.0
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)		30	-

Drilling Equipment and Procedures

Rig Make & Model: Track CME 850 XR
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Drilled through existing observation well CCR-AP-1, see test boring report for soils logged from 0-20 ft. -OVERBURDEN-										
5																	
10																	
15																	
						18.0	Top of weathered bedrock -BEDROCK-										
20																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
7/27/16	7:15	-	-	-	5.60

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	18.0
Rock Cored (ft)	19.0
Samples	1S

Boring No. CCR-AP-1R

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-1R
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25																	
	4 5 5 16	S1 24	28.0 30.0				Loose reddish-brown sandy SILT (ML) with occasional layers of highly weathered rock with distinct rock fabric (sandstone/siltstone)	-	5	10	15	10	60				
30																	
							Drill action, occasional rig chatter and soil cuttings indicated highly weathered Siltstone/Sandstone										
35																	
						37.0	BOTTOM OF EXPLORATION 37.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-1R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-2

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No. 42796-001
Sheet No. 1 of 2
Start 17 December 2015
Finish 17 December 2015
Driller B. Marshall
H&A Rep. T. Vanage
Elevation 465.2 (est.)
Datum
Location See Plan
N 969079.16
E 2771922.52

	Casing	Sampler	Barrel
Type	Sonic	-	Steel
Inside Diameter (in.)	4.5	-	6.0
Hammer Weight (lb)	-	-	-
Hammer Fall (in.)		-	-

Drilling Equipment and Procedures

Rig Make & Model: Track Geoprobe 8140LS
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 47	0.0 5.0	CL		Medium stiff brown lean CLAY (CL), no odor, moist, red mottling at 3 feet, organics present -FILL-	-	-	-	-	-	100				
5		U2 58	5.0 10.0	CL		Medium stiff yellow-brown lean CLAY (CL), no door, moist	-	-	-	-	-	100				
10		U3 57	10.0 15.0													
				MH	452.7 12.5	Soft to medium stiff yellow-brown elastic SILT (MH), no odor, dry -OVERBURDEN-	-	-	-	-	-	100				
15		U4 60	15.0 20.0	MH		Driller indicated collapse at 15.5 feet Soft yellow-brown elastic SILT (MH), no odor, wet	-	-	-	-	5	95				
20		U5 60	20.0 25.0													

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/20/15	-	-	-	-	18.46

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 25.5
Rock Cored (ft) -
Samples 5U

Boring No. CCR-AP-2

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-2
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
				MH			Similar as above, except wet										
25						439.7											
						25.5	BOTTOM OF EXPLORATION 25.5 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-2

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-2R

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	28 July 2016
Finish	28 July 2016
Driller	J. Gryska
H&A Rep.	C. Toscano
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	9.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Drilled through existing observation well CCR-AP-2, see test boring report for soils logged from 0-25 ft.										
							-OVERBURDEN-										
5																	
10																	
15																	
20																	
25																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
7/29/15	7:30	-	-	-	28.80

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	30.0
Rock Cored (ft)	23.3
Samples	3S

Boring No. CCR-AP-2R

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-2R
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	1 1 1 1	S1 8	25.0 27.0	ML			Very soft yellowish-brown sandy SILT (ML), mps 1 mm, no odor, wet	-	-	-	-	25	75				
							Top of decomposed bedrock at 30.0 ft										
30	7 9 13 12	S2 24	30.0 32.0			30.0	Stiff yellowish-brown to tan sandy SILT (ML) with frequent alternating layers and seems of silt and fine sand. Trace coal and decomposed rock fragments, wet	-	-	-	-	25	75				
						32.0	-BEDROCK-										
35	50/6	S3 6	35.0 37.0				Hard yellowish-brown to gray-brown SILT with sand (ML) with frequent alternating layers and seams of sandy silt and silty fine sand, well stratified, entire sample exhibits distinct rock fabric, wet	-	-	-	-	15	85				
40																	
45																	
50																	
						53.3	Drill action and rig chatter indicated harder rock at 53.0 ft, soil cuttings on auger flights indicated limestone bedrock										
							BOTTOM OF EXPLORATION 53.3 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-2R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-3

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No. 42796-001
Sheet No. 1 of 2
Start 19 December 2015
Finish 20 December 2015
Driller B. Marshall
H&A Rep. T. Vanage
Elevation 450.0 (est.)
Datum
Location See Plan
N 966865.12
E 2771404.27

	Casing	Sampler	Barrel
Type	Sonic	-	Steel
Inside Diameter (in.)	4.5	-	6.0
Hammer Weight (lb)	-	-	-
Hammer Fall (in.)		-	-

Drilling Equipment and Procedures

Rig Make & Model: Track Geoprobe 8140LS
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 42	0.0 3.5	CL		Medium stiff brown lean CLAY (CL), interbedded gravel, very fine sand partings, no odor, dry -FILL-	-	5	-	-	10	85				
5		U2 48	5.5 9.0	ML	444.5 5.5	Very soft brown SILT (ML), no odor, dry -OVERBURDEN-	-	-	-	-	-	100				
10		U3 120	9.0 19.0													
15						Grades to very moist at 14 feet Grades to wet at 15 feet										
20		U4 120	19.0 29.0													

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/20/15	-	-	-	-	21.97

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 32.5
Rock Cored (ft) 2.5
Samples 5U

Boring No. CCR-AP-3

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.
Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

HALEY ALDRICH

Boring No. CCR-AP-3
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
				CL		429.0 21.0	Medium stiff red-brown lean CLAY (CL), no odor, moist -OVERBURDEN-	-	-	-	-	-	100				
25																	
30						417.5 32.5	Highly weathered brown SANDSTONE, fine-grained, trace silt and clay present -BEDROCK-										
35						415.0 35.0	BOTTOM OF EXPLORATION 35.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-3

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-3R

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	27 July 2016
Finish	28 July 2016
Driller	J. Gryska
H&A Rep.	S.Lewis
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	9.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Drilled through existing observation well CCR-AP-3, see test boring report for soils logged from 0-25 ft -OVERBURDEN-										
5																	
10																	
15																	
20																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
7/27/16	8:00	-	-	-	37.90

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	32.5
Rock Cored (ft)	14.5
Samples	1S

Boring No. CCR-AP-3R

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-3R
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25																	
30																	
						32.5	Top of decomposed bedrock at 32.5 ft -BEDROCK-										
35	12 21 18 25	S1 24	35.0 37.0				Dense tan to yellow-brown silty SAND (SM) with frequent interbedded seams layers of sandy silt and silt, well stratified, entire sample exhibits distinct rock fabric, dry	-	-	5	15	45	35				
40																	
45																	
						47.0	BOTTOM OF EXPLORATION 47.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-3R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-4

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	14 March 2016
Finish	14 March 2016
Driller	J. Gryska
H&A Rep.	J. Yonts
Elevation Datum	472.9 (est.)
Location	See Plan N 966741.47 E 2772827.01

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	6.0	Bit Type: Cutting Head Drill Mud: None
Hammer Weight (lb)	-	140	-	Casing: Spun
Hammer Fall (in.)		30	-	Hoist/Hammer: - PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0				ML		Hand clear to 5.0 ft bgs, mostly brown SILT (ML), no odor, moist -OVERBURDEN-										
5	WOH 1 WOH 1	S1 22	5.0 7.0	ML		Very soft brown SILT (ML), no structure, moist, trace clay, trace woody debris Wet at 6.0 ft	-	-	-	-	5	95				
					464.4 8.5											
10	1 1 2 3	S2 16	8.5 10.5	ML		Soft brown SILT (ML), no odor, dry, faint laminae from light brown to brown (1-2 mm thick)	-	-	-	-	10	90				
15	2 5 4 5	S3 17	13.5 15.5	ML		Similar as above Water between 15.6 ft to 18.5 ft										
20	2 2 2 3	S4 20	18.5 20.5	ML		Similar as above except no structure and wet										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	17:05	-	-	-	31.69

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	28.5
Rock Cored (ft)	7.0
Samples	7S

Boring No. CCR-AP-4

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

HALEY ALDRICH

Boring No. CCR-AP-4
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						449.4											
25	2 3 4 5	S5 24	23.5 25.5	CL		23.5	Medium stiff dark red brown red-brown CLAY (CL), no structure										
						444.4											
30	2 2 3 5	S6 24	28.5 30.5	SC		28.5	Brown red-brown black clayey SAND (SC), no odor, moist, mostly medium to fine poorly graded sands, weathered sandstone -BEDROCK-										
35	3 6 11 14	S7 24	33.5 35.5	SC			Red-brown orange black yellow mottled clayey SAND (SC), weathered sandstone										
						437.4 35.5	BOTTOM OF EXPLORATION 35.5 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-4

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TEST BORING REPORT

Boring No. CCR-AP-4R

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	27 July 2016
Finish	27 July 2016
Driller	J. Gryska
H&A Rep.	C. Toscano
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	9.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Drilled through existing observation well CCR-AP-4, see test boring report for soils logged from 0-35.5 ft.										
							-OVERBURDEN-										
5																	
10																	
15																	
20																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
7/27/16	12:30	-	-	-	31.60

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	28.5
Rock Cored (ft)	19.5
Samples	1S

Boring No. CCR-AP-4R

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-4R
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25																	
						28.0	-BEDROCK-										
30																	
35						35.5	Medium dense tan to yellow-brown silty SAND (SM) with occasional layers of completely weathered bedrock exhibiting distinct rock fabric	-	-	10	15	40	35				
	2 12 18 22	S1 24	35.5 37.5	SM													
						38.0	Drill action, occasional rig chatter and soil cuttings indicated completely weathered bedrock at 38.0 ft.										
40																	
45																	
						48.0	BOTTOM OF EXPLORATION 48.0 ft										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-4R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-5

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No. 42796-001
Sheet No. 1 of 2
Start 13 March 2016
Finish 14 March 2016
Driller J. Gryska
H&A Rep. S. Lewis
Elevation 451.0 (est.)
Datum
Location See Plan
N 968166.03
E 3771019.7

	Casing	Sampler	Barrel
Type	HSA	S	Steel
Inside Diameter (in.)	4.25	1 3/8	6.0
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)		30	-

Drilling Equipment and Procedures

Rig Make & Model: Track CME 850 XR
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0				ML			Hand auger to 0.0 ft to 5.0 ft, brown SILT (ML), dry -FILL-										
5	4 2 5 7	S1 18	5.0 7.0	ML			Medium stiff grayish brown SILT (ML), no odor, moist	-	5	-	-	5	90				
	WOH 2 3 2	S2 9	8.0 10.0	ML			Medium stiff grayish brown SILT (ML), no odor, moist	-	-	-	-	5	95				
10																	
	4 7 6 12	S3 15	13.0 15.0	ML			Stiff grayish brown SILT (ML), no odor, dry, mottled with red color	-	-	-	-	10	90				
15																	
	2 5 10 18	S4 12	18.0 20.0	ML			Stiff grayish brown sandy SILT (ML), no odor, dry, trace clay, mottled with red color	-	10	-	-	30	60				
20																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	09:12	-	-	-	37.46

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 45.0
Rock Cored (ft) -
Samples 9S

Boring No. CCR-AP-5

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

HALEY ALDRICH

Boring No. CCR-AP-5
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	4 11 15 18	S5 18	23.0 25.0	ML		Very stiff brown SILT with sand (ML), no odor, dry, trace clay, mottled with red color	-	5	-	-	15	80				
					423.0 28.0	Soft brown and gray SILT (ML), no odor, wet	-	-	-	-	5	95				
	1 2 1 3	S6 24	28.0 30.0	ML		-OVERBURDEN-										
30																
35	1 3 3 4	S7 24	33.0 35.0	ML		Medium stiff gray SILT (ML), no odor, wet	-	-	-	-	-	100				
					413.0 38.0	Soft brown lean CLAY (CL), no odor, wet	-	-	-	-	-	100				
40	WOH WOH 3 4	S8 24	38.0 40.0	CL												
					408.0 43.0	Very soft brown SILT (ML), no odor, wet, trace clay	-	-	-	-	-	100				
	WOH WOH 2 3	S9 24	43.0 45.0	ML												
45					406.0 45.0	BOTTOM OF EXPLORATION 45.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-5

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-6

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	10 March 2016
Finish	11 March 2016
Driller	J. Gryska
H&A Rep.	S. Lewis
Elevation Datum	458.9 (est.)
Location	See Plan N 969932.76 E 2771626.75

	Casing	Sampler	Barrel
Type	HSA	S	Steel
Inside Diameter (in.)	4.25	1 3/8	6.0
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)		30	-

Drilling Equipment and Procedures

Rig Make & Model: Track CME 850 XR
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							-FILL-										
						454.9											
	1 2 2 4	S1 24	4.0 6.0	CL		4.0	Soft brown lean CLAY (CL), no odor, moist -OVERBURDEN-	-	-	-	-	10	90				
5																	
						449.9											
	8 15 30 50/2	S2 24	9.0 11.0	SM		9.0	Dense grayish brown silty SAND (SM), no odor, moist	-	-	-	10	60	30				
10																	
						444.9											
	20 50/6	S3 6	14.0 16.0			14.0	Tan mottled with red brown and dark gray weathered SANDSTONE, moist, thinly laminated -BEDROCK-										
15																	
	50/6	S4 2	19.0 21.0				Brownish tan weathered SANDSTONE, moist, thinly laminated										
20																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	15:33	-	-	-	12.15

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	14.0
Rock Cored (ft)	25.0
Samples	8S

Boring No. CCR-AP-6

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

HALEY ALDRICH

Boring No. CCR-AP-6
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	6 9 15 16	S5 24	24.0 26.0				Brownish tan weathered SANDSTONE, moist, thinly laminated										
						429.9 29.0	Dark gray weathered SHALE, wet, fissile										
30	50/5	S6 4	29.0 31.0														
35	50/6	S7 7	34.0 36.0				Dark gray weathered SHALE, organic matter at 34.5 ft (1.0 in. thick)										
						419.9 39.0	Dark gray weathered SHALE										
	50/1	S8 1	39.0 39.0				BOTTOM OF EXPLORATION 39.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-6

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-7

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	13 March 2016
Finish	14 March 2016
Driller	B. Marshall
H&A Rep.	J. Yonts
Elevation Datum	486.0 (est.)
Location	See Plan N 970758.7 E 2773501.63

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	Sonic	-	Steel	Rig Make & Model: Track Geoprobe 8140LS
Inside Diameter (in.)	4.5	-	6.0	Bit Type: Cutting Head Drill Mud: None
Hammer Weight (lb)	-	-	-	Casing: Spun Hoist/Hammer: -
Hammer Fall (in.)		-	-	PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 60	0.0 5.0	ML		Brown SILT with trace clay (ML), no structure, no odor, moist, root material	-	-	-	-	5	95				
						-OVERBURDEN-										
				ML		Brown SILT (ML), no odor, moist, no wood material	-	-	-	-	10	90				
5		U2 60	5.0 10.0	ML		Similar as above										
				ML		Brown SILT with trace clay (ML), no structure, no odor, moist	-	-	-	-	10	90				
10		U3 96	10.0 18.0	ML		Similar as above										
15					471.0 15.0	Orange red red-brown weathered SANDSTONE, moist, mostly medium to fine sands										
						-BEDROCK-										
		U4 24	18.0 20.0			Similar as above except more competent, bedrock										
20		U5 120	20.0 30.0			Similar as above										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	14:18	-	-	-	31.95

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	15.0
Rock Cored (ft)	20.0
Samples	6U

Boring No. CCR-AP-7

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-7
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						464.0											
						22.0	Brown orange gray SHALE, moist, fissile, trace fine sand										
25						460.0											
						26.0	Gray SILTSTONE, soft, wet										
						458.0											
						28.0	Red brown orange brown SANDSTONE, moist, moistly fine sands										
30		U6 60	30.0 35.0				Brown tan black gray orange SANDSTONE, moist to wet, fine to medium sands										
35						451.0 35.0	BOTTOM OF EXPLORATION 35.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-7

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-7R

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 3
Start	30 July 2016
Finish	30 July 2016
Driller	J. Gryska
H&A Rep.	C. Toscano
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	9.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Drilled through existing observation well CCR-AP-7, see test boring report for soils logged from 0-35.0 ft. -OVERBURDEN-										
5																	
10																	
15						15.0	Drill action, rig chatter and soil cuttings indicated highly to slightly weathered Sandstone/Shale -BEDROCK-										
20																	

Water Level Data					
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
7/30/16	-	-	-	-	28.30

Sample ID
- O - Open End Rod
- T - Thin Wall Tube
- U - Undisturbed Sample
- S - Split Spoon Sample

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (ft)	15.0
Rock Cored (ft)	38.5
Samples	-

Boring No. CCR-AP-7R

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-7R
File No. 42796-001
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25																	
30																	
35						35.0											
40																	
45																	
50																	

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-7R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

HALEY ALDRICH

Boring No. CCR-AP-7R

File No. 42796-001

Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						53.5	BOTTOM OF EXPLORATION 53.5 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-7R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-10

Project	Nature and Extent, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	ATC

File No. 129420-018
Sheet No. 1 of 2
Start January 25, 2019
Finish January 25, 2019
Driller J. Mitchner
H&A Rep. J. Yonts
Elevation
Datum
Location See Plan

	Casing	Sampler	Barrel
Type	HSA	S	
Inside Diameter (in.)	4.25	1 3/8	
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)	-	30	-

Drilling Equipment and Procedures

Rig Make & Model: Diedrich D-50 Turbo
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0																
5	4 5 6 6	S1 8	4.0 6.0	ML		Stiff, brown and yellow-brown SILT (ML), mps < 0.075 mm, no structure, no odor, dry						100				
10	3 3 5 5	S2 11	9.0 11.0	ML	9.0	Medium stiff, yellow-brown SILT (ML), mps < 0.075 mm, stratified, no odor, dry						100				
15	4 5 6 7	S3 16	14.0 16.0	ML		Similar to above, except moist						100				
20	3 7 9 10	S4 19	19.0 21.0	ML		Similar to above										
25	3 3	S5 20	24.0	ML	24.7	Similar to above										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 46.3
Rock Cored (ft) -
Samples 11S

Boring No. CCR-AP-10

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV 132892_HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT G:\129420 VECTREN\PROJECT DATA\FIELD DATA\04_GINT\AB BROWN\2019_0328_HAI_N&E ABBROWN_D1.GPJ Jul 16, 19

TEST BORING REPORT

HALEY ALDRICH

Boring No. CCR-AP-10
File No. 129420-018
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	6 6		26.0	CL		Stiff, red-brown CLAY (CL), mps < 0.075 mm, no structure, no odor, moist						100				
30	2 3 4 5	S6 24	29.0 31.0	CL-ML		Stiff, red-brown silty CLAY (CL), mps < 0.075 mm, no structure, no odor, moist					5	95				
35	2 3 5 10	S7 24	34.0 36.0		34.0	Very soft, completely weathered, brown red-brown, fine- to medium-grained SANDSTONE. Bedding thin and horizontal, close, rough, decomposed, open, wet. Note: Rig chatter from 38.5-39 ft.										
40	16 28 38 50	S8 24	39.0 41.0		39.4	Hard, completely weathered, tan and yellow-brown fine- to medium-grained SANDSTONE. Bedding thin and horizontal, close, rough, decomposed, open, wet.										
	11 22 38 50/5"	S9 24	41.0 43.0			Mica-rich parting at 42.2 ft.										
	7 6 8 9	S10 24	43.0 45.0		44.1	Soft, completely weathered, black fine-grained COAL. Decomposed, open, wet.										
45	5 26 50/3"	S11 15	45.0 47.0		44.3	Soft, completely weathered, maroon and gray, aphanitic, SHALE. Bedding thin and horizontal, close, smooth, discolored, open, wet. Hard, completely weathered, tan and yellow-brown fine- to fine-grained SANDSTONE. Bedding thin and horizontal, closer, rough, discolored, open, wet. Hard, highly weathered, tan and yellow-brown fine- to fine-grained SANDSTONE. Bedding thin and horizontal, closer, rough, discolored, open, wet. Hard, moderately weathered, blue, fine-grained SANDSTONE. Bedding thin and horizontal, closer, rough, decomposed, open, wet. BOTTOM OF EXPLORATION 46.3 FT Note: Backfill borehole with hydrated bentonite to 43.5 ft										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-10

H&A-TEST BORING-09 REV 132892_HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT G:\129420 VECTREN\PROJECT DATA\FIELD DATA\04_GINT\AB BROWN\2019_0328_HAI_N&E ABBROWN_D1.GPJ Jul 16, 19

TEST BORING REPORT

Boring No. CCR-AP-2I

Project	Nature and Extent, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	ATC

File No. 129420-018
Sheet No. 1 of 3
Start January 13, 2019
Finish January 14, 2019
Driller J. Mitchner
H&A Rep. J. Yonts
Elevation
Datum
Location See Plan

	Casing	Sampler	Barrel
Type	HSA	S	Steel
Inside Diameter (in.)	4.25	1 3/8	1 7/8
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)	-	30	-

Drilling Equipment and Procedures

Rig Make & Model: Diedrich D-50 Turbo
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Refer to Soil Boring CCR-AP-2 for lithology from 0-35 ft.										
5																	
10																	
15																	
20																	
25																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 74.5
Rock Cored (ft) 19.9
Samples 8S, 5C

Boring No. CCR-AP-2I

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV 132892_HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT G:\129420 VECTREN\PROJECT DATA\FIELD DATA\04_GINT\AB BROWN\2019_0328_HAI_N&E ABBROWN_D1.GPJ Jul 16, 19

TEST BORING REPORT

HALEY ALDRICH

Boring No. CCR-AP-2I
File No. 129420-018
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25																
30																
35	3 11 50/4"	S1 20	34.0 36.0	ML SM	34.7	Hard, red-yellow to gray SILT with sand (ML) interbedded with red-yellow silty SAND (SM), mps 1.0 mm, stratified, no odor, moist Hard, gray and red-yellow silty fine SAND (SM) interbedded with sandy SILT (ML), mps 2.0 mm, moist					25	75				
40	38 42 50/1"	S2 24	39.0 41.0		39.0	Soft, tan and brown, highly weathered fine-grained interbedded SHALE and SILTSTONE, extremely thin, smooth, dry/moist, trace seams of fine sandstone										
45	28 50/3"	S3 9	44.0 46.0		44.0	Soft, moderately weathered, gray, aphanitic SHALE. Bedding extremely thin and horizontal, extremely close, smooth, fresh, tight, moist										
50	38 26 10 6	S4 24	49.0 51.0		49.0 49.8	Soft, moderately weathered, dark gray, aphanitic SHALE. Bedding extremely thin and horizontal, extremely close, smooth, discolored, tight, abundant organic-rich partings, wet Very soft, highly weathered, gray black and brown fine-grained SILTSTONE. Bedding extremely thin and horizontal, extremely close, smooth, discolored, tight, abundant organic-rich partings, wet										
55	WOH WOH 1 2	S5 9	54.0 56.0	CL	54.0 55.0	Very soft, residual, red-brown CLAY (CL), no structure, no odor, wet, completely weathered SHALE and SILTSTONE Very soft, highly weathered, brown and gray aphanitic SHALE and fine-grained SILTSTONE, wet, residual rock fabric Sample rods fell from 56-ft to 59-ft after pulling S5 sample. Possible void or very soft material					10	90				
60	3 50/2"	S6 0	59.0 61.0			Sample rods pulled, full of wet red-brown CLAY, similar to S5 Note: Drill action and rig chatter indicate hard rock at 59.5 ft.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-2I

H&A-TEST BORING-09 REV 132892_HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT G:\129420 VECTREN\PROJECT DATA\FIELD DATA\04_GINT\AB BROWN\2019_0328_HAI_N&E ABBROWN_D1.GPJ Jul 16, 19

TEST BORING REPORT

HALEY ALDRICH

Boring No. CCR-AP-2I

File No. 129420-018
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
							Note: Rig chatter 59.5-63.0 ft.										
65	50/2"	S7 2	64.0 66.0			64.0	Soft. slightly weathered, dark gray, aphanitic SHALE and gray, fine-grained SILTSTONE. Bedding extremely thin and horizontal, extremely close, rough, fresh, open, moist										
70	50/3"	S8 3	69.0 71.0			69.0	Soft, slightly weathered, gray, fine-grained SANDSTONE and gray, fine-grained SILTSTONE. Bedding extremely thin to very thin and horizontal, extremely close, rough, fresh, tight, moist										
75		C1 10	74.5 75.4			74.5	Moderately hard to hard, fresh, cross-bedded, olive-gray, fine-grained SANDSTONE. Bedding extremely thin to very thin, extremely close, rough, stepped, fresh, tight to open										
		C2 60	75.4 80.4														
80		C3 60	80.4 85.4														
85		C4 46	85.4 90.4			85.4	Moderately hard to hard, fresh, cross-bedded, olive-gray, fine-grained SILTSTONE. Bedding extremely thin to very thin, extremely close, rough, stepped, fresh, tight to open										
90		C5 37	90.4 94.4			90.4	Moderately hard to hard, fresh, olive-gray, fine-grained SANDSTONE. Bedding extremely thin to very thin, extremely close, rough, stepped, discolored and CLAY filled, open. Cross-bedding ends at 91.0 ft										
						94.4	BOTTOM OF EXPLORATION 94.4 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-2I

H&A-TEST BORING-09 REV 132892_HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT G:\129420 VECTREN\PROJECT DATA\FIELD DATA\04_GINT\AB BROWN\2019_0328_HAI_N&E ABBROWN_D1.GPJ Jul 16, 19

TEST BORING REPORT

Boring No. CCR-AP-3I

Project	Nature and Extent, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	ATC

File No. 129420-018
Sheet No. 1 of 3
Start January 22, 2019
Finish January 24, 2019
Driller J. Mitchner
H&A Rep. J. Yonts
Elevation
Datum
Location See Plan

	Casing	Sampler	Barrel
Type	HSA	S	Steel
Inside Diameter (in.)	4.25	1 3/8	1 7/8
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)	-	30	-

Drilling Equipment and Procedures

Rig Make & Model: Diedrich D-50 Turbo
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Refer to Soil Boring CCR-AP-3 for lithology from 0-44 ft										
5																	
10																	
15																	
20																	
25																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 44.6
Rock Cored (ft) 33.7
Samples 1S, 8C

Boring No. CCR-AP-3I

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV 132892_HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT G:\129420 VECTREN\PROJECT DATA\FIELD DATA\04_GINT\AB BROWN\2019_0328_HAI_N&E ABBROWN_D1.GPJ Jul 16, 19

TEST BORING REPORT

HALEY ALDRICH

Boring No. CCR-AP-3I

File No. 129420-018
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25																	
30																	
35																	
40																	
45	2 50/5"	S1 11	44.0 44.6			44.0 44.3 44.6	Very soft, completely weathered, tan and brown, fine-grained SANDSTONE interbedded brown, fine-grained SILTSTONE. Bedding extremely thin and horizontal, extremely close, rough, fresh, open, moist Soft, highly weathered, red-brown and dark brown, fine-grained SILTSTONE and gray fine-grained SHALE. Bedding extremely thin to very thin and horizontal, extremely close, smooth, fresh, tight, wet Note: Rig chatter at 44.5 ft bgs.										
		C1 20	44.6 48.5														
		C2 6.5	48.5 50.1				Hard, slightly weathered, gray and dark gray, fine-grained LIMESTONE with numerous fossils (crinoid stems, brachiopods) with interbedded frequent dark gray shaley LIMESTONE. Bedding extremely thin to very thin and horizontal, extremely close, smooth to rough, fresh to discolored, tight to open, wet. Low angle black stylolite at 48.4 ft Similar to above, except slightly darker gray										
50		C3 12	50.1 55.1			50.4 54.4	Interbedded hard, slightly weathered, gray and dark gray, fine-grained to medium-grained, fossiliferous LIMESTONE and soft, gray, aphanitic SHALE. Bedding extremely thin to very thin and horizontal, extremely close, smooth to rough, fresh to discolored, tight to open, wet										
55		C4 58	55.1 60.1				Soft, slightly weathered, olive, fine-grained SILTSTONE. Bedding extremely thin and horizontal, extremely close, rough, fresh, open Residual soil composed of very soft, olive fine-grained SAND and CLAY Interbedded, soft, olive-green to gray, fine-grained SHALE and SILTSTONE with gray, fine-grained LIMESTONE with frequent stylolites (dark gray) and occasional fossils with occasional gray, fine-grained SANDSTONE. Bedding extremely thin to very thin and horizontal, extremely close, smooth to rough, fresh to discolored, open to tight, wet										
60		C5 60	60.1 65.1				Similar to above. Transition to moistly SHALE, occasional limestone.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-3I

H&A-TEST BORING-09 REV 132892_HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT G:\129420 VECTREN\PROJECT DATA\FIELD DATA\04_GINT\AB BROWN\2019_0328_HAI_N&E ABBROWN_D1.GPJ Jul 16, 19

TEST BORING REPORT

HALEY ALDRICH

Boring No. CCR-AP-3I

File No. 129420-018
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						62.5	Moderately hard to hard, fresh, cross-bedded, olive-gray, fine-grained SILTSTONE and SANDSTONE. Bedding extremely thin to very thin, extremely close, rough, stepped, fresh, tight to open										
65		C6 56	65.1 70.0				Vertical/nearly vertical fracture from 69.3 ft to 69.7 ft bgs, 0.2 mm thick with voids filled with quartz crystals										
70		C7 12	70.0 75.0			70.0	Moderately hard to hard, fresh, cross-bedded, olive-gray, fine-grained SILTSTONE and SANDSTONE. Bedding extremely thin to very thin, high angle, extremely close, rough, stepped, fresh, open. Fracture frequency increases with depth and no crystallization along fractures.										
75		C8 39	75.0 77.7			75.0	Similar to above, except no fractures and horizontal bedding.										
						78.3	BOTTOM OF EXPLORATION 78.3 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-3I

H&A-TEST BORING-09 REV 132892_HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT G:\129420 VECTREN\PROJECT DATA\FIELD DATA\04_GINT\AB BROWN\2019_0328_HAI_N&E ABBROWN_D1.GPJ Jul 16, 19

TEST BORING REPORT

Boring No. CCR-AP-8

Project	Nature and Extent, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	ATC

File No.	129420-018
Sheet No.	1 of 1
Start	January 26, 2019
Finish	January 26, 2019
Driller	J. Mitchner
H&A Rep.	J. Yonts
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel
Type	HSA	S	
Inside Diameter (in.)	4.25	1 3/8	
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)	-	30	-

Drilling Equipment and Procedures

Rig Make & Model: Diedrich D-50 Turbo
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						Grass and topsoil										
	3 3 7 5	S1	3.5 5.5	CL	3.5	Interbedded stiff red-brown CLAY (CL), and red-gray clayey SAND (SC), mps 1.5 mm, no odor, wet Note: 3 in. piece of black wood in the shoe of S1, spoon indicated hitting at 4.9 ft				5	5 60	90 40				
5																
	4 4 4 5	S2 16	8.5 10.5	CL	8.5	Medium stiff, gray and red-gray CLAY (CL), stratified, no odor, wet Note: Wood from 8.8 to 8.9 ft.					10	90				
10				CL	9.8	Medium stiff, red-gray CLAY (CL), stratified, no odor, wet					5	95				
	16 28 50/5"	S3	13.5 15.5		13.5	Soft, highly weathered, gray and brown, aphanitic SHALE. Bedding extremely thin and horizontal, extremely close, smooth, fresh, tight, wet										
15					14.5	Soft, slightly weathered, gray, aphanitic SHALE. Bedding extremely thin and horizontal, extremely close, smooth, fresh, tight, wet Spoon refusal at 16.5 ft										
					16.5	BOTTOM OF EXPLORATION 16.5 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	16.5
Rock Cored (ft)	-
Samples	3S

Boring No. CCR-AP-8

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV 132892_HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT G:\129420 VECTREN\PROJECT DATA\FIELD DATA\04_GINT\AB BROWN\2019_0328_HAI_N&E ABBROWN_D1.GPJ Jul 16, 19

TEST BORING REPORT

Boring No. CCR-AP-9

Project	Nature and Extent, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	ATC

File No.	129420-018
Sheet No.	1 of 2
Start	January 26, 2019
Finish	January 26, 2019
Driller	J. Mitchner
H&A Rep.	J. Yonts
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel
Type	HSA	S	
Inside Diameter (in.)	4.25	1 3/8	
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)	-	30	-

Drilling Equipment and Procedures

Rig Make & Model: Diedrich D-50 Turbo
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						Gravel roadway										
	6 8 9 9	S1 20	3.5 5.5	ML	3.5	Medium stiff, brown clayey SILT (ML), mps 1 mm, stratified, no odor, moist				5	5	90				
				CL	4.1							100				
5				ML	4.8	Stiff, dark brown and gray CLAY (CL), mps < 0.075 mm, stratified, no odor, moist										
				CL	5.1	Medium stiff, brown clayey SILT (ML), mps 1 mm, stratified, no odor, moist										
						Stiff, dark brown and gray CLAY (CL), mps < 0.075 mm, stratified, no odor, moist										
	1 1 1 1	S2 24	8.5 10.5	CL	8.5	Very soft, black CLAY (CL), no structure, strong sulfur-like odor, wet, possibly coal run-off						100				
10																
	1 2 1 3	S3 24	13.5 15.5	CL		Similar to above										
				CL	13.9	Soft, yellow-brown to brown, fat CLAY (CL), mps < 0.075 mm, no structure, no odor, wet						100				
15																
	2 4 2 2	S4 18	18.5 20.5	ML	18.5	Soft, yellow-brown SILT (ML), mps 1 mm, stratified, no odor, wet					10	90				
				SM	19.2	Medium stiff, red-brown silty SAND (SM), mps 15 mm, no structure, no odor, wet		5	10	30	25	30				
20				ML	20.0	Soft, gray sandy SILT (ML), mps < 2.0 mm, stratified, no odor, wet					25	75				
	WOH WOH 1	S5 24	23.5 25.5	ML		Similar to above except brown wood noted at 24.1 ft, occasional sandy SILT (ML) layers <1 in. thick					10	90				
25																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	35.5
Rock Cored (ft)	-
Samples	7S

Boring No. CCR-AP-9

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV 132892_HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT G:\129420 VECTREN\PROJECT DATA\FIELD DATA\04_GINT\AB BROWN\2019_0328_HAI_N&E ABBROWN_D1.GPJ Jul 16, 19

TEST BORING REPORT

HALEY ALDRICH

Boring No. CCR-AP-9

File No. 129420-018

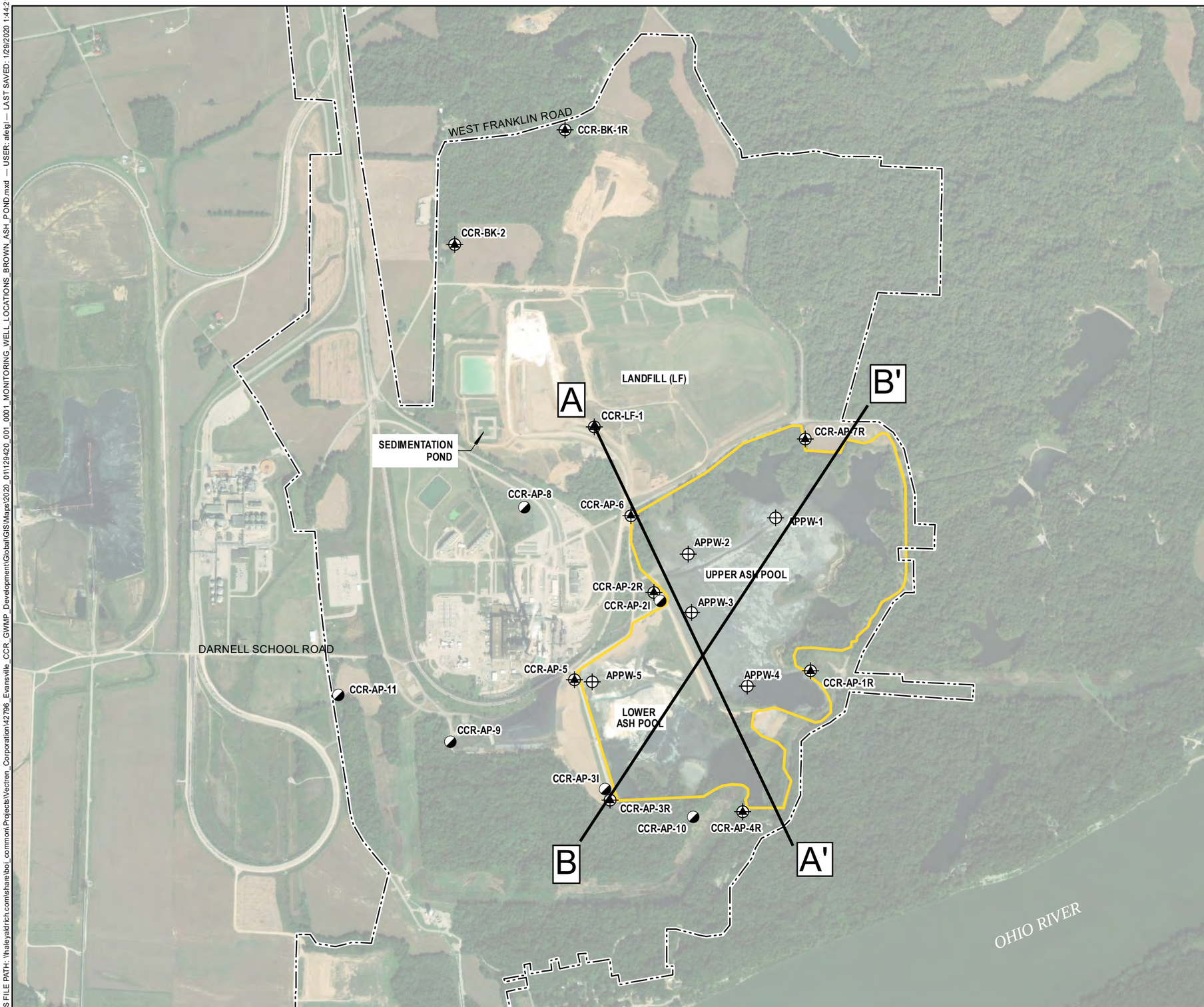
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	1																
	WOH 2 3 2	S6 24	28.5 30.5	ML			Similar to S5					5	95				
30																	
	WOH WOH WOH WOH	S7 24	33.5 35.5	ML/ CL		33.5	Soft, gray sandy silty CLAY (ML/CL), mps < 2.0 mm, stratified, no odor, wet					10	20				
35						35.5	BOTTOM OF EXPLORATION 35.5 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-9

H&A-TEST BORING-09 REV 132892_HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT G:\129420 VECTREN\PROJECT DATA\FIELD DATA\04_GINT\AB BROWN\2019_0328_HAI_N&E ABBROWN_D1.GPJ Jul 16, 19



LEGEND

- CCR MONITORING WELL
- NATURE AND EXTENT MONITORING WELL
- CCR PIEZOMETER WELL
- ASH POND UNIT BOUNDARY

NOTES

1. AERIAL IMAGERY SOURCE: ESRI
2. LOCATIONS DERIVED FROM THREE I DESIGN DATA.

N

0 1,100 2,200
SCALE IN FEET

HALEY ALDRICH

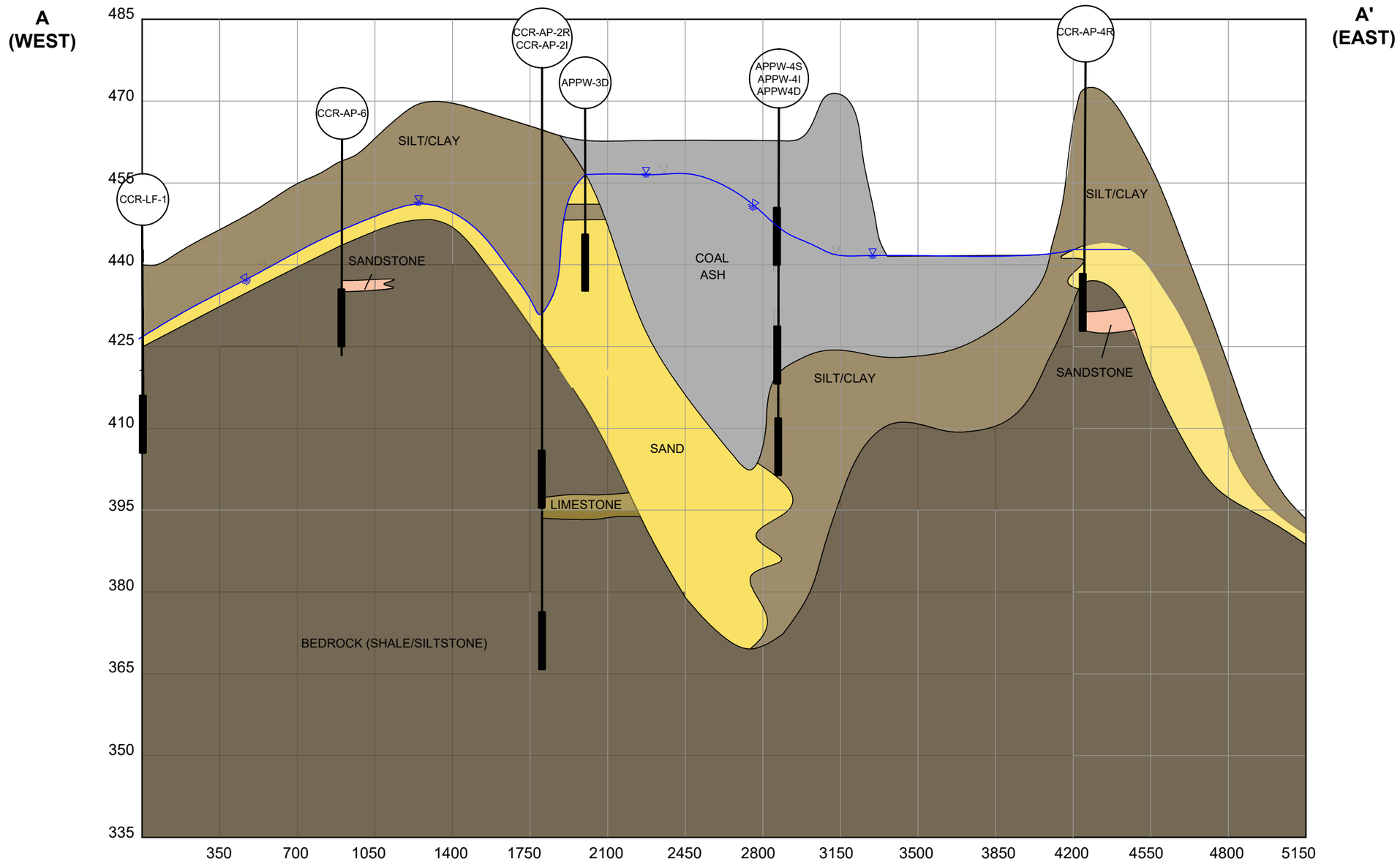
SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

CROSS-SECTION TRANSECT
BASE MAP

OCTOBER 2020

FIGURE 1

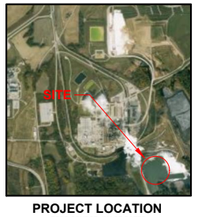
GIS FILE PATH: \\haleyaldrich.com\share\boi_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2020_01\129420_001_0001_MONITORING_WELL_LOCATIONS_BROWN_ASH_POND.mxd — USER: afeigl — LAST SAVED: 12/9/2020 1:44:21 PM



LEGEND

- COAL ASH
- LIMESTONE
- POORLY GRADED AND WELL GRADED SANDS
- SILT/CLAY
- SHALE
- SANDSTONE
- SHALE/SANDSTONE
- GROUNDWATER LEVEL
- INTERPRETED SOIL/BEDROCK LEVELS
- BORING ID/LOCATION WITH GROUND SURFACE ELEVATION
- SCREEN LOCATION

HORIZ. 0 500 1,000
VERT. 0 20 40
SCALE IN FEET



PROJECT LOCATION
TOPO SOURCE: IMAGE DATED 2019 TAKEN ELECTRONICALLY FROM BING MAPS

PREPARED FOR:

SIGECO
A.B. BROWN GENERATION STATION
ASH POND

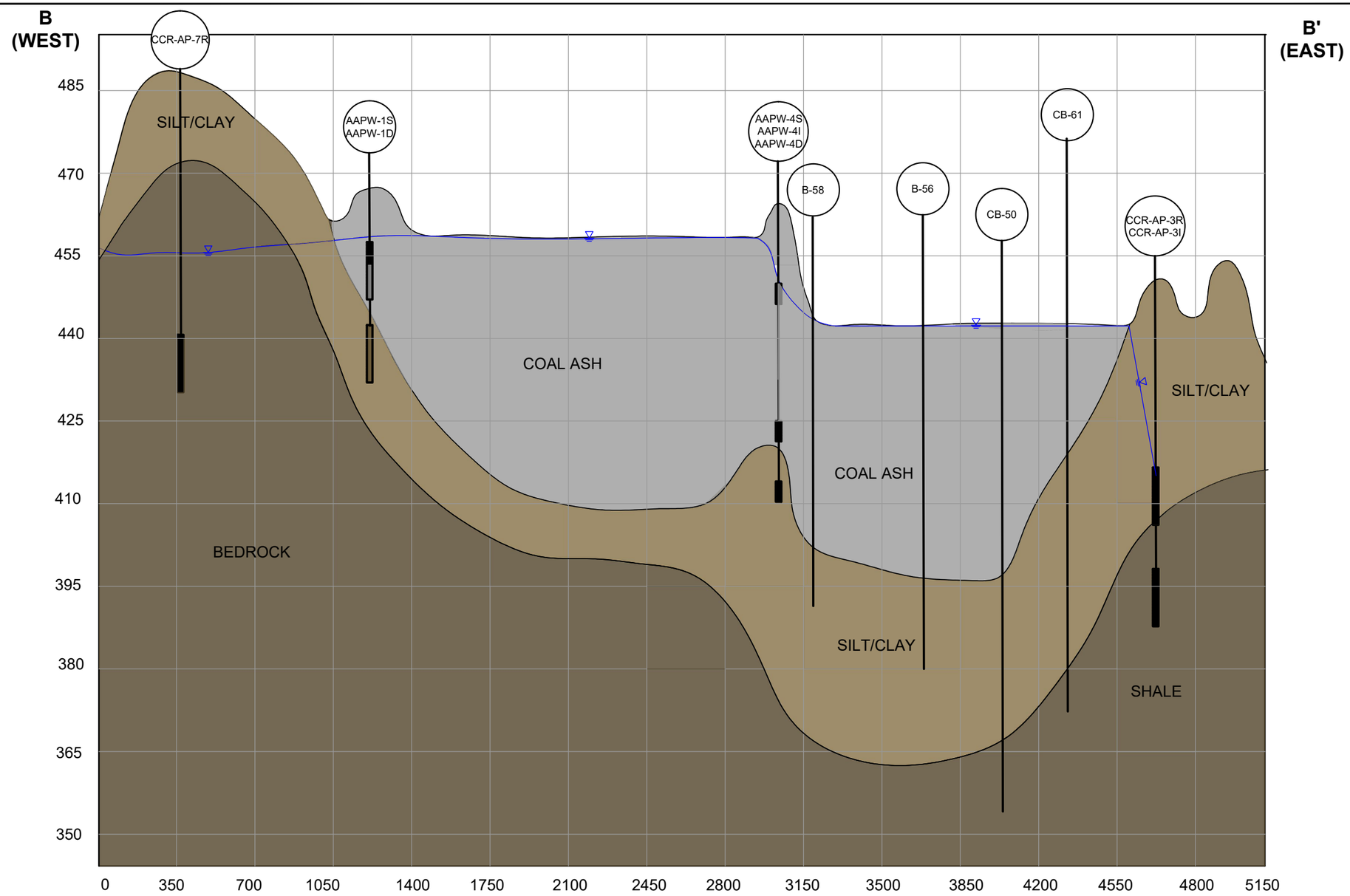
A.B. BROWN GENERATION STATION
MOUNT VERNON, INDIANA

FIGURE 1A

EXISTING CONDITIONS
CROSS SECTION A-A'
ASH POND

PROJECT: 129420	BY: OS/KC	REVISIONS:
DATE: OCT 2020	CHECKED: SL	

HALEY & ALDRICH



LEGEND

- COAL ASH
- LIMESTONE
- WELL GRADED AND POORLY GRADED SANDS
- SILT/CLAY
- SHALE
- SANDSTONE
- SHALE/SANDSTONE
- GROUNDWATER LEVEL
- INTERPRETED SOIL/BEDROCK LEVELS
- BORING ID/LOCATION WITH GROUND SURFACE ELEVATION
- SCREEN LOCATION

HORIZ. 0 500 1,000
VERT. 0 20 40
SCALE IN FEET

PROJECT LOCATION
TOPO SOURCE: IMAGE DATED 2019 TAKEN ELECTRONICALLY FROM BING MAPS

PREPARED FOR:

SIGECO
A.B. BROWN GENERATION STATION
ASH POND

A.B. BROWN GENERATION STATION
MOUNT VERNON, INDIANA

FIGURE 1B

EXISTING CONDITIONS
CROSS SECTION B-B'
ASH POND

PROJECT: 129420	BY: OS/KC	REVISIONS:
DATE: OCT 2020	CHECKED: SL	

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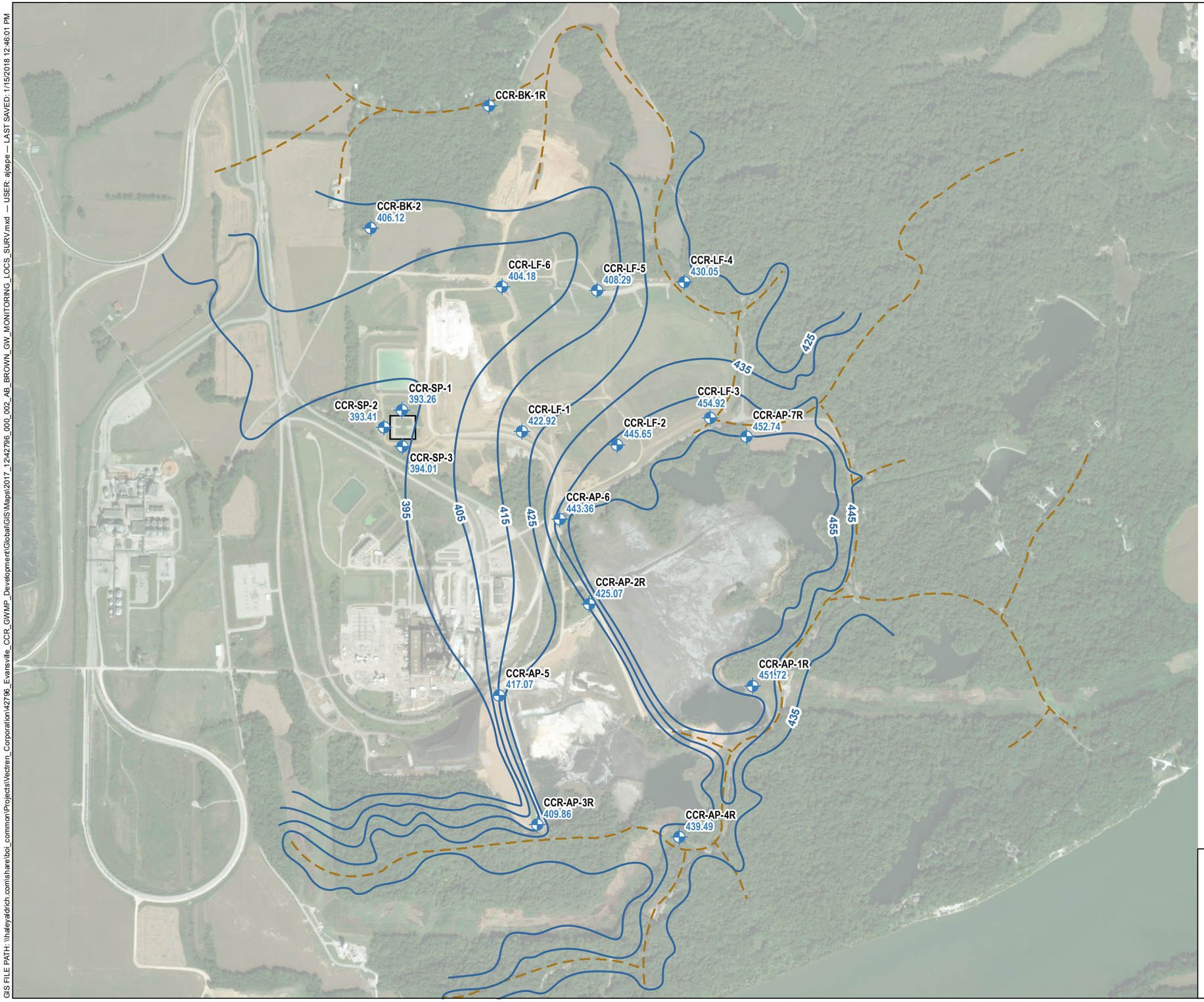
Appendix H
Groundwater Flow Direction



LEGEND

- MONITORING WELL
- GROUNDWATER ELEVATION CONTOUR, IN FEET
- TOPOGRAPHIC DIVIDE

NOTES

1. LOCATIONS DERIVED FROM THREE I DESIGN DATA.
2. WATER LEVELS MEASURED 14-16 NOVEMBER 2016
3. AERIAL IMAGERY SOURCE: ESRI

N

0 500 1,000 1,500 2,000
SCALE IN FEET

HALEY ALDRICH

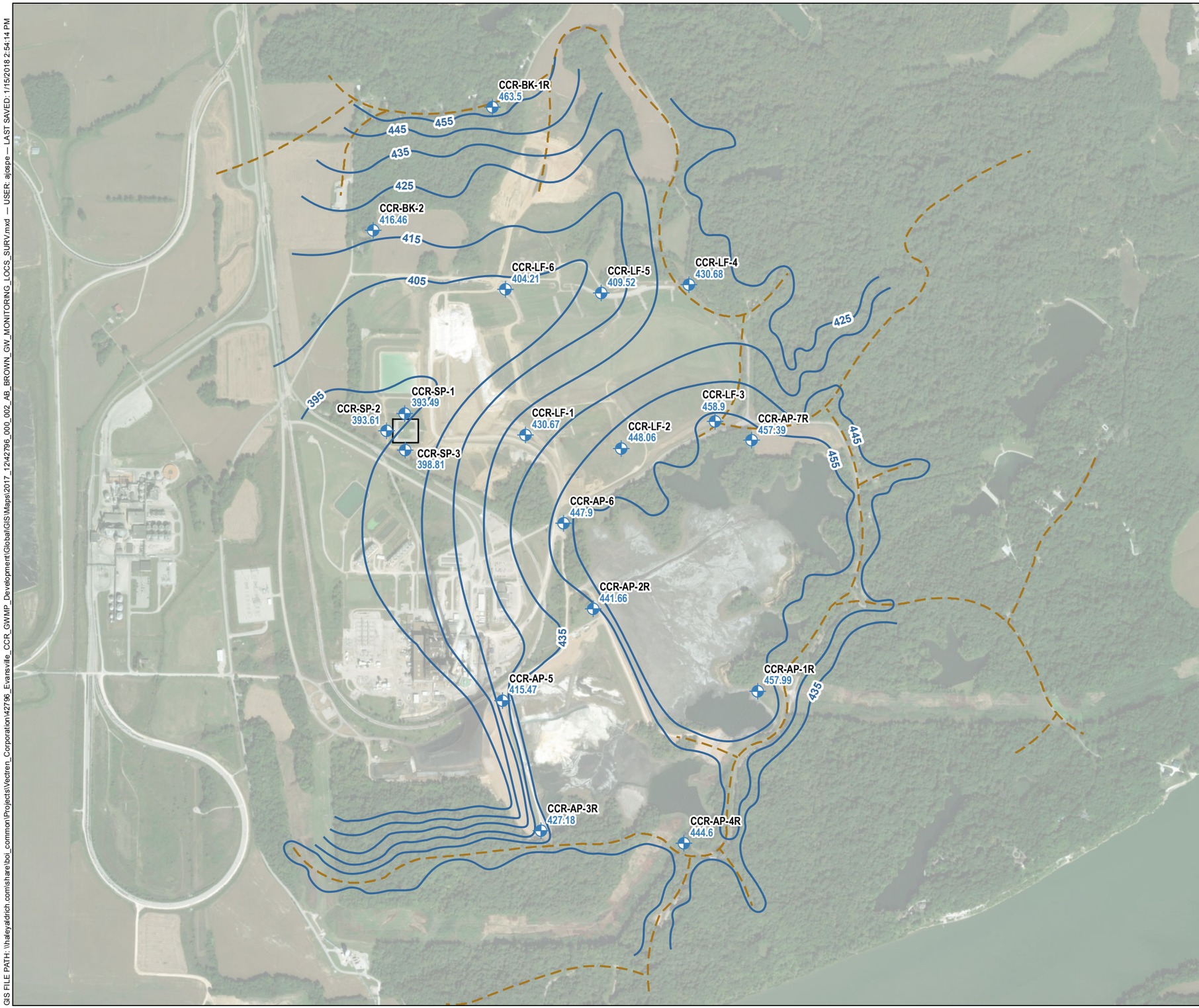
VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620

GROUNDWATER ELEVATION CONTOURS - NOVEMBER 2016

JANUARY 2018

FIGURE 2

GIS FILE PATH: \\haleyaldrich.com\share\boi_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2017_12\42796_000_002_AB_BROWN_GW_MONITORING_LOCS_SURV.mxd — USER: ajospe — LAST SAVED: 1/15/2018 12:46:01 PM



LEGEND

- MONITORING WELL
- GROUNDWATER ELEVATION CONTOUR, IN FEET
- TOPOGRAPHIC DIVIDE

NOTES

1. LOCATIONS DERIVED FROM THREE I DESIGN DATA.
2. WATER LEVELS MEASURED JUNE 2017
3. AERIAL IMAGERY SOURCE: ESRI

N

0 500 1,000 1,500 2,000
SCALE IN FEET

HALEY ALDRICH

VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620

GROUNDWATER ELEVATION CONTOURS - JUNE 2017

JANUARY 2018

FIGURE 2

GIS FILE PATH: \\haleyaldrich.com\share\boi_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2017_12\42796_000_002_AB_BROWN_GW_MONITORING_LOCS_SURV.mxd — USER: ajospe — LAST SAVED: 1/15/2018 2:54:14 PM

Appendix I
Groundwater Monitoring Analytical Results

TABLE II
SUMMARY OF ANALYTICAL RESULTS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Upgradient								
Location Name	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R
Sample Name	CCR-BK-1-20160811	CCR-BK-1-20161027	CCR-BK-1R-20161107	CCR-BK-1R-20161206	CCR-BK-1R-20170207	CCR-BK-1R-20170407	CCR-BK-1R-20170606	CCR-BK-1R-20170928	CCR-BK-1R-20171116
Sample Date	08/11/2016	10/27/2016	11/07/2016	12/06/2016	02/07/2017	04/07/2017	06/06/2017	09/28/2017	11/16/2017
Lab Sample ID	180-57528-14	180-60271-6	180-60609-5	180-61491-18	180-63324-18	180-65040-1	180-67229-16	180-70809-15	180-72643-21
Water Level (ft amsl)	463.50	422.65	423.39	422.39	421.39	425.39	425.39	425.39	-
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**20.68**	**15.88**	**20.42**	**11.36**	**14.52**	**14.94**	**17.06**	**24.01**	**10.95**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**0.76**	-
Dissolved Oxygen, Field (mg/L)	**5.15**	**5.85**	**5.89**	**7.03**	**5.98**	**5.43**	**6.28**	**6**	**8.82**
Conductivity, Field (mS/cm)	**0.3475**	**0.38255**	**0.36566**	**0.32748**	**0.3703**	**0.31348**	**0.35539**	**0.35718**	**0.40797**
ORP, Field (mv)	**222**	**223.99**	**116.48**	**52.8**	**131.91**	**98.13**	**266.28**	**147.09**	**47.02**
Turbidity, Field (NTU)	**17.39**	**19.19**	**10.68**	**97.13**	**6.47**	**17.2**	**24.08**	-	**131.33**
pH, Field (su)	**6.8**	**6.95**	**7.02**	**7.14**	**6.87**	**7.22**	**6.95**	**6.88**	**7.13**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	0.014 U	0.02 U	0.023 U	0.02 U	0.08 U	**0.019 J**	**0.026 J**	**0.015 J+**	**0.041 J**
Calcium, Total	**36**	**41**	**38**	**36**	**34**	**35**	**34**	**35**	**39**
Chloride (mg/L)	R	**2.4**	**1.5**	**2.3**	**2.3**	**2.7**	**2.1**	**2.2**	**2.6**
Fluoride (mg/L)	R	**0.35**	**0.32**	**0.35**	**0.3**	**0.38**	**0.3**	**0.35 J+**	**0.3**
Sulfate (mg/L)	R	**26**	**21**	**26**	**27**	**28**	**25**	**25**	**26 J-**
pH (lab) (su)	**7.4 J**	**7.5 J**	**7 J**	**6.9 J**	**7.2 J**	**7.2 J**	**7.1 J**	**7.1 J**	**7.8 J**
Total Dissolved Solids (TDS) (mg/L)	**220**	**210**	**220**	**200**	**230**	**250**	**270**	**210**	**210**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	**0.000056 J**	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	**0.00045 J**
Arsenic, Total	**0.0011**	**0.00021 J**	0.001 U	**0.00031 J**	**0.00094 J**	**0.00095 J**	**0.00047 J**	**0.0025 J+**	**0.0015 J+**
Barium, Total	**0.048**	**0.035**	**0.037 J-**	**0.031 J-**	**0.038**	**0.04**	**0.038**	**0.032 J-**	**0.082 J-**
Beryllium, Total	**0.00012 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	**0.0025**	**0.00046 J**	**0.00087 J**	**0.00071 J**	**0.003**	**0.0026**	**0.0019 J**	R	**0.0027 J+**
Cobalt, Total	**0.0028**	**0.00076**	**0.00051**	0.0005 U	**0.0011**	**0.001**	**0.00062**	R	**0.0022**
Lead, Total	**0.00082 J**	**0.00024 J**	**0.000079 J**	**0.000096 J**	**0.00099 J**	**0.00092 J**	**0.00052 J**	0.001 U	**0.0008 J**
Lithium, Total	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	**0.0086 J**
Molybdenum, Total	**0.0025 J**	0.005 U	0.005 U	**0.0015 J**	**0.0017 J**	**0.0025 J**	**0.0015 J**	R	**0.0034 J**
Selenium, Total	**0.00067 J**	0.005 U	**0.00037 J**	**0.00051 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	**0.000038 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Mercury, Total	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	R	**0.35**	**0.32**	**0.35**	**0.3**	**0.38**	**0.3**	**0.35 J+**	**0.3**
Radiological (pCi/L)									
Radium-226	0.0484 U ± 0.104	0.0760 U ± 0.210	R	0.303 U ± 0.296	**0.142 ± 0.0913**	**0.280 ± 0.0981**	**0.177 J ± 0.0924**	R	**0.165 ± 0.0740**
Radium-228	0.0724 UJ ± 0.514	0.191 U ± 0.217	-0.0566 U ± 0.222	0.179 U ± 0.238	-0.0934 U ± 0.194	0.177 U ± 0.257	**0.337 ± 0.257**	0.171 U ± 0.226	0.388 U ± 0.268
Radium-226 & 228	0.121 UJ ± 0.525	0.267 U ± 0.302	R	**0.482 ± 0.380**	0.142 UJ ± 0.214	**0.457 J ± 0.275**	**0.515 J ± 0.273**	**0.426 J+ ± 0.243**	**0.553 J+ ± 0.278**

ABBREVIATIONS AND NOTES:
CCR: Coal Combustion Residuals
CFR: Code of Federal Regulations
ft amsl: feet above mean sea level
MCL: Maximum Contaminant Level
mg/L: milligram per liter
mS/cm: milliSiemen per centimeter
mv: millivolt
NA: Not Applicable
NTU: Nephelometric Turbidity Units
pCi/L: picoCurie per liter
su: standard units
USEPA: United States Environmental Protection Agency

QUALIFIERS:
J: value is estimated
J+: value is estimated with a potentially high bias
J-: value is estimated with a potentially low bias
R: value is rejected
U: Not detected value is the laboratory reporting limit

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257.
https://www.epa.gov/coalash/coal-ash-rule

TABLE II
SUMMARY OF ANALYTICAL RESULTS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Upgradient								
Location Name	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2
Sample Name	CCR-BK-2-20160608	CCR-BK-2-20160810	CCR-BK-2-20161027	CCR-BK-2-20161206	CCR-BK-2-20170210	CCR-BK-2-20170405	CCR-BK-2-20170606	CCR-BK-2-20170927	CCR-BK-2-20171116
Sample Date	06/08/2016	08/10/2016	10/27/2016	12/06/2016	02/10/2017	04/05/2017	06/06/2017	09/27/2017	11/16/2017
Lab Sample ID	180-55607-6	180-57528-15	180-60271-7	180-61491-19	180-63446-1	180-64974-1	180-67229-17	180-70809-16	180-72643-22
Water Level (ft amsl)	416.46	412.21	408.69	407.90	412.89	413.71	413.94	412.64	406.12
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**17.51**	**17.4**	**15.98**	**14.25**	**13.49**	**15.79**	**15.68**	**16.85**	**14.23**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**167.49**	-
Dissolved Oxygen, Field (mg/L)	**0.42**	**0.22**	**0.38**	**0.33**	**0.35**	**1.08**	**0.14**	**0.43**	**0.47**
Conductivity, Field (mS/cm)	**0.6551**	**0.4173**	**0.40128**	**0.30961**	**0.38131**	**0.29739**	**0.41407**	**0.38594**	**0.38795**
ORP, Field (mv)	**28.72**	**144**	**234.6**	**87.3**	**120.09**	**200.74**	**212.67**	**212.04**	**108.47**
Turbidity, Field (NTU)	**17.85**	**1.751**	**858.51**	**336.44**	**11.66**	**-22.18**	**-1.12**	-	**181.78**
pH, Field (su)	**6.98**	**6.64**	**6.7**	**6.19**	**6.72**	**6.66**	**6.67**	**6.64**	**6.74**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	**0.018 J+**	0.014 U	0.02 U	0.02 U	0.08 U	0.016 U	**0.021 J**	**0.018 J+**	**0.02 J**
Calcium, Total	**53**	**39**	**46**	**36**	**34**	**45**	**37**	**37**	**35**
Chloride (mg/L)	**12**	**17**	**17**	**19**	**12 J+**	**19**	**14**	**19**	**19**
Fluoride (mg/L)	R	**0.14 J+**	**0.16**	**0.2 J+**	**0.14**	**0.16**	**0.13**	R	**0.13**
Sulfate (mg/L)	**61**	**30 J-**	**28**	**26**	**25 J+**	**29**	**27**	**24**	**23 J-**
pH (lab) (su)	**7.09 J**	**7.1 J**	**6.8 J**	**6.7 J**	**8.5 J**	**7.2 J**	**7 J**	**6.8 J**	**7.3 J**
Total Dissolved Solids (TDS) (mg/L)	**360**	**260**	**350**	**260**	**230**	**240**	**270**	**320**	**250**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	**0.00048 J**
Arsenic, Total	**0.00032 J**	0.001 U	**0.0013**	**0.00051 J**	**0.00031 J**	0.001 U	0.001 U	**0.0035 J+**	**0.0028**
Barium, Total	**0.041 J-**	**0.033**	**0.15**	**0.036 J-**	**0.033 J-**	**0.034 J-**	**0.035**	**0.048 J-**	**0.046 J-**
Beryllium, Total	0.001 U	0.001 U	**0.0004 J**	0.001 U	0.001 U	0.001 U	0.001 U	**0.00018 J**	0.001 U
Cadmium, Total	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	0.002 U	0.002 U	**0.0047**	**0.00076 J**	0.002 UJ	0.002 U	0.002 U	R	**0.0043 J+**
Cobalt, Total	**0.000096 J**	**0.0001 J**	**0.0062**	0.0005 U	0.0005 U	0.0005 U	0.0005 U	**0.0015 J+**	**0.0012**
Lead, Total	**0.000028 J**	0.001 U	**0.011**	**0.00057 J**	0.001 U	0.001 U	0.001 U	**0.0028 J+**	**0.0024**
Lithium, Total	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Molybdenum, Total	**0.0017 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.00062 J**	0.005 U	**0.00068 J**
Selenium, Total	0.005 U	0.005 U	**0.00098 J**	**0.00047 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.000059 J**
Mercury, Total	0.0002 UJ	0.0002 U	**0.0001 J**	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	R	**0.14 J+**	**0.16**	**0.2 J+**	**0.14**	**0.16**	**0.13**	R	**0.13**
Radiological (pCi/L)									
Radium-226	**0.102 J ± 0.0557**	0.0387 U ± 0.0693	**1.14 J ± 0.720**	0.346 U ± 0.284	0.0539 UJ ± 0.0753	0.0198 U ± 0.0619	0.00911 UJ ± 0.0490	R	**0.149 ± 0.0943**
Radium-228	0.0185 U ± 0.200	0.0797 UJ ± 0.324	0.764 U ± 0.727	R	0.163 U ± 0.253	0.102 U ± 0.198	**0.144 ± 0.284**	0.279 U ± 0.416	**2.98 ± 0.579**
Radium-226 & 228	0.120 U ± 0.207	0.118 UJ ± 0.331	**1.91 J ± 1.02**	**0.796 J ± 0.380**	0.217 UJ ± 0.264	0.122 U ± 0.208	0.153 U ± 0.288	0.525 UJ ± 0.436	**3.13 ± 0.587**

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CCR: Coal Combustion Residuals
CFR: Code of Federal Regulations
ft amsl: feet above mean sea level
MCL: Maximum Contaminant Level
mg/L: milligram per liter
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J: value is estimated
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TABLE II
SUMMARY OF ANALYTICAL RESULTS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Downgradient								
Location Name	CCR-AP-1R	CCR-AP-1R	CCR-AP-1R	CCR-AP-1R	CCR-AP-1R	CCR-AP-1R	CCR-AP-1R	CCR-AP-1R	CCR-AP-1R
Sample Name	CCR-AP-1-20160607	CCR-AP-1-20160810	CCR-AP-1-20161026	CCR-AP-1R-20161205	CCR-AP-1R-20170206	CCR-AP-1R-20170404	CCR-AP-1R-20170605	CCR-AP-1R-20170926	CCR-AP-1R-20171114
Sample Date	06/07/2016	08/10/2016	10/26/2016	12/05/2016	02/06/2017	04/04/2017	06/05/2017	09/26/2017	11/14/2017
Lab Sample ID	180-55566-3	180-57528-16	180-60193-1	180-61491-1	180-63324-4	180-64974-2	180-67229-1	180-70809-1	180-72643-14
Water Level (ft amsl)	457.99	457.78	451.26	450.94	451.51	450.75	449.88	448.78	451.72
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**19.22**	**20.4**	**17.85**	**14.6**	**13.31**	**17.97**	**16.45**	**16.88**	**15.21**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**72.64**	-
Dissolved Oxygen, Field (mg/L)	**7.03**	**0.14**	**0.17**	**0.17**	**5.67**	**0.32**	**0.03**	**0.01**	**0.02**
Conductivity, Field (mS/cm)	**2.00099**	**7.41**	**7.48293**	**4.554**	**0.98911**	**4.76554**	**5.6183**	**5.10195**	**5.2188**
ORP, Field (mv)	**-13.54**	**88**	**200.43**	**99.2**	**126.78**	**190.47**	**224.98**	**420.3**	**115.65**
Turbidity, Field (NTU)	**41.73**	**28.41**	**-1.47**	**573.87**	**24.67**	**604.32**	**-1.78**	-	**117.39**
pH, Field (su)	**6.47**	**6.67**	**6.73**	**6.57**	**6.98**	**6.63**	**6.75**	**6.81**	**6.73**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	**2.2**	**9.5**	**9.5**	**9.8**	**12**	**9.5**	**11**	**7.5 J+**	**7.6**
Calcium, Total	**41**	**480**	**530**	**420**	**370**	**420**	**320**	**230**	**270**
Chloride (mg/L)	**110**	**670**	**840**	**740**	**700**	**640**	**520**	**390**	**430**
Fluoride (mg/L)	**0.22**	0.5 U	5 U	**0.73**	0.5 U	**0.25 J**	**0.41 J**	**0.46 J+**	**0.2 J**
Sulfate (mg/L)	**460**	**2700 J-**	**3500 J-**	**3200**	**3700**	**2800**	**2300**	**2100**	**2100 J-**
pH (lab) (su)	**6.51 J**	**7 J**	**6.8 J**	**6.8 J**	**7.2 J**	**7 J**	**7.2 J**	**7 J**	**7.8 J**
Total Dissolved Solids (TDS) (mg/L)	**1100**	**6500**	**6800**	**6400**	**6600**	**5600**	**5100**	**4000**	**4200**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	**0.0052**	**0.0012 J+**	**0.0008 J**	**0.00039 J**	0.001 U	**0.00033 J**	**0.00031 J**	R	0.001 U
Barium, Total	**0.041**	**0.022**	**0.018 J-**	**0.018 J-**	**0.049**	**0.017 J-**	**0.016**	**0.012 J-**	**0.017 J-**
Beryllium, Total	**0.000065 J**	0.001 U	**0.00019 J**	**0.00019 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.001 U	**0.00028 J**	**0.00017 J**	**0.00016 J**	**0.0008 J**	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	**0.0011 J**	0.002 U	0.002 U	0.002 U	**0.00087 J**	0.002 U	0.002 U	0.002 UJ	0.002 U
Cobalt, Total	**0.011**	**0.0077**	**0.0025**	**0.0019**	**0.003**	**0.00071**	**0.0006**	**0.00042 J**	**0.00084**
Lead, Total	**0.0013**	**0.00031 J**	**0.00015 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium, Total	**0.012 J**	**0.0099 J**	**0.016 J**	**0.015 J**	**0.066**	0.05 U	0.05 U	0.05 U	0.05 U
Molybdenum, Total	**0.005**	**0.0049 J**	**0.0031 J**	**0.0039 J**	**1.6**	**0.0024 J**	**0.0032 J**	**0.0024 J**	**0.0036 J**
Selenium, Total	0.005 U	**0.00049 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	**0.000038 J**	**0.000075 J**	**0.00013 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Mercury, Total	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	**0.22**	0.5 U	5 U	**0.73**	0.5 U	**0.25 J**	**0.41 J**	**0.46 J+**	**0.2 J**
Radiological (pCi/L)									
Radium-226	0.0602 U ± 0.0870	**0.411 ± 0.108**	**0.717 J ± 0.337**	R	**0.292 ± 0.120**	**0.193 ± 0.0909**	**0.211 J ± 0.0870**	R	**0.256 ± 0.0859**
Radium-228	0.229 U ± 0.397	0.300 UJ ± 0.262	0.320 U ± 0.247	**0.493 ± 0.246**	**0.513 ± 0.252**	**0.391 ± 0.255**	0.247 U ± 0.265	**0.673 ± 0.280**	**0.594 ± 0.243**
Radium-226 & 228	0.289 U ± 0.406	**0.711 J ± 0.284**	**1.04 J ± 0.418**	R	**0.805 ± 0.279**	**0.583 ± 0.270**	**0.458 J ± 0.278**	**1.05 J+ ± 0.303**	**0.849 ± 0.258**

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mg/L: milligram per liter
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TABLE II
SUMMARY OF ANALYTICAL RESULTS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Downgradient								
Location Name	CCR-AP-2R	CCR-AP-2R	CCR-AP-2R	CCR-AP-2R	CCR-AP-2R	CCR-AP-2R	CCR-AP-2R	CCR-AP-2R	CCR-AP-2R
Sample Name	CCR-AP-2-20160811	CCR-AP-2-20161025	CCR-AP-2R-20161107	CCR-AP-2R-20161206	CCR-AP-2R-20170207	CCR-AP-2R-20170404	CCR-AP-2R-20170606	CCR-AP-2R-20170927	CCR-AP-2R-20171115
Sample Date	08/11/2016	10/25/2016	11/07/2016	12/06/2016	02/07/2017	04/04/2017	06/06/2017	09/27/2017	11/15/2017
Lab Sample ID	180-57528-17	180-60160-5	180-60609-1	180-61491-2	180-63324-2	180-64974-3	180-67229-2	180-70809-2	180-72643-15
Water Level (ft amsl)	441.66	435.66	435.24	436.03	435.12	431.29	431.57	425.15	425.07
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**19.8**	**19.46**	**20.24**	**14.47**	**16.1**	**19.54**	**18.76**	**19.71**	**16.19**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**-11.22**	-
Dissolved Oxygen, Field (mg/L)	**1.25**	**0.68**	**0.69**	**0.72**	**0.53**	**0.69**	**0.23**	**0.25**	**0.27**
Conductivity, Field (mS/cm)	**8.151**	**8.54406**	**5.18532**	**6.975**	**7.58134**	**5.4526**	**8.67183**	**8.90809**	**8.01588**
ORP, Field (mv)	**189**	**145.29**	**107.1**	**115**	**115.79**	**187.26**	**167.33**	**358.49**	**123.91**
Turbidity, Field (NTU)	**756.5**	**15.14**	**17.82**	**20.32**	**12.2**	**-15.03**	**5.16**	-	**0.74**
pH, Field (su)	**7.11**	**7.03**	**6.99**	**6.82**	**6.87**	**6.91**	**6.94**	**6.96**	**6.83**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	**12**	**14**	**15**	**15**	**9.9**	**12**	**12**	**12 J+**	**12**
Calcium, Total	**290**	**370**	**380**	**360**	**430**	**390**	**410**	**350**	**350**
Chloride (mg/L)	R	**870**	**810**	**710**	**670**	**920**	**850**	**790**	**760**
Fluoride (mg/L)	0.5 U	**0.58 J**	**0.5 J**	**0.7**	0.5 U	**0.9**	**0.51 J**	**0.5 J+**	**0.27 J**
Sulfate (mg/L)	R	**3800**	**3700**	**3800**	**3100**	**4400**	**4200**	**4100**	**3900 J-**
pH (lab) (su)	**7.4 J**	**7.2 J**	**7 J**	**7 J**	**6.9 J**	**7.1 J**	**7.2 J**	**7.1 J**	**7.5 J**
Total Dissolved Solids (TDS) (mg/L)	**6800**	**8500**	**7200**	**6300**	**5700**	**7100**	**8000**	**7200**	**6000**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.02 U	**0.00011 J**	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	**0.0024**	0.01 U	**0.0011 J+**	**0.00071 J**	0.001 U	**0.00043 J**	**0.00034 J**	R	0.001 U
Barium, Total	**0.041**	**0.035 J**	**0.037 J-**	**0.051 J-**	**0.019**	**0.045 J-**	**0.046**	**0.035 J-**	**0.043 J-**
Beryllium, Total	**0.00027 J**	0.01 U	0.001 U	**0.0002 J**	0.001 U	**0.00015 J**	0.001 U	**0.00013 J**	0.001 U
Cadmium, Total	**0.0003 J**	0.01 U	**0.00056 J**	**0.00031 J**	**0.00019 J**	**0.0003 J**	**0.00032 J**	**0.00063 J**	**0.00038 J**
Chromium, Total	**0.0036**	0.02 U	**0.00071 J**	0.002 U	0.002 U	0.002 U	0.002 U	0.002 UJ	0.002 U
Cobalt, Total	**0.0079**	**0.0022 J**	**0.0025**	**0.0032**	**0.0012**	**0.0021**	**0.0023**	**0.0019 J+**	**0.0026**
Lead, Total	**0.0052 J**	0.01 U	**0.00019 J**	**0.000083 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium, Total	**0.054**	**0.06**	**0.062**	**0.067**	**0.011 J**	**0.056**	**0.061**	**0.062**	**0.058**
Molybdenum, Total	**1.2**	**1.6**	**1.8**	**1.5**	0.005 U	**1.4**	**1.5**	**1.6**	**1.7**
Selenium, Total	**0.00079 J**	0.05 U	**0.00042 J**	**0.0004 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	**0.000041 J**	0.01 U	**0.00015 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Mercury, Total	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	**0.00008 J**	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	0.5 U	**0.58 J**	**0.5 J**	**0.7**	0.5 U	**0.9**	**0.51 J**	**0.5 J+**	**0.27 J**
Radiological (pCi/L)									
Radium-226	**0.703 ± 0.205**	**0.434 J ± 0.280**	0.261 U ± 0.223	0.0875 U ± 0.213	**0.188 ± 0.108**	**0.141 ± 0.0848**	**0.233 J ± 0.0901**	**0.409 J ± 0.118**	**0.217 ± 0.0813**
Radium-228	0.675 UJ ± 0.622	0.352 U ± 0.249	**0.394 ± 0.241**	**0.647 ± 0.271**	**0.373 ± 0.236**	0.291 U ± 0.229	**0.403 ± 0.224**	R	**0.620 ± 0.256**
Radium-226 & 228	**1.38 J ± 0.655**	**0.786 J ± 0.374**	R	R	**0.562 ± 0.259**	**0.432 J ± 0.244**	**0.636 ± 0.241**	**1.09 J+ ± 0.311**	**0.837 ± 0.269**

ABBREVIATIONS AND NOTES:
CCR: Coal Combustion Residuals
CFR: Code of Federal Regulations
ft amsl: feet above mean sea level
MCL: Maximum Contaminant Level
mg/L: milligram per liter
mS/cm: milliSiemen per centimeter
mv: millivolt
NA: Not Applicable
NTU: Nephelometric Turbidity Units
pCi/L: picoCurie per liter
su: standard units
USEPA: United States Environmental Protection Agency

QUALIFIERS:
J: value is estimated
J+: value is estimated with a potentially high bias
J-: value is estimated with a potentially low bias
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U: Not detected value is the laboratory reporting limit

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https://www.epa.gov/coalash/coal-ash-rule

TABLE II
SUMMARY OF ANALYTICAL RESULTS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Downgradient								
Location Name	CCR-AP-3R	CCR-AP-3R	CCR-AP-3R	CCR-AP-3R	CCR-AP-3R	CCR-AP-3R	CCR-AP-3R	CCR-AP-3R	CCR-AP-3R
Sample Name	CCR-AP-3-20160815	CCR-AP-3-20161027	CCR-AP-3R-20161108	CCR-AP-3R-20161206	CCR-AP-3R-20170207	CCR-AP-3R-20170405	CCR-AP-3R-20170606	CCR-AP-3R-20170927	CCR-AP-3R-20171115
Sample Date	08/15/2016	10/27/2016	11/08/2016	12/06/2016	02/07/2017	04/05/2017	06/06/2017	09/27/2017	11/15/2017
Lab Sample ID	180-57626-1	180-60271-4	180-60609-2	180-61491-3	180-63324-3	180-64974-4	180-67229-3	180-70809-3	180-72643-16
Water Level (ft amsl)	427.18	411.89	409.39	413.95	410.28	408.61	408.56	410.77	409.86
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**19.68**	**17.53**	**18.16**	**16.4**	**17.21**	**18.78**	**18.62**	**19.96**	**17.14**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**-11.22**	-
Dissolved Oxygen, Field (mg/L)	**0.65**	**0.38**	**0.97**	**0.26**	**0.17**	**0.7**	**0.12**	**0.07**	**0.08**
Conductivity, Field (mS/cm)	**7.828**	**8.67638**	**8.57001**	**8.645**	**8.63738**	**6.66285**	**9.48072**	**10.426**	**10.517**
ORP, Field (mv)	**48**	**217.95**	**152.88**	**131.8**	**117.35**	**189.49**	**179.62**	**232.4**	**126.38**
Turbidity, Field (NTU)	**10.41**	**-4.28**	**-4.38**	**0**	**-1.71**	**-22.88**	**-3.07**	-	**-0.87**
pH, Field (su)	**7.25**	**7.04**	**7.17**	**6.91**	**6.9**	**6.96**	**7**	**7.01**	**6.97**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	**11**	**14**	**13**	**15**	**11**	**16**	**12**	**14 J+**	**13**
Calcium, Total	**260**	**380**	**370**	**380**	**400**	**450**	**480**	**420**	**420**
Chloride (mg/L)	**730**	**900**	**860**	**880**	**820**	**1500 J**	**990**	**930**	**980**
Fluoride (mg/L)	**0.95**	**0.96 J**	**0.96 J**	**1.1**	**0.82 J+**	**1.1**	**0.87 J**	**1 J+**	**0.72 J**
Sulfate (mg/L)	**3000**	**3400**	**3500**	**3900**	**3700**	**6900 J**	**4400**	**4900**	**5300 J-**
pH (lab) (su)	**7.4 J**	**7.2 J**	**7 J**	**7 J**	**7.1 J**	**7 J**	**7.3 J**	**7.1 J**	**7.5 J**
Total Dissolved Solids (TDS) (mg/L)	**6200**	**7000**	**6900**	**7100**	**7100**	**7800**	**8500**	**8500**	**8000**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.00022 U	0.02 U	**0.000092 J**	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	**0.00044 J**	0.01 U	0.001 U	**0.00036 J**	0.001 U	**0.00029 J**	0.001 U	R	0.001 U
Barium, Total	**0.015**	**0.016 J**	**0.02 J-**	**0.024 J-**	**0.017**	**0.017 J-**	**0.017**	**0.016 J-**	**0.017 J-**
Beryllium, Total	0.001 U	0.01 U	0.001 U	**0.00021 J**	0.001 U	**0.00017 J**	0.001 U	0.001 U	0.001 U
Cadmium, Total	**0.00017 J**	0.01 U	**0.00024 J**	**0.0003 J**	**0.0002 J**	**0.00013 J**	**0.00018 J**	**0.00029 J**	**0.0002 J**
Chromium, Total	**0.0008 J**	0.02 U	**0.00085 J**	**0.00051 J**	0.002 U	0.002 U	0.002 U	0.002 UJ	0.002 U
Cobalt, Total	**0.00035 J**	0.005 U	**0.00011 J**	0.0005 U	**0.00017 J**	0.0005 U	**0.00015 J**	R	**0.00021 J**
Lead, Total	**0.00028 J**	0.01 U	0.001 U	**0.00014 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium, Total	**0.071**	**0.077**	**0.083**	**0.08**	**0.065**	**0.062**	**0.077**	**0.087**	**0.09**
Molybdenum, Total	**0.94**	**0.91**	**1**	**0.93**	**0.72**	**0.74**	**0.82**	**0.81**	**0.86**
Selenium, Total	**0.021**	**0.017 J**	**0.024**	**0.016**	**0.0041 J**	**0.0017 J**	**0.0028 J**	**0.0043 J+**	**0.0031 J**
Thallium, Total	0.001 U	0.01 U	**0.00014 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Mercury, Total	**0.000071 J**	**0.000082 J**	0.0002 U	**0.000094 J-**	**0.00053**	**0.00012 J**	**0.000085 J**	**0.00018 J**	**0.00016 J-**
Fluoride (mg/L)	**0.95**	**0.96 J**	**0.96 J**	**1.1**	**0.82 J+**	**1.1**	**0.87 J**	**1 J+**	**0.72 J**
Radiological (pCi/L)									
Radium-226	**0.199 ± 0.0723**	0.173 U ± 0.202	R	0.0963 U ± 0.229	**0.172 ± 0.104**	0.0894 U ± 0.0714	**0.116 J ± 0.0696**	R	**0.138 ± 0.0700**
Radium-228	**0.523 ± 0.314**	**0.431 ± 0.281**	0.162 U ± 0.254	**1.06 ± 0.285**	0.393 U ± 0.263	**0.429 ± 0.253**	0.367 U ± 0.248	R	**0.509 ± 0.277**
Radium-226 & 228	**0.722 ± 0.322**	**0.603 J ± 0.346**	R	R	**0.565 J ± 0.283**	**0.518 J ± 0.263**	**0.484 J ± 0.257**	**1.24 J+ ± 0.320**	**0.647 ± 0.286**

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Sample Name	CCR-AP-4-20160607	CCR-AP-4-20160811	CCR-AP-4-20161026	CCR-AP-4R-20161205	CCR-AP-4R-20170206	CCR-AP-4R-20170425	CCR-AP-4R-20170605	CCR-AP-4R-20170926	CCR-AP-4R-20171114
Sample Date	06/07/2016	08/11/2016	10/26/2016	12/05/2016	02/06/2017	04/25/2017	06/05/2017	09/26/2017	11/14/2017
Lab Sample ID	180-55566-2	180-57528-18	180-60193-2	180-61491-4	180-63324-1	180-65681-1	180-67229-4	180-70809-4	180-72643-17
Water Level (ft amsl)	444.60	441.50	439.76	440.62	440.39	-	440.65	439.72	439.49
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**14.77**	**21.89**	**14.98**	**12.35**	**15.08**	**14.55**	**16.87**	**16.55**	**13.58**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**74.75**	-
Dissolved Oxygen, Field (mg/L)	**4.6**	**6.51**	**4.79**	**6.91**	**0.1**	**6.18**	**5.93**	**6.64**	**6.23**
Conductivity, Field (mS/cm)	**1.98612**	**1.891**	**1.8735**	**2.92**	**6.67429**	**1.01**	**1.35109**	**1.05291**	**1.06282**
ORP, Field (mv)	**86.77**	**105**	**226.69**	**107.6**	**114.16**	**259**	**210.43**	**154.14**	**135.88**
Turbidity, Field (NTU)	**2.16**	**48.15**	**9.75**	**441.79**	**34.52**	**150.4**	**-1.82**	-	**329.8**
pH, Field (su)	**7.06**	**7.03**	**6.98**	**6.9**	**6.71**	**6.97**	**6.92**	**6.98**	**6.89**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	**0.018**	**0.089 J+**	**0.045 J+**	**0.13 J+**	**0.16**	**0.21**	**0.2**	**0.23 J+**	**0.15**
Calcium, Total	**210**	**180**	**210**	**130**	**110**	**110**	**160**	**110**	**110**
Chloride (mg/L)	**48**	R	**79**	**34**	**23**	**21**	**30**	**20**	**22**
Fluoride (mg/L)	**0.44**	**0.41**	**0.4**	**0.48**	**0.33 J+**	**0.41**	**0.39**	**0.39 J+**	**0.41**
Sulfate (mg/L)	**220**	R	**150 J-**	**86**	**97**	**130**	**96**	**120**	**140 J-**
pH (lab) (su)	**6.97 J**	**7.3 J**	**7.1 J**	**7.1 J**	**7.3 J**	**7.5 J**	**7.3 J**	**7.3 J**	**7.7 J**
Total Dissolved Solids (TDS) (mg/L)	**1300**	**1200**	**1300**	**710**	**630**	**640**	**930**	**650**	**650**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	**0.00029 J**	**0.00059 J**	**0.00032 J**	**0.00032 J**	0.001 U	**0.0003 J**	**0.00026 J**	R	0.001 U
Barium, Total	**0.12**	**0.089**	**0.11 J-**	**0.063 J-**	**0.051**	**0.043**	**0.069**	**0.042 J-**	**0.045 J-**
Beryllium, Total	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.001 U	**0.00018 J**	0.001 U	0.001 U	**0.000084 J**	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	**0.0022**	**0.0016 J**	**0.0022**	**0.0018 J**	**0.0015 J**	**0.0018 J**	**0.0022**	R	**0.0027 J+**
Cobalt, Total	**0.00026 J**	**0.0033**	**0.00081**	0.0005 U	**0.0002 J**	**0.00011 J**	0.0005 U	0.0005 U	**0.0003 J**
Lead, Total	**0.000085 J**	**0.00023 J**	**0.00017 J**	**0.00009 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium, Total	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Molybdenum, Total	**0.0016 J**	**0.0088**	**0.0033 J**	**0.0046 J**	0.005 U	**0.0019 J**	**0.0028 J**	**0.002 J**	**0.0017 J**
Selenium, Total	0.005 U	**0.001 J**	**0.00057 J+**	**0.00051 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	**0.000021 J**	0.001 U	0.001 U	0.001 U	**0.00022 J**	0.001 U	0.001 U	0.001 U	0.001 U
Mercury, Total	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	**0.44**	**0.41**	**0.4**	**0.48**	**0.33 J+**	**0.41**	**0.39**	**0.39 J+**	**0.41**
Radiological (pCi/L)									
Radium-226	**0.157 ± 0.0919**	**0.327 ± 0.108**	0.116 U ± 0.206	R	0.0779 U ± 0.0791	0.126 U ± 0.0996	**0.185 J ± 0.0926**	R	**0.159 ± 0.0794**
Radium-228	0.127 U ± 0.259	**7.60 J ± 1.03**	0.369 U ± 0.307	**0.370 ± 0.239**	0.199 U ± 0.251	-0.0800 U ± 0.296	0.144 U ± 0.215	-0.0756 U ± 0.212	**0.488 ± 0.307**
Radium-226 & 228	0.285 U ± 0.275	**7.93 J ± 1.04**	0.485 U ± 0.370	R	0.277 U ± 0.263	0.126 U ± 0.313	0.329 UJ ± 0.234	0.11 UJ ± 0.223	**0.647 ± 0.317**

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MOUNT VERNON, INDIANA

Location Group	Downgradient								
Location Name	CCR-AP-5	CCR-AP-5	CCR-AP-5	CCR-AP-5	CCR-AP-5	CCR-AP-5	CCR-AP-5	CCR-AP-5	CCR-AP-5
Sample Name	CCR-AP-5-20160606	CCR-AP-5-20160811	CCR-AP-5-20161027	CCR-AP-5-20161206	CCR-AP-5-20170207	CCR-AP-5-20170405	CCR-AP-5-20170606	CCR-AP-5-20170927	CCR-AP-5-20171115
Sample Date	06/06/2016	08/11/2016	10/27/2016	12/06/2016	02/07/2017	04/05/2017	06/06/2017	09/27/2017	11/15/2017
Lab Sample ID	180-55566-1	180-57528-19	180-60271-5	180-61491-5	180-63324-5	180-64974-5	180-67229-5	180-70809-5	180-72643-18
Water Level (ft amsl)	415.47	415.79	415.43	415.67	416.24	416.25	416.06	416.61	417.07
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**19.24**	**22.87**	**16.36**	**13.43**	**16.93**	**18.87**	**17.69**	**19.05**	**15.34**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**-11.22**	-
Dissolved Oxygen, Field (mg/L)	**0.28**	**0.66**	**0.51**	**0.26**	**0.24**	**0.2**	**0.06**	**0.06**	**0.07**
Conductivity, Field (mS/cm)	**5.99649**	**6.133**	**4.98392**	**5.8693**	**5.87591**	**4.20036**	**5.60685**	**5.99388**	**5.89855**
ORP, Field (mv)	**8.67**	**209**	**30**	**120.8**	**91.74**	**126.06**	**210.99**	**461.25**	**108.88**
Turbidity, Field (NTU)	**10.35**	**4.789**	**7.46**	**0**	**0.17**	**-20.21**	**-2.99**	-	**332.69**
pH, Field (su)	**7**	**6.89**	**7.12**	**6.95**	**6.97**	**7.01**	**7.02**	**7.02**	**6.99**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	**11**	**11**	**10**	**12**	**11**	**11**	**12**	**9.3 J+**	**11**
Calcium, Total	**300**	**310**	**350**	**350**	**330**	**360**	**340**	**300**	**310**
Chloride (mg/L)	**380**	R	**380**	**380**	**370**	**370**	**380**	**350**	**360**
Fluoride (mg/L)	**0.26 J**	0.5 U	**0.31 J**	**0.54**	0.5 U	**0.23 J**	**0.34 J**	**0.2 J+**	**0.32 J**
Sulfate (mg/L)	**2900**	R	**2600**	**3000**	**3000**	**3100**	**2700**	**3000**	**3100 J-**
pH (lab) (su)	**7.05 J**	**7.4 J**	**7.2 J**	**7.1 J**	**7.2 J**	**7.2 J**	**7.2 J**	**7.1 J**	**8 J**
Total Dissolved Solids (TDS) (mg/L)	**5000**	**5100**	**5000**	**5000**	**5300**	**4900**	**5000**	**4900**	**4800**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	0.02 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	**0.00057 J**	**0.0003 J**	0.01 U	**0.00016 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Barium, Total	**0.019**	**0.016**	**0.015 J**	**0.016 J-**	**0.016**	**0.016 J-**	**0.015**	**0.012**	**0.015 J-**
Beryllium, Total	**0.000052 J**	0.001 U	0.01 U	**0.00016 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.001 U	0.001 U	0.01 U	0.001 U	**0.00012 J**	0.001 U	**0.00012 J**	0.001 U	0.001 U
Chromium, Total	**0.00062 J**	0.002 U	0.02 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt, Total	**0.00081**	**0.00011 J**	0.005 U	0.0005 U	**0.000098 J**	0.0005 U	0.0005 U	0.0005 U	**0.00016 J**
Lead, Total	**0.00024 J**	0.001 U	**0.0007 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium, Total	**0.014 J**	**0.015 J**	**0.018 J**	**0.023 J**	**0.022 J**	**0.014 J**	**0.017 J**	**0.019 J**	**0.016 J**
Molybdenum, Total	**0.022**	**0.019**	**0.016 J**	**0.038**	**0.049**	**0.044**	**0.059**	**0.055**	**0.067**
Selenium, Total	0.005 U	0.005 U	0.05 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	**0.000076 J**	0.001 U	0.01 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Mercury, Total	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	**0.26 J**	0.5 U	**0.31 J**	**0.54**	0.5 U	**0.23 J**	**0.34 J**	**0.2 J+**	**0.32 J**
Radiological (pCi/L)									
Radium-226	**0.107 ± 0.0697**	**0.179 ± 0.0827**	0.293 U ± 0.242	-0.0341 U ± 0.180	**0.130 ± 0.0873**	**0.145 ± 0.0840**	0.0962 UJ ± 0.0743	R	**0.100 ± 0.0637**
Radium-228	0.214 U ± 0.278	0.161 UJ ± 0.287	0.0785 U ± 0.226	**0.743 ± 0.259**	0.294 U ± 0.220	0.208 U ± 0.204	0.222 U ± 0.289	0.198 U ± 0.226	0.330 U ± 0.233
Radium-226 & 228	0.321 U ± 0.287	0.339 UJ ± 0.298	0.372 U ± 0.332	R	**0.424 J ± 0.236**	**0.354 J ± 0.221**	0.318 U ± 0.298	**0.522 J+ ± 0.249**	**0.430 J ± 0.242**

ABBREVIATIONS AND NOTES:

CCR: Coal Combustion Residuals
CFR: Code of Federal Regulations
ft amsl: feet above mean sea level
MCL: Maximum Contaminant Level
mg/L: milligram per liter
mS/cm: milliSiemen per centimeter
mv: millivolt
NA: Not Applicable
NTU: Nephelometric Turbidity Units
pCi/L: picoCurie per liter
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QUALIFIERS:

J: value is estimated
J+: value is estimated with a potentially high bias
J-: value is estimated with a potentially low bias
R: value is rejected
U: Not detected value is the laboratory reporting limit

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https://www.epa.gov/coalash/coal-ash-rule

TABLE II
SUMMARY OF ANALYTICAL RESULTS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Downgradient								
Location Name	CCR-AP-6	CCR-AP-6	CCR-AP-6	CCR-AP-6	CCR-AP-6	CCR-AP-6	CCR-AP-6	CCR-AP-6	CCR-AP-6
Sample Name	CCR-AP-6-20160607	CCR-AP-6-20160810	CCR-AP-6-20161026	CCR-AP-6-20161206	CCR-AP-6-20170207	CCR-AP-6-20170404	CCR-AP-6-20170605	CCR-AP-6-20170926	CCR-AP-6-20171116
Sample Date	06/07/2016	08/10/2016	10/26/2016	12/06/2016	02/07/2017	04/04/2017	06/05/2017	09/26/2017	11/16/2017
Lab Sample ID	180-55566-5	180-57528-20	180-60193-3	180-61491-6	180-63324-6	180-64974-6	180-67229-6	180-70809-6	180-72643-19
Water Level (ft amsl)	447.90	447.74	445.41	446.06	447.62	445.63	446.05	443.90	443.36
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**16.68**	**17.63**	**15.71**	**13.31**	**13.86**	**16.14**	**15.3**	**15.47**	**13.29**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**854.31**	-
Dissolved Oxygen, Field (mg/L)	**0.39**	**0.23**	**0.16**	**0.21**	**1.34**	**2.04**	**2.05**	**0.08**	**0.4**
Conductivity, Field (mS/cm)	**2.86715**	**2.622**	**2.34393**	**2.0108**	**2.10516**	**1.76314**	**2.25261**	**2.26168**	**2.1014**
ORP, Field (mv)	**30.1**	**12**	**18.27**	**28.3**	**5.82**	**21.67**	**-19.79**	**-23.68**	**16.07**
Turbidity, Field (NTU)	**58.7**	**47.74**	**50.74**	**20.35**	**20.98**	**171.35**	**-0.8**	-	**357.65**
pH, Field (su)	**6.9**	**6.89**	**7.01**	**6.97**	**7.02**	**6.98**	**7.07**	**6.98**	**6.93**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	**2.2**	**2.2**	**1.4**	**0.88**	**0.83**	**0.98**	**1.5**	**0.95 J+**	**0.59**
Calcium, Total	**240**	**250**	**260**	**270**	**250**	**290**	**280**	**260**	**240**
Chloride (mg/L)	**150**	**150**	**130**	**100**	**100**	**110**	**130**	**110**	**100**
Fluoride (mg/L)	**0.12**	0.1 U	**0.18**	**0.24**	**0.2 J+**	**0.2**	**0.19 J**	**0.21 J+**	**0.21**
Sulfate (mg/L)	**1000**	**900 J-**	**920 J-**	**890**	**880**	**900**	**1100**	**930**	**880 J-**
pH (lab) (su)	**7.14 J**	**7.2 J**	**7.1 J**	**7.1 J**	**7.4 J**	**7.3 J**	**7.2 J**	**7.1 J**	**7.4 J**
Total Dissolved Solids (TDS) (mg/L)	**2100**	**2100**	**2000**	**1800**	**3300**	**1800**	**2100**	**1800**	**1700**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	**0.00068 J**
Arsenic, Total	**0.0053**	**0.0045**	**0.0041**	**0.0039**	**0.0029 J+**	**0.0021**	**0.002**	**0.0032 J+**	**0.0044 J**
Barium, Total	**0.028**	**0.019**	**0.022 J-**	**0.021 J-**	**0.021**	**0.018 J-**	**0.018**	**0.026 J-**	**0.04 J-**
Beryllium, Total	**0.0001 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.00051 J**	**0.00042 J**
Cadmium, Total	**0.00021 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.00013 J**
Chromium, Total	**0.0012 J**	0.002 U	**0.001 J**	**0.00048 J**	0.002 U	0.002 U	0.002 U	R	**0.0072 J+**
Cobalt, Total	**0.0068**	**0.0038**	**0.0032**	**0.0023**	**0.0013**	**0.001**	**0.00099**	**0.0033**	**0.0054**
Lead, Total	**0.0011**	**0.00023 J**	**0.00061 J**	**0.00028 J**	0.001 U	0.001 U	0.001 U	**0.005**	**0.0036 J**
Lithium, Total	**0.043 J**	**0.04 J**	**0.042 J**	**0.041 J**	**0.04 J**	**0.036 J**	**0.039 J**	**0.042 J**	**0.043 J**
Molybdenum, Total	**0.021**	**0.015**	**0.012**	**0.011**	**0.01**	**0.0086**	**0.009**	**0.0066**	**0.0089**
Selenium, Total	**0.00065 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	**0.00006 J**	0.001 U	**0.000039 J**	0.001 U	0.001 U	0.001 U	0.001 U	**0.00018 J**	**0.000097 J**
Mercury, Total	**0.000055 J**	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	**0.12**	0.1 U	**0.18**	**0.24**	**0.2 J+**	**0.2**	**0.19 J**	**0.21 J+**	**0.21**
Radiological (pCi/L)									
Radium-226	**0.162 ± 0.0727**	**0.177 ± 0.0778**	0.195 U ± 0.228	0.278 U ± 0.281	0.0398 U ± 0.0860	**0.120 ± 0.0878**	0.0399 UJ ± 0.0601	**1.10 J ± 0.398**	**0.122 ± 0.0669**
Radium-228	-0.0541 U ± 0.342	-0.0414 UJ ± 0.239	0.394 U ± 0.274	**0.641 ± 0.284**	0.0520 U ± 0.252	-0.0275 U ± 0.213	**0.0246 ± 0.242**	**3.67 ± 1.20**	**0.406 ± 0.244**
Radium-226 & 228	0.108 U ± 0.350	0.136 UJ ± 0.251	**0.589 ± 0.356**	R	0.0918 U ± 0.266	0.12 UJ ± 0.230	0.0646 U ± 0.250	**4.77 ± 1.26**	**0.528 ± 0.253**

ABBREVIATIONS AND NOTES:

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CFR: Code of Federal Regulations
ft amsl: feet above mean sea level
MCL: Maximum Contaminant Level
mg/L: milligram per liter
mS/cm: milliSiemen per centimeter
mv: millivolt
NA: Not Applicable
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J: value is estimated
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TABLE II
SUMMARY OF ANALYTICAL RESULTS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Downgradient								
Location Name	CCR-AP-7R	CCR-AP-7R	CCR-AP-7R	CCR-AP-7R	CCR-AP-7R	CCR-AP-7R	CCR-AP-7R	CCR-AP-7R	CCR-AP-7R
Sample Name	CCR-AP-7-20160609	CCR-AP-7-20160810	CCR-AP-7-20161026	CCR-AP-7R-20161205	CCR-AP-7R-20170206	CCR-AP-7R-20170425	CCR-AP-7R-20170605	CCR-AP-7R-20170926	CCR-AP-7R-20171114
Sample Date	06/09/2016	08/10/2016	10/26/2016	12/05/2016	02/06/2017	04/25/2017	06/05/2017	09/26/2017	11/14/2017
Lab Sample ID	180-55607-7	180-57528-21	180-60193-4	180-61491-7	180-63324-7	180-65681-2	180-67229-7	180-70809-7	180-72643-20
Water Level (ft amsl)	457.39	457.59	456.07	455.82	456.15	-	454.32	453.14	452.74
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**17.91**	**16.91**	**15.41**	**12.19**	**13.33**	**14.48**	**15.06**	**15.56**	**13.51**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**524.01**	-
Dissolved Oxygen, Field (mg/L)	**7.01**	**7.69**	**9.08**	**10.04**	**6.85**	**7.2**	**8.31**	**6.67**	**6.72**
Conductivity, Field (mS/cm)	**0.53443**	**4.234**	**4.08942**	**1.9895**	**4.16272**	**4.453**	**4.15439**	**4.62098**	**4.68238**
ORP, Field (mv)	**121.77**	**198**	**195.26**	**166.1**	**179.67**	**269**	**256.13**	**257.35**	**129.8**
Turbidity, Field (NTU)	**3.02**	**171.8**	**11.72**	**53.54**	**57.61**	**487.6**	**136.87**	-	**121.17**
pH, Field (su)	**6.49**	**6.37**	**6.47**	**6.31**	**6.43**	**6.42**	**6.46**	**6.53**	**6.51**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	0.011 U	**5.4**	**3.7**	**3.6**	**3.4**	**4.1**	**4.1**	**2.7 J+**	**2.8**
Calcium, Total	**47**	**320**	**340**	**340**	**330**	**340**	**340**	**300**	**320**
Chloride (mg/L)	**26**	**300**	**320**	**320**	**290**	**320**	**330**	**260**	**280**
Fluoride (mg/L)	R	0.25 U	**0.17 J**	**0.25**	0.25 U	**0.2 J**	**0.19 J**	R	**0.094 J**
Sulfate (mg/L)	**15**	**1600 J-**	**1900 J-**	**2100**	**1900**	**2200**	**2100**	**2300**	**2400 J-**
pH (lab) (su)	**6.75 J**	**6.9 J**	**6.6 J**	**6.6 J**	**6.8 J**	**6.9 J**	**6.7 J**	**6.6 J**	**7.2 J**
Total Dissolved Solids (TDS) (mg/L)	**350**	**3700**	**3700**	**3600**	**3800**	**7800**	**4000**	**4100**	**3900**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	**0.00059 J**	0.002 U	0.002 U	0.002 U
Arsenic, Total	**0.00067 J**	R	**0.00061 J**	**0.00051 J**	**0.0016 J+**	**0.0032**	**0.0017**	R	**0.0014 J+**
Barium, Total	**0.024 J-**	**0.039**	**0.032 J-**	**0.033 J-**	**0.039**	**0.063**	**0.05**	**0.048 J-**	**0.039 J-**
Beryllium, Total	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.00024 J**	0.001 U	**0.00013 J**	0.001 U
Cadmium, Total	0.001 U	**0.00032 J**	**0.00019 J**	**0.00015 J**	**0.00014 J**	**0.00015 J**	**0.0002 J**	0.001 U	**0.00011 J**
Chromium, Total	**0.0016 J**	**0.00093 J**	**0.00076 J**	**0.00093 J**	**0.0016 J**	**0.0063**	**0.0033**	R	**0.0029 J+**
Cobalt, Total	**0.0002 J**	**0.0039**	**0.0012**	**0.0012**	**0.0015**	**0.004**	**0.0023**	**0.0019**	**0.0013**
Lead, Total	R	**0.00041 J**	**0.00022 J**	**0.00014 J**	**0.00062 J**	**0.0033**	**0.0017**	**0.0018 J+**	**0.0011**
Lithium, Total	**0.011 J**	**0.02 J**	**0.024 J**	**0.025 J**	**0.023 J**	**0.03 J**	**0.021 J**	**0.025 J**	**0.022 J**
Molybdenum, Total	**0.0016 J**	**0.0011 J**	0.005 U	0.005 U	0.005 U	0.005 U	**0.00062 J**	**0.00065 J**	0.005 U
Selenium, Total	0.005 U	**0.0007 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.000054 J**	0.001 U
Mercury, Total	0.0002 UJ	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	R	0.25 U	**0.17 J**	**0.25**	0.25 U	**0.2 J**	**0.19 J**	R	**0.094 J**
Radiological (pCi/L)									
Radium-226	**0.0958 J ± 0.0549**	**0.324 ± 0.149**	0.284 U ± 0.252	0.0965 U ± 0.221	**0.164 ± 0.0985**	**0.350 ± 0.130**	**0.248 J ± 0.0930**	R	**0.217 ± 0.0812**
Radium-228	-0.0103 U ± 0.186	0.127 UJ ± 0.584	0.157 U ± 0.248	0.347 U ± 0.251	0.193 U ± 0.275	0.0871 U ± 0.274	**0.202 ± 0.223**	0.450 U ± 0.305	**0.559 ± 0.268**
Radium-226 & 228	0.0856 U ± 0.194	0.451 UJ ± 0.603	**0.441 ± 0.353**	R	0.357 UJ ± 0.292	0.437 UJ ± 0.303	**0.451 J ± 0.242**	R	**0.776 ± 0.280**

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TABLE II
SUMMARY OF GROUNDWATER QUALITY DATA
ASH POND - JUNE THROUGH AUGUST 2018
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA
FILE NO. 129420

Location Group	Action Level	Upgradient			
Location Name	Maximum	CCR-BK-1R	CCR-BK-1R	CCR-BK-2	CCR-BK-2
Sample Name	Contaminant	CCR-BK-1R-20180608	CCR-BK-1R20180827	CCR-BK-2-20180608	CCR-BK-2-20180820
Sample Date	Level/Regonal	06/08/2018	08/27/2018	06/08/2018	08/20/2018
Lab Sample ID	Screening Level	180-78556-5	180-81365-1	180-78556-6	180-81110-10
Detection Monitoring - EPA Appendix III Constituents (mg/L)					
Boron, Total	NA	-	0.08 U	-	0.08 U
Calcium, Total	NA	-	**34**	-	**36**
Chloride	NA	-	**1.9**	-	**15**
Fluoride	4	**0.37**	**0.31**	**0.16**	**0.13 J+**
Sulfate	NA	-	**21 J-**	-	**18 J-**
Total Dissolved Solids (TDS)	NA	-	**220**	-	**230**
pH (lab) (SU)	NA	-	**7.2 J**	-	**6.8 J**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)					
Antimony, Total	0.006	0.002 U	-	0.002 U	-
Arsenic, Total	0.01	R	**0.0011**	0.001 U	0.001 U
Barium, Total	2	**0.049 J-**	**0.041 J**	**0.037 J-**	**0.033 J**
Beryllium, Total	0.004	0.001 UJ	-	0.001 UJ	-
Cadmium, Total	0.005	0.001 UJ	0.001 U	0.001 UJ	0.001 U
Chromium, Total	0.1	**0.003 J+**	**0.0076**	0.002 U	0.002 U
Cobalt, Total	0.006	**0.0008 J**	**0.001**	**0.000098 J**	0.0005 U
Fluoride	4	**0.37**	**0.31**	**0.16**	**0.13 J+**
Lead, Total	0.015	**0.00063 J**	**0.0011**	0.001 UJ	0.001 U
Lithium, Total	0.04	**0.0036 J**	**0.0048 J**	0.005 U	0.05 U
Mercury, Total	0.002	0.0002 UJ	0.0002 U	0.0002 UJ	0.0002 U
Molybdenum, Total	0.1	**0.0014 J**	**0.0013 J**	**0.00051 J**	0.005 U
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.002	0.001 U	-	0.001 U	-
Radiological (pCi/L)					
Radium-226	NA	**0.223 ± 0.148**	R	0.0863 U ± 0.108	R
Radium-228	NA	0.263 U ± 0.217	0.285 U ± 0.313	0.230 U ± 0.194	0.0380 U ± 0.238
Radium-226 & 228	5	R	R	R	0.209 UJ ± 0.251

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TABLE II
SUMMARY OF GROUNDWATER QUALITY DATA
ASH POND - JUNE THROUGH AUGUST 2018
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA
FILE NO. 129420

Location Group	Action Level	Downgradient							
Location Name	Maximum	CCR-AP-1R	CCR-AP-1R	CCR-AP-2R	CCR-AP-2R	CCR-AP-3R	CCR-AP-3R	CCR-AP-3R	CCR-AP-3R
Sample Name	Contaminant	CCR-AP-1R-20180606	CCR-AP-1R-20180822	CCR-AP-2R-20180606	CCR-AP-2R-20180821	CCR-AP-3R-20180606	BLIND DUPLICATE 1-20180606	CCR-AP-3R-20180821	BLIND DUPLICATE 1-20180821
Sample Date	Level/Regonal	06/06/2018	08/22/2018	06/06/2018	08/21/2018	06/06/2018	06/06/2018	08/21/2018	08/21/2018
Lab Sample ID	Screening Level	180-78475-8	180-81267-1	180-78475-9	180-81110-1	180-78475-10	180-78475-14	180-81110-2	180-81110-11
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	NA	-	**0.57**	-	**12**	-	-	**12**	**12**
Calcium, Total	NA	-	**280**	-	**290**	-	-	**260**	**260**
Chloride	NA	-	**110**	-	**510**	-	-	**700**	**700**
Fluoride	4	**0.49**	**0.2 J+**	**0.49 J**	**0.39 J**	**1.6**	**1.5**	**1.3**	**1.6**
Sulfate	NA	-	**900 J-**	-	**2500 J-**	-	-	**3600 J-**	**3500 J-**
Total Dissolved Solids (TDS)	NA	-	**1800**	-	**5200**	-	-	**7100**	**7000**
pH (lab) (SU)	NA	-	**7.3 J**	-	**7 J**	-	-	**7.4 J**	**7.2 J**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	0.002 U	-	0.002 U	-	0.002 U	0.002 U	-	-
Arsenic, Total	0.01	0.001 U	**0.00099 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Barium, Total	2	**0.015 J-**	**0.02 J**	**0.043 J-**	**0.047 J**	**0.016 J-**	**0.015 J-**	**0.013 J**	**0.013 J**
Beryllium, Total	0.004	0.001 UJ	-	0.001 UJ	-	0.001 UJ	0.001 UJ	-	-
Cadmium, Total	0.005	0.001 UJ	0.001 U	**0.00045 J**	**0.0004 J**	**0.00025 J**	**0.00023 J**	**0.00022 J**	**0.0002 J**
Chromium, Total	0.1	0.002 U	0.0023 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt, Total	0.006	**0.00021 J**	**0.0014**	**0.0022 J**	**0.0021**	**0.00016 J**	**0.00015 J**	0.0005 U	0.0005 U
Fluoride	4	**0.49**	**0.2 J+**	**0.49 J**	**0.39 J**	**1.6**	**1.5**	**1.3**	**1.6**
Lead, Total	0.015	0.001 UJ	**0.00015 J**	**0.00022 J**	**0.00015 J**	0.001 UJ	0.001 UJ	**0.00015 J**	0.001 U
Lithium, Total	0.04	0.005 U	**0.032**	**0.044 J**	**0.053**	**0.076 J**	**0.073 J**	**0.087**	**0.082**
Mercury, Total	0.002	**0.000085 J-**	0.0002 U	0.0002 UJ	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U
Molybdenum, Total	0.1	**0.0028 J**	**0.0074**	**1.9 J**	**1.7**	**1 J**	**0.99 J**	**1**	**0.98**
Selenium, Total	0.05	0.005 U	0.005 U	**0.00083 J+**	0.005 U	**0.011 J+**	**0.01 J+**	**0.019 J**	**0.019 J**
Thallium, Total	0.002	0.001 U	-	0.001 U	-	0.001 U	0.001 U	-	-
Radiological (pCi/L)									
Radium-226	NA	**0.360 ± 0.209**	R	0.139 U ± 0.15	R	0.136 U ± 0.153	**0.336 ± 0.201**	R	R
Radium-228	NA	0.0870 U ± 0.21	0.192 U ± 0.271	**0.393 ± 0.226**	0.309 U ± 0.215	0.223 U ± 0.179	0.125 U ± 0.191	**0.400 ± 0.232**	0.364 U ± 0.238
Radium-226 & 228	5	**0.447 J ± 0.296**	0.372 UJ ± 0.282	**0.532 J ± 0.271**	R	**0.359 ± 0.235**	**0.461 J ± 0.277**	**0.738 J+ ± 0.259**	**0.639 J+ ± 0.257**

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MOUNT VERNON, INDIANA
FILE NO. 129420

Location Group	Action Level	Downgradient							
Location Name	Maximum	CCR-AP-4R	CCR-AP-4R	CCR-AP-5	CCR-AP-5	CCR-AP-6	CCR-AP-6	CCR-AP-7R	CCR-AP-7R
Sample Name	Contaminant	CCR-AP-4R-20180606	CCR-AP-4R-20180821	CCR-AP-5-20180606	CCR-AP-5-20180821	CCR-AP-6-20180607	CCR-AP-6-20180822	CCR-AP-7R-20180606	CCR-AP-7R-20180822
Sample Date	Level/Regonal	06/06/2018	08/21/2018	06/06/2018	08/21/2018	06/07/2018	08/22/2018	06/06/2018	08/22/2018
Lab Sample ID	Screening Level	180-78475-11	180-81110-3	180-78475-12	180-81110-4	180-78556-7	180-81267-2	180-78475-13	180-81267-3
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	NA	-	**0.077 J**	-	**11**	-	**6**	-	**3.4**
Calcium, Total	NA	-	**160**	-	**290**	-	**120**	-	**330**
Chloride	NA	-	**33**	-	**280**	-	**160**	-	**320**
Fluoride	4	**0.43**	**0.34**	**0.4**	**0.26 J+**	**0.23**	**0.44**	**0.15 J**	**0.19 J+**
Sulfate	NA	-	**100 J-**	-	**2400 J-**	-	**1100 J-**	-	**2600 J-**
Total Dissolved Solids (TDS)	NA	-	**960**	-	**4500**	-	**2500**	-	**4500**
pH (lab) (SU)	NA	-	**7.2 J**	-	**7.2 J**	-	**7.2 J**	-	**6.7 J**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	0.002 U	-	0.002 U	-	0.002 U	-	0.002 U	-
Arsenic, Total	0.01	0.001 U	0.001 U	0.001 U	0.001 U	R	**0.00046 J**	0.001 U	**0.00077 J**
Barium, Total	2	**0.098 J-**	**0.094 J**	**0.016 J-**	**0.015 J**	**0.022 J-**	**0.015 J**	**0.032 J-**	**0.031 J**
Beryllium, Total	0.004	0.001 UJ	-	0.001 UJ	-	0.001 UJ	-	0.001 UJ	-
Cadmium, Total	0.005	0.001 UJ	0.001 U	0.001 UJ	0.001 U	0.001 UJ	0.001 U	0.001 UJ	0.001 U
Chromium, Total	0.1	**0.0036 J+**	**0.0038 J+**	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	**0.0033 J+**
Cobalt, Total	0.006	**0.00013 J**	0.0005 U	**0.00012 J**	0.0005 U	**0.0011 J**	**0.00017 J**	**0.00037 J**	**0.00049 J**
Fluoride	4	**0.43**	**0.34**	**0.4**	**0.26 J+**	**0.23**	**0.44**	**0.15 J**	**0.19 J+**
Lead, Total	0.015	0.001 UJ	0.001 U	0.001 UJ	0.001 U	**0.00013 J**	0.001 U	**0.00013 J**	**0.00031 J**
Lithium, Total	0.04	0.005 U	0.05 U	**0.013 J**	**0.023 J**	**0.026 J**	0.005 U	**0.02 J**	**0.019 J+**
Mercury, Total	0.002	0.0002 UJ	0.0002 U	0.0002 UJ	0.0002 U	0.0002 UJ	0.0002 U	0.0002 UJ	0.0002 U
Molybdenum, Total	0.1	**0.0016 J**	**0.0015 J**	**0.054 J**	**0.052**	**0.0064 J**	**0.0032 J**	0.005 U	0.005 U
Selenium, Total	0.05	**0.0014 J+**	0.005 U	**0.00085 J+**	0.005 U	0.005 U	0.005 U	0.005 U	**0.00099 J**
Thallium, Total	0.002	0.001 U	-	0.001 U	-	0.001 U	-	0.001 U	-
Radiological (pCi/L)									
Radium-226	NA	0.216 U ± 0.173	R	**0.234 ± 0.173**	R	0.0628 U ± 0.107	**0.438 J ± 0.119**	0.186 U ± 0.169	R
Radium-228	NA	**0.354 ± 0.224**	0.414 U ± 0.284	0.225 U ± 0.222	**0.371 ± 0.222**	R	R	0.0364 U ± 0.199	R
Radium-226 & 228	5	**0.569 J ± 0.283**	**0.743 J+ ± 0.3**	**0.459 J ± 0.281**	**0.552 J+ ± 0.235**	R	R	0.222 U ± 0.261	R

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SUMMARY OF GROUNDWATER QUALITY DATA
ASH POND - MAY THROUGH OCTOBER 2019
A.B. BROWN GENERATION STATION
MOUNT VERNON, INDIANA

Location Group	Action Level	Background			
Location Name	Maximum	CCR-BK-1R	CCR-BK-1R	CCR-BK-2	CCR-BK-2
Sample Name	Contaminant	CCR-BK-1R-20190521	CCR-BK-1R-20191014	CCR-BK-2-20190521	CCR-BK-2-20191014
Sample Date	Level/ Regional	05/21/2019	10/14/2019	05/21/2019	10/14/2019
Lab Sample ID	Screening Levels	180-90467-7	180-97392-1	180-90467-8	180-97392-2
Detection Monitoring - EPA Appendix III Constituents (mg/L)					
Boron, Total	NA	0.08 U	**0.056 J**	**0.58**	**0.051 J**
Calcium, Total	NA	**37**	**34**	**71**	**35**
Chloride	NA	**2.3**	**2.4**	**4.6**	**17**
Fluoride	4	0.23 U	**0.2**	0.12 U	**0.07 J**
Sulfate	NA	**23**	**22**	**60**	**20**
Total Dissolved Solids (TDS)	NA	**230**	**210**	**440**	**230**
pH (lab) (SU)	NA	**7.4 J**	**7.2 HF**	**7.5 J**	**7 HF**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)					
Antimony, Total	0.006	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	**0.00034 J**	**0.00036 J**	**0.00041 J**	0.001 U
Barium, Total	2	**0.027 J**	**0.036**	**0.045 J-**	**0.032**
Beryllium, Total	0.004	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.005	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	0.1	0.002 U	0.002 U	**0.0087**	0.002 U
Cobalt, Total	0.006	**0.00012 J**	**0.00017 J**	**0.0005**	**0.00011 J**
Fluoride	4	0.23 U	**0.2**	0.12 U	**0.07 J**
Lead, Total	0.015	**0.00016 J**	**0.00023 J**	0.001 U	0.001 U
Lithium, Total	0.04	0.0065 U	0.005 U	0.0095 U	0.005 U
Mercury, Total	0.002	0.0002 U	-	0.0002 U	-
Molybdenum, Total	0.1	**0.00063 J**	**0.00075 J**	**0.0025 J**	0.005 U
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.002	0.001 U	0.001 U	0.001 U	0.001 U
Radiological (pCi/L)					
Radium-226	NA	**0.336 J ± 0.108**	0.0729 U ± 0.182	-0.0109 U ± 0.184	-0.0644 U ± 0.0992
Radium-228	NA	-0.0733 UJ ± 0.235	0.147 U ± 0.233	0.0733 U ± 0.246	0.323 U ± 0.292
Radium-226 & 228	5	0.336 UJ ± 0.259	0.220 U ± 0.296	0.0733 U ± 0.307	0.259 U ± 0.308
Field Parameters					
Temperature (Deg C)	NA	**15.78**	**15.72**	**14.47**	**16.04**
Dissolved Oxygen, Field (mg/L)	NA	**5.82**	**5.98**	**0.48**	**0.51**
Conductivity, Field (mS/cm)	NA	**0.34186**	**0.3542**	**0.72035**	**0.38427**
ORP, Field (mv)	NA	**43.3**	**104.9**	**47.9**	**72.1**
Turbidity, Field (NTU)	NA	**0.97**	**9.8**	**12.88**	**11.89**
pH, Field (SU)	NA	**7**	**6.34**	**7.2**	**6.54**

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ASH POND - MAY THROUGH OCTOBER 2019
A.B. BROWN GENERATION STATION
MOUNT VERNON, INDIANA

Location Group	Action Level	Downgradient									
Location Name	Maximum	CCR-AP-1R	CCR-AP-1R	CCR-AP-2I	CCR-AP-2I	CCR-AP-2R	CCR-AP-2R	CCR-AP-3I	CCR-AP-3I	CCR-AP-3R	CCR-AP-3R
Sample Name	Contaminant	CCR-AP-1R-20190524	CCR-AP-1R-20191016	CCR-AP-2I-20190614	CCR-AP-2I-20191021	CCR-AP-2R-20190524	CCR-AP-2R-20191017	CCR-AP-3I-20190614	CCR-AP-3I-20191018	CCR-AP-3R-20190522	CCR-AP-3R-20191017
Sample Date	Level/ Regional	05/24/2019	10/16/2019	06/14/2019	10/21/2019	05/24/2019	10/17/2019	06/14/2019	10/18/2019	05/22/2019	10/17/2019
	Screening			180-91430-1				180-91430-2			
Lab Sample ID	Levels	180-90606-4	180-97535-1	1906640-1	180-97725-1	180-90606-5	180-97535-2	1906640-3	180-97535-4	180-90467-9	180-97535-3
Detection Monitoring - EPA Appendix III Constituents (mg/L)											
Boron, Total	NA	**4.5**	**4.6**	**2.1**	**2.2**	**11**	**11**	**2.2**	**2.3**	**11**	**14**
Calcium, Total	NA	**68**	**61**	**19**	**13 F1**	**300**	**280**	**16**	**18**	**260**	**280**
Chloride	NA	**69**	**55**	**110**	**97**	**530**	**440**	**150**	**140**	**620**	**670**
Fluoride	4	**0.57 J+**	**0.37**	**0.83**	**1.1**	**0.47 J+**	**0.3 J**	**1.1**	**1.2**	**1.3 J+**	**0.79**
Sulfate	NA	**530**	**410**	**23**	**7.6**	**2600**	**2500**	**16**	**14**	**3100**	**3700**
Total Dissolved Solids (TDS)	NA	**1500**	**1300**	**710**	**710**	**4100**	**4400**	**700**	**720**	**5800**	**5100**
pH (lab) (SU)	NA	**7.5 J**	**7.3 HF**	**7.6 J**	**8 HF**	**7.3 J**	**7.2 HF**	**8.1 J**	**8.1 HF**	**7.5 J**	**7.5 HF**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)											
Antimony, Total	0.006	0.002 U	0.002 U	**0.00053 J**	**0.00052 J**	0.002 U	0.002 U	**0.00045 J**	0.002 U	0.02 U	0.002 U
Arsenic, Total	0.01	**0.00047 J**	**0.00038 J**	**0.0022**	**0.0019**	**0.00053 J**	**0.00058 J**	**0.0018**	**0.0016**	0.01 U	**0.00035 J**
Barium, Total	2	**0.025 J+**	**0.027 B**	**0.11**	**0.1**	**0.042 J+**	**0.023 B**	**0.17**	**0.17 B**	**0.16 J-**	**0.016 B**
Beryllium, Total	0.004	0.001 U	0.001 U	0.001 U	**0.00027 J^**	0.001 U	0.001 U	**0.00026 J**	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.005	0.001 U	0.001 U	0.001 U	**0.00023 J**	**0.00059 J**	**0.00039 J**	0.001 U	0.001 U	0.01 U	**0.00025 J**
Chromium, Total	0.1	0.002 U	0.002 U	0.004 U	**0.0027**	0.002 U	0.002 U	0.0046 U	0.002 U	0.02 U	0.002 U
Cobalt, Total	0.006	**0.00021 J**	**0.0002 J**	0.0005 U	**0.0004 J**	**0.0026**	**0.0026**	**0.0013**	**0.00059**	**0.0017 J**	**0.0019**
Fluoride	4	**0.57 J+**	**0.37**	**0.83**	**1.1**	**0.47 J+**	**0.3 J**	**1.1**	**1.2**	**1.3 J+**	**0.79**
Lead, Total	0.015	0.001 U	0.001 U	0.001 U	**0.00047 J**	**0.00016 J**	**0.00015 J**	0.0011 U	**0.00072 J**	0.01 U	**0.00013 J**
Lithium, Total	0.04	**0.0036 J**	0.025 U	**0.024**	**0.023**	**0.033**	**0.05**	**0.025**	**0.026**	**0.062**	**0.1**
Mercury, Total	0.002	0.0002 U	-	0.0002 U	-	0.0002 U	-	0.0002 U	-	0.0002 U	-
Molybdenum, Total	0.1	**0.0042 J**	**0.0047 J**	**0.0092**	**0.0038 J**	**1.9**	**1.7**	**0.0061**	**0.0043 J**	**0.89**	**0.9**
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.05 U	**0.0074**
Thallium, Total	0.002	0.001 U	0.001 U	0.001 U	**0.00048 J**	0.001 U	0.001 U	**0.00013 J**	0.001 U	0.01 U	0.001 U
Radiological (pCi/L)											
Radium-226	NA	0.0879 U ± 0.0697	0.0796 U ± 0.0757	0.07 U ± 0.11	**0.349 ± 0.12**	**0.264 ± 0.102**	-0.0236 U ± 0.0528	**0.43 ± 0.25**	**0.397 ± 0.135**	**0.283 J ± 0.0999**	-0.0190 U ± 0.0631
Radium-228	NA	-0.0354 U ± 0.241	0.0814 U ± 0.239	0.53 U ± 0.37	0.237 U ± 0.249	**0.448 ± 0.291**	**0.518 ± 0.269**	0.56 U ± 0.39	0.357 U ± 0.251	0.163 UJ ± 0.283	**0.437 ± 0.253**
Radium-226 & 228	5	0.0879 U ± 0.251	0.161 U ± 0.251	0.60 U ± 0.386	**0.587 ± 0.276**	**0.713 ± 0.308**	**0.494 ± 0.274**	**0.99 J ± 0.463**	**0.753 ± 0.285**	0.447 UJ ± 0.3	**0.418 ± 0.261**
Field Parameters											
Temperature (Deg C)	NA	**16.16**	**15.44**	**19.55**	**17.3**	**18.73**	**16.89**	**18.31**	**18.55**	**18.78**	**18.29**
Dissolved Oxygen, Field (mg/L)	NA	**0.03**	**0.13**	**1.62**	**2.77**	**0.66**	**0.28**	**0.09**	**0.46**	**0.08**	**0.21**
Conductivity, Field (mS/cm)	NA	**2.0135**	**1.9694**	**1.264**	**1.2276**	**5.577**	**5.6187**	**1.2331**	**1.2989**	**7.4198**	**8.2589**
ORP, Field (mv)	NA	**-8.6**	**32.2**	**-16.2**	**99.2**	**90.9**	**111.1**	**-114.6**	**89**	**85.5**	**113.4**
Turbidity, Field (NTU)	NA	**0**	**3.77**	**17.09**	**14.99**	**2.19**	**1.83**	**141.52**	**49.94**	**0**	**0.49**
pH, Field (SU)	NA	**7.21**	**6.94**	**7.71**	**7.71**	**7.05**	**6.83**	**8.23**	**7.82**	**7.26**	**7.23**

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Location Group	Action Level	Downgradient									
Location Name	Maximum	CCR-AP-4R	CCR-AP-4R	CCR-AP-5	CCR-AP-5	CCR-AP-5	CCR-AP-6	CCR-AP-6	CCR-AP-6	CCR-AP-7R	CCR-AP-7R
Sample Name	Contaminant	CCR-AP-4R-20190522	CCR-AP-4R-20191017	CCR-AP-5-20190522	ND DUPLICATE 2-20190	CCR-AP-5-20191017	CCR-AP-6-20190521	CCR-AP-6-20191016	ND DUPLICATE 1-20191	CCR-AP-7R-20190521	CCR-AP-7R-20191016
Sample Date	Level/ Regional Screening	05/22/2019	10/17/2019	05/22/2019	05/22/2019	10/17/2019	05/21/2019	10/16/2019	10/16/2019	05/21/2019	10/16/2019
Lab Sample ID	Levels	180-90467-10	180-97535-5	180-90467-11	180-90467-17	180-97535-6	180-90467-12	180-97535-7	180-97535-10	180-90467-13	180-97535-8
Detection Monitoring - EPA Appendix III Constituents (mg/L)											
Boron, Total	NA	**0.045 J**	**0.14**	**11**	**11**	**12**	**2.9**	**3.2**	**3**	**5.6**	**3.6**
Calcium, Total	NA	**190**	**180**	**410**	**420**	**390**	**320**	**300**	**310**	**410**	**370**
Chloride	NA	**40**	**41**	**410**	**390**	**380**	**230**	**220**	**210**	**500**	**250**
Fluoride	4	**0.41 J+**	**0.1**	**0.31 J+**	**0.31 J+**	**0.23 J**	0.17 U	**0.14 J**	**0.14 J**	0.17 U	**0.16 J**
Sulfate	NA	**99**	**94**	**3100**	**2900**	**2900**	**1200**	**1200**	**1200**	**2600**	**3100**
Total Dissolved Solids (TDS)	NA	**950**	**940**	**5000**	**4900**	**4800**	**2400**	**2400**	**2300**	**4200**	**4500**
pH (lab) (SU)	NA	**7.4 J**	**7.3 HF**	**7.4 J**	**7.4 J**	**7.3 HF**	**7.5 J**	**7.3 HF**	**7.2 HF**	**6.8 J**	**6.7 HF**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)											
Antimony, Total	0.006	0.002 U	0.002 U	0.02 U	0.02 U	0.002 U	0.02 U	0.002 U	0.002 U	0.02 U	0.002 U
Arsenic, Total	0.01	**0.00038 J**	0.001 U	0.01 U	0.01 U	0.001 U	0.01 U	**0.00049 J**	**0.00043 J**	0.01 U	**0.00046 J**
Barium, Total	2	**0.094 J-**	**0.1 B**	**0.018 J**	**0.02 J**	**0.019 B**	0.1 UJ	**0.014 B**	**0.015 B**	**0.029 J**	**0.028 B**
Beryllium, Total	0.004	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.005	0.001 U	0.001 U	0.01 U	0.01 U	0.001 U	0.01 U	0.001 U	0.001 U	0.01 U	0.001 U
Chromium, Total	0.1	**0.0035**	**0.0025**	0.02 U	0.02 U	0.002 U	0.02 U	0.002 U	0.002 U	0.02 U	0.002 U
Cobalt, Total	0.006	**0.00017 J**	**0.00024 J**	0.005 U	0.005 U	**0.00034 J**	**0.0013 J**	**0.0011**	**0.001**	0.005 U	**0.00052**
Fluoride	4	**0.41 J+**	**0.1**	**0.31 J+**	**0.31 J+**	**0.23 J**	0.17 U	**0.14 J**	**0.14 J**	0.17 U	**0.16 J**
Lead, Total	0.015	0.001 U	**0.00013 J**	0.01 U	0.01 U	0.001 U	0.01 U	0.001 U	0.001 U	0.01 U	**0.00016 J**
Lithium, Total	0.04	0.0067 U	0.005 U	0.05 U	0.05 U	0.05 U	**0.034 J+**	**0.042**	**0.04**	0.05 U	**0.034 J**
Mercury, Total	0.002	0.0002 U	-	0.0002 U	0.0002 U	-	0.0002 U	-	-	0.0002 U	-
Molybdenum, Total	0.1	**0.0014 J**	**0.0013 J**	**0.059**	**0.053**	**0.058**	**0.0067 J**	**0.0064**	**0.0061**	0.05 U	0.005 U
Selenium, Total	0.05	0.005 U	0.005 U	0.05 U	0.05 U	0.005 U	0.05 U	0.005 U	0.005 U	0.05 U	0.005 U
Thallium, Total	0.002	0.001 U	0.001 U	0.01 U	0.01 U	0.001 U	0.01 U	0.001 U	0.001 U	0.01 U	0.001 U
Radiological (pCi/L)											
Radium-226	NA	0.0797 UJ ± 0.0791	0.132 U ± 0.0937	0.0606 UJ ± 0.0578	0.153 U ± 0.196	0.0430 U ± 0.0752	0.0195 UJ ± 0.0643	0.116 U ± 0.0914	**0.129 ± 0.0881**	-0.0773 U ± 0.198	0.104 U ± 0.0828
Radium-228	NA	0.412 UJ ± 0.361	0.251 U ± 0.244	-0.0634 UJ ± 0.257	0.254 U ± 0.27	**0.468 ± 0.264**	0.237 UJ ± 0.234	-0.0619 U ± 0.234	0.166 U ± 0.233	0.307 U ± 0.26	0.0730 U ± 0.233
Radium-226 & 228	5	0.492 UJ ± 0.37	0.382 U ± 0.261	0.0606 UJ ± 0.263	0.406 U ± 0.334	**0.511 ± 0.275**	0.257 UJ ± 0.243	0.0546 U ± 0.251	0.294 U ± 0.249	0.307 U ± 0.327	0.177 U ± 0.247
Field Parameters											
Temperature (Deg C)	NA	**15.77**	**14.22**	**16.6**	**16.6**	**16.67**	**15.42**	**14.33**	**14.33**	**15.25**	**13.9**
Dissolved Oxygen, Field (mg/L)	NA	**6.71**	**5.74**	**0.13**	**0.13**	**0.25**	**2.86**	**1.08**	**1.08**	**8.7**	**6.78**
Conductivity, Field (mS/cm)	NA	**1.4896**	**1.6039**	**5.9903**	**5.9903**	**6.2118**	**2.9476**	**3.154**	**3.154**	**5.2145**	**5.6246**
ORP, Field (mv)	NA	**25.7**	**55.9**	**73.3**	**73.3**	**87.8**	**-2.9**	**56.5**	**56.5**	**66.1**	**85.3**
Turbidity, Field (NTU)	NA	**1.67**	**8.3**	**0**	**0**	**0**	**4.05**	**1.52**	**1.52**	**6.41**	**25.87**
pH, Field (SU)	NA	**7.12**	**6.73**	**7.15**	**7.15**	**7**	**7.19**	**6.86**	**6.86**	**6.54**	**6.37**

ABBREVIATIONS AND NOTES:

CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
SU: standard units.
USEPA: United States Environmental Protection Agency.
Results in **bold** are detected.

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257.
https://www.epa.gov/coalash/coal-ash-rule

TABLE II
SUMMARY OF GROUNDWATER QUALITY DATA
ASH POND - MAY THROUGH OCTOBER 2019
A.B. BROWN GENERATION STATION
MOUNT VERNON, INDIANA

Location Group	Action Level	Downgradient						
Location Name	Maximum	CCR-AP-8	CCR-AP-8	CCR-AP-9	CCR-AP-9	CCR-AP-9	CCR-AP-10	CCR-AP-10
Sample Name	Contaminant	CCR-AP-8-20190617	CCR-AP-8-20191021	CCR-AP-9-20190617	ND DUPLICATE-20190	CCR-AP-9-20191021	CCR-AP-10-20190617	CCR-AP-10-20191018
Sample Date	Level/ Regional	06/17/2019	10/21/2019	06/17/2019	06/17/2019	10/21/2019	06/17/2019	10/18/2019
	Screening	180-91430-3		180-91430-4	180-91430-6		180-91430-5	
Lab Sample ID	Levels	1906640-4	180-97725-2	1906640-5	1906640-7	180-97725-3	1906640-6	180-97535-9
Detection Monitoring - EPA Appendix III Constituents (mg/L)								
Boron, Total	NA	0.12 U	**0.2**	**9.5**	**9**	**7.9**	**7.5**	**7.4**
Calcium, Total	NA	**140**	**190**	**470**	**490**	**440**	**230**	**220**
Chloride	NA	**41**	**52**	**870**	**820**	**720**	**250**	**220**
Fluoride	4	**0.29 J+**	**0.3**	**0.33 J+**	**0.33 J+**	**0.52 J**	**0.45 J+**	**0.24 J**
Sulfate	NA	**210**	**500**	**4400**	**4200**	**4800**	**2000**	**2000**
Total Dissolved Solids (TDS)	NA	**810**	**1200**	**6900**	**7300**	**6600**	**3400**	**3300**
pH (lab) (SU)	NA	**7.2 J**	**7.2 HF**	**6.8 J**	**6.8 J**	**6.8 HF**	**7.4 J**	**7.4 HF**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)								
Antimony, Total	0.006	0.002 U	0.002 U	0.02 U	0.02 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	**0.0013**	**0.001**	**0.023**	**0.023**	**0.022**	**0.0011**	**0.00054 J**
Barium, Total	2	**0.066**	**0.1**	**0.086 J**	**0.074 J**	**0.088**	**0.019**	**0.016 B**
Beryllium, Total	0.004	0.001 U	**0.00024 J^**	0.01 U	0.01 U	0.001 U^	**0.00021 J**	0.001 U
Cadmium, Total	0.005	0.001 U	**0.00015 J**	0.01 U	0.01 U	0.001 U	0.001 U	0.001 U
Chromium, Total	0.1	0.0039 U	**0.0022**	0.02 U	0.02 U	**0.0027**	0.0038 U	0.002 U
Cobalt, Total	0.006	**0.0046**	**0.0018**	0.005 U	0.005 U	**0.00081**	**0.0016**	**0.0011**
Fluoride	4	**0.29 J+**	**0.3**	**0.33 J+**	**0.33 J+**	**0.52 J**	**0.45 J+**	**0.24 J**
Lead, Total	0.015	0.001 U	**0.00018 J**	0.01 U	0.01 U	**0.00065 J**	0.001 U	**0.00031 J**
Lithium, Total	0.04	**0.011**	**0.013**	0.05 U	0.05 U	**0.032**	**0.0059**	0.025 U
Mercury, Total	0.002	0.0002 U	-	0.0002 U	0.0002 U	-	0.0002 U	-
Molybdenum, Total	0.1	**0.001 J**	**0.001 J**	**0.021 J**	**0.021 J**	**0.014**	**0.0039 J**	**0.0028 J**
Selenium, Total	0.05	0.005 U	0.005 U	0.05 U	0.05 U	**0.0015 J**	**0.015**	**0.014**
Thallium, Total	0.002	0.001 U	**0.00029 J**	0.01 U	0.01 U	**0.00016 J**	**0.00013 J**	0.001 U
Radiological (pCi/L)								
Radium-226	NA	**0.35 ± 0.23**	0.104 U ± 0.0875	**0.58 ± 0.38**	**0.61 ± 0.38**	**0.260 ± 0.104**	0.32 U ± 0.27	0.0667 U ± 0.0737
Radium-228	NA	0.67 U ± 0.44	0.127 U ± 0.252	**0.76 ± 0.41**	0.63 U ± 0.38	**0.452 ± 0.294**	0.66 U ± 0.38	**0.490 ± 0.241**
Radium-226 & 228	5	**1.02 J ± 0.496**	0.231 U ± 0.267	**1.34 ± 0.559**	**1.24 J ± 0.537**	**0.713 ± 0.312**	**0.98 ± 0.466**	**0.556 ± 0.252**
Field Parameters								
Temperature (Deg C)	NA	**17.86**	**18.78**	**20.57**	**20.57**	**18.87**	**16.26**	**14.62**
Dissolved Oxygen, Field (mg/L)	NA	**0.35**	**0.76**	**0.01**	**0.01**	**0.15**	**0.43**	**1.79**
Conductivity, Field (mS/cm)	NA	**1.0861**	**1.5669**	**9.4045**	**9.4045**	**8.5938**	**4.6168**	**4.6003**
ORP, Field (mv)	NA	**12.4**	**-7.8**	**-165.1**	**-165.1**	**-82.2**	**11.5**	**120.8**
Turbidity, Field (NTU)	NA	**10.63**	**1.29**	**49.53**	**49.53**	**29.83**	**97.33**	**177.4**
pH, Field (SU)	NA	**7.38**	**6.85**	**7.66**	**7.66**	**7.03**	**7.85**	**7.09**

ABBREVIATIONS AND NOTES:

CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
SU: standard units.
USEPA: United States Environmental Protection Agency.
Results in **bold** are detected.

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257.
https://www.epa.gov/coalash/coal-ash-rule

www.haleyaldrich.com

ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT

ASH POND
A.B. BROWN GENERATING STATION
POSEY COUNTY, INDIANA

by
Haley & Aldrich, Inc.
Greenville, South Carolina

for
Southern Indiana Gas and Electric Company
Evansville, Indiana

File No. 129420
January 2020

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1. 40 CFR § 257.90 Applicability

1.1 40 CFR § 257.90(a)

Except as provided for in § 257.100 for inactive CCR surface impoundments, all CCR landfills, CCR surface impoundments, and lateral expansions of CCR units are subject to the groundwater monitoring and corrective action requirements under § 257.90 through § 257.98.

The Ash Pond at A.B. Brown Generating Station (ABB) is subject to the groundwater monitoring and corrective action requirements described under Code of Federal Regulations Title 40 (40 CFR) § 257.90 through § 257.98 (Rule). This document addresses the requirement for the Owner/Operator to prepare an Annual Groundwater Monitoring and Corrective Action Report per § 257.90(e).

1.2 40 CFR § 257.90(e) - SUMMARY

Annual groundwater monitoring and corrective action report. For existing CCR landfills and existing CCR surface impoundments, no later than January 31, 2018, and annually thereafter, the owner or operator must prepare an annual groundwater monitoring and corrective action report. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, the owner or operator must prepare the initial annual groundwater monitoring and corrective action report no later than January 31 of the year following the calendar year a groundwater monitoring system has been established for such CCR unit as required by this subpart, and annually thereafter. For the preceding calendar year, the annual report must document the status of the groundwater monitoring and corrective action program for the CCR unit, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year. For purposes of this section, the owner or operator has prepared the annual report when the report is placed in the facility's operating record as required by § 257.105(h)(1).

This Annual Groundwater Monitoring and Corrective Action Report documents the activities completed in 2019 for the Ash Pond as required by the Rule. Groundwater sampling and analysis was conducted per the requirements described in § 257.93, and the status of the groundwater monitoring program described in § 257.95 is provided in this report.

1.2.1 Status of the Groundwater Monitoring Program

As provided in the notification on 15 January 2018 statistically significant increases (SSI) of Appendix III constituents were identified downgradient of the Ash Pond. An evaluation of alternate sources was conducted; however, a successful alternate source demonstration (ASD) was not achieved at that time. As a result, an Assessment Monitoring program was initiated as required by § 257.94(e)(2). The notification was placed in the facility's operating record as required by 257.105(h)(5). Annual and semi-annual groundwater samples were collected as outlined in § 257.95(b) and 257.95(d)(1) and groundwater protection standards were established as required by § 257.95(d)(2). Statistical analysis was completed in January 2019 as described in § 257.93(h)(2) and statistically significant levels (SSL) of Appendix IV constituents (lithium and molybdenum) were identified downgradient of the Ash Pond. An alternate source evaluation was conducted and was not successful in identifying a source other than the CCR unit. As a result, nature and extent and assessment of corrective measures was initiated as defined in § 257.96. A 60-day extension to complete the assessment of corrective measures (Appendix A) was

required and certified by a professional engineer as required by 257.96(a) resulting in completion of the Assessment of Corrective Measures in September 2019.

1.2.2 Key Actions Completed

The following key actions were completed in 2019:

- Completed a statistical analysis of assessment monitoring results to evaluate potential SSLs;
- Prepared 2018 Annual Report including:
  - The Annual Report was placed in the facility's operating record pursuant to § 257.105(h)(1);
  - Pursuant to § 257.106(h)(1), the notification was sent to the relevant State Director and/or Tribal authority within 30 days of the Annual Report being placed in the facility's operating record [§ 257.106(d)];
  - Pursuant to § 257.107(h)(1), the Annual Report was posted to the CCR Website within 30 days of the Annual Report being placed in the facility's operating record [§ 257.107(d) and 257.107(h)(1)];
- Evaluated the nature and extent of Appendix IV SSLs as required by § 257.95(g)(1);
- Collected and analyzed two rounds of groundwater samples in accordance with § 257.95
- Initiated and completed an assessment of corrective measures in accordance with § 257.96;
  - The 90-day deadline to complete the assessment of corrective measures was extended an additional 60-days in accordance with § 257.96(a). (Appendix A)
  - The assessment of corrective measures was placed in the facility's operating record in accordance with § 257.96(d).

1.2.3 Problems Encountered

No problems such as damaged wells, issues with sample collection or lack of sampling, and problems with analytical analysis were encountered at the ABB Ash Pond in 2019.

1.2.4 Actions to Resolve Problems

Actions to resolve problems were not required.

1.2.5 Project Key Activities for Upcoming Year

Key activities to be completed in 2020 include the following:

- Further refine the characterization of the nature and extent of lithium and molybdenum in groundwater downgradient of the Ash Pond.
- Continue semiannual groundwater monitoring in accordance with § 257.95.
- Complete statistical analysis of the semiannual groundwater sampling results as required by § 257.93(h)(2).
- Hold a public meeting with interested and affected parties in accordance with § 257.96(e) to discuss the results of the corrective measures assessment at least 30 days prior to the selection of remedy.
- As soon as feasible following the public meeting select a remedy that, meets the standards outlined in § 257.97(b).

- As part of the selected remedy SIGECO will develop a schedule for implementing and completing remedial activities as defined in § 257.97(d).
- Prepare semiannual and annual progress reports, , describing the progress in selecting and designing the remedy as outlined in § 257.97(a).

1.3 40 CFR § 257.90(e) - INFORMATION

At a minimum, the annual groundwater monitoring and corrective action report must contain the following information, to the extent available:

1.3.1 40 CFR § 257.90(e)(1)

A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;

As required by § 257.90(e)(1), a map showing the locations of the Ash Pond and associated upgradient, nature and extent and downgradient wells is presented as Figure 1.

1.3.2 40 CFR § 257.90(e)(2)

Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;

To characterize the horizontal and vertical nature and extent of SSLs at the Ash Pond, five new monitoring wells were installed in the uppermost aquifer downgradient of the Ash Pond. The new monitoring wells, identified as CCR-AP-2I, CCR-AP-3I, CCR-AP-8, CCR-AP-9 and CCR-AP-10 as shown on Figure 1, were completed in the intermediate zone within the uppermost aquifer. Location and construction details are provided in Table I.

1.3.3 40 CFR § 257.90(e)(3)

In addition to all the monitoring data obtained under § 257.90 through § 257.98, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;

In accordance with § 257.95(b) and § 257.95(d)(1), two independent samples from each background and downgradient monitoring well were collected and analyzed. A summary table including the sample names, dates of sample collection, reason for sample collection (detection or assessment), and monitoring data obtained for the groundwater monitoring program for the Ash Pond is presented in Table II of this report.

1.3.4 40 CFR § 257.90(e)(4)

A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels); and

As required by § 257.95(d) through § 257.95(g) a statistical analysis of the Appendix IV constituents was completed by 15 January 2019. This statistical analysis determined that statistically significant levels of lithium and molybdenum were present downgradient of the Ash Pond. An evaluation of alternate

sources was initiated as required by § 257.94(e)(2). The Assessment Monitoring program was established to meet the requirements of 40 CFR § 257.95. Nature and extent and assessment of corrective measures was initiated as required by § 257.95 and § 257.96. Semiannual sampling will continue in 2020.

1.3.5 40 CFR § 257.90(e)(5)

Other information required to be included in the annual report as specified in § 257.90 through § 257.98.

Other information including development of groundwater protection standards, recording groundwater monitoring results in the operating record, and an evaluation of alternate sources is discussed in preceding sections.

TABLES

TABLE I

GROUNDWATER MONITORING WELL LOCATION AND CONSTRUCTION DETAILS

A.B. BROWN GENERATING STATION - ASH POND

MOUNT VERNON, INDIANA

Well	CCR Unit	Date Installed	Easting	Northing	Top of Pad Elevation (ft msl)	Top of Riser Elevation (ft msl)	Surface Grout (ft bgs)	Bentonite (ft bgs)	Sand Pack (ft bgs)	Screen Zone (ft bgs)	Screen Length (ft)	Well Radius (in)	Status
CCR-AP-1R	Ash Pond	July 2016	2773560.71	968260.82	464.70	467.57	0.0 - 23.0	23.0 - 25.0	25.0 - 37.0	27.00 - 37.00	10	2	Active
CCR-AP-2R	Ash Pond	July 2016	2771922.52	969079.16	465.40	468.13	0.0 - 39.0	39.0 - 41.0	41.0 - 53.3	43.30 - 53.30	10	2	Active
CCR-AP-2I	Ash Pond	January 2019	**319167.75	**148852.17	465.82	468.88	0.0 - 77.0	77.0 - 79.0	79.0 - 93.3	83.00 - 93.00	10	2	Available
CCR-AP-3R	Ash Pond	July 2016	2771404.27	966865.12	450.10	449.13	0.0 - 33.0	33.0 - 35.0	35.0 - 47.0	37.00 - 47.00	10	2	Active
CCR-AP-3I	Ash Pond	January 2019	**318653.79	**146643.51	450.35	450.35	0.0 - 63.5	63.5 - 67.5	67.5 - 77.8	67.50 - 77.50	10	2	Available
CCR-AP-4R	Ash Pond	July 2016	2772827.01	966741.47	472.80	475.38	0.0 - 34.0	34.0 - 36.0	36.0 - 48.0	38.00 - 48.00	10	2	Active
CCR-AP-5	Ash Pond	March 2016	2771019.70	968166.03	451.00	453.77	0.0 - 31.0	31.0 - 33.0	33.0 - 45.0	35.00 - 45.00	10	2	Active
CCR-AP-6	Ash Pond	March 2016	2771626.75	969932.76	458.90	461.57	0.0 - 25.0	25.0 - 27.0	27.0 - 39.0	29.00 - 39.00	10	2	Active
CCR-AP-7R	Ash Pond	July 2016	2773501.63	970758.70	486.00	488.57	0.0 - 39.5	39.5 - 41.5	41.5 - 53.5	43.50 - 53.50	10	2	Active
CCR-AP-8	Ash Pond	January 2019	**317746.04	**149793.38	413.97	417.17	0.0 - 2.0	2.0 - 4.2	4.2 - 16.5	6.20 - 16.20	10	2	Available
CCR-AP-9	Ash Pond	January 2019	**316940.58	**147282.61	392.51	392.51	0.0 - 19.5	19.5 - 22.5	22.5 - 35.5	25.20 - 35.20	10	2	Available
CCR-AP-10	Ash Pond	January 2019	**319549.96	**146467.58	471.46	474.34	0.0 - 29.2	29.2 - 31.2	31.2 - 43.5	33.20 - 43.20	10	2	Available
CCR-BK-1R	Background	March 2016	2770919.08	974083.40	480.10	483.39	0.0 - 50.0	50.0 - 52.0	52.0 - 64.0	54.00 - 64.00	10	2	Active
CCR-BK-2	Background	March 2016	2769728.14	972854.33	427.50	430.60	0.0 - 11.5	11.5 - 13.5	13.5 - 25.5	15.50 - 25.50	10	2	Active
APPW-1I	Ash Pond	November 2018	-	-	-	-	+	12.0 - 14.0	14.0 - 20.0	15.00 - 20.00	5	2	Available
APPW-1D	Ash Pond	November 2018	-	-	-	-	+	24.0 - 28.0	28.0 - 29.0	29.00 - 34.00	5	2	Available
APPW-2S	Ash Pond	November 2018	-	-	-	-	+	10.0 - 12.0	13.0 - 19.0	14.00 - 19.00	5	2	Available
APPW-2I	Ash Pond	November 2018	-	-	-	-	+	26.0 - 28.0	28.0 - 34.0	29.00 - 34.00	5	2	Available
APPW-2D	Ash Pond	November 2018	-	-	-	-	+	34.0 - 38.0	38.0 - 44.0	39.00 - 44.00	5	2	Available
APPW-3	Ash Pond	November 2018	-	-	-	-	+	16.0 - 18.0	18.0 - 29.0	19.00 - 29.00	10	2	Available
APPW-4S	Ash Pond	November 2018	-	-	-	-	+	12.0 - 14.0	14.0 - 20.0	15.00 - 20.00	5	2	Available
APPW-4I	Ash Pond	November 2018	-	-	-	-	+	34.0 - 36.0	36.0 - 42.0	37.00 - 42.00	5	2	Available
APPW-4D	Ash Pond	November 2018	-	-	-	-	+	42.0 - 47.0	47.0 - 54.0	49.00 - 54.00	5	2	Available
APPW-5I	Ash Pond	November 2018	-	-	-	-	+	10.0 - 12.0	12.0 - 18.0	13.00 - 18.00	5	2	Available
APPW-5D	Ash Pond	November 2018	-	-	-	-	+	17.0 - 23.0	23.0 - 29.0	24.00 - 29.00	5	2	Available

Notes:

bgs = below ground surface

- = not been surveyed

+ = Natural collaspe

ft = feet

in = inches

msl = mean sea level

Datum of Elevations in NAVD 88

**Elevation of wells is based on IN State Plane (US Foot) West NAD27

TABLE II
SUMMARY OF GROUNDWATER QUALITY DATA
ASH POND - MAY THROUGH OCTOBER 2019
A.B. BROWN GENERATION STATION
MOUNT VERNON, INDIANA

Location Group	Action Level	Background			
Location Name	Maximum	CCR-BK-1R	CCR-BK-1R	CCR-BK-2	CCR-BK-2
Sample Name	Contaminant	CCR-BK-1R-20190521	CCR-BK-1R-20191014	CCR-BK-2-20190521	CCR-BK-2-20191014
Sample Date	Level/ Regional	05/21/2019	10/14/2019	05/21/2019	10/14/2019
Lab Sample ID	Screening Levels	180-90467-7	180-97392-1	180-90467-8	180-97392-2
Detection Monitoring - EPA Appendix III Constituents (mg/L)					
Boron, Total	NA	0.08 U	**0.056 J**	**0.58**	**0.051 J**
Calcium, Total	NA	**37**	**34**	**71**	**35**
Chloride	NA	**2.3**	**2.4**	**4.6**	**17**
Fluoride	4	0.23 U	**0.2**	0.12 U	**0.07 J**
Sulfate	NA	**23**	**22**	**60**	**20**
Total Dissolved Solids (TDS)	NA	**230**	**210**	**440**	**230**
pH (lab) (SU)	NA	**7.4 J**	**7.2 HF**	**7.5 J**	**7 HF**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)					
Antimony, Total	0.006	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	**0.00034 J**	**0.00036 J**	**0.00041 J**	0.001 U
Barium, Total	2	**0.027 J**	**0.036**	**0.045 J-**	**0.032**
Beryllium, Total	0.004	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.005	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	0.1	0.002 U	0.002 U	**0.0087**	0.002 U
Cobalt, Total	0.006	**0.00012 J**	**0.00017 J**	**0.0005**	**0.00011 J**
Fluoride	4	0.23 U	**0.2**	0.12 U	**0.07 J**
Lead, Total	0.015	**0.00016 J**	**0.00023 J**	0.001 U	0.001 U
Lithium, Total	0.04	0.0065 U	0.005 U	0.0095 U	0.005 U
Mercury, Total	0.002	0.0002 U	-	0.0002 U	-
Molybdenum, Total	0.1	**0.00063 J**	**0.00075 J**	**0.0025 J**	0.005 U
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.002	0.001 U	0.001 U	0.001 U	0.001 U
Radiological (pCi/L)					
Radium-226	NA	**0.336 J ± 0.108**	0.0729 U ± 0.182	-0.0109 U ± 0.184	-0.0644 U ± 0.0992
Radium-228	NA	-0.0733 UJ ± 0.235	0.147 U ± 0.233	0.0733 U ± 0.246	0.323 U ± 0.292
Radium-226 & 228	5	0.336 UJ ± 0.259	0.220 U ± 0.296	0.0733 U ± 0.307	0.259 U ± 0.308
Field Parameters					
Temperature (Deg C)	NA	**15.78**	**15.72**	**14.47**	**16.04**
Dissolved Oxygen, Field (mg/L)	NA	**5.82**	**5.98**	**0.48**	**0.51**
Conductivity, Field (mS/cm)	NA	**0.34186**	**0.3542**	**0.72035**	**0.38427**
ORP, Field (mv)	NA	**43.3**	**104.9**	**47.9**	**72.1**
Turbidity, Field (NTU)	NA	**0.97**	**9.8**	**12.88**	**11.89**
pH, Field (SU)	NA	**7**	**6.34**	**7.2**	**6.54**

ABBREVIATIONS AND NOTES:

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mg/L: milligram per liter.
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Results in **bold** are detected.

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SUMMARY OF GROUNDWATER QUALITY DATA
ASH POND - MAY THROUGH OCTOBER 2019
A.B. BROWN GENERATION STATION
MOUNT VERNON, INDIANA

Location Group	Action Level	Downgradient									
Location Name	Maximum	CCR-AP-1R	CCR-AP-1R	CCR-AP-2I	CCR-AP-2I	CCR-AP-2R	CCR-AP-2R	CCR-AP-3I	CCR-AP-3I	CCR-AP-3R	CCR-AP-3R
Sample Name	Contaminant	CCR-AP-1R-20190524	CCR-AP-1R-20191016	CCR-AP-2I-20190614	CCR-AP-2I-20191021	CCR-AP-2R-20190524	CCR-AP-2R-20191017	CCR-AP-3I-20190614	CCR-AP-3I-20191018	CCR-AP-3R-20190522	CCR-AP-3R-20191017
Sample Date	Level/ Regional	05/24/2019	10/16/2019	06/14/2019	10/21/2019	05/24/2019	10/17/2019	06/14/2019	10/18/2019	05/22/2019	10/17/2019
	Screening			180-91430-1				180-91430-2			
Lab Sample ID	Levels	180-90606-4	180-97535-1	1906640-1	180-97725-1	180-90606-5	180-97535-2	1906640-3	180-97535-4	180-90467-9	180-97535-3
Detection Monitoring - EPA Appendix III Constituents (mg/L)											
Boron, Total	NA	**4.5**	**4.6**	**2.1**	**2.2**	**11**	**11**	**2.2**	**2.3**	**11**	**14**
Calcium, Total	NA	**68**	**61**	**19**	**13 F1**	**300**	**280**	**16**	**18**	**260**	**280**
Chloride	NA	**69**	**55**	**110**	**97**	**530**	**440**	**150**	**140**	**620**	**670**
Fluoride	4	**0.57 J+**	**0.37**	**0.83**	**1.1**	**0.47 J+**	**0.3 J**	**1.1**	**1.2**	**1.3 J+**	**0.79**
Sulfate	NA	**530**	**410**	**23**	**7.6**	**2600**	**2500**	**16**	**14**	**3100**	**3700**
Total Dissolved Solids (TDS)	NA	**1500**	**1300**	**710**	**710**	**4100**	**4400**	**700**	**720**	**5800**	**5100**
pH (lab) (SU)	NA	**7.5 J**	**7.3 HF**	**7.6 J**	**8 HF**	**7.3 J**	**7.2 HF**	**8.1 J**	**8.1 HF**	**7.5 J**	**7.5 HF**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)											
Antimony, Total	0.006	0.002 U	0.002 U	**0.00053 J**	**0.00052 J**	0.002 U	0.002 U	**0.00045 J**	0.002 U	0.02 U	0.002 U
Arsenic, Total	0.01	**0.00047 J**	**0.00038 J**	**0.0022**	**0.0019**	**0.00053 J**	**0.00058 J**	**0.0018**	**0.0016**	0.01 U	**0.00035 J**
Barium, Total	2	**0.025 J+**	**0.027 B**	**0.11**	**0.1**	**0.042 J+**	**0.023 B**	**0.17**	**0.17 B**	**0.16 J-**	**0.016 B**
Beryllium, Total	0.004	0.001 U	0.001 U	0.001 U	**0.00027 J^**	0.001 U	0.001 U	**0.00026 J**	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.005	0.001 U	0.001 U	0.001 U	**0.00023 J**	**0.00059 J**	**0.00039 J**	0.001 U	0.001 U	0.01 U	**0.00025 J**
Chromium, Total	0.1	0.002 U	0.002 U	0.004 U	**0.0027**	0.002 U	0.002 U	0.0046 U	0.002 U	0.02 U	0.002 U
Cobalt, Total	0.006	**0.00021 J**	**0.0002 J**	0.0005 U	**0.0004 J**	**0.0026**	**0.0026**	**0.0013**	**0.00059**	**0.0017 J**	**0.0019**
Fluoride	4	**0.57 J+**	**0.37**	**0.83**	**1.1**	**0.47 J+**	**0.3 J**	**1.1**	**1.2**	**1.3 J+**	**0.79**
Lead, Total	0.015	0.001 U	0.001 U	0.001 U	**0.00047 J**	**0.00016 J**	**0.00015 J**	0.0011 U	**0.00072 J**	0.01 U	**0.00013 J**
Lithium, Total	0.04	**0.0036 J**	0.025 U	**0.024**	**0.023**	**0.033**	**0.05**	**0.025**	**0.026**	**0.062**	**0.1**
Mercury, Total	0.002	0.0002 U	-	0.0002 U	-	0.0002 U	-	0.0002 U	-	0.0002 U	-
Molybdenum, Total	0.1	**0.0042 J**	**0.0047 J**	**0.0092**	**0.0038 J**	**1.9**	**1.7**	**0.0061**	**0.0043 J**	**0.89**	**0.9**
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.05 U	**0.0074**
Thallium, Total	0.002	0.001 U	0.001 U	0.001 U	**0.00048 J**	0.001 U	0.001 U	**0.00013 J**	0.001 U	0.01 U	0.001 U
Radiological (pCi/L)											
Radium-226	NA	0.0879 U ± 0.0697	0.0796 U ± 0.0757	0.07 U ± 0.11	**0.349 ± 0.12**	**0.264 ± 0.102**	-0.0236 U ± 0.0528	**0.43 ± 0.25**	**0.397 ± 0.135**	**0.283 J ± 0.0999**	-0.0190 U ± 0.0631
Radium-228	NA	-0.0354 U ± 0.241	0.0814 U ± 0.239	0.53 U ± 0.37	0.237 U ± 0.249	**0.448 ± 0.291**	**0.518 ± 0.269**	0.56 U ± 0.39	0.357 U ± 0.251	0.163 UJ ± 0.283	**0.437 ± 0.253**
Radium-226 & 228	5	0.0879 U ± 0.251	0.161 U ± 0.251	0.60 U ± 0.386	**0.587 ± 0.276**	**0.713 ± 0.308**	**0.494 ± 0.274**	**0.99 J ± 0.463**	**0.753 ± 0.285**	0.447 UJ ± 0.3	**0.418 ± 0.261**
Field Parameters											
Temperature (Deg C)	NA	**16.16**	**15.44**	**19.55**	**17.3**	**18.73**	**16.89**	**18.31**	**18.55**	**18.78**	**18.29**
Dissolved Oxygen, Field (mg/L)	NA	**0.03**	**0.13**	**1.62**	**2.77**	**0.66**	**0.28**	**0.09**	**0.46**	**0.08**	**0.21**
Conductivity, Field (mS/cm)	NA	**2.0135**	**1.9694**	**1.264**	**1.2276**	**5.577**	**5.6187**	**1.2331**	**1.2989**	**7.4198**	**8.2589**
ORP, Field (mv)	NA	**-8.6**	**32.2**	**-16.2**	**99.2**	**90.9**	**111.1**	**-114.6**	**89**	**85.5**	**113.4**
Turbidity, Field (NTU)	NA	**0**	**3.77**	**17.09**	**14.99**	**2.19**	**1.83**	**141.52**	**49.94**	**0**	**0.49**
pH, Field (SU)	NA	**7.21**	**6.94**	**7.71**	**7.71**	**7.05**	**6.83**	**8.23**	**7.82**	**7.26**	**7.23**

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SUMMARY OF GROUNDWATER QUALITY DATA
ASH POND - MAY THROUGH OCTOBER 2019
A.B. BROWN GENERATION STATION
MOUNT VERNON, INDIANA

Location Group	Action Level	Downgradient									
Location Name	Maximum	CCR-AP-4R	CCR-AP-4R	CCR-AP-5	CCR-AP-5	CCR-AP-5	CCR-AP-6	CCR-AP-6	CCR-AP-6	CCR-AP-7R	CCR-AP-7R
Sample Name	Contaminant	CCR-AP-4R-20190522	CCR-AP-4R-20191017	CCR-AP-5-20190522	ND DUPLICATE 2-20190	CCR-AP-5-20191017	CCR-AP-6-20190521	CCR-AP-6-20191016	ND DUPLICATE 1-20191	CCR-AP-7R-20190521	CCR-AP-7R-20191016
Sample Date	Level/ Regional	05/22/2019	10/17/2019	05/22/2019	05/22/2019	10/17/2019	05/21/2019	10/16/2019	10/16/2019	05/21/2019	10/16/2019
Lab Sample ID	Screening Levels	180-90467-10	180-97535-5	180-90467-11	180-90467-17	180-97535-6	180-90467-12	180-97535-7	180-97535-10	180-90467-13	180-97535-8
Detection Monitoring - EPA Appendix III Constituents (mg/L)											
Boron, Total	NA	**0.045 J**	**0.14**	**11**	**11**	**12**	**2.9**	**3.2**	**3**	**5.6**	**3.6**
Calcium, Total	NA	**190**	**180**	**410**	**420**	**390**	**320**	**300**	**310**	**410**	**370**
Chloride	NA	**40**	**41**	**410**	**390**	**380**	**230**	**220**	**210**	**500**	**250**
Fluoride	4	**0.41 J+**	**0.1**	**0.31 J+**	**0.31 J+**	**0.23 J**	0.17 U	**0.14 J**	**0.14 J**	0.17 U	**0.16 J**
Sulfate	NA	**99**	**94**	**3100**	**2900**	**2900**	**1200**	**1200**	**1200**	**2600**	**3100**
Total Dissolved Solids (TDS)	NA	**950**	**940**	**5000**	**4900**	**4800**	**2400**	**2400**	**2300**	**4200**	**4500**
pH (lab) (SU)	NA	**7.4 J**	**7.3 HF**	**7.4 J**	**7.4 J**	**7.3 HF**	**7.5 J**	**7.3 HF**	**7.2 HF**	**6.8 J**	**6.7 HF**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)											
Antimony, Total	0.006	0.002 U	0.002 U	0.02 U	0.02 U	0.002 U	0.02 U	0.002 U	0.002 U	0.02 U	0.002 U
Arsenic, Total	0.01	**0.00038 J**	0.001 U	0.01 U	0.01 U	0.001 U	0.01 U	**0.00049 J**	**0.00043 J**	0.01 U	**0.00046 J**
Barium, Total	2	**0.094 J-**	**0.1 B**	**0.018 J**	**0.02 J**	**0.019 B**	0.1 UJ	**0.014 B**	**0.015 B**	**0.029 J**	**0.028 B**
Beryllium, Total	0.004	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.005	0.001 U	0.001 U	0.01 U	0.01 U	0.001 U	0.01 U	0.001 U	0.001 U	0.01 U	0.001 U
Chromium, Total	0.1	**0.0035**	**0.0025**	0.02 U	0.02 U	0.002 U	0.02 U	0.002 U	0.002 U	0.02 U	0.002 U
Cobalt, Total	0.006	**0.00017 J**	**0.00024 J**	0.005 U	0.005 U	**0.00034 J**	**0.0013 J**	**0.0011**	**0.001**	0.005 U	**0.00052**
Fluoride	4	**0.41 J+**	**0.1**	**0.31 J+**	**0.31 J+**	**0.23 J**	0.17 U	**0.14 J**	**0.14 J**	0.17 U	**0.16 J**
Lead, Total	0.015	0.001 U	**0.00013 J**	0.01 U	0.01 U	0.001 U	0.01 U	0.001 U	0.001 U	0.01 U	**0.00016 J**
Lithium, Total	0.04	0.0067 U	0.005 U	0.05 U	0.05 U	0.05 U	**0.034 J+**	**0.042**	**0.04**	0.05 U	**0.034 J**
Mercury, Total	0.002	0.0002 U	-	0.0002 U	0.0002 U	-	0.0002 U	-	-	0.0002 U	-
Molybdenum, Total	0.1	**0.0014 J**	**0.0013 J**	**0.059**	**0.053**	**0.058**	**0.0067 J**	**0.0064**	**0.0061**	0.05 U	0.005 U
Selenium, Total	0.05	0.005 U	0.005 U	0.05 U	0.05 U	0.005 U	0.05 U	0.005 U	0.005 U	0.05 U	0.005 U
Thallium, Total	0.002	0.001 U	0.001 U	0.01 U	0.01 U	0.001 U	0.01 U	0.001 U	0.001 U	0.01 U	0.001 U
Radiological (pCi/L)											
Radium-226	NA	0.0797 UJ ± 0.0791	0.132 U ± 0.0937	0.0606 UJ ± 0.0578	0.153 U ± 0.196	0.0430 U ± 0.0752	0.0195 UJ ± 0.0643	0.116 U ± 0.0914	**0.129 ± 0.0881**	-0.0773 U ± 0.198	0.104 U ± 0.0828
Radium-228	NA	0.412 UJ ± 0.361	0.251 U ± 0.244	-0.0634 UJ ± 0.257	0.254 U ± 0.27	**0.468 ± 0.264**	0.237 UJ ± 0.234	-0.0619 U ± 0.234	0.166 U ± 0.233	0.307 U ± 0.26	0.0730 U ± 0.233
Radium-226 & 228	5	0.492 UJ ± 0.37	0.382 U ± 0.261	0.0606 UJ ± 0.263	0.406 U ± 0.334	**0.511 ± 0.275**	0.257 UJ ± 0.243	0.0546 U ± 0.251	0.294 U ± 0.249	0.307 U ± 0.327	0.177 U ± 0.247
Field Parameters											
Temperature (Deg C)	NA	**15.77**	**14.22**	**16.6**	**16.6**	**16.67**	**15.42**	**14.33**	**14.33**	**15.25**	**13.9**
Dissolved Oxygen, Field (mg/L)	NA	**6.71**	**5.74**	**0.13**	**0.13**	**0.25**	**2.86**	**1.08**	**1.08**	**8.7**	**6.78**
Conductivity, Field (mS/cm)	NA	**1.4896**	**1.6039**	**5.9903**	**5.9903**	**6.2118**	**2.9476**	**3.154**	**3.154**	**5.2145**	**5.6246**
ORP, Field (mv)	NA	**25.7**	**55.9**	**73.3**	**73.3**	**87.8**	**-2.9**	**56.5**	**56.5**	**66.1**	**85.3**
Turbidity, Field (NTU)	NA	**1.67**	**8.3**	**0**	**0**	**0**	**4.05**	**1.52**	**1.52**	**6.41**	**25.87**
pH, Field (SU)	NA	**7.12**	**6.73**	**7.15**	**7.15**	**7**	**7.19**	**6.86**	**6.86**	**6.54**	**6.37**

ABBREVIATIONS AND NOTES:

CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
SU: standard units.
USEPA: United States Environmental Protection Agency.
Results in **bold** are detected.

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257.
https://www.epa.gov/coalash/coal-ash-rule

TABLE II
SUMMARY OF GROUNDWATER QUALITY DATA
ASH POND - MAY THROUGH OCTOBER 2019
A.B. BROWN GENERATION STATION
MOUNT VERNON, INDIANA

Location Group	Action Level	Downgradient						
Location Name	Maximum	CCR-AP-8	CCR-AP-8	CCR-AP-9	CCR-AP-9	CCR-AP-9	CCR-AP-10	CCR-AP-10
Sample Name	Contaminant	CCR-AP-8-20190617	CCR-AP-8-20191021	CCR-AP-9-20190617	ND DUPLICATE-20190	CCR-AP-9-20191021	CCR-AP-10-20190617	CCR-AP-10-20191018
Sample Date	Level/ Regional	06/17/2019	10/21/2019	06/17/2019	06/17/2019	10/21/2019	06/17/2019	10/18/2019
	Screening	180-91430-3		180-91430-4	180-91430-6		180-91430-5	
Lab Sample ID	Levels	1906640-4	180-97725-2	1906640-5	1906640-7	180-97725-3	1906640-6	180-97535-9
Detection Monitoring - EPA Appendix III Constituents (mg/L)								
Boron, Total	NA	0.12 U	**0.2**	**9.5**	**9**	**7.9**	**7.5**	**7.4**
Calcium, Total	NA	**140**	**190**	**470**	**490**	**440**	**230**	**220**
Chloride	NA	**41**	**52**	**870**	**820**	**720**	**250**	**220**
Fluoride	4	**0.29 J+**	**0.3**	**0.33 J+**	**0.33 J+**	**0.52 J**	**0.45 J+**	**0.24 J**
Sulfate	NA	**210**	**500**	**4400**	**4200**	**4800**	**2000**	**2000**
Total Dissolved Solids (TDS)	NA	**810**	**1200**	**6900**	**7300**	**6600**	**3400**	**3300**
pH (lab) (SU)	NA	**7.2 J**	**7.2 HF**	**6.8 J**	**6.8 J**	**6.8 HF**	**7.4 J**	**7.4 HF**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)								
Antimony, Total	0.006	0.002 U	0.002 U	0.02 U	0.02 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	**0.0013**	**0.001**	**0.023**	**0.023**	**0.022**	**0.0011**	**0.00054 J**
Barium, Total	2	**0.066**	**0.1**	**0.086 J**	**0.074 J**	**0.088**	**0.019**	**0.016 B**
Beryllium, Total	0.004	0.001 U	**0.00024 J^**	0.01 U	0.01 U	0.001 U^	**0.00021 J**	0.001 U
Cadmium, Total	0.005	0.001 U	**0.00015 J**	0.01 U	0.01 U	0.001 U	0.001 U	0.001 U
Chromium, Total	0.1	0.0039 U	**0.0022**	0.02 U	0.02 U	**0.0027**	0.0038 U	0.002 U
Cobalt, Total	0.006	**0.0046**	**0.0018**	0.005 U	0.005 U	**0.00081**	**0.0016**	**0.0011**
Fluoride	4	**0.29 J+**	**0.3**	**0.33 J+**	**0.33 J+**	**0.52 J**	**0.45 J+**	**0.24 J**
Lead, Total	0.015	0.001 U	**0.00018 J**	0.01 U	0.01 U	**0.00065 J**	0.001 U	**0.00031 J**
Lithium, Total	0.04	**0.011**	**0.013**	0.05 U	0.05 U	**0.032**	**0.0059**	0.025 U
Mercury, Total	0.002	0.0002 U	-	0.0002 U	0.0002 U	-	0.0002 U	-
Molybdenum, Total	0.1	**0.001 J**	**0.001 J**	**0.021 J**	**0.021 J**	**0.014**	**0.0039 J**	**0.0028 J**
Selenium, Total	0.05	0.005 U	0.005 U	0.05 U	0.05 U	**0.0015 J**	**0.015**	**0.014**
Thallium, Total	0.002	0.001 U	**0.00029 J**	0.01 U	0.01 U	**0.00016 J**	**0.00013 J**	0.001 U
Radiological (pCi/L)								
Radium-226	NA	**0.35 ± 0.23**	0.104 U ± 0.0875	**0.58 ± 0.38**	**0.61 ± 0.38**	**0.260 ± 0.104**	0.32 U ± 0.27	0.0667 U ± 0.0737
Radium-228	NA	0.67 U ± 0.44	0.127 U ± 0.252	**0.76 ± 0.41**	0.63 U ± 0.38	**0.452 ± 0.294**	0.66 U ± 0.38	**0.490 ± 0.241**
Radium-226 & 228	5	**1.02 J ± 0.496**	0.231 U ± 0.267	**1.34 ± 0.559**	**1.24 J ± 0.537**	**0.713 ± 0.312**	**0.98 ± 0.466**	**0.556 ± 0.252**
Field Parameters								
Temperature (Deg C)	NA	**17.86**	**18.78**	**20.57**	**20.57**	**18.87**	**16.26**	**14.62**
Dissolved Oxygen, Field (mg/L)	NA	**0.35**	**0.76**	**0.01**	**0.01**	**0.15**	**0.43**	**1.79**
Conductivity, Field (mS/cm)	NA	**1.0861**	**1.5669**	**9.4045**	**9.4045**	**8.5938**	**4.6168**	**4.6003**
ORP, Field (mv)	NA	**12.4**	**-7.8**	**-165.1**	**-165.1**	**-82.2**	**11.5**	**120.8**
Turbidity, Field (NTU)	NA	**10.63**	**1.29**	**49.53**	**49.53**	**29.83**	**97.33**	**177.4**
pH, Field (SU)	NA	**7.38**	**6.85**	**7.66**	**7.66**	**7.03**	**7.85**	**7.09**

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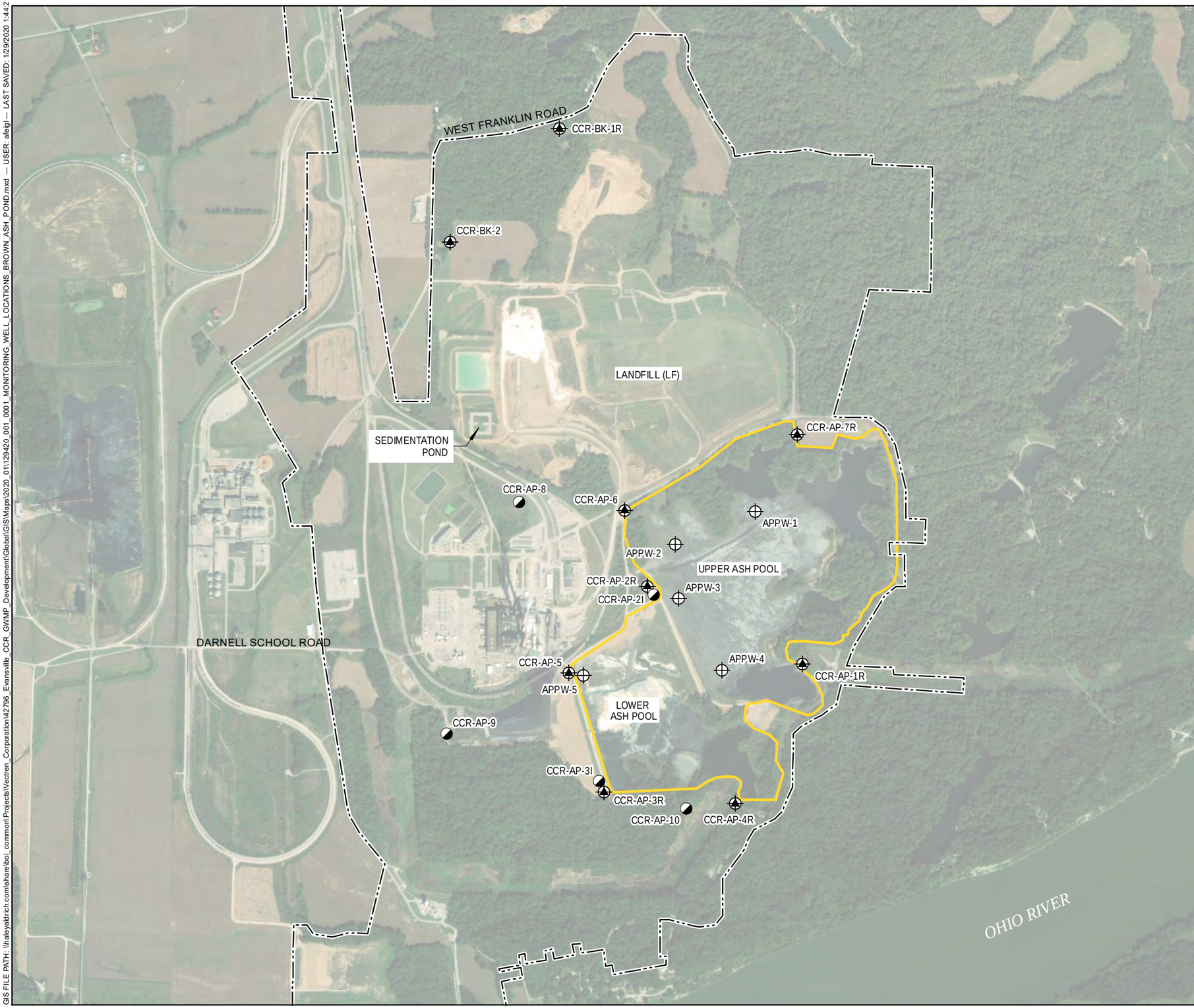
Results in **bold** are detected.

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257. https://www.epa.gov/coalash/coal-ash-rule

FIGURES



LEGEND

- CCR MONITORING WELL
- NATURE AND EXTENT MONITORING WELL
- CCR PIEZOMETER WELL
- ASH POND UNIT BOUNDARY

NOTES

1. AERIAL IMAGERY SOURCE: ESRI
2. LOCATIONS DERIVED FROM THREE I DESIGN DATA.

N

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SCALE IN FEET

HALEY ALDRICH

SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

GROUNDWATER MONITORING WELL LOCATIONS - ASH POND

JANAURY 2020

FIGURE 1

GIS FILE PATH: \\haleyaldrich.com\share\bos_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2020_01\129420_001_0001_MONITORING_WELL_LOCATIONS_BROWN_ASH_POND.mxd — USER: afeigl — LAST SAVED: 1/29/2020 1:44:21 PM

APPENDIX A

60 Day CMA Extension Demonstration

HALEY & ALDRICH, INC.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
216.739.0555

MEMORANDUM

July 2019
Project No. 129420-011

SUBJECT: **Demonstration for 60-Day Extension – Corrective Measures Assessment (CMA)**
Southern Indiana Gas and Electric Company (SIGECO)
Ash Pond
A. B. Brown Generating Station (ABB); Posey County, Indiana

Pursuant to 40 CFR §257.96(a) (CCR Rule Assessment of Corrective Measures), I certify that SIGECO has demonstrated the need for additional time beyond the period of 90 days to complete the assessment of corrective measures due to site-specific conditions and the evaluation of remedial treatment alternatives in support of an informed CMA process.

In the case of the assessment of corrective measures for the ABB Ash Pond, the site has complex hydrogeology. In addition, SIGECO is in the process of reviewing possible groundwater remedies and is having ongoing discussions with third-party experts regarding potential closure strategies, including beneficial reuse as well as implementation of critical steps in the groundwater treatment and remedy assessment process. Based on these site-specific conditions and related groundwater treatment alternatives evaluations in support of the CMA by SIGECO, the CCR Rule allows for a 60-day extension to complete the CMA process.

This certification as submitted, is to the best of my knowledge, accurate and complete.

Signed:_____

Certifying Engineer
Print Name: Steven F. Putrich, P.E.
Indiana License No.: PE11200566
Title: CCR Practice Lead, Senior Consulting Engineer
Company: Haley & Aldrich, Inc.

Professional Engineer's Seal

HALEY & ALDRICH, INC.
400 Augusta Street
Suite 130
Greenville, SC 29601
864.214.8750

24 September 2020
File No. 129420

TO: Southern Indiana Gas and Electric Company

FROM: Haley & Aldrich, Inc.
[Steven F. Putrich, P.E., Project Principal
Mark Miesfeldt, Lead Hydrogeologist]

SUBJECT: May 2020 Sampling Results and Assessment Monitoring Statistical Analysis Summary Pursuant to 40 CFR § 257.96(b)
A.B. Brown Generating Station – Ash Pond – West Franklin, Indiana

Southern Indiana Gas and Electric Company (SIGECO) is implementing the 17 April 2015 United States Environmental Protection Agency Federal Coal Combustion Residuals (CCR) Rule (40 CFR § 257 and 261) for the A.B. Brown Generating Station, in Posey County near West Franklin, Indiana. Detection monitoring events occurred in 2016 and 2017. The results of the sampling events were compared to background using appropriate statistical methods to determine if Appendix III constituents were present at concentrations above background. The result of the statistical analysis identified statistically significant increases of Appendix III constituents downgradient of the Ash Pond thereby triggering Assessment Monitoring and respective notification of the same.

During the Assessment Monitoring phase, groundwater samples were collected from the CCR monitoring well network. Samples were collected in June, and August 2018 and subsequently analyzed for the Appendix III and Appendix IV constituents as required by 40 CFR § 257.95(b) and 40 CFR § 257.95(d)(1). Concurrent with the second assessment sampling round, and as required by 40 CFR § 257.95(h), groundwater protection standards (GWPS) were established for the detected Appendix IV constituents. The assessment monitoring sampling results were compared to the GWPS to determine if statistically significant levels (SSL) of Appendix IV constituents were present downgradient of the Ash Pond. The results of this evaluation indicated that lithium and molybdenum were present in groundwater at SSLs above the GWPS thereby requiring notification as established by 40 CFR § 105(h)(8) and triggering an assessment of corrective measures.

As a result of this determination, and in accordance with 40 CFR § 257.95(g)(3), a field investigation was initiated to demonstrate that a source other than the Ash Pond caused the lithium and molybdenum contamination. The field investigation included sampling and analysis of naturally occurring coal identified near monitoring well CCR-AP-2R as an alternative source of molybdenum and lithium and surface water sampling from the Coal Pile Runoff Pond and lower pool of the Ash Pond to evaluate the effluent from the coal pile runoff as an alternate source of the Appendix IV SSLs detected at CCR-AP-3R. While this investigation showed that the naturally occurring coal and the coal pile runoff were contributing sources, they did not contribute lithium and molybdenum at levels that resulted in a

determination of an alternative source. Consequently, both lithium and molybdenum were carried forward into the assessment of corrective measures.

As required by 40 CFR § 257.95(b) and 40 CFR § 257.95(d)(1), semiannual groundwater sampling and analysis continued for the Ash Pond in 2020. The first round of semiannual groundwater sampling was conducted in May 2020. Analytical results for the May 2020 semiannual sampling event are summarized in Table I. For the Ash Pond, statistical analysis of the May 2020 analytical results was finalized within 90-days of completion of sampling and analysis as required by 40 CFR § 257.93(g). Downgradient wells were compared to each constituents' respective GWPS. The assessment monitoring statistical analysis summary is provided in Table II.

If the detected constituent was greater than the associated GWPS for that Unit, pursuant to 40 CFR § 257.93 (f)(5), the confidence interval method was used to evaluate if that Appendix IV constituent was present at a SSL. Based on the comparisons outlined above, the results of the statistical analyses conducted for those detected Appendix IV constituents confirm that lithium and molybdenum remain as the only constituents present at SSLs above GWPSs downgradient of the Ash Pond. This information is being provided for SIGECO's records. Since no new constituents were identified at SSLs above the GWPS, further notifications associated with the statistical analysis of the May 2020 sampling results are not required at this time.

Attachments:
Table I - Summary of Analytical Results – May 2020
Table II - Assessment Monitoring Statistical Analysis Summary – May 2020

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TABLE I
SUMMARY OF GROUNDWATER QUALITY DATA
ASH POND - MAY 2020
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA
FILE NO. 129420

Location Group	Action Level	Upgradient		Downgradient								
Location	Maximum	CCR-BK-1R	CCR-BK-2	CCR-AP-1R	CCR-AP-2I	CCR-AP-2R	CCR-AP-3I	CCR-AP-3R	CCR-AP-4R	CCR-AP-5	CCR-AP-6	CCR-AP-7R
Sample Date	Contaminant Level/	05/26/2020	05/26/2020	05/26/2020	05/26/2020	05/26/2020	05/26/2020	05/26/2020	05/21/2020	05/26/2020	05/22/2020	05/22/2020
Sample Type	Regional Screening	N	N	N	N	N	N	N	N	N	N	N
Sample Name	Levels	CCR-BK-1R-20200526	CCR-BK-2-20200526	CCR-AP-1R-20200526	CCR-AP-2I-20200526	CCR-AP-2R-20200526	CCR-AP-3I-20200526	CCR-AP-3R-20200526	CCR-AP-4R-20200521	CCR-AP-5-20200526	CCR-AP-6-20200522	CCR-AP-7R-20200522
Detection Monitoring - EPA Appendix III Constituents (mg/L)												
Boron, Total	-	**0.11 B**	**0.091 B**	**3.5 B**	**1.9 B**	**13 B**	**2.2 B**	**13 B**	**0.041 J**	**12 B**	**4.5**	**5**
Calcium, Total	-	**41**	**56**	**47**	**14**	**340**	**19**	**300**	**180**	**430**	**310**	**420**
Chloride	-	**3.7**	**10**	**39**	**97**	**580**	**150**	**730**	**28**	**420**	**260**	**2400**
Fluoride	4	**0.37**	**0.21**	**0.62**	**1.1**	**0.76**	**1.4**	**1.7**	**0.26**	**0.56**	**0.12 J**	**0.55**
Sulfate	-	**24**	**42**	**280**	**1.9**	**2800**	**12**	**4200**	**99**	**2900**	**1500**	**14000**
Total Dissolved Solids (TDS)	-	**220**	**450**	**1100**	**740**	**5600**	**740**	**6600**	**920**	**4900**	**2600**	**4400**
pH (lab) (SU)	-	**7 HF**	**7.1 HF**	**7.2 HF**	**7.5 HF**	**7.1 HF**	**8 HF**	**7.4 HF**	**7.2 HF**	**7.1 HF**	**7.2 HF**	**6.6 HF**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)												
Antimony, Total	0.006	0.002 U	0.002 U	0.002 U	0.002 U	0.02 U	0.002 U	0.02 U	0.002 U	0.02 U	0.002 U	**0.0004 J**
Arsenic, Total	0.01	0.001 U	0.001 U	**0.00031 J**	**0.0013**	0.01 U	**0.0021**	0.01 U	0.001 U	0.01 U	**0.0011**	**0.00057 J**
Barium, Total	2	**0.031**	**0.038**	**0.026**	**0.096**	**0.021 J**	**0.16**	**0.019 J**	**0.091**	**0.02 J**	**0.013**	**0.026**
Beryllium, Total	0.004	0.001 U	0.001 U	0.001 U	0.001 U	0.01 U	0.001 U	0.01 U	0.001 U	0.01 U	0.001 U	0.001 U
Cadmium, Total	0.005	0.001 U	0.001 U	0.001 U	0.001 U	0.01 U	0.001 U	0.01 U	0.001 U	0.01 U	0.001 U	0.001 U
Chromium, Total	0.1	0.002 U	0.002 U	0.002 U	0.002 U	0.02 U	0.002 U	0.02 U	**0.0027**	0.02 U	0.002 U	0.002 U
Cobalt, Total	0.006	**0.00015 J**	0.0005 U	0.0005 U	**0.00019 J**	**0.0027 J**	**0.00014 J**	0.005 U	0.0005 U	0.005 U	**0.00098**	**0.00023 J**
Fluoride	4	**0.37**	**0.21**	**0.62**	**1.1**	**0.76**	**1.4**	**1.7**	**0.26**	**0.56**	**0.12 J**	**0.55**
Lead, Total	0.015	**0.00023 J**	0.001 U	0.001 U	0.001 U	0.01 U	**0.00021 J**	0.01 U	0.001 U	0.01 U	**0.00019 J**	**0.00016 J**
Lithium, Total	0.04	0.005 U	**0.0036 J**	0.005 U	**0.022**	**0.035 J**	**0.023**	**0.074**	0.005 U	0.05 U	**0.029**	**0.021**
Mercury, Total	0.002	0.0002 U	**0.0002**	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum, Total	0.1	**0.00079 J**	**0.0015 J**	**0.0042 J**	**0.0014 J**	**2**	**0.0023 J**	**0.86**	**0.0012 J**	**0.071**	**0.0057**	0.005 U
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U	0.05 U	0.005 U	0.05 U	0.005 U	0.05 U	0.005 U	0.005 U
Thallium, Total	0.002	0.001 U	0.001 U	0.001 U	0.001 U	0.01 U	**0.00023 J**	0.01 U	0.001 U	0.01 U	0.001 U	0.001 U
Radiological (pCi/L)												
Radium-226	-	0.0680 U ± 0.124	-0.0171 U ± 0.066	0.0878 U ± 0.123	**0.329 ± 0.196**	**0.213 ± 0.148**	**0.385 ± 0.17**	-0.0218 U ± 0.0691	**0.114 ± 0.0759**	0.0594 U ± 0.0909	0.00136 U ± 0.0653	0.0914 U ± 0.0671
Radium-228	-	0.141 U ± 0.307	-0.0790 U ± 0.213	0.113 U ± 0.259	**0.362 ± 0.226**	**0.339 ± 0.224**	**0.391 ± 0.228**	**0.636 ± 0.247**	0.319 U ± 0.335	**0.492 ± 0.235**	0.300 U ± 0.211	0.327 U ± 0.237
Radium-226 & 228	5	0.209 U ± 0.331	-0.0961 U ± 0.223	0.200 U ± 0.287	**0.690 ± 0.299**	**0.552 ± 0.268**	**0.776 ± 0.284**	**0.615 ± 0.256**	0.433 U ± 0.343	**0.552 ± 0.252**	0.301 U ± 0.221	**0.418 ± 0.246**

ABBREVIATIONS AND NOTES:
CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
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Results in **bold** are detected.

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https://www.epa.gov/coalash/coal-ash-rule

TABLE I
SUMMARY OF GROUNDWATER QUALITY DATA
ASH POND - MAY 2020
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA
FILE NO. 129420

Location Group	Action Level	Downgradient				
Location	Maximum	CCR-AP-7R	CCR-AP-8	CCR-AP-9	CCR-AP-10	CCR-AP-11
Sample Date	Contaminant Level/	05/22/2020	05/22/2020	05/26/2020	05/21/2020	05/29/2020
Sample Type	Regional Screening	FD	N	N	N	N
Sample Name	Levels	BLIND DUPLICATE 1-20200522	CCR-AP-8-20200522	CCR-AP-9-20200526	CCR-AP-10-20200521	CCR-AP-11-20200529
Detection Monitoring - EPA Appendix III Constituents (mg/L)						
Boron, Total	-	**5.2**	**0.34**	**7.5 B**	**7.1**	**0.91 B**
Calcium, Total	-	**400**	**240**	**490**	**220**	**120**
Chloride	-	**430**	**79**	**630**	**210**	**54**
Fluoride	4	0.5 U	**0.22**	**0.56**	**0.34**	**0.19**
Sulfate	-	**3000**	**700**	**3700**	**2300**	**200**
Total Dissolved Solids (TDS)	-	**4700**	**1500**	**6000**	**3100**	**850**
pH (lab) (SU)	-	**6.6 HF**	**7.1 HF**	**6.7 HF**	**7.4 HF**	**7 HF**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)						
Antimony, Total	0.006	0.002 U	0.002 U	0.02 U	0.002 U	0.002 U
Arsenic, Total	0.01	**0.00043 J**	**0.00036 J**	**0.017**	**0.00045 J**	**0.0011**
Barium, Total	2	**0.025**	**0.089**	**0.083 J**	**0.012**	**0.06**
Beryllium, Total	0.004	0.001 U	0.001 U	**0.0022 J**	0.001 U	0.001 U
Cadmium, Total	0.005	0.001 U	0.001 U	0.01 U	0.001 U	0.001 U
Chromium, Total	0.1	0.002 U	0.002 U	0.02 U	0.002 U	0.002 U
Cobalt, Total	0.006	**0.00021 J**	**0.00054**	0.005 U	**0.00073**	**0.00099**
Fluoride	4	0.5 U	**0.22**	**0.56**	**0.34**	**0.19**
Lead, Total	0.015	**0.00034 J**	0.001 U	**0.0028 J**	**0.00016 J**	**0.00091 J**
Lithium, Total	0.04	**0.02**	**0.012**	0.05 U	0.005 U	**0.014**
Mercury, Total	0.002	0.0002 U	0.0002 U	0.0002 U	0.0002 U	-
Molybdenum, Total	0.1	0.005 U	**0.00082 J**	**0.0089 J**	**0.0026 J**	**0.00082 J**
Selenium, Total	0.05	0.005 U	0.005 U	0.05 U	**0.018**	**0.0075**
Thallium, Total	0.002	0.001 U	0.001 U	0.01 U	0.001 U	0.001 U
Radiological (pCi/L)						
Radium-226	-	**0.227 ± 0.096**	**0.208 ± 0.0939**	**0.319 ± 0.185**	0.113 U ± 0.107	0.0569 U ± 0.0942
Radium-228	-	**0.352 ± 0.221**	0.177 U ± 0.309	**0.807 ± 0.381**	0.294 U ± 0.295	**0.440 ± 0.267**
Radium-226 & 228	5	**0.578 ± 0.241**	0.385 U ± 0.323	**1.13 ± 0.424**	0.408 U ± 0.314	**0.497 ± 0.283**

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Table II
A.B. Brown Generating Station
Ash Pond
Assessment Monitoring Statistical Analysis Summary
Prepared: September 01, 2020

																				Inter-well Analysis					
Location Id	Frequency of Detection	Percent Non-Detects	Range of Non-Detect	Mean	50th Percentile (Median)	95th Percentile	Maximum Detect	Variance	Standard Deviation	Coefficient of Variance	CCR MCL/RSL	Report Result Unit	Detection Exceedances (Y/N)	Number of Detection Exceedances	Outlier Detected	Outlier Removed	Trend	Distribution Group*	Distribution Well*	May 2020 Concentrations	Detect?	Upper Tolerance Limit	Background Limit (Higher of MCL/RSL or Upper Tolerance Limit)	[2]Exceedance above Background at Individual Well	SSL
CCR Appendix-IV: Antimony, Total (mg/L)																									
CCR-BK-1	2/13	85%	0.002-0.002	0.00346	0.004	0.004	0.0009	8.388E-07	0.0012952	0.7482	0.006	mg/L	N	0	N	N	Stable	Non-parametric	Non-parametric			0.002	0.006		
CCR-BK-2	1/13	92%	0.002-0.002	0.00376	0.004	0.004	0.00096	3.412E-07	0.0008262	0.4388	0.006	mg/L	N	0	N	N	Stable		Non-parametric						
CCR-AP-1	0/13	100%	0.002-0.002	0.004	0.004	0.004		0	0	0	0.006	mg/L	N	0	N	N	NA		Non-parametric	0.002	N			N	FALSE
CCR-AP-2	1/13	92%	0.002-0.02	0.00924	0.004	0.04	0.00022	0.00008994	0.013412	2.9	0.006	mg/L	N	0	Y	N	Stable		Non-parametric	0.020	N			Y	FALSE
CCR-AP-3	1/13	92%	0.00022-0.02	0.01174	0.004	0.04	0.000184	0.00012546	0.01584	2.698	0.006	mg/L	N	0	Y	N	Stable		Non-parametric	0.020	N			Y	FALSE
CCR-AP-4	0/13	100%	0.002-0.002	0.004	0.004	0.004		0	0	0	0.006	mg/L	N	0	N	N	NA		Non-parametric	0.002	N			N	FALSE
CCR-AP-5	0/13	100%	0.002-0.02	0.0123	0.004	0.04		0.00011964	0.015468	2.514	0.006	mg/L	N	0	N	N	NA		Non-parametric	0.020	N			Y	FALSE
CCR-AP-6	1/13	92%	0.002-0.02	0.00656	0.004	0.031	0.00136	0.0000487	0.009868	3.006	0.006	mg/L	N	0	N	N	Stable		Non-parametric	0.002	N			N	FALSE
CCR-AP-7	2/13	85%	0.002-0.02	0.0063	0.004	0.031	0.00118	0.0000498	0.00998	3.166	0.006	mg/L	N	0	N	N	Stable		Non-parametric	0.0004	Y			N	FALSE
CCR Appendix-IV: Arsenic, Total (mg/L)																									
CCR-BK-1	12/14	14%	0.001-0.001	0.00184	0.00195	0.0043	0.005	6.922E-07	0.0011766	1.279	0.01	mg/L	N	0	N	N	Stable	Non-parametric	Normal			0.004	0.010		
CCR-BK-2	7/14	50%	0.001-0.001	0.0023	0.002	0.00651	0.007	1.5966E-06	0.001787	1.549	0.01	mg/L	N	0	N	N	Stable		Log-transformed						
CCR-AP-1	11/14	21%	0.001-0.001	0.001962	0.00127	0.0076	0.0104	0.000003048	0.00247	2.518	0.01	mg/L	N	0	N	N	Stable		Log-transformed	0.00031	Y			N	FALSE
CCR-AP-2	8/14	43%	0.001-0.01	0.00438	0.002	0.02	0.0048	0.00002156	0.006566	2.996	0.01	mg/L	N	0	N	N	Stable		Log-transformed	0.01000	N			N	FALSE
CCR-AP-3	5/14	64%	0.001-0.01	0.0054	0.002	0.02	0.00088	0.00003026	0.00778	2.878	0.01	mg/L	N	0	Y	N	Stable		Non-parametric	0.01000	N			N	FALSE
CCR-AP-4	8/14	43%	0.001-0.001	0.001242	0.00097	0.002	0.00118	2.356E-07	0.0006864	1.1046	0.01	mg/L	N	0	N	N	Stable		Non-parametric	0.00100	N			N	FALSE
CCR-AP-5	3/14	79%	0.001-0.01	0.00558	0.002	0.02	0.00114	0.00002958	0.00769	2.758	0.01	mg/L	N	0	Y	N	Stable		Non-parametric	0.01000	N			N	FALSE
CCR-AP-6	13/14	7%	0.01-0.01	0.0065	0.0061	0.01671	0.0106	0.000012066	0.004912	1.51	0.01	mg/L	N	0	N	N	Decrease		Normal	0.00110	Y			N	FALSE
CCR-AP-7	12/14	14%	0.001-0.01	0.00362	0.002	0.01524	0.0064	0.000011766	0.00485	2.686	0.01	mg/L	N	0	N	N	Stable		Normal	0.00057	Y			N	FALSE
CCR Appendix-IV: Barium, Total (mg/L)																									
CCR-BK-1	14/14	0%	-	0.0808	0.075	0.1409	0.164	0.0003498	0.02646	0.6554	2	mg/L	N	0	Y	N	Stable	Non-parametric	Non-parametric			0.150	2.000		
CCR-BK-2	14/14	0%	-	0.0916	0.073	0.2286	0.3	0.0017864	0.05978	1.3056	2	mg/L	N	0	Y	N	Stable		Non-parametric						
CCR-AP-1	14/14	0%	-	0.0418	0.037	0.0722	0.082	0.00009998	0.014142	0.6756	2	mg/L	N	0	N	N	Stable		Log-transformed	0.026	Y			N	FALSE
CCR-AP-2	14/14	0%	-	0.0798	0.085	0.1006	0.102	0.00015462	0.017586	0.4412	2	mg/L	N	0	N	N	Stable		Normal	0.021	Y			N	FALSE
CCR-AP-3	14/14	0%	-	0.0548	0.034	0.2248	0.32	0.00282	0.0751	2.746	2	mg/L	N	0	Y	N	Stable		Log-transformed	0.019	Y			N	FALSE
CCR-AP-4	14/14	0%	-	0.1584	0.18	0.233	0.24	0.001348	0.05192	0.6554	2	mg/L	N	0	N	N	Stable		Normal	0.091	Y			N	FALSE
CCR-AP-5	14/14	0%	-	0.0326	0.032	0.0393	0.04	0.000008424	0.004104	0.252	2	mg/L	N	0	Y	N	Stable		Normal	0.020	Y			N	FALSE
CCR-AP-6	13/14	7%	0.1-0.1	0.0538	0.042	0.158	0.08	0.0009418	0.0434	1.6116	2	mg/L	N	0	N	N	Stable		Normal	0.013	Y			N	FALSE
CCR-AP-7	14/14	0%	-	0.0732	0.065	0.1169	0.126	0.0002242	0.02118	0.5778	2	mg/L	N	0	N	N	Stable		Normal	0.026	Y			N	FALSE
CCR Appendix-IV: Beryllium, Total (mg/L)																									
CCR-BK-1	1/13	92%	0.001-0.001	0.001864	0.002	0.002	0.00024	1.1438E-07	0.0004782	0.513	0.004	mg/L	N	0	N	N	Stable	Non-parametric	Non-parametric			0.001	0.004		
CCR-BK-2	2/13	85%	0.001-0.001	0.001782	0.002	0.002	0.0008	1.4036E-07	0.0005298	0.5948	0.004	mg/L	N	0	N	N	Stable		Non-parametric						
CCR-AP-1	3/13	77%	0.001-0.001	0.001606	0.002	0.002	0.00038	2.694E-07	0.0007342	0.9138	0.004	mg/L	N	0	N	N	Stable		Non-parametric	0.001	N			N	FALSE
CCR-AP-2	4/13	69%	0.001-0.01	0.00426	0.002	0.02	0.00054	0.00002366	0.00688	3.224	0.004	mg/L	N	0	Y	N	Stable		Non-parametric	0.010	N			Y	FALSE
CCR-AP-3	2/13	85%	0.001-0.01	0.00452	0.002	0.02	0.00042	0.00002282	0.006756	2.99	0.004	mg/L	N	0	Y	N	Stable		Non-parametric	0.010	N			Y	FALSE
CCR-AP-4	0/13	100%	0.001-0.001	0.002	0.002	0.002		0	0	0	0.004	mg/L	N	0	N	N	NA		Non-parametric	0.001	N			N	FALSE
CCR-AP-5	2/13	85%	0.001-0.01	0.0045	0.002	0.02	0.00032	0.00002294	0.006774	3.014	0.004	mg/L	N	0	Y	N	Stable		Non-parametric	0.010	N			Y	FALSE
CCR-AP-6	3/13	77%	0.001-0.001	0.001696	0.002	0.002	0.00102	1.7408E-07	0.00059	0.6954	0.004	mg/L	N	0	N	N	Stable		Non-parametric	0.001	N			N	FALSE
CCR-AP-7	2/13	85%	0.001-0.001	0.00175	0.002	0.002	0.00048	1.8082E-07	0.0006014	0.6876	0.004	mg/L	N	0	N	N	Stable		Non-parametric	0.001	N			N	FALSE
CCR Appendix-IV: Cadmium, Total (mg/L)																									
CCR-BK-1	0/14	100%	0.001-0.001	0.002	0.002	0.002		0	0	0	0.005	mg/L	N	0	N	N	NA	Non-parametric	Non-parametric			0.001	0.005		
CCR-BK-2	0/14	100%	0.001-0.001	0.002	0.002	0.002		0	0	0	0.005	mg/L	N	0	N	N	NA		Non-parametric						
CCR-AP-1	4/14	71%	0.001-0.001	0.001542	0.002	0.002	0.00056	2.722E-07	0.0007378	0.9566	0.005	mg/L	N	0	N	N	Stable		Non-parametric	0.0010	N			N	FALSE
CCR-AP-2	12/14	14%	0.01-0.01	0.00364	0.00085	0.02	0.0016	0.0000232	0.00681	3.75	0.005	mg/L	N	0	y	N	Stable		Non-parametric	0.0100	N			Y	FALSE
CCR-AP-3	11/14	21%	0.01-0.01	0.00464	0.00049	0.02	0.0006	0.0000334	0.008172	3.528	0.005	mg/L	N	0	y	N	Stable		Non-parametric	0.0100	N			Y	FALSE
CCR-AP-4	2/14	86%	0.001-0.001	0.001752	0.002	0.002	0.00036	1.9202E-07	0.0006198	0.7074	0.005	mg/L	N	0	y	N	Stable		Non-parametric	0.0010	N			N	FALSE
CCR-AP-5	2/14	86%	0.001-0.01	0.0056	0.002	0.02	0.00024	0.00002948	0.00768	2.74	0.005	mg/L	N	0	y	N	Stable		Non-parametric	0.0100	N			Y	FALSE
CCR-AP-6	2/14	86%	0.001-0.01	0.00304	0.002	0.0137	0.00042	0.000011634	0.004824	3.164	0.005	mg/L	N	0	y	N	Stable		Non-parametric	0.0010	N			N	FALSE
CCR-AP-7	7/14	50%	0.001-0.01	0.00246	0.00132	0.0137	0.00064	0.00001259	0.005018	4.07	0.005	mg/L	N	0	N	N	Stable		Non-parametric	0.0010	N			N	FALSE
CCR Appendix-IV: Chromium, Total (mg/L)																									
CCR-BK-1	11/14	21%	0.002-0.002	0.00484	0.0045	0.01198	0.0152	0.000005574	0.003338	1.3772	0.1	mg/L	N	0	Y	N	Increase	Non-parametric	Normal			0.009	0.1		
CCR-BK-2	5/14	64%	0.002-0.002	0.0058	0.004	0.0146	0.0174	0.000007726	0.00393	1.3568	0.1	mg/L	N	0	N	N	Stable		Non-parametric						
CCR-AP-1	1/14	93%	0.002-0.0023	0.00392	0.004	0.00439	0.0022	1.2952E-07	0.000509	0.26	0.1	mg/L	N	0	y	N	Stable		Non-parametric	0.0020	N			N	FALSE
CCR-AP-2	3/14	79%	0.002-0.02	0.00902	0.004	0.04	0.0072	0.00008372	0.01294	2.868	0.1	mg/L	N	0	y	N	Stable		Non-parametric	0.0200	N			N	FALSE
CCR-AP-3	3/14	79%	0.002-0.02	0.01116	0.004	0.04	0.0017	0.00011812	0.01537	2.754	0.1	mg/L	N	0	y	N	Stable		Non-parametric	0.0200	N			N	FALSE
CCR-AP-4	14/14	0%	-	0.00482	0.0044	0.00746	0.0076	0.000001145	0.0015134	0.6286	0.1	mg/L	N	0	N	N	Increase		Normal	0.0027	Y			N	FALSE
CCR-AP-5	1/14	93%	0.002-0.02	0.01152	0.004	0.04	0.00124	0.00011498	0.015164	2.634	0.1	mg/L	N	0	y	N	Stable		Non-parametric	0.0200	N			N	FALSE
CCR-AP-6	5/14	64%	0.002-0.02	0.00692	0.004	0.03104	0.0144	0.0000482	0.009818	2.836	0.1	mg/L	N	0	y	N	Stable		Non-parametric	0.0020	N			N	FALSE
CCR-AP-7	10/14	29%	0.002-0.02	0.00728	0.004	0.0304	0.0126	0.00004666	0.00966	2.65	0.1	mg/L	N	0	N	N	Stable		Normal	0.0020	N			N	FALSE

CCR Appendix-IV: Cobalt, Total (mg/L)																										
CCR-BK-1	13/14	7%	0.0005-0.0005	0.000855	0.00069	0.00241	0.0028	0.000000607	0.0007791	0.9112	0.006	mg/L	N	0	Y	N	Stable	Non-parametric	Log-transformed			0.006	0.006			
CCR-BK-2	8/14	43%	0.0005-0.0005	0.000915	0.0005	0.003145	0.0062	0.000002478	0.001574	1.721	0.006	mg/L	Y	1	Y	N	Stable		Log-transformed							
CCR-AP-1	13/14	7%	0.0005-0.0005	0.0021	0.000775	0.008855	0.011	0.00001031	0.00321	1.529	0.006	mg/L	Y	2	N	N	Decrease		Log-transformed	0.00050	N			N	FALSE
CCR-AP-2	14/14	0%	-	0.00285	0.00255	0.004845	0.0079	0.000002243	0.001498	0.5255	0.006	mg/L	Y	1	Y	N	Stable		Log-transformed	0.00270	Y			N	FALSE
CCR-AP-3	9/14	36%	0.0005-0.005	0.00117	0.000425	0.005	0.0019	0.000002956	0.001719	1.472	0.006	mg/L	N	0	Y	N	Stable		Log-transformed	0.00500	N			N	FALSE
CCR-AP-4	9/14	36%	0.0005-0.0005	0.000573	0.0004	0.001681	0.0033	0.000000655	0.0008093	1.413	0.006	mg/L	N	0	N	N	Stable		Log-transformed	0.00050	N			N	FALSE
CCR-AP-5	6/14	57%	0.0005-0.005	0.00137	0.0005	0.005	0.00081	0.000003917	0.001979	1.448	0.006	mg/L	N	0	N	N	Stable		Log-transformed	0.00500	N			N	FALSE
CCR-AP-6	14/14	0%	-	0.00234	0.0013	0.00589	0.0068	0.000003728	0.001931	0.8256	0.006	mg/L	Y	1	N	N	Decrease		Normal	0.00098	Y			N	FALSE
CCR-AP-7	13/14	7%	0.005-0.005	0.00172	0.00125	0.00435	0.004	0.000002396	0.001548	0.8988	0.006	mg/L	N	0	N	N	Stable		Normal	0.00023	Y			N	FALSE
CCR Appendix-III: Fluoride (mg/L)																										
CCR-BK-1	13/14	7%	0.23-0.23	2.56	2.68	3.04	3.04	0.020944	0.40936	1.2792	4	mg/L	N	0	N	N	Stable	Non-parametric	Normal			0.380	4.000			
CCR-BK-2	13/14	7%	0.12-0.12	1.192	1.12	1.68	1.68	0.010456	0.2892	1.9464	4	mg/L	N	0	N	N	Decrease		Normal							
CCR-AP-1	11/14	21%	0.5-5	6.008	3.8	40	5.84	11.512	9.6	12.768	4	mg/L	N	0	Y	N	Stable		Non-parametric	0.62	Y			N	FALSE
CCR-AP-2	12/14	14%	0.5-0.5	4.208	4	7.2	7.2	0.21544	1.3128	2.4936	4	mg/L	N	0	N	N	Stable		Normal	0.76	Y			N	FALSE
CCR-AP-3	14/14	0%	-	8.64	7.84	13.6	13.6	0.65728	2.2928	2.116	4	mg/L	N	0	N	N	Stable		Normal	1.70	Y			N	FALSE
CCR-AP-4	14/14	0%	-	2.968	3.24	3.84	3.84	0.067592	0.73536	1.98	4	mg/L	N	0	N	N	Stable		Normal	0.26	Y			N	FALSE
CCR-AP-5	12/14	14%	0.5-0.5	2.832	2.52	4.48	4.48	0.11584	0.9624	2.7176	4	mg/L	N	0	N	N	Stable		Normal	0.56	Y			N	FALSE
CCR-AP-6	11/14	21%	0.1-0.17	1.568	1.56	3.52	3.52	0.051152	0.63968	3.2568	4	mg/L	N	0	N	N	Increase		Log-transformed	0.12	N			N	FALSE
CCR-AP-7	11/14	21%	0.17-0.25	1.728	1.52	4.4	4.4	0.08472	0.8232	3.8104	4	mg/L	N	0	N	N	Stable		Normal	0.55	Y			N	FALSE
CCR Appendix-IV: Lead, Total (mg/L)																										
CCR-BK-1	13/14	7%	0.001-0.001	0.001116	0.00115	0.00213	0.0022	2.752E-07	0.000742	1.3292	0.015	mg/L	N	0	N	N	Stable	Non-parametric	Normal			0.011	0.015			
CCR-BK-2	5/14	64%	0.001-0.001	0.00368	0.002	0.01626	0.022	0.00001428	0.005344	2.9	0.015	mg/L	N	0	Y	N	Stable		Non-parametric							
CCR-AP-1	4/14	71%	0.001-0.001	0.001702	0.002	0.00239	0.0026	2.518E-07	0.0007096	0.834	0.015	mg/L	N	0	N	N	Stable		Non-parametric	0.00100	N			N	FALSE
CCR-AP-2	7/14	50%	0.001-0.01	0.00446	0.002	0.02	0.0104	0.00002414	0.006946	3.122	0.015	mg/L	N	0	Y	N	Stable		Non-parametric	0.01000	N			N	FALSE
CCR-AP-3	4/14	71%	0.001-0.01	0.00538	0.002	0.02	0.00056	0.00003046	0.007806	2.898	0.015	mg/L	N	0	Y	N	Stable		Non-parametric	0.01000	N			N	FALSE
CCR-AP-4	5/14	64%	0.001-0.001	0.001386	0.002	0.002	0.00046	3.536E-07	0.0008408	1.213	0.015	mg/L	N	0	N	N	Stable		Non-parametric	0.00100	N			N	FALSE
CCR-AP-5	2/14	86%	0.001-0.01	0.00442	0.002	0.02	0.0014	0.00002106	0.00649	2.936	0.015	mg/L	N	0	Y	N	Stable		Non-parametric	0.01000	N			N	FALSE
CCR-AP-6	8/14	43%	0.001-0.01	0.00374	0.002	0.0165	0.01	0.00001421	0.005332	2.856	0.015	mg/L	N	0	N	N	Stable		Log-transformed	0.00019	Y			N	FALSE
CCR-AP-7	13/14	7%	0.01-0.01	0.00288	0.00072	0.01531	0.0066	0.000013332	0.005164	3.586	0.015	mg/L	N	0	N	N	Stable		Normal	0.00016	Y			N	FALSE
CCR Appendix-IV: Lithium, Total (mg/L)																										
CCR-BK-1	3/14	79%	0.005-0.05	0.031	0.05	0.05	0.0086	0.0005215	0.02284	0.7375	0.04	mg/L	N	0	N	N	Stable	Non-parametric	Non-parametric			0.050	0.050			
CCR-BK-2	1/14	93%	0.005-0.05	0.0374	0.05	0.05	0.0036	0.0004314	0.02077	0.5559	0.04	mg/L	N	0	N	N	Stable		Non-parametric							
CCR-AP-1	7/14	50%	0.005-0.05	0.0278	0.0205	0.0556	0.066	0.000458	0.0214	0.7693	0.04	mg/L	Y	1	N	N	Stable		Normal	0.005	N			N	FALSE
CCR-AP-2	14/14	0%	-	0.0504	0.055	0.06375	0.067	0.0002301	0.01517	0.3008	0.04	mg/L	Y	11	Y	N	Stable		Non-parametric	0.035	Y			N	FALSE
CCR-AP-3	14/14	0%	-	0.0779	0.077	0.0935	0.1	0.0001208	0.01099	0.1411	0.04	mg/L	Y	14	N	N	Stable		Normal	0.074	Y			Y	TRUE
CCR-AP-4	0/14	100%	0.005-0.05	0.0373	0.05	0.05		0.0004369	0.0209	0.5609	0.04	mg/L	N	0	N	N	NA		NA	0.005	N			N	FALSE
CCR-AP-5	11/14	21%	0.05-0.05	0.0246	0.0185	0.05	0.023	0.0002004	0.01416	0.5762	0.04	mg/L	N	0	N	N	Stable		Normal	0.050	N			N	FALSE
CCR-AP-6	13/14	7%	0.005-0.005	0.0359	0.04	0.043	0.043	0.0001066	0.01032	0.2879	0.04	mg/L	Y	6	N	N	Stable		Non-parametric	0.029	Y			N	FALSE
CCR-AP-7	13/14	7%	0.05-0.05	0.0246	0.0225	0.0396	0.034	0.00008132	0.009018	0.3659	0.04	mg/L	N	0	N	N	Stable		Normal	0.021	Y			N	FALSE
CCR Appendix-IV: Mercury, Total (mg/L)																										
CCR-BK-1	0/13	100%	0.0002-0.0002	0.0004	0.0004	0.0004		6.776E-23	1.1642E-11	5.82E-08	0.002	mg/L	N	0	N	N	Stable	Non-parametric	Normal			0.0002	0.002			
CCR-BK-2	2/13	85%	0.0002-0.0002	0.000384	0.0004	0.0004	0.0004	1.477E-09	0.00005434	0.2826	0.002	mg/L	N	0	N	N	Stable		Non-parametric							
CCR-AP-1	1/13	92%	0.0002-0.0002	0.000382	0.0004	0.0004	0.00017	1.9532E-09	0.0000625	0.327	0.002	mg/L	N	0	Y	Y	Stable		Normal	0.0002	N			N	FALSE
CCR-AP-2	1/13	92%	0.0002-0.0002	0.000382	0.0004	0.0004	0.00016	2.126E-09	0.00006522	0.3418	0.002	mg/L	N	0	Y	Y	Stable		Normal	0.0002	N			N	FALSE
CCR-AP-3	8/13	38%	0.0002-0.0002	0.000358	0.00036	0.000895	0.00106	2.662E-08	0.0002308	1.2918	0.002	mg/L	N	0	N	N	Increase		Normal	0.0002	N			N	FALSE
CCR-AP-4	0/13	100%	0.0002-0.0002	0.0004	0.0004	0.0004		6.776E-23	1.1642E-11	5.82E-08	0.002	mg/L	N	0	N	N	Stable		Log-transformed	0.0002	N			N	FALSE
CCR-AP-5	0/13	100%	0.0002-0.0002	0.0004	0.0004	0.0004		6.776E-23	1.1642E-11	5.82E-08	0.002	mg/L	N	0	N	N	Increase		Normal	0.0002	N			N	FALSE
CCR-AP-6	1/13	92%	0.0002-0.0002	0.000378	0.0004	0.0004	0.00011	3.106E-09	0.0000788	0.4174	0.002	mg/L	N	0	N	N	Decrease		Normal	0.0002	N			N	FALSE
CCR-AP-7	0/13	100%	0.0002-0.0002	0.0004	0.0004	0.0004		6.776E-23	1.1642E-11	5.82E-08	0.002	mg/L	N	0	N	N	Stable		Non-parametric	0.0002	N			N	FALSE
CCR Appendix-IV: Molybdenum, Total (mg/L)																										
CCR-BK-1	12/14	14%	0.005-0.005	0.00208	0.0015	0.005	0.0034	0.000002118	0.001455	0.7009	0.1	mg/L	N	0	N	N	Decrease	Non-parametric	Normal			0.005	0.1			
CCR-BK-2	6/14	57%	0.005-0.005	0.00339	0.005	0.005	0.0025	0.000003944	0.001986	0.5852	0.1	mg/L	N	0	N	N	Stable		Non-parametric							
CCR-AP-1	13/14	7%	0.005-0.005	0.00406	0.00405	0.00584	0.0074	0.000001775	0.001332	0.3284	0.1	mg/L	N	0	Y	Y	Stable		Normal	0.0042	Y			N	FALSE
CCR-AP-2	14/14	0%	-	1.65	1.65	1.935	2	0.04577	0.2139	0.1297	0.1	mg/L	Y	14	Y	Y	Increase		Normal	2.0000	Y			Y	TRUE
CCR-AP-3	14/14	0%	-	0.884	0.895	1	1	0.008073	0.08985	0.1016	0.1	mg/L	Y	14	N	N	Stable		Normal	0.8600	Y			Y	TRUE
CCR-AP-4	13/14	7%	0.005-0.005	0.00276	0.0018	0.00633	0.0088	0.000004486	0.002118	0.7662	0.1	mg/L	N	0	N	N	Decrease		Log-transformed	0.0012	Y			N	FALSE
CCR-AP-5	14/14	0%	-	0.0474	0.053	0.0684	0.071	0.0003066	0.01751	0.3697	0.1	mg/L	N	0	N	N	Increase		Normal	0.0710	Y			N	FALSE
CCR-AP-6	14/14	0%	-	0.00932	0.00875	0.0171	0.021	0.00002014	0.004488	0.4814	0.1	mg/L	N	0	N	N	Decrease		Normal	0.0057	Y			N	FALSE
CCR-AP-7	4/14	71%	0.005-0.05	0.00707	0.005	0.02075	0.0016	0.0001561	0.0125	1.768	0.1	mg/L	N	0	N	N	Stable		Non-parametric	0.0050	N			N	FALSE
CCR Appendix-IV: Radium-226 & 228 (pCi/L)																										
CCR-BK-1	8/14	43%	0.366-5	2.96	1.001	10	1.59	7.032	3.75	2.526	5	pCi/L	N	0	Y	N	Increase	Non-parametric	Normal			0.005	5.000			
CCR-BK-2	4/14	71%	0.356-5	6.72	10	10	6.26	8.344	4.086	1.2148	5	pCi/L	N	0	N	N	Stable		Non-parametric							
CCR-AP-1	9/14	36%	0.672-5	3.94	1.879	10	2.1	7.664	3.916	1.9826	5	pCi/L	N	0	Y	N	Stable		Non-parametric	5.00	N			N	FALSE
CCR-AP-2	14/14	0%	-	1.452	1.368	2.556	2.76	0.12064	0.4912	0.6762	5	pCi/L	N	0	N	N	Stable		Normal	0.55	Y			N	FALSE
CCR-AP-3	13/14	7%	5-5	2.02	1.262	7.368	2.48	2.678	2.314	2.298	5	pCi/L	N	0	Y	N	Stable		Normal	0.62	Y			N	FALSE
CCR-AP-4	5/14	64%	0.414-5	6.02	5.856	13.81	15.86	13.182	5.134	1.7078	5	pCi/L	Y	2	N	N	Stable		Non-parametric	5.00	N			N	FALSE
CCR-AP-5	9/14	36%	0.393-5	2.26	0.998	10	1.486	5.18	3.218	2.836	5	pCi/L	N	0	Y	N	Stable		Non-parametric	0.55	Y			N	FALSE
CCR-AP-6	6/14	57%	0.441-5	4.94	1.778	10	9.54	9.704	4.406	1.7836	5	pCi/L	N	0	N	N	Stable		Non-parametric	5.00	N			N	FALSE
CCR-AP-7	7/14	50%	0.339-5	3.68	1.382	10	1.552	8.354	4.088	2.224	5	pCi/L	N	0	N	N	Stable		Non-parametric	0.42	Y			N	FALSE

CCR Appendix-IV: Selenium, Total (mg/L)																									
CCR-BK-1	3/14	79%	0.005-0.005	0.00808	0.01	0.01	0.00134	0.000007026	0.003748	0.928	0.05	mg/L	N	0	N	N	Stable	Non-parametric	Non-parametric			0.005	0.050		
CCR-BK-2	2/14	86%	0.005-0.005	0.00878	0.01	0.01	0.00196	0.00000466	0.003054	0.6956	0.05	mg/L	N	0	Y	N	Stable		Non-parametric						
CCR-AP-1	1/14	93%	0.005-0.005	0.00936	0.01	0.01	0.00098	0.000002798	0.002366	0.5058	0.05	mg/L	N	0	N	N	Stable		Non-parametric	0.0050	N			N	FALSE
CCR-AP-2	4/14	71%	0.005-0.05	0.0204	0.01	0.1	0.00166	0.000556	0.03334	3.278	0.05	mg/L	N	0	Y	N	Stable		Non-parametric	0.0500	N			N	FALSE
CCR-AP-3	12/14	14%	0.05-0.05	0.033	0.027	0.1	0.048	0.0004932	0.0314	1.9004	0.05	mg/L	N	0	N	N	Stable		Normal	0.0500	N			N	FALSE
CCR-AP-4	4/14	71%	0.005-0.005	0.00764	0.01	0.01	0.0028	0.000007296	0.00382	1	0.05	mg/L	N	0	N	N	Stable		Non-parametric	0.0050	N			N	FALSE
CCR-AP-5	1/14	93%	0.005-0.05	0.0286	0.01	0.1	0.0017	0.0007214	0.03798	2.648	0.05	mg/L	N	0	Y	N	Stable		Non-parametric	0.0500	N			N	FALSE
CCR-AP-6	1/14	93%	0.005-0.05	0.0158	0.01	0.0685	0.0013	0.0002854	0.02388	3.022	0.05	mg/L	N	0	N	N	Stable		Non-parametric	0.0050	N			N	FALSE
CCR-AP-7	2/14	86%	0.005-0.05	0.01524	0.01	0.0685	0.00198	0.0002908	0.02412	3.164	0.05	mg/L	N	0	Y	N	Stable		Non-parametric	0.0050	N			N	FALSE
CCR Appendix-IV: Thallium, Total (mg/L)																									
CCR-BK-1	1/13	92%	0.001-0.001	0.001852	0.002	0.002	0.000076	1.3668E-07	0.0005228	0.5646	0.002	mg/L	N	0	N	N	Stable	Non-parametric	Non-parametric			0.001	0.002		
CCR-BK-2	1/13	92%	0.001-0.001	0.001856	0.002	0.002	0.000118	1.3078E-07	0.0005114	0.5514	0.002	mg/L	N	0	N	N	Stable		Non-parametric						
CCR-AP-1	3/13	77%	0.001-0.001	0.001576	0.002	0.002	0.00026	3.126E-07	0.0007906	1.0034	0.002	mg/L	N	0	N	N	Stable		Non-parametric	0.001	N			N	FALSE
CCR-AP-2	2/13	85%	0.001-0.01	0.0045	0.002	0.02	0.0003	0.00002296	0.006776	3.018	0.002	mg/L	N	0	Y	N	Stable		Non-parametric	0.010	N			Y	FALSE
CCR-AP-3	1/13	92%	0.001-0.01	0.00602	0.002	0.02	0.00028	0.00003058	0.007822	2.598	0.002	mg/L	N	0	Y	N	Stable		Non-parametric	0.010	N			Y	FALSE
CCR-AP-4	2/13	85%	0.001-0.001	0.00173	0.002	0.002	0.00044	2.126E-07	0.000652	0.7542	0.002	mg/L	N	0	N	N	Stable		Non-parametric	0.001	N			N	FALSE
CCR-AP-5	1/13	92%	0.001-0.01	0.00602	0.002	0.02	0.000152	0.00003064	0.00783	2.604	0.002	mg/L	N	0	Y	N	Stable		Non-parametric	0.010	N			Y	FALSE
CCR-AP-6	4/13	69%	0.001-0.01	0.00282	0.002	0.0155	0.00036	0.000013132	0.005124	3.626	0.002	mg/L	N	0	N	N	Stable		Non-parametric	0.001	N			N	FALSE
CCR-AP-7	1/13	92%	0.001-0.01	0.00324	0.002	0.0155	0.000108	0.000012304	0.00496	3.064	0.002	mg/L	N	0	N	N	Stable		Non-parametric	0.001	N			N	FALSE

UG - Up Gradient DG - Down Gradient N/A - Not available NT- Not tested

* - Determined using the Shapiro-Wilks statistical test at a 1% significance level and a residual probability plot.

Appendix J
Description of Site Hydrogeology

2. Site Geology and Hydrogeology

The regional geology and hydrogeology is described in the *Surficial Geologic Map of the Evansville Indiana, and Henderson, Kentucky, Area* prepared by the USGS 2009 and in the *May 2017 Groundwater Quality Data and Statistics* prepared by Cardno ATC in May 2017.

2.1 SITE GEOLOGY

The Ohio River valley contains fill and loess (windblown) deposits derived indirectly from continental ice sheets. These were deposited from meltwater heavily loaded with entrained sediments accumulated in the area on the Pennsylvanian age shale, limestone and sandstone bedrock. Westerly winds simultaneously deposited silty sediments. As a result, base levels of the valley floor increased in elevation and created natural levees and outwashes. These natural levees produced slackwater lakes which deposited thick sequences of silt and clay. When the ice sheets retreated, the sediment load in the Ohio River diminished and lowered base levels. Consequently, the river incised the slackwater lake sediments, sculpted lacustrine terraces, and deposited silty and clayey stream alluvium.

Soil borings drilled at the Site indicates that the uppermost geologic unit is comprised of unconsolidated alluvial deposits consisting of primarily silts and clays with discontinuous layers of sand. This unit overlies Pennsylvanian age sandstone which is commonly identified as the Inglefield Sandstone. Underlying the Inglefield Sandstone is low-permeability weathered shale and siltstone. The sandstone and shale unit has been eroded on the north side of the landfill where the underlying limestone unit was encountered.

2.2 SITE HYDROGEOLOGY

Hydrogeologic units are defined based on their ability to transmit groundwater or serve as confining units between zones of groundwater saturation. The uppermost aquifer at the Site occurs within unconsolidated alluvial deposits which consist primarily of silty clay containing discontinuous layers of sand. Beneath upland areas, or ridgelines the uppermost aquifer occurs in weathered sandstone, shale, or siltstone. Recharge to the surficial aquifer occurs through direct surface infiltration.

Piezometric data recorded from the monitoring wells installed on-Site shows that the configuration of the uppermost aquifer is primarily controlled by surface topography with some influence from the underlying weathered bedrock. Groundwater flow across the eastern portion of the Landfill is to the north and northeast. Beneath the western portion of the Landfill groundwater flow shifts to the north and northwest into a trough that flows to the southwest beneath the Sedimentation Ponds (Figure 3). Groundwater flow in the vicinity of the permitted Ash Pond is predominantly to the west with a component of flow to the northwest from the northern portion of the Ash Pond beneath the Landfill. Groundwater elevations vary seasonally but the groundwater flow patterns remain consistent.

Groundwater flow velocity in the uppermost aquifer beneath the CCR units was estimated using site-specific hydraulic conductivity obtained from slug testing and hydraulic gradients, and an assumed effective porosity of 25 percent. Hydraulic conductivity varied from 1E-3 cm/sec in the vicinity of the Landfill to 3E-4 cm/sec in the vicinity of the Sedimentation Ponds and the Ash Pond. The hydraulic gradient beneath and downgradient of the Landfill and the Ash Pond is 0.03 feet/foot and 0.04 feet/foot respectively. The hydraulic gradient lessens beneath and downgradient of the Sedimentation Pond

dropping to 0.004 feet/foot. Using the site-specific hydraulic conductivity and hydraulic gradients, and assuming an effective porosity of 25 percent the groundwater flow velocity in the vicinity of the CCR units is estimated as follows; 120 feet/year at the Landfill, 50 feet/year at the Ash Pond, and approximately 5 feet/year beneath and downgradient of the Sedimentation Pond.

Appendix K
Corrective Measures Assessment

REPORT ON

CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

by
Haley & Aldrich, Inc.
Cleveland, Ohio

for
Southern Indiana Gas and Electric Company
Evansville, Indiana

File No. 129420-021
September 2019

Overview

Southern Indiana Gas and Electric Company (SIGECO) retained Haley & Aldrich, Inc. (Haley & Aldrich) to prepare this Corrective Measures Assessment (CMA) for the Coal Combustion Residual (CCR) management unit, referred to as the Ash Pond, located at A.B. Brown Generating Station (ABB) in Mount Vernon, Indiana. ABB is a coal-fired power plant located in Posey County near the community of West Franklin, in Posey County, Indiana. The CMA was completed in accordance with requirements stated in the U.S. Environmental Protection Agency's (USEPA) rule entitled *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities*. 80 Fed. Reg. 21302 (Apr. 17, 2015) (promulgating 40 CFR §257.61); 83 Fed. Reg. 36435 (July 30, 2018) (amending 40 CFR §257.61) (CCR Rule).

SIGECO implemented groundwater monitoring under the CCR Rule through a phased approach to allow for a graduated response and evaluation of steps to address groundwater quality. Assessment monitoring completed in 2018 evaluated the presence and concentration of Appendix IV constituents in groundwater specified in the CCR Rule. Of the 23 CCR parameters evaluated, only two Appendix IV constituents, lithium and molybdenum, are present at concentrations above the Groundwater Protection Standards (GWPS) established for the Ash Pond.

SIGECO completed a detailed environmental evaluation of the Ash Pond and surrounding area in preparing this CMA. In 2019, a risk evaluation was undertaken to identify whether current groundwater conditions pose an unacceptable risk to human health and the environment. The risk evaluation, presented in **Section 3**, concluded that there are **no adverse effects on human health or the environment currently or under reasonably anticipated future uses** from groundwater due to CCR management practices at the Ash Pond.

Recognizing that SIGECO has entered into a long-term contract to beneficially use the CCR materials stored in the Ash Pond, the remedial alternatives presented in this CMA focus on varying groundwater remediation alternatives as the source will be removed through the beneficial use project, including:

- Alternative 1: Monitored Natural Attenuation (MNA) with Closure by Removal (CBR);
- Alternative 2: Hydraulic Containment with No Treatment, CBR, and MNA; and
- Alternative 3: Hydraulic Containment with Treatment, CBR, and MNA.

These three alternatives were developed to meet the threshold criteria provided in the CCR rule at § 257.97 as discussed in **Section 4**, which are:

- Be protective of human health and the environment;
- Attain the groundwater protection standard as specified pursuant to §257.95(h);
- Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in appendix IV to this part into the environment;
- Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems;
- Comply with standards for management of wastes as specified in §257.98(d).

The alternatives were then compared to three of the four balancing criteria stated in the CCR Rule at §257.97. The four balancing criteria consider:

1. The long- and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful;
2. The effectiveness of the remedy in controlling the source to reduce further releases;
3. The ease or difficulty of implementing a potential remedy; and
4. The degree to which community concerns are addressed by a potential remedy.

Balancing criteria four, which considers community concerns, will be evaluated following a public information session to be conducted at least 30 days prior to remedy selection by SIGECO.

The following observations are made regarding beneficial use and groundwater remedial alternatives for the Ash Pond and are described more fully in this report:

- **Groundwater Compliance**: Under current conditions there is no risk to human health and the environment associated with the Ash Pond. Upon completion of the beneficial use project, lithium and molybdenum concentrations in groundwater are expected to decline below their GWPS through the chemical, physical, and biological processes of natural attenuation. Additional, or supplemental, remedial alternatives are included in this document for consideration in addition to MNA.

- **Groundwater Treatment:** In order to implement a groundwater alternative that includes treatment, laboratory testing would be required to demonstrate effective treatment of lithium and molybdenum using ex-situ treatment methods, such as ion exchange or reverse osmosis. Following laboratory-scale testing, pilot-scale treatment evaluations for the constituents would also be required if such remedies were selected as part of the Corrective Action process.

- **Beneficial Use Timeframe:** The Ash Pond at ABB contains approximately 6 million cubic yards of CCR material to be removed under the beneficial use plan. Removal of large volumes of CCR stored at the Ash Pond could take as much as 13 years to complete, during which time the impoundment would remain open (although not receiving CCR) and would be subject to ongoing infiltration from precipitation. However, this time frame would not pose a risk as the risk evaluation concludes that there is currently no risk to human health or the environment from the Ash Pond.

In accordance with §257.98, SIGECO will implement a groundwater monitoring program to document the effectiveness of the selected remedial alternative. Corrective measures are considered complete when monitoring reflects concentrations of lithium and molybdenum in groundwater downgradient of the Ash Pond are not above GWPS for three consecutive years.

USEPA is in the process of modifying certain CCR Rule requirements and, depending upon the nature of such changes, assessments made herein could be modified or supplemented to reflect such future regulatory revisions. See *Federal Register (March 15, 2018; 83 FR 11584*).

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List of Acronyms and Abbreviations

Abbreviation	Definition
ABB	A.B. Brown Generating Station
Ash Pond	CCR Management Unit
CBR	Closure by Removal
CCR	Coal Combustion Residual
COC	Constituent of Concern
CMA	Corrective Measures Assessment
CSM	Conceptual Site Model
GMP	Groundwater Monitoring Plan
GWPS	Groundwater Protection Standards
Haley & Aldrich	Haley & Aldrich, Inc.
MNA	Monitored Natural Attenuation
msl	Mean Sea Level
N&E	Nature and Extent
SIGECO	Southern Indiana Gas and Electric Company
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
USEPA	United States Environmental Protection Agency

1. Introduction

Haley & Aldrich, Inc. (Haley & Aldrich) was retained by Southern Indiana Gas and Electric Company (SIGECO) to prepare this Corrective Measures Assessment (CMA) for the Coal Combustion Residual (CCR) management unit "Ash Pond" located at the A.B. Brown Generating Station (ABB), herein referred to as the "Site", in Posey County, Indiana. SIGECO has conducted detailed geologic and hydrogeologic investigations under the U.S. Environmental Protection Agency (USEPA) rule entitled *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities*. 80 Fed. Reg. 21302 (Apr. 17, 2015) (promulgating 40 CFR §257.61); 83 Fed. Reg. 36435 (July 30, 2018) (amending 40 CFR §257.61) (CCR Rule). These investigations were, in part, related to determination of requirements related to the potential for both Ash Pond closure and groundwater corrective action.

This CMA includes a summary of the groundwater monitoring results for Appendix IV constituents, a summary of the evaluation of the Appendix III constituents for statistically significant increases (SSI) compared to background, and a comparison of the Appendix IV constituents detected in assessment monitoring to the Groundwater Protection Standards (GWPS). These evaluations identified statistically significant levels (SSL) of lithium and molybdenum at two monitoring locations in groundwater downgradient of the Ash Pond. This report evaluates potential corrective measures to remediate groundwater for the exceedance of the GWPS.

1.1 FACILITY DESCRIPTION/BACKGROUND

The Site is located approximately 0.5 miles north of the Ohio River (**Figure 1-1**). The Site began operations in 1978 with the construction of a 250-megawatt generating unit. In 1985, an additional generating unit was added. Both units use Illinois Basin coal. SIGECO currently owns the land and operates the station for supplying electric power to industrial, commercial, and residential customers in its service territory. The Ash Pond was constructed and commissioned in 1978 by building an earthen dam across an existing valley. In 2003, a second dam was constructed east of the original dam and further up the valley to increase the storage capacity. This temporarily created an upper pond and a lower pond. The upper and lower ponds were operated separately until 2016 when the upper dam was decommissioned. A 10-foot-wide breach was cut into the upper embankment and the normal pool elevation was lowered. Currently, the upper pool and the lower pool act as one CCR unit referred to as the Ash Pond, which has a surface area of approximately 159 acres. Site features are shown on **Figure 1-2**.

1.2 SITE CHARACTERIZATION WORK SUMMARY

Three significant subsurface geotechnical and/or hydrogeological investigations have been completed at the Site dating back to 1993, after the construction of the generating station and CCR units and continuing through 2015. These studies generated subsurface data characterizing the Site geology and hydrogeology which were used to support the development of a hydrogeologic Conceptual Site Model (CSM). The CSM has been further enhanced with ongoing CCR groundwater monitoring and supplemental subsurface investigation activities performed by Haley & Aldrich. Findings from these investigations have added to the CSM that supports the CMA activities discussed in this report.

1.3 GROUNDWATER MONITORING

Groundwater monitoring under the CCR Rule occurs through a phased approach to allow for a graduated response (i.e., baseline, detection, and assessment monitoring as applicable) and evaluation of steps to address groundwater quality. Haley & Aldrich prepared a *Groundwater Monitoring Plan* (GMP) as required by the CCR Rule. The GMP presents the design of the groundwater monitoring system, groundwater sampling and analysis procedures, and groundwater statistical analysis methods.

To establish baseline groundwater quality results, monitoring wells were installed in March 2016, and July 2016. The monitoring well network includes two background wells (CCR-BK-1R and CCR-BK-2) and seven downgradient monitoring wells (CCR-AP-1R, CCR-AP-2R, CCR-AP-3R, CCR-AP-4R, CCR-AP-5, CCR-AP-6, CCR-AP-7R) located around the perimeter of the Ash Pond. Monitoring well locations are shown on **Figure 1-3**.

Detection monitoring events occurred in 2016 and 2017. The results of the sampling events were then compared to background using statistical methods to determine if Appendix III constituents are present at concentrations above background, called SSIs downgradient of the Ash Pond. The result of the statistical analysis identified SSIs that triggered Assessment Monitoring and respective notification of the same.

During the Assessment Monitoring phase, two rounds of groundwater samples were collected in accordance with 40 CFR §257.95(b) and 40 CFR §257.95(d)(1) of the CCR Rule. Groundwater samples were collected during June, and August 2018. Concurrent with the second assessment sampling round, and as required by 40 CFR §257.95(h), GWPS were established for the detected Appendix IV constituents. The assessment monitoring sampling results were compared statistically to the GWPS to determine if SSLs of Appendix IV constituents were present downgradient of the Ash Pond. The results of this evaluation indicated that lithium and molybdenum were present in groundwater at SSLs above the GWPS. Appendix IV analytical results are summarized in **Table 1A**.

As a result of this determination, and in accordance with 40 CFR §257.95(g)(3), a field investigation was initiated to demonstrate that a source other than the Ash Pond caused the lithium and molybdenum contamination. The field investigation included sampling and analysis of naturally occurring coal identified near monitoring well CCR-AP-2R as an alternative source of molybdenum and lithium and surface water sampling from the Coal Pile Runoff Pond and lower pool of the Ash Pond to evaluate the effluent from the coal pile runoff as an alternate source of the Appendix IV SSLs detected at CCR-AP-3R. While this investigation showed that the naturally occurring coal and the coal pile runoff were contributing sources, they did not contribute lithium and molybdenum at levels that resulted in a determination of an alternative source. Therefore, the Ash Pond at ABB is moving forward with a CMA for lithium and molybdenum.

1.4 CORRECTIVE MEASURES ASSESSMENT PROCESS

The CMA process involves development of groundwater remediation technologies that will result in meeting the following threshold criteria: protection of human health and the environment, attainment of GWPS, source control, constituent removal, and compliance with standards for waste management. Once these technologies are demonstrated to meet these criteria, they are then compared to one another with respect to the following balancing criteria: long- and short-term effectiveness, source control, and ease or difficulty of implementation. Input from the community on such proposed measures will occur as part of a public meeting to be conducted at least 30 days prior to remedy selection by SIGECO.

1.5 RISK REDUCTION AND REMEDY

The CCR Rule (§257.97(b)(1) - Selection of Remedy) requires that remedies must be protective of human health and the environment. Further, §257.97(c) of the CCR Rule requires that in selecting a remedy, the owner or operator of the CCR unit must consider specific evaluation factors, including the risk reduction achieved by each of the proposed corrective measures. Each of the following evaluation factors listed here from §257.97 and discussed in **Section 4** are those that are directly related to human health and environmental risk:

- (c)(1)(i) Magnitude of reduction of existing risks;
- (c)(1)(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy;
- (c)(1)(iv) Short-term risks that might be posed to the community or the environment during implementation of such a remedy, including potential threats to human health and the environment associated with excavation, transportation, and re-disposal of contaminant;
- (c)(1)(vi) Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment;

The following are additional factors related to risk that are considered when developing the schedule for implementing and completing remedial activities once a remedy is selected (§257.97(d)):

- (d)(4) Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy[1];
- (d)(5)(i) Current and future uses of the aquifer;
- (d)(5)(ii) Proximity and withdrawal rate of users; and
- (d)(5)(iv) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to CCR constituents.

[1] Factors (d)(4) and (d)(5) are not part of the CMA evaluation process as described in §257.97(d)(4), §257.97(d)(5)(i)(ii)(iv); rather they are factors the owner or operator must consider as part of the schedule for remedy implementation.

2. Groundwater Conceptual Site Model

The Site geology and hydrogeology was initially described in the *Groundwater Monitoring Plan* prepared by Haley & Aldrich in October 2017. The CSM presented in this section of the CMA has been updated to reflect information gathered to comply with the CCR Rule.

2.1 SITE SETTING

The Site is located in Posey County near the community of West Franklin, Indiana. The Site is located approximately 0.5 miles north of the Ohio River (**Figure 1-1**). The Site varies in elevation with natural ground surface, with elevations varying from 380 to 520-feet above msl. The higher elevations are generally to the north of the Site with surface topography dominated by a series of ridges separated by ravines. In general, surface topography across the Site generally slopes to the west towards the western property boundary then to the south toward the Ohio River. Surface water runoff occurs via sheet flow to low lying areas or ravines which eventually lead to the Ohio River.

2.2 GEOLOGY AND HYDROGEOLOGY

The Ohio River valley contains fill and loess (windblown) deposits derived indirectly from continental ice sheets. These were deposited from meltwater heavily loaded with entrained sediments accumulated in the area on the Pennsylvanian age shale, limestone and sandstone bedrock. Westerly winds simultaneously deposited silty sediments that cap the upland areas north of the river.

Logs from soil borings drilled at the Site indicate that the uppermost geologic unit is comprised of unconsolidated alluvial deposits consisting of primarily silts and clays with discontinuous layers of sand. This unit overlies Pennsylvanian age sandstone which is commonly identified as the Inglefield Sandstone. Underlying the Inglefield Sandstone is low-permeability weathered shale and siltstone. The sandstone and shale unit has been eroded on the north side of the property where the underlying limestone unit was encountered.

The Site is located in the vicinity of the Wabash Valley and New Madrid seismic zones. The largest earthquake recorded (magnitude 5.2) proximal to the Site occurred in April 18, 2008 approximately fifty miles northwest of the facility.

Hydrogeologic units are defined based on their ability to transmit groundwater or serve as confining units between zones of groundwater saturation. The uppermost aquifer at the Site occurs within unconsolidated alluvial deposits which consist primarily of silty clay containing discontinuous layers of sand. Beneath upland areas, or ridgelines the uppermost aquifer occurs in weathered sandstone, shale, or siltstone. Recharge to the surficial aquifer occurs through direct surface infiltration.

Piezometric data recorded from the monitoring wells installed on-Site show that the configuration of the uppermost aquifer mimics surface topography with groundwater flow from the ridges into the ravines where groundwater discharges into small perennial streams. Groundwater flow in the vicinity of the Ash Pond is predominantly to the west with a component of flow to the northwest from the northern portion of the Ash Pond beneath the Landfill. Groundwater elevations vary seasonally but the groundwater flow patterns remain consistent.

Groundwater flow velocity in the uppermost aquifer beneath the CCR units was estimated using site-specific hydraulic conductivity obtained from slug testing and hydraulic gradients, and an assumed effective porosity of 25 percent. Hydraulic conductivity is approximately $3E^{-4}$ cm/sec in the vicinity of the Ash Pond. The hydraulic gradient downgradient of the Ash Pond is 0.04 feet/foot. Using the site-specific hydraulic conductivity and hydraulic gradients, and assuming an effective porosity of 25 percent the groundwater flow velocity in the vicinity of the Ash Pond is 50 feet/year at the Ash Pond.

2.3 GROUNDWATER PROTECTION STANDARDS

Haley & Aldrich completed a statistical evaluation of groundwater samples using the methods and procedures outlined in the Groundwater Monitoring Plan's *Statistical Analysis Plan* (Haley & Aldrich 2017) to develop site-specific GWPS for each Appendix IV constituent, as required by the CCR Rule.

Groundwater results were compared to the site-specific GWPS. SSLs above the GWPS are limited to samples collected from two monitoring wells (CCR-AP-2R and CCR-AP-3R) and for two Appendix IV constituents (molybdenum and lithium). Monitoring well locations with SSLs above the GWPS are illustrated on **Figure 2-1**.

2.4 NATURE AND EXTENT OF GROUNDWATER IMPACTS

As outlined in **Section 1.3** of this CMA, SSLs for lithium and molybdenum were identified from the assessment monitoring results. Because of the compressed schedule in the CCR Rule, SIGECO decided to initiate an evaluation of the nature and extent of molybdenum and lithium based on preliminary statistical analysis of the assessment monitoring results, while simultaneously evaluating the potential for sources other than the Ash Pond to be the source of lithium and molybdenum. Haley & Aldrich initiated an investigation to define the horizontal and vertical nature and extent (N&E) of Appendix IV SSLs, as required by the CCR Rule, in November 2018 by installing five new monitoring wells (CCR-AP-2I, CCR-AP-3I, CCR-AP-8, CCR-AP-9, and CCR-AP-10). Monitoring wells CCR-AP-8, CCR-AP-9, and CCR-AP-10 were installed to horizontally delineate the Appendix IV SSLs detected in samples collected from CCR-AP-2R and CCR-AP-3R, and CCR-AP-2I and CCR-AP-3I were installed to vertically delineate the SSLs at these same locations. The location of the new monitoring wells is shown on **Figure 2-1**.

Analytical results from the N&E wells indicate that molybdenum and lithium concentrations are limited to the shallow aquifer at CCR-AP-2R and CCR-AP-3R. Lithium and molybdenum have been vertically and horizontally delineated by the newly installed wells. Appendix IV analytical results for the nature and extent monitoring wells are summarized in **Table 1B**.

3. Risk Assessment and Exposure Evaluation

The purpose of the risk evaluation is to provide the information needed to interpret and meaningfully understand the groundwater monitoring data collected and published for the ABB Ash Pond under the CCR Rule.

The risk evaluation was completed by developing a conceptual site model (CSM) to identify the potential for human or ecological exposure to constituents that may have been released to the environment. The CSM was used to resolve questions such as: Is there a source? Are constituents released from the source? Are environmental media (soil, groundwater, surface water, sediments and air) affected by the constituent release? Do constituents travel within and between media? Is there a point where a receptor (human or ecological) could contact the constituents in the medium? If the answers to these questions are 'Yes', then the risk evaluation resolves the question "Are the constituent concentrations high enough to potentially have a toxic effect?" by comparing constituent concentrations in groundwater to risk-based screening levels.

Based on the investigation results, SSLs for lithium and molybdenum were detected in the groundwater monitoring wells at the waste boundary, indicating that a migration pathway between the ABB Ash Pond and groundwater beneath the Ash Pond exists. However, analytical results from the Nature & Extent wells indicate that statistically significant molybdenum and lithium concentrations are limited to the shallow aquifer at CCR-AP-2R and CCR-AP-3R, which are located on the facility property (**Figure 2-2**). There are no statistically significant concentrations in further downgradient wells (e.g., CCR-AP-9; **Figure 2-2**), thereby indicating that concentrations of molybdenum and lithium are not elevated beyond the property boundary. Furthermore, groundwater downgradient of the ABB Ash Pond is not used as a source of drinking water and is not flowing toward locations where receptors could contact it. Specifically:

- Groundwater flow is towards the west and northwest. There are no groundwater supply wells within one-half mile to the west and northwest of the ABB Ash Pond.

- Groundwater does not flow from the ABB Ash Pond south toward the Ohio River.

Therefore, there is not a point where a receptor (human or ecological) could contact the CCR constituents in groundwater. Without the ability for a receptor to contact the CCR constituents, the risk is negated.

This risk evaluation demonstrates that there are no adverse impacts on human health or ecological receptors from groundwater resulting from coal ash management practices at the A.B. Brown Generating Station Ash Pond.

Therefore, because no adverse risk currently exists, any of the remedies considered in this CMA are all protective of human health and the environment, and implementation of any of the remedial alternatives will not result in a meaningful reduction in risk to groundwater-related exposures or risk.

4. Corrective Measures Alternatives

4.1 CORRECTIVE MEASURES ASSESSMENT GOALS

The overall goal of this CMA is to identify and evaluate the appropriateness of potential corrective measures to prevent further releases of Appendix IV constituents to groundwater above their GWPS, to remediate releases of Appendix IV constituents detected during groundwater monitoring above their GWPS that have already occurred, and to restore groundwater in the affected area to conditions where Appendix IV constituents are present at concentrations below the GWPS. The corrective measures evaluation that is discussed below and subsequent sections provides an analysis of the effectiveness of the three potential corrective measures in meeting the requirements and objectives of remedies as described under §257.97 (also shown graphically on **Figure 4-1**). Additional remedial alternatives were considered but were determined to not be viable for remediating groundwater at this Site. By meeting these requirements, this assessment also meets the requirements promulgated in §257.96 which include an evaluation of:

- The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to residual contamination;
- The time required to complete the remedy; and
- The institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy.

The criteria listed above are included in the balancing criteria considered during the corrective measures evaluation, described in **Section 5**.

4.2 GROUNDWATER FATE AND TRANSPORT MODELING

Groundwater at the Site was modeled utilizing Groundwater Vista Version 7 for flow and solute transport. The model was constructed, calibrated, and subsequent simulations run to evaluate remedy alternatives for Appendix IV constituents above the GWPS. Site-specific parameters (i.e., groundwater elevations and hydraulic conductivity) were utilized for model preparation. MODFLOW 2005, a finite difference three-dimensional solver, was utilized for groundwater flow estimation. Modeled groundwater elevations were compared to observed values from the on-site well network (February 2019) to achieve a calibration of less than 10% scaled root mean squared (RMS) of measured water levels. Once groundwater flow was calibrated in the model, solute transport was completed using MT3DMS, a three-dimensional solute transport modeling program. Parameters affecting transport such as advection, diffusion, dispersion, and adsorption are utilized within the MT3DMS package to estimate solute transport within the model domain.

The calibrated flow models were used to simulate the different remediation alternatives and the effects they have on groundwater quality through time. These simulations are incorporated into the discussion on remediation alternatives provided below.

4.3 CORRECTIVE MEASURES ALTERNATIVES

Corrective measures are considered complete when Appendix IV constituents are present in groundwater at the Ash Pond at concentrations below the Appendix IV GWPS for three consecutive years of groundwater monitoring. In accordance with §257.97, the groundwater corrective measures to be considered must meet, at a minimum, the following threshold criteria:

1. Be protective of human health and the environment;
2. Attain the GWPS;
3. Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of COCs to the environment;
4. Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, considering factors such as avoiding inappropriate disturbance of sensitive ecosystems; and
5. Comply with standards (regulations) for waste management.

Each of the remedial alternatives assembled as part of this CMA meet the requirements of the threshold criteria listed above.

Due to the existence of long-term contracts for the beneficial use of CCR materials contained in the Ash Pond, the remedial alternatives presented below contemplate Closure by Removal (CBR) of the Ash Pond only.

4.3.1 Alternative 1 – Monitored Natural Attenuation (MNA) with Closure by Removal (CBR) with Beneficial Use

This alternative consists of removal of the Ash Pond CCR material followed by natural attenuation of lithium and molybdenum in groundwater. This alternative would eliminate the source (through beneficial use/removal), and over time, allow the concentrations of these constituents in downgradient groundwater to attenuate. Through the beneficial use of reclaimed CCR materials, the amount of material contained in the Ash Pond will be reduced over time. The existence of long-term contracts for the beneficial use of these products makes the option of CBR extremely viable.

Technical and logistical challenges of implementing a large-scale ash removal project have already been addressed by SIGECO through the planning and development of the beneficial use program. Removal activities require dewatering and temporary staging/stockpiling of material for drying prior to transportation, which may affect productivity and extend the timeframe to complete removal. Additionally, the rate of use is subject to fluctuations that are driven by market conditions and the receiving industry. During periods of rain and inclement weather, the removal schedule will be negatively impacted. Excavation and construction safety during the removal duration is another schedule factor due to heavy equipment (e.g., bulldozers, excavators, front end loaders, and off-road trucks) and dump truck operation within the active ABB Site.

Groundwater would be addressed through MNA. MNA is a viable remedial technology recognized by both state and federal regulators that is applicable to inorganic compounds in groundwater. The USEPA defines MNA as “the reliance on natural attenuation processes to achieve site-specific remediation objectives within a time frame that is reasonable compared to that offered by other more active methods.” The ‘natural attenuation processes’ that are at work in such a remediation approach include

a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. These in-situ processes include biodegradation; dispersion; dilution; sorption; volatilization; radioactive decay; and chemical or biological stabilization, transformation, or destruction of contaminants (USEPA, 2015). When combined with removal for beneficial use, MNA can reduce concentrations of molybdenum and lithium in groundwater at the Ash Pond boundary, although the time required to achieve the GWPS would be lengthy due to the low groundwater velocity and flux.

SIGECO would implement post-closure care activities that includes long-term groundwater monitoring.

4.3.2 Alternative 2 – Hydraulic Containment with No Treatment, Close by Removal (CBR) with Beneficial Use

Similar to Alternative 1, the Ash Pond would be closed by removal; however, under this alternative, lithium and molybdenum detected in groundwater at concentrations above GWPS would be addressed through groundwater pumping to hydraulically control the migration of those constituents downgradient. Pumping would be undertaken in the shallow groundwater at the boundary of the Ash Pond since lithium and molybdenum have not been detected above GWPS in the bedrock aquifer or in the shallow monitoring wells downgradient.

Implementation of a large-scale hydraulic containment system would require a detailed and lengthy design effort. Pilot testing, such as pumping tests and additional groundwater modeling, would be needed to verify the hydraulic capture zone.

The pumping well effluent would be discharged directly to a receiving water body in accordance with a National Pollutant Discharge Elimination System (NPDES) Permit. Under this alternative, no treatment would be used prior to discharge. The construction of a conveyance system from the Ash Pond to the receiving water body would require engineering design, permitting, and site construction. In order for the effluent to be discharged to a receiving water body, the existing ABB NPDES Operating Permit may be modified, or a new permit issued. Either option would require effluent testing or modeling to support a permit application. The anticipated timeline for engineering, procurement, permit modification, and construction of this option is estimated to be one year.

Following CCR removal, lithium and molybdenum concentrations would decrease through active pumping and natural attenuation, and pumping would eventually cease. Further reduction of lithium and molybdenum concentrations, if required, would occur through natural attenuation until concentrations decrease to levels below the GWPS. Because active groundwater pumping along the boundary of the Ash Pond would reduce the hydraulic gradient and, therefore, the groundwater flux, the time period for active pumping would be greater than MNA alone.

SIGECO would implement post-closure care activities that include groundwater monitoring.

4.3.3 Alternative 3 – Hydraulic Containment with Treatment and Close by Removal (CBR) with Beneficial Use

Similar to Alternative 1, the Ash Pond would be closed by removal; however, under this alternative lithium and molybdenum detected in groundwater at concentrations above GWPS would be addressed with hydraulic containment through groundwater pumping to hydraulically control the migration of

those constituents downgradient. In addition, pumping well effluent would be treated ex-situ, likely with an ion exchange or a reverse osmosis (RO) treatment system. Both systems would have on-going operation and maintenance and would generate a secondary waste stream – including regeneration/replacement of the ion exchange media or concentration of reject water from the RO system.

The design and construction of an ion exchange or RO system would require additional development of a treatment system enclosure, equipment, and space, all of which adds complexity to this alternative. As noted in the previous option, implementation of a large-scale hydraulic containment system would require a detailed and lengthy design effort. Pilot testing, such as pumping tests and additional groundwater modeling, would be needed to verify the hydraulic capture zone. The timeline for engineering, procurement, permit modification, including the ex-situ treatment component and construction of this option is an estimated 2 years.

Following CCR removal, lithium and molybdenum concentrations in groundwater would decrease through active pumping and natural attenuation downgradient of the pumping system. The timeline for active treatment is expected to be 13 years. Further reduction of lithium and molybdenum concentrations, if required, would occur through natural attenuation until concentrations attenuate to levels less than the GWPS. Because active groundwater pumping along the boundary of the Ash Pond would decrease hydraulic gradient and therefore the groundwater flux, the time period for active pumping and treatment will be greater than MNA alone.

Following the installation of the groundwater pumping well network and ex-situ treatment system, SIGECO would implement post-closure care activities that include operation and maintenance of the hydraulic containment system, operation and maintenance of the treatment system, and long-term groundwater monitoring to assess hydraulic control system performance.

5. Comparison of Corrective Measures Alternatives

The purpose of this section is to evaluate, compare, and rank the three corrective measures alternatives using the balancing criteria described in §257.97.

5.1 EVALUATION CRITERIA

In accordance with §257.97, remedial alternatives that satisfy the threshold criteria are then compared to four balancing (evaluation) criteria. The balancing criteria allow a comparative analysis for each corrective measure, thereby providing the basis for final corrective measure selection. The four balancing criteria include the following:

1. The long- and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful;
2. The effectiveness of the remedy in controlling the source to reduce further releases;
3. The ease or difficulty of implementing a potential remedy; and
4. The degree to which community concerns are addressed by a potential remedy.

Public input and feedback will be considered following a public information session to be conducted at least 30 days prior to remedy selection by SIGECO.

5.2 COMPARISON OF ALTERNATIVES

This section compares the alternatives to each other based on evaluation of the balancing criteria listed above. Each of the balancing criteria consists of several sub criteria listed in the CCR Rule which have been considered in this assessment. The goal of this analysis is to identify the alternative that is technologically feasible, relevant, and readily implementable, provides adequate protection of human health and the environment, and minimizes impacts to the community.

A color-coded graphic which is part of a comprehensive visual comparison tool (see **Table 2**) is presented within each subsection below. These graphics provide a visual snapshot of the favorability of each alternative compared to the other alternatives, where green represents “most favorable”, yellow represents “less favorable”, and red represents “least favorable”.

5.2.1 Balancing Criterion 1 - The Long- and Short-Term Effectiveness and Protectiveness of the Potential Remedy, along with the Degree of Certainty that the Remedy Will Prove Successful

This balancing criterion takes into consideration the relative long-term and short-term effectiveness of the remedy, along with the anticipated success of the remedy.

5.2.1.1 Magnitude of reduction of existing risks

As indicated by the N&E evaluation and the most recent groundwater sampling results, no unacceptable risk to human health and the environment exists with respect to the Ash Pond. Therefore, none of the remedial alternatives are necessary to reduce risks because no such unacceptable risk to lithium or molybdenum currently exists. However, other types of impacts may be posed by the various remedial alternatives considered herein. Alternative 1 (Closure by Removal and MNA) is the most favorable

option because the source is completely removed from the environment, the beneficial use program will reduce the volume of material in the Pond over time until CCR is removed. In addition, this concept has been proven to be a viable option for this location. Alternatives 2 and 3, which incorporate hydraulic containment, are less favorable due to the installation of pumping wells and long-term operation, with Alternative 3 being the least favorable due to the operation, maintenance, and monitoring of an ex-situ treatment system and generation of secondary waste streams.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 1 - Subcriteria i) Magnitude of reduction of risks			

5.2.1.2 Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy

The alternatives being considered for the ABB Ash Pond, which include closure by removal for beneficial use, all have a low long-term residual risk because the CCR materials are being removed from the Ash Pond. Alternative 1 (CBR with MNA) has the lowest residual risk because groundwater is being addressed through natural processes. Alternative 2 is considered only slightly less favorable due to the operation of the hydraulic containment system. Alternative 3 which includes a pumping component with ex-situ treatment of effluent is considered less favorable due to the operation of the ex-situ treatment system and the generation of secondary waste streams. Additionally, ABB is located within a seismic hazard area with potential for liquification and as such the alternatives being considered have a significantly lower risk than leaving the material in place.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 1 - Subcriteria ii) Magnitude of residual risk in terms of likelihood of further release			

5.2.1.3 The type and degree of long-term management required, including monitoring, operation, and maintenance

Alternative 1 (CBR with MNA) is the most favorable alternative with respect to this criterion because it requires the least amount of long-term management and involves no mechanical systems as part of the remedy. Alternative 2 (CBR with hydraulic containment and direct discharge) is slightly less favorable because it requires long-term maintenance of a groundwater recovery system. Alternative 3 is the least favorable due to the O&M of groundwater treatment systems and the generation of secondary waste streams.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 1 - Subcriteria iii) Type and degree of long-term management required			

5.2.1.4 Short-term risks that might be posed to the community or the environment during implementation of such a remedy

Community impacts include general impacts to the community due to increased truck traffic on public roads during construction and operation of the remedies, along with generation of secondary waste streams with transportation and off-site disposal of waste streams. The beneficial use project is common to all the alternatives so the increased truck traffic and material shipped by barge would be the same for all options. As a result, Alternative 3, which includes ex-situ treatment and the generation of secondary waste streams with off-site disposal, is the least favorable alternative with respect to this criterion.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 1 - Subcriteria iv) Short term risk to community or environment during implementation			

5.2.1.5 Time until full protection is achieved

As previously stated, there is currently no unacceptable exposure to groundwater impacted by lithium and molybdenum associated with the Ash Pond; therefore, protection is already achieved. The timeframes to achieve GWPS were evaluated using a predictive model as described in **Section 4.2**. Based upon predictive modeling, the timeframe to achieve GWPS for all the alternatives is long. Alternatives 2 and 3, which incorporate hydraulic containment would attain GWPS in the shortest amount of time. Closure by removal with MNA is predicted to take more time to achieve GWPS due to the low groundwater flow velocities and is, therefore, less favorable.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 1 - Subcriteria v) Time until full protection is achieved			

5.2.1.6 *Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment*

Because the extent of groundwater impacted by the Ash Pond is limited to the shallow aquifer, Alternative 1 (CBR with MNA) has the lowest potential for exposure to human and environmental receptors and is considered most favorable with respect to this criterion. Alternative 2 is only slightly less favorable than Alternative 1 because it pumps groundwater without treatment which creates some potential exposure. Alternative 3, which includes hydraulic containment with ex-situ treatment, has a potential risk associated with the generation and management of secondary waste streams and is considered less favorable.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 1 - Subcriteria vi) Potential for exposure of humans and environmental receptors to remaining wastes			

5.2.1.7 *Long-term reliability of the engineering and institutional controls*

Alternative 1 (CBR with MNA) is expected to have high long-term reliability and is considered most favorable with respect to this criteria. Hydraulic containment (Alternatives 2 and 3) are considered reliable, proven technologies and would have high long-term reliability, but require field pilot studies and bench scale testing, and rely on installation of electrical infrastructure, and mechanical systems (groundwater pumping and/or treatment systems) to operate and maintain. Alternative 3 is considered less favorable with respect to this criteria because it includes treatment systems that reduce reliability.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 1 - Subcriteria vii) Long-term reliability of engineering and institutional controls			

5.2.1.8 *Potential need for replacement of the remedy*

The alternatives being evaluated are all considered reliable due to the removal of the source. Alternative 1, which includes CBR with MNA, is considered the most favorable since it relies on natural processes to reduce the concentrations of lithium and molybdenum in groundwater.

Should monitoring results indicate that the selected remedial alternative is not effective at reducing the concentration of the SSL constituents over time, alternate and/or additional active remedial methods for groundwater may be considered in the future. From the perspective of needing to replace the remedy, the alternatives that rely on operating systems (Alternatives 2 and 3) are considered more likely to require replacement and, therefore, are considered less reliable.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 1 - Subcriteria viii) Potential need for replacement of the remedy			

5.2.1.9 Long- and short-term effectiveness and protectiveness criterion summary

The graphic below provides a summary of the long- and short-term effectiveness and protectiveness of the potential remedy, along with the degree of certainty that the remedy would prove successful.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
CATEGORY 1 Long- and Short Term Effectiveness, Protectiveness, and Certainty of Success			

5.2.2 Balancing Criterion 2 - The Effectiveness of the Remedy in Controlling the Source to Reduce Further Releases

This balancing criterion takes into consideration the ability of the remedy to control a future release, and the degree of complexity of treatment technologies that would be required.

5.2.2.1 The extent to which containment practices will reduce further releases

For Alternatives 1 through 3, the source would be controlled by removing the CCR material from the Ash Pond, thereby minimizing or eliminating the potential for lithium and/or molybdenum to enter groundwater over time.

Alternative 1 (CBR with MNA) would rely on natural attenuation to decrease the downgradient concentration of the constituents over time and was shown by predictive modeling to require the longest timeframe to achieve GWPS.

Alternatives 2 and 3 rely on hydraulic containment to achieve the performance criterion at the waste boundary and are also considered less favorable with respect to this criterion. Under Alternative 2 pumping system effluent would be discharged elsewhere on the property without treatment. Under Alternative 3, which includes ex-situ treatment, additional waste streams would be generated and would require management on- and off-site.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 2 - Subcriteria i) Extent to which containment practices will reduce further releases			

5.2.2.2 The extent to which treatment technologies may be used

In-situ groundwater treatment technologies have not been identified that would successfully treat the combination of lithium and molybdenum and, as a result, in-situ treatment alternatives were not considered in this comparative analysis. With respect to Alternative 1, natural attenuation would be the groundwater treatment technology. Alternative 2 would rely on one technology (hydraulic containment) to address groundwater with the effluent being directly discharged elsewhere on the property. For Alternative 3, which includes hydraulic containment with ex-situ treatment, two technologies, hydraulic containment and ex-situ treatment, would be utilized. The operation of an ex-situ treatment system would create a secondary waste stream, such as concentrated reject water (from RO) requiring off-site disposal, or depleted resin (from ion exchange), requiring regeneration or off-site disposal.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 2 - Subcriteria ii) Extent to which treatment technologies may be used			

5.2.2.3 Effectiveness of the remedy in controlling the source to reduce further releases summary

The graphic below provides a summary of the effectiveness of the remedial alternatives to control the source to reduce further releases. Alternative 1 (CBR with MNA) is the most favorable, while Alternatives 2 and 3 are less favorable.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
CATEGORY 2 Effectiveness in controlling the source to reduce further releases			

5.2.3 Balancing Criterion 3 - The Ease or Difficulty of Implementing a Potential Remedy

This balancing criterion takes into consideration the following technical and logistical challenges required to implement a remedy:

1. Degree of difficulty associated with constructing the technology;
2. Expected operational reliability of the technologies;
3. Need to coordinate with and obtain necessary approvals and permits from other agencies;
4. Availability of necessary equipment and specialists; and
5. Available capacity and location of needed treatment, storage, and disposal services.

5.2.3.1 Degree of difficulty associated with constructing the technology

All alternatives use removal through beneficial use. Given that the project is driven by considerations beyond groundwater remedy selection, the degree of difficulty is not relevant to the removal portion of the remedy. For Alternative 1 (CBR with MNA), the concept already has been evaluated and shown to be viable through the beneficial use project evaluation. The most favorable remedy alternative for this criterion is MNA because it is not difficult to implement.

Alternatives 2 and 3, which both incorporate hydraulic containment, would be more difficult to construct and would require additional treatability testing, field scale pilot studies, and permitting. Alternative 3 would be the most difficult due to the O&M of ex-situ treatment systems.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 3 - Subcriteria i) Degree of difficulty associated with constructing the technology			

5.2.3.2 Expected operational reliability of the technologies

Alternative 1 (CBR with MNA) is considered the most favorable from an operational perspective because removal of the source followed by MNA has a proven track record and only requires long-term monitoring following implementation. While Alternatives 2 and 3, which include hydraulic containment, are also expected to be reliable, these alternatives would utilize additional groundwater treatment technologies which would require treatability studies and O&M and, therefore, are considered less favorable when compared to Alternative 1.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 3 - Subcriteria ii) Expected operational reliability of the technologies			

5.2.3.3 Need to coordinate with and obtain necessary approvals and permits from other agencies

Alternative 1 (CBR with MNA) is the most favorable since the implementation of the remedy is straightforward and only includes MNA. The remaining alternatives would require additional permitting

and approvals for treatability testing, field scale pilot testing, groundwater discharge, groundwater treatment, and disposal of secondary waste streams.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 3 - Subcriteria iii) Need to coordinate with and obtain necessary approvals and permits from other agencies			

5.2.3.4 Availability of necessary equipment and specialists

Alternative 1 (CBR with MNA) is the most favorable since specialty equipment and specialists would not be required to implement the MNA remedy. Alternative 2 would require equipment for pumping and is slightly less favorable than Alternative 1, but the equipment required should not present a great challenge. Alternative 3, which includes an ex-situ treatment component, is less favorable since it would require construction, and O&M of ex-situ treatment systems.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 3 - Subcriteria iv) Availability of necessary equipment and specialists			

5.2.3.5 Available capacity and location of needed treatment, storage, and disposal services

The alternatives being considered, which include closure by removal, require adequate capacity, storage, and disposal service for on-site and off-site receiving facilities. This would be addressed through the beneficial use of CCR combined with disposal of CCR materials in a permitted disposal facility (if necessary). The majority of the CCR material would be excavated and transported off-site under a beneficial use contract. Non-marketable materials would be excavated and moved to a permitted disposal facility.

For Alternative 3, the ex-situ treatment system may generate a concentrated waste stream which would require off-site transportation and disposal that the other alternatives would not require and is, therefore, considered the less favorable.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
Category 3 - Subcriteria v) Available capacity and location of needed treatment, storage, and disposal services			

5.2.3.6 Ease or difficulty of implementation summary

The graphic below provides a summary of the ease or difficulty of implementation of each alternative. Alternative 1 (CBR with MNA) is considered the most favorable, while the remaining alternatives that include a hydraulic containment component are considered less favorable.

	Alternative 1 MNA with CBR with Beneficial Use	**Alternative 2** Hydrulic Containment with no Treatment, CBR with Beneficial Use	**Alternative 3** Hydrulic Containment with Treatment, CBR with Beneficial Use
CATEGORY 3 Ease of implementation			

6. Summary

This Corrective Measures Assessment has evaluated the following alternatives:

- Alternative 1: MNA with CBR;
- Alternative 2: Hydraulic Containment with No Treatment, CBR, and MNA; and
- Alternative 3: Hydraulic Containment with Treatment, CBR, and MNA.

In accordance with §257.97, each of these alternatives has been confirmed to meet the following threshold criteria:

- Be protective of human health and the environment;
- Attain the GWPS;
- Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of COCs to the environment;
- Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, considering factors such as avoiding inappropriate disturbance of sensitive ecosystems; and
- Comply with standards (regulations) for waste management.

In addition, in accordance with §257.97, each of the alternatives has been evaluated in the context of the following balancing criteria:

- The long- and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful;
- The effectiveness of the remedy in controlling the source to reduce further releases;
- The ease or difficulty of implementing a potential remedy; and
- The degree to which community concerns are addressed by a potential remedy.

This Corrective Measures Assessment, and the input received during the public comment period, will be used to identify and select a final corrective measure for implementation at the Ash Pond.

References

1. USEPA. 2015a. Final Rule: Disposal of Coal Combustion Residuals (CCRs) for Electric Utilities. 80 FR 21301-21501. U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.govinfo.gov/content/pkg/FR-2015-04-17/pdf/2015-00257.pdf

2. USEPA. 2015b. Use of Monitored Natural Attenuation for Inorganic Contaminants in Groundwater at Superfund Sites.

3. USEPA. 2018a. USEPA Regional Screening Levels. November 2018, values for tapwater. U.S. Environmental Protection Agency. Available at: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

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TABLES

TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-1 CCR-AP-1-20160607 06/07/2016	CCR-AP-1 CCR-AP-1-20160810 08/10/2016	CCR-AP-1R CCR-AP-1-20161026 10/26/2016	CCR-AP-1R CCR-AP-1R-20161205 12/05/2016	CCR-AP-1R CCR-AP-1R-20170206 02/06/2017	CCR-AP-1R CCR-AP-1R-20170404 04/04/2017	CCR-AP-1R CCR-AP-1R-20170605 06/05/2017	CCR-AP-1R CCR-AP-1R-20170926 09/26/2017
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	**0.0052**	**0.0012 J+**	**0.0008 J**	**0.00039 J**	0.001 U	**0.00033 J**	**0.00031 J**	R
Barium, Total	2	**0.041**	**0.022**	**0.018 J-**	**0.018 J-**	**0.019**	**0.017 J-**	**0.016**	**0.012 J-**
Beryllium, Total	0.004	**0.000065 J**	0.001 U	**0.00019 J**	**0.00019 J**	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.005	0.001 U	**0.00028 J**	**0.00017 J**	**0.00016 J**	**0.00019 J**	0.001 U	0.001 U	0.001 U
Chromium, Total	0.1	**0.0011 J**	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 UJ
Cobalt, Total	0.006	**0.011**	**0.0077**	**0.0025**	**0.0019**	**0.0012**	**0.00071**	**0.0006**	**0.00042 J**
Fluoride	4	**0.22**	0.5 U	5 U	**0.73**	0.5 U	**0.25 J**	**0.41 J**	**0.46 J+**
Lead, Total	0.015	**0.0013**	**0.00031 J**	**0.00015 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium, Total	0.04	**0.012 J**	**0.0099 J**	**0.016 J**	**0.015 J**	**0.066**	0.05 U	0.05 U	0.05 U
Mercury, Total	0.002	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum, Total	0.1	**0.005**	**0.0049 J**	**0.0031 J**	**0.0039 J**	0.005 U	**0.0024 J**	**0.0032 J**	**0.0024 J**
Selenium, Total	0.05	0.005 U	**0.00049 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.002	**0.000038 J**	**0.000075 J**	**0.00013 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Radiological (pCi/L)									
Radium-226	NA	0.0602 U ± 0.087	**0.411 ± 0.108**	**0.717 J ± 0.337**	R	**0.292 ± 0.12**	**0.193 ± 0.0909**	**0.211 J ± 0.087**	R
Radium-228	NA	0.229 U ± 0.397	0.300 UJ ± 0.262	0.320 U ± 0.247	**0.493 ± 0.246**	**0.513 ± 0.252**	**0.391 ± 0.255**	0.247 U ± 0.265	**0.673 ± 0.28**
Radium-226 & 228	5	0.289 U ± 0.406	**0.711 J ± 0.284**	**1.04 J ± 0.418**	R	**0.805 ± 0.279**	**0.583 ± 0.27**	**0.458 J ± 0.278**	**1.05 J+ ± 0.303**

ABBREVIATIONS AND NOTES:

Statistically significant level (SSL) concentration.
CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
su: standard units.
USEPA: United States Environmenta.l Protection Agency
J: Value is estimated
J-: Value is estimated, biased low
J+: Value is estimated, biased high
R: Rejected during validation
U: Not detected, value is the laboratory reporting limit

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257. https://www.epa.gov/coalash/coal-ash-rule

TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-1R CCR-AP-1R-20171114 11/14/2017	CCR-AP-1R CCR-AP-1R-20180606 06/06/2018	CCR-AP-1R CCR-AP-1R-20180822 08/22/2018	CCR-AP-1R CCR-AP-1R-20181114 11/14/2018	CCR-AP-1R CCR-AP-1R-20190524 05/24/2019	CCR-AP-2 CCR-AP-2-20160811 08/11/2016	CCR-AP-2 DUP-1-20160811 08/11/2016	CCR-AP-2R CCR-AP-2-20161025 10/25/2016
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	0.002 U	0.002 U	-	0.002 U	0.002 U	0.002 U	0.002 U	0.02 U
Arsenic, Total	0.01	0.001 U	0.001 U	**0.00099 J**	**0.00059 J**	**0.00047 J**	**0.0024**	**0.0026**	0.01 U
Barium, Total	2	**0.017 J-**	**0.015 J-**	**0.02 J**	**0.016 B**	**0.025 J+**	**0.041**	**0.036**	**0.035 J**
Beryllium, Total	0.004	0.001 U	0.001 UJ	-	0.001 U	0.001 U	**0.00027 J**	**0.00017 J**	0.01 U
Cadmium, Total	0.005	0.001 U	0.001 UJ	0.001 U	0.001 U	0.001 U	**0.0003 J**	**0.00031 J**	0.01 U
Chromium, Total	0.1	0.002 U	0.002 U	0.0023 U	**0.0023**	0.002 U	**0.0036**	**0.0039**	0.02 U
Cobalt, Total	0.006	**0.00084**	**0.00021 J**	**0.0014**	**0.00024 J**	**0.00021 J**	**0.0079**	**0.0056**	**0.0022 J**
Fluoride	4	**0.2 J**	**0.49**	**0.2 J+**	-	**0.57 J+**	0.5 U	0.5 U	**0.58 J**
Lead, Total	0.015	0.001 U	0.001 UJ	**0.00015 J**	0.001 U	0.001 U	**0.0052 J**	**0.003 J**	0.01 U
Lithium, Total	0.04	0.05 U	0.005 U	**0.032**	0.005 U	**0.0036 J**	**0.054**	**0.054**	**0.06**
Mercury, Total	0.002	0.0002 UJ	**0.000085 J-**	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum, Total	0.1	**0.0036 J**	**0.0028 J**	**0.0074**	**0.0037 J**	**0.0042 J**	**1.2**	**1.4**	**1.6**
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.00079 J**	**0.00061 J**	0.05 U
Thallium, Total	0.002	0.001 U	0.001 U	-	0.001 U	0.001 U	**0.000041 J**	**0.000048 J**	0.01 U
Radiological (pCi/L)									
Radium-226	NA	**0.256 ± 0.0859**	**0.360 ± 0.209**	R	-	0.0879 U ± 0.0697	**0.703 ± 0.205**	**0.520 ± 0.175**	**0.434 J ± 0.28**
Radium-228	NA	**0.594 ± 0.243**	0.0870 U ± 0.21	0.192 U ± 0.271	-	-0.0354 U ± 0.241	0.675 UJ ± 0.622	**1.41 J ± 0.736**	0.352 U ± 0.249
Radium-226 & 228	5	**0.849 ± 0.258**	**0.447 J ± 0.296**	0.372 UJ ± 0.282	-	0.0879 U ± 0.251	**1.38 J ± 0.655**	**1.93 J ± 0.757**	**0.786 J ± 0.374**

ABBREVIATIONS AND NOTES:

Statistically significant level (SSL) concentration.
CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
su: standard units.
USEPA: United States Environmenta.l Protection Agency
J: Value is estimated
J-: Value is estimated, biased low
J+: Value is estimated, biased high
R: Rejected during validation
U: Not detected, value is the laboratory reporting limit

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residua
from Electric Utilities. July 26. 40 CFR Part 257.
https://www.epa.gov/coalash/coal-ash-rule

TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-2R CCR-AP-2R-20161107 11/07/2016	CCR-AP-2R CCR-AP-2R-20161206 12/06/2016	CCR-AP-2R CCR-AP-2R-20170207 02/07/2017	CCR-AP-2R CCR-AP-2R-20170404 04/04/2017	CCR-AP-2R CCR-AP-2R-20170606 06/06/2017	CCR-AP-2R CCR-AP-2R-20170927 09/27/2017	CCR-AP-2R CCR-AP-2R-20171115 11/15/2017	CCR-AP-2R CCR-AP-2R-20180606 06/06/2018
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	**0.00011 J**	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	**0.0011 J+**	**0.00071 J**	0.001 U	**0.00043 J**	**0.00034 J**	R	0.001 U	0.001 U
Barium, Total	2	**0.037 J-**	**0.051 J-**	**0.049**	**0.045 J-**	**0.046**	**0.035 J-**	**0.043 J-**	**0.043 J-**
Beryllium, Total	0.004	0.001 U	**0.0002 J**	0.001 U	**0.00015 J**	0.001 U	**0.00013 J**	0.001 U	0.001 UJ
Cadmium, Total	0.005	**0.00056 J**	**0.00031 J**	**0.0008 J**	**0.0003 J**	**0.00032 J**	**0.00063 J**	**0.00038 J**	**0.00045 J**
Chromium, Total	0.1	**0.00071 J**	0.002 U	**0.00087 J**	0.002 U	0.002 U	0.002 UJ	0.002 U	0.002 U
Cobalt, Total	0.006	**0.0025**	**0.0032**	**0.003**	**0.0021**	**0.0023**	**0.0019 J+**	**0.0026**	**0.0022 J**
Fluoride	4	**0.5 J**	**0.7**	0.5 U	**0.9**	**0.51 J**	**0.5 J+**	**0.27 J**	**0.49 J**
Lead, Total	0.015	**0.00019 J**	**0.000083 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.00022 J**
Lithium, Total	0.04	**0.062**	**0.067**	**0.011 J**	**0.056**	**0.061**	**0.062**	**0.058**	**0.044 J**
Mercury, Total	0.002	0.0002 U	0.0002 UJ	**0.00008 J**	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ
Molybdenum, Total	0.1	**1.8**	**1.5**	**1.6**	**1.4**	**1.5**	**1.6**	**1.7**	**1.9 J**
Selenium, Total	0.05	**0.00042 J**	**0.0004 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.00083 J+**
Thallium, Total	0.002	**0.00015 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Radiological (pCi/L)									
Radium-226	NA	0.261 U ± 0.223	0.0875 U ± 0.213	**0.188 ± 0.108**	**0.141 ± 0.0848**	**0.233 J ± 0.0901**	**0.409 J ± 0.118**	**0.217 ± 0.0813**	0.139 U ± 0.15
Radium-228	NA	**0.394 ± 0.241**	**0.647 ± 0.271**	**0.373 ± 0.236**	0.291 U ± 0.229	**0.403 ± 0.224**	R	**0.620 ± 0.256**	**0.393 ± 0.226**
Radium-226 & 228	5	R	R	**0.562 ± 0.259**	**0.432 J ± 0.244**	**0.636 ± 0.241**	**1.09 J+ ± 0.311**	**0.837 ± 0.269**	**0.532 J ± 0.271**

ABBREVIATIONS AND NOTES:

Statistically significant level (SSL) concentration.
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mg/L: milligram per liter.
pCi/L: picoCurie per liter.
su: standard units.
USEPA: United States Environmenta.l Protection Agency
J: Value is estimated
J-: Value is estimated, biased low
J+: Value is estimated, biased high
R: Rejected during validation
U: Not detected, value is the laboratory reporting limit

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https://www.epa.gov/coalash/coal-ash-rule

TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-2R CCR-AP-2R-20180821 08/21/2018	CCR-AP-2R CCR-AP-2R-20181113 11/13/2018	CCR-AP-2R CCR-AP-2R-20190524 05/24/2019	CCR-AP-3 CCR-AP-3-20160815 08/15/2016	CCR-AP-3R CCR-AP-3-20161027 10/27/2016	CCR-AP-3R IND DUPLICATE-201611 11/07/2016	CCR-AP-3R CCR-AP-3R-20161108 11/08/2016	CCR-AP-3R CCR-AP-3R-20161206 12/06/2016
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	-	0.002 U	0.002 U	0.00022 U	0.02 U	0.002 UJ	**0.000092 J**	0.002 U
Arsenic, Total	0.01	0.001 U	**0.00071 J**	**0.00053 J**	**0.00044 J**	0.01 U	0.001 UJ	0.001 U	**0.00036 J**
Barium, Total	2	**0.047 J**	**0.05 B**	**0.042 J+**	**0.015**	**0.016 J**	**0.021 J-**	**0.02 J-**	**0.024 J-**
Beryllium, Total	0.004	-	0.001 U	0.001 U	0.001 U	0.01 U	0.001 UJ	0.001 U	**0.00021 J**
Cadmium, Total	0.005	**0.0004 J**	**0.00035 J**	**0.00059 J**	**0.00017 J**	0.01 U	**0.00024 J**	**0.00024 J**	**0.0003 J**
Chromium, Total	0.1	0.002 U	**0.0025**	0.002 U	**0.0008 J**	0.02 U	**0.00072 J**	**0.00085 J**	**0.00051 J**
Cobalt, Total	0.006	**0.0021**	**0.0019**	**0.0026**	**0.00035 J**	0.005 U	**0.00009 J**	**0.00011 J**	0.0005 U
Fluoride	4	**0.39 J**	-	**0.47 J+**	**0.95**	**0.96 J**	**0.96 J**	**0.96 J**	**1.1**
Lead, Total	0.015	**0.00015 J**	0.001 U	**0.00016 J**	**0.00028 J**	0.01 U	0.001 UJ	0.001 U	**0.00014 J**
Lithium, Total	0.04	**0.053**	**0.04**	**0.033**	**0.071**	**0.077**	**0.083 J**	**0.083**	**0.08**
Mercury, Total	0.002	0.0002 U	0.0002 U	0.0002 U	**0.000071 J**	**0.000082 J**	**0.000074 J**	0.0002 U	**0.000094 J-**
Molybdenum, Total	0.1	**1.7**	**1.6**	**1.9**	**0.94**	**0.91**	**1 J**	**1**	**0.93**
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	**0.021**	**0.017 J**	**0.023 J**	**0.024**	**0.016**
Thallium, Total	0.002	-	0.001 U	0.001 U	0.001 U	0.01 U	**0.000057 J**	**0.00014 J**	0.001 U
Radiological (pCi/L)									
Radium-226	NA	R	-	**0.264 ± 0.102**	**0.199 ± 0.0723**	0.173 U ± 0.202	R	R	0.0963 U ± 0.229
Radium-228	NA	0.309 U ± 0.215	-	**0.448 ± 0.291**	**0.523 ± 0.314**	**0.431 ± 0.281**	0.455 UJ ± 0.331	0.162 U ± 0.254	**1.06 ± 0.285**
Radium-226 & 228	5	R	-	**0.713 ± 0.308**	**0.722 ± 0.322**	**0.603 J ± 0.346**	R	R	R

ABBREVIATIONS AND NOTES:

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TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-3R DUP 1-20170206 02/06/2017	CCR-AP-3R CCR-AP-3R-20170207 02/07/2017	CCR-AP-3R CCR-AP-3R-20170405 04/05/2017	CCR-AP-3R DUP 1-20170405 04/05/2017	CCR-AP-3R CCR-AP-3R-20170606 06/06/2017	CCR-AP-3R CCR-AP-3R-20170927 09/27/2017	CCR-AP-3R DUP1-20170927 09/27/2017	CCR-AP-3R CCR-AP-3R-20171115 11/15/2017
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	0.002 UJ	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	0.001 UJ	0.001 U	**0.00029 J**	**0.00026 J**	0.001 U	R	**0.011 J+**	0.001 U
Barium, Total	2	**0.017 J**	**0.017**	**0.017 J-**	**0.016 J-**	**0.017**	**0.016 J-**	**0.017 J-**	**0.017 J-**
Beryllium, Total	0.004	0.001 UJ	0.001 U	**0.00017 J**	**0.00016 J**	0.001 U	0.001 U	**0.00017 J**	0.001 U
Cadmium, Total	0.005	**0.00034 J**	**0.0002 J**	**0.00013 J**	**0.00015 J**	**0.00018 J**	**0.00029 J**	**0.0019 J**	**0.0002 J**
Chromium, Total	0.1	**0.0004 J**	0.002 U	0.002 U	0.002 U	0.002 U	0.002 UJ	R	0.002 U
Cobalt, Total	0.006	**0.00022 J**	**0.00017 J**	0.0005 U	0.0005 U	**0.00015 J**	R	R	**0.00021 J**
Fluoride	4	**0.82 J+**	**0.82 J+**	**1.1**	**0.92**	**0.87 J**	**1 J+**	**0.96 J+**	**0.72 J**
Lead, Total	0.015	0.001 UJ	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium, Total	0.04	**0.064 J**	**0.065**	**0.062**	**0.06**	**0.077**	**0.087**	**0.091**	**0.09**
Mercury, Total	0.002	**0.00053 J**	**0.00053**	**0.00012 J**	**0.00012 J**	**0.000085 J**	**0.00018 J**	**0.00017 J**	**0.00016 J-**
Molybdenum, Total	0.1	**0.72 J**	**0.72**	**0.74**	**0.73**	**0.82**	**0.81**	**0.95**	**0.86**
Selenium, Total	0.05	**0.0041 J**	**0.0041 J**	**0.0017 J**	**0.002 J**	**0.0028 J**	**0.0043 J+**	**0.0057 J+**	**0.0031 J**
Thallium, Total	0.002	0.001 UJ	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Radiological (pCi/L)									
Radium-226	NA	0.0275 UJ ± 0.0814	**0.172 ± 0.104**	0.0894 U ± 0.0714	**0.184 ± 0.0978**	**0.116 J ± 0.0696**	R	R	**0.138 ± 0.07**
Radium-228	NA	**0.561 J ± 0.291**	0.393 U ± 0.263	**0.429 ± 0.253**	**0.392 ± 0.242**	0.367 U ± 0.248	R	R	**0.509 ± 0.277**
Radium-226 & 228	5	**0.588 J ± 0.303**	**0.565 J ± 0.283**	**0.518 J ± 0.263**	**0.576 ± 0.261**	**0.484 J ± 0.257**	**1.24 J+ ± 0.32**	**1.16 J+ ± 0.27**	**0.647 ± 0.286**

ABBREVIATIONS AND NOTES:

Statistically significant level (SSL) concentration.
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TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-3R CCR-AP-3R-20180606 06/06/2018	CCR-AP-3R BLIND DUPLICATE 1-20180606 06/06/2018	CCR-AP-3R CCR-AP-3R-20180821 08/21/2018	CCR-AP-3R BLIND DUPLICATE 1-20180821 08/21/2018	CCR-AP-3R CCR-AP-3R-20181113 11/13/2018	CCR-AP-3R CCR-AP-3R-20190522 05/22/2019	CCR-AP-4 CCR-AP-4-20160607 06/07/2016
Appendix IV Constituents (mg/L)								
Antimony, Total	0.006	0.002 U	0.002 U	-	-	0.002 U	0.02 U	0.002 U
Arsenic, Total	0.01	0.001 U	0.001 U	0.001 U	0.001 U	**0.0006 J**	0.01 U	**0.00029 J**
Barium, Total	2	**0.016 J-**	**0.015 J-**	**0.013 J**	**0.013 J**	**0.015 B**	**0.16 J-**	**0.12**
Beryllium, Total	0.004	0.001 UJ	0.001 UJ	-	-	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.005	**0.00025 J**	**0.00023 J**	**0.00022 J**	**0.0002 J**	**0.00028 J**	0.01 U	0.001 U
Chromium, Total	0.1	0.002 U	0.002 U	0.002 U	0.002 U	**0.0024**	0.02 U	**0.0022**
Cobalt, Total	0.006	**0.00016 J**	**0.00015 J**	0.0005 U	0.0005 U	**0.0015**	**0.0017 J**	**0.00026 J**
Fluoride	4	**1.6**	**1.5**	**1.3**	**1.6**	-	**1.3 J+**	**0.44**
Lead, Total	0.015	0.001 UJ	0.001 UJ	**0.00015 J**	0.001 U	0.001 U	0.01 U	**0.000085 J**
Lithium, Total	0.04	**0.076 J**	**0.073 J**	**0.087**	**0.082**	**0.064**	**0.062**	0.05 U
Mercury, Total	0.002	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum, Total	0.1	**1 J**	**0.99 J**	**1**	**0.98**	**1**	**0.89**	**0.0016 J**
Selenium, Total	0.05	**0.011 J+**	**0.01 J+**	**0.019 J**	**0.019 J**	**0.0078**	0.05 U	0.005 U
Thallium, Total	0.002	0.001 U	0.001 U	-	-	0.001 U	0.01 U	**0.000021 J**
Radiological (pCi/L)								
Radium-226	NA	0.136 U ± 0.153	**0.336 ± 0.201**	R	R	-	**0.283 J ± 0.0999**	**0.157 ± 0.0919**
Radium-228	NA	0.223 U ± 0.179	0.125 U ± 0.191	**0.400 ± 0.232**	0.364 U ± 0.238	-	0.163 UJ ± 0.283	0.127 U ± 0.259
Radium-226 & 228	5	**0.359 ± 0.235**	**0.461 J ± 0.277**	**0.738 J+ ± 0.259**	**0.639 J+ ± 0.257**	-	-	0.285 U ± 0.275

ABBREVIATIONS AND NOTES:

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TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-4 CCR-AP-4-20160811 08/11/2016	CCR-AP-4R CCR-AP-4-20161026 10/26/2016	CCR-AP-4R DUP 1-20161026 10/26/2016	CCR-AP-4R CCR-AP-4R-20161205 12/05/2016	CCR-AP-4R CCR-AP-4R-20170206 02/06/2017	CCR-AP-4R CCR-AP-4R-20170425 04/25/2017	CCR-AP-4R CCR-AP-4R-20170605 06/05/2017	CCR-AP-4R CCR-AP-4R-20170926 09/26/2017
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	**0.00059 J**	**0.00032 J**	**0.00047 J**	**0.00032 J**	0.001 U	**0.0003 J**	**0.00026 J**	R
Barium, Total	2	**0.089**	**0.11 J-**	**0.11 J-**	**0.063 J-**	**0.051**	**0.043**	**0.069**	**0.042 J-**
Beryllium, Total	0.004	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.005	**0.00018 J**	0.001 U	0.001 U	0.001 U	**0.000084 J**	0.001 U	0.001 U	0.001 U
Chromium, Total	0.1	**0.0016 J**	**0.0022**	**0.002**	**0.0018 J**	**0.0015 J**	**0.0018 J**	**0.0022**	R
Cobalt, Total	0.006	**0.0033**	**0.00081**	**0.00073**	0.0005 U	**0.0002 J**	**0.00011 J**	0.0005 U	0.0005 U
Fluoride	4	**0.41**	**0.4**	**0.4**	**0.48**	**0.33 J+**	**0.41**	**0.39**	**0.39 J+**
Lead, Total	0.015	**0.00023 J**	**0.00017 J**	**0.000068 J**	**0.00009 J**	0.001 U	0.001 U	0.001 U	0.001 U
Lithium, Total	0.04	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Mercury, Total	0.002	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum, Total	0.1	**0.0088**	**0.0033 J**	**0.0032 J**	**0.0046 J**	0.005 U	**0.0019 J**	**0.0028 J**	**0.002 J**
Selenium, Total	0.05	**0.001 J**	**0.00057 J+**	**0.00076 J+**	**0.00051 J**	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.002	0.001 U	0.001 U	0.001 U	0.001 U	**0.00022 J**	0.001 U	0.001 U	0.001 U
Radiological (pCi/L)									
Radium-226	NA	**0.327 ± 0.108**	0.116 U ± 0.206	0.281 U ± 0.282	R	0.0779 U ± 0.0791	0.126 U ± 0.0996	**0.185 J ± 0.0926**	R
Radium-228	NA	**7.60 J ± 1.03**	0.369 U ± 0.307	0.291 U ± 0.271	**0.370 ± 0.239**	0.199 U ± 0.251	-0.0800 U ± 0.296	0.144 U ± 0.215	-0.0756 U ± 0.212
Radium-226 & 228	5	**7.93 J ± 1.04**	0.485 U ± 0.37	**0.572 ± 0.391**	R	0.277 U ± 0.263	0.126 U ± 0.313	0.329 UJ ± 0.234	0.11 UJ ± 0.223

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TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-4R CCR-AP-4R-20171114 11/14/2017	CCR-AP-4R CCR-AP-4R-20180606 06/06/2018	CCR-AP-4R CCR-AP-4R-20180821 08/21/2018	CCR-AP-4R CCR-AP-4R-20181114 11/14/2018	CCR-AP-4R CCR-AP-4R-20190522 05/22/2019	CCR-AP-5 CCR-AP-5-20160606 06/06/2016	CCR-AP-5 CCR-AP-5-20160811 08/11/2016	CCR-AP-5 CCR-AP-5-20161027 10/27/2016
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	0.002 U	0.002 U	-	0.002 U	0.002 U	0.002 U	0.002 U	0.02 U
Arsenic, Total	0.01	0.001 U	0.001 U	0.001 U	**0.00051 J**	**0.00038 J**	**0.00057 J**	**0.0003 J**	0.01 U
Barium, Total	2	**0.045 J-**	**0.098 J-**	**0.094 J**	**0.051 B**	**0.094 J-**	**0.019**	**0.016**	**0.015 J**
Beryllium, Total	0.004	0.001 U	0.001 UJ	-	0.001 U	0.001 U	**0.000052 J**	0.001 U	0.01 U
Cadmium, Total	0.005	0.001 U	0.001 UJ	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.01 U
Chromium, Total	0.1	**0.0027 J+**	**0.0036 J+**	**0.0038 J+**	**0.0043**	**0.0035**	**0.00062 J**	0.002 U	0.02 U
Cobalt, Total	0.006	**0.0003 J**	**0.00013 J**	0.0005 U	**0.000096 J**	**0.00017 J**	**0.00081**	**0.00011 J**	0.005 U
Fluoride	4	**0.41**	**0.43**	**0.34**	-	**0.41 J+**	**0.26 J**	0.5 U	**0.31 J**
Lead, Total	0.015	0.001 U	0.001 UJ	0.001 U	0.001 U	0.001 U	**0.00024 J**	0.001 U	**0.0007 J**
Lithium, Total	0.04	0.05 U	0.005 U	0.05 U	0.005 U	0.0067 U	**0.014 J**	**0.015 J**	**0.018 J**
Mercury, Total	0.002	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum, Total	0.1	**0.0017 J**	**0.0016 J**	**0.0015 J**	**0.0014 J**	**0.0014 J**	**0.022**	**0.019**	**0.016 J**
Selenium, Total	0.05	0.005 U	**0.0014 J+**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.05 U
Thallium, Total	0.002	0.001 U	0.001 U	-	0.001 U	0.001 U	**0.000076 J**	0.001 U	0.01 U
Radiological (pCi/L)									
Radium-226	NA	**0.159 ± 0.0794**	0.216 U ± 0.173	R	-	0.0797 UJ ± 0.0791	**0.107 ± 0.0697**	**0.179 ± 0.0827**	0.293 U ± 0.242
Radium-228	NA	**0.488 ± 0.307**	**0.354 ± 0.224**	0.414 U ± 0.284	-	0.412 UJ ± 0.361	0.214 U ± 0.278	0.161 UJ ± 0.287	0.0785 U ± 0.226
Radium-226 & 228	5	**0.647 ± 0.317**	**0.569 J ± 0.283**	**0.743 J+ ± 0.3**	-	-	0.321 U ± 0.287	0.339 UJ ± 0.298	0.372 U ± 0.332

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TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-5 CCR-AP-5-20161206 12/06/2016	CCR-AP-5 CCR-AP-5-20170207 02/07/2017	CCR-AP-5 CCR-AP-5-20170405 04/05/2017	CCR-AP-5 CCR-AP-5-20170606 06/06/2017	CCR-AP-5 DUP1-20170606 06/06/2017	CCR-AP-5 CCR-AP-5-20170927 09/27/2017	CCR-AP-5 CCR-AP-5-20171115 11/15/2017	CCR-AP-5 CCR-AP-5-20180606 06/06/2018
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	**0.00016 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Barium, Total	2	**0.016 J-**	**0.016**	**0.016 J-**	**0.015**	**0.015**	**0.012**	**0.015 J-**	**0.016 J-**
Beryllium, Total	0.004	**0.00016 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UJ
Cadmium, Total	0.005	0.001 U	**0.00012 J**	0.001 U	**0.00012 J**	0.001 U	0.001 U	0.001 U	0.001 UJ
Chromium, Total	0.1	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt, Total	0.006	0.0005 U	**0.000098 J**	0.0005 U	0.0005 U	0.0005 U	0.0005 U	**0.00016 J**	**0.00012 J**
Fluoride	4	**0.54**	0.5 U	**0.23 J**	**0.34 J**	1 U	**0.2 J+**	**0.32 J**	**0.4**
Lead, Total	0.015	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UJ
Lithium, Total	0.04	**0.023 J**	**0.022 J**	**0.014 J**	**0.017 J**	**0.015 J**	**0.019 J**	**0.016 J**	**0.013 J**
Mercury, Total	0.002	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ
Molybdenum, Total	0.1	**0.038**	**0.049**	**0.044**	**0.059**	**0.059**	**0.055**	**0.067**	**0.054 J**
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.00085 J+**
Thallium, Total	0.002	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Radiological (pCi/L)									
Radium-226	NA	-0.0341 U ± 0.18	**0.130 ± 0.0873**	**0.145 ± 0.084**	0.0962 UJ ± 0.0743	**0.181 J ± 0.0794**	R	**0.100 ± 0.0637**	**0.234 ± 0.173**
Radium-228	NA	**0.743 ± 0.259**	0.294 U ± 0.22	0.208 U ± 0.204	0.222 U ± 0.289	**0.329 ± 0.28**	0.198 U ± 0.226	0.330 U ± 0.233	0.225 U ± 0.222
Radium-226 & 228	5	R	**0.424 J ± 0.236**	**0.354 J ± 0.221**	0.318 U ± 0.298	**0.510 J ± 0.291**	**0.522 J+ ± 0.249**	**0.430 J ± 0.242**	**0.459 J ± 0.281**

ABBREVIATIONS AND NOTES:

Statistically significant level (SSL) concentration.
CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
su: standard units.
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https://www.epa.gov/coalash/coal-ash-rule

TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-5 CCR-AP-5-20180821 08/21/2018	CCR-AP-5 CCR-AP-5-20181112 11/12/2018	CCR-AP-5 CCR-AP-5-20190522 05/22/2019	CCR-AP-5 BLIND DUPLICATE 2-20190522 05/22/2019	CCR-AP-6 CCR-AP-6-20160607 06/07/2016	CCR-AP-6 DUP 1-20160607 06/07/2016	CCR-AP-6 CCR-AP-6-20160810 08/10/2016
Appendix IV Constituents (mg/L)								
Antimony, Total	0.006	-	0.002 U	0.02 U	0.02 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	0.001 U	**0.00048 J**	0.01 U	0.01 U	**0.0053**	**0.0052**	**0.0045**
Barium, Total	2	**0.015 J**	**0.016 B**	**0.018 J**	**0.02 J**	**0.028**	**0.029**	**0.019**
Beryllium, Total	0.004	-	0.001 U	0.001 U	0.001 U	**0.0001 J**	**0.000095 J**	0.001 U
Cadmium, Total	0.005	0.001 U	0.001 U	0.01 U	0.01 U	**0.00021 J**	**0.00022 J**	0.001 U
Chromium, Total	0.1	0.002 U	**0.0021**	0.02 U	0.02 U	**0.0012 J**	**0.0013 J**	0.002 U
Cobalt, Total	0.006	0.0005 U	**0.00018 J**	0.005 U	0.005 U	**0.0068**	**0.0069**	**0.0038**
Fluoride	4	**0.26 J+**	-	**0.31 J+**	**0.31 J+**	**0.12**	**0.12**	0.1 U
Lead, Total	0.015	0.001 U	0.001 U	0.01 U	0.01 U	**0.0011**	**0.0013**	**0.00023 J**
Lithium, Total	0.04	**0.023 J**	**0.012**	0.05 U	0.05 U	**0.043 J**	**0.044 J**	**0.04 J**
Mercury, Total	0.002	0.0002 U	0.0002 U	0.0002 U	0.0002 U	**0.000055 J**	**0.000057 J**	0.0002 U
Molybdenum, Total	0.1	**0.052**	**0.044**	**0.059**	**0.053**	**0.021**	**0.022**	**0.015**
Selenium, Total	0.05	0.005 U	0.005 U	0.05 U	0.05 U	**0.00065 J**	0.005 U	0.005 U
Thallium, Total	0.002	-	0.001 U	0.01 U	0.01 U	**0.00006 J**	**0.000056 J**	0.001 U
Radiological (pCi/L)								
Radium-226	NA	R	-	0.0606 UJ ± 0.0578	0.153 U ± 0.196	**0.162 ± 0.0727**	0.0847 U ± 0.0641	**0.177 ± 0.0778**
Radium-228	NA	**0.371 ± 0.222**	-	-0.0634 UJ ± 0.257	0.254 U ± 0.27	-0.0541 U ± 0.342	-0.0238 U ± 0.214	-0.0414 UJ ± 0.239
Radium-226 & 228	5	**0.552 J+ ± 0.235**	-	-	-	0.108 U ± 0.35	0.0609 U ± 0.223	0.136 UJ ± 0.251

ABBREVIATIONS AND NOTES:

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TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-6 CCR-AP-6-20161026 10/26/2016	CCR-AP-6 CCR-AP-6-20161206 12/06/2016	CCR-AP-6 DUP 1-20161206 12/06/2016	CCR-AP-6 CCR-AP-6-20170207 02/07/2017	CCR-AP-6 CCR-AP-6-20170404 04/04/2017	CCR-AP-6 CCR-AP-6-20170605 06/05/2017	CCR-AP-6 CCR-AP-6-20170926 09/26/2017	CCR-AP-6 CCR-AP-6-20171116 11/16/2017
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	**0.00068 J**
Arsenic, Total	0.01	**0.0041**	**0.0039**	**0.0031**	**0.0029 J+**	**0.0021**	**0.002**	**0.0032 J+**	**0.0044 J**
Barium, Total	2	**0.022 J-**	**0.021 J-**	**0.02 J-**	**0.021**	**0.018 J-**	**0.018**	**0.026 J-**	**0.04 J-**
Beryllium, Total	0.004	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.00051 J**	**0.00042 J**
Cadmium, Total	0.005	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.00013 J**
Chromium, Total	0.1	**0.001 J**	**0.00048 J**	**0.00058 J**	0.002 U	0.002 U	0.002 U	R	**0.0072 J+**
Cobalt, Total	0.006	**0.0032**	**0.0023**	**0.0023**	**0.0013**	**0.001**	**0.00099**	**0.0033**	**0.0054**
Fluoride	4	**0.18**	**0.24**	**0.24**	**0.2 J+**	**0.2**	**0.19 J**	**0.21 J+**	**0.21**
Lead, Total	0.015	**0.00061 J**	**0.00028 J**	**0.00014 J**	0.001 U	0.001 U	0.001 U	**0.005**	**0.0036 J**
Lithium, Total	0.04	**0.042 J**	**0.041 J**	**0.041 J**	**0.04 J**	**0.036 J**	**0.039 J**	**0.042 J**	**0.043 J**
Mercury, Total	0.002	0.0002 UJ	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Molybdenum, Total	0.1	**0.012**	**0.011**	**0.01**	**0.01**	**0.0086**	**0.009**	**0.0066**	**0.0089**
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.002	**0.000039 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.00018 J**	**0.000097 J**
Radiological (pCi/L)									
Radium-226	NA	0.195 U ± 0.228	0.278 U ± 0.281	0.174 U ± 0.256	0.0398 U ± 0.086	**0.120 ± 0.0878**	0.0399 UJ ± 0.0601	**1.10 J ± 0.398**	**0.122 ± 0.0669**
Radium-228	NA	0.394 U ± 0.274	**0.641 ± 0.284**	**0.732 ± 0.337**	0.0520 U ± 0.252	-0.0275 U ± 0.213	**0.0246 ± 0.242**	**3.67 ± 1.2**	**0.406 ± 0.244**
Radium-226 & 228	5	**0.589 ± 0.356**	R	R	0.0918 U ± 0.266	0.12 UJ ± 0.23	0.0646 U ± 0.25	**4.77 ± 1.26**	**0.528 ± 0.253**

ABBREVIATIONS AND NOTES:

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TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-6 DUP 1-20171116 11/16/2017	CCR-AP-6 CCR-AP-6-20180607 06/07/2018	CCR-AP-6 CCR-AP-6-20180822 08/22/2018	CCR-AP-6 CCR-AP-6-20181113 11/13/2018	CCR-AP-6 CCR-AP-6-20190521 05/21/2019	CCR-AP-7 CCR-AP-7-20160609 06/09/2016	CCR-AP-7 CCR-AP-7-20160810 08/10/2016	CCR-AP-7R CCR-AP-7-20161026 10/26/2016
Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	**0.00046 J**	0.002 U	-	0.002 U	0.02 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	**0.0023 J+**	R	**0.00046 J**	**0.00089 J**	0.01 U	**0.00067 J**	R	**0.00061 J**
Barium, Total	2	**0.026 J-**	**0.022 J-**	**0.015 J**	**0.02 B**	0.1 UJ	**0.024 J-**	**0.039**	**0.032 J-**
Beryllium, Total	0.004	**0.00027 J**	0.001 UJ	-	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.005	**0.00021 J**	0.001 UJ	0.001 U	0.001 U	0.01 U	0.001 U	**0.00032 J**	**0.00019 J**
Chromium, Total	0.1	**0.0029 J+**	0.002 U	0.002 U	**0.0025**	0.02 U	**0.0016 J**	**0.00093 J**	**0.00076 J**
Cobalt, Total	0.006	**0.0046**	**0.0011 J**	**0.00017 J**	**0.00081**	**0.0013 J**	**0.0002 J**	**0.0039**	**0.0012**
Fluoride	4	**0.23**	**0.23**	**0.44**	-	0.17 U	R	0.25 U	**0.17 J**
Lead, Total	0.015	**0.0023 J**	**0.00013 J**	0.001 U	0.001 U	0.01 U	R	**0.00041 J**	**0.00022 J**
Lithium, Total	0.04	**0.042 J**	**0.026 J**	0.005 U	**0.034**	**0.034 J+**	**0.011 J**	**0.02 J**	**0.024 J**
Mercury, Total	0.002	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 U	0.0002 UJ
Molybdenum, Total	0.1	**0.0084**	**0.0064 J**	**0.0032 J**	**0.0074**	**0.0067 J**	**0.0016 J**	**0.0011 J**	0.005 U
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U	0.05 U	0.005 U	**0.0007 J**	0.005 U
Thallium, Total	0.002	**0.00016 J**	0.001 U	-	0.001 U	0.01 U	0.001 U	0.001 U	0.001 U
Radiological (pCi/L)									
Radium-226	NA	**0.251 ± 0.115**	0.0628 U ± 0.107	**0.438 J ± 0.119**	-	0.0195 UJ ± 0.0643	**0.0958 J ± 0.0549**	**0.324 ± 0.149**	0.284 U ± 0.252
Radium-228	NA	R	R	R	-	0.237 UJ ± 0.234	-0.0103 U ± 0.186	0.127 UJ ± 0.584	0.157 U ± 0.248
Radium-226 & 228	5	R	R	R	-	-	0.0856 U ± 0.194	0.451 UJ ± 0.603	**0.441 ± 0.353**

ABBREVIATIONS AND NOTES:

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TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-7R CCR-AP-7R-20161205 12/05/2016	CCR-AP-7R CCR-AP-7R-20170206 02/06/2017	CCR-AP-7R CCR-AP-7R-20170425 04/25/2017	CCR-AP-7R CCR-AP-7R-20170605 06/05/2017	CCR-AP-7R CCR-AP-7R-20170926 09/26/2017	CCR-AP-7R CCR-AP-7R-20171114 11/14/2017	CCR-AP-7R CCR-AP-7R-20180606 06/06/2018
Appendix IV Constituents (mg/L)								
Antimony, Total	0.006	0.002 U	0.002 U	**0.00059 J**	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	**0.00051 J**	**0.0016 J+**	**0.0032**	**0.0017**	R	**0.0014 J+**	0.001 U
Barium, Total	2	**0.033 J-**	**0.039**	**0.063**	**0.05**	**0.048 J-**	**0.039 J-**	**0.032 J-**
Beryllium, Total	0.004	0.001 U	0.001 U	**0.00024 J**	0.001 U	**0.00013 J**	0.001 U	0.001 UJ
Cadmium, Total	0.005	**0.00015 J**	**0.00014 J**	**0.00015 J**	**0.0002 J**	0.001 U	**0.00011 J**	0.001 UJ
Chromium, Total	0.1	**0.00093 J**	**0.0016 J**	**0.0063**	**0.0033**	R	**0.0029 J+**	0.002 U
Cobalt, Total	0.006	**0.0012**	**0.0015**	**0.004**	**0.0023**	**0.0019**	**0.0013**	**0.00037 J**
Fluoride	4	**0.25**	0.25 U	**0.2 J**	**0.19 J**	R	**0.094 J**	**0.15 J**
Lead, Total	0.015	**0.00014 J**	**0.00062 J**	**0.0033**	**0.0017**	**0.0018 J+**	**0.0011**	**0.00013 J**
Lithium, Total	0.04	**0.025 J**	**0.023 J**	**0.03 J**	**0.021 J**	**0.025 J**	**0.022 J**	**0.02 J**
Mercury, Total	0.002	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ
Molybdenum, Total	0.1	0.005 U	0.005 U	0.005 U	**0.00062 J**	**0.00065 J**	0.005 U	0.005 U
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.002	0.001 U	0.001 U	0.001 U	0.001 U	**0.000054 J**	0.001 U	0.001 U
Radiological (pCi/L)								
Radium-226	NA	0.0965 U ± 0.221	**0.164 ± 0.0985**	**0.350 ± 0.13**	**0.248 J ± 0.093**	R	**0.217 ± 0.0812**	0.186 U ± 0.169
Radium-228	NA	0.347 U ± 0.251	0.193 U ± 0.275	0.0871 U ± 0.274	**0.202 ± 0.223**	0.450 U ± 0.305	**0.559 ± 0.268**	0.0364 U ± 0.199
Radium-226 & 228	5	R	0.357 UJ ± 0.292	0.437 UJ ± 0.303	**0.451 J ± 0.242**	R	**0.776 ± 0.28**	0.222 U ± 0.261

ABBREVIATIONS AND NOTES:

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TABLE 1A
ASSESSMENT MONITORING GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-7R CCR-AP-7R-20180822 08/22/2018	CCR-AP-7R CCR-AP-7R-20181113 11/13/2018	CCR-AP-7R CCR-AP-7R-20190521 05/21/2019
Appendix IV Constituents (mg/L)				
Antimony, Total	0.006	-	0.002 U	0.02 U
Arsenic, Total	0.01	**0.00077 J**	**0.00076 J**	0.01 U
Barium, Total	2	**0.031 J**	**0.025 B**	**0.029 J**
Beryllium, Total	0.004	-	0.001 U	0.001 U
Cadmium, Total	0.005	0.001 U	0.001 U	0.01 U
Chromium, Total	0.1	**0.0033 J+**	**0.0024**	0.02 U
Cobalt, Total	0.006	**0.00049 J**	**0.00026 J**	0.005 U
Fluoride	4	**0.19 J+**	-	0.17 U
Lead, Total	0.015	**0.00031 J**	**0.000095 J**	0.01 U
Lithium, Total	0.04	**0.019 J+**	**0.017**	0.05 U
Mercury, Total	0.002	0.0002 U	0.0002 U	0.0002 U
Molybdenum, Total	0.1	0.005 U	0.005 U	0.05 U
Selenium, Total	0.05	**0.00099 J**	0.005 U	0.05 U
Thallium, Total	0.002	-	0.001 U	0.01 U
Radiological (pCi/L)				
Radium-226	NA	R	-	-0.0773 U ± 0.198
Radium-228	NA	R	-	0.307 U ± 0.26
Radium-226 & 228	5	R	-	-

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J-: Value is estimated, biased low
J+: Value is estimated, biased high
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TABLE 1B
NATURE AND EXTENT GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-2I CCR-AP-2I-20190214 02/14/2019	CCR-AP-2I CCR-AP-2I-20190614 06/14/2019	CCR-AP-3I CCR-AP-3I-20190214 02/14/2019	CCR-AP-3I CCR-AP-3I-20190614 06/14/2019	CCR-AP-8 CCR-AP-8-20190212 02/12/2019	CCR-AP-8 CCR-AP-8-20190617 06/17/2019
Appendix IV Constituents (mg/L)							
Antimony, Total	0.006	-	**0.00053 J**	-	**0.00045 J**	-	0.002 U
Arsenic, Total	0.01	**0.0035**	**0.0022**	**0.0014**	**0.0018**	**0.0016**	**0.0013**
Barium, Total	2	**0.09**	**0.11**	**0.11**	**0.17**	**0.06**	**0.066**
Beryllium, Total	0.004	-	0.001 U	-	**0.00026 J**	-	0.001 U
Cadmium, Total	0.005	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	0.1	0.002 U	0.004 U	**0.0018 J**	0.0046 U	0.002 U	0.0039 U
Cobalt, Total	0.006	**0.00022 J**	0.0005 U	**0.00024 J**	**0.0013**	**0.0009**	**0.0046**
Fluoride	4	**1.1**	**0.83**	**1.3**	**1.1**	**0.27**	**0.29 J+**
Lead, Total	0.015	0.001 U	0.001 U	**0.00047 J**	0.0011 U	0.001 U	0.001 U
Lithium, Total	0.04	**0.027**	**0.024**	**0.019**	**0.025**	**0.009**	**0.011**
Mercury, Total	0.002	-	0.0002 U	-	0.0002 U	0.0002 U	0.0002 U
Molybdenum, Total	0.1	**0.037**	**0.0092**	**0.012**	**0.0061**	**0.00094 J**	**0.001 J**
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.002	-	0.001 U	-	**0.00013 J**	-	0.001 U
Radiological (pCi/L)							
Radium-226	NA	**0.301 ± 0.108**	0.07 U ± 0.11	**0.192 ± 0.096**	**0.43 ± 0.25**	**0.111 ± 0.0784**	**0.35 ± 0.23**
Radium-228	NA	0.307 U ± 0.206	0.53 U ± 0.37	0.290 U ± 0.224	0.56 U ± 0.39	0.0610 U ± 0.19	0.67 U ± 0.44
Radium-226 & 228	5	**0.608 ± 0.233**	0.60 U ± 0.386	**0.483 ± 0.244**	**0.99 J ± 0.463**	0.172 U ± 0.206	**1.02 J ± 0.496**

ABBREVIATIONS AND NOTES:

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su: standard units.
USEPA: United States Environmenta.l Protection Agency
J: Value is estimated
J-: Value is estimated, biased low
J+: Value is estimated, biased high
R: Rejected during validation
U: Not detected, value is the laboratory reporting limit

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257. https://www.epa.gov/coalash/coal-ash-rule

TABLE 1B
NATURE AND EXTENT GROUNDWATER ANALYTICAL RESULTS - APPENDIX IV CONSTITUENTS
CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION - ASH POND

Location Name Sample Name Sample Date	Groundwater Protection Standard	CCR-AP-9 CCR-AP-9-20190214 02/14/2019	CCR-AP-9 CCR-AP-9-20190617 06/17/2019	CCR-AP-9 BLIND DUPLICATE-20190617 06/17/2019	CCR-AP-10 CCR-AP-10-20190213 02/13/2019	CCR-AP-10 CCR-AP-10-20190617 06/17/2019
Appendix IV Constituents (mg/L)						
Antimony, Total	0.006	-	0.02 U	0.02 U	-	0.002 U
Arsenic, Total	0.01	**0.0056**	**0.023**	**0.023**	**0.0037**	**0.0011**
Barium, Total	2	**0.051 F1F2**	**0.086 J**	**0.074 J**	**0.039**	**0.019**
Beryllium, Total	0.004	-	0.01 U	0.01 U	-	**0.00021 J**
Cadmium, Total	0.005	0.001 U	0.01 U	0.01 U	**0.00015 J**	0.001 U
Chromium, Total	0.1	0.002 U	0.02 U	0.02 U	**0.0061**	0.0038 U
Cobalt, Total	0.006	**0.0069**	0.005 U	0.005 U	**0.0051**	**0.0016**
Fluoride	4	**0.45 J**	**0.33 J+**	**0.33 J+**	**0.53**	**0.45 J+**
Lead, Total	0.015	**0.00037 JF1**	0.01 U	0.01 U	**0.0036**	0.001 U
Lithium, Total	0.04	**0.026**	0.05 U	0.05 U	**0.0066**	**0.0059**
Mercury, Total	0.002	-	0.0002 U	0.0002 U	-	0.0002 U
Molybdenum, Total	0.1	**0.04**	**0.021 J**	**0.021 J**	**0.012**	**0.0039 J**
Selenium, Total	0.05	0.005 U	0.05 U	0.05 U	**0.011**	**0.015**
Thallium, Total	0.002	-	0.01 U	0.01 U	-	**0.00013 J**
Radiological (pCi/L)						
Radium-226	NA	**0.149 ± 0.0782**	**0.58 ± 0.38**	**0.61 ± 0.38**	**0.238 ± 0.115**	0.32 U ± 0.27
Radium-228	NA	0.146 U ± 0.214	**0.76 ± 0.41**	0.63 U ± 0.38	0.277 U ± 0.328	0.66 U ± 0.38
Radium-226 & 228	5	0.295 U ± 0.228	**1.34 ± 0.559**	**1.24 J ± 0.537**	0.515 U ± 0.348	**0.98 ± 0.466**

ABBREVIATIONS AND NOTES:

Statistically significant level (SSL) concentration.
CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
su: standard units.
USEPA: United States Environmenta.l Protection Agency
J: Value is estimated
J-: Value is estimated, biased low
J+: Value is estimated, biased high
R: Rejected during validation
U: Not detected, value is the laboratory reporting limit

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257.
https://www.epa.gov/coalash/coal-ash-rule

TABLE 2

SUMMARY OF CORRECTIVE MEASURES

CORRECTIVE MEASURES ASSESSMENT

A.B. BROWN GENERATING STATION

MOUNT VERNON, INDIANA

Alternative Number	Remedial Alternative Description	THRESHOLD CRITERIA					BALANCING CRITERIA																	
								Sub-Category 1										Sub-Cat. 2			Sub-Category 3				
								1	2	3	4	5	6	7	8			1	2		1	2	3	4	5
		Be protective of human health and the environment	Attain the groundwater protective standard	Control the source of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of Appendix IV constituents into the environment	Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems	Management of waste to comply with all applicable RCRA requirements	CATEGORY 1 Long- and Short-Term Effectiveness, Protectiveness, and Certainty of Success that the remedy will prove successful	*Magnitude of reduction of existing risks*	*Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy*	*Type and degree of long-term management required including monitoring, operation and maintenance*	*Short-term risk to community or environment during implementation of remedy*	*Time until full protection is achieved*	*Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment*	*Long-term reliability of engineering and institutional controls*	*Potential need for replacement of the remedy*	CATEGORY 2 Effectiveness in controlling the source to reduce further releases	*Extent to which containment practices will reduce further releases*	*Extent to which treatment technologies may be used*	CATEGORY 3 The ease or difficulty of implementation	*Degree of difficulty associated with constructing the technology*	*Expected operational reliability of the technologies*	*Need to coordinate with and obtain necessary approvals and permits from other agencies*	*Availability of necessary equipment and specialists*	*Available capacity and location of needed treatment, storage, and disposal services*
1	Monitored Natural Attenuation (MNA) with Closure by Removal (CBR)	✓	✓	✓	✓	✓																		
2	Hydraulic Containment with No Treatment, CBR, and MNA	✓	✓	✓	✓	✓																		
3	Hydraulic Containment with Treatment, CBR, and MNA	✓	✓	✓	✓	✓																		

COLOR LEGEND

- **Most favorable when compared to other alternatives**
- **Less favorable when compared to other alternatives**
- **Least favorable when compared to other alternatives**

1. For context, this a relative comparison of remedial options for this site. Site conditions, weather, and site-specific considerations are made in this table. This is not a comparison to all options at all sites.

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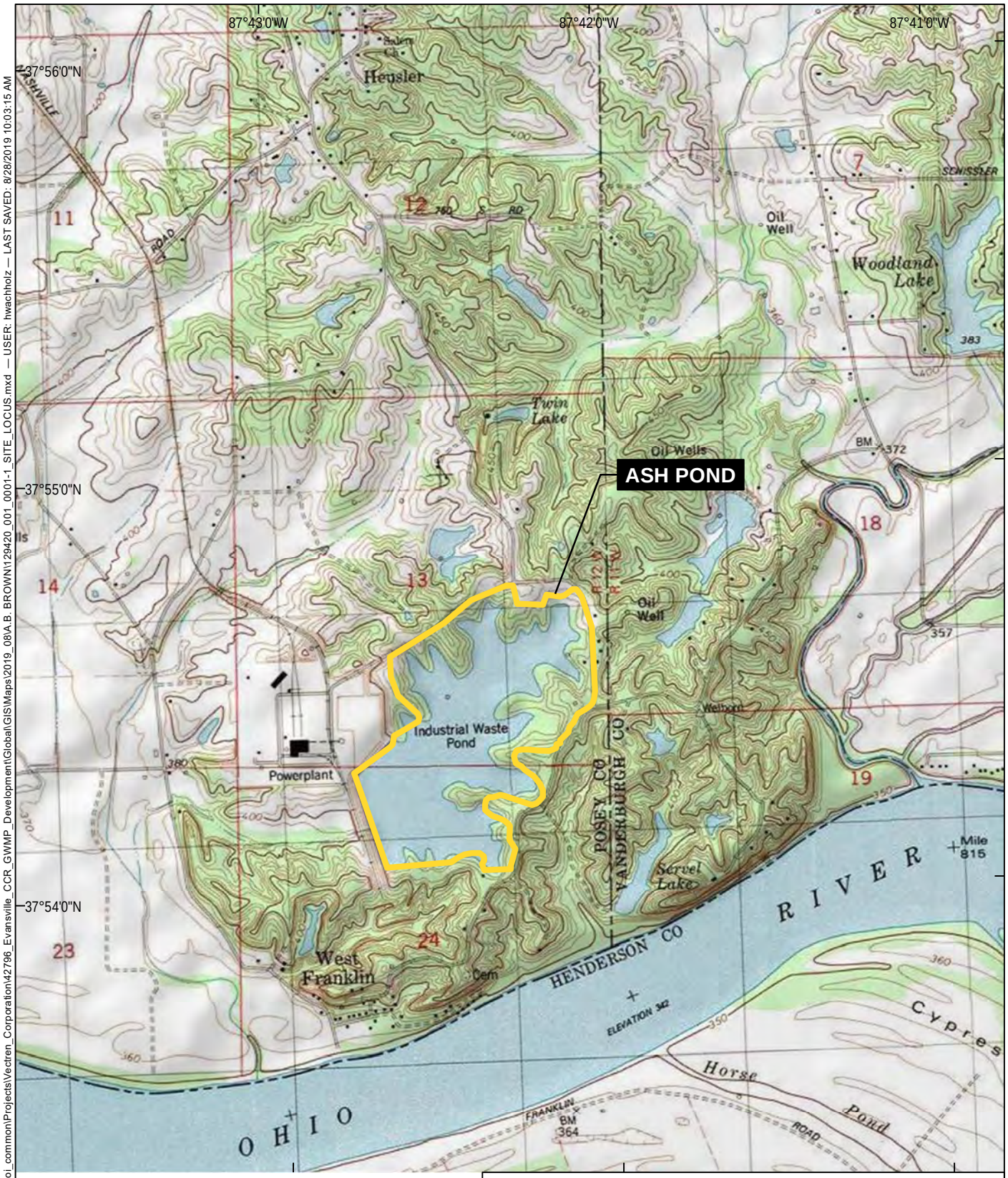
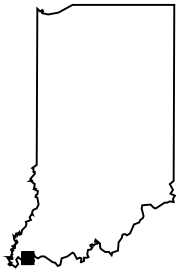
FIGURES





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CORRECTIVE MEASURES ASSESSMENT
SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

SITE LOCATION MAP

MAP SOURCE: ESRI
SITE COORDINATES: 37°54'21"N, 87°42'30"W

APPROXIMATE SCALE: 1 IN = 2000 FT
SEPTEMBER 2019

FIGURE 1-1

GIS FILE PATH: \\haleyaldrich.com\share\boi_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2019_08\A.B. BROWN\129420_001_0001-1_SITE_LOCUS.mxd — USER: hwachholz — LAST SAVED: 8/28/2019 10:03:15 AM

LEGEND

- CCR UNIT BOUNDARY
- APPROXIMATE PROPERTY BOUNDARY
- ASH POND UNIT BOUNDARY

NOTES

1. AERIAL IMAGERY SOURCE: ESRI
2. LOCATIONS DERIVED FROM THREE I DESIGN DATA.

N

0 500 1,000 1,500 2,000 2,500 3,000 3,500
SCALE IN FEET

HALEY ALDRICH

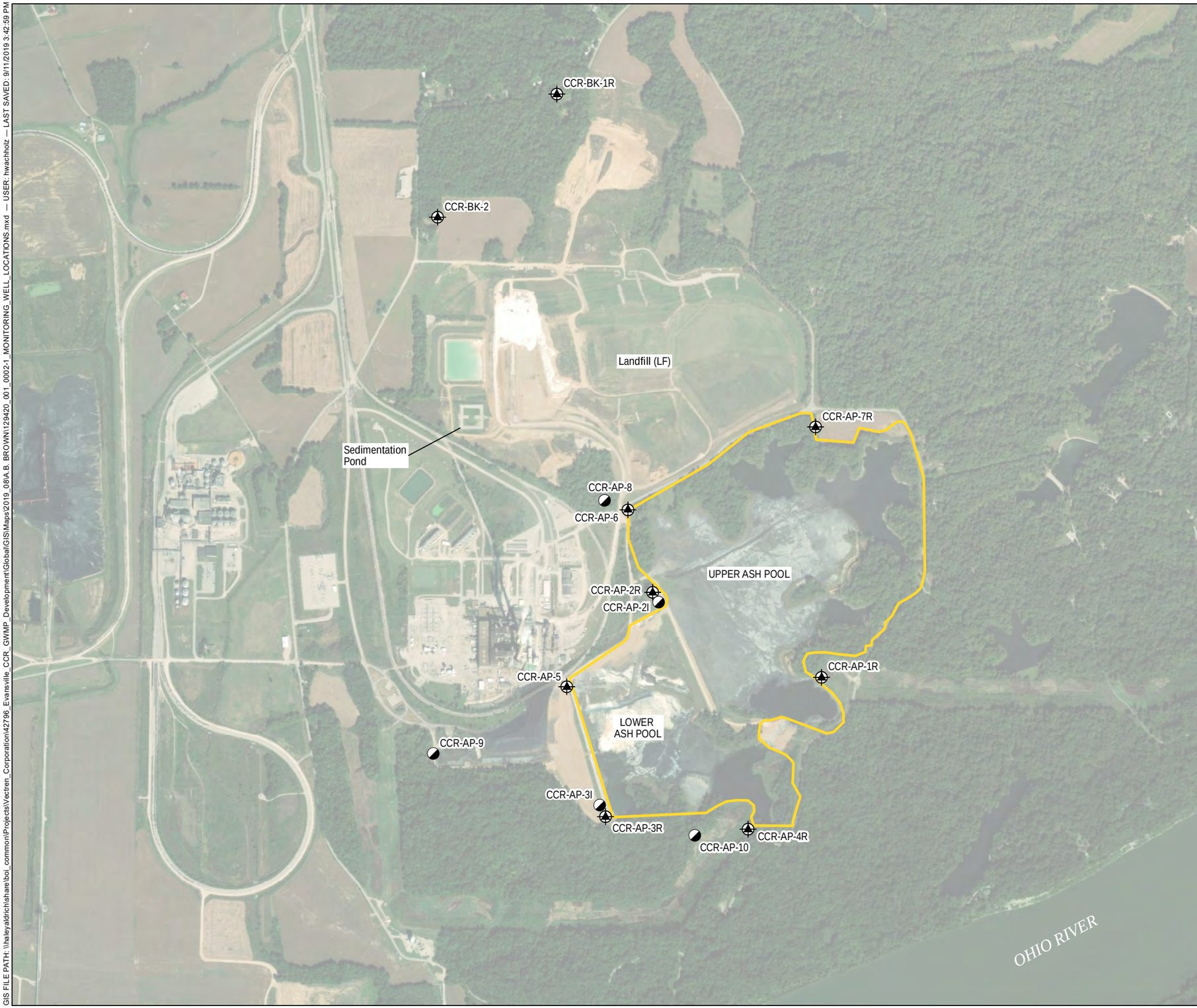
CORRECTIVE MEASURES ASSESSMENT
SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

SITE FEATURES MAP

SEPTEMBER 2019

FIGURE 1-2

GIS FILE PATH: \\haleyaldrich\share\bol_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2019_08\A.B. BROWN\129420_001_0001-2_SITE_FEATURES_MAP.mxd — USER: hwachholz — LAST SAVED: 9/11/2019 3:40:26 PM



LEGEND

- CCR MONITORING WELL
- NATURE AND EXTENT MONITORING WELL
- ASH POND UNIT BOUNDARY
- CCR UNIT BOUNDARY

NOTES

1. AERIAL IMAGERY SOURCE: ESRI
2. LOCATIONS DERIVED FROM THREE I DESIGN DATA.

N

0 1,000 2,000
SCALE IN FEET

HALEY ALDRICH

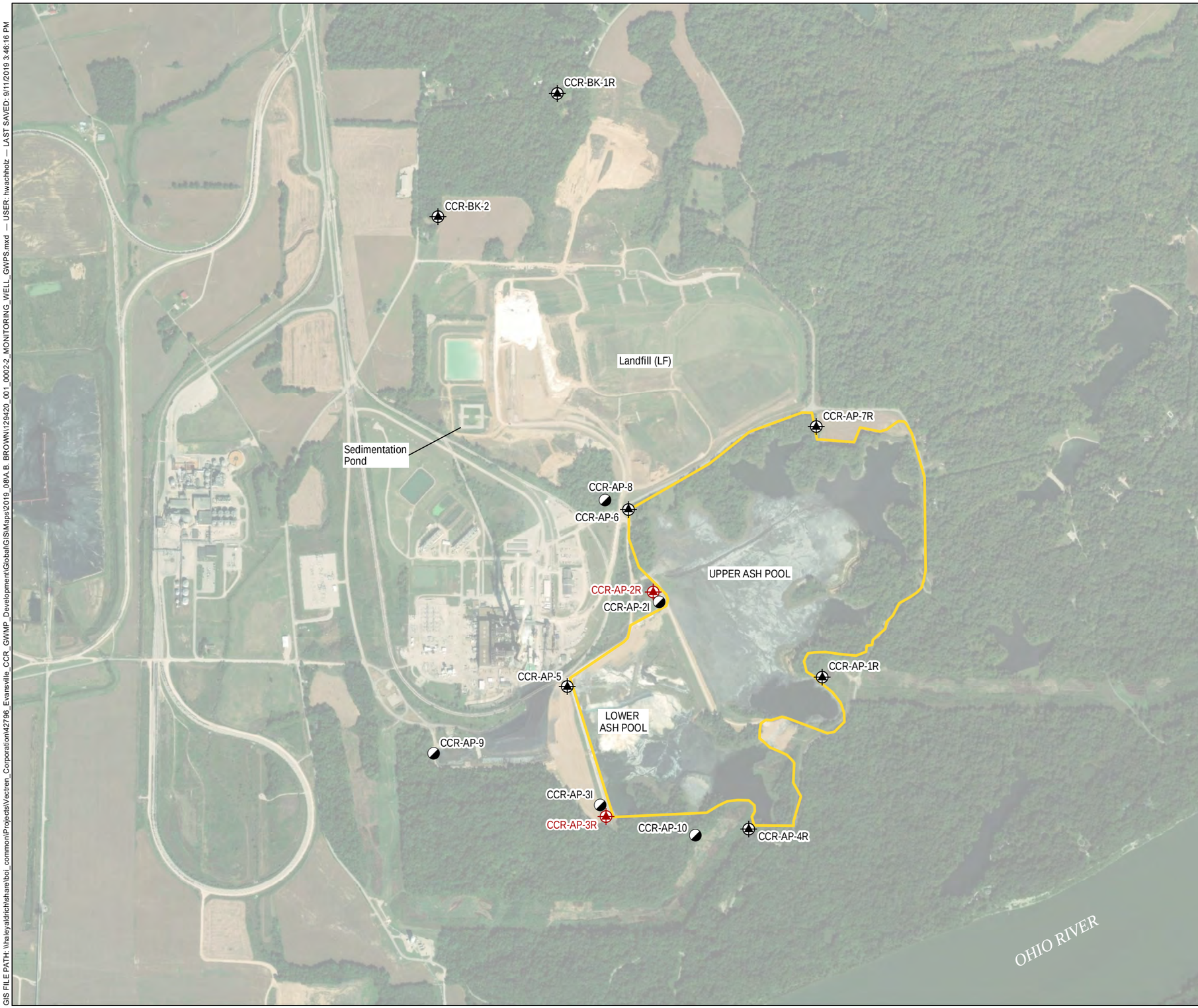
CORRECTIVE MEASURES ASSESSMENT
SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

MONITORING WELL LOCATIONS

SEPTEMBER 2019

FIGURE 1-3

GIS FILE PATH: \\haleyaldrich\share\bol_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2019_08\A.B. BROWN\129420_001_0002-1_MONITORING_WELL_LOCATIONS.mxd — USER: hwachholz — LAST SAVED: 9/11/2019 3:42:59 PM



LEGEND

- CCR MONITORING WELL WITH NO CONSTITUENTS ABOVE GWPS
- CCR-AP-2R — MONITORING WELL WITH LITHIUM AND MOLYBDENUM CONCENTRATION ABOVE THE GWPS
- CCR-AP-8 — NATURE AND EXTENT MONITORING WELL
- APPROXIMATE UNIT BOUNDARY

NOTES

1. LOCATIONS DERIVED FROM THREE I DESIGN DATA.
2. GWPS = GROUNDWATER PROTECTION STANDARDS
3. REFER TO TABLE 1 FOR GROUNDWATER ANALYTICAL RESULTS.
4. AERIAL IMAGERY SOURCE: ESRI

N

0 1,000 2,000
SCALE IN FEET

HALEY ALDRICH

CORRECTIVE MEASURES ASSESSMENT
SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

MONITORING WELL LOCATIONS WITH STATISTICALLY SIGNIFICANT LEVELS ABOVE GWPS

SEPTEMBER 2019

FIGURE 2-1

GIS FILE PATH: \\haleyaldrich\share\bol_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2019_08\A.B. BROWN\129420_001_0002-2_MONITORING_WELL_GWPS.mxd — USER: hwachholz — LAST SAVED: 9/11/2019 3:46:16 PM

FIGURE 4-1
REMEDIAL ALTERNATIVE ROADMAP
CORRECTIVE MEASURES ASSESSMENT
SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION - ASH POND
MOUNT VERNON, INDIANA

Alternative Number	Remedial Alternative Description	Ash Pond Closure Method	Interim Measure Options for Groundwater	Post-Closure Options for Groundwater
1	**Monitored Natural Attenuation (MNA) with Closure by Removal (CBR)**	**Closure by Removal with Beneficial Use**	**Natural Attenuation with Monitoring** Mitigate migration of groundwater with CCR constituents above Groundwater Protection Standards (GWPS) through processes of natural attenuation	**MNA** Post-closure groundwater monitoring to confirm reduction of CCR constituents following removal
2	**Hydraulic Containment with No Treatment, CBR, and MNA**		**Hydraulic Containment with No Treatment** Mitigate migration of groundwater with CCR constituents above GWPS using extraction wells, direct discharge of effluent	
3	**Hydraulic Containment with Treatment, CBR, and MNA**		**Hydraulic Containment with Ex-Situ Treatment** Mitigate migration of groundwater with CCR constituents above GWPS using extraction wells, ex-situ treatment of effluent prior to discharge	

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REPORT ON
GROUNDWATER FLOW MODELING
ADDENDUM TO CORRECTIVE MEASURES ASSESSMENT
A.B. BROWN GENERATING STATION
ASH POND
MOUNT VERNON, INDIANA

by
Haley & Aldrich, Inc.
Cleveland, Ohio

for
Southern Indiana Gas and Electric Company
Evansville, Indiana

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6	Initial Molybdenum Concentration
7	Molybdenum Eh-Ph Diagram (in text)
8	Modeled Molybdenum Concentrations for CMA Options Over Time

1. Groundwater Flow Modeling

A groundwater flow and solute transport model was constructed to evaluate and compare potential corrective measures in support of the Corrective Measures Assessment (CMA) for the A.B. Brown Generating Facility (Site) near Mount Vernon, Indianapolis. The Appendix IV constituents above the Groundwater Protection Standard (GWPS) at the Site include lithium and molybdenum. Molybdenum was chosen for the solute transport portion of the model since it was the most conservative constituent which would require the most amount of time to attenuate for each remedial option. The following text describes the model construction, calibration and subsequent simulations of remedy alternatives for Appendix IV constituents above the GWPS.

The numerical model MODFLOW-2005 (Harbaugh, 2005) was selected for the modeling effort and is a three-dimensional, finite difference groundwater flow model capable of simulating the groundwater conditions under various scenarios including pumping and changes to infiltration over time. Models were built using available information and for the purpose of aiding decision making in the CMA process. The level of accuracy is directly dependent on the data available to construct the model and should not be construed by the user as a definitive predictor of the future. Instead the CMA alternatives model simulations should be viewed relative to one another to enable the user to determine (when appropriate) favorable, less favorable and least favorable CMA alternatives.

1.1 MODEL DOMAIN

The model domain was established to encompass the Site and surrounding areas that represented model boundaries including the nearby Ohio River located south of the ash pond and landfill.

MODFLOW uses a rectangular grid within the domain and allows for establishing irregular groundwater flow boundary conditions that represent actual and Site-specific features in the study area. The setup is facilitated by assigning boundary types and values to specific grid cells. **Figure 1** depicts the model domain boundary overlain on an aerial photograph of the Site.

Figure 2 depicts the model domain with the grid spacing selected for the model. The three-dimensional finite difference groundwater flow model domain covers a length of 13,000 feet (ft) in the x-direction (west to east), 13,000 ft in the y-direction (north to south), and approximately 45 ft in the z-direction (vertical). The model consists of 474 rows, 384 columns, and 4 layers for a total of 728,064 cells covering an approximate area of 3306 acres. In MODFLOW, the groundwater-flow system is subdivided laterally and vertically into rectilinear blocks called cells. The hydraulic properties of the material in each cell are assigned and assumed to be uniform within each cell. The row and column dimension of each cell is variable based on proximity to the Site. This variability was created to allow for finer resolution within the vicinity of the primary flow pathway for the Site.

A Digital Elevation Model was obtained from the United States Geological Survey website to create the surface of the model for the Site. Lithologic descriptions contained in the boring logs generated during various phases of geo-environmental investigations as well as cross-sections were used to develop formation geometry and hydraulic properties. The Site was divided into two vertical lithologic units to represent geologic conditions underlying the Site and to account for vertical heterogeneities within the model. A summary of each geologic unit is as follows:

- Unconsolidated alluvial deposits which consist primarily of silty clay containing discontinuous layers of sand (Haley & Aldrich, Inc., 2017).
- Weathered sandstone, shale, or siltstone.

Elevations used in the model were determined from digital elevation models for the area. The topography of the ground surface is mimicked in the subsequent lower layers; however, the elevation has been reduced by the layer thickness. Layer thicknesses were determined through the review of the above-mentioned Site geology.

Figure 3 depicts the two-dimensional views of the model layer elevations. The surfaces shown in **Figure 3** represent the model top (i.e., land surface), the flat model bottom, and all the lithologic interfaces between.

1.2 BOUNDARY CONDITIONS

Boundary conditions define the locations and manner in which water enters and exits the active model domain. The conceptual model for the groundwater system that forms the basis for the model boundaries are as follows:

1. A specified head boundary condition is used to control groundwater flow across the western side of the model,
2. Recharge at the Site creates radial flow away from the Site toward lower elevations to the west,
3. There is a topographic divide at approximately 470 ft along the eastern boundary.

The specified boundaries of the model coincide with predicted natural hydrologic boundaries. To recreate observed groundwater a specified head boundary was used. The location of this boundary condition in the model is illustrated in **Figure 4**.

1.2.1 Specified Head Boundaries

The MODFLOW Time Variant Specified Head Package (Harbaugh, 2005) also known as the Constant Head Package, was used to simulate boundaries presented in **Figure 4**. The package is used to fix the head values in selected grid cells regardless of the conditions in the surrounding grid cells. The cell with the assigned constant head acts either as a source of water entering or a sink of water leaving the system. The value for this boundary is referenced to datum NAVD 88 and is set to 371.0 ft to the north and decreases to 355.07 ft to the south and is active in Layer 2 through Layer 4. These values were estimated based on topography, the depths to water in wells at the Site, the pattern of groundwater flow, elevations of nearby water bodies, and through calibration of the groundwater flow model as described in **Section 1.3** below.

1.2.2 Recharge Boundaries

The magnitude of recharge varies between 4.7×10^{-5} ft per day (ft/day) and 2.6×10^{-3} ft/day. The low-end value represents model area surrounding the site and the high-end value represents conditions for the pond area.

1.3 HYDRAULIC MODEL PROPERTIES

Hydraulic properties were initially assigned consistent with observations presented in the 2017 Groundwater Monitoring Program (Haley & Aldrich, Inc., 2017). Values were assigned for horizontal hydraulic conductivity and vertical hydraulic conductivity. These parameters were iteratively varied during model calibration to achieve the best fit to observed hydraulic patterns including head elevations, hydraulic gradients, and flow directions.

For calibration, uniform hydraulic properties were applied within discrete model layers. Results of the initial calibration indicated that hydraulic conductivities in the range of those values associated with material described in boring logs were representative with regard to groundwater flow observed at the Site. The hydraulic conductivity values used in the model are presented below for the five hydrogeologic units underlying at the Site:

- Silty sand – 30 ft/day or 1.1 x 10-2 centimeters per second (cm/s)
- Silty clay – 4.1 ft/day or 1.4 x 10-3 cm/s
- Weathered sandstone, shale, or siltstone – 0.5 ft/day or 1.8 x 10-4 cm/s

1.3.1 Calibrated Horizontal and Vertical Hydraulic Conductivity

The calibrated horizontal (K_X and K_Y) and vertical (K_Z) hydraulic conductivity values in Model Layer 1 through Layer 4 were distributed uniformly across the model domain. Vertical hydraulic conductivity values were estimated at 1/10th of the horizontal hydraulic conductivity values. This ratio between horizontal and vertical conductivities was selected to represent resultant hydraulic conductivity when stratification typical of alluvial sediments is evident.

1.3.2 Porosity, Storage, and Yield

Effective porosity values are needed for particle tracking and solute transport simulations. The effective porosity values were conservatively estimated based on the soil type through the examination of boring logs. For areas that are generally silty clay, a porosity of 0.35, specific storage of 0.33 ft^{-1} and specific yield of 0.02 were utilized.

1.4 METHODS OF EVALUATING MODEL CALIBRATION QUALITY

Model calibration is the process of refining the model representation of the hydrogeologic framework, hydraulic properties, and boundary conditions to minimize the difference between the simulated heads and fluxes to the measured data. Construction of a complex model with more parameters than the data support may reduce the residuals (difference between measured and simulated values) but does not ensure a more accurate model. Therefore, calibrated model parameters also need to be checked for their validity. Throughout the calibration process, no adjustments were made that conflicted with the general understanding of the groundwater system and previously documented information.

The iterative calibration process of “trial and error” was used for model calibration. It involves making changes to the input values, running MODFLOW, and assessing the impact of the changes. Beside the trial and error approach, a model independent parameter optimization software tool – PEST was used to adjust selected input values to further improve model calibration (Doherty, 2016).

The quality of model fit can be assessed from many statistical and graphical methods. One method is based on the difference between simulated and observed heads and flows, or residuals. The overall magnitude of the residuals is considered, but the distribution of those residuals, both statistically and spatially, can be equally important. The magnitude of residuals can initially point to gross errors in the model, the data (measured quantity), or how the measured quantity is simulated (Hill, 2000). A useful graphical analysis is a simple scatter plot of all simulated values as a function of all observed values.

For the flow calibration, the statistics of the mean error (ME), mean absolute error (MAE), and the root mean square (RMS) error were used to assess the calibration quality. They are defined as follows:

$$ME = \frac{\sum_{i=1}^{n}(O_i - C_i)}{n}$$

$$MAE = \frac{\sum_{i=1}^{n}|O_i - C_i|}{n}$$

$$RMS = \frac{\sum_{i=1}^{n}(O_i - C_i)^2}{n}$$

Where:
Oi = Observed head at observation point i
Ci = Calculated head at observation point i
n = Number of observation points

The mean error is the average of the differences between the observed and calculated heads (or residuals) and can indicate the overall comparison between computed and observed data. Negative and positive residuals can cancel each other out, resulting in a mean error close to zero even when the calibration is not good. The sign of the mean error is an indication of the overall comparison of the model to the data (e.g. a positive mean error indicates the model is generally computing heads that are too high).

The mean absolute error is the average of the absolute values of the residuals. The absolute value prevents positive and negative residuals from canceling each other, providing a clearer picture of the magnitude of errors across the model, without an indication of the direction (high or low) of the errors. The RMS error is the square root of the average of the squares of the residuals. The RMS adds additional weight to points where the residual is greatest. If the residuals at all points are very similar, the RMS will be close to the mean absolute error. Alternatively, a few points with high errors can add significantly to the RMS for an otherwise well calibrated model. For all three of these criteria the optimal value is zero.

The numerical goals for the groundwater flow model calibration are to (1) minimize the ME and MAE errors and (2) achieve the ratio of the RMS error of the head residuals to the range of observed heads (i.e., normalized RMS error) to be at least less than 10 percent (%) (Anderson, M.P., Woessner, WW., 1992).

Groundwater flow field calibration for the Site has been conducted to provide a reasonable representation of the groundwater flow field in the vicinity of the Site, which forms the basis of assessing cobalt migration potential through the fate and transport process. To accomplish this objective, a MODFLOW numerical model was developed to simulate observed groundwater conditions

at the Site through calibrating a representative steady-state flow field. The decision of using a steady-state flow field for the flow model calibration was made through an evaluation of the available groundwater elevation data for the Site. Most importantly is that historical flow patterns have been relatively consistent at the Site; therefore, a steady-state flow model was deemed reasonable to represent average flow conditions.

The evaluation of collected groundwater elevation data resulted in the selection of 31 May 2019 as the observed heads for the flow model calibration for representing Site conditions (**Table 1**).

Based on the outcome of this quality of model fit evaluation, it is concluded that the numerical calibration goals have been achieved for the Site. The mean error in head was 5.55 ft or 7.7 percent (%) of the head observation range, 72.15 ft. The absolute residual is +4.33 ft. The RMS error for the calibrated model was +5.59 ft and the normalized RMS error was 6.0 percent (%). Presented below is the scatter plot of the observed versus simulated heads, which generally fall along the theoretical slope of 1 to 1. **Table 1** provides the observed heads on 4 June 2019, as discussed above, used to generate the plot below. The quality of the flow model calibration meets the calibration goals as described herein. Observed versus computed target values is shown in **Figure 5.**

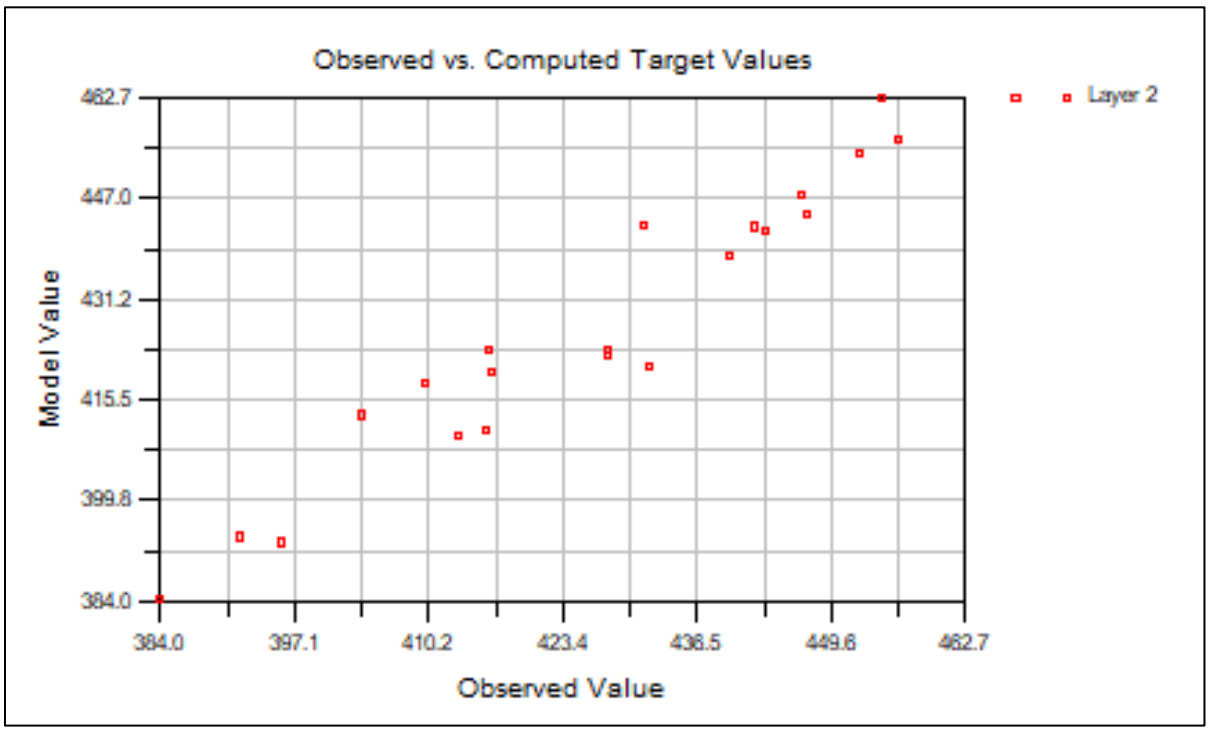

Figure 5: Calibration scatter plot. Values represent steady-state targets.

Furthermore, the calibration assessment has met the acceptable calibration goals, and therefore, the groundwater flow model is considered to be usable for the development of the molybdenum fate and transport models described in **Section 2**.

2. Fate and Transport Modeling

Contaminant fate and transport modeling was conducted utilizing the three-dimensional, numerical model MT3DMS (Version 5 of MT3D) (Zheng, C. and Wang, P.P., 1999). MT3DMS simulates advection, dispersion, adsorption and decay of dissolved constituents in groundwater using a modular structure similar to MODFLOW to permit simulation of transport components independently or jointly. MT3D interfaces directly with MODFLOW for the head solution and supports all the hydrologic and discretization features of MODFLOW. The MT3D code has a comprehensive set of solution options, including the method of characteristics, the modified method of characteristics, a hybrid of these two methods, and the standard finite-difference method. MT3D was originally released in 1990 as a public domain code from the United States Environmental Protection Agency and has been widely used and accepted by federal and state regulatory agencies.

For this modeling effort, the MT3DMS model utilized the flow regime from the steady-state, calibrated Site groundwater flow model presented in **Section 1** to simulate transport of molybdenum. The steady state model was transformed into a transient model so various CMA options could be evaluated with respect to time. The strength and locations of the potential molybdenum sources specified in the transport models were based on surface water concentrations from the Site.

In addition to the MODFLOW groundwater flow field discussed in **Section 1**, the fate and transport models require inputs of effective porosity values, dispersivity coefficients, and adsorption rate constants for molybdenum. In the modeling effort, input parameter values were defined from Site data, whenever possible, or through the use of conservative literature values.

2.1 TRANSPORT MODELING APPROACH

The solute transport portion of the modeling effort focused mainly on the future flow pathway for molybdenum at the Site. As such, the initial concentration including the current plume extent and the estimated leachable mass near the ash pond were utilized in place as a constant source. The location and initial concentrations for molybdenum within the model (layer 4) is presented in **Figure 6**.

The calibrated flow model was allowed to run for 300 years following implementation of the groundwater remedy. Calibration of the concentrations through time was not performed on the predictive model as the starting conditions were the current conditions at the Site and thus represent a conservative estimate of transport through the Site.

2.2 KEY PARAMETERS FOR TRANSPORT MODELING

The following sections describe the key input parameters of the transport model, and how they were derived. Note that these parameters were selected for the purpose of comparative evaluation of relative benefits of various corrective measures. The parameters and conditions used for the modeling are selected based on the data available to date. Therefore, simulated remedial timeframes using the parameters described in this section should not be construed as absolute predictions of remedial time frames for various corrective measures.

2.2.1 Effective Porosity

The effective porosities used in the model were presented in previous **Section 1.3.2**.

2.2.2 Dispersivity

Dispersion incorporates the effects of fluid mixing that result from heterogeneities within the groundwater system and molecular diffusion, which is the random movement of ions or molecules. If the molecules of water and dissolved constituents traveled at the average seepage velocity, there would be an abrupt interface and dispersion would be negligible. However, in natural systems water molecules and dissolved contaminants do not all travel at the same rate; some travel faster and some slower. Dispersion in the model accounts for the spreading of the dissolved plume. Diffusion is time dependent and is significant at low velocities. In general, dispersion acts to decrease the contaminant concentration on the leading edge of the plume, while increasing the size and rate of transport of the dissolved plume. Longitudinal dispersion occurs in the direction of advective groundwater flow, while transverse dispersion occurs perpendicular to groundwater flow.

The groundwater modeling generally accepted longitudinal dispersity value (α_L) estimate is 1 to 100. The horizontal transverse dispersivity (α_T) can be estimated as approximately one-tenth of the α_L, and vertical transverse (α_v) dispersivity can be estimated as one-hundredth of the α_L. The values utilized for dispersivity values are as follows:

- α_L - 100 ft,
- α_T - 10 ft, and
- α_V - 1 ft

2.2.3 First-Order Degradation Rate Constant – Lambda (λ)

Another input parameter for the fate and transport model is the first order degradation rate constant (λ) for molybdenum. This rate constant only takes into account degradation of the dissolved constituent during transport, as it leaves the source. This rate constant does not factor in effects of advection, sorption or dispersivity (dispersion). The field-scale degradation rate constant usually can be expressed as a first order decay process. Due to the general lack of decay for metals within the groundwater system, a first-order decay rate was not specified for model simulations.

2.2.4 Retardation Effects

Chemical retardation occurs when a solute (contaminant) reacts with the porous media and its rate of movement is retarded relative the advective groundwater velocity. Retardation can occur by a variety of processes including adsorption and mass transfer in porous media. The effects of retardation are often related to site-specific adsorption isotherms. For this modeling purpose, a liner adsorption isotherm is used to account for the effects of transport retardation that may occur for Site-related contaminants. The effects of retardation on contaminant mobility is usually expressed in terms of a retardation factor (R), which is the ratio of the groundwater velocity to contaminant transport velocity (Bedient, P.B., Rifai, H.S. and Newell, C.J., 1994). When a linear adsorption isotherm is used to characterize contaminant mobility, the linear adsorption coefficient (K_d) can be linked to the retardation factor with the mathematical relationship below:

$$R = \frac{v_{gw}}{v_c} = 1 + \frac{\rho_b}{n} \times K_d$$

Where:

R = Retardation factor
v_{gw} = Groundwater velocity
v_c = Contaminant transport
ρ_b = Aquifer solid bulk density
n = Effective transport porosity of the medium
K_d = Linear adsorption coefficient

The following describe the adsorption effects on solute transport based on the geochemical properties and published empirical data, as well as the choice of the linear adsorption coefficient for each contaminant used for transport modeling.

2.2.5 Adsorption of Molybdenum on Aquifer Solids

Molybdenum (atomic number 42) is a transition metal in Group VI of the periodic classification of the elements. The affinity for molybdenum to adsorb to the geologic matrix can be affected by factors such as pH, redox conditions, mineral contents of aquifer solids, organic matter abundance, and the presence of organic ligands in the groundwater system.

The aqueous speciation of molybdenum and potential formation of molybdenum-related minerals under a spectrum of the electro-potential (Eh) and pH conditions are shown below (**Figure 7**). Based on Site groundwater monitoring results, the range of pH is within the neutral pH range (between 6.5 and 7.5) and the range of oxidation-reduction potential is generally near or higher than 100 millivolts. The Site geochemical conditions are likely between microaerobic and iron-reducing conditions and not sulfide-genic; therefore, the main molybdenum species in groundwater is expected to be molybdenum species of a valence state of +6. Due to high concentrations of molybdenum and calcium in Site groundwater at some locations, it is likely that the mineral, powellite ($CaMoO_4$), may form and precipitate in the aquifer matrix where molybdenum concentrations are high (e.g., > 1 milligrams per liter (mg/L)). This precipitation reaction may reduce molybdenum concentrations in groundwater during its transport.

2.2.5.1 Empirical data on adsorption

The adsorption of molybdenum has been studied on a variety of minerals, sediments, soils, and crushed rock materials. The extent of adsorption is greatly influenced by pH; generally, the degree of adsorption decreases with an increase in pH (Sheppard, S., Long, J., Sanipelli, B. and Sohlenius, G., 2009). Metal oxides (iron, manganese, and aluminum oxides) in aquifer solids are shown to play a major role in molybdenum adsorption; the K_d values reported by Goldberg et al. (1996) for oxide minerals range from 10 to 10^3 liter per kilogram (L/Kg). Adsorption on a weight basis of iron oxide minerals increased in the order: hematite< goethite < amorphous Fe oxide < poorly crystalline goethite; adsorption on a weight basis for clay minerals increases in the order: well crystallized kaolinite < poorly crystallized kaolinite < illite < montmorillonite.

2.2.5.2 K_d value used for molybdenum transport modeling

There is no site-specific iron concentration data for aquifer solids. Based on the total iron concentrations found at the nearby FB Culley Generating Station, a total iron concentration of 24,000

mg/Kg is considered representative. Site aquifer zones that are permeable for flow exhibit redox conditions between microaerobic and iron-reducing. The source of the weather material at both Sites have a similar provenance in terms of parent rock. The geometric mean of the published Kd values for iron oxide minerals for more weathered iron oxides (e.g., hematite and goethite) are approximately 100 L/Kg at pH = 7. Assuming that only 10,000 mg/Kg of iron oxide minerals in aquifer solids is available for adsorption, a nominal K_d value of 1 L/Kg for bulk aquifer solids is estimated (= 10,000 mg/Kg x 10^{-6} Kg/mg x 100 L/Kg). This value is considered a representative, yet conservative value for evaluation of molybdenum transport in the saturated zone.

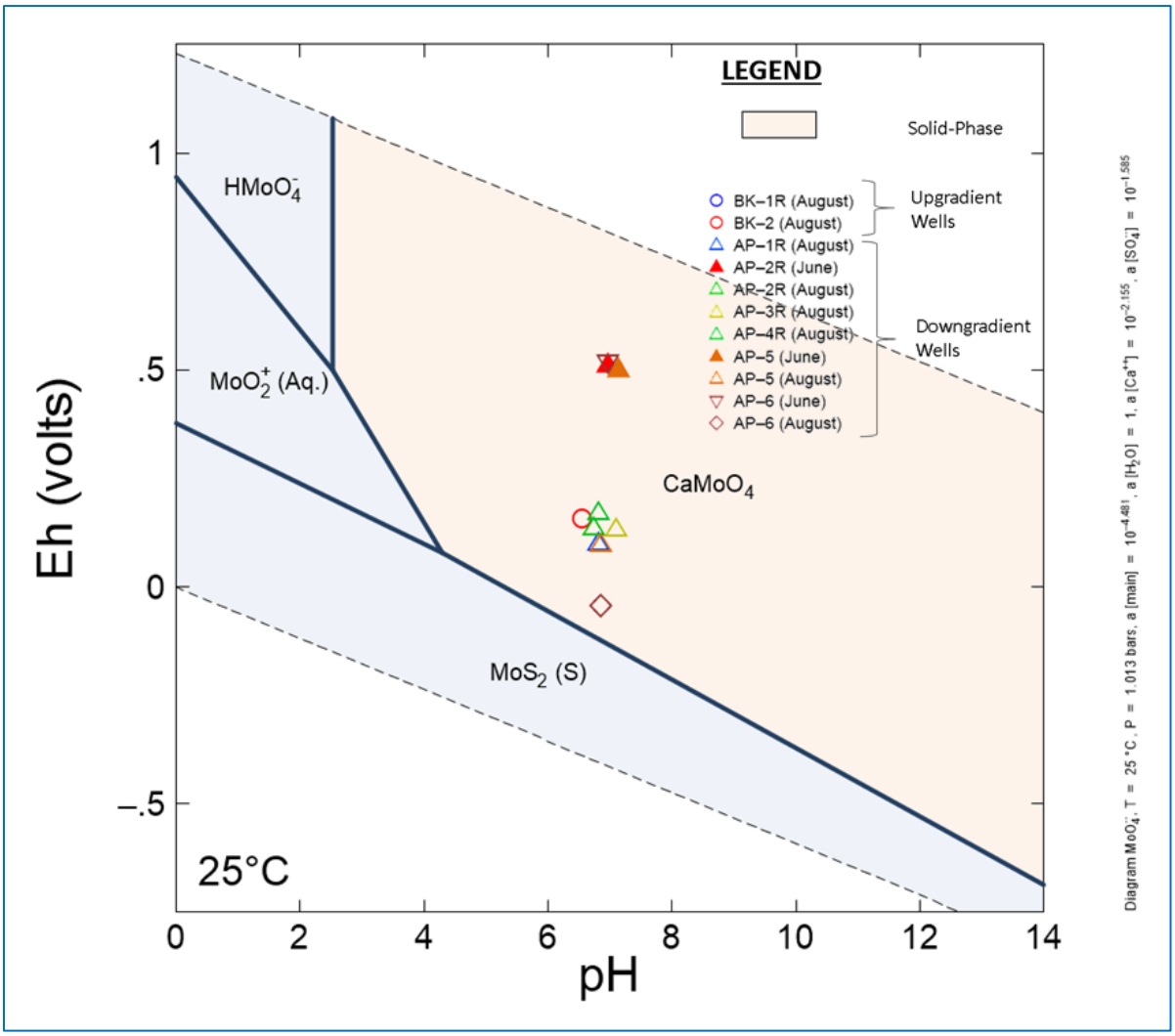

Figure 7: Molybdenum Eh-pH Diagram for a molybdenum-sulfur-oxygen-hydrogen-calcium system; groundwater monitoring data collected in June and August 2018 used; field ORP measurements converted to the Standard Hydrogen Electrode (SHE); field pH measurements plotted; assumptions: solute activities = measured concentrations in mols/L; analytical concentrations results for AP-2R used to generate stability diagram. Thermodynamic database used: thermo.com.V8.R6+, fully modified with molybdenum solubility data from Vlek and Lindsay (1977).

2.2.6 Source Initial Concentration Data

To conservatively predict the transport of molybdenum and preserve the mass transported through the Site, the source area was defined utilizing initial concentration and constant sources in the form of

recharge. The current extent of the groundwater plume for molybdenum was generated based on groundwater concentrations in the monitoring well network.

Four discrete areas with concentrations of molybdenum above detection are present at the Site within the vicinity of the ash pond. Initial concentrations were created near the following wells at concentrations observed from groundwater sampling events conducted in May and June 2019.

- CCR-AP-2R – 1.9 milligrams per liter (mg/L)
- CCR-AP-3R – 0.89 mg/L
- CCR-AP-5 – 0.059 mg/L
- CCR-AP-9 – 0.021 mg/L

With the exception of scenarios where the source material was removed from the Site, ash was modeled as a continuous source.

2.3 TRANSPORT MODEL RESULTS - MOLYBDENUM

Model results for Molybdenum concentrations for each CMA option is shown in **Figure 8**. A detailed discussion of each option is presented in the CMA report (Haley & Aldrich, Inc., 2019).

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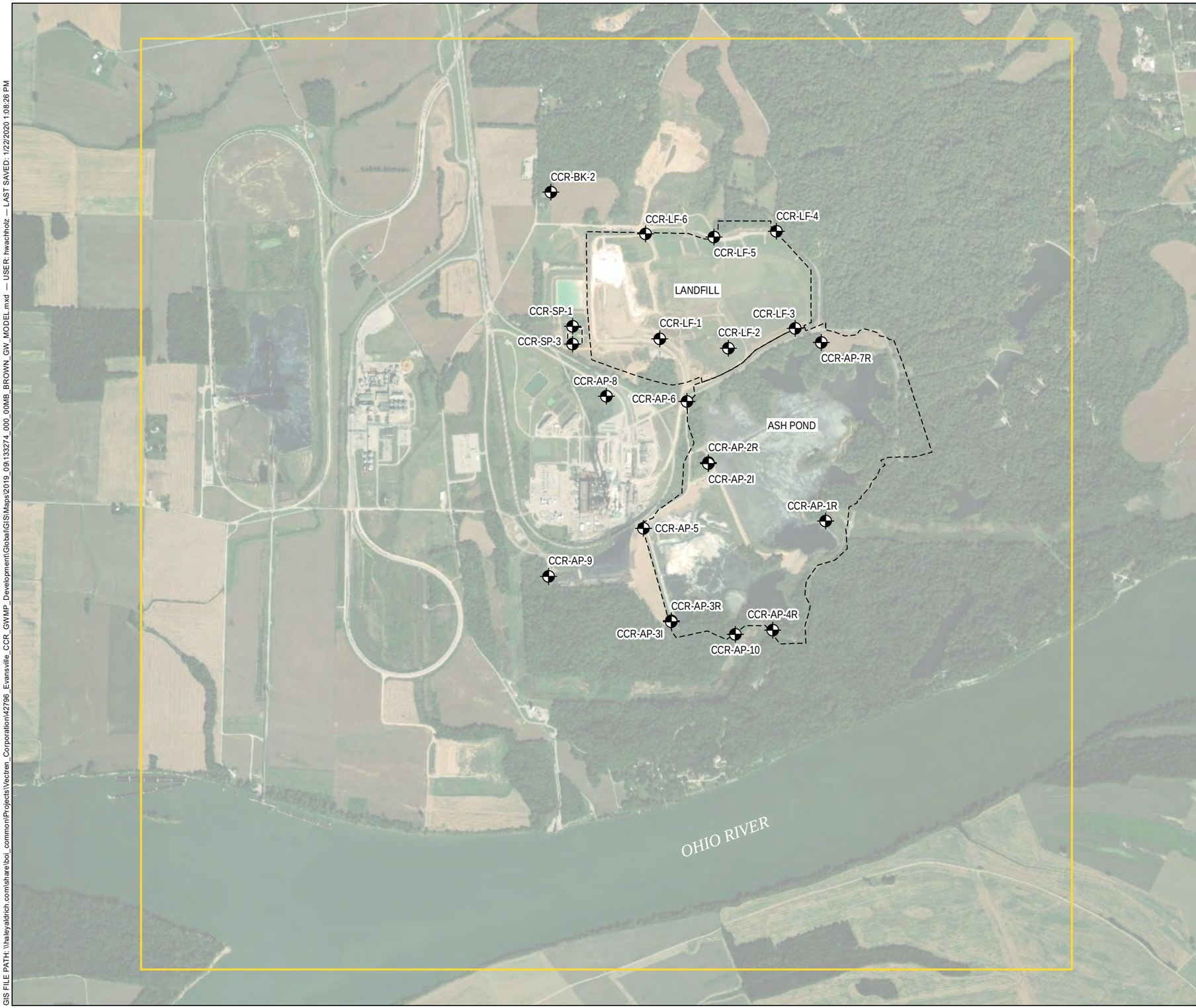
TABLES

Table 1
June 2019 Groundwater Elevations
A.B. Brown Generating Station
Mount Vernon, Indiana

Well Location	Easting Feet	Northing Feet	Depth To Water Feet	Groundwater Elevation Feet (NAVD88)
CCR-AP-1R	2773560.00	968260.82	15.28	452.29
CCR-AP-2R	2771920.00	969079.16	37.90	431.23
CCR-AP-2I	2771920.00	969063.77	26.69	442.19
CCR-AP-3R	2771404.27	966865.12	33.11	416.02
CCR-AP-3I	2771408.31	966855.06	22.68	427.67
CCR-AP-4R	2772827.01	966741.47	32.29	443.09
CCR-AP-5	2772827.01	968166.03	37.40	416.37
CCR-AP-6	2771626.75	969932.76	14.39	447.18
CCR-AP-7R	2773501.63	970758.70	33.94	454.63
CCR-AP-8	2770500.58	970005.00	4.05	413.12
CCR-AP-9	2769695.14	967494.17	8.50	384.01
CCR-AP-10	2772304.46	966679.13	34.74	439.60
CCR-LF-1	2771247.76	970812.18	7.80	427.83
CCR-LF-2	2772205.05	970681.32	26.21	446.79
CCR-LF-3	2773138.97	970949.70	28.59	456.16
CCR-LF-4	2772876.83	972312.24	46.98	431.87
CCR-LF-5	2772003.91	972228.16	20.60	409.81
CCR-LF-6	2771046.15	972269.53	8.38	403.67
CCR-SP-1	2770030.26	970981.89	11.83	391.68
CCR-SP-3	2770027.64	970735.02	7.77	395.80
CCR-BK-2	2769728.14	972854.33	14.68	415.92

FIGURES



LEGEND

- MONITORING WELL LOCATION
- ASH POND
- MODEL DOMAIN

NOTES

1. ALL LOCATIONS ARE APPROXIMATE
2. AERIAL IMAGERY SOURCE: ESRI

N

0 1,400 2,800
SCALE IN FEET

HALEY ALDRICH

CORRECTIVE MEASURES ASSESSMENT
SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

SITE PLAN WITH MODEL DOMAIN

SEPTEMBER 2019

FIGURE 1

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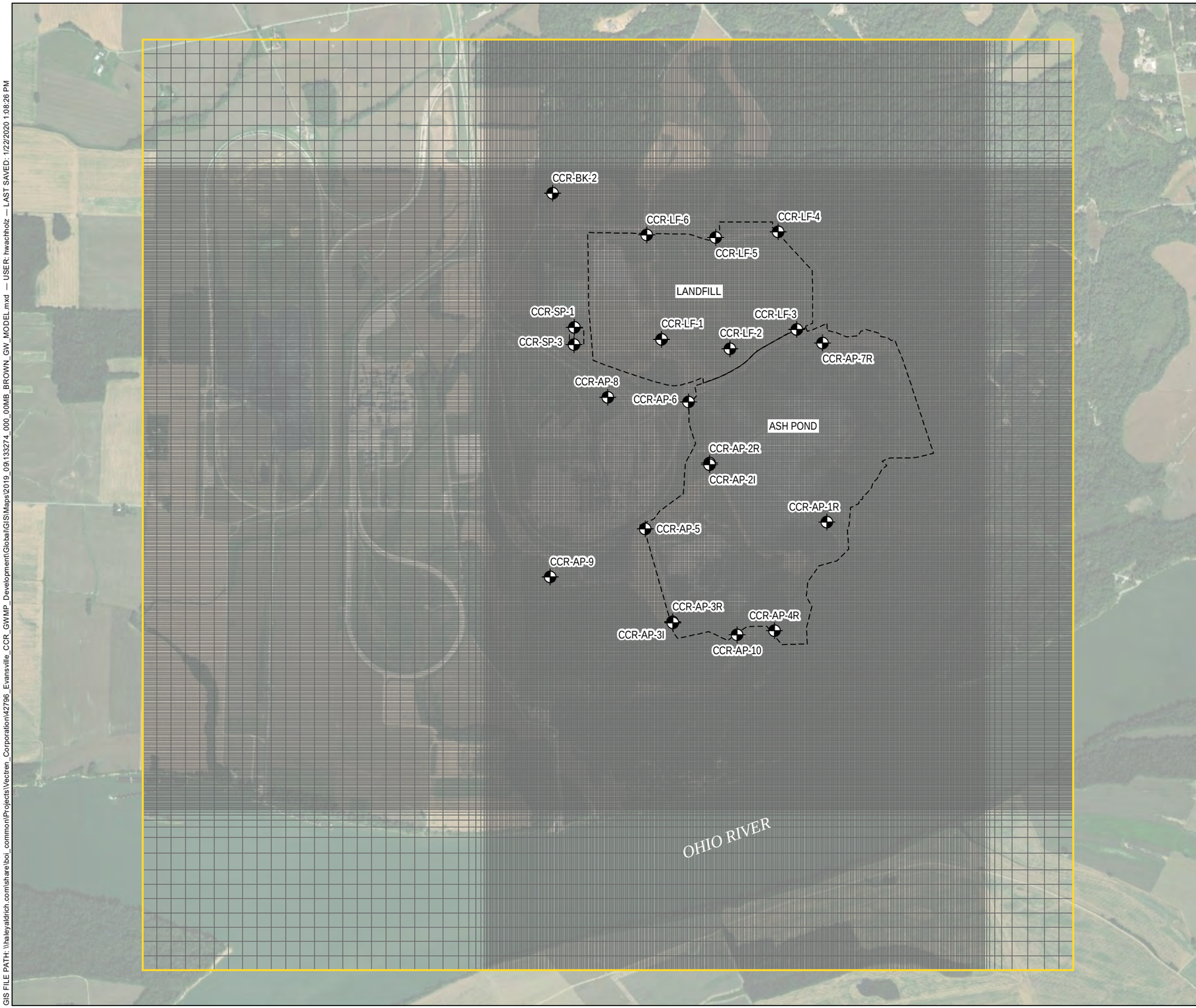

LEGEND

- MONITORING WELL LOCATION
- MODEL DOMAIN
- GRID
- ASH POND

NOTES

1. ALL LOCATIONS ARE APPROXIMATE
2. AERIAL IMAGERY SOURCE: ESRI

N

0 1,400 2,800
SCALE IN FEET

HALEY ALDRICH

CORRECTIVE MEASURES ASSESSMENT
SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

SITE PLAN WITH MODEL GRID

SEPTEMBER 2019

FIGURE 2

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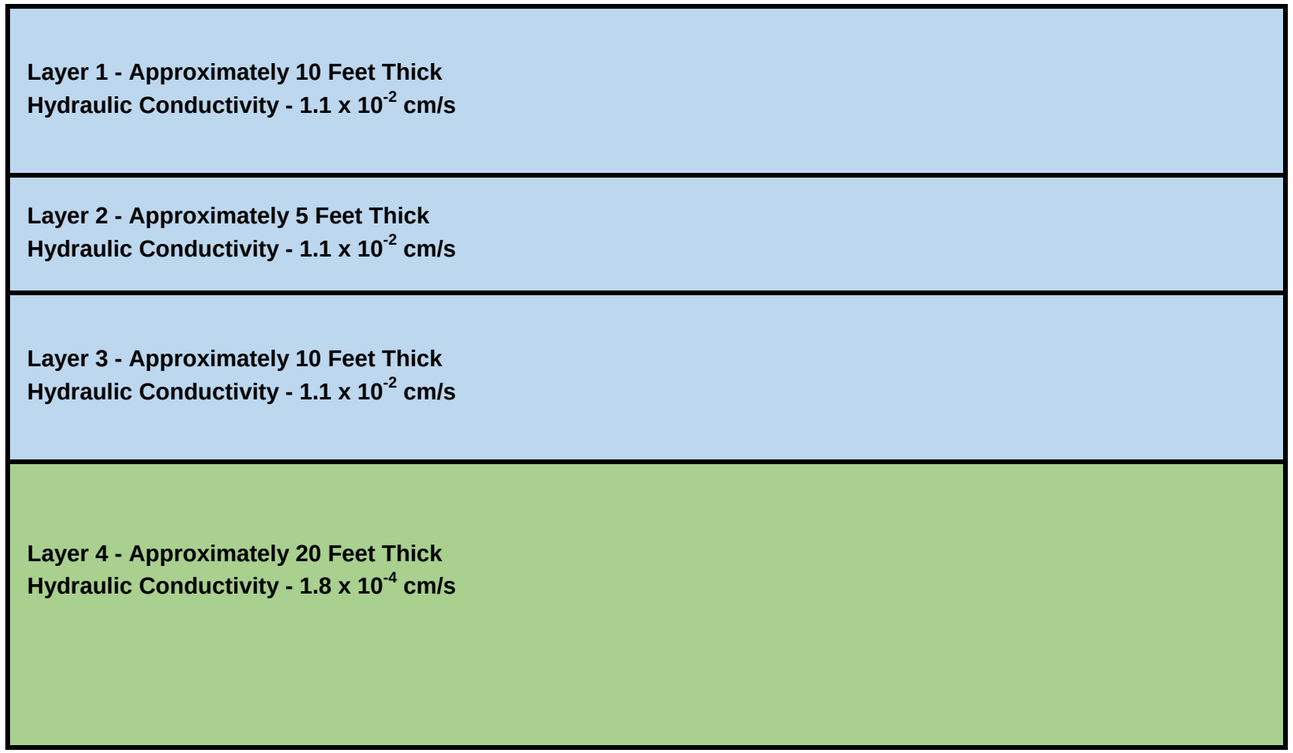


NOTES:

1. Layer Thicknesses Approximate Due To Variability In Model
2. Layers 1 , 2, and 3 represent silty clay ; Layers 4 represents weathered sandstone, shale, or siltstone

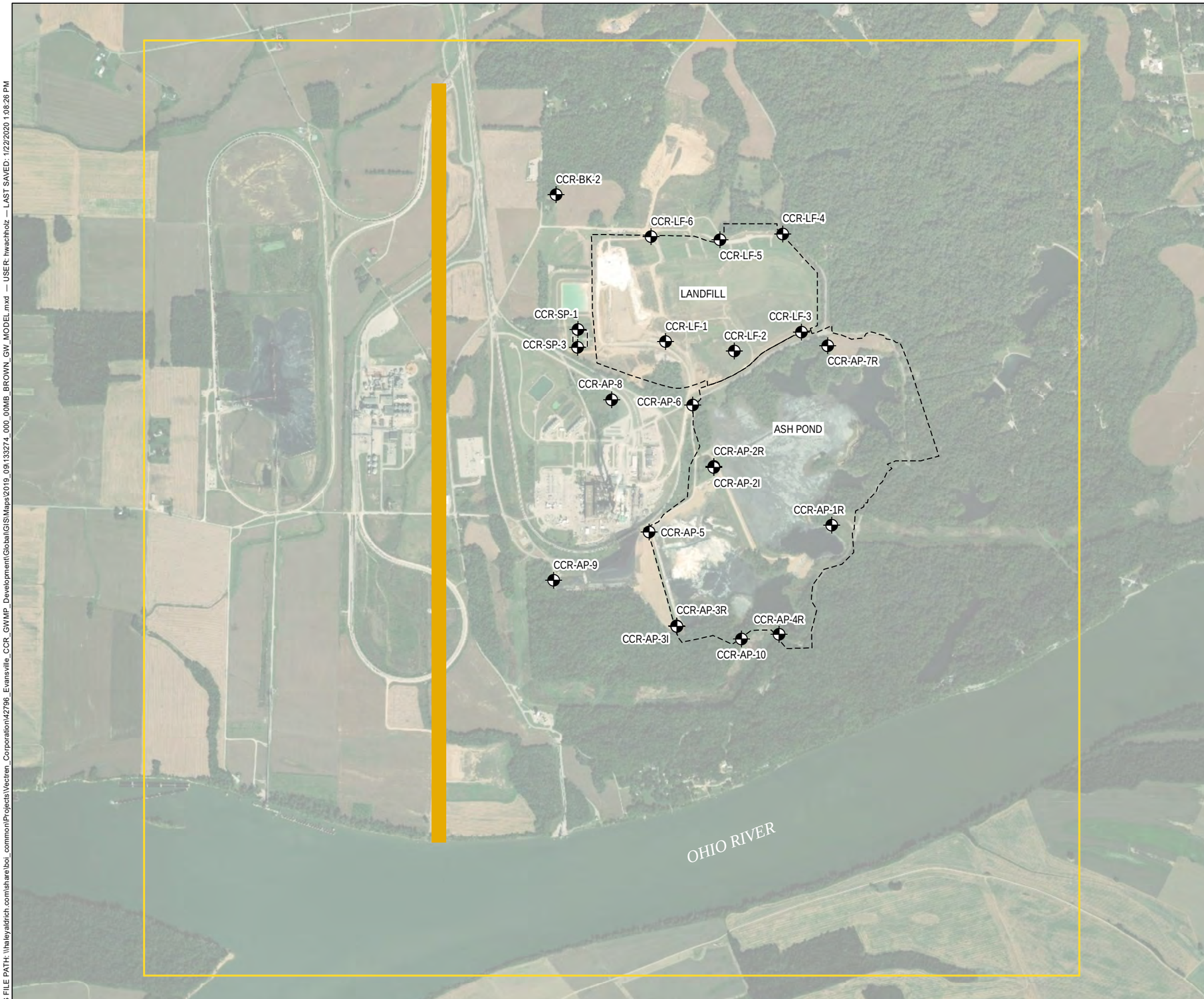
HALEY ALDRICH

VECTREN CORPORATION
A.B BROWN GENERATING STATION
MOUNT VERNON, IN 47620

MODEL LAYERS 1 THROUGH 4 WITH HYDRAULIC CONDUCTIVITIES AND LAYER THICKNESSES

SEPTEMBER 2019

FIGURE 3



LEGEND

- MONITORING WELL LOCATION
- MODEL DOMAIN
- CONSTANT HEAD BOUNDARY
- ASH POND

NOTES

1. ALL LOCATIONS ARE APPROXIMATE
2. AERIAL IMAGERY SOURCE: ESRI

N

0 1,400 2,800
SCALE IN FEET

HALEY ALDRICH

CORRECTIVE MEASURES ASSESSMENT
SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

SITE PLAN WITH CONSTANT HEAD BOUNDARY LAYERS 2 THROUGH 4

SEPTEMBER 2019

FIGURE 4

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LEGEND

MONITORING WELL LOCATION

MODEL DOMAIN

ASH POND

MOLYBDENUM CONCENTRATION

0.01 mg/L

0.1 mg/L

1 mg/ L

NOTES

1. ALL LOCATIONS ARE APPROXIMATE
2. AERIAL IMAGERY SOURCE: ESRI

N

0 1,400 2,800

SCALE IN FEET

HALEY ALDRICH

CORRECTIVE MEASURES ASSESSMENT
SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

INITIAL MOLYBDENUM CONCENTRATION

SEPTEMBER 2019

FIGURE 6

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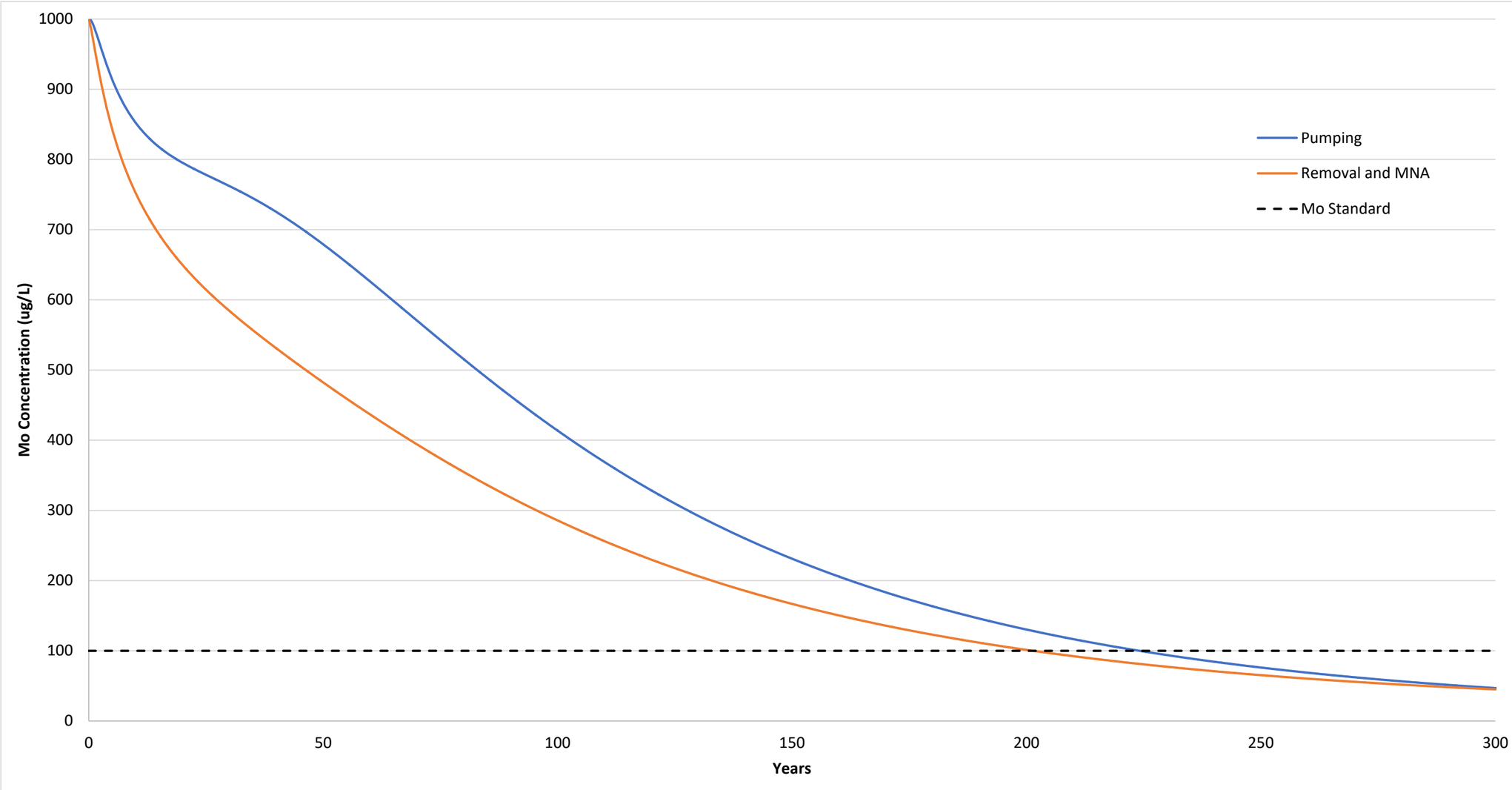

NOTES:

1. Modeled Monitoring Well Located Approximately 600 Feet Downgradient from Pond Toward The West.

HALEY ALDRICH

VECTREN CORPORATION
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA 47620

MODELED MOLYBDENUM CONCENTRATIONS FOR CMA OPTIONS OVER TIME

SEPTEMBER 2019

FIGURE 8

Appendix L
Progress Reports Toward Selection of Remedy

HALEY & ALDRICH, INC.
400 Augusta Street
Suite 130
Greenville, SC 29601
864.214.8750

13 March 2020
File No. 129420

TO: Southern Indiana Gas and Electric Company

FROM: Haley & Aldrich, Inc.

SUBJECT: Semi-Annual Remedy Selection Progress Report Pursuant to 40 CFR §257.97(a)
A.B. Brown Generating Station - Ash Pond

The Southern Indiana Gas and Electric Company (SIGECO) initiated corrective measures for the Ash Pond at the A.B. Brown Generating Station on 15 April 2019 in response to a statistically significant level (SSL) of an Appendix IV constituent exceeding Groundwater Protection Standards. Pursuant to 40 CFR §257.96(a), a demonstration of need for a 60-day extension for the assessment of corrective measures was completed on 12 July 2019. The Corrective Measures Assessment (CMA) Report was completed and placed in the facility operating record on 13 September 2019.

Following completion of the CMA, SIGECO must, as soon as feasible, select a remedy that meets the standards listed in 40 CFR §257.97(b). Pursuant to §257.97(a), the owner or operator of a Coal Combustion Residual (CCR) management unit that has completed a CMA for groundwater shall prepare a semi-annual report describing the progress in selecting and designing the remedy. This report constitutes the first semi-annual remedy selection progress report and is comprised of activities during the period of 13 September 2019 through 13 March 2020. A summary of the progress in selecting a remedy is provided below.

SUMMARY OF ACTIONS COMPLETED

The following actions have been completed during this reporting period:

- Efforts to determine the nature and extent (N&E) of the Appendix IV SSLs continued pursuant to § 257.95(g). Groundwater samples were collected from the N&E monitoring wells in November 2019. The analytical results will be used to supplement and enhance the evaluation of the extent of groundwater impacts and assessment of corrective measures. Groundwater characterization of the N&E monitoring wells is ongoing.
- Discussion and follow-up activities between Haley & Aldrich and SIGECO representatives to further evaluate the details and feasibility of potential corrective measures identified by the completed CMA.
- Conducted site reconnaissance survey to understand the location and installation of a French drain system installed during construction of the generating station to manage shallow groundwater between the upgradient Ash Pond and the downgradient generating station.

- Conducted site reconnaissance survey, during which time Haley & Aldrich representatives inspected the tunnel system constructed to convey coal from the coal pile storage area to the generating station and the water management system associated with this feature.
- Developed an investigation program to evaluate the effect these water management improvements have on groundwater flow downgradient of the Ash Pond.

PLANNED ACTIVITIES

Anticipated activities for the upcoming six months include the following:

- Install four, shallow/deep piezometer nests upgradient and downgradient of the French drain to evaluate its effect on shallow groundwater flow and contaminant transport.
- Install two push point piezometers adjacent to the creek below the Ash Pond in the vicinity of the previously installed staff gauge to evaluate groundwater/surface water interactions.
- Install an additional well at the downgradient property line per 257.95(g)(1)(iii).
- Collect additional soil, groundwater, and/or surface water samples to better define the naturally occurring physical, chemical, and biological factors responsible for attenuating molybdenum and lithium.
- Update and refine the hydrogeologic framework, groundwater flow and solute transport model, remediation timeframes, and corrective action cost estimates.
- Upon completion of the Integrated Resource Plan study and report, evaluate the effects of anticipated future generation on the availability of equipment and effect on water flows and treatment systems as they relate to the potential corrective actions.

HALEY & ALDRICH, INC.
400 Augusta Street
Suite 130
Greenville, SC 29601
864.214.8750

22 September 2020
File No. 129420

TO: Southern Indiana Gas and Electric Company

FROM: Haley & Aldrich, Inc.

SUBJECT: Semi-Annual Remedy Selection Progress Report Pursuant to 40 CFR §257.97(a)
A.B. Brown Generating Station - Ash Pond

The Southern Indiana Gas and Electric Company (SIGECO) initiated corrective measures for the Ash Pond at the A.B. Brown Generating Station on 15 April 2019 in response to a statistically significant level (SSL) of an Appendix IV constituent exceeding Groundwater Protection Standards. Pursuant to 40 CFR §257.96(a), a demonstration of need for a 60-day extension for the assessment of corrective measures was completed on 12 July 2019. The Corrective Measures Assessment (CMA) Report was completed and placed in the facility operating record on 13 September 2019.

Following completion of the CMA, SIGECO must, as soon as feasible, select a remedy that meets the standards listed in 40 CFR §257.97(b). Pursuant to §257.97(a), the owner or operator of a Coal Combustion Residual (CCR) management unit that has completed a CMA for groundwater shall prepare a semi-annual report describing the progress in selecting and designing the remedy. This report constitutes the second semi-annual remedy selection progress report and documents activities completed during the period of 13 March 2020 through 13 September 2020. A summary of the progress in selecting a remedy is provided below.

SUMMARY OF ACTIONS COMPLETED

The following actions have been completed during this reporting period:

- Efforts to determine the nature and extent (N&E) of the Appendix IV SSLs continued pursuant to § 257.95(g). Groundwater samples were collected from the N&E monitoring wells in May 2020. The analytical results will be used to supplement and enhance the evaluation of the extent of groundwater impacts and assessment of corrective measures. Groundwater characterization and the evaluation of the N&E of Appendix IV constituents is ongoing and included the following during this reporting period.
    - Installed two shallow piezometers upgradient and downgradient of the on-site French drain to evaluate its effect on shallow groundwater flow and contaminant transport;
    - Installed two push point piezometers adjacent to the creek below the Ash Pond in the vicinity of the previously installed staff gauge to evaluate groundwater/surface water interactions;
    - Installed an additional well (CCR-AP-11) at the downgradient property line per 257.95(g)(1)(iii);

  - Updated the hydrogeologic framework and groundwater flow in the vicinity of the French drain.

- Discussion and follow-up activities between Haley & Aldrich and SIGECO representatives to further evaluate the details and feasibility of potential corrective measures identified by the completed CMA and the on-going evaluation of nature and extent and site-specific conditions.
- Began preparations for the public meeting;

PLANNED ACTIVITIES

Anticipated activities for the upcoming six months include the following:

- Conduct semiannual groundwater sampling in November consistent with 257.95(b) and (d)(1).
- Collect, as needed, additional soil, groundwater, and/or surface water samples to better define the naturally occurring physical, chemical, and biological factors responsible for attenuating molybdenum and lithium.
- Incorporate the N&E evaluation into the refined hydrogeologic framework and groundwater flow and solute transport model to update remediation timeframes, and corrective action cost estimates.
- In consideration of the Integrated Resource Plan study and report that was completed in June 2020 and the resulting future electricity generation planning activities that have begun, evaluate the effects of anticipated future generation on the availability of equipment and effect on water flows and treatment systems as they relate to the potential corrective actions.
- Hold public meeting and begin to evaluate community input provided at meeting as part of the selection of remedy process.

Appendix M
Structural Stability Assessment

Submitted to
Southern Indiana
Gas & Electric Company
dba Vectren Power
Supply, Inc. (SIGECO)
One Vectren Square
Evansville, IN 47708

Submitted by
AECOM
9400 Amberglen Boulevard
Austin, Texas 78729

October 13, 2016

CCR Certification:
Initial Structural Stability Assessment
§257.73 (d)

for the

Ash Pond

at the

A.B. Brown Generating Station

Revision 0

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Table 1-1 CCR Rule Cross Reference Table

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Figure 2 – Site Map

Appendix B AECOM Site Visit Report

Executive Summary

This Coal Combustion Residuals (CCR) Initial Structural Stability Assessment (Structural Stability Assessment) for the Ash Pond at the Southern Indiana Gas & Electric Company dba Vectren Power Supply, Inc., A.B. Brown Generating Station has been prepared in accordance with the requirements specified in the USEPA CCR Rule under 40 Code of Federal Regulations §257.73 (d)(1). These regulations require that the specified documentation, assessments and plans for an existing CCR surface impoundment be prepared by October 17, 2016.

This Structural Stability Assessment for the Ash Pond meets the regulatory requirements as summarized in **Table ES-1**.

Table ES-1 – Certification Summary

Report Section	CCR Rule Reference	Requirement Summary	Requirement Met?	Comments
2.1	§257.73 (d)(1)(i)	*Foundations and Abutments*	Yes	The CCR Unit has stable foundations
2.2	§257.73 (d)(1)(ii)	*Slope Protections*	Yes	The CCR Unit has sufficient slope protection
2.3	§257.73 (d)(1)(iii)	*Dike Compaction*	Yes	The CCR Unit has appropriate dike Compaction
2.4	§257.73 (d)(1)(iv)	*Vegetated Slopes*	Yes	The CCR Unit has vegetated slopes or other forms of protection
2.5	§257.73 (d)(1)(v)	*Spillways*	Yes	The CCR Unit spillways are sufficient for the 1000 year event
2.6	§257.73 (d)(1)(vi)	*Stability and Structural Integrity of Hydraulic Structures*	Yes	Hydraulic structures passing through the base of the unit are free from noticeable defects which may negatively affect the operation of the unit
2.7	§257.73 (d)(1)(vii)	*Downstream Slope Inundation / Stability*	Yes	The CCR Unit maintains structural stability during low pool or sudden drawdown of adjacent water body

The Brown Ash Pond is currently an active surface impoundment. All structural stability assessment requirements were evaluated and the surface impoundment was found to meet all requirements as required within each individual structural stability assessment in §257.73 (d)(1).

1 Introduction

1.1 Purpose of this Report

The purpose of the Initial Structural Stability Assessment (Structural Stability Assessment) presented in this report is to document that the requirements specified in 40 Code of Federal Regulations (CFR) §257.73 (d) have been met to support the certification required under each of the applicable regulatory provisions for the A.B. Brown Generating Station (Brown) Ash Pond. The Brown Ash Pond is an existing coal combustion residual (CCR) surface impoundment as defined by 40 CFR §257.53. The CCR Rule requires that the structural stability assessment for an existing CCR surface impoundment be prepared by October 17, 2016.

The Brown station has an interconnected existing CCR surface impoundment, the Ash Pond, which consists of a lower pool and an upper pool. The following table summarizes the documentation required within the CCR Rule and the sections that specifically respond to those requirements of this assessment.

Table 1-1 – CCR Rule Cross Reference Table

Report Section	Title	CCR Rule Reference
2.1	Foundations and Abutments	§257.73 (d)(1)(i)
2.2	Slope Protection	§257.73 (d)(1)(ii)
2.3	Dike Compaction	§257.73 (d)(1)(iii)
2.4	Vegetated Slopes	§257.73 (d)(1)(iv)
2.5	Spillways	§257.73 (d)(1)(v)
2.6	Stability and Structural Integrity of Hydraulic Structures	§257.73 (d)(1)(vi)
2.7	Downstream Slope Inundation / Stability	§257.73 (d)(1)(vii)

1.2 Brief Description of Impoundment

The Brown station is a coal-fired power plant located approximately 10 miles east of Mount Vernon in Posey County, Indiana and is owned and operated by Southern Indiana Gas & Electric Company, dba Vectren Power Supply, Inc. (SIGECO). The Brown station is situated just west of the Vanderburgh-Posey County line and north of the Ohio River with the Ash Pond positioned on the east side of the generating station.

The Ash Pond was commissioned in 1978. An earthen dam was constructed across an existing valley to create the impoundment. In 2003, a second dam was constructed east of the original dam and further up the valley to increase the storage capacity. This temporarily created an upper pond and a lower pond. The upper and lower ponds were operated separately until 2016 when the upper dam was decommissioned. A 10’ wide breach was installed in the upper embankment and the normal pool elevation was lowered. Currently, the upper pool and the

lower pool act as one CCR unit referred to as the Ash Pond, which has a surface area of approximately 159 acres.

The lower pool dam embankment is approximately 1,540 feet long, 30 feet high, and has 3 to 1 (horizontal to vertical) side slopes covered with grassy vegetation. The embankment crest elevation is 450.9 feet[1] and has a crest width of 20 feet. An earthen buttress was constructed against the outboard slope of the dam. The buttress crest extends the length of the dam, is up to 200 feet wide and varies in elevation from 442 feet to 432 feet. A site Location Map showing the area surrounding the station is included as **Figure 1** of **Appendix A**. **Figure 2** in **Appendix A** presents the Brown Site Map.

[1] Unless otherwise noted, all elevations in this report are in the NAVD88 datum.

2 Structural Stability Assessment Description

Regulatory Citation: 40 CFR §257.73 (d)(1);

- *The owner or operator of the CCR unit must conduct initial and periodic structural stability assessments and document whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein. The assessment must, at a minimum, document whether the CCR unit has been designed, constructed, operated, and maintained with [the standards in (d)(1)(i)-(vii)]:*

The Structural Stability Analysis for the Ash Pond is described in this section. Information about operational and maintenance procedures was provided by Brown plant personnel. The Brown station follows an established maintenance program that quickly identifies and resolves issues of concern.

2.1 Foundations and Abutments

Regulatory Citation: 40 CFR §257.73 (d)(1);

- *(i) Stable foundations and abutments;*

Background and Assessment

The stability of the foundations was evaluated using soil data from field investigations and reviewing design drawings, operational and maintenance procedures, and conditions observed in the field by AECOM. Additionally, slope stability analyses were performed to evaluate slip surfaces passing through the foundations.

The foundation soils consist of interbedded stiff to very stiff clay and loose to medium dense silt soils. While the silts are susceptible to liquefaction as a result of strong earthquake shaking, the slope stability analyses exceed the criteria listed in §257.73(e)(1) for slip surfaces passing through the foundation (including the post-liquefaction loading condition). Therefore, the foundation soils are considered to be stable under all loading conditions. The slope stability analyses are discussed in the *CCR Certification Report: Initial Safety Factor Assessment for the Ash Pond at the A.B. Brown Generating Station* (October 2016). A review of operational and maintenance procedures as well as current and past performance of the dikes has determined appropriate processes are in place for continued operational performance.

Conclusion and Recommendation

Based on the conditions observed by AECOM, the Ash Pond was designed and constructed with stable foundations. Operational and maintenance procedures are in place to address any issues related to the stability of foundations.

Therefore, the Ash Pond meets the requirements in §257.73 (d)(1)(i).

2.2 Slope Protection

Regulatory Citation: 40 CFR §257.73 (d)(1);

- *(ii) Adequate slope protection to protect against surface erosion, wave action and adverse effects of sudden drawdown;*

Background and Assessment

The adequacy of slope protection was evaluated by reviewing design drawings, operational and maintenance procedures, and conditions observed in the field by AECOM.

The exterior slopes of the lower pool berm are covered with grass vegetation. The interior slopes of the lower pool and upper pool berms are covered with rip-rap which has an approximate median diameter of 15-inches. No evidence of significant areas of erosion or wave action was observed during AECOM's site visit on February 23, 2016. See **Appendix B** for further details from AECOM's site visit.

Due to the recent installation of a buttress at the toe of the lower pool embankment, vegetation has not been fully established on the buttress. After construction of the buttress was completed in October 2016, seed was placed on the disturbed areas, and a straw mat was installed to protect the area from erosion during the growing season. Grass has begun to grow, but will require additional time to become adequately established.

Conclusion and Recommendation

Based on this evaluation, adequate slope protection was designed and constructed at the Ash Pond. Areas outside of the limits of construction of the buttress show no evidence of significant areas of erosion or wave action. However, areas within the limits of the buttress construction that are not fully vegetated due to recent construction are protected against wind and stormwater erosion with straw mat and must be inspected regularly and repaired as necessary until they are adequately vegetated. Operational and maintenance procedures to repair the vegetation (exterior slopes) and rip-rap (interior slopes) as needed are appropriate to protect against surface erosion or wave action. Sudden drawdown of the pool in the Ash Pond is not expected to occur. See Section 2.7 of this report for further information on sudden drawdown.

Therefore, the Ash Pond meets the requirements in §257.73 (d)(1)(ii).

2.3 Dike Compaction

Regulatory Citation: 40 CFR §257.73 (d)(1)

- *(iii) Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit;*

Background and Assessment

The density of the dike materials was evaluated using soil data from field investigations and reviewing design drawings, operational and maintenance procedures, and conditions observed in the field by AECOM. Additionally, slope stability analyses were performed to evaluate slip surfaces passing through the dike over the range of expected loading conditions as defined within §257.73 (e)(1).

Historical construction drawings for the dam required that the embankment be compacted to 95% of the Standard Proctor maximum dry density (ASTM D 698). Based on the geotechnical field evaluations, the dam embankment consists of stiff to very stiff clayey soils that have consistency and strength indicative of well-compacted materials. The soil buttress that exists against the downstream slope of the dam was constructed in 8-inch loose lifts and was mechanically compacted to at least 95% of the Standard Proctor maximum dry density. Soil densities for the buttress were verified using nuclear methods. Slope stability analyses exceed the criteria listed in §257.73 (e)(1) for slip surfaces passing through the dike. The slope stability analyses and results are discussed in the *CCR Rule Report: Initial Safety Factor Assessment for the Ash Pond at the A.B. Brown Generating Station* (October 2016).

Conclusion and Recommendation

Based on the conditions observed by AECOM, the Ash Pond was designed and constructed with sufficient dike compaction.

Therefore, the Ash Pond meets the requirements in §257.73 (d)(1)(iii).

2.4 Vegetated Slopes

Regulatory Citation: 40 CFR §257.73 (d)(1)

- *(iv) Vegetated slopes of dikes and surrounding areas, except for slopes which have an alternate form or forms of slope protection;*[2]

Background and Assessment

The adequacy of slope vegetation was evaluated by reviewing design drawings, operational and maintenance procedures, and conditions observed in the field by AECOM.

The exterior slopes of the lower pool berm are covered with grass vegetation. No evidence of significant areas of erosion was observed during AECOM's site visit on February 23, 2016. See **Appendix B** for further details from AECOM's site visit.

Due to the recent installation of a buttress at the toe of the lower pool embankment, vegetation was not fully established in the construction area. After construction of the buttress was completed in October 2016, seed was placed on the disturbed areas, and a straw mat was installed to protect the seed from erosion during the growing season. Grass has begun to grow, but will require additional time to become adequately established.

Conclusion and Recommendation

Based on this evaluation, the vegetation on the exterior slopes of the areas outside of the limits of construction of the buttress is adequate as no substantial bare or overgrown areas were observed. Therefore, the original design and construction of the Ash Pond included adequate vegetation of the dikes and surrounding areas. Areas within the limits of the buttress construction that are not fully vegetated due to recent construction are protected against wind and stormwater erosion with straw mat and must be inspected regularly and repaired as necessary until they are adequately vegetated. Adequate operational and maintenance procedures are in place to regularly manage

[2] As modified by court order issued June 14, 2016, Utility Solid Waste Activities Group v. EPA, D.C. Cir. No. 15-1219 (order granting remand and vacatur of specific regulatory provisions).

vegetation growth, including mowing and seeding any bare areas, and to address erosional issues as they occur, as evidenced by the conditions observed by AECOM.

Therefore, the Ash Pond meets the requirements in §257.73 (d)(1)(iv).

2.5 Spillways

Regulatory Citation: 40 CFR §257.73 (d)(1)

- *(v) single spillway or a combination of spillways configured as specified in [paragraph (A) and (B)]:*
  - *(A) All spillways must be either:*
    - *(1) of non-erodible construction and designed to carry sustained flows; or*
    - *(2) earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected.*
  - *(B) The combined capacity of all spillways must adequately manage flow during and following the peak discharge from a:*
    - *(1) Probable maximum flood (PMF) for a high hazard potential CCR surface impoundment; or*
    - *(2) 1000-year flood for a significant hazard potential CCR surface impoundment; or*
    - *(3) 100-year flood for a low hazard potential CCR surface impoundment.*

Background and Assessment

The plant operates as a zero-discharge facility during normal operating conditions, so it is uncommon for water to discharge from the lower pool. However, if a discharge does occur, the runoff drains through the permitted NPDES outfall to an unnamed tributary which travels west for approximately 0.5 mile before turning south for approximately one mile and discharging into the Ohio River.

There are five spillways available for discharge runoff from the lower pool. These spillways were evaluated using design drawings, operational and maintenance procedures, and conditions observed in the field by AECOM. The conditions of each structure were observed in the field by AECOM February 23, 2016. See Site Visit Report in **Appendix B** for additional details.

The first outlet is a 12-inch HDPE Ash Pond Discharge Line that goes to a chemical precipitation treatment system prior to mixing with other plant water and going to an NPDES permitted outfall. The HDPE pipe is a non-erodible material.

The second outlet is a Low Pressure Recirculation System. This system is comprised of three pumps that are rated for 2,750 gpm each. All three pumps discharge into individual 8-inch diameter carbon steel pipes before combining into a common header and proceeding as a 20-inch diameter carbon steel pipeline to the plant. The carbon steel pipe is a non-erodible material.

The third outlet is a High Pressure Recirculation System. This system is comprised of two high pressure pumps that are rated for 2,100 gpm each. Both pumps discharge into individual 8-inch diameter carbon steel pipes before combining into a common header and proceeding as a 10-inch diameter carbon steel pipeline to the plant. The carbons steel pipe is a non-erodible material.

The fourth outlet is the Principal Spillway which consists of a metal gooseneck inlet structure connected to a 36-inch RCP drop inlet. Discharge from the inlet flows to a 36-inch diameter RCP pipe that discharges near the toe of the embankment. The steel and RCP pipes of the Principal Spillway are non-erodible material.

The fifth outlet is the Emergency Spillway which is a grass-lined, trapezoidal channel spillway. Class II rip-rap, which has a median diameter of approximately 15-inches, was used to line the discharge channel to prevent erosion. The grass-lined spillway and the rip-rap lined channel of the Emergency Spillway discharge channel were designed to prevent erosion. The velocities through the spillways during peak discharge were analyzed to determine if erosion would occur within preparation of the *CCR Certification: Initial Inflow Design Flood Control System Plan for the Ash Pond at the A.B. Brown Generating Station* (October 2016).

Additionally, hydrologic and hydraulic analyses were completed to evaluate the capacity of the spillway relative to inflow estimated for the 1,000-year flood event for the significant hazard potential for the Ash Pond. The ability of the spillway design to carry sustained flows, as well as the capacity of the spillway, was evaluated using hydrologic and hydraulic analysis performed per §257.82(a). The hydrologic and hydraulic analyses are discussed in the *CCR Certification: Initial Inflow Design Flood Control System Plan for the Ash Pond at the A.B. Brown Generating Station* (October 2016).

Conclusion and Recommendation

All outlet devices were designed to prevent erosion. The HDPE, steel and RCP pipes of the outlets are non-erodible material, while the channel of the Emergency Spillway is lined with rip-rap.

The analysis found that the spillways can adequately manage flow during peak discharge resulting from the 1,000-year storm event without overtopping of the embankments. The peak water surcharge elevation is 446.8 feet during the IDF, and the minimum crest elevation of the Ash Pond dike is 450.9 feet, resulting in 4.1 feet of freeboard. This also indicates that the design of the spillway is adequate to carry sustained flows. Operational and maintenance procedures are in place to remove debris or other obstructions from the spillway, if observed after normal inspections. As a result, these procedures are appropriate for maintaining the spillway.

Therefore, the Ash Pond meets the requirements in §257.73 (d)(1)(v).

2.6 Stability and Structural Integrity of Hydraulic Structures

Regulatory Citation: 40 CFR §257.73 (d)(1)

- *(vi) Hydraulic structures underlying the base of the CCR unit or passing through the dike of the CCR unit that maintain structural integrity and are free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation of the hydraulic structure.*

Background and Assessment

The stability and structural integrity of hydraulic structures penetrating the dike of the Ash Pond was evaluated using design drawings, operational and maintenance procedures, inspections, and conditions observed in the field by AECOM.

The only hydraulic structure that penetrates the lower pool embankment is the Principal Spillway. This gooseneck inlet structure is attached to a vertical 36-inch RCP drop inlet which connects to a horizontal 36-inch diameter

RCP pipe that outlets near the toe of the embankment. A visual inspection of this spillway structure was completed by AECOM on February 23, 2016. See AECOM's Site Visit Report in **Appendix B** for additional information.

SIGECO contracted Stantec Consulting Service, Inc. (Stantec) to inspect the gooseneck structure. This inspection was completed December 4th and 5th, 2014 by Hydromax USA via closed-circuit television (CCTV) for the vertical and horizontal portions of this structure. Stantec reviewed this video and noted 4, grade 5 areas, all notated as "Surface Reinforcement Visible." Stantec concluded there was no indication of active staining of the interior of the pipe, which would have indicated possible intrusion of the surrounding soil into the pipe at these locations or at any pipe joints. The signed report by Stantec concludes that the noted defects are not expected to adversely impact the structural integrity of the discharge pipes, but that they should be CCTV inspected periodically and the inspection video compared to the original video. Stantec also noted a 15-inch diversion conduit SIGECO identified as plugged with concrete. The historical drawings indicate that the pipe is 24-inch, reinforced concrete with anti-seep collars, plugged at the upstream end. Stantec was unable to verify the plug location and length of plugged segment. Other inspection methods were considered for the vertical stand of the Principal Spillway but were discarded due to the physical impracticality of the methods and potential employee or contractor safety concerns.

Conclusion and Recommendation

Based on this evaluation, the Principal Spillway structure did not display any areas of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, or debris that may negatively affect the operation of the structure. Operational and maintenance procedures are in place to remove debris or other obstructions from the hydraulic structures, and address any deficiencies, as evidenced by conditions observed by AECOM. As a result, these procedures are appropriate for maintaining in the stability and structural integrity of the hydraulic structure.

There is no current evidence of ash transport within the pipe and no noted signs of failure. However, since the pipe is a potential pathway for ash release from the impoundment, AECOM recommends a CCTV inspection of the Principal Spillway every other year, including the previous diversion conduit, as far as practical. Comparison of a current, bi-annual video to the baseline video established in 2014 provides for identification of potential changes in the pipe, joints, or staining which could be indicative of deterioration, deformation or distortion.

Therefore, the Ash Pond meets the requirements in §257.73 (d)(1)(vi).

2.7 Downstream Slope Inundation / Stability

Regulatory Citation: 40 CFR §257.73 (d)(1)

- *(vii) For CCR units with downstream slopes which can be inundated by the pool of an adjacent water body, such as a river, stream or lake, downstream slopes that maintain structural stability during low pool of the adjacent water body or sudden drawdown of the adjacent water body.*

Background and Assessment

The structural stability of the downstream slopes of the Ash Pond was evaluated by comparing the location of the Ash Pond relative to adjacent water bodies using published United States Geological Survey (USGS) topographic maps, aerial imagery, and conditions observed in the field by AECOM.

Based on this evaluation, water bodies adjacent to the downstream slopes of the Ash Pond are not present. The nearest downstream water body is the Ohio River, which is approximately 2,500 lateral feet beyond the downstream slopes of the Ash Pond. The 100 year flood event (elevation 373 feet) from the Ohio River is 77 feet below the elevation of the toe of the lower pool berm. Therefore, there are no adjacent water bodies that can inundate the downstream slopes of the Ash Pond.

Conclusion and Recommendation

Based on this evaluation, the requirements in §257.73 (d)(1)(vii) are not applicable to the Ash Pond, as inundation of the downstream slopes is not expected to occur.

3 Certification

This Certification Statement documents that the Ash Pond at the A. B. Brown Generating Station meets the Initial Structural Stability Assessment requirements specified in 40 CFR §257.73 (d). The Ash Pond is an existing CCR surface impoundment as defined by 40 CFR §257.53. The CCR Rule requires that the Initial Structural Stability Assessment for an existing CCR surface impoundment be prepared by October 17, 2016.

CCR Unit: Southern Indiana Gas & Electric Company; A. B. Brown Generating Station; Ash Pond

I, Vikram K. Gautam, being a Registered Professional Engineer in good standing in the State of Indiana, do hereby certify, to the best of my knowledge, information, and belief that the information contained in this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above referenced CCR Unit, that the Initial Structural Stability Assessment dated October 13, 2016 meets the requirements of 40 CFR § 257.73 (d).

Vikram K. Gautam
Printed Name

10/13/2016
Date

VIKRAM K. GAUTAM
REGISTERED
No. PE11600291
STATE OF
INDIANA
PROFESSIONAL ENGINEER
10/13/16

4 Limitations

Background information, design basis, and other data which AECOM has used in preparation of this report have been furnished to AECOM by SIGECO. AECOM has relied on this information as furnished, and is not responsible for the accuracy of this information. Our recommendations are based on available information from previous and current investigations. These recommendations may be updated as future investigations are performed.

The conclusions presented in this report are intended only for the purpose, site location, and project indicated. The recommendations presented in this report should not be used for other projects or purposes. Conclusions or recommendations made from these data by others are their responsibility. The conclusions and recommendations are based on AECOM's understanding of current plant operations, maintenance, stormwater handling, and ash handling procedures at the station, as provided by SIGECO. Changes in any of these operations or procedures may invalidate the findings in this report until AECOM has had the opportunity to review the findings, and revise the report if necessary.

This development of the Initial Structural Stability Assessment was performed in accordance with the standard of care commonly used as state-of-practice in our profession. Specifically, our services have been performed in accordance with accepted principles and practices of the engineering profession. The conclusions presented in this report are professional opinions based on the indicated project criteria and data available at the time this report was prepared. Our services were provided in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation is intended.

Appendix A
Figures

Figure 1 – Location Map
Figure 2 – Site Map

AECOM
9400 Amberglen Boulevard
Austin, TX 78729-1100
512-454-4797 (phone)
512-454-8807 (fax)

SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
dba VECTREN POWER SUPPLY, INC.

One Vectren Square
Evansville, IN 47708
1-800-227-1376 (phone)

A.B. BROWN
GENERATING STATION
MT. VERNON, IN

CCR CERTIFICATION
ASH POND

ISSUED FOR CERTIFICATION

ISSUED FOR BIDDING	DATE	BY
ISSUED FOR CONSTRUCTION	DATE	BY

REVISIONS

NO.	DESCRIPTION	DATE
△		
△		
△		
△		
△		

AECOM PROJECT NO:	60442676
DRAWN BY:	MJC
DESIGNED BY:	MJC
CHECKED BY:	TLE
DATE CREATED:	
PLOT DATE:	4/22/2016
SCALE:	AS SHOWN
ACAD VER:	2014

SHEET TITLE

LOCATION MAP

FIGURE 1

AECOM DRAWING PATH: P:\Projects\Environmental\60442676_VectrenCCR\7.0_CAD_GIS\7.04_Plan_Sheets\BROWN-LOCATION MAP.dwg
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AECOM
9400 Amberglen Boulevard
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512-454-4797 (phone)
512-454-8807 (fax)

SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
dba VECTREN POWER SUPPLY, INC.

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Evansville, IN 47708
1-800-227-1376 (phone)

A.B. BROWN
GENERATING STATION
MT. VERNON, IN

CCR CERTIFICATION
ASH POND

ISSUED FOR CERTIFICATION

ISSUED FOR BIDDING — DATE BY

ISSUED FOR CONSTRUCTION — DATE BY

REVISIONS

NO.	DESCRIPTION	DATE
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AECOM PROJECT NO:	60442676
DRAWN BY:	MJC
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CHECKED BY:	TLE
DATE CREATED:	
PLOT DATE:	4/22/2016
SCALE:	AS SHOWN
ACAD VER:	2014

SHEET TITLE

SITE MAP

FIGURE 2

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AECOM DRAWING PATH: P:\Projects\Environmental\60442676_VectrenCCR\7.0_CAD_GIS\7.04_Plan_Sheets\BROWN-SITE MAP.dwg

Appendix B
AECOM Site Visit Report

AECOM

STATION SITE VISIT SUMMARY

Station:	A.B. Brown Generating Station
Station Location:	Indiana
Site Visit Date:	02/23/2016
Prepared by:	Teresa L. Entwistle, PE (AECOM)
Checked by:	John Davis, PE (AECOM)
ITR by:	Vik Gautam, PE (AECOM)
Distribution to:	File

Background:

AECOM engineering and program management team visited the A.B. Brown Generating Station (Brown) and were accompanied by Vectren personnel. AECOM personnel inspected the Ash Pond at the Brown station to assess the unit in regards to the CCR Rule and to better understand the operating methods of the surface impoundment for the analysis required under the CCR Rule. Engineering design personnel that toured the facility included Teresa Entwistle, John Davis, Vik Gautam, and John Priebe. AECOM program management personnel included Tommy Bell, Milton Owen, Ty Cloud and Steven Kosler. Vectren personnel present included Lisa Messinger, Chris Leslie, and John Minnette.

Summary of Observation/Comments on Site Visit:

AECOM performed a visual inspection of the Ash Pond and the areas surrounding the Ash Pond. Inspections were conducted from the top of the downstream berm of the unit along an access road and from the west side of the impoundment via an access road between the unit and the generating station. The surface impoundment was created by the construction of an earthen dam across an existing valley. A secondary berm is located upstream of the lower berm to separate the Ash Pond into two operating pools, the upper pool and the lower pool.

Drainage into the surface impoundment is from pumped process flows, rainfall falling directly onto the surface impoundment and from runoff from upstream areas. Discharge from the unit is via an active pumping station that recycles the water back to the generating station for process use. The plant operates as a zero-discharge facility during normal conditions, so it is uncommon for water to discharge from the unit. However, if a discharge does occur, the runoff drains through the permitted NPDES outfall to an unnamed tributary which travels west for approximately 0.5 mile before turning south for approximately one mile and discharging into the Ohio River.

Two emergency overflow structures are present, a primary spillway consisting of a gooseneck that penetrates the lower berm and a grass lined trapezoidal secondary emergency spillway channel. The gooseneck ties into a vertical riser that ties into a 36-inch Class V, reinforced concrete pipe (RCP). A junction chamber enables the transition from the vertical section of the RCP to the horizontal section of the RCP. No seepage was observed on the exterior of the berm at the locations of these penetrations or along the downstream slope of the berm. Vectren personnel informed AECOM that a video-taped inspection of the interior of the gooseneck was performed by others and will be submitted to AECOM for review. The secondary emergency spillway is protected by established grass cover. The discharge from this spillway is a riprap lined channel.

Slope protection included established grass cover along the external slopes of the impoundment berm and rip-rap along the interior slopes.

No downstream structures were observed between the unit and the Ohio River.

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Photo No. 1	Date: 02/23/2016
Location: A.B. Brown Generating Station	
Description: Standing at east end of berm, looking west. Picture shows slope protection on downslope of berm. Photographer: Entwistle	
Photo No. 2	Date: 11/04/2015
Location: A.B. Brown Generating Station	
Description: Standing at west end of berm, looking east. Picture shows slope protection on downslope of berm. Photographer: Entwistle	

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Photo No. 3	Date: 02/23/2016
Location: A.B. Brown Generating Station	
Description: Standing on western leg of berm, looking north. Picture shows slope protection on exterior face of berm. Photographer: Entwistle	
Photo No. 4	Date: 11/04/2015
Location: A.B. Brown Generating Station	
Description: Standing midway along southern berm, looking back over surface impoundment. Picture shows stability of berm into surface impoundment. Photographer: Entwistle	

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Photo No. 5	Date: 02/23/2016
Location: A.B. Brown Generating Station	
Description: Standing in secondary emergency spillway looking downstream. Picture shows adequate slope protection and no evidence of erosion. Photographer: Entwistle	

Photo No. 6	Date: 02/23/2016
Location: A.B. Brown Generating Station	
Description: Standing at top of secondary emergency spillway, showing riprap lining of discharge channel Picture shows adequate erosion protection. Photographer: Entwistle	

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Photo No. 7	Date: 02/23/2016
Location: A.B. Brown Generating Station	
Description: Standing on the pumping station. Picture shows inlet to gooseneck emergency overflow penetration into lower berm. Video of this structure provided separately. Photographer: Entwistle	

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9400 Amberglen Boulevard
Austin, Texas 78729
1-512-454-4797

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Appendix N
Safety Factor Assessment

Attorney Client Privileged

Submitted to
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CCR Certification: Safety Factor Assessment §257.73 (e)

for the

Ash Pond

at the

A.B. Brown Generating Station

Revision 0

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Executive Summary

This Coal Combustion Residuals (CCR) Safety Factor Assessment for the Ash Pond at the Southern Indiana Gas & Electric Company, dba Vectren Power Supply, Inc., A.B. Brown Generating Station has been prepared in accordance with the requirements specified in the USEPA CCR Rule under 40 Code of Federal Regulations §257.73 (e)(1). These regulations require that the specified documentation, assessments and plans for an existing CCR surface impoundment be prepared by October 17, 2016.

The Ash Pond meets the regulatory requirements for the safety factor assessment analysis, as summarized in **Table ES-1**.

Table ES-1 – Certification Summary

Report Section	CCR Rule Reference	Requirement Summary	Requirement Met?	Comments
Safety Factor Assessment				
6.1	§257.73 (e)(1)(i)	*Maximum storage pool safety factor must be at least 1.50*	Yes	Safety factors were calculated to be 3.21 and higher.
6.2	§257.73 (e)(1)(ii)	*Maximum surcharge pool safety factor must be at least 1.40*	Yes	Safety factors were calculated to be 3.06 and higher.
6.3	§257.73 (e)(1)(iii)	*Seismic safety factor must be at least 1.00*	Yes	Safety factors were calculated to be 1.32 and higher.
6.4	§257.73 (e)(1)(iv)	*Liquefaction safety factor must be at least 1.20*	Yes	Safety factors were calculated to be 1.23 and higher.

1 Introduction

1.1 Purpose of this Report

The purpose of the Safety Factor Assessment is to document that the requirements specified in 40 Code of Federal Regulations (CFR) §257.73 (e) have been met to support the certification required under each of the applicable regulatory provisions for the A.B. Brown Generating Station (Brown) Ash Pond. The Ash Pond is an existing CCR surface impoundment as defined by 40 CFR §257.53. The CCR Rule requires that the Safety Factor Assessment for an existing CCR surface impoundment be prepared by October 17, 2016.

The Brown station has an interconnected, existing CCR surface impoundment, the Ash Pond, which consists of a lower pool and an upper pool. The following table summarizes the documentation required within the CCR Rule and the sections that specifically respond to those requirements of this assessment.

Table 1-1 – CCR Rule Cross Reference Table

Report Section	Title	CCR Rule Reference
6.1	Factor of Safety: Maximum Storage Pool Loading	§257.73 (e)(1)(i)
6.1	Factor of Safety: Maximum Surcharge Pool Loading	§257.73 (e)(1)(ii)
6.2	Factor of Safety: Seismic	§257.73 (e)(1)(iii)
6.2	Factor of Safety: Post-Liquefaction	§257.73 (e)(1)(iv)

The purpose of the geotechnical investigation and analyses is to evaluate the design, performance, and condition of the Brown Ash Pond using available design drawings, construction records, inspection reports, previous engineering investigations, reports and analyses, station operating records, and other pertinent documents provided by Southern Indiana Gas & Electric Company, dba Vectren Power Supply, Inc. (SIGECO). This information was used in combination with subsurface investigations, laboratory testing, and engineering analyses to evaluate the design and operation of the surface impoundment using current regulatory and engineering practice, and to identify potential geotechnical deficiencies that may require additional investigation, repair or remediation. The regulatory criteria and current engineering practice related to the design of CCR ash impoundments was used as guidance during development of geotechnical analysis and stability evaluations.

Geotechnical field investigations supporting the evaluation were conducted starting in the Spring of 2015 and continued into early Winter 2016, under various mobilizations. These investigations were performed by AECOM and Cardno ATC. The combined field program consisted of 25 conventional hollow stem auger (HSA) borings, and 5 Cone Penetration testing (CPT) soundings. Laboratory testing was conducted on the materials obtained through various sampling techniques to assist in characterization of the subsurface conditions.

In addition to the 2015 / 2016 investigations, historical data available from SIGECO was also reviewed and utilized. Historical data included borings drilled on or in the vicinity of the dam from two previous investigations: one performed by ATC Associates in 2002 (which included seven borings); and the second was performed by Harding Lawson and Associates in 1982, and included seven borings.

Using the collective data set, stability analyses were performed by AECOM to evaluate the potential for slope instabilities, in accordance with the EPA regulation 40 CFR 257.73(d) and (e). The potential for slope instability is dependent on factors such as slope geometry, piezometer/phreatic surface conditions, seismic activity, and soil shear strengths of the embankment and foundation soils. A summary of the geotechnical field program, laboratory testing program and stability evaluations are presented in the following sections.

1.2 Brief Description of Impoundment

The Brown station is a coal-fired power plant located approximately 10 miles east of Mount Vernon in Posey County, Indiana and is owned and operated by SIGECO. The station is situated just west of the Vanderburgh-Posey County line and north of the Ohio River with the Ash Pond positioned on the east side of the generating station.

The Brown Ash Pond was commissioned in 1978. An earthen dam was constructed across an existing valley to create the impoundment. In 2003, a second dam was constructed east of the original dam and further up the valley to increase the storage capacity. This temporarily created an upper pond and a lower pond. The upper and lower ponds were operated separately until 2016 when the upper dam was decommissioned. A 10’ wide breach was installed in the upper embankment and the normal pool elevation was lowered. Currently, the upper pool and the lower pool act as one CCR unit referred to as the Ash Pond, which has a surface area of approximately 159 acres.

The Ash Pond dam embankment is approximately 1,540 feet long, 30 feet high, and has 3 to 1 (horizontal to vertical) side slopes covered with grassy vegetation. The embankment crest elevation is 450.9 feet[1] and has a crest width of 20 feet. An earthen buttress was constructed against the outboard slope of the dam. The buttress crest extends the length of the dam, is up to 200 feet wide and varies in elevation from 442.0 feet to 432.0 feet. The operating elevation of the pool fluctuates from 439.0 feet to 444.0 feet. However, the pool normally operates at an elevation of 441.5 feet. The surface area of the lower pool impoundment is approximately 57 acres. The surface area of the upper pool impoundment is approximately 102 acres and has a normal operating level of 450 feet. A Site Location Map showing the area surrounding the station is included as **Figure 1** of **Appendix A**. **Figure 2** in **Appendix A** presents the Brown Site Map.

[1] Unless otherwise noted, all elevations in this report are in the NAVD88 datum.

2 Summary of Field Investigations

Subsurface explorations were performed at the Brown Ash Pond dam in 2015 and 2016, and included 25 soil borings, and a program of 5, cone-penetration test (CPT) soundings, with seismic wave velocity measurements and pore pressure dissipation testing. Boring depths ranged from 26 to 94 ft, and CPT depths ranged from 54 to 94 ft below existing grades. Boring and CPT locations are depicted in **Figure 3 (Appendix A).** Boring and CPT exploration location data (ID, easting, northing, and ground surface elevation) are summarized in **Table 2-1**. Boring logs are provided in **Appendix B** and CPT data plots are provided in **Appendix C**.

All borings were drilled by Cardno ATC of Indianapolis, Indiana, who was subcontracted directly to SIGECO. Borings B-201 through B-219 were drilled between April 15 and July 16, 2015. Borings AECOM-B-1 through AECOM B-5, and CPT-1 through CPT-5 were performed between October 8 and October 12, 2015. Boring AECOM B-8 was advanced on January 27, 2016. A Cardno ATC representative logged borings B-201 through B-219. An AECOM geotechnical engineer logged borings AECOM-B1 through AECOM-B5 and AECOM-B8. Cardno ATC used an All-Terrain Vehicle-mounted drill rig (GeoProbe 8040DT) and hollow stem augers (3.25-inch inner diameter) to drill the borings.

CPT soundings were performed by Cardno ATC, with full-time oversight by an AECOM geotechnical engineer. The soundings were performed by Cardno using a GeoProbe 8040DT rig equipped to advance CPT tooling and instrumentation with real-time data collection. The SCPTu soundings were completed in accordance with ASTM D5778 and provided nearly continuous digital logging of tip and sleeve resistance and generated pore pressure with depth. Shear wave measurements were taken during soundings at two-meter intervals in order to provide a shear wave velocity profile for the subsurface materials to support seismic site response analyses. Pore pressure dissipation tests were conducted at selected locations in each sounding.

Historical geotechnical investigations performed by Harding Lawson Associates in 1982 (Boring 1 through Boring 7, located at the northern area of the dam) were also considered in the interpretation and analysis of the site's geologic conditions.

Additional borings performed in the area of the former upper dam were also reviewed and considered herein. These borings were utilized only to establish a general characterization of the impounded sluiced ash within the Ash Pond and do not directly influence the stability evaluation performed herein. Location maps, logs, and lab testing data associated with these borings are provided in **Appendix D**.

Representative soil samples were collected from each of the borings for classification and/or testing. The soil samples were obtained using split spoon samplers and in accordance with the Standard Penetration Test (SPT) methodology (ASTM D 1586). Undisturbed samples of fine-grained soils (silts and clays) were obtained using 3-inch outside diameter steel (Shelby) tubes, either conventionally pushed in accordance with ASTM D1587 or by utilizing a piston sampler in accordance with ASTM D6519 (in very soft soils). Selected SPT and Shelby tube soil samples were tested at the GeoTesting Express Laboratory in Acton, Massachusetts or by Cardno ATC. Laboratory testing associated with seismic strength characterization was performed at the GeoTesting Express Laboratory.

Table 2-1 – Boring and CPT Exploration Location Data				
Exploration ID	**Firm and Date**	**Easting (ft, NAD83)**	**Northing (ft, NAD83)**	**Elevation (ft, NAVD88)**
Borings				
AECOM-B1	AECOM (2015)	Adjacent to B-201		451.3
AECOM-B2	AECOM (2015)	Adjacent to B-210		451.2
AECOM-B3	AECOM (2015)	Adjacent to B-219		417.9
AECOM-B4	AECOM (2015)	Adjacent to B-205		416.1
AECOM-B5	AECOM (2015)	Adjacent to B-215		416.4
AECOM-B8	AECOM (2016)	2770903.02	968016.65	427.7
B-201	Cardno ATC (2015)	2771353.5	967075.1	450.9
B-202	Cardno ATC (2015)	2771274.5	967334.1	450.7
B-203	Cardno ATC (2015)	2771191.0	967637.5	450.8
B-204	Cardno ATC (2015)	2771106.2	967924.7	450.8
B-205	Cardno ATC (2015)	2771053.2	967603.2	415.6
B-206	Cardno ATC (2015)	2771114.7	967362.0	414.8
B-207	Cardno ATC (2015)	2770917.0	967453.0	395.0
B-208	Cardno ATC (2015)	2770911.3	967590.7	396.7
B-209	Cardno ATC (2015)	2771087.7	967991.4	450.9
B-210	Cardno ATC (2015)	2771131.0	967838.5	450.9
B-211	Cardno ATC (2015)	2771162.2	967727.2	451.1
B-212	Cardno ATC (2015)	2771214.9	967535.1	450.2
B-213	Cardno ATC (2015)	2771306.0	967234.0	451.0
B-214	Cardno ATC (2015)	2771330.8	967147.5	451.0
B-215	Cardno ATC (2015)	2771017.3	967805.7	416.1
B-216	Cardno ATC (2015)	2771057.7	967701.0	416.5
B-217	Cardno ATC (2015)	2771095.3	967516.0	416.3
B-218	Cardno ATC (2015)	2771166.6	967245.4	416.1
B-219	Cardno ATC (2015)	2771199.9	967126.1	417.6
HLA-1	Harding Lawson and Associates (1982)	**	**	**

Table 2-1 – Boring and CPT Exploration Location Data				
Exploration ID	**Firm and Date**	**Easting (ft, NAD83)**	**Northing (ft, NAD83)**	**Elevation (ft, NAVD88)**
HLA-2	Harding Lawson and Associates (1982)	**	**	**
HLA-3	Harding Lawson and Associates (1982)	**	**	**
HLA-4	Harding Lawson and Associates (1982)	**	**	**
HLA-5	Harding Lawson and Associates (1982)	**	**	**
HLA-6	Harding Lawson and Associates (1982)	**	**	**
HLA-6A	Harding Lawson and Associates (1982)	**	**	**
HLA-7	Harding Lawson and Associates (1982)	**	**	**
CPT Soundings				
CPT-1	AECOM (2015)	2771277.3	967331.9	451.4
CPT-2	AECOM (2015)	2771188.1	967638.0	450.9
CPT-3	AECOM (2015)	2771196.7	967136.2	417.4
CPT-4	AECOM (2015)	2771107.0	967358.4	414.8
CPT-5	AECOM (2015)	2771056.0	967606.9	415.8

** Survey coordinates for the historical borings were not available. Locations shown on Figure 3 have been estimated based on location maps provided in the historical data.

3 Summary of Site-Specific Subsurface Conditions

3.1 Site Stratigraphy

3.1.1 Regional Geologic Setting

The Brown station is situated on the western edge of the Boonville Hills Physiographic subdivision of the Southern Hills and Lowlands Region of Indiana. This region is underlain by Pennsylvanian bedrock of the Mcleansboro group (lower part), which is predominantly shale, sandstone and limestone with interbedded thin coal layers.

The Heusler Fault is located roughly 2½ miles northwest of the site The New Madrid Seismic Zone, located in southeastern Missouri, and the Wabash Valley Fault System in southwestern Indiana, are both capable of significant seismic accelerations in the region that could impact the site.

3.1.2 Site-Specific Stratigraphy

Six strata were encountered during the geotechnical investigations at the Ash Pond dam:

1) Impounded Ash Materials: No ash materials were present in the Ash Pond dam. Ash materials are impounded behind the dam, within the pond. Based on historical information, these materials are primarily bottom ash and fly ash, and are generally in a very loose to loose condition.

2) Embankment Fill Materials: Embankment Fill materials were encountered from the ground surface and extending to depths ranging from approximately 37 to 58 ft below ground surface (bgs) from the crest boring and 5.5 to 26.5 ft bgs from the bench borings. Embankment Fill materials were typically a mixture of lean clays (CL) and silty clays (CL-ML) with varying amounts of sand. Visual classifications were most often described as slightly moist to moist, reddish brown to brown, silty clay to sandy lean clay. Uncorrected field Standard Penetration Test (SPT) N-values in the embankment ranged widely between 3 and 50 blows per foot (bpf) with an average of 16 bpf, indicating a stiff to very stiff overall consistency. Plasticity indices from Atterberg limit testing ranged from 3 to 26 percent, with an average of 13 percent. Liquid limits ranged from 24 to 38 percent with an average value of 30 percent. CPT results indicated a Cone Tip Resistance ranging from 56.6 to 111.7 tons per square foot (tsf) with an average of 71.3 tsf. Cone Sleeve Resistance ranged from 1.8 tsf to 3.0 tsf with an average value of 2.3 tsf. Shear wave velocity results ranged from 670 to 878 ft per second (ft/sec) with an average of 815 ft/sec.

3) Foundation Silts: Natural, alluvial silt deposits were encountered in most borings drilled in the lower bench area and beyond the toe of the dam. Silts were not encountered at any of the borings drilled at the crest of the dam, indicating that the deposit grades out moving from west to east across the width of the dam and buttress structures. The deposits consisted of a moist to wet, brown to gray, very soft to very stiff silt (ML) with occasion traces of fine sand. Silts varied in thickness from approximately 2.0 ft to 27.5 ft. Uncorrected field SPT N-values ranged between 0 and 23 blows bpf with an average of 7 bpf, indicating a medium stiff consistency overall. The fines content of the silt layers (as indicated by material that passes through a No. 200 sieve) was often above 95%, Atterberg limits testing indicated about half of the samples to be non-plastic, with others exhibiting very low plasticity indices, often below 7 percent. CPT results within the Foundation Silts indicated Cone Tip Resistance values ranging from 23.9 to 50.3 tsf with an average of 34.0 and Cone Sleeve Resistance values ranged from 0.64 to 1.32 tsf with an average of 0.90 tsf. Shear wave velocity results ranged from 533 to 737 ft/sec with an average of 692 tsf.

4) Foundation Silty Clay: The silt horizons discussed above were interbedded within native lean clays that made up much of the foundation materials of the Ash Pond dam, especially at the eastern regions of the dam footprint and below the crest. These clays consisted primarily of moist to wet, light brown to gray, very soft to very stiff lean clays (CL) to silty clays (CL-ML) with varying amounts of sand. The thickness of the clays varied widely, becoming more interbedded with silt layers to the west towards the bench and downstream toe of the embankment. Uncorrected field SPT N-values ranged between 0 and 33 bpf with an average of 10 bpf, indicating a typically stiff consistency. CPT results exhibited Cone Tip Resistances ranging from 17.5 to 38.4 tsf with an average of 26.6 and Cone Sleeve Resistances ranged from 0.46 to 1.43 tsf with an average of 0.91 tsf. Shear wave velocity results ranged from 804 to 984 ft/sec with an average of 882 ft/sec.

5) Buttress Fill: The buttress fill was obtained from near-site borrow sources, and consists of fine-grained soils most typically classified as lean clay (CL). Plasticity indices of the fill material generally ranging from 6 to 14 percent, with an average of about 12 percent. To a much lesser extent, the buttress fill includes materials classified as silt (ML). The fill was placed and compacted in lifts, and density testing of each lift using nuclear methods was performed. The compaction specification was to achieve 95% of the Standard Proctor Maximum Dry Density.

6) Bedrock: Bedrock was encountered in most of the borings advanced at the site. Borings were terminated at the top of bedrock or after collecting a single split spoon sample in rock in all cases (rock was not cored). As revealed in these limited samples, bedrock primarily consisted of gray to brown weathered to severely weathered siltstone with instances of gray weathered shale and gray to brown weathered to severely weathered sandstone. **Table 3-1** summarizes the depth/elevation of the top of rock as encountered in the borings. In general, the bedrock was found at a shallower depth (and elevation) on the north end of the dam and was found at a depth greater from ground surface at the south end of the dam.

Table 3-1 – Summary of Bedrock Depth and Elevation

Boring No.	Depth at Top of Rock (ft bgs)	Elevation at Top of Rock (ft NAVD88)	Rock Type
AECOM-B2	77.5	373.7	Siltstone
B-202	94	356.7	Siltstone
B-203	91.5	359.0	Siltstone
B-204	74.5	376.0	Siltstone
B-205	61.5	354.0	Siltstone
B-206	79	335.8	Siltstone
B-207	45	350.0	Siltstone
B-208	44	352.7	Siltstone
B-209	69.5	381.5	Sandstone
B-214	69	382.0	Shale
B-215	52	363.0	Shale

Table 3-1 – Summary of Bedrock Depth and Elevation			
Boring No.	**Depth at Top of Rock (ft bgs)**	**Elevation at Top of Rock (ft NAVD88)**	**Rock Type**
B-216	53.9	361.1	Siltstone
B-218	57.4	357.6	Siltstone
B-219	46.8	368.2	Sandstone/Shale
HLA-1	71	379.9	Siltstone
HLA-3	52.5	399.4	Siltstone
HLA-4	55	394.6	Siltstone
HLA-5	34	382.1	Siltstone
HLA-6	24	392.2	Siltstone
HLA-7	28	373.6	Siltstone

Logs of the borings and CPT soundings are included in **Appendices B and C**, respectively, and laboratory test results are included in **Appendix D**.

3.2 Groundwater Conditions

The presence of groundwater was noted on the boring logs at the time of drilling on the drilling tools. Standpipe piezometers were installed during the additional field exploration in boring location B-212 on the crest and B-217 on the mid-slope bench. Ongoing readings of these piezometers appear to indicate steady-state water levels had equilibrated near a depth of 25.8 ft (approximate elevation of 424 ft) at crest boring B-212 and a depth of 8.6 ft (approximately 406 ft) at the mid-slope bench boring B-217.

The 1982 work by Harding Lawson indicated groundwater elevations similar to those above in the northern area of the Ash Pond dam. Steady state water levels below the crest of the dam were near El. 420 ft and near the toe of the dam were near El. 410 ft at the time of that investigation. One piezometer, located approximately 200 ft beyond the dam toe, had a water level near El. 395 ft.

An existing sand blanket and perforated drainage pipe system alleviates pore water pressure along the upstream face of the dam as well as along the flat bench area below the existing gravity buttress. The elevation of the drainage blanket in the flat area is approximately 412 ft. The drainage blanket has substantially greater hydraulic conductivity than the surrounding soils, and is intended to intercept seepage through the dam embankment, convey it downstream of the toe, and lower the phreatic surface through the dam.

4 Summary of Laboratory Testing

4.1 Summary of Laboratory Testing Scope

The laboratory testing program performed for the Ash Pond dam was intended to obtain information on index properties and shear strength properties of the subsurface materials at the site. The laboratory testing program for characterization of the materials at the Ash Pond dam are summarized in **Table 4-1**.

Table 4-1 – Summary of Laboratory Testing Program for Ash Pond Dam

ASTM Designation	Test Type	Number of Tests			
		Total	Embankment	Foundation Clay	Foundation Silt
D2216	Moisture Content	417	198	128	94
D2937	Dry Unit Weight	42	20	14	12
D4318	Atterberg Limits	105	32	39	34
D422	Sieve/Hydrometer	54	17	22	20
D5084	Hydraulic Conductivity	6	1	1	4
D4767	Consolidated Undrained Triaxial (CIU)	27	5	12	10
D6528	Cyclic Direct Simple Shear	6	0	0	6

4.2 Summary of Laboratory Testing Results

A summary of laboratory test results for the embankment fill, foundation clay, and foundation silt at the Ash Pond dam are presented in **Tables 4-2, 4-3,** and **4-4**, respectively. Seismic laboratory test results of the foundation silts are summarized in **Table 4-5.** See **Appendix D** and boring logs in **Appendix B** for a complete list of laboratory test data and results.

4.2.1 Embankment Fill

Table 4-2 summarizes the results of static laboratory testing performed within the Embankment fill.

Table 4-2 – Summary of Lab Test Results: Embankment Fill		
LAB TEST	**Range**	**Average**
Index/General Properties:		
Moisture Content (%)	11.7 – 25.8	17.5
Atterberg Limits (%)		
Liquid Limit	24 – 38	31
Plastic Limit	12 – 27	18
Plasticity Index	1– 30	14
Particle Size Analysis (%)		
Percent Fines (passing No. 200 Sieve)	58.7 – 99.5	85.9
Moist Unit Weight (pcf)	120.4 – 137.4	129.9
Dry Unit Weight (pcf)	101.0 – 119.0	110.4
Strength Properties:	**Friction Angle ϕ (degrees)**	**Cohesion c (psf)**
Drained (Effective) Strength	30	50
Peak Undrained (Total) Strength	22	600

4.2.2 Foundation Silty Clay Soils

Table 4-3 summarizes the results of static laboratory testing performed within the foundation clays.

Table 4-3 – Summary of Lab Test Results: Foundation Silty Clay Soils		
LAB TEST	**Range**	**Average**
Index/General Properties:		
Moisture Content (%)	8.0 – 48.1	24.0
Atterberg Limits (%)		
Liquid Limit	21 – 75	33
Plastic Limit	13 – 27	19
Plasticity Index	4 – 48	14
Particle Size Analysis (%)		
Percent Fines (passing No. 200 Sieve)	43.6 – 99.6	83.8

Table 4-3 – Summary of Lab Test Results: Foundation Silty Clay Soils		
LAB TEST	**Range**	**Average**
Index/General Properties:		
Moist Unit Weight (pcf)	112.0 – 132.1	123.5
Dry Unit Weight (pcf)	77.0 – 111.0	98.2
Strength Properties:	Friction Angle ϕ (degrees)	Cohesion c (psf)
Drained (Effective) Strength	31	80
Peak Undrained (Total) Strength	23	400

4.2.3 Foundation Silt Soils

Table 4-4 summarizes the results of static laboratory testing performed within the foundation silts.

Table 4-4 – Summary of Lab Test Results: Foundation Silt Soils		
LAB TEST	**Range**	**Average**
Index/General Properties:		
Moisture Content (%)	18.1 – 54.3	30.0
*Atterberg Limits (%)**		
Liquid Limit	23 – 38	29
Plastic Limit	20 – 35	26
Plasticity Index	1 – 6	3
Particle Size Analysis (%)		
Percent Fines (passing No. 200 Sieve)	71.2 – 99.9	95.2
Moist Unit Weight (pcf)	106.4 – 128.6	120.8
Dry Unit Weight (pcf)	71 – 106.2	93.2
Strength Properties:	Friction Angle ϕ (degrees)	Cohesion c (psf)
Drained (Effective) Strength	33	0
Peak Undrained (Total) Strength	22	650

**Note: Of 32 samples subject to Atterberg limits testing, 17 were classified as "Non-Plastic." Ranges and averages listed are from the16 samples that exhibited plasticity.*

Stress-controlled, Cyclic Direct Simple Shear (CDSS) testing (per ASTM D6528) was performed on undisturbed silt samples obtained from multiple locations within silt zones beneath the Ash Pond dam. A total of six samples

were tested. Samples were loaded to normal stresses at or slightly above the existing overburden pressure estimate for that sample.

Laboratory data from the CDSS tested are presented in **Appendix D.** The test results (including excess pore pressure generated and axial strain) are presented as a function of the number of cycles that have been applied at any point in the test. Herein, failure (i.e., liquefaction) was interpreted at the cycle where the single-phase axial strain exceeded 5% (or 10% peal-to-peak) or the excess pore pressure ratio reached 85% of the applied normal stress, whichever was less.

The results of CDSS testing are summarized in **Table 4-5** below.

Table 4-5 – Summary of Lab Test Results: CDSS Testing of Foundation Silts

Boring No.	Depth (ft)	CSR	Vertical Consolidation Stress (psf)	Number of Load Cycles To Failure	Failure Mechanism
AECOM-B1	39-41	0.25[1]	4,275	4	Strain Criteria
AECOM-B2	56-58	0.15	4,950	17	Excess Pressure Criteria
	62-64	0.20	6,040	3	Strain Criteria
AECOM-B4	33-35	0.08	2,965	>50	Sample did not liquefy
	46-48	0.20	3,380	6	Excess Pressure Criteria
AECOM-B5	30-32	0.15	2,660	20	Excess Pressure Criteria

5 Slope Stability Analyses

Slope stability analyses were performed for varying loading conditions at selected cross-sections, as described in the following sub-sections. Analysis section development, soil material properties, and seismic analyses related to the slope stability analysis are also discussed in the following sub-sections.

5.1 Cross-Sections for Analysis

Five cross-sections were identified for the stability evaluation of the Ash Pond dam. The analysis sections were selected based on factors including the height and steepness of the downstream embankment slope and subsurface conditions in the foundation of the embankment as revealed by the borings. Taken together, the five analysis sections are considered to comprehensively represent the Ash Pond dam. Descriptions of each analysis cross-section are given below and the locations of the sections are shown on **Figure 3 (Appendix A).**

- **Cross-Section A:** This section was analyzed based on stratigraphy from borings B-210 with offset boring AECOM-B2) at the crest and B-215 (with offset boring AECOM-B5) on the bench.
- **Cross-Section B:** This section was analyzed based on stratigraphy from borings B-203 (with offset CPT sounding AECOM-C2) at the crest, B-205 (along with offsets AECOM-B4 and -C5) on the bench, and B-208 at the toe. The Foundation Silt layer featured most prominently within this cross-section. Additionally, this cross-section models the tallest height (vertical difference between crest of the embankment and the toe of the embankment fill) of the dam embankment.
- **Cross-Section C:** This section was analyzed based on stratigraphy from borings B-202 (with offset CPT sounding AECOM-C1) at the crest, B-206 (with offset CPT sounding AECOM-C4) on the bench, and B-207 at the toe. Additional borings in the vicinity of this cross-section (including B-217 and B-218), were also reviewed to assess continuity of various interbedded silt layers. The embankment is relatively tall at this section, similar to Section B.
- **Cross-Section D:** This section is representative of the southern end of the dam. The section southernmost was analyzed based on stratigraphy from borings B-201 (with offset boring AECOM-B1) at the crest and B-219 (along with offsets AECOM-B3 and -C3) on the bench.
- **Cross-Section E:** This section is representative of the northern end of the dam, where bedrock rises sharply in elevation and the groundwater level at and beyond the toe of the dam is higher than at other areas. The cross-section was analyzed based on stratigraphy from borings B-208 and B-209 at the crest and AECOM-B8 at the toe.

The topography for each analysis cross-section was determined based on specific ground surveys performed to support this project (for Cross-Section A thru D) or from the aerial basemapping shown on **Figure 3** of **Appendix A** (for Section E)**.** Stratigraphy was established from the subsurface information indicated by the borings and CPT soundings. The relevant CPT soundings and test borings that were used to develop subsurface stratigraphy at the five analysis sections are shown on the geologic sections shown in **Figure 3 (Appendix A)**.

5.2 Stability Analysis Conditions Considered

Consistent with the criteria provided in §257.73(e), the stability of the Ash Pond dam was evaluated for the following four load cases.

5.2.1 Static, Steady-State, Normal Pool Condition

This case models the embankment and connected buttress under static, long-term conditions, at normal water level within the impoundment. The CCR Rule requires a maximum storage pool factor of safety greater than or equal to 1.50.

5.2.2 Static, Maximum Surcharge Pool Condition

This case models the conditions under short-term surcharge pool conditions, with the water level in the pond corresponding to the anticipated level during the design flood condition (which is a 1,000 year recurrence interval flood event for this site). This condition requires a minimum Factor of Safety greater than or equal to 1.40.

5.2.3 Seismic Slope Stability Analysis

These analyses incorporate a horizontal seismic coefficient k_h selected to be representative of expected loading during the design earthquake event (i.e., a “pseudostatic” analysis). The design earthquake event is one with a 2% probability of exceedance in 50 years (approximately 2,500 year recurrence interval), as required by the CCR Rule. The seismic coefficient was selected on the basis of the results of the site-specific, Probabilistic Seismic Hazard Analysis (PSHA) and dynamic response analysis. The analyses utilized peak undrained strength parameters for soils that are not considered to be rapidly draining materials (including the dam embankment and buttress soils, silty clay foundation stratum, and silt foundation stratum). The phreatic surface and pore water pressures corresponding to the steady state pool from the static analyses were utilized. This condition requires a minimum Factor of Safety greater than or equal to 1.00.

5.2.4 Post-Liquefaction Condition

These analyses were performed at each stability cross-section where liquefaction triggering analysis indicates potential liquefaction of non-plastic materials or cyclic softening of fine-grained soils. The purpose of the post-liquefaction stability analysis is to assess stability conditions immediately following the design seismic event. No horizontal seismic coefficient is included in these analyses, but selection of strength parameters for the analyses takes into account the potential for the softening/weakening of the soils as a result of pore pressures generated in sand-like materials, or cyclic softening in clay-like materials due to the earthquake shaking. Liquefaction potential analysis was performed on the foundation silt deposits, using cyclic stress ratios (CSRs) determined from finite element dynamic response analysis, and cyclic resistance ratios (CRRs) determined from the results of cyclic direct simple shear testing. The liquefaction potential analysis is presented in **Appendix I**.

The CCR Rule requires a minimum Factor of Safety greater than or equal to 1.20 for the post-liquefaction slope stability analysis.

5.2.5 Sudden Drawdown of Adjacent Water Bodies

The Ash Pond dam is not adjacent to any external water bodies. Therefore, analysis of a sudden drawdown condition is not applicable.

5.3 Material Properties

Material properties for slope stability analyses were developed using both laboratory testing data (index and strength testing) and strength correlations from CPT and SPT data. Material strength parameter characterization used in the slope stability analyses for each of the pertinent strata are provided in **Table 5-1**. A detailed presentation of the calculations and interpretations related to the strength characterization is provided in **Appendix E**. Application of the material properties in the table to the specific stability analysis loading conditions is discussed in **Section 5.4**.

Table 5-1 – Material Properties For Slope Stability Analyses

Material	Unit Weight (pcf)	Effective (drained) Shear Strength Parameters		Total (undrained) Shear Strength Parameters		Post-Earthquake Shear Strength Parameters		
		c' (psf)	Φ' (°)	c (psf)	Φ (°)	c (psf)	Φ (°)	S_{ur} / σ'_{vc}
Embankment Fill	128	50	30	600	22	475	18	-
Foundation Silt	119	0	33	650	22	-	-	0.10
Foundation Clay	126	80	31	400	23	320	19	
Buttress Fill	123	45	27	540	20	425	16	-
Sluiced Ash	100	0	32	100	12	-	-	0.12
Bedrock	Assumed to be impenetrable in the slope stability models							

Peak effective and undrained strengths were selected based on interpretation of triaxial test data in accordance with the Modified Mohr-Coulomb plot (a p-q and p'-q plot) procedures, as described in Appendix D of the United States Corps of Engineers Manual EM-1110-2-1902 "Slope Stability." In analyzing the test results, a number of definitions of failure were considered, including the point of peak deviator stress during the test, the deviator stress corresponding to an axial strain of 12% and 15%, and the point of the test with the maximum effective principle stress ratio (obliquity) from the tabulated CU test data. For both effective and total strength conditions, defining the failure point to coincide with the deviator stress corresponding to 15% strain was selected to establish the shear strength parameters. P-Q plots are provided in **Appendix E**.

Liquefaction of the foundation silt deposit is predicted under the design earthquake. Steady-state strength was therefore estimated for use in the post-liquefaction stability analysis. The steady state strength was determined based on the empirical, SPT and CPT-based procedures given in "Soil Liquefaction During Earthquakes" by Idriss and Boulanger (2008), as presented in detail in **Appendix E**.

The embankment fill, buttress fill, and silty clay foundation soils are generally stiff to very stiff fine-grained materials. Static laboratory strength test results do not indicate significant post-peak softening in these materials,

which indicates low susceptibility to cyclic softening. However as a conservative interpretation, the strength of these soils was reduced for the post-liquefaction stability analyses. Specifically, the strength used for this condition corresponded to 80% of the peak undrained shear strength of the materials.

For impounded Coal Ash materials, strength properties were selected based on past experience and conservative engineering judgment. Furthermore, liquefaction was conservatively assumed by inspection, and steady-state strengths were also assigned based on conservative engineering judgment. It is noted that the impounded ash has little to no influence in the stability analyses.

Unit weight of the buttress fill was established based on review of the field compaction test data generated during its construction. The unit weight assigned in the models was the average of all tests performed. Strength testing of the buttress materials was not performed. The buttress fills are similar to the embankment fill materials in consistency and index properties and were placed and compacted using modern construction techniques. Strength of the buttress fill is therefore anticipated to be similar to the embankment. As a conservative assumption, strength parameters assigned to the buttress are approximately 90% of the strength of the embankment materials.

5.4 Methodology of Analyses

Limit equilibrium stability analysis was completed using the two-dimensional Slope/W computer program by Geo-Slope International. Factors of safety were calculated using Spencer's method and using iterative analyses of both circular and block failure surfaces to determine the critical failure surface for each analysis section and load case. Shallow finite slope failure surfaces or failure surfaces occurring at a depth less than 10 ft were not analyzed as they correspond to sloughing failure which can be addressed as part of regular maintenance. Critical surfaces with respect to dam safety were considered to be those which intersected the dam crest at or upstream of the centerline, which are considered to have the potential to create an immediate threat to dam safety. Pore pressures were assigned as hydrostatic pressure under the phreatic surface.

The earthen buttress that is present against the downstream slope is intended to stabilize the dam against earthquake-induced accelerations and liquefaction. The buttress works by gravity, adding stabilizing forces to the dam, which offset the effects of earthquake loading. A similar stabilizing effect is imparted under static conditions as well. The buttress and its effects on the dam are included in all the slope stability models.

A summary of the analyses is presented in the following sections. A more detailed discussion is provided in **Appendix F**.

5.4.1 Static Analysis Conditions

5.4.1.1 Pool Elevations

The static analysis conditions include the steady-state normal pool and maximum surcharge pool loading conditions. Static stability was evaluated for steady-state conditions using a maximum normal pool elevation of 444.0 ft, and a maximum pool surcharge elevation of 446.8 ft. The latter elevation corresponds to the anticipated water level in the pond during the IDF event, as identified in AECOM's *CCR Certification: Initial Inflow Design Flood Control System Plan* (October 2016).

5.4.1.2 Phreatic Surface

The phreatic surface used in the steady-state normal pool condition was established using the water levels in the piezometers installed near the centerline of the dam. Depths and elevations of free water as indicated in the borings and observations of water flow in the streams and ditches that lie to the west of the dam were also used to compare against the piezometer data for sections located away from the centerline (especially to estimate groundwater elevations in the far field beyond the toe of the dam). The water elevations were drawn into the stability models with straight line interpolation between the pool elevation and piezometer locations. AECOM reviewed the water elevations and cross-checked the interpolated phreatic surface with finite element seepage analysis using GeoStudio's SEEP/W software. Phreatic surfaces calculated in SEEP/W were in reasonable agreement with the straight-line interpolations from the available field groundwater measurements, but generally resulted in a lower phreatic level than the field measurements. Therefore, the straight-line interpolation was conservatively selected for the slope stability models.

For the maximum surcharge pool condition, the pool level in the pond was raised to the design flood level. The straight-line interpolation described above was adjusted accordingly to the raised water level. Therefore, the phreatic surface used for this loading condition corresponds to steady-state seepage to the raised pool level. This is a conservative representation, as the maximum storage pool water level is likely to be a short-term event and steady state seepage conditions through the dam are unlikely to develop.

5.4.1.3 Shear Strength Parameters

For the steady-state normal pool condition, drained (effective stress) shear strength parameters were used for all materials.

The change in water level from the normal pool case to the maximum surcharge pool condition is relatively small (less than 3 vertical ft). The small forcing effect created by this change is not expected to generate an undrained stress condition in the dam or its foundation. Therefore, drained (effective stress) shear strength parameters were used for all materials in the maximum surcharge pool condition as well.

5.4.2 Earthquake Analysis Conditions

A site specific seismic hazard assessment (PSHA) was performed to identify the earthquake loads at the site, and dynamic response analysis was performed to determine the appropriate seismic loads and material properties for the earthquake stability analysis load cases. Liquefaction triggering analyses were completed to assess the potential for liquefaction or cyclic softening of the materials and determine the appropriate material properties for use in the seismic and post-liquefaction slope stability loading conditions.

5.4.2.1 Probabilistic Seismic Hazard Analysis

The PSHA was completed for the Brown station to develop 2,500-year earthquake ground motions for use in liquefaction and dynamic response analyses of the facility. The PSHA results were used to compute a 2,500-yr return period Uniform Hazard Spectrum (UHS) for both hard rock (Class A rock, with shear wave velocity greater than 9,200 ft/s) and firm rock (Class B rock, with shear wave velocity between 2,500 and 9,200 ft/s). Parameters were developed including magnitude, distance, style of faulting, response spectra, and Arias Intensity. All seismically capable fault systems in the project region were considered, including the Illinois Basin Extended Basin Zone, New Madrid Seismic Zone which lies to the west and the Wabash Valley Seismic Zone.

Table 5-2 summarizes the UHS computed from the PSHA for the top of firm rock at the site, and **Table 5-3** summarizes modal magnitude and source distance which represent the highest contributor to the hazard for the design return period.

Table 5-2 – Uniform Hazard Response Spectrum For Firm Rock

Period	Spectral Acceleration (g)
0.01	0.53
0.02	0.96
0.03	1.16
0.04	1.21
0.10	1.02
0.20	0.68
0.40	0.40
1.0	0.14
2.0	0.07
3.0	0.041
4.0	0.028

Table 5-3 – Modal Earthquake Magnitude and Source Distance

Period	Modal Magnitude (M*)	Modal Source Distance (D*)
PGA	5.1	12.5 km
0.4 (bimodal)	7.1 7.6	12.5 km 238 km
1.0	7.6	238 km

Four sets of time histories were developed for each design spectrum. The time histories represent the site-specific ground motions associated with the controlling near-field or far-field earthquake event, and consider the magnitude, distance, and Arias Intensity. The site-specific acceleration time histories were then used in two-dimensional dynamic response analysis (see section below) to estimate site-specific seismic loads for liquefaction triggering and seismic (pseudo-static) stability analysis.

Details of the PSHA are included in **Appendix G**.

5.4.2.2 Dynamic Response Analysis

The dynamic response of the Ash Pond embankment was evaluated by analyzing Cross-Section B using the most recent version of the finite element program QUAD4M (Hudson et al. 1994). This is a modified version of the program QUAD4, originally developed by Idriss, et al. (1973). The dynamic response analysis was useful for more precisely estimating the amplification / attenuation characteristics of the dam structure and local foundation soils to the design ground motions at the top of firm rock and to estimate site-specific PGA values at the embankment crest for use in liquefaction triggering and seismic (pseudo-static) slope stability analysis. In addition, the dynamic response analysis was used to estimate the cyclic stress ratios (CSR) induced by the earthquake loading. Input to the dynamic response analyses includes the acceleration time histories developed as part of the PSHA for the station.

The QUAD4M program uses a two-dimensional, dynamic finite-element formulation that utilizes equivalent-linear, strain-dependent modulus and damping properties. The program performs a time-domain analysis that allows variable damping throughout the model, and uses an iterative process to approximate the nonlinear behavior of soil. Shear moduli and damping ratios are estimated initially for each element in the model, and the system is analyzed using those properties. After each iteration, values of the effective shear strain are computed and the modulus and damping values are updated to correspond to the computed strain level for each element. The analysis iterations are repeated until compatibility between moduli, damping, and strain levels is achieved in all elements.

Based on the dynamic response analyses at Section B, the calculated site-specific PGA values for a 2,500-year event were approximately 0.53g at the embankment crest, and CSRs in the foundation silt deposit ranged from 0.11 to 0.27. These values were used to define the earthquake loading for the liquefaction triggering analysis and pseudostatic stability analysis for all five analysis cross-sections.

Details of the dynamic response analysis are included in **Appendix H**.

5.4.2.3 Seismic Coefficient

The seismic coefficient, k_h, was calculated for use in the seismic loading condition slope stability analysis based on the simplified procedure developed by Makdisi and Seed (1978) and using the site-specific acceleration at the crest of the dam from the dynamic response analysis. For the site-specific value of PGA at the embankment crest of 0.53g and the full-height critical slip surfaces that were identified in the stability analysis (presented in **Appendix F**), a seismic coefficient of 0.18g was used in the pseudo-static analysis.

5.4.2.4 Liquefaction Triggering Analysis

Liquefaction triggering analysis was used to evaluate the potential for liquefaction of the foundation silt deposit under the 2,500-year event. Liquefaction triggering evaluations were performed using two methods:

1. An empirical SPT-based Procedure

2. A laboratory-based procedure, in which the cyclic resistance is established on the basis of laboratory cyclic direct simple shear testing.

The SPT- based liquefaction triggering analyses were performed using the procedure proposed by Idriss and Boulanger (2008, 2014). The procedure considers a stress-based approach to evaluate the potential for liquefaction triggering, and compares calculated earthquake-induced cyclic stress ratios (CSRs) with the

estimated cyclic resistance ratios (CRRs) of the soil to establish the factor of safety against liquefaction triggering. CSRs used as input to this analysis were based on the results of the site-specific dynamic response analyses. Within the method, CRRs are a function of the soil's fines content (FC), relative density and effective stress, and penetration resistance (SPT). The CRR is also dependent on the duration of shaking, and is adjusted to the site-specific design earthquake using a Magnitude Scaling Factor (MSF). Fines content, density, and other material parameters used as input to the analysis were based on the laboratory test data obtained as part of this project. The magnitude of the design earthquake was input as M 7.1, based on the modal results from the site-specific PSHA.

In the laboratory-based procedure, the calculated cyclic stress ratios (CSRs) from the dynamic response analysis were compared to cyclic resistance ratios (CRRs), established from interpretation of the cyclic direct simple shear testing performed on representative silt samples.

In both procedures, the ratio of CRR to CSR is the triggering factor of safety. For calculated triggering factors of safety less than 1.20, the material was considered to be potentially liquefiable.

Details of the liquefaction triggering analysis are provided in **Appendix I.**

5.4.2.5 Pool Elevations and Phreatic Surface

Pool elevation in the pond and the phreatic surface for both the seismic and post-liquefaction loading conditions were the same as utilized in the steady-state normal pool loading condition.

5.4.2.6 Shear Strength Parameters

All soil strata at the site are considered to be fine-grained materials which are not expected to rapidly drain as a result of seismic shaking. Therefore, peak undrained strength parameters (as summarized in **Table 5-1**) were utilized in the slope stability analyses of the seismic loading condition. As this condition incorporates a horizontal seismic coefficient, liquefied strengths are not pertinent to the analysis and were not utilized.

The post-liquefaction loading case represents conditions following the design earthquake, and no horizontal seismic coefficient is incorporated. As described in **Section 6.2.1** below and further presented in **Appendix I,** liquefaction of the foundation silt deposit is predicted as a result of the design earthquake. Therefore, steady-state (liquefied) strength was assigned to this stratum in the slope stability analysis of the post-liquefaction loading condition. The steady-state strength was estimated based on correlations with SPT and CPT-resistance and methodologies presented in Idriss and Boulanger (2008, 2014), as described in **Appendix E**. The resulting strength is presented in **Table 5-1**.

Liquefaction of the sluiced ash impounded by the dam has been assumed by inspection herein. Steady-state strength of this deposit (as given in **Table 5-1**) was therefore also assumed in the post-liquefaction loading condition analysis.

The embankment fill, buttress fill, and silty clay foundation soils are generally stiff to very stiff fine-grained materials. Static laboratory strength test results do not indicate significant post-peak softening in these materials, which indicates low susceptibility to cyclic softening. However as a conservative interpretation, the strength of these soils was reduced for the post-liquefaction stability analyses. Specifically, the strength used for this condition corresponded to 80% of the peak undrained shear strength of the materials, as established through laboratory testing.

6 Results

Regulatory Citation: 40 CFR §257.73 (e); Periodic safety factor assessments. (1) The owner or operator must conduct an initial and periodic safety factor assessments for each CCR unit and document whether the calculated factors of safety for each CCR unit achieve the minim safety factors specified in paragraphs (e)(1)(i) through (iv) of this section for the critical cross-section of the embankment..

6.1 Results of Static Stability Analyses

Regulatory Citation: 40 CFR §257.73 (e)(1);

- *(i) The calculated static factor of safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50.*
- *(ii) The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.*

The results of the limit equilibrium slope stability analyses for the static load cases are summarized in **Table 6-1**. The Slope/W output figures showing the critical slip surfaces and details of the analyses are included in **Appendix F**.

Table 6-1 – Summary of Minimum Slope Stability Factors of Safety for Static Load Cases

Load Case	Criteria	Cross-Section A	Cross-Section B	Cross-Section C	Cross-Section D	Cross-Section E
Steady State (Normal Pool)	FS ≥ 1.50	3.43	3.42	3.21	3.32	3.36
Max Surcharge Pool (Flood Pool)	FS ≥ 1.40	3.33	3.32	3.06	3.22	3.36

The calculated factors of safety at all analysis sections are greater than the minimum values required in §257.73 (e)(i) and (ii), thereby satisfying the regulatory requirement.

6.2 Results of Earthquake Stability Analyses

Regulatory Citation: 40 CFR §257.73 (e)(1);

- *(iii) The calculated seismic factor of safety must equal or exceed 1.00.*
- *(iv) For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.*

6.2.1 Liquefaction Triggering Analysis

The liquefaction triggering analyses using the SPT-based procedure results in factors of safety against liquefaction in the silt deposit that are consistently below 1.20 (with a majority of the results being less than 1.0). Furthermore, the laboratory-based analysis procedure predicts that liquefaction of the silt deposit will occur in seven to nine cycles of the equivalent reference loading corresponding to the design earthquake. For the M 7.1 design earthquake being considered herein, the estimated cycles of equivalent loading is approximately 12. These results are presented in detail in **Appendix I**.

The results of both triggering analysis procedures are consistent and indicate that liquefaction of the silt deposit is likely as a result of the design earthquake event. As a result of this conclusion, steady-state (liquefied) strength was assigned to this stratum in the slope stability analysis of the post-liquefaction loading condition.

6.2.2 Slope Stability Analysis

The results of the slope stability analyses for the seismic load cases are summarized in **Table 6-2**. The Slope/W output figures showing the critical slip surfaces and details of the analyses are included in **Appendix F**.

Table 6-2 – Summary of Minimum Slope Stability Factors of Safety for Earthquake Load Cases

Load Case	Program Criteria	Cross-Section A	Cross-Section B	Cross-Section C	Cross-Section D	Cross-Section E
Seismic (Pseudostatic)	FS ≥ 1.00	1.51	1.56	1.32	1.49	1.56
Post-Liquefaction	FS ≥ 1.20	1.23	1.25	1.32	1.25	1.32

The calculated factors of safety at all analysis sections are greater than the minimum values required in §257.73 (e)(iii) and (iv), satisfying the regulatory requirement.

6.3 Critical Cross-Sections

CCR Rule §257.73 (e) requires identification of a critical cross-section to represent the impoundment. As presented herein, five cross-sections of the dam have been evaluated, to provide a thorough evaluation of the stratigraphic and topographic conditions across the structure. As such, the resulting factors of safety for each loading condition considered vary between cross-sections and certain sections are critical. Herein, the critical cross-section for any given load case has been interpreted as that section which has the lowest factor of safety for that particular load case. **Table 6-3** below summarizes the critical cross-section and corresponding factor of safety for each load case. The factors of safety presented in this table correspond to the values being certified in this document.

Table 6-3 – Summary of Critical Cross-Section and Factors of Safety For Stability Analysis Loading Conditions

Load Case	Critical Cross-Section	Minimum Factor of Safety
Steady State (Normal Pool)	Section C	3.21
Max Surcharge Pool (Flood Pool)	Section C	3.06
Seismic (Pseudostatic)	Section C	1.32
Post-Liquefaction	Section A	1.23

7 Conclusions

The calculated factors of safety from the limit equilibrium slope stability analysis satisfy the CCR Rule §257.73 (e) requirements for all the load cases analyzed at the critical analysis sections for the Brown Ash Pond dam embankment. Load cases analyzed for this study included static (steady-state) normal pool, maximum flood surcharge pool, seismic (pseudo-static), and static post-liquefaction.

8 Certification

This Certification Statement documents that the Ash Pond at the A.B. Brown Generating Station meets the Safety Factor Assessment requirements specified in 40 CFR §257.73 (e). The Ash Pond is an existing CCR surface impoundment as defined by 40 CFR §257.53. The CCR Rule requires that the Safety Factor Assessment for an existing CCR surface impoundment be prepared by October 17, 2016.

CCR Unit: Southern Indiana Gas & Electric Company; A.B. Brown Generating Station; Ash Pond

I, Vikram K. Gautam, being a Registered Professional Engineer in good standing in the State of Indiana, do hereby certify, to the best of my knowledge, information, and belief that the information contained in this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above referenced CCR Unit, that the Safety Factor Assessment dated October 13, 2016 meets the requirements of 40 CFR § 257.73 (e).

Vikram K. Gautam
Printed Name

10/13/16
Date

9 Limitations

Background information, design basis, and other data have been furnished to AECOM by SIGECO. AECOM has used this data in preparing this report. AECOM has relied on this information as furnished, and is not responsible for the accuracy of this information. Our recommendations are based on available information from previous and current investigations. These recommendations may be updated as future investigations are performed.

Borings have been spaced as closely as economically feasible, but variations in soil properties between borings, that may become evident at a later date, are possible. The conclusions developed in this report are based on the assumption that the subsurface soil, rock, and groundwater conditions do not deviate appreciably from those encountered in the site-specific exploratory borings. If any variations or undesirable conditions are encountered in any future exploration, we should be notified so that additional analyses can be made, if necessary.

The conclusions presented in this report are intended only for the purpose, site location, and project indicated. The recommendations presented in this report should not be used for other projects or purposes. Conclusions or recommendations made from these data by others are their responsibility. The conclusions and recommendations are based on AECOM's understanding of current plant operations, maintenance, stormwater handling, and ash handling procedures at the station, as provided by SIGECO. Changes in any of these operations or procedures may invalidate the findings in this report until AECOM has had the opportunity to review the findings, and revise the report if necessary.

This geotechnical investigation was performed in accordance with the standard of care commonly used as state-of-practice in our profession. Specifically, our services have been performed in accordance with accepted principles and practices of the geological and geotechnical engineering profession. The conclusions presented in this report are professional opinions based on the indicated project criteria and data available at the time this report was prepared. Our services were provided in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation is intended.

10 References

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Appendix A
Figures

Figure 1 – Site Location Map

Figure 2 – Site Map

Figure 3 – Geotechnical Cross-Section Plan

AECOM
9400 Amberglen Boulevard
Austin, TX 78729-1100
512-454-4797 (phone)
512-454-8807 (fax)

SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
dba VECTREN POWER SUPPLY, INC.

One Vectren Square
Evansville, IN 47708
1-800-227-1376 (phone)

A.B. BROWN
GENERATING STATION
MT. VERNON, IN

CCR CERTIFICATION
ASH POND

ISSUED FOR CERTIFICATION

ISSUED FOR BIDDING	DATE	BY
ISSUED FOR CONSTRUCTION	DATE	BY

REVISIONS

NO.	DESCRIPTION	DATE
△		
△		
△		
△		
△		

AECOM PROJECT NO:	60442676
DRAWN BY:	MJC
DESIGNED BY:	MJC
CHECKED BY:	TLE
DATE CREATED:	
PLOT DATE:	4/22/2016
SCALE:	AS SHOWN
ACAD VER:	2014

SHEET TITLE

LOCATION MAP

FIGURE 1

AECOM DRAWING PATH: P:\Projects\Environmental\60442676_VectrenCCR\7.0_CAD_GIS\7.04_Plan_Sheets\BROWN-LOCATION MAP.dwg
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AECOM
9400 Amberglen Boulevard
Austin, TX 78729-1100
512-454-4797 (phone)
512-454-8807 (fax)

SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
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ISSUED FOR BIDDING — DATE BY

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REVISIONS

NO.	DESCRIPTION	DATE
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AECOM PROJECT NO:	60442676
DRAWN BY:	MJC
DESIGNED BY:	MJC
CHECKED BY:	TLE
DATE CREATED:	
PLOT DATE:	4/22/2016
SCALE:	AS SHOWN
ACAD VER:	2014

SHEET TITLE

SITE MAP

FIGURE 2

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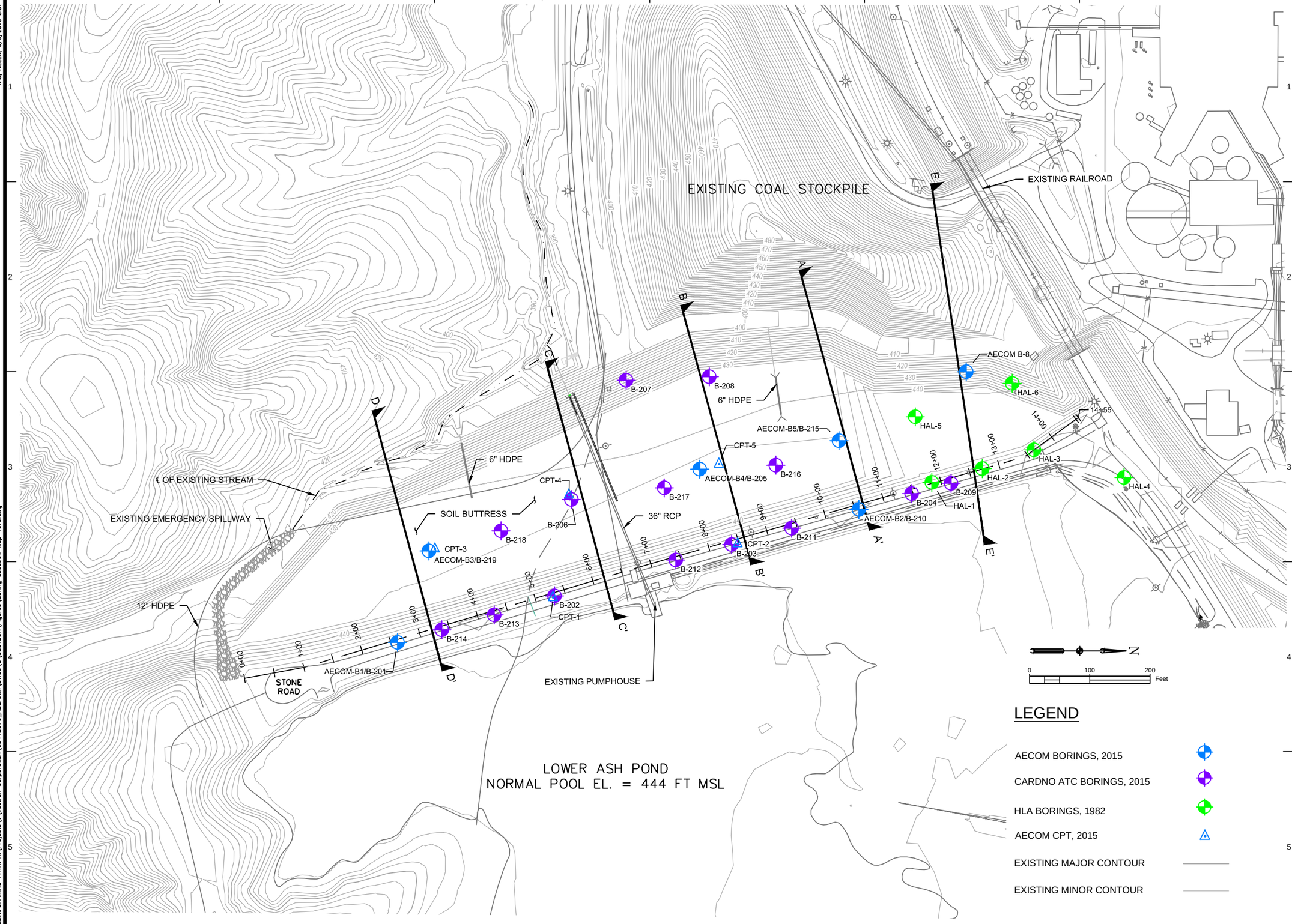
AECOM DRAWING PATH: P:\Projects\Environmental\60442676_VectrenCCR\7.0_CAD_GIS\7.04_Plan_Sheets\BROWN-SITE MAP.dwg



AECOM
1300 E. 9TH STREET
SUITE 500
CLEVELAND, OH
216-622-2300 (PHONE)

VECTREN
Live Smart
P.O.BOX 209
EVANSVILLE, IN 47702
1-800-227-1376

A.B. BROWN
GENERATING STATION
POSEY COUNTY, IN

ISSUED FOR BIDDING — DATE BY

ISSUED FOR CONSTRUCTION — DATE BY

REVISIONS

NO.	DESCRIPTION	DATE

AECOM PROJECT NO:	60442676
DRAWN BY:	ACI
DESIGNED BY:	ACI
CHECKED BY:	VKG
DATE CREATED:	9/9/2016
PLOT DATE:	9/9/2016
SCALE:	AS SHOWN
ACAD VER:	AUTOCAD CIVIL 3D 2016

SHEET TITLE

FIGURE 3 -
GEOTECHNICAL
CROSS-SECTION PLAN

AECOM DRAWING PATH: K:\Projects\V\Vectren Corporation\60442676_ABBrown\DWGs\C\GEOTECH\Figures\Boring Location Map-rev0.dwg
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Appendix B
Boring Logs

Project: A.B. Brown Ash Pond Lower Dam Evaluation

Project Location: Posey County, Indiana

Project Number: 60442676

Log of Boring AECOM-B1

Date(s) Drilled	10/09/2015 12:00 AM to 10/12/2015 12:00 AM	Logged By	M. Jones	Checked By	V. Gautam
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	3.25" I.D. HSA	Borehole Depth	51.0 ft
Drill Rig Type	GeoProbe 8040DT	Drilling Contractor	Cardno ATC	Surface Elevation	451.3 ft NAVD88
Borehole Backfill	Grout	Sampling Method(s)	18" Split Spoon 2" ID, 30" Shelby Tube 3" ID	Hammer Data	Auto-Hammer, 81% efficiency
Boring Location	Adjacent to B-201 (ft NAD83)	Groundwater Level(s)	37 ft on 4/17/2015		

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
451.3	0.0						Refer to Cardno ATC boring log B-201 for complete description and approximate depths of materials, stratigraphy, and groundwater levels. Blank drilling conducted between sample intervals.								
435.8	15.5	SS-1		5 4 6	100		Stiff, moist, orange to reddish brown with gray, silty, low plasticity, lean CLAY (CL) [FILL]								
		ST-1			42			18.0	126.0						
		ST-1A			92			17.0	131.0	33	16				*Passing No. 200 Sieve = 95.4%*
425.8	25.5	SS-2		2 4 6	100		Stiff, moist, reddish to orange brown with some gray, silty, low to moderate plasticity, lean CLAY (CL) [FILL]								
		ST-2			100			16.3	129.0	29	4				*Passing No. 200 Sieve = 97.9%*

Report: GEO_SOIL; File C:\USERS\MESIS\DESKTOP\VECTREN\AB BROWN BORING LOGS.GPJ; 9/12/2016 11:56:39 AM

AECOM

Project: A.B. Brown Ash Pond Lower Dam Evaluation

Project Location: Posey County, Indiana

Project Number: 60442676

Log of Boring AECOM-B1

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
420	30														
415	35														
							413.8 / 37.5								
		SS-3		WH WH WH	100		Very soft, wet, brown, SILT (ML) [ALLUVIUM]								
410	40	ST-3			100			27.5		NP	NP				*Passing No. 200 Sieve = 99.6%*
							408.8 / 42.5								
		SS-4		1 2 1	100		Soft, wet, brown with occasional gray lenses, SILT (ML) [ALLUVIUM]								
405	45	ST-4			100			26.5	124.0						*Passing No. 200 Sieve = 99.6%*
							403.8 / 47.5								
		SS-5		WH WH WH	100		Very soft, wet, gray, SILT (ML) [ALLUVIUM]								
400	50	ST-5			100		-Material recovered in ST-5 appeared more clayey than SPT-5	26.8	123.0						
							400.3 / 51.0								
							End of Boring at 51 ft								
395	55														
390	60														
	65														

Report: GEO_SOIL; File C:\USERS\MES\S\DESKTOP\VECTREN\AB BROWN BORING LOGS.GPJ; 9/12/2016 11:56:39 AM

Project: A.B. Brown Ash Pond Lower Dam Evaluation

Project Location: Posey County, Indiana

Project Number: 60442676

Log of Boring AECOM-B2

Date(s) Drilled	10/12/2015 12:00 AM to 10/12/2015 12:00 AM	Logged By	M. Jones	Checked By	V. Gautam
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	3.25" I.D. HSA	Borehole Depth	77.7 ft
Drill Rig Type	GeoProbe 8040DT	Drilling Contractor	Cardno ATC	Surface Elevation	451.2 ft NAVD88
Borehole Backfill	Grout	Sampling Method(s)	18" Split Spoon 2" ID, 30" Shelby Tube 3" ID	Hammer Data	Auto-Hammer, 81% efficiency
Boring Location	Adjacent to B-210 (ft NAD83)	Groundwater Level(s)	54.5 ft on 7/1/2015		

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
	0						451.2 / 0.0								
450							Refer to Cardno ATC boring log B-210 for complete description and depths of materials, stratigraphy, and groundwater levels. Blank drilling conducted between sample intervals.								
	5														
445															
	10														
440															
	15														
435															
	20														
430															
	25														
425															
							422.7 / 28.5								
			1	5 9 12	100		Very Stiff, moist, brown and orange brown, silty, low plasticity, lean CLAY (CL) [FILL]								
	30														

Report: GEO_SOIL; File C:\USERS\MES\S\DESKTOP\VECTREN\AB BROWN BORING LOGS.GPJ; 9/12/2016 11:56:44 AM

Project: A.B. Brown Ash Pond Lower Dam Evaluation

Project Location: Posey County, Indiana

Project Number: 60442676

Log of Boring AECOM-B2

Elevation (feet)	Depth (feet)	Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
420	30		1		92			17.9	127.0						*Passing No. 200 Sieve = 79.6%*
415	35														
410	40														
405	45						404.7 / 46.5								
			2	6 7 10	100		Very Stiff, moist, brown, silty, low plasticity, lean CLAY (CL) [FILL]								
			2		88			15.2	128.0						*Passing No. 200 Sieve = 63.7%*
400	50														
							396.7 / 54.5								
	55		3	3 6 7	100		Stiff, moist, brown and orange brown with gray, clayey SILT (ML) [ALLUVIUM]								
395			3		92			25.0		NP	NP				*Passing No. 200 Sieve = 99.1%*
							392.7 / 58.5								
			4	4 4 5	100		Stiff, wet, gray and orange brown, SILT (ML) [ALLUVIUM]								
390	60		4		54			25.9	124.0						
			4A		100			24.7							*Passing No. 200 Sieve = 99.7%*
	65														

Report: GEO_SOIL; File C:\USERS\MES\S\DESKTOP\VECTREN\AB BROWN BORING LOGS.GPJ; 9/12/2016 11:56:44 AM

Project: A.B. Brown Ash Pond Lower Dam Evaluation

Project Location: Posey County, Indiana

Project Number: 60442676

Log of Boring AECOM-B2

Elevation (feet)	Depth (feet)	Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
385							384.7 / 66.5								
			5	2 3 4	100		Medium stiff, moist to wet, brown, clayey SILT (ML) [ALLUVIUM]								
			5		92										
	70														
380							379.7 / 71.5								
			6	5 6 9	100		Very Stiff, moist with occasional wet silty zones, orange brown and gray, silty CLAY (CL) [ALLUVIUM]								
							377.7 / 73.5								
			7	7 9 11	100		-trace fine sand								
	75														
375							373.7 / 77.5								
			8	50/0.2'	100		373.5 / 77.7 Highly weathered SILTSTONE, grayish brown								
							End of Boring at 77.7 ft								
	80														
370															
	85														
365															
	90														
360															
	95														
355															
	100														

Report: GEO_SOIL; File C:\USERS\MESIS\DESKTOP\VECTREN\AB BROWN BORING LOGS.GPJ; 9/12/2016 11:56:44 AM

Project: A.B. Brown Ash Pond Lower Dam Evaluation

Project Location: Posey County, Indiana

Project Number: 60442676

Log of Boring AECOM-B3

Date(s) Drilled	10/08/2015 12:00 AM to 10/08/2015 12:00 AM	Logged By	M. Jones	Checked By	V. Gautam
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	3.25" I.D. HSA	Borehole Depth	40.0 ft
Drill Rig Type	GeoProbe 8040DT	Drilling Contractor	Cardno ATC	Surface Elevation	417.9 ft NAVD88
Borehole Backfill	Grout	Sampling Method(s)	18" Split Spoon 2" ID, 30"	Hammer Data	Auto-Hammer, 81% efficiency
Boring Location	Adjacent to B-219 (ft NAD83)	Groundwater Level(s)	6.9 ft on 7/13/2015		

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
	0						417.9 / 0.0								
415							Refer to Cardno ATC boring log B-219 for complete description and approximate depths of materials, stratigraphy, and groundwater levels. Blank drilling conducted between sample intervals.								
	5														
							411.4 / 6.5								
410			1	7 5 6	100		Stiff, wet, grayish brown and orange brown, SILT (ML) [ALLUVIUM]								
			1		100			30.6	115.0						
	10														3" SPT sampler used from 10' to 12'
							406.4 / 11.5								
405			2	1 WH 1	100		Very soft, wet, brown, SILT (ML) [ALLUVIUM]								
			2		0										3" SPT sampler used from 14' to 16'
	15														
400			2A		88										
	20														
395															
	25														
							391.4 / 26.5								
390			3	1 2 4	100		Medium stiff, moist to wet, gray, silty, low plasticity, lean CLAY (CL) [ALLUVIUM]								
			3		100			21.2	127.0						
	30														

Report: GEO_SOIL; File C:\USERS\MES\S\DESKTOP\VECTREN\AB BROWN BORING LOGS.GPJ; 9/12/2016 11:56:51 AM

Project: A.B. Brown Ash Pond Lower Dam Evaluation

Project Location: Posey County, Indiana

Project Number: 60442676

Log of Boring AECOM-B3

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
	30														
385															
	35														
							381.4 / 36.5								
			4	3 4 4	100		Stiff, moist, orange brown with some grayish brown, silty, low plasticity, lean CLAY (CL) [ALLUVIUM]								
380															
			4		92										
	40						377.9 / 40.0								
							End of Boring at 40 ft								
375															
	45														
370															
	50														
365															
	55														
360															
	60														
355															
	65														

Report: GEO_SOIL; File C:\USERS\MES\S\DESKTOP\VECTREN\AB BROWN BORING LOGS.GPJ; 9/12/2016 11:56:51 AM

Project: A.B. Brown Ash Pond Lower Dam Evaluation

Project Location: Posey County, Indiana

Project Number: 60442676

Log of Boring AECOM-B4

Date(s) Drilled	10/08/2015 12:00 AM to 10/08/2015 12:00 AM	Logged By	M. Jones	Checked By	V. Gautam
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	3.25" I.D. HSA	Borehole Depth	57.0 ft
Drill Rig Type	GeoProbe 8040DT	Drilling Contractor	Cardno ATC	Surface Elevation	416.1 ft NAVD88
Borehole Backfill	Grout	Sampling Method(s)	18" Split Spoon 2" ID, 30" Shelby Tube 3" ID	Hammer Data	Auto-Hammer, 81% efficiency
Boring Location	Adjacent to B-205 (ft NAD83)	Groundwater Level(s)	45 ft on 4/16/2015		

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
416.1	0.0						Refer to Cardno ATC boring log B-205 for complete description and approximate depths of materials, stratigraphy, and groundwater levels. Blank drilling conducted between sample intervals.								
							Fine gravel and medium grained sand observed in cuttings from approximately 5 to 10 feet (apparent blanket drain material)								
405.6	10.5						Stiff, moist, reddish brown, silty, low plasticity, lean CLAY (CL) [FILL]								
			1	4 4 5	100										
			1		75			16.4	128.0						*Passing No. 200 Sieve = 82.9%*

Report: GEO_SOIL; File C:\USERS\MES\S\DESKTOP\VECTREN\AB BROWN BORING LOGS.GPJ; 9/12/2016 11:56:56 AM

AECOM

Project: A.B. Brown Ash Pond Lower Dam Evaluation

Project Location: Posey County, Indiana

Project Number: 60442676

Log of Boring AECOM-B4

Elevation (feet)	Depth (feet)	Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
385	30						384.6 / 31.5 Soft, moist, gray and orange brown, SILT (ML), trace organics [ALLUVIUM]								
			2	2 2 2	100										
			2		100			38.4	115.0	31	2				*Passing No. 200 Sieve = 99.7%*
380	35														
375	40														
							371.6 / 44.5								
370	45		3	2 2 3	100		Medium Stiff, moist to wet, gray, SILT (ML), trace organics [ALLUVIUM]								
			3		100			26.8	124.0						*Passing No. 200 Sieve = 99.9%*
365	50														
							362.6 / 53.5								
			4	WH WH 4	100		Soft, moist, gray and bluish gray, low plasticity, silty CLAY (CL) [ALLUVIUM]								
360	55		4		100										
							359.1 / 57.0 End of Boring at 57 ft								
355	60														
	65														

Report: GEO_SOIL; File C:\USERS\MES\S\DESKTOP\VECTREN\AB BROWN BORING LOGS.GPJ; 9/12/2016 11:56:56 AM

Project: A.B. Brown Ash Pond Lower Dam Evaluation

Project Location: Posey County, Indiana

Project Number: 60442676

Log of Boring AECOM-B5

Date(s) Drilled	10/08/2015 12:00 AM to 10/09/2015 12:00 AM	Logged By	M. Jones	Checked By	V. Gautam
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	3.25" I.D. HSA	Borehole Depth	39.0 ft
Drill Rig Type	GeoProbe 8040DT	Drilling Contractor	Cardno ATC	Surface Elevation	416.4 ft NAVD88
Borehole Backfill	Grout	Sampling Method(s)	18" Split Spoon 2" ID, 30" Shelby Tube 3" ID	Hammer Data	Auto-Hammer, 81% efficiency
Boring Location	Adjacent to B-215 (ft NAD83)	Groundwater Level(s)	6.5 ft on 7/16/2015		

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
416.4	0.0														
415							Refer to Cardno ATC boring log B-215 for complete description and approximate depths of materials and stratigraphy. Blank drilling conducted between sample intervals.								
413.4	3.0														
410	5						Fine gravel and medium grained sand observed in cuttings from approximately 3 to 6.5 feet (apparent blanket drain material; jar sample retained)								
407.9	8.5														
			1	4 7 12	100		Very stiff, moist, yellowish brown with gray, silty, low plasticity, lean CLAY (CL) [FILL]								
405	10		1		100										
400	15														
395	20														
390	25														
387.9	28.5														
			2	2 3 2	100		Medium stiff, moist to wet, gray with some yellowish brown, SILT (ML) [ALLUVIUM]								
	30														

Report: GEO_SOIL; File C:\USERS\MES\S\DESKTOP\VECTREN\AB BROWN BORING LOGS.GPJ; 9/12/2016 11:57:01 AM

Project: A.B. Brown Ash Pond Lower Dam Evaluation

Project Location: Posey County, Indiana

Project Number: 60442676

Log of Boring AECOM-B5

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
	30		2		100			33.8							*Passing No. 200 Sieve = 71.2%*
385															
	35						380.9 / 35.5								
380			3	1 WH WH	100		Very soft, wet, gray, SILT (ML), trace fine sand and organics [ALLUVIUM]	49.8	106.0						
			3		88		377.4 / 39.0								
							End of Boring at 39 ft								
	40														
375															
	45														
370															
	50														
365															
	55														
360															
	60														
355															
	65														

Report: GEO_SOIL; File C:\USERS\MESIS\DESKTOP\VECTREN\AB BROWN BORING LOGS.GPJ; 9/12/2016 11:57:01 AM

Project: A.B. Brown Ash Pond Lower Dam Evaluation

Project Location: Posey County, Indiana

Project Number: 60442676

Log of Boring AECOM-B8

Date(s) Drilled	01/27/2016 12:00 AM to 01/27/2016 12:00 AM	Logged By	C. Siegel	Checked By	V. Gautam
Drilling Method	Hollow Stem Auger	Drill Bit Size/Type	3.25" I.D. HSA	Borehole Depth	26.3 ft
Drill Rig Type	Mobile B53 ATV	Drilling Contractor	Cardno ATC	Surface Elevation	427.7 ft NAVD88
Borehole Backfill	Grout	Sampling Method(s)	24" Split Spoon 2" ID	Hammer Data	
Boring Location	N 968016.65 E 2770903.02 (ft NAD83)	Groundwater Level(s)	16 ft on 1/27/2016		

Elevation (feet)	Depth (feet)	SAMPLES Type	Number	Sampling Resist. OR Core RQD (%)	Recovery (%)	Graphic Symbol	MATERIAL DESCRIPTION (Elevation (feet) / Depth (feet))	Natural Moisture Content (%)	Total Unit Weight (pcf)	Liquid Limit	Plasticity Index	Pocket Pen. Su (ksf)	Torvane Su (ksf)	TXUU (ksf)	REMARKS
	0						427.7 / 0.0 Medium dense, moist, brown, SILT (ML), with clay, trace coal fragments and vegetation [FILL]								
							426.7 / 1.0 Medium dense, moist, brown SILT (ML), with clay [ALLUVIUM]								
425		SS-1		9 12 15 15	75										
	5	SS-2		8 10 8 6	83										
		SS-3		2 1 1 2	83		becomes very loose and wet								
420															
	10	SS-4		2 1 2 2	86										
							416.7 / 11.0 Very loose, wet, brown CLAY-SILT (CL-ML) [ALLUVIUM]								
415		SS-5		2 1 2 3	100										
							414.7 / 13.0 Medium stiff, moist, brown CLAY (CL) with silt and occasional weathered silt partings [ALLUVIUM]								
	15	SS-6		4 3 3 5	100										
		SS-7		2 2 2 3	83		encountered water at 16-ft								
410															
	20	SS-8		3 3 4 4	83		becomes stiff								
		SS-9		4 5 5 6	100										
405															
	25	SS-10		4 5 6 8	100										
							401.7 / 26.0								
		SS-11		50/0.2'	17		401.4 / 26.3 SHALE highly weathered								
							End of Boring at 26.3 ft								
400															
	30														

AECOM

Report: GEO_SOIL; File C:\USERS\MESIS\DESKTOP\VECTREN\AB BROWN BORING LOGS.GPJ; 9/12/2016 11:57:06 AM

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TEST BORING LOG

CLIENT: **Vectren Corporation**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
PROJECT LOCATION: **A.B. Brown Generating Facility**, **Posey County, Indiana**

BORING #: **B-201**
JOB #: **170GC00108**

DRILLING and SAMPLING INFORMATION

Date Started	4/16/15	Hammer Wt.	140	lbs.
Date Completed	4/17/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 450.3	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Reddish brown, slightly moist, silty clay (EMBANKMENT FILL)				1	SS			13-6-6			Boring coordinates and ground surface elevation surveyed by Three I Design.
			5	2	SS			7-10-10	15.2	2.5	**Sample No. SS-2:** Atterberg limits: LL=29, PL=22, PI=7 Passing No. 200 sieve = 99.4%
				3	SS			13-15-15	18.1		
	441.3	9.0		4	SS			8-9-8			
Reddish brown, slightly moist, fine sand (EMBANKMENT FILL)	439.8	10.5	10								
Reddish brown and gray, slightly moist, silty clay (EMBANKMENT FILL)	437.3	13.0		5	SS			10-12-14	15.6	2.5	Borehole backfilled with cement/bentonite grout.
Reddish brown, slightly moist, fine sand (EMBANKMENT FILL)	434.8	15.5	15	6	SS			4-5-5			
Reddish brown, moist, silty clay (EMBANKMENT FILL)				7	SS			9-9-11	14.5		**Sample No. SS-7:** Atterberg limits: LL=30, PL=19, PI=11 Passing No. 200 sieve = 96.8%
	429.8	20.5	20	8	SS			3-3-4	22.1		
Brown and gray, slightly moist, clayey silt (EMBANKMENT FILL)				9	SS			9-12-12	17.0		
			25	10	SS			5-7-8	16.1	2.5	
				11	SS			11-16-16	15.5		**Sample No. SS-11:** Atterberg limits: LL=29, PL=21, PI=8 Passing No. 200 sieve = 97.4%
			30	12	SS			6-9-11	16.7		
				13	SS			8-15-14	16.1		
			35	14	SS			9-8-8	23.4	3.0	
	413.3	37.0		15	SS		●	11-11-10	24.3		
Brown, wet, soft to medium stiff, SILT (ML)				16	SS			2-2-2	31.3		

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 37.0 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: Vectren Corporation
PROJECT NAME: Ash Pond Safety Factor Assessment
PROJECT LOCATION: A.B. Brown Generating Facility, Posey County, Indiana
BORING #: B-201
JOB #: 170GC00108

DRILLING and SAMPLING INFORMATION

Date Started	4/16/15	Hammer Wt.	140	lbs.
Date Completed	4/17/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Brown, wet, soft to medium stiff, SILT (ML)				17	SS			3-3-3	26.7		
			45	18	SS			2-2-3	29.0		**Sample No. SS-18:** Atterberg limits: non-plastic Passing No. 200 sieve = 99.7%
				19	SS			3-3-3	25.7		
	402.3	48.0									
Gray, moist, very soft to medium stiff, SILTY CLAY (CL)			50	20	SS			2-1-1	23.9	0.5	**Sample No. SS-20:** Atterberg limits: LL=32, PL=17, PI=15 Passing No. 200 sieve = 98.2%
				21	SS			0-0-0	23.0	0.5	
			55	22	SS			3-4-5	22.4	1.25	
	394.3	56.0									
Reddish brown and gray, moist, very stiff to stiff, SANDY CLAY (CL)				23	SS			6-8-8	18.6	3.0	
	390.3	60.0	60	24	SS			5-6-6	22.2	2.0	
Bottom of Test Boring at 60.0 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 37.0 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
BORING #: **B-202**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
JOB #: **170GC00108**
PROJECT LOCATION: **A.B. Brown Generating Facility**
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/20/15	Hammer Wt.	140	lbs.
Date Completed	4/20/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 450.7	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Reddish brown, slightly moist, silty clay with crushed stone (EMBANKMENT FILL)				1	HA						Boring coordinates and ground surface elevation surveyed by Three I Design.
				2	HA						
	444.7	6.0	5								Borehole backfilled with cement/bentonite grout.
Brown, moist to slightly moist, silty clay (EMBANKMENT FILL)				3	SS			6-6-2	15.1	2.5	
				4	SS			7-7-6	16.3	3.0	
			10	5	SS			11-10-10	18.1		
				6	SS			11-6-9	14.0	3.0	**Sample No. SS-6:** Atterberg limits: LL=28, PL=18, PI=10 Passing No. 200 sieve = 95.2%
			15	7	SS			9-9-10	16.2	2.0	
				8	SS			8-13-10	17.3	2.25	
			20								
	428.2	22.5		9	SS			7-8-10	13.1		
Reddish brown, slightly moist, sandy clay (EMBANKMENT FILL)				10	SS			6-6-6	16.2	2.0	
			25	11	SS			6-6-8	15.6	2.5	**Sample No. SS-11:** Atterberg limits: LL=33, PL=15, PI=18 Passing No. 200 sieve = 66.1%
				12	SS			5-5-7	15.7	2.5	
			30								
				13	SS			8-8-8	16.0	3.0	
	417.7	33.0									
Brown and gray, moist, silty clay with little sand and gravel (EMBANKMENT FILL)				14	SS			5-6-7	18.0	3.5	
			35								
				15	SS			7-11-14	13.9		**Sample No. SS-16:** Atterberg limits: LL=32, PL=17, PI=15 Passing No. 200 sieve = 81.7%
				16	SS			10-7-9	14.7	3.5	

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 80.0 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: Vectren Corporation
BORING #: B-202
PROJECT NAME: Ash Pond Safety Factor Assessment
JOB #: 170GC00108
PROJECT LOCATION: A.B. Brown Generating Facility
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/20/15	Hammer Wt.	140	lbs.
Date Completed	4/20/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Brown and gray, moist, silty clay with little sand and gravel (EMBANKMENT FILL)				17	SS			16-18-32	15.8		
			45	18	SS			7-9-8	17.4	4.0	
				19	SS			10-13-14	17.8		
	402.7	48.0									
Reddish brown, moist, very stiff to medium stiff SANDY CLAY (CL)				20	SS			4-6-7	17.1	2.5	
			50	21	SS			11-13-13	16.3		
				22	SS			10-10-11	14.0	1.5	**Sample No. SS-22:** Atterberg limits: LL=42, PL=16, PI=26 Passing No. 200 sieve = 66.1%
			55	23	SS			13-13-16	19.1	1.5	
				24	SS			4-5-5	22.8		
	390.2	60.5	60								
Gray, moist, medium stiff, SILTY CLAY (CL) with little sand				25	SS			5-7-7	8.0	3.0	**Sample No. SS-25:** Atterberg limits: LL=29, PL=19, PI=10 Passing No. 200 sieve = 88.6%
				26	ST				23.2		
	385.2	65.5	65								
Reddish brown, moist, medium stiff to very stiff, SANDY CLAY (CL)				27	SS			3-4-4	17.7	1.25	**Sample No. ST-26:** Atterberg limits: LL=26, PL=20, PI=6 Passing No. 200 sieve = 67.8%
	382.7	68.0									
Reddish brown, moist, very stiff to stiff, SILTY CLAY (CL-ML)				28	SS			7-7-9			
			70								
				29	SS			10-10-10	24.4		
				30	SS			4-5-9	24.4	1.5	**Sample No. SS-30:** Atterberg limits: LL=28, PL=21, PI=7 Passing No. 200 sieve = 99.3%
			75								
				31	SS			7-6-5	25.6		
	372.7	78.0									
Reddish brown, moist, very soft to stiff, SANDY CLAY (CL)				32	SS		●	0-1-2	16.4	0.75	**Sample No. SS-32:** Atterberg limits: LL=21, PL=13, PI=8 Passing No. 200 sieve =

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 80.0 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: Vectren Corporation
BORING #: B-202
PROJECT NAME: Ash Pond Safety Factor Assessment
JOB #: 170GC00108
PROJECT LOCATION: A.B. Brown Generating Facility
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/20/15	Hammer Wt.	140	lbs.
Date Completed	4/20/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Reddish brown, moist, very soft to stiff, SANDY CLAY (CL)				33	SS			6-7-8	16.0	1.5	71.7%
	367.7	83.0									
Brown, very moist, stiff to very stiff SANDY CLAY (CL) with trace sandstone fragments			85	34	SS			5-6-9	15.3	2.5	**Sample No. SS-34:** Atterberg limits: LL=31, PL=15, PI=16 Passing No. 200 sieve = 43.6%
				35	SS			9-9-9	18.0		
				36	SS			6-6-7	20.4	1.0	
	360.2	90.5	90								
Bluish gray, slightly moist, very stiff, SANDY CLAY (CL)				37	SS			7-11-15	16.7		
	356.7	94.0									
Grayish brown, severely weathered, SILTSTONE	356.4	94.3		38	SS			20-50/0.3			
Bottom of Test Boring at 94.3 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 80.0 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: Vectren Corporation
PROJECT NAME: Ash Pond Safety Factor Assessment
PROJECT LOCATION: A.B. Brown Generating Facility, Posey County, Indiana
BORING #: B-203
JOB #: 170GC00108

DRILLING and SAMPLING INFORMATION

Date Started	4/21/15	Hammer Wt.	140 lbs.
Date Completed	4/21/15	Hammer Drop	30 in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0 in.
Inspector	S. Marcum	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 450.5	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Reddish brown, slightly moist, sandy clay (EMBANKMENT FILL)				1	HA						Boring coordinates and ground surface elevation surveyed by Three I Design.
				2	HA						
	445.0	5.5	5								
Brown, slightly moist, clayey silt (EMBANKMENT FILL)				3	SS			7-7-9	16.9		Borehole backfilled with cement/bentonite grout.
				4	SS			3-4-5		1.5	
	440.0	10.5	10								
Reddish brown, moist, silt (EMBANKMENT FILL)				5	SS			9-10-10			
				6	SS			4-6-8			
	435.0	15.5	15								
Light brown and brown, slightly moist, silty clay (EMBANKMENT FILL)				7	SS			17-14-17	16.5	4.0	**Sample No. SS-7:** Atterberg limits: LL=31, PL=14, PI=17 Passing No. 200 sieve = 71.0%
			20	8	SS			5-7-8	15.0		
				9	SS			11-10-9	14.3	4.0	
	427.5	23.0									
Tan, slightly moist, fine sand (EMBANKMENT FILL)			25	10	SS			5-6-6			
	424.0	26.5									
Brown, slightly moist, silt (EMBANKMENT FILL)	422.5	28.0		11	SS			6-11-14			
Brown, moist, silty clay with little sand (EMBANKMENT FILL)			30	12	SS			6-7-11		2.5	
				13	SS			12-12-11	15.7		**Sample No. SS-13:** Atterberg limits: LL=25, PL=18, PI=7 Passing No. 200 sieve = 87.2%
				14	SS			8-6-7			
	415.0	35.5	35								
Reddish brown, moist, silty clay (EMBANKMENT FILL)				15	SS			6-9-9	19.2	2.0	
	412.5	38.0									
Light brown, moist, sandy clay (EMBANKMENT FILL)	410.5	40.0		16	SS			5-7-8	13.9		

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 74.5 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: Vectren Corporation
PROJECT NAME: Ash Pond Safety Factor Assessment
PROJECT LOCATION: A.B. Brown Generating Facility, Posey County, Indiana
BORING #: B-203
JOB #: 170GC00108

DRILLING and SAMPLING INFORMATION

Date Started	4/21/15	Hammer Wt.	140	lbs.
Date Completed	4/21/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Brown and gray, moist, sandy clay (EMBANKMENT FILL)				17	SS			9-13-14	12.9		
	407.5	43.0									
Brown, moist, silty clay (EMBANKMENT FILL)				18	SS			4-4-7	14.8		
	405.0	45.5	45								
Light brown, moist, sandy clay (EMBANKMENT FILL)				19	SS			9-9-6	17.3	1.5	
				20	SS			7-8-9	15.0		
			50								
				21	SS			10-12-13	12.7		
				22	SS			6-9-12	11.7		**Sample No. SS-22:** Atterberg limits: LL=26, PL=16, PI=10 Passing No. 200 sieve = 58.7%
			55								
				23	SS			10-14-16	17.1		
	392.5	58.0									
Brown, moist, medium stiff, SILTY CLAY (CL)				24	SS			3-4-4	24.4		
			60								
				25	SS			3-3-6	23.5		
				26	ST						**Sample No. ST-26:** Atterberg limits: LL=30, PL=19, PI=11 Passing No. 200 sieve = 96.6%
	385.0	65.5	65								
Gray, moist, stiff to medium stiff, SILTY CLAY (CL)				27	SS			3-5-5	34.0		
				28	SS			4-5-5	21.9	1.5	**Sample No. SS-28:** Atterberg limits: LL=36, PL=19, PI=17 Passing No. 200 sieve = 99.6%
			70								
				29	SS			4-7-8	28.1	1.0	
				30	SS		●	3-3-5	41.9		
			75								
				31	SS			4-5-5	35.9		
				32	SS			3-4-5	32.5		

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 74.5 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: Vectren Corporation
PROJECT NAME: Ash Pond Safety Factor Assessment
PROJECT LOCATION: A.B. Brown Generating Facility, Posey County, Indiana
BORING #: B-203
JOB #: 170GC00108

DRILLING and SAMPLING INFORMATION

Date Started	4/21/15	Hammer Wt.	140	lbs.
Date Completed	4/21/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Gray, moist, medium stiff to stiff, SILTY CLAY (CL)				33	SS			4-6-7	32.1		
	367.5	83.0									
Gray, moist, medium stiff, SILTY CLAY (CL) with fine sand seams			85	34	SS			2-3-3	31.4	0.75	
				35	ST						
	361.5	89.0									
Bluish gray, very stiff, SANDY CLAY (CL)			90	36	SS			22-16-12			
	359.0	91.5									
Bluish gray, severely weathered SILTSTONE	358.1	92.4		37	SS			4-14-50/0.4			
Bottom of Test Boring at 92.4 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 74.5 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
PROJECT LOCATION: **A.B. Brown Generating Facility**, **Posey County, Indiana**

BORING #: **B-204**
JOB #: **170GC00108**

DRILLING and SAMPLING INFORMATION

Date Started	4/21/15	Hammer Wt.	140 lbs.
Date Completed	4/21/15	Hammer Drop	30 in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0 in.
Inspector	S. Marcum	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 450.5	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Brown, moist, silty clay (EMBANKMENT FILL)				1	HA						Boring coordinates and ground surface elevation surveyed by Three I Design.
				2	HA						
	444.5	6.0	5								
Reddish brown, moist, silty clay (EMBANKMENT FILL)				3	SS			4-7-7	15.0		
				4	SS			4-3-5	18.1	3.0	**Sample No. SS-4:** Atterberg limits: LL=32, PL=19, PI=13 Passing No. 200 sieve = 98.8%
			10	5	SS			5-11-12	21.6		
	437.5	13.0									
Light brown, slightly moist, silt (EMBANKMENT FILL)				6	SS			5-8-6	15.0		
	435.0	15.5	15								
Brown, slightly moist, silty clay (EMBANKMENT FILL)				7	SS			14-15-17	13.2	4.0	
				8	SS			7-7-7	19.9	2.0	
	430.0	20.5	20								
Brown, slightly moist, silt with interbedded silty clay (EMBANKMENT FILL)				9	SS			9-14-13	15.7	4.5+	Borehole backfilled with cement/bentonite grout.
	427.5	23.0									
Brown, slightly moist, silty clay (EMBANKMENT FILL)				10	SS			4-7-8	19.9		
			25	11	SS			9-9-15	13.9	4.0	
	422.5	28.0									
Reddish brown, moist, sandy clay (EMBANKMENT FILL)				12	SS			3-4-7	20.9	3.0	
	420.0	30.5	30								
Brown and light brown, moist, silty clay (EMBANKMENT FILL)				13	SS			10-15-20	15.0		
	417.5	33.0									
Brown, moist, silty clay with interbedded sandy clay (EMBANKMENT FILL)				14	SS			8-12-10	15.6		
			35	15	SS			12-13-13	16.3	3.0	**Sample No. SS-15:** Atterberg limits: LL=29, PL=22, PI=7 Passing No. 200 sieve = 99.5%
				16	SS			11-9-10	17.6		

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 66.0 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: Vectren Corporation
BORING #: B-204
PROJECT NAME: Ash Pond Safety Factor Assessment
JOB #: 170GC00108
PROJECT LOCATION: A.B. Brown Generating Facility
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/21/15	Hammer Wt.	140	lbs.
Date Completed	4/21/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Brown, moist, silty clay with interbedded sandy clay (EMBANKMENT FILL)				17	SS			10-17-18	14.9	4.5+	
			45	18	SS			5-7-9	17.0		
	404.5	46.0									
Reddish brown, moist, stiff to medium, stiff CLAYEY SILT (ML)				19	SS			5-7-8	21.9		
			50	20	SS			4-7-7	23.5	1.5	**Sample No. SS-20:** Atterberg limits: LL=27, PL=22, PI=5 Passing No. 200 sieve = 97.2%
				21	SS			5-5-5	27.8		
	397.5	53.0									
Gray, moist, medium stiff to very soft, SILTY CLAY (CL-ML)				22	SS			4-3-4			
			55	23	SS			5-4-4	28.1		**Sample No. SS-23:** Atterberg limits: LL=28, PL=21, PI=7 Passing No. 200 sieve = 99.3%
				24	SS			3-3-3	27.3		
			60	25	SS			3-4-5			
				26	SS			0-0-0			
			65				●				
				27	SS			1-2-3			
	382.5	68.0									
Reddish brown, moist, stiff, SANDY CLAY (CL)				28	ST						
			70								
				29	SS			4-5-7	19.6		
	377.5	73.0									
Orange, moist, hard, SANDY SILT (ML)	376.0	74.5		30	SS			16-38-50/0.1			
Orange and gray, severely weathered, SILTSTONE	375.9	74.6									
Bottom of Test Boring at 74.6 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 66.0 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
PROJECT LOCATION: **A.B. Brown Generating Facility**, **Posey County, Indiana**
BORING #: **B-205**
JOB #: **170GC00108**

DRILLING and SAMPLING INFORMATION

Date Started	4/16/15	Hammer Wt.	140	lbs.
Date Completed	4/16/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 415.5	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Reddish brown, moist, silty clay (EMBANKMENT FILL)	413.5	2.0		1	SS			6-5-8	17.1	3.0	Boring coordinates and ground surface elevation surveyed by Three I Design.
Reddish brown, moist sandy clay with trace gravel (EMBANKMENT FILL)			5	2	SS			6-11-14	14.4		
				3	SS			8-6-8	20.2		Borehole backfilled with cement/bentonite grout.
Light brown and gray, moist, silty clay with little sand (EMBANKMENT FILL)	407.5	8.0		4	SS			7-7-7	14.0		
Brown, moist, silty clay (EMBANKMENT FILL)	405.0	10.5	10	5	SS			8-9-9	16.3	2.5	**Sample No. SS-5:** Atterberg limits: LL=33, PL=15, PI=18 Passing No. 200 sieve = 88.5%
			15	6	SS			3-3-3	20.7	1.5	
Brown and light brown, slightly moist, silty clay with trace sand (EMBANKMENT FILL)	399.0	16.5		7	SS			5-6-8	17.3		
Brown, moist, silty clay (EMBANKMENT FILL)	397.5	18.0	20	8	SS			6-6-8	19.3	2.0	
				9	SS			7-7-14	16.2	2.5	
			25	10	SS			8-10-7	20.1	2.0	
Gray, slightly moist, very stiff, CLAYEY SILT (ML)	389.0	26.5		11	SS			8-9-10	20.9		
			30	12	SS			7-8-9	21.9		
				13	SS			9-9-9	22.2	3.0	
Dark gray, very moist, soft to medium stiff, SILT (ML) with trace organics and trace fine sand	382.5	33.0	35	14	SS			3-2-3	36.6	2.0	**Sample No. SS-14:** Atterberg limits: non-plastic Passing No. 200 sieve = 95.0%
				15	SS			4-4-6	40.9		
				16	SS			2-3-3	33.1		

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 45.0 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: Vectren Corporation
PROJECT NAME: Ash Pond Safety Factor Assessment
PROJECT LOCATION: A.B. Brown Generating Facility, Posey County, Indiana
BORING #: B-205
JOB #: 170GC00108

DRILLING and SAMPLING INFORMATION

Date Started	4/16/15	Hammer Wt.	140	lbs.
Date Completed	4/16/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Dark gray, moist, soft to medium stiff, SILT (ML) with trace organics and trace fine sand				17	SS			3-4-4	38.9		
				18	SS		●	2-2-4	43.3		
			45								
				19	SS			4-4-4	43.5		**Sample No. SS-19:** Atterberg limits: non-plastic Passing No. 200 sieve = 92.9%
				20	SS			3-4-4	34.2		
			50								
				21	SS			4-4-5	27.0		
	361.5	54.0									
Gray and bluish gray, very moist, very soft to medium stiff, SILTY CLAY (CL)				22	SS			0-1-2	19.4	1.0	
			55								
				23	SS			3-4-4	19.0	2.0	
				24	SS			3-4-5	19.4	4.0	
			60								
	354.0	61.5									
Gray, severely weathered, SILTSTONE	353.3	62.2		25	SS			19-38-50/0.2			
Bottom of Test Boring at 62.2 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 45.0 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
BORING #: **B-206**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
JOB #: **170GC00108**
PROJECT LOCATION: **A.B. Brown Generating Facility**
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/16/15	Hammer Wt.	140 lbs.
Date Completed	4/16/15	Hammer Drop	30 in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0 in.
Inspector	S. Marcum	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 414.8	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Reddish brown, slightly moist, sandy clay (EMBANKMENT FILL)				1	SS			9-10-10			Boring coordinates and ground surface elevation surveyed by Three I Design.
	410.8	4.0		2	SS			3-5-8			
Brown, moist to very moist, sand with trace gravel (EMBANKMENT FILL)			5	3	SS			8-8-4			Borehole backfilled with cement/bentonite grout.
	406.8	8.0									
Light brown, moist, silty clay (EMBANKMENT FILL)			10	4	SS			3-5-6	18.5	2.0	
				5	SS			7-6-8	17.9		
	401.8	13.0									
Gray, slightly moist, clayey silt (EMBANKMENT FILL)			15	6	SS			4-6-6	19.7		
				7	SS			9-10-8	20.8	4.5+	
	396.8	18.0									
Brown and gray, slightly moist to moist, very stiff, SILT (ML)			20	8	SS			7-11-12	21.7	1.75	
				9	SS			10-10-11	23.7		**Sample No. SS-9:** Atterberg limits: non-plastic Passing No. 200 sieve = 98.3%
	391.8	23.0									
Brown and gray, slightly moist to moist, stiff, CLAYEY SILT (ML)			25	10	SS			5-6-7	20.5		
				11	SS			6-7-7	20.7	2.5	
				12	ST		●		21.1		**Sample No. ST-12:** Atterberg limits: LL=23, PL=20, PI=3 Passing No. 200 sieve = 96.6%
	384.3	30.5	30								
Light brown and gray, moist, medium stiff to very stiff, SILTY CLAY (CL) with little sand				13	SS			3-3-3	20.9	0.75	**Sample No. SS-13:** Atterberg limits: LL=32, PL=15, PI=17 Passing No. 200 sieve = 80.3%
			35	14	SS			3-6-9	18.4	1.5	
				15	SS			7-8-8	23.2	1.5	
				16	ST				24.2		**Sample No. ST-16:** Atterberg limits: LL=29, PL=16, PI=13
	374.8	40.0									

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 29.5 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: Vectren Corporation
BORING #: B-206
PROJECT NAME: Ash Pond Safety Factor Assessment
JOB #: 170GC00108
PROJECT LOCATION: A.B. Brown Generating Facility
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/16/15	Hammer Wt.	140	lbs.
Date Completed	4/16/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Gray, wet medium stiff to soft, CLAYEY SILT (ML)				17	SS			3-3-3	24.6		Passing No. 200 sieve = 82.3%
	371.8	43.0									
Gray, moist, medium stiff to stiff, SILTY CLAY (CL)			45	18	SS			3-2-2	27.3	0.5	**Sample No. SS-17:** Atterberg limits: LL=26, PL=23, PI=3 Passing No. 200 sieve = 94.2%
				19	SS			7-10-5	40.3	0.5	**Sample No. SS-19:** Atterberg limits: LL=48, PL=23, PI=25 Passing No. 200 sieve = 99.0%
			50	20	SS			3-3-3	24.8	1.5	
				21	SS			4-5-5	32.6		
	360.8	54.0									
Gray, moist, very soft to soft, SILTY CLAY (CL) with little sand			55	22	SS			0-1-1	39.1		
				23	SS			3-2-3	17.7		
	356.8	58.0									
Gray, wet, soft to medium stiff, CLAYEY SILT (ML)			60	24	SS			2-3-3	36.9		**Sample No. SS-24:** Atterberg limits: LL=33, PL=31, PI=2 Passing No. 200 sieve = 96.4%
				25	SS			3-3-4	39.8		
			65	26	SS			2-2-3	42.5		**Sample No. SS-25:** Atterberg limits: LL=38, PL=34, PI=4 Passing No. 200 sieve = 96.3%
				27	SS			2-2-4	54.1		
			70	28	SS			2-2-2	37.8		
				29	SS			3-2-2	54.3		
	341.8	73.0									
Bluish gray, moist medium stiff to very stiff, SILTY CLAY (CL) with trace sand			75	30	SS			3-4-5	20.3	2.0	
				31	SS			19-13-14	18.3	4.0	
	335.8	79.0									
Gray, severely weathered, SILTSTONE	334.8	80.0		32	SS			18-35-50/0.4			

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 29.5 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
BORING #: **B-207**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
JOB #: **170GC00108**
PROJECT LOCATION: **A.B. Brown Generating Facility**
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/15/15	Hammer Wt.	140	lbs.
Date Completed	4/15/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 395.0	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Brown, moist, silty clay with coal ash (EMBANKMENT FILL)	392.0	3.0		1	SS			3-3-4			Boring coordinates and ground surface elevation surveyed by Three I Design.
Brown, moist, silty clay (EMBANKMENT FILL)	388.0	7.0	5	2	SS			5-5-4	18.0		
Reddish brown, moist, silty clay (EMBANKMENT FILL)	387.0	8.0		3	SS			7-8-11	16.1	3.0	Borehole backfilled with cement/bentonite grout.
Brown and gray, moist, silty clay (EMBANKMENT FILL)	382.0	13.0	10	4	SS			5-5-6	18.9		
				5	SS			10-9-9	18.4	3.0	
Brown and gray, moist, very soft to medium stiff, SILTY CLAY (CL-ML)	376.5	18.5	15	6	SS			2-1-2	23.9	0.75	
				7	SS			6-6-4	20.4	0.25	**Sample No. SS-7:** Atterberg limits: LL=24, PL=19, PI=5 Passing No. 200 sieve = 94.8%
Bluish gray, moist, medium stiff to soft, SILTY CLAY (CL)			20	8	ST				23.4		
				9	SS			3-3-3	27.4	1.0	**Sample No. ST-8:** Atterberg limits: LL=31, PL=16, PI=15 Passing No. 200 sieve = 92.9%
			25	10	SS			2-2-3	28.6	1.0	
				11	SS			3-2-3	25.7	1.25	
Gray, wet, medium stiff, CLAYEY SILT (ML)	366.0	29.0	30	12	SS		●	3-4-3	27.1		
				13	SS			2-3-2	26.7		**Sample No. SS-13:** Atterberg limits: non-plastic Passing No. 200 sieve = 95.2%
			35	14	SS			1-4-4	24.3		
				15	ST				32.0		**Sample No. ST-15:** Atterberg limits: LL=31, PL=25, PI=6 Passing No. 200 sieve = 73.5%
Gray, very moist, medium stiff, SANDY CLAY (CL)	357.0	38.0		16	SS			3-3-4	17.6	0.5	

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 29.0 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: Vectren Corporation
PROJECT NAME: Ash Pond Safety Factor Assessment
PROJECT LOCATION: A.B. Brown Generating Facility, Posey County, Indiana
BORING #: B-207
JOB #: 170GC00108

DRILLING and SAMPLING INFORMATION

Date Started	4/15/15	Hammer Wt.	140	lbs.
Date Completed	4/15/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Gray, very moist, medium stiff, SANDY CLAY (CL)	352.0	43.0		17	SS			2-3-4	19.5		**Sample No. SS-16:** Atterberg limits: LL=30, PL=15, PI=15 Passing No. 200 sieve = 61.7%
Gray, wet, dense, SILTY SAND (SM)	350.0	45.0	45	18	SS			11-13-23			
Gray, severely weathered, SILTSTONE	347.9	47.1		19	SS			31-41-50/0.1			
Bottom of Test Boring at 47.1 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 29.0 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
PROJECT LOCATION: **A.B. Brown Generating Facility**, **Posey County, Indiana**
BORING #: **B-208**
JOB #: **170GC00108**

DRILLING and SAMPLING INFORMATION

Date Started	4/15/15	Hammer Wt.	140	lbs.
Date Completed	4/15/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 396.7	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Black, coal ash (EMBANKMENT FILL)	395.2	1.5									Boring coordinates and ground surface elevation surveyed by Three I Design.
Brown, moist, silty clay (EMBANKMENT FILL)				1	SS			5-8-8			
				2	SS			6-7-8	16.8		
			5	3	SS			12-14-15	19.6	2.5	Borehole backfilled with cement/bentonite grout.
				4	SS			8-9-10	18.3		
			10	5	SS			10-9-9	20.4	1.5	
	383.7	13.0									
Brown, slightly moist to moist, very stiff to medium stiff, CLAYEY SILT (ML)				6	SS			3-4-4	20.5		
			15	7	SS			4-4-3	26.3		**Sample No. SS-7:** Atterberg limits: LL=26, PL=22, PI=4 Passing No. 200 sieve = 99.7%
	378.7	18.0									
Dark gray, moist to very moist, medium stiff, CLAYEY SILT (ML) with trace fine sand and trace organics				8	SS			3-4-5	35.6		
			20	9	SS			4-3-5	36.8		
				10	SS			2-3-3	37.4		
			25	11	SS			3-3-4	36.9		
				12	SS			2-3-4	29.8		
			30	13	SS			5-5-5	27.6		**Sample No. SS-13:** Atterberg limits: LL=28, PL=24, PI=4 Passing No. 200 sieve = 99.6%
	361.7	35.0		14	SS			3-3-4	18.1		
Bluish gray, moist, medium stiff, SILTY CLAY (CL) with little sand			35	15	SS			4-5-5	18.8	0.75	**Sample No. SS-15:** Atterberg limits: LL=33, PL=16, PI=17 Passing No. 200 sieve = 84.1%
				16	SS			3-5-4	22.2	1.5	

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 44.0 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: Vectren Corporation
BORING #: B-208
PROJECT NAME: Ash Pond Safety Factor Assessment
JOB #: 170GC00108
PROJECT LOCATION: A.B. Brown Generating Facility
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/15/15	Hammer Wt.	140	lbs.
Date Completed	4/15/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Bluish gray, moist, medium stiff, SILTY CLAY (CL) with little sand	354.5	42.2		17	SS			7-7-7			
Gray, wet, medium dense, SILTY SAND (SM)	352.7	44.0									
Gray, severely weathered, SILTSTONE	351.7	45.0	45	18	SS		●	15-50/0.3			
Bottom of Test Boring at 45.0 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 44.0 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
PROJECT LOCATION: **A.B. Brown Generating Facility**, **Posey County, Indiana**

BORING #: **B-209**
JOB #: **170GC00108**

DRILLING and SAMPLING INFORMATION

Date Started	6/30/15	Hammer Wt.	140	lbs.
Date Completed	6/30/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	M. Foye	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 451	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Topsoil and Crushed Stone	450.5	0.5									Ground surface elevation estimated from available topographic data.
Reddish brown, slightly moist, sandy clay (EMBANKMENT FILL)				1	SS			8-9-9			
				2	SS			5-8-9			
	445.5	5.5	5								
Reddish brown and gray, moist, sandy clay (EMBANKMENT FILL)				3	SS			8-9-7	20.8	2.5	Borehole backfilled with cement/bentonite grout.
	443.0	8.0									
Brown and gray, moist, silty clay (EMBANKMENT FILL)				4	SS			7-7-9		1.5	
			10	5	SS			8-11-9	19.7	3.0	
				6	SS			6-5-9		3.0	
			15	7	SS			11-13-12			
	433.0	18.0									
Brown, moist, silt (EMBANKMENT FILL)				8	SS			7-6-9			
			20	9	SS			4-8-6			
	428.0	23.0									
Light brown, moist, clayey silt (EMBANKMENT FILL)				10	SS			7-9-9		4.0	
	425.0	26.0	25								
Red and brown, moist, sandy clay (EMBANKMENT FILL)				11	SS			6-6-7	18.0		
	422.0	29.0									
Reddish brown and gray, moist, clayey sand (EMBANKMENT FILL)				12	SS			5-8-13	15.9	4.5+	
	420.5	30.5	30								
Brown, moist, silt (EMBANKMENT FILL)				13	SS			7-8-9			
	418.0	33.0									
Brown, moist, sandy clay (EMBANKMENT FILL)				14	SS			7-12-10	15.6	3.0	
			35								
				15	SS			5-8-11	18.7		**Sample No. SS-16:** Atterberg limits: LL=25, PL=14, PI=11
				16	SS			9-11-10	14.7		

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 47.3 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
PROJECT LOCATION: **A.B. Brown Generating Facility**, **Posey County, Indiana**

BORING #: **B-209**
JOB #: **170GC00108**

DRILLING and SAMPLING INFORMATION

Date Started	6/30/15	Hammer Wt.	140	lbs.
Date Completed	6/30/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	M. Foye	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Brown, moist, sandy clay (EMBANKMENT FILL)				17	SS			2-3-4	20.1	1.0	
				18	SS			2-2-4	20.1		
	405.5	45.5	45								
Brown, wet, very soft to soft SILT (ML)				19	SS		●	2-2-2	29.3		**Sample No. SS-19:** Atterberg limits: Non-plastic
				20	SS			1-2-1			
			50								
				21	SS			1-1-3			
	398.0	53.0									
Gray, moist, soft, SILTY CLAY (CL)				22	SS			1-2-2	24.0	1.0	
	395.0	56.0	55								
Brown, very moist, soft to stiff, SILTY CLAY (CL)				23	SS			2-2-3	29.2	1.5	**Sample No. SS-23:** Atterberg limits: LL=38, PL=18, PI=20
				24	SS			4-4-5	28.0		
			60								
				25	SS			6-6-7	26.4		
				26	SS			4-6-6	21.0	1.5	
	385.5	65.5	65								
Brown, moist, medium stiff, SANDY CLAY (CL)				27	SS			4-4-6		1.75	
	381.5	69.5		28	SS			5-20-50/0.2			
Reddish brown and gray, weathered, SANDSTONE	381.3	69.7	70								
Bottom of Test Boring at 69.7 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 47.3 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
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TEST BORING LOG

CLIENT: **Vectren Corporation**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
PROJECT LOCATION: **A.B. Brown Generating Facility**, **Posey County, Indiana**

BORING #: **B-210**
JOB #: **170GC00108**

DRILLING and SAMPLING INFORMATION

Date Started	7/1/15	Hammer Wt.	140	lbs.
Date Completed	7/1/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	M. Foye	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 451	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Topsoil and Crushed Stone	450.5	0.5									Ground surface elevation estimated from available topographic data.
Reddish brown, slightly moist, sandy clay (EMBANKMENT FILL)				1	SS			5-5-9			
				2	SS			6-6-7		3.0	
	445.5	5.5	5								
Brown and gray, slightly moist to moist, silty clay (EMBANKMENT FILL)				3	SS			5-6-11	18.4	2.5	Borehole backfilled with cement/bentonite grout.
				4	SS			6-6-7		2.0	
			10								
				5	SS			10-11-9	21.1		
	438.0	13.0									
Tan, slightly moist, clayey silt (EMBANKMENT FILL)				6	SS			6-6-9			
			15								
				7	SS			5-9-11			
	432.0	19.0									
				8	SS			7-9-11			
Tan, slightly moist, sandy silt (EMBANKMENT FILL)	430.0	21.0	20								
Tan and gray, moist, sandy clay (EMBANKMENT FILL)				9	SS			6-5-8		3.0	
	427.5	23.5									
Brown, moist, silt (EMBANKMENT FILL)				10	SS			3-4-10			
			25								
	425.0	26.0									
Brown, moist, silty clay (EMBANKMENT FILL)				11	SS			4-5-6	21.7	2.0	
				12	SS			4-6-7	18.9	1.75	
			30								
				13	SS			3-4-6	16.0	2.0	**Sample No. SS-13:** Atterberg limits: LL=37, PL=17, PI=26
	417.0	34.0									
Gray, moist, clayey silt (EMBANKMENT FILL)				14	SS			8-11-13	17.3		
	415.0	36.0	35								
Tan and gray, moist, sandy clay (EMBANKMENT FILL)				15	SS			5-5-7	25.8		
				16	SS			4-4-6	13.6	3.5	

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools: 54.5 ft.
At Completion: -- ft.
After -- hours: -- ft.
Cave Depth: -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
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TEST BORING LOG

CLIENT: **Vectren Corporation**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
PROJECT LOCATION: **A.B. Brown Generating Facility**, **Posey County, Indiana**
BORING #: **B-210**
JOB #: **170GC00108**

DRILLING and SAMPLING INFORMATION

Date Started	7/1/15	Hammer Wt.	140	lbs.
Date Completed	7/1/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	M. Foye	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Tan and gray, moist sandy clay (EMBANKMENT FILL)				17	SS			6-6-8	17.5	2.0	**Sample No. SS-17:** Atterberg limits: LL=35, PL=13, PI=22
	407.5	43.5									
Reddish brown, moist, silty clay (EMBANKMENT FILL)			45	18	SS			2-4-5	20.5	1.5	
				19	SS			5-5-5	14.8	2.5	
			50	20	SS			5-7-10	17.8	1.5	**Sample No. SS-20:** Atterberg limits: LL=27, PL=16, PI=11
				21	SS			4-5-6	18.7	1.0	
	398.0	53.0									
Brown, wet, stiff to soft, CLAYEY SILT (ML)			55	22	SS		●	5-7-7			
				23	SS			5-6-7	24.5		**Sample No. SS-23:** Atterberg limits: LL=26, PL=23, PI=3
			60	24	SS			4-4-4			
				25	SS			1-2-2			
			65	26	SS			2-3-3			
	385.5	65.5									
Brown, moist, medium stiff to stiff, SILTY CLAY (CL)				27	SS			12-3-5	20.2	1.5	**Sample No. SS-27:** Atterberg limits: LL=26, PL=17, PI=9
	381.0	70.0	70	28	SS			2-4-7		2.0	
Bottom of Test Boring at 70.0 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 54.5 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
BORING #: **B-211**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
JOB #: **170GC00108**
PROJECT LOCATION: **A.B. Brown Generating Facility**
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	7/2/15	Hammer Wt.	140 lbs.
Date Completed	7/2/15	Hammer Drop	30 in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0 in.
Inspector	M. Foye	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 451	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Topsoil and Crushed Stone	450.5	0.5									Ground surface elevation estimated from available topographic data.
Brown, slightly moist, silty clay (EMBANKMENT FILL)				1	SS			2-4-3			
				2	SS			6-7-9			
			5	3	SS			8-7-10		4.5	Borehole backfilled with cement/bentonite grout.
				4	SS			5-6-8	21.0	1.5	
			10	5	SS			7-8-8		4.0	
Reddish brown, brown and gray, moist, silty clay (EMBANKMENT FILL)	438.0	13.0		6	SS			4-6-7	17.1	3.0	
			15	7	SS			5-8-8		4.0	
				8	SS			5-6-9	15.3		
			20	9	SS			7-9-11			
Brown and gray, moist clayey silt (EMBANKMENT FILL)	428.0	23.0		10	SS			4-8-9			
Brown, moist, silty clay (EMBANKMENT FILL)	425.5	25.5	25	11	SS			3-4-4	19.0		**Sample No. SS-11:** Atterberg limits: LL=31, PL=17, PI=14
				12	SS			4-7-7	16.8		
			30	13	SS			3-4-5	16.2		
				14	SS			3-5-6	21.2		
			35	15	SS			3-4-7	17.7		**Sample No. SS-15:** Atterberg limits: LL=30, PL=17, PI=13
Brown, moist silty clay with interbedded red, sandy clay (EMBANKMENT FILL)	413.0	38.0		16	SS			8-8-16	18.8		

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 61.0 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
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TEST BORING LOG

CLIENT: **Vectren Corporation**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
PROJECT LOCATION: **A.B. Brown Generating Facility**, **Posey County, Indiana**

BORING #: **B-211**
JOB #: **170GC00108**

DRILLING and SAMPLING INFORMATION

Date Started	7/2/15	Hammer Wt.	140	lbs.
Date Completed	7/2/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	M. Foye	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Brown, moist silty clay with interbedded red, sandy clay (EMBANKMENT FILL)				17	SS			4-3-6		1.5	
				18	SS			3-5-7	16.7	2.0	
			45	19	SS			4-6-8	19.8	1.5	
				20	SS			3-6-10	17.3	1.5	
	400.5	50.5	50								
Brown, moist to very moist, very stiff to stiff, SILTY CLAY (CL)				21	SS			5-8-12			**Sample No. SS-21:** Atterberg limits: LL=29, PL=19, PI=10
				22	SS			6-7-7			
			55	23	SS			6-8-9			
				24	SS			4-7-8	20.7		**Sample No. SS-24:** Atterberg limits: LL=30, PL=20, PI=10
			60				●				
				25	SS			9-8-7			
	387.0	64.0									
Gray, wet, medium stiff, SILT (ML)				26	SS			3-4-4			
			65	27	SS			2-2-4			
				28	SS			1-3-3	29.9		**Sample No. SS-28:** Atterberg limits: Non-plastic
	381.0	70.0	70								
Bottom of Test Boring at 70.0 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 61.0 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
BORING #: **B-212**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
JOB #: **170GC00108**
PROJECT LOCATION: **A.B. Brown Generating Facility**
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	7/9/15	Hammer Wt.	140	lbs.
Date Completed	7/10/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	M. Foye	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 451	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Topsoil and Crushed Stone	450.5	0.5									Ground surface elevation estimated from available topographic data.
Brown, slightly moist, silty clay (EMBANKMENT FILL)				1	SS			7-6-6			
				2	SS			6-6-7			
			5	3	SS			8-8-10	19.3	4.5	Borehole backfilled with cement/bentonite grout.
	443.0	8.0									
Brown, moist, clayey silt (EMBANKMENT FILL)				4	SS			7-14-21			
			10	5	SS			8-10-12			Installed piezometer.
	438.0	13.0									
Brown, moist, silty clay (EMBANKMENT FILL)				6	SS			8-7-8	15.1	3.5	
			15	7	SS			6-6-8	17.6	1.5	
	432.5	18.5									
Tan, slightly moist, sandy silt (EMBANKMENT FILL)				8	SS			11-7-10			
	430.5	20.5	20								
Brown and gray, moist, silty clay (EMBANKMENT FILL)				9	SS			6-9-10	18.1		
				10	SS			7-9-9	15.6		
			25								
	425.0	26.0									
Gray, moist, silty clay (EMBANKMENT FILL)				11	SS			4-4-6	16.2		**Sample No. SS-11:** Atterberg limits: LL=38, PL=19, PI=19
	422.0	29.0									
Reddish brown, moist, silty clay (EMBANKMENT FILL)				12	SS			6-7-12	19.5		
			30								
				13	SS			6-7-12	17.1		
				14	SS			7-7-8	15.4	2.5	**Sample No. SS-14:** Atterberg limits: LL=34, PL=14, PI=20
			35				▼				
				15	SS			6-10-16	16.8		
	411.0	40.0		16	SS			7-5-7	16.6	1.5	

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 68.0 ft.
At Completion -- ft.
After 1152 hours 35.7 ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: Vectren Corporation
PROJECT NAME: Ash Pond Safety Factor Assessment
PROJECT LOCATION: A.B. Brown Generating Facility, Posey County, Indiana
BORING #: B-212
JOB #: 170GC00108

DRILLING and SAMPLING INFORMATION

Date Started	7/9/15	Hammer Wt.	140	lbs.
Date Completed	7/10/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	M. Foye	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Light brown, brown and gray, moist, silty clay (EMBANKMENT FILL)				17	SS			3-4-6	17.7	3.5	
				18	SS			5-6-6	15.4		
	405.0	46.0	45								
Tan, reddish brown and gray, moist, stiff, SANDY CLAY (CL)				19	SS			4-5-8	18.8		
	401.5	49.5		20	SS			6-9-13			
Gray, moist, very stiff, SILTY CLAY (CL) with trace organic matter			50								
				21	SS			6-8-12			
	398.0	53.0									
Brown and gray, moist, very stiff, SILTY CLAY (CL)				22	SS			7-21-12	20.6		**Sample No. SS-22:** Atterberg limits: LL=27, PL=17, PI=10
	395.0	56.0	55								
Reddish brown, moist, stiff to very stiff, SANDY CLAY (CL)				23	SS			3-5-8	15.0		
				24	SS			8-10-8	16.6		
			60								
				25	SS			4-7-7			
	388.0	63.0									
Gray, moist, very stiff, CLAYEY SILT (ML)				26	SS			7-8-10	20.5		
			65								
				27	SS			5-6-6	22.2		**Sample No. SS-27:** Atterberg limits: LL=25, PL=22, PI=3
	383.0	68.0					●				
Reddish brown, moist, stiff to very stiff, SANDY CLAY (CL)	381.3	69.7		28	SS			4-6-7			
Red, wet, medium dense, SAND (SP)	381.0	70.0	70								
Bottom of Test Boring at 70.0 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 68.0 ft.
▽ At Completion -- ft.
▼ After 1152 hours 35.7 ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
PROJECT LOCATION: **A.B. Brown Generating Facility**, **Posey County, Indiana**

BORING #: **B-213**
JOB #: **170GC00108**

DRILLING and SAMPLING INFORMATION

Date Started	7/8/15	Hammer Wt.	140	lbs.
Date Completed	7/9/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	M. Foye	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 451	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Topsoil and Crushed Stone	450.5	0.5									Ground surface elevation estimated from available topographic data.
Tan, slightly moist, silty clay (EMBANKMENT FILL)	448.0	3.0		1	SS			4-6-7		3.0	
Reddish brown and gray, moist, silty clay (EMBANKMENT FILL)	445.5	5.5	5	2	SS			4-6-8	18.8		
Brown, moist, silt (EMBANKMENT FILL)				3	SS			6-9-13			Borehole backfilled with cement/bentonite grout.
				4	SS			10-9-5	19.7		
Brown, moist, silty clay (EMBANKMENT FILL)	440.5	10.5	10	5	SS			5-10-10		3.0	
				6	SS			5-4-6		2.5	
Brown, moist clayey silt (EMBANKMENT FILL)	435.5	15.5	15	7	SS			7-8-9			
Brown and light brown, moist, silty clay (EMBANKMENT FILL)	433.0	18.0		8	SS			4-5-5		4.5	
			20	9	SS			5-6-8	14.6	4.0	**Sample No. SS-9:** Atterberg limits: LL=29, PL=16, PI=13
			25	10	SS			4-5-4			
				11	SS			4-3-5		2.0	
Brown, moist, clayey silt (EMBANKMENT FILL)	423.0	28.0		12	SS			4-3-4	18.4		**Sample No. SS-12:** Atterberg limits: LL=24, PL=21, PI=3
			30	13	SS			6-6-10	16.2		
Brown, moist, silty clay (EMBANKMENT FILL)	418.0	33.0		14	SS			5-5-6	20.4	3.5	
			35	15	SS			6-7-10	16.0	2.0	
	411.0	40.0		16	SS			3-7-7	15.9	3.0	

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 67.1 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
PROJECT LOCATION: **A.B. Brown Generating Facility**, **Posey County, Indiana**
BORING #: **B-213**
JOB #: **170GC00108**

DRILLING and SAMPLING INFORMATION

Date Started	7/8/15	Hammer Wt.	140	lbs.
Date Completed	7/9/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	M. Foye	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Light brown and gray, moist, silty clay (EMBANKMENT FILL)				17	SS			6-8-10	15.5		**Sample No. SS-17:** Atterberg limits: LL=37, PL=16, PI=21
			45	18	SS			9-11-13	15.0		
	405.0	46.0									
Brown, moist, clayey silt (EMBANKMENT FILL)				19	SS			7-8-11	17.7		
				20	SS			6-4-6	18.1		**Sample No. SS-20:** Atterberg limits: LL=26, PL=22, PI=4
	400.0	51.0	50								
Brown and light brown, moist silty clay with little sand (EMBANKMENT FILL)				21	SS			5-4-4	21.1		
	398.0	53.0									
Brown, very moist, medium stiff, SILTY CLAY (CL)				22	SS			14-3-4	24.0		
	395.0	56.0	55								
Brown, wet, medium stiff, SILT (ML)				23	SS			3-4-3	26.0		
	393.0	58.0									
Brown and gray, moist to very moist, soft to medium stiff, SILTY CLAY (CL)				24	SS			2-2-3	22.2		
			60								
				25	SS			2-3-4	23.3		**Sample No. SS-25:** Atterberg limits: LL=35, PL=16, PI=19
				26	SS			4-4-4	20.9		
			65								
				27	SS		●	2-3-2	21.4		
				28	SS			3-3-3			
	381.0	70.0	70								
Bottom of Test Boring at 70.0 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 67.1 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
BORING #: **B-214**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
JOB #: **170GC00108**
PROJECT LOCATION: **A.B. Brown Generating Facility**
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	7/7/15	Hammer Wt.	140	lbs.
Date Completed	7/8/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	M. Foye	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 451	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Topsoil and Crushed Stone	450.5	0.5									Ground surface elevation estimated from available topographic data.
Brown, moist, silty clay (EMBANKMENT FILL)				1	SS			6-6-8			
				2	SS			4-4-5	21.3	2.0	
	445.5	5.5	5								Borehole backfilled with cement/bentonite grout.
Brown, moist, clayey silt (EMBANKMENT FILL)				3	SS			11-11-13			
				4	SS			6-7-9	18.9		
	440.5	10.5	10								
Light brown to brown, moist, silty clay (EMBANKMENT FILL)				5	SS			4-6-8			
				6	SS			8-6-7	16.8		
	435.0	16.0	15								
Reddish brown, moist, silty clay (EMBANKMENT FILL)				7	SS			8-11-15		4.0	
	433.0	18.0									
Brown, moist, silty clay (EMBANKMENT FILL)				8	SS			11-15-11	17.5	3.0	
			20								
				9	SS			9-12-11		4.5+	
				10	SS			6-6-7	19.5		
			25								
				11	SS			7-9-12	16.6	2.5	**Sample No. SS-11:** Atterberg limits: LL=31, PL=17, PI=14
				12	SS			5-7-11	19.9	2.5	
			30								
				13	SS			7-6-9	16.4		
				14	SS			8-7-9	19.8		
			35								
				15	SS			6-7-10	19.7		
				16	SS			6-8-9	16.1		

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 54.1 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
PROJECT LOCATION: **A.B. Brown Generating Facility**, **Posey County, Indiana**

BORING #: **B-214**
JOB #: **170GC00108**

DRILLING and SAMPLING INFORMATION

Date Started	7/7/15	Hammer Wt.	140	lbs.
Date Completed	7/8/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	M. Foye	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Brown, moist, silty clay (EMBANKMENT FILL)				17	SS			7-5-10	15.6		**Sample No. SS-17:** Atterberg limits: LL=29, PL=18, PI=11
			45	18	SS			7-9-10	18.2	2.0	
				19	SS			8-7-8	22.9		
	403.0	48.0									
Brown to gray, wet, soft, SILTY CLAY (CL-ML)			50	20	SS			1-2-2	27.4		**Sample No. SS-20:** Atterberg limits: LL=28, PL=24, PI=4
				21	SS			2-2-2			
	398.0	53.0									
Brown, moist to very moist, very soft to stiff, SILTY CLAY (CL)			55	22	SS		●	0-3-4	23.3		
				23	SS			2-1-1	22.5	1.0	**Sample No. SS-23:** Atterberg limits: LL=29, PL=16, PI=13
			60	24	SS			1-1-3		1.0	
				25	SS			4-5-7	22.2		
			65	26	SS			5-4-4			
	385.0	66.0									
Gray, moist, stiff, SANDY CLAY (CL)				27	SS			8-8-8			
	382.0	69.0									
Gray and brown, weathered, SHALE	381.0	70.0	70	28	SS			6-9-11			
Bottom of Test Boring at 70.0											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 54.1 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
PROJECT LOCATION: **A.B. Brown Generating Facility**, **Posey County, Indiana**
BORING #: **B-215**
JOB #: **170GC00108**

DRILLING and SAMPLING INFORMATION

Date Started	7/16/15	Hammer Wt.	140	lbs.
Date Completed	7/16/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	K. Sweet	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 415	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Topsoil	414.7	0.3									Ground surface elevation estimated from available topographic data.
Brown, moist, silty clay with some sand (EMBANKMENT FILL)	411.5	3.5		1	SS			7-8-11			
Brown, moist, sand (EMBANKMENT FILL)	408.5	6.5	5	2	SS			13-14-15			
Gray and brown, moist, silty clay with little sand (EMBANKMENT FILL)	406.5	8.5		3	SS		●	2-3-5	18.8	1.75	Borehole backfilled with cement/bentonite grout.
Brown, wet, clayey sand (EMBANKMENT FILL)	405.5	9.5		4	SS			4-3-7	16.1		**Sample No. SS-4:** Atterberg limits: LL=28, PL=12, PI=16
Reddish brown to brown, moist, silty clay (EMBANKMENT FILL)	401.5	13.5	10	5	SS			6-8-11	15.5		
Brown and gray, moist, clayey silt (EMBANKMENT FILL)	399.0	16.0		6	SS			4-7-12			
Reddish brown, moist, sandy clay (EMBANKMENT FILL)	395.5	19.5	15	7	SS			4-3-5	17.1		
Brown, moist, very soft, SILTY CLAY (CL)	394.0	21.0		8	SS			0-1-2	25.1		
Brown and gray, very moist, medium stiff, SILTY CLAY (CL)	389.0	26.0	20	9	SS			3-4-3	27.3		**Sample No. SS-9:** Atterberg limits: LL=29, PL=20, PI=9
Gray, very moist, very soft, SILTY CLAY (CL)	387.0	28.0	25	10	SS			3-3-4			
Gray, wet, soft to very soft, SILT (ML)	381.0	34.0		11	SS			1-0-1	41.5	0.5	
Gray, wet, very soft, SILT (ML) with trace organic matter			30	12	SS			2-2-2	36.3	0.5	**Sample No. SS-12:** Atterberg limits: Non-plastic
				13	SS			1-2-1			
			35	14	SS			0-0-2	36.0		
				15	SS			0-0-2	35.9	0.75	**Sample No. SS-15:** Atterberg limits: Non-plastic
				16	SS			0-0-1			

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 6.5 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
PROJECT LOCATION: **A.B. Brown Generating Facility**, **Posey County, Indiana**

BORING #: **B-215**
JOB #: **170GC00108**

DRILLING and SAMPLING INFORMATION

Date Started	7/16/15	Hammer Wt.	140	lbs.
Date Completed	7/16/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	K. Sweet	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Gray, wet, very soft, SILT (ML) with trace organic matter				17	SS			1-1-2			
	372.0	43.0									
Gray, wet, very soft, CLAYEY SILT (ML)				18	SS			1-1-1	26.5	0.75	**Sample No. SS-18:** Atterberg limits: LL=26, PL=23, PI=3
	369.0	46.0	45								
Dark gray, moist, medium stiff, SILTY CLAY (CL)				19	SS			0-4-5		1.5	
				20	SS			3-3-4		0.75	
	364.0	51.0	50								
Bluish gray, miost, hard, SILTY CLAY (CL)	363.0	52.0		21	SS			50/0.4			
Gray, weathered, SHALE				22	SS			50/0.2			
			55	23	SS			50/0.1			
	355.0	60.0	60	24	SS			50/0.1			
Bottom of Test Boring at 60.0 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 6.5 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
PROJECT LOCATION: **A.B. Brown Generating Facility**, **Posey County, Indiana**
BORING #: **B-216**
JOB #: **170GC00108**

DRILLING and SAMPLING INFORMATION

Date Started	7/15/15	Hammer Wt.	140	lbs.
Date Completed	7/15/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	B. Kleeman	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 415	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Topsoil	414.7	0.3									Ground surface elevation estimated from available topographic data.
Reddish brown, moist, sandy clay (EMBANKMENT FILL)	411.0	4.0		1	SS			6-9-8			
Brown, moist, sandy gravel (EMBANKMENT FILL)	410.5	4.5	5	2	SS			8-10-13			
Brown, very moist to wet, sand (EMBANKMENT FILL)	408.2	6.8		3	SS		●	3-4-5	15.0	3.5	Borehole backfilled with cement/bentonite grout.
Reddish brown, moist, clay (EMBANKMENT FILL)	404.0	11.0	10	4	SS			4-4-6			
Reddish brown, moist, silty clay with trace sand (EMBANKMENT FILL)	401.5	13.5		5	SS			3-4-5	16.8	2.5	
Reddish brown, moist, sandy clay (EMBANKMENT FILL)	396.5	18.5	15	6	SS			6-4-6	21.6	2.0	**Sample No. SS-6:** Atterberg limits: LL=36, PL=15, PI=21
				7	SS			6-6-8	17.9	2.25	
Brown, moist, silty clay (EMBANKMENT FILL)	391.5	23.5	20	8	SS			5-10-11			
				9	SS			1-2-4	23.9		**Sample No. SS-9:** Atterberg limits: LL=30, PL=17, PI=13
Gray and brown, very moist to wet, stiff to soft, SILT (ML) with little sand			25	10	SS			3-4-7	21.9		
				11	SS			3-3-3	24.3		**Sample No. SS-11:** Atterberg limits: Non-plastic
			30	12	SS			2-1-1			
				13	SS			1-1-2	35.4		
Gray, wet, very soft to soft, SILT (ML)	382.0	33.0	35	14	SS			1-2-1			
				15	SS			1-2-2			**Sample No. SS-16:** Atterberg limits: Non-plastic
				16	SS			2-2-3	33.9		

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 6.0 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: Vectren Corporation
BORING #: B-216
PROJECT NAME: Ash Pond Safety Factor Assessment
JOB #: 170GC00108
PROJECT LOCATION: A.B. Brown Generating Facility
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	7/15/15	Hammer Wt.	140	lbs.
Date Completed	7/15/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	B. Kleeman	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Gray, wet, soft to medium stiff, SILT (ML)				17	SS			2-1-3			
			45	18	SS			2-2-4	51.8		
	369.0	46.0									
Gray, wet, soft, CLAYEY SILT (ML)				19	SS			1-3-2	25.6		
	367.0	48.0									
Gray and brown, moist, soft to stiff, SILTY CLAY (CL)				20	SS			1-2-3	20.2		
			50	21	SS			4-4-7	24.7		
	361.1	53.9									
Gray and brown, weathered, SILTSTONE				22	SS			7-11-19			
			55	23	SS			49-50/0.1			
	355.0	60.0		24	SS			47-50/0.3			
			60								
Bottom of Test Boring at 60.0 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 6.0 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
BORING #: **B-217**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
JOB #: **170GC00108**
PROJECT LOCATION: **A.B. Brown Generating Facility**
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	7/14/15	Hammer Wt.	140	lbs.
Date Completed	7/14/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	B. Kleeman	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 415	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Topsoil	414.7	0.3									Ground surface elevation estimated from available topographic data.
Brown, slightly moist, silty clay (EMBANKMENT FILL)				1	SS			8-7-5			
				2	SS			7-7-8			
			5								Borehole backfilled with cement/bentonite grout.
	408.0	7.0		3	SS			6-4-3			
Brown, wet, sandy gravel (EMBANKMENT FILL)	406.5	8.5					▼				
Grayish brown, moist, sandy clay with trace shale and sandstone fragments				4	SS			5-5-5	18.1	1.5	
			10	5	SS			5-5-6	13.7		Installed piezometer.
				6	SS			4-6-7	17.3		
			15	7	SS			2-3-4	21.8		
				8	SS			3-4-5	20.5		**Sample No. SS-8:** Atterberg limits: LL=28, PL=17, PI=11
	394.0	21.0	20								
Brown and gray, moist, medium stiff to stiff, SILTY CLAY (CL)				9	SS			5-5-5			
				10	SS			7-8-12	17.8		**Sample No. SS-10:** Atterberg limits: LL=29, PL=20, PI=9
			25	11	SS			3-4-5			
				12	SS			0-3-7	22.1		
	384.0	31.0	30								
Gray, moist, medium stiff, SILTY CLAY (CL)				13	SS		●	2-3-6	24.4		
				14	SS			3-2-4			
	379.0	36.0	35								
Brown to gray, wet, medium stiff to soft, SILTY CLAY (CL-ML)				15	SS			3-3-3	30.6		**Sample No. SS-15:** Atterberg limits: LL=29, PL=21, PI=8
				16	SS			1-2-2			

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 32.0 ft.
▽ At Completion -- ft.
▼ After 1152 hours 8.4 ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: Vectren Corporation
BORING #: B-217
PROJECT NAME: Ash Pond Safety Factor Assessment
JOB #: 170GC00108
PROJECT LOCATION: A.B. Brown Generating Facility
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	7/14/15	Hammer Wt.	140	lbs.
Date Completed	7/14/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	B. Kleeman	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Brown to gray, wet, medium stiff to soft, SILTY CLAY (CL-ML)	372.0	43.0		17	SS			1-1-2			
Dark gray, wet, very soft to medium stiff, SILT (ML)			45	18	SS			0-1-2	39.5		**Sample No. SS-18:** Atterberg limits: LL=37, PL=35, PI=2
				19	SS			0-1-2			
			50	20	SS			0-1-2			
				21	SS			3-2-5	26.4		**Sample No. SS-21:** Atterberg limits: Non-plastic
				22	SS			1-3-3			
Dark gray, moist, soft, SILTY CLAY (CL)	359.5	55.5	55	23	SS			1-2-3	23.5		**Sample No. SS-23:** Atterberg limits: LL=38, PL=16, PI=22
	355.0	60.0	60	24	SS			1-2-3			
Bottom of Test Boring at 60.0 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 32.0 ft.
At Completion -- ft.
After 1152 hours 8.4 ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
BORING #: **B-218**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
JOB #: **170GC00108**
PROJECT LOCATION: **A.B. Brown Generating Facility**
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	7/6/15	Hammer Wt.	140	lbs.
Date Completed	7/6/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	M. Foye	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 415	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Topsoil	414.7	0.3									Ground surface elevation estimated from available topographic data.
Tan, slightly moist, silty clay (EMBANKMENT FILL)				1	SS			4-6-7			
	410.2	4.8		2	SS			4-9-11			
Gray, moist, sand with trace gravel (EMBANKMENT FILL)	409.0	6.0	5								Borehole backfilled with cement/bentonite grout.
				3	SS			8-6-7			
Reddish brown, slightly moist to moist, silt (EMBANKMENT FILL)	406.5	8.5									
				4	SS			8-11-7	22.3		**Sample No. SS-4:** Atterberg limits: LL=26, PL=25, PI=1
Brown, moist, very stiff to very soft, SILT (ML)			10				●				
-wet below 11.0 ft				5	SS			2-1-1	30.6		**Sample No. SS-5:** Atterberg limits: LL=27, PL=26, PI=1
				6	SS			2-1-1			
			15								
				7	SS			2-1-2			
				8	SS			2-1-2			
			20								
	393.5	21.5		9	SS			2-2-3			
Gray, wet, soft to very soft, SILT (ML)	391.5	23.5									
Gray, very moist, soft to stiff, SILTY CLAY (CL-ML)				10	SS			0-0-1	23.4	0.5	**Sample No. SS-10:** Atterberg limits: LL=24, PL=18, PI=6
			25								
				11	SS			0-1-3	21.8	1.0	
				12	SS			2-3-6		2.0	
			30								
				13	SS			4-4-4	20.9		
				14	SS			4-4-7	18.9		
	379.0	36.0	35								
Reddish brown, moist, medium stiff, SANDY CLAY (CL)				15	SS			4-4-5			
	377.0	38.0									
Reddish brown, moist, medium stiff to very soft, SILTY CLAY (CL-ML)				16	SS			3-2-4	25.6		

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 11.0 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
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TEST BORING LOG

CLIENT: **Vectren Corporation**
BORING #: **B-218**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
JOB #: **170GC00108**
PROJECT LOCATION: **A.B. Brown Generating Facility**
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	7/6/15	Hammer Wt.	140	lbs.
Date Completed	7/6/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	M. Foye	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Reddish brown, moist, medium stiff to very soft, SILTY CLAY (CL-ML)				17	SS			2-2-2	28.6	1.25	**Sample No. SS-17:** Atterberg limits: LL=32, PL=25, PI=7
			45	18	SS			1-1-1			
	368.5	46.5		19	SS			2-4-3			
Gray, wet, medium stiff to very soft, CLAYEY SILT (ML)				20	SS			2-2-2	23.0		**Sample No. SS-20:** Atterberg limits: Non-plastic
			50	21	SS			0-0-0			
	362.0	53.0									
Gray and brown, moist, medium stiff to hard, SILTY CLAY (CL)				22	SS			3-4-6	20.9		**Sample No. SS-22:** Atterberg limits: LL=45, PL=16, PI=29
			55	23	SS			23-23-50/0.3			
	357.6	57.4									
Gray, weathered, SILTSTONE	356.1	58.9		24	SS			50/0.3			
Bottom of Test Boring at 58.9 ft			60								

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 11.0 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Vectren Corporation**
PROJECT NAME: **Ash Pond Safety Factor Assessment**
PROJECT LOCATION: **A.B. Brown Generating Facility**, **Posey County, Indiana**

BORING #: **B-219**
JOB #: **170GC00108**

DRILLING and SAMPLING INFORMATION

Date Started	7/13/15	Hammer Wt.	140	lbs.
Date Completed	7/13/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	B. Kleeman	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION / SURFACE ELEVATION 415	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Topsoil	414.5	0.5									Ground surface elevation estimated from available topographic data.
Brown, slightly moist, silty clay (EMBANKMENT FILL)				1	SS			5-7-8			
				2	SS			10-13-21			
Brown, very moist, soft to very soft, SILT (ML)	409.5	5.5	5								Borehole backfilled with cement/bentonite grout.
-wet below 6.9 ft				3	SS		●	3-2-2	29.8		
				4	SS			1-2-2	28.9		**Sample No. SS-4:** Atterberg limits: Non-plastic
			10	5	SS			2-2-1			
				6	SS			2-2-2			
	398.8	16.2	15								
Gray, wet, very soft, SILT (ML)				7	SS			1-1-1	29.9		**Sample No. SS-7:** Atterberg limits: Non-plastic
	397.0	18.0									
Gray, moist, very soft, SILTY CLAY (CL)				8	SS			0-1-1	23.9		**Sample No. SS-8:** Atterberg limits: LL=28, PL=18, PI=10
			20	9	SS			1-1-2	24.1		
	392.0	23.0									
Brown and gray, moist, medium stiff to stiff, SILTY CLAY (CL)				10	SS			4-4-5			
			25	11	SS			5-6-7	21.5		**Sample No. SS-11:** Atterberg limits: LL=30, PL=13, PI=17
				12	SS			4-5-6			
			30	13	SS			3-3-5			
	382.0	33.0									
Brown, very moist, medium stiff, SANDY CLAY (CL)				14	SS			3-3-5	22.6		
	379.0	36.0	35								
Brown, wet, medium stiff to very soft, SILTY CLAY (CL)				15	SS			5-5-5			**Sample No. SS-16:** Atterberg limits: LL=30, PL=20, PI=10
				16	SS			2-3-3	26.0		

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 6.9 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: Vectren Corporation
PROJECT NAME: Ash Pond Safety Factor Assessment
PROJECT LOCATION: A.B. Brown Generating Facility, Posey County, Indiana
BORING #: B-219
JOB #: 170GC00108

DRILLING and SAMPLING INFORMATION

Date Started	7/13/15	Hammer Wt.	140	lbs.
Date Completed	7/13/15	Hammer Drop	30	in.
Drill Foreman	J. Cook	Spoon Sampler OD	2.0	in.
Inspector	B. Kleeman	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Brown, wet, medium stiff to very soft, SILTY CLAY (CL)				17	SS			1-1-2			
				18	SS			1-1-2			
			45								
	368.2	46.8		19	SS			3-11-28			
Light brown, weathered, SANDSTONE				20	SS			22-50			
			50								
				21	SS			50/0.3			
				22	SS			50			
			55								
	357.6	57.4		23	SS			50/0.3			
Gray, weathered, SHALE											
	355.0	60.0		24	SS			50/0.2			
			60								
Bottom of Test Boring at 60.0 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 6.9 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

Equipment CME75/Solid Flight Auger

Elevation 450.9 ft. Date 5/6/82

Laboratory Tests	Blows/foot*	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD**	Depth (ft)	Sample	Description
						0		SILTY CLAY (CL) and CLAYEY SILT (ML) layers; Brown and light brown, medium stiff and medium dense, moist; trace sand and gravel; sandy layers; FILL
	16	20.0				5		
	17					10		Clayey sample; slightly moister below 9.0'
								Switched to rotary wash methods at 10.0'
	24	15.4	119			15		Clayey sample; becoming hard
	22					20		Silty sample
	21					25		Clayey and silty layers
Hyd LL = 29 PI = 18	24	15.5	119			30		Sandy silty clay; brown and reddish brown, hard
	28					35		Silty sample; ferrous (reddish brown) pockets; black specks (decayed shells?)
	23	18.5	112			40		Clayey sample; ferrous and clay nodules

*Generally standard penetration test (N) values; obtained by driving a 2.0" O.D. split spoon sampler with a 140-pound rammer free-falling 30 inches. Values followed by an asterisk obtained by driving a 3" O.D. sampler.

**Rock Quality Designation - percentage of core greater than 4 inches in length per run.

DRAFT

(Continuation of Log)

Laboratory Tests	Blows/foot	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD	Depth (ft)	Sample	Description
						40		SILTY CLAY (CL) and CLAYEY SILT (ML) layers; FILL
	8	20.9				45		CLAYEY SILT (ML) Brown, loose, moist; ferrous clay pockets; sandy layers
	8	29.6						SILT (ML) Brown and gray (mottled and layered), loose, wet; clayey and sandy layers; ferrous clay pockets; black specks
	8					50		
	6	31.0						
	5					55		
	4							
	4	26.2				60		
	4							CLAYEY SILT (ML) Brownish gray to grayish brown, loose, moist; trace fine sand
	9	25.4				65		
	36					70		SILTY CLAY (CL) Light brown to brown very stiff, moist; trace sand; black specks
				91	79	75		SILTSTONE, light brown, shaly; moderately hard with occ. soft clay seams, occ. undulating bedding; iron-stained bedding and fissures (to 78.0')
						80		Stratum extends to 80.5'

Harding Lawson Associates
Engineers, Geologists & Geophysicists

LOG OF BORING 1
A. B. Brown Station
Southern Indiana Gas & Electric Company
West Franklin, Indiana

PLATE 4

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
MVMachalinski	9922.001.14	AJGallet	6/14/82		

DRAFT

(Continuation of Log)

Laboratory Tests	Blows/foot	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD	Depth (ft)	Sample	
						80		SILTSTONE, gray, shaly; moderately hard; frequent shale seams
								End of boring
						85		No free water encountered during auger drilling
								Piezometer set from 69.0' to 74.0' with sand packing from 65.0' to 75.0'
						90		
						95		
						100		
						105		
						110		
						115		
						120		

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LOG OF BORING 1 (Cont.)
A. B. Brown Station
Southern Indiana Gas & Electric Company
West Franklin, Indiana

PLATE 5

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
MVMachalinski	9922,001,14	AJGallet	6/14/82		

Equipment CME75/Solid Flight Auger

Elevation 450.7 ft. Date 5/13/82

Laboratory Tests	Blows/foot	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD	Depth (ft)	Sample	
						0		SILTY CLAY (CL) Brown, very stiff, moist; trace fine sand, sandy layers; FILL
	16	15.0	114			5		
								CLAYEY SILT (ML) Brown, medium dense, moist; trace fine sand; FILL
Disp D2*		19.2	101					
Hyd	41*	23.9	102			10		
LL = 26								
PI = 1								
								SILTY CLAY (CL) Brown, hard, moist; trace fine sand, occ. ferrous nodules; silt layers; FILL
	26					15		
Disp ND1		17.3	114					
Disp ND2		17.6	111			20		
								Switched to rotary wash drilling at 21.0'
	14	20.5				25		SANDY SILTY CLAY (CL) Reddish brown, stiff, moist; trace fine gravel; brown silty clay pockets; FILL
								CLAYEY SILT (ML) Brown, medium dense moist; trace fine sand, occ. ferrous nodules, sandy layers; FILL
	25	19.9				30		
								SILTY CLAY (CL) Reddish brown, stiff, moist; trace fine sand, occ. grey clay pockets
	8	20.8	106			35		
	10							
						40		CLAYEY SILT (ML)

*Dispersion test classifications:

D1 and D2	Dispersive soils
ND4 and ND 3	Intermediate soils
ND2 and ND 1	Non-dispersive soils

DRAFT

(Continuation of Log)

Laboratory Tests	Blows/foot	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD	Depth (ft)	Sample	
						40		CLAYEY SILT (ML) Light brown, medium dense, wet
		27.2	98					
								SILT (ML) Light brown, loose, saturated; trace fine sand
						45		
						50		End of Boring
								No water encountered during auger drilling.
						55		Piezometer set from 43.0' to 48.0' with sand packing from 41.5' to 49.0'.
						60		
						65		
						70		
						75		
						80		

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LOG OF BORING 2
A. B. Brown Station
Southern Indiana Gas & Electric Company
West Franklin, Indiana

PLATE 6

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
MVMachalinski	9922.001.14	AJGaller	6/14/82		

Equipment CME75/Solid Flight Auger

Elevation 451.9 ft. Date 5/12/82

Laboratory Tests	Blows/foot	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD	Depth (ft)	Sample	
						0		CLAYEY SILT (ML) Brown, medium dense, moist; trace sand and fine gravel; clay layers; FILL
	14	18.8				5		
Hyd LL = 28 PI = 1	30					10		
Disp D2		20.7	108					
Perm (Plate 35)		18.9	107					
TxCU(3) (Plate 32)		18.5	114					
Hyd		17.5	110					
	26	14.6				15		Switched to rotary wash drilling at 15.0'
	19					20		CLAYEY SILT (ML) Light brown, medium dense, to very dense, moist; trace sand occ. fine gravel; reddish brown (ferrous clay pockets; clay layers; cemented seams; FILL
		15.9	117					
		12.9	124					
	54	16.6				25		
	18					30		SILTY CLAY (CL) Reddish brown, very stiff, moist; trace sand, occ. fine gravel; clay seams
	11	26.8				35		SILT (ML) Brown, medium dense to loose, wet; trace find sand; ferrous seams
	7					40		

DRAFT

(Continuation of Log)

Laboratory Tests	Blows/foot	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD	Depth (ft)	Sample	
						40		SILTY CLAY (CL) Grayish brown, soft, very moist; ferrous seams
LL = 29 PI = 9 TxCU (Plate 33)	9*	25.6	99					
	8	24.4				45		CLAY (CH) Reddish brown, medium stiff, moist; ferrous gravel layer at 44.5'
	6	28.4						
	9					50		SILTY CLAY (CL) Reddish brown and brown, medium stiff to very stiff, moist; trace sand and gravel
	20					55		
	100/6"	15.2				60		SILTSTONE, light brown, very shaly; weakly cemented to 59.0'; moderately hard with soft pockets; iron-stained bedding and fissures; undulating bedding
				100	70			
						65		SILTSTONE, gray, shaly; moderately hard; massive
								End of Boring
						70		No free water encountered during auger drilling
						75		Set piezometer from 56.0' to 61.0' with sand packing from 56.0' to 64.0
						80		

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LOG OF BORING 3
A. B. Brown Station
Southern Indiana Gas & Electric Company
West Franklin, Indiana

PLATE 7

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
MVMachalinski	9922,001.14	AJGallet	6/14/82		

Equipment CME75/Solid Flight Auger

Elevation 449.6 ft. Date 5/13/82

Laboratory Tests	Blows/foot	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD	Depth (ft)	Sample	
						0		SILTY CLAY (CL) Brown, stiff, moist; gravelly for the upper 1.0'; FILL
	29	20.2				5		CLAYEY SILT (ML) Light brown, medium dense, moist; trace fine sand; reddish brown (ferrous) clay seams; FILL
	16	13.9				10		SILTY CLAY (CL) Light brown, very stiff to stiff, moist; trace sand and gravel; micaceous; cemented seams; FILL
	31					15		Fine sandy silt pockets; ferrous seams Switched to rotary wash drilling at 15.0'
	10	18.2				20		SANDY SILTY CLAY (CL) Reddish brown, very stiff, moist; trace sand and fine gravel; slightly micaceous
Hyd LL = NP	3	32.8 32.0				25		CLAYEY SILT (ML) Brown, loose, wet; trace find sand; slightly micaceous; silt layers
	4	25.1				30		
	5	22.9						SILTY CLAY (CL) Reddish brown, medium stiff to very stiff, moist; trace fine sand; occ. black specks (decayed shells?)
	3					35		
	4							
	5	25.4				40		

DRAFT

(Continuation of Log)

Laboratory Tests	Blows/foot	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD	Depth (ft)	Sample	
	8					40		SILTY CLAY (CL) becoming stiff
	10					45		Becoming very stiff; trace sand and fine gravel, micaceous; ferrous nodules
	21	17.9						
	15					50		CLAY (CL-CH) Light brown, medium stiff, very moist; trace fine sand, numerous black specks
LL = 93 PI = 36 TxCU (Plate 34)	36*	45.5 32.7	77 88					
	100/5"	18.4						SILTY CLAY (CL) Light brown and brown (mottled), hard, moist; silty sand pockets; cemented layers
				96	37	55		SILTSTONE, light brown, very shaly, low hardness and soft pockets, weathered with iron-stained fissures
						60		SILTSTONE, gray, shaly with shale seams and a 1" thick shale layer at 56.7'. Low hardness, weathered to slightly weathered, with iron-stained fissures above 57.2'. Moderately hard below 57.2' with undulating beds below 58.7'.
						65		
						70		End of boring
								No free water encountered during auger drilling
						75		Piezometer set from 53.0' to 58.0' with sand packing from 52.0' to 60.3'
						80		

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LOG OF BORING 4
A. B. Brown Station
Southern Indiana Gas & Electric Company
West Franklin, Indiana

PLATE 8

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
MVMachalinski	9922,001.14	AJGallet	8/14/82		

Equipment CME75/Solid Flight Auger

Elevation 416.1 ft. Date 5/11/82

Laboratory Tests	Blows/foot	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD	Depth (ft)	Sample	
						0		CLAYEY SILT (ML) Brown, moist; trace fine sand; FILL
	23	20.2	101			5		CLAYEY SILT (ML) Brown, medium dense, moist; trace fine sand; slightly micaceous; clay layers
	6	30.8				10		Becoming reddish brown and brown, loose and wet below 9.0'
	7							SILT (ML) Gray (and reddish brown to 13.0'), loose, wet; trace fine sand; slightly micaceous
Hyd LL = NP Disp D1 Perm (Plate 35)	11*	27.5	98			15		Free water encountered during drilling; water level rising.
		29.6	95					
	6					20		Switched to rotary wash drilling at 15.0'
	5	29.6						Ferrous (reddish) pockets
LL = 29 PI = 9	10	23.6				25		SILTY CLAY (CL) Gray to grayish brown, medium stiff, moist
	17	21.0				30		SILTY CLAY (CL) Reddish brown, very stiff, moist; trace sand and fine gravel; sandy layers
	100/3"	19.1				35		SILTSTONE, light brown, shaly; moderately hard; undulating bedding; iron-stained bedding and fissures (to 37.3')
				100	87			
						40		

DRAFT

(Continuation of Log)

Laboratory Tests	Blows/foot	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	RQD	Depth (ft)	Sample	
						40		SILTSTONE
								End of boring
						45		Piezometer located 10' north of Boring 5. Slotted portion set from 11.0' to 16.0' with sand packing from 10.0' to 18.0'
						50		
						55		
						60		
						65		
						70		
						75		
						80		

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LOG OF BORING 5
A. B. Brown Station
Southern Indiana Gas & Electric Company
West Franklin, Indiana

PLATE 9

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
MVMachalinski	9922,001.14	AJGallet	6/14/82		

DRAFT

Equipment 4" Hollow Stem Flight Auger

Elevation 416.2 ft. Date 5/11/82

▽ See note at end of boring

Laboratory Tests	Blows/foot	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	Cored Interval	Depth (ft)	Sample	
	8	23.1				0		CLAYEY SILT (ML) Brown, loose to medium dense, moist; trace sand; mixed with coal to 2.2'; FILL (reworked?)
	12	15.8	118			5		
	6							SILTY CLAY (CL) Reddish brown, medium stiff to stiff, very moist; trace fine sand; clayey silt layers
	12	28.9				10		
	7							Switched to rotary wash drilling at 10.0' Becoming stiff with sandy layers
LL = 75 PI = 48	7	43.3				15		CLAY (CH) Reddish brown, stiff, very moist; trace silt; soft silty pockets; black specks (decayed shells?)
	4	48.1						
	15	19.0	111			20		SILTY CLAY (CL) Light brown, very stiff, moist; trace find sand, sandy silt pockets (slightly cemented);ferrous nodules and black specks
	100/6"	17.1						
				96	87	25		SILTSTONE, light brown from 24.0' to 25.4' and 26.8' to 27.8', gray from 25.4' to 26.8' and 27.8' to 33.0'; shaly; low hardness 26.8' to 27.8' otherwise moderately hard; slightly weathered to 27.8'; iron-stained bedding and fissures from 24.0' to 25.4' and 26.8' to 27.8'; massive below 27.8'
						30		
								End of boring
						35		Piezometer set from 7.0' to 12.0' with sand packing from 5.0' to 12.0'
						40		

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LOG OF BORING 6
A. B. Brown Station
Southern Indiana Gas & Electric Company
West Franklin, Indiana

PLATE 10

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
MMachalinski	9922,001.14	AJGallet	6/14/82		

DRAFT

Equipment [illegible] Hand Auger

Elevation 416.2 ft. Date 5/11/82

▽ See note at end of boring

Laboratory Tests	Blows/foot	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	Cored Interval	Depth (ft)	Sample	
						0		CLAYEY SILT (ML) Brown, loose, moist; trace sand; FILL (reworked?)
Hyd		22.5				5		
LL = 37		25.4						
PI = 15		28.2	94					SILTY CLAY (CL) Reddish brown, medium stiff to stiff, moist; trace fine sand; layer of ferrous gravel at top of strata; clayey silt layers
Disp ND1		28.1						
TxCU(2) (Plate 32		28.3	97					
Perm and 33)		28.5	94					
(Plate 35)		28.6	93			10		End of boring.
						15		Free water encountered after driving sampler to 8.0'. Water level subsequently rose to ground surface.
						20		Borehole was cement grouted to ground surface.
						25		
						30		
						35		
						40		

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LOG OF BORING 6A
A. B. Brown Station
Southern Indiana Gas & Electric Company
West Franklin, Indiana

PLATE 11

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
MVMachalinski	9922/001.14	AJGallet	6/14/82		

DRAFT

Equipment: [illegible]/Solid Flight Auger

Elevation: 401.6 ft. Date: 5/13/82

Laboratory Tests	Blows/foot	Moisture Content (%)	Dry Density (pcf)	Core Recovery (%)	Cored Interval	Depth (ft)	Description
						0	SILT (ML) Gray and brown (mottled), medium dense, dry to moist; trace fine sand; sandy layers
	11	21.2				5	▽ Free water encountered at 6.0'
							Becoming gray, loose and wet below 6.0'; with organic seams
	3	32.0				10	
							CLAYEY SILT (ML) Gray, loose, very moist; trace fine sand
	2	28.6				15	
	5	23.1				20	SILTY CLAY (CL) Light brown and reddish brown, stiff to very stiff; trace fine sand; occ. ferrous nodules
	17	19.7				25	Switch to rotary wash drilling at 20.0'
	50/3"			100	91	30	SILTSTONE, light brown, shaly; moderately hard with occ. soft clay seams; iron-stained bedding and fissures (to 31.8'); undulated bedding; frequent shale seams below 33.3'
						35	End of boring
							Piezometer set from 26.0' to 31.0' with sand packing from 24.7' to 34.2'
						40	

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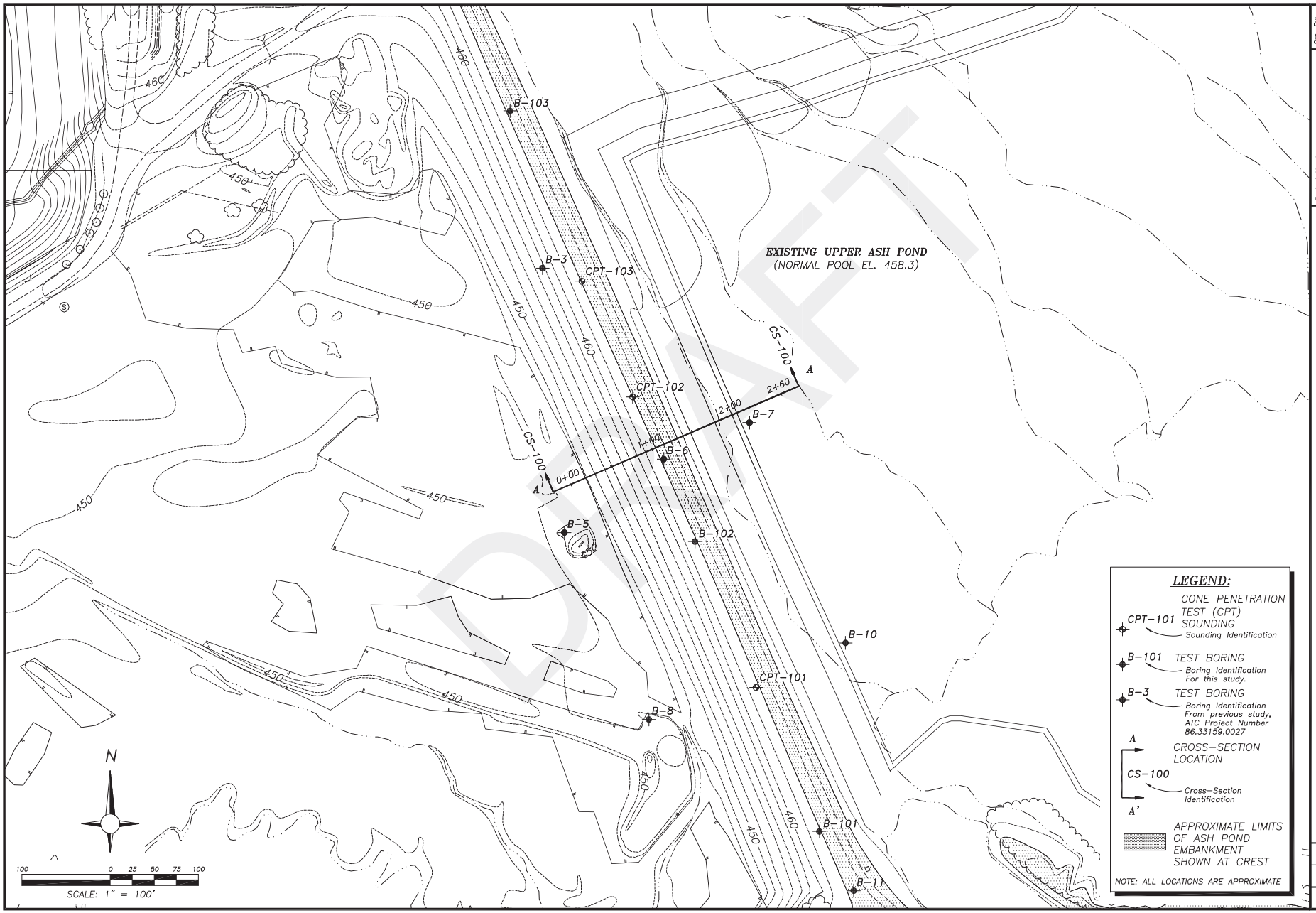
LOG OF BORING 7
A. B. Brown Station
Southern Indiana Gas & Electric Company
West Franklin, Indiana

PLATE 12

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
MVMachalinski	9922,001.14	AJGallet	6/14/82		

Test Boring Logs Drilled through Ash Materials



Dm. By: SP
Ckd. By: SM
App'd By:
Ckd. Date:

Project Number: 170GC00108
Drawing File: SEE LOWER LEFT

Cardno ATC

BORING PLAN - UPPER ASH POND
SAFETY FACTOR ASSESSMENT
UPPER AND LOWER ASH PONDS
VECTREN AB BROWN GENERATING STATION
POSEY COUNTY, INDIANA

Date: 6/15
Scale: AS SHOWN
Figure: 2

H:\2015\VECTREN CORPORATION\AB BROWN - SSA\GEO (170GC00108)\ABB-SSA-GEOTECH.DWG, BPLAN-UPPER

Cardno ATC
7988 Centerpoint Drive, Suite 100
Indianapolis, IN 46256
(317) 849-4990
Fax (317) 849-4278

TEST BORING LOG

CLIENT: Vectren Corporation
PROJECT NAME: Ash Pond Safety Factor Assessment
PROJECT LOCATION: A.B. Brown Generating Facility, Posey County, Indiana
BORING #: B-101
JOB #: 170GC00108

DRILLING and SAMPLING INFORMATION

Date Started	4/14/15	Hammer Wt.	140 lbs.
Date Completed	4/14/15	Hammer Drop	30 in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0 in.
Inspector	S. Marcum	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

SURFACE ELEVATION 463.7

SOIL CLASSIFICATION	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Brown, very moist, sandy clay (EMBANKMENT FILL)	460.7	3.0		1	SS			2-3-3	22.0	0.75	Boring coordinates and ground surface elevation surveyed by Three I Design.
Dark brown, moist, sandy clay with coal ash (EMBANKMENT FILL)	455.7	8.0	5	2	SS			4-7-15	15.0	1.5	Borehole backfilled with cement/bentonite grout.
				3	SS			19-17-16			
Black, moist, fine to coarse, coal ash (EMBANKMENT FILL)			10	4	SS			17-21-16			
				5	SS			13-13-18	10.4		**Sample No. SS-5:** Atterberg limits: non-plastic Passing No. 200 sieve = 30.5%
			15	6	SS			8-12-11			
				7	SS			9-8-6			
	443.7	20.0	20	8	SS		●	12-6-6	19.5		**Sample No. SS-8:** Atterberg limits: non-plastic Passing No. 200 sieve = 30.5%
Black, wet, fine coal ash (FILL)				9	SS			4-3-3			
			25	10	SS			2-2-1			
	437.2	26.5		11	SS			2-1-2	24.1	0.75	**Sample No. SS-11:** Atterberg limits: LL=33, PL=20, PI=13 Passing No. 200 sieve = 97.2%
Brown and black, very moist, silty clay with coal ash (FILL)			30	12	SS			2-3-3	25.6		
	432.7	31.0									
Reddish brown, moist, medium stiff, SILTY CLAY (CL) with sandy clay seams				13	SS			3-5-5	20.7	1.5	**Sample No. SS-13:** Atterberg limits: LL=27, PL=10, PI=17 Passing No. 200 sieve = 97.5%
			35	14	SS			3-3-4	25.6	1.0	
				15	SS			3-3-3	32.7		**Sample No. SS-16:** Atterberg limits: LL=35, PL=18, PI=17 Passing No. 200 sieve = 99.4%
				16	SS			3-4-4	29.6	1.25	

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 20.0 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: Vectren Corporation
PROJECT NAME: Ash Pond Safety Factor Assessment
PROJECT LOCATION: A.B. Brown Generating Facility, Posey County, Indiana
BORING #: B-101
JOB #: 170GC00108

DRILLING and SAMPLING INFORMATION

Date Started	4/14/15	Hammer Wt.	140	lbs.
Date Completed	4/14/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Reddish brown, moist, medium stiff, SILTY CLAY (CL) with sandy clay seams	420.7	43.0	45	17	SS			6-3-4	27.7		
Reddish brown, slightly moist, very stiff to hard, SANDY CLAY (CL)	417.7	46.0		18	SS			14-9-13	19.0		
Brown and reddish brown, severely weathered SANDSTONE	415.2	48.5		19	SS			41-53-50/0.1	19.0		
Bottom of Test Boring at 48.5 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 20.0 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: Vectren Corporation
BORING #: B-102
PROJECT NAME: Ash Pond Safety Factor Assessment
JOB #: 170GC00108
PROJECT LOCATION: A.B. Brown Generating Facility
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/14/15	Hammer Wt.	140	lbs.
Date Completed	4/14/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 463.4	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Brown, moist, sandy clay (EMBANKMENT FILL)				1	SS			3-4-5	19.1		Boring coordinates and ground surface elevation surveyed by Three I Design.
	459.4	4.0		2	SS			5-6-7			Borehole backfilled with cement/bentonite grout.
Dark brown, very moist, sandy silt with coal ash (EMBANKMENT FILL)			5	3	SS			17-17-21			
			10	4	SS			5-5-8	25.0		**Sample No. SS-4:** Atterberg limits: non-plastic Passing No. 200 sieve = 81.5%
	450.4	13.0		5	SS			12-12-14			
Dark brown, moist, silty sand with coal ash (EMBANKMENT FILL)	447.9	15.5	15	6	SS			6-11-9	17.5		**Sample No. SS-6:** Atterberg limits: non-plastic Passing No. 200 sieve = 33.9%
Reddish brown, moist, silty clay (EMBANKMENT FILL)				7	SS			7-5-8	17.0		
			20	8	SS		●	3-3-4	21.9		**Sample No. SS-7:** Atterberg limits: LL=43, PL=17, PI=26 Passing No. 200 sieve = 81.0%
	442.4	21.0									
Black, wet, fine coal ash (FILL)				9	SS			4-2-2			
			25	10	SS			3-1-1	56.5		**Sample No. SS-10:** Atterberg limits: non-plastic Passing No. 200 sieve = 74.5%
				11	SS			0-0-0			
			30	12	SS			0-0-0			
				13	SS			0-0-1	71.2		**Sample No. SS-13:** Atterberg limits: non-plastic Passing No. 200 sieve = 74.4%
			35	14	SS			5-1-1			
				15	SS			0-0-0			**Sample No. SS-16:** Atterberg limits: non-plastic Passing No. 200 sieve = 78.9%
				16	SS			1-0-0	57.7		

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 20.5 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: Vectren Corporation
BORING #: B-102
PROJECT NAME: Ash Pond Safety Factor Assessment
JOB #: 170GC00108
PROJECT LOCATION: A.B. Brown Generating Facility
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/14/15	Hammer Wt.	140	lbs.
Date Completed	4/14/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Black, wet, fine coal ash (FILL)				17	SS			0-0-0			
				18	SS			0-0-0			
			45	19	SS			0-0-0			
				20	SS			0-0-0	54.8		**Sample No. SS-20:** Atterberg limits: non-plastic Passing No. 200 sieve = 94.9%
			50	21	SS			0-0-0			
				22	SS			1-0-0			
			55	23	SS			0-0-0			
				24	SS			0-0-0			
			60	25	SS			0-0-0			
				26	SS			0-0-0			
			65	27	SS			1-2-1			
Reddish brown, very moist, medium stiff to stiff, SILTY CLAY (CL)	396.4	67.0									
				28	SS			3-3-4	24.3	1.0	**Sample No. SS-28:** Atterberg limits: LL=31, PL=20, PI=11 Passing No. 200 sieve = 98.0%
			70	29	SS			3-3-3	25.9		
Reddish brown, very moist, medium stiff to stiff, SILTY CLAY (CL-ML)	390.4	73.0									
				30	SS			3-3-3	24.6	1.0	**Sample No. SS-30:** Atterberg limits: LL=29, PL=22, PI=7 Passing No. 200 sieve = 91.0%
			75	31	SS			3-5-5	32.2	1.5	
Bottom of Test Boring at 80.0 ft	383.4	80.0		32	SS			5-6-7			

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 20.5 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

Cardno ATC
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TEST BORING LOG

CLIENT: Vectren Corporation
BORING #: B-103
PROJECT NAME: Ash Pond Safety Factor Assessment
JOB #: 170GC00108
PROJECT LOCATION: A.B. Brown Generating Facility
Posey County, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/15/15	Hammer Wt.	140	lbs.
Date Completed	4/15/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 463.7	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Brown, moist, sandy clay with coal ash (EMBANKMENT FILL)				1	SS			3-3-3			Boring coordinates and ground surface elevation surveyed by Three I Design.
			5	2	SS			5-6-6	20.5	0.5	**Sample No. SS-2:** Passing No. 200 sieve = 71.0%
				3	SS			7-10-11			Borehole backfilled with cement/bentonite grout.
	455.7	8.0									
Black, very moist, fine to coarse, coal ash (EMBANKMENT FILL)				4	SS			6-5-4			
			10				●				
-wet below 10.5 ft				5	SS			5-3-4	24.5		**Sample No. SS-5:** Atterberg limits: non-plastic
	450.7	13.0									
Reddish brown, moist, silty clay (EMBANKMENT FILL)				6	SS			4-5-6	18.1	2.5	Passing No. 200 sieve = 62.7%
			15	7	SS			7-7-6	17.1	3.5	**Sample No. SS-7:** Atterberg limits: LL=42, PL=18, PI=24
				8	ST				23.2	1.8	Passing No. 200 sieve = 90.2%
	443.7	20.0	20								
Black, wet, fine, coal ash (FILL)				9	SS			2-2-2			**Sample No. ST-8:** Atterberg limits: LL=41, PL=18, PI=23 Passing No. 200 sieve = 95.4%
				10	SS			1-0-0			
			25								
				11	SS			0-0-0	62.9		**Sample No. SS-10:** Atterberg limits: non-plastic Passing No. 200 sieve = 97.3%
				12	SS			0-0-0			
			30								
				13	SS			0-1-1			
				14	SS			0-0-0			
			35								
				15	SS			0-0-0			**Sample No. SS-15:** Atterberg limits: non-plastic Passing No. 200 sieve = 96.0%
	425.7	38.0									
Brown, very moist to moist, soft to medium stiff, SILTY CLAY (CL)				16	SS			0-2-3	72.4	0.5	

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools 10.5 ft.
▽ At Completion -- ft.
▼ After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

Cardno ATC
7988 Centerpoint Drive, Suite 100
Indianapolis, IN 46256
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Fax (317) 849-4278

TEST BORING LOG

CLIENT: Vectren Corporation
PROJECT NAME: Ash Pond Safety Factor Assessment
PROJECT LOCATION: A.B. Brown Generating Facility, Posey County, Indiana
BORING #: B-103
JOB #: 170GC00108

DRILLING and SAMPLING INFORMATION

Date Started	4/15/15	Hammer Wt.	140	lbs.
Date Completed	4/15/15	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Inspector	S. Marcum	Rock Core Dia.	--	in.
Boring Method	HSA	Shelby Tube OD	--	in.

TEST DATA

SOIL CLASSIFICATION (continued)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
Brown, very moist to moist, soft to medium stiff, SILTY CLAY (CL)				17	SS			6-5-4	29.5		
			45	18	SS			0-2-3	25.2	0.75	**Sample No. SS-18:** Atterberg limits: LL=27, PL=18, PI=9 Passing No. 200 sieve = 97.2%
				19	SS			5-4-5	23.0		
	415.7	48.0									
Reddish Brown, moist, medium stiff to very stiff, SANDY CLAY (CL)				20	SS			3-3-3	20.3		
			50	21	SS			4-4-4	25.8	0.75	
				22	SS			5-6-6	20.1	1.0	**Sample No. SS-22:** Atterberg limits: LL=29, PL=11, PI=18 Passing No. 200 sieve = 53.0%
			55	23	SS			7-11-15	15.6	2.0	
	405.7	58.0									
Light brown, slightly moist, hard, SILT (ML)				24	SS			9-12-21	18.2	3.5	
	402.7	61.0	60								
Light brown, weathered, SILTSTONE	402.4	61.3		25	SS			50/0.3			
Bottom of Test Boring at 61.3 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 10.5 ft.
At Completion -- ft.
After -- hours -- ft.
Cave Depth -- ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

ATC Associates Inc.

RECORD OF SUBSURFACE EXPLORATION

Client: SIGECO
Boring #: B-3
Project Name: Ash Pond Embankment
Job #: 86.33159.0022
Project Location: A.B. Brown Generating Station; West Franklin, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/9/02	Hammer Wt.	140 lbs.
Date Completed	4/9/02	Hammer Drop	30 in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0 in.
Boring Inspector	J. Kleeman	Rock Core Dia.	-- in.
Drill Method	HSA	Shelby Tube OD	3.0 in.

SOIL CLASSIFICATION / SURFACE ELEVATION	STRATUM DEPTH	DEPTH ft	SAMPLE NO.	SAMPLE TYPE	GROUND WATER	BLOWS/6-INCH INCREMENTS THREE 6-INCH INCREMENTS	RECOVERY, Percent (%)	BORING AND SAMPLING NOTES
Gray to black moist medium dense Coal Ash								
			1	SS	▽	5/5/6	100	Pushed tube from 6.0 ft to 8.0 ft.
			2	SS		3/3/4	95	
		5						
			ST 1	ST			100	
			4	SS		3/18/25	100	
		10						Bulk Sample
			5	SS		12/7/41	100	
			6	SS		7/11/10	100	
		15						
-wet and loose below 16 ft			7	SS		4/4/3	100	
-very loose below 18 ft			8	SS		1/0/1	100	
		20						

SAMPLER TYPE

SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CASING ADVANCER
RC – ROCK CORING
CU – CUTTING
CT – CONTINUOUS TUBE

▽ AT COMPLETION 3.0 FT.
▼ AFTER HRS. FT.
● WATER ON RODS FT.

HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
MD – MUD DRILLING
HA – HAND AUGER

ATC Associates Inc.

RECORD OF SUBSURFACE EXPLORATION

Client: SIGECO
Boring #: B-3
Project Name: Ash Pond Embankment
Job #: 86.33159.0022
Project Location: A.B. Brown Generating Station; West Franklin, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/9/02	Hammer Wt.	140 lbs.
Date Completed	4/9/02	Hammer Drop	30 in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0 in.
Boring Inspector	J. Kleeman	Rock Core Dia.	-- in.
Drill Method	HSA	Shelby Tube OD	3.0 in.

SOIL CLASSIFICATION / SURFACE ELEVATION	STRATUM DEPTH	DEPTH ft	SAMPLE NO.	SAMPLE TYPE	GROUND WATER	BLOWS/6-INCH INCREMENTS THREE 6-INCH INCREMENTS	RECOVERY, Percent (%)	BORING AND SAMPLING NOTES
Gray to black wet very loose Coal Ash								
			9	SS		0/0/0	30	
			10	SS		0/0/0	100	
		25						
			11	SS		1/0/0	100	
			12	SS		0/0/0	100	
		30						
			13	SS		3/4/4	50	
	33.5							
Brown moist soft to medium stiff SILTY CLAY (CL-ML)			14	SS		2/1/2	100	
		35						
			15	SS		4/4/4	100	
	37.5							
Bottom of Test Boring at 37.5 ft								

SAMPLER TYPE

SS — DRIVEN SPLIT SPOON
ST — PRESSED SHELBY TUBE
CA — CASING ADVANCER
RC — ROCK CORING
CU — CUTTING
CT — CONTINUOUS TUBE

▽ AT COMPLETION 3.0 FT.
▼ AFTER HRS. FT.
● WATER ON RODS FT.

HSA — HOLLOW STEM AUGERS
CFA — CONTINUOUS FLIGHT AUGERS
MD — MUD DRILLING
HA — HAND AUGER

ATC Associates Inc.

RECORD OF SUBSURFACE EXPLORATION

Client: SIGECO
Boring #: B-5
Project Name: Ash Pond Embankment
Job #: 86.33159.0022
Project Location: A.B. Brown Generating Station; West Franklin, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/9/02	Hammer Wt.	140 lbs.
Date Completed	4/9/02	Hammer Drop	30 in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0 in.
Boring Inspector	J. Kleeman	Rock Core Dia.	-- in.
Drill Method	HSA	Shelby Tube OD	3.0 in.

SOIL CLASSIFICATION / SURFACE ELEVATION	STRATUM DEPTH	DEPTH ft	SAMPLE NO.	SAMPLE TYPE	GROUND WATER	BLOWS/6-INCH INCREMENTS THREE 6-INCH INCREMENTS	RECOVERY, Percent (%)	BORING AND SAMPLING NOTES
Gray to black moist very loose to medium dense Coal Ash								
			1	SS		2/2/3	100	
			T 1	ST			7	
-wet below 5 ft		5						
			3	SS		0/0/1	100	
			4	SS		0/0/0	100	
-moist below 10 ft		10						Bulk Sample
			5	SS		8/6/11	100	
			6	SS		5/9/10	100	
		15						
			7	SS		2/0/6	100	
			8	SS		3/8/11	100	
		20						

SAMPLER TYPE

SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CASING ADVANCER
RC – ROCK CORING
CU – CUTTING
CT – CONTINUOUS TUBE

AT COMPLETION 3.0 FT.*
AFTER HRS. FT.
WATER ON RODS FT.

HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
MD – MUD DRILLING
HA – HAND AUGER

ATC Associates Inc.

RECORD OF SUBSURFACE EXPLORATION

Client: SIGECO
Boring #: B-5
Project Name: Ash Pond Embankment
Job #: 86.33159.0022
Project Location: A.B. Brown Generating Station; West Franklin, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/9/02	Hammer Wt.	140 lbs.
Date Completed	4/9/02	Hammer Drop	30 in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0 in.
Boring Inspector	J. Kleeman	Rock Core Dia.	-- in.
Drill Method	HSA	Shelby Tube OD	3.0 in.

SOIL CLASSIFICATION / SURFACE ELEVATION	STRATUM DEPTH	DEPTH ft	SAMPLE NO.	SAMPLE TYPE	GROUND WATER	BLOWS/6-INCH INCREMENTS THREE 6-INCH INCREMENTS	RECOVERY, Percent (%)	BORING AND SAMPLING NOTES
Gray to black wet very loose to loose Coal Ash								
			9	SS		4/2/1	100	
			10	SS		8/3/4	100	
		25						
			11	SS		2/1/0	30	
			12	SS		0/0/0	100	
		30						
			13	SS		2/1/0	100	
			14	SS		0/0/0	30	
		35						
			15	SS		0/0/0	80	
			16	SS		0/0/0	75	
		40						

SAMPLER TYPE

SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CASING ADVANCER
RC – ROCK CORING
CU – CUTTING
CT – CONTINUOUS TUBE

▽ AT COMPLETION 3.0 FT.*
▼ AFTER HRS. FT.
● WATER ON RODS FT.

HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
MD – MUD DRILLING
HA – HAND AUGER

ATC Associates Inc.

RECORD OF SUBSURFACE EXPLORATION

Client: SIGECO

Boring #: B-5

Project Name: Ash Pond Embankment

Job #: 86.33159.0022

Project Location: A.B. Brown Generating Station; West Franklin, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/9/02	Hammer Wt.	140 lbs.
Date Completed	4/9/02	Hammer Drop	30 in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0 in.
Boring Inspector	J. Kleeman	Rock Core Dia.	-- in.
Drill Method	HSA	Shelby Tube OD	3.0 in.

SOIL CLASSIFICATION / SURFACE ELEVATION	STRATUM DEPTH	DEPTH ft	SAMPLE NO.	SAMPLE TYPE	GROUND WATER	BLOWS/6-INCH INCREMENTS THREE 6-INCH INCREMENTS	RECOVERY, Percent (%)	BORING AND SAMPLING NOTES
Gray to black wet very loose to loose Coal Ash	41.0							
Gray to brown soft to medium stiff SILTY CLAY (CL-ML)			17	SS		3/3/7	50	
			18	SS		3/3/4	80	
		45						
			19	SS		2/1/2	75	
	47.5							
Bottom of Test Boring at 47.5 ft								

SAMPLER TYPE

SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CASING ADVANCER
RC – ROCK CORING
CU – CUTTING
CT – CONTINUOUS TUBE

▽ AT COMPLETION 3.0 FT.*
▼ AFTER HRS. FT.
● WATER ON RODS FT.

HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
MD – MUD DRILLING
HA – HAND AUGER

ATC Associates Inc.

RECORD OF SUBSURFACE EXPLORATION

Client: SIGECO
Boring #: B-6
Project Name: Ash Pond Embankment
Job #: 86.33159.0022
Project Location: A.B. Brown Generating Station; West Franklin, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/9/02	Hammer Wt.	140 lbs.
Date Completed	4/9/02	Hammer Drop	30 in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0 in.
Boring Inspector	J. Kleeman	Rock Core Dia.	-- in.
Drill Method	HSA	Shelby Tube OD	3.0 in.

SOIL CLASSIFICATION / SURFACE ELEVATION	STRATUM DEPTH	DEPTH ft	SAMPLE NO.	SAMPLE TYPE	GROUND WATER	BLOWS/6-INCH INCREMENTS THREE 6-INCH INCREMENTS	RECOVERY, Percent (%)	BORING AND SAMPLING NOTES
Gray to black moist very loose Coal Ash								
			1	SS		2/1/0	30	
			2	SS	▽	4/1/1	30	
-wet below 4.5 ft		5						
			3	SS		0/0/0	0	
			4	SS		0/0/0	0	
		10						
			5	SS		0/0/0	100	
			6	SS		0/0/0	100	
		15						
			7	SS		1/1/1	100	
			8	SS		0/0/0	50	
		20						

SAMPLER TYPE

SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CASING ADVANCER
RC – ROCK CORING
CU – CUTTING
CT – CONTINUOUS TUBE

▽ AT COMPLETION 4.5 FT.
▼ AFTER HRS. FT.
● WATER ON RODS FT.

HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
MD – MUD DRILLING
HA – HAND AUGER

ATC Associates Inc.

RECORD OF SUBSURFACE EXPLORATION

Client: SIGECO
Boring #: B-6
Project Name: Ash Pond Embankment
Job #: 86.33159.0022
Project Location: A.B. Brown Generating Station; West Franklin, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/9/02	Hammer Wt.	140 lbs.
Date Completed	4/9/02	Hammer Drop	30 in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0 in.
Boring Inspector	J. Kleeman	Rock Core Dia.	-- in.
Drill Method	HSA	Shelby Tube OD	3.0 in.

SOIL CLASSIFICATION / SURFACE ELEVATION	STRATUM DEPTH	DEPTH ft	SAMPLE NO.	SAMPLE TYPE	GROUND WATER	BLOWS/6-INCH INCREMENTS THREE 6-INCH INCREMENTS	RECOVERY, Percent (%)	BORING AND SAMPLING NOTES
Gray to black wet very loose Coal Ash								
			9	SS		0/0/1	100	
			10	SS		0/5/4	100	
		25						
			11	SS		1/0/1	100	
			12	SS		0/1/0	100	
		30						
			13	SS		0/0/0	100	
			14	SS		0/0/0	100	
		35						
			15	SS		0/0/0	100	
			16	SS		0/0/0	100	
		40						

SAMPLER TYPE

SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CASING ADVANCER
RC – ROCK CORING
CU – CUTTING
CT – CONTINUOUS TUBE

▽ AT COMPLETION 4.5 FT.
▼ AFTER HRS. FT.
● WATER ON RODS FT.

HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
MD – MUD DRILLING
HA – HAND AUGER

ATC Associates Inc.

RECORD OF SUBSURFACE EXPLORATION

Client: SIGECO

Boring #: B-6

Project Name: Ash Pond Embankment

Job #: 86.33159.0022

Project Location: A.B. Brown Generating Station; West Franklin, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/9/02	Hammer Wt.	140 lbs.
Date Completed	4/9/02	Hammer Drop	30 in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0 in.
Boring Inspector	J. Kleeman	Rock Core Dia.	-- in.
Drill Method	HSA	Shelby Tube OD	3.0 in.

SOIL CLASSIFICATION / SURFACE ELEVATION	STRATUM DEPTH	DEPTH ft	SAMPLE NO.	SAMPLE TYPE	GROUND WATER	BLOWS/6-INCH INCREMENTS THREE 6-INCH INCREMENTS	RECOVERY, Percent (%)	BORING AND SAMPLING NOTES
Gray to black wet very loose Coal Ash			17	SS		0/0/0	100	
	43.5							
Brown to gray moist soft SILTY CLAY (CL-ML)			18	SS		1/2/3	100	
		45						
			19	SS		2/1/3	100	
	47.5							
Bottom of Test Boring at 47.5 ft								

SAMPLER TYPE

SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CASING ADVANCER
RC – ROCK CORING
CU – CUTTING
CT – CONTINUOUS TUBE

▽ AT COMPLETION 4.5 FT.
▼ AFTER HRS. FT.
● WATER ON RODS FT.

HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
MD – MUD DRILLING
HA – HAND AUGER

ATC Associates Inc.

RECORD OF SUBSURFACE EXPLORATION

Client: SIGECO

Boring #: B-7

Project Name: Ash Pond Embankment

Job #: 86.33159.0022

Project Location: A.B. Brown Generating Station; West Franklin, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/9/02	Hammer Wt.	140	lbs.
Date Completed	4/9/02	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Boring Inspector	J. Kleeman	Rock Core Dia.	--	in.
Drill Method	HSA	Shelby Tube OD	3.0	in.

SOIL CLASSIFICATION / SURFACE ELEVATION	STRATUM DEPTH	DEPTH ft	SAMPLE NO.	SAMPLE TYPE	GROUND WATER	BLOWS/6-INCH INCREMENTS THREE 6-INCH INCREMENTS	RECOVERY, Percent (%)	BORING AND SAMPLING NOTES
Gray to black moist very loose to loose Coal Ash								
			1	SS		1/1/1	30	Pushed tube from 6.0 ft to 8.0 ft.
			2	SS		2/1/5	30	
		5						
-wet below 6 ft			ST 1	ST	▽		100	
			3	SS		6/7/5	100	
		10						Bulk Sample
			4	SS		1/0/0	60	
			5	SS		0/0/0	100	
		15						
			6	SS		0/0/0	50	
			7	SS		0/0/0	100	
		20						

SAMPLER TYPE

SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CASING ADVANCER
RC – ROCK CORING
CU – CUTTING
CT – CONTINUOUS TUBE

▽ AT COMPLETION 6.0 FT.*
▽ AFTER HRS. FT.
● WATER ON RODS FT.

HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
MD – MUD DRILLING
HA – HAND AUGER

ATC Associates Inc.

RECORD OF SUBSURFACE EXPLORATION

Client: SIGECO
Boring #: B-7
Project Name: Ash Pond Embankment
Job #: 86.33159.0022
Project Location: A.B. Brown Generating Station; West Franklin, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/9/02	Hammer Wt.	140 lbs.
Date Completed	4/9/02	Hammer Drop	30 in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0 in.
Boring Inspector	J. Kleeman	Rock Core Dia.	-- in.
Drill Method	HSA	Shelby Tube OD	3.0 in.

SOIL CLASSIFICATION / SURFACE ELEVATION	STRATUM DEPTH	DEPTH ft	SAMPLE NO.	SAMPLE TYPE	GROUND WATER	BLOWS/6-INCH INCREMENTS THREE 6-INCH INCREMENTS	RECOVERY, Percent (%)	BORING AND SAMPLING NOTES
Gray to black moist very loose to loose Coal Ash								
			8	SS		0/0/0	100	
			9	SS		0/0/0	100	
		25						
			10	SS		0/0/0	50	
			11	SS		0/0/0	10	
		30						
			12	SS		0/0/0	100	
			13	SS		0/0/0	100	
		35						
			14	SS		0/0/0	100	
			15	SS		0/0/0	10	
		40						

SAMPLER TYPE

SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CASING ADVANCER
RC – ROCK CORING
CU – CUTTING
CT – CONTINUOUS TUBE

▽ AT COMPLETION 6.0 FT.*
▼ AFTER HRS. FT.
● WATER ON RODS FT.

HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
MD – MUD DRILLING
HA – HAND AUGER

ATC Associates Inc.

RECORD OF SUBSURFACE EXPLORATION

Client: SIGECO
Boring #: B-7
Project Name: Ash Pond Embankment
Job #: 86.33159.0022
Project Location: A.B. Brown Generating Station; West Franklin, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/9/02	Hammer Wt.	140 lbs.
Date Completed	4/9/02	Hammer Drop	30 in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0 in.
Boring Inspector	J. Kleeman	Rock Core Dia.	-- in.
Drill Method	HSA	Shelby Tube OD	3.0 in.

SOIL CLASSIFICATION / SURFACE ELEVATION	STRATUM DEPTH	DEPTH ft	SAMPLE NO.	SAMPLE TYPE	GROUND WATER	BLOWS/6-INCH INCREMENTS THREE 6-INCH INCREMENTS	RECOVERY, Percent (%)	BORING AND SAMPLING NOTES
Gray to black moist very loose to loose Coal Ash			16	SS		0/0/0	80	
			17	SS		0/0/0	30	
		45						
	46.0							
Brown and gray moist soft to medium stiff SILTY CLAY (CL)			18	SS		3/3/2	40	
			19	SS		3/3/4	70	
	50.0	50						
Bottom of Test Boring at 50.0 ft								

SAMPLER TYPE

SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CASING ADVANCER
RC – ROCK CORING
CU – CUTTING
CT – CONTINUOUS TUBE

AT COMPLETION 6.0 FT.*
AFTER HRS. FT.
WATER ON RODS FT.

HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
MD – MUD DRILLING
HA – HAND AUGER

ATC Associates Inc.

RECORD OF SUBSURFACE EXPLORATION

Client: SIGECO

Boring #: B-8

Project Name: Ash Pond Embankment

Job #: 86.33159.0022

Project Location: A.B. Brown Generating Station; West Franklin, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/8/02	Hammer Wt.	140 lbs.
Date Completed	4/8/02	Hammer Drop	30 in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0 in.
Boring Inspector	J. Kleeman	Rock Core Dia.	-- in.
Drill Method	HSA	Shelby Tube OD	3.0 in.

SOIL CLASSIFICATION / SURFACE ELEVATION	STRATUM DEPTH	DEPTH ft	SAMPLE NO.	SAMPLE TYPE	GROUND WATER	BLOWS/6-INCH INCREMENTS THREE 6-INCH INCREMENTS	RECOVERY, Percent (%)	BORING AND SAMPLING NOTES
Gray to black moist very loose to loose Coal Ash								
			1	SS		6/6/4	100	
			2	SS		3/2/1	100	
		5						
-wet below 6 ft					▽			
			3	SS		1/2/0	45	
			4	SS		0/0/1	100	
		10			●			Bulk Sample
			5	SS		0/0/1	100	
			6	SS		0/0/0	100	
		15						
			7	SS		0/0/0	75	
			8	SS		0/0/0	75	
		20						

SAMPLER TYPE

SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CASING ADVANCER
RC – ROCK CORING
CU – CUTTING
CT – CONTINUOUS TUBE

▽ AT COMPLETION 6.0 FT.
▽ AFTER HRS. FT.
● WATER ON RODS 10.0 FT.

HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
MD – MUD DRILLING
HA – HAND AUGER

ATC Associates Inc.

RECORD OF SUBSURFACE EXPLORATION

Client: SIGECO
Boring #: B-8
Project Name: Ash Pond Embankment
Job #: 86.33159.0022
Project Location: A.B. Brown Generating Station; West Franklin, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/8/02	Hammer Wt.	140 lbs.
Date Completed	4/8/02	Hammer Drop	30 in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0 in.
Boring Inspector	J. Kleeman	Rock Core Dia.	-- in.
Drill Method	HSA	Shelby Tube OD	3.0 in.

SOIL CLASSIFICATION / SURFACE ELEVATION	STRATUM DEPTH	DEPTH ft	SAMPLE NO.	SAMPLE TYPE	GROUND WATER	BLOWS/6-INCH INCREMENTS THREE 6-INCH INCREMENTS	RECOVERY, Percent (%)	BORING AND SAMPLING NOTES
Gray to black moist very loose to loose Coal Ash								
			9	SS		0/0/0	100	
			10	SS		0/0/0	50	
		25						
			11	SS		0/0/0	100	
			12	SS		0/0/0	100	
		30						
			13	SS		0/0/0	100	
			14	SS		0/0/0	100	
		35						
	37.0		15	SS		2/1/2	100	
Brown wet soft SILTY CLAY (CL-ML)								
Bottom of Test Boring at 40.0 ft			16	SS		0/2/2	30	
	40.0	40						

SAMPLER TYPE

SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CASING ADVANCER
RC – ROCK CORING
CU – CUTTING
CT – CONTINUOUS TUBE

▽ AT COMPLETION 6.0 FT.
▼ AFTER HRS. FT.
● WATER ON RODS 10.0 FT.

HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
MD – MUD DRILLING
HA – HAND AUGER

ATC Associates Inc.

RECORD OF SUBSURFACE EXPLORATION

Client: SIGECO

Boring #: B-10

Project Name: Ash Pond Embankment

Job #: 86.33159.0022

Project Location: A.B. Brown Generating Station; West Franklin, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/8/02	Hammer Wt.	140 lbs.
Date Completed	4/8/02	Hammer Drop	30 in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0 in.
Boring Inspector	J. Kleeman	Rock Core Dia.	-- in.
Drill Method	HSA	Shelby Tube OD	3.0 in.

SOIL CLASSIFICATION / SURFACE ELEVATION	STRATUM DEPTH	DEPTH ft	SAMPLE NO.	SAMPLE TYPE	GROUND WATER	BLOWS/6-INCH INCREMENTS THREE 6-INCH INCREMENTS	RECOVERY, Percent (%)	BORING AND SAMPLING NOTES
Gray to black moist very loose Coal Ash								
			1	SS		1/1/1	50	
			2	SS		4/2/1	50	
		5						
			3	SS	▽	1/0/0	100	
-wet below 7 ft								
			4	SS		0/1/0	100	
		10						Bulk Sample
			5	SS		0/0/0	100	
			6	SS		0/0/0	50	
		15						
			7	SS		0/0/0	100	
			8	SS		0/0/0	100	
		20						

SAMPLER TYPE

SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CASING ADVANCER
RC – ROCK CORING
CU – CUTTING
CT – CONTINUOUS TUBE

▽ AT COMPLETION 7.0 FT.
▼ AFTER HRS. FT.
● WATER ON RODS FT.

HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
MD – MUD DRILLING
HA – HAND AUGER

ATC Associates Inc.

RECORD OF SUBSURFACE EXPLORATION

Client: SIGECO

Boring #: B-10

Project Name: Ash Pond Embankment

Job #: 86.33159.0022

Project Location: A.B. Brown Generating Station; West Franklin, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/8/02	Hammer Wt.	140	lbs.
Date Completed	4/8/02	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Boring Inspector	J. Kleeman	Rock Core Dia.	--	in.
Drill Method	HSA	Shelby Tube OD	3.0	in.

SOIL CLASSIFICATION / SURFACE ELEVATION	STRATUM DEPTH	DEPTH ft	SAMPLE NO.	SAMPLE TYPE	GROUND WATER	BLOWS/6-INCH INCREMENTS THREE 6-INCH INCREMENTS	RECOVERY, Percent (%)	BORING AND SAMPLING NOTES
Gray to black moist very loose Coal Ash								
			9	SS		0/0/0	100	
			10	SS		0/0/0	100	
		25						
	27.0		11	SS		0/0/1	100	
Brown wet soft SILTY CLAY (CL-ML)								
			12	SS		2/2/2	100	
	30.0	30						
Bottom of Test Boring at 30.0 ft								

SAMPLER TYPE

SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CASING ADVANCER
RC – ROCK CORING
CU – CUTTING
CT – CONTINUOUS TUBE

AT COMPLETION 7.0 FT.
AFTER HRS. FT.
WATER ON RODS FT.

HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
MD – MUD DRILLING
HA – HAND AUGER

ATC Associates Inc.

RECORD OF SUBSURFACE EXPLORATION

Client: SIGECO

Boring #: B-11

Project Name: Ash Pond Embankment

Job #: 86.33159.0022

Project Location: A.B. Brown Generating Station; West Franklin, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/8/02	Hammer Wt.	140 lbs.
Date Completed	4/8/02	Hammer Drop	30 in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0 in.
Boring Inspector	J. Kleeman	Rock Core Dia.	-- in.
Drill Method	HSA	Shelby Tube OD	3.0 in.

SOIL CLASSIFICATION / SURFACE ELEVATION	STRATUM DEPTH	DEPTH ft	SAMPLE NO.	SAMPLE TYPE	GROUND WATER	BLOWS/6-INCH INCREMENTS THREE 6-INCH INCREMENTS	RECOVERY, Percent (%)	BORING AND SAMPLING NOTES
Brown moist very soft Silty Clay (POSSIBLE FILL)			1	SS		2/1/1	100	
	3.0							
Brown wet very soft Clayey Silt (POSSIBLE FILL)			2	SS		1/1/1	75	
		5						
			3	SS		1/1/1	100	
	8.0							
Brown moist soft SILTY CLAY (CL-ML)			4	SS		1/2/3	100	
		10						
			5	SS		1/2/3	100	
			6	SS		2/2/3	100	
		15						
	16.0							
Reddish brown moist medium stiff SILTY CLAY (CL)			7	SS		2/3/3	100	
			8	SS		3/3/4	100	
		20						

SAMPLER TYPE

SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CASING ADVANCER
RC – ROCK CORING
CU – CUTTING
CT – CONTINUOUS TUBE

AT COMPLETION FT.
AFTER HRS. FT.
WATER ON RODS 20.5 FT.

HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
MD – MUD DRILLING
HA – HAND AUGER

ATC Associates Inc.

RECORD OF SUBSURFACE EXPLORATION

Client: SIGECO
Boring #: B-11
Project Name: Ash Pond Embankment
Job #: 86.33159.0022
Project Location: A.B. Brown Generating Station; West Franklin, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	4/8/02	Hammer Wt.	140	lbs.
Date Completed	4/8/02	Hammer Drop	30	in.
Drill Foreman	W. Bates	Spoon Sampler OD	2.0	in.
Boring Inspector	J. Kleeman	Rock Core Dia.	--	in.
Drill Method	HSA	Shelby Tube OD	3.0	in.

SOIL CLASSIFICATION / SURFACE ELEVATION	STRATUM DEPTH	DEPTH ft	SAMPLE NO.	SAMPLE TYPE	GROUND WATER	BLOWS/6-INCH INCREMENTS THREE 6-INCH INCREMENTS	RECOVERY, Percent (%)	BORING AND SAMPLING NOTES
Reddish brown moist stiff to very stiff SILTY CLAY (CL)					●			
			9	SS		3/6/7	100	
-mottled yellow brown below 23 ft								
			10	SS		4/6/9	100	
	25.0	25						
Bottom of Test Boring at 25.0 ft								

SAMPLER TYPE

SS – DRIVEN SPLIT SPOON
ST – PRESSED SHELBY TUBE
CA – CASING ADVANCER
RC – ROCK CORING
CU – CUTTING
CT – CONTINUOUS TUBE

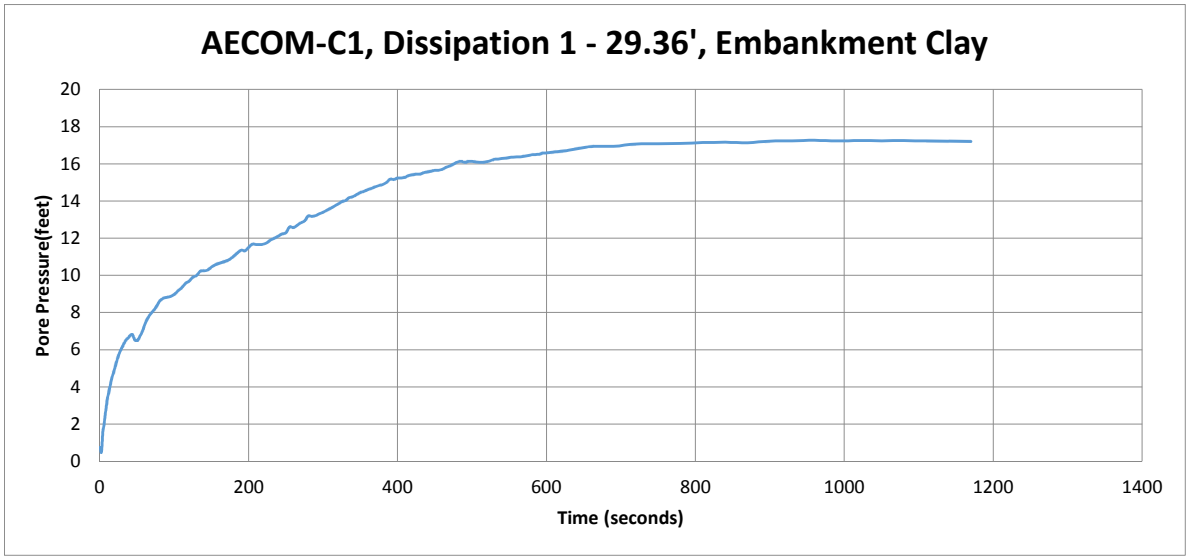
▽ AT COMPLETION FT.
▼ AFTER HRS. FT.
● WATER ON RODS 20.5 FT.

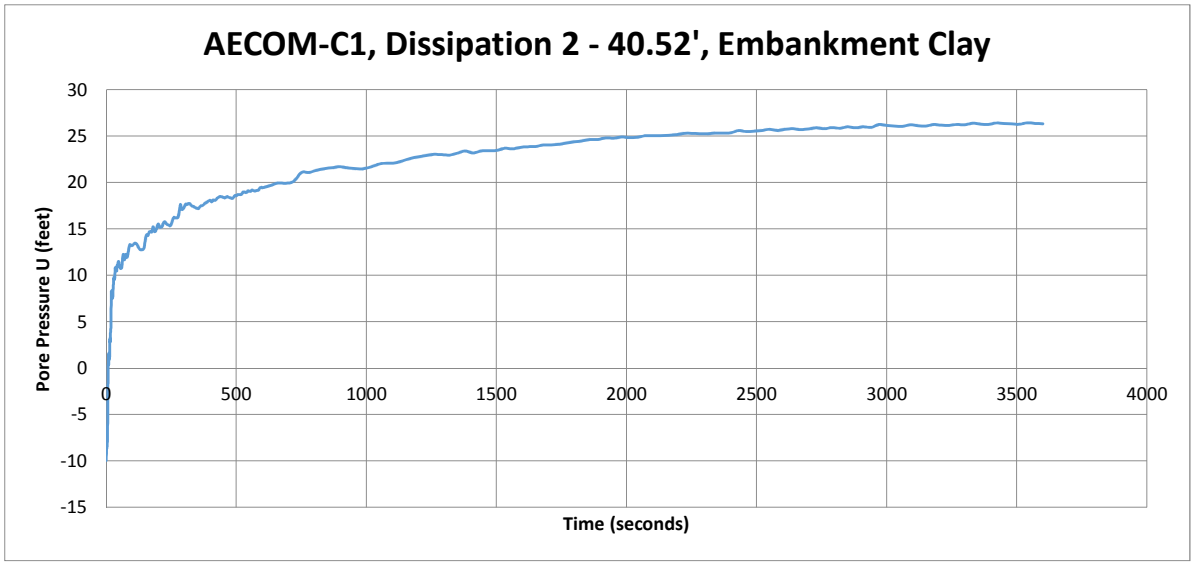
HSA – HOLLOW STEM AUGERS
CFA – CONTINUOUS FLIGHT AUGERS
MD – MUD DRILLING
HA – HAND AUGER

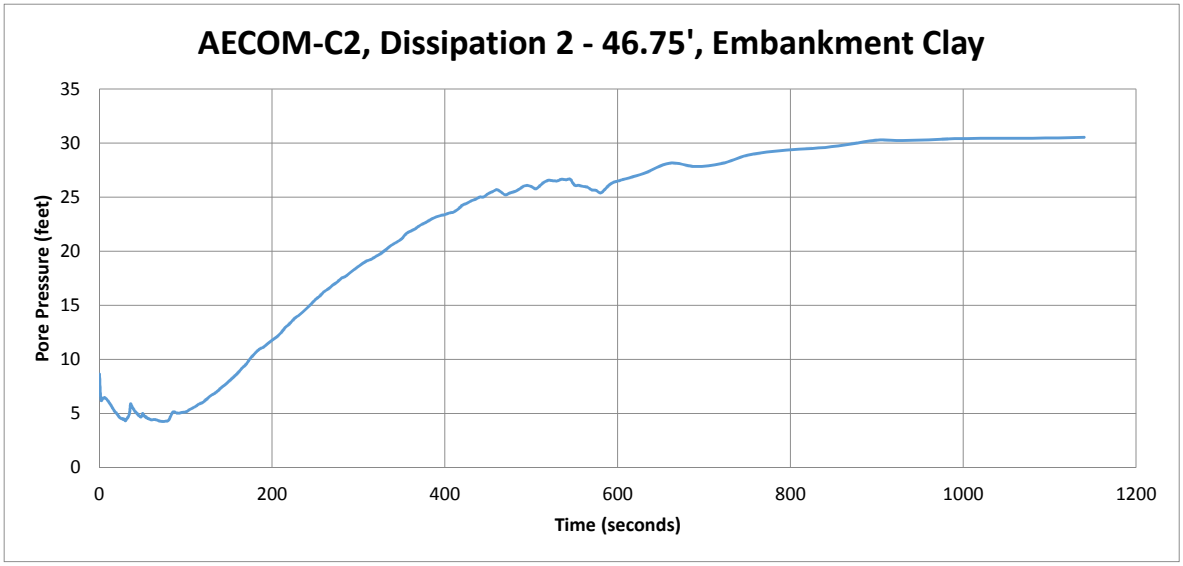
Appendix C
CPT Data Report

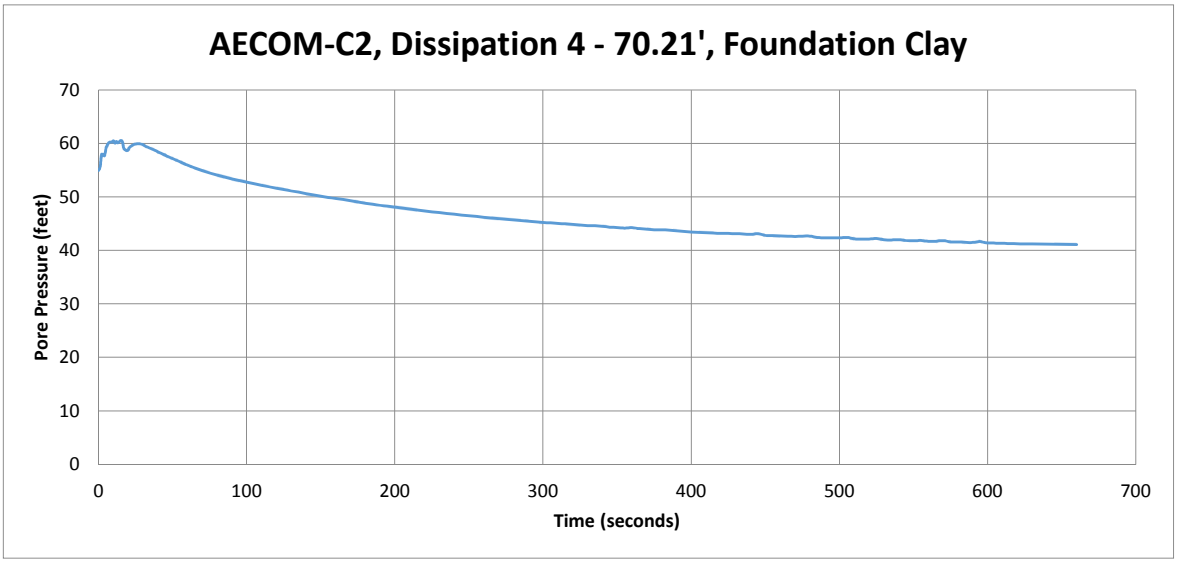
Shear Wave Velocity Summary			
CPT Sounding/Cardno Boring ID	Depth (ft)	Vs (ft/sec)	Material
AECOM-C1/B-202	13.2	704	Embankment Fill
	19.8	733.27	
	26.4	836.22	
	33	846.88	
	39.6	721.85	
	46.2	1185.27	
	52.8	878.12	Foundation Silty Clays
	59.4	696.13	
	66	982.25	
	72.6	747.15	
	79.2	1255.91	
	85.8	1046.85	
	92.4	1283.5	
AECOM-C2/B-203	13.2	823.46	Embankment Fill
	20.1	755.87	
	26.7	988.65	
	33.3	756.69	
	40	922.77	
	46.6	948.49	
	53.2	947.8	
	57	815.09	Foundation Silty Clays
	63.6	830.74	
	74	958.15	
	80.6	780.28	
	87.2	1163.52	
AECOM-C3/B-219	7	562.16	Foundation Silts
	13.6	504.69	
	20.2	631.86	Foundation Silty Clays
	26.8	988.65	
	33.4	928.57	
	40	721.36	
	46.6	991.4	
AECOM-C4/B-206	7.3	607.74	Embankment Fill
	13.9	733.7	
	20.5	765.12	Foundation Silts
	27.1	712.86	
	33.7	984.38	Foundation Silty Clays
	40.1	734.94	Foundation Silts
	46.7	694	Foundation Silty Clays
	53.3	613.52	
	60	792.91	Foundation Silts
	66.6	679.89	
	73.2	883.37	Foundation Silty Clays
AECOM-C5/B-205	6.6	649.54	Embankment Fill
	13.2	773.52	
	20.1	728.25	
	26.7	718.77	Foundation Silts
	33.3	661.41	
	40	723.92	
	45	725.59	
	50.1	725.72	
	55	845.8	Foundation Silty Clays

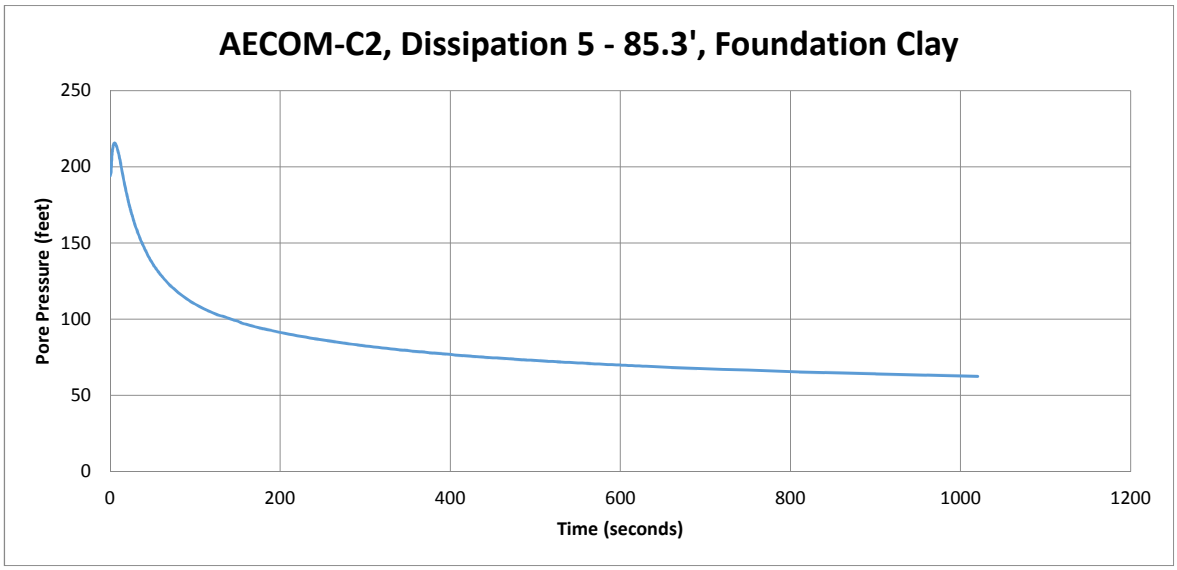
CPT Sounding	Dissipation Test	Depth (ft)	Estimated t50 (sec)	Estimated Hydraulic Conductivity kh (cm/sec)	Material	Run to apparent Equilibrium?
AECOM-C1	1	29.4	100	3.17E-06	Embankment Fill	Yes
	2	40.5	26	1.70E-05		Yes
	3	55.0	Poor Data	Poor Data	Foundation Clay	--
AECOM-C2	1	30.2	645	3.08E-07	Embankment Fill	No
	2	46.8	48	7.92E-06		Yes
	3	55.1	380	5.97E-07		No
	4	70.2	115	2.66E-06	Foundation Clay	Yes
	5	85.3	995	1.79E-07		Yes
AECOM-C3	1	7.4	42	9.36E-06	Foundation Silt	No
	2	14.8	1121	1.54E-07		Yes
	3	7.2	18	2.70E-05		Yes
	4	30.2	1033	1.71E-07	Foundation Clay	No
	5	40.7	477	4.49E-07		No
AECOM-C4	1	7.4	Poor Data	Poor Data	Embankment Fill	--
	2	19.5	600	3.37E-07	Foundation Silt	No
	3	24.9	745	2.57E-07		No
	4	30.0	100	3.17E-06		No
	5	49.9	569	3.60E-07	Foundation Clay	Yes
	6	60.4	375	6.07E-07	Foundation Silt	Yes
	7	65.0	14	3.70E-05		Yes
	8	69.9	172	1.61E-06		No
	9	75.6	330	7.12E-07	Foundation Clay	No
AECOM-C5	1	19.9	900	2.03E-07	Embankment Fill	No
	2	24.9	19	2.52E-05		Yes
	3	30.0	47	8.13E-06	Foundation Silt	Yes
	4	34.9	82	4.06E-06		No
	5	40.0	84	3.94E-06		No
	6	45.0	61	5.87E-06		No
	7	49.9	113	2.72E-06		No
	8	55.0	87	3.77E-06	Foundation Clay	No

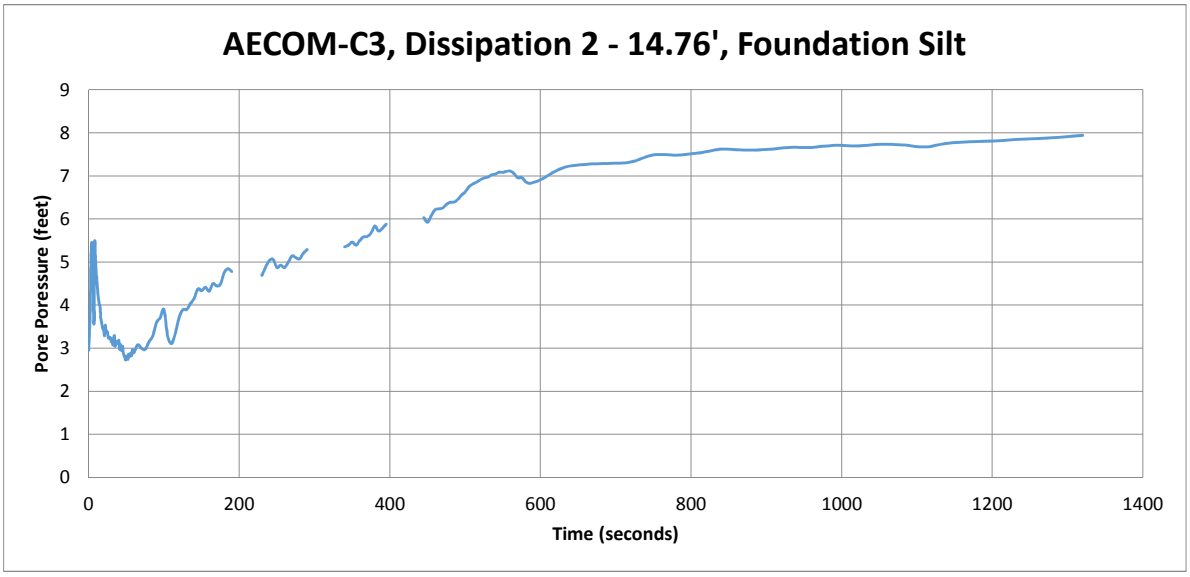

AECOM-C1, Dissipation 1 - 29.36', Embankment Clay
Pore Pressure(feet)
Time (seconds)
0
2
4
6
8
10
12
14
16
18
20
0
200
400
600
800
1000
1200
1400

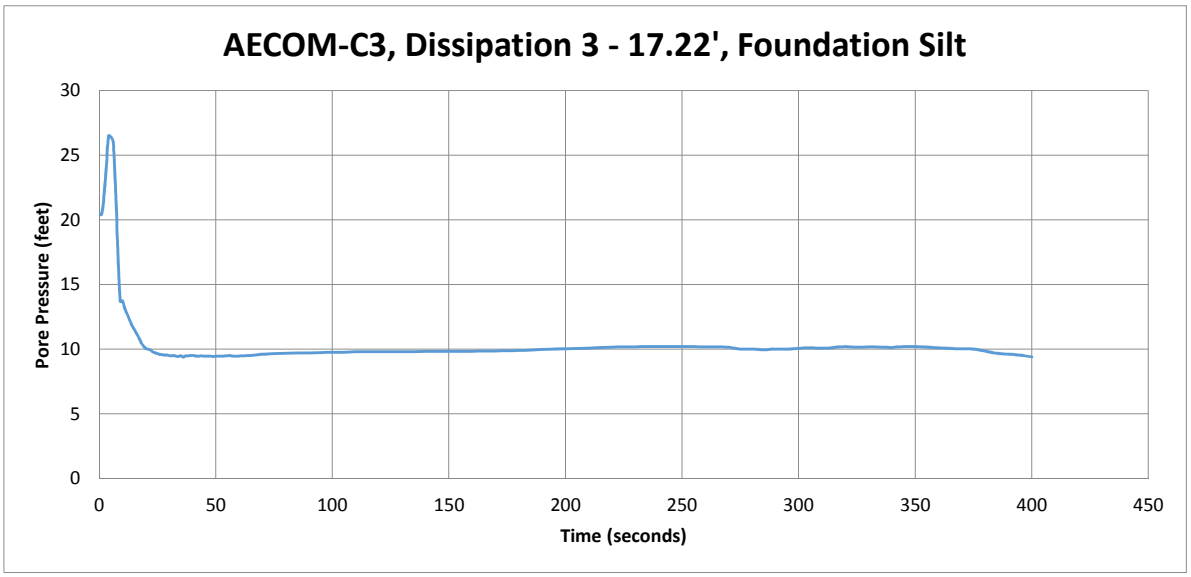

AECOM-C1, Dissipation 2 - 40.52', Embankment Clay
Pore Pressure U (feet)
Time (seconds)
30
25
20
15
10
5
0
-5
-10
-15
0
500
1000
1500
2000
2500
3000
3500
4000

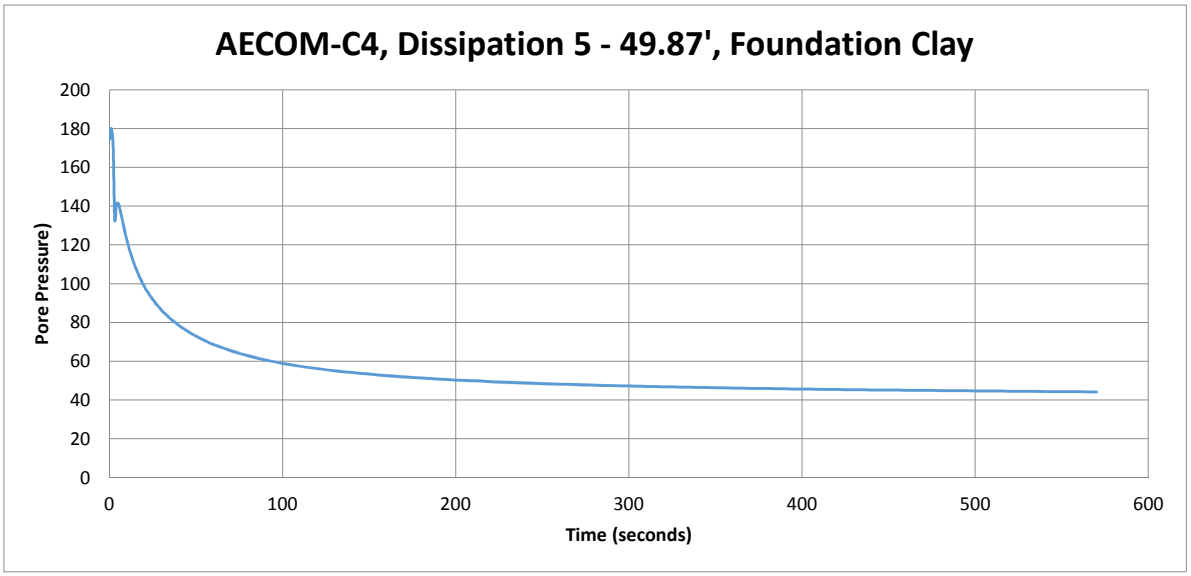

AECOM-C2, Dissipation 2 - 46.75', Embankment Clay
Pore Pressure (feet)
Time (seconds)
35
30
25
20
15
10
5
0
0
200
400
600
800
1000
1200

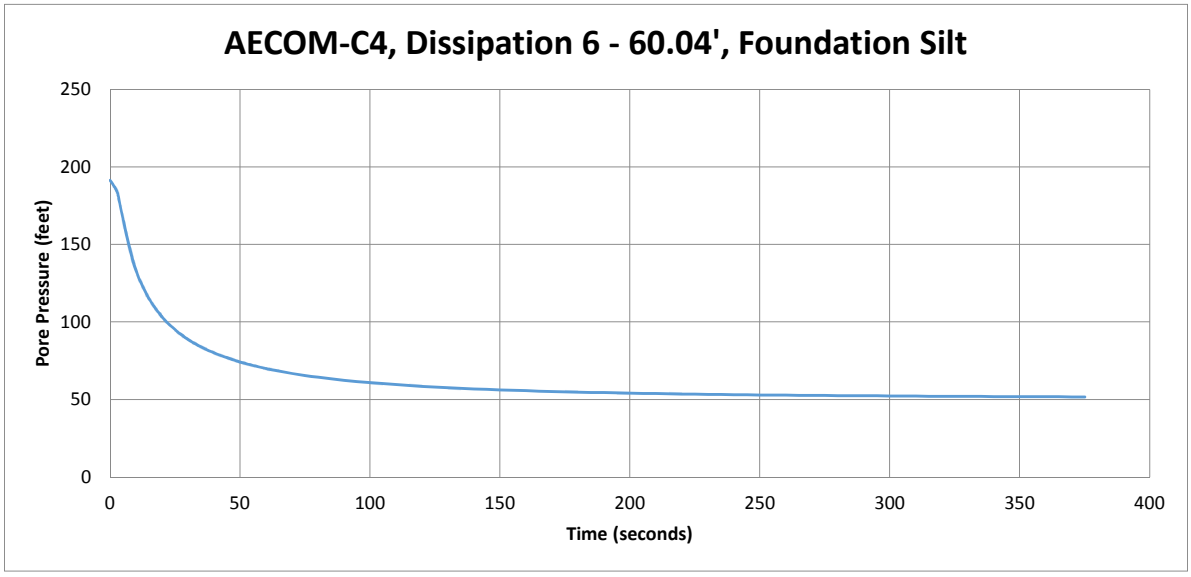

AECOM-C2, Dissipation 4 - 70.21', Foundation Clay
Pore Pressure (feet)
70
60
50
40
30
20
10
0
0
100
200
300
400
500
600
700
Time (seconds)

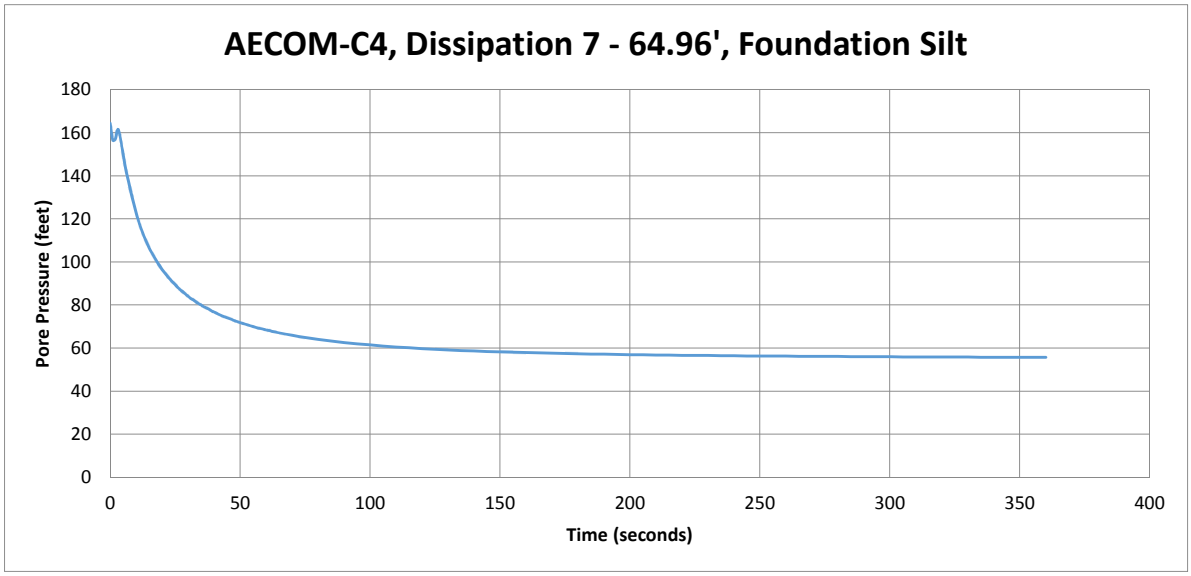

AECOM-C2, Dissipation 5 - 85.3', Foundation Clay
Pore Pressure (feet)
250
200
150
100
50
0
0
200
400
600
800
1000
1200
Time (seconds)

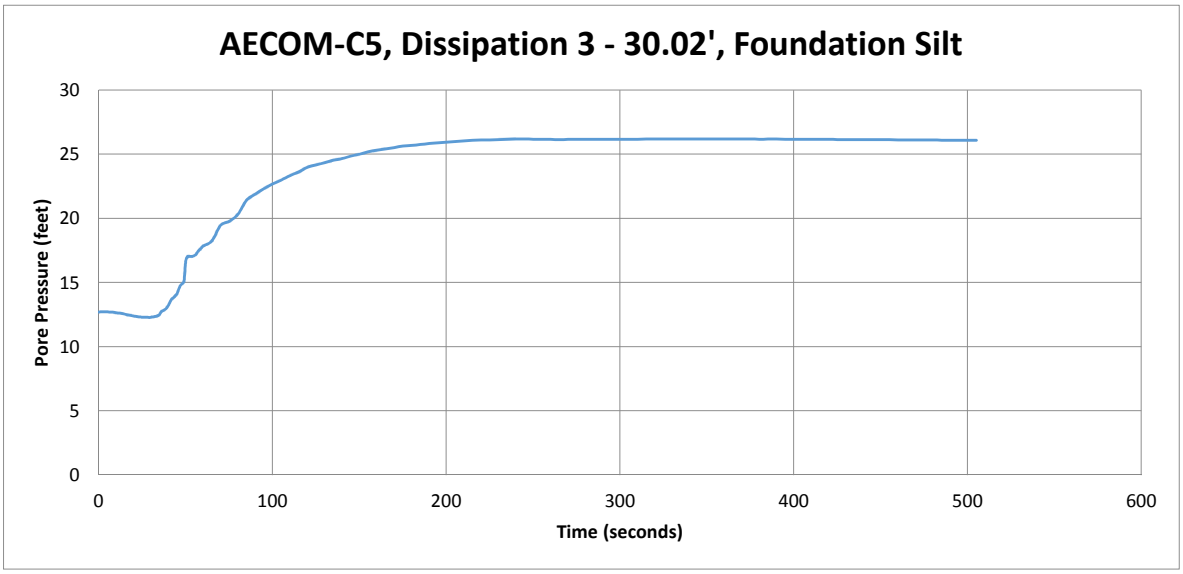

AECOM-C3, Dissipation 2 - 14.76', Foundation Silt
Pore Poressure (feet)
9
8
7
6
5
4
3
2
1
0
0
200
400
600
800
1000
1200
1400
Time (seconds)


AECOM-C3, Dissipation 3 - 17.22', Foundation Silt
Pore Pressure (feet)
30
25
20
15
10
5
0
0
50
100
150
200
250
300
350
400
450
Time (seconds)


AECOM-C4, Dissipation 5 - 49.87', Foundation Clay
Pore Pressure)
200
180
160
140
120
100
80
60
40
20
0
0
100
200
300
400
500
600
Time (seconds)


AECOM-C4, Dissipation 6 - 60.04', Foundation Silt
Pore Pressure (feet)
250
200
150
100
50
0
0
50
100
150
200
250
300
350
400
Time (seconds)


AECOM-C4, Dissipation 7 - 64.96', Foundation Silt
Pore Pressure (feet)
180
160
140
120
100
80
60
40
20
0
0
50
100
150
200
250
300
350
400
Time (seconds)


AECOM-C5, Dissipation 3 - 30.02', Foundation Silt
Pore Pressure (feet)
30
25
20
15
10
5
0
0
100
200
300
400
500
600
Time (seconds)

AECOM-C1

Depth (ft)	U_{peak} (ft)	t-U_{peak} (sec)	U_{eq} (ft)	$U_{average}$ (ft)	t-$U_{average}$ (sec)	t_{50} (sec)	Hydraulic Conductivity, k_h (cm/s)
29.1	0.9	0	17.2	9.0	100	100.0	3.17E-06
40.5	-9.9	0	26.2	8.2	26	26.0	1.70E-05

AECOM-C2

Depth (ft)	U_{peak} (ft)	t-U_{peak} (sec)	U_{eq} (ft)	$U_{average}$ (ft)	t-$U_{average}$ (sec)	t_{50} (sec)	Hydraulic Conductivity, k_h (cm/s)
30.2	4.3	75	30.3	17.3	123	48.0	7.92E-06
70.2	60.6	15	41.6	51.1	130	115.0	2.66E-06
85.3	215.7	5	63.0	139.3	1000	995.0	1.79E-07

AECOM-C3

Depth (ft)	U_{peak} (ft)	t-U_{peak} (sec)	U_{eq} (ft)	$U_{average}$ (ft)	t-$U_{average}$ (sec)	t_{50} (sec)	Hydraulic Conductivity, k_h (cm/s)
14.8	2.7	49	7.8	5.3	1170	1121.0	1.54E-07
17.2	26.5	4	9.9	18.2	22	18.0	2.70E-05

AECOM-C4

Depth (ft)	U_{peak} (ft)	t-U_{peak} (sec)	U_{eq} (ft)	$U_{average}$ (ft)	t-$U_{average}$ (sec)	t_{50} (sec)	Hydraulic Conductivity, k_h (cm/s)
49.9	180.1	1	44.2	112.2	570	569.0	3.60E-07
60.0	191.4	0	51.7	121.6	375	375.0	6.07E-07
65.0	164.4	0	55.8	110.1	14	14.0	3.70E-05

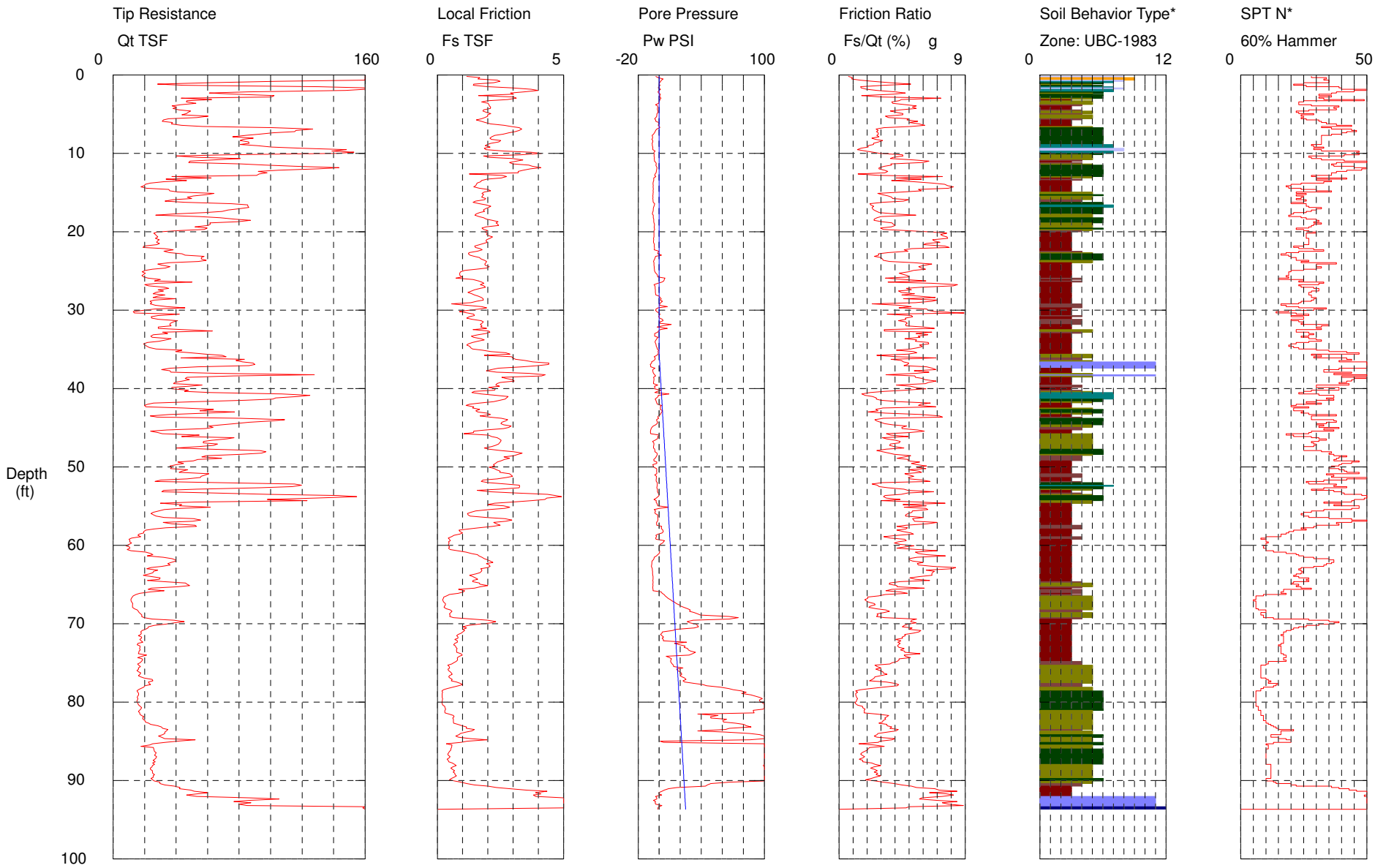
AECOM-C5

Depth (ft)	U_{peak} (ft)	t-U_{peak} (sec)	U_{eq} (ft)	$U_{average}$ (ft)	t-$U_{average}$ (sec)	t_{50} (sec)	Hydraulic Conductivity, k_h (cm/s)
24.9	15.9	0	20.5	18.2	19	19.0	2.52E-05
30.0	12.3	22	26.1	19.2	69	47.0	8.13E-06

CPT-1

Operator: Cardno ATC
Sounding: Elev: 450
Cone Used: DDG1181

CPT Date/Time: 10/2/2015 9:46:26 AM
Location: Vectren-AB Brown
Job Number: 170GC00108



Maximum Depth = 93.67 feet

Depth Increment = 0.164 feet

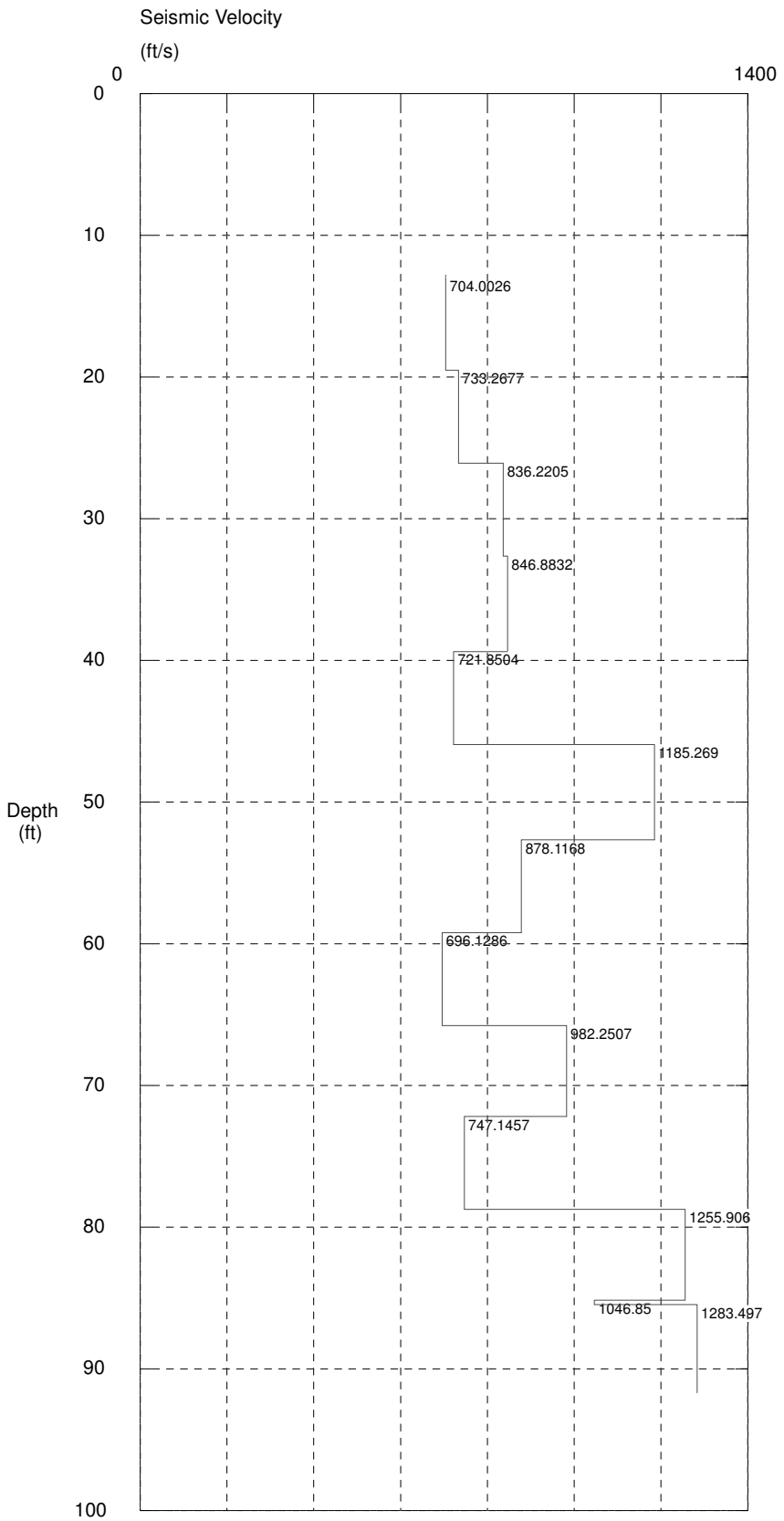
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

CPT-1

Operator: Cardno ATC
Sounding: Elev: 450
Cone Used: DDG1181

CPT Date/Time: 10/2/2015 9:46:26 AM
Location: Vectren-AB Brown
Job Number: 170GC00108



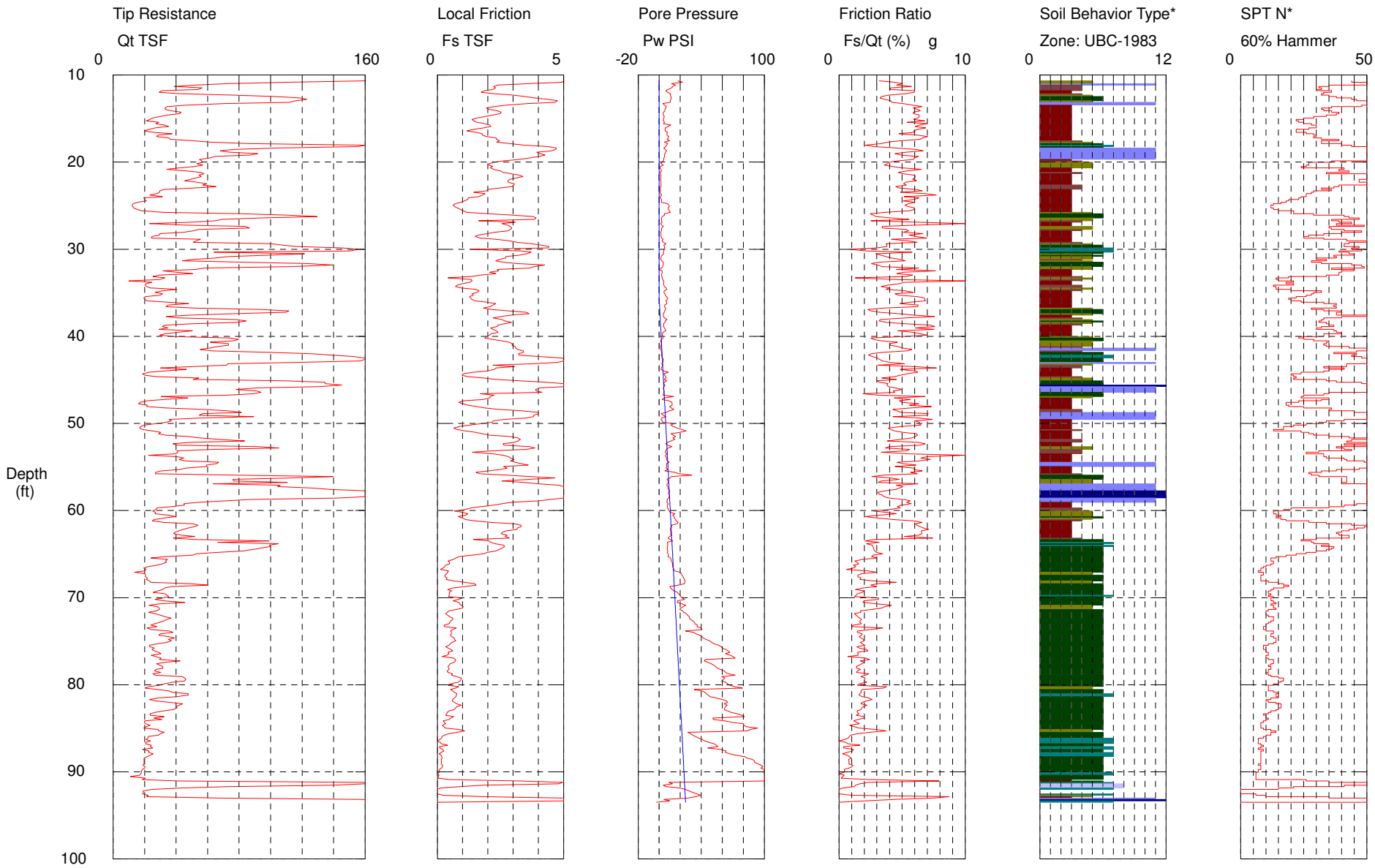
Maximum Depth = 93.67 feet

Depth Increment = 0.164 feet

CPT-2

Operator: Cardno ATC
Sounding: Elev.: 450
Cone Used: DDG1181

CPT Date/Time: 10/2/2015 1:48:58 PM
Location: Vectren-AB Brown
Job Number: 170GC00108



Maximum Depth = 93.50 feet

Depth Increment = 0.164 feet

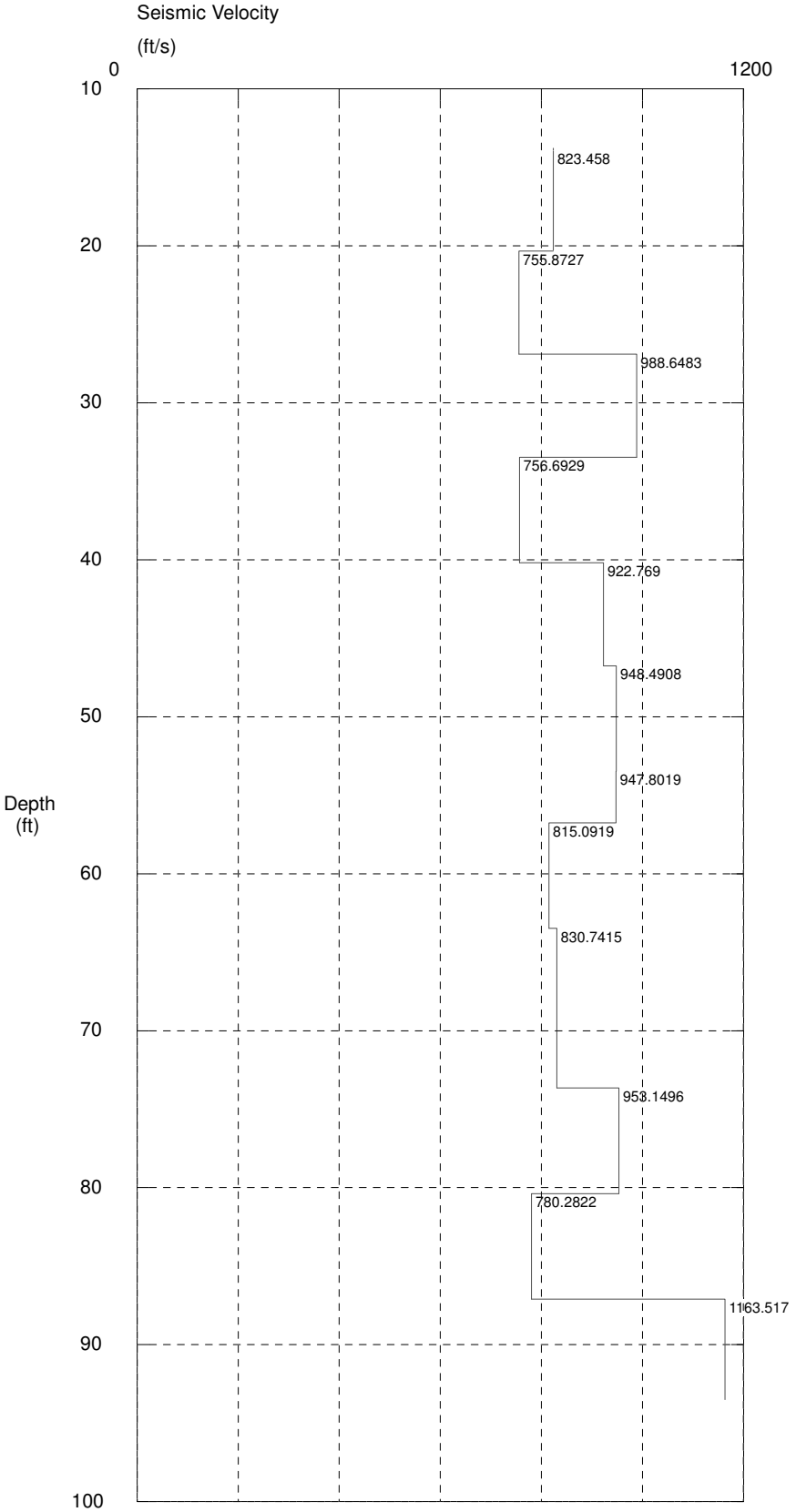
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

CPT-2

Operator: Cardno ATC
Sounding: Elev.: 450
Cone Used: DDG1181

CPT Date/Time: 10/2/2015 1:48:58 PM
Location: Vectren-AB Brown
Job Number: 170GC00108



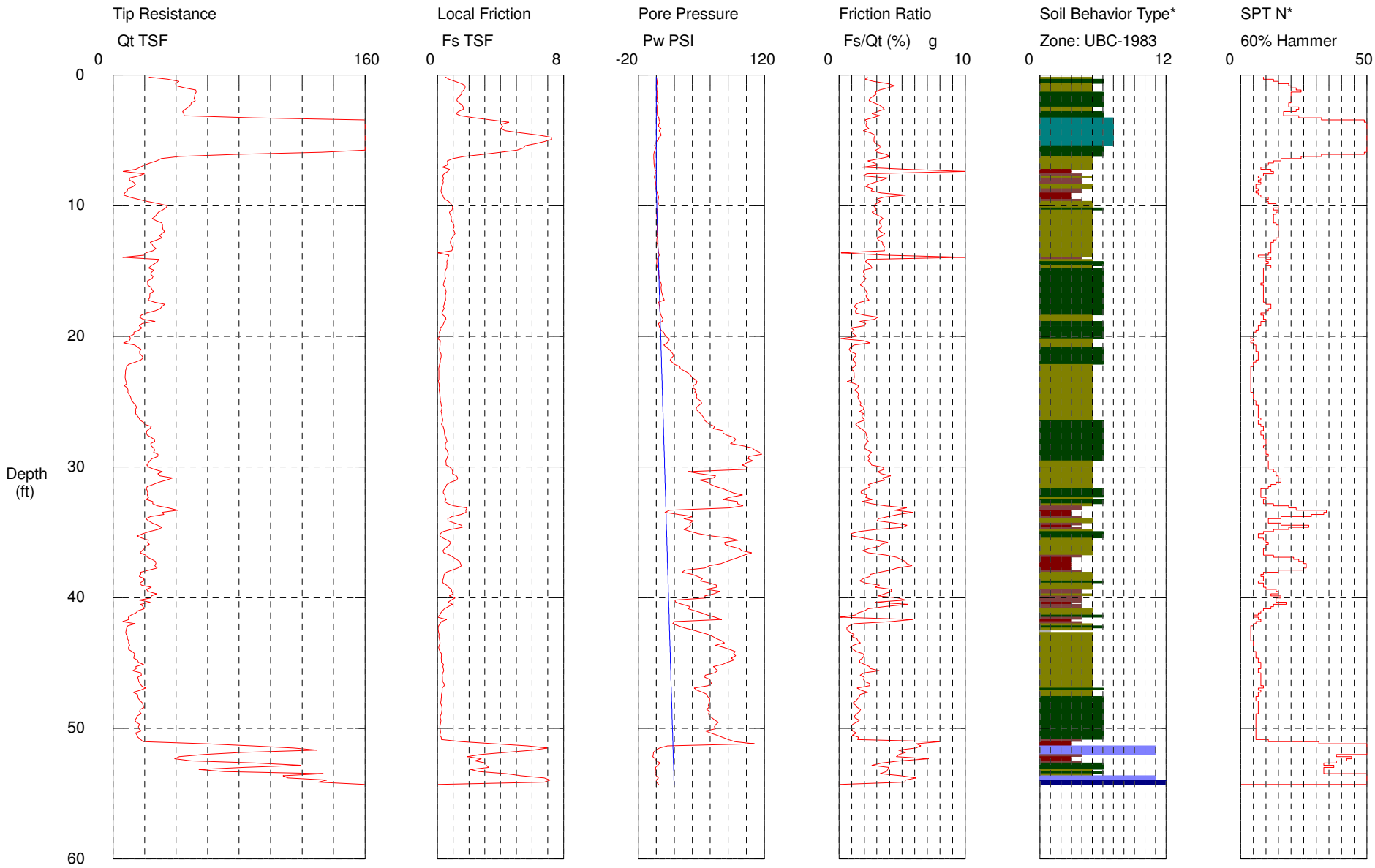
Maximum Depth = 93.50 feet

Depth Increment = 0.164 feet

CPT-3

Operator: Cardno ATC
Sounding: Elev: 415
Cone Used: DDG1181

CPT Date/Time: 10/1/2015 12:04:46 PM
Location: Vectren-AB Brown
Job Number: 170GC00108



Maximum Depth = 54.30 feet

Depth Increment = 0.164 feet

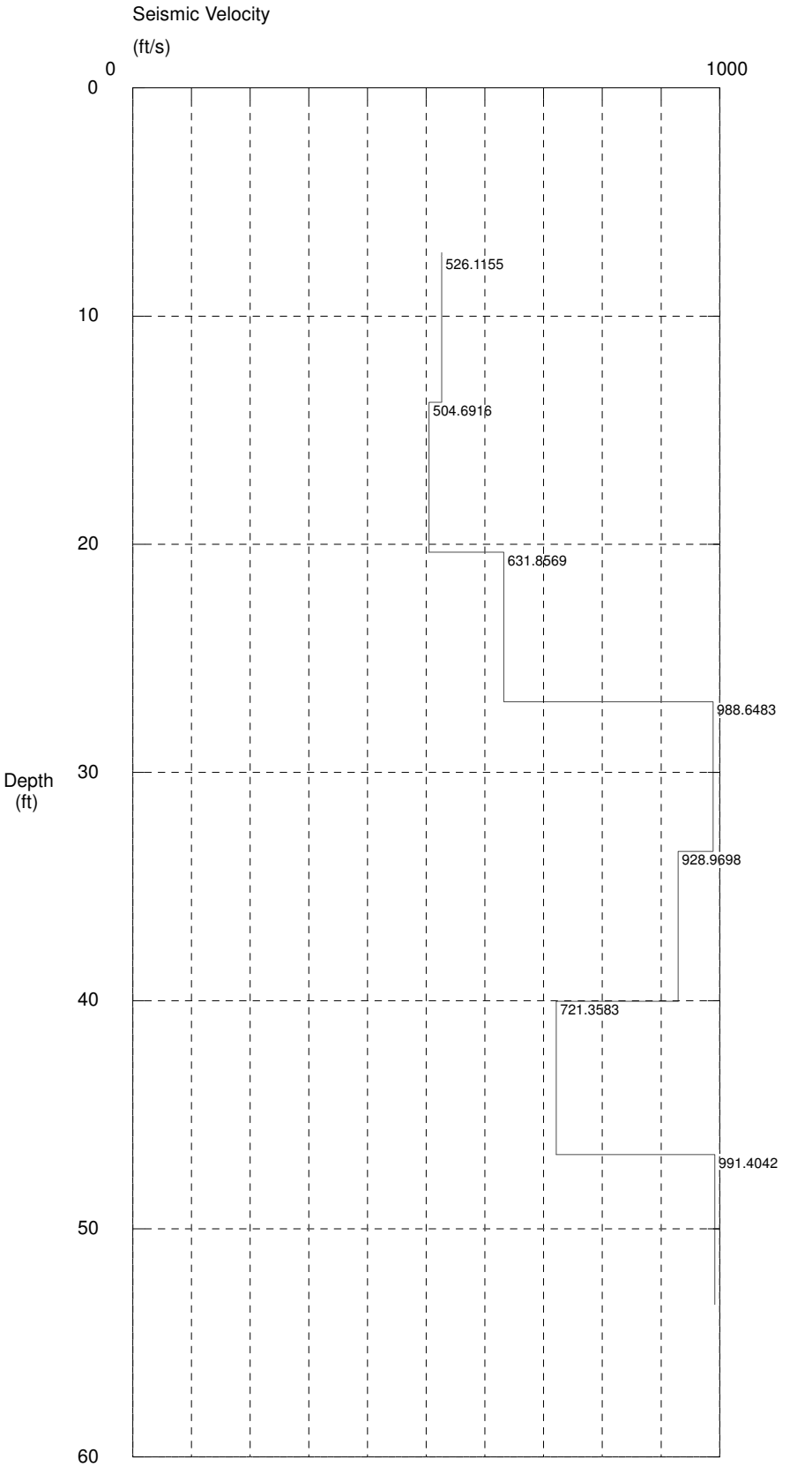
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

CPT-3

Operator: Cardno ATC
Sounding: Elev: 415
Cone Used: DDG1181

CPT Date/Time: 10/1/2015 12:04:46 PM
Location: Vectren-AB Brown
Job Number: 170GC00108



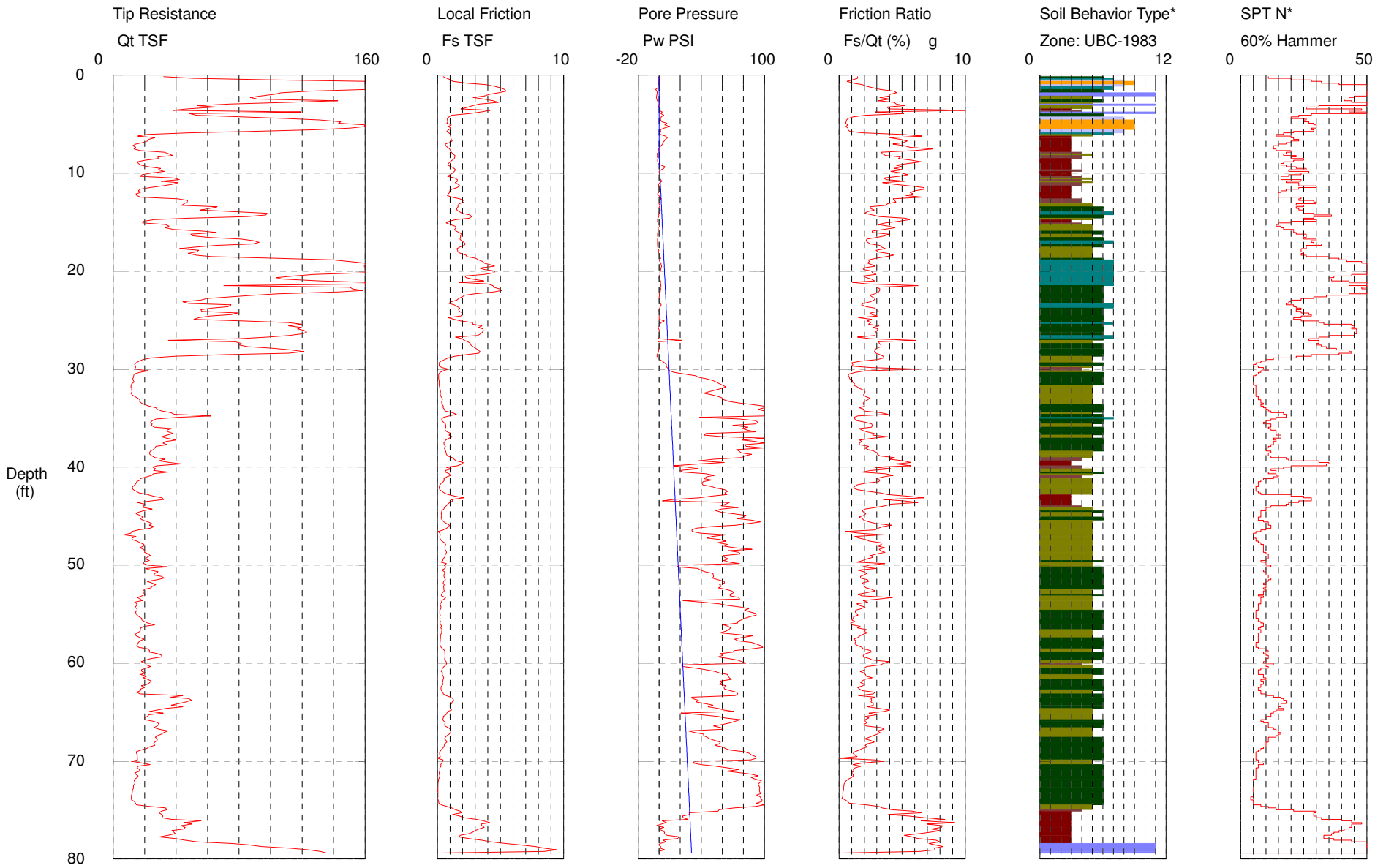
Maximum Depth = 54.30 feet

Depth Increment = 0.164 feet

CPT-4

Operator: Cardno ATC
Sounding: Elev.: 415
Cone Used: DDG1181

CPT Date/Time: 10/1/2015 2:34:16 PM
Location: Vectren-AB Brown
Job Number: 170GC00108



Maximum Depth = 79.40 feet

Depth Increment = 0.164 feet

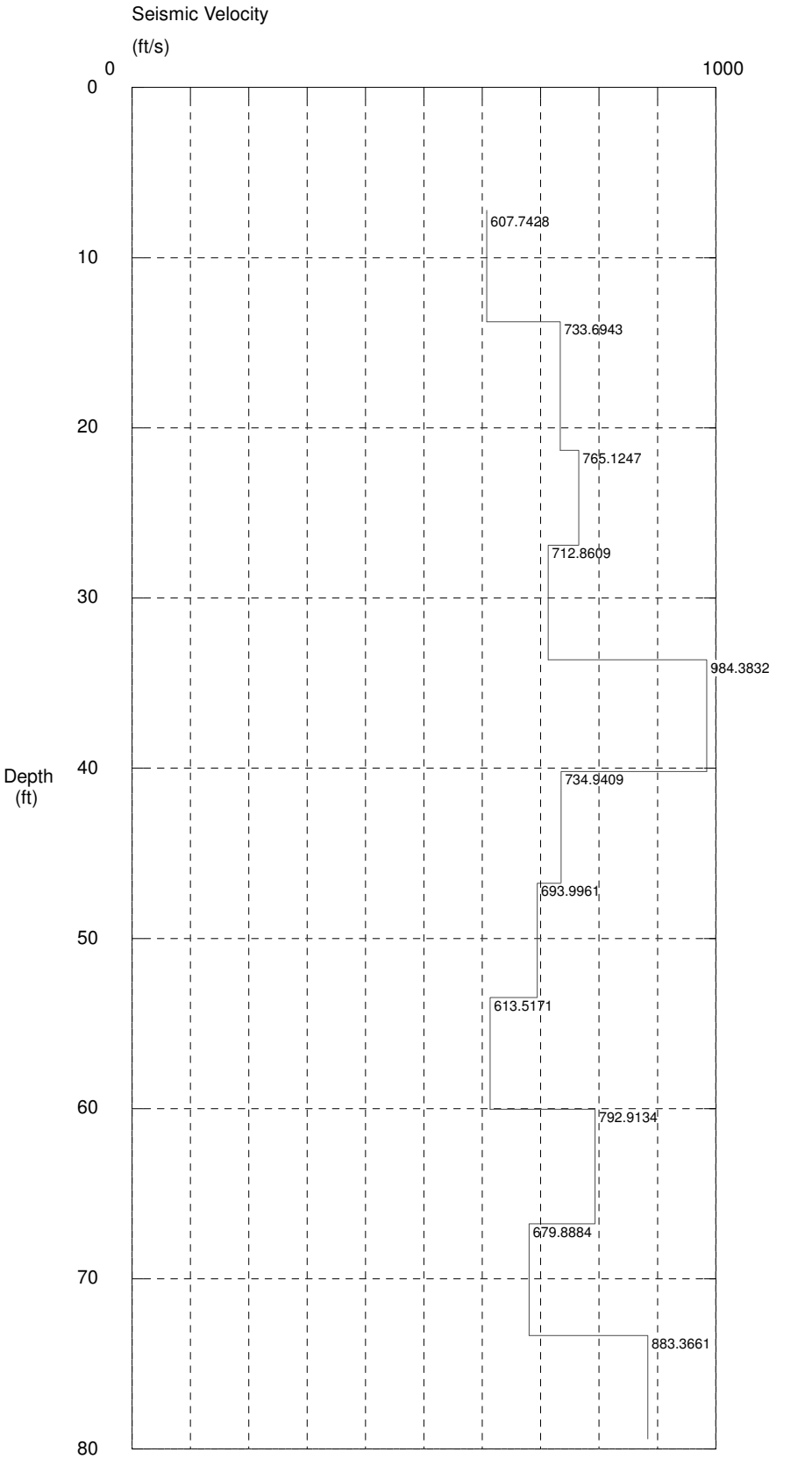
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

CPT-4

Operator: Cardno ATC
Sounding: Elev.: 415
Cone Used: DDG1181

CPT Date/Time: 10/1/2015 2:34:16 PM
Location: Vectren-AB Brown
Job Number: 170GC00108



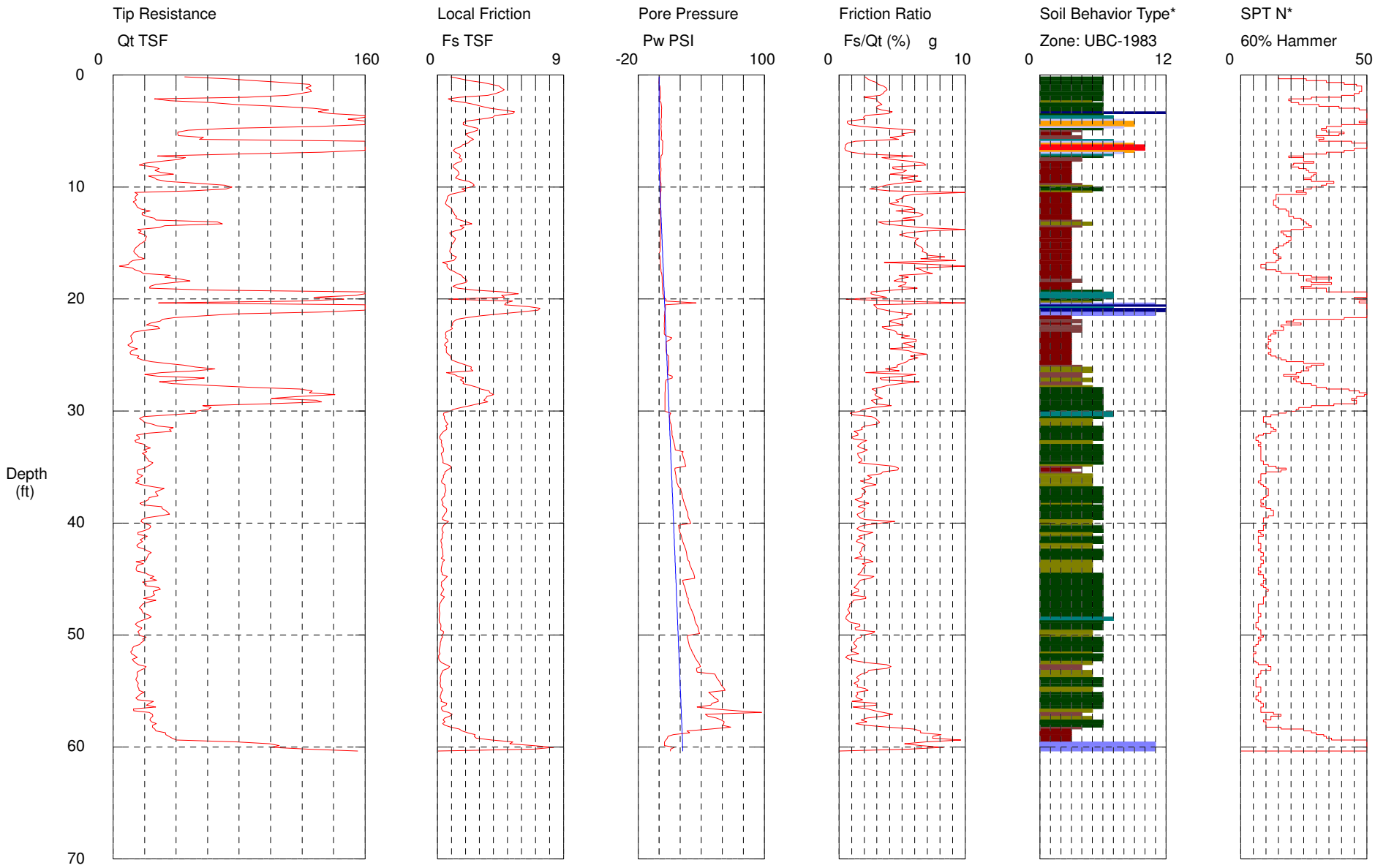
Maximum Depth = 79.40 feet

Depth Increment = 0.164 feet

CPT-5

Operator: Cardno ATC
Sounding: Elev: 415
Cone Used: DDG1181

CPT Date/Time: 10/1/2015 6:00:58 PM
Location: Vectren-AB Brown
Job Number: 170GC00108



Maximum Depth = 60.37 feet

Depth Increment = 0.164 feet

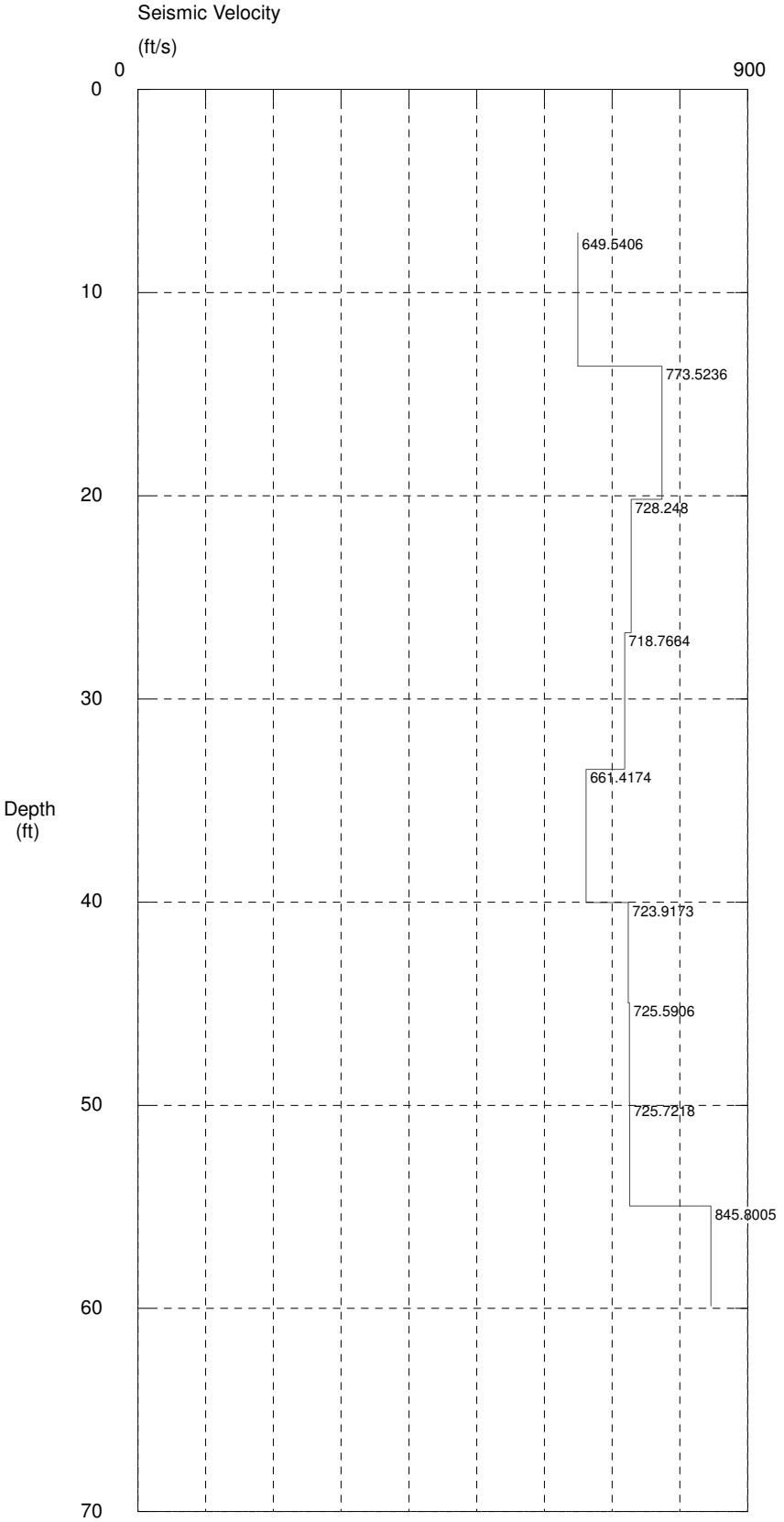
1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

CPT-5

Operator: Cardno ATC
Sounding: Elev: 415
Cone Used: DDG1181

CPT Date/Time: 10/1/2015 6:00:58 PM
Location: Vectren-AB Brown
Job Number: 170GC00108



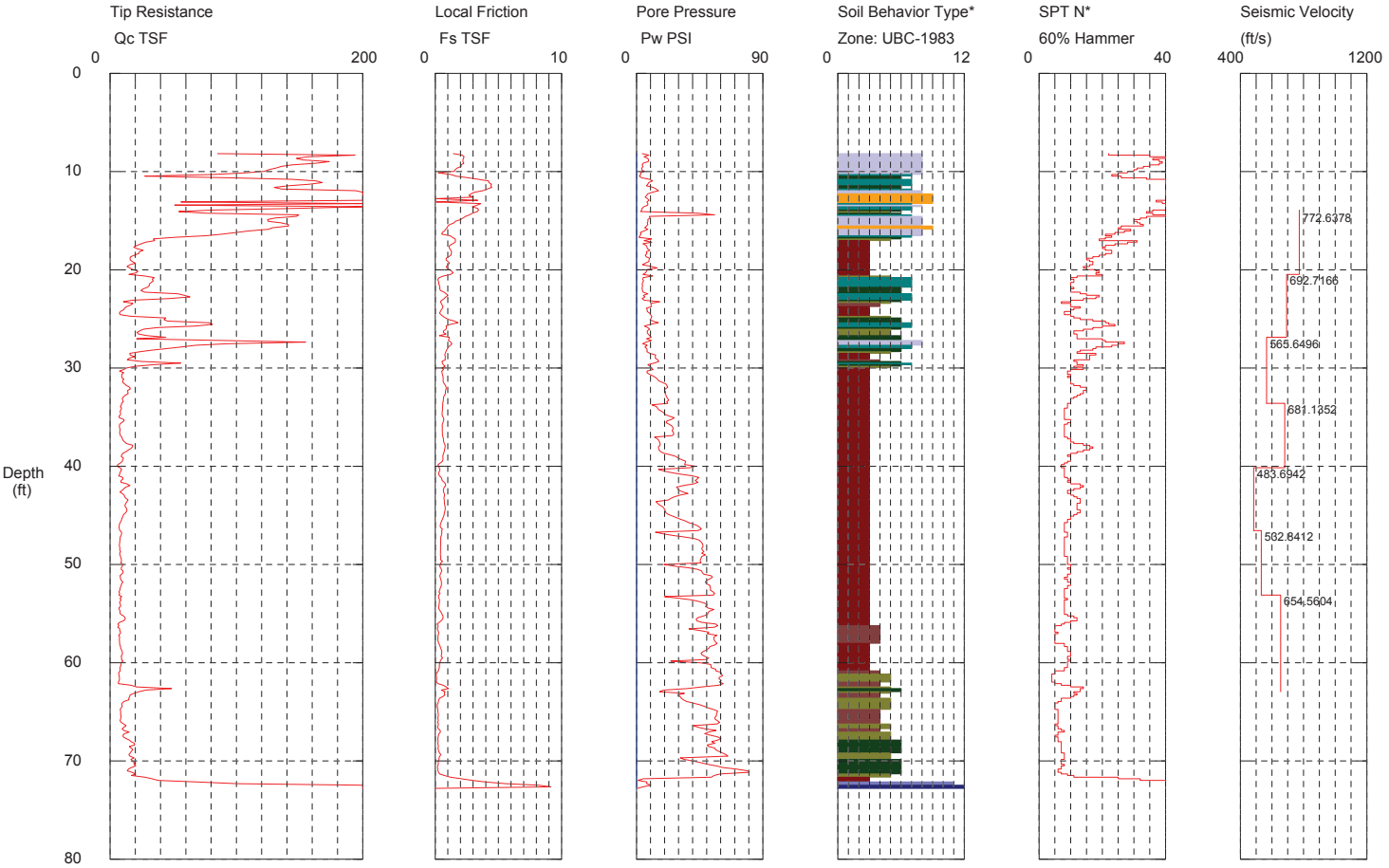
Maximum Depth = 60.37 feet

Depth Increment = 0.164 feet

CPT-101

Operator: Cardno - ZV
Sounding: Elev: 463.5
Cone Used: DDG1181

CPT Date/Time: 4/16/2015 8:48:59 AM
Location: North=968144, East=2772356
Job Number: 170GC00108



Maximum Depth = 72.80 feet

Depth Increment = 0.164 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

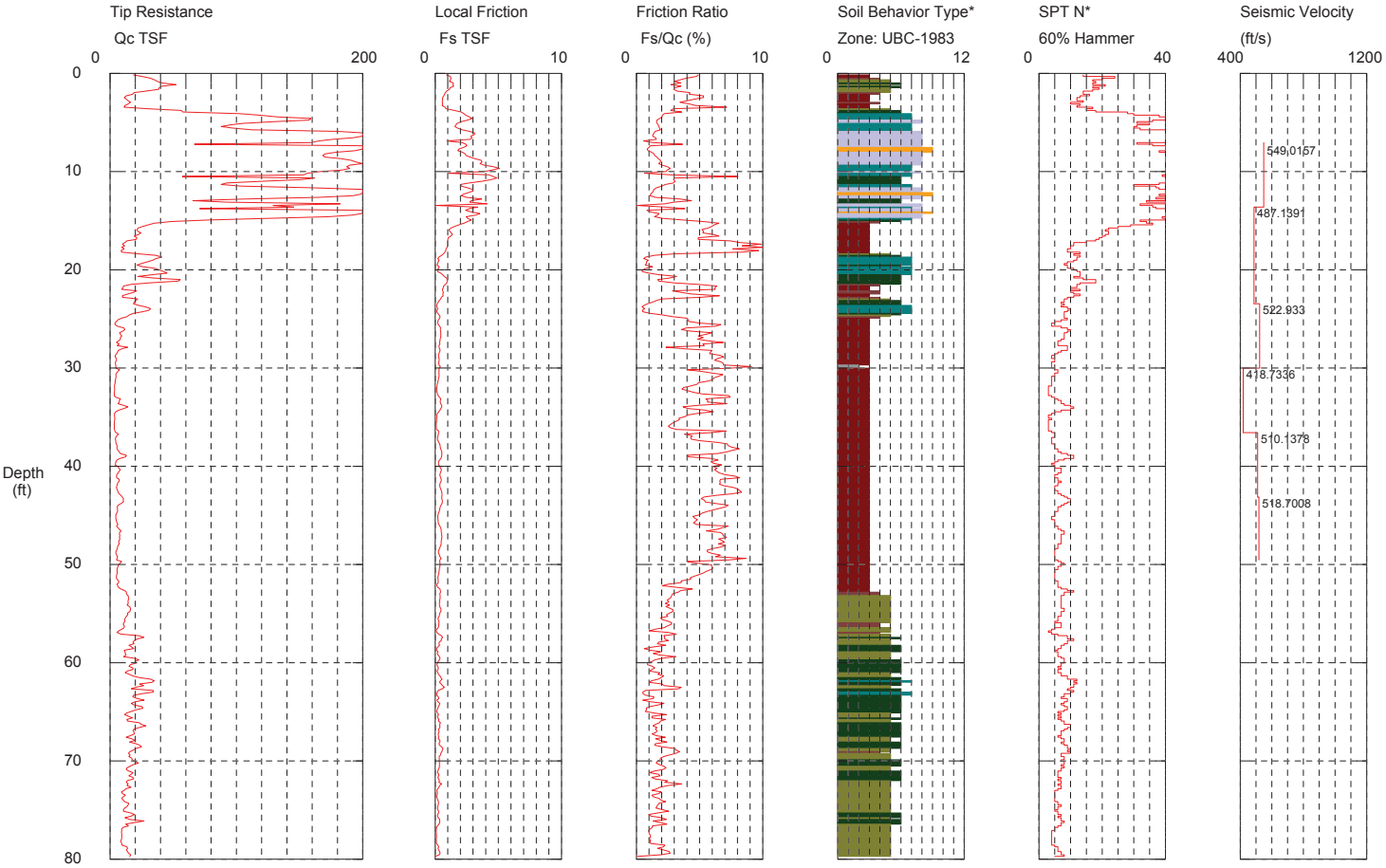
AB-Brown

*Soil behavior type and SPT based on data from UBC-1983

CPT-102

Operator: Cardno - ZV
Sounding: Elev: 463.7
Cone Used: DDG1181

CPT Date/Time: 4/15/2015 1:18:25 PM
Location: North=968474, East=2772217
Job Number: 170GC00108



Maximum Depth = 79.72 feet

Depth Increment = 0.164 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

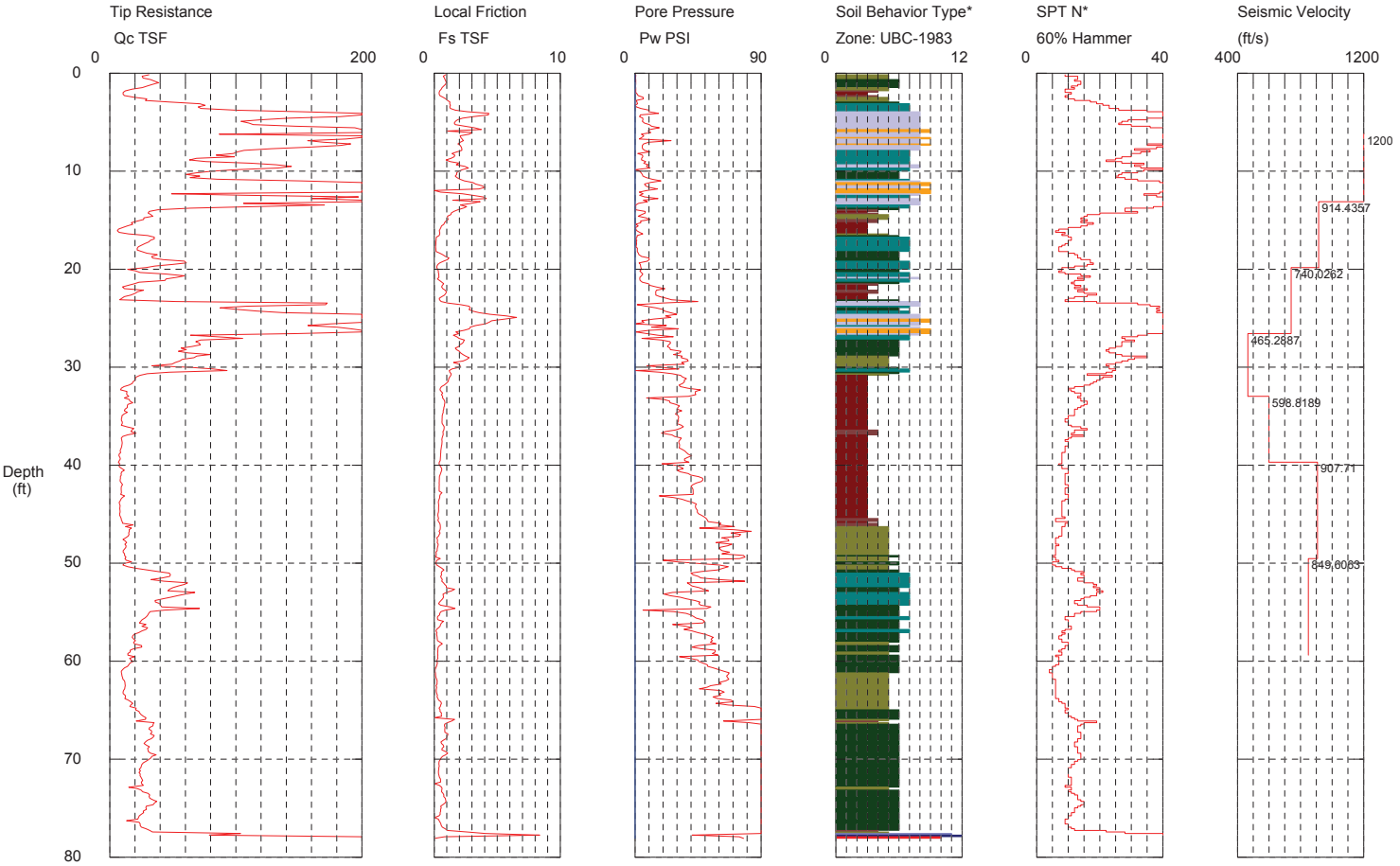
AB Brown

*Soil behavior type and SPT based on data from UBC-1983

CPT-103

Operator: Cardno - ZV
Sounding: Elev: 463.8
Cone Used: DDG1181

CPT Date/Time: 4/15/2015 11:49:19 AM
Location: North=968605, East=2772159
Job Number: 170GC00108



Maximum Depth = 78.08 feet

Depth Increment = 0.164 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

AB Brown

*Soil behavior type and SPT based on data from UBC-1983

FLOW PROPERTIES from PIEZOCONE DISSIPATION TESTS

Soils exhibit flow properties that control ***hydraulic conductivity*** (k), rates of consolidation, construction behavior, and drainage characteristics in the ground. Field measurements for soil permeability include pumping tests with measured drawdown, slug tests, and packer methods. Laboratory methods include falling head and constant head types in permeameters, controlled gradient, and constant rate of strain consolidation (Leroueil, et al., *Geotechnique*, June 1992). An indirect assessment of permeability can be made from consolidation test data. Results of pressure dissipation readings from piezocone and flat dilatometer and holding tests during pressuremeter testing can be used to determine permeability and the coefficient of consolidation (Jamiolkowski, et al. 1985, *Proc. 11th ICSMFE*, San Francisco, Vol. 1). Herein, only the piezocone approach will be discussed.

The ***permeability*** (k) can be determined from the dissipation test data, either by use of the direct correlative relationship presented earlier, or alternatively by the evaluation of the ***coefficient of consolidation***, c_h. Assuming radial flow, the horizontal permeability (k_h) is obtained from:

$$k_h = \frac{c_h \gamma_w}{D'}$$

where D′ = constrained modulus obtained from oedometer tests. Note: results of high-quality lab testing of natural clays show $k_h \approx 1.1\ k_v$ unless the deposit is highly stratified or consists of varved materials (Tavenas, et al., Nov. 1983, *Canadian Geot. Journal*).

Piezocone Dissipation Tests

In a CPTu test performed in saturated clays and silts, large excess porewater pressures (Δu) are generated during penetration of the piezocone. Soft to firm intact clays will exhibit measured penetration porewater pressures which are 3 to 6 times greater than the hydrostatic water pressure, while values of 10 to 20 times greater than the hydrostatic water pressure will typically be measured in stiff to hard intact clays. In fissured materials, zero or negative porewater pressures will be recorded. Regardless, once penetration is stopped, these excess pressures will decay with time and eventually reach equilibrium conditions which correspond to hydrostatic values. In essence, this is analogous to a push-in type piezometer. In addition to piezometers and piezocones, excess pressures occur during the driving of pile foundations, installation of displacement devices such as vibroflots for stone columns and mandrels for vertical wick-drains, as well as insertion of other in-situ tests including dilatometer, full-displacement pressuremeter, and field vane.

How quickly the porewater pressures decay depends on the permeability of the surrounding medium (k), as well as the horizontal coefficient of consolidation (c_h). In clean sands and gravels that are pervious, essentially drained response is observed at the time of penetration and the measured porewater pressures are hydrostatic. In most other cases, an initial undrained response occurs that is followed by drainage. For example, in silty sands, generated excess pressures can dissipate in 1 to 2 minutes, while in contrast, fat plastic clays may require 2 to 3 days for complete equalization.

Representative dissipation curves from two types of piezocone elements (midface u_1 and shoulder u_2) are presented in Figure F-1. These data were recorded at a depth of 15.2 meters in a deposit of soft varved silty clay at the National Geotechnical Experimentation Site (NGES) in Amherst, MA. Full equalization tohydrostatic conditions is reached in about 1 hour (3600 s). In routine testing, data are recorded to just 50 percent consolidation in order to maintain productivity. In this case, the initial penetration pressures correspond to 0 percent decay and a calculated hydrostatic value (u_0) based on groundwater levels represents the 100 percent completion. Figure F-1 illustrates the procedure to obtain the time to 50% completion (t_{50}).

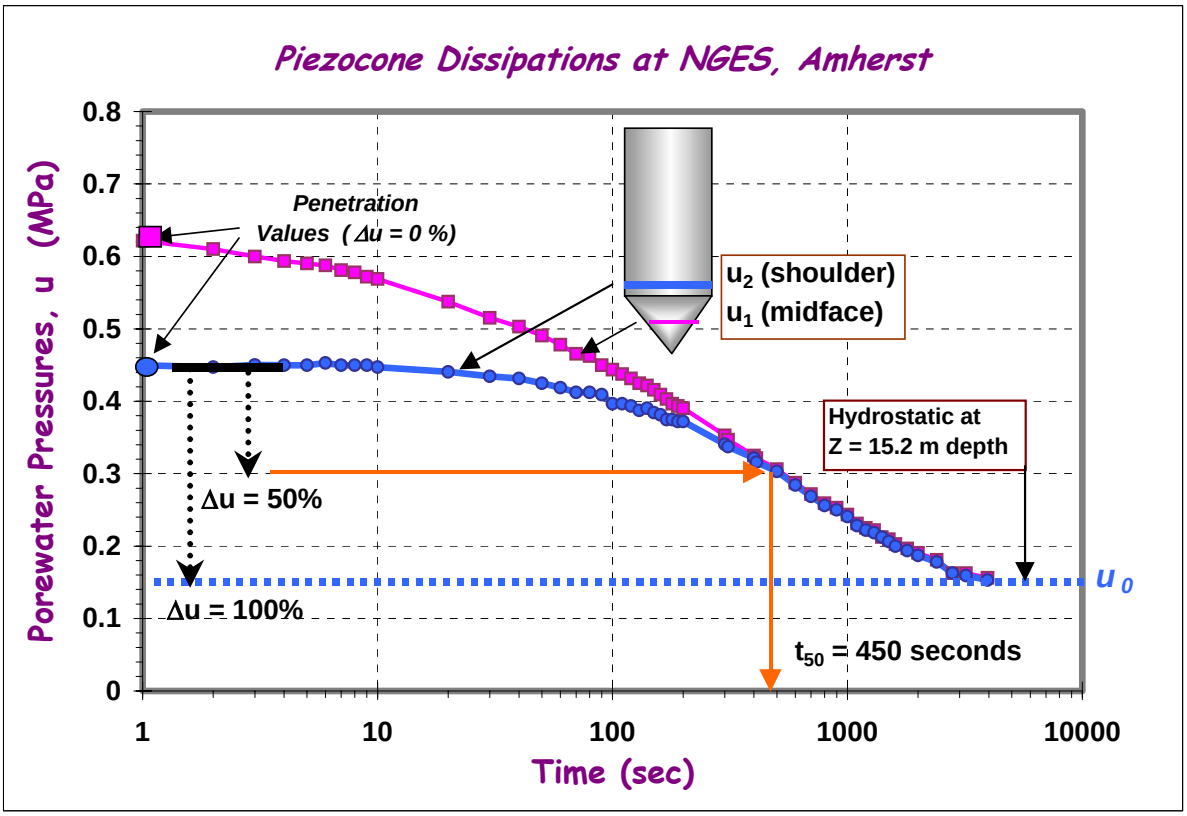


Figure F-1. Porewater Pressure Dissipation Response in Soft Varved Clay at Amherst NGES.
(Procedure for t_{50} determination using U_2 readings shown)

The aforementioned approach applies to soils that exhibit monotonic decay of porewater pressures with logarithm of time. For cases involving heavily overconsolidated and fissured geomaterials, a dilatory response can occur whereby the porewater pressures initially rise with time, reach a peak value, and then subsequently decrease with time.

For type 2 piezocones with shoulder filter elements, the t_{50} reading from monotonic responses can be used to evaluate the permeability according to the chart provided in Figure F-2. The average relationship may be approximately expressed by:

$$k \ \text{(cm/s)} \approx 1/(251 \cdot t_{50})^{1.25}$$

where t_{50} is given in seconds. The interpretation of the coefficient of consolidation from dissipation data is discussed subsequently and includes both monotonic and dilatory porewater pressure behavior.

Monotonic Dissipation

For *monotonic* porewater decays where the readings always decrease with time, these responses are generally are associated with soft to firm clays and silts. For these cases, the strain path method (Teh & Houlsby, 1991, *Geotechnique*) may be used to determine c_h from the expression:

$$c_h = \frac{T * a^2 \sqrt{I_R}}{t_{50}}$$

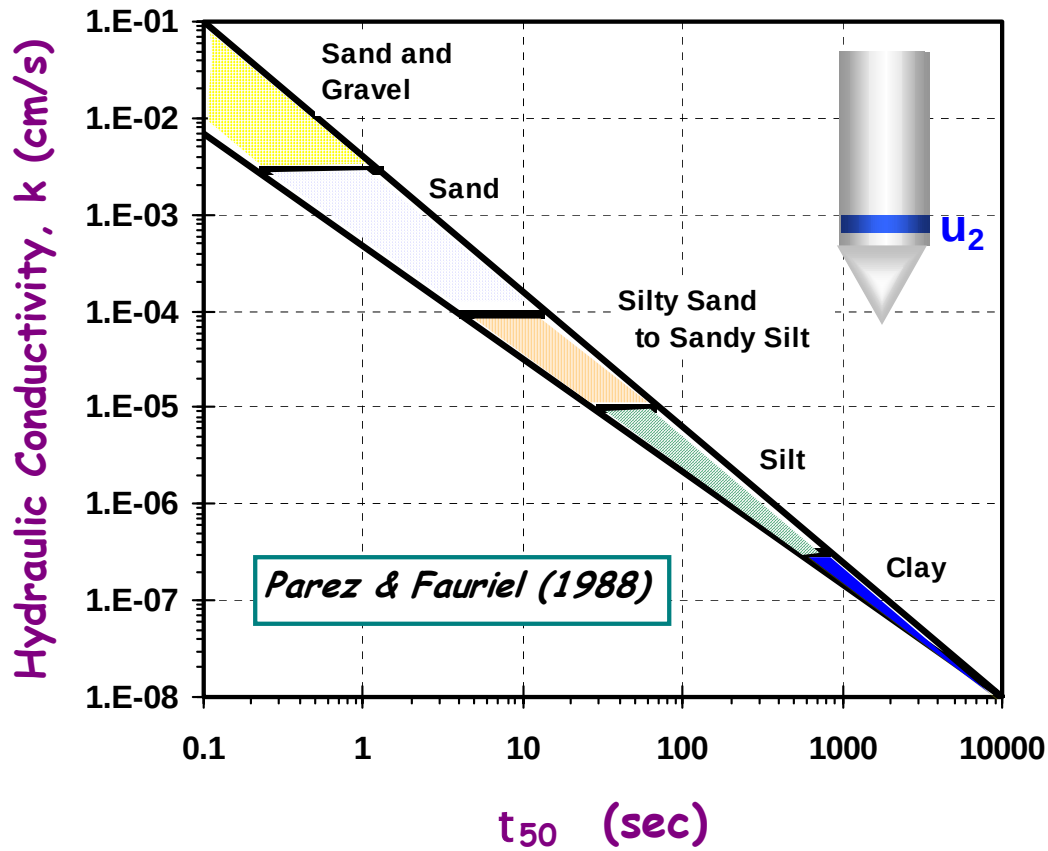


Figure F-2: Coefficient of Permeability (k = Hydraulic Conductivity) from Measured Time to 50% Consolidation (t_{50}) for Monotonic Type 2 Dissipations (from Parez & Fauriel, 1988).

where T* = modified time factor from consolidation theory, a = probe radius, $I_R = G/s_u$ = rigidity index of the soil, and t = measured time on the dissipation record (usually taken at 50% equalization). Several solutions have been presented for the modified time factor T* based on different theories, including cavity expansion, strain path, and dislocation points (Burns & Mayne, 1998, *Can. Geot. J.*). For monotonic dissipation response, the strain path solutions (Teh & Houlsby, 1991, *Geot.*) are presented in Figures F-3 and F-4 for both midface and shoulder type elements, respectively.

The determination of t_{50} from shoulder porewater decays is illustrated by example in Figure F-1. These strain path solutions can be approximately described by the following:

$$\frac{\Delta u}{\Delta u_{initial}} = \left(\frac{1}{1.12 + 30 \cdot T^*}\right)^{0.48}$$

$$\frac{\Delta u_2}{\Delta u_{2-INITIAL}} = \left(\frac{1}{1 + 10 \cdot T^*}\right)^{0.64}$$

For the particular case of 50% consolidation, the respective time factors are T* = 0.118 for the type 1 (midface element) and T* = 0.245 for the type 2 (shoulder element).

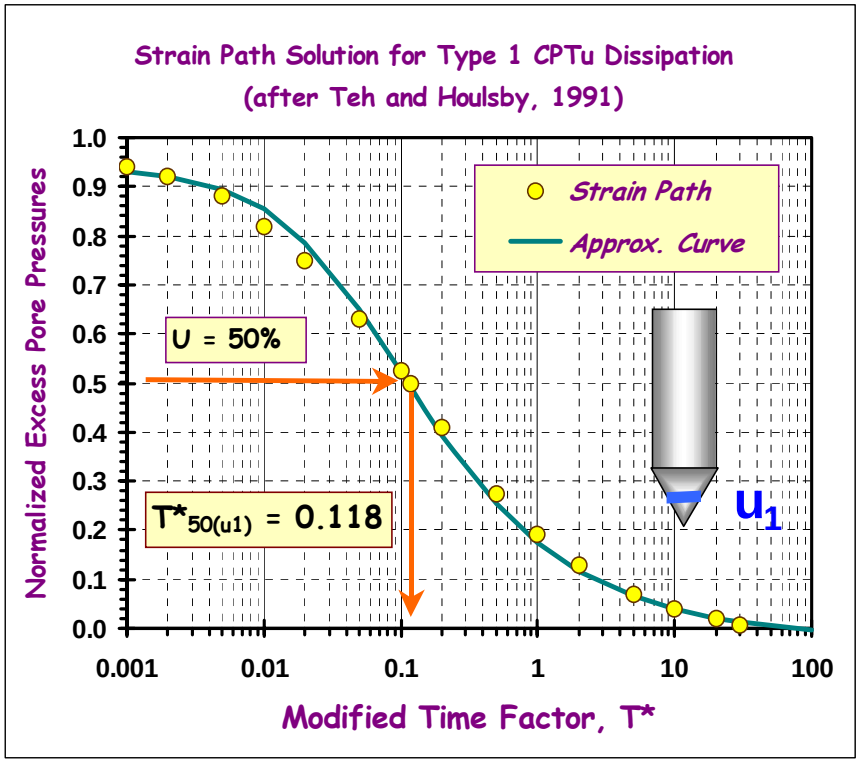


Figure F-3.

Modified Time Factors for u_1 Monotonic Porewater Dissipations

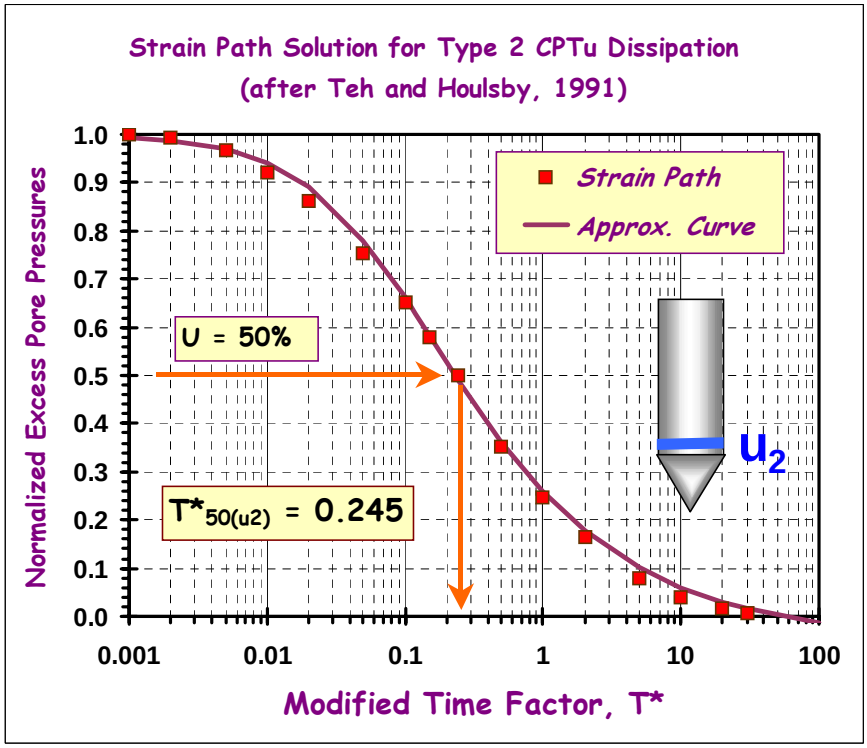


Figure F-4. Modified Time Factors for u_2 Monotonic Porewater Dissipations

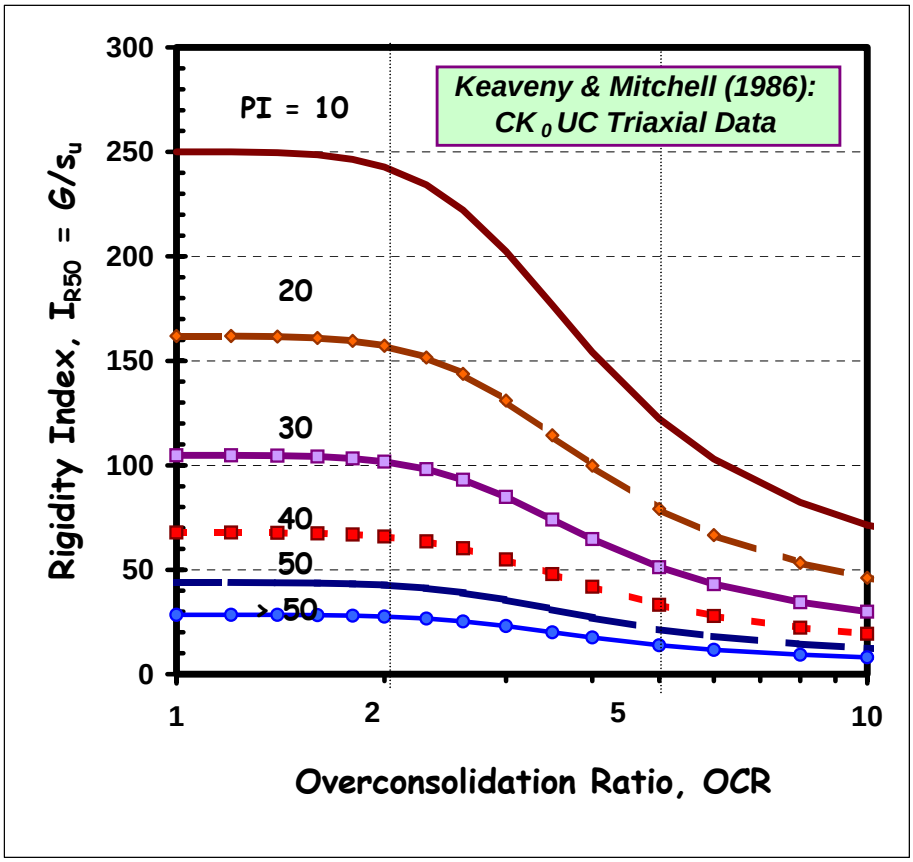


Figure F-5. Estimation of Undrained Rigidity Index of Clays and Silts from OCR and Plasticity Index (Keaveny & Mitchell, 1986).

For clays, the undrained rigidity index (I_R) is the ratio of shear modulus (G) to shear strength (s_u) and may be obtained from a number of different means including: (a) measured triaxial stress-strain curve, (b) measured pressuremeter tests, and (c) empirical correlation. One correlation based on anisotropically-consolidated triaxial compression test data expresses I_R in terms of OCR and plasticity index (PI), as shown in Figure F-5. For spreadsheet use, the empirical trend may be approximated by:

$$I_R \approx \frac{\exp\left[\dfrac{137 - PI}{23}\right]}{\left[1 + \ln\left\{1 + \dfrac{(OCR - 1)^{3.2}}{26}\right\}\right]^{0.8}}$$

Additional approaches to estimating the value of I_R are reviewed elsewhere (Mayne, *Proc. In-Situ 2001*, Bali). To facilitate the interpretation of c_h corresponding to t_{50} readings using the standard penetrometer, Figure F-6 presents a graphical plot for various I_R values.

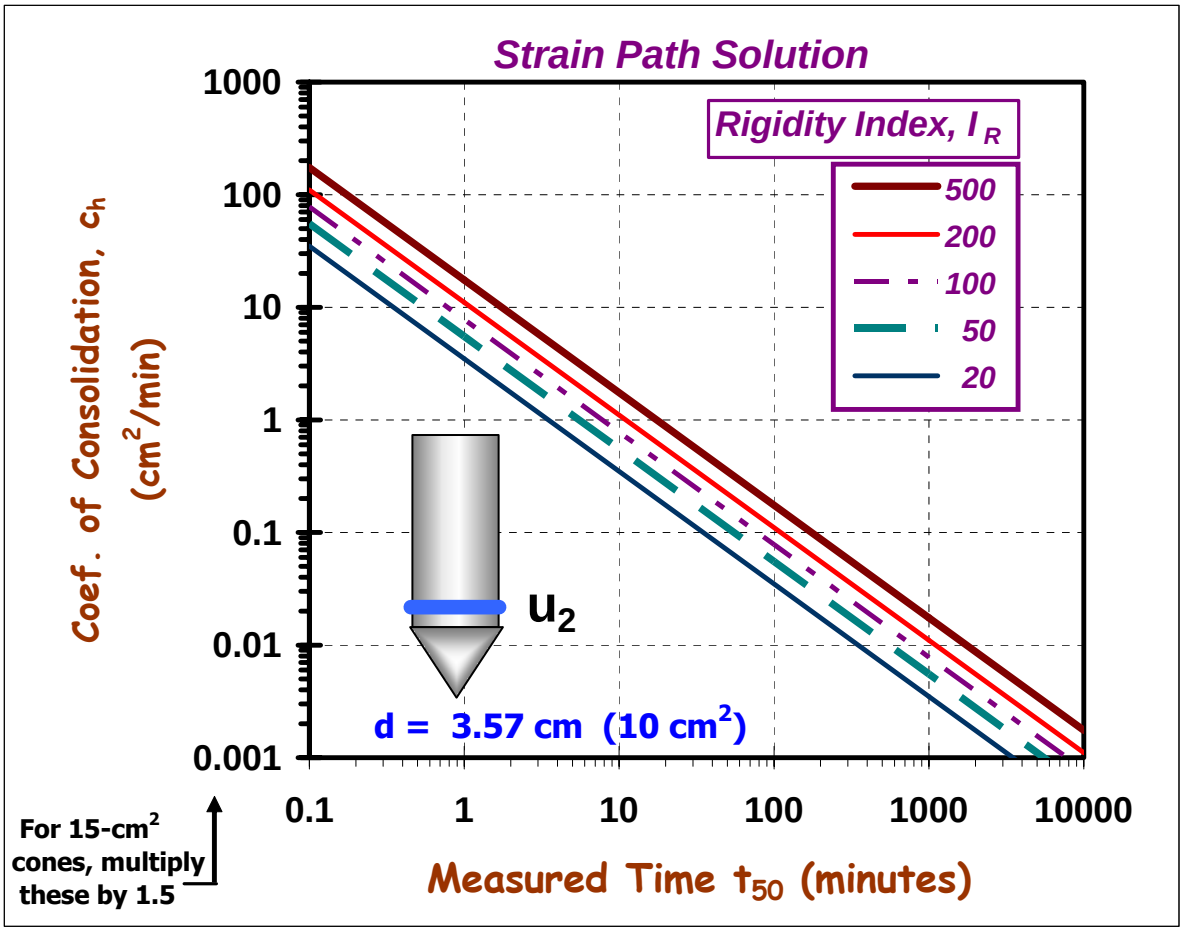


Figure F-6. Coefficient of consolidation at 50% dissipation for shoulder elements.

Dilatory Dissipations

In many overconsolidated and fissured materials, a dissipation test may first show an increase in Δu with time, reaching a peak value, and subsequent decrease in Δu with time (e.g., Lunne, et al. 1997). This type of response is termed *dilatory* dissipation, referring to both the delay in time and cause of the phenomenon (dilation). The dilatory response has been observed during type 2 piezocone tests as well as during installation of driven piles in fine-grained soils. The definition of 50% completion is not clear and thus the previous approach is not applicable.

A rigorous mathematics derivation has been presented elsewhere that provides a cavity expansion-critical state solution to both monotonic and dilatory porewater decay with time (Burns & Mayne, 1998). For practical use, an approximate closed-form expression is presented here. In lieu of merely matching one point on the dissipation curve (i.e, t_{50}), the entire curve is matched to provide the best overall value of c_h. The excess porewater pressures Δu_t at any time t can be compared with the initial values during penetration (Δu_i).

The measured initial excess porewater pressure ($\Delta u_i = u_2 - u_o$) is given by:

$$\Delta u_i = (\Delta u_{oct})_i + (\Delta u_{shear})_i$$

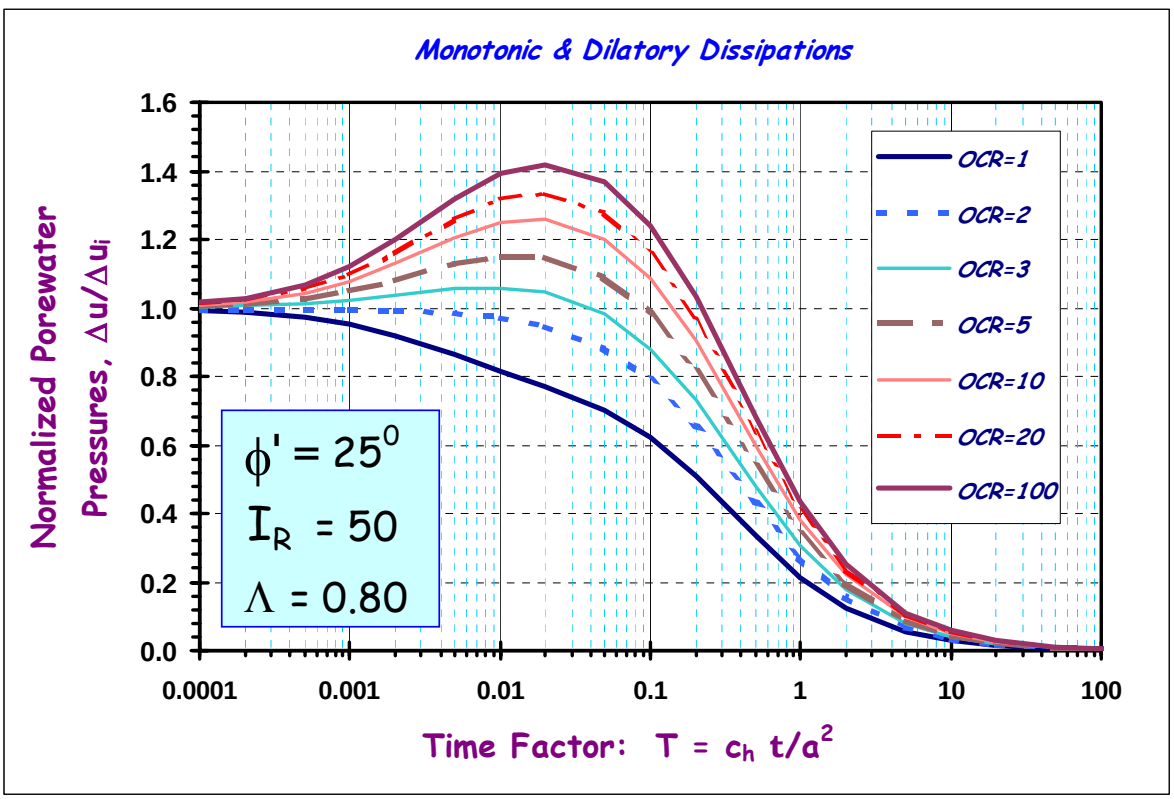
where $(\Delta u_{oct})_i = \sigma_{vo}'(2M/3)(OCR/2)^{\Lambda} \ln(I_R)$ = the octahedral component during penetration;

and $(\Delta u_{shear})_i = \sigma_{vo}'[1 - (OCR/2)^{\Lambda}]$ is the shear-induced component during penetration.

The porewater pressures at **<u>any</u>** time (t) are obtained in terms of the modified time factor T* from:

$$\Delta u_t = (\Delta u_{oct})_i [1 + 50\, T']^{-1} + (\Delta u_{shear})_i [1 + 5000\, T']^{-1}$$

where a different modified time factor is defined by: $T' = (c_h\, t)/(a^2\, I_R^{0.75})$. On a spreadsheet, a column of assumed (logarithmic) values of T' are used to generate the corresponding time (t) for a given rigidity index (I_R) and probe radius (a). Then, trial & error can be used to obtain the best fit c_h for the measured dissipation data. Series of dissipation curves can be developed for a given set of soil properties. One example set of curves is presented in Figure F-7 for various OCRs and the following parameters: $\Lambda = 0.8$, $I_R = 50$, and $\phi' = 25^{\circ}$, in order to obtain the more conventional time



factor, $T = (c_h\, t)/a^2$.

Figure F-7. Representative Solutions for Type 2 Dilatory Dissipation Curves at Various OCRs (after Burns & Mayne, 1998, *Canadian Geotechnical Journal*).

Appendix D
Lab Test Data

Summary of Laboratory Test Results – Embankment Fill

Boring and Sample ID	Ground Surface Elevation	Material Description	Sample Depth	Moisture Content	Dry Unit Weight	Total Unit Weight	Atterberg Limits			Gradations			USCS	Hydraulic Conductivity
							Liquid Limit	Plastic Limit	Plasticity Index	Sieve Analysis (3 inch to #200 Sieve)				
										Gravel	Sand	Fines		
	(ft)		(ft)	(%)	(pcf)	(pcf)	(%)	(%)	(%)	(%)	(%)	(%)		(cm/sec)
AECOM-B1, 1	451.3	Embankment Fill	17.0-19.0	18.0	106.4	125.6	-	-	-	-	-	-	CL	6.2E-07
AECOM-B1, 1A	451.3	Embankment Fill	19.0-21.0	17.0	112	131.0	33	17	16	0.7	3.9	95.4	CL	
AECOM-B1, 2	451.3	Embankment Fill	27.0-29.0	16.3	111	129.1	29	25	4	0.0	2.1	97.9	CL	-
AECOM-B2, 1	451.2	Embankment Fill	30.0-32.0	17.9	108	127.3	-	-	-	0.0	20.4	79.6	CL	-
AECOM-B2, 2	451.2	Embankment Fill	48.0-50.0	15.2	111	127.9	-	-	-	0.0	36.3	63.7	CL	-
AECOM-B4, 1	416.1	Embankment Fill	12.0-14.0	16.4	110	128.0	-	-	-	0.1	17.0	82.9	CL	-
B-201, SS-2	450.3	Embankment Fill	3.5-5.0	15.2	-	-	29	22	7	-	-	99.4	CL	-
B-201, SS-7	450.3	Embankment Fill	16.0-17.5	14.5	-	-	-	-	-	-	-	96.8	CL	-
B-201, SS-11	450.3	Embankment Fill	26.0-27.5	15.5	-	-	29	21	8	-	-	97.4	ML	-
B-202, SS-6	450.7	Embankment Fill	13.5-15.0	14.0	-	-	28	18	10	-	-	95.2	CL	-
B-202, SS-11	450.7	Embankment Fill	26.0-27.5	15.6	-	-	33	15	18	-	-	66.1	CL	-
B-202, SS-16	450.7	Embankment Fill	38.5-40.0	14.7	-	-	32	17	15	-	-	81.7	CL	-
B-203, SS-7	450.5	Embankment Fill	16.0-17.5	16.5	-	-	31	14	17	-	-	71.0	CL	-
B-203, SS-13	450.5	Embankment Fill	31.0-32.5	15.7	-	-	25	18	7	-	-	87.2	CL	-
B-203, SS-22	450.5	Embankment Fill	53.5-55.0	11.7	-	-	26	16	10	-	-	58.7	CL	-
B-204, SS-4	450.5	Embankment Fill	8.5-10.0	18.1	-	-	32	19	13	-	-	98.8	CL	-
B-204, SS-15	450.5	Embankment Fill	36.0-37.5	16.3	-	-	29	22	7	-	-	99.5	CL	-
B-205, SS-5	415.5	Embankment Fill	11.0-12.5	16.3	-	-	33	15	18	-	-	88.5	CL	-
B-209, SS-16	451.0	Embankment Fill	38.5-40	14.7	-	-	25	14	11	-	-	-	CL	-
B-210, SS-13	451.0	Embankment Fill	31-32.5	16.0	-	-	37	17	26	-	-	-	CL	-
B-210, SS-17	451.0	Embankment Fill	41-42.5	17.5	-	-	35	13	22	-	-	-	CL	-
B-210, SS-20	451.0	Embankment Fill	48.5-50	17.8	-	-	27	16	11	-	-	-	CL	-
B-211, SS-11	451.0	Embankment Fill	26-27.5	19.0	-	-	31	17	14	-	-	-	CL	-
B-211, SS-15	451.0	Embankment Fill	36-37.5	17.7	-	-	30	17	30	-	-	-	CL	-
B-212, SS-11	451.0	Embankment Fill	26-27.5	16.2	-	-	38	19	19	-	-	-	CL	-
B-212, SS-14	451.0	Embankment Fill	33.5-35	15.4	-	-	34	14	20	-	-	-	CL	-
B-213, SS-9	451.0	Embankment Fill	21-22.5	14.6	-	-	29	16	13	-	-	-	CL	-
B-213, SS-12	451.0	Embankment Fill	28.5-30	18.4	-	-	24	21	3	-	-	-	ML	-
B-213, SS-17	451.0	Embankment Fill	41-42.5	15.5	-	-	37	16	21	-	-	-	CL	-
B-214, SS-11	451.0	Embankment Fill	21-22.5	16.6	-	-	31	17	14	-	-	-	CL	-
B-214, SS-17	451.0	Embankment Fill	41-42.5	15.6	-	-	29	18	11	-	-	-	CL	-
B-215, SS-4	415.0	Embankment Fill	8.5-10	16.1	-	-	28	12	16	-	-	-	SP	-
B-216, SS-6	415.0	Embankment Fill	13.5-15	21.6	-	-	36	15	21	-	-	-	CL	-
B-216, SS-9	415.0	Embankment Fill	21-22.5	23.9	-	-	30	17	13	-	-	-	CL	-
B-217, SS-8	415.0	Embankment Fill	18.5-20	20.5	-	-	28	17	11	-	-	-	CL	-
HLA-1, SS-3	450.9	Embankment Fill	13.5-15	15.4	119	137.3	-	-	-	-	-	-	CL	-

Summary of Laboratory Test Results – Embankment Fill

Boring and Sample ID	Ground Surface Elevation	Material Description	Sample Depth	Moisture Content	Dry Unit Weight	Total Unit Weight	Atterberg Limits			Gradations			USCS	Hydraulic Conductivity
							Liquid Limit	Plastic Limit	Plasticity Index	Sieve Analysis (3 inch to #200 Sieve)				
										Gravel	Sand	Fines		
	(ft)		(ft)	(%)	(pcf)	(pcf)	(%)	(%)	(%)	(%)	(%)	(%)		(cm/sec)
HLA-1, SS-6	450.9	Embankment Fill	28.5-30	15.5	119	137.4	29	19	10	-	-	-	CL	-
HLA-1, SS-8	450.9	Embankment Fill	38.5-40	18.5	112	132.7	-	-	-	-	-	-	CL	-
HLA-2, SS-1	450.7	Embankment Fill	3.5-5	15.0	114	131.1	-	-	-	-	-	-	CL	-
HLA-2, SS-2	450.7	Embankment Fill	8.5-10	19.2	101	120.4	-	-	-	-	-	-	ML	-
HLA-2, SS-3	450.7	Embankment Fill	8.5-10	23.9	102	126.4	-	-	-	-	-	-	ML	-
HLA-2, ST-6	450.7	Embankment Fill	19-21	17.3	114	133.7	-	-	-	-	-	-	CL	-
HLA-2, ST-7	450.7	Embankment Fill	19-21	17.6	111	130.5	-	-	-	-	-	-	CL	-
HLA-3, ST-3	451.9	Embankment Fill	8.5-10	20.7	108	130.4	28	27	1	-	-	-	ML	-
HLA-3, ST-3	451.9	Embankment Fill	10-12	18.9	107	127.2	-	-	-	-	-	-	ML	-
HLA-3, ST-3	451.9	Embankment Fill	10-12	18.5	114	135.1	-	-	-	-	-	-	ML	-
HLA-3, ST-3	451.9	Embankment Fill	10-12	17.5	110	129.3	-	-	-	-	-	-	ML	-
HLA-5, SS-1	416.1	Embankment Fill	3.5-5	20.2	101	121.4	-	-	-	-	-	-	ML	-
HLA-6, SS-2	416.2	Embankment Fill	3.5-5	15.8	118	136.6	-	-	-	-	-	-	ML	-

Summary of Laboratory Test Results - Foundation Silty Clays

Boring and Sample ID	Ground Surface Elevation	Material Description	Sample Depth	Moisture Content	Dry Unit Weight	Total Unit Weight	Atterberg Limits			Gradations			USCS	Hydraulic Conductivity
							Liquid Limit	Plastic Limit	Plasticity Index	Sieve Analysis (3 inch to #200 Sieve)				
										Gravel	Sand	Fines		
	(ft)		(ft)	(%)	(pcf)	(pcf)	(%)	(%)	(%)	(%)	(%)	(%)		(cm/sec)
AECOM-B3, 3	417.9	Foundation Clay	28.0-30.0	21.2	104.8	127	-	-	-	-	-	-	CL	4.2E-07
B-201, SS-20	450.3	Foundation Clay	48.5-50.0	23.9	-	-	32	17	15	-	-	98.2	CL	-
B-201, SS-21	450.3	Foundation Clay	51-52.5	23.0	-	-	-	-	-	-	-	-	CL	-
B-201, SS-22	450.3	Foundation Clay	53.5-55	22.4	-	-	-	-	-	-	-	-	CL	-
B-201, SS-23	450.3	Foundation Clay	56-57.5	18.6	-	-	-	-	-	-	-	-	CL	-
B-201, SS-24	450.3	Foundation Clay	58.5-60	22.2	-	-	-	-	-	-	-	-	CL	-
B-202, SS-20	450.7	Foundation Clay	48.5-50	14.0	-	-	-	-	-	-	-	-	CL	-
B-202, SS-21	450.7	Foundation Clay	51-52.5	16.3	-	-	-	-	-	-	-	-	CL	-
B-202, SS-22	450.7	Foundation Clay	53.5-55.0	14.0	-	-	42	16	26	-	-	66.1	CL	-
B-202, SS-23	450.7	Foundation Clay	56-57.5	19.1	-	-	-	-	-	-	-	-	CL	-
B-202, SS-24	450.7	Foundation Clay	58.5-60	22.8	-	-	-	-	-	-	-	-	CL	-
B-202, SS-25	450.7	Foundation Clay	61.0-62.5	8.0	-	-	29	19	10	-	-	88.6	CL	-
B-202, ST-26	450.7	Foundation Clay	63.0-65.0	23.2	102.5	126.3	26	20	6	-	-	67.8	CL	-
B-202, SS-27	450.7	Foundation Clay	66-67.5	17.7	-	-	-	-	-	-	-	-	CL	-
B-202, SS-29	450.7	Foundation Clay	71-72.5	24.4	-	-	-	-	-	-	-	-	CL-ML	-
B-202, SS-30	450.7	Foundation Clay	73.5-75.0	24.4	-	-	28	21	7	-	-	99.3	CL-ML	-
B-202, SS-32	450.7	Foundation Clay	78.5-80.0	16.4	-	-	21	13	8	-	-	71.7	CL	-
B-202, SS-34	450.7	Foundation Clay	83.5-85.0	15.3	-	-	31	15	16	-	-	43.6	CL	-
B-203, ST-26	450.5	Foundation Clay	63.0-65.0	19.3	106.4	126.9	30	19	11	-	-	96.6	CL	-
B-203, SS-28	450.5	Foundation Clay	68.5-70.0	21.9	-	-	36	19	17	-	-	99.6	CL	-
B-204, SS-23	450.5	Foundation Clay	56.0-57.5	28.1	-	-	28	21	7	-	-	99.3	CL-ML	-
B-206, SS-13	414.8	Foundation Clay	31.0-32.5	20.9	-	-	32	15	17	-	-	80.3	CL	-
B-206, ST-16	414.8	Foundation Clay	38.0-40.0	24.3	100.5	124.9	29	16	13	-	-	82.3	CL	-
B-206, SS-19	414.8	Foundation Clay	46.0-47.5	40.3	-	-	48	23	25	-	-	99.0	CL	-
B-207, SS-7	395.0	Foundation Clay	16.0-17.5	20.4	-	-	24	19	5	-	-	94.8	CL-ML	-
B-207, ST-8	395.0	Foundation Clay	18.0-20.0	23.4	101.2	124.9	31	16	15	-	-	92.2	CL	-
B-207, SS-16	395.0	Foundation Clay	38.5-40.0	17.6	-	-	30	15	15	-	-	61.7	CL	-
B-208, SS-15	396.7	Foundation Clay	36.0-37.5	18.8	-	-	33	16	17	-	-	84.1	CL	-
B-209, SS-23	451.0	Foundation Clay	56-57.5	29.2	-	-	38	18	20	-	-	-	CL	-
B-210, SS-27	451.0	Foundation Clay	66-67.5	20.2	-	-	26	17	9	-	-	-	CL	-
B-211, SS-21	451.0	Foundation Clay	51-52.5	-	-	-	29	19	10	-	-	-	CL	-
B-211, SS-24	451.0	Foundation Clay	58.5-60	20.7	-	-	30	20	10	-	-	-	CL	-
B-212, SS-22	451.0	Foundation Clay	53.5-55	20.6	-	-	27	17	10	-	-	-	CL	-
B-213, SS-25	451.0	Foundation Clay	61-62.5	23.3	-	-	35	16	19	-	-	-	CL	-
B-214, SS-20	451.0	Foundation Clay	48.5-50	27.4	-	-	28	24	4	-	-	-	CL-ML	-
B-214, SS-23	451.0	Foundation Clay	56-57.5	22.5	-	-	29	16	13	-	-	-	CL	-
B-215, SS-9	415.0	Foundation Clay	21-22.5	27.3	-	-	29	20	9	-	-	-	CL	-

Summary of Laboratory Test Results - Foundation Silty Clays

Boring and Sample ID	Ground Surface Elevation	Material Description	Sample Depth	Moisture Content	Dry Unit Weight	Total Unit Weight	Atterberg Limits			Gradations			USCS	Hydraulic Conductivity
							Liquid Limit	Plastic Limit	Plasticity Index	Sieve Analysis (3 inch to #200 Sieve)				
										Gravel	Sand	Fines		
	(ft)		(ft)	(%)	(pcf)	(pcf)	(%)	(%)	(%)	(%)	(%)	(%)		(cm/sec)
B-217, SS-10	415.0	Foundation Clay	23.5-25	17.8	-	-	29	20	9	-	-	-	CL	-
B-217, SS-15	415.0	Foundation Clay	36-37.5	30.6	-	-	29	21	8	-	-	-	CL-ML	-
B-217, SS-23	415.0	Foundation Clay	56-57.5	23.5	-	-	38	16	22	-	-	-	CL	-
B-218, SS-10	415.0	Foundation Clay	23.5-25	23.4	-	-	24	18	6	-	-	-	CL-ML	-
B-218, SS-17	415.0	Foundation Clay	41-42.5	28.6	-	-	32	25	7	-	-	-	CL-ML	-
B-218, SS-22	415.0	Foundation Clay	53.5-55	20.9	-	-	45	16	29	-	-	-	CL	-
B-219, SS-8	415.0	Foundation Clay	18.5-20	23.9	-	-	28	18	10	-	-	-	CL	-
B-219, SS-11	415.0	Foundation Clay	26-27.5	21.5	-	-	30	13	17	-	-	-	CL	-
B-219, SS-16	415.0	Foundation Clay	38.5-40	26.0	-	-	30	20	10	-	-	-	CL	-
HLA-2, SS-9	450.7	Foundation Clay	33.5-35	20.8	106	127.8	-	-	-	-	-	-	CL	-
HLA-3, SS-11	451.9	Foundation Clay	41-42.5	25.6	99	124.3	-	-	-	-	-	-	CL	-
HLA-4, SS-16	449.6	Foundation Clay	51-52.5	45.5	77	112.0	63	27	36	-	-	-	CL	-
HLA-4, SS-16	449.6	Foundation Clay	51-52.6	32.7	88	116.8	-	-	-	-	-	-	CL	-
HLA-5, SS-8	416.1	Foundation Clay	23.5-25	23.6	-	-	29	20	9	-	-	-	CL	-
HLA-6, SS-6	416.2	Foundation Clay	13.5-15	43.3	-	-	75	27	48	-	-	-	CL	-
HLA-6, SS-8	416.2	Foundation Clay	18.5-20	19.0	111	132.1	-	-	-	-	-	-	CL	-
HLA-6A, SS-2	416.2	Foundation Clay	6-7.5	28.2	94	120.5	-	-	-	-	-	-	CL	-
HLA-6A, ST-3	416.2	Foundation Clay	8-10	28.1	-	-	37	22	15	-	-	-	CL	-
HLA-6A, ST-3	416.2	Foundation Clay	8-10	28.3	97	124.5	-	-	-	-	-	-	CL	-
HLA-6A, ST-3	416.2	Foundation Clay	8-10	28.5	94	120.8	-	-	-	-	-	-	CL	-
HLA-6A, ST-3	416.2	Foundation Clay	8-11	28.6	93	119.6	-	-	-	-	-	-	CL	-

Summary of Laboratory Test Results - Foundation Silts

Boring and Sample ID	Ground Surface Elevation	Material Description	Sample Depth	Moisture Content	Dry Unit Weight	Total Unit Weight	Atterberg Limits			Gradations			USCS	Hydraulic Conductivity
							Liquid Limit	Plastic Limit	Plasticity Index	Sieve Analysis (3 inch to #200 Sieve)				
										Gravel	Sand	Fines		
	(ft)		(ft)	(%)	(pcf)	(pcf)	(%)	(%)	(%)	(%)	(%)	(%)		(cm/sec)
AECOM-B1, 3	451.3	Foundation Silt	39.0-41.0	27.5	-	-	Non-Plastic			0.0	0.4	99.6	ML	-
AECOM-B1, 4	451.3	Foundation Silt	44.0-46.0	26.5	98	124.0	-	-	-	0.0	0.4	99.6	ML	-
AECOM-B1, 5	451.3	Foundation Silt	49.0-51.0	26.8	96.6	122.7	-	-	-	-	-	-	ML	2.6E-07
AECOM-B2, 3	451.2	Foundation Silt	56.0-58.0	25.0	-	-	Non-Plastic			0.0	0.9	99.1	ML	-
AECOM-B2, 4	451.2	Foundation Silt	60.0-62.0	25.9	98.3	123.8	-	-	-	0.0	0.3	99.7	ML	8.70E-07
AECOM-B3, 1	417.9	Foundation Silt	8.0-10.0	30.6	88	115.0	-	-	-	-	-	-	ML	5.20E-06
AECOM-B4, 2	416.1	Foundation Silt	33.0-35.0	38.4	82.7	114.5	31	29	2	0.0	0.3	99.7	ML	-
AECOM-B4, 3	416.1	Foundation Silt	46.0-48.0	26.8	97.4	123.5	-	-	-	0.0	0.1	99.9	ML	-
AECOM-B5, 2	416.4	Foundation Silt	30.0-32.0	33.8	-	-	-	-	-	0.4	28.4	71.2	ML	-
AECOM-B5, 3	416.4	Foundation Silt	34.0-36.0	49.8	71	106.4	-	-	-	-	-	-	ML	7.80E-06
B-201, SS-18	450.3	Foundation Silt	43.5-45.0	29.0	-	-	Non-Plastic			-	-	99.7	ML	-
B-204, SS-20	450.5	Foundation Silt	48.5-50.0	23.5	-	-	27	22	5	-	-	97.2	ML	-
B-205, SS-14	415.5	Foundation Silt	33.5-35.0	36.6	-	-	Non-Plastic			-	-	95.0	ML	-
B-205, SS-19	415.5	Foundation Silt	46.0-47.5	43.5	-	-	Non-Plastic			-	-	92.9	ML	-
B-206, SS-9	414.8	Foundation Silt	21.0-22.5	23.7	-	-	Non-Plastic			-	-	98.3	ML	-
B-206, ST-12	414.8	Foundation Silt	28.0-30.0	21.1	106.2	128.6	23	20	3	-	-	96.6	ML	-
B-206, SS-17	414.8	Foundation Silt	41.0-42.5	24.6	-	-	26	23	3	-	-	94.2	ML	-
B-206, SS-24	414.8	Foundation Silt	58.5-60.0	36.9	-	-	33	31	2	-	-	96.4	ML	-
B-206, SS-25	414.8	Foundation Silt	61.0-62.5	39.8	-	-	38	34	4	-	-	96.3	ML	-
B-207, SS-13	395.0	Foundation Silt	31.0-32.5	26.7	-	-	Non-Plastic			-	-	95.2	ML	-
B-207, ST-15	395.0	Foundation Silt	35.0-37.0	32.0	89.5	118.1	31	25	6	-	-	73.5	ML	-
B-208, SS-7	396.7	Foundation Silt	16.0-17.5	26.3	-	-	26	22	4	-	-	99.7	ML	-
B-208, SS-13	396.7	Foundation Silt	31.0-32.5	27.6	-	-	28	24	4	-	-	99.6	ML	-
B-209, SS-19	451.0	Foundation Silt	46-47.5	29.3	-	-	Non-Plastic			-	-	-	ML	-
B-210, SS-23	451	Foundation Silt	56-57.5	24.5	-	-	26	23	3	-	-	-	ML	-
B-211, SS-28	451.0	Foundation Silt	68.5-70	29.9	-	-	Non-Plastic			-	-	-	ML	-
B-212, SS-27	451.0	Foundation Silt	66-67.5	22.2	-	-	25	22	3	-	-	-	ML	-
B-215, SS-12	415.0	Foundation Silt	28.5-30	36.3	-	-	Non-Plastic			-	-	-	ML	-
B-215, SS-15	415.0	Foundation Silt	36-37.5	35.9	-	-	Non-Plastic			-	-	-	ML	-
B-215, SS-18	415.0	Foundation Silt	43.5-45	26.5	-	-	26	23	3	-	-	-	ML	-
B-216, SS-11	415.0	Foundation Silt	26-27.5	24.3	-	-	Non-Plastic			-	-	-	ML	-
B-216, SS-16	415.0	Foundation Silt	38.5-40	33.9	-	-	Non-Plastic			-	-	-	ML	-
B-217, SS-18	415.0	Foundation Silt	43.5-45	39.5	-	-	37	35	2	-	-	-	ML	-
B-217, SS-21	415.0	Foundation Silt	51-52.5	26.4	-	-	Non-Plastic			-	-	-	ML	-

Summary of Laboratory Test Results - Foundation Silts

Boring and Sample ID	Ground Surface Elevation	Material Description	Sample Depth	Moisture Content	Dry Unit Weight	Total Unit Weight	Atterberg Limits			Gradations			USCS	Hydraulic Conductivity
							Liquid Limit	Plastic Limit	Plasticity Index	Sieve Analysis (3 inch to #200 Sieve)				
										Gravel	Sand	Fines		
	(ft)		(ft)	(%)	(pcf)	(pcf)	(%)	(%)	(%)	(%)	(%)	(%)		(cm/sec)
B-218, SS-4	415.0	Foundation Silt	8.5-10	22.3	-	-	26	25	1	-	-	-	ML	-
B-218, SS-5	415.0	Foundation Silt	11-13.5	30.6	-	-	27	26	1	-	-	-	ML	-
B-218, SS-20	415.0	Foundation Silt	48.5-50	23.0	-	-	Non-Plastic			-	-	-	ML	-
B-219, SS-4	415.0	Foundation Silt	8.5-10	28.9	-	-	Non-Plastic			-	-	-	ML	-
B-219, SS-7	415.0	Foundation Silt	16-17.5	29.9	-	-	Non-Plastic			-	-	-	ML	-
HLA-2, ST-11	450.7	Foundation Silt	43-45	27.2	98	124.7	-	-	-	-	-	-	ML	-
HLA-4, SS-6	449.6	Foundation Silt	26-27.5	32.0	-	-	Non-Plastic			-	-	-	ML	-
HLA-5, SS-4	416.1	Foundation Silt	13.5-15	27.5	98	125.0	Non-Plastic			-	-	-	ML	-
HLA-5, ST-5	416.1	Foundation Silt	15-17	29.6	95	123.1	-	-	-	-	-	-	ML	-

Soil Index Properties Laboratory Test Results

Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	AECOM-B1	Sample Type:	tube	Tested By:	jbr
Sample ID:	3	Test Date:	11/17/15	Checked By:	jdt
Depth :	31-41	Test Id:	354184		
Test Comment:	---				
Visual Description:	Moist, brown silt				
Sample Comment:	---				

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content,%
AECOM-B1	3	31-41	Moist, brown silt	27.5

Notes: Temperature of Drying : 110º Celsius

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Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	---	Sample Type:	---	Tested By:	GA
Sample ID:	---	Test Date:	12/14/15	Checked By:	emm
Depth :	---	Test Id:	354994		

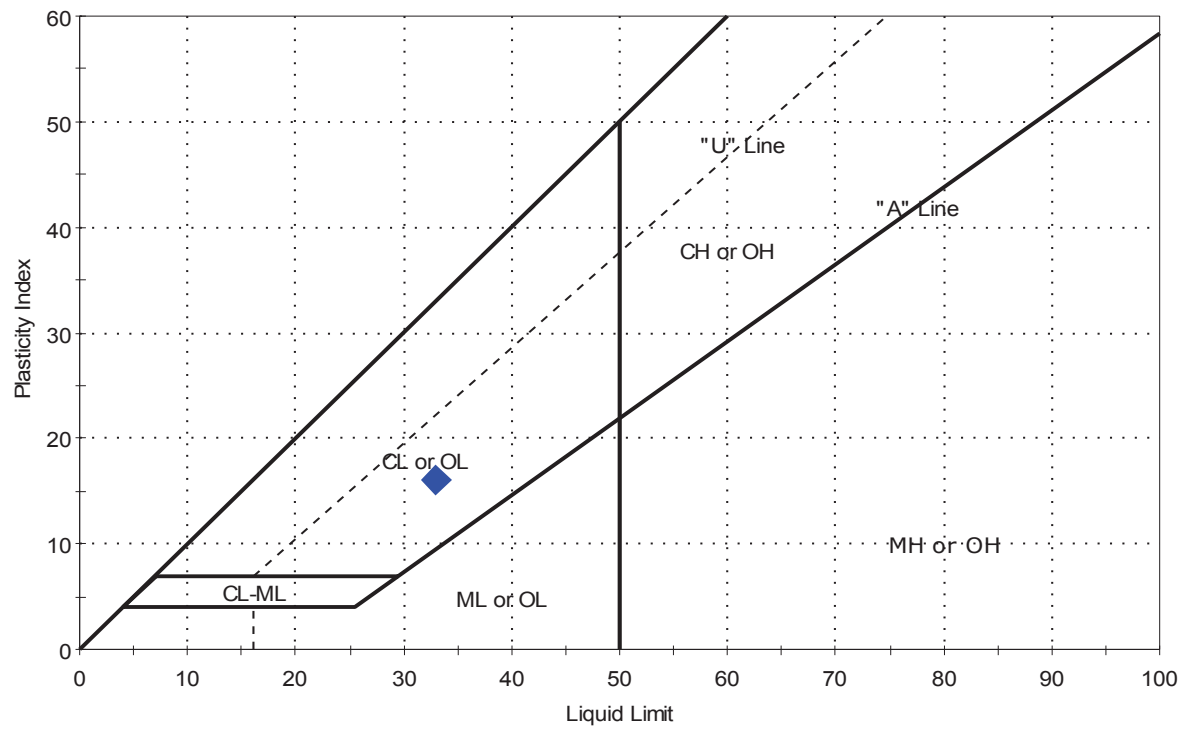
Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content,%
AECOM-B1	1A	19-21	Moist, reddish yellow clay	20.7
AECOM-B1	2	27-29	Moist, dark yellowish brown silt	15.5
AECOM-B2	1	30-32	Moist, reddish yellow clay with sand	16.2
AECOM-B2	2	48-50	Moist, reddish yellow sandy clay	15.3
AECOM-B2	3	56-58	Moist, brown silt	25.0
AECOM-B2	4A	62-64	Moist, gray silt	24.7
AECOM-B4	1	12-14	Moist, yellowish brown clay with sand	16.8
AECOM-B4	2	33-35	Wet, olive silt	37.2
AECOM-B4	3	46-48	Moist, olive silt	29.9
AECOM-B5	2	30-32	Moist, gray silt with sand	33.8

Notes: Temperature of Drying : 110º Celsius

Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	AECOM- B1	Sample Type:	tube	Tested By:	GA
Sample ID:	1A	Test Date:	12/14/15	Checked By:	emm
Depth :	19-21	Test Id:	354627		
Test Comment:	---				
Visual Description:	Moist, reddish yellow clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	1A	AECOM-B1	19-21	21	33	17	16	0.2	Lean clay (CL)

Sample Prepared using the WET method

2% Retained on #40 Sieve

Dry Strength: HIGH

Dilatancy: NONE

Toughness: MEDIUM

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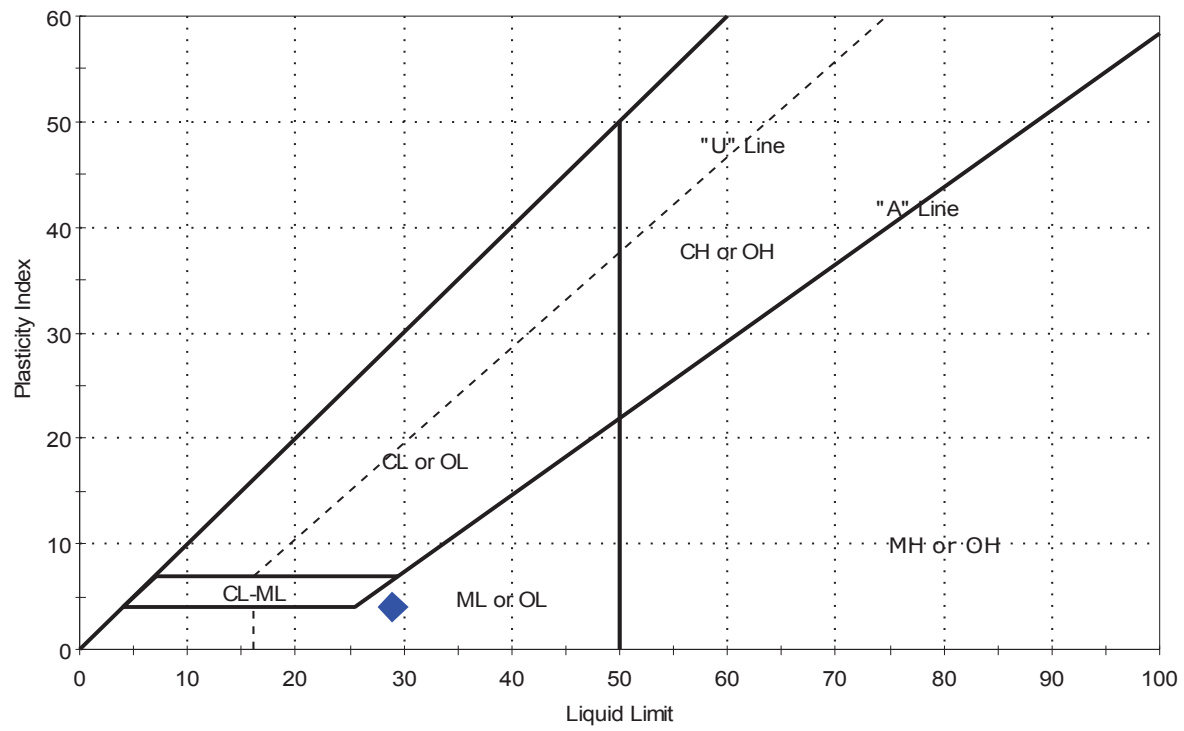
Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	AECOM- B1	Sample Type:	tube	Tested By:	GA
Sample ID:	2	Test Date:	12/14/15	Checked By:	emm
Depth :	27-29	Test Id:	354626		
Test Comment:	---				
Visual Description:	Moist, dark yellowish brown silt				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	2	AECOM-B1	27-29	15	29	25	4	-2.4	Silt (ML)

Sample Prepared using the WET method

0% Retained on #40 Sieve

Dry Strength: LOW

Dilatancy: SLOW

Toughness: LOW

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Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	AECOM-B1	Sample Type:	tube	Tested By:	cam
Sample ID:	3	Test Date:	11/17/15	Checked By:	jdt
Depth :	31-41	Test Id:	354183		
Test Comment:	---				
Visual Description:	Moist, brown silt				
Sample Comment:	---				

Atterberg Limits - ASTM D4318

Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	3	AECOM-B1	31-41	27	n/a	n/a	n/a	n/a	Silt (ML)

0% Retained on #40 Sieve

Dry Strength: MEDIUM

Dilatancy: RAPID

Toughness: n/a

The sample was determined to be Non-Plastic

Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	AECOM- B2	Sample Type:	tube	Tested By:	cam
Sample ID:	3	Test Date:	11/23/15	Checked By:	emm
Depth :	56-58	Test Id:	354629		
Test Comment:	---				
Visual Description:	Moist, brown silt				
Sample Comment:	---				

Atterberg Limits - ASTM D4318

Sample Determined to be non-plastic

Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	3	AECOM-B2	56-58	25	n/a	n/a	n/a	n/a	Silt (ML)

0% Retained on #40 Sieve

Dry Strength: MEDIUM

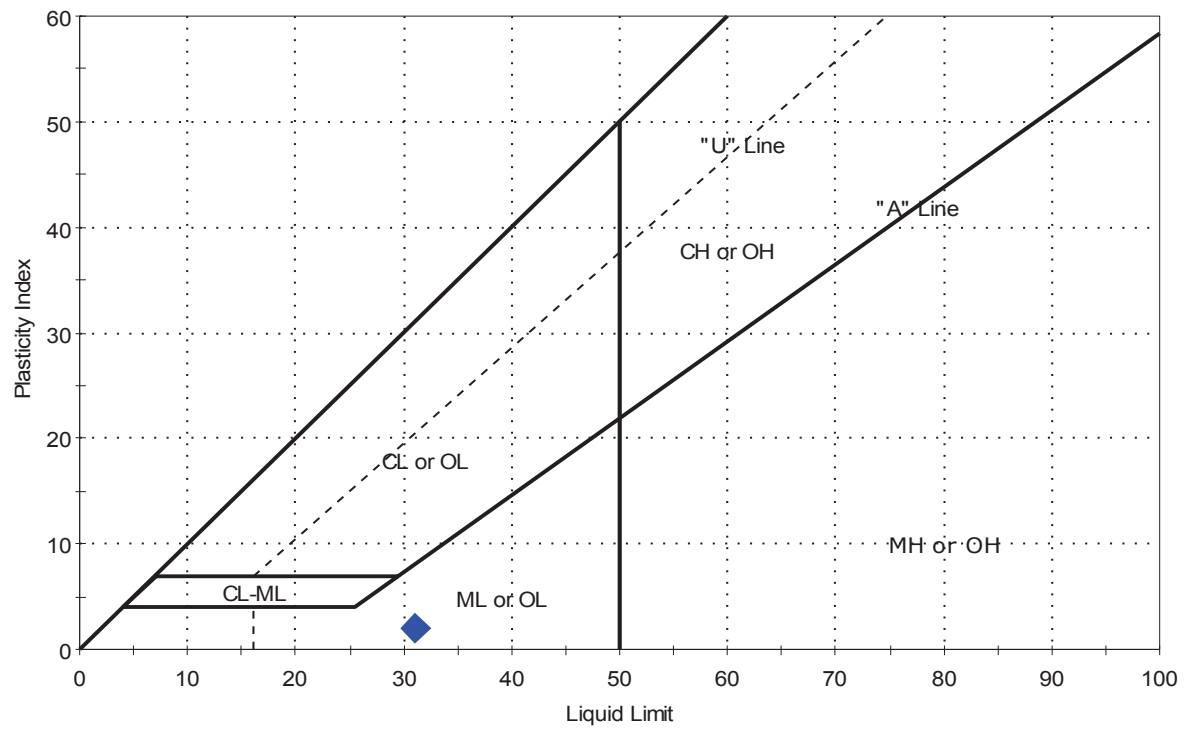
Dilatancy: RAPID

Toughness: n/a

The sample was determined to be Non-Plastic

Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	AECOM- B4	Sample Type:	tube	Tested By:	cam
Sample ID:	2	Test Date:	11/24/15	Checked By:	emm
Depth :	33-35	Test Id:	354628		
Test Comment:	---				
Visual Description:	Wet, olive silt				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content,%	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	2	AECOM-B4	33-35	37	31	29	2	4.1	Silt (ML)

Sample Prepared using the WET method

0% Retained on #40 Sieve

Dry Strength: HIGH

Dilatancy: SLOW

Toughness: LOW

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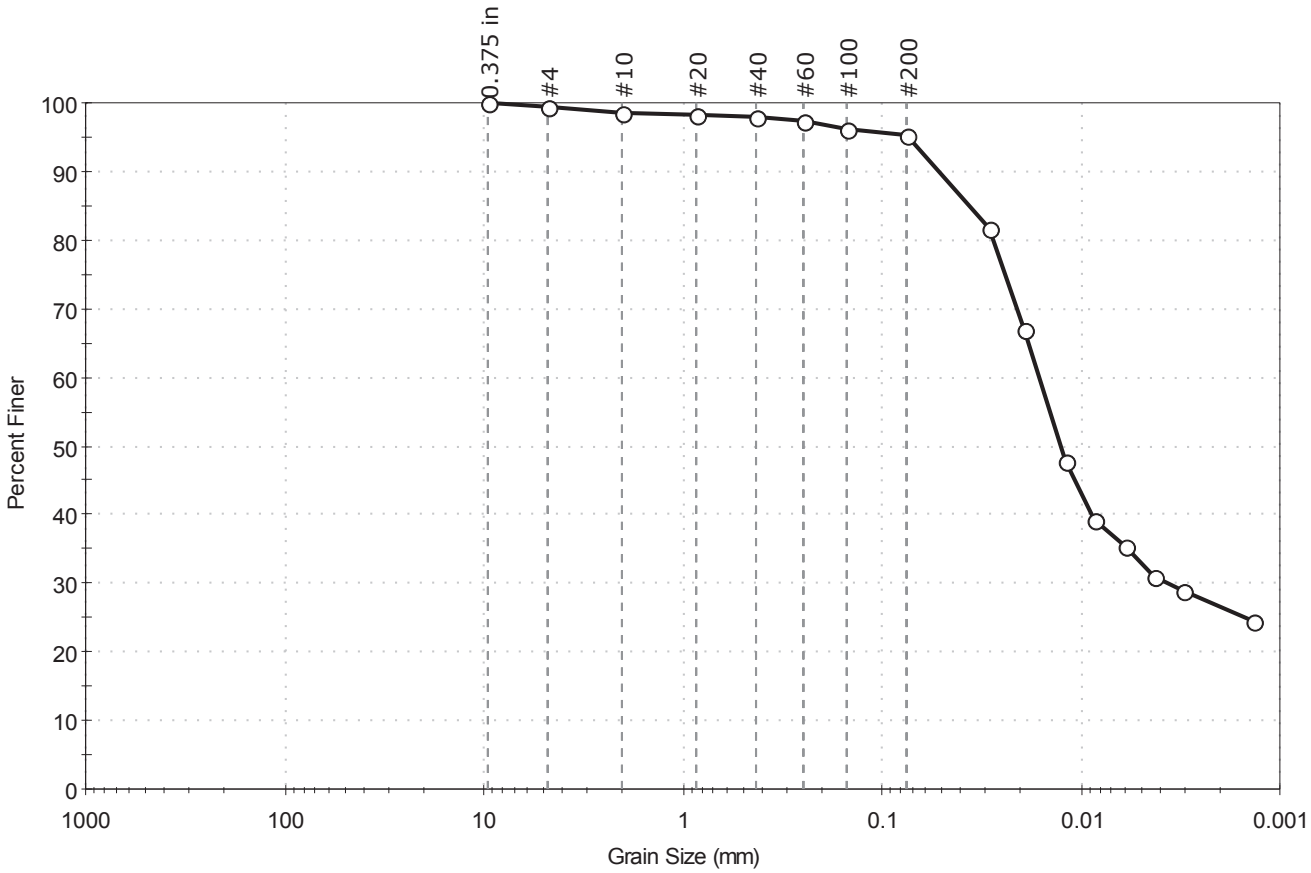
Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	AECOM-B1	Sample Type:	tube	Tested By:	GA
Sample ID:	1A	Test Date:	12/14/15	Checked By:	emm
Depth :	19-21	Test Id:	354617		
Test Comment:	---				
Visual Description:	Moist, reddish yellow clay				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.7	3.9	95.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	99		
#10	2.00	99		
#20	0.85	98		
#40	0.42	98		
#60	0.25	97		
#100	0.15	96		
#200	0.075	95		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0292	82		
---	0.0194	67		
---	0.0119	48		
---	0.0085	39		
---	0.0059	35		
---	0.0043	31		
---	0.0031	29		
---	0.0014	24		

Coefficients

D_{85} =0.0366 mm	D_{30} =0.0036 mm
D_{60} =0.0162 mm	D_{15} =N/A
D_{50} =0.0125 mm	D_{10} =N/A
C_u =N/A	C_c =N/A

Classification

ASTM Lean clay (CL)

AASHTO Clayey Soils (A-6 (15))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

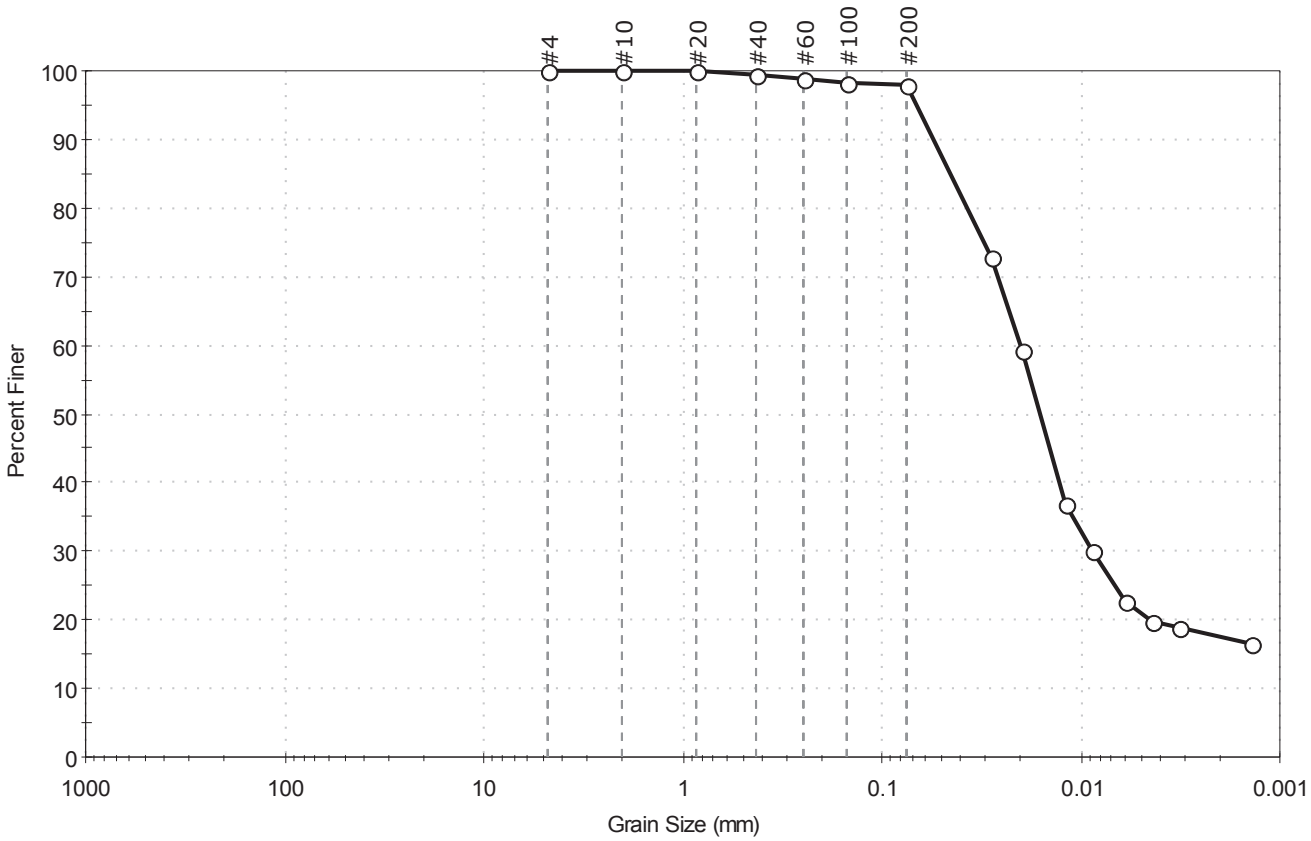
Dispersion Period : 1 minute

Specific Gravity : 2.65

Separation of Sample: #200 Sieve

Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	AECOM-B1	Sample Type:	tube	Tested By:	GA
Sample ID:	2	Test Date:	12/14/15	Checked By:	emm
Depth :	27-29	Test Id:	354616		
Test Comment:	---				
Visual Description:	Moist, dark yellowish brown silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	2.1	97.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	99		
#100	0.15	98		
#200	0.075	98		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0279	73		
---	0.0195	59		
---	0.0121	37		
---	0.0088	30		
---	0.0061	23		
---	0.0044	20		
---	0.0032	19		
---	0.0014	17		

Coefficients

D_{85} =0.0452 mm	D_{30} =0.0087 mm
D_{60} =0.0199 mm	D_{15} =N/A
D_{50} =0.0160 mm	D_{10} =N/A
C_u =N/A	C_c =N/A

Classification

ASTM Silt (ML)

AASHTO Silty Soils (A-4 (4))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

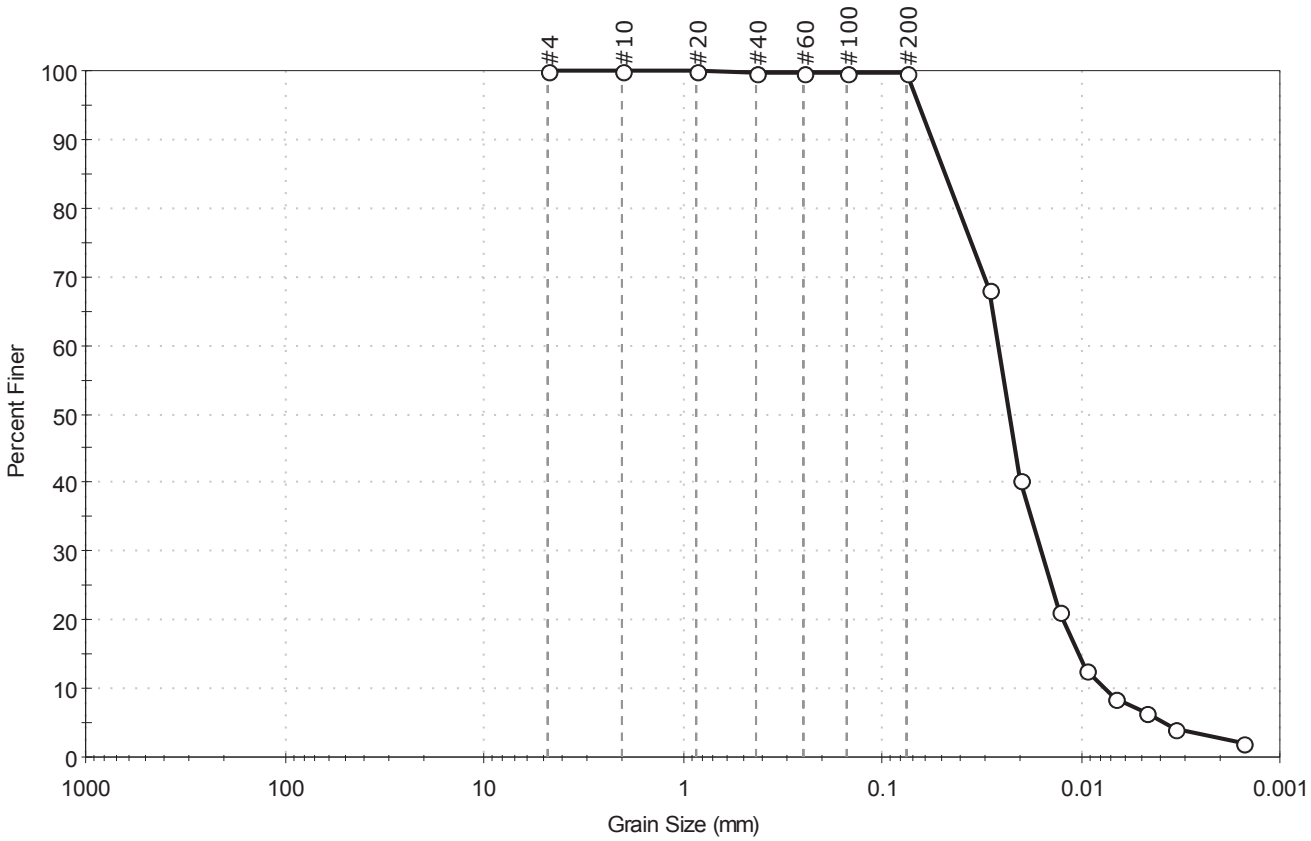
Dispersion Period : 1 minute

Specific Gravity : 2.65

Separation of Sample: #200 Sieve

Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	AECOM-B1	Sample Type:	tube	Tested By:	jbr
Sample ID:	3	Test Date:	11/17/15	Checked By:	jdt
Depth :	31-41	Test Id:	354182		
Test Comment:	---				
Visual Description:	Moist, brown silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	0.4	99.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	100		
#100	0.15	100		
#200	0.075	100		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0288	68		
---	0.0203	41		
---	0.0129	21		
---	0.0093	13		
---	0.0067	9		
---	0.0048	6		
---	0.0034	4		
---	0.0015	2		

Coefficients

D_{85} = 0.0481 mm	D_{30} = 0.0158 mm
D_{60} = 0.0259 mm	D_{15} = 0.0102 mm
D_{50} = 0.0228 mm	D_{10} = 0.0075 mm
C_u = 3.453	C_c = 1.285

Classification

ASTM Silt (ML)

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

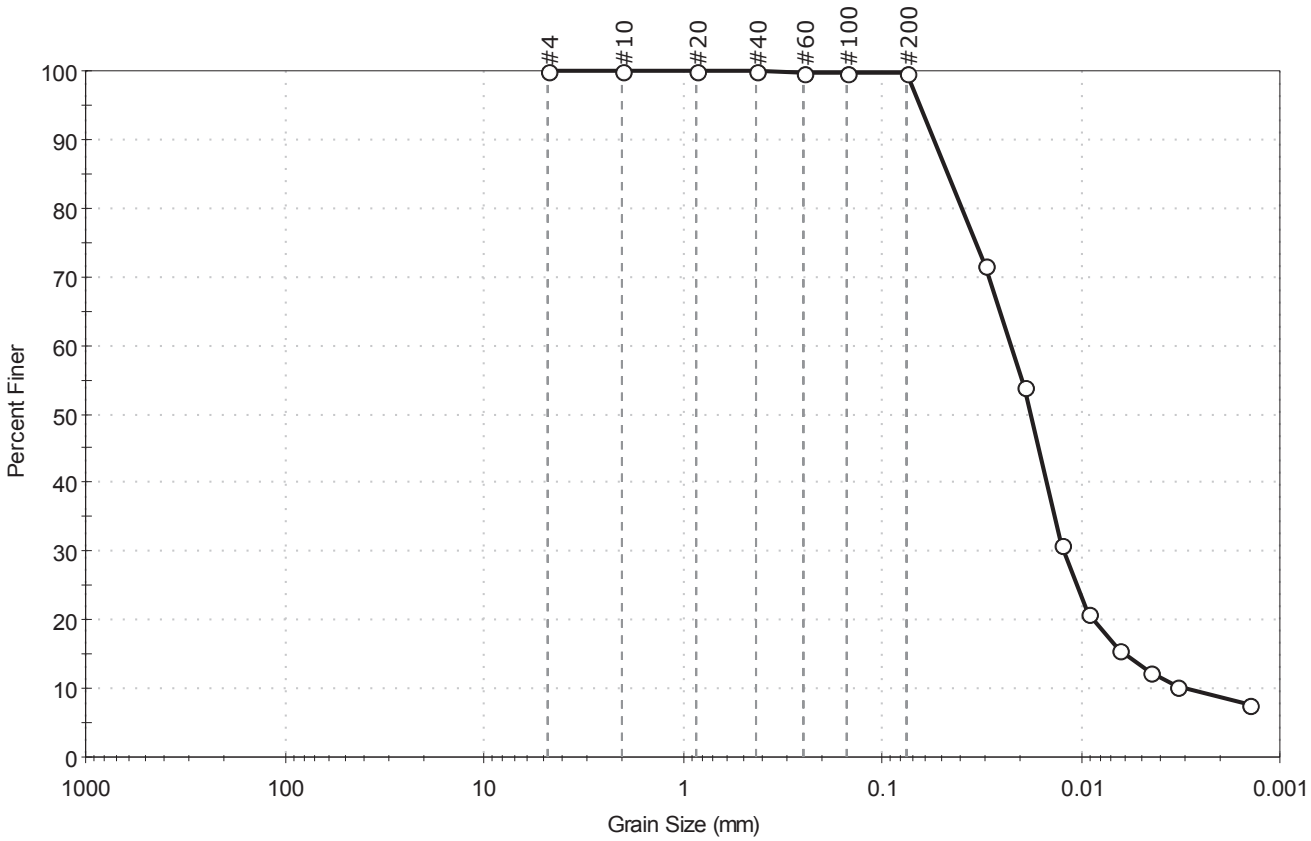
Dispersion Period : 1 minute

Specific Gravity : 2.65

Separation of Sample: #200 Sieve

Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	AECOM-B1	Sample Type:	tube	Tested By:	GA
Sample ID:	4	Test Date:	12/14/15	Checked By:	emm
Depth :	44-46	Test Id:	354630		
Test Comment:	---				
Visual Description:	Moist, dark yellowish brown clay				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	0.4	99.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	100		
#100	0.15	100		
#200	0.075	100		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0305	72		
---	0.0193	54		
---	0.0126	31		
---	0.0091	21		
---	0.0064	16		
---	0.0045	12		
---	0.0033	10		
---	0.0014	8		

Coefficients

D_{85} =0.0469 mm	D_{30} =0.0122 mm
D_{60} =0.0226 mm	D_{15} =0.0059 mm
D_{50} =0.0179 mm	D_{10} =0.0030 mm
C_u =7.533	C_c =2.195

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

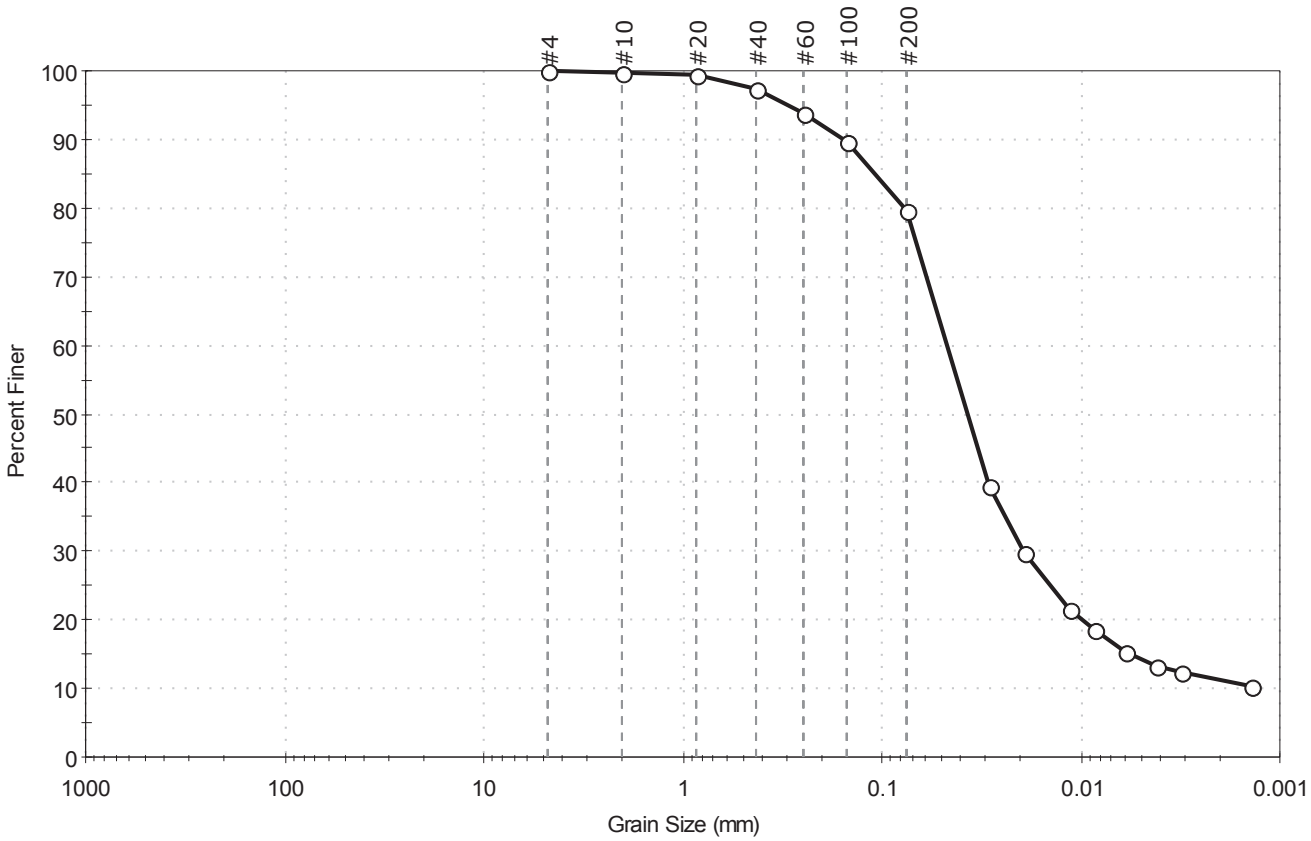
Dispersion Period : 1 minute

Specific Gravity : 2.65

Separation of Sample: #200 Sieve

Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	AECOM-B2	Sample Type:	tube	Tested By:	GA
Sample ID:	1	Test Date:	12/14/15	Checked By:	emm
Depth :	30-32	Test Id:	354622		
Test Comment:	---				
Visual Description:	Moist, reddish yellow clay with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	20.4	79.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	97		
#60	0.25	94		
#100	0.15	90		
#200	0.075	80		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0289	40		
---	0.0193	30		
---	0.0114	22		
---	0.0086	19		
---	0.0060	15		
---	0.0042	13		
---	0.0031	12		
---	0.0014	10		

Coefficients

D_{85} = 0.1085 mm D_{30} = 0.0194 mm
D_{60} = 0.0471 mm D_{15} = 0.0057 mm
D_{50} = 0.0371 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Specific Gravity : 2.65
Separation of Sample: #200 Sieve

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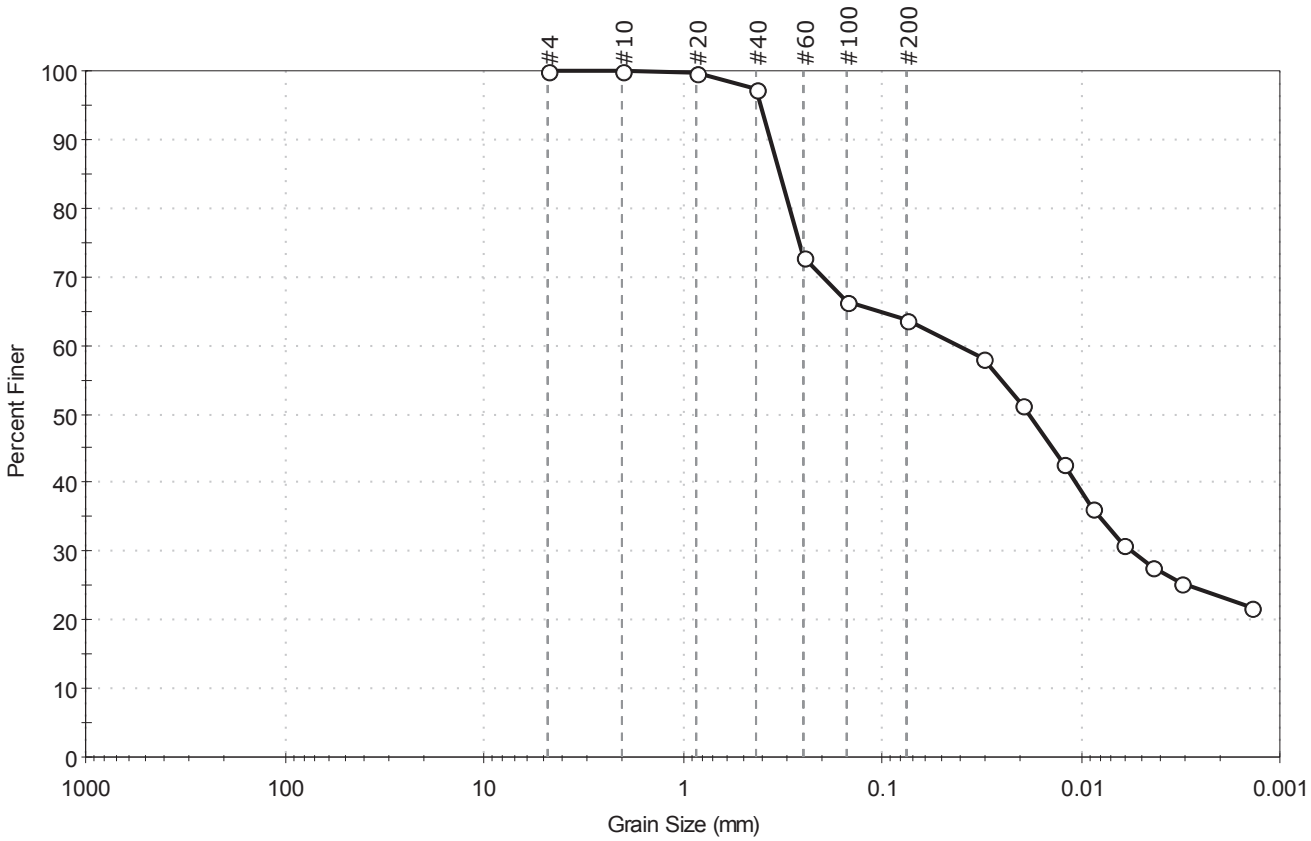
Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	AECOM-B2	Sample Type:	tube	Tested By:	GA
Sample ID:	2	Test Date:	12/14/15	Checked By:	emm
Depth :	48-50	Test Id:	354623		
Test Comment:	---				
Visual Description:	Moist, reddish yellow sandy clay				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	36.3	63.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	97		
#60	0.25	73		
#100	0.15	66		
#200	0.075	64		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0314	58		
---	0.0199	51		
---	0.0121	43		
---	0.0087	36		
---	0.0061	31		
---	0.0043	28		
---	0.0031	25		
---	0.0014	22		

Coefficients

D_{85} =0.3251 mm	D_{30} =0.0055 mm
D_{60} =0.0425 mm	D_{15} =N/A
D_{50} =0.0183 mm	D_{10} =N/A
C_u =N/A	C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

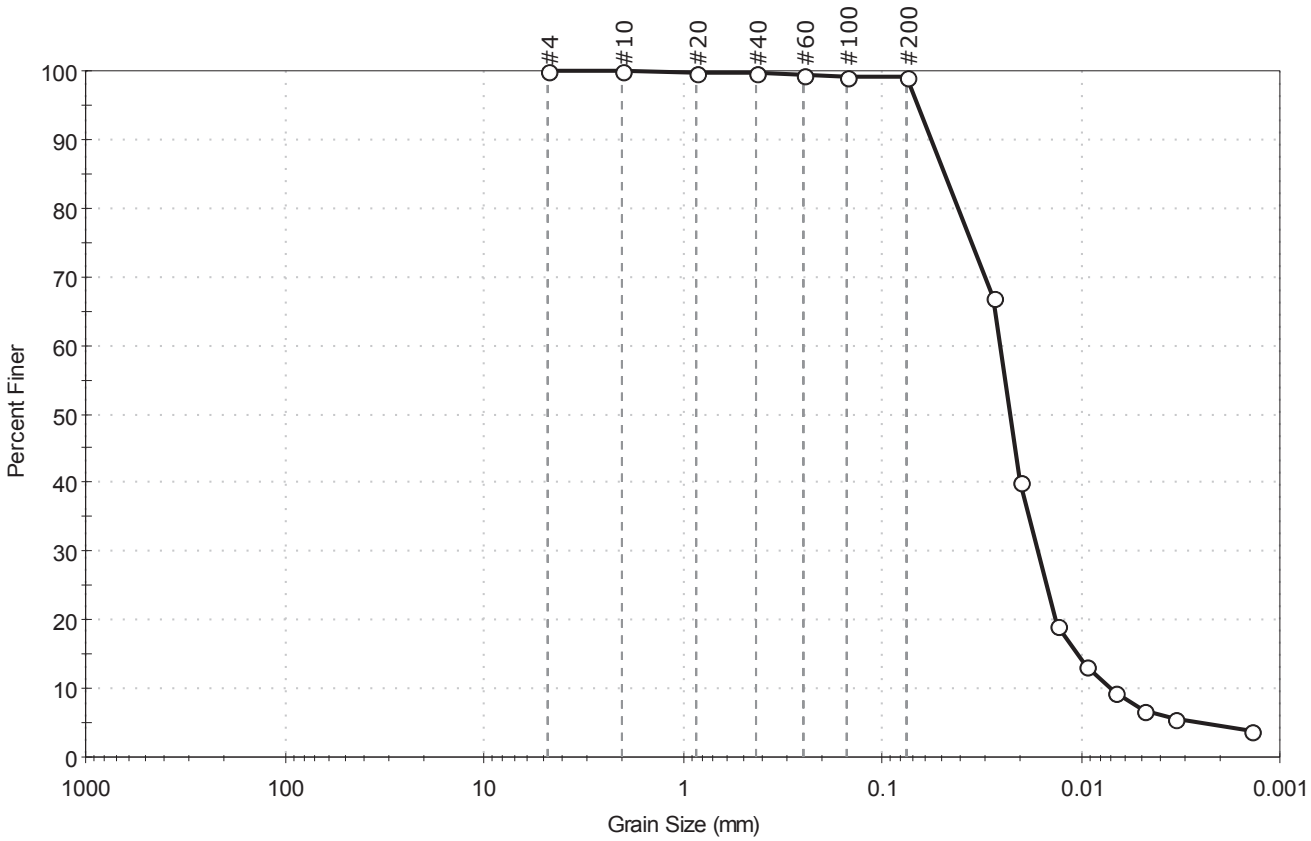
Dispersion Period : 1 minute

Specific Gravity : 2.65

Separation of Sample: #200 Sieve

Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	AECOM-B2	Sample Type:	tube	Tested By:	jbr
Sample ID:	3	Test Date:	11/24/15	Checked By:	emm
Depth :	56-58	Test Id:	354624		
Test Comment:	---				
Visual Description:	Moist, brown silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	0.9	99.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	99		
#100	0.15	99		
#200	0.075	99		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0277	67		
---	0.0201	40		
---	0.0130	19		
---	0.0093	13		
---	0.0067	10		
---	0.0048	7		
---	0.0034	6		
---	0.0014	4		

Coefficients

D_{85} = 0.0484 mm	D_{30} = 0.0163 mm
D_{60} = 0.0255 mm	D_{15} = 0.0102 mm
D_{50} = 0.0226 mm	D_{10} = 0.0069 mm
C_u = 3.696	C_c = 1.510

Classification

ASTM Silt (ML)

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

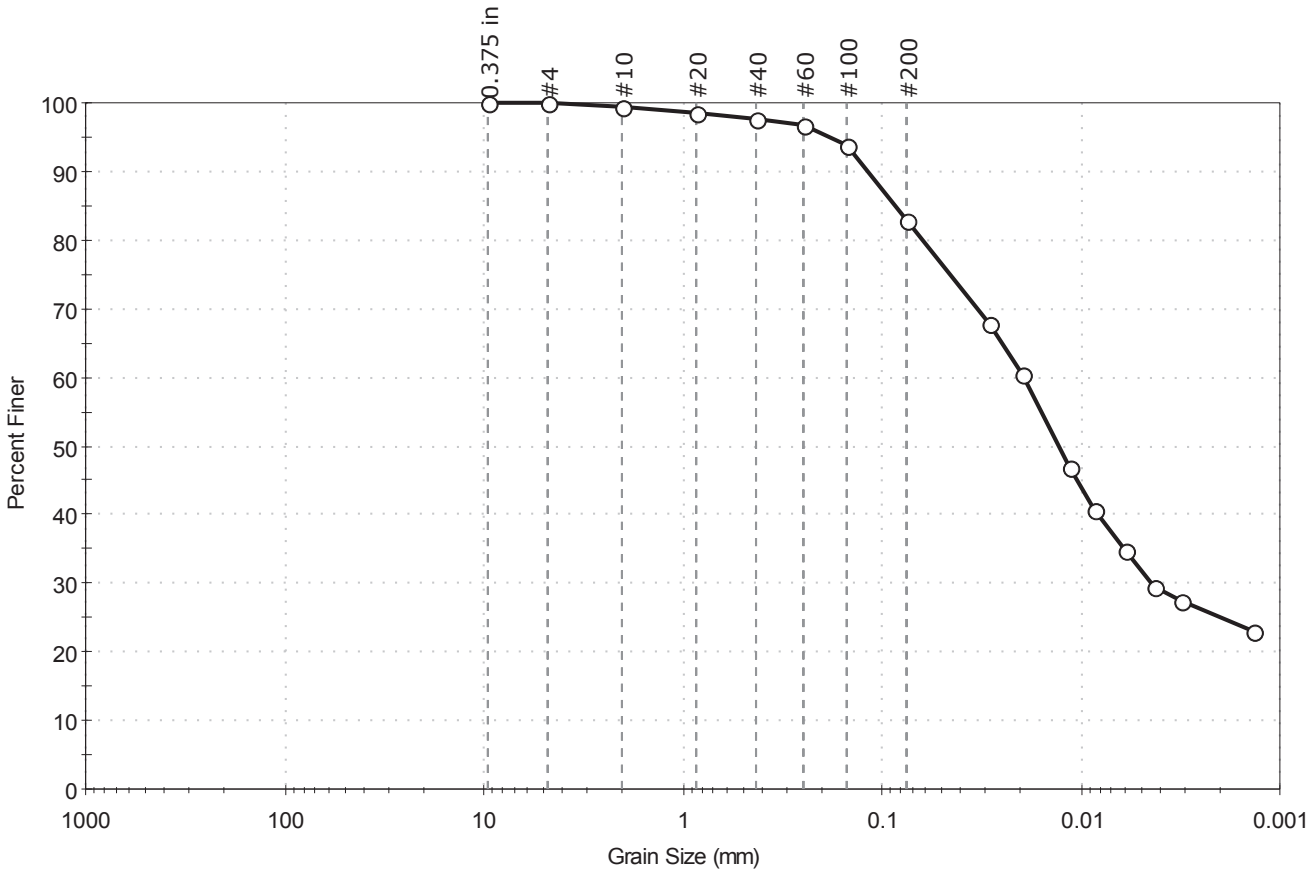
Dispersion Period : 1 minute

Specific Gravity : 2.65

Separation of Sample: #200 Sieve

Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	AECOM-B4	Sample Type:	tube	Tested By:	GA
Sample ID:	1	Test Date:	12/14/15	Checked By:	emm
Depth :	12-14	Test Id:	354618		
Test Comment:	---				
Visual Description:	Moist, yellowish brown clay with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.1	17.0	82.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	99		
#20	0.85	98		
#40	0.42	98		
#60	0.25	97		
#100	0.15	94		
#200	0.075	83		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0290	68		
---	0.0198	60		
---	0.0115	47		
---	0.0085	41		
---	0.0060	35		
---	0.0042	29		
---	0.0031	27		
---	0.0014	23		

Coefficients

D_{85} = 0.0856 mm D_{30} = 0.0044 mm
D_{60} = 0.0194 mm D_{15} = N/A
D_{50} = 0.0130 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Specific Gravity : 2.65
Separation of Sample: #200 Sieve

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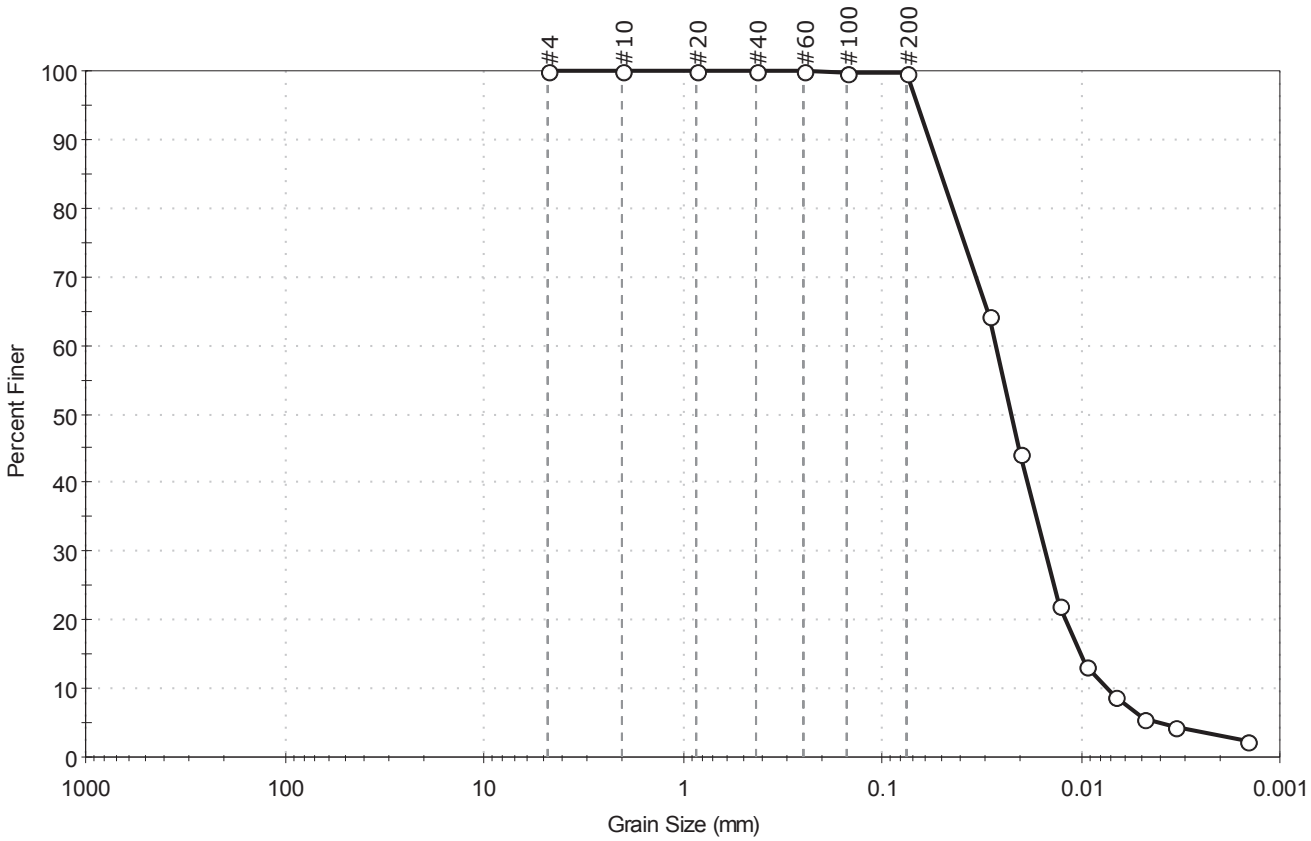
Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	AECOM-B4	Sample Type:	tube	Tested By:	jbr
Sample ID:	2	Test Date:	11/24/15	Checked By:	emm
Depth :	33-35	Test Id:	354619		
Test Comment:	---				
Visual Description:	Wet, olive silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	0.3	99.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	100		
#100	0.15	100		
#200	0.075	100		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0286	64		
---	0.0202	44		
---	0.0129	22		
---	0.0094	13		
---	0.0067	9		
---	0.0048	6		
---	0.0034	4		
---	0.0015	2		

Coefficients

D_{85} = 0.0503 mm D_{30} = 0.0151 mm
D_{60} = 0.0266 mm D_{15} = 0.0100 mm
D_{50} = 0.0224 mm D_{10} = 0.0074 mm
C_u = 3.595 C_c = 1.158

Classification

ASTM Silt (ML)

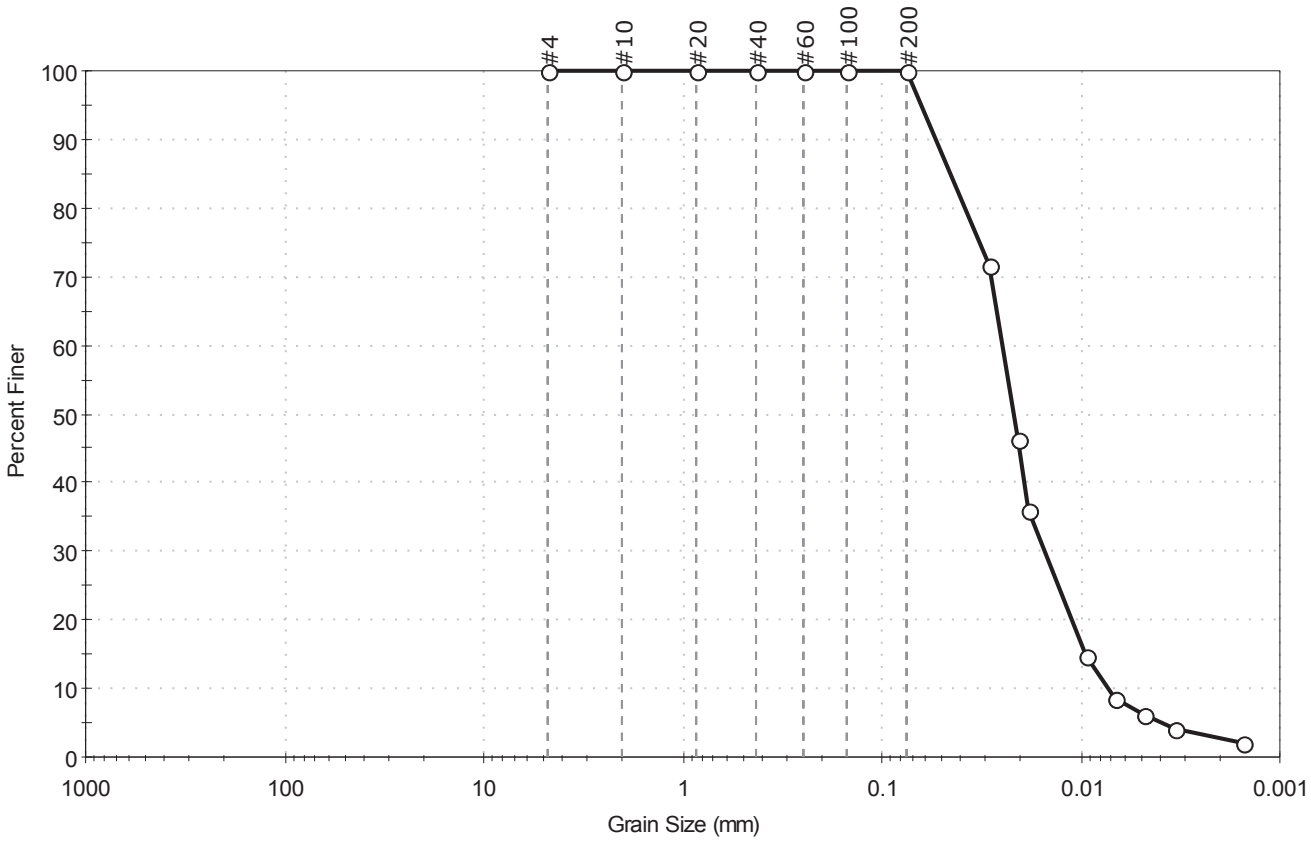
AASHTO Silty Soils (A-4 (3))

Sample/Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Specific Gravity : 2.65
Separation of Sample: #200 Sieve

Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	AECOM-B4	Sample Type:	tube	Tested By:	jbr
Sample ID:	3	Test Date:	11/25/15	Checked By:	emm
Depth :	46-48	Test Id:	354620		
Test Comment:	---				
Visual Description:	Moist, olive silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	0.1	99.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	100		
#100	0.15	100		
#200	0.075	100		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0292	72		
---	0.0208	46		
---	0.0184	36		
---	0.0094	15		
---	0.0067	8		
---	0.0048	6		
---	0.0034	4		
---	0.0015	2		

Coefficients

D_{85} = 0.0455 mm D_{30} = 0.0152 mm
D_{60} = 0.0250 mm D_{15} = 0.0094 mm
D_{50} = 0.0219 mm D_{10} = 0.0073 mm
C_u = 3.425 C_c = 1.266

Classification

ASTM N/A

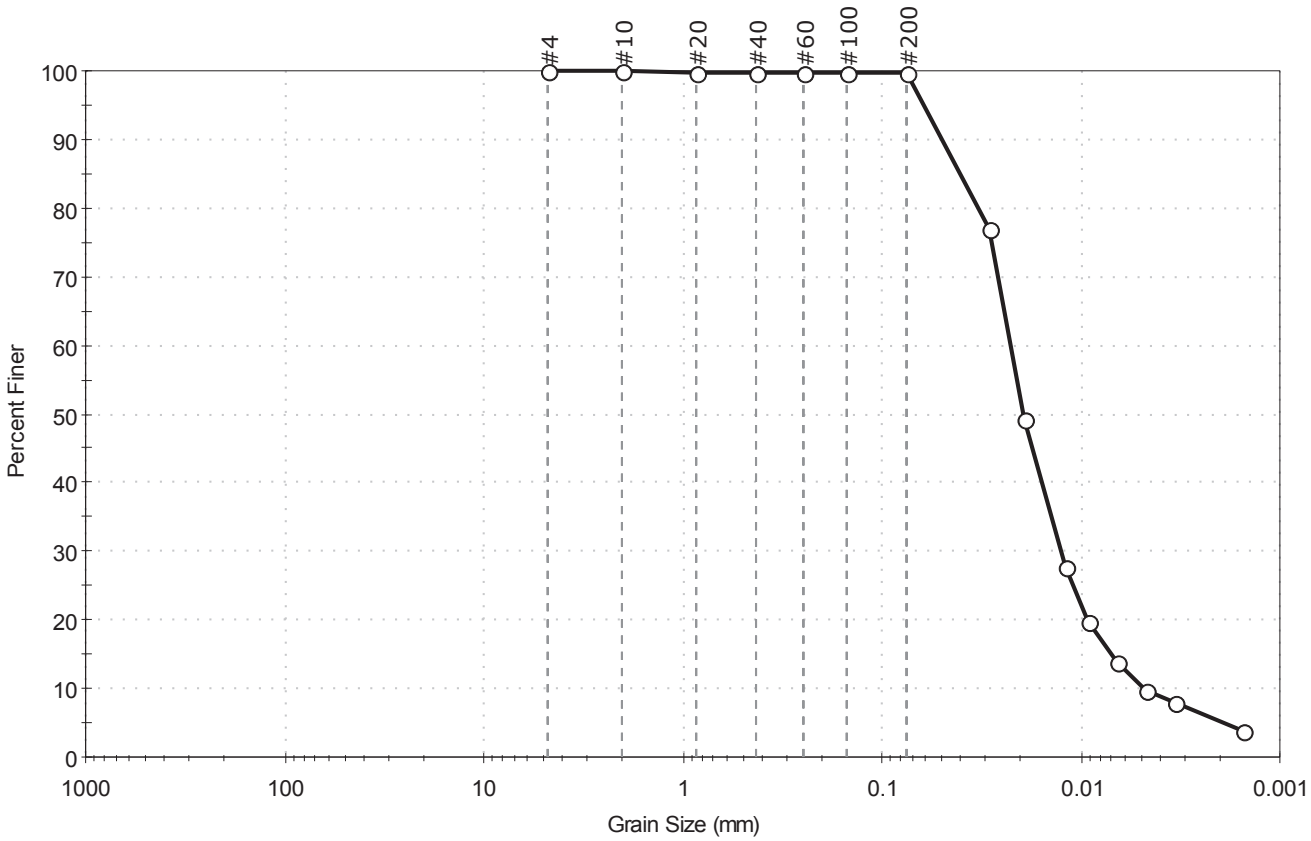
AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Specific Gravity : 2.65
Separation of Sample: #200 Sieve

Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	AECOM-B2	Sample Type:	tube	Tested By:	jbr
Sample ID:	4A	Test Date:	11/25/15	Checked By:	emm
Depth :	62-64	Test Id:	354625		
Test Comment:	---				
Visual Description:	Moist, gray silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	0.3	99.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	100		
#100	0.15	100		
#200	0.075	100		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0287	77		
---	0.0193	49		
---	0.0119	28		
---	0.0092	20		
---	0.0066	14		
---	0.0047	10		
---	0.0034	8		
---	0.0015	4		

Coefficients

D_{85} = 0.0404 mm D_{30} = 0.0126 mm
D_{60} = 0.0225 mm D_{15} = 0.0071 mm
D_{50} = 0.0195 mm D_{10} = 0.0047 mm
C_u = 4.787 C_c = 1.501

Classification

ASTM N/A

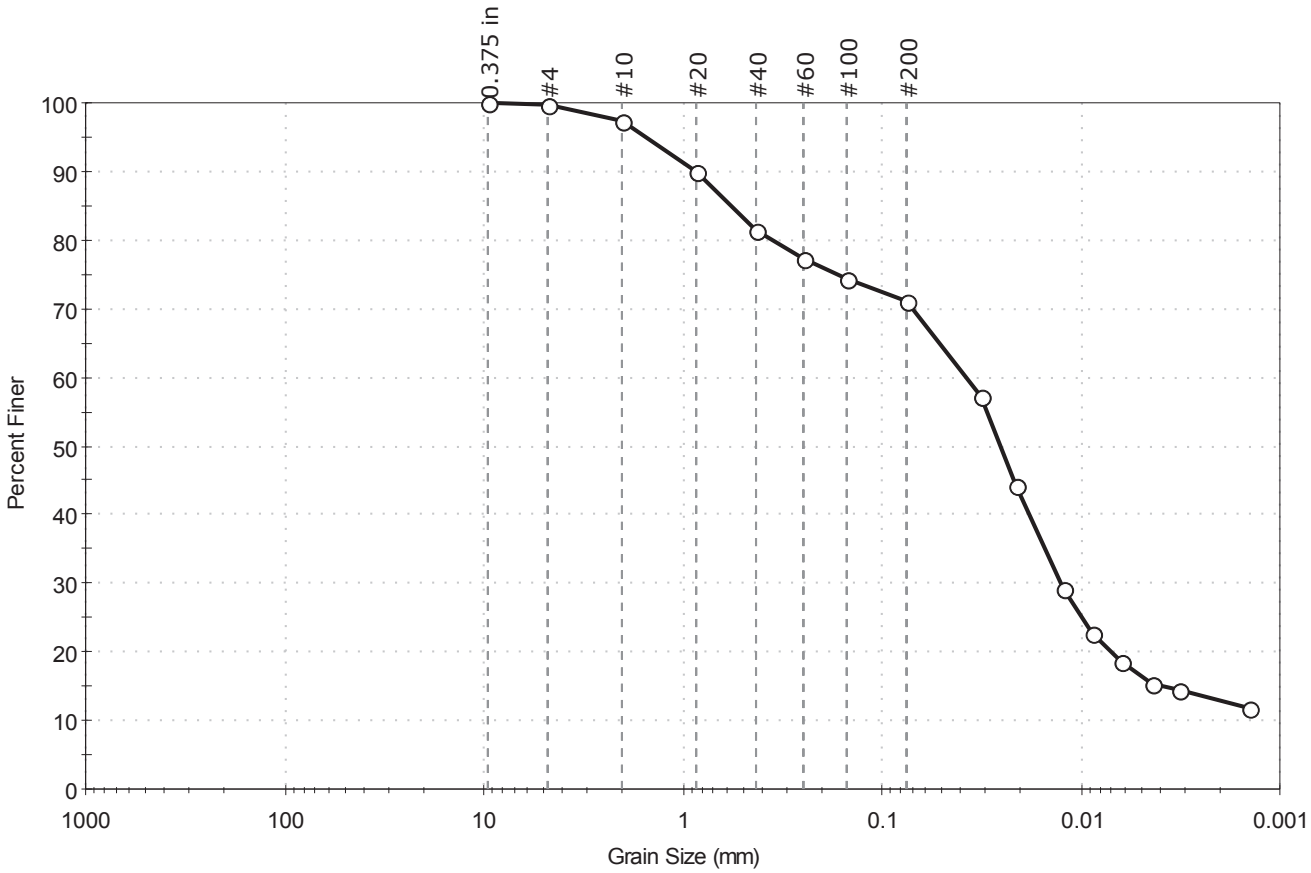
AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Specific Gravity : 2.65
Separation of Sample: #200 Sieve

Client:	AECOM				
Project:	Vectran AB Brown Ash Pond Lower Dam				
Location:	Evansville, IN			Project No:	GTX-303915
Boring ID:	AECOM-B5	Sample Type:	tube	Tested By:	GA
Sample ID:	2	Test Date:	12/14/15	Checked By:	emm
Depth :	30-32	Test Id:	354995		
Test Comment:	---				
Visual Description:	Moist, gray silt with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.4	28.4	71.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	97		
#20	0.85	90		
#40	0.42	81		
#60	0.25	77		
#100	0.15	74		
#200	0.075	71		
---	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0321	57		
---	0.0210	44		
---	0.0122	29		
---	0.0089	23		
---	0.0062	19		
---	0.0044	15		
---	0.0032	14		
---	0.0014	12		

Coefficients

D_{85} =0.5703 mm D_{30} =0.0126 mm
D_{60} =0.0378 mm D_{15} =0.0039 mm
D_{50} =0.0253 mm D_{10} =N/A
C_u =N/A C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---
Dispersion Device : Apparatus A - Mech Mixer
Dispersion Period : 1 minute
Specific Gravity : 2.65
Separation of Sample: #200 Sieve

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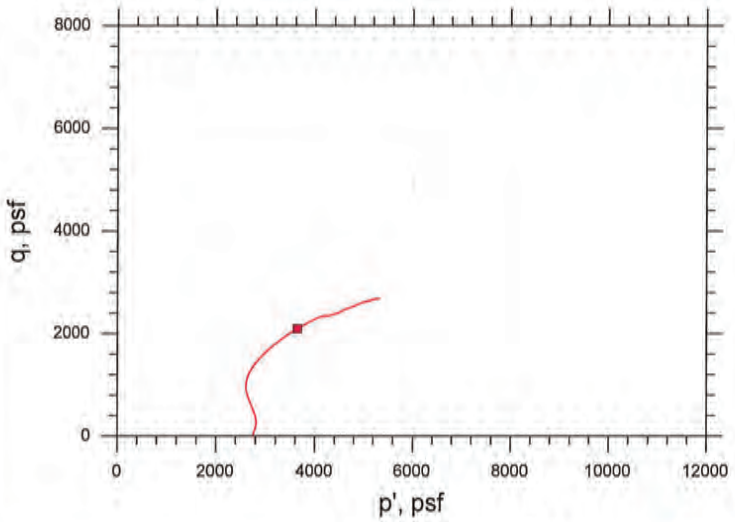
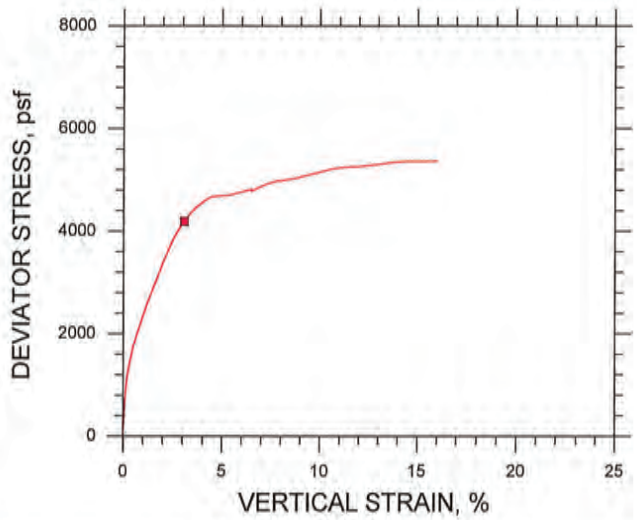
Soil Consolidated Undrained Triaxial Laboratory Test Results

Client: AECOM	
Project Name: Vectran AB Brown Ash Pond	
Project Location: Evansville, IN	
Project Number: GTX-303915	
Tested By: md	Checked By: jdt
Boring ID: AECOM-B1	
Preparation: intact	
Description: Moist, yellow and brown silt with red clay	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.7

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





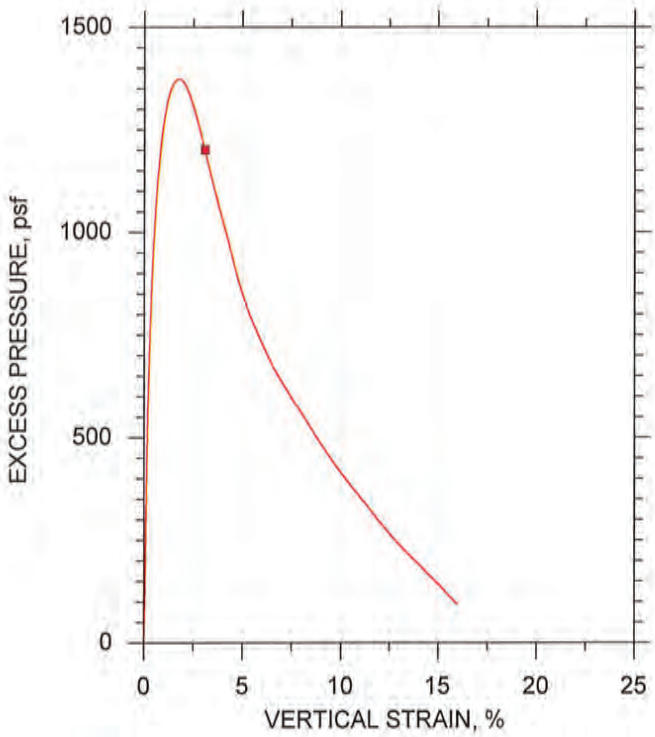
Symbol		■			
Sample ID		1A			
Depth, ft		19-21 ft			
Test Number		CU-2-1			
Initial	Height, in	6.200			
	Diameter, in	2.870			
	Moisture Content (from Cuttings), %	17.0			
	Dry Density, pcf	112.			
	Saturation (Wet Method), %	90.9			
	Void Ratio	0.506			
Before Shear	Moisture Content, %	17.2			
	Dry Density, pcf	115.			
	Cross-sectional Area (Method A), in²	6.367			
	Saturation, %	100.0			
	Void Ratio	0.465			
	Back Pressure, psf	1.281e+004			
Vertical Effective Consolidation Stress, psf		2742.			
Horizontal Effective Consolidation Stress, psf		2751.			
Vertical Strain after Consolidation, %		1.085			
Volumetric Strain after Consolidation, %		2.516			
Time to 50% Consolidation, min		12.25			
Shear Strength, psf		2093.			
Strain at Failure, %		3.08			
Strain Rate, %/min		0.01600			
Deviator Stress at Failure, psf		4186.			
Effective Minor Principal Stress at Failure, psf		1550.			
Effective Major Principal Stress at Failure, psf		5736.			
B-Value		0.95			

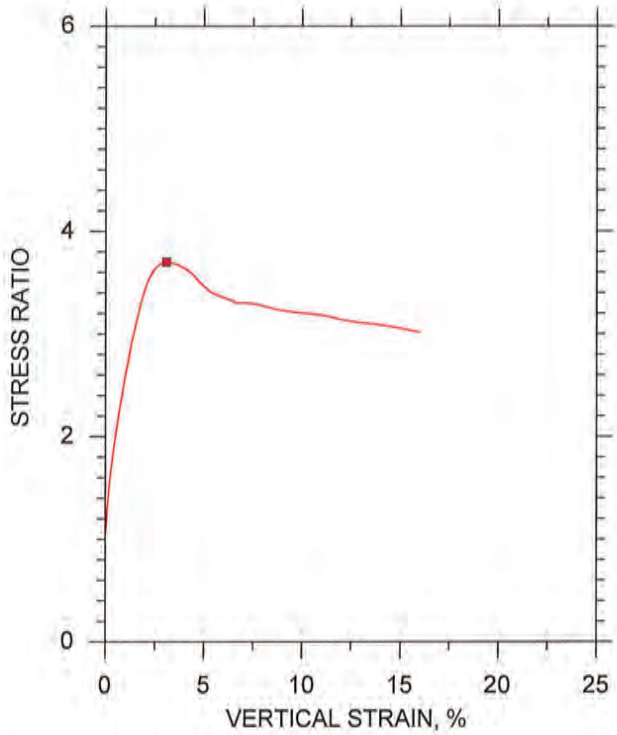
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

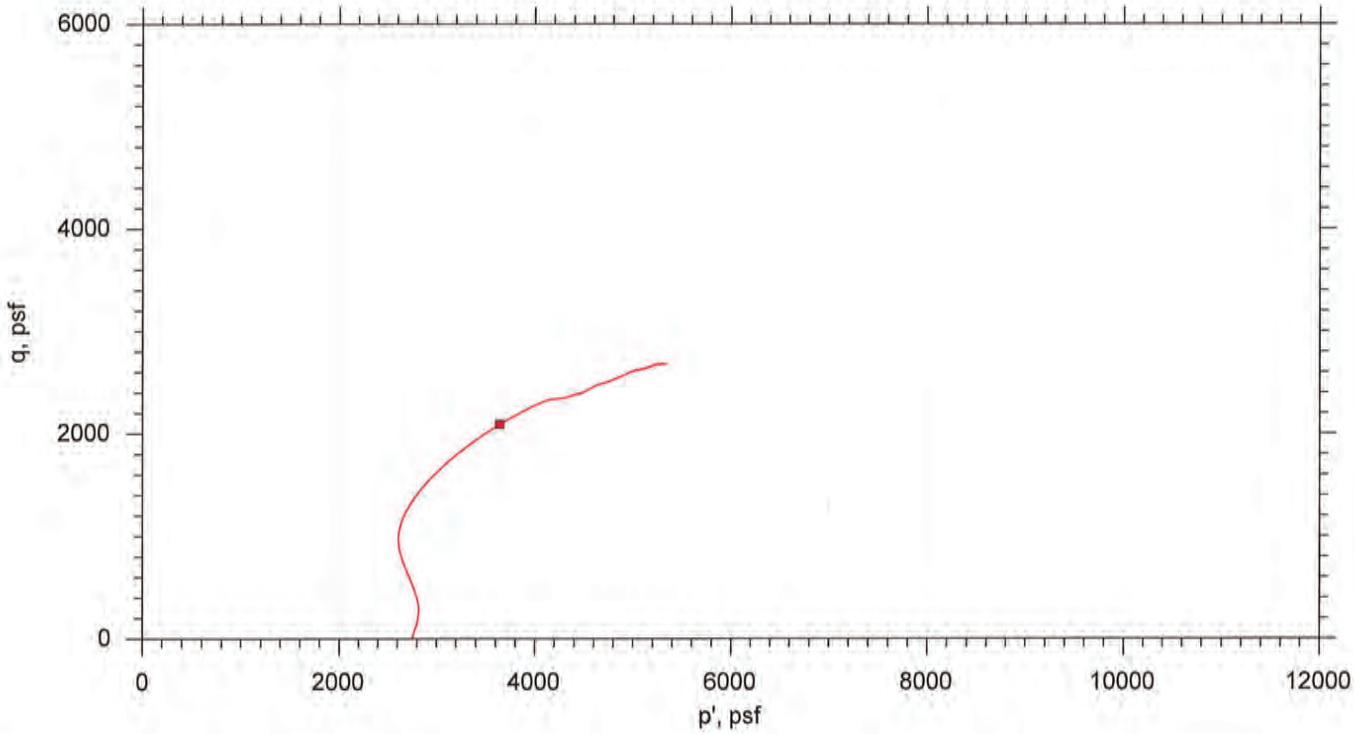
Remarks:

System F

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







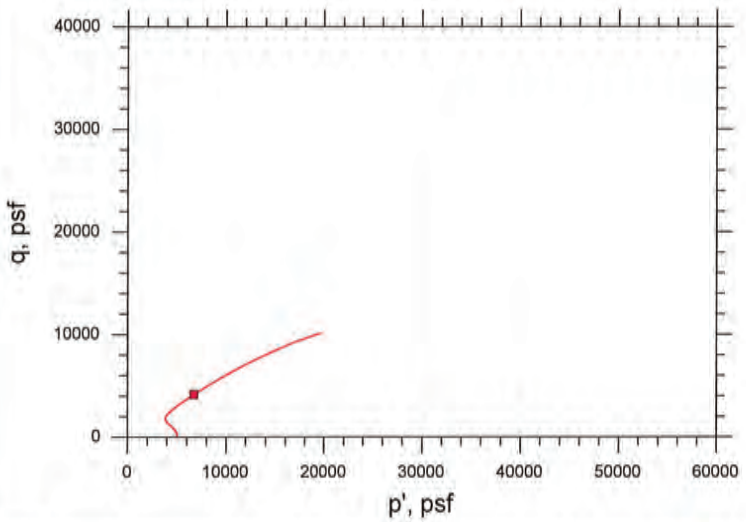
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	1A	CU-2-1	19-21 ft	md	11/11/15	jdt	11/17/15	303915-CU-2-1n.dat

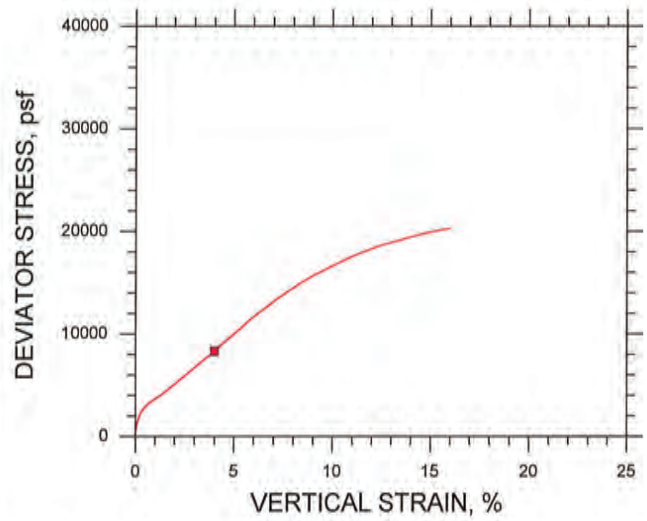
GeoTesting EXPRESS

Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
Boring No.: AECOM-B1	Sample Type: intact	
Description: Moist, yellow and brown silt with red clay		
Remarks: System F		

Client: AECOM	
Project Name: Vectran AB Brown Ash Pond	
Project Location: Evansville, IN	
Project Number: GTX-303915	
Tested By: md	Checked By: jdt
Boring ID: AECOM-B1	
Preparation: intact	
Description: Moist, brown silty clay and sand	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.65

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





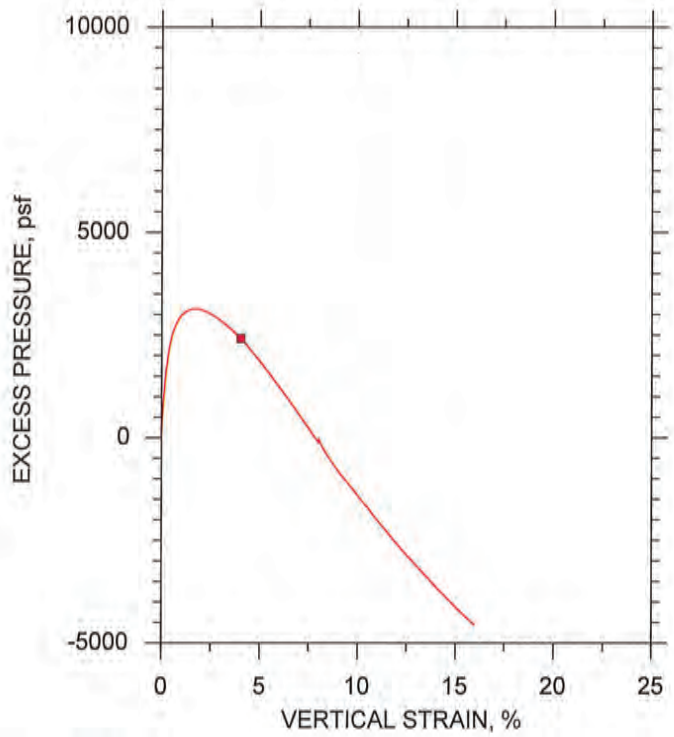
Symbol		■			
Sample ID		2			
Depth, ft		27-29 ft			
Test Number		CU-1-1			
Initial	Height, in	6.150			
	Diameter, in	2.870			
	Moisture Content (from Cuttings), %	16.3			
	Dry Density, pcf	111.			
	Saturation (Wet Method), %	87.4			
	Void Ratio	0.494			
Before Shear	Moisture Content, %	17.0			
	Dry Density, pcf	114.			
	Cross-sectional Area (Method A), in²	6.352			
	Saturation, %	100.0			
	Void Ratio	0.449			
	Back Pressure, psf	1.944e+004			
Vertical Effective Consolidation Stress, psf		4991.			
Horizontal Effective Consolidation Stress, psf		4997.			
Vertical Strain after Consolidation, %		1.065			
Volumetric Strain after Consolidation, %		2.671			
Time to 50% Consolidation, min		7.840			
Shear Strength, psf		4160.			
Strain at Failure, %		4.00			
Strain Rate, %/min		0.01600			
Deviator Stress at Failure, psf		8319.			
Effective Minor Principal Stress at Failure, psf		2578.			
Effective Major Principal Stress at Failure, psf		1.090e+004			
B-Value		0.95			

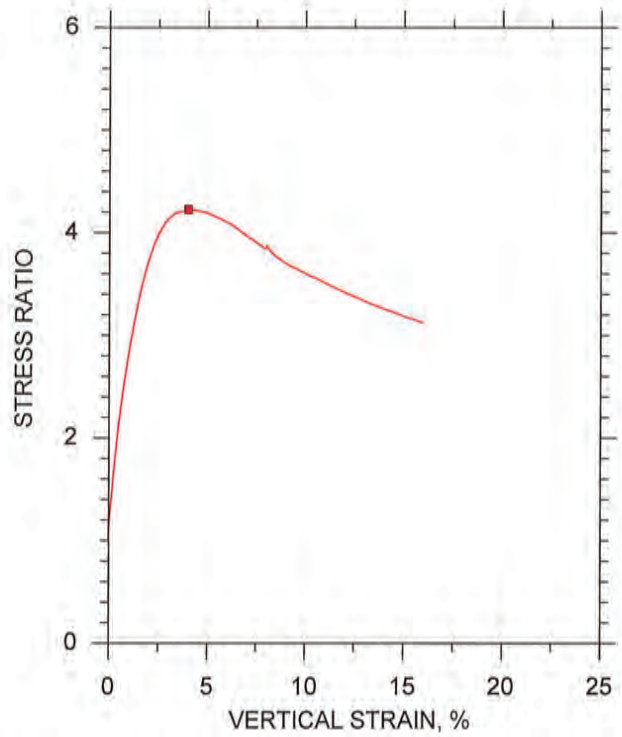
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

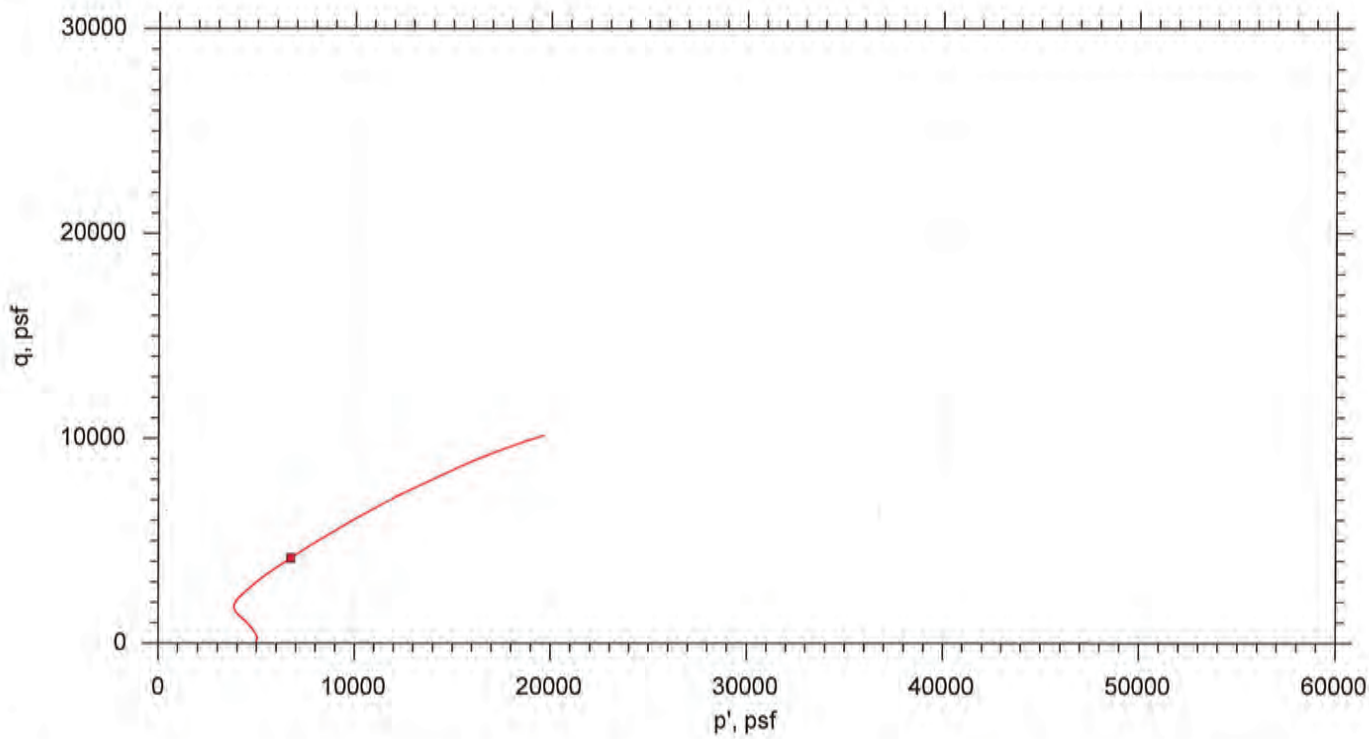
Remarks:

System E

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







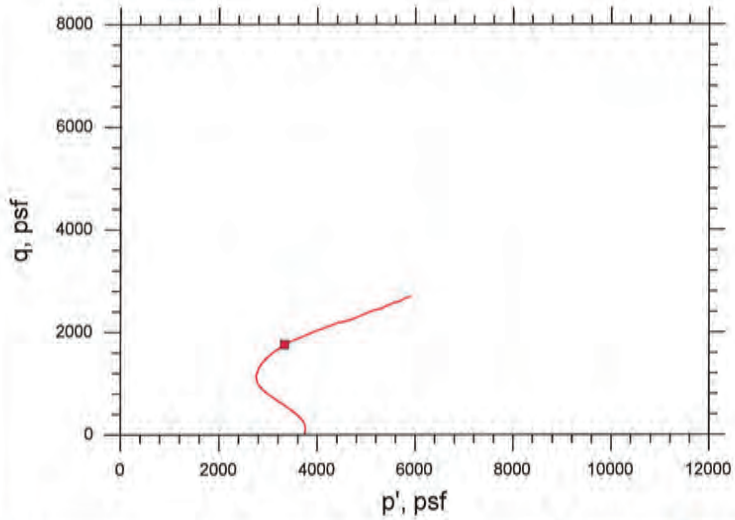
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	2	CU-1-1	27-29 ft	md	11/11/15	jdt	11/17/15	303915-CU-1-1n.dat

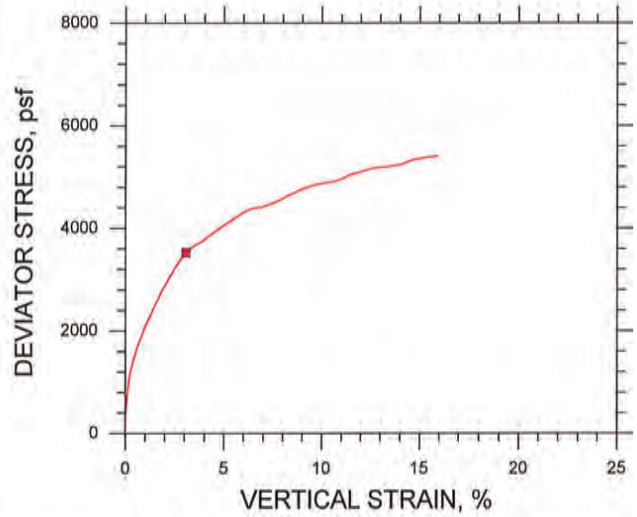
GeoTesting EXPRESS

Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
Boring No.: AECOM-B1	Sample Type: intact	
Description: Moist, brown silty clay and sand		
Remarks: System E		

Client: AECOM	
Project Name: Vectran AB Brown Ash Pond	
Project Location: Evansville, IN	
Project Number: GTX-303915	
Tested By: md	Checked By: jdt
Boring ID: AECOM-B2	
Preparation: intact	
Description: Moist, reddish brown sandy clay	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.7

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





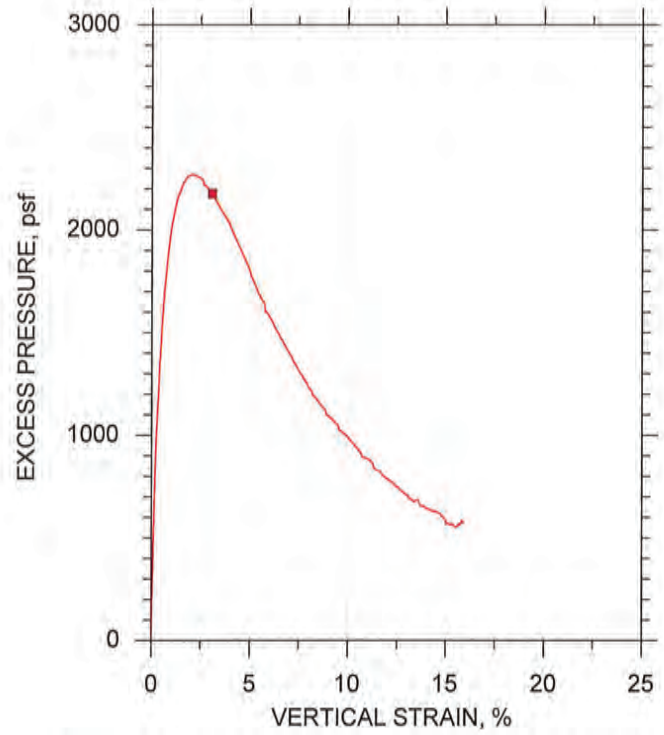
Symbol		■			
Sample ID		1			
Depth, ft		30-32 ft			
Test Number		CU-3-1			
Initial	Height, in	6.200			
	Diameter, in	2.870			
	Moisture Content (from Cuttings), %	17.9			
	Dry Density, pcf	108.			
	Saturation (Wet Method), %	87.1			
	Void Ratio	0.556			
Before Shear	Moisture Content, %	19.2			
	Dry Density, pcf	111.			
	Cross-sectional Area (Method A), in²	6.377			
	Saturation, %	100.0			
	Void Ratio	0.517			
	Back Pressure, psf	2.083e+004			
Vertical Effective Consolidation Stress, psf		3744.			
Horizontal Effective Consolidation Stress, psf		3750.			
Vertical Strain after Consolidation, %		0.8401			
Volumetric Strain after Consolidation, %		1.803			
Time to 50% Consolidation, min		56.25			
Shear Strength, psf		1763.			
Strain at Failure, %		3.08			
Strain Rate, %/min		0.01600			
Deviator Stress at Failure, psf		3526.			
Effective Minor Principal Stress at Failure, psf		1571.			
Effective Major Principal Stress at Failure, psf		5097.			
B-Value		0.95			

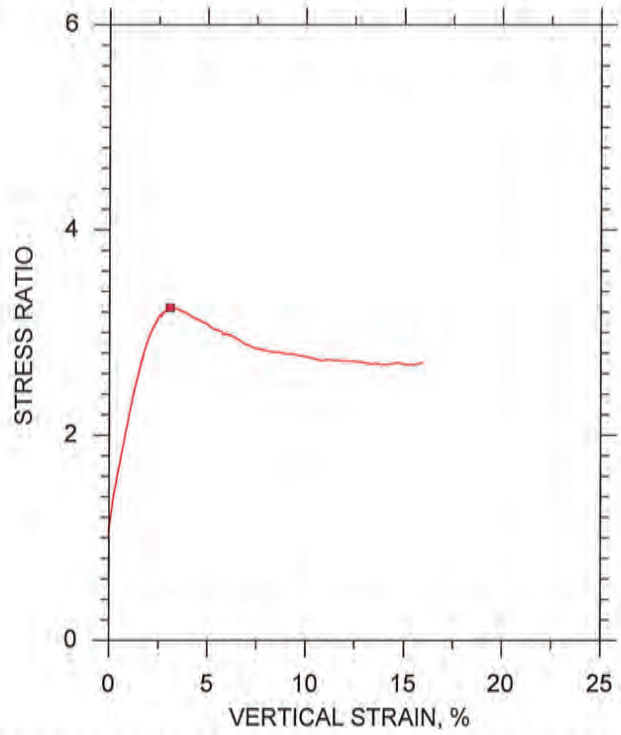
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

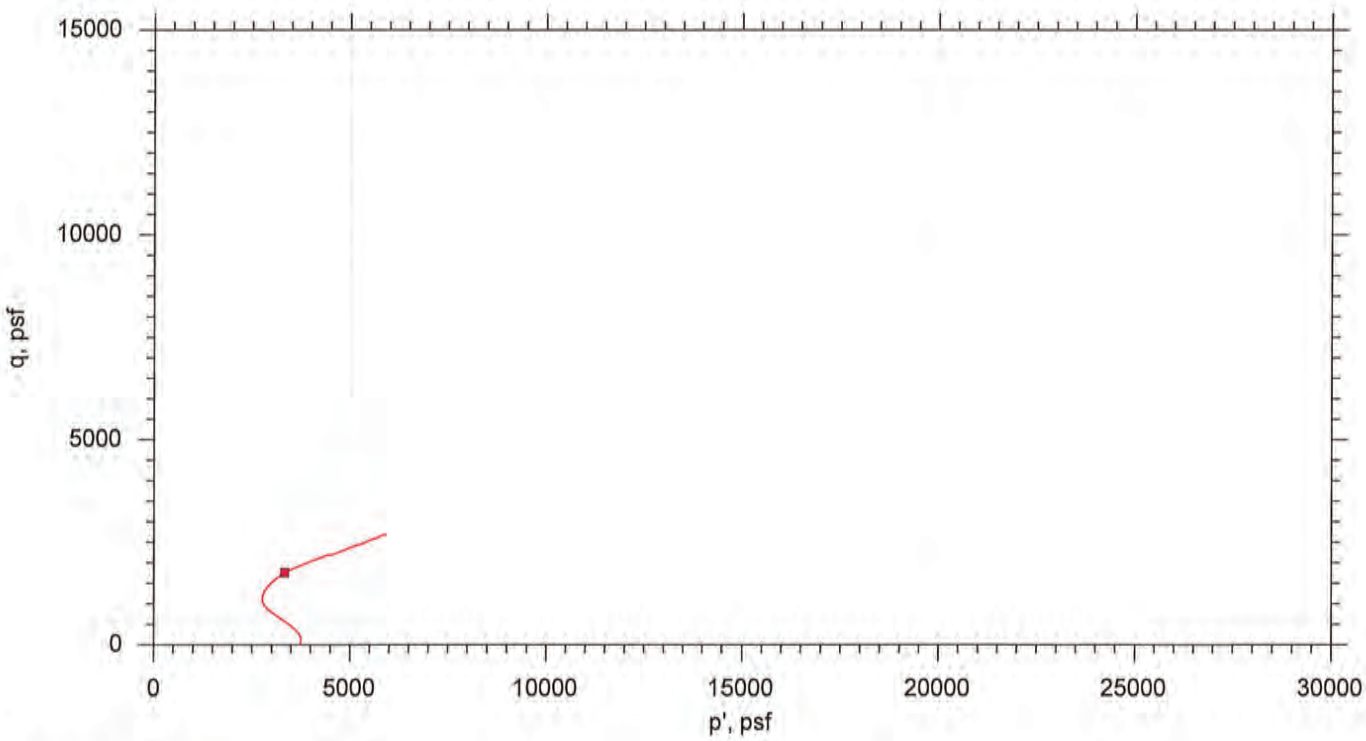
Remarks:

System X

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







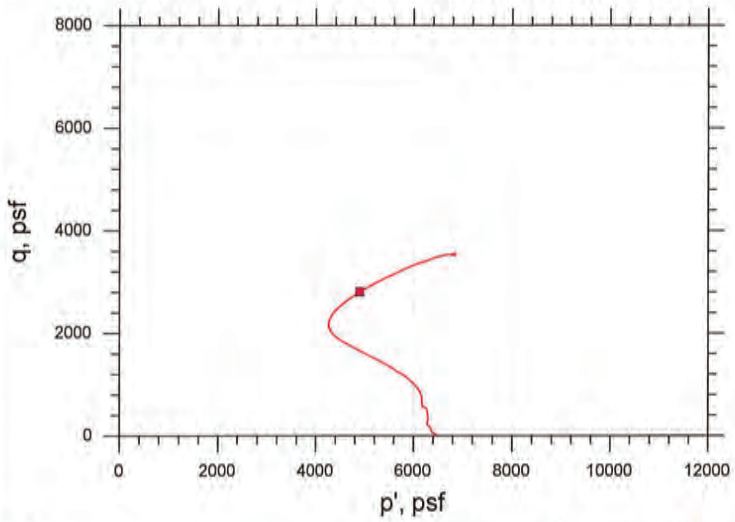
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	1	CU-3-1	30-32 ft	md	11/11/15	jdt	11/17/15	303915-CU-3-1n.dat

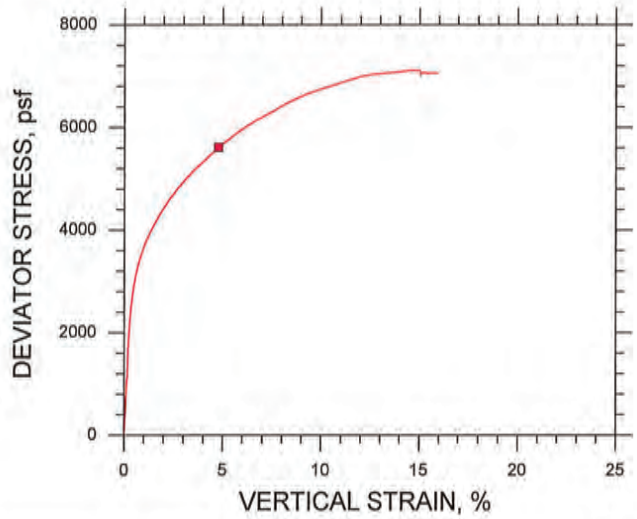
GeoTesting EXPRESS

Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
Boring No.: AECOM-B2	Sample Type: intact	
Description: Moist, reddish brown sandy clay		
Remarks: System X		

Client: AECOM	
Project Name: Vectran AB Brown Ash Pond	
Project Location: Evansville, IN	
Project Number: GTX-303915	
Tested By: md	Checked By: jdt
Boring ID: AECOM-B2	
Preparation: Intact	
Description: Moist, reddish brown clay with sand	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.7

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





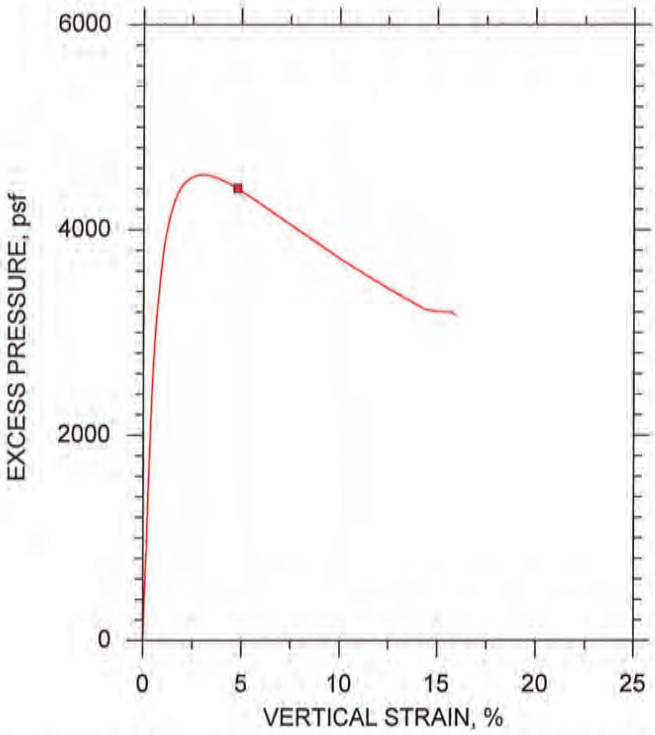
Symbol		■			
Sample ID		2			
Depth, ft		48-50 ft			
Test Number		CU-5-1			
Initial	Height, in	6.180			
	Diameter, in	2.870			
	Moisture Content (from Cuttings), %	15.2			
	Dry Density, pcf	111.			
	Saturation (Wet Method), %	80.2			
	Void Ratio	0.512			
Before Shear	Moisture Content, %	16.1			
	Dry Density, pcf	117.			
	Cross-sectional Area (Method A), in²	6.262			
	Saturation, %	100.0			
	Void Ratio	0.435			
	Back Pressure, psf	1.858e+004			
Vertical Effective Consolidation Stress, psf		6483.			
Horizontal Effective Consolidation Stress, psf		6497.			
Vertical Strain after Consolidation, %		1.739			
Volumetric Strain after Consolidation, %		4.478			
Time to 50% Consolidation, min		100.0			
Shear Strength, psf		2806.			
Strain at Failure, %		4.78			
Strain Rate, %/min		0.01600			
Deviator Stress at Failure, psf		5612.			
Effective Minor Principal Stress at Failure, psf		2092.			
Effective Major Principal Stress at Failure, psf		7703.			
B-Value		0.95			

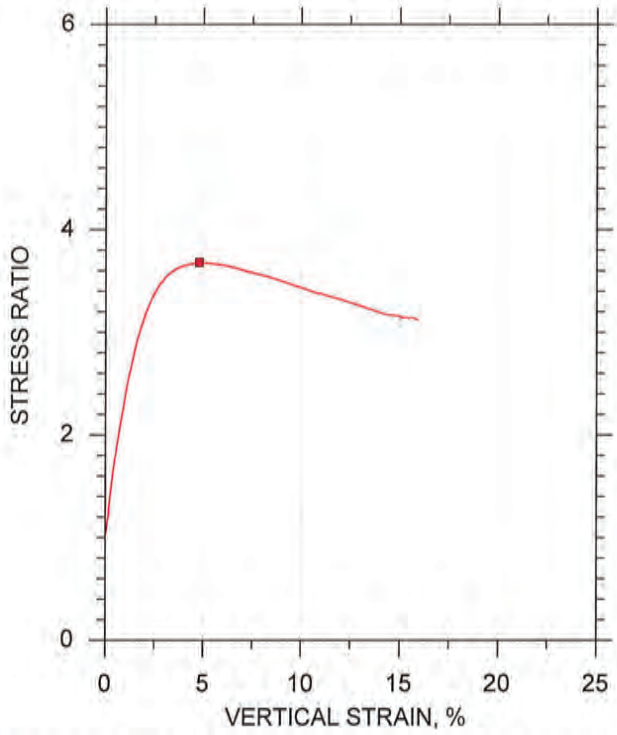
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

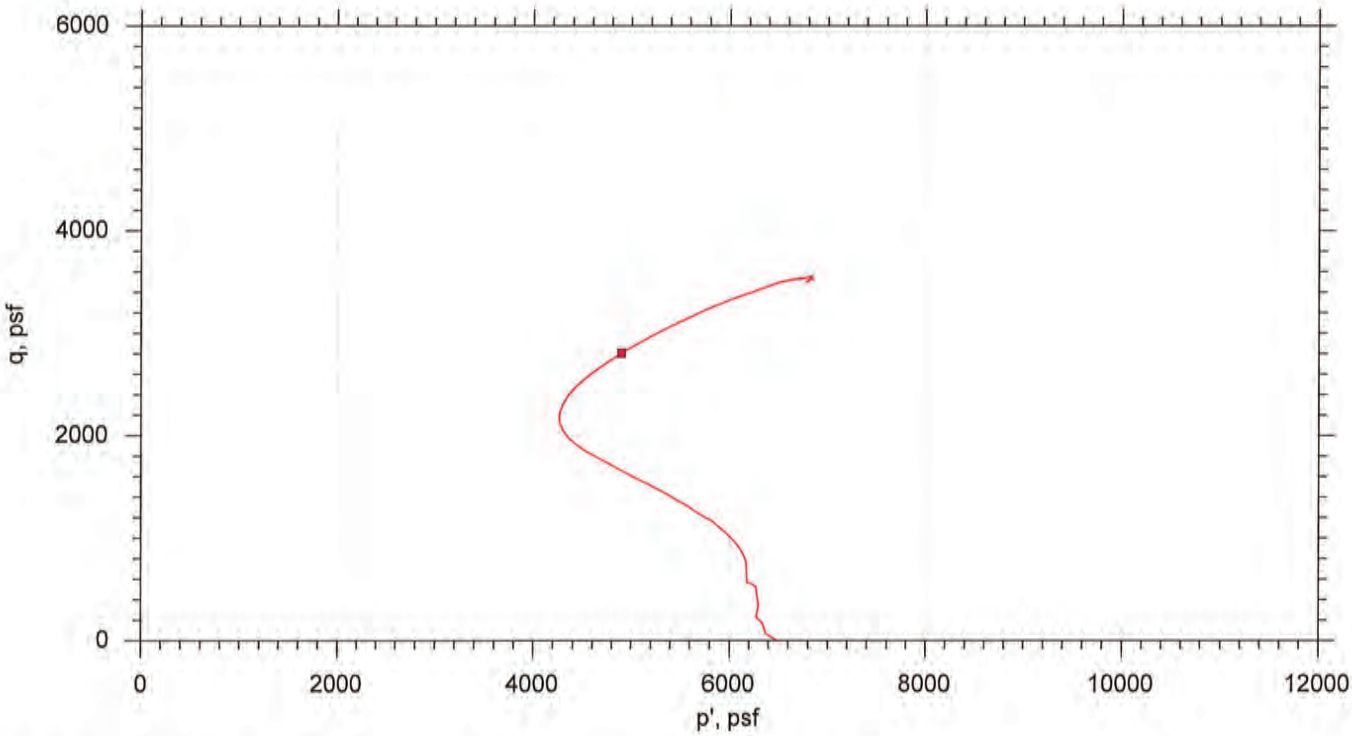
Remarks:

System T

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







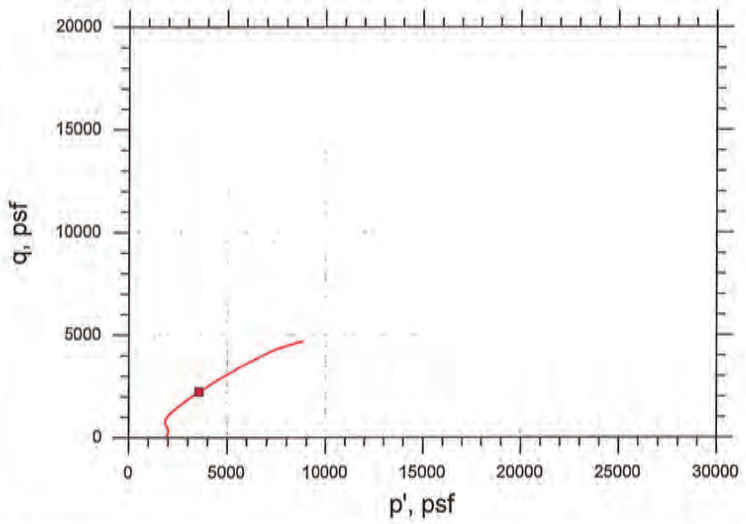
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	2	CU-5-1	48-50 ft	md	11/11/15	jdt	---	303915-CU-5-1n.dat

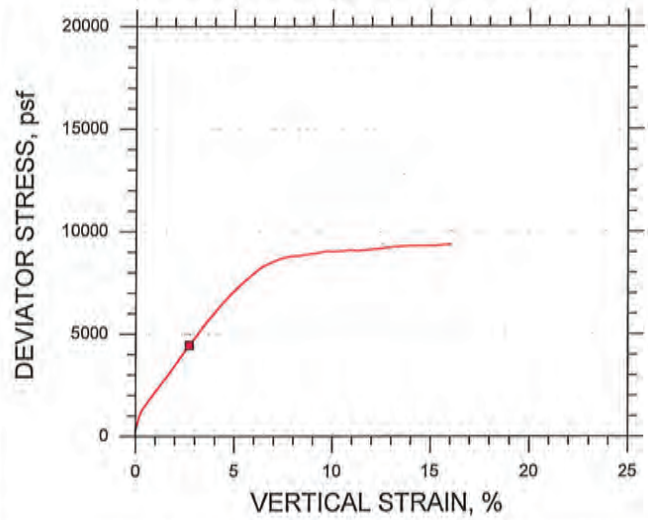
GeoTesting EXPRESS

Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
Boring No.: AECOM-B2	Sample Type: Intact	
Description: Moist, reddish brown clay with sand		
Remarks: System T		

Client: AECOM	
Project Name: Vectran AB Brown Ash Pond	
Project Location: Evansville, IN	
Project Number: GTX-303915	
Tested By: md	Checked By: jdt
Boring ID: AECOM-B4	
Preparation: intact	
Description: Moist, yellowish brown sandy clay	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.7

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





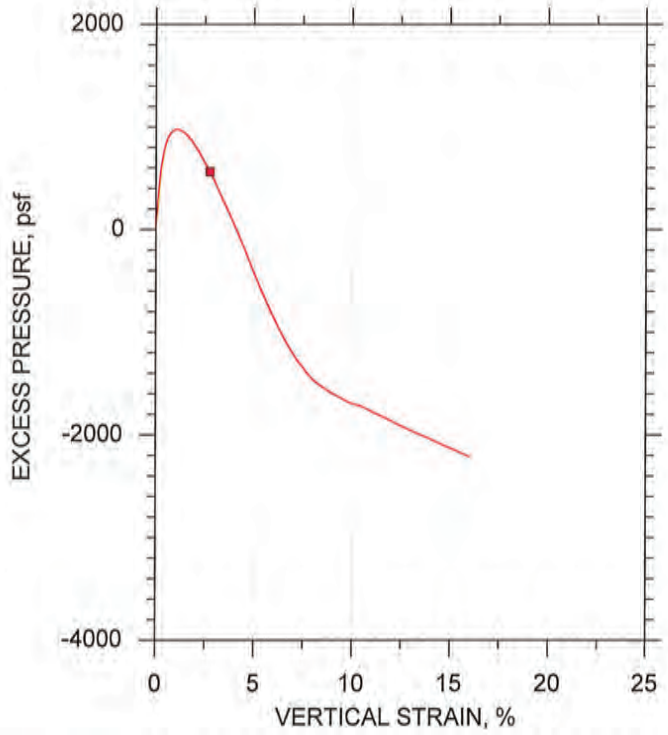
Symbol		■			
Sample ID		1			
Depth, ft		12-14 ft			
Test Number		CU-4-1			
Initial	Height, in	6.300			
	Diameter, in	2.870			
	Moisture Content (from Cuttings), %	16.4			
	Dry Density, pcf	110.			
	Saturation (Wet Method), %	82.3			
	Void Ratio	0.538			
Before Shear	Moisture Content, %	18.5			
	Dry Density, pcf	112.			
	Cross-sectional Area (Method A), in²	6.322			
	Saturation, %	100.0			
	Void Ratio	0.500			
	Back Pressure, psf	4175.			
Vertical Effective Consolidation Stress, psf		1898.			
Horizontal Effective Consolidation Stress, psf		1899.			
Vertical Strain after Consolidation, %		0.2220			
Volumetric Strain after Consolidation, %		2.550			
Time to 50% Consolidation, min		25.00			
Shear Strength, psf		2227.			
Strain at Failure, %		2.73			
Strain Rate, %/min		0.01600			
Deviator Stress at Failure, psf		4453.			
Effective Minor Principal Stress at Failure, psf		1336.			
Effective Major Principal Stress at Failure, psf		5789.			
B-Value		1.			

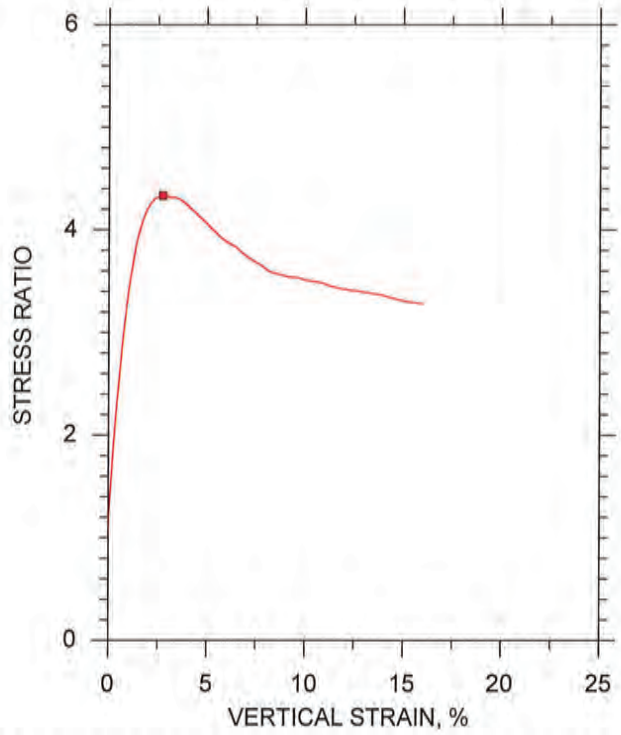
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

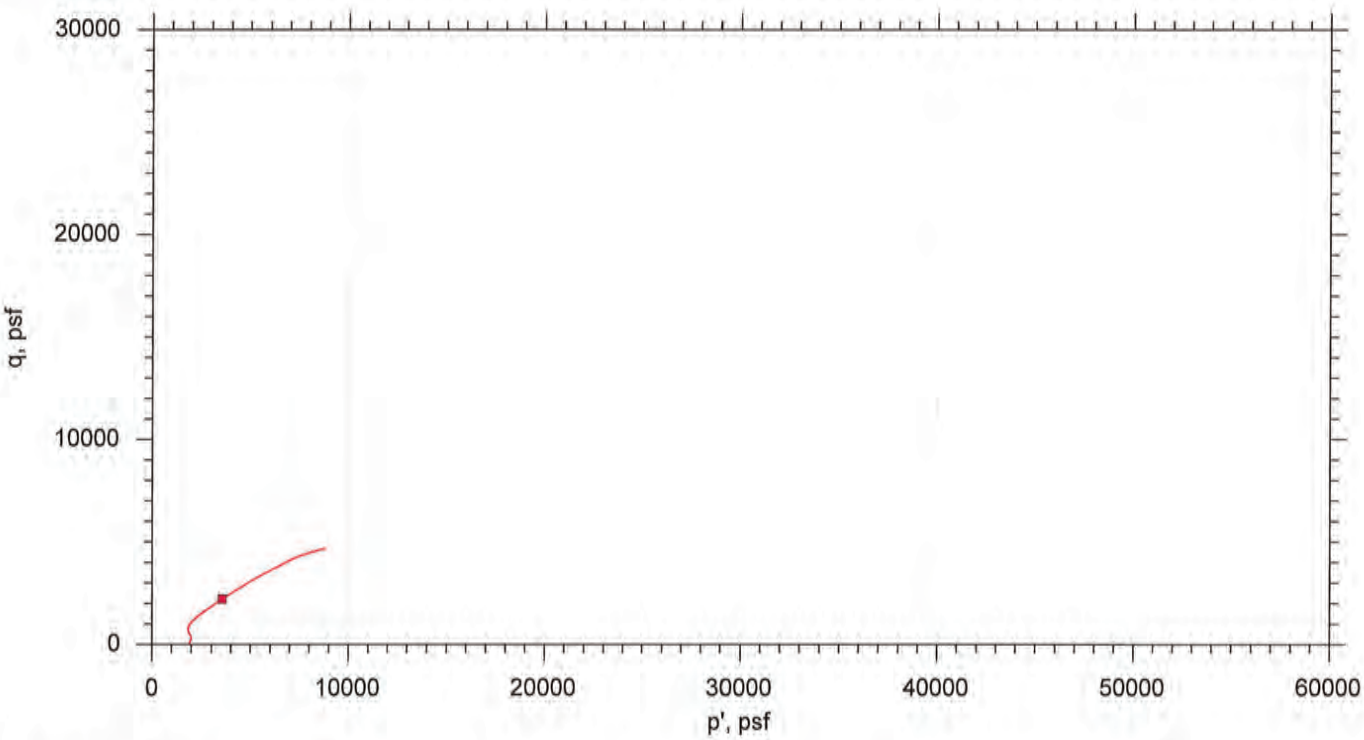
Remarks:

System Y

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







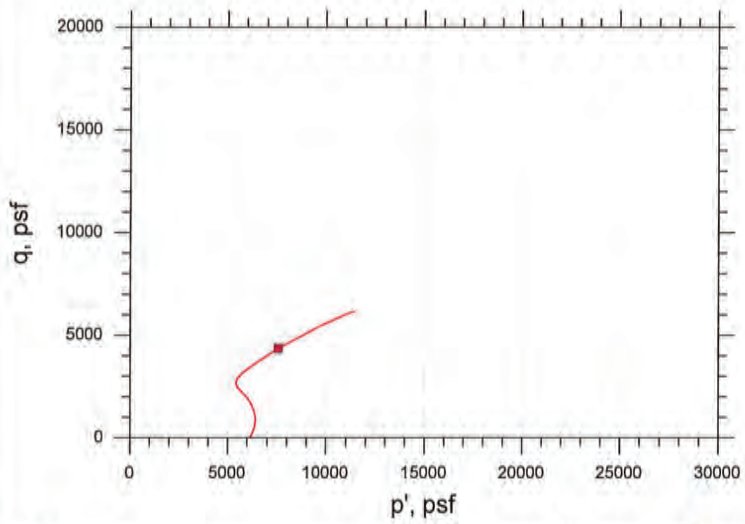
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	1	CU-4-1	12-14 ft	md	11/11/15	jdt	11/17/15	303915-CU-4-1n.dat

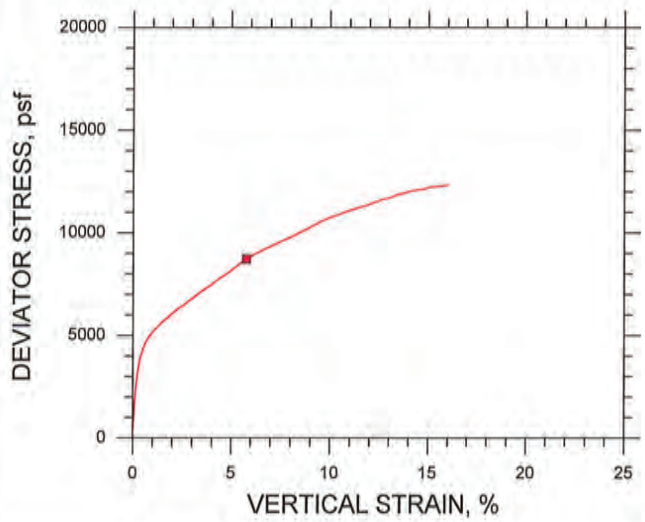
GeoTesting EXPRESS

Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
Boring No.: AECOM-B4	Sample Type: intact	
Description: Moist, yellowish brown sandy clay		
Remarks: System Y		

Client: AECOM	
Project Name: Vectran AB Brown Ash Pond	
Project Location: Evansville, IN	
Project Number: GTX-303915	
Tested By: md	Checked By: njh
Boring ID: AECOM-B1	
Preparation: intact	
Description: Moist, yellowish brown silt	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.7

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





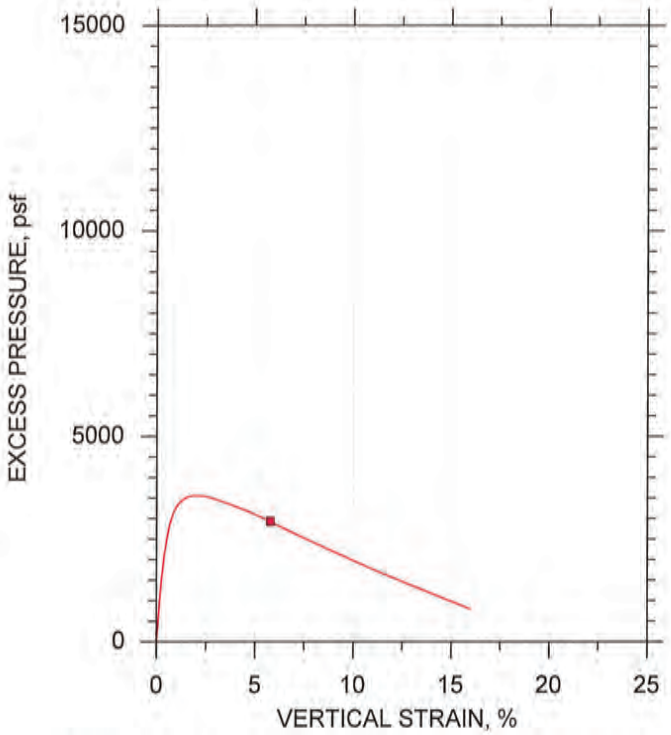
Symbol		■			
Sample ID		4			
Depth, ft		44-46 ft			
Test Number		CU-12-1			
Initial	Height, in	4.500			
	Diameter, in	2.010			
	Moisture Content (from Cuttings), %	26.5			
	Dry Density, pcf	98.0			
	Saturation (Wet Method), %	99.6			
	Void Ratio	0.719			
Before Shear	Moisture Content, %	24.5			
	Dry Density, pcf	101.			
	Cross-sectional Area (Method A), in²	3.090			
	Saturation, %	100.0			
	Void Ratio	0.662			
	Back Pressure, psf	2.172e+004			
Vertical Effective Consolidation Stress, psf		6142.			
Horizontal Effective Consolidation Stress, psf		6148.			
Vertical Strain after Consolidation, %		0.6199			
Volumetric Strain after Consolidation, %		2.959			
Time to 50% Consolidation, min		0.2500			
Shear Strength, psf		4361.			
Strain at Failure, %		5.78			
Strain Rate, %/min		0.01600			
Deviator Stress at Failure, psf		8722.			
Effective Minor Principal Stress at Failure, psf		3213.			
Effective Major Principal Stress at Failure, psf		1.193e+004			
B-Value		0.95			

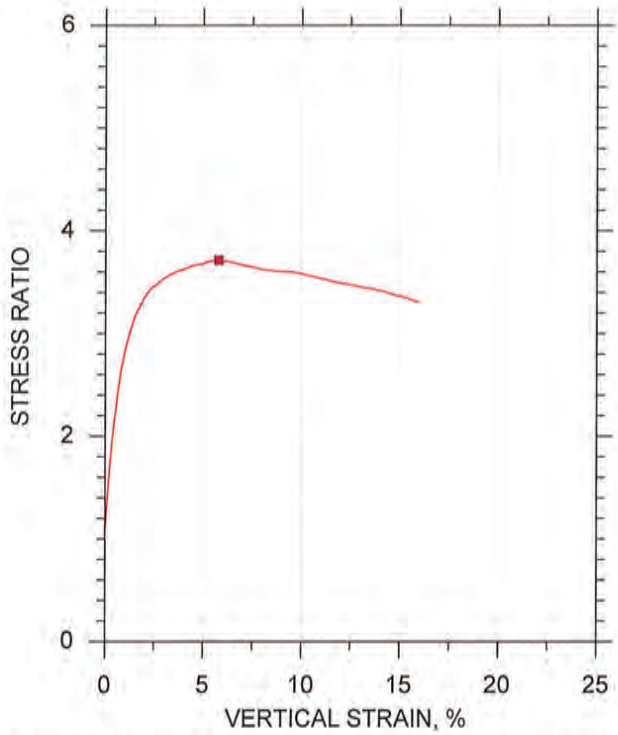
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

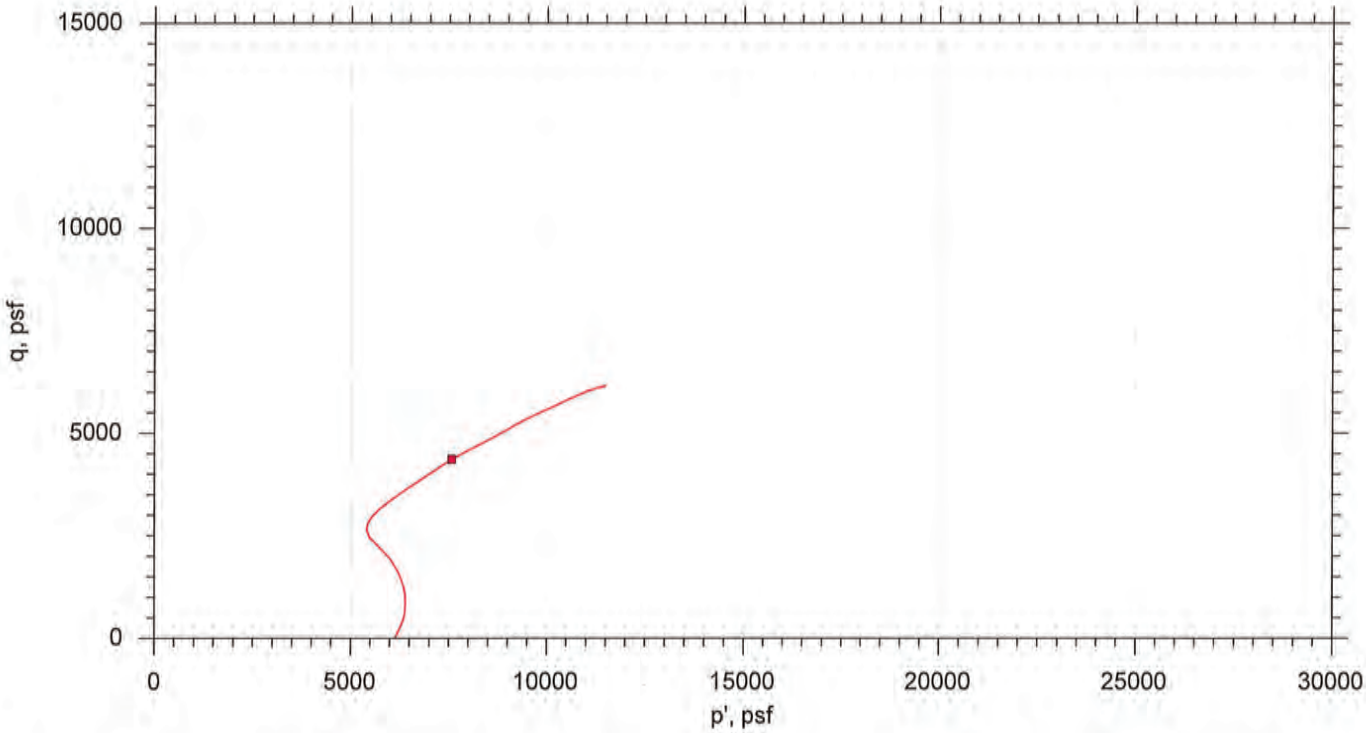
Remarks:

System W

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







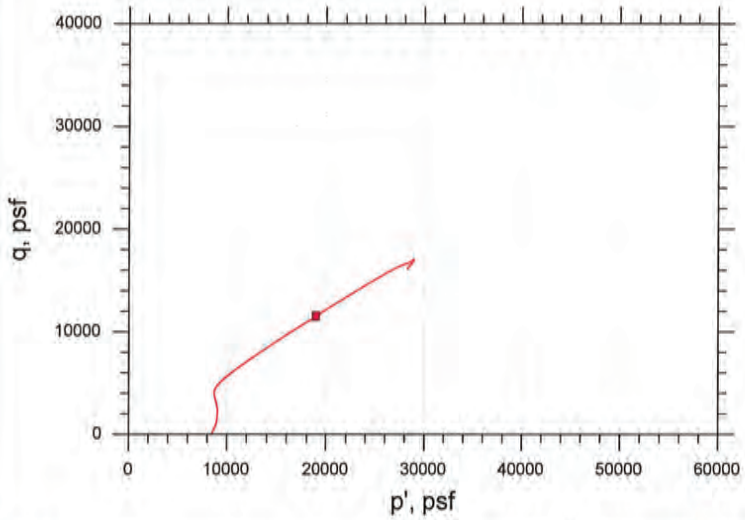
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	4	CU-12-1	44-46 ft	md	2/25/16	njh	3/2/16	303915-CU-12-1n.dat

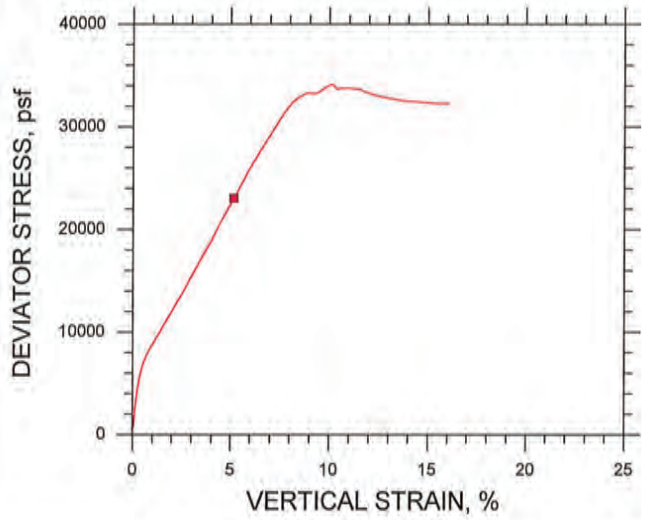
GeoTesting EXPRESS

Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
Boring No.: AECOM-B1	Sample Type: intact	
Description: Moist, yellowish brown silt		
Remarks: System W		

Client: AECOM	
Project Name: Vectran AB Brown Ash Pond	
Project Location: Evansville, IN	
Project Number: GTX-303915	
Tested By: md	Checked By: njh
Boring ID: AECOM-B2	
Preparation: intact	
Description: Moist, light brown silt	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.7

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





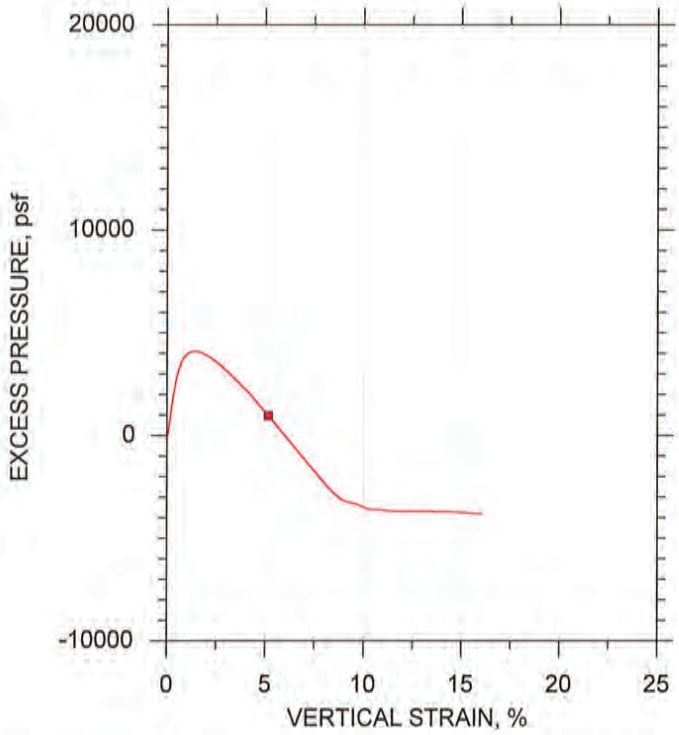
Symbol		■			
Sample ID		4			
Depth, ft		60-62 ft			
Test Number		CU-8-1			
Initial	Height, in	4.650			
	Diameter, in	2.040			
	Moisture Content (from Cuttings), %	25.9			
	Dry Density, pcf	98.3			
	Saturation (Wet Method), %	97.9			
	Void Ratio	0.715			
Before Shear	Moisture Content, %	24.9			
	Dry Density, pcf	101.			
	Cross-sectional Area (Method A), in²	3.196			
	Saturation, %	100.0			
	Void Ratio	0.673			
	Back Pressure, psf	2.171e+004			
Vertical Effective Consolidation Stress, psf		8396.			
Horizontal Effective Consolidation Stress, psf		8397.			
Vertical Strain after Consolidation, %		0.4461			
Volumetric Strain after Consolidation, %		3.018			
Time to 50% Consolidation, min		0.6400			
Shear Strength, psf		1.152e+004			
Strain at Failure, %		5.15			
Strain Rate, %/min		0.01600			
Deviator Stress at Failure, psf		2.305e+004			
Effective Minor Principal Stress at Failure, psf		7427.			
Effective Major Principal Stress at Failure, psf		3.048e+004			
B-Value		0.95			

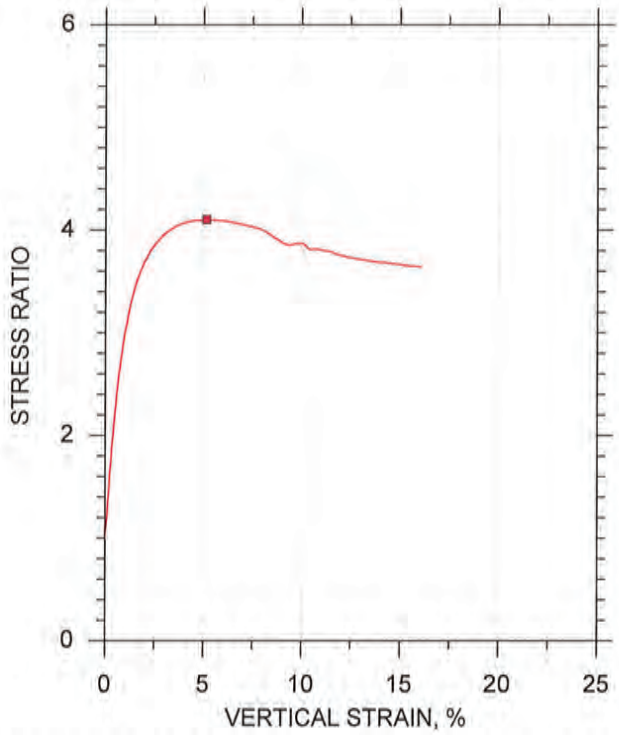
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

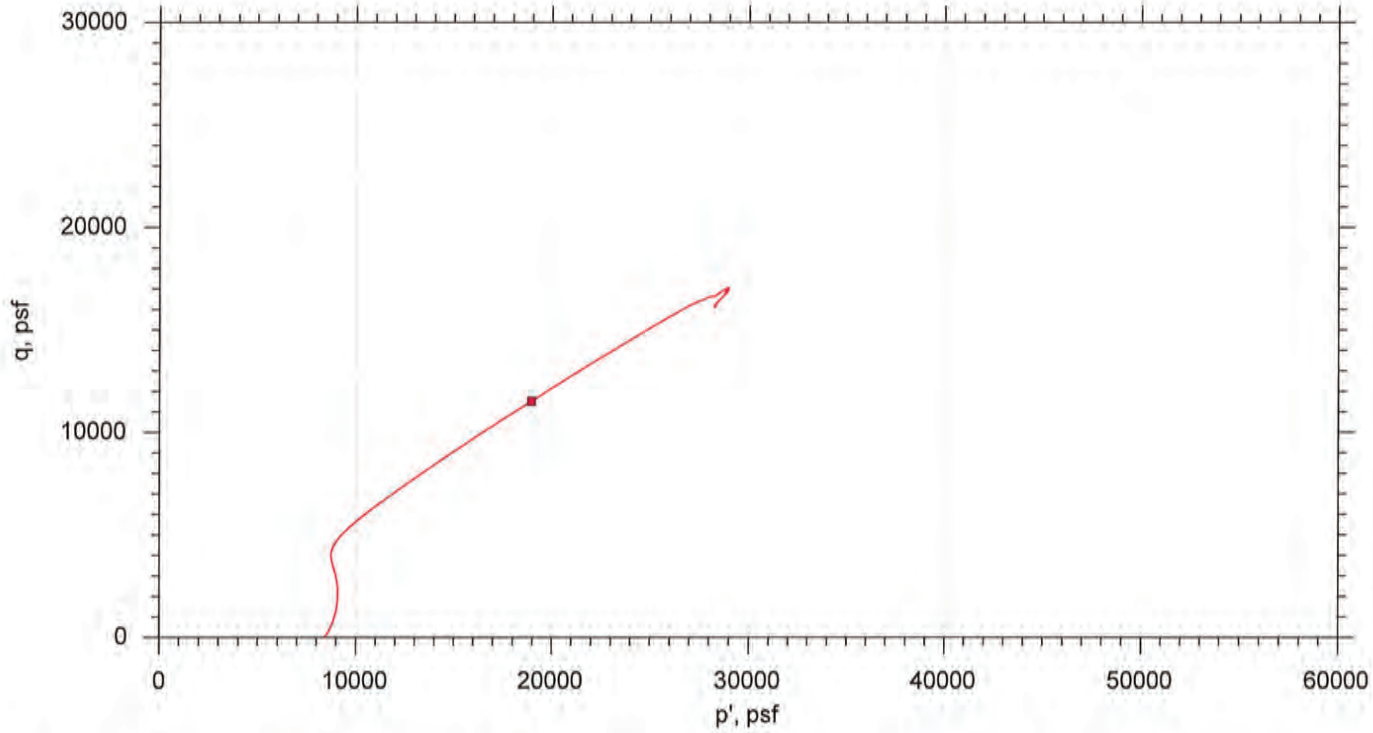
Remarks:

System Q

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







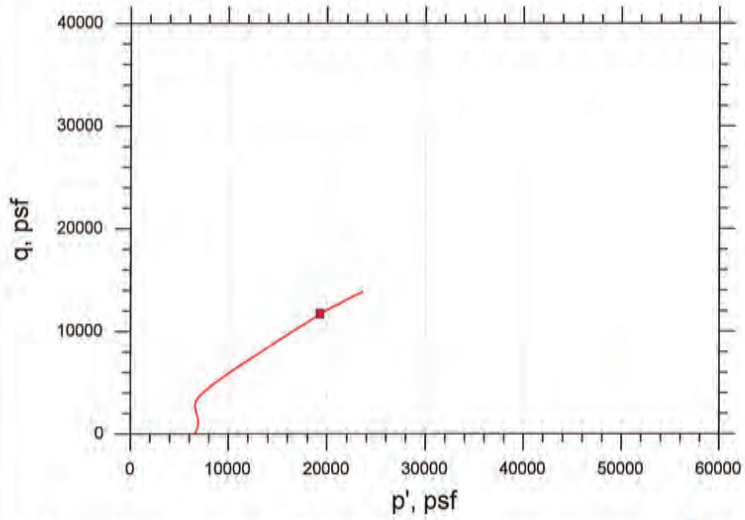
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	4	CU-8-1	60-62 ft	md	2/25/16	njh	3/2/16	303915-CU-8-1n.dat

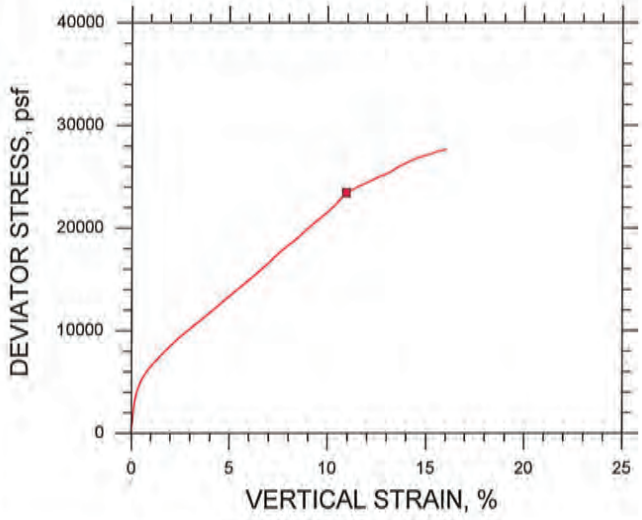
GeoTesting EXPRESS

Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
Boring No.: AECOM-B2	Sample Type: intact	
Description: Moist, light brown silt		
Remarks: System Q		

Client: AECOM	
Project Name: Vectran AB Brown Ash Pond	
Project Location: Evansville, IN	
Project Number: GTX-303915	
Tested By: md	Checked By: njh
Boring ID: AECOM-B4	
Preparation: intact	
Description: Moist, brown silt	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.7

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





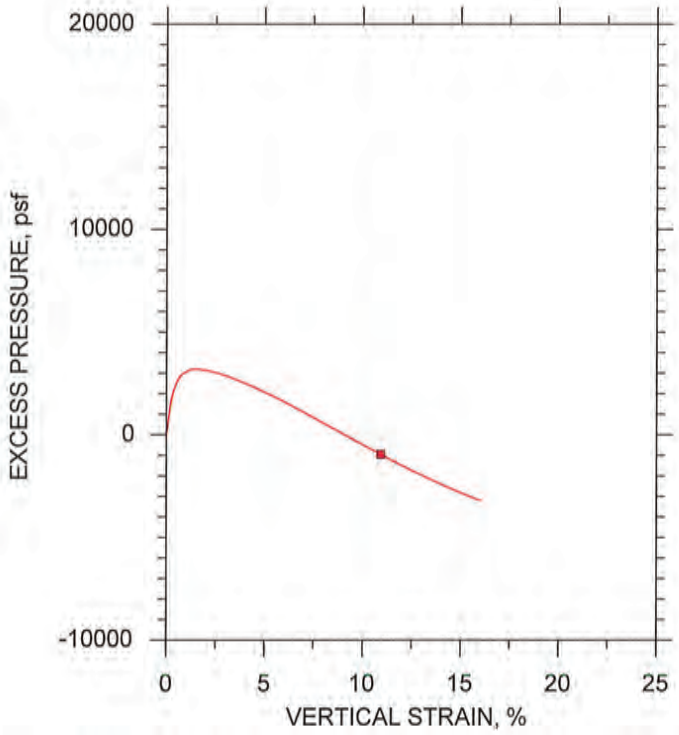
Symbol		■			
Sample ID		3			
Depth, ft		46-48 ft			
Test Number		CU-11-1			
Initial	Height, in	4.580			
	Diameter, in	2.020			
	Moisture Content (from Cuttings), %	26.8			
	Dry Density, pcf	97.4			
	Saturation (Wet Method), %	99.0			
	Void Ratio	0.731			
Before Shear	Moisture Content, %	25.0			
	Dry Density, pcf	101.			
	Cross-sectional Area (Method A), in²	3.105			
	Saturation, %	100.0			
	Void Ratio	0.674			
	Back Pressure, psf	2.173e+004			
Vertical Effective Consolidation Stress, psf		6597.			
Horizontal Effective Consolidation Stress, psf		6600.			
Vertical Strain after Consolidation, %		0.3480			
Volumetric Strain after Consolidation, %		3.773			
Time to 50% Consolidation, min		0.2500			
Shear Strength, psf		1.172e+004			
Strain at Failure, %		10.9			
Strain Rate, %/min		0.01600			
Deviator Stress at Failure, psf		2.344e+004			
Effective Minor Principal Stress at Failure, psf		7543.			
Effective Major Principal Stress at Failure, psf		3.098e+004			
B-Value		0.96			

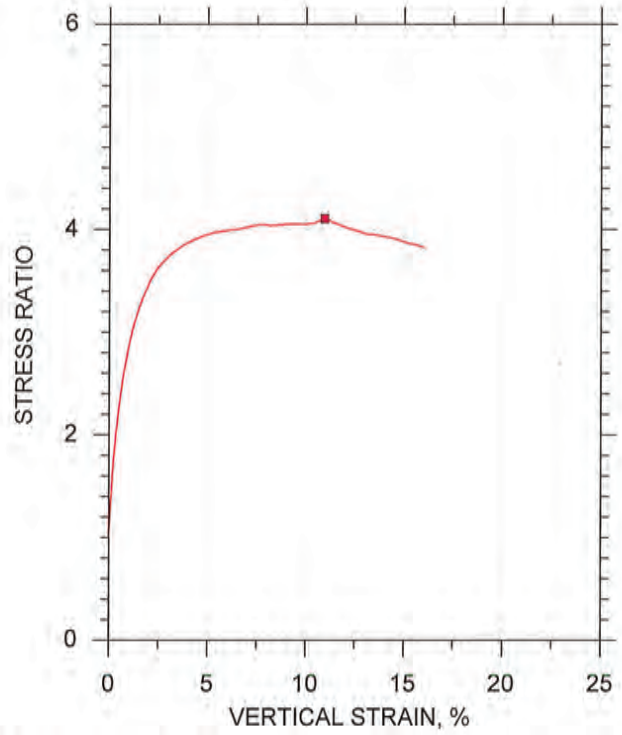
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

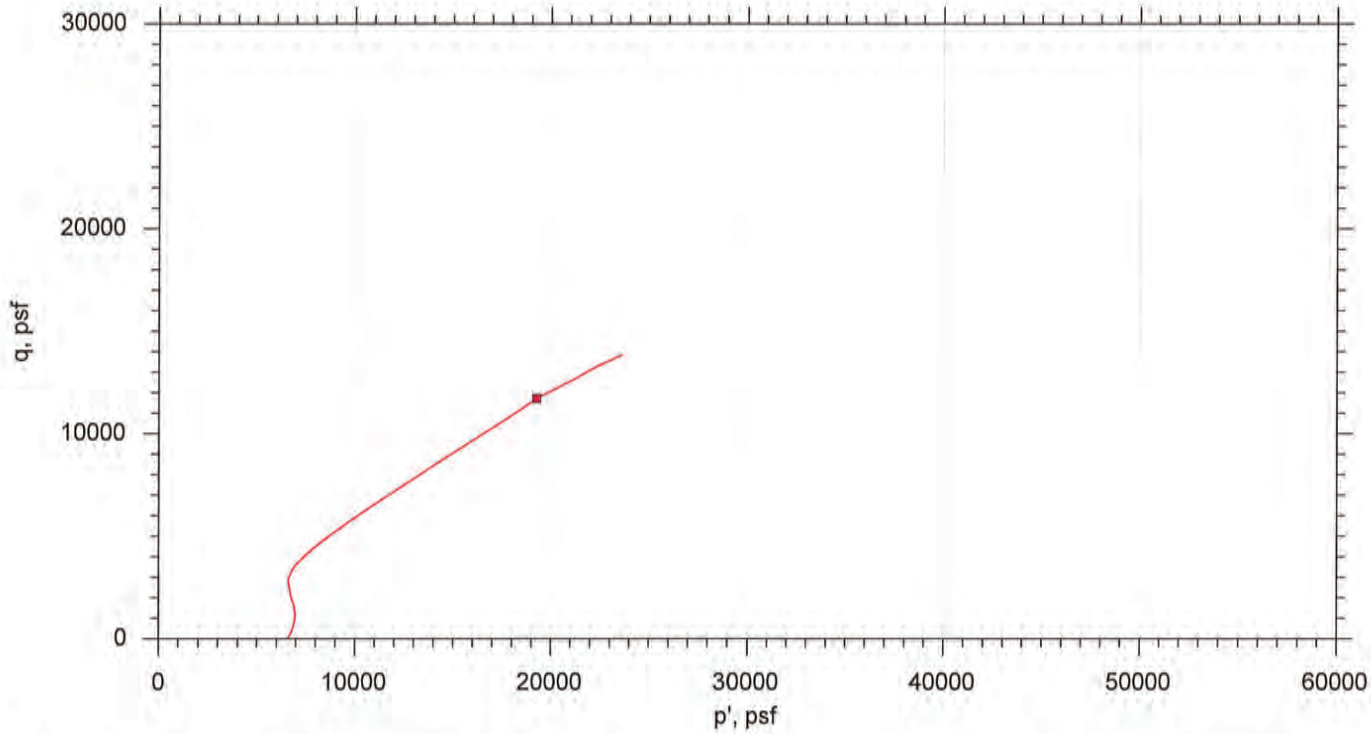
Remarks:

System K

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







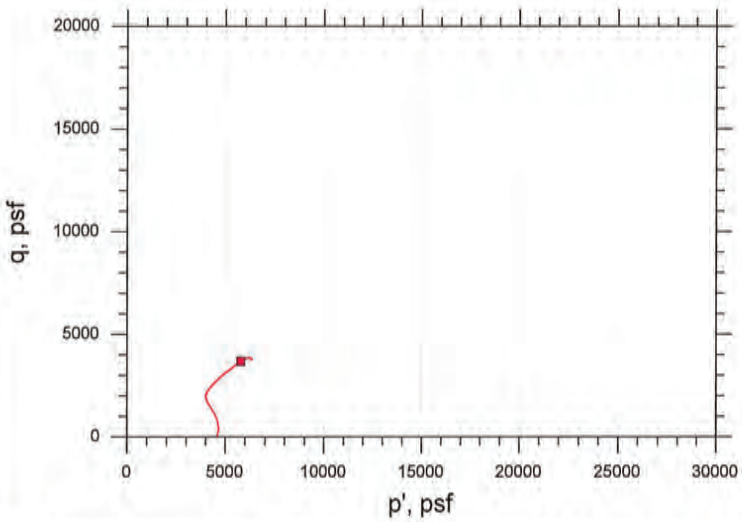
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	3	CU-11-1	46-48 ft	md	2/25/16	njh	3/2/16	303915-CU-11-1n.dat

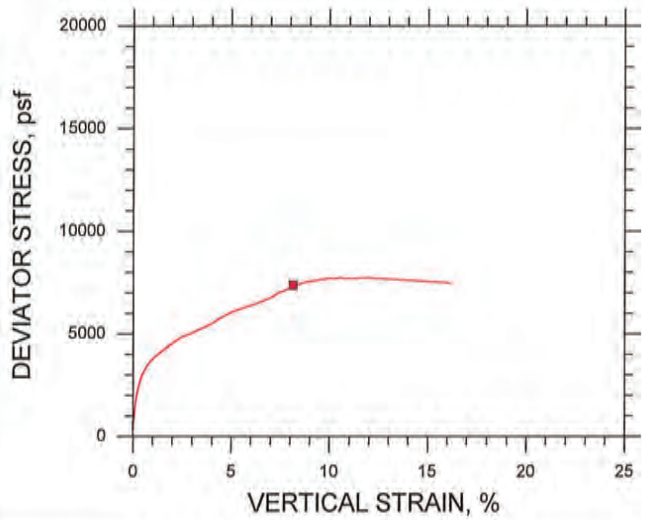
GeoTesting EXPRESS

Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
Boring No.: AECOM-B4	Sample Type: intact	
Description: Moist, brown silt		
Remarks: System K		

Client: AECOM	
Project Name: Vectran AB Brown Ash Pond	
Project Location: Evansville, IN	
Project Number: GTX-303915	
Tested By: md	Checked By: njh
Boring ID: AECOM-B4	
Preparation: intact	
Description: Moist, gray silty clay	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.7

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





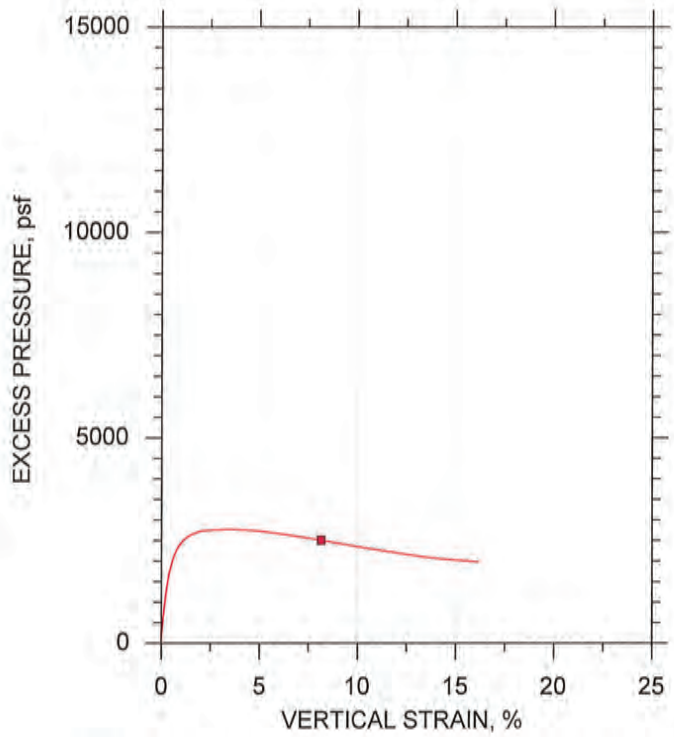
Symbol		■			
Sample ID		2			
Depth, ft		33-35 ft			
Test Number		CU-10-1			
Initial	Height, in	4.780			
	Diameter, in	2.020			
	Moisture Content (from Cuttings), %	38.4			
	Dry Density, pcf	82.7			
	Saturation (Wet Method), %	100.0			
	Void Ratio	1.04			
Before Shear	Moisture Content, %	35.7			
	Dry Density, pcf	85.9			
	Cross-sectional Area (Method A), in²	3.120			
	Saturation, %	100.0			
	Void Ratio	0.963			
	Back Pressure, psf	2.173e+004			
Vertical Effective Consolidation Stress, psf		4587.			
Horizontal Effective Consolidation Stress, psf		4599.			
Vertical Strain after Consolidation, %		1.170			
Volumetric Strain after Consolidation, %		3.967			
Time to 50% Consolidation, min		0.2500			
Shear Strength, psf		3690.			
Strain at Failure, %		8.15			
Strain Rate, %/min		0.01600			
Deviator Stress at Failure, psf		7380.			
Effective Minor Principal Stress at Failure, psf		2090.			
Effective Major Principal Stress at Failure, psf		9470.			
B-Value		0.96			

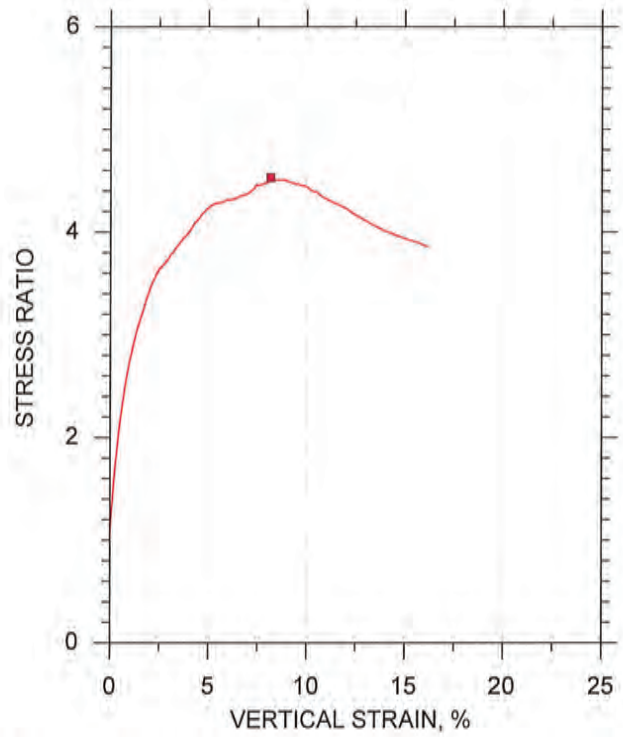
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

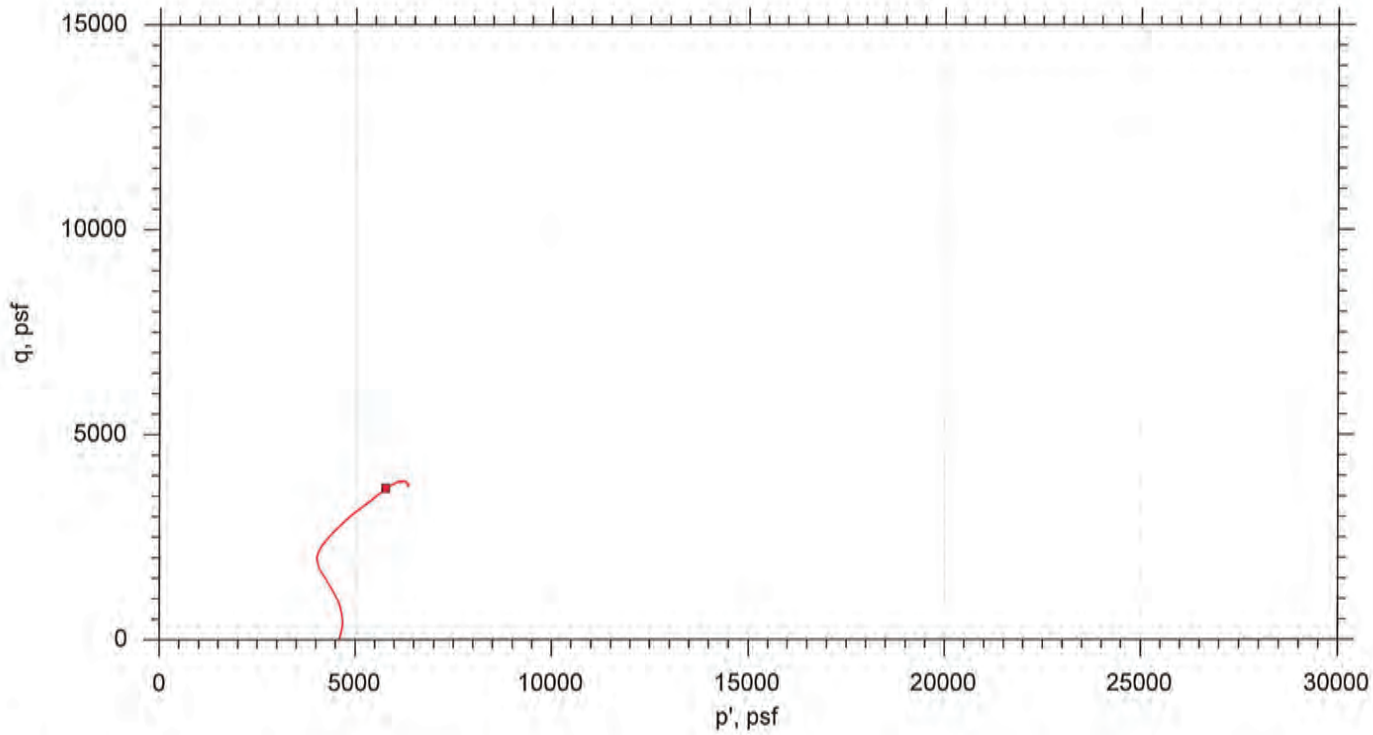
Remarks:

System F

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767







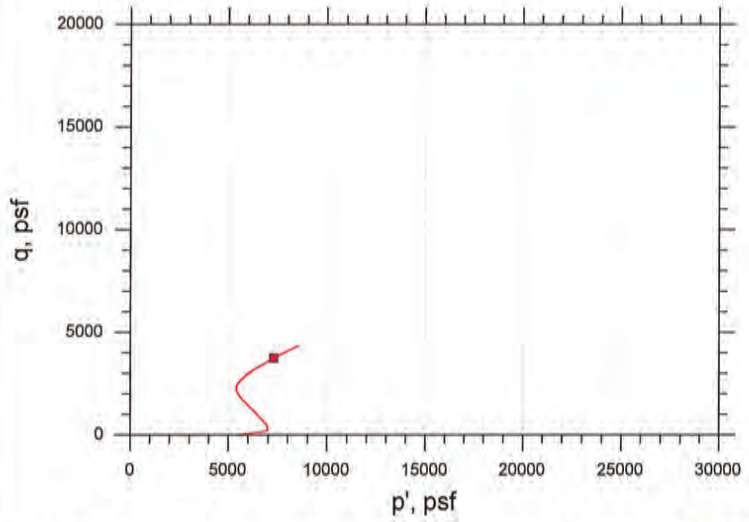
	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	2	CU-10-1	33-35 ft	md	2/25/16	njh	2/2/16	303915-CU-10-1n.dat

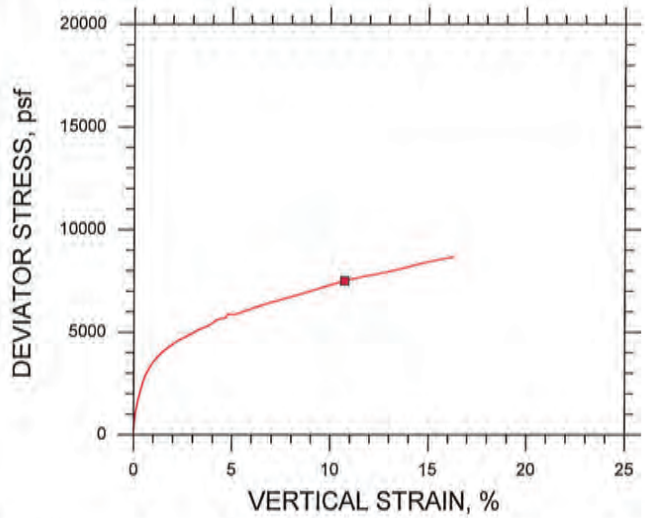
GeoTesting EXPRESS

Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
Boring No.: AECOM-B4	Sample Type: Intact	
Description: Moist, gray silty clay		
Remarks: System F		

Client: AECOM	
Project Name: Vectran AB Brown Ash Pond	
Project Location: Evansville, IN	
Project Number: GTX-303915	
Tested By: md	Checked By: njh
Boring ID: AECOM-B5	
Preparation: intact	
Description: Moist, gray silty clay	
Classification: ---	
Group Symbol: ---	
Liquid Limit: ---	Plastic Limit: ---
Plasticity Index: ---	Estimated Specific Gravity: 2.7

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767





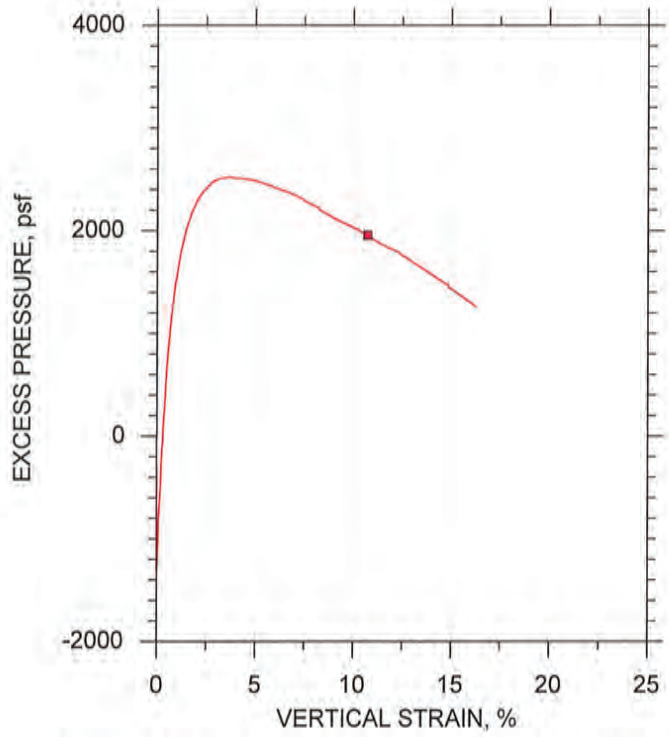
Symbol		■			
Sample ID		3			
Depth, ft		34-36 ft			
Test Number		CU-9-1			
Initial	Height, in	4.600			
	Diameter, in	2.040			
	Moisture Content (from Cuttings), %	49.8			
	Dry Density, pcf	71.0			
	Saturation (Wet Method), %	97.7			
	Void Ratio	1.38			
Before Shear	Moisture Content, %	53.9			
	Dry Density, pcf	68.7			
	Cross-sectional Area (Method A), in²	3.434			
	Saturation, %	100.0			
	Void Ratio	1.45			
	Back Pressure, psf	2.084e+004			
Vertical Effective Consolidation Stress, psf		5478.			
Horizontal Effective Consolidation Stress, psf		5499.			
Vertical Strain after Consolidation, %		1.907			
Volumetric Strain after Consolidation, %		-2.500			
Time to 50% Consolidation, min		0.3000			
Shear Strength, psf		3751.			
Strain at Failure, %		10.7			
Strain Rate, %/min		0.01600			
Deviator Stress at Failure, psf		7502.			
Effective Minor Principal Stress at Failure, psf		3539.			
Effective Major Principal Stress at Failure, psf		1.104e+004			
B-Value		0.95			

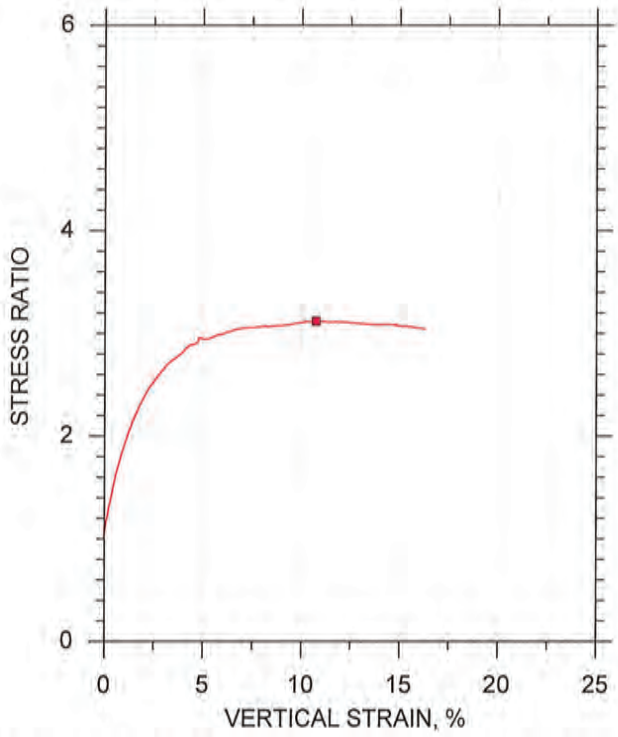
Notes:
- Before Shear Saturation set to 100% for phase calculation.
- Moisture Content determined by ASTM D2216.
- Deviator Stress includes membrane correction.
- Values for c and φ determined from best-fit straight line for the specific test conditions. Actual strength parameters may vary and should be determined by an engineer for site conditions.

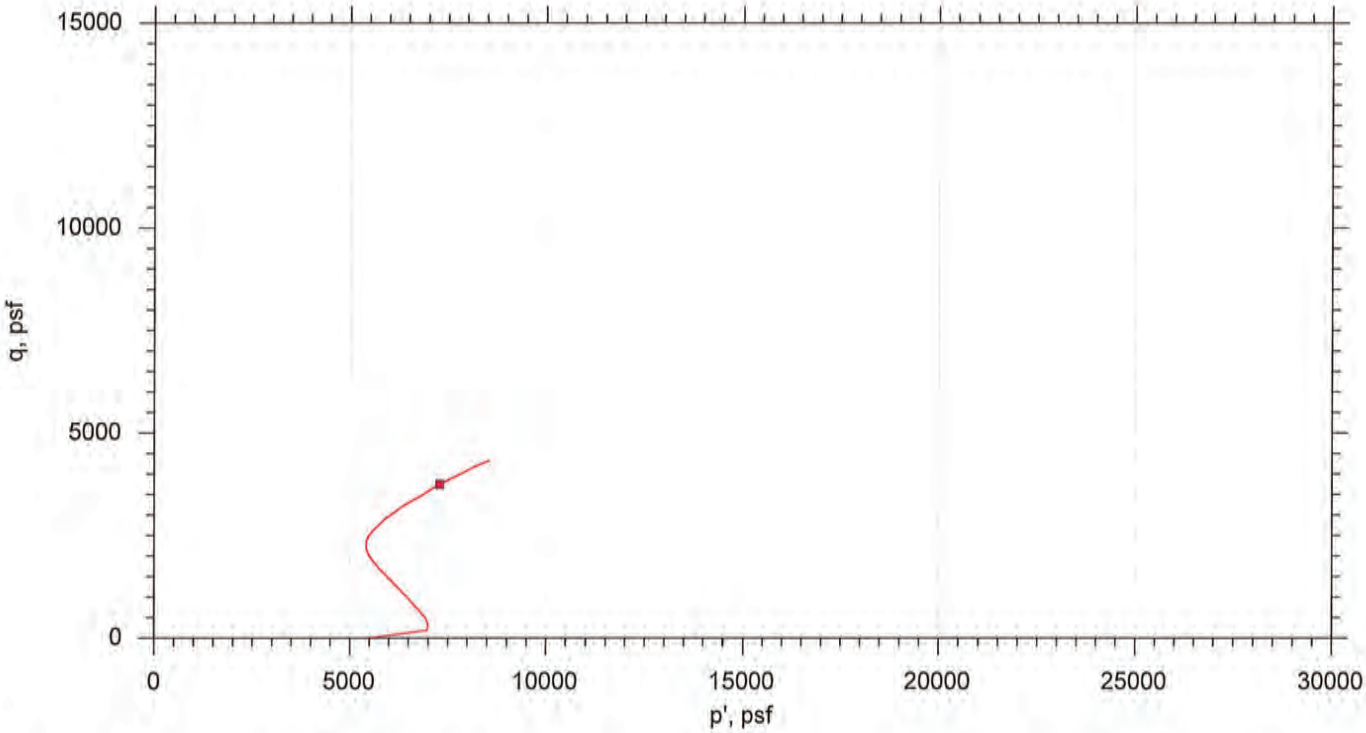
Remarks:

System Y

CONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D4767



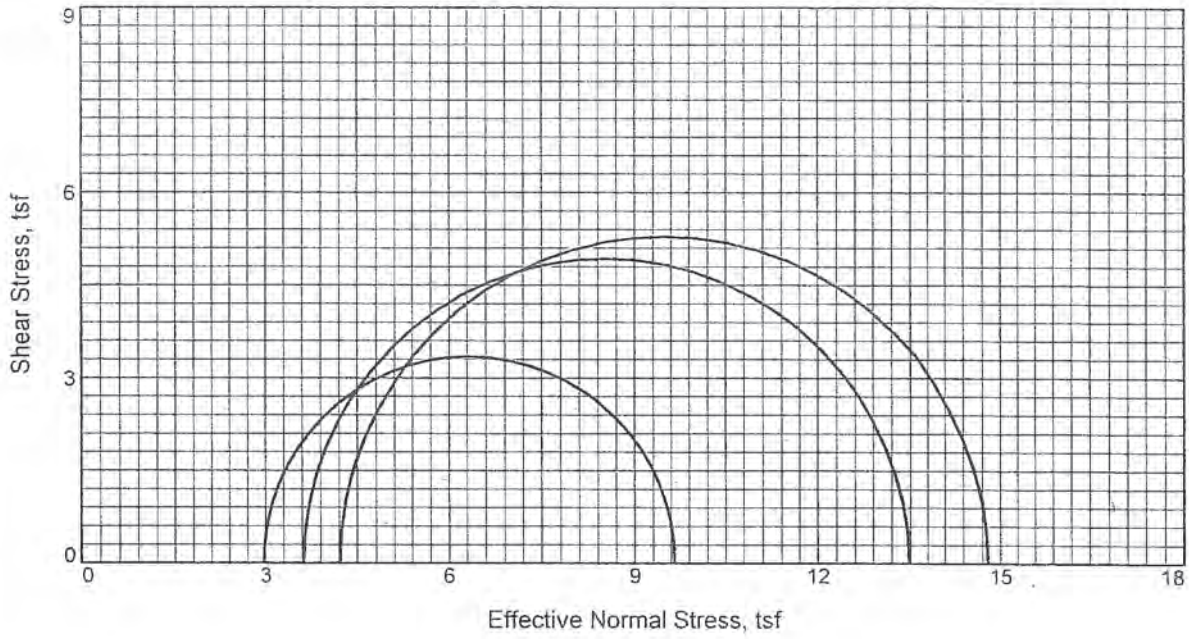


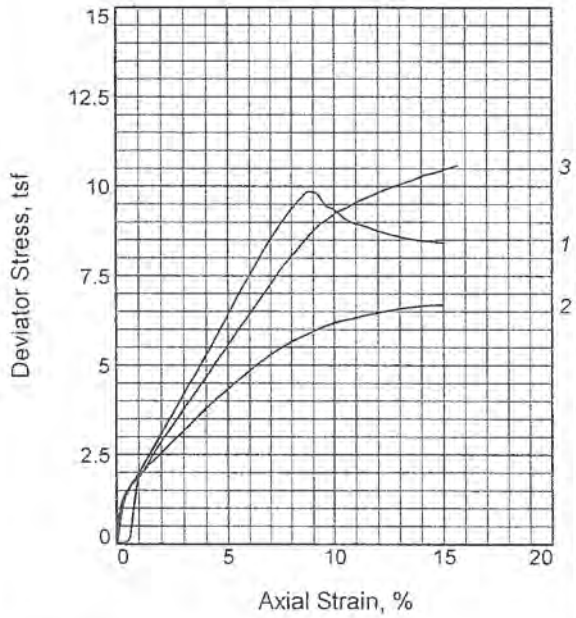


	Sample No.	Test No.	Depth	Tested By	Test Date	Checked By	Check Date	Test File
■	3	CU-9-1	34-36 ft	md	2/25/16	njh	3/2/16	303915-CU-9-1n.dat

GeoTesting EXPRESS

Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
Boring No.: AECOM-B5	Sample Type: intact	
Description: Moist, gray silty clay		
Remarks: System Y		





Sample No.		1	2	3
Initial	Water Content, %	22.7	23.4	23.2
	Dry Density, pcf	103.3	102.0	102.5
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.6019	0.6212	0.6135
	Diameter, in.	2.87	2.87	2.86
	Height, in.	5.73	5.78	5.69
At Test	Water Content, %	22.7	22.4	22.5
	Dry Density, pcf	103.3	103.8	103.6
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.6019	0.5944	0.5965
	Diameter, in.	2.87	2.85	2.85
	Height, in.	5.73	5.75	5.67
Strain rate, %/min.		0.06	0.06	0.06
Back Pressure, psi		50.00	45.00	40.00
Cell Pressure, psi		73.00	73.00	73.00
Fail. Stress, tsf		9.9	6.7	10.6
Total Pore Pr., tsf		1.6	2.3	1.0
Ult. Stress, tsf				
Total Pore Pr., tsf				
$\bar{\sigma}_1$ Failure, tsf		13.5	9.7	14.8
$\bar{\sigma}_3$ Failure, tsf		3.6	3.0	4.2

Type of Test:
CU with Pore Pressures
Sample Type: Shelby tube
Description:

Assumed Specific Gravity= 2.65
Remarks:

Client: Vectren

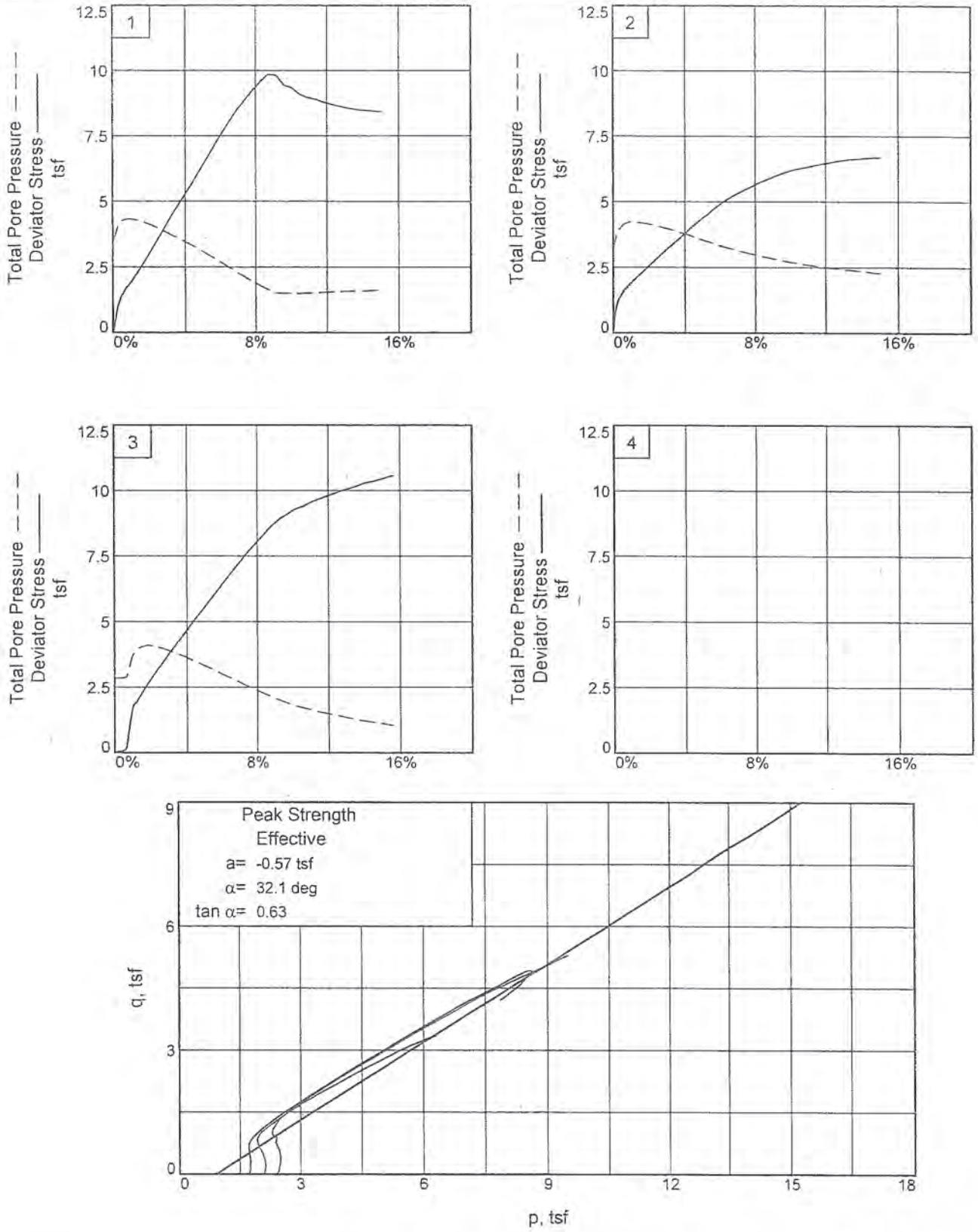
Project: Brown Safety Factor Assessment

Source of Sample: 7211 **Depth:** 63-65'
Sample Number: B-202
Proj. No.: 170GC00108 **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT
Cardno ATC, INC.
Indianapolis, Indiana

Figure CU7211C

Tested By: MDr



Client: Vectren

Project: Brown Safety Factor Assessment

Source of Sample: 7211 **Depth:** 63-65' **Sample Number:** B-202

Project No.: 170GC00108 Figure _____

Cardno ATC, Inc.

Tested By: MDr

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

6/25/2015
4:38 PM

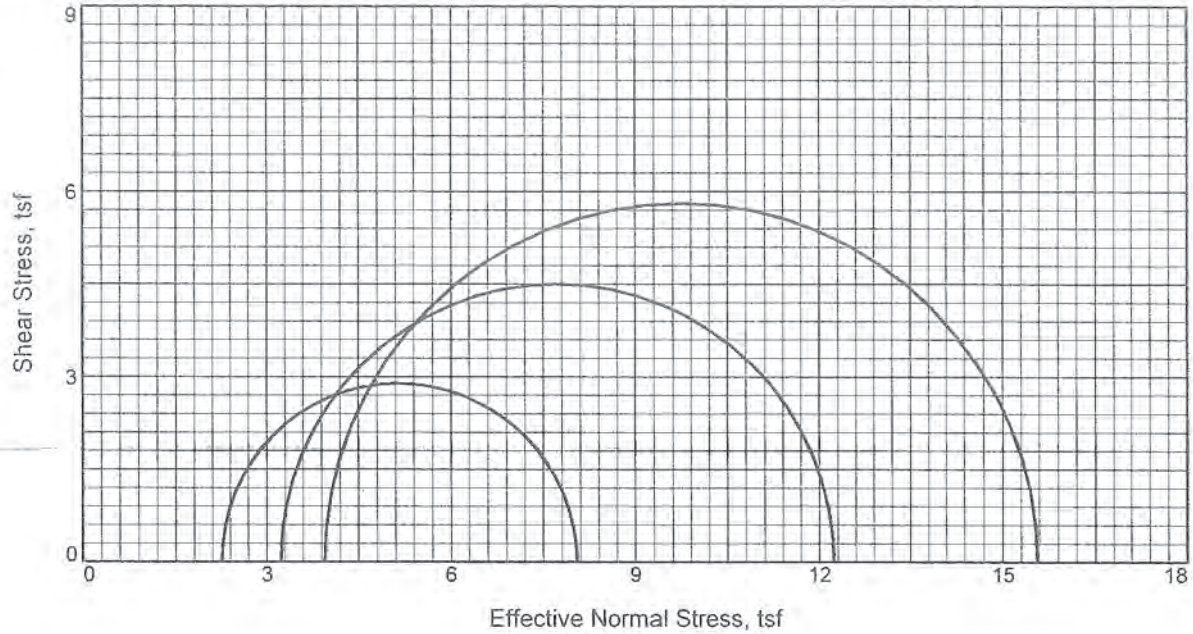
Date:
Client: Vectren
Project: Brown Safety Factor Assessment
Project No.: 170GC00108
Location: 7211
Depth: 63-65' Sample Number: B-202
Description:
Remarks:
Type of Sample: Shelby tube
Assumed Specific Gravity=2.65 LL= PL= PI=
Test Method: COE uniform strain

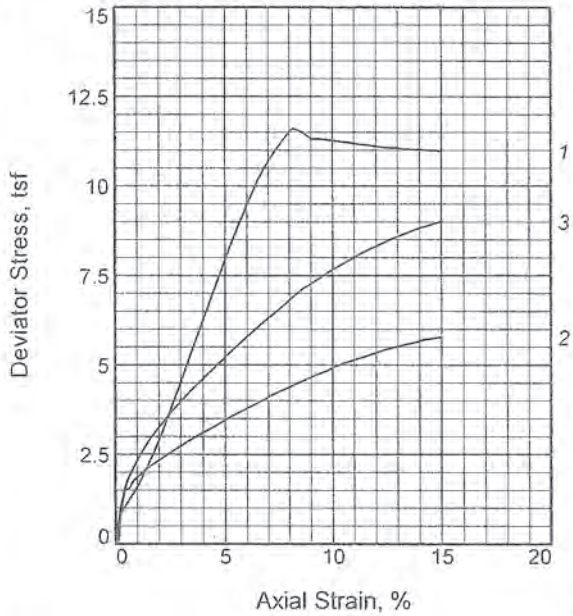
Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	1228.900			1328.080
Moisture content: Dry soil+tare, gms.	1001.380			1113.250
Moisture content: Tare, gms.	0.000			111.870
Moisture, %	22.7	22.8	22.7	21.5
Moist specimen weight, gms.	1228.9			
Diameter, in.	2.87	2.87	2.87	
Area, in.^{2}	6.45	6.46	6.45	
Height, in.	5.73	5.73	5.73	
Net decrease in height, in.		0.00	0.00	
Wet density, pcf	126.7	126.6	126.7	
Dry density, pcf	103.3	103.1	103.3	
Void ratio	0.6019	0.6053	0.6019	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 73.00 psi (5.256 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 1.656 tsf
Strain rate, %/min. = 0.06
Fail. Stress = 9.856 tsf at reading no. 34





Sample No.		1	2	3
Initial	Water Content, %	19.8	19.1	19.0
	Dry Density, pcf	105.8	105.4	108.0
	Saturation, %	93.0	88.6	94.5
	Void Ratio	0.5642	0.5703	0.5315
	Diameter, in.	2.85	2.87	2.85
	Height, in.	5.86	6.03	6.14
At Test	Water Content, %	19.6	19.9	18.6
	Dry Density, pcf	108.9	108.2	110.8
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.5189	0.5283	0.4928
	Diameter, in.	2.83	2.84	2.82
	Height, in.	5.80	5.97	6.09
Strain rate, %/min.		0.07	0.07	0.07
Back Pressure, psi		55.00	45.00	45.00
Cell Pressure, psi		78.00	73.00	78.00
Fail. Stress, tsf		11.6	5.8	9.0
Total Pore Pr., tsf		1.7	3.0	2.4
Ult. Stress, tsf				
Total Pore Pr., tsf				
$\bar{\sigma}_1$ Failure, tsf		15.6	8.0	12.2
$\bar{\sigma}_3$ Failure, tsf		4.0	2.3	3.2

Type of Test:
CU with Pore Pressures
Sample Type: Shelby tube
Description:

Assumed Specific Gravity= 2.65
Remarks:

Figure CU7211E

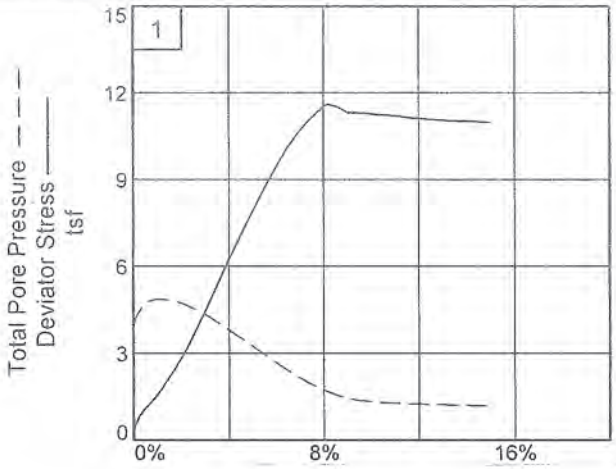
Client: Vectren

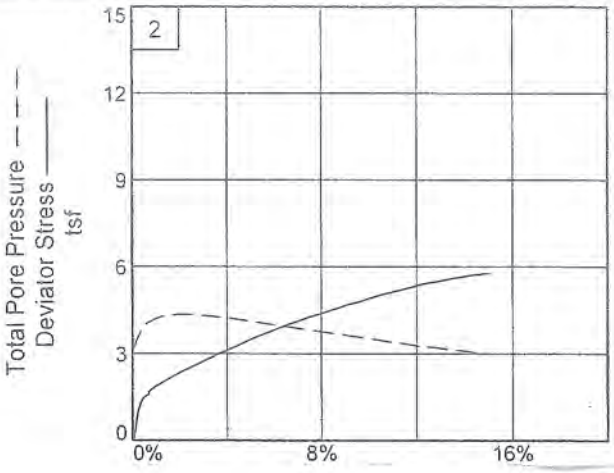
Project: Brown Safety Factor Assessment

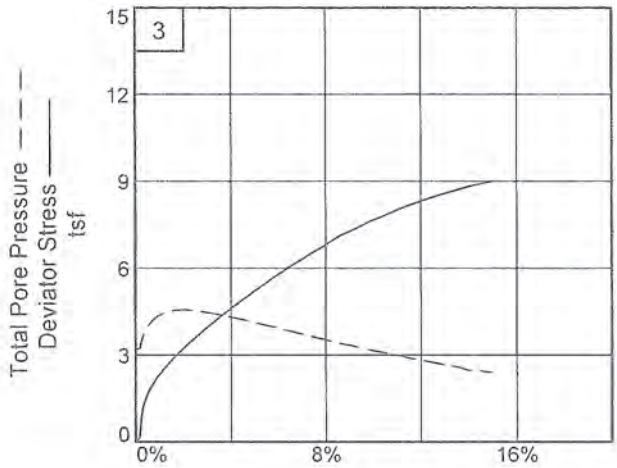
Source of Sample: 7211 **Depth:** 63-65'
Sample Number: B-203
Proj. No.: 170GC00108 **Date Sampled:**

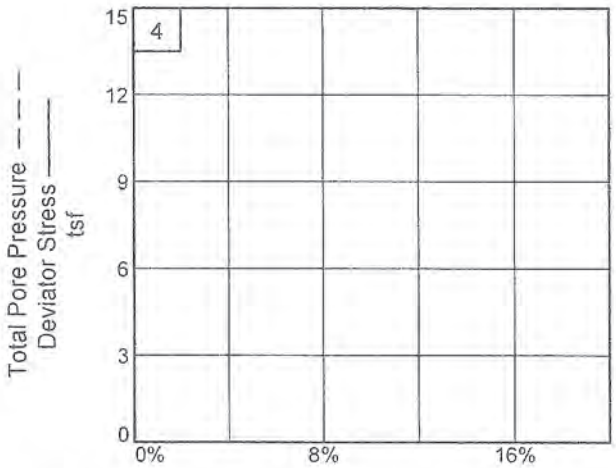
TRIAXIAL SHEAR TEST REPORT
Cardno ATC, INC.
Indianapolis, Indiana

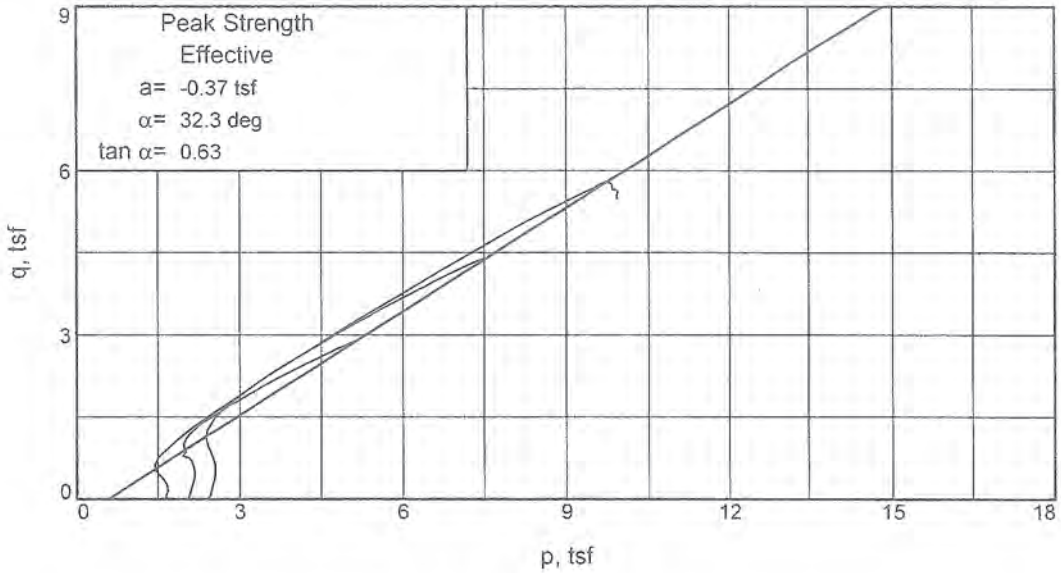
Tested By: MDr











Client: Vectren

Project: Brown Safety Factor Assessment

Source of Sample: 7211 **Depth:** 63-65' **Sample Number:** B-203

Project No.: 170GC00108 **Figure** _____

Cardno ATC, Inc.

Tested By: MDr

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

6/28/2015
2:57 PM

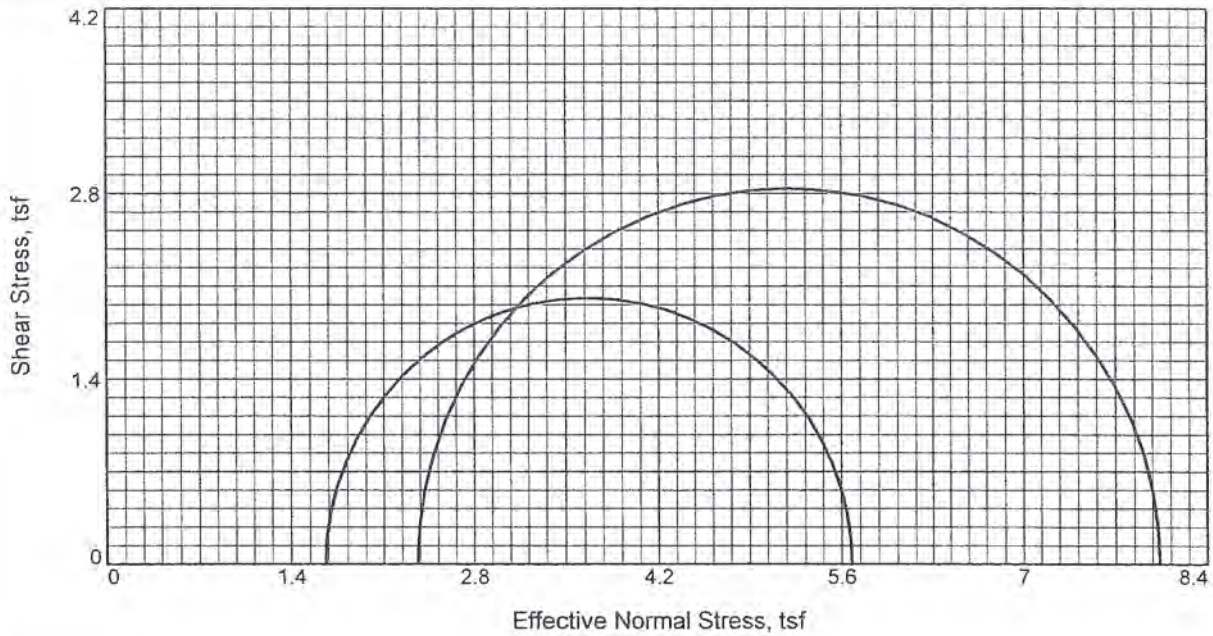
Date:
Client: Vectren
Project: Brown Safety Factor Assessment
Project No.: 170GC00108
Location: 7211
Depth: 63-65' **Sample Number:** B-203
Description:
Remarks:
Type of Sample: Shelby tube
Assumed Specific Gravity=2.65 **LL=** **PL=** **PI=**
Test Method: COE uniform strain

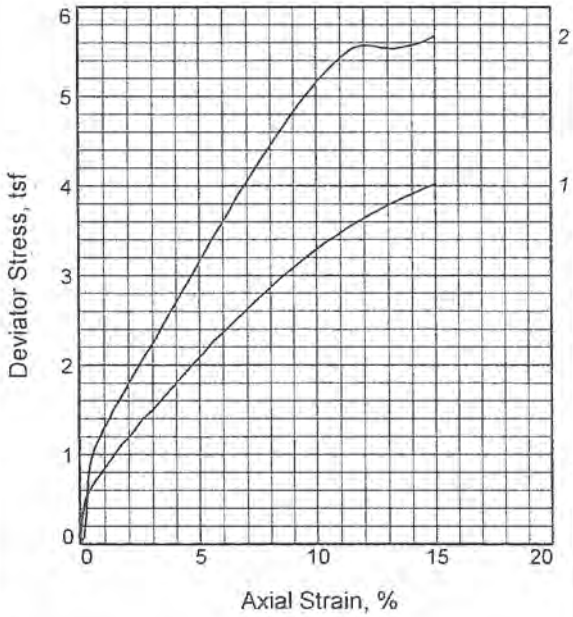
Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	1245.910			1359.100
Moisture content: Dry soil+tare, gms.	1040.020			1148.530
Moisture content: Tare, gms.	0.000			108.510
Moisture, %	19.8	20.3	19.6	20.2
Moist specimen weight, gms.	1245.9			
Diameter, in.	2.85	2.84	2.83	
Area, in.^{2}	6.39	6.32	6.27	
Height, in.	5.86	5.83	5.80	
Net decrease in height, in.		0.03	0.02	
Wet density, pcf	126.7	129.4	130.2	
Dry density, pcf	105.8	107.6	108.9	
Void ratio	0.5642	0.5371	0.5189	
Saturation, %	93.0	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 78.00 psi (5.616 tsf)
Consolidation back pressure = 55.00 psi (3.960 tsf)
Consolidation effective confining stress = 1.656 tsf
Strain rate, %/min. = 0.07
Fail. Stress = 11.616 tsf **at reading no.** 34





Sample No.		1	2
Initial	Water Content, %	20.7	21.5
	Dry Density, pcf	106.8	105.5
	Saturation, %	100.0	100.0
	Void Ratio	0.5492	0.5686
	Diameter, in.	2.85	2.85
	Height, in.	5.80	5.65
At Test	Water Content, %	20.1	20.9
	Dry Density, pcf	108.0	106.5
	Saturation, %	100.0	100.0
	Void Ratio	0.5324	0.5528
	Diameter, in.	2.84	2.84
	Height, in.	5.78	5.63
Strain rate, %/min.		0.06	0.06
Back Pressure, psi		55.00	45.00
Cell Pressure, psi		69.00	64.00
Fail. Stress, tsf		4.02	5.68
Total Pore Pr., tsf		3.31	2.25
Ult. Stress, tsf			
Total Pore Pr., tsf			
$\bar{\sigma}_1$ Failure, tsf		5.68	8.04
$\bar{\sigma}_3$ Failure, tsf		1.66	2.36

Type of Test:
CU with Pore Pressures
Sample Type: Shelby tube
Description:

Assumed Specific Gravity= 2.65
Remarks:

Client: Vectren

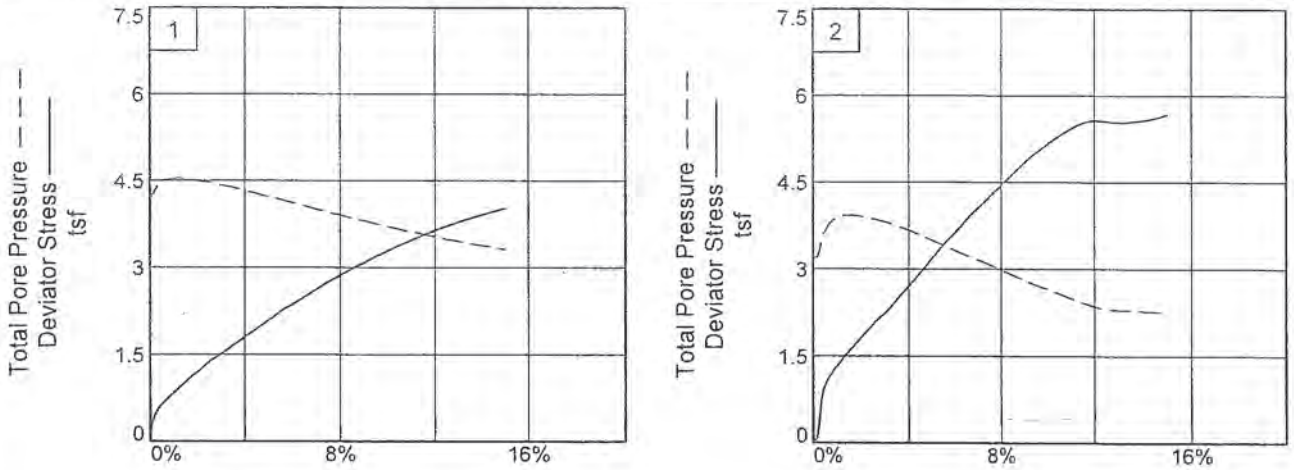
Project: Brown Safety Factor Assessment

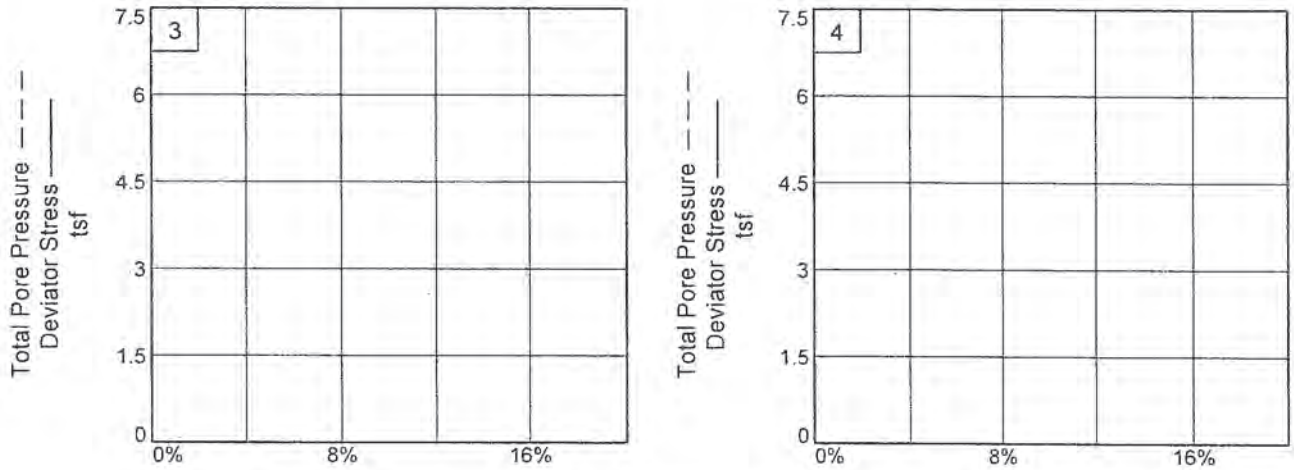
Source of Sample: 7211 **Depth:** 28-30'
Sample Number: B-206
Proj. No.: 170GC00108 **Date Sampled:**

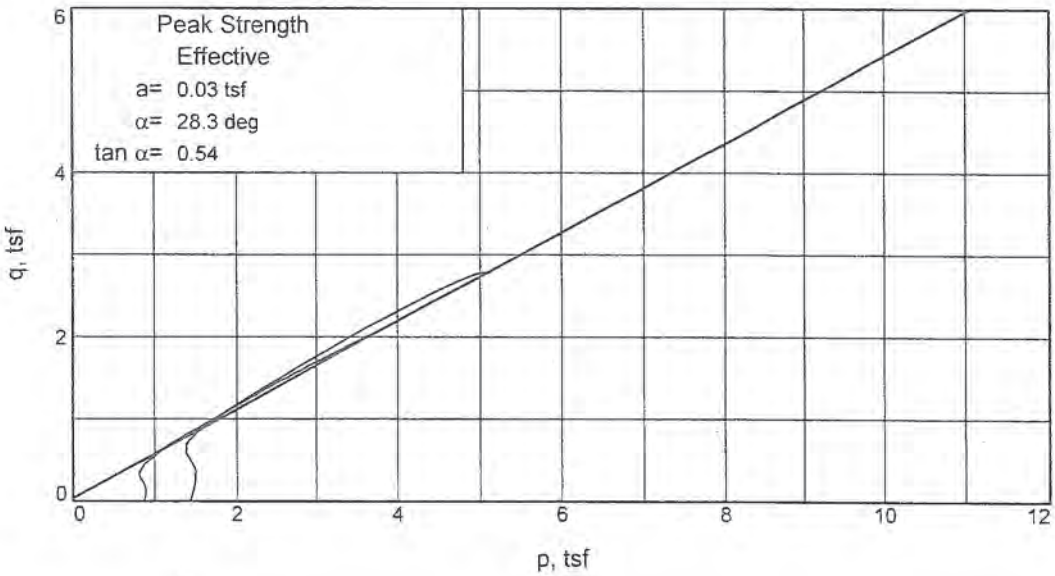
TRIAXIAL SHEAR TEST REPORT
Cardno ATC, INC.
Indianapolis, Indiana

Figure CU7211J

Tested By: MDr







Client: Vectren
Project: Brown Safety Factor Assessment
Source of Sample: 7211 **Depth:** 28-30' **Sample Number:** B-206
Project No.: 170GC00108 Figure _____

Cardno ATC, Inc.

Tested By: MDr

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

5/31/2015
6:43 PM

Date:			
Client:	Vectren		
Project:	Brown Safety Factor Assessment		
Project No.:	170GC00108		
Location:	7211		
Depth:	28-30'	Sample Number:	B-206
Description:			
Remarks:			
Type of Sample:	Shelby tube		
Assumed Specific Gravity=2.65	LL=	PL=	PI=
Test Method:	COE uniform strain		

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	1255.800			1347.270
Moisture content: Dry soil+tare, gms.	1040.240			1150.470
Moisture content: Tare, gms.	0.000			110.230
Moisture, %	20.7	20.5	20.1	18.9
Moist specimen weight, gms.	1255.8			
Diameter, in.	2.85	2.85	2.84	
Area, in.^{2}	6.40	6.38	6.35	
Height, in.	5.80	5.79	5.78	
Net decrease in height, in.		0.01	0.01	
Wet density, pcf	128.9	129.2	129.6	
Dry density, pcf	106.8	107.2	108.0	
Void ratio	0.5492	0.5428	0.5324	
Saturation, %	100.0	100.0	100.0	

Test Readings for Specimen No. 1

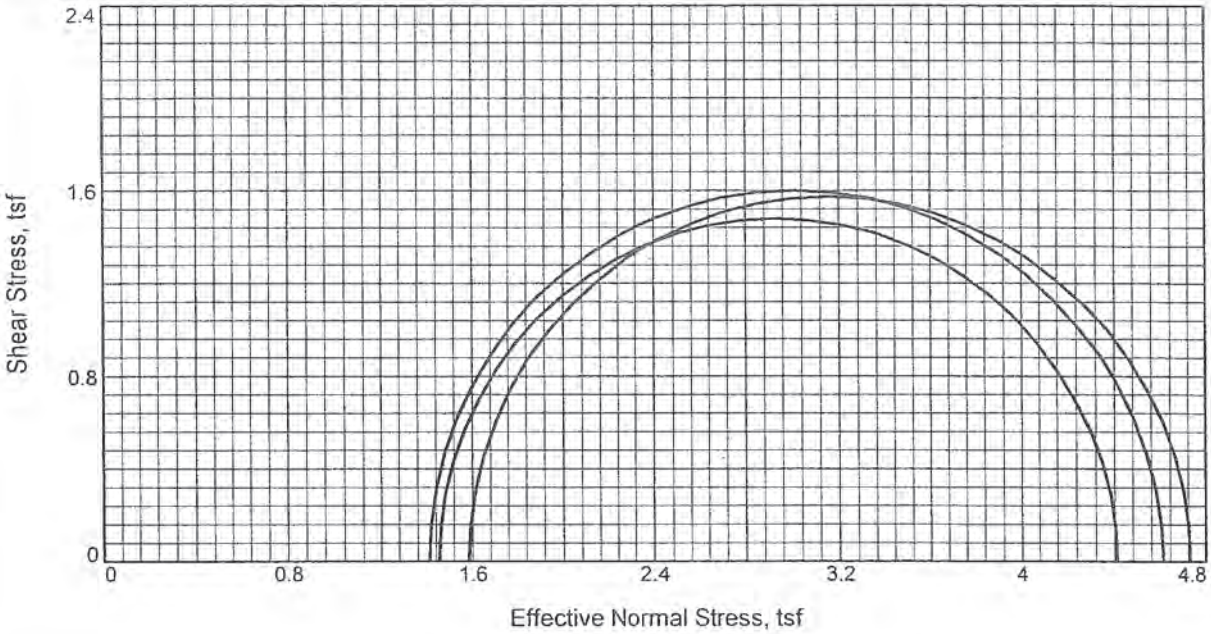
Consolidation cell pressure = 69.00 psi (4.968 tsf)

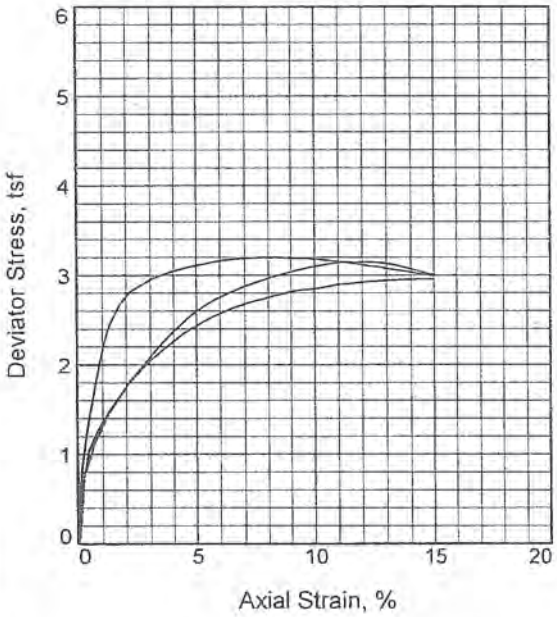
Consolidation back pressure = 55.00 psi (3.960 tsf)

Consolidation effective confining stress = 1.008 tsf

Strain rate, %/min. = 0.06

Fail. Stress = 4.023 tsf at reading no. 50





Sample No.		1	2	3
Initial	Water Content, %	24.7	25.2	22.9
	Dry Density, pcf	99.5	99.1	103.0
	Saturation, %	98.7	99.9	99.9
	Void Ratio	0.6630	0.6690	0.6064
	Diameter, in.	2.85	2.87	2.86
	Height, in.	5.74	5.73	5.72
At Test	Water Content, %	23.7	23.9	21.1
	Dry Density, pcf	101.5	101.3	106.0
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.6292	0.6325	0.5603
	Diameter, in.	2.83	2.85	2.83
	Height, in.	5.70	5.69	5.66
Strain rate, %/min.		0.06	0.06	0.06
Back Pressure, psi		55.00	55.00	50.00
Cell Pressure, psi		70.00	75.00	75.00
Fail. Stress, tsf		2.96	3.20	3.15
Total Pore Pr., tsf		3.59	3.99	3.82
Ult. Stress, tsf				
Total Pore Pr., tsf				
$\bar{\sigma}_1$ Failure, tsf		4.41	4.61	4.73
$\bar{\sigma}_3$ Failure, tsf		1.45	1.41	1.58

Type of Test:
CU with Pore Pressures
Sample Type: Shelby tube
Description:

Assumed Specific Gravity= 2.65
Remarks:

Client: Vectren

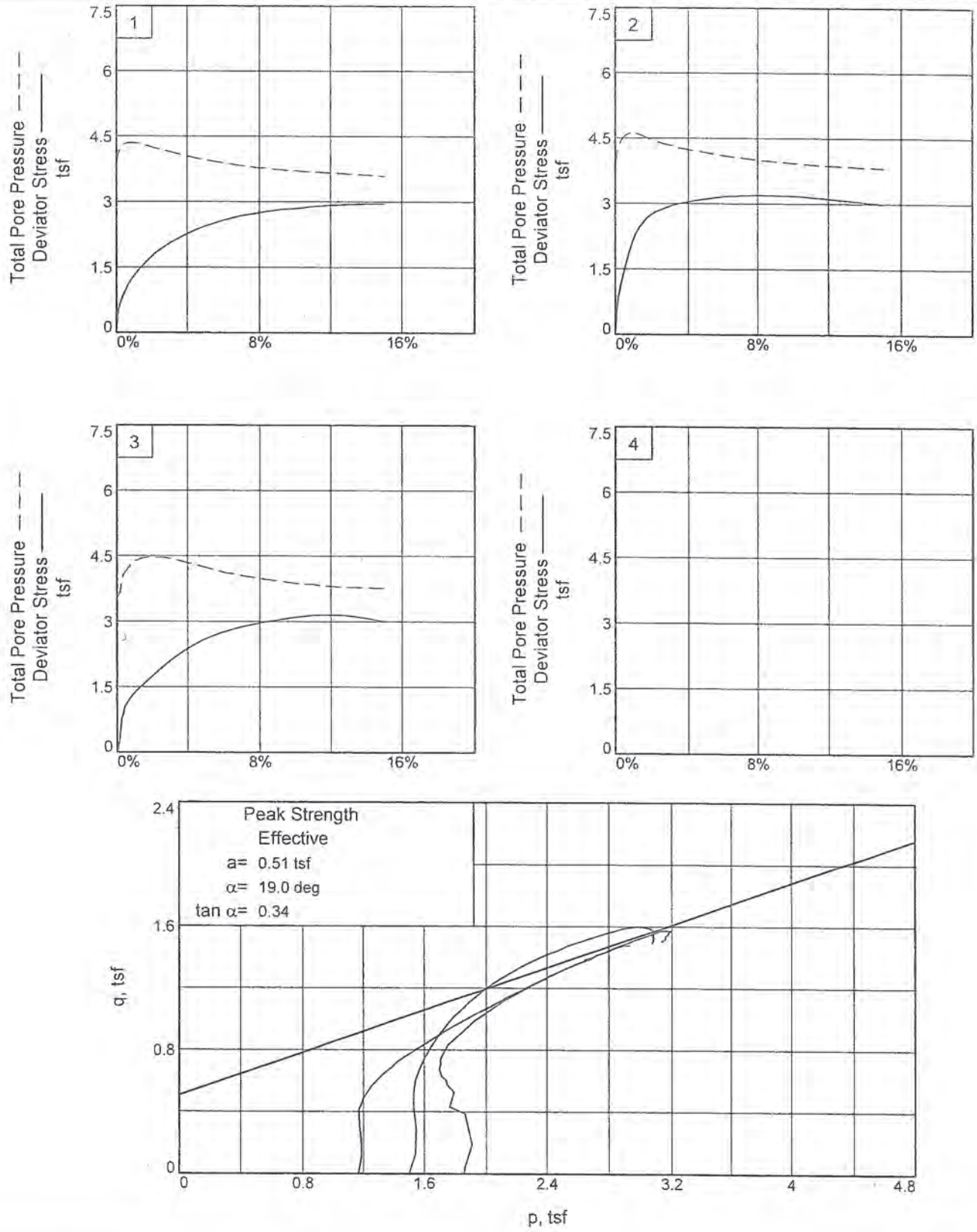
Project: Brown Safety Factor Assessment

Source of Sample: 7211 **Depth:** 38-40'
Sample Number: B-206
Proj. No.: 170GC00108 **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT
Cardno ATC, INC.
Indianapolis, Indiana

Figure CU7211K

Tested By: MDr



Client: Vectren

Project: Brown Safety Factor Assessment

Source of Sample: 7211 **Depth:** 38-40' **Sample Number:** B-206

Project No.: 170GC00108 **Figure** _____

Cardno ATC, Inc.

Tested By: MDr

TRIAXIAL COMPRESSION TEST

CU with Pore Pressures

6/12/2015
2:18 PM

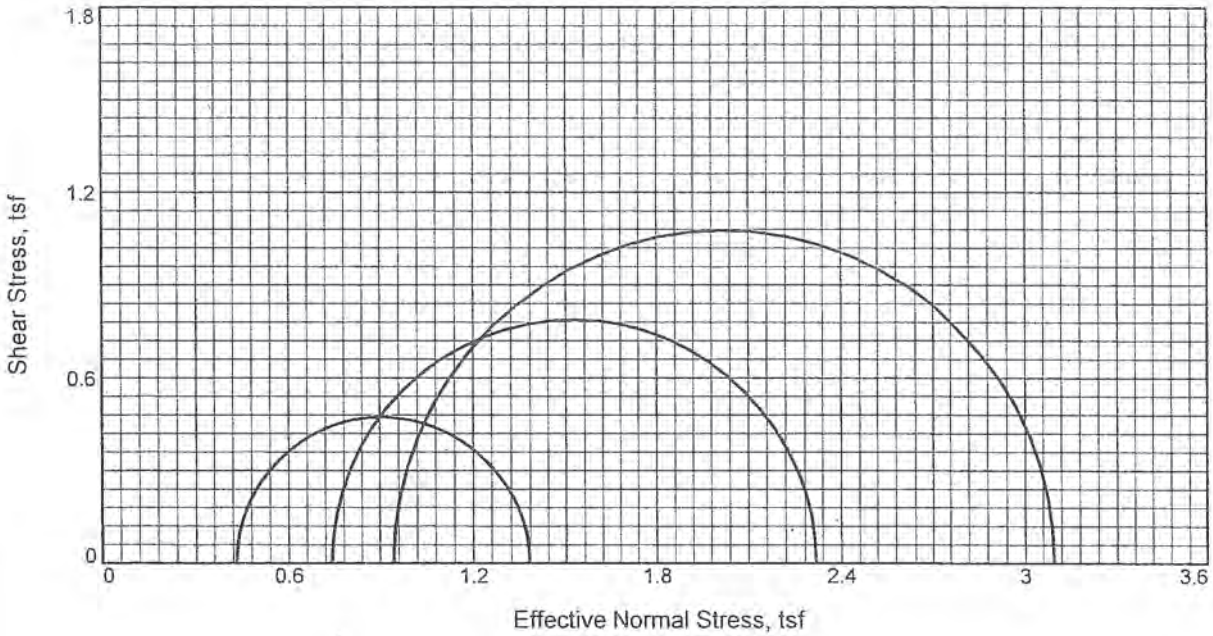
Date:
Client: Vectren
Project: Brown Safety Factor Assessment
Project No.: 170GC00108
Location: 7211
Depth: 38-40' Sample Number: B-206
Description:
Remarks:
Type of Sample: Shelby tube
Assumed Specific Gravity=2.65 LL= PL= PI=
Test Method: COE uniform strain

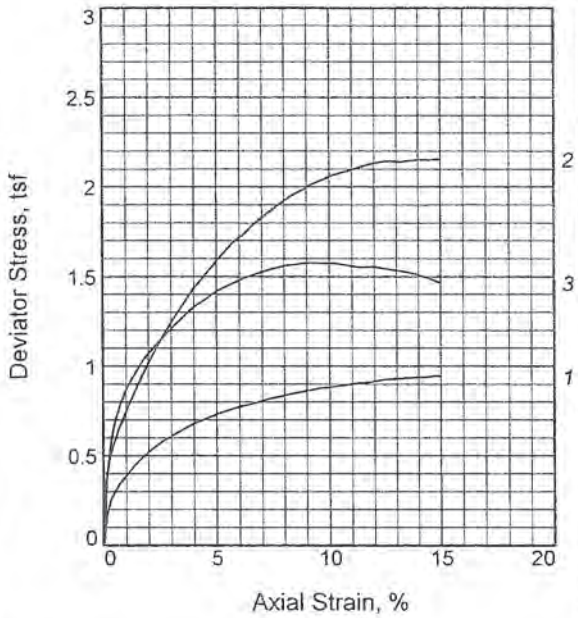
Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	1190.530			1305.400
Moisture content: Dry soil+tare, gms.	954.690			1065.990
Moisture content: Tare, gms.	0.000			111.300
Moisture, %	24.7	24.3	23.7	25.1
Moist specimen weight, gms.	1190.5			
Diameter, in.	2.85	2.84	2.83	
Area, in.^{2}	6.37	6.33	6.29	
Height, in.	5.74	5.71	5.70	
Net decrease in height, in.		0.02	0.02	
Wet density, pcf	124.1	125.1	125.7	
Dry density, pcf	99.5	100.6	101.5	
Void ratio	0.6630	0.6439	0.6292	
Saturation, %	98.7	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 70.00 psi (5.040 tsf)
Consolidation back pressure = 55.00 psi (3.960 tsf)
Consolidation effective confining stress = 1.080 tsf
Strain rate, %/min. = 0.06
Fail. Stress = 2.957 tsf at reading no. 48





Sample No.		1	2	3
Initial	Water Content, %	24.1	22.5	23.5
	Dry Density, pcf	99.7	102.1	101.9
	Saturation, %	96.8	96.3	100.0
	Void Ratio	0.6596	0.6203	0.6238
	Diameter, in.	2.82	2.84	2.85
	Height, in.	5.76	5.70	5.71
At Test	Water Content, %	23.5	22.9	21.7
	Dry Density, pcf	102.0	103.0	105.1
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.6226	0.6067	0.5738
	Diameter, in.	2.80	2.84	2.82
	Height, in.	5.71	5.69	5.65
Strain rate, %/min.		0.07	0.07	0.07
Back Pressure, psi		50.00	45.00	40.00
Cell Pressure, psi		55.00	55.00	55.00
Fail. Stress, tsf		0.95	2.15	1.58
Total Pore Pr., tsf		3.53	3.02	3.22
Ult. Stress, tsf				
Total Pore Pr., tsf				
$\bar{\sigma}_1$ Failure, tsf		1.38	3.10	2.32
$\bar{\sigma}_3$ Failure, tsf		0.43	0.94	0.74

Type of Test:
CU with Pore Pressures
Sample Type: Shelby tube
Description:

Assumed Specific Gravity= 2.65
Remarks:

Client: Vectren

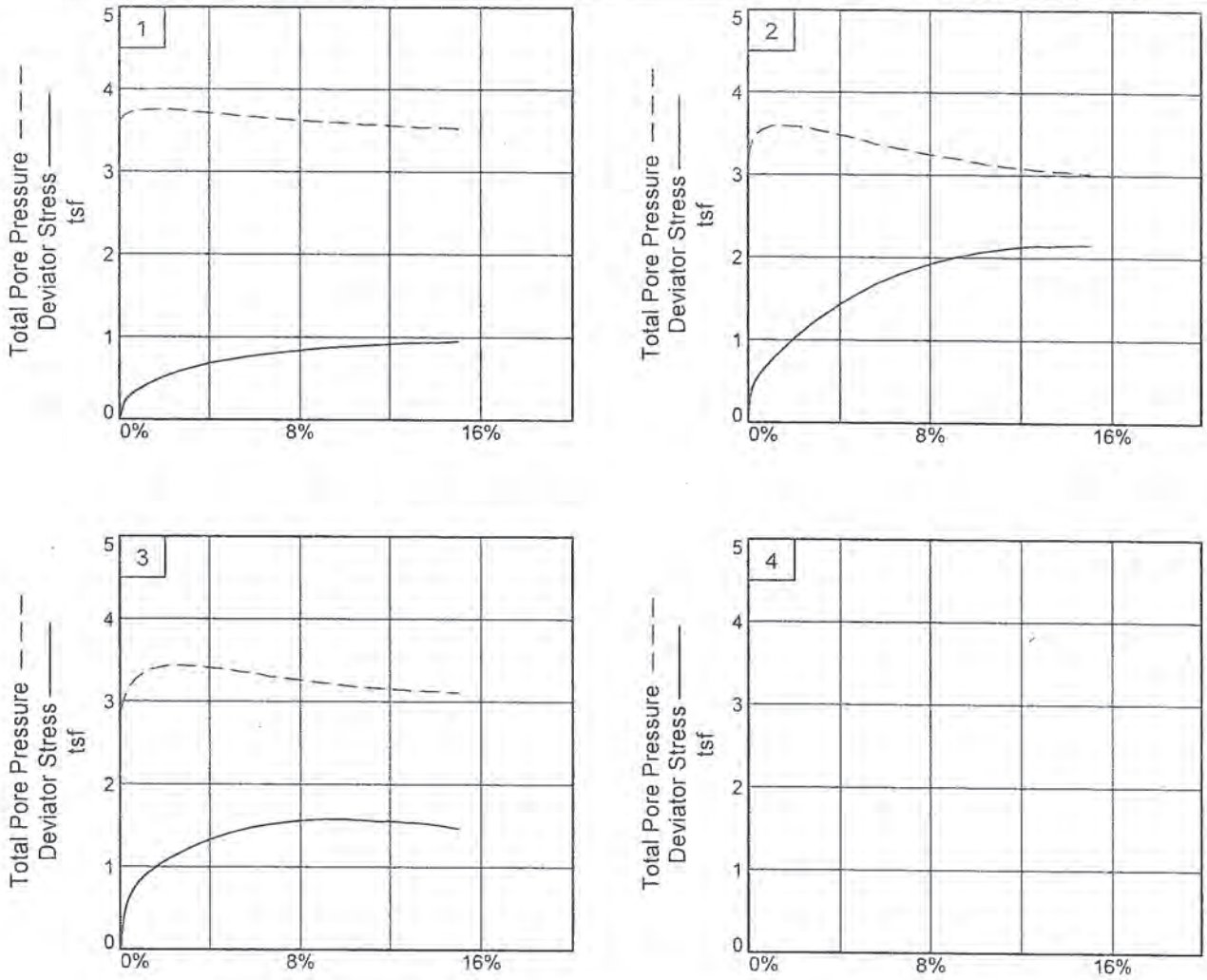
Project: Brown Safety Factor Assessment

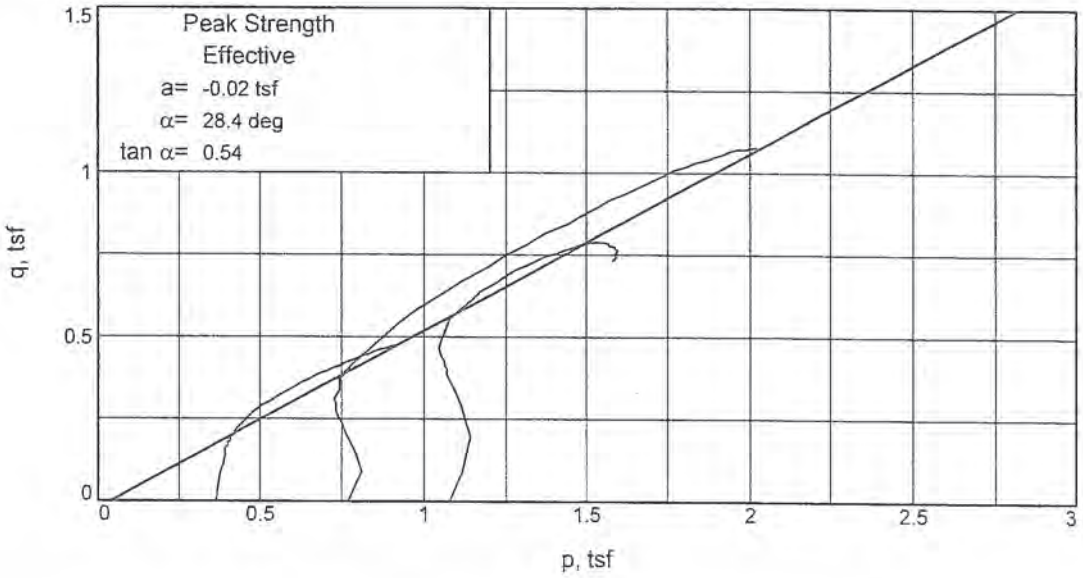
Source of Sample: 7211 **Depth:** 18-20'
Sample Number: B-207
Proj. No.: 170GC00108 **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT
Cardno ATC, INC.
Indianapolis, Indiana

Figure CU7211M

Tested By: MDr





Client: Vectren

Project: Brown Safety Factor Assessment

Source of Sample: 7211 **Depth:** 18-20' **Sample Number:** B-207

Project No.: 170GC00108 **Figure** _____

Cardno ATC, Inc.

Tested By: MDr

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

6/9/2015
2:48 PM

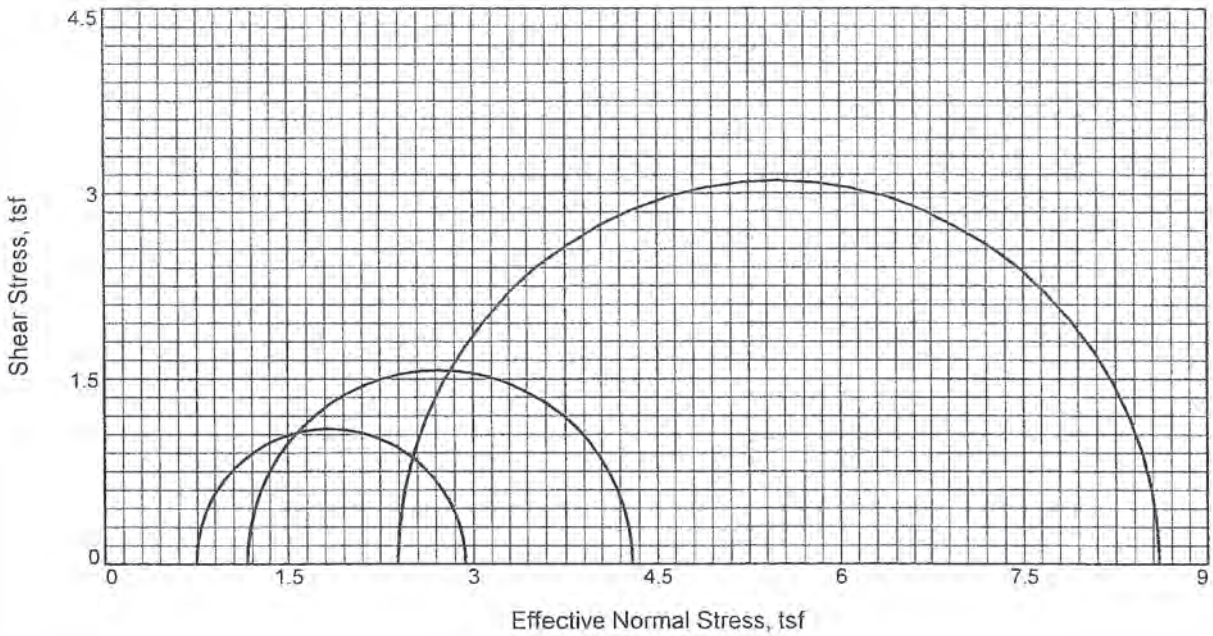
Date:
Client: Vectren
Project: Brown Safety Factor Assessment
Project No.: 170GC00108
Location: 7211
Depth: 18-20' Sample Number: B-207
Description:
Remarks:
Type of Sample: Shelby tube
Assumed Specific Gravity=2.65 LL= PL= PI=
Test Method: COE uniform strain

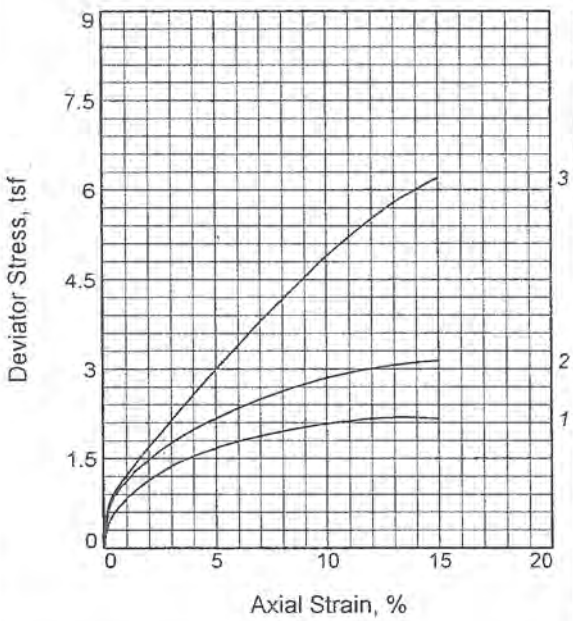
Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	1165.230			1266.050
Moisture content: Dry soil+tare, gms.	939.050			1050.890
Moisture content: Tare, gms.	0.000			111.840
Moisture, %	24.1	23.5	23.5	22.9
Moist specimen weight, gms.	1165.2			
Diameter, in.	2.82	2.80	2.80	
Area, in.^{2}	6.23	6.14	6.14	
Height, in.	5.76	5.71	5.71	
Net decrease in height, in.		0.04	0.00	
Wet density, pcf	123.7	125.9	125.9	
Dry density, pcf	99.7	102.0	102.0	
Void ratio	0.6596	0.6226	0.6226	
Saturation, %	96.8	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 55.00 psi (3.960 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 0.360 tsf
Strain rate, %/min. = 0.07
Fail. Stress = 0.946 tsf at reading no. 48





Sample No.		1	2	3
Initial	Water Content, %	33.7	33.3	29.1
	Dry Density, pcf	87.4	87.8	93.4
	Saturation, %	99.9	99.9	100.0
	Void Ratio	0.8927	0.8839	0.7711
	Diameter, in.	2.85	2.86	2.82
	Height, in.	5.71	5.65	5.82
At Test	Water Content, %	31.9	31.9	28.2
	Dry Density, pcf	89.6	89.7	94.7
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.8461	0.8441	0.7465
	Diameter, in.	2.82	2.84	2.81
	Height, in.	5.66	5.61	5.79
Strain rate, %/min.		0.07	0.07	0.07
Back Pressure, psi		50.00	45.00	40.00
Cell Pressure, psi		60.00	60.00	60.00
Fail. Stress, tsf		2.19	3.14	6.21
Total Pore Pr., tsf		3.58	3.16	1.93
Ult. Stress, tsf				
Total Pore Pr., tsf				
$\bar{\sigma}_1$ Failure, tsf		2.93	4.30	8.60
$\bar{\sigma}_3$ Failure, tsf		0.74	1.16	2.39

Type of Test:
CU with Pore Pressures
Sample Type: Shelby tube
Description:

Assumed Specific Gravity= 2.65
Remarks:

Client: Vectren

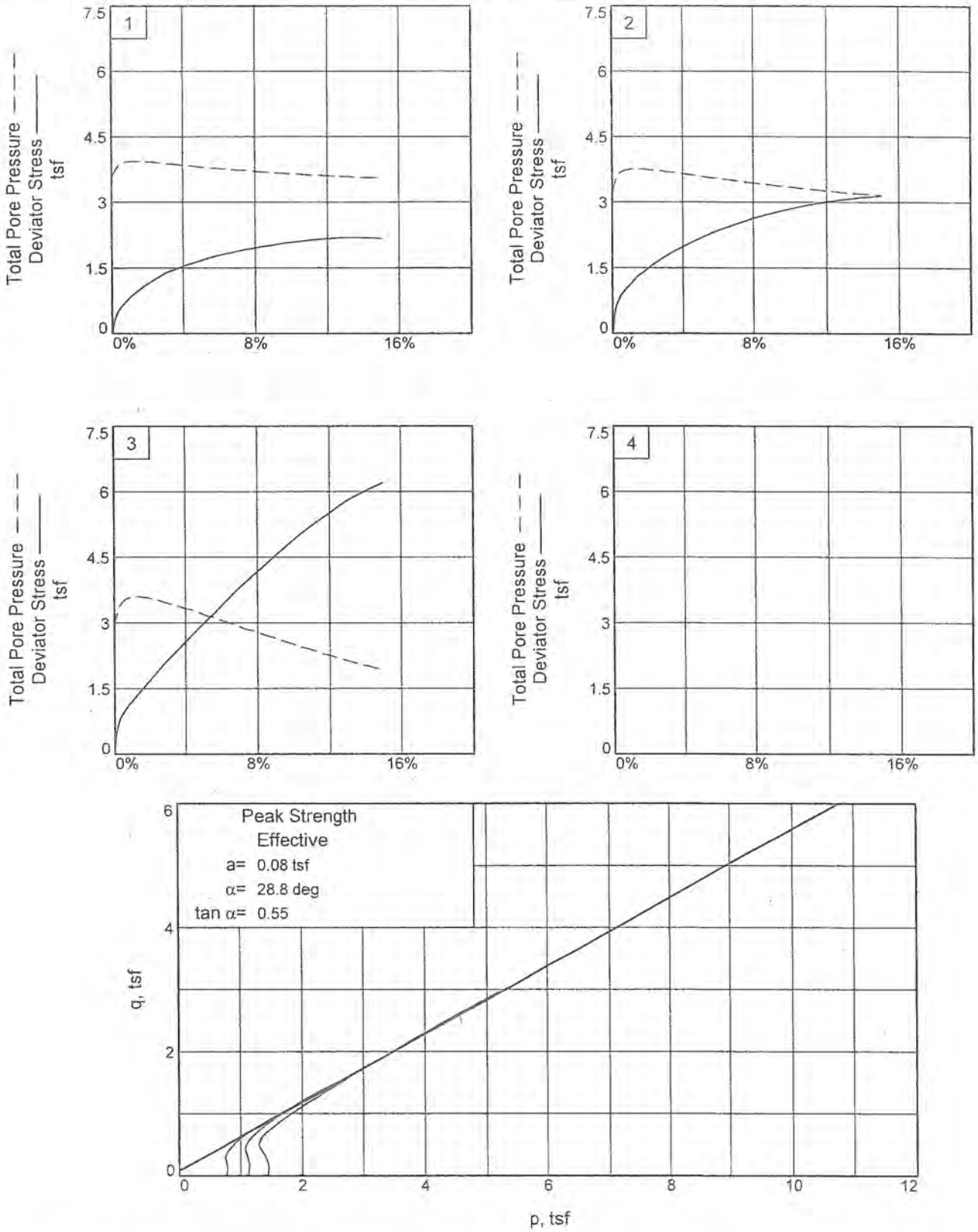
Project: Brown Safety Factor Assessment

Source of Sample: 7211 **Depth:** 35-37'
Sample Number: B-207
Proj. No.: 170GC00108 **Date Sampled:**

TRIAXIAL SHEAR TEST REPORT
Cardno ATC, INC.
Indianapolis, Indiana

Figure CU7211N

Tested By: MDr



Client: Vectren

Project: Brown Safety Factor Assessment

Source of Sample: 7211 **Depth:** 35-37' **Sample Number:** B-207

Project No.: 170GC00108 **Figure** _____

Cardno ATC, Inc.

Tested By: MDr

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

6/18/2015
1:43 PM

Date:
Client: Vectren
Project: Brown Safety Factor Assessment
Project No.: 170GC00108
Location: 7211
Depth: 35-37' Sample Number: B-207
Description:
Remarks:
Type of Sample: Shelby tube
Assumed Specific Gravity=2.65 LL= PL= PI=
Test Method: COE uniform strain

Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Moisture content: Moist soil+tare, gms.	1114.800			1213.360
Moisture content: Dry soil+tare, gms.	834.020			941.580
Moisture content: Tare, gms.	0.000			107.560
Moisture, %	33.7	32.4	31.9	32.6
Moist specimen weight, gms.	1114.8			
Diameter, in.	2.85	2.83	2.82	
Area, in.²	6.37	6.29	6.27	
Height, in.	5.71	5.67	5.66	
Net decrease in height, in.		0.03	0.01	
Wet density, pcf	116.8	117.8	118.2	
Dry density, pcf	87.4	89.0	89.6	
Void ratio	0.8927	0.8590	0.8461	
Saturation, %	99.9	100.0	100.0	

Test Readings for Specimen No. 1

Consolidation cell pressure = 60.00 psi (4.320 tsf)
Consolidation back pressure = 50.00 psi (3.600 tsf)
Consolidation effective confining stress = 0.720 tsf
Strain rate, %/min. = 0.07
Fail. Stress = 2.193 tsf at reading no. 43

Soil Hydraulic Conductivity Laboratory Test Results

Client:	AECOM		
Project Name:	Vectran AB Brown Ash Pond Lower Dam		
Project Location:	Evansville, IN		
GTX #:	303915		
Start Date:	2/25/2016	Tested By:	jcw
End Date:	2/29/2016	Checked By:	emm
Boring #:	AECOM-B1		
Sample #:	1		
Depth:	17-19		
Visual Description:	Moist, dark yellowish brown clay		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Intact	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	8/13

Sample Preparation: Extruded from tube, cut, trimmed and placed into permeameter at as-received density and moisture content. Trimmings moisture content = 18.1%.

Assumed Specific Gravity: 2.70

Parameter	Initial	Final
Height, in	3.30	3.21
Diameter, in	2.85	2.85
Area, in^2	6.38	6.38
Volume, in^3	21.1	20.5
Mass, g	695	705
Bulk Density, pcf	125.5	130.9
Moisture Content, %	18.0	19.7
Dry Density, pcf	106.4	109.3
Degree of Saturation, %	83	98

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	89.96	Increased Cell Pressure, psi:	95.04	Cell Pressure Increment, psi:	5.08
Sample Pressure, psi:	84.95	Corresponding Sample Pressure, psi:	89.86	Sample Pressure Increment, psi:	4.91
				B Coefficient:	0.97

FLOW DATA

Date	Trial #	Pressure, psi Cell	Pressure, psi Sample	Manometer Readings Z_1	Manometer Readings Z_2	Manometer Readings Z_1-Z_2	Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
2/26	1	90.0	85.0	12.5	12.0	0.5	30	19.3	6.7E-07	20.4	0.991	6.7E-07
2/26	2	90.0	85.0	12.5	12.0	0.5	32	19.3	6.3E-07	20.4	0.991	6.2E-07
2/26	3	90.0	85.0	12.5	12.0	0.5	33	19.3	6.1E-07	20.4	0.991	6.1E-07
2/26	4	90.0	85.0	12.5	12.0	0.5	34	19.3	5.9E-07	20.4	0.991	5.9E-07

PERMEABILITY AT 20° C: 6.2 x 10^{-7} cm/sec (@ 5 psi effective stress)

Client:	AECOM		
Project Name:	Vectran AB Brown Ash Pond Lower Dam		
Project Location:	Evansville, IN		
GTX #:	303915		
Start Date:	2/26/2016	Tested By:	jcw
End Date:	3/1/2016	Checked By:	emm
Boring #:	AECOM-B1		
Sample #:	5		
Depth:	49-51		
Visual Description:	Moist, dark olive brown clay		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Intact	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	9/15

Sample Preparation: Extruded from tube, cut, trimmed and placed into permeameter at as-received density and moisture content. Trimmings moisture content = 26.7%.

Assumed Specific Gravity: 2.70

Parameter	Initial	Final
Height, in	2.96	2.93
Diameter, in	2.85	2.85
Area, in^2	6.38	6.38
Volume, in^3	18.9	18.7
Mass, g	610	603
Bulk Density, pcf	122.7	122.6
Moisture Content, %	26.8	25.4
Dry Density, pcf	96.8	97.8
Degree of Saturation, %	98	95

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	89.97	Increased Cell Pressure, psi:	94.87	Cell Pressure Increment, psi:	4.90
Sample Pressure, psi:	84.95	Corresponding Sample Pressure, psi:	89.58	Sample Pressure Increment, psi:	4.63
				B Coefficient:	0.95

FLOW DATA

Date	Trial #	Pressure, psi Cell	Pressure, psi Sample	Manometer Readings Z_1	Manometer Readings Z_2	Manometer Readings Z_1-Z_2	Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
2/29	1	90.0	85.0	11.5	11.2	0.3	45	19.5	2.6E-07	20.7	0.983	2.6E-07
2/29	2	90.0	85.0	11.5	11.2	0.3	46	19.5	2.6E-07	20.7	0.983	2.5E-07
2/29	3	90.0	85.0	11.5	11.2	0.3	46	19.5	2.6E-07	20.7	0.983	2.5E-07
2/29	4	90.0	85.0	11.5	11.2	0.3	47	19.5	2.5E-07	20.7	0.983	2.5E-07

PERMEABILITY AT 20° C: 2.6 x 10^{-7} cm/sec (@ 5 psi effective stress)

Client:	AECOM		
Project Name:	Vectran AB Brown Ash Pond Lower Dam		
Project Location:	Evansville, IN		
GTX #:	303915		
Start Date:	2/26/2016	Tested By:	jcw
End Date:	3/1/2016	Checked By:	emm
Boring #:	AECOM-B2		
Sample #:	4		
Depth:	60-62		
Visual Description:	Moist, light brown silt		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Intact	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	6/7

Sample Preparation: Extruded from tube, cut, trimmed and placed into permeameter at as-received density and moisture content. Trimmings moisture content = 23.7%.

Assumed Specific Gravity: 2.70

Parameter	Initial	Final
Height, in	2.37	2.34
Diameter, in	2.85	2.85
Area, in^2	6.38	6.38
Volume, in^3	15.1	14.9
Mass, g	497	492
Bulk Density, pcf	125.0	125.3
Moisture Content, %	24.2	23.0
Dry Density, pcf	100.6	101.9
Degree of Saturation, %	97	95

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	90.04	Increased Cell Pressure, psi:	94.91	Cell Pressure Increment, psi:	4.87
Sample Pressure, psi:	84.97	Corresponding Sample Pressure, psi:	89.72	Sample Pressure Increment, psi:	4.75
				B Coefficient:	0.97

FLOW DATA

Date	Trial #	Pressure, psi Cell	Pressure, psi Sample	Manometer Readings Z_1	Manometer Readings Z_2	Manometer Readings Z_1-Z_2	Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
2/29	1	90.0	85.0	5.0	4.6	0.4	33	10.6	9.1E-07	20.7	0.983	9.0E-07
2/29	2	90.0	85.0	5.0	4.6	0.4	34	10.6	8.8E-07	20.7	0.983	8.7E-07
2/29	3	90.0	85.0	5.0	4.6	0.4	34	10.6	8.8E-07	20.7	0.983	8.7E-07
2/29	4	90.0	85.0	5.0	4.6	0.4	35	10.6	8.6E-07	20.7	0.983	8.4E-07

PERMEABILITY AT 20° C: 8.7 x 10^{-7} cm/sec (@ 5 psi effective stress)

Client:	AECOM		
Project Name:	Vectran AB Brown Ash Pond Lower Dam		
Project Location:	Evansville, IN		
GTX #:	303915		
Start Date:	2/26/2016	Tested By:	jcw
End Date:	3/1/2016	Checked By:	emm
Boring #:	AECOM-B3		
Sample #:	3		
Depth:	28-30		
Visual Description:	Moist, dark yellowish brown clay		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Intact	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	15/4

Sample Preparation: Extruded from tube, cut, trimmed and placed into permeameter at as-received density and moisture content. Trimmings moisture content = 21.3%.

Assumed Specific Gravity: 2.70

Parameter	Initial	Final
Height, in	3.03	3.00
Diameter, in	2.85	2.85
Area, in^2	6.38	6.38
Volume, in^3	19.3	19.1
Mass, g	646	644
Bulk Density, pcf	127.0	127.9
Moisture Content, %	21.2	20.8
Dry Density, pcf	104.8	105.8
Degree of Saturation, %	94	95

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	89.98	Increased Cell Pressure, psi:	94.90	Cell Pressure Increment, psi:	4.92
Sample Pressure, psi:	84.95	Corresponding Sample Pressure, psi:	89.65	Sample Pressure Increment, psi:	4.70
				B Coefficient:	0.96

FLOW DATA

Date	Trial #	Pressure, psi Cell	Pressure, psi Sample	Manometer Readings Z_1	Manometer Readings Z_2	Manometer Readings Z_1-Z_2	Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
2/29	1	90.0	85.0	11.5	11.1	0.4	34	19.0	4.8E-07	20.7	0.983	4.7E-07
2/29	2	90.0	85.0	11.5	11.1	0.4	38	19.0	4.3E-07	20.7	0.983	4.2E-07
2/29	3	90.0	85.0	11.5	11.1	0.4	40	19.0	4.1E-07	20.7	0.983	4.0E-07
2/29	4	90.0	85.0	11.5	11.1	0.4	43	19.0	3.8E-07	20.7	0.983	3.7E-07

PERMEABILITY AT 20° C: 4.2 x 10^{-7} cm/sec (@ 5 psi effective stress)

Client:	AECOM		
Project Name:	Vectran AB Brown Ash Pond Lower Dam		
Project Location:	Evansville, IN		
GTX #:	303915		
Start Date:	2/26/2016	Tested By:	jcw
End Date:	3/1/2016	Checked By:	emm
Boring #:	AECOM-B3		
Sample #:	1		
Depth:	8-10		
Visual Description:	Moist, yellowish brown silt		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Intact	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	8/13

Sample Preparation: Extruded from tube, cut, trimmed and placed into permeameter at as-received density and moisture content. Trimmings moisture content = 31.4%.

Assumed Specific Gravity: 2.70

Parameter	Initial	Final
Height, in	2.84	2.73
Diameter, in	2.85	2.85
Area, in^2	6.38	6.38
Volume, in^3	18.1	17.4
Mass, g	548	543
Bulk Density, pcf	115.0	118.6
Moisture Content, %	30.6	29.5
Dry Density, pcf	88.0	91.6
Degree of Saturation, %	90	95

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	89.96	Increased Cell Pressure, psi:	94.89	Cell Pressure Increment, psi:	4.93
Sample Pressure, psi:	84.95	Corresponding Sample Pressure, psi:	89.77	Sample Pressure Increment, psi:	4.82
				B Coefficient:	0.98

FLOW DATA

Date	Trial #	Pressure, psi Cell	Pressure, psi Sample	Manometer Readings Z_1	Manometer Readings Z_2	Manometer Readings Z_1-Z_2	Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
2/29	1	90.0	85.0	5.5	3.5	2.0	35	10.0	5.5E-06	20.7	0.983	5.4E-06
2/29	2	90.0	85.0	5.5	3.5	2.0	36	10.0	5.3E-06	20.7	0.983	5.2E-06
2/29	3	90.0	85.0	5.5	3.5	2.0	37	10.0	5.2E-06	20.7	0.983	5.1E-06
2/29	4	90.0	85.0	5.5	3.5	2.0	37	10.0	5.2E-06	20.7	0.983	5.1E-06

PERMEABILITY AT 20° C: 5.2 x 10^{-6} cm/sec (@ 5 psi effective stress)

Client:	AECOM		
Project Name:	Vectran AB Brown Ash Pond Lower Dam		
Project Location:	Evansville, IN		
GTX #:	303915		
Start Date:	2/26/2016	Tested By:	jcw
End Date:	3/1/2016	Checked By:	emm
Boring #:	AECOM-B5		
Sample #:	3		
Depth:	34-36		
Visual Description:	Moist, gray silty clay		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type:	Intact	Permeant Fluid:	De-aired Distilled water
Orientation:	Vertical	Cell #:	2/5

Sample Preparation: Extruded from tube, cut, trimmed and placed into permeameter at as-received density and moisture content. Trimmings moisture content = 39.7%.

Assumed Specific Gravity: 2.70

Parameter	Initial	Final
Height, in	2.53	2.51
Diameter, in	2.85	2.85
Area, in^2	6.38	6.38
Volume, in^3	16.1	16.0
Mass, g	473	468
Bulk Density, pcf	111.4	111.2
Moisture Content, %	39.9	38.5
Dry Density, pcf	79.6	80.3
Degree of Saturation, %	97	95

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	90.03	Increased Cell Pressure, psi:	94.93	Cell Pressure Increment, psi:	4.90
Sample Pressure, psi:	84.95	Corresponding Sample Pressure, psi:	89.72	Sample Pressure Increment, psi:	4.77
				B Coefficient:	0.97

FLOW DATA

Date	Trial #	Pressure, psi Cell	Pressure, psi Sample	Manometer Readings Z_1	Manometer Readings Z_2	Manometer Readings Z_1-Z_2	Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
2/29	1	90.0	85.0	4.5	3.0	1.5	20	8.9	7.9E-06	20.7	0.983	7.8E-06
2/29	2	90.0	85.0	4.5	3.0	1.5	20	8.9	7.9E-06	20.7	0.983	7.8E-06
2/29	3	90.0	85.0	4.5	3.0	1.5	20	8.9	7.9E-06	20.7	0.983	7.8E-06
2/29	4	90.0	85.0	4.5	3.0	1.5	20	8.9	7.9E-06	20.7	0.983	7.8E-06

PERMEABILITY AT 20° C: 7.8 x 10^{-6} cm/sec (@ 5 psi effective stress)

Soil Cyclic Direct Simple Shear Laboratory Test Results

Consolidated Undrained Cyclic Direct Simple Shear Test of Cohesive Soils

Client:	AECOM	GTX#:	303915
Project Name:	Vectran AB Brown Ash Pond Lower Dam	Test Date:	10/28/15
Project Location:	Evansville, IN		

Boring ID: AECOM-B1
Sample ID: 3
Depth, ft: 31-41

Visual Description: Moist, greenish brown silt with clay

Test Equipment: Top and bottom box (circular) = 2.5 in diameter. Load cells and LVDT's connected to data acquisition system for shear force, normal load, horizontal and vertical displacement; surface area = 4.91 in^2, soil height = 1 inch.
Stacked Teflon Rings set-up used, which included porous stones with pins.

Test Condition: Inundated prior to consolidation.

Sample Type and Preparation: Extruded from tube, cut, trimmed and placed into apparatus at as-received density and moisture content.

Parameter	Point 1	Point 2	Point 3	Point 4	Point 5
Test No.	CDSS-1A				
Initial Moisture Content, %	30.8				
Initial Dry Density, pcf	89.5				
Vertical Consolidation Stress, psf	4275				
Cyclic Stress Ratio	0.25				
Number of cycles completed	21				
Frequency, Hz	1				
Final Moisture Content, %	25.4				
Measured Post-Cyclic Peak Shear Stress, psf	---				
Shear Strain at Post-Cyclic Peak shear Stress, %	---				
Membrane Correction, psf	---				
Corrected Post-Cyclic Peak Shear Stress, psf	---				
S_r/σ'_{vc}	---				

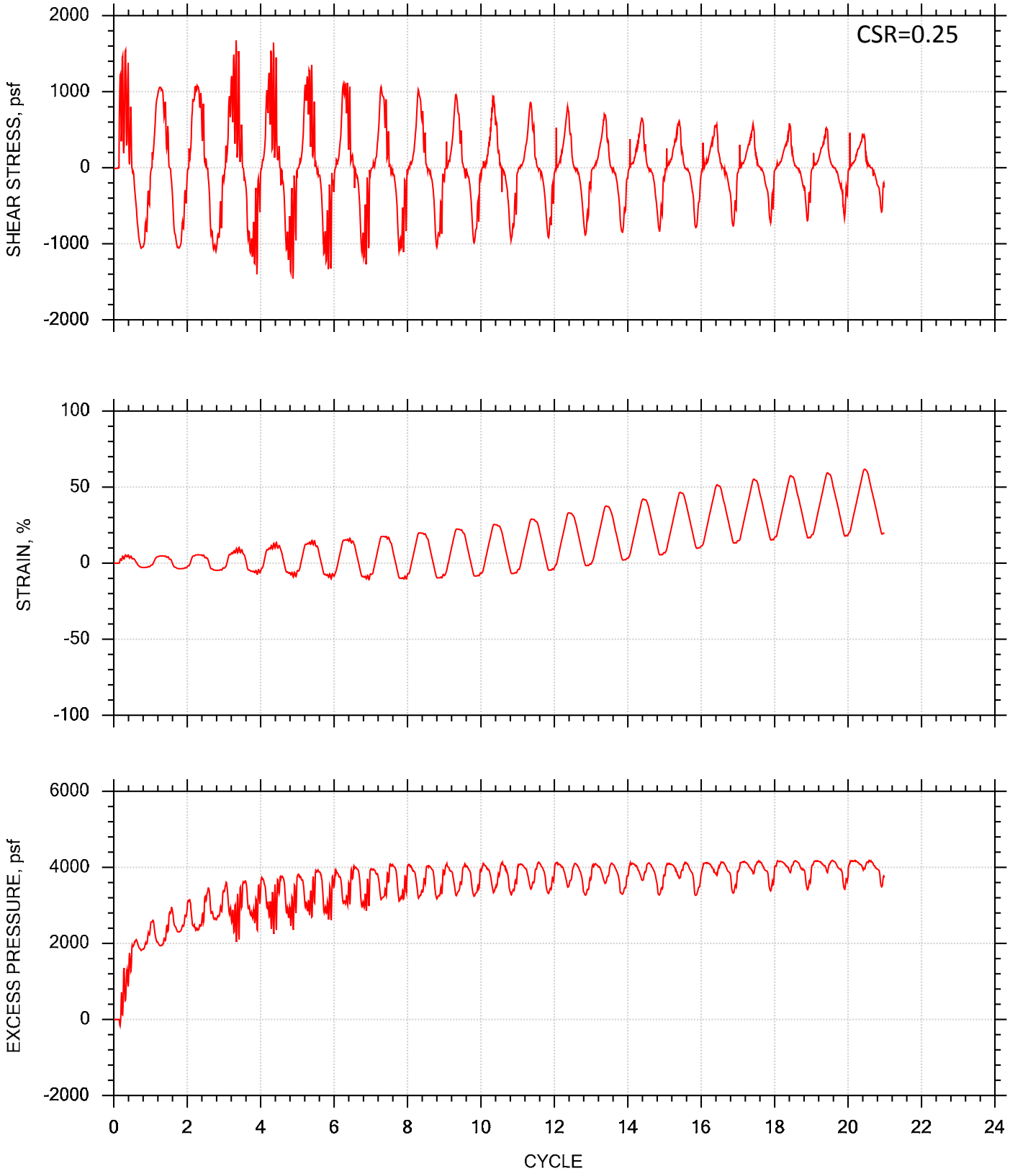
Comments: 500 cycles were requested. Specimen reached a 40% peak-to-peak strain, which is excessive, at 21 cycles which terminated the test. Shear strains higher than 10% peak-to-peak caused the sample to drift and the equipment had trouble keeping up with the target loading. There was no strength left to measure in the post cyclic condition.

Tested By: md/njh Checked By: jdt

Notes: These results apply only to the sample tested for the specific test conditions. The test procedures employed follow accepted industry practice and the indicated test method. GeoTesting Express has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

CYCLIC SIMPLE SHEAR DATA

Step 1 of **1**

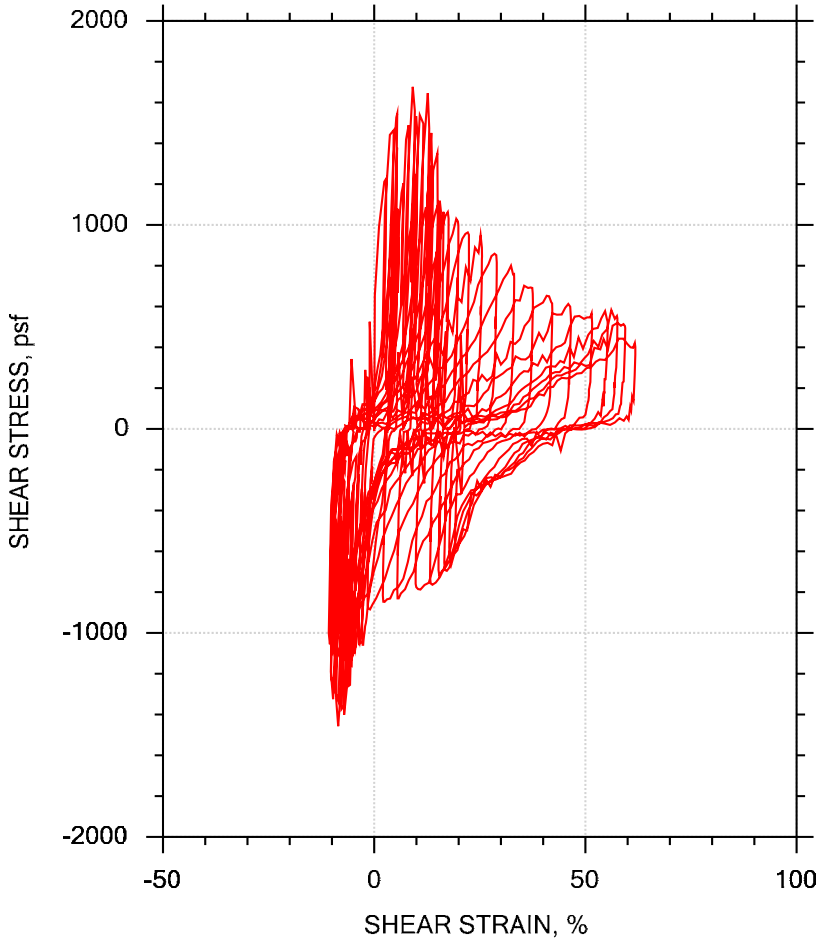


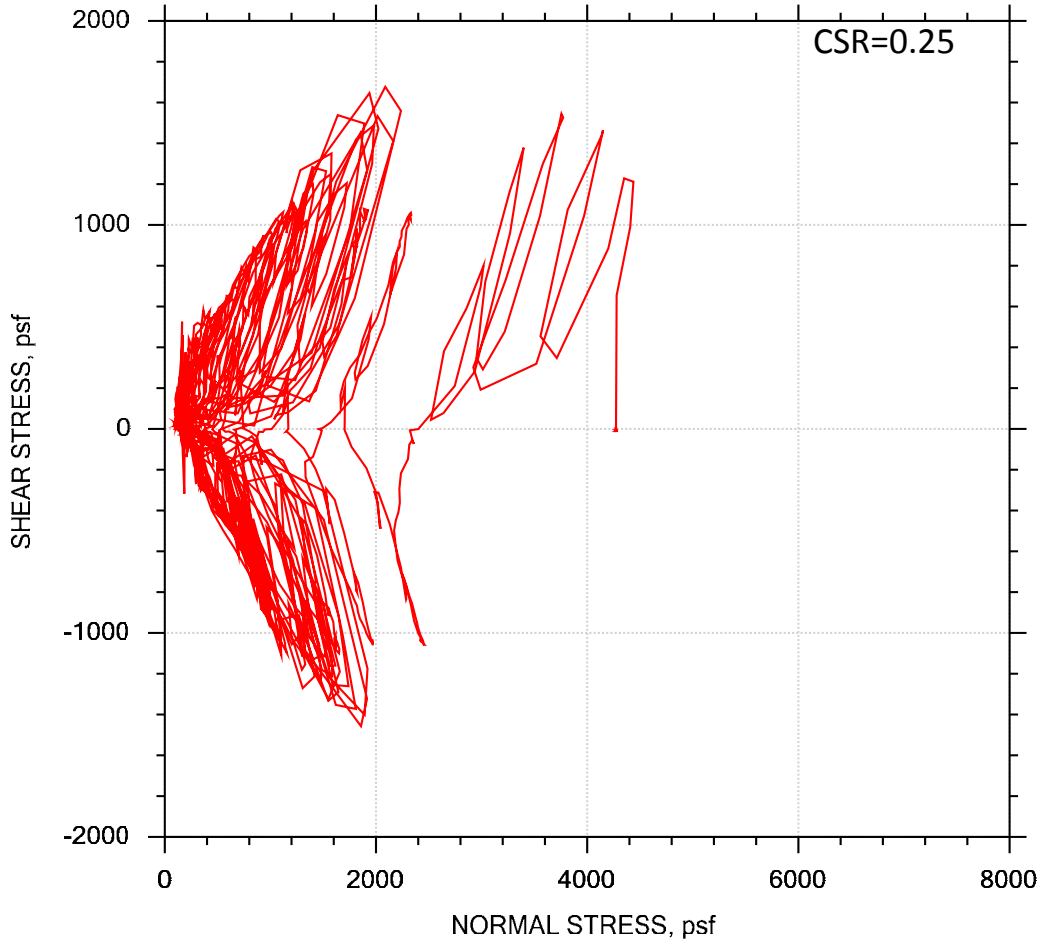
GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond Lower	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B1	Tested By: md/njh	Checked By: jdt
	Sample No.: 3	Test Date: 10/30/15	Test No.: CDSS-1A
	Depth: 31-41 ft	Sample Type: intact	Elevation: ---
	Description: Moist greenish Brown silt with clay		
	Remarks: System GG		Page 2 of 3
	File: \\hal1\Projects\GTX303915\6 Lab Testing\Soil\CDSS\303915-CDSS-1A.dat		

CYCLIC SIMPLE SHEAR STRESS DATA

Step 1 of 1

Cycle: 0.0 to 21.0





GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond Lower	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B1	Tested By: md/njh	Checked By: jdt
	Sample No.: 3	Test Date: 10/30/15	Depth: 31-41 ft
	Test No.: CDSS-1A	Sample Type: intact	Elevation: ---
	Description: Moist greenish Brown silt with clay		
	Remarks: System GG		Page 3 of 3
	File: \\hal1\Projects\GTX303915\6 Lab Testing\Soil\CDSS\303915-CDSS-1A.dat		

Consolidated Undrained Cyclic Direct Simple Shear Test of Cohesive Soils

Client:	AECOM	GTX#:	303915
Project Name:	Vectran AB Brown Ash Pond Lower Dam	Test Date:	11/18/15
Project Location:	Evansville, IN		

Boring ID: AECOM-B2
Sample ID: 3
Depth, ft: 56-58

Visual Description: Moist, brown silt

Test Equipment: Top and bottom box (circular) = 2.5 in diameter. Load cells and LVDT's connected to data acquisition system for shear force, normal load, horizontal and vertical displacement; surface area = 4.91 in^2, soil height = 1 inch.
Stacked Teflon Rings set-up used, which included porous stones with pins.

Test Condition: Inundated prior to consolidation.

Sample Type and Preparation: Extruded from tube, cut, trimmed and placed into apparatus at as-received density and moisture content.

Parameter	Point 1	Point 2	Point 3	Point 4	Point 5
Test No.	CDSS-2A				
Initial Moisture Content, %	23.3				
Initial Dry Density, pcf	99.2				
Vertical Consolidation Stress, psf	4950				
Cyclic Stress Ratio	0.15				
Number of cycles completed	29				
Frequency, Hz	1				
Final Moisture Content, %	23.5				
Delay before shearing, min	60				
Nominal Rate of Shear Strain, %/hr	5.0				
Measured Post-Cyclic Peak Shear Stress, psf	2918				
Shear Strain at Post-Cyclic Peak shear Stress, %	20.0				
Membrane Correction, psf	49				
Corrected Post-Cyclic Peak Shear Stress, psf	2869				
S_r/σ'_{vc}	0.58				

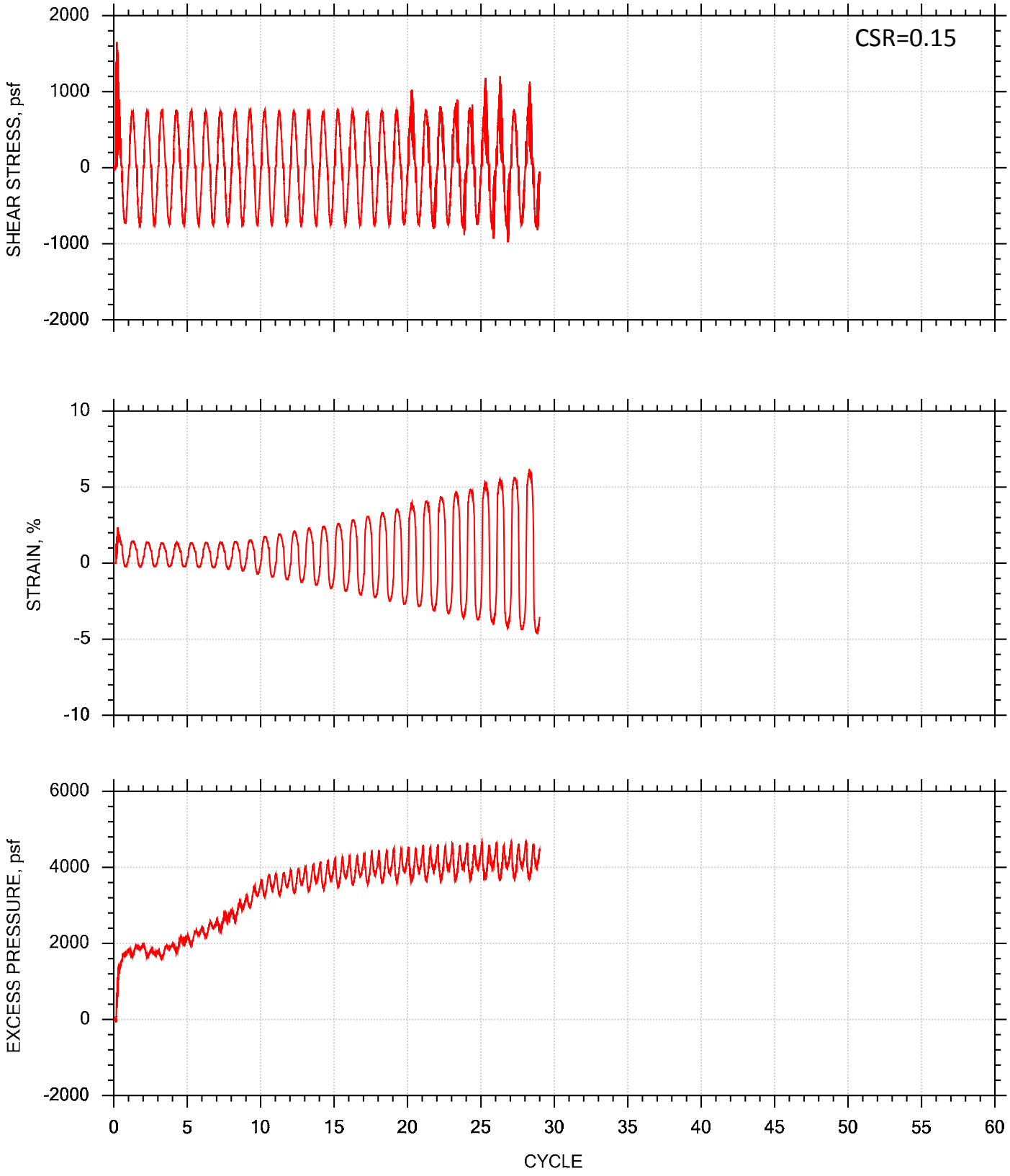
Comments: The cyclic portion of the test resulted in an R value approaching 1, and terminated the test at a 10% peak-to-peak axial strain. Actual post cyclic strength parameters should be determined by an engineer familiar with dynamic testing data.

Tested By: md Checked By: jdt

Notes: These results apply only to the sample tested for the specific test conditions. The test procedures employed follow accepted industry practice and the indicated test method. GeoTesting Express has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

CYCLIC SIMPLE SHEAR DATA

Step 1 of 1



GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B2	Tested By: md	Checked By: jdt
	Sample No.: 3	Test Date: 11/23/15	Test No.: CDSS-2A
	Depth: 56-58 ft	Sample Type: intact	Elevation: ---
	Description: Moist, brown silt		
	Remarks: System GG		Page 2 of 5
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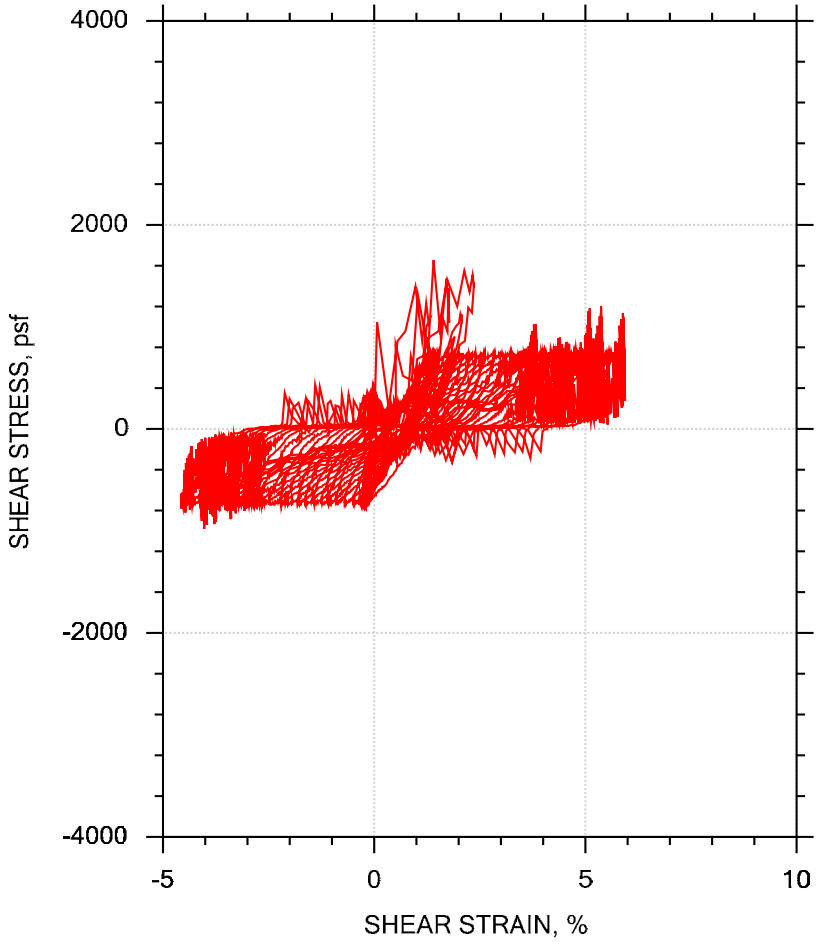
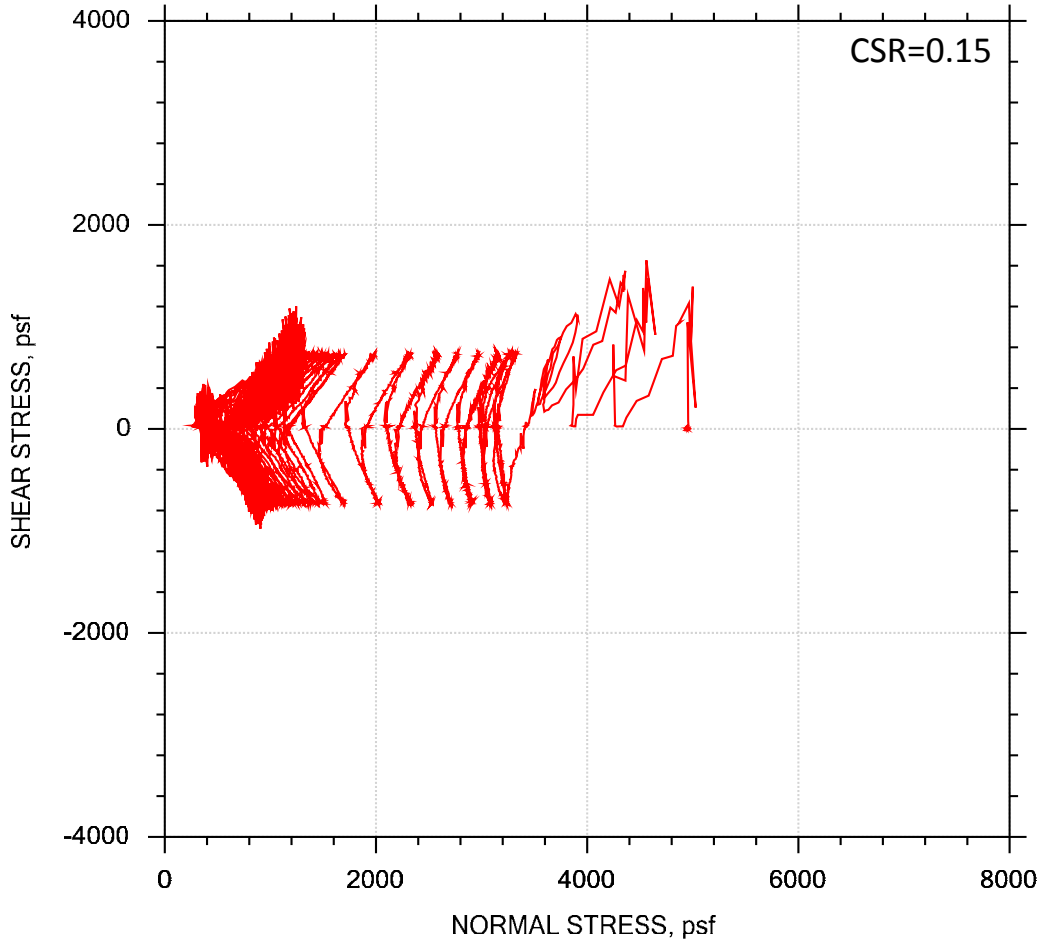
CYCLIC SIMPLE SHEAR STRESS DATA

Step 1 of 1

Cycle: 0.0 to 29.0

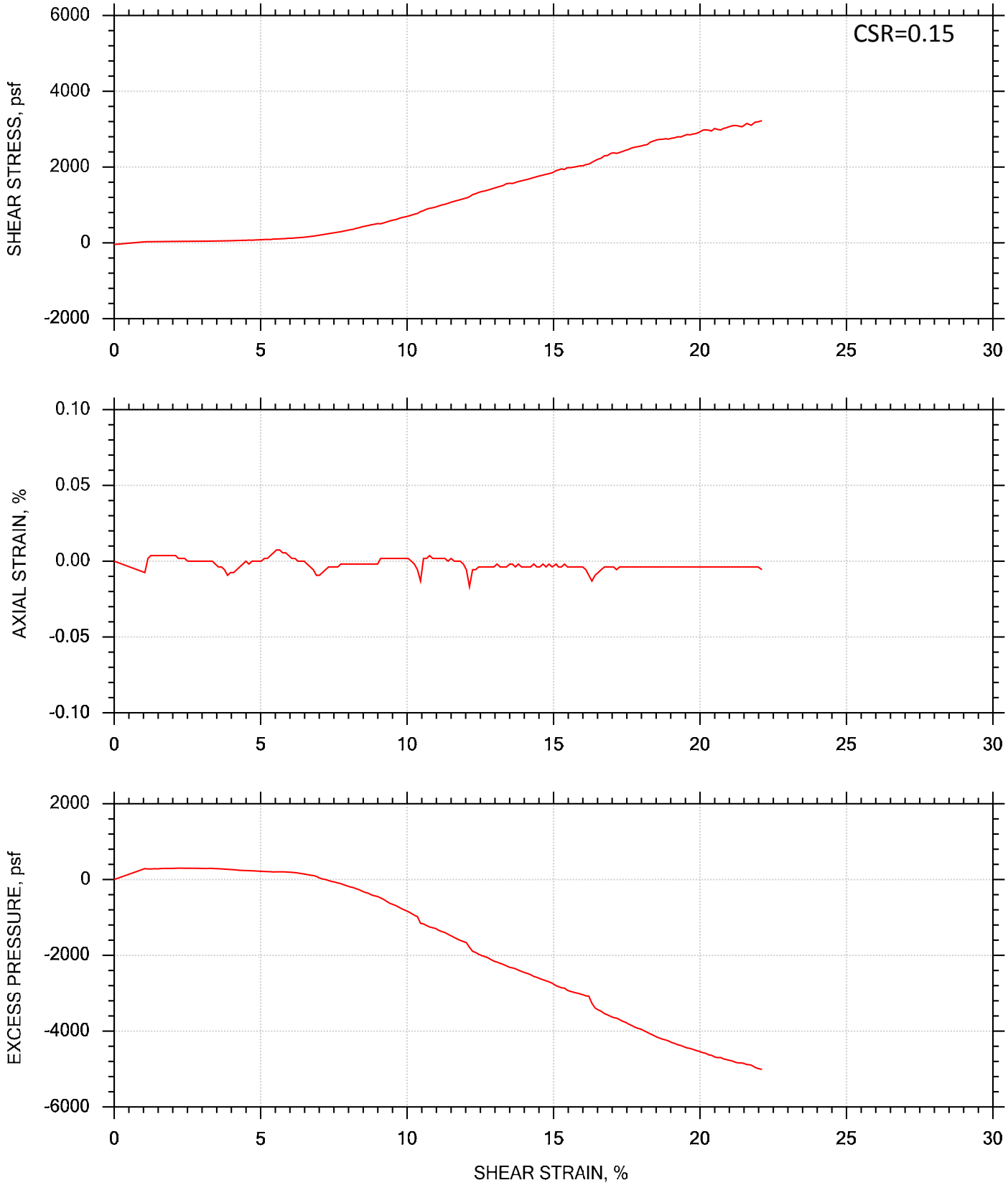




GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B2	Tested By: md	Checked By: jdt
	Sample No.: 3	Test Date: 11/23/15	Depth: 56-58 ft
	Test No.: CDSS-2A	Sample Type: intact	Elevation: ---
	Description: Moist, brown silt		
	Remarks: System GG		Page 3 of 5
	File: \\hal1\Projects\GTX303915 - AECOM - Vectran AB Brown Ash Pond\6 Lab Testing\Soil\CDSS\303915-CDSS-2A.dat		

DIRECT SIMPLE SHEAR TEST by ASTM D6528

POST CYCLIC



GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B2	Tested By: md	Checked By: jdt
	Sample No.: 3	Test Date: 11/23/15	Test No.: CDSS-2A
	Depth: 56-58 ft	Sample Type: intact	Elevation: ---
	Description: Moist, brown silt		
	Remarks: System GG		Page 4 of 5
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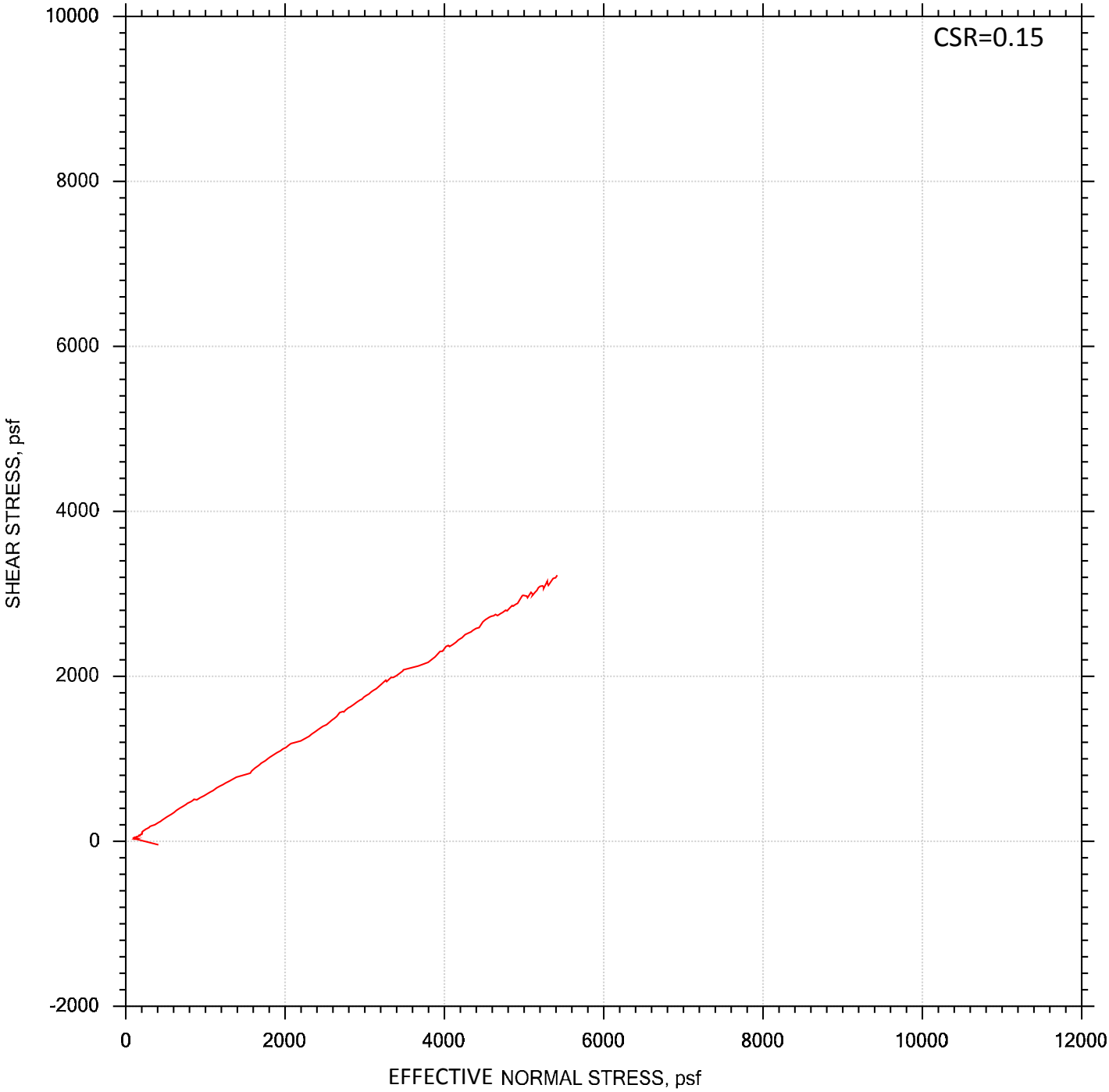
DIRECT SIMPLE SHEAR TEST by ASTM D6528

POST CYCLIC



GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B2	Tested By: md	Checked By: jdt
	Sample No.: 3	Test Date: 11/23/15	Test No.: CDSS-2A
	Depth: 56-58 ft	Sample Type: intact	Elevation: ---
	Description: Moist, brown silt		
	Remarks: System GG		Page 5 of 5
	File: \\hal1\Projects\GTX303915 - AECOM - Vectran AB Brown Ash Pond\6 Lab Testing\Soil\CDSS\303915-CDSS-2A.dat		

Consolidated Undrained Cyclic Direct Simple Shear Test of Cohesive Soils

Client:	AECOM	GTX#:	303915
Project Name:	Vectran AB Brown Ash Pond Lower Dam	Test Date:	11/20/15
Project Location:	Evansville, IN		

Boring ID: AECOM-B2
Sample ID: 4A
Depth, ft: 62-64

Visual Description: Moist, gray silt

Test Equipment: Top and bottom box (circular) = 2.5 in diameter. Load cells and LVDT's connected to data acquisition system for shear force, normal load, horizontal and vertical displacement; surface area = 4.91 in^2, soil height = 1 inch.
Stacked Teflon Rings set-up used, which included porous stones with pins.

Test Condition: Inundated prior to consolidation.

Sample Type and Preparation: Extruded from tube, cut, trimmed and placed into apparatus at as-received density and moisture content.

Parameter	Point 1	Point 2	Point 3	Point 4	Point 5
Test No.	CDSS-5				
Initial Moisture Content, %	24.5				
Initial Dry Density, pcf	99.0				
Vertical Consolidation Stress, psf	6040				
Cyclic Stress Ratio	0.20				
Number of cycles completed	6				
Frequency, Hz	1				
Final Moisture Content, %	22.6				
Delay before shearing, min	60				
Nominal Rate of Shear Strain, %/hr	5.0				
Measured Post-Cyclic Peak Shear Stress, psf	2215				
Shear Strain at Post-Cyclic Peak shear Stress, %	20.0				
Membrane Correction, psf	49				
Corrected Post-Cyclic Peak Shear Stress, psf	2166				
S_r/σ'_{vc}	0.36				

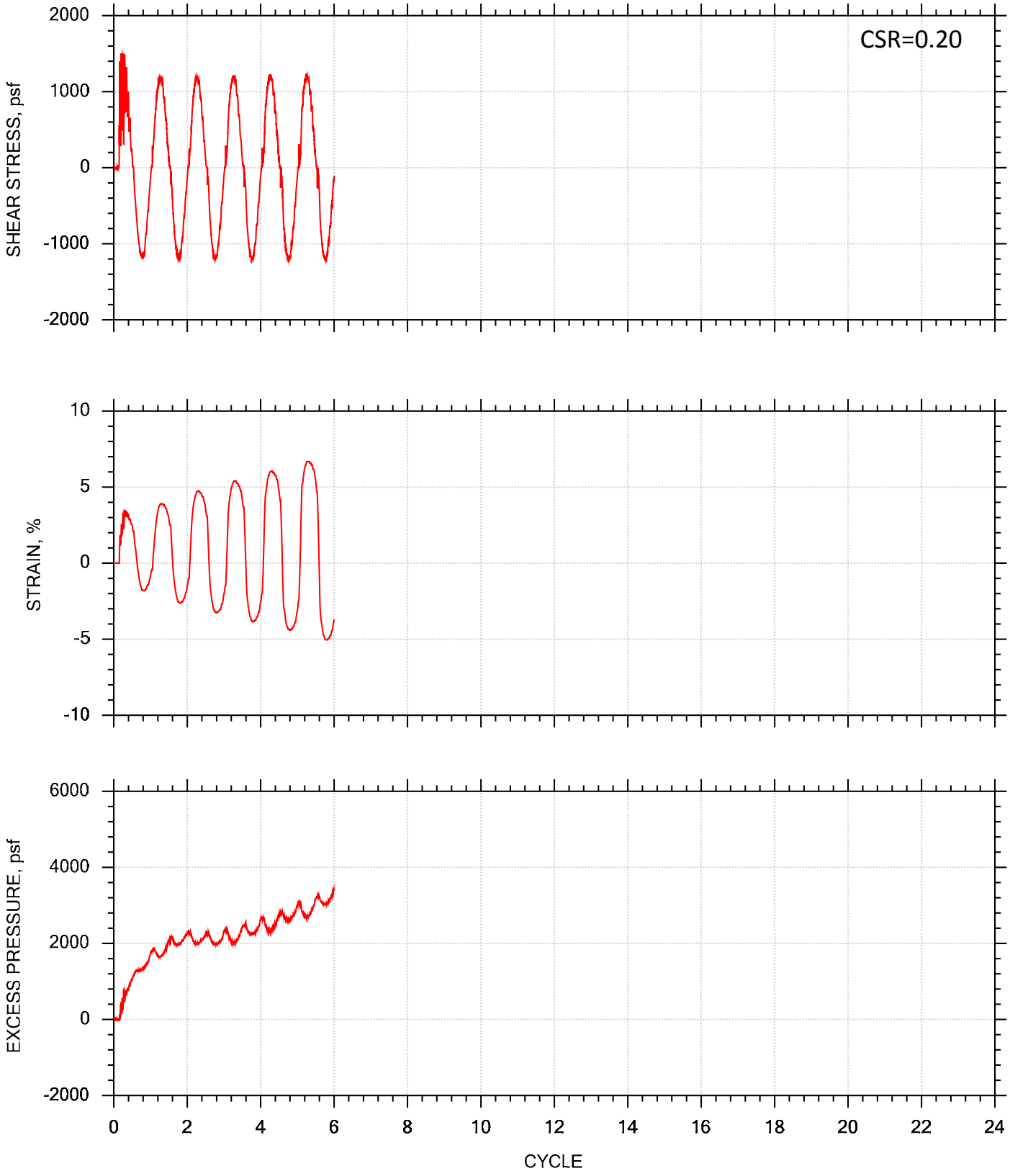
Comments: The cyclic portion of the test was terminated at a 10% peak-to-peak axial strain. Actual post cyclic strength parameters should be determined by an engineer familiar with dynamic testing data.

Tested By: md Checked By: jdt

Notes: These results apply only to the sample tested for the specific test conditions. The test procedures employed follow accepted industry practice and the indicated test method. GeoTesting Express has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

CYCLIC SIMPLE SHEAR DATA

Step 1 of 1



GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B2	Tested By: md	Checked By: jdt
	Sample No.: 4A	Test Date: 11/20/15	Test No.: CDSS-5
	Depth: 62-64 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray silt		
	Remarks: System GG		Page 2 of 5
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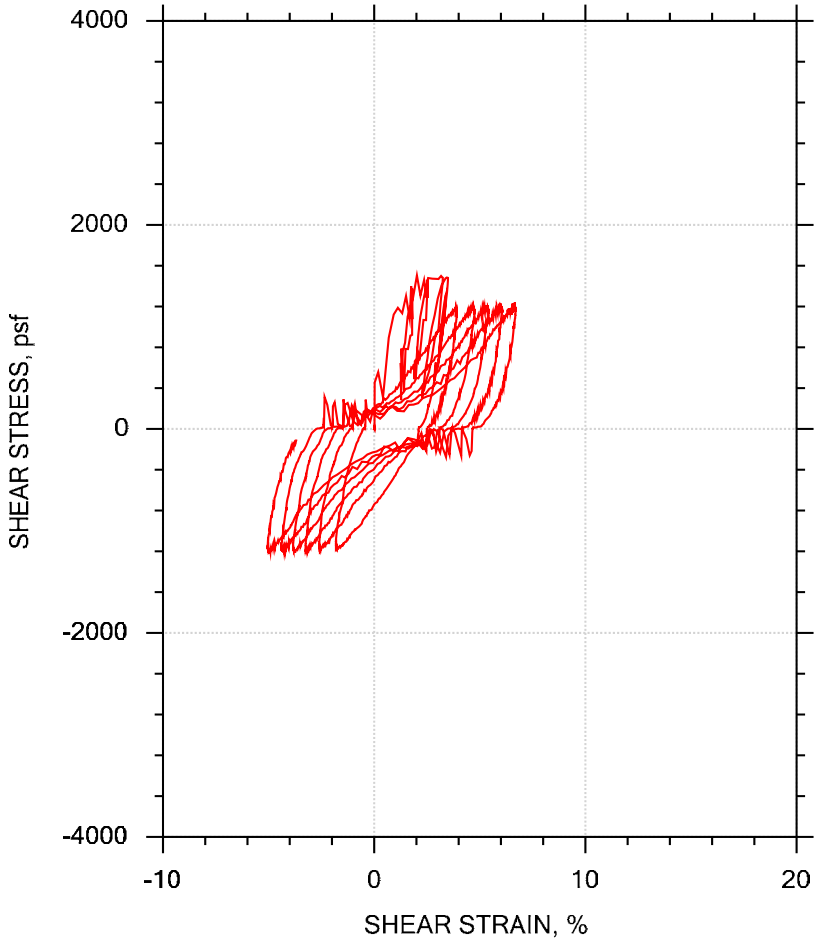
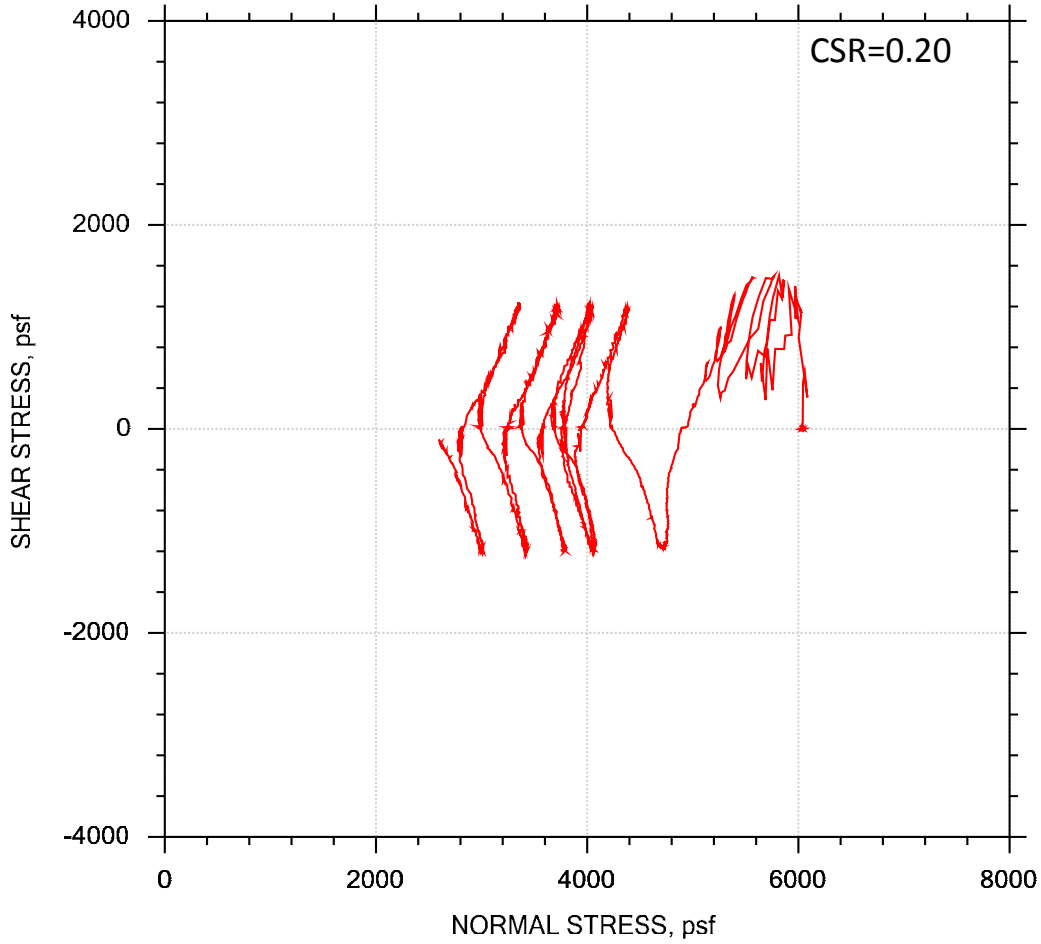
CYCLIC SIMPLE SHEAR STRESS DATA

Step 1 of 1

Cycle: 0.0 to 6.0





GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B2	Tested By: md	Checked By: jdt
	Sample No.: 4A	Test Date: 11/20/15	Depth: 62-64 ft
	Test No.: CDSS-5	Sample Type: intact	Elevation: ---
	Description: Moist, gray silt		
	Remarks: System GG		Page 3 of 5
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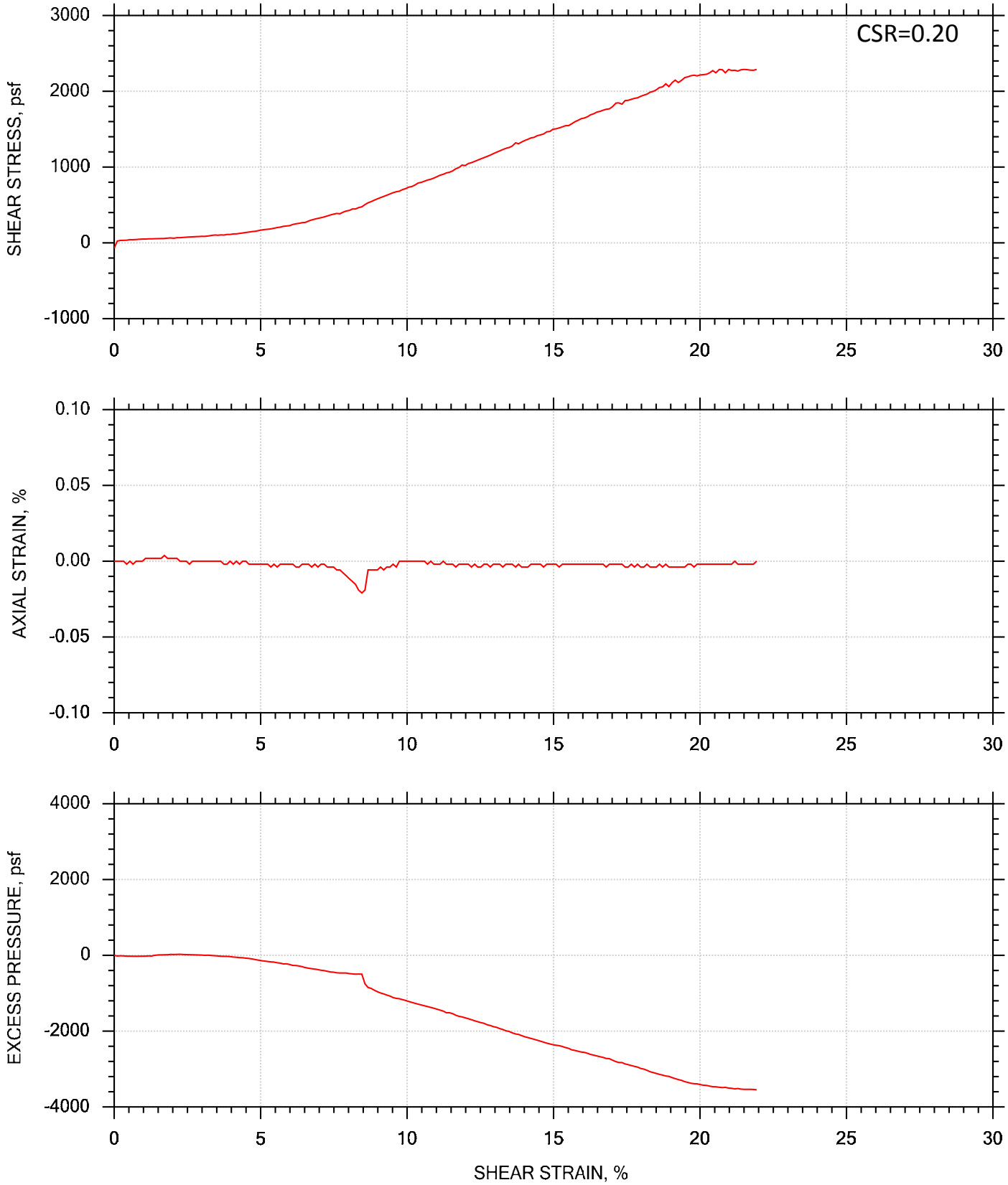
DIRECT SIMPLE SHEAR TEST by ASTM D6528

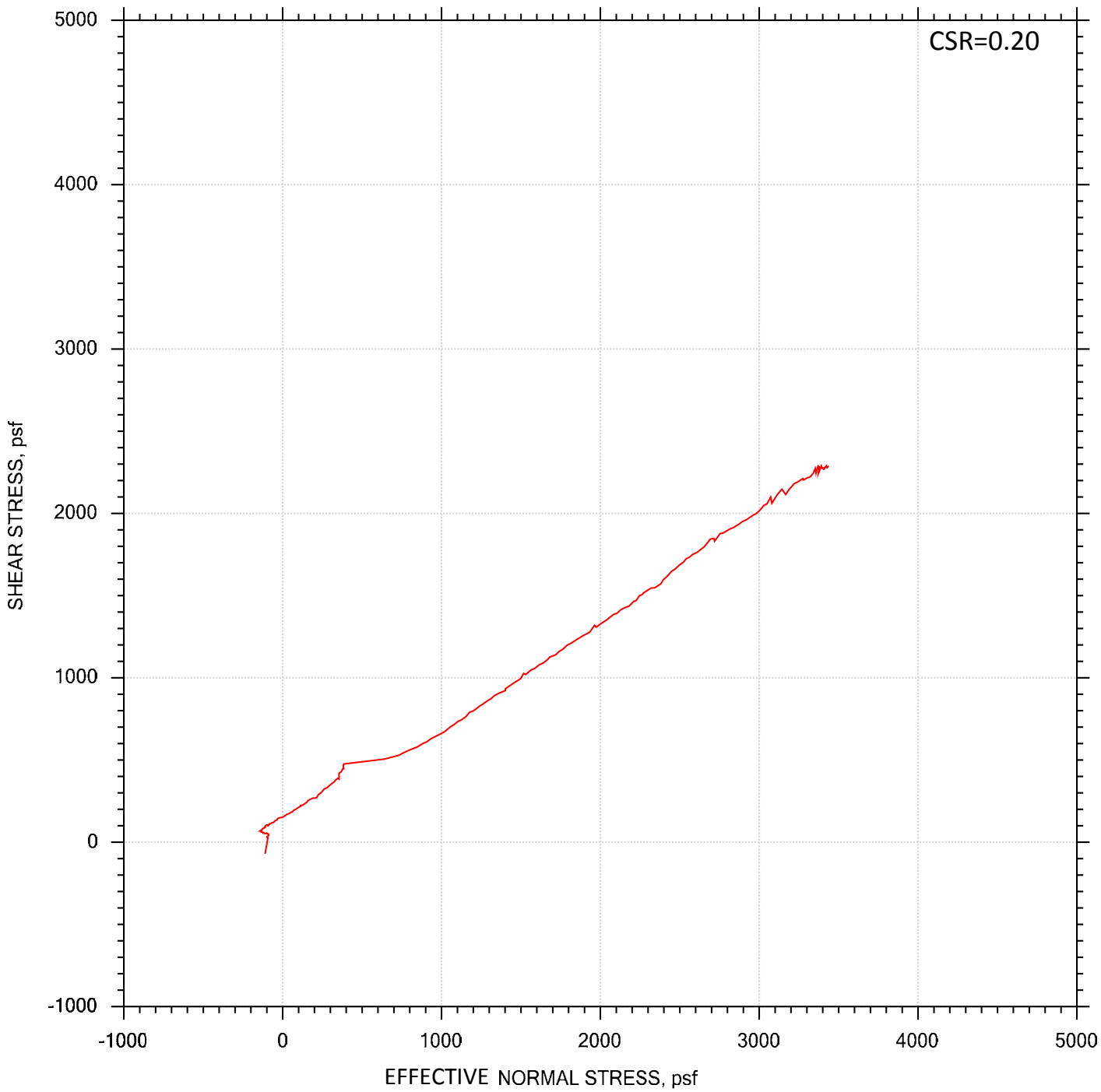
POST CYCLIC



GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B2	Tested By: md	Checked By: jdt
	Sample No.: 4A	Test Date: 11/20/15	Test No.: CDSS-5
	Depth: 62-64 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray silt		
	Remarks: System GG		Page 4 of 5
	File: \\hal1\Projects\GTX303915 - AECOM - Vectran AB Brown Ash Pond\6 Lab Testing\Soil\CDSS\303915-CDSS-5n.dat		

DIRECT SIMPLE SHEAR TEST by ASTM D6528

POST CYCLIC



GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B2	Tested By: md	Checked By: jdt
	Sample No.: 4A	Test Date: 11/20/15	Test No.: CDSS-5
	Depth: 62-64 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray silt		
	Remarks: System GG		Page 5 of 5
	File: \\hal1\Projects\GTX303915 - AECOM - Vectran AB Brown Ash Pond\6 Lab Testing\Soil\CDSS\303915-CDSS-5n.dat		

Consolidated Undrained Cyclic Direct Simple Shear Test of Cohesive Soils

Client:	AECOM	GTX#:	303915
Project Name:	Vectran AB Brown Ash Pond Lower Dam	Test Date:	11/18/15
Project Location:	Evansville, IN		

Boring ID: AECOM-B4
Sample ID: 2
Depth, ft: 33-35

Visual Description: Wet, olive silt

Test Equipment: Top and bottom box (circular) = 2.5 in diameter. Load cells and LVDT's connected to data acquisition system for shear force, normal load, horizontal and vertical displacement; surface area = 4.91 in^2, soil height = 1 inch.
Stacked Teflon Rings set-up used, which included porous stones with pins.

Test Condition: Inundated prior to consolidation.

Sample Type and Preparation: Extruded from tube, cut, trimmed and placed into apparatus at as-received density and moisture content.

Parameter	Point 1	Point 2	Point 3	Point 4	Point 5
Test No.	CDSS-3				
Initial Moisture Content, %	27.8				
Initial Dry Density, pcf	85.8				
Vertical Consolidation Stress, psf	2965				
Cyclic Stress Ratio	0.08				
Number of cycles completed	50				
Frequency, Hz	1				
Final Moisture Content, %	36.1				
Delay before shearing, min	60				
Nominal Rate of Shear Strain, %/hr	5.0				
Measured Post-Cyclic Peak Shear Stress, psf	1722				
Shear Strain at Post-Cyclic Peak shear Stress, %	20.0				
Membrane Correction, psf	49				
Corrected Post-Cyclic Peak Shear Stress, psf	1673				
S_r/σ'_{vc}	0.56				

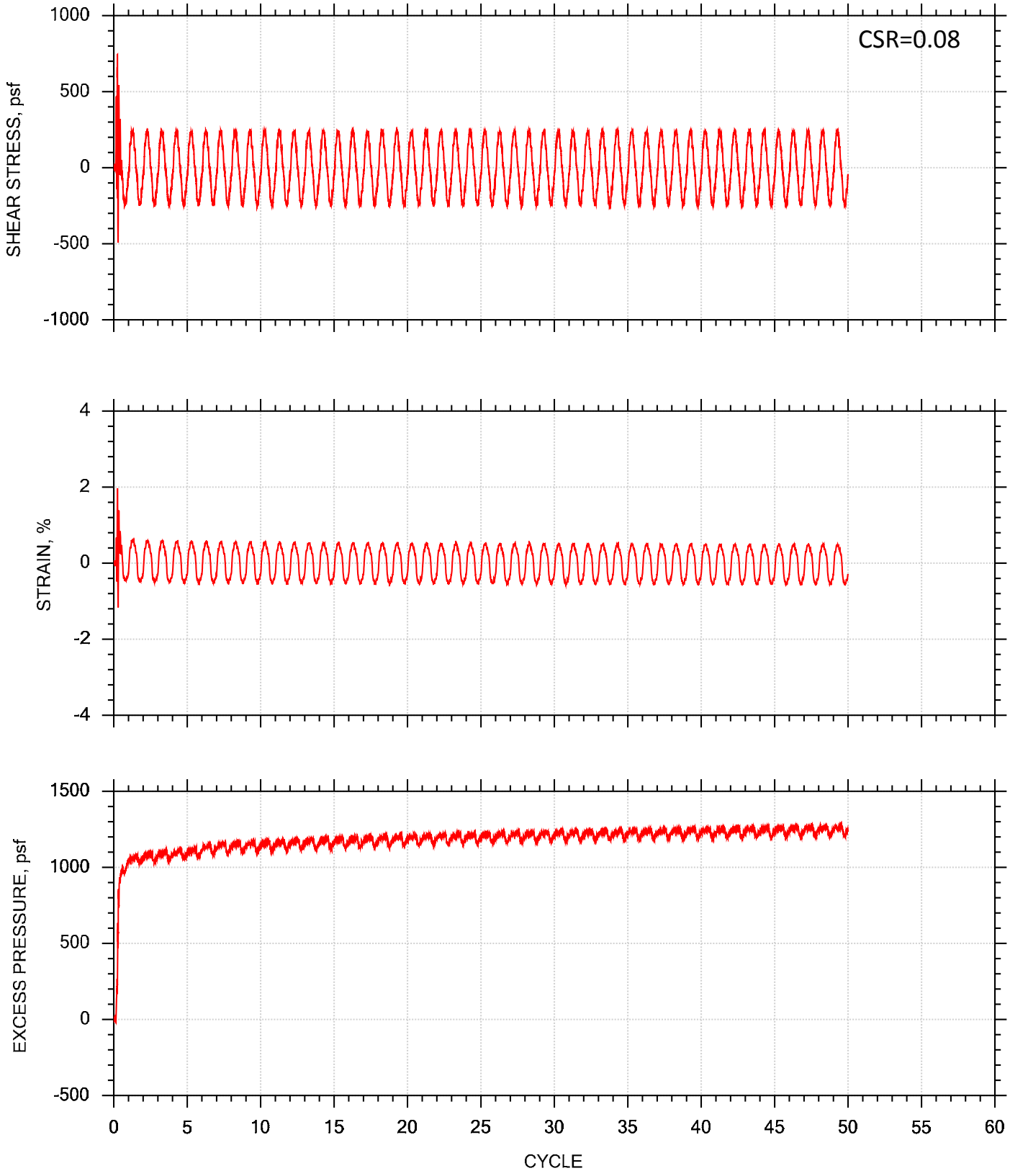
Comments: Actual post cyclic strength parameters should be determined by an engineer familiar with dynamic testing data.

Tested By: md Checked By: jdt

Notes: These results apply only to the sample tested for the specific test conditions. The test procedures employed follow accepted industry practice and the indicated test method. GeoTesting Express has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

CYCLIC SIMPLE SHEAR DATA

Step 1 of **1**

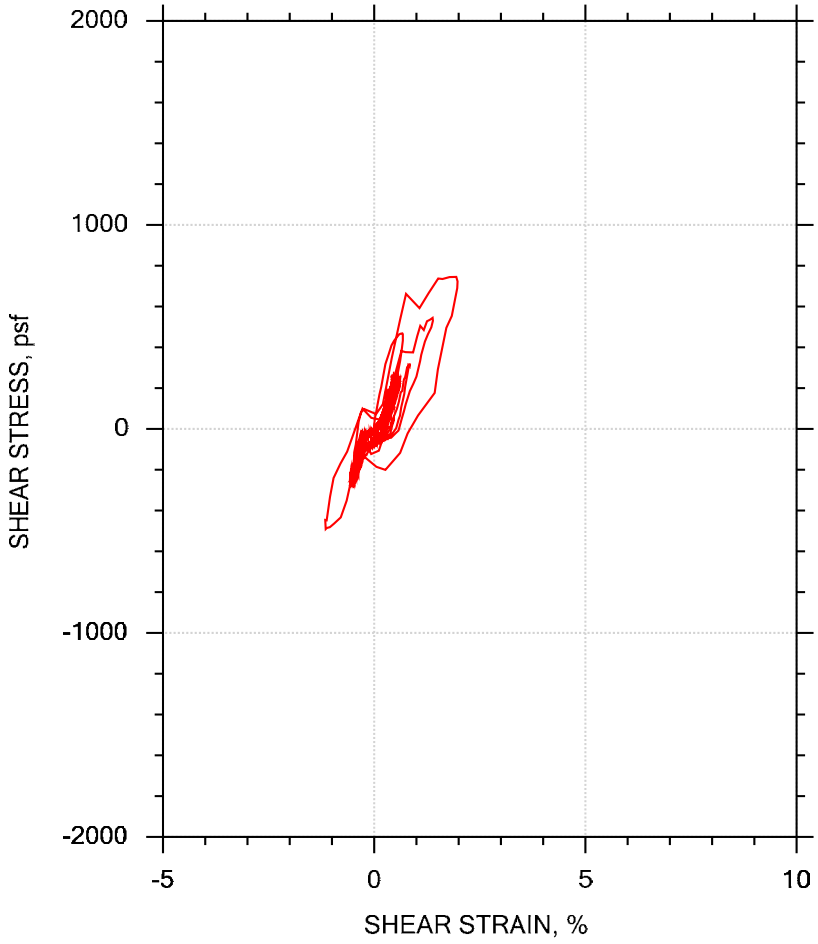


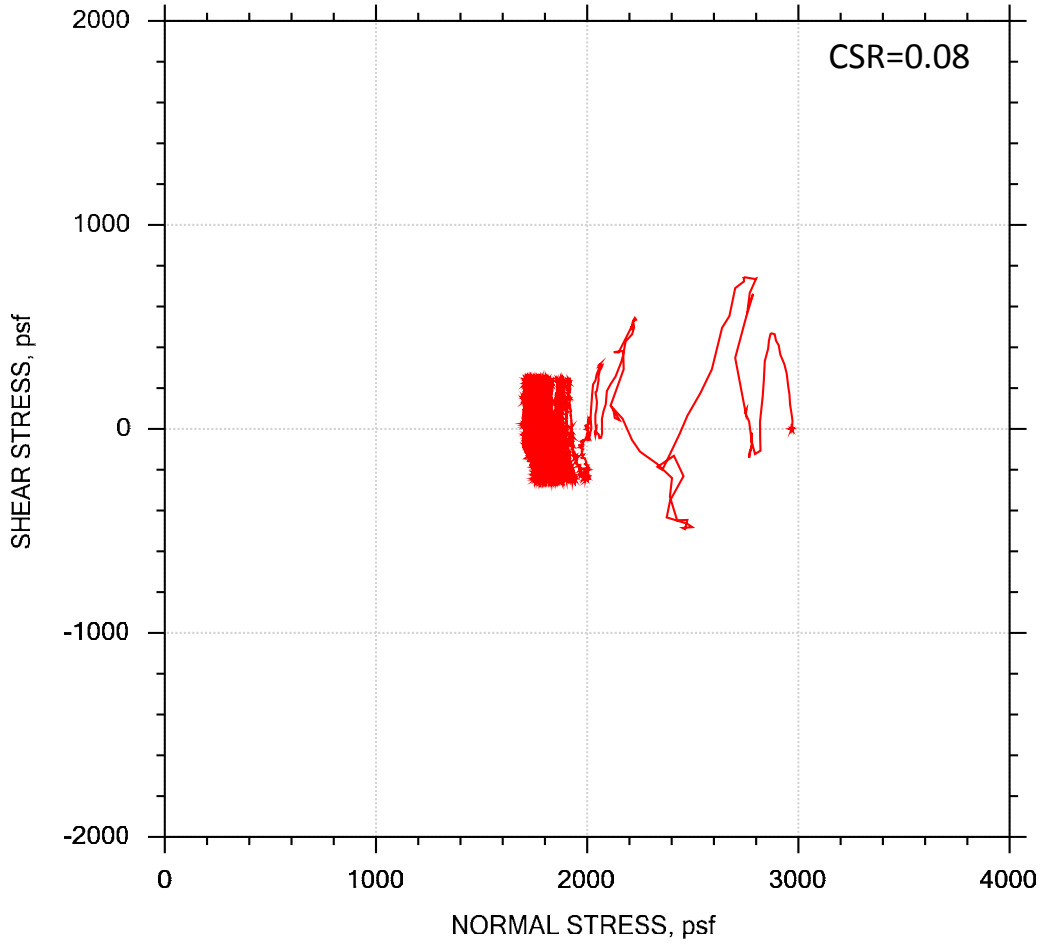
GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B4	Tested By: md	Checked By: jdt
	Sample No.: 2	Test Date: 11/18/15	Test No.: CDSS-3
	Depth: 33-35 ft	Sample Type: intact	Elevation: ---
	Description: Wet, olive silt		
	Remarks: System HH		Page 2 of 5
	File: \\hal1\Projects\GTX303915 - AECOM - Vectran AB Brown Ash Pond\6 Lab Testing\Soil\CDSS\303915-CDSS-3n.dat		

CYCLIC SIMPLE SHEAR STRESS DATA

Step 1 of 1

Cycle: 0.0 to 50.0

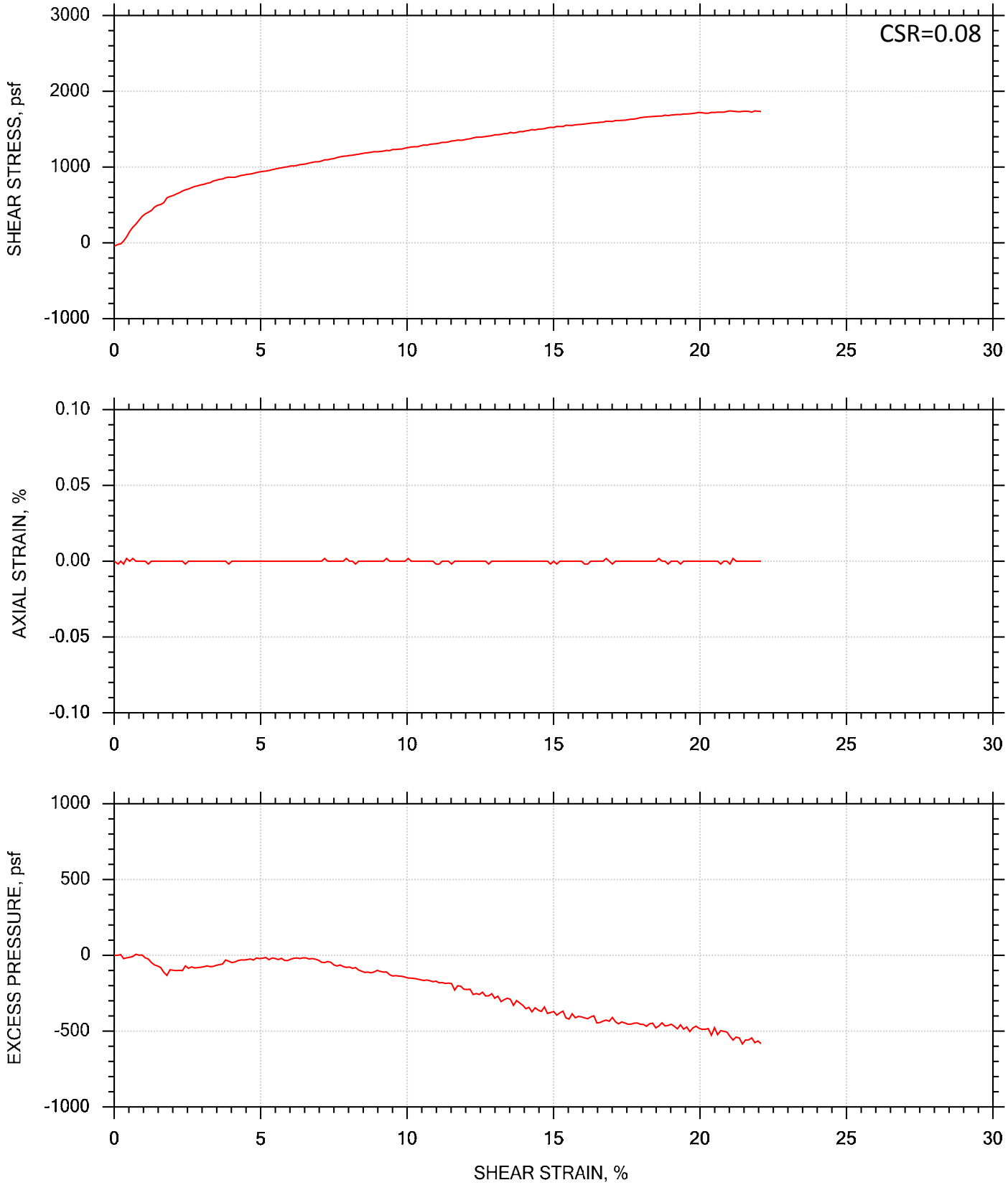




GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B4	Tested By: md	Checked By: jdt
	Sample No.: 2	Test Date: 11/18/15	Depth: 33-35 ft
	Test No.: CDSS-3	Sample Type: intact	Elevation: ---
	Description: Wet, olive silt		
	Remarks: System HH		Page 3 of 5
	File: \\hal1\Projects\GTX303915 - AECOM - Vectran AB Brown Ash Pond\6 Lab Testing\Soil\CDSS\303915-CDSS-3n.dat		

DIRECT SIMPLE SHEAR TEST by ASTM D6528

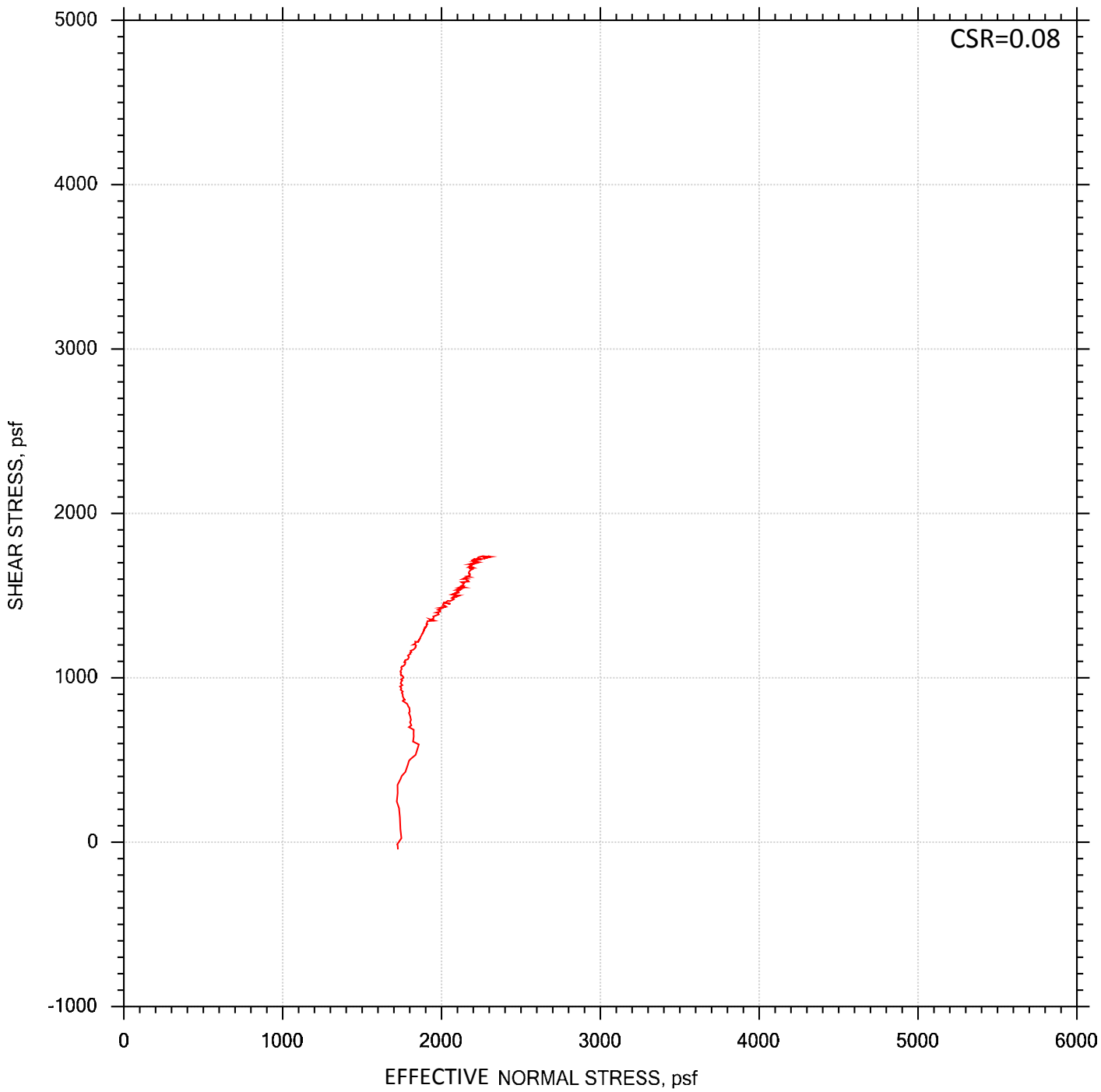
POST CYCLIC



GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B4	Tested By: md	Checked By: jdt
	Sample No.: 2	Test Date: 11/18/15	Test No.: CDSS-3
	Depth: 33-35 ft	Sample Type: intact	Elevation: ---
	Description: Wet, olive silt		
	Remarks: System HH		Page 4 of 5
	File: \\hal1\Projects\GTX303915 - AECOM - Vectran AB Brown Ash Pond\6 Lab Testing\Soil\CDSS\303915-CDSS-3n.dat		

DIRECT SIMPLE SHEAR TEST by ASTM D6528

POST CYCLIC



GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B4	Tested By: md	Checked By: jdt
	Sample No.: 2	Test Date: 11/18/15	Test No.: CDSS-3
	Depth: 33-35 ft	Sample Type: intact	Elevation: ---
	Description: Wet, olive silt		
	Remarks: System HH		Page 5 of 5
	File: \\hal1\Projects\GTX303915 - AECOM - Vectran AB Brown Ash Pond\6 Lab Testing\Soil\CDSS\303915-CDSS-3n.dat		

Consolidated Undrained Cyclic Direct Simple Shear Test of Cohesive Soils

Client:	AECOM	GTX#:	303915
Project Name:	Vectran AB Brown Ash Pond Lower Dam	Test Date:	11/20/15
Project Location:	Evansville, IN		

Boring ID: AECOM-B4
Sample ID: 3
Depth, ft: 46-48

Visual Description: Moist, olive silt

Test Equipment: Top and bottom box (circular) = 2.5 in diameter. Load cells and LVDT's connected to data acquisition system for shear force, normal load, horizontal and vertical displacement; surface area = 4.91 in^2, soil height = 1 inch.
Stacked Teflon Rings set-up used, which included porous stones with pins.

Test Condition: Inundated prior to consolidation.

Sample Type and Preparation: Extruded from tube, cut, trimmed and placed into apparatus at as-received density and moisture content.

Parameter	Point 1	Point 2	Point 3	Point 4	Point 5
Test No.	CDSS-4				
Initial Moisture Content, %	29.1				
Initial Dry Density, pcf	91.8				
Vertical Consolidation Stress, psf	3830				
Cyclic Stress Ratio	0.20				
Number of cycles completed	9				
Frequency, Hz	1				
Final Moisture Content, %	26.8				
Delay before shearing, min	60				
Nominal Rate of Shear Strain, %/hr	5.0				
Measured Post-Cyclic Peak Shear Stress, psf	1516				
Shear Strain at Post-Cyclic Peak shear Stress, %	20.0				
Membrane Correction, psf	49				
Corrected Post-Cyclic Peak Shear Stress, psf	1467				
S_r/σ'_{vc}	0.38				

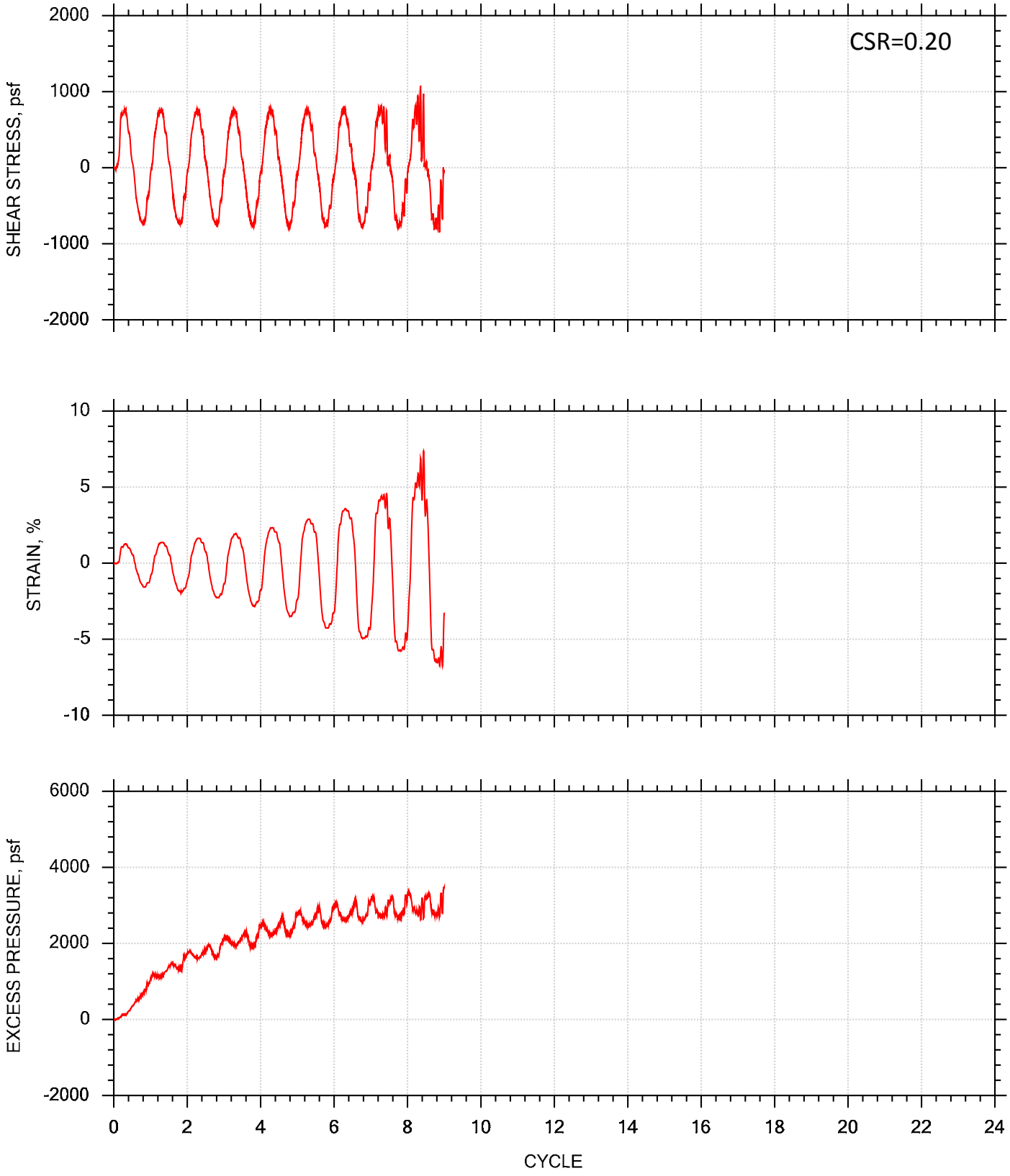
Comments: The cyclic portion of the test resulted in an R value approaching 1, and terminated the test at a 10% peak-to-peak axial strain. Actual post cyclic strength parameters should be determined by an engineer familiar with dynamic testing data.

Tested By: md Checked By: jdt

Notes: These results apply only to the sample tested for the specific test conditions. The test procedures employed follow accepted industry practice and the indicated test method. GeoTesting Express has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

CYCLIC SIMPLE SHEAR DATA

Step 1 of 1

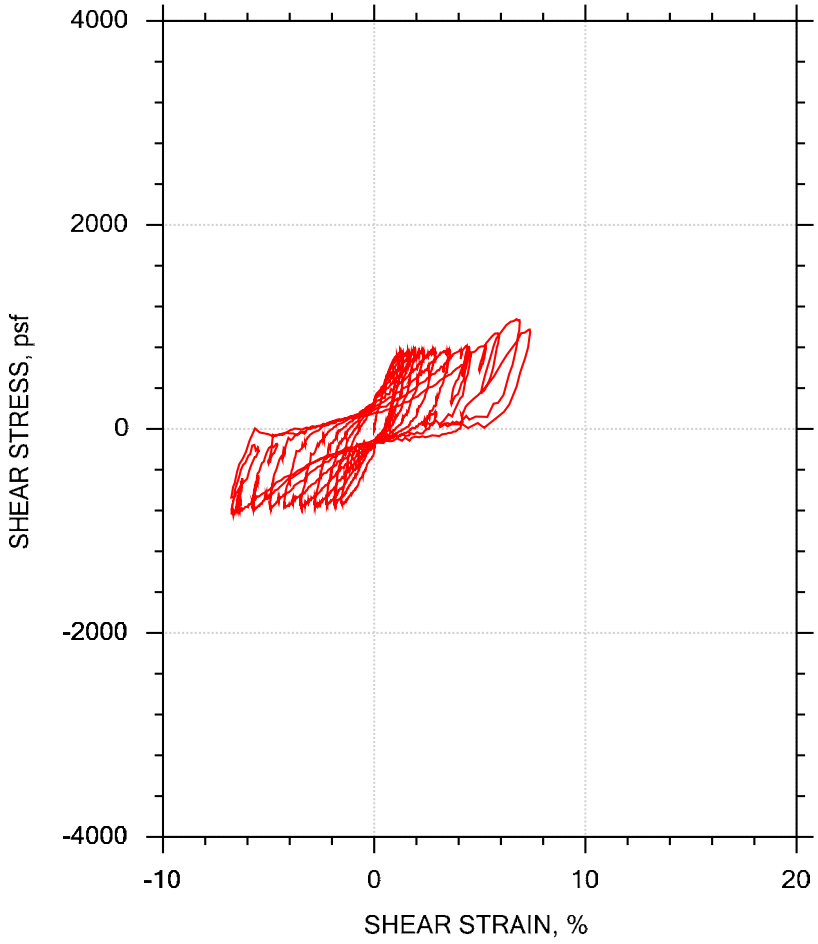


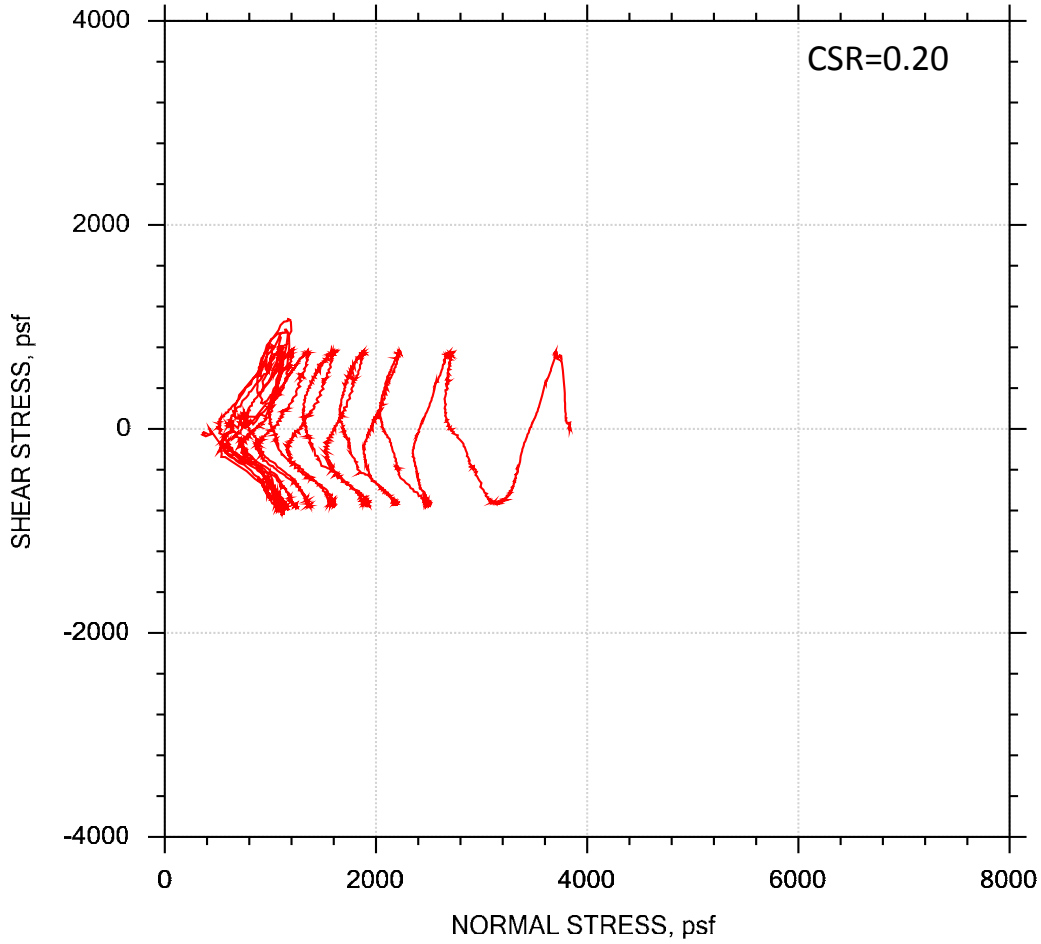
GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B4	Tested By: md	Checked By: jdt
	Sample No.: 3	Test Date: 11/20/15	Test No.: CDSS-4
	Depth: 46-48 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive silt		
	Remarks: System HH		Page 2 of 5
	File: \\hal1\Projects\GTX303915 - AECOM - Vectran AB Brown Ash Pond\6 Lab Testing\Soil\CDSS\303915-CDSS-4n.dat		

CYCLIC SIMPLE SHEAR STRESS DATA

Step 1 of 1

Cycle: 0.0 to 9.0

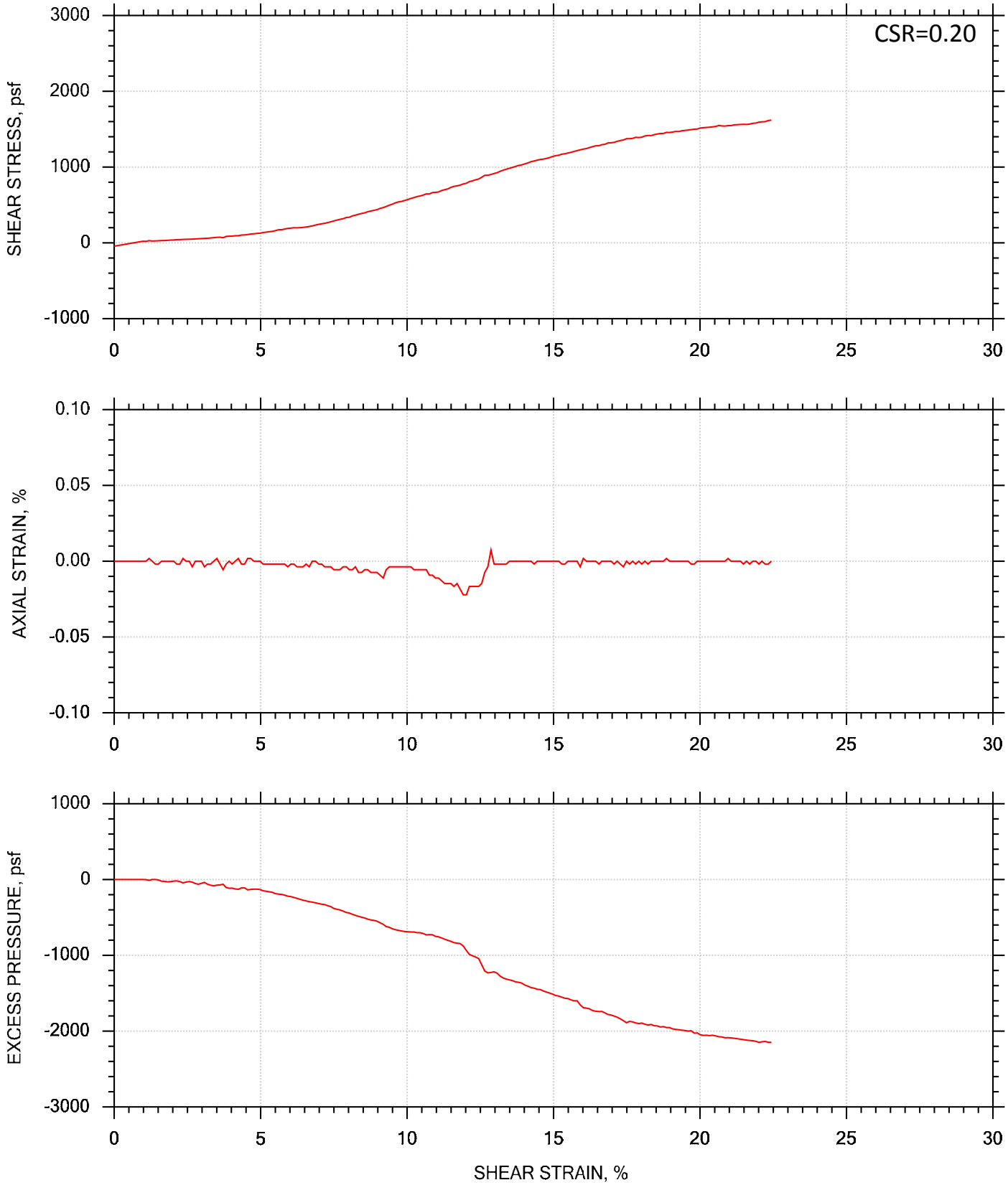




GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B4	Tested By: md	Checked By: jdt
	Sample No.: 3	Test Date: 11/20/15	Depth: 46-48 ft
	Test No.: CDSS-4	Sample Type: intact	Elevation: ---
	Description: Moist, olive silt		
	Remarks: System HH		Page 3 of 5
	File: \\hal1\Projects\GTX303915 - AECOM - Vectran AB Brown Ash Pond\6 Lab Testing\Soil\CDSS\303915-CDSS-4n.dat		

DIRECT SIMPLE SHEAR TEST by ASTM D6528

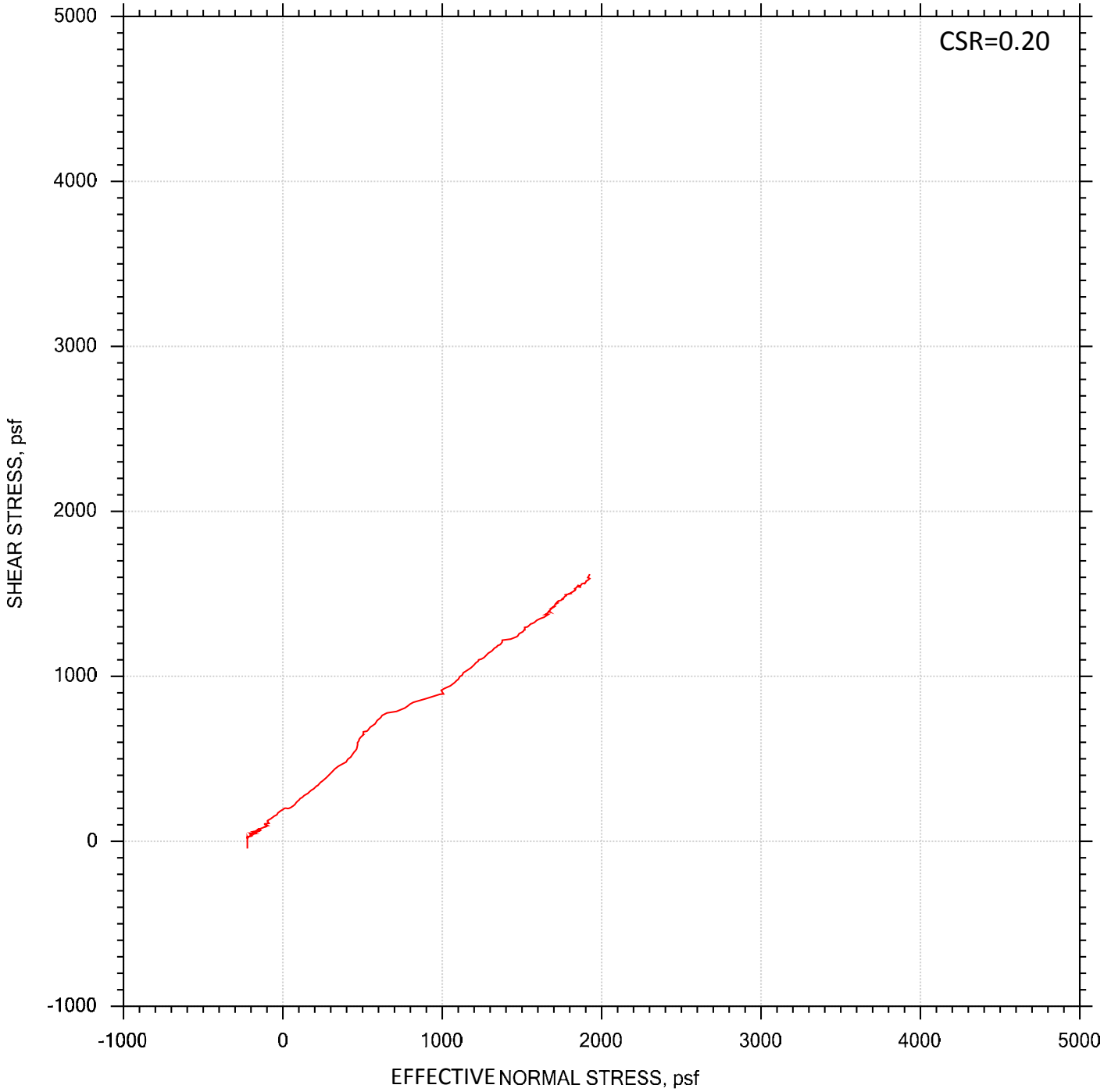
POST CYCLIC



GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B4	Tested By: md	Checked By: jdt
	Sample No.: 3	Test Date: 11/20/15	Test No.: CDSS-4
	Depth: 46-48 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive silt		
	Remarks: System HH		Page 4 of 5
	File: \\hal1\Projects\GTX303915 - AECOM - Vectran AB Brown Ash Pond\6 Lab Testing\Soil\CDSS\303915-CDSS-4n.dat		

DIRECT SIMPLE SHEAR TEST by ASTM D6528

POST CYCLIC



GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B4	Tested By: md	Checked By: jdt
	Sample No.: 3	Test Date: 11/20/15	Test No.: CDSS-4
	Depth: 46-48 ft	Sample Type: intact	Elevation: ---
	Description: Moist, olive silt		
	Remarks: System HH		Page 5 of 5
	File: \\hal1\Projects\GTX303915 - AECOM - Vectran AB Brown Ash Pond\6 Lab Testing\Soil\CDSS\303915-CDSS-4n.dat		

Consolidated Undrained Cyclic Direct Simple Shear Test of Cohesive Soils

Client:	AECOM	GTX#:	303915
Project Name:	Vectran AB Brown Ash Pond Lower Dam	Test Date:	12/7/15
Project Location:	Evansville, IN		

Boring ID: AECOM-B5
Sample ID: 2
Depth, ft: 30-32

Visual Description: Moist, gray silt with sand

Test Equipment: Top and bottom box (circular) = 2.5 in diameter. Load cells and LVDT's connected to data acquisition system for shear force, normal load, horizontal and vertical displacement; surface area = 4.91 in^2, soil height = 1 inch.
Stacked Teflon Rings set-up used, which included porous stones with pins.

Test Condition: Inundated prior to consolidation.

Sample Type and Preparation: Extruded from tube, cut, trimmed and placed into apparatus at as-received density and moisture content.

Parameter	Point 1	Point 2	Point 3	Point 4	Point 5
Test No.	CDSS-6				
Initial Moisture Content, %	32.2				
Initial Dry Density, pcf	86.3				
Vertical Consolidation Stress, psf	2660				
Cyclic Stress Ratio	0.15				
Number of cycles completed	50				
Frequency, Hz	1				
Final Moisture Content, %	30.6				
Delay before shearing, min	60				
Nominal Rate of Shear Strain, %/hr	5.0				
Measured Post-Cyclic Peak Shear Stress, psf	1222				
Shear Strain at Post-Cyclic Peak shear Stress, %	20.0				
Membrane Correction, psf	49				
Corrected Post-Cyclic Peak Shear Stress, psf	1173				
S_r/σ'_{vc}	0.44				

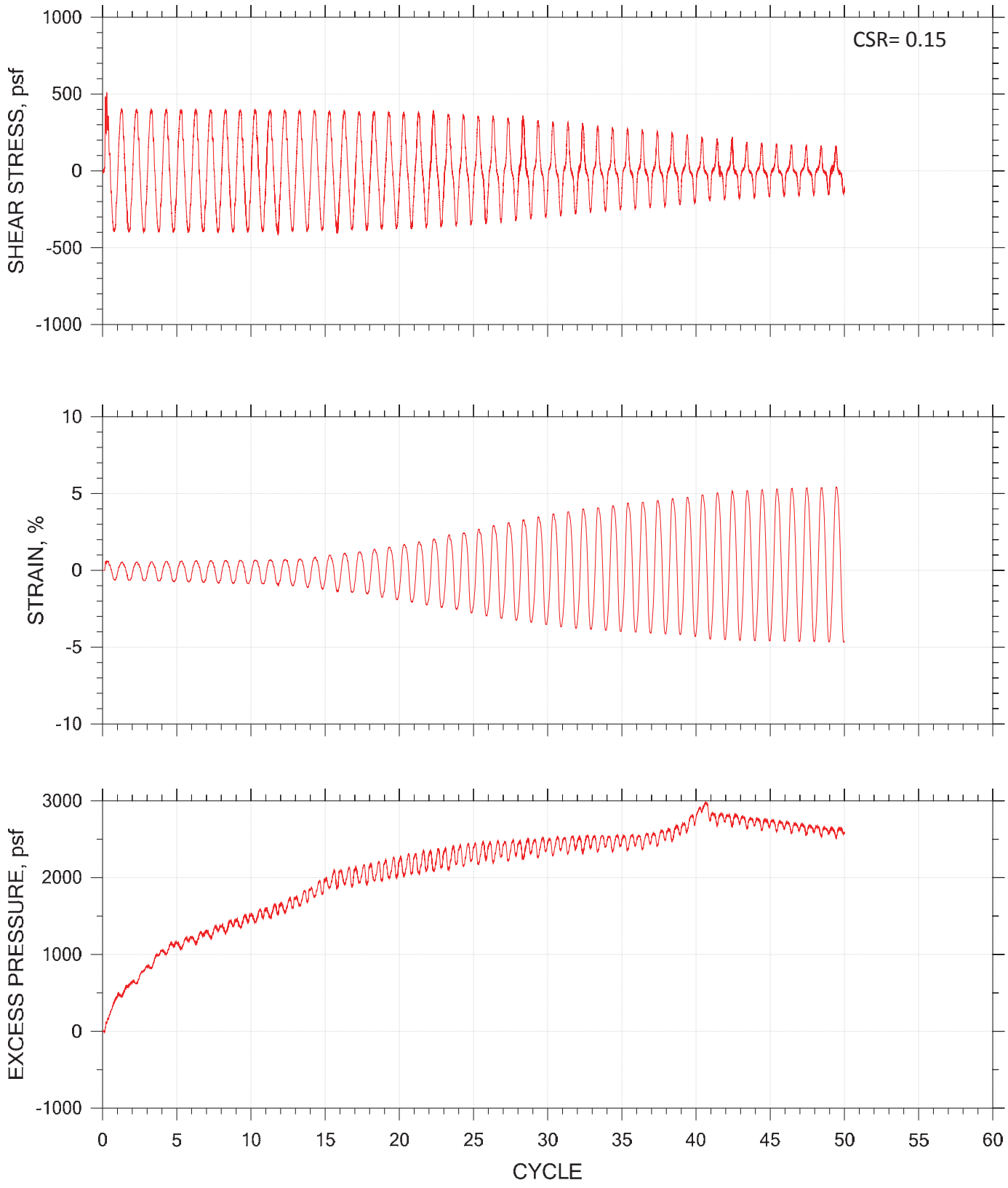
Comments: Actual post cyclic strength parameters should be determined by an engineer familiar with dynamic testing data.

Tested By: md Checked By: njh

Notes: These results apply only to the sample tested for the specific test conditions. The test procedures employed follow accepted industry practice and the indicated test method. GeoTesting Express has no specific knowledge as to conditioning, origin, sampling procedure or intended use of the material.

CYCLIC SIMPLE SHEAR DATA

Step 1 of 1

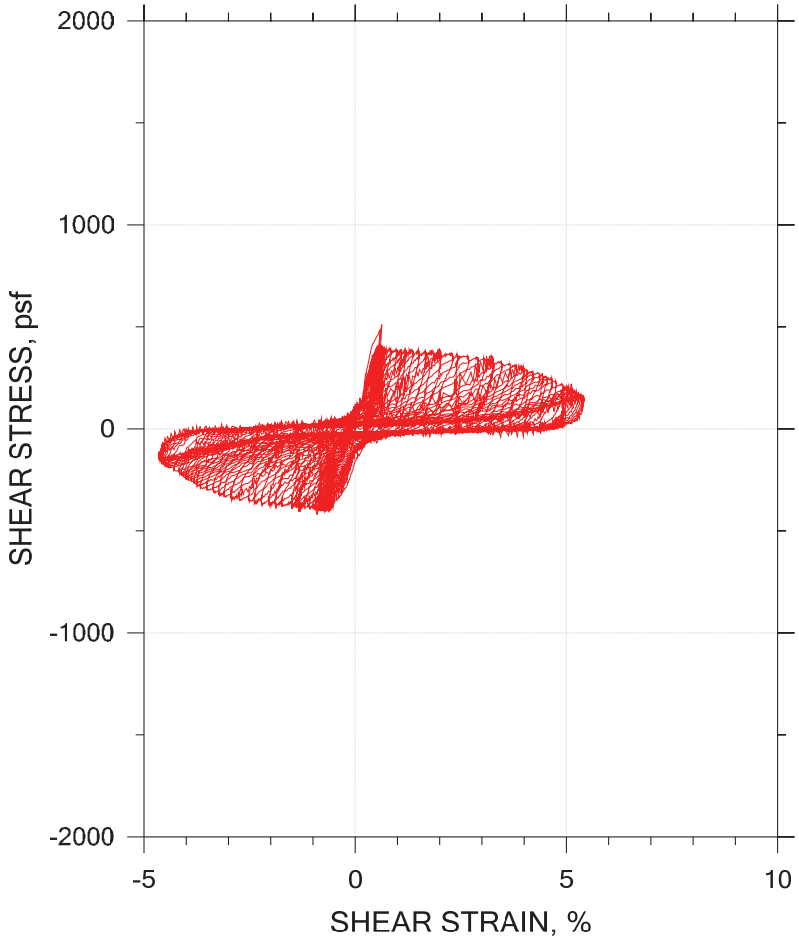


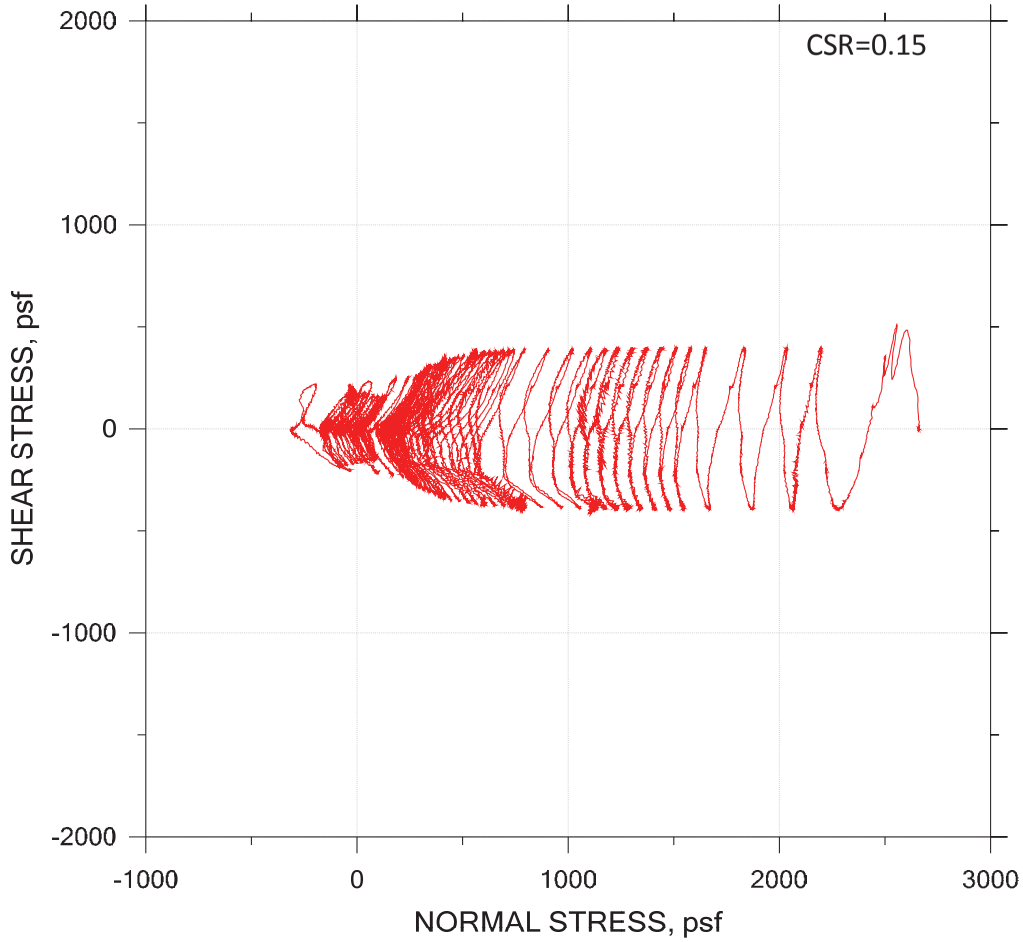
GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B5	Tested By: md	Checked By: njh
	Sample No.: 2	Test Date: 12/07/15	Test No.: CDSS-6
	Depth: 30-32 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray silt with sand		
	Remarks: System HH		Page 2 of 5
	File: \\hal1\Projects\GTX303915 - AECOM - Vectran AB Brown Ash Pond\6 Lab Testing\Soil\CDSS\303915-CDSS-6n.dat		

CYCLIC SIMPLE SHEAR STRESS DATA

Step 1 of 1

Cycle: 0.0 to 50.0





GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B5	Tested By: md	Checked By: njh
	Sample No.: 2	Test Date: 12/07/15	Depth: 30-32 ft
	Test No.: CDSS-6	Sample Type: intact	Elevation: ---
	Description: Moist, gray silt with sand		
	Remarks: System HI-		Page 3 of 5
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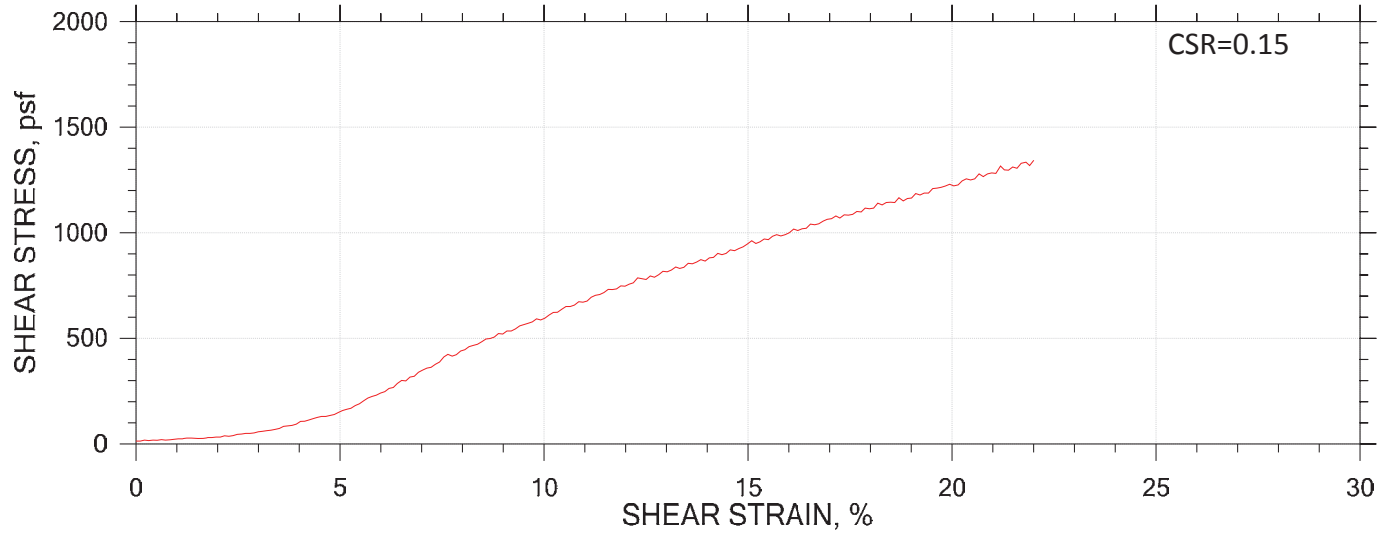
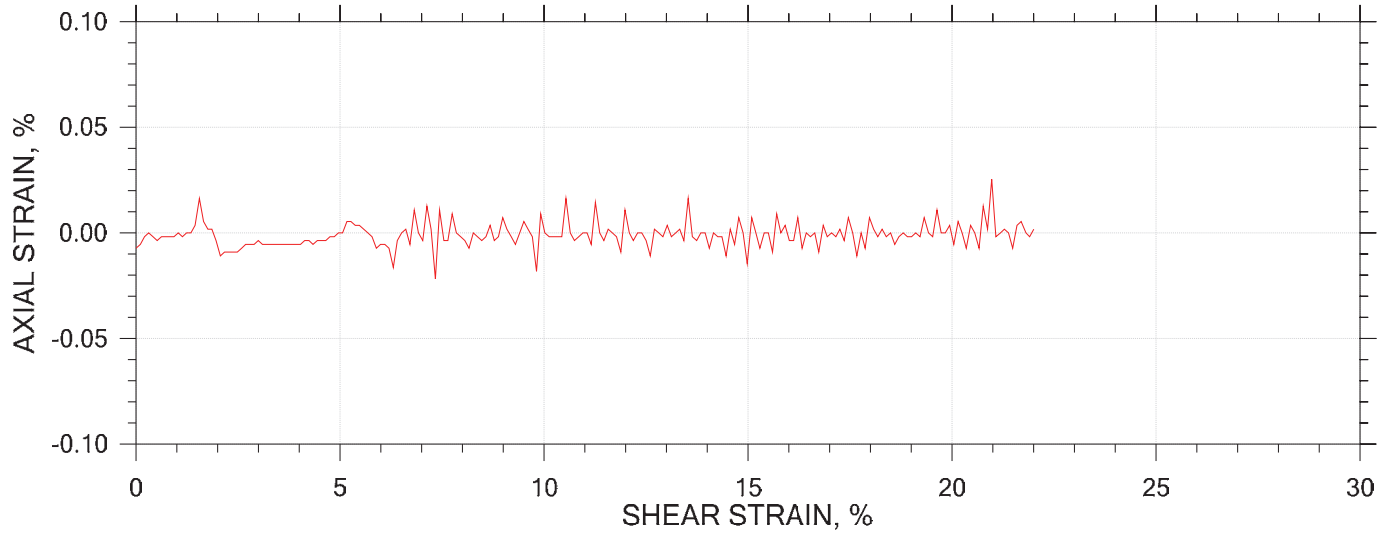
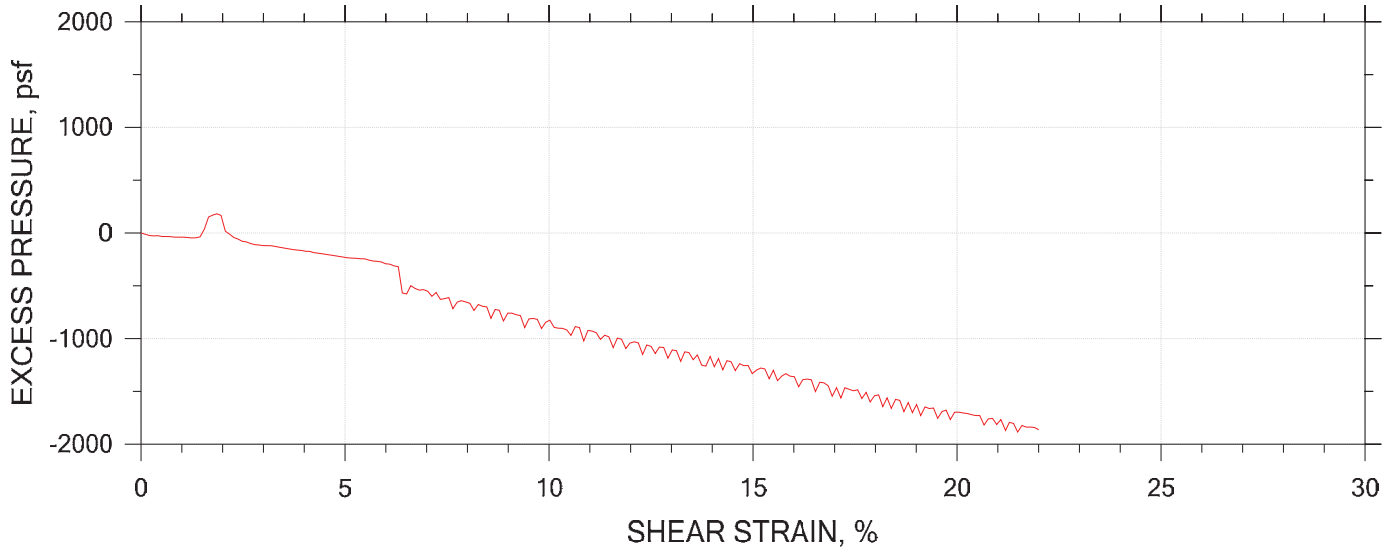
DIRECT SIMPLE SHEAR TEST by ASTM D6528
POST CYCLIC







GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B5	Tested By: md	Checked By: njh
	Sample No.: 2	Test Date: 12/07/15	Test No.: CDSS-6
	Depth: 30-32 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray silt with sand		
	Remarks: System HH		Page 4 of 5
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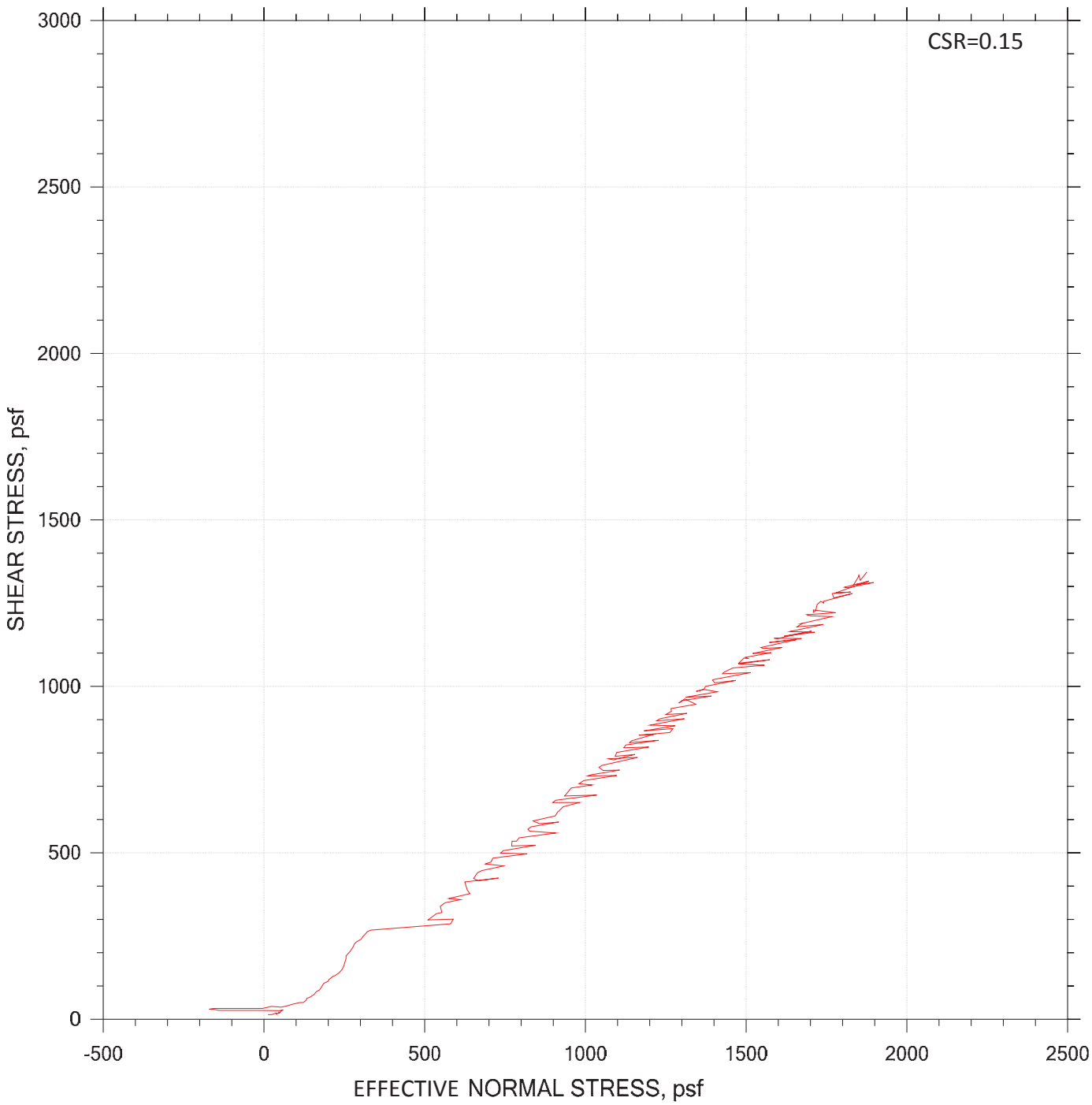
DIRECT SIMPLE SHEAR TEST by ASTM D6528
POST CYCLIC



GeoTesting EXPRESS	Project: Vectran AB Brown Ash Pond	Location: Evansville, IN	Project No.: GTX-303915
	Boring No.: AECOM-B5	Tested By: md	Checked By: njh
	Sample No.: 2	Test Date: 12/07/15	Test No.: CDSS-6
	Depth: 30-32 ft	Sample Type: intact	Elevation: ---
	Description: Moist, gray silt with sand		
	Remarks: System HH		Page 5 of 5
	File: \\hal1\Projects\GTX303915 - AECOM - Vectran AB Brown Ash Pond\6 Lab Testing\Soil\CDSS\303915-CDSS-6n.dat		

Ash Material Index Properties Laboratory Test Results

Summary of Laboratory Test Results - Impounded Ash										
Boring and Sample ID	Ground Surface Elevation	Material Description	Sample Depth	Moisture Content	Atterberg Limits			Gradations		
					Liquid Limit	Plastic Limit	Plasticity Index	Sieve Analysis (3 inch to #200 Sieve)		
								Gravel	Sand	Fines
	(ft)		(ft)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
B-101, SS-11	463.7	Ash	26.0-27.5	24.1	33	20	13	-	-	97.2
B-102, SS-10	463.4	Ash	23.5-25.0	56.5	Non-Plastic			-	-	74.5
B-102, SS-13	463.4	Ash	31.0-32.5	71.2	Non-Plastic			-	-	74.4
B-102, SS-16	463.4	Ash	38.5-40.0	57.7	Non-Plastic			-	-	78.9
B-102, SS-20	463.4	Ash	48.5-50.0	54.8	Non-Plastic			-	-	94.9
B-103, SS-10	463.7	Ash	23.5-25.0	62.9	Non-Plastic			-	-	97.3
B-103, SS-15	463.7	Ash	36.0-37.5	72.4	Non-Plastic			-	-	96.0

Appendix E
Material Characterization Calculations

I. Objective

This calculation package summarizes the interpretations and analyses performed to select material properties for use in the slope stability analyses of the Lower Dam at Vectren's A.B. Brown power station.

II. Subsurface Conditions

Various modern and historical subsurface investigations were performed at the Lower Dam, including in 2015/2016 and 1982. Collectively, a total of 32 borings and 5 cone penetration test soundings (with pore pressure dissipation testing and seismic shear wave velocity measurements) were performed. A full set of AECOM's boring logs, including soil descriptions, types of sampling, and choice laboratory test results, is provided in **Appendix B** of the report. A CPT data report is provided in **Appendix C** and complete laboratory testing results are provided in **Appendix D**.

Based on the results of the investigation, five stratigraphic materials were identified at the site. These are listed below and briefly summarized:

Dam Embankment Fill: Embankment Fill materials were encountered from the ground surface and extending to depths ranging from approximately 37 to 58 feet below ground surface (bgs) from the crest boring and 5.5 to 26.5 feet bgs from the bench borings. Embankment Fill materials were typically a mixture of lean clays (CL) and silty clays (CL-ML) with varying amounts of sand. Visual classifications were most often described as slightly moist to moist, reddish brown to brown, silty clay to sandy lean clay.

Table E-1 summarizes the field data obtained within the Embankment Fill.

Table E-1: Embankment Fill Material Field Data Summary

Category	Min.	Max.	Average
SPT-N	3	50	16
Pocket Penetrometer (tsf)	0.5	4.5	2.6
Cone Tip Resistance (tsf)	56.6	111.7	71.3
Cone Sleeve Resistance (tsf)	1.8	3.0	2.3
SCPTu Shear Wave Velocity (ft/sec)	670	878	815

The field results in the Embankment Fill reflect a material with stiff to very stiff consistency, and indicate that the fill is well-compacted.

Foundation Silt Materials: Natural, alluvial silt deposits were encountered in most borings drilled in the lower bench area and beyond the toe of the dam. Silts were not encountered at any of the borings drilled at the crest of the dam, indicating that the deposit grades out moving from west to east across the width of the dam and buttress structures. The deposits consisted of a moist to wet, brown to gray, very soft to very stiff silt (ML) with occasion traces of fine sand. The silts were generally non-plastic or had very low plasticity indices. Silts varied in thickness from approximately 2.0 feet to 27.5 feet.

Table E-2 summarizes the field data obtained within the Foundation Silt deposit.

Table E-2: Foundation Silt Material Field Data Summary

Category	Min.	Max.	Average
SPT-N	0	23	7
Pocket Penetrometer (tsf)	NA	NA	NA
Cone Tip Resistance (tsf)	23.9	50.3	34.0
Cone Sleeve Resistance (tsf)	0.64	1.32	0.90
SCPTu Shear Wave Velocity (ft/sec)	533	737	692

Foundation Silty Clay Materials: Native lean clays make up much of the foundation materials of the Lower Dam, especially at the eastern regions of the dam footprint and below the crest. These clays consisted primarily of moist to wet, light brown to gray, very soft to very stiff lean clays (CL) to silty clays (CL-ML) with varying amounts of sand. In some locations, the clays are interbedded with the foundation silts described previously. The thickness of the clays varied widely, becoming more interbedded with silt layers to the west towards the bench and downstream toe of the embankment.

Table E-3 summarizes the field data obtained within the Foundation Clay deposit.

Table E-3: Foundation Clay Material Field Data Summary

Category	Min.	Max.	Average
SPT-N	0	33	10
Pocket Penetrometer (tsf)	0.25	4.0	1.4
Cone Tip Resistance (tsf)	17.5	38.4	26.6
Cone Sleeve Resistance (tsf)	0.46	1.43	0.91
SCPTu Shear Wave Velocity (ft/sec)	804	984	882

Buttress Fill Materials: The buttress fill was obtained from near-site borrow sources, and consists of fine-grained soils most typically classified as lean clay (CL). Plasticity indices of the fill material generally range from 6 to 14, with an average of about 12. To a much lesser extent, the buttress fill includes materials classified as silt (ML). The fill was placed and compacted in lifts (construction was to 95% of the Standard Proctor Maximum Dry Density), and density testing of each lift using nuclear methods was performed. Field SPT and CPT data are not available for the buttress, because construction of this structure occurred after the field investigations for the project were completed.

Sluiced Ash Materials: No ash materials were present in the Lower Dam. Bottom ash materials were encountered in historical borings drilled in the area east of the dam. The material was generally classified as fine- to coarse-grained sand, silly clay, sandy silt. The materials were generally very loose to loose, moist to wet, and brown to black.

III. Laboratory Strength Testing Program

Representative samples were collected at regular intervals from the borings and were utilized for laboratory index and strength testing. Strength testing included isotropically consolidated-undrained triaxial tests with pore pressure measurements (CIU) on the Embankment Fill, Foundation Silt, and Foundation Silty Clay materials, and cyclic direct simple shear (CDSS) tests on the Foundation Silt materials. Table E-4 summarizes the strength testing performed.

Table E-4: Laboratory Strength Testing Program for Lower Dam

Test	ASTM Method	Number of Test Points		
		Embankment Fill	Foundation Silt	Foundation Clay
Unit Weight		6	18	14
Consolidated Undrained (CIU)	D4767	5	10	12
Cyclic Direct Simple Shear (CDSS)	GTX S1085	-	6	-

IV. Material Properties For Stability Analyses

Material properties for slope stability analyses were developed using both laboratory testing data (index and strength testing) and strength correlations from SPT and CPT data.

The following specific material properties were developed for each material, for use in the various stability analyses performed as part of this study:

- Unit Weight
- Drained and Undrained Shear Strength of Fine-Grained Soil Strata
- Post-Earthquake Shear Strengths For Foundation Silts

Material properties for the coal ash materials were conservatively estimated based on experience with similar materials. It is noted that the impounded ash layer has little to no influence on the stability analysis.

Unit Weight

Unit weight for the embankment fill and the foundation silts and silty clays were evaluated using measured results from samples collected. **Table E-5** below summarizes the unit weights as measured from samples collected:

Table E-5: Total Unit Weight from Laboratory Testing Program

Strata	No. Tests	Min. (pcf)	Max. (pcf)	Average (pcf)
Embankment Fill	6	125.6	131.0	128.2
Foundation Silts	18	106.4	128.9	118.9
Foundation Silty Clays	14	122.7	128.5	123.5

The buttress fill materials were constructed in a controlled manner and density testing of each lift of fill was performed using nuclear methods. The results of all the field testing were reviewed and found to have very little variation. The average total unit weight among all test data points is approximately 123 pcf.

Drained and Undrained Shear Strength Fine-Grained Soil Strata

Shear Strength From Laboratory Triaxial Testing

Multiple laboratory triaxial tests were performed for the embankment fill, foundation silt and foundation silty clay soils over a range of confining pressures. In analyzing the test results, a number of definitions of failure were considered, including the point of peak deviator stress during the test, the deviator stress corresponding to an axial strain of 12% and 15%, and the point of the test with the maximum effective principle stress ratio (obliquity) from the tabulated CU test data. For both effective and total strength conditions, defining the failure point to coincide with the deviator stress corresponding to 15% strain was selected to establish the shear strength parameters.

As a result of having multiple laboratory CU tests, a failure envelope was defined for each material by plotting the failure points on a Modified Mohr-Coulomb plot (a p-q and p'-q plot), as described in Appendix D of the United States Corps of Engineers Engineer Manual EM-1110-2-1902 "Slope Stability."

For A.B. Brown, p-q and p'-q plots were constructed for each of the following materials based on multiple CU laboratory test data:

- Embankment Fill
- Foundation Silty Clay
- Foundation Silt

The p-q relationship is as follows:

$$p = \tfrac{1}{2}(\sigma_3 + \sigma_1)$$
$$p' = \tfrac{1}{2}(\sigma'_3 + \sigma'_1)$$
$$q = \tfrac{1}{2}(\sigma_1 - \sigma_3)$$

Where:

σ_1 = total major principal stress at failure (axial stress)
σ'_1 = effective major principal stress at failure (axial stress)
σ_3 = total minor principal stress at failure (confining stress)
σ'_3 = effective minor principal stress at failure (confining stress)
p = mean total normal stress at failure
p' = mean effective normal stress at failure
q = shear stress at failure

A fit line through the p-q and p'-q failure points will have an intercept of d and a slope of tangent α (or d' and α' for effective stress conditions). Equivalent Mohr-Coulomb parameters can then be computed as follows:

$\sin \phi = \tan y$ or $\sin \phi' = \tan y'$
$c = (d / \cos \phi)$ or $c' = (d' / \cos \phi')$

In fitting strength parameters to multiple test results, the US Army Corps of Engineers recommends selecting design parameters such that about two thirds of the total tests are above the failure envelope. As considered appropriate, occasional test points which were outliers to the high (stronger) side were removed from consideration on the plots.

Total and effective stress p-q plots for the embankment fill, foundation silty clay and foundation silt materials are shown on **Figures E-1 through E-6** below. The calculated shear strength parameters are also shown.

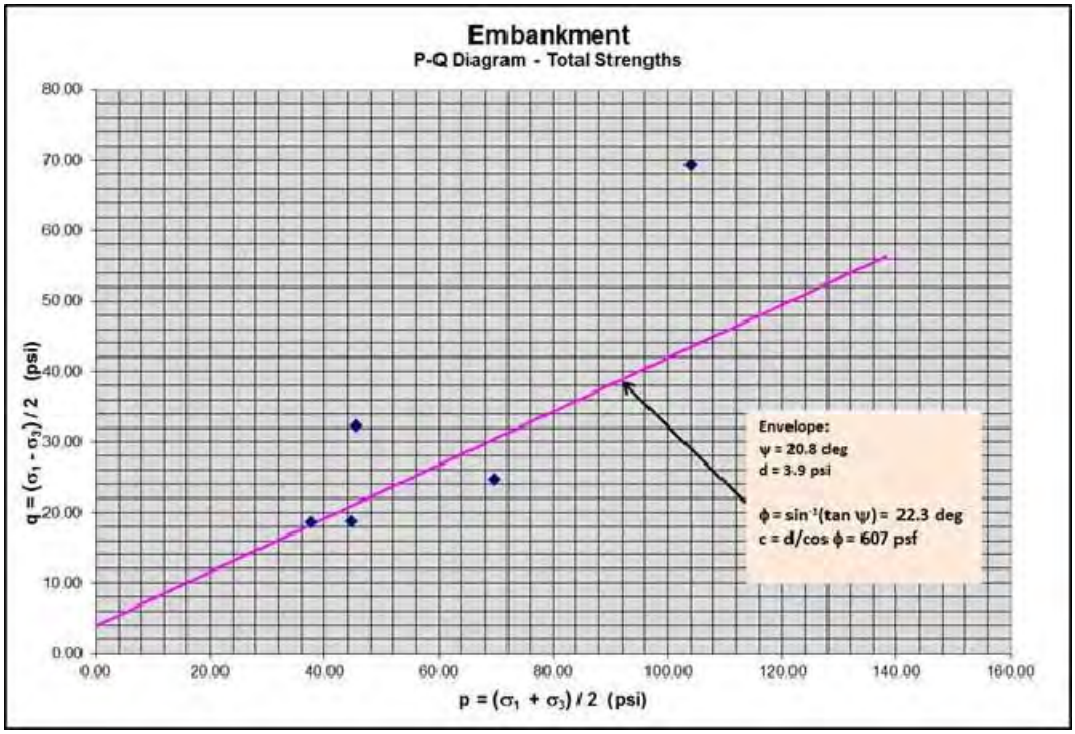


Figure E-1. Total Strength P-Q Plot for Embankment FIll at A.B. Brown

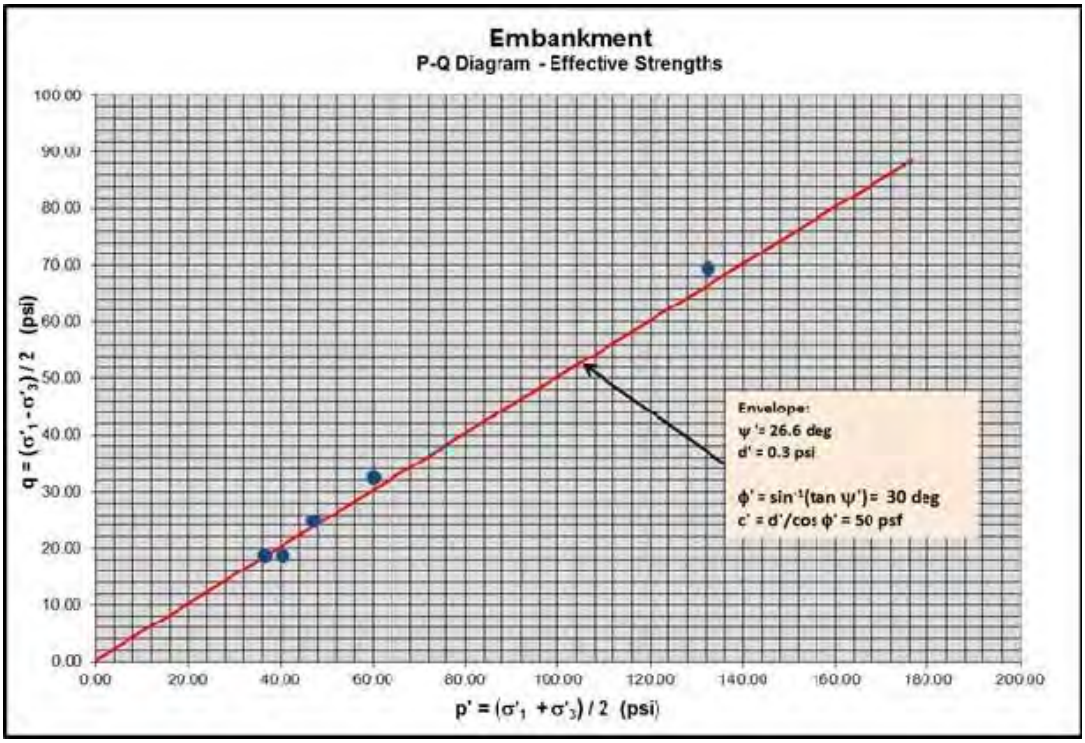


Figure E-2. Effective Strength P-Q Plot for Embankment Fill at A.B. Brown

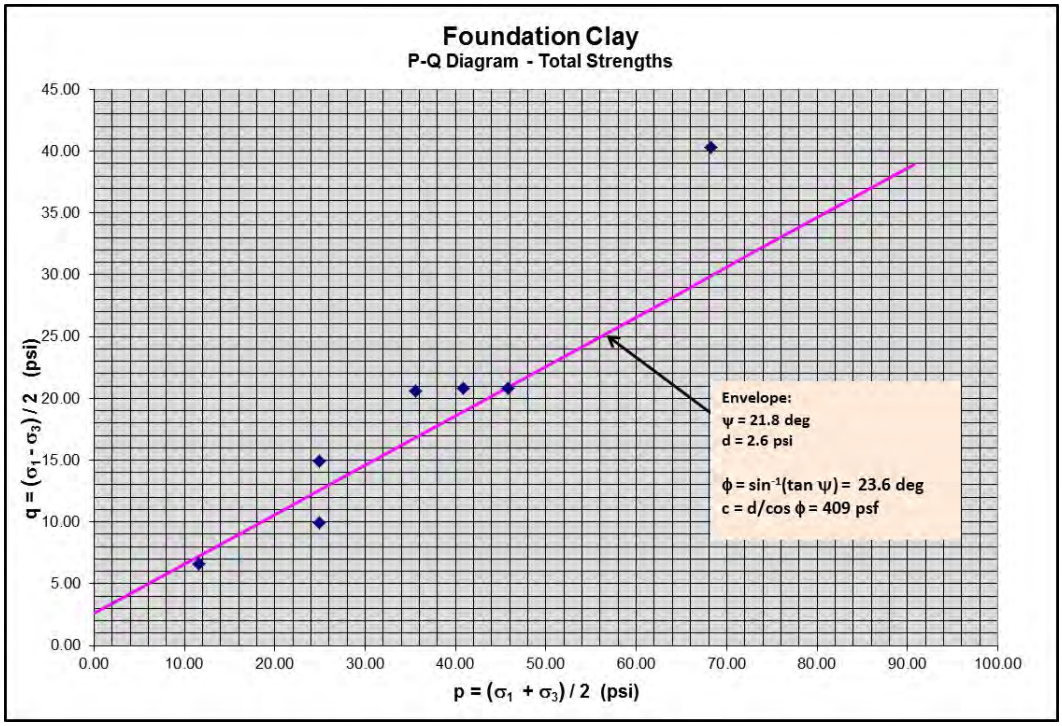


Figure E-3. Total Strength P-Q Plot for Foundation Silty Clay at A.B. Brown

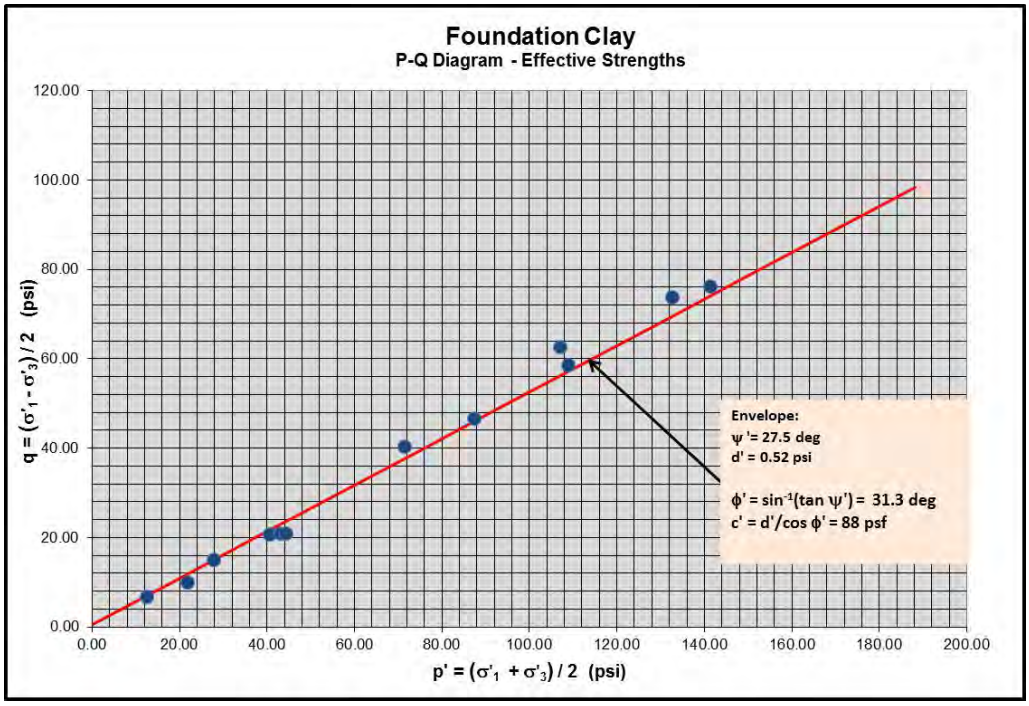


Figure E-4. Effective Strength P-Q Plot for Foundation Silty Clay at A.B. Brown

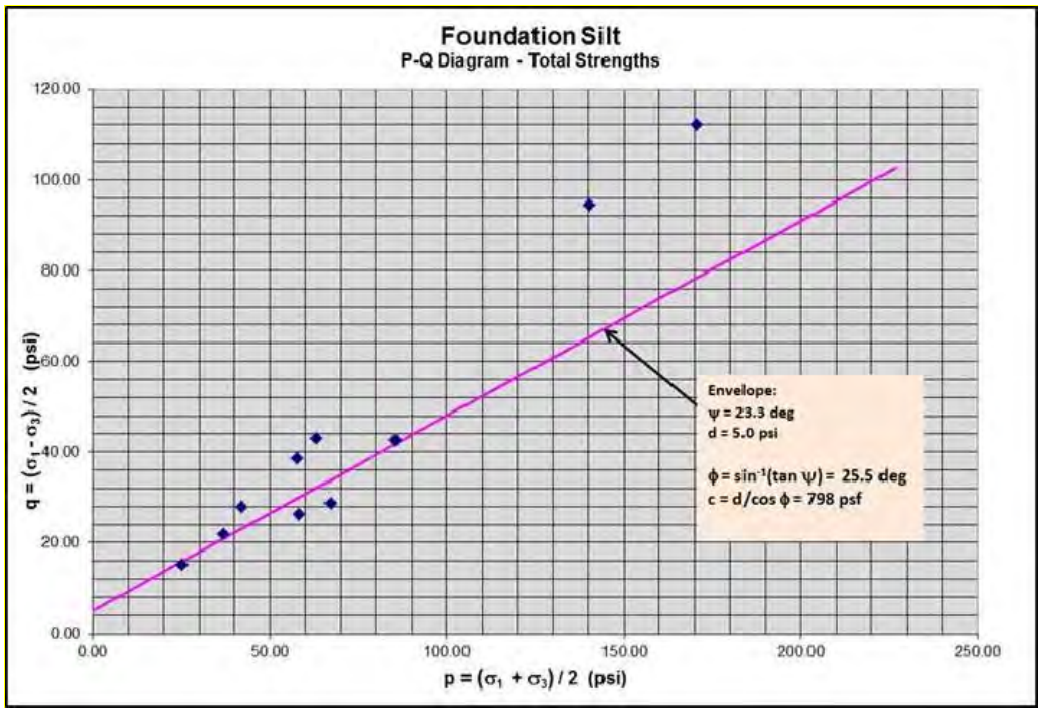


Figure E-5. Total Strength P-Q Plot for Foundation Silt at A.B. Brown

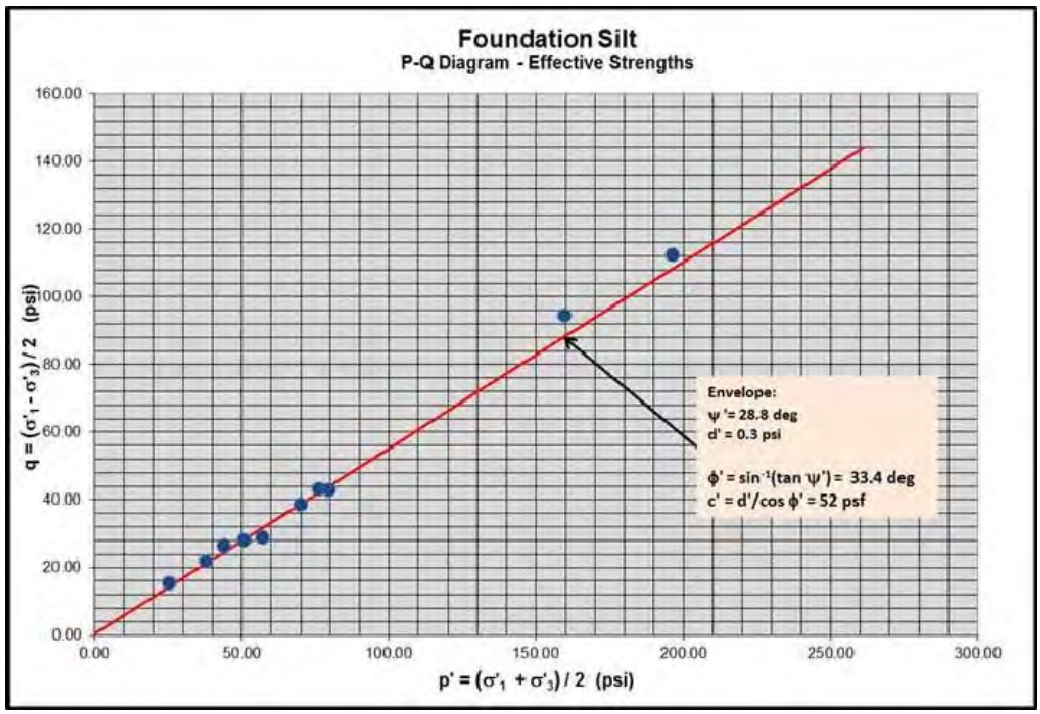


Figure E-6. Effective Strength P-Q Plot for Foundation Silt at A.B. Brown

Post-Earthquake Shear Strength for Foundation Silts

The liquefied strength (residual strength) of the foundation silts was estimated following procedures in Idriss and Boulanger (2008, 2014). Strength estimates presented in those references are based on empirical observations and back-analyses made at actual sites that have experienced liquefaction in past earthquakes and is based on correlations with SPT and CPT results. It relates the residual strength of a liquefied sand or silt (non- or low-plasticity material) to the normalized, fines-corrected resistance (SPT N-value or CPT tip resistance). Specifically, the method relates the equivalent fines-corrected clean sand SPT blow count, $(N_1)_{60CS\text{-}Sr}$, and CPT tip resistance $q_{c1Ncs\text{-}Sr}$ to the steady-state (post-liquefaction) shear strength. The strength is expressed as a ratio of the existing vertical overburden stress at any point in the layer, i.e., S_r / σ'_v.

The analyses performed as part of the SPT-based liquefaction screening analysis utilizes the fines-corrected blow count, $(N_1)_{60CS\text{-}Sr}$, and this parameter is calculated for each sample of silt within the spreadsheets that were created for that purpose. Cardno furnished the most recent hammer calibration data of the drill rig used on the site which was determined to be 81% efficient; this efficiency was used in determining the corrected N-values. These data were used to select the steady-state strength of the silt deposit, as follows:

- The $(N_1)_{60CS\text{-}Sr}$ for each silt sample among all borings were taken from the liquefaction screening analysis spreadsheet, and combined in a single graph. This is shown in **Figure E-7** below.
- The mean $(N_1)_{60CS\text{-}Sr}$ was determined from graph, and this value was selected for analysis purposes, to represent the silt deposit as a whole. From **Figure E-7**, mean $(N_1)_{60CS\text{-}Sr} = 12$.
- **Figure E-8** was then used to estimate the shear strength ratio, that corresponds to $(N_1)_{60CS\text{-}Sr} = 12$. As shown on the figure, the shear strength ratio of the silt was determined to be $Sr / \sigma'_v = 0.11$.

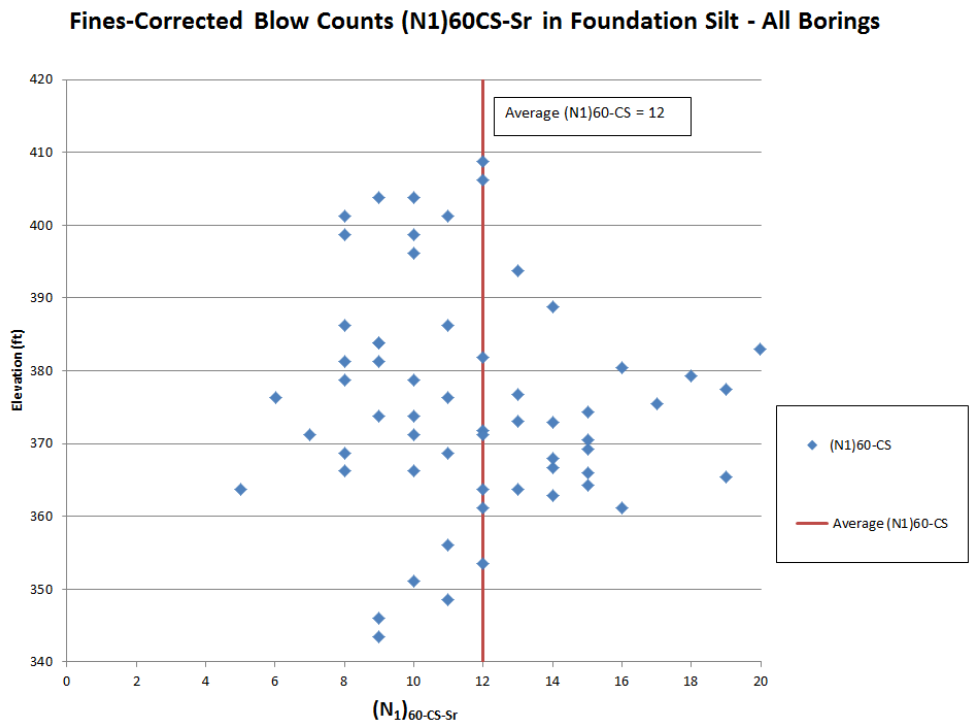


Figure E-7: Compilation of Fines Corrected Blow Counts in Foundation Silts

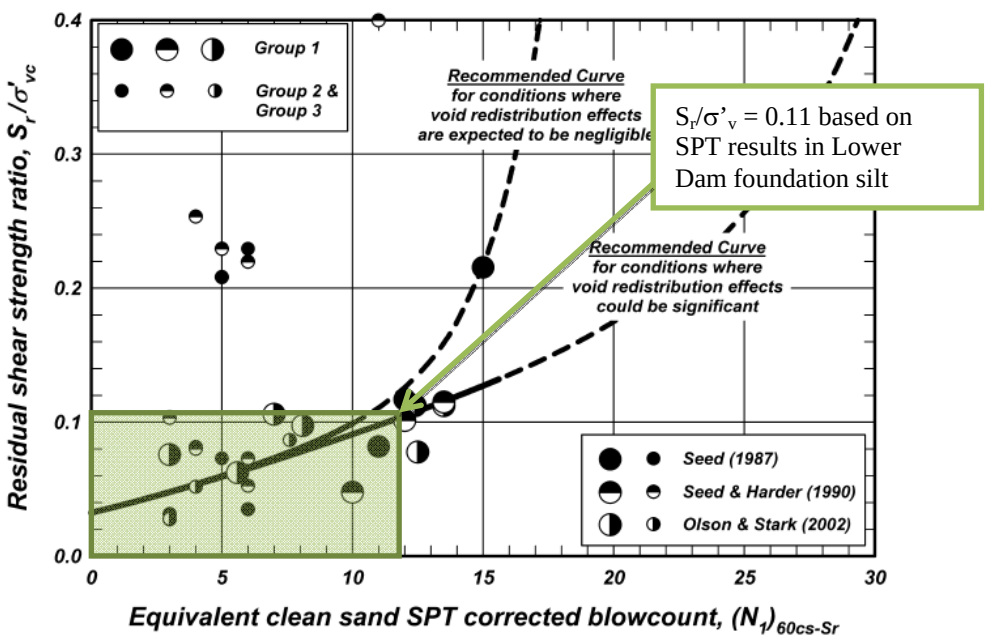


Figure E-8: Steady-State Strength Ratio vs.Equivalent Clean Sand Blow Count (Idriss and Boulanger, 2008)

The analyses performed as part of the CPT-based liquefaction screening analysis utilized the fines-corrected tip resistance $q_{c1Ncs\text{-}Sr}$; this parameter is calculated for each tip-resistance data point within the silt deposits. CPT data points were taken every 0.05 meter (0.16 foot), essentially creating a continuous profile of data which were used to select the residual strength of the silt deposit.

The equivalent fines-corrected and normalized clean sand tip resistance, $q_{c1Ncs\ \text{-}Sr}$ taken from each CPT data point were calculated for all intervals within the silt layer. The average values from each CPT Sounding were tabulated, as shown in **Table E-6** below and an overall average tip resistance was determined ($q_{c1Ncs\ \text{-}Sr}$ = 87.1). This value was conservatively selected as the basis for determining the residual strength of silt for modeling purposes.

Table E-6: Summary of Equivalent Clean Sand Normalized CPT Tip Resistance q_{c1Ncs}

CPT Sounding	Adjacent Cardno Boring	Top of Silt Horizon Examined	Bottom of Silt Horizon Examined	Average q_{c1Ncs}	Overall Average q_{c1Ncs} (tsf)
		Elevation (ft)	Elevation (ft)	Tons per square foot (tsf)	
AECOM-C1	B-202	382.7	372.7	62.7	87.1
AECOM-C2	B-203	--	--	--	
AECOM-C3	B-219	409.5	397.0	98.0	
AECOM-C4	B-206	396.8	384.3	154.1	
		374.8	371.8	67.1	
		356.8	341.8	65.8	
AECOM-C5	B-205	389.0	361.5	74.6	

Figure E-9, reproduced from Idriss and Boulanger (2008), relates $q_{c1Ncs\ \text{-}Sr}$ to the residual shear strength. The strength is expressed as a ratio of the existing vertical overburden stress at any point in the layer, i.e., Sr / σ'_v. For $q_{c1Ncs\ \text{-}Sr}$ of 87.1, the estimated strength ratio is 0.10. This strength was selected to represent that portion of the foundation silt material that is anticipated to liquefy, for use in the post-liquefaction stability analyses.

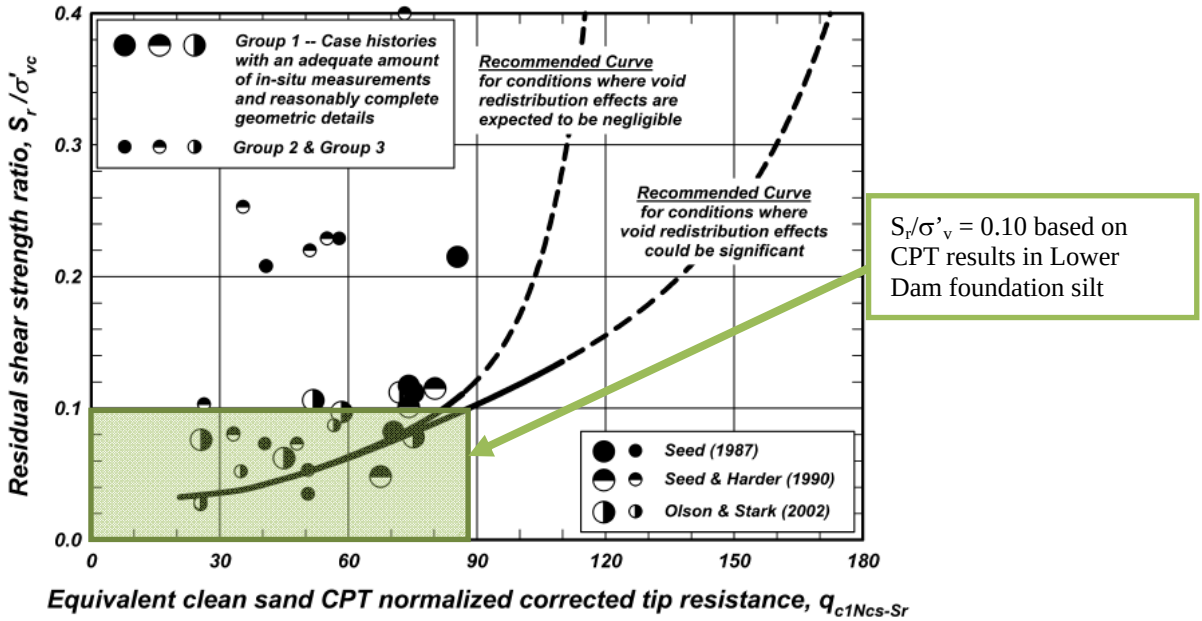


Figure E-9. Steady-State Strength Ratio vs. Equivalent Clean Sand CPT Tip Resistance (Idriss and Boulanger, 2008)

V. Material Properties for Analysis

The table below summarizes the material parameters used as the basis for slope stability analysis, based on the analysis and strength selection procedures and considerations presented in the preceding sections.

Table E-7: Summary of Material Parameters used in Stability Analysis

Material	Unit Weight (pcf)	Effective (drained) Shear Strength Parameters		Total (undrained) Shear Strength Parameters		Post-Earthquake Shear Strength Parameters		
		c' (psf)	Φ' (°)	c (psf)	Φ (°)	c (psf)	Φ (°)	S_{ur}/σ'_{vc}
Embankment Fill	128	50	30	600	22	475	18	-
Foundation Silt	119	0	33	650	22	-	-	0.10
Foundation Clay	126	80	31	400	23	320	19	
Buttress Fill	123	45	27	540	20	425	16	-
Sluiced Ash	100	0	32	100	12	-	-	0.12
Bedrock	Assumed to be impenetrable in the slope stability models							

The following additional considerations were made in selecting the above parameters:

- As stated above, drilling and sampling in the Buttress Fill was not performed, because construction of the buttress occurred after the end of the geotechnical investigations for this project. The buttress is comprised of engineered fill material, similar to the Embankment Fill, and constructed using modern techniques. The buttress is therefore expected to have material parameters equal to or better than the dam embankment. As a conservative judgment, shear strength of the buttress is assumed to be 90% that of the Embankment Fill for analysis purposes.
- For impounded sluiced materials, strength properties were selected based on past experience and conservative engineering judgment. Furthermore, liquefaction was conservatively assumed by inspection, and steady-state strengths were also assigned based on conservative engineering judgment. It is noted that the impounded ash has little to no influence in the stability analyses.
- The total (undrained) strength parameters of the foundation silt layer used for analysis were reduced by 15% with respect to the values resulting from the P-Q diagrams, as a conservative engineering judgment.
- The fine-grained Foundation Silty Clay and Embankment Fill soils are generally stiff to very stiff materials. The laboratory triaxial strength test results did not indicate significant post-peak softening in these materials, which indicates low susceptibility to cyclic softening. Furthermore, the Embankment Fill was a mechanically compacted material.

  It is considered unlikely that the Embankment Fill and Foundation Silty Clay deposits will undergo strength loss as a result of cyclic loading in an earthquake, as these materials have stiff consistency and generally did not exhibit significant post-peak loss of strength in the triaxial tests. However, as a conservative consideration, a 20% strength loss has been assumed for analysis purposes for these materials, for the post-liquefaction analysis condition – i.e., the strengths in **Table E-7** for these materials for the post-earthquake condition correspond to 80% of the static undrained shear strength.

Appendix F
Slope Stability Analysis Calculations

This calculation package summarizes the limit equilibrium slope stability analyses for both the static and seismic loading conditions performed in support of certifications of the Ash Pond Complex at Vectren's A.B. Brown Generating Station. The analyses pertain to the Lower Dam, which impounds the pond system. The methodology of the analyses are presented herein, along with figures, calculations and computer program outputs.

I. Objective

The objective for the slope stability analysis is to determine factors of safety (FoS) at critical cross section locations across the Lower Dam for the following loading cases:

- Static, Steady-State, Normal Pool Conditions;
- Static, Maximum Pool Surcharge Conditions;
- Seismic Slope Stability Analysis; and
- Post-Liquefaction Condition.

The factors of safety determined from each of these loading conditions will be utilized to determine if the requirements outlined by the United States Environmental Protection Agency (USEPA) CCR Rule under 40 Code of Federal Regulations (CFR) §257.73 (e) are met. The methodology used to perform the slope stability analyses and the results of the analyses are summarized in the subsequent sections listed below.

II. Development of Cross-Sections for Analysis

Five cross sections were identified for the stability evaluation of the Lower Dam. The analysis sections were selected based on factors including the height and steepness of the downstream embankment slope and subsurface conditions in the foundation of the embankment as revealed by the borings. Taken together, the five analysis sections are considered to comprehensively represent the Lower Dam. Each of the five analysis cross-sections are briefly summarized below:

- **Cross-Section A:** This section is located in the northern half of the dam and is representative of the surface and subsurface conditions in that area.
- **Cross-Section B:** This section is located central to the axis of the dam and models the tallest height (vertical difference between crest of the embankment and the toe of the embankment fill) of the dam embankment. The Foundation Silt layer (which is of interest because it is prone to liquefaction after a strong earthquake) featured most prominently within this cross section.
- **Cross-Section C:** This section is located along the southern half of the dam and is roughly in line with an existing pump house structure. The embankment is relatively tall at this section, similar to Section B.
- **Cross-Section D:** This section is representative of the southern end of the dam.
- **Cross-Section E:** This section is representative of the northern end of the dam, where bedrock rises sharply in elevation and the groundwater level at and beyond the toe of the dam is higher than at other areas.

The section locations are shown on **Figure F-1**.

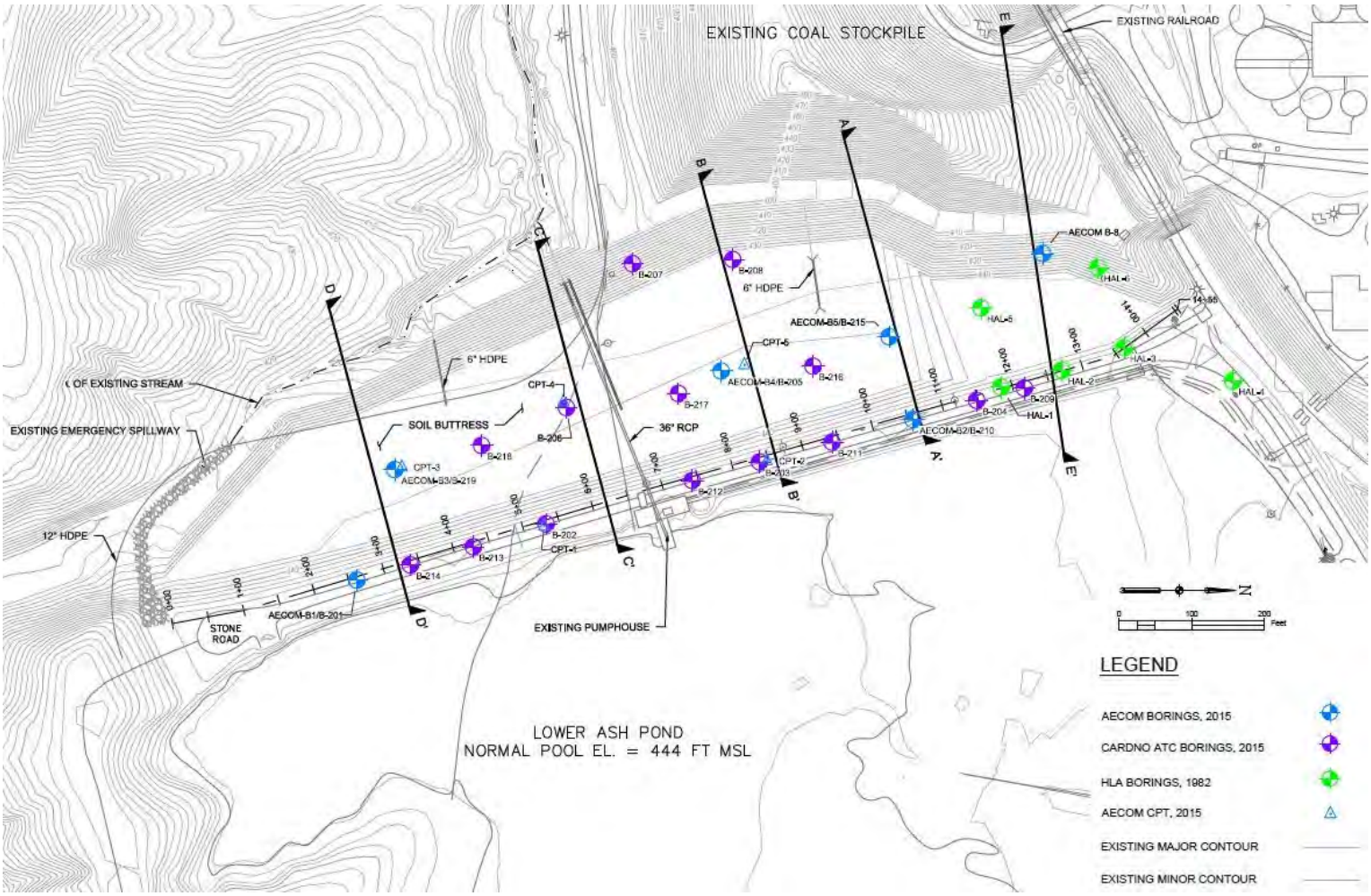


Figure F-1: Analysis Cross-Section Location Plan

III. Interpretation of Topography and Stratigraphy

Subsurface materials and extents (stratigraphy) at each cross section were developed by utilizing nearby subsurface explorations (CPTs and borings) from the various geotechnical investigations performed at the site. The subsurface strata generally encountered across the exploration locations can be generalized into five typical layers:

- Sluiced Ash
- Embankment Fill
- Foundation Silty Clay
- Foundation Silt
- Buttress Fill

These layers are described in detail in **Appendix E – Shear Strength Characterization**.

The topography for each analysis cross-section was determined based on ground surveys performed to support this project (for Cross-Section A thru D) or from the aerial basemapping provided by Vectren (for Section E). It is noted that the generating station's coal storage area lies directly to the west of cross-sections A, B, and E. The coal pile rises above the natural grade in this area and would act as a stabilizing surcharge against very large failure surfaces, such as are calculated under the post-liquefaction loading condition (described below). While the coal pile is a permanent feature of the station, the size of the pile can vary, depending on production needs at any given time. In the slope stability models for these sections, the surface grade at the toe of the gravity buttress (which will not change) was carried as constant to the west. This assumption conservatively eliminates any stabilizing effect of the coal pile on the stability models.

Stratigraphy was established from the subsurface information indicated by the borings and CPT soundings. The relevant CPT soundings and test borings that were used to develop subsurface stratigraphy at the five analysis sections are shown in **Table F-1**:

Table F-1: Summary of Geotechnical Explorations at Cross Sectional Locations

Cross-Section	Geotechnical Explorations Used
A-A	AECOM-B5, AECOM-B2, B-215, B-210
B-B	AECOM-B4, AECOM-C5, AECOM-C2, B-203, B-205, B-208
C-C	AECOM-C4, AECOM-C1, B-206, B-207, B-217
D-D	AECOM-B1, AECOM-B3, AECOM-C3, B-219, B-214, B-201
E-E	HLA-2, HLA-3, HLA-5, and HLA-6

A full set of AECOM's boring logs, including soil descriptions, types of sampling, and choice laboratory test results, is provided in **Appendix B** of the report. A CPT data report is provided in **Appendix C**, and complete laboratory testing results are provided in **Appendix D**.

IV. Groundwater Conditions

The phreatic surface under normal conditions was established using the water levels in the piezometers installed near the centerline of the dam (at boring location B-212 and B-217). Long term water levels in these piezometers are shown in **Table F-2**.

Table F-2: Long-Term Water Levels in Piezometers

Piezometer	Water El. (ft NAD 83)
B-212	424
B-217	406

Depths and elevations of free water as indicated in the borings and observations of water flow in the streams and ditches that lie to the west of the dam were also used to compare against the piezometer data for areas located away from the centerline (especially to estimate groundwater elevations in the far field beyond the toe of the dam). The available data and observations indicate that the static groundwater table beyond the toe of the dam lies at around El. 390 at the northern area of the dam, and at or below El. 380 at the central and southern areas.

The water elevations were drawn into the stability models as piezometric lines with straight line interpolation between the pool elevation and piezometer locations. AECOM reviewed the water elevations and cross-checked the interpolated phreatic surface with finite element seepage analysis using GeoStudio's SEEP/W software. Phreatic surfaces calculated in SEEP/W were in reasonable agreement with the straight-line interpolations from the available field groundwater measurements, but generally resulted in a lower phreatic level than the field measurements. Therefore, the straight-line interpolation was conservatively selected for the slope stability models.

V. Analysis Methodology

Analyses were performed using Spencer's Method which is a limit equilibrium slope stability analysis procedure satisfying both force and moment equilibrium. The computer program SLOPE/W 2007 by Geo-Slope International was utilized. The program analyzes a large number of potential slip surface geometries and identifies the geometry that results in a critical (i.e. lowest) factor of safety (FS). Additional information on the program is available at http://www.geo-slope.com/. Both circular and plane (block) shaped failure surfaces were analyzed, for the each of the loading cases considered.

Each section was analyzed for the following cases, which are in accordance with USEPA CCR Rule requirements:

- **Static, Steady-State, Normal Pool Condition:** This case models the embankment and connected buttress under static, long-term conditions, at normal water level within the impoundment. The USEPA CCR Rule requires a maximum storage pool factor of safety greater than or equal to 1.50.

  The steady-state condition used a normal pool elevation of 444.0 feet in the impoundment, which corresponds to the inlet elevation of the gooseneck outlet structure at the dam. This is the highest elevation that water can pool in the impoundment under normal conditions. The phreatic surface was modeled using piezometric lines and the straight-line interpolation between the pool level and the groundwater elevations in the reference piezometers and borings, as described in Section IV above.

- **Static, Maximum Surcharge Pool Condition:** This case models the conditions under short-term surcharge pool conditions, with the water level in the pond corresponding to the anticipated level during the design flood condition (which is a 1,000 year recurrence interval flood event for this site). This condition requires a minimum Factor of Safety greater than or equal to 1.40.

  The maximum surcharge pool elevation for this condition was set at El. 446.8 feet. This corresponds to the anticipated water level in the pond during the design flood event (which is a 1,000 year recurrence interval flood event for this site), as provided by the Hydraulics Engineer. For the maximum surcharge pool condition, the pool level in the pond was raised to the design flood level. The straight-line interpolation described above was adjusted accordingly to the raised water level. Therefore, the phreatic surface used for this loading condition corresponds to steady-state seepage to the raised pool level. This is a conservative representation, as the maximum storage pool water level is likely to be a short-term event and steady state seepage conditions through the dam are unlikely to develop.

- **Seismic Stability Condition:** These analyses incorporate a horizontal seismic coefficient k_h selected to be representative of expected loading during the design earthquake event (i.e., a "pseudostatic" analysis). The design earthquake event is one with a 2% probability of exceedance in 50 years (approximately 2,500 year recurrence interval), as required by the CCR Rule. The seismic coefficient was selected on the basis of the results of the site-specific Probabilistic Seismic Hazard Analysis (PSHA) and dynamic response analysis (See **Appendices G and H**). The analyses utilized peak undrained strength parameters for soils that are not considered to be rapidly draining materials (including the dam embankment and buttress soils, silty clay foundation stratum, and silt foundation stratum). The phreatic surface and pore water pressures corresponding to the steady state pool from the static analyses were utilized. This condition requires a minimum Factor of Safety greater than or equal to 1.00.

  Pool elevation in the pond and the phreatic surface for the seismic loading condition were the same as utilized in the steady-state normal pool loading condition.

  The pseudostatic coefficient was selected using the simplified procedure outlined by Makdisi and Seed (1977), and based on earthquake ground motions established from the probabilistic seismic hazard analysis (PSHA) and dynamic response analyses performed for the site (see **Attachment G** and **H**). Specifically, the pseudostatic coefficient was taken as the parameter k_{max}, which represents the peak average acceleration along the failure surface. As shown in **Figure F-2** below (excerpted from the above reference), the ratio k_{max}/u_{max} (where u_{max} is the peak acceleration at the crest of the embankment) for a full height failure surface (y/H = 1.0) is 0.34. The value for full-height failure surfaces is pertinent to the slope stability analyses, as these analyses are focused on global failure surfaces that could release the contents of the impoundment, if mobilized.

  Peak ground accelerations at the crest of the dam were determined in the dynamic response analysis (see **Attachment H**), for each of four reference time histories generated from the PSHA. The results from the QUAD4M model representing the existing condition of the dam (with the stabilizing soil buttress in place) were used to establish the crest PGA. The average crest PGA among the time histories from this model was 0.53g. Therefore, the pseudostatic coefficient k_h was estimated as k_h= 0.34*0.53g = 0.18g. This value was input as the seismic coefficient in the slope stability models.

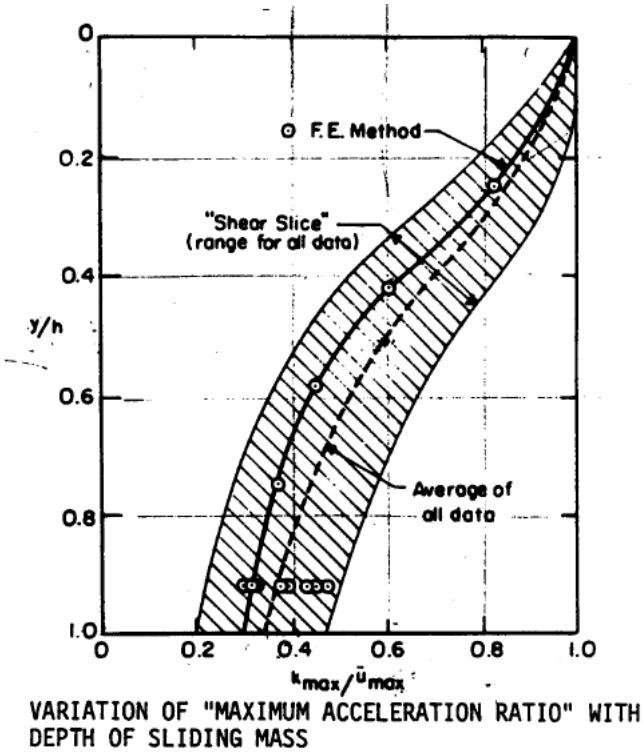


Figure F-2: Determination of Maximum Average Acceleration Along Failure Surface

- **Post-Liquefaction Condition:** These analyses were performed at each stability cross section where liquefaction triggering analysis indicates potential liquefaction of non-plastic materials or cyclic softening of fine-grained soils. The purpose of the post-liquefaction stability analysis is to assess stability conditions immediately following the design seismic event. No horizontal seismic coefficient is included in these analyses, but selection of strength parameters for the analyses takes into account the potential for the softening/weakening of the soils as a result of pore pressures generated in sand-like materials, or cyclic softening in clay-like materials due to the earthquake shaking. Liquefaction potential analysis was performed on the foundation silt deposits, using cyclic stress ratios (CSRs) determined from finite element dynamic response analysis, and cyclic resistance ratios (CRRs) determined from the results of cyclic direct simple shear testing. The liquefaction potential analysis is presented in **Appendix I**. As discussed in subsequent sections, these analyses predict that the silt deposit will liquefy as a result of the design earthquake. In the post-liquefaction stability analyses, steady state (liquefied) strength was therefore assigned to the silt.

  Pool elevation in the pond and the phreatic surface for the post-liquefaction loading condition were the same as utilized in the steady-state normal pool loading condition.

The CCR Rule requires a minimum Factor of Safety greater than or equal to 1.20 for the post-liquefaction slope stability analysis.

VI. Material Properties for Analysis

Material properties for slope stability analyses were developed using both laboratory testing data (index and strength testing) and strength correlations from CPT and SPT data. Details of the material characterization and strength parameter selection for each stratum are provided in **Appendix E** of this report. The properties used in the stability analysis are summarized in the table below:

Table F-3: Summary of Material Parameters used in Stability Analysis

Material	Unit Weight (pcf)	Effective (drained) Shear Strength Parameters		Total (undrained) Shear Strength Parameters		Post-Earthquake Shear Strength Parameters		
		c' (psf)	Φ' (°)	c (psf)	Φ (°)	c (psf)	Φ (°)	S_{ur}/σ'_{vc}
Embankment Fill	128	50	30	600	22	475	18	-
Foundation Silt	119	0	33	650	22	-	-	0.10
Foundation Clay	126	80	31	400	23	320	19	
Buttress Fill	123	45	27	540	20	425	16	-
Sluiced Ash	100	0	32	100	12	-	-	0.12
Bedrock	Assumed to be impenetrable in the slope stability models							

VII. Results

Table F-4 summarizes the results of the stability analyses for each section, and output figures from the SLOPE/W models are provided at the back of this appendix.

Table F-4: Summary of Minimum Slope Stability Factors

Load Case	CCR Rule Criteria	Failure Geometry	A-A	B-B	C-C	D-D	E-E
Steady State (Normal Pool)	FS ≥ 1.50	Circular	3.43	3.42	3.21	3.32	3.65
		Block	3.48	3.72	3.36	3.38	3.36
Surcharge Pool (Flood)	FS ≥ 1.40	Circular	3.33	3.32	3.06	3.22	3.61
		Block	3.57	3.48	3.24	3.30	3.36
Seismic (Pseudostatic)	FS ≥ 1.00	Circular	1.51	1.56	1.32	1.49	1.56
		Block	1.62	1.64	1.38	1.58	1.65
Post-Liquefaction	FS ≥ 1.20	Circular	1.61	1.61	1.55	2.17	1.69
		Block	1.23	1.25	1.32	1.25	1.32

VIII. Conclusions

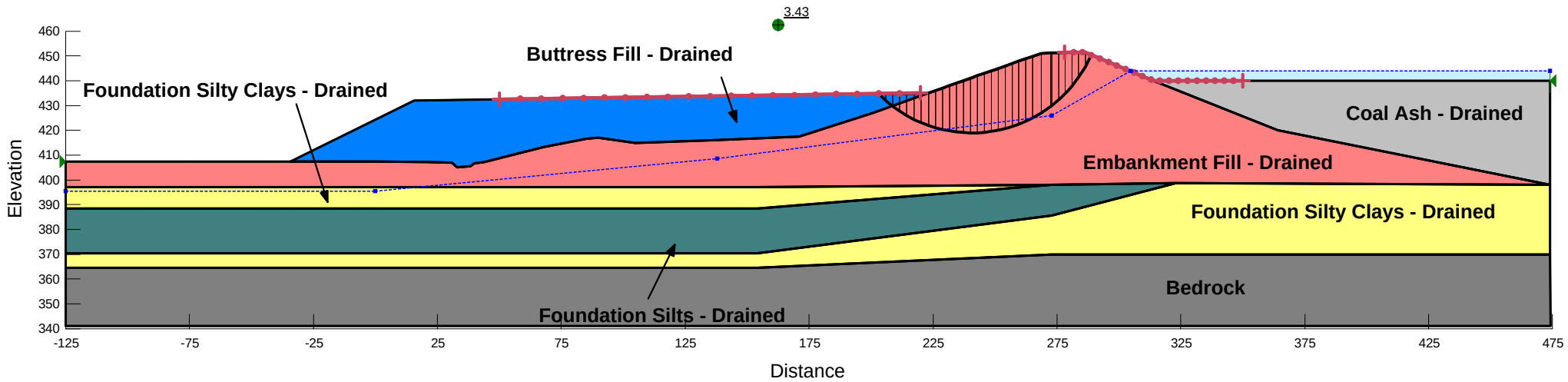
Calculated factors of safety at all cross-sections are greater than or equal to the minimum values required in USEPA CCR Rule §257.73(e), for all loading conditions considered.

IX. References

Makdisi, F.I. and Seed, B. H., August, 1977. "A Simplified Procedure for Estimating Earthquake-Induced Deformations in Dams and Embankments", Earthquake Engineering Research Center Report No. UCB/EERC-77/19, University of California, Berkeley, CA.

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Storage Pool - Critical Circular Surface Failure Geometry
Cross-Section A
Date: 10/8/2016



Material Properties

Embankment Fill - Drained
Unit Weight: 128 pcf
Cohesion: 50 psf
Phi: 30 °

Coal Ash - Drained
Unit Weight: 100 pcf
Cohesion: 0 psf
Phi: 32 °

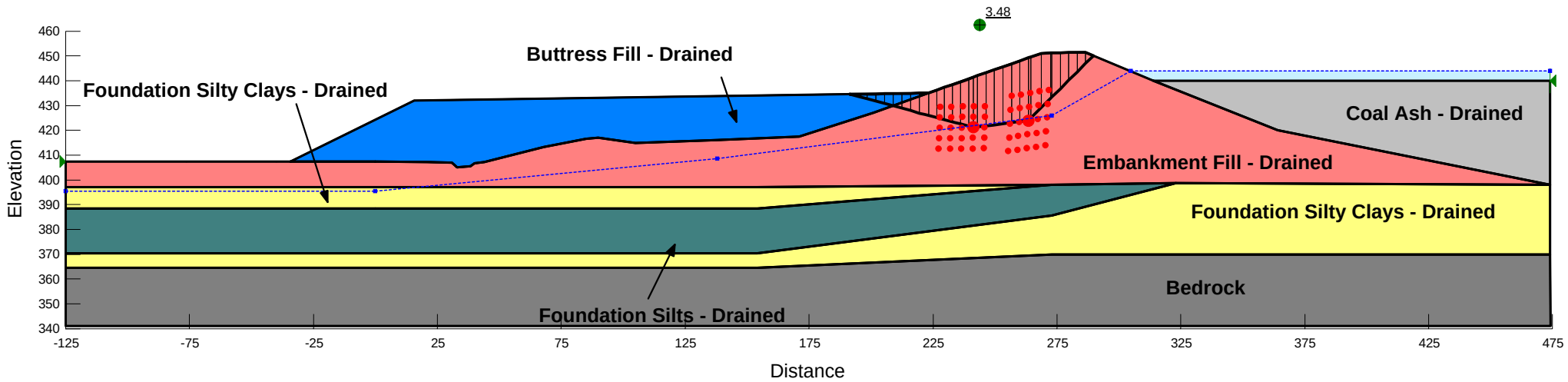
Foundation Silty Clays - Drained
Unit Weight: 126 pcf
Cohesion: 80 psf
Phi: 31 °

Foundation Silts - Drained
Unit Weight: 119 pcf
Cohesion: 0 psf
Phi: 33 °

Buttress Fill - Drained
Unit Weight: 123 pcf
Cohesion: 45 psf
Phi: 27 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Storage Pool - Critical Block Failure Surface Geometry
Cross-Section A
Date: 10/8/2016



Material Properties

Embankment Fill - Drained
Unit Weight: 128 pcf
Cohesion: 50 psf
Phi: 30 °

Coal Ash - Drained
Unit Weight: 100 pcf
Cohesion: 0 psf
Phi: 32 °

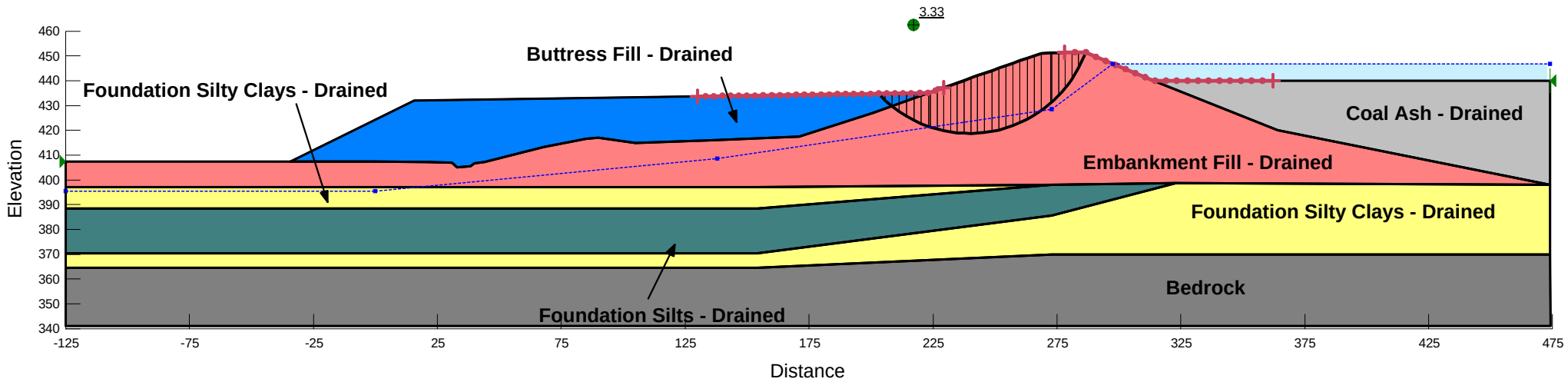
Foundation Silty Clays - Drained
Unit Weight: 126 pcf
Cohesion: 80 psf
Phi: 31 °

Foundation Silts - Drained
Unit Weight: 119 pcf
Cohesion: 0 psf
Phi: 33 °

Buttress Fill - Drained
Unit Weight: 123 pcf
Cohesion: 45 psf
Phi: 27 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Surcharge Pool - Critical Circular Failure Geometry
Cross-Section A
Date: 10/8/2016



Material Properties

Embankment Fill - Drained
Unit Weight: 128 pcf
Cohesion: 50 psf
Phi: 30 °

Coal Ash - Drained
Unit Weight: 100 pcf
Cohesion: 0 psf
Phi: 32 °

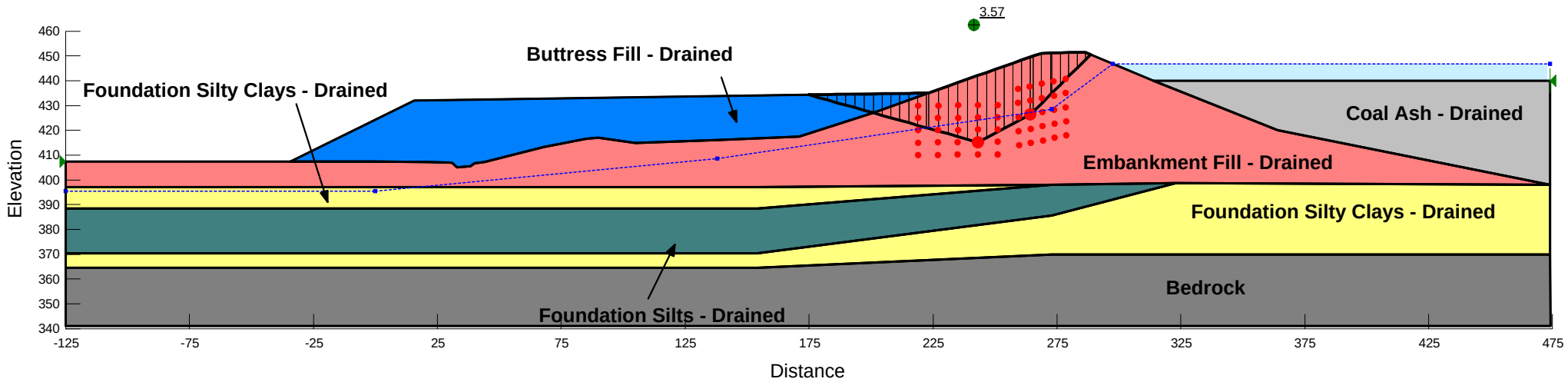
Foundation Silty Clays - Drained
Unit Weight: 126 pcf
Cohesion: 80 psf
Phi: 31 °

Foundation Silts - Drained
Unit Weight: 119 pcf
Cohesion: 0 psf
Phi: 33 °

Buttress Fill - Drained
Unit Weight: 123 pcf
Cohesion: 45 psf
Phi: 27 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Surcharge Pool - Critical Block Failure Surface Geometry
Cross-Section A
Date: 10/8/2016



Material Properties

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Phi: 30 °

Coal Ash - Drained
Unit Weight: 100 pcf
Cohesion: 0 psf
Phi: 32 °

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Unit Weight: 126 pcf
Cohesion: 80 psf
Phi: 31 °

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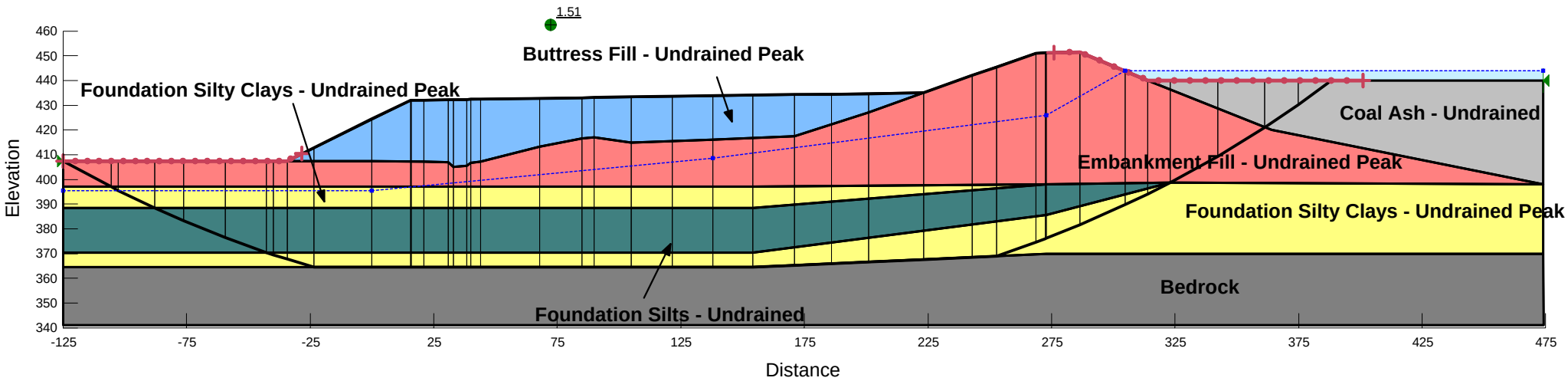
Unit Weight: 119 pcf
Cohesion: 0 psf
Phi: 33 °

Buttress Fill - Drained
Unit Weight: 123 pcf
Cohesion: 45 psf
Phi: 27 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Seismic - Critical Circular Buttress Failure Geometry
Cross-Section A
Date: 10/10/2016

Horizontal Seismic Load = 0.18 g



Material Properties

Embankment Fill - Undrained Peak
Unit Weight: 128 pcf
Cohesion: 600 psf
Phi: 22 °

Coal Ash - Undrained
Unit Weight: 100 pcf
Cohesion: 100 psf
Phi: 12 °

Foundation Silty Clays - Undrained Peak
Unit Weight: 126 pcf
Cohesion: 400 psf
Phi: 23 °

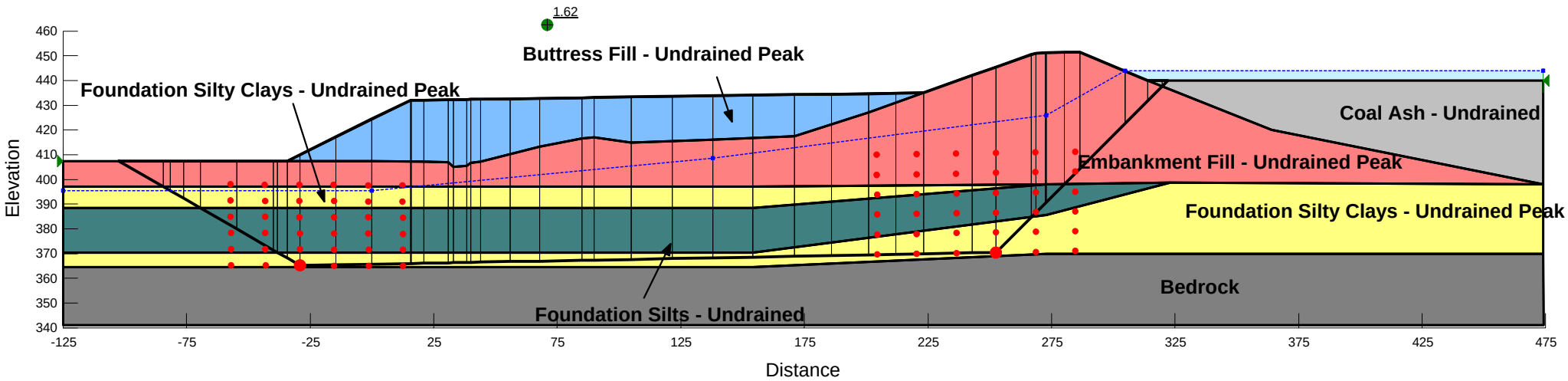
Foundation Silts - Undrained
Unit Weight: 119 pcf
Cohesion: 650 psf
Phi: 22 °

Buttress Fill - Undrained Peak
Unit Weight: 123 pcf
Cohesion: 540 psf
Phi: 20 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Seismic - Critical Block Failure Surface Geometry
Cross-Section A
Date: 10/10/2016

Horizontal Seismic Load = 0.18 g



Material Properties

Embankment Fill - Undrained Peak
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Phi: 22 °

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Cohesion: 100 psf
Phi: 12 °

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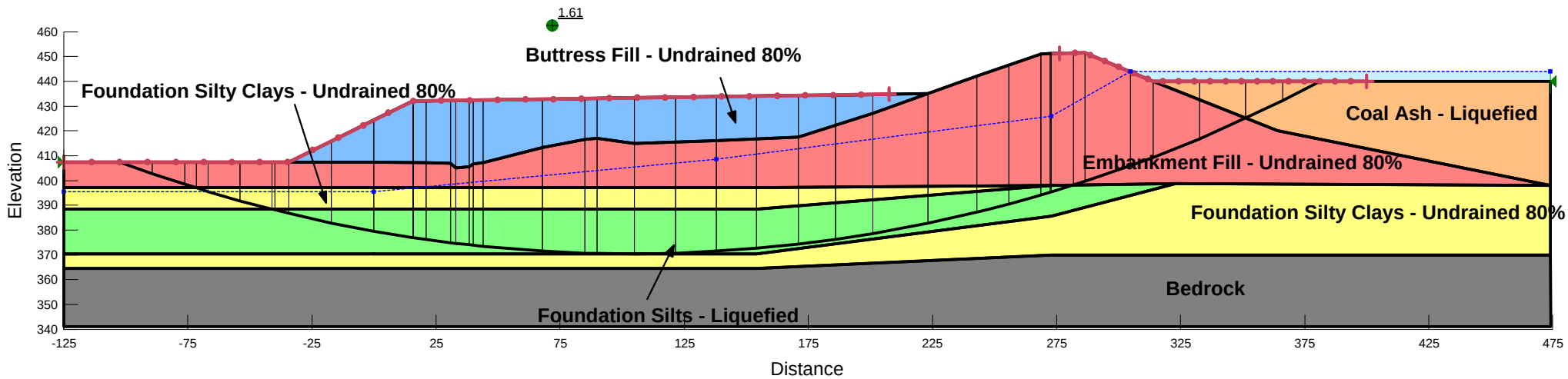
Cohesion: 400 psf
Phi: 23 °

Foundation Silts - Undrained
Unit Weight: 119 pcf
Cohesion: 650 psf
Phi: 22 °

Buttress Fill - Undrained Peak
Unit Weight: 123 pcf
Cohesion: 540 psf
Phi: 20 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Post-Liquefaction - Critical Circular Surface Failure Geometry
Cross-Section A
Date: 9/13/2016



Material Properties

Embankment Fill - Undrained 80%
Unit Weight: 128 pcf
Cohesion: 475 psf
Phi: 18 °

Coal Ash - Liquefied
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.12
Minimum Strength: 0

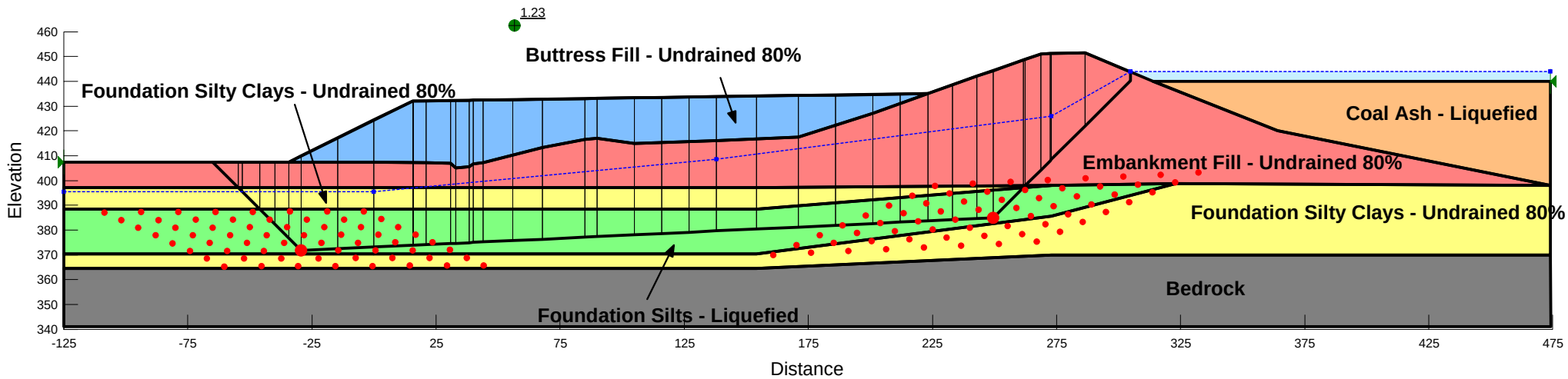
Foundation Silty Clays - Undrained 80%
Unit Weight: 126 pcf
Cohesion: 320 psf
Phi: 19 °

Foundation Silts - Liquefied
Unit Weight: 119 pcf
Tau/Sigma Ratio: 0.1
Minimum Strength: 100

Buttress Fill - Undrained 80%
Unit Weight: 123 pcf
Cohesion: 425 psf
Phi: 16 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Post-Liquefaction - Critical Block Failure Surface Geometry
Cross-Section A
Date: 9/13/2016



Material Properties

Embankment Fill - Undrained 80%
Unit Weight: 128 pcf
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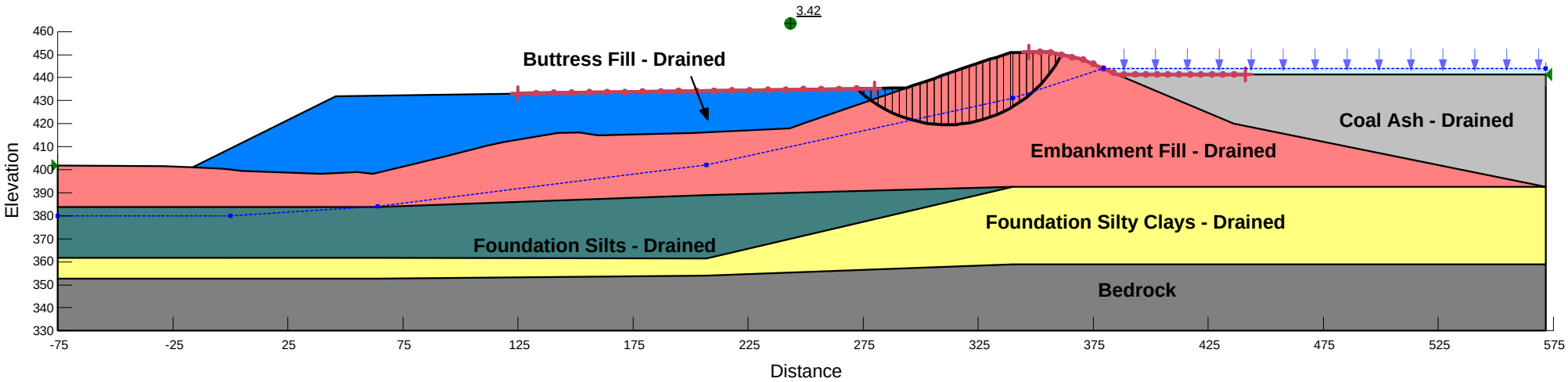
Unit Weight: 119 pcf
Tau/Sigma Ratio: 0.1
Minimum Strength: 100

Buttress Fill - Undrained 80%
Unit Weight: 123 pcf
Cohesion: 425 psf
Phi: 16 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Storage Pool - Critical Circular Surface Failure Geometry
Cross-Section B
Date: 10/8/2016



Material Properties

Embankment Fill - Drained
Unit Weight: 128 pcf
Cohesion: 50 psf
Phi: 30 °

Coal Ash - Drained
Unit Weight: 100 pcf
Cohesion: 0 psf
Phi: 32 °

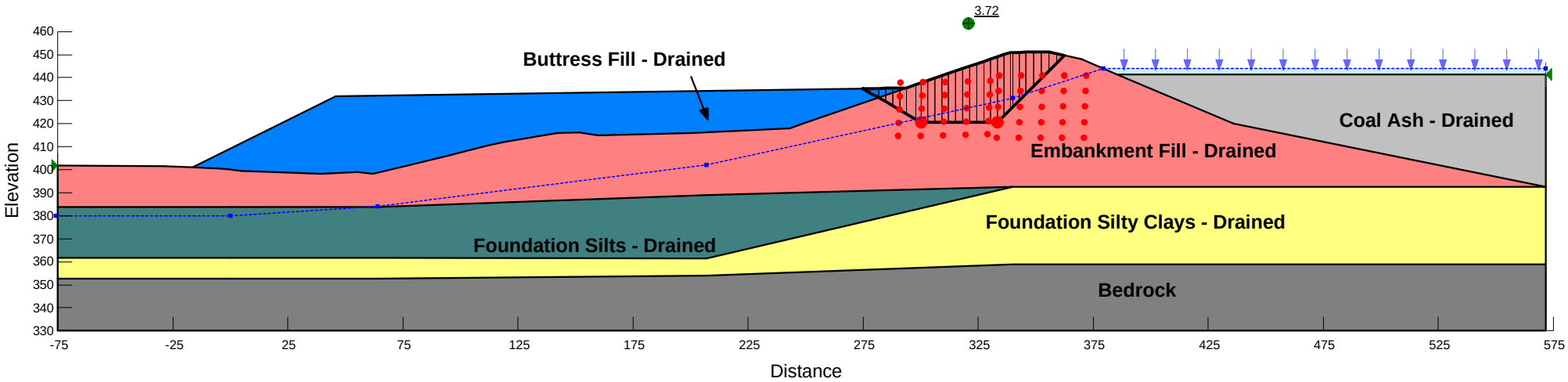
Foundation Silty Clays - Drained
Unit Weight: 126 pcf
Cohesion: 80 psf
Phi: 31 °

Foundation Silts - Drained
Unit Weight: 119 pcf
Cohesion: 0 psf
Phi: 33 °

Buttress Fill - Drained
Unit Weight: 123 pcf
Cohesion: 45 psf
Phi: 27 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Storage Pool - Critical Block Failure Surface Geometry
Cross-Section B
Date: 10/8/2016



Material Properties

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Cohesion: 80 psf
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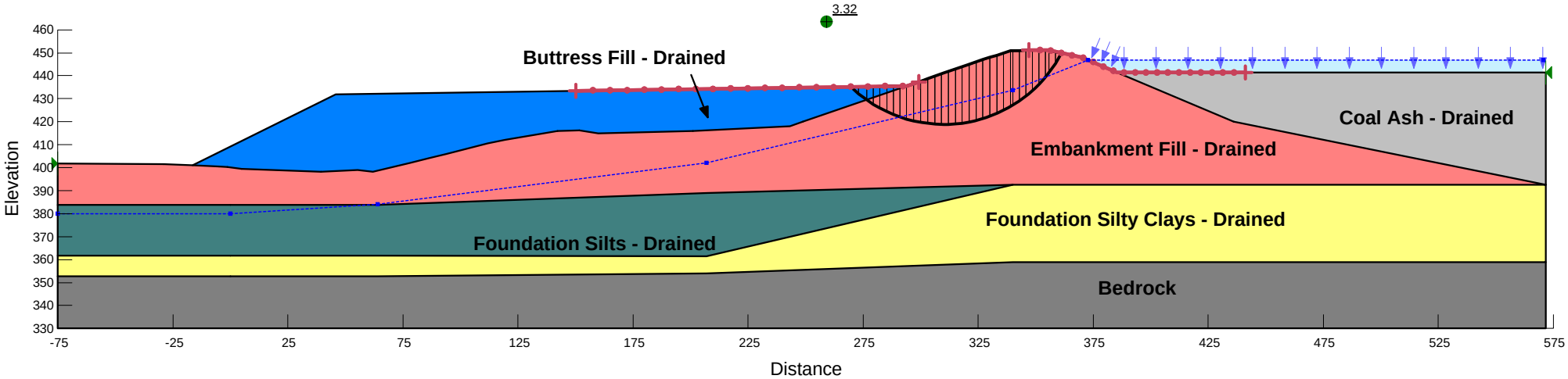
Foundation Silts - Drained
Unit Weight: 119 pcf
Cohesion: 0 psf
Phi: 33 °

Buttress Fill - Drained
Unit Weight: 123 pcf
Cohesion: 45 psf
Phi: 27 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Surcharge Pool - Critical Circular Surface Failure Geometry
Cross-Section B
Date: 10/8/2016



Material Properties

Embankment Fill - Drained
Unit Weight: 128 pcf
Cohesion: 50 psf
Phi: 30 °

Coal Ash - Drained
Unit Weight: 100 pcf
Cohesion: 0 psf
Phi: 32 °

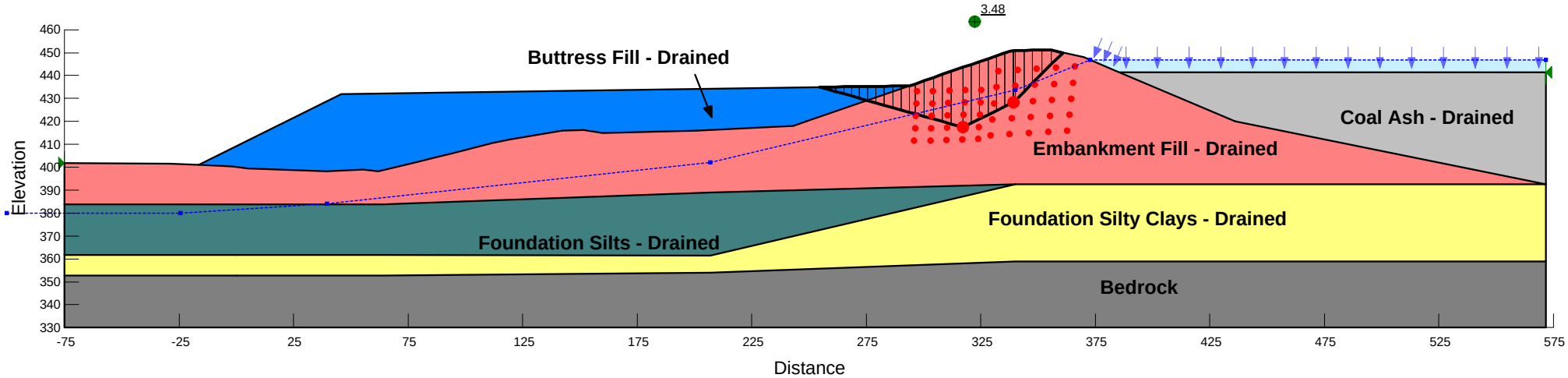
Foundation Silty Clays - Drained
Unit Weight: 126 pcf
Cohesion: 80 psf
Phi: 31 °

Foundation Silts - Drained
Unit Weight: 119 pcf
Cohesion: 0 psf
Phi: 33 °

Buttress Fill - Drained
Unit Weight: 123 pcf
Cohesion: 45 psf
Phi: 27 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Surcharge Pool - Critical Block Failure Surface Geometry
Cross-Section B
Date: 10/8/2016



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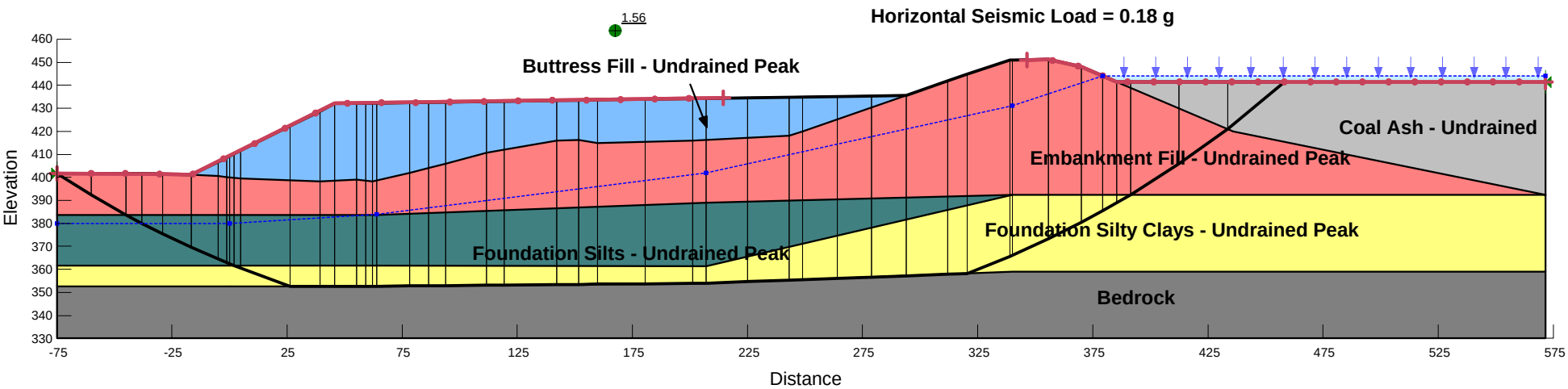
Buttress Fill - Drained
Unit Weight: 123 pcf
Cohesion: 45 psf
Phi: 27 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Seismic - Critical Circular Surface Failure Geometry
Cross-Section B
Date: 10/7/2016



Material Properties

Embankment Fill - Undrained Peak
Unit Weight: 128 pcf
Cohesion: 600 psf
Phi: 22 °

Coal Ash - Undrained
Unit Weight: 100 pcf
Cohesion: 100 psf
Phi: 12 °

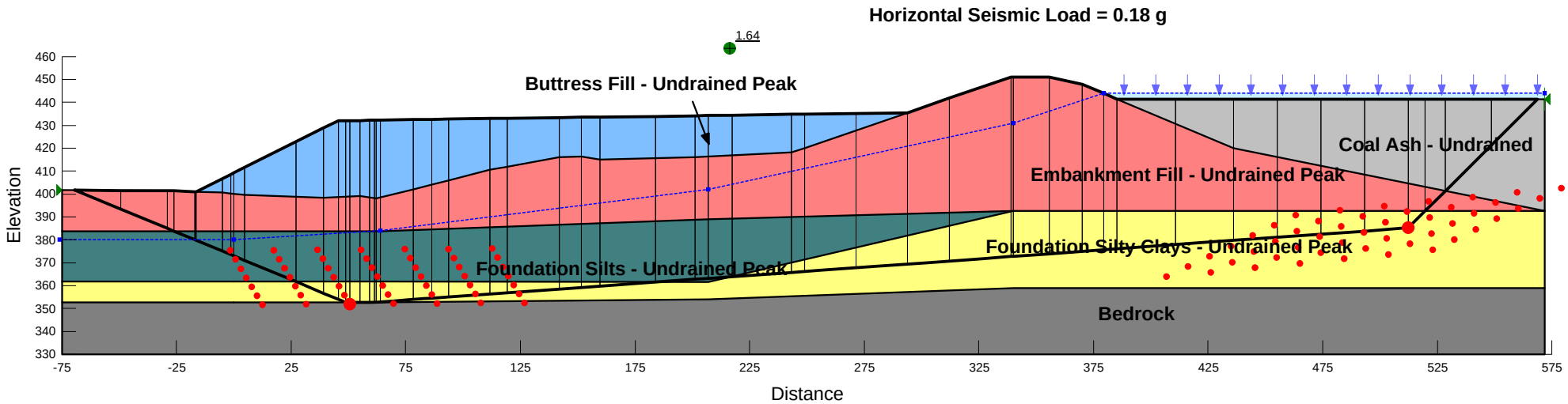
Foundation Silty Clays - Undrained Peak
Unit Weight: 126 pcf
Cohesion: 400 psf
Phi: 23 °

Foundation Silts - Undrained Peak
Unit Weight: 119 pcf
Cohesion: 650 psf
Phi: 22 °

Buttress Fill - Undrained Peak
Unit Weight: 123 pcf
Cohesion: 540 psf
Phi: 20 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Seismic - Critical Block Failure Surface Geometry
Cross-Section B
Date: 10/7/2016



Material Properties

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Unit Weight: 128 pcf
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Unit Weight: 123 pcf
Cohesion: 540 psf
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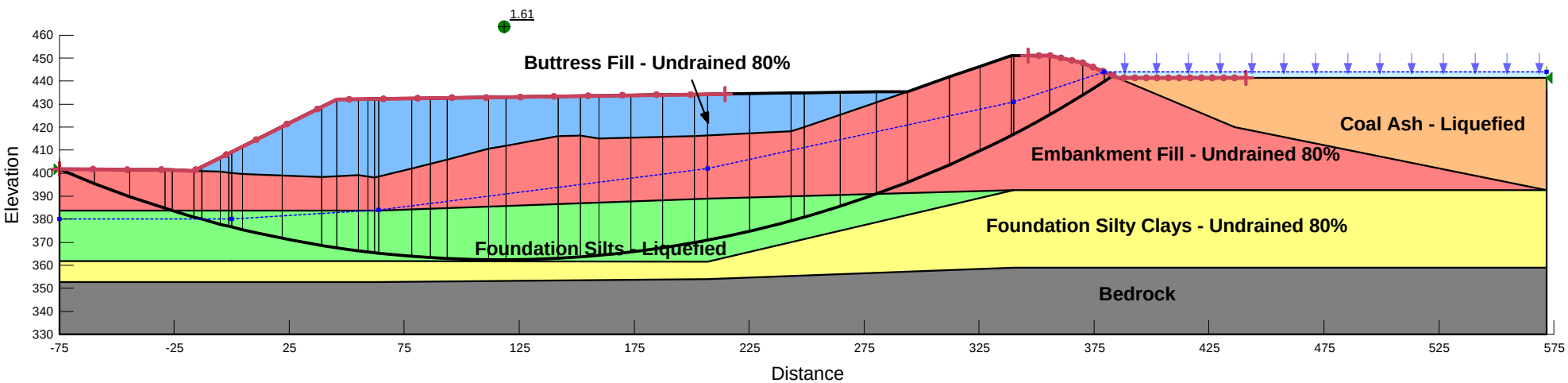
Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Post-Liquefaction - Critical Circular Surface Failure Geometry
Cross-Section B
Date: 9/13/2016



Material Properties

Embankment Fill - Undrained 80%
Unit Weight: 128 pcf
Cohesion: 475 psf
Phi: 18 °

Coal Ash - Liquefied
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.12
Minimum Strength: 0

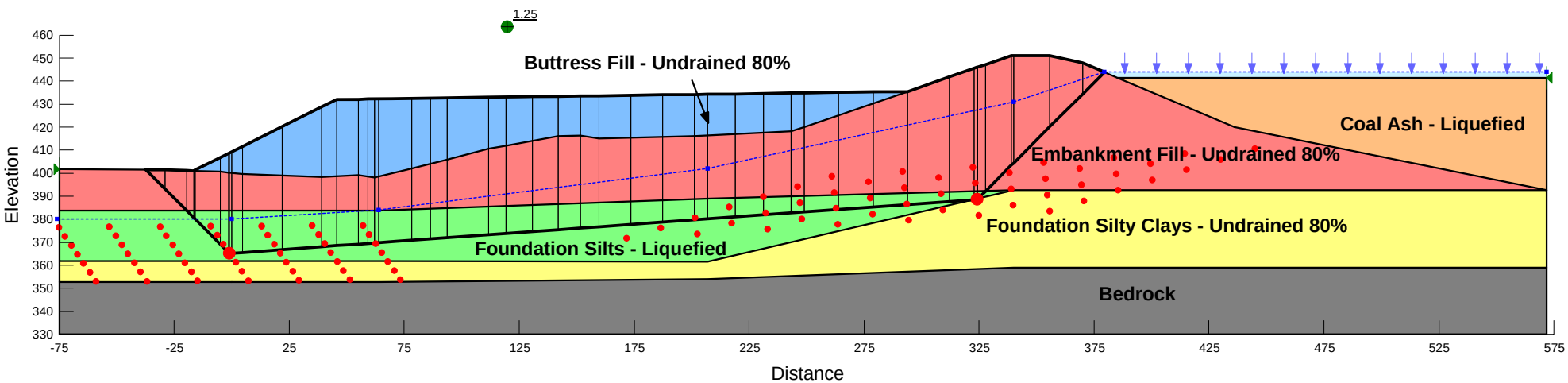
Foundation Silty Clays - Undrained 80%
Unit Weight: 126 pcf
Cohesion: 320 psf
Phi: 19 °

Foundation Silts - Liquefied
Unit Weight: 119 pcf
Tau/Sigma Ratio: 0.1
Minimum Strength: 100

Buttress Fill - Undrained 80%
Unit Weight: 123 pcf
Cohesion: 425 psf
Phi: 16 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Post-Liquefaction - Critical Block Failure Surface Geometry
Cross-Section B
Date: 9/13/2016



Material Properties

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Unit Weight: 119 pcf
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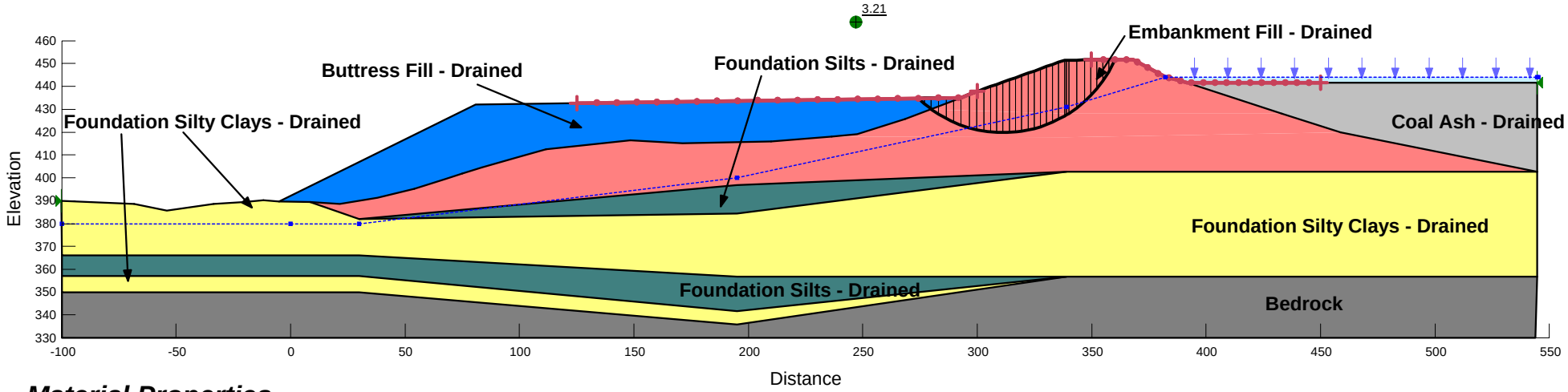
Minimum Strength: 100

Buttress Fill - Undrained 80%
Unit Weight: 123 pcf
Cohesion: 425 psf
Phi: 16 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Storage Pool - Critical Circular Failure Surface Geometry
Cross-Section C
Date: 10/10/2016



Material Properties

Embankment Fill - Drained
Unit Weight: 128 pcf
Cohesion: 50 psf
Phi: 30 °

Coal Ash - Drained
Unit Weight: 100 pcf
Cohesion: 0 psf
Phi: 32 °

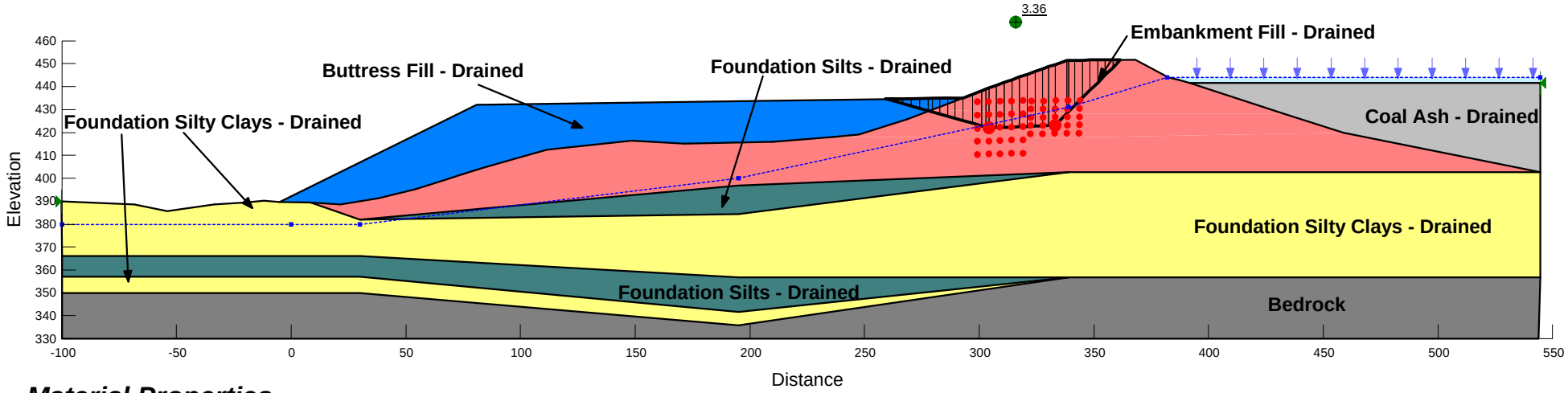
Buttress Fill - Drained
Unit Weight: 123 pcf
Cohesion: 45 psf
Phi: 27 °

Foundation Silts - Drained
Unit Weight: 119 pcf
Cohesion: 0 psf
Phi: 33 °

Foundation Silty Clays - Drained
Unit Weight: 126 pcf
Cohesion: 80 psf
Phi: 31 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Storage Pool - Critical Block Failure Surface Geometry
Cross-Section C
Date: 10/10/2016



Material Properties

Embankment Fill - Drained
Unit Weight: 128 pcf
Cohesion: 50 psf
Phi: 30 °

Coal Ash - Drained
Unit Weight: 100 pcf
Cohesion: 0 psf
Phi: 32 °

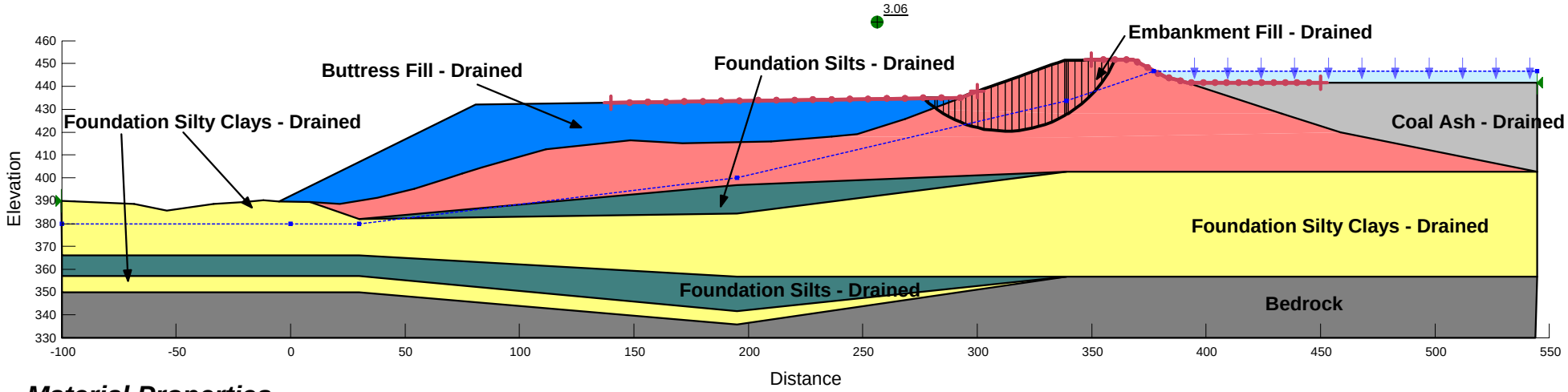
Buttress Fill - Drained
Unit Weight: 123 pcf
Cohesion: 45 psf
Phi: 27 °

Foundation Silts - Drained
Unit Weight: 119 pcf
Cohesion: 0 psf
Phi: 33 °

Foundation Silty Clays - Drained
Unit Weight: 126 pcf
Cohesion: 80 psf
Phi: 31 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Surcharge Pool - Critical Circular Failure Surface Geometry
Cross-Section C
Date: 10/10/2016



Material Properties

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Phi: 30 °

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Unit Weight: 100 pcf
Cohesion: 0 psf
Phi: 32 °

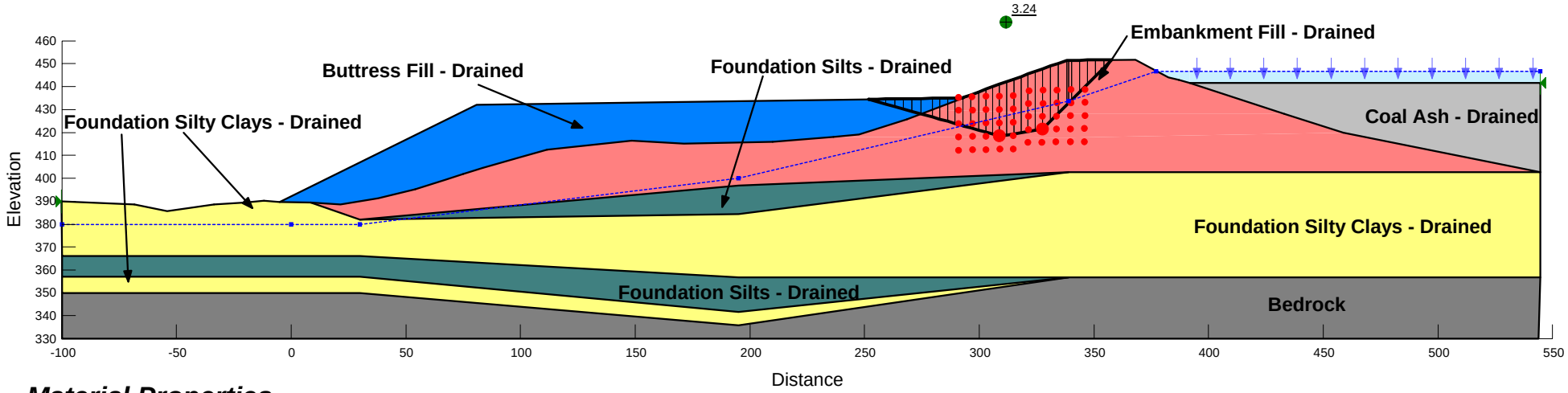
Buttress Fill - Drained
Unit Weight: 123 pcf
Cohesion: 45 psf
Phi: 27 °

Foundation Silts - Drained
Unit Weight: 119 pcf
Cohesion: 0 psf
Phi: 33 °

Foundation Silty Clays - Drained
Unit Weight: 126 pcf
Cohesion: 80 psf
Phi: 31 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Surcharge Pool - Critical Block Failure Surface Geometry
Cross-Section C
Date: 10/10/2016



Material Properties

Embankment Fill - Drained
Unit Weight: 128 pcf
Cohesion: 50 psf
Phi: 30 °

Coal Ash - Drained
Unit Weight: 100 pcf
Cohesion: 0 psf
Phi: 32 °

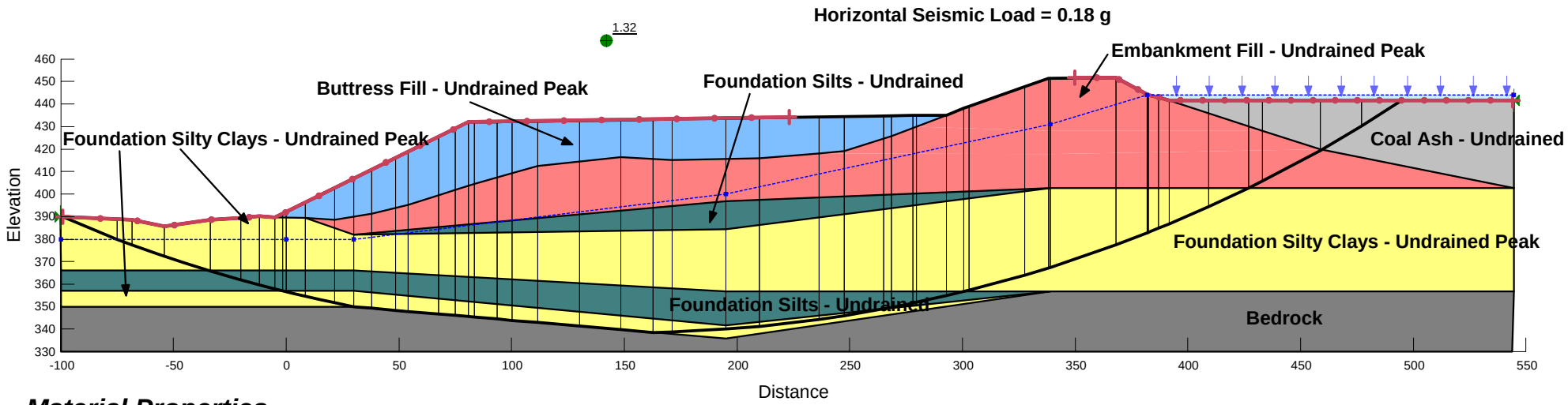
Buttress Fill - Drained
Unit Weight: 123 pcf
Cohesion: 45 psf
Phi: 27 °

Foundation Silts - Drained
Unit Weight: 119 pcf
Cohesion: 0 psf
Phi: 33 °

Foundation Silty Clays - Drained
Unit Weight: 126 pcf
Cohesion: 80 psf
Phi: 31 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Seismic - Critical Circular Failure Surface Geometry
Cross-Section C
Date: 10/7/2016



Material Properties

Embankment Fill - Undrained Peak
Unit Weight: 128 pcf
Cohesion: 600 psf
Phi: 22 °

Coal Ash - Undrained
Unit Weight: 100 pcf
Cohesion: 100 psf
Phi: 12 °

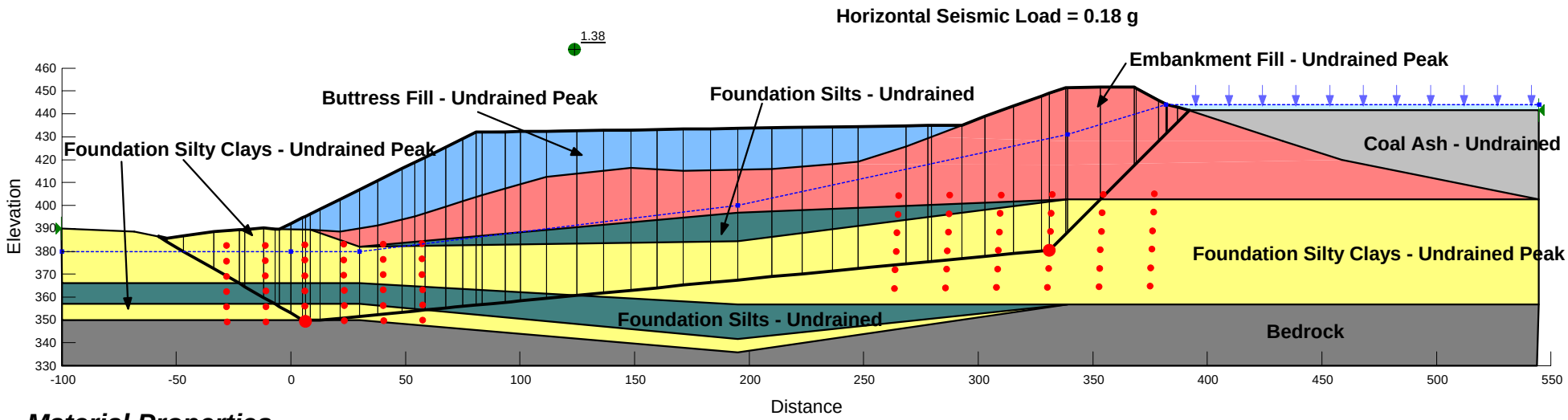
Buttress Fill - Undrained Peak
Unit Weight: 123 pcf
Cohesion: 540 psf
Phi: 20 °

Foundation Silts - Undrained
Unit Weight: 119 pcf
Cohesion: 650 psf
Phi: 22 °

Foundation Silty Clays - Undrained Peak
Unit Weight: 126 pcf
Cohesion: 400 psf
Phi: 23 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Seismic - Critical Block Failure Surface Geometry
Cross-Section C
Date: 10/7/2016



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Cohesion: 600 psf
Phi: 22 °

Coal Ash - Undrained
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Cohesion: 100 psf
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Unit Weight: 123 pcf
Cohesion: 540 psf
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Foundation Silts - Undrained
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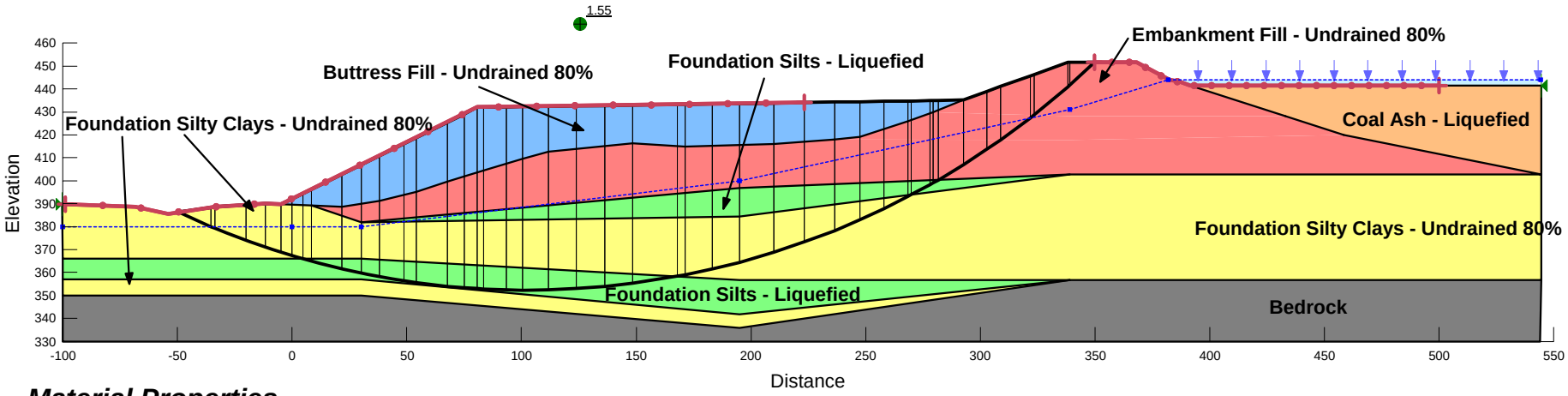
Foundation Silty Clays - Undrained Peak
Unit Weight: 126 pcf
Cohesion: 400 psf
Phi: 23 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Post-Liquefaction - Critical Circular Failure Surface Geometry
Cross-Section C
Date: 9/13/2016



Material Properties

Embankment Fill - Undrained 80%
Unit Weight: 128 pcf
Cohesion: 475 psf
Phi: 18 °

Coal Ash - Liquefied
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.12
Minimum Strength: 0

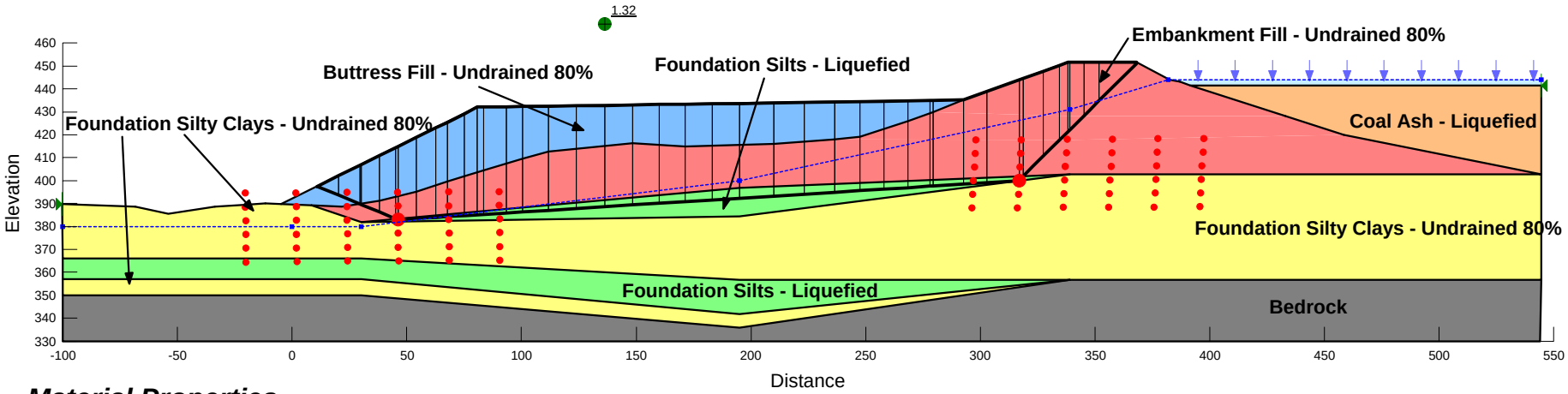
Buttress Fill - Undrained 80%
Unit Weight: 123 pcf
Cohesion: 425 psf
Phi: 16 °

Foundation Silts - Liquefied
Unit Weight: 119 pcf
Tau/Sigma Ratio: 0.1
Minimum Strength: 100

Foundation Silty Clays - Undrained 80%
Unit Weight: 126 pcf
Cohesion: 320 psf
Phi: 19 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Post-Liquefaction - Critical Block Failure Surface Geometry
Cross-Section C
Date: 9/13/2016



Material Properties

Embankment Fill - Undrained 80%
Unit Weight: 128 pcf
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Foundation Silty Clays - Undrained 80%
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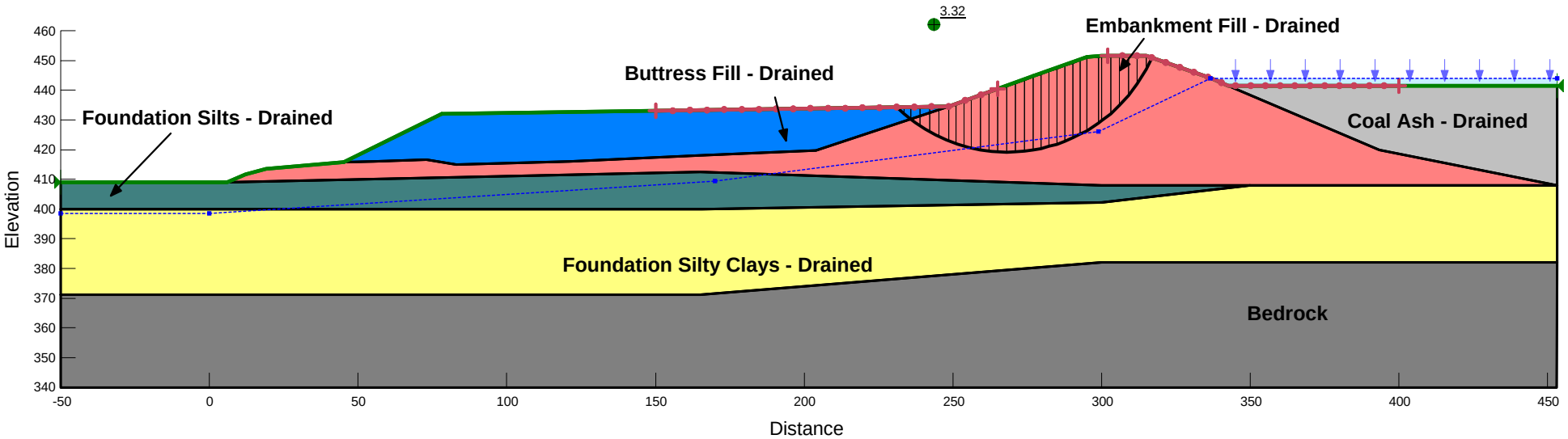
Cohesion: 320 psf
Phi: 19 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Storage Pool - Critical Circular Failure Surface Geometry
Cross-Section D
Date: 10/10/2016



Material Properties

Embankment Fill - Drained
Unit Weight: 128 pcf
Cohesion: 50 psf
Phi: 30 °

Foundation Silts - Drained
Unit Weight: 119 pcf
Cohesion: 0 psf
Phi: 33 °

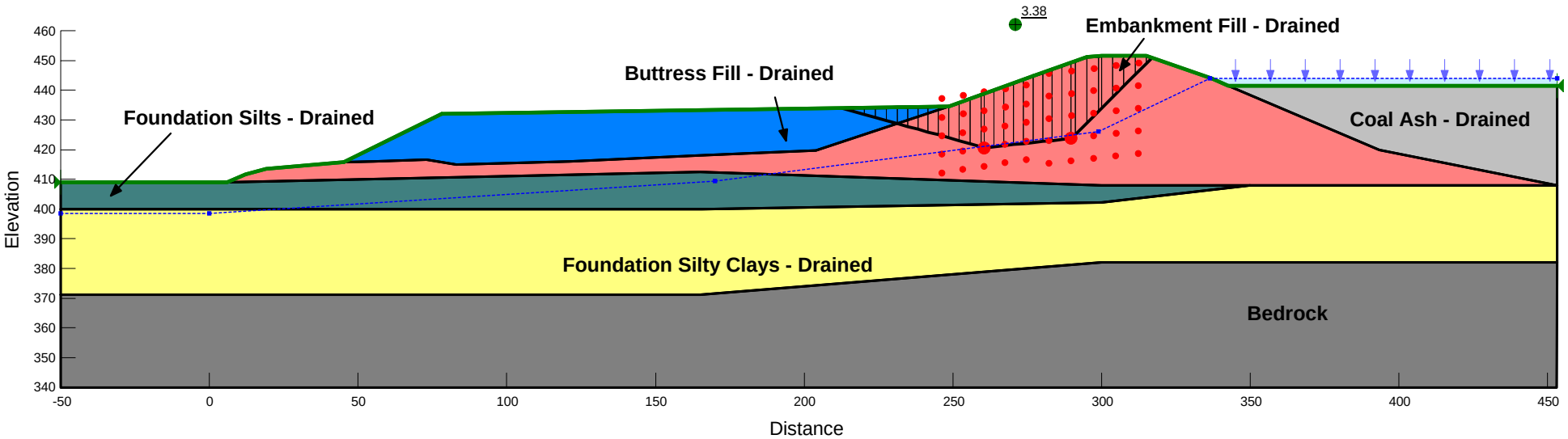
Foundation Silty Clays - Drained
Unit Weight: 126 pcf
Cohesion: 80 psf
Phi: 31 °

Coal Ash - Drained
Unit Weight: 100 pcf
Cohesion: 0 psf
Phi: 32 °

Buttress Fill - Drained
Unit Weight: 123 pcf
Cohesion: 45 psf
Phi: 27 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Storage Pool - Critical Block Failure Surface Geometry
Cross-Section D
Date: 10/10/2016



Material Properties

Embankment Fill - Drained
Unit Weight: 128 pcf
Cohesion: 50 psf
Phi: 30 °

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Cohesion: 0 psf
Phi: 33 °

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Unit Weight: 126 pcf
Cohesion: 80 psf
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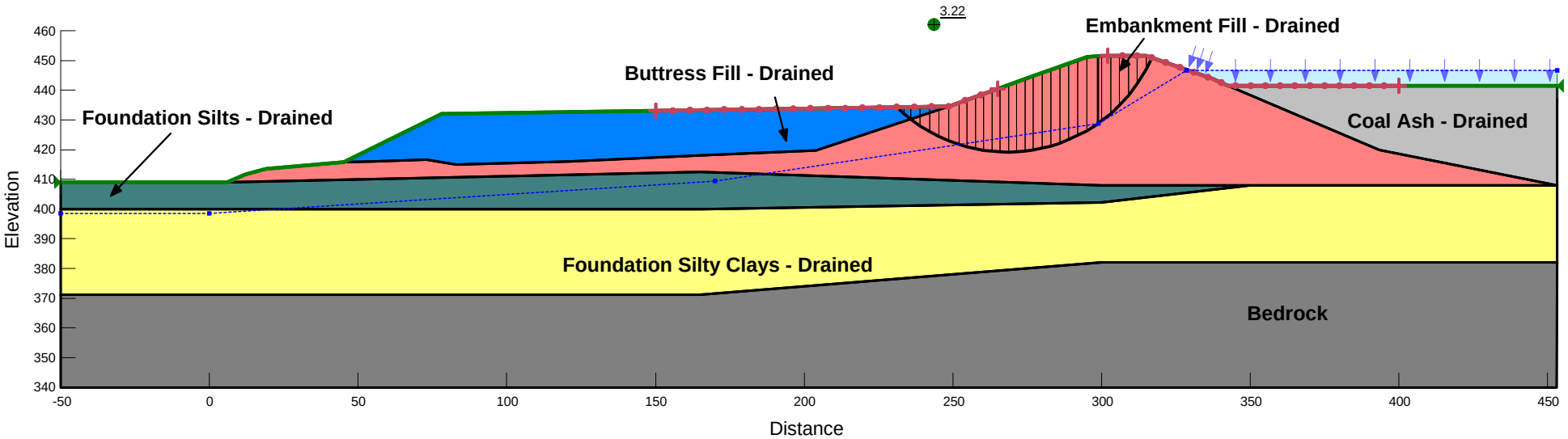
Coal Ash - Drained
Unit Weight: 100 pcf
Cohesion: 0 psf
Phi: 32 °

Buttress Fill - Drained
Unit Weight: 123 pcf
Cohesion: 45 psf
Phi: 27 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Surcharge Pool - Critical Circular Failure Surface Geometry
Cross-Section D
Date: 10/10/2016



Material Properties

Embankment Fill - Drained
Unit Weight: 128 pcf
Cohesion: 50 psf
Phi: 30 °

Foundation Silts - Drained
Unit Weight: 119 pcf
Cohesion: 0 psf
Phi: 33 °

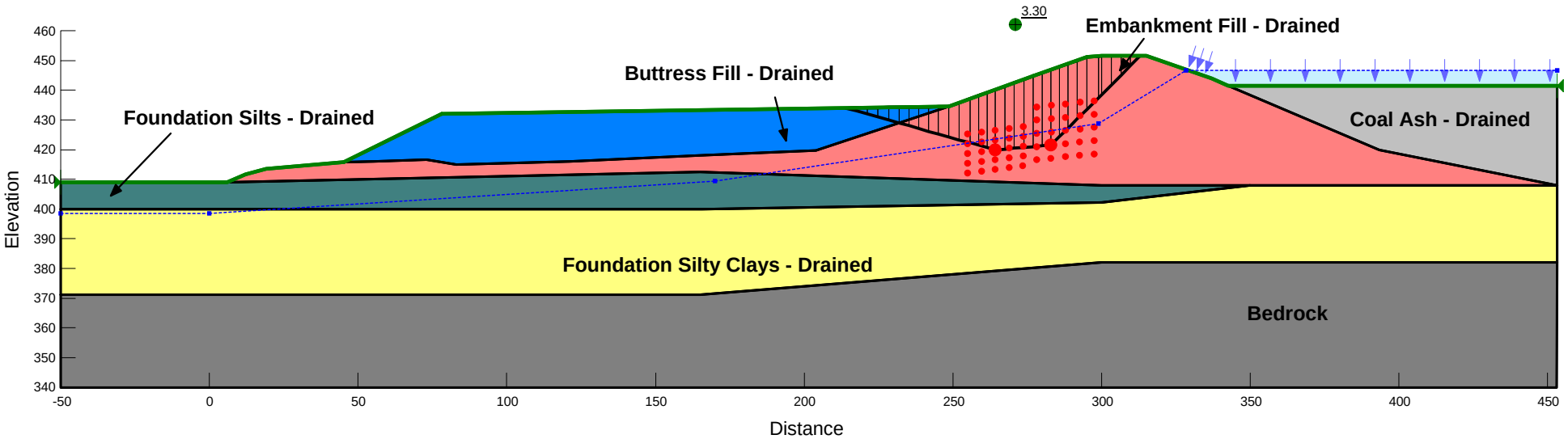
Foundation Silty Clays - Drained
Unit Weight: 126 pcf
Cohesion: 80 psf
Phi: 31 °

Coal Ash - Drained
Unit Weight: 100 pcf
Cohesion: 0 psf
Phi: 32 °

Buttress Fill - Drained
Unit Weight: 123 pcf
Cohesion: 45 psf
Phi: 27 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Surcharge Pool - Critical Block Failure Surface Geometry
Cross-Section D
Date: 10/10/2016



Material Properties

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Unit Weight: 128 pcf
Cohesion: 50 psf
Phi: 30 °

Foundation Silts - Drained
Unit Weight: 119 pcf
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Unit Weight: 100 pcf
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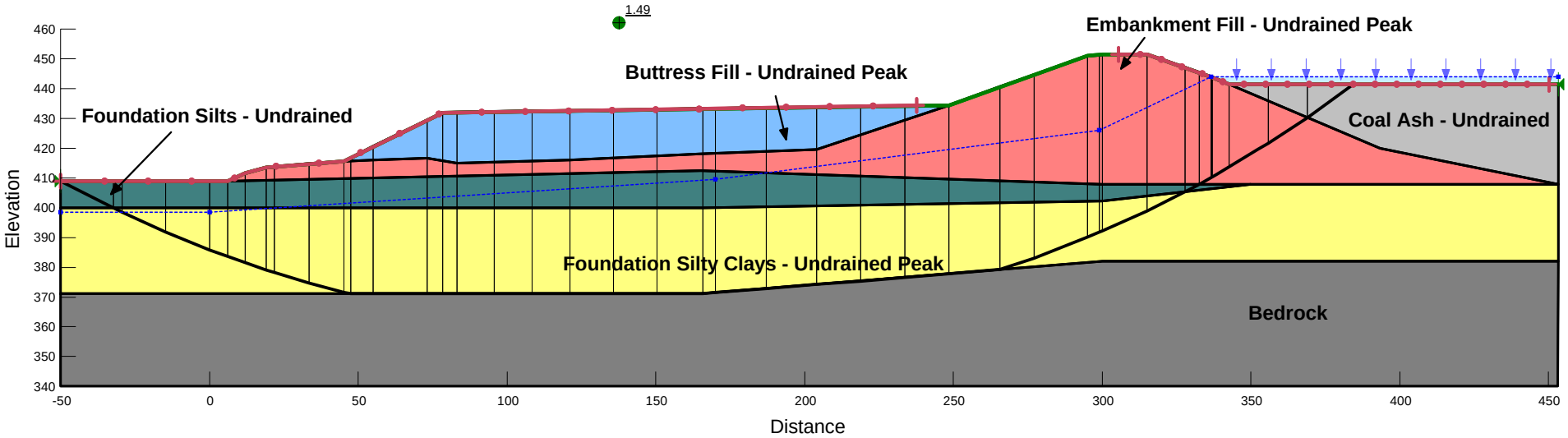
Buttress Fill - Drained
Unit Weight: 123 pcf
Cohesion: 45 psf
Phi: 27 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Seismic - Critical Circular Failure Surface Geometry
Cross-Section D
Date: 10/7/2016

Horizontal Seismic Load = 0.18 g



Material Properties

Embankment Fill - Undrained Peak
Unit Weight: 128 pcf
Cohesion: 600 psf
Phi: 22 °

Foundation Silts - Undrained
Unit Weight: 119 pcf
Cohesion: 650 psf
Phi: 22 °

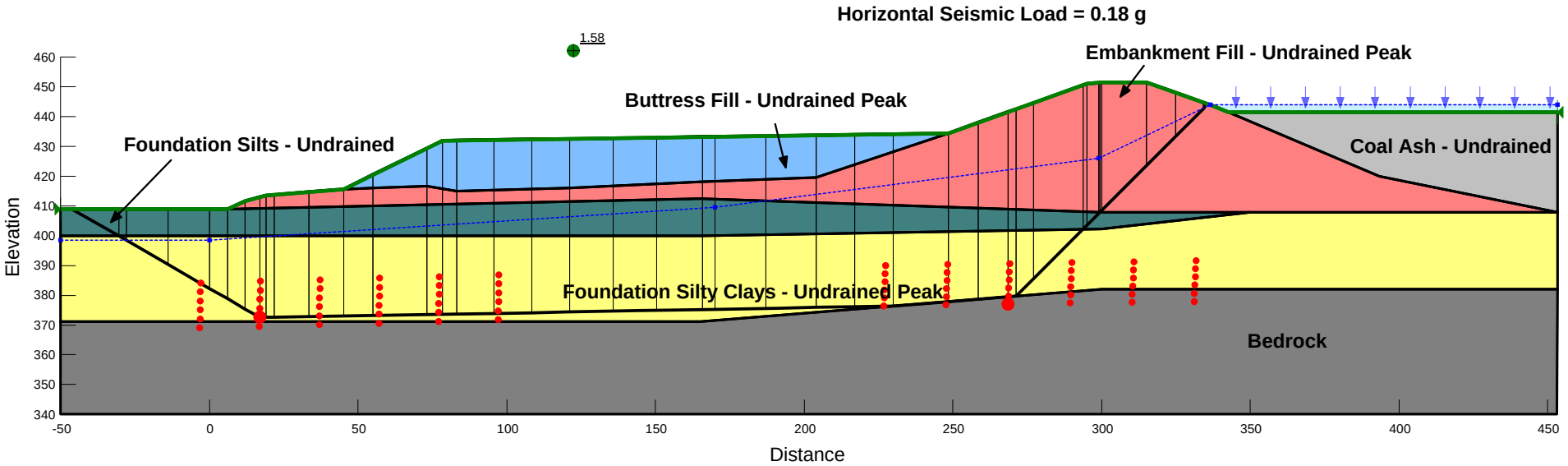
Foundation Silty Clays - Undrained Peak
Unit Weight: 126 pcf
Cohesion: 400 psf
Phi: 23 °

Coal Ash - Undrained
Unit Weight: 100 pcf
Cohesion: 100 psf
Phi: 12 °

Buttress Fill - Undrained Peak
Unit Weight: 123 pcf
Cohesion: 540 psf
Phi: 20 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Seismic - Critical Block Failure Surface Geometry
Cross-Section D
Date: 10/7/2016



Material Properties

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Unit Weight: 128 pcf
Cohesion: 600 psf
Phi: 22 °

Foundation Silts - Undrained
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Cohesion: 100 psf
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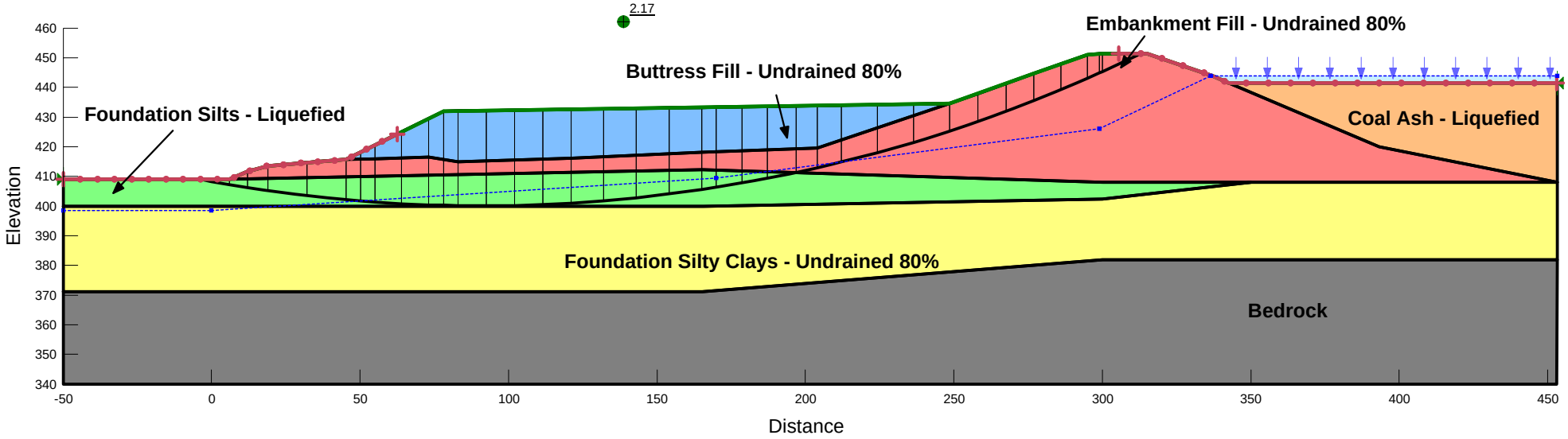
Buttress Fill - Undrained Peak
Unit Weight: 123 pcf
Cohesion: 540 psf
Phi: 20 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Post-Liquefaction - Critical Circular Failure Surface Geometry
Cross-Section D
Date: 9/13/2016



Material Properties

Embankment Fill - Undrained 80%
Unit Weight: 128 pcf
Cohesion: 475 psf
Phi: 18 °

Coal Ash - Liquefied
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.12
Minimum Strength: 0

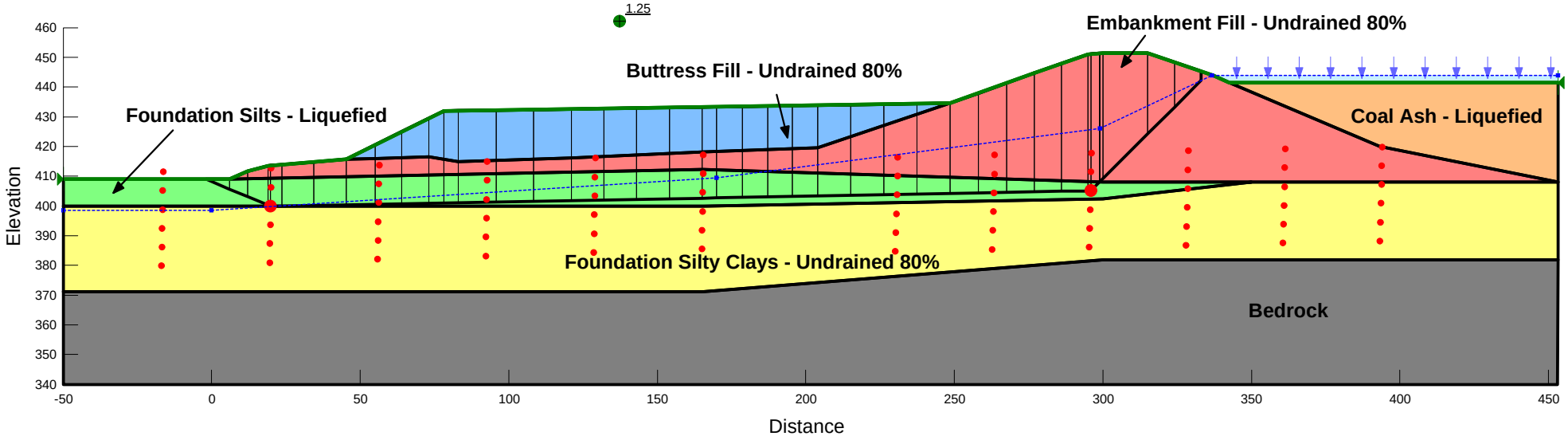
Foundation Silty Clays - Undrained 80%
Unit Weight: 126 pcf
Cohesion: 320 psf
Phi: 19 °

Foundation Silts - Liquefied
Unit Weight: 119 pcf
Tau/Sigma Ratio: 0.1
Minimum Strength: 100

Buttress Fill - Undrained 80%
Unit Weight: 123 pcf
Cohesion: 425 psf
Phi: 16 °

Ash Pond Lower Dam Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Post-Liquefaction - Critical Block Failure Surface Geometry
Cross-Section D
Date: 9/13/2016



Material Properties

Embankment Fill - Undrained 80%
Unit Weight: 128 pcf
Cohesion: 475 psf
Phi: 18 °

Coal Ash - Liquefied
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.12
Minimum Strength: 0

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Unit Weight: 126 pcf
Cohesion: 320 psf
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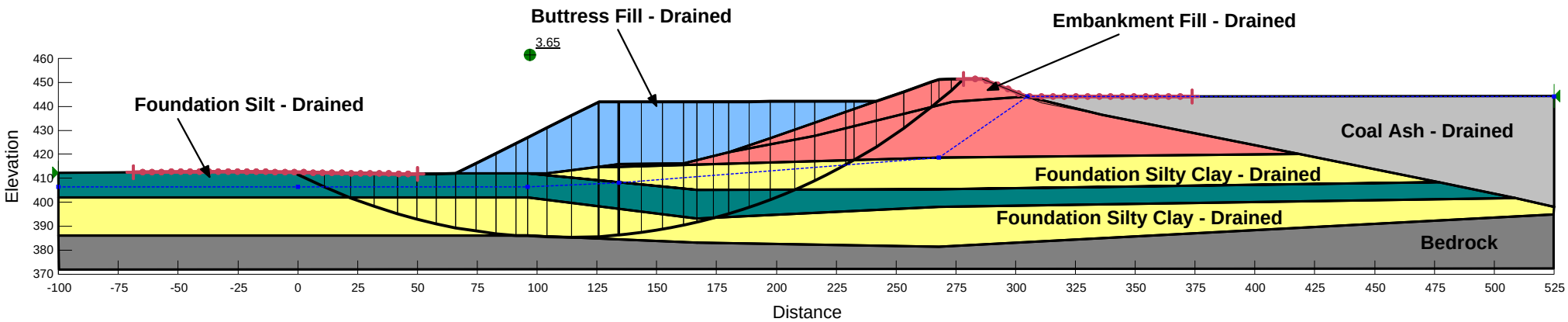
Foundation Silts - Liquefied
Unit Weight: 119 pcf
Tau/Sigma Ratio: 0.1
Minimum Strength: 100

Buttress Fill - Undrained 80%
Unit Weight: 123 pcf
Cohesion: 425 psf
Phi: 16 °

Ash Pond Lower Dan Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Storage Pool - Critical Circular Failure Surface Geometry
Cross-Section E
Date: 10/10/2016



Material Properties

Embankment Fill - Drained
Unit Weight: 128 pcf
Cohesion: 50 psf
Phi: 30 °

Coal Ash - Drained
Unit Weight: 100 pcf
Cohesion: 0 psf
Phi: 32 °

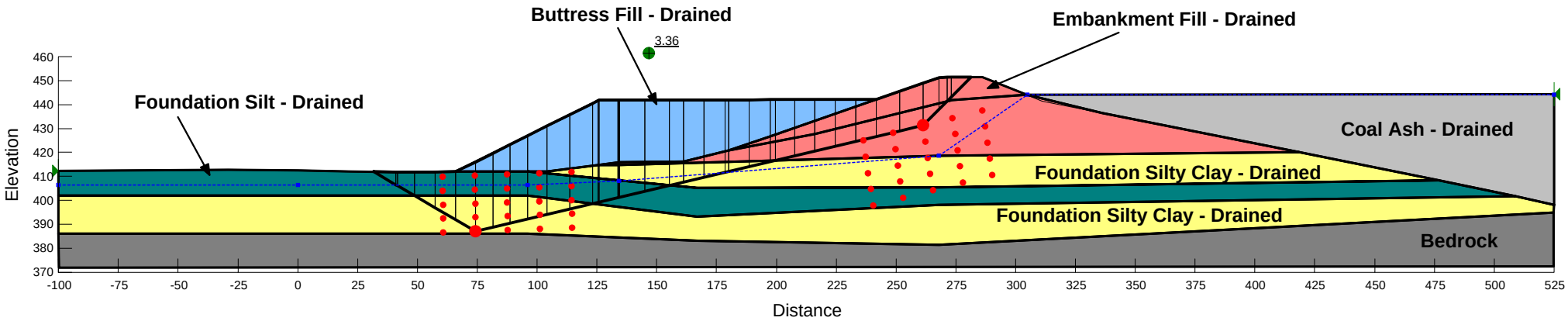
Foundation Silty Clay - Drained
Unit Weight: 126 pcf
Cohesion: 80 psf
Phi: 31 °

Foundation Silt - Drained
Unit Weight: 119 pcf
Cohesion: 0 psf
Phi: 33 °

Buttress Fill - Drained
Unit Weight: 123 pcf
Cohesion: 45 psf
Phi: 27 °

Ash Pond Lower Dan Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Storage Pool - Critical Block Failure Surface Geometry
Cross-Section E
Date: 10/10/2016



Material Properties

Embankment Fill - Drained
Unit Weight: 128 pcf
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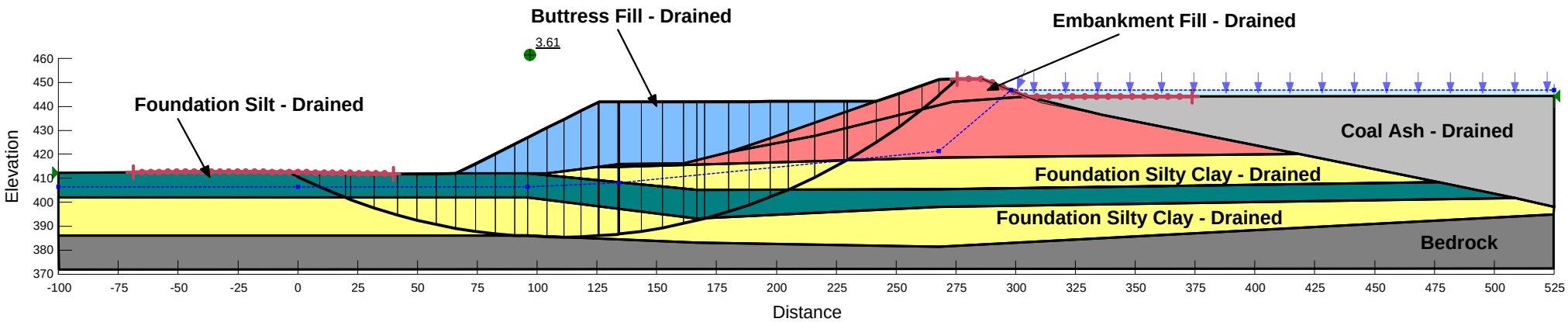
Unit Weight: 123 pcf
Cohesion: 45 psf
Phi: 27 °

Ash Pond Lower Dan Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Static Surcharge Pool - Critical Circular Failure Surface Geometry
Cross-Section E
Date: 10/10/2016



Material Properties

Embankment Fill - Drained
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Cohesion: 0 psf
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Cohesion: 80 psf
Phi: 31 °

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Unit Weight: 119 pcf
Cohesion: 0 psf
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Unit Weight: 123 pcf
Cohesion: 45 psf
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Vectren A.B. Brown Station

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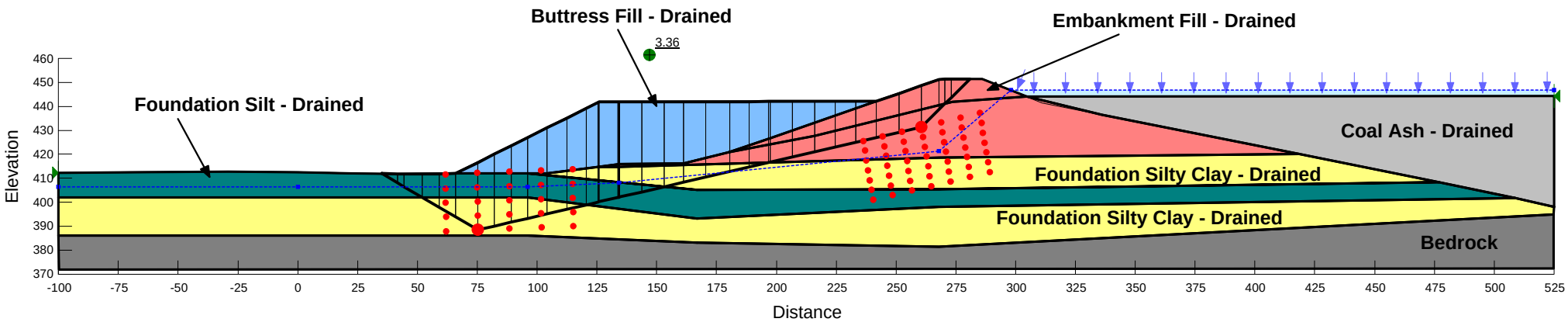

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Unit Weight: 123 pcf
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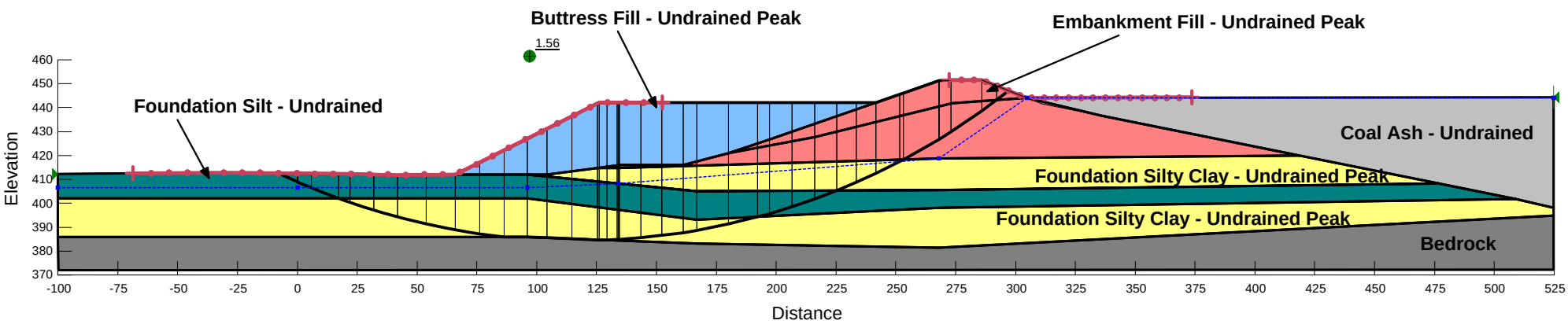
Ash Pond Lower Dan Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Seismic - Critical Circular Failure Surface Geometry
Cross-Section E
Date: 10/7/2016

Horizontal Seismic Load: 0.18 g



Material Properties

Embankment Fill - Undrained Peak
Unit Weight: 128 pcf
Cohesion: 600 psf
Phi: 22 °

Coal Ash - Undrained
Unit Weight: 100 pcf
Cohesion: 100 psf
Phi: 12 °

Foundation Silty Clay - Undrained Peak
Unit Weight: 126 pcf
Cohesion: 400 psf
Phi: 23 °

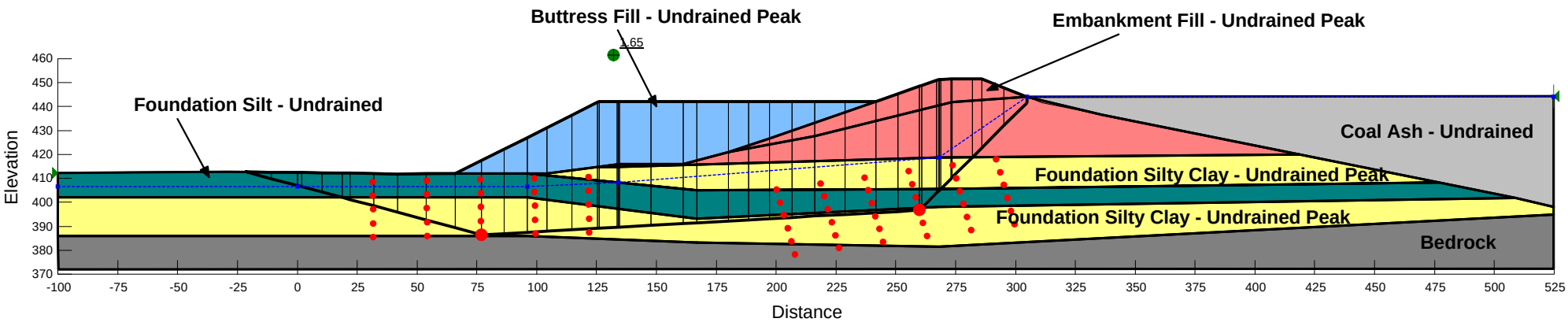
Foundation Silt - Undrained
Unit Weight: 119 pcf
Cohesion: 650 psf
Phi: 22 °

Buttress Fill - Undrained Peak
Unit Weight: 123 pcf
Cohesion: 540 psf
Phi: 20 °

Ash Pond Lower Dan Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Seismic - Critical Block Failure Surface Geometry
Cross-Section E
Date: 10/7/2016

Horizontal Seismic Load: 0.18 g



Material Properties

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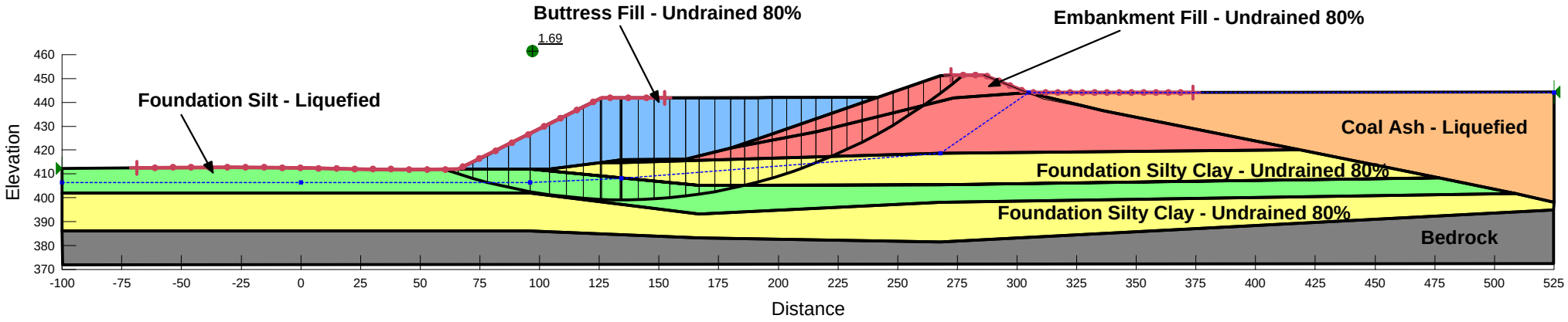
Ash Pond Lower Dan Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Post-Liquefaction - Critical Circular Failure Surface Geometry
Cross-Section E
Date: 9/13/2016



Material Properties

Embankment Fill - Undrained 80%
Unit Weight: 128 pcf
Cohesion: 475 psf
Phi: 18 °

Coal Ash - Liquefied
Unit Weight: 100 pcf
Tau/Sigma Ratio: 0.12
Minimum Strength: 0

Foundation Silty Clay - Undrained 80%
Unit Weight: 126 pcf
Cohesion: 320 psf
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Foundation Silt - Liquefied
Unit Weight: 119 pcf
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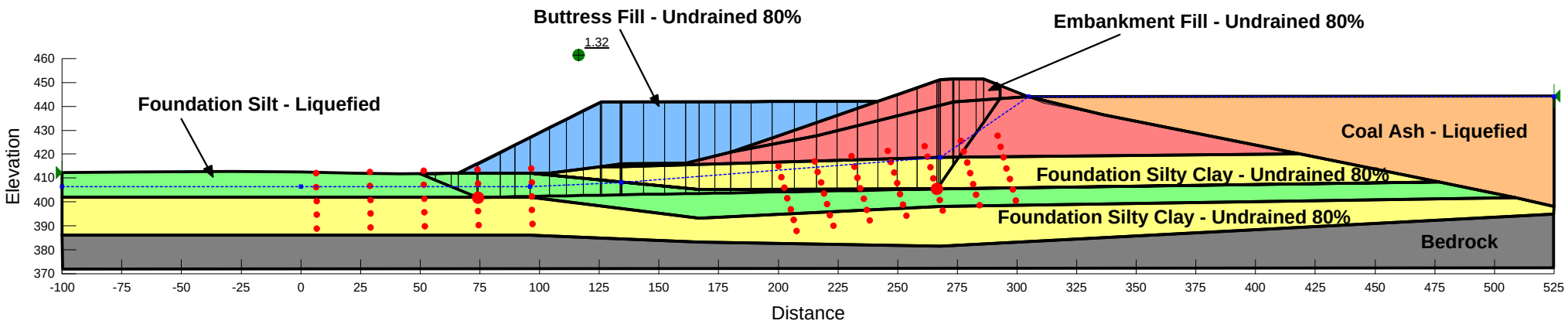
Buttress Fill - Undrained 80%
Unit Weight: 123 pcf
Cohesion: 425 psf
Phi: 16 °

Ash Pond Lower Dan Buttress Evaluation
Vectren A.B. Brown Station

CCR Rule Safety Factor Assessment
Post- Liquefaction - Critical Block Failure Surface Geometry
Cross-Section E
Date: 9/13/2016



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Buttress Fill - Undrained 80%
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Cohesion: 425 psf
Phi: 16 °

Appendix G
Probabilistic Seismic Hazard Analysis Report

Site-Specific Probabilistic Seismic Hazard Analysis and Development of Time Histories for A.B. Brown Generating Station in Southwestern Indiana

Prepared for

Vectren Corporation

14 December 2015

Prepared by

AECOM

Patricia Thomas, Melanie Walling, Mark Dober, and Ivan Wong
Seismic Hazards Group
AECOM
1333 Broadway, Suite 800
Oakland, CA 94612

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At the request of Vectren Corporation, a site-specific probabilistic seismic hazard analysis (PSHA) has been performed for A.B. Brown Generating Station in southwestern Indiana (Figure 1) for a hard rock site condition. The hard rock hazard results and period-dependent amplification factors were used to compute a 2,500-yr return period Uniform Hazard Spectrum (UHS) for a firm rock site condition characterized by a time-averaged shear-wave velocity in the top 30 m (V_S30) of 760 m/sec (NEHRP B/C boundary). Horizontal acceleration time histories were developed consistent with the firm rock 2,500-yr return period UHS. The firm rock acceleration time histories will be used in liquefaction and deformation analysis of the Lower Ash Pond Dam at the A.B. Brown Generating Station. This report presents the results of the site-specific PSHA and the development of the horizontal acceleration time histories

A.B. Brown Generating Station is located in the Midcontinent region of the U.S. away from active plate boundaries in a region that has exhibited a moderate level of historical seismicity (Figure 1). There have been seven known earthquakes larger than moment magnitude (**M**) 5.0 within 200 km of the site. However, the region is capable of experiencing strong ground motions from moderate to large earthquakes (**M** > 6) particularly from the Wabash Seismic Zone and the New Madrid Seismic Zone to the southwest of the site (Figure 1).

1.1 PURPOSE

As stated in the Statement of Work, the following is the scope of work and deliverables.

Develop mean hazard curves based on performing a PSHA for the site utilizing the 2012 EPRI/DOE/NRC Central and Eastern U.S. (CEUS) Seismic Source Characterization (CEUS-SSC) model and the EPRI (2013) ground motion prediction models. Compute the Uniform Hazard Spectra (UHS) corresponding to horizontal motion in hard rock (shear-wave velocity [V_S] 9,200 ft/sec [2,804 m/sec]) outcrop conditions for an annual frequency of exceedance of 1 in 2,500 at 5% damping. Develop three sets of horizontal acceleration time histories consistent with the 2,500-year hard rock UHS.

Current ground motion prediction models for the CEUS are only available for hard rock conditions, hence the PSHA must be performed for hard rock conditions. However, the depth to hard rock at A.B. Brown Generating Station is estimated to be more than 60 m (200 ft). In order to limit the size of the model used in deformation analyses, acceleration time histories consistent with a 2,500-year UHS for a firm rock site condition (V_S of 760 m/sec) were developed using amplification factors to convert the hard rock UHS to a firm rock site condition.

The PSHA methodology used in this study allows for the explicit inclusion of the range of possible interpretations in components of the model, including seismic source characterization and ground motion estimation. Uncertainties in models and parameters are incorporated into the PSHA through the use of logic trees. This report describes the seismic source model, the ground motion prediction models used in the PSHA, the hard rock hazard results and the development of a 2,500-yr UHS for firm rock and associated time histories.

1.2 ACKNOWLEDGMENTS

The seismic hazard analysis of A.B. Brown Generating Station was performed by Melanie Walling, Mark Dober, Patricia Thomas, and Ivan Wong of the Seismic Hazards Group of

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The PSHA approach used in this study is based on the model developed principally by Cornell (1968). The occurrence of earthquakes on a fault is assumed to be a Poisson process. The Poisson model is widely used and is a reasonable assumption in regions where data are sufficient to provide only an estimate of average recurrence rate (Cornell, 1968). The occurrence of ground motions at the site in excess of a specified level is also a Poisson process, if (1) the occurrence of earthquakes is a Poisson process, and (2) the probability that any one event will result in ground motions at the site in excess of a specified level is independent of the occurrence of other events.

The probability that a ground motion parameter "*Z*" exceeds a specified value "*z*" in a time period "t" is given by:

$$p(Z > z) = 1\text{-}e^{-\nu(z)\cdot t} \qquad (2\text{-}1)$$

where $\nu(z)$ is the annual mean number (or rate) of events in which Z exceeds z. It should be noted that the assumption of a Poisson process for the number of events is not critical. This is because the mean number of events in time t, $\nu(z) \bullet t$, can be shown to be a close upper bound on the probability $p(Z > z)$ for small probabilities (less than 0.10) that generally are of interest for engineering applications. The annual mean number of events is obtained by summing the contributions from all sources, that is:

$$\nu(z) = \sum_n \nu_n(z) \qquad (2\text{-}2)$$

where $\nu_n(z)$ is the annual mean number (or rate) of events on source n for which Z exceeds z at the site. The parameter $\nu_n(z)$ is given by the expression:

$$\nu_n(z) = \sum_i \sum_j \beta_n(m_i) \bullet p(R=r_j|m_i) \bullet p(Z>z|m_i,r_j) \qquad (2\text{-}3)$$

where:

$\beta_n(m_i)$	=	annual mean rate of recurrence of earthquakes of magnitude increment m_i on source n;
$p(R=r_j\|m_i)$	=	probability that given the occurrence of an earthquake of magnitude m_i on source n, r_j is the closest distance increment from the rupture surface to the site;
$p(Z > z\|m_i,r_j)$	=	probability that given an earthquake of magnitude m_i at a distance of r_j, the ground motion exceeds the specified level z.

The calculations were made using the computer program HAZ38CEUS. The basic program (HAZ38) has been validated in the Pacific Earthquake Engineering Research (PEER) Center-sponsored "Validation of PSHA Computer Programs" Project (Thomas *et al.*, 2010). Modifications were made to HAZ38 to incorporate the CEUS-SSC model and the resulting revision, HAZ38CEUS, was validated by comparing hazard results with the test case results contained in EPRI/DOE/NRC (2012).

The following is a general overview of PSHA methodology used by AECOM. For this study, we have adopted the EPRI/DOE/NRC (2012) seismic source model, which required modifications to our general approach. For a detailed description, see EPRI/DOE/NRC (2012). A sample logic tree is shown on Figure 2. Logic trees such as shown on Figure 3 are used in the EPRI/DOE/NRC (2012) model.

2.1 SEISMIC SOURCE CHARACTERIZATION

Three types of earthquake sources are characterized in the CEUS-SSC model: (1) known fault sources; (2) seismotectonic zones; and (3) Mmax zones. Fault sources are modeled as three-dimensional fault surfaces and details of their behavior are incorporated into the source characterization. The inventory of fault sources in the CEUS is small and undoubtedly incomplete. Given this shortcoming, the historical seismicity is used as a proxy to address the hazard from those buried or unknown faults. The spatial density of the historical seismicity was assumed to be stationary; in this model the recurrence rates per area for each small area were smoothed using a Gaussian filter. The resulting seismotectonic and Mmax zones are areal source zones in which earthquakes are modeled as point sources.

The geometric source parameters for faults include fault location, segmentation model, dip, and thickness of the seismogenic zone (Figure 2). The recurrence parameters include recurrence model, recurrence rate (slip rate or average recurrence interval for the maximum event), slope of the recurrence curve (*b*-value), and maximum magnitude. Clearly, the geometry and recurrence are not totally independent. For example, if a fault is modeled with several small segments instead of large segments, the maximum magnitude is lower, and a given slip rate requires many more small earthquakes to accommodate a cumulative seismic moment. For areal source zones, only the area, seismogenic thickness, maximum magnitude, and recurrence parameters (based on the historical earthquake record) need to be defined.

Uncertainties in the CEUS-SSC source parameters are modeled using logic trees. In this procedure, values of the source parameters are represented by the branches of logic trees with weights that define the distribution of values. Sample logic trees are shown on Figures 2 and 3. In general, three or five values for each parameter were weighted and used in the analysis. Note that the weights associated with the percentiles are not equivalent to probabilities for these values, but rather are weights assigned to define the distribution.

2.1.1 Source Geometry

In the PSHA, it is assumed that earthquakes of a certain magnitude may occur randomly along the length of a given fault or segment. The distance from an earthquake to the site is dependent on the source geometry, the size and shape of the rupture on the fault plane, and the likelihood of the earthquake occurring at different points along the fault length. The distance to the fault is defined to be consistent with the specific ground motion prediction model used to calculate the ground motions. The distance, therefore, is dependent on both the dip and depth of the fault plane, and a separate distance function is calculated for each geometry and each ground motion prediction model. The size and shape of the rupture on the fault plane are dependent on the magnitude of the earthquake, with larger events rupturing longer and wider portions of the fault plane. For a given magnitude, the associated rupture surface is uniformly distributed along the fault length and width. Ruptures are constrained to occur entirely on the defined fault plane.

The rupture dimensions can be modeled using magnitude-rupture area and rupture width relationships.

2.1.2 Fault Recurrence

The recurrence relationships for faults are generally modeled using the exponentially truncated Gutenberg-Richter, characteristic earthquake, and the maximum moment (magnitude) recurrence models (Figure 2). These models are weighted to represent judgment on their applicability to the sources. For the areal source zones, only a truncated exponential recurrence relationship is assumed appropriate.

The general approach of Molnar (1979) and Anderson (1979) is often used to arrive at the recurrence for the exponentially truncated model. The number of events exceeding a given magnitude, *N(m)*, for the truncated exponential relationship is

$$N(m) = \alpha(m^o)\frac{10^{-b(m-m^o)} - 10^{-b(m^u-m^o)}}{1-10^{-b(m^u-m^o)}} \qquad (2\text{-}4)$$

where $\alpha(m^o)$ is the annual frequency of occurrence of earthquake greater than the minimum magnitude, m^o; b is the Gutenberg-Richter parameter defining the slope of the recurrence curve; and m^u is the upper-bound magnitude event that can occur on the source. A m^o of **M** 5.0 was used for the hazard calculations; this value is also used by the USGS in the National Hazard Maps (Frankel *et al*., 1996; Petersen *et al*., 2008).

A popular model often used in PSHA is where faults rupture with a "characteristic" magnitude on specific segments; this model is described by Aki (1983) and Schwartz and Coppersmith (1984). For the characteristic model, the numerical model of Youngs and Coppersmith (1985) is often used. In the characteristic model, the number of events exceeding a given magnitude is the sum of the characteristic events and the non-characteristic events. The characteristic events are distributed uniformly over a ± 0.25 magnitude unit around the characteristic magnitude and the remainder of the moment rate is distributed exponentially up to the characteristic range using the above equation (Youngs and Coppersmith, 1985).

The maximum moment model can be regarded as an extreme version of the characteristic model. The model proposed by Wesnousky (1986) is often used when there is no exponential portion of the recurrence curve, i.e., no events can occur between the minimum magnitude of **M** 5.0 and the distribution about the maximum magnitude.

The recurrence rates for the fault sources are defined by either the slip rate or the average return time for the maximum or characteristic event and the recurrence *b*-value. The slip rate is used to calculate the moment rate on the fault using the following equation defining the seismic moment:

$$M_o = \mu A D \qquad (2\text{-}5)$$

where M_o is the seismic moment, μ is the shear modulus, A is the area of the rupture plane, and D is the slip on the plane. Dividing both sides of the equation by time results in the moment rate as a function of slip rate:

$$\dot{M}_o = \mu A S \quad (2\text{-}6)$$

where $\dot{M}_o$ is the moment rate and S is the slip rate. M_o has been related to moment magnitude, **M**, by Hanks and Kanamori (1979):

$$\mathbf{M} = 2/3 \log M_o - 10.7 \quad (2\text{-}7)$$

Using this relationship and the relative frequency of different magnitude events from the recurrence model, the slip rate can be used to estimate the absolute frequency of different magnitude events.

The average return time for the characteristic or maximum magnitude event defines the high magnitude (low likelihood) end of the recurrence curve. When combined with the relative frequency of different magnitude events from the recurrence model, the recurrence curve is established.

2.2 GROUND MOTION PREDICTION

To characterize the ground motions at a specified site as a result of the seismic sources considered in the PSHA, we used ground motion prediction models for spectral accelerations (Figure 2; Section 4.2). Ground motion prediction models have at a minimum the variables of magnitude, distance, and site condition (e.g., rock, soil).

The uncertainty in ground motion models was included in the PSHA by using the log-normal distribution about the median values as defined by the standard deviation associated with each model. This distribution was truncated at five standard deviations above the median value predicted by the each model. We have tested our approach using the five sigma truncation against the test cases contained in EPRI/DOE/NRC (2012) where sigma was untruncated. The differences are insignificant.

In this section, we describe the seismotectonic and geologic setting and historical seismicity of the site region.

3.1 SEISMOTECTONIC SETTING

A.B. Brown Generating Station is located in southwestern Indiana, within the Wabash Valley Seismic Zone and about 140 km northeast of the New Madrid Seismic Zone (NMSZ) (Figure 4). Although the site is located within the continental interior and far from active plate boundaries, the preexisting structures formed in earlier tectonic settings are still capable of generating seismicity that can pose a hazard to the region. This seismicity has included several large historical earthquakes in the area (**M** > 7), e.g., the 1811 and 1812 New Madrid earthquakes (Figure 1).

The Wabash Valley Seismic Zone is a region of southwestern Indiana and southeastern Illinois that contains the Wabash Valley fault system (WVFS; see below). Numerous Holocene paleoliquefaction features have been mapped along river valleys within the Wabash Valley Seismic Zone and other regions of southern Indiana and Illinois and have been interpreted as having been caused by paleoearthquakes (e.g., Obermeier *et al.*, 1993). Munson *et al*. (1997) reported that at least eight paleoearthquakes had occurred in the area in the past 20,000 years. However, the faults of the WVFS have been mapped as pre-Quaternary, and no fault has been identified as the causative structure for the liquefaction nor been explicitly correlated with historic or paleoseismicity.

The CEUS is part of a broad mid-plate compressive stress province that also includes most of Canada (Zoback and Zoback, 1991). Over this large region, the stress field is oriented with a relatively uniform east-northeast direction of maximum horizontal compression. This compression direction corresponds well to the direction of absolute plate motion of the North American Plate, which suggests that a far-field tectonic source such as ridge-push or basal drag at the Mid-Atlantic Ridge may be the primary source of stress in the mid-plate region (Zoback and Zoback, 1991).

3.2 HISTORICAL SEISMICITY

The following is a discussion of the historical seismicity and significant earthquakes in the region surrounding A.B. Brown Generating Station.

3.2.1 Catalog

A historical seismicity catalog was derived mainly from the Central and Eastern United States Seismic Source Characterization (CEUS-SSC) catalog (EPRI/NRC/DOE, 2012). This catalog includes data primarily from the catalog compiled by the U.S. Geological Survey (USGS) for the National Seismic Hazard Mapping Project (Mueller *et al*., 1997; Petersen *et al*., 2008) and from the Geological Survey of Canada (GSC) catalog for seismic hazard analyses (Adams and Halchuk, 2003). The main source for the USGS catalog was the NCEER-91 catalog (Seeber and Ambruster, 1991) which updated the original EPRI-SOG (EPRI 1988) catalog. The catalog was then updated using the National Earthquake Information Center's (NEIC) Preliminary Determination of Epicenters (PDE) and data from the National Earthquake Database (NEDB) of Canada. Researchers reviewed original catalogs and special earthquake studies to verify and if needed update original entries, and regional catalogs were incorporated into the continental scale

catalogs described above (see EPRI/NRC/DOE, 2012 for details of special study references and list of regional catalogs used). The CEUS-SSC catalog spans the time period of 1568 to 2008. We updated this catalog with more recent data (through 6 March 2013) from the Advanced National Seismic System (ANSS) and NEIC PDE catalogs (Figure 1).

All of the events in the USGS catalog used to compile the CEUS-SSC catalog have body-wave (m_b) magnitude values, which were converted to **M** using the equations of Atkinson and Boore (1995):

$$\mathbf{M} = -0.39 + 0.98Mn \text{ for magnitudes} \leq 5.5$$

$$\mathbf{M} = 2.715 - 0.277Mn + 0.127(Mn^2) \text{ for magnitudes} > 5.5$$

and Johnston (1996):

$$\mathbf{M} = 1.14 + 0.24\, m_b + 0.0933\, m_b^2$$

Mn (Nuttli magnitude) was considered to be equivalent to m_b. All events in the PDE catalog that we used to update the CEUS-SSC catalog were Mn or M_D. We converted the PDE Mn magnitudes to **M** using the average of Atkinson and Boore (1995) and Johnston (1996). For the M_D values, we used the same conversion used in the CEUS-SSC catalog to convert them to **M** values for the Mid-Continent U.S. east of 100º W (EPRI/DOE/NRC, 2012).

$$\mathbf{M} = 0.869 + 0.762\, M_D$$

3.2.2 Significant Earthquakes

The most significant earthquakes to have occurred in the CEUS are the 1811-1812 **M** 7 to 8 New Madrid earthquake sequence and the 1886 **M** 6.8 Charleston, South Carolina, earthquake (Figure 1). The New Madrid earthquake sequence occurred over the winter of 1811-1812 in southeastern Missouri/northeastern Arkansas. This sequence, which was felt as far away as the East Coast (Figure 5), consisted of three principal events on 16 December 1811, 23 January 1812, and 7 February 1812 (referred to as NM1, NM2, and NM3, respectively in Hough *et al*., 2000) (Figure 6). Because the epicentral region was sparsely populated at the time of the events, little structural damage occurred, and the maximum Modified Mercalli (MM) intensity is IX (NM1) as reinterpreted by Hough *et al.* (2000). The A.B. Brown Generating Station site probably underwent strong ground shaking of MM VII to VIII in the 16 December 1811 mainshock (Figure 5). The NMSZ is currently the most seismically active area in the CEUS (Figure 1).

The most damaging earthquake to have occurred in the southeast U.S. is the 31 August 1886 **M** 6.8 Charleston, South Carolina earthquake. Sixty people were killed and many buildings in the old city of Charleston were damaged or destroyed and estimated property damage was on the order of $23 million (Stover and Coffman, 1993). Liquefaction was extensive with cratering, sand ejecta and fissuring over an area of 1,300 km^2. No surface-faulting was observed. The maximum intensity reported was MM X within an elliptical area trending northeasterly between Charleston and Jedburg (Stover and Coffman, 1993) (Figure 7). The earthquake affected an area of over 5 million km^2 and the site may have been subjected to moderate ground shaking of MM IV even though it is located 880 km northwest of the epicenter (Figure 7).

The Wabash Valley has historically been seismically active with several earthquakes of **M** 4.5 and larger (Figure 1). Hence, the site has been strongly shaken numerous times after the 1811-1812 and 1886 earthquakes. An event on 27 September 1891 occurred near Mt. Vernon, Illinois, which caused chimney damage in the epicentral area (Stover and Coffman, 1993). The size of the earthquake was estimated to be a body-wave magnitude (m_b) 5.8 and the event was felt widely in several states (Figure 8). Shaking at the site could have been as strong as MM V.

On 31 October 1895, an earthquake of estimated surface wave magnitude (M_S) 6.7 struck the northern end of the NMSZ (Figure 9). This is the largest earthquake to have occurred in the central Mississippi Valley since 1811-1812 (Stover and Coffman, 1993). The event caused extensive damage in the town of Charleston, Missouri. Sand blows due to liquefaction were also reported in the epicentral area (Stover and Coffman, 1993). In the area of the site, the ground shaking was probably at a MM VII level (Figure 9).

On 9 November 1968, a m_b 5.5 earthquake struck southern Illinois and neighboring states with a maximum reported MM VII (Figure 10). Damage consisted of damaged chimneys, broken windows, cracked or fallen plaster, cracked foundations, and scattered instances of collapsed parapets (Stover and Coffman, 1993). The site was probably subjected to MM VI to VII ground shaking from this event. Another notable earthquake was the 18 April 2008 **M** 5.4 Southern Illinois earthquake south of the site (Figure 1).

On 27 July 1980, a **M** 5.1 earthquake struck the area near Sharpsburg, Kentucky. This event, the strongest in the history of Kentucky, occurred approximately 340 km east of the site and caused over $1 million in property damage (Stover and Coffman, 1993). The site was probably subjected to intensities of MM II to III (Figure 11).

The 23 August 2011 **M** 5.8 Mineral, Virginia, earthquake occurred within the Central Virginia Seismic Zone and is the largest reported event in this zone. The previous largest event in this zone was an event of estimated **M** 4.8 in 1875. The 2011 earthquake occurred at a shallow depth of 6 km but it was felt throughout the eastern U.S. from central Georgia to central Maine and as far west as Detroit, Michigan and Chicago, Illinois (Figure 12). It may possibly have been lightly felt at the site more than 875 km away, based on the USGS Did You Feel It (DYFI) map (Figure 12).

The following discusses the two major inputs into the PSHA: the seismic source model and the ground motion prediction models.

4.1 SEISMIC SOURCE MODEL

Seismic source characterization is concerned with three fundamental elements: (1) the location, geometry, and characteristics of significant sources of future earthquakes; (2) the maximum size of these earthquakes; and (3) the rate at which different size earthquakes occur. Two types of seismic sources were considered in this PSHA: discrete fault or fault zone sources and regional seismic source zones.

The seismic source characterization presented here is adopted from the comprehensive seismic source characterization of the CEUS, developed for nuclear facilities by EPRI/DOE/NRC (2012). Two zonation models, account for earthquakes associated with buried or generally unknown faults (background), were characterized and included in the PSHA; these models include multiple zones, many having alternative geometries (Figures 13 and 14). In addition, the source parameters for several fault sources or RLMEs (repeated large magnitude earthquakes) were characterized for input into the PSHA (Figure 13).

A major challenge in understanding the earthquake potential in the CEUS has been associating the observed seismicity with specific geologic structures. Few active faults are known east of the Rocky Mountains. Thus the traditional approach in addressing the seismic hazard in the CEUS has been to rely on the historical earthquake record in conjunction with seismic source zones that separate regions of different seismotectonic characteristics and hence possibly different earthquake potential. Each seismic source zone is defined and characterized according to geologic, tectonic, and seismicity data. The zones comprise regions having a common geologic history that distinguishes them from neighboring areas. They may have a similar structure (e.g., faults or fractures of similar age, type, orientation), a similar pattern of seismicity, and/or a homogeneous stress regime. The EPRI/DOE/NRC (2012) model retains this methodology by dividing the CEUS into numerous “seismotectonic zones”, defined by differences in various seismic source assessment criteria such as style of faulting, earthquake recurrence, maximum magnitude, seismogenic thickness, etc. The model includes an alternative approach to dividing the CEUS into source zones, which is based solely on the expected maximum magnitude in the zone. This alternative zonation approach divides the study area into “Mmax zones” (Figure 14). The seismotectonic zone approach receives slightly higher weight, 0.6, than the Mmax zone approach, 0.4.

Figures 13 and 14 show the locations of the seismotectonic and Mmax zones, respectively. There are three Mmax zones and 12 seismotectonic zones in the EPRI/DOE/NRC model. The Mmax zones and some seismotectonic zones have one or more alternate geometries. Table 1 summarizes the source zone parameters used in the analysis. (Not all seismic source zones are shown on Figure 13.) A.B. Brown Generating Station lies in the Illinois Basin Extended Basin Zone (IBEB) zone and near the boundary of the Wabash Valley RLME zone (Figure 13).

Table 1
Seismic Source Zones Incorporated Into Analysis

Source Zone	Symbol	Mmax (M)[1]	Seismogenic Depth[2] (km)	Area (km^2)
Seismotectonic Zones				
Atlantic Highly Extended Crust	AHEX	6.0 6.7 7.2 7.7 8.1	8 (0.5) 15 (0.5)	177683
Extended Continental Crust–Atlantic Margin Zone	ECC-AM	6.0 6.7 7.2 7.7 8.1	13 (0.4) 17 (0.4) 22 (0.2)	881480
Extended Continental Crust–Gulf Coast	ECC-GC	6.0 6.7 7.2 7.7 8.1	13 (0.4) 17 (0.4) 22 (0.2)	1239288
Gulf Highly Extended Crust	GHEX	6.0 6.7 7.2 7.7 8.1	8 (0.5) 15 (0.5)	509090
Great Meteor Hotspot Zone	GMH	6.0 6.7 7.2 7.7 8.1	25 (0.5) 30 (0.5)	32250
Illinois Basin Extended Basin Zone	IBEB	6.5 6.9 7.4 7.8 8.1	13 (0.4) 17 (0.4) 22 (0.2)	114526
Midcontinent Craton Zone (all alternatives)	MidC	5.6 6.1 6.6 7.2 8.0	13 (0.4) 17 (0.4) 22 (0.2)	4258598 4246625 4025001 4013028
Northern Appalachian Zone	NAP	6.1 6.7 7.2 7.7 8.1	13 (0.4) 17 (0.4) 22 (0.2)	378331
Oklahoma Aulacogen Zone	OKA	5.8 6.4 6.9 7.4 8.0	15 (0.5) 20 (0.5)	53583

Source Zone	Symbol	Mmax (M)[1]	Seismogenic Depth[2] (km)	Area (km^2)
Paleozoic Extended Crust (Narrow and Wide alternatives)	PEZ	5.9 6.4 6.8 7.2 7.9	13 (0.4) 17 (0.4) 22 (0.2)	365395 598992
Reelfoot Rift Zone	RR	6.2 6.7 7.2 7.7 8.1	13 (0.4) 15 (0.4) 17 (0.2)	69479
Reelfoot Rift with Rough Creek Graben Zone	RR and RR_RCG	6.1 6.6 7.1 7.6 8.1	13 (0.4) 15 (0.4) 17 (0.2)	81452
St. Lawrence Rift Zone	SLR	6.2 6.8 7.3 7.7 8.1	25 (0.5) 30 (0.5)	329322
Mmax Zones				
Mesozoic and Younger Extended Crust - Narrow	MESE-N	6.4 6.8 7.2 7.7 8.1	13 (0.4) 17 (0.4) 22 (0.2)	3616923
Mesozoic and Younger Extended Crust - Wide	MESE-W	6.5 6.9 7.3 7.7 8.1	13 (0.4) 17 (0.4) 22 (0.2)	4342413
Non-Mesozoic and Younger Extended Crust - Narrow	NMESE-N	6.4 6.8 7.1 7.5 8.0	13 (0.4) 17 (0.4) 22 (0.2)	4792101
Non-Mesozoic and Younger Extended Crust - Wide	NMESE-W	5.7 6.1 6.6 7.2 7.9	13 (0.4) 17 (0.4) 22 (0.2)	4066611
Study Region	Study Region	6.5 6.9 7.2 7.7 8.1	13 (0.4) 17 (0.4) 22 (0.2)	8409024

Notes:

[1] Weights for all magnitude distributions are 0.101/0.244/0.310/0.244/0.101, a discrete five-point approximation to an arbitrary continuous distribution (EPRI/DOE/NRC, 2012).

[2] Weights for depth in parentheses

The EPRI/DOE/NRC (2012) model includes sources defined based on RLMEs rather than only fault sources. Many of the RLMEs correlate with identified geologic faults, but some are defined solely by geographically clustered paleoliquefaction events that suggest a localized source even if the responsible fault has not been identified and characterized. The site is adjacent to the Wabash Valley RLME zone and the New Madrid fault system (NMFS) lies approximately 200 km to the south of the site (Figures 6 and 13). Although quite distant from the site, we include the Charleston source and the NMFS and its associated elements (Figures 6 and 13) in the PSHA because their maximum earthquakes and relatively high activity rates often dominate the hazard in the CEUS, particularly at long-period ground motions. The Reelfoot Rift-Eastern Rift Margin (ERM) fault, the Reelfoot Rift-Marianna fault, and the Reelfoot-Commerce fault zone, to the southwest were also included in the PSHA (Figure 6). Tables 2 and 3 summarize the RLME (fault) source parameters used in the analysis.

4.1.1 Seismotectonic Zones

This section describes the seismotectonic characteristics of the most significant seismotectonic zones to the site, the basis for delineating the zone and for defining the model values for style of faulting, geometry, seismogenic depth, and Mmax. Recurrence for the zones is discussed in Section 4.1.3.

Illinois Basin Extended Basement Zone (IBEB)

The site lies within the IBEB zone, which encompasses southwestern Indiana and southeastern Illinois (Figure 13). Southern Indiana and southern Illinois are characterized by several moderate-sized paleoearthquakes and by higher rates of seismicity than adjacent craton regions (Figure 4). Several characteristics combine to support the delineation of IBEB as a separate seismotectonic zone. The southern part of the Illinois basin is one of the most structurally complex areas of the Midcontinent (McBride *et al*., 2002), with a crust distinct from that of the neighboring craton. Numerous moderately dipping reflectors interpreted to be faults are present in the basement. Moderate-sized historical earthquakes that appear to be spatially associated with Precambrian basement faults and with Paleozoic faults suggest continued reactivation of older basement features as well as younger Paleozoic structures (McBride *et al*., 2002). Stresses induced by Mesozoic rifting possibly extend into the southern Illinois basin causing the reactivation of deep structures (Braile *et al*., 1984). The IBEB source zone is defined to characterize sources of moderate- to large-magnitude earthquakes (excluding those attributed to the Wabash Valley RLME source) that may occur on deep structures in the Precambrian basement and as Paleozoic faults that extend into the overlying Paleozoic sedimentary rocks (EPRI/DOE/NRC 2012).

Fault dips are generalized based on sense of slip, with strike-slip ruptures assigned steep dips between 70° and 90° and reverse ruptures assigned moderate dips between 40° and 70°. Seismogenic thickness ranges from 13 to 22 km, the default values for the entire study area (EPRI/NRC/DOE, 2012). The seismogenic thickness is based on reported depths of seismicity within the IBEB. The deepest well-constrained earthquake hypocenters in the deep part of the Illinois basin, are located at depths of 20 to 22 km (McBride *et al.*, 2002; Yang *et al*., 2009). However, the average depth throughout the IBEB zone based on other historical earthquakes may be less (EPRI/DOE/NRC, 2012).

The largest earthquakes in the IBEB zone include an August 1891 **M** 5.5 event, a September 1891 **M** 5.0 event in eastern Nebraska, and a 2008 **M** 5.3 event. Four prehistoric earthquakes inferred from the paleoliquefaction studies have estimated magnitudes (**M** 6.2 to 6.3) that are larger than the historical earthquakes (EPRI/DOE/NRC, 2012). Maximum magnitudes modeled in the IBEB range from **M** 6.5 to 8.1, with a value of **M** 7.4 being preferred.

Midcontinent-Craton Zone (MidC)

The MidC zone occupies most of the CEUS study area, dominating the central United States and encompassing most of the Great Plains area (Figure 13). The MidC zone includes those regions of the continent that have not occupied the Phanerozoic continental margin, specifically Precambrian basement rocks of the Canadian shield and the platform (EPRI/DOE/NRC, 2012). The craton was formed by Paleoproterozoic accretion and now forms a cold, strong crustal core to the continent. Two orthogonal sets of structures, northeast-striking ductile shear zones and northwest-striking brittle-ductile faults dominate the Precambrian basement structure (Sims *et al*., 2005). Numerous geophysical anomalies have been observed within the MidC zone and may represent zones of crustal weakness that could localize future seismicity. Seismicity in the MidC zone is spatially variable and includes a few concentrations of activity that constitute seismic zones within the greater seismotectonic zone, such as the Anna seismic zone and Northeast Ohio seismic zone in Ohio, and the Nehama Ridge seismic zone in Kansas.

The fundamental distinguishing characteristic of the MidC zone is that it contains crust that has not experienced Mesozoic or younger extension, and generally not Paleozoic extension either. The characterization of the seismotectonic zone includes four alternative geometries, based on the inclusion or exclusion of smaller Mid-Continent regions. These smaller zones include a northeast-trending band of crust along the Appalachian Mountains that is included either within the PEZ or within the MidC zone, and the Rough Creek Graben, which is included either in the Reelfoot Ridge zone (RR) or in the MidC zone (Figure 13).

The largest earthquakes in the MidC zone include a 1909 **M** 5.7 event in eastern Montana, an 1877 **M** 5.5 event in eastern Nebraska, and a 1964 **M** 4.8 earthquake in eastern Ontario. Maximum magnitudes have a broader distribution in the MidC than most other seismotectonic zones, ranging from **M** 5.6 to 8.0, with a value of **M** 6.6 being preferred.

Few data exist to characterize independently the deep Precambrian structures within the intracratonic MidC region on which future earthquakes might be preferentially located. Thus the characterization of the MidC region is equivalent to what EPRI/DOE/NRC (2012) calls the "default" seismotectonic characteristics, representative of the entire study region. Thus both strike-slip and reverse mechanisms are included, with a 2/3 weight on strike-slip, reflecting the occurrence of both mechanisms in focal mechanism data, the state of stress, and the orientation of existing geologic structures in the region. Strikes include northwest, north-south, northeast and east-west orientations, determined based on focal mechanism data, tectonic stress, and structural grain within the study area. The dips are generalized based on sense of slip, with strike-slip ruptures assigned steep dips between 60° and 90° and reverse ruptures assigned moderate dips between 30° and 60°. Seismogenic thickness ranges from 13 to 22 km.

4.1.2 Mmax Zones

The Mmax zones are based on the observation that within the global catalogue of earthquakes within stable continental regions, there is little to distinguish any of them in a statistically significant way except that larger earthquakes seem to occur more commonly within those parts of the stable continental regions that have undergone extension, especially Mesozoic or younger extension (Johnston *et al*., 1994). Consequently, the zonation model is based on using global analogues to characterize the maximum magnitudes, with regions divided into extended and cratonic categories, each with a different distribution of maximum magnitudes. We adopt the zone boundaries and maximum magnitude distribution of EPRI/DOE/NRC (2012). The maximum magnitude distributions are used for the background seismicity.

The EPRI/DOE/NRC statistical analysis of the global database of earthquakes in stable continental regions (SCR) showed that the distinction between Mesozoic extended crust and non-extended crust noted by Johnston *et al*. (1994), while present, is only marginally significant. Therefore, within the Mmax zonation approach, two models are included: 1) the CEUS is divided into two Mmax zones, each with its own Mmax distribution, based on the presence or absence of Mesozoic-extended crust, and 2) the CEUS can be described by a single Mmax zone with a single Mmax distribution. The former model has slightly higher weight because of the marginally significant difference observed in the statistical analyses.

Mesozoic and Younger Extended Crust (MESE)

The Mesozoic extended zone (MESE) includes areas that underwent Paleozoic and Mesozoic or younger extension and includes the Atlantic and Gulf coastal regions as well as the failed rifts in the central U.S. (including the Reelfoot Rift and southern Oklahoma aulocogen) (Figure 14).

Non-Mesozoic and Younger Extended Crust (NMESE)

The Non-Mesozoic and Younger extended crust (NMESE) includes that part of the CEUS stable continental region that has not undergone Mesozoic or younger extension. This includes primarily interior cratonic regions and overlaps significantly with the MidC seismotectonic zone.

The boundaries between the extended and non-extended Mmax zones have two alternatives, reflecting uncertainty in the geographic extent of extended crust (Figure 14). The MESE-N (N = “narrow”) includes regions that have definitively experienced Mesozoic extension as inferred based on the presence of certain distinguishing characteristics. These may include: Mesozoic grabens and rift basin, Mesozoic and younger plutons, Mesozoic and younger uplift and unroofing associated with normal faulting (EPRI/DOE/NRC, 2012). Generally, regions that meet most of these criteria are considered to be extended and are assigned to the MESE-N zone. Regions with less compelling evidence, such as localized Mesozoic and younger reactivation of older structures or the presence of structures favorably oriented for reactivation, are less certainly extended and are assigned to the MESE-W (W = “wide”) zone. The NMESE-N and NMESE-W zones include the rest of the CEUS region outside the MESE-N and MESE-W zones, respectively. The narrow boundary, dividing definitively extended crust from the rest of the craton receives most of the weight (0.8) due to the lack of clear evidence for extension in the MESE-W zone.

The narrow and wide geometry for each zone has its own maximum magnitude distribution for this region, based on the largest historical earthquake known in each zone. These appear in Table 1 (Table 6.3.2-1 in EPRI/DOE/NRC, 2012).

Study Region

The single-zone alternative of the Mmax zone model includes the Study Region (StudyR) source zone (Figure 14), which encompasses the entire study area, which is represented by a single Mmax distribution. The distributions for seismogenic depth and Mmax for this zone appear in Table 1.

4.1.3 Recurrence for Seismic Zonation

The CEUS-SSC model is based on the spatial stationarity of seismicity, which is defined from small- to moderate-magnitude earthquakes that have occurred during a relatively short historical and instrumental record (EPRI/DOE/NRC, 2012).

For the seismotectonic and Mmax source zones, the seismicity rates are determined from the historical seismicity catalog. All dependent earthquakes were removed from the catalog, and earthquakes associated with the RLME sources were also removed to avoid double-counting. The cell size for all seismotectonic source zones except MidC was 0.25 degrees; the cell size for MidC was set to 0.5 degrees. The spatial smoothing operation, a penalized-likelihood function, is based on calculations of earthquake recurrence within each cell. Both *a*- and *b*- values are allowed to vary, but the degree of variation has been optimized such that *b*-values vary little across the study region, and the *a*-values are neither too smooth or spikey. Also, the recurrence calculations consider weighting of magnitudes in the recurrence rate calculations, with moderate events assigned more weight than smaller events.

Five alternative cases were considered for weights, which affect the degree of smoothing, for various magnitude bins; Cases A, B, C, D, and E (EPRI/DOE/NRC, 2012). Case C was dropped as it is very similar to Case B, and Case D was considered too extreme. Thus for each source zone three magnitude weighted cases were used: A, B, and E, with weights of 0.3, 0.3, and 0.4, respectively.

Furthermore, more than point estimates of the recurrence parameters are needed as modern PSHA requires an assessment of the epistemic uncertainty associated with these estimates, including correlations between the recurrence parameters of cells in the same geographical region, which may jointly affect the hazard at one site. The approach used to generate alternative maps of the recurrence parameters uses a technique known as Markov Chain Monte Carlo (MCMC) (EPRI/DOE/NRC, 2012).

This resulted in eight alternative maps representing the uncertainty in recurrence parameters that result from the limited duration of the catalog. If the smoothing parameters are treated as uncertain and estimated objectively from the data, the eight alternative maps also include the uncertainty about the appropriate values of the smoothing parameters. The eight realizations are equally weighted. For computational efficiency, the mean of the eight realizations was utilized in these calculations.

4.1.4 RLME

The following describes the Wabash Valley and NMFS RLMEs, which are the most significant RLMEs to the site.

Wabash Valley Fault Zone

The north-northeast-trending WVFS consists of numerous high-angle oblique-slip faults that comprise a broad 80-km-long zone located within the limits of the Grayville graben (Figure 6). The Wabash Valley RLME as configured in the CEUS-SSC model is significantly longer than the WVFS proper and extends north to include the Vincennes, Indiana area (Figures 6 and 13). The Grayville graben formed during Iapetan rifting (Hildenbrand and Ravat, 1997; EPRI/DOE/NRC, 2012). Direct evidence for neotectonic activity, including exposures of Quaternary displacement, was documented along the WVFS by Woolery (2005). He interpreted offset of a reflector, identified as a late Quaternary (ca 37,000 years old) sand, revealed in high-resolution seismic reflection profiles as due to displacement across the Hovey Lake fault at the south end of the WVFS. More recent work by Counts *et al*. (2009) and Van Arsdale *et al*. (2009) has identified Holocene deformation across the Uniontown scarp, part of the Hovey Lake fault. Van Arsdale *et al*. (2009) excavated a trench exposing 3500-year-old Ohio River alluvium that had been folded in a monocline with a 3-m amplitude, and also observed fractures within a younger unit that indicate possible activity within the last 295 years. For the most part, activity of the WVFS is indicated by historical seismicity and the aforementioned paleoliquefaction features. The historic seismicity includes five slightly damaging earthquakes of mb 5.0 to 5.8 during 200 years of historical time (Figure 1).

The maximum magnitude estimates adopted from the EPRI/DOE/NRC (2012) CEUS source characterization of the Wabash Valley source are based on analysis of paleoliquefaction features in the vicinity of the lower Wabash Valley of southern Illinois and Indiana. The magnitude of the largest paleoearthquake in the lower Wabash Valley (the Vincennes-Bridgeport earthquake), which occurred 6,011 ± 200 yr BP, was estimated to be ≥ **M** 7.5 using the magnitude-bound method (Obermeier, 1998). Use of a more recently developed magnitude-bound curve for the CEUS gives a lower estimate of **M** 7.1 to 7.3 (Olsen *et al*. (2005). The lower-bound relationship developed by Castilla and Audermard (2007) from a worldwide database gives a range of **M** 7.0 to 7.3. Estimates based on asuite of geotechnical analyses (cyclic stress and energy stress methods) range from **M** 7.5 to 7.8 (summarized in Obermeier *et al*., 1993). The next largest earthquake, the Skelton paleoearthquake, occurred 12,000 ± 1,000 yr BP (Obermeier, 1998). Lower and upperbound magnitude range from **M** 6.3 to 7.3 based on estimates by Munson *et al*. 1997, Olsen *et al*., 2005 and Castilla and Audemard (2007). The magnitude distribution of the EPRI/DOE/NRC (2012) CEUS source model (Table 2) incorporates the range of estimated sizes of the Vincennes-Bridgeport and Skelton paleoearthquakes as representative of both the aleatory variability in the size of individual Wabash Valley RLMEs and the epistemic uncertainty in the approaches and data used to estimate the magnitudes of prehistoric earthquakes.

The recurrence rates for the Wabash Valley RLME (Table 2) are based on the estimated ages for the Vincennes-Bridgeport and Skeleton paleoearthquakes using a Poisson model (EPRI/DOE/NRC, 2012).

Table 2
RLME Sources Incorporated Into Analysis

Fault	Geometry	Style of Faulting[1]	Mmax (M)	Dip (deg)	Seismogenic Thickness (km)	Recurrence Data[2]	Recurrence Interval (yr)[3]
Reelfoot Rift - Eastern Rift Margin Fault (ERM)							
ERM-N	ERM-N (1.0)	SS	6.7 (0.3) 6.9 (0.3) 7.1 (0.3) 7.4 (0.1)	90	13 (0.3) 15 (0.5) 17 (0.2)	1 event in 12-35 kyr (0.9)	3448 6667 12500 25000 71429
						2 events in 12-35 kyr (0.1)	2564 4545 7692 13889 31250
ERM-S	ERM-SCC (0.6)	SS	6.7 (0.15) 6.9 (0.2) 7.1 (0.2) 7.3 (0.2) 7.5 (0.2) 7.7 (0.05)	90	same as above	2 events in 17.7-21.7 kyr (0.333)	2857 4762 7143 12500 27778
						3 events in 17.7-21.7 kyr (0.334)	2326 3571 5263 8333 16129
						4 events in 17.7-21.7 kyr (0.333)	2000 2941 4167 6250 11111
	ERM-SRP (0.4)	same as above	same as above	same as above	same as above	same as above	same as above
Reelfoot Rift-Marianna In cluster (0.5) [Out of cluster (0.5) - default to background]	Marianna NW-strike (0.5)	SS	6.7 (0.15) 6.9 (0.2) 7.1 (0.2) 7.3 (0.2) 7.5 (0.2) 7.7 (0.05)	90	13 (0.3) 15 (0.5) 17 (0.2)	3 events in 9.6-10.2 kyr	1449 2381 3704 6250 13889
						4 events in 9.6-10.2 kyr	1190 1818 2703 4167 8333
	Marianna NE-strike (0.5)	same as above	same as above	same as above	same as above	same as above	same as above

Fault	Geometry	Style of Faulting[1]	Mmax (M)	Dip (deg)	Seismogenic Thickness (km)	Recurrence Data[2]	Recurrence Interval (yr)[3]
Reelfoot Rift - Commerce Fault Zone	Commerce fault (1.0)	SS	6.7 (0.15) 6.9 (0.35) 7.1 (0.35) 7.3 (0.1) 7.7 (0.05)	90	13 (0.3) 15 (0.5) 17 (0.2)	2 events in 18.9-23.6 kyr	4000 7143 12500 25000 71429
						3 events in 18.9-23.6 kyr	3030 5000 7692 13158 29412
Wabash Valley	Wabash Valley zone (1.0)	SS	6.75 (0.05) 7 (0.25) 7.25 (0.35) 7.5 (0.35)	90		2 events in 11-13 kyr	2273 4000 7143 13889 41667
Charleston	Local (0.5)	SS	6.7 (0.1) 6.9 (0.25) 7.1 (0.3) 7.3 (0.25) 7.5 (0.1)	90	13 (0.4) 17 (0.4) 22 (0.2)	2,000-yr record (0.8) 4 events in 2 kyr (1.0)	213 323 476 769 1471
						5,500-yr record (0.2) 4 events in 5.5 kyr (0.2)	213 323 476 769 1471
						5 events in 5.5 kyr (0.3)	370 526 769 1136 2000
						5 events in 5.5 kyr (0.2)	526 769 1086 1562 2941
						6 events in 5.5 kyr (0.3)	455 667 909 1282 2174
	Narrow (0.3)	SS	same as above	90	same as above	same as above	same as above
	Regional (0.2)	SS	same as above	90	same as above	same as above	same as above
New Madrid Fault System (NMFS)	see Table 3						

Note: Values in parentheses are weights. All faults are modeled with the Characteristic recurrence model

[1] SS Strike-slip

[2] "Recurrence Data" describes datasets used to calculate recurrence intervals.

[3] Weights for all distributions are: 0.101/0.244/0.310/0.244/0.101.

New Madrid Fault System (NMFS) RLME

The NMSZ is the most likely site of the 1811-1812 New Madrid earthquake sequence, which includes three of the largest earthquakes to have occurred within the North American plate in historical times (Johnston and Shedlock, 1992) (Figure 6). The pattern of seismicity and surface uplift is generally interpreted as delineating a left-stepping, right-lateral, strike-slip fault system (Cox *et al*., 2001; Johnston and Schweig, 1996). Johnston and Schweig (1996) developed faulting models for the 1811-1812 sequence based on geological, geophysical, seismological, and historical data. They concur with the commonly held assumption that the current seismicity is illuminating the most active faults; i.e., those that ruptured in 1811–1812 and also prior to 1811.

Schweig and Ellis (1994) and Johnston and Schweig (1996) provide summaries of the seismological, geodetic, and paleoseismologic data that have been used to assess the repeat times of large-magnitude events in the New Madrid region. In addition, Wheeler and Perkins (2000) provide additional information from the 2002 USGS National Hazard Maps for the CEUS. Correlation of dated liquefaction features suggest that widespread liquefaction occurred within the zone in A.D. 1811-1812, 1450, 900, 300 as well as about 2350 B.C. (Tuttle *et al*., 2005). Liquefaction deposits can constrain the ages of prehistoric events but not the causative faults. However, several of the prehistoric liquefaction deposits are composite, indicating they were formed in multiple episodes within a short period and thus may have occurred in a rapid sequence of large earthquakes similar to the 1811-1812 sequence.

The occurrence of two large events in A.D. ~900 and 2500-1400 B.C. is supported by recent studies of Mississippi River channel morphology that suggest that the Mississippi River changed its course in response to a sudden localized change in base level at those times (Holbrook *et al*., 2006). That change in base level is attributed to uplift of the downstream side of the channel across the Reelfoot reverse fault (described below).

These paleoseismic results indicate a recurrence interval of about 500 years for large earthquakes or earthquake sequences in the NMSZ over the past 2,000 years. The absence of paleoseismic evidence for earthquakes between 300 A.D. and 2200-2350 B.C. has been cited as indicative of temporal clustering of earthquakes in the NMSZ, with large earthquakes or earthquake sequences happening every few hundred years over a period of time followed by a long hiatus in activity (Holbrook *et al*., 2006). However, at this point it remains uncertain if the lack of events documented between A.D. 300 and 2200 B.C. in New Madrid is due to clustering or an incomplete paleoseismic record.

The possibly clustered behavior in the NMSZ, coupled with the discovery of paleoliquefaction features in the Reelfoot Rift (RR) southwest of the New Madrid zone (indicative of large earthquakes between about 5,000 and 7,000 years ago but not during the New Madrid cycles), has led to the suggestion that the locus of earthquake activity moves around the RR, on time scales of 5 to 15 kyr. In this model, the New Madrid region is the current, or most recent, locus of activity, but other areas have been so in the past, and the locus may shift again.

In the seismic source model, the elevated seismicity in the NMSZ is included in the RR seismotectonic zone, whereas large historical and paleoseismic events that likely occurred on the structures that ruptured in 1811-1812 are modeled as part of the NMFS RLME, in keeping with

the EPRI/DOE/NRC (2012) model. The source zone accommodates the hazard from background seismicity; the NMFS contributes an additional hazard (Tables 1 and 2). In the seismic source model, the NMFS comprises three distinct fault zones, located within the NMSZ source zone (Figure 6). The three NMFS faults, defined after the models of Van Arsdale (2000) and Johnston and Schwieg (1996), include: 1) the southern section (NMS), comprising the Blytheville arch (BA), extending into the Blytheville fault zone (BFZ) and Bootheel lineament (BL) area, 2) the central section, comprising the Reelfoot reverse fault (RFT), and 3) the northern section, comprising the New Madrid North fault and the Northwestern Seismicity Arm (NMN) (Figure 6; Table 3). Each of these sections ruptured to produce the 1811 and 1812 earthquakes.

The faults of the NMFS are defined primarily based on concentrations of seismicity as geomorphic expression of faulting is poor; only the Reelfoot reverse fault is well expressed as a definitively tectonic feature. Several different geologic faults have been postulated as the source of the events but there remains considerable uncertainty in defining the causative faults. The southern and northern sections of the fault system are northeast-striking features that are probably ancient faults related to rifting that have been reactivated in the modern stress regime as primarily right-lateral strike-slip faults. Focal mechanisms from these areas are consistent with predominantly dextral motion. The Reelfoot reverse fault strikes northwest and dips southwest; earthquakes associated with it have a variety of focal mechanisms. The fault has been described as a cross-structure in a compressional left step between right-lateral strike-slip faults.

Van Arsdale (2000) reports that the first of the 1811 and 1812 earthquakes, the NM1 event in December 1811, occurred on the southern section (NMS), which extends about 110 km (69 mi) from northeastern Arkansas to the southeastern bootheel of Missouri (EOI, 2008). The rupture occurred along the Blytheville arch, a 10 to 15-km wide northeast-trending Paleozoic upwarp that lies along the axis of the RR, and extended northeast of the arch proper. Van Arsdale (2000) considers that the event may have resulted from rupture of the 65-km long, steeply dipping to vertical, dextral-oblique Cottonwood Grove-Ridgely fault. Johnston and Schweig (1996) assign the northern extension of the rupture to the Blytheville fault, a 55-km long structure that continues on trend with the Blytheville arch and lies about 4 km east of the Cottonwood Grove fault. However, they suggest the Blytheville fault and the Cottonwood Grove fault may be essentially the same structure.

In contrast, Schweig and Ellis (1994) and Johnston and Schweig (1996) have proposed that the 1811 rupture did not follow the northeastern trend of seismicity along the Blytheville and/or Cottonwood Grove fault but rather branched onto the more northerly trending Bootheel lineament to the west of the Cottonwood Grove fault (Figure 6). This structure extends 135 km south-southwest from the western edge of the Reelfoot fault, crossing the Blytheville Arch. It was originally defined only as a lineament based on a linear alignment of *en echelon* fissures and sandblows, but has since been identified as a fault based on observations of Holocene surface faulting (Guccione *et al*., 2005). Unlike the Cottonwood Grove-Ridgely fault, the Bootheel lineament is not associated with a significant amount of seismicity, yet it is considered a candidate for the source of the December 1811 main event because of the numerous liquefaction features that occurred along it (Schweig and Marple, 1991).

Johnston and Schweig (1996) propose two alternative rupture scenarios for the December earthquake: 1) the Blytheville Arch region ruptured along with its extension to the northeast, the Blytheville fault (NMS: BA-BFZ) and 2) the Blytheville Arch ruptured, but the rupture branched

onto the Bootheel lineament and ruptured the northernmost 70 km of that structure (NMS: BA-BL) (Figure 6). In each scenario, the structure that did not rupture in the main event was the source of one of more of the large aftershocks, which have been proposed as smaller mainshocks (Johnston and Schweig, 1996). In other words, the Bootheel lineament and Blytheville fault sustained the aftershocks in the first and second scenarios, respectively.

The second mainshock of the New Madrid 1811-1812 sequence was the NM2 earthquake, in January 1812, on the northern margin of the fault system (NMN; Figure 6). The source of this event is also uncertain. The region is delineated by a line of seismicity, the Northwestern Seismicity Arm. Concentrated seismicity extends about 40 km (25 mi), with more sparse seismicity extending another 20 km to near the Illinois border. This seismicity has been postulated to be correlated with the New Madrid North fault (sometimes the East Prairie fault), which has been seen in the subsurface, geomorphically, and in trench exposures (Baldwin *et al*., 2005; Johnston and Schweig, 1996). That fault is at least 30 km long; the seismicity extends beyond the known fault. Wheeler (1997) postulated that the structure continued still farther north to merge with the Rough Creek graben in western Kentucky; he considered this extent, about 100 km , to be the maximum extent of RR faults. There is little in the sparse distribution of seismicity and lack of significant Quaternary faulting in the northern extent to support that assertion, and based on surface and subsurface expression as well as focal mechanisms, this fault is likely a steeply dipping dextral fault (DTEE, 2011).

The last of the three 1811-1812 mainshocks, NM3, occurred in February 1812, on the central section, the Reelfoot reverse fault, the proposed cross-structure in a compressional step-over between the dextral southern and northern sections of the system (Figure 6). The Reelfoot fault is a south-dipping blind reverse fault that has a dip that varies laterally and down dip. The dip can be as steep as 45°-75° in the upper few kilometers and as shallow as 25°-30° at depth (Mueller and Pujol 2001; Csontos and Van Arsdale, 2008). This fault is well-expressed geomorphically with a pronounced scarp, but its extent is also uncertain because seismicity extends beyond the scarp in both directions, beyond the strike-slip faults of the postulated stepover. Johnston and Schweig (1996) define three distinct fault segments: 1) the central Reelfoot fault, defined by its mapped surface extent of about 32 km (Van Arsdale *et al*., 1995); 2) the Reelfoot South seismicity trend, extending 35 km east of the Reelfoot fault; and 3) the New Madrid West seismicity trend, extending about 40 km west of the Reelfoot fault. Their proposed rupture scenarios include rupture of the Reelfoot fault with one or the other of the flanking seismicity trends in the NM3 mainshock.

Table 3
New Madrid Fault System RLME Source Model

Cluster?	wt	Localizing Structures	Southern Fault Geometry	wt	Northern Fault Geometry	wt	Central Fault Geometry	wt	Thickness (km)	wt	Mmax	wt	Recurrence method	wt	Recurrence Data	wt	Earthquake Recurrence Model	wt	Repeat Time Coefficient of Variation	wt	Rate (yrs)	wt
All In	0.9	NMS NMN RFT	BA-BL	0.6	NMN-S	0.7	RFT-S	0.7	13	0.4	NMS, RFT, NMN 7.9, 7.8, 7.6	0.167	Intervals	1.0	1811-1812, 1450, and 900 AD	1.0	Poisson	0.75	NA		167	0.101
																					270	0.244
																					417	0.310
																					714	0.244
																					1613	0.101
											7.8, 7.7, 7.5	0.167	same as above				Renewal	0.25	0.3	0.2	286	0.101
											7.6, 7.8, 7.5	0.25									909	0.244
											7.2, 7.4, 7.2	0.085									3125	0.310
											6.9, 7.3, 7.0	0.25									15625	0.244
											6.7, 7.1, 6.8	0.085									212766	0.101
									15	0.4	same as above								0.5	0.5	208	0.101
									17	0.2											455	0.244
							RFT-L	0.3	same as above												1124	0.310
					NMN-L	0.3	same as above														3846	0.244
																					32258	0.101
			BA-BFZ	0.4	same as above														0.7	0.3	227	0.101
																					455	0.244
																					1000	0.310
																					2941	0.244
																					21277	0.101
All out except RFT	0.05	RFT	NA		NA		RFT-S	0.7	13	0.4	7.8	0.167	Intervals	1.0	2000 BC and 1000 AD	1.0	Poisson	1.0	NA		769	0.101
																					1389	0.244
																					2381	0.310
																					4545	0.244
																					12500	0.101
											7.7	0.167	same as above									
											7.8	0.25										
											7.4	0.085										
											7.3	0.25										
											7.1	0.085										
									15	0.4	same as above											
									17	0.2												
							RFT-L	0.3	same as above													
All Out	0.05	None	Revert to background																			

The third event may have served to accommodate the strain produced by the previous two bounding events (Van Arsdale, 2000). Van Arsdale (2000) also suggests that this sequence of multiple, temporally-clustered events may not be unusual for the NMFS. He cites evidence from subsurface analyses that suggests that these three faults may have identical displacement histories since the Late Cretaceous. Thus, he suggests that the paleoseismic history for the Reelfoot reverse fault can serve as a proxy for the other two faults. Trench exposures of the Reelfoot fault indicate that deformation occurs primarily as folding rather than faulting at the surface and that the structure has experienced at least three earthquakes in the past 2400 years at times consistent with those determined from regional paleoliquefaction studies (Kelson *et al*., 1996). This interpretation is supported by paleoliquefaction studies, which indicate that large magnitude earthquakes on the faults of the New Madrid system have occurred in clusters like those of 1811-1812 (e.g., Tuttle *et al*., 2002; 2005).

There is significant uncertainty regarding the exact identification and geometry of the faults that ruptured in the 1811-1812 and earlier earthquakes, and some models of rupture (e.g., EPRI/DOE/NRC, 2012; STNOC 2011; USNRC, 2006) include weighted alternative geometries for each of the three faults. We adopt the characterization of EPRI/DOE/NRC (2012; Table 3). We include two alternative geometries for the northern extent of the southern section, the Blytheville fault zone (NMS: BA-BL), weighted 0.4, and the Bootheel Lineament (NMS: BA-BFZ), weighted 0.6. For the central and northern sections, we include two alternatives: short and long (RFT-S, RFT-L, NMN-S, MNM-L). The short central section (RFT-S) includes only that part of the Reelfoot reverse fault that is defined by the Reelfoot scarp and extends from the Blytheville fault to the New Madrid North fault; the long alternative (RFT-L) extends both east and west, based on continued seismicity. The short alternative for the New Madrid north fault (NMN-S) is the fault as defined by Johnston and Schweig (1996); the long alternative (NMN-L) extends the source along northward continuations of seismicity identified by Wheeler (1997). Because the causative faults are not well understood, the dips are not well constrained. The northern and southern sections of the system are modeled as vertical. The Reelfoot fault is modeled with a 40-degree southwest dip.

The EPRI/DOE/NRC (2012) characterization also addresses the apparent clustering of activity along the NMFS faults using the approach of Toro and Silva (2001). The rate of earthquakes and geomorphic expression of faulting on the Reelfoot fault in the late Holocene suggests that the system is or has recently been in a cluster. However, geodetic data gathered over the last decade or so suggest that little or no interseismic deformation is occurring across the NMSZ, which some researchers have interpreted as evidence that the system is shutting down and entering an inter-cluster period of quiescence (e.g., Calais *et al*., 2005; Calais and Stein, 2009). The EPRI/DOE/NRC model strongly favors the interpretation that the system is currently in a cluster (0.9), based on the recent history of activity and the unlikelihood that we have just happened upon the exact moment the system is shutting down. However, they, and we, give some weight to two alternative models: 1) only the Reelfoot faultis currently in a cluster, and the other faults are quiescent (0.05), and 2) the entire system is out of a cluster (0.05) (Table 3). In the former case, the Reelfoot faultis active, but at a lower rate than the in-cluster case; in the latter case, no faults are active and the system defaults to the RR background zone characterization.

Several recent hazard analyses have developed source characterizations for the NMFS. The USGS National Seismic Hazard Maps (Petersen *et al*., 2008) compiled recent data to develop a

model with lower weighted mean magnitudes for the faults than in previous models, and with a recurrence model reflecting possibly clustered timing of events. Their magnitudes range from **M** 7.3 to 8.0 for the southern and central sections, with a preferred magnitude of **M** 7.7 and weighted mean of **M** 7.6, and from **M** 7.1 to 7.8 for the northern section, with a preferred value of **M** 7.5 and weighted mean of **M** 7.4. Models developed for the Site Safety Analysis for Exelon Generation Company in Illinois (USNRC, 2006) include a lower magnitude distribution, with **M** 7.2 to 7.9 (weighted mean **M** 7.5), **M** 7.4 to 7.8 (weighted mean of **M** 7.6), and **M** 7.0 to 7.6 (weighted mean of **M** 7.3) for the southern, central, and northern faults, respectively. EPRI/DOE/NRC (2012) include distributions for the NMS, Reelfoot reverse fault, and NMN sections of the NMFS of **M** 6.7 to 7.9, **M** 7.1 to 7.8, and **M** 6.8 to 7.6, respectively. In our model, we adopt the EPRI/DOE/NRC distribution of maximum magnitudes. The preferred values and weighted means are similar to those developed in the nuclear studies described above.

4.2 EPRI GROUND MOTION PREDICTION MODELS

Several factors control the level and character of earthquake ground shaking. These factors are in general: (1) rupture dimensions, geometry, and orientation of the causative fault; (2) distance from the causative fault; (3) magnitude of the earthquake; (4) the rate of attenuation of the seismic waves along the propagation path from the source to site; and (5) site factors, including the effects of near-surface geology, particularly from soils and unconsolidated sediments. Other factors, which vary in their significance depending on specific conditions, include slip distribution along the fault, rupture process, footwall/hanging-wall effects, and the effects of crustal structure such as basin effects.

Several parameters may be used to characterize earthquake ground motions. The common parameters include: peak ground acceleration, velocity, and displacement; response spectral accelerations or velocities, duration, and time histories in acceleration, velocity, or displacement. In this analysis, we have estimated peak horizontal ground acceleration (PGA) and horizontal spectral accelerations (SA) at 0.04, 0.1, 0.2, 0.4, 1.0, and 2.0 sec.

Crustal ground motion prediction models for tectonically active regions like the western U.S. are empirical in nature and derived from strong motion data from such areas as California, Taiwan, Japan, and Italy. In contrast, few useable strong motion records exist for earthquakes in the Central and Eastern North America (CENA). Thus ground motion prediction models for the CENA have been developed, in large part, using seismological-based numerical models. During the past decade, ground motion models for the CENA have been derived using three different approaches: the stochastic method, the Green's function method, and the complex/empirical source method.

Recent efforts have been made to update the ground motion models for the CENA. One project is called the Next Generation of Attenuation (NGA) – East sponsored by Pacific Earthquake Engineering Research (PEER) Center. The objective of the project is to develop a new suite of ground motion prediction model for the CENA. The median ground motion models were just released but no standard deviations for the models were specified. There are 20 new NGA-East models and we expect it will be several months before the models become vetted.

In a second project, EPRI (2013) updated the 2004/2006 EPRI models in the near-term so that preliminary Ground Motion Response Spectra (GMRS) could be developed for existing nuclear

power plant sites as required by the NRC's Recommendation 2.1 pending completion of the NGA East Project. The models were used in this study. The EPRI Ground-Motion Model (GMM) Review Project (EPRI, 2013), an enhanced SSHAC Level 2 assessment process, established a methodology to evaluate the existing 2004 EPRI GMM and determine if it should be updated. After reviewing the current literature and conducting interviews and convening a workshop with ground-motion experts and seismologists it was decided to update the 2004 GMM because (1) seven of the 13 developers of the 2004 EPRI GMM recommended that their models be replaced; (2) three new models have been developed for the CENA by ground-motion experts; (3) 80% of the earthquake records in a new ground-motion database provided by the NGA-East Project are from earthquakes that occurred after the development of the 2004 EPRI GMM; (4) comparisons to the updated CENA database indicate the 2004 EPRI GMM overpredicts ground motions at some magnitude-distance and structural frequency ranges that are important to nuclear power plant PSHA; and (5) the models used to develop the aleatory portion of the 2006 EPRI GMM have been superseded.

The 2013 EPRI GMM retains the structure of the 2004 EPRI GMM, grouping the candidate individual models into four clusters according to their seismological characteristics, weighting the models within each cluster according to their consistency with the data, representing each cluster by three fitted relationships (5th percentile, median, and 95th percentile), and assessing cluster weights based on consistency with observed data and seismological attributes of the models within each cluster. The GMM Review Project identified new candidate models for the updated GMM clusters, models and weights, as shown in Table 4 and a summary of the overall elements of the model are listed in Table 5.

For reference, the ground motion prediction models used by the USGS to develop the 2014 National Seismic Hazard Maps include Toro *et al.* (1997), Frankel *et al.* (1996), Silva *et al.* (2002), Atkinson and Boore (2006), Atkinson (2008), Campbell (2003), Tavakoli and Pezeshk (2005), Pezeshk *et al.* (2011), and Somerville *et al*. (2001). The versions of Atkinson and Boore (2006) and Atkinson (2008) in the EPRI study have been updated with Atkinson and Boore (2011). All the ground motion prediction models are for hard rock characterized by a V_S30 of 2,800 m/sec.

Comparisons indicate that the 2013 GMM is somewhat lower than 2004 EPRI GMM when the two models are taken as a whole, but these differences are moderate, given the broad uncertainty range spanned by both GMMs. The greater differences occur at low frequencies. For PGA the bulk of the curves are consistent between the two GMMs. In addition, there is a substantial overlap in the 10 to 200 km range indicating that the updated GMM does not represent a radical departure from the 2004 EPRI GMM. The observed differences are the result of possessing and using substantially more data and having acquired additional insights from other regions over a period of nearly 10 years.

The 2006 EPRI model for aleatory uncertainty (sigma) was based on preliminary NGA-West 1 models for sigma from active tectonic regions, adjusted to account for differences in properties of the earth's crust between active (western North America [WNA]) and stable tectonic regions (i.e., CENA) (EPRI, 2006). The EPRI GMM Review Project updated the model to incorporate the nearly final NGA-West 2 aleatory models, with the same adjustments for differences between WNA and CENA. The updated sigma model is frequency and magnitude dependent, with inter-event and intra-event components. There is additional aleatory variability for distances of R_{JB} <

20 km. The updated aleatory variability model has higher values of total sigma than the 2006 EPRI model for **M** 5 earthquakes, and lower values for **M** 6 and 7 earthquakes for motions at 2.5 Hz and higher. At 1 Hz, the values of sigma are comparable in the two models and at 0.5 Hz, the updated GMM has slightly higher sigma than the 2006 EPRI model.

Table 4

EPRI (2013) GMM Clusters and Models

Cluster	Model Types and Cluster Weights (repeated large-magnitude earthquake sources/area earthquake sources)	Models
1	Single-corner Brune source (0.15/0.185)	Silva *et al*. (2002) – SC-CS-Sat[1] Silva *et al*. (2002) – SC-VS[1] Toro *et al*. (1997) Frankel et al. (1996)
2	Complex/Empirical Source $\sim R^{-1}$ geometrical spreading (0.31/0.383)	Silva *et al*. (2002) – DC-Sat Atkinson (2008) with 2011 modifications (A08′)
3	Complex/Empirical Source $\sim R^{-1.3}$ geometrical spreading (0.35/0.432)	Atkinson-Boore (2006) with 2011 modifications (AB06′) Pezeshk *et al*. (2011)
4	Finite-source /Green's function (0.19/0)	Somerville *et al*. (2001); slightly different models for rifted and nonrifted (not used for distributed seismicity sources with large contribution from **M** < 6)

SC = single-corner; DC = double-corner; CS = constant stress; VS = variable stress; Sat = saturation.
[1] Treated as one model for calculation of weights.

Table 5

Elements of the CENA Ground Motion Models

Feature	Attribute
Ground Motion Measure	Peak ground acceleration Spectral acceleration at frequencies of 0.5, 1, 2.5, 5, 10, 25 Hz
Site Conditions	Hard rock (V_S 2.8 km/sec, 9200 ft/sec)
Regions	Midcontinent (includes east coast) Gulf Coast
Ground Motion Model Types	Four types included: • Single-corner Brune source • Complex/empirical source ~R^{-1} geometrical spreading • Complex/empirical source ~$R^{-1.3}$ geometrical spreading • Finite-source/Green's function
Aleatory Variability	Magnitude and frequency dependent Includes additional variability for distances of R_{JB} < 20 km

The hard rock PSHA results are presented below including comparisons with the National Seismic Hazard Maps.

5.1 PSHA RESULTS

The results of the PSHA are presented in terms of ground motion for hard rock site conditions as a function of annual frequency of exceedance (AFE). AFE is the reciprocal of the average return period. Figure 15 shows the mean, median (50th percentile), 5th, 15th, 85th, and 95th percentile hazard curves for PGA. These fractiles indicate the range of epistemic uncertainties about the mean hazard. The uncertainties are very large due to both the large uncertainties in the ground motion prediction models and the source parameters of the controlling seismic source. The 0.4 sec and 1.0 sec horizontal spectral acceleration (SA) hazard are shown in Figures 16 and 17. The 2,500 year return period mean PGA for hard rock is 0.35 g (Table 6).

The contributions of the various seismic sources to the mean PGA hazard are shown on Figure 18. The major contributors to the hazard at the site for a return period of 2,500 years are the IBEB zone and the Wabash Valley RLME. The distributed seismicity contributes just over 70 percent of the PGA hazard at 2,500-year return period with the Wabash Valley and New Madrid RLMEs contributing approximately 15 percent each (Figure 19). At longer periods (0.4 and 1.0 sec SA), the New Madrid RLME relative contribution increases to up to 75 percent of the hazard at 2,500 years (Figures 20 through 23).

By deaggregating the PGA, 0.4 and 1.0 sec SA hazard by magnitude, distance and epsilon bins, we can illustrate the contributions by events at a return period of 2,500 years (Figures 24 through 26). Epsilon is the difference between the logarithm of the ground motion amplitude and the mean logarithm of ground motion (for that M and R) measured in units of the standard deviation (σ) of the logarithm of the ground motion. As shown on Figure 24, a majority of the PGA hazard at the site is coming from nearby distributed seismicity of **M** 5.0 to 6.0 within 25 km and the Wabash Valley RLME (**M** 7.0 to 7.75 within 25 km). The 0.4 sec SA hazard is bimodal with significant contributions from nearby events from both distributed seismicity (**M** 5.0 to 6.0 within 25 km) and the Wabash Valley RLME (**M** 7.0 to 7.75 within 25 km) and from more distant events from the NMFS RLME (**M** 7.0 to 8.25 at 150 to 250 km) (Figure 25). At 1.0 sec SA, the hazard is dominated by the NMFS RLME (Figure 26).

The deaggregation shown in Figures 24 through 26 also provides the modal magnitude M*, modal distance D*, and modal epsilon ε*, which represent the largest contributor to the hazard at the defined return period. The M* and D* for the 2,500-year return period for PGA, 0.4 and 1.0 sec horizontal SA are listed in Table 7. Because the 0.4 sec hazard is bimodal (Figure 25), Table 7 lists the modes for both peaks.

A horizontal UHS on hard rock computed for the 2,500-year return period is shown on Figure 27. A UHS shows the hazard across all periods for the same annual exceedance probability or return period. The SA hazard has been calculated at 0.01 (PGA), 0.04, 0.1, 0.2, 0.4, 1.0 and 2.0 sec. These are the spectral periods specified in the EPRI (2013) ground motion models.

To obtain a smooth spectrum at very short and longer periods, interpolation and extrapolation were required. For periods between PGA and 0.04 sec, linear or log-linear interpolation of the ground motions defined at those frequencies is not ideal. More recent ground motion models

indicate that the UHS in the CEUS peak in this period range. The spectral accelerations in this range were determined using the shape predicted by recent ground motion models for the modal magnitude and distances controlling the UHS at 0.04 sec. The median acceleration response spectra were computed for the controlling M and D using the Silva *et al*. (2002) and Pezeshk *et al*. (2011) ground motion models. Each of these spectra were then scaled to their respective 0.04 sec SA to compute scale factors (ratios of 0.02 sec SA to 0.04 sec SA and 0.03 sec SA to 0.04 sec SA). The scale factors from the two ground motion models were then weighted equally. The weighted mean scale factors were then applied to the 0.04 sec value from the UHS to obtain the 0.02 and 0.03 sec SA values.

Similarly, the 3.0, 4.0, 5.0 7.5, and 10.0 sec SA values were computed by using the long-period spectral shape predicted by available CEUS ground motion models that are defined at these long periods. The Silva *et al*. (2002) and Pezeshk *et al.* (2011) ground motion models were equally weighted. Scale factors were computed relative to the 2.0 sec SA using the controlling M and D for the 2.0 sec hazard.

Given the large depth to hard rock at the site, ground motions consistent with firm rock (V_S of 760 m/sec) were requested for input into finite element deformation analyses. The hard rock UHS was adjusted to firm rock using the generic amplification factors developed by David Boore (Frankel *et al.*, 1996). These factors are used in the development of the National Seismic Hazard Maps (NSHMs) by the USGS. They are not site-specific and therefore are highly uncertain, but are probably adequate in lieu of performing a site response analysis. Figure 28 shows the firm rock 2,500-year UHS. The mean firm rock PGA is 0.53 g (Table 8).

5.2 COMPARISON WITH USGS NATIONAL HAZARD MAPS

In 1996, the USGS released a "landmark" set of NSHMs for earthquake ground shaking, which was a significant improvement from previous maps they had developed (Frankel *et al.*, 1996). These maps were the result of the most comprehensive analyses of seismic sources and ground motion prediction ever undertaken on a national scale. The maps are the basis for the NEHRP Maximum Considered Earthquake (MCE_R) maps, which are used in the International Building Code. The maps are for NEHRP site class B/C (firm rock) (V_S30 760 m/sec).

For a 2,500-year return period, the 2014 NSHMs indicate firm rock (site class B/C) PGA, 0.2 sec SA and 1.0 sec SA values of 0.33, 0.57, and 0.17 g, respectively (USGS website). The site-specific firm rock values of 0.53, 0.68, and 0.14 g for PGA, 0.2 and 1.0 sec SA. The site-specific values are higher at short periods and slightly lower at long periods. These differences are likely due to the differences in the seismic source model and/or the ground motion prediction models. Note that the EPRI (2013) ground motion models were not available at the time the 2014 USGS NSHMs began development. As noted in the documentation of these maps, the EPRI (2013) suite of ground motion models and weights produce higher short-period and lower long-period ground motions than the suite of models implemented in the 2014 USGS NSHM (Petersen *et al*., 2014). Also the 2014 NSHMs simplified the EPRI/DOE/NRC (2012) CEUS-SSC model for use in their PSHA and weighted this model in addition to the previous USGS model for Wabash Valley and New Madrid RLMEs.

Table 6

2,500-Year Return Period UHS for Hard Rock

Period (sec)	SA (g)
0.01	0.35
0.04	0.73
0.10	0.58
0.20	0.39
0.40	0.24
1.00	0.10
2.00	0.058

Table 7

Modal M* and D* at 2,500-year Return Period

	M*	D*
PGA	5.1	12.5 km
0.4 Sec SA (bimodal)	7.1 7.6	12.5 km 238 km
1.0 Sec SA	7.6	238 km

Table 8

2,500-Year Return Period UHS for Firm Rock (V_S of 760 m/sec)

Period (sec)	SA (g)
0.01	0.53
0.02	0.96
0.03	1.16
0.04	1.21
0.10	1.02
0.20	0.68
0.40	0.40
1.0	0.14
2.0	0.070
3.0	0.041
4.0	0.028
5.0	0.021

Four sets of two-component time histories were spectrally-matched to the firm rock 2,500-year UHS. At short periods, the 2,500-year hazard is from large events from the Wabash Valley RLME (**M** 7.0 to 7.75) and from moderate events (**M** 5.0 to 6.0) return period both within 25 km (Figure 24). At longer periods (0.4 and 1.0 sec), the hazard is bimodal with contribution from large events from the Wabash Valley RLME (**M** 7.0 to 7.75 within 25 km) and from large events of the New Madrid RLME (**M** 7.25 to 8.25 at 150 to 250 km) (Figures 25 and 26). Hence, two sets of seed time histories were selected consistent with a **M** 7.0 to 7.5 event within 25 km and two sets of seed time histories consistent with a larger, distant event (Table 9).

Because the response spectrum of a time history has peaks and valleys that deviate from the design response spectrum (target spectrum), it is necessary to modify the motion to improve its response spectrum compatibility. The procedure proposed by Lilhanand and Tseng (1988), as modified by Al Atik and Abrahamson (2010) and contained in the computer code RSPMatch09 (Fouad and Rathje, 2012), was used to develop the acceleration time histories through spectral matching to the target (seed) spectrum. This time-domain procedure has been shown to be superior to previous frequency-domain approaches because the adjustments to the time history are only done at the time at which the spectral response occurs resulting in only localized perturbations on both the time history and the spectra (Lilhanand and Tseng, 1988).

To match the design (target) spectrum, seed time histories should be from events of similar magnitude and distance (for duration) and most importantly, spectral shape as the earthquake dominating the spectrum. Figure 29 shows the spectra from the seed time histories scaled to the target spectrum at PGA. The spectral shapes of the seed time histories peak at about 0.1 sec typical of earthquakes in tectonically active regions compared to the 0.4 sec peak in the 2,500-Year UHS. The lack of strong motion records in stable continental interiors such as CEUS necessitates use of records from active regions.

The seed acceleration time history series are shown on Figures 30 to 33. The spectral matches and resulting time histories are shown on Figures 34 to 49. Arias intensities and durations of the spectrally-matched time histories are provided in Table 10. There are currently no predictive models available for the CEUS for Arias intensity or 5-95% duration.

Table 9

Seed Time Histories

Record Sequence Number	Year	Earthquake Name	Station Name	Earthquake Magnitude (M)	ClstD (km)	V_S30 (m/sec)	Comp	PGA(g)	PGV (cm/sec)	PGD (cm)	5-95% AI (m/sec)	5-95% Dur (sec)
1404	1999	Chi-Chi, Taiwan	PNG	7.6	110	466	E	0.03	1.5	0.47	0.027	31.99
							N	0.03	2.3	0.66	0.030	28.10
2112	2002	Denali, Alaska	TAPS Pump Station #8	7.9	105	425	049°	0.07	10.0	7.13	0.245	75.93
							319°	0.09	14.6	11.12	0.337	73.40
5804	2008	Iwate	Yamauchi Tsuchibuchi Yokote	6.9	28	562	E	0.26	10.5	7.76	0.648	9.18
							N	0.29	17.1	6.97	0.874	9.94
6928	2010	Darfield, NZ	LPCC	7.0	26	650	080°	0.24	17.7	3.82	0.613	12.91
							170°	0.36	30.3	21.27	0.618	11.37

ClstD Closest distance
Comp Component
PGV Peak horizontal ground velocity
PGD Peak horizontal ground displacement
AI Arias intensity
Dur Duration

Table 10

Spectrally-Matched Time Histories

Record Sequence Number	Year	Earthquake Name	Station Name	Earthquake Magnitude (M)	ClstD (km)	V_S30 (m/sec)	Comp	PGA(g)	PGV (cm/sec)	PGD (cm)	5-95% AI (m/sec)	5-95% Dur (sec)
1404	1999	Chi-Chi, Taiwan	PNG	7.6	110	466	E	0.54	13.9	3.3	4.69	35.3
							N	0.54	12.5	3.6	3.82	31.7
2112	2002	Denali, Alaska	TAPS Pump Station #8	7.9	105	425	049°	0.55	13.4	6.1	2.76	39.4
							319°	0.52	15.5	8.2	4.16	41.4
5804	2008	Iwate	Yamauchi Tsuchibuchi Yokote	6.9	28	562	E	0.55	19.0	9.7	1.79	10.2
							N	0.54	13.9	5.5	1.70	12.3
6928	2010	Darfield, NZ	LPCC	7.0	26	650	080°	0.53	18.8	9.8	1.80	17.1
							170°	0.53	20.4	8.3	1.07	12.6

ClstD Closest distance
Comp Component
PGV Peak horizontal ground velocity
PGD Peak horizontal ground displacement
AI Arias intensity
Dur Duration

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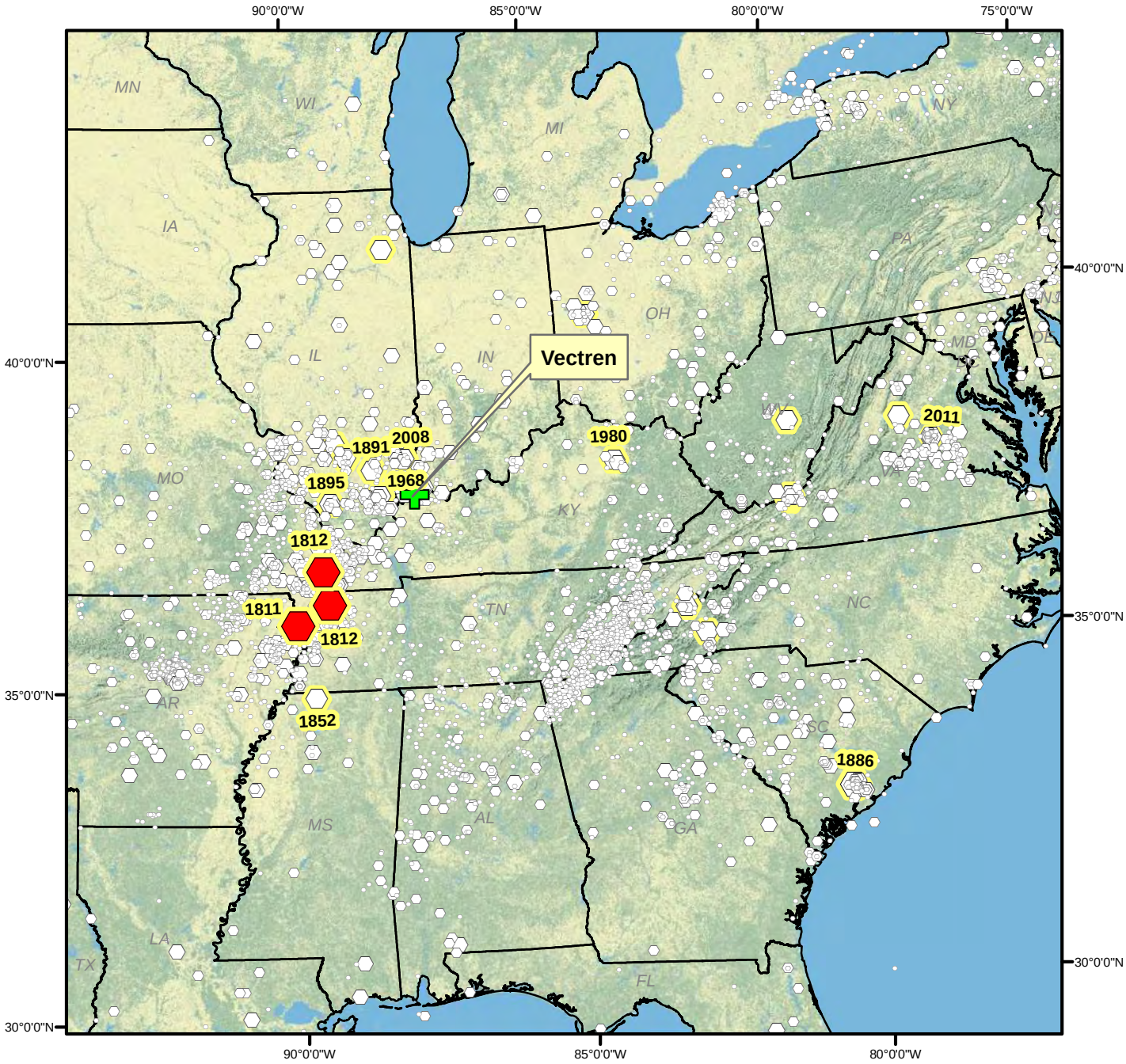


Magnitude Mw

- <= 3.0
- 3.0 - 4.0
- 4.1 - 5.0
- 5.1 - 6.0
- 6.1 - 7.0
- > 7.0

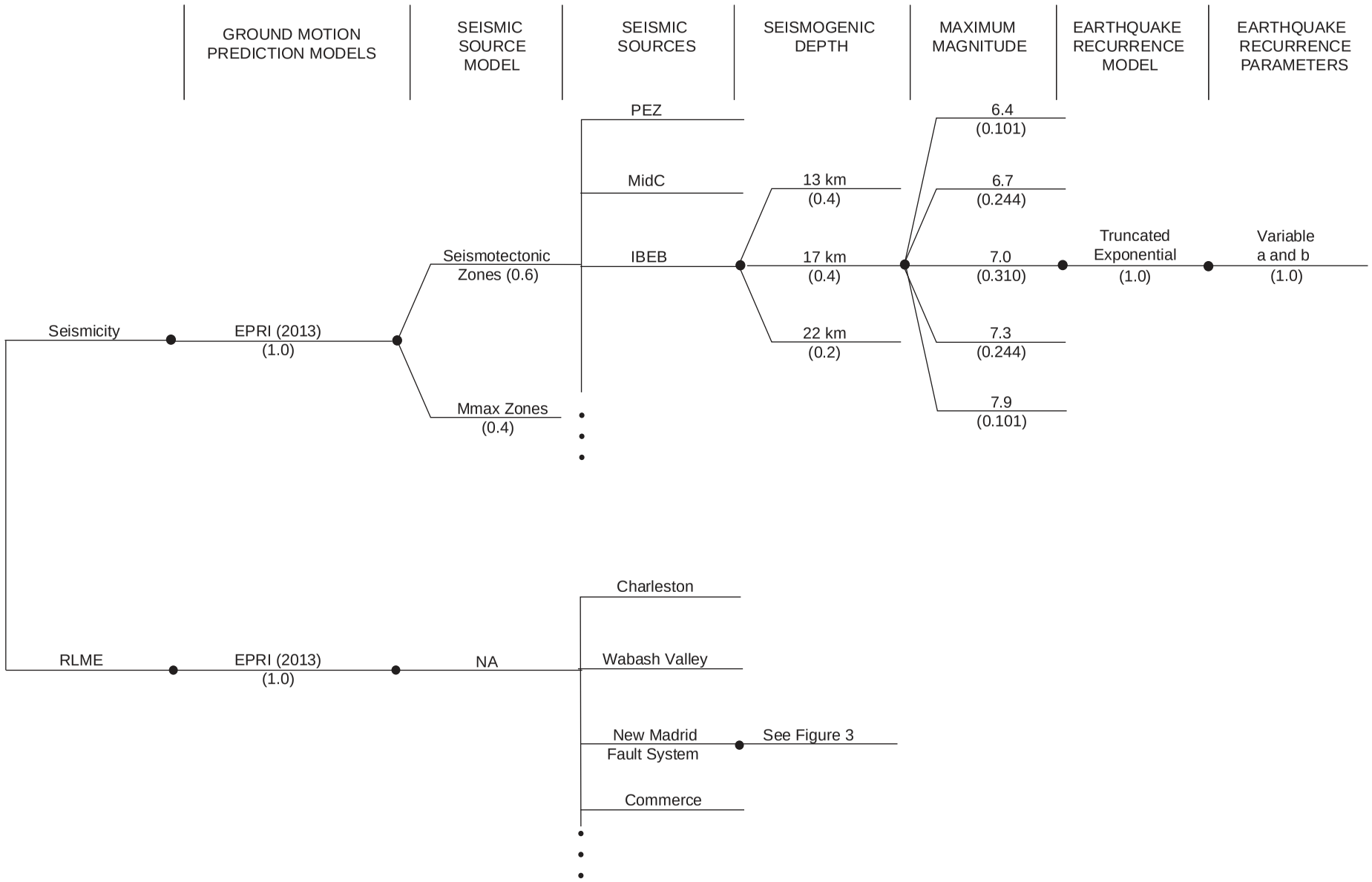
Data Sources: 1699 to 2008 from EPRI/DOE/NRC (2012)
2009 to May 2013 from NEIC

0 55 110 220 330 440 Kilometers

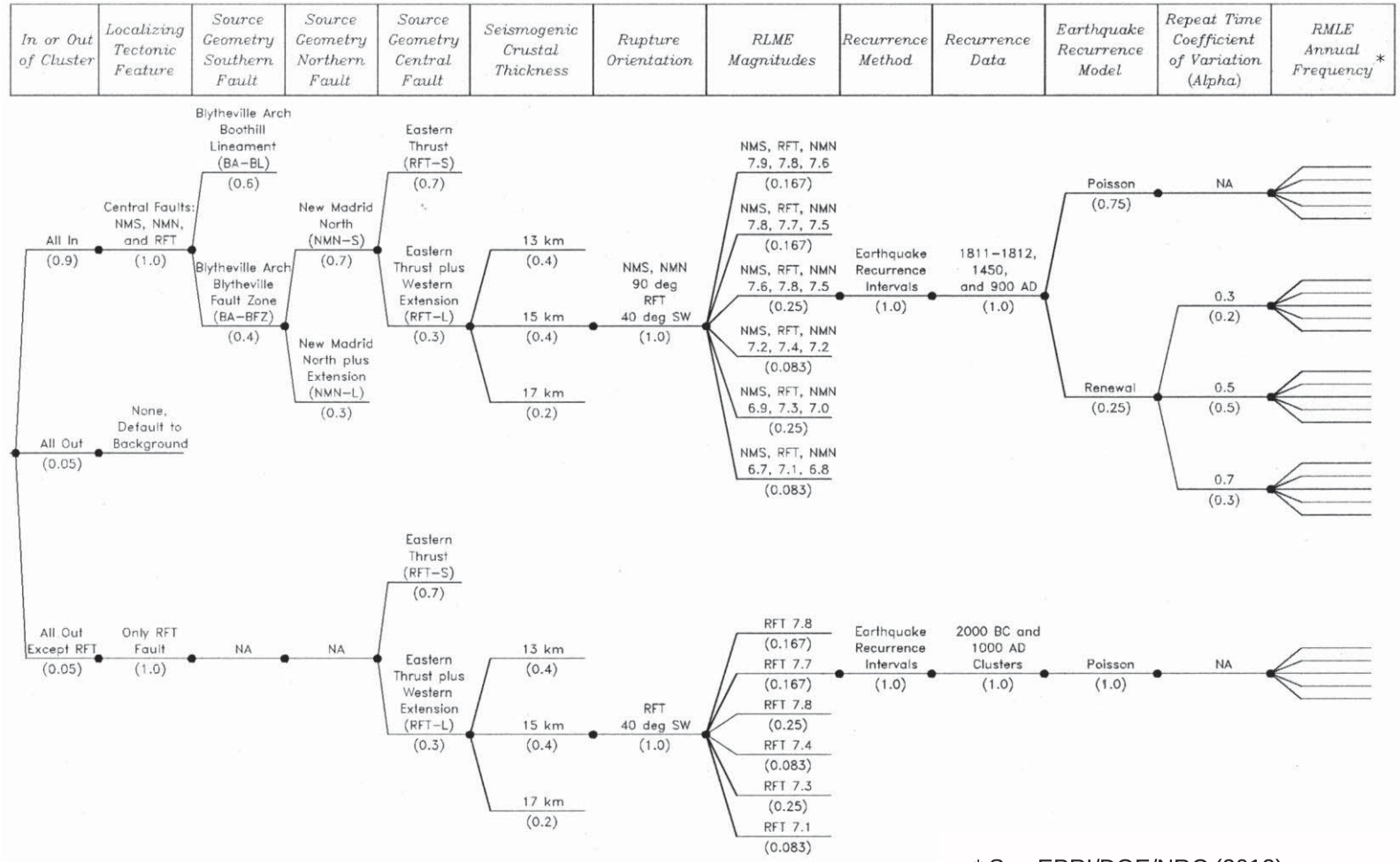
0 40 80 160 240 320 Miles

N

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	HISTORICAL SEISMICITY OF CENTRAL AND EASTERN UNITED STATES (1699 - 2013)	Figure 1

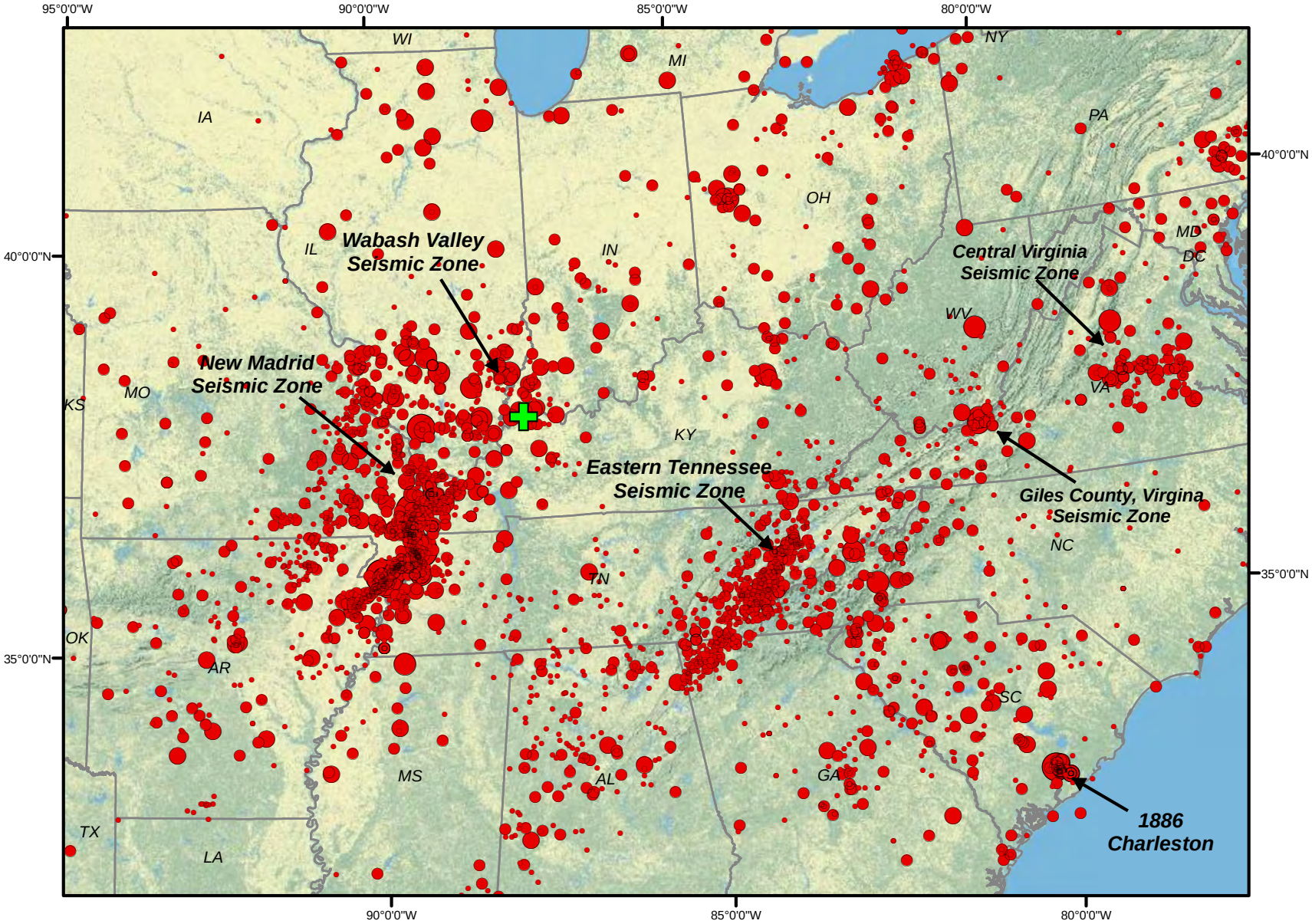


AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	EXAMPLE SEISMIC HAZARD MODEL LOGIC TREE	Figure 2



* See EPRI/DOE/NRC (2012)

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	NEW MADRID RLME LOGIC TREE	Figure 3

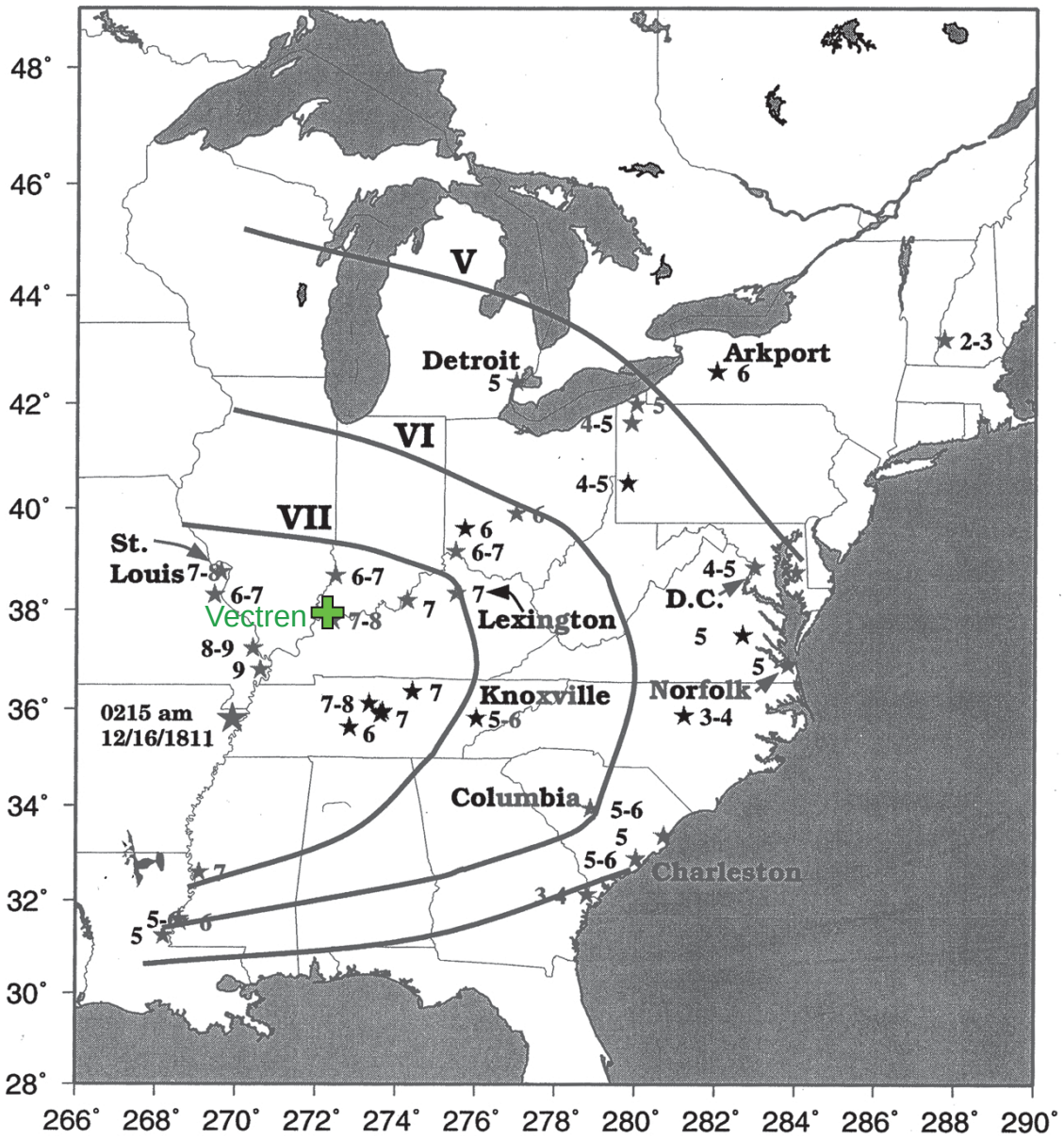


Seismicity from:
EPRI/DOE/NRC (2012)

Project Site

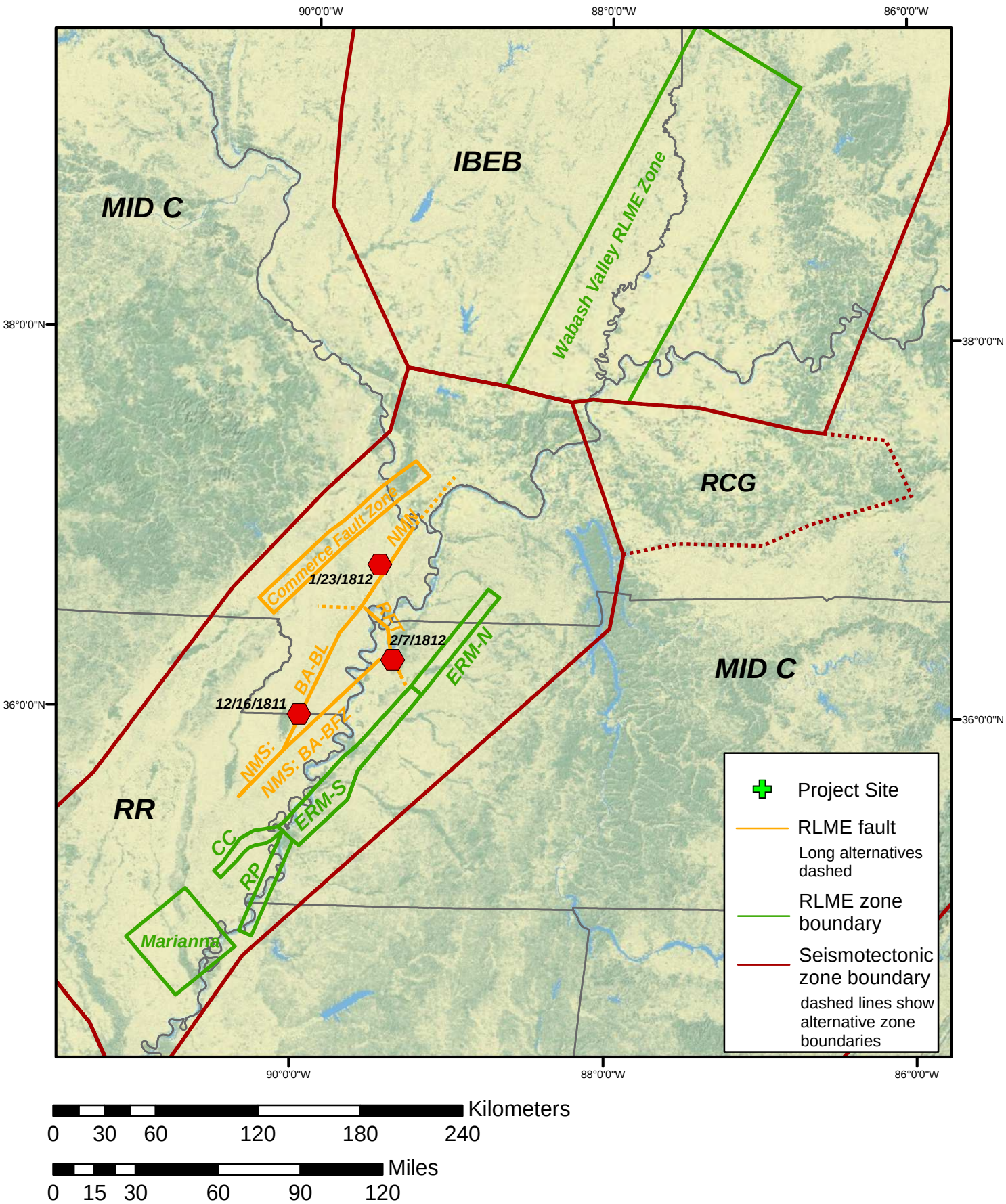
Earthquake Epicenters

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	HISTORICAL SEISMICITY AND SEISMIC ZONES IN THE CENTRAL AND EASTERN U.S.	Figure 4

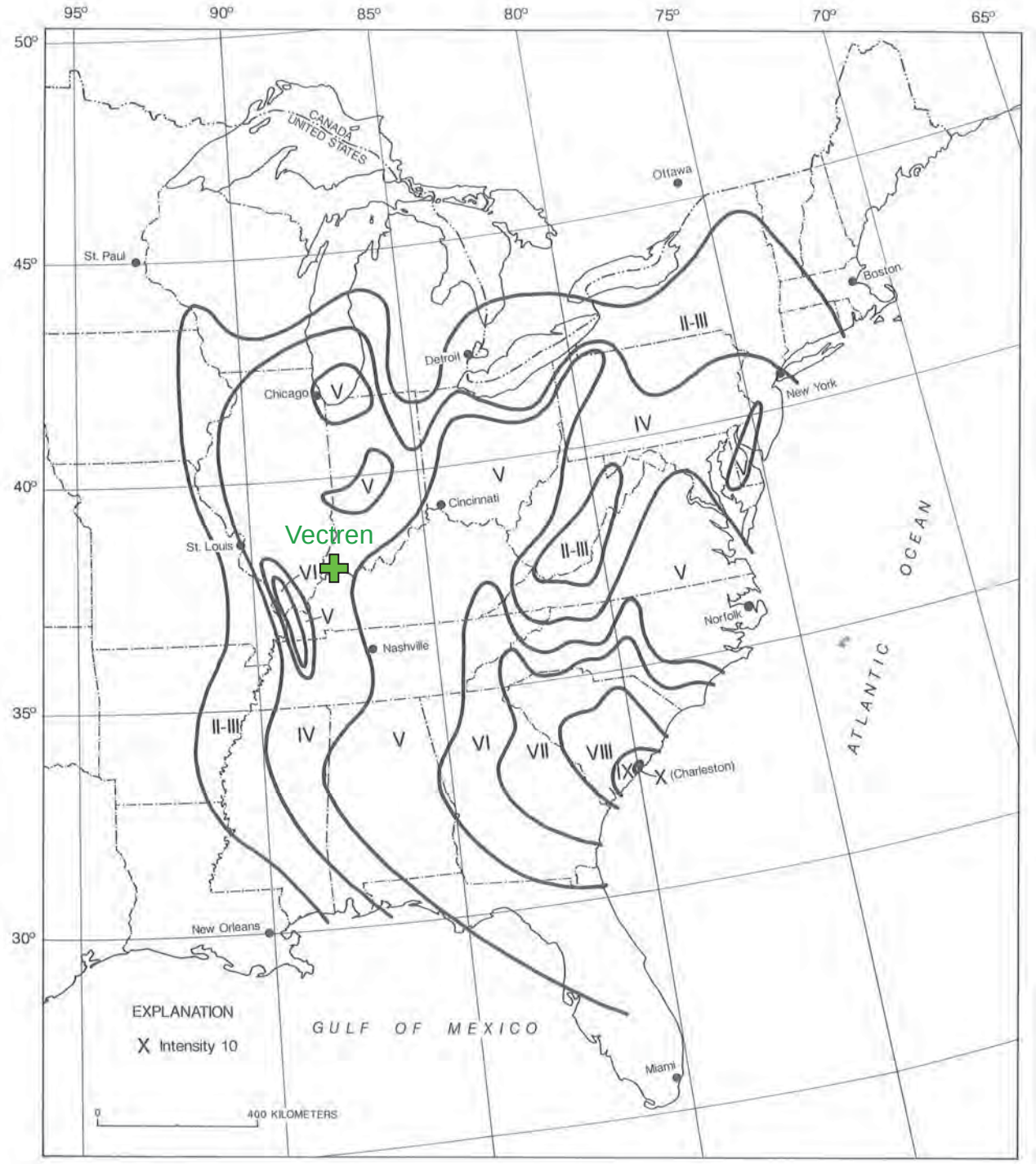


Source: Hough *et al*. (2000)

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	ISOSEISMAL MAP OF THE 16 DECEMBER 1811 **M** 7.2-7.3 NEW MADRID EARTHQUAKE	Figure 5

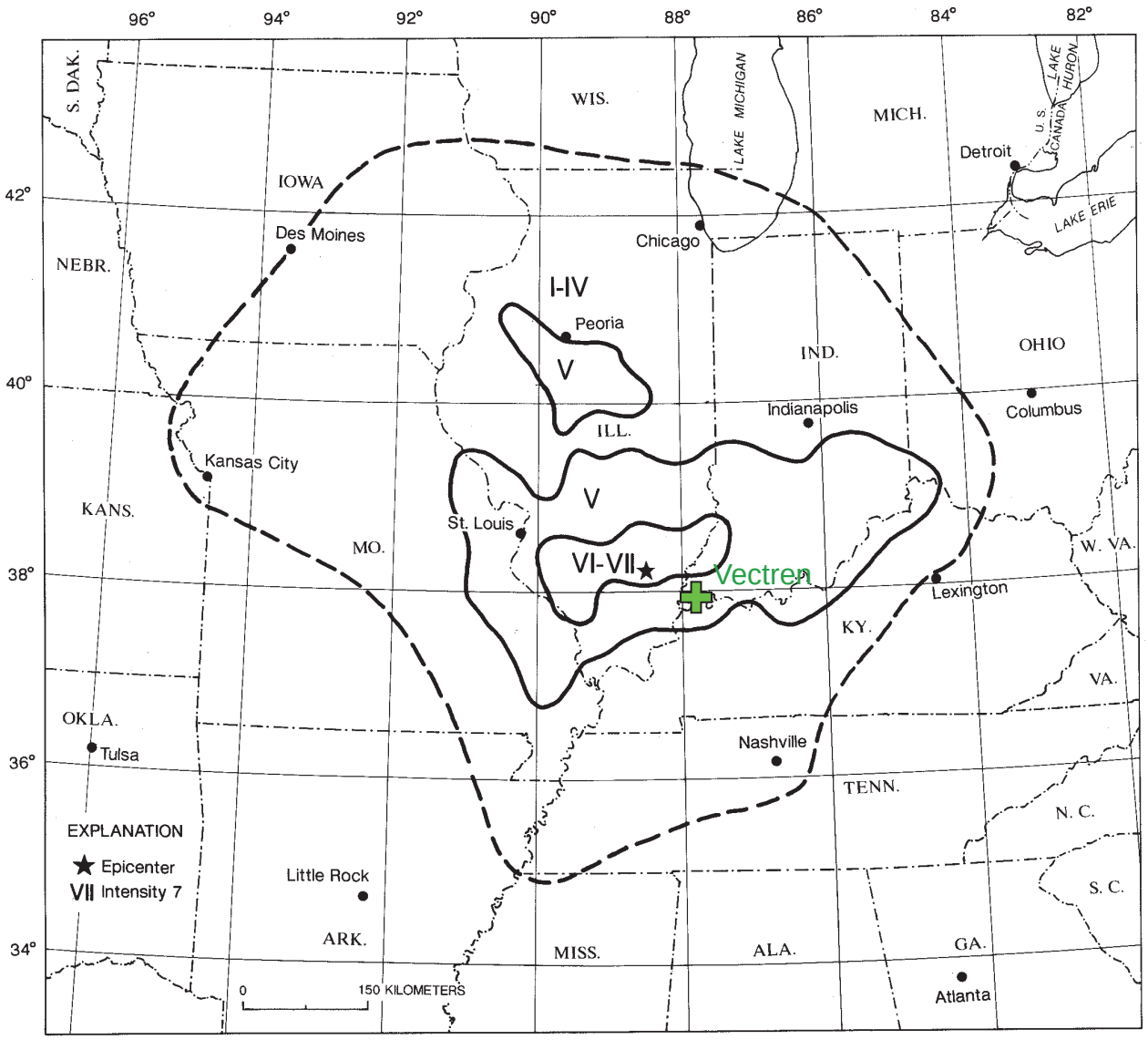


AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	NEW MADRID FAULT SYSTEM, 1811-1812 NMFS EARTHQUAKES, AND NEIGHBORING RLMEs	Figure 6



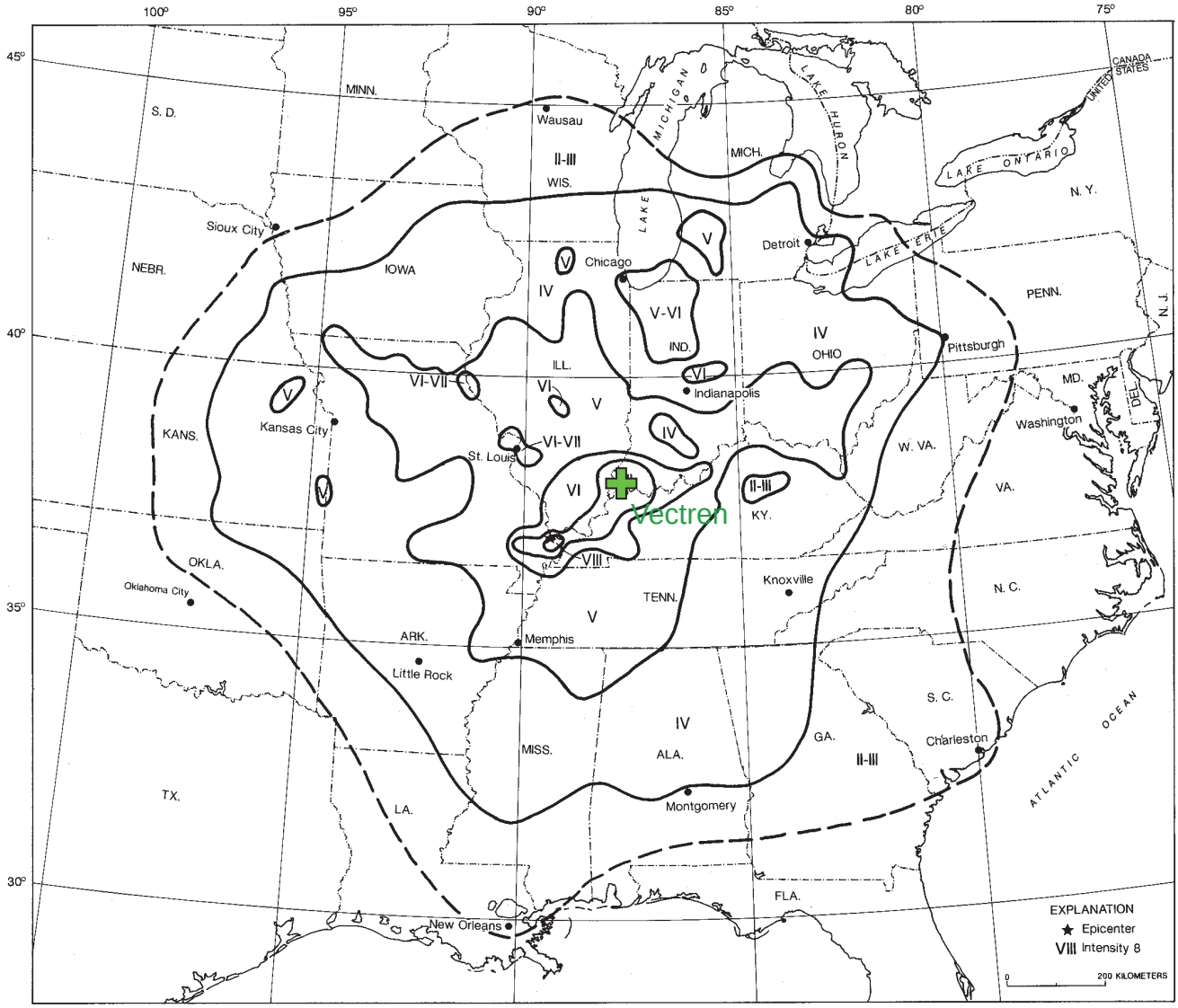
Source: Stover and Coffman (1993)

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	ISOSEISMAL MAP FOR THE 1 SEPTEMBER 1886 **M**~7 CHARLESTON EARTHQUAKE	Figure 7



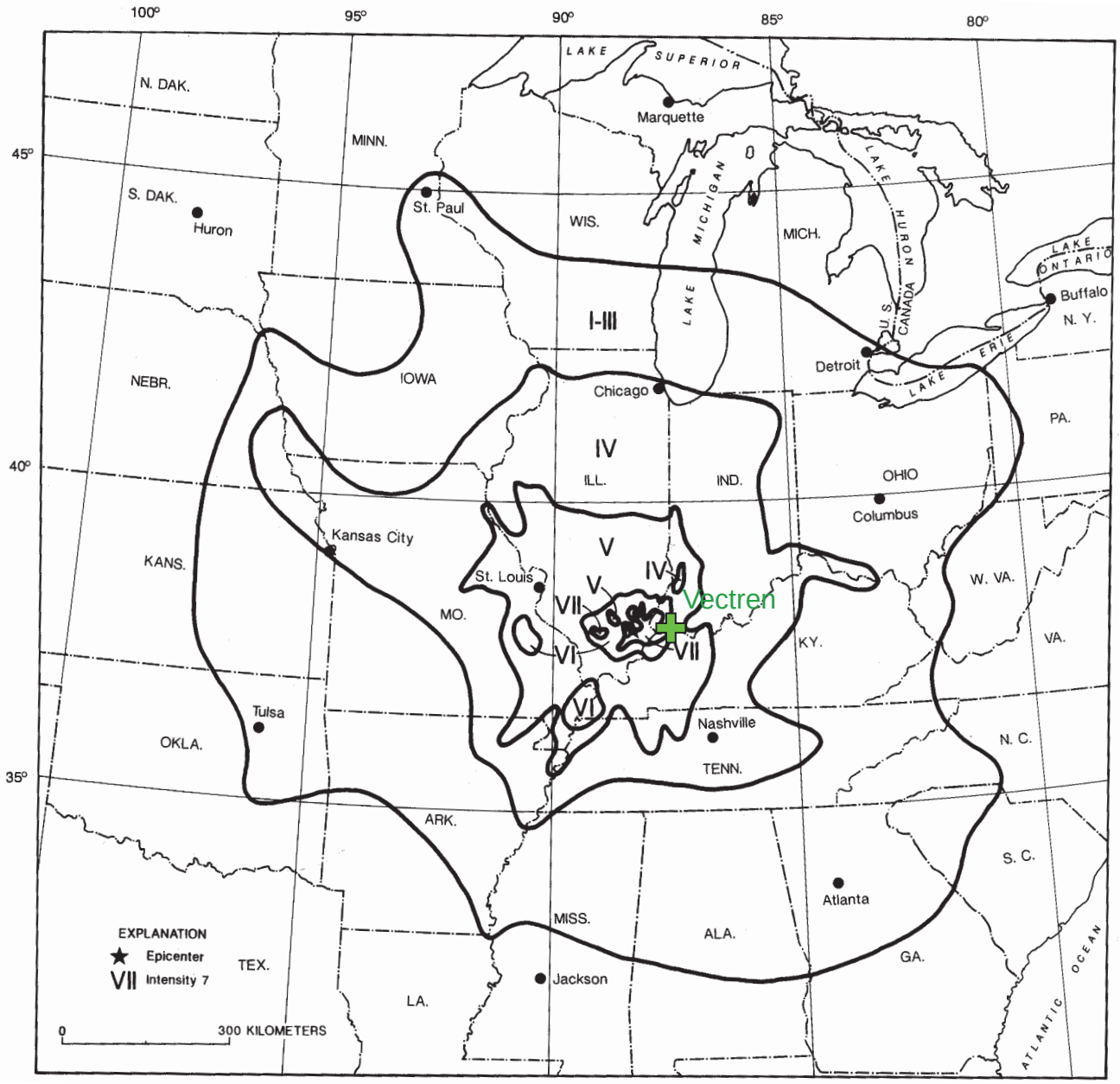
Source: Stover and Coffman (1993)

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	ISOSEISMAL MAP OF THE 27 SEPTEMBER 1891 m_b 5.8 SOUTHERN ILLINOIS EARTHQUAKE	Figure 8



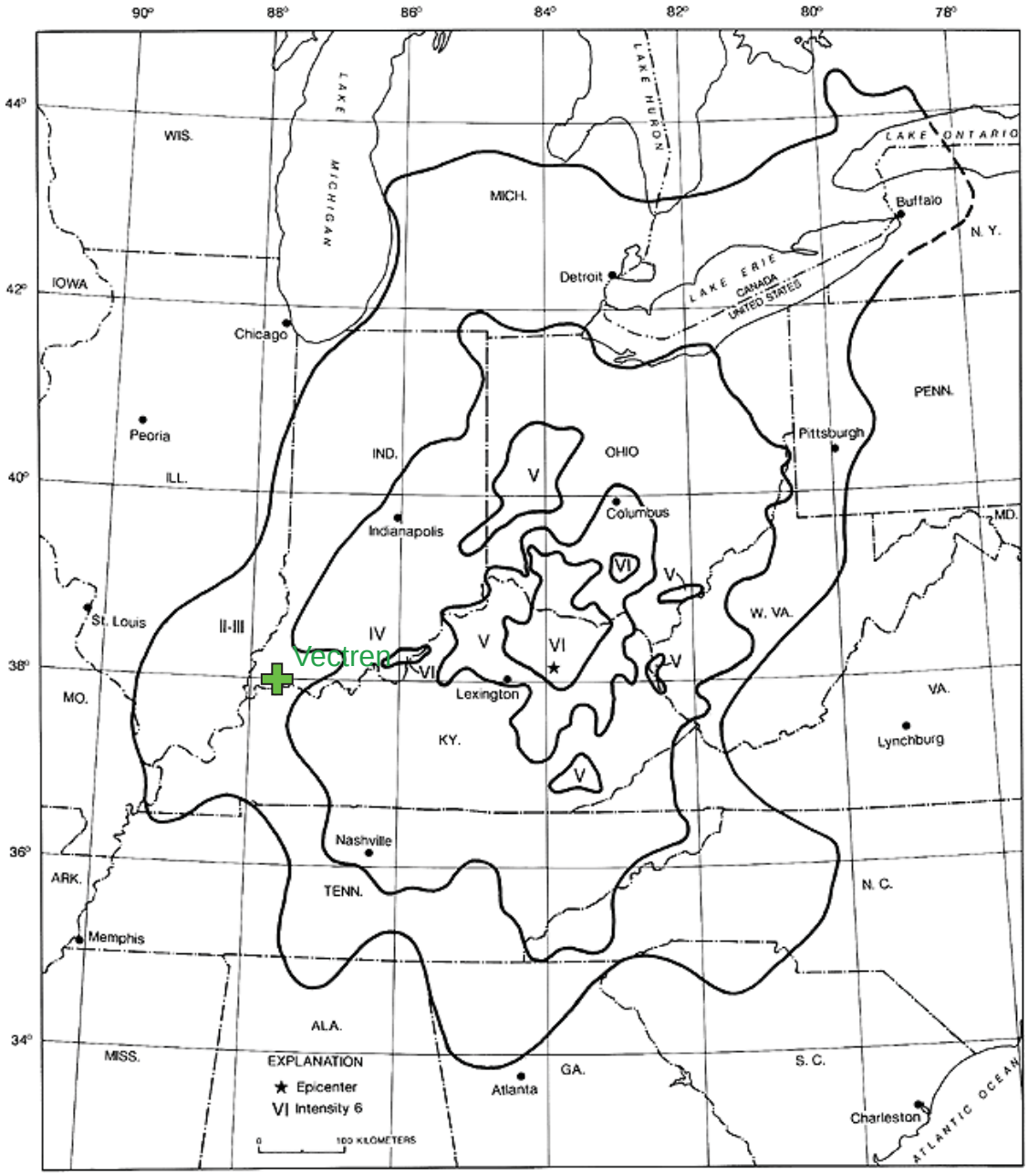
Source: Stover and Coffman (1993)

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	ISOSEISMAL MAP OF THE 31 OCTOBER 1895 M_S 6.7 CHARLESTON, MISSOURI EARTHQUAKE	Figure 9



Source: Stover and Coffman (1993)

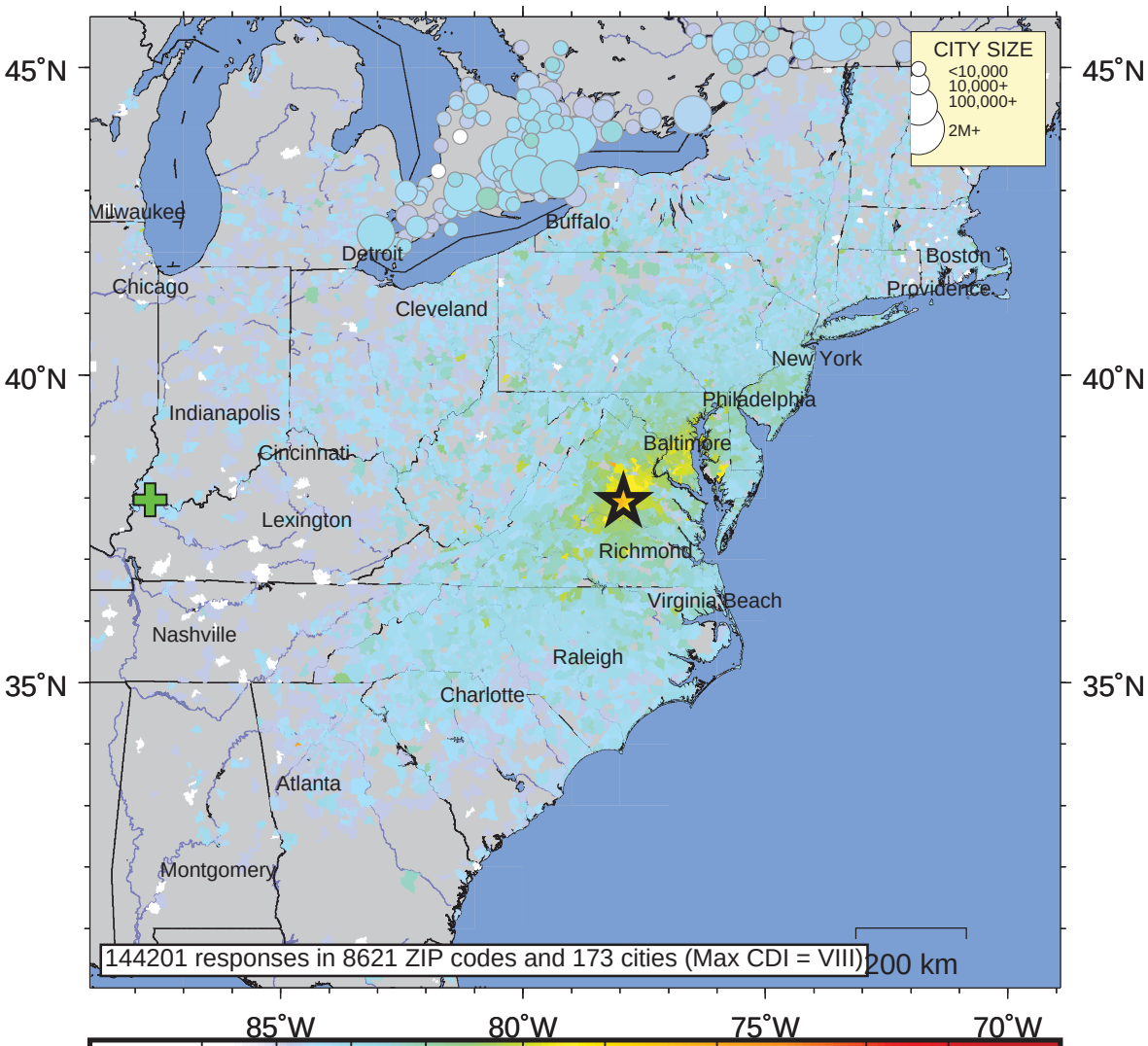
AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	ISOSEISMAL MAP OF THE 9 NOVEMBER 1968 m_b 5.5 SOUTHERN ILLINOIS EARTHQUAKE	Figure 10



Source: Stover and Coffman (1993)

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	ISOSEISMAL MAP FOR THE 27 JULY 1980 M 5.1 SHARPSBURG, KENTUCKY EARTHQUAKE	Figure 11

USGS Community Internet Intensity Map
VIRGINIA
Aug 23 2011 01:51:04 PM local 37.936N 77.933W M5.8 Depth: 6 km ID:se082311a

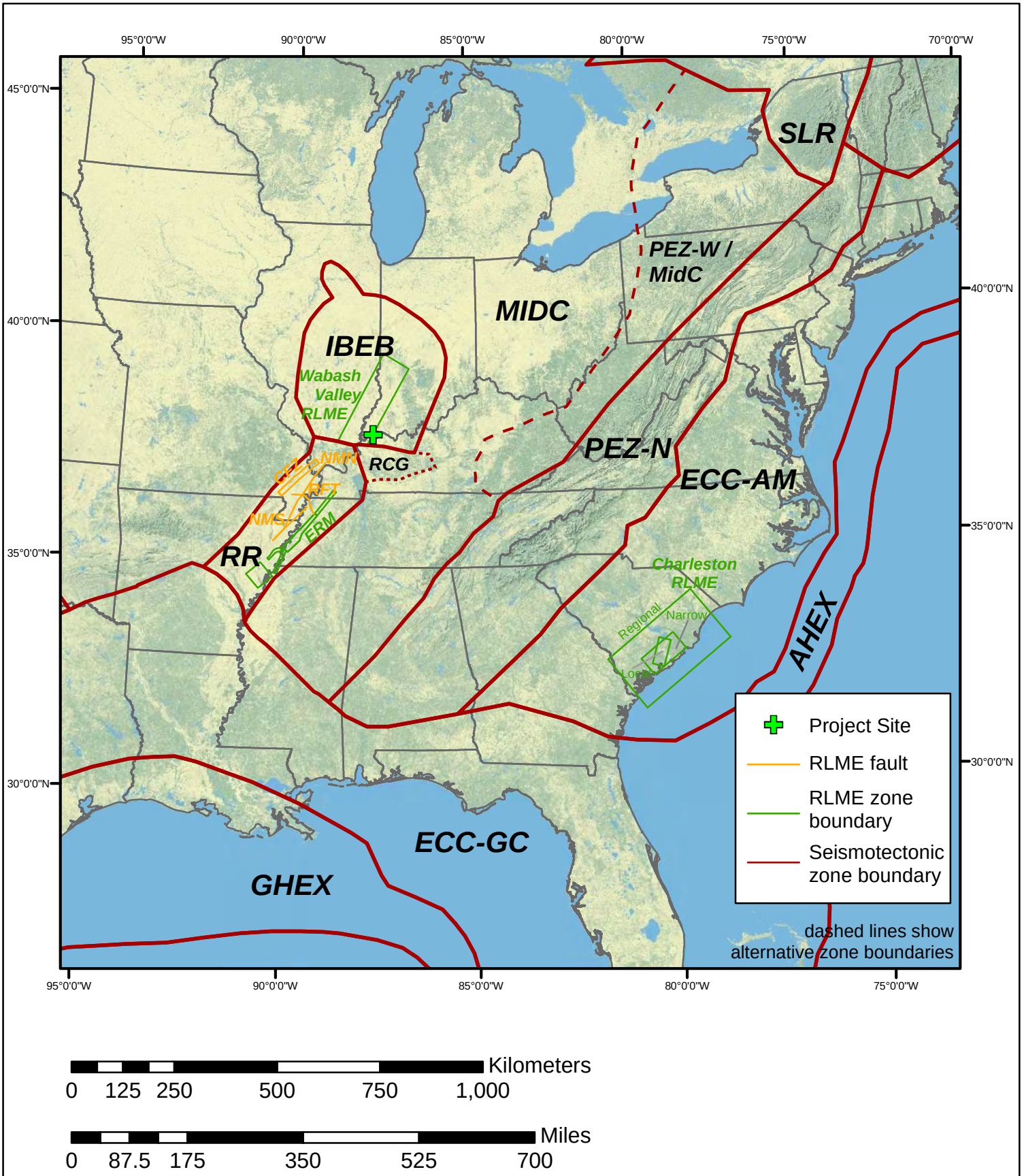


INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+
SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy

Processed: Wed Jan 28 00:56:30 2015

Source: http://earthquake.usgs.gov/earthquakes/dyfi/events/se/082311a/us/index.html

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	DYFI MAP FOR THE 23 AUGUST 2011 **M**5.8 MINERAL, VIRGINA EARTHQUAKE	Figure 12



Kilometers

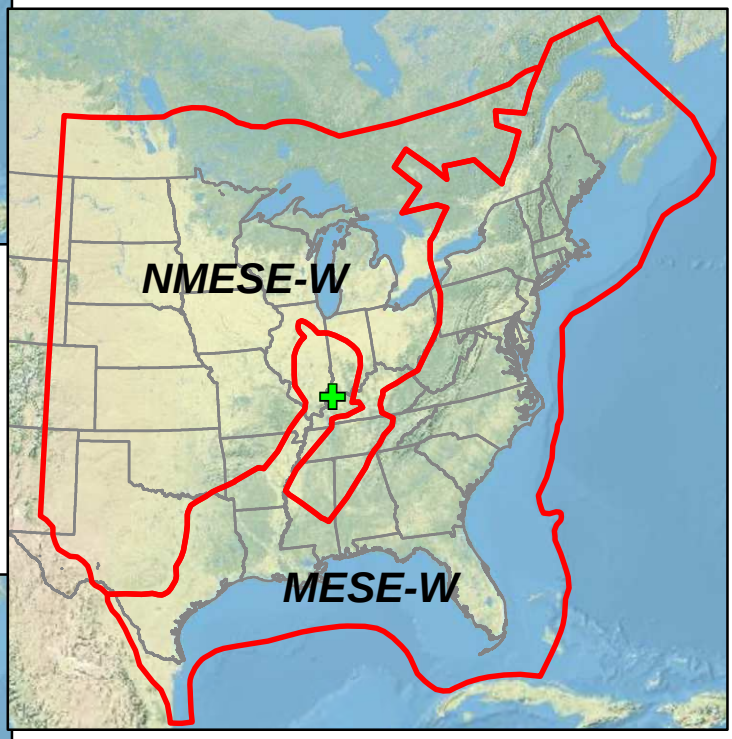
0 125 250 500 750 1,000

Miles

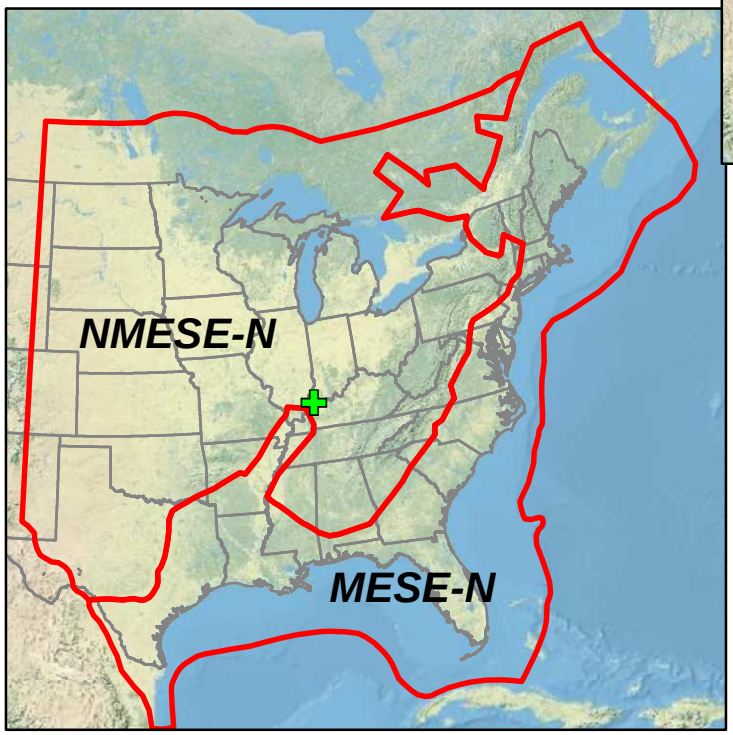
0 87.5 175 350 525 700

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	SEISMOTECTONIC ZONES AND RLMES	Figure 13

1-Zone Model

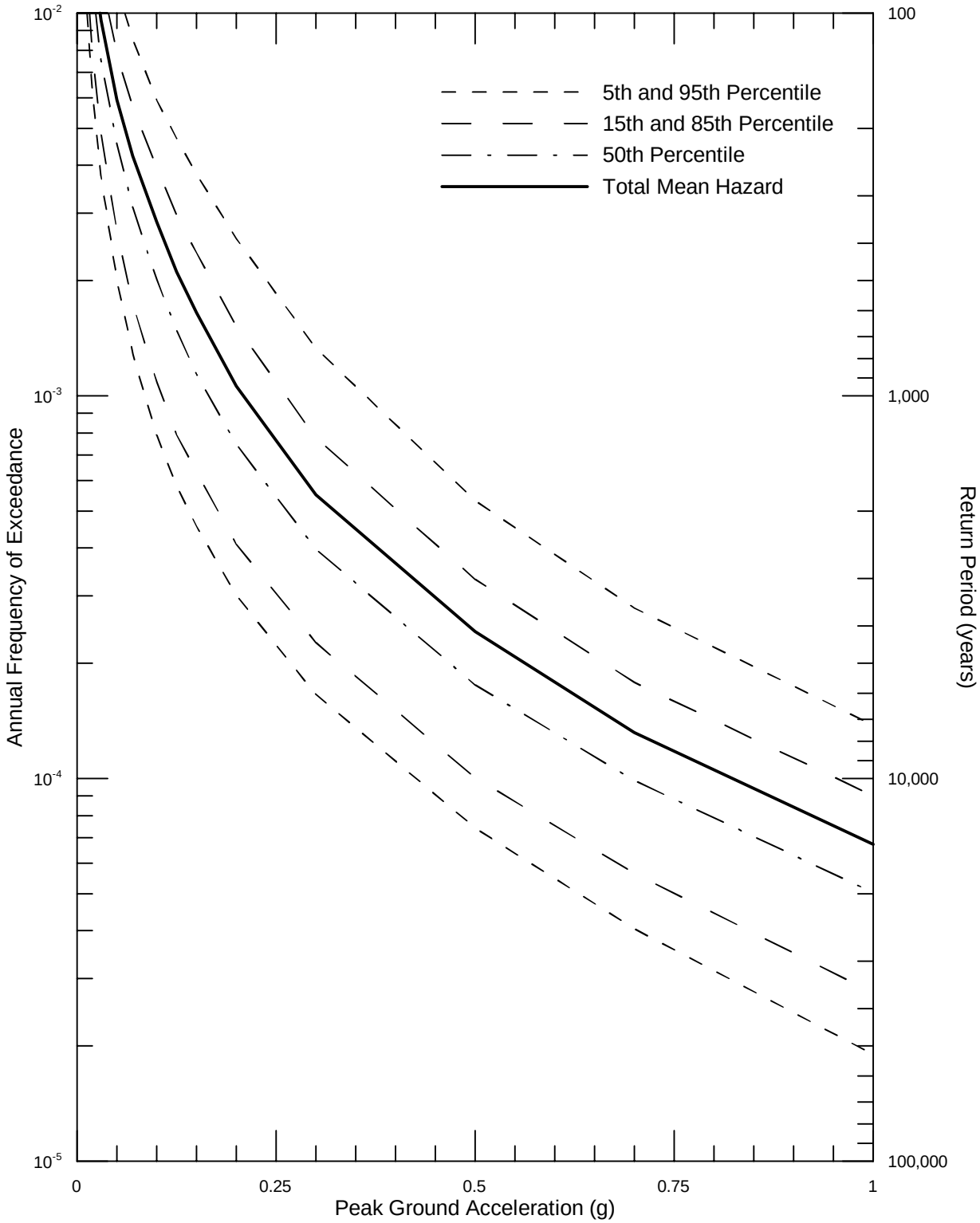


2-Zone Model Wide

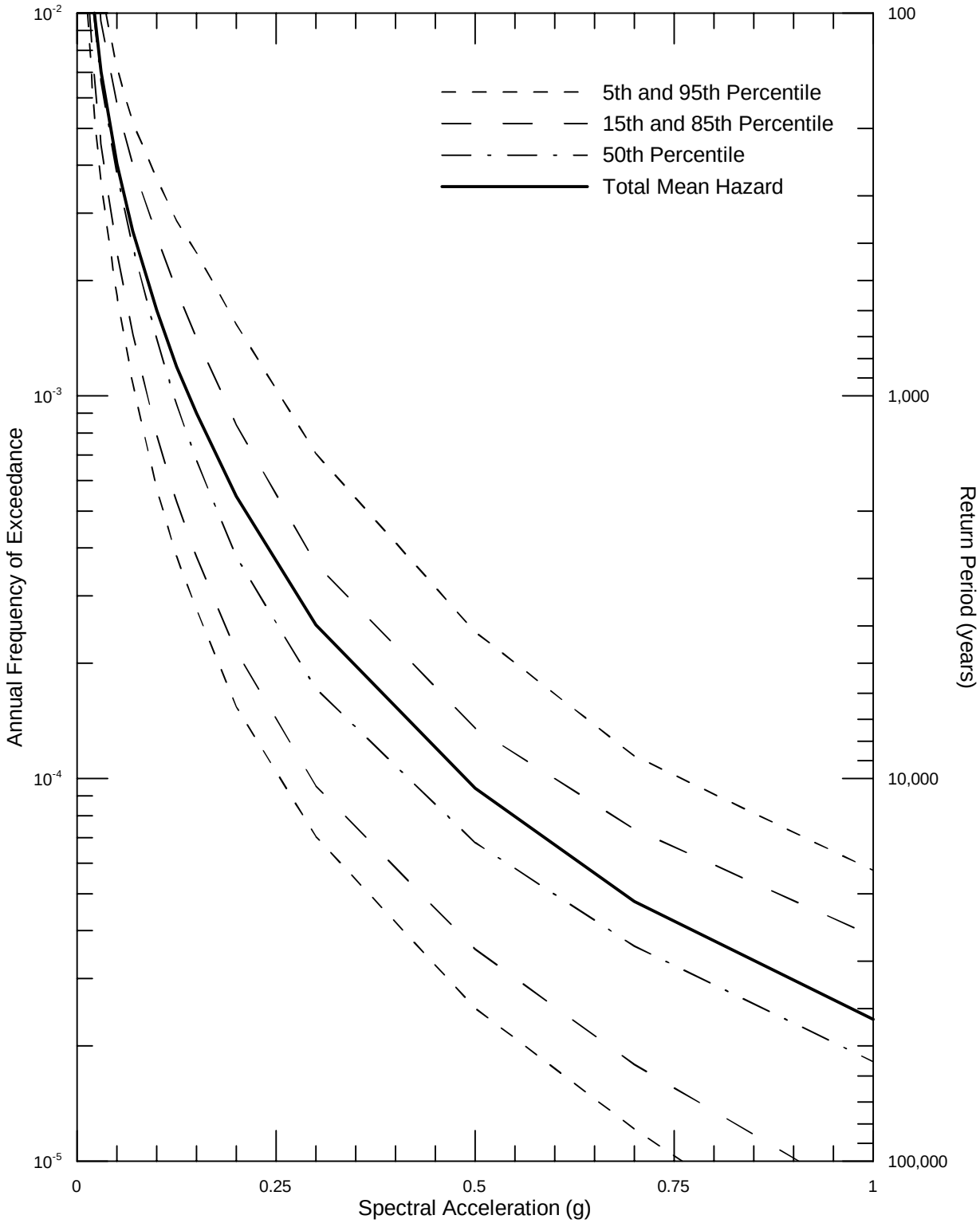


2-Zone Model Narrow

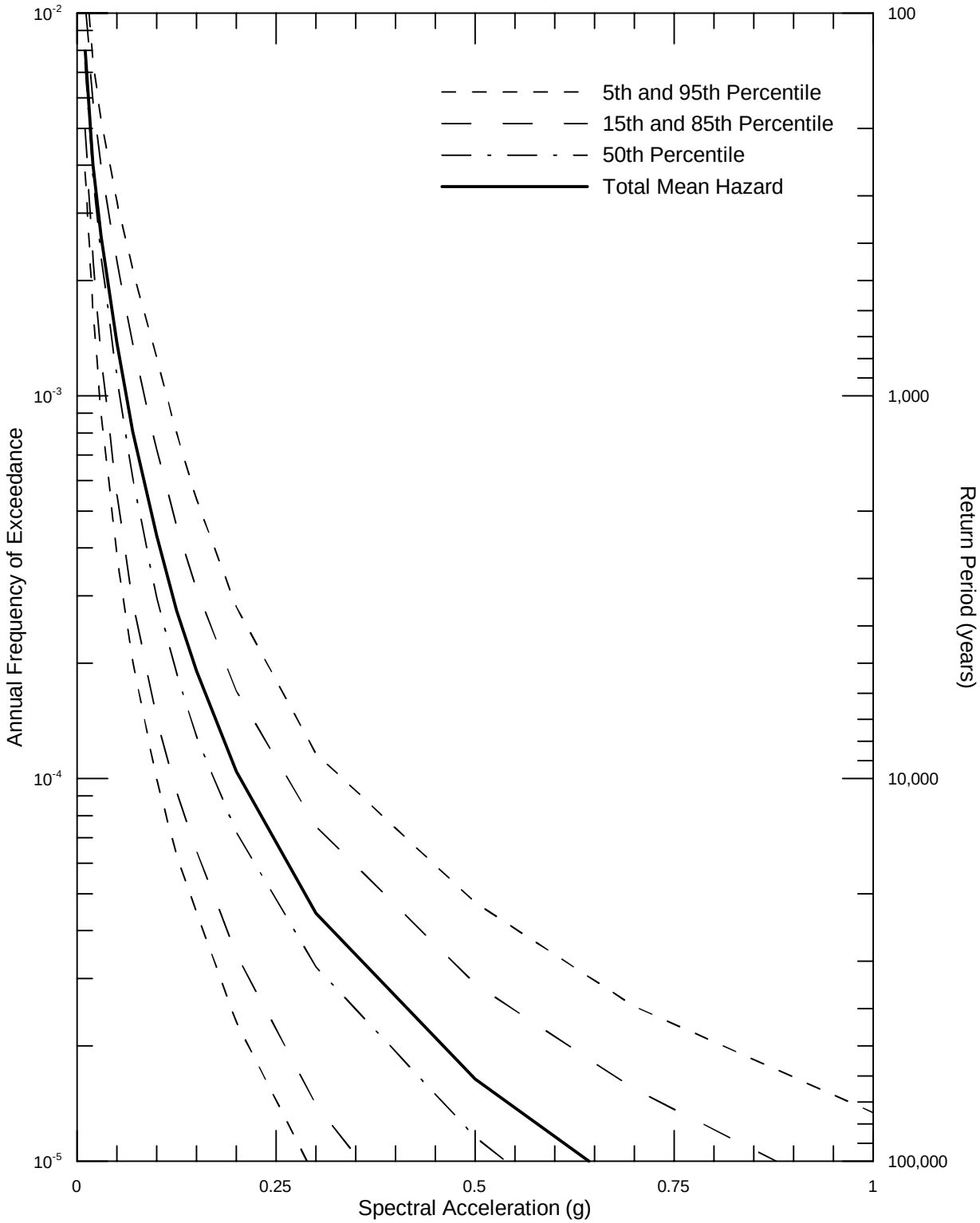
AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	Mmax ZONES	Figure 14



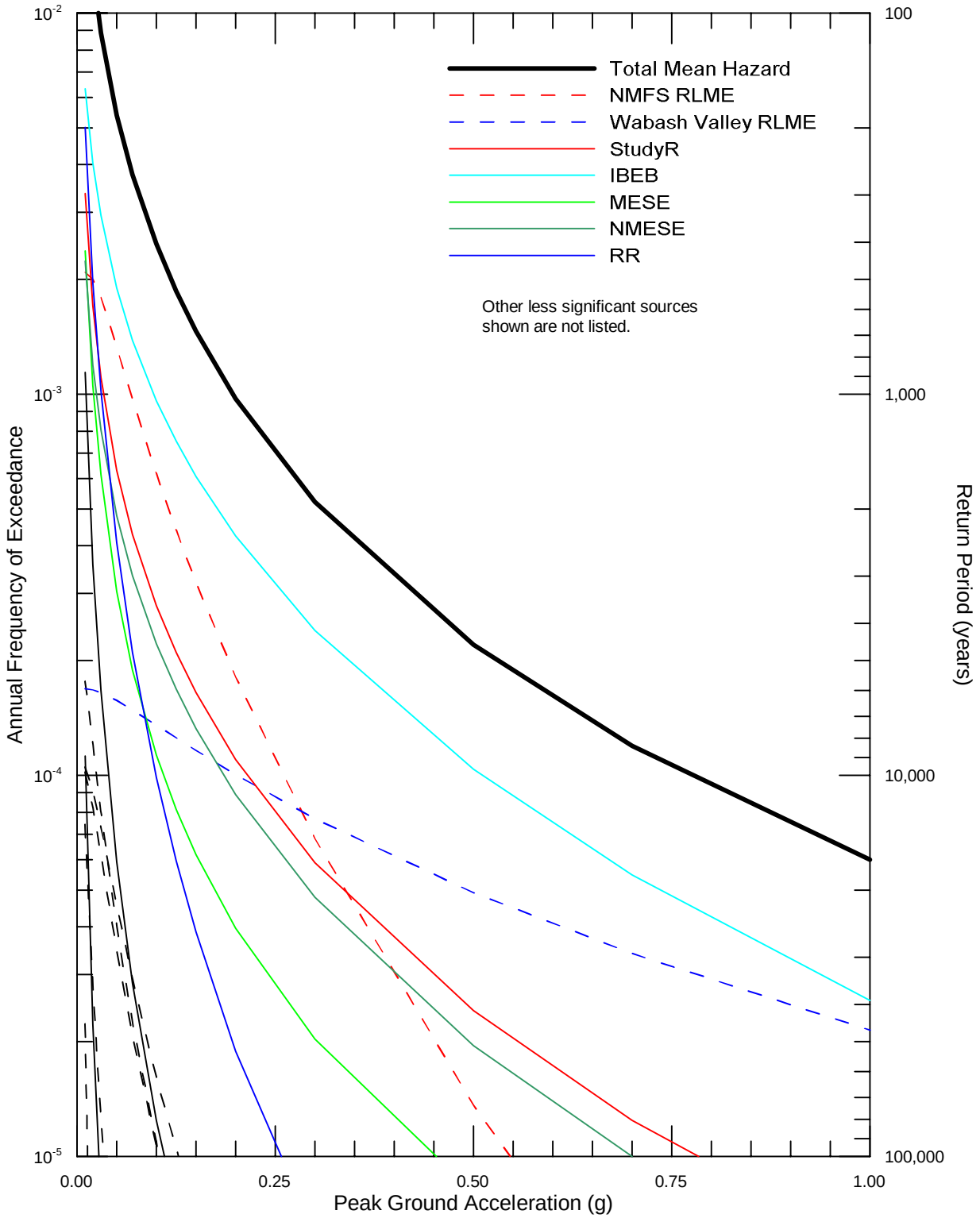
AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	SEISMIC HAZARD CURVES FOR PEAK HORIZONTAL ACCELERATION ON HARD ROCK	Figure 15



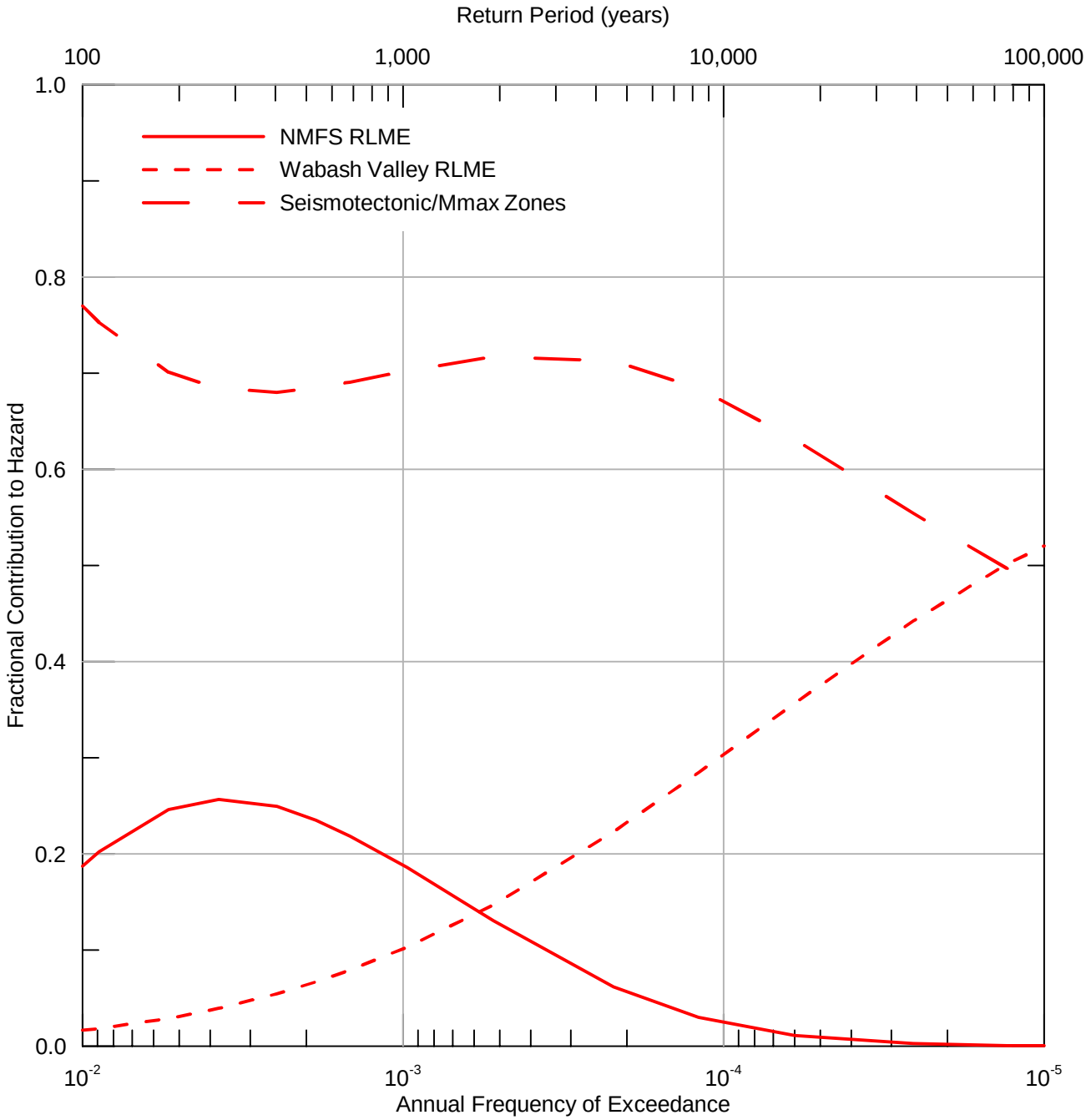
AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	SEISMIC HAZARD CURVES FOR 0.4 SEC HORIZONTAL SPECTRAL ACCELERATION ON HARD ROCK	Figure 16



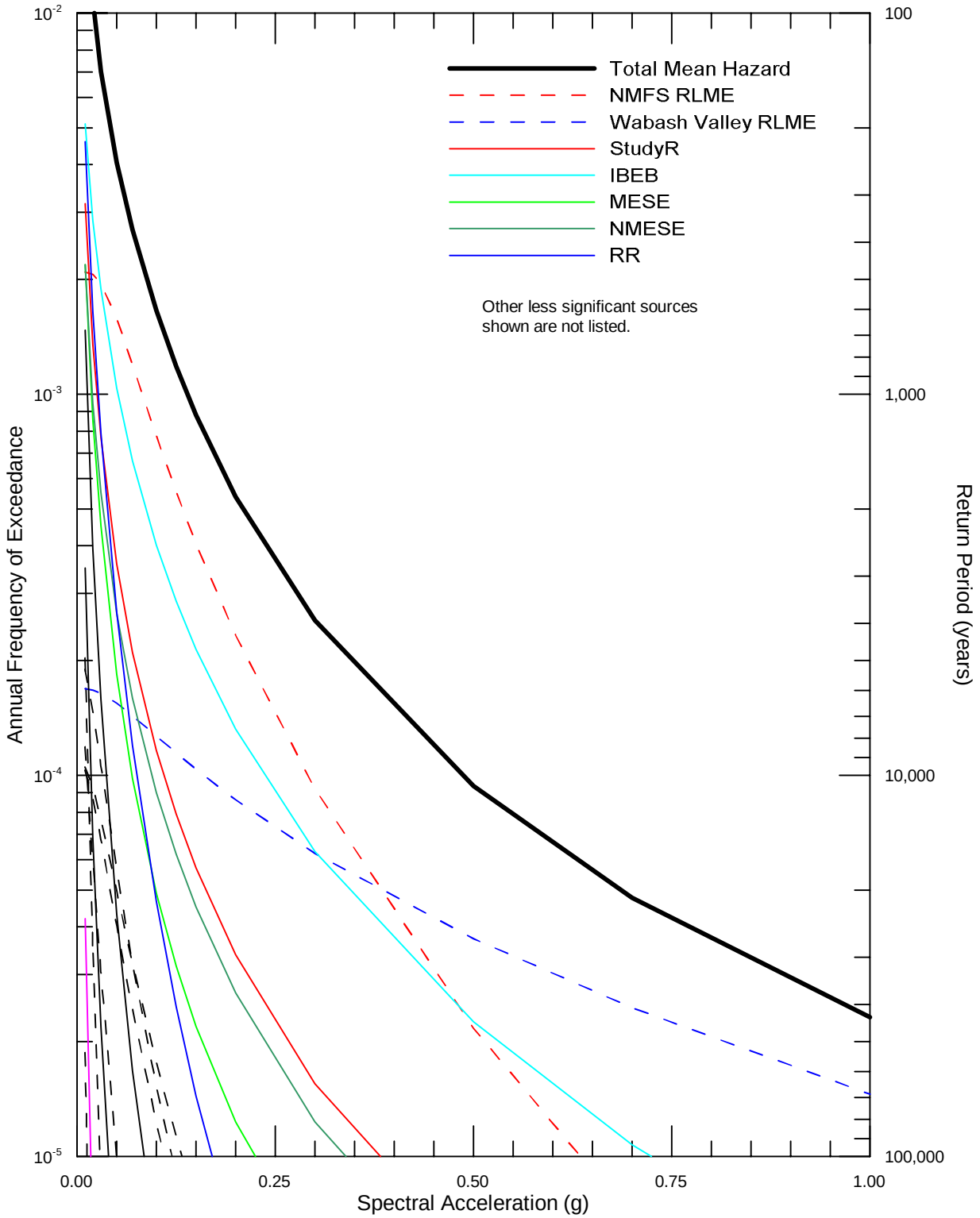
AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	SEISMIC HAZARD CURVES FOR 1.0 SEC HORIZONTAL SPECTRAL ACCELERATION ON HARD ROCK	Figure 17



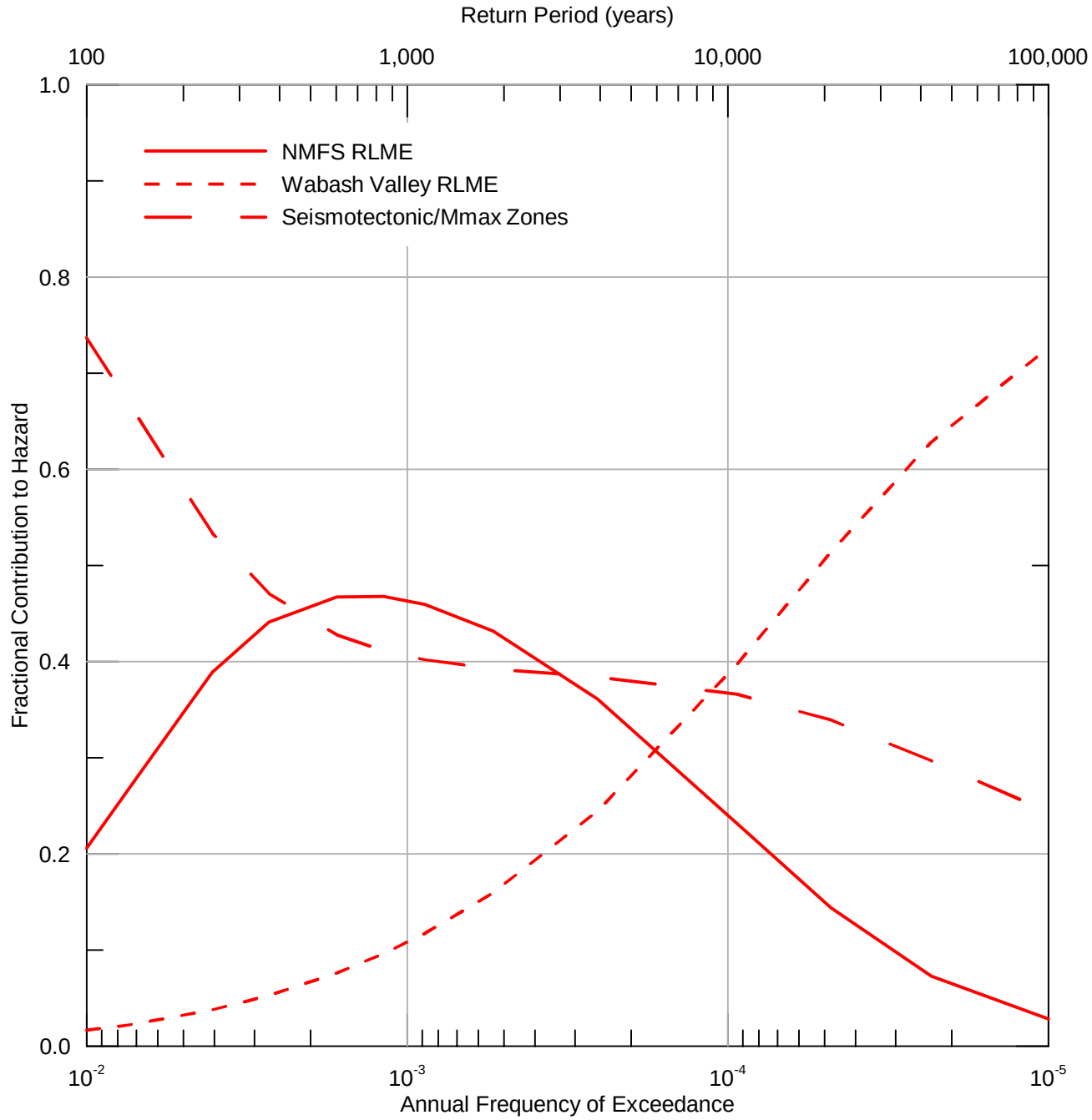
AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	SEISMIC SOURCE CONTRIBUTIONS TO MEAN PEAK HORIZONTAL ACCELERATION HAZARD ON HARD ROCK	Figure 18



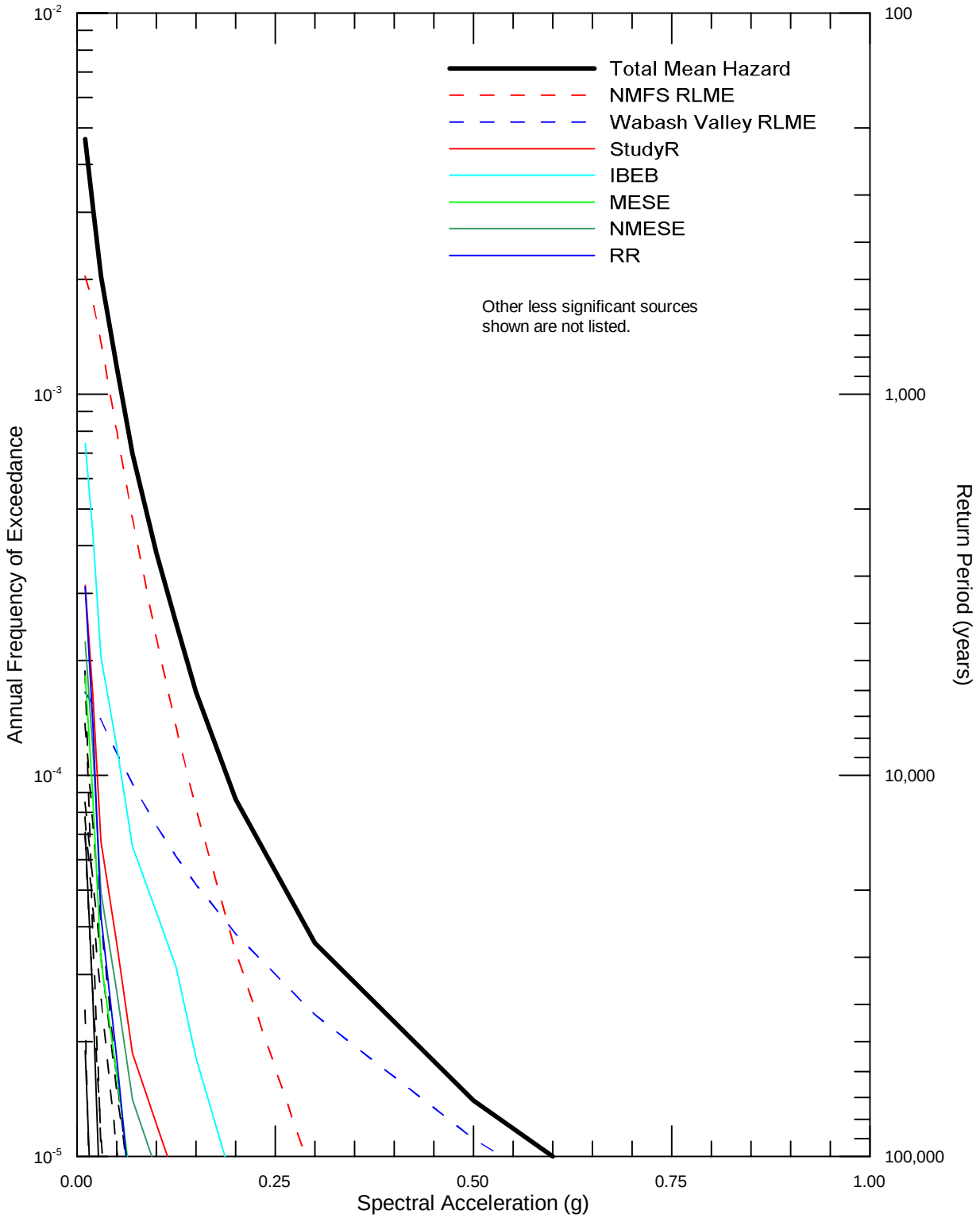
AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	SEISMIC SOURCE FRACTIONAL CONTRIBUTION TO MEAN PEAK HORIZONTAL ACCELERATION HAZARD ON HARD ROCK	Figure 19



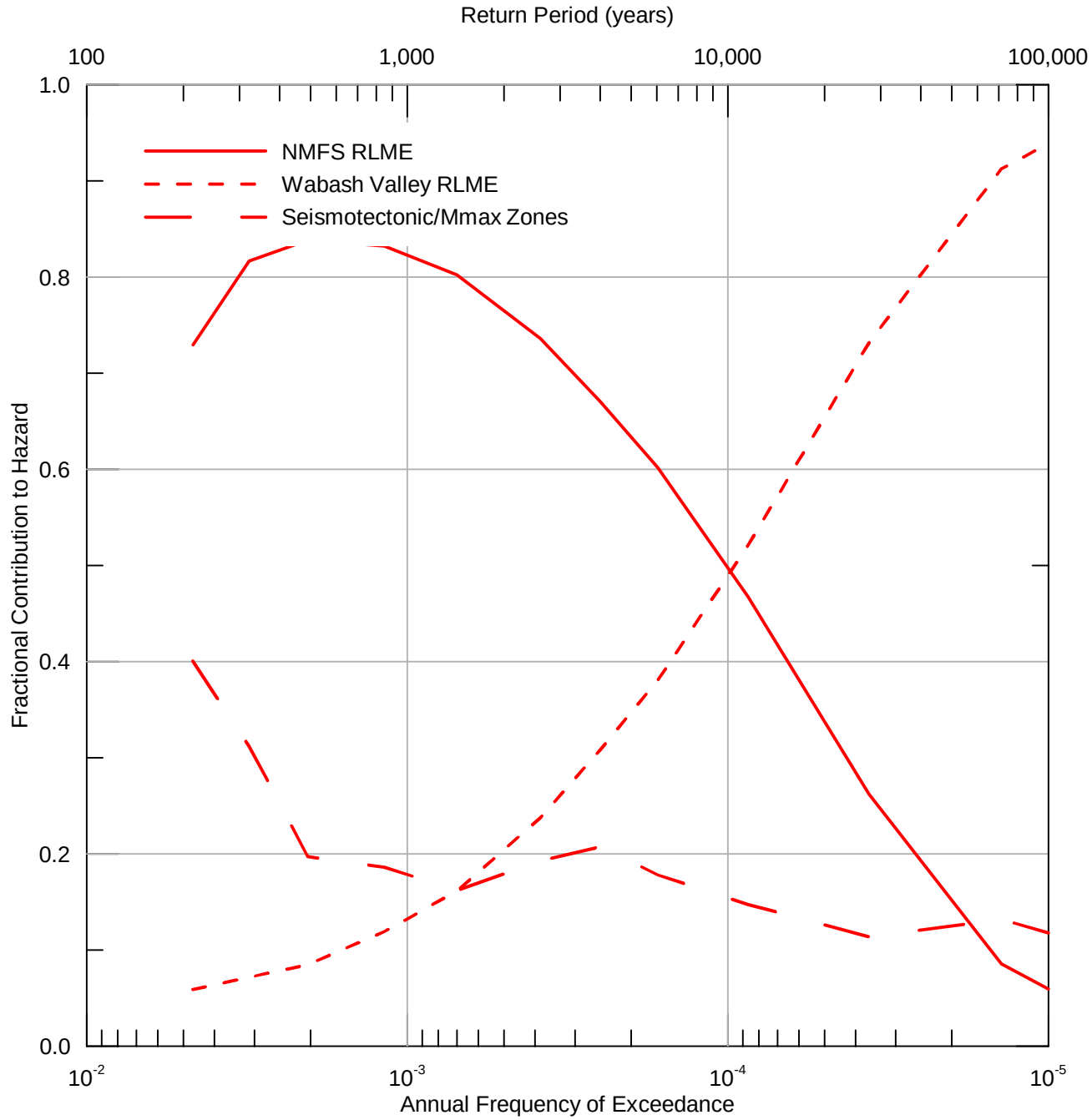
AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	SEISMIC SOURCE CONTRIBUTIONS TO MEAN 0.4 SEC HORIZONTAL SPECTRAL ACCELERATION HAZARD ON HARD ROCK	Figure 20



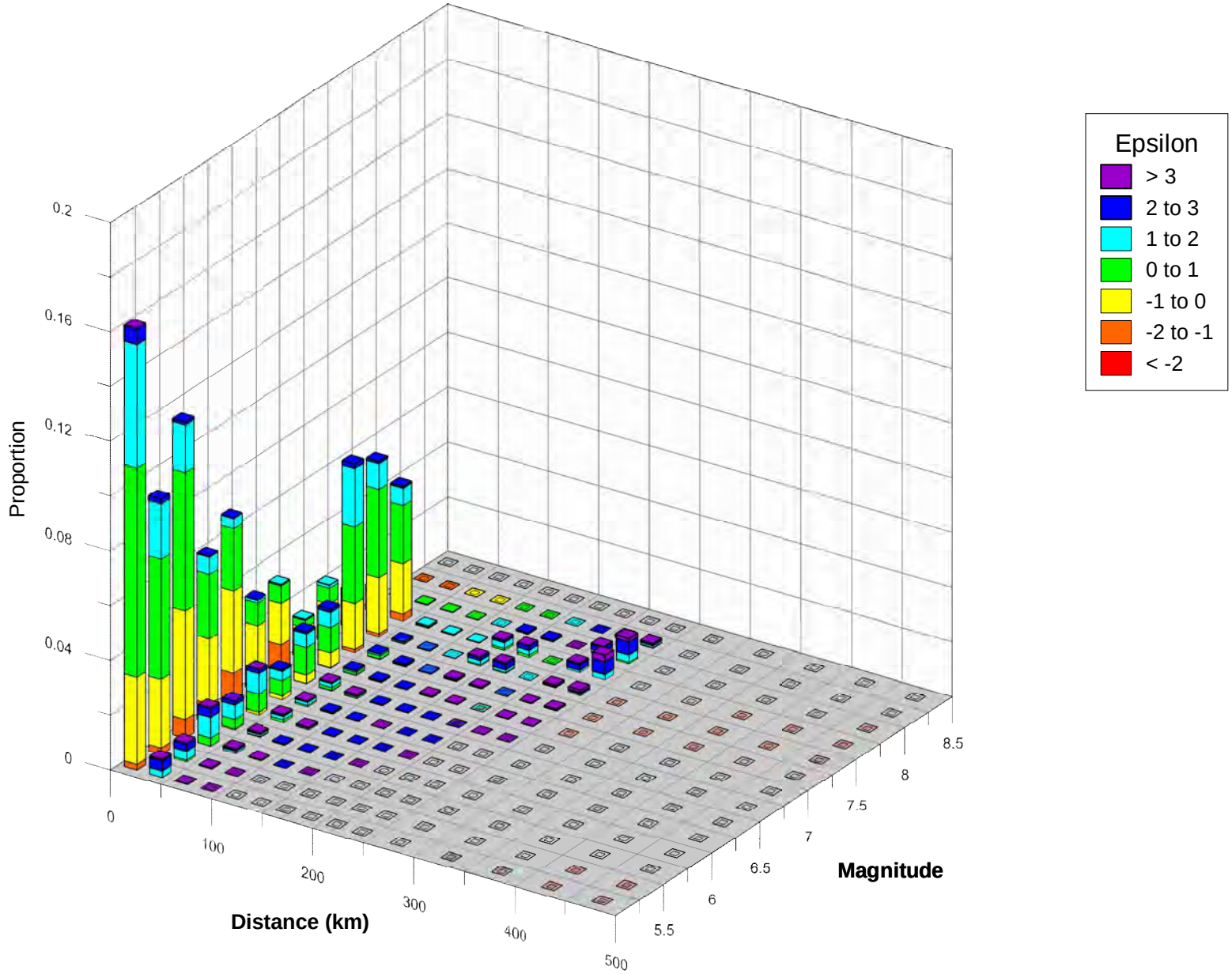
AECOM	Project No.60442676 A.B. Brown Generating Station Vectren Corporation	SEISMIC SOURCE FRACTIONAL CONTRIBUTION TO MEAN 0.4 SEC HORIZONTAL SPECTRAL ACCELERATION HAZARD ON HARD ROCK	Figure 21



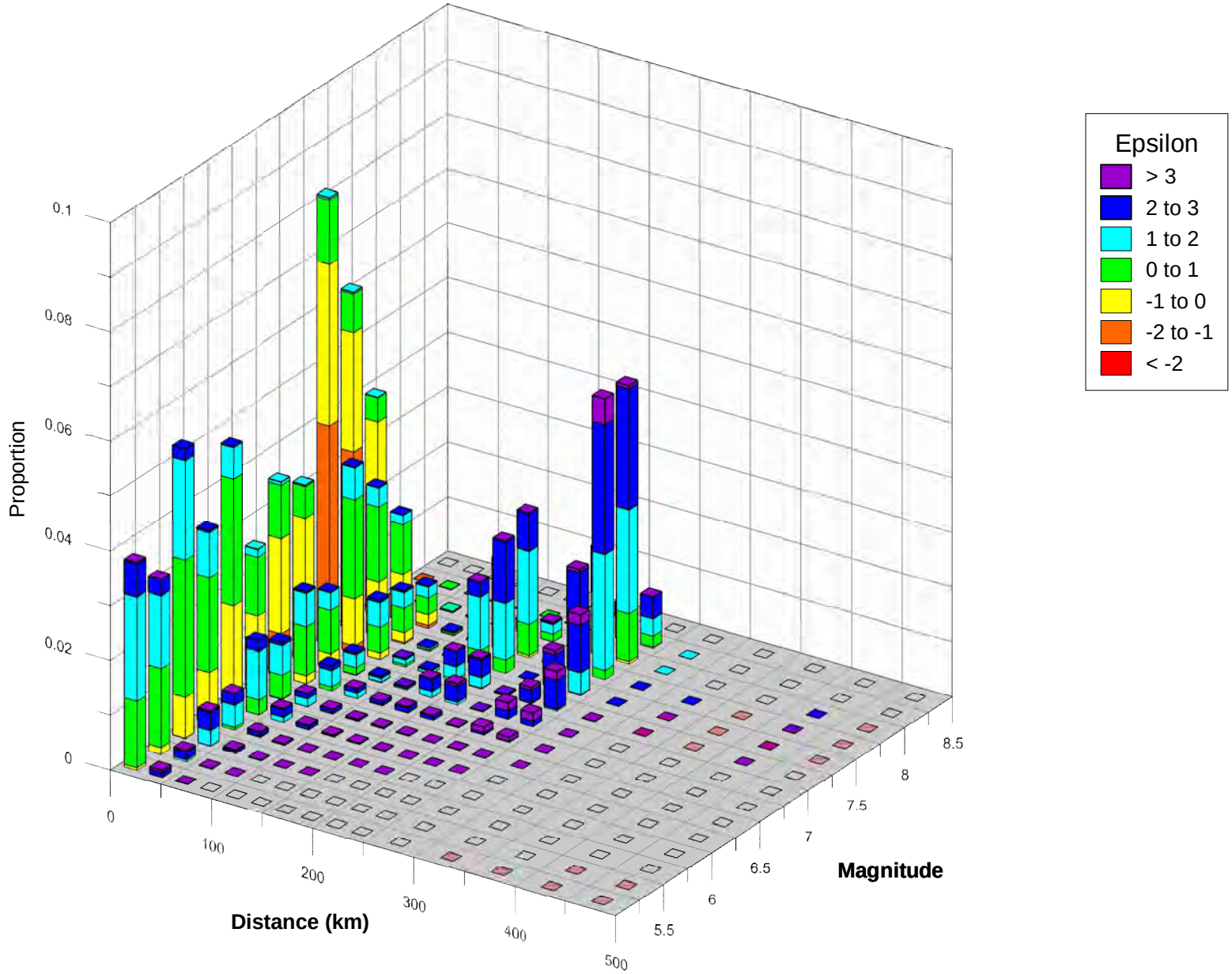
AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	SEISMIC SOURCE CONTRIBUTIONS TO MEAN 1.0 SEC HORIZONTAL SPECTRAL ACCELERATION HAZARD ON HARD ROCK	Figure 22



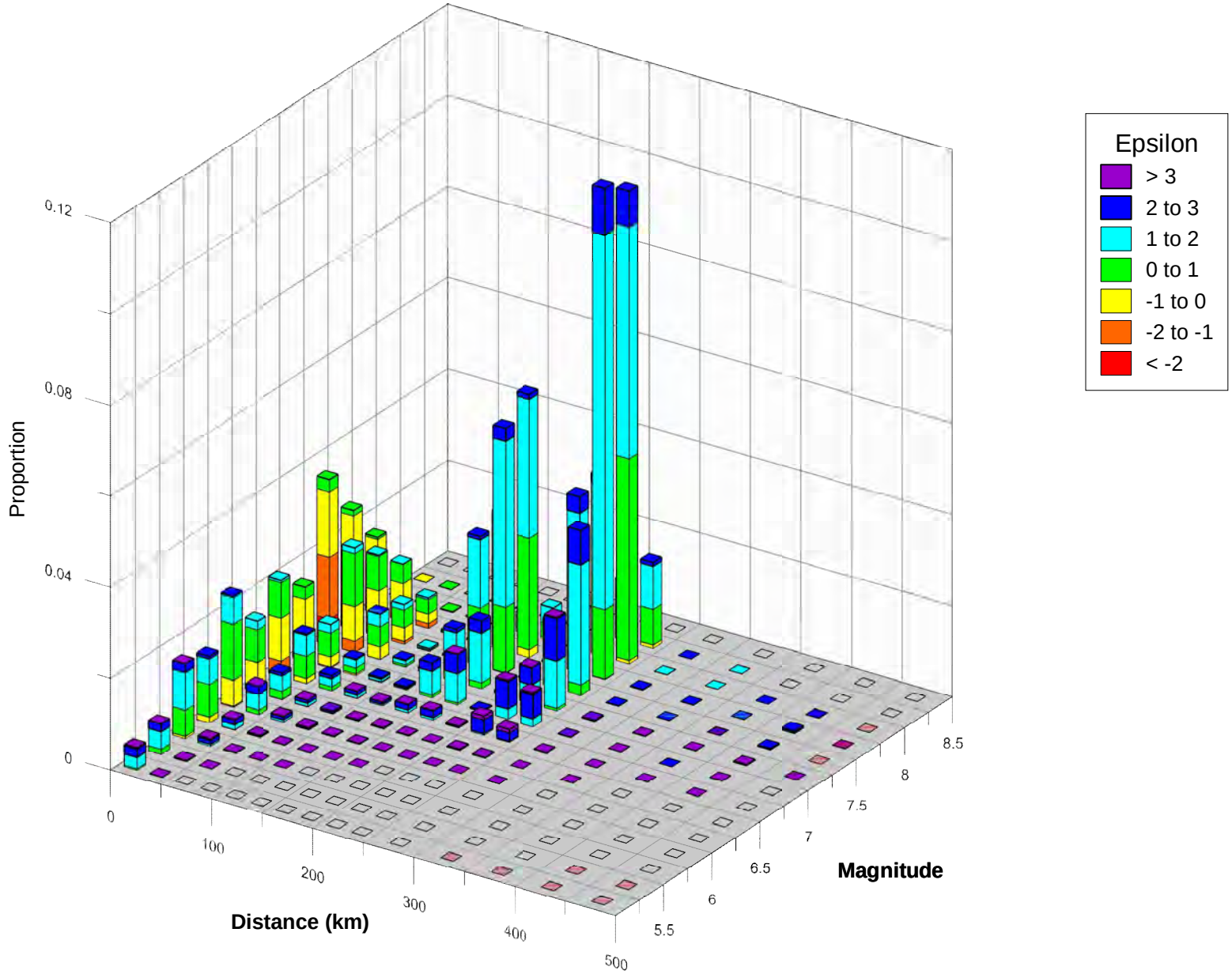
AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	SEISMIC SOURCE FRACTIONAL CONTRIBUTION TO MEAN 1.0 SEC HORIZONTAL SPECTRAL ACCELERATION HAZARD ON HARD ROCK	Figure 23



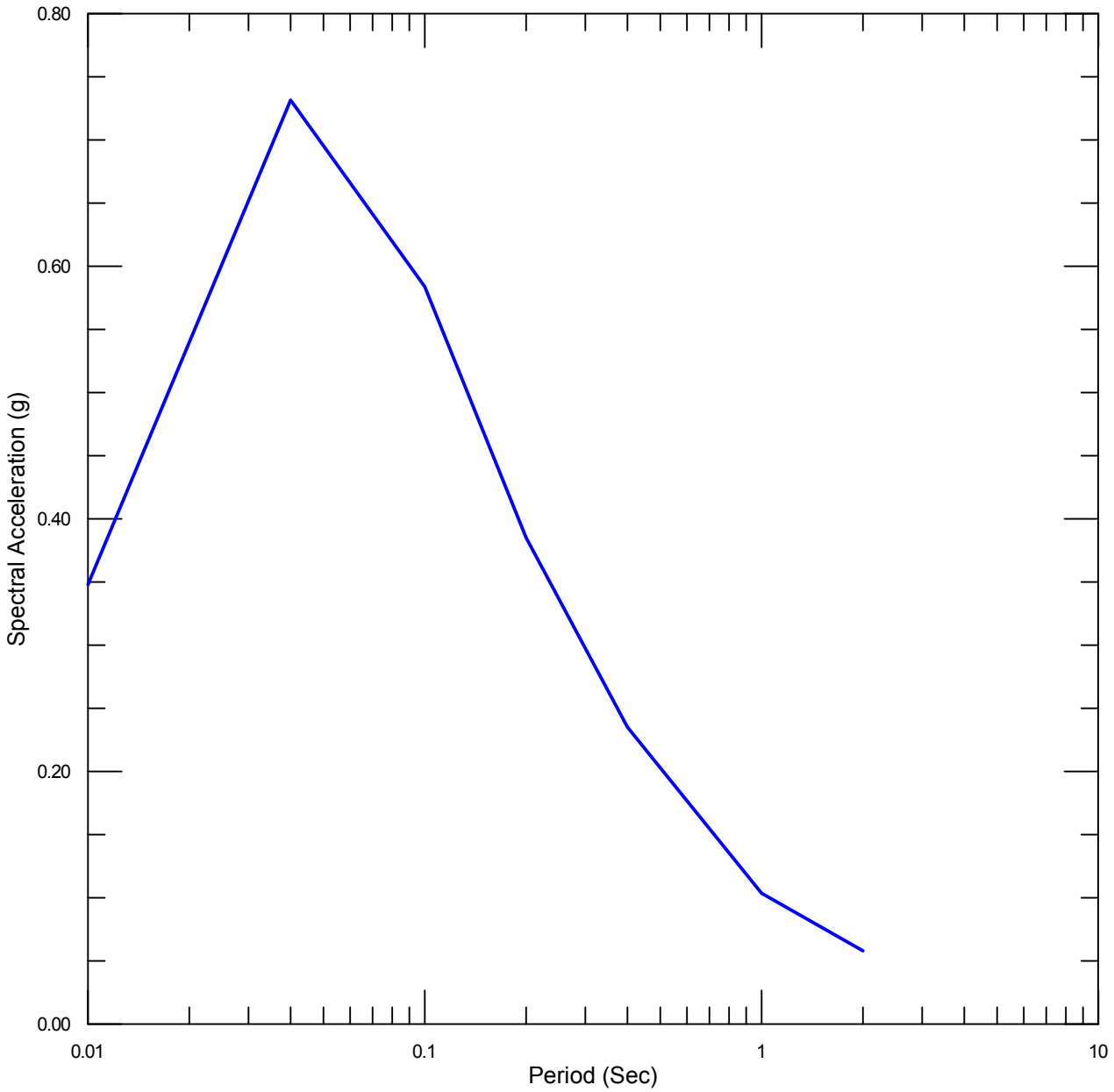
AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	MAGNITUDE, DISTANCE AND EPSILON CONTRIBUTIONS TO THE MEAN PEAK HORIZONTAL ACCELERATIONHAZARD AT 2,500-YEAR RETURN PERIOD ON HARD ROCK	Figure 24



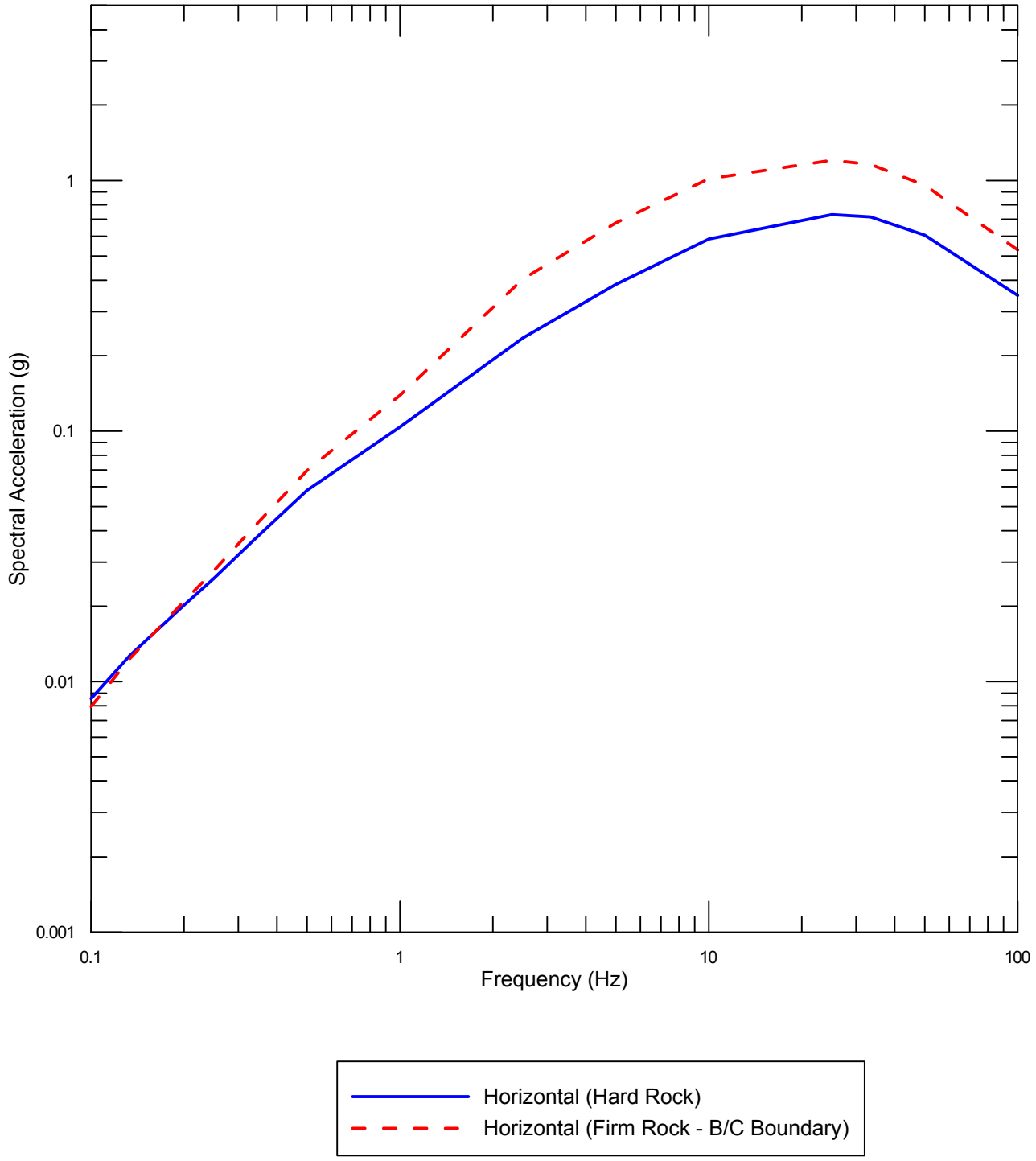
AECOM	Project No.60442676 A.B. Brown Generating Station Vectren Corporation	MAGNITUDE,DISTANCE AND EPSILON CONTRIBUTIONS TO THE MEAN 0.4 SEC HORIZONTAL SPECTRALACCELERATION HAZARD AT 2,500-YEAR RETURN PERIOD ON HARD ROCK	Figure 25



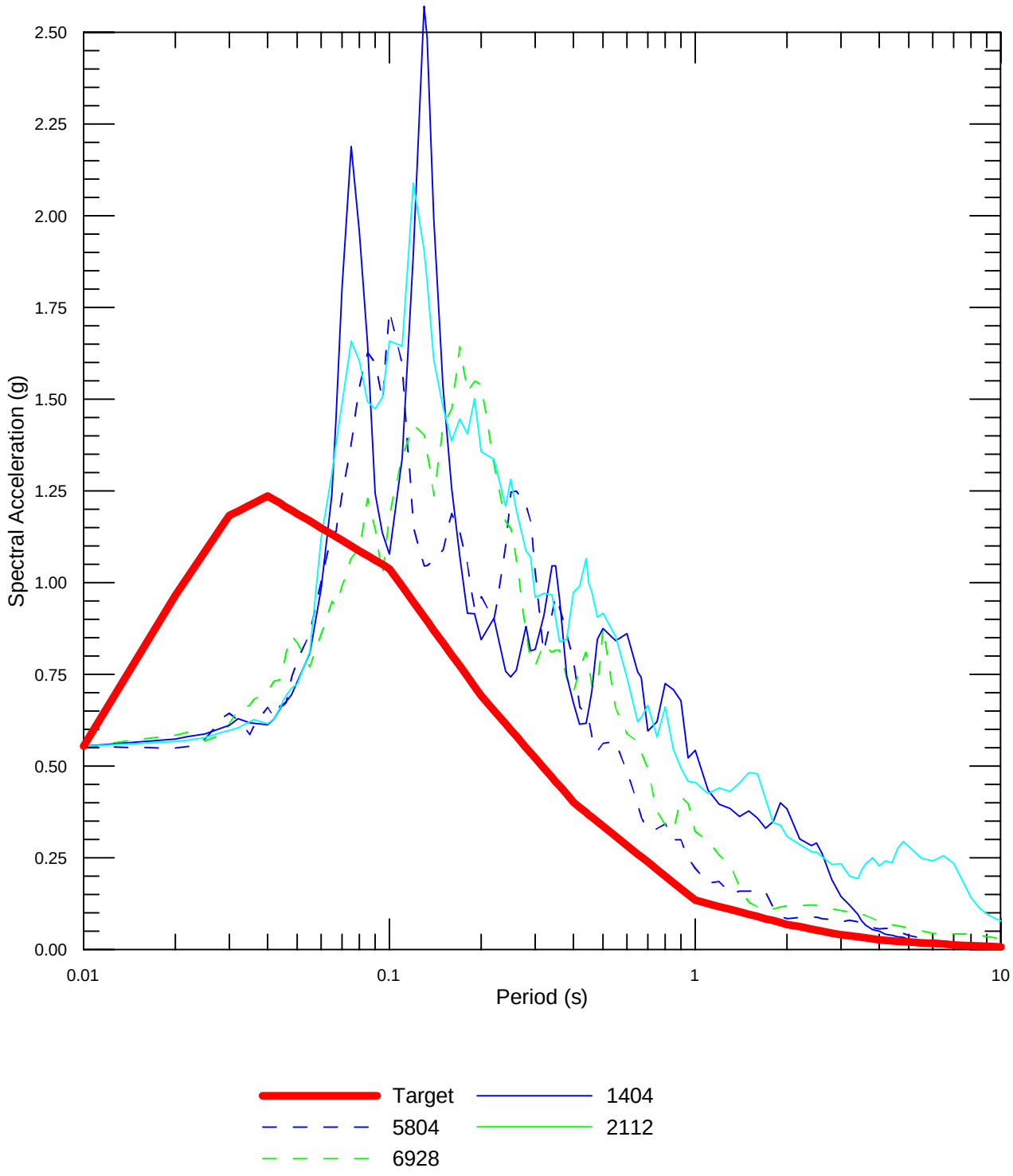
AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	MAGNITUDE,DISTANCE AND EPSILON CONTRIBUTIONS TO THE MEAN 1.0 SEC HORIZONTAL SPECTRALACCELERATION HAZARD AT 2,500-YEAR RETURN PERIOD ON HARD ROCK	Figure 26



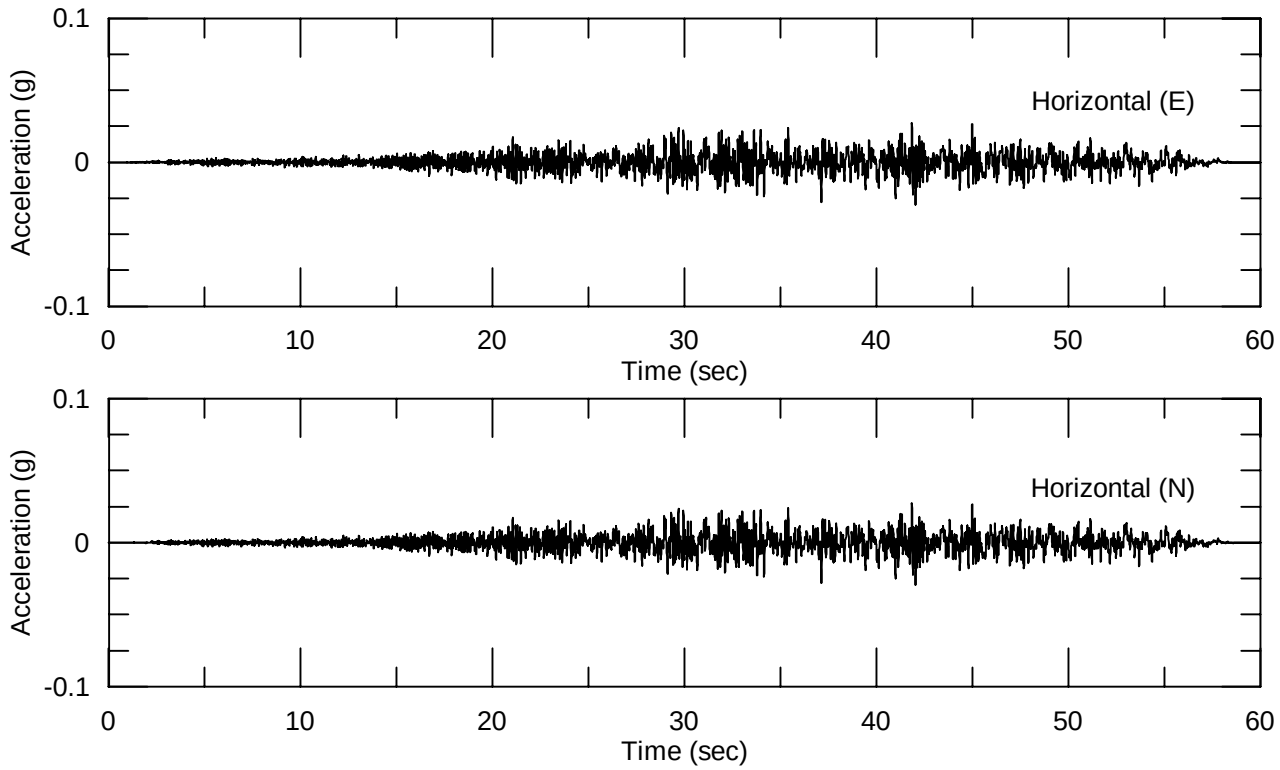
AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	HORIZONTAL 5%-DAMPED MEAN UHS AT 2,500-YEAR RETURN PERIOD ON HARD ROCK	Figure 27



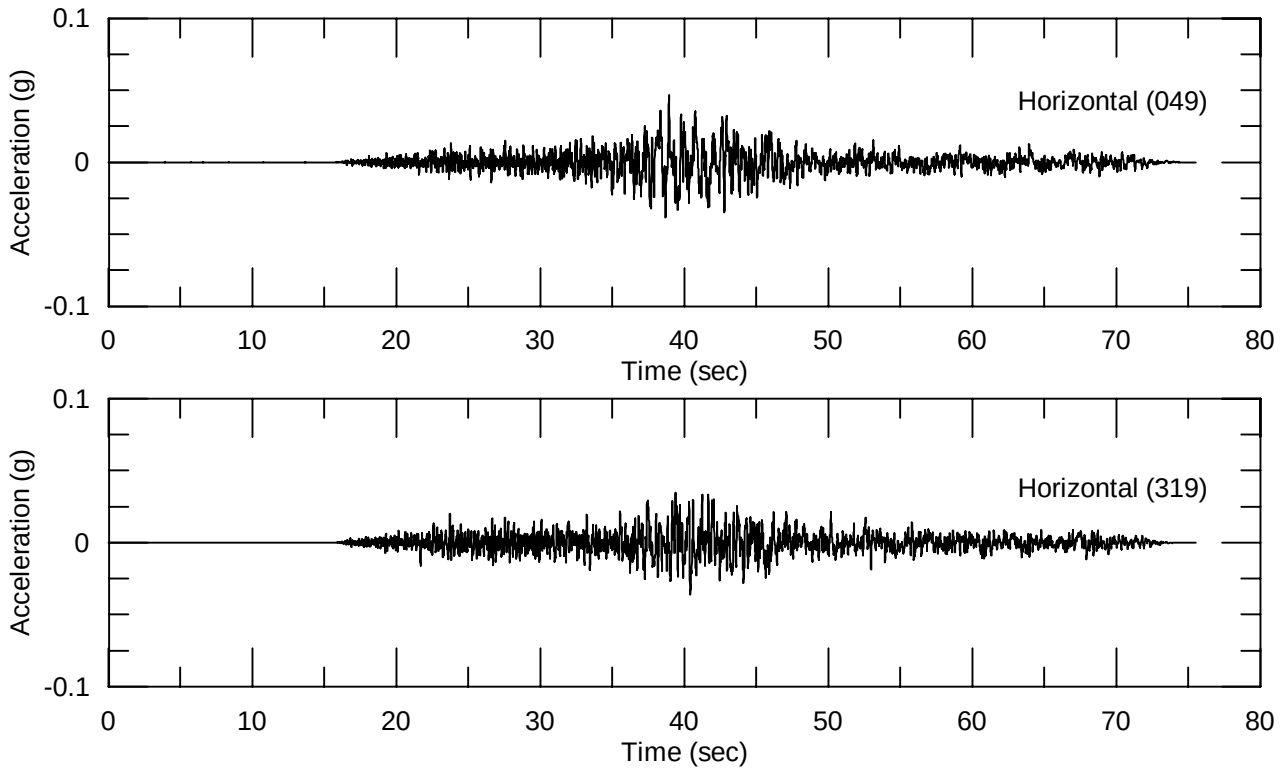
AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	COMPARISON OF HORIZONTAL 5%-DAMPED MEAN UHS AT 2,500-YEAR RETURN PERIOD ON HARD AND FIRM ROCK	Figure 28



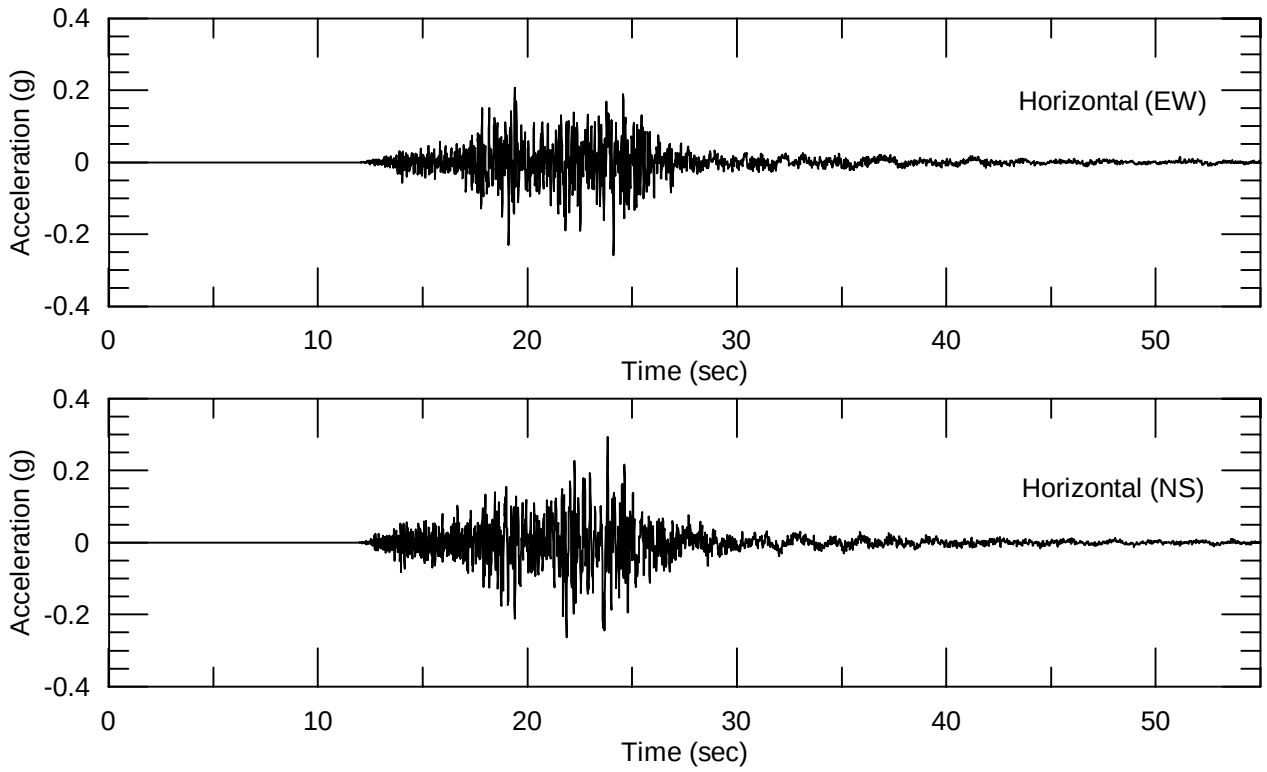
AECOM	Project No.60442676 A.B. Brown Generating Station Vectren Corporation	HORIZONTAL TARGET AND SELECTED SEED RESPONSE SPECTRA	Figure 29



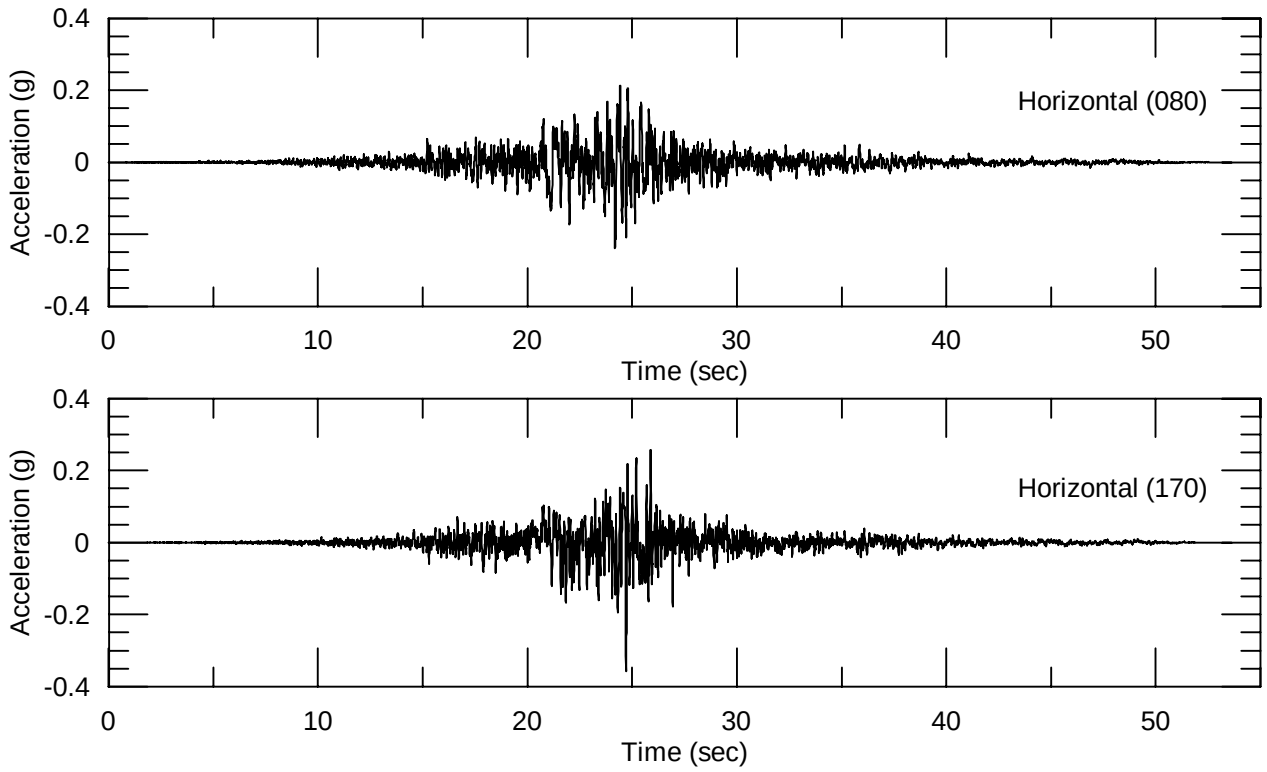
AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	SEED TIME HISTORIES RSN1404 - 1999 CHI CHI PNG	Figure 30



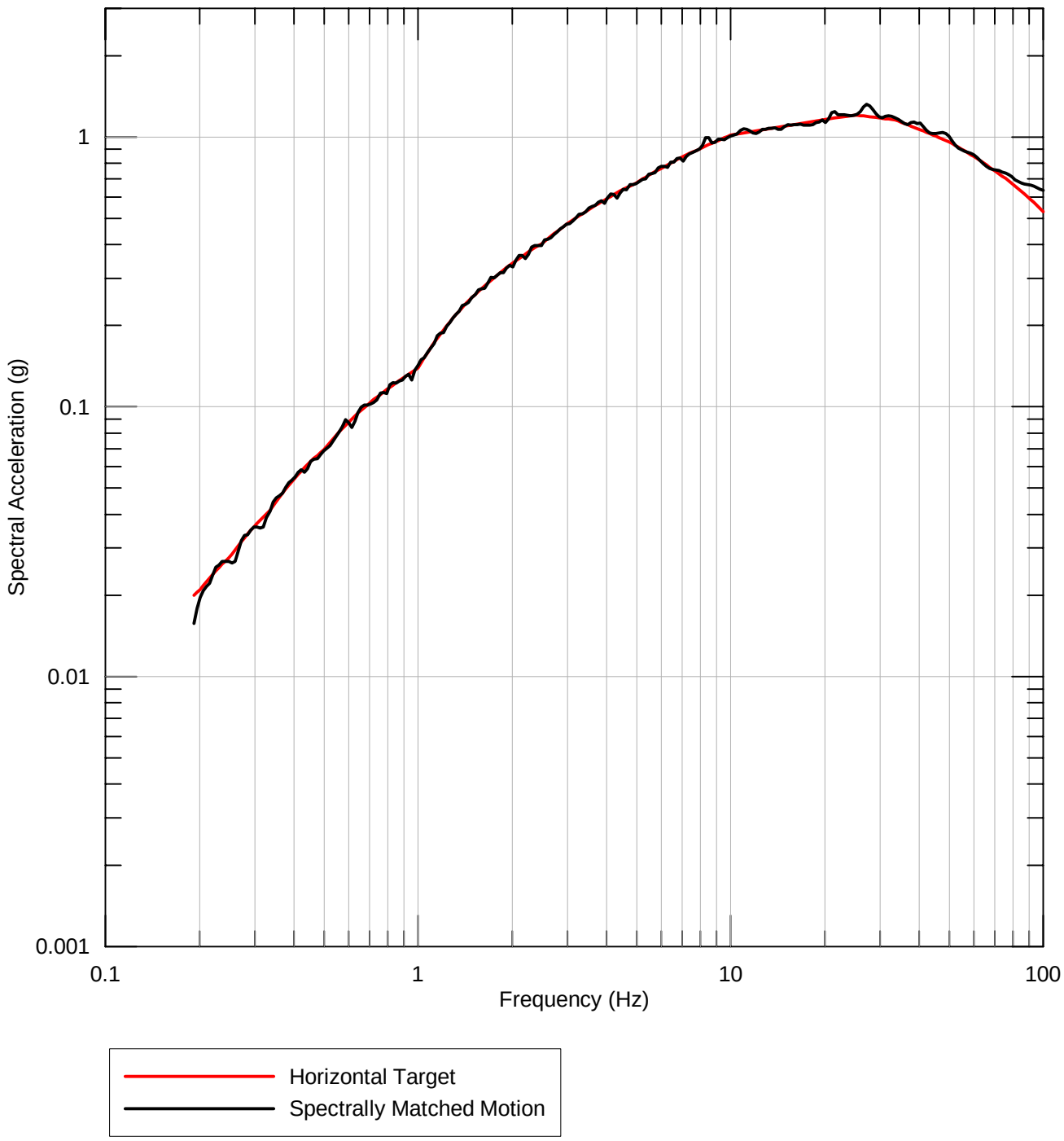
AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	SEED TIME HISTORIES RSN2112 - 2002 DENALI TAPS PUMP STATION #8	Figure 31



AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	SEED TIME HISTORIES RSN5804 - IWATE 55446	Figure 32

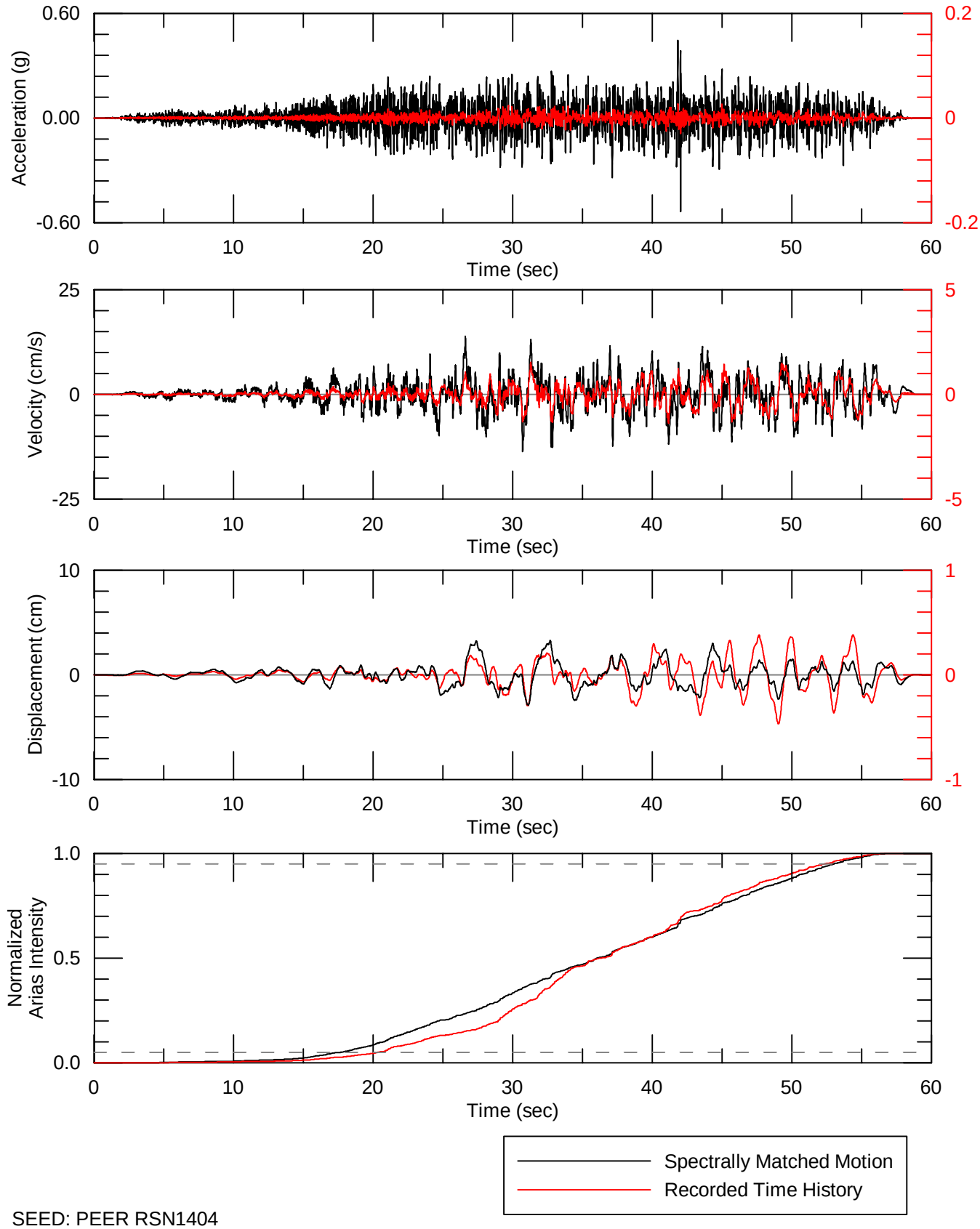


AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	SEED TIME HISTORIES RSN6928 - DARFIELD LPCC	Figure 33



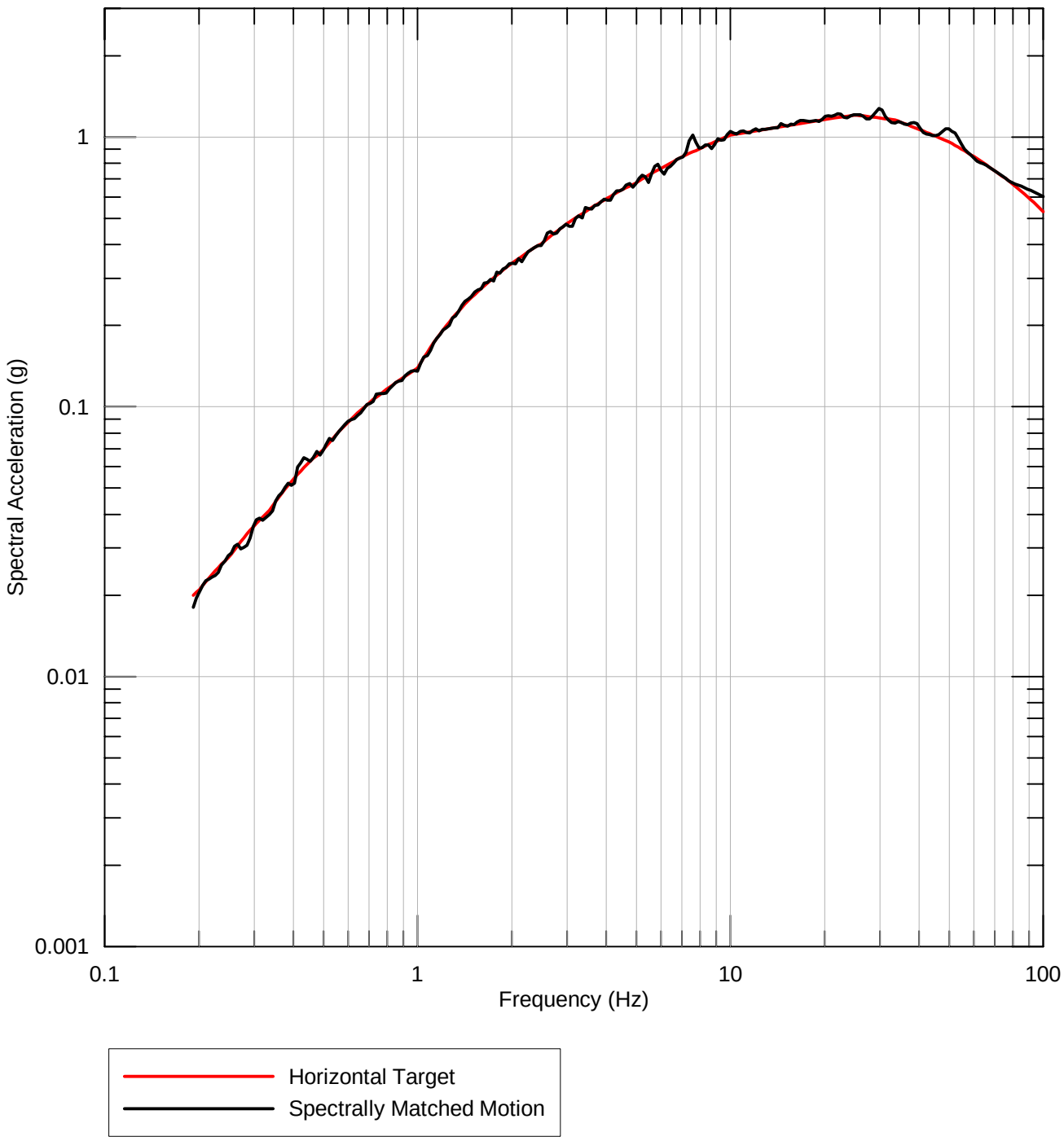
SEED: PEER RSN1404

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	RESPONSE SPECTRUM FOR TIME HISTORY SPECTRALLY MATCHED TO 2,500-YEAR RETURN PERIOD UHS HORIZONTAL TARGET 1999 CHI CHI - PNG (E) SEED	Figure 34



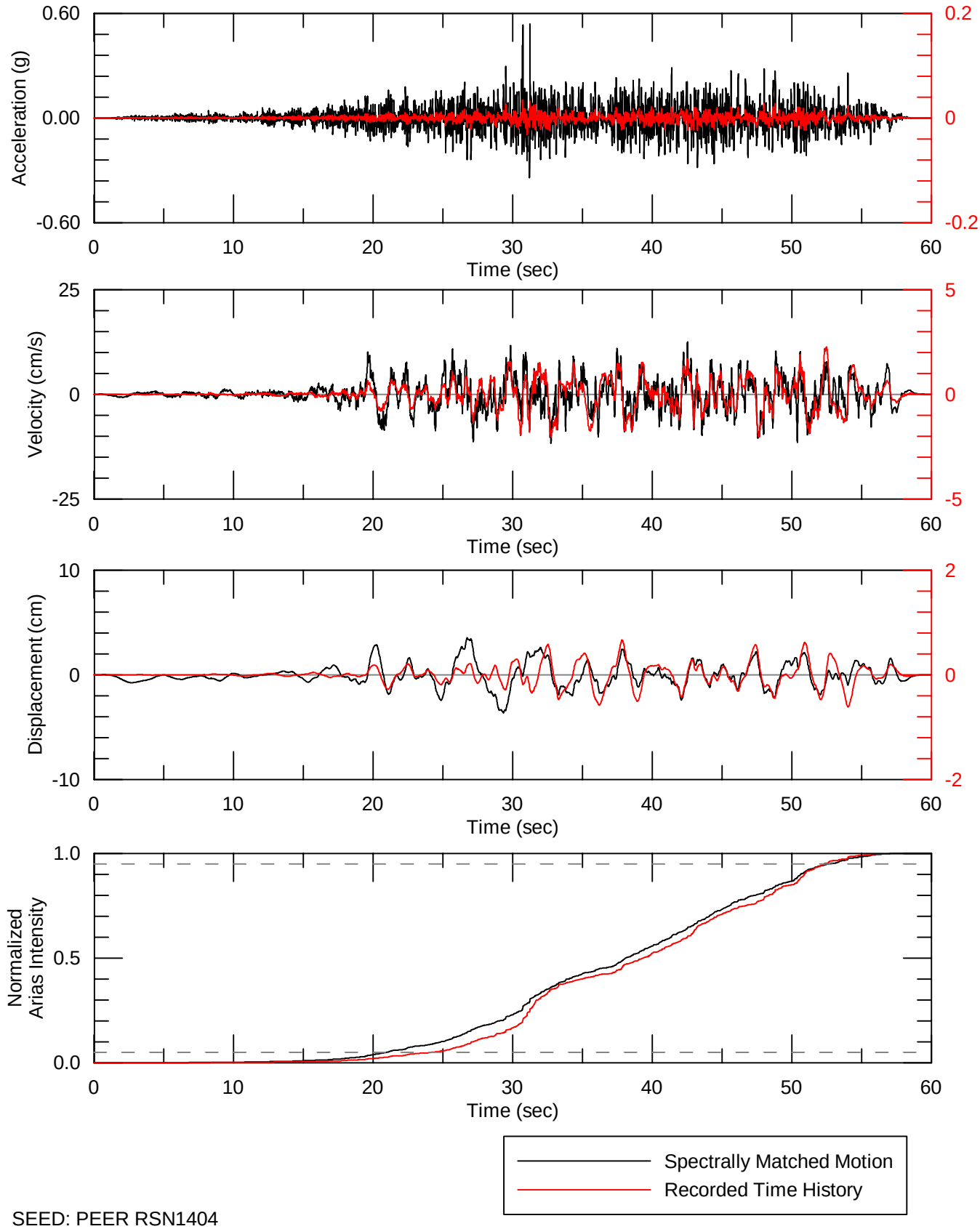
SEED: PEER RSN1404

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	TIME HISTORY SPECTRALLY MATCHED TO 2,500-YEAR RETURN PERIOD UHS HORIZONTAL TARGET 1999 CHI CHI - PNG (E) SEED	Figure 35



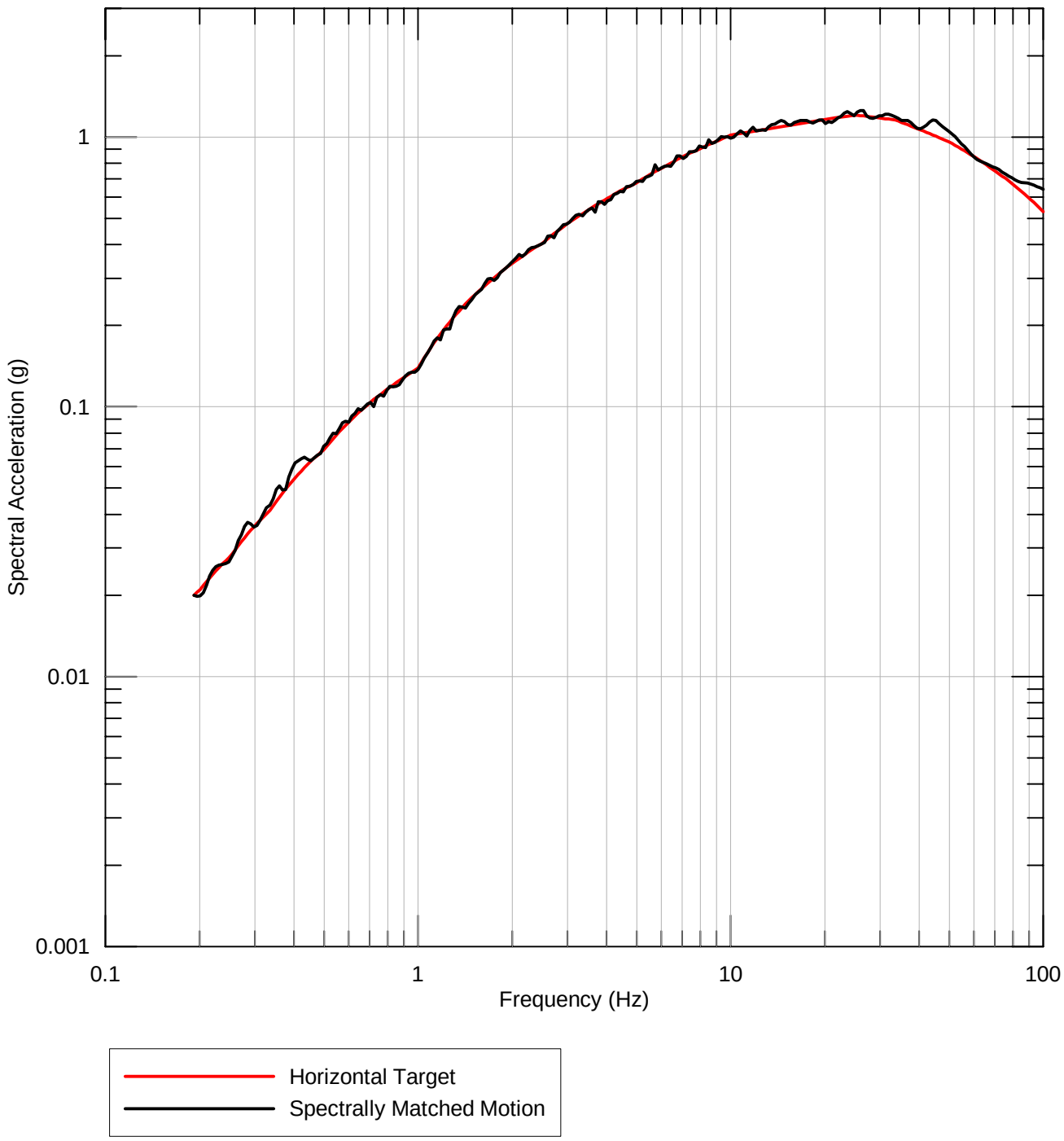
SEED: PEER RSN1404

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	RESPONSE SPECTRUM FOR TIME HISTORY SPECTRALLY MATCHED TO 2,500-YEAR RETURN PERIOD UHS HORIZONTAL TARGET 1999 CHI CHI - PNG (N) SEED	Figure 36



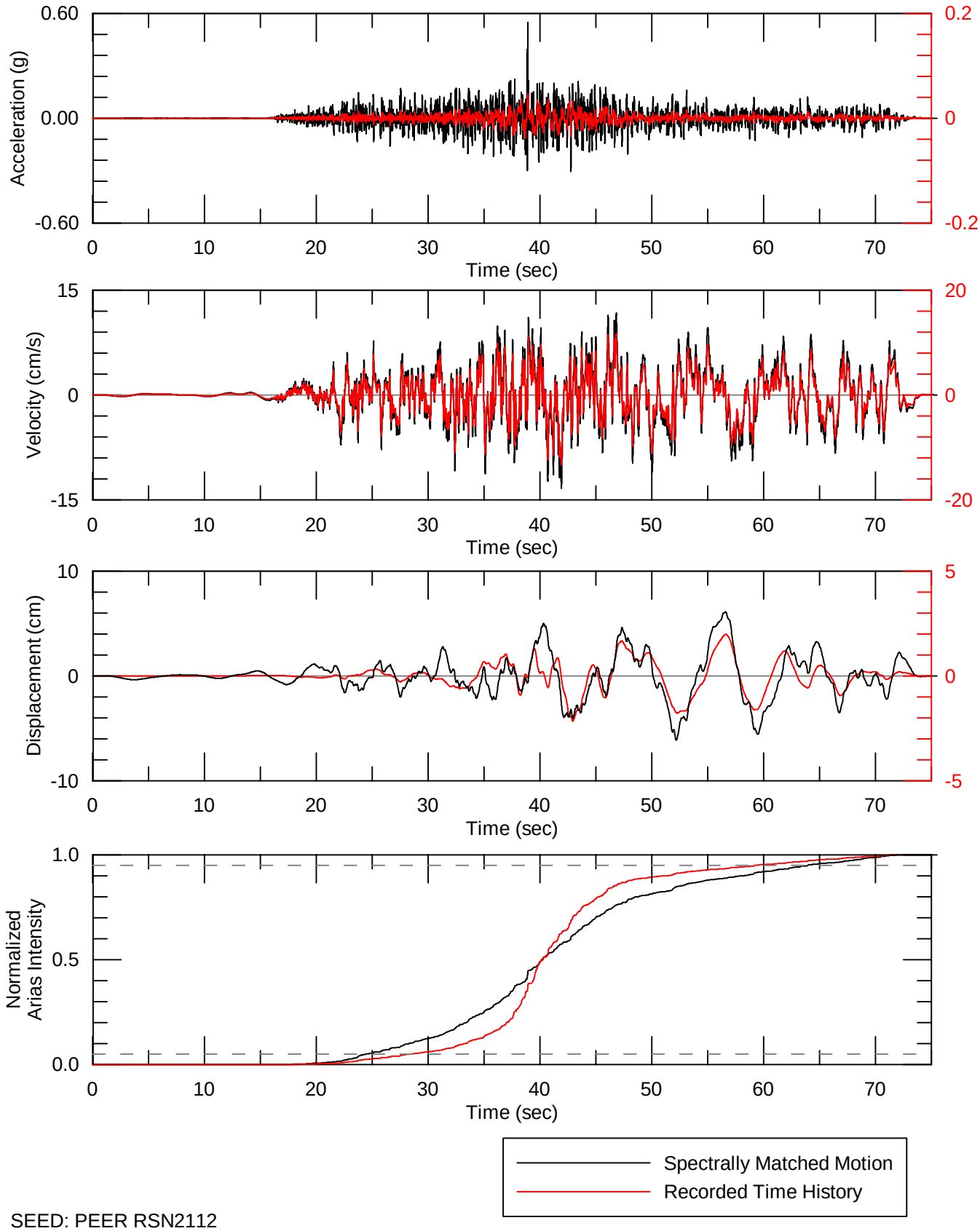
SEED: PEER RSN1404

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	TIME HISTORY SPECTRALLY MATCHED TO 2,500-YEAR RETURN PERIOD UHS HORIZONTAL TARGET 1999 CHI CHI - PNG (N) SEED	Figure 37



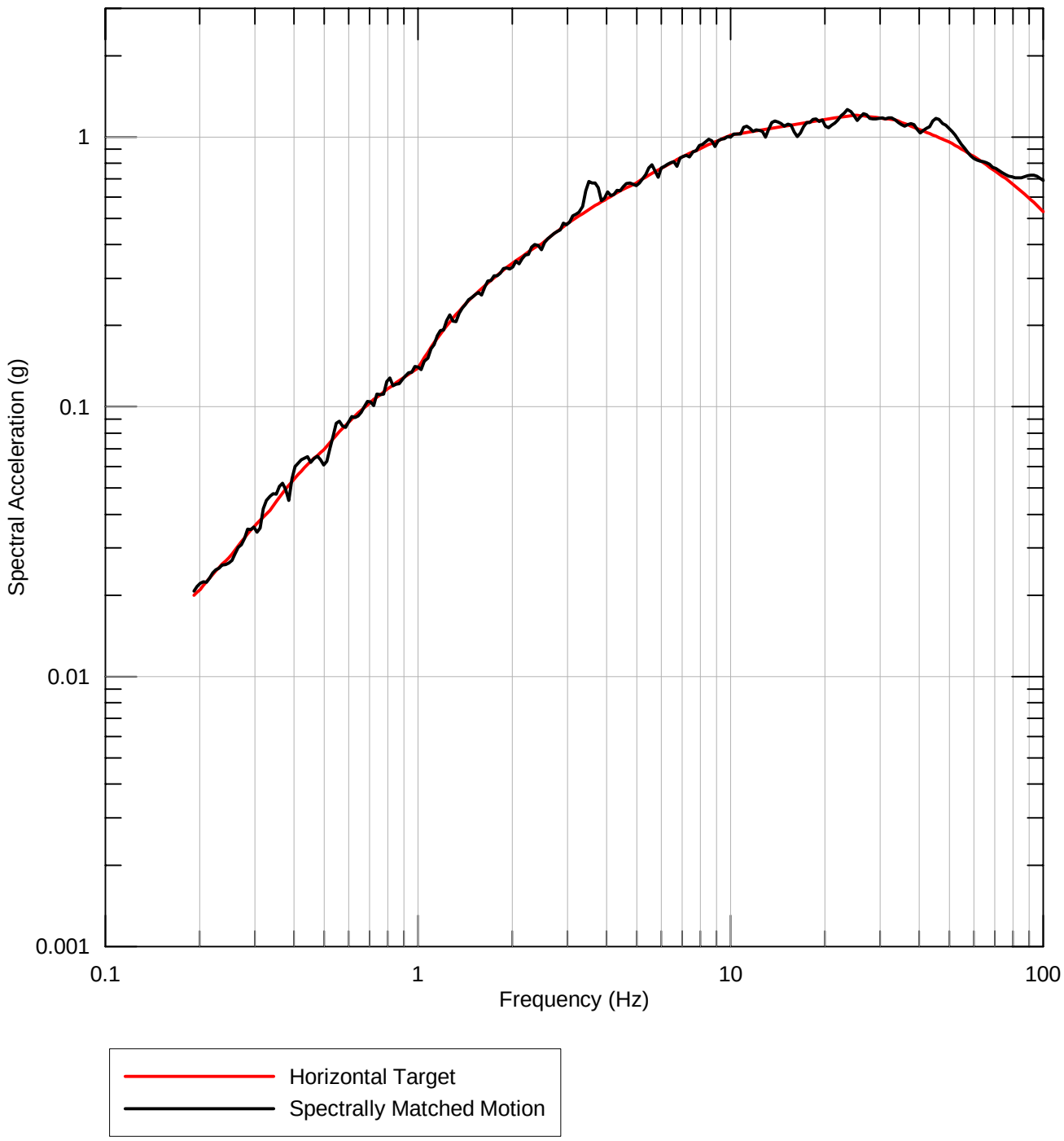
SEED: PEER RSN2112

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	RESPONSE SPECTRUM FOR TIME HISTORY SPECTRALLY MATCHED TO 2,500-YEAR RETURN PERIOD UHS HORIZONTAL TARGET 2002 DENALI - TAPS PUMP STATION #8 (049) SEED	Figure 38



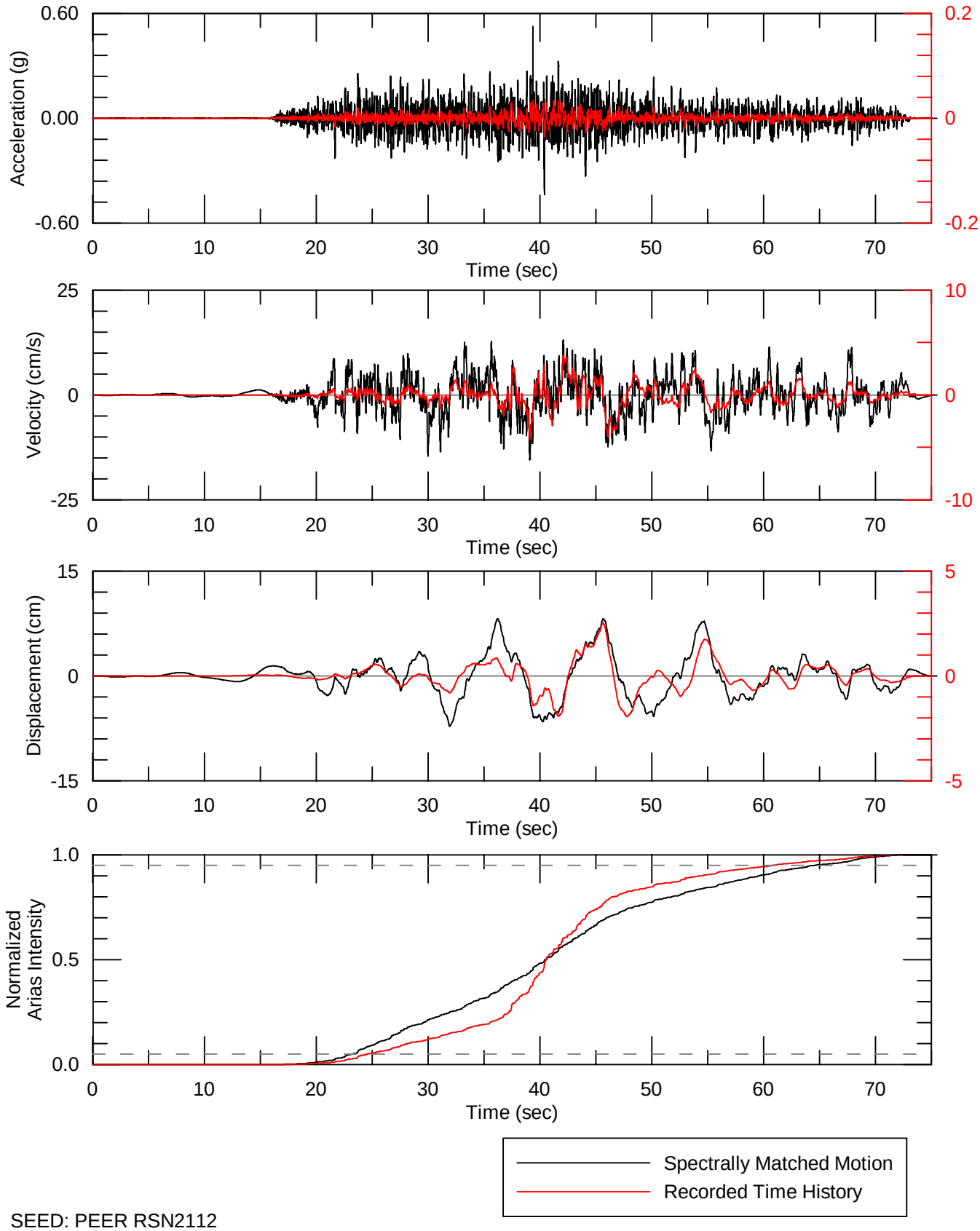
SEED: PEER RSN2112

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	TIME HISTORY SPECTRALLY MATCHED TO 2,500-YEAR RETURN PERIOD UHS HORIZONTAL TARGET 2002 DENALI - TAPS PUMP STATION #8 (049) SEED	Figure 39



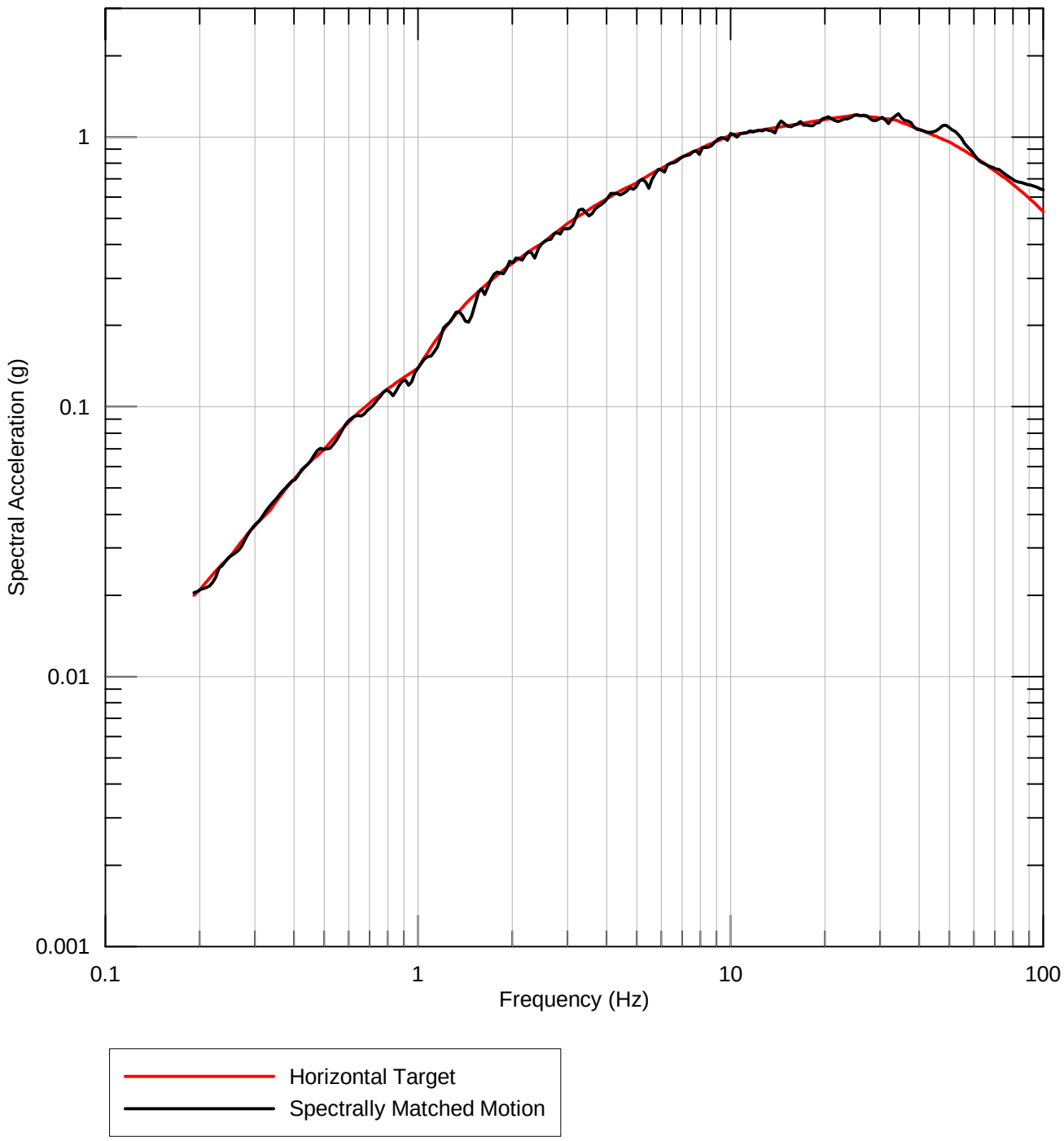
SEED: PEER RSN2112

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	RESPONSE SPECTRUM FOR TIME HISTORY SPECTRALLY MATCHED TO 2,500-YEAR RETURN PERIOD UHS HORIZONTAL TARGET 2002 DENALI - TAPS PUMP STATION #8 (319) SEED	Figure 40



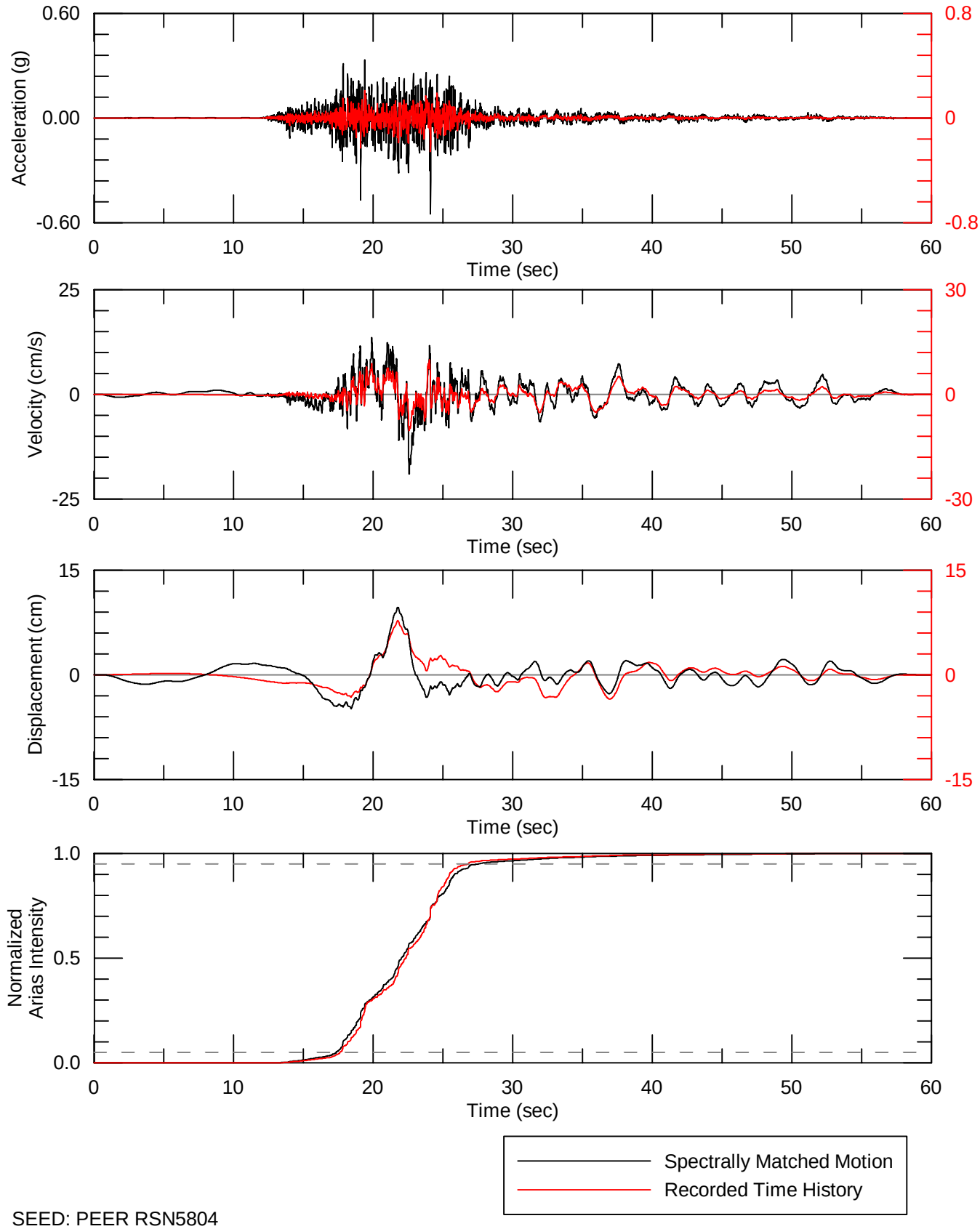
SEED: PEER RSN2112

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	TIME HISTORY SPECTRALLY MATCHED TO 2,500-YEAR RETURN PERIOD UHS HORIZONTAL TARGET 2002 DENALI - TAPS PUMP STATION #8 (319) SEED	Figure 41



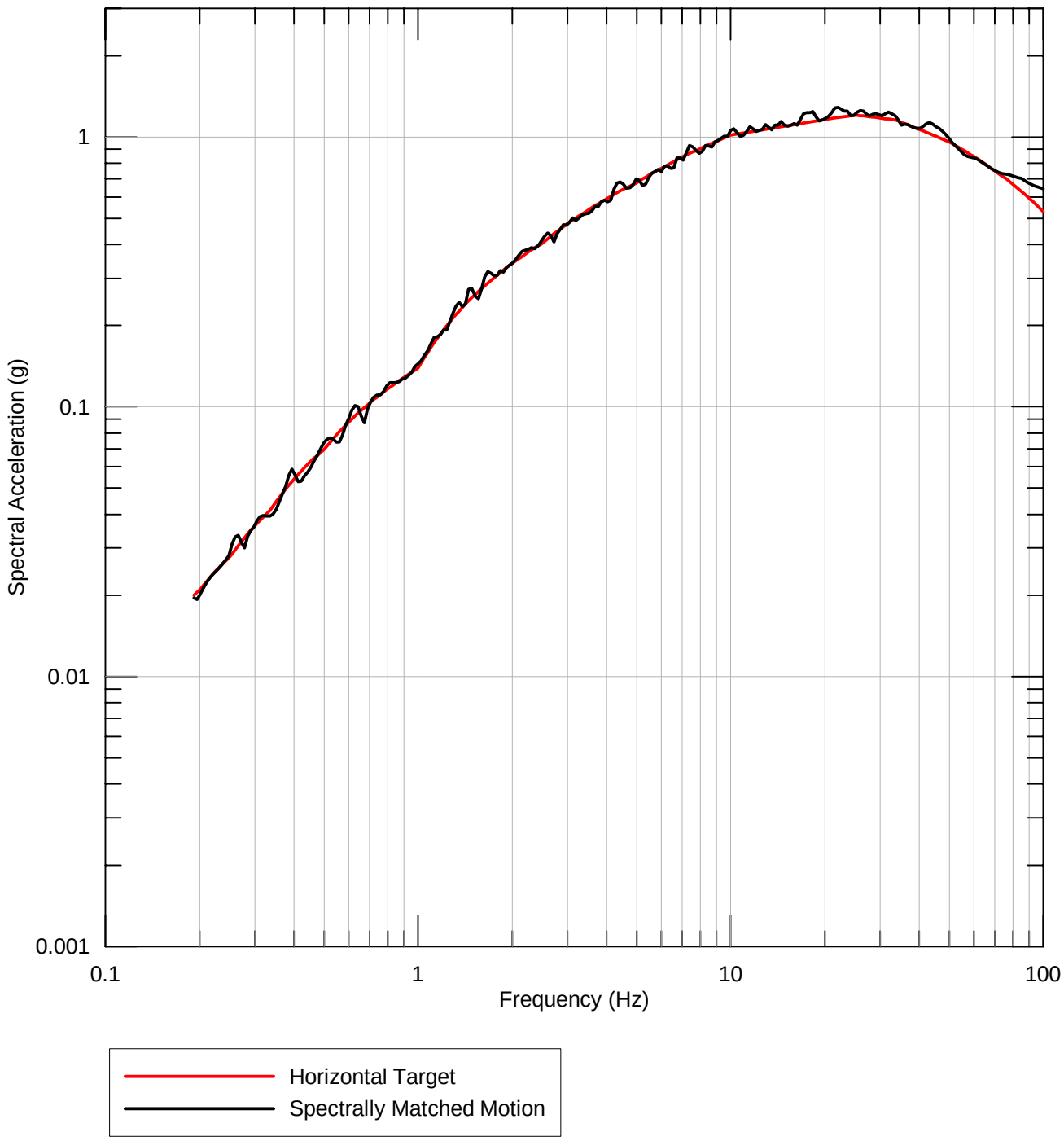
SEED: PEER RSN5804

AECOM	Project No.60442676 A.B. Brown Generating Station Vectren Corporation	RESPONSE SPECTRUM FOR TIME HISTORY SPECTRALLY MATCHED TO 2,500-YEAR RETURN PERIOD UHS HORIZONTAL TARGET 2008 IWATE - YAMAUCHI TSUCHIBUCHI YOKOTE (EW) SEED	Figure 42



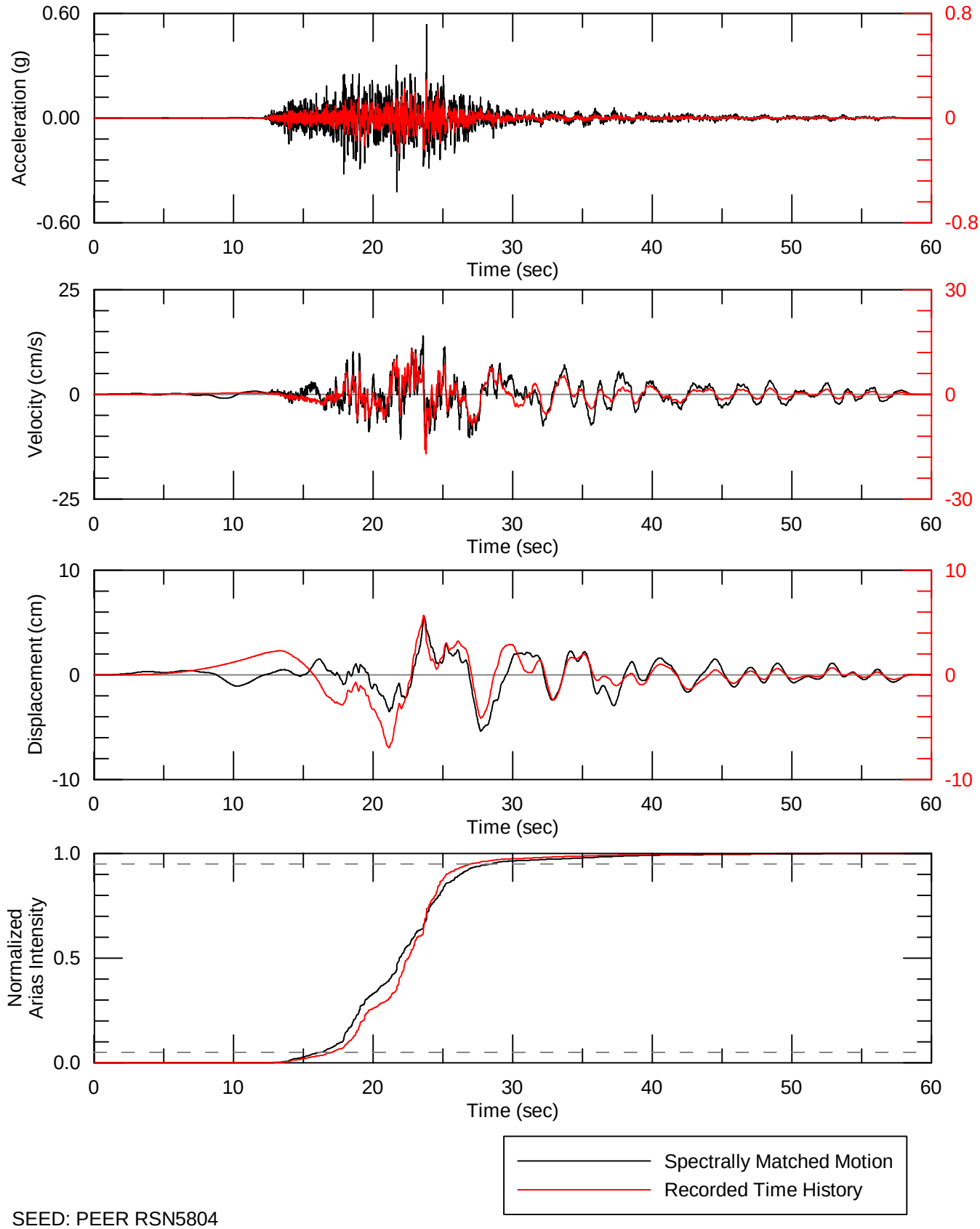
SEED: PEER RSN5804

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	TIME HISTORY SPECTRALLY MATCHED TO 2,500-YEAR RETURN PERIOD UHS HORIZONTAL TARGET 2008 IWATE - YAMAUCHI TSUCHIBUCHI YOKOTE (EW) SEED	Figure 43



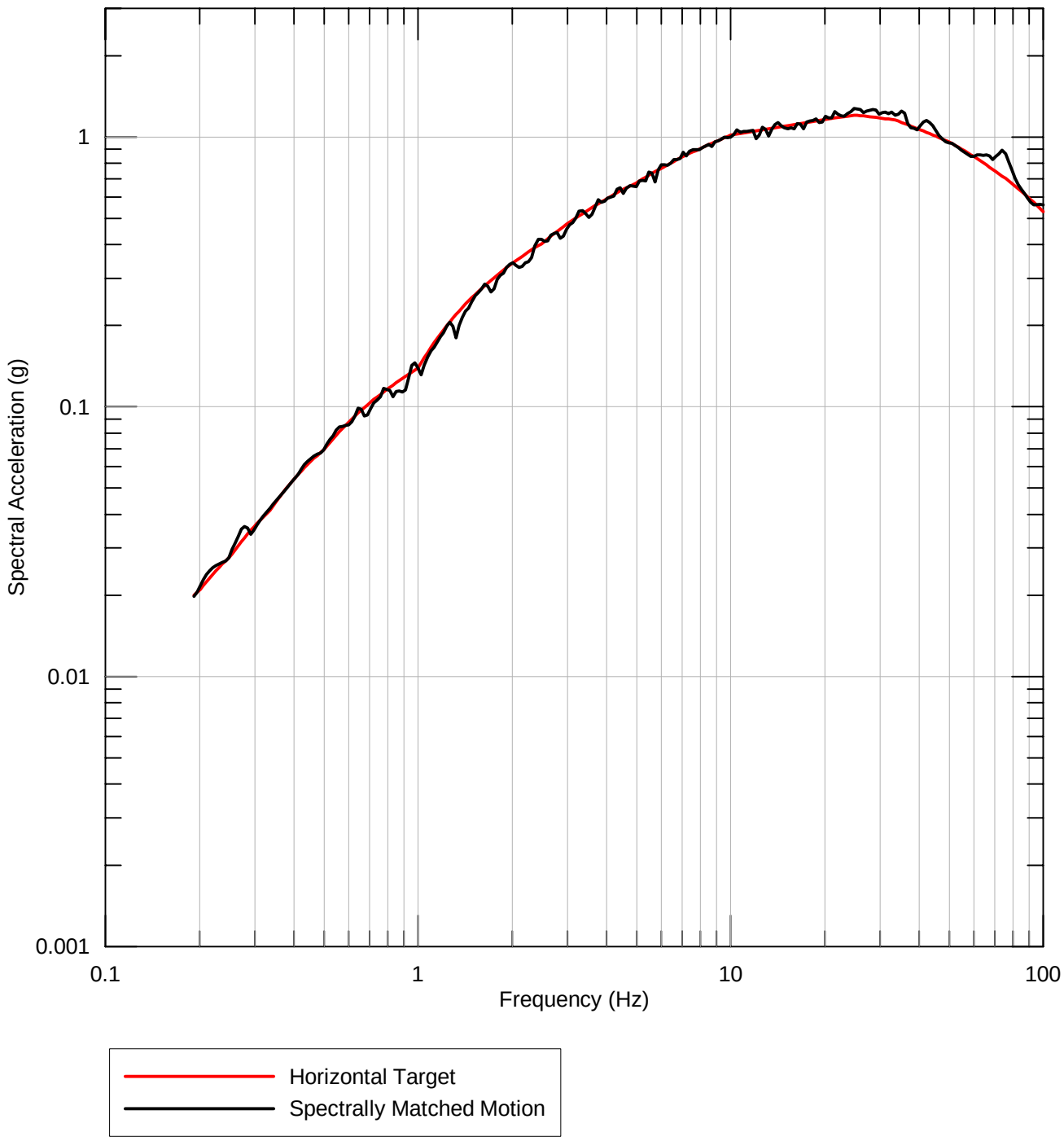
SEED: PEER RSN5804

AECOM	Project No.60442676 A.B. Brown Generating Station Vectren Corporation	RESPONSE SPECTRUM FOR TIME HISTORY SPECTRALLY MATCHED TO 2,500-YEAR RETURN PERIOD UHS HORIZONTAL TARGET 2008 IWATE - YAMAUCHI TSUCHIBUCHI YOKOTE (NS) SEED	Figure 44



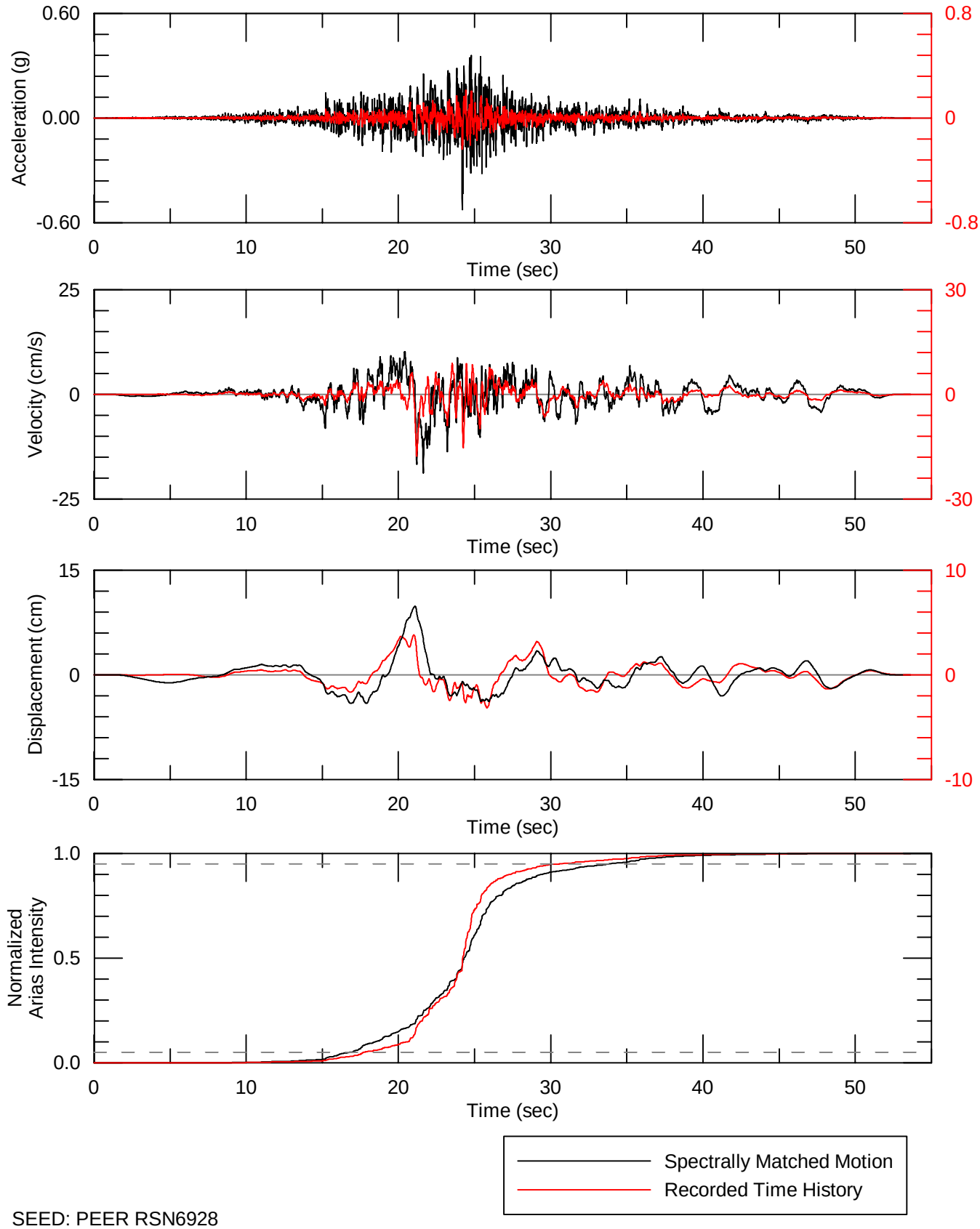
SEED: PEER RSN5804

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	TIME HISTORY SPECTRALLY MATCHED TO 2,500-YEAR RETURN PERIOD UHS HORIZONTAL TARGET 2008 IWATE - YAMAUCHI TSUCHIBUCHI YOKOTE (NS) SEED	Figure 45



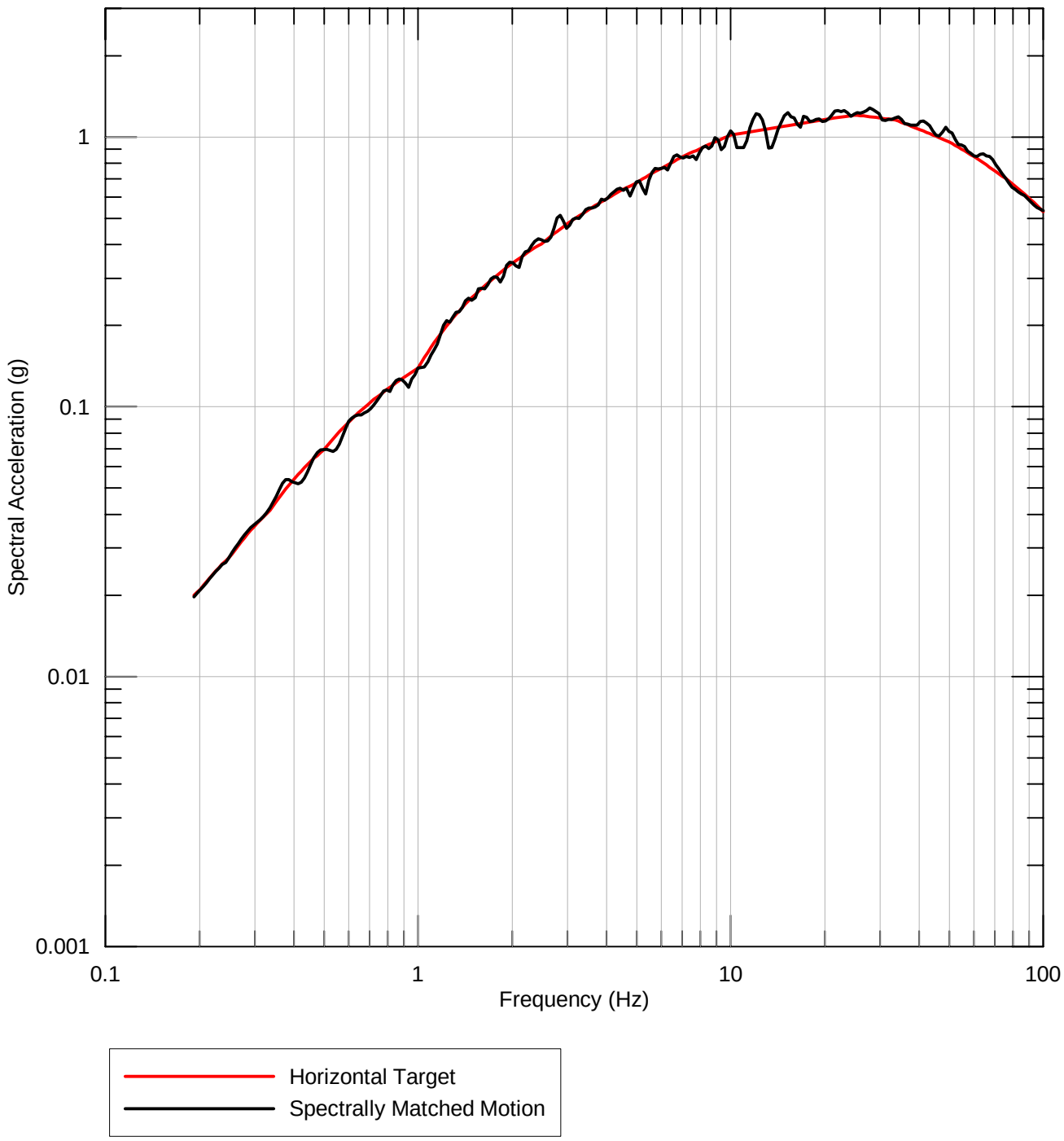
SEED: PEER RSN6928

AECOM	Project No.60442676 A.B. Brown Generating Station Vectren Corporation	RESPONSE SPECTRUM FOR TIME HISTORY SPECTRALLY MATCHED TO 2,500-YEAR RETURN PERIOD UHS HORIZONTAL TARGET 2010 DARFIELD - LPCC (080) SEED	Figure 46



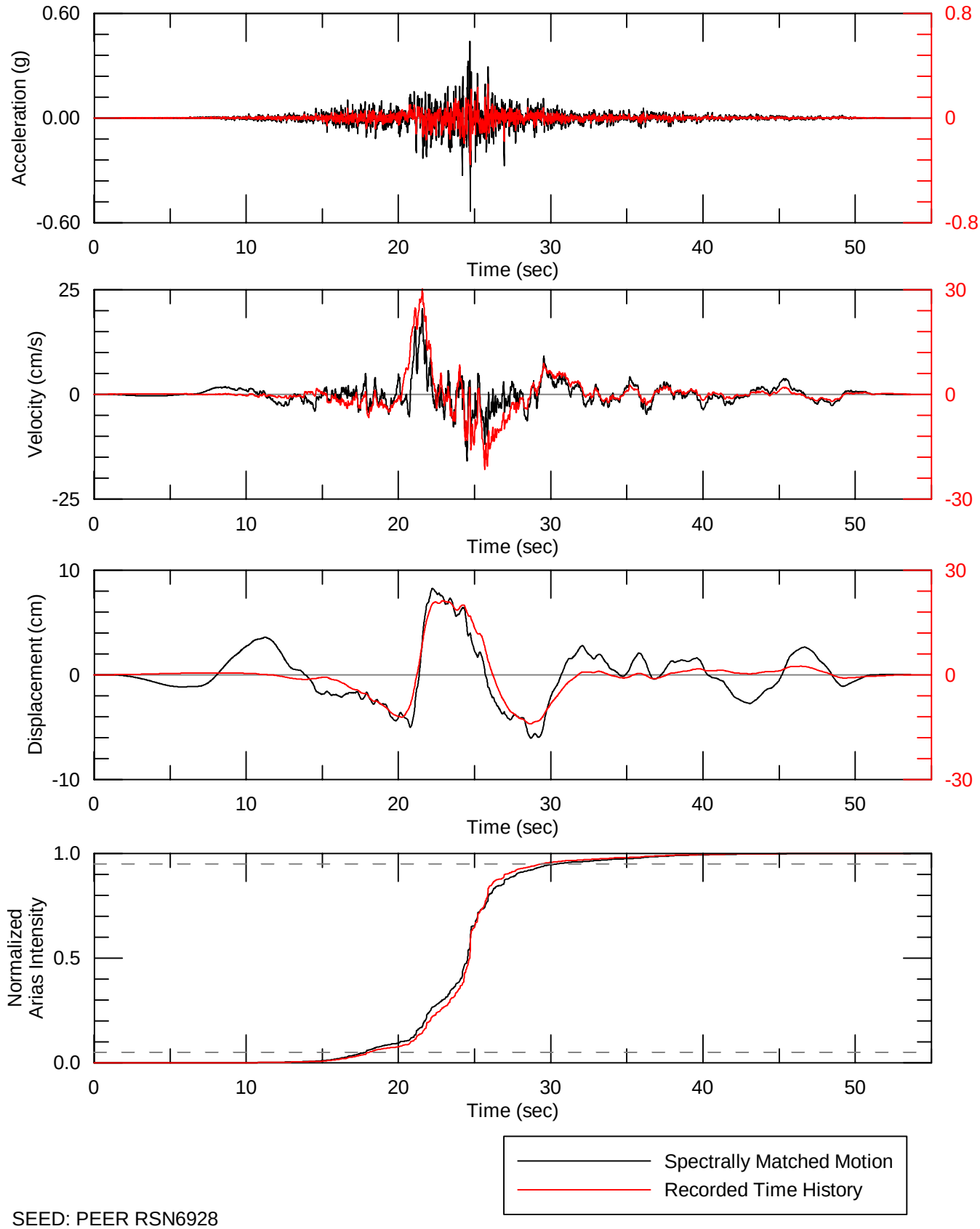
SEED: PEER RSN6928

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	TIME HISTORY SPECTRALLY MATCHED TO 2,500-YEAR RETURN PERIOD UHS HORIZONTAL TARGET 2010 DARFIELD - LPCC (080) SEED	Figure 47



SEED: PEER RSN6928

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	RESPONSE SPECTRUM FOR TIME HISTORY SPECTRALLY MATCHED TO 2,500-YEAR RETURN PERIOD UHS HORIZONTAL TARGET 2010 DARFIELD - LPCC (170) SEED	Figure 48



SEED: PEER RSN6928

AECOM	Project No. 60442676 A.B. Brown Generating Station Vectren Corporation	TIME HISTORY SPECTRALLY MATCHED TO 2,500-YEAR RETURN PERIOD UHS HORIZONTAL TARGET 2010 DARFIELD - LPCC (170) SEED	Figure 49

Appendix H
Dynamic Response Analysis Calculations

This package presents the pertinent results of the Probabilistic Seismic Hazard Analysis (PSHA) performed for the Vectren A.B. Brown Generating Station site (complete PSHA report is provided in **Appendix G**) and the methodology and results of the dynamic response analysis performed for the Lower Dam. These analyses were performed to estimate ground motion parameters and the resulting cyclic shear stresses within the various strata that can be expected during the design earthquake event. The design earthquake is defined within the CCR Rule as an event that has 2% probability of exceedance in 50 years (approximately 2500-year return period). The resulting cyclic shear stresses are utilized in the liquefaction triggering analyses presented in **Appendix I**.

I. Results of Probabilistic Seismic Hazard Analysis

As presented in **Appendix G**, AECOM conducted a site-specific probabilistic seismic hazard analysis (PSHA) for the A.B. Brown Generating Station. The PSHA results are used to compute a 2,500-yr return period Uniform Hazard Spectrum (UHS) and develop horizontal acceleration time histories consistent with the hard rock 2,500-yr UHS. The site-specific acceleration time histories are then used in site response analysis to estimate seismic-induced shear stresses for use in liquefaction analysis.

A.B. Brown Generating Station is located in southwestern Indiana, within the Illinois Basin Extended Basin Zone, adjacent to the Wabash Valley Seismic Zone and about 140 km northeast of the New Madrid Seismic Zone (NMSZ). The site is in a region that has exhibited a moderate level of historical seismicity. There have been seven known earthquakes larger than moment magnitude (M) 5.0 within 200 km of the site. However, the region is capable of experiencing strong ground motions from moderate to large earthquakes (M > 6) particularly from the Wabash Seismic Zone and the New Madrid Seismic Zone to the southwest of the site. The preexisting structures formed in earlier tectonic settings are still capable of generating seismicity that can pose a hazard to the region. This seismicity has included several large historical earthquakes in the area (M > 7), e.g., the 1811 and 1812 New Madrid earthquakes. The Wabash Valley has historically been seismically active with several earthquakes of M 4.5 and larger (**Figure H-1**). Hence, the site has been strongly shaken numerous times after the 1811-1812 earthquakes.

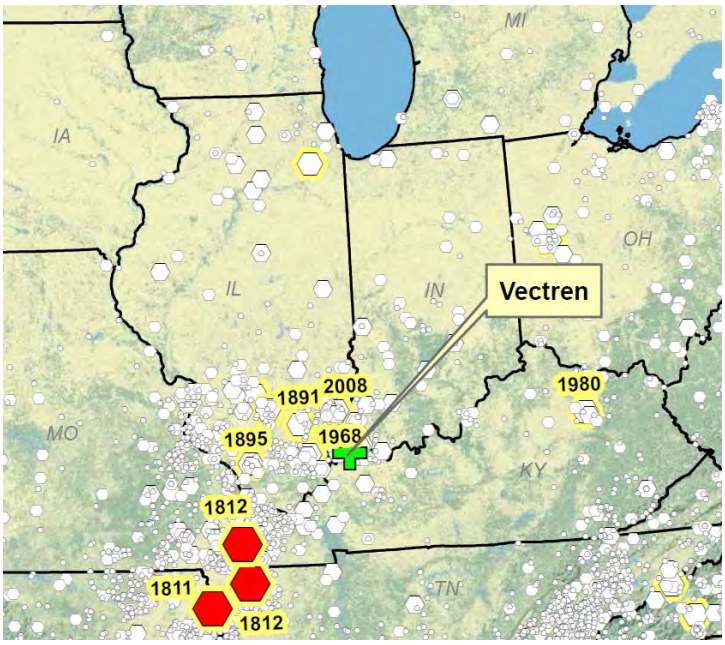


Figure H-1: Historical Seismicity Regional to the Site

The design ground motions were developed in two steps: 1) earthquake parameters; and 2) time histories. Parameters were developed including magnitude, distance, style of faulting, response spectra, and Arias Intensity for the current study. All seismically capable faults in the project region were considered. Near field and directivity effects were also considered. Response spectra were established for both hard rock (Class A rock, with shear wave velocity greater than 9,200 ft/s) and firm rock (Class B rock, with shear wave velocity between 2,500 and 9,200 ft/s). Hard rock is anticipated to be at great depth below the site. Given this, ground motions consistent with firm rock were obtained by adjusting the hard rock motions to firm rock using the generic amplification factors developed by David Boore (Frankel et al., 1996). These factors are used in the development of the National Seismic Hazard Maps (NSHMs) by the USGS.

Four sets of time histories were developed for each design spectrum. The time histories represent the site-specific ground motions associated with the controlling near-field or far-field earthquake event, and consider the magnitude, distance, and Arias Intensity. Each acceleration time history was developed from a pair of orthogonal horizontal components that was matched to the fault-normal and fault-parallel components of the design spectra. The seed motion records were selected from available strong-motion recordings obtained during previous earthquakes that have occurred in similar tectonic environments. The characteristics include earthquake magnitude, faulting mechanism, source-to-site distance, and site conditions. A time-domain approach was used to modify the natural recordings and to generate time histories compatible with the respective target response spectrum. The response spectra for the resolved acceleration time histories were developed to closely match the spectral amplitudes of the smooth target

spectrum through the period range of interest. The time histories were then used as input motions for the dynamic response analyses, as discussed in Section 4.2 below.

Uniform Hazard response spectra from the PSHA are summarized in **Tables H-1 and H-2** below. An example time history (Time History 4) resulting from the analysis is provided in **Figure H-2.** The complete results of the PSHA are included in **Appendix G** of this report.

Table H-1: Uniform Hazard Response Spectrum for Hard Rock – A.B. Brown Generating Station

Period	Spectral Acceleration (g)
0.01	0.35
0.04	0.73
0.10	0.58
0.20	0.39
0.40	0.24
1.00	0.10
2.00	0.058

Table H-2: Uniform Hazard Response Spectrum for Firm Rock – A.B. Brown Generating Station

Period	Spectral Acceleration (g)
0.01	0.53
0.02	0.96
0.03	1.16
0.04	1.21
0.10	1.02
0.20	0.68
0.40	0.40
1.0	0.14
2.0	0.07
3.0	0.041
4.0	0.028

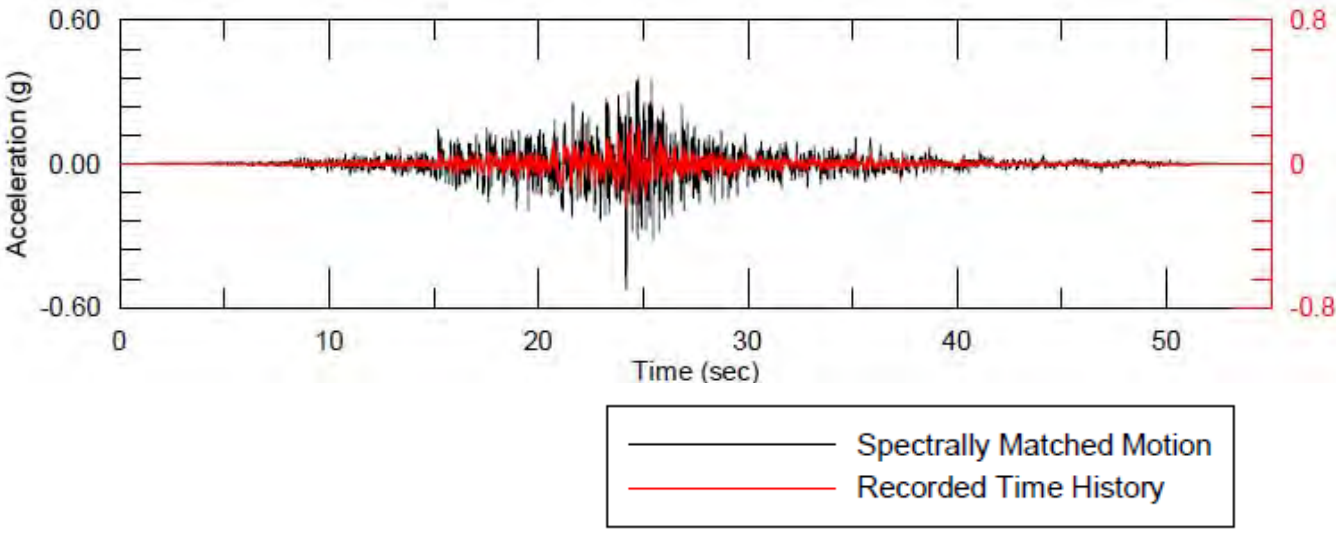


Figure H-2 – Acceleration Record of Time History 4 (With Seed Motion Superposed)

The major contributors to the hazard at the site for a return period of 2,500 years are the IBEB zone and the Wabash Valley zone. The near-site distributed seismicity corresponding to the IBEB contributes just over 70 percent of the peak ground acceleration (PGA) hazard at 2,500-year return period, and has an associated earthquake moment magnitude between M 5.0 and M 6.0. At longer periods (0.4 and 1.0 sec SA), the relative contribution of the Wabash Valley and New Madrid zones increases to up to 75 percent of the hazard at 2,500 years, with much higher associated moment magnitude (M 7.0 to M 8.25). This is illustrated in **Figures H-3 and H-4**, which portray the deaggregation of the PGA and 1.0 sec spectral acceleration hazard by magnitude and distance, respectively. **Table H-3** summarizes the modal magnitude (M*) and source distance (D*), which represent the highest contributors to the hazard for the design return period.

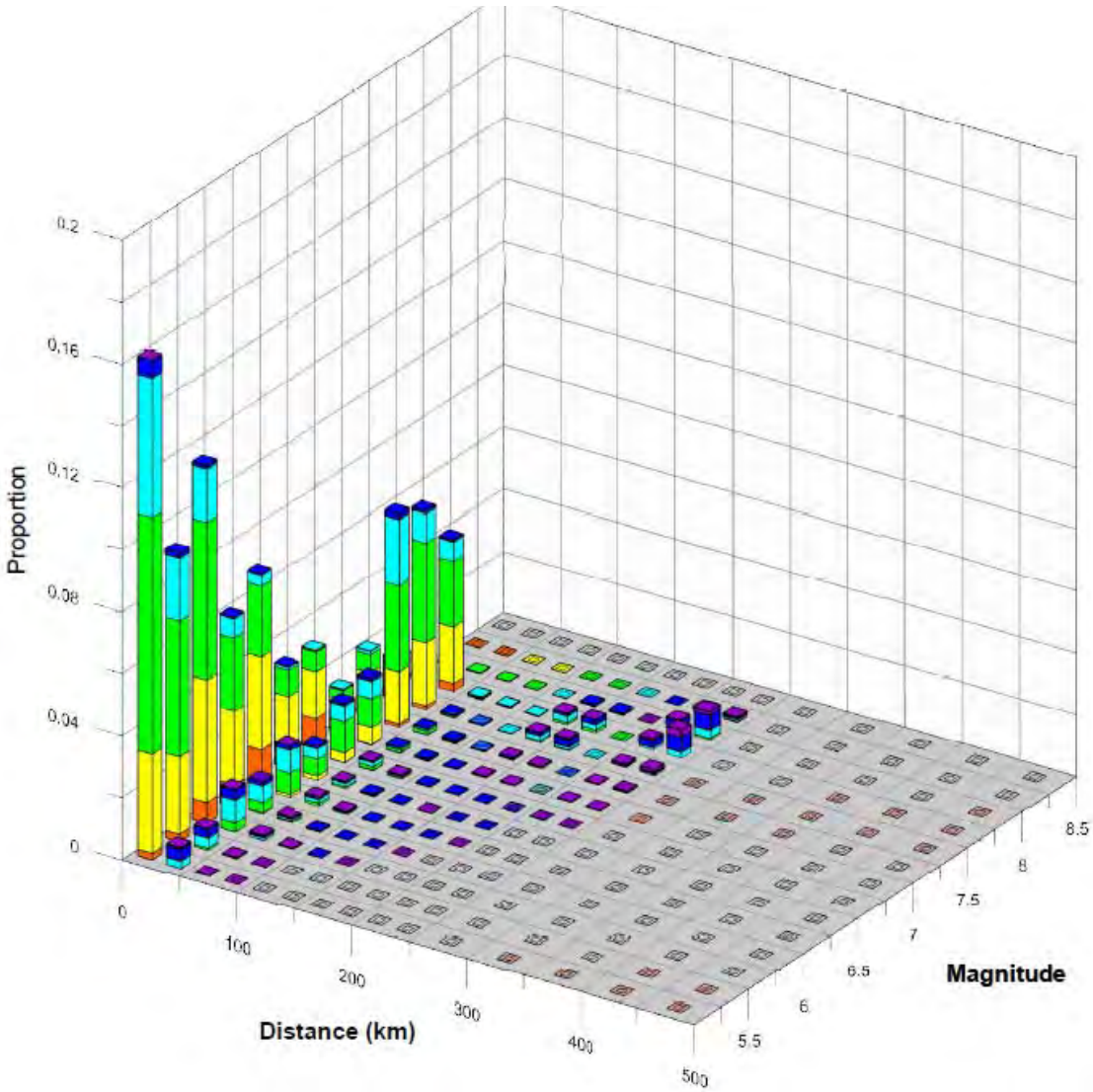


Figure H-3: Deaggregation for Peak Ground Acceleration

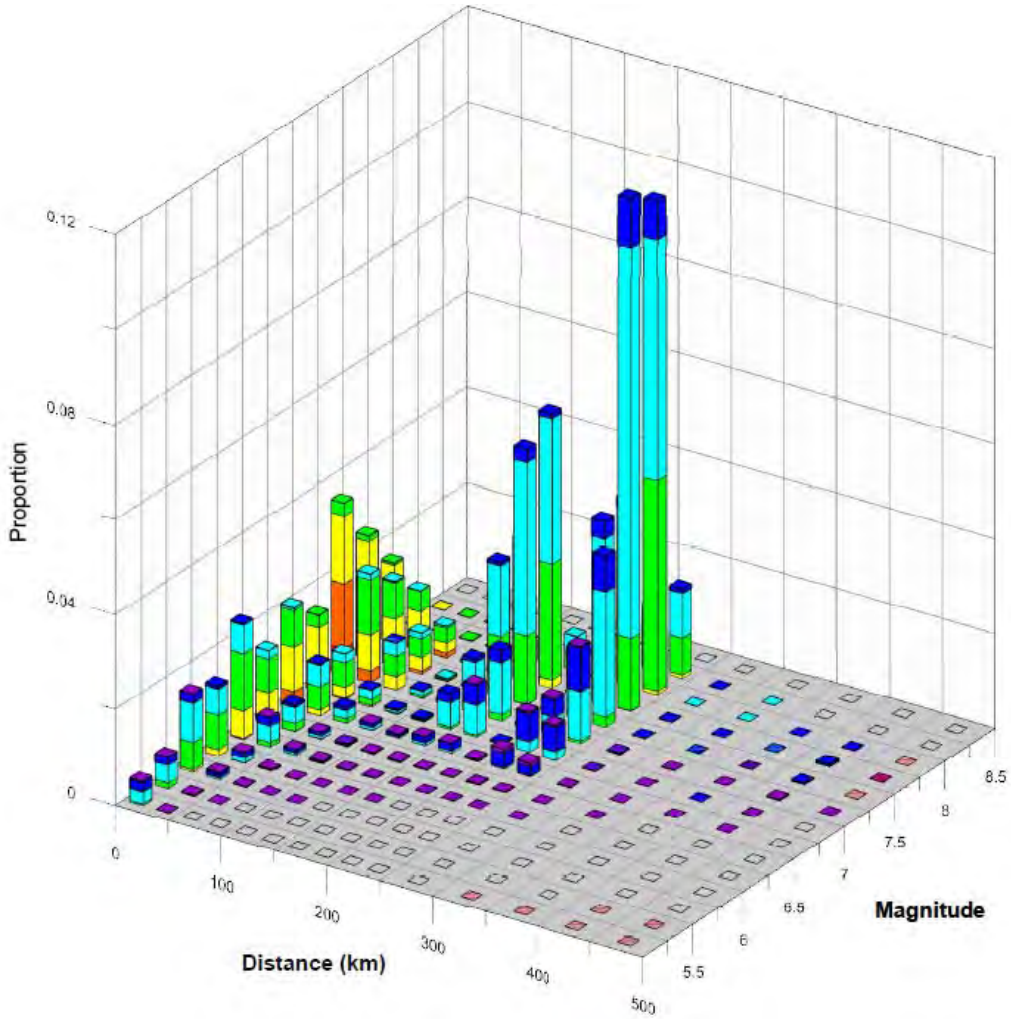


Figure H-4: – Deaggregation for 1.0-sec Spectral Acceleration

Table H-3: Modal Earthquake Magnitude and Source Distance

Period	Modal Magnitude (M*)	Modal Source Distance (D*)
PGA	5.1	12.5 km
0.4 (bimodal)	7.1 7.6	12.5 km 238 km
1.0	7.6	238 km

II. Methodology for Dynamic Response Analysis (QUAD-4 Analysis)

The dynamic response (calculation of the earthquake-induced shear stresses) of the A.B. Brown Station was evaluated by analyzing a typical cross-section through the dam using the most recent version of the finite element program QUAD4M (Hudson et al. 1994). This is a modified version of the program QUAD4, originally developed by Idriss, et al. (1973). The dynamic response analysis was useful for more precisely estimating the amplification / attenuation characteristics of the dam structure and local soils to the design rock motions and to estimate the earthquake-induced stresses within the embankment and foundation. Input to the dynamic response analyses includes the acceleration time histories developed as part of the PSHA for the A.B. Brown Station. Earthquake-induced shear stresses computed using QUAD4 were used directly in the updated SPT-based liquefaction triggering analysis.

The QUAD4M program uses a two-dimensional, dynamic finite-element formulation that utilizes equivalent-linear, strain-dependent modulus and damping properties. The program performs a time-domain analysis that allows variable damping throughout the model and uses an iterative process to approximate the nonlinear behavior of soil. Shear moduli and damping ratios are estimated initially for each element in the model, and the system is analyzed using those properties. After each iteration, values of the effective shear strain are computed and the modulus and damping values are updated to correspond to the computed strain level for each element. The analysis iterations are repeated until compatibility between moduli, damping, and strain levels is achieved in all elements.

III. Geometry

The analysis was performed for a cross-section oriented along the approximate center of the dam (north-south) – specifically, Cross-Section B (see **Appendix F** of this report). The cross section was modeled as a two-dimensional plane-strain finite element mesh with input motions applied in the transverse direction at the base of the mesh.

Separate models were created for the cross-section configuration as it existed prior to construction of the stabilizing soil buttress and the configuration after construction.

IV. Dynamic Material Properties

Dynamic response analysis of the model required characterization of the shear modulus (G), Poisson's ratio (v), and damping characteristics of embankment and foundation materials. To consider the variation in dynamic shear modulus with strain, the shear modulus is commonly represented in terms of its value at small strains (Gmax) and the variation in the ratio (G/Gmax) with shear strain, which is referred to as a modulus reduction relationship. Likewise, the variation in hysteretic damping with strain is represented by a damping relationship. For the silty clay embankment and silty clay foundation soils, the shear modulus reduction and damping relationships by Vucetic and Dobry (1991) were selected based on the index characteristics of the materials and experience. The average modulus-reduction and lower-bound damping relationships for sands by Seed and Idriss (1970) were selected to represent the silt foundation layer.

An estimate of the shear wave velocity of each soil stratum of the cross-section subsurface profile was developed using the average seismic shear wave velocity measurements obtained during the CPT testing program. Shear wave velocity measurements are summarized in **Appendix E**, and the complete CPT data report is provided in **Appendix C**. The shear wave velocities were used to evaluate the

dynamic shear modulus at small strains of the embankment and foundation materials, and the corresponding values of Poisson's ratio. The shear modulus at small strains was obtained from the measured shear wave velocity through the expression:

$$G_{max} = \rho V_s^2$$

where: Vs is the shear wave velocity and ρ is the mass density of the material.

V. Analysis Results

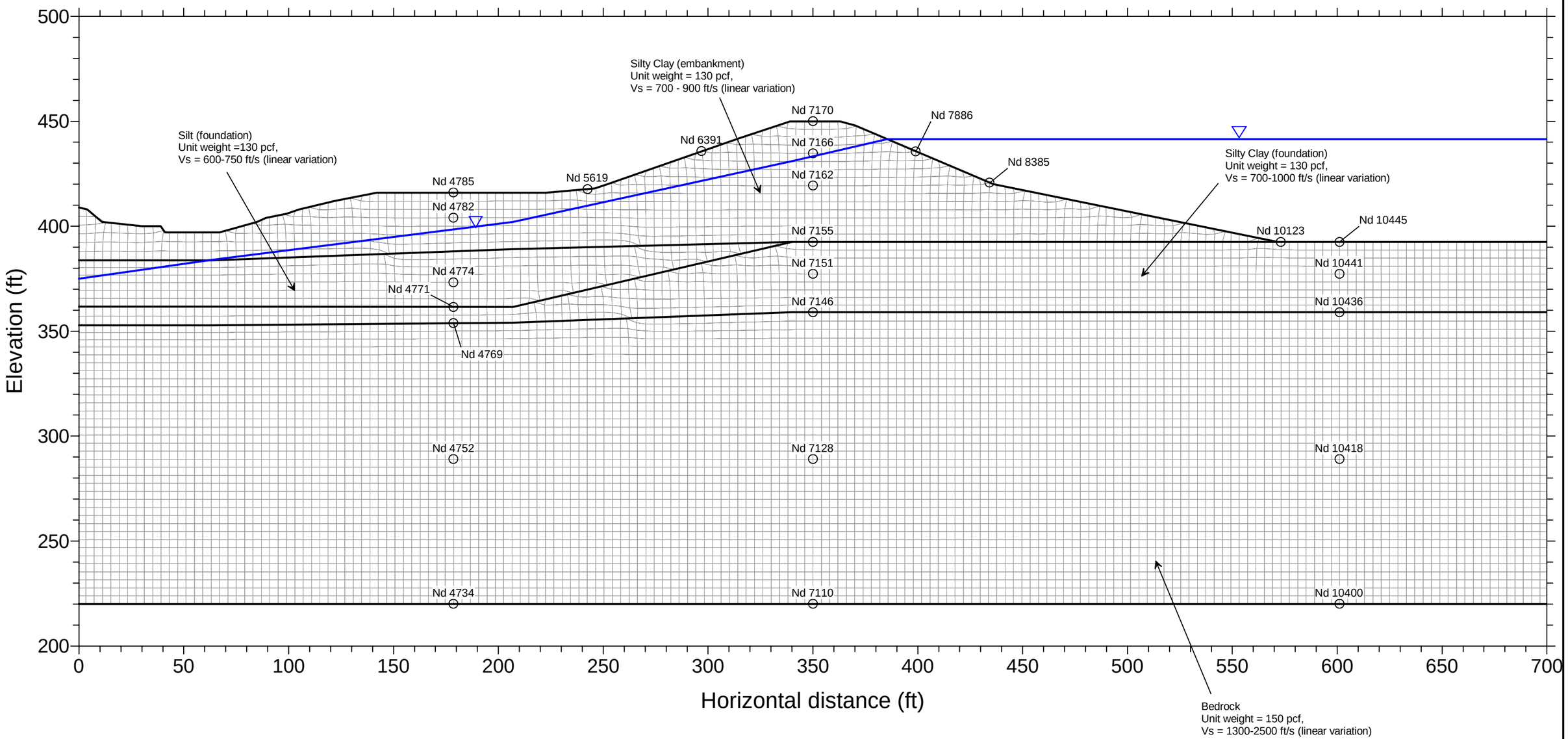
The QUAD4M model incorporates a large number of finite elements making up the meshing for the whole cross-section. Seismically induced shear stresses are calculated for each element, and 2-dimensional plots of shear stress contours within the cross-section are generated. These plots are provided for each of the four time histories analyzed in the attachment. Separate sets of plots are provided for the pre- and post-buttress configuration. In each set, estimated peak nodal accelerations are presented in Figures 2-1 to 2-4 of this attachment. Further, the peak cyclic shear stresses (in ksf) estimated for each time history are shown in Figures 3-1 to 3-4 of this attachment.

VI. References

1. Frankel, A., Mueller, C., Barnhard, T., Perkins, D., Leyendecker, E.V., Dickman, N., Hanson, S.,and Hopper, M., 1996, National Seismic Hazard Maps; documentation: U.S. Geological Survey Open-File Report 96-532, 110 p.
2. Hudson, M., Idriss, I.M., and Beikae, M. (1994). User's Manual for QUAD4M, Center for Geotechnical Modeling, Department of Civil and Environmental Engineering, University of California, Davis, California
3. Idriss, I.M., Lysmer, J., Hwang, R., and Seed, H.B., 1973, QUAD4: A computer program for evaluating the seismic response of soil structures by variable damping finite-element procedures: Earthquake Engineering Research Institute, University of California, Berkeley, Report 73-16.
4. Seed, H.B., and Idriss, I.M., (1970). "Soil Moduli and Damping Factors for Dynamic Response Analysis", Earthquake Engineering Research Center, College of Engineering, University of California, Berkley, California.

QUAD4M RESULTS

PRE-BUTTRESS CONSTRUCTION MODEL



Project No. 60442676	Vectren A.B. Brown Station CCR Study	A.B. Brown Station Section B QUAD4 Model and Output Nodes	Figure 1
	AECOM		

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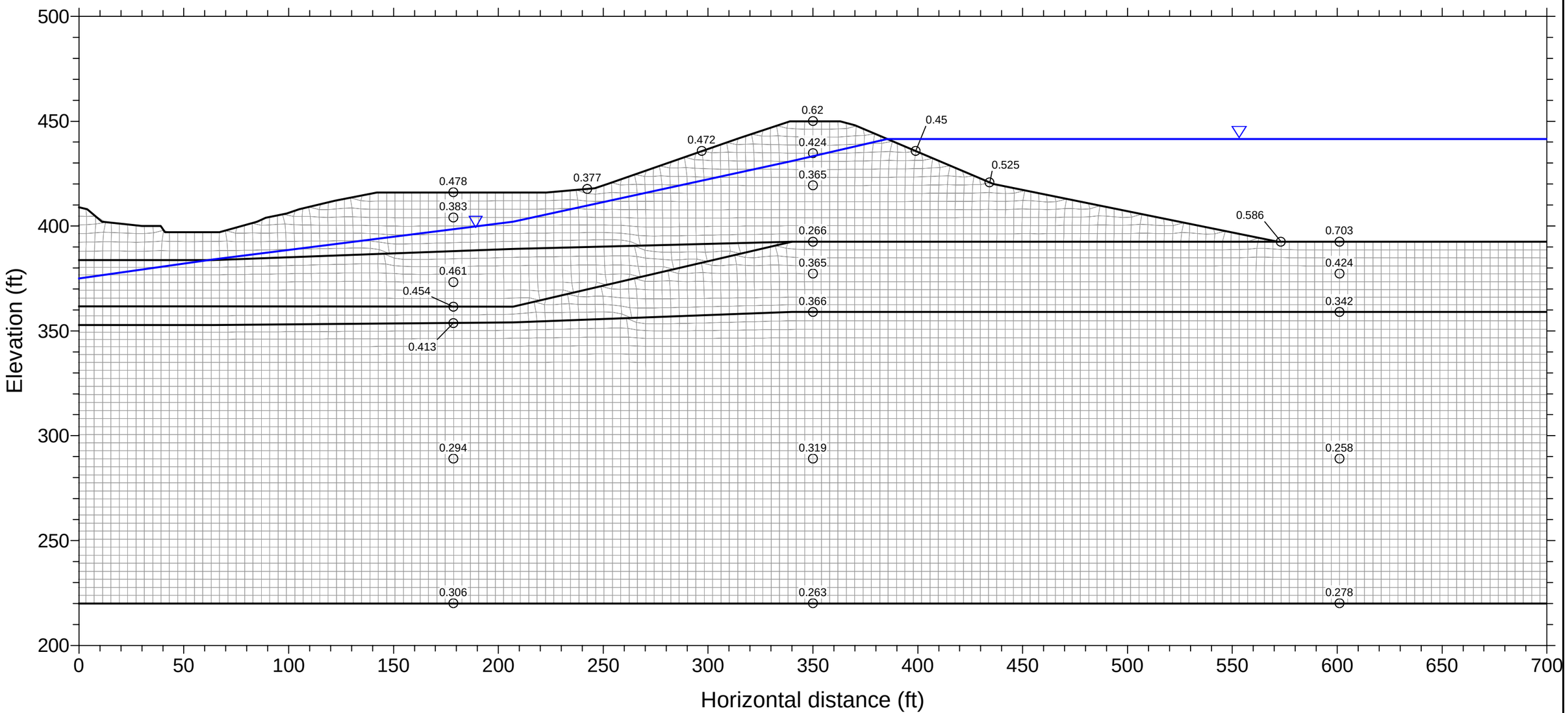

Project No. 60442676	Vectren A.B. Brown Station CCR Study	A.B. Brown Station Section B QUAD4 Output - Nodal Acceleration (g) Base Motion: TH1	Figure 2-1
	AECOM		

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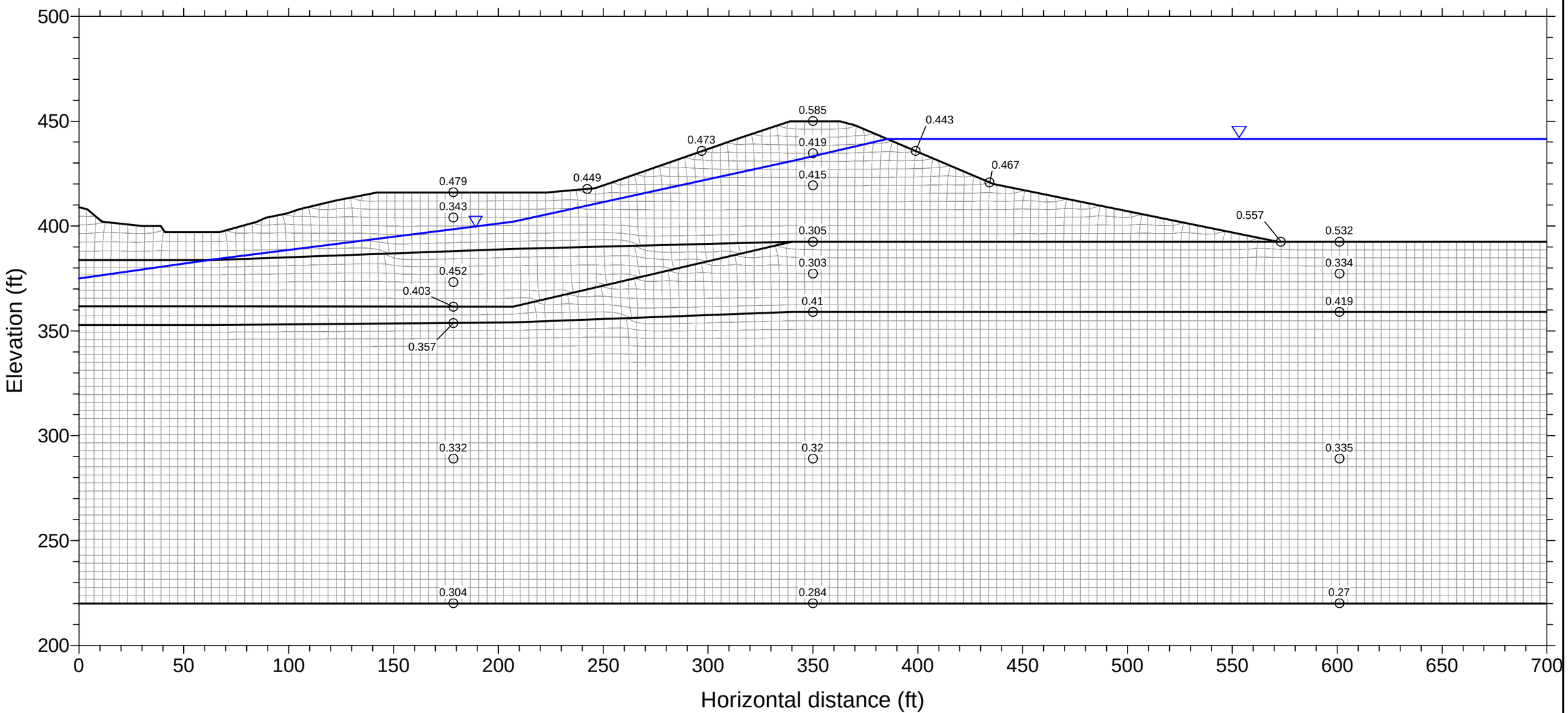

Project No. 60442676	Vectren A.B. Brown Station CCR Study	A.B. Brown Station Section B QUAD4 Output - Nodal Acceleration (g) Base Motion: TH2	Figure 2-2
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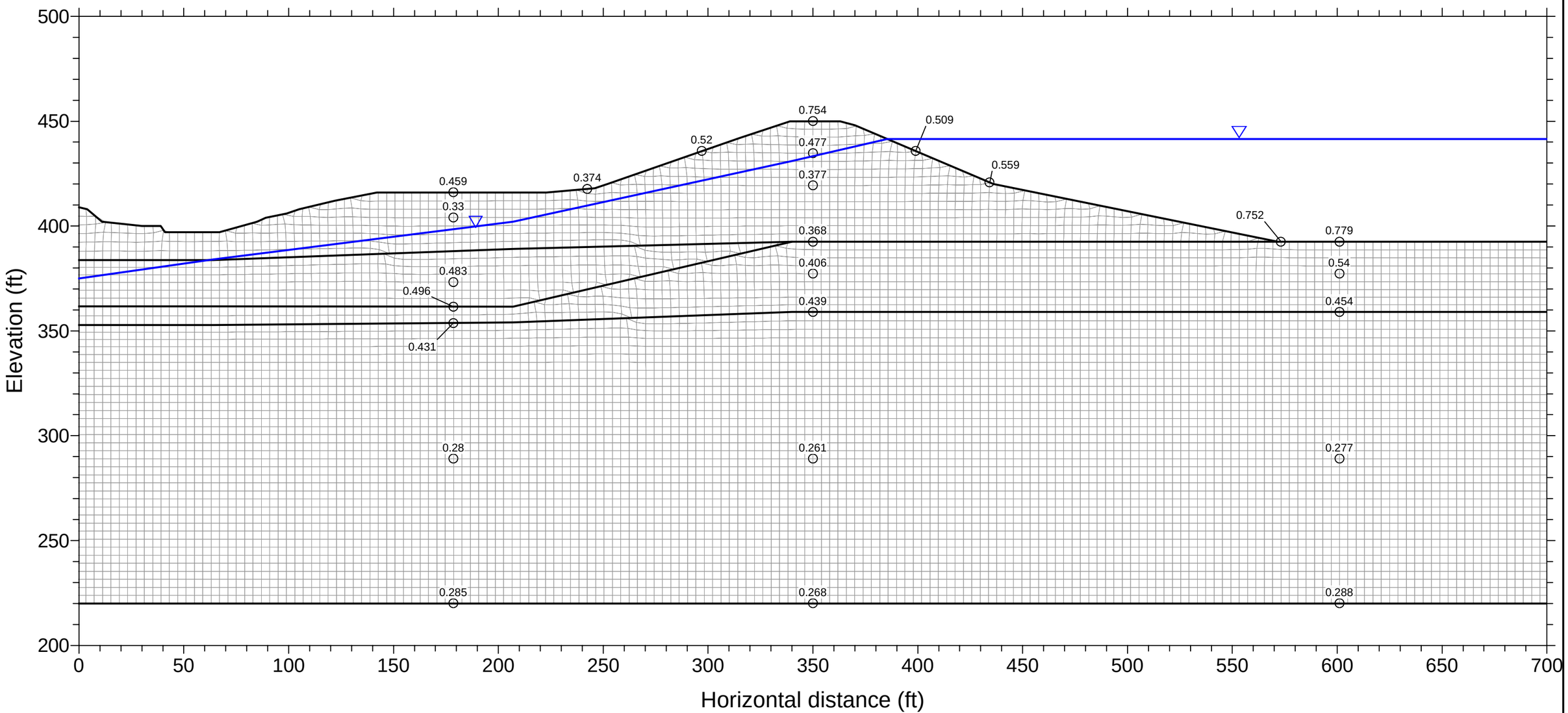

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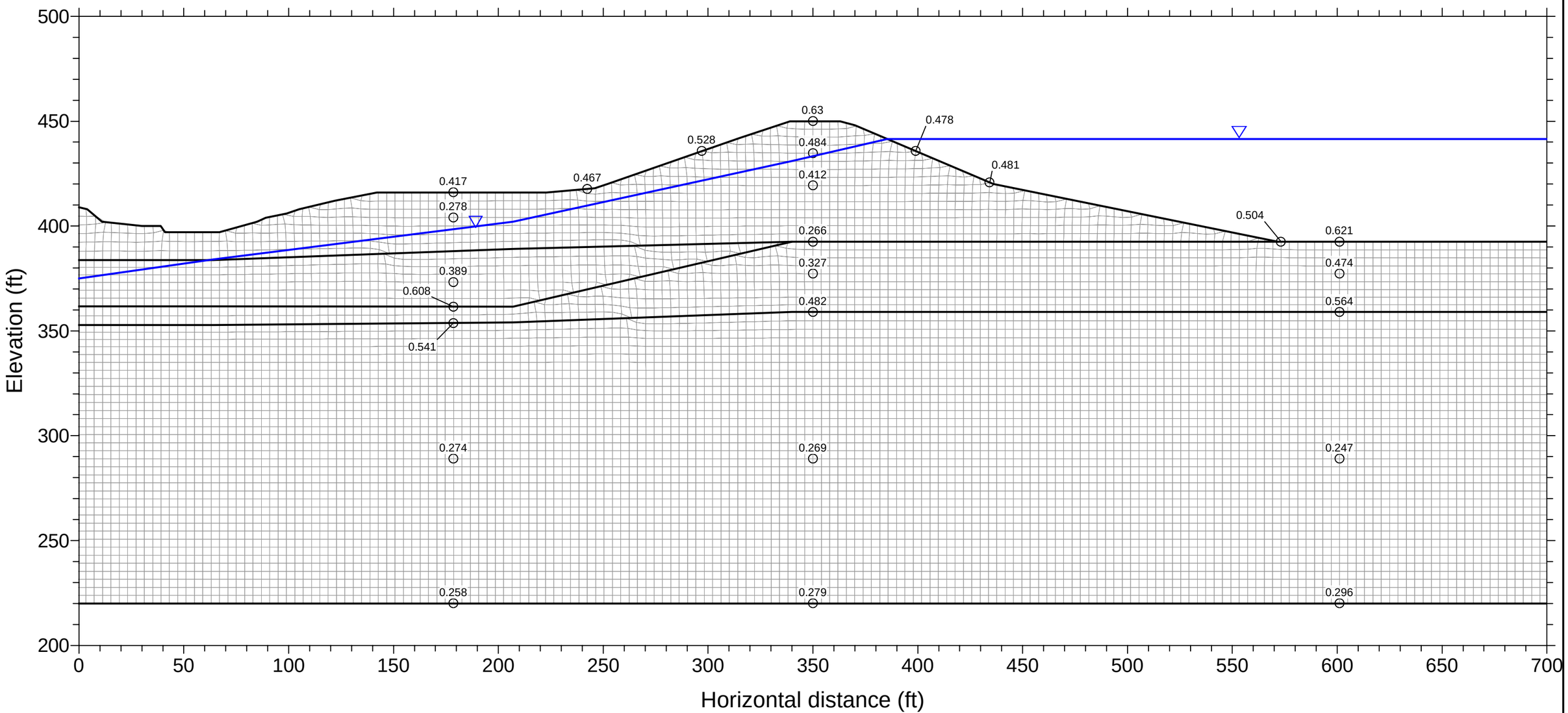

Project No. 60442676	Vectren A.B. Brown Station CCR Study	A.B. Brown Station Section B QUAD4 Output - Nodal Acceleration (g) Base Motion: TH4	Figure 2-4
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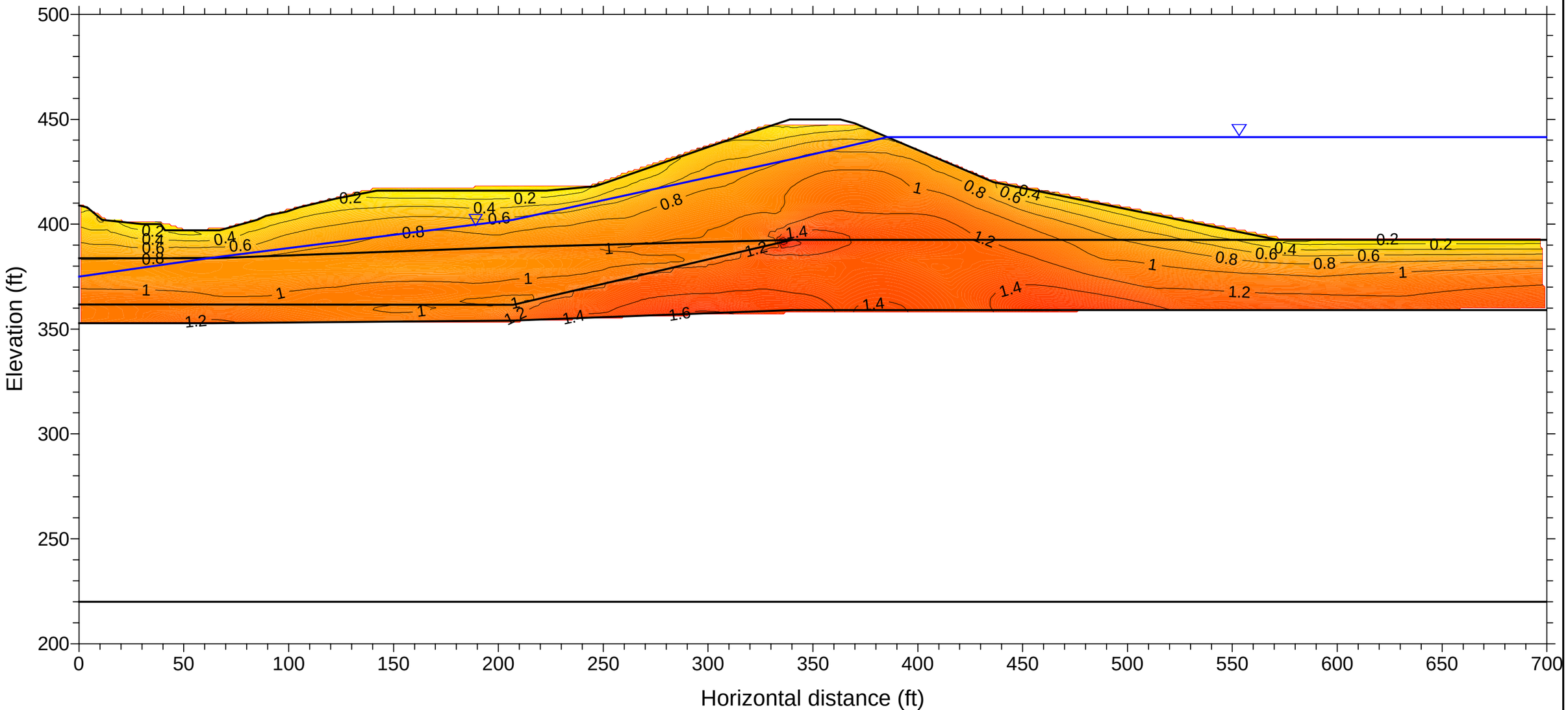

Project No. 60442676	Vectren A.B. Brown Station CCR Study	A.B. Brown Station Section B QUAD4 Output - Peak Shear Stress (ksf) Base Motion: TH1	Figure 3-1
	AECOM		

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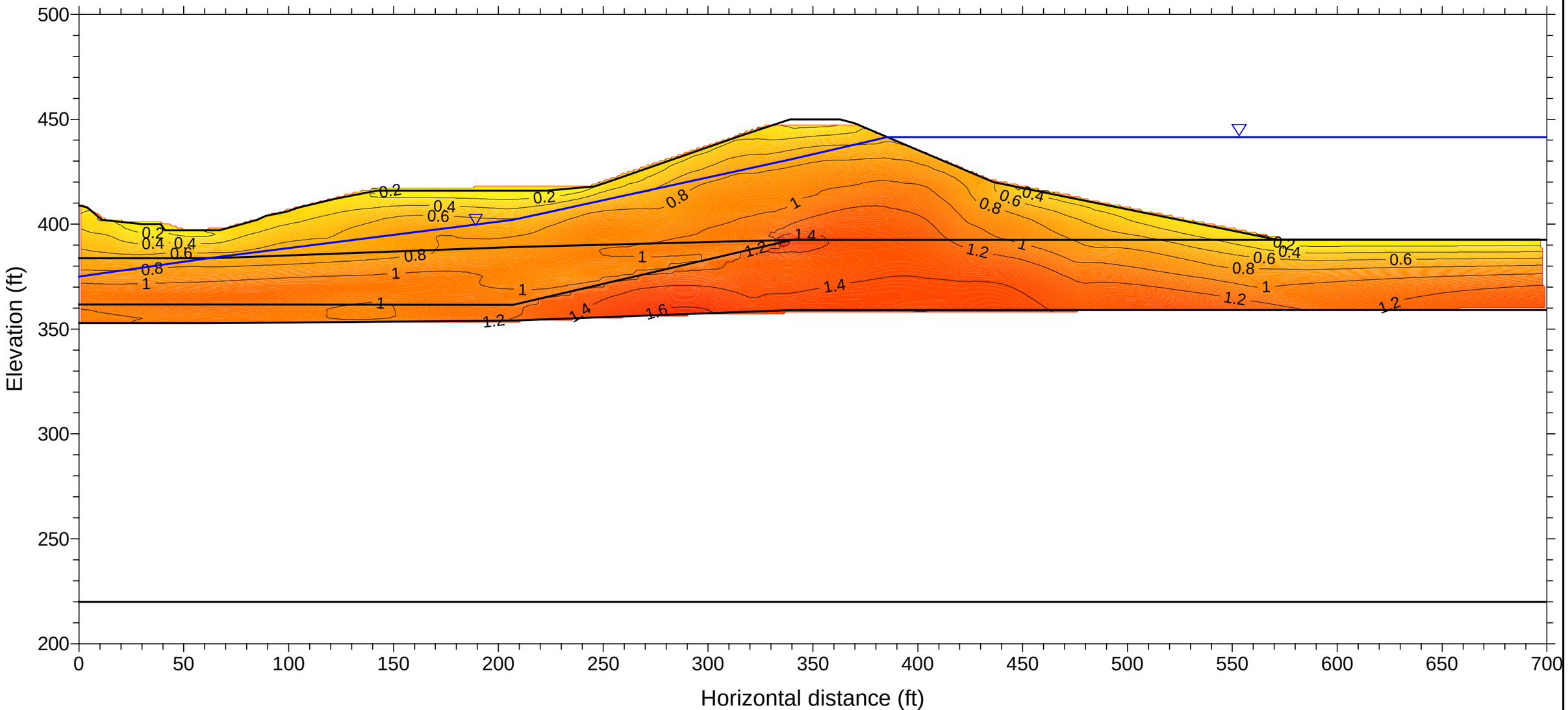

Project No. 60442676	Vectren A.B. Brown Station CCR Study	A.B. Brown Station Section B QUAD4 Output - Peak Shear Stress (ksf) Base Motion: TH2	Figure 3-2
	AECOM		

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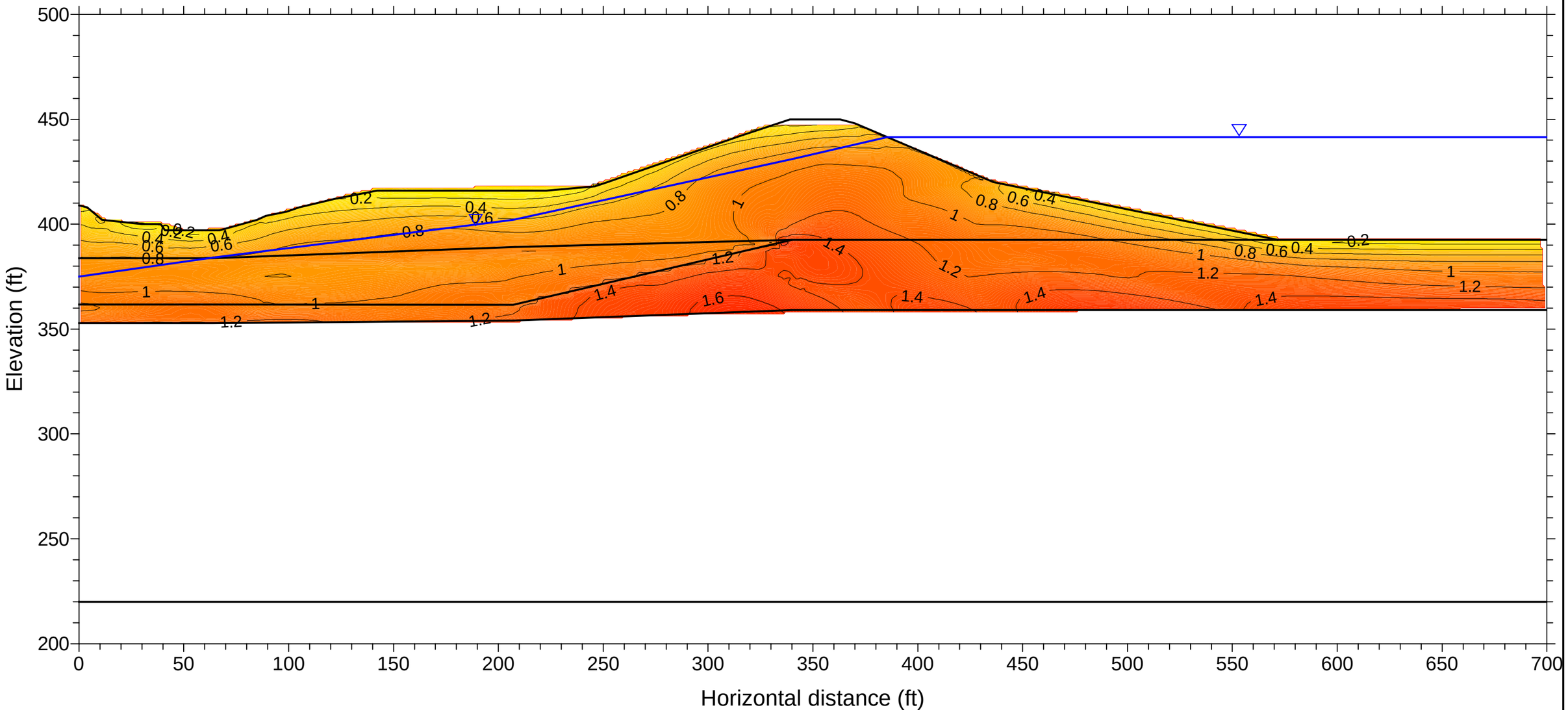

Project No. 60442676	Vectren A.B. Brown Station CCR Study	A.B. Brown Station Section B QUAD4 Output - Peak Shear Stress (ksf) Base Motion: TH3	Figure 3-3
	AECOM		

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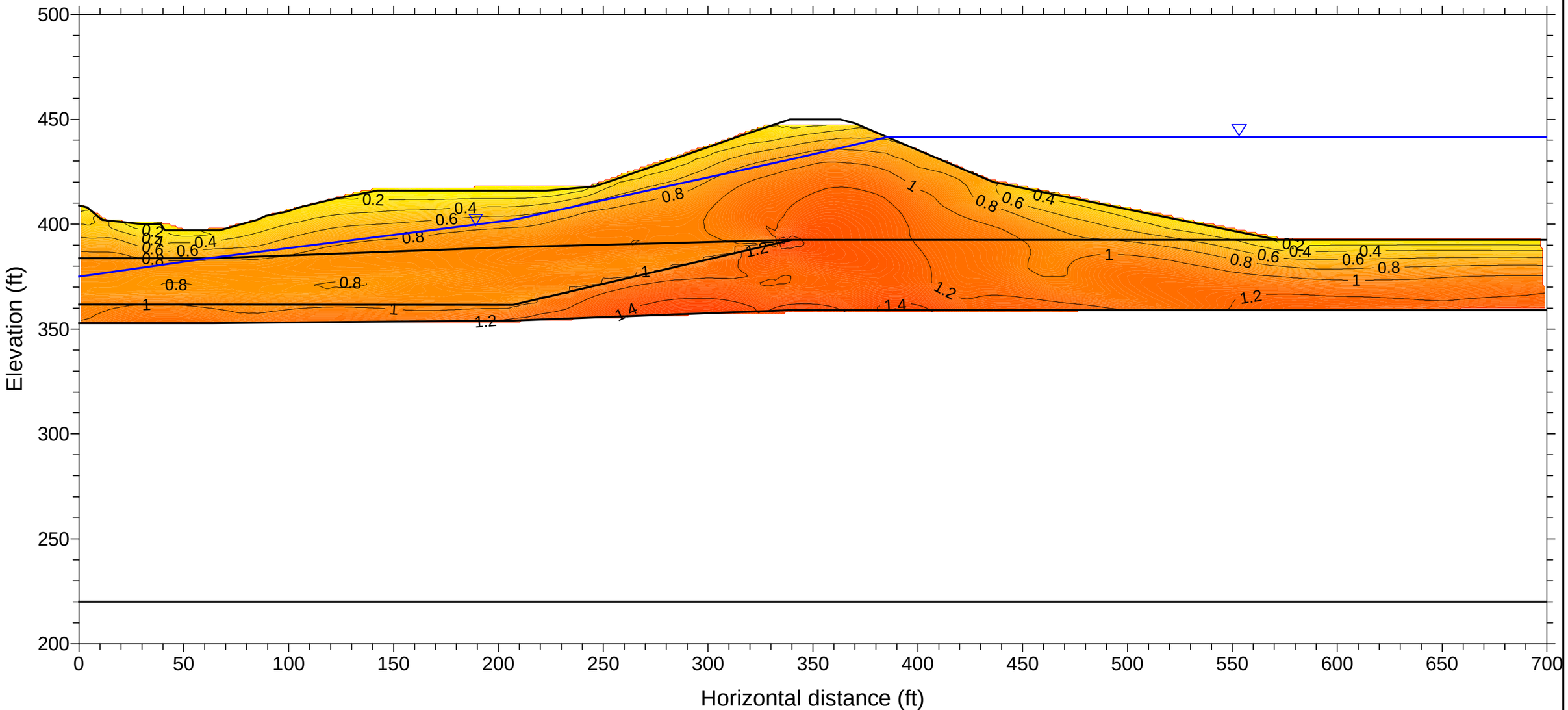
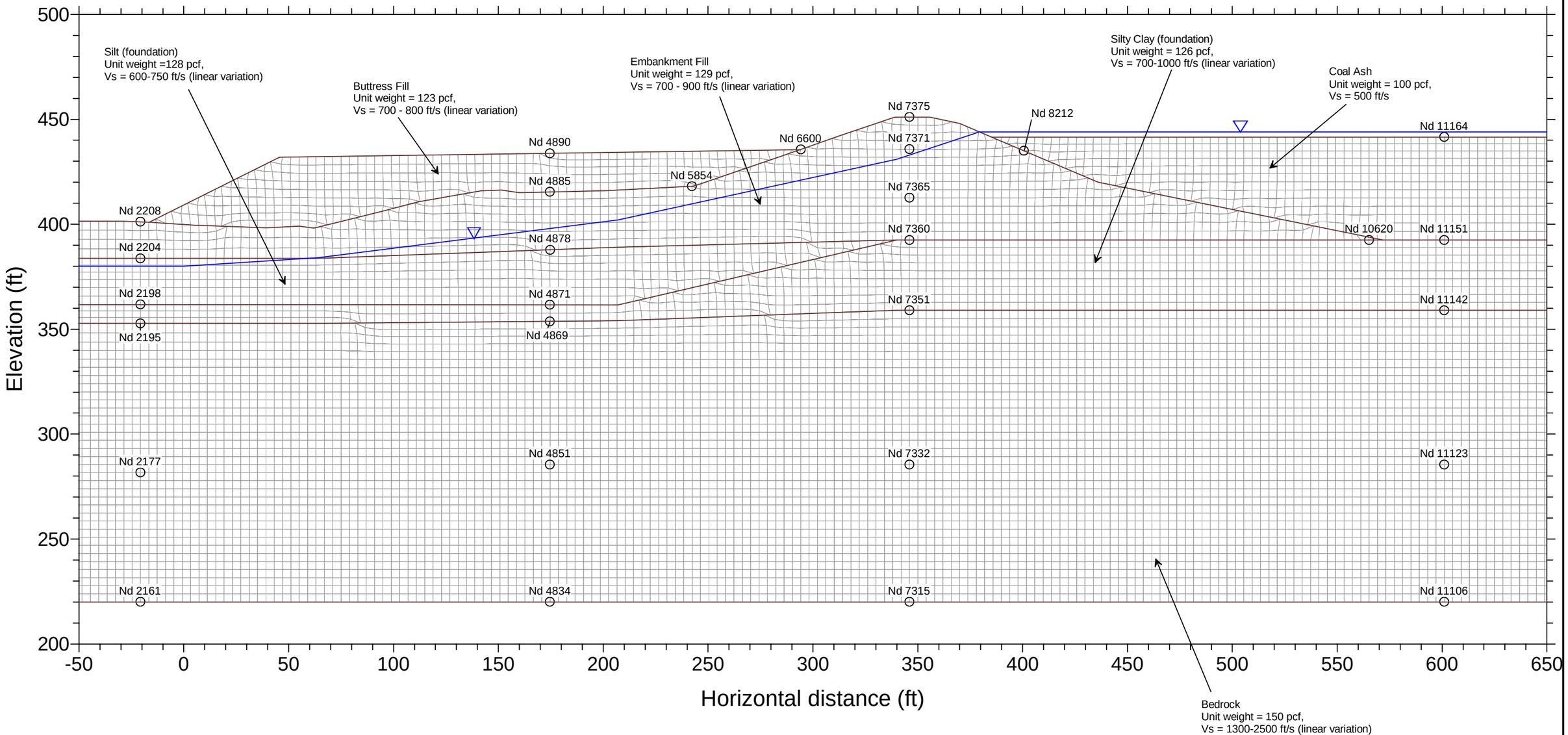


Project No. 60442676	Vectren A.B. Brown Station CCR Study	A.B. Brown Station Section B QUAD4 Output - Peak Shear Stress (ksf) Base Motion: TH4	Figure 3-4
	AECOM		

QUAD4M RESULTS

BUTTRESS MODEL



Project No. 60442676	Vectren A.B. Brown Station CCR Study	A.B. Brown Station Section B QUAD4 Model and Output Nodes	Figure 1
	AECOM		

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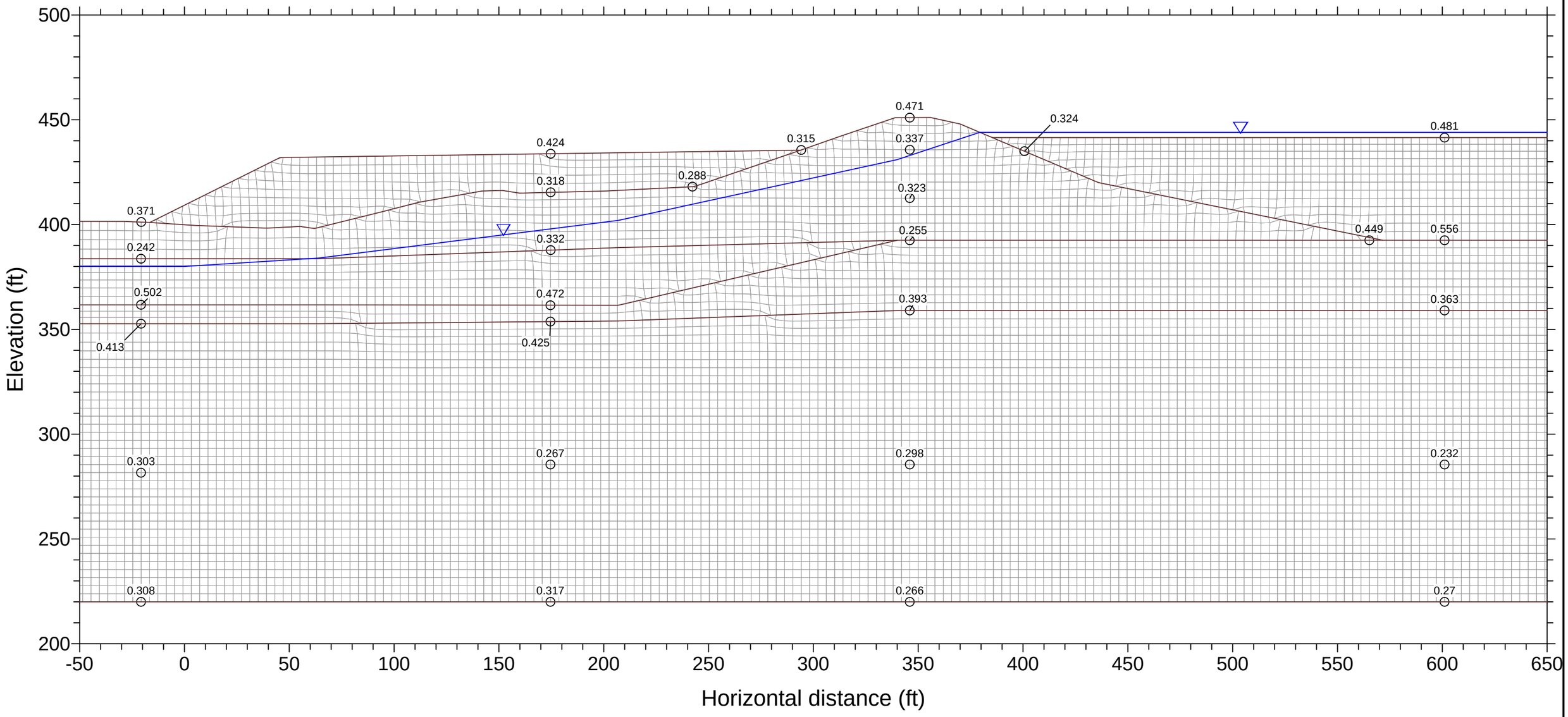

Project No. 60442676	Vectren A.B. Brown Station CCR Study	A.B. Brown Station Section B QUAD4 Output - Nodal Acceleration (g) Base Motion: TH1	Figure 2-1
	AECOM		

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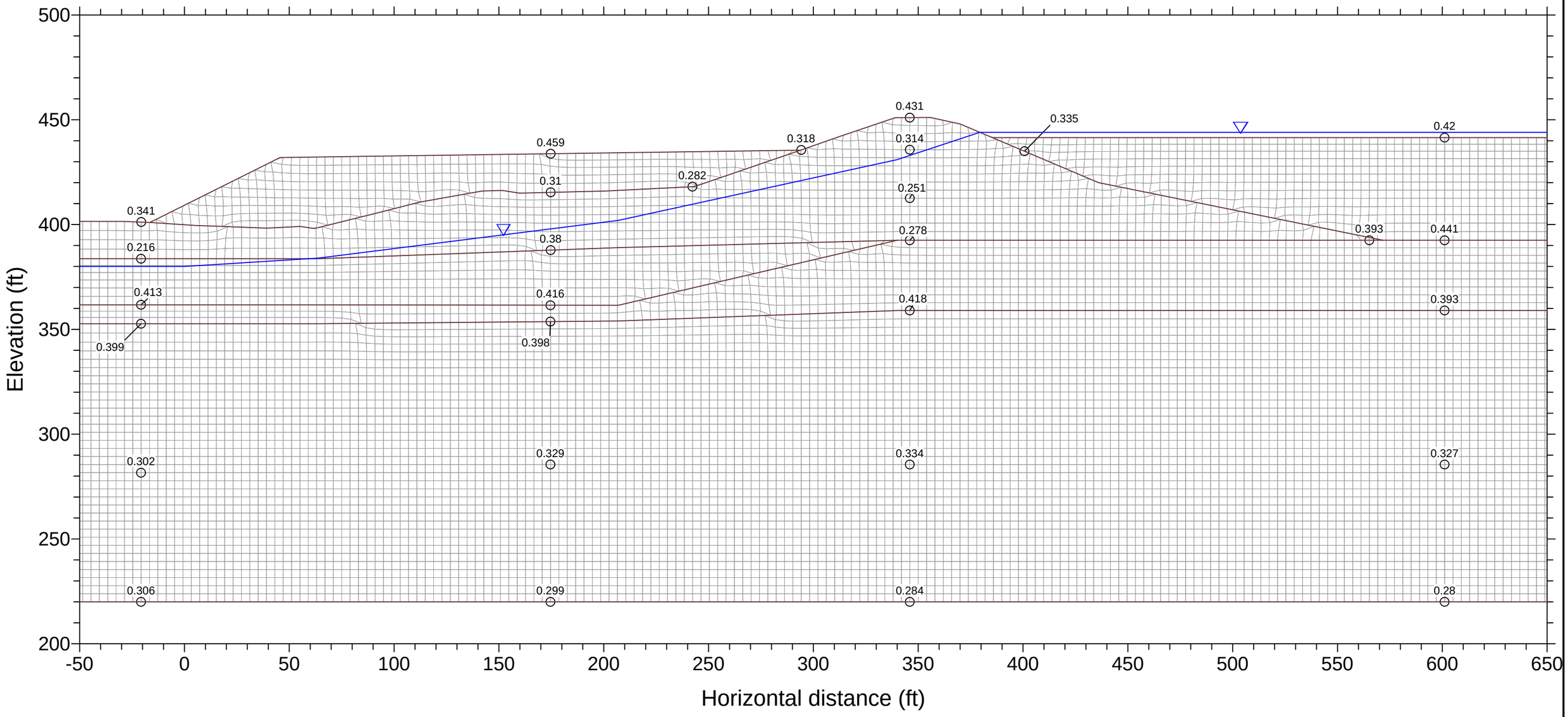
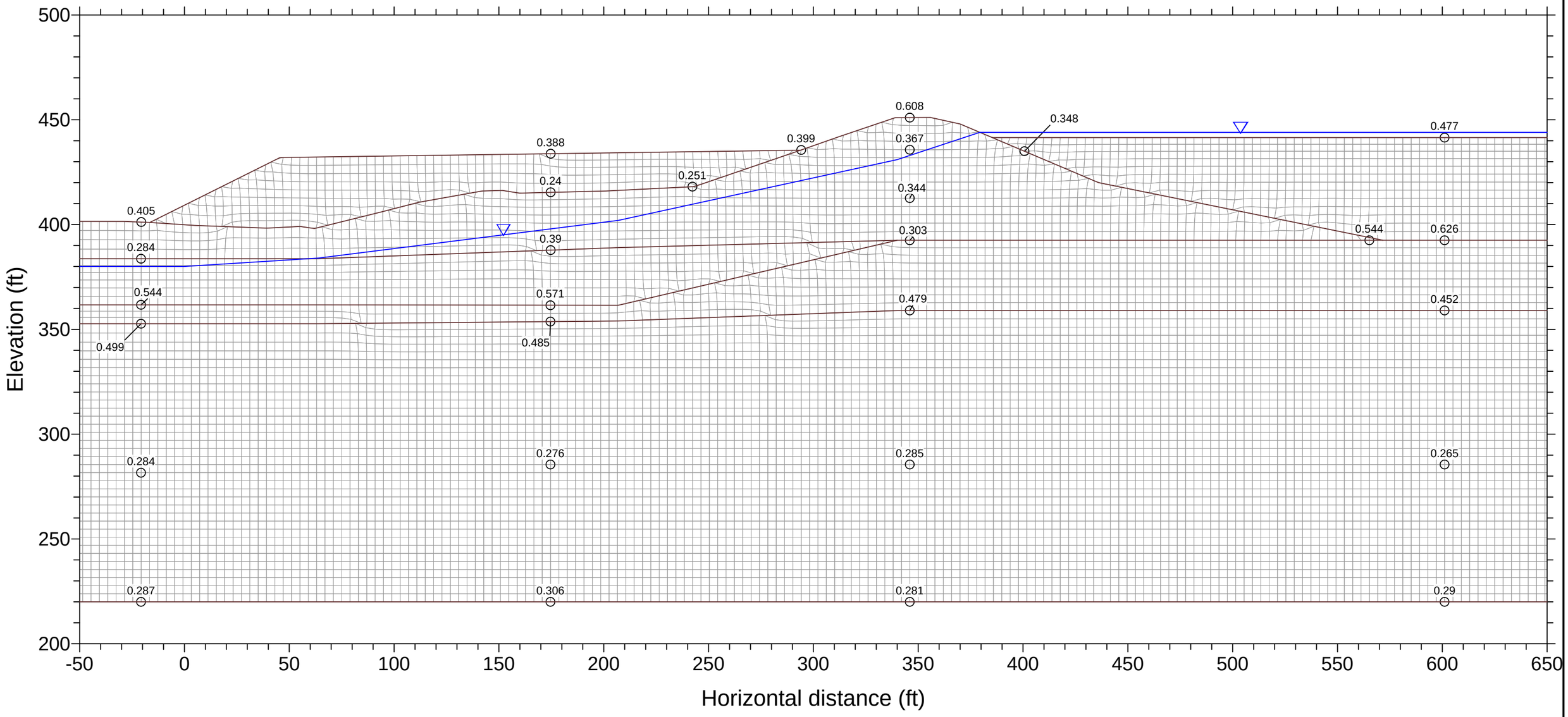


Project No. 60442676	Vectren A.B. Brown Station CCR Study	A.B. Brown Station Section B QUAD4 Output - Nodal Acceleration (g) Base Motion: TH2	Figure 2-2
	AECOM		

\Projects\Vectren\60442676_ABBrown\400-Technical\503 Revised Quad4 Analysis\



Project No. 60442676	Vectren A.B. Brown Station CCR Study	A.B. Brown Station Section B QUAD4 Output - Nodal Acceleration (g) Base Motion: TH3	Figure 2-3
	AECOM		

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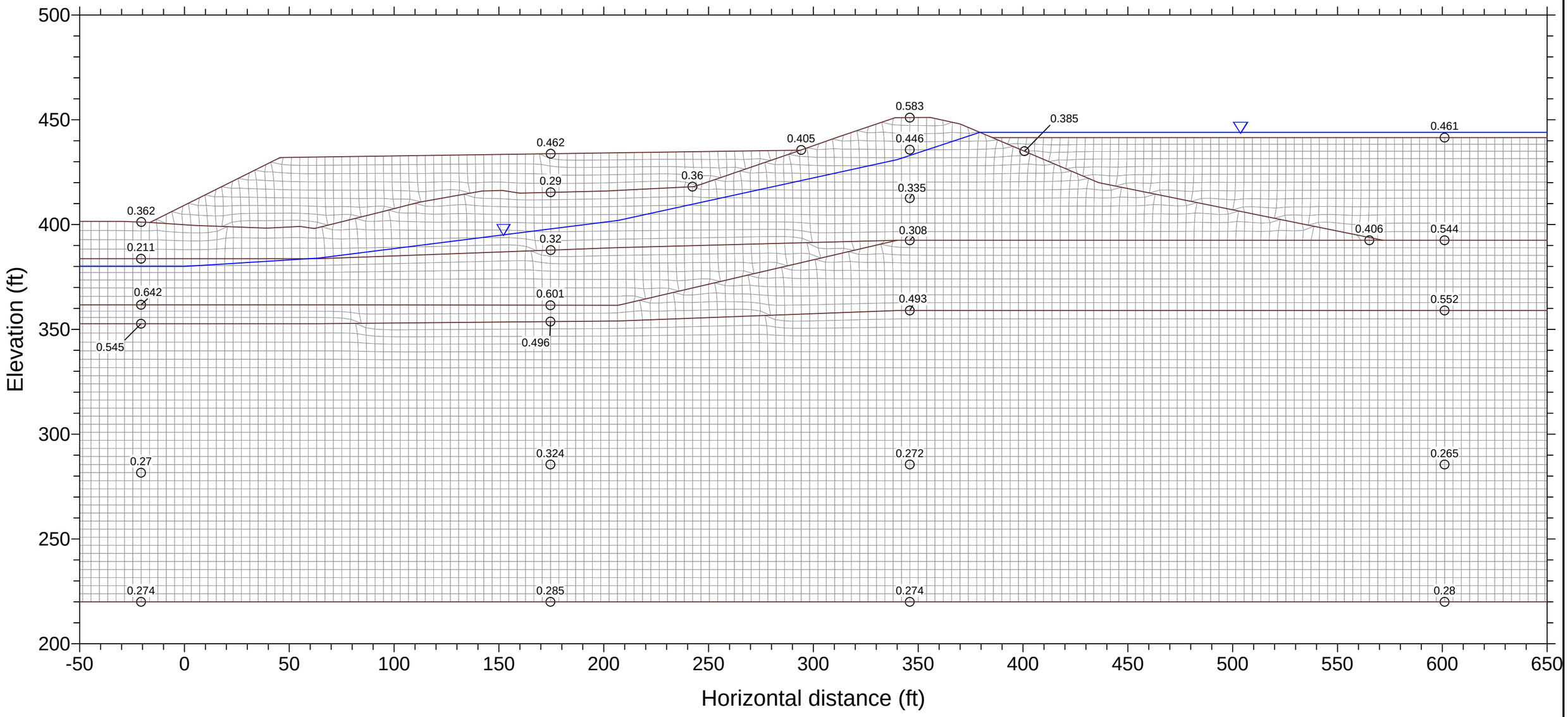

Project No. 60442676	Vectren A.B. Brown Station CCR Study	A.B. Brown Station Section B QUAD4 Output - Nodal Acceleration (g) Base Motion: TH4	Figure 2-4
	AECOM		

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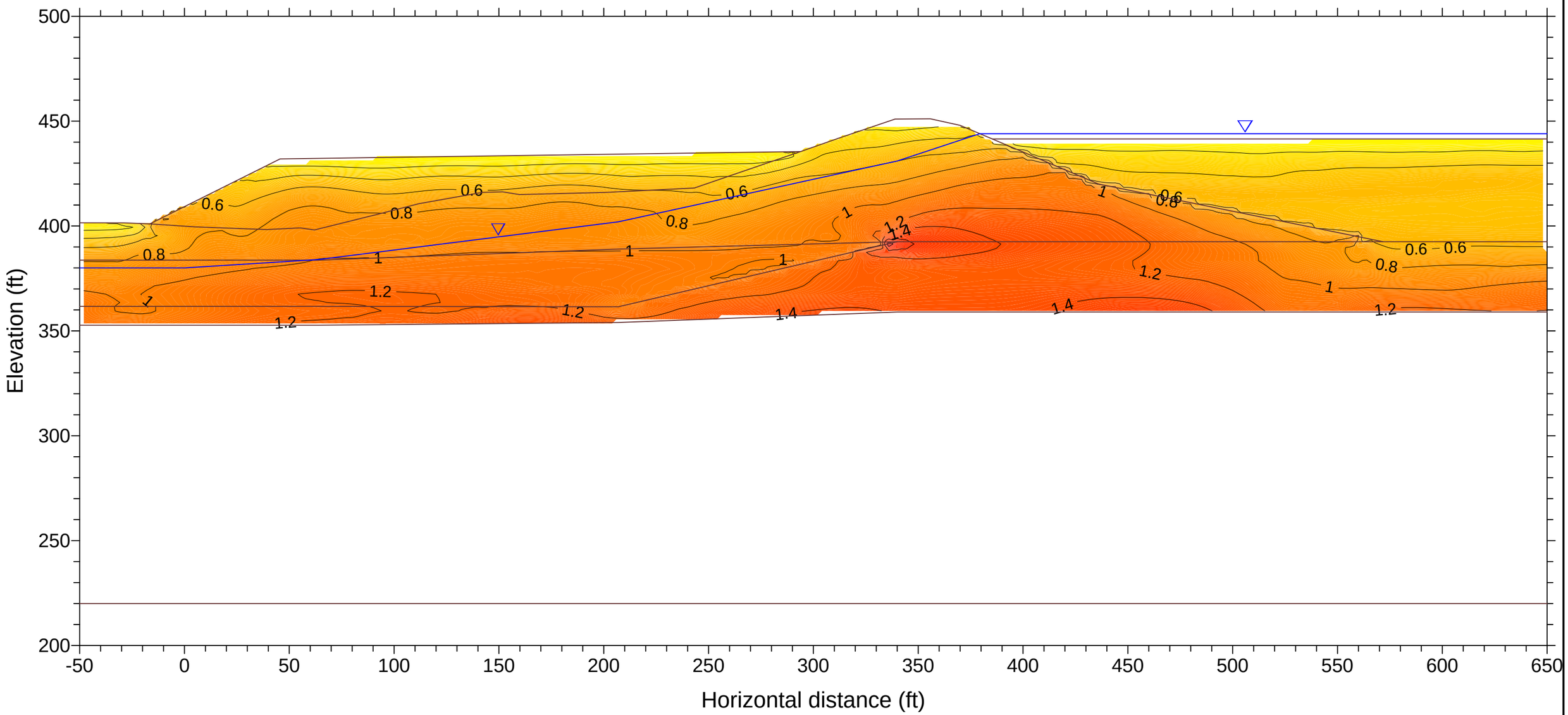
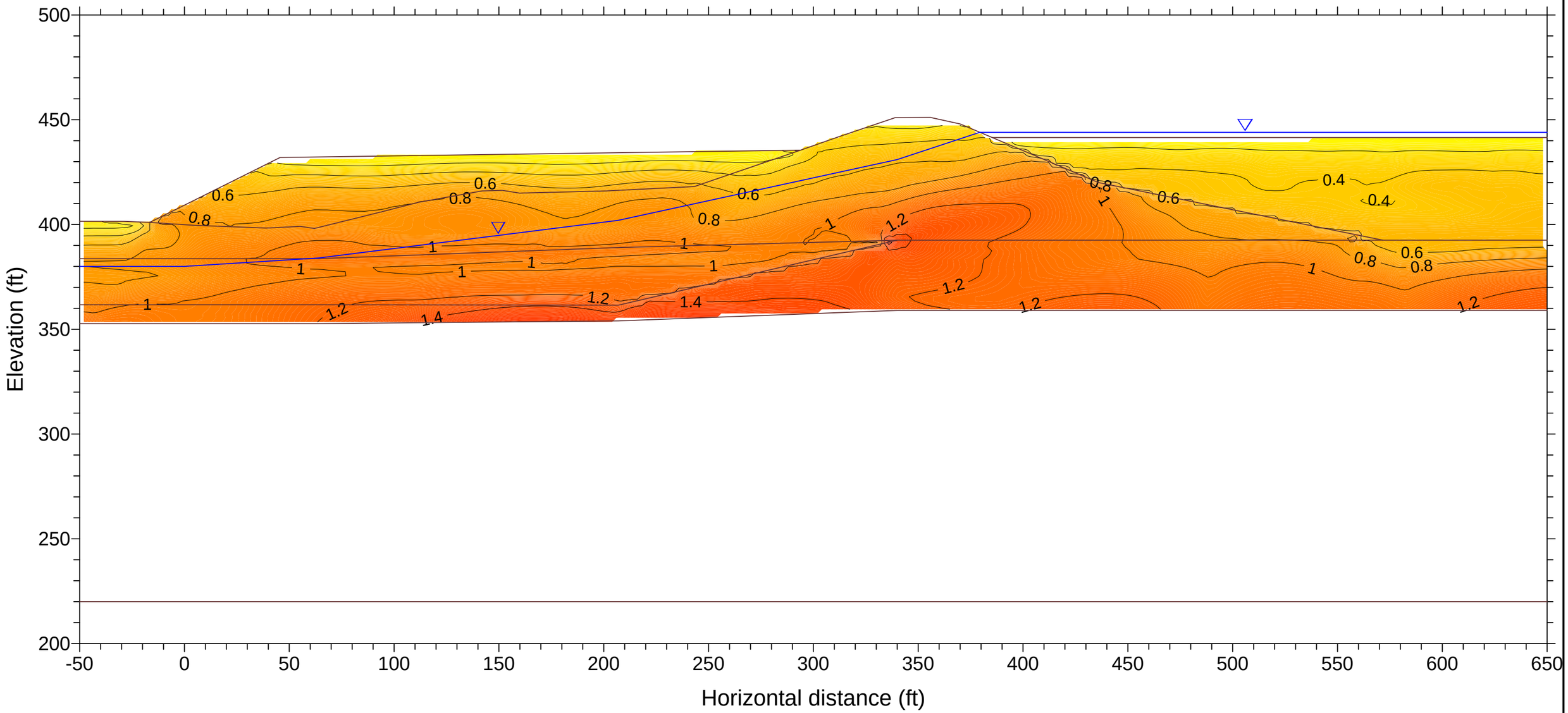


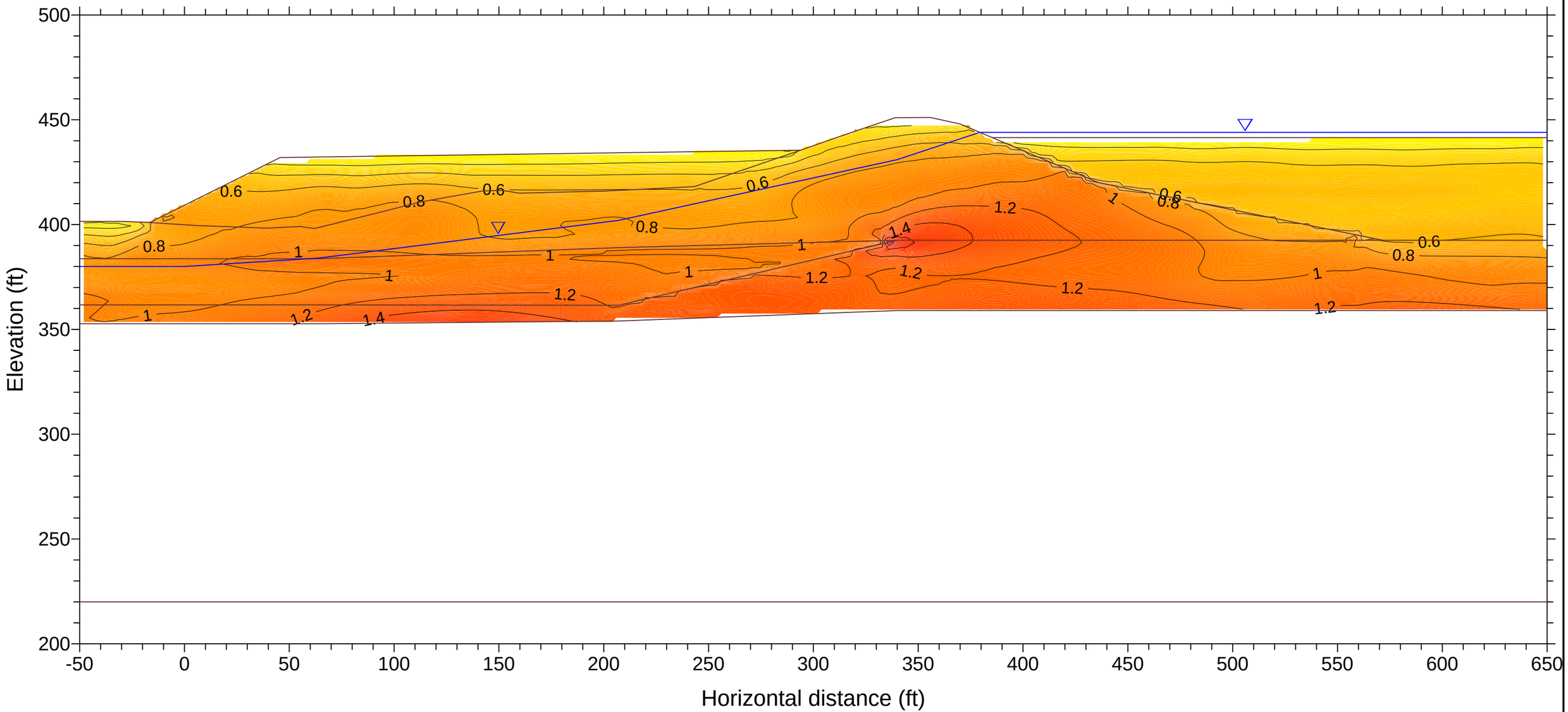
Project No. 60442676	Vectren A.B. Brown Station CCR Study	A.B. Brown Station Section B QUAD4 Output - Peak Shear Stress (ksf) Base Motion: TH1	Figure 3-1
AECOM			

\Projects\Vectren\60442676_ABBrown\400-Technical\503 Revised Quad4 Analysis\



Project No. 60442676	Vectren A.B. Brown Station CCR Study	A.B. Brown Station Section B QUAD4 Output - Peak Shear Stress (ksf) Base Motion: TH2	Figure 3-2
AECOM			

\Projects\Vectren\60442676_ABBrown\400-Technical\503 Revised Quad4 Analysis\



Project No. 60442676	Vectren A.B. Brown Station CCR Study	A.B. Brown Station Section B QUAD4 Output - Peak Shear Stress (ksf) Base Motion: TH3	Figure 3-3
AECOM			

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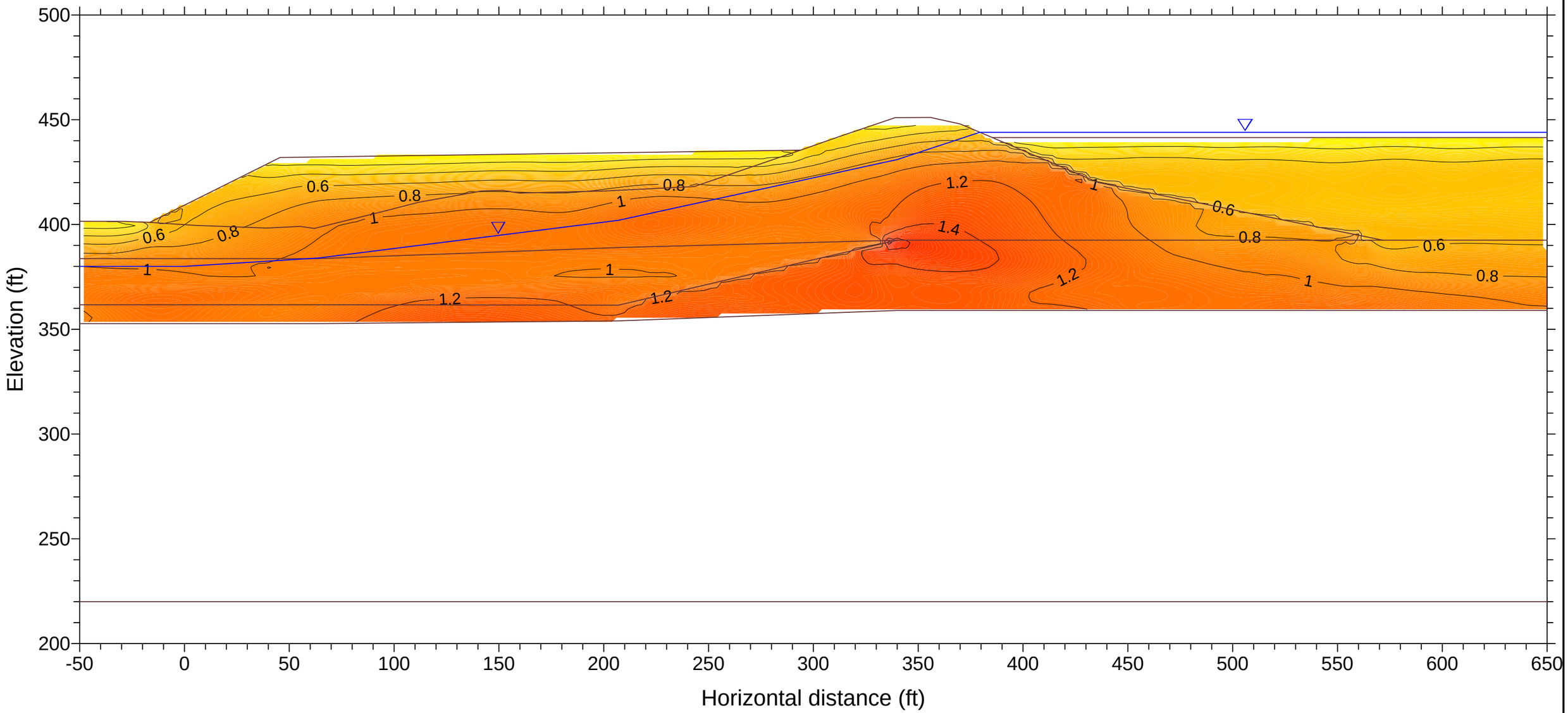


Project No. 60442676	Vectren A.B. Brown Station CCR Study	A.B. Brown Station Section B QUAD4 Output - Peak Shear Stress (ksf) Base Motion: TH4	Figure 3-4
AECOM			

\Projects\Vectren\60442676_ABBrown\400-Technical\503 Revised Quad4 Analysis\

Appendix I
Liquefaction Analysis Calculations

I. Purpose: **This presents the liquefaction triggering evaluation performed to support stability analysis of the Lower Dam, at Vectren's A.B. Brown Generating Station.**

This analysis is being performed in conjunction with dike slope stability analyses for the Lower Dam, in accordance with the requirements of Section 257.73 of the CCR Rule. Liquefaction triggering analyses of the various soil units comprising and underlying the dam are required in order to establish the shear strength of subsurface materials for use in the post-liquefaction slope stability condition. The basis for selection of these parameters is provided in Attachment F, and the post-liquefaction slope stability analyses are developed and presented in Attachment F.

II. Basis and Methodology of Liquefaction Analysis

- Based on the subsurface exploration, the materials that may have potential for liquefaction include the sluiced fly ash deposit that is impounded behind the dam, as well as the native silt deposit which underlies the dam across the majority of the site. As liquefaction of the sluiced ash poses no impact to dam stability, the liquefaction analyses presented herein focus on the native silt deposit.
- The silt deposit varied in thickness from approximately 2.0 feet to 27.5 feet as summarized in **Table I-1.** Uncorrected field SPT N-values ranged between 0 and 23 blows per foot (bpf) with an average of 7 bpf, indicating a medium stiff consistency overall. The fines content of the silt layers (as indicated by material that passes through a No. 200 sieve) was often above 95%. Atterberg limits testing indicated about half of the samples to be non-plastic, with others exhibiting very low plasticity indices, usually below 7.

Table I-1. Presence of Potentially Liquefiable Silts

Boring No.	Depth to Top of Layer (feet)	Layer Thickness (feet)
B-201	37.0	11.0
B-202	--	--
B-203	--	--
B-204	46.0	7.0
B-205	26.5	27.5
B-206	18.0	12.5
	40.0	3.0
	58.0	15.0
B-207	29.0	9.0
B-208	13.0	22.0

Table I-1. Presence of Potentially Liquefiable Silts

Boring No.	Depth to Top of Layer (feet)	Layer Thickness (feet)
B-209	45.5	7.5
B-210	53.0	12.5
B-211	64.0	≥6.0
B-212	63.0	5.0
B-213	56.0	2.0
B-214	--	--
B-215	28.0	18.0
B-216	23.5	24.5
B-217	43.0	12.5
B-218	8.5	15.0
	46.5	6.5
B-219	5.5	12.5

- The clayey fill materials that comprise the dam embankment are considered to be non-liquefiable as they have plasticity indices well above 7, and the majority of these materials lie above the phreatic surface. The materials were present in the borings as well-compacted materials with stiff to very stiff consistency and are therefore not considered to be susceptible to softening as a result of cyclic loading. Undrained strength is used to represent this deposit in the seismic and post-liquefaction stability analyses.
- The native silty clay deposit which underlies the pond consists of materials classified as lean clay (CL) and (to a lesser degree) silty clay (CL-ML). Plasticity indices in this unit were generally well above 7 (average of 13), and the materials were generally stiff to very stiff in consistency. Like the clay embankment fill, this deposit is not considered to be prone to liquefaction or softening as a result of cyclic loading. Undrained strength is used to represent this deposit in the seismic and post-liquefaction stability analyses.
- All liquefaction analyses (as well as the dynamic response analyses that are used to establish ground motions for input in these analyses) reference a design earthquake event with 2% probability of exceedance in 50 years (recurrence interval of approximately 2500 years). This event is as stipulated by the CCR Rule.
- A Probabilistic Seismic Hazard Analysis (PSHA) was performed for the A.B. Brown site and is presented in **Appendix G**. The PSHA results were used to compute a

2,500-yr return period Uniform Hazard Spectrum (UHS) and develop horizontal acceleration time histories consistent with the hard rock 2,500-yr UHS. Four sets of time histories were developed for each design spectrum. The time histories represent the site-specific ground motions associated with the controlling near-field or far-field earthquake event, and consider the magnitude, distance, and Arias Intensity.

- The site-specific acceleration time histories were then used in a dynamic response analysis to estimate seismic-induced shear stresses for use in liquefaction analysis. QUAD4M dynamic response analyses were performed for Cross-Section B-B, which is located central to the axis of the dam and is considered representative of the site. The seismic load demand (cyclic shear stresses and cyclic stress ratios) resulting in the various soil units were estimated based on the results for this section, and were broadly applied for liquefaction analyses in other locations at the dam. QUAD4 analyses were performed for both the configuration of the dam prior to construction of the stabilizing soil buttress and for the current configuration with the buttress in place. The dynamic response analyses are presented in **Appendix H**.
- Liquefaction triggering evaluations for the native silt deposit were performed using three methods:
    1. A SPT-based Procedure
    2. A comparison of the seismic load demand to cyclic resistance, established on the basis of laboratory cyclic direct simple shear testing.
- The soil buttress is designed to mitigate the potential for slope instabilities following an earthquake event, even accounting for predicted liquefaction in the silt deposit. The gravity loads applied by the buttress will consolidate and strengthen the silt deposit relative to the pre-buttress configuration, and can be expected to increase the liquefaction resistance of the silt. However, it is anticipated that any such increase in resistance would be minor.

The soil borings and CPT soundings performed at the site were advanced prior to construction of the soil buttress and therefore liquefaction resistances established on the basis of this data also represent the pre-buttress conditions. For this reason, the liquefaction potential evaluation was performed based on the configuration of the dam prior to construction of the soil buttress. This is considered to be conservative, as the liquefaction resistance of the silt soils following buttress construction would be expected to be higher, as explained above.

The presence of the buttress could influence the cyclic shear stresses generated during the design earthquake event. A comparison of the stresses in the silt deposit between the QUAD 4 models representing the pre- and post-buttress configurations was performed to address this, as described in Section III below.

- The SPT-based liquefaction triggering analyses were performed using the procedure proposed by Idriss and Boulanger (2008, 2014). The procedure considers a stress-based approach to evaluate the potential for liquefaction triggering, and compares calculated earthquake-induced cyclic stress ratios (CSRs) with the estimated cyclic resistance ratios (CRRs) of the soil to establish the factor of safety against liquefaction triggering.
- Stress-controlled Cyclic Direct Simple Shear (CDSS) tests (per ASTM D 6528) were performed on undisturbed samples of silt obtained from multiple locations from beneath the dam. A total of six silt samples were tested. The CDSS tests were performed for a range of CSRs, which covers the load demand that the silt is anticipated to experience during the design earthquake. Samples were loaded to normal stresses at or slightly above the existing overburden pressure estimated for that sample, with the intent of testing each sample in a normally consolidated condition.

III. Calculation of Seismic Load Demand

The QUAD4M model for Section B-B incorporates a large number of finite elements making up the meshing for the whole cross-section. Seismically induced shear stresses are calculated for each element, and 2-dimensional plots of shear stress contours within the cross-section are generated. These plots are provided in Appendix H, for each of the four time histories analyzed. Estimated peak nodal accelerations are presented in Figures 2-1 to 2-4 of that Appendix. Further, the peak cyclic shear stresses (in ksf) estimated for each time history are shown in Figures 3-1 to 3-4 of the Appendix.

The shear stresses vary both vertically and horizontally within the cross-section, and also vary by time history. The CSR at any location is defined as follows:

$$CSR = \frac{0.65 * \tau_{cyc}}{\sigma_{vc}{}'}$$

where:

τ_{cyc} = cyclic shear stress
$\sigma_{vc}{}'$ = effective vertical stress

As a broad interpretation of the results, the shear stresses and corresponding CSRs calculated for elements within the foundation silt layer were tallied, and ranges and averages were determined. As described above, this was done using the QUAD4M model representing the pre-buttress configuration. A summary of these values is provided in **Table I-2** below:

Table I-2: Shear Stresses and Cyclic Stress Ratios (CSR) in Silt Deposit (From QUAD4 Analysis) – Pre-Buttress Model

Time History	Range of Shear Stresses in Silt (ksf)	Average CSR in Silt	Range of CSRs in Silt
1	0.5-2.0	0.17	0.12-0.27
2	0.4-1.8	0.17	0.11-0.25
3	0.5-1.8	0.17	0.12-0.26
4	0.4-1.7	0.16	0.11-0.26

The QUAD4M results were utilized to establish the variation of CSR as a function of depth within the silt deposit for these analyses. As the majority of the borings that encountered the silt deposit were drilled at or close to the center of the mid-slope bench on the dam, the element cyclic shear stress results at the location of the centerline of the bench (the reference location) were taken from the QUAD4M results, as shown in **Figure I-1** below. These shear stresses were then transformed to CSRs for use in liquefaction analyses. **Table I-3** summarizes the average CSR (among all time histories analyzed) at the top, center, and bottom of the silt layer at the reference location. The CSRs utilized in the liquefaction screening analyses were linearly interpolated based on the values in the table.

Figure I-1: Location Used for Establishing CSRs in Silt for Liquefaction Screening

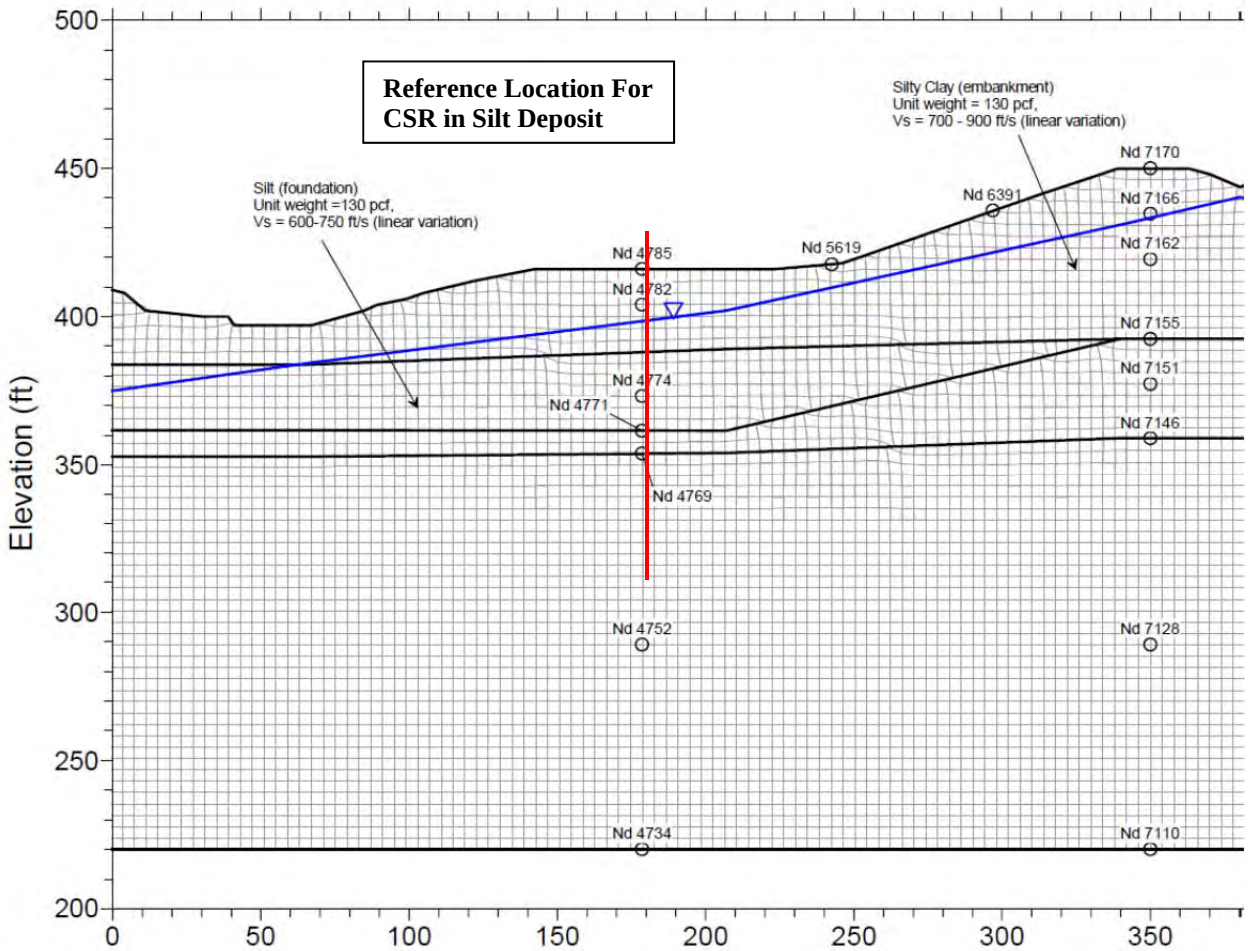


Table I-3: Shear Stresses and Cyclic Stress Ratios (CSR) in Silt Deposit (From QUAD4 Analysis) – Pre-Buttress Model

Location	Average CSR
Top of Silt Deposit	0.20
Center of Silt Deposit	0.16
Bottom of Silt Deposit	0.14

As described in Section II, the presence of the buttress may affect the cyclic shear stresses generated in the silt deposit. The above calculations of CSR were therefore repeated for the

QUAD4M model that represents the post-buttress configuration and the results were compared to the values given in **Table I-2**. The comparison is presented below in **Table I-4**:

Table I-4: Comparison of CSRs in Silt Deposit – Pre-Buttress Model vs. Post-Buttress Models

Time History	Average CSR in Silt		Range of CSRs in Silt	
	Pre-Buttress Model	Post-Buttress Model	Pre-Buttress Model	Post-Buttress Model
1	0.17	0.15	0.12-0.27	0.10-0.23
2	0.17	0.14	0.11-0.25	0.10-0.22
3	0.17	0.14	0.12-0.26	0.10-0.24
4	0.16	0.15	0.11-0.26	0.10-0.25

CSRs in the silt deposit are slightly lower in the post-buttress model than in the pre-buttress model. As stated previously, liquefaction resistance of the silt deposit in the presence of the buttress is also expected to be somewhat higher than without it. For these reasons, it is conservative to utilize the pre-buttress model results for the liquefaction potential analyses and this has been done herein.

IV. SPT-Based Liquefaction Potential Evaluation

Spreadsheets developed by AECOM utilizing the SPT-based procedures given in Idriss and Boulanger (2008, 2014) and in conjunction with SPT data from the available borings were used for the analyses.

The spreadsheets calculate a Factor of Safety against liquefaction, which is defined as the quotient of the soil's cyclic resistance ratio and the cyclic stress ratio induced by the earthquake:

$$FS_{liq} = \frac{CRR}{CSR}$$

CSRs were determined as described previously. The CRR is the cyclic resistance ratio at which liquefaction occurs during an earthquake. It is obtained from case history-based semi-empirical correlations with SPT values recorded at sites with level ground conditions, and it also is normalized to $\sigma'_v \approx 1$ atm for an earthquake with M = 7.5. Within the SPT-based procedure, the CRR is a function of a soil's fines content (FC), relative density and effective stress, and penetration resistance (SPT). The CRR is also dependent on the duration of shaking and is adjusted to the site-specific design earthquake using a Magnitude Scaling Factor (MSF). The PSHA indicates that predicted ground motions at the site have a bimodal response, with small

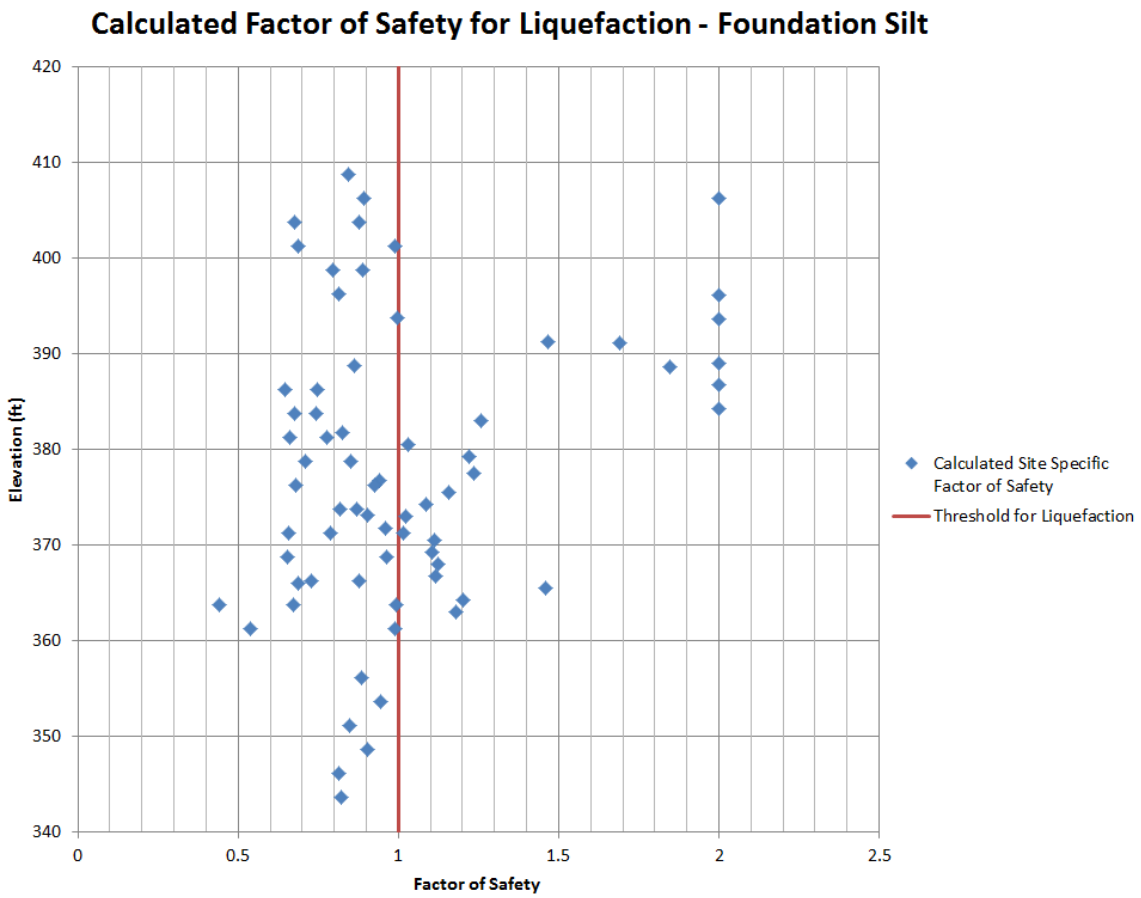
magnitude events dominating the short-period spectral accelerations, and large magnitude events dominating the longer period portions of the spectrum. As liquefaction is a phenomenon most commonly associated with long-duration, high-magnitude earthquakes, the magnitude assumed in the liquefaction screening analysis was 7.1, corresponding to the sources that dominate the longer-period portion of the spectrum. Regarding fines content, the foundation silt is a largely fine material. Based on the results of laboratory particle size analysis, the fines content of all silt materials was assumed to be 90% for analysis purposes.

Analyses were performed for each boring that encountered significant thickness of the silt, including B-205 to B-208, and B-215 to B-219. Analysis focused on liquefaction potential of the silt deposit. As described previously, the CSRs provided in **Table I-3** were linearly interpolated throughout the depth of the silt layer for the analysis of each SPT boring, and were manually input into the spreadsheet analysis.

In general, a factor of safety of less than 1.0 indicates that liquefaction could occur during seismic shaking. A factor of safety was calculated for each interval within the exploration (each depth at which a SPT N-value is available). The spreadsheet limits liquefaction factors of safety to 2.0, even if the computed factor of safety is higher than 2.0.

Spreadsheet analysis output files are provided in **Attachment I-1**. **Figure I-2** portrays the calculated factors of safety within the foundation silt material. Data from all borings have been combined into the figure. The majority of calculated factors of safety are below 1.0, and substantially below in many cases.

Figure I-2: Compilation of Liquefaction Factor of Safety in Foundation Silts



Based on the results of the SPT-based screening analysis, it is concluded that liquefaction can be triggered within the silt layer as a result of the design seismic event.

V. Laboratory-Based Liquefaction Potential Evaluation

While the liquefaction resistance of sand materials (especially clean sands) is well-documented within geotechnical practice, the resistance of silty soils is less well-established. In general, it is known that higher fines content in a soil increases the resistance to liquefaction, and various methodologies (including that adopted by Idriss and Boulanger (2008, 2014) and utilized in the SPT-based screening analyses presented above) have been proposed and are in use. Considering that the layer of concern consists of a high-fines silt (90% fines or greater in most samples that were tested in the laboratory), and considering that the screening analysis presented previously is a first-level, approximate evaluation, a second more rigorous laboratory-based approach was

taken herein, to rule out the possibility that the silt is not prone to liquefaction during the design earthquake.

Stress-controlled CDSS testing (per ASTM D 6528) was performed on undisturbed silt samples obtained from multiple locations beneath the Lower Dam. A total of six samples were tested. As presented in **Table I-2**, the average CSR demand in the silt layer predicted from the QUAD4M dynamic response analysis, is about 0.17, and ranges from about 0.10 to about 0.25. Therefore, CDSS testing was performed at test CSRs of 0.08, 0.15, 0.20, and 0.25, to cover the expected range. Samples were loaded to normal stresses at or slightly above the existing overburden pressure estimated for that sample.

Laboratory data from the CDSS tests are presented in **Appendix D.** The test results (including excess pore pressure generated and axial strain) are presented as a function of the number of cycles that have been applied at any point in the test. Herein, failure (i.e., liquefaction) was interpreted at the cycle where the single-phase axial strain exceeded 5% (or 10% peak-to-peak) or the excess pore pressure ratio reached 85% of the applied normal stress, whichever was less.

The results of CDSS testing are summarized in **Table I-4** below.

Table I-4: Summary of CDSS Testing Results

Boring No.	Depth (feet)	Test CSR	Vertical Consolidation Stress (psf)	Number of Load Cycles To Failure	Failure Mechanism
AECOM-B1	39-41	0.25	4,275	4	Strain Criteria
AECOM-B2	56-58	0.15	4,950	17	Excess Pressure Criteria
	62-64	0.20	6,040	3	Strain Criteria
AECOM-B4	33-35	0.08	2,965	>50	Sample did not liquefy
	46-48	0.20	3,380	6	Excess Pressure Criteria
AECOM-B5	30-32	0.15	2,660	20	Excess Pressure Criteria

Figure I-3 plots the CDSS failure points as a function of the number of cycles. For an average CSR of 0.17, the expected number of cycles to failure is expected to be approximately 9. The cyclic resistance of soils in the field is likely to be less than that interpreted from laboratory results, due to the potential for multidirectional shaking. Consequently, the number of cycles to liquefaction in an earthquake setting is expected to be somewhat less than that determined from laboratory testing. Herein, the number of cycles to liquefaction in the field is assumed to be in the range of 7 to 9.

Figure I-3: CSR Vs. Number of Cycles at Failure – Laboratory CDSS Testing

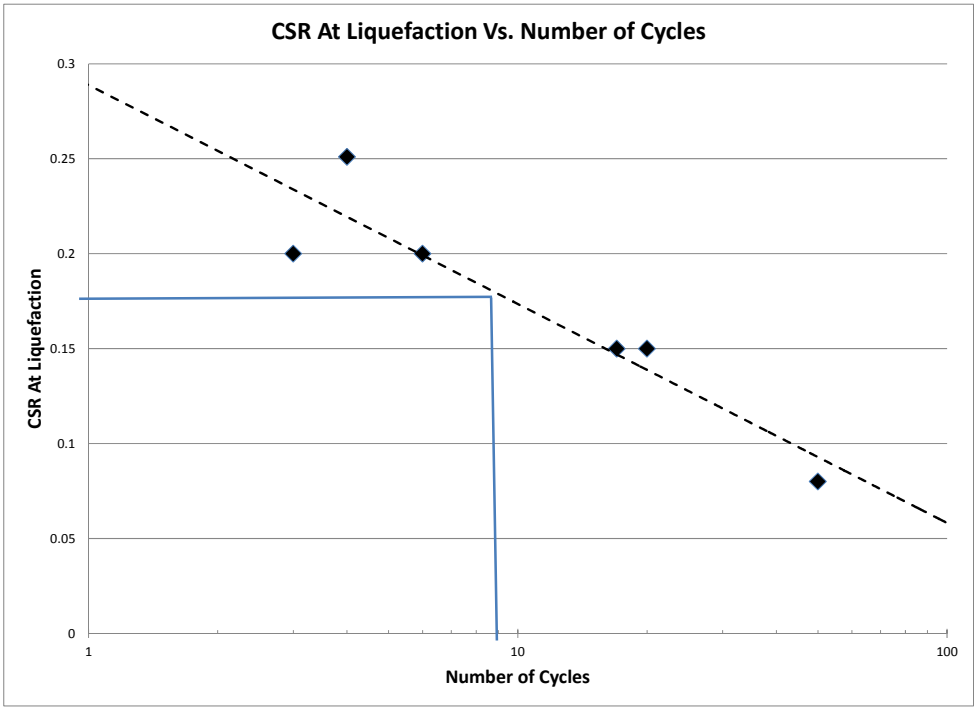
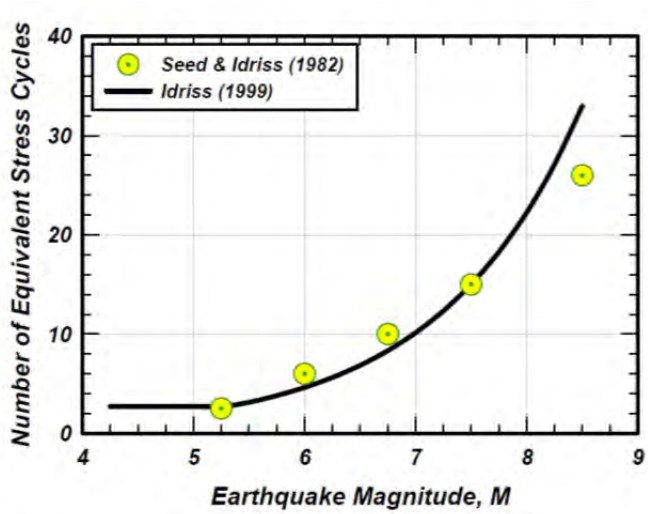


Figure I-4 (Boulanger and Idriss, 2008) shown below presents an estimate of the mean number of equivalent uniform cycles at reference stress of 65% of the peak stress (i.e., the definition of the CSR) that can be expected for a given earthquake magnitude.

Figure I-4: Mean number of equivalent uniform cycles at reference stress of 65% of the peak stress versus earthquake magnitude for sand soils (Boulanger and Idriss, 2008).



For an earthquake of magnitude 7.1, the figure indicates that approximately 12 equivalent cycles can be anticipated. As the laboratory CDSS samples reached failure in a smaller number of cycles, liquefaction of the silt is considered to be highly likely during the design earthquake.

VI. Conclusion

Based on the collective results of the laboratory-based and SPT -based triggering analyses, it is concluded that the native silt materials that underlie the dam are prone to liquefaction as a result of the design earthquake. Liquefaction and accompanying strength loss in these materials is expected to impact the factor of safety against stability in the post-liquefaction stability condition that is stipulated by the CCR Rule. As such, there is a need to establish the shear strength of the ash deposit in a liquefied state. This is presented in detail in **Appendix F**.

VII. References

1. Idriss, I.M., and Boulanger, R. W. (2008). "SPT-Based Liquefaction Triggering Procedures", Report No. UCD/CGM-10-02, Center for Geotechnical Modeling, Department of Civil and Environmental Engineering, University of California, Davis, CA.

2. Idriss, I.M. and Boulanger, R.W. (2014). "CPT and SPT Based Liquefaction Triggering Procedures", Center of Geotechnical Modeling, Department of Civil and Environmental Engineering, University of California, Davis, California.

Attachment I-1
SPT-Based Liquefaction Analysis Output

Method: Idriss and Boulanger (2008), *Soil Liquefaction during Earthquakes*, EERI MNO-12

Title: Vectren AB Brown
Project: Lower Dam
Project No.: 60442676
Date: 1/22/2016
Boring No. B-205
Units American feet, pounds, pcf

Input Parameters:

Peak ground acceleration, pga (g):				
Earthquake Magnitude (M):	7.1			
Water Table Depth at the time of drilling	9.5	ft	2.90	m
Water Table Depth at the time of earthquake	9.5	ft	2.90	m
Avg Unit Weight above GWT	130	pcf	20.4213703	kN/m^3
Avg Unit Weight below GWT	130	pcf	20.4213703	kN/m^3
Borehole Diameter	0.5833	ft	178	mm
Correction for Sampler Liner (N/Y)	N	ft		
Rod stickup above ground at start of drive	5	ft	1.524	m
Boring Total Depth	62.2	ft	18.95856	m
Ground Surface Elevation	415.5	ft	126.6444	m

Bold values for N and Fines were directly mesured.

Data No.	Depth	Elevation	Measured N Previously corrected for gravel content (*)	Soil Type (USCS)	Flag: "Unsaturated", "Clay", "85% Sat"	Fines Content (%)	Energy Ratio (%)	N_{60}	$(N_1)_{60}$	$(N_1)_{60\text{-}cs}$ for liquefaction triggering	$(N_1)_{60\text{-}cs}$ for residual strength	CRR	CSR	Factor of Safety	Layer Thickness ΔH_i	ΔLDI_i	Vertical Reconsol. Strain, ε_v	Layer Settlement ΔS_i
	ft	ft													ft	ft		ft
1	26.5	389	**19**	ML	85% Sat	90	81	25.1	28.2	33.7	33	1.041	0.200	2.00	13.25	0.00	0.000	0.000
2	28.75	386.75	**17**	ML	85% Sat	90	81	25.1	23.7	29.2	29	0.474	0.192	2.00	14.38	0.00	0.000	0.000
3	31.25	384.25	**18**	ML	85% Sat	90	81	27.9	25.9	31.4	31	0.623	0.184	2.00	2.38	0.00	0.000	0.000
4	33.75	381.75	**5**	ML	85% Sat	90	81	7.8	6.7	12.2	12	0.145	0.176	0.82	2.50	0.93	0.033	0.083
5	36.25	379.25	**10**	ML	85% Sat	90	81	15.5	13.3	18.8	18	0.205	0.168	1.22	2.50	0.04	0.005	0.014
6	38.75	376.75	**6**	ML	85% Sat	90	81	9.3	7.6	13.1	13	0.151	0.160	0.94	2.50	0.14	0.022	0.055
7	41.25	374.25	**8**	ML	85% Sat	90	81	12.4	10.0	15.5	15	0.170	0.156	1.09	2.50	0.06	0.008	0.021
8	43.75	371.75	**6**	ML	85% Sat	90	81	9.3	7.2	12.7	12	0.146	0.152	0.96	2.50	0.12	0.020	0.049
9	46.25	369.25	**8**	ML	85% Sat	90	81	12.4	9.5	15.1	15	0.163	0.148	1.10	2.50	0.06	0.008	0.020
10	48.75	366.75	**8**	ML	85% Sat	90	81	12.4	9.3	14.8	14	0.161	0.144	1.12	2.50	0.05	0.008	0.019
11	51.25	364.25	**9**	ML	85% Sat	90	81	14.0	10.3	15.8	15	0.168	0.140	1.20	2.50	0.04	0.006	0.014

Method: Idriss and Boulanger (2008), *Soil Liquefaction during Earthquakes*, EERI MNO-12

Title: Vectren AB Brown
Project: Lower Dam
Project No.: 60442676
Date: 1/22/2016
Boring No. B-206
Units American feet, pounds, pcf

Input Parameters:

Peak ground acceleration, pga (g):				
Earthquake Magnitude (M):	7.1			
Water Table Depth at the time of drilling	8.8	ft	2.68	m
Water Table Depth at the time of earthquake	8.8	ft	2.68	m
Avg Unit Weight above GWT	130	pcf	20.4213703	kN/m^3
Avg Unit Weight below GWT	130	pcf	20.4213703	kN/m^3
Borehole Diameter	0.583	ft	178	mm
Correction for Sampler Liner (N/Y)	N	ft		
Rod stickup above ground at start of drive	5	ft	1.524	m
Boring Total Depth	80	ft	24.384	m
Ground Surface Elevation	414.8	ft	126.43104	m

Bold values for N and Fines were directly mesured.

Data No.	Depth	Elevation	Measured N Previously corrected for gravel content (*)	Soil Type (USCS)	Flag: "Unsaturated", "Clay", "85% Sat"	Fines Content (%)	Energy Ratio (%)	N_{60}	$(N_1)_{60}$	$(N_1)_{60\text{-}cs}$ for liquefaction triggering	$(N_1)_{60\text{-}cs}$ for residual strength	CRR	CSR	Factor of Safety	Layer Thickness ΔH_i	ΔLDI_i	Vertical Reconsol. Strain, ε_v	Layer Settlement ΔS_i
	ft	ft													ft	ft		ft
1	18.75	396.05	**23**	ML	85% Sat	90	81	30.4	35.9	41.4	41	2.000	0.200	2.00	9.38	0.00	0.000	0.000
2	21.25	393.55	**21**	ML	85% Sat	90	81	31.0	32.0	37.5	37	2.000	0.194	2.00	10.63	0.00	0.000	0.000
3	23.75	391.05	**13**	ML	85% Sat	90	81	19.2	19.3	24.8	24	0.319	0.189	1.69	2.50	0.01	0.001	0.003
4	26.25	388.55	**14**	ML	85% Sat	90	81	20.6	20.2	25.7	25	0.338	0.183	1.85	2.50	0.01	0.001	0.001
5	31.25	383.55	**6**	CL	Clay	90	81	9.3	na	na	na	#N/A	0.177	2.00	3.75	0.00	0.000	0.000
6	36.25	378.55	**16**	CL	Clay	90	81	24.8	na	na	na	#N/A	0.171	2.00	5.00	0.00	0.000	0.000
7	41.75	373.05	**6**	ML	85% Sat	90	81	9.3	7.6	13.1	13	0.150	0.166	0.90	5.25	0.46	0.032	0.166
8	46.25	368.55	**15**	CL	Clay	90	81	23.3	na	na	na	#N/A	0.160	2.00	5.00	0.00	0.000	0.000
9	51.25	363.55	**10**	CL	Clay	90	81	15.5	na	na	na	#N/A	0.158	2.00	4.75	0.00	0.000	0.000
10	56.25	358.55	**5**	CL	Clay	90	81	7.8	na	na	na	#N/A	0.155	2.00	5.00	0.00	0.000	0.000
11	58.75	356.05	**6**	ML	85% Sat	90	81	9.3	6.3	11.8	11	0.135	0.153	0.89	3.75	0.98	0.034	0.126
12	61.25	353.55	**7**	ML	85% Sat	90	81	10.9	7.3	12.8	12	0.142	0.150	0.95	2.50	0.14	0.022	0.055
13	63.75	351.05	**5**	ML	85% Sat	90	81	7.8	5.0	10.5	10	0.125	0.148	0.85	2.50	1.12	0.036	0.091
14	66.25	348.55	**6**	ML	85% Sat	90	81	9.3	6.0	11.5	11	0.131	0.145	0.90	2.50	0.44	0.034	0.086
15	68.75	346.05	**4**	ML	85% Sat	90	81	6.2	3.8	9.3	9	0.116	0.143	0.81	2.50	1.27	0.039	0.097
16	71.25	343.55	**4**	ML	85% Sat	90	81	6.2	3.7	9.3	9	0.115	0.140	0.82	2.50	1.28	0.039	0.098

Method: Idriss and Boulanger (2008), *Soil Liquefaction during Earthquakes*, EERI MNO-12

Input Parameters:

Title:	Vectren AB Brown	Peak ground acceleration, pga (g):	0.47			Calculated Volumetric Settlement:	0.98 ft
Project:	Lower Dam	Earthquake Magnitude (M):	6.1			Calculated LDI:	10.0 ft
Project No.:	60442676	Water Table Depth at the time of drilling	10	ft	3.05 m	MSF for Sand	1.44
		Water Table Depth at the time of earthquake	10	ft	3.05 m		
Date:	1/22/2016	Avg Unit Weight above GWT	130	pcf	20.4213703 kN/m^3		
Boring No.	B-207	Avg Unit Weight below GWT	130	pcf	20.4213703 kN/m^3		
Units	American feet, pounds, pcf	Borehole Diameter	0.583	ft	178 mm		
		Correction for Sampler Liner (N/Y)	N	ft			
		Rod stickup above ground at start of drive	5	ft	1.524 m		
		Boring Total Depth	47.1	ft	14.35608 m		
		Ground Surface Elevation	395	ft	120.396 m		

Bold values for N and Fines were directly mesured.

Data No.	Depth	Elevation	Measured N Previously corrected for gravel content (*)	Soil Type (USCS)	Flag: "Unsaturated", "Clay", "85% Sat"	Fines Content (%)	Energy Ratio (%)	N_{60}	$(N_1)_{60}$	$(N_1)_{60\text{-}cs}$ for liquefaction triggering	$(N_1)_{60\text{-}cs}$ for residual strength	CRR	CSR	Factor of Safety	Layer Thickness ΔH_i	ΔLDI_i	Vertical Reconsol. Strain, ε_v	Layer Settlement ΔS_i
	ft	ft													ft	ft		ft
1	29	366	**7**	ML	85% Sat	90	81	8.9	10.1	15.6	15	0.240	0.359	0.67	14.50	3.73	0.028	0.405
2	31.25	363.75	**5**	ML	85% Sat	90	81	7.8	6.9	12.4	12	0.191	0.444	0.43	15.63	5.69	0.033	0.511
3	33.75	361.25	**8**	ML	85% Sat	90	81	12.4	10.8	16.3	16	0.234	0.445	0.53	2.38	0.57	0.027	0.064

Method: Idriss and Boulanger (2008), *Soil Liquefaction during Earthquakes*, EERI MNO-12

Title: Vectren AB Brown
Project: Lower Dam
Project No.: 60442676
Date: 1/22/2016
Boring No. B-208
Units American feet, pounds, pcf

Input Parameters:

Peak ground acceleration, pga (g):				
Earthquake Magnitude (M):	7.1			
Water Table Depth at the time of drilling	11.7	ft	3.57	m
Water Table Depth at the time of earthquake	11.7	ft	3.57	m
Avg Unit Weight above GWT	130	pcf	20.4213703	kN/m^3
Avg Unit Weight below GWT	130	pcf	20.4213703	kN/m^3
Borehole Diameter	0.583	ft	178	mm
Correction for Sampler Liner (N/Y)	N	ft		
Rod stickup above ground at start of drive	5	ft	1.524	m
Boring Total Depth	45	ft	13.716	m
Ground Surface Elevation	396.7	ft	120.91416	m

Bold values for N and Fines were directly mesured.

Data No.	Depth	Elevation	Measured N Previously corrected for gravel content (*)	Soil Type (USCS)	Flag: "Unsaturated", "Clay", "85% Sat"	Fines Content (%)	Energy Ratio (%)	N_{60}	$(N_1)_{60}$	$(N_1)_{60\text{-}cs}$ for liquefaction triggering	$(N_1)_{60\text{-}cs}$ for residual strength	CRR	CSR	Factor of Safety	Layer Thickness ΔH_i	ΔLDI_i	Vertical Reconsol. Strain, ε_v	Layer Settlement ΔS_i
	ft	ft													ft	ft		ft
1	13.75	382.95	**8**	ML	85% Sat	90	81	9.9	14.5	20.0	20	0.252	0.200	1.26	6.88	0.12	0.005	0.033
2	16.25	380.45	**7**	ML	85% Sat	90	81	10.3	11.3	16.8	16	0.196	0.190	1.03	8.13	0.25	0.010	0.084
3	19.25	377.45	**9**	ML	85% Sat	90	81	13.3	13.8	19.3	19	0.223	0.180	1.24	2.75	0.05	0.005	0.014
4	21.25	375.45	**8**	ML	85% Sat	90	81	11.8	11.8	17.3	17	0.197	0.170	1.16	2.50	0.05	0.007	0.016
5	23.75	372.95	**6**	ML	85% Sat	90	81	8.8	8.6	14.1	14	0.164	0.160	1.02	2.25	0.07	0.011	0.026
6	26.25	370.45	**7**	ML	85% Sat	90	81	10.3	9.7	15.2	15	0.172	0.155	1.11	2.50	0.05	0.008	0.019
7	28.75	367.95	**7**	ML	85% Sat	90	81	10.3	9.3	14.9	14	0.168	0.150	1.12	2.50	0.05	0.007	0.018
8	31.25	365.45	**10**	ML	85% Sat	90	81	15.5	13.8	19.3	19	0.212	0.145	1.46	2.50	0.02	0.003	0.007
9	33.75	362.95	**7**	ML	85% Sat	90	81	10.9	9.3	14.8	14	0.165	0.140	1.18	2.50	0.04	0.006	0.015

Method: Idriss and Boulanger (2008), *Soil Liquefaction during Earthquakes*, EERI MNO-12

Title: Vectren AB Brown
Project: Lower Dam
Project No.: 60442676
Date: 1/22/2016
Boring No. B-215
Units American feet, pounds, pcf

Input Parameters:

Peak ground acceleration, pga (g):				
Earthquake Magnitude (M):	7.1			
Water Table Depth at the time of drilling	9	ft	2.74	m
Water Table Depth at the time of earthquake	9	ft	2.74	m
Avg Unit Weight above GWT	130	pcf	20.4213703	kN/m^3
Avg Unit Weight below GWT	130	pcf	20.4213703	kN/m^3
Borehole Diameter	0.583	ft	178	mm
Correction for Sampler Liner (N/Y)	N	ft		
Rod stickup above ground at start of drive	5	ft	1.524	m
Boring Total Depth	60	ft	18.288	m
Ground Surface Elevation	415	ft	126.492	m

Bold values for N and Fines were directly mesured.

Data No.	Depth	Elevation	Measured N Previously corrected for gravel content (*)	Soil Type (USCS)	Flag: "Unsaturated", "Clay", "85% Sat"	Fines Content (%)	Energy Ratio (%)	N_{60}	$(N_1)_{60}$	$(N_1)_{60\text{-}cs}$ for liquefaction triggering	$(N_1)_{60\text{-}cs}$ for residual strength	CRR	CSR	Factor of Safety	Layer Thickness ΔH_i	ΔLDI_i	Vertical Reconsol. Strain, ε_v	Layer Settlement ΔS_i
	ft	ft													ft	ft		ft
1	28.75	386.25	**4**	ML	85% Sat	90	81	5.3	6.2	11.7	11	0.150	0.200	0.75	14.38	5.62	0.034	0.487
2	31.25	383.75	**3**	ML	85% Sat	90	81	4.7	4.2	9.7	9	0.126	0.187	0.68	15.63	7.66	0.038	0.595
3	33.75	381.25	**2**	ML	85% Sat	90	81	3.1	2.7	8.2	8	0.115	0.173	0.66	2.50	1.45	0.042	0.104
4	36.25	378.75	**2**	ML	85% Sat	90	81	3.1	2.6	8.1	8	0.114	0.160	0.71	2.50	1.46	0.042	0.105
5	38.75	376.25	**1**	ML	85% Sat	90	81	1.6	1.2	6.8	6	0.104	0.153	0.68	2.50	1.71	0.046	0.115
6	41.25	373.75	**3**	ML	85% Sat	90	81	4.7	3.7	9.2	9	0.120	0.147	0.82	2.50	1.30	0.039	0.098
7	43.75	371.25	**2**	ML	85% Sat	90	81	3.1	2.4	7.9	7	0.111	0.140	0.79	2.50	1.50	0.043	0.107

Method: Idriss and Boulanger (2008), *Soil Liquefaction during Earthquakes*, EERI MNO-12

Input Parameters:

Title:	Vectren AB Brown	Peak ground acceleration, pga (g):				
Project:	Lower Dam	Earthquake Magnitude (M):	7.1			
Project No.:	60442676	Water Table Depth at the time of drilling	9	ft	2.74	m
		Water Table Depth at the time of earthquake	9	ft	2.74	m
Date:	1/22/2016	Avg Unit Weight above GWT	130	pcf	20.4213703	kN/m^3
Boring No.	B-216	Avg Unit Weight below GWT	130	pcf	20.4213703	kN/m^3
Units	American feet, pounds, pcf	Borehole Diameter	0.583	ft	178	mm
		Correction for Sampler Liner (N/Y)	N	ft		
		Rod stickup above ground at start of drive	5	ft	1.524	m
		Boring Total Depth	60	ft	18.288	m
		Ground Surface Elevation	415	ft	126.492	m

Bold values for N and Fines were directly mesured.

Data No.	Depth	Elevation	Measured N Previously corrected for gravel content (*)	Soil Type (USCS)	Flag: "Unsaturated", "Clay", "85% Sat"	Fines Content (%)	Energy Ratio (%)	N_{60}	$(N_1)_{60}$	$(N_1)_{60\text{-}cs}$ for liquefaction triggering	$(N_1)_{60\text{-}cs}$ for residual strength	CRR	CSR	Factor of Safety	Layer Thickness ΔH_i	ΔLDI_i	Vertical Reconsol. Strain, ε_v	Layer Settlement ΔS_i
	ft	ft													ft	ft		ft
1	23.75	391.25	**11**	ML	85% Sat	90	81	14.5	17.4	22.9	22	0.294	0.200	1.47	11.88	0.13	0.003	0.033
2	26.25	388.75	**6**	ML	85% Sat	90	81	8.8	8.6	14.1	14	0.164	0.190	0.86	13.13	1.51	0.030	0.394
3	28.75	386.25	**2**	ML	85% Sat	90	81	2.9	2.7	8.2	8	0.117	0.180	0.65	2.50	1.44	0.042	0.104
4	31.25	383.75	**3**	ML	85% Sat	90	81	4.7	4.2	9.7	9	0.126	0.170	0.74	2.50	1.23	0.038	0.095
5	33.75	381.25	**3**	ML	85% Sat	90	81	4.7	4.0	9.5	9	0.125	0.160	0.78	2.50	1.25	0.038	0.096
6	36.25	378.75	**4**	ML	85% Sat	90	81	6.2	5.2	10.7	10	0.133	0.156	0.85	2.50	1.09	0.036	0.090
7	38.75	376.25	**5**	ML	85% Sat	90	81	7.8	6.4	11.9	11	0.141	0.152	0.93	2.50	0.21	0.034	0.084
8	41.25	373.75	**4**	ML	85% Sat	90	81	6.2	4.9	10.4	10	0.129	0.148	0.87	2.50	1.13	0.036	0.091
9	43.75	371.25	**6**	ML	85% Sat	90	81	9.3	7.3	12.8	12	0.146	0.144	1.01	2.50	0.08	0.013	0.032
10	46.25	368.75	**5**	ML	85% Sat	90	81	7.8	5.9	11.4	11	0.135	0.140	0.96	2.50	0.13	0.023	0.057

Method: Idriss and Boulanger (2008), *Soil Liquefaction during Earthquakes*, EERI MNO-12

Input Parameters:

Title:	Vectren AB Brown	Peak ground acceleration, pga (g):				
Project:	Lower Dam	Earthquake Magnitude (M):	7.1			
Project No.:	60442676	Water Table Depth at the time of drilling	9	ft	2.74	m
		Water Table Depth at the time of earthquake	9	ft	2.74	m
Date:	1/22/2016	Avg Unit Weight above GWT	130	pcf	20.4213703	kN/m^3
Boring No.	B-217	Avg Unit Weight below GWT	130	pcf	20.4213703	kN/m^3
Units	American feet, pounds, pcf	Borehole Diameter	0.583	ft	178	mm
		Correction for Sampler Liner (N/Y)	N	ft		
		Rod stickup above ground at start of drive	5	ft	1.524	m
		Boring Total Depth	60	ft	18.288	m
		Ground Surface Elevation	415	ft	126.492	m

Bold values for N and Fines were directly mesured.

Data No.	Depth	Elevation	Measured N Previously corrected for gravel content (*)	Soil Type (USCS)	Flag: "Unsaturated", "Clay", "85% Sat"	Fines Content (%)	Energy Ratio (%)	N_{60}	$(N_1)_{60}$	$(N_1)_{60\text{-}cs}$ for liquefaction triggering	$(N_1)_{60\text{-}cs}$ for residual strength	CRR	CSR	Factor of Safety	Layer Thickness ΔH_i	ΔLDI_i	Vertical Reconsol. Strain, ε_v	Layer Settlement ΔS_i
	ft	ft													ft	ft		ft
1	43.75	371.25	**3**	ML	85% Sat	90	81	4.4	4.5	10.0	10	0.132	0.200	0.66	21.88	10.33	0.037	0.816
2	46.25	368.75	**3**	ML	85% Sat	90	81	4.7	3.5	9.0	8	0.118	0.180	0.65	23.13	12.26	0.040	0.919
3	48.75	366.25	**3**	ML	85% Sat	90	81	4.7	3.4	8.9	8	0.116	0.160	0.73	2.50	1.34	0.040	0.100
4	51.25	363.75	**7**	ML	85% Sat	90	81	10.9	7.9	13.5	13	0.149	0.150	0.99	2.50	0.09	0.014	0.035
5	53.75	361.25	**6**	ML	85% Sat	90	81	9.3	6.6	12.1	12	0.138	0.140	0.99	2.50	0.10	0.016	0.040

Method: Idriss and Boulanger (2008), *Soil Liquefaction during Earthquakes*, EERI MNO-12

Input Parameters:

Title:	Vectren AB Brown	Peak ground acceleration, pga (g):				
Project:	Lower Dam	Earthquake Magnitude (M):	7.1			
Project No.:	60442676	Water Table Depth at the time of drilling	9	ft	2.74	m
		Water Table Depth at the time of earthquake	9	ft	2.74	m
Date:	1/22/2016	Avg Unit Weight above GWT	130	pcf	20.4213703	kN/m^3
Boring No.	B-218	Avg Unit Weight below GWT	130	pcf	20.4213703	kN/m^3
Units	American feet, pounds, pcf	Borehole Diameter	0.583	ft	178	mm
		Correction for Sampler Liner (N/Y)	N	ft		
		Rod stickup above ground at start of drive	5	ft	1.524	m
		Boring Total Depth	58.9	ft	17.95272	m
		Ground Surface Elevation	415	ft	126.492	m

Bold values for N and Fines were directly mesured.

Data No.	Depth	Elevation	Measured N Previously corrected for gravel content (*)	Soil Type (USCS)	Flag: "Unsaturated", "Clay", "85% Sat"	Fines Content (%)	Energy Ratio (%)	N_{60}	$(N_1)_{60}$	$(N_1)_{60\text{-}cs}$ for liquefaction triggering	$(N_1)_{60\text{-}cs}$ for residual strength	CRR	CSR	Factor of Safety	Layer Thickness ΔH_i	ΔLDI_i	Vertical Reconsol. Strain, ε_v	Layer Settlement ΔS_i
	ft	ft													ft	ft		ft
1	8.75	406.25	**18**	ML	85% Sat	90	81	21.0	31.7	37.2	37	2.000	0.200	2.00	4.38	0.00	0.000	0.000
2	11.25	403.75	**2**	ML	85% Sat	90	81	2.6	3.5	9.1	9	0.130	0.192	0.68	5.63	2.96	0.040	0.222
3	13.75	401.25	**2**	ML	85% Sat	90	81	2.6	3.3	8.8	8	0.127	0.184	0.69	2.50	1.35	0.040	0.100
4	16.25	398.75	**3**	ML	85% Sat	90	81	4.4	5.2	10.7	10	0.140	0.176	0.80	2.50	1.10	0.036	0.090
5	18.75	396.25	**3**	ML	85% Sat	90	81	4.4	4.9	10.4	10	0.137	0.168	0.81	2.50	1.13	0.036	0.091
6	21.25	393.75	**5**	ML	85% Sat	90	81	7.4	7.7	13.3	13	0.159	0.160	1.00	2.50	0.09	0.014	0.035
7	26.25	388.75	**4**	CL	Clay	90	85	6.2	na	na	na	#N/A	0.157	2.00	3.75	0.00	0.000	0.000
8	31.25	383.75	**8**	CL	Clay	90	85	13.0	na	na	na	#N/A	0.153	2.00	5.00	0.00	0.000	0.000
9	36.25	378.75	**9**	CL	Clay	90	85	14.7	na	na	na	#N/A	0.150	2.00	5.00	0.00	0.000	0.000
10	41.25	373.75	**4**	CL	Clay	90	85	6.5	na	na	na	#N/A	0.147	2.00	5.00	0.00	0.000	0.000
11	48.75	366.25	**4**	ML	85% Sat	90	81	6.2	4.7	10.2	10	0.126	0.143	0.88	6.25	2.90	0.037	0.231
12	51.25	363.75	**0**	ML	85% Sat	90	81	0.0	0.0	5.5	5	0.094	0.140	0.67	5.00	3.98	0.050	0.252

Method: Idriss and Boulanger (2008), *Soil Liquefaction during Earthquakes*, EERI MNO-12

Input Parameters:

Title:	Vectren AB Brown	Peak ground acceleration, pga (g):				
Project:	Lower Dam	Earthquake Magnitude (M):	7.1			
Project No.:	60442676	Water Table Depth at the time of drilling	9	ft	2.74	m
		Water Table Depth at the time of earthquake	9	ft	2.74	m
Date:	1/22/2016	Avg Unit Weight above GWT	130	pcf	20.4213703	kN/m^3
Boring No.	B-219	Avg Unit Weight below GWT	130	pcf	20.4213703	kN/m^3
Units	American feet, pounds, pcf	Borehole Diameter	0.583	ft	178	mm
		Correction for Sampler Liner (N/Y)	N	ft		
		Rod stickup above ground at start of drive	5	ft	1.524	m
		Boring Total Depth	60	ft	18.288	m
		Ground Surface Elevation	415	ft	126.492	m

Bold values for N and Fines were directly mesured.

Data No.	Depth	Elevation	Measured N Previously corrected for gravel content (*)	Soil Type (USCS)	Flag: "Unsaturated", "Clay", "85% Sat"	Fines Content (%)	Energy Ratio (%)	N_{60}	$(N_1)_{60}$	$(N_1)_{60\text{-}cs}$ for liquefaction triggering	$(N_1)_{60\text{-}cs}$ for residual strength	CRR	CSR	Factor of Safety	Layer Thickness ΔH_i	ΔLDI_i	Vertical Reconsol. Strain, ε_v	Layer Settlement ΔS_i
	ft	ft													ft	ft		ft
1	6.25	408.75	**4**	ML	85% Sat	90	81	4.7	7.9	13.4	13	0.175	0.200	0.88	3.13	0.37	0.031	0.097
2	8.75	406.25	**4**	ML	85% Sat	90	81	5.0	7.4	12.9	12	0.167	0.180	0.93	4.38	0.30	0.027	0.118
3	11.25	403.75	**3**	ML	85% Sat	90	81	4.0	5.3	10.8	10	0.144	0.160	0.90	2.50	1.09	0.036	0.089
4	13.75	401.25	**4**	ML	85% Sat	90	81	5.3	6.5	12.0	12	0.153	0.150	1.02	2.50	0.07	0.012	0.031
5	16.25	398.75	**2**	ML	85% Sat	90	81	2.9	3.5	9.0	8	0.127	0.140	0.90	2.50	1.32	0.040	0.099

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Submitted to
Southern Indiana
Gas & Electric Company
(SIGECO)
One Vectren Square
Evansville, IN 47708

Submitted by
AECOM
525 Vine Street, Suite 1800
Cincinnati, Ohio 45202

November 25, 2020

Addendum to the Request for Site-Specific Alternative Deadline to Initiate Closure of CCR Surface Impoundment

Landfill and Sedimentation Pond Supplemental Attachments for the A.B. Brown Generating Station

Appendices

Appendix A Landfill Groundwater Monitoring Program
Appendix B Landfill Annual Groundwater Monitoring and Corrective Action Reports
Appendix C Landfill Stratigraphic Cross Sections
Appendix D Landfill and Sedimentation Pond Geology and Hydrogeology
Appendix E Sedimentation Pond Groundwater Monitoring Program
Appendix F Sedimentation Pond Groundwater Monitoring and Corrective Action Reports
Appendix G Sedimentation Pond Stratigraphic Cross Sections

Appendix A
Landfill Groundwater Monitoring Program

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REPORT ON

GROUNDWATER MONITORING PROGRAM
A.B BROWN GENERATING STATION LANDFILL
WEST FRANKLIN, INDIANA

By Haley & Aldrich, Inc.
Greenville, South Carolina

for Southern Indiana Gas and Electric Company
Evansville, Indiana

File No. 129420-006
October 2017

Haley & Aldrich, Inc.
400 Augusta Street
Suite 130
Greenville, SC 29601
864.214.8750

17 October 2017
File No. 129420-006

SIGECO Corporation
P.O. Box 209
Evansville, Indiana 47702-0209

Attention: Ms. Lisa C. Messinger

Subject: Groundwater Monitoring Program
A.B Brown Station
West Franklin, Indiana

Dear Ms. Messinger:

Haley & Aldrich, Inc. (Haley & Aldrich) is pleased to submit this Groundwater Monitoring Program (GMP) report for the A.B. Brown Generating Station Landfill. This GMP was developed to comply with the United States Environmental Protection Agency (USEPA) Coal Combustion Residual (CCR) Rule dated 17 April 2015 (Rule), and is based on our review of the existing data on hydrogeology and groundwater quality and considering other site conditions at the A.B. Brown Generating Station. This GMP addresses the groundwater monitoring requirements specified in the CCR Rule, which requires monitoring for existing CCR management facilities, or units, and includes specifications for location of the monitoring wells, sampling and chemical analysis procedures, and collection of groundwater quality data for the Appendix III and Appendix IV list of constituents for statistical analysis to determine if the next step of groundwater monitoring (e.g. Assessment Monitoring) is required.

Sincerely yours,
HALEY & ALDRICH, INC.

Mark Miesfeldt
Hydrogeologist

Steven F. Putrich, P.E.
CCR Program Manager

Enclosures

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1. Introduction

Haley & Aldrich, Inc. (Haley & Aldrich) was retained by Southern Indiana Gas and Electric Company (SIGECO) to perform technical services associated with development of a groundwater monitoring program (GMP) that complies with the April 17, 2015 Coal Combustion Residuals (CCR) Rule (Rule) published by the U.S. Environmental Protection Agency (USEPA). Haley & Aldrich has prepared this GMP on behalf of SIGECO for the A.B. Brown Generating Station (Site) located in Posey County near the community of West Franklin. Under the CCR Rule, the first step in groundwater monitoring at existing CCR units is Detection Monitoring, which requires construction of an adequate groundwater monitoring network established in the uppermost aquifer from which a minimum of 8 rounds of representative hydrological and groundwater quality data can be obtained by October 17, 2017. This GMP was prepared in general accordance with the USEPA "Sampling and Analysis Plan Guidance and Template" (USEPA, 2000), to establish a groundwater monitoring program for the Site that complies with the groundwater monitoring requirements of the USEPA CCR Rule for existing CCR units. The groundwater monitoring requirements of the CCR Rule are provided in Appendix A of this document, as outlined in 40 CFR §257.90 through §257.98, including the accompanying list of constituents in Appendices III and IV for the analysis of groundwater.

There are three components that are referenced in the CCR Rule that together describe the groundwater monitoring activities being undertaken. One component is the GMP which provides a summary of relevant background information and Site geology and hydrogeology along with a detailed description of the groundwater monitoring network and sampling program. The second component is the Groundwater Sampling and Analysis Plan (GWSAP) which is based on the CCR Rule specifications in §257.93 and contains the sampling and chemical analysis procedures and processes that will be followed to obtain representative and technically defensible groundwater monitoring results. The third component presents the methods for the statistical analysis of the collected groundwater quality data as required by the Rule to determine whether a Statistically Significance Increase (SSI) of Appendix III constituents in the downgradient wells, compared to upgradient/background well(s), has occurred. The "Statistical Data Analysis Plan (SDAP) – A.B Brown Generating Station" is based on the CCR Rule-specified statistical methods in §257.93 paragraphs f(1) through f(5).

1.1 SITE SETTING

The Site is located in Posey County near the community of West Franklin, Indiana. The location of the Site is shown on Figure 1. The Site is located approximately 0.5 miles north of the Ohio River. The Site varies in elevation with natural ground surface elevations varying from 380 to 520-feet above mean sea level (msl). The higher elevations are generally to the north of the Site with surface topography dominated by a series of ridges separated by ravines. In general, surface topography across the site generally slopes to the west towards the western property boundary then to the south toward the Ohio River. Surface water runoff occurs via sheet flow to low lying areas or ravines which eventually lead to the Ohio River.

1.2 SITE HISTORY

The Site began operations in 1978 with the construction of a 250 MW generating unit. In 1985, an additional generating unit was added. Both units burn southern Indiana coal. SIGECO currently owns

the land and operates the station for supplying electric power to industrial, commercial, and residential customers in its service territory.

In accordance with the CCR Rule, individual monitoring systems have been designed and constructed for the three CCR management units that include: the Ash Pond, the Landfill, and the Sedimentation Pond (CCR management units). The Ash Pond was constructed and commissioned in 1978 by building an earthen dam across an existing valley. The surface area of the Ash Pond is approximately 159 acres. The Landfill is approximately 87-acres. The Sedimentation Pond receives water from the landfill and was constructed in 2015 with a composite liner across the base overlain by a riprap protective layer. A Site Index Map is provided as Figure 2. The groundwater sampling areas and the associated groundwater monitoring well networks are shown in Figure 3. Table 1 presents a summary of well construction information.

1.3 PREVIOUS INVESTIGATIONS

Three significant subsurface geotechnical and/or hydrogeological investigations have been completed at the Site dating back to 1993, after the construction of the generating station and CCR units and continuing through 2015. These studies generated subsurface data characterizing the Site geology and hydrogeology at the Landfill. In addition, to comply with the IDEM Landfill Permit, SIGECO has installed and sampled a network of groundwater monitoring wells in the vicinity of the Landfill. Haley & Aldrich reviewed the field sampling procedures, monitoring results, and well construction details and concluded that a sufficient amount of reliable hydrogeologic data was available to develop the CCR Rule compliant groundwater monitoring program for the Landfill outlined in this document. To design CCR Rule compliant groundwater monitoring programs for the Ash Pond and the Sedimentation Ponds, a hydrogeological characterization was conducted to interpret groundwater flow characteristics surrounding these units.

2. Site Geology and Hydrogeology

The regional geology and hydrogeology is described in the *Surficial Geologic Map of the Evansville Indiana, and Henderson, Kentucky, Area* prepared by the USGS 2009 and in the *May 2017 Groundwater Quality Data and Statistics* prepared by Cardno ATC in May 2017.

2.1 SITE GEOLOGY

The Ohio River valley contains fill and loess (windblown) deposits derived indirectly from continental ice sheets. These were deposited from meltwater heavily loaded with entrained sediments accumulated in the area on the Pennsylvanian age shale, limestone and sandstone bedrock. Westerly winds simultaneously deposited silty sediments. As a result, base levels of the valley floor increased in elevation and created natural levees and outwashes. These natural levees produced slackwater lakes which deposited thick sequences of silt and clay. When the ice sheets retreated, the sediment load in the Ohio River diminished and lowered base levels. Consequently, the river incised the slackwater lake sediments, sculpted lacustrine terraces, and deposited silty and clayey stream alluvium.

Soil borings drilled at the Site indicates that the uppermost geologic unit is comprised of unconsolidated alluvial deposits consisting of primarily silts and clays with discontinuous layers of sand. This unit overlies Pennsylvanian age sandstone which is commonly identified as the Inglefield Sandstone. Underlying the Inglefield Sandstone is low-permeability weathered shale and siltstone. The sandstone and shale unit has been eroded on the north side of the landfill where the underlying limestone unit was encountered.

2.2 SITE HYDROGEOLOGY

Hydrogeologic units are defined based on their ability to transmit groundwater or serve as confining units between zones of groundwater saturation. The uppermost aquifer at the Site occurs within unconsolidated alluvial deposits which consist primarily of silty clay containing discontinuous layers of sand. Beneath upland areas, or ridgelines the uppermost aquifer occurs in weathered sandstone, shale, or siltstone. Recharge to the surficial aquifer occurs through direct surface infiltration.

Piezometric data recorded from the monitoring wells installed on-Site shows that the configuration of the uppermost aquifer is primarily controlled by surface topography with some influence from the underlying weathered bedrock. Groundwater flow across the eastern portion of the Landfill is to the north and northeast. Beneath the western portion of the Landfill groundwater flow shifts to the north and northwest into a trough that flows to the southwest beneath the Sedimentation Ponds (Figure 3). Groundwater flow in the vicinity of the permitted Ash Pond is predominantly to the west with a component of flow to the northwest from the northern portion of the Ash Pond beneath the Landfill. Groundwater elevations vary seasonally but the groundwater flow patterns remain consistent.

Groundwater flow velocity in the uppermost aquifer beneath the CCR units was estimated using site-specific hydraulic conductivity obtained from slug testing and hydraulic gradients, and an assumed effective porosity of 25 percent. Hydraulic conductivity varied from 1E-3 cm/sec in the vicinity of the Landfill to 3E-4 cm/sec in the vicinity of the Sedimentation Ponds and the Ash Pond. The hydraulic gradient beneath and downgradient of the Landfill and the Ash Pond is 0.03 feet/foot and 0.04 feet/foot respectively. The hydraulic gradient lessens beneath and downgradient of the Sedimentation Pond

dropping to 0.004 feet/foot. Using the site-specific hydraulic conductivity and hydraulic gradients, and assuming an effective porosity of 25 percent the groundwater flow velocity in the vicinity of the CCR units is estimated as follows; 120 feet/year at the Landfill, 50 feet/year at the Ash Pond, and approximately 5 feet/year beneath and downgradient of the Sedimentation Pond.

3. Groundwater Monitoring Program

Haley & Aldrich developed the groundwater monitoring program outlined below after reviewing and evaluating the existing hydrogeologic and groundwater quality data provided by SIGECO, as well as the hydrogeological characterization data obtained by Haley & Aldrich, and considering the performance standards provided in the CCR Rule §257.91 (Appendix A). The groundwater monitoring program includes a sufficient number of wells installed at appropriate locations and depths to obtain representative groundwater samples from the uppermost aquifer. Groundwater sampling locations have been established to accurately characterize groundwater quality, not affected by potential releases from the CCR unit(s) as well as the quality of groundwater passing the waste boundary of the CCR units. New monitoring wells were installed at the three CCR units at the Site.

The three CCR facilities subject to the CCR Rule-required groundwater monitoring at the Site are; one Ash Pond, one landfill, and one sedimentation pond as depicted on Figure 2. Details of the groundwater monitoring program for the CCR units at the Site are further described below.

3.1 GROUNDWATER MONITORING NETWORK FOR THE ASH POND

The Ash Pond at the Site is located to the east of the generating station and coal pile area. As shown on Figure 3, groundwater flow in the uppermost aquifer around the Ash Pond flows generally flows to the west and northwest. With a minor component of flow to the east and south. Therefore, to properly monitor the Ash Pond, downgradient wells were installed along the perimeter of the unit. Haley & Aldrich concluded that the seven new downgradient monitoring wells (CCR-AP-1R, CCR-AP-2R, CCR-AP-3R, CCR-AP-4R, CCR-AP-5, CCR-AP-6 and CCR-AP-7R) located at the boundary of the unit, and screened in the uppermost aquifer, will adequately monitor the potential release and migration of ash constituents from the pond, should that occur. In July 2016 (CCR-AP-1R, CCR-AP-2R, CCR-AP-3R, CCR-AP-4R and CCR-AP-7R) were deepened to ensure that a sufficient amount of groundwater was available for sampling. The location of these seven downgradient groundwater monitoring wells is shown on Figure 4. Well placement has been determined based on interpretations of site-specific hydrogeology including groundwater flow directions and rates of groundwater movement. The groundwater monitoring well network for the existing Ash Pond complies with the Rule by monitoring the uppermost aquifer at the CCR management unit. Based on the groundwater flow pattern around the Ash Pond, the upgradient (unaffected by the CCR unit) background monitoring wells are identified as CCR-BK-1R and CCR-BK-2 located north of the generating station property as shown in Figure 4, which is also installed in the uppermost aquifer. The two upgradient wells provide spatial variability in the background groundwater quality and increases the statistical power of the data analysis. Therefore, the complete groundwater network for the CCR Rule for the Ash Pond consists of seven downgradient wells and two upgradient/background wells. A summary of the monitoring network for the Ash Pond along with well construction details is provided in Table 1.

3.2 GROUNDWATER MONITORING NETWORK FOR THE LANDFILL

For the Landfill, six downgradient groundwater monitoring wells (CCR-LF-1, CCR- LF -2, CCR- LF -3, CCR-LF -4, CCR- LF-5 and CCR- LF-6) were installed (see Figure 4). The same two upgradient/background wells identified for the Ash Pond (CCR-BK-1R and CCR-BK-2) will also be used as background wells for the Landfill, as they also fulfill the requirements of background wells for these units. Well placement has been determined based on interpretations of site-specific hydrogeology including groundwater flow

direction and rate of groundwater movement and exceeds the CCR Rule requirement for at least one background monitoring well. Groundwater quality for these upgradient/background wells is not impacted or affected by the CCR management units at the Site. The groundwater monitoring well network for the landfill has been designed to comply with the Rule by monitoring the uppermost aquifer at the CCR unit boundary. A summary of the monitoring network for the Site Landfill along with well construction details is provided in Table 1.

3.3 GROUNDWATER MONITORING NETWORK FOR THE SEDIMENTATION POND

For the Sedimentation Pond three downgradient groundwater monitoring wells (CCR-SP-1, CCR-SP-2 and CCR-SP-3) were installed (see Figure 4). The same two upgradient/background wells identified for the Ash Pond (CCR-BK-1R and CCR-BK-2) will also be used as background wells for the sedimentation ponds, as they also fulfill the requirements of background wells for these units. Well placement has been determined based on interpretations of site-specific hydrogeology including groundwater flow direction and rate of groundwater movement and exceeds the CCR Rule requirement for at least one background monitoring well. Groundwater quality in these upgradient/background wells is not impacted or affected by the CCR management units at the Site. The groundwater monitoring well network for the sedimentation pond has been designed to comply with the Rule by monitoring the uppermost aquifer at the CCR unit boundary. A summary of the monitoring network for the Site sedimentation pond along with well construction details is provided in Table 1.

3.4 MONITORING WELL CONSTRUCTION AND DOCUMENTATION

As described above, the Detection Monitoring program will include seven monitoring wells located around the Ash Pond (CCR-AP-1R, CCR-AP-2R, CCR-AP-3R, CCR-AP-4R, CCR-AP-5, CCR-AP-6 and CCR-AP-7R), six monitoring wells (CCR-LF-1, CCR- LF -2, CCR- LF -3, CCR- LF -4, CCR- LF-5 and CCR- LF-6) located around the Landfill, three monitoring wells (CCR-SP-1, CCR-SP-2 and CCR-SP-3) located around the Sedimentation Pond, along with two upgradient/background wells installed on the north side of the facility (CCR-BK-1R and CCR-BK-2). Boring logs and well construction diagrams for these wells are included in Appendix B.

Groundwater monitoring wells were constructed with 2-inch Inside Diameter (ID) Schedule 40 PVC casing; a 10-foot long, 0.01-inch machine slotted PVC screen; and a locking, steel, 5-foot long protective casing. Where possible, the well screen was placed so that the encountered water table was approximately five feet above the top of the well screen. Groundwater samples were collected from the mid-point of the well screen.

At each monitoring well, the top of the PVC well casing was surveyed by a registered Indiana surveyor to within 0.01 foot, and the ground surface was surveyed to 0.1 foot. The surveyed top of the well casing, identified on each well, is used for measuring and recording water levels. Each sample location was surveyed to North American Datum of 1988 (NAD88). A summary of the survey results for the monitoring wells, with horizontal and vertical coordinates, is provided in Table 1.

All downhole drilling equipment was cleaned prior to use at the next well location. Decontamination fluids was contained and placed into the Ash Pond. Well casing and screens were new and protected by factory packaging. Monitoring wells were installed according to the procedures described below.

Monitoring wells were installed using conventional hollow-stem auger drilling techniques. Soil sampling

was performed while advancing the borehole using standard split-spoon sampling on five-foot centers to provide samples for soil descriptions and to estimate the depth to groundwater. After the borehole was advanced approximately 15 feet below the water table, well casing and screen was placed through the augers to the bottom of the borehole. Filter sand was added by gravity to approximately 2 feet above the top of the well screen as the augers were withdrawn from the borehole. The filter pack was surged as the sand was emplaced to promote proper packing and to minimize the potential for settlement of the filter pack following placement of the bentonite seal. Approximately 2 feet of bentonite pellets was added by gravity above the sand pack to seal the well screen against surface water infiltration. A neat cement grout was emplaced by tremie pipe into the remaining annular space. Risers extend approximately 2 or 3 feet above the ground surface. The depth of the filter sand, bentonite seal, and annular space seal was carefully measured to 0.1 feet prior to the installation of the next layer. A locking steel protective casing was stabilized in place with a 3-foot by 3-foot square concrete pad sloping away from the casing at monitoring wells CCR-AP-1, CCR-AP-2 CCR-AP-4 through CCR-AP-7, and CCR-LF-1 through CCR-LF-6. A weep hole was drilled at the base of the protective casing just above the concrete pad to evacuate rainwater that may have entered the casing. One to three steel bollards were installed around each newly constructed, above grade, well to protect it from being damaged. To protect new wells installed in high traffic areas, the monitoring wells were completed below grade in vaults. These wells include CCR-AP-3 and CCR-SP-1 through CCR-SP-3.

The installed groundwater monitoring wells were developed after construction by surging and purging each well with a pump. The pump was decontaminated by submersing the pump and pumping through a soapy water solution, followed by a distilled water rinse. For wells that could not be purged dry, development was considered complete when a minimum of ten well volumes of groundwater was removed and purge water was free of turbidity. For wells that purge dry, a minimum of four well volumes of groundwater was removed.

4. Groundwater Sampling Program

This section includes an explanation of activities required to comply with the groundwater monitoring requirements outlined in the CCR Rule. Assessment Monitoring will only be implemented if one or more of the constituents listed in Appendix III of the Rule is detected at a SSI over background levels in a downgradient well located at the waste boundary of a CCR unit once the first 8 rounds of data have been collected, as specified in §257.93. Initiation of Corrective Measures in accordance with §257.96 will commence within 90 days of finding that constituents listed in Appendix IV have been detected at statistically significant levels exceeding the groundwater protection standard defined under §257.95(h) during the Assessment Monitoring.

4.1 DETECTION MONITORING

For existing CCR landfills and existing CCR impoundments Detection Monitoring is the first step in carrying out the groundwater monitoring program at a CCR facility, as required by §257.94 in the CCR Rule. An initial Detection Monitoring program is required to collect and analyze a minimum of eight independent samples from background and downgradient wells for the constituents listed in Appendix III and IV. The timeframe for completion of this initial step is no later than October 17, 2017. Procedures for sampling and chemical analysis methods are provided in a separate GWSAP. Similarly, methods for statistical analysis of the groundwater quality data will also be presented in a separate Statistical Data Analysis Plan (SDAP) for the Site. As described above, the Detection Monitoring program will include seven new monitoring wells located around the Ash Pond (CCR-AP-1R, CCR-AP-2R, CCR-AP-3R, CCR-AP-4R, CCR-AP-5, CCR-AP-6 and CCR-AP-7R) six new monitoring wells (CCR-LF-1, CCR- LF -2, CCR-LF -3, CCR- LF -4, CCR- LF-5 and CCR- LF-6) located around the landfill, three new monitoring wells (CCR-SP-1, CCR-SP-2 and CCR-SP-3) located around the sedimentation pond and two upgradient/background well on the north side of the facility (CCR-BK-1R and CCR-BK-2). Groundwater monitoring locations are shown on Figure 4.

4.1.1 Sampling Schedule and Frequency

The CCR Rule requires that a total of eight independent samples from each upgradient/background and downgradient monitoring well for each existing CCR landfill and surface impoundment must be collected no later than October 17, 2017.

The collection of the eight independent samples from each monitoring well has not been established within the Rule. SIGECO collected samples from background and downgradient monitoring wells beginning in June 2016 and approximately every two months thereafter, resulting in eight independent and representative samples being collected by the deadline of 17 October 2017. Groundwater sampling methods are described in the GWSAP.

4.1.2 Chemical Analysis

Groundwater samples collected for chemical analysis will be analyzed for constituents listed in Appendix III and Appendix IV of the Rule. Analytical methods are described in the GWSAP. The Appendix III and Appendix IV constituents consist of the following:

Appendix III Constituents	Appendix IV Constituents	
Boron	Antimony	Lead
Calcium	Arsenic	Lithium
Chloride	Barium	Mercury
Fluoride	Beryllium	Molybdenum
pH	Cadmium	Selenium
Sulfate	Chromium	Thallium
Total Dissolved Solids	Cobalt	Radium 226 and 228 combined
	Fluoride	

4.1.3 Sampling and Analysis Plan

The GWSAP identifies the site-specific activities and methodologies for groundwater sampling for the groundwater monitoring program as defined in §257.93 of the Rule. The GWSAP includes field data collection, sample collection, sample preservation and shipment, interpretation, laboratory analytical methods, and reporting for all groundwater sampling at each CCR unit. The administrative procedures and frequency for collection of groundwater elevation measurement, flow direction, and gradient are provided in the GWSAP.

Laboratory results from the eight initial Detection Monitoring events for each CCR unit will be statistically analyzed for each of the Appendix III constituents by selecting one of the statistical methods specified in paragraphs (f)(1) through (5) of §257.93 of the Rule. The statistical methods used for the evaluation of groundwater monitoring data are described in the SDAP. The SDAP identifies the appropriate statistical analyses to be applied to the groundwater quality data based on the sample population distribution as defined in §257.93 of the Rule, and guidance provided by USEPA in the RCRA Statistical Analysis of Groundwater Monitoring Data Unified Guidance Document (USEPA, 2009).

4.1.4 Trigger for Assessment Monitoring

Assessment Monitoring is triggered for the CCR unit when statistical analysis of the groundwater quality data collected under the Detection Monitoring program for constituents in Appendix III indicates that a SSI over background levels for one or more of the Appendix III constituents has been detected at any downgradient well during Detection Monitoring at the waste boundary.

However, one may demonstrate that a source other than the CCR unit caused the SSI over the background levels for a constituent. In this case a written demonstration report, certified by a qualified professional engineer verifying the accuracy of the information, must be submitted within 90-days of the determination of an SSI. Successful demonstration of the alternative source of impact allows the CCR unit to continue with Detection Monitoring.

4.2 ASSESSMENT MONITORING

Pursuant to 40 CFR § 257.95(a), assessment monitoring is conducted whenever a SSI over background levels has been detected for one or more of the constituents listed in Appendix III of the Rule. Within 90 days of triggering assessment monitoring, and annually thereafter, groundwater samples will be analyzed for the constituents listed in Appendix IV of the Rule. Within 90 days of obtaining the results from the initial assessment monitoring samples, semi-annual sampling will begin for all wells installed

pursuant 40 CFR § 257.91; these samples will be analyzed for constituents listed in Appendices III and IV of the Rule. Field methods and procedures detailed in the GWSAP will be followed for the collection of the assessment monitoring groundwater samples.

If within 90 days of finding that any constituents listed in Appendix IV of the Rule have been detected at a SSL over the Groundwater Protection Standard (GWPS), which is defined as the Maximum Concentration Limit (MCL) or background for those constituents that do not have an MCL, SIGECO must initiate an assessment of corrective measures to prevent further releases and define the nature and extent of the release.

4.3 GROUNDWATER ELEVATION MEASUREMENT

The depth to groundwater must be measured in each well immediately prior to purging, each time groundwater samples are collected. Groundwater measurements from monitoring wells surrounding each CCR unit should be recorded within a period short enough to avoid temporal variations in groundwater conditions. The measured groundwater levels are converted to groundwater elevations for subsequent interpretation of groundwater flow direction and rate.

4.3.1 Procedures for Groundwater Elevation Measurement

The water level in each well will be measured using an electric water level indicator. Water level measurements should be made from a surveyed fixed reference point marked on the well. The fixed reference point will usually be located on the top of the well casing or on the top of the water level access point into the well, depending on the completion of the well at the surface. If a surveyed mark is not present, the reference point is typically established and marked on the north side of the well casing. More details for groundwater measurement procedures are in the GWSAP.

4.3.2 Frequency

The depth to groundwater, in wells which monitor the same CCR unit, must be measured within a period short enough to avoid temporal variations in groundwater conditions which could preclude accurate determination of groundwater flow rate and direction.

4.4 GROUNDWATER FLOW DIRECTION AND GRADIENT

The groundwater elevations will be used to construct a water table configuration map to interpret direction of groundwater flow and calculate the hydraulic gradient each time groundwater is sampled.

4.4.1 Procedures for Calculation

Groundwater flow direction and gradient will be calculated using one of several computer programs such as Surfer, AutoCAD, or equivalent. Groundwater flow direction and gradient can also be calculated without the use of a computer program by the following steps:

- Determine the groundwater surface elevation by subtracting the water level measurement (depth to water) from the surveyed measuring point elevation at each well.

- Determine the difference in groundwater surface elevation between each of the wells by subtracting the groundwater elevation of a well with a higher elevation from the groundwater elevation of a well with a lower elevation. The elevation differences are divided up into equal increments. Repeat this step between multiple wells. Groundwater elevation contours can be drawn at corresponding elevation increments between wells.

- Determine groundwater flow direction by drawing a line perpendicular to the groundwater contour lines from higher elevations to lower elevations.

- Determine the hydraulic gradient by dividing the groundwater elevation change in the direction of flow by the horizontal difference between measurement points.

4.4.2 Frequency

The gradient and direction of groundwater flow within each CCR unit must be calculated upon completion of each groundwater sampling event.

5. Reporting

5.1 DATA MANAGEMENT

A project database that incorporates hydrogeologic and groundwater quality data has been established to allow efficient management of chemical and physical data collected in the field and received from the laboratories. Laboratories conducting groundwater analyses for this program have been supplied with specific formats for electronic data deliverables to ensure compatibility with the project database requirements. Qualified personnel will be assigned to conduct quality assurance/quality control (QA/QC) reviews for each dataset generated. The database will be integrated with a geographical information system to allow for presentation of spatial information and data, such as site features, ownership boundaries, and sample locations. Each sample location was surveyed to North American Datum of 1988 (NAD88).

5.2 ANNUAL REPORTING

Per the CCR Rule, SIGECO, or a designated representative, must prepare an annual groundwater monitoring report for each CCR unit. The first annual report must be completed by 31 January 2018 and annually thereafter for existing CCR units. The annual groundwater monitoring report summarizes key actions completed, for the previous year; describes any problems that may have encountered, and the corresponding actions to resolve the problems. At a minimum, the annual groundwater monitoring report should include the following:

- A detailed site map showing the CCR units, including all background and downgradient monitoring wells;
- Identification of any monitoring wells installed or decommissioned during the preceding year;
- A summary of all groundwater monitoring activities, including number of samples collected, specific analysis for each groundwater sample, field procedures followed during sample collection activities, and dates of sampling events;
- Discussion of any transition between monitoring programs, including dates of transition, cause for transition, identification of constituents detected at a SSI over background levels; and
- Any other pertinent information regarding the groundwater monitoring system or groundwater monitoring program.

The annual groundwater monitoring report must comply with recordkeeping requirements specified in §257.105 and Section 6 of this Work Plan.

6. Documentation

6.1 RECORDKEEPING

Per the CCR Rule, SIGECO, or a designated representative, must maintain adequate information in a written operating record at the subject facility, as described in §257.105. The operating record must be retained for at least five years following the date of each occurrence, measurement, sampling event, maintenance activity, corrective action, or report for each CCR unit. One operating record may be kept for multi-unit facilities, provided that each CCR unit is clearly identified. The operating record may be maintained in a variety of methods, such as saved on a computer, computer storage devices, or equivalent system that ensure that adequate information is kept for the required timeframe. Documentation must be submitted to the state director or tribal authority upon request when such documentation is not available on SIGECO's maintained website, as described in Section 6.3, below. The following information pertinent to the groundwater monitoring network and the groundwater monitoring program must be placed in the operating record:

- The annual groundwater monitoring report, as required by §257.90(e);
- Documentation of the design, installation, development, and decommissioning of any monitoring well, piezometer, and other measurement or sampling device as required under §257.91(e)(1);
- The groundwater monitoring system certification, as required under §257.91(f);
- Selection of the statistical method certification (SDAP), as required under §257.93(f)(6);
- Notification of establishing an Assessment Monitoring program (within 30 days of triggering), as required under §257.94(e)(3);
- Results of Appendix III and IV constituent concentrations, as required under §257.95(d)(1);
- Notification of returning to Detection Monitoring (within 30 days), as required under §257.95(e);
- Notification of detection of one or more Appendix IV constituents at statistically significant levels above the groundwater protection standard (within 30 days), as required by §257.95(g). Note - Appendix III constituents are not assessed above the groundwater protection standards but are assessed against the upgradient/background concentrations;
- Notification of initiating the assessment of Corrective Measures (within 30 days), as required under §257.95(g)(5);
- Completed assessment of Corrective Measures, as required under §257.96(d);
- Documents prepared by owner/operator recording the public meeting for Corrective Measures assessment, as required under §257.96(e);
- The semi-annual report documenting the progress in selecting and designing the remedy and the selection of remedy report, as required under §257.97(a); and
- Notification of completing the remedy (within 30 days), as required under §257.98(e).

6.2 NOTIFICATION

Notifications must be provided to the relevant State Director before the close of business on the day the notification is required to be completed, as specified under §257.106. The State must be notified when information is added or placed in the operating recorded and on SIGECO's publicly accessible internet site. Notification must be made to the relevant authority of any design or operating criteria

modifications or actions specified under §257.106(f) and §257.106(g) of the Rule. Notification of the availability of the annual groundwater monitoring report is specified under §257.105(h)(1).

6.3 POSTING INFORMATION TO THE INTERNET

A publicly accessible Internet website (CCR website) must be maintained, titled "CCR Rule Compliance Data and Information," and must contain the information specified under §257.107 of the Rule. One CCR website may be kept for multi-unit facilities provided the name or identification number of each unit is clearly specified. All information must be made available to the public within 30 days of placing the information in the operating record and for at least five years following the date on which the information was first posted to the CCR website. Notification information provided to the relevant State Director must be posted on the CCR website as specified under §257.106.

7. Certification

Pursuant to CFR Title 40 Chapter I Subchapter I Part 257 Subpart D §257.91(f), the owner or operator must obtain a certification from a qualified engineer stating that the groundwater monitoring system has been designed and constructed to meet the requirements of §257.91. The certification for the Landfill is provided on the following page.

HALEY & ALDRICH, INC.
400 Augusta Street
Suite 130
Greenville, SC 29601
864-214-8750

17 October 2017
File No. 129420-006

SUBJECT: A.B. Brown Generating Station Groundwater Monitoring System Certification for the Landfill, Southern Indiana Gas and Electric Company (SIGECO)

SIGECO operates the existing coal combustion residuals (CCR) management unit referred to as the Landfill at A.B. Brown Generating Station located in Evansville, Indiana. This CCR unit is considered subject to the CCR Rule since it was active as of the effective date of the CCR Rule. This document addresses the requirements of §257.91 *Groundwater Monitoring Systems*, specifically section §257.91(f), of the US Environmental Protection Agency's (EPA's) Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, 40 CFR Part 257 (CCR Rule) effective 19 October 2015. This document serves as certification that the Landfill complies with the requirements defined in the CCR Rule and cited below. This certification has been prepared based upon information made accessible by SIGECO pursuant to §257.91(e)(1).

The groundwater monitoring system at the Landfill has been designed to include as a minimum one upgradient and three downgradient monitoring wells pursuant to §257.91(c). The actual number of wells used in the groundwater monitoring system is sufficient and appropriate to characterize the quality of groundwater flowing beneath the Landfill based on site-specific conditions.

Pursuant to CFR Title 40 Chapter I Subchapter I Part 257 Subpart D §257.91(f), I certify that the groundwater monitoring system for the Landfill has been designed and constructed to meet the requirements of §257.91. The certification submitted is, to the best of my knowledge accurate and complete.

STEVEN F. PUTRICH
REGISTERED
No. PE11200566
STATE OF
INDIANA
PROFESSIONAL ENGINEER

Signed: _____
Certified Engineer

Print Name: Steven F. Putrich, P.E.
Indiana License No.: PE11200566
Title: CCR Program Manager
Company: Haley & Aldrich, Inc.

References

1. Cardno ATC, 2017, May 2017 Groundwater Quality Data Statistics, May 2017.

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3. United States Environmental Protection Agency (USEPA), 2000. Sampling and Analysis Plan Guidance and Template, R9QA/002.1. April 2000.

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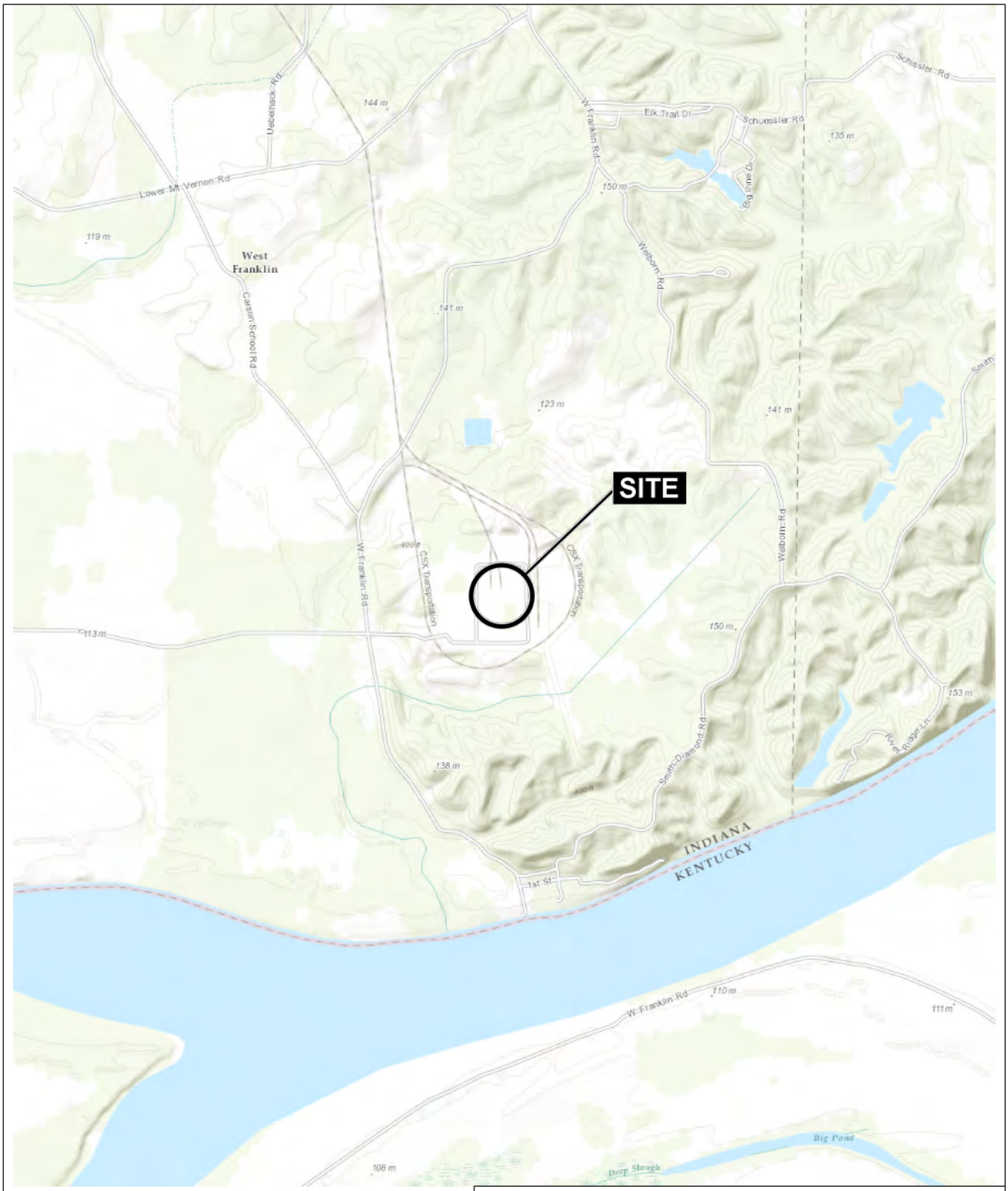
Tables

TABLE 1
GROUNDWATER MONITORING WELL LOCATION AND CONSTRUCTION DETAILS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Well	CCR Unit	Date Installed	Easting	Northing	Top of Pad Elevation (ft msl)	Top of Riser Elevation (ft msl)	Surface Grout (ft bgs)	Bentonite (ft bgs)	Sand Pack (ft bgs)	Screen Zone (ft bgs)	Screen Length (ft)	Well Radius (in)
CCR-AP-1R	Ash Pond	July 2016	2773560.71	968260.82	464.70	467.57	0.0 - 23.0	23.0 - 25.0	25.0 - 37.0	27.0 - 37.0	10	2.00
CCR-AP-2R	Ash Pond	July 2016	2771922.52	969079.16	465.40	468.13	0.0 - 39.0	39.0 - 41.0	41.0 - 53.3	43.3 - 53.3	10	2.00
CCR-AP-3R	Ash Pond	July 2016	2771404.27	966865.12	450.10	449.13	0.0 - 33.0	33.0 - 35.0	35.0 - 47.0	37.0 - 47.0	10	2.00
CCR-AP-4R	Ash Pond	July 2016	2772827.01	966741.47	472.80	475.38	0.0 - 34.0	34.0 - 36.0	36.0 - 48.0	38.0 - 48.0	10	2.00
CCR-AP-5	Ash Pond	March 2016	2771019.70	968166.03	451.00	453.77	0.0 - 31.0	31.0 - 33.0	33.0 - 45.0	35.0 - 45.0	10	2.00
CCR-AP-6	Ash Pond	March 2016	2771626.75	969932.76	458.90	461.57	0.0 - 25.0	25.0 - 27.0	27.0 - 39.0	29.0 - 39.0	10	2.00
CCR-AP-7R	Ash Pond	July 2016	2773501.63	970758.70	486.00	488.57	0.0 - 39.5	39.5 - 41.5	41.5 - 53.5	43.5 - 53.5	10	2.00
CCR-LF-1	Landfill	March 2016	2771247.76	970812.18	432.80	435.63	0.0 - 3.0	3.0 - 7.0	7.0 - 19.0	9.0 - 19.0	10	2.00
CCR-LF-2	Landfill	March 2016	2772205.05	970681.32	470.10	473.00	0.0 - 30.0	30.0 - 32.0	32.0 - 45.0	35.0 - 45.0	10	2.00
CCR-LF-3	Landfill	March 2016	2773138.97	970949.70	482.00	484.75	0.0 - 21.0	21.0 - 23.0	23.0 - 35.0	25.0 - 35.0	10	2.00
CCR-LF-4	Landfill	March 2016	2772876.83	972312.24	476.60	478.85	0.0 - 40.8	40.8 - 43.0	43.0 - 55.0	45.0 - 55.0	10	2.00
CCR-LF-5	Landfill	March 2016	2772003.91	972228.16	427.50	430.41	0.0 - 16.0	16.0 - 18.0	18.0 - 30.0	20.0 - 30.0	10	2.00
CCR-LF-6	Landfill	March 2016	2771046.15	972269.53	409.20	412.05	0.0 - 0.0	0.0 - 2.66	2.66 - 9.66	4.66 - 9.66	10	2.00
CCR-SP-1	Sediment Pond	March 2016	2770030.26	970981.89	403.90	403.51	0.0 - 6.0	6.0 - 8.0	8.0 - 20.0	10.0 - 20.0	10	2.00
CCR-SP-2	Sediment Pond	March 2016	2769939.51	970887.25	403.60	403.23	0.0 - 6.0	6.0 - 8.0	8.0 - 20.0	10.0 - 20.0	10	2.00
CCR-SP-3	Sediment Pond	March 2016	2770027.64	970735.02	403.90	403.57	0.0 - 6.0	6.0 - 8.0	8.0 - 20.0	10.0 - 20.0	10	2.00
CCR-BK-1R	Background	March 2016	2770919.08	974083.40	480.10	483.39	0.0 - 50.0	50.0 - 52.0	52.0 - 64.0	54.0 - 64.0	10	2.00
CCR-BK-2	Background	March 2016	2769728.14	972854.33	427.50	430.60	0.0 - 11.5	11.5 - 13.5	13.5 - 25.5	15.5 - 25.5	10	2.00
SG-2	--	December 2016	2769926.52	967306.25	*378.50	--	--	--	--	--	--	--
SG-3	--	December 2016	2769283.63	971032.24	*386.03	--	--	--	--	--	--	--
SG-4	--	December 2016	2769953.05	965243.95	+369.99	--	--	--	--	--	--	--
PZ-1	--	December 2016	2772095.52	972970.06	415.90	417.37	--	--	--	4.0 - 5.0	1	1
PZ-5	--	December 2016	2772500.01	965928.39	484.10	486.47	4.0-31.5	31.5-35.0	35.0-47.0	37.0-47.0	10	2

Notes:
+ Elevation of Staff Guage is base at top of guardrail over flowline of creek.
*Elevation of Staff Guage is based on the 3.0' mark of the vertical staff guage. Piezometers/staff guages for water level only.
bgs = below ground surface
ft = feet
in = inches
msl = mean sea level
Datum of Elevations in NAVD 88

Figures



MAP SOURCE: ESRI

SITE COORDINATES: 37°54'25"N, 87°42'55"W

HALEY ALDRICH

VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MT. VERNON, INDIANA 47620

SITE LOCATION MAP

APPROXIMATE SCALE: 1 IN = 2000 FT
MAY 2016

FIGURE 1

42796-000_1_LOCUS.PDF

NOTES

1. AERIAL IMAGERY SOURCE: ESRI
2. LOCATIONS DERIVED FROM THREE I DESIGN DATA.

0 500 1,000 1,500 2,000
SCALE IN FEET

HALEY ALDRICH

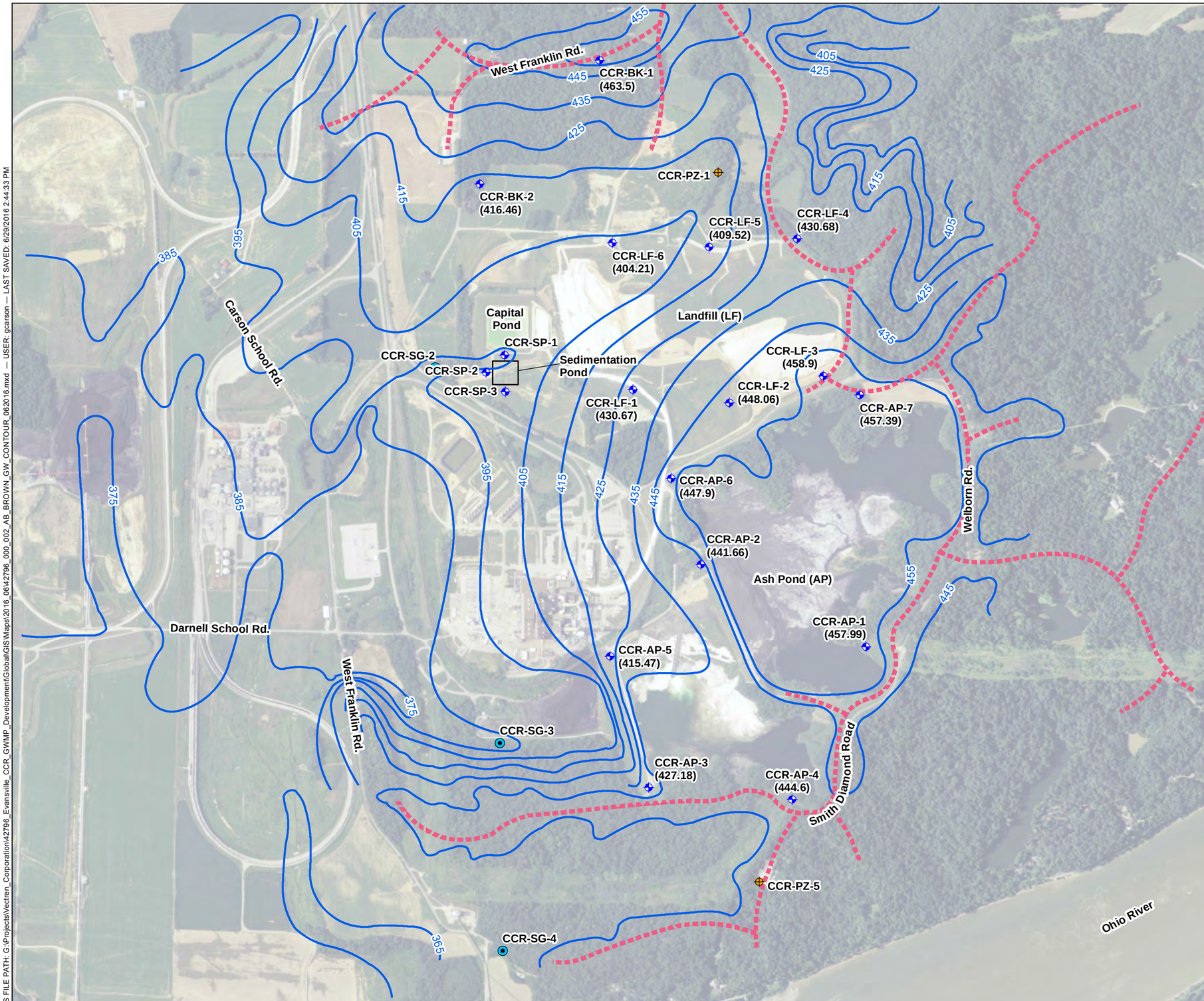
VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620

SITE INDEX MAP

OCTOBER 2016

FIGURE 2

GIS FILE PATH: G:\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2016_10\42796_000_002_AB_BROWN_GW_MONITORING_LOCS_SURV.mxd — USER: gcarson — LAST SAVED: 10/25/2016 2:57:13 PM



LEGEND

CCR-AP-1 MONITORING WELL

CCR-PZ-1 PIEZOMETER

CCR-SG-1 STAFF GAUGE

GROUNDWATER ELEVATION CONTOURS (10 FT. INTERVALS)

(430.86) GROUNDWATER ELEVATION (6/6/2016)

TOPOGRAPHIC DIVIDE

NOTES

1. AERIAL IMAGERY SOURCE: ESRI
2. LOCATIONS DERIVED FROM THREE I DESIGN DATA.
3. ELEVATIONS ARE FEET ABOVE MEAN SEA LEVEL.

N

0 500 1,000 1,500 2,000

SCALE IN FEET

HALEY ALDRICH

VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620

GROUNDWATER ELEVATION CONTOURS - JUNE 2016

JUNE 2016

FIGURE 3

GIS FILE PATH: G:\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2016_06\42796_000_002_AB_BROWN_GW_CONTOUR_062016.mxd — USER: gcarson — LAST SAVED: 6/29/2016 2:44:33 PM

LEGEND

CCR-AP-1
MONITORING WELL

CCR-PZ-1
PIEZOMETER

CCR-SG-1
STAFF GAUGE

NOTES

1. AERIAL IMAGERY SOURCE: ESRI
2. LOCATIONS DERIVED FROM THREE I DESIGN DATA.

N

0 500 1,000 1,500 2,000
SCALE IN FEET

HALEY ALDRICH

VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620

MONITORING WELL LOCATIONS FOR COMPLIANCE WITH FEDERAL CCR RULE

OCTOBER 2016

FIGURE 4

GIS FILE PATH: G:\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2016_10\42796_000_002_AB_BROWN_GW_MONITORING_LOCS_SURV.mxd — USER: gcarson — LAST SAVED: 10/25/2016 2:57:13 PM

APPENDIX A

40 CFR §257.90 through §257.98 and Appendices III and IV

following the date of initial receipt of CCR in the CCR unit.

(4) *Frequency of inspections.* (i) Except as provided for in paragraph (b)(4)(ii) of this section, the owner or operator of the CCR unit must conduct the inspection required by paragraphs (b)(1) and (2) of this section on an annual basis. The date of completing the initial inspection report is the basis for establishing the deadline to complete the first subsequent inspection. Any required inspection may be conducted prior to the required deadline provided the owner or operator places the completed inspection report into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing subsequent inspection reports is based on the date of completing the previous inspection report. For purposes of this section, the owner or operator has completed an inspection when the inspection report has been placed in the facility's operating record as required by § 257.105(g)(6).

(ii) In any calendar year in which both the periodic inspection by a qualified professional engineer and the quinquennial (occurring every five years) structural stability assessment by a qualified professional engineer required by §§ 257.73(d) and 257.74(d) are required to be completed, the annual inspection is not required, provided the structural stability assessment is completed during the calendar year. If the annual inspection is not conducted in a year as provided by this paragraph (b)(4)(ii), the deadline for completing the next annual inspection is one year from the date of completing the quinquennial structural stability assessment.

(5) If a deficiency or release is identified during an inspection, the owner or operator must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.

(c) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

§ 257.84 Inspection requirements for CCR landfills.

(a) *Inspections by a qualified person.* (1) All CCR landfills and any lateral expansion of a CCR landfill must be examined by a qualified person as follows:

(i) At intervals not exceeding seven days, inspect for any appearances of actual or potential structural weakness and other conditions which are disrupting or have the potential to disrupt the operation or safety of the CCR unit; and

(ii) The results of the inspection by a qualified person must be recorded in the facility's operating record as required by § 257.105(g)(8).

(2) *Timeframes for inspections by a qualified person*—(i) *Existing CCR landfills.* The owner or operator of the CCR unit must initiate the inspections required under paragraph (a) of this section no later than October 19, 2015.

(ii) *New CCR landfills and any lateral expansion of a CCR landfill.* The owner or operator of the CCR unit must initiate the inspections required under paragraph (a) of this section upon initial receipt of CCR by the CCR unit.

(b) *Annual inspections by a qualified professional engineer.* (1) Existing and new CCR landfills and any lateral expansion of a CCR landfill must be inspected on a periodic basis by a qualified professional engineer to ensure that the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering standards. The inspection must, at a minimum, include:

(i) A review of available information regarding the status and condition of the CCR unit, including, but not limited to, files available in the operating record (*e.g.*, the results of inspections by a qualified person, and results of previous annual inspections); and

(ii) A visual inspection of the CCR unit to identify signs of distress or malfunction of the CCR unit.

(2) *Inspection report.* The qualified professional engineer must prepare a report following each inspection that addresses the following:

(i) Any changes in geometry of the structure since the previous annual inspection;

(ii) The approximate volume of CCR contained in the unit at the time of the inspection;

(iii) Any appearances of an actual or potential structural weakness of the CCR unit, in addition to any existing conditions that are disrupting or have the potential to disrupt the operation and safety of the CCR unit; and

(iv) Any other change(s) which may have affected the stability or operation of the CCR unit since the previous annual inspection.

(3) *Timeframes for conducting the initial inspection*—(i) *Existing CCR landfills.* The owner or operator of the CCR unit must complete the initial inspection required by paragraphs (b)(1) and (2) of this section no later than January 18, 2016.

(ii) *New CCR landfills and any lateral expansion of a CCR landfill.* The owner or operator of the CCR unit must complete the initial annual inspection required by paragraphs (b)(1) and (2) of this section no later than 14 months following the date of initial receipt of CCR in the CCR unit.

(4) *Frequency of inspections.* The owner or operator of the CCR unit must conduct the inspection required by paragraphs (b)(1) and (2) of this section on an annual basis. The date of completing the initial inspection report is the basis for establishing the deadline to complete the first subsequent inspection. Any required inspection may be conducted prior to the required deadline provided the owner or operator places the completed inspection report into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing subsequent inspection reports is based on the date of completing the previous inspection report. For purposes of this section, the owner or operator has completed an inspection when the inspection report has been placed in the facility's operating record as required by § 257.105(g)(9).

(5) If a deficiency or release is identified during an inspection, the owner or operator must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.

(c) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

Groundwater Monitoring and Corrective Action

§ 257.90 Applicability.

(a) Except as provided for in § 257.100 for inactive CCR surface impoundments, all CCR landfills, CCR surface impoundments, and lateral expansions of CCR units are subject to the groundwater monitoring and corrective action requirements under §§ 257.90 through 257.98.

(b) *Initial timeframes*—(1) *Existing CCR landfills and existing CCR surface impoundments.* No later than October 17, 2017, the owner or operator of the CCR unit must be in compliance with the following groundwater monitoring requirements:

(i) Install the groundwater monitoring system as required by § 257.91;

(ii) Develop the groundwater sampling and analysis program to include selection of the statistical

procedures to be used for evaluating groundwater monitoring data as required by § 257.93;

(iii) Initiate the detection monitoring program to include obtaining a minimum of eight independent samples for each background and downgradient well as required by § 257.94(b); and

(iv) Begin evaluating the groundwater monitoring data for statistically significant increases over background levels for the constituents listed in appendix III of this part as required by § 257.94.

(2) *New CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units.* Prior to initial receipt of CCR by the CCR unit, the owner or operator must be in compliance with the groundwater monitoring requirements specified in paragraph (b)(1)(i) and (ii) of this section. In addition, the owner or operator of the CCR unit must initiate the detection monitoring program to include obtaining a minimum of eight independent samples for each background well as required by § 257.94(b).

(c) Once a groundwater monitoring system and groundwater monitoring program has been established at the CCR unit as required by this subpart, the owner or operator must conduct groundwater monitoring and, if necessary, corrective action throughout the active life and post-closure care period of the CCR unit.

(d) In the event of a release from a CCR unit, the owner or operator must immediately take all necessary measures to control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of contaminants into the environment. The owner or operator of the CCR unit must comply with all applicable requirements in §§ 257.96, 257.97, and 257.98.

(e) *Annual groundwater monitoring and corrective action report.* For existing CCR landfills and existing CCR surface impoundments, no later than January 31, 2018, and annually thereafter, the owner or operator must prepare an annual groundwater monitoring and corrective action report. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, the owner or operator must prepare the initial annual groundwater monitoring and corrective action report no later than January 31 of the year following the calendar year a groundwater monitoring system has been established for such CCR unit as required by this subpart, and annually thereafter. For the preceding calendar year, the annual report must document the status of the groundwater monitoring and corrective action program for the CCR unit, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year. For purposes of this section, the owner or operator has prepared the annual report when the report is placed in the facility's operating record as required by § 257.105(h)(1). At a minimum, the annual groundwater monitoring and corrective action report must contain the following information, to the extent available:

(1) A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;

(2) Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;

(3) In addition to all the monitoring data obtained under §§ 257.90 through 257.98, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;

(4) A narrative discussion of any transition between monitoring programs (*e.g.*, the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels); and

(5) Other information required to be included in the annual report as specified in §§ 257.90 through 257.98.

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the internet requirements specified in § 257.107(h).

§ 257.91 Groundwater monitoring systems.

(a) *Performance standard.* The owner or operator of a CCR unit must install a groundwater monitoring system that consists of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that:

(1) Accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit. A determination of background quality may include sampling of wells that are not hydraulically upgradient of the CCR management area where:

(i) Hydrogeologic conditions do not allow the owner or operator of the CCR unit to determine what wells are hydraulically upgradient; or

(ii) Sampling at other wells will provide an indication of background groundwater quality that is as representative or more representative than that provided by the upgradient wells; and

(2) Accurately represent the quality of groundwater passing the waste boundary of the CCR unit. The downgradient monitoring system must be installed at the waste boundary that ensures detection of groundwater contamination in the uppermost aquifer. All potential contaminant pathways must be monitored.

(b) The number, spacing, and depths of monitoring systems shall be determined based upon site-specific technical information that must include thorough characterization of:

(1) Aquifer thickness, groundwater flow rate, groundwater flow direction including seasonal and temporal fluctuations in groundwater flow; and

(2) Saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer, and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including, but not limited to, thicknesses, stratigraphy, lithology, hydraulic conductivities, porosities and effective porosities.

(c) The groundwater monitoring system must include the minimum number of monitoring wells necessary to meet the performance standards specified in paragraph (a) of this section, based on the site-specific information specified in paragraph (b) of this section. The groundwater monitoring system must contain:

(1) A minimum of one upgradient and three downgradient monitoring wells; and

(2) Additional monitoring wells as necessary to accurately represent the quality of background groundwater that has not been affected by leakage from the CCR unit and the quality of groundwater passing the waste boundary of the CCR unit.

(d) The owner or operator of multiple CCR units may install a multiunit groundwater monitoring system instead of separate groundwater monitoring systems for each CCR unit.

(1) The multiunit groundwater monitoring system must be equally as capable of detecting monitored constituents at the waste boundary of

the CCR unit as the individual groundwater monitoring system specified in paragraphs (a) through (c) of this section for each CCR unit based on the following factors:

(i) Number, spacing, and orientation of each CCR unit;

(ii) Hydrogeologic setting;

(iii) Site history; and

(iv) Engineering design of the CCR unit.

(2) If the owner or operator elects to install a multiunit groundwater monitoring system, and if the multiunit system includes at least one existing unlined CCR surface impoundment as determined by § 257.71(a), and if at any time after October 19, 2015 the owner or operator determines in any sampling event that the concentrations of one or more constituents listed in appendix IV to this part are detected at statistically significant levels above the groundwater protection standard established under § 257.95(h) for the multiunit system, then all unlined CCR surface impoundments comprising the multiunit groundwater monitoring system are subject to the closure requirements under § 257.101(a) to retrofit or close.

(e) Monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole. This casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of groundwater samples. The annular space (*i.e.*, the space between the borehole and well casing) above the sampling depth must be sealed to prevent contamination of samples and the groundwater.

(1) The owner or operator of the CCR unit must document and include in the operating record the design, installation, development, and decommissioning of any monitoring wells, piezometers and other measurement, sampling, and analytical devices. The qualified professional engineer must be given access to this documentation when completing the groundwater monitoring system certification required under paragraph (f) of this section.

(2) The monitoring wells, piezometers, and other measurement, sampling, and analytical devices must be operated and maintained so that they perform to the design specifications throughout the life of the monitoring program.

(f) The owner or operator must obtain a certification from a qualified professional engineer stating that the groundwater monitoring system has been designed and constructed to meet the requirements of this section. If the groundwater monitoring system includes the minimum number of monitoring wells specified in paragraph (c)(1) of this section, the certification must document the basis supporting this determination.

(g) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the internet requirements specified in § 257.107(h).

§ 257.92 [Reserved]

§ 257.93 Groundwater sampling and analysis requirements.

(a) The groundwater monitoring program must include consistent sampling and analysis procedures that are designed to ensure monitoring results that provide an accurate representation of groundwater quality at the background and downgradient wells required by § 257.91. The owner or operator of the CCR unit must develop a sampling and analysis program that includes procedures and techniques for:

(1) Sample collection;

(2) Sample preservation and shipment;

(3) Analytical procedures;

(4) Chain of custody control; and

(5) Quality assurance and quality control.

(b) The groundwater monitoring program must include sampling and analytical methods that are appropriate for groundwater sampling and that accurately measure hazardous constituents and other monitoring parameters in groundwater samples. For purposes of §§ 257.90 through 257.98, the term *constituent* refers to both hazardous constituents and other monitoring parameters listed in either appendix III or IV of this part.

(c) Groundwater elevations must be measured in each well immediately prior to purging, each time groundwater is sampled. The owner or operator of the CCR unit must determine the rate and direction of groundwater flow each time groundwater is sampled. Groundwater elevations in wells which monitor the same CCR management area must be measured within a period of time short enough to avoid temporal variations in groundwater flow which could preclude accurate determination of groundwater flow rate and direction.

(d) The owner or operator of the CCR unit must establish background groundwater quality in a hydraulically upgradient or background well(s) for each of the constituents required in the particular groundwater monitoring program that applies to the CCR unit as determined under § 257.94(a) or § 257.95(a). Background groundwater quality may be established at wells that are not located hydraulically upgradient from the CCR unit if it meets the requirements of § 257.91(a)(1).

(e) The number of samples collected when conducting detection monitoring and assessment monitoring (for both downgradient and background wells) must be consistent with the statistical procedures chosen under paragraph (f) of this section and the performance standards under paragraph (g) of this section. The sampling procedures shall be those specified under § 257.94(b) through (d) for detection monitoring, § 257.95(b) through (d) for assessment monitoring, and § 257.96(b) for corrective action.

(f) The owner or operator of the CCR unit must select one of the statistical methods specified in paragraphs (f)(1) through (5) of this section to be used in evaluating groundwater monitoring data for each specified constituent. The statistical test chosen shall be conducted separately for each constituent in each monitoring well.

(1) A parametric analysis of variance followed by multiple comparison procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's mean and the background mean levels for each constituent.

(2) An analysis of variance based on ranks followed by multiple comparison procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's median and the background median levels for each constituent.

(3) A tolerance or prediction interval procedure, in which an interval for each constituent is established from the distribution of the background data and the level of each constituent in each compliance well is compared to the upper tolerance or prediction limit.

(4) A control chart approach that gives control limits for each constituent.

(5) Another statistical test method that meets the performance standards of paragraph (g) of this section.

(6) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the selected statistical method is appropriate for evaluating the groundwater monitoring data for the CCR management area. The certification must include a narrative description of the statistical method selected to evaluate the groundwater monitoring data.

(g) Any statistical method chosen under paragraph (f) of this section shall comply with the following performance standards, as appropriate, based on the statistical test method used:

(1) The statistical method used to evaluate groundwater monitoring data shall be appropriate for the distribution of constituents. Normal distributions of data values shall use parametric methods. Non-normal distributions shall use non-parametric methods. If the distribution of the constituents is shown by the owner or operator of the CCR unit to be inappropriate for a normal theory test, then the data must be transformed or a distribution-free (non-parametric) theory test must be used. If the distributions for the constituents differ, more than one statistical method may be needed.

(2) If an individual well comparison procedure is used to compare an individual compliance well constituent concentration with background constituent concentrations or a groundwater protection standard, the test shall be done at a Type I error level no less than 0.01 for each testing period. If a multiple comparison procedure is used, the Type I experiment wise error rate for each testing period shall be no less than 0.05; however, the Type I error of no less than 0.01 for individual well comparisons must be maintained. This performance standard does not apply to tolerance intervals, prediction intervals, or control charts.

(3) If a control chart approach is used to evaluate groundwater monitoring data, the specific type of control chart and its associated parameter values shall be such that this approach is at least as effective as any other approach in this section for evaluating groundwater data. The parameter values shall be determined after considering the number of samples in the background data base, the data distribution, and the range of the concentration values for each constituent of concern.

(4) If a tolerance interval or a predictional interval is used to evaluate groundwater monitoring data, the levels of confidence and, for tolerance intervals, the percentage of the population that the interval must contain, shall be such that this approach is at least as effective as any other approach in this section for evaluating groundwater data. These parameters shall be determined after considering the number of samples in the background data base, the data distribution, and the range of the concentration values for each constituent of concern.

(5) The statistical method must account for data below the limit of detection with one or more statistical procedures that shall at least as effective as any other approach in this section for evaluating groundwater data. Any practical quantitation limit that is used in the statistical method shall be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility.

(6) If necessary, the statistical method must include procedures to control or correct for seasonal and spatial variability as well as temporal correlation in the data.

(h) The owner or operator of the CCR unit must determine whether or not there is a statistically significant increase over background values for each constituent required in the particular groundwater monitoring program that applies to the CCR unit, as determined under § 257.94(a) or § 257.95(a).

(1) In determining whether a statistically significant increase has occurred, the owner or operator must compare the groundwater quality of each constituent at each monitoring well designated pursuant to § 257.91(a)(2) or (d)(1) to the background value of that constituent, according to the statistical procedures and performance standards specified under paragraphs (f) and (g) of this section.

(2) Within 90 days after completing sampling and analysis, the owner or operator must determine whether there has been a statistically significant increase over background for any constituent at each monitoring well.

(i) The owner or operator must measure "total recoverable metals" concentrations in measuring groundwater quality. Measurement of total recoverable metals captures both the particulate fraction and dissolved fraction of metals in natural waters. Groundwater samples shall not be field-filtered prior to analysis.

(j) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

§ 257.94 Detection monitoring program.

(a) The owner or operator of a CCR unit must conduct detection monitoring at all groundwater monitoring wells consistent with this section. At a minimum, a detection monitoring program must include groundwater monitoring for all constituents listed in appendix III to this part.

(b) Except as provided in paragraph (d) of this section, the monitoring frequency for the constituents listed in appendix III to this part shall be at least semiannual during the active life of the CCR unit and the post-closure period. For existing CCR landfills and existing CCR surface impoundments, a minimum of eight independent samples from each background and downgradient well must be collected and analyzed for the constituents listed in appendix III and IV to this part no later than October 17, 2017. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, a minimum of eight independent samples for each background well must be collected and analyzed for the constituents listed in appendices III and IV to this part during the first six months of sampling.

(c) The number of samples collected and analyzed for each background well and downgradient well during subsequent semiannual sampling events must be consistent with § 257.93(e), and must account for any unique characteristics of the site, but must be at least one sample from each background and downgradient well.

(d) The owner or operator of a CCR unit may demonstrate the need for an alternative monitoring frequency for repeated sampling and analysis for constituents listed in appendix III to this part during the active life and the post-closure care period based on the availability of groundwater. If there is not adequate groundwater flow to sample wells semiannually, the alternative frequency shall be no less than annual. The need to vary monitoring frequency must be evaluated on a site-specific basis. The demonstration must be supported by, at a minimum, the information specified in paragraphs (d)(1) and (2) of this section.

(1) Information documenting that the need for less frequent sampling. The alternative frequency must be based on consideration of the following factors:

(i) Lithology of the aquifer and unsaturated zone;

(ii) Hydraulic conductivity of the aquifer and unsaturated zone; and

(iii) Groundwater flow rates.

(2) Information documenting that the alternative frequency will be no less effective in ensuring that any leakage from the CCR unit will be discovered within a timeframe that will not materially delay establishment of an assessment monitoring program.

(3) The owner or operator must obtain a certification from a qualified

professional engineer stating that the demonstration for an alternative groundwater sampling and analysis frequency meets the requirements of this section. The owner or operator must include the demonstration providing the basis for the alternative monitoring frequency and the certification by a qualified professional engineer in the annual groundwater monitoring and corrective action report required by § 257.90(e).

(e) If the owner or operator of the CCR unit determines, pursuant to § 257.93(h) that there is a statistically significant increase over background levels for one or more of the constituents listed in appendix III to this part at any monitoring well at the waste boundary specified under § 257.91(a)(2), the owner or operator must:

(1) Except as provided for in paragraph (e)(2) of this section, within 90 days of detecting a statistically significant increase over background levels for any constituent, establish an assessment monitoring program meeting the requirements of § 257.95.

(2) The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The owner or operator must complete the written demonstration within 90 days of detecting a statistically significant increase over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report. If a successful demonstration is completed within the 90-day period, the owner or operator of the CCR unit may continue with a detection monitoring program under this section. If a successful demonstration is not completed within the 90-day period, the owner or operator of the CCR unit must initiate an assessment monitoring program as required under § 257.95. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

(3) The owner or operator of a CCR unit must prepare a notification stating that an assessment monitoring program has been established. The owner or operator has completed the notification when the notification is placed in the facility's operating record as required by § 257.105(h)(5).

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

§ 257.95 Assessment monitoring program.

(a) Assessment monitoring is required whenever a statistically significant increase over background levels has been detected for one or more of the constituents listed in appendix III to this part.

(b) Within 90 days of triggering an assessment monitoring program, and annually thereafter, the owner or operator of the CCR unit must sample and analyze the groundwater for all constituents listed in appendix IV to this part. The number of samples collected and analyzed for each well during each sampling event must be consistent with § 257.93(e), and must account for any unique characteristics of the site, but must be at least one sample from each well.

(c) The owner or operator of a CCR unit may demonstrate the need for an alternative monitoring frequency for repeated sampling and analysis for constituents listed in appendix IV to this part during the active life and the post-closure care period based on the availability of groundwater. If there is not adequate groundwater flow to sample wells semiannually, the alternative frequency shall be no less than annual. The need to vary monitoring frequency must be evaluated on a site-specific basis. The demonstration must be supported by, at a minimum, the information specified in paragraphs (c)(1) and (2) of this section.

(1) Information documenting that the need for less frequent sampling. The alternative frequency must be based on consideration of the following factors:

(i) Lithology of the aquifer and unsaturated zone;

(ii) Hydraulic conductivity of the aquifer and unsaturated zone; and

(iii) Groundwater flow rates.

(2) Information documenting that the alternative frequency will be no less effective in ensuring that any leakage from the CCR unit will be discovered within a timeframe that will not materially delay the initiation of any necessary remediation measures.

(3) The owner or operator must obtain a certification from a qualified professional engineer stating that the demonstration for an alternative groundwater sampling and analysis frequency meets the requirements of this section. The owner or operator must include the demonstration providing the basis for the alternative monitoring frequency and the certification by a qualified professional engineer in the annual groundwater monitoring and corrective action report required by § 257.90(e).

(d) After obtaining the results from the initial and subsequent sampling events required in paragraph (b) of this section, the owner or operator must:

(1) Within 90 days of obtaining the results, and on at least a semiannual basis thereafter, resample all wells that were installed pursuant to the requirements of § 257.91, conduct analyses for all parameters in appendix III to this part and for those constituents in appendix IV to this part that are detected in response to paragraph (b) of this section, and record their concentrations in the facility operating record. The number of samples collected and analyzed for each background well and downgradient well during subsequent semiannual sampling events must be consistent with § 257.93(e), and must account for any unique characteristics of the site, but must be at least one sample from each background and downgradient well;

(2) Establish groundwater protection standards for all constituents detected pursuant to paragraph (b) or (d) of this section. The groundwater protection standards must be established in accordance with paragraph (h) of this section; and

(3) Include the recorded concentrations required by paragraph (d)(1) of this section, identify the background concentrations established under § 257.94(b), and identify the groundwater protection standards established under paragraph (d)(2) of this section in the annual groundwater monitoring and corrective action report required by § 257.90(e).

(e) If the concentrations of all constituents listed in appendices III and IV to this part are shown to be at or below background values, using the statistical procedures in § 257.93(g), for two consecutive sampling events, the owner or operator may return to detection monitoring of the CCR unit. The owner or operator must prepare a notification stating that detection monitoring is resuming for the CCR unit. The owner or operator has completed the notification when the notification is placed in the facility's operating record as required by § 257.105(h)(7).

(f) If the concentrations of any constituent in appendices III and IV to this part are above background values, but all concentrations are below the groundwater protection standard

established under paragraph (h) of this section, using the statistical procedures in § 257.93(g), the owner or operator must continue assessment monitoring in accordance with this section.

(g) If one or more constituents in appendix IV to this part are detected at statistically significant levels above the groundwater protection standard established under paragraph (h) of this section in any sampling event, the owner or operator must prepare a notification identifying the constituents in appendix IV to this part that have exceeded the groundwater protection standard. The owner or operator has completed the notification when the notification is placed in the facility's operating record as required by § 257.105(h)(8). The owner or operator of the CCR unit also must:

(1) Characterize the nature and extent of the release and any relevant site conditions that may affect the remedy ultimately selected. The characterization must be sufficient to support a complete and accurate assessment of the corrective measures necessary to effectively clean up all releases from the CCR unit pursuant to § 257.96. Characterization of the release includes the following minimum measures:

(i) Install additional monitoring wells necessary to define the contaminant plume(s);

(ii) Collect data on the nature and estimated quantity of material released including specific information on the constituents listed in appendix IV of this part and the levels at which they are present in the material released;

(iii) Install at least one additional monitoring well at the facility boundary in the direction of contaminant migration and sample this well in accordance with paragraph (d)(1) of this section; and

(iv) Sample all wells in accordance with paragraph (d)(1) of this section to characterize the nature and extent of the release.

(2) Notify all persons who own the land or reside on the land that directly overlies any part of the plume of contamination if contaminants have migrated off-site if indicated by sampling of wells in accordance with paragraph (g)(1) of this section. The owner or operator has completed the notifications when they are placed in the facility's operating record as required by § 257.105(h)(8).

(3) Within 90 days of finding that any of the constituents listed in appendix IV to this part have been detected at a statistically significant level exceeding the groundwater protection standards the owner or operator must either:

(i) Initiate an assessment of corrective measures as required by § 257.96; or

(ii) Demonstrate that a source other than the CCR unit caused the contamination, or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Any such demonstration must be supported by a report that includes the factual or evidentiary basis for any conclusions and must be certified to be accurate by a qualified professional engineer. If a successful demonstration is made, the owner or operator must continue monitoring in accordance with the assessment monitoring program pursuant to this section, and may return to detection monitoring if the constituents in appendices III and IV to this part are at or below background as specified in paragraph (e) of this section. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

(4) If a successful demonstration has not been made at the end of the 90 day period provided by paragraph (g)(3)(ii) of this section, the owner or operator of the CCR unit must initiate the assessment of corrective measures requirements under § 257.96.

(5) If an assessment of corrective measures is required under § 257.96 by either paragraph (g)(3)(i) or (g)(4) of this section, and if the CCR unit is an existing unlined CCR surface impoundment as determined by § 257.71(a), then the CCR unit is subject to the closure requirements under § 257.101(a) to retrofit or close. In addition, the owner or operator must prepare a notification stating that an assessment of corrective measures has been initiated.

(h) The owner or operator of the CCR unit must establish a groundwater protection standard for each constituent in appendix IV to this part detected in the groundwater. The groundwater protection standard shall be:

(1) For constituents for which a maximum contaminant level (MCL) has been established under §§ 141.62 and 141.66 of this title, the MCL for that constituent;

(2) For constituents for which an MCL has not been established, the background concentration for the constituent established from wells in accordance with § 257.91; or

(3) For constituents for which the background level is higher than the MCL identified under paragraph (h)(1) of this section, the background concentration.

(i) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

§ 257.96 Assessment of corrective measures.

(a) Within 90 days of finding that any constituent listed in appendix IV to this part has been detected at a statistically significant level exceeding the groundwater protection standard defined under § 257.95(h), or immediately upon detection of a release from a CCR unit, the owner or operator must initiate an assessment of corrective measures to prevent further releases, to remediate any releases and to restore affected area to original conditions. The assessment of corrective measures must be completed within 90 days, unless the owner or operator demonstrates the need for additional time to complete the assessment of corrective measures due to site-specific conditions or circumstances. The owner or operator must obtain a certification from a qualified professional engineer attesting that the demonstration is accurate. The 90-day deadline to complete the assessment of corrective measures may be extended for no longer than 60 days. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

(b) The owner or operator of the CCR unit must continue to monitor groundwater in accordance with the assessment monitoring program as specified in § 257.95.

(c) The assessment under paragraph (a) of this section must include an analysis of the effectiveness of potential corrective measures in meeting all of the requirements and objectives of the remedy as described under § 257.97 addressing at least the following:

(1) The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to any residual contamination;

(2) The time required to begin and complete the remedy;

(3) The institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy(s).

(d) The owner or operator must place the completed assessment of corrective measures in the facility's operating record. The assessment has been completed when it is placed in the facility's operating record as required by § 257.105(h)(10).

(e) The owner or operator must discuss the results of the corrective measures assessment at least 30 days prior to the selection of remedy, in a public meeting with interested and affected parties.

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

§ 257.97 Selection of remedy.

(a) Based on the results of the corrective measures assessment conducted under § 257.96, the owner or operator must, as soon as feasible, select a remedy that, at a minimum, meets the standards listed in paragraph (b) of this section. This requirement applies to, not in place of, any applicable standards under the Occupational Safety and Health Act. The owner or operator must prepare a semiannual report describing the progress in selecting and designing the remedy. Upon selection of a remedy, the owner or operator must prepare a final report describing the selected remedy and how it meets the standards specified in paragraph (b) of this section. The owner or operator must obtain a certification from a qualified professional engineer that the remedy selected meets the requirements of this section. The report has been completed when it is placed in the operating record as required by § 257.105(h)(12).

(b) Remedies must:

(1) Be protective of human health and the environment;

(2) Attain the groundwater protection standard as specified pursuant to § 257.95(h);

(3) Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in appendix IV to this part into the environment;

(4) Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems;

(5) Comply with standards for management of wastes as specified in § 257.98(d).

(c) In selecting a remedy that meets the standards of paragraph (b) of this section, the owner or operator of the CCR unit shall consider the following evaluation factors:

(1) The long- and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful based on consideration of the following:

(i) Magnitude of reduction of existing risks;

(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy;

(iii) The type and degree of long-term management required, including monitoring, operation, and maintenance;

(iv) Short-term risks that might be posed to the community or the environment during implementation of such a remedy, including potential threats to human health and the environment associated with excavation, transportation, and re-disposal of contaminant;

(v) Time until full protection is achieved;

(vi) Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment;

(vii) Long-term reliability of the engineering and institutional controls; and

(viii) Potential need for replacement of the remedy.

(2) The effectiveness of the remedy in controlling the source to reduce further releases based on consideration of the following factors:

(i) The extent to which containment practices will reduce further releases; and

(ii) The extent to which treatment technologies may be used.

(3) The ease or difficulty of implementing a potential remedy(s) based on consideration of the following types of factors:

(i) Degree of difficulty associated with constructing the technology;

(ii) Expected operational reliability of the technologies;

(iii) Need to coordinate with and obtain necessary approvals and permits from other agencies;

(iv) Availability of necessary equipment and specialists; and

(v) Available capacity and location of needed treatment, storage, and disposal services.

(4) The degree to which community concerns are addressed by a potential remedy(s).

(d) The owner or operator must specify as part of the selected remedy a schedule(s) for implementing and completing remedial activities. Such a schedule must require the completion of remedial activities within a reasonable period of time taking into consideration the factors set forth in paragraphs (d)(1) through (6) of this section. The owner or operator of the CCR unit must consider the following factors in determining the schedule of remedial activities:

(1) Extent and nature of contamination, as determined by the characterization required under § 257.95(g);

(2) Reasonable probabilities of remedial technologies in achieving compliance with the groundwater protection standards established under § 257.95(h) and other objectives of the remedy;

(3) Availability of treatment or disposal capacity for CCR managed during implementation of the remedy;

(4) Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy;

(5) Resource value of the aquifer including:

(i) Current and future uses;

(ii) Proximity and withdrawal rate of users;

(iii) Groundwater quantity and quality;

(iv) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to CCR constituents;

(v) The hydrogeologic characteristic of the facility and surrounding land; and

(vi) The availability of alternative water supplies; and

(6) Other relevant factors.

(e) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

§ 257.98 Implementation of the corrective action program.

(a) Within 90 days of selecting a remedy under § 257.97, the owner or operator must initiate remedial activities. Based on the schedule established under § 257.97(d) for implementation and completion of remedial activities the owner or operator must:

(1) Establish and implement a corrective action groundwater monitoring program that:

(i) At a minimum, meets the requirements of an assessment monitoring program under § 257.95;

(ii) Documents the effectiveness of the corrective action remedy; and

(iii) Demonstrates compliance with the groundwater protection standard pursuant to paragraph (c) of this section.

(2) Implement the corrective action remedy selected under § 257.97; and

(3) Take any interim measures necessary to reduce the contaminants leaching from the CCR unit, and/or potential exposures to human or ecological receptors. Interim measures must, to the greatest extent feasible, be consistent with the objectives of and contribute to the performance of any remedy that may be required pursuant to § 257.97. The following factors must be considered by an owner or operator in determining whether interim measures are necessary:

(i) Time required to develop and implement a final remedy;

(ii) Actual or potential exposure of nearby populations or environmental receptors to any of the constituents listed in appendix IV of this part;

(iii) Actual or potential contamination of drinking water supplies or sensitive ecosystems;

(iv) Further degradation of the groundwater that may occur if remedial action is not initiated expeditiously;

(v) Weather conditions that may cause any of the constituents listed in appendix IV to this part to migrate or be released;

(vi) Potential for exposure to any of the constituents listed in appendix IV to this part as a result of an accident or failure of a container or handling system; and

(vii) Other situations that may pose threats to human health and the environment.

(b) If an owner or operator of the CCR unit, determines, at any time, that compliance with the requirements of § 257.97(b) is not being achieved through the remedy selected, the owner or operator must implement other methods or techniques that could feasibly achieve compliance with the requirements.

(c) Remedies selected pursuant to § 257.97 shall be considered complete when:

(1) The owner or operator of the CCR unit demonstrates compliance with the groundwater protection standards established under § 257.95(h) has been achieved at all points within the plume of contamination that lie beyond the groundwater monitoring well system established under § 257.91.

(2) Compliance with the groundwater protection standards established under § 257.95(h) has been achieved by demonstrating that concentrations of constituents listed in appendix IV to this part have not exceeded the groundwater protection standard(s) for a period of three consecutive years using the statistical procedures and performance standards in § 257.93(f) and (g).

(3) All actions required to complete the remedy have been satisfied.

(d) All CCR that are managed pursuant to a remedy required under § 257.97, or an interim measure required under paragraph (a)(3) of this section, shall be managed in a manner that complies with all applicable RCRA requirements.

(e) Upon completion of the remedy, the owner or operator must prepare a notification stating that the remedy has been completed. The owner or operator must obtain a certification from a qualified professional engineer attesting that the remedy has been completed in compliance with the requirements of paragraph (c) of this section. The report has been completed when it is placed in the operating record as required by § 257.105(h)(13).

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the internet requirements specified in § 257.107(h).

Closure and Post-Closure Care

§ 257.100 Inactive CCR surface impoundments.

(a) Except as provided by paragraph (b) of this section, inactive CCR surface impoundments are subject to all of the requirements of this subpart applicable to existing CCR surface impoundments.

(b) An owner or operator of an inactive CCR surface impoundment that completes closure of such CCR unit, and meets all of the requirements of either paragraphs (b)(1) through (4) of this section or paragraph (b)(5) of this section no later than April 17, 2018, is exempt from all other requirements of this subpart.

(1) *Closure by leaving CCR in place.* If the owner or operator of the inactive CCR surface impoundment elects to close the CCR surface impoundment by leaving CCR in place, the owner or operator must ensure that, at a minimum, the CCR unit is closed in a manner that will:

(i) Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere;

(ii) Preclude the probability of future impoundment of water, sediment, or slurry;

(iii) Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system; and

(iv) Minimize the need for further maintenance of the CCR unit.

(2) The owner or operator of the inactive CCR surface impoundment must meet the requirements of paragraphs (b)(2)(i) and (ii) of this section prior to installing the final cover system required under paragraph (b)(3) of this section.

(i) Free liquids must be eliminated by removing liquid wastes or solidifying the remaining wastes and waste residues.

(ii) Remaining wastes must be stabilized sufficient to support the final cover system.

(3) The owner or operator must install a final cover system that is designed to minimize infiltration and erosion, and at a minimum, meets the requirements of paragraph (b)(3)(i) of this section, or the requirements of an alternative final cover system specified in paragraph (b)(3)(ii) of this section.

(i) The final cover system must be designed and constructed to meet the criteria specified in paragraphs (b)(3)(i)(A) through (D) of this section.

(A) The permeability of the final cover system must be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1×10^{-5} centimeters/second, whichever is less.

(B) The infiltration of liquids through the CCR unit must be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.

(C) The erosion of the final cover system must be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

(D) The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.

(ii) The owner or operator may select an alternative final cover system design, provided the alternative final cover system is designed and constructed to meet the criteria in paragraphs (b)(3)(ii)(A) through (C) of this section.

(A) The design of the final cover system must include an infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraphs (b)(3)(i)(A) and (B) of this section.

(B) The design of the final cover system must include an erosion layer that provides equivalent protection from wind or water erosion as the erosion layer specified in paragraph (b)(3)(i)(C) of this section.

deficiency or release specified under § 257.105(f)(11).

(11) The initial and periodic safety factor assessments specified under § 257.105(f)(12).

(12) The design and construction plans, and any revisions of them, specified under § 257.105(f)(13).

(g) *Operating criteria.* The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The CCR fugitive dust control plan, or any subsequent amendment of the plan, specified under § 257.105(g)(1) except that only the most recent plan must be maintained on the CCR Web site irrespective of the time requirement specified in paragraph (c) of this section.

(2) The annual CCR fugitive dust control report specified under § 257.105(g)(2).

(3) The initial and periodic run-on and run-off control system plans specified under § 257.105(g)(3).

(4) The initial and periodic inflow design flood control system plans specified under § 257.105(g)(4).

(5) The periodic inspection reports specified under § 257.105(g)(6).

(6) The documentation detailing the corrective measures taken to remedy the deficiency or release specified under § 257.105(g)(7).

(7) The periodic inspection reports specified under § 257.105(g)(9).

(h) *Groundwater monitoring and corrective action.* The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The annual groundwater monitoring and corrective action report specified under § 257.105(h)(1).

(2) The groundwater monitoring system certification specified under § 257.105(h)(3).

(3) The selection of a statistical method certification specified under § 257.105(h)(4).

(4) The notification that an assessment monitoring programs has been established specified under § 257.105(h)(5).

(5) The notification that the CCR unit is returning to a detection monitoring program specified under § 257.105(h)(7).

(6) The notification that one or more constituents in appendix IV to this part have been detected at statistically significant levels above the groundwater protection standard and the notifications to land owners specified under § 257.105(h)(8).

(7) The notification that an assessment of corrective measures has been initiated specified under § 257.105(h)(9).

(8) The assessment of corrective measures specified under § 257.105(h)(10).

(9) The semiannual reports describing the progress in selecting and designing remedy and the selection of remedy report specified under § 257.105(h)(12), except that the selection of the remedy report must be maintained until the remedy has been completed.

(10) The notification that the remedy has been completed specified under § 257.105(h)(13).

(i) *Closure and post-closure care.* The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The notification of intent to initiate closure of the CCR unit specified under § 257.105(i)(1).

(2) The annual progress reports of closure implementation specified under § 257.105(i)(2).

(3) The notification of closure completion specified under § 257.105(i)(3).

(4) The written closure plan, and any amendment of the plan, specified under § 257.105(i)(4).

(5) The demonstration(s) for a time extension for initiating closure specified under § 257.105(i)(5).

(6) The demonstration(s) for a time extension for completing closure specified under § 257.105(i)(6).

(7) The notification of intent to close a CCR unit specified under § 257.105(i)(7).

(8) The notification of completion of closure of a CCR unit specified under § 257.105(i)(8).

(9) The notification recording a notation on the deed as required by § 257.105(i)(9).

(10) The notification of intent to comply with the alternative closure requirements as required by § 257.105(i)(10).

(11) The annual progress reports under the alternative closure requirements as required by § 257.105(i)(11).

(12) The written post-closure plan, and any amendment of the plan, specified under § 257.105(i)(12).

(13) The notification of completion of post-closure care specified under § 257.105(i)(13).

(j) *Retrofit criteria.* The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The written retrofit plan, and any amendment of the plan, specified under § 257.105(j)(1).

(2) The notification of intent to comply with the alternative retrofit requirements as required by § 257.105(j)(2).

(3) The annual progress reports under the alternative retrofit requirements as required by § 257.105(j)(3).

(4) The demonstration(s) for a time extension for completing retrofit activities specified under § 257.105(j)(4).

(5) The notification of intent to retrofit a CCR unit specified under § 257.105(j)(5).

(6) The notification of completion of retrofit activities specified under § 257.105(j)(6).

■ 5. Amend part 257 by adding "Appendix III to Part 257" and "Appendix IV to Part 257" to read as follows:

Appendix III to Part 257—Constituents for Detection Monitoring

Common name [1]
Boron
Calcium
Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids (TDS)

[1] Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

Appendix IV to Part 257—Constituents for Assessment Monitoring

Common name [1]
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228 combined

[1] Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

PART 261—IDENTIFICATION AND LISTING OF HAZARDOUS WASTE

■ 6. The authority citation for part 261 continues to read as follows:

Authority: 42 U.S.C. 6905, 6912(a), 6921, 6922, 6924(y) and 6938.

■ 7. Section 261.4 is amended by revising paragraph (b)(4) to read as follows:

APPENDIX B

Boring Logs and Construction Diagrams

TEST BORING REPORT

Boring No. CCR-AP-1

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 1
Start	18 December 2015
Finish	18 December 2015
Driller	B. Marshall
H&A Rep.	T. Vanage
Elevation Datum	465.7 (est.)
Location	See Plan N 968260.82 E 2773560.71

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	Sonic	-	Steel	Rig Make & Model: Track Geoprobe 8140LS
Inside Diameter (in.)	6	-	6.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	-	-	Drill Mud: None
Hammer Fall (in.)		-	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 38	0.0 5.0	CL		Soft brown lean CLAY (CL), mps 20 mm, no odor, moist, roots throughout -OVERBURDEN-	-	5	-	-	5	90				
5		U2 58	5.0 10.0	ML	460.0 5.8	Soft brown SILT (ML), no odor, wet -OVERBURDEN-	-	-	-	-	5	95				
10		U3 108	10.0 20.0													
15					447.7 18.0	Moderately weathered red-brown medium-grained SANDSTONE -BEDROCK-										
20					445.7 20.0	BOTTOM OF EXPLORATION 20.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/20/15	-	-	-	-	4.87

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	18.0
Rock Cored (ft)	2.0
Samples	3U

Boring No. CCR-AP-1

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-1R

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	26 July 2016
Finish	26 July 2016
Driller	J. Gryska
H&A Rep.	C. Toscano
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	9.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Drilled through existing observation well CCR-AP-1, see test boring report for soils logged from 0-20 ft. -OVERBURDEN-										
5																	
10																	
15																	
						18.0	Top of weathered bedrock -BEDROCK-										
20																	

Water Level Data					
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
7/27/16	7:15	-	-	-	5.60

Sample ID
- O - Open End Rod
- T - Thin Wall Tube
- U - Undisturbed Sample
- S - Split Spoon Sample

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary	
Overburden (ft)	18.0
Rock Cored (ft)	19.0
Samples	1S

Boring No. CCR-AP-1R

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-1R
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25																	
	4 5 5 16	S1 24	28.0 30.0				Loose reddish-brown sandy SILT (ML) with occasional layers of highly weathered rock with distinct rock fabric (sandstone/siltstone)	-	5	10	15	10	60				
30																	
							Drill action, occasional rig chatter and soil cuttings indicated highly weathered Siltstone/Sandstone										
35																	
						37.0	BOTTOM OF EXPLORATION 37.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-1R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-2

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No. 42796-001
Sheet No. 1 of 2
Start 17 December 2015
Finish 17 December 2015
Driller B. Marshall
H&A Rep. T. Vanage
Elevation 465.2 (est.)
Datum
Location See Plan
N 969079.16
E 2771922.52

	Casing	Sampler	Barrel
Type	Sonic	-	Steel
Inside Diameter (in.)	4.5	-	6.0
Hammer Weight (lb)	-	-	-
Hammer Fall (in.)		-	-

Drilling Equipment and Procedures

Rig Make & Model: Track Geoprobe 8140LS
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 47	0.0 5.0	CL		Medium stiff brown lean CLAY (CL), no odor, moist, red mottling at 3 feet, organics present -FILL-	-	-	-	-	-	100				
5		U2 58	5.0 10.0	CL		Medium stiff yellow-brown lean CLAY (CL), no door, moist	-	-	-	-	-	100				
10		U3 57	10.0 15.0													
				MH	452.7 12.5	Soft to medium stiff yellow-brown elastic SILT (MH), no odor, dry -OVERBURDEN-	-	-	-	-	-	100				
15		U4 60	15.0 20.0	MH		Driller indicated collapse at 15.5 feet Soft yellow-brown elastic SILT (MH), no odor, wet	-	-	-	-	5	95				
20		U5 60	20.0 25.0													

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/20/15	-	-	-	-	18.46

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 25.5
Rock Cored (ft) -
Samples 5U

Boring No. CCR-AP-2

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-2
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
				MH			Similar as above, except wet										
25						439.7											
						25.5	BOTTOM OF EXPLORATION 25.5 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-2

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-2R

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	28 July 2016
Finish	28 July 2016
Driller	J. Gryska
H&A Rep.	C. Toscano
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	9.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Drilled through existing observation well CCR-AP-2, see test boring report for soils logged from 0-25 ft.										
							-OVERBURDEN-										
5																	
10																	
15																	
20																	
25																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
7/29/15	7:30	-	-	-	28.80

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	30.0
Rock Cored (ft)	23.3
Samples	3S

Boring No. CCR-AP-2R

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-2R
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	1 1 1 1	S1 8	25.0 27.0	ML			Very soft yellowish-brown sandy SILT (ML), mps 1 mm, no odor, wet	-	-	-	-	25	75				
							Top of decomposed bedrock at 30.0 ft										
30	7 9 13 12	S2 24	30.0 32.0			30.0	Stiff yellowish-brown to tan sandy SILT (ML) with frequent alternating layers and seems of silt and fine sand. Trace coal and decomposed rock fragments, wet	-	-	-	-	25	75				
						32.0	-BEDROCK-										
35	50/6	S3 6	35.0 37.0				Hard yellowish-brown to gray-brown SILT with sand (ML) with frequent alternating layers and seams of sandy silt and silty fine sand, well stratified, entire sample exhibits distinct rock fabric, wet	-	-	-	-	15	85				
40																	
45																	
50																	
						53.3	Drill action and rig chatter indicated harder rock at 53.0 ft, soil cuttings on auger flights indicated limestone bedrock										
							BOTTOM OF EXPLORATION 53.3 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-2R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-3

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	19 December 2015
Finish	20 December 2015
Driller	B. Marshall
H&A Rep.	T. Vanage
Elevation Datum	450.0 (est.)
Location	See Plan N 966865.12 E 2771404.27

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	Sonic	-	Steel	Rig Make & Model: Track Geoprobe 8140LS
Inside Diameter (in.)	4.5	-	6.0	Bit Type: Cutting Head Drill Mud: None
Hammer Weight (lb)	-	-	-	Casing: Spun Hoist/Hammer: -
Hammer Fall (in.)		-	-	PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 42	0.0 3.5	CL		Medium stiff brown lean CLAY (CL), interbedded gravel, very fine sand partings, no odor, dry -FILL-	-	5	-	-	10	85				
5		U2 48	5.5 9.0	ML	444.5 5.5	Very soft brown SILT (ML), no odor, dry -OVERBURDEN-	-	-	-	-	-	100				
10		U3 120	9.0 19.0													
15						Grades to very moist at 14 feet Grades to wet at 15 feet										
20		U4 120	19.0 29.0													

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/20/15	-	-	-	-	21.97

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	32.5
Rock Cored (ft)	2.5
Samples	5U

Boring No. CCR-AP-3

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-3
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
				CL		429.0 21.0	Medium stiff red-brown lean CLAY (CL), no odor, moist -OVERBURDEN-	-	-	-	-	-	100				
25																	
30						417.5 32.5	Highly weathered brown SANDSTONE, fine-grained, trace silt and clay present -BEDROCK-										
35						415.0 35.0	BOTTOM OF EXPLORATION 35.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-3

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-3R

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	27 July 2016
Finish	28 July 2016
Driller	J. Gryska
H&A Rep.	S.Lewis
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel
Type	HSA	S	Steel
Inside Diameter (in.)	4.25	1 3/8	9.0
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)		30	-

Drilling Equipment and Procedures

Rig Make & Model: Track CME 850 XR
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Drilled through existing observation well CCR-AP-3, see test boring report for soils logged from 0-25 ft -OVERBURDEN-										
5																	
10																	
15																	
20																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
7/27/16	8:00	-	-	-	37.90

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	32.5
Rock Cored (ft)	14.5
Samples	1S

Boring No. CCR-AP-3R

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-3R
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25																	
30																	
						32.5	Top of decomposed bedrock at 32.5 ft -BEDROCK-										
35	12 21 18 25	S1 24	35.0 37.0				Dense tan to yellow-brown silty SAND (SM) with frequent interbedded seams layers of sandy silt and silt, well stratified, entire sample exhibits distinct rock fabric, dry	-	-	5	15	45	35				
40																	
45																	
						47.0	BOTTOM OF EXPLORATION 47.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-3R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-4

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	14 March 2016
Finish	14 March 2016
Driller	J. Gryska
H&A Rep.	J. Yonts
Elevation Datum	472.9 (est.)
Location	See Plan N 966741.47 E 2772827.01

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	6.0	Bit Type: Cutting Head Drill Mud: None
Hammer Weight (lb)	-	140	-	Casing: Spun
Hammer Fall (in.)		30	-	Hoist/Hammer: - PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0				ML		Hand clear to 5.0 ft bgs, mostly brown SILT (ML), no odor, moist -OVERBURDEN-										
5	WOH 1 WOH 1	S1 22	5.0 7.0	ML		Very soft brown SILT (ML), no structure, moist, trace clay, trace woody debris Wet at 6.0 ft	-	-	-	-	5	95				
					464.4 8.5											
10	1 1 2 3	S2 16	8.5 10.5	ML		Soft brown SILT (ML), no odor, dry, faint laminae from light brown to brown (1-2 mm thick)	-	-	-	-	10	90				
15	2 5 4 5	S3 17	13.5 15.5	ML		Similar as above Water between 15.6 ft to 18.5 ft										
20	2 2 2 3	S4 20	18.5 20.5	ML		Similar as above except no structure and wet										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	17:05	-	-	-	31.69

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	28.5
Rock Cored (ft)	7.0
Samples	7S

Boring No. CCR-AP-4

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-4
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						449.4											
25	2 3 4 5	S5 24	23.5 25.5	CL		23.5	Medium stiff dark red brown red-brown CLAY (CL), no structure										
						444.4											
30	2 2 3 5	S6 24	28.5 30.5	SC		28.5	Brown red-brown black clayey SAND (SC), no odor, moist, mostly medium to fine poorly graded sands, weathered sandstone -BEDROCK-										
35	3 6 11 14	S7 24	33.5 35.5	SC			Red-brown orange black yellow mottled clayey SAND (SC), weathered sandstone										
						437.4 35.5	BOTTOM OF EXPLORATION 35.5 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-4

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-4R

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	27 July 2016
Finish	27 July 2016
Driller	J. Gryska
H&A Rep.	C. Toscano
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	9.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Drilled through existing observation well CCR-AP-4, see test boring report for soils logged from 0-35.5 ft.										
							-OVERBURDEN-										
5																	
10																	
15																	
20																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
7/27/16	12:30	-	-	-	31.60

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	28.5
Rock Cored (ft)	19.5
Samples	1S

Boring No. CCR-AP-4R

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-4R
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25																	
						28.0	-BEDROCK-										
30																	
35																	
	2 12 18 22	S1 24	35.5 37.5	SM		35.5	Medium dense tan to yellow-brown silty SAND (SM) with occasional layers of completely weathered bedrock exhibiting distinct rock fabric	-	-	10	15	40	35				
						38.0	Drill action, occasional rig chatter and soil cuttings indicated completely weathered bedrock at 38.0 ft.										
40																	
45																	
						48.0	BOTTOM OF EXPLORATION 48.0 ft										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-4R

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TEST BORING REPORT

Boring No. CCR-AP-5

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	13 March 2016
Finish	14 March 2016
Driller	J. Gryska
H&A Rep.	S. Lewis
Elevation Datum	451.0 (est.)
Location	See Plan N 968166.03 E 3771019.7

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	6.0	Bit Type: Cutting Head Drill Mud: None
Hammer Weight (lb)	-	140	-	Casing: Spun Hoist/Hammer: -
Hammer Fall (in.)		30	-	PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0				ML			Hand auger to 0.0 ft to 5.0 ft, brown SILT (ML), dry -FILL-										
5	4 2 5 7	S1 18	5.0 7.0	ML			Medium stiff grayish brown SILT (ML), no odor, moist	-	5	-	-	5	90				
	WOH 2 3 2	S2 9	8.0 10.0	ML			Medium stiff grayish brown SILT (ML), no odor, moist	-	-	-	-	5	95				
10																	
	4 7 6 12	S3 15	13.0 15.0	ML			Stiff grayish brown SILT (ML), no odor, dry, mottled with red color	-	-	-	-	10	90				
15																	
	2 5 10 18	S4 12	18.0 20.0	ML			Stiff grayish brown sandy SILT (ML), no odor, dry, trace clay, mottled with red color	-	10	-	-	30	60				
20																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	09:12	-	-	-	37.46

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	45.0
Rock Cored (ft)	-
Samples	9S

Boring No. CCR-AP-5

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

HALEY ALDRICH

Boring No. CCR-AP-5
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	4 11 15 18	S5 18	23.0 25.0	ML		Very stiff brown SILT with sand (ML), no odor, dry, trace clay, mottled with red color	-	5	-	-	15	80				
					423.0 28.0	Soft brown and gray SILT (ML), no odor, wet	-	-	-	-	5	95				
	1 2 1 3	S6 24	28.0 30.0	ML		-OVERBURDEN-										
30																
35	1 3 3 4	S7 24	33.0 35.0	ML		Medium stiff gray SILT (ML), no odor, wet	-	-	-	-	-	100				
					413.0 38.0	Soft brown lean CLAY (CL), no odor, wet	-	-	-	-	-	100				
40	WOH WOH 3 4	S8 24	38.0 40.0	CL												
					408.0 43.0	Very soft brown SILT (ML), no odor, wet, trace clay	-	-	-	-	-	100				
	WOH WOH 2 3	S9 24	43.0 45.0	ML												
45					406.0 45.0	BOTTOM OF EXPLORATION 45.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-5

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-6

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	10 March 2016
Finish	11 March 2016
Driller	J. Gryska
H&A Rep.	S. Lewis
Elevation Datum	458.9 (est.)
Location	See Plan N 969932.76 E 2771626.75

	Casing	Sampler	Barrel
Type	HSA	S	Steel
Inside Diameter (in.)	4.25	1 3/8	6.0
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)		30	-

Drilling Equipment and Procedures

Rig Make & Model: Track CME 850 XR
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							-FILL-										
						454.9											
	1 2 2 4	S1 24	4.0 6.0	CL		4.0	Soft brown lean CLAY (CL), no odor, moist -OVERBURDEN-	-	-	-	-	10	90				
5																	
						449.9											
	8 15 30 50/2	S2 24	9.0 11.0	SM		9.0	Dense grayish brown silty SAND (SM), no odor, moist	-	-	-	10	60	30				
10																	
						444.9											
	20 50/6	S3 6	14.0 16.0			14.0	Tan mottled with red brown and dark gray weathered SANDSTONE, moist, thinly laminated -BEDROCK-										
15																	
	50/6	S4 2	19.0 21.0				Brownish tan weathered SANDSTONE, moist, thinly laminated										
20																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	15:33	-	-	-	12.15

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	14.0
Rock Cored (ft)	25.0
Samples	8S

Boring No. CCR-AP-6

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. CCR-AP-6
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	6 9 15 16	S5 24	24.0 26.0				Brownish tan weathered SANDSTONE, moist, thinly laminated										
						429.9 29.0	Dark gray weathered SHALE, wet, fissile										
30	50/5	S6 4	29.0 31.0														
35	50/6	S7 7	34.0 36.0				Dark gray weathered SHALE, organic matter at 34.5 ft (1.0 in. thick)										
						419.9 39.0	Dark gray weathered SHALE										
	50/1	S8 1	39.0 39.0				BOTTOM OF EXPLORATION 39.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-6

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-7

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No. 42796-001
Sheet No. 1 of 2
Start 13 March 2016
Finish 14 March 2016
Driller B. Marshall
H&A Rep. J. Yonts
Elevation 486.0 (est.)
Datum
Location See Plan
N 970758.7
E 2773501.63

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	Sonic	-	Steel	Rig Make & Model: Track Geoprobe 8140LS
Inside Diameter (in.)	4.5	-	6.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	-	-	Drill Mud: None
Hammer Fall (in.)		-	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 60	0.0 5.0	ML		Brown SILT with trace clay (ML), no structure, no odor, moist, root material	-	-	-	-	5	95				
						-OVERBURDEN-										
				ML		Brown SILT (ML), no odor, moist, no wood material	-	-	-	-	10	90				
5		U2 60	5.0 10.0	ML		Similar as above										
				ML		Brown SILT with trace clay (ML), no structure, no odor, moist	-	-	-	-	10	90				
10		U3 96	10.0 18.0	ML		Similar as above										
15					471.0 15.0	Orange red red-brown weathered SANDSTONE, moist, mostly medium to fine sands										
						-BEDROCK-										
		U4 24	18.0 20.0			Similar as above except more competent, bedrock										
20		U5 120	20.0 30.0			Similar as above										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	14:18	-	-	-	31.95

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	15.0
Rock Cored (ft)	20.0
Samples	6U

Boring No. CCR-AP-7

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-7
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						464.0											
						22.0	Brown orange gray SHALE, moist, fissile, trace fine sand										
25						460.0											
						26.0	Gray SILTSTONE, soft, wet										
						458.0											
						28.0	Red brown orange brown SANDSTONE, moist, moistly fine sands										
30		U6 60	30.0 35.0				Brown tan black gray orange SANDSTONE, moist to wet, fine to medium sands										
35						451.0 35.0	BOTTOM OF EXPLORATION 35.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-7

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-7R

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No. 42796-001
Sheet No. 1 of 3
Start 30 July 2016
Finish 30 July 2016
Driller J. Gryska
H&A Rep. C. Toscano
Elevation
Datum
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	9.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Drilled through existing observation well CCR-AP-7, see test boring report for soils logged from 0-35.0 ft. -OVERBURDEN-										
5																	
10																	
15						15.0	Drill action, rig chatter and soil cuttings indicated highly to slightly weathered Sandstone/Shale -BEDROCK-										
20																	

Water Level Data					
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
7/30/16	-	-	-	-	28.30

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 15.0
Rock Cored (ft) 38.5
Samples -

Boring No. CCR-AP-7R

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-7R
File No. 42796-001
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25																	
30																	
35						35.0											
40																	
45																	
50																	

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-7R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-7R
File No. 42796-001
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						53.5	BOTTOM OF EXPLORATION 53.5 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-7R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-BK-1

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 1
Start	10 March 2016
Finish	10 March 2016
Driller	B. Marshall
H&A Rep.	J. Yonts
Elevation Datum	480.4 (est.)
Location	See Plan N 974083.4 E 2770919.08

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	Sonic	-	Steel	Rig Make & Model: Track Geoprobe 8140LS
Inside Diameter (in.)	4.5	-	6.0	Bit Type: Cutting Head Drill Mud: None
Hammer Weight (lb)	-	-	-	Casing: Spun
Hammer Fall (in.)		-	-	Hoist/Hammer: - PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 60	0.0 5.0	ML		Brown and tan SILT (ML), moist, trace clay, trace roots and wood debris -TOPSOIL-	-	-	-	-	10	90				
5		U2 48	5.0 9.0	ML		Similar as above -OVERBURDEN-										
10		U3 120	9.0 19.0	ML		Similar as above except wet in top 6.0 in. of sample										
				CL	464.4 16.0	Dense red brown lean CLAY (CL), moist	-	-	-	-	5	95				
20		U4 43	19.0 22.5	SC	461.4 19.0	Similar as above except more sand content, gradual increase in sand, weathered sandstone	-	-	10	20	30	40				
					459.9 20.5	-BEDROCK- Red brown SANDSTONE										
					457.9 22.5	BOTTOM OF EXPLORATION 22.5 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	13:50	-	-	-	19.51

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	19.0
Rock Cored (ft)	3.5
Samples	4U

Boring No. CCR-BK-1

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-BK-1R

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	29 July 2016
Finish	29 July 2016
Driller	J. Gryska
H&A Rep.	C. Toscano
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	9.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						Drilled through existing observation well CCR-BK-1, see test boring report for soils logged from 0-22.5 ft. -OVERBURDEN-										
19.0						-BEDROCK-										
	1 12 50/1	S1 10	23.0 25.0	SM		Medium dense red-brown to gray-brown silty SAND (SM), trace decomposed bedrock fragments. Note: Bottom 3-inches at tip of spoon consist of pulverized bedrock fragments. Drill action and increase in rig chatter indicated harder rock at 24.0 ft.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
7/29/16	-	-	-	-	54.00

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	19.0
Rock Cored (ft)	45.0
Samples	1S

Boring No. CCR-BK-1R

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-BK-1R
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
30																	
35																	
40																	
45							Drill action indicated harder bedrock at 45.0 ft.										
50																	
55																	
60																	
						64.0	BOTTOM OF EXPLORATION 64.0 ft.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-BK-1R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-BK-2

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	11 March 2016
Finish	11 March 2016
Driller	J. Gryska
H&A Rep.	S. Lewis
Elevation Datum	427.5 (est.)
Location	See Plan N 972854.33 E 2769728.14

	Casing	Sampler	Barrel
Type	HSA	S	Steel
Inside Diameter (in.)	4.25	1 3/8	6.0
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)		30	-

Drilling Equipment and Procedures

Rig Make & Model: Track CME 850 XR
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0				ML		-TOPSOIL-										
	1 2 3 4	S1 16	3.5 5.5	ML	424.0 3.5	Medium stiff brown SILT (ML), no odor, moist	-	-	-	-	10	90				
5						-OVERBURDEN-										
	1 1 1 1	S2 24	8.5 10.5	ML		Very soft brown SILT (ML), no odor, wet, mottled with gray colors	-	-	-	-	10	90				
10					414.0 13.5											
	1 1 1 2	S3 24	13.5 15.5	CL		Very soft brownish gray lean CLAY (CL), no door, wet, wood fragments present	-	-	-	-	5	95				
15																
	1 1 2 2	S4 24	18.5 20.5	CL		Soft brownish gray silty lean CLAY (CL), no odor, wet	-	-	-	-	5	95				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	10:38	-	-	-	13.40

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	25.5
Rock Cored (ft)	-
Samples	5S

Boring No. CCR-BK-2

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-BK-2
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						404.0											
25	2 2 2 4	S5 24	23.5 25.5	ML		23.5	Medium stiff brown clayey SILT (ML), no odor, wet	-	-	-	-	5	95				
						402.0 25.5	BOTTOM OF EXPLORATION 25.5 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-BK-2

TEST BORING REPORT

Boring No. CCR-LF-1

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	10 March 2016
Finish	10 March 2016
Driller	B. Marshall
H&A Rep.	J. Yonts
Elevation Datum	432.8 (est.)
Location	See Plan N 970812.18 E 2771247.76

	Casing	Sampler	Barrel
Type	Sonic	-	Steel
Inside Diameter (in.)	4.5	-	6.0
Hammer Weight (lb)	-	-	-
Hammer Fall (in.)		-	-

Drilling Equipment and Procedures

Rig Make & Model: Track Geoprobe 8140LS
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 12	0.0 5.0	CH		Red brown sandy CLAY (CH), no structure, mps 1.0 in., moist -FILL-	5	5	5	10	15	60				
				SC	430.3 2.5	Black orange yellow red-brown clayey SAND (SC), mps 1.1 in., no structure, moist	-	-	10	40	30	20				
					428.8 4.0	-BEDROCK-										
5		U2 48	5.0 9.0			Black orange yellow SANDSTONE, wet Similar as above except white tan orange Similar as above except no clay, uniform sand (medium > fine)										
		U3 60	9.0 14.0		423.8 9.0	Black coal, organic rich, no structure, wet										
10					423.3 9.5	Gray SHALE, weathered, no structure, moist, thinly laminated										
					420.8 12.0	Black coal, organic rich layer, moist White gray orange SILTSTONE, weathered, moist, soft										
					419.8 13.0	Orange and tan SILTSTONE, soft to hard, weathered, dry										
		U4 36	14.0 17.0		418.8 14.0	Similar as above										
15		U5 24	17.0 19.0			Similar as above										
					413.8 19.0	BOTTOM OF EXPLORATION 19.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	14:35	-	-	-	4.04

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	4.0
Rock Cored (ft)	15.0
Samples	5U

Boring No. CCR-LF-1

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-LF-2

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 3
Start	12 March 2016
Finish	12 March 2016
Driller	B. Marshall
H&A Rep.	J. Yonts
Elevation Datum	470.1 (est.)
Location	See Plan N 970681.32 E 2772205.05

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	Sonic	-	Steel	Rig Make & Model: Track Geoprobe 8140LS
Inside Diameter (in.)	4.5	-	6.0	Bit Type: Cutting Head Drill Mud: None
Hammer Weight (lb)	-	-	-	Casing: Spun Hoist/Hammer: -
Hammer Fall (in.)		-	-	PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					469.9	-TOPSOIL-										
		U1 30	0.0 5.0	ML	0.2	Brown SILT (ML), no structure, wet, root material, gradual increase in sand content with depth	-	-	-	-	10	90				
						-FILL-										
				ML		Brown sandy SILT (ML), no structure, moist	-	-	-	5	25	70				
				CL	467.1 3.0	Brown red-brown CLAY (CL), no structure, moist mostly fine material, trace fine sand	-	-	-	-	5	95				
5		U2 20	5.0 10.0	CL		Similar as above										
				ML	462.6 7.5	Brown SILT (ML), moist, breaks into 1-2 mm layers	-	-	-	-	5	95				
						-OVERBURDEN-										
10		U3 96	10.0 13.0	ML		Gray brown SILT (ML), moist, few woody materials (black)	-	-	-	5	10	85				
				ML		Similar as above except increased clay content										
15					454.1 16.0											
				CL		Dense red brown yellow CLAY (CL), moist, trace coarse material, few sandstone rock fragments < 1.0 in. bottom of sample	-	-	-	-	5	95				
		U4 24	18.0 20.0			Drilling action indicates bedrock at 18.5 ft										
					451.4 18.7	Yellow to yellow brown orange SANDSTONE, weathered, dry, mostly medium sands										
20		U5 72	20.0 26.0			-BEDROCK-										

Water Level Data					
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	14:45	-	-	-	24.75

Sample ID
- O - Open End Rod
- T - Thin Wall Tube
- U - Undisturbed Sample
- S - Split Spoon Sample

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (ft)	18.7
Rock Cored (ft)	26.3
Samples	8U

Boring No. CCR-LF-2

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-LF-2
File No. 42796-001
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						446.1 24.0	Gray white black and orange laminated (1-2 mm) SILTSTONE, dry										
25						444.1 26.0	Brown tan SANDSTONE, dry, mostly fine and medium sands										
		U6 48	26.0 30.0														
30		U7 120	30.0 40.0				Notes: Drilling action changed at ~33.0 ft to 35.0 ft Similar as above except tan brown and orange, wet										
35																	
40		U8 60	40.0 45.0				Similar as above except poorly graded										
45						425.1 45.0	BOTTOM OF EXPLORATION 45.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-LF-2

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-LF-3

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 CR
Inside Diameter (in.)	4.25	1 3/8	6.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

File No. 42796-001
Sheet No. 1 of 2
Start 14 March 2016
Finish 14 March 2016
Driller J. Gryska
H&A Rep. J. Yonts
Elevation 482.0 (est.)
Datum
Location See Plan
N 970949.7
E 2773138.97

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						Hand cleared to 5.0 ft bgs, no sample, brown SILT (ML), no odor, moist	-	-	-	-	5	95				
5	1 1 1 1	S1 23	5.0 7.0	ML		Brown SILT (ML), no structure, no odor, wet, trace roots -OVERBURDEN-	-	-	-	-	5	95				
10	4 14 12 14	S2 20	10.0 12.0	ML		Similar as above except moist, no roots										
				SP	471.2 10.8	Brown black and orange poorly graded SAND (SP), weathered sandstone	-	-	5	50	40	5				
15	50/4	S3 41	15.0 17.0		467.0 15.0	Brown tan SANDSTONE medium to fine sands, uniform, moist, trace clay										
20	50/5	S4 5	20.0 22.0			Tan light brown to brown SANDSTONE, medium to fine sands, moist										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	16:30	-	-	-	25.80

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 15.3
Rock Cored (ft) 20.0
Samples 7S

Boring No. CCR-LF-3

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-LF-3
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	50/4	S5 4	25.0 27.0				Similar as above except wet										
30	50/5	S6 5	30.0 32.0				Similar as above except red brown/maroon, wet Note: Driller noted drilling action indicated fractures between 30.0 and 35.0 ft bgs										
35	50/3	S7 3	35.0 37.0			446.7 35.3	BOTTOM OF EXPLORATION 35.3 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-LF-3

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-LF-4

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No. 42796-001
Sheet No. 1 of 3
Start 11 March 2016
Finish 11 March 2016
Driller B. Marshall
H&A Rep. J. Yonts
Elevation 476.6 (est.)
Datum
Location See Plan
N 972312.24
E 2772876.83

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	Sonic	-	Steel	Rig Make & Model: Track Geoprobe 8140LS
Inside Diameter (in.)	4.5	-	6.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	-	-	Drill Mud: None
Hammer Fall (in.)		-	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 60	0.0 5.0	ML			Brown SILT (ML), no structure, no odor, moist, trace clay, less clay with depth to 5.0 ft, trace root material	-	-	-	-	5	95				
5		U2 60	5.0 10.0	ML			Similar as above										
10		U3 120	10.0 20.0	ML			Similar as above Wet at 12.0 ft, possible perched										
				CL		463.6 13.0	Dense red brown CLAY (CL), no odor, moist, trace coarse material -OVERBURDEN-	-	-	-	-	5	95				
15																	
20		U4 120	20.0 30.0	CL			Similar as above except more fine sand, increasing sand content with depth, moist	-	-	-	-	30	70				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	14:00	-	-	-	48.36

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 28.5
Rock Cored (ft) 31.5
Samples 8U

Boring No. CCR-LF-4

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-LF-4
File No. 42796-001
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						453.6											
				SC		23.0	Red-brown yellow-brown clayey SAND (SC), moist, weathered bedrock	-	-	-	10	50	40				
25							-BEDROCK-										
						448.1											
						28.5	Yellow brown white red-brown SANDSTONE, mostly medium to fine sands, dry										
30		U5 120	30.0 40.0				Similar as above except yellow, tan, yellow-brown, white, and red										
35																	
40		U6 120	40.0 50.0				Similar as above except color variations Light brown SANDSTONE, dry										
							Yellow to yellow-brown SANDSTONE, dry										
							Brown light brown SANDSTONE, dry										
							Dark brown SANDSTONE, dry										
45																	
							Red brown, SANDSTONE, moist, trace clay										
						429.6											
						47.0	Gray to dark gray SHALE, fissile, no fossil or other identifiers										
							Black organic rich SHALE, no fossils or layering										
50		U7 36	50.0 53.0				Similar as above Gray SHALE, fissile, no other identifiers observed, dry										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-LF-4

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-LF-4
File No. 42796-001
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
		U8 84	53.0 60.0														
55						421.6 55.0	Gray SILTSTONE										
60						416.6 60.0	BOTTOM OF EXPLORATION 60.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-LF-4

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-LF-5

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	12 March 2016
Finish	12 March 2016
Driller	J. Gryska
H&A Rep.	S. Lewis
Elevation Datum	427.5 (est.)
Location	See Plan N 972228.16 E 2772003.91

	Casing	Sampler	Barrel
Type	HSA	S	Steel
Inside Diameter (in.)	4.25	1 3/8	6.0
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)		30	-

Drilling Equipment and Procedures

Rig Make & Model: Track CME 850 XR
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0				ML		Hand auger from 0.0 ft to 5.0 ft, brown SILT (ML), dry										
						-FILL-										
				ML		Gray and black SILT (ML), petroleum-like odor, moist										
5	4 9 7 6	S1 19	5.0 7.0	ML ML		Very stiff gray and black SILT (ML), petroleum-like odor, moist Very stiff brown SILT (ML), no odor, moist	- -	- -	- -	- -	5 5	95 95				
	2 2 3 5	S2 24	9.0 11.0	CL	418.5 9.0	Medium stiff brown lean CLAY (CL), no odor, moist	-	-	-	-	5	95				
10						-OVERBURDEN-										
	2 6 7 10	S3 24	14.0 16.0	ML	413.5 14.0	Stiff grayish brown SILT with gravel (ML), no odor, moist, organic matter present	-	15	5	5	5	70				
15				ML		Stiff orange black SILT with gravel (ML), no odor, moist, organic matter present	-	15	5	5	5	70				
	4 12 19 36	S4 24	19.0 21.0		408.5 19.0	Gray brown black SILTSTONE, dry, layers of organic matter and laminated less than a mm										
20						-BEDROCK-										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	11:01	-	-	-	20.50

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	19.0
Rock Cored (ft)	11.0
Samples	6S

Boring No. CCR-LF-5

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-LF-5
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	9 16 22 27	S5 24	24.0 26.0				Similar as above										
						398.5											
30	5 5 50/0	S6 no recovery	29.0 31.0			29.0 397.5 30.0	Similar as above, refusal at 30.0 ft, wet, dark gray limestone BOTTOM OF EXPLORATION 30.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-LF-5

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-LF-6

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 1
Start	11 March 2016
Finish	12 March 2016
Driller	J. Gryska
H&A Rep.	S. Lewis
Elevation Datum	409.2 (est.)
Location	See Plan N 972269.53 E 2771046.15

	Casing	Sampler	Barrel
Type	HSA	S	Steel
Inside Diameter (in.)	4.25	1 3/8	6.0
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)		30	-

Drilling Equipment and Procedures

Rig Make & Model: Track CME 850 XR
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Hand clear to 5.0 ft bgs, brown and gray SILT (ML), rock fragments -FILL-										
5	8 14 19 19	S1 17	5.0 7.0	ML		404.2 5.0	Hard brownish gray SILT (ML), no odor, moist	-	-	-	-	-	100				
						400.7 8.5	Dark gray LIMESTONE, no odor, wet -BEDROCK-										
10						399.2 10.0	BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	10:00	-	-	-	12.15

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	1S

Boring No. CCR-LF-6

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-PZ-5

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No. 42796-001
Sheet No. 1 of 3
Start 18 December 2015
Finish 18 December 2015
Driller B. Marshall
H&A Rep. T. Vanage
Elevation 484.1 (est.)
Datum
Location See Plan
N 965928.39
E 2772500.01

	Casing	Sampler	Barrel
Type	Sonic	S	Steel
Inside Diameter (in.)	4.5	1 3/8	6.0
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)		30	-

Drilling Equipment and Procedures

Rig Make & Model: Track Geoprobe 8140LS
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 30	0.0 5.0			Missing recovery - gravel										
				CL		Brown lean CLAY, no odor, moist -FILL-	-	-	-	-	-	100				
5		U2 32	5.0 10.0													
				ML	475.4 8.8	Brown SILT, no odor, dry, laminae bedding observed -OVERBURDEN-	-	-	-	-	-	100				
10		U3 55	10.0 15.0													
15																
20		U4 58	20.0 25.0													

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/20/15	-	-	-	-	Dry

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 40.3
Rock Cored (ft) 8.8
Samples 8U

Boring No. CCR-PZ-5

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-PZ-5
File No. 42796-001
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
							Moist at 21.0 ft										
				CL		459.6 24.5	Medium stiff brown lean CLAY with silt, no odor, dry to moist	-	-	-	-	-	100				
25		U5 60	25.0 30.0														
30		U6 36	30.0 35.0	CL			Similar as above										
35		U7 60	35.0 40.0	CL			Similar as above										
40		U8 120	40.0 50.0			443.9 40.3	Tan moderately weathered fine-grained SANDSTONE -BEDROCK-										
45																	
50						434.1 50.0	BOTTOM OF EXPLORATION 50.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-PZ-5

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-SP-1

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 1
Start	13 March 2016
Finish	13 March 2016
Driller	J. Gryska
H&A Rep.	S. Lewis
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	6.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0				ML		Hand clear to 5.0 ft bgs, brown SILT (ML), dry -FILL-										
5	4 5 8 8	S1 15	5.0 7.0	ML	5.0	Stiff brown SILT (ML), no odor, moist	-	-	-	-	-	100				
10	3 5 7 5	S2 17	8.5 10.5	ML		Stiff dark gray SILT (ML), no odor, moist, trace wood fragments	-	-	-	-	-	100				
15	WOH WOH WOH 3	S3 24	13.5 15.5	ML		Very soft grayish brown SILT ML), no odor, wet	-	-	-	-	-	100				
20	WOH 2 1 2	S4 20	18.5 20.5	ML		Soft grayish brown SILT (ML), no odor, wet, mottled with orange/black colors	-	-	-	-	-	100				
					20.5	BOTTOM OF EXPLORATION 20.5 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	09:41	-	-	-	9.00

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	20.0
Rock Cored (ft)	-
Samples	4S

Boring No. CCR-SP-1

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-SP-2

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	13 March 2016
Finish	13 March 2016
Driller	J. Gryska
H&A Rep.	S. Lewis
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel
Type	HSA	S	Steel
Inside Diameter (in.)	4.25	1 3/8	6.0
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)		30	-

Drilling Equipment and Procedures

Rig Make & Model: Track CME 850 XR
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Hand auger from 0.0 ft to 5.0 ft 1.0 ft to 1.5 ft, crushed limestone and clay										
				CL		1.5	-FILL- Brown CLAY (CL), dry										
5	4 7 12 12	S1 18	5.0 7.0	ML		5.0	Very stiff grayish brown SILT (ML), no odor, moist	-	-	-	-	-	100				
10	3 4 6 6	S2 14	8.5 10.5	ML			Stiff gray SILT with sand (ML), no odor, moist -OVERBURDEN-	-	-	-	-	15	85				
15	1 2 2 2	S3 17	13.5 15.5	ML			Soft grayish brown SILT (ML), no odor, wet, trace clay present	-	-	-	-	5	95				
20	1 1 1 1	S4 18	18.5 20.5	ML			Very soft grayish brown SILT (ML), no odor, wet, trace clay present	-	-	-	-	5	95				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	09:35	-	-	-	8.60

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	25.5
Rock Cored (ft)	-
Samples	5S

Boring No. CCR-SP-2

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-SP-2
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	2 1 2 3	S5 24	23.5 25.5	ML			Soft gray SILT (ML), no odor, wet, trace wood fragments, trace clay present	-	-	-	-	5	95				
						25.5	BOTTOM OF EXPLORATION 25.5 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-SP-2

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-SP-3

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 1
Start	13 March 2016
Finish	13 March 2016
Driller	J. Gryska
H&A Rep.	S. Lewis
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	6.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer:
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0				ML		Hand auger from 0.0 ft to 5.0 ft, brown SILT (ML), dry -FILL-										
5	1 1 2 3	S1 22	5.0 7.0	ML	5.0	Soft brownish gray mottled SILT (ML), no odor, wet -OVERBURDEN-	-	-	-	-	5	95				
10	1 1 2 2	S2 21	8.5 10.5	ML		Soft grayish brown mottled SILT (ML), no odor, wet	-	-	-	-	-	100				
15	WOH WOH WOH WOH	S3 24	13.5 15.5	CL	13.5	Very soft gray lean CLAY (CL), no odor, wet	-	-	-	-	-	100				
20	2 5 8 9	S4 24	18.5 20.5	ML	18.5	Stiff gray-brown lean CLAY (CL), no odor, moist, red mottling	-	-	-	-	-	100				
					20.5	BOTTOM OF EXPLORATION 20.5 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	09:28	-	-	-	3.44

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	20.5
Rock Cored (ft)	-
Samples	4S

Boring No. CCR-SP-3

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-1

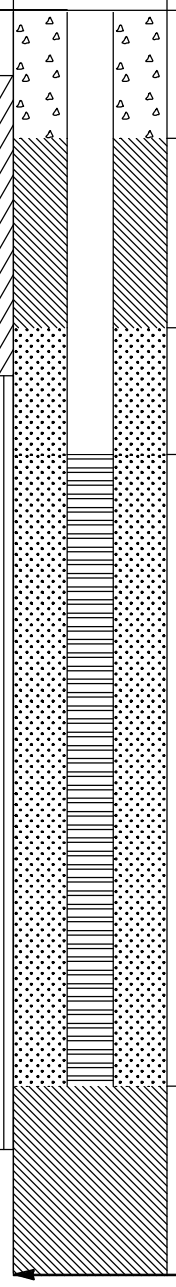
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	B. Marshall
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	18 Dec 2015
H&A Rep.	T. Vanage
Location	N 968260.82 E 2773560.71
Ground El. Datum	465.7 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
				2.0	463.7
	5			5.0	460.7
				7.0	458.7
OVERBURDEN	10				
	15			17.0	448.7
	18.0				
BEDROCK	20.0			20.0	445.7



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.0 ft
Height of top of riser above ground surface	2.8 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.0 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	7.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Bentonite	2.0	3.0
Sand	5.0	12.5
Bentonite	17.5	2.5
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	7.0 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	17.0 ft
Bottom of silt trap	-
Depth of bottom of borehole	20.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-1R

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

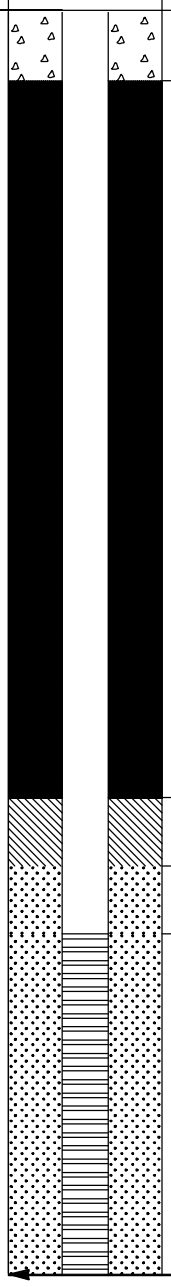
Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001
Date Installed 26 Jul 2016
H&A Rep. C. Toscano
Location See Plan

Ground El.
Datum

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
OVERBURDEN	0 – 18.0			2.0	
BEDROCK	18.0 – 37.0			23.0	
				25.0	
				27.0	
				37.0	



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.0 ft
Height of top of riser above ground surface	2.8 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.0 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	26.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	0.0	23.0
Bentonite	23.0	2.0
Sand	25.0	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	26.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	36.7 ft
Bottom of silt trap	37.0 ft
Depth of bottom of borehole	37.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-2

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	B. Marshall
Initial Water Level (depth bgs)	ft

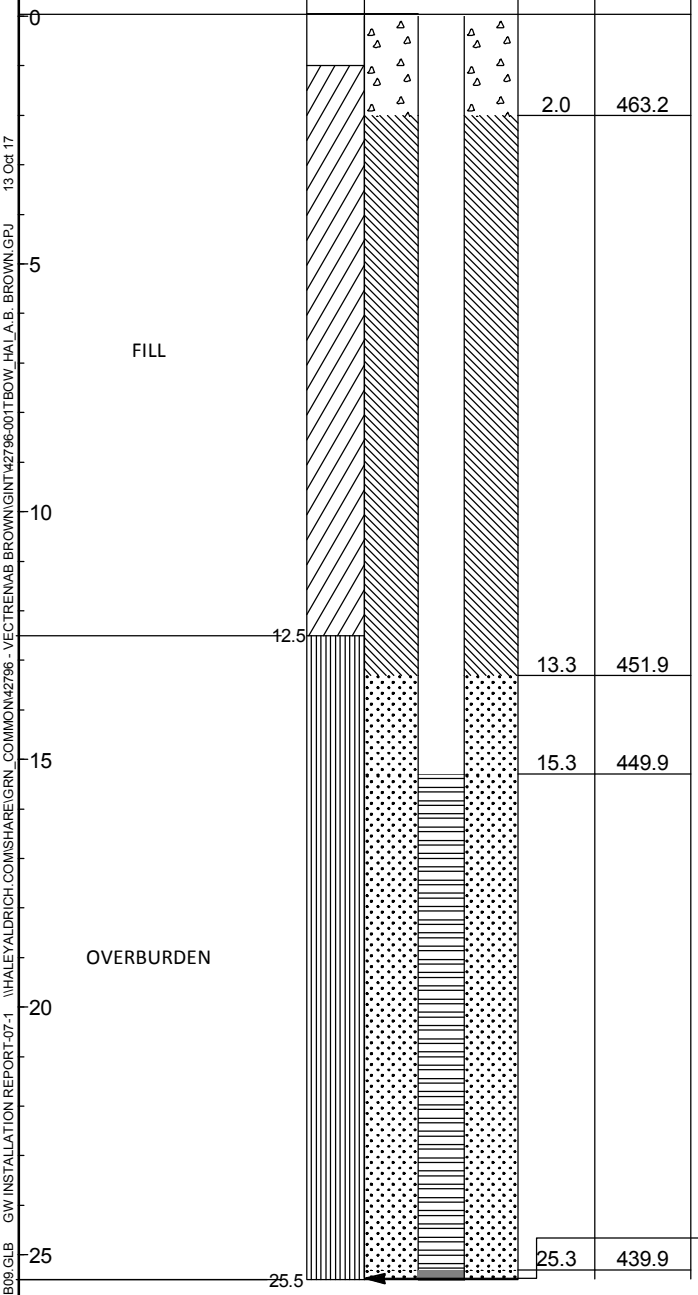
Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	17 Dec 2015
H&A Rep.	T. Vanage
Location	N 969079.16 E 2771922.52
Ground El. Datum	465.2 (est.)

SOIL/ROCK

CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
FILL	0			2.0	463.2
	12.5			13.3	451.9
OVERBURDEN				15.3	449.9
	25.5			25.3	439.9



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.2 ft
Height of top of riser above ground surface	2.8 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	2.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	15.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	2.0
Bentonite	2.0	10.5
Sand	12.5	13.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	15.0 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	25.5 ft
Bottom of silt trap	25.3 ft
Depth of bottom of borehole	25.5 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-2R

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

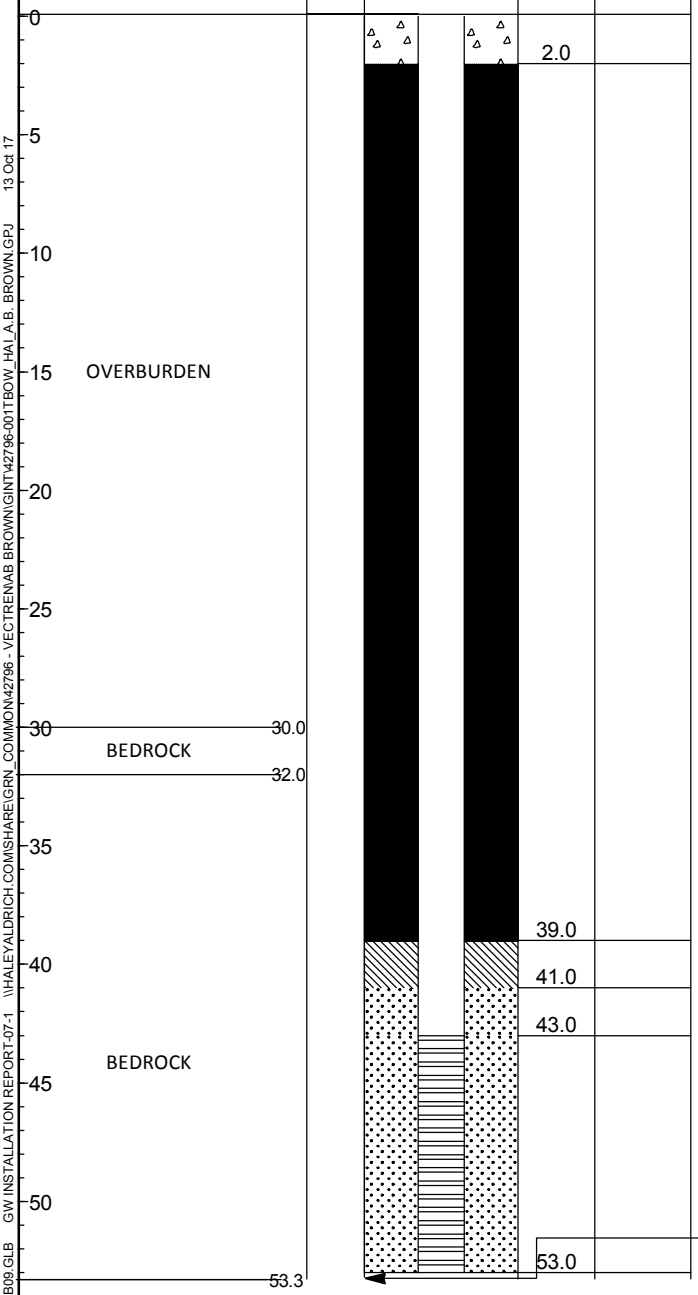
Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001
Date Installed 28 Jul 2016
H&A Rep. C. Toscano
Location See Plan

Ground El.
Datum

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
OVERBURDEN				2.0	
BEDROCK	30.0			39.0	
	32.0			41.0	
BEDROCK				43.0	
	53.3			53.0	



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.0 ft
Height of top of riser above ground surface	2.8 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.0 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	43.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	0.0	39.0
Bentonite	39.0	2.0
Sand	41.0	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	43.0 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	53.0 ft
Bottom of silt trap	53.3 ft
Depth of bottom of borehole	53.3 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-3

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	B. Marshall
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	20 Dec 2015
H&A Rep.	T. Vanage
Location	N 966865.12 E 2771404.27
Ground El. Datum	450.0 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
				2.0	448.0
	5				
	10			13.0	437.0
	15			15.0	435.0
	20				
	25			25.0	425.0
				26.0	424.0
OVERBURDEN					
	30				
	32.5				
BEDROCK					
	35.0			35.0	415.0

WELL CONSTRUCTION DETAILS

Type of protective cover	Flush Mount
Depth of Morrison Flush Mount below ground surface	0.0 ft
Height of top of riser above ground surface	0.3 ft
Type of protective casing	Morrison Flush Mount
Length	0.8 ft
Inside diameter	0.8 in.
Depth of bottom of Morrison Flush Mount	0.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	15.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Bentonite	2.0	11.0
Sand	13.0	13.0
Bentonite	26.0	9.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	15.0 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	25.0 ft
Bottom of silt trap	25.5 ft
Depth of bottom of borehole	35.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-3R

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	28 Jul 2016
H&A Rep.	S.Lewis
Location	See Plan
Ground El.	
Datum	

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
	5			2.0	
	10				
	15				
	20				
	25				
	30			33.0	
	35			35.0	
	40			37.0	
	45				
	47.0			47.0	

WELL CONSTRUCTION DETAILS

Type of protective cover	Flush Mount
Depth of Morrison Flush Mount below ground surface	0.0 ft
Height of top of riser above ground surface	0.2 ft
Type of protective casing	Morrison Flush Mount
Length	0.8 ft
Inside diameter	3.0 in.
Depth of bottom of Morrison Flush Mount	0.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	36.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	33.0
Bentonite	33.0	2.0
Sand	35.0	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	36.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	46.7 ft
Bottom of silt trap	47.0 ft
Depth of bottom of borehole	47.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-4

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

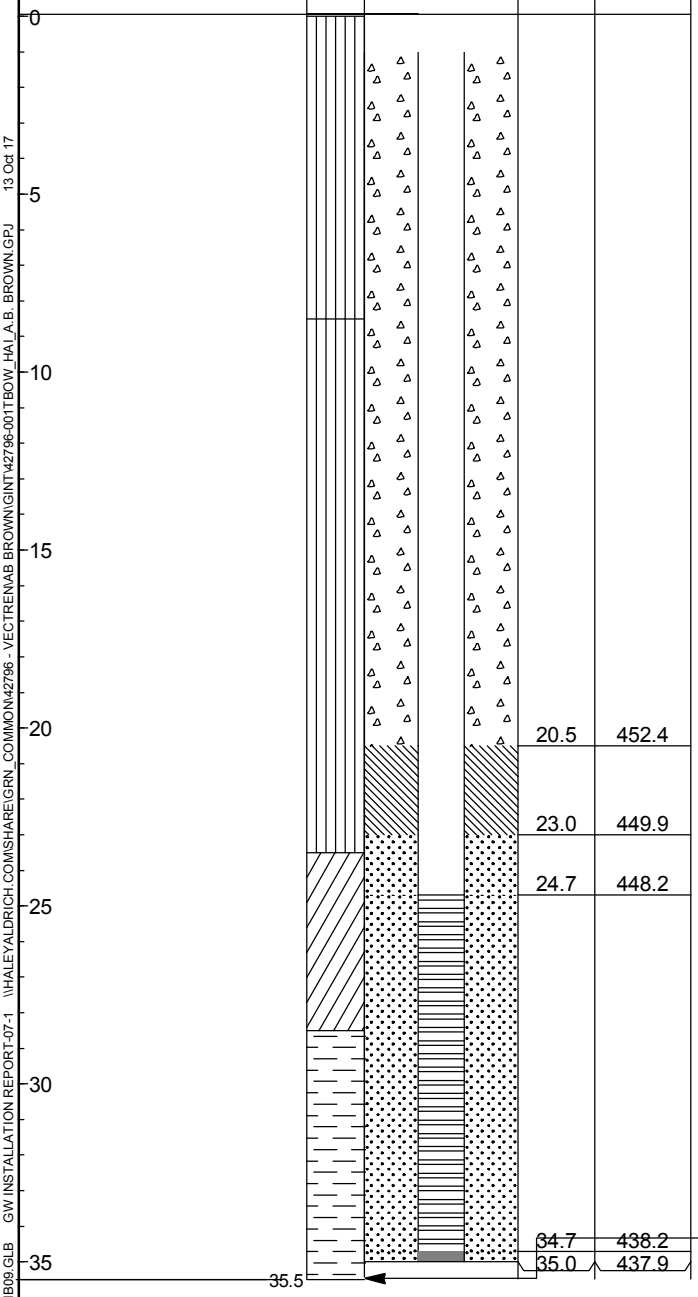
Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	14 Mar 2016
H&A Rep.	J. Yonts
Location	N 966741.47 E 2772827.01
Ground El. Datum	472.9 (est.)

SOIL/ROCK

CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
				20.5	452.4
				23.0	449.9
				24.7	448.2
				34.7	438.2
				35.0	437.9



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	2.8 ft
Height of top of riser above ground surface	2.5 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.3 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	24.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	1.0	19.5
Bentonite	20.5	2.5
Sand	23.0	12.0
	-	-

Diameter of borehole	8.0 in.
Depth to top of well screen	24.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	34.7 ft
Bottom of silt trap	35.0 ft
Depth of bottom of borehole	35.5 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-4R

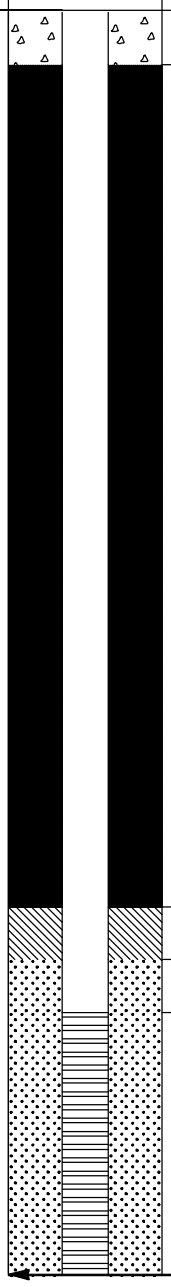
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	27 Jul 2016
H&A Rep.	C. Toscano
Location	See Plan
Ground El.	
Datum	

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
				2.0	
	5				
	10				
	15				
	20				
	25				
	28.0				
	30				
				34.0	
	35			36.0	
				38.0	
	40				
	45				
	48.0			48.0	



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.0 ft
Height of top of riser above ground surface	2.7 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.0 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	37.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	1.0	36.0
Bentonite	36.0	2.0
Sand	38.0	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	37.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	47.7 ft
Bottom of silt trap	48.0 ft
Depth of bottom of borehole	48.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-5

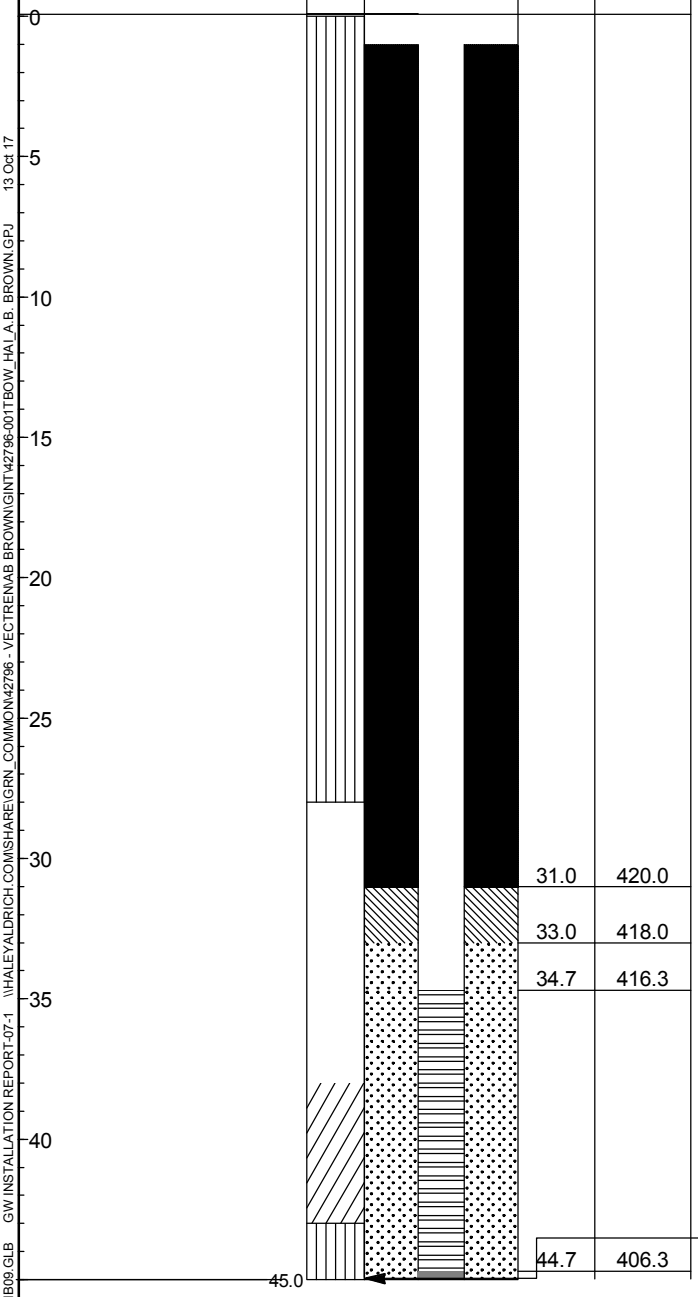
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	14 Mar 2016
H&A Rep.	S. Lewis
Location	N 968166.03 E 3771019.7
Ground El. Datum	451.0 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
	5				
	10				
	15				
	20				
	25				
	30			31.0	420.0
				33.0	418.0
	35			34.7	416.3
	40				
	45.0			44.7	406.3



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.0 ft
Height of top of riser above ground surface	2.7 ft
Type of protective casing	Steel
Length	5.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	2.0 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	34.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	1.0	30.0
Bentonite	31.0	2.0
Sand	33.0	12.0
	-	-

Diameter of borehole	8.0 in.
Depth to top of well screen	34.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	44.7 ft
Bottom of silt trap	45.0 ft
Depth of bottom of borehole	45.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-6

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	11 Mar 2016
H&A Rep.	S. Lewis
Location	N 969932.76 E 2771626.75
Ground El. Datum	458.9 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
	5				
ALLUVIUM	10				
	14.0				
	15				
BEDROCK	20				
	25			25.0	433.9
				27.0	431.9
	29.0			28.7	430.2
	30				
	35				
	39.0			38.7	420.2

WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.2 ft
Height of top of riser above ground surface	2.9 ft
Type of protective casing	Steel
Length	5.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	1.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	28.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	1.0	24.0
Bentonite	25.0	2.0
Sand	27.0	12.0
	-	-

Diameter of borehole	8.0 in.
Depth to top of well screen	28.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	39.0 ft
Bottom of silt trap	28.7 ft
Depth of bottom of borehole	39.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HA_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-7

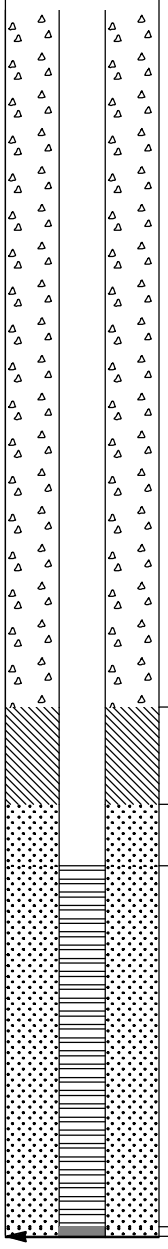
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	B. Marshall
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	14 Mar 2016
H&A Rep.	J. Yonts
Location	N 970758.7 E 2773501.63
Ground El.	486.0 (est.)
Datum	

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
	5				
	10				
	15	15.0			
	20			20.3	465.7
	22.0			23.0	463.0
	25			24.7	461.3
	26.0				
	28.0				
	30				
	35.0			34.7	451.3



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.0 ft
Height of top of riser above ground surface	2.7 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.1 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	24.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	1.0	19.3
Bentonite	20.3	2.7
Sand	23.0	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	24.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	34.7 ft
Bottom of silt trap	35.0 ft
Depth of bottom of borehole	35.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-7R

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

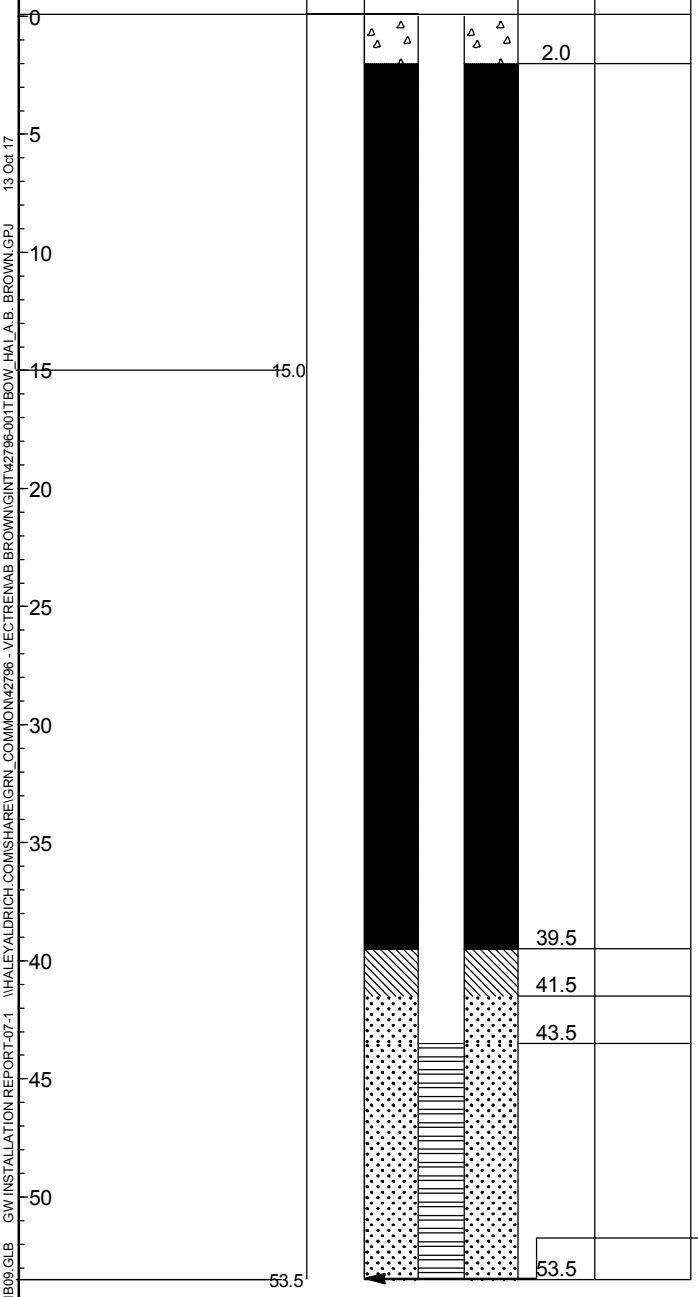
Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001
Date Installed 30 Jul 2016
H&A Rep. C. Toscano
Location See Plan

Ground El.
Datum

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0			2.0	
	15.0			39.5	
				41.5	
				43.5	
	53.5			53.5	



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.0 ft
Height of top of riser above ground surface	2.7 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.0 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	53.2 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	1.0	41.5
Bentonite	41.5	2.0
Sand	43.5	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	53.2 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	53.2 ft
Bottom of silt trap	53.5 ft
Depth of bottom of borehole	53.5 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-BK-1

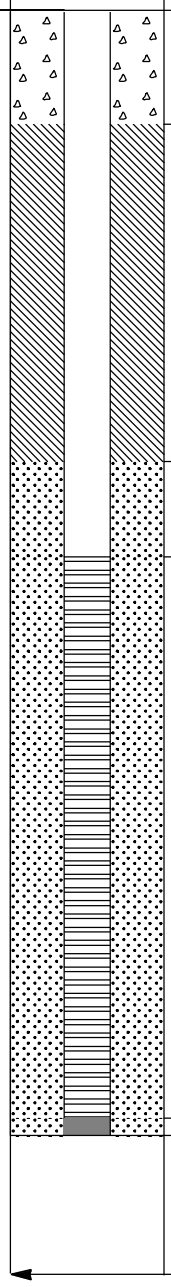
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	B. Marshall
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	10 Mar 2016
H&A Rep.	J. Yonts
Location	N 974083.4 E 2770919.08
Ground El. Datum	480.4 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
				2.0	478.4
	5				
TOPSOIL				8.0	472.4
				9.7	470.7
	10				
	15				
	16.0				
				19.7	460.7
	20			20.0	460.4
	22.5				



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.3 ft
Height of top of riser above ground surface	3.0 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	2.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	9.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	2.0
Bentonite	2.0	6.0
Sand	8.0	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	9.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	19.7 ft
Bottom of silt trap	20.0 ft
Depth of bottom of borehole	22.5 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-BK-1R

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

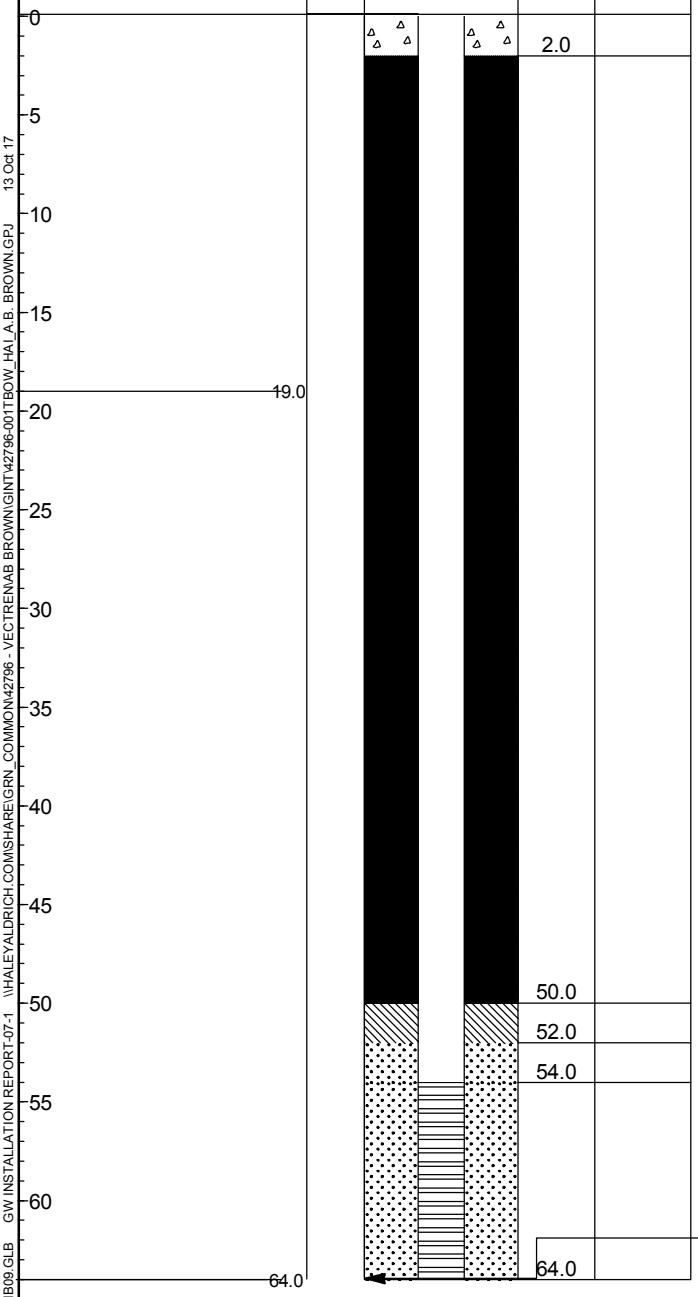
Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001
Date Installed 29 Jul 2016
H&A Rep. C. Toscano
Location See Plan

Ground El.
Datum

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	19.0			2.0	
	64.0			50.0	
				52.0	
				54.0	
				64.0	



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.0 ft
Height of top of riser above ground surface	2.7 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.0 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	53.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	1.0	50.0
Bentonite	50.0	2.0
Sand	52.0	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	53.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	63.7 ft
Bottom of silt trap	64.0 ft
Depth of bottom of borehole	64.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HA_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-BK-2

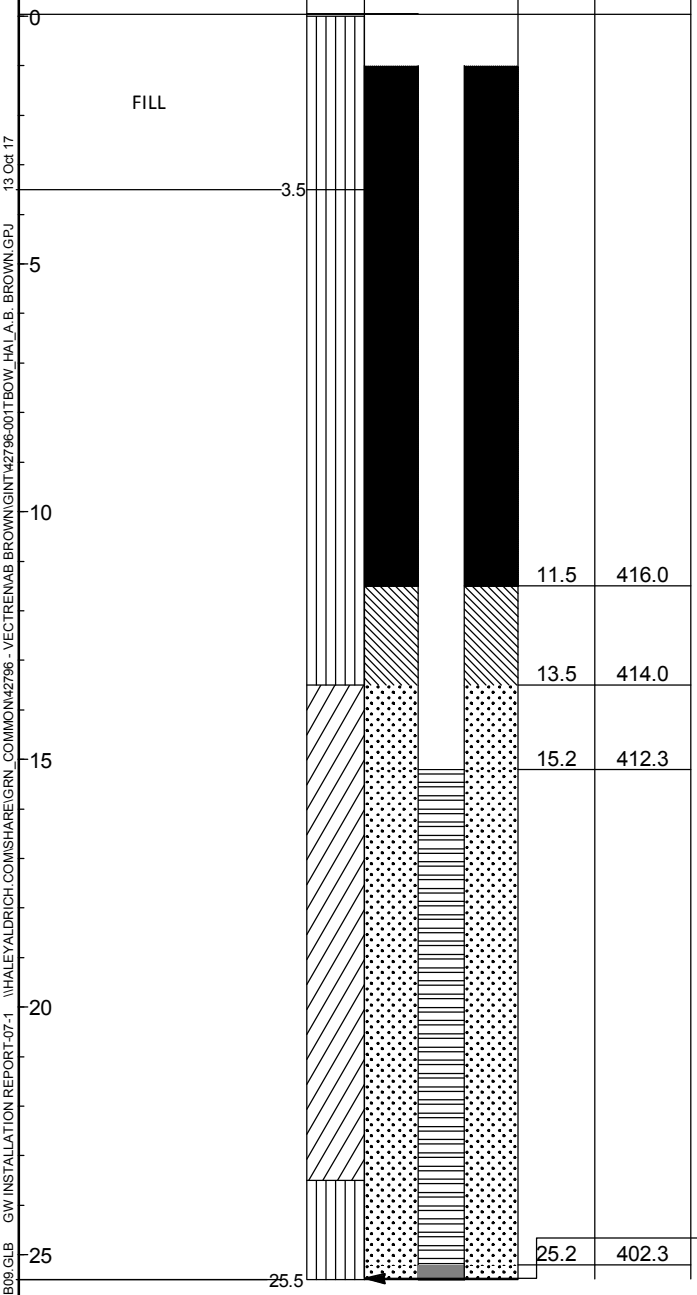
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	11 Mar 2016
H&A Rep.	S. Lewis
Location	N 972854.33 E 2769728.14
Ground El. Datum	427.5 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
FILL	0				
	3.5				
				11.5	416.0
				13.5	414.0
				15.2	412.3
	25.5			25.2	402.3



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.4 ft
Height of top of riser above ground surface	3.1 ft
Type of protective casing	Steel
Length	5.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	1.6 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	15.2 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	1.0	10.5
Bentonite	11.5	2.0
Sand	13.5	12.0
	-	-

Diameter of borehole	8.0 in.
Depth to top of well screen	15.2 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	25.5 ft
Bottom of silt trap	25.2 ft
Depth of bottom of borehole	25.5 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-LF-1

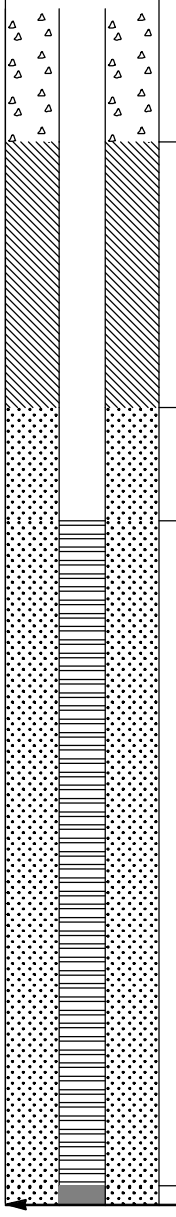
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	B. Marshall
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	10 Mar 2016
H&A Rep.	J. Yonts
Location	N 970812.18 E 2771247.76
Ground El. Datum	432.8 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
FILL				3.0	429.8
	4.0				
BEDROCK				7.0	425.8
				8.7	424.1
	9.0				
	9.5				
	12.0				
	13.0				
				18.7	414.1
	19.0			19.0	413.8



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.2 ft
Height of top of riser above ground surface	2.9 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	2.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	8.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	1.0	2.0
Bentonite	3.0	4.0
Sand	7.0	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	8.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	18.7 ft
Bottom of silt trap	19.0 ft
Depth of bottom of borehole	19.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HA_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-LF-2

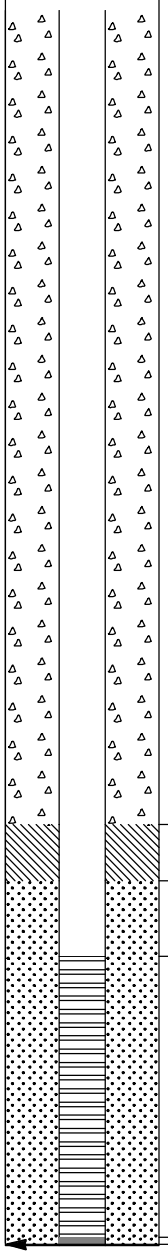
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	B. Marshall
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	12 Mar 2016
H&A Rep.	J. Yonts
Location	N 970681.32 E 2772205.05
Ground El. Datum	470.1 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
0 TOPSOIL	0.2				
FILL	3.0				
FILL	7.5				
	18.7				
	24.0				
				30.0	440.1
				32.0	438.1
				34.7	435.4
	45.0			44.7	425.4



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.2 ft
Height of top of riser above ground surface	2.9 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	2.9 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	34.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	1.0	29.0
Bentonite	30.0	2.0
Sand	32.0	13.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	34.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	44.7 ft
Bottom of silt trap	45.0 ft
Depth of bottom of borehole	45.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-LF-3

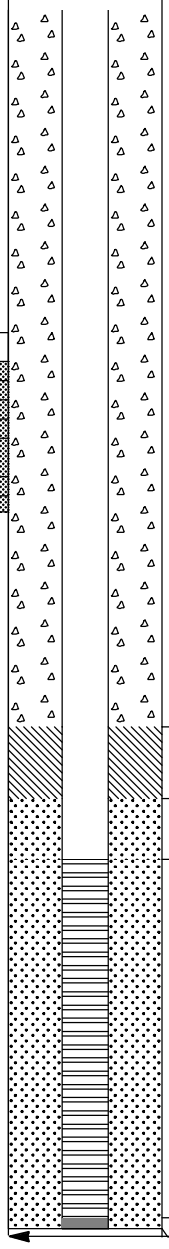
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	14 Mar 2016
H&A Rep.	J. Yonts
Location	N 970949.7 E 2773138.97
Ground El. Datum	482.0 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
	5				
	10				
BEDROCK	10.8				
	15.0				
	20				
				21.0	461.0
				23.0	459.0
				24.7	457.3
	25				
	30				
				34.7	447.3
	35			35.0	447.0
	35.3				



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.2 ft
Height of top of riser above ground surface	2.8 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	2.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	24.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	1.0	20.0
Bentonite	21.0	2.0
Sand	23.0	12.0
	-	-

Diameter of borehole	8.0 in.
Depth to top of well screen	24.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	34.7 ft
Bottom of silt trap	35.0 ft
Depth of bottom of borehole	35.3 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-LF-4

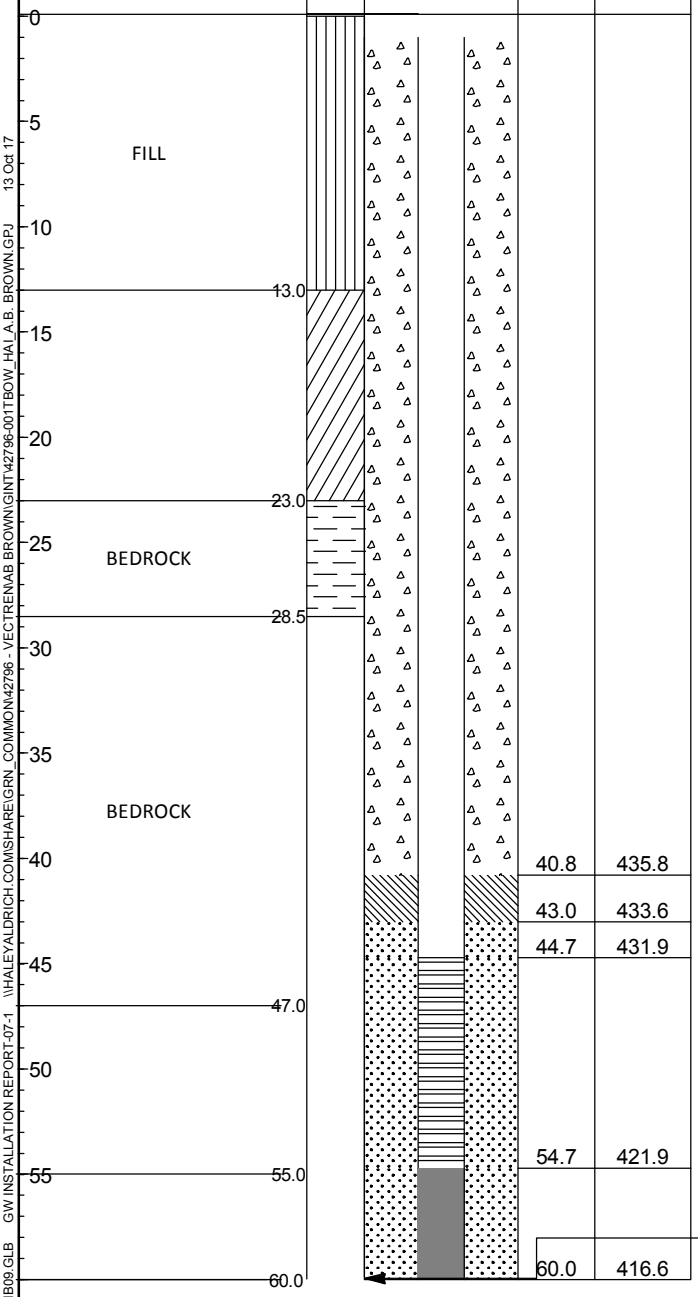
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	B. Marshall
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	11 Mar 2016
H&A Rep.	J. Yonts
Location	N 972312.24 E 2772876.83
Ground El. Datum	476.6 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
FILL	0				
	13.0				
BEDROCK	23.0				
	28.5				
BEDROCK				40.8	435.8
				43.0	433.6
				44.7	431.9
	47.0				
	55.0			54.7	421.9
	60.0			60.0	416.6



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	2.7 ft
Height of top of riser above ground surface	2.4 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.3 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	44.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	1.0	39.8
Bentonite	40.8	2.2
Sand	43.0	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	44.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	54.7 ft
Bottom of silt trap	55.0 ft
Depth of bottom of borehole	60.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-LF-5

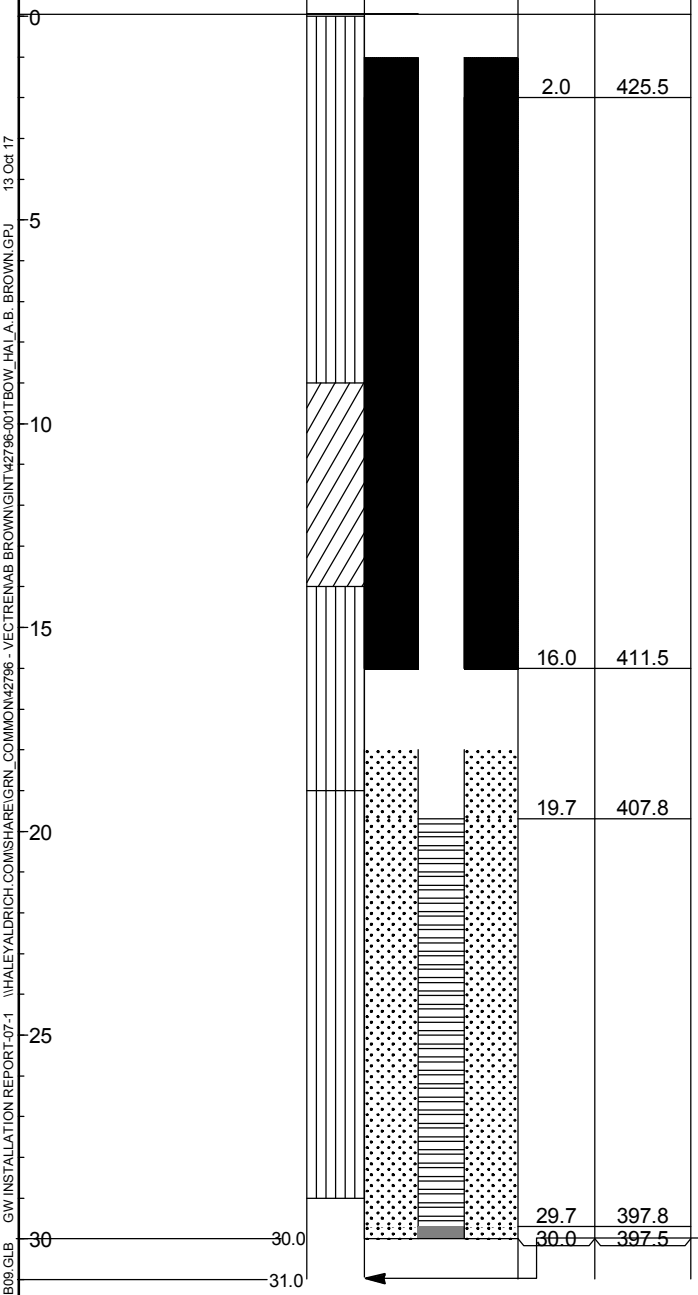
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	12 Mar 2016
H&A Rep.	S. Lewis
Location	N 972228.16 E 2772003.91
Ground El. Datum	427.5 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
				2.0	425.5
	5				
	10				
	15			16.0	411.5
				19.7	407.8
	20				
	25				
				29.7	397.8
	30			30.0	397.5
	30.0				
	31.0				



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.1 ft
Height of top of riser above ground surface	2.8 ft
Type of protective casing	Steel
Length	5.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	1.9 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	19.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	1.0	15.0
Bentonite	16.0	2.0
Sand	18.0	12.0
	-	-

Diameter of borehole	8.0 in.
Depth to top of well screen	19.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	30.0 ft
Bottom of silt trap	29.7 ft
Depth of bottom of borehole	31.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-LF-6

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	12 Mar 2016
H&A Rep.	S. Lewis
Location	N 972269.53 E 2771046.15
Ground El. Datum	409.2 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
				2.7	406.5
				4.4	404.8
	5				
	5.0				
	8.5				
				9.4	399.8
				9.7	399.5
	10.0				

WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.3 ft
Height of top of riser above ground surface	2.8 ft
Type of protective casing	Steel
Length	5.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	1.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	4.4 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Bentonite	1.0	1.7
Sand	2.7	7.0
	-	-
	-	-

Diameter of borehole	8.0 in.
Depth to top of well screen	4.4 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	9.66 ft
Bottom of silt trap	9.7 ft
Depth of bottom of borehole	10.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-PZ-5

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	B. Marshall
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	18 Dec 2015
H&A Rep.	T. Vanage
Location	N 965928.39 E 2772500.01
Ground El. Datum	484.1 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0			1.0	483.1
				4.0	480.1
FILL	5				
	8.8				
ALLUVIUM	10, 15, 20				
	24.5				
ALLUVIUM	25, 30			31.5	452.6
				35.0	449.1
	35			37.0	447.1
	40.3				
SANDSTONE	45			47.0	437.1
	50.0			50.0	434.1

WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	2.8 ft
Height of top of riser above ground surface	2.7 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.2 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	37.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	4.0	27.5
Bentonite	31.5	3.5
Sand	35.0	15.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	37.0 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	47.0 ft
Bottom of silt trap	47.2 ft
Depth of bottom of borehole	50.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HA_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-SP-1

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska

Initial Water Level (depth bgs) ft

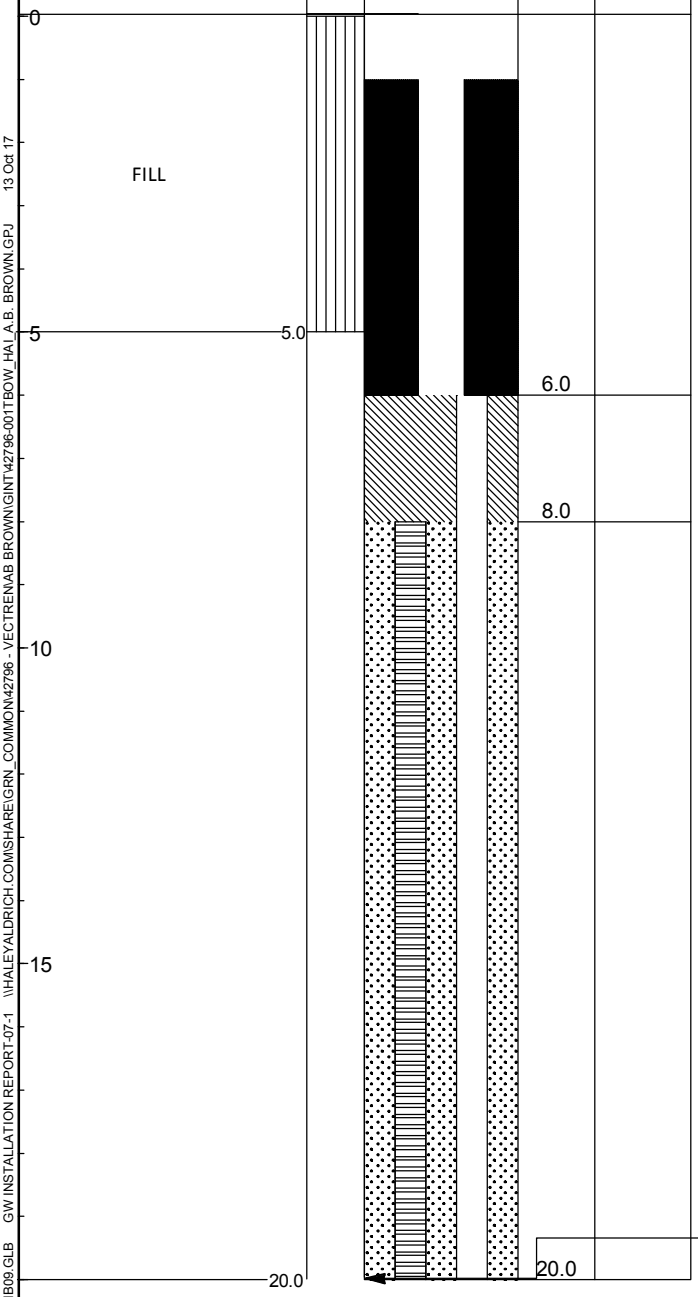
Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001
Date Installed 13 Mar 2016
H&A Rep. S. Lewis
Location See Plan

Ground El.
Datum

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
FILL	5.0			6.0	
				8.0	
	20.0			20.0	



WELL CONSTRUCTION DETAILS

Type of protective cover: Flush Mount

Depth of Morrison Flush Mount below ground surface: 0.0 ft

Height of top of riser above ground surface: 0.5 ft

Type of protective casing: Morrison Flush Mount

Length: 0.8 ft

Inside diameter: 9.0 in.

Depth of bottom of Morrison Flush Mount: 0.8 ft

Type of riser pipe: Schedule 40 PVC

Inside diameter of riser pipe: 2.0 in.

Depth of bottom of riser pipe: 9.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	1.0	5.0
Bentonite	6.0	2.0
Sand	8.0	12.0
	-	-

Diameter of borehole: 8.0 in.

Depth to top of well screen: 9.7 ft

Type of screen: Machine slotted Sch 40 PVC

Screen gauge or size of openings: 0.010 in.

Diameter of screen: 2.0 in.

Type of Backfill around Screen: Quartz Sand

Depth to bottom of well screen:

Bottom of silt trap: 20.0 ft

Depth of bottom of borehole: 20.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-SP-2

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

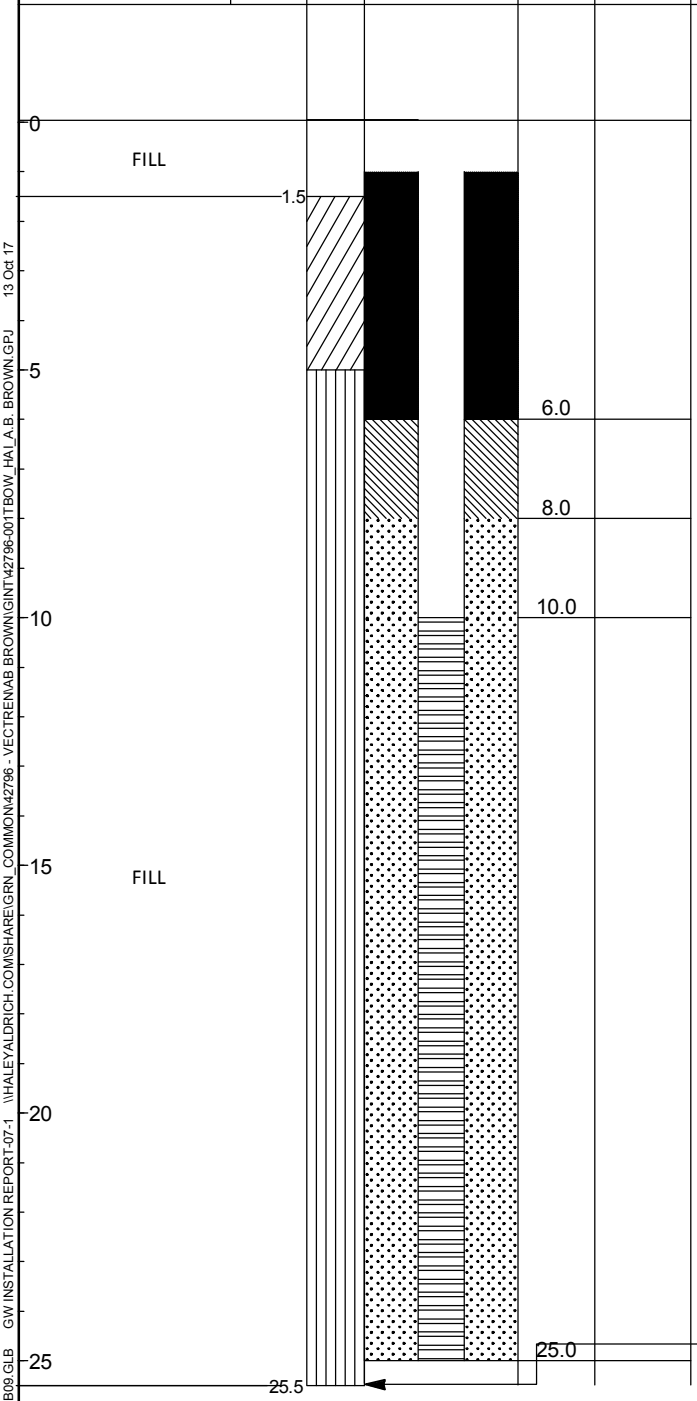
Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001
Date Installed 13 Mar 2016
H&A Rep. S. Lewis
Location See Plan

Ground El.
Datum

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
FILL	0				
	1.5				
	5			6.0	
				8.0	
	10			10.0	
FILL	15				
	20				
	25			25.0	
	25.5				



WELL CONSTRUCTION DETAILS

Type of protective cover	Flush Mount
Depth of Morrison Flush Mount below ground surface	0.0 ft
Height of top of riser above ground surface	0.4 ft
Type of protective casing	Morrison Flush Mount
Length	0.8 ft
Inside diameter	9.0 in.
Depth of bottom of Morrison Flush Mount	0.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	9.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	1.0	5.0
Bentonite	6.0	2.0
Sand	8.0	12.0
	-	-

Diameter of borehole	8.0 in.
Depth to top of well screen	9.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	20.0 ft
Bottom of silt trap	19.7 ft
Depth of bottom of borehole	25.5 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-SP-3

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

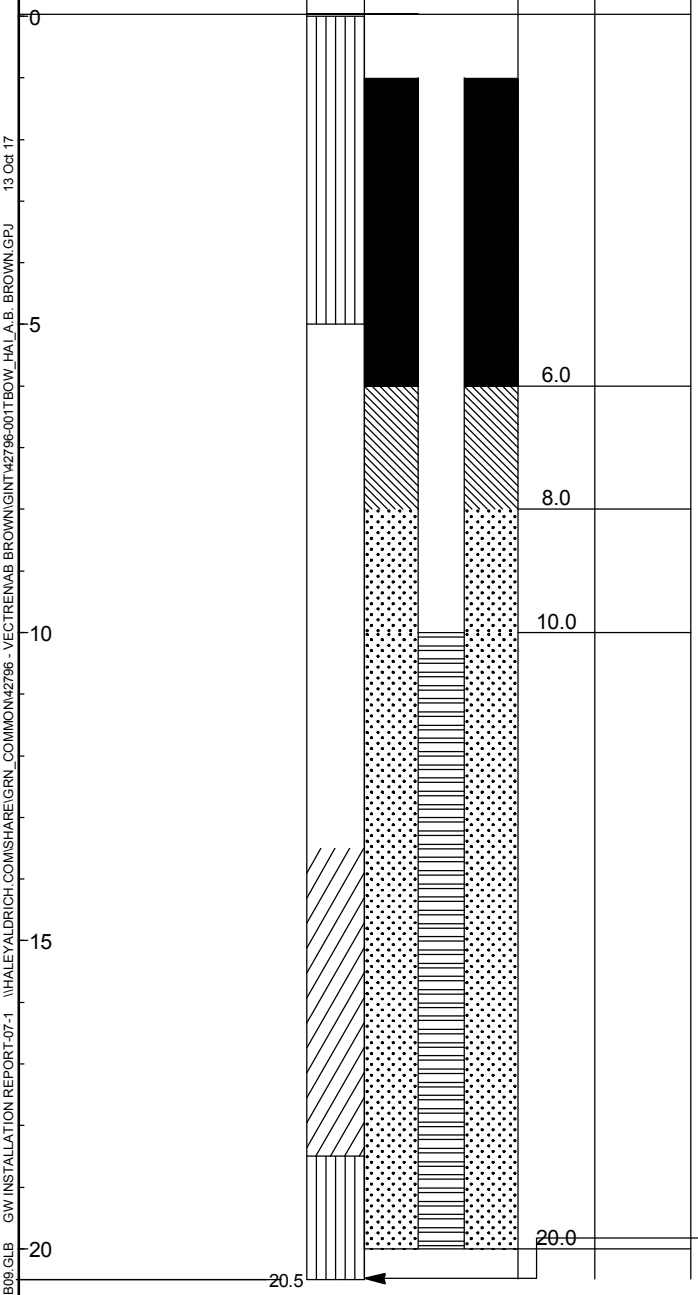
Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001
Date Installed 13 Mar 2016
H&A Rep. S. Lewis
Location See Plan

Ground El.
Datum

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)



WELL CONSTRUCTION DETAILS

Type of protective cover	Flush Mount
Depth of Morrison Flush Mount below ground surface	0.0 ft
Height of top of riser above ground surface	0.4 ft
Type of protective casing	Morrison Flush Mount
Length	0.8 ft
Inside diameter	9.0 in.
Depth of bottom of Morrison Flush Mount	0.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	9.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	1.0	5.0
Bentonite	6.0	2.0
Sand	8.0	12.0
	-	-

Diameter of borehole	8.0 in.
Depth to top of well screen	9.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	20.0 ft
Bottom of silt trap	19.7 ft
Depth of bottom of borehole	20.5 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

Appendix B
Landfill Annual Groundwater Monitoring and Corrective Action Reports

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REPORT ON

2017 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT A.B. BROWN GENERATING STATION WEST FRANKLIN, INDIANA

by Haley & Aldrich, Inc.
Greenville, South Carolina

for Southern Indiana Gas and Electric Company (SIGECO)
Evansville, Indiana

File No. 129420-003
January 2018

Annual Groundwater Monitoring Report Summary

Haley & Aldrich, Inc. (Haley & Aldrich) has prepared this 2017 Annual Groundwater Monitoring Corrective Action Report for the A.B. Brown Generating Station (ABB). This 2017 Annual Report was developed to comply with the United States Environmental Protection Agency (USEPA) Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals (CCR) from Electric Utilities, 40 CFR Part 257, Subpart D dated 17 April 2015 (Rule), specifically subsection §257.90(e)(1) through (5). Southern Indiana Gas and Electric Company (SIGECO) operates the existing coal combustion residuals (CCR) management unit referred to as Ash pond at ABB located in Posey County, Indiana near the community of West Franklin. This CCR unit is subject to the Rule since it was active as of the effective date of the Rule.

This annual report addresses the CCR management unit, referred to as Ash pond, at ABB, as described in the Groundwater Monitoring Program report, which was certified and placed in the facility's operating record on October 17, 2017 as required by §257.105(h)(2) and posted on the facility's website on November 16, 2017 as required by §257.107(h)(2).

To report on the activities conducted during the prior calendar year and document compliance with the Rule, the specific requirements listed in §257.90(e)(1) through (5) are provided below in bold/italic type followed by a short narrative addressing how that specific requirement was met.

§257.90 APPLICABILITY

§257.90(e) Annual groundwater monitoring and corrective action report. For existing CCR landfills and existing CCR surface impoundments, no later than January 31, 2018, and annually thereafter, the owner or operator must prepare an annual groundwater monitoring and corrective action report. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, the owner or operator must prepare the initial annual groundwater monitoring and corrective action report no later than January 31 of the year following the calendar year a groundwater monitoring system has been established for such CCR unit as required by this subpart, and annually thereafter. For the preceding calendar year, the annual report must document the status of the groundwater monitoring and corrective action program for the CCR unit, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year. For purposes of this section, the owner or operator has prepared the annual report when the report is placed in the facility's operating record as required by §257.105(h)(1).

> As required, this annual report documents the status of the groundwater monitoring program for the CCR management unit at ABB and summarizes key actions completed during the prior calendar year.

At a minimum, the annual groundwater monitoring and corrective action report must contain the following information, to the extent available:

§257.90(e)(1) AERIAL IMAGE OF GROUNDWATER MONITORING PROGRAM

§257.90(e)(1) A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;

As required by §257.90(e)(1), maps showing the location of the Ash pond and associated upgradient and downgradient monitoring wells are included in this report as **Figure 1**. In addition, this information is presented in the Groundwater Monitoring Program report prepared for ABB, which was placed in the facility's operating record on October 17, 2017 as required by §257.105(h)(2).

§257.90(e)(2) ADJUSTMENTS TO GROUNDWATER MONITORING PROGRAM

§257.90(e)(2) Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;

To comply with the requirements of §257.91, a groundwater monitoring network of nine (9) wells were installed for the Ash pond at ABB. Details of the design, and construction of the monitoring wells are summarized in Table 1. Additional description of the monitoring network is presented in the Groundwater Monitoring Program report, which was placed in the facility's operating record on October 17, 2017, as required by §257.105(h)(2). None of the wells installed to monitor groundwater quality upgradient and downgradient of the Ash Pond were decommissioned in 2017.

§257.90(e)(3) SUMMARY OF GROUNDWATER ANALYSIS

§257.90(e)(3) In addition to all the monitoring data obtained under §257.90 through §257.98, a summary including the number of groundwater samples that were collected for analysis for each background [upgradient] ***and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;***

In accordance with §257.94(b), a minimum of eight independent samples from each upgradient and downgradient monitoring well were collected prior to October 17, 2017. A summary of the groundwater monitoring program for the Ash pond, including the analytical results for the Appendix III and Appendix IV list of constituents, is presented in **Table 2** of this report. All the samples obtained were required by the detection monitoring program.

§257.90(e)(4) CURRENT GROUNDWATER MONITORING PROGRAM

§257.90(e)(4) A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels);

Consistent with §257.90(e), the 2017 annual report documents groundwater related activities conducted during the prior calendar year at the Ash pond. The statistical analysis of the initial minimum eight rounds of groundwater sampling was completed by January 15, 2018 as required. This statistical analysis relied on the use of tolerance intervals as originally certified on October 17, 2017. The results of this statistical analysis identified statistically significant increases (SSI) of Appendix III constituents in one or more wells monitoring the uppermost aquifer downgradient of the Ash pond. Consistent with §257.94(e)(2), SIGECO is evaluating options to demonstrate that a source other than the CCR unit caused the SSI and will provide a narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels), as appropriate, in subsequent annual reports.

§257.90(e)(5) OTHER REQUIRED INFORMATION

§257.90(e)(5) Other information required to be included in the annual report as specified in §257.90 through §257.98.

This initial Annual Report documents activities conducted to comply with Sections §257.90 through §257.94 of the Rule. There are no applicable requirements from Sections §257.95 through §257.98.

Attachments
Table 1. Groundwater Monitoring Well Location and Construction Details
Table 2. Summary of Analytical Results
Figure 1. Monitoring Well Network

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TABLES

TABLE I

GROUNDWATER MONITORING WELL LOCATION AND CONSTRUCTION DETAILS

A.B. BROWN GENERATING STATION ASH POND

MOUNT VERNON, INDIANA

Well	CCR Unit	Date Installed	Easting	Northing	Top of Pad Elevation (ft msl)	Top of Riser Elevation (ft msl)	Surface Grout (ft bgs)	Bentonite (ft bgs)	Sand Pack (ft bgs)	Screen Zone (ft bgs)	Screen Length (ft)	Well Radius (in)
CCR-AP-1R	Ash Pond	July 2016	2773560.71	968260.82	464.70	467.57	0.0 - 23.0	23.0 - 25.0	25.0 - 37.0	27.0 - 37.0	10	2.00
CCR-AP-2R	Ash Pond	July 2016	2771922.52	969079.16	465.40	468.13	0.0 - 39.0	39.0 - 41.0	41.0 - 53.3	43.3 - 53.3	10	2.00
CCR-AP-3R	Ash Pond	July 2016	2771404.27	966865.12	450.10	449.13	0.0 - 33.0	33.0 - 35.0	35.0 - 47.0	37.0 - 47.0	10	2.00
CCR-AP-4R	Ash Pond	July 2016	2772827.01	966741.47	472.80	475.38	0.0 - 34.0	34.0 - 36.0	36.0 - 48.0	38.0 - 48.0	10	2.00
CCR-AP-5	Ash Pond	March 2016	2771019.70	968166.03	451.00	453.77	0.0 - 31.0	31.0 - 33.0	33.0 - 45.0	35.0 - 45.0	10	2.00
CCR-AP-6	Ash Pond	March 2016	2771626.75	969932.76	458.90	461.57	0.0 - 25.0	25.0 - 27.0	27.0 - 39.0	29.0 - 39.0	10	2.00
CCR-AP-7R	Ash Pond	July 2016	2773501.63	970758.70	486.00	488.57	0.0 - 39.5	39.5 - 41.5	41.5 - 53.5	43.5 - 53.5	10	2.00
CCR-BK-1R	Background	March 2016	2770919.08	974083.40	480.10	483.39	0.0 - 50.0	50.0 - 52.0	52.0 - 64.0	54.0 - 64.0	10	2.00
CCR-BK-2	Background	March 2016	2769728.14	972854.33	427.50	430.60	0.0 - 11.5	11.5 - 13.5	13.5 - 25.5	15.5 - 25.5	10	2.00

Notes:

bgs = below ground surface

ft = feet

in = inches

msl = mean sea level

Datum of Elevations in NAVD 88

TABLE II
SUMMARY OF ANALYTICAL RESULTS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Upgradient								
Location Name	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R
Sample Name	CCR-BK-1-20160811	CCR-BK-1-20161027	CCR-BK-1R-20161107	CCR-BK-1R-20161206	CCR-BK-1R-20170207	CCR-BK-1R-20170407	CCR-BK-1R-20170606	CCR-BK-1R-20170928	CCR-BK-1R-20171116
Sample Date	08/11/2016	10/27/2016	11/07/2016	12/06/2016	02/07/2017	04/07/2017	06/06/2017	09/28/2017	11/16/2017
Lab Sample ID	180-57528-14	180-60271-6	180-60609-5	180-61491-18	180-63324-18	180-65040-1	180-67229-16	180-70809-15	180-72643-21
Water Level (ft amsl)	463.50	422.65	423.39	422.39	421.39	425.39	425.39	425.39	-
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**20.68**	**15.88**	**20.42**	**11.36**	**14.52**	**14.94**	**17.06**	**24.01**	**10.95**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**0.76**	-
Dissolved Oxygen, Field (mg/L)	**5.15**	**5.85**	**5.89**	**7.03**	**5.98**	**5.43**	**6.28**	**6**	**8.82**
Conductivity, Field (mS/cm)	**0.3475**	**0.38255**	**0.36566**	**0.32748**	**0.3703**	**0.31348**	**0.35539**	**0.35718**	**0.40797**
ORP, Field (mv)	**222**	**223.99**	**116.48**	**52.8**	**131.91**	**98.13**	**266.28**	**147.09**	**47.02**
Turbidity, Field (NTU)	**17.39**	**19.19**	**10.68**	**97.13**	**6.47**	**17.2**	**24.08**	-	**131.33**
pH, Field (su)	**6.8**	**6.95**	**7.02**	**7.14**	**6.87**	**7.22**	**6.95**	**6.88**	**7.13**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	0.014 U	0.02 U	0.023 U	0.02 U	0.08 U	**0.019 J**	**0.026 J**	**0.015 J+**	**0.041 J**
Calcium, Total	**36**	**41**	**38**	**36**	**34**	**35**	**34**	**35**	**39**
Chloride (mg/L)	R	**2.4**	**1.5**	**2.3**	**2.3**	**2.7**	**2.1**	**2.2**	**2.6**
Fluoride (mg/L)	R	**0.35**	**0.32**	**0.35**	**0.3**	**0.38**	**0.3**	**0.35 J+**	**0.3**
Sulfate (mg/L)	R	**26**	**21**	**26**	**27**	**28**	**25**	**25**	**26 J-**
pH (lab) (su)	**7.4 J**	**7.5 J**	**7 J**	**6.9 J**	**7.2 J**	**7.2 J**	**7.1 J**	**7.1 J**	**7.8 J**
Total Dissolved Solids (TDS) (mg/L)	**220**	**210**	**220**	**200**	**230**	**250**	**270**	**210**	**210**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	**0.000056 J**	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	**0.00045 J**
Arsenic, Total	**0.0011**	**0.00021 J**	0.001 U	**0.00031 J**	**0.00094 J**	**0.00095 J**	**0.00047 J**	**0.0025 J+**	**0.0015 J+**
Barium, Total	**0.048**	**0.035**	**0.037 J-**	**0.031 J-**	**0.038**	**0.04**	**0.038**	**0.032 J-**	**0.082 J-**
Beryllium, Total	**0.00012 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	**0.0025**	**0.00046 J**	**0.00087 J**	**0.00071 J**	**0.003**	**0.0026**	**0.0019 J**	R	**0.0027 J+**
Cobalt, Total	**0.0028**	**0.00076**	**0.00051**	0.0005 U	**0.0011**	**0.001**	**0.00062**	R	**0.0022**
Lead, Total	**0.00082 J**	**0.00024 J**	**0.000079 J**	**0.000096 J**	**0.00099 J**	**0.00092 J**	**0.00052 J**	0.001 U	**0.0008 J**
Lithium, Total	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	**0.0086 J**
Molybdenum, Total	**0.0025 J**	0.005 U	0.005 U	**0.0015 J**	**0.0017 J**	**0.0025 J**	**0.0015 J**	R	**0.0034 J**
Selenium, Total	**0.00067 J**	0.005 U	**0.00037 J**	**0.00051 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	**0.000038 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Mercury, Total	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	R	**0.35**	**0.32**	**0.35**	**0.3**	**0.38**	**0.3**	**0.35 J+**	**0.3**
Radiological (pCi/L)									
Radium-226	0.0484 U ± 0.104	0.0760 U ± 0.210	R	0.303 U ± 0.296	**0.142 ± 0.0913**	**0.280 ± 0.0981**	**0.177 J ± 0.0924**	R	**0.165 ± 0.0740**
Radium-228	0.0724 UJ ± 0.514	0.191 U ± 0.217	-0.0566 U ± 0.222	0.179 U ± 0.238	-0.0934 U ± 0.194	0.177 U ± 0.257	**0.337 ± 0.257**	0.171 U ± 0.226	0.388 U ± 0.268
Radium-226 & 228	0.121 UJ ± 0.525	0.267 U ± 0.302	R	**0.482 ± 0.380**	0.142 UJ ± 0.214	**0.457 J ± 0.275**	**0.515 J ± 0.273**	**0.426 J+ ± 0.243**	**0.553 J+ ± 0.278**

ABBREVIATIONS AND NOTES:
CCR: Coal Combustion Residuals
CFR: Code of Federal Regulations
ft amsl: feet above mean sea level
MCL: Maximum Contaminant Level
mg/L: milligram per liter
mS/cm: milliSiemen per centimeter
mv: millivolt
NA: Not Applicable
NTU: Nephelometric Turbidity Units
pCi/L: picoCurie per liter
su: standard units
USEPA: United States Environmental Protection Agency

QUALIFIERS:
J: value is estimated
J+: value is estimated with a potentially high bias
J-: value is estimated with a potentially low bias
R: value is rejected
U: Not detected value is the laboratory reporting limit

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257.
https://www.epa.gov/coalash/coal-ash-rule

TABLE II
SUMMARY OF ANALYTICAL RESULTS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Upgradient								
Location Name	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2
Sample Name	CCR-BK-2-20160608	CCR-BK-2-20160810	CCR-BK-2-20161027	CCR-BK-2-20161206	CCR-BK-2-20170210	CCR-BK-2-20170405	CCR-BK-2-20170606	CCR-BK-2-20170927	CCR-BK-2-20171116
Sample Date	06/08/2016	08/10/2016	10/27/2016	12/06/2016	02/10/2017	04/05/2017	06/06/2017	09/27/2017	11/16/2017
Lab Sample ID	180-55607-6	180-57528-15	180-60271-7	180-61491-19	180-63446-1	180-64974-1	180-67229-17	180-70809-16	180-72643-22
Water Level (ft amsl)	416.46	412.21	408.69	407.90	412.89	413.71	413.94	412.64	406.12
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**17.51**	**17.4**	**15.98**	**14.25**	**13.49**	**15.79**	**15.68**	**16.85**	**14.23**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**167.49**	-
Dissolved Oxygen, Field (mg/L)	**0.42**	**0.22**	**0.38**	**0.33**	**0.35**	**1.08**	**0.14**	**0.43**	**0.47**
Conductivity, Field (mS/cm)	**0.6551**	**0.4173**	**0.40128**	**0.30961**	**0.38131**	**0.29739**	**0.41407**	**0.38594**	**0.38795**
ORP, Field (mv)	**28.72**	**144**	**234.6**	**87.3**	**120.09**	**200.74**	**212.67**	**212.04**	**108.47**
Turbidity, Field (NTU)	**17.85**	**1.751**	**858.51**	**336.44**	**11.66**	**-22.18**	**-1.12**	-	**181.78**
pH, Field (su)	**6.98**	**6.64**	**6.7**	**6.19**	**6.72**	**6.66**	**6.67**	**6.64**	**6.74**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	**0.018 J+**	0.014 U	0.02 U	0.02 U	0.08 U	0.016 U	**0.021 J**	**0.018 J+**	**0.02 J**
Calcium, Total	**53**	**39**	**46**	**36**	**34**	**45**	**37**	**37**	**35**
Chloride (mg/L)	**12**	**17**	**17**	**19**	**12 J+**	**19**	**14**	**19**	**19**
Fluoride (mg/L)	R	**0.14 J+**	**0.16**	**0.2 J+**	**0.14**	**0.16**	**0.13**	R	**0.13**
Sulfate (mg/L)	**61**	**30 J-**	**28**	**26**	**25 J+**	**29**	**27**	**24**	**23 J-**
pH (lab) (su)	**7.09 J**	**7.1 J**	**6.8 J**	**6.7 J**	**8.5 J**	**7.2 J**	**7 J**	**6.8 J**	**7.3 J**
Total Dissolved Solids (TDS) (mg/L)	**360**	**260**	**350**	**260**	**230**	**240**	**270**	**320**	**250**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	**0.00048 J**
Arsenic, Total	**0.00032 J**	0.001 U	**0.0013**	**0.00051 J**	**0.00031 J**	0.001 U	0.001 U	**0.0035 J+**	**0.0028**
Barium, Total	**0.041 J-**	**0.033**	**0.15**	**0.036 J-**	**0.033 J-**	**0.034 J-**	**0.035**	**0.048 J-**	**0.046 J-**
Beryllium, Total	0.001 U	0.001 U	**0.0004 J**	0.001 U	0.001 U	0.001 U	0.001 U	**0.00018 J**	0.001 U
Cadmium, Total	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	0.002 U	0.002 U	**0.0047**	**0.00076 J**	0.002 UJ	0.002 U	0.002 U	R	**0.0043 J+**
Cobalt, Total	**0.000096 J**	**0.0001 J**	**0.0062**	0.0005 U	0.0005 U	0.0005 U	0.0005 U	**0.0015 J+**	**0.0012**
Lead, Total	**0.000028 J**	0.001 U	**0.011**	**0.00057 J**	0.001 U	0.001 U	0.001 U	**0.0028 J+**	**0.0024**
Lithium, Total	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Molybdenum, Total	**0.0017 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.00062 J**	0.005 U	**0.00068 J**
Selenium, Total	0.005 U	0.005 U	**0.00098 J**	**0.00047 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.000059 J**
Mercury, Total	0.0002 UJ	0.0002 U	**0.0001 J**	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	R	**0.14 J+**	**0.16**	**0.2 J+**	**0.14**	**0.16**	**0.13**	R	**0.13**
Radiological (pCi/L)									
Radium-226	**0.102 J ± 0.0557**	0.0387 U ± 0.0693	**1.14 J ± 0.720**	0.346 U ± 0.284	0.0539 UJ ± 0.0753	0.0198 U ± 0.0619	0.00911 UJ ± 0.0490	R	**0.149 ± 0.0943**
Radium-228	0.0185 U ± 0.200	0.0797 UJ ± 0.324	0.764 U ± 0.727	R	0.163 U ± 0.253	0.102 U ± 0.198	**0.144 ± 0.284**	0.279 U ± 0.416	**2.98 ± 0.579**
Radium-226 & 228	0.120 U ± 0.207	0.118 UJ ± 0.331	**1.91 J ± 1.02**	**0.796 J ± 0.380**	0.217 UJ ± 0.264	0.122 U ± 0.208	0.153 U ± 0.288	0.525 UJ ± 0.436	**3.13 ± 0.587**

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CCR: Coal Combustion Residuals
CFR: Code of Federal Regulations
ft amsl: feet above mean sea level
MCL: Maximum Contaminant Level
mg/L: milligram per liter
mS/cm: milliSiemen per centimeter
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NA: Not Applicable
NTU: Nephelometric Turbidity Units
pCi/L: picoCurie per liter
su: standard units
USEPA: United States Environmental Protection Agency

QUALIFIERS:
J: value is estimated
J+: value is estimated with a potentially high bias
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https://www.epa.gov/coalash/coal-ash-rule

TABLE II
SUMMARY OF ANALYTICAL RESULTS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Downgradient								
Location Name	CCR-AP-1R	CCR-AP-1R	CCR-AP-1R	CCR-AP-1R	CCR-AP-1R	CCR-AP-1R	CCR-AP-1R	CCR-AP-1R	CCR-AP-1R
Sample Name	CCR-AP-1-20160607	CCR-AP-1-20160810	CCR-AP-1-20161026	CCR-AP-1R-20161205	CCR-AP-1R-20170206	CCR-AP-1R-20170404	CCR-AP-1R-20170605	CCR-AP-1R-20170926	CCR-AP-1R-20171114
Sample Date	06/07/2016	08/10/2016	10/26/2016	12/05/2016	02/06/2017	04/04/2017	06/05/2017	09/26/2017	11/14/2017
Lab Sample ID	180-55566-3	180-57528-16	180-60193-1	180-61491-1	180-63324-4	180-64974-2	180-67229-1	180-70809-1	180-72643-14
Water Level (ft amsl)	457.99	457.78	451.26	450.94	451.51	450.75	449.88	448.78	451.72
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**19.22**	**20.4**	**17.85**	**14.6**	**13.31**	**17.97**	**16.45**	**16.88**	**15.21**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**72.64**	-
Dissolved Oxygen, Field (mg/L)	**7.03**	**0.14**	**0.17**	**0.17**	**5.67**	**0.32**	**0.03**	**0.01**	**0.02**
Conductivity, Field (mS/cm)	**2.00099**	**7.41**	**7.48293**	**4.554**	**0.98911**	**4.76554**	**5.6183**	**5.10195**	**5.2188**
ORP, Field (mv)	**-13.54**	**88**	**200.43**	**99.2**	**126.78**	**190.47**	**224.98**	**420.3**	**115.65**
Turbidity, Field (NTU)	**41.73**	**28.41**	**-1.47**	**573.87**	**24.67**	**604.32**	**-1.78**	-	**117.39**
pH, Field (su)	**6.47**	**6.67**	**6.73**	**6.57**	**6.98**	**6.63**	**6.75**	**6.81**	**6.73**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	**2.2**	**9.5**	**9.5**	**9.8**	**12**	**9.5**	**11**	**7.5 J+**	**7.6**
Calcium, Total	**41**	**480**	**530**	**420**	**370**	**420**	**320**	**230**	**270**
Chloride (mg/L)	**110**	**670**	**840**	**740**	**700**	**640**	**520**	**390**	**430**
Fluoride (mg/L)	**0.22**	0.5 U	5 U	**0.73**	0.5 U	**0.25 J**	**0.41 J**	**0.46 J+**	**0.2 J**
Sulfate (mg/L)	**460**	**2700 J-**	**3500 J-**	**3200**	**3700**	**2800**	**2300**	**2100**	**2100 J-**
pH (lab) (su)	**6.51 J**	**7 J**	**6.8 J**	**6.8 J**	**7.2 J**	**7 J**	**7.2 J**	**7 J**	**7.8 J**
Total Dissolved Solids (TDS) (mg/L)	**1100**	**6500**	**6800**	**6400**	**6600**	**5600**	**5100**	**4000**	**4200**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	**0.0052**	**0.0012 J+**	**0.0008 J**	**0.00039 J**	0.001 U	**0.00033 J**	**0.00031 J**	R	0.001 U
Barium, Total	**0.041**	**0.022**	**0.018 J-**	**0.018 J-**	**0.049**	**0.017 J-**	**0.016**	**0.012 J-**	**0.017 J-**
Beryllium, Total	**0.000065 J**	0.001 U	**0.00019 J**	**0.00019 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.001 U	**0.00028 J**	**0.00017 J**	**0.00016 J**	**0.0008 J**	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	**0.0011 J**	0.002 U	0.002 U	0.002 U	**0.00087 J**	0.002 U	0.002 U	0.002 UJ	0.002 U
Cobalt, Total	**0.011**	**0.0077**	**0.0025**	**0.0019**	**0.003**	**0.00071**	**0.0006**	**0.00042 J**	**0.00084**
Lead, Total	**0.0013**	**0.00031 J**	**0.00015 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium, Total	**0.012 J**	**0.0099 J**	**0.016 J**	**0.015 J**	**0.066**	0.05 U	0.05 U	0.05 U	0.05 U
Molybdenum, Total	**0.005**	**0.0049 J**	**0.0031 J**	**0.0039 J**	**1.6**	**0.0024 J**	**0.0032 J**	**0.0024 J**	**0.0036 J**
Selenium, Total	0.005 U	**0.00049 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	**0.000038 J**	**0.000075 J**	**0.00013 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Mercury, Total	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	**0.22**	0.5 U	5 U	**0.73**	0.5 U	**0.25 J**	**0.41 J**	**0.46 J+**	**0.2 J**
Radiological (pCi/L)									
Radium-226	0.0602 U ± 0.0870	**0.411 ± 0.108**	**0.717 J ± 0.337**	R	**0.292 ± 0.120**	**0.193 ± 0.0909**	**0.211 J ± 0.0870**	R	**0.256 ± 0.0859**
Radium-228	0.229 U ± 0.397	0.300 UJ ± 0.262	0.320 U ± 0.247	**0.493 ± 0.246**	**0.513 ± 0.252**	**0.391 ± 0.255**	0.247 U ± 0.265	**0.673 ± 0.280**	**0.594 ± 0.243**
Radium-226 & 228	0.289 U ± 0.406	**0.711 J ± 0.284**	**1.04 J ± 0.418**	R	**0.805 ± 0.279**	**0.583 ± 0.270**	**0.458 J ± 0.278**	**1.05 J+ ± 0.303**	**0.849 ± 0.258**

ABBREVIATIONS AND NOTES:
CCR: Coal Combustion Residuals
CFR: Code of Federal Regulations
ft amsl: feet above mean sea level
MCL: Maximum Contaminant Level
mg/L: milligram per liter
mS/cm: milliSiemen per centimeter
mv: millivolt
NA: Not Applicable
NTU: Nephelometric Turbidity Units
pCi/L: picoCurie per liter
su: standard units
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J: value is estimated
J+: value is estimated with a potentially high bias
J-: value is estimated with a potentially low bias
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TABLE II
SUMMARY OF ANALYTICAL RESULTS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Downgradient								
Location Name	CCR-AP-2R	CCR-AP-2R	CCR-AP-2R	CCR-AP-2R	CCR-AP-2R	CCR-AP-2R	CCR-AP-2R	CCR-AP-2R	CCR-AP-2R
Sample Name	CCR-AP-2-20160811	CCR-AP-2-20161025	CCR-AP-2R-20161107	CCR-AP-2R-20161206	CCR-AP-2R-20170207	CCR-AP-2R-20170404	CCR-AP-2R-20170606	CCR-AP-2R-20170927	CCR-AP-2R-20171115
Sample Date	08/11/2016	10/25/2016	11/07/2016	12/06/2016	02/07/2017	04/04/2017	06/06/2017	09/27/2017	11/15/2017
Lab Sample ID	180-57528-17	180-60160-5	180-60609-1	180-61491-2	180-63324-2	180-64974-3	180-67229-2	180-70809-2	180-72643-15
Water Level (ft amsl)	441.66	435.66	435.24	436.03	435.12	431.29	431.57	425.15	425.07
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**19.8**	**19.46**	**20.24**	**14.47**	**16.1**	**19.54**	**18.76**	**19.71**	**16.19**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**-11.22**	-
Dissolved Oxygen, Field (mg/L)	**1.25**	**0.68**	**0.69**	**0.72**	**0.53**	**0.69**	**0.23**	**0.25**	**0.27**
Conductivity, Field (mS/cm)	**8.151**	**8.54406**	**5.18532**	**6.975**	**7.58134**	**5.4526**	**8.67183**	**8.90809**	**8.01588**
ORP, Field (mv)	**189**	**145.29**	**107.1**	**115**	**115.79**	**187.26**	**167.33**	**358.49**	**123.91**
Turbidity, Field (NTU)	**756.5**	**15.14**	**17.82**	**20.32**	**12.2**	**-15.03**	**5.16**	-	**0.74**
pH, Field (su)	**7.11**	**7.03**	**6.99**	**6.82**	**6.87**	**6.91**	**6.94**	**6.96**	**6.83**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	**12**	**14**	**15**	**15**	**9.9**	**12**	**12**	**12 J+**	**12**
Calcium, Total	**290**	**370**	**380**	**360**	**430**	**390**	**410**	**350**	**350**
Chloride (mg/L)	R	**870**	**810**	**710**	**670**	**920**	**850**	**790**	**760**
Fluoride (mg/L)	0.5 U	**0.58 J**	**0.5 J**	**0.7**	0.5 U	**0.9**	**0.51 J**	**0.5 J+**	**0.27 J**
Sulfate (mg/L)	R	**3800**	**3700**	**3800**	**3100**	**4400**	**4200**	**4100**	**3900 J-**
pH (lab) (su)	**7.4 J**	**7.2 J**	**7 J**	**7 J**	**6.9 J**	**7.1 J**	**7.2 J**	**7.1 J**	**7.5 J**
Total Dissolved Solids (TDS) (mg/L)	**6800**	**8500**	**7200**	**6300**	**5700**	**7100**	**8000**	**7200**	**6000**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.02 U	**0.00011 J**	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	**0.0024**	0.01 U	**0.0011 J+**	**0.00071 J**	0.001 U	**0.00043 J**	**0.00034 J**	R	0.001 U
Barium, Total	**0.041**	**0.035 J**	**0.037 J-**	**0.051 J-**	**0.019**	**0.045 J-**	**0.046**	**0.035 J-**	**0.043 J-**
Beryllium, Total	**0.00027 J**	0.01 U	0.001 U	**0.0002 J**	0.001 U	**0.00015 J**	0.001 U	**0.00013 J**	0.001 U
Cadmium, Total	**0.0003 J**	0.01 U	**0.00056 J**	**0.00031 J**	**0.00019 J**	**0.0003 J**	**0.00032 J**	**0.00063 J**	**0.00038 J**
Chromium, Total	**0.0036**	0.02 U	**0.00071 J**	0.002 U	0.002 U	0.002 U	0.002 U	0.002 UJ	0.002 U
Cobalt, Total	**0.0079**	**0.0022 J**	**0.0025**	**0.0032**	**0.0012**	**0.0021**	**0.0023**	**0.0019 J+**	**0.0026**
Lead, Total	**0.0052 J**	0.01 U	**0.00019 J**	**0.000083 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium, Total	**0.054**	**0.06**	**0.062**	**0.067**	**0.011 J**	**0.056**	**0.061**	**0.062**	**0.058**
Molybdenum, Total	**1.2**	**1.6**	**1.8**	**1.5**	0.005 U	**1.4**	**1.5**	**1.6**	**1.7**
Selenium, Total	**0.00079 J**	0.05 U	**0.00042 J**	**0.0004 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	**0.000041 J**	0.01 U	**0.00015 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Mercury, Total	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	**0.00008 J**	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	0.5 U	**0.58 J**	**0.5 J**	**0.7**	0.5 U	**0.9**	**0.51 J**	**0.5 J+**	**0.27 J**
Radiological (pCi/L)									
Radium-226	**0.703 ± 0.205**	**0.434 J ± 0.280**	0.261 U ± 0.223	0.0875 U ± 0.213	**0.188 ± 0.108**	**0.141 ± 0.0848**	**0.233 J ± 0.0901**	**0.409 J ± 0.118**	**0.217 ± 0.0813**
Radium-228	0.675 UJ ± 0.622	0.352 U ± 0.249	**0.394 ± 0.241**	**0.647 ± 0.271**	**0.373 ± 0.236**	0.291 U ± 0.229	**0.403 ± 0.224**	R	**0.620 ± 0.256**
Radium-226 & 228	**1.38 J ± 0.655**	**0.786 J ± 0.374**	R	R	**0.562 ± 0.259**	**0.432 J ± 0.244**	**0.636 ± 0.241**	**1.09 J+ ± 0.311**	**0.837 ± 0.269**

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MOUNT VERNON, INDIANA

Location Group	Downgradient								
Location Name	CCR-AP-3R	CCR-AP-3R	CCR-AP-3R	CCR-AP-3R	CCR-AP-3R	CCR-AP-3R	CCR-AP-3R	CCR-AP-3R	CCR-AP-3R
Sample Name	CCR-AP-3-20160815	CCR-AP-3-20161027	CCR-AP-3R-20161108	CCR-AP-3R-20161206	CCR-AP-3R-20170207	CCR-AP-3R-20170405	CCR-AP-3R-20170606	CCR-AP-3R-20170927	CCR-AP-3R-20171115
Sample Date	08/15/2016	10/27/2016	11/08/2016	12/06/2016	02/07/2017	04/05/2017	06/06/2017	09/27/2017	11/15/2017
Lab Sample ID	180-57626-1	180-60271-4	180-60609-2	180-61491-3	180-63324-3	180-64974-4	180-67229-3	180-70809-3	180-72643-16
Water Level (ft amsl)	427.18	411.89	409.39	413.95	410.28	408.61	408.56	410.77	409.86
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**19.68**	**17.53**	**18.16**	**16.4**	**17.21**	**18.78**	**18.62**	**19.96**	**17.14**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**-11.22**	-
Dissolved Oxygen, Field (mg/L)	**0.65**	**0.38**	**0.97**	**0.26**	**0.17**	**0.7**	**0.12**	**0.07**	**0.08**
Conductivity, Field (mS/cm)	**7.828**	**8.67638**	**8.57001**	**8.645**	**8.63738**	**6.66285**	**9.48072**	**10.426**	**10.517**
ORP, Field (mv)	**48**	**217.95**	**152.88**	**131.8**	**117.35**	**189.49**	**179.62**	**232.4**	**126.38**
Turbidity, Field (NTU)	**10.41**	**-4.28**	**-4.38**	**0**	**-1.71**	**-22.88**	**-3.07**	-	**-0.87**
pH, Field (su)	**7.25**	**7.04**	**7.17**	**6.91**	**6.9**	**6.96**	**7**	**7.01**	**6.97**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	**11**	**14**	**13**	**15**	**11**	**16**	**12**	**14 J+**	**13**
Calcium, Total	**260**	**380**	**370**	**380**	**400**	**450**	**480**	**420**	**420**
Chloride (mg/L)	**730**	**900**	**860**	**880**	**820**	**1500 J**	**990**	**930**	**980**
Fluoride (mg/L)	**0.95**	**0.96 J**	**0.96 J**	**1.1**	**0.82 J+**	**1.1**	**0.87 J**	**1 J+**	**0.72 J**
Sulfate (mg/L)	**3000**	**3400**	**3500**	**3900**	**3700**	**6900 J**	**4400**	**4900**	**5300 J-**
pH (lab) (su)	**7.4 J**	**7.2 J**	**7 J**	**7 J**	**7.1 J**	**7 J**	**7.3 J**	**7.1 J**	**7.5 J**
Total Dissolved Solids (TDS) (mg/L)	**6200**	**7000**	**6900**	**7100**	**7100**	**7800**	**8500**	**8500**	**8000**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.00022 U	0.02 U	**0.000092 J**	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	**0.00044 J**	0.01 U	0.001 U	**0.00036 J**	0.001 U	**0.00029 J**	0.001 U	R	0.001 U
Barium, Total	**0.015**	**0.016 J**	**0.02 J-**	**0.024 J-**	**0.017**	**0.017 J-**	**0.017**	**0.016 J-**	**0.017 J-**
Beryllium, Total	0.001 U	0.01 U	0.001 U	**0.00021 J**	0.001 U	**0.00017 J**	0.001 U	0.001 U	0.001 U
Cadmium, Total	**0.00017 J**	0.01 U	**0.00024 J**	**0.0003 J**	**0.0002 J**	**0.00013 J**	**0.00018 J**	**0.00029 J**	**0.0002 J**
Chromium, Total	**0.0008 J**	0.02 U	**0.00085 J**	**0.00051 J**	0.002 U	0.002 U	0.002 U	0.002 UJ	0.002 U
Cobalt, Total	**0.00035 J**	0.005 U	**0.00011 J**	0.0005 U	**0.00017 J**	0.0005 U	**0.00015 J**	R	**0.00021 J**
Lead, Total	**0.00028 J**	0.01 U	0.001 U	**0.00014 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium, Total	**0.071**	**0.077**	**0.083**	**0.08**	**0.065**	**0.062**	**0.077**	**0.087**	**0.09**
Molybdenum, Total	**0.94**	**0.91**	**1**	**0.93**	**0.72**	**0.74**	**0.82**	**0.81**	**0.86**
Selenium, Total	**0.021**	**0.017 J**	**0.024**	**0.016**	**0.0041 J**	**0.0017 J**	**0.0028 J**	**0.0043 J+**	**0.0031 J**
Thallium, Total	0.001 U	0.01 U	**0.00014 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Mercury, Total	**0.000071 J**	**0.000082 J**	0.0002 U	**0.000094 J-**	**0.00053**	**0.00012 J**	**0.000085 J**	**0.00018 J**	**0.00016 J-**
Fluoride (mg/L)	**0.95**	**0.96 J**	**0.96 J**	**1.1**	**0.82 J+**	**1.1**	**0.87 J**	**1 J+**	**0.72 J**
Radiological (pCi/L)									
Radium-226	**0.199 ± 0.0723**	0.173 U ± 0.202	R	0.0963 U ± 0.229	**0.172 ± 0.104**	0.0894 U ± 0.0714	**0.116 J ± 0.0696**	R	**0.138 ± 0.0700**
Radium-228	**0.523 ± 0.314**	**0.431 ± 0.281**	0.162 U ± 0.254	**1.06 ± 0.285**	0.393 U ± 0.263	**0.429 ± 0.253**	0.367 U ± 0.248	R	**0.509 ± 0.277**
Radium-226 & 228	**0.722 ± 0.322**	**0.603 J ± 0.346**	R	R	**0.565 J ± 0.283**	**0.518 J ± 0.263**	**0.484 J ± 0.257**	**1.24 J+ ± 0.320**	**0.647 ± 0.286**

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Sample Name	CCR-AP-4-20160607	CCR-AP-4-20160811	CCR-AP-4-20161026	CCR-AP-4R-20161205	CCR-AP-4R-20170206	CCR-AP-4R-20170425	CCR-AP-4R-20170605	CCR-AP-4R-20170926	CCR-AP-4R-20171114
Sample Date	06/07/2016	08/11/2016	10/26/2016	12/05/2016	02/06/2017	04/25/2017	06/05/2017	09/26/2017	11/14/2017
Lab Sample ID	180-55566-2	180-57528-18	180-60193-2	180-61491-4	180-63324-1	180-65681-1	180-67229-4	180-70809-4	180-72643-17
Water Level (ft amsl)	444.60	441.50	439.76	440.62	440.39	-	440.65	439.72	439.49
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**14.77**	**21.89**	**14.98**	**12.35**	**15.08**	**14.55**	**16.87**	**16.55**	**13.58**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**74.75**	-
Dissolved Oxygen, Field (mg/L)	**4.6**	**6.51**	**4.79**	**6.91**	**0.1**	**6.18**	**5.93**	**6.64**	**6.23**
Conductivity, Field (mS/cm)	**1.98612**	**1.891**	**1.8735**	**2.92**	**6.67429**	**1.01**	**1.35109**	**1.05291**	**1.06282**
ORP, Field (mv)	**86.77**	**105**	**226.69**	**107.6**	**114.16**	**259**	**210.43**	**154.14**	**135.88**
Turbidity, Field (NTU)	**2.16**	**48.15**	**9.75**	**441.79**	**34.52**	**150.4**	**-1.82**	-	**329.8**
pH, Field (su)	**7.06**	**7.03**	**6.98**	**6.9**	**6.71**	**6.97**	**6.92**	**6.98**	**6.89**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	**0.018**	**0.089 J+**	**0.045 J+**	**0.13 J+**	**0.16**	**0.21**	**0.2**	**0.23 J+**	**0.15**
Calcium, Total	**210**	**180**	**210**	**130**	**110**	**110**	**160**	**110**	**110**
Chloride (mg/L)	**48**	R	**79**	**34**	**23**	**21**	**30**	**20**	**22**
Fluoride (mg/L)	**0.44**	**0.41**	**0.4**	**0.48**	**0.33 J+**	**0.41**	**0.39**	**0.39 J+**	**0.41**
Sulfate (mg/L)	**220**	R	**150 J-**	**86**	**97**	**130**	**96**	**120**	**140 J-**
pH (lab) (su)	**6.97 J**	**7.3 J**	**7.1 J**	**7.1 J**	**7.3 J**	**7.5 J**	**7.3 J**	**7.3 J**	**7.7 J**
Total Dissolved Solids (TDS) (mg/L)	**1300**	**1200**	**1300**	**710**	**630**	**640**	**930**	**650**	**650**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	**0.00029 J**	**0.00059 J**	**0.00032 J**	**0.00032 J**	0.001 U	**0.0003 J**	**0.00026 J**	R	0.001 U
Barium, Total	**0.12**	**0.089**	**0.11 J-**	**0.063 J-**	**0.051**	**0.043**	**0.069**	**0.042 J-**	**0.045 J-**
Beryllium, Total	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.001 U	**0.00018 J**	0.001 U	0.001 U	**0.000084 J**	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	**0.0022**	**0.0016 J**	**0.0022**	**0.0018 J**	**0.0015 J**	**0.0018 J**	**0.0022**	R	**0.0027 J+**
Cobalt, Total	**0.00026 J**	**0.0033**	**0.00081**	0.0005 U	**0.0002 J**	**0.00011 J**	0.0005 U	0.0005 U	**0.0003 J**
Lead, Total	**0.000085 J**	**0.00023 J**	**0.00017 J**	**0.00009 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium, Total	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Molybdenum, Total	**0.0016 J**	**0.0088**	**0.0033 J**	**0.0046 J**	0.005 U	**0.0019 J**	**0.0028 J**	**0.002 J**	**0.0017 J**
Selenium, Total	0.005 U	**0.001 J**	**0.00057 J+**	**0.00051 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	**0.000021 J**	0.001 U	0.001 U	0.001 U	**0.00022 J**	0.001 U	0.001 U	0.001 U	0.001 U
Mercury, Total	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	**0.44**	**0.41**	**0.4**	**0.48**	**0.33 J+**	**0.41**	**0.39**	**0.39 J+**	**0.41**
Radiological (pCi/L)									
Radium-226	**0.157 ± 0.0919**	**0.327 ± 0.108**	0.116 U ± 0.206	R	0.0779 U ± 0.0791	0.126 U ± 0.0996	**0.185 J ± 0.0926**	R	**0.159 ± 0.0794**
Radium-228	0.127 U ± 0.259	**7.60 J ± 1.03**	0.369 U ± 0.307	**0.370 ± 0.239**	0.199 U ± 0.251	-0.0800 U ± 0.296	0.144 U ± 0.215	-0.0756 U ± 0.212	**0.488 ± 0.307**
Radium-226 & 228	0.285 U ± 0.275	**7.93 J ± 1.04**	0.485 U ± 0.370	R	0.277 U ± 0.263	0.126 U ± 0.313	0.329 UJ ± 0.234	0.11 UJ ± 0.223	**0.647 ± 0.317**

ABBREVIATIONS AND NOTES:
CCR: Coal Combustion Residuals
CFR: Code of Federal Regulations
ft amsl: feet above mean sea level
MCL: Maximum Contaminant Level
mg/L: milligram per liter
mS/cm: milliSiemen per centimeter
mv: millivolt
NA: Not Applicable
NTU: Nephelometric Turbidity Units
pCi/L: picoCurie per liter
su: standard units
USEPA: United States Environmental Protection Agency

QUALIFIERS:
J: value is estimated
J+: value is estimated with a potentially high bias
J-: value is estimated with a potentially low bias
R: value is rejected
U: Not detected value is the laboratory reporting limit

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TABLE II
SUMMARY OF ANALYTICAL RESULTS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Downgradient								
Location Name	CCR-AP-5	CCR-AP-5	CCR-AP-5	CCR-AP-5	CCR-AP-5	CCR-AP-5	CCR-AP-5	CCR-AP-5	CCR-AP-5
Sample Name	CCR-AP-5-20160606	CCR-AP-5-20160811	CCR-AP-5-20161027	CCR-AP-5-20161206	CCR-AP-5-20170207	CCR-AP-5-20170405	CCR-AP-5-20170606	CCR-AP-5-20170927	CCR-AP-5-20171115
Sample Date	06/06/2016	08/11/2016	10/27/2016	12/06/2016	02/07/2017	04/05/2017	06/06/2017	09/27/2017	11/15/2017
Lab Sample ID	180-55566-1	180-57528-19	180-60271-5	180-61491-5	180-63324-5	180-64974-5	180-67229-5	180-70809-5	180-72643-18
Water Level (ft amsl)	415.47	415.79	415.43	415.67	416.24	416.25	416.06	416.61	417.07
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**19.24**	**22.87**	**16.36**	**13.43**	**16.93**	**18.87**	**17.69**	**19.05**	**15.34**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**-11.22**	-
Dissolved Oxygen, Field (mg/L)	**0.28**	**0.66**	**0.51**	**0.26**	**0.24**	**0.2**	**0.06**	**0.06**	**0.07**
Conductivity, Field (mS/cm)	**5.99649**	**6.133**	**4.98392**	**5.8693**	**5.87591**	**4.20036**	**5.60685**	**5.99388**	**5.89855**
ORP, Field (mv)	**8.67**	**209**	**30**	**120.8**	**91.74**	**126.06**	**210.99**	**461.25**	**108.88**
Turbidity, Field (NTU)	**10.35**	**4.789**	**7.46**	**0**	**0.17**	**-20.21**	**-2.99**	-	**332.69**
pH, Field (su)	**7**	**6.89**	**7.12**	**6.95**	**6.97**	**7.01**	**7.02**	**7.02**	**6.99**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	**11**	**11**	**10**	**12**	**11**	**11**	**12**	**9.3 J+**	**11**
Calcium, Total	**300**	**310**	**350**	**350**	**330**	**360**	**340**	**300**	**310**
Chloride (mg/L)	**380**	R	**380**	**380**	**370**	**370**	**380**	**350**	**360**
Fluoride (mg/L)	**0.26 J**	0.5 U	**0.31 J**	**0.54**	0.5 U	**0.23 J**	**0.34 J**	**0.2 J+**	**0.32 J**
Sulfate (mg/L)	**2900**	R	**2600**	**3000**	**3000**	**3100**	**2700**	**3000**	**3100 J-**
pH (lab) (su)	**7.05 J**	**7.4 J**	**7.2 J**	**7.1 J**	**7.2 J**	**7.2 J**	**7.2 J**	**7.1 J**	**8 J**
Total Dissolved Solids (TDS) (mg/L)	**5000**	**5100**	**5000**	**5000**	**5300**	**4900**	**5000**	**4900**	**4800**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	0.02 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	**0.00057 J**	**0.0003 J**	0.01 U	**0.00016 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Barium, Total	**0.019**	**0.016**	**0.015 J**	**0.016 J-**	**0.016**	**0.016 J-**	**0.015**	**0.012**	**0.015 J-**
Beryllium, Total	**0.000052 J**	0.001 U	0.01 U	**0.00016 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.001 U	0.001 U	0.01 U	0.001 U	**0.00012 J**	0.001 U	**0.00012 J**	0.001 U	0.001 U
Chromium, Total	**0.00062 J**	0.002 U	0.02 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt, Total	**0.00081**	**0.00011 J**	0.005 U	0.0005 U	**0.000098 J**	0.0005 U	0.0005 U	0.0005 U	**0.00016 J**
Lead, Total	**0.00024 J**	0.001 U	**0.0007 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium, Total	**0.014 J**	**0.015 J**	**0.018 J**	**0.023 J**	**0.022 J**	**0.014 J**	**0.017 J**	**0.019 J**	**0.016 J**
Molybdenum, Total	**0.022**	**0.019**	**0.016 J**	**0.038**	**0.049**	**0.044**	**0.059**	**0.055**	**0.067**
Selenium, Total	0.005 U	0.005 U	0.05 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	**0.000076 J**	0.001 U	0.01 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Mercury, Total	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	**0.26 J**	0.5 U	**0.31 J**	**0.54**	0.5 U	**0.23 J**	**0.34 J**	**0.2 J+**	**0.32 J**
Radiological (pCi/L)									
Radium-226	**0.107 ± 0.0697**	**0.179 ± 0.0827**	0.293 U ± 0.242	-0.0341 U ± 0.180	**0.130 ± 0.0873**	**0.145 ± 0.0840**	0.0962 UJ ± 0.0743	R	**0.100 ± 0.0637**
Radium-228	0.214 U ± 0.278	0.161 UJ ± 0.287	0.0785 U ± 0.226	**0.743 ± 0.259**	0.294 U ± 0.220	0.208 U ± 0.204	0.222 U ± 0.289	0.198 U ± 0.226	0.330 U ± 0.233
Radium-226 & 228	0.321 U ± 0.287	0.339 UJ ± 0.298	0.372 U ± 0.332	R	**0.424 J ± 0.236**	**0.354 J ± 0.221**	0.318 U ± 0.298	**0.522 J+ ± 0.249**	**0.430 J ± 0.242**

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ft amsl: feet above mean sea level
MCL: Maximum Contaminant Level
mg/L: milligram per liter
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TABLE II
SUMMARY OF ANALYTICAL RESULTS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Downgradient								
Location Name	CCR-AP-6	CCR-AP-6	CCR-AP-6	CCR-AP-6	CCR-AP-6	CCR-AP-6	CCR-AP-6	CCR-AP-6	CCR-AP-6
Sample Name	CCR-AP-6-20160607	CCR-AP-6-20160810	CCR-AP-6-20161026	CCR-AP-6-20161206	CCR-AP-6-20170207	CCR-AP-6-20170404	CCR-AP-6-20170605	CCR-AP-6-20170926	CCR-AP-6-20171116
Sample Date	06/07/2016	08/10/2016	10/26/2016	12/06/2016	02/07/2017	04/04/2017	06/05/2017	09/26/2017	11/16/2017
Lab Sample ID	180-55566-5	180-57528-20	180-60193-3	180-61491-6	180-63324-6	180-64974-6	180-67229-6	180-70809-6	180-72643-19
Water Level (ft amsl)	447.90	447.74	445.41	446.06	447.62	445.63	446.05	443.90	443.36
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**16.68**	**17.63**	**15.71**	**13.31**	**13.86**	**16.14**	**15.3**	**15.47**	**13.29**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**854.31**	-
Dissolved Oxygen, Field (mg/L)	**0.39**	**0.23**	**0.16**	**0.21**	**1.34**	**2.04**	**2.05**	**0.08**	**0.4**
Conductivity, Field (mS/cm)	**2.86715**	**2.622**	**2.34393**	**2.0108**	**2.10516**	**1.76314**	**2.25261**	**2.26168**	**2.1014**
ORP, Field (mv)	**30.1**	**12**	**18.27**	**28.3**	**5.82**	**21.67**	**-19.79**	**-23.68**	**16.07**
Turbidity, Field (NTU)	**58.7**	**47.74**	**50.74**	**20.35**	**20.98**	**171.35**	**-0.8**	-	**357.65**
pH, Field (su)	**6.9**	**6.89**	**7.01**	**6.97**	**7.02**	**6.98**	**7.07**	**6.98**	**6.93**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	**2.2**	**2.2**	**1.4**	**0.88**	**0.83**	**0.98**	**1.5**	**0.95 J+**	**0.59**
Calcium, Total	**240**	**250**	**260**	**270**	**250**	**290**	**280**	**260**	**240**
Chloride (mg/L)	**150**	**150**	**130**	**100**	**100**	**110**	**130**	**110**	**100**
Fluoride (mg/L)	**0.12**	0.1 U	**0.18**	**0.24**	**0.2 J+**	**0.2**	**0.19 J**	**0.21 J+**	**0.21**
Sulfate (mg/L)	**1000**	**900 J-**	**920 J-**	**890**	**880**	**900**	**1100**	**930**	**880 J-**
pH (lab) (su)	**7.14 J**	**7.2 J**	**7.1 J**	**7.1 J**	**7.4 J**	**7.3 J**	**7.2 J**	**7.1 J**	**7.4 J**
Total Dissolved Solids (TDS) (mg/L)	**2100**	**2100**	**2000**	**1800**	**3300**	**1800**	**2100**	**1800**	**1700**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	**0.00068 J**
Arsenic, Total	**0.0053**	**0.0045**	**0.0041**	**0.0039**	**0.0029 J+**	**0.0021**	**0.002**	**0.0032 J+**	**0.0044 J**
Barium, Total	**0.028**	**0.019**	**0.022 J-**	**0.021 J-**	**0.021**	**0.018 J-**	**0.018**	**0.026 J-**	**0.04 J-**
Beryllium, Total	**0.0001 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.00051 J**	**0.00042 J**
Cadmium, Total	**0.00021 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.00013 J**
Chromium, Total	**0.0012 J**	0.002 U	**0.001 J**	**0.00048 J**	0.002 U	0.002 U	0.002 U	R	**0.0072 J+**
Cobalt, Total	**0.0068**	**0.0038**	**0.0032**	**0.0023**	**0.0013**	**0.001**	**0.00099**	**0.0033**	**0.0054**
Lead, Total	**0.0011**	**0.00023 J**	**0.00061 J**	**0.00028 J**	0.001 U	0.001 U	0.001 U	**0.005**	**0.0036 J**
Lithium, Total	**0.043 J**	**0.04 J**	**0.042 J**	**0.041 J**	**0.04 J**	**0.036 J**	**0.039 J**	**0.042 J**	**0.043 J**
Molybdenum, Total	**0.021**	**0.015**	**0.012**	**0.011**	**0.01**	**0.0086**	**0.009**	**0.0066**	**0.0089**
Selenium, Total	**0.00065 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	**0.00006 J**	0.001 U	**0.000039 J**	0.001 U	0.001 U	0.001 U	0.001 U	**0.00018 J**	**0.000097 J**
Mercury, Total	**0.000055 J**	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	**0.12**	0.1 U	**0.18**	**0.24**	**0.2 J+**	**0.2**	**0.19 J**	**0.21 J+**	**0.21**
Radiological (pCi/L)									
Radium-226	**0.162 ± 0.0727**	**0.177 ± 0.0778**	0.195 U ± 0.228	0.278 U ± 0.281	0.0398 U ± 0.0860	**0.120 ± 0.0878**	0.0399 UJ ± 0.0601	**1.10 J ± 0.398**	**0.122 ± 0.0669**
Radium-228	-0.0541 U ± 0.342	-0.0414 UJ ± 0.239	0.394 U ± 0.274	**0.641 ± 0.284**	0.0520 U ± 0.252	-0.0275 U ± 0.213	**0.0246 ± 0.242**	**3.67 ± 1.20**	**0.406 ± 0.244**
Radium-226 & 228	0.108 U ± 0.350	0.136 UJ ± 0.251	**0.589 ± 0.356**	R	0.0918 U ± 0.266	0.12 UJ ± 0.230	0.0646 U ± 0.250	**4.77 ± 1.26**	**0.528 ± 0.253**

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CCR: Coal Combustion Residuals
CFR: Code of Federal Regulations
ft amsl: feet above mean sea level
MCL: Maximum Contaminant Level
mg/L: milligram per liter
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SUMMARY OF ANALYTICAL RESULTS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

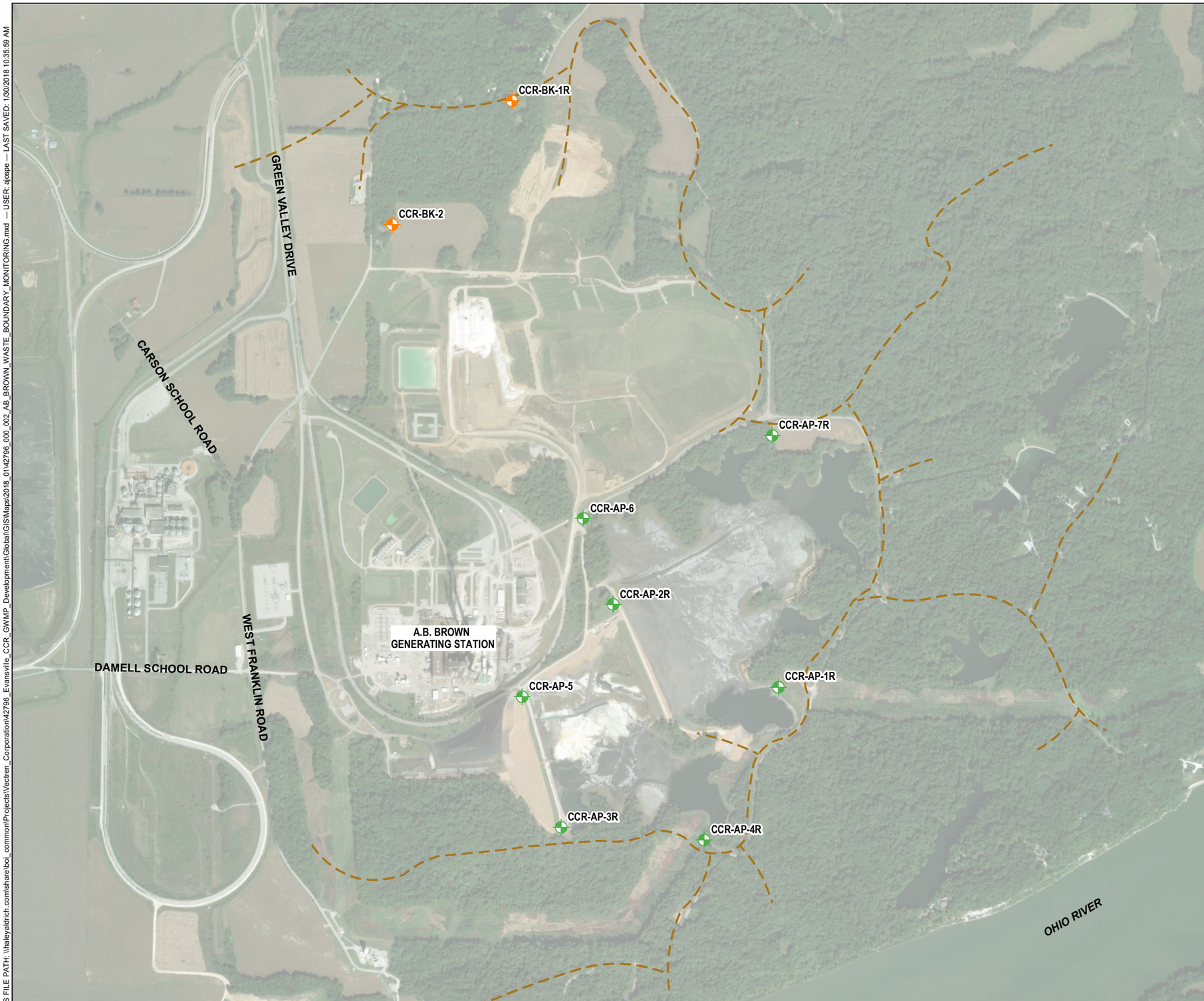
Location Group	Downgradient								
Location Name	CCR-AP-7R	CCR-AP-7R	CCR-AP-7R	CCR-AP-7R	CCR-AP-7R	CCR-AP-7R	CCR-AP-7R	CCR-AP-7R	CCR-AP-7R
Sample Name	CCR-AP-7-20160609	CCR-AP-7-20160810	CCR-AP-7-20161026	CCR-AP-7R-20161205	CCR-AP-7R-20170206	CCR-AP-7R-20170425	CCR-AP-7R-20170605	CCR-AP-7R-20170926	CCR-AP-7R-20171114
Sample Date	06/09/2016	08/10/2016	10/26/2016	12/05/2016	02/06/2017	04/25/2017	06/05/2017	09/26/2017	11/14/2017
Lab Sample ID	180-55607-7	180-57528-21	180-60193-4	180-61491-7	180-63324-7	180-65681-2	180-67229-7	180-70809-7	180-72643-20
Water Level (ft amsl)	457.39	457.59	456.07	455.82	456.15	-	454.32	453.14	452.74
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**17.91**	**16.91**	**15.41**	**12.19**	**13.33**	**14.48**	**15.06**	**15.56**	**13.51**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**524.01**	-
Dissolved Oxygen, Field (mg/L)	**7.01**	**7.69**	**9.08**	**10.04**	**6.85**	**7.2**	**8.31**	**6.67**	**6.72**
Conductivity, Field (mS/cm)	**0.53443**	**4.234**	**4.08942**	**1.9895**	**4.16272**	**4.453**	**4.15439**	**4.62098**	**4.68238**
ORP, Field (mv)	**121.77**	**198**	**195.26**	**166.1**	**179.67**	**269**	**256.13**	**257.35**	**129.8**
Turbidity, Field (NTU)	**3.02**	**171.8**	**11.72**	**53.54**	**57.61**	**487.6**	**136.87**	-	**121.17**
pH, Field (su)	**6.49**	**6.37**	**6.47**	**6.31**	**6.43**	**6.42**	**6.46**	**6.53**	**6.51**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	0.011 U	**5.4**	**3.7**	**3.6**	**3.4**	**4.1**	**4.1**	**2.7 J+**	**2.8**
Calcium, Total	**47**	**320**	**340**	**340**	**330**	**340**	**340**	**300**	**320**
Chloride (mg/L)	**26**	**300**	**320**	**320**	**290**	**320**	**330**	**260**	**280**
Fluoride (mg/L)	R	0.25 U	**0.17 J**	**0.25**	0.25 U	**0.2 J**	**0.19 J**	R	**0.094 J**
Sulfate (mg/L)	**15**	**1600 J-**	**1900 J-**	**2100**	**1900**	**2200**	**2100**	**2300**	**2400 J-**
pH (lab) (su)	**6.75 J**	**6.9 J**	**6.6 J**	**6.6 J**	**6.8 J**	**6.9 J**	**6.7 J**	**6.6 J**	**7.2 J**
Total Dissolved Solids (TDS) (mg/L)	**350**	**3700**	**3700**	**3600**	**3800**	**7800**	**4000**	**4100**	**3900**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	**0.00059 J**	0.002 U	0.002 U	0.002 U
Arsenic, Total	**0.00067 J**	R	**0.00061 J**	**0.00051 J**	**0.0016 J+**	**0.0032**	**0.0017**	R	**0.0014 J+**
Barium, Total	**0.024 J-**	**0.039**	**0.032 J-**	**0.033 J-**	**0.039**	**0.063**	**0.05**	**0.048 J-**	**0.039 J-**
Beryllium, Total	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.00024 J**	0.001 U	**0.00013 J**	0.001 U
Cadmium, Total	0.001 U	**0.00032 J**	**0.00019 J**	**0.00015 J**	**0.00014 J**	**0.00015 J**	**0.0002 J**	0.001 U	**0.00011 J**
Chromium, Total	**0.0016 J**	**0.00093 J**	**0.00076 J**	**0.00093 J**	**0.0016 J**	**0.0063**	**0.0033**	R	**0.0029 J+**
Cobalt, Total	**0.0002 J**	**0.0039**	**0.0012**	**0.0012**	**0.0015**	**0.004**	**0.0023**	**0.0019**	**0.0013**
Lead, Total	R	**0.00041 J**	**0.00022 J**	**0.00014 J**	**0.00062 J**	**0.0033**	**0.0017**	**0.0018 J+**	**0.0011**
Lithium, Total	**0.011 J**	**0.02 J**	**0.024 J**	**0.025 J**	**0.023 J**	**0.03 J**	**0.021 J**	**0.025 J**	**0.022 J**
Molybdenum, Total	**0.0016 J**	**0.0011 J**	0.005 U	0.005 U	0.005 U	0.005 U	**0.00062 J**	**0.00065 J**	0.005 U
Selenium, Total	0.005 U	**0.0007 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.000054 J**	0.001 U
Mercury, Total	0.0002 UJ	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	R	0.25 U	**0.17 J**	**0.25**	0.25 U	**0.2 J**	**0.19 J**	R	**0.094 J**
Radiological (pCi/L)									
Radium-226	**0.0958 J ± 0.0549**	**0.324 ± 0.149**	0.284 U ± 0.252	0.0965 U ± 0.221	**0.164 ± 0.0985**	**0.350 ± 0.130**	**0.248 J ± 0.0930**	R	**0.217 ± 0.0812**
Radium-228	-0.0103 U ± 0.186	0.127 UJ ± 0.584	0.157 U ± 0.248	0.347 U ± 0.251	0.193 U ± 0.275	0.0871 U ± 0.274	**0.202 ± 0.223**	0.450 U ± 0.305	**0.559 ± 0.268**
Radium-226 & 228	0.0856 U ± 0.194	0.451 UJ ± 0.603	**0.441 ± 0.353**	R	0.357 UJ ± 0.292	0.437 UJ ± 0.303	**0.451 J ± 0.242**	R	**0.776 ± 0.280**

ABBREVIATIONS AND NOTES:
CCR: Coal Combustion Residuals
CFR: Code of Federal Regulations
ft amsl: feet above mean sea level
MCL: Maximum Contaminant Level
mg/L: milligram per liter
mS/cm: milliSiemen per centimeter
mv: millivolt
NA: Not Applicable
NTU: Nephelometric Turbidity Units
pCi/L: picoCurie per liter
su: standard units
USEPA: United States Environmental Protection Agency

QUALIFIERS:
J: value is estimated
J+: value is estimated with a potentially high bias
J-: value is estimated with a potentially low bias
R: value is rejected
U: Not detected value is the laboratory reporting limit

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257.
https://www.epa.gov/coalash/coal-ash-rule

FIGURES



LEGEND

- UPGRADIENT MONITORING WELL
- DOWNGRADIENT MONITORING WELL
- TOPOGRAPHIC DIVIDE

NOTES

1. LOCATIONS DERIVED FROM THREE I DESIGN DATA.
2. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
3. AERIAL IMAGERY SOURCE: ESRI

N

0 500 1,000 1,500 2,000
SCALE IN FEET

HALEY ALDRICH

VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620

MONITORING WELL NETWORK
ASH POND

JANUARY 2018

FIGURE 1

GIS FILE PATH: \\haleyaldrich.com\share\boi_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2018_01\42796_000_002_AB_BROWN_WASTE_BOUNDARY_MONITORING.mxd — USER: ajdspe — LAST SAVED: 1/30/2018 10:35:59 AM

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REPORT ON

ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
LANDFILL
A.B. BROWN GENERATING STATION
POSEY COUNTY, INDIANA

by Haley & Aldrich, Inc.
Greenville, South Carolina

for Southern Indiana Gas and Electric Company
Evansville, Indiana

File No. 129420
January 2019

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1	Landfill Monitoring Well Location Map

1. 40 CFR § 257.90 Applicability

1.1 40 CFR § 257.90(a)

Except as provided for in § 257.100 for inactive CCR surface impoundments, all CCR landfills, CCR surface impoundments, and lateral expansions of CCR units are subject to the groundwater monitoring and corrective action requirements under § 257.90 through § 257.98.

The Landfill at A.B. Brown Generating Station (ABB) is subject to the groundwater monitoring and corrective action requirements described under Code of Federal Regulations Title 40 (40 CFR) § 257.90 through § 257.98 (Rule). This document addresses the requirement for the Owner/Operator to prepare an Annual Report per § 257.90(e).

1.2 40 CFR § 257.90(e) - SUMMARY

Annual groundwater monitoring and corrective action report. For existing CCR landfills and existing CCR surface impoundments, no later than January 31, 2018, and annually thereafter, the owner or operator must prepare an annual groundwater monitoring and corrective action report. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, the owner or operator must prepare the initial annual groundwater monitoring and corrective action report no later than January 31 of the year following the calendar year a groundwater monitoring system has been established for such CCR unit as required by this subpart, and annually thereafter. For the preceding calendar year, the annual report must document the status of the groundwater monitoring and corrective action program for the CCR unit, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year. For purposes of this section, the owner or operator has prepared the annual report when the report is placed in the facility's operating record as required by § 257.105(h)(1).

This Annual Report documents the activities completed in 2018 for the Landfill as required by the Rule. Groundwater sampling and analysis was conducted per the requirements described in § 257.93, and the status of the groundwater monitoring program described in § 257.95 is provided in this report.

1.2.1 Status of the Groundwater Monitoring Program

As provided in the notification on January 15, 2018 statistically significant increases (SSI) of Appendix III constituents were identified downgradient of the Landfill. An evaluation of Alternate sources (ASD) was conducted; however, a successful alternative source demonstration was not achieved at this time. As a result, an Assessment Monitoring program was initiated as required by § 257.94(e)(2). The notification was placed in the facility's operating record as required by 257.106(h)(4).

1.2.2 Key Actions Completed

The following key actions were completed in 2018:

- Conducted a statistical analysis of detection monitoring results to evaluate potential SSIs.
- Prepared 2017 Annual Report including:
    - The Annual Report was placed in the facility's operating record pursuant to § 257.105(h)(1);

- Pursuant to § 257.106(h)(1), the notification was sent to the relevant State Director and/or Tribal authority within 30 days of the Annual Report being placed in the facility's operating record [§ 257.106(d)];
- Pursuant to § 257.107(h)(1), the Annual Report was posted to the CCR Website within 30 days of the Annual Report being placed in the facility's operating record [§ 257.107(d)];

- Conducted an evaluation of possible alternate sources for Appendix III SSIs (Appendix A);
- Pursuant to § 257.106(h)(4), the notification was sent to the relevant State Director and/or Tribal authority within 30 days of establishing an assessment monitoring program;
- Collected and analyzed two rounds of Assessment Monitoring results in accordance with § 257.95(b) and § 257.95(d)(1) and recorded the concentrations in the facility's operating record as required by § 257.95(d)(1); and
- Established groundwater protection standards for those detected Appendix IV constituents in accordance with § 257.95(d)(2).

1.2.3 Problems Encountered

Problems such as damaged wells, issues with sample collection or lack of sampling, and problems with analytical analysis were not encountered at the ABB Landfill in 2018.

1.2.4 Actions to Resolve Problems

Actions to resolve problems were not required.

1.2.5 Project Key Activities for Upcoming Year

Key activities to be completed in 2019 include the following:

- Statistical analysis of Assessment Monitoring analytical data to determine if statistically significant levels (SSLs) of the detected Appendix IV constituents are present;
- Based on the findings of the statistical analysis, conduct semi-annual groundwater monitoring and subsequent statistical analysis as required by § 257.94 or § 257.95; and
- Based on the findings of the statistical analysis, an evaluation of alternate sources, determination of nature and extent, and an assessment of corrective measures will be considered as required by § 257.95(g)(1) and § 257.95(g)(3).

1.3 40 CFR § 257.90(e) - INFORMATION

At a minimum, the annual groundwater monitoring and corrective action report must contain the following information, to the extent available:

1.3.1 40 CFR § 257.90(e)(1)

A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;

As required by § 257.90(e)(1), a map showing the locations of the CCR unit and associated upgradient and downgradient monitoring wells for the Landfill is presented as Figure 1. In addition, this information is presented in the CCR Groundwater Monitoring Plan, which was placed in the facility's operating record by October 17, 2017 as required by § 257.105(h)(2).

1.3.2 40 CFR § 257.90(e)(2)

Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;

Additional monitoring wells were not installed or decommissioned during 2018. However, location and construction details of the existing monitoring well network for the Landfill is provided for reference as Table I.

1.3.3 40 CFR § 257.90(e)(3)

In addition to all the monitoring data obtained under § 257.90 through § 257.98, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;

In accordance with § 257.95(b) and § 257.95(d)(1), two independent samples from each background and downgradient monitoring well were collected and analyzed. A summary table including the sample names, dates of sample collection, reason for sample collection (detection or assessment), and monitoring data obtained for the groundwater monitoring program for the Landfill is presented in Table II of this report.

1.3.4 40 CFR § 257.90(e)(4)

A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels); and

As required by § 257.93(h) a statistical analysis of the Appendix III constituents was completed by January 15, 2018. This statistical analysis determined that statistically significant increases of boron, calcium, chloride, fluoride, sulfate, and total dissolved solids were present downgradient of the Landfill. An evaluation of alternate sources was initiated and completed on April 13, 2018 as required by § 257.94(e)(2). A source causing the SSI over background levels other than the CCR unit was not identified at that time and an Assessment Monitoring program was initiated. The Assessment Monitoring program has been established to meet the requirements of 40 CFR § 257.95.

1.3.5 40 CFR § 257.90(e)(5)

Other information required to be included in the annual report as specified in § 257.90 through § 257.98.

Other information including development of groundwater protection standards, recording groundwater monitoring results in the operating record, and an evaluation of alternate sources is discussed in preceding sections.

TABLES

TABLE I
GROUNDWATER MONITORING WELL LOCATION AND CONSTRUCTION DETAILS
A.B. BROWN GENERATING STATION - LANDFILL
MOUNT VERNON, INDIANA

Well	CCR Unit	Date Installed	Easting	Northing	Top of Pad Elevation (ft msl)	Top of Riser Elevation (ft msl)	Surface Grout (ft bgs)	Bentonite (ft bgs)	Sand Pack (ft bgs)	Screen Zone (ft bgs)	Screen Length (ft)	Well Radius (in)	Status
CCR-BK-1R	Background	March 2016	2770919.08	974083.40	480.10	483.39	0.0 - 50.0	50.0 - 52.0	52.0 - 64.0	54.0 - 64.0	10	2.00	Active
CCR-BK-2	Background	March 2016	2769728.14	972854.33	427.50	430.60	0.0 - 11.5	11.5 - 13.5	13.5 - 25.5	15.5 - 25.5	10	2.00	Active
CCR-LF-1	Landfill	March 2016	2771247.76	970812.18	432.80	435.63	0.0 - 3.0	3.0 - 7.0	7.0 - 19.0	9.0 - 19.0	10	2.00	Active
CCR-LF-2	Landfill	March 2016	2772205.05	970681.32	470.10	473.00	0.0 - 30.0	30.0 - 32.0	32.0 - 45.0	35.0 - 45.0	10	2.00	Active
CCR-LF-3	Landfill	March 2016	2773138.97	970949.70	482.00	484.75	0.0 - 21.0	21.0 - 23.0	23.0 - 35.0	25.0 - 35.0	10	2.00	Active
CCR-LF-4	Landfill	March 2016	2772876.83	972312.24	476.60	478.85	0.0 - 40.8	40.8 - 43.0	43.0 - 55.0	45.0 - 55.0	10	2.00	Active
CCR-LF-5	Landfill	March 2016	2772003.91	972228.16	427.50	430.41	0.0 - 16.0	16.0 - 18.0	18.0 - 30.0	20.0 - 30.0	10	2.00	Active
CCR-LF-6	Landfill	March 2016	2771046.15	972269.53	409.20	412.05	0.0 - 0.0	0.0 - 2.66	2.66 - 9.66	4.66 - 9.66	10	2.00	Active

Notes:
bgs = below ground surface
ft = feet
in = inches
msl = mean sea level
Datum of Elevations in NAVD 88
Statuses could include active, available, or decommissioned

TABLE II
SUMMARY OF GROUNDWATER QUALITY DATA
LANDFILL - JUNE THROUGH AUGUST 2018
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA
FILE NO. 129420

Location Group	Action Level	Upgradient			
Location Name	Maximum	CCR-BK-1R	CCR-BK-1R	CCR-BK-2	CCR-BK-2
Sample Name	Contaminant	CCR-BK-1R-20180608	CCR-BK-1R20180827	CCR-BK-2-20180608	CCR-BK-2-20180820
Sample Date	Level/Regional	06/08/2018	08/27/2018	06/08/2018	08/20/2018
Lab Sample ID	Screening Level	180-78556-5	180-81365-1	180-78556-6	180-81110-10
Detection Monitoring - EPA Appendix III Constituents (mg/L)					
Boron, Total	NA	-	0.08 U	-	0.08 U
Calcium, Total	NA	-	**34**	-	**36**
Chloride	NA	-	**1.9**	-	**15**
Fluoride	4	**0.37**	**0.31**	**0.16**	**0.13 J+**
Sulfate	NA	-	**21 J-**	-	**18 J-**
Total Dissolved Solids (TDS)	NA	-	**220**	-	**230**
pH (lab) (SU)	NA	-	**7.2 J**	-	**6.8 J**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)					
Antimony, Total	0.006	0.002 U	-	0.002 U	-
Arsenic, Total	0.01	R	**0.0011**	0.001 U	0.001 U
Barium, Total	2	**0.049 J-**	**0.041 J**	**0.037 J-**	**0.033 J**
Beryllium, Total	0.004	0.001 UJ	-	0.001 UJ	-
Cadmium, Total	0.005	0.001 UJ	0.001 U	0.001 UJ	0.001 U
Chromium, Total	0.1	**0.003 J+**	**0.0076**	0.002 U	0.002 U
Cobalt, Total	0.006	**0.0008 J**	**0.001**	**0.000098 J**	0.0005 U
Fluoride	4	**0.37**	**0.31**	**0.16**	**0.13 J+**
Lead, Total	0.015	**0.00063 J**	**0.0011**	0.001 UJ	0.001 U
Lithium, Total	0.04	**0.0036 J**	**0.0048 J**	0.005 U	0.05 U
Mercury, Total	0.002	0.0002 UJ	0.0002 U	0.0002 UJ	0.0002 U
Molybdenum, Total	0.1	**0.0014 J**	**0.0013 J**	**0.00051 J**	0.005 U
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.002	0.001 U	-	0.001 U	-
Radiological (pCi/L)					
Radium-226	NA	**0.223 ± 0.148**	R	0.0863 U ± 0.108	R
Radium-228	NA	0.263 U ± 0.217	0.285 U ± 0.313	0.230 U ± 0.194	0.0380 U ± 0.238
Radium-226 & 228	5	R	R	R	0.209 UJ ± 0.251

ABBREVIATIONS AND NOTES:

CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
SU: standard units.
USEPA: United States Environmental Protection Agency
Results in **bold** are detected.

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257. https://www.epa.gov/coalash/coal-ash-rule

TABLE II
SUMMARY OF GROUNDWATER QUALITY DATA
LANDFILL - JUNE THROUGH AUGUST 2018
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA
FILE NO. 129420

Location Group	Action Level	Downgradient						
Location Name	Maximum	CCR-LF-1	CCR-LF-1	CCR-LF-2	CCR-LF-2	CCR-LF-3	CCR-LF-3	CCR-LF-3
Sample Name	Contaminant	CCR-LF-1-20180607	CCR-LF-1-20180822	CCR-LF-2-20180607	CCR-LF-2-20180820	CCR-LF-3-20180607	CCR-LF-3-20180820	BLIND DUPLICATE 2-20180820
Sample Date	Level/Regional	06/07/2018	08/22/2018	06/07/2018	08/20/2018	06/07/2018	08/20/2018	08/20/2018
Lab Sample ID	Screening Level	180-78556-1	180-81267-4	180-78556-2	180-81110-5	180-78556-3	180-81110-6	180-81110-12
Detection Monitoring - EPA Appendix III Constituents (mg/L)								
Boron, Total	NA	-	**0.04 J**	-	**5.3**	-	0.08 U	**0.063 J**
Calcium, Total	NA	-	**270**	-	**390**	-	**290**	**280**
Chloride	NA	-	**19**	-	**290**	-	**31**	**32**
Fluoride	4	**0.27**	**0.26 J+**	2.5 U	5 U	**0.2 J**	**0.19 J+**	**0.2 J+**
Sulfate	NA	-	**1200 J-**	-	**15000**	-	**1500 J-**	**1500 J-**
Total Dissolved Solids (TDS)	NA	-	**2000**	-	**24000**	-	**2900**	**2800**
pH (lab) (SU)	NA	-	**6.9 J**	-	**6.6 J**	-	**7.2 J**	**6.9 J**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)								
Antimony, Total	0.006	0.002 U	-	0.02 U	-	0.002 U	-	-
Arsenic, Total	0.01	0.001 U	**0.0015**	0.01 U	0.01 U	0.001 U	0.001 U	0.001 U
Barium, Total	2	**0.045 J-**	**0.088 J**	**0.012 J**	**0.012 J**	**0.029 J-**	**0.025 J**	**0.025 J**
Beryllium, Total	0.004	0.001 UJ	-	0.01 UJ	-	0.001 UJ	-	-
Cadmium, Total	0.005	0.001 UJ	0.001 U	**0.0039 J**	**0.0035 J**	0.001 UJ	0.001 U	0.001 U
Chromium, Total	0.1	0.002 U	**0.0062 J+**	0.02 U	0.02 U	0.002 U	0.0035 U	0.0032 U
Cobalt, Total	0.006	**0.00022 J**	**0.00068**	**0.01 J**	**0.011**	**0.00033 J**	0.0005 U	0.0005 U
Fluoride	4	**0.27**	**0.26 J+**	2.5 U	5 U	**0.2 J**	**0.19 J+**	**0.2 J+**
Lead, Total	0.015	**0.00021 J**	**0.0011**	0.01 UJ	0.01 U	0.001 UJ	0.001 U	0.001 U
Lithium, Total	0.04	**0.0036 J**	**0.008 J+**	0.05 U	**0.041 J**	0.005 U	**0.0098 J**	0.05 U
Mercury, Total	0.002	0.0002 UJ	0.0002 U	0.0002 UJ	0.0002 U	0.0002 UJ	0.0002 U	0.0002 U
Molybdenum, Total	0.1	**0.00083 J**	**0.0012 J**	0.05 U	0.05 U	**0.0014 J**	**0.0011 J**	**0.0012 J**
Selenium, Total	0.05	0.005 U	0.005 U	0.05 U	0.05 U	**0.0011 J+**	**0.0014 J**	**0.0011 J**
Thallium, Total	0.002	0.001 U	-	0.01 U	-	0.001 U	-	-
Radiological (pCi/L)								
Radium-226	NA	**0.299 ± 0.175**	**0.776 ± 0.153**	**0.486 ± 0.2**	**0.466 J ± 0.114**	0.138 U ± 0.116	R	R
Radium-228	NA	**0.446 ± 0.247**	0.281 U ± 0.213	**1.30 ± 0.32**	**1.86 ± 0.384**	**0.387 ± 0.24**	0.235 U ± 0.232	0.404 U ± 0.268
Radium-226 & 228	5	R	R	**1.79 ± 0.377**	**2.32 J ± 0.401**	R	**0.432 J+ ± 0.245**	**0.710 J+ ± 0.289**

ABBREVIATIONS AND NOTES:

CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
SU: standard units.
USEPA: United States Environmental Protection Agency
Results in **bold** are detected.

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257. https://www.epa.gov/coalash/coal-ash-rule

TABLE II
SUMMARY OF GROUNDWATER QUALITY DATA
LANDFILL - JUNE THROUGH AUGUST 2018
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA
FILE NO. 129420

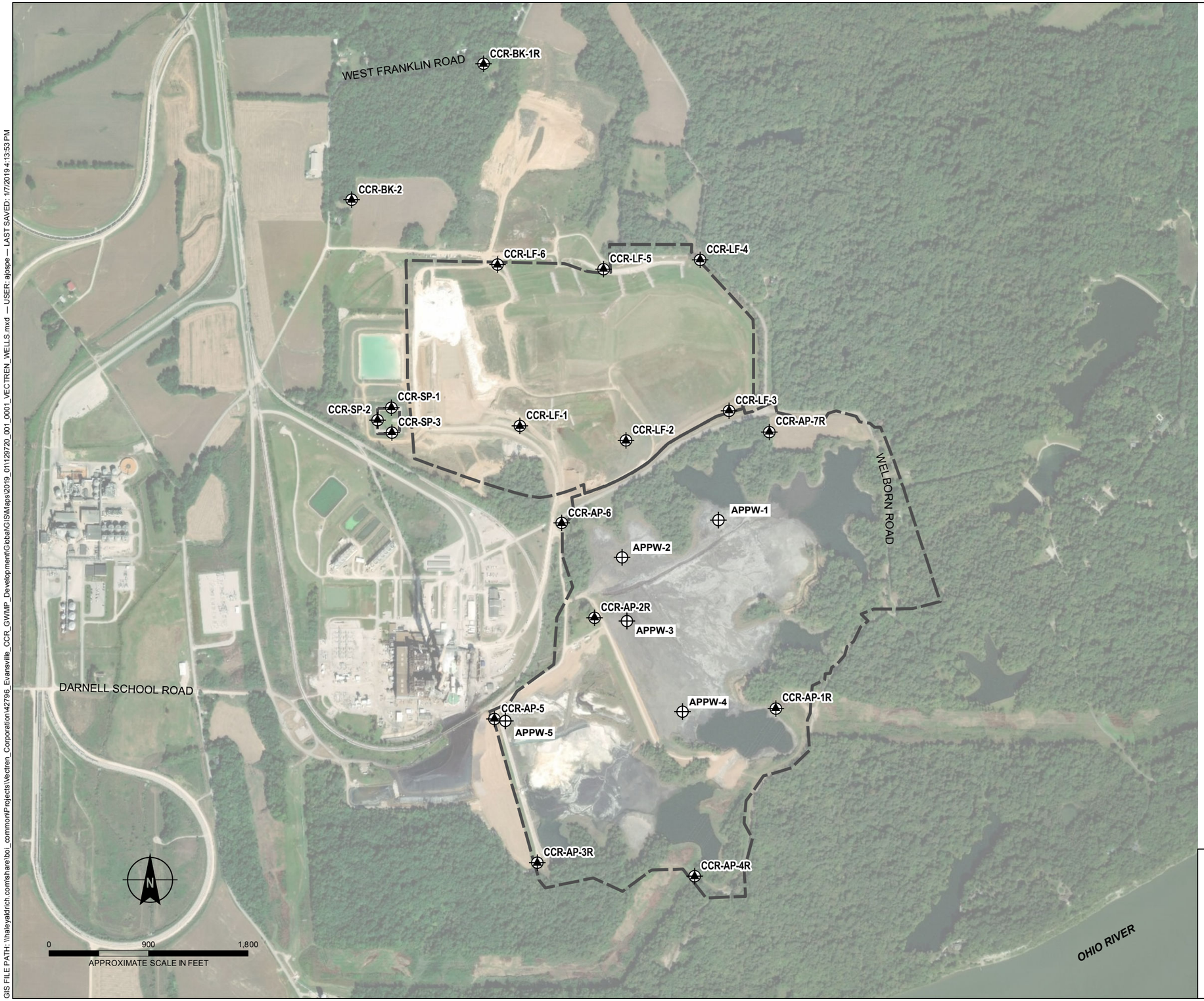
Location Group	Action Level	Downgradient						
Location Name	Maximum	CCR-LF-4	CCR-LF-4	CCR-LF-4	CCR-LF-5	CCR-LF-5	CCR-LF-6	CCR-LF-6
Sample Name	Contaminant	CCR-LF-4-20180608	DUP2-20180608	CCR-LF-4-20180821	CCR-LF-5-20180605	CCR-LF-5-20180820	CCR-LF-6-20180605	CCR-LF-6-20180820
Sample Date	Level/Regional	06/08/2018	06/08/2018	08/21/2018	06/05/2018	08/20/2018	06/05/2018	08/20/2018
Lab Sample ID	Screening Level	180-78556-4	180-78556-8	180-81110-7	180-78475-6	180-81110-8	180-78475-7	180-81110-9
Detection Monitoring - EPA Appendix III Constituents (mg/L)								
Boron, Total	NA	-	-	**0.2**	-	**0.93**	-	**0.79**
Calcium, Total	NA	-	-	**360**	-	**410**	-	**190**
Chloride	NA	-	-	**600**	-	**34**	-	**21**
Fluoride	4	1 U	1 U	2.5 U	0.5 U	1 U	**0.51**	**0.47**
Sulfate	NA	-	-	**5600 J-**	-	**3000 J-**	-	**520 J-**
Total Dissolved Solids (TDS)	NA	-	-	**12000**	-	**4400**	-	**1200**
pH (lab) (SU)	NA	-	-	**6.8 J**	-	**6.9 J**	-	**7.1 J**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)								
Antimony, Total	0.006	0.02 U	0.02 U	-	0.002 U	-	0.002 U	-
Arsenic, Total	0.01	**0.015 J**	**0.01 J**	**0.016**	0.001 U	0.001 U	0.001 U	0.001 U
Barium, Total	2	**0.011 J**	R	**0.011 J**	**0.026 J-**	**0.024 J**	**0.024 J-**	**0.03 J**
Beryllium, Total	0.004	0.01 UJ	0.01 UJ	-	0.001 UJ	-	0.001 UJ	-
Cadmium, Total	0.005	0.01 UJ	0.01 UJ	0.001 U	**0.00021 J**	**0.00022 J**	0.001 UJ	**0.00021 J**
Chromium, Total	0.1	0.02 U	0.02 U	0.002 U	0.002 U	0.002 U	0.002 U	0.0023 U
Cobalt, Total	0.006	**0.0013 J**	**0.00079 J**	**0.001**	**0.00019 J**	0.0005 U	**0.00021 J**	**0.00086 J+**
Fluoride	4	1 U	1 U	2.5 U	0.5 U	1 U	**0.51**	**0.47**
Lead, Total	0.015	**0.079 J**	0.01 UJ	0.001 U	0.001 UJ	**0.00011 J**	0.001 UJ	**0.00017 J**
Lithium, Total	0.04	**0.068 J**	**0.046 J**	**0.096**	**0.019 J**	**0.031 J**	**0.014 J**	**0.021 J**
Mercury, Total	0.002	0.0002 UJ	0.0002 UJ	0.0002 U	**0.000086 J-**	**0.000081 J**	0.0002 UJ	0.0002 U
Molybdenum, Total	0.1	**0.022 J**	**0.014 J**	**0.021**	**0.00069 J**	**0.00063 J**	**0.0012 J**	**0.0015 J**
Selenium, Total	0.05	0.05 U	0.05 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.002 J**
Thallium, Total	0.002	0.01 U	0.01 U	-	0.001 U	-	0.001 U	-
Radiological (pCi/L)								
Radium-226	NA	**3.06 ± 0.522**	**3.08 ± 0.523**	**3.10 ± 0.392**	0.162 U ± 0.162	R	0.169 U ± 0.169	R
Radium-228	NA	**1.18 ± 0.338**	**1.18 ± 0.315**	**1.28 ± 0.323**	0.0364 U ± 0.186	0.260 U ± 0.3	0.0736 U ± 0.174	0.320 U ± 0.269
Radium-226 & 228	5	**4.24 ± 0.622**	**4.27 ± 0.611**	**4.38 ± 0.508**	0.198 U ± 0.247	0.465 UJ ± 0.312	0.242 U ± 0.243	**0.615 J+ ± 0.287**

ABBREVIATIONS AND NOTES:

CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
SU: standard units.
USEPA: United States Environmental Protection Agency
Results in **bold** are detected.

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257. https://www.epa.gov/coalash/coal-ash-rule

FIGURES



LEGEND

- MONITORING WELL
- APPROXIMATE WASTE BOUNDARY
- PIEZOMETER WELL

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI
3. PIEZOMETER WELLS WILL BE SURVEYED IN THE FUTURE.

HALEY ALDRICH

VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, INDIANA

GROUNDWATER MONITORING WELL LOCATIONS FOR COMPLIANCE WITH FEDERAL CCR RULE

JANUARY 2018

FIGURE 1

GIS FILE PATH: \\haleyaldrich.com\share\bpi_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\GlobalGIS\Maps\2019_01\129720_001_0001_VECTREN_WELLS.mxd — USER: ajospe — LAST SAVED: 1/7/2019 4:13:53 PM

APPENDIX A – Alternate Source Demonstration

www.haleyaldrich.com

REPORT ON

ALTERNATE SOURCE DEMONSTRATION
SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN - LANDFILL
WEST FRANKLIN, INDIANA

by Haley & Aldrich, Inc.
Greenville, South Carolina

for Southern Indiana Gas and Electric Company (SIGECO)
West Franklin, Indiana

File No. 129420
April 2018

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2	Monitoring Well Network Groundwater Landfill
3	Potentiometric Surface Map
4	Decision Diagram for CCR Alternate Source Demonstration Evaluation

1. Introduction

Haley & Aldrich, Inc. (Haley & Aldrich) was retained by Southern Indiana Gas and Electric Company (SIGECO) to perform an alternate source evaluation for the Landfill at the A.B. Brown Generating Station (ABB; Site) located near West Franklin, Indiana.

1.1 BACKGROUND

Consistent with §257.90 through §257.94, SIGECO has installed and certified a groundwater monitoring network for the Landfill, collected a minimum of eight rounds of groundwater samples (nine rounds were collected for this unit) for the analysis of constituent lists as specified in the Coal Combustion Residuals (CCR) Rule. In addition, completed interwell statistical analysis to determine if the Appendix III constituents in downgradient wells indicate a statistically significant increase (SSI) when compared to background (in this case upgradient wells). The statistical evaluation of the Appendix III constituents detected in groundwater downgradient of the Landfill identified SSI's above background .

Pursuant to 40 CFR §257.94(e)(2), *The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality*. The CCR Rule provides 90-days from detecting a statistically significant increase over background to complete an Alternate Source Demonstration (ASD). If a successful demonstration is completed, and certified by a qualified professional engineer, the CCR unit may continue with detection monitoring (§257.94(e)(2)). If, however, an alternate source of any of the Appendix III SSI is not identified the owner or operator must, within 90-days, initiate an assessment monitoring program (§257.94(e)(3)). Supplemental site-specific and regional information may be reconsidered at a later date to re-evaluate apparent alternate sources for Appendix III SSI's and may result in potentially different outcomes than presented in this report.

This report documents the findings and conclusions of this alternate source demonstration completed for the Landfill at the ABB.

1.2 SITE SETTING

The Site is located in Posey County near the community of West Franklin, Indiana. The location of the Site is shown on Figure 1. The Site is located approximately 0.5 miles north of the Ohio River. The Site varies in elevation with natural ground surface elevations varying from 380 to 520-feet above mean sea level (msl). The higher elevations are generally to the north of the Site with surface topography dominated by a series of ridges separated by ravines. In general, surface topography across the site generally slopes to the west towards the western property boundary then to the south toward the Ohio River. Surface water runoff occurs via sheet flow to low lying areas or ravines which eventually lead to the Ohio River.

2. Site Geology and Hydrogeology

The Site geology and hydrogeology is described in numerous documents prepared by others and in the *Groundwater Monitoring Plan* prepared by Haley & Aldrich in October 2017.

2.1 SITE GEOLOGY

The Ohio River valley contains fill and loess (windblown) deposits derived indirectly from continental ice sheets. These were deposited from meltwater heavily loaded with entrained sediments accumulated in the area on the Pennsylvanian age shale, limestone and sandstone bedrock. Westerly winds simultaneously deposited silty sediments. As a result, base levels of the valley floor increased in elevation and created natural levees and outwashes. These natural levees produced slackwater lakes which deposited thick sequences of silt and clay. When the ice sheets retreated, the sediment load in the Ohio River diminished and lowered base levels. Consequently, the river incised the slackwater lake sediments, sculpted lacustrine terraces, and deposited silty and clayey stream alluvium.

Soil borings drilled at the Site indicates that the uppermost geologic unit is comprised of unconsolidated alluvial deposits consisting of primarily silts and clays with discontinuous layers of sand. This unit overlies Pennsylvanian age sandstone which is commonly identified as the Inglefield Sandstone. Underlying the Inglefield Sandstone is low-permeability weathered shale and siltstone. The sandstone and shale unit has been eroded on the north side of the landfill where the underlying limestone unit was encountered.

2.2 SITE HYDROGEOLOGY

Hydrogeologic units are defined based on their ability to transmit groundwater or serve as confining units between zones of groundwater saturation. The uppermost aquifer at the Site occurs within unconsolidated alluvial deposits which consist primarily of silty clay containing discontinuous layers of sand. Beneath upland areas, or ridgelines the uppermost aquifer occurs in weathered sandstone, shale, or siltstone. Recharge to the surficial aquifer occurs through direct surface infiltration.

Piezometric data recorded from the monitoring wells installed on-Site shows that the configuration of the uppermost aquifer is primarily controlled by surface topography with some influence from the underlying weathered bedrock. Groundwater flow across the eastern portion of the Landfill is to the north and northeast. Beneath the western portion of the Landfill groundwater flow shifts to the north and northwest into a trough that extends to the southwest beneath the Sedimentation Ponds (Figure 3). Groundwater flow in the vicinity of the Landfill is predominantly to the west with a component of flow to the northwest from the northern portion of the Landfill. Groundwater elevations vary seasonally but the groundwater flow patterns remain consistent.

Groundwater flow velocity in the uppermost aquifer beneath the CCR units was estimated using site-specific hydraulic conductivity obtained from slug testing and hydraulic gradients, and an assumed effective porosity of 25 percent. Hydraulic conductivity varied from 1E-3 cm/sec in the vicinity of the Landfill to 3E-4 cm/sec in the vicinity of the Sedimentation Ponds and the Ash Pond. The hydraulic gradient beneath and downgradient of the Landfill and the Ash Pond is 0.03 feet/foot and 0.04 feet/foot respectively. The hydraulic gradient lessens beneath and downgradient of the Sedimentation Pond dropping to 0.004 feet/foot. Using the site-specific hydraulic conductivity and hydraulic gradients, and

assuming an effective porosity of 25 percent the groundwater flow velocity in the vicinity of the CCR units is estimated as follows; 120 feet/year at the Landfill, 50 feet/year at the Ash Pond, and approximately 5 feet/year beneath and downgradient of the Sedimentation Pond.

3. Alternate Source Evaluation

Haley & Aldrich conducted an evaluation of potential alternate sources of Appendix III constituents in downgradient groundwater at the Landfill as potential cause(s) of the statistically significant increases. These potential sources include:

1. Sampling procedures, laboratory procedures and statistical analyses to determine if potential errors may have been made that would result in the apparent statistically significant increase;
2. Potential point and non-point sources of contamination in the vicinity of the unit; or,
3. Observed natural geochemical conditions that affect the natural variability of groundwater quality.

Each of these analyses and the resulting findings are described below. The systematic approach used to conduct this evaluation is illustrated on Figure 5.

3.1 REVIEW OF SAMPLING, ANALYSIS, AND STATISTICAL EVALUATION

3.1.1 Field Sampling Procedures

In accordance with §257.93 of the CCR Rule, Haley & Aldrich prepared a Groundwater Sampling and Analysis Plan (GWSAP) for the ABB. The GWSAP identified the site-specific activities and methodologies for groundwater sampling for the groundwater monitoring program. The GWSAP included procedures for field data collection, sample collection, sample preservation and shipment, interpretation, laboratory analytical methods, and reporting for groundwater sampling for the Landfill. The administrative procedures and frequency for collection of groundwater elevation measurements, determination of flow directions, and gradients were also provided in the GWSAP.

Haley & Aldrich has reviewed the field sampling and equipment calibration logs and the field indicator parameters and at this time did not identify deviations or errors in sampling.

3.1.2 Laboratory Quality Control

A project database that incorporates hydrogeologic and groundwater quality data was established to allow efficient management of chemical and physical data collected in the field and received from the laboratories. Laboratories conducting groundwater analyses for this program were supplied with specific formats for electronic data deliverables to ensure compatibility with the project database requirements.

Haley & Aldrich conducted quality assurance/quality control (QA/QC) reviews of the laboratory data generated for the Landfill and at this time has not identified any laboratory errors.

3.1.3 Statistical Evaluation

SIGECO collected a total of nine groundwater samples from each monitoring well in the groundwater monitoring network from 7 June 2016 through 16 November 2017. The data satisfies the CCR Rule requirement of collecting a minimum of eight rounds of hydrological and groundwater quality data from upgradient and downgradient wells. The Upper Tolerance Limit (UTL) statistical analysis was used as specified in the certification statement of 15 October 2017. The UTL is an accepted method under the

CCR Rule and is the upper endpoint of a tolerance interval that is designed to contain a pre-specified proportion (e.g. 95 percent) of the background dataset.

Data from the most recent sampling event from the downgradient monitoring wells for the Landfill were compared to the UTL calculated from the background data Based on these comparisons, SSI's were identified in one or more of the downgradient wells.

Haley & Aldrich has reviewed the statistical evaluation for the Landfill at ABB and at this time we have concluded that there were no errors in the statistical evaluation, the certified statistical evaluation met the performance standard of the certified statistical procedure and the evaluation complies with the requirements of the CCR Rule.

3.2 POTENTIAL POINT AND NON-POINT SOURCES

This evaluation includes an assessment of point and non-point sources of Appendix III constituents other than the regulated. Point sources could include units associated with the generating station. Non-point sources could include the leaching of inorganic constituents from the underlying subsurface soil and rock formations, runoff from parking areas or storm water conveyances or the application of agricultural chemicals. Both Point and Non-Point Sources are discussed below.

3.2.1 Point Sources

Haley & Aldrich has assessed possible point sources that may have produced the observed SSI's. At this time Haley & Aldrich was unable to identify an alternate point source that would produce an SSI of Appendix III constituent.

3.2.2 Non-Point Sources

At this time, no agricultural, mining, industrial, or other activities have been identified at the site that might constitute a non-point source of the observed Appendix III SSI's. Records used to evaluate the potential for non-point sources included historical topographic maps, historical aerial photographs and Site records. EDR's are provided in Appendix A. To date, there are no apparent non-point sources that could potentially be associated with the Appendix III SSI's for the Landfill.

3.3 NATURAL VARIABILITY OF ON-SITE GROUNDWATER QUALITY

As presented in section 2.1, unconsolidated sediments consisting of clay and silt and consolidated sediments of limestone, sandstone and shale make up the unconfined uppermost aquifer beneath the site. To date, Haley & Aldrich did not identify natural variability of groundwater quality at ABB that could be associated with the SSI's identified for the Landfill at this time.

3.4 REGIONAL WATER QUALITY OBSERVATIONS

3.4.1 Indiana Integrated Water Monitoring and Assessment Report 2016

Haley & Aldrich conducted a search of the Indiana Department of Environmental Management (IDEM) database including publicly available data describing groundwater quality in similar aquifers in Posey County. From the data reviewed to date, while many of the Appendix III constituents are naturally occurring in groundwater, the reported concentrations are generally below the levels detected in the downgradient monitoring wells surrounding Landfill. Relevant portions of the IDEM 2016 Integrated Water Monitoring and Assessment Report are presented in Appendix B.

4. Findings and Conclusions

Haley & Aldrich conducted an evaluation of groundwater quality at the Landfill to identify alternate sources for the Appendix III SSI's observed downgradient of the unit. The evaluation included review of sampling procedures, laboratory procedures, and statistical analyses to determine if potential errors may have been made that could result in the apparent SSI's observed downgradient of the Landfill. Haley & Aldrich also evaluated potential point and non-point sources of contamination in the vicinity and evaluated natural geologic conditions and the effect of those conditions on native groundwater chemistry.

At this time, this review did not identify contributing sources that could serve as an ASD for the SSI's observed in the CCR well network for the Landfill. Supplemental site-specific and regional information may be reconsidered at a later date to re-evaluate apparent alternate sources for Appendix III SSI's and may result in potentially different outcomes than presented in this report.
Landfill

References

1. United States Environmental Protection Agency (USEPA), 2000. Sampling and Analysis Plan Guidance and Template, R9QA/002.1. April 2000.

2. United States Environmental Protection Agency (USEPA), 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance, EPA 530/R-09-007. March 2009.

3. Haley & Aldrich, Inc. 2017. Groundwater Monitoring Report, SIGECO, A.B. Brown Station, West Franklin, Indiana.

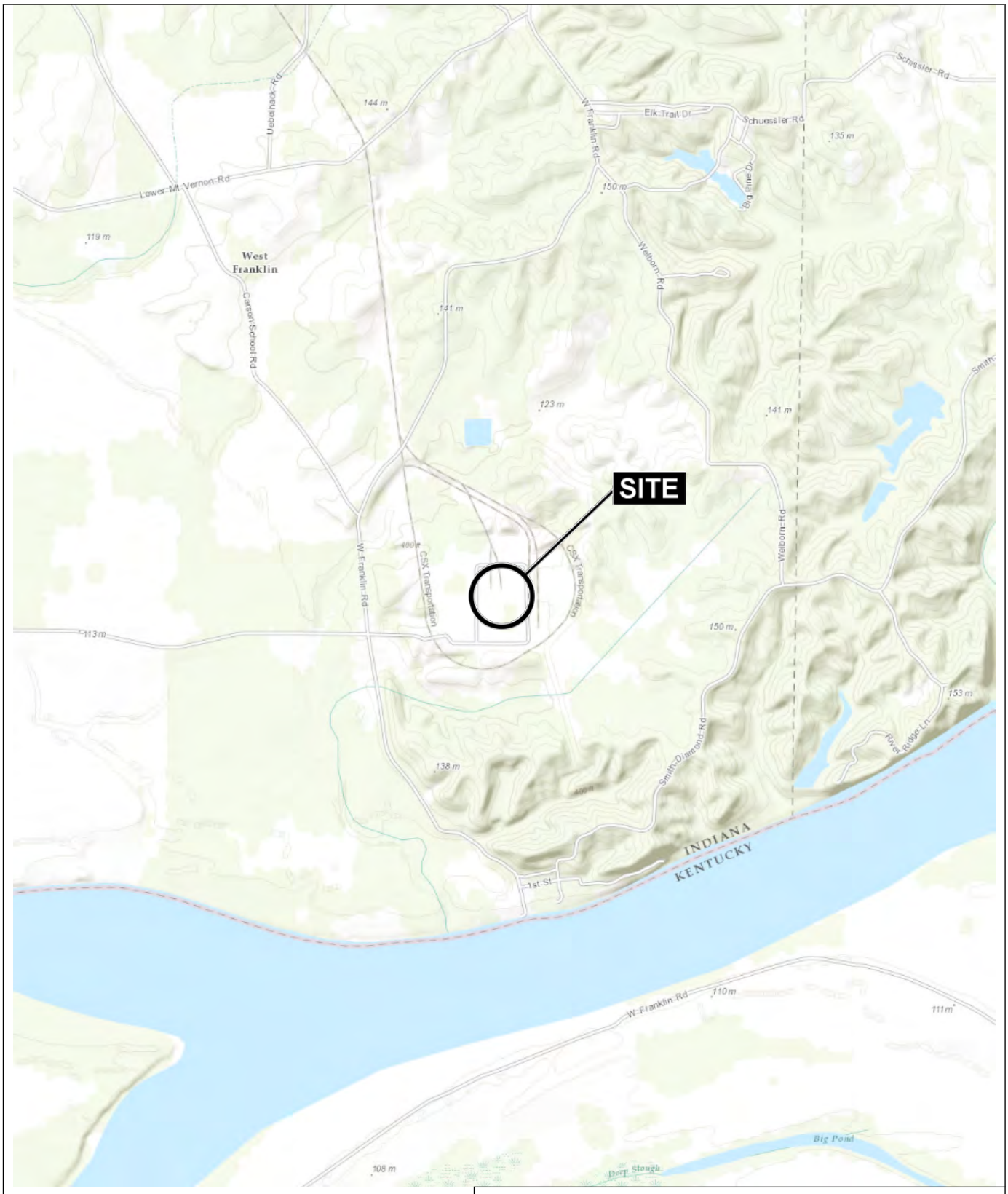
4. Haley & Aldrich, Inc. 2017. Sampling and Analysis Plan, SIGECO, A.B. Brown Station, West Franklin, Indiana.

5. Haley & Aldrich, Inc. 2017. Appendix III Statistical Results Memo, A.B. Brown Station, West Franklin, Indiana.

6. USGS. 2009. *Surficial Geologic Map of the Evansville Indiana, and Henderson, Kentucky, Area.*

https://hank.haleyaldrich.com/sites/communities/CCRASD/Client/Vectren/A.B. Brown/Landfill/Documents/ASD Evaluation/ASD Evaluation_AB Brown_Landfill_Vectren_2018_0413_F1.docx

FIGURES



MAP SOURCE: ESRI

SITE COORDINATES: 37°54'25"N, 87°42'55"W

HALEY ALDRICH

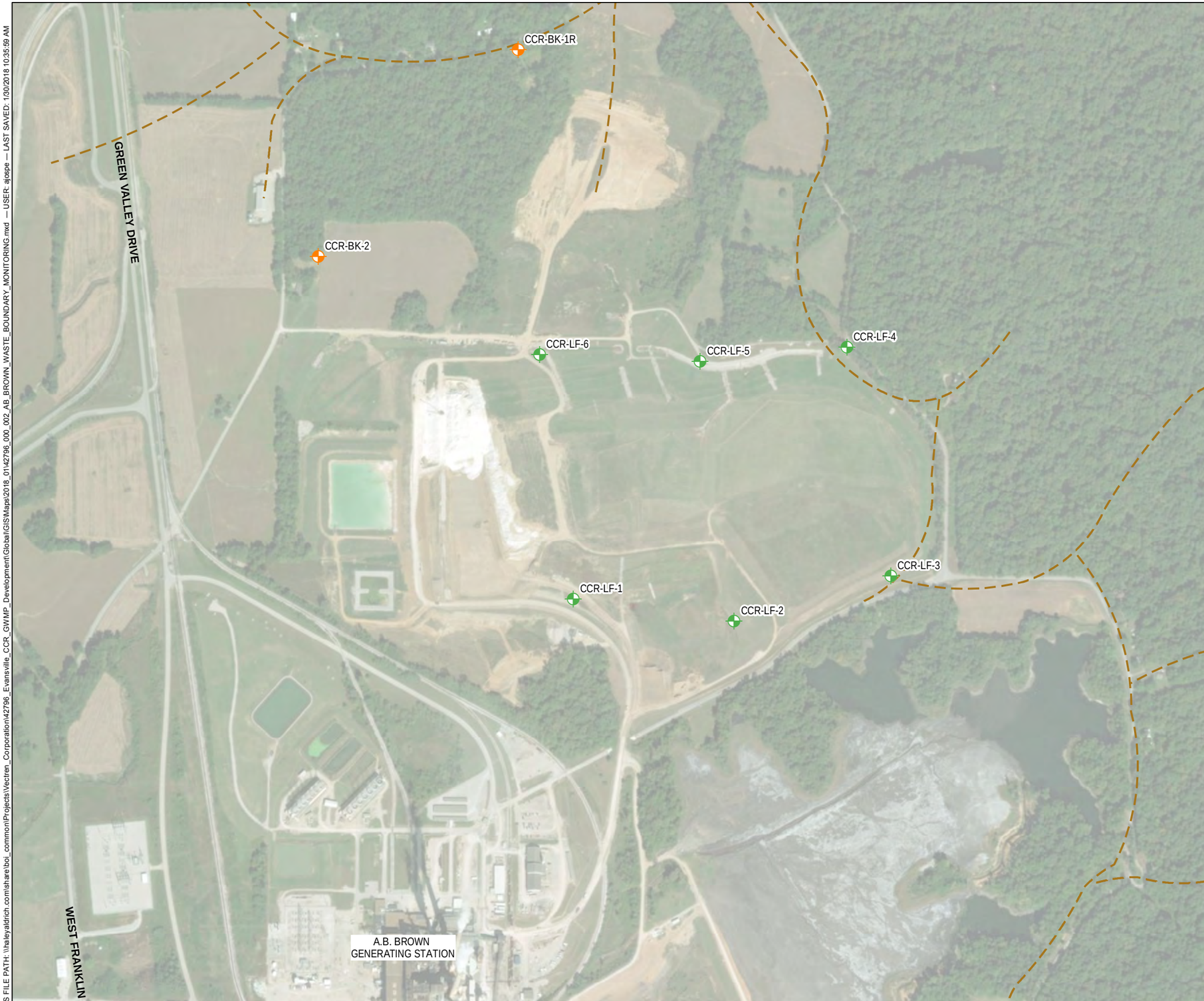
VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MT. VERNON, INDIANA 47620

SITE LOCATION MAP

APPROXIMATE SCALE: 1 IN = 2000 FT
APRIL 2018

FIGURE 1

42796-000_1_LOCUS.PDF



LEGEND

- UPGRADIENT MONITORING WELL
- DOWNGRADIENT MONITORING WELL
- TOPOGRAPHIC DIVIDE

NOTES

1. LOCATIONS DERIVED FROM THREE I DESIGN DATA.
2. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
3. AERIAL IMAGERY SOURCE: ESRI

N

0 500 1,000
SCALE IN FEET

HALEY ALDRICH

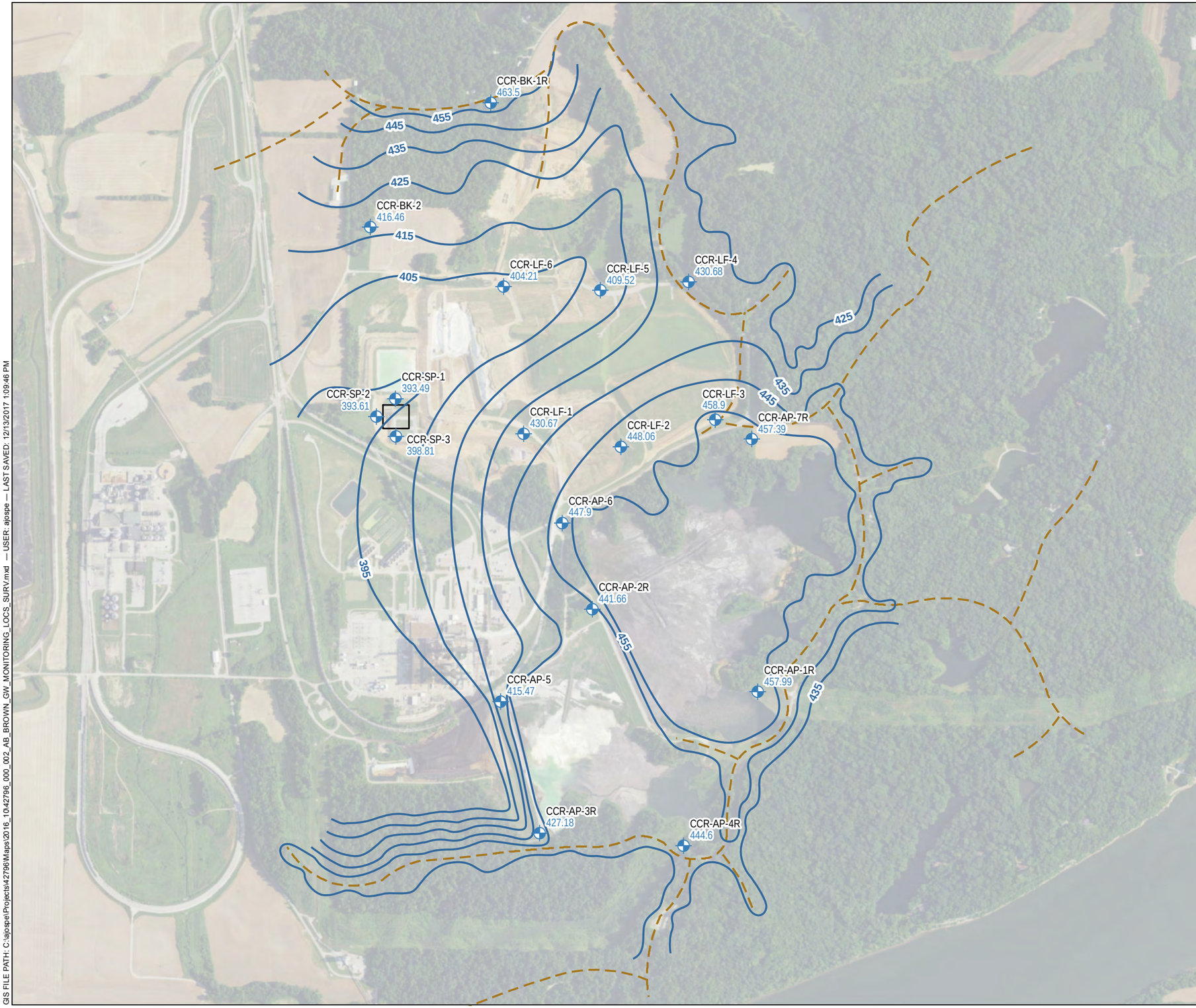
VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620

MONITORING WELL NETWORK
LANDFILL

JANUARY 2018

FIGURE 2

GIS FILE PATH: \\haleyaldrich.com\share\boi_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2018_01\42796_000_002_AB_BROWN_WASTE_BOUNDARY_MONITORING.mxd — USER: ajdspe — LAST SAVED: 1/30/2018 10:35:59 AM



LEGEND

- MONITORING WELL
- GROUNDWATER ELEVATION CONTOUR, IN FEET
- TOPOGRAPHIC DIVIDE

NOTES

1. LOCATIONS DERIVED FROM THREE I DESIGN DATA.
2. WATER LEVELS MEASURED 6 JUNE 2017
3. AERIAL IMAGERY SOURCE: ESRI

N

0 500 1,000 1,500 2,000

SCALE IN FEET

HALEY ALDRICH

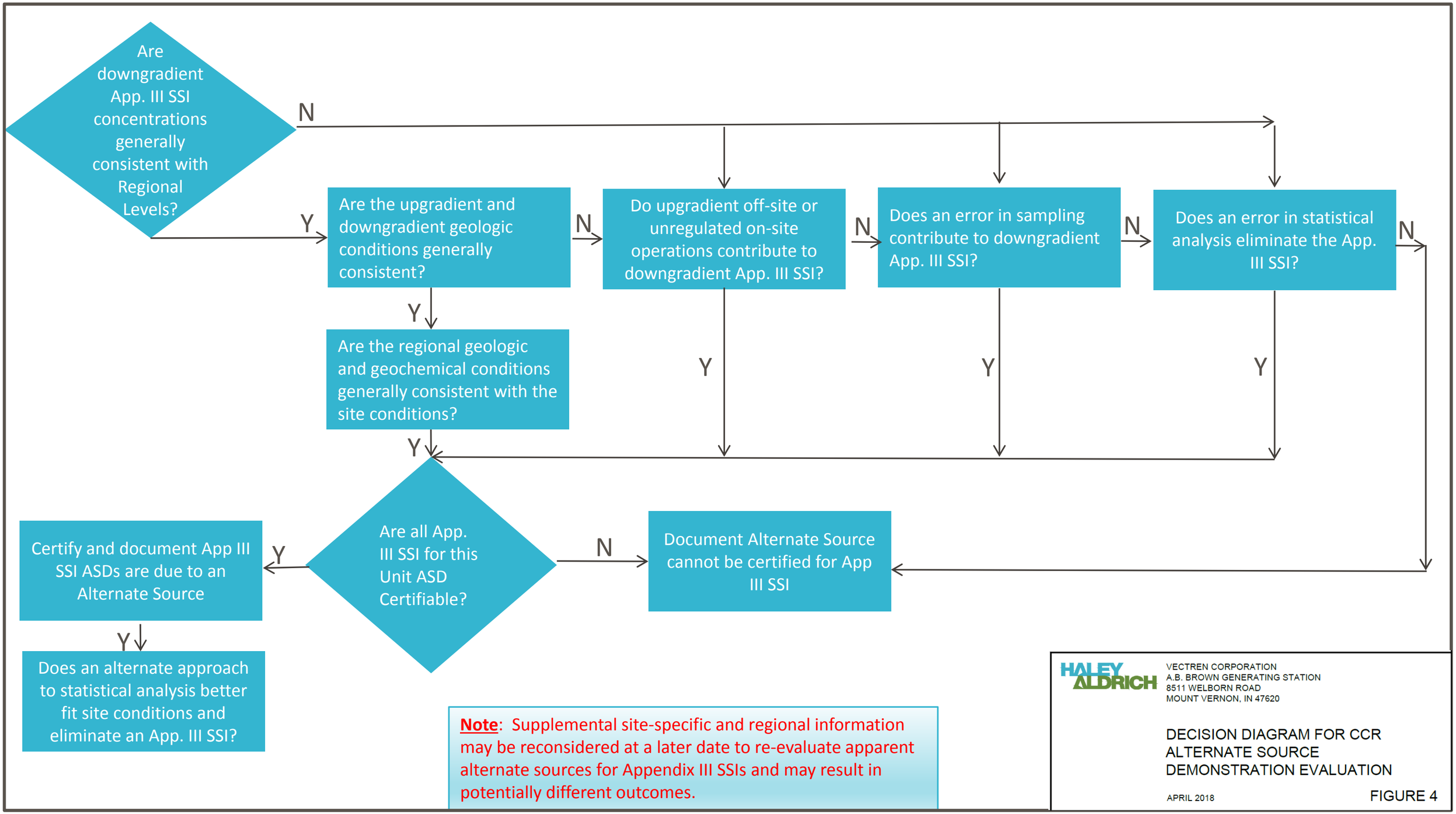
VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620

POTENTIOMETRIC SURFACE MAP

DECEMBER 2017

FIGURE 3

GIS FILE PATH: C:\ajospe\Projects\42796\Maps\2016_10\42796_000_002_AB_BROWN_GW_MONITORING_LOCS_SURV.mxd — USER: ajospe — LAST SAVED: 12/13/2017 1:09:46 PM


Are downgradient App. III SSI concentrations generally consistent with Regional Levels?
N
Y
Are the upgradient and downgradient geologic conditions generally consistent?
N
Do upgradient off-site or unregulated on-site operations contribute to downgradient App. III SSI?
N
Does an error in sampling contribute to downgradient App. III SSI?
N
Does an error in statistical analysis eliminate the App. III SSI?
N
Y
Are the regional geologic and geochemical conditions generally consistent with the site conditions?
Y
Y
Y
Y
Are all App. III SSI for this Unit ASD Certifiable?
Y
Certify and document App III SSI ASDs are due to an Alternate Source
N
Document Alternate Source cannot be certified for App III SSI
Y
Does an alternate approach to statistical analysis better fit site conditions and eliminate an App. III SSI?
Note: Supplemental site-specific and regional information may be reconsidered at a later date to re-evaluate apparent alternate sources for Appendix III SSIs and may result in potentially different outcomes.
HALEY ALDRICH
VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620
DECISION DIAGRAM FOR CCR ALTERNATE SOURCE DEMONSTRATION EVALUATION
APRIL 2018
FIGURE 4

APPENDIX A

EDR Reports

HALEY ALDRICH

A.B.Brown Generating Station
8511 Welborn Rd
Evansville, IN 47712

Inquiry Number: 05203791.2r
February 28, 2018

The EDR Radius Map™ Report with GeoCheck®

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

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GEOCHECK ADDENDUM

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Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

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EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-13), the ASTM Standard Practice for Environmental Site Assessments for Forestland or Rural Property (E 2247-16), the ASTM Standard Practice for Limited Environmental Due Diligence: Transaction Screen Process (E 1528-14) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

8511 WELBORN RD
EVANSVILLE, IN 47712

COORDINATES

Latitude (North):	37.9077760 - 37˚ 54' 27.99''
Longitude (West):	87.7079510 - 87˚ 42' 28.62''
Universal Tranverse Mercator:	Zone 16
UTM X (Meters):	437764.1
UTM Y (Meters):	4195613.5
Elevation:	453 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	5946019 WEST FRANKLIN, IN
Version Date:	2013

AERIAL PHOTOGRAPHY IN THIS REPORT

Portions of Photo from:	20140705
Source:	USDA

MAPPED SITES SUMMARY

Target Property Address:
8511 WELBORN RD
EVANSVILLE, IN 47712

Click on Map ID to see full detail.

MAP ID	SITE NAME	ADDRESS	DATABASE ACRONYMS	RELATIVE ELEVATION	DIST (ft. & mi.) DIRECTION
A1	SIGECO - A.B. BROWN	8511 WELBORN RD	EPA WATCH LIST		TP
A2	SOUTHERN INDIANA GAS	8511 WELBORN RD	IN SWF/LF, IN SPILLS, IN AIRS, IN NPDES, IN TIER 2		TP
A3	SIGECO FILTER CAKE D	8511 WELBORN RD	IN RGA LF		TP
A4	VECTREN- NEW SEDIMEN	8511 WELBORN RD	IN NPDES		TP
A5	SIGECO - A.B. BROWN	8511 WELLBORN ROAD	EPA WATCH LIST		TP
A6	ABB DAM MODIFICATION	8511 WELBORN RD	IN NPDES		TP
A7	SIGECO - A.B. BROWN	8511 WELBORN RD	EPA WATCH LIST		TP
A8	SIGECO AB BROWN GENE	8511 WELBORN RD	RCRA-CESQG, IN MANIFEST		TP
A9	SIGECO A B BROWN GEN	8511 WELBORN RD	TSCA, TRIS		TP
A10	AB BROWN RWS III DIS	8511 WELBORN RD	IN RGA LF		TP
A11		8511 WELBORN ROAD MO	IN SPILLS		TP
A12	A.B. BROWN GENERATIN	8511 WELBORN RD	IN NPDES		TP
A13	VECTREN - A.B. BROWN	8511 WELBORN RD	IN NPDES		TP
A14	VECTREN - A B BROWN	8511 WELBORN RD	IN NPDES		TP

EXECUTIVE SUMMARY

TARGET PROPERTY SEARCH RESULTS

The target property was identified in the following records. For more information on this property see page 8 of the attached EDR Radius Map report:

Site	Database(s)	EPA ID
SIGECO - A.B. BROWN 8511 WELBORN RD EVANSVILLE, IN 47620	EPA WATCH LIST Facility ID: 1812900010	N/A
SOUTHERN INDIANA GAS 8511 WELBORN RD MOUNT VERNON, IN 47620	IN SWF/LF IN SPILLS Facility Id: 200005087 Facility Id: 199902080 IN AIRS Status: Issued Status: Combined Status: Draft Status: Canceled Status: Withdrawn Permit ID: 129-6848-00010 Permit ID: 129-17032-00010 Permit ID: 129-12029-00010 Permit ID: 129-14441-00010 Permit ID: 129-14021-00010 **Additional key fields are available in the Map Findings section* IN NPDES Permit Status Desc: Effective NPDES Id: IN0052191 IN TIER 2 Facility Id: 11785	N/A
SIGECO FILTER CAKE D 8511 WELBORN RD MOUNT VERNON, IN	IN RGA LF Facility ID: 65-07	N/A
VECTREN- NEW SEDIMEN 8511 WELBORN RD MOUNT VERNON, IN 47620	IN NPDES Permit Status Desc: Effective NPDES Id: INR10K394	N/A
SIGECO - A.B. BROWN 8511 WELLBORN ROAD EVANSVILLE, IN 47620	EPA WATCH LIST Facility ID: 1812900010	N/A
ABB DAM MODIFICATION 8511 WELBORN RD MOUNT VERNON, IN 47620	IN NPDES	N/A

	Permit Status Desc: Effective NPDES Id: INR10L912	
SIGECO - A.B. BROWN 8511 WELBORN RD MOUNT VERNON, IN 47712	EPA WATCH LIST Facility ID: 1812900010	N/A
SIGECO AB BROWN GENE 8511 WELBORN RD MOUNT VERNON, IN 47620	RCRA-CESQG EPA ID:: IND000685800 IN MANIFEST EPA ID: IND000685800	IND000685800
SIGECO A B BROWN GEN 8511 WELBORN RD MOUNT VERNON, IN 47620	TSCA TRIS TRIS ID: 47620SGCBB8511W	47620SGCBB8511W
AB BROWN RWS III DIS 8511 WELBORN RD MOUNT VERNON, IN	IN RGA LF	N/A
8511 WELBORN ROAD MO 8511 WELBORN ROAD MO POSEY (County), IN	IN SPILLS Facility Id: 57793	N/A
A.B. BROWN GENERATIN 8511 WELBORN RD MOUNT VERNON, IN 47620	IN NPDES Permit Status Desc: Effective NPDES Id: INR10N110	N/A
VECTREN - A.B. BROWN 8511 WELBORN RD MOUNT VERNON, IN 47620	IN NPDES Permit Status Desc: Effective NPDES Id: INR10F189	N/A
VECTREN - A B BROWN 8511 WELBORN RD MOUNT VERNON, IN 47620	IN NPDES Permit Status Desc: Effective NPDES Id: INR10J646	N/A

EXECUTIVE SUMMARY

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL ..... National Priority List
Proposed NPL ..... Proposed National Priority List Sites
NPL LIENS ..... Federal Superfund Liens

Federal Delisted NPL site list

Delisted NPL ..... National Priority List Deletions

Federal CERCLIS list

FEDERAL FACILITY ..... Federal Facility Site Information listing
SEMS ..... Superfund Enterprise Management System

Federal CERCLIS NFRAP site list

SEMS-ARCHIVE ..... Superfund Enterprise Management System Archive

Federal RCRA CORRACTS facilities list

CORRACTS ..... Corrective Action Report

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF ..... RCRA - Treatment, Storage and Disposal

Federal RCRA generators list

RCRA-LQG ..... RCRA - Large Quantity Generators
RCRA-SQG ..... RCRA - Small Quantity Generators

Federal institutional controls / engineering controls registries

LUCIS ..... Land Use Control Information System
US ENG CONTROLS ..... Engineering Controls Sites List
US INST CONTROL ..... Sites with Institutional Controls

Federal ERNS list

ERNS ..... Emergency Response Notification System

State- and tribal - equivalent CERCLIS

IN SHWS ..... List of Hazardous Waste Response Sites Scored Using the Indiana Scoring Model

KY SHWS ..... State Leads List

State and tribal landfill and/or solid waste disposal site lists

IN OPEN DUMPS ..... Open Dump Waste Sites
KY SWF/LF ..... Solid Waste Facilities List

State and tribal leaking storage tank lists

IN LUST ..... Lust Leaking Underground Storage Tank List
INDIAN LUST ..... Leaking Underground Storage Tanks on Indian Land

State and tribal registered storage tank lists

FEMA UST ..... Underground Storage Tank Listing
IN UST ..... Indiana Registered Underground Storage Tanks
KY UST ..... Underground Storage Tank Database
IN AST ..... Above Ground Storage Tanks
INDIAN UST ..... Underground Storage Tanks on Indian Land

State and tribal institutional control / engineering control registries

IN AUL ..... Sites with Restrictions

State and tribal voluntary cleanup sites

IN VCP ..... Voluntary Remediation Program Site List
KY VCP ..... Voluntary Cleanup Program Sites
INDIAN VCP ..... Voluntary Cleanup Priority Listing

State and tribal Brownfields sites

IN BROWNFIELDS ..... Brownfields Site List
KY BROWNFIELDS ..... Kentucky Brownfield Inventory

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS ..... A Listing of Brownfields Sites

Local Lists of Landfill / Solid Waste Disposal Sites

IN SWTIRE ..... Waste Tire Sites Listing
IN SWRCY ..... Recycling Facilities
KY SWRCY ..... Recycling Facilities
INDIAN ODI ..... Report on the Status of Open Dumps on Indian Lands
DEBRIS REGION 9 ..... Torres Martinez Reservation Illegal Dump Site Locations
ODI ..... Open Dump Inventory
IHS OPEN DUMPS ..... Open Dumps on Indian Land

Local Lists of Hazardous waste / Contaminated Sites

US HIST CDL ..... Delisted National Clandestine Laboratory Register

IN CDL	Clandestine Drug Lab Listing
KY CDL	Clandestine Drub Lab Location Listing
IN DEL SHWS	Deleted Commissioner's Bulletin Sites List
US CDL	National Clandestine Laboratory Register

Local Land Records

LIENS 2	CERCLA Lien Information

Records of Emergency Release Reports

HMIRS	Hazardous Materials Information Reporting System
KY SPILLS	State spills
IN SPILLS 90	SPILLS 90 data from FirstSearch
IN SPILLS 80	SPILLS 80 data from FirstSearch

Other Ascertainable Records

RCRA NonGen / NLR	RCRA - Non Generators / No Longer Regulated
FUDS	Formerly Used Defense Sites
DOD	Department of Defense Sites
SCRD DRYCLEANERS	State Coalition for Remediation of Drycleaners Listing
US FIN ASSUR	Financial Assurance Information
2020 COR ACTION	2020 Corrective Action Program List
SSTS	Section 7 Tracking Systems
ROD	Records Of Decision
RMP	Risk Management Plans
RAATS	RCRA Administrative Action Tracking System
PRP	Potentially Responsible Parties
PADS	PCB Activity Database System
ICIS	Integrated Compliance Information System
FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
MLTS	Material Licensing Tracking System
COAL ASH DOE	Steam-Electric Plant Operation Data
COAL ASH EPA	Coal Combustion Residues Surface Impoundments List
PCB TRANSFORMER	PCB Transformer Registration Database
RADINFO	Radiation Information Database
HIST FTTS	FIFRA/TSCA Tracking System Administrative Case Listing
DOT OPS	Incident and Accident Data
CONSENT	Superfund (CERCLA) Consent Decrees
INDIAN RESERV	Indian Reservations
FUSRAP	Formerly Utilized Sites Remedial Action Program
UMTRA	Uranium Mill Tailings Sites
LEAD SMELTERS	Lead Smelter Sites
US AIRS	Aerometric Information Retrieval System Facility Subsystem
US MINES	Mines Master Index File
ABANDONED MINES	Abandoned Mines
FINDS	Facility Index System/Facility Registry System
UXO	Unexploded Ordnance Sites
DOCKET HWC	Hazardous Waste Compliance Docket Listing
ECHO	Enforcement & Compliance History Information
FUELS PROGRAM	EPA Fuels Program Registered Listing
KY AIRS	Permitted Airs Facility Listing
IN BULK	Registered Bulk Fertilizer and Pesticide Storage Facilities

EXECUTIVE SUMMARY

IN CFO ..... Confined Feeding Operations
IN COAL ASH ..... Coal Ash Disposal Sites
KY COAL ASH ..... Coal Ash Disposal Sites
IN DRYCLEANERS ..... Drycleaner Facility Listing
KY DRYCLEANERS ..... Drycleaner Listing
IN Financial Assurance ..... Financial Assurance Information Listing
KY Financial Assurance ..... Financial Assurance Information Listing
IN IND WASTE ..... Industrial Waste Sites Listing
KY NPDES ..... Permitted Facility Listing
IN OISC ..... Office of Indiana State Chemist Database
IN SCP ..... State Cleanup Program Sites
IN UIC ..... UIC Site Listing
KY UIC ..... UIC Information

EDR HIGH RISK HISTORICAL RECORDS

EDR Exclusive Records

EDR MGP ..... EDR Proprietary Manufactured Gas Plants
EDR Hist Auto ..... EDR Exclusive Historical Auto Stations
EDR Hist Cleaner ..... EDR Exclusive Historical Cleaners

EDR RECOVERED GOVERNMENT ARCHIVES

Exclusive Recovered Govt. Archives

IN RGA HWS ..... Recovered Government Archive State Hazardous Waste Facilities List
KY RGA HWS ..... Recovered Government Archive State Hazardous Waste Facilities List
KY RGA LF ..... Recovered Government Archive Solid Waste Facilities List
IN RGA LUST ..... Recovered Government Archive Leaking Underground Storage Tank

SURROUNDING SITES: SEARCH RESULTS

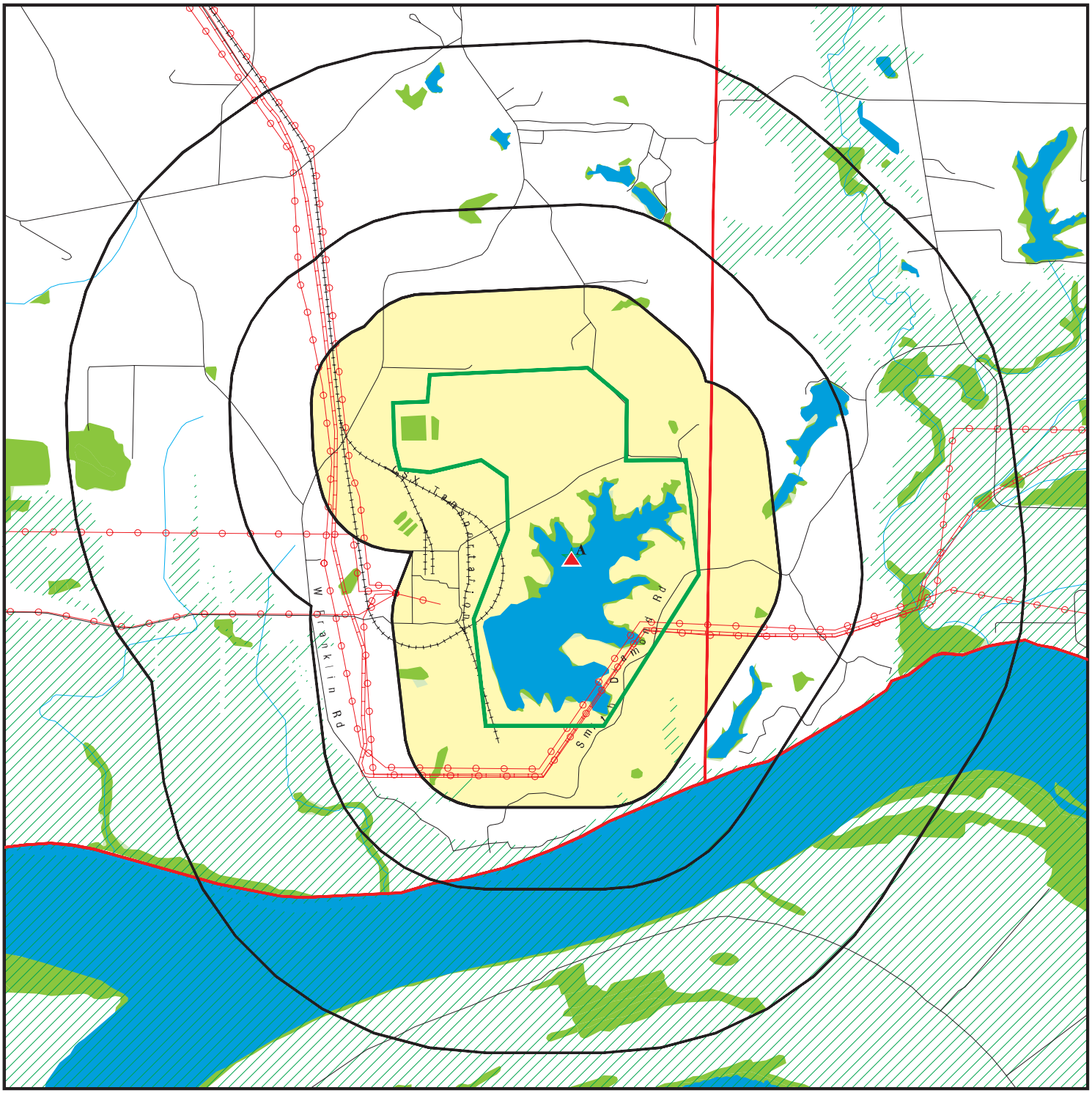
Surrounding sites were not identified.

Unmappable (orphan) sites are not considered in the foregoing analysis.

EXECUTIVE SUMMARY

There were no unmapped sites in this report.

OVERVIEW MAP - 05203791.2R



- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- National Priority List Sites
- Dept. Defense Sites

0 1/4 1/2 1 Miles

- Indian Reservations BIA
- County Boundary
- Power transmission lines
- Pipelines
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands
- Upgradient Area

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: A.B.Brown Generating Station	CLIENT: Haley & Aldrich, Inc.
ADDRESS: 8511 Welborn Rd Evansville IN 47712	CONTACT: Julia Scott INQUIRY #: 05203791.2r
LAT/LONG: 37.907776 / 87.707951	DATE: February 28, 2018 2:45 pm

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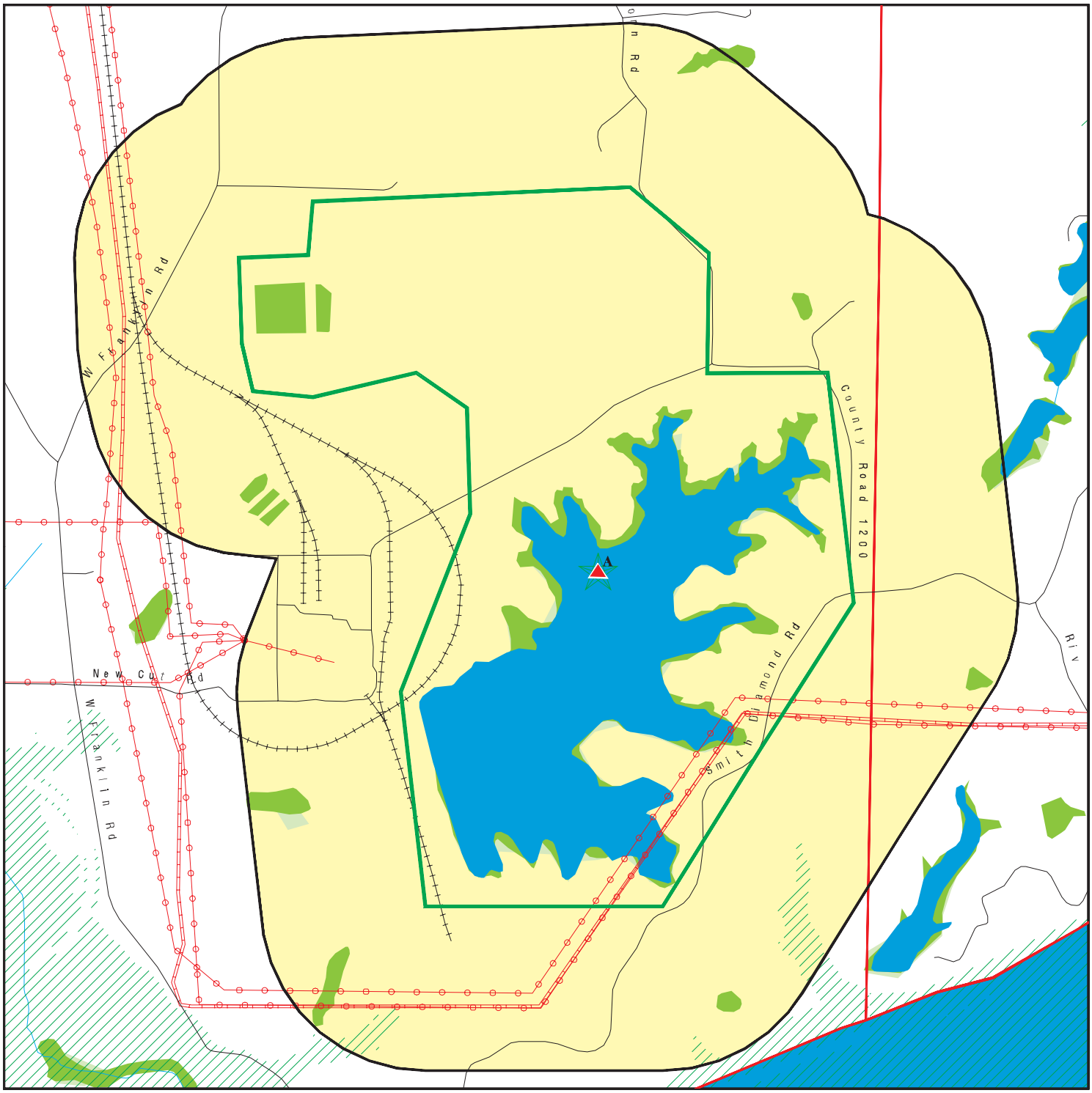
DETAIL MAP - 05203791.2R



0 1/8 1/4 1/2 Miles

- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- Sensitive Receptors
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- County Boundary
- Power transmission lines
- Pipelines
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: A.B.Brown Generating Station ADDRESS: 8511 Welborn Rd Evansville IN 47712 LAT/LONG: 37.907776 / 87.707951	CLIENT: Haley & Aldrich, Inc. CONTACT: Julia Scott INQUIRY #: 05203791.2r DATE: February 28, 2018 2:46 pm

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MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
STANDARD ENVIRONMENTAL RECORDS								
Federal NPL site list								
NPL	1.000		0	0	0	0	NR	0
Proposed NPL	1.000		0	0	0	0	NR	0
NPL LIENS	TP		NR	NR	NR	NR	NR	0
Federal Delisted NPL site list								
Delisted NPL	1.000		0	0	0	0	NR	0
Federal CERCLIS list								
FEDERAL FACILITY	0.500		0	0	0	NR	NR	0
SEMS	0.500		0	0	0	NR	NR	0
Federal CERCLIS NFRAP site list								
SEMS-ARCHIVE	0.500		0	0	0	NR	NR	0
Federal RCRA CORRACTS facilities list								
CORRACTS	1.000		0	0	0	0	NR	0
Federal RCRA non-CORRACTS TSD facilities list								
RCRA-TSDF	0.500		0	0	0	NR	NR	0
Federal RCRA generators list								
RCRA-LQG	0.250		0	0	NR	NR	NR	0
RCRA-SQG	0.250		0	0	NR	NR	NR	0
RCRA-CESQG	0.250	1	0	0	NR	NR	NR	1
Federal institutional controls / engineering controls registries								
LUCIS	0.500		0	0	0	NR	NR	0
US ENG CONTROLS	0.500		0	0	0	NR	NR	0
US INST CONTROL	0.500		0	0	0	NR	NR	0
Federal ERNS list								
ERNS	TP		NR	NR	NR	NR	NR	0
State- and tribal - equivalent CERCLIS								
IN SHWS	1.000		0	0	0	0	NR	0
KY SHWS	1.000		0	0	0	0	NR	0
State and tribal landfill and/or solid waste disposal site lists								
IN OPEN DUMPS	0.500		0	0	0	NR	NR	0
IN SWF/LF	0.500	1	0	0	0	NR	NR	1
KY SWF/LF	0.500		0	0	0	NR	NR	0
State and tribal leaking storage tank lists								
IN LUST	0.500		0	0	0	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
INDIAN LUST	0.500		0	0	0	NR	NR	0
State and tribal registered storage tank lists								
FEMA UST	0.250		0	0	NR	NR	NR	0
IN UST	0.250		0	0	NR	NR	NR	0
KY UST	0.250		0	0	NR	NR	NR	0
IN AST	0.125		0	NR	NR	NR	NR	0
INDIAN UST	0.250		0	0	NR	NR	NR	0
State and tribal institutional control / engineering control registries								
IN AUL	0.500		0	0	0	NR	NR	0
State and tribal voluntary cleanup sites								
IN VCP	0.500		0	0	0	NR	NR	0
KY VCP	0.500		0	0	0	NR	NR	0
INDIAN VCP	0.500		0	0	0	NR	NR	0
State and tribal Brownfields sites								
IN BROWNFIELDS	0.500		0	0	0	NR	NR	0
KY BROWNFIELDS	0.500		0	0	0	NR	NR	0
ADDITIONAL ENVIRONMENTAL RECORDS								
Local Brownfield lists								
US BROWNFIELDS	0.500		0	0	0	NR	NR	0
Local Lists of Landfill / Solid Waste Disposal Sites								
IN SWTIRE	0.500		0	0	0	NR	NR	0
IN SWRCY	0.500		0	0	0	NR	NR	0
KY SWRCY	0.500		0	0	0	NR	NR	0
INDIAN ODI	0.500		0	0	0	NR	NR	0
DEBRIS REGION 9	0.500		0	0	0	NR	NR	0
ODI	0.500		0	0	0	NR	NR	0
IHS OPEN DUMPS	0.500		0	0	0	NR	NR	0
Local Lists of Hazardous waste / Contaminated Sites								
US HIST CDL	TP		NR	NR	NR	NR	NR	0
IN CDL	TP		NR	NR	NR	NR	NR	0
KY CDL	TP		NR	NR	NR	NR	NR	0
IN DEL SHWS	1.000		0	0	0	0	NR	0
US CDL	TP		NR	NR	NR	NR	NR	0
Local Land Records								
LIENS 2	TP		NR	NR	NR	NR	NR	0
Records of Emergency Release Reports								
HMIRS	TP		NR	NR	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
IN SPILLS	TP	2	NR	NR	NR	NR	NR	2
KY SPILLS	TP		NR	NR	NR	NR	NR	0
IN SPILLS 90	TP		NR	NR	NR	NR	NR	0
IN SPILLS 80	TP		NR	NR	NR	NR	NR	0
Other Ascertainable Records								
RCRA NonGen / NLR	0.250		0	0	NR	NR	NR	0
FUDS	1.000		0	0	0	0	NR	0
DOD	1.000		0	0	0	0	NR	0
SCRD DRYCLEANERS	0.500		0	0	0	NR	NR	0
US FIN ASSUR	TP		NR	NR	NR	NR	NR	0
EPA WATCH LIST	TP	3	NR	NR	NR	NR	NR	3
2020 COR ACTION	0.250		0	0	NR	NR	NR	0
TSCA	TP	1	NR	NR	NR	NR	NR	1
TRIS	TP	1	NR	NR	NR	NR	NR	1
SSTS	TP		NR	NR	NR	NR	NR	0
ROD	1.000		0	0	0	0	NR	0
RMP	TP		NR	NR	NR	NR	NR	0
RAATS	TP		NR	NR	NR	NR	NR	0
PRP	TP		NR	NR	NR	NR	NR	0
PADS	TP		NR	NR	NR	NR	NR	0
ICIS	TP		NR	NR	NR	NR	NR	0
FTTS	TP		NR	NR	NR	NR	NR	0
MLTS	TP		NR	NR	NR	NR	NR	0
COAL ASH DOE	TP		NR	NR	NR	NR	NR	0
COAL ASH EPA	0.500		0	0	0	NR	NR	0
PCB TRANSFORMER	TP		NR	NR	NR	NR	NR	0
RADINFO	TP		NR	NR	NR	NR	NR	0
HIST FTTS	TP		NR	NR	NR	NR	NR	0
DOT OPS	TP		NR	NR	NR	NR	NR	0
CONSENT	1.000		0	0	0	0	NR	0
INDIAN RESERV	1.000		0	0	0	0	NR	0
FUSRAP	1.000		0	0	0	0	NR	0
UMTRA	0.500		0	0	0	NR	NR	0
LEAD SMELTERS	TP		NR	NR	NR	NR	NR	0
US AIRS	TP		NR	NR	NR	NR	NR	0
US MINES	0.250		0	0	NR	NR	NR	0
ABANDONED MINES	0.250		0	0	NR	NR	NR	0
FINDS	TP		NR	NR	NR	NR	NR	0
UXO	1.000		0	0	0	0	NR	0
DOCKET HWC	TP		NR	NR	NR	NR	NR	0
ECHO	TP		NR	NR	NR	NR	NR	0
FUELS PROGRAM	0.250		0	0	NR	NR	NR	0
IN AIRS	TP	1	NR	NR	NR	NR	NR	1
KY AIRS	TP		NR	NR	NR	NR	NR	0
IN BULK	0.250		0	0	NR	NR	NR	0
IN CFO	TP		NR	NR	NR	NR	NR	0
IN COAL ASH	0.500		0	0	0	NR	NR	0
KY COAL ASH	0.500		0	0	0	NR	NR	0
IN DRYCLEANERS	0.250		0	0	NR	NR	NR	0
KY DRYCLEANERS	0.250		0	0	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
IN Financial Assurance	TP		NR	NR	NR	NR	NR	0
KY Financial Assurance	TP		NR	NR	NR	NR	NR	0
IN IND WASTE	0.250		0	0	NR	NR	NR	0
IN MANIFEST	0.250	1	0	0	NR	NR	NR	1
IN NPDES	TP	6	NR	NR	NR	NR	NR	6
KY NPDES	TP		NR	NR	NR	NR	NR	0
IN OISC	0.250		0	0	NR	NR	NR	0
IN SCP	0.500		0	0	0	NR	NR	0
IN TIER 2	TP	1	NR	NR	NR	NR	NR	1
IN UIC	TP		NR	NR	NR	NR	NR	0
KY UIC	TP		NR	NR	NR	NR	NR	0
EDR HIGH RISK HISTORICAL RECORDS								
EDR Exclusive Records								
EDR MGP	1.000		0	0	0	0	NR	0
EDR Hist Auto	0.125		0	NR	NR	NR	NR	0
EDR Hist Cleaner	0.125		0	NR	NR	NR	NR	0
EDR RECOVERED GOVERNMENT ARCHIVES								
Exclusive Recovered Govt. Archives								
IN RGA HWS	TP		NR	NR	NR	NR	NR	0
KY RGA HWS	TP		NR	NR	NR	NR	NR	0
IN RGA LF	TP	2	NR	NR	NR	NR	NR	2
KY RGA LF	TP		NR	NR	NR	NR	NR	0
IN RGA LUST	TP		NR	NR	NR	NR	NR	0
- Totals --		20	0	0	0	0	0	20

NOTES:

TP = Target Property

NR = Not Requested at this Search Distance

Sites may be listed in more than one database

A1 Target Property | **SIGECO - A.B. BROWN (SOUTHERN INDIANA GA** | **EPA WATCH LIST** | **1016145509**
8511 WELBORN RD | **N/A**
EVANSVILLE, IN 47620

Site 1 of 14 in cluster A

Actual: 453 ft.

EPA WATCH LIST:

Facility ID:	1812900010
Program:	CAA Facilities
List date:	April 2013 CAA Watch List
Facility ID:	1812900010
Program:	CAA Facilities
List date:	June 2013 CAA Watch List
Facility ID:	1812900010
Program:	CAA Facilities
List date:	March 2013 CAA Watch List
Facility ID:	1812900010
Program:	CAA Facilities
List date:	May 2013 CAA Watch List

A2 Target Property | **SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN G** | **IN SWF/LF** | **S107706550**
8511 WELBORN RD | **IN SPILLS** | **N/A**
MOUNT VERNON, IN 47620 | **IN AIRS**
IN NPDES
Site 2 of 14 in cluster A | **IN TIER 2**

Actual: 453 ft.

LF:

Facility ID:	Not reported
Facility Type:	RESTRICTED WASTE SITE TYPE III
Facility Status:	Not reported
SR No:	177
Contact:	LISA MESSENGER
Operating Num:	65-07
Date Closed:	Not reported
Responsible Party:	NORMAN P WAGNER
RP Phone:	812-424-6411
RP Address:	20-24 NW FORUTH
RP City,St,Zip:	EVANSVILLE, IN 47741
Contact Phone:	812-491-4000
Owner Name:	SOUTHERN INDIANA GAS & ELECTRIC COMPANY
Owner Type:	P
Permanent Expiration:	10/31/2021
Open To Public:	N

SPILL:

Facility ID:	200005087
Incident Date:	05/10/2000
Report Date:	05/10/2000
Material:	Sulfuric acid
Spill Source:	Industrial
Recovered Amount:	Not reported
Recovered Units:	Not reported
Spilled Amount:	Not reported
Spilled Units:	Not reported
Contained:	Not reported
Water Affected:	Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Spill Type:	Air
Area Affected:	Not reported
Fish Killed:	Not reported
Water Supply Affected:	Not reported
Public Intake:	N
Incident Status:	Not reported

Facility ID:	199902080
Incident Date:	02/09/1999
Report Date:	02/09/1999
Material:	Sulfuric Acid
Spill Source:	Trans - Truck
Recovered Amount:	U
Recovered Units:	Not reported
Spilled Amount:	Not reported
Spilled Units:	U
Contained:	N
Water Affected:	Not reported
Spill Type:	Spill
Area Affected:	Not reported
Fish Killed:	Not reported
Water Supply Affected:	Not reported
Public Intake:	U
Incident Status:	Not reported

AIRS:

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Vickie Cordell
Responsible Official Phone:	317-233-1782
SIC Code:	4911
Permit ID:	129-6848-00010
Permit Level:	Title V
Subtype Qualifier:	Not reported
Issue Date:	12/15/2004
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	10/08/1996
Application Received End Date:	Not reported
Public Notice Begins Start Date:	12/24/2003
Public Notice Begins End Date:	01/23/2004
Proposed Internet Upload Start Date:	10/28/2004
Proposed Internet Upload End Date:	12/11/2004

Status:	Combined
Source ID:	129-00010
Responsible Official Name:	Rebecca Mason
Responsible Official Phone:	3-5692
SIC Code:	4911
Permit ID:	129-17032-00010
Permit Level:	Title V
Subtype Qualifier:	SPM - NOx Budget Permit
Issue Date:	Not reported
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	08/01/2003
Application Received End Date:	Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Vickie Cordell
Responsible Official Phone:	317-233-1782
SIC Code:	4911
Permit ID:	129-12029-00010
Permit Level:	Title V
Subtype Qualifier:	Significant Source Mod. (Major PSD/EO) (270)
Issue Date:	11/29/2001
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	03/13/2000
Application Received End Date:	Not reported
Public Notice Begins Start Date:	09/26/2001
Public Notice Begins End Date:	10/26/2001
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Not reported
Responsible Official Phone:	Not reported
SIC Code:	4911
Permit ID:	129-14441-00010
Permit Level:	Acid Rain
Subtype Qualifier:	Not reported
Issue Date:	11/19/2001
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	05/30/2001
Application Received End Date:	Not reported
Public Notice Begins Start Date:	09/26/2001
Public Notice Begins End Date:	10/26/2001
Proposed Internet Upload Start Date:	09/24/2001
Proposed Internet Upload End Date:	11/08/2001

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Gurinder Saini
Responsible Official Phone:	800-451-6027
SIC Code:	4911
Permit ID:	129-14021-00010
Permit Level:	Title V
Subtype Qualifier:	Significant Source Mod. (Major PSD/EO) (270)
Issue Date:	11/16/2001
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	03/05/2001
Application Received End Date:	Not reported
Public Notice Begins Start Date:	09/26/2001
Public Notice Begins End Date:	10/26/2001
Proposed Internet Upload Start Date:	Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Proposed Internet Upload End Date:	Not reported

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Robert W. Ondrusek
Responsible Official Phone:	800-451-6027
SIC Code:	4911
Permit ID:	129-10331-00010
Permit Level:	Acid Rain
Subtype Qualifier:	Administrative Amendment
Issue Date:	09/25/2001
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	11/06/1998
Application Received End Date:	Not reported
Public Notice Begins Start Date:	12/30/1998
Public Notice Begins End Date:	01/29/1999
Proposed Internet Upload Start Date:	12/14/1999
Proposed Internet Upload End Date:	12/22/1999

Status:	Draft
Source ID:	129-00010
Responsible Official Name:	Deena Patton
Responsible Official Phone:	317-234-5400
SIC Code:	4911
Permit ID:	129-37317-00010 (No Electronic File Exists)
Permit Level:	Title V
Subtype Qualifier:	Significant Permit Modification
Issue Date:	Not reported
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	06/21/2016
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Josiah Balogun
Responsible Official Phone:	317-234-5257
SIC Code:	4911
Permit ID:	129-36150-00010
Permit Level:	Acid Rain
Subtype Qualifier:	Renewal
Issue Date:	01/25/2016
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	08/11/2015
Application Received End Date:	Not reported
Public Notice Begins Start Date:	12/01/2015
Public Notice Begins End Date:	12/31/2015
Proposed Internet Upload Start Date:	01/06/2016
Proposed Internet Upload End Date:	01/21/2016

Status:	Issued

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Source ID:	129-00010
Responsible Official Name:	Deena Patton
Responsible Official Phone:	317-234-5400
SIC Code:	4911
Permit ID:	129-35974-00010
Permit Level:	Title V
Subtype Qualifier:	Significant Permit Modification
Issue Date:	12/28/2015
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	06/23/2015
Application Received End Date:	Not reported
Public Notice Begins Start Date:	10/28/2015
Public Notice Begins End Date:	11/27/2015
Proposed Internet Upload Start Date:	12/03/2015
Proposed Internet Upload End Date:	12/18/2015

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Anh Nguyen
Responsible Official Phone:	317-233-5334
SIC Code:	4911
Permit ID:	129-33047-00010
Permit Level:	Title V
Subtype Qualifier:	Renewal
Issue Date:	11/07/2014
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	04/04/2013
Application Received End Date:	Not reported
Public Notice Begins Start Date:	09/10/2014
Public Notice Begins End Date:	10/10/2014
Proposed Internet Upload Start Date:	10/21/2014
Proposed Internet Upload End Date:	11/05/2014

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Josiah Balogun
Responsible Official Phone:	317-234-5257
SIC Code:	4911
Permit ID:	129-29915-00010
Permit Level:	Acid Rain
Subtype Qualifier:	Renewal
Issue Date:	02/10/2011
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	11/22/2010
Application Received End Date:	Not reported
Public Notice Begins Start Date:	12/15/2010
Public Notice Begins End Date:	01/14/2011
Proposed Internet Upload Start Date:	01/24/2011
Proposed Internet Upload End Date:	02/08/2011

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	PR 2
Responsible Official Phone:	XXX-XXX-XXXX

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

SIC Code:	4911
Permit ID:	129-26321-00010
Permit Level:	Title V
Subtype Qualifier:	SPM - CAIR
Issue Date:	07/24/2009
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	03/24/2008
Application Received End Date:	Not reported
Public Notice Begins Start Date:	06/03/2009
Public Notice Begins End Date:	07/03/2009
Proposed Internet Upload Start Date:	07/07/2009
Proposed Internet Upload End Date:	07/22/2009

Status:	Canceled
Source ID:	129-00010
Responsible Official Name:	PR 2
Responsible Official Phone:	XXX-XXX-XXXX
SIC Code:	4911
Permit ID:	129-20365-00010 (No Electronic File Exists)
Permit Level:	Appeal Resolution
Subtype Qualifier:	Not reported
Issue Date:	Not reported
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	01/12/2005
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Josiah Balogun
Responsible Official Phone:	317-234-5257
SIC Code:	4911
Permit ID:	129-26415-00010
Permit Level:	Title V
Subtype Qualifier:	Renewal
Issue Date:	01/26/2009
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	04/14/2008
Application Received End Date:	Not reported
Public Notice Begins Start Date:	12/03/2008
Public Notice Begins End Date:	01/02/2009
Proposed Internet Upload Start Date:	01/09/2009
Proposed Internet Upload End Date:	01/24/2009

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Alexandra Yeung
Responsible Official Phone:	800-451-6027
SIC Code:	4911
Permit ID:	129-19748-00010
Permit Level:	Acid Rain

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Subtype Qualifier:	Renewal
Issue Date:	05/09/2006
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	04/22/2004
Application Received End Date:	Not reported
Public Notice Begins Start Date:	11/04/2004
Public Notice Begins End Date:	12/03/2004
Proposed Internet Upload Start Date:	03/23/2006
Proposed Internet Upload End Date:	05/07/2006

Status:	Canceled
Source ID:	129-00010
Responsible Official Name:	Walter Habeeb
Responsible Official Phone:	317-232-8422
SIC Code:	4911
Permit ID:	129-17709-00010 (No Electronic File Exists)
Permit Level:	Amendment
Subtype Qualifier:	Not reported
Issue Date:	Not reported
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	05/07/2003
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Vickie Cordell
Responsible Official Phone:	317-233-1782
SIC Code:	4911
Permit ID:	129-21413-00010
Permit Level:	Title V
Subtype Qualifier:	Administrative Amendment
Issue Date:	07/21/2005
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	06/10/2005
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Withdrawn
Source ID:	129-00010
Responsible Official Name:	Vickie Cordell
Responsible Official Phone:	317-233-1782
SIC Code:	4911
Permit ID:	129-12848-00010 (No Electronic File Exists)
Permit Level:	Title V
Subtype Qualifier:	Significant Permit Modification
Issue Date:	Not reported
End Date:	Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Source Contact:	Allen K. Rose
Application Received Start Date:	10/12/2000
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Combined
Source ID:	129-00010
Responsible Official Name:	Vickie Cordell
Responsible Official Phone:	317-233-1782
SIC Code:	4911
Permit ID:	129-11288-00010
Permit Level:	Title V
Subtype Qualifier:	Significant Source Mod. (Major PSD/EO) (270)
Issue Date:	Not reported
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	08/24/1999
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Withdrawn
Source ID:	129-00010
Responsible Official Name:	Bryan Sheets
Responsible Official Phone:	800-451-6027
SIC Code:	4911
Permit ID:	129-10856-00010 (No Electronic File Exists)
Permit Level:	Title V
Subtype Qualifier:	Significant Source Mod. (Major PSD/EO) (270)
Issue Date:	Not reported
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	04/13/1999
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Bryan Sheets
Responsible Official Phone:	800-451-6027
SIC Code:	4911
Permit ID:	129-11581-00010 (No Electronic File Exists)
Permit Level:	Review Request
Subtype Qualifier:	Not reported
Issue Date:	12/03/1999
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	11/23/1999
Application Received End Date:	Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Combined
Source ID:	129-00010
Responsible Official Name:	Not reported
Responsible Official Phone:	Not reported
SIC Code:	4911
Permit ID:	129-8930-00010
Permit Level:	Acid Rain
Subtype Qualifier:	Administrative Amendment
Issue Date:	Not reported
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	06/24/1997
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Tena Hopkins
Responsible Official Phone:	800-451-6027
SIC Code:	4911
Permit ID:	129-5153-00010
Permit Level:	Acid Rain
Subtype Qualifier:	Not reported
Issue Date:	12/31/1997
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	12/27/1995
Application Received End Date:	Not reported
Public Notice Begins Start Date:	10/29/1997
Public Notice Begins End Date:	11/28/1997
Proposed Internet Upload Start Date:	12/30/1997
Proposed Internet Upload End Date:	12/31/1997

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Holly Stockrahm
Responsible Official Phone:	800-451-6027
SIC Code:	4911
Permit ID:	129-4226-00010 (No Electronic File Exists)
Permit Level:	Construction
Subtype Qualifier:	Registration
Issue Date:	12/29/1994
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	11/16/1994
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Proposed Internet Upload End Date:	Not reported

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Holly Stockrahm
Responsible Official Phone:	800-451-6027
SIC Code:	4911
Permit ID:	129-4198-00010 (No Electronic File Exists)
Permit Level:	Construction
Subtype Qualifier:	Interim (Registration)
Issue Date:	11/30/1994
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	11/16/1994
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

NPDES:

Permit Number:	IN0052191
Primary Facility Sic Code:	Not reported
Major/Minor:	Major
Primary Facility Sic Desc:	Not reported
Facility Type Desc:	Privately Owned Facility
Permit Status Desc:	Effective
Issue Date:	02/28/2017
Expired Date:	03/31/2022
Effective Date:	04/01/2017
Terminated Date:	Not reported
DMR Cognizant Official:	DAVID REHERMAN, PLT DIR
DMR Cognizant Telephone:	812-491-4666
Waterbody:	OHIO RIVER
Total Actual Average Flow (MGD):	1.03
Total App. Design Flow (MGD):	Not reported
FRS HUC Code:	05140202
Latitude In Decimal Degrees:	37.969694
Longitude In Decimal Degrees:	-87.605389

TIER 2:

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Chlorine
Chemical Info:	CAS Num:7782505 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 100 - 499 Quantity: 365 Container Type: L - Cylinder
Location Description:	2x150-lb cylinder in chlorine bldg
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100 - 499

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	GE Betz PDC9325
Chemical Info:	CAS Num: Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

	Inside Building
Location Description:	Unit 1 boiler
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Mineral oil, light and heavy
Chemical Info:	CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	Electric transformers east of cooling tower #1
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Sodium Carbonate
Chemical Info:	CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	Unit 1 scrubber
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Fuel Oil # 2
Chemical Info:	CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	Landfill - 2 tanks
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Other Chemical 11
Chemical Info:	CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description:	Coal handling area
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Other Chemical 11
Chemical Info:	CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description:	6000 gal, Unit 2 main floor
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Calcium Oxide
Chemical Info: CAS Num:1305788 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000000-499999999 Quantity: 365 Container Type: H - Silo
Location Description: Storage silo 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000000-499999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: 260 gal, Unit #1 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 50000 - 74999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6 ton tank near entrance road
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 50000 - 74999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: De-energized transformer at plant entrance
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: D - Steel Drum
Location Description: Boiler Unit #2 drums
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Boiler Unit #2 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Landfill - 2 tanks
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfur
Chemical Info: CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 2 thickener tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Black Beauty Abrasive
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 75000 - 99999 Quantity: 365 Container Type: R - Other
Location Description: U2 absorber towers; Maintenance shop; SIMI Bldg; So side of U2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 75000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ferric Chloride
Chemical Info: CAS Num:7705080 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 150 Container Type: O - Tote Bin
Location Description: Ash Pond Chemical Building - 2 totes
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Steel Drum
Location Description: Boiler Unit #2 drums

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Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Other
Location Description: substation battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: Not reported
SIC Code: Not reported
Chemical Name: Not reported
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: Quantity: Container Type:
Location Description: Not reported
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt:

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Hydroxide
Chemical Info: CAS Num:1310732 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: #2 Cooling Tower - 1500 gal tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: R - Other
Location Description: Unit 1 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: 2-8000 gal tank at cooling towers
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:

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More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: C - Tank I
Location Description: Boiler Unit #2 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: De-energized transformer at plant entrance
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Boiler Unit #1 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit #2 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Coal handling area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 06 Quantity: 365 Container Type: Above-Ground Tank
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt:

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Facility Id: 11785
SIC Code: Not reported
Chemical Name: 1-hydroxycthylidene-1, 1-diphosphonic acid
Chemical Info: CAS Num:2809214 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Tank Inside Building
Location Description: Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Chlorine
Chemical Info: CAS Num:7782505 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 02 Quantity: 365 Container Type: Cylinder
Location Description: 100 lb cylinder in chlorine bldg
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 02

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3
Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 25000 - 49999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 1500 gal, Unit 2 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 25000 - 49999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 50000 - 74999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 30 ton tank S of Unit 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 50000 - 74999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: GE Betz PDC9325
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Electric transformers east of cooling tower #1
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 1 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6000 gal, Unit 2 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Maintenance shop
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: substation battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfur

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Chemical Info: CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 1 thickener tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 5
Chemical Info: CAS Num:999005 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000000 - 9999999999 Quantity: 365 Container Type: R - Other
Location Description: coal pile
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000000 - 9999999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit #3
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: Maintenance shop
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Calcium Oxide
Chemical Info: CAS Num:1305788 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000000-499999999 Quantity: 365 Container Type: H - Silo

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Location Description: Storage silo 1
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000000-499999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Chlorine
Chemical Info: CAS Num:7782505 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100-999 Quantity: 365 Container Type: L - Cylind
Location Description: 100 lb cylinder in chlorine bldg
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100-999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 50000 - 74999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 30 ton tank S of Unit 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 50000 - 74999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 300 gal, Unit #2 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Two 50,000 gal tanks at Unit #3
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Coal handling area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ammonium hydroxide
Chemical Info: CAS Num:1336216 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 06 Quantity: 365 Container Type: Tank Inside Building
Location Description: Two 36,000-gal tanks on south side of pl
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 06

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: Unit #1 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Tank Inside Building
Location Description: Boiler Unit #1 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: 6000 gal, Unit 2 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Chlorine
Chemical Info: CAS Num:7782505 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100 - 999 Quantity: 365 Container Type: L - Cylinder
Location Description: 2x150-lb cylinder in chlorine bldg

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Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100 - 999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Boiler Unit #2 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6000 gal, Unit 1 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Calcium Oxide
Chemical Info: CAS Num:1305788 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 09 Quantity: 365 Container Type: Silo
Location Description: Storage silo 1
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 09

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Two 50,000 gal tanks at Unit #3
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 2-7000 gal tank at cooling towers
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ferric Chloride
Chemical Info: CAS Num:7705080 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 150 Container Type: O - Tote Bin
Location Description: Ash Pond Chemical Building - 2 totes
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Boiler Unit #2 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 7
Chemical Info: CAS Num:999007 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6000 gal, Unit 1 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 2-8000 gal tank at cooling towers
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: Unit #2 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 5
Chemical Info: CAS Num:999005 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000000-999999999 Quantity: 365 Container Type: R - Other
Location Description: coal pile
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000000-999999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 1000000-9999999 Quantity: 365 Container Type: A - Above-
Location Description: Unit 1 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 1000000-9999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Hydroxide
Chemical Info: CAS Num:1310732 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: #1 Cooling Tower - 1500 gal tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Oil water separator
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Location Description: 2-7000 gal tank at cooling towers
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: Unit 2 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: Unit 1 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ferric Chloride
Chemical Info: CAS Num:7705080 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 150 Container Type: O - Tote Bin
Location Description: Unit 2 Main Floor - max 4 totes
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfur
Chemical Info: CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 05 Quantity: 365 Container Type: Above-Ground Tank
Location Description: 15,000 gal Unit 1thickener tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 05

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Other
Location Description: gas turbine battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3
Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: 1500 gal, Unit 2 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Other
Location Description: Unit 2 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Hydroxide
Chemical Info: CAS Num:1310732 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: #2 Cooling Tower - 1500 gal tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: R - Other
Location Description: gas turbine battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Electric transformers east of cooling tower #1
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Location Description: Landfill - 2 tanks
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Crane bay
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ammonium hydroxide
Chemical Info: CAS Num:1336216 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: South side of plant
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Hydroxide
Chemical Info: CAS Num:1310732 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: #1 Cooling Tower - 1500 gal tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ammonium hydroxide
Chemical Info: CAS Num:1336216 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: South side of plant
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Calcium Oxide
Chemical Info: CAS Num:1305788 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 1000000 - 9999999 Quantity: 365 Container Type: H - Silo
Location Description: Storage Silo 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt:

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

1000000 - 9999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: 6000 gal, Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: Unit 1 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ferric Chloride
Chemical Info: CAS Num:7705080 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 150 Container Type: O - Tote Bin
Location Description: Unit 2 Main Floor - max 4 totes
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 50000 - 74999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 30 ton tank S of Unit 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 50000 - 74999

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: GE Betz PDC9325
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit #2 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: Unit 2 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: gas turbine battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: Landfill - 2 tanks
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: 1500 gal, Unit 1 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 1000000-9999999 Quantity: 365 Container Type: A - Above-
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 1000000-9999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ammonium hydroxide
Chemical Info: CAS Num:1336216 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 1000000-9999999 Quantity: 365 Container Type: C - Tank I
Location Description: Two 36,000-gal tanks on south side of plant
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 1000000-9999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Boiler Unit #1 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 5
Chemical Info: CAS Num:999005 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000000 - 9999999999 Quantity: 365 Container Type: R - Other
Location Description: coal pile
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000000 - 9999999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Location Description: Coal Handling Service Area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 300 gal, Unit #1 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Maintenance shop
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ferric Chloride
Chemical Info: CAS Num:7705080 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 150 Container Type: O - Tote Bin
Location Description: Cooling Tower Chemical Building - 2 totes
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: Oil water separator
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Hydroxide
Chemical Info: CAS Num:1310732 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: #1 Cooling Tower - 1500 gal tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: 260 gal, Unit #1 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: D - Steel
Location Description: Boiler Unit #2 drums
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Calcium Oxide
Chemical Info: CAS Num:1305788 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 1000000 - 9999999 Quantity: 365 Container Type: H - Silo
Location Description: Storage Silo 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 1000000 - 9999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 1000000 - 9999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 1000000 - 9999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Coal Handling Service Area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

More Chemical Info:	Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: R - Other
Location Description:	substation battery bank
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Sulfur
Chemical Info:	CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	Unit 1 thickener tank
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Sulfur
Chemical Info:	CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	Unit 2 thickener tank
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Fuel Oil # 2
Chemical Info:	CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	Unit #2 Compressor
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Fuel Oil # 2
Chemical Info:	CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	Unit #3
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	trixylenyl phosphate
Chemical Info:	CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Location Description: Boiler Unit #1 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Boiler Unit #2 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Coal Handling Service Area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 300 gal, Unit #1 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Coal handling area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: 6000 gal, Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt:

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: 6000 gal, Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Boiler Unit #1 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3
Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 25000 - 49999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 1500 gal, Unit 1 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 25000 - 49999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Black Beauty Abrasive
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 75000 - 99999 Quantity: 365 Container Type: R - Other
Location Description: U2 absorber towers; Maintenance shop; SIMI Bldg; So side of U2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 75000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: Unit #1 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

SIC Code: Not reported
Chemical Name: GE Betz PDC9325
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: C - Tank I
Location Description: Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: GE Betz PDC9325
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: C - Tank I
Location Description: Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 7
Chemical Info: CAS Num:999007 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000-999999 Quantity: 365 Container Type: C - Tank I
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000-999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Chlorine
Chemical Info: CAS Num:7782505 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100 - 499 Quantity: 365 Container Type: L - Cylinder
Location Description: 2x150-lb cylinder in chlorine bldg
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100 - 499

Facility Id: 11785
SIC Code: Not reported
Chemical Name: GE Betz PDC9325
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Location Description: Crane bay
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: 2-8000 gal tank at cooling towers
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: Unit #2 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 7
Chemical Info: CAS Num:999007 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 05 Quantity: 365 Container Type: Tank Inside Building
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 05

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: Coal Handling Service Area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: GE Betz PDC9325
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: 6000 gal, Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: D - Steel Drum
Location Description: Boiler Unit #2 drums
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit #2 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 260 gal, Unit #1 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 2-8000 gal tank at cooling towers
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: R - Other
Location Description: Unit 1 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: R - Other
Location Description: gas turbine battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Hydroxide
Chemical Info: CAS Num:1310732 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: #2 Cooling Tower - 1500 gal tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 06 Quantity: 365 Container Type: Above-Ground Tank
Location Description: Unit 1 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 06

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 05 Quantity: 365 Container Type: Tank Inside Building
Location Description: 6000 gal, Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 05

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 2-8000 gal tank at cooling towers

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Hydrogen Bromide
Chemical Info: CAS Num:10035106 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 25000 - 49999 Quantity: 60 Container Type: O - Tote Bin
Location Description: Unit 1&2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 25000 - 49999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 50000 - 74999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6 ton tank near entrance road
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 50000 - 74999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: 6000 gal, Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 5
Chemical Info: CAS Num:999005 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000000 - 9999999999 Quantity: 365 Container Type: R - Other
Location Description: coal pile
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000000 - 9999999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 300 gal, west side of Unit #1 near Potable Water Storage
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Crane bay
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ferric Chloride
Chemical Info: CAS Num:7705080 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 150 Container Type: O - Tote Bin
Location Description: Cooling Tower Chemical Building - 2 totes
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: De-energized transformer at plant entrance
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: D - Steel Drum
Location Description: Boiler Unit #2 drums
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6000 gal, Unit 2 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Maintenance shop
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: substation battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ammonium hydroxide
Chemical Info: CAS Num:1336216 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: South side of plant
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Hydrogen Bromide
Chemical Info: CAS Num:10035106 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 25000 - 49999 Quantity: 60 Container Type: O - Tote Bin
Location Description: Unit 1&2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 25000 - 49999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: Coal Handling Service Area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000-999999 Quantity: 365 Container Type: C - Tank

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

I
Location Description: 6000 gal, Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000-999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: 6 ton tank near entrance road
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: Unit #2 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: 6000 gal, Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 1 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 7
Chemical Info: CAS Num:999007 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 300 gal, Unit #1 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 300 gal, west side of Unit #1 near Potable Water Storage
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 300 gal near Guard Station
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: substation battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ammonium hydroxide
Chemical Info: CAS Num:1336216 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: South side of plant
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Name: Sulfur
Chemical Info: CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 05 Quantity: 365 Container Type: Above-Ground Tank
Location Description: 5,000 gal Unit 2 thickener tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 05

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3
Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: 1500 gal, Unit 1 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: 1-hydroxycthylidene-1, 1-diphosphonic acid
Chemical Info: CAS Num:2809214 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Tank Inside Building
Location Description: Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Other
Location Description: Unit 1 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: Coal handling area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: Unit #2 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Hydroxide
Chemical Info: CAS Num:1310732 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: E - Plasti
Location Description: Reverse Osmosis Room - 330 gal tote
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: GE Betz PDC9325
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 1000000 - 9999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 1 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 1000000 - 9999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 5
Chemical Info: CAS Num:999005 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000000 - 999999999 Quantity: 365 Container Type: R - Other
Location Description: coal pile
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000000 - 999999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit #3
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Oil water separator
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Maintenance shop
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: R - Other
Location Description: Unit 2 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Hydroxide
Chemical Info: CAS Num:1310732 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: E - Plastic or Non-Metal Drum
Location Description: Reverse Osmosis Room - 330 gal tote
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3
Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 25000 - 49999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 1500 gal, Unit 1 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 25000 - 49999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A -

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

	Above-Ground Tank
Location Description:	Unit #2 Fuel Oil Tank
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Fuel Oil # 2
Chemical Info:	CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	260 gal, Unit #1 Fuel Oil Tank
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Fuel Oil # 2
Chemical Info:	CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	300 gal, Unit #1 Compressor
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Fuel Oil # 2
Chemical Info:	CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	300 gal near Guard Station
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Sulfuric Acid
Chemical Info:	CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description:	gas turbine battery bank
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Ammonium hydroxide
Chemical Info:	CAS Num:1336216 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	South side of plant

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 50000 - 74999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6 ton tank near entrance road
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 50000 - 74999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Calcium Oxide
Chemical Info: CAS Num:1305788 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 1000000 - 9999999 Quantity: 365 Container Type: H - Silo
Location Description: Storage Silo 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 1000000 - 9999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3
Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 25000 - 49999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 1500 gal, Unit 2 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 25000 - 49999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit #2 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: Unit 1 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfur
Chemical Info: CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 1 thickener tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3
Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: 1500 gal, Unit 2 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6000 gal, Unit 1 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Tank Inside Building
Location Description: Boiler Unit #2 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfur
Chemical Info: CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000-999999 Quantity: 365 Container Type: A - Above-
Location Description: 5,000 gal Unit 2 thickener tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000-999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: R - Other
Location Description: Unit 2 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: R - Other
Location Description: substation battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 30 ton tank S of Unit 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit #1 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6000 gal, Unit 2 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Calcium Oxide
Chemical Info: CAS Num:1305788 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 09 Quantity: 365 Container Type: Silo
Location Description: Storage silo 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 09

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: 6 ton tank near entrance road
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: GE Betz PDC9325
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: De-energized transformer at plant entrance
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 7
Chemical Info: CAS Num:999007 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Landfill - 2 tanks
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Oil water separator
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfur
Chemical Info: CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 2 thickener tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Black Beauty Abrasive
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 75000 - 99999 Quantity: 365 Container Type: R - Other
Location Description: U2 absorber towers; Maintenance shop; SIMI Bldg; So side of U2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 75000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Coal Handling Service Area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit #1 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Location Description: 260 gal, Unit #1 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Oil water separator
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Coal handling area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Crane bay
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfur
Chemical Info: CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 2 thickener tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000-999999 Quantity: 365 Container Type: C - Tank I
Location Description: 6000 gal, Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt:

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

100000-999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: Oil water separator
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: Crane bay
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: 6000 gal, Unit 1 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: 30 ton tank S of Unit 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Calcium Oxide
Chemical Info: CAS Num:1305788 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 1000000 - 9999999 Quantity: 365 Container Type: H - Silo
Location Description: Storage Silo 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 1000000 - 9999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: GE Betz PDC9325

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Electric transformers east of cooling tower #1
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: 6000 gal, Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6000 gal, Unit 2 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: gas turbine battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfur
Chemical Info: CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A -

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

	Above-Ground Tank
Location Description:	Unit 1 thickener tank
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Mineral oil, light and heavy
Chemical Info:	CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 05 Quantity: 365 Container Type: Tank Inside Building
Location Description:	6000 gal, Unit 1 boiler
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 05

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Sodium Hydroxide
Chemical Info:	CAS Num:1310732 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 04 Quantity: 365 Container Type: Plastic or Non-Metal Drum
Location Description:	Reverse Osmosis Room - 330 gal tote
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Other Chemical 11
Chemical Info:	CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description:	6000 gal, Unit 1 main floor
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Sulfur
Chemical Info:	CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 100000-999999 Quantity: 365 Container Type: A - Above-
Location Description:	15,000 gal Unit 1thickener tank
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000-999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	trixylenyl phosphate
Chemical Info:	CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 10000-99999 Quantity: 365 Container Type: C - Tank I
Location Description:	Boiler Unit #1 EHC Reservoir
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6 ton tank near entrance road
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: 6000 gal, Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3
Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 1500 gal, Unit 1 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3
Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 1500 gal, Unit 2 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 7
Chemical Info: CAS Num:999007 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Name: Other Chemical 5
Chemical Info: CAS Num:999005 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10 Quantity: 365 Container Type: Other
Location Description: coal pile
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: 30 ton tank S of Unit 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: Landfill - 2 tanks
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit #1 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Chlorine
Chemical Info: CAS Num:7782505 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100 - 499 Quantity: 365 Container Type: L - Cylinder
Location Description: 2x150-lb cylinder in chlorine bldg
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100 - 499

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: D - Steel Drum
Location Description: Boiler Unit #2 drums
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt:

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 300 gal, Unit #2 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6000 gal, Unit 1 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: Unit 2 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: Not reported
Facility Id: 11785

Contact:
Contact Type: Primary Emergency Contact
Contact Name: JIM PECKENPAUGH
Mailing Address1: PO Box 209
Mailing Address2: Not reported
Mailing Address3: Not reported
Mailing City/State/Zip: Evansville, IN 47702
Phone: 812-305-5427
Type: Mobile

Contact Type: Secondary Emergency Contact
Contact Name: WAYNE GAMES
Mailing Address1: PO Box 209
Mailing Address2: Not reported
Mailing Address3: Not reported
Mailing City/State/Zip: Evansville, IN 47702
Phone: 812-305-4386
Type: Mobile

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Contact Type:	Secondary Emergency Contact
Contact Name:	WAYNE GAMES
Mailing Address1:	PO Box 209
Mailing Address2:	Not reported
Mailing Address3:	Not reported
Mailing City/State/Zip:	Evansville, IN 47702
Phone:	812-491-5508
Type:	Work

Contact Type:	Primary Emergency Contact
Contact Name:	JIM PECKENPAUGH
Mailing Address1:	PO Box 209
Mailing Address2:	Not reported
Mailing Address3:	Not reported
Mailing City/State/Zip:	Evansville, IN 47702
Phone:	812-491-5516
Type:	Work

Contact Type:	is primary emergency contact for
Contact Name:	JIM PECKENPAUGH
Mailing Address1:	PO Box 209
Mailing Address2:	Not reported
Mailing Address3:	Not reported
Mailing City/State/Zip:	Evansville, IN 47702
Phone:	812-491-5516
Type:	Not reported

Contact Type:	Business Owner
Contact Name:	SOUTHERN INDIANA GAS & ELECTRIC COMPANY
Mailing Address1:	PO Box 209
Mailing Address2:	ATTN: Environmental Affairs
Mailing Address3:	Not reported
Mailing City/State/Zip:	Evansville, IN 47702
Phone:	800-227-1376
Type:	Work

Contact Type:	is business owner for
Contact Name:	SOUTHERN INDIANA GAS & ELECTRIC COMPANY
Mailing Address1:	PO Box 209
Mailing Address2:	Not reported
Mailing Address3:	Not reported
Mailing City/State/Zip:	Evansville, IN 47702
Phone:	800-227-1376
Type:	Not reported

Contact Type:	is primary emergency contact for
Contact Name:	JIM PECKENPAUGH
Mailing Address1:	PO Box 209
Mailing Address2:	Not reported
Mailing Address3:	Not reported
Mailing City/State/Zip:	Evansville, IN 47702
Phone:	812-305-5427
Type:	Not reported

Contact Type:	is business owner for
Contact Name:	SOUTHERN INDIANA GAS & ELECTRIC COMPANY
Mailing Address1:	PO Box 209

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Mailing Address2:	Not reported
Mailing Address3:	Not reported
Mailing City/State/Zip:	Evansville, IN 47702
Phone:	812-424-6411
Type:	Not reported

A3 Target Property **SIGECO FILTER CAKE DISPOSAL RWS 3** **IN RGA LF** **S116016026**
8511 WELBORN RD **N/A**
MOUNT VERNON, IN

Site 3 of 14 in cluster A

Actual: 453 ft.

RGA LF:

2010	SIGECO FILTER CAKE DISPOSAL RWS 3	8511 WELBORN RD
2009	SIGECO FILTER CAKE DISPOSAL RWS 3	8511 WELBORN RD
2008	SIGECO FILTER CAKE DISPOSAL RWS 3	8511 WELBORN RD
2007	SIGECO FILTER CAKE DISPOSAL RWS 3	8511 WELBORN RD
2006	SIGECO FILTER CAKE DISPOSAL RWS 3	8511 WELBORN RD
2005	SIGECO FILTER CAKE DISPOSAL RWS 3	8511 WELBORN RD

A4 Target Property **VECTREN- NEW SEDIMENT BASIN, PERIMETER ACCESS BASI** **IN NPDES** **S121409611**
8511 WELBORN RD **N/A**
MOUNT VERNON, IN 47620

Site 4 of 14 in cluster A

Actual: 453 ft.

NPDES:

Permit Number:	INR10K394
Primary Facility Sic Code:	Not reported
Major/Minor:	Minor
Primary Facility Sic Desc:	Not reported
Facility Type Desc:	Not reported
Permit Status Desc:	Effective
Issue Date:	07/03/2015
Expired Date:	07/01/2020
Effective Date:	07/03/2015
Terminated Date:	Not reported
DMR Cognizant Official:	Not reported
DMR Cognizant Telephone:	Not reported
Waterbody:	Not reported
Total Actual Average Flow (MGD):	Not reported
Total App. Design Flow (MGD):	Not reported
FRS HUC Code:	Not reported
Latitude In Decimal Degrees:	37.9125
Longitude In Decimal Degrees:	-87.7167

A5 Target Property | **SIGECO - A.B. BROWN (SOUTHERN INDIANA GA** | **EPA WATCH LIST** | **1015769560**
8511 WELLBORN ROAD | **N/A**
EVANSVILLE, IN 47620

Site 5 of 14 in cluster A

Actual: 453 ft.

EPA WATCH LIST:

Facility ID:	1812900010
Program:	CAA Facilities
List date:	September 2012 Watch List
Facility ID:	1812900010
Program:	CAA Facilities
List date:	August 2012 Watch List
Facility ID:	1812900010
Program:	CAA Facilities
List date:	December 2012 Watch List
Facility ID:	1812900010
Program:	CAA Facilities
List date:	November 2012 Watch List
Facility ID:	1812900010
Program:	CAA Facilities
List date:	October 2012 Watch List

A6 Target Property | **ABB DAM MODIFICATION ACTIVITIES** | **IN NPDES** | **S121411056**
8511 WELBORN RD | **N/A**
MOUNT VERNON, IN 47620

Site 6 of 14 in cluster A

Actual: 453 ft.

NPDES:

Permit Number:	INR10L912
Primary Facility Sic Code:	Not reported
Major/Minor:	Minor
Primary Facility Sic Desc:	Not reported
Facility Type Desc:	Privately Owned Facility
Permit Status Desc:	Effective
Issue Date:	05/06/2016
Expired Date:	05/05/2021
Effective Date:	05/06/2016
Terminated Date:	Not reported
DMR Cognizant Official:	Not reported
DMR Cognizant Telephone:	Not reported
Waterbody:	Not reported
Total Actual Average Flow (MGD):	Not reported
Total App. Design Flow (MGD):	Not reported
FRS HUC Code:	Not reported
Latitude In Decimal Degrees:	37.9028
Longitude In Decimal Degrees:	-87.7128

A7 Target Property | **SIGECO - A.B. BROWN (SOUTHERN INDIANA GA**
8511 WELBORN RD
MOUNT VERNON, IN 47712 | **EPA WATCH LIST** | **1016461355**
N/A

Site 7 of 14 in cluster A

Actual: 453 ft.

EPA WATCH LIST:

Facility ID:	1812900010
Program:	CAA Facilities
List date:	August 2013 Watch List
Facility ID:	1812900010
Program:	CAA Facilities
List date:	July 2013 Watch List

A8 Target Property | **SIGECO AB BROWN GENERATING STATION**
8511 WELBORN RD
MOUNT VERNON, IN 47620 | **RCRA-CESQG**
IN MANIFEST | **1001213841**
IND000685800

Site 8 of 14 in cluster A

Actual: 453 ft.

RCRA-CESQG:

Date form received by agency:	03/01/2017
Facility name:	SIGECO AB BROWN GENERATING STATION
Facility address:	8511 WELBORN RD MOUNT VERNON, IN 47620
EPA ID:	IND000685800
Mailing address:	N MAIN ST PO BOX 209 EVANSVILLE, IN 47702
Contact:	BRANDIE RUCKER
Contact address:	PO BOX 209 EVANSVILLE, IN 47702
Contact country:	US
Contact telephone:	812-491-4787
Contact email:	BRUCKER@VECTREN.COM
EPA Region:	05
Land type:	Private
Classification:	Conditionally Exempt Small Quantity Generator
Description:	Handler: generates 100 kg or less of hazardous waste per calendar month, and accumulates 1000 kg or less of hazardous waste at any time; or generates 1 kg or less of acutely hazardous waste per calendar month, and accumulates at any time: 1 kg or less of acutely hazardous waste; or 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, of acutely hazardous waste; or generates 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, of acutely hazardous waste during any calendar month, and accumulates at any time: 1 kg or less of acutely hazardous waste; or 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, of acutely hazardous waste

Owner/Operator Summary:

Owner/operator name:	SO INDIANA GAS AND ELECTRIC COMPANY, INC
Owner/operator address:	NW RIVERSIDE DRIVE PO BOX 209 EVANSVILLE EVANSVILLE, IN 47702
Owner/operator country:	US

SIGECO AB BROWN GENERATING STATION (Continued) **1001213841**

Owner/operator telephone: 812-491-4000
Owner/operator email: Not reported
Owner/operator fax: Not reported
Owner/operator extension: Not reported
Legal status: Private
Owner/Operator Type: Operator
Owner/Op start date: 08/18/1980
Owner/Op end date: Not reported

Owner/operator name: SO INDIANA GAS AND ELECTRIC COMPANY, INC
Owner/operator address: NW RIVERSIDE DRIVE PO BOX 209 EVANSVILLE
EVANSVILLE, IN 47702
Owner/operator country: US
Owner/operator telephone: 812-491-4000
Owner/operator email: Not reported
Owner/operator fax: Not reported
Owner/operator extension: Not reported
Legal status: Private
Owner/Operator Type: Owner
Owner/Op start date: 08/18/1980
Owner/Op end date: Not reported

Handler Activities Summary:
U.S. importer of hazardous waste: No
Mixed waste (haz. and radioactive): No
Recycler of hazardous waste: No
Transporter of hazardous waste: No
Treater, storer or disposer of HW: No
Underground injection activity: No
On-site burner exemption: No
Furnace exemption: No
Used oil fuel burner: No
Used oil processor: No
User oil refiner: No
Used oil fuel marketer to burner: No
Used oil Specification marketer: No
Used oil transfer facility: No
Used oil transporter: No

. Waste code: D001
. Waste name: IGNITABLE WASTE

. Waste code: D002
. Waste name: CORROSIVE WASTE

. Waste code: D008
. Waste name: LEAD

. Waste code: D035
. Waste name: METHYL ETHYL KETONE

Historical Generators:
Date form received by agency: 02/26/2016
Site name: SIGECO AB BROWN GENERATING STATION
Classification: Conditionally Exempt Small Quantity Generator

SIGECO AB BROWN GENERATING STATION (Continued) **1001213841**

. Waste code: D001
. Waste name: IGNITABLE WASTE

. Waste code: D002
. Waste name: CORROSIVE WASTE

. Waste code: D008
. Waste name: LEAD

. Waste code: D035
. Waste name: METHYL ETHYL KETONE

Date form received by agency: 03/02/2015
Site name: SIGECO AB BROWN GENERATING STATION
Classification: Small Quantity Generator

. Waste code: D001
. Waste name: IGNITABLE WASTE

. Waste code: D002
. Waste name: CORROSIVE WASTE

. Waste code: D008
. Waste name: LEAD

. Waste code: D035
. Waste name: METHYL ETHYL KETONE

Date form received by agency: 08/29/2014
Site name: SIGECO AB BROWN GENERATING STATION
Classification: Small Quantity Generator

. Waste code: D001
. Waste name: IGNITABLE WASTE

. Waste code: D002
. Waste name: CORROSIVE WASTE

. Waste code: D008
. Waste name: LEAD

. Waste code: D035
. Waste name: METHYL ETHYL KETONE

Date form received by agency: 02/21/2014
Site name: SIGECO AB BROWN GENERATING STATION
Classification: Conditionally Exempt Small Quantity Generator

. Waste code: D001
. Waste name: IGNITABLE WASTE

. Waste code: D002
. Waste name: CORROSIVE WASTE

. Waste code: D008
. Waste name: LEAD

SIGECO AB BROWN GENERATING STATION (Continued) **1001213841**

. Waste code: D035
. Waste name: METHYL ETHYL KETONE

Date form received by agency: 02/14/2014
Site name: SIGECO AB BROWN GENERATING STATION
Classification: Large Quantity Generator

. Waste code: D001
. Waste name: IGNITABLE WASTE

. Waste code: D002
. Waste name: CORROSIVE WASTE

. Waste code: D008
. Waste name: LEAD

. Waste code: D035
. Waste name: METHYL ETHYL KETONE

Date form received by agency: 01/23/2013
Site name: SIGECO AB BROWN GEN STATION
Classification: Conditionally Exempt Small Quantity Generator

. Waste code: D001
. Waste name: IGNITABLE WASTE

Date form received by agency: 02/12/2008
Site name: SIGECO AB BROWN GEN STA
Classification: Conditionally Exempt Small Quantity Generator

Date form received by agency: 02/27/2006
Site name: SIGECO AB BROWN GEN STA
Classification: Small Quantity Generator

Date form received by agency: 02/08/2006
Site name: SIGECO AB BROWN GEN STA
Classification: Large Quantity Generator

Date form received by agency: 02/10/2005
Site name: SIGECO AB BROWN GEN STA
Classification: Small Quantity Generator

Date form received by agency: 01/07/2004
Site name: SIGECO AB BROWN GEN STA
Classification: Small Quantity Generator

Date form received by agency: 02/12/2003
Site name: SIGECO AB BROWN GEN STA
Classification: Small Quantity Generator

Date form received by agency: 08/19/1997
Site name: SIGECO A B BROWN GEN STA
Classification: Small Quantity Generator

. Waste code: D001
. Waste name: IGNITABLE WASTE

SIGECO AB BROWN GENERATING STATION (Continued) **1001213841**

. Waste code: D002
. Waste name: CORROSIVE WASTE

. Waste code: D003
. Waste name: REACTIVE WASTE

Violation Status: No violations found

Evaluation Action Summary:
Evaluation date: 05/31/2016
Evaluation: COMPLIANCE EVALUATION INSPECTION ON-SITE
Area of violation: Not reported
Date achieved compliance: Not reported
Evaluation lead agency: State

Evaluation date: 06/25/2002
Evaluation: COMPLIANCE EVALUATION INSPECTION ON-SITE
Area of violation: Not reported
Date achieved compliance: Not reported
Evaluation lead agency: State

IN MANIFEST:
Year: 2016
EPA ID: IND000685800
Tons Generated: 0.175
Tons Shipped OffSite: Not reported
Report Type: Annual
Page No: 1
Waste Desc: UN 1866, RESIN SOLUTION, 3, PG II
UOM: Short Tons
TSDF EPAID: MID980991566
Management code: 47620
Management Desc: Not reported

Manifest Handler:
EPA Id #: IND000685800
Generator Type: SQG
Generator Status: Active Handler
Transporter Type: Code no longer valid
Transporter Status: Non Active
TSD Type: Not reported
TSD Status: Not reported
Handler Mailing Address: PO BOX 209
Handler Mailing City/State/Zip: EVANSVILLE, IN 47702
Contact Name: LISA MESSINGER
Contact Telephone: 812-491-4666
Contact Type: Environmental Coordinator

Receiver Records:
Report Year: 2006.00000
TSD EPA Id: IND093219012
Page Number: 1446.00000
Sub Page: 2.00000
Generator EPA ID: IND000685800
Waste Description: CORROSION RESISTING MORTAR FROM UNUSED PRODUCT, OUT OF DATE
Quantity of Waste: 201
Quantity Rec Report Yrly Tons: 0.1005

SIGECO AB BROWN GENERATING STATION (Continued) **1001213841**

Unit of Measure: 1

Report Year: 2006.00000
TSD EPA Id: IND093219012
Page Number: 1446.00000
Sub Page: 3.00000
Generator EPA ID: IND000685800
Waste Description: SOLIDIFED CORROSION RESISTIN MORTAR&SOL' FROM UNUSED PRODUCT
Quantity of Waste: 253
Quantity Rec Report Yrly Tons: 0.1265
Unit of Measure: 1

Shipment Records:

Generator EPA Id: IND000685800
Actual Generator Type: 2
Waste Description Shipped: UNUSED, SOLIDIFIED CORROSION RESISTANT MORTAR (ACETONE, MEK)
Shipped File Page Number: 1
Number Of TSD Facilities: 1
Waste Codes on Page Number: 1
Waste Code: D001
Tons Of Waste Shipped Year: 0.12650
TSD Facility EPA ID: IND093219012
TSD Name: HERITAGE ENVIRONMENTAL SERVICES LLC

Generator EPA Id: IND000685800
Actual Generator Type: 2
Waste Description Shipped: UNUSED, SOLIDIFIED CORROSION RESISTANT MORTAR (ACETONE, MEK)
Shipped File Page Number: 1
Number Of TSD Facilities: 1
Waste Codes on Page Number: 2
Waste Code: D035
Tons Of Waste Shipped Year: 0.12650
TSD Facility EPA ID: IND093219012
TSD Name: HERITAGE ENVIRONMENTAL SERVICES LLC

Generator EPA Id: IND000685800
Actual Generator Type: 2
Waste Description Shipped: UNUSED. LIQUID CORROSION RESISTANT MORTAR (CORROSIVE, BASIC, INORGANIC)
Shipped File Page Number: 2
Number Of TSD Facilities: 1
Waste Codes on Page Number: 1
Waste Code: D002
Tons Of Waste Shipped Year: 0.10050
TSD Facility EPA ID: IND093219012
TSD Name: HERITAGE ENVIRONMENTAL SERVICES LLC

Transporter Records:

Report Year: 2006
Generator EPA ID: IND000685800
Page Number of Report: 2
TSD EPA Id: IND058484114
Num Of Tranporters Used: 1

Report Year: 2006
Generator EPA ID: IND000685800

SIGECO AB BROWN GENERATING STATION (Continued) **1001213841**

Page Number of Report: 1
TSD EPA Id: IND058484114
Num Of Tranporters Used: 1

Year: 2016
EPA ID: IND000685800
Tons Generated: 0.34
Tons Shipped OffSite: Not reported
Report Type: Annual
Page No: 8
Waste Desc: UN 3265, WASTE CORROSIVE LIQUID ACIDIC, ORGANIC, N.O.S., 8 PG III
UOM: Short Tons
TSDF EPAID: MID980991566
Management code: 47620
Management Desc: Not reported

Year: 2016
EPA ID: IND000685800
Tons Generated: 0.0055
Tons Shipped OffSite: Not reported
Report Type: Annual
Page No: 7
Waste Desc: UN 1873, WASTE PERCHLORIC ACID, 5.1, 8, PG I
UOM: Short Tons
TSDF EPAID: MID980991566
Management code: 47620
Management Desc: Not reported

Year: 2016
EPA ID: IND000685800
Tons Generated: 0.0065
Tons Shipped OffSite: Not reported
Report Type: Annual
Page No: 6
Waste Desc: UN 3264, CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S., 8 PG III
UOM: Short Tons
TSDF EPAID: MID980991566
Management code: 47620
Management Desc: Not reported

Year: 2016
EPA ID: IND000685800
Tons Generated: 0.038
Tons Shipped OffSite: Not reported
Report Type: Annual
Page No: 5
Waste Desc: UN 3109, WASTE ORGANIC PEROXIDE, TYPE F, 5.2, PG II
UOM: Short Tons
TSDF EPAID: OHD980613541
Management code: 47620
Management Desc: Not reported

Click this hyperlink while viewing on your computer to access
12 additional IN MANIFEST: record(s) in the EDR Site Report.

A9 Target Property — **SIGECO A B BROWN GENERATING STATION**, **8511 WELBORN RD**, **MOUNT VERNON, IN 47620** — **TSCA** **1016951163**; **TRIS** **47620SGCBB8511W**

Site 9 of 14 in cluster A

Actual: 453 ft.

Click this hyperlink while viewing on your computer to access additional TSCA detail in the EDR Site Report.

TRIS:

Click this hyperlink while viewing on your computer to access 15 additional US_TRIS: record(s) in the EDR Site Report.

A10 Target Property — **AB BROWN RWS III DISPOSAL FACILITY**, **8511 WELBORN RD**, **MOUNT VERNON, IN** — **IN RGA LF** **S116015606**, **N/A**

Site 10 of 14 in cluster A

Actual: 453 ft.

RGA LF:

2012	AB BROWN RWS III DISPOSAL FACILITY	8511 WELBORN RD
2011	AB BROWN RWS III DISPOSAL FACILITY	8511 WELBORN RD

A11 Target Property — **8511 WELBORN ROAD MOUNT VERNON, IN POSEY**, **POSEY (County), IN** — **IN SPILLS** **S118360282**, **N/A**

Site 11 of 14 in cluster A

Actual: 453 ft.

SPILL:

Facility ID:	57793
Incident Date:	09/15/2015
Report Date:	09/17/2015
Material:	Not reported
Spill Source:	Not reported
Recovered Amount:	Not reported
Recovered Units:	Not reported
Spilled Amount:	Not reported
Spilled Units:	Not reported
Contained:	Not reported
Water Affected:	Not reported
Spill Type:	Emergency Response-Reportable Spill
Area Affected:	Not reported
Fish Killed:	Not reported
Water Supply Affected:	Not reported
Public Intake:	Not reported
Incident Status:	Assigned to Staff

A12 Target Property — **A.B. BROWN GENERATING STATION - STORM WATER MANAGE** — **IN NPDES** — **S121412173** / **N/A**
8511 WELBORN RD
MOUNT VERNON, IN 47620

Site 12 of 14 in cluster A

Actual: 453 ft.

NPDES:

Permit Number:	INR10N110
Primary Facility Sic Code:	Not reported
Major/Minor:	Minor
Primary Facility Sic Desc:	Not reported
Facility Type Desc:	Not reported
Permit Status Desc:	Effective
Issue Date:	12/06/2016
Expired Date:	12/05/2021
Effective Date:	12/06/2016
Terminated Date:	Not reported
DMR Cognizant Official:	Not reported
DMR Cognizant Telephone:	Not reported
Waterbody:	Not reported
Total Actual Average Flow (MGD):	Not reported
Total App. Design Flow (MGD):	Not reported
FRS HUC Code:	Not reported
Latitude In Decimal Degrees:	37.9055
Longitude In Decimal Degrees:	-87.7056

A13 Target Property — **VECTREN - A.B. BROWN STATION BORROW AREA LOCATIONS** — **IN NPDES** — **S121406760** / **N/A**
8511 WELBORN RD
MOUNT VERNON, IN 47620

Site 13 of 14 in cluster A

Actual: 453 ft.

NPDES:

Permit Number:	INR10F189
Primary Facility Sic Code:	Not reported
Major/Minor:	Minor
Primary Facility Sic Desc:	Not reported
Facility Type Desc:	Not reported
Permit Status Desc:	Effective
Issue Date:	06/30/2017
Expired Date:	06/29/2022
Effective Date:	06/30/2017
Terminated Date:	Not reported
DMR Cognizant Official:	Not reported
DMR Cognizant Telephone:	Not reported
Waterbody:	Not reported
Total Actual Average Flow (MGD):	Not reported
Total App. Design Flow (MGD):	Not reported
FRS HUC Code:	Not reported
Latitude In Decimal Degrees:	37.91
Longitude In Decimal Degrees:	-87.7122

A14 Target Property | **VECTREN - A B BROWN STATION NORTH BORROW AREA EXPA**
8511 WELBORN RD
MOUNT VERNON, IN 47620 | **IN NPDES** | **S121408905**
N/A

Site 14 of 14 in cluster A

Actual: 453 ft.

NPDES:

Permit Number:	INR10J646
Primary Facility Sic Code:	Not reported
Major/Minor:	Minor
Primary Facility Sic Desc:	Not reported
Facility Type Desc:	Not reported
Permit Status Desc:	Effective
Issue Date:	02/18/2015
Expired Date:	02/17/2020
Effective Date:	02/18/2015
Terminated Date:	Not reported
DMR Cognizant Official:	Not reported
DMR Cognizant Telephone:	Not reported
Waterbody:	Not reported
Total Actual Average Flow (MGD):	Not reported
Total App. Design Flow (MGD):	Not reported
FRS HUC Code:	Not reported
Latitude In Decimal Degrees:	37.9183
Longitude In Decimal Degrees:	-87.7122

Count: 0 records.

ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)
		NO SITES FOUND			

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Number of Days to Update: Provides confirmation that EDR is reporting records that have been updated within 90 days from the date the government agency made the information available to the public.

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL: National Priority List

National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC) and regional EPA offices.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/22/2017
Date Made Active in Reports: 01/05/2018
Number of Days to Update: 14

Source: EPA
Telephone: N/A
Last EDR Contact: 02/06/2018
Next Scheduled EDR Contact: 04/16/2018
Data Release Frequency: Quarterly

NPL Site Boundaries

Sources:

EPA's Environmental Photographic Interpretation Center (EPIC)
Telephone: 202-564-7333

EPA Region 1
Telephone 617-918-1143

EPA Region 6
Telephone: 214-655-6659

EPA Region 3
Telephone 215-814-5418

EPA Region 7
Telephone: 913-551-7247

EPA Region 4
Telephone 404-562-8033

EPA Region 8
Telephone: 303-312-6774

EPA Region 5
Telephone 312-886-6686

EPA Region 9
Telephone: 415-947-4246

EPA Region 10
Telephone 206-553-8665

Proposed NPL: Proposed National Priority List Sites

A site that has been proposed for listing on the National Priorities List through the issuance of a proposed rule in the Federal Register. EPA then accepts public comments on the site, responds to the comments, and places on the NPL those sites that continue to meet the requirements for listing.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/22/2017
Date Made Active in Reports: 01/05/2018
Number of Days to Update: 14

Source: EPA
Telephone: N/A
Last EDR Contact: 02/06/2018
Next Scheduled EDR Contact: 05/21/2018
Data Release Frequency: Quarterly

NPL LIENS: Federal Superfund Liens

Federal Superfund Liens. Under the authority granted the USEPA by CERCLA of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner received notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/1991
Date Data Arrived at EDR: 02/02/1994
Date Made Active in Reports: 03/30/1994
Number of Days to Update: 56

Source: EPA
Telephone: 202-564-4267
Last EDR Contact: 08/15/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: No Update Planned

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Federal Delisted NPL site list

Delisted NPL: National Priority List Deletions

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 12/11/2017	Source: EPA
Date Data Arrived at EDR: 12/22/2017	Telephone: N/A
Date Made Active in Reports: 01/05/2018	Last EDR Contact: 02/06/2018
Number of Days to Update: 14	Next Scheduled EDR Contact: 04/16/2018
	Data Release Frequency: Quarterly

Federal CERCLIS list

FEDERAL FACILITY: Federal Facility Site Information listing

A listing of National Priority List (NPL) and Base Realignment and Closure (BRAC) sites found in the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) Database where EPA Federal Facilities Restoration and Reuse Office is involved in cleanup activities.

Date of Government Version: 11/07/2016	Source: Environmental Protection Agency
Date Data Arrived at EDR: 01/05/2017	Telephone: 703-603-8704
Date Made Active in Reports: 04/07/2017	Last EDR Contact: 01/05/2018
Number of Days to Update: 92	Next Scheduled EDR Contact: 04/16/2018
	Data Release Frequency: Varies

SEMS: Superfund Enterprise Management System

SEMS (Superfund Enterprise Management System) tracks hazardous waste sites, potentially hazardous waste sites, and remedial activities performed in support of EPA's Superfund Program across the United States. The list was formerly know as CERCLIS, renamed to SEMS by the EPA in 2015. The list contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This dataset also contains sites which are either proposed to or on the National Priorities List (NPL) and the sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 12/11/2017	Source: EPA
Date Data Arrived at EDR: 12/22/2017	Telephone: 800-424-9346
Date Made Active in Reports: 01/12/2018	Last EDR Contact: 02/06/2018
Number of Days to Update: 21	Next Scheduled EDR Contact: 04/30/2018
	Data Release Frequency: Quarterly

Federal CERCLIS NFRAP site list

SEMS-ARCHIVE: Superfund Enterprise Management System Archive

SEMS-ARCHIVE (Superfund Enterprise Management System Archive) tracks sites that have no further interest under the Federal Superfund Program based on available information. The list was formerly known as the CERCLIS-NFRAP, renamed to SEMS ARCHIVE by the EPA in 2015. EPA may perform a minimal level of assessment work at a site while it is archived if site conditions change and/or new information becomes available. Archived sites have been removed and archived from the inventory of SEMS sites. Archived status indicates that, to the best of EPA's knowledge, assessment at a site has been completed and that EPA has determined no further steps will be taken to list the site on the National Priorities List (NPL), unless information indicates this decision was not appropriate or other considerations require a recommendation for listing at a later time. The decision does not necessarily mean that there is no hazard associated with a given site; it only means that. based upon available information, the location is not judged to be potential NPL site.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/22/2017
Date Made Active in Reports: 01/12/2018
Number of Days to Update: 21

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 02/06/2018
Next Scheduled EDR Contact: 04/30/2018
Data Release Frequency: Quarterly

Federal RCRA CORRACTS facilities list

CORRACTS: Corrective Action Report
CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/26/2017
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 45

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Quarterly

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF: RCRA - Treatment, Storage and Disposal
RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Transporters are individuals or entities that move hazardous waste from the generator offsite to a facility that can recycle, treat, store, or dispose of the waste. TSDFs treat, store, or dispose of the waste.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/26/2017
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 45

Source: Environmental Protection Agency
Telephone: 312-886-6186
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Quarterly

Federal RCRA generators list

RCRA-LQG: RCRA - Large Quantity Generators
RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Large quantity generators (LQGs) generate over 1,000 kilograms (kg) of hazardous waste, or over 1 kg of acutely hazardous waste per month.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/26/2017
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 45

Source: Environmental Protection Agency
Telephone: 312-886-6186
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Quarterly

RCRA-SQG: RCRA - Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Small quantity generators (SQGs) generate between 100 kg and 1,000 kg of hazardous waste per month.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/26/2017
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 45

Source: Environmental Protection Agency
Telephone: 312-886-6186
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Quarterly

RCRA-CESQG: RCRA - Conditionally Exempt Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Conditionally exempt small quantity generators (CESQGs) generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/26/2017
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 45

Source: Environmental Protection Agency
Telephone: 312-886-6186
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Quarterly

Federal institutional controls / engineering controls registries

LUCIS: Land Use Control Information System

LUCIS contains records of land use control information pertaining to the former Navy Base Realignment and Closure properties.

Date of Government Version: 05/22/2017
Date Data Arrived at EDR: 06/13/2017
Date Made Active in Reports: 09/15/2017
Number of Days to Update: 94

Source: Department of the Navy
Telephone: 843-820-7326
Last EDR Contact: 02/09/2018
Next Scheduled EDR Contact: 05/28/2018
Data Release Frequency: Varies

US ENG CONTROLS: Engineering Controls Sites List

A listing of sites with engineering controls in place. Engineering controls include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health.

Date of Government Version: 11/13/2017
Date Data Arrived at EDR: 11/27/2017
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 74

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 02/27/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Varies

US INST CONTROL: Sites with Institutional Controls

A listing of sites with institutional controls in place. Institutional controls include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls.

Date of Government Version: 11/13/2017
Date Data Arrived at EDR: 11/27/2017
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 74

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 02/27/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Varies

Federal ERNS list

ERNS: Emergency Response Notification System

Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 09/18/2017
Date Data Arrived at EDR: 09/21/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 22

Source: National Response Center, United States Coast Guard
Telephone: 202-267-2180
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Quarterly

State- and tribal - equivalent CERCLIS

IN SHWS: List of Hazardous Waste Response Sites Scored Using the Indiana Scoring Model

List of hazardous waste response sites scored utilizing the Indiana Scoring Model. The Indiana Scoring Model is a method of prioritizing, for state response actions, those hazardous substances response sites which are not on the National Priorities List. The ISM serves as the Commissioners management tool to address those sites which pose the most significant threat to human health and the environment in addition to assuring the departments resources are allocated accordingly.

Date of Government Version: 03/01/2007
Date Data Arrived at EDR: 08/27/2007
Date Made Active in Reports: 09/18/2007
Number of Days to Update: 22

Source: Department of Environmental Management
Telephone: 317-308-3052
Last EDR Contact: 02/22/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: No Update Planned

KY SHWS: State Leads List

State Hazardous Waste Sites. State hazardous waste site records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where cleanup will be paid for by potentially responsible parties. Available information varies by state.

Date of Government Version: 01/04/2018
Date Data Arrived at EDR: 01/09/2018
Date Made Active in Reports: 02/15/2018
Number of Days to Update: 37

Source: Department of Environmental Protection
Telephone: 502-564-6716
Last EDR Contact: 02/26/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Quarterly

State and tribal landfill and/or solid waste disposal site lists

IN OPEN DUMPS: Open Dump Waste Sites

Open Dumps are sites that are not regulated and are illegal dump sites of solid waste, as defined by IAC 10-2-28 329 and IAC 10-2-128 of the Indiana Administrative Code.

Date of Government Version: 06/26/2009
Date Data Arrived at EDR: 12/11/2013
Date Made Active in Reports: 01/20/2014
Number of Days to Update: 40

Source: Department of Environmental Management
Telephone: 317-232-8726
Last EDR Contact: 12/08/2017
Next Scheduled EDR Contact: 03/19/2018
Data Release Frequency: Varies

IN SWF/LF: Permitted Solid Waste Facilities

Solid Waste Facilities/Landfill Sites. SWF/LF type records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 10/31/2017
Date Data Arrived at EDR: 12/14/2017
Date Made Active in Reports: 01/23/2018
Number of Days to Update: 40

Source: Department of Environmental Management
Telephone: 317-232-0066
Last EDR Contact: 12/11/2017
Next Scheduled EDR Contact: 03/26/2018
Data Release Frequency: Semi-Annually

KY SWF/LF: Solid Waste Facilities List

Solid Waste Facilities/Landfill Sites. SWF/LF type records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 11/27/2017
Date Data Arrived at EDR: 11/28/2017
Date Made Active in Reports: 01/04/2018
Number of Days to Update: 37

Source: Department of Environmental Protection
Telephone: 502-564-6716
Last EDR Contact: 01/29/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Semi-Annually

State and tribal leaking storage tank lists

IN LUST: Lust Leaking Underground Storage Tank List

Leaking Underground Storage Tank Incident Reports. LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state.

Date of Government Version: 11/06/2017
Date Data Arrived at EDR: 11/28/2017
Date Made Active in Reports: 12/05/2017
Number of Days to Update: 7

Source: Department of Environmental Management
Telephone: 317-232-8900
Last EDR Contact: 11/28/2017
Next Scheduled EDR Contact: 03/12/2018
Data Release Frequency: Quarterly

INDIAN LUST R5: Leaking Underground Storage Tanks on Indian Land

Leaking underground storage tanks located on Indian Land in Michigan, Minnesota and Wisconsin.

Date of Government Version: 04/26/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 78

Source: EPA, Region 5
Telephone: 312-886-7439
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN LUST R8: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming.

Date of Government Version: 05/01/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 78

Source: EPA Region 8
Telephone: 303-312-6271
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN LUST R10: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Alaska, Idaho, Oregon and Washington.

Date of Government Version: 04/25/2017
Date Data Arrived at EDR: 11/07/2017
Date Made Active in Reports: 12/08/2017
Number of Days to Update: 31

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN LUST R9: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Arizona, California, New Mexico and Nevada

Date of Government Version: 04/13/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 78

Source: Environmental Protection Agency
Telephone: 415-972-3372
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN LUST R7: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Iowa, Kansas, and Nebraska

Date of Government Version: 04/14/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/06/2017
Number of Days to Update: 71

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN LUST R6: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in New Mexico and Oklahoma.

Date of Government Version: 04/24/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/06/2017
Number of Days to Update: 71

Source: EPA Region 6
Telephone: 214-665-6597
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN LUST R4: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Florida, Mississippi and North Carolina.

Date of Government Version: 10/14/2016
Date Data Arrived at EDR: 01/27/2017
Date Made Active in Reports: 05/05/2017
Number of Days to Update: 98

Source: EPA Region 4
Telephone: 404-562-8677
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Semi-Annually

INDIAN LUST R1: Leaking Underground Storage Tanks on Indian Land
A listing of leaking underground storage tank locations on Indian Land.

Date of Government Version: 04/14/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/06/2017
Number of Days to Update: 71

Source: EPA Region 1
Telephone: 617-918-1313
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

State and tribal registered storage tank lists

FEMA UST: Underground Storage Tank Listing
A listing of all FEMA owned underground storage tanks.

Date of Government Version: 05/15/2017
Date Data Arrived at EDR: 05/30/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 136

Source: FEMA
Telephone: 202-646-5797
Last EDR Contact: 01/09/2018
Next Scheduled EDR Contact: 04/23/2018
Data Release Frequency: Varies

IN UST: Indiana Registered Underground Storage Tanks
Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

Date of Government Version: 11/06/2017
Date Data Arrived at EDR: 11/28/2017
Date Made Active in Reports: 12/05/2017
Number of Days to Update: 7

Source: Department of Environmental Management
Telephone: 317-308-3008
Last EDR Contact: 11/28/2017
Next Scheduled EDR Contact: 03/12/2018
Data Release Frequency: Quarterly

KY UST: Underground Storage Tank Database
Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

Date of Government Version: 11/13/2017
Date Data Arrived at EDR: 11/28/2017
Date Made Active in Reports: 12/28/2017
Number of Days to Update: 30

Source: Department of Environmental Protection
Telephone: 502-564-5981
Last EDR Contact: 11/28/2017
Next Scheduled EDR Contact: 03/12/2018
Data Release Frequency: Quarterly

IN AST: Above Ground Storage Tanks

A listing of aboveground storage tank sites that reported under the emergency rule.

Date of Government Version: 01/25/2017
Date Data Arrived at EDR: 05/16/2017
Date Made Active in Reports: 09/06/2017
Number of Days to Update: 113

Source: N/A
Telephone: 317-232-2393
Last EDR Contact: 11/02/2017
Next Scheduled EDR Contact: 02/19/2018
Data Release Frequency: N/A

INDIAN UST R7: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 7 (Iowa, Kansas, Missouri, Nebraska, and 9 Tribal Nations).

Date of Government Version: 05/02/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/06/2017
Number of Days to Update: 71

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN UST R8: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 8 (Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming and 27 Tribal Nations).

Date of Government Version: 05/01/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 78

Source: EPA Region 8
Telephone: 303-312-6137
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN UST R6: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 6 (Louisiana, Arkansas, Oklahoma, New Mexico, Texas and 65 Tribes).

Date of Government Version: 04/24/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 12/08/2017
Number of Days to Update: 134

Source: EPA Region 6
Telephone: 214-665-7591
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN UST R5: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 5 (Michigan, Minnesota and Wisconsin and Tribal Nations).

Date of Government Version: 04/26/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/06/2017
Number of Days to Update: 71

Source: EPA Region 5
Telephone: 312-886-6136
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN UST R4: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 4 (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee and Tribal Nations)

Date of Government Version: 10/14/2016
Date Data Arrived at EDR: 01/27/2017
Date Made Active in Reports: 05/05/2017
Number of Days to Update: 98

Source: EPA Region 4
Telephone: 404-562-9424
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Semi-Annually

INDIAN UST R1: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 1 (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont and ten Tribal Nations).

Date of Government Version: 04/14/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/06/2017
Number of Days to Update: 71

Source: EPA, Region 1
Telephone: 617-918-1313
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN UST R10: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 10 (Alaska, Idaho, Oregon, Washington, and Tribal Nations).

Date of Government Version: 04/25/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 78

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN UST R9: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 9 (Arizona, California, Hawaii, Nevada, the Pacific Islands, and Tribal Nations).

Date of Government Version: 04/13/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 78

Source: EPA Region 9
Telephone: 415-972-3368
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

State and tribal institutional control / engineering control registries

IN AUL: Sites with Restrictions

Activity and use limitations include both engineering controls and institutional controls. A listing of Comfort/Site Status Letter sites that have been issued with controls.

Date of Government Version: 11/06/2017
Date Data Arrived at EDR: 11/27/2017
Date Made Active in Reports: 12/01/2017
Number of Days to Update: 4

Source: Department of Environmental Management
Telephone: 317-232-8603
Last EDR Contact: 02/26/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Varies

State and tribal voluntary cleanup sites

IN VCP: Voluntary Remediation Program Site List

A current list of Voluntary Remediation Program sites that are no longer confidential.

Date of Government Version: 08/22/2014
Date Data Arrived at EDR: 08/22/2014
Date Made Active in Reports: 09/12/2014
Number of Days to Update: 21

Source: Department of Environmental Management
Telephone: 317-234-0966
Last EDR Contact: 01/05/2018
Next Scheduled EDR Contact: 04/23/2018
Data Release Frequency: Semi-Annually

INDIAN VCP R7: Voluntary Cleanup Priority Lisitng
A listing of voluntary cleanup priority sites located on Indian Land located in Region 7.

Date of Government Version: 03/20/2008
Date Data Arrived at EDR: 04/22/2008
Date Made Active in Reports: 05/19/2008
Number of Days to Update: 27

Source: EPA, Region 7
Telephone: 913-551-7365
Last EDR Contact: 04/20/2009
Next Scheduled EDR Contact: 07/20/2009
Data Release Frequency: Varies

INDIAN VCP R1: Voluntary Cleanup Priority Listing
A listing of voluntary cleanup priority sites located on Indian Land located in Region 1.

Date of Government Version: 07/27/2015
Date Data Arrived at EDR: 09/29/2015
Date Made Active in Reports: 02/18/2016
Number of Days to Update: 142

Source: EPA, Region 1
Telephone: 617-918-1102
Last EDR Contact: 12/20/2017
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Varies

KY VCP: Voluntary Cleanup Program Sites
Sites that have been accepted into the Voluntary Cleanup Program or have submitted an application.

Date of Government Version: 01/05/2018
Date Data Arrived at EDR: 01/09/2018
Date Made Active in Reports: 02/20/2018
Number of Days to Update: 42

Source: Department of Environmental Protection
Telephone: 502-564-6716
Last EDR Contact: 02/26/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Varies

State and tribal Brownfields sites

IN BROWNFIELDS: Brownfields Site List
A brownfield site is an industrial or commercial property that is abandoned, inactive, or underutilized, on which expansion or redeveloopment is complicated due to the actual or perceived environmental contamination.

Date of Government Version: 11/15/2017
Date Data Arrived at EDR: 11/27/2017
Date Made Active in Reports: 12/01/2017
Number of Days to Update: 4

Source: Department of Environmental Management
Telephone: 317-233-2570
Last EDR Contact: 02/26/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Semi-Annually

KY BROWNFIELDS: Kentucky Brownfield Inventory
The Kentucky Brownfield Program has created an inventory of brownfield sites in order to market the properties to those interested in brownfield redevelopment. The Kentucky Brownfield Program is working to promote the redevelopment of these sites by helping to remove barriers that prevent reuse, providing useful information to communities, developers and the public and encouraging a climate that fosters redevelopment of contaminated sites.

Date of Government Version: 02/06/2018
Date Data Arrived at EDR: 02/07/2018
Date Made Active in Reports: 02/21/2018
Number of Days to Update: 14

Source: Division of Compliance Assistance
Telephone: 502-564-0323
Last EDR Contact: 01/16/2018
Next Scheduled EDR Contact: 04/30/2018
Data Release Frequency: Varies

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS: A Listing of Brownfields Sites
Brownfields are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up and reinvesting in these properties takes development pressures off of undeveloped, open land, and both improves and protects the environment. Assessment, Cleanup and Redevelopment Exchange System (ACRES) stores information reported by EPA Brownfields grant recipients on brownfields properties assessed or cleaned up with grant funding as well as information on Targeted Brownfields Assessments performed by EPA Regions. A listing of ACRES Brownfield sites is obtained from Cleanups in My Community. Cleanups in My Community provides information on Brownfields properties for which information is reported back to EPA, as well as areas served by Brownfields grant programs.

Date of Government Version: 01/19/2018
Date Data Arrived at EDR: 01/19/2018
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 21

Source: Environmental Protection Agency
Telephone: 202-566-2777
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/02/2018
Data Release Frequency: Semi-Annually

Local Lists of Landfill / Solid Waste Disposal Sites

IN SWRCY: Recycling Facilities
A listing of recycling facilities located in the state of Indiana.

Date of Government Version: 10/01/2017
Date Data Arrived at EDR: 10/02/2017
Date Made Active in Reports: 10/31/2017
Number of Days to Update: 29

Source: Department of Environmental Management
Telephone: 317-234-4050
Last EDR Contact: 01/10/2018
Next Scheduled EDR Contact: 04/30/2018
Data Release Frequency: Varies

IN SWTIRE: Waste Tire Sites Listing
This listing consists of Tire Sites - sites which contain tires - either for processing, for storage, or transport - as well as some illegal tire dumps, as defined by IC 13-11-2-251, IC 13-11-2-252, and IC 13-11-250.5 of the Indiana Code.

Date of Government Version: 08/04/2015
Date Data Arrived at EDR: 09/09/2015
Date Made Active in Reports: 10/07/2015
Number of Days to Update: 28

Source: Department of Environmental Management
Telephone: 317-232-8726
Last EDR Contact: 12/08/2017
Next Scheduled EDR Contact: 03/19/2018
Data Release Frequency: Varies

KY SWRCY: Recycling Facilities
A listing of recycling facilities located in the state of Kentucky.

Date of Government Version: 07/20/2017
Date Data Arrived at EDR: 10/19/2017
Date Made Active in Reports: 10/31/2017
Number of Days to Update: 12

Source: Department of Environmental Protection
Telephone: 502-564-6716
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/30/2018
Data Release Frequency: Varies

INDIAN ODI: Report on the Status of Open Dumps on Indian Lands
Location of open dumps on Indian land.

Date of Government Version: 12/31/1998
Date Data Arrived at EDR: 12/03/2007
Date Made Active in Reports: 01/24/2008
Number of Days to Update: 52

Source: Environmental Protection Agency
Telephone: 703-308-8245
Last EDR Contact: 01/30/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Varies

ODI: Open Dump Inventory
An open dump is defined as a disposal facility that does not comply with one or more of the Part 257 or Part 258 Subtitle D Criteria.

Date of Government Version: 06/30/1985
Date Data Arrived at EDR: 08/09/2004
Date Made Active in Reports: 09/17/2004
Number of Days to Update: 39

Source: Environmental Protection Agency
Telephone: 800-424-9346
Last EDR Contact: 06/09/2004
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

DEBRIS REGION 9: Torres Martinez Reservation Illegal Dump Site Locations
A listing of illegal dump sites location on the Torres Martinez Indian Reservation located in eastern Riverside County and northern Imperial County, California.

Date of Government Version: 01/12/2009
Date Data Arrived at EDR: 05/07/2009
Date Made Active in Reports: 09/21/2009
Number of Days to Update: 137

Source: EPA, Region 9
Telephone: 415-947-4219
Last EDR Contact: 01/22/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: No Update Planned

IHS OPEN DUMPS: Open Dumps on Indian Land

A listing of all open dumps located on Indian Land in the United States.

Date of Government Version: 04/01/2014
Date Data Arrived at EDR: 08/06/2014
Date Made Active in Reports: 01/29/2015
Number of Days to Update: 176

Source: Department of Health & Human Serivces, Indian Health Service
Telephone: 301-443-1452
Last EDR Contact: 02/02/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Varies

Local Lists of Hazardous waste / Contaminated Sites

US HIST CDL: National Clandestine Laboratory Register

A listing of clandestine drug lab locations that have been removed from the DEAs National Clandestine Laboratory Register.

Date of Government Version: 01/19/2018
Date Data Arrived at EDR: 01/24/2018
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 16

Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 02/27/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: No Update Planned

IN CDL: Clandestine Drug Lab Listing

A listing of clandestine drub labs that have been cleaned up.

Date of Government Version: 08/29/2016
Date Data Arrived at EDR: 10/05/2016
Date Made Active in Reports: 10/20/2016
Number of Days to Update: 15

Source: Department of Environmental Management
Telephone: 317-416-5031
Last EDR Contact: 01/05/2018
Next Scheduled EDR Contact: 04/23/2018
Data Release Frequency: Quarterly

KY CDL: Clandestine Drub Lab Location Listing

Clandestine drug lab site locations.

Date of Government Version: 01/05/2018
Date Data Arrived at EDR: 01/09/2018
Date Made Active in Reports: 02/15/2018
Number of Days to Update: 37

Source: Department of Environmental Protection
Telephone: 502-564-6716
Last EDR Contact: 02/26/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Varies

IN DEL SHWS: Deleted Commissioner's Bulletin Sites List

A listing of sites deleted/removed from the Commissioner's Bulletin List

Date of Government Version: 04/03/2008
Date Data Arrived at EDR: 04/04/2008
Date Made Active in Reports: 04/14/2008
Number of Days to Update: 10

Source: Department of Environmental Management
Telephone: 317-234-0347
Last EDR Contact: 02/22/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Varies

US CDL: Clandestine Drug Labs

A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.

Date of Government Version: 01/09/2018
Date Data Arrived at EDR: 01/24/2018
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 16

Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 02/27/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Quarterly

Local Land Records

LIENS 2: CERCLA Lien Information

A Federal CERCLA ('Superfund') lien can exist by operation of law at any site or property at which EPA has spent Superfund monies. These monies are spent to investigate and address releases and threatened releases of contamination. CERCLIS provides information as to the identity of these sites and properties.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/22/2017
Date Made Active in Reports: 01/12/2018
Number of Days to Update: 21

Source: Environmental Protection Agency
Telephone: 202-564-6023
Last EDR Contact: 02/06/2018
Next Scheduled EDR Contact: 05/21/2018
Data Release Frequency: Semi-Annually

Records of Emergency Release Reports

HMIRS: Hazardous Materials Information Reporting System

Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 09/21/2017
Date Data Arrived at EDR: 09/21/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 22

Source: U.S. Department of Transportation
Telephone: 202-366-4555
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Quarterly

IN SPILLS: Spills Incidents

Oil, hazardous, or objectionable materials that may be released to soil and water.

Date of Government Version: 10/31/2017
Date Data Arrived at EDR: 11/28/2017
Date Made Active in Reports: 01/23/2018
Number of Days to Update: 56

Source: Department of Environmental Management
Telephone: 317-308-3038
Last EDR Contact: 11/28/2017
Next Scheduled EDR Contact: 03/12/2018
Data Release Frequency: Quarterly

KY SPILLS: State spills

A listing of spill and/or release related incidents.

Date of Government Version: 01/26/2018
Date Data Arrived at EDR: 02/09/2018
Date Made Active in Reports: 02/20/2018
Number of Days to Update: 11

Source: DEP, Emergency Response
Telephone: 502-564-2380
Last EDR Contact: 01/16/2018
Next Scheduled EDR Contact: 04/30/2018
Data Release Frequency: Varies

IN SPILLS 90: SPILLS90 data from FirstSearch

Spills 90 includes those spill and release records available exclusively from FirstSearch databases. Typically, they may include chemical, oil and/or hazardous substance spills recorded after 1990. Duplicate records that are already included in EDR incident and release records are not included in Spills 90.

Date of Government Version: 09/07/2012
Date Data Arrived at EDR: 01/03/2013
Date Made Active in Reports: 02/11/2013
Number of Days to Update: 39

Source: FirstSearch
Telephone: N/A
Last EDR Contact: 01/03/2013
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

IN SPILLS 80: SPILLS80 data from FirstSearch

Spills 80 includes those spill and release records available from FirstSearch databases prior to 1990. Typically, they may include chemical, oil and/or hazardous substance spills recorded before 1990. Duplicate records that are already included in EDR incident and release records are not included in Spills 80.

Date of Government Version: 09/11/2002
Date Data Arrived at EDR: 01/03/2013
Date Made Active in Reports: 02/28/2013
Number of Days to Update: 56

Source: FirstSearch
Telephone: N/A
Last EDR Contact: 01/03/2013
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

Other Ascertainable Records

RCRA NonGen / NLR: RCRA - Non Generators / No Longer Regulated

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Non-Generators do not presently generate hazardous waste.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/26/2017
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 45

Source: Environmental Protection Agency
Telephone: 312-886-6186
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Quarterly

FUDS: Formerly Used Defense Sites

The listing includes locations of Formerly Used Defense Sites properties where the US Army Corps of Engineers is actively working or will take necessary cleanup actions.

Date of Government Version: 01/31/2015
Date Data Arrived at EDR: 07/08/2015
Date Made Active in Reports: 10/13/2015
Number of Days to Update: 97

Source: U.S. Army Corps of Engineers
Telephone: 202-528-4285
Last EDR Contact: 02/21/2018
Next Scheduled EDR Contact: 06/04/2018
Data Release Frequency: Varies

DOD: Department of Defense Sites

This data set consists of federally owned or administered lands, administered by the Department of Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 11/10/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 62

Source: USGS
Telephone: 888-275-8747
Last EDR Contact: 10/13/2017
Next Scheduled EDR Contact: 01/22/2018
Data Release Frequency: Semi-Annually

FEDLAND: Federal and Indian Lands

Federally and Indian administrated lands of the United States. Lands included are administrated by: Army Corps of Engineers, Bureau of Reclamation, National Wild and Scenic River, National Wildlife Refuge, Public Domain Land, Wilderness, Wilderness Study Area, Wildlife Management Area, Bureau of Indian Affairs, Bureau of Land Management, Department of Justice, Forest Service, Fish and Wildlife Service, National Park Service.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 02/06/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 339

Source: U.S. Geological Survey
Telephone: 888-275-8747
Last EDR Contact: 10/11/2017
Next Scheduled EDR Contact: 01/22/2018
Data Release Frequency: N/A

SCRD DRYCLEANERS: State Coalition for Remediation of Drycleaners Listing

The State Coalition for Remediation of Drycleaners was established in 1998, with support from the U.S. EPA Office of Superfund Remediation and Technology Innovation. It is comprised of representatives of states with established drycleaner remediation programs. Currently the member states are Alabama, Connecticut, Florida, Illinois, Kansas, Minnesota, Missouri, North Carolina, Oregon, South Carolina, Tennessee, Texas, and Wisconsin.

Date of Government Version: 01/01/2017
Date Data Arrived at EDR: 02/03/2017
Date Made Active in Reports: 04/07/2017
Number of Days to Update: 63

Source: Environmental Protection Agency
Telephone: 615-532-8599
Last EDR Contact: 02/16/2018
Next Scheduled EDR Contact: 05/28/2018
Data Release Frequency: Varies

US FIN ASSUR: Financial Assurance Information

All owners and operators of facilities that treat, store, or dispose of hazardous waste are required to provide proof that they will have sufficient funds to pay for the clean up, closure, and post-closure care of their facilities.

Date of Government Version: 10/17/2017
Date Data Arrived at EDR: 11/01/2017
Date Made Active in Reports: 12/08/2017
Number of Days to Update: 37

Source: Environmental Protection Agency
Telephone: 202-566-1917
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Quarterly

EPA WATCH LIST: EPA WATCH LIST

EPA maintains a "Watch List" to facilitate dialogue between EPA, state and local environmental agencies on enforcement matters relating to facilities with alleged violations identified as either significant or high priority. Being on the Watch List does not mean that the facility has actually violated the law only that an investigation by EPA or a state or local environmental agency has led those organizations to allege that an unproven violation has in fact occurred. Being on the Watch List does not represent a higher level of concern regarding the alleged violations that were detected, but instead indicates cases requiring additional dialogue between EPA, state and local agencies - primarily because of the length of time the alleged violation has gone unaddressed or unresolved.

Date of Government Version: 08/30/2013
Date Data Arrived at EDR: 03/21/2014
Date Made Active in Reports: 06/17/2014
Number of Days to Update: 88

Source: Environmental Protection Agency
Telephone: 617-520-3000
Last EDR Contact: 01/31/2018
Next Scheduled EDR Contact: 05/21/2018
Data Release Frequency: Quarterly

2020 COR ACTION: 2020 Corrective Action Program List

The EPA has set ambitious goals for the RCRA Corrective Action program by creating the 2020 Corrective Action Universe. This RCRA cleanup baseline includes facilities expected to need corrective action. The 2020 universe contains a wide variety of sites. Some properties are heavily contaminated while others were contaminated but have since been cleaned up. Still others have not been fully investigated yet, and may require little or no remediation. Inclusion in the 2020 Universe does not necessarily imply failure on the part of a facility to meet its RCRA obligations.

Date of Government Version: 04/22/2013
Date Data Arrived at EDR: 03/03/2015
Date Made Active in Reports: 03/09/2015
Number of Days to Update: 6

Source: Environmental Protection Agency
Telephone: 703-308-4044
Last EDR Contact: 02/08/2018
Next Scheduled EDR Contact: 05/21/2018
Data Release Frequency: Varies

TSCA: Toxic Substances Control Act

Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/2016
Date Data Arrived at EDR: 06/21/2017
Date Made Active in Reports: 01/05/2018
Number of Days to Update: 198

Source: EPA
Telephone: 202-260-5521
Last EDR Contact: 12/22/2017
Next Scheduled EDR Contact: 04/02/2018
Data Release Frequency: Every 4 Years

TRIS: Toxic Chemical Release Inventory System

Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/2016
Date Data Arrived at EDR: 01/10/2018
Date Made Active in Reports: 01/12/2018
Number of Days to Update: 2

Source: EPA
Telephone: 202-566-0250
Last EDR Contact: 02/23/2018
Next Scheduled EDR Contact: 06/04/2018
Data Release Frequency: Annually

SSTS: Section 7 Tracking Systems

Section 7 of the Federal Insecticide, Fungicide and Rodenticide Act, as amended (92 Stat. 829) requires all registered pesticide-producing establishments to submit a report to the Environmental Protection Agency by March 1st each year. Each establishment must report the types and amounts of pesticides, active ingredients and devices being produced, and those having been produced and sold or distributed in the past year.

Date of Government Version: 12/31/2009
Date Data Arrived at EDR: 12/10/2010
Date Made Active in Reports: 02/25/2011
Number of Days to Update: 77

Source: EPA
Telephone: 202-564-4203
Last EDR Contact: 01/25/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Annually

ROD: Records Of Decision

Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/22/2017
Date Made Active in Reports: 01/12/2018
Number of Days to Update: 21

Source: EPA
Telephone: 703-416-0223
Last EDR Contact: 02/06/2018
Next Scheduled EDR Contact: 03/19/2018
Data Release Frequency: Annually

RMP: Risk Management Plans

When Congress passed the Clean Air Act Amendments of 1990, it required EPA to publish regulations and guidance for chemical accident prevention at facilities using extremely hazardous substances. The Risk Management Program Rule (RMP Rule) was written to implement Section 112(r) of these amendments. The rule, which built upon existing industry codes and standards, requires companies of all sizes that use certain flammable and toxic substances to develop a Risk Management Program, which includes a(n): Hazard assessment that details the potential effects of an accidental release, an accident history of the last five years, and an evaluation of worst-case and alternative accidental releases; Prevention program that includes safety precautions and maintenance, monitoring, and employee training measures; and Emergency response program that spells out emergency health care, employee training measures and procedures for informing the public and response agencies (e.g the fire department) should an accident occur.

Date of Government Version: 11/02/2017
Date Data Arrived at EDR: 11/17/2017
Date Made Active in Reports: 12/08/2017
Number of Days to Update: 21

Source: Environmental Protection Agency
Telephone: 202-564-8600
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

RAATS: RCRA Administrative Action Tracking System

RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/1995
Date Data Arrived at EDR: 07/03/1995
Date Made Active in Reports: 08/07/1995
Number of Days to Update: 35

Source: EPA
Telephone: 202-564-4104
Last EDR Contact: 06/02/2008
Next Scheduled EDR Contact: 09/01/2008
Data Release Frequency: No Update Planned

PRP: Potentially Responsible Parties
A listing of verified Potentially Responsible Parties

Date of Government Version: 10/25/2013
Date Data Arrived at EDR: 10/17/2014
Date Made Active in Reports: 10/20/2014
Number of Days to Update: 3

Source: EPA
Telephone: 202-564-6023
Last EDR Contact: 02/06/2018
Next Scheduled EDR Contact: 05/21/2018
Data Release Frequency: Quarterly

PADS: PCB Activity Database System
PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 06/01/2017
Date Data Arrived at EDR: 06/09/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 126

Source: EPA
Telephone: 202-566-0500
Last EDR Contact: 01/12/2018
Next Scheduled EDR Contact: 04/23/2018
Data Release Frequency: Annually

ICIS: Integrated Compliance Information System
The Integrated Compliance Information System (ICIS) supports the information needs of the national enforcement and compliance program as well as the unique needs of the National Pollutant Discharge Elimination System (NPDES) program.

Date of Government Version: 11/18/2016
Date Data Arrived at EDR: 11/23/2016
Date Made Active in Reports: 02/10/2017
Number of Days to Update: 79

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 01/09/2018
Next Scheduled EDR Contact: 04/23/2018
Data Release Frequency: Quarterly

FTTS: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25

Source: EPA/Office of Prevention, Pesticides and Toxic Substances
Telephone: 202-566-1667
Last EDR Contact: 08/18/2017
Next Scheduled EDR Contact: 12/04/2017
Data Release Frequency: Quarterly

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
A listing of FIFRA/TSCA Tracking System (FTTS) inspections and enforcements.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25

Source: EPA
Telephone: 202-566-1667
Last EDR Contact: 08/18/2017
Next Scheduled EDR Contact: 12/04/2017
Data Release Frequency: Quarterly

MLTS: Material Licensing Tracking System
MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 08/30/2016
Date Data Arrived at EDR: 09/08/2016
Date Made Active in Reports: 10/21/2016
Number of Days to Update: 43

Source: Nuclear Regulatory Commission
Telephone: 301-415-7169
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 05/21/2018
Data Release Frequency: Quarterly

COAL ASH DOE: Steam-Electric Plant Operation Data
A listing of power plants that store ash in surface ponds.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 08/07/2009
Date Made Active in Reports: 10/22/2009
Number of Days to Update: 76

Source: Department of Energy
Telephone: 202-586-8719
Last EDR Contact: 12/05/2017
Next Scheduled EDR Contact: 03/19/2018
Data Release Frequency: Varies

COAL ASH EPA: Coal Combustion Residues Surface Impoundments List
A listing of coal combustion residues surface impoundments with high hazard potential ratings.

Date of Government Version: 07/01/2014
Date Data Arrived at EDR: 09/10/2014
Date Made Active in Reports: 10/20/2014
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: N/A
Last EDR Contact: 12/08/2017
Next Scheduled EDR Contact: 03/19/2018
Data Release Frequency: Varies

PCB TRANSFORMER: PCB Transformer Registration Database
The database of PCB transformer registrations that includes all PCB registration submittals.

Date of Government Version: 05/24/2017
Date Data Arrived at EDR: 11/30/2017
Date Made Active in Reports: 12/15/2017
Number of Days to Update: 15

Source: Environmental Protection Agency
Telephone: 202-566-0517
Last EDR Contact: 01/26/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

RADINFO: Radiation Information Database
The Radiation Information Database (RADINFO) contains information about facilities that are regulated by U.S. Environmental Protection Agency (EPA) regulations for radiation and radioactivity.

Date of Government Version: 10/02/2017
Date Data Arrived at EDR: 10/05/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 8

Source: Environmental Protection Agency
Telephone: 202-343-9775
Last EDR Contact: 01/04/2018
Next Scheduled EDR Contact: 04/16/2018
Data Release Frequency: Quarterly

HIST FTTS: FIFRA/TSCA Tracking System Administrative Case Listing
A complete administrative case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2007
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

HIST FTTS INSP: FIFRA/TSCA Tracking System Inspection & Enforcement Case Listing
A complete inspection and enforcement case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2008
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

DOT OPS: Incident and Accident Data

Department of Transporation, Office of Pipeline Safety Incident and Accident data.

Date of Government Version: 07/31/2012
Date Data Arrived at EDR: 08/07/2012
Date Made Active in Reports: 09/18/2012
Number of Days to Update: 42

Source: Department of Transporation, Office of Pipeline Safety
Telephone: 202-366-4595
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Varies

CONSENT: Superfund (CERCLA) Consent Decrees

Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: 09/30/2017
Date Data Arrived at EDR: 11/10/2017
Date Made Active in Reports: 01/12/2018
Number of Days to Update: 63

Source: Department of Justice, Consent Decree Library
Telephone: Varies
Last EDR Contact: 01/04/2018
Next Scheduled EDR Contact: 04/02/2018
Data Release Frequency: Varies

BRS: Biennial Reporting System

The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/31/2015
Date Data Arrived at EDR: 02/22/2017
Date Made Active in Reports: 09/28/2017
Number of Days to Update: 218

Source: EPA/NTIS
Telephone: 800-424-9346
Last EDR Contact: 02/23/2018
Next Scheduled EDR Contact: 06/04/2018
Data Release Frequency: Biennially

INDIAN RESERV: Indian Reservations

This map layer portrays Indian administered lands of the United States that have any area equal to or greater than 640 acres.

Date of Government Version: 12/31/2014
Date Data Arrived at EDR: 07/14/2015
Date Made Active in Reports: 01/10/2017
Number of Days to Update: 546

Source: USGS
Telephone: 202-208-3710
Last EDR Contact: 01/09/2018
Next Scheduled EDR Contact: 04/23/2018
Data Release Frequency: Semi-Annually

FUSRAP: Formerly Utilized Sites Remedial Action Program

DOE established the Formerly Utilized Sites Remedial Action Program (FUSRAP) in 1974 to remediate sites where radioactive contamination remained from Manhattan Project and early U.S. Atomic Energy Commission (AEC) operations.

Date of Government Version: 12/23/2016
Date Data Arrived at EDR: 12/27/2016
Date Made Active in Reports: 02/17/2017
Number of Days to Update: 52

Source: Department of Energy
Telephone: 202-586-3559
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 05/21/2018
Data Release Frequency: Varies

UMTRA: Uranium Mill Tailings Sites

Uranium ore was mined by private companies for federal government use in national defense programs. When the mills shut down, large piles of the sand-like material (mill tailings) remain after uranium has been extracted from the ore. Levels of human exposure to radioactive materials from the piles are low; however, in some cases tailings were used as construction materials before the potential health hazards of the tailings were recognized.

Date of Government Version: 06/23/2017
Date Data Arrived at EDR: 10/11/2017
Date Made Active in Reports: 11/03/2017
Number of Days to Update: 23

Source: Department of Energy
Telephone: 505-845-0011
Last EDR Contact: 02/23/2018
Next Scheduled EDR Contact: 06/04/2018
Data Release Frequency: Varies

LEAD SMELTER 1: Lead Smelter Sites
A listing of former lead smelter site locations.

Date of Government Version: 10/10/2017
Date Data Arrived at EDR: 11/03/2017
Date Made Active in Reports: 12/15/2017
Number of Days to Update: 42

Source: Environmental Protection Agency
Telephone: 703-603-8787
Last EDR Contact: 02/06/2018
Next Scheduled EDR Contact: 05/21/2018
Data Release Frequency: Varies

LEAD SMELTER 2: Lead Smelter Sites
A list of several hundred sites in the U.S. where secondary lead smelting was done from 1931and 1964. These sites may pose a threat to public health through ingestion or inhalation of contaminated soil or dust

Date of Government Version: 04/05/2001
Date Data Arrived at EDR: 10/27/2010
Date Made Active in Reports: 12/02/2010
Number of Days to Update: 36

Source: American Journal of Public Health
Telephone: 703-305-6451
Last EDR Contact: 12/02/2009
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

US AIRS (AFS): Aerometric Information Retrieval System Facility Subsystem (AFS)
The database is a sub-system of Aerometric Information Retrieval System (AIRS). AFS contains compliance data on air pollution point sources regulated by the U.S. EPA and/or state and local air regulatory agencies. This information comes from source reports by various stationary sources of air pollution, such as electric power plants, steel mills, factories, and universities, and provides information about the air pollutants they produce. Action, air program, air program pollutant, and general level plant data. It is used to track emissions and compliance data from industrial plants.

Date of Government Version: 10/12/2016
Date Data Arrived at EDR: 10/26/2016
Date Made Active in Reports: 02/03/2017
Number of Days to Update: 100

Source: EPA
Telephone: 202-564-2496
Last EDR Contact: 09/26/2017
Next Scheduled EDR Contact: 01/08/2018
Data Release Frequency: Annually

US AIRS MINOR: Air Facility System Data
A listing of minor source facilities.

Date of Government Version: 10/12/2016
Date Data Arrived at EDR: 10/26/2016
Date Made Active in Reports: 02/03/2017
Number of Days to Update: 100

Source: EPA
Telephone: 202-564-2496
Last EDR Contact: 09/26/2017
Next Scheduled EDR Contact: 01/08/2018
Data Release Frequency: Annually

US MINES: Mines Master Index File
Contains all mine identification numbers issued for mines active or opened since 1971. The data also includes violation information.

Date of Government Version: 10/29/2017
Date Data Arrived at EDR: 11/28/2017
Date Made Active in Reports: 01/12/2018
Number of Days to Update: 45

Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959
Last EDR Contact: 11/28/2017
Next Scheduled EDR Contact: 03/12/2018
Data Release Frequency: Semi-Annually

US MINES 2: Ferrous and Nonferrous Metal Mines Database Listing
This map layer includes ferrous (ferrous metal mines are facilities that extract ferrous metals, such as iron ore or molybdenum) and nonferrous (Nonferrous metal mines are facilities that extract nonferrous metals, such as gold, silver, copper, zinc, and lead) metal mines in the United States.

Date of Government Version: 12/05/2005
Date Data Arrived at EDR: 02/29/2008
Date Made Active in Reports: 04/18/2008
Number of Days to Update: 49

Source: USGS
Telephone: 703-648-7709
Last EDR Contact: 12/01/2017
Next Scheduled EDR Contact: 03/12/2018
Data Release Frequency: Varies

US MINES 3: Active Mines & Mineral Plants Database Listing

Active Mines and Mineral Processing Plant operations for commodities monitored by the Minerals Information Team of the USGS.

Date of Government Version: 04/14/2011
Date Data Arrived at EDR: 06/08/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 97

Source: USGS
Telephone: 703-648-7709
Last EDR Contact: 12/01/2017
Next Scheduled EDR Contact: 03/12/2018
Data Release Frequency: Varies

ABANDONED MINES: Abandoned Mines

An inventory of land and water impacted by past mining (primarily coal mining) is maintained by OSMRE to provide information needed to implement the Surface Mining Control and Reclamation Act of 1977 (SMCRA). The inventory contains information on the location, type, and extent of AML impacts, as well as, information on the cost associated with the reclamation of those problems. The inventory is based upon field surveys by State, Tribal, and OSMRE program officials. It is dynamic to the extent that it is modified as new problems are identified and existing problems are reclaimed.

Date of Government Version: 09/25/2017
Date Data Arrived at EDR: 09/26/2017
Date Made Active in Reports: 10/20/2017
Number of Days to Update: 24

Source: Department of Interior
Telephone: 202-208-2609
Last EDR Contact: 12/19/2017
Next Scheduled EDR Contact: 03/26/2018
Data Release Frequency: Quarterly

FINDS: Facility Index System/Facility Registry System

Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 07/23/2017
Date Data Arrived at EDR: 09/06/2017
Date Made Active in Reports: 09/15/2017
Number of Days to Update: 9

Source: EPA
Telephone: (312) 353-2000
Last EDR Contact: 02/23/2018
Next Scheduled EDR Contact: 03/19/2018
Data Release Frequency: Quarterly

UXO: Unexploded Ordnance Sites

A listing of unexploded ordnance site locations

Date of Government Version: 09/30/2016
Date Data Arrived at EDR: 10/31/2017
Date Made Active in Reports: 01/12/2018
Number of Days to Update: 73

Source: Department of Defense
Telephone: 703-704-1564
Last EDR Contact: 01/02/2018
Next Scheduled EDR Contact: 04/30/2018
Data Release Frequency: Varies

DOCKET HWC: Hazardous Waste Compliance Docket Listing

A complete list of the Federal Agency Hazardous Waste Compliance Docket Facilities.

Date of Government Version: 06/27/2017
Date Data Arrived at EDR: 11/21/2017
Date Made Active in Reports: 01/12/2018
Number of Days to Update: 52

Source: Environmental Protection Agency
Telephone: 202-564-0527
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 03/12/2018
Data Release Frequency: Varies

ECHO: Enforcement & Compliance History Information
ECHO provides integrated compliance and enforcement information for about 800,000 regulated facilities nationwide.

Date of Government Version: 09/02/2017
Date Data Arrived at EDR: 09/06/2017
Date Made Active in Reports: 10/20/2017
Number of Days to Update: 44

Source: Environmental Protection Agency
Telephone: 202-564-2280
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 03/19/2018
Data Release Frequency: Quarterly

FUELS PROGRAM: EPA Fuels Program Registered Listing
This listing includes facilities that are registered under the Part 80 (Code of Federal Regulations) EPA Fuels Programs. All companies now are required to submit new and updated registrations.

Date of Government Version: 11/20/2017
Date Data Arrived at EDR: 11/20/2017
Date Made Active in Reports: 01/12/2018
Number of Days to Update: 53

Source: EPA
Telephone: 800-385-6164
Last EDR Contact: 02/21/2018
Next Scheduled EDR Contact: 06/04/2018
Data Release Frequency: Quarterly

IN AIRS: Permitted Sources & Emissions Listing
Current permitted sources and emissions inventory information.

Date of Government Version: 08/03/2016
Date Data Arrived at EDR: 08/05/2016
Date Made Active in Reports: 08/23/2016
Number of Days to Update: 18

Source: Department of Environmental Management
Telephone: 317-233-0185
Last EDR Contact: 01/03/2018
Next Scheduled EDR Contact: 04/16/2018
Data Release Frequency: Varies

KY AIRS: Permitted Airs Facility Listing
A listing of permitted Airs facilities.

Date of Government Version: 01/02/2018
Date Data Arrived at EDR: 01/05/2018
Date Made Active in Reports: 02/20/2018
Number of Days to Update: 46

Source: Department of Environmental Protection
Telephone: 502-573-3382
Last EDR Contact: 01/29/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Semi-Annually

IN BULK: Registered Bulk Fertilizer and Pesticide Storage Facilities
A listing of registered dry or liquid bulk fertilizer and pesticide storage facilities.

Date of Government Version: 05/01/2017
Date Data Arrived at EDR: 05/11/2017
Date Made Active in Reports: 09/07/2017
Number of Days to Update: 119

Source: Office of Indiana State Chemist
Telephone: 765-494-0579
Last EDR Contact: 12/26/2017
Next Scheduled EDR Contact: 04/16/2018
Data Release Frequency: Varies

IN CFO: Confined Feeding Operations
This dataset consists of Confined Feeding Operations - i.e. A swine, chicken, turkey, beef or dairy agri-business that has large enough numbers of animals that IDEM regulates for environmental concerns, as defined by IC 13-18-10 of the Indiana Code.

Date of Government Version: 09/03/2013
Date Data Arrived at EDR: 12/11/2013
Date Made Active in Reports: 01/17/2014
Number of Days to Update: 37

Source: Department of Environmental Management
Telephone: 317-232-8726
Last EDR Contact: 12/12/2014
Next Scheduled EDR Contact: 03/23/2015
Data Release Frequency: Varies

IN COAL ASH: Coal Ash Disposal Sites
A listing of coal ash disposal site locations.

Date of Government Version: 11/19/2016
Date Data Arrived at EDR: 01/04/2017
Date Made Active in Reports: 01/20/2017
Number of Days to Update: 16

Source: Department of Environmental Management
Telephone: 317-233-4624
Last EDR Contact: 01/22/2018
Next Scheduled EDR Contact: 03/26/2018
Data Release Frequency: Varies

KY COAL ASH: Coal Ash Disposal Sites
A listing of coal ash pond site locations.

Date of Government Version: 12/09/2013
Date Data Arrived at EDR: 05/01/2014
Date Made Active in Reports: 07/07/2014
Number of Days to Update: 67

Source: Department of Environmental Protection
Telephone: 502-564-6716
Last EDR Contact: 01/29/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Varies

IN DRYCLEANERS: Drycleaner Facility Listing
A list of drycleaners involved in the Indiana 5-Star Environmental Recognition Program. It is a voluntary program that ranks participating drycleaners on a scale of one to five stars. The program recognizes those drycleaners willing to do more for the environment and worker safety than the rules require. These drycleaners are going above and beyond the rules to protect the environment, their employees and their neighbors and customers.

Date of Government Version: 06/27/2016
Date Data Arrived at EDR: 06/28/2016
Date Made Active in Reports: 08/15/2016
Number of Days to Update: 48

Source: Department of Environmental Management
Telephone: 800-988-7901
Last EDR Contact: 12/08/2017
Next Scheduled EDR Contact: 03/26/2018
Data Release Frequency: Varies

KY DRYCLEANERS: Drycleaner Listing
A listing of drycleaner facility locations.

Date of Government Version: 01/02/2018
Date Data Arrived at EDR: 01/05/2018
Date Made Active in Reports: 02/20/2018
Number of Days to Update: 46

Source: Department of Environmental Protection
Telephone: 502-573-3382
Last EDR Contact: 01/29/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Semi-Annually

IN Financial Assurance 1: Financial Assurance Information Listing
Financial assurance information.

Date of Government Version: 01/11/2018
Date Data Arrived at EDR: 01/11/2018
Date Made Active in Reports: 02/23/2018
Number of Days to Update: 43

Source: Department of Environmental Management
Telephone: 317-233-1052
Last EDR Contact: 01/10/2018
Next Scheduled EDR Contact: 04/16/2018
Data Release Frequency: Varies

KY Financial Assurance 1: Financial Assurance Information Listing
A listing of financial assurance information.

Date of Government Version: 11/27/2017
Date Data Arrived at EDR: 11/27/2017
Date Made Active in Reports: 12/28/2017
Number of Days to Update: 31

Source: Department of Environmental Protection
Telephone: 502-564-6716
Last EDR Contact: 01/29/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Varies

IN Financial Assurance 2: Financial Assurance Information Listing
Financial assurance information for solid waste facilities. Financial assurance is intended to ensure that resources are available to pay for the cost of closure, post-closure care, and corrective measures if the owner or operator of a regulated facility is unable or unwilling to pay.

Date of Government Version: 01/11/2018
Date Data Arrived at EDR: 01/11/2018
Date Made Active in Reports: 02/23/2018
Number of Days to Update: 43

Source: Department of Environmental Management
Telephone: 317-233-1052
Last EDR Contact: 01/10/2018
Next Scheduled EDR Contact: 04/16/2018
Data Release Frequency: Varies

KY Financial Assurance 2: Financial Assurance Information Listing

Financial Assurance information for underground storage tank facilities. Financial assurance is intended to ensure that resources are available to pay for the cost of closure, post-closure care, and corrective measures if the owner or operator of a regulated facility is unable or unwilling to pay.

Date of Government Version: 05/14/2014
Date Data Arrived at EDR: 06/06/2014
Date Made Active in Reports: 06/24/2014
Number of Days to Update: 18

Source: Department of Environmental Protection
Telephone: 502-564-5981
Last EDR Contact: 01/29/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Varies

KY Financial Assurance 3: Financial Assurance Information Listing

A listing of financial assurance information for solid waste facilities. Financial assurance is intended to ensure that resources are available to pay for the cost of closure, post-closure care, and corrective measures if the owner or operator of a regulated facility is unable or unwilling to pay.

Date of Government Version: 11/27/2017
Date Data Arrived at EDR: 11/28/2017
Date Made Active in Reports: 12/28/2017
Number of Days to Update: 30

Source: Department of Environmental Protection
Telephone: 502-564-6716
Last EDR Contact: 01/29/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Varies

IND WASTE: Industrial Waste Sites Listing

The listing contains industrial waste site locations in Indiana, provided by personnel of Indiana Department of Environmental Management, Office of Land Quality.

Date of Government Version: 08/04/2015
Date Data Arrived at EDR: 09/09/2015
Date Made Active in Reports: 10/07/2015
Number of Days to Update: 28

Source: Department of Environmental Management
Telephone: 317-232-8726
Last EDR Contact: 12/08/2017
Next Scheduled EDR Contact: 03/19/2018
Data Release Frequency: Quarterly

IN MANIFEST: Manifest Data

Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a tsd facility.

Date of Government Version: 12/31/2016
Date Data Arrived at EDR: 10/03/2017
Date Made Active in Reports: 12/05/2017
Number of Days to Update: 63

Source: Department of Environmental Management
Telephone: 317-233-4624
Last EDR Contact: 01/03/2018
Next Scheduled EDR Contact: 04/16/2018
Data Release Frequency: Annually

IN NPDES: NPDES Permit Listing

A listing of active NPDES Permit Section facility locations.

Date of Government Version: 10/29/2017
Date Data Arrived at EDR: 02/06/2018
Date Made Active in Reports: 02/27/2018
Number of Days to Update: 21

Source: Department of Environmental Management
Telephone: 317-233-0676
Last EDR Contact: 01/05/2018
Next Scheduled EDR Contact: 04/23/2018
Data Release Frequency: Varies

KY NPDES: Permitted Facility Listing

A listing of permitted wastewater facilities.

Date of Government Version: 11/29/2017
Date Data Arrived at EDR: 11/30/2017
Date Made Active in Reports: 12/28/2017
Number of Days to Update: 28

Source: Department of Environmental Protection
Telephone: 502-564-3410
Last EDR Contact: 02/05/2018
Next Scheduled EDR Contact: 05/21/2018
Data Release Frequency: Semi-Annually

IN OISC: Office of Indiana State Chemist Database
Restricted use pesticide dealers and pesticide & fertilizer applicators.

Date of Government Version: 12/18/2017
Date Data Arrived at EDR: 12/19/2017
Date Made Active in Reports: 01/24/2018
Number of Days to Update: 36

Source: Office of Indiana State Chemist & Seed
Telephone: 765-494-1492
Last EDR Contact: 12/19/2017
Next Scheduled EDR Contact: 04/02/2018
Data Release Frequency: Quarterly

IN SCP: State Cleanup Program Sites
The goals for the State Cleanup Section are to mitigate risk to human health and the environment.

Date of Government Version: 08/29/2016
Date Data Arrived at EDR: 08/29/2016
Date Made Active in Reports: 10/20/2016
Number of Days to Update: 52

Source: Department of Environmental Management
Telephone: 317-233-0068
Last EDR Contact: 01/05/2018
Next Scheduled EDR Contact: 04/23/2018
Data Release Frequency: Quarterly

IN TIER 2: Tier 2 Facility Listing
A listing of facilities which store or manufacture hazardous materials that submit a chemical inventory report.

Date of Government Version: 12/31/2016
Date Data Arrived at EDR: 07/25/2017
Date Made Active in Reports: 09/07/2017
Number of Days to Update: 44

Source: Department of Environmental Management
Telephone: 317-233-0066
Last EDR Contact: 02/22/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Varies

IN UIC: UIC Site Listing
A listing of class II well locations

Date of Government Version: 09/27/2017
Date Data Arrived at EDR: 09/27/2017
Date Made Active in Reports: 12/04/2017
Number of Days to Update: 68

Source: Department of Natural Resources
Telephone: 317-232-0045
Last EDR Contact: 02/23/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Varies

KY UIC: UIC Information
A listing of wells identified as underground injection wells, in the Kentucky Oil & Gas Wells data base.

Date of Government Version: 12/15/2017
Date Data Arrived at EDR: 01/17/2018
Date Made Active in Reports: 02/20/2018
Number of Days to Update: 34

Source: Kentucky Geological Survey
Telephone: 859-323-0544
Last EDR Contact: 01/17/2018
Next Scheduled EDR Contact: 04/30/2018
Data Release Frequency: Quarterly

EDR HIGH RISK HISTORICAL RECORDS

EDR Exclusive Records

EDR MGP: EDR Proprietary Manufactured Gas Plants
The EDR Proprietary Manufactured Gas Plant Database includes records of coal gas plants (manufactured gas plants) compiled by EDR's researchers. Manufactured gas sites were used in the United States from the 1800's to 1950's to produce a gas that could be distributed and used as fuel. These plants used whale oil, rosin, coal, or a mixture of coal, oil, and water that also produced a significant amount of waste. Many of the byproducts of the gas production, such as coal tar (oily waste containing volatile and non-volatile chemicals), sludges, oils and other compounds are potentially hazardous to human health and the environment. The byproduct from this process was frequently disposed of directly at the plant site and can remain or spread slowly, serving as a continuous source of soil and groundwater contamination.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

EDR Hist Auto: EDR Exclusive Historical Auto Stations

EDR has searched selected national collections of business directories and has collected listings of potential gas station/filling station/service station sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include gas station/filling station/service station establishments. The categories reviewed included, but were not limited to gas, gas station, gasoline station, filling station, auto, automobile repair, auto service station, service station, etc. This database falls within a category of information EDR classifies as "High Risk Historical Records", or HRHR. EDR's HRHR effort presents unique and sometimes proprietary data about past sites and operations that typically create environmental concerns, but may not show up in current government records searches.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

EDR Hist Cleaner: EDR Exclusive Historical Cleaners

EDR has searched selected national collections of business directories and has collected listings of potential dry cleaner sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include dry cleaning establishments. The categories reviewed included, but were not limited to dry cleaners, cleaners, laundry, laundromat, cleaning/laundry, wash & dry etc. This database falls within a category of information EDR classifies as "High Risk Historical Records", or HRHR. EDR's HRHR effort presents unique and sometimes proprietary data about past sites and operations that typically create environmental concerns, but may not show up in current government records searches.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

EDR RECOVERED GOVERNMENT ARCHIVES

Exclusive Recovered Govt. Archives

IN RGA HWS: Recovered Government Archive State Hazardous Waste Facilities List

The EDR Recovered Government Archive State Hazardous Waste database provides a list of SHWS incidents derived from historical databases and includes many records that no longer appear in current government lists. Compiled from Records formerly available from the Department of Environmental Management in Indiana.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 12/24/2013
Number of Days to Update: 176

Source: Department of Environmental Management
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

KY RGA HWS: Recovered Government Archive State Hazardous Waste Facilities List

The EDR Recovered Government Archive State Hazardous Waste database provides a list of SHWS incidents derived from historical databases and includes many records that no longer appear in current government lists.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 01/03/2014
Number of Days to Update: 186

Source: Department of Environmental Protection
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

IN RGA LF: Recovered Government Archive Solid Waste Facilities List

The EDR Recovered Government Archive Landfill database provides a list of landfills derived from historical databases and includes many records that no longer appear in current government lists. Compiled from Records formerly available from the Department of Environmental Management in Indiana.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 01/20/2014
Number of Days to Update: 203

Source: Department of Environmental Management
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

KY RGA LF: Recovered Government Archive Solid Waste Facilities List

The EDR Recovered Government Archive Landfill database provides a list of landfills derived from historical databases and includes many records that no longer appear in current government lists.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 01/15/2014
Number of Days to Update: 198

Source: Department of Environmental Protection
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

IN RGA LUST: Recovered Government Archive Leaking Underground Storage Tank

The EDR Recovered Government Archive Leaking Underground Storage Tank database provides a list of LUST incidents derived from historical databases and includes many records that no longer appear in current government lists. Compiled from Records formerly available from the Department of Environmental Management in Indiana.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 12/24/2013
Number of Days to Update: 176

Source: Department of Environmental Management
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

OTHER DATABASE(S)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

CT MANIFEST: Hazardous Waste Manifest Data

Facility and manifest data. Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a tsd facility.

Date of Government Version: 11/11/2017
Date Data Arrived at EDR: 11/14/2017
Date Made Active in Reports: 12/18/2017
Number of Days to Update: 34

Source: Department of Energy & Environmental Protection
Telephone: 860-424-3375
Last EDR Contact: 02/14/2018
Next Scheduled EDR Contact: 05/28/2018
Data Release Frequency: No Update Planned

NJ MANIFEST: Manifest Information

Hazardous waste manifest information.

Date of Government Version: 12/31/2016
Date Data Arrived at EDR: 04/11/2017
Date Made Active in Reports: 07/27/2017
Number of Days to Update: 107

Source: Department of Environmental Protection
Telephone: N/A
Last EDR Contact: 01/05/2018
Next Scheduled EDR Contact: 04/23/2018
Data Release Frequency: Annually

NY MANIFEST: Facility and Manifest Data
Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a TSD facility.

Date of Government Version: 10/01/2017
Date Data Arrived at EDR: 11/01/2017
Date Made Active in Reports: 11/13/2017
Number of Days to Update: 12

Source: Department of Environmental Conservation
Telephone: 518-402-8651
Last EDR Contact: 01/31/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Quarterly

PA MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2016
Date Data Arrived at EDR: 07/25/2017
Date Made Active in Reports: 09/25/2017
Number of Days to Update: 62

Source: Department of Environmental Protection
Telephone: 717-783-8990
Last EDR Contact: 01/16/2018
Next Scheduled EDR Contact: 04/30/2018
Data Release Frequency: Annually

RI MANIFEST: Manifest information
Hazardous waste manifest information

Date of Government Version: 12/31/2013
Date Data Arrived at EDR: 06/19/2015
Date Made Active in Reports: 07/15/2015
Number of Days to Update: 26

Source: Department of Environmental Management
Telephone: 401-222-2797
Last EDR Contact: 02/21/2018
Next Scheduled EDR Contact: 06/04/2018
Data Release Frequency: Annually

VT MANIFEST: Hazardous Waste Manifest Data
Hazardous waste manifest information.

Date of Government Version: 01/12/2018
Date Data Arrived at EDR: 01/19/2018
Date Made Active in Reports: 02/13/2018
Number of Days to Update: 25

Source: Department of Environmental Conservation
Telephone: 802-241-3443
Last EDR Contact: 01/12/2018
Next Scheduled EDR Contact: 04/30/2018
Data Release Frequency: Annually

WI MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2016
Date Data Arrived at EDR: 04/13/2017
Date Made Active in Reports: 07/14/2017
Number of Days to Update: 92

Source: Department of Natural Resources
Telephone: N/A
Last EDR Contact: 12/11/2017
Next Scheduled EDR Contact: 03/26/2018
Data Release Frequency: Annually

Oil/Gas Pipelines
Source: PennWell Corporation
Petroleum Bundle (Crude Oil, Refined Products, Petrochemicals, Gas Liquids (LPG/NGL), and Specialty Gases (Miscellaneous)) N = Natural Gas Bundle (Natural Gas, Gas Liquids (LPG/NGL), and Specialty Gases (Miscellaneous)). This map includes information copyrighted by PennWell Corporation. This information is provided on a best effort basis and PennWell Corporation does not guarantee its accuracy nor warrant its fitness for any particular purpose. Such information has been reprinted with the permission of PennWell.

Electric Power Transmission Line Data
Source: PennWell Corporation
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Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

AHA Hospitals:
Source: American Hospital Association, Inc.
Telephone: 312-280-5991
The database includes a listing of hospitals based on the American Hospital Association's annual survey of hospitals.

Medical Centers: Provider of Services Listing
Source: Centers for Medicare & Medicaid Services
Telephone: 410-786-3000
A listing of hospitals with Medicare provider number, produced by Centers of Medicare & Medicaid Services, a federal agency within the U.S. Department of Health and Human Services.

Nursing Homes
Source: National Institutes of Health
Telephone: 301-594-6248
Information on Medicare and Medicaid certified nursing homes in the United States.

Public Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on elementary and secondary public education in the United States. It is a comprehensive, annual, national statistical database of all public elementary and secondary schools and school districts, which contains data that are comparable across all states.

Private Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on private school locations in the United States.

Daycare Centers: Child Care Listing
Source: Family & Social Services Administration
Telephone: 317-232-4740

Flood Zone Data: This data was obtained from the Federal Emergency Management Agency (FEMA). It depicts 100-year and 500-year flood zones as defined by FEMA. It includes the National Flood Hazard Layer (NFHL) which incorporates Flood Insurance Rate Map (FIRM) data and Q3 data from FEMA in areas not covered by NFHL.
Source: FEMA
Telephone: 877-336-2627
Date of Government Version: 2003, 2015

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002, 2005 and 2010 from the U.S. Fish and Wildlife Service.

State Wetlands Data: Wetland Inventory
Source: US Fish & Wildlife Service
Telephone: 703-358-2171

Current USGS 7.5 Minute Topographic Map
Source: U.S. Geological Survey

STREET AND ADDRESS INFORMATION

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GEOCHECK ®- PHYSICAL SETTING SOURCE ADDENDUM

TARGET PROPERTY ADDRESS

A.B.BROWN GENERATING STATION
8511 WELBORN RD
EVANSVILLE, IN 47712

TARGET PROPERTY COORDINATES

Latitude (North):	37.907776 - 37˚ 54’ 27.99’’
Longitude (West):	87.707951 - 87˚ 42’ 28.62’’
Universal Tranverse Mercator:	Zone 16
UTM X (Meters):	437764.1
UTM Y (Meters):	4195613.5
Elevation:	453 ft. above sea level

USGS TOPOGRAPHIC MAP

Target Property Map:	5946019 WEST FRANKLIN, IN
Version Date:	2013

EDR’s GeoCheck Physical Setting Source Addendum is provided to assist the environmental professional in forming an opinion about the impact of potential contaminant migration.

Assessment of the impact of contaminant migration generally has two principal investigative components:

1. Groundwater flow direction, and
2. Groundwater flow velocity.

Groundwater flow direction may be impacted by surface topography, hydrology, hydrogeology, characteristics of the soil, and nearby wells. Groundwater flow velocity is generally impacted by the nature of the geologic strata.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW DIRECTION INFORMATION

Groundwater flow direction for a particular site is best determined by a qualified environmental professional using site-specific well data. If such data is not reasonably ascertainable, it may be necessary to rely on other sources of information, such as surface topographic information, hydrologic information, hydrogeologic data collected on nearby properties, and regional groundwater flow information (from deep aquifers).

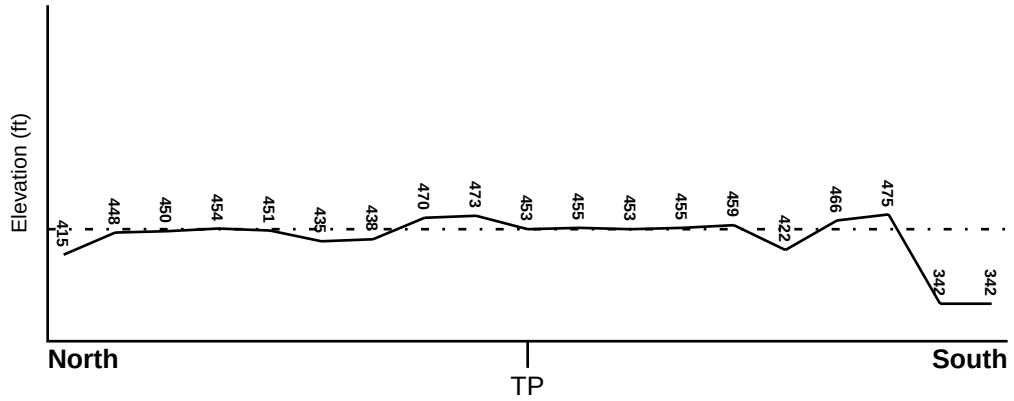
TOPOGRAPHIC INFORMATION

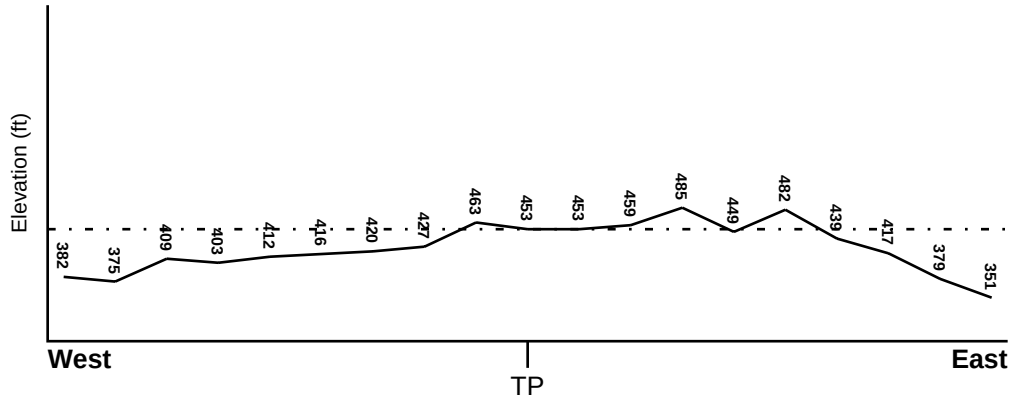
Surface topography may be indicative of the direction of surficial groundwater flow. This information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

TARGET PROPERTY TOPOGRAPHY

General Topographic Gradient: General South

SURROUNDING TOPOGRAPHY: ELEVATION PROFILES





Target Property Elevation: 453 ft.

0 1/2 1 Miles

Source: Topography has been determined from the USGS 7.5' Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

HYDROLOGIC INFORMATION

Surface water can act as a hydrologic barrier to groundwater flow. Such hydrologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Refer to the Physical Setting Source Map following this summary for hydrologic information (major waterways and bodies of water).

FEMA FLOOD ZONE

Flood Plain Panel at Target Property	FEMA Source Type
21101C0065E	FEMA FIRM Flood data

Additional Panels in search area:	FEMA Source Type
Not Reported	

NATIONAL WETLAND INVENTORY

NWI Quad at Target Property	NWI Electronic Data Coverage
WEST FRANKLIN	YES - refer to the Overview Map and Detail Map

HYDROGEOLOGIC INFORMATION

Hydrogeologic information obtained by installation of wells on a specific site can often be an indicator of groundwater flow direction in the immediate area. Such hydrogeologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

AQUIFLOW®

Search Radius: 1.000 Mile.

EDR has developed the AQUIFLOW Information System to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted by environmental professionals to regulatory authorities at select sites and has extracted the date of the report, groundwater flow direction as determined hydrogeologically, and the depth to water table.

MAP ID	LOCATION FROM TP	GENERAL DIRECTION GROUNDWATER FLOW
Not Reported		

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW VELOCITY INFORMATION

Groundwater flow velocity information for a particular site is best determined by a qualified environmental professional using site specific geologic and soil strata data. If such data are not reasonably ascertainable, it may be necessary to rely on other sources of information, including geologic age identification, rock stratigraphic unit and soil characteristics data collected on nearby properties and regional soil information. In general, contaminant plumes move more quickly through sandy-gravelly types of soils than silty-clayey types of soils.

GEOLOGIC INFORMATION IN GENERAL AREA OF TARGET PROPERTY

Geologic information can be used by the environmental professional in forming an opinion about the relative speed at which contaminant migration may be occurring.

ROCK STRATIGRAPHIC UNIT

Era:	Paleozoic
System:	Pennsylvanian
Series:	Missourian Series
Code:	PP3 *(decoded above as Era, System & Series)*

GEOLOGIC AGE IDENTIFICATION

Category: Stratifed Sequence

Geologic Age and Rock Stratigraphic Unit Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - a digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

DOMINANT SOIL COMPOSITION IN GENERAL AREA OF TARGET PROPERTY

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) leads the National Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps. The following information is based on Soil Conservation Service STATSGO data.

Soil Component Name:	ALFORD
Soil Surface Texture:	silt loam
Hydrologic Group:	Class B - Moderate infiltration rates. Deep and moderately deep, moderately well and well drained soils with moderately coarse textures.
Soil Drainage Class:	Well drained. Soils have intermediate water holding capacity. Depth to water table is more than 6 feet.

Hydric Status: Soil does not meet the requirements for a hydric soil.

Corrosion Potential - Uncoated Steel:	MODERATE
Depth to Bedrock Min:	> 60 inches
Depth to Bedrock Max:	> 60 inches

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Soil Layer Information							
	Boundary			Classification			
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil	Permeability Rate (in/hr)	Soil Reaction (pH)
1	0 inches	6 inches	silt loam	Silt-Clay Materials (more than 35 pct. passing No. 200), Silty Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), Lean Clay	Max: 2.00 Min: 0.60	Max: 7.30 Min: 4.50
2	6 inches	72 inches	silty clay loam	Silt-Clay Materials (more than 35 pct. passing No. 200), Clayey Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), Lean Clay	Max: 2.00 Min: 0.60	Max: 6.00 Min: 4.50
3	72 inches	80 inches	silt loam	Silt-Clay Materials (more than 35 pct. passing No. 200), Silty Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), silt.	Max: 2.00 Min: 0.60	Max: 6.50 Min: 5.10

OTHER SOIL TYPES IN AREA

Based on Soil Conservation Service STATSGO data, the following additional subordinant soil types may appear within the general area of target property.

Soil Surface Textures: No Other Soil Types

Surficial Soil Types: No Other Soil Types

Shallow Soil Types: No Other Soil Types

Deeper Soil Types: No Other Soil Types

LOCAL / REGIONAL WATER AGENCY RECORDS

EDR Local/Regional Water Agency records provide water well information to assist the environmental professional in assessing sources that may impact ground water flow direction, and in forming an opinion about the impact of contaminant migration on nearby drinking water wells.

WELL SEARCH DISTANCE INFORMATION

DATABASE	SEARCH DISTANCE (miles)
Federal USGS	1.000
Federal FRDS PWS	Nearest PWS within 1 mile
State Database	1.000

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

FEDERAL USGS WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No Wells Found		

FEDERAL FRDS PUBLIC WATER SUPPLY SYSTEM INFORMATION

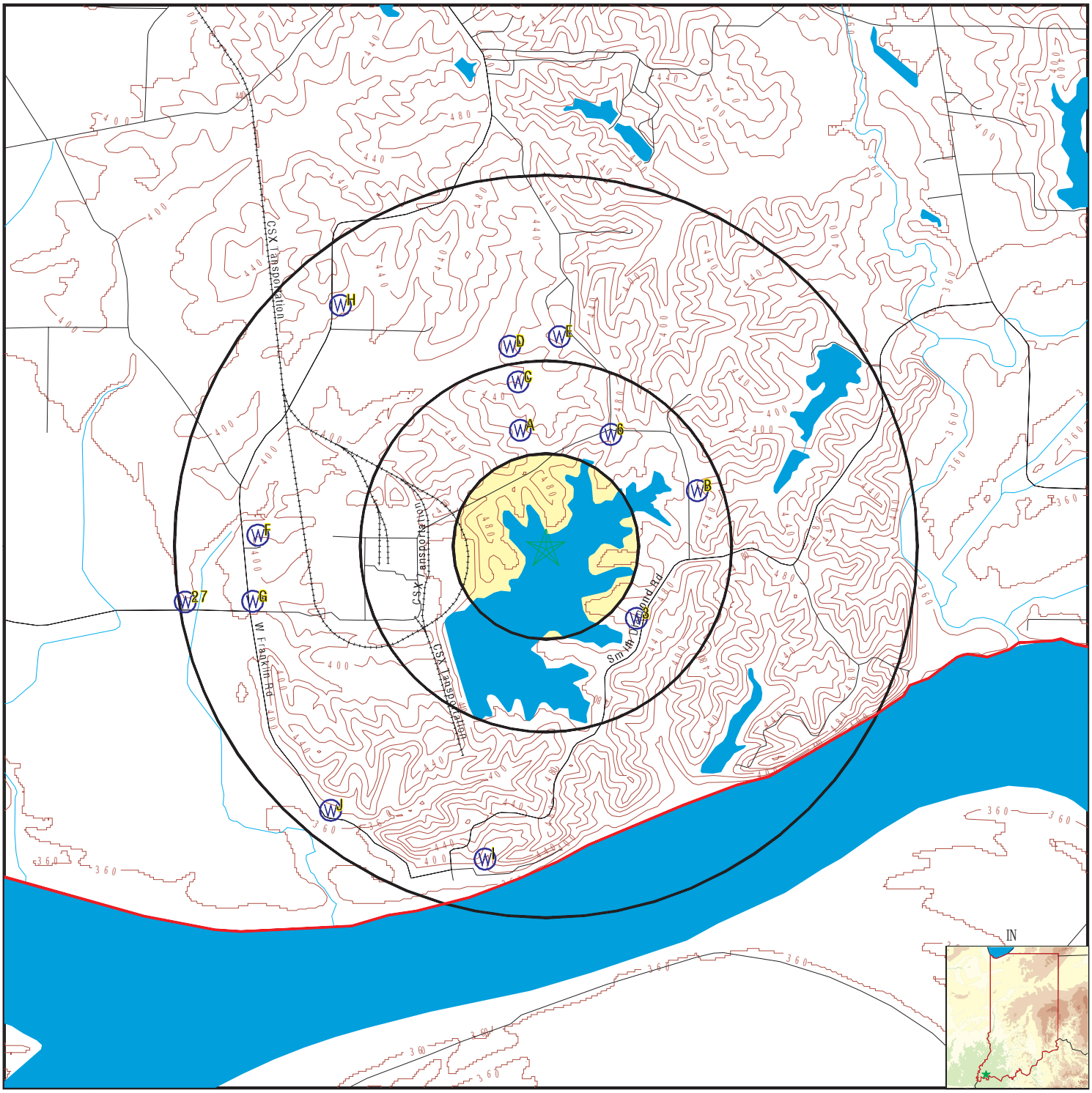
MAP ID	WELL ID	LOCATION FROM TP
No PWS System Found		

Note: PWS System location is not always the same as well location.

STATE DATABASE WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
A1	INLIT2000000152	1/4 - 1/2 Mile North
A2	INDNR3000291930	1/4 - 1/2 Mile North
3	INDNR3000291753	1/4 - 1/2 Mile SE
A4	INDNR3000106930	1/4 - 1/2 Mile NNW
A5	INDNR3000115607	1/4 - 1/2 Mile NNW
6	INDNR3000166084	1/4 - 1/2 Mile NNE
B7	INDNR3000290940	1/4 - 1/2 Mile ENE
B8	INLIT2000000147	1/4 - 1/2 Mile ENE
C9	INLIT2000000160	1/4 - 1/2 Mile North
C10	INDNR3000291962	1/4 - 1/2 Mile North
D11	INLIT2000000176	1/2 - 1 Mile North
D12	INDNR3000290938	1/2 - 1 Mile North
E13	INLIT2000000182	1/2 - 1 Mile North
E14	INDNR3000291545	1/2 - 1 Mile North
F15	INDNR3000306433	1/2 - 1 Mile West
F16	INLIT2000000141	1/2 - 1 Mile West
F17	INDNR3000291307	1/2 - 1 Mile West
G18	INLIT2000000131	1/2 - 1 Mile West
G19	INDNR3000291707	1/2 - 1 Mile West
H20	INLIT2000000188	1/2 - 1 Mile NW
H21	INDNR3000291759	1/2 - 1 Mile NW
I22	INDNR3000291965	1/2 - 1 Mile South
I23	INLIT2000000109	1/2 - 1 Mile South
J24	INDNR3000291976	1/2 - 1 Mile SW
J25	INLIT2000000115	1/2 - 1 Mile SW
J26	INDNR3000290743	1/2 - 1 Mile SW
27	INDNR3000291314	1/2 - 1 Mile West

PHYSICAL SETTING SOURCE MAP - 05203791.2r



County Boundary
Major Roads
Contour Lines
Earthquake epicenter, Richter 5 or greater
Water Wells
Public Water Supply Wells
Cluster of Multiple Icons

0 1/4 1/2 1 Miles

Groundwater Flow Direction
GI Indeterminate Groundwater Flow at Location
GV Groundwater Flow Varies at Location

N

SITE NAME:	A.B.Brown Generating Station	CLIENT:	Haley & Aldrich, Inc.
ADDRESS:	8511 Welborn Rd Evansville IN 47712	CONTACT:	Julia Scott
		INQUIRY #:	05203791.2r
LAT/LONG:	37.907776 / 87.707951	DATE:	February 28, 2018 2:46 pm

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Map ID Direction Distance Elevation		Database	EDR ID Number
A1 **North** **1/4 - 1/2 Mile** **Higher**		**IN WELLS**	**INLIT2000000152**

Area:	0		
Perimeter:	0		
Lith 2:	152	Lith 2 id:	152
Index :	96555		
Alias :	233541		
Z:	0		
Z dem f:	467		
Z dem m:	142.397268		
Lith depth:	48		
Depth:	48		
Static:	0		
Comp date:	1979-10-29 00:00:00		
Owner addr:	20 NW 4TH ST EVANSVILLE IN		
Owner zip:	47741		
Driller na:	Goebel Brothers		
Entered by:	SCF		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	36		
Brdepth:	27		
Site id:	INLIT2000000152		
Edr latitude:	37.9120160981975		
Edr longitude:	-87.7089431575292		
Edr x:	-25613858.4046372		
Edr y:	11912067.7865137		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.9120160981975		
Longitude:	-87.7089431575292		
X coord:	-25613858.4046372		
Y coord:	11912067.7865137		

A2 **North** **1/4 - 1/2 Mile** **Higher**		**IN WELLS**	**INDNR3000291930**

Objectid:	291930
Dblrefno:	233541
Dblaquelv:	0
Dblbailerr:	0
Dblbedrock:	27
Dblpumprat:	0
Dblbedro 1:	418
Dblscreenl:	0
Dblstatic:	0
Dbldepth:	48

Strowner:	SIGECO	Strownerad:	20 NW 4TH ST EVANSVILLE IN
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	13		
Dblutmy:	4196085		
Dblutmx:	437680		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	4		
Dblcasingl:	50		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	29-OCT-79		
Dblgrndele:	445		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	437679.86774		
Utmy nad83:	4196295.16676		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233541&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291930		

3
SE **IN WELLS** **INDNR3000291753**
1/4 - 1/2 Mile
Higher

Objectid:	291753		
Dblrefno:	233562		
Dblaquelv:	0		
Dblbailerr:	3		
Dblbedrock:	25		
Dblpumprat:	0		
Dblbedro 1:	455		
Dblscreenl:	0		
Dblstatic:	50		
Dbldepth:	83		
Strowner:	BOB CARR	Strownerad:	R2 EVANSVILLE
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	24		
Dblutmy:	4195294		
Dblutmx:	438156		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	6.63		

Dblcasingl:	27		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	07-MAY-65		
Dblgrndele:	480		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	438155.883825		
Utmy nad83:	4195504.15023		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233562&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291753		

A4
NNW **IN WELLS** **INDNR3000106930**
1/4 - 1/2 Mile
Higher

Objectid:	106930		
Dblrefno:	233571		
Dblaquelv:	0		
Dblbailerr:	0		
Dblbedrock:	0		
Dblpumprat:	0		
Dblbedro 1:	458		
Dblscreenl:	10		
Dblstatic:	0		
Dbldepth:	50		
Strowner:	SOUTHERN IND GAS & ELECTRIC	Strownerad:	PO BOX 569 EVANSVILLE IN
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	13		
Dblutmy:	4196143		
Dblutmx:	437637		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	4		
Dblcasingl:	42		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	4		

Dtmcompdat:	09-OCT-81		
Dblgrndele:	476		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	437636.866462		
Utmy nad83:	4196353.16798		
Loc type:	Estimated Location/TRS_quarter sections_county		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233571&_from=SUMMARY&_action=Details		
Site id:	INDNR3000106930		

A5
NNW **IN WELLS** **INDNR3000115607**
1/4 - 1/2 Mile
Higher

Objectid:	115607		
Dblrefno:	264265		
Dblaquelv:	0		
Dblbailerr:	0		
Dblbedrock:	0		
Dblpumprat:	0		
Dblbedro 1:	0		
Dblscreenl:	0		
Dblstatic:	0		
Dbldepth:	0		
Strowner:	SOUTHERN INDIANA GAS/ELECTRIC	Strownerad:	8511 WELBORN RD, MT VERNON IN/ AB BROWN STATIO
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	13		
Dblutmy:	4196143		
Dblutmx:	437637		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	0		
Dblcasingl:	0		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	06-DEC-89		
Dblgrndele:	0		
Strpumptyp:	Not Reported	Strownertx:	(812)985-6225
Utmx nad83:	437636.866462		
Utmy nad83:	4196353.16798		
Loc type:	Estimated Location/TRS_quarter sections_county		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=264265&_from=SUMMARY&_action=Details		
Site id:	INDNR3000115607		

6
NNE **IN WELLS** **INDNR3000166084**
1/4 - 1/2 Mile
Higher

Objectid:	166084		
Dblrefno:	327916		
Dblaquelv:	0		
Dblbailerr:	0		
Dblbedrock:	0		
Dblpumprat:	0		
Dblbedro 1:	0		
Dblscreenl:	10		
Dblstatic:	7		
Dbldepth:	30		
Strowner:	SIGECO	Strownerad:	8511 WELLBORN RD., MT VERNON, IN
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	13		
Dblutmy:	4196092		
Dblutmx:	438051		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	4		
Dblcasingl:	20		
Strcasingm:	VPC		
Dblgroutt:	18		
Strgroutm:	BENT		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	4		
Dtmcompdat:	18-MAY-99		
Dblgrndele:	0		
Strpumptyp:	Not Reported	Strownertx:	(812)465-5434
Utmx nad83:	438050.872667		
Utmy nad83:	4196302.16719		
Loc type:	Estimated Location/Geocoding addresses		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=327916&_from=SUMMARY&_action=Details		
Site id:	INDNR3000166084		

B7
ENE
1/4 - 1/2 Mile
Higher

IN WELLS **INDNR3000290940**

Objectid:	290940
Dblrefno:	233561
Dblaquelv:	0
Dblbailerr:	0
Dblbedrock:	18
Dblpumprat:	0
Dblbedro 1:	452
Dblscreenl:	0
Dblstatic:	0
Dbldepth:	78

Strowner:	JEFF SCOTT	Strownerad:	Not Reported
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	13		
Dblutmy:	4195848		
Dblutmx:	438423		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	5.5		
Dblcasingl:	50		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	10-AUG-79		
Dblgrndele:	470		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	438422.880691		
Utmy nad83:	4196058.16228		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233561&_from=SUMMARY&_action=Details		
Site id:	INDNR3000290940		

B8
ENE **IN WELLS** **INLIT2000000147**
1/4 - 1/2 Mile
Higher

Area:	0		
Perimeter:	0		
Lith 2:	147	Lith 2 id:	147
Index :	96565		
Alias :	233561		
Z:	470		
Z dem f:	486		
Z dem m:	148.143199		
Lith depth:	78		
Depth:	78		
Static:	0		
Comp date:	1979-08-10 00:00:00		
Owner addr:	Not Reported		
Owner zip:	0		
Driller na:	Goebel Brothers		
Entered by:	RR		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	78		

Brdepth:	48		
Site id:	INLIT2000000147		
Edr latitude:	37.9099307776073		
Edr longitude:	-87.7004709595389		
Edr x:	-25611384.2478194		
Edr y:	11911299.1388152		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.9099307776073		
Longitude:	-87.7004709595389		
X coord:	-25611384.2478194		
Y coord:	11911299.1388152		

C9
North
1/4 - 1/2 Mile
Lower

IN WELLS **INLIT2000000160**

Area:	0		
Perimeter:	0		
Lith 2:	160	Lith 2 id:	160
Index :	96558		
Alias :	233551		
Z:	0		
Z dem f:	443		
Z dem m:	135.017358		
Lith depth:	48		
Depth:	48		
Static:	0		
Comp date:	1979-10-30 00:00:00		
Owner addr:	20 NW FOUTH ST. EVANSVILLE IN		
Owner zip:	47741		
Driller na:	Goebel Brothers		
Entered by:	RR		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	36		
Brdepth:	36		
Site id:	INLIT2000000160		
Edr latitude:	37.9141770039021		
Edr longitude:	-87.7093051886962		
Edr x:	-25613964.1294894		
Edr y:	11912864.3180111		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.9141770039021		
Longitude:	-87.7093051886962		
X coord:	-25613964.1294894		
Y coord:	11912864.3180111		

C10
North
1/4 - 1/2 Mile
Lower

IN WELLS **INDNR3000291962**

Objectid:	291962		
Dblrefno:	233551		
Dblaquelv:	0		
Dblbailerr:	6		
Dblbedrock:	36		
Dblpumprat:	0		
Dblbedro 1:	445		
Dblscreenl:	0		
Dblstatic:	0		
Dbldepth:	48		
Strowner:	SIGECO	Strownerad:	20 NW FOUTH ST., EVANSVILLE, IN
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	13		
Dblutmy:	4196325		
Dblutmx:	437650		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	4		
Dblcasingl:	50		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	30-OCT-79		
Dblgrndele:	481		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	437649.864447		
Utmy nad83:	4196535.1719		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233551&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291962		

D11
North **IN WELLS** **INLIT2000000176**
1/2 - 1 Mile
Lower

Area:	0		
Perimeter:	0		
Lith 2:	176	Lith 2 id:	176
Index :	96561		
Alias :	233556		
Z:	0		
Z dem f:	438		
Z dem m:	133.505377		
Lith depth:	48		
Depth:	48		

Static:	0		
Comp date:	1979-10-30 00:00:00		
Owner addr:	20 NW FOURTH ST EVANSVILLE IN		
Owner zip:	0		
Driller na:	Goebel Brothers		
Entered by:	CWY		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	0		
Brdepth:	0		
Site id:	INLIT2000000176		
Edr latitude:	37.9155715159231		
Edr longitude:	-87.7097167616912		
Edr x:	-25614084.3221635		
Edr y:	11913378.3616426		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.9155715159231		
Longitude:	-87.7097167616912		
X coord:	-25614084.3221635		
Y coord:	11913378.3616426		

D12
North
1/2 - 1 Mile
Lower

IN WELLS **INDNR3000290938**

Objectid:	290938		
Dblrefno:	233556		
Dblaquelv:	410		
Dblbailerr:	5		
Dblbedrock:	0		
Dblpumprat:	0		
Dblbedro 1:	0		
Dblscreenl:	0		
Dblstatic:	0		
Dbldepth:	48		
Strowner:	SIGECO	Strownerad:	20 NW FOURTH ST, EVANSVILLE, IN
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	13		
Dblutmy:	4196480		
Dblutmx:	437615		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	4		
Dblcasingl:	50		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		

Dtmcompdat:	30-OCT-79		
Dblgrndele:	458		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	437614.862115		
Utmy nad83:	4196690.17521		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233556&_from=SUMMARY&_action=Details		
Site id:	INDNR3000290938		

E13
North
1/2 - 1 Mile
Higher

IN WELLS **INLIT2000000182**

Area:	0		
Perimeter:	0		
Lith 2:	182	Lith 2 id:	182
Index :	96557		
Alias :	233546		
Z:	0		
Z dem f:	472		
Z dem m:	143.852251		
Lith depth:	52		
Depth:	45		
Static:	0		
Comp date:	1979-10-30 00:00:00		
Owner addr:	20 NW FOUTH ST. EVANSVILLE IN.		
Owner zip:	0		
Driller na:	Goebel Brothers		
Entered by:	RR		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	23		
Brdepth:	23		
Site id:	INLIT2000000182		
Edr latitude:	37.9159467338231		
Edr longitude:	-87.707274380796		
Edr x:	-25613371.0676632		
Edr y:	11913516.6757686		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.9159467338231		
Longitude:	-87.707274380796		
X coord:	-25613371.0676632		
Y coord:	11913516.6757686		

E14
North
1/2 - 1 Mile
Higher

IN WELLS **INDNR3000291545**

Objectid:	291545		
Dblrefno:	233546		
Dblaquelv:	0		
Dblbailerr:	1		
Dblbedrock:	23		
Dblpumprat:	0		
Dblbedro 1:	407		
Dblscreenl:	0		
Dblstatic:	0		
Dbldepth:	45		
Strowner:	SIGECO	Strownerad:	20 NW FOUTH ST., EVANSVILLE, IN.
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	13		
Dblutmy:	4196520		
Dblutmx:	437830		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	4		
Dblcasingl:	45		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	30-OCT-79		
Dblgrndele:	430		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	437829.864507		
Utmy nad83:	4196730.1762		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233546&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291545		

F15
West
1/2 - 1 Mile
Lower

IN WELLS **INDNR3000306433**

Objectid:	306433
Dblrefno:	313382
Dblaquelv:	0
Dblbailerr:	0
Dblbedrock:	0
Dblpumprat:	0
Dblbedro 1:	0
Dblscreenl:	0
Dblstatic:	0
Dbldepth:	18

Strowner:	RUDOLPH BOERNER	Strownerad:	Not Reported
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	14		
Dblutmy:	4195650		
Dblutmx:	436525		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	0		
Dblcasingl:	0		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	01-JUL-56		
Dblgrndele:	384		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	436524.857204		
Utmy nad83:	4195860.1564		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=313382&_from=SUMMARY&_action=Details		
Site id:	INDNR3000306433		

F16
West
1/2 - 1 Mile
Lower

IN WELLS **INLIT2000000141**

Area:	0		
Perimeter:	0		
Lith 2:	141	Lith 2 id:	141
Index :	96553		
Alias :	233536		
Z:	404		
Z dem f:	406		
Z dem m:	123.733495		
Lith depth:	120		
Depth:	120		
Static:	43		
Comp date:	1966-03-29 00:00:00		
Owner addr:	RRT. #1 MT. VERNON IN.		
Owner zip:	0		
Driller na:	Weinzapfel - Paul - Well Drilling		
Entered by:	RR		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	67		

Brdepth:	67		
Site id:	INLIT2000000141		
Edr latitude:	37.9082675085674		
Edr longitude:	-87.7221596357258		
Edr x:	-25617718.0452731		
Edr y:	11910686.0747691		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.9082675085674		
Longitude:	-87.7221596357258		
X coord:	-25617718.0452731		
Y coord:	11910686.0747691		

F17
West
1/2 - 1 Mile
Lower

IN WELLS **INDNR3000291307**

Objectid:	291307		
Dblrefno:	233536		
Dblaquelv:	0		
Dblbailerr:	2		
Dblbedrock:	25		
Dblpumprat:	0		
Dblbedro 1:	379		
Dblscreenl:	0		
Dblstatic:	43		
Dbldepth:	120		
Strowner:	JERRY BOERNER	Strownerad:	RRT. #1, MT. VERNON, IN.
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	14		
Dblutmy:	4195678		
Dblutmx:	436515		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	1		
Dblcasingd:	6.25		
Dblcasingl:	67		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	29-MAR-66		
Dblgrndele:	404		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	436514.856741		
Utmy nad83:	4195888.157		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233536&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291307		

Map ID Direction Distance Elevation	Database	EDR ID Number
G18 **West** **1/2 - 1 Mile** **Lower**	**IN WELLS**	**INLIT2000000131**

Area:	0		
Perimeter:	0		
Lith 2:	131	Lith 2 id:	131
Index :	96548		
Alias :	233526		
Z:	380		
Z dem f:	398		
Z dem m:	121.279525		
Lith depth:	95		
Depth:	95		
Static:	0		
Comp date:	1941-02-06 00:00:00		
Owner addr:	WEST FRANKLIN		
Owner zip:	0		
Driller na:	Dunvillle Inc.		
Entered by:	KRL		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	62		
Brdepth:	62		
Site id:	INLIT2000000131		
Edr latitude:	37.905607336997		
Edr longitude:	-87.7223838875196		
Edr x:	-25617783.534076		
Edr y:	11909705.5916402		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.905607336997		
Longitude:	-87.7223838875196		
X coord:	-25617783.534076		
Y coord:	11909705.5916402		

G19 **West** **1/2 - 1 Mile** **Lower**	**IN WELLS**	**INDNR3000291707**

Objectid:	291707
Dblrefno:	233526
Dblaquelv:	0
Dblbailerr:	0
Dblbedrock:	62
Dblpumprat:	0
Dblbedro 1:	318
Dblscreenl:	0
Dblstatic:	0
Dbldepth:	95

Strowner:	MRS. ANNA(RUDOLPH) BEERNER	Strownerad:	WEST FRANKLIN
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	14		
Dblutmy:	4195383		
Dblutmx:	436493		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	0		
Dblcasingl:	0		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	06-FEB-41		
Dblgrndele:	380		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	436492.859878		
Utmy nad83:	4195593.15054		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233526&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291707		

H20
NW **IN WELLS** **INLIT2000000188**
1/2 - 1 Mile
Lower

Area:	0		
Perimeter:	0		
Lith 2:	188	Lith 2 id:	188
Index :	96567		
Alias :	233566		
Z:	420		
Z dem f:	440		
Z dem m:	134.128369		
Lith depth:	120		
Depth:	120		
Static:	0		
Comp date:	1971-03-01 00:00:00		
Owner addr:	RRT. 2 MT. VERNON IN.		
Owner zip:	0		
Driller na:	Little - D.L. Drilling		
Entered by:	RR		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	42		

Brdepth:	15		
Site id:	INLIT2000000188		
Edr latitude:	37.9171702582587		
Edr longitude:	-87.7180599892739		
Edr x:	-25616520.815436		
Edr y:	11913967.7005399		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.9171702582587		
Longitude:	-87.7180599892739		
X coord:	-25616520.815436		
Y coord:	11913967.7005399		

H21
NW **IN WELLS** **INDNR3000291759**
1/2 - 1 Mile
Lower

Objectid:	291759		
Dblrefno:	233566		
Dblaquelv:	0		
Dblbailerr:	2		
Dblbedrock:	15		
Dblpumprat:	0		
Dblbedro 1:	405		
Dblscreenl:	0		
Dblstatic:	0		
Dbldepth:	120		
Strowner:	RICHARD FOLZ	Strownerad:	RRT. 2, MT. VERNON, IN.
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	13		
Dblutmy:	4196663		
Dblutmx:	436883		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	120		
Dblbailerh:	1		
Dblcasingd:	5.5		
Dblcasingl:	48		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	01-MAR-71		
Dblgrndele:	420		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	436882.850166		
Utmy nad83:	4196873.17871		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233566&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291759		

Map ID Direction Distance Elevation	Database	EDR ID Number
I22 **South** **1/2 - 1 Mile** **Lower**	**IN WELLS**	**INDNR3000291965**

Objectid:	291965		
Dblrefno:	233557		
Dblaquelv:	0		
Dblbailerr:	.75		
Dblbedrock:	15		
Dblpumprat:	0		
Dblbedro 1:	355		
Dblscreenl:	0		
Dblstatic:	18		
Dbldepth:	80		
Strowner:	CHARLES MCDONALD	Strownerad:	5200 FULLERTON, CHICAGO, IL
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	24		
Dblutmy:	4194258		
Dblutmx:	437491		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	6.25		
Dblcasingl:	30		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	01-MAR-73		
Dblgrndele:	370		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	437490.887087		
Utmy nad83:	4194468.12725		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233557&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291965		

I23 **South** **1/2 - 1 Mile** **Lower**	**IN WELLS**	**INLIT2000000109**

Area:	0		
Perimeter:	0		
Lith 2:	109	Lith 2 id:	109
Index :	96562		
Alias :	233557		
Z:	370		
Z dem f:	396		
Z dem m:	120.739532		
Lith depth:	80		
Depth:	80		

Static:	18		
Comp date:	1973-03-01 00:00:00		
Owner addr:	5200 FULLERTON CHICAGO IL		
Owner zip:	60639		
Driller na:	Richardville Well Drilling		
Entered by:	RR		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	30		
Brdepth:	15		
Site id:	INLIT2000000109		
Edr latitude:	37.8955375603513		
Edr longitude:	-87.7109346789822		
Edr x:	-25614439.9935456		
Edr y:	11905994.4080507		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.8955375603513		
Longitude:	-87.7109346789822		
X coord:	-25614439.9935456		
Y coord:	11905994.4080507		

J24
SW **IN WELLS** **INDNR3000291976**
1/2 - 1 Mile
Lower

Objectid:	291976		
Dblrefno:	233567		
Dblaquelv:	0		
Dblbailerr:	.5		
Dblbedrock:	50		
Dblpumprat:	0		
Dblbedro 1:	335		
Dblscreenl:	0		
Dblstatic:	48		
Dbldepth:	180		
Strowner:	J. BOERER	Strownerad:	Not Reported
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	24		
Dblutmy:	4194488		
Dblutmx:	436822		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	VANDERBURGH	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	132		
Dblbailerh:	0		
Dblcasingd:	6.25		
Dblcasingl:	44		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		

Dtmcompdat:	14-OCT-53		
Dblgrndele:	385		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	436821.874931		
Utmy nad83:	4194698.13139		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233567&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291976		

J25
SW **IN WELLS** **INLIT2000000115**
1/2 - 1 Mile
Lower

Area:	0		
Perimeter:	0		
Lith 2:	115	Lith 2 id:	115
Index :	96568		
Alias :	233567		
Z:	385		
Z dem f:	399		
Z dem m:	121.72352		
Lith depth:	180		
Depth:	180		
Static:	48		
Comp date:	1953-10-14 00:00:00		
Owner addr:	Not Reported		
Owner zip:	0		
Driller na:	Richardville - Edmond		
Entered by:	KRL		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	85		
Brdepth:	50		
Site id:	INLIT2000000115		
Edr latitude:	37.8975642008719		
Edr longitude:	-87.7185632751526		
Edr x:	-25616667.791249		
Edr y:	11906741.2787029		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.8975642008719		
Longitude:	-87.7185632751526		
X coord:	-25616667.791249		
Y coord:	11906741.2787029		

J26
SW **IN WELLS** **INDNR3000290743**
1/2 - 1 Mile
Lower

Objectid:	290743		
Dblrefno:	233572		
Dblaquelv:	0		
Dblbailerr:	0		
Dblbedrock:	0		
Dblpumprat:	0		
Dblbedro 1:	0		
Dblscreenl:	2		
Dblstatic:	17		
Dbldepth:	36		
Strowner:	J. BOERNER	Strownerad:	WEST FRANKLIN
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	24		
Dblutmy:	4194445		
Dblutmx:	436828		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	2		
Dblcasingl:	0		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	02-JUL-56		
Dblgrndele:	365		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	436827.875521		
Utmy nad83:	4194655.13046		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233572&_from=SUMMARY&_action=Details		
Site id:	INDNR3000290743		

27
West
1/2 - 1 Mile
Lower

IN WELLS **INDNR3000291314**

Objectid:	291314
Dblrefno:	233531
Dblaquelv:	337
Dblbailerr:	0
Dblbedrock:	0
Dblpumprat:	7
Dblbedro 1:	0
Dblscreenl:	8
Dblstatic:	28
Dbldepth:	40

Strowner:	BOB BOERNER	Strownerad:	DARNELL SCHOOL RD.
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	14		
Dblutmy:	4195380		
Dblutmx:	436202		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	6.63		
Dblcasingl:	36		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	5		
Dblpumphou:	1		
Dblscreend:	4		
Dtmcompdat:	15-MAR-79		
Dblgrndele:	377		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	436201.855911		
Utmy nad83:	4195590.1502		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233531&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291314		

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS
RADON

AREA RADON INFORMATION

State Database: IN Radon

Radon Test Results

Zipcode	Year	Test Type	Location	Result
47712	1994	Post-Mitigation	Other	3.4
47712	0	Unknown	Other	2.8
47712	0	Unknown	Other	2.8
47712	1999	Long Term	1st Floor	4.0
47712	1996	Short Term	Other	5.1
47712	1996	Short Term	Other	12.8
47712	1994	Short Term	Other	1.4
47712	2000	Short Term	Other	2.2
47712	2000	Short Term	Other	1.6
47712	2000	Short Term	Other	2.2
47712	2000	Short Term	Other	0.9
47712	2000	Short Term	Other	0.9
47712	2000	Short Term	Other	0.6
47712	2000	Short Term	Other	3.7
47712	1995	Short Term	Other	3.5
47712	1995	Short Term	Other	1.1
47712	1995	Short Term	Other	1.1
47712	1995	Short Term	Other	1.9
47712	1995	Short Term	Other	2.0
47712	1997	Short Term	1st Floor	0.4
47712	2000	Short Term	Basement	0.5
47712	1997	Short Term	Other	9.1
47712	2004	Short Term	Basement	5.3
47712	2004	Post-Mitigation	Basement	3.6
47712	2004	Short Term	Basement	4.3
47712	2004	Short Term	Basement	2.2
47712	2004	Short Term	Other	3.4
47712	2004	Short Term	Basement	4.5
47712	2004	Short Term	Basement	1.6
47712	2004	Short Term	Basement	6.4
47712	2004	Short Term	Basement	3.8
47712	2004	Short Term	Other	1.5
47712	2004	Short Term	Basement	3.9
47712	2004	Short Term	Other	0.7
47712	2004	Short Term	Other	0.7
47712	2001	Short Term	Basement	6.5
47712	2001	Short Term	Basement	4.8
47712	2001	Short Term	1st Floor	2.9
47712	2001	Short Term	1st Floor	9.2
47712	2001	Short Term	Basement	4.6
47712	2001	Short Term	1st Floor	6.6
47712	2000	Short Term	0	0.5
47712	2001	Long Term	1st Floor	1.7
47712	2002	Short Term	1st Floor	0.8
47712	2002	Short Term	1st Floor	1.2
47712	2002	Short Term	1st Floor	3.0
47712				

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS
RADON

AREA RADON INFORMATION

	2002	Short Term	1st Floor	2.4
47712	2002	Short Term	1st Floor	2.9
47712	2002	Short Term	1st Floor	2.9
47712	2002	Short Term	1st Floor	0.9
47712	2002	Short Term	1st Floor	7.3
47712	1996	Short Term	Other	5.2
47712	2000	Short Term	Other	2.8
47712	2000	Short Term	Other	3.7
47712	1999	Short Term	Other	3.9
47712	2004	Short Term	Basement	0.9
47712	2004	Short Term	Basement	4.8
47712	2004	Short Term	Other	1.5
47712	2000	Short Term	Basement	0.5
47712	2002	Short Term	1st Floor	1.0

Federal EPA Radon Zone for POSEY County: 2

Note: Zone 1 indoor average level > 4 pCi/L.
: Zone 2 indoor average level >= 2 pCi/L and <= 4 pCi/L.
: Zone 3 indoor average level < 2 pCi/L.

Federal Area Radon Information for Zip Code: 47712

Number of sites tested: 5

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	3.375 pCi/L	75%	25%	0%
Living Area - 2nd Floor	Not Reported	Not Reported	Not Reported	Not Reported
Basement	3.320 pCi/L	80%	20%	0%

PHYSICAL SETTING SOURCE RECORDS SEARCHED

TOPOGRAPHIC INFORMATION

USGS 7.5' Digital Elevation Model (DEM)
Source: United States Geologic Survey
EDR acquired the USGS 7.5' Digital Elevation Model in 2002 and updated it in 2006. The 7.5 minute DEM corresponds to the USGS 1:24,000- and 1:25,000-scale topographic quadrangle maps. The DEM provides elevation data with consistent elevation units and projection.

Current USGS 7.5 Minute Topographic Map
Source: U.S. Geological Survey

HYDROLOGIC INFORMATION

Flood Zone Data: This data was obtained from the Federal Emergency Management Agency (FEMA). It depicts 100-year and 500-year flood zones as defined by FEMA. It includes the National Flood Hazard Layer (NFHL) which incorporates Flood Insurance Rate Map (FIRM) data and Q3 data from FEMA in areas not covered by NFHL.
Source: FEMA
Telephone: 877-336-2627
Date of Government Version: 2003, 2015

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002, 2005 and 2010 from the U.S. Fish and Wildlife Service.

State Wetlands Data: Wetland Inventory
Source: US Fish & Wildlife Service
Telephone: 703-358-2171

HYDROGEOLOGIC INFORMATION

AQUIFLOW[R] Information System
Source: EDR proprietary database of groundwater flow information
EDR has developed the AQUIFLOW Information System (AIS) to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted to regulatory authorities at select sites and has extracted the date of the report, hydrogeologically determined groundwater flow direction and depth to water table information.

GEOLOGIC INFORMATION

Geologic Age and Rock Stratigraphic Unit
Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - A digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

STATSGO: State Soil Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Service (NRCS)
The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) leads the national Conservation Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps.

SSURGO: Soil Survey Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Service (NRCS)
Telephone: 800-672-5559
SSURGO is the most detailed level of mapping done by the Natural Resources Conservation Service, mapping scales generally range from 1:12,000 to 1:63,360. Field mapping methods using national standards are used to construct the soil maps in the Soil Survey Geographic (SSURGO) database. SSURGO digitizing duplicates the original soil survey maps. This level of mapping is designed for use by landowners, townships and county natural resource planning and management.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

LOCAL / REGIONAL WATER AGENCY RECORDS

FEDERAL WATER WELLS

PWS: Public Water Systems
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SDWIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

USGS Water Wells: USGS National Water Inventory System (NWIS)
This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on wells, springs, and other sources of groundwater.

STATE RECORDS

Public Water Supply Wells
Source: Department of Environmental Management
Telephone: 317-308-3323
Community and non-community drinking water wells.

Water Wells Database
Source: Indiana Geological Survey
Telephone: 812-855-7636
Shows data points that represent water wells contained in the Lithologic database, which is derived from the water well database of the Indiana Department of Natural Resources

OTHER STATE DATABASE INFORMATION

RADON

State Database: IN Radon
Source: Department of Health
Telephone: 317-233-7148
Radon Test Results

Area Radon Information
Source: USGS
Telephone: 703-356-4020
The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

EPA Radon Zones
Source: EPA
Telephone: 703-356-4020
Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

OTHER

Airport Landing Facilities: Private and public use landing facilities
Source: Federal Aviation Administration, 800-457-6656

Epicenters: World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

Earthquake Fault Lines: The fault lines displayed on EDR's Topographic map are digitized quaternary faultlines, prepared in 1975 by the United State Geological Survey

PHYSICAL SETTING SOURCE RECORDS SEARCHED

STREET AND ADDRESS INFORMATION

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A.B.Brown Generating Station

8511 Welborn Rd

Evansville, IN 47712

Inquiry Number: 5203791.3

February 28, 2018

Certified Sanborn® Map Report

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Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

Certified Sanborn® Map Report

02/28/18

Site Name:	Client Name:
A.B.Brown Generating Station	Haley & Aldrich, Inc.
8511 Welborn Rd	465 Medford Street
Evansville, IN 47712	Boston, MA 02129
EDR Inquiry # 5203791.3	Contact: Julia Scott

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The Sanborn Library is continually enhanced with newly identified map archives. This report accesses all maps in the collection as of the day this report was generated.

Certified Sanborn Results:

Certification # D212-494E-A6CC

PO # 129420

Project A.B.Brown

UNMAPPED PROPERTY

This report certifies that the complete holdings of the Sanborn Library, LLC collection have been searched based on client supplied target property information, and fire insurance maps covering the target property were not found.

Sanborn® Library search results

Certification #: D212-494E-A6CC

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- ✔ Library of Congress
- ✔ University Publications of America
- ✔ EDR Private Collection

The Sanborn Library LLC Since 1866™

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A.B.Brown Generating Station

8511 Welborn Rd

Evansville, IN 47712

Inquiry Number: 5203791.4

February 28, 2018

EDR Historical Topo Map Report

with QuadMatch™

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

EDR Historical Topo Map Report

02/28/18

Site Name:	Client Name:
A.B.Brown Generating Station	Haley & Aldrich, Inc.
8511 Welborn Rd	465 Medford Street
Evansville, IN 47712	Boston, MA 02129
EDR Inquiry # 5203791.4	Contact: Julia Scott

EDR Topographic Map Library has been searched by EDR and maps covering the target property location as provided by Haley & Aldrich, Inc. were identified for the years listed below. EDR's Historical Topo Map Report is designed to assist professionals in evaluating potential liability on a target property resulting from past activities. EDRs Historical Topo Map Report includes a search of a collection of public and private color historical topographic maps, dating back to the late 1800s.

Search Results:		*Coordinates:*	
P.O.#	129420	**Latitude:**	37.907776 37° 54' 28" North
Project:	A.B.Brown	**Longitude:**	-87.707951 -87° 42' 29" West
		UTM Zone:	Zone 16 North
		UTM X Meters:	437765.64
		UTM Y Meters:	4195818.89
		Elevation:	453.00' above sea level

Maps Provided:

2013
1981
1957
1916
1914

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Topo Sheet Key

This EDR Topo Map Report is based upon the following USGS topographic map sheets.

2013 Source Sheets

West Franklin
2013
7.5-minute, 24000

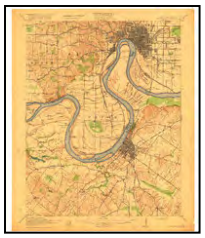
1981 Source Sheets

West Franklin
1981
7.5-minute, 24000
Aerial Photo Revised 1974

1957 Source Sheets

West Franklin
1957
7.5-minute, 24000
Aerial Photo Revised 1956

1916 Source Sheets

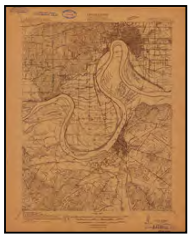


Henderson
1916
15-minute, 62500

Topo Sheet Key

This EDR Topo Map Report is based upon the following USGS topographic map sheets.

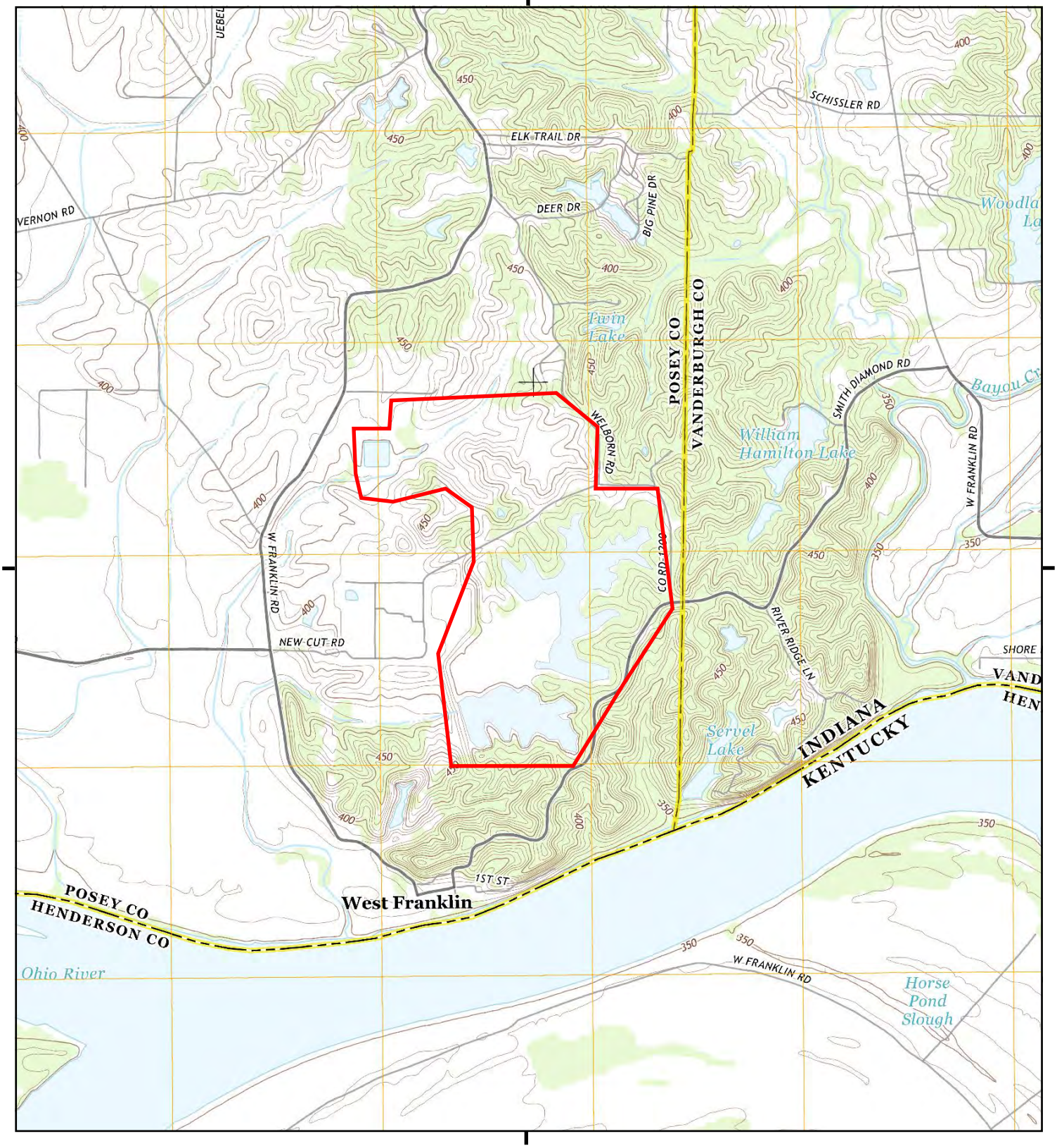
1914 Source Sheets



Henderson
1914
15-minute, 48000

Historical Topo Map

2013



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

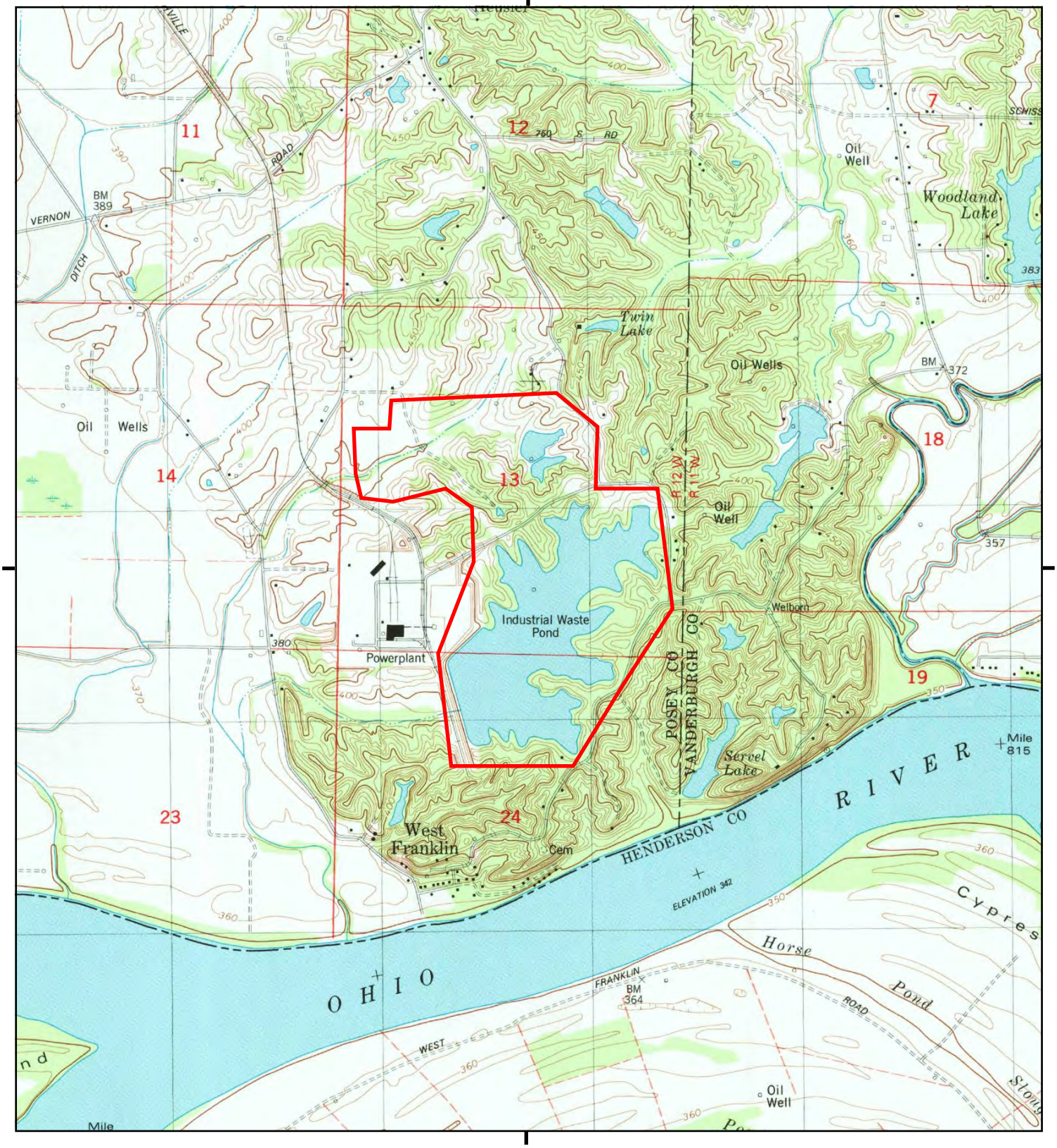
TP, West Franklin, 2013, 7.5-minute

SITE NAME: A.B.Brown Generating Station
ADDRESS: 8511 Welborn Rd
Evansville, IN 47712
CLIENT: Haley & Aldrich, Inc.

N

Historical Topo Map

1981



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

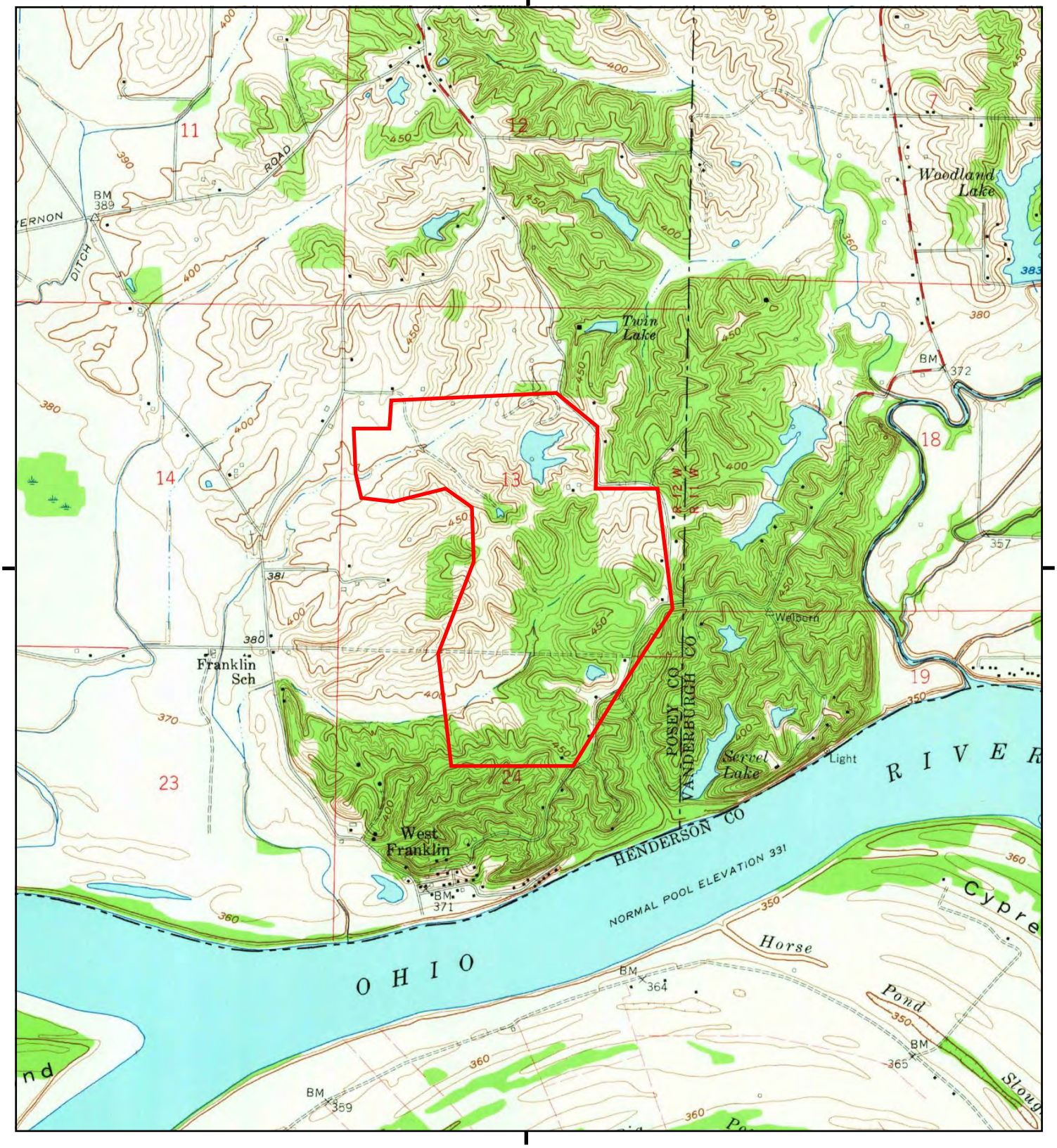
TP, West Franklin, 1981, 7.5-minute

SITE NAME: A.B.Brown Generating Station
ADDRESS: 8511 Welborn Rd
Evansville, IN 47712
CLIENT: Haley & Aldrich, Inc.

N

Historical Topo Map

1957



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

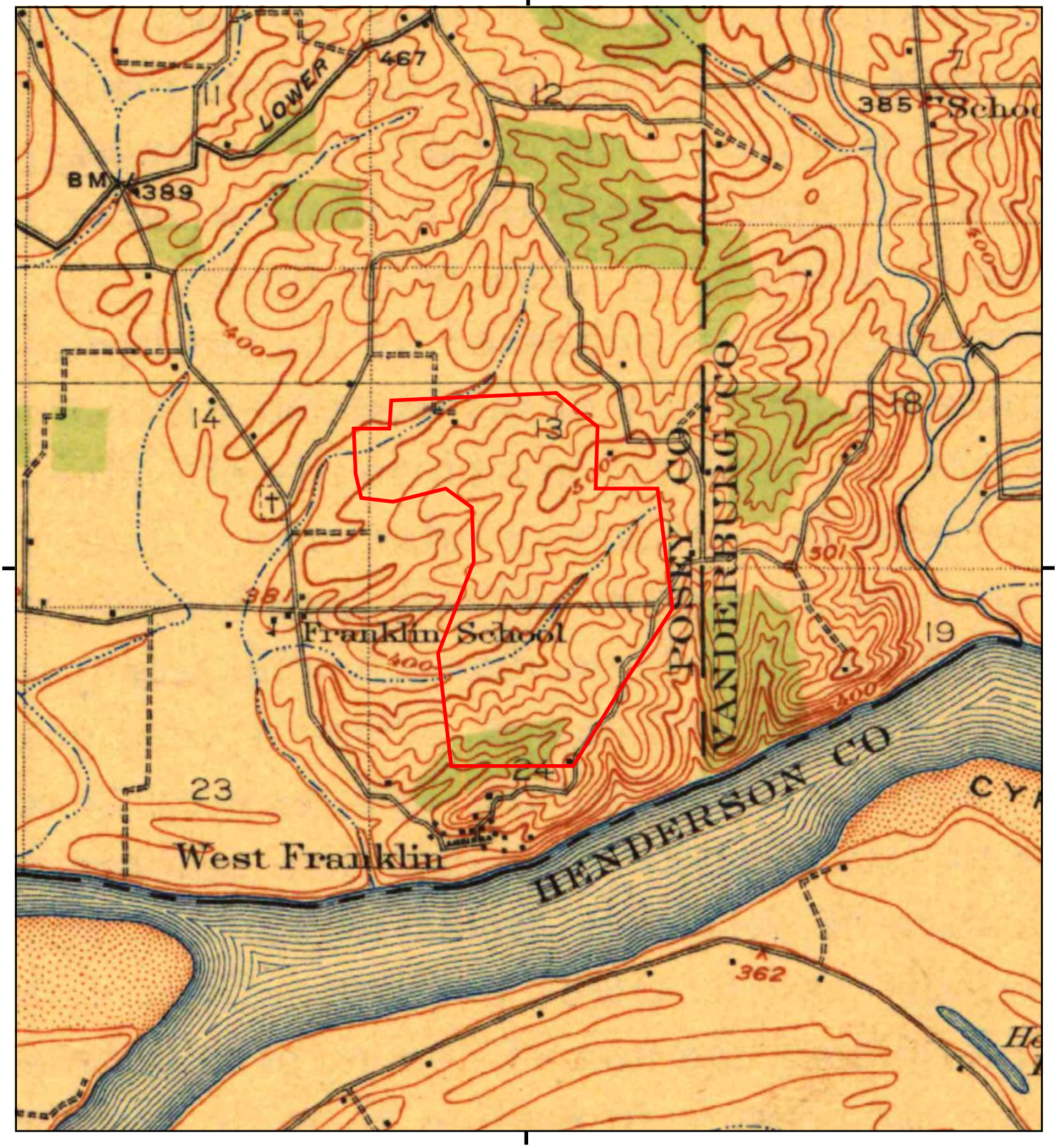
TP, West Franklin, 1957, 7.5-minute

SITE NAME: A.B.Brown Generating Station
ADDRESS: 8511 Welborn Rd
Evansville, IN 47712
CLIENT: Haley & Aldrich, Inc.

N

Historical Topo Map

1916



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

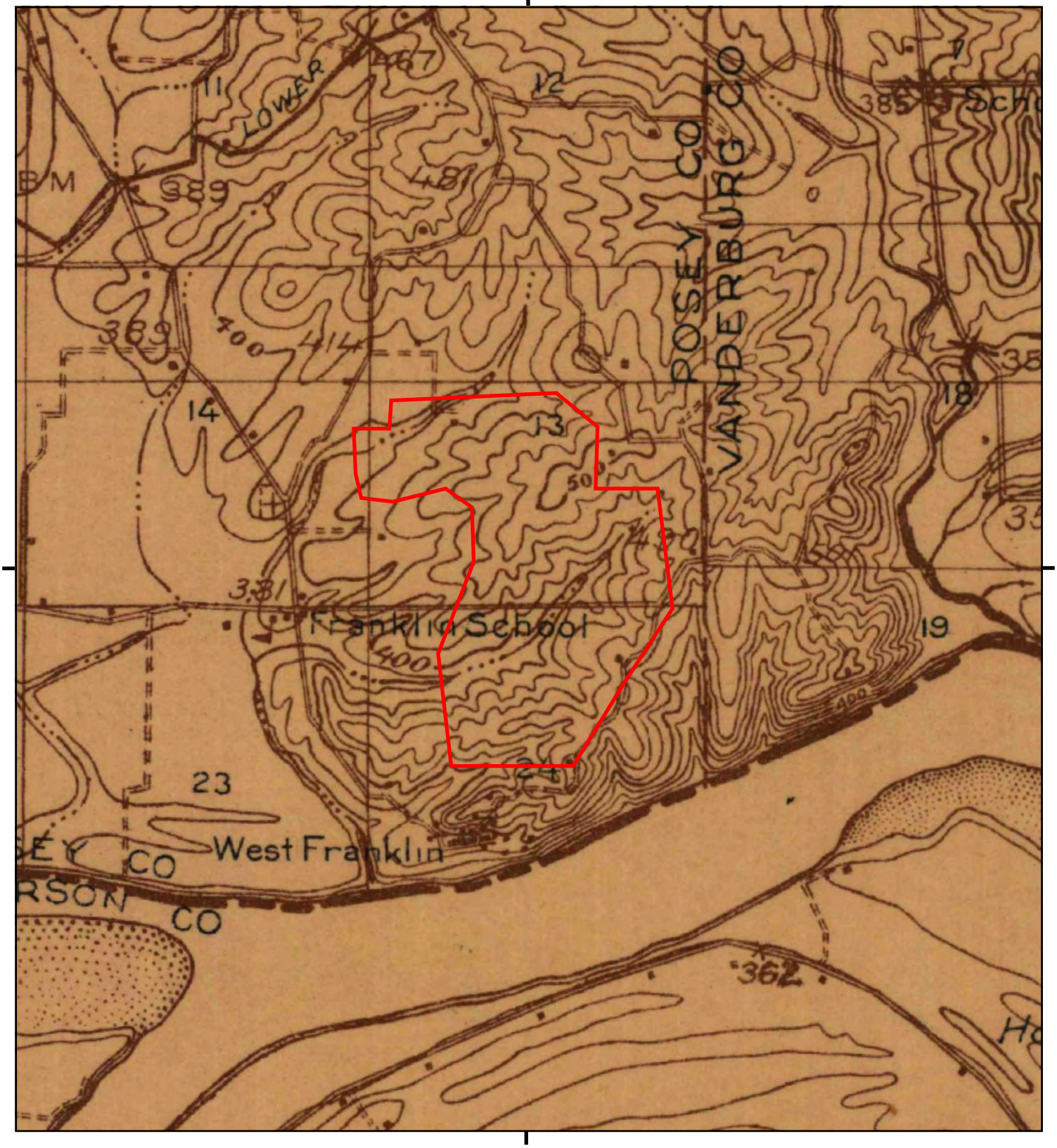
TP, Henderson, 1916, 15-minute

SITE NAME: A.B.Brown Generating Station
ADDRESS: 8511 Welborn Rd
Evansville, IN 47712
CLIENT: Haley & Aldrich, Inc.

N

Historical Topo Map

1914



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

TP, Henderson, 1914, 15-minute

SITE NAME: A.B.Brown Generating Station
ADDRESS: 8511 Welborn Rd
Evansville, IN 47712
CLIENT: Haley & Aldrich, Inc.

N

A.B.Brown Generating Station

8511 Welborn Rd

Evansville, IN 47712

Inquiry Number: 5203791.9

March 01, 2018

The EDR Aerial Photo Decade Package

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www.edrnet.com

EDR Aerial Photo Decade Package

03/01/18

Site Name:

A.B.Brown Generating Station
8511 Welborn Rd
Evansville, IN 47712
EDR Inquiry # 5203791.9

Client Name:

Haley & Aldrich, Inc.
465 Medford Street
Boston, MA 02129
Contact: Julia Scott

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Search Results:

Year	***Scale***	***Details***	***Source***
2014	1"=875'	Flight Year: 2014	USDA/NAIP
2010	1"=875'	Flight Year: 2010	USDA/NAIP
2007	1"=875'	Flight Year: 2007	USDA/NAIP
1998	1"=875'	Acquisition Date: April 06, 1998	USGS/DOQQ
1993	1"=875'	Flight Date: April 17, 1993	USGS
1983	1"=875'	Flight Date: March 14, 1983	USGS
1973	1"=875'	Flight Date: March 01, 1973	USGS
1956	1"=875'	Flight Date: April 05, 1956	USGS
1950	1"=875'	Flight Date: April 16, 1950	USGS

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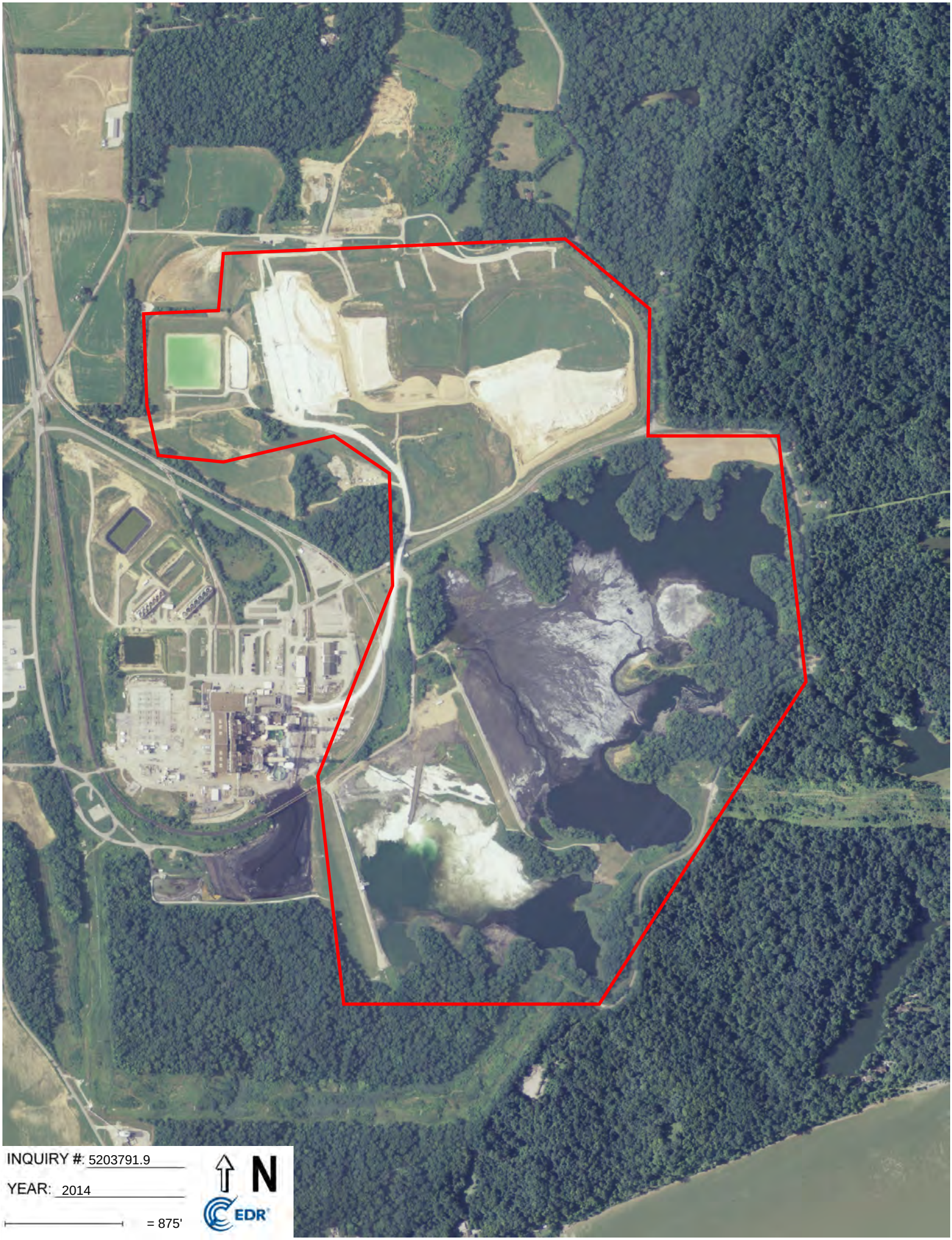
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EDR

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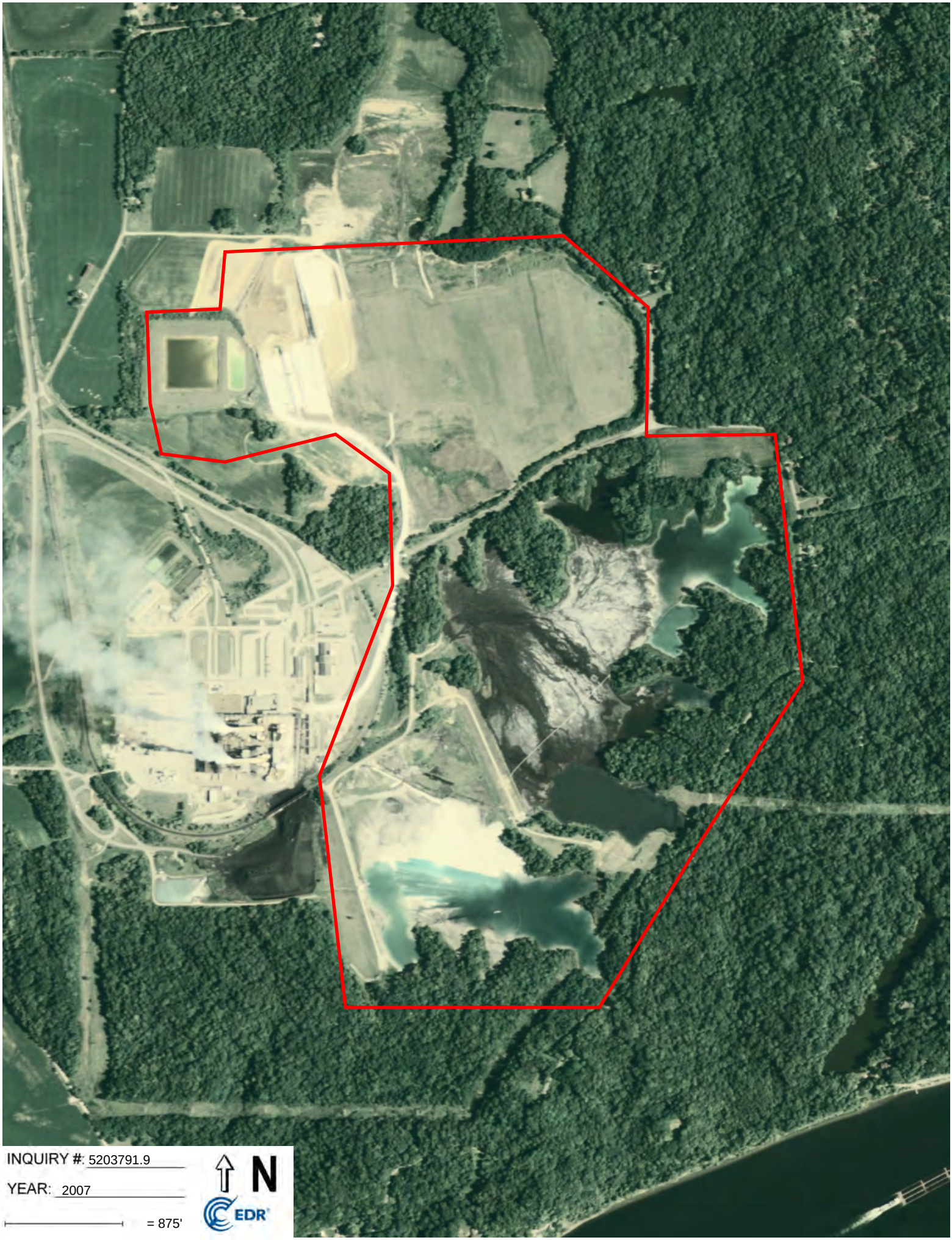
YEAR: 2010
= 875'
N
EDR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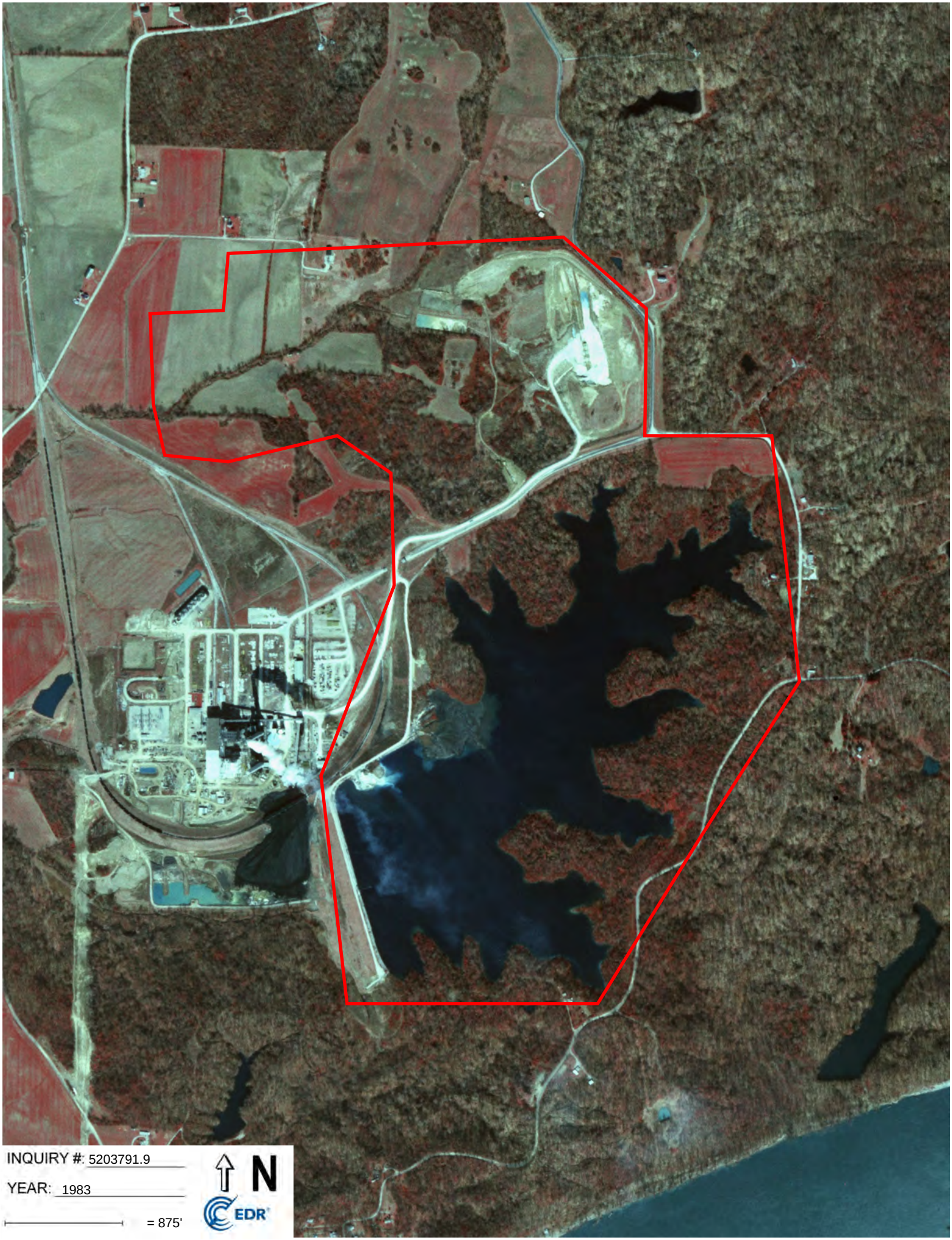
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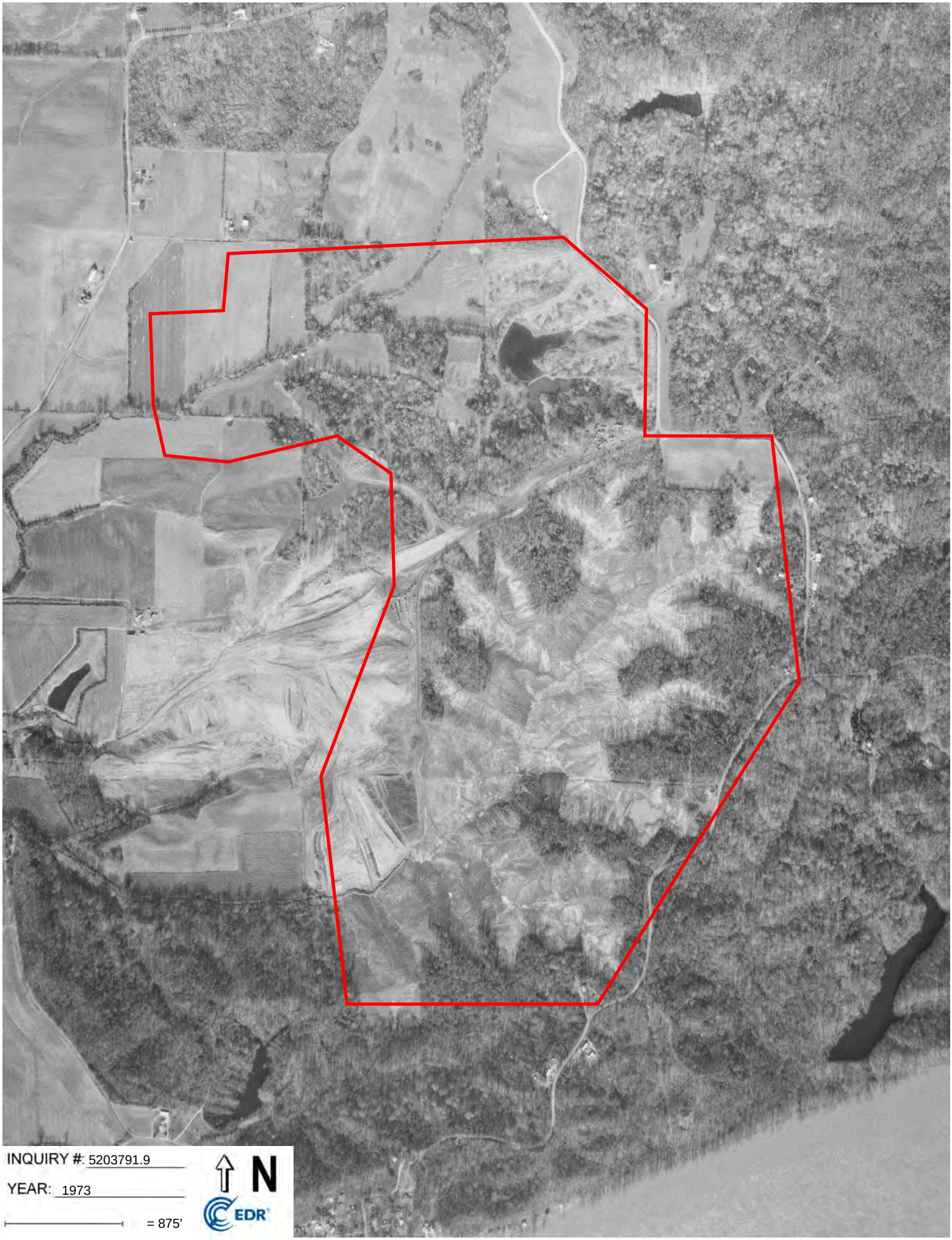
EDR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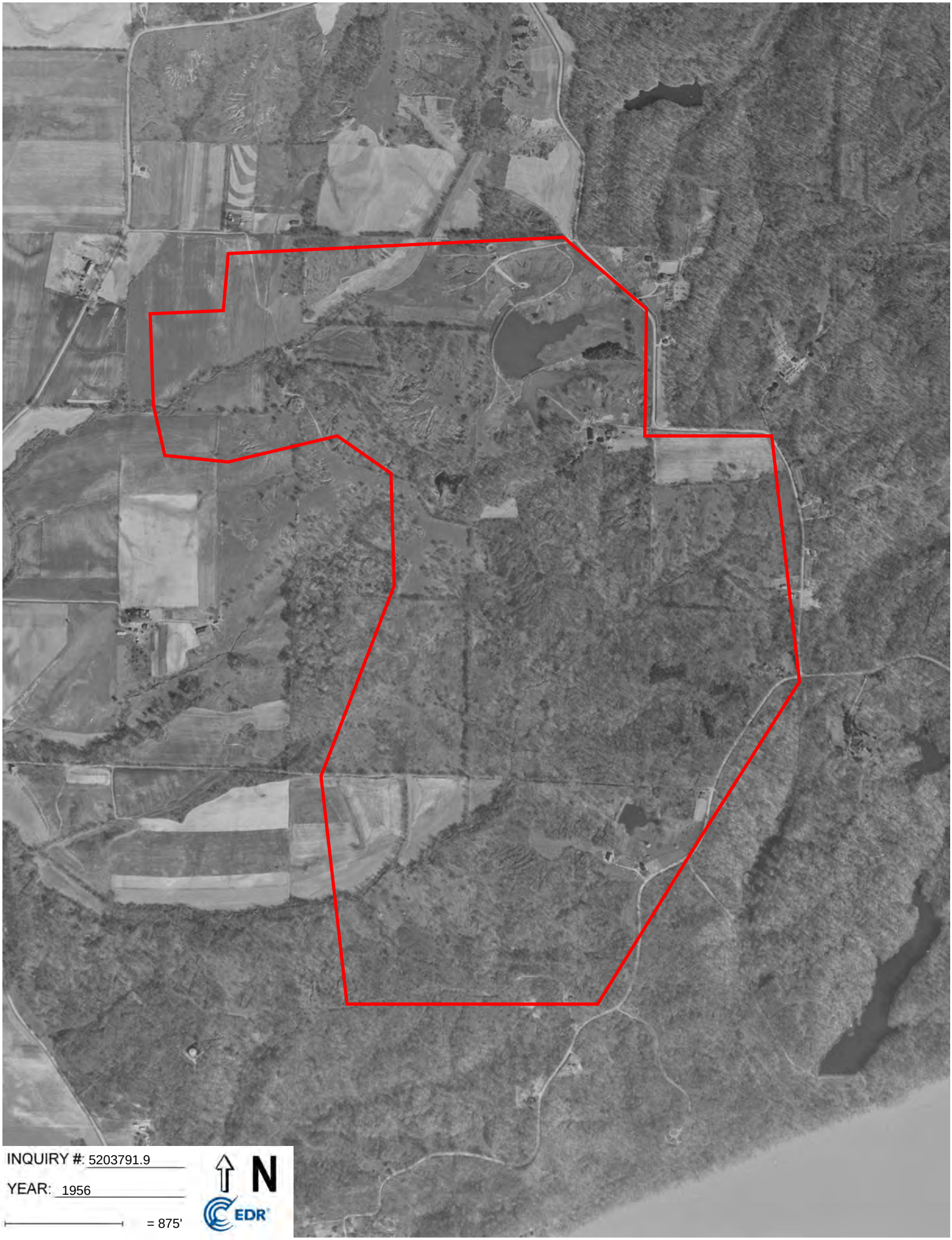
EDR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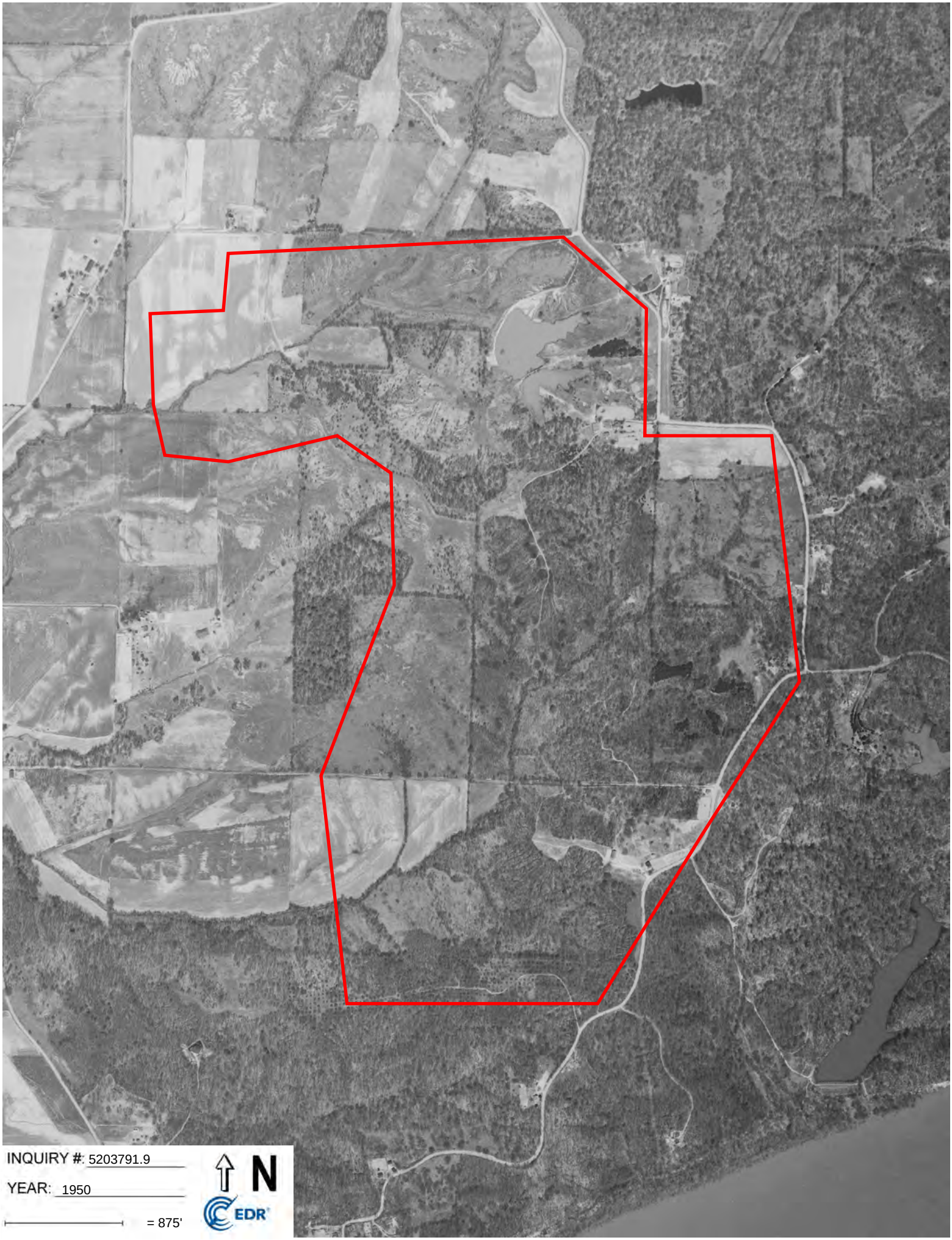
EDR


INQUIRY #: 5203791.9
YEAR: 1950
= 875'
N
EDR

A.B.Brown Generating Station
8511 Welborn Rd
Evansville, IN 47712

Inquiry Number: 5203791.5
March 05, 2018

The EDR-City Directory Image Report

Environmental Data Resources Inc

6 Armstrong Road
Shelton, CT 06484
800.352.0050
www.edrnet.com

TABLE OF CONTENTS

SECTION

Executive Summary

Findings

City Directory Images

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EXECUTIVE SUMMARY

DESCRIPTION

Environmental Data Resources, Inc.'s (EDR) City Directory Report is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's City Directory Report includes a search of available city directory data at 5 year intervals.

RECORD SOURCES

EDR's Digital Archive combines historical directory listings from sources such as Cole Information and Dun & Bradstreet. These standard sources of property information complement and enhance each other to provide a more comprehensive report.

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RESEARCH SUMMARY

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Year	Target Street	Cross Street	Source
2014	☑	☐	EDR Digital Archive
2010	☑	☐	EDR Digital Archive
2005	☑	☐	EDR Digital Archive
2000	☑	☐	EDR Digital Archive
1995	☑	☐	EDR Digital Archive
1992	☐	☐	EDR Digital Archive
1989	☐	☐	Polk's City Directory
1984	☐	☐	Polk's City Directory
1979	☐	☐	Polk's City Directory
1974	☐	☐	Polk's City Directory
1969	☐	☐	Polk's City Directory
1964	☐	☐	Polk's City Directory
1961	☐	☐	Polk's City Directory
1941	☐	☐	Bennett's City Directory
1924	☐	☐	Bennett's City Directory

EXECUTIVE SUMMARY

Year	Target Street	Cross Street	Source

FINDINGS

TARGET PROPERTY STREET

8511 Welborn Rd
Evansville, IN 47712

Year	CD Image	Source	
S WELBORN RD			
1995	pg A5	EDR Digital Archive	
1992	-	EDR Digital Archive	Street not listed in Source
1989	-	Polk's City Directory	Street not listed in Source
1984	-	Polk's City Directory	Street not listed in Source
1979	-	Polk's City Directory	Street not listed in Source
1974	-	Polk's City Directory	Street not listed in Source
1969	-	Polk's City Directory	Street not listed in Source
1964	-	Polk's City Directory	Street not listed in Source
1961	-	Polk's City Directory	Street not listed in Source
1941	-	Bennett's City Directory	Street not listed in Source
1924	-	Bennett's City Directory	Street not listed in Source
WELBORN RD			
2014	pg A1	EDR Digital Archive	
2010	pg A2	EDR Digital Archive	
2005	pg A3	EDR Digital Archive	
2000	pg A4	EDR Digital Archive	
1995	-	EDR Digital Archive	Street not listed in Source
1992	-	EDR Digital Archive	Street not listed in Source
1989	-	Polk's City Directory	Street not listed in Source
1984	-	Polk's City Directory	Street not listed in Source
1979	-	Polk's City Directory	Street not listed in Source
1974	-	Polk's City Directory	Street not listed in Source
1969	-	Polk's City Directory	Street not listed in Source
1964	-	Polk's City Directory	Street not listed in Source
1961	-	Polk's City Directory	Street not listed in Source
1941	-	Bennett's City Directory	Street not listed in Source
1924	-	Bennett's City Directory	Street not listed in Source

FINDINGS

CROSS STREETS

No Cross Streets Identified

City Directory Images

Target Street	Cross Street	Source
✓	-	EDR Digital Archive

WELBORN RD 2014

7940	OCCUPANT UNKNOWN,
8500	BURGDORF, PAULINE L
8520	THOMAS, RANDALL B
8590	JOSEY WILDER ENTERPRISES INC
	JOSEY, MICHAEL W
	STUCCO HOUSE
8600	BIRDWELL, WILLIAM B
8622	OCCUPANT UNKNOWN,

Target Street	Cross Street	Source
✓	-	EDR Digital Archive

WELBORN RD 2010

7940	JORDAN, KAREN M
8520	THOMAS, RANDALL B
8590	JOSEY MICHAEL
	JOSEY, MICHAEL W
	STUCCO HOUSE
8600	WILDER, DONNA E
8622	HINES, MARCIA L

Target Street	Cross Street	Source
✓	-	EDR Digital Archive

WELBORN RD 2005

7700	WIRTHWEIN, ERIC
7940	WILLIAMS, RICK A
8300	WEBB, M
8500	JOURDAN, TIM W
8590	JOSEY, MICHAEL W
8622	HINES, MARCIA L

Target Street	Cross Street	Source
✓	-	EDR Digital Archive

WELBORN RD 2000

7700	GIES, ANDREW
8300	MCCORMICK, JOHN
8311	SOUTHERN INDIANA MINERALS
8590	JOSEY, MICHAEL W
8600	DERRINGTON, ROB

Target Street	Cross Street	Source
✓	-	EDR Digital Archive

S WELBORN RD 1995

7701 SOUTHWIND OSTRICH RANCH INC

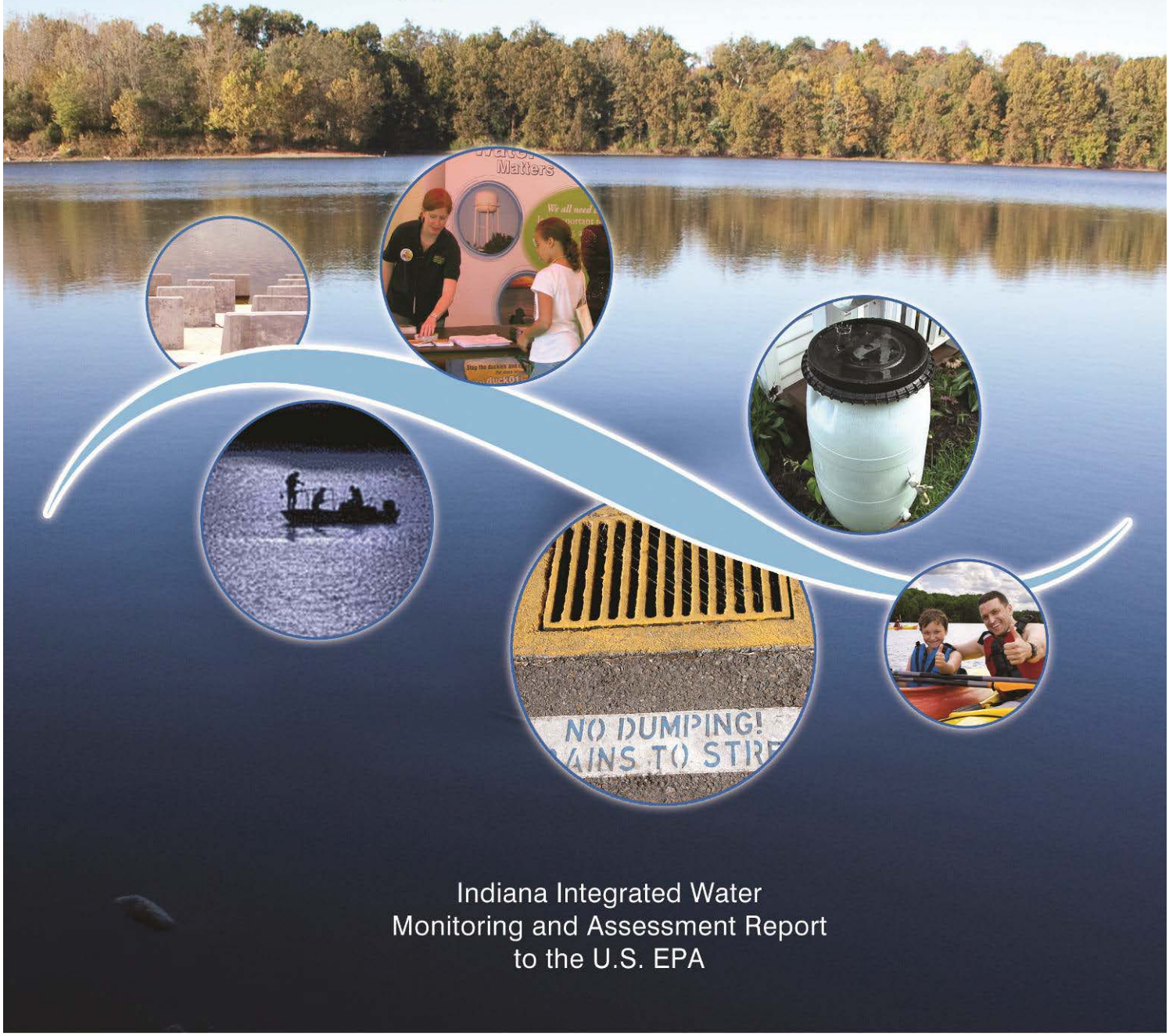
APPENDIX B

IDEM 2016 Integrated Water Monitoring and Assessment Report

HALEY ALDRICH

IDEM

Indiana Department of
Environmental Management



Indiana Integrated Water Monitoring and Assessment Report to the U.S. EPA

2016

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EXECUTIVE SUMMARY

Section 305(b) of the federal Clean Water Act (CWA) requires states to prepare and submit a water quality assessment report of state water resources to the U.S. Environmental Protection Agency (U.S. EPA) every two years. States are also required to develop and submit a list of impaired waters to U.S. EPA for approval under CWA Section 303(d).

IDEM used agency-collected data and other data collected by other organizations to develop this report. IDEM's solicitation, review and use of external data are described in detail in the section of this report entitled, Assessment Methodology and Summary Data. IDEM data used to develop this report were collected in accordance with IDEM's 2010 water quality monitoring strategy (WQMS), which describes a nine-year basin rotation approach to monitoring for CWA purposes. Using this strategy, one basin (approximately 10% of the state) is monitored each year, which provides a comprehensive statewide data set for assessments every nine years. The most current and readily existing available data were reviewed for the purposes of making 305(b) assessment and 303(d) listing decisions using IDEM's consolidated assessment and listing methodology (CALM).

A summary of IDEM's methods for determining support of beneficial uses is provided in the Assessment Methodology and Summary Data Section. IDEM's CALM is provided in its entirety in Appendix N. Indiana's water quality standards provide the basis for IDEM's CWA Section 305(b) water quality assessments, designating the beneficial uses that Indiana waters must support. Of the beneficial uses designated in the state's water quality standards, IDEM assesses aquatic life use support, recreational use support and drinking water for surface waters that serve as a public water supply. IDEM also assesses waterbodies for fish consumption. Although there are additional uses designated in Indiana's water quality standards, IDEM limits its assessments

to these four uses because the criteria in place to protect them are more stringent than those necessary to protect other uses. Thus, by protecting these four uses, other uses such as agricultural and industrial uses are also protected.

IDEM conducts water quality assessments using both statistical and empirical methods. Using data from its Probabilistic Monitoring Program, IDEM determines statistically for each of Indiana's nine major basins the percentage of river and stream miles that are meeting recreational and aquatic life uses and the percentage likely to be impaired. While the results from IDEM's comprehensive assessments cannot be applied to specific waterbodies, they provide important information regarding the overall water quality condition of waters in each basin. IDEM also uses the data it collects through its Probabilistic Monitoring Program and other available data to make reach-specific assessments of rivers and streams for recreational and aquatic life uses. Other empirical assessments include waterbody-specific assessments for fish consumption and public water supply.

IDEM completed its first comprehensive aquatic life use support assessments for the entire state in 2002 and reported similar information for recreational uses for the first time in 2012. IDEM published its first Integrated Report (IR) in 2002, which has been revised biennially since then. The 2016 IR provides the most recent comprehensive report on Indiana water quality to date.

Results from IDEM's comprehensive recreational and aquatic life use support assessments are provided in this report (Appendix E). Cumulative results for IDEM's stream-specific assessments are summarized in Table 1 (Appendix A). Approximately 68 percent of the 37,693 stream miles assessed for aquatic life use were found to be fully supporting. Approximately 26 percent of the 31,683 stream miles assessed support full body contact recreational use. Almost all of Indiana's 59 miles of Lake Michigan shoreline outside the Indiana Harbor fully supports aquatic life use, while only 7% of the shoreline waters support full body contact recreational use.

Causes of nonsupport (impairment) are included in this report for each waterbody type including flowing waters (rivers and streams) and non-flowing waters (lakes and reservoirs). Lake Michigan and its shoreline in Indiana are also discussed in this report. Pathogens are the top cause of stream impairments, impacting more than 23,000 miles of streams. Polychlorinated biphenyl (PCB) in fish tissue impacts more than 4,900 miles of streams while mercury in fish tissue impacts nearly 760 miles. Nearly 8,300 stream miles also have biological communities with measurable adverse response to pollutants.

Potential sources impacting Indiana waters include nonpoint sources that impact 16,040 miles of streams, while unknown sources impact almost 10,000 miles of streams. IDEM has several programs in place to address nonpoint source pollution. The Nonpoint Source Program and the Total Maximum Daily Load Program work together to facilitate restoration of impaired waters by locally-led groups committed to improving Indiana's water resources. IDEM's Watershed Specialists promote the holistic watershed approach by working closely with these groups to ensure they have the resources and information they need to succeed in their restoration efforts.

INTRODUCTION

States are required by the Clean Water Act (CWA) to prepare a water quality assessment report of state water resources and a list of impaired waters to submit to the U.S. Environmental Protection Agency (EPA) every two years. In 2002, the U.S. EPA encouraged states to combine the information that was previously submitted as two separate reports – the 305(b) water quality monitoring and assessment report and the 303(d) list of impaired waters – into one integrated report following the two-year schedule mandated in CWA Section 305(b).

The Indiana Department of Environmental Management (IDEM), Office of Water Quality (OWQ) publishes the Indiana Integrated Water Quality Monitoring and Assessment Report (IR) every two years. Using U.S. EPA's integrated format, Indiana's IR contains two lists – the Consolidated List and the 303(d) List of Impaired Waters. While they differ in purpose and scope, together they provide a comprehensive assessment of surface water quality conditions throughout the state of Indiana. The Consolidated List contains comprehensive statistical assessments for all major basins in the state, which is developed to fulfill CWA Section 305(b) requirements. The 303(d) List of Impaired Waters is a subset of the Consolidated List and identifies only those waters that are impaired and for which total maximum daily loads (TMDLs) are required per CWA Section 303(d). In accordance with U.S. EPA guidance, the IR also contains information on trends and trophic state of Indiana's lakes pursuant to CWA Section 314 as well as information pertaining to Indiana's ground water and wetland resources.

IDEM's OWQ prepared the 2016 IR following the guidelines provided by U.S. EPA (1997a, 1997b, 2005, 2006a, 2009a, 2011, 2013 & 2015). This report for 2016 meets the reporting requirements articulated in Sections 305(b), 303(d) and 314 of the CWA.

Most of the data used in this report come from IDEM's Probabilistic Monitoring Program, which employs a stratified random sampling (probabilistic) design to generate a representative set of sampling locations for each basin. IDEM uses probabilistic results to make comprehensive use support assessments, which are statistically valid statements about the overall water quality within a given watershed. The same data used to make comprehensive statistical assessments for a given basin are also applied to the specific stream or stream reach from which they were collected in order to make site-specific assessments.

In addition to data from the Probabilistic Monitoring Program, results from IDEM's targeted monitoring programs were used to make empirical, waterbody-specific assessments included in this report, including the Fixed Station Monitoring Program, the Watershed Characterization (formerly Baseline) Monitoring Program, the Fish Tissue Contaminant Program, and the Special Studies Program. Results from monitoring conducted by Indiana-University's Indiana Clean Lakes Program, which operates under a contractual agreement with funding from IDEM, were also used.

IDEM stores assessment information – decisions about water quality based on the data collected – in the Assessment Database. The Assessment Database is continually updated with new assessment information in order to facilitate the transmittal to U.S. EPA of the most up-to-date and accurate information concerning Indiana waters.

BACKGROUND

Indiana is located on the eastern edge of the North American great interior plains. The North - South continental divide traverses through northern Indiana, draining watersheds into the Great Lakes basin and the Mississippi River and Ohio River systems. Surface water in the northern one-quarter of the state flows north into the Great Lakes and then through the St. Lawrence River to the Atlantic Ocean. The southern three-quarters of the state drains into the Ohio River or Illinois River, flows into the Mississippi River and then south to the Gulf of Mexico. Indiana has approximately 63,130 miles of rivers, streams, ditches and drainage ways based on the Indiana Reach Index, which is keyed to the U.S. Geological Survey's high resolution (1:24,000 scale) National Hydrography Dataset (UGSG, 2014). State water types are described in Table 2 (Appendix A). Metadata and definitions for this report are located in Appendix C.

WATER POLLUTION CONTROL IN INDIANA

Water pollution control authority is shared by several agencies in Indiana. IDEM holds authority to carry out several Clean Water Act (CWA) programs, including Sections 305(b), 303(d), 314, and others. The Indiana State Department of Health (ISDH) has regulatory authority for septic systems, and the Office of the Indiana State Chemist (OISC) regulates pesticides and nutrients.

The State Soil Conservation Board (SSCB), Indiana State Department of Agriculture (ISDA), and the Indiana Department of Natural Resources (IDNR) – including its Lake and River Enhancement (LARE) Program and its Lake Michigan Coastal Program (LMCP) – administer voluntary and grant programs to help abate various types of nonpoint source pollution. Indiana also partners with many federal agencies and nonprofit organizations in order to accomplish its work, including assistance from the United States Geological Survey (USGS), the United States Environmental Protection Agency (USEPA), the United States Department of Agriculture (USDA), the United States Fish and Wildlife Service (USFWS), the United States Forest Service (USFS), and the National Park Service. Additional research, technical and funding assistance is provided by Purdue University and its Extension Service, Indiana University, The Nature Conservancy, the Indiana Water Monitoring Council, county soil and water conservation districts, and local non-profit and ad-hoc watershed groups.

IDEM'S WATERSHED APPROACH

IDEM employs a watershed approach in its Clean Water Act (CWA) programs. This approach is hydrologically well defined and geographically focused, providing an effective framework to address water quality issues by taking into account land, air and water stressors. Key benefits of the watershed approach are that it integrates multiple programs through coordination of public, private, and not-for-profit stakeholders and leverages limited resources to address priority concerns.

The foundation of IDEM's watershed approach is internal and external collaboration across program areas through timely and effective communication and adaptive management. IDEM's work with other state and federal agencies and other external organizations is described in more detail in later sections of this report.

Internally, IDEM's senior staff, including the commissioner, meets weekly to discuss progress on priorities as well as emerging concerns and then relays this information to IDEM's Office of Water Quality (OWQ) managers at their weekly meeting. Cross-program teams continually work to develop strategies and work plans that ensure internal resources are focused on addressing the most significant environmental issues affecting water quality.

IDEM's water quality monitoring also employs a watershed approach. IDEM adopted a statewide rotating basin approach to watershed monitoring in 1996 in order to regularly update the water quality information for the entire state. From 1996-2010, IDEM monitored watersheds throughout the state on a five-year rotation, which provided a complete update once every five years.

In 2010, IDEM revised its water monitoring strategy and began using a nine-year rotating basin approach in 2011, which will result in a comprehensive and updated data set for the entire state in 2019. The water quality assessments included in this report are cumulative and include all waterbodies that have been assessed to date in all basins of the state. Figure 1 (Appendix B) shows the monitoring locations for all of IDEM's surface water sampling programs and illustrates the sampling density achieved through IDEM's water quality monitoring strategy over

the past five years (2011-2015).

IDEM'S OFFICE OF WATER QUALITY PROGRAMS

IDEM's Clean Water Act (CWA) programs work together to protect and improve the quality of Indiana's surface waters. Indiana's water quality standards, which are developed by the Office of Water Quality (OWQ) Water Quality Standards (WQS) program, provide the foundation for implementation of many of IDEM's CWA programs. IDEM's water monitoring programs provide much of the data necessary to conduct CWA Section 305(b) water quality assessments and to support the development of Indiana's 303(d) List of Impaired Waters and total maximum daily loads (TMDLs) required under Section 303(d) of the CWA.

Nonpoint source (NPS) pollution is addressed primarily through non-regulatory watershed management planning and implementation projects funded through IDEM's NPS Program and through the development of TMDLs for impaired waters. The agency's National Pollution Discharge Elimination System (NPDES) provides a robust regulatory program to control point sources of pollution to Indiana surface waters.

IDEM also works with the Indiana Finance Authority (IFA) to issue low cost loans to communities for infrastructure improvements to their wastewater and drinking water facilities. Many of these loans go to municipalities in watersheds where water quality impairments have been identified and for which total maximum daily loads (TMDLs) have been approved by the U.S. Environmental Protection Agency (EPA). It is anticipated that in time these projects will result in measureable improvements in water quality.

Water Quality Standards Program

Indiana's WQS can be found in 327 IAC Article 2. They were first adopted into the Indiana Administrative Code (IAC) in 1986 and underwent significant revisions in 1990. At that time, Indiana adopted numeric criteria into its WQS for all pollutants for which U.S. EPA had developed ambient water quality criteria for the protection of either human health or aquatic life. Procedures for developing additional criteria were also included in these rules.

Beneficial uses, which are the uses that the waterbody should support, were also established at that time. With a few exceptions, all waters in Indiana were designated for warm water aquatic life use, full body contact recreational use, public water supply[1] (where there are drinking water

[1]There are 34 streams or stream reaches designated for limited use in 327 IAC 2-1-11(a) and 327 IAC 2-1-1.5-19(a). These waters so designated after use attainability analyses confirmed their inability to fully support aquatic life use due to natural low flow conditions throughout much of the year. In 2007, another limited use designation was added to Indiana's WQS in 327 IAC 2-1-3.1, which is applicable only to waters receiving wet weather discharges from combined sewer overflows (CSOs). Currently, no waters are so designated because to date, no communities with CSOs have completed the steps required to receive this designation. Indiana's WQS also include waters that are designated as outstanding state resources in 327 IAC 2-1.5-19(b), 327 IAC 2-1.3-3(d) and 327 IAC 2-1-11(b). Thus, all waters in the state are currently designated for uses consistent with the requirements of the CWA or U.S. EPA's implementing regulations and have criteria appropriate to determine support of these uses.

intakes from surface waters), industrial uses and agricultural uses. In addition, certain waters, where natural temperature conditions will support cold water fisheries, were designated for put-and-take (stocked) trout fishing. For those waters where multiple uses exist, the criteria that support the most stringent uses must be met. The most stringent criteria in Indiana's WQS are those established to protect aquatic life use, recreational uses for all Indiana waters and where applicable, public water supply. IDEM's water quality assessments focus primarily on these uses and are based on the narrative and numeric criteria in the WQS established to protect them.

NPDES permits are also based on Indiana's WQS. In 1993, the rules and regulations that guide the implementation of Indiana's WQS through NPDES permits were extensively revised. Although this revision resulted in significant changes to these rules, only minor changes were made to Indiana's WQS.

With the issuance of the final Great Lakes Water Quality Guidance in 1995, IDEM began the process of revising the WQS and implementation regulations for those waters in Indiana's Great Lakes system. These revisions incorporated the various criteria and procedures identified in the guidance into Indiana's WQS. As a part of this rulemaking, IDEM also developed procedures to implement the antidegradation policy for all substances discharged to waters in the Great Lakes system. These revisions adopted by the Indiana Water Pollution Control Board became effective in February, 1997 and were subsequently submitted to the U.S. Environmental Protection Agency (EPA) for approval.

Ground water quality standards became effective in March 2002. Drinking water from public water supplies is regulated through the Safe Drinking Water Act (SDWA). IDEM defines public water supplies in accordance with the SDWA and has established minimum requirements regarding the information included in consumer confidence reports, which public water suppliers must deliver to their customers annually.

WQS development is an ongoing process. For example, 2008, in order to begin using fish tissue data to make its fish consumption assessments, IDEM had to first derive a numeric criterion for polychlorinated biphenyls (PCBs) in fish tissue. IDEM used U.S. EPA guidance for calculating screening values for target analytes, which provides the basis for developing water quality criteria for the protection of human health.

In 2012, Indiana formally adopted antidegradation standards and implementation procedures applicable to all waters of the state. These rules supersede previous antidegradation rules established in 1997, which applied only to the Great Lakes Basin. And in 2013, Indiana adopted revised chloride criteria developed by the WQS Program based on hardness and sulfate concentrations.

U.S. EPA has required all states to develop numeric water quality criteria for nutrients to support CWA Assessments and permit development. The agency has also issued guidance that appears to give states flexibility in the development of nutrient criteria if the state and U.S. EPA have agreed on a plan to accomplish this goal. Indiana is actively participating in this effort and has submitted a nutrient criteria development plan to U.S. EPA that includes a schedule for the development of nutrient criteria. This plan has been approved by U.S. EPA and is kept updated.

In accordance with the approved plan, IDEM is working with U.S. EPA Region 5 and the United States Geological Survey (USGS) to develop nutrient criteria for different water body types throughout the state. IDEM has worked collaboratively with the USGS in Indianapolis over the last 14 years to collect and analyze relevant stream data from waters throughout the state. Recent analyses of these data indicate that another study is warranted, this time collecting diurnal dissolved oxygen in addition to nutrient parameters for flowing streams. For lakes and reservoirs, data analysis was completed in 2008 by LimnoTech, Inc. IDEM then performed additional analyses on the data set to refine the nutrient benchmarks developed by LimnoTech. On June 30, 2010, IDEM issued a first notice in the Indiana Register announcing a rulemaking to formally incorporate numeric nutrient water quality criteria for lakes and reservoirs into Indiana's water quality standards. IDEM also developed a non-rule policy that went into effect on 12/12/2014 to limit total phosphorus discharge to 1 mg/L for wastewater treatment plants discharging ≥1 million gallons per day.

Currently, IDEM is planning revisions to the metals criteria in the WQS for the protection of aquatic life and human health. On March 5, 2014, IDEM issued a first notice in the Indiana Register announcing a rulemaking to formally incorporate revised water quality criteria for dissolved metals into Indiana's water quality standards. More information about this rulemaking can be found on IDEM's WQS website at: http://in.gov/idem/cleanwater/2329.htm.

IDEM has also collected considerable data on the macroinvertebrate and fish communities for many Indiana waters. A 2014 evaluation of IDEM's biological monitoring program revealed a need to select reference sites that are based on quantitative descriptions of non-biological characteristics (primarily land use and landscape condition); to refine macroinvertebrate assessment techniques; to update biological indices; and to establish a biological condition gradient to characterize the state of aquatic communities in Indiana waters at a finer resolution. IDEM has begun this work through a Section 106 Monitoring Initiative grant from the U.S. EPA.

National Pollutant Discharge Elimination System Permit Program

Point source pollution in Indiana is controlled primarily through permits issued by IDEM for discharges to surface water under the National Pollutant Discharge Elimination System (NPDES) Permit Program in IDEM's Permits Branch. Regulated facilities which discharge to waters of the state must apply for and receive a NPDES permit. Limitations in each permit are determined based on water quality criteria developed to protect all designated and existing uses of the receiving water body.

The Permits Branch issues individual (municipal, semi-public and industrial) NPDES permits. The program also issues industrial wastewater pretreatment permits to industries that discharge to municipal wastewater treatment plants. In addition, the Permits Branch issues general permits for:

- Hydrostatic testing
- Non-contact cooling
- Sand and gravel operations
- Petroleum product terminals
- Groundwater petroleum remediation systems
- Coal mines

There are currently 1194 active individual NPDES permits, 180 pretreatment permits, and 300 facilities covered by general permits.

The Permits Branch is also responsible for the review and approval of long term control plans (LTCPs) submitted by communities to reduce discharges from combined sewers. All of the combined sewer overflow communities for which IDEM is the lead regulating agency are currently under one of three enforceable mechanisms (permit, agreed order or state judicial agreement). These mechanisms are in place to help implement the approved LTCP and/or to develop and implement an approvable LTCP. There are two remaining communities for which U.S. EPA is the lead regulating agency that have not yet entered into an enforceable mechanism for development and implementation of an approved LTCP. These communities are still in negotiations with U.S. EPA.

Compliance and Technical Assistance Program

The Compliance Branch in the Office of Water Quality is responsible for the following:

- Conducting routine inspections of wastewater treatment plants to evaluate operation and maintenance, as well as complaint investigations.
- Providing operator assistance and training.
- Administration of the wastewater operator continuing education and certification program.
- Entering a wide range of NPDES compliance data into the Federal ICIS data system.
- Tracking reported bypass and overflow events.
- Administration of the sewer ban and early warning program.
- Review of compliance data, including data quality assurance.
- Conducting informal enforcement actions through the issuance of violation letters, and assisting in the enforcement process.
- Oversight and auditing of municipal pretreatment programs in the 47 municipalities with U.S. EPA delegated pretreatment programs.
- Administering the laboratory proficiency program.

The Compliance Branch works closely with the Permits Branch and staff from the OWQ's Enforcement section to ensure that permit limits are adequate for protection of designated uses and dischargers remain in compliance with their permit requirements. For example, when unpermitted dischargers are identified, or when NPDES permit holders are found to be in violation of permit limitations or conditions, they may be referred to OWQ's Enforcement section for appropriate action.

Storm Water Program

Storm water run-off from urban, industrial, and rural areas contributes to water pollution in Indiana. IDEM's Stormwater Programs process permit applications and issue permits, conducts compliance inspections, and conducts audits for three program areas that together, help to mitigate the impacts of storm water to Indiana waters. These program areas target storm water discharges from construction site run-off, industrial storm water run-off, and municipal separate storm sewer systems.

Most of the activities that discharge storm water are regulated through general permits. General permits are issued through rulemaking and as such, become part of Indiana's Administrative Code. Unlike individual permits, which IDEM issues to individual permittees when needed, general permits apply universally to all entities required to operate in accordance with the rule.

Construction Site Run-off

Any activity that results in the disturbance of one acre or more of land requires a permit in accordance with 327 IAC 15-5 (commonly known as "Rule 5"). Rule 5 is intended to reduce pollutants, principally sediment, which is a result of soil erosion. Rule 5 also covers other activities associated with construction projects including, concrete washout; fueling, etc. Most construction projects in Indiana are regulated through the general Rule 5 permit. However, in cases where an adverse environmental impact from a project site is evident or if IDEM determines that the discharge will significantly lower water quality, an individual permit may be required.

Industrial Storm Water

Industrial storm water is managed through a general permit developed in accordance with 327 IAC 15-6 (commonly known as "Rule 6"). Rule 6 permits are required for certain categories of industrial activities that are exposed to storm water and where the run-off is discharged through a point source to one or more Indiana waters. There are at least 32 categories of industrial activities regulated under Rule 6. Most industrial activities in Indiana are covered by the Rule 6 general permit. However, under certain circumstances, an industrial facility may require an individual storm water permit. Individual permits are typically required only if a regulated industrial activity category has established effluent limitations under IDEM's NPDES Program or if IDEM determines the storm water discharge will significantly lower water quality.

Municipal Separate Storm Sewer Systems

Municipal separate storm sewer systems (MS4s) are entities that are required by IDEM under 327 IAC 15-13, or "Rule 13" to develop and implement a local storm water management program.

The first MS4s were designated in 1990 and included cities (and certain counties) with a population of 100,000 or more. In Indiana, the City of Indianapolis is the only designated Phase I MS4. The city has an individual storm water permit that was specifically written to address storm water quality and management.

Federal Phase II MS4 rules were complete in 1999 and designated small urbanized areas such as cities, towns, universities, colleges, correctional facilities, hospitals, conservancy districts, homeowner's associations and military bases located within urbanized areas, as delineated by the U.S. Census Bureau. Most of these MS4s are covered under a general permit and are required to develop a storm water quality management plan that must address six minimum control measures (public education, public involvement, illicit discharged detection and elimination, construction site run-off, post-construction run-off, and good housekeeping for MS4 owned and operated facilities). Indiana currently has 186 MS4 permittees implementing Storm Water Quality Management Plans under a general permit.

Wetlands Program

IDEM administers the federal Clean Water Act (CWA) Section 401 Water Quality Certification (WQC) Program and also administers Indiana's State Isolated Wetlands Law (IC 13-18-22) for those wetlands that are not under federal jurisdiction.

IDEM regulates the placement of fill materials, excavation (in certain cases) and mechanical clearing of wetlands and other waterbodies. IDEM draws its authority from the federal CWA, state law and rules for state-regulated wetlands, and from Indiana's water quality standards. IDEM regulates some activities in waterbodies in conjunction with the U.S. Army Corps of Engineers (ACOE).

Anyone who wants to place fill materials, use heavy equipment to excavate, dredge, or mechanically clear areas within a jurisdictional wetland, lake, river or stream must first apply to the ACOE for a CWA Section 404 permit. If the ACOE decides a permit is needed, then the person must also obtain a CWA Section 401 WQC from IDEM. Placement of fill into non-jurisdictional wetlands is also regulated by Indiana law (IC 13-18-22 and 327 IAC 17).

Under CWA Section 401, IDEM reviews the proposed activity to determine if it will comply with Indiana's water quality standards. The applicant may be required to avoid impacts, minimize impacts or mitigate for impacts to wetlands and other waters. IDEM will deny water quality certification if the activity will cause adverse impacts to water quality, the application is deficient, the wetland activities are not necessary, or compensatory mitigation does not offset impacts. A regulated project is not allowed to proceed until it has received a certification from

IDEM. A key goal of the program is to ensure that all activities regulated by IDEM meet the national no-net-loss of wetlands policy.

Development of Wetlands Program Plan

In March 2015, the Indiana Department of Environmental Management (IDEM), Office of Water Quality completed work on a long-term Wetlands Program Plan (WPP) for Indiana. A WPP is a voluntary plan that describes the goals a state or tribe wants to achieve related to its wetland resources over time. The WPP is not a rule-making or regulatory document, nor is it a strict commitment by the state to achieve all aspects of the plan. Rather, it serves to inform future prioritization and action. The planning effort was funded through a U.S. Environmental Protection Agency (EPA) Wetland Program Development grant and is intended to guide IDEM's wetland program activities through 2022. The WPP is available online at http://www.in.gov/idem/wetlands/files/program_plan.pdf.

In-lieu Fee Program

The Indiana Department of Natural Resources (IDNR) is developing, and seeking approval to sponsor (referred to as the "in-lieu fee program"), the Indiana Stream and Wetland Mitigation Program. The program requires the approval of the U.S. Army Corps of Engineers (USACE) and the Interagency Review Team and must meet the requirements laid out in the federal mitigation rule (33 CFR §332.8). The in-lieu program, once fully developed, will provide an additional option for permittees to meet mitigation requirements associated with a Section 404 permit from the USACE, a 401 Water Quality Certification and/or an Isolated Wetland Permit from IDEM. The IDNR hopes to have the program approved by the USACE before the end of 2016.

Integrity and Extent of Wetland Resources

Wetlands occur in and provide benefits to every county in Indiana. The lack of quantitative information on some aspects of Indiana's wetland resources is a major obstacle to improving wetland conservation efforts. The most extensive database of wetland resources in Indiana is the National Wetlands Inventory (NWI) developed by the U.S. Fish and Wildlife Service (USFWS). The original NWI maps were produced primarily from interpretation of high-altitude color infrared aerial photographs taken of Indiana during spring and fall 1980-87. These maps were updated at a much higher resolution during 2008-2009 through a grant to Ducks Unlimited. The updated maps indicate wetlands extent and type, using the Cowardin, *et al*. classification scheme (Cowardin 1979). A 2009 analysis of the state's wetlands compared with 1986 conditions indicates that:

- Indiana has experienced a net loss in the number of emergent, forested, shore, and scrub-shrub wetlands.
- Indiana has experienced a net loss in the extent (acres) of forested, scrub-shrub, and shore wetland sub-types.

The results of this study are available at http://www.fws.gov/wetlands/Data/SupMapInf/R03Y11P02.pdf.

IDEM uses the updated, higher resolution NWI inventory primarily in its Wetlands Program as a screening tool when evaluating applications for impacts to wetlands and streams and also to help identify wetland compensatory mitigation or restoration sites. It has also helped IDEM wetland staff to set priorities for complaint investigations.

Wetland Protection Activities

In addition to the review of applications for Section 401 WQC and state regulated wetland permits, IDEM's Wetlands Program works on additional projects devoted to wetland assessment and wetland protection:

- IDEM staff work closely with the ACOE, U.S. FWS, and IDNR to evaluate proposed projects to coordinate requirements for various state and federal permits related to wetlands.
- IDEM maintains a web page devoted to wetlands and water quality issues: http://www.in.gov/idem/wetlands/index.htm. This page includes information on the status of Indiana's wetlands, current laws and rules, conservation programs and links to other regulatory and non-regulatory wetland programs.
- IDEM maintains a web-based mapping tool for potential wetland restoration sites, including opportunities for compensatory mitigation and non-regulatory purposes: http://idemmaps.idem.in.gov/MitigationVolunteer/.
- Section 401 WQC Program staff conduct outreach events at various locations to promote the importance of wetlands and to educate the public on regulations protecting wetlands.
- IDEM continues to work closely with all partners in the Indiana wetland conservation plan.

Total Maximum Daily Load Program

Status of Total Maximum Daily Load Development

As of March 1, 2016, the Total maximum Daily Load (TMDL) program has developed 1224 TMDLs (individually counting each waterbody impairment that was evaluated), all of which have been approved by U.S. EPA. Appendix D provides an accounting of all TMDLs approved to date. Appendix E provides IDEM's short term TMDL schedule – those either planned or currently being developed for the 2018 cycle.

Two watersheds – the Upper Mississinewa and the South Fork Blue River – are in progress for the 2016 cycle. Previous TMDLs have focused on *E. coli* impairments. More recently, however, the TMDL program has worked to develop TMDLs to address other issues related to NPS pollution such as impaired biotic communities and nutrient impairments.

Long Term Total Maximum Daily Load Development Schedule

U.S. EPA announced its long term vision in 2013 to improve implementation of the CWA 303(d) Program through a new framework for managing program responsibilities. In order to achieve the goals of its vision, U.S. EPA required states to develop a new framework for prioritizing impaired waters for TMDL development.

IDEM developed its TMDL Program Priority Framework in 2015, which describes IDEM's methods for prioritizing waters for TMDL planning and watershed restoration and includes the agency's long term TMDL development schedule. This long term schedule identifies the watersheds in which TMDLs will be developed through the 2022 cycle (Appendix F). IDEM submitted the framework and its long term schedule to U.S. EPA on July 8, 2015. U.S. EPA has since reviewed IDEM's Priority Framework and in a letter to IDEM dated September 16, 2015, agreed that it meets the goals of its new long term vision. . IDEM's long term schedule for TMDL development can be found in Appendix F, while more detailed information on IDEM's 303(d) TMDL Program Priority Framework is provided in Appendix H, Attachment 3). The specific waterbodies identified on IDEM's long term schedule, like those identified in IDEM's short term schedule, may change based on unanticipated circumstances. Although the specific waterbodies may change, IDEM will follow the methods described in its Program Priority Framework when prioritizing impaired waters for TMDL development to help ensure ongoing consistency with U.S. EPA's long term vision.

Nonpoint Source Pollution Program

Nonpoint source (NPS) pollution in Indiana is addressed in many ways through a number of agencies and organizations in the state. IDEM's Watershed Planning and Restoration Section leads the agency's efforts to reduce nonpoint source pollution in Indiana waters in partnership with other agencies and organizations including the Natural Resources Conservation Service (NRCS), Indiana Association of Soil and Water Conservation Districts (IASWCD), Indiana State Department of Agriculture (ISDA), the Indiana Department of Natural Resources (IDNR) and the Indiana Finance Authority (IFA) State Revolving Fund (SRF) Loan Program. The Watershed Planning and Restoration Section also leads efforts to restore waters of the state that are identified on the 303(d) List of Impaired Waters. In addition to working with other state and federal agencies, IDEM employs four watershed specialists who work with local watershed groups to promote the watershed approach and assist them in their watershed planning and restoration activities.

Nonpoint Source Program Grants

The Watershed Planning and Restoration Section manages two federal pass-through grant programs aimed at improving water quality in the state – Section 205(j) and Section 319(h) – each named after the authorizing section of the CWA.

The Section 205(j) Grant Program is dedicated to water quality management planning. Funds are used to determine the nature, extent, and causes of point and nonpoint source pollution

problems and to develop plans to solve these problems. In federal fiscal year (FFY) 2014-15, U.S. EPA allocated to Indiana $681,000 in 205(j) funds. These funds were used to support five projects: three watershed management plan development projects (on the Browns-Wonder Sugar Creek, South Fork Blue River, and Upper Middle Eel River), one sampling project on the Kankakee River, and one database enhancement project.

The Section 319(h) Program is one of the primary resources for reducing NPS pollution in Indiana and receives a significantly larger allocation than that under CWA Section 205(j) (Table 3, Appendix A). In FFYs 2014 and 2015, U.S. EPA allocated $7,023,714 in Section 319(h) funds to Indiana, which funded a total of 18 projects. An additional $131,600 planning project was funded in FFY 2015 using remaining funds from FFY 2013. Several grant proposals are submitted to the program each year by eligible organizations. Proposals are reviewed internally by a committee comprised of OWQ staff and selected for funding based on the NPS Program's priorities and the quality of the proposal. Much of this funding goes to groups working to develop and/or implement a comprehensive watershed management plan which will lead to implementation of on-the-ground best management practices (BMPs) in critical areas of their watersheds.

Additional information about IDEM's 205(j) and 319(h) grant programs and their different requirements is available online at: http://www.in.gov/idem/nps/.

Nonpoint Source Program Focus

IDEM's NPS Program is built on the foundation of the Indiana State Nonpoint Source (NPS) Management Plan. The NPS management plan, required by Section 319(b) of the CWA, is a strategic document developed by state program staff and approved by U.S. EPA that identifies strategic priorities, goals, and milestones to more effectively address NPS problems in Indiana. The plan, which is updated every five years, provides the basis for funding decisions and programmatic direction for the state program and its partners. The current plan was last revised in FFY 2013 and approved by U.S. EPA on March 14, 2014.

The majority of Indiana's Section 319(h) grant funds provide for the development and implementation of watershed management plans (WMPs). Developing and implementing a comprehensive watershed management plan is an effective way to focus efforts and resources on a watershed and its particular problems and to implement solutions to those problems. In the planning process the watershed group identifies the problems, causes, sources, and critical or target areas in the watershed, then sets goals and chooses measures or best management practices (BMPs) to be implemented to achieve those goals. WMPs now under development must meet the required elements of IDEM's 2009 Watershed Management Plan Checklist before they can be implemented with CWA Section 319(h) funds. The checklist incorporates EPA's nine required components of a watershed-based plan and also provides comprehensive guidance on IDEM's Nonpoint Source Program expectations, as well as examples and direction on how to meet those expectations.

Many of the projects funded with NPS Program grants include the collection of water quality data for watershed planning and other purposes. In accordance with their grant agreements, these projects must develop a quality assurance project plan (QAPP) to ensure the data they collect will be reliable for their project needs. Once the QAPP is approved by the NPS Program, they may begin sampling and submitting their data – also a requirement for funding – to the NPS Program. These data are then entered into IDEM's Assessment Information Management System (AIMS) database. The AIMS database is continually maintained and was recently upgraded to make NPS Program data more readily available for internal and external use. In addition, the NPS Program also funded a recent project to update IDEM's Hoosier Riverwatch database in order to improve its ability to manage and display volunteer data and accept data submitted through Indiana's External Data Framework.

Nonpoint Source Program Priorities

Each year, IDEM identifies priority projects for Section 319(h) funds in order to more efficiently meet NPS Program goals, coordinate with TMDL Program efforts to identify and reduce NPS pollution, and focus more funding on impaired waters.

For FFYs 2014 and 2015, the NPS Program has focused funding on the following priorities:

- In order to continue to make measurable improvements in water quality in Indiana, and to prioritize watersheds for actions focused on reducing nutrient loading to the Gulf of Mexico in coordination with the Indiana Conservation Partnership, IDEM's Nonpoint Source Program has focused funding watershed management plan implementation projects addressing nutrients in the following watersheds:
    - White River, East Fork Basin
    - Upper Wabash River Basin
    - Lower Wabash River Basin
- In 2014 the NPS program prioritized funding to support the conditionally approved Lake Michigan Coastal Plan. Until this plan is finalized and meets the requirements of the Coastal Zone Act Reauthorization Amendments (CZARA), IDEM's NPS Program will continue to provide technical and financial assistance for watershed planning and/or implementation in the Coastal Zone Program area.
- The program has continued to prioritize funding for:
    - Watershed planning and/or implementation efforts in watersheds with one or more impaired waterbodies that have an approved TMDL.
    - Watershed planning and/or implementation in watersheds that include waterbodies in categories 5A or 4A of Indiana's Draft 2012 Integrated Report.
    - Implementation of watershed management plans that have met, or will soon meet, IDEM's Watershed Management Plan 2003 or 2009 Checklists.

In FFY 2016, the CWA Section 319(h) program tied its funding to the TMDL vision. IDEM continued in FFY 2016 to prioritize funding for implementation of watershed management plans that meet IDEM's 2009 watershed management plan checklist and in addition, targeted specific watersheds for the following three priorities in its solicitation:

- Develop a WMP or implement an IDEM approved WMP that contains a 10-digit HUC watershed with a public lake (a lake with public access) identified as having a high blue-green algae count when monitored by IDEM and/or the lake is influenced by waterbodies listed in category 5A of the then-draft 2014 303(d) List of Impaired Waters.
- Develop a WMP or implement an IDEM approved WMP in a watershed that includes waterbodies listed on the then-draft 2014 303(d) List of Impaired Waters for Impaired Biotic Communities (IBC).
- Develop a WMP or implement an IDEM approved WMP that includes a 10-digit HUC watershed with a surface water intake for public water supply and waters identified in category 5A of the then-draft 2014 303(d) List of Impaired Waters.

One important indicator of program and project success is the quantity of pollutants, such as sediment, phosphorus, nitrogen, and *E. coli,* prevented from entering waterbodies as a result of BMPs implemented. Most NPS Program projects in Indiana use the U.S. EPA Region 5 Load Estimation Model to estimate the pollutant load reductions for each BMP they implement and submit their data to IDEM. The total reported estimated pollutant load reductions in Indiana for FFY 2014 and 2015 combined are represented in Table 4 (Appendix A). Another program measure (commonly referred to as "WQ-10" or "success stories") tracks the number of waterbodies identified by states as being primarily NPS-impaired that have been partially or fully restored as a result of restoration efforts (5, Appendix A). More detail on Indiana's FFY 2014 and 2015 success stories can be found in the cost/Benefit Section of the report.

IDEM's Watershed Specialists

The NPS Program employs four watershed specialists who provide an important link between watershed groups and other interested stakeholders and OWQ programs. In 2014 and 2015, the watershed specialists assisted nearly 90 watershed groups on many levels including: meeting facilitation, reviewing draft and final watershed management plans, reviewing grant proposals, providing water quality data and watershed maps, connecting them with other local organizations and agencies to complement planning efforts, and assisting watershed coordinators with the overall watershed planning and implementation processes. The watershed specialists also work with the TMDL Program by attending TMDL public meetings to provide information on watershed planning and to build local partnerships to address water quality.

Volunteer Monitoring Programs

Hoosier Riverwatch

From 1999-2002, IDEM and IDNR worked cooperatively to develop and implement the Hoosier Riverwatch Program (HRW), a statewide volunteer stream water quality monitoring program. The mission of Hoosier Riverwatch is to involve the citizens of Indiana in becoming active stewards of Indiana's water resources through watershed education, water monitoring, and clean-up activities. The program accomplishes the first two parts of this goal by educating citizen volunteers in a variety of watershed and pollution issues, and providing them with training and equipment to conduct water quality monitoring. The HRW Program also maintains an online database which allows volunteers to enter their own data and view data collected by other volunteers. Volunteers are encouraged to enter their results into the database to make them available to other interested parties such as watershed groups, schools and IDEM technical staff for potential use in various OWQ programs. In addition to basic search functions, the visualization tools of the database also allow volunteers to view their data and that collected by others in comparison with state and watershed averages through simple graphics.

HRW resided at IDNR until late 2012, when the program moved to IDEM's OWQ to better integrate volunteer water monitoring with OWQ's watershed monitoring and planning activities. Over the past three years, HRW has become more fully integrated into the Watershed Assessment and Planning Branch within OWQ, allowing better coordination with NPS Program whose grantees commonly use HRW methods to meet the monitoring and outreach components of their funded projects and encouraging greater data sharing through OWQ's EDF. The HRW Program has also initiated planning discussions to determine how volunteer monitoring can become more fully involved in watershed planning and restoration efforts as a whole.

The move to IDEM also provides volunteer monitors more opportunities to interact with their professional counterparts. Since 2012, HRW program staff have worked with OWQ biologists and others to offer training to the program's corps of trained volunteer instructors in topics such as basic fish and advanced macroinvertebrate identification, introductions to IDEM's mobile *E. coli* van, the collection and analysis of fish tissue for consumption advisories, the use of various electrofishing gear, and the process of estimating pollutant loads using flow and concentration data.

Indiana Clean Lakes Program

The Indiana University School of Public and Environmental Affairs (IU-SPEA) has been working with IDEM's NPS Program since 1989 to administer the Indiana Clean Lakes Program (CLP). The Indiana CLP is funded through CWA Section 319(h) and provides a comprehensive, statewide public lake management program that includes public information and education, technical assistance, volunteer lake monitoring, and lake water quality assessment.

Indiana has more than 1,400 lakes, reservoirs, and ponds, many of which are under pressure from human activities such as poorly managed agriculture, suburbanization of lakeshores, boating

impacts, and septic system discharges. These activities can result in excessive nutrient concentrations reaching lakes which can lead to accelerated eutrophication and related undesirable effects including nuisance algae, excessive plant growth, murky water, odor, and fish kills.

Indiana's CLP, which is coordinated by IU-SPEA staff and students, includes the following components:

- Annual professional sampling of lakes and reservoirs.
- Training and support of a corps of volunteer lake monitors.
- Education and outreach through a quarterly newsletter
- Development of other educational materials such as brochures and fact sheets.
- Maintenance of the Indiana Clean Lakes Program website.
- Technical assistance and expertise on lake-related issues.

The Indiana CLP also participates in the annual Indiana Lake Management Conference as part of its education and outreach activities.

In 2012, IU-SPEA expanded its volunteer monitoring program to include aquatic invasive species monitoring with the goal of helping to detect the presence of invasive species early and to prevent their spread. In 2014, Zebra mussels were added to the program.

The program also holds workshops each year to help increase public understanding of the important zones of a lake that provide essential habitat and ecosystem services. Volunteers that participate in the workshops often expand their monitoring efforts becoming even better lake stewards. This program has been very well received and continues to improve with each workshop.

Volunteers enter their data on the Indiana CLP website. Volunteer data reports are available on the website for the years 1999-2011. Information regarding IDEM's use of the data collected by IU-SPEA staff and students for CWA Section 305(b) and Section 314 assessments can be found in a later section of this report.

COORDINATION WITH OTHER AGENCIES

Nonpoint source (NPS) pollution ranges from urban sources to construction and agricultural run-off which makes cooperation essential across political boundaries and disciplines. Many local, regional, state, and federal agencies play an essential part in addressing NPS pollution, especially at the watershed level. Various agencies in Indiana provide data, technical resources and grants to local watershed groups to assist with planning, infrastructure design review and implementation of best management practices (BMPs) to reduce and prevent NPS pollution. Through coordination and collaboration, IDEM and the other agencies can more effectively focus water quality protection efforts.

IDEM works closely with other state and federal agencies engaged in improving water quality. For example, IDEM serves as a member of the Indiana Conservation Partnership (ICP) – a partnership comprised of eight state and federal agencies and other organizations committed to the goal of promoting conservation.

IDEM also has four watershed specialists that act as liaisons for local, state and federal entities to integrate watershed planning into local level planning efforts. These specialists serve as Section 319(h) project managers and assist in a technical, managerial and financial advisory role for local watershed groups.

IDEM staff in the Wetlands and Storm Water Programs work cooperatively with the U.S. Army Corps of Engineers, IDNR, the U.S. Fish and Wildlife Service (USFWS), local soil and water conservation districts (SWCDs) and other agencies to provide technical assistance and to issue Clean Water Act (CWA) Section 401 water quality certifications, state permits for isolated wetlands, and construction /land disturbance permits to protect water quality.

Indiana Department of Natural Resources

Division of Reclamation, Abandoned Mine Lands Program

IDEM's total Maximum Daily Load (TMDL) and Nonpoint source (NPS) Programs work with IDNR's Abandoned Mine Lands (AML) Program on any TMDL development and potential water quality improvements in watersheds where abandoned coal mines exist. The AML Program contributes to these efforts by sharing water quality data and information regarding the costs and techniques involved in their reclamation projects. The AML Program has also helped educate IDEM's Office of Water Quality (OWQ) staff about areas impacted by acid mine drainage by touring reclamation projects with them at different points in the reclamation process.

Division of Fish and Wildlife, Lake and River Enhancement Program

The goal of the Lake and River Enhancement (LARE) Program in the IDNR Division of Fish and Wildlife is to reduce the amount of sediment and nutrients entering Indiana's lakes and rivers. Coincidental to this goal is an ongoing effort to utilize LARE-funded projects to protect and enhance aquatic habitat for fish and wildlife to ensure the continued viability of Indiana's publicly accessible lakes and streams for multiple uses, including recreational opportunities.

These goals are accomplished through the granting of funds to appropriate sponsoring entities to provide for technical and financial assistance to qualifying projects. These projects range from diagnostic studies of targeted sub-watersheds to determine the design and construction feasibility of measures to reduce erosion and sedimentation in lakes and streams. Indiana law dedicates a portion of LARE funding to the removal of sediment, logjams and other obstructions, and control of invasive aquatic species. And, the program also provides funding to county SWCDs to assist individual landowners in the use of BMPs in targeted watersheds.

In 2015, LARE grants totaled more than two million dollars to projects in numerous counties across the state. Funding for the program comes from a lake and river enhancement fee paid by boat owners annually to the Bureau of Motor Vehicles. LARE projects leverage these funds to benefit not only boaters but everyone who uses Indiana's publicly accessible lakes and streams. LARE-funded projects also help to improve aquatic habitat and reduce the amount of nutrients entering both the Great Lakes and the Mississippi River System.

Indiana Lake Michigan Coastal Program

The purpose of IDNR's Lake Michigan Coastal Program (LMCP) is to enhance the state's role in planning for and managing natural and cultural resources in the coastal region and to support partnerships between federal, state and local agencies, and other organizations.

The LMCP annually awards a variety of grants through its Coastal Grants Program to coastal municipalities, counties, nonprofit groups, and universities for projects that protect and restore natural, cultural and historic resources in Indiana's Lake Michigan coastal region. Examples of how these funds might be used include:

- Protection and restoration of significant natural and cultural resources.
- Programs to prevent the loss of life and property in coastal hazard areas.
- Improved public access for recreational purposes.
- Revitalized urban waterfronts and ports.
- Improved coordination among government agencies when making policy decisions.
- Pollution prevention initiatives, including NPS pollution into coastal water.

The Coastal Nonpoint Pollution Control Program, established in 1990 by Section 6217 of the Coastal Zone Act Reauthorization Amendments, is jointly administered by National Oceanic and Atmospheric Administration (NOAA) and the U.S. Environmental Protection Agency (EPA). The program establishes a set of management measures for states to use in controlling runoff from six main sources: agriculture, forestry, urban areas, marinas, hydromodification (shoreline and stream channel modification), wetlands, and riparian and vegetated treatment systems. The goal is to reduce polluted runoff to coastal waters. All coastal and Great Lakes states and territories that participate in the National Coastal Zone Management Program are required to develop coastal nonpoint pollution control programs. State authorities ensure implementation.

Indiana's Coastal Nonpoint Pollution Control Program received conditional U.S. EPA/NOAA approval in 2008. The LMCP is working closely with IDEM's NPS Program and other NPS program partners to implement management measures specified by U.S. EPA to prevent and mitigate NPS pollution in Lake Michigan coastal watersheds. Documentation indicating how Indiana meets all remaining Coastal NPS Pollution Control Program conditions must be submitted to U.S. EPA/NOAA by September 30, 2019.

The Septic System Coordination Work Group established and facilitated by the LMCP is an example of how coastal partners collaborate to address the management measure for inspection of potentially failing septic systems. The Indiana State Department of Health (ISDH), county

health departments, IDEM, the Northwest Indiana Federal Urban Waters Partnership, local municipal separate storm sewer systems (MS4s), watershed groups, and regional environmental agencies and organizations meet on a regular basis to share information on local conditions and ordinance development, address failing systems, and identify innovative funding mechanisms. In 2014 and 2015 the work group spearheaded adoption and promotion of U.S. EPA's SepticSmart Week by ISDH, IDEM, IDNR, and more than 40 coastal towns, agencies, and organizations.

Indiana Conservation Partnership

IDEM is one of eight agencies and organizations that comprise the Indiana Conservation Partnership (ICP). The ICP works to provide technical, financial, and educational assistance needed to implement conservation practices that are environmentally and economically compatible and that promote good stewardship of Indiana's soil and water resources. IDEM serves on the ICP with the following agencies and organizations:

- Natural Resources Conservation Service (NRCS)
- Farm Service Agency (FSA)
- State Soil Conservation Board
- Indiana State Department of Agriculture (ISDA)
- Indiana Department of Natural Resources (IDNR)
- Indiana Association of Soil and Water Conservation Districts (IASWCD)
- Purdue University Cooperative Extension Service

The ICP meets bimonthly for partner updates, to coordinate and collaborate where possible to optimize their resources – particularly their various cost-share and grant programs – and the technical training they can provide for achieving water quality objectives. The ICP also prepares an annual work plan that defines objectives for up to four conservation focus areas and includes the actions, responsible entities and deadlines for achieving them.

The ICP sponsors a number of initiatives that have the potential to improve water quality in Indiana. One example is the Conservation Cropping Systems Initiative, which provides education on the use of a system of practices that promote soil health. These include cover crops, nutrient and pest management, continuous no-till/strip-till, and precision farming, all of which can provide water quality benefits. Many of the agencies participating in the ICP also provide funding on a continuing or limited basis to address nonpoint source (NPS) pollution such as NRCS's Regional Conservation Partnership Program and ISDA's Clean Water Indiana (CWI) program.

Indiana's State Nutrient Reduction Strategy – a collaborative effort between ISDA and IDEM with contributions from other ICP partners – was developed in 2015 to provide a framework for reducing nutrients entering Indiana waters. As part of this strategy, the ICP has committed to report load reductions of sediment, nitrogen, and phosphorus achieved by the practices installed under various funding authorities of its participating agencies. ISDA technicians were trained by

IDEM NPS staff to use the U.S. EPA Region 5 model to calculate load reductions. For calendar years 2013 and 2014, the ICP has reported the following load reductions for the Indiana:

- Sediment – 2,658,398 tons/year
- Nitrogen – 4,901,344 pounds/year
- Phosphorus – 2,607,847 pounds/year

Indiana's State Nutrient Reduction Strategy along with maps showing the locations at which these reductions were achieved are available at: http://www.in.gov/isda/2991.htm. More detail information about the ICP and its activities can be found at: http://icp.iaswcd.org/.

National Water Quality Initiative

The U.S. Department of Agriculture (USDA) annually targets Farm Bill dollars to the NRCS National Water Quality Initiative (NWQI) Monitoring Project watersheds to promote the implementation of conservation practices. IDEM worked closely with NRCS to prioritize watersheds for the NWQI using the decision criteria of watersheds with impaired waters, high risk natural resource areas, active local watershed groups or conservation interests, and baseline water quality data. As a partner on the NWQI, the U.S. EPA requires IDEM, as the state agency in Indiana charged with implementing the CWA, to contribute monitoring resources to at least one NWQI watershed.

The watershed selected for NWQI monitoring is the School Branch watershed, a small (8.4 square miles) watershed located in northeastern Hendricks County, Indiana. School Branch is nested in the Eagle Creek watershed, which is located in the larger Upper White River Watershed. Land use in the watershed is predominately agricultural with interspersed residential areas. Soil classes in the School Branch watershed are predominantly poorly drained and the watershed is extensively tile drained. School Branch eventually drains into Eagle Creek Reservoir, a primary drinking water source for Indianapolis.

School Branch, Eagle Creek, and the Upper White River watersheds are on Indiana's 303d List of Impaired Waters due to high levels of nutrients. The size of the Eagle Creek and Upper White River watersheds (163 and 2,718 square miles, respectively) and the variety in land uses at these scales has made it difficult to evaluate the effects of conservation and land management strategies. Therefore, focusing on the much smaller School Branch watershed, in which 80% of the land use is agricultural, will allow researchers to adequately isolate water quality impacts from agriculture versus other sources.

Previous attempts to document water quality improvements from agricultural conservation practices at the watershed scale have proven particularly difficult due to the number of issues that can hinder the ability to attribute improvements to specific practices. These issues include:

- Insufficient baseline data
- Incomplete separation of agricultural influences from non-agricultural sources
- Inadequate sampling duration and intensity to account for "lag time", seasonal influences, and storm events
- Insufficient adoption of complete conservation systems within watersheds

A collaboration of federal, state, local, and academic entities along with dedicated conservation-minded farmers in the School Branch watershed has provided a unique monitoring opportunity to assess the chemical, physical, and biological impacts of conservation practices at the watershed, sub-watershed, and edge-of-field scales. The project is currently measuring water quality associated with conservation cropping systems that improve soil health in predominantly corn and soybean row crop agriculture.

The data collected in this watershed will allow evaluation of how production agriculture can complement sustainable water resources. In addition, because the School Branch watershed is nested within two successively larger watersheds of similar land use and hydrology, the project is monitoring and can model impacts of conservation at multiple scales. Historical data is also available to enhance the assessment of improvements over time.

Monitoring and evaluation efforts are being conducted at different scales by IDEM, the U.S. Geological Survey (USGS), the Indiana Geological Survey (IGS), the Marion County Health Department (MCHD), USDA-NRCS, and the Center for Earth and Environmental Services (CEES) at Indiana University - Purdue University, Indianapolis.

Through this monitoring – a collaborative effort without precedent in Indiana – these agencies and organizations are measuring streamflow and groundwater levels, collecting water samples from the stream and edge-of-field surface runoff, and monitoring sub-surface flows for nitrogen, phosphorus, and suspended sediment. Groundwater is also being monitored for nitrogen and phosphorus. Soils are being monitored as well, to determine moisture levels, water-holding capacity, and nutrient content. Supplementary biological indicators will used to evaluate factors affecting water quality and nutrient source tracking from field, in-stream bed and bank, and residential sources and sediment characteristics analyses will be conducted.

Thanks to conservation-minded farmers participating in this study, the research partners collaborating on this project will be better able to distinguish between the water quality effects associated with complete conservation cropping systems from other agricultural and non-agricultural sources of sediment and nutrients.

Indiana Water Monitoring Council

The Indiana Water Monitoring Council (InWMC), is a broad-based, state-wide organization whose primary mission is to enhance the communication, collaboration and coordination of professionals, organizations, and individuals involved in water monitoring within Indiana. As a charter member, IDEM has remained actively involved with the InWMC since its formation in 2008. IDEM staff serve on the board and on a number of InWMC committees to assist with activities to:

- Provide a forum for communication among groups involved in monitoring Indiana waters.
- Promote the sharing of monitoring data and information on effective procedures and protocols for sample collection.
- Facilitate the development of collaborative monitoring strategies.

The Ag Water Monitoring Forum is one example of the type of activities IDEM supports through its work on the InWMC. On August 28, 2015, the InWMC partnered with Indiana Farm Bureau, Purdue University's Agricultural Research Department, and the NRCS to convene a meeting of several leading researchers in the state who are focusing on the effects of conservation practices on water quality.

The meeting focused on the Indiana Nutrient Management and Soil Health Strategy, a 10-year plan developed through a collaborative effort of Indiana agricultural producers to help protect Indiana's soil and water resources through the optimization of nutrient management and implementation of practices to reduce nutrient loss from fields. Researchers and producers shared updates on the strategy and gathered input on recommended protocols and study designs for its continued implementation. The meeting agenda and presentations are available at the InWMC website: http://www.inwmc.org/event-1986971. The Indiana Nutrient Management and Soil Health Strategy, which is an addendum to the Indiana's State Nutrient Reduction Strategy, is also available online at: https://inagnutrients-public.sharepoint.com/.

Multiple state, federal, and local agencies and organizations are monitoring water quality within Indiana, each with its own mandate or reason for monitoring. Although each agency and organization is collecting potentially valuable data on Indiana's water resources, the lack of coordination can lead to duplication of efforts and important information that may be overlooked from the resulting lack of data sharing.

Members of the InWMC have overwhelmingly cited the need for a shared understanding among the water resources community of existing active monitoring networks within Indiana as critical to more effective management of water resources throughout the state. Shortly after its formation, the InWMC's Coordination and Collaboration Committee responded to this need by convening the Integrated Water Monitoring Network Optimization Taskforce to begin working toward a better understanding of the monitoring efforts going on throughout the state.

Soon, the InWMC will release the first product of the taskforce – a study of ongoing monitoring networks throughout Indiana to help environmental managers, researchers, and interested citizens find data from sampling sites with long periods of record. The study will highlight the existing river and stream water quality networks that can provide data and identify new sites that may be needed to augment existing networks and/or eliminate sites that are currently being monitored by more than one group. The paper is currently in draft and is expected to be published later in 2016. In the meantime, those wanting to learn more about the InWMC can find more information about its activities as well as a number of resources online at: www.InWMC.org.

Indiana State Revolving Fund Loan Program

The Indiana State Revolving Fund (SRF) Loan Program administers two different loan programs that provide low-interest loans to Indiana communities, one for projects that improve drinking water and the other for wastewater infrastructure projects. The Indiana Finance Authority administers these programs to protect public health and the environment. Cities, towns, counties, regional sewer/water districts, and conservancy districts are eligible for the programs. Private and not-for-profit public water systems and water authorities are alsoeligible for drinking water SRF loans.

Eligible projects include those that abate water pollution problems, provide greater protection for public health or ensure compliance with either the CWA or the Safe Water Drinking Act. Wastewater projects may include wastewater treatment plant construction or improvements, sewer line extensions to existing unsewered areas, decentralized treatment systems, combined sewer overflow elimination and infiltration/inflow corrections. Drinking water projects may include treatment plant construction and improvements, water storage facilities, water distribution systems and water supply. The program provides additional financial incentives to projects to include green technology, a Brownfields Program[2] project or a sustainable infrastructure component.

Both SRF Loan Programs offer a 20-year, fixed rate loan term. Interest rates on loans through the SRF Programs use a base interest rate, which is reset on the first business day of each January, April, July, and October. The base rate is calculated by using 90 percent of the average 20-year AAA-rated, general obligation bond Municipal Market Data composite index for the most recent calendar month. The base rate is then discounted further based upon a community's median household income from 2010 census data and projected user rates. As an incentive to communities to address nonpoint source water pollution, for projects with a NPS component or green/sustainable infrastructure components, the interest rate on their loans may be reduced by up to 0.5 percent. The program has established a floor of two percent as the lowest possible interest rate, including any reductions.

[2]The Indiana Brownfields Program works in partnership with the U.S. Environmental Protection Agency and other Indiana agencies to assist communities with redevelopment of "brownfield" properties where making productive use redevelopment is complicated due to actual or potential environmental contamination.

The SRF Loan Programs coordinate with state and federal programs, including IDEM's OWQ, to identify ways it might provide assistance to Indiana communities that will ultimately help to achieve common goals. For example, the Clean Water SRF ranking and scoring gives additional points for projects that remove a pollutant source from an impaired stream. This way of scoring increases the likelihood that projects with a water quality benefit will rank high on the SRF project priority list. The funds loaned for these removal projects can be documented as a match, when applicable, for projects submitting grant proposals to the NPS Program. Projects eligible for match must provide water quality benefits to their respective communities and may include, but are not limited to, one or more of the following:

- Wetland restoration/protection
- Erosion control measures
- Groundwater remediation
- Repair or replacement of failing septic systems or connection to sewer
- Storm water BMPs
- Source water and wellhead protection
- Conservation easements
- Agricultural and waste management BMPs

The SRF Loan Programs also serve on the Indiana Rural Wastewater Task Force's Environmental Infrastructure Working Group, which allows the SRF Program the opportunity to provide input and offer financing options to communities for their drinking water and/or wastewater infrastructure needs. The SRF Loan Programs work with communities addressing combined sewer overflows, enforcement issues or those with or nearing a sewer ban.

Over the State Fiscal Years (SFYs) 2014 and 2015, one project with a NPS component saved an additional $3,314,189 over the 20-year term of their loans. While these savings are realized over the longer term, these projects are typically completed within two years and the water quality benefits are achieved much sooner than 20 years.

Annex 4 of the Great Lakes Water Quality Agreement

The 2012 amendments to the Great Lakes Water Quality Agreement (GLWQA) included Annex 4 on nutrients. The Annex 4 binational subcommittee was established in 2013 to coordinate binational actions to manage phosphorus loadings and concentrations in the Great Lakes. Indiana has been an active member of this subcommittee since its inception. The GLWQA Lake Ecosystem Objectives include the following:

- Minimize the extent of hypoxic zones in the Great Lakes due to excessive phosphorous loading with emphasis on Lake Erie.
- Maintain levels of algal biomass below nuisance level conditions.
- Maintain algal species consistent with healthy aquatic ecosystems in nearshore waters.

- Maintain cyanobacteria biomass at levels that do not produce concentrations of toxins that pose a threat to human or ecosystem health.
- Maintain an oligotrophic state, relative algal biomass, and algal species consistent with healthy aquatic ecosystems in the open waters of Lakes Superior, Michigan, Huron and Ontario.
- Maintain mesotrophic conditions in the open waters of the western and central basins of Lake Erie, and oligotrophic conditions in the eastern basin of Lake Erie.

Commitments under the Nutrients Annex include the following:

- By February 2016, establish binational phosphorous objectives, loading targets and allocations for the nearshore and offshore waters to achieve the ecosystem objectives for each lake, starting with Lake Erie.
- Assess and where necessary, develop/implement regulatory and non-regulatory programs/measures to reduce phosphorous loadings from agricultural, rural non-farm, urban and industrial point and nonpoint sources.
- By 2018, develop a binational phosphorous reduction strategy and domestic action plans designed to meet nearshore and open water phosphorous objectives and loading targets for Lake Erie.

On February 22, 2016, the United States and Canada adopted new phosphorous reduction targets for Lake Erie, which are noted in Table 6 (Appendix A). Indiana's Domestic Action Plan (DAP) will be led by IDEM and developed by a steering committee comprised of representatives from different stakeholder sectors. The DAP will follow an outline that includes purpose, background, goals, objectives, tactics, and measuring and reporting progress.

Indiana's portion of the Western Lake Erie Basin is comprised of the St. Joseph, Maumee, Auglaize, and St. Marys watersheds. The St. Joseph River and the St. Marys River enter Indiana from Ohio and, at their confluence, form the Maumee River. The Maumee flows eastward into Ohio and into Lake Erie. The 40 percent reduction in spring-time total phosphorus and soluble reactive phosphorus noted in Table 6 for the Maumee River translates to a flow-weighted mean concentration of 0.23 milligrams per liter total phosphorus and 0.05 milligrams per liter soluble reactive phosphorus. Progress toward these target values will be measured on the Maumee River as close to the Indiana-Ohio border as feasible. A draft of the DAP will be available by December 31, 2016.

COST/BENEFIT ASSESSMENT

Water is a vital component of the economic health of Indiana, which is diverse in its agriculture, industry, population, and environmental resources. Finding the right balance between these often competing needs promises the benefits associated with a robust economy, high quality of life, and healthy ecosystems. However, the finances available to restore, enhance, and protect our water resources is limited in comparison to the work needed to ensure that balance. The following is a discussion of some of the revenue sources available to state, regional, and local

entities to achieve the objectives of the Clean Water Act (CWA) as well as case studies that illustrate improvements in water quality and their resulting benefits.

Funding Water Quality Improvements through Better Infrastructure

Since 1992, the State Revolving Fund (SRF) Programs have provided more than $3.7 billion dollars for more than 679 wastewater (Figure 2, Appendix B) and drinking water (Figure 3, Appendix B) infrastructure improvement projects. SRF Program assistance to communities is expected to result in water quality benefits for many Indiana rivers and streams.

In state fiscal years (SFYs) 2014 and 2015, the Wastewater SRF Program closed 34 loans totaling almost $300 million. This provided an estimated savings (compared to open market interest rates) of more than $64.5 million. In SFYs 2014 and 2015, the Drinking Water SRF Program closed on 22 loans for totaling almost $40 million with savings to Indiana communities estimated at more than $19 million (Table 7, Appendix A).

Successes in Water Quality Improvement through Strategic Measures

IDEM has reported improvements in water quality in almost 220 miles of streams in 12 different watersheds since 2007 to the U.S. Environmental Protection Agency (U.S. EPA) to meet measures outlined in U.S. EPA's strategic plan (Table 5). Measure SP-12 (commonly called "Measure W") is used by U.S. EPA to track improvements in water quality conditions in impaired watersheds resulting from watershed planning and restoration activities. For the purposes of meeting this measure, improvements may be demonstrated by the removal of at least 40 percent of the impairments or impaired miles/acres in the watershed from the state's 303(d) List of Impaired Waters or by valid scientific information that indicates significant watershed-wide improvement in one or more water quality parameters associated with impairments listed on Indiana's 2002 303(d) list. WQ-10 is a performance measure that requires states to develop Nonpoint Source (NPS) Program "Success Stories" and submit them to U.S. EPA for the purposes of tracking how NPS restoration efforts are improving water quality. To meet this measure, IDEM must identify nonpoint source-impaired waters that have been improved as a result of watershed restoration efforts funded in whole or in part by IDEM's NPS Program.

In 2014 and 2015, IDEM reported water quality improvements in the Emma Creek and Indian Creek watersheds, respectively. Two additional stories will be reported in 2016. These successes and others can be found on U.S. EPA's Nonpoint Source Success Stories website.

Reducing Livestock-Induced Pollution in Emma Creek

Emma Creek is a 38.2-mile tributary to the Little Elkhart River, which flows through southeastern Lagrange County in northeastern Indiana. IDEM monitored a small, 2.3-mile tributary to Emma Creek in 2000, collecting fish community and habitat data along with water chemistry samples. Analysis of fish community data showed an Index of Biotic Integrity score of 14, well below the score necessary to be considered supportive of the biological integrity. In addition, habitat and chemistry data collected by IDEM in 2000 revealed that siltation, excess

nutrients and low dissolved oxygen (particularly during the summer months) contributed to impaired biotic communities in the stream. IDEM's analyses of water samples also showed an ammonia level much higher than the state's water quality criterion for the protection of aquatic life. These results prompted IDEM to add the stream to the 303(d) list in 2002 for impaired biotic communities (IBC) and ammonia. Suspected pollutant sources included barnyard runoff, failing septic systems, and livestock access to the stream.

The Lagrange County Soil and Water Conservation District (SWCD) developed a watershed management plan (WMP) for the Little Elkhart River in 2007 using water quality data collected from June 2005 through December 2006 to guide the efforts. As part of the WMP implementation, the SWCD conducted a paired watershed study on the upper and lower Emma Creek subwatersheds from 2009 to 2011 (Figure 4, Appendix B). In the paired study, the lower watershed was used as the control watershed while project partners implemented best management practices (BMPs) in the upper watershed – the treatment watershed.

Between 2009 and 2010, landowners installed numerous BMPs in the Little Elkhart River watershed including the upper Emma Creek treatment watershed. As a result, water quality in the Emma Creek Tributary is improving. Data collected along the impaired segment (Figure 4) show that pollutant levels decreased in 2009–2010 as compared to 2007–2008 (Table 8, Appendix A).

Key to this restoration effort was the participation of members of the Amish community, which comprises about 75 percent of the agrarian population of the Emma Creek watershed. Participation in cost-share programs by this community has been traditionally low. Outreach and education proved to be a successful strategy in convincing the community to change their management practices to protect water quality, including installing some BMPs without financial assistance.

Data collected by the SWCD at the mouth of Emma Creek showed similar improvements in water quality, indicating that the benefits realized by the BMPs implemented in the upper watershed carry through the watershed and into the Little Elkhart River. Net load reductions in the Emma Creek watershed were 42 percent for *E. coli*, 20 percent for nitrates, 58 percent for total suspended solids, 63 percent for total phosphorus, and 89 percent for ammonia. With the exception of *E. coli*, all of these parameters are associated with watershed-based improvements eventually leading to healthier biological communities.

In 2011 IDEM returned to the Emma Creek tributary to monitor for improvements in the fish community. The IBI score indicated that no significant change in biological condition has yet occurred suggesting a time-lag between BMP implementation and the habitat recovery necessary to fully support a healthy fish community. Although the SWCD data appear to show that ammonia levels are meeting water quality standards, the stream cannot be removed from the 303(d) list for ammonia until data meeting IDEM's data quality requirements for CWA Section 305(b) assessments are available. The impaired segment must remain listed as impaired for both IBC and ammonia.

These water quality improvements are the result of collaboration between the Lagrange County SWCD, IDEM, Indiana Department of Natural Resources, the Great Lakes Commission and the Natural Resources Conservation Service (NRCS). The Lagrange County SWCD sponsored the development of the WMP and coordinated the implementation of the paired watershed study with funding and assistance from IDEM. IDEM also provided more than 1.7 million in CWA Section 319(h) funding to implement BMPs. The Indiana Department of Natural Resources and Great Lakes Commission provided additional funding for watershed land treatment practices and implementation of the WMP, with contributions of $75,000 and $515,000, respectively. NRCS provided engineering design and support. And, landowners in the watershed paid $30,000 out-of-pocket to install BMPs without the added incentive of cost-share funding.

Watershed Restoration Work Improved a Section of Indian Creek

The Devils Backbone section of Indian Creek is a 21-mile reach in Harrison County, Indiana, just upstream of Indian Creek's confluence with the Ohio River (Figure 5, Appendix B). Water quality data collected from this reach by IDEM in 2000 indicated that the geometric mean of the *E. coli* samples collected as well as the individual sample results exceeded the state's water quality criteria for recreational use. In addition, four out of the six dissolved oxygen results were below the levels set in the water quality standards for the protection of aquatic life use. Given these results, IDEM added the Devils Backbone section of Indian Creek to the 303(d) list in 2002 for and *E. coli* and low dissolved oxygen.

From 1996 to 2010, numerous state and federal partners and other organizations funded watershed planning and restoration efforts in the Indian Creek watershed. As a result, water quality conditions in the Devils Backbone reach have improved.

From 1996 to 2006 The Nature Conservancy (TNC) provided $210,000 is funding for stream restoration and outreach projects in the Indian Creek watershed. Then in 2006, IDEM awarded the Harrison County Regional Sewer District a CWA Section 205(j) almost $100 thousand in grant funds to develop a watershed management plan (WMP) for the Indian Creek watershed. The resulting WMP helped to inform the installation of numerous BMPs throughout the watershed, targeting areas where they might have the greatest impact.

Project partners in the Indian Creek watershed used $687,567 in financial and technical assistance provided through the NRCS' Environmental Quality Incentives Program (EQIP) to implement numerous conservation practices between 2003 and 2010. Additional practices were also installed during this time with $55,094 in Farm Service Agency (FSA) Conservation Reserve Program (CRP) funds. Harrison County also allocated $950,000 between 2002 and 2010 toward agricultural BMPs in the county and used funding from the Clean Water Indiana state fund to install additional BMPs in the Indian Creek watershed.

In 2010, IDEM returned to monitor the Devils Backbone reach of Indian Creek and found that water quality has improved, with results meeting the state's water quality standards for *E. coli* and dissolved oxygen. Based on these results, Indiana removed the Devils Backbone section of Indian Creek from its 2014 CWA section 303(d) impaired waters list.

Grand Calumet River Indiana Harbor Ship Canal Area of Concern

Prior to strict environmental regulations industries, factories, and municipal sanitary districts commonly discharged chemicals and contaminants directly into the Grand Calumet River in northwest Indiana. The accumulation of such pollution containing oils and greases in the river sediments caused drastic harm to the ecosystem. By the 1980s, new environmental regulations changed how municipalities and industries could operate, which reduced the amount of contaminants being discharged into the river. However, even with new operational standards the impacts of legacy contaminants – those discharge prior to the change in regulations – had already caused great harm to the river. The Grand Calumet River was highly impaired for human and wildlife use and as a result, was identified by the International Joint Commission as an Area of Concern (AOC). The Grand Calumet River Indiana Harbor Ship Canal AOC is one of 43 AOCs identified by the commission in its 1978 Great Lakes Water Quality Agreement (GLWQA). The GLWQA requires that each AOC have a Remedial Action Plan (RAP) developed for it to provide a blueprint for the remediation of 14 designated beneficial use impairments (BUIs) of the waterway.

1. Restrictions on fish and wildlife consumption
2. Tainting of fish and wildlife flavor
3. Degradation of fish and wildlife populations
4. Fish tumors or other deformities
5. Bird or animal deformities or reproduction problems
6. Degradation of benthos
7. Restriction on dredging activities
8. Eutrophication or undesirable algae
9. Restrictions on drinking water consumption, or taste and odor
10. Beach closings
11. Degradation of aesthetics
12. Added costs to agriculture and industry
13. Degradation of phytoplankton and zooplankton populations
14. Loss of fish and wildlife habitat

For Indiana this meant that IDEM would take the lead in developing the RAP with the aid of the Citizens Advisory for the Remediation of the Environment (CARE) Committee – a group of individuals selected by IDEM to provide input into the RAP planning process.

The RAP identifies key projects including sediment remediation for the entire river system as well as habitat restoration on over 900 acres. Through the assistance of the Great Lakes Legacy Act (GLLA) and the Great Lakes Restoration Initiative (GLRI) as well as funding from state and local sponsors, significant progress has been made toward the RAP restoration goals. In 2011 and 2012 respectively BUI #12 and BUI #9 were removed from the list of impairments for the Grand Calumet River Indiana Harbor Ship Canal AOC. Since the early 2000s more that 3.25 million cubic yards of contaminated sediments containing heavy metals, polycyclic aromatic hydrocarbons, and polychlorinated biphenyls have been removed. An additional 14,600 cubic

yards of sediment are expected to be removed by the end of 2016. Habitat restoration has also been a priority, with GLLA projects restoring 84 acres of wetland and riverine marshes including Roxana Marsh in East Chicago, Indiana and Seidner Dune and Swale in Hammond, Indiana. In addition, the GLRI has funded the restoration of more than 800 acres throughout the AOC including key dune and swale habitats such as Clark and Pine Nature Preserve, DuPont Natural Area and Gibson Woods Nature Preserve. GLRI-funded projects are expected to conclude in 2020.

Monitoring throughout the restoration process is essential to ensure work is on track to meet restoration goals. IDEM has implemented monitoring projects to assess fish and benthic communities, water chemistry and aesthetics and provides GLRI funds to universities and federal agencies to monitor algal and plankton populations in the river and conduct microbial source tracking at AOC beaches.

SPECIAL STATE CONCERNS AND RECOMMENDATIONS

Reductions in federal and state resources for data collection and analysis coupled with increased federal directives and competing policy and program objectives continue to strain IDEM's ability to optimize its limited resources to monitor Indiana waters in order to support Office of Water Quality (OWQ) programs and emerging state priorities.

IDEM acknowledges that fiscal responsibility may necessitate reductions in funding and staffing levels. In light of these constraints, IDEM recommends the following actions:

- Increase states' flexibility to allocate the federal funding it receives to take advantage of and optimize other funding sources.
- Combine supplemental and base funding to states provided through Clean Water Act (CWA) Section 106 funds so that in lean times, maintaining current monitoring efforts may be considered by the U.S. Environmental Protection Agency (U.S. EPA) as a valid use of supplemental funds.
- Eliminate the use of states' 2002 303(d) lists as the baseline for showing CWA program successes – this is a false construct that fails to recognize that other more recently listed waters may be better candidates for restoration in the short term.
- Acknowledge the continuum of progress demonstrated by social indicators or other factors in addition to measurable water quality improvements.

SURFACE WATER MONITORING AND ASSESSMENT

IDEM conducts most of its surface water monitoring through various programs in the Watershed Assessment and Planning Branch (WAPB). This section includes a discussion of IDEM's surface water monitoring strategy, a description of the assessment methodology for classifying all surface waters according to the degree to which they meet their designated uses, and the most current assessment results available. This section also provides a description of Indiana's Wetlands Program, an analysis of surface water quality trends, and information on public health issues.

SURFACE WATER MONITORING STRATEGY

The United States Environmental Protection Agency (U.S. EPA) recommends that states develop a comprehensive monitoring program strategy for collecting the data and information needed to address its water quality management needs. IDEM developed its first IDEM's Water Quality Monitoring Strategy (WQMS) in 1995 (IDEM, 1995), which has undergone a number of revisions, most recently in 2011 (IDEM, 2010). Table 10 shows the Office of Water Quality's (OWQ's) primary water quality monitoring objectives identified in IDEM WQMS and the types of monitoring needed to meet them.

IDEM's WQMS uses a watershed approach to prioritize water quality management needs and the monitoring activities intended to meet them. Most of IDEM's surface water monitoring is conducted by the WAPB within IDEM's Office of Water Quality (OWQ). The WAPB includes several Clean Water Act (CWA) programs and conducts both targeted and probabilistic (randomized) monitoring to meet the following objectives:

- To fulfill requirements of the CWA Sections 305(b), 303(d) and 314 to assess all waters of the state to determine if they are meeting their designated uses and to identify those waters that are not.
- To support OWQ programs including WQ standards development, NPDES permitting, and compliance.
- To support public health advisories and address emerging water quality issues.
- To support watershed planning and restoration activities.
- To determine WQ trends and evaluate performance of programs.

For its Probabilistic Monitoring Program, IDEM has divided the state into nine major water management basins and employs a rotating basin strategy that targets a different basin each year (Figure 6, Appendix B). IDEM's 305(b) assessment and 303(d) listing processes also follow this rotating basin approach, which ensures that all basins in the state are assessed at least once every nine years.

Probabilistic monitoring is conducted within a given basin and the results are reviewed for quality assurance and quality control in year one. In year two, the quality-assured data are used to make water quality assessments for the basin. These assessments and any waterbody impairments identified through these assessments are reported in the next biennial integrated reporting cycle. Appendix G provides a detailed schedule of IDEM's 305(b) assessment and reporting, and 303(d) listing activities before and after the change made to the rotating basin approach.

IDEM's targeted monitoring programs select sites based on their specific program objectives. Therefore, data collected from these programs in a given year may come from anywhere in the state, which may or may not include the basin monitored by the Probabilistic Monitoring Program that year. These data are likewise quality assured and are assessed as they become available.

The following monitoring programs are employed to achieve the above objectives:

- Probabilistic monitoring in one basin/year on a nine-year rotating basin cycle.
- Fixed station monitoring at 163 sites across the state.
- Fish tissue and sediment contaminants' monitoring on a five-year rotating basin cycle.
- Targeted monitoring for TMDL reassessments and development, watershed baseline planning, and performance measures.
- Cyanobacteria monitoring of 10-12 lakes.
- Special studies such as that conducted to support hydrographically controlled release facilities.

Lakes monitoring is conducted by the Indiana Clean Lakes Program (CLP) under contract for IDEM and is discussed in later sections of this report.

Probabilistic Monitoring Program

IDEM's Probabilistic Monitoring Program samples at least 38 randomly selected sites in a given basin and is the primary source of data used in IDEM's CWA assessments. This program, which focuses specifically on rivers and streams, is designed to characterize the overall water quality in each major river basin and to identify specific waterbodies within each basin that are not fully supporting their beneficial designated uses.

IDEM uses the data collected by the Probabilistic Monitoring Program to make water quality assessments of rivers and streams at two different spatial scales, reach-specific assessments and basin-wide assessments.

Reach-specific Use Support Assessments

IDEM uses the data collected by the Watershed Monitoring Program to make use support assessments of the stream or stream reach from which they were collected and any other reaches for which the results are representative. For these assessments, the water quality data are compared to applicable water quality criteria to determine whether or not the reach or reaches represented by the data are supporting one or more of their designated uses. Results from IDEM's reach-specific assessments are summarized in the "Rivers and Streams Water Quality Assessment" section of this report. In addition to data collected through the Watershed Monitoring program, IDEM also uses data collected by the agency's other water monitoring programs to make reach-specific assessments and may use data from external sources if they meet the necessary data quality requirements.

Comprehensive Use Support Assessments

Comprehensive assessments are statistical calculations that allow IDEM to predict with reasonable certainty the percentage of Indiana's rivers and streams within a given basin that are either impaired or supporting their designated uses. Comprehensive use support assessments are

based solely on the reach-specific assessment results from data collected by the Probabilistic Monitoring Program because, unlike data collected through other IDEM monitoring programs and most external organizations, these data are collected using a probability-based sampling design, which is necessary to make statistically valid calculations.

IDEM's comprehensive use support assessments and its reach-specific assessments of designated use support provide water quality information in two very different ways, and IDEM uses both types of assessments to meet different CWA requirements. The agency's comprehensive assessments, which rely on probabilistic data, provide statistically valid statements about the overall water quality throughout Indiana on a basin level, which allows IDEM to meet the CWA requirement to assess all the waters of the state. These results are stated as the percentage of the total stream miles in each basin meeting their designated uses and the percentage that are impaired. These percentages are statistically derived and cannot be applied to specific streams or stream reaches. Given this, they do not identify where specific impairments exist, which is required by Section 303(d) of the CWA. Information regarding the location of impairments is provided by IDEM's reach-specific results, which are based on data collected from a variety of sources including IDEM's Probabilistic Monitoring Program.

This report provides comprehensive assessments for watersheds in all of Indiana's major basins (Appendix H) in addition to summaries of results from IDEM reach-specific assessments (Appendix I). This report also includes the 2016 draft 303(d) List of Impaired Waters (N), which identifies waters that are impaired for one or more designated uses.

This report builds on the water quality assessment results reported in the 2014 Integrated Report and includes revised assessments for the Patoka River monitored in 2012 and the East Fork White River monitored in 2013. This report also contains assessment information based on total maximum daily loads developed in other basins throughout Indiana.

DATA QUALITY ASSURANCE AND QUALITY CONTROL

To ensure the quality of the data used in IDEM's Clean Water Act Section 305(b) assessments, all surface water monitoring is conducted in accordance with IDEM's quality assurance project plan (QAPP) for its surface water monitoring programs. This QAPP is part of IDEM's overall quality management plan approved by the U.S. Environmental Protection Agency (EPA). IDEM's surface water monitoring QAPP was most recently revised in October 2004 and complies with the 2002 U.S. EPA guidance (U.S. EPA, 2002).

The QAPP outlines specific data quality objectives and serves as a tool for planning for the collection of environmental data to support IDEM Office of Water Quality needs. Additionally, the QAPP describes a well-defined data quality assessment process for reviewing analytical data and categorizing analytical results in one of four levels of data quality. These data quality levels are used to determine the usability of the data for water quality assessments and other decisions.

DATA MANAGEMENT

Management of Water Quality Monitoring Data

IDEM's Watershed Assessment and Planning Branch (WAPB) in the Office of Water Quality (OWQ) maintains its surface water quality data in the Assessment Information Management System (AIMS) database. The AIMS houses several types of data including surface water chemistry data, fish and macroinvertebrate community data, assessments of habitat quality, results from algal monitoring, and fish tissue and sediment contaminant data.

Water chemistry and fish community results from water quality monitoring programs which were collected prior to 2014 have been uploaded into the new U.S. Environmental Protection Agency (EPA) EnviroFacts Data Warehouse through the Water Quality Exchange (WQX). IDEM is continuing modifications to the AIMS database that will improve quality control and usability of results uploaded through the WQX.

Recent modifications to the AIMS database now allow for more efficient datasheet upload and retrieval with additional search functions for faster query building through a user-friendly interface for staff members. AIMS also now allows for storage of additional water quality data from nonpoint source (NPS) projects (including estimated load reductions) and third-party datasets for potential use in assessing waters for the integrated report. IDEM is now receiving data from NPS projects for import into the AIMS database. IDEM is working to develop and implement standard operating procedures for receiving, assessing, and importing water quality data from third-party sources to make them more readily available for potential use in IDEM's water quality assessments.

The load reduction estimates provided by the NPS project sponsors, which are housed in AIMS and reported to U.S. EPA through its Grants Reporting and Tracking System are included in this report (Table 4). The load reductions are estimated using models and are used to assist in the evaluation of water quality sampling data collected by the project sponsors and IDEM WAPB staff.

Management of Water Quality Assessment Information

IDEM's WAPB maintains IDEM's assessment database (ADB). The assessment database houses the CWA Section 305(b) assessment decisions that have been made on the basis of the results stored in the AIMS database.

In the ADB, water quality assessment information is associated with a specific waterbody assessment unit (AU), which is assigned a unique assessment unit identifier (AUID). The geographical extent and location of each AU within a given watershed based on its 12- or 14-digit hydrologic unit code (HUC)[3] is defined for mapping purposes through a process called

[3] Hydrologic unit codes (HUCs) are a numbering system used to identify watersheds at various scales. The length of the code corresponds to the relative size of the watershed with 12- or 14-digit HUCs assigned to smaller watersheds that lie within larger watersheds, which are identified by 8- or 10-digit HUCs.

reach indexing. Reach indexing uses tools that work within geographical information systems (GIS) software to associate one or more reaches of a given waterbody to a single AU and to "key" these AUs to the National Hydrography Dataset (NHD)[4]. This "key" is called the Reach Index. By associating the information in the ADB to its geographic location, the Reach Index allows IDEM to display assessment information on a map through the use of GIS software.

Indiana lakes and reservoirs, including Lake Michigan, are each treated as a single AU and assigned an AUID based on the 12- or 14-digit watershed in which they are located. Sizes are reported in acres.

Indiana's Lake Michigan shoreline is divided into five separate AUs with AUIDs based on the 8-digit HUC in which each shoreline reach is located. The shoreline is measured and reported in miles.

All flowing waters are measured and reported in miles. The Ohio River is divided into 69 AUs ranging in size between 2-14 miles and with AUIDs that are likewise associated with the 8-digit HUCs in which they are located. Other Indiana rivers and streams in the Reach Index may be divided or combined into one or more AUs, each of which is assigned an AUID based on the 12-digit HUC in which it is located. The length of a stream AU can vary, and a single AU may or may not represent the entire stream to which it is associated. For example, large rivers are commonly broken into smaller, separate AUs while smaller streams may be grouped together into a single, "catchment" AU based on hydrology and other factors that can affect water quality. More detailed information on how IDEM determines the size extent of a given AU is provided in its Consolidated Assessment and Listing Methodology (Appendix N).

IDEM's biennial Integrated Report (IR) to U.S. EPA includes the ADB. U.S. EPA extracts the data contained in the ADB for incorporation into its Assessment, TMDL Tracking and Implementation System (ATTAINS). ATTAINS is a national database U.S. EPA uses to evaluate assessment data submitted by states and to make those data available to the public online.

In 2014, U.S. EPA convened four workgroups to redesign ATTAINS. These workgroups were comprised of headquarter and regional staff along with staff from several state agencies. IDEM participated in two of these workgroups to help:

- Define the data elements needed in the redesigned ATTAINS.
- Draft an extensible markup language schema for exchanging integrated reporting information between the states and U.S. EPA.
- Develop recommendations on data exchange approaches and system design.

[4] The NHD is a database created by the U.S. EPA and the United States Geological Survey that provides a comprehensive coverage of hydrographic data for the United States. It uniquely identifies and interconnects the stream segments that comprise the nation's surface water drainage system and contains information for other common surface waterbodies such as lakes, reservoirs, estuaries, and coastlines.

The new ATTAINS became available for states to begin using in late 2015. In 2016, IDEM will begin migrating the assessment data presently housed in its ADB to the new ATTAINS online. Once this process is complete and the data verified, IDEM will begin entering its water quality assessments and other integrated reporting information directly into ATTAINS instead of sending its ADB to U.S. EPA for upload into the system.

WATER QUALITY ASSESSMENTS

Indiana's water quality standards (WQS) provide the basis for IDEM's Clean Water Act (CWA) Section 305(b) water quality assessments and are intended to protect the beneficial uses for Indiana waters. IDEM's water quality assessments determine the degree to which Indiana's waterbodies are supporting aquatic life use, recreational uses, and fishable uses. IDEM also assesses drinking water use support on surface waters that serve as a public water supply. There are additional uses for Indiana waters described in the state's WQS. However, IDEM limits its assessments to these four because the criteria in place to protect them are more stringent than those necessary to protect other uses. Thus, by protecting these uses, other uses such as agricultural and industrial uses are also protected.

Water Quality Data Used to Make Designated Use Assessments

IDEM uses all existing and readily available data to make its CWA Section 305(b) water quality assessments, including data collected by IDEM's water quality monitoring programs as well as external sources whenever possible. Internally, IDEM draws from the following Office of Water Quality (OWQ) monitoring programs:

- Probabilistic Monitoring Program
- Fixed Station Monitoring Program
- Contaminants Monitoring Program
- Performance Measure Monitoring Program
- Special Studies Program
- Watershed Characterization Program

In addition to the water quality data IDEM collects, the agency reviews data from other sources for potential use in its CWA assessments, including data collected through partnerships with other state and federal agencies and by nonpoint source grant projects, including the Indiana Clean Lakes Program (CLP).

IDEM is committed to making greater use of external data not only in its CWA Section 305(b) assessments but wherever possible in all OWQ programs. On September 23, 2015, IDEM launched its External Data Framework (EDF) to provide a systematic, transparent, and voluntary means for external organizations to share the water quality data they collect with IDEM for possible use in its CWA assessment and listing processes and other OWQ programs.

A number of organizations submitted their data sets in response to solicitations conducted by IDEM when the EDF was still under development. IDEM was able to complete its review of

these data and found that the external data sets shown in Table 11 (Appendix A) met the necessary data quality requirements for the 305(b) and 303(d) assessment and listing processes that were in place at the time they were submitted. However, with continued development of EDF, these requirements have since been revised.

In addition, the data sets in Table 11 were not standardized in any way in terms of their format or the data quality documentation provided. The time and staff resources required to review data sets from varied sources in various formats and with various levels of data quality documentation have long been significant barriers to the use of external data in the development of state 303(d) lists. The EDF will remove these barriers going forward.

For the 2016 cycle, IDEM focused its resources on completing development of the EDF rather than investing the significant time that would be required to re-evaluate data sets that may no longer be representative of current conditions. Now that the EDF is complete, IDEM will contact early EDF participants and work with them directly to submit any more current data they might have through one of the three data submittal processes built into the EDF. These processes are designed to facilitate broader solicitation and more efficient data quality review of external data going forward. In cases where the data set originally submitted are the only data available for the waterbody in question, IDEM will evaluate the data set as time allows to determine if the results are reliable for assessment despite their age.

External organizations can learn more about the EDF and how to participate on the agency's EDF website at http://in.gov/idem/cleanwater/2485.htm. Those interested in sharing their water quality data through the EDF and may begin submitting data sets to IDEM in one of three ways through the Secondary Data Portal at: http://www.hoosierriverwatch.com/portal/

Water Quality Assessment Methodology

IDEM's CWA Section 305(b) water quality assessments are conducted in accordance with its Consolidated Assessment and Listing Methodology (CALM), which is provided in Appendix N.

Water quality assessments are made for each designated use and waterbody type by comparing the available with the applicable WQS following the methods articulated in the CALM and summarized in Table 12 (Appendix A). Assessment results are then entered into IDEM's Assessment Database, which IDEM uses to compile its Consolidated List and 303(d) List of Impaired Waters.

Assessment Methods for Public Water Supply

IDEM's methods for determining support of the public water supply (previously referred to as the "Drinking Water Use") have changed very little since 2002 when IDEM published its first CALM. While these methods provide the ability to make assessments for a wide variety of potential drinking water contaminants, generally, there is very little data available for use in making such assessments. In addition, for lakes and reservoirs, IDEM's method for determining whether the source water is supporting the public water supply use relies solely on whether or

not a facility has applied for a permit to apply chemicals on the waterbody to control algae – an indirect measure of use support lacking the follow-through necessary to determine whether the chemicals were in fact applied.

Given these issues, IDEM convened an internal work group in 2015 to review the current methodology and explore ways to improve the assessment of the quality of surface waters designated as source waters for public water supplies. The result of this effort is a new set of methods for determining use support for waters that serve as a source of public water supply.

IDEM has published these methods in its notice of comment period for the draft 2016 303(d) list (Appendix L). IDEM hopes to implement these methods beginning with the 2018 integrated reporting cycle. However, further refinements may be needed based on the information received during the public comment period. In the meantime, although IDEM currently lacks the resources to support a new monitoring program dedicated to monitoring source waters for public water supplies, IDEM is continuing to explore strategies for increasing the amount of available data for source water assessments. IDEM believes that these methods, coupled with more readily available data for assessments, will result in greater protection of Indiana's public water supplies going forward.

Assessment Methods for the Ohio River

For the Ohio River, IDEM collaborates with the Ohio River Sanitation Commission (ORSANCO) to conduct water quality assessments of the river reaches that border Indiana. ORSANCO is an interstate water pollution control agency for the Ohio River established through a compact agreement between member states and approved by Congress. Under the terms of the compact, member states cooperate in the control of water pollution in the Ohio River Basin.

ORSANCO collects most of the data used to make assessments and works with the compact states to determine the degree to which the Ohio River is meeting its designated uses. Based on the results of this collaborative assessment, ORSANCO produces a CWA Section 305(b) water quality assessment report for the Ohio River every two years. Member states then incorporate those results into their individual CWA 303(d) lists in accordance with their individual 303(d) listing methods. A more detailed discussion of the Ohio River assessments can be found in IDEM's CALM (Appendix NAppendix N).

Although the assessment methodology for the Ohio River differs somewhat from the methods IDEM uses to assess other Indiana rivers and streams, the assessment results for all rivers and streams in Indiana, including the Ohio River are combined for the purposes of this report.

REPORTING WATER QUALITY ASSESSMENT RESULTS

Indiana's Consolidated List

For the purposes of CWA 305(b) reporting, IDEM employs a multi-category approach to develop the state's Consolidated List, which provides a full inventory of all Indiana waters IDEM tracks in its ADB and information regarding the degree to which they are supporting their designated uses.

With a multi-category approach, every waterbody in the ADB is placed into one of five categories (or subcategories where applicable) for each of the following designated uses: aquatic life use, recreational use, fish consumption[5], and public water supply[6].

For each use, a waterbody is assessed as fully supporting when it is found to be meeting the WQS applicable to the use. When a waterbody is not meeting one or more of the applicable standards, it is considered impaired, meaning it is not fully supporting the use. Figure 7 in Appendix B illustrates the decision-making process IDEM uses to determine the appropriate category for each use for which a waterbody is designated. A more detailed explanation of the five categories and their subcategories is provided in IDEM's CALM (Appendix N). The following provides a summary:

Category 1	The available data and/or information indicate that all designated uses are supported and no use is threatened.
Category 2	The available data/or information indicate the individual designated use is supported.
Category 3	The available data and/or other information are insufficient data to determine if the individual designated use is supported.
Category 4	The available data and/or information indicate that the individual designated use is impaired or threatened but a total maximum daily load (TMDL) is not required.
Category 5	The available data and/or information indicate the individual designated use is impaired or threatened, and a TMDL is required.

Indiana's Consolidated List for 2016 is provided in Appendix I and includes the results of all assessments of Indiana waters to date.

[5]Fish consumption is not a designated use in Indiana's WQS. IDEM assesses Indiana waters for fish consumption pursuant to current U.S. EPA policy and in keeping with CWA goals, which are reflected in Indiana's WQS (327 IAC 2-1-1.5 and 2-1.5-3.

[6]Applicable only to waters that serve as a routine or emergency source of water for a public water system.

Indiana's 303(d) List of Impaired Waters

The 303(d) List of Impaired Waters is a subset of the Consolidated List and includes only Category 5 waters – those for which a TMDL is required. Unlike the Consolidated List, which is required under CWA Section 305(b), the CWA Section 303(d) List of Impaired Waters is subject to U.S. EPA approval.

On May 8, 2013, U.S. EPA partially approved Indiana's 2010 303(d) List of Impaired Waters. U.S. EPA's partial approval is based on concerns regarding IDEM's methods for evaluating metals data for the purposes of determining impairment. More detail about these concerns and IDEM's response to them can be found online at: http://www.in.gov/idem/nps/3889.htm.

The issues delaying full approval by U.S. EPA remain unresolved. In the meantime, IDEM has continued to conduct water quality assessments and remains committed to reporting the results of its assessments to the public.

To ensure that Indiana's 303(d) list contains the most up-to-date assessment information, each 303(d) list builds upon the list developed for the previous two-year reporting cycle. Therefore, to develop its 2012 303(d) List of Impaired Waters, IDEM used the approved portion of the 2010 303(d) list as a starting point. IDEM used the same approach to develop the 2014 303(d) list and now, the draft 2016 303(d) list, building each from the list submitted for the previous cycle.

The Notice of Public Comment Period, which includes the draft 2016 Section 303(d) Impaired Waters List (Category 5 of the Consolidated List) and the Consolidated Assessment and Listing Methodology used to develop it is included in Appendix L of this report. The draft 2016 303(d) list reflects the most current information IDEM has regarding the status of impairment of Indiana's surface waters.

CLEAN WATER ACT SECTION 305(B) ASSESSMENTS

This report provides summary assessment results for designated use support for waters throughout Indiana based on waterbody type. Lakes and reservoirs are each assigned a single AUID with sizes reported in acres. Due to its large size and unique characteristics as compared to other freshwater lakes in Indiana, Lake Michigan and its shoreline are each discussed in separate sections of this report. Results for Lake Michigan reported in acres, and results for the shoreline are reported in miles. Assessment information for rivers and streams are likewise discussed in a separate section of this report with results given in miles.

Each section provides a table summarizing designated use support by individual use and total size in miles or acres. It should be noted that these values are not additive because a single waterbody is typically designated for at least three uses and sometimes four. Thus, adding the total values reported for each use would result in far more stream miles and lake acres than what actually exists in Indiana.

Summary results regarding the causes/stressors and sources of impairment are also provided for each water body type. As with the values in the summary tables for designated use support, the summary values in each table should not be added because doing so will artificially inflate the number of miles or acres actually impaired. A summary of the total number of impaired waters in Indiana waters to date is provided in Appendix O.

Causes of impairment identified in the summary tables are those pollutants or other stressors that contribute to the actual or threatened impairment of designated uses in a waterbody. In some cases, only the symptom(s) of impairment can be identified. For example, IDEM may have evidence that biotic communities in a waterbody are impaired but the data are insufficient to determine the actual pollutant or stressor causing the impairment. In these cases, the symptom – impaired biotic communities – are treated as the cause of impairment for the purposes of this report.

The sources shown in the summary tables are the activities that contribute the pollutant(s) or create other stressors that result in impairment of a designated use. For most assessments, the sources identified at the time of assessment for a given impairment are not precisely known, this is because IDEM's monitoring and assessment processes are designed to identify impairments, not specific sources.

Accurately attributing a given impairment to specific sources is difficult at best without more detailed and resource intensive sampling and analyses than and is in many cases impossible to do with a high degree of certainty. This kind of monitoring is typically conducted with watershed characterization monitoring during total maximum daily load (TMDL) development, which must identify the sources of impairment to a waterbody and develop recommended loadings to support its restoration.

The sources identified during the assessment process and summarized in the following sections represent those sources determined by IDEM staff to be the most likely sources given a variety of factors, including but not limited to:

- Land uses (as indicated by field observations and land use data from published sources such as the U.S. Geological Survey Gap Analysis Program, aerial photography, etc.).
- Field observations of potential sources such as illegal straight pipes, tillage to the stream's edge, livestock in the stream, etc.
- The presence of permitted facilities within close proximity of the impaired waterbody in cases where the impairment is something that could reasonably be expected to be associated with the discharge of those facilities.
- Naturally occurring conditions that could contribute to impairment.

IDEM believes that by using best professional judgment, scientists can distinguish the most likely sources of impairment in the watershed and provide a starting point for a TMDL, watershed planning or other activities aimed at restoring the waterbody.

Rivers and Streams Water Quality Assessment

Rivers and streams are assessed for support of aquatic life use, recreational uses, and fish consumption. Where there is sufficient data, rivers and streams that serve as a source water for a public water supply are also assessed to determine the degree to which they support such use.

The number of stream miles in Indiana that have been assessed to date, and the number of miles fully supporting and impaired are shown for each individual use in Table 13 (Appendix A).

Table 14 (Appendix A) represents the total miles of streams affected by each cause/stressor in Indiana. These tables include identified causes of impairment and symptom of other unknown causes, including impaired biotic community status. For these impairments, the fish and/or benthic macroinvertebrate communities have been found to be impaired by substances or stressors not yet identified.

Table 15 (Appendix A) includes all the potential sources driving one or more of the impairments in Table 14, and the total stream miles impaired due to each. Potential sources include agricultural sources and sources resulting from urban activities and land development. Illicit connections identify "straight pipes" from buildings in unsewered areas that flow into state waters with no or insufficient treatment. Contaminated sediments are largely due to polychlorinated biphenyls (PCBs) that correlate with elevated PCB levels in fish tissue.

Great Lakes Shoreline Water Quality Assessment

Indiana's entire portion of the Lake Michigan shoreline was last assessed in 2001 and was found to be fully supporting of aquatic life use and fully supporting its use as a public water supply for the 33 miles so designated. All 59 miles of the shoreline in Indiana were assessed as impaired for recreational use and fish consumption.

The required total maximum daily loads for the shoreline's recreational uses have been approved by U.S. EPA in 2004: http://www.in.gov/idem/nps/2856.htm. As a result, the *E. coli* impairments for which the shoreline has been assessed now appear in Category 4 of Indiana's Consolidated List while the fish consumption impairments for PCBs and mercury in fish tissue remain in Category 5 (Indiana's 303(d) list).

IDEM's assessment results are summarized in Table 16 (Appendix A). The specific causes of impairment to Indiana's Lake Michigan shoreline are reported in Table 17 (Appendix A), and the potential sources are summarized in Table 18 (Appendix A).

Lake Michigan Water Quality Assessment

Because Lake Michigan is assessed as a single unit, any impairment identified in any part of the lake is applied to all 154,176 acres of Lake Michigan. Assessments made in the Indiana waters of Lake Michigan indicate impairment for mercury and PCBs in fish tissue. Tables 19-21 in Appendix A reflect the results of these assessments.

Lake Water Quality Assessment

IDEM conducts two types of assessments on Indiana Lakes and Reservoirs. CWA Section 314 requires states to report on the trophic status and trends of all publicly owned lakes in Indiana, and CWA Section 305(b) requires states to report on the degree to which Indiana's lakes and reservoirs are supporting their designated uses. Both types of assessments and the methods with which they are conducted are described in IDEM's CALM (Appendix N).

IDEM evaluates lakes primarily for recreational uses and fish consumption for the purposes of CWA Section 305(b) assessments. While IDEM monitors several lakes and reservoirs for fish consumption, other types of monitoring for CWA Section 305(b) designated use support assessments of Indiana lakes is limited. As a result, IDEM's assessments have relied primarily on external data collected through the Indiana Clean Lakes Program for the purposes of CWA Section 314 assessments.

The monitoring conducted by the Indiana CLP provides results for all the parameters necessary to calculate an Indiana trophic state index (TSI) score, which allows IDEM to make both CWA Section 314 trophic state assessments and some CWA Section 305(b) assessments for recreational use. However, neither the individual parameter results nor the TSI scores are considered sufficient for determining the condition of biological communities for the purposes of Section 305(b) assessments for aquatic life use support.

Use support assessments of lakes and reservoirs for public water supply are also limited but for different reasons. Compared to other designated uses, which apply to all waters of the state, these assessments are made only to the relatively few lakes and reservoirs in Indiana that are used directly or indirectly as source water for public water supplies.

IDEM's assessment methods for CWA Section 305(b) assessments of lakes and reservoirs are described in more detail in its CALM (Appendix N, Attachment 1). Summary assessment results for the 2016 cycle are provided in Tables 22-24 (Appendix A).

CLEAN WATER ACT SECTION 314 ASSESSMENTS

Section 314 of the federal Clean Water Act (CWA) requires states to report on the trophic status and trends of all publicly owned lakes in Indiana. To determine the trophic state for a given lake (the amount of biomass present at the time the measurement is taken), IDEM uses Carlson's Trophic State Index (TSI), which can be calculated for three variables, each of which can be used as independent indicators of the trophic state of the lake or reservoir in question. The three indicators used are Secchi depth (SD), total phosphorus (TP), and Chlorophyll-*a* (CHL). Although any of the three could be used to determine trophic state, IDEM uses the TSI for CHL to make its trophic state assessments because CHL concentrations provide a more direct measure of phytoplankton abundance than SD or TP. Lakes are classified based on their TSI (CHL) scores. Higher scores are an indicator of nutrient enrichment, which can come from both natural sources and sources related to human activities. Details on how the TSI (CHL) scores are calculated can be found in IDEM's CALM (Appendix N).

For the purposes of this report, Indiana lakes were placed into one of four classes based on their trophic state as measured by the Carlson TSI (CHL) score. These classes are shown in Table 25 (Appendix A). A summary of the trophic status information for lakes assessed to date is presented in Table 26 (Appendix A).

Lake trends based on changes in trophic status over time as indicated by TSI scores are summarized in Table 27 (Appendix A). Approximately 19 percent of the lakes assessed to date (20 percent of the acres assessed) show some water quality improvement as measured by a reduction in their trophic scores. Forty-one percent of the lakes assessed (23 percent of the acres assessed) appear to have relatively stable trophic conditions. Thirty-six percent of the lakes assessed to date (53% of the total acres assessed) show an increase in their trophic scores indicating that the trophic conditions are degrading.

The water quality trend is fluctuating for four percent of the lakes (four percent of the acres assessed). For these lakes, the lack of detectable trend may be due to abnormal seasonal effects or changing activities in the surrounding watershed. An unknown trend is used in this report in cases where the available data are insufficient to determine a trend.

Waterbody-specific results for trend and trophic status and trends for Indiana's lakes and reservoirs statewide are provided in Appendix J.

PUBLIC HEALTH/AQUATIC LIFE CONCERNS

The release of toxic materials into the aquatic environment can produce harmful impacts:

- Contaminants present in acutely toxic amounts can directly kill fish or other aquatic organisms.
- Substances present in lesser, chronically toxic amounts can reduce densities and growth rates of aquatic organisms and/or become concentrated in their body tissues. These substances can be further passed to humans through consumption of the organism.
- Toxic materials in the water could potentially affect human health by contaminating public water supplies.

Fish Consumption

In the last several years, advances in analytical capabilities and techniques and the generation of more frequent and higher quality toxicity information on chemicals have led to an increased concern about their presence in the aquatic environment and the associated effects on human health and other organisms. Because many pollutants are likely to be found in fish tissue and bottom sediments at levels higher than in the water column, much of the data on toxic substances used for fishable use assessments in this report were obtained through IDEM's Contaminants Monitoring Program.

While not all species of fish found in Indiana lakes and streams have been tested, carp are commonly found to be contaminated with both polychlorinated biphenyls (PCBs) and mercury at levels exceeding the state's benchmark criteria for these contaminants in fish tissue. Waterbodies in which exceedances are found are considered impaired for fish consumption and placed on Indiana's 303d) List of Impaired Waters.

Fish consumption assessments are reported separately from aquatic life use in order to provide more information about each individual use. Concerns related to fish consumption should be evaluated independently by referring to the Indiana State Department of Health (ISDH) fish consumption advisories online at: http://www.in.gov/isdh/23650.htm. The 303(d) List of Impaired Waters is not designed to provide public health information whereas the fish consumption advisory is and as such is far more reliable for using in deciding how much fish might safely be consumed from a given waterbody.

Cyanobacteria and Algal Toxins

Blue-green algae (cyanobacteria) continue to be a concern in Indiana lakes and reservoirs both with respect to recreational uses and public water supply for drinking water. Blue-green algae are common constituents of algal communities in lakes and many are known to produce potent toxins, which are now recognized as a potentially serious threat to human and animal health. Microcystin is the cyanotoxin most commonly monitored. In 2010, IDEM piloted a targeted monitoring effort to support the development of an interagency process for the development of public health advisories for blue green algae and algal toxins. Monitoring is conducted statewide at 14 swimming areas owned or managed by the Indiana Department of Natural Resources (IDNR) on a monthly basis from May through August. Sampling frequency is increased to biweekly for lakes where cyanobacteria densities are found to be greater than 100,000 cells per milliliter, as recommended by the World Health Organization.

The public is kept informed of the status of the sampled swimming areas by the www.algae.IN.gov website and the IDNR site for the specific property. IDEM's website also incorporates public health information related to blue-green algae from the ISDH and the Board of Animal Health (BOAH) as well as other relevant information from government agencies and educational institutions. When the two-year grant period for the pilot project ended, IDEM incorporated a blue-green algae monitoring program as a part of its overall water monitoring strategy.

In 2010, IDEM also contracted with Indiana University's School of Public and Environmental Affairs (SPEA) to conduct a different, but related, pilot project to monitor Microcystin at all of the same lakes to be monitored for the Indiana Clean Lakes Program (CLP). Like the Microcystin monitoring conducted by IDEM, it is anticipated that the results from this monitoring will help IDEM to better understand the environmental variables associated with blue-green algal blooms and Microcystin production. However, results from the CLP Microcystin monitoring are not used to support the development of public health advisories because they are collected for a different purpose and use different methods than those used by IDEM to conduct its sampling.

IDEM does not use information collected through these monitoring programs to make 305(b) assessments because the environmental factors that influence the occurrence and production of algal toxins are still not well understood, and there are no federal drinking water standards for blue-green algae. However, algal toxins now appear on U.S. Environmental Protection Agency's (EPA's) federal drinking water contaminant candidate list (CCL 3), which is used to prioritize federal research and data collection efforts to help determine whether a specific contaminant needs to be regulated. Details regarding U.S. EPA's CCL are available online at: http://water.epa.gov/scitech/drinkingwater/dws/ccl/ccl3.cfm#microbial. It is anticipated that as more scientific information becomes available, including the development of a federal water quality criteria for algal toxins, it may be possible to develop water quality assessment methods that will allow IDEM to determine the impact that algal toxins may be having on designated uses of Indiana waters.

Fish Kills and Chemical or Other Spills

A diverse and healthy fish community is considered an indication of good water quality. Serious public concern is often raised when dead and dying fish are noted in the aquatic environment because fish kills are sometimes evidence of a severe water quality problem. Fish kills also have the potential to impair the use of the waterbody in the short or long term. A fish kill can occur as a result of:

- An accidental or intentional spill of a toxic compound or oxygen depleting substance into the aquatic environment.
- A continuous industrial or municipal discharge due to a system upset which can result releases of atypical or unusually high concentrations of pollutants.
- Natural causes such as disease, extreme drought or depletion of dissolved oxygen from extreme weather conditions.

IDEM's Office of Land Quality tracks spills and fish kills that are reported to IDEM or discovered by agency staff. The total number of calls, spills, and kills recorded from 1998 to 2015 are listed in Table 28 (Appendix A).

GROUND WATER ASSESSMENT

In order to be eligible for Clean Water Act (CWA) Section 106 grant funds, Indiana is required to have the means to monitor water quality and to annually update water quality data and include the results in their biennial Integrated Reports (IR) to U.S. Environmental Protection Agency (EPA). While the IR requirement pertains primarily to navigable waters, U.S. EPA guidance suggests that state updates should also include ground waters to the extent practicable. This section provides a summary of Indiana's ground water monitoring and protection programs, ground water/surface water interactions within Indiana, and ground water quality and ground water contamination sources.

INTRODUCTION TO INDIANA GROUND WATER

Ground water is an important resource for Indiana citizens, agriculture and industry. The majority of Indiana's population relies on ground water for drinking water and other household uses. IDEM's 2014 Annual Compliance Report for Indiana public water supply (PWS) systems is online at: http://in.gov/idem/cleanwater/files/dw_compliance_report_2014.pdf.

Major Sources of Ground Water Contamination

The major contaminant sources impacting Indiana ground water are listed by general activity types in Table 29 (Appendix A). All sources listed are a potential threat to ground water. However, the degree to which the source is a threat to ground water depends on several factors with the most significant being hydrogeologic sensitivity. Other major risk factors include location of the contaminant source relative to drinking water sources, toxicity of the contaminant and the size of the population at risk. All risk factors listed in Table 29 were considered in the selection of the 10 priority contaminant sources, and those risk factors relevant to the highest priorities are identified. Classes of contaminants commonly associated with each high priority contaminant source are also given. Due to resource constraints, this information has not been significantly updated since the 2000 305(b) report. However, anecdotal evidence indicates the same major contaminant sources are impacting Indiana ground water now as they were at that time.

Fertilizers

Nitrate is a potential contaminant from commercial fertilizer and animal manure applications to farm land, and septic systems, all of which are considered high priority sources of potential contamination to Indiana ground water. Nitrate is a highly mobile and soluble contaminant and is most frequently detected in ground water contaminant in rural areas. However, determining the specific sources of nitrates detected in ground water can be difficult and costly.

When applied at the proper rate and time, commercial fertilizer poses little threat of contamination to ground water. Purdue University Cooperative Extension Service staff, Natural Resource Conservation Service staff, and private consultants assist crop producers in developing nutrient management plans that focus on meeting crop nutrient needs.

On July 28, 2010, the Indiana rule requiring certification for distributors and users of fertilizer materials (355 IAC 7-1-1) became effective and is administered through the Office of the Indiana State Chemist (OISC). The rule was supported by a variety of agricultural groups and other stakeholders who envisioned this as an opportunity for fertilizer material applicators and distributors to demonstrate their competency to handle and apply these materials safely and effectively. In addition, the rule provides a statewide standard for applicator certification and training.

For purposes of this rule, "fertilizer material" is defined to mean both commercial fertilizer and manure from a confined feeding operation (CFO). Any person hired to apply, handle, or

transport fertilizer material for the purposes of producing an agricultural crop must be certified and licensed by OISC. Alternatively, he or she must be trained and supervised by a certified applicator and be working for a licensed fertilizer business. Any person applying manure from a CFO (in excess of 10 cubic yards or 4,000 gallons per year) to his/her own property must be certified by OISC as a private fertilizer applicator. Any person, partnership, corporation, or business that only distributes but does not use fertilizer material must obtain a fertilizer distributor business license.

Confined Feeding Operations

Livestock and poultry confined feeding operations exist throughout Indiana and are an integral component of Indiana's agricultural economy. The primary concerns associated with CFOs are the proper storage and land application of the large volumes of manure produced by these operations. The manure is applied to farmland to recycle the nutrients to fertilize crops. Manure contains ammonia-nitrogen which is converted to nitrate through biological processes in the soil. Consequently, the rate of manure application to farmland is a major concern when the application provides more nitrogen than a crop will use. Because excess nitrogen can move beyond the crop root zone and potentially into underlying aquifers, Indiana's current regulations for CFOs require the proper design and construction of manure storage structures and the application of manure to land in a manner that protects ground and surface water quality. Crop nutrients contained in manure are available at a slower rate than commercial fertilizer nutrients due to the rate of decomposition of the manure. Therefore, when applied at the proper agronomic rate, manure poses little threat of contamination to ground water.

Septic Systems

Properly constructed and maintained septic systems provide satisfactory on-site treatment of domestic wastewater in rural and unsewered suburban areas of Indiana. However, improperly constructed or poorly maintained septic systems, as well as systems operating in areas of high seasonal water tables or other ground water sensitive areas, are also of concern as a source of nitrate contamination to ground water.

Landfills and Underground Storage Tanks

Landfills and underground storage tanks are a high priority concern for ground water largely due to practices or activities that occurred prior to construction standards and legislation established for the protection of ground water. Landfills constructed after 1988 have been required to adhere to stringent construction standards. Since then, all underground storage tank registrations, upgrades, closure activities and site assessments have been closely reviewed by the IDEM's Underground Storage Tank (UST) Section.

IDEM ensures that all regulated UST system owners and operators properly registered, upgraded and/or closed existing UST systems in accordance with state requirements. Currently, IDEM inspects all USTs systems at least once every three years to ensure that systems are properly designed and operated for corrosion protection, spill and overfill protection, and leak detection in

order to prevent releases or ensure early detection of releases. UST systems that are no longer in use are inspected to ensure they are properly closed. In addition, IDEM ensures that all confirmed releases to the environment of petroleum and hazardous substances are cleaned up as necessary to protect human health, including those released into ground water.

Underground Injection Wells

Class V underground injection wells are widespread throughout the state and occur in high concentration in several areas, including some areas where ground water is highly sensitive to contamination. Most Class V wells are shallow wells that are used by business and individuals to dispose of a wide variety of waste fluids into the ground. Under current regulation, Class V wells may be used to dispose of non-hazardous fluids only. However, this was not always the case.

Prior to 2000 when the U.S. Environmental Protection Agency (EPA) passed more intensive regulations and enforcement for Class V wells, they were sometimes used to dispose of potentially hazardous fluids. These older wells create the potential for groundwater contamination if the fluids they contain are hazardous and leach into or above aquifers supplying drinking water. These wells are regulated directly through the U.S. EPA Class V Underground Injection Control Program, which targets the wells that pose the greatest environmental risk.

Industrial Activities

Several cases of ground water contamination due to industrial facilities or their ancillary operations have been documented in Indiana. Although many contamination events occurred prior to the development of regulations for the storage and handling of industrial materials, ground water contamination still occurs as a result of either accidents or intentional dumping of waste. In 1998, Indiana's Secondary Containment of Above-Ground Storage Tanks Containing Hazardous Materials Rule (327 IAC 2-10) was adopted. This rule requires that new facilities provide secondary containment for storage of 660 gallons or more of hazardous wastes if the facility is located outside an approved delineated wellhead protection area. However, if the facility is located within an approved delineated wellhead protection area, the tank requires secondary containment if 275 gallons or more of hazardous materials are stored there. The secondary containment rule, along with outreach and education programs, has helped to prevent further ground water contamination from the storage and handling of industrial materials. However, these activities continue to be a potential source of contamination to ground water in Indiana.

Road Salts

The storage and extensive use of salt as a deicing agent during the winter months can also have an impact on ground water, and contamination from road salt has been documented in Indiana. Efforts are being made by the Indiana Department of Transportation (INDOT) to build salt storage facilities in areas where ground water is not sensitive to contamination and to upgrade existing facilities to protect ground water. Currently, all INDOT salt storage facilities are covered by domes or canopies, and several new facilities were built to contain all surface runoff

on-site to reduce ground water contamination. In addition, road salt use and application rates have been significantly reduced from past years through computerized weather forecasting and roadway temperature sensors.

Spills

Ground water contamination as a result of spills can be avoided or minimized if spills are reported to IDEM, which helps to ensure that they are handled and cleaned up properly. Indiana has a law in place to ensure that spills with the potential to contaminate ground water are reported and managed in a way that minimizes their impact (327 IAC 2-6.1).

Ground Water Protection Programs

Programs that conduct monitoring to evaluate and protect ground water resources in Indiana occur at all levels of government. At the state level, several ground water protection programs and activities have been implemented or are in the process of being implemented. Table 30 (Appendix A) lists key ground water protection programs and activities in Indiana, the developmental stage of the program or activity, and the agency or agencies responsible for the program's implementation and/or enforcement.

Classification of Indiana's Ground Water Resources

Indiana's ground water quality standards became effective in March 2002. The language of the rule includes numeric standards that provides ground water protection for wells and allows for the classification of ground water. The rule states that all ground water of the state shall be classified as drinking water class ground water unless it is classified as limited class ground water or impaired drinking water class ground water. IDEM may classify ground water as limited when ground water is shown to have a yield of less than 200 gallons per day or a total dissolved solids concentration of more than 10,000 parts per million (ppm). Additionally, ground water that is in the crop root zone, in a coal mined area, or in an injection zone of a permitted Class I, II or III injection well or gas storage well may be considered limited. IDEM may classify ground water as impaired when specific conditions are also met. These conditions include, but are not limited to:

- The ground water is not in a state approved wellhead protection area established pursuant to 327 IAC 8-4.1.
- The ground water has one or more contaminant concentrations above the numeric criteria established in the rule.
- The commissioner has approved a ground water remediation, closure, cleanup or corrective action plan that describes the nature and extent of contaminants exceeding the criteria.

Source Water Assessment Program

In 2000, U.S. EPA approved Indiana's Source Water Assessment Program developed by Indiana stakeholders. IDEM has prepared source water protection plans (SWAPs) for public water systems with the exception of community water systems that instead use ground water as their primary source of water. Those community ground water systems are required by the Indiana Wellhead Protection Rule (327 IAC 8.4.1) to prepare a wellhead protection plan for each well or well field that provides water to the public. Since 2000, source water areas for more than 3,600 public water systems have been delineated. IDEM has also inventoried the potential sources of contamination of these source water areas from regulated facilities and has assessed water system susceptibility to contamination. As of the end of 2008, IDEM distributed all SWAPs for Indiana's public water systems to their owners. As a result of this effort, IDEM's Source Water Assessment Program is completely implemented and satisfies the requirements of the Source Water Assessment Program as defined by IDEM and accepted by U.S. EPA Region 5.

Wellhead Protection Program

The Indiana Wellhead Protection Rule (327 IAC 8-4.1) became effective in March 1997. IDEM's Wellhead Protection Program implements this rule to proactively protect public water supplies from contamination. The Wellhead Protection Rule outlines the minimum requirements community public water supplies must meet to comply with the Wellhead Protection Program. As of October 2009, 633 (close to 98 percent) of Indiana's community water systems using ground water as their source of drinking water have an approved wellhead protection plan. Having an approved Wellhead Protection Plan indicates that a community has met the requirements of the Indiana Wellhead Protection Rule and has developed strategies to adequately protect their community water supplies from becoming contaminated.

Other Programs Working to Protect Indiana's Ground Water Resources

In addition to regulatory programs and other structured ground water protection activities listed in Table 30, there are several educational programs conducted in Indiana that place an emphasis on ground water protection. The Purdue University Extension Service's Safe Water for the Future Program serves as an umbrella program for several other programs that provide resources on drinking water protection for individuals and communities. The Farm*A*Syst and Home*A*Syst Programs are essentially wellhead protection programs for rural and domestic private wells. A series of publications and brochures on wellhead protection are also available to assist communities working on wellhead protection. "Watershed Connections" brings together local contacts to produce a community specific publication on water resources and their protection.

The Indiana Department of Natural Resources' Project WET (Water Education for Teachers) and Purdue University Extension Service's "Water Riches" Program are two general water education programs that provide information about ground water protection. The Purdue University Cooperative Extension Service's Water Quality Program has made more than 70 publications addressing specific topics for the general public available through its website.

Ground Water Monitoring for Public Water Supplies

The Compliance Section of the Drinking Water Branch at IDEM receives ground water compliance monitoring results reported by public water systems for volatile organic compounds (VOCs), synthetic organic compounds (SOCs), inorganic compounds (IOCs), nitrates (NO_3), and radionuclides.

Radionuclide monitoring consists of analysis for gross alpha particle activity. Public water supply systems collect samples from various points within their system including after the water is treated and before it enters the distribution system. Samples can be collected from a single well or blended from two or more wells.

Other parameters monitored by public water systems depend on the type of system. There are three types of public water systems: community, non-transient non-community, and transient non-community. Compliance monitoring results reported by public water systems are considered "treated water" and may not represent "source" or "raw water" results. Information reported to IDEM from public water systems may be viewed through the Safe Drinking Water Information System at: https://myweb.in.gov/IDEM/DWW/ .

The three types of public water systems are defined below:

- A community system is defined as a system that serves water to the public and has at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents. Examples of community water systems are municipal systems, mobile home parks, nursing homes and homeowners associations. Along with regular bacteria sampling, community systems are required to test for thirty regulated SOCs, 21 VOCs, 12 regulated IOCs, sodium, and radionuclides. Sampling for these parameters is required a minimum of once every three years depending on the levels of contaminants detected. As of this report, there are 788 community systems in Indiana.
- A non-transient non-community water system is defined as a public water system that is not a community water system and which regularly serves the same 25 or more persons at least six months per year. Examples of non-transient non-community water systems could include restaurants, factories, daycares and schools. Along with regular bacteria sampling, non-community non-transient systems are required to test for 30 regulated SOCs, 21 VOCs, 11 regulated IOCs (except sodium and fluoride), and radionuclides. Sampling for these parameters is required a minimum of once every three years depending on the levels of contaminants detected. As of this report, there are 582 non-transient non-community systems in Indiana.

- A transient non-community is defined as a non-community water system that does not serve at least the same 25 people for more than six months per year. Examples of transient non-community water systems include restaurants, rest stops and gas stations. Along with regular bacteria sampling, transient non-community systems are required to test for radionuclides. As of this report, there are 2677 transient non-community systems in Indiana.

Statewide Ground Water Monitoring Network

The Ground Water Section of the Drinking Water Branch manages a statewide ground water monitoring network (GWMN) consisting of private residential wells and non-community public water supplies (PWS), including schools, daycares, churches, and businesses. Sampling for the GWMN has been conducted annually since it was established. Seven complete rounds of sampling have been conducted to date. Although many of the sampling sites were revisited during multiple sampling rounds, the number of sites sampled each year varies based on site suitability, participant interest, availability of resources, and previous sampling results. Sites sampled for the sixth round of monitoring, which occurred between May 2013 and August 2016 are shown in Figure 15 (Appendix B).

The Indiana Geological Survey (IGS) has divided the state into hydrogeologic settings to "provide a conceptual model to help interpret the occurrence, movement, and sensitivity to contamination of ground water in relation to … the surface and subsurface environment" (Fleming, 1995). The IGS has identified more than 240 individual hydrogeologic settings across the state based largely on glacial activity. IGS and IDEM scientists then grouped these hydrogeologic settings into 20 generalized settings that are common throughout Indiana.

IDEM determined based on the 20 generalized hydrogeologic settings that 398 samples are needed to accurately represent ambient ground water quality across the state for each sampling round in the GWMN. These sampling sites were proportionally distributed throughout the 20 lumped hydrogeologic settings using a weighting procedure (also known as stratified sampling) based on the percentage of located wells in that setting. The weighted number of samples in the generalized settings ranged from 1 to 154 samples. Appendix I provides the descriptions of the 20 generalized hydrogeologic settings monitored and summary results for each.

Protocols and Methods

As part of its implementation of the GWMN, IDEM's Ground Water Section staff:

- Statistically analyzed previous study designs employed in earlier iterations of the GWMN.
- Randomly selected sampling sites in each general hydrogeologic setting.
- Collected ground water samples from drinking water wells for analysis at IDEM's contract laboratories.
- Reviewed analytical sampling results.
- Distributed sampling results to GWMN participants.
- Developed a program report.

IDEM's Ground Water Section collects most samples from April to August. Samples are generally collected from outdoor spigots that have not been treated or from source water sample taps in the case of public water supplies. Samples are analyzed for more than 200 parameters; including alkalinity, anions/cations, metals, nitrogen as nitrate-nitrite (N+N), synthetic organic compounds, volatile organic compounds and pesticide degradates.

Summary of Results

Table 31 (Appendix A) shows summary statistics for the analytical parameters that were detected in the ground water samples collected during the most recent round of sampling (with the exception of disinfection byproducts and plasticizers, which are not included in this analysis). If a particular analyte was not detected, it was not included in the table. Applicable U.S. EPA Maximum Contaminant Levels (MCLs), Secondary Maximum Contaminant Levels (SMCLs), or Recommended Levels are provided where applicable.

For all samples collected in the most recent round, analytes that had the most occurrences above a MCL included arsenic and nitrogen as nitrate-nitrite (hereafter referred to as simply "nitrogen") Parameters for with there were occurrences above the SMCL or U.S. EPA Recommended Level included iron, sulfate, and strontium. Several VOCs were detected, including methyl tert-butyl ether, tetrachloroethylene, toluene, and atrazine. These VOCs occurred in one sample each, at concentrations that did not exceed or approach an MCL. Appendix K provides the descriptions of the 20 generalized hydrogeologic settings and ground water quality summary results for each.

In the most recent round of sampling, 139 samples (about 36 percent) contained detectable levels of nitrogen. Nine of those samples exceeded the MCL of 10 milligrams per liter, and the highest reported concentration was 22 milligrams per liter. The locations of the sites sampled for nitrogen are displayed with their corresponding hydrogeologic sensitivity developed by Fleming *et al* (Figure 16, Appendix B) and aquifer sensitivity developed by Letsinger (2015) (Figure 17, Appendix B). Fleming's hydrogeologic sensitivity map is qualitative based on typical characteristics for the individual hydrogeologic settings, while the Letsinger aquifer sensitivities were quantitatively calculated from factors including slope, sand thickness, surficial clay thickness, percentage clay in soil, land cover, and vegetation. In highly sensitive areas, ground

water can be rapidly recharged by surficial infiltration, allowing potential contaminants (including nitrates and pesticides) found at the ground surface or shallow subsurface to be transported into the aquifer. Summary statistics were calculated for the nitrogen data for Indiana's generalized hydrogeologic settings (Table 32, Appendix A).

Average nitrogen concentrations for each hydrogeologic setting were also calculated for different well type and depth, aquifer conditions and aquifer sensitivity (Table 33, Appendix A). Oxidizing aquifers had significantly greater nitrogen levels and higher average concentrations than reducing aquifers. Previous studies (Freeze & Cherry, 1979) have shown that the distribution and mobility of nitrogen within aquifers can be influenced by groundwater redox conditions.

Additionally, 12 of the 19 general hydrogeologic settings had their highest average nitrogen concentrations in wells less than 100 feet deep. The averages calculated for this study suggest that nitrogen concentrations tend to be higher in shallow, unconsolidated wells in highly-sensitive, oxidizing aquifers. Additional geochemical and statistical analyses are needed to evaluate the causal relationship between these parameters.

Arsenic

Arsenic is a naturally occurring element found primarily in rocks, soil, water, and plants in many areas of the United States, including Indiana. Natural events, such as infiltration of water, dissolution of minerals from clay, and erosion of rocks, can release arsenic into water. Arsenic can also be released into the environment as a byproduct of industrial activities, such as wood preservation, mining, and smelting (IDEM, 2015).

In the most recent round of sampling, 147 samples (around 38%) contained detectable levels of arsenic. Forty-three of those samples (11%) contained arsenic concentrations above the MCL (10 micrograms per liter). The highest reported concentration was 68 micrograms per liter. Figure 18 (Appendix B) shows the location of the arsenic samples by hydrogeologic setting. Table 34 (Appendix A) shows summary statistics for arsenic samples by hydrogeologic setting, and Table 35 (Appendix A) provides an intra-setting comparison.

Reducing aquifers had significantly greater arsenic levels and higher averages concentrations than oxidizing aquifers. Geochemical modeling is needed to determine the species of arsenic found in Indiana ground water, and additional geochemical and statistical analyses are needed to evaluate the causal relationship between these parameters.

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APPENDIX A:

INTEGRATED REPORT TABLES (REVISED)

Table 1: Summary of designated use support by waterbody type.

Designated Beneficial Use	Total Size	Size Assessed	Size Fully Supporting	Size Not Supporting	Size Not Attainable
Rivers and Streams (Miles)					
Full Body Contact (Recreational Use)	63,130	31,683	8,122	23,561	0
Human Health and Wildlife (Fishable Use)	63,130	8,873	3,418	5,455	0
Public Water Supply[1]	354	25	0	25	0
Warm Water Aquatic Life (Aquatic Life Use)	63,130	37,693	25,793	11,900	122
Lake Michigan Shoreline (Miles)					
Full Body Contact (Recreational Use)	59	59	4	55	0
Human Health and Wildlife (Fishable Use)	59	59	0	59	0
Public Water Supply	35	31	31	0	0
Warm Water Aquatic Life (Aquatic Life Use)	59	59	59	0	0
Lake Michigan (Acres)					
Human Health and Wildlife (Fishable Use)	154,176	154,176	0	154,176	0
Lakes and Reservoirs (Acres)					
Full Body Contact (Recreational Use)	127,607	37,047	29,035	8,012	0
Human Health and Wildlife (Fishable Use)	127,607	77,845	27,290	50,555	0
Public Water Supply	29,541	16,615	230	16,385	0
Warm Water Aquatic Life (Aquatic Life Use)	127,607	10,379	3,754	6,625	0

Source: IDEM's assessment database

[1]While all waterbodies in Indiana are designated for aquatic life and recreational uses, not all are designated for public water supply. There are a total of 29,541 lake acres, 354 stream miles, and 35 miles along Lake Michigan's shoreline designated for public water supply in Indiana. The values for lake acres does not include the 154,176 acres of Lake Michigan.

Table 2: Atlas information.

Description	Value	Units
Indiana population[1]	6,483,802	People
Indiana surface area[2]	36,291	Square Miles
Total miles of rivers and streams[3]	63,130	Miles
Number of publicly-owned lakes, reservoirs and ponds[4]	575+	-
Publicly-owned lakes, reservoirs, and ponds[4]	106,205	Acres
Great Lakes[4]	154,176	Acres
Great Lakes shoreline[5]	59	Miles
Fresh water wetlands[6]	813,000	Acres

[1]U.S. Census Bureau, 2010 census [2]State Information Center [3]2014 Reach Index [4]U.S. EPA (1993) [5]Indiana Reach Index [6]Rolley (1991)

Table 3: 205(j) and 319(h) Investments in SFY 2003-2013. Table does not include an additional $434,328 from the American Recovery and Reinvestment Act of 2009, which was awarded through the SRF Program.

205(j)			319(h)		
FFY	Number of Projects	Amount Awarded	FFY	Number of Projects	Amount Awarded
2003	6	$507,054	2003*	34	$4,544,480
2004	6	$497,220	2004**	27	$4,159,332
2005	3	$254,430	2005***	21	$3,747,145
2006	2	$251,310	2006	18	$3,374,538
2007	2	$148,915	2007	12	$3,022,961
2008	0	0	2008	8	$2,967,181
2009	2	$271,432	2009	9	$2,759,609
2010	2	$293,753	2010	11	$3,653,209
2011	4	$699,775	2011	8	$2,457,215
2012	2	$331,250	2012	8	$2,221,471
2013	2	$337,750	2013	7	$2,276,973
2014	3	$341,000	2014	9	$2,628,234
2015	2	$340,000	2015	9	$2,317,768

* includes 2 in-house projects totaling $526,122
** includes 2 in-house projects totaling $248,792
*** includes 1 in-house project totaling $155,686

Table 4: Reductions in sediment, phosphorus, and nitrogen reaching Indiana waters.

FFY(s)	Sediment Reduction (tons/year)	Phosphorus Reduction (lbs/year)	Nitrogen Reduction (lbs/year)
2000-2003	35,870	42,662	85,710
2004	18,561	21,993	44,527
2005	33,415	39,347	79,349
2006	25,831	40,538	99,434
2007	23,279	126,529	125,848
2008	18,119	25,400	65,367
2009	7,965	15,479	15,319
2010	33,420	31,374	66,400
2011	28,880	33,434	70,450
2012	47,616	94,980	141,709
2013	54,507	92,360	170,376
2014	67,403	168,542	168,710
2015	97,212	132,737	228,334

Source: IDEM OWQ nonpoint source project tracking database

Table 5: Water quality improvements in Indiana watersheds reported to U.S. EPA for measures SP-12 and WQ-10.

Stream Name	Watershed Hydrologic Unit Code	Stream Miles Improved	Impairment Removed	Year Removed from 303(d) List
Pigeon	05140202	32	Chlordane	2002
Lower Clifty Creek	051202060107	8.12	E. coli	2010
West Fork Big Walnut	051202030104	34.64	E. coli	2010
East Fork Big Walnut	051202030102	15.76	E. coli	2010
Bull Run	071200011308	25.09	Impaired biotic communities	2012
Metcalf Ditch	041000030504	14.33	Impaired biotic communities	2012
North Prong Stotts Cr	051202011404	1.25	Impaired biotic communities	2012
South Prong Stotts Cr	051202011405	13.23	Impaired biotic communities	2012
Mill Creek	051201011404	13.14	Impaired biotic communities	2012
Jenkins Ditch	051201070308	2.13	Impaired biotic communities	2012
Emma Creek	040500011201	38.2	Ammonia	2014
Devils Backbone Indian Cr	051401040502	21	Impaired biotic communities	2015

Table: 6: Binational phosphorus load reduction targets for Lake Erie under the Great Lakes Water Quality Agreement, Annex 4.

Great Lakes Water Quality Agreement Lake Ecosystem Objectives	Annex 4 Phosphorus Reduction Goals	
Minimize the extent of hypoxic zones in the Waters of the Great Lakes associated with excessive phosphorus loading, with particular emphasis on Lake Erie	40 percent reduction in total phosphorus entering the Western Basin and Central Basin of Lake Erie – from the United States and from Canada – to achieve 600 metric-ton Central Basin load	
Maintain algal species consistent with healthy aquatic ecosystems in the nearshore Waters of the Great Lakes	40 percent reduction spring total and soluble reactive phosphorus loads from the following watersheds where localized algae is a problem:	
	Western Basin of Lake Erie	**Central Basin of Lake Erie**
	• Thames River (Canada) • Maumee River (U.S.) • River Raisin (U.S.). • Portage River (U.S.) • Toussaint Creek (U.S.) • Leamington Tributaries (Canada)	• Sandusky River (U.S.) • Huron River (U.S.)
Maintain cyanobacteria biomass at levels that do not produce concentrations of toxins that pose a threat to human or ecosystem health in the Waters of the Great Lakes	40 percent reduction in spring total (860 metric tons) and soluble reactive phosphorus (186 metric tons) loads from the Maumee River (U.S.)	N/A

Table 7. SRF investments in SFY 2014 and 2015.

SRF Program	Number of Projects	Loan Amount	Savings Realized
Clean Water	34	$297,390,310	$64,582,500
Drinking Water	22	$39,657,401	$19,243,179

Source: SRF tracking database

Table 8. A comparison of means for selected nonpoint source pollution-related parameters at two sites on Emma Creek, before (2007–2008) and after (2009–2010) BMP implementation. All parameters expressed as milligrams per liter unles otherwise noted.

Parameter	Site 1 (Tributary of Emma Creek)		Site 13 (Mouth of Emma Creek)	
	2007–2008	2009–2010	2007-2008	2009-2010
Turbidity (nephelometric turbidity units)	13	8.8	74	56
Total Suspended Solids	23.4	17.2	107	27
Nitrate	1.1	1.1	3.1	2.8
Total Phosphorus	0.497	0.287	2.01	0.57
Biological Oxygen Demand	1.31	0.72	2.05	1.15
Ammonia	0.15	0.11	0.11	0.09
E. coli (colony-forming units per 100 milliliters)	1,147	750	17,109	16,483

Table 9. Pathogen concentrations in colony-forming units per 100 milliters (cfu/100mL) and dissolved oxygen levels in milligrams per liter (mg/L) in the Devils Backbone segment of Indian Creek, 2000 and 2010. Values in bolded red font indicate exceedances of state water quality criteria.

Pre-project E. coli Data			Pre-project Dissolved Oxygen (DO) Data		
Sample Date	**Site Number**	**E. coli (cfu/100 mL)**	**Sample Date**	**Site Number**	**DO (mg/L)**
7/12/2000	OBS100-0006	**243**	5/16/2000	OBS100-0001	9.87
7/19/2000	OBS100-0006	**708**	7/12/2000	OBS100-0006	7.83
7/26/2000	OBS100-0006	40	7/19/2000	OBS100-0006	**3.98**
8/2/2000	OBS100-0006	20	7/26/2000	OBS100-0006	**4**
8/9/2000	OBS100-0006	**833**	8/2/2000	OBS100-0006	**2.52**
	Geometric Mean:	**162.88**	8/9/2000	OBS100-0006	**3.06**
Post-project E. coli Data			**Post-project Dissolved Oxygen Data**		
Sample Date	**Site Number**	**E. coli (cfu/100 mL)**	**Sample Date**	**Site Number**	**DO (mg/L)**
5/17/2010	OBS100-0010	35.5	5/17/2010	OBS100-0010	9.16
5/24/2010	OBS100-0010	142.1	6/1/2010	OBS100-0010	8.72
6/1/2010	OBS100-0010	20.9	6/7/2010	OBS100-0010	7.63
6/7/2010	OBS100-0010	12	6/14/2010	OBS100-0010	7.16
6/14/2010	OBS100-0010	16.9	7/28/2010	OBS100-0010	7.46
	Geometric Mean:	29.24			

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Table 10: OWQ's primary water quality monitoring objectives and the monitoring approaches needed to meet them.

Key	Monitoring Objective	Probabilistic	Targeted	Priority Rationale
A	Conduct water quality assessments pursuant to CWA Section 305(b) to support the development of Indiana's Integrated Report to U.S. EPA	X	X	Required for CWA Section 106 funding to meet CWA goals
B	Development of Indiana's CWA Section 303(d) List of Impaired Waters for Indiana's Integrated Report	X	X	Required for CWA Section 106 funding to meet CWA goals
C	Develop Total Maximum Daily Loads to address impairments identified on Indiana's 303(d) list	X	X	Required for CWA Section 106 funding to meet CWA goals
D	Determine trends and trophic status of Indiana's lakes and reservoirs under CWA Section 314		X	Required for CWA Section 106 funding to meet CWA goals
E	Develop water quality criteria, including nutrient criteria for lakes and reservoirs, rivers and streams	X	X	Required for CWA Section 106 funding to meet CWA goals
F	Support watershed planning and restoration efforts	X	X	Required for to CWA Section 319 funding and to meet performance measures in U.S. EPA's Strategic Plan
G	Identify water quality improvements accomplished by watershed restoration efforts funded through CWA programs		X	Required to meet performance measures in U.S. EPA's Strategic Plan
H	Support the development of public health advisories related to the use of Indiana's water resources, including fish consumption advisories and recreational use advisories		X	Supports protection of human health
I	Determine ambient ground water quality and extent of contaminated areas		X	Supports protection of human health
J	Support source water protection including both ground water and surface source water supplies		X	Supports protection of human health
K	Support development of National Pollutant Discharge Elimination System permit limits	X	X	Required for CWA Section 106 funding to meet CWA goals
L	Develop environmental indicators, including indices of biological integrity, for use in making water quality assessments	X		Supports primary monitoring objectives (A-C, E)
M	Responding to citizen complaints about activities that may be impacting private wells		X	Mandated by State Statute

Modified from IDEM OWQ's Surface Water Monitoring Strategy, 2011-2019.

Table 11: External data sets that met the data quality requirements for the 305(b) and 303(d) assessment and listing processes under the draft External Data Framework.

Source	Type of Assessment
American Water Company	Drinking water use support
City of Elkhart	Aquatic life use support; Fishable use support
City of Indianapolis	Recreational use support; Drinking water use support; Aquatic life use support
City of Muncie	Recreational use support; Drinking water use support; Aquatic life use support
City of South Bend	Recreational use support
City of Valparaiso	Recreational use support; Drinking water use support; Aquatic life use support
Marion County Health Department	Recreational use support; Drinking water use support; Aquatic life use support

Table 12: Summary of water quality assessment methodology for determining designated use support.

Aquatic Life Use Support - Rivers and Streams		
Toxicants	Dissolved metals, pesticides, polynuclear aromatic hydrocarbons (PAHs), free cyanide, and ammonia were evaluated on a site-by-site basis and judged according to the magnitude of the exceedance(s) of Indiana's WQS and the number of times the exceedance(s) occurred. For any one pollutant (grab or composite samples), the following assessment criteria are applied to data sets consisting of three or more measurements.	
	Fully Supporting	**Not Supporting**
	No more than one exceedance of the acute or chronic criteria for aquatic life within a three year period[1].	More than one exceedance of the acute or chronic criteria for aquatic life within a three year period.
Conventional inorganics	Dissolved oxygen, pH, sulfate, and chloride were evaluated for the exceedance(s) of Indiana's WQS. For any one pollutant, the following assessment criteria are applied to data sets consisting of three or more measurements.	
	Fully Supporting	**Not Supporting**
	Criteria are exceeded in less than or equal to 10% of measurements.	Criteria are exceeded in greater than10% of measurements.
Nutrients	Nutrient conditions were evaluated on a site-by-site basis using the benchmarks described below. In most cases, two or more of these conditions must be met on the same date in order to classify a waterbody as impaired. This methodology assumes a minimum of three sampling events: • Total Phosphorus -- One or more measurements greater than 0.3 mg/L • Nitrogen (measured as NO3 + NO2) – One or more measurements greater than 10.0 mg/L • Dissolved Oxygen (DO) – One or more measurements below the water quality standard of 4.0 mg/l or measurements that are consistently at/close to the standard, in the range of 4.0-5.0 mg/L or values greater than 12.0 mg/L • pH measurements – One or more measurements exceed the water quality standard of no more than 9.0 pH units or measurements are consistently at/close to the standard, in the range of 8.7- 9.0 pH units • Algal Conditions -- Algae are described as "excessive" based on field observations by IDEM scientists.	

Benthic aquatic macroinvertebrate Index of Biotic Integrity (mIBI) Scores (Range of possible scores is 12-60)	**Fully Supporting**	**Not Supporting**
	mIBI greater than or equal to 36	mIBI less than 36
Fish community (IBI) Scores (Range of possible scores is 0-60)	IBI greater than or equal to 36	IBI less than 36
Aquatic Life Use Support – Rivers and Streams		
Qualitative habitat use evaluation (QHEI) (Range of possible scores is 0-100)	The Qualitative Habitat Evaluation Index (QHEI) is not used to determine aquatic life- use support. Rather, the QHEI is an index designed to evaluate the lotic habitat quality important to aquatic communities and is used in conjunction with mIBI or IBI data, or both, to evaluate the role that habitat plays in waterbodies where impaired biotic communities (IBC) have been identified. QHEI scores are calculated using six metrics: substrate, instream cover, channel morphology, riparian zone, pool/riffle quality, and gradient. A higher QHEI score represents a more diverse habitat for colonization of aquatic organisms. IDEM has determined that a QHEI total score of <51 indicates poor habitat. For streams where the macroinvertebrate community (mIBI or mHab) or fish community (IBI) scores indicate IBC, QHEI scores are evaluated to determine if habitat is the primary stressor on the aquatic communities, or if there may be other stressors/pollutants causing the IBC.	
Aquatic Life Use Support – Lakes and Reservoirs		
Indiana Department of Natural Resources surveys of the status of sport fish communities in lakes and information on trout stocking.	**Fully Supporting**	**Not Supporting**
	Supports cold water fishery, including native Cisco and stocked trout, or both.	Native Cisco population is gone and/or the lake unable to support stocked trout and/or the lake's attributes appear to contribute to warm water fishery condition.
Temperature and pH	Lakes in which thermal modifications have caused an adverse effect on aquatic life and lakes that do not meet Indiana's WQS for pH have been assessed as not supporting of aquatic life use.	
Fish Consumption Use Support (Human Health) – All Waters		
Available fish tissue data for the most recent 12 years of data collection are evaluated. Only waters for which sufficient fish tissue data were available were assessed for fish consumption. All results from sampling locations considered representative of a given assessment unit (lake or reservoir; stream or stream reach) must be below the benchmarks for mercury and PCBs in order to be assessed as fully-supporting. For mercury, all waters with a trophic level weighted arithmetic mean result (calculated with all the samples collected during the same sampling event) that exceeds the applicable benchmark are classified as impaired. For PCBs, all waters with a single sample result for a given species exceeding the applicable benchmark are classified as impaired.		
Mercury in Fish Tissue	**Fully Supporting**	**Not Supporting**
	Trophic level weighted arithmetic mean concentration values for all sampling events are less than or equal to 0.3 mg/kg wet weight	Trophic level weighted arithmetic mean concentration values for one or more sampling events are greater than 0.3 mg/kg wet weight
PCBs in Fish Tissue	**Fully Supporting**	**Not Supporting**
	Actual concentration values for all samples are less than or equal to 0.02 mg/kg wet weight	Actual concentration values for one or more samples are greater than 0.02 mg/kg wet weight

Recreational Use Support (Human Health) – All Waters		
IDEM has two different methods for determining recreational use support, depending on the type of data set being used in making the assessment. For data sets consisting of five equally-spaced samples over a 30-day period, IDEM applies two tests, both of which are based on the U.S. EPA's Ambient Water Quality Criteria for Bacteria - 1986 (U.S. EPA, 1986), which provides the foundation for Indiana's WQS for recreational use. For data sets with 10 or more grab samples but without the five samples equally-spaced over the 30 days required to calculate a geometric mean, the 10% rule is applied. When both types of data sets are available, the assessment decision is based on the data set consisting of five samples, equally-spaced over a 30-day period.		
Bacteria (E. *coli*): at least five equally-spaced samples over 30 days. (cfu = colony forming units)	**Fully Supporting**	**Not Supporting**
	Geometric mean does not exceed 125 cfu/100mL	Geometric mean exceeds 125 cfu/100mL.
Bacteria (E. *coli*): grab samples (cfu = colony forming units)	Not more than 10% of measurements are greater than 576 cfu/100ml (for waters infrequently used for full body contact) or 235 cfu/100mL (for bathing beaches)[2]. And Not more than one sample is greater than 2,400 cfu/100mL.	More than 10% of samples are greater than 576 cfu/100mL or more than one sample is greater than 2,400 cfu/100mL.
Drinking Water Use Support – Rivers and Streams		
River and stream segments are designated for drinking water uses if a community water supply has a drinking water intake somewhere along the segment. When IDEM has data for a segment with a drinking water intake, those data are compared to the applicable ambient water quality criteria in Indiana's WQS to determine if the drinking water use is met. The appropriate water quality criteria are applied for specific substances identified in the WQS. Information regarding non-naturally occurring taste and odor-producing substances not specifically identified in the WQS are reviewed within the context of a water treatment facility's ability to meet Indiana's drinking WQS using conventional treatment.		
Toxicants	Dissolved metals, pesticides, PCBs, and free cyanide were evaluated on a site by site basis and judged according to magnitude of the exceedance(s) of Indiana's WQS for point-of-water intake and the number of times exceedance(s) occurred. For any one pollutant (grab or composite samples), the following assessment criteria are applied.	
	Fully Supporting	**Not Supporting**
	Not more than one exceedance of the acute or chronic criteria for human health within a three year period.	More than one exceedance of the acute or chronic criteria for human health within a three year period.
Conventional inorganics	Total dissolved solids, specific conductance, sulfate, chloride, nitrite-N and nitrogen (measured as NO_3 + NO_2) were evaluated for the exceedance(s) of Indiana's WQS for point-of-water intake and the number of times the exceedance(s) occurred. For any single pollutant (grab or composite samples), the following assessment criteria are applied to data sets consisting of three or more measurements.	
	Fully Supporting	**Not Supporting**
	Not more than one exceedance of the acute or chronic criteria for human health within a three year period.	More than one exceedance of the acute or chronic criteria for human health within a three year period.

Recreational Use Support (Aesthetics) – Lakes and Reservoirs		
	Fully Supporting	**Not Supporting**
Natural Lakes	Not more than 10% of all TP values greater than 54 ug/L and their associated Chlorophyll *a* values are less than or equal to20 ug/L	Less than 10% of all TP values are greater than 54 ug/L but their associated Chlorophyll *a* values are greater than 20 ug/L, and the TSI (CHL) score for the lake indicates eutrophic (50-70) or hypereutrophic (greater than 70) conditions Or More than 10% of all TP values are greater than 54 ug/L with associated Chlorophyll *a* values less than 4 ug/L, but the TSI (CHL) score for the lake indicates eutrophic (50-70) or hypereutrophic (greater than 70) conditions Or More than 10% of all TP values are greater than 54 ug/L with associated Chlorophyll *a* values greater than 4 ug/L
	Fully Supporting	**Not Supporting**
Reservoirs	Not more than 10% of all TP values greater than 51 ug/L and their associated Chlorophyll *a* values are less than 25 ug/L	Less than 10% of all TP values are greater than 51 ug/L but their associated Chlorophyll *a* values are greater than 25 ug/L and the TSI (CHL) score for the lake indicates eutrophic (50-70) or hypereutrophic (greater than 70) conditions Or More than 10% of all TP values are greater than 51 ug/L with associated Chlorophyll *a* values less than 2ug/L, but the TSI (CHL) score for the lake indicates eutrophic (50-70) or hypereutrophic (greater than 70) conditions Or More than 10% of all TP values are greater than 51 ug/L with associated Chlorophyll *a* values greater than 2 ug/L
Drinking Water Use Support – Lakes and Reservoirs		
	Fully Supporting	**Not Supporting**
Taste and odor-producing substances	Taste and odor substances not present in quantities sufficient to interfere with production of drinking water by conventional treatment	Taste and odor substances present in quantities requiring additional treatment by the public water supply to prevent taste and odor problems
Information on the application of pesticides to surface drinking water reservoirs	Reservoirs or lakes that serve as source water for public water supplies that received pesticide (algaecide) application permits for algae were classified as not supporting because additional treatment by the public water supply was required to prevent taste and odor problems.	

Other Assessments – Lakes and Reservoirs	
Carlson's Trophic State Index (TSI) for Chlorophyll *a* (CHL)	Chlorophyll *a* results were used to calculate Carlson TSI scores. Trophic scores were used to classify lakes according to their trophic state. Lake trends were also assessed for lakes with two or more trophic scores if at least one of the scores was less than five years old. Trophic scores and lake trends are not used to determine use support status. These assessments are conducted to fulfill Clean Water Act Section 314 reporting requirements for publicly owned lakes and reservoirs.

[1]For Indiana waters within the Great Lakes Basin, acute aquatic criteria refer to the "criterion maximum concentration (CMC) identified in 327 IAC 2-1.5, and the chronic aquatic criteria refer to the criterion continuous concentration (CCC) also described therein. For downstate waters (those located outside of the Great Lakes Basin, the acute aquatic criteria refer to the "AAC" values shown in 327 IAC 2-1 and the chronic aquatic criteria are shown as the "CAC" values.

[2]The value of 576 cfu/100mL comes from U.S. EPA's Ambient Water Quality Criteria for Bacteria - 1986 (U.S. EPA, 1986) and represents the single sample maximum applicable to waters infrequently used for full body recreation. For data collected from bathing beaches, the single day maximum value of 235 cfu/100mL is applied.

Source: IDEM OWQ 2016 Consolidated Assessment and Listing Methodology (Revised)

Table 13: Individual use support summary for Indiana streams.

Designated Beneficial Uses						
Designated Beneficial Use	**Total Size (Miles)**	**Size Assessed (Miles)**	**Percent Assessed**	**Size Fully Supporting (Miles)**	**Size Not Supporting (Miles)**	**Size Not Attainable* (Miles)**
Full Body Contact (Recreational Use)	63,130	32,730	52%	8,116	24,614	0
Human Health and Wildlife (Fishable Use)	63,130	8,935	14%	3,415	5,520	0
Public Water Supply	388	23	6%	0	0	0
Warm Water Aquatic Life (Aquatic Life Use)	63,130	38,043	60%	25,855	12,188	156

*"Size Not Attainable" refers to limited use waters as designated in Indiana's Water Quality Standards. See 327 IAC 2-1-11 and 2-1.5-8.
Source: IDEM 305(b) assessment database

Table 14: Summary of national and state causes impairing Indiana streams.

Causes of Impairment	Total Size (miles)
Pathogens	
Escherichia coli	24,437
Oxygen Depletion	
Oxygen, Dissolved	2,684
Flow Alterations	
Low flow alterations	91
Habitat alterations (Including Wetlands)	
Physical substrate habitat alterations	195
Thermal Impacts	
Temperature, water	103
Nutrients (Macronutrients/Growth Factors)	
Nutrient/Eutrophication Biological Indicators	3,064
Organic Enrichment (Sewage) Biological Indicators	97

Causes of Impairment	Total Size (miles)
Toxic Inorganics	
Ammonia (Un-ionized)	135
Chloride	228
Cyanide (as free cyanide)	158
Sulfate	439
Toxic Organics	
Dioxin (including 2,3,7,8-TCDD)	364
Hexachlorocyclohexane (mixture)	52
Polycyclic Aromatic Hydrocarbons (PAHs) (Aquatic Ecosystems)	20
PCB (Fish Tissue)	4,924
PCB (Water)	364
Metals	
Mercury (Fish Tissue)	768
Mercury (Water)	342
Pesticides	
Atrazine	7
pH/Acidity/Caustic Comditions	
pH	295
Sedimentation	
Sedimentation/Siltation	292
Oil and Grease	
Oil and Grease	22
Algae	
Chlorophyll-a	111
Biological Integrity (Bioassessments)	
Impaired Biotic Communities	8,539

Source: IDEM 305(b) assessment database

Table 15: Summary of national and state sources impairing Indiana streams.

Sources of Impairment	Total Size (miles)
Agriculture – Animal Feeding/Handling Operations (Nonpoint Source – Not Regulated)	
Animal Feeding Operations (NPS)	10,510
Managed Pasture Grazing	36
Permitted Runoff from Confined Animal Feeding Operations (CAFOs)	1,900
Agriculture	2,336
Livestock (Grazing or Feeding Operations)	6,300
Unrestricted Cattle Access	862
Agriculture – Crop Production	
Crop Production with Subsurface Drainage	2,660
Crop Production (Crop Land or Dry Land)	241

Sources of Impairment	Total Size (miles)
Construction	
Site Clearance (Land Development or Redevelopment)	49
Ground Water Loadings	
Contaminated Ground Water	13
Habitat Alterations (Not Directly Related to Hydromodification)	
Impacts from Hydrostructure Flow Regulation/modification	511
Loss of Riparian Habitat	1,357
Streambank Modifications/destabilization	488
Upstream Impoundments (e.g., PI-566 NRCS Structures)	15
Hydromodification	
Channelization	233
Dam Construction (Other than Upstream Flood Control Projects)	26
Industrial Permitted Discharge	
Industrial Point Source Discharge	342
RCRA Hazardous Waste Sites	3
Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO)	33
Land Application Waste Sites	
Illegal Dumps or Other Inappropriate Waste Disposal	680
On-site Treatment Systems (Septic Systems and Similar Decentralized Systems)	1,220
Legacy/Historical Pollutants	
Acid Mine Drainage	406
Contaminated Sediments	301
Historic Bottom Deposits (Not Sediment)	65
Impacts from Abandoned Mine Lands (Inactive)	18
Municipal Permitted Discharges (Direct and Indirect)	
Combined Sewer Overflows	1,652
Municipal Point Source Discharges	3,269
Package Plant or Other Permitted Small Flows Discharges	2,876
Sanitary Sewer Overflows (Collection System Failures)	20
Stormwater Permitted Discharges (Direct and Indirect)	
Unspecified Urban Stormwater	1,128
Natural Sources	
Waterfowl	3,975
Wildlife Other than Waterfowl	3,954
Upstream/Downstream Source	492
Natural Sources	1,420

Sources of Impairment	Total Size (miles)
Resource Extraction	
Dredge Mining	25
Reclamation of Inactive Mining	195
Spills and Unpermitted Discharges	
Sewage Discharges in Unsewered Areas	7,379
Urban-related Runoff/Stormwater (Other than Regulated Discharges)	
Golf Courses	60
Highways, Roads, Bridges, Infrastructure (New Construction)	14
Post-development Erosion and Sedimentation	19
Wastes from Pets	190
Impervious Surface/Parking Lot Runoff	461
Urban Runoff/Storm Sewers	205
Other Sources	
Source Unknown	10,182
Non-Point Source	16,035

Source: IDEM 305(b) assessment database

Table 16: Individual use support summary for Indiana's Great Lakes shoreline.

Designated Beneficial Uses						
Designated Beneficial Use	**Total Size (Miles)**	**Size Assessed (Miles)**	**Percent Assessed**	**Size Fully Supporting (Miles)**	**Size Not Supporting (Miles)**	**Size Not Attainable (Miles)**
Full Body Contact (Recreational Use)	59	59	100%	4	55	0
Human Health and Wildlife (Fishable Use)	59	59	100%	0	59	0
Public Water Supply	31	31	100%	31	0	0
Warm Water Aquatic Life (Aquatic Life Use)	59	59	100%	59	0	0

Source: IDEM 305(b) assessment database

Table 17: Summary of national and state causes impairing Indiana's Great Lakes shoreline.

Causes of Impairment	Total Size (Miles)
Pathogens	
Escherichia coli	55
Toxic Organics	
PCB (Fish Tissue)	59
Metals	
Mercury (Fish Tissue)	59

Source: IDEM 305(b) assessment database

Table 18: Summary of National and State Sources Impairing Great Lakes Shoreline.

Sources of Impairment	Total Size (Miles)
Land Application Waste Sites	
On-site Treatment Systems (Septic Systems and Similar Decentralized Systems)	19
Municipal Permitted Discharges (Direct and Indirect)	
Illicit Connections/Hook-ups to Storm Sewers	19
Other Sources	
Source Unknown	59
Non-Point Source	5

Source: IDEM 305(b) assessment database

Table 19: Individual use support summary for Lake Michigan.

Designated Beneficial Uses						
Designated Beneficial Use	**Total Size (Acres)**	**Size Assessed (Acres)**	**Percent Assessed**	**Size Fully Supporting (Acres)**	**Size Not Supporting (Acres)**	**Size Not Attainable (Acres)**
Aquatic life use	-	-	-	-	-	-
Fishable uses	154,176	154,176	100%	0	154,176	0
Drinking water supply	-	-	-	-	-	-
Recreational use (human health)	-	-	-	-	-	-

Source: IDEM 305(b) assessment database

Table 20: Summary of national and state causes impairing Lake Michigan.

Causes of Impairment	Total Size (Acres)
Bioaccumulative Chemicals of Concern	
PCBs (Fish Tissue)	154,176
Mercury (Fish Tissue)	154,176

Source: IDEM 305(b) assessment database

Table 21: Summary of national and state sources impairing Lake Michigan.

Sources of Impairment	Total Size (Acres)
Source Unknown (Applied to Fish Tissue Impairments)	154,176

Source: IDEM 305(b) assessment database

Table 22: Individual use support summary for Indiana lakes.

Designated Beneficial Uses						
Designated Beneficial Use	**Total Size (Acres)**	**Size Assessed (Acres)**	**Percent Assessed**	**Size Fully Supporting (Acres)**	**Size Not Supporting (Acres)**	**Size Not Attainable (Acres)**
Full Body Contact (Recreational Use)	127,607	37,047	29%	29,035	8,012	0
Human Health and Wildlife (Fishable Use)	127,607	77,845	61%	27,290	50,555	0
Public Water Supply Supply	29,541	16,615	56%	230	16,385	0
Warm Water Aquatic Life (Aquatic Life Use)	127,607	10,379	8%	3,754	6,625	0

Source: IDEM 305(b) assessment database

Table 23: Summary of national and state causes impairing lakes and reservoirs.

Causes of Impairment	Total Size (Acres)
Pathogens	
Escherichia coli	983
Thermal Impacts	
Temperature, water	1,556
Nutrients (Macronutrients/Growth Factors)	
Phosphorus (Total)	7,023
Toxic Organics	
PCB (Fish Tissue)	38,290
Metals	
Mercury (Fish Tissue)	14,736
Mineralization	
Taste and Odor	16,385
pH/Acidity/Caustic Conditions	
pH	105
Algae	
Chlorophyll-a	16,385
Other Causes	
Cause Unknown	6,520

Source: IDEM 305(b) assessment database

Table 24: Summary of national and state sources impairing lakes and reservoirs.

Sources of Impairment	Total Size (Acres)
Agriculture – Animal Feeding Operations (Nonpoint Source – Not Regulated)	
Agriculture	30
Industrial Permitted Discharges	
Industrial Point Source Discharge	1,556
Legacy/Historical Pollutants	
Acid Mine Drainage	105
Municipal Permitted Discharges (Direct and Indirect)	
Combined Sewer Overflows	30
Urban-related Runoff/Stormwater (Other than Regulated Discharges)	
Impervious Surface/Parking Lot Runoff	30
Other Sources	
Source Unknown	52,202
Nonpoint Source	7,054

Source: IDEM 305(b) assessment database

Table 25: Trophic states and predicted characteristics based on Carlson TSI scores for chlorophyll-*a* (CHL).

Trophic State	TSI (CHL)	Corresponding CHL values (ug/L)	Characteristics of Trophic State
Oligotrophic	Greater than 40	Less than 0.95 – 2.6	Low biological productivity • High transparency (clear water) • Low levels of nutrients • Low algal production and little/no aquatic vegetation • Well oxygenated hypolimnion year round; hypolimnion of shallower lakes may become anoxic at TSI scores >30
Mesotrophic	40-50*	2.6-7.3	Moderate biological productivity • Moderately transparency (moderately clear water) • Moderate levels of nutrients • Beds of submerged aquatic plants • Increasing possibility of anoxia in the hypolimnion during summer
Eutrophic	50-70	7.3-56	High biological productivity • Water has a low transparency • High levels of nutrients • Large amounts of aquatic plants or algae • At TSI scores >60, blue-green algae dominate and algal scums and excessive macrophytes possible • Hypolimnion commonly anoxic; fish kills possible
Hypereutrophic	Greater than 70	56-155	Very high biological productivity • Very low transparency, usually <3 feet • Very high levels of nutrients • Dense algae and aquatic vegetation; algal scums and few aquatic plants at TSI scores >80 • Fish kills and/or dead zones below the surface are common • Hypolimnion persistently anoxic; Fish kills and/or “dead zones” below the surface common

*Lakes with a TSI score of 50, which is on the boundary between mesotrophic and eutrophic conditions are evaluated with their corresponding TSI scores for TP and SD along with any other available information disk and classified in accordance to the best professional judgment of IDEM scientists.

Table 26: Trophic status of lakes assessed with Carlson Trophic State Index scores for Chlorophyll *a* 1990-2015.

Trophic Status	Number of Lakes	Total Size (Acres)*
Oligotrophic	95	19,000
Mesotrophic	130	24,061
Eutrophic	202	50,205
Hypereutrophic	28	5,267
Unknown	17	2,404

*Actual values are higher. These result do not reflect acres for non-indexed lakes for which size is currently unknown.
Source: IDEM 305(b) assessment database

Table 27: Trends in the trophic status of lakes assessed 1990-2015.

Trend	Number of Lakes	Total Size (Acres)*
Improving	46	13,773
Stable	100	1,6070
Fluctuating	89	36,314
Degrading	10	2,408
Unknown	227	32,372

*Actual values are higher. These result do not reflect acres for non-indexed lakes for which size is currently unknown.
Source: IDEM 305(b) assessment database

Table 28: Calls, spills and fish kills reported from 1998 to 2016.

Year	Calls	Spills	Fish Kills
1998	2,649	1,393	28
1999	2,507	1,246	41
2000	2,930	1,491	43
2001	3,093	1,591	51
2002	3,043	1,666	55
2003	3,026	1,551	30
2004	2,829	1,406	37
2005	3,319	1,271	40
2006	3,319	1,368	31
2007	2,852	1,354	36
2008	3,250	1,588	39
2009	2,889	1,226	39
2010	2,411	1,035	47
2011	2,160	934	10
2012	2,163	665	11
2013	2,162	653	38
2014	2026	788	9
2015	1931	1755	11
2016	206	170	

Source: IDEM TEMPO database

Table 29: Major sources of ground water contamination.

Contaminant Source	Highest Priority	Risk Factors*	Type of Contaminant**
Agricultural Activities			
Agricultural chemical facilities		A,C,H,I	5
Commercial fertilizer applications	X	A, C, D, E	5
Confined animal feeding operations	X	A, D, E	5, 9
Farmstead agricultural mixing and loading procedures			
Irrigation practices		A,C,H,I	1,2,5,8,9
Animal manure applications	X	A,C,H,I	5, 9
Pesticide applications		A,C,H,I	1,2
Storage and Treatment Activities			
Land application		A,C,H,I	5,9
Domestic and industrial residual applications		A,C,H,I	5,9
Material stockpiles		A,C,H,I	5,9
Storage tanks (above ground)		A,C,H,I	
Storage tanks (underground)	X	A, B, C, D, E, F	2, 3, 4
Surface impoundments			
Waste piles		A,C,H,I	5,9
Disposal Activities			
Deep injection wells			
Landfills (constructed prior to 1989)	X	A, B, C, D, E, F	1, 2, 3, 4, 5, 6, 7, 8, 9
Permitted landfills (constructed 1989- present)			
Septic systems	X	A, C, D, E, F, G	1, 2, 3, 4, 5, 7, 9
Shallow (Class V) injection wells	X	A, B, C, D, E, I	1, 2, 3, 4, 5, 7, 9
Other			
Hazardous waste generators		A	
Hazardous waste sites		A	
Industrial facilities	X	A, B, C, D, E, F	1, 2, 3, 4, 5, 7, 8, 9
Liquid transport pipelines (including sewer)		A	8
Materials spills (including during transport)	X	A, B, C, D, E, F	1, 2, 3, 4, 5, 7, 8, 9
Material transfer operations		A	
Small-scale manufacturing and repair shops		A, I	8
Mining and mine drainage		A	7,8
Salt storage (state and nonstate facilities) and road salting	X	A, C, D, E, F	6
Urban runoff		A, C, H, I	1, 2, 4, 5, 7, 8, 9

Source: U.S. EPA 2006a; 2007

*Factors considered in selecting the contaminant source: (A) human health and/or environmental risk (toxicity); (B) size of the population at risk; (C) location of source relative to drinking water source; (D) number and/or size of contaminant sources; (E) hydrogeologic sensitivity; (F) documented state findings, other findings; (G) high to very high priority in localized areas, but not over majority of Indiana; (H) geographic distribution/occurrence; and, (I) lack of information.

**Classes of contaminants associated with contamination source: (1) Inorganic pesticides; (2) Organic pesticides; (3) Halogenated solvents; (4) Petroleum compounds; (5) Nitrate; (6) Salinity/brine; (7) Metals; (8) Radionuclides; and, (9) Bacteria, protozoa and viruses.

Table 30: Ground water protection programs and activities currently established or under development in Indiana.

Program or Activity	Status	State Agency/Organization
Active SARA Title III Program	Fully established	IDEM-OLQ[1]
Ambient ground water monitoring program	Under development	IDEM-OWQ
Aquifer sensitivity assessment	Fully established	IDEM-OWQ, IDNR, IGS[2], OISC[3]
Aquifer mapping/basin studies	Under development	IDNR, IDEM-OWQ
Aquifer/ hydrogeologic setting characterization	Fully established	IGS, IDEM-OWQ, IDNR
Bulk storage program for agricultural chemicals	Fully established	OISC
Comprehensive data management system	Under development	IDEM-OWQ
Complaint response program for private wells	Fully established	IDEM-OWQ
Confined animal feeding program	Fully established	IDEM-OWQ
Ground water discharge permits for constructed wetlands	Under development	IDEM-OWQ
Ground water Best Management Practices	Under development	OISC*, IDEM-OWQ
Ground water legislation	Fully established	IDEM, IDNR, OISC, ISDH
Ground water classification	Fully established	IDEM-OWQ
Ground water quality standards	Fully established	IDEM-OWQ
Land application of domestic and industrial residuals	Fully established	IDEM-OLQ
Nonpoint source controls	Under development	IDEM-OWQ
Oil and Gas	Fully established	IDNR
Pesticide State Management Plan	Pending	OISC*, IDEM-OWQ, IDNR, IGS
Pollution Prevention Program	Fully established	IDEM-OPPTA[4]
Reclamation	Fully established	IDNR
Resource Conservation and Recovery Act (RCRA) Primacy	Fully established	IDEM-OLQ
Sensitivity assessment for drinking water/ wellhead protection	Fully established	IGS, IDEM-OWQ
Spill Monitoring	Fully established	IDEM-OWQ
State Superfund	Fully established	IDEM-OLQ
State RCRA Program incorporating more stringent requirements than RCRA primacy	Fully established	IDEM-OLQ
State septic system regulations	Fully established	ISDH
Underground storage tank installation requirements	Fully established	IDEM-OLQ
Underground Storage Tank Remediation Fund	Fully established	IDEM-OLQ
Underground Storage Tank Permit Program	Fully established	IDEM-OLQ
Underground Injection Control Program	Fully established for Class II wells	IDNR
Well abandonment regulations	Fully established	IDNR
Wellhead Protection Program	Fully established	IDEM-OWQ
Well installation regulations	Fully established	IDNR

*Indicates lead agency involved in enforcement or implementation.
"Pending" is used to describe those programs that have a written draft policy; "under development" is used to describe those programs still in the planning stage.
[1]OLQ, Office of Land Quality; [2]IGS, Indiana Geological Survey; [3]OISC, Office of the Indiana State Chemist; [4]OPPTA, Office of Pollution Prevention and Technical Assistance (IDEM).

Table 31: Indiana Ground Water Monitoring Network analytical results, 2012.

Analyte Measured as Milligrams per Liter (mg/L) or Micrograms per Liter (ug/L)	Number of Samples (n)	n Below Detection Limit (BDL)	% BDL	DL	Median	Mean	Min	Max	Standard Deviation	EPA Maximum Contaminant Level (MCL)	EPA Secondary Maximum Contaminant Level (SMCL) or Recommendation (REC)	n > MCL or SMCL	% > MCL or SMCL
Alkalinity and Anions/Cations													
Alkalinity (mg/L)	326	0	0.00	1	273	267.30	21.6	767	82.75	--	--		
Calcium (mg/L)	326	8	2.50	0.1	80	79.68	0.1	300	39.55	--	--		
Chloride (mg/L)	326	37	11.30	2	12	23.63	2	400	39.75	--	--		
Magnesium (mg/L)	326	12	3.70	0.1	28	28.94	0.1	200	19.37	--	--		
Potassium (mg/L)	326	4	1.20	0.2	1.4	2.06	0.2	40	3.01	--	--		
Sodium (mg/L)	326	0	0.00	0.1	11	35.62	1.3	660	66.90	--	200 mg/L (rec)	11	3.37
Sulfate (mg/L)	326	46	14.10	5	34	69.46	5	1500	159.28	--	250 mg/L	15	4.60
Metals and Minerals													
Arsenic (ug/L)	326	211	64.70	2	2	4.18	2	69	6.79	10 ug/L	--	23	7.06
Barium (ug/L)	326	14	4.30	2	82.5	129.25	2	1100	148.30	2000 ug/L	--	0	0.00
Boron (ug/L)	326	3	0.90	5	28	102.24	5	1400	193.09	--	--		
Bromide (mg/L)	326	20	6.10	10	27	65.98	10	4000	257.81	--	--		
Chromium (ug/L)	326	324	99.40	2	2	2.02	2	6.2	0.26	100 ug/L	--	0	0.00
Copper (ug/L)	326	147	45.10	1	1.3	4.11	1	97	8.65	1300 ug/L	--	0	0.00
Iron (mg/L)	326	104	31.90	0.02	0.49	0.91	0.02	7.2	1.15	--	0.3 mg/L	180	55.21
Lead (ug/L)	326	323	99.10	1	1	1.05	1	10	0.59	15 ug/L	--	0	0.00
Nickel (ug/L)	326	91	27.90	1	1.6	2.07	1	19	1.71	--	100 ug/L (rec)	0	0.00
Silicon (mg/L)	326	0	0.00	0.1	14	14.69	6.7	36	4.36	--	--		
Strontium (mg/L)	326	10	3.10	2	0.18	1.68	0.002	37	4.20	--	4 mg/L (rec)	35	10.74
Zinc (ug/L)	326	106	32.50	5	11	32.67	5	600	71.03	--	5000 ug/L	0	0.00

Analyte Measured as Milligrams per Liter (mg/L) or Micrograms per Liter (ug/L)	Number of Samples (n)	n Below Detection Limit (BDL)	% BDL	DL	Median	Mean	Min	Max	Standard Deviation	EPA Maximum Contaminant Level (MCL)	EPA Secondary Maximum Contaminant Level (SMCL) or Recommendation (REC)	n > MCL or SMCL	% > MCL or SMCL
Nitrogen, Nitrate-Nitrite													
Nitrogen, Nitrate-Nitrite (mg/L)	326	167	51.20	0.1	0.1	2.02	0.01	27	4.30	10 mg/L	--	17	5.21
Pesticides and Breakdown Products													
Acetochlor ESA (ug/L)	50	46	92.00	0.1	0.1	0.21	0.1	3.8	0.57	--	--		
Acetochlor OA (ug/L)	51	48	94.10	0.1	0.1	0.13	0.1	1.6	0.21	--	--		
Alachlor ESA (ug/L)	43	40	93.00	0.1	0.1	0.14	0.1	1.2	0.19	--	--		
Atrazine (ug/L)	325	324	99.70	0.1	0.1	0.10	0.1	0.3	0.01	3 ug/L	--	0	0.00
Metolochlor ESA (ug/L)	46	39	84.80	0.1	0.1	0.21	0.1	2	0.34	--	--		
Metolochlor OA (ug/L)	47	44	93.60	0.1	0.1	0.12	0.1	0.6	0.08	--	--		
Volatile Organic Compounds													
Benzo(a)pyrene (ug/L)	326	325	99.70	0.02	0.02	0.02	0.02	0.03	0.0005	0.2 ug/L	--	0	0.00
Methyl-t-butyl ether (MTBE) (ug/L)	325	324	99.70	0.5	0.5	0.51	0.5	3.8	0.18	--	20 ug/L	0	0.00
Tetrachloroethylene (ug/L)	325	324	99.70	0.5	0.5	0.51	0.5	4.7	0.23	5 ug/L	--	0	0.00
Toluene (ug/L)	325	324	99.70	0.6	0.5	0.50	0.5	0.6	0.01	1000 ug/L	--	0	0.00

***Disinfection Byproducts and plasticizers have been omitted from this list until further analysis and sampling can be conducted to determine the source

Table 32: Summary statistics calculated from nitrogen concentrations measured as milligrams per liter (mg/L) nitrate-nitrite for Indiana's generalized hydrogeologic settings.

Hydrogeologic Setting	Number of Samples (n)	n Above Detection Limit (ADL)	% ADL	n Above Maximum Contaminant Level (MCL)	% Above MCL	Median	Mean	Min	Max	Standard Deviation
Ablation Sequence	5	0	0	0	0	0.005	0.005	0.005	0.01	0.00
Alluvial Valley	5	2	40	0	0	0.005	0.473	0.005	1.60	0.71
Dissected Bedrock	4	2	50	0	0	0.068	0.070	0.005	0.14	0.08
Dissected Bedrock Thin Till	17	11	65	1	6	0.170	1.736	0.005	13.00	3.28
Fan Head Complex	5	1	20	0	0	0.005	0.080	0.005	0.38	0.17
Ice Contact Deposits	2	1	50	1	50	7.003	7.003	0.005	14.00	9.90
Karst Plain and Escarpment	9	7	78	0	0	0.530	2.235	0.005	7.90	2.92
Lake Deposits	5	3	60	0	0	0.051	1.610	0.005	7.70	3.41
Meltwater Channel	1	0	0	0	0	0.005	0.005	0.005	0.01	
Outwash Complex	6	2	33	0	0	0.005	0.127	0.005	0.45	0.20
Outwash Plain	22	8	36	2	9	0.005	2.627	0.005	22.00	5.47
Sand Plains and Loess Sands	30	17	57	1	3	0.012	1.638	0.005	16.00	3.54
Sluiceway or Discrete Channel	34	15	44	2	6	0.005	1.802	0.005	15.00	3.69
Till Capped Fan	9	4	44	0	0	0.005	0.467	0.005	4.00	1.33
Till Cored Moraine	44	9	20	0	0	0.005	0.088	0.005	2.80	0.42
Till Plain	151	40	26	0	0	0.005	0.180	0.005	6.40	0.79
Trough System	4	1	25	0	0	0.005	0.379	0.005	1.50	0.75
Tunnel Valley	10	3	30	0	0	0.005	0.532	0.005	4.30	1.35
Unconfined Outwash Fan	16	6	38	0	0	0.005	0.344	0.005	1.90	0.71
Wabash River Valley	11	7	64	2	18	1.100	5.023	0.005	17.00	6.57

Table 33 Average nitrogen concentrations measured as milligrams per liter (mg/L) nitrate-nitrite for each hydrogeologic setting calculated for different well type and depth, aquifer conditions and aquifer sensitivity.

Hydrogeologic Setting	Well Type		Well Depth				Aquifer Conditions	Aquifer Conditions				
	Bedrock	Unconsolidated	0-50	50-100	100-150	>150	Oxidizing	High	Moderate	Low	Variable	Low , High
Ablation Sequence	ND	ND	ND	ND	ND	--	ND	ND	--	--	--	--
Alluvial Valley	0.473	--	--	0.803	--	0.253	1.175	0.473	--	--	--	--
Dissected Bedrock	0.092	0.070	--	--	0.130	0.050	0.092	0.070	--	--	--	--
Dissected Bedrock Thin Till	0.447	3.576	4.972	0.045	1.104	0.279	3.130	0.869	0.038	4.410	--	0.280
Fan Head Complex	0.193	ND	--	0.130	ND	--	ND	0.380	ND	--	ND	--
Ice Contact Deposits	--	7.003	--	14.000	ND	--	--	ND	14.000	--	--	--
Karst Plain and Escarpment	2.472	0.340		6.000	1.762	1.770	2.152	2.235	--	--	--	--
Lake Deposits	ND	2.012	ND	7.700	0.115	--	0.115	ND	ND	2.680	--	--
Outwash Complex	0.370	ND	--	ND	0.148	0.450	0.370	0.127	--	--	--	--
Outwash Plain	ND	2.752	4.038	1.332	ND	ND	9.140	2.627	--	--	--	--
Sand Plains and Loess Sands	3.041	0.825	0.829	1.760	2.683	1.965	3.473	0.485	2.923	6.800	--	--
Sluiceway or Discrete Channel	0.017	2.184	3.869	1.594	0.610	0.038	4.699	1.856	ND	--	--	--
Till Capped Fan	--	0.467	--	0.008	1.040	--	1.385	ND	ND	0.078	0.807	--
Till Cored Moraine	0.050	0.096	1.403	0.036	0.030	0.006	0.135	ND	0.034	0.119	ND	--
Till Plain	0.139	0.203	0.595	0.177	0.148	0.085	0.975	0.219	0.047	0.244	ND	--
Trough System	--	0.379	ND	0.503	--	--	1.500	0.379	--	--	--	--
Tunnel Valley	1.735	0.016	0.303	0.873	0.021	--	1.735	ND	--	--	0.663	--
Unconfined Outwash Fan	--	0.344	0.006	0.345	0.624	0.011	0.855	0.240	1.900	--	--	--
Wabash River Valley	0.007	6.904	8.515	3.376	6.179	ND	6.368	5.525	--	--	ND	--

Note: ND = not detected. Detailed averages were not compiled for the Meltwater Channel Setting, which consisted of only one sample.

Table 34: Summary statistics calculated from arsenic concentrations in micrograms per liter (ug/L) for Indiana's generalized hydrogeologic settings.

Hydrogeologic Setting	Number of Samples (n)	n Above Detection Limit (ADL)	% ADL	n Above Maximum Contaminant Level (MCL)	% Above MCL	Median (ug/L)	Mean (ug/L)	Minimum (ug/L)	Maximum (ug/L)	Standard Deviation (ug/L)
Ablation Sequence	5	3	60	1	20	2.5	5.3	1.0	16.0	6.32
Alluvial Valley	5	1	20	1	20	1.0	6.6	1.0	29.0	12.52
Dissected Bedrock	4	1	25	0	0	1.0	1.8	1.0	4.2	1.60
Dissected Bedrock Thin Till	17	3	18	0	0	1.0	1.3	1.0	3.8	0.74
Fan Head Complex	5	1	20	0	0	1.0	1.4	1.0	3.2	0.98
Ice Contact Deposits	2	1	50	1	50	6.5	6.5	1.0	12.0	7.78
Karst Plain and Escarpment	9	0	0	0	0	1.0	1.0	1.0	1.0	0.00
Lake Deposits	5	2	40	1	20	1.0	5.9	1.0	21.0	8.66
Meltwater Channel	1	1	100	0	0	6.1	6.1	6.1	6.1	
Outwash Complex	6	2	33	0	0	1.0	2.4	1.0	8.0	2.80
Outwash Plain	22	7	32	2	9	1.0	3.1	1.0	19.0	4.51
Sand Plains and Loess Sands	30	7	23	3	10	1.0	4.4	1.0	63.0	11.61
Sluiceway or Discrete Channel	34	13	38	3	9	1.0	5.9	1.0	68.0	13.99
Till Capped Fan	9	3	33	1	11	1.0	4.7	1.0	28.0	8.90
Till Cored Moraine	44	20	45	2	5	1.0	3.2	1.0	16.0	3.44
Till Plain	151	67	44	25	17	1.0	5.2	1.0	65.0	7.81
Trough System	4	1	25	0	0	1.0	1.4	1.0	2.7	0.85
Tunnel Valley	10	4	40	1	10	1.0	4.1	1.0	21.0	6.41
Unconfined Outwash Fan	16	8	50	1	6	1.8	4.5	1.0	17.0	4.64
Wabash River Valley	11	2	18	1	9	1.0	3.6	1.0	27.0	7.80

Table 35: Average arsenic concentrations in micrograms per liter (ug/L) for each hydrogeologic setting calculated for different well type and depth, aquifer conditions and aquifer sensitivity.

Hydrogeologic Setting	Well Type		Aquifer Conditions		Hydrogeologic Sensitivity					Well Depth			
	Bedrock	Unconsolidated	Oxidizing	Reducing	High	Moderate	Low	Variable	Low , High	0-50	50-100	100-150	>150
Ablation Sequence	16.00	2.65	6.10	5.13	2.50	--	--	--	--	1.00	3.55	9.25	--
Alluvial Valley	6.60	--	ND	10.33	ND	--	--	--	--	--	ND	--	10.33
Dissected Bedrock	2.07	ND	ND	4.20	1.80	--	--	--	--	--	--	ND	2.07
Dissected Bedrock Thin Till	1.11	1.56	1.12	1.49	ND	1.78	ND	--	ND	1.22	1.78	ND	1.00
Fan Head Complex	ND	1.73	ND	1.55	ND	ND	--	2.10	--	--	1.73	ND	--
Ice Contact Deposits	--	6.50	--	6.50	12.00	ND	--	--	--	--	ND	12.00	--
Karst Plain and Escarpment	ND	ND	ND	ND	ND	--	--	--	--		ND	ND	ND
Lake Deposits	ND	7.18	9.23	ND	21.00	1.00	2.57	--	--	ND	ND	9.23	--
Outwash Complex	ND	3.15	ND	3.15	2.43	--	--	--	--	--	3.87	ND	ND
Outwash Plain	ND	3.23	ND	3.75	3.13	--	--	--	--	1.55	4.73	8.05	ND
Sand Plains and Loess Sands	ND	6.29	1.74	5.86	6.29	ND	ND	--	--	3.06	2.98	11.33	ND
Sluiceway or Discrete Channel	2.10	6.67	ND	8.87	5.85	6.40	--	--	--	1.61	9.68	2.26	2.65
Till Capped Fan	--	4.74	1.43	6.40	ND	ND	15.15	2.08	--	--	2.08	8.08	--
Till Cored Moraine	2.01	3.49	1.58	3.43	2.10	3.25	3.25	3.15	--	3.15	2.66	3.11	4.10
Till Plain	3.93	5.88	1.24	5.89	3.67	3.81	5.63	6.59	--	5.08	4.61	8.49	3.60
Trough System	--	1.43	ND	1.57	1.43	--	--	--	--	2.70	ND	--	--
Tunnel Valley	1.67	5.11	ND	5.40	4.85	--	--	3.89	--	3.57	5.62	ND	--
Unconfined Outwash Fan	--	4.47	ND	4.96	4.32	6.70	--	--	--	2.75	5.66	5.20	ND
Wabash River Valley	10.43	ND	1.38	6.20	1.23	--	--	27.00	--	ND	ND	1.58	1.58

Note: ND = not detected

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ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT

LANDFILL
A.B. BROWN GENERATING STATION
POSEY COUNTY, INDIANA

by
Haley & Aldrich, Inc.
Greenville, South Carolina

for
Southern Indiana Gas and Electric Company
Evansville, Indiana

File No. 129420
January 2020

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1. 40 CFR § 257.90 Applicability

1.1 40 CFR § 257.90(a)

Except as provided for in § 257.100 for inactive CCR surface impoundments, all CCR landfills, CCR surface impoundments, and lateral expansions of CCR units are subject to the groundwater monitoring and corrective action requirements under § 257.90 through § 257.98.

The Landfill at A.B. Brown Generating Station (ABB) is subject to the groundwater monitoring and corrective action requirements described under Code of Federal Regulations Title 40 (40 CFR) § 257.90 through § 257.98 (Rule). This document addresses the requirement for the Owner/Operator to prepare an Annual Groundwater Monitoring and Corrective Action Report per § 257.90(e).

1.2 40 CFR § 257.90(e) - SUMMARY

Annual groundwater monitoring and corrective action report. For existing CCR landfills and existing CCR surface impoundments, no later than January 31, 2018, and annually thereafter, the owner or operator must prepare an annual groundwater monitoring and corrective action report. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, the owner or operator must prepare the initial annual groundwater monitoring and corrective action report no later than January 31 of the year following the calendar year a groundwater monitoring system has been established for such CCR unit as required by this subpart, and annually thereafter. For the preceding calendar year, the annual report must document the status of the groundwater monitoring and corrective action program for the CCR unit, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year. For purposes of this section, the owner or operator has prepared the annual report when the report is placed in the facility's operating record as required by § 257.105(h)(1).

This Annual Groundwater Monitoring and Corrective Action Report documents the activities completed in 2019 for the Landfill as required by the Rule. Groundwater sampling and analysis was conducted per the requirements described in § 257.93, and the status of the groundwater monitoring program described in § 257.95 is provided in this report.

1.2.1 Status of the Groundwater Monitoring Program

As provided in the notification on 15 January 2018 statistically significant increases (SSI) of Appendix III constituents were identified downgradient of the Landfill. An evaluation of alternate sources was conducted; however, a successful alternate source demonstration (ASD) was not achieved at that time. As a result, an Assessment Monitoring program was initiated as required by § 257.94(e)(2). The notification was placed in the facility's operating record as required by 257.105(h)(5). Annual and semi-annual groundwater samples were collected as outlined in § 257.95(b) and 257.95(d)(1) and groundwater protection standards were established as required by § 257.95(d)(2). Statistical analysis was completed in January 2019 as described in § 257.93(h)(2) and statistically significant levels (SSL) of Appendix IV constituents (arsenic, cobalt and lithium) were identified downgradient of the Landfill. An alternate source evaluation was conducted and was successful in demonstrating that a source other than Landfill caused the SSLs for arsenic, cobalt and lithium. The ASD is provided in Appendix A. As a result, the Landfill remains in assessment monitoring.

1.2.2 Key Actions Completed

The following key actions were completed in 2019:

- Completed a statistical analysis of assessment monitoring results to evaluate potential SSLs;
- Prepared 2018 Annual Report including:
  - The Annual Report was placed in the facility's operating record pursuant to § 257.105(h)(1);
  - Pursuant to § 257.106(h)(1), the notification was sent to the relevant State Director and/or Tribal authority within 30 days of the Annual Report being placed in the facility's operating record [§ 257.106(d)];
  - Pursuant to § 257.107(h)(1), the Annual Report was posted to the CCR Website within 30 days of the Annual Report being placed in the facility's operating record [§ 257.107(d)] and 257.107(h)(1)];
- Conducted and certified an ASD for arsenic, cobalt and lithium (Appendix A);
- Collected and analyzed two rounds of groundwater samples in accordance with § 257.95

1.2.3 Problems Encountered

No problems such as damaged wells, issues with sample collection or lack of sampling, and problems with analytical analysis were encountered at the ABB Landfill in 2019.

1.2.4 Actions to Resolve Problems

Actions to resolve problems were not required.

1.2.5 Project Key Activities for Upcoming Year

Key activities to be completed in 2020 include the following:

- Continue Assessment Monitoring as required by § 257.95.
- Complete statistical analysis of the semiannual groundwater sampling results as required by § 257.93(h)(2).

1.3 40 CFR § 257.90(e) - INFORMATION

At a minimum, the annual groundwater monitoring and corrective action report must contain the following information, to the extent available:

1.3.1 40 CFR § 257.90(e)(1)

A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;

As required by § 257.90(e)(1), a map showing the locations of the Landfill and associated upgradient, downgradient wells is presented as Figure 1.

1.3.2 40 CFR § 257.90(e)(2)

Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;

Additional monitoring wells were not installed or decommissioned during 2019. However, location and construction details of the existing monitoring well network for the Landfill is provided for reference as Table I.

1.3.3 40 CFR § 257.90(e)(3)

In addition to all the monitoring data obtained under § 257.90 through § 257.98, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;

In accordance with § 257.95(b) and § 257.95(d)(1), two independent samples from each background and downgradient monitoring well were collected and analyzed. A summary table including the sample names, dates of sample collection, reason for sample collection (detection or assessment), and monitoring data obtained for the groundwater monitoring program for the Landfill is presented in Table II of this report.

1.3.4 40 CFR § 257.90(e)(4)

A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels); and

As required by § 257.94(h) a statistical analysis of the Appendix IV constituents was completed by January 15, 2019. This statistical analysis determined that statistically significant levels of arsenic, cobalt and lithium were present downgradient of the Landfill. An evaluation of alternate sources was initiated and completed in April 2019 as required by § 257.94(e)(2). A source causing the SSL of arsenic, cobalt and lithium over background levels other than the CCR Unit was identified. As a result, the Landfill will remain in assessment monitoring.

1.3.5 40 CFR § 257.90(e)(5)

Other information required to be included in the annual report as specified in § 257.90 through § 257.98.

Other information including development of groundwater protection standards, recording groundwater monitoring results in the operating record, and an evaluation of alternate sources is discussed in preceding sections.

TABLES

TABLE I

GROUNDWATER MONITORING WELL LOCATION AND CONSTRUCTION DETAILS

A.B. BROWN GENERATING STATION - LANDFILL

MOUNT VERNON, INDIANA

Well	CCR Unit	Date Installed	Easting	Northing	Top of Pad Elevation (ft msl)	Top of Riser Elevation (ft msl)	Surface Grout (ft bgs)	Bentonite (ft bgs)	Sand Pack (ft bgs)	Screen Zone (ft bgs)	Screen Length (ft)	Well Radius (in)	Status
CCR-LF-1	Landfill	March 2016	2771247.76	970812.18	432.80	435.63	0.0 - 3.0	3.0 - 7.0	7.0 - 19.0	9.00 - 19.00	10	2	Active
CCR-LF-2	Landfill	March 2016	2772205.05	970681.32	470.10	473.00	0.0 - 30.0	30.0 - 32.0	32.0 - 45.0	35.00 - 45.00	10	2	Active
CCR-LF-3	Landfill	March 2016	2773138.97	970949.70	482.00	484.75	0.0 - 21.0	21.0 - 23.0	23.0 - 35.0	25.00 - 35.00	10	2	Active
CCR-LF-4	Landfill	March 2016	2772876.83	972312.24	476.60	478.85	0.0 - 40.8	40.8 - 43.0	43.0 - 55.0	45.00 - 55.00	10	2	Active
CCR-LF-5	Landfill	March 2016	2772003.91	972228.16	427.50	430.41	0.0 - 16.0	16.0 - 18.0	18.0 - 30.0	20.00 - 30.00	10	2	Active
CCR-LF-6	Landfill	March 2016	2771046.15	972269.53	409.20	412.05	0.0 - 0.0	0.0 - 2.66	2.66 - 9.66	4.66 - 9.66	5	2	Active
CCR-BK-1R	Background	March 2016	2770919.08	974083.40	480.10	483.39	0.0 - 50.0	50.0 - 52.0	52.0 - 64.0	54.00 - 64.00	10	2	Active
CCR-BK-2	Background	March 2016	2769728.14	972854.33	427.50	430.60	0.0 - 11.5	11.5 - 13.5	13.5 - 25.5	15.50 - 25.50	10	2	Active

Notes:

bgs = below ground surface

ft = feet

in = inches

msl = mean sea level

Datum of Elevations in NAVD 88

TABLE II
SUMMARY OF GROUNDWATER QUALITY DATA
LANDFILL - MAY THROUGH OCTOBER 2019
A.B. BROWN GENERATION STATION
MOUNT VERNON, INDIANA

Location Group	Action Level	Background			
Location Name	Maximum Contaminant Level	CCR-BK-1R	CCR-BK-1R	CCR-BK-2	CCR-BK-2
Sample Name		CCR-BK-1R-20190521	CCR-BK-1R-20191014	CCR-BK-2-20190521	CCR-BK-2-20191014
Sample Date		05/21/2019	10/14/2019	05/21/2019	10/14/2019
Lab Sample ID		180-90467-7	180-97392-1	180-90467-8	180-97392-2
Detection Monitoring - EPA Appendix III Constituents (mg/L)					
Boron, Total	NA	0.08 U	**0.056 J**	**0.58**	**0.051 J**
Calcium, Total	NA	**37**	**34**	**71**	**35**
Chloride	NA	**2.3**	**2.4**	**4.6**	**17**
Fluoride	4	0.23 U	**0.2**	0.12 U	**0.07 J**
Sulfate	NA	**23**	**22**	**60**	**20**
Total Dissolved Solids (TDS)	NA	**230**	**210**	**440**	**230**
pH (lab) (SU)	NA	**7.4 J**	**7.2 HF**	**7.5 J**	**7 HF**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)					
Antimony, Total	0.006	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	**0.00034 J**	**0.00036 J**	**0.00041 J**	0.001 U
Barium, Total	2	**0.027 J**	**0.036**	**0.045 J-**	**0.032**
Beryllium, Total	0.004	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.005	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	0.1	0.002 U	0.002 U	**0.0087**	0.002 U
Cobalt, Total	0.006	**0.00012 J**	**0.00017 J**	**0.0005**	**0.00011 J**
Fluoride	4	0.23 U	**0.2**	0.12 U	**0.07 J**
Lead, Total	0.015	**0.00016 J**	**0.00023 J**	0.001 U	0.001 U
Lithium, Total	0.04	0.0065 U	0.005 U	0.0095 U	0.005 U
Mercury, Total	0.002	0.0002 U	-	0.0002 U	-
Molybdenum, Total	0.1	**0.00063 J**	**0.00075 J**	**0.0025 J**	0.005 U
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.002	0.001 U	0.001 U	0.001 U	0.001 U
Radiological (pCi/L)					
Radium-226	NA	**0.336 J ± 0.108**	0.0729 U ± 0.182	-0.0109 U ± 0.184	-0.0644 U ± 0.0992
Radium-228	NA	-0.0733 UJ ± 0.235	0.147 U ± 0.233	0.0733 U ± 0.246	0.323 U ± 0.292
Radium-226 & 228	5	0.336 UJ ± 0.259	0.220 U ± 0.296	0.0733 U ± 0.307	0.259 U ± 0.308
Field Parameters					
Temperature (Deg C)	NA	**15.78**	**15.72**	**14.47**	**16.04**
Dissolved Oxygen, Field (mg/L)	NA	**5.82**	**5.98**	**0.48**	**0.51**
Conductivity, Field (mS/cm)	NA	**0.34186**	**0.3542**	**0.72035**	**0.38427**
ORP, Field (mv)	NA	**43.3**	**104.9**	**47.9**	**72.1**
Turbidity, Field (NTU)	NA	**0.97**	**9.8**	**12.88**	**11.89**
pH, Field (SU)	NA	**7**	**6.34**	**7.2**	**6.54**

ABBREVIATIONS AND NOTES:

CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
SU: standard units.
USEPA: United States Environmental Protection Agency.
Results in **bold** are detected.

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TABLE II
SUMMARY OF GROUNDWATER QUALITY DATA
LANDFILL - MAY THROUGH OCTOBER 2019
A.B. BROWN GENERATION STATION
MOUNT VERNON, INDIANA

Location Group	Action Level	Downgradient							
Location Name	Maximum Contaminant Level	CCR-LF-1	CCR-LF-1	CCR-LF-2	CCR-LF-2	CCR-LF-3	CCR-LF-3	CCR-LF-4	CCR-LF-4
Sample Name		CCR-LF-1-20190520	CCR-LF-1-20191015	CCR-LF-2-20190522	CCR-LF-2-20191015	CCR-LF-3-20190520	CCR-LF-3-20191015	CCR-LF-4-20190521	CCR-LF-4-20191016
Sample Date		05/20/2019	10/15/2019	05/22/2019	10/15/2019	05/20/2019	10/15/2019	05/21/2019	10/16/2019
Lab Sample ID		180-90467-1	180-97385-1	180-90467-2	180-97385-2	180-90467-3	180-97385-3	180-90467-4	180-97385-4
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	NA	**0.034 J**	0.08 U	**5.4**	**0.48**	**0.13**	**0.16**	0.8 U	0.8 U
Calcium, Total	NA	**290**	**260**	**420**	**370**	**350**	**370**	**370**	**350**
Chloride	NA	**23**	**18**	**390**	**350**	**98**	**56**	**120**	**110**
Fluoride	4	**0.21 J+**	**0.1**	2.5 U	2.5 U	**0.34 J+**	**0.17 J**	**0.34 J+**	1 U
Sulfate	NA	**1100**	**1000**	**15000**	**16000**	**1600**	**1700 F1**	**7900**	**7800**
Total Dissolved Solids (TDS)	NA	**1900**	**1800**	**21000**	**22000**	**2800**	**2900**	**10000**	**11000**
pH (lab) (SU)	NA	**7.1 J**	**6.7 HF**	**6.8 J**	**6.5 HF**	**7.4 J**	**7.1 HF**	**6.9 J**	**6.7 HF**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	0.002 U	-	0.02 U	-	0.002 U	-	0.02 U	-
Arsenic, Total	0.01	**0.00039 J**	**0.00094 J**	0.01 U	**0.0013**	**0.00037 J**	**0.00056 J**	**0.017**	**0.018**
Barium, Total	2	**0.029 J-**	**0.055**	0.1 UJ	**0.013**	**0.019 J-**	**0.02**	0.1 UJ	**0.014**
Beryllium, Total	0.004	0.001 U	-	0.001 U	-	0.001 U	-	0.001 U	-
Cadmium, Total	0.005	0.001 U	0.001 U	**0.0044 J**	**0.0045**	0.001 U	0.001 U	0.01 U	0.001 U
Chromium, Total	0.1	0.002 U	**0.0032 B**	0.02 U	**0.0018 JB**	**0.0025**	**0.0033 B**	0.02 U	**0.0016 JB**
Cobalt, Total	0.006	**0.0002 J**	**0.00041 J**	**0.0098**	**0.011**	**0.00028 J**	**0.00027 J**	**0.0014 J**	**0.0013**
Fluoride	4	**0.21 J+**	**0.1**	2.5 U	2.5 U	**0.34 J+**	**0.17 J**	**0.34 J+**	1 U
Lead, Total	0.015	0.001 U	-	0.01 U	-	0.001 U	-	0.01 U	-
Lithium, Total	0.04	0.0059 U	**0.0048 J**	0.05 U	0.005 U	0.0074 U	**0.0042 J**	**0.074**	**0.075**
Mercury, Total	0.002	0.0002 U	-	0.0002 U	-	0.0002 U	-	0.0002 U	-
Molybdenum, Total	0.1	**0.0009 J**	**0.0011 J**	0.05 U	**0.0025 J**	**0.0056**	**0.0016 J**	**0.021 J**	**0.022**
Selenium, Total	0.05	0.005 U	-	0.05 U	-	0.005 U	-	0.05 U	-
Thallium, Total	0.002	0.001 U	-	0.01 U	-	0.001 U	-	0.01 U	-
Radiological (pCi/L)									
Radium-226	NA	0.000 U ± 0.172	**0.271 ± 0.129**	**0.593 ± 0.295**	**0.362 ± 0.136**	**0.196 J ± 0.0954**	0.0345 U ± 0.0959	**1.61 ± 0.446**	**2.21 ± 0.337**
Radium-228	NA	0.466 R ± 0.281	-0.169 U ± 0.266	**2.31 ± 0.469**	**1.75 ± 0.436**	0.105 UJ ± 0.333	0.153 U ± 0.383	**1.50 J ± 0.41**	**1.25 ± 0.405**
Radium-226 & 228	5	0.466 R ± 0.329	0.103 U ± 0.296	**2.90 ± 0.554**	**2.11 ± 0.457**	0.301 UJ ± 0.346	0.188 U ± 0.395	**3.11 J+ ± 0.606**	**3.46 ± 0.527**
Field Parameters									
Temperature (Deg C)	NA	**15.62**	**19.97**	**16.21**	**16.23**	**16.07**	**15.73**	**16**	**14.62**
Dissolved Oxygen, Field (mg/L)	NA	**4.08**	**1.26**	**1.15**	**0.09**	**8.1**	**7.51**	**0.61**	**0.79**
Conductivity, Field (mS/cm)	NA	**2.0471**	**2.0961**	**24.022**	**23.467**	**2.937**	**3.1858**	**12.83**	**1.264**
ORP, Field (mv)	NA	**30**	**80.3**	**85.6**	**159.6**	**29.6**	**131.8**	**13.7**	**58.8**
Turbidity, Field (NTU)	NA	**0**	**1.14**	**2.73**	**1.41**	**0**	**0**	**5.06**	**1.17**
pH, Field (SU)	NA	**6.82**	**6.5**	**6.61**	**6.4**	**7.16**	**6.95**	**6.76**	**6.58**

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MOUNT VERNON, INDIANA

Location Group	Action Level	Downgradient					
Location Name	Maximum Contaminant Level	CCR-LF-5	CCR-LF-5	CCR-LF-5	CCR-LF-5	CCR-LF-6	CCR-LF-6
Sample Name		CCR-LF-5-20190520	BLIND DUPLICATE 1-20190520	CCR-LF-5-20191014	BLIND DUPLICATE 2-20191014	CCR-LF-6-20190520	CCR-LF-6-20191014
Sample Date		05/20/2019	05/20/2019	10/14/2019	10/14/2019	05/20/2019	10/14/2019
Lab Sample ID		180-90467-5	180-90467-16	180-97385-5	180-97385-7	180-90467-6	180-97385-6
Detection Monitoring - EPA Appendix III Constituents (mg/L)							
Boron, Total	NA	**1.9**	**2**	**1.1**	**1.1**	**0.73**	**0.78**
Calcium, Total	NA	**430**	**430**	**410**	**400**	**260**	**170**
Chloride	NA	**460**	**450**	**290**	**290**	**35**	**24**
Fluoride	4	**0.34 J+**	**0.3 J+**	**0.21 J**	**0.23 J**	**0.34 J+**	**0.26**
Sulfate	NA	**3000**	**3000**	**2700**	**2700**	**730**	**480**
Total Dissolved Solids (TDS)	NA	**5400**	**5200**	**4500**	**4200**	**1500**	**1100**
pH (lab) (SU)	NA	**7.2 J**	**7.3 J**	**6.9 HF**	**6.9 HF**	**7.3 J**	**7 HF**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)							
Antimony, Total	0.006	0.02 U	0.02 U	-	-	0.002 U	-
Arsenic, Total	0.01	0.01 U	0.01 U	**0.00043 J**	**0.00046 J**	0.001 U	**0.00047 J**
Barium, Total	2	**0.023 J-**	**0.023 J-**	**0.027**	**0.026**	**0.016 J-**	**0.019**
Beryllium, Total	0.004	0.001 U	0.001 U	-	-	0.001 U	-
Cadmium, Total	0.005	0.01 U	0.01 U	**0.00023 J**	**0.00023 J**	**0.00019 J**	**0.00015 J**
Chromium, Total	0.1	0.02 U	0.02 U	**0.002 B**	**0.002 B**	0.002 U	**0.0022 B**
Cobalt, Total	0.006	0.005 U	0.005 U	**0.00035 J**	**0.00032 J**	**0.00027 J**	**0.00033 J**
Fluoride	4	**0.34 J+**	**0.3 J+**	**0.21 J**	**0.23 J**	**0.34 J+**	**0.26**
Lead, Total	0.015	0.01 U	0.01 U	-	-	0.001 U	-
Lithium, Total	0.04	0.05 U	0.05 U	**0.02**	**0.019**	**0.019 J+**	**0.016**
Mercury, Total	0.002	0.0002 U	0.0002 U	-	-	0.0002 U	-
Molybdenum, Total	0.1	0.05 U	0.05 U	**0.00068 J**	**0.00066 J**	**0.00061 J**	**0.001 J**
Selenium, Total	0.05	0.05 U	0.05 U	-	-	0.005 U	-
Thallium, Total	0.002	0.01 U	0.01 U	-	-	0.001 U	-
Radiological (pCi/L)							
Radium-226	NA	0.0326 UJ ± 0.0578	0.00860 U ± 0.216	-0.0526 U ± 0.0693	0.0199 U ± 0.0781	**0.144 J ± 0.0796**	-0.0661 U ± 0.0669
Radium-228	NA	0.0605 UJ ± 0.273	0.292 U ± 0.266	-0.370 U ± 0.303	0.374 U ± 0.34	0.129 UJ ± 0.29	0.101 U ± 0.316
Radium-226 & 228	5	0.0931 UJ ± 0.279	0.301 U ± 0.343	-0.423 U ± 0.311	0.394 U ± 0.349	0.273 UJ ± 0.301	0.0344 U ± 0.323
Field Parameters							
Temperature (Deg C)	NA	**15.72**	**15.72**	**15.6**	**15.6**	**15.03**	**20.34**
Dissolved Oxygen, Field (mg/L)	NA	**0.03**	**0.03**	**0.1**	**0.1**	**0.56**	**0.2**
Conductivity, Field (mS/cm)	NA	**6.1115**	**6.1115**	**5.2561**	**5.2561**	**1.783**	**1.4581**
ORP, Field (mv)	NA	**-7.1**	**-7.1**	**118.6**	**118.6**	**-0.7**	**98.7**
Turbidity, Field (NTU)	NA	**13.1**	**13.1**	**13.44**	**13.44**	**0**	-
pH, Field (SU)	NA	**6.98**	**6.98**	**6.74**	**6.74**	**7**	**6.79**

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Results in **bold** are detected.

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FIGURES

LEGEND

CCR MONITORING WELL

ASH POND UNIT BOUNDARY

NOTES

1. AERIAL IMAGERY SOURCE: ESRI
2. LOCATIONS DERIVED FROM THREE I DESIGN DATA.

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SCALE IN FEET

HALEY ALDRICH

SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

GROUNDWATER MONITORING WELL LOCATIONS - LANDFILL

JANAURY 2020

FIGURE 1

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APPENDIX A

Alternate Source Demonstration

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REPORT ON

ALTERNATE SOURCE DEMONSTRATION (ASD) MEMORANDUM A.B. BROWN GENERATING STATION; FGD LANDFILL WEST FRANKLIN, INDIANA

by
Haley & Aldrich, Inc.
Greenville, South Carolina

for
Southern Indiana Gas and Electric Company (SIGECO)
West Franklin, Indiana

File No. 129420-015
24 July 2019

Alternate Source Demonstration (ASD) Memorandum for the Appendix IV Constituents at the FGD Landfill; A.B. Brown Generating Station

This memorandum was prepared by Haley & Aldrich to evaluate the occurrence of Appendix IV constituents detected in groundwater downgradient of the FGD Landfill and demonstrate that the FGD Landfill is not the source of arsenic and lithium encountered at monitoring well CCR-LF-4 or the source of cobalt encountered at monitoring well CCR-LF-2. The memorandum focuses on the operational history of the FGD Landfill, the spatial distribution of the detected Appendix IV constituents, subsurface conditions encountered around and beneath the FGD Landfill, and groundwater quality conditions downgradient of the FGD Landfill compared to leachable Appendix IV constituent concentrations in naturally occurring coal seams and FGD waste streams placed in the FGD Landfill.

INTRODUCTION

As required by §257.95 of the Federal CCR Rule, Haley & Aldrich performed a statistical analysis of the Appendix IV constituents detected in groundwater downgradient of the A.B. Brown FGD Landfill to evaluate the presence of any detected Appendix IV constituents at a statistically significant level (SSL) above groundwater protection standards (GWPS) in accordance with §257.95(h). Findings from this evaluation indicated the presence of SSLs for cobalt at CCR-LF-2 and arsenic and lithium at CCR-LF-4. However, as described below and consistent with §257.95(g)(3)(ii), Haley & Aldrich conducted an evaluation to demonstrate that a source other than the FGD Landfill caused the SSLs over the GWPS. This memorandum documents the findings and conclusions of this evaluation.

BACKGROUND

The Site is located in Posey County near the community of West Franklin, Indiana. The location of the Site is shown on Figure 1. The Site is located approximately 0.5 miles north of the Ohio River. The Site varies in elevation with natural ground surface elevations varying from 380 to 520-feet above mean sea level (msl). The higher elevations are generally to the north of the Site with surface topography dominated by a series of ridges separated by ravines. In general, surface topography across the site generally slopes to the west towards the western property boundary then to the south toward the Ohio River. Surface water runoff occurs via sheet flow to low lying areas or ravines which eventually lead to the Ohio River.

The Site began operations in 1978 with the construction of a 250 MW generating unit. In 1985, an additional generating unit was added. Both units burn high-sulphur coal sourced in southern Indiana. Southern Indiana Gas and Electric Company (SIGECO) currently owns the land and operates the station for supplying electric power to industrial, commercial, and residential customers in its service territory.

Consistent with §257.90 through §257.94, SIGECO installed and certified a groundwater monitoring network for the Landfill (Haley & Aldrich, *Report on Groundwater Monitoring Program, A.B. Brown Generating Station* Landfill, October 2017), collected a minimum of eight rounds of groundwater samples (nine rounds were collected for this unit) for the analysis of constituent lists as specified in the Coal Combustion Residuals (CCR) Rule. Maps showing the location of groundwater monitoring wells and groundwater elevations as measured in November 2016 and June 2017 are presented in Figures 2 and 3, respectively. Figures 2 and 3 also depict interpreted groundwater elevation contours and groundwater flow direction. Interwell statistical analysis was completed to determine if the Appendix III constituents in downgradient wells indicate a statistically significant increase (SSI) when compared to background (in this case upgradient wells). The statistical evaluation of the Appendix III constituents detected in

groundwater downgradient of the Landfill identified statistically significant increases (SSIs) above background. In accordance with § 257.94 and § 257.95, an Assessment Monitoring Program was initiated in April 2018.

As required by 40 CFR § 257.95(b) and 40 CFR § 257.95(d)(1), two rounds of groundwater sampling and analysis were completed by October 15, 2018. GWPSs, pursuant to 40 CFR § 257.95(d)(2) and in accordance with Phase I, Part 1 CCR Rule Revisions dated 17 July 2018, effective 16 August 2018, were generated for each Appendix IV constituent detected during assessment monitoring. The GWPSs were set at the maximum contaminant level (MCL) or Regional Screening Level (RSL) for those constituents that did not have a promulgated MCL since the background values for the detected Appendix IV constituents did not exceed those values.

For the FGD Landfill, which was in Assessment Monitoring in 2018, analytical results from downgradient wells were compared to each respective GWPS. If the detected constituent was greater than the GWPS for that Unit, pursuant to 40 CFR § 257.93 (f)(5), the confidence interval method was used to evaluate if that Appendix IV constituent was present at a statistically significant level (SSL). Based on the comparisons outlined above, the results of the statistical analyses conducted for those detected Appendix IV constituents confirm that an SSL for cobalt is present at monitoring well CCR-LF-2, and an SSL for arsenic and lithium is present at monitoring well CCR-LF-4.

FINDINGS AND CONCLUSIONS

Haley & Aldrich has concluded that neither the FGD Landfill nor the FGD sludge contained within the FGD Landfill are the source of cobalt detected at CCR-LF-2 or the arsenic and lithium detected at CCR-LF-4 which were identified at SSLs over GWPSs. Haley & Aldrich has also concluded the coal seam intersecting the screened interval at CCR-LF-4 is a potential alternate source of arsenic and lithium identified at SSLs at CCR-LF-4.

Operational History

- The FGD Landfill was permitted for the disposal of FGD in 1978 and began receiving FGD in 1979. The FGD Landfill only contains FGD and is not permitted to receive other CCR's.
- The process that generates FGD at the A.B. Brown Generating Station has not changed during the operating life of the FGD Landfill.
- As required by permit, waste characterization samples are collected and analyzed for inorganic constituents many of which are included on the Appendix IV list of constituents. While the detection limits exceed the GWPSs in many cases, the results support the conclusion that the composition of the FGD has not changed through time. Laboratory reports for the waste characterization samples are provided in Appendix A.

Spatial Distribution of Appendix IV Constituents

- Given that the FGD Landfill has only received FGD sludge for its entire operating history, one would expect that arsenic (CCF-LF-4), lithium (CCR-LF-4), and cobalt (CCR-LF-2) would be

collocated and identified in more than one location if the Landfill was the source of the Appendix IV SSL's.

- Arsenic was detected in background wells BK-1, BK-1R, and BK-2 at 1.1 µg/L, 2.5 µg/L, and 3.5 µg/L, respectively.
- Cobalt was detected in background wells BK-1, BK-1R, and BK-2 at 2.8 µg/L, 2.2 µg/L, and 6.2 µg/L, respectively.
- Lithium was detected in background wells BK-1, BK-1R, and BK-2 at 1.1 µg/L, 2.5 µg/L, and 3.5 µg/L, respectively.

Subsurface Conditions

- During the drilling and installation of CCR-LF-4, a 6-inch layer of black, organic rich shale containing a 2-inch coal seam was encountered at a depth of 49.5 to 50.0 feet below ground surface. The layer intersects the screened interval of CCR-LF-4. The coal from this layer was submitted for analysis of total and leachable arsenic and lithium. The results of this analysis, presented in Appendix A, were compared to the Appendix IV groundwater results, presented in Table 1. While the sample submitted for analysis exceeded hold time, the analytical results can be relied upon as they represent minimum values as this condition could only have biased the results low.
- The major coal bearing units present in Indiana are described in the July 2004 *Characterization of Indiana's Coal Resource: Availability of the Reserves, Physical and Chemical Properties to the Coal, and Present and Potential Uses* by Maria Mastalerz, Agnieszka Drobniak, John Rupp, and Nelson Shaffer. The major coal units described in the vicinity of the facility are mapped at depths greater than 200 feet.
- Of the major coal bearing units mapped in the vicinity of the facility, Danville coal is the uppermost coal bearing unit. The depth to Danville coal is mapped as being greater than 200 feet.
- The Danville contains arsenic, cobalt, and lithium at average concentrations of 12.68 mg/kg, 6.79 mg/kg, and 12.33 mg/kg, respectively (Mastalerz, et al., 2004).
- The average concentrations of arsenic, cobalt, and lithium in all major coal units within the Illinois Basin in Indiana are reported as 17.4 mg/kg, 9.05 mg/kg, and 10.93 mg/kg, respectively (Mastalerz et al., 2004).

Groundwater Quality

- Historic waste characterization reports indicate the filter cake sample results for leachable arsenic have historically been less than the reporting limit of 20 µg/L. This reporting limit is above the U.S. EPA maximum contaminant level (MCL) of 10 µg/L but supports the conclusion that the composition of FGD has been consistent over the operating history of the Landfill.
- Historic groundwater reports for the A.B. Brown Landfill Permit the indicate arsenic has not been detected above the reporting limit of 50 µg/L from approximately 1991 through 1999. Beginning in 2000, the reporting limit for arsenic was lowered to 5 µg/L. Arsenic was detected above the GWPS of 10 µg/L from 2000 until approximately 2014. After 2014, concentrations of arsenic at MW-4.3B were detected at concentrations less than the GWPS or not detected above the detection limit of 5 µg/L.

- A sample of FGD "sludge", sometimes referred to as filter cake or FGD solids, was collected on October 10, 2018, and analyzed for total and leachable antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium. The analytical results, presented in Appendix A, were compared to the Appendix IV groundwater results for the landfill, presented in Table 1.
- FGD sludge analytical sample results and the maximum detected concentration for arsenic, cobalt, and lithium, compared to the GWPS, are summarized below. As shown, the amount of these constituents detected in the leachate are well below the GWPS and the concentrations measured in groundwater. Therefore, the FGD sludge contained in the landfill could not be the source of arsenic, cobalt, or lithium detected in groundwater.

Appendix IV Constituent	GWPS (µg/L)	FGD Sludge Leachable Concentration (µg/L)	Maximum Detected at CCR-LF-4 (µg/L)	Maximum Detected at CCR-LF-2 (µg/L)
Arsenic	10	0.99 J	30 (9/27/2017)	6.2 (9/27/2018)
Cobalt	6	0.14 J	1.8(2/07/2017)	14 (6/8/2016)
Lithium	40	7.7	120 (9/27/2017)	41 (8/20/2018)

J: Result is less than the Reporting Limit but greater than or equal to the Method Detection Limit and the concentration is an approximate value.

- Coal seam sample results indicate leachable concentrations are higher than the maximum concentrations of arsenic and lithium at CCR-LF-4. This coal seam intersects the screened interval of CCR-LF-4.
- Coal seam analytical sample results and the maximum detected concentration for arsenic and lithium at CCR-LF-4 are summarized below:

Appendix IV Constituent	GWPS (µg/L)	Leachable (µg/L)	Total (mg/kg)	Maximum Detected at CCR-LF-4 (µg/L)
Arsenic	10	69 JHB	28 H	30 (9/27/2017)
Lithium	40	160 JH	13 JH	120 (9/27/2017)
Percent Moisture 4.2%				
Percent Solid 95.8%				

J: Result is less than the Reporting Limit but greater than or equal to the Method Detection Limit and the concentration is an approximate value.
H: Sample was prepped or analyzed beyond the specified holding time.
B: Compound was found in the blank and sample.

The fact that arsenic, cobalt, and lithium do not leach from the FGD sludge at concentrations approaching the GWPSs and are well below the concentrations detected in groundwater support the conclusion that the FGD Landfill is not the source of the SSL's identified for these constituents at LF-2 and LF-4. Furthermore, the fact that arsenic and lithium leach out of the coal encountered at LF-4 at concentrations greater than the concentrations detected in groundwater at monitoring well LF-4 and

that fact that monitoring well LF-4 is the only location where coal is present in the screened interval support the conclusion that the naturally occurring coal is an alternate source of arsenic and lithium.

Consistent with§257.95(g)(3)(ii), this written successful demonstration, which includes obtaining a certification from a qualified professional engineer (certification follows), has been completed within 90-days of detecting SSL above GWPS. As a result, and consistent with §257.95(g)(3)(ii), the A.B. Brown Landfill will remain in the Assessment Monitoring Program.

SOUTHERN INDIANA GAS AND ELECTRIC COMPANY (SIGECO)
A.B. BROWN GENERATING STATION; LANDFILL
APPENDIX IV SSL ALTERNATE SOURCE EVALUATION

Pursuant to 40 CFR §257.95(g)(3)(ii), Haley & Aldrich, Inc., on behalf of SIGECO conducted an alternate source evaluation to demonstrate that a source other than the A.B. Brown Generating Station Landfill caused the statistically significant levels of arsenic and lithium encountered at monitoring well CCR-LF-4 and cobalt encountered at monitoring well CCR-LF-2 over groundwater protection standards identified during assessment monitoring. I certify that this report and all attachments were prepared by me or under my direct supervision. I am a professional engineer who is registered in the State of Indiana.

This certification and the underlying data support the conclusion that a source other than the Landfill is the cause of the statistically significant levels (SSLs) over groundwater protection standards for Appendix IV constituents detected during assessment monitoring of this unit.

The information contained in this evaluation is, to the best of my knowledge, true, accurate and complete.

HALEY & ALDRICH, INC.

Signed: _____ 15 April 2019
Certifying Engineer

Print Name:	Steven F. Putrich, P.E.
Indiana License No.:	PE11200566
Title:	CCR Program Manager
Company:	Haley & Aldrich, Inc.

STEVEN F. PUTRICH
REGISTERED
No. PE11200566
STATE OF INDIANA
4-15-2019
PROFESSIONAL ENGINEER

HALEY ALDRICH

TABLES

TABLE 1
SUMMARY OF GROUNDWATER QUALITY DATA
LANDFILL - AUGUST 2018
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA
FILE NO. 129420

Location Group	Action Level												_Background	
Location Name		CCR-BK-1	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-2
Sample Name	MCL	CCR-BK-1-20160811	CCR-BK-1-20161027	CCR-BK-1R-20161107	CCR-BK-1R-20161206	CCR-BK-1R-20170207	CCR-BK-1R-20170407	CCR-BK-1R-20170606	CCR-BK-1R-20170928	CCR-BK-1R-20171116	CCR-BK-1R-20180608	CCR-BK-1R-20180824	CCR-BK-1R20180827	CCR-BK-2-20160608
Sample Date		08/11/2016	10/27/2016	11/07/2016	12/06/2016	02/07/2017	04/07/2017	06/06/2017	09/28/2017	11/16/2017	06/08/2018	08/24/2018	08/27/2018	06/08/2016
Lab Sample ID		180-57528-14	180-60271-6	180-60609-5	180-61491-18	180-63324-18	180-65040-1	180-67229-16	180-70809-15	180-72643-21	180-78556-5		180-81365-1	180-55607-6
Detection Monitoring - EPA Appendix III Constituents (mg/L)														
Boron	NA	0.014 U	0.02 U	0.023 U	0.02 U	0.08 U	0.019 J	0.026 J	0.015 J+	0.041 J	-	-	0.08 U	0.018 J+
Calcium	NA	36	41	38	36	34	35	34	35	39	-	-	34	53
Antimony	0.006	0.002 U	0.002 U	0.000056 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.00045 J	0.002 U	-	-	0.002 U
Chloride	NA	R	2.4	1.5	2.3	2.3	2.7	2.1	2.2	2.6	-	-	1.9	12
Fluoride	4	R	0.35	0.32	0.35	0.3	0.38	0.3	0.35 J+	0.3	0.37	-	0.31	R
Sulfate	NA	R	26	21	26	27	28	25	25	26 J-	-	-	21 J-	61
Total Dissolved Solids (TDS)	NA	220	210	220	200	230	250	270	210	210	-	-	220	360
pH (lab) (su)	NA	7.4 J	7.5 J	7 J	6.9 J	7.2 J	7.2 J	7.1 J	7.1 J	7.8 J	-	-	7.2 J	7.09 J
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)														
Arsenic	0.01	0.0011	0.00021 J	0.001 U	0.00031 J	0.00094 J	0.00095 J	0.00047 J	0.0025 J+	0.0015 J+	R	-	0.0011	0.00032 J
Barium	2	0.048	0.035	0.037 J-	0.031 J-	0.038	0.04	0.038	0.032 J-	0.082 J-	0.049 J-	-	0.041 J	0.041 J-
Cadmium	0.005	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UJ	-	0.001 U	0.001 U
Chromium	0.1	0.0025	0.00046 J	0.00087 J	0.00071 J	0.003	0.0026	0.0019 J	R	0.0027 J+	0.003 J+	-	0.0076	0.002 U
Cobalt	0.006	0.0028	0.00076	0.00051	0.0005 U	0.0011	0.001	0.00062	R	0.0022	0.0008 J	-	0.001	0.000096 J
Lead	0.015	0.00082 J	0.00024 J	0.000079 J	0.000096 J	0.00099 J	0.00092 J	0.00052 J	0.001 U	0.0008 J	0.00063 J	-	0.0011	0.000028 J
Fluoride	4	R	0.35	0.32	0.35	0.3	0.38	0.3	0.35 J+	0.3	0.37	-	0.31	R
Lithium	0.04	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.0086 J	0.0036 J	-	0.0048 J	0.05 U
Mercury	0.002	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ	-	0.0002 U	0.0002 UJ
Molybdenum	0.1	0.0025 J	0.005 U	0.005 U	0.0015 J	0.0017 J	0.0025 J	0.0015 J	R	0.0034 J	0.0014 J	-	0.0013 J	0.0017 J
Selenium	0.05	0.00067 J	0.005 U	0.00037 J	0.00051 J	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	-	0.005 U	0.005 U
Radiological (pCi/L)														
Radium-226	NA	0.0484 U ± 0.104	0.0760 U ± 0.21	R	0.303 U ± 0.296	0.142 ± 0.0913	0.280 ± 0.0981	0.177 J ± 0.0924	R	0.165 ± 0.074	0.223 ± 0.148	-	R	0.102 J ± 0.0557
Radium-228	NA	0.0724 UJ ± 0.514	0.191 U ± 0.217	-0.0566 U ± 0.222	0.179 U ± 0.238	-0.0934 U ± 0.194	0.177 U ± 0.257	0.337 ± 0.257	0.171 U ± 0.226	0.388 U ± 0.268	0.263 U ± 0.217	-	0.285 U ± 0.313	0.0185 U ± 0.2
Radium-226 & 228	5	0.121 UJ ± 0.525	0.267 U ± 0.302	R	0.482 ± 0.38	0.142 UJ ± 0.214	0.457 J ± 0.275	0.515 J ± 0.273	0.426 J+ ± 0.243	0.553 J+ ± 0.278	R	-	R	0.120 U ± 0.207
Constituents not Monitored by the CCR Rule (mg/L)														
Beryllium	0.004	0.00012 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UJ	-	-	0.001 U
Thallium	0.002	0.000038 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	-	-	0.001 U
Field Parameters														
Temperature (Deg C)	NA	20.68	15.88	20.42	11.36	14.52	14.94	17.06	24.01	10.95	19.28	16.84	-	17.51
Turbidity, Field (FNU)	NA	-	-	-	-	-	-	-	0.76	-	-	-	-	-
Dissolved Oxygen, Field (mg/L)	NA	5.15	5.85	5.89	7.03	5.98	5.43	6.28	6	8.82	3.56	4.01	-	0.42
Conductivity, Field (mS/cm)	NA	0.3475	0.38255	0.36566	0.32748	0.3703	0.31348	0.35539	0.35718	0.40797	0.40732	0.55264	-	0.6551
ORP, Field (mv)	NA	222	223.99	116.48	52.8	131.91	98.13	266.28	147.09	47.02	953.28	-40.88	-	28.72
Turbidity, Field (NTU)	NA	17.39	19.19	10.68	97.13	6.47	17.2	24.08	-	131.33	57.12	184.84	-	17.85
pH, Field (su)	NA	6.8	6.95	7.02	7.14	6.87	7.22	6.95	6.88	7.13	6.94	6.98	-	6.98

ABBREVIATIONS AND NOTES:

CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
su: standard units.
USEPA: United States Environmental Protection Agency.

QUALIFIERS:

J: value is estimated.
J-: value is estimated with a potentially low bias
J+: value is estimated with a potentially high bias
U: Not detected value is the laboratory reporting limit.

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257. https://www.epa.gov/coalash/coal-ash-rule

TABLE 1
SUMMARY OF GROUNDWATER QUALITY DATA
LANDFILL - AUGUST 2018
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA
FILE NO. 129420

Location Group	Action Level														
Location Name	MCL	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-LF-1	CCR-LF-1	CCR-LF-1
Sample Name		DUP 3-20160608	CCR-BK-2-20160810	CCR-BK-2-20161027	CCR-BK-2-20161206	CCR-BK-2-20170210	CCR-BK-2-20170405	CCR-BK-2-20170606	CCR-BK-2-20170927	CCR-BK-2-20171116	CCR-BK-2-20180608	CCR-BK-2-20180820	CCR-LF-1-20160608	CCR-LF-1-20160810	DUP-2-20160810
Sample Date		06/08/2016	08/10/2016	10/27/2016	12/06/2016	02/10/2017	04/05/2017	06/06/2017	09/27/2017	11/16/2017	06/08/2018	08/20/2018	06/08/2016	08/10/2016	08/10/2016
Lab Sample ID		180-55607-9	180-57528-15	180-60271-7	180-61491-19	180-63446-1	180-64974-1	180-67229-17	180-70809-16	180-72643-22	180-78556-6	180-81110-10	180-55607-1	180-57528-1	180-57528-7
Detection Monitoring - EPA Appendix III Constituents (mg/L)															
Boron	NA	0.017 J+	0.014 U	0.02 U	0.02 U	0.08 U	0.016 U	0.021 J	0.018 J+	0.02 J	-	0.08 U	0.031 J+	0.033 UJ	0.067 J+
Calcium	NA	53	39	46	36	34	45	37	37	35	-	36	230	230	250
Antimony	0.006	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.00048 J	0.002 U	-	0.002 U	0.002 U	0.002 U
Chloride	NA	12	17	17	19	12 J+	19	14	19	19	-	15	15	11	11
Fluoride	4	R	0.14 J+	0.16	0.2 J+	0.14	0.16	0.13	R	0.13	0.16	0.13 J+	R	0.3 J+	0.3 J+
Sulfate	NA	67	30 J-	28	26	25 J+	29	27	24	23 J-	-	18 J-	1100	920 J-	970 J-
Total Dissolved Solids (TDS)	NA	360	260	350	260	230	240	270	320	250	-	230	1800	1800	1900
pH (lab) (su)	NA	7.06 J	7.1 J	6.8 J	6.7 J	8.5 J	7.2 J	7 J	6.8 J	7.3 J	-	6.8 J	6.87 J	7 J	7 J
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)															
Arsenic	0.01	0.001 U	0.001 U	0.0013	0.00051 J	0.00031 J	0.001 U	0.001 U	0.0035 J+	0.0028	0.001 U	0.001 U	0.00054 J	0.001 U	0.001 U
Barium	2	0.046 J-	0.033	0.15	0.036 J-	0.033 J-	0.034 J-	0.035	0.048 J-	0.046 J-	0.037 J-	0.033 J	0.041 J-	0.048	0.058
Cadmium	0.005	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UJ	0.001 U	0.001 U	0.001 U	0.001 U
Chromium	0.1	0.002 U	0.002 U	0.0047	0.00076 J	0.002 UJ	0.002 U	0.002 U	R	0.0043 J+	0.002 U	0.002 U	0.00091 J	0.0011 J	0.0016 J
Cobalt	0.006	0.00011 J	0.0001 J	0.0062	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0015 J+	0.0012	0.000098 J	0.0005 U	0.000057 J	0.000077 J	0.00018 J
Lead	0.015	0.000039 J	0.001 U	0.011	0.00057 J	0.001 U	0.001 U	0.001 U	0.0028 J+	0.0024	0.001 UJ	0.001 U	0.000033 J	0.001 U	0.00029 J
Fluoride	4	R	0.14 J+	0.16	0.2 J+	0.14	0.16	0.13	R	0.13	0.16	0.13 J+	R	0.3 J+	0.3 J+
Lithium	0.04	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.005 U	0.05 U	0.05 U	0.05 U	0.05 U
Mercury	0.002	0.0002 UJ	0.0002 U	0.0001 J	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 UJ	0.0002 U	0.0002 U
Molybdenum	0.1	0.0017 J	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.00062 J	0.005 U	0.00068 J	0.00051 J	0.005 U	0.0016 J	0.0015 J	0.0012 J
Selenium	0.05	0.00046 J	0.005 U	0.00098 J	0.00047 J	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.001 J	0.0013 J	0.00089 J
Radiological (pCi/L)															
Radium-226	NA	0.0696 U ± 0.0542	0.0387 U ± 0.0693	1.14 J ± 0.72	0.346 U ± 0.284	0.0539 UJ ± 0.0753	0.0198 U ± 0.0619	0.00911 UJ ± 0.049	R	0.149 ± 0.0943	0.0863 U ± 0.108	R	0.330 J ± 0.0989	0.304 J ± 0.0911	0.816 J ± 0.201
Radium-228	NA	-0.0314 U ± 0.199	0.0797 UJ ± 0.324	0.764 U ± 0.727	R	0.163 U ± 0.253	0.102 U ± 0.198	0.144 ± 0.284	0.279 U ± 0.416	2.98 ± 0.579	0.230 U ± 0.194	0.0380 U ± 0.238	0.355 U ± 0.279	0.392 U ± 0.261	0.547 U ± 0.543
Radium-226 & 228	5	0.0382 U ± 0.207	0.118 UJ ± 0.331	1.91 J ± 1.02	0.796 J ± 0.38	0.217 UJ ± 0.264	0.122 U ± 0.208	0.153 U ± 0.288	0.525 UJ ± 0.436	3.13 ± 0.587	R	0.209 UJ ± 0.251	0.685 ± 0.296	0.696 ± 0.277	1.36 ± 0.578
Constituents not Monitored by the CCR Rule (mg/L)															
Beryllium	0.004	0.001 U	0.001 U	0.0004 J	0.001 U	0.001 U	0.001 U	0.001 U	0.00018 J	0.001 U	0.001 UJ	-	0.001 U	0.001 U	0.001 U
Thallium	0.002	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.000059 J	0.001 U	-	0.001 U	0.001 U	0.001 U
Field Parameters															
Temperature (Deg C)	NA	17.51	17.4	15.98	14.25	13.49	15.79	15.68	16.85	14.23	18.58	17.12	24.21	19.33	19.33
Turbidity, Field (FNU)	NA	-	-	-	-	-	-	-	167.49	-	-	-	-	-	-
Dissolved Oxygen, Field (mg/L)	NA	0.42	0.22	0.38	0.33	0.35	1.08	0.14	0.43	0.47	0.36	0.72	1.45	1.02	1.02
Conductivity, Field (mS/cm)	NA	0.6551	0.4173	0.40128	0.30961	0.38131	0.29739	0.41407	0.38594	0.38795	0.43327	0.39173	2.08187	2.028	2.028
ORP, Field (mv)	NA	28.72	144	234.6	87.3	120.09	200.74	212.67	212.04	108.47	1080.86	154.46	92.49	96	96
Turbidity, Field (NTU)	NA	17.85	1.751	858.51	336.44	11.66	-22.18	-1.12	-	181.78	13.78	2.45	47.16	-2.224	-2.224
pH, Field (su)	NA	6.98	6.64	6.7	6.19	6.72	6.66	6.67	6.64	6.74	6.68	6.55	6.54	6.51	6.51

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LANDFILL - AUGUST 2018
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA
FILE NO. 129420

Location Group	Action Level	Landfill										
Location Name	MCL	CCR-LF-1	CCR-LF-1	CCR-LF-1	CCR-LF-1	CCR-LF-1	CCR-LF-1	CCR-LF-1	CCR-LF-1	CCR-LF-1	CCR-LF-1	CCR-LF-1
Sample Name		CCR-LF-1-20161025	DUP2-20161025	CCR-LF-1-20161205	CCR-LF-1-20170210	CCR-LF-1-20170405	CCR-LF-1-20170607	CCR-LF-1-20170929	CCR-LF-1-20171116	DUP 2-20171116	CCR-LF-1-20180607	CCR-LF-1-20180822
Sample Date		10/25/2016	10/25/2016	12/05/2016	02/10/2017	04/05/2017	06/07/2017	09/29/2017	11/16/2017	11/16/2017	06/07/2018	08/22/2018
Lab Sample ID		180-60160-1	180-60160-4	180-61491-10	180-63446-2	180-64974-9	180-67229-10	180-70838-12	180-72643-1	180-72643-10	180-78556-1	180-81267-4
Detection Monitoring - EPA Appendix III Constituents (mg/L)												
Boron	NA	0.037	0.04	0.04 U	0.08 U	0.041 J	0.046 J	0.028 J	0.12 J	0.033 J	-	0.04 J
Calcium	NA	270	270	270	250	290	270	260	260	260	-	270
Antimony	0.006	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.00059 J	0.00065 J	0.002 U	-
Chloride	NA	13	13	16	16 J+	16	11	17	16	17	-	19
Fluoride	4	0.27	0.29	0.25 J+	0.23	0.22	0.21 J	0.18	0.27	0.21	0.27	0.26 J+
Sulfate	NA	970	1000	1100	1100 J+	1000	990	1100	1100 J-	1100 J-	-	1200 J-
Total Dissolved Solids (TDS)	NA	1900	1900	1800	1800	1800	1900	1800	1800	1800	-	2000
pH (lab) (su)	NA	6.7 J	6.8 J	6.8 J	7.2 J	6.9 J	7 J	7 J	7.5 J	7.2 J	-	6.9 J
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)												
Arsenic	0.01	0.001 U	0.00015 J	0.00052 J	0.0011	0.0012	0.00084 J	0.00084 J	0.001 U	0.0012 J+	0.001 U	0.0015
Barium	2	0.047	0.049	0.05 J-	0.036 J-	0.052 J-	0.04	0.035	0.042 J-	0.047 J-	0.045 J-	0.088 J
Cadmium	0.005	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UJ	0.001 U
Chromium	0.1	0.00097 J	0.0011 J	0.0013 J	0.00089 J-	0.0018 J	0.0017 J	0.0016 J	0.002 U	0.002 U	0.002 U	0.0062 J+
Cobalt	0.006	0.000043 J	0.000047 J	0.0005 U	0.0005 U	0.0003 J	0.00032 J	0.00066	0.00026 J	0.0003 J	0.00022 J	0.00068
Lead	0.015	0.001 U	0.001 U	0.0002 J	0.001 U	0.00068 J	0.00047 J	0.00063 J	0.001 U	0.001 U	0.00021 J	0.0011
Fluoride	4	0.27	0.29	0.25 J+	0.23	0.22	0.21 J	0.18	0.27	0.21	0.27	0.26 J+
Lithium	0.04	0.05 U	0.05 U	0.01 J	0.05 U	0.05 U	0.0096 J	0.05 U	0.05 U	0.05 U	0.0036 J	0.008 J+
Mercury	0.002	0.0002 U	0.0002 U	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 UJ	0.0002 U
Molybdenum	0.1	0.00098 J	0.0013 J	0.005 U	0.005 U	0.0012 J	0.0011 J	0.0016 J	0.0015 J	0.0014 J	0.00083 J	0.0012 J
Selenium	0.05	0.0011 J	0.00095 J	0.00089 J	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Radiological (pCi/L)												
Radium-226	NA	0.470 J ± 0.292	0.915 J ± 0.357	1.00 J ± 0.389	0.288 J ± 0.123	0.240 ± 0.102	0.732 J ± 0.159	0.349 ± 0.107	0.450 ± 0.122	0.312 ± 0.0967	0.299 ± 0.175	0.776 ± 0.153
Radium-228	NA	0.255 U ± 0.234	0.401 ± 0.242	R	0.172 U ± 0.235	0.509 ± 0.272	0.293 ± 0.236	0.397 ± 0.243	0.622 ± 0.285	0.192 U ± 0.213	0.446 ± 0.247	0.281 U ± 0.213
Radium-226 & 228	5	0.726 J ± 0.374	1.32 J ± 0.432	1.47 J ± 0.457	0.459 J ± 0.265	0.749 ± 0.291	1.02 J ± 0.284	0.747 ± 0.266	1.07 ± 0.31	0.504 J ± 0.234	R	R
Constituents not Monitored by the CCR Rule (mg/L)												
Beryllium	0.004	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UJ	-
Thallium	0.002	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.000055 J	0.001 U	0.001 U	-
Field Parameters												
Temperature (Deg C)	NA	19.02	19.02	15.63	11.86	14.16	16.87	18.02	16.67	16.67	30.7	19.59
Turbidity, Field (FNU)	NA	-	-	-	-	-	-	-	-	-	-	-
Dissolved Oxygen, Field (mg/L)	NA	1.05	1.05	1.58	1.74	1.35	2.84	6.27	5.79	5.79	5.81	2.75
Conductivity, Field (mS/cm)	NA	1.79792	1.79792	1.4898	2.02562	2.00881	1.90568	2.03117	2.01289	2.01289	2.1228	2.11697
ORP, Field (mv)	NA	50	50	32.2	187.09	102.62	108.63	164.85	146.45	146.45	1016.17	174.8
Turbidity, Field (NTU)	NA	-0.1	-0.1	6.22	1.39	39.98	30.27	32.85	16.28	16.28	19.52	11.01
pH, Field (su)	NA	6.63	6.63	6.66	6.68	6.78	6.65	6.59	6.64	6.64	6.63	6.48

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LANDFILL - AUGUST 2018
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA
FILE NO. 129420

Location Group	Action Level	Landfill										
Location Name	MCL	CCR-LF-2	CCR-LF-2	CCR-LF-2	CCR-LF-2	CCR-LF-2	CCR-LF-2	CCR-LF-2	CCR-LF-2	CCR-LF-2	CCR-LF-2	CCR-LF-2
Sample Name		CCR-LF-2-20160608	CCR-LF-2-20160810	CCR-LF-2-20161026	CCR-LF-2-20161205	CCR-LF-2-20170210	CCR-LF-2-20170405	CCR-LF-2-20170607	CCR-LF-2-20170927	CCR-LF-2-20171114	CCR-LF-2-20180607	CCR-LF-2-20180820
Sample Date		06/08/2016	08/10/2016	10/26/2016	12/05/2016	02/10/2017	04/05/2017	06/07/2017	09/27/2017	11/14/2017	06/07/2018	08/20/2018
Lab Sample ID		180-55607-2	180-57528-2	180-60193-7	180-61491-11	180-63446-3	180-64974-10	180-67229-11	180-70809-10	180-72643-2	180-78556-2	180-81110-5
Detection Monitoring - EPA Appendix III Constituents (mg/L)												
Boron	NA	3.4	3.9	3.8	4.5	4.2	4.3	5.3	4.7 J+	5	-	5.3
Calcium	NA	340	380	410	400	380	430	430	400	380	-	390
Antimony	0.006	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.02 U	0.0021	0.002 U	0.02 U	0.02 U	-
Chloride	NA	290	320	280	290	330 J+	320	350	350	350	-	290
Fluoride	4	R	2.5 U	2.5 U	1 U	2.5 U	1 U	2.5 U	1 U	1 U	2.5 U	5 U
Sulfate	NA	12000	12000 J-	11000 J-	12000	14000 J+	14000	14000	15000	15000 J-	-	15000
Total Dissolved Solids (TDS)	NA	19000	19000	18000	19000	19000	22000	22000	21000	21000	-	24000
pH (lab) (su)	NA	6.6 J	6.7 J	6.5 J	6.6 J	6.8 J	6.7 J	6.7 J	6.6 J	7.2 J	-	6.6 J
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)												
Arsenic	0.01	0.0028	0.0022	0.0023	0.0015	0.0016	0.01 U	0.0013	0.0062 J+	0.01 U	0.01 U	0.01 U
Barium	2	0.012 J-	0.014	0.013 J-	0.013 J-	0.012 J	R	0.013	0.011 J-	R	0.012 J	0.012 J
Cadmium	0.005	0.00075 J	0.0027	0.0047	0.0043	0.0027	0.0032 J	0.004	0.0039	0.0043 J	0.0039 J	0.0035 J
Chromium	0.1	0.00073 J	0.0014 J	0.0018 J	0.001 J	0.00067 J-	0.02 U	0.00084 J	R	0.02 U	0.02 U	0.02 U
Cobalt	0.006	0.014	0.0076	0.0076	0.0067	0.0057	0.0072	0.0079	0.0073	0.0076	0.01 J	0.011
Lead	0.015	0.00022 J	0.00096 J	0.0014	0.00045 J	0.00046 J	0.01 U	0.00036 J	0.001 U	0.01 U	0.01 UJ	0.01 U
Fluoride	4	R	2.5 U	2.5 U	1 U	2.5 U	1 U	2.5 U	1 U	1 U	2.5 U	5 U
Lithium	0.04	0.019 J	0.025 J	0.03 J	0.029 J	0.03 J	0.025 J	0.022 J	0.25 U	0.028 J	0.05 U	0.041 J
Mercury	0.002	0.0002 UJ	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U
Molybdenum	0.1	0.0048 J	0.0031 J	0.0018 J	0.0026 J	0.0015 J	0.05 U	0.0034 J	R	0.05 U	0.05 U	0.05 U
Selenium	0.05	0.0021 J	0.0021 J	0.0018 J+	0.0027 J	0.002 J	0.05 U	0.0026 J	0.0034 J+	0.05 U	0.05 U	0.05 U
Radiological (pCi/L)												
Radium-226	NA	0.213 J ± 0.0852	0.350 ± 0.172	0.627 J ± 0.319	0.566 J ± 0.348	0.576 J ± 0.162	0.451 ± 0.143	0.308 J ± 0.108	0.503 J ± 0.136	0.465 ± 0.122	0.486 ± 0.2	0.466 J ± 0.114
Radium-228	NA	0.940 ± 0.307	1.03 ± 0.609	1.52 ± 0.401	1.44 ± 0.347	1.59 ± 0.355	1.36 ± 0.34	1.46 ± 0.389	1.83 ± 0.407	1.84 ± 0.381	1.30 ± 0.32	1.86 ± 0.384
Radium-226 & 228	5	1.15 ± 0.319	1.38 ± 0.633	2.15 J ± 0.513	2.01 J ± 0.491	2.17 J ± 0.39	1.81 ± 0.369	1.77 ± 0.403	2.33 ± 0.429	2.31 ± 0.4	1.79 ± 0.377	2.32 J ± 0.401
Constituents not Monitored by the CCR Rule (mg/L)												
Beryllium	0.004	0.001 U	0.001 U	0.00013 J	0.00028 J	0.00013 J	0.01 U	0.001 U	0.00018 J	0.01 U	0.01 UJ	-
Thallium	0.002	0.00018 J	0.00034 J	0.00037 J	0.001 U	0.001 U	0.01 U	0.00056 J	0.00065 J	0.01 U	0.01 U	-
Field Parameters												
Temperature (Deg C)	NA	17.41	17.54	19.88	12.73	15	16.13	17.12	16.95	15.85	16.36	16.53
Turbidity, Field (FNU)	NA	-	-	-	-	-	-	-	-	-	-	-
Dissolved Oxygen, Field (mg/L)	NA	0.14	0.28	0.62	0.47	0.12	0.11	0.13	0.05	0.15	0.16	0.07
Conductivity, Field (mS/cm)	NA	19.4913	19.51	18.0976	16.545	19.5139	20.3435	19.871	20.6399	21.9844	23.93	23.8507
ORP, Field (mv)	NA	-46.57	9	20	-90.2	14.64	105.47	48.33	-16.58	18.31	449.61	41.43
Turbidity, Field (NTU)	NA	138.29	23.46	92.84	44.98	33.32	17.4	15.67	556.68	48.42	7.73	32.76
pH, Field (su)	NA	6.38	6.38	6.53	6.32	6.42	6.58	6.42	6.45	6.41	6.44	6.28

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FILE NO. 129420

Location Group	Action Level	Landfill											
Location Name	MCL	CCR-LF-3	CCR-LF-3	CCR-LF-3	CCR-LF-3	CCR-LF-3	CCR-LF-3	CCR-LF-3	CCR-LF-3	CCR-LF-3	CCR-LF-3	CCR-LF-3	CCR-LF-3
Sample Name		CCR-LF-3-20160608	CCR-LF-3-20160809	CCR-LF-3-20161026	CCR-LF-3-20161205	CCR-LF3-20170315	CCR-LF-3-20170405	CCR-LF-3-20170606	CCR-LF-3-20170928	CCR-LF-3-20171114	CCR-LF-3-20180607	CCR-LF-3-20180820	BLIND DUPLICATE 2-20180820
Sample Date		06/08/2016	08/09/2016	10/26/2016	12/05/2016	03/15/2017	04/05/2017	06/06/2017	09/28/2017	11/14/2017	06/07/2018	08/20/2018	08/20/2018
Lab Sample ID		180-55607-3	180-57528-3	180-60193-8	180-61491-12	180-64383-1	180-64974-11	180-67229-12	180-70809-11	180-72643-3	180-78556-3	180-81110-6	180-81110-12
Detection Monitoring - EPA Appendix III Constituents (mg/L)													
Boron	NA	0.0087 U	0.042 J+	0.02 U	0.02 U	0.014 J	0.015 J	0.04 J	0.023 J+	0.039 J	-	0.08 U	0.063 J
Calcium	NA	320	300	370	370	280	350	320	260	200	-	290	280
Antimony	0.006	0.002 U	0.002 U	0.002 U	0.002 U	0.0011 J	0.002 U	0.00066 J	0.002 U	0.002 U	0.002 U	-	-
Chloride	NA	51	41	44	42	41	48	34	59	70	-	31	32
Fluoride	4	R	0.24 J	0.23 J	R	0.1 J	0.25	0.21 J	R	0.18	0.2 J	0.19 J+	0.2 J+
Sulfate	NA	1900	1600 J-	2000 J-	2000	1700	1600	1600	1300	1100 J-	-	1500 J-	1500 J-
Total Dissolved Solids (TDS)	NA	3200	3200	3400	3200	2600	2800	3000	2300	1900	-	2900	2800
pH (lab) (su)	NA	6.94 J	7.2 J	6.9 J	6.8 J	6.8 J	7 J	7.1 J	7.1 J	7.7 J	-	7.2 J	6.9 J
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)													
Arsenic	0.01	0.00047 J	0.001 U	0.00032 J	0.00045 J	0.00062 J	0.00026 J	0.00025 J	0.0088 J+	0.001 U	0.001 U	0.001 U	0.001 U
Barium	2	0.027 J-	0.026	0.03 J-	0.03 J-	0.026	0.025 J-	0.027	0.026 J-	0.025 J-	0.029 J-	0.025 J	0.025 J
Cadmium	0.005	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00011 J	0.0001 J	0.000095 J	0.001 UJ	0.001 U	0.001 U
Chromium	0.1	0.002	0.0018 J	0.0022	0.0025	0.0019 J	0.0017 J	0.0018 J	R	0.002 U	0.002 U	0.0035 U	0.0032 U
Cobalt	0.006	0.00071	0.0006 J+	0.0003 J	0.0005 U	0.00048 J	0.00038 J	0.0004 J	R	0.00044 J	0.00033 J	0.0005 U	0.0005 U
Lead	0.015	0.000059 J	0.000074 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UJ	0.001 U	0.001 U
Fluoride	4	R	0.24 J	0.23 J	R	0.1 J	0.25	0.21 J	R	0.18	0.2 J	0.19 J+	0.2 J+
Lithium	0.04	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.018 J	0.05 U	0.005 U	0.0098 J	0.05 U
Mercury	0.002	0.0002 UJ	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U
Molybdenum	0.1	0.00089 J	0.00098 J	0.0015 J	0.0012 J	0.0013 J	0.005 U	0.0017 J	R	0.0026 J	0.0014 J	0.0011 J	0.0012 J
Selenium	0.05	0.0022 J	0.0022 J	0.0024 J+	0.002 J	0.0017 J	0.005 U	0.0019 J	0.002 J+	0.0016 J	0.0011 J+	0.0014 J	0.0011 J
Radiological (pCi/L)													
Radium-226	NA	0.168 J ± 0.0729	0.107 ± 0.0624	0.217 U ± 0.28	0.398 U ± 0.307	0.120 U ± 0.0869	0.0829 U ± 0.0845	R	R	0.0670 U ± 0.0519	0.138 U ± 0.116	R	R
Radium-228	NA	0.229 U ± 0.261	0.258 U ± 0.248	0.266 U ± 0.319	R	0.616 ± 0.321	0.584 ± 0.299	0.182 ± 0.202	R	0.590 ± 0.255	0.387 ± 0.24	0.235 U ± 0.232	0.404 U ± 0.268
Radium-226 & 228	5	0.398 U ± 0.271	0.366 U ± 0.256	0.483 U ± 0.424	1.10 J ± 0.446	0.736 J ± 0.332	0.666 J ± 0.311	0.330 J+ ± 0.216	0.523 J+ ± 0.226	0.657 J ± 0.26	R	0.432 J+ ± 0.245	0.710 J+ ± 0.289
Constituents not Monitored by the CCR Rule (mg/L)													
Beryllium	0.004	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UJ	-	-
Thallium	0.002	0.000015 J	0.001 U	0.00018 J	0.001 U	0.001 U	0.001 U	0.00007 J	0.0001 J	0.00027 J	0.001 U	-	-
Field Parameters													
Temperature (Deg C)	NA	17.58	17.07	20.23	13.91	13.5	15.71	17.14	17.3	15.72	18.36	17.36	17.36
Turbidity, Field (FNU)	NA	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Oxygen, Field (mg/L)	NA	4.54	4.33	5.41	4.68	5.15	5.02	5.72	5.34	3.46	5.33	4.85	4.85
Conductivity, Field (mS/cm)	NA	3.52381	3.414	3.13537	2.9634	3.10374	3.11922	2.99956	2.60234	2.2566	3.03772	3.12913	3.12913
ORP, Field (mv)	NA	117.52	93	90	35	161.76	134.03	151.21	154.67	166.8	582.16	164.55	164.55
Turbidity, Field (NTU)	NA	7.32	-0.3407	-1.48	0	0.57	-1.66	-0.63	-0.44	-0.67	1.66	0.38	0.38
pH, Field (su)	NA	6.63	6.73	6.84	6.71	6.8	7.07	6.85	6.86	6.63	6.74	6.6	6.6

ABBREVIATIONS AND NOTES:

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LANDFILL - AUGUST 2018
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA
FILE NO. 129420

Location Group	Action Level	Landfill														
Location Name	MCL	CCR-LF-4	CCR-LF-4	CCR-LF-4	CCR-LF-4	CCR-LF-4	CCR-LF-4	CCR-LF-4	CCR-LF-4	CCR-LF-4	CCR-LF-4	CCR-LF-4	CCR-LF-4	CCR-LF-4	CCR-LF-4	CCR-LF-4
Sample Name		CCR-LF-4-20160607	CCR-LF-4-20160809	CCR-LF-4-20161025	CCR-LF-4-20161206	CCR-LF-4-20170207	DUP 2-20170207	CCR-LF-4-20170405	CCR-LF-4-20170607	DUP2-20170607	CCR-LF-4-20170927	DUP3-20170927	CCR-LF-4-20171116	CCR-LF-4-20180608	DUP2-20180608	CCR-LF-4-20180821
Sample Date		06/07/2016	08/09/2016	10/25/2016	12/06/2016	02/07/2017	02/07/2017	04/05/2017	06/07/2017	06/07/2017	09/27/2017	09/27/2017	11/16/2017	06/08/2018	06/08/2018	08/21/2018
Lab Sample ID		180-55566-4	180-57528-4	180-60160-2	180-61491-13	180-63324-15	180-63324-17	180-64974-12	180-67229-13	180-67229-20	180-70809-12	180-70809-20	180-72643-4	180-78556-4	180-78556-8	180-81110-7
Detection Monitoring - EPA Appendix III Constituents (mg/L)																
Boron	NA	0.16	0.13 J+	0.2 U	0.15 J+	0.14	0.15	0.021 J	0.2	0.26	0.2 J+	0.19 J+	0.22 J	-	-	0.2
Calcium	NA	420	420	370	410	410	420	46	440	440	420	430	440	-	-	360
Antimony	0.006	0.002 U	0.002 U	0.02 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.02 U	0.02 U	0.02 U	-
Chloride	NA	110	99	91	110	110	120	130	88	89	130	130	130	-	-	600
Fluoride	4	0.35 J	1 U	2.5 U	1 U	0.51 J	0.54 J	1 U	2.5 U	2.5 U	1 U	1 U	1 U	1 U	1 U	2.5 U
Sulfate	NA	8200	7500 J-	6500	7900	7900	8100	8400	7300	7400	8700	8600	8600 J-	-	-	5600 J-
Total Dissolved Solids (TDS)	NA	13000	13000	11000	12000	12000	12000	12000	12000	13000	12000	12000	11000	-	-	12000
pH (lab) (su)	NA	6.7 J	6.9 J	6.8 J	6.7 J	6.8 J	6.8 J	7.2 J	6.8 J	6.8 J	6.8 J	6.7 J	7.5 J	-	-	6.8 J
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)																
Arsenic	0.01	0.016	0.016	0.011	0.018	0.019	0.02	0.0021	0.0057	0.0057	0.03	0.028	0.021	0.015 J	0.01 J	0.016
Barium	2	0.013	0.012	0.0078 J	0.014 J-	0.016	0.021	R	0.014	0.016	0.011 J-	0.011 J-	R	0.011 J	R	0.011 J
Cadmium	0.005	0.001 U	0.001 U	0.01 U	0.001 U	0.001 U	0.001 U	0.001 U	0.000092 J	0.0001 J	0.001 U	0.00011 J	0.01 U	0.01 UJ	0.01 UJ	0.001 U
Chromium	0.1	0.002 U	0.002 U	0.02 U	0.0005 J	0.00076 J	0.0013 J	0.002 U	0.00044 J	0.00075 J	R	R	0.02 U	0.02 U	0.02 U	0.002 U
Cobalt	0.006	0.0011	0.00091	0.0012 J	0.00088	0.0018	0.0019	0.00015 J	0.0018	0.002	0.0012 J+	0.0017 J+	0.0013 J	0.0013 J	0.00079 J	0.001
Lead	0.015	0.0002 J	0.000084 J	0.01 U	0.00018 J	0.00047 J	0.00079 J	0.001 U	0.001 U	0.00045 J	0.001 U	0.001 U	0.01 U	0.079 J	0.01 UJ	0.001 U
Fluoride	4	0.35 J	1 U	2.5 U	1 U	0.51 J	0.54 J	1 U	2.5 U	2.5 U	1 U	1 U	1 U	1 U	1 U	2.5 U
Lithium	0.04	0.099	0.11	0.078	0.093	0.087	0.089	0.092	0.087	0.091	0.12	0.1	0.1	0.068 J	0.046 J	0.096
Mercury	0.002	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 UJ	0.0002 U
Molybdenum	0.1	0.021	0.023	0.013 J	0.022	0.02	0.022	0.005 U	0.018	0.018	0.026	0.026	0.024 J	0.022 J	0.014 J	0.021
Selenium	0.05	0.00061 J	0.0007 J	0.05 U	0.00055 J	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.05 U	0.05 U	0.05 U	0.005 U
Radiological (pCi/L)																
Radium-226	NA	3.99 ± 0.49	3.96 ± 0.46	5.22 J ± 0.894	4.16 J ± 0.851	3.51 ± 0.492	3.88 ± 0.528	5.78 J- ± 0.819	5.08 J ± 0.589	2.55 J ± 0.349	2.87 ± 0.381	2.81 ± 0.371	3.22 ± 0.409	3.06 ± 0.522	3.08 ± 0.523	3.10 ± 0.392
Radium-228	NA	0.630 ± 0.351	1.38 ± 0.358	0.995 ± 0.307	R	1.44 ± 0.365	0.950 ± 0.318	2.36 J- ± 0.682	1.49 ± 0.406	1.27 ± 0.388	1.21 J ± 0.305	2.35 J ± 0.468	1.35 ± 0.346	1.18 ± 0.338	1.18 ± 0.315	1.28 ± 0.323
Radium-226 & 228	5	4.62 ± 0.602	5.34 ± 0.583	6.21 J ± 0.945	5.14 J ± 0.913	4.95 ± 0.613	4.83 ± 0.616	8.14 J- ± 1.07	6.58 J ± 0.716	3.83 J ± 0.522	4.08 ± 0.488	5.16 ± 0.597	4.58 ± 0.536	4.24 ± 0.622	4.27 ± 0.611	4.38 ± 0.508
Constituents not Monitored by the CCR Rule (mg/L)																
Beryllium	0.004	0.001 U	0.001 U	0.01 U	0.00014 J	0.00018 J	0.00019 J	0.001 U	0.00013 J	0.00016 J	0.00028 J	0.00022 J	0.01 U	0.01 UJ	0.01 UJ	-
Thallium	0.002	0.000033 J	0.001 U	0.01 U	0.001 U	0.001 U	0.001 U	0.001 U	0.00012 J	0.0001 J	0.000089 J	0.000059 J	0.01 U	0.01 U	0.01 U	-
Field Parameters																
Temperature (Deg C)	NA	19.18	22.92	15.3	12.7	14.59	14.59	15.17	15.98	15.98	16.94	16.94	13.51	19.72	19.72	18.58
Turbidity, Field (FNU)	NA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Oxygen, Field (mg/L)	NA	1.24	1.19	0.51	0.53	0.37	0.37	0.26	1.65	1.65	0.54	0.54	0.3	0.61	0.61	0.58
Conductivity, Field (mS/cm)	NA	13.6008	13.77	9.08224	11.125	12.0347	12.0347	12.4354	10.9543	10.9543	12.5405	12.5405	12.8545	12.6597	12.6597	12.4934
ORP, Field (mv)	NA	-21	-14	10	-15.3	-19.74	-19.74	-9.68	31.27	31.27	-18.97	-18.97	-39.78	347.28	347.28	-30.82
Turbidity, Field (NTU)	NA	17.71	9.251	10.36	20.29	8.51	8.51	25.59	14.89	14.89	47.58	47.58	13.77	12.89	12.89	3.42
pH, Field (su)	NA	6.53	6.49	6.73	6.53	6.62	6.62	6.7	6.59	6.59	6.61	6.61	6.64	6.58	6.58	6.48

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LANDFILL - AUGUST 2018
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA
FILE NO. 129420

Location Group	Action Level	Landfill											
Location Name	MCL	CCR-LF-5	CCR-LF-5	CCR-LF-5	CCR-LF-5	CCR-LF-5	CCR-LF-5	CCR-LF-5	CCR-LF-5	CCR-LF-5	CCR-LF-5	CCR-LF-5	CCR-LF-5
Sample Name		CCR-LF-5-20160608	CCR-LF-5-20160809	CCR-LF-5-20161026	CCR-LF-5-20161205	DUP 2-20161205	CCR-LF-5-20170207	CCR-LF-5-20170404	CCR-LF-5-20170606	CCR-LF-5-20170927	CCR-LF-5-20171114	CCR-LF-5-20180605	CCR-LF-5-20180820
Sample Date		06/08/2016	08/09/2016	10/26/2016	12/05/2016	12/05/2016	02/07/2017	04/04/2017	06/06/2017	09/27/2017	11/14/2017	06/05/2018	08/20/2018
Lab Sample ID		180-55607-4	180-57528-5	180-60193-10	180-61491-14	180-61491-16	180-63324-16	180-64974-13	180-67229-14	180-70809-13	180-72643-5	180-78475-6	180-81110-8
Detection Monitoring - EPA Appendix III Constituents (mg/L)													
Boron	NA	1.1	0.61	0.68	0.91	0.9	1.1	1.2	1.2	1.1 J+	0.86	-	0.93
Calcium	NA	340	330	400	430	420	430	480	450	440	430	-	410
Antimony	0.006	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.00055 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	-
Chloride	NA	380	240	250	260	260	330	270	320	260	270	-	34
Fluoride	4	R	0.091 J	0.19 J	R	R	0.22 J	0.17 J	0.23 J	0.23 J+	0.12 J	0.5 U	1 U
Sulfate	NA	2500	2000 J-	2100 J-	2500	2500	2400	2300	2300	2500	2700 J-	-	3000 J-
Total Dissolved Solids (TDS)	NA	4300	4000	4000	4500	4400	4300	4300	4500	4500	4300	-	4400
pH (lab) (su)	NA	7 J	7.2 J	6.9 J	6.9 J	7 J	7.1 J	7.3 J	7.1 J	7 J	7.5 J	-	6.9 J
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)													
Arsenic	0.01	0.00061 J	0.001 U	0.00063 J	0.00038 J	0.00027 J	0.0028	0.00033 J	0.00032 J	0.015	0.001 U	0.001 U	0.001 U
Barium	2	0.025 J-	0.026	0.03 J-	0.028 J-	0.028 J-	0.031	0.026 J-	0.026	0.025 J-	0.026 J-	0.026 J-	0.024 J
Cadmium	0.005	0.00015 J	0.00018 J	0.001 U	0.00015 J	0.00016 J	0.00024 J	0.00016 J	0.00018 J	0.00025 J	0.00017 J	0.00021 J	0.00022 J
Chromium	0.1	0.00092 J	0.00093 J	0.0011 J	0.00073 J	0.00063 J	0.022	0.00061 J	0.0006 J	R	0.002 U	0.002 U	0.002 U
Cobalt	0.006	0.00031 J	0.0005 U	0.00034 J	0.0005 U	0.0005 U	0.0033	0.00019 J	0.00018 J	0.00076 J+	0.00025 J	0.00019 J	0.0005 U
Lead	0.015	0.00023 J	0.00031 J	0.0003 J	0.00013 J	0.00015 J	0.0012	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UJ	0.00011 J
Fluoride	4	R	0.091 J	0.19 J	R	R	0.22 J	0.17 J	0.23 J	0.23 J+	0.12 J	0.5 U	1 U
Lithium	0.04	0.024 J	0.02 J	0.024 J	0.026 J	0.027 J	0.027 J	0.022 J	0.023 J	0.031 J	0.025 J	0.019 J	0.031 J
Mercury	0.002	0.000053 J-	0.0002 U	0.0002 UJ	0.000077 J-	0.000078 J-	0.00012 J	0.0002 U	0.00008 J	0.00012 J	0.00015 J-	0.000086 J-	0.000081 J
Molybdenum	0.1	0.00058 J	0.005 U	0.005 U	0.005 U	0.005 U	0.0023 J	0.005 U	0.00087 J	0.005 U	0.005 U	0.00069 J	0.00063 J
Selenium	0.05	0.005 U	0.00054 J	0.005 U	0.005 U	0.00035 J	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Radiological (pCi/L)													
Radium-226	NA	0.106 J ± 0.064	0.252 ± 0.126	0.115 U ± 0.247	0.334 U ± 0.281	-0.0390 U ± 0.186	0.161 ± 0.0973	0.0594 U ± 0.0672	0.0697 UJ ± 0.0573	R	0.135 ± 0.067	0.162 U ± 0.162	R
Radium-228	NA	-0.129 U ± 0.202	0.242 U ± 0.422	0.227 U ± 0.256	0.307 U ± 0.221	0.103 U ± 0.196	0.0356 U ± 0.183	0.362 U ± 0.252	0.115 ± 0.224	0.0879 U ± 0.224	0.222 U ± 0.219	0.0364 U ± 0.186	0.260 U ± 0.3
Radium-226 & 228	5	-0.0225 U ± 0.211	0.494 U ± 0.44	0.342 U ± 0.356	0.641 ± 0.358	0.103 U ± 0.27	0.197 UJ ± 0.207	0.421 ± 0.261	0.185 UJ ± 0.231	0.246 UJ ± 0.237	0.357 J ± 0.229	0.198 U ± 0.247	0.465 UJ ± 0.312
Constituents not Monitored by the CCR Rule (mg/L)													
Beryllium	0.004	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UJ	-
Thallium	0.002	0.000025 J	0.001 U	0.000067 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	-
Field Parameters													
Temperature (Deg C)	NA	17.1	20.92	15.39	13.81	13.81	14.76	16.45	17.41	18.75	15.23	16.07	16.72
Turbidity, Field (FNU)	NA	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Oxygen, Field (mg/L)	NA	0.53	0.41	0.51	0.21	0.21	0.09	0.18	0.14	0.21	0.09	0.06	0.15
Conductivity, Field (mS/cm)	NA	4.88274	4.322	3.36377	4.0028	4.0028	4.99069	4.54569	4.65393	4.80614	4.81019	5.44825	5.0729
ORP, Field (mv)	NA	58.7	154	50	24.6	24.6	187.04	195.99	106.41	124.58	94.61	300.95	113.22
Turbidity, Field (NTU)	NA	51.2	73.4	25.93	19.16	19.16	10.48	8.41	17.73	14.61	4.59	4.63	8.91
pH, Field (su)	NA	6.9	6.75	6.92	6.79	6.79	6.81	6.68	6.84	6.77	6.77	6.75	6.69

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MOUNT VERNON, INDIANA
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Location Group	Action Level	Landfill												
Location Name	MCL	CCR-LF-6	CCR-LF-6	CCR-LF-6	CCR-LF-6	CCR-LF-6	CCR-LF-6	CCR-LF-6	CCR-LF-6	CCR-LF-6	CCR-LF-6	CCR-LF-6	CCR-LF-6	CCR-LF-6
Sample Name		CCR-LF-6-20160608	DUP 2-20160608	CCR-LF-6-20160809	CCR-LF-6-20161026	CCR-LF-6-20161205	CCR-LF6-20170315	CCR-LF-6-20170404	DUP 2-20170404	CCR-LF-6-20170606	CCR-LF-6-20170927	CCR-LF-6-20171114	CCR-LF-6-20180605	CCR-LF-6-20180820
Sample Date		06/08/2016	06/08/2016	08/09/2016	10/26/2016	12/05/2016	03/15/2017	04/04/2017	04/04/2017	06/06/2017	09/27/2017	11/14/2017	06/05/2018	08/20/2018
Lab Sample ID		180-55607-5	180-55607-8	180-57528-6	180-60193-9	180-61491-15	180-64383-2	180-64974-14	180-64974-15	180-67229-15	180-70809-14	180-72643-6	180-78475-7	180-81110-9
Detection Monitoring - EPA Appendix III Constituents (mg/L)														
Boron	NA	1	0.96	0.94	0.67	0.64	0.78	1	1.1	0.99	1 J+	0.59	-	0.79
Calcium	NA	250	250	250	200	210	300	310	320	290	250	210	-	190
Antimony	0.006	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.0011 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	-
Chloride	NA	67	68	59	43	48	100	85	84	68	42	50	-	21
Fluoride	4	R	R	0.26	0.43	0.32	0.12	0.32	0.32	0.37	0.39 J+	0.42	0.51	0.47
Sulfate	NA	1100	1100	820 J-	680 J-	770	1100	960	1000	910	870	720 J-	-	520 J-
Total Dissolved Solids (TDS)	NA	1900	1900	1900	1300	1300	2000	1900	1800	1900	1600	1400	-	1200
pH (lab) (su)	NA	7.09 J	7.07 J	7.2 J	7 J	7.1 J	7 J	7.4 J	7.4 J	7.1 J	7.2 J	7.6 J	-	7.1 J
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)														
Arsenic	0.01	0.00039 J	0.00029 J	0.001 U	0.00029 J	0.00029 J	0.00043 J	0.0003 J	0.00046 J	0.001 U	0.0097 J+	0.001 U	0.001 U	0.001 U
Barium	2	0.015 J-	0.016 J-	0.016	0.017 J-	0.021 J-	0.018	0.017 J-	0.021 J-	0.018	0.017 J-	0.018 J-	0.024 J-	0.03 J
Cadmium	0.005	0.00012 J	0.00012 J	0.001 U	0.001 U	0.00017 J	0.00011 J	0.00015 J	0.00013 J	0.000089 J	0.00014 J	0.00015 J	0.001 UJ	0.00021 J
Chromium	0.1	0.002 U	0.002 U	0.002 U	0.00035 J	0.00066 J	0.002 U	0.002 U	0.00056 J	0.002 U	R	0.002 U	0.002 U	0.0023 U
Cobalt	0.006	0.00011 J	0.00019 J	0.0005 U	0.000099 J	0.0005 U	0.00016 J	0.00047 J	0.00057	0.00017 J	R	0.00022 J	0.00021 J	0.00086 J+
Lead	0.015	0.000045 J	0.000044 J	0.001 U	0.00015 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UJ	0.00017 J
Fluoride	4	R	R	0.26	0.43	0.32	0.12	0.32	0.32	0.37	0.39 J+	0.42	0.51	0.47
Lithium	0.04	0.023 J	0.02 J	0.023 J	0.017 J	0.019 J	0.019 J	0.017 J	0.017 J	0.022 J	0.019 J	0.017 J	0.014 J	0.021 J
Mercury	0.002	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U
Molybdenum	0.1	0.00066 J	0.0011 J	0.005 U	0.005 U	0.0016 J	0.00087 J	0.005 U	0.005 U	0.0012 J	R	0.0012 J	0.0012 J	0.0015 J
Selenium	0.05	0.005 U	0.00093 J	0.005 U	0.005 U	0.00074 J	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.002 J
Radiological (pCi/L)														
Radium-226	NA	0.108 J ± 0.0623	0.0721 U ± 0.0593	0.110 ± 0.0729	0.248 U ± 0.309	0.214 U ± 0.284	0.0587 U ± 0.0685	0.101 U ± 0.0802	0.0753 U ± 0.0695	R	R	0.131 ± 0.0691	0.169 U ± 0.169	R
Radium-228	NA	0.194 U ± 0.219	-0.0212 U ± 0.228	0.200 U ± 0.277	0.232 U ± 0.279	0.405 U ± 0.283	0.0519 U ± 0.255	0.155 U ± 0.246	0.183 U ± 0.239	0.0229 ± 0.267	-0.0356 U ± 0.202	0.296 U ± 0.221	0.0736 U ± 0.174	0.320 U ± 0.269
Radium-226 & 228	5	0.302 U ± 0.227	0.0508 U ± 0.236	0.310 U ± 0.286	0.480 U ± 0.416	0.619 ± 0.401	0.111 U ± 0.264	0.255 U ± 0.259	0.258 U ± 0.249	0.286 UJ ± 0.287	0.141 UJ ± 0.215	0.426 J ± 0.232	0.242 U ± 0.243	0.615 J+ ± 0.287
Constituents not Monitored by the CCR Rule (mg/L)														
Beryllium	0.004	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 UJ	-
Thallium	0.002	0.001 U	0.000028 J	0.001 U	0.000073 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	-
Field Parameters														
Temperature (Deg C)	NA	18.19	18.19	23.5	18.51	12.72	10.17	14.6	14.6	17.09	20.28	15.71	17.47	21.59
Turbidity, Field (FNU)	NA	-	-	-	-	-	-	-	-	-	-	-	-	-
Dissolved Oxygen, Field (mg/L)	NA	0.48	0.48	0.2	0.39	0.96	0.94	0.7	0.7	0.34	0.26	0.4	0.5	0.15
Conductivity, Field (mS/cm)	NA	2.27865	2.27865	2.18	1.40432	1.3022	2.44599	2.17252	2.17252	2.04141	1.83595	1.69982	1.46838	1.43063
ORP, Field (mv)	NA	38	38	34	40	26.5	166.45	181.6	181.6	79.49	130.2	102.65	320.9	112.41
Turbidity, Field (NTU)	NA	29.28	29.28	45.06	1.73	0.71	0.12	-1.46	-1.46	3.17	42.73	4.34	0.88	0.9
pH, Field (su)	NA	6.93	6.93	6.75	7.01	7.07	7.05	6.94	6.94	6.94	6.87	6.94	6.97	6.86

ABBREVIATIONS AND NOTES:

CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
su: standard units.
USEPA: United States Environmental Protection Agency.

QUALIFIERS:

J: value is estimated.
J-: value is estimated with a potentially low bias
J+: value is estimated with a potentially high bias
U: Not detected value is the laboratory reporting limit.

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257. https://www.epa.gov/coalash/coal-ash-rule

FIGURES

LEGEND

- MONITORING WELL
- TOPOGRAPHIC DIVIDE
- APPROXIMATE WASTE BOUNDARY

NOTES

1. LOCATIONS DERIVED FROM THREE I DESIGN DATA.
2. AERIAL IMAGERY SOURCE: ESRI

N

0 500 1,000 1,500 2,000
SCALE IN FEET

HALEY ALDRICH

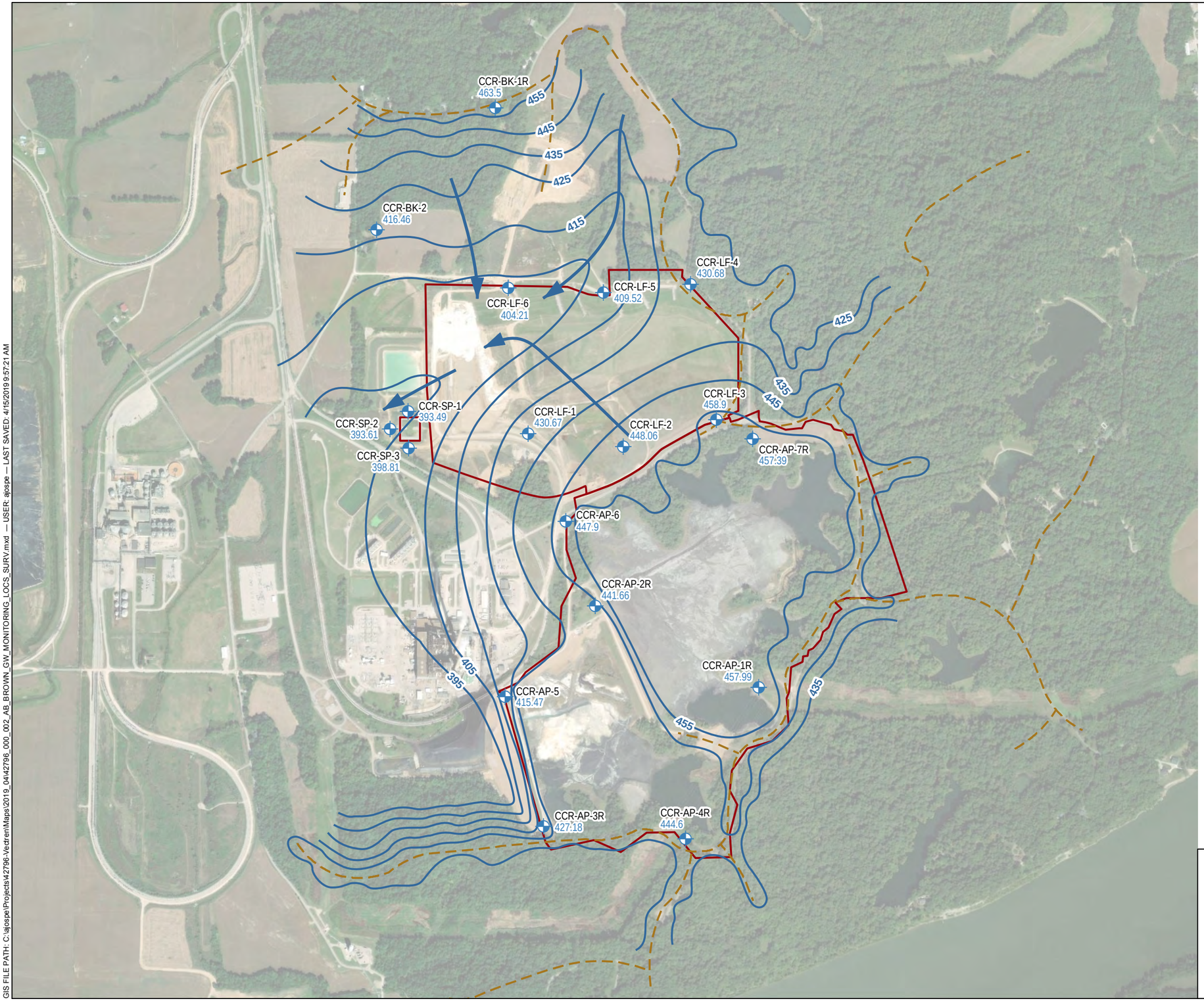
VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620

GROUNDWATER MONITORING WELL LOCATIONS FOR COMPLIANCE WITH FEDERAL CCR RULE

APRIL 2019

FIGURE 1

GIS FILE PATH: C:\ajospe\Projects\42796-Vectren\Maps\2019_04\42796_000_002_AB_BROWN_GW_MONITORING_LOCS_SURV.mxd — USER: ajospe — LAST SAVED: 4/15/2019 9:57:21 AM



LEGEND

- MONITORING WELL
- GROUNDWATER ELEVATION CONTOUR, IN FEET
- APPROXIMATE DIRECTION OF GROUNDWATER FLOW
- TOPOGRAPHIC DIVIDE
- APPROXIMATE WASTE BOUNDARY

NOTES

1. LOCATIONS DERIVED FROM THREE I DESIGN DATA.
2. WATER LEVELS MEASURED JUNE 2017.
3. AERIAL IMAGERY SOURCE: ESRI

N

0 500 1,000 1,500 2,000
SCALE IN FEET

HALEY ALDRICH

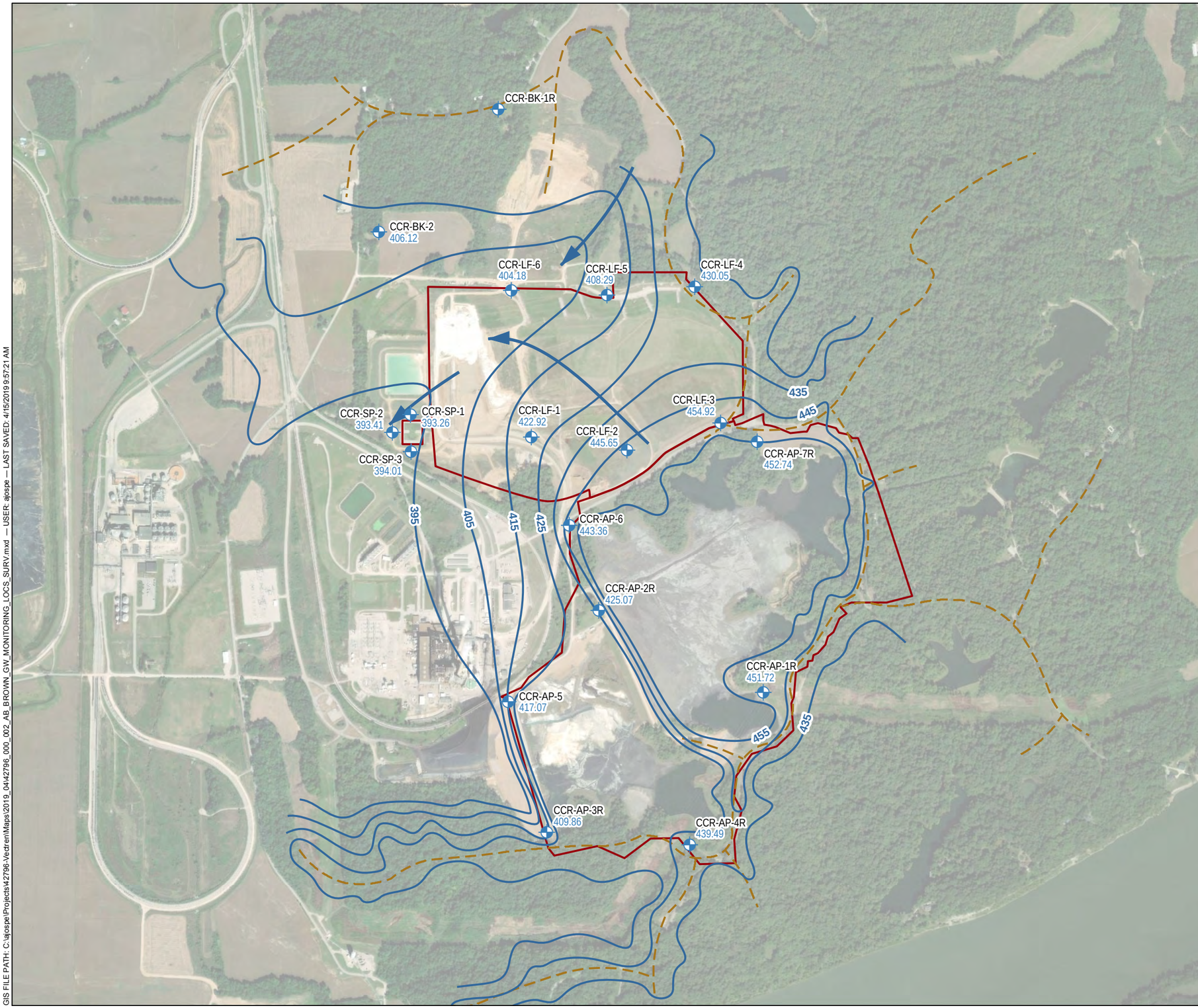
VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620

GROUNDWATER ELEVATION CONTOURS - NOVEMBER 2017

APRIL 2019

FIGURE 2

GIS FILE PATH: C:\ajospe\Projects\42796-Vectren\Maps\2019_04\42796_000_002_AB_BROWN_GW_MONITORING_LOCS_SURV.mxd — USER: ajospe — LAST SAVED: 4/15/2019 9:57:21 AM



LEGEND

- MONITORING WELL
- GROUNDWATER ELEVATION CONTOUR, IN FEET
- APPROXIMATE DIRECTION OF GROUNDWATER FLOW
- TOPOGRAPHIC DIVIDE
- APPROXIMATE WASTE BOUNDARY

NOTES

1. LOCATIONS DERIVED FROM THREE I DESIGN DATA.
2. WATER LEVELS MEASURED NOVEMBER 2017.
3. AERIAL IMAGERY SOURCE: ESRI

N

0 500 1,000 1,500 2,000

SCALE IN FEET

HALEY ALDRICH

VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620

GROUNDWATER ELEVATION CONTOURS - JUNE 2017

APRIL 2019

FIGURE 3

GIS FILE PATH: C:\ajospe\Projects\42796-Vectren\Maps\2019_04\42796_000_002_AB_BROWN_GW_MONITORING_LOCS_SURV.mxd — USER: ajospe — LAST SAVED: 4/15/2019 9:57:21 AM

APPENDIX A

Analytical Report

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica Pittsburgh
301 Alpha Drive
RIDC Park
Pittsburgh, PA 15238
Tel: (412)963-7058

TestAmerica Job ID: 180-82992-1
Client Project/Site: Vectren ASD Sampling

For:
Haley & Aldrich, Inc.
400 Augusta Street
Suite 130
Greenville, South Carolina 29601

Attn: Sean Lewis

Authorized for release by:
10/30/2018 2:19:20 PM

Veronica Bortot, Senior Project Manager
(412)963-2435
veronica.bortot@testamericainc.com

LINKS

Review your project results through TotalAccess

Have a Question? Ask The Expert

Visit us at: www.testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

PA Lab ID: 02-00416

Table of Contents

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Certification Summary 5
Sample Summary 6
Method Summary 7
Lab Chronicle 8
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QC Sample Results 12
QC Association Summary 16
Chain of Custody 18
Receipt Checklists 23

Case Narrative

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Job ID: 180-82992-1

Laboratory: TestAmerica Pittsburgh

Narrative

Job Narrative
180-82992-1

Comments
No additional comments.

Receipt
The sample was received on 10/12/2018 1:00 PM; the sample arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 18.3º C.

GC Semi VOA

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Metals
No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

General Chemistry
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

SPLP
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Definitions/Glossary

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Qualifiers

Metals

Qualifier	Qualifier Description
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
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)
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
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)

Accreditation/Certification Summary

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Laboratory: TestAmerica Pittsburgh

All accreditations/certifications held by this laboratory are listed. Not all accreditations/certifications are applicable to this report.

Authority	Program	EPA Region	Identification Number	Expiration Date
Arkansas DEQ	State Program	6	88-0690	06-27-19
California	State Program	9	2891	04-30-19
Connecticut	State Program	1	PH-0688	09-30-20
Florida	NELAP	4	E871008	06-30-19
Illinois	NELAP	5	200005	06-30-19
Kansas	NELAP	7	E-10350	01-31-19
Louisiana	NELAP	6	04041	06-30-19
Nevada	State Program	9	PA00164	07-31-19
New Hampshire	NELAP	1	2030	04-04-19
New Jersey	NELAP	2	PA005	06-30-19
New York	NELAP	2	11182	03-31-19
North Carolina (WW/SW)	State Program	4	434	12-31-18
Oregon	NELAP	10	PA-2151	01-28-19
Pennsylvania	NELAP	3	02-00416	04-30-19
South Carolina	State Program	4	89014	04-30-19
Texas	NELAP	6	T104704528-15-2	03-31-19
US Fish & Wildlife	Federal		LE94312A-1	07-31-19
USDA	Federal		P330-16-00211	06-26-19
Utah	NELAP	8	PA001462015-4	05-31-19
Virginia	NELAP	3	460189	09-14-19
West Virginia DEP	State Program	3	142	01-31-19
Wisconsin	State Program	5	998027800	08-31-19

Sample Summary

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
180-82992-1	FGD Sludge	Solid	10/10/18 13:52	10/12/18 13:00

Method Summary

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Method	Method Description	Protocol	Laboratory
EPA 9056A	Anions, Ion Chromatography	SW846	TAL PIT
6020A	SPLP Metals	SW846	TAL PIT
7470A	SPLP Mercury	SW846	TAL PIT
EPA 6020A	Metals (ICP/MS)	SW846	TAL PIT
EPA 7471B	Mercury (CVAA)	SW846	TAL PIT
2540G	SM 2540G	SM22	TAL PIT
3010A	Preparation, Total Metals	SW846	TAL PIT
3050B	Preparation, Metals	SW846	TAL PIT
7470A	Preparation, Mercury	SW846	TAL PIT
7471B	Preparation, Mercury	SW846	TAL PIT
DI Leach	Deionized Water Leaching Procedure	ASTM	TAL PIT
EPA 1312	SPLP Extraction	SW846	TAL PIT

Protocol References:

ASTM = ASTM International

SM22 = Standard Methods For The Examination Of Water And Wastewater, 22nd Edition

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL PIT = TestAmerica Pittsburgh, 301 Alpha Drive, RIDC Park, Pittsburgh, PA 15238, TEL (412)963-7058

Lab Chronicle

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Client Sample ID: FGD Sludge

Lab Sample ID: 180-82992-1
Date Collected: 10/10/18 13:52
Matrix: Solid
Date Received: 10/12/18 13:00

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
SPLP East	Leach	EPA 1312			125 g	2500 mL	260869	10/24/18 16:00	MTT	TAL PIT
SPLP East	Analysis	EPA 9056A		2.5	1 mL	1.0 mL	260915	10/25/18 16:26	MJH	TAL PIT
	Instrument ID:	CHIC2100A								
SPLP East	Leach	EPA 1312			125 g	2500 mL	260869	10/24/18 16:00	MTT	TAL PIT
SPLP East	Prep	3010A			50 mL	50 mL	261002	10/25/18 12:25	NAM	TAL PIT
SPLP East	Analysis	6020A		1			261210	10/26/18 10:51	RSK	TAL PIT
	Instrument ID:	A								
SPLP East	Leach	EPA 1312			125 g	2500 mL	260869	10/24/18 16:00	MTT	TAL PIT
SPLP East	Prep	7470A			50 mL	50 mL	261091	10/26/18 09:09	KA	TAL PIT
SPLP East	Analysis	7470A		1			261181	10/26/18 17:38	KA	TAL PIT
	Instrument ID:	HGZ								
Total/NA	Analysis	2540G		1			259850	10/15/18 13:07	CLL	TAL PIT
	Instrument ID:	NOEQUIP								

Client Sample ID: FGD Sludge

Lab Sample ID: 180-82992-1
Date Collected: 10/10/18 13:52
Matrix: Solid
Date Received: 10/12/18 13:00
Percent Solids: 44.0

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Soluble	Leach	DI Leach			010.1108 g	100 mL	260097	10/17/18 10:35	CMR	TAL PIT
Soluble	Analysis	EPA 9056A		5			260068	10/17/18 16:26	CMR	TAL PIT
	Instrument ID:	CHICS2000								
Total/NA	Prep	3050B			1.04 g	100 mL	259888	10/16/18 15:33	NAM	TAL PIT
Total/NA	Analysis	EPA 6020A		1	1.0 mL	1.0 mL	260252	10/17/18 20:02	WTR	TAL PIT
	Instrument ID:	M								
Total/NA	Prep	7471B			0.56 g	100 mL	259862	10/15/18 13:56	KA	TAL PIT
Total/NA	Analysis	EPA 7471B		1			260017	10/16/18 14:05	KA	TAL PIT
	Instrument ID:	HGZ								

Laboratory References:
TAL PIT = TestAmerica Pittsburgh, 301 Alpha Drive, RIDC Park, Pittsburgh, PA 15238, TEL (412)963-7058

Analyst References:

Lab: TAL PIT

Batch Type: Leach

CMR = Carl Reagle

MTT = Michaela Trueman

Batch Type: Prep

KA = Kayla Kalamasz

NAM = Nicole Marfisi

Batch Type: Analysis

CLL = Cheryl Loheyde

CMR = Carl Reagle

KA = Kayla Kalamasz

MJH = Matthew Hartman

RSK = Robert Kurtz

WTR = Bill Reinheimer

Client Sample Results

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Client Sample ID: FGD Sludge

Lab Sample ID: 180-82992-1
Date Collected: 10/10/18 13:52
Matrix: Solid
Date Received: 10/12/18 13:00

Method: EPA 9056A - Anions, Ion Chromatography - SPLP East

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	3.1		0.25	0.066	mg/L			10/25/18 16:26	2.5

Method: 6020A - SPLP Metals - SPLP East

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	0.99	J	1.0	0.32	ug/L		10/25/18 12:25	10/26/18 10:51	1
Barium	10		10	0.37	ug/L		10/25/18 12:25	10/26/18 10:51	1
Cadmium	ND		1.0	0.13	ug/L		10/25/18 12:25	10/26/18 10:51	1
Beryllium	ND		1.0	0.057	ug/L		10/25/18 12:25	10/26/18 10:51	1
Chromium	4.3		2.0	0.63	ug/L		10/25/18 12:25	10/26/18 10:51	1
Lead	0.12	J	1.0	0.094	ug/L		10/25/18 12:25	10/26/18 10:51	1
Selenium	83		5.0	0.81	ug/L		10/25/18 12:25	10/26/18 10:51	1
Cobalt	0.14	J	0.50	0.075	ug/L		10/25/18 12:25	10/26/18 10:51	1
Molybdenum	33		5.0	0.47	ug/L		10/25/18 12:25	10/26/18 10:51	1
Antimony	ND		2.0	1.1	ug/L		10/25/18 12:25	10/26/18 10:51	1
Thallium	ND		1.0	0.063	ug/L		10/25/18 12:25	10/26/18 10:51	1
Lithium	7.7		5.0	2.6	ug/L		10/25/18 12:25	10/26/18 10:51	1

Method: 7470A - SPLP Mercury - SPLP East

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.20	0.065	ug/L		10/26/18 09:09	10/26/18 17:38	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	56.0		0.1	0.1	%			10/15/18 13:07	1
Percent Solids	44.0		0.1	0.1	%			10/15/18 13:07	1

Client Sample ID: FGD Sludge

Lab Sample ID: 180-82992-1
Date Collected: 10/10/18 13:52
Matrix: Solid
Date Received: 10/12/18 13:00
Percent Solids: 44.0

Method: EPA 9056A - Anions, Ion Chromatography - Soluble

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	57		11	7.6	mg/Kg	☼		10/17/18 16:26	5

Method: EPA 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	0.88		0.22	0.057	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Barium	3.0		2.2	0.12	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Beryllium	0.067	J	0.22	0.016	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Cadmium	0.16	J	0.22	0.037	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Chromium	4.8		0.44	0.14	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Cobalt	0.11		0.11	0.018	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Molybdenum	1.6		1.1	0.14	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Lead	0.23		0.22	0.077	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Antimony	ND		0.44	0.14	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Selenium	4.8		1.1	0.13	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Thallium	0.031	J	0.22	0.028	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Lithium	ND		1.1	0.60	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1

Client Sample Results

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Client Sample ID: FGD Sludge

Date Collected: 10/10/18 13:52
Date Received: 10/12/18 13:00

Lab Sample ID: 180-82992-1

Matrix: Solid
Percent Solids: 44.0

Method: EPA 7471B - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	0.22		0.080	0.018	mg/Kg	☼	10/15/18 13:56	10/16/18 14:05	1

QC Sample Results

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Method: EPA 9056A - Anions, Ion Chromatography

Lab Sample ID: MB 180-260915/6
Matrix: Solid
Analysis Batch: 260915

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	ND		0.10	0.026	mg/L			10/25/18 05:33	1

Lab Sample ID: LCS 180-260915/5
Matrix: Solid
Analysis Batch: 260915

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Bromide	5.00	4.92		mg/L		98	80 - 120
Chloride	25.0	25.0		mg/L		100	80 - 120
Fluoride	1.25	1.29		mg/L		103	80 - 120
Sulfate	25.0	24.9		mg/L		100	80 - 120

Lab Sample ID: LB 180-260097/1-A
Matrix: Solid
Analysis Batch: 260068

Client Sample ID: Method Blank
Prep Type: Soluble

Analyte	LB Result	LB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	ND		1.0	0.68	mg/Kg			10/17/18 13:46	1

Lab Sample ID: LCS 180-260097/2-A
Matrix: Solid
Analysis Batch: 260068

Client Sample ID: Lab Control Sample
Prep Type: Soluble

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Bromide	50.0	47.7		mg/Kg		95	80 - 120
Chloride	250	225		mg/Kg		90	80 - 120
Fluoride	12.5	11.9		mg/Kg		96	80 - 120
Sulfate	250	225		mg/Kg		90	80 - 120

Lab Sample ID: LB 180-260869/1-A
Matrix: Solid
Analysis Batch: 260915

Client Sample ID: Method Blank
Prep Type: SPLP East

Analyte	LB Result	LB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	ND		0.10	0.026	mg/L			10/25/18 16:11	1

Method: 6020A - SPLP Metals

Lab Sample ID: MB 180-261002/1-A
Matrix: Solid
Analysis Batch: 261210

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 261002

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		1.0	0.32	ug/L		10/25/18 12:25	10/26/18 10:30	1
Barium	ND		10	0.37	ug/L		10/25/18 12:25	10/26/18 10:30	1
Beryllium	ND		1.0	0.057	ug/L		10/25/18 12:25	10/26/18 10:30	1
Cadmium	ND		1.0	0.13	ug/L		10/25/18 12:25	10/26/18 10:30	1
Chromium	ND		2.0	0.63	ug/L		10/25/18 12:25	10/26/18 10:30	1
Cobalt	ND		0.50	0.075	ug/L		10/25/18 12:25	10/26/18 10:30	1

Method: 6020A - SPLP Metals (Continued)

Lab Sample ID: MB 180-261002/1-A
Matrix: Solid
Analysis Batch: 261210

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 261002

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Lead	ND		1.0	0.094	ug/L		10/25/18 12:25	10/26/18 10:30	1
Molybdenum	ND		5.0	0.47	ug/L		10/25/18 12:25	10/26/18 10:30	1
Antimony	ND		2.0	1.1	ug/L		10/25/18 12:25	10/26/18 10:30	1
Selenium	ND		5.0	0.81	ug/L		10/25/18 12:25	10/26/18 10:30	1
Thallium	ND		1.0	0.063	ug/L		10/25/18 12:25	10/26/18 10:30	1
Lithium	ND		5.0	2.6	ug/L		10/25/18 12:25	10/26/18 10:30	1

Lab Sample ID: LCS 180-261002/2-A
Matrix: Solid
Analysis Batch: 261210

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 261002

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Arsenic	40.0	42.1		ug/L		105	80 - 120
Barium	2000	2000		ug/L		100	80 - 120
Beryllium	50.0	49.6		ug/L		99	80 - 120
Cadmium	50.0	47.1		ug/L		94	80 - 120
Chromium	200	205		ug/L		102	80 - 120
Cobalt	500	517		ug/L		103	80 - 120
Lead	20.0	20.9		ug/L		104	80 - 120
Molybdenum	1000	991		ug/L		99	80 - 120
Antimony	500	497		ug/L		99	80 - 120
Selenium	10.0	9.91		ug/L		99	80 - 120
Thallium	50.0	49.6		ug/L		99	80 - 120
Lithium	50.0	56.4		ug/L		113	80 - 120

Lab Sample ID: LCSD 180-261002/3-A
Matrix: Solid
Analysis Batch: 261210

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 261002

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Arsenic	40.0	41.4		ug/L		103	80 - 120	2	20
Barium	2000	1960		ug/L		98	80 - 120	2	20
Beryllium	50.0	48.1		ug/L		96	80 - 120	3	20
Cadmium	50.0	46.6		ug/L		93	80 - 120	1	20
Chromium	200	205		ug/L		102	80 - 120	0	20
Cobalt	500	516		ug/L		103	80 - 120	0	20
Lead	20.0	20.6		ug/L		103	80 - 120	1	20
Molybdenum	1000	965		ug/L		97	80 - 120	3	20
Antimony	500	493		ug/L		99	80 - 120	1	20
Selenium	10.0	9.61		ug/L		96	80 - 120	3	20
Thallium	50.0	49.6		ug/L		99	80 - 120	0	20
Lithium	50.0	54.3		ug/L		109	80 - 120	4	20

Lab Sample ID: LB 180-260869/1-B
Matrix: Solid
Analysis Batch: 261210

Client Sample ID: Method Blank
Prep Type: SPLP East
Prep Batch: 261002

Analyte	LB Result	LB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		1.0	0.32	ug/L		10/25/18 12:25	10/26/18 10:34	1

Method: 6020A - SPLP Metals (Continued)

Lab Sample ID: LB 180-260869/1-B
Matrix: Solid
Analysis Batch: 261210

Client Sample ID: Method Blank
Prep Type: SPLP East
Prep Batch: 261002

Analyte	LB Result	LB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Barium	ND		10	0.37	ug/L		10/25/18 12:25	10/26/18 10:34	1
Beryllium	ND		1.0	0.057	ug/L		10/25/18 12:25	10/26/18 10:34	1
Cadmium	ND		1.0	0.13	ug/L		10/25/18 12:25	10/26/18 10:34	1
Chromium	ND		2.0	0.63	ug/L		10/25/18 12:25	10/26/18 10:34	1
Cobalt	ND		0.50	0.075	ug/L		10/25/18 12:25	10/26/18 10:34	1
Lead	ND		1.0	0.094	ug/L		10/25/18 12:25	10/26/18 10:34	1
Molybdenum	ND		5.0	0.47	ug/L		10/25/18 12:25	10/26/18 10:34	1
Antimony	ND		2.0	1.1	ug/L		10/25/18 12:25	10/26/18 10:34	1
Selenium	ND		5.0	0.81	ug/L		10/25/18 12:25	10/26/18 10:34	1
Thallium	ND		1.0	0.063	ug/L		10/25/18 12:25	10/26/18 10:34	1
Lithium	ND		5.0	2.6	ug/L		10/25/18 12:25	10/26/18 10:34	1

Method: 7470A - SPLP Mercury

Lab Sample ID: MB 180-261091/1-A
Matrix: Solid
Analysis Batch: 261181

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 261091

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.20	0.065	ug/L		10/26/18 09:09	10/26/18 17:34	1

Lab Sample ID: LCS 180-261091/2-A
Matrix: Solid
Analysis Batch: 261181

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 261091

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Mercury			2.50	2.48		ug/L		99	80 - 120		

Lab Sample ID: LCSD 180-261091/3-A
Matrix: Solid
Analysis Batch: 261181

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 261091

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Mercury			2.50	2.44		ug/L		98	80 - 120	1	20

Lab Sample ID: LB 180-260869/1-D
Matrix: Solid
Analysis Batch: 261181

Client Sample ID: Method Blank
Prep Type: SPLP East
Prep Batch: 261091

Analyte	LB Result	LB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.20	0.065	ug/L		10/26/18 09:09	10/26/18 17:37	1

QC Sample Results

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Method: EPA 6020A - Metals (ICP/MS)

Lab Sample ID: MB 180-259888/1-A — **Client Sample ID: Method Blank**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 260252 — **Prep Batch: 259888**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.10	0.026	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Barium	ND		1.0	0.057	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Beryllium	ND		0.10	0.0075	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Cadmium	ND		0.10	0.017	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Chromium	ND		0.20	0.066	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Cobalt	ND		0.050	0.0083	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Lead	ND		0.10	0.035	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Molybdenum	ND		0.50	0.062	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Antimony	ND		0.20	0.062	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Selenium	ND		0.50	0.060	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Thallium	ND		0.10	0.013	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Lithium	ND		0.50	0.28	mg/Kg		10/15/18 19:17	10/17/18 18:30	1

Lab Sample ID: LCS 180-259888/2-A — **Client Sample ID: Lab Control Sample**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 260252 — **Prep Batch: 259888**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Arsenic	4.00	3.90		mg/Kg		98	80 - 120
Barium	200	179		mg/Kg		89	80 - 120
Beryllium	5.00	5.07		mg/Kg		101	80 - 120
Cadmium	5.00	4.95		mg/Kg		99	80 - 120
Chromium	20.0	19.8		mg/Kg		99	80 - 120
Cobalt	50.0	48.4		mg/Kg		97	80 - 120
Lead	2.00	1.92		mg/Kg		96	80 - 120
Molybdenum	100	94.8		mg/Kg		95	80 - 120
Antimony	50.0	45.9		mg/Kg		92	80 - 120
Selenium	1.00	0.964		mg/Kg		96	80 - 120
Thallium	105	98.5		mg/Kg		94	80 - 120
Lithium	5.00	5.05		mg/Kg		101	80 - 120

Method: EPA 7471B - Mercury (CVAA)

Lab Sample ID: MB 180-259862/1-A — **Client Sample ID: Method Blank**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 260017 — **Prep Batch: 259862**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.033	0.0074	mg/Kg		10/15/18 13:56	10/16/18 13:42	1

Lab Sample ID: LCS 180-259862/2-A — **Client Sample ID: Lab Control Sample**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 260017 — **Prep Batch: 259862**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	0.417	0.384		mg/Kg		92	80 - 120

QC Association Summary

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

HPLC/IC

Analysis Batch: 260068

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	Soluble	Solid	EPA 9056A	260097
LB 180-260097/1-A	Method Blank	Soluble	Solid	EPA 9056A	260097
LCS 180-260097/2-A	Lab Control Sample	Soluble	Solid	EPA 9056A	260097

Leach Batch: 260097

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	Soluble	Solid	DI Leach	
LB 180-260097/1-A	Method Blank	Soluble	Solid	DI Leach	
LCS 180-260097/2-A	Lab Control Sample	Soluble	Solid	DI Leach	

Leach Batch: 260869

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	SPLP East	Solid	EPA 1312	
LB 180-260869/1-A	Method Blank	SPLP East	Solid	EPA 1312	

Analysis Batch: 260915

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	SPLP East	Solid	EPA 9056A	260869
LB 180-260869/1-A	Method Blank	SPLP East	Solid	EPA 9056A	260869
MB 180-260915/6	Method Blank	Total/NA	Solid	EPA 9056A	
LCS 180-260915/5	Lab Control Sample	Total/NA	Solid	EPA 9056A	

Metals

Prep Batch: 259862

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	Total/NA	Solid	7471B	
MB 180-259862/1-A	Method Blank	Total/NA	Solid	7471B	
LCS 180-259862/2-A	Lab Control Sample	Total/NA	Solid	7471B	

Prep Batch: 259888

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	Total/NA	Solid	3050B	
MB 180-259888/1-A	Method Blank	Total/NA	Solid	3050B	
LCS 180-259888/2-A	Lab Control Sample	Total/NA	Solid	3050B	

Analysis Batch: 260017

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	Total/NA	Solid	EPA 7471B	259862
MB 180-259862/1-A	Method Blank	Total/NA	Solid	EPA 7471B	259862
LCS 180-259862/2-A	Lab Control Sample	Total/NA	Solid	EPA 7471B	259862

Analysis Batch: 260252

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	Total/NA	Solid	EPA 6020A	259888
MB 180-259888/1-A	Method Blank	Total/NA	Solid	EPA 6020A	259888
LCS 180-259888/2-A	Lab Control Sample	Total/NA	Solid	EPA 6020A	259888

QC Association Summary

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Metals (Continued)

Leach Batch: 260869

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	SPLP East	Solid	EPA 1312	
LB 180-260869/1-B	Method Blank	SPLP East	Solid	EPA 1312	
LB 180-260869/1-D	Method Blank	SPLP East	Solid	EPA 1312	

Prep Batch: 261002

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	SPLP East	Solid	3010A	260869
LB 180-260869/1-B	Method Blank	SPLP East	Solid	3010A	260869
MB 180-261002/1-A	Method Blank	Total/NA	Solid	3010A	
LCS 180-261002/2-A	Lab Control Sample	Total/NA	Solid	3010A	
LCSD 180-261002/3-A	Lab Control Sample Dup	Total/NA	Solid	3010A	

Prep Batch: 261091

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	SPLP East	Solid	7470A	260869
LB 180-260869/1-D	Method Blank	SPLP East	Solid	7470A	260869
MB 180-261091/1-A	Method Blank	Total/NA	Solid	7470A	
LCS 180-261091/2-A	Lab Control Sample	Total/NA	Solid	7470A	
LCSD 180-261091/3-A	Lab Control Sample Dup	Total/NA	Solid	7470A	

Analysis Batch: 261181

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	SPLP East	Solid	7470A	261091
LB 180-260869/1-D	Method Blank	SPLP East	Solid	7470A	261091
MB 180-261091/1-A	Method Blank	Total/NA	Solid	7470A	261091
LCS 180-261091/2-A	Lab Control Sample	Total/NA	Solid	7470A	261091
LCSD 180-261091/3-A	Lab Control Sample Dup	Total/NA	Solid	7470A	261091

Analysis Batch: 261210

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	SPLP East	Solid	6020A	261002
LB 180-260869/1-B	Method Blank	SPLP East	Solid	6020A	261002
MB 180-261002/1-A	Method Blank	Total/NA	Solid	6020A	261002
LCS 180-261002/2-A	Lab Control Sample	Total/NA	Solid	6020A	261002
LCSD 180-261002/3-A	Lab Control Sample Dup	Total/NA	Solid	6020A	261002

General Chemistry

Analysis Batch: 259850

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	Total/NA	Solid	2540G	

COLUMBUS
240507

Chain of Custody Record

270501

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.
TAL-8210 (0713)

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	Project Manager: Mark Miesfeldt	Site Contact:	Date: 10/10/18	COC No: 270501
Company Name: HALEY + ALDRICH	Tel/Fax: (864) 230-3757	Lab Contact:	Carrier:	1 of 1 COCs
Address:	Analysis Turnaround Time			Sampler:
City/State/Zip:	☐ CALENDAR DAYS ☐ WORKING DAYS			For Lab Use Only:
Phone: (864) 230-3757	TAT if different from Below _____			Walk-in Client:
Fax:	☐ 2 weeks			Lab Sampling:
Project Name: Vectren ASD Sampling	☐ 1 week			
Site:	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y/N)	Perform MS/MSD (Y/N)	Sample Specific Notes:
Ra 226/Ra 228 Standard Target List	10/10/18	1:45p	G	S	1	N		
Ra226/Ra228 GFPC	10/10/18	1:46p	G	S	1	N		
Ra226/Ra228 Standard Target List								
TCLP Metals, TCLP Mercury	10/10/18	1:50p	G	S	1	N		
Metals, Mercury, Anions, Moisture	10/10/18	1:52p	G	S	1	N		

180-82992 Chain of Custody

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other NONE

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☑ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☑ Disposal by Lab ☐ Archive for _____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd: _____ Corr'd: _____ Therm ID No.: _____

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Brandi Rucker	Vectren	10/10/18 3:00p	[illegible]	[illegible]	10/12/18 1300
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TABLE 3
MAXIMUM CONTAMINANT LEVELS, BACKGROUND LEVELS,
LABORATORY REPORTING LIMITS, AND METHOD DETECTION LIMITS
F.B. CULLEY GENERATING STATION - EAST ASH POND
NEWBURGH, INDIANA

180 19531

Analyte Group	Analyte	Analytical Method	Maximum Contaminant Level	Reporting Limit	Method Detection Limit
Detection Monitoring - EPA Appendix III Constituents - 40 CFR Part 257					
Inorganics	Boron	EPA 6020A	--	0.5	0.04
Inorganics	Calcium	EPA 6020A	--	0.0005	0.0001
Anions	Chloride	EPA 9056A	--	1.0	0.08
Anions	Fluoride	EPA 9056A	4.0	0.1	0.05
Anions	Sulfate	EPA 9056A	--	1.0	0.2
Wet Chemistry	pH	EPA 9040C	--	N/A	N/A
Wet Chemistry	Total Dissolved Solids	SM 2540C	--	30	10
Assessment Monitoring - EPA Appendix IV Constituents - 40 CFR Part 257					
Inorganics	Antimony	EPA 6020A	0.006	0.005	0.001
Inorganics	Arsenic	EPA 6020A	0.010	0.005	0.002
Inorganics	Barium	EPA 6020A	2	0.005	0.001
Inorganics	Beryllium	EPA 6020A	0.004	0.002	0.0002
Inorganics	Cadmium	EPA 6020A	0.005	0.002	0.0002
Inorganics	Chromium	EPA 6020A	0.1	0.005	0.002
Inorganics	Cobalt	EPA 6020A	--	0.002	0.0002
Inorganics	Lead	EPA 6020A	0.05	0.003	0.0006
Inorganics	Lithium	EPA 6020A	--	0.00500	0.00107
Inorganics	Molybdenum	EPA 6020A	--	0.005	0.001
Inorganics	Selenium	EPA 6020A	0.01	0.005	0.002
Inorganics	Thallium	EPA 6020A	0.002	0.002	0.00006
Inorganics	Mercury	EPA 7470A	0.002	0.0002	0.00003
Anions	Fluoride	EPA 9056A	4.0	0.1	0.05
Radiochemistry	Radium 226 and 228 combined	EPA 903.0/904.0	5 pCi/L	1 pCi/L	N/A

SPLP

NOTES:
Units in mg/L except where noted
-- = not established
CFR = Code of Federal Regulations
EPA = U.S. Environmental Protection Agency
mg/L = milligrams per liter
N/A = not applicable
pCi/L = picocuries per liter
SM = Standard Method
TBD = to be determined

BRANDIE RUCKER
(812) 491-4895
THE UPS STORE #5015
STE F
5625 PEARL DR
EVANSVILLE IN 47712-8107

7 LBS 1 OF 1
SHP WT: 7 LBS
DWT: 15,15,13
DATE: 10 OCT 2018

SHIP SAMPLE RECEIVING
TO: TEST AMERICA
301 ALPHA DR

PITTSBURGH PA 15238-2907

2

180-82992 Waybill

UPS GROUND
TRACKING #: 1Z A88 748 03 3802 2492

Uncorrected temp 18.3 °C No Ice
Thermometer ID 9
CF 0 Initials TB

PT-WI-SR-001 effective 7/26/13

ISH 13.00N ZZP 450 03.5V 07/2

limitation of liability. Where allowed by law, shipper authorizes UPS to act as forwarding agent for export con
that the commodities, technology or software were exported from the US in accordance with the Export Admin

PITTSBURGH PA 15238
P:BLACK S:MR I:8
DELT-7400
1ZA88748033802 2492
NKU1MXS PABEA996UDC OCT 12 00:52:14 2018

TestAmerica Pittsburgh
301 Alpha Drive RIDC Park
Pittsburgh, PA 15238
Phone (412) 963-7058 Fax (412) 963-2468

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Client Information (Sub Contract Lab)	Sampler:	Lab PM: Bortot, Veronica	Carrier Tracking No(s):	COC No: 180-344309.1
Client Contact: Shipping/Receiving	Phone:	E-Mail: veronica.bortot@testamericainc.com	State of Origin: Indiana	Page: Page 1 of 1
Company: TestAmerica Laboratories, Inc.		Accreditations Required (See note):		Job #: 180-82992-1
Address: 13715 Rider Trail North, ,	Due Date Requested: 11/2/2018			
City: Earth City	TAT Requested (days):			
State, Zip: MO, 63045				
Phone: 314-298-8566(Tel) 314-298-8757(Fax)	PO #:			
Email:	WO #:			
Project Name: Vectren ASD Sampling	Project #: 18019531			
Site:	SSOW#:			

Analysis Requested

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, Z - other (specify)

Other:

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)	9315_Ra226/Dry_Grind Radium-226	Ra226Ra228_GFPC/ Combined Radium-226 and Radium-228	9320_Ra228/Dry_Grind Radium-228	9320_Ra228/1312_E SPLP -9320 Radium-228 (GFPC)	9315_Ra226/1312_E SPLP 9315	Ra226Ra228_GFPC/ SPLP CALCULATION	Total Number of containers	Special Instructions/Note:
			Preservation Code:											
VECTREN ASD SAMPLING (180-82992-1)	10/10/18	13:52 Eastern		Solid			X	X	X	X	X	X	1	

Note: Since laboratory accreditations are subject to change, TestAmerica Laboratories, Inc. places the ownership of method, analyte & accreditation compliance upon out 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 TestAmerica laboratory or other instructions will be provided. Any changes to accreditation status should be brought to TestAmerica Laboratories, Inc. attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said complicance to TestAmerica Laboratories, Inc.

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: 10/15/18 1700	Company: TA Pitt	Received by: Michael Fleem	Date/Time: 10/16/18 0945	Company: TA 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: 09/20/2016

TestAmerica Pittsburgh
301 Alpha Drive RIDC Park
Pittsburgh, PA 15238
Phone (412) 963-7058 Fax (412) 963-2468

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Client Information (Sub Contract Lab)	Sampler:	Lab PM: Bortot, Veronica	Carrier Tracking No(s):	COC No: 180-345122.1
Client Contact: Shipping/Receiving	Phone:	E-Mail: veronica.bortot@testamericainc.com	State of Origin: Indiana	Page: Page 1 of 1
Company: TestAmerica Laboratories, Inc.		Accreditations Required (See note):		Job #: 180-82992-1
Address: 13715 Rider Trail North, ,	Due Date Requested: 11/2/2018			
City: Earth City	TAT Requested (days):			
State, Zip: MO, 63045				
Phone: 314-298-8566(Tel) 314-298-8757(Fax)	PO #:			
Email:	WO #:			
Project Name: Vectren ASD Sampling	Project #: 18019531			
Site:	SSOW#:			

Analysis Requested

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, Z - other (specify)
Other:

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)	9315_Ra226/Dry_Grind Radium-226	9315_Ra226/DPS_21 Radium-226	Ra226Ra228_GFPC/ Combined Radium-226 and Radium-228	9320_Ra228/Dry_Grind Radium-228	9320_Ra228/DPS_0 Radium-228	9320_Ra228/1312_E SPLP -9320 Radium-228 (GFPC)	9320_Ra228/PrecSep_0 SPLP -9320 Radium-228 (GFPC)	9315_Ra226/1312_E SPLP 9315	9315_Ra226/PrecSep_21 SPLP 9315	Ra226Ra228_GFPC/ SPLP CALCULATION				Total Number of containers	Special Instructions/Note:
			Preservation Code:																		
VECTREN ASD SAMPLING (180-82992-1)	10/10/18	13:52 Eastern		Solid			X	X	X	X	X	X	X	X	X	X				2	

Note: Since laboratory accreditations are subject to change, TestAmerica Laboratories, Inc. places the ownership of method, analyte & accreditation compliance upon out 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 TestAmerica laboratory or other instructions will be provided. Any changes to accreditation status should be brought to TestAmerica Laboratories, Inc. attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said complicance to TestAmerica Laboratories, Inc.

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: 10/25/18 1700	Company TA PITT	Received by: Michael Fleem	Date/Time: 10/26/18 0945	Company TA 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: 09/20/2016

Login Sample Receipt Checklist

Client: Haley & Aldrich, Inc.

Job Number: 180-82992-1

Login Number: 82992
List Number: 1
Creator: Neri, Tom

List Source: TestAmerica Pittsburgh

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	
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.	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").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica Pittsburgh
301 Alpha Drive
RIDC Park
Pittsburgh, PA 15238
Tel: (412)963-7058

TestAmerica Job ID: 180-82992-1
Client Project/Site: Vectren ASD Sampling

For:
Haley & Aldrich, Inc.
400 Augusta Street
Suite 130
Greenville, South Carolina 29601

Attn: Sean Lewis

Authorized for release by:
10/30/2018 2:19:16 PM

Veronica Bortot, Senior Project Manager
(412)963-2435
veronica.bortot@testamericainc.com

Preliminary Data

LINKS

Review your project results through TotalAccess

Have a Question? Ask The Expert

Visit us at: www.testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

PA Lab ID: 02-00416

Table of Contents

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Preliminary Data

Job ID: 180-82992-1

Laboratory: TestAmerica Pittsburgh

Narrative

Job Narrative
180-82992-1

Comments
No additional comments.

Receipt
The sample was received on 10/12/2018 1:00 PM; the sample arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 18.3º C.

GC Semi VOA

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Metals
No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

General Chemistry
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

SPLP
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Preliminary Data

Definitions/Glossary

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Qualifiers

Metals

Qualifier	Qualifier Description
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
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)
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
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)

Preliminary Data

Accreditation/Certification Summary

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Laboratory: TestAmerica Pittsburgh

All accreditations/certifications held by this laboratory are listed. Not all accreditations/certifications are applicable to this report.

Authority	Program	EPA Region	Identification Number	Expiration Date
Arkansas DEQ	State Program	6	88-0690	06-27-19
California	State Program	9	2891	04-30-19
Connecticut	State Program	1	PH-0688	09-30-20
Florida	NELAP	4	E871008	06-30-19
Illinois	NELAP	5	200005	06-30-19
Kansas	NELAP	7	E-10350	01-31-19
Louisiana	NELAP	6	04041	06-30-19
Nevada	State Program	9	PA00164	07-31-19
New Hampshire	NELAP	1	2030	04-04-19
New Jersey	NELAP	2	PA005	06-30-19
New York	NELAP	2	11182	03-31-19
North Carolina (WW/SW)	State Program	4	434	12-31-18
Oregon	NELAP	10	PA-2151	01-28-19
Pennsylvania	NELAP	3	02-00416	04-30-19
South Carolina	State Program	4	89014	04-30-19
Texas	NELAP	6	T104704528-15-2	03-31-19
US Fish & Wildlife	Federal		LE94312A-1	07-31-19
USDA	Federal		P330-16-00211	06-26-19
Utah	NELAP	8	PA001462015-4	05-31-19
Virginia	NELAP	3	460189	09-14-19
West Virginia DEP	State Program	3	142	01-31-19
Wisconsin	State Program	5	998027800	08-31-19

Preliminary Data

Sample Summary

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
180-82992-1	FGD Sludge	Solid	10/10/18 13:52	10/12/18 13:00

Preliminary Data

Method Summary

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Method	Method Description	Protocol	Laboratory
EPA 9056A	Anions, Ion Chromatography	SW846	TAL PIT
6020A	SPLP Metals	SW846	TAL PIT
7470A	SPLP Mercury	SW846	TAL PIT
EPA 6020A	Metals (ICP/MS)	SW846	TAL PIT
EPA 7471B	Mercury (CVAA)	SW846	TAL PIT
2540G	SM 2540G	SM22	TAL PIT
3010A	Preparation, Total Metals	SW846	TAL PIT
3050B	Preparation, Metals	SW846	TAL PIT
7470A	Preparation, Mercury	SW846	TAL PIT
7471B	Preparation, Mercury	SW846	TAL PIT
DI Leach	Deionized Water Leaching Procedure	ASTM	TAL PIT
EPA 1312	SPLP Extraction	SW846	TAL PIT

Protocol References:

ASTM = ASTM International

SM22 = Standard Methods For The Examination Of Water And Wastewater, 22nd Edition

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL PIT = TestAmerica Pittsburgh, 301 Alpha Drive, RIDC Park, Pittsburgh, PA 15238, TEL (412)963-7058

Preliminary Data

Lab Chronicle

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Client Sample ID: FGD Sludge — Lab Sample ID: 180-82992-1

Date Collected: 10/10/18 13:52 — **Matrix: Solid**
Date Received: 10/12/18 13:00

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
SPLP East	Leach	EPA 1312			125 g	2500 mL	260869	10/24/18 16:00	MTT	TAL PIT
SPLP East	Analysis	EPA 9056A		2.5	1 mL	1.0 mL	260915	10/25/18 16:26	MJH	TAL PIT
	Instrument ID:	CHIC2100A								
SPLP East	Leach	EPA 1312			125 g	2500 mL	260869	10/24/18 16:00	MTT	TAL PIT
SPLP East	Prep	3010A			50 mL	50 mL	261002	10/25/18 12:25	NAM	TAL PIT
SPLP East	Analysis	6020A		1			261210	10/26/18 10:51	RSK	TAL PIT
	Instrument ID:	A								
SPLP East	Leach	EPA 1312			125 g	2500 mL	260869	10/24/18 16:00	MTT	TAL PIT
SPLP East	Prep	7470A			50 mL	50 mL	261091	10/26/18 09:09	KA	TAL PIT
SPLP East	Analysis	7470A		1			261181	10/26/18 17:38	KA	TAL PIT
	Instrument ID:	HGZ								
Total/NA	Analysis	2540G		1			259850	10/15/18 13:07	CLL	TAL PIT
	Instrument ID:	NOEQUIP								

Client Sample ID: FGD Sludge — Lab Sample ID: 180-82992-1

Date Collected: 10/10/18 13:52 — **Matrix: Solid**
Date Received: 10/12/18 13:00 — **Percent Solids: 44.0**

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Soluble	Leach	DI Leach			010.1108 g	100 mL	260097	10/17/18 10:35	CMR	TAL PIT
Soluble	Analysis	EPA 9056A		5			260068	10/17/18 16:26	CMR	TAL PIT
	Instrument ID:	CHICS2000								
Total/NA	Prep	3050B			1.04 g	100 mL	259888	10/16/18 15:33	NAM	TAL PIT
Total/NA	Analysis	EPA 6020A		1	1.0 mL	1.0 mL	260252	10/17/18 20:02	WTR	TAL PIT
	Instrument ID:	M								
Total/NA	Prep	7471B			0.56 g	100 mL	259862	10/15/18 13:56	KA	TAL PIT
Total/NA	Analysis	EPA 7471B		1			260017	10/16/18 14:05	KA	TAL PIT
	Instrument ID:	HGZ								

Laboratory References:
TAL PIT = TestAmerica Pittsburgh, 301 Alpha Drive, RIDC Park, Pittsburgh, PA 15238, TEL (412)963-7058

Preliminary Data

Analyst References:

Lab: TAL PIT

Batch Type: Leach

CMR = Carl Reagle

MTT = Michaela Trueman

Batch Type: Prep

KA = Kayla Kalamasz

NAM = Nicole Marfisi

Batch Type: Analysis

CLL = Cheryl Loheyde

CMR = Carl Reagle

KA = Kayla Kalamasz

MJH = Matthew Hartman

RSK = Robert Kurtz

WTR = Bill Reinheimer

Preliminary Data

Client Sample Results

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Client Sample ID: FGD Sludge

Lab Sample ID: 180-82992-1
Date Collected: 10/10/18 13:52
Matrix: Solid
Date Received: 10/12/18 13:00

Method: EPA 9056A - Anions, Ion Chromatography - SPLP East

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	3.1		0.25	0.066	mg/L			10/25/18 16:26	2.5

Method: 6020A - SPLP Metals - SPLP East

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	0.99	J	1.0	0.32	ug/L		10/25/18 12:25	10/26/18 10:51	1
Barium	10		10	0.37	ug/L		10/25/18 12:25	10/26/18 10:51	1
Cadmium	ND		1.0	0.13	ug/L		10/25/18 12:25	10/26/18 10:51	1
Beryllium	ND		1.0	0.057	ug/L		10/25/18 12:25	10/26/18 10:51	1
Chromium	4.3		2.0	0.63	ug/L		10/25/18 12:25	10/26/18 10:51	1
Lead	0.12	J	1.0	0.094	ug/L		10/25/18 12:25	10/26/18 10:51	1
Selenium	83		5.0	0.81	ug/L		10/25/18 12:25	10/26/18 10:51	1
Cobalt	0.14	J	0.50	0.075	ug/L		10/25/18 12:25	10/26/18 10:51	1
Molybdenum	33		5.0	0.47	ug/L		10/25/18 12:25	10/26/18 10:51	1
Antimony	ND		2.0	1.1	ug/L		10/25/18 12:25	10/26/18 10:51	1
Thallium	ND		1.0	0.063	ug/L		10/25/18 12:25	10/26/18 10:51	1
Lithium	7.7		5.0	2.6	ug/L		10/25/18 12:25	10/26/18 10:51	1

Method: 7470A - SPLP Mercury - SPLP East

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.20	0.065	ug/L		10/26/18 09:09	10/26/18 17:38	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	56.0		0.1	0.1	%			10/15/18 13:07	1
Percent Solids	44.0		0.1	0.1	%			10/15/18 13:07	1

Client Sample ID: FGD Sludge

Lab Sample ID: 180-82992-1
Date Collected: 10/10/18 13:52
Matrix: Solid
Date Received: 10/12/18 13:00
Percent Solids: 44.0

Method: EPA 9056A - Anions, Ion Chromatography - Soluble

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	57		11	7.6	mg/Kg	☼		10/17/18 16:26	5

Method: EPA 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	0.88		0.22	0.057	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Barium	3.0		2.2	0.12	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Beryllium	0.067	J	0.22	0.016	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Cadmium	0.16	J	0.22	0.037	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Chromium	4.8		0.44	0.14	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Cobalt	0.11		0.11	0.018	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Molybdenum	1.6		1.1	0.14	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Lead	0.23		0.22	0.077	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Antimony	ND		0.44	0.14	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Selenium	4.8		1.1	0.13	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Thallium	0.031	J	0.22	0.028	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1
Lithium	ND		1.1	0.60	mg/Kg	☼	10/16/18 15:33	10/17/18 20:02	1

Preliminary Data

Client Sample Results

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Client Sample ID: FGD Sludge

Date Collected: 10/10/18 13:52
Date Received: 10/12/18 13:00

Lab Sample ID: 180-82992-1

Matrix: Solid
Percent Solids: 44.0

Method: EPA 7471B - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	0.22		0.080	0.018	mg/Kg	☼	10/15/18 13:56	10/16/18 14:05	1

Preliminary Data

QC Sample Results

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Method: EPA 9056A - Anions, Ion Chromatography

Lab Sample ID: MB 180-260915/6
Matrix: Solid
Analysis Batch: 260915

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	ND		0.10	0.026	mg/L			10/25/18 05:33	1

Lab Sample ID: LCS 180-260915/5
Matrix: Solid
Analysis Batch: 260915

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Bromide	5.00	4.92		mg/L		98	80 - 120
Chloride	25.0	25.0		mg/L		100	80 - 120
Fluoride	1.25	1.29		mg/L		103	80 - 120
Sulfate	25.0	24.9		mg/L		100	80 - 120

Lab Sample ID: LB 180-260097/1-A
Matrix: Solid
Analysis Batch: 260068

Client Sample ID: Method Blank
Prep Type: Soluble

Analyte	LB Result	LB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	ND		1.0	0.68	mg/Kg			10/17/18 13:46	1

Lab Sample ID: LCS 180-260097/2-A
Matrix: Solid
Analysis Batch: 260068

Client Sample ID: Lab Control Sample
Prep Type: Soluble

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Bromide	50.0	47.7		mg/Kg		95	80 - 120
Chloride	250	225		mg/Kg		90	80 - 120
Fluoride	12.5	11.9		mg/Kg		96	80 - 120
Sulfate	250	225		mg/Kg		90	80 - 120

Lab Sample ID: LB 180-260869/1-A
Matrix: Solid
Analysis Batch: 260915

Client Sample ID: Method Blank
Prep Type: SPLP East

Analyte	LB Result	LB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	ND		0.10	0.026	mg/L			10/25/18 16:11	1

Method: 6020A - SPLP Metals

Lab Sample ID: MB 180-261002/1-A
Matrix: Solid
Analysis Batch: 261210

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 261002

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		1.0	0.32	ug/L		10/25/18 12:25	10/26/18 10:30	1
Barium	ND		10	0.37	ug/L		10/25/18 12:25	10/26/18 10:30	1
Beryllium	ND		1.0	0.057	ug/L		10/25/18 12:25	10/26/18 10:30	1
Cadmium	ND		1.0	0.13	ug/L		10/25/18 12:25	10/26/18 10:30	1
Chromium	ND		2.0	0.63	ug/L		10/25/18 12:25	10/26/18 10:30	1
Cobalt	ND		0.50	0.075	ug/L		10/25/18 12:25	10/26/18 10:30	1

Preliminary Data

Method: 6020A - SPLP Metals (Continued)

Lab Sample ID: MB 180-261002/1-A
Matrix: Solid
Analysis Batch: 261210

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 261002

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Lead	ND		1.0	0.094	ug/L		10/25/18 12:25	10/26/18 10:30	1
Molybdenum	ND		5.0	0.47	ug/L		10/25/18 12:25	10/26/18 10:30	1
Antimony	ND		2.0	1.1	ug/L		10/25/18 12:25	10/26/18 10:30	1
Selenium	ND		5.0	0.81	ug/L		10/25/18 12:25	10/26/18 10:30	1
Thallium	ND		1.0	0.063	ug/L		10/25/18 12:25	10/26/18 10:30	1
Lithium	ND		5.0	2.6	ug/L		10/25/18 12:25	10/26/18 10:30	1

Lab Sample ID: LCS 180-261002/2-A
Matrix: Solid
Analysis Batch: 261210

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 261002

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Arsenic	40.0	42.1		ug/L		105	80 - 120
Barium	2000	2000		ug/L		100	80 - 120
Beryllium	50.0	49.6		ug/L		99	80 - 120
Cadmium	50.0	47.1		ug/L		94	80 - 120
Chromium	200	205		ug/L		102	80 - 120
Cobalt	500	517		ug/L		103	80 - 120
Lead	20.0	20.9		ug/L		104	80 - 120
Molybdenum	1000	991		ug/L		99	80 - 120
Antimony	500	497		ug/L		99	80 - 120
Selenium	10.0	9.91		ug/L		99	80 - 120
Thallium	50.0	49.6		ug/L		99	80 - 120
Lithium	50.0	56.4		ug/L		113	80 - 120

Lab Sample ID: LCSD 180-261002/3-A
Matrix: Solid
Analysis Batch: 261210

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 261002

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Arsenic	40.0	41.4		ug/L		103	80 - 120	2	20
Barium	2000	1960		ug/L		98	80 - 120	2	20
Beryllium	50.0	48.1		ug/L		96	80 - 120	3	20
Cadmium	50.0	46.6		ug/L		93	80 - 120	1	20
Chromium	200	205		ug/L		102	80 - 120	0	20
Cobalt	500	516		ug/L		103	80 - 120	0	20
Lead	20.0	20.6		ug/L		103	80 - 120	1	20
Molybdenum	1000	965		ug/L		97	80 - 120	3	20
Antimony	500	493		ug/L		99	80 - 120	1	20
Selenium	10.0	9.61		ug/L		96	80 - 120	3	20
Thallium	50.0	49.6		ug/L		99	80 - 120	0	20
Lithium	50.0	54.3		ug/L		109	80 - 120	4	20

Lab Sample ID: LB 180-260869/1-B
Matrix: Solid
Analysis Batch: 261210

Client Sample ID: Method Blank
Prep Type: SPLP East
Prep Batch: 261002

Analyte	LB Result	LB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		1.0	0.32	ug/L		10/25/18 12:25	10/26/18 10:34	1

Preliminary Data

Method: 6020A - SPLP Metals (Continued)

Lab Sample ID: LB 180-260869/1-B
Matrix: Solid
Analysis Batch: 261210

Client Sample ID: Method Blank
Prep Type: SPLP East
Prep Batch: 261002

Analyte	LB Result	LB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Barium	ND		10	0.37	ug/L		10/25/18 12:25	10/26/18 10:34	1
Beryllium	ND		1.0	0.057	ug/L		10/25/18 12:25	10/26/18 10:34	1
Cadmium	ND		1.0	0.13	ug/L		10/25/18 12:25	10/26/18 10:34	1
Chromium	ND		2.0	0.63	ug/L		10/25/18 12:25	10/26/18 10:34	1
Cobalt	ND		0.50	0.075	ug/L		10/25/18 12:25	10/26/18 10:34	1
Lead	ND		1.0	0.094	ug/L		10/25/18 12:25	10/26/18 10:34	1
Molybdenum	ND		5.0	0.47	ug/L		10/25/18 12:25	10/26/18 10:34	1
Antimony	ND		2.0	1.1	ug/L		10/25/18 12:25	10/26/18 10:34	1
Selenium	ND		5.0	0.81	ug/L		10/25/18 12:25	10/26/18 10:34	1
Thallium	ND		1.0	0.063	ug/L		10/25/18 12:25	10/26/18 10:34	1
Lithium	ND		5.0	2.6	ug/L		10/25/18 12:25	10/26/18 10:34	1

Method: 7470A - SPLP Mercury

Lab Sample ID: MB 180-261091/1-A
Matrix: Solid
Analysis Batch: 261181

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 261091

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.20	0.065	ug/L		10/26/18 09:09	10/26/18 17:34	1

Lab Sample ID: LCS 180-261091/2-A
Matrix: Solid
Analysis Batch: 261181

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 261091

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits		
Mercury			2.50	2.48		ug/L		99	80 - 120		

Lab Sample ID: LCSD 180-261091/3-A
Matrix: Solid
Analysis Batch: 261181

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 261091

Analyte			Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Mercury			2.50	2.44		ug/L		98	80 - 120	1	20

Lab Sample ID: LB 180-260869/1-D
Matrix: Solid
Analysis Batch: 261181

Client Sample ID: Method Blank
Prep Type: SPLP East
Prep Batch: 261091

Analyte	LB Result	LB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.20	0.065	ug/L		10/26/18 09:09	10/26/18 17:37	1

Preliminary Data

QC Sample Results

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

Method: EPA 6020A - Metals (ICP/MS)

Lab Sample ID: MB 180-259888/1-A — **Client Sample ID: Method Blank**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 260252 — **Prep Batch: 259888**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.10	0.026	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Barium	ND		1.0	0.057	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Beryllium	ND		0.10	0.0075	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Cadmium	ND		0.10	0.017	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Chromium	ND		0.20	0.066	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Cobalt	ND		0.050	0.0083	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Lead	ND		0.10	0.035	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Molybdenum	ND		0.50	0.062	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Antimony	ND		0.20	0.062	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Selenium	ND		0.50	0.060	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Thallium	ND		0.10	0.013	mg/Kg		10/15/18 19:17	10/17/18 18:30	1
Lithium	ND		0.50	0.28	mg/Kg		10/15/18 19:17	10/17/18 18:30	1

Lab Sample ID: LCS 180-259888/2-A — **Client Sample ID: Lab Control Sample**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 260252 — **Prep Batch: 259888**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Arsenic	4.00	3.90		mg/Kg		98	80 - 120
Barium	200	179		mg/Kg		89	80 - 120
Beryllium	5.00	5.07		mg/Kg		101	80 - 120
Cadmium	5.00	4.95		mg/Kg		99	80 - 120
Chromium	20.0	19.8		mg/Kg		99	80 - 120
Cobalt	50.0	48.4		mg/Kg		97	80 - 120
Lead	2.00	1.92		mg/Kg		96	80 - 120
Molybdenum	100	94.8		mg/Kg		95	80 - 120
Antimony	50.0	45.9		mg/Kg		92	80 - 120
Selenium	1.00	0.964		mg/Kg		96	80 - 120
Thallium	105	98.5		mg/Kg		94	80 - 120
Lithium	5.00	5.05		mg/Kg		101	80 - 120

Method: EPA 7471B - Mercury (CVAA)

Lab Sample ID: MB 180-259862/1-A — **Client Sample ID: Method Blank**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 260017 — **Prep Batch: 259862**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.033	0.0074	mg/Kg		10/15/18 13:56	10/16/18 13:42	1

Lab Sample ID: LCS 180-259862/2-A — **Client Sample ID: Lab Control Sample**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 260017 — **Prep Batch: 259862**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	0.417	0.384		mg/Kg		92	80 - 120

Preliminary Data

QC Association Summary

Client: Haley & Aldrich, Inc.
Project/Site: Vectren ASD Sampling

TestAmerica Job ID: 180-82992-1

HPLC/IC

Analysis Batch: 260068

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	Soluble	Solid	EPA 9056A	260097
LB 180-260097/1-A	Method Blank	Soluble	Solid	EPA 9056A	260097
LCS 180-260097/2-A	Lab Control Sample	Soluble	Solid	EPA 9056A	260097

Leach Batch: 260097

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	Soluble	Solid	DI Leach	
LB 180-260097/1-A	Method Blank	Soluble	Solid	DI Leach	
LCS 180-260097/2-A	Lab Control Sample	Soluble	Solid	DI Leach	

Leach Batch: 260869

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	SPLP East	Solid	EPA 1312	
LB 180-260869/1-A	Method Blank	SPLP East	Solid	EPA 1312	

Analysis Batch: 260915

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	SPLP East	Solid	EPA 9056A	260869
LB 180-260869/1-A	Method Blank	SPLP East	Solid	EPA 9056A	260869
MB 180-260915/6	Method Blank	Total/NA	Solid	EPA 9056A	
LCS 180-260915/5	Lab Control Sample	Total/NA	Solid	EPA 9056A	

Metals

Prep Batch: 259862

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	Total/NA	Solid	7471B	
MB 180-259862/1-A	Method Blank	Total/NA	Solid	7471B	
LCS 180-259862/2-A	Lab Control Sample	Total/NA	Solid	7471B	

Prep Batch: 259888

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	Total/NA	Solid	3050B	
MB 180-259888/1-A	Method Blank	Total/NA	Solid	3050B	
LCS 180-259888/2-A	Lab Control Sample	Total/NA	Solid	3050B	

Analysis Batch: 260017

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	Total/NA	Solid	EPA 7471B	259862
MB 180-259862/1-A	Method Blank	Total/NA	Solid	EPA 7471B	259862
LCS 180-259862/2-A	Lab Control Sample	Total/NA	Solid	EPA 7471B	259862

Analysis Batch: 260252

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	Total/NA	Solid	EPA 6020A	259888
MB 180-259888/1-A	Method Blank	Total/NA	Solid	EPA 6020A	259888
LCS 180-259888/2-A	Lab Control Sample	Total/NA	Solid	EPA 6020A	259888

Preliminary Data

Metals (Continued)

Leach Batch: 260869

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	SPLP East	Solid	EPA 1312	
LB 180-260869/1-B	Method Blank	SPLP East	Solid	EPA 1312	
LB 180-260869/1-D	Method Blank	SPLP East	Solid	EPA 1312	

Prep Batch: 261002

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	SPLP East	Solid	3010A	260869
LB 180-260869/1-B	Method Blank	SPLP East	Solid	3010A	260869
MB 180-261002/1-A	Method Blank	Total/NA	Solid	3010A	
LCS 180-261002/2-A	Lab Control Sample	Total/NA	Solid	3010A	
LCSD 180-261002/3-A	Lab Control Sample Dup	Total/NA	Solid	3010A	

Prep Batch: 261091

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	SPLP East	Solid	7470A	260869
LB 180-260869/1-D	Method Blank	SPLP East	Solid	7470A	260869
MB 180-261091/1-A	Method Blank	Total/NA	Solid	7470A	
LCS 180-261091/2-A	Lab Control Sample	Total/NA	Solid	7470A	
LCSD 180-261091/3-A	Lab Control Sample Dup	Total/NA	Solid	7470A	

Analysis Batch: 261181

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	SPLP East	Solid	7470A	261091
LB 180-260869/1-D	Method Blank	SPLP East	Solid	7470A	261091
MB 180-261091/1-A	Method Blank	Total/NA	Solid	7470A	261091
LCS 180-261091/2-A	Lab Control Sample	Total/NA	Solid	7470A	261091
LCSD 180-261091/3-A	Lab Control Sample Dup	Total/NA	Solid	7470A	261091

Analysis Batch: 261210

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	SPLP East	Solid	6020A	261002
LB 180-260869/1-B	Method Blank	SPLP East	Solid	6020A	261002
MB 180-261002/1-A	Method Blank	Total/NA	Solid	6020A	261002
LCS 180-261002/2-A	Lab Control Sample	Total/NA	Solid	6020A	261002
LCSD 180-261002/3-A	Lab Control Sample Dup	Total/NA	Solid	6020A	261002

General Chemistry

Analysis Batch: 259850

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-82992-1	FGD Sludge	Total/NA	Solid	2540G	

Preliminary Data

COLUMBUS
240507

Chain of Custody Record

270501

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.
TAL-8210 (0713)

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	Project Manager: Mark Miesfeldt	Site Contact:	Date: 10/10/18	COC No: 270501
Company Name: HALEY + ALDRICH	Tel/Fax: (864) 230-3757	Lab Contact:	Carrier:	1 of 1 COCs
Address:	Analysis Turnaround Time			Sampler:
City/State/Zip:	☐ CALENDAR DAYS ☐ WORKING DAYS			For Lab Use Only:
Phone: (864) 230-3757	TAT if different from Below ____			Walk-in Client:
Fax:	☐ 2 weeks			Lab Sampling:
Project Name: Vectren ASD Sampling	☐ 1 week			
Site:	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y/N)	Perform MS / MSD (Y/N)	Sample Specific Notes:
Ra 226/Ra 228 Standard Target List	10/10/18	1:45p	G	S	1	N		
Ra226/Ra228 GFPC	10/10/18	1:46p	G	S	1	N		
Ra226/Ra228 Standard Target List								
TCLP Metals, TCLP Mercury	10/10/18	1:50p	G	S	1	N		
Metals, Mercury, Anions, Moisture	10/10/18	1:52p	G	S	1	N		

180-82992 Chain of Custody

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other NONE

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☑ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☑ Disposal by Lab ☐ Archive for ____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd: ____ Corr'd: ____ Therm ID No.: ____

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Brandi Rucker	Vectren	10/10/18 3:00p	[signature]	[signature]	10/12/18 1300
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TABLE 3
MAXIMUM CONTAMINANT LEVELS, BACKGROUND LEVELS,
LABORATORY REPORTING LIMITS, AND METHOD DETECTION LIMITS
F.B. CULLEY GENERATING STATION - EAST ASH POND
NEWBURGH, INDIANA

180 9531

Analyte Group	Analyte	Analytical Method	Maximum Contaminant Level	Reporting Limit	Method Detection Limit
Detection Monitoring - EPA Appendix III Constituents - 40 CFR Part 257					
Inorganics	Boron	EPA 6020A	--	0.5	0.04
Inorganics	Calcium	EPA 6020A	--	0.0005	0.0001
Anions	Chloride	EPA 9056A	--	1.0	0.08
Anions	Fluoride	EPA 9056A	4.0	0.1	0.05
Anions	Sulfate	EPA 9056A	--	1.0	0.2
Wet Chemistry	pH	EPA 9040C	--	N/A	N/A
Wet Chemistry	Total Dissolved Solids	SM 2540C	--	30	10
Assessment Monitoring - EPA Appendix IV Constituents - 40 CFR Part 257					
Inorganics	Antimony	EPA 6020A	0.006	0.005	0.001
Inorganics	Arsenic	EPA 6020A	0.010	0.005	0.002
Inorganics	Barium	EPA 6020A	2	0.005	0.001
Inorganics	Beryllium	EPA 6020A	0.004	0.002	0.0002
Inorganics	Cadmium	EPA 6020A	0.005	0.002	0.0002
Inorganics	Chromium	EPA 6020A	0.1	0.005	0.002
Inorganics	Cobalt	EPA 6020A	--	0.002	0.0002
Inorganics	Lead	EPA 6020A	0.05	0.003	0.0006
Inorganics	Lithium	EPA 6020A	--	0.00500	0.00107
Inorganics	Molybdenum	EPA 6020A	--	0.005	0.001
Inorganics	Selenium	EPA 6020A	0.01	0.005	0.002
Inorganics	Thallium	EPA 6020A	0.002	0.002	0.00006
Inorganics	Mercury	EPA 7470A	0.002	0.0002	0.00003
Anions	Fluoride	EPA 9056A	4.0	0.1	0.05
Radiochemistry	Radium 226 and 228 combined	EPA 903.0/904.0	5 pCi/L	1 pCi/L	N/A

SPLP

NOTES:
Units in mg/L except where noted
-- = not established
CFR = Code of Federal Regulations
EPA = U.S. Environmental Protection Agency
mg/L = milligrams per liter
N/A = not applicable
pCi/L = picocuries per liter
SM = Standard Method
TBD = to be determined

Draft

BRANDIE RUCKER
(812) 491-4895
THE UPS STORE #5015
STE F
5625 PEARL DR
EVANSVILLE IN 47712-8107

7 LBS 1 OF 1
SHP WT: 7 LBS
DWT: 15,15,13
DATE: 10 OCT 2018

SHIP SAMPLE RECEIVING
TO: TEST AMERICA
301 ALPHA DR

PITTSBURGH PA 15238-2907

2

180-82992 Waybill

UPS GROUND
TRACKING #: 1Z A88 748 03 3802 2492

Uncorrected temp 18.3 °C No
Thermometer ID 9 Ice
CF 0 Initials TB

PT-WI-SR-001 effective 7/26/13

ISH 13.00N ZZP 450 03.5V 07/2

limitation of liability. Where allowed by law, shipper authorizes UPS to act as forwarding agent for export con
that the commodities, technology or software were exported from the US in accordance with the Export Admin

PITTSBURGH PA 15238
P:BLACK S:MR I:8
DELT-7400
1ZA88748033802 2492
NKV1MXS PABEA996UDC OCT 12 00:52:14 2018

Preliminary

TestAmerica Pittsburgh
301 Alpha Drive RIDC Park
Pittsburgh, PA 15238
Phone (412) 963-7058 Fax (412) 963-2468

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Client Information (Sub Contract Lab)	Sampler:	Lab PM: Bortot, Veronica	Carrier Tracking No(s):	COC No: 180-344309.1
Client Contact: Shipping/Receiving	Phone:	E-Mail: veronica.bortot@testamericainc.com	State of Origin: Indiana	Page: Page 1 of 1
Company: TestAmerica Laboratories, Inc.		Accreditations Required (See note):		Job #: 180-82992-1
Address: 13715 Rider Trail North, ,	Due Date Requested: 11/2/2018			
City: Earth City	TAT Requested (days):			
State, Zip: MO, 63045				
Phone: 314-298-8566(Tel) 314-298-8757(Fax)	PO #:			
Email:	WO #:			
Project Name: Vectren ASD Sampling	Project #: 18019531			
Site:	SSOW#:			

Analysis Requested

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, Z - other (specify)
Other:

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)	9315_Ra226/Dry_Grind Radium-226	Ra226Ra228_GFPC/ Combined Radium-226 and Radium-228	9320_Ra228/Dry_Grind Radium-228	9320_Ra228/1312_E SPLP -9320 Radium-228 (GFPC)	9315_Ra226/1312_E SPLP 9315	Ra226Ra228_GFPC/ SPLP CALCULATION	Total Number of containers	Special Instructions/Note:
			Preservation Code:											
VECTREN ASD SAMPLING (180-82992-1)	10/10/18	13:52 Eastern		Solid			X	X	X	X	X	X	1	

Note: Since laboratory accreditations are subject to change, TestAmerica Laboratories, Inc. places the ownership of method, analyte & accreditation compliance upon out 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 TestAmerica laboratory or other instructions will be provided. Any changes to accreditation status should be brought to TestAmerica Laboratories, Inc. attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said complicance to TestAmerica Laboratories, Inc.

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: 10/15/18 1700	Company: TA Pitt	Received by: Michael Fleem	Date/Time: 10/16/18 0945	Company: TA 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: 09/20/2016

10/30/2018

TestAmerica Pittsburgh
301 Alpha Drive RIDC Park
Pittsburgh, PA 15238
Phone (412) 963-7058 Fax (412) 963-2468

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Client Information (Sub Contract Lab)	Sampler:	Lab PM: Bortot, Veronica	Carrier Tracking No(s):	COC No: 180-345122.1
Client Contact: Shipping/Receiving	Phone:	E-Mail: veronica.bortot@testamericainc.com	State of Origin: Indiana	Page: Page 1 of 1
Company: TestAmerica Laboratories, Inc.		Accreditations Required (See note):		Job #: 180-82992-1
Address: 13715 Rider Trail North, ,	Due Date Requested: 11/2/2018			
City: Earth City	TAT Requested (days):			
State, Zip: MO, 63045				
Phone: 314-298-8566(Tel) 314-298-8757(Fax)	PO #:			
Email:	WO #:			
Project Name: Vectren ASD Sampling	Project #: 18019531			
Site:	SSOW#:			

Analysis Requested

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, Z - other (specify)

Other:

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)	9315_Ra226/Dry_Grind Radium-226	9315_Ra226/DPS_21 Radium-226	Ra226Ra228_GFPC/ Combined Radium-226 and Radium-228	9320_Ra228/Dry_Grind Radium-228	9320_Ra228/DPS_0 Radium-228	9320_Ra228/1312_E SPLP -9320 Radium-228 (GFPC)	9320_Ra228/PrecSep_0 SPLP -9320 Radium-228 (GFPC)	9315_Ra226/1312_E SPLP 9315	9315_Ra226/PrecSep_21 SPLP 9315	Ra226Ra228_GFPC/ SPLP CALCULATION				Total Number of containers	Special Instructions/Note:
			Preservation Code:																		
VECTREN ASD SAMPLING (180-82992-1)	10/10/18	13:52 Eastern		Solid			X	X	X	X	X	X	X	X	X	X				2	

Note: Since laboratory accreditations are subject to change, TestAmerica Laboratories, Inc. places the ownership of method, analyte & accreditation compliance upon out 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 TestAmerica laboratory or other instructions will be provided. Any changes to accreditation status should be brought to TestAmerica Laboratories, Inc. attention immediately. If all requested accreditations are current to date, return the signed Chain of Custody attesting to said complicance to TestAmerica Laboratories, Inc.

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: 10/25/18 1700	Company TA PITT	Received by: Michael Fleem	Date/Time: 10/26/18 0945	Company TA 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: 09/20/2016

Draft

Login Sample Receipt Checklist

Client: Haley & Aldrich, Inc.

Job Number: 180-82992-1

Login Number: 82992
List Number: 1
Creator: Neri, Tom

List Source: TestAmerica Pittsburgh

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	
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.	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").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Preliminary Data

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica Pittsburgh
301 Alpha Drive
RIDC Park
Pittsburgh, PA 15238
Tel: (412)963-7058

TestAmerica Job ID: 180-71653-1
Client Project/Site: Vectren Soil Sampling

For:
Haley & Aldrich, Inc.
400 Augusta Street
Suite 130
Greenville, South Carolina 29601

Attn: Sean Lewis

Authorized for release by:
11/3/2017 11:31:00 AM

Veronica Bortot, Senior Project Manager
(412)963-2435
veronica.bortot@testamericainc.com

LINKS

Review your project results through TotalAccess

Have a Question? Ask The Expert

Visit us at: www.testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

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Case Narrative

Client: Haley & Aldrich, Inc.
Project/Site: Vectren Soil Sampling

TestAmerica Job ID: 180-71653-1

Job ID: 180-71653-1

Laboratory: TestAmerica Pittsburgh

Narrative

Job Narrative
180-71653-1

Comments
No additional comments.

Receipt
The sample was received on 10/24/2017 10:20 AM; the sample arrived in good condition. The temperature of the cooler at receipt was 17.6º C.

Receipt Exceptions

The sample was received at the laboratory outside the required temperature criteria. Additionally the sample was outside of holding time for metals analysis. The client contacted the laboratory prior to sending the sample and indicated that the sample was out of hold .

Metals
Method(s) 6010B: Due to sample matrix effect on the internal standard (ISTD), a dilution was required for the following sample: CCR-LF-4 (49.3-50.5) (180-71653-1). All analytes referencing the yttrium internal standards required dilution due to the yttrium counts being high and outside the 70%-130% control limits.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

General Chemistry
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Definitions/Glossary

Client: Haley & Aldrich, Inc.
Project/Site: Vectren Soil Sampling

TestAmerica Job ID: 180-71653-1

Qualifiers

Metals

Qualifier	Qualifier Description
H	Sample was prepped or analyzed beyond the specified holding time
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
B	Compound was found in the blank and sample.

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
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)
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
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)

Accreditation/Certification Summary

Client: Haley & Aldrich, Inc.
Project/Site: Vectren Soil Sampling

TestAmerica Job ID: 180-71653-1

Laboratory: TestAmerica Pittsburgh

All accreditations/certifications held by this laboratory are listed. Not all accreditations/certifications are applicable to this report.

Authority	Program	EPA Region	Identification Number	Expiration Date
A2LA	A2LA		PA00164	07-31-18
Arkansas DEQ	State Program	6	88-0690	06-27-18
California	State Program	9	2891	03-31-18
Connecticut	State Program	1	PH-0688	09-30-18
Florida	NELAP	4	E871008	06-30-18
Illinois	NELAP	5	200005	06-30-18
Kansas	NELAP	7	E-10350	01-31-18
Louisiana	NELAP	6	04041	06-30-18
Nevada	State Program	9	PA00164	07-31-18
New Hampshire	NELAP	1	2030	04-04-18
New Jersey	NELAP	2	PA005	06-30-18
New York	NELAP	2	11182	03-31-18
North Carolina (WW/SW)	State Program	4	434	12-31-17
Pennsylvania	NELAP	3	02-00416	04-30-18
South Carolina	State Program	4	89014	04-30-18
Texas	NELAP	6	T104704528-15-2	03-31-18
US Fish & Wildlife	Federal		LE94312A-1	07-31-18
USDA	Federal		P330-16-00211	06-26-19
Utah	NELAP	8	PA001462015-4	05-31-18
Virginia	NELAP	3	460189	09-14-18
West Virginia DEP	State Program	3	142	01-31-18
Wisconsin	State Program	5	998027800	08-31-18

Sample Summary

Client: Haley & Aldrich, Inc.
Project/Site: Vectren Soil Sampling

TestAmerica Job ID: 180-71653-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
180-71653-1	CCR-LF-4 (49.3-50.5)	Solid	03/11/16 15:15	10/24/17 10:20

Method Summary

Client: Haley & Aldrich, Inc.
Project/Site: Vectren Soil Sampling

TestAmerica Job ID: 180-71653-1

Method	Method Description	Protocol	Laboratory
6010B	Metals (ICP)	SW846	TAL PIT
2540G	SM 2540G	SM22	TAL PIT

Protocol References:

SM22 = SM22

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL PIT = TestAmerica Pittsburgh, 301 Alpha Drive, RIDC Park, Pittsburgh, PA 15238, TEL (412)963-7058

Lab Chronicle

Client: Haley & Aldrich, Inc.
Project/Site: Vectren Soil Sampling

TestAmerica Job ID: 180-71653-1

Client Sample ID: CCR-LF-4 (49.3-50.5)

Lab Sample ID: 180-71653-1
Date Collected: 03/11/16 15:15
Matrix: Solid
Date Received: 10/24/17 10:20

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
SPLP East	Leach	1312			100.34 g	2000 mL	227121	10/26/17 15:00	JPM	TAL PIT
SPLP East	Prep	3010A			5 mL	50 mL	227446	10/30/17 11:55	KA	TAL PIT
SPLP East	Analysis	6010B		1			227628	10/31/17 13:44	RJG	TAL PIT
	Instrument ID: Q									
Total/NA	Analysis	2540G		1			226976	10/25/17 15:21	CLL	TAL PIT
	Instrument ID: NOEQUIP									

Client Sample ID: CCR-LF-4 (49.3-50.5)

Lab Sample ID: 180-71653-1
Date Collected: 03/11/16 15:15
Matrix: Solid
Date Received: 10/24/17 10:20
Percent Solids: 95.8

Prep Type	Batch Type	Batch Method	Run	Dil Factor	Initial Amount	Final Amount	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	3050B			1.02 g	100 mL	227137	10/26/17 15:39	KA	TAL PIT
Total/NA	Analysis	6010B		10			227420	10/30/17 08:53	RJG	TAL PIT
	Instrument ID: C									

Laboratory References:

TAL PIT = TestAmerica Pittsburgh, 301 Alpha Drive, RIDC Park, Pittsburgh, PA 15238, TEL (412)963-7058

Analyst References:

Lab: TAL PIT

Batch Type: Leach

JPM = Jeremy Merriman

Batch Type: Prep

KA = Kayla Kalamasz

Batch Type: Analysis

CLL = Cheryl Loheyde

RJG = Rob Good

Client Sample Results

Client: Haley & Aldrich, Inc.
Project/Site: Vectren Soil Sampling

TestAmerica Job ID: 180-71653-1

Client Sample ID: CCR-LF-4 (49.3-50.5)

Lab Sample ID: 180-71653-1
Date Collected: 03/11/16 15:15
Matrix: Solid
Date Received: 10/24/17 10:20

Method: 6010B - Metals (ICP) - SPLP East

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	69	J H B	100	41	ug/L		10/30/17 11:55	10/31/17 13:44	1
Molybdenum	96	J H	400	28	ug/L		10/30/17 11:55	10/31/17 13:44	1
Lithium	160	J H	500	86	ug/L		10/30/17 11:55	10/31/17 13:44	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture	4.2		0.1	0.1	%			10/25/17 15:21	1
Percent Solids	95.8		0.1	0.1	%			10/25/17 15:21	1

Client Sample ID: CCR-LF-4 (49.3-50.5)

Lab Sample ID: 180-71653-1
Date Collected: 03/11/16 15:15
Matrix: Solid
Date Received: 10/24/17 10:20
Percent Solids: 95.8

Method: 6010B - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	28	H	10	2.8	mg/Kg	☼	10/26/17 15:39	10/30/17 08:53	10
Molybdenum	15	J H	41	2.2	mg/Kg	☼	10/26/17 15:39	10/30/17 08:53	10
Lithium	13	J H	51	6.0	mg/Kg	☼	10/26/17 15:39	10/30/17 08:53	10

QC Sample Results

Client: Haley & Aldrich, Inc.
Project/Site: Vectren Soil Sampling

TestAmerica Job ID: 180-71653-1

Method: 6010B - Metals (ICP)

Lab Sample ID: MB 180-227137/1-A — **Client Sample ID: Method Blank**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 227404 — **Prep Batch: 227137**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		1.0	0.28	mg/Kg		10/26/17 15:39	10/28/17 14:43	1
Molybdenum	ND		4.0	0.21	mg/Kg		10/26/17 15:39	10/28/17 14:43	1
Lithium	ND		5.0	0.59	mg/Kg		10/26/17 15:39	10/28/17 14:43	1

Lab Sample ID: LCS 180-227137/2-A — **Client Sample ID: Lab Control Sample**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 227404 — **Prep Batch: 227137**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Arsenic	50.0	49.4		mg/Kg		99	80 - 120
Molybdenum	100	102		mg/Kg		102	80 - 120
Lithium	100	98.4		mg/Kg		98	80 - 120

Lab Sample ID: MB 180-227446/1-A — **Client Sample ID: Method Blank**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 227628 — **Prep Batch: 227446**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	5.76	J	10	4.1	ug/L		10/30/17 11:55	10/31/17 13:23	1
Molybdenum	ND		40	2.8	ug/L		10/30/17 11:55	10/31/17 13:23	1
Lithium	ND		50	8.6	ug/L		10/30/17 11:55	10/31/17 13:23	1

Lab Sample ID: LCS 180-227446/2-A — **Client Sample ID: Lab Control Sample**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 227628 — **Prep Batch: 227446**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Arsenic	500	496		ug/L		99	80 - 120
Molybdenum	1000	971		ug/L		97	80 - 120
Lithium	1000	975		ug/L		97	80 - 120

Lab Sample ID: LCSD 180-227446/3-A — **Client Sample ID: Lab Control Sample Dup**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 227628 — **Prep Batch: 227446**

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Arsenic	500	497		ug/L		99	80 - 120	0	20
Molybdenum	1000	959		ug/L		96	80 - 120	1	20
Lithium	1000	982		ug/L		98	80 - 120	1	20

Lab Sample ID: LB 180-227121/1-B — **Client Sample ID: Method Blank**
Matrix: Solid — **Prep Type: SPLP East**
Analysis Batch: 227628 — **Prep Batch: 227446**

Analyte	LB Result	LB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	44.6	J	100	41	ug/L		10/30/17 11:55	10/31/17 13:39	1
Molybdenum	ND		400	28	ug/L		10/30/17 11:55	10/31/17 13:39	1
Lithium	ND		500	86	ug/L		10/30/17 11:55	10/31/17 13:39	1

QC Association Summary

Client: Haley & Aldrich, Inc.
Project/Site: Vectren Soil Sampling

TestAmerica Job ID: 180-71653-1

Metals

Leach Batch: 227121

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-71653-1	CCR-LF-4 (49.3-50.5)	SPLP East	Solid	1312	
LB 180-227121/1-B	Method Blank	SPLP East	Solid	1312	

Prep Batch: 227137

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-71653-1	CCR-LF-4 (49.3-50.5)	Total/NA	Solid	3050B	
MB 180-227137/1-A	Method Blank	Total/NA	Solid	3050B	
LCS 180-227137/2-A	Lab Control Sample	Total/NA	Solid	3050B	

Analysis Batch: 227404

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
MB 180-227137/1-A	Method Blank	Total/NA	Solid	6010B	227137
LCS 180-227137/2-A	Lab Control Sample	Total/NA	Solid	6010B	227137

Analysis Batch: 227420

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-71653-1	CCR-LF-4 (49.3-50.5)	Total/NA	Solid	6010B	227137

Prep Batch: 227446

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-71653-1	CCR-LF-4 (49.3-50.5)	SPLP East	Solid	3010A	227121
LB 180-227121/1-B	Method Blank	SPLP East	Solid	3010A	227121
MB 180-227446/1-A	Method Blank	Total/NA	Solid	3010A	
LCS 180-227446/2-A	Lab Control Sample	Total/NA	Solid	3010A	
LCSD 180-227446/3-A	Lab Control Sample Dup	Total/NA	Solid	3010A	

Analysis Batch: 227628

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-71653-1	CCR-LF-4 (49.3-50.5)	SPLP East	Solid	6010B	227446
LB 180-227121/1-B	Method Blank	SPLP East	Solid	6010B	227446
MB 180-227446/1-A	Method Blank	Total/NA	Solid	6010B	227446
LCS 180-227446/2-A	Lab Control Sample	Total/NA	Solid	6010B	227446
LCSD 180-227446/3-A	Lab Control Sample Dup	Total/NA	Solid	6010B	227446

General Chemistry

Analysis Batch: 226976

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
180-71653-1	CCR-LF-4 (49.3-50.5)	Total/NA	Solid	2540G	

TestAmerica Pittsburgh
301 Alpha Drive RIDC Park
Pittsburgh, PA 15238-2907
phone 412.963.7058 fax 412.963.2468

Chain of Custody Record for
Haley & Aldrich, Inc. Blanket Service Agreement #2015-18-TestAmerica

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica's services under this CoC shall be performed in accordance with the T&Cs within Blanket Service Agreement# 2015-18-TestAmerica by and between Haley & Aldrich, Inc., its subsidiaries and affiliates, and TestAmerica Laboratories Inc..

Client Contact	H&A Project Manager: Christine Horch	H&A Site Contact: Sean Lewis	Date: 10/23/17	COC No:
Haley and Aldrich	Tel/Fax: 937.530.1406	Lab Contact: Veronica Bortot	Carrier:	1 of 1 COCs
Address: 400 Augusta Street, Suite 130	Analysis Turnaround Time			Sampler:
City/State/Zip: Greenville, SC 29601	☐ CALENDAR DAYS ☐ WORKING DAYS			For Lab Use Only:
(xxx) xxx-xxxx Phone: 864.214.8750	TAT if different from Below _____			Walk-in Client:
(xxx) xxx-xxxx FAX:	☑ 2 weeks			Lab Sampling:
H&A Project Number: 129420-004	☐ 1 week			
Site: A.B. Brown	☐ 2 days			Job / SDG No.:
H&A P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y/N)	Perform MS / MSD (Y/N)	Arsenic SPLP	Lithium SPLP	Molybdenum SPLP	Total Metals (As,Li, Mo)	Sample Specific Notes:
CCR-LF-4 (49.3-50.5)	3/11/2016	1515	G	S	3	N	N	X	X	X	X	

180-71653 Chain of Custody

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal
☐ Return to Client ☐ Disposal by Lab ☐ Archive for _____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd:_____ Corr'd:_____ | Therm ID No.:_____

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Sean Lewis	H+A	1005 10/23/17	Bellie Waters	TAP	10-24-17 10:20
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-045, Rev. 1.2, dated 1/8/2016

Login Sample Receipt Checklist

Client: Haley & Aldrich, Inc.

Job Number: 180-71653-1

Login Number: 71653
List Number: 1
Creator: Watson, Debbie

List Source: TestAmerica Pittsburgh

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.	False	
Cooler Temperature is acceptable.	False	
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?	False	
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").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

HALEY & ALDRICH, INC.
400 Augusta Street
Suite 130
Greenville, SC 29601
864.214.8750

24 September 2020
File No. 129420

TO: Southern Indiana Gas and Electric Company

FROM: Haley & Aldrich, Inc.
[Steven F. Putrich, P.E., Project Principal
Mark Miesfeldt, Lead Hydrogeologist]

SUBJECT: May 2020 Sampling Results and Assessment Monitoring Statistical Analysis Summary Pursuant to 40 CFR § 257.95
A.B. Brown Generating Station – Landfill – West Franklin, Indiana

Southern Indiana Gas and Electric Company (SIGECO) is implementing the 17 April 2015 United States Environmental Protection Agency Federal Coal Combustion Residuals (CCR) Rule (40 CFR § 257 and 261) for the A.B. Brown Generating Station, in Posey County near West Franklin, Indiana. Detection monitoring events occurred in 2016 and 2017. The results of the sampling events were compared to background using appropriate statistical methods to determine if Appendix III constituents were present at concentrations above background. The result of the statistical analysis identified statistically significant increases of Appendix III constituents downgradient of the Landfill thereby triggering Assessment Monitoring and respective notification of the same.

During the Assessment Monitoring phase, groundwater samples were collected from the CCR monitoring well network. Samples were collected in June, and August 2018 and subsequently analyzed for the Appendix III and Appendix IV constituents as required by 40 CFR § 257.95(b) and 40 CFR § 257.95(d)(1). Concurrent with the second assessment sampling round, and as required by 40 CFR § 257.95(h), groundwater protection standards (GWPS) were established for the detected Appendix IV constituents. The assessment monitoring sampling results were compared to the GWPS to determine if statistically significant levels (SSL) of Appendix IV constituents were present downgradient of the Landfill. The results of this evaluation indicated that an SSL for cobalt was present at monitoring well CCR-LF-2, and SSLs of arsenic and lithium were present at monitoring well CCR-LF-4.

As a result of this determination, and in accordance with 40 CFR § 257.95(g)(3), Haley & Aldrich evaluated the occurrence of Appendix IV constituents detected in groundwater downgradient of the Landfill. In July 2019, a successful alternate source demonstration (ASD) was completed for cobalt, arsenic and lithium.

As required by 40 CFR § 257.95(b) and 40 CFR § 257.95(d)(1), semiannual groundwater sampling and analysis continued for the Landfill in 2020. The first round of semiannual groundwater sampling was conducted in May 2020. Analytical results for the May 2020 semiannual sampling event are summarized in Table I. For the Landfill, statistical analysis of the May 2020 analytical results was finalized within 90-days of completion of sampling and analysis as required by 40 CFR § 257.93(g). Downgradient wells

were compared to each constituents' respective GWPS. The assessment monitoring statistical analysis summary is provided in Table II.

Intrawell statistical analysis was used to evaluate cobalt, arsenic and lithium as a result of the certified ASD. The results of the statistical analyses conducted for those detected Appendix IV constituents did not identify Appendix IV constituents downgradient of the Landfill at statistically significant levels above GWPS. This information is being provided for SIGECO's records. Since no new constituents were identified at SSLs above the GWPS, further notifications associated with the statistical analysis of the May 2020 sampling results are not required at this time.

Attachments:
Table I - Summary of Analytical Results – May 2020
Table II - Assessment Monitoring Statistical Analysis Summary – May 2020

\\haleyaldrich.com\share\grn_common\129420 Vectren\Deliverables\AB_Brown\SSL Notification\September 2020\Landfill\2020_0924_HAI_ABB_GW Stats Summary_SSL_notification_Landfill_F.docx

TABLE I
SUMMARY OF GROUNDWATER QUALITY DATA
LANDFILL - MAY 2020
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA
FILE NO. 129420

Location Group	Action Level	Upgradient		Downgradient						
Location	Maximum	CCR-BK-1R	CCR-BK-2	CCR-LF-1	CCR-LF-2	CCR-LF-3	CCR-LF-3	CCR-LF-4	CCR-LF-5	CCR-LF-6
Sample Date	Contaminant Level/	05/26/2020	05/26/2020	05/27/2020	05/27/2020	05/22/2020	05/22/2020	05/26/2020	05/22/2020	05/22/2020
Sample Type	Regional Screening	N	N	N	N	N	FD	N	N	N
Sample Name	Levels	CCR-BK-1R-20200526	CCR-BK-2-20200526	CCR-LF-1-20200527	CCR-LF-2-20200527	CCR-LF-3-20200522	BLIND DUPLICATE 2-20200522	CCR-LF-4-2020-0526	CCR-LF-5-20200522	CCR-LF-6-20200522
Detection Monitoring - EPA Appendix III										
Constituents (mg/L)										
Boron, Total	-	**0.11 B**	**0.091 B**	**0.061 JB**	**5.3 B**	**0.24**	**0.25**	**0.33 B**	**1.7**	**0.88**
Calcium, Total	-	**41**	**56**	**290**	**390**	**380**	**370**	**420**	**450**	**310**
Chloride	-	**3.7**	**10**	**19**	**400**	**43**	**43**	**120**	**420**	**32**
Fluoride	4	**0.37**	**0.21**	**0.12**	25 U	**0.34**	**0.34**	**0.33 J**	**0.38 J**	**0.29**
Sulfate	-	**24**	**42**	**1200**	**16000**	**1500**	**1500**	**8500**	**2600**	**920**
Total Dissolved Solids (TDS)	-	**220**	**450**	**1900**	**17000**	**2600**	**2500**	**9800**	**5300**	**1700**
pH (lab) (SU)	-	**7 HF**	**7.1 HF**	**6.9 HF**	**6.5 HF**	**7.9 HF**	**7.5 HF**	**6.7 HF**	**7.2 HF**	**7.2 HF**
Assessment Monitoring - EPA Appendix IV										
Constituents (mg/L)										
Antimony, Total	0.006	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	0.001 U	0.001 U	**0.00035 J**	**0.0013**	**0.00066 J**	0.001 U	**0.021**	**0.00046 J**	**0.00036 J**
Barium, Total	2	**0.031**	**0.038**	**0.033 B**	**0.021 BF1F2**	**0.027 B**	**0.047 B**	**0.017 B**	**0.034 B**	**0.043 B**
Beryllium, Total	0.004	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.005	0.001 U	0.001 U	0.001 U	**0.0054**	**0.00023 J**	0.001 U	0.001 U	**0.00039 J**	**0.00022 J**
Chromium, Total	0.1	0.002 U	0.002 U	0.002 U	0.002 U	**0.0022**	**0.0018 J**	0.002 U	0.002 U	0.002 U
Cobalt, Total	0.006	**0.00015 J**	0.0005 U	0.0005 U	**0.011**	**0.00021 J**	0.0005 U	**0.00098**	**0.00026 J**	**0.00028 J**
Fluoride	4	**0.37**	**0.21**	**0.12**	25 U	**0.34**	**0.34**	**0.33 J**	**0.38 J**	**0.29**
Lead, Total	0.015	**0.00023 J**	0.001 U	0.001 U	**0.00025 J**	**0.00047 JB**	0.001 U	**0.00019 J**	**0.0004 JB**	**0.00024 JB**
Lithium, Total	0.04	0.005 U	**0.0036 J**	**0.0046 J**	**0.019**	0.005 U	0.005 U	**0.087**	**0.024**	**0.019**
Mercury, Total	0.002	0.0002 U	**0.0002**	0.0002 U	0.0002 UF1	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum, Total	0.1	**0.00079 J**	**0.0015 J**	**0.00087 J**	**0.0025 J**	**0.0033 J**	**0.0031 J**	**0.027**	**0.001 J**	0.005 U
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	**0.0023 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.002	0.001 U	0.001 U	0.001 U	**0.00073 J**	**0.0004 J**	0.001 U	0.001 U	**0.0003 J**	**0.00017 J**
Radiological (pCi/L)										
Radium-226	-	0.0680 U ± 0.124	-0.0171 U ± 0.066	0.109 U ± 0.12	**0.574 ± 0.258**	0.0710 U ± 0.0561	**0.113 ± 0.066**	**4.12 ± 0.641**	**0.0922 ± 0.0599**	**0.188 ± 0.0934**
Radium-228	-	0.141 U ± 0.307	-0.0790 U ± 0.213	0.329 U ± 0.225	**1.85 ± 0.421**	**0.372 ± 0.227**	0.0669 U ± 0.195	**1.21 ± 0.309**	0.142 U ± 0.172	0.305 U ± 0.207
Radium-226 & 228	5	0.209 U ± 0.331	-0.0961 U ± 0.223	**0.438 ± 0.255**	**2.43 ± 0.494**	**0.443 ± 0.234**	0.180 U ± 0.206	**5.33 ± 0.712**	0.234 U ± 0.182	**0.493 ± 0.227**

ABBREVIATIONS AND NOTES:

CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
SU: standard units.
USEPA: United States Environmental Protection Agency.
Results in **bold** are detected.

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257. https://www.epa.gov/coalash/coal-ash-rule

Table II
A.B. Brown Generating Station
Landfill
Assessment Monitoring Statistical Analysis Summary
Prepared: September 1, 2020

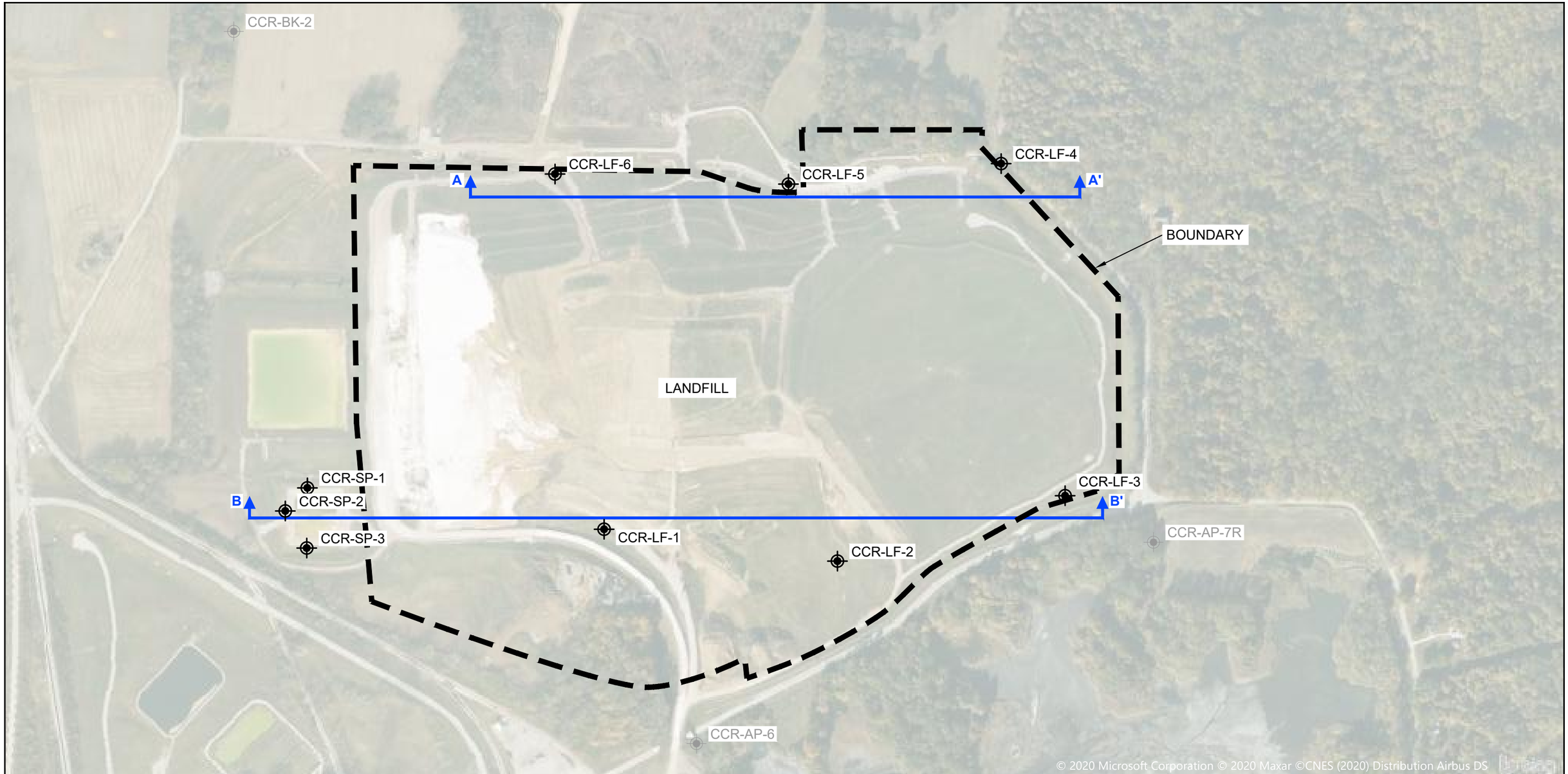
													MCL Comparison							Inter-well Analysis						Intra-well Analysis		
Location Id	Frequency of Detection	Percent Non-Detects	Range of Non-Detect	Mean	50th Percentile (Median)	95th Percentile	Maximum Detect	Variance	Standard Deviation	Coefficient of Variance	CCR MCL/RSL	Report Result Unit	Detection Exceedances (Y/N)	Number of Detection Exceedances	Outlier Detected	Outlier Removed	Trend	Distribution Group*	Distribution Well*	May 2020 Concentration	Detect?	95% Lower Confidence Limit (LCL)	Upper Tolerance Limit	Groundwater Protection Standard (Higher of MCL/RSL or Upper Tolerance Limit)	Exceedance above Background at Individual Well	Upper Prediction Limit	Exceedance above Background at Individual Well	SSL
CCR Appendix-IV: Antimony, Total (mg/L)																												
CCR-BK-1	2/13	85%	0.002-0.002	0.00346	0.004	0.004	0.0009	8.388E-07	0.0012952	0.7482	0.006	mg/L	N	0	N	N	Stable	Non-parametric	Non-parametric				0.002	0.006				
CCR-BK-2	1/13	92%	0.002-0.002	0.00376	0.004	0.004	0.00096	3.412E-07	0.0008262	0.4388	0.006	mg/L	N	0	N	N	Stable		Non-parametric									
CCR-LF-1	1/12	92%	0.002-0.002	0.00376	0.004	0.004	0.00118	0.000000317	0.0007962	0.423	0.006	mg/L	N	0	N	N	Stable		Non-parametric	0.002	N				N			FALSE
CCR-LF-2	1/12	92%	0.002-0.02	0.01602	0.004	0.04	0.0042	0.00015006	0.017324	2.164	0.006	mg/L	N	0	N	N	Stable		Non-parametric	0.002	N				N			FALSE
CCR-LF-3	2/12	83%	0.002-0.002	0.00362	0.004	0.004	0.0022	3.804E-07	0.0008722	0.481	0.006	mg/L	N	0	N	N	Stable		Non-parametric	0.002	N				N			FALSE
CCR-LF-4	0/12	100%	0.002-0.02	0.016	0.004	0.04		0.00015026	0.017336	2.166	0.006	mg/L	N	0	N	N	Stable		Non-parametric	0.002	N				N			FALSE
CCR-LF-5	1/12	92%	0.002-0.02	0.00676	0.004	0.0346	0.0011	0.00005274	0.01027	3.04	0.006	mg/L	N	0	N	N	Stable		Non-parametric	0.002	N				N			FALSE
CCR-LF-6	1/12	92%	0.002-0.002	0.00386	0.004	0.004	0.0022	1.2914E-07	0.0005082	0.264	0.006	mg/L	N	0	N	N	Stable		Non-parametric	0.002	N				N			FALSE
CCR Appendix-IV: Arsenic, Total (mg/L)																												
CCR-BK-1	12/14	14%	0.001-0.001	0.00184	0.00195	0.0043	0.005	6.922E-07	0.0011766	1.279	0.01	mg/L	N	0	Y	N	Stable	Non-parametric	Normal				0.004	0.010				
CCR-BK-2	7/14	50%	0.001-0.001	0.0023	0.002	0.00651	0.007	1.5966E-06	0.001787	1.549	0.01	mg/L	N	0	Y	N	Stable		Log-transformed									
CCR-LF-1	10/14	29%	0.001-0.001	0.001746	0.00194	0.00279	0.003	2.022E-07	0.000636	0.7286	0.01	mg/L	N	0	N	N	Stable		Normal	0.00035	Y				N	0.002	N	FALSE
CCR-LF-2	9/14	36%	0.01-0.01	0.01008	0.0051	0.02	0.0124	0.0000313	0.007912	1.5712	0.01	mg/L	N	0	N	N	Stable		Log-transformed	0.00130	Y				N	0.114	N	FALSE
CCR-LF-3	10/14	29%	0.001-0.001	0.0024	0.00118	0.01214	0.0176	0.000009378	0.00433	3.618	0.01	mg/L	N	0	N	N	Stable		Log-transformed	0.00066	Y				N	0.028	N	FALSE
CCR-LF-4	14/14	0%	-	0.0322	0.033	0.0537	0.06	0.00008726	0.013212	0.8192	0.01	mg/L	Y	24	N	N	Stable		Normal	0.02100	Y				Y	0.043	N	FALSE
CCR-LF-5	9/14	36%	0.001-0.01	0.005	0.00163	0.0265	0.03	0.0000372	0.008624	3.454	0.01	mg/L	Y	2	Y	N	Stable		Log-transformed	0.00046	Y				N	0.143	N	FALSE
CCR-LF-6	8/14	43%	0.001-0.001	0.0026	0.00147	0.01331	0.0194	0.000011452	0.004786	3.676	0.01	mg/L	N	0	Y	N	Stable		Non-parametric	0.00036	Y				N	0.010	N	FALSE
CCR Appendix-IV: Barium, Total (mg/L)																												
CCR-BK-1	14/14	0%	-	0.0808	0.075	0.1409	0.164	0.0003498	0.02646	0.6554	2	mg/L	N	0	Y	N	Stable	Non-parametric	Non-parametric				0.150	2.0				
CCR-BK-2	14/14	0%	-	0.0916	0.073	0.2286	0.3	0.0017864	0.05978	1.3056	2	mg/L	N	0	Y	N	Stable		Non-parametric									
CCR-LF-1	14/14	0%	-	0.0916	0.087	0.1529	0.176	0.0003938	0.02806	0.613	2	mg/L	N	0	Y	N	Stable		Non-parametric	0.033	Y				N			FALSE
CCR-LF-2	11/14	21%	0.1-0.1	0.0638	0.026	0.2	0.042	0.002638	0.07262	2.28	2	mg/L	N	0	N	N	Stable		Normal	0.021	Y				N			FALSE
CCR-LF-3	14/14	0%	-	0.0518	0.052	0.06	0.06	0.000019514	0.006248	0.2416	2	mg/L	N	0	N	N	Stable		Normal	0.027	Y				N			FALSE
CCR-LF-4	10/14	29%	0.01-0.1	0.0502	0.027	0.2	0.032	0.0019526	0.0625	2.494	2	mg/L	N	0	N	N	Stable		Normal	0.017	N				N			FALSE
CCR-LF-5	14/14	0%	-	0.0538	0.052	0.0659	0.068	0.00001673	0.005784	0.2148	2	mg/L	N	0	N	N	Stable		Normal	0.034	Y				N			FALSE
CCR-LF-6	14/14	0%	-	0.0412	0.036	0.0769	0.086	0.00010922	0.01478	0.716	2	mg/L	N	0	N	N	Increase		Log-transformed	0.043	Y				N			FALSE
CCR Appendix-IV: Beryllium, Total (mg/L)																												
CCR-BK-1	1/13	92%	0.001-0.001	0.001864	0.002	0.002	0.00024	1.1438E-07	0.0004782	0.513	0.004	mg/L	N	0	N	N	Stable	Non-parametric	Non-parametric				0.001	0.004				
CCR-BK-2	2/13	85%	0.001-0.001	0.001782	0.002	0.002	0.0008	1.4036E-07	0.0005298	0.5948	0.004	mg/L	N	0	N	N	Stable		Non-parametric									
CCR-LF-1	0/12	100%	0.001-0.001	0.002	0.002	0.002		0	0	0	0.004	mg/L	N	0	N	N	Stable		Non-parametric	0.001	N				N			FALSE
CCR-LF-2	4/12	67%	0.001-0.01	0.00596	0.002	0.02	0.00056	0.00003458	0.008316	2.794	0.004	mg/L	N	0	N	N	Stable		Non-parametric	0.001	N				N			FALSE
CCR-LF-3	0/12	100%	0.001-0.001	0.002	0.002	0.002		0	0	0	0.004	mg/L	N	0	N	N	Stable		Non-parametric	0.001	N				N			FALSE
CCR-LF-4	4/12	67%	0.001-0.01	0.00596	0.002	0.02	0.00056	0.00003456	0.008314	2.792	0.004	mg/L	N	0	N	N	Stable		Non-parametric	0.001	N				N			FALSE
CCR-LF-5	0/12	100%	0.001-0.001	0.002	0.002	0.002		0	0	0	0.004	mg/L	N	0	N	N	Stable		Non-parametric	0.001	N				N			FALSE
CCR-LF-6	0/12	100%	0.001-0.001	0.002	0.002	0.002		0	0	0	0.004	mg/L	N	0	N	N	Stable		Non-parametric	0.001	N				N			FALSE
CCR Appendix-IV: Cadmium, Total (mg/L)																												
CCR-BK-1	0/14	100%	0.001-0.001	0.002	0.002	0.002		0	0	0	0.005	mg/L	N	0	N	N	Stable	Non-parametric	Non-parametric				0.001	0.005				
CCR-BK-2	0/14	100%	0.001-0.001	0.002	0.002	0.002		0	0	0	0.005	mg/L	N	0	N	N	Stable		Non-parametric									
CCR-LF-1	0/14	100%	0.001-0.001	0.002	0.002	0.002		0	0	0	0.005	mg/L	N	0	N	N	Stable		Non-parametric	0.0010	N				N			FALSE
CCR-LF-2	14/14	0%	-	0.00746	0.0079	0.01031	0.0108	0.000002502	0.002236	0.5994	0.005	mg/L	Y	2	N	N	Increase		Normal	0.0054	Y	0.0032			N			FALSE
CCR-LF-3	4/14	71%	0.001-0.001	0.001506	0.002	0.002	0.00046	3.194E-07	0.0007994	1.0622	0.005	mg/L	N	0	N	N	Stable		Non-parametric	0.0002	Y				N			FALSE
CCR-LF-4	1/14	93%	0.001-0.01	0.00702	0.002	0.02	0.000184	0.0000351	0.008378	2.39	0.005	mg/L	N	0	N	N	Stable		Non-parametric	0.0010	N				N			FALSE
CCR-LF-5	12/14	14%	0.001-0.01	0.001932	0.00043	0.0137	0.00078	0.000013112	0.00512	5.298	0.005	mg/L	N	0	Y	N	Increase		Non-parametric	0.0004	Y				N			FALSE
CCR-LF-6	11/14	21%	0.001-0.001	0.000672	0.00032	0.002	0.00044	2.522E-07	0.0007102	2.116	0.005	mg/L	N	0	N	N	Stable		Non-parametric	0.0002	Y				N			FALSE
CCR Appendix-IV: Chromium, Total (mg/L)																												
CCR-BK-1	11/14	21%	0.002-0.002	0.00484	0.0045	0.01198	0.0152	0.000005574	0.003338	1.3772	0.1	mg/L	N	0	Y	N	Increase	Non-parametric	Normal				0.009	0.10				
CCR-BK-2	5/14	64%	0.002-0.002	0.0058	0.004	0.0146	0.0174	0.000007726	0.00393	1.3568	0.1	mg/L	N	0	N	N	Stable		Non-parametric									
CCR-LF-1	9/14	36%	0.002-0.0032	0.00396	0.0035	0.0103	0.0124	0.000003576	0.002674	1.3532	0.1	mg/L	N	0	N	N	Increase		Normal	0.0020	N				N			FALSE
CCR-LF-2	7/14	50%	0.002-0.02	0.0161	0.004	0.04	0.0044	0.0001651	0.018172	2.258	0.1	mg/L	N	0	N	N	Stable		Non-parametric	0.0020	N				N			FALSE
CCR-LF-3	10/14	29%	0.002-0.0035	0.00468	0.0042	0.00693	0.0068	7.428E-07	0.0012188	0.5202	0.1	mg/L	N	0	N	N	Stable		Log-transformed	0.0022	Y				N			FALSE
CCR-LF-4	4/14	71%	0.002-0.02	0.01368	0.004	0.04	0.0042	0.00014428	0.016988	2.482	0.1	mg/L	N	0	N	N	Stable		Log-transformed	0.0020	N				N			FALSE
CCR-LF-5	8/14	43%	0.002-0.02	0.0085	0.004	0.0426	0.044	0.0000981	0.014006	3.296	0.1	mg/L	N	0	Y	N	Stable		Non-parametric	0.0020	N				N			FALSE
CCR-LF-6	3/14	79%	0.002-0.0023	0.00396	0.004	0.00707	0.0084	1.4048E-06	0.0016762	0.8468	0.1	mg/L	N	0	N	N	Stable		Non-parametric	0.0020	N				N			FALSE
CCR Appendix-IV: Cobalt, Total (mg/L)																												
CCR-BK-1	13/14	7%	0.0005-0.0005	0.000855	0.00069	0.00241	0.0028	0.000000607	0.0007791	0.9112	0.006	mg/L	N	0	Y	N	Stable	Non-parametric	Log-transformed				0.0062	0.006				
CCR-BK-2	8/14	43%	0.0005-0.0005	0.000915	0.0005	0.003145	0.0062	0.000002478	0.001574	1.721	0.006	mg/L	Y	1	Y	N	Stable		Log-transformed									
CCR-LF-1	11/14	21%	0.0005-0.0005	0.000338	0.00031	0.000667	0.00068	4.458E-08	0.0002111	0.6253	0.006	mg/L	N	0	N	N	Stable		Normal	0.00050	N				N	0.001	N	FALSE
CCR-LF-2	14/14	0%	-	0.00889	0.00775	0.01205	0.014	0.00000522	0.002285	0.2571	0.006	mg/L	Y	13	Y	N	Stable		Normal	0.01100	Y				Y	0.017	N	FALSE
CCR-LF-3	12/14	14%	0.0005-0.0005	0.000437	0.00042	0.0007135	0.00072	2.538E-08	0.0001593	0.3644	0.006	mg/L	N	0	N	N	Decrease		Normal	0.00021	Y				N	0.001	N	FALSE
CCR-LF-4	14/14	0%	-	0.00117	0.0012	0.0018	0.0018	1.662E-07	0.0004077	0.3498	0.006	mg/L	N	0	N	N	Stable		Normal	0.00098	Y				N	0.003	N	FALSE
CCR-LF-5	10/14	29%	0.0005-0.005	0.000902	0.000345	0.003895	0.0033	0.00000203	0.001425	1.579	0.006	mg/L	N	0	N	N	Stable		Log-transformed	0.00026	Y				N	0.031	N	FALSE
CCR-LF-6	12/14	14%	0.0005-0.0005	0.000344	0.000275	0.0007105	0.00086	4.882E-08	0.0002209	0.6432	0.006	mg/L	N	0	N	N	Stable		Normal	0.00028	Y				N	0.001	N	FALSE
CCR Appendix-III: Fluoride (mg/L)																												
CCR-BK-1	13/14	7%	0.23-0.23	2.56	2.68	3.04	3.04	0.020944	0.40936	1.2792	4	mg/L	N	0	N	N	Stable	Non-parametric	Normal				0.380	4.0				
CCR-BK-2	13/14	7%	0.12-0.12	1.192	1.12	1.68	1.68	0.010456	0.2892	1.9464	4	mg/L	N	0	N	N	Decrease		Normal									
CCR-LF-1	12/14	14%	0.1-0.12	1.808	1.92	2.4	2.4	0.026032	0.45632	2.0216	4	mg/L	N	0	N	N	Decrease		Normal	0.12	N				N			FALSE
CCR-LF-2	1/14	93%	1-25	29.6	20	200	2.08	294.64	48.552	13.136	4	mg/L	N	0	Y	N	Stable		Non-parametric	25.00	N				Y			FALSE
CCR-LF-3	13/14	7%	0.25-0.25	1.84	1.76	2.72	2.72	0.03316	0.51512	2.2392	4	mg/L	N	0	N	N	Stable		Normal	0.34	Y				N			FALSE
CCR-LF-4	4/14	71%	1-2.5	9.2	8	20	4.08	4.656	6.1032	5.3304	4	mg/L	N	0	N	N	Stable		Non-parametric	0.33	Y				N			FALSE
CCR-LF-5	11/14	21%	0.5-1	2.512	1.84	8	3.04	0.41504	1.8224	5.796	4	mg/L	N	0	N	N	Increase		Log-transformed	0.38	Y				N			FALSE
CCR-LF-6	14/14	0%	-	2.72	2.64	4.08	4.08	0.078312	0.79152	2.328	4	mg/L	N	0	N	N	Increase		Normal	0.29	Y				N			FALSE

CCR Appendix-IV: Lead, Total (mg/L)																												
CCR-BK-1	13/14	7%	0.001-0.001	0.001116	0.00115	0.00213	0.0022	2.752E-07	0.000742	1.3292	0.015	mg/L	N	0	N	N	Stable	Non-parametric	Normal				0.011	0.015				
CCR-BK-2	5/14	64%	0.001-0.001	0.00368	0.002	0.01626	0.022	0.00001428	0.005344	2.9	0.015	mg/L	N	0	Y	N	Stable		Non-parametric									
CCR-LF-1	7/13	46%	0.001-0.001	0.001434	0.002	0.00215	0.0022	2.702E-07	0.0007352	1.0252	0.015	mg/L	N	0	N	N	Stable		Normal	0.001	N				N			FALSE
CCR-LF-2	7/13	46%	0.001-0.01	0.00848	0.002	0.02	0.0028	0.00004336	0.009312	2.198	0.015	mg/L	N	0	N	N	Stable		Non-parametric	0.000	Y				N			FALSE
CCR-LF-3	2/13	85%	0.00047-0.001	0.001632	0.002	0.002	0.000148	2.532E-07	0.0007114	0.8724	0.015	mg/L	N	0	Y	N	Stable		Non-parametric	0.000	N				N			FALSE
CCR-LF-4	6/13	54%	0.001-0.01	0.01756	0.002	0.1235	0.158	0.000887	0.04212	4.798	0.015	mg/L	Y	2	Y	N	Stable		Non-parametric	0.000	Y				N			FALSE
CCR-LF-5	6/13	54%	0.0004-0.01	0.00272	0.002	0.0156	0.0024	0.000013252	0.005148	3.786	0.015	mg/L	N	0	N	N	Stable		Non-parametric	0.000	N				N			FALSE
CCR-LF-6	3/13	77%	0.00024-0.001	0.001478	0.002	0.002	0.00034	3.224E-07	0.0008028	1.0866	0.015	mg/L	N	0	N	N	Stable		Non-parametric	0.000	N				N			FALSE
CCR Appendix-IV: Lithium, Total (mg/L)																												
CCR-BK-1	3/14	79%	0.005-0.05	0.031	0.05	0.05	0.0086	0.0005215	0.02284	0.7375	0.04	mg/L	N	0	N	N	Stable	Non-parametric	Non-parametric				0.050	0.050				
CCR-BK-2	1/14	93%	0.005-0.05	0.0374	0.05	0.05	0.0036	0.0004314	0.02077	0.5559	0.04	mg/L	N	0	N	N	Stable		Non-parametric									
CCR-LF-1	6/14	57%	0.0059-0.05	0.0283	0.03	0.05	0.01	0.0005091	0.02256	0.7967	0.04	mg/L	N	0	N	N	Decrease		Non-parametric	0.0046	Y				N	0.050	N	FALSE
CCR-LF-2	10/14	29%	0.005-0.25	0.0445	0.0285	0.12	0.041	0.003643	0.06036	1.356	0.04	mg/L	Y	1	Y	N	Stable		Non-parametric	0.0190	Y				N	0.250	N	FALSE
CCR-LF-3	3/14	79%	0.005-0.05	0.0321	0.05	0.05	0.018	0.0004705	0.02169	0.6757	0.04	mg/L	N	0	N	N	Stable		Non-parametric	0.0050	N				N	0.050	N	FALSE
CCR-LF-4	14/14	0%	-	0.0904	0.0895	0.1135	0.12	0.0002049	0.01431	0.1583	0.04	mg/L	Y	14	N	N	Stable		Normal	0.0870	Y				Y	0.158	N	FALSE
CCR-LF-5	13/14	7%	0.05-0.05	0.0261	0.024	0.03765	0.031	0.00006044	0.007774	0.2974	0.04	mg/L	N	0	N	N	Stable		Log-transformed	0.0240	Y				N	0.040	N	FALSE
CCR-LF-6	14/14	0%	-	0.0189	0.019	0.023	0.023	0.000006995	0.002645	0.1397	0.04	mg/L	N	0	N	N	Stable		Normal	0.0190	Y				N	0.031	N	FALSE
CCR Appendix-IV: Mercury, Total (mg/L)																												
CCR-BK-1	0/13	100%	0.0002-0.0002	0.0004	0.0004	0.0004		6.776E-23	1.1642E-11	5.82E-08	0.002	mg/L	N	0	N	N	Stable	Non-parametric	Normal				0.0002	0.002				
CCR-BK-2	2/13	85%	0.0002-0.0002	0.000384	0.0004	0.0004	0.0004	1.477E-09	0.00005434	0.2826	0.002	mg/L	N	0	N	N	Stable		Non-parametric									
CCR-LF-1	0/13	100%	0.0002-0.0002	0.0004	0.0004	0.0004		6.776E-23	1.1642E-11	5.82E-08	0.002	mg/L	N	0	Y	N	Stable		Non-parametric	0.0002	N				N			FALSE
CCR-LF-2	0/13	100%	0.0002-0.0002	0.0004	0.0004	0.0004		6.776E-23	1.1642E-11	5.82E-08	0.002	mg/L	N	0	N	N	Stable		Non-parametric	0.0002	N				N			FALSE
CCR-LF-3	0/13	100%	0.0002-0.0002	0.0004	0.0004	0.0004		6.776E-23	1.1642E-11	5.82E-08	0.002	mg/L	N	0	N	N	Stable		Log-transformed	0.0002	N				N			FALSE
CCR-LF-4	0/13	100%	0.0002-0.0002	0.0004	0.0004	0.0004		6.776E-23	1.1642E-11	5.82E-08	0.002	mg/L	N	0	Y	N	Stable		Normal	0.0002	N				N			FALSE
CCR-LF-5	8/13	38%	0.0002-0.0002	0.000272	0.00024	0.0004	0.0003	6.436E-09	0.00011344	0.8346	0.002	mg/L	N	0	N	N	Stable		Non-parametric	0.0002	N				N			FALSE
CCR-LF-6	0/13	100%	0.0002-0.0002	0.0004	0.0004	0.0004		6.776E-23	1.1642E-11	5.82E-08	0.002	mg/L	N	0	N	N	Stable		Non-parametric	0.0002	N				N			FALSE
CCR Appendix-IV: Molybdenum, Total (mg/L)																												
CCR-BK-1	12/14	14%	0.005-0.005	0.00208	0.0015	0.005	0.0034	0.000002118	0.001455	0.7009	0.1	mg/L	N	0	N	N	Decrease	Non-parametric	Normal				0.005	0.10				
CCR-BK-2	6/14	57%	0.005-0.005	0.00339	0.005	0.005	0.0025	0.000003944	0.001986	0.5852	0.1	mg/L	N	0	N	N	Stable		Non-parametric									
CCR-LF-1	12/14	14%	0.005-0.005	0.00174	0.0012	0.005	0.0016	0.000001975	0.001405	0.8071	0.1	mg/L	N	0	Y	N	Decrease		Non-parametric	0.0009	Y				N			FALSE
CCR-LF-2	9/14	36%	0.05-0.05	0.0197	0.0033	0.05	0.0048	0.0005509	0.02347	1.193	0.1	mg/L	N	0	N	N	Stable		Non-parametric	0.0025	Y				N			FALSE
CCR-LF-3	13/14	7%	0.005-0.005	0.00217	0.00155	0.00521	0.0056	0.000002209	0.001486	0.6852	0.1	mg/L	N	0	N	N	Increase		Log-transformed	0.0033	Y				N			FALSE
CCR-LF-4	13/14	7%	0.005-0.005	0.0204	0.0215	0.02635	0.027	0.00003086	0.005555	0.2729	0.1	mg/L	N	0	Y	N	Stable		Normal	0.0270	Y				N			FALSE
CCR-LF-5	7/14	50%	0.005-0.05	0.0062	0.00365	0.02075	0.0023	0.0001632	0.01277	2.061	0.1	mg/L	N	0	N	N	Stable		Non-parametric	0.0010	Y				N			FALSE
CCR-LF-6	10/14	29%	0.005-0.005	0.00229	0.00135	0.005	0.0022	0.000003324	0.001823	0.7966	0.1	mg/L	N	0	N	N	Stable		Non-parametric	0.0050	N				N			FALSE
CCR Appendix-IV: Radium-226 & 228 (pCi/L)																												
CCR-BK-1	8/14	43%	0.366-5	2.96	1.001	10	1.59	7.032	3.75	2.526	5	pCi/L	N	0	Y	N	Stable	Non-parametric	Normal				5.000	5.0				
CCR-BK-2	4/14	71%	0.356-5	6.72	10	10	6.26	8.344	4.086	1.2148	5	pCi/L	N	0	N	N	Stable		Non-parametric									
CCR-LF-1	13/14	7%	5-5	2.2	1.492	7.528	2.94	2.586	2.274	2.076	5	pCi/L	N	0	N	N	Stable		Normal	0.4	Y				N			FALSE
CCR-LF-2	14/14	0%	-	4.08	4.26	5.472	5.8	0.3818	0.874	0.4274	5	pCi/L	N	0	N	N	Increase		Normal	2.4	Y				N			FALSE
CCR-LF-3	9/14	36%	0.399-5	2.4	1.049	10	2.2	5.068	3.184	2.66	5	pCi/L	N	0	N	N	Stable		Non-parametric	0.4	Y				N			FALSE
CCR-LF-4	14/14	0%	-	10.02	9.57	15.188	16.28	3.28	2.562	0.511	5	pCi/L	Y	12	N	N	Stable		Normal	5.3	Y	4.34			N			FALSE
CCR-LF-5	3/14	79%	0.323-5	5.46	5.716	10	1.282	10.664	4.618	1.6888	5	pCi/L	N	0	N	N	Stable		Non-parametric	5.0	N				N			FALSE
CCR-LF-6	4/14	71%	0.358-5	5.5	5.618	10	1.238	10.52	4.588	1.6688	5	pCi/L	N	0	N	N	Stable		Non-parametric	0.5	Y				N			FALSE
CCR Appendix-IV: Selenium, Total (mg/L)																												
CCR-BK-1	3/14	79%	0.005-0.005	0.00808	0.01	0.01	0.00134	0.000007026	0.003748	0.928	0.05	mg/L	N	0	N	N	Stable	Non-parametric	Non-parametric				0.005	0.050				
CCR-BK-2	2/14	86%	0.005-0.005	0.00878	0.01	0.01	0.00196	0.00000466	0.003054	0.6956	0.05	mg/L	N	0	Y	N	Stable		Non-parametric									
CCR-LF-1	4/13	69%	0.005-0.005	0.00758	0.01	0.01	0.0026	0.00000685	0.003702	0.9762	0.05	mg/L	N	0	N	N	Increase		Non-parametric	0.005	N				N			FALSE
CCR-LF-2	8/13	38%	0.05-0.05	0.0414	0.0054	0.1	0.0068	0.001117	0.04726	2.284	0.05	mg/L	N	0	N	N	Increase		Non-parametric	0.002	Y				N			FALSE
CCR-LF-3	10/13	23%	0.005-0.005	0.00516	0.004	0.01	0.0048	0.000003894	0.002792	1.083	0.05	mg/L	N	0	N	N	Decrease		Log-transformed	0.005	N				N			FALSE
CCR-LF-4	3/13	77%	0.005-0.05	0.0356	0.01	0.1	0.0014	0.0009626	0.04388	2.46	0.05	mg/L	N	0	N	N	Stable		Non-parametric	0.005	N				N			FALSE
CCR-LF-5	1/13	92%	0.005-0.05	0.01624	0.01	0.0775	0.00108	0.000307	0.02478	3.052	0.05	mg/L	N	0	N	N	Stable		Non-parametric	0.005	N				N			FALSE
CCR-LF-6	2/13	85%	0.005-0.005	0.00888	0.01	0.01	0.004	0.000003694	0.002718	0.612	0.05	mg/L	N	0	Y	N	Stable		Non-parametric	0.005	N				N			FALSE
CCR Appendix-IV: Thallium, Total (mg/L)																												
CCR-BK-1	1/13	92%	0.001-0.001	0.001852	0.002	0.002	0.000076	1.3668E-07	0.0005228	0.5646	0.002	mg/L	N	0	N	N	Stable	Non-parametric	Non-parametric				0.001	0.002				
CCR-BK-2	1/13	92%	0.001-0.001	0.001856	0.002	0.002	0.000118	1.3078E-07	0.0005114	0.5514	0.002	mg/L	N	0	N	N	Stable		Non-parametric									
CCR-LF-1	1/12	92%	0.001-0.001	0.001842	0.002	0.002	0.00011	1.4236E-07	0.0005336	0.5792	0.002	mg/L	N	0	N	N	Stable		Non-parametric	0.001	N				N			FALSE
CCR-LF-2	6/12	50%	0.001-0.01	0.00748	0.00173	0.02	0.00146	0.00004106	0.009062	2.426	0.002	mg/L	N	0	N	N	Increase		Non-parametric	0.001	Y				N			FALSE
CCR-LF-3	6/12	50%	0.001-0.001	0.001172	0.0014	0.002	0.0008	0.000000375	0.000866	1.4772	0.002	mg/L	N	0	N	N	Stable		Non-parametric	0.000	Y				N			FALSE
CCR-LF-4	3/12	75%	0.001-0.01	0.00754	0.002	0.02	0.00024	0.00004078	0.00903	2.396	0.002	mg/L	N	0	N	N	Stable		Non-parametric	0.001	N				N			FALSE
CCR-LF-5	3/12	75%	0.001-0.01	0.00306	0.002	0.0173	0.0006	0.000013896	0.005272	3.44	0.002	mg/L	N	0	N	N	Stable		Non-parametric	0.000	Y				N			FALSE
CCR-LF-6	2/12	83%	0.001-0.001	0.001708	0.002	0.002	0.00034	2.246E-07	0.0006702	0.785	0.002	mg/L	N	0	N	N	Stable		Non-parametric	0.000	Y				N			FALSE

N/A - Not available NT- Not tested

* - Determined using the Shapiro-Wilks statistical test at a 5% significance level and a residual probability plot.

Appendix C
Landfill Stratigraphic Cross Sections



NOTES

1. AERIAL IMAGERY OBTAINED FROM BING MAPS DATED JUN 2019.

N

0 400 800

SCALE IN FEET

PROJECT LOCATION

TOPO SOURCE: IMAGE DATED 2019 TAKEN ELECTRONICALLY FROM BING MAPS

PREPARED FOR:

VECTREN
A.B.BROWN GENERATING STATION
LANDFILL

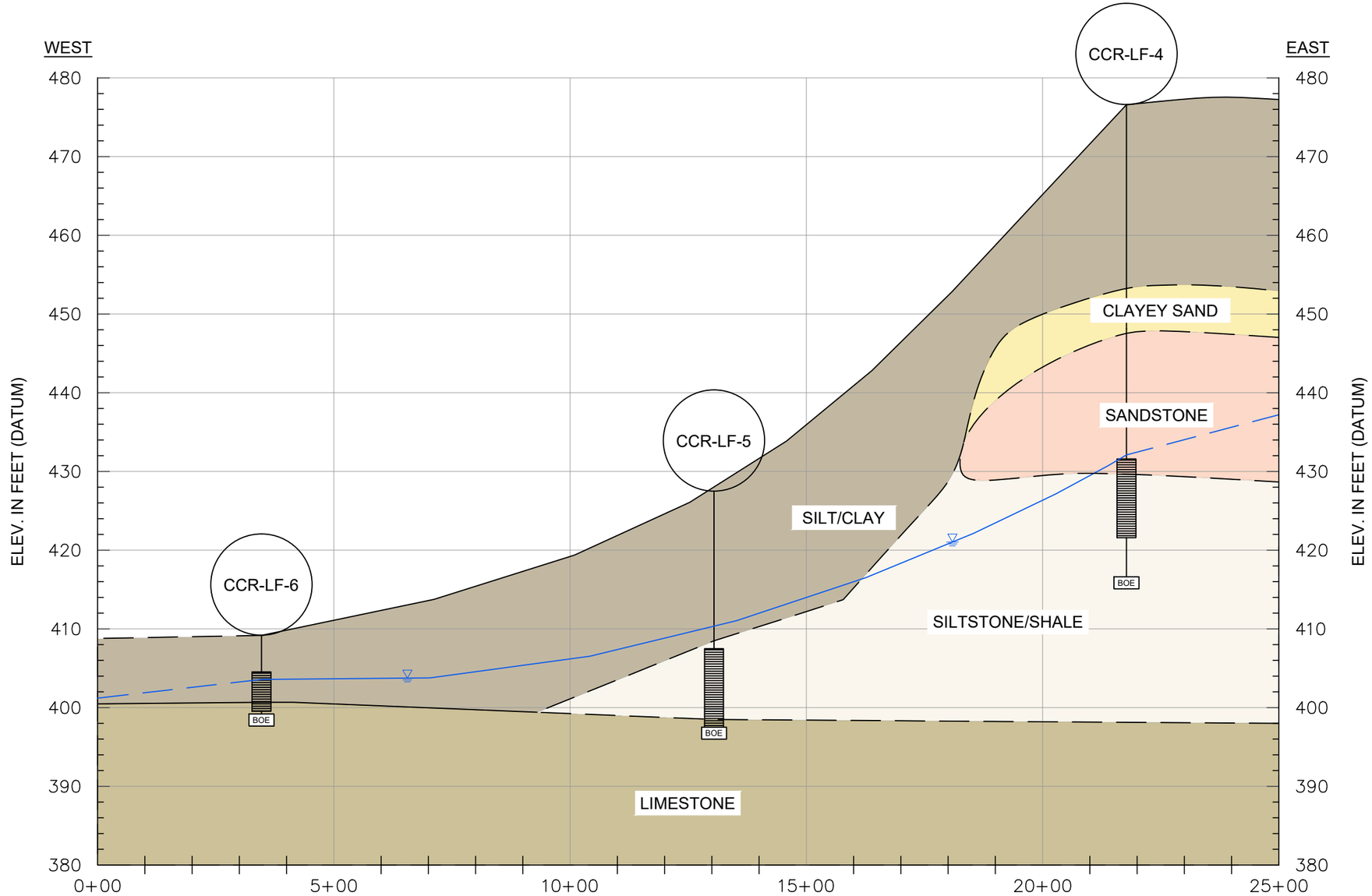
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

FIGURE 1

EXISTING CONDITIONS
CROSS SECTIONS A-A' AND B-B'
LANDFILL

PROJECT: 129420	BY: RY	REVISIONS:
DATE: NOV 2020	CHECKED: MM	

HALEY & ALDRICH



LEGEND

- LIMESTONE
- SAND/CLAYEY SANDS
- SILT/CLAY
- SANDSTONE
- SHALE/SILTSTONE
- GROUNDWATER LEVEL
- INTERPRETED SOIL/BEDROCK LEVELS
- BORING ID/LOCATION WITH GROUND SURFACE ELEVATION
- SCREEN LOCATION
- BOE — BOTTOM OF EXPLORATION

NOTES

1. SOIL/BEDROCK STRATA DETERMINED FROM BORINGS DOCUMENTED BY H&A IN MARCH 2016.
2. GROUNDWATER DATA DETERMINED FROM GW SAMPLING EVENT MAY 2020.
3. DASHED LINES ARE INTERPRETED CONTACTS/GW ELEVATIONS WHERE DATA IS NOT PRESENT

HORIZ.	0	250	500
VERT.	0	15	30

SCALE IN FEET

PROJECT LOCATION

TOPO SOURCE: IMAGE DATED 2019 TAKEN ELECTRONICALLY FROM BING MAPS

PREPARED FOR:

VECTREN
A.B.BROWN GENERATING STATION
LANDFILL

A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

FIGURE 2

EXISTING CONDITIONS
CROSS SECTIONS A-A'
LANDFILL

PROJECT: 129420	BY: RY	REVISIONS:
DATE: NOV 2020	CHECKED: MM	

HALEY & ALDRICH

WEST

EAST

ELEV. IN FEET (DATUM)

490 480 470 460 450 440 430 420 410 400 390 380

0+00 5+00 10+00 15+00 20+00 25+00 30+00 35+00

CCR-SP-2

CCR-LF-1

CCR-LF-2

CCR-LF-3

COAL

SILT/CLAY

SAND

SILTSTONE/SHALE/SANDSTONE

BOE

LEGEND

- COAL
- SAND/CLAYEY SANDS
- SILT/CLAY
- SHALE/SILTSTONE/SANDSTONE
- GROUNDWATER LEVEL
- INTERPRETED SOIL/BEDROCK LEVELS
- BORING ID/LOCATION WITH GROUND SURFACE ELEVATION
- SCREEN LOCATION
- BOE — BOTTOM OF EXPLORATION

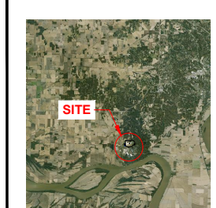
NOTES

1. SOIL/BEDROCK STRATA DETERMINED FROM BORINGS DOCUMENTED BY H&A IN MARCH 2016.
2. GROUNDWATER DATA DETERMINED FROM GW SAMPLING EVENT MAY 2020.
3. DASHED LINES ARE INTERPRETED CONTACTS/GW ELEVATIONS WHERE DATA IS NOT PRESENT

HORIZ. 0 250 500

VERT. 0 15 30

SCALE IN FEET



PROJECT LOCATION

TOPO SOURCE: IMAGE DATED 2019 TAKEN ELECTRONICALLY FROM BING MAPS

PREPARED FOR:

VECTREN
A.B.BROWN GENERATING STATION
LANDFILL

A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

FIGURE 3

EXISTING CONDITIONS CROSS SECTIONS B-B' LANDFILL

PROJECT: 129420	BY: RY	REVISIONS:
DATE: NOV 2020	CHECKED: MM	

HALEY & ALDRICH

Appendix D
Landfill and Sedimentation Pond Geology and Hydrogeology

Landfill and Sedimentation Pond Geology and Hydrogeology

The Site geology and hydrogeology is described in numerous documents prepared by others and in the *Groundwater Monitoring Plan* prepared by Haley & Aldrich in October 2017.

Site Geology

The Ohio River valley contains fill and loess (windblown) deposits derived indirectly from continental ice sheets. These were deposited from meltwater heavily loaded with entrained sediments accumulated in the area on the Pennsylvanian age shale, limestone and sandstone bedrock. Westerly winds simultaneously deposited silty sediments. As a result, base levels of the valley floor increased in elevation and created natural levees and outwashes. These natural levees produced slackwater lakes which deposited thick sequences of silt and clay. When the ice sheets retreated, the sediment load in the Ohio River diminished and lowered base levels. Consequently, the river incised the slackwater lake sediments, sculpted lacustrine terraces, and deposited silty and clayey stream alluvium.

Soil borings drilled at the Site indicates that the uppermost geologic unit is comprised of unconsolidated alluvial deposits consisting of primarily silts and clays with discontinuous layers of sand. This unit overlies Pennsylvanian age sandstone which is commonly identified as the Inglefield Sandstone. Underlying the Inglefield Sandstone is low-permeability weathered shale and siltstone. The sandstone and shale unit has been eroded on the north side of the landfill where the underlying limestone unit was encountered.

Site Hydrogeology

Hydrogeologic units are defined based on their ability to transmit groundwater or serve as confining units between zones of groundwater saturation. The uppermost aquifer at the Site occurs within unconsolidated alluvial deposits which consist primarily of silty clay containing discontinuous layers of sand. Beneath upland areas, or ridgelines the uppermost aquifer occurs in weathered sandstone, shale, or siltstone. Recharge to the surficial aquifer occurs through direct surface infiltration.

Piezometric data recorded from the monitoring wells installed on-Site shows that the configuration of the uppermost aquifer is primarily controlled by surface topography with some influence from the underlying weathered bedrock. Groundwater flow across the eastern portion of the Landfill is to the north and northeast. Beneath the western portion of the Landfill groundwater flow shifts to the north and northwest into a trough that extends to the southwest beneath the Sedimentation Ponds. Groundwater flow in the vicinity of the Landfill is predominantly to the west with a component of flow to the northwest from the northern portion of the Landfill. Groundwater elevations vary seasonally but the groundwater flow patterns remain consistent.

Groundwater flow velocity in the uppermost aquifer beneath the CCR units was estimated using site-specific hydraulic conductivity obtained from slug testing and hydraulic gradients, and an assumed effective porosity of 25 percent. Hydraulic conductivity varied from 1E-3 cm/sec in the vicinity of the Landfill to 3E-4 cm/sec in the vicinity of the Sedimentation Pond. The hydraulic gradient beneath and downgradient of the Landfill is 0.03 feet/foot and 0.04 feet/foot respectively. The hydraulic gradient lessens beneath and downgradient of the Sedimentation Pond dropping to 0.004 feet/foot. Using the site-specific hydraulic conductivity and hydraulic gradients, and assuming an

effective porosity of 25 percent the groundwater flow velocity in the vicinity of the CCR units is estimated as follows; 120 feet/year at the Landfill and approximately 5 feet/year beneath and downgradient of the Sedimentation Pond.

Appendix E
Sedimentation Pond Groundwater Monitoring Program

www.haleyaldrich.com

REPORT ON

GROUNDWATER MONITORING PROGRAM
A.B BROWN GENERATING STATION SEDIMENTATION POND
WEST FRANKLIN, INDIANA

By Haley & Aldrich, Inc.
Greenville, South Carolina

for Southern Indiana Gas and Electric Company
Evansville, Indiana

File No. 129420-006
October 2017

Haley & Aldrich, Inc.
400 Augusta Street
Suite 130
Greenville, SC 29601
864.214.8750

17 October 2017
File No. 129420-006

SIGECO Corporation
P.O. Box 209
Evansville, Indiana 47702-0209

Attention: Ms. Lisa C. Messinger

Subject: Groundwater Monitoring Program
A.B Brown Station
West Franklin, Indiana

Dear Ms. Messinger:

Haley & Aldrich, Inc. (Haley & Aldrich) is pleased to submit this Groundwater Monitoring Program (GMP) report for the A.B. Brown Generating Station Sedimentation Pond. This GMP was developed to comply with the United States Environmental Protection Agency (USEPA) Coal Combustion Residual (CCR) Rule dated 17 April 2015 (Rule), and is based on our review of the existing data on hydrogeology and groundwater quality and considering other site conditions at the A.B. Brown Generating Station. This GMP addresses the groundwater monitoring requirements specified in the CCR Rule, which requires monitoring for existing CCR management facilities, or units, and includes specifications for location of the monitoring wells, sampling and chemical analysis procedures, and collection of groundwater quality data for the Appendix III and Appendix IV list of constituents for statistical analysis to determine if the next step of groundwater monitoring (e.g. Assessment Monitoring) is required.

Sincerely yours,
HALEY & ALDRICH, INC.

Mark Miesfeldt
Hydrogeologist

Steven F. Putrich, P.E.
CCR Program Manager

Enclosures

G:\42796 - Vectren\AB Brown\Groundwater Monitoring Report\Text\2017-0929_HAI_ABB-GMP_DF.docx

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Appendix A – 40 CFR §257.90 through §257.98 and Appendices III and IV
Appendix B – Boring Logs and Construction Diagrams

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Table No.	Title
1	Groundwater Monitoring Well Location and Construction Details

List of Figures

Figure No.	Title
1	Site Location Map
2	Site Index Map
3	Water Table Configuration Map
4	Groundwater Monitoring Locations for Compliance with CCR Rule

1. Introduction

Haley & Aldrich, Inc. (Haley & Aldrich) was retained by Southern Indiana Gas and Electric Company (SIGECO) to perform technical services associated with development of a groundwater monitoring program (GMP) that complies with the April 17, 2015 Coal Combustion Residuals (CCR) Rule (Rule) published by the U.S. Environmental Protection Agency (USEPA). Haley & Aldrich has prepared this GMP on behalf of SIGECO for the A.B. Brown Generating Station (Site) located in Posey County near the community of West Franklin. Under the CCR Rule, the first step in groundwater monitoring at existing CCR units is Detection Monitoring, which requires construction of an adequate groundwater monitoring network established in the uppermost aquifer from which a minimum of 8 rounds of representative hydrological and groundwater quality data can be obtained by October 17, 2017. This GMP was prepared in general accordance with the USEPA "Sampling and Analysis Plan Guidance and Template" (USEPA, 2000), to establish a groundwater monitoring program for the Site that complies with the groundwater monitoring requirements of the USEPA CCR Rule for existing CCR units. The groundwater monitoring requirements of the CCR Rule are provided in Appendix A of this document, as outlined in 40 CFR §257.90 through §257.98, including the accompanying list of constituents in Appendices III and IV for the analysis of groundwater.

There are three components that are referenced in the CCR Rule that together describe the groundwater monitoring activities being undertaken. One component is the GMP which provides a summary of relevant background information and Site geology and hydrogeology along with a detailed description of the groundwater monitoring network and sampling program. The second component is the Groundwater Sampling and Analysis Plan (GWSAP) which is based on the CCR Rule specifications in §257.93 and contains the sampling and chemical analysis procedures and processes that will be followed to obtain representative and technically defensible groundwater monitoring results. The third component presents the methods for the statistical analysis of the collected groundwater quality data as required by the Rule to determine whether a Statistically Significance Increase (SSI) of Appendix III constituents in the downgradient wells, compared to upgradient/background well(s), has occurred. The "Statistical Data Analysis Plan (SDAP) – A.B Brown Generating Station" is based on the CCR Rule-specified statistical methods in §257.93 paragraphs f(1) through f(5).

1.1 SITE SETTING

The Site is located in Posey County near the community of West Franklin, Indiana. The location of the Site is shown on Figure 1. The Site is located approximately 0.5 miles north of the Ohio River. The Site varies in elevation with natural ground surface elevations varying from 380 to 520-feet above mean sea level (msl). The higher elevations are generally to the north of the Site with surface topography dominated by a series of ridges separated by ravines. In general, surface topography across the site generally slopes to the west towards the western property boundary then to the south toward the Ohio River. Surface water runoff occurs via sheet flow to low lying areas or ravines which eventually lead to the Ohio River.

1.2 SITE HISTORY

The Site began operations in 1978 with the construction of a 250 MW generating unit. In 1985, an additional generating unit was added. Both units burn southern Indiana coal. SIGECO currently owns

the land and operates the station for supplying electric power to industrial, commercial, and residential customers in its service territory.

In accordance with the CCR Rule, individual monitoring systems have been designed and constructed for the three CCR management units that include: the Ash Pond, the Landfill, and the Sedimentation Pond (CCR management units). The Ash Pond was constructed and commissioned in 1978 by building an earthen dam across an existing valley. The surface area of the Ash Pond is approximately 159 acres. The Landfill is approximately 87-acres. The Sedimentation Pond receives water from the landfill and was constructed in 2015 with a composite liner across the base overlain by a riprap protective layer. A Site Index Map is provided as Figure 2. The groundwater sampling areas and the associated groundwater monitoring well networks are shown in Figure 3. Table 1 presents a summary of well construction information.

1.3 PREVIOUS INVESTIGATIONS

Three significant subsurface geotechnical and/or hydrogeological investigations have been completed at the Site dating back to 1993, after the construction of the generating station and CCR units and continuing through 2015. These studies generated subsurface data characterizing the Site geology and hydrogeology at the Landfill. In addition, to comply with the IDEM Landfill Permit, SIGECO has installed and sampled a network of groundwater monitoring wells in the vicinity of the Landfill. Haley & Aldrich reviewed the field sampling procedures, monitoring results, and well construction details and concluded that a sufficient amount of reliable hydrogeologic data was available to develop the CCR Rule compliant groundwater monitoring program for the Landfill outlined in this document. To design CCR Rule compliant groundwater monitoring programs for the Ash Pond and the Sedimentation Ponds, a hydrogeological characterization was conducted to interpret groundwater flow characteristics surrounding these units.

2. Site Geology and Hydrogeology

The regional geology and hydrogeology is described in the *Surficial Geologic Map of the Evansville Indiana, and Henderson, Kentucky, Area* prepared by the USGS 2009 and in the *May 2017 Groundwater Quality Data and Statistics* prepared by Cardno ATC in May 2017.

2.1 SITE GEOLOGY

The Ohio River valley contains fill and loess (windblown) deposits derived indirectly from continental ice sheets. These were deposited from meltwater heavily loaded with entrained sediments accumulated in the area on the Pennsylvanian age shale, limestone and sandstone bedrock. Westerly winds simultaneously deposited silty sediments. As a result, base levels of the valley floor increased in elevation and created natural levees and outwashes. These natural levees produced slackwater lakes which deposited thick sequences of silt and clay. When the ice sheets retreated, the sediment load in the Ohio River diminished and lowered base levels. Consequently, the river incised the slackwater lake sediments, sculpted lacustrine terraces, and deposited silty and clayey stream alluvium.

Soil borings drilled at the Site indicates that the uppermost geologic unit is comprised of unconsolidated alluvial deposits consisting of primarily silts and clays with discontinuous layers of sand. This unit overlies Pennsylvanian age sandstone which is commonly identified as the Inglefield Sandstone. Underlying the Inglefield Sandstone is low-permeability weathered shale and siltstone. The sandstone and shale unit has been eroded on the north side of the landfill where the underlying limestone unit was encountered.

2.2 SITE HYDROGEOLOGY

Hydrogeologic units are defined based on their ability to transmit groundwater or serve as confining units between zones of groundwater saturation. The uppermost aquifer at the Site occurs within unconsolidated alluvial deposits which consist primarily of silty clay containing discontinuous layers of sand. Beneath upland areas, or ridgelines the uppermost aquifer occurs in weathered sandstone, shale, or siltstone. Recharge to the surficial aquifer occurs through direct surface infiltration.

Piezometric data recorded from the monitoring wells installed on-Site shows that the configuration of the uppermost aquifer is primarily controlled by surface topography with some influence from the underlying weathered bedrock. Groundwater flow across the eastern portion of the Landfill is to the north and northeast. Beneath the western portion of the Landfill groundwater flow shifts to the north and northwest into a trough that flows to the southwest beneath the Sedimentation Ponds (Figure 3). Groundwater flow in the vicinity of the permitted Ash Pond is predominantly to the west with a component of flow to the northwest from the northern portion of the Ash Pond beneath the Landfill. Groundwater elevations vary seasonally but the groundwater flow patterns remain consistent.

Groundwater flow velocity in the uppermost aquifer beneath the CCR units was estimated using site-specific hydraulic conductivity obtained from slug testing and hydraulic gradients, and an assumed effective porosity of 25 percent. Hydraulic conductivity varied from 1E-3 cm/sec in the vicinity of the Landfill to 3E-4 cm/sec in the vicinity of the Sedimentation Ponds and the Ash Pond. The hydraulic gradient beneath and downgradient of the Landfill and the Ash Pond is 0.03 feet/foot and 0.04 feet/foot respectively. The hydraulic gradient lessens beneath and downgradient of the Sedimentation Pond

dropping to 0.004 feet/foot. Using the site-specific hydraulic conductivity and hydraulic gradients, and assuming an effective porosity of 25 percent the groundwater flow velocity in the vicinity of the CCR units is estimated as follows; 120 feet/year at the Landfill, 50 feet/year at the Ash Pond, and approximately 5 feet/year beneath and downgradient of the Sedimentation Pond.

3. Groundwater Monitoring Program

Haley & Aldrich developed the groundwater monitoring program outlined below after reviewing and evaluating the existing hydrogeologic and groundwater quality data provided by SIGECO, as well as the hydrogeological characterization data obtained by Haley & Aldrich, and considering the performance standards provided in the CCR Rule §257.91 (Appendix A). The groundwater monitoring program includes a sufficient number of wells installed at appropriate locations and depths to obtain representative groundwater samples from the uppermost aquifer. Groundwater sampling locations have been established to accurately characterize groundwater quality, not affected by potential releases from the CCR unit(s) as well as the quality of groundwater passing the waste boundary of the CCR units. New monitoring wells were installed at the three CCR units at the Site.

The three CCR facilities subject to the CCR Rule-required groundwater monitoring at the Site are; one Ash Pond, one landfill, and one sedimentation pond as depicted on Figure 2. Details of the groundwater monitoring program for the CCR units at the Site are further described below.

3.1 GROUNDWATER MONITORING NETWORK FOR THE ASH POND

The Ash Pond at the Site is located to the east of the generating station and coal pile area. As shown on Figure 3, groundwater flow in the uppermost aquifer around the Ash Pond flows generally flows to the west and northwest. With a minor component of flow to the east and south. Therefore, to properly monitor the Ash Pond, downgradient wells were installed along the perimeter of the unit. Haley & Aldrich concluded that the seven new downgradient monitoring wells (CCR-AP-1R, CCR-AP-2R, CCR-AP-3R, CCR-AP-4R, CCR-AP-5, CCR-AP-6 and CCR-AP-7R) located at the boundary of the unit, and screened in the uppermost aquifer, will adequately monitor the potential release and migration of ash constituents from the pond, should that occur. In July 2016 (CCR-AP-1R, CCR-AP-2R, CCR-AP-3R, CCR-AP-4R and CCR-AP-7R) were deepened to ensure that a sufficient amount of groundwater was available for sampling. The location of these seven downgradient groundwater monitoring wells is shown on Figure 4. Well placement has been determined based on interpretations of site-specific hydrogeology including groundwater flow directions and rates of groundwater movement. The groundwater monitoring well network for the existing Ash Pond complies with the Rule by monitoring the uppermost aquifer at the CCR management unit. Based on the groundwater flow pattern around the Ash Pond, the upgradient (unaffected by the CCR unit) background monitoring wells are identified as CCR-BK-1R and CCR-BK-2 located north of the generating station property as shown in Figure 4, which is also installed in the uppermost aquifer. The two upgradient wells provide spatial variability in the background groundwater quality and increases the statistical power of the data analysis. Therefore, the complete groundwater network for the CCR Rule for the Ash Pond consists of seven downgradient wells and two upgradient/background wells. A summary of the monitoring network for the Ash Pond along with well construction details is provided in Table 1.

3.2 GROUNDWATER MONITORING NETWORK FOR THE LANDFILL

For the Landfill, six downgradient groundwater monitoring wells (CCR-LF-1, CCR- LF -2, CCR- LF -3, CCR-LF -4, CCR- LF-5 and CCR- LF-6) were installed (see Figure 4). The same two upgradient/background wells identified for the Ash Pond (CCR-BK-1R and CCR-BK-2) will also be used as background wells for the Landfill, as they also fulfill the requirements of background wells for these units. Well placement has been determined based on interpretations of site-specific hydrogeology including groundwater flow

direction and rate of groundwater movement and exceeds the CCR Rule requirement for at least one background monitoring well. Groundwater quality for these upgradient/background wells is not impacted or affected by the CCR management units at the Site. The groundwater monitoring well network for the landfill has been designed to comply with the Rule by monitoring the uppermost aquifer at the CCR unit boundary. A summary of the monitoring network for the Site Landfill along with well construction details is provided in Table 1.

3.3 GROUNDWATER MONITORING NETWORK FOR THE SEDIMENTATION POND

For the Sedimentation Pond three downgradient groundwater monitoring wells (CCR-SP-1, CCR-SP-2 and CCR-SP-3) were installed (see Figure 4). The same two upgradient/background wells identified for the Ash Pond (CCR-BK-1R and CCR-BK-2) will also be used as background wells for the sedimentation ponds, as they also fulfill the requirements of background wells for these units. Well placement has been determined based on interpretations of site-specific hydrogeology including groundwater flow direction and rate of groundwater movement and exceeds the CCR Rule requirement for at least one background monitoring well. Groundwater quality in these upgradient/background wells is not impacted or affected by the CCR management units at the Site. The groundwater monitoring well network for the sedimentation pond has been designed to comply with the Rule by monitoring the uppermost aquifer at the CCR unit boundary. A summary of the monitoring network for the Site sedimentation pond along with well construction details is provided in Table 1.

3.4 MONITORING WELL CONSTRUCTION AND DOCUMENTATION

As described above, the Detection Monitoring program will include seven monitoring wells located around the Ash Pond (CCR-AP-1R, CCR-AP-2R, CCR-AP-3R, CCR-AP-4R, CCR-AP-5, CCR-AP-6 and CCR-AP-7R), six monitoring wells (CCR-LF-1, CCR- LF -2, CCR- LF -3, CCR- LF -4, CCR- LF-5 and CCR- LF-6) located around the Landfill, three monitoring wells (CCR-SP-1, CCR-SP-2 and CCR-SP-3) located around the Sedimentation Pond, along with two upgradient/background wells installed on the north side of the facility (CCR-BK-1R and CCR-BK-2). Boring logs and well construction diagrams for these wells are included in Appendix B.

Groundwater monitoring wells were constructed with 2-inch Inside Diameter (ID) Schedule 40 PVC casing; a 10-foot long, 0.01-inch machine slotted PVC screen; and a locking, steel, 5-foot long protective casing. Where possible, the well screen was placed so that the encountered water table was approximately five feet above the top of the well screen. Groundwater samples were collected from the mid-point of the well screen.

At each monitoring well, the top of the PVC well casing was surveyed by a registered Indiana surveyor to within 0.01 foot, and the ground surface was surveyed to 0.1 foot. The surveyed top of the well casing, identified on each well, is used for measuring and recording water levels. Each sample location was surveyed to North American Datum of 1988 (NAD88). A summary of the survey results for the monitoring wells, with horizontal and vertical coordinates, is provided in Table 1.

All downhole drilling equipment was cleaned prior to use at the next well location. Decontamination fluids was contained and placed into the Ash Pond. Well casing and screens were new and protected by factory packaging. Monitoring wells were installed according to the procedures described below.

Monitoring wells were installed using conventional hollow-stem auger drilling techniques. Soil sampling

was performed while advancing the borehole using standard split-spoon sampling on five-foot centers to provide samples for soil descriptions and to estimate the depth to groundwater. After the borehole was advanced approximately 15 feet below the water table, well casing and screen was placed through the augers to the bottom of the borehole. Filter sand was added by gravity to approximately 2 feet above the top of the well screen as the augers were withdrawn from the borehole. The filter pack was surged as the sand was emplaced to promote proper packing and to minimize the potential for settlement of the filter pack following placement of the bentonite seal. Approximately 2 feet of bentonite pellets was added by gravity above the sand pack to seal the well screen against surface water infiltration. A neat cement grout was emplaced by tremie pipe into the remaining annular space. Risers extend approximately 2 or 3 feet above the ground surface. The depth of the filter sand, bentonite seal, and annular space seal was carefully measured to 0.1 feet prior to the installation of the next layer. A locking steel protective casing was stabilized in place with a 3-foot by 3-foot square concrete pad sloping away from the casing at monitoring wells CCR-AP-1, CCR-AP-2 CCR-AP-4 through CCR-AP-7, and CCR-LF-1 through CCR-LF-6. A weep hole was drilled at the base of the protective casing just above the concrete pad to evacuate rainwater that may have entered the casing. One to three steel bollards were installed around each newly constructed, above grade, well to protect it from being damaged. To protect new wells installed in high traffic areas, the monitoring wells were completed below grade in vaults. These wells include CCR-AP-3 and CCR-SP-1 through CCR-SP-3.

The installed groundwater monitoring wells were developed after construction by surging and purging each well with a pump. The pump was decontaminated by submersing the pump and pumping through a soapy water solution, followed by a distilled water rinse. For wells that could not be purged dry, development was considered complete when a minimum of ten well volumes of groundwater was removed and purge water was free of turbidity. For wells that purge dry, a minimum of four well volumes of groundwater was removed.

4. Groundwater Sampling Program

This section includes an explanation of activities required to comply with the groundwater monitoring requirements outlined in the CCR Rule. Assessment Monitoring will only be implemented if one or more of the constituents listed in Appendix III of the Rule is detected at a SSI over background levels in a downgradient well located at the waste boundary of a CCR unit once the first 8 rounds of data have been collected, as specified in §257.93. Initiation of Corrective Measures in accordance with §257.96 will commence within 90 days of finding that constituents listed in Appendix IV have been detected at statistically significant levels exceeding the groundwater protection standard defined under §257.95(h) during the Assessment Monitoring.

4.1 DETECTION MONITORING

For existing CCR landfills and existing CCR impoundments Detection Monitoring is the first step in carrying out the groundwater monitoring program at a CCR facility, as required by §257.94 in the CCR Rule. An initial Detection Monitoring program is required to collect and analyze a minimum of eight independent samples from background and downgradient wells for the constituents listed in Appendix III and IV. The timeframe for completion of this initial step is no later than October 17, 2017. Procedures for sampling and chemical analysis methods are provided in a separate GWSAP. Similarly, methods for statistical analysis of the groundwater quality data will also be presented in a separate Statistical Data Analysis Plan (SDAP) for the Site. As described above, the Detection Monitoring program will include seven new monitoring wells located around the Ash Pond (CCR-AP-1R, CCR-AP-2R, CCR-AP-3R, CCR-AP-4R, CCR-AP-5, CCR-AP-6 and CCR-AP-7R) six new monitoring wells (CCR-LF-1, CCR- LF -2, CCR-LF -3, CCR- LF -4, CCR- LF-5 and CCR- LF-6) located around the landfill, three new monitoring wells (CCR-SP-1, CCR-SP-2 and CCR-SP-3) located around the sedimentation pond and two upgradient/background well on the north side of the facility (CCR-BK-1R and CCR-BK-2). Groundwater monitoring locations are shown on Figure 4.

4.1.1 Sampling Schedule and Frequency

The CCR Rule requires that a total of eight independent samples from each upgradient/background and downgradient monitoring well for each existing CCR landfill and surface impoundment must be collected no later than October 17, 2017.

The collection of the eight independent samples from each monitoring well has not been established within the Rule. SIGECO collected samples from background and downgradient monitoring wells beginning in June 2016 and approximately every two months thereafter, resulting in eight independent and representative samples being collected by the deadline of 17 October 2017. Groundwater sampling methods are described in the GWSAP.

4.1.2 Chemical Analysis

Groundwater samples collected for chemical analysis will be analyzed for constituents listed in Appendix III and Appendix IV of the Rule. Analytical methods are described in the GWSAP. The Appendix III and Appendix IV constituents consist of the following:

Appendix III Constituents	Appendix IV Constituents	
Boron	Antimony	Lead
Calcium	Arsenic	Lithium
Chloride	Barium	Mercury
Fluoride	Beryllium	Molybdenum
pH	Cadmium	Selenium
Sulfate	Chromium	Thallium
Total Dissolved Solids	Cobalt	Radium 226 and 228 combined
	Fluoride	

4.1.3 Sampling and Analysis Plan

The GWSAP identifies the site-specific activities and methodologies for groundwater sampling for the groundwater monitoring program as defined in §257.93 of the Rule. The GWSAP includes field data collection, sample collection, sample preservation and shipment, interpretation, laboratory analytical methods, and reporting for all groundwater sampling at each CCR unit. The administrative procedures and frequency for collection of groundwater elevation measurement, flow direction, and gradient are provided in the GWSAP.

Laboratory results from the eight initial Detection Monitoring events for each CCR unit will be statistically analyzed for each of the Appendix III constituents by selecting one of the statistical methods specified in paragraphs (f)(1) through (5) of §257.93 of the Rule. The statistical methods used for the evaluation of groundwater monitoring data are described in the SDAP. The SDAP identifies the appropriate statistical analyses to be applied to the groundwater quality data based on the sample population distribution as defined in §257.93 of the Rule, and guidance provided by USEPA in the RCRA Statistical Analysis of Groundwater Monitoring Data Unified Guidance Document (USEPA, 2009).

4.1.4 Trigger for Assessment Monitoring

Assessment Monitoring is triggered for the CCR unit when statistical analysis of the groundwater quality data collected under the Detection Monitoring program for constituents in Appendix III indicates that a SSI over background levels for one or more of the Appendix III constituents has been detected at any downgradient well during Detection Monitoring at the waste boundary.

However, one may demonstrate that a source other than the CCR unit caused the SSI over the background levels for a constituent. In this case a written demonstration report, certified by a qualified professional engineer verifying the accuracy of the information, must be submitted within 90-days of the determination of an SSI. Successful demonstration of the alternative source of impact allows the CCR unit to continue with Detection Monitoring.

4.2 ASSESSMENT MONITORING

Pursuant to 40 CFR § 257.95(a), assessment monitoring is conducted whenever a SSI over background levels has been detected for one or more of the constituents listed in Appendix III of the Rule. Within 90 days of triggering assessment monitoring, and annually thereafter, groundwater samples will be analyzed for the constituents listed in Appendix IV of the Rule. Within 90 days of obtaining the results from the initial assessment monitoring samples, semi-annual sampling will begin for all wells installed

pursuant 40 CFR § 257.91; these samples will be analyzed for constituents listed in Appendices III and IV of the Rule. Field methods and procedures detailed in the GWSAP will be followed for the collection of the assessment monitoring groundwater samples.

If within 90 days of finding that any constituents listed in Appendix IV of the Rule have been detected at a SSL over the Groundwater Protection Standard (GWPS), which is defined as the Maximum Concentration Limit (MCL) or background for those constituents that do not have an MCL, SIGECO must initiate an assessment of corrective measures to prevent further releases and define the nature and extent of the release.

4.3 GROUNDWATER ELEVATION MEASUREMENT

The depth to groundwater must be measured in each well immediately prior to purging, each time groundwater samples are collected. Groundwater measurements from monitoring wells surrounding each CCR unit should be recorded within a period short enough to avoid temporal variations in groundwater conditions. The measured groundwater levels are converted to groundwater elevations for subsequent interpretation of groundwater flow direction and rate.

4.3.1 Procedures for Groundwater Elevation Measurement

The water level in each well will be measured using an electric water level indicator. Water level measurements should be made from a surveyed fixed reference point marked on the well. The fixed reference point will usually be located on the top of the well casing or on the top of the water level access point into the well, depending on the completion of the well at the surface. If a surveyed mark is not present, the reference point is typically established and marked on the north side of the well casing. More details for groundwater measurement procedures are in the GWSAP.

4.3.2 Frequency

The depth to groundwater, in wells which monitor the same CCR unit, must be measured within a period short enough to avoid temporal variations in groundwater conditions which could preclude accurate determination of groundwater flow rate and direction.

4.4 GROUNDWATER FLOW DIRECTION AND GRADIENT

The groundwater elevations will be used to construct a water table configuration map to interpret direction of groundwater flow and calculate the hydraulic gradient each time groundwater is sampled.

4.4.1 Procedures for Calculation

Groundwater flow direction and gradient will be calculated using one of several computer programs such as Surfer, AutoCAD, or equivalent. Groundwater flow direction and gradient can also be calculated without the use of a computer program by the following steps:

- Determine the groundwater surface elevation by subtracting the water level measurement (depth to water) from the surveyed measuring point elevation at each well.

- Determine the difference in groundwater surface elevation between each of the wells by subtracting the groundwater elevation of a well with a higher elevation from the groundwater elevation of a well with a lower elevation. The elevation differences are divided up into equal increments. Repeat this step between multiple wells. Groundwater elevation contours can be drawn at corresponding elevation increments between wells.

- Determine groundwater flow direction by drawing a line perpendicular to the groundwater contour lines from higher elevations to lower elevations.

- Determine the hydraulic gradient by dividing the groundwater elevation change in the direction of flow by the horizontal difference between measurement points.

4.4.2 Frequency

The gradient and direction of groundwater flow within each CCR unit must be calculated upon completion of each groundwater sampling event.

5. Reporting

5.1 DATA MANAGEMENT

A project database that incorporates hydrogeologic and groundwater quality data has been established to allow efficient management of chemical and physical data collected in the field and received from the laboratories. Laboratories conducting groundwater analyses for this program have been supplied with specific formats for electronic data deliverables to ensure compatibility with the project database requirements. Qualified personnel will be assigned to conduct quality assurance/quality control (QA/QC) reviews for each dataset generated. The database will be integrated with a geographical information system to allow for presentation of spatial information and data, such as site features, ownership boundaries, and sample locations. Each sample location was surveyed to North American Datum of 1988 (NAD88).

5.2 ANNUAL REPORTING

Per the CCR Rule, SIGECO, or a designated representative, must prepare an annual groundwater monitoring report for each CCR unit. The first annual report must be completed by 31 January 2018 and annually thereafter for existing CCR units. The annual groundwater monitoring report summarizes key actions completed, for the previous year; describes any problems that may have encountered, and the corresponding actions to resolve the problems. At a minimum, the annual groundwater monitoring report should include the following:

- A detailed site map showing the CCR units, including all background and downgradient monitoring wells;
- Identification of any monitoring wells installed or decommissioned during the preceding year;
- A summary of all groundwater monitoring activities, including number of samples collected, specific analysis for each groundwater sample, field procedures followed during sample collection activities, and dates of sampling events;
- Discussion of any transition between monitoring programs, including dates of transition, cause for transition, identification of constituents detected at a SSI over background levels; and
- Any other pertinent information regarding the groundwater monitoring system or groundwater monitoring program.

The annual groundwater monitoring report must comply with recordkeeping requirements specified in §257.105 and Section 6 of this Work Plan.

6. Documentation

6.1 RECORDKEEPING

Per the CCR Rule, SIGECO, or a designated representative, must maintain adequate information in a written operating record at the subject facility, as described in §257.105. The operating record must be retained for at least five years following the date of each occurrence, measurement, sampling event, maintenance activity, corrective action, or report for each CCR unit. One operating record may be kept for multi-unit facilities, provided that each CCR unit is clearly identified. The operating record may be maintained in a variety of methods, such as saved on a computer, computer storage devices, or equivalent system that ensure that adequate information is kept for the required timeframe. Documentation must be submitted to the state director or tribal authority upon request when such documentation is not available on SIGECO's maintained website, as described in Section 6.3, below. The following information pertinent to the groundwater monitoring network and the groundwater monitoring program must be placed in the operating record:

- The annual groundwater monitoring report, as required by §257.90(e);
- Documentation of the design, installation, development, and decommissioning of any monitoring well, piezometer, and other measurement or sampling device as required under §257.91(e)(1);
- The groundwater monitoring system certification, as required under §257.91(f);
- Selection of the statistical method certification (SDAP), as required under §257.93(f)(6);
- Notification of establishing an Assessment Monitoring program (within 30 days of triggering), as required under §257.94(e)(3);
- Results of Appendix III and IV constituent concentrations, as required under §257.95(d)(1);
- Notification of returning to Detection Monitoring (within 30 days), as required under §257.95(e);
- Notification of detection of one or more Appendix IV constituents at statistically significant levels above the groundwater protection standard (within 30 days), as required by §257.95(g). Note - Appendix III constituents are not assessed above the groundwater protection standards but are assessed against the upgradient/background concentrations;
- Notification of initiating the assessment of Corrective Measures (within 30 days), as required under §257.95(g)(5);
- Completed assessment of Corrective Measures, as required under §257.96(d);
- Documents prepared by owner/operator recording the public meeting for Corrective Measures assessment, as required under §257.96(e);
- The semi-annual report documenting the progress in selecting and designing the remedy and the selection of remedy report, as required under §257.97(a); and
- Notification of completing the remedy (within 30 days), as required under §257.98(e).

6.2 NOTIFICATION

Notifications must be provided to the relevant State Director before the close of business on the day the notification is required to be completed, as specified under §257.106. The State must be notified when information is added or placed in the operating recorded and on SIGECO's publicly accessible internet site. Notification must be made to the relevant authority of any design or operating criteria

modifications or actions specified under §257.106(f) and §257.106(g) of the Rule. Notification of the availability of the annual groundwater monitoring report is specified under §257.105(h)(1).

6.3 POSTING INFORMATION TO THE INTERNET

A publicly accessible Internet website (CCR website) must be maintained, titled "CCR Rule Compliance Data and Information," and must contain the information specified under §257.107 of the Rule. One CCR website may be kept for multi-unit facilities provided the name or identification number of each unit is clearly specified. All information must be made available to the public within 30 days of placing the information in the operating record and for at least five years following the date on which the information was first posted to the CCR website. Notification information provided to the relevant State Director must be posted on the CCR website as specified under §257.106.

7. Certification

Pursuant to CFR Title 40 Chapter I Subchapter I Part 257 Subpart D §257.91(f), the owner or operator must obtain a certification from a qualified engineer stating that the groundwater monitoring system has been designed and constructed to meet the requirements of §257.91. The certification for the Sedimentation Pond is provided on the following page.

HALEY & ALDRICH, INC.
400 Augusta Street
Suite 130
Greenville, SC 29601
864-214-8750

17 October 2017
File No. 129420-006

SUBJECT: A.B. Brown Generating Station Groundwater Monitoring System Certification for the Sedimentation Pond, Southern Indiana Gas and Electric Company (SIGECO)

SIGECO operates the existing coal combustion residuals (CCR) management unit referred to as the Sedimentation Pond at A.B. Brown Generating Station located in Evansville, Indiana. This CCR unit is considered subject to the CCR Rule since it was active as of the effective date of the CCR Rule. This document addresses the requirements of §257.91 *Groundwater Monitoring Systems*, specifically section §257.91(f), of the US Environmental Protection Agency's (EPA's) Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, 40 CFR Part 257 (CCR Rule) effective 19 October 2015. This document serves as certification that the Sedimentation Pond complies with the requirements defined in the CCR Rule and cited below. This certification has been prepared based upon information made accessible by SIGECO pursuant to §257.91(e)(1).

The groundwater monitoring system at the Sedimentation Pond has been designed to include as a minimum one upgradient and three downgradient monitoring wells pursuant to §257.91(c). The actual number of wells used in the groundwater monitoring system is sufficient and appropriate to characterize the quality of groundwater flowing beneath the Sedimentation Pond based on site-specific conditions.

Pursuant to CFR Title 40 Chapter I Subchapter I Part 257 Subpart D §257.91(f), I certify that the groundwater monitoring system for the Sedimentation Pond has been designed and constructed to meet the requirements of §257.91. The certification submitted is, to the best of my knowledge accurate and complete.

STEVEN F. PUTRICH
REGISTERED
No. PE11200566
STATE OF
INDIANA
PROFESSIONAL ENGINEER

Signed: _____
Certifying Engineer

Print Name: Steven F. Putrich, P.E.
Indiana License No.: PE11200566
Title: CCR Program Manager
Company: Haley & Aldrich, Inc.

References

1. Cardno ATC, 2017, May 2017 Groundwater Quality Data Statistics, May 2017.

2. Moore, D.W., Lundstrom, S.C., Counts, R.C., Martin, S.L., Andrews, Jr., W.M., Newell, W.L., Murphy, M.L., Thompson, M.F., Taylor, E.M., Kvale, E.P., and Brandt, T.R., 2009, Surficial geologic map of the Evansville, Indiana, and Henderson, Kentucky, area: U.S. Geological Survey Scientific Investigations Map 3069, scale 1:50,000, 21-p. pamphlet. [Available at URL https://pubs.usgs.gov/sim/3069]

3. United States Environmental Protection Agency (USEPA), 2000. Sampling and Analysis Plan Guidance and Template, R9QA/002.1. April 2000.

4. United States Environmental Protection Agency (USEPA), 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance, EPA 530/R-09-007. March 2009.

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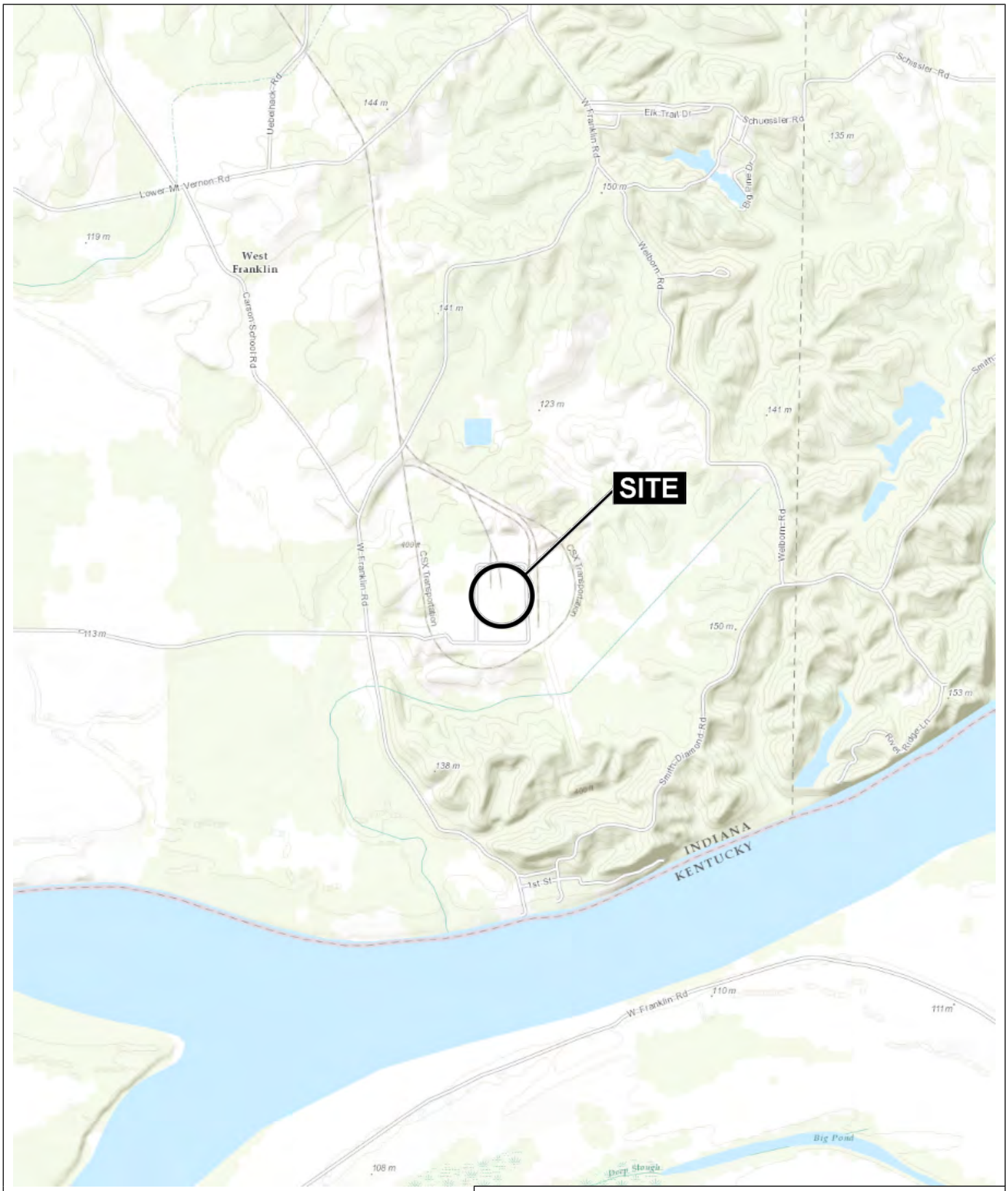
Tables

TABLE 1
GROUNDWATER MONITORING WELL LOCATION AND CONSTRUCTION DETAILS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Well	CCR Unit	Date Installed	Easting	Northing	Top of Pad Elevation (ft msl)	Top of Riser Elevation (ft msl)	Surface Grout (ft bgs)	Bentonite (ft bgs)	Sand Pack (ft bgs)	Screen Zone (ft bgs)	Screen Length (ft)	Well Radius (in)
CCR-AP-1R	Ash Pond	July 2016	2773560.71	968260.82	464.70	467.57	0.0 - 23.0	23.0 - 25.0	25.0 - 37.0	27.0 - 37.0	10	2.00
CCR-AP-2R	Ash Pond	July 2016	2771922.52	969079.16	465.40	468.13	0.0 - 39.0	39.0 - 41.0	41.0 - 53.3	43.3 - 53.3	10	2.00
CCR-AP-3R	Ash Pond	July 2016	2771404.27	966865.12	450.10	449.13	0.0 - 33.0	33.0 - 35.0	35.0 - 47.0	37.0 - 47.0	10	2.00
CCR-AP-4R	Ash Pond	July 2016	2772827.01	966741.47	472.80	475.38	0.0 - 34.0	34.0 - 36.0	36.0 - 48.0	38.0 - 48.0	10	2.00
CCR-AP-5	Ash Pond	March 2016	2771019.70	968166.03	451.00	453.77	0.0 - 31.0	31.0 - 33.0	33.0 - 45.0	35.0 - 45.0	10	2.00
CCR-AP-6	Ash Pond	March 2016	2771626.75	969932.76	458.90	461.57	0.0 - 25.0	25.0 - 27.0	27.0 - 39.0	29.0 - 39.0	10	2.00
CCR-AP-7R	Ash Pond	July 2016	2773501.63	970758.70	486.00	488.57	0.0 - 39.5	39.5 - 41.5	41.5 - 53.5	43.5 - 53.5	10	2.00
CCR-LF-1	Landfill	March 2016	2771247.76	970812.18	432.80	435.63	0.0 - 3.0	3.0 - 7.0	7.0 - 19.0	9.0 - 19.0	10	2.00
CCR-LF-2	Landfill	March 2016	2772205.05	970681.32	470.10	473.00	0.0 - 30.0	30.0 - 32.0	32.0 - 45.0	35.0 - 45.0	10	2.00
CCR-LF-3	Landfill	March 2016	2773138.97	970949.70	482.00	484.75	0.0 - 21.0	21.0 - 23.0	23.0 - 35.0	25.0 - 35.0	10	2.00
CCR-LF-4	Landfill	March 2016	2772876.83	972312.24	476.60	478.85	0.0 - 40.8	40.8 - 43.0	43.0 - 55.0	45.0 - 55.0	10	2.00
CCR-LF-5	Landfill	March 2016	2772003.91	972228.16	427.50	430.41	0.0 - 16.0	16.0 - 18.0	18.0 - 30.0	20.0 - 30.0	10	2.00
CCR-LF-6	Landfill	March 2016	2771046.15	972269.53	409.20	412.05	0.0 - 0.0	0.0 - 2.66	2.66 - 9.66	4.66 - 9.66	10	2.00
CCR-SP-1	Sediment Pond	March 2016	2770030.26	970981.89	403.90	403.51	0.0 - 6.0	6.0 - 8.0	8.0 - 20.0	10.0 - 20.0	10	2.00
CCR-SP-2	Sediment Pond	March 2016	2769939.51	970887.25	403.60	403.23	0.0 - 6.0	6.0 - 8.0	8.0 - 20.0	10.0 - 20.0	10	2.00
CCR-SP-3	Sediment Pond	March 2016	2770027.64	970735.02	403.90	403.57	0.0 - 6.0	6.0 - 8.0	8.0 - 20.0	10.0 - 20.0	10	2.00
CCR-BK-1R	Background	March 2016	2770919.08	974083.40	480.10	483.39	0.0 - 50.0	50.0 - 52.0	52.0 - 64.0	54.0 - 64.0	10	2.00
CCR-BK-2	Background	March 2016	2769728.14	972854.33	427.50	430.60	0.0 - 11.5	11.5 - 13.5	13.5 - 25.5	15.5 - 25.5	10	2.00
SG-2	--	December 2016	2769926.52	967306.25	*378.50	--	--	--	--	--	--	--
SG-3	--	December 2016	2769283.63	971032.24	*386.03	--	--	--	--	--	--	--
SG-4	--	December 2016	2769953.05	965243.95	+369.99	--	--	--	--	--	--	--
PZ-1	--	December 2016	2772095.52	972970.06	415.90	417.37	--	--	--	4.0 - 5.0	1	1
PZ-5	--	December 2016	2772500.01	965928.39	484.10	486.47	4.0-31.5	31.5-35.0	35.0-47.0	37.0-47.0	10	2

Notes:
+ Elevation of Staff Guage is base at top of guardrail over flowline of creek.
*Elevation of Staff Guage is based on the 3.0' mark of the vertical staff guage. Piezometers/staff guages for water level only.
bgs = below ground surface
ft = feet
in = inches
msl = mean sea level
Datum of Elevations in NAVD 88

Figures



MAP SOURCE: ESRI

SITE COORDINATES: 37°54'25"N, 87°42'55"W

HALEY ALDRICH

VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MT. VERNON, INDIANA 47620

SITE LOCATION MAP

APPROXIMATE SCALE: 1 IN = 2000 FT
MAY 2016

FIGURE 1

42796-000_1_LOCUS.PDF

NOTES

1. AERIAL IMAGERY SOURCE: ESRI
2. LOCATIONS DERIVED FROM THREE I DESIGN DATA.

0 500 1,000 1,500 2,000
SCALE IN FEET

HALEY ALDRICH

VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620

SITE INDEX MAP

OCTOBER 2016

FIGURE 2

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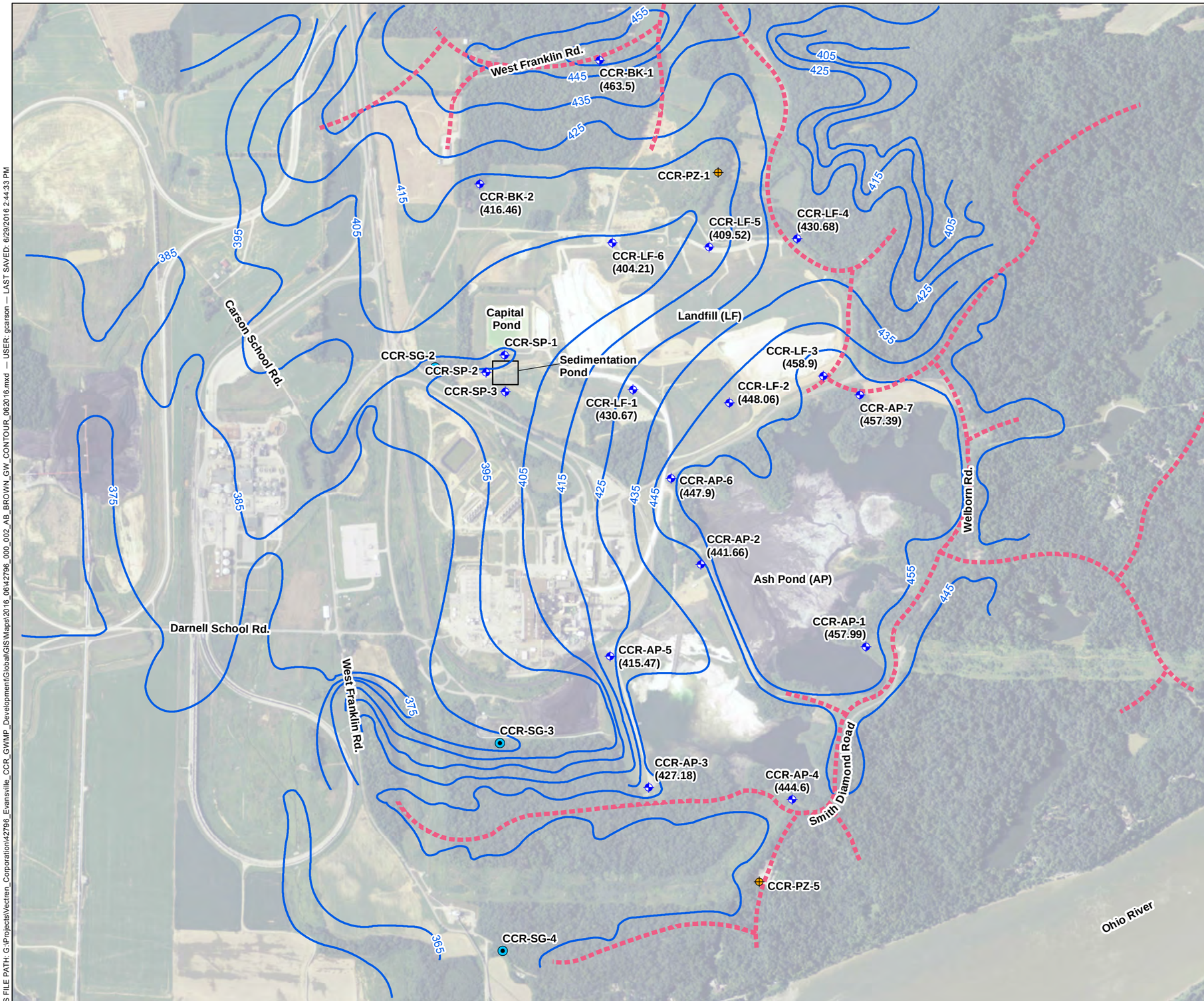

LEGEND

CCR-AP-1 MONITORING WELL

CCR-PZ-1 PIEZOMETER

CCR-SG-1 STAFF GAUGE

GROUNDWATER ELEVATION CONTOURS (10 FT. INTERVALS)

(430.86) GROUNDWATER ELEVATION (6/6/2016)

TOPOGRAPHIC DIVIDE

NOTES

1. AERIAL IMAGERY SOURCE: ESRI
2. LOCATIONS DERIVED FROM THREE I DESIGN DATA.
3. ELEVATIONS ARE FEET ABOVE MEAN SEA LEVEL.

N

0 500 1,000 1,500 2,000

SCALE IN FEET

HALEY ALDRICH

VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620

GROUNDWATER ELEVATION CONTOURS - JUNE 2016

JUNE 2016

FIGURE 3

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LEGEND

CCR-AP-1
MONITORING WELL

CCR-PZ-1
PIEZOMETER

CCR-SG-1
STAFF GAUGE

NOTES

1. AERIAL IMAGERY SOURCE: ESRI
2. LOCATIONS DERIVED FROM THREE I DESIGN DATA.

N

0 500 1,000 1,500 2,000
SCALE IN FEET

HALEY ALDRICH

VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620

MONITORING WELL LOCATIONS FOR COMPLIANCE WITH FEDERAL CCR RULE

OCTOBER 2016

FIGURE 4

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APPENDIX A

40 CFR §257.90 through §257.98 and Appendices III and IV

following the date of initial receipt of CCR in the CCR unit.

(4) *Frequency of inspections.* (i) Except as provided for in paragraph (b)(4)(ii) of this section, the owner or operator of the CCR unit must conduct the inspection required by paragraphs (b)(1) and (2) of this section on an annual basis. The date of completing the initial inspection report is the basis for establishing the deadline to complete the first subsequent inspection. Any required inspection may be conducted prior to the required deadline provided the owner or operator places the completed inspection report into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing subsequent inspection reports is based on the date of completing the previous inspection report. For purposes of this section, the owner or operator has completed an inspection when the inspection report has been placed in the facility's operating record as required by § 257.105(g)(6).

(ii) In any calendar year in which both the periodic inspection by a qualified professional engineer and the quinquennial (occurring every five years) structural stability assessment by a qualified professional engineer required by §§ 257.73(d) and 257.74(d) are required to be completed, the annual inspection is not required, provided the structural stability assessment is completed during the calendar year. If the annual inspection is not conducted in a year as provided by this paragraph (b)(4)(ii), the deadline for completing the next annual inspection is one year from the date of completing the quinquennial structural stability assessment.

(5) If a deficiency or release is identified during an inspection, the owner or operator must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.

(c) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

§ 257.84 Inspection requirements for CCR landfills.

(a) *Inspections by a qualified person.* (1) All CCR landfills and any lateral expansion of a CCR landfill must be examined by a qualified person as follows:

(i) At intervals not exceeding seven days, inspect for any appearances of actual or potential structural weakness and other conditions which are disrupting or have the potential to disrupt the operation or safety of the CCR unit; and

(ii) The results of the inspection by a qualified person must be recorded in the facility's operating record as required by § 257.105(g)(8).

(2) *Timeframes for inspections by a qualified person*—(i) *Existing CCR landfills.* The owner or operator of the CCR unit must initiate the inspections required under paragraph (a) of this section no later than October 19, 2015.

(ii) *New CCR landfills and any lateral expansion of a CCR landfill.* The owner or operator of the CCR unit must initiate the inspections required under paragraph (a) of this section upon initial receipt of CCR by the CCR unit.

(b) *Annual inspections by a qualified professional engineer.* (1) Existing and new CCR landfills and any lateral expansion of a CCR landfill must be inspected on a periodic basis by a qualified professional engineer to ensure that the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering standards. The inspection must, at a minimum, include:

(i) A review of available information regarding the status and condition of the CCR unit, including, but not limited to, files available in the operating record (*e.g.*, the results of inspections by a qualified person, and results of previous annual inspections); and

(ii) A visual inspection of the CCR unit to identify signs of distress or malfunction of the CCR unit.

(2) *Inspection report.* The qualified professional engineer must prepare a report following each inspection that addresses the following:

(i) Any changes in geometry of the structure since the previous annual inspection;

(ii) The approximate volume of CCR contained in the unit at the time of the inspection;

(iii) Any appearances of an actual or potential structural weakness of the CCR unit, in addition to any existing conditions that are disrupting or have the potential to disrupt the operation and safety of the CCR unit; and

(iv) Any other change(s) which may have affected the stability or operation of the CCR unit since the previous annual inspection.

(3) *Timeframes for conducting the initial inspection*—(i) *Existing CCR landfills.* The owner or operator of the CCR unit must complete the initial inspection required by paragraphs (b)(1) and (2) of this section no later than January 18, 2016.

(ii) *New CCR landfills and any lateral expansion of a CCR landfill.* The owner or operator of the CCR unit must complete the initial annual inspection required by paragraphs (b)(1) and (2) of this section no later than 14 months following the date of initial receipt of CCR in the CCR unit.

(4) *Frequency of inspections.* The owner or operator of the CCR unit must conduct the inspection required by paragraphs (b)(1) and (2) of this section on an annual basis. The date of completing the initial inspection report is the basis for establishing the deadline to complete the first subsequent inspection. Any required inspection may be conducted prior to the required deadline provided the owner or operator places the completed inspection report into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing subsequent inspection reports is based on the date of completing the previous inspection report. For purposes of this section, the owner or operator has completed an inspection when the inspection report has been placed in the facility's operating record as required by § 257.105(g)(9).

(5) If a deficiency or release is identified during an inspection, the owner or operator must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.

(c) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

Groundwater Monitoring and Corrective Action

§ 257.90 Applicability.

(a) Except as provided for in § 257.100 for inactive CCR surface impoundments, all CCR landfills, CCR surface impoundments, and lateral expansions of CCR units are subject to the groundwater monitoring and corrective action requirements under §§ 257.90 through 257.98.

(b) *Initial timeframes*—(1) *Existing CCR landfills and existing CCR surface impoundments.* No later than October 17, 2017, the owner or operator of the CCR unit must be in compliance with the following groundwater monitoring requirements:

(i) Install the groundwater monitoring system as required by § 257.91;

(ii) Develop the groundwater sampling and analysis program to include selection of the statistical

procedures to be used for evaluating groundwater monitoring data as required by § 257.93;

(iii) Initiate the detection monitoring program to include obtaining a minimum of eight independent samples for each background and downgradient well as required by § 257.94(b); and

(iv) Begin evaluating the groundwater monitoring data for statistically significant increases over background levels for the constituents listed in appendix III of this part as required by § 257.94.

(2) *New CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units.* Prior to initial receipt of CCR by the CCR unit, the owner or operator must be in compliance with the groundwater monitoring requirements specified in paragraph (b)(1)(i) and (ii) of this section. In addition, the owner or operator of the CCR unit must initiate the detection monitoring program to include obtaining a minimum of eight independent samples for each background well as required by § 257.94(b).

(c) Once a groundwater monitoring system and groundwater monitoring program has been established at the CCR unit as required by this subpart, the owner or operator must conduct groundwater monitoring and, if necessary, corrective action throughout the active life and post-closure care period of the CCR unit.

(d) In the event of a release from a CCR unit, the owner or operator must immediately take all necessary measures to control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of contaminants into the environment. The owner or operator of the CCR unit must comply with all applicable requirements in §§ 257.96, 257.97, and 257.98.

(e) *Annual groundwater monitoring and corrective action report.* For existing CCR landfills and existing CCR surface impoundments, no later than January 31, 2018, and annually thereafter, the owner or operator must prepare an annual groundwater monitoring and corrective action report. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, the owner or operator must prepare the initial annual groundwater monitoring and corrective action report no later than January 31 of the year following the calendar year a groundwater monitoring system has been established for such CCR unit as required by this subpart, and annually thereafter. For the preceding calendar year, the annual report must document the status of the groundwater monitoring and corrective action program for the CCR unit, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year. For purposes of this section, the owner or operator has prepared the annual report when the report is placed in the facility's operating record as required by § 257.105(h)(1). At a minimum, the annual groundwater monitoring and corrective action report must contain the following information, to the extent available:

(1) A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;

(2) Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;

(3) In addition to all the monitoring data obtained under §§ 257.90 through 257.98, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;

(4) A narrative discussion of any transition between monitoring programs (*e.g.*, the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels); and

(5) Other information required to be included in the annual report as specified in §§ 257.90 through 257.98.

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the internet requirements specified in § 257.107(h).

§ 257.91 Groundwater monitoring systems.

(a) *Performance standard.* The owner or operator of a CCR unit must install a groundwater monitoring system that consists of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that:

(1) Accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit. A determination of background quality may include sampling of wells that are not hydraulically upgradient of the CCR management area where:

(i) Hydrogeologic conditions do not allow the owner or operator of the CCR unit to determine what wells are hydraulically upgradient; or

(ii) Sampling at other wells will provide an indication of background groundwater quality that is as representative or more representative than that provided by the upgradient wells; and

(2) Accurately represent the quality of groundwater passing the waste boundary of the CCR unit. The downgradient monitoring system must be installed at the waste boundary that ensures detection of groundwater contamination in the uppermost aquifer. All potential contaminant pathways must be monitored.

(b) The number, spacing, and depths of monitoring systems shall be determined based upon site-specific technical information that must include thorough characterization of:

(1) Aquifer thickness, groundwater flow rate, groundwater flow direction including seasonal and temporal fluctuations in groundwater flow; and

(2) Saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer, and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including, but not limited to, thicknesses, stratigraphy, lithology, hydraulic conductivities, porosities and effective porosities.

(c) The groundwater monitoring system must include the minimum number of monitoring wells necessary to meet the performance standards specified in paragraph (a) of this section, based on the site-specific information specified in paragraph (b) of this section. The groundwater monitoring system must contain:

(1) A minimum of one upgradient and three downgradient monitoring wells; and

(2) Additional monitoring wells as necessary to accurately represent the quality of background groundwater that has not been affected by leakage from the CCR unit and the quality of groundwater passing the waste boundary of the CCR unit.

(d) The owner or operator of multiple CCR units may install a multiunit groundwater monitoring system instead of separate groundwater monitoring systems for each CCR unit.

(1) The multiunit groundwater monitoring system must be equally as capable of detecting monitored constituents at the waste boundary of

the CCR unit as the individual groundwater monitoring system specified in paragraphs (a) through (c) of this section for each CCR unit based on the following factors:

(i) Number, spacing, and orientation of each CCR unit;

(ii) Hydrogeologic setting;

(iii) Site history; and

(iv) Engineering design of the CCR unit.

(2) If the owner or operator elects to install a multiunit groundwater monitoring system, and if the multiunit system includes at least one existing unlined CCR surface impoundment as determined by § 257.71(a), and if at any time after October 19, 2015 the owner or operator determines in any sampling event that the concentrations of one or more constituents listed in appendix IV to this part are detected at statistically significant levels above the groundwater protection standard established under § 257.95(h) for the multiunit system, then all unlined CCR surface impoundments comprising the multiunit groundwater monitoring system are subject to the closure requirements under § 257.101(a) to retrofit or close.

(e) Monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole. This casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of groundwater samples. The annular space (*i.e.*, the space between the borehole and well casing) above the sampling depth must be sealed to prevent contamination of samples and the groundwater.

(1) The owner or operator of the CCR unit must document and include in the operating record the design, installation, development, and decommissioning of any monitoring wells, piezometers and other measurement, sampling, and analytical devices. The qualified professional engineer must be given access to this documentation when completing the groundwater monitoring system certification required under paragraph (f) of this section.

(2) The monitoring wells, piezometers, and other measurement, sampling, and analytical devices must be operated and maintained so that they perform to the design specifications throughout the life of the monitoring program.

(f) The owner or operator must obtain a certification from a qualified professional engineer stating that the groundwater monitoring system has been designed and constructed to meet the requirements of this section. If the groundwater monitoring system includes the minimum number of monitoring wells specified in paragraph (c)(1) of this section, the certification must document the basis supporting this determination.

(g) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the internet requirements specified in § 257.107(h).

§ 257.92 [Reserved]

§ 257.93 Groundwater sampling and analysis requirements.

(a) The groundwater monitoring program must include consistent sampling and analysis procedures that are designed to ensure monitoring results that provide an accurate representation of groundwater quality at the background and downgradient wells required by § 257.91. The owner or operator of the CCR unit must develop a sampling and analysis program that includes procedures and techniques for:

(1) Sample collection;

(2) Sample preservation and shipment;

(3) Analytical procedures;

(4) Chain of custody control; and

(5) Quality assurance and quality control.

(b) The groundwater monitoring program must include sampling and analytical methods that are appropriate for groundwater sampling and that accurately measure hazardous constituents and other monitoring parameters in groundwater samples. For purposes of §§ 257.90 through 257.98, the term *constituent* refers to both hazardous constituents and other monitoring parameters listed in either appendix III or IV of this part.

(c) Groundwater elevations must be measured in each well immediately prior to purging, each time groundwater is sampled. The owner or operator of the CCR unit must determine the rate and direction of groundwater flow each time groundwater is sampled. Groundwater elevations in wells which monitor the same CCR management area must be measured within a period of time short enough to avoid temporal variations in groundwater flow which could preclude accurate determination of groundwater flow rate and direction.

(d) The owner or operator of the CCR unit must establish background groundwater quality in a hydraulically upgradient or background well(s) for each of the constituents required in the particular groundwater monitoring program that applies to the CCR unit as determined under § 257.94(a) or § 257.95(a). Background groundwater quality may be established at wells that are not located hydraulically upgradient from the CCR unit if it meets the requirements of § 257.91(a)(1).

(e) The number of samples collected when conducting detection monitoring and assessment monitoring (for both downgradient and background wells) must be consistent with the statistical procedures chosen under paragraph (f) of this section and the performance standards under paragraph (g) of this section. The sampling procedures shall be those specified under § 257.94(b) through (d) for detection monitoring, § 257.95(b) through (d) for assessment monitoring, and § 257.96(b) for corrective action.

(f) The owner or operator of the CCR unit must select one of the statistical methods specified in paragraphs (f)(1) through (5) of this section to be used in evaluating groundwater monitoring data for each specified constituent. The statistical test chosen shall be conducted separately for each constituent in each monitoring well.

(1) A parametric analysis of variance followed by multiple comparison procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's mean and the background mean levels for each constituent.

(2) An analysis of variance based on ranks followed by multiple comparison procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's median and the background median levels for each constituent.

(3) A tolerance or prediction interval procedure, in which an interval for each constituent is established from the distribution of the background data and the level of each constituent in each compliance well is compared to the upper tolerance or prediction limit.

(4) A control chart approach that gives control limits for each constituent.

(5) Another statistical test method that meets the performance standards of paragraph (g) of this section.

(6) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the selected statistical method is appropriate for evaluating the groundwater monitoring data for the CCR management area. The certification must include a narrative description of the statistical method selected to evaluate the groundwater monitoring data.

(g) Any statistical method chosen under paragraph (f) of this section shall comply with the following performance standards, as appropriate, based on the statistical test method used:

(1) The statistical method used to evaluate groundwater monitoring data shall be appropriate for the distribution of constituents. Normal distributions of data values shall use parametric methods. Non-normal distributions shall use non-parametric methods. If the distribution of the constituents is shown by the owner or operator of the CCR unit to be inappropriate for a normal theory test, then the data must be transformed or a distribution-free (non-parametric) theory test must be used. If the distributions for the constituents differ, more than one statistical method may be needed.

(2) If an individual well comparison procedure is used to compare an individual compliance well constituent concentration with background constituent concentrations or a groundwater protection standard, the test shall be done at a Type I error level no less than 0.01 for each testing period. If a multiple comparison procedure is used, the Type I experiment wise error rate for each testing period shall be no less than 0.05; however, the Type I error of no less than 0.01 for individual well comparisons must be maintained. This performance standard does not apply to tolerance intervals, prediction intervals, or control charts.

(3) If a control chart approach is used to evaluate groundwater monitoring data, the specific type of control chart and its associated parameter values shall be such that this approach is at least as effective as any other approach in this section for evaluating groundwater data. The parameter values shall be determined after considering the number of samples in the background data base, the data distribution, and the range of the concentration values for each constituent of concern.

(4) If a tolerance interval or a predictional interval is used to evaluate groundwater monitoring data, the levels of confidence and, for tolerance intervals, the percentage of the population that the interval must contain, shall be such that this approach is at least as effective as any other approach in this section for evaluating groundwater data. These parameters shall be determined after considering the number of samples in the background data base, the data distribution, and the range of the concentration values for each constituent of concern.

(5) The statistical method must account for data below the limit of detection with one or more statistical procedures that shall at least as effective as any other approach in this section for evaluating groundwater data. Any practical quantitation limit that is used in the statistical method shall be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility.

(6) If necessary, the statistical method must include procedures to control or correct for seasonal and spatial variability as well as temporal correlation in the data.

(h) The owner or operator of the CCR unit must determine whether or not there is a statistically significant increase over background values for each constituent required in the particular groundwater monitoring program that applies to the CCR unit, as determined under § 257.94(a) or § 257.95(a).

(1) In determining whether a statistically significant increase has occurred, the owner or operator must compare the groundwater quality of each constituent at each monitoring well designated pursuant to § 257.91(a)(2) or (d)(1) to the background value of that constituent, according to the statistical procedures and performance standards specified under paragraphs (f) and (g) of this section.

(2) Within 90 days after completing sampling and analysis, the owner or operator must determine whether there has been a statistically significant increase over background for any constituent at each monitoring well.

(i) The owner or operator must measure "total recoverable metals" concentrations in measuring groundwater quality. Measurement of total recoverable metals captures both the particulate fraction and dissolved fraction of metals in natural waters. Groundwater samples shall not be field-filtered prior to analysis.

(j) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

§ 257.94 Detection monitoring program.

(a) The owner or operator of a CCR unit must conduct detection monitoring at all groundwater monitoring wells consistent with this section. At a minimum, a detection monitoring program must include groundwater monitoring for all constituents listed in appendix III to this part.

(b) Except as provided in paragraph (d) of this section, the monitoring frequency for the constituents listed in appendix III to this part shall be at least semiannual during the active life of the CCR unit and the post-closure period. For existing CCR landfills and existing CCR surface impoundments, a minimum of eight independent samples from each background and downgradient well must be collected and analyzed for the constituents listed in appendix III and IV to this part no later than October 17, 2017. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, a minimum of eight independent samples for each background well must be collected and analyzed for the constituents listed in appendices III and IV to this part during the first six months of sampling.

(c) The number of samples collected and analyzed for each background well and downgradient well during subsequent semiannual sampling events must be consistent with § 257.93(e), and must account for any unique characteristics of the site, but must be at least one sample from each background and downgradient well.

(d) The owner or operator of a CCR unit may demonstrate the need for an alternative monitoring frequency for repeated sampling and analysis for constituents listed in appendix III to this part during the active life and the post-closure care period based on the availability of groundwater. If there is not adequate groundwater flow to sample wells semiannually, the alternative frequency shall be no less than annual. The need to vary monitoring frequency must be evaluated on a site-specific basis. The demonstration must be supported by, at a minimum, the information specified in paragraphs (d)(1) and (2) of this section.

(1) Information documenting that the need for less frequent sampling. The alternative frequency must be based on consideration of the following factors:

(i) Lithology of the aquifer and unsaturated zone;

(ii) Hydraulic conductivity of the aquifer and unsaturated zone; and

(iii) Groundwater flow rates.

(2) Information documenting that the alternative frequency will be no less effective in ensuring that any leakage from the CCR unit will be discovered within a timeframe that will not materially delay establishment of an assessment monitoring program.

(3) The owner or operator must obtain a certification from a qualified

professional engineer stating that the demonstration for an alternative groundwater sampling and analysis frequency meets the requirements of this section. The owner or operator must include the demonstration providing the basis for the alternative monitoring frequency and the certification by a qualified professional engineer in the annual groundwater monitoring and corrective action report required by § 257.90(e).

(e) If the owner or operator of the CCR unit determines, pursuant to § 257.93(h) that there is a statistically significant increase over background levels for one or more of the constituents listed in appendix III to this part at any monitoring well at the waste boundary specified under § 257.91(a)(2), the owner or operator must:

(1) Except as provided for in paragraph (e)(2) of this section, within 90 days of detecting a statistically significant increase over background levels for any constituent, establish an assessment monitoring program meeting the requirements of § 257.95.

(2) The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The owner or operator must complete the written demonstration within 90 days of detecting a statistically significant increase over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report. If a successful demonstration is completed within the 90-day period, the owner or operator of the CCR unit may continue with a detection monitoring program under this section. If a successful demonstration is not completed within the 90-day period, the owner or operator of the CCR unit must initiate an assessment monitoring program as required under § 257.95. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

(3) The owner or operator of a CCR unit must prepare a notification stating that an assessment monitoring program has been established. The owner or operator has completed the notification when the notification is placed in the facility's operating record as required by § 257.105(h)(5).

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

§ 257.95 Assessment monitoring program.

(a) Assessment monitoring is required whenever a statistically significant increase over background levels has been detected for one or more of the constituents listed in appendix III to this part.

(b) Within 90 days of triggering an assessment monitoring program, and annually thereafter, the owner or operator of the CCR unit must sample and analyze the groundwater for all constituents listed in appendix IV to this part. The number of samples collected and analyzed for each well during each sampling event must be consistent with § 257.93(e), and must account for any unique characteristics of the site, but must be at least one sample from each well.

(c) The owner or operator of a CCR unit may demonstrate the need for an alternative monitoring frequency for repeated sampling and analysis for constituents listed in appendix IV to this part during the active life and the post-closure care period based on the availability of groundwater. If there is not adequate groundwater flow to sample wells semiannually, the alternative frequency shall be no less than annual. The need to vary monitoring frequency must be evaluated on a site-specific basis. The demonstration must be supported by, at a minimum, the information specified in paragraphs (c)(1) and (2) of this section.

(1) Information documenting that the need for less frequent sampling. The alternative frequency must be based on consideration of the following factors:

(i) Lithology of the aquifer and unsaturated zone;

(ii) Hydraulic conductivity of the aquifer and unsaturated zone; and

(iii) Groundwater flow rates.

(2) Information documenting that the alternative frequency will be no less effective in ensuring that any leakage from the CCR unit will be discovered within a timeframe that will not materially delay the initiation of any necessary remediation measures.

(3) The owner or operator must obtain a certification from a qualified professional engineer stating that the demonstration for an alternative groundwater sampling and analysis frequency meets the requirements of this section. The owner or operator must include the demonstration providing the basis for the alternative monitoring frequency and the certification by a qualified professional engineer in the annual groundwater monitoring and corrective action report required by § 257.90(e).

(d) After obtaining the results from the initial and subsequent sampling events required in paragraph (b) of this section, the owner or operator must:

(1) Within 90 days of obtaining the results, and on at least a semiannual basis thereafter, resample all wells that were installed pursuant to the requirements of § 257.91, conduct analyses for all parameters in appendix III to this part and for those constituents in appendix IV to this part that are detected in response to paragraph (b) of this section, and record their concentrations in the facility operating record. The number of samples collected and analyzed for each background well and downgradient well during subsequent semiannual sampling events must be consistent with § 257.93(e), and must account for any unique characteristics of the site, but must be at least one sample from each background and downgradient well;

(2) Establish groundwater protection standards for all constituents detected pursuant to paragraph (b) or (d) of this section. The groundwater protection standards must be established in accordance with paragraph (h) of this section; and

(3) Include the recorded concentrations required by paragraph (d)(1) of this section, identify the background concentrations established under § 257.94(b), and identify the groundwater protection standards established under paragraph (d)(2) of this section in the annual groundwater monitoring and corrective action report required by § 257.90(e).

(e) If the concentrations of all constituents listed in appendices III and IV to this part are shown to be at or below background values, using the statistical procedures in § 257.93(g), for two consecutive sampling events, the owner or operator may return to detection monitoring of the CCR unit. The owner or operator must prepare a notification stating that detection monitoring is resuming for the CCR unit. The owner or operator has completed the notification when the notification is placed in the facility's operating record as required by § 257.105(h)(7).

(f) If the concentrations of any constituent in appendices III and IV to this part are above background values, but all concentrations are below the groundwater protection standard

established under paragraph (h) of this section, using the statistical procedures in § 257.93(g), the owner or operator must continue assessment monitoring in accordance with this section.

(g) If one or more constituents in appendix IV to this part are detected at statistically significant levels above the groundwater protection standard established under paragraph (h) of this section in any sampling event, the owner or operator must prepare a notification identifying the constituents in appendix IV to this part that have exceeded the groundwater protection standard. The owner or operator has completed the notification when the notification is placed in the facility's operating record as required by § 257.105(h)(8). The owner or operator of the CCR unit also must:

(1) Characterize the nature and extent of the release and any relevant site conditions that may affect the remedy ultimately selected. The characterization must be sufficient to support a complete and accurate assessment of the corrective measures necessary to effectively clean up all releases from the CCR unit pursuant to § 257.96. Characterization of the release includes the following minimum measures:

(i) Install additional monitoring wells necessary to define the contaminant plume(s);

(ii) Collect data on the nature and estimated quantity of material released including specific information on the constituents listed in appendix IV of this part and the levels at which they are present in the material released;

(iii) Install at least one additional monitoring well at the facility boundary in the direction of contaminant migration and sample this well in accordance with paragraph (d)(1) of this section; and

(iv) Sample all wells in accordance with paragraph (d)(1) of this section to characterize the nature and extent of the release.

(2) Notify all persons who own the land or reside on the land that directly overlies any part of the plume of contamination if contaminants have migrated off-site if indicated by sampling of wells in accordance with paragraph (g)(1) of this section. The owner or operator has completed the notifications when they are placed in the facility's operating record as required by § 257.105(h)(8).

(3) Within 90 days of finding that any of the constituents listed in appendix IV to this part have been detected at a statistically significant level exceeding the groundwater protection standards the owner or operator must either:

(i) Initiate an assessment of corrective measures as required by § 257.96; or

(ii) Demonstrate that a source other than the CCR unit caused the contamination, or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Any such demonstration must be supported by a report that includes the factual or evidentiary basis for any conclusions and must be certified to be accurate by a qualified professional engineer. If a successful demonstration is made, the owner or operator must continue monitoring in accordance with the assessment monitoring program pursuant to this section, and may return to detection monitoring if the constituents in appendices III and IV to this part are at or below background as specified in paragraph (e) of this section. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

(4) If a successful demonstration has not been made at the end of the 90 day period provided by paragraph (g)(3)(ii) of this section, the owner or operator of the CCR unit must initiate the assessment of corrective measures requirements under § 257.96.

(5) If an assessment of corrective measures is required under § 257.96 by either paragraph (g)(3)(i) or (g)(4) of this section, and if the CCR unit is an existing unlined CCR surface impoundment as determined by § 257.71(a), then the CCR unit is subject to the closure requirements under § 257.101(a) to retrofit or close. In addition, the owner or operator must prepare a notification stating that an assessment of corrective measures has been initiated.

(h) The owner or operator of the CCR unit must establish a groundwater protection standard for each constituent in appendix IV to this part detected in the groundwater. The groundwater protection standard shall be:

(1) For constituents for which a maximum contaminant level (MCL) has been established under §§ 141.62 and 141.66 of this title, the MCL for that constituent;

(2) For constituents for which an MCL has not been established, the background concentration for the constituent established from wells in accordance with § 257.91; or

(3) For constituents for which the background level is higher than the MCL identified under paragraph (h)(1) of this section, the background concentration.

(i) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

§ 257.96 Assessment of corrective measures.

(a) Within 90 days of finding that any constituent listed in appendix IV to this part has been detected at a statistically significant level exceeding the groundwater protection standard defined under § 257.95(h), or immediately upon detection of a release from a CCR unit, the owner or operator must initiate an assessment of corrective measures to prevent further releases, to remediate any releases and to restore affected area to original conditions. The assessment of corrective measures must be completed within 90 days, unless the owner or operator demonstrates the need for additional time to complete the assessment of corrective measures due to site-specific conditions or circumstances. The owner or operator must obtain a certification from a qualified professional engineer attesting that the demonstration is accurate. The 90-day deadline to complete the assessment of corrective measures may be extended for no longer than 60 days. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

(b) The owner or operator of the CCR unit must continue to monitor groundwater in accordance with the assessment monitoring program as specified in § 257.95.

(c) The assessment under paragraph (a) of this section must include an analysis of the effectiveness of potential corrective measures in meeting all of the requirements and objectives of the remedy as described under § 257.97 addressing at least the following:

(1) The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to any residual contamination;

(2) The time required to begin and complete the remedy;

(3) The institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy(s).

(d) The owner or operator must place the completed assessment of corrective measures in the facility's operating record. The assessment has been completed when it is placed in the facility's operating record as required by § 257.105(h)(10).

(e) The owner or operator must discuss the results of the corrective measures assessment at least 30 days prior to the selection of remedy, in a public meeting with interested and affected parties.

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

§ 257.97 Selection of remedy.

(a) Based on the results of the corrective measures assessment conducted under § 257.96, the owner or operator must, as soon as feasible, select a remedy that, at a minimum, meets the standards listed in paragraph (b) of this section. This requirement applies to, not in place of, any applicable standards under the Occupational Safety and Health Act. The owner or operator must prepare a semiannual report describing the progress in selecting and designing the remedy. Upon selection of a remedy, the owner or operator must prepare a final report describing the selected remedy and how it meets the standards specified in paragraph (b) of this section. The owner or operator must obtain a certification from a qualified professional engineer that the remedy selected meets the requirements of this section. The report has been completed when it is placed in the operating record as required by § 257.105(h)(12).

(b) Remedies must:

(1) Be protective of human health and the environment;

(2) Attain the groundwater protection standard as specified pursuant to § 257.95(h);

(3) Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in appendix IV to this part into the environment;

(4) Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems;

(5) Comply with standards for management of wastes as specified in § 257.98(d).

(c) In selecting a remedy that meets the standards of paragraph (b) of this section, the owner or operator of the CCR unit shall consider the following evaluation factors:

(1) The long- and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful based on consideration of the following:

(i) Magnitude of reduction of existing risks;

(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy;

(iii) The type and degree of long-term management required, including monitoring, operation, and maintenance;

(iv) Short-term risks that might be posed to the community or the environment during implementation of such a remedy, including potential threats to human health and the environment associated with excavation, transportation, and re-disposal of contaminant;

(v) Time until full protection is achieved;

(vi) Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment;

(vii) Long-term reliability of the engineering and institutional controls; and

(viii) Potential need for replacement of the remedy.

(2) The effectiveness of the remedy in controlling the source to reduce further releases based on consideration of the following factors:

(i) The extent to which containment practices will reduce further releases; and

(ii) The extent to which treatment technologies may be used.

(3) The ease or difficulty of implementing a potential remedy(s) based on consideration of the following types of factors:

(i) Degree of difficulty associated with constructing the technology;

(ii) Expected operational reliability of the technologies;

(iii) Need to coordinate with and obtain necessary approvals and permits from other agencies;

(iv) Availability of necessary equipment and specialists; and

(v) Available capacity and location of needed treatment, storage, and disposal services.

(4) The degree to which community concerns are addressed by a potential remedy(s).

(d) The owner or operator must specify as part of the selected remedy a schedule(s) for implementing and completing remedial activities. Such a schedule must require the completion of remedial activities within a reasonable period of time taking into consideration the factors set forth in paragraphs (d)(1) through (6) of this section. The owner or operator of the CCR unit must consider the following factors in determining the schedule of remedial activities:

(1) Extent and nature of contamination, as determined by the characterization required under § 257.95(g);

(2) Reasonable probabilities of remedial technologies in achieving compliance with the groundwater protection standards established under § 257.95(h) and other objectives of the remedy;

(3) Availability of treatment or disposal capacity for CCR managed during implementation of the remedy;

(4) Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy;

(5) Resource value of the aquifer including:

(i) Current and future uses;

(ii) Proximity and withdrawal rate of users;

(iii) Groundwater quantity and quality;

(iv) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to CCR constituents;

(v) The hydrogeologic characteristic of the facility and surrounding land; and

(vi) The availability of alternative water supplies; and

(6) Other relevant factors.

(e) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

§ 257.98 Implementation of the corrective action program.

(a) Within 90 days of selecting a remedy under § 257.97, the owner or operator must initiate remedial activities. Based on the schedule established under § 257.97(d) for implementation and completion of remedial activities the owner or operator must:

(1) Establish and implement a corrective action groundwater monitoring program that:

(i) At a minimum, meets the requirements of an assessment monitoring program under § 257.95;

(ii) Documents the effectiveness of the corrective action remedy; and

(iii) Demonstrates compliance with the groundwater protection standard pursuant to paragraph (c) of this section.

(2) Implement the corrective action remedy selected under § 257.97; and

(3) Take any interim measures necessary to reduce the contaminants leaching from the CCR unit, and/or potential exposures to human or ecological receptors. Interim measures must, to the greatest extent feasible, be consistent with the objectives of and contribute to the performance of any remedy that may be required pursuant to § 257.97. The following factors must be considered by an owner or operator in determining whether interim measures are necessary:

(i) Time required to develop and implement a final remedy;

(ii) Actual or potential exposure of nearby populations or environmental receptors to any of the constituents listed in appendix IV of this part;

(iii) Actual or potential contamination of drinking water supplies or sensitive ecosystems;

(iv) Further degradation of the groundwater that may occur if remedial action is not initiated expeditiously;

(v) Weather conditions that may cause any of the constituents listed in appendix IV to this part to migrate or be released;

(vi) Potential for exposure to any of the constituents listed in appendix IV to this part as a result of an accident or failure of a container or handling system; and

(vii) Other situations that may pose threats to human health and the environment.

(b) If an owner or operator of the CCR unit, determines, at any time, that compliance with the requirements of § 257.97(b) is not being achieved through the remedy selected, the owner or operator must implement other methods or techniques that could feasibly achieve compliance with the requirements.

(c) Remedies selected pursuant to § 257.97 shall be considered complete when:

(1) The owner or operator of the CCR unit demonstrates compliance with the groundwater protection standards established under § 257.95(h) has been achieved at all points within the plume of contamination that lie beyond the groundwater monitoring well system established under § 257.91.

(2) Compliance with the groundwater protection standards established under § 257.95(h) has been achieved by demonstrating that concentrations of constituents listed in appendix IV to this part have not exceeded the groundwater protection standard(s) for a period of three consecutive years using the statistical procedures and performance standards in § 257.93(f) and (g).

(3) All actions required to complete the remedy have been satisfied.

(d) All CCR that are managed pursuant to a remedy required under § 257.97, or an interim measure required under paragraph (a)(3) of this section, shall be managed in a manner that complies with all applicable RCRA requirements.

(e) Upon completion of the remedy, the owner or operator must prepare a notification stating that the remedy has been completed. The owner or operator must obtain a certification from a qualified professional engineer attesting that the remedy has been completed in compliance with the requirements of paragraph (c) of this section. The report has been completed when it is placed in the operating record as required by § 257.105(h)(13).

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the internet requirements specified in § 257.107(h).

Closure and Post-Closure Care

§ 257.100 Inactive CCR surface impoundments.

(a) Except as provided by paragraph (b) of this section, inactive CCR surface impoundments are subject to all of the requirements of this subpart applicable to existing CCR surface impoundments.

(b) An owner or operator of an inactive CCR surface impoundment that completes closure of such CCR unit, and meets all of the requirements of either paragraphs (b)(1) through (4) of this section or paragraph (b)(5) of this section no later than April 17, 2018, is exempt from all other requirements of this subpart.

(1) *Closure by leaving CCR in place.* If the owner or operator of the inactive CCR surface impoundment elects to close the CCR surface impoundment by leaving CCR in place, the owner or operator must ensure that, at a minimum, the CCR unit is closed in a manner that will:

(i) Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere;

(ii) Preclude the probability of future impoundment of water, sediment, or slurry;

(iii) Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system; and

(iv) Minimize the need for further maintenance of the CCR unit.

(2) The owner or operator of the inactive CCR surface impoundment must meet the requirements of paragraphs (b)(2)(i) and (ii) of this section prior to installing the final cover system required under paragraph (b)(3) of this section.

(i) Free liquids must be eliminated by removing liquid wastes or solidifying the remaining wastes and waste residues.

(ii) Remaining wastes must be stabilized sufficient to support the final cover system.

(3) The owner or operator must install a final cover system that is designed to minimize infiltration and erosion, and at a minimum, meets the requirements of paragraph (b)(3)(i) of this section, or the requirements of an alternative final cover system specified in paragraph (b)(3)(ii) of this section.

(i) The final cover system must be designed and constructed to meet the criteria specified in paragraphs (b)(3)(i)(A) through (D) of this section.

(A) The permeability of the final cover system must be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1×10^{-5} centimeters/second, whichever is less.

(B) The infiltration of liquids through the CCR unit must be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.

(C) The erosion of the final cover system must be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

(D) The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.

(ii) The owner or operator may select an alternative final cover system design, provided the alternative final cover system is designed and constructed to meet the criteria in paragraphs (b)(3)(ii)(A) through (C) of this section.

(A) The design of the final cover system must include an infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraphs (b)(3)(i)(A) and (B) of this section.

(B) The design of the final cover system must include an erosion layer that provides equivalent protection from wind or water erosion as the erosion layer specified in paragraph (b)(3)(i)(C) of this section.

deficiency or release specified under § 257.105(f)(11).

(11) The initial and periodic safety factor assessments specified under § 257.105(f)(12).

(12) The design and construction plans, and any revisions of them, specified under § 257.105(f)(13).

(g) *Operating criteria.* The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The CCR fugitive dust control plan, or any subsequent amendment of the plan, specified under § 257.105(g)(1) except that only the most recent plan must be maintained on the CCR Web site irrespective of the time requirement specified in paragraph (c) of this section.

(2) The annual CCR fugitive dust control report specified under § 257.105(g)(2).

(3) The initial and periodic run-on and run-off control system plans specified under § 257.105(g)(3).

(4) The initial and periodic inflow design flood control system plans specified under § 257.105(g)(4).

(5) The periodic inspection reports specified under § 257.105(g)(6).

(6) The documentation detailing the corrective measures taken to remedy the deficiency or release specified under § 257.105(g)(7).

(7) The periodic inspection reports specified under § 257.105(g)(9).

(h) *Groundwater monitoring and corrective action.* The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The annual groundwater monitoring and corrective action report specified under § 257.105(h)(1).

(2) The groundwater monitoring system certification specified under § 257.105(h)(3).

(3) The selection of a statistical method certification specified under § 257.105(h)(4).

(4) The notification that an assessment monitoring programs has been established specified under § 257.105(h)(5).

(5) The notification that the CCR unit is returning to a detection monitoring program specified under § 257.105(h)(7).

(6) The notification that one or more constituents in appendix IV to this part have been detected at statistically significant levels above the groundwater protection standard and the notifications to land owners specified under § 257.105(h)(8).

(7) The notification that an assessment of corrective measures has been initiated specified under § 257.105(h)(9).

(8) The assessment of corrective measures specified under § 257.105(h)(10).

(9) The semiannual reports describing the progress in selecting and designing remedy and the selection of remedy report specified under § 257.105(h)(12), except that the selection of the remedy report must be maintained until the remedy has been completed.

(10) The notification that the remedy has been completed specified under § 257.105(h)(13).

(i) *Closure and post-closure care.* The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The notification of intent to initiate closure of the CCR unit specified under § 257.105(i)(1).

(2) The annual progress reports of closure implementation specified under § 257.105(i)(2).

(3) The notification of closure completion specified under § 257.105(i)(3).

(4) The written closure plan, and any amendment of the plan, specified under § 257.105(i)(4).

(5) The demonstration(s) for a time extension for initiating closure specified under § 257.105(i)(5).

(6) The demonstration(s) for a time extension for completing closure specified under § 257.105(i)(6).

(7) The notification of intent to close a CCR unit specified under § 257.105(i)(7).

(8) The notification of completion of closure of a CCR unit specified under § 257.105(i)(8).

(9) The notification recording a notation on the deed as required by § 257.105(i)(9).

(10) The notification of intent to comply with the alternative closure requirements as required by § 257.105(i)(10).

(11) The annual progress reports under the alternative closure requirements as required by § 257.105(i)(11).

(12) The written post-closure plan, and any amendment of the plan, specified under § 257.105(i)(12).

(13) The notification of completion of post-closure care specified under § 257.105(i)(13).

(j) *Retrofit criteria.* The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The written retrofit plan, and any amendment of the plan, specified under § 257.105(j)(1).

(2) The notification of intent to comply with the alternative retrofit requirements as required by § 257.105(j)(2).

(3) The annual progress reports under the alternative retrofit requirements as required by § 257.105(j)(3).

(4) The demonstration(s) for a time extension for completing retrofit activities specified under § 257.105(j)(4).

(5) The notification of intent to retrofit a CCR unit specified under § 257.105(j)(5).

(6) The notification of completion of retrofit activities specified under § 257.105(j)(6).

■ 5. Amend part 257 by adding "Appendix III to Part 257" and "Appendix IV to Part 257" to read as follows:

Appendix III to Part 257—Constituents for Detection Monitoring

Common name [1]
Boron
Calcium
Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids (TDS)

[1] Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

Appendix IV to Part 257—Constituents for Assessment Monitoring

Common name [1]
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228 combined

[1] Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

PART 261—IDENTIFICATION AND LISTING OF HAZARDOUS WASTE

■ 6. The authority citation for part 261 continues to read as follows:

Authority: 42 U.S.C. 6905, 6912(a), 6921, 6922, 6924(y) and 6938.

■ 7. Section 261.4 is amended by revising paragraph (b)(4) to read as follows:

APPENDIX B

Boring Logs and Construction Diagrams

TEST BORING REPORT

Boring No. CCR-AP-1

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 1
Start	18 December 2015
Finish	18 December 2015
Driller	B. Marshall
H&A Rep.	T. Vanage
Elevation Datum	465.7 (est.)
Location	See Plan N 968260.82 E 2773560.71

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	Sonic	-	Steel	Rig Make & Model: Track Geoprobe 8140LS
Inside Diameter (in.)	6	-	6.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	-	-	Drill Mud: None
Hammer Fall (in.)		-	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 38	0.0 5.0	CL		Soft brown lean CLAY (CL), mps 20 mm, no odor, moist, roots throughout -OVERBURDEN-	-	5	-	-	5	90				
5		U2 58	5.0 10.0	ML	460.0 5.8	Soft brown SILT (ML), no odor, wet -OVERBURDEN-	-	-	-	-	5	95				
10		U3 108	10.0 20.0													
15					447.7 18.0	Moderately weathered red-brown medium-grained SANDSTONE -BEDROCK-										
20					445.7 20.0	BOTTOM OF EXPLORATION 20.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/20/15	-	-	-	-	4.87

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	18.0
Rock Cored (ft)	2.0
Samples	3U

Boring No. CCR-AP-1

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-1R

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	26 July 2016
Finish	26 July 2016
Driller	J. Gryska
H&A Rep.	C. Toscano
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	9.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Drilled through existing observation well CCR-AP-1, see test boring report for soils logged from 0-20 ft. -OVERBURDEN-										
5																	
10																	
15																	
						18.0	Top of weathered bedrock -BEDROCK-										
20																	

Water Level Data					
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
7/27/16	7:15	-	-	-	5.60

Sample ID
- O - Open End Rod
- T - Thin Wall Tube
- U - Undisturbed Sample
- S - Split Spoon Sample

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary	
Overburden (ft)	18.0
Rock Cored (ft)	19.0
Samples	1S

Boring No. CCR-AP-1R

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-1R
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25																	
	4 5 5 16	S1 24	28.0 30.0				Loose reddish-brown sandy SILT (ML) with occasional layers of highly weathered rock with distinct rock fabric (sandstone/siltstone)	-	5	10	15	10	60				
30																	
							Drill action, occasional rig chatter and soil cuttings indicated highly weathered Siltstone/Sandstone										
35																	
						37.0	BOTTOM OF EXPLORATION 37.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-1R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-2

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No. 42796-001
Sheet No. 1 of 2
Start 17 December 2015
Finish 17 December 2015
Driller B. Marshall
H&A Rep. T. Vanage
Elevation 465.2 (est.)
Datum
Location See Plan
N 969079.16
E 2771922.52

	Casing	Sampler	Barrel
Type	Sonic	-	Steel
Inside Diameter (in.)	4.5	-	6.0
Hammer Weight (lb)	-	-	-
Hammer Fall (in.)		-	-

Drilling Equipment and Procedures

Rig Make & Model: Track Geoprobe 8140LS
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 47	0.0 5.0	CL		Medium stiff brown lean CLAY (CL), no odor, moist, red mottling at 3 feet, organics present -FILL-	-	-	-	-	-	100				
5		U2 58	5.0 10.0	CL		Medium stiff yellow-brown lean CLAY (CL), no door, moist	-	-	-	-	-	100				
10		U3 57	10.0 15.0													
				MH	452.7 12.5	Soft to medium stiff yellow-brown elastic SILT (MH), no odor, dry -OVERBURDEN-	-	-	-	-	-	100				
15		U4 60	15.0 20.0	MH		Driller indicated collapse at 15.5 feet Soft yellow-brown elastic SILT (MH), no odor, wet	-	-	-	-	5	95				
20		U5 60	20.0 25.0													

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/20/15	-	-	-	-	18.46

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 25.5
Rock Cored (ft) -
Samples 5U

Boring No. CCR-AP-2

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-2
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
				MH			Similar as above, except wet										
25						439.7											
						25.5	BOTTOM OF EXPLORATION 25.5 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-2

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-2R

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	28 July 2016
Finish	28 July 2016
Driller	J. Gryska
H&A Rep.	C. Toscano
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	9.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Drilled through existing observation well CCR-AP-2, see test boring report for soils logged from 0-25 ft.										
							-OVERBURDEN-										
5																	
10																	
15																	
20																	
25																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
7/29/15	7:30	-	-	-	28.80

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	30.0
Rock Cored (ft)	23.3
Samples	3S

Boring No. CCR-AP-2R

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-2R
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	1 1 1 1	S1 8	25.0 27.0	ML			Very soft yellowish-brown sandy SILT (ML), mps 1 mm, no odor, wet	-	-	-	-	25	75				
							Top of decomposed bedrock at 30.0 ft										
30	7 9 13 12	S2 24	30.0 32.0			30.0	Stiff yellowish-brown to tan sandy SILT (ML) with frequent alternating layers and seems of silt and fine sand. Trace coal and decomposed rock fragments, wet	-	-	-	-	25	75				
						32.0	-BEDROCK-										
35	50/6	S3 6	35.0 37.0				Hard yellowish-brown to gray-brown SILT with sand (ML) with frequent alternating layers and seams of sandy silt and silty fine sand, well stratified, entire sample exhibits distinct rock fabric, wet	-	-	-	-	15	85				
40																	
45																	
50																	
						53.3	Drill action and rig chatter indicated harder rock at 53.0 ft, soil cuttings on auger flights indicated limestone bedrock										
							BOTTOM OF EXPLORATION 53.3 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-2R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-3

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	19 December 2015
Finish	20 December 2015
Driller	B. Marshall
H&A Rep.	T. Vanage
Elevation Datum	450.0 (est.)
Location	See Plan N 966865.12 E 2771404.27

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	Sonic	-	Steel	Rig Make & Model: Track Geoprobe 8140LS
Inside Diameter (in.)	4.5	-	6.0	Bit Type: Cutting Head Drill Mud: None
Hammer Weight (lb)	-	-	-	Casing: Spun Hoist/Hammer: -
Hammer Fall (in.)		-	-	PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 42	0.0 3.5	CL		Medium stiff brown lean CLAY (CL), interbedded gravel, very fine sand partings, no odor, dry -FILL-	-	5	-	-	10	85				
5		U2 48	5.5 9.0	ML	444.5 5.5	Very soft brown SILT (ML), no odor, dry -OVERBURDEN-	-	-	-	-	-	100				
10		U3 120	9.0 19.0													
15						Grades to very moist at 14 feet Grades to wet at 15 feet										
20		U4 120	19.0 29.0													

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/20/15	-	-	-	-	21.97

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	32.5
Rock Cored (ft)	2.5
Samples	5U

Boring No. CCR-AP-3

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-3
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
				CL		429.0 21.0	Medium stiff red-brown lean CLAY (CL), no odor, moist -OVERBURDEN-	-	-	-	-	-	100				
25																	
30						417.5 32.5	Highly weathered brown SANDSTONE, fine-grained, trace silt and clay present -BEDROCK-										
35						415.0 35.0	BOTTOM OF EXPLORATION 35.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-3

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-3R

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	27 July 2016
Finish	28 July 2016
Driller	J. Gryska
H&A Rep.	S.Lewis
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel
Type	HSA	S	Steel
Inside Diameter (in.)	4.25	1 3/8	9.0
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)		30	-

Drilling Equipment and Procedures

Rig Make & Model: Track CME 850 XR
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Drilled through existing observation well CCR-AP-3, see test boring report for soils logged from 0-25 ft -OVERBURDEN-										
5																	
10																	
15																	
20																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
7/27/16	8:00	-	-	-	37.90

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	32.5
Rock Cored (ft)	14.5
Samples	1S

Boring No. CCR-AP-3R

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-3R
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25																	
30																	
						32.5	Top of decomposed bedrock at 32.5 ft -BEDROCK-										
35	12 21 18 25	S1 24	35.0 37.0				Dense tan to yellow-brown silty SAND (SM) with frequent interbedded seams layers of sandy silt and silt, well stratified, entire sample exhibits distinct rock fabric, dry	-	-	5	15	45	35				
40																	
45																	
						47.0	BOTTOM OF EXPLORATION 47.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-3R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-4

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	14 March 2016
Finish	14 March 2016
Driller	J. Gryska
H&A Rep.	J. Yonts
Elevation Datum	472.9 (est.)
Location	See Plan N 966741.47 E 2772827.01

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	6.0	Bit Type: Cutting Head Drill Mud: None
Hammer Weight (lb)	-	140	-	Casing: Spun
Hammer Fall (in.)		30	-	Hoist/Hammer: - PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0				ML		Hand clear to 5.0 ft bgs, mostly brown SILT (ML), no odor, moist -OVERBURDEN-										
5	WOH 1 WOH 1	S1 22	5.0 7.0	ML		Very soft brown SILT (ML), no structure, moist, trace clay, trace woody debris Wet at 6.0 ft	-	-	-	-	5	95				
					464.4 8.5											
10	1 1 2 3	S2 16	8.5 10.5	ML		Soft brown SILT (ML), no odor, dry, faint laminae from light brown to brown (1-2 mm thick)	-	-	-	-	10	90				
15	2 5 4 5	S3 17	13.5 15.5	ML		Similar as above Water between 15.6 ft to 18.5 ft										
20	2 2 2 3	S4 20	18.5 20.5	ML		Similar as above except no structure and wet										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	17:05	-	-	-	31.69

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	28.5
Rock Cored (ft)	7.0
Samples	7S

Boring No. CCR-AP-4

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-4
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						449.4											
25	2 3 4 5	S5 24	23.5 25.5	CL		23.5	Medium stiff dark red brown red-brown CLAY (CL), no structure										
						444.4											
30	2 2 3 5	S6 24	28.5 30.5	SC		28.5	Brown red-brown black clayey SAND (SC), no odor, moist, mostly medium to fine poorly graded sands, weathered sandstone -BEDROCK-										
35	3 6 11 14	S7 24	33.5 35.5	SC			Red-brown orange black yellow mottled clayey SAND (SC), weathered sandstone										
						437.4 35.5	BOTTOM OF EXPLORATION 35.5 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-4

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-4R

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	27 July 2016
Finish	27 July 2016
Driller	J. Gryska
H&A Rep.	C. Toscano
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	9.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Drilled through existing observation well CCR-AP-4, see test boring report for soils logged from 0-35.5 ft.										
							-OVERBURDEN-										
5																	
10																	
15																	
20																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
7/27/16	12:30	-	-	-	31.60

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	28.5
Rock Cored (ft)	19.5
Samples	1S

Boring No. CCR-AP-4R

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-4R
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25																	
						28.0	-BEDROCK-										
30																	
35																	
	2 12 18 22	S1 24	35.5 37.5	SM		35.5	Medium dense tan to yellow-brown silty SAND (SM) with occasional layers of completely weathered bedrock exhibiting distinct rock fabric	-	-	10	15	40	35				
						38.0	Drill action, occasional rig chatter and soil cuttings indicated completely weathered bedrock at 38.0 ft.										
40																	
45																	
						48.0	BOTTOM OF EXPLORATION 48.0 ft										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-4R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-5

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	13 March 2016
Finish	14 March 2016
Driller	J. Gryska
H&A Rep.	S. Lewis
Elevation Datum	451.0 (est.)
Location	See Plan N 968166.03 E 3771019.7

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	6.0	Bit Type: Cutting Head Drill Mud: None
Hammer Weight (lb)	-	140	-	Casing: Spun Hoist/Hammer: -
Hammer Fall (in.)		30	-	PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0				ML			Hand auger to 0.0 ft to 5.0 ft, brown SILT (ML), dry -FILL-										
5	4 2 5 7	S1 18	5.0 7.0	ML			Medium stiff grayish brown SILT (ML), no odor, moist	-	5	-	-	5	90				
	WOH 2 3 2	S2 9	8.0 10.0	ML			Medium stiff grayish brown SILT (ML), no odor, moist	-	-	-	-	5	95				
10																	
	4 7 6 12	S3 15	13.0 15.0	ML			Stiff grayish brown SILT (ML), no odor, dry, mottled with red color	-	-	-	-	10	90				
15																	
	2 5 10 18	S4 12	18.0 20.0	ML			Stiff grayish brown sandy SILT (ML), no odor, dry, trace clay, mottled with red color	-	10	-	-	30	60				
20																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	09:12	-	-	-	37.46

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	45.0
Rock Cored (ft)	-
Samples	9S

Boring No. CCR-AP-5

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

HALEY ALDRICH

Boring No. CCR-AP-5
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	4 11 15 18	S5 18	23.0 25.0	ML		Very stiff brown SILT with sand (ML), no odor, dry, trace clay, mottled with red color	-	5	-	-	15	80				
					423.0 28.0	Soft brown and gray SILT (ML), no odor, wet	-	-	-	-	5	95				
	1 2 1 3	S6 24	28.0 30.0	ML		-OVERBURDEN-										
30																
35	1 3 3 4	S7 24	33.0 35.0	ML		Medium stiff gray SILT (ML), no odor, wet	-	-	-	-	-	100				
					413.0 38.0	Soft brown lean CLAY (CL), no odor, wet	-	-	-	-	-	100				
40	WOH WOH 3 4	S8 24	38.0 40.0	CL												
					408.0 43.0	Very soft brown SILT (ML), no odor, wet, trace clay	-	-	-	-	-	100				
	WOH WOH 2 3	S9 24	43.0 45.0	ML												
45					406.0 45.0	BOTTOM OF EXPLORATION 45.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-5

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-6

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	10 March 2016
Finish	11 March 2016
Driller	J. Gryska
H&A Rep.	S. Lewis
Elevation Datum	458.9 (est.)
Location	See Plan N 969932.76 E 2771626.75

	Casing	Sampler	Barrel
Type	HSA	S	Steel
Inside Diameter (in.)	4.25	1 3/8	6.0
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)		30	-

Drilling Equipment and Procedures

Rig Make & Model: Track CME 850 XR
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							-FILL-										
						454.9											
	1 2 2 4	S1 24	4.0 6.0	CL		4.0	Soft brown lean CLAY (CL), no odor, moist -OVERBURDEN-	-	-	-	-	10	90				
5																	
						449.9											
	8 15 30 50/2	S2 24	9.0 11.0	SM		9.0	Dense grayish brown silty SAND (SM), no odor, moist	-	-	-	10	60	30				
10																	
						444.9											
	20 50/6	S3 6	14.0 16.0			14.0	Tan mottled with red brown and dark gray weathered SANDSTONE, moist, thinly laminated -BEDROCK-										
15																	
	50/6	S4 2	19.0 21.0				Brownish tan weathered SANDSTONE, moist, thinly laminated										
20																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	15:33	-	-	-	12.15

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	14.0
Rock Cored (ft)	25.0
Samples	8S

Boring No. CCR-AP-6

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. CCR-AP-6
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	6 9 15 16	S5 24	24.0 26.0				Brownish tan weathered SANDSTONE, moist, thinly laminated										
						429.9 29.0	Dark gray weathered SHALE, wet, fissile										
30	50/5	S6 4	29.0 31.0														
35	50/6	S7 7	34.0 36.0				Dark gray weathered SHALE, organic matter at 34.5 ft (1.0 in. thick)										
						419.9 39.0	Dark gray weathered SHALE										
	50/1	S8 1	39.0 39.0				BOTTOM OF EXPLORATION 39.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-6

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TEST BORING REPORT

Boring No. CCR-AP-7

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No. 42796-001
Sheet No. 1 of 2
Start 13 March 2016
Finish 14 March 2016
Driller B. Marshall
H&A Rep. J. Yonts
Elevation 486.0 (est.)
Datum
Location See Plan
N 970758.7
E 2773501.63

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	Sonic	-	Steel	Rig Make & Model: Track Geoprobe 8140LS
Inside Diameter (in.)	4.5	-	6.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	-	-	Drill Mud: None
Hammer Fall (in.)		-	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 60	0.0 5.0	ML		Brown SILT with trace clay (ML), no structure, no odor, moist, root material	-	-	-	-	5	95				
						-OVERBURDEN-										
				ML		Brown SILT (ML), no odor, moist, no wood material	-	-	-	-	10	90				
5		U2 60	5.0 10.0	ML		Similar as above										
				ML		Brown SILT with trace clay (ML), no structure, no odor, moist	-	-	-	-	10	90				
10		U3 96	10.0 18.0	ML		Similar as above										
15					471.0 15.0	Orange red red-brown weathered SANDSTONE, moist, mostly medium to fine sands										
						-BEDROCK-										
		U4 24	18.0 20.0			Similar as above except more competent, bedrock										
20		U5 120	20.0 30.0			Similar as above										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	14:18	-	-	-	31.95

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	15.0
Rock Cored (ft)	20.0
Samples	6U

Boring No. CCR-AP-7

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. CCR-AP-7
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						464.0											
						22.0	Brown orange gray SHALE, moist, fissile, trace fine sand										
25						460.0											
						26.0	Gray SILTSTONE, soft, wet										
						458.0											
						28.0	Red brown orange brown SANDSTONE, moist, moistly fine sands										
30		U6 60	30.0 35.0				Brown tan black gray orange SANDSTONE, moist to wet, fine to medium sands										
35						451.0 35.0	BOTTOM OF EXPLORATION 35.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-7

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-7R

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No. 42796-001
Sheet No. 1 of 3
Start 30 July 2016
Finish 30 July 2016
Driller J. Gryska
H&A Rep. C. Toscano
Elevation
Datum
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	9.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Drilled through existing observation well CCR-AP-7, see test boring report for soils logged from 0-35.0 ft. -OVERBURDEN-										
5																	
10																	
15						15.0	Drill action, rig chatter and soil cuttings indicated highly to slightly weathered Sandstone/Shale -BEDROCK-										
20																	

Water Level Data					
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
7/30/16	-	-	-	-	28.30

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 15.0
Rock Cored (ft) 38.5
Samples -

Boring No. CCR-AP-7R

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-7R
File No. 42796-001
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25																	
30																	
35						35.0											
40																	
45																	
50																	

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-7R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-AP-7R
File No. 42796-001
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						53.5	BOTTOM OF EXPLORATION 53.5 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-7R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-BK-1

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 1
Start	10 March 2016
Finish	10 March 2016
Driller	B. Marshall
H&A Rep.	J. Yonts
Elevation Datum	480.4 (est.)
Location	See Plan N 974083.4 E 2770919.08

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	Sonic	-	Steel	Rig Make & Model: Track Geoprobe 8140LS
Inside Diameter (in.)	4.5	-	6.0	Bit Type: Cutting Head Drill Mud: None
Hammer Weight (lb)	-	-	-	Casing: Spun
Hammer Fall (in.)		-	-	Hoist/Hammer: - PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 60	0.0 5.0	ML		Brown and tan SILT (ML), moist, trace clay, trace roots and wood debris -TOPSOIL-	-	-	-	-	10	90				
5		U2 48	5.0 9.0	ML		Similar as above -OVERBURDEN-										
10		U3 120	9.0 19.0	ML		Similar as above except wet in top 6.0 in. of sample										
				CL	464.4 16.0	Dense red brown lean CLAY (CL), moist	-	-	-	-	5	95				
20		U4 43	19.0 22.5	SC	461.4 19.0	Similar as above except more sand content, gradual increase in sand, weathered sandstone	-	-	10	20	30	40				
					459.9 20.5	-BEDROCK- Red brown SANDSTONE										
					457.9 22.5	BOTTOM OF EXPLORATION 22.5 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	13:50	-	-	-	19.51

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	19.0
Rock Cored (ft)	3.5
Samples	4U

Boring No. CCR-BK-1

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-BK-1R

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	29 July 2016
Finish	29 July 2016
Driller	J. Gryska
H&A Rep.	C. Toscano
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	9.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						Drilled through existing observation well CCR-BK-1, see test boring report for soils logged from 0-22.5 ft. -OVERBURDEN-										
19.0						-BEDROCK-										
	1 12 50/1	S1 10	23.0 25.0	SM		Medium dense red-brown to gray-brown silty SAND (SM), trace decomposed bedrock fragments. Note: Bottom 3-inches at tip of spoon consist of pulverized bedrock fragments. Drill action and increase in rig chatter indicated harder rock at 24.0 ft.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
7/29/16	-	-	-	-	54.00

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	19.0
Rock Cored (ft)	45.0
Samples	1S

Boring No. CCR-BK-1R

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-BK-1R
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
30																	
35																	
40																	
45							Drill action indicated harder bedrock at 45.0 ft.										
50																	
55																	
60																	
						64.0	BOTTOM OF EXPLORATION 64.0 ft.										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-BK-1R

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-BK-2

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	11 March 2016
Finish	11 March 2016
Driller	J. Gryska
H&A Rep.	S. Lewis
Elevation Datum	427.5 (est.)
Location	See Plan N 972854.33 E 2769728.14

	Casing	Sampler	Barrel
Type	HSA	S	Steel
Inside Diameter (in.)	4.25	1 3/8	6.0
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)		30	-

Drilling Equipment and Procedures

Rig Make & Model: Track CME 850 XR
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0				ML		-TOPSOIL-										
	1 2 3 4	S1 16	3.5 5.5	ML	424.0 3.5	Medium stiff brown SILT (ML), no odor, moist	-	-	-	-	10	90				
5						-OVERBURDEN-										
	1 1 1 1	S2 24	8.5 10.5	ML		Very soft brown SILT (ML), no odor, wet, mottled with gray colors	-	-	-	-	10	90				
10					414.0 13.5											
	1 1 1 2	S3 24	13.5 15.5	CL		Very soft brownish gray lean CLAY (CL), no door, wet, wood fragments present	-	-	-	-	5	95				
15																
	1 1 2 2	S4 24	18.5 20.5	CL		Soft brownish gray silty lean CLAY (CL), no odor, wet	-	-	-	-	5	95				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	10:38	-	-	-	13.40

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	25.5
Rock Cored (ft)	-
Samples	5S

Boring No. CCR-BK-2

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. CCR-BK-2
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						404.0											
25	2 2 2 4	S5 24	23.5 25.5	ML		23.5	Medium stiff brown clayey SILT (ML), no odor, wet	-	-	-	-	5	95				
						402.0 25.5	BOTTOM OF EXPLORATION 25.5 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-BK-2

TEST BORING REPORT

Boring No. CCR-LF-1

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	10 March 2016
Finish	10 March 2016
Driller	B. Marshall
H&A Rep.	J. Yonts
Elevation Datum	432.8 (est.)
Location	See Plan N 970812.18 E 2771247.76

	Casing	Sampler	Barrel
Type	Sonic	-	Steel
Inside Diameter (in.)	4.5	-	6.0
Hammer Weight (lb)	-	-	-
Hammer Fall (in.)		-	-

Drilling Equipment and Procedures

Rig Make & Model: Track Geoprobe 8140LS
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 12	0.0 5.0	CH		Red brown sandy CLAY (CH), no structure, mps 1.0 in., moist -FILL-	5	5	5	10	15	60				
				SC	430.3 2.5	Black orange yellow red-brown clayey SAND (SC), mps 1.1 in., no structure, moist	-	-	10	40	30	20				
					428.8 4.0	-BEDROCK-										
5		U2 48	5.0 9.0			Black orange yellow SANDSTONE, wet Similar as above except white tan orange Similar as above except no clay, uniform sand (medium > fine)										
		U3 60	9.0 14.0		423.8 9.0	Black coal, organic rich, no structure, wet										
10					423.3 9.5	Gray SHALE, weathered, no structure, moist, thinly laminated										
					420.8 12.0	Black coal, organic rich layer, moist White gray orange SILTSTONE, weathered, moist, soft										
					419.8 13.0	Orange and tan SILTSTONE, soft to hard, weathered, dry										
		U4 36	14.0 17.0		418.8 14.0	Similar as above										
15		U5 24	17.0 19.0			Similar as above										
					413.8 19.0	BOTTOM OF EXPLORATION 19.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	14:35	-	-	-	4.04

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	4.0
Rock Cored (ft)	15.0
Samples	5U

Boring No. CCR-LF-1

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. CCR-LF-2

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 3
Start	12 March 2016
Finish	12 March 2016
Driller	B. Marshall
H&A Rep.	J. Yonts
Elevation Datum	470.1 (est.)
Location	See Plan N 970681.32 E 2772205.05

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	Sonic	-	Steel	Rig Make & Model: Track Geoprobe 8140LS
Inside Diameter (in.)	4.5	-	6.0	Bit Type: Cutting Head Drill Mud: None
Hammer Weight (lb)	-	-	-	Casing: Spun Hoist/Hammer: -
Hammer Fall (in.)		-	-	PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0					469.9	-TOPSOIL-										
		U1 30	0.0 5.0	ML	0.2	Brown SILT (ML), no structure, wet, root material, gradual increase in sand content with depth	-	-	-	-	10	90				
						-FILL-										
				ML		Brown sandy SILT (ML), no structure, moist	-	-	-	5	25	70				
				CL	467.1 3.0	Brown red-brown CLAY (CL), no structure, moist mostly fine material, trace fine sand	-	-	-	-	5	95				
5		U2 20	5.0 10.0	CL		Similar as above										
				ML	462.6 7.5	Brown SILT (ML), moist, breaks into 1-2 mm layers	-	-	-	-	5	95				
						-OVERBURDEN-										
10		U3 96	10.0 13.0	ML		Gray brown SILT (ML), moist, few woody materials (black)	-	-	-	5	10	85				
				ML		Similar as above except increased clay content										
15					454.1 16.0											
				CL		Dense red brown yellow CLAY (CL), moist, trace coarse material, few sandstone rock fragments < 1.0 in. bottom of sample	-	-	-	-	5	95				
		U4 24	18.0 20.0			Drilling action indicates bedrock at 18.5 ft										
					451.4 18.7	Yellow to yellow brown orange SANDSTONE, weathered, dry, mostly medium sands										
20		U5 72	20.0 26.0			-BEDROCK-										

Water Level Data					
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	14:45	-	-	-	24.75

Sample ID
- O - Open End Rod
- T - Thin Wall Tube
- U - Undisturbed Sample
- S - Split Spoon Sample

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary

Overburden (ft)	18.7
Rock Cored (ft)	26.3
Samples	8U

Boring No. CCR-LF-2

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. CCR-LF-2
File No. 42796-001
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						446.1 24.0	Gray white black and orange laminated (1-2 mm) SILTSTONE, dry										
25						444.1 26.0	Brown tan SANDSTONE, dry, mostly fine and medium sands										
		U6 48	26.0 30.0														
30		U7 120	30.0 40.0				Notes: Drilling action changed at ~33.0 ft to 35.0 ft Similar as above except tan brown and orange, wet										
35																	
40		U8 60	40.0 45.0				Similar as above except poorly graded										
45						425.1 45.0	BOTTOM OF EXPLORATION 45.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-LF-2

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TEST BORING REPORT

Boring No. CCR-LF-3

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 CR
Inside Diameter (in.)	4.25	1 3/8	6.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

File No. 42796-001
Sheet No. 1 of 2
Start 14 March 2016
Finish 14 March 2016
Driller J. Gryska
H&A Rep. J. Yonts
Elevation 482.0 (est.)
Datum
Location See Plan
N 970949.7
E 2773138.97

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						Hand cleared to 5.0 ft bgs, no sample, brown SILT (ML), no odor, moist	-	-	-	-	5	95				
5	1 1 1 1	S1 23	5.0 7.0	ML		Brown SILT (ML), no structure, no odor, wet, trace roots -OVERBURDEN-	-	-	-	-	5	95				
10	4 14 12 14	S2 20	10.0 12.0	ML		Similar as above except moist, no roots										
				SP	471.2 10.8	Brown black and orange poorly graded SAND (SP), weathered sandstone	-	-	5	50	40	5				
15	50/4	S3 41	15.0 17.0		467.0 15.0	Brown tan SANDSTONE medium to fine sands, uniform, moist, trace clay										
20	50/5	S4 5	20.0 22.0			Tan light brown to brown SANDSTONE, medium to fine sands, moist										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	16:30	-	-	-	25.80

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 15.3
Rock Cored (ft) 20.0
Samples 7S

Boring No. CCR-LF-3

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. CCR-LF-3
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	50/4	S5 4	25.0 27.0				Similar as above except wet										
30	50/5	S6 5	30.0 32.0				Similar as above except red brown/maroon, wet Note: Driller noted drilling action indicated fractures between 30.0 and 35.0 ft bgs										
35	50/3	S7 3	35.0 37.0			446.7 35.3	BOTTOM OF EXPLORATION 35.3 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-LF-3

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TEST BORING REPORT

Boring No. CCR-LF-4

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No. 42796-001
Sheet No. 1 of 3
Start 11 March 2016
Finish 11 March 2016
Driller B. Marshall
H&A Rep. J. Yonts
Elevation 476.6 (est.)
Datum
Location See Plan
N 972312.24
E 2772876.83

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	Sonic	-	Steel	Rig Make & Model: Track Geoprobe 8140LS
Inside Diameter (in.)	4.5	-	6.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	-	-	Drill Mud: None
Hammer Fall (in.)		-	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 60	0.0 5.0	ML			Brown SILT (ML), no structure, no odor, moist, trace clay, less clay with depth to 5.0 ft, trace root material	-	-	-	-	5	95				
5		U2 60	5.0 10.0	ML			Similar as above										
10		U3 120	10.0 20.0	ML			Similar as above Wet at 12.0 ft, possible perched										
				CL		463.6 13.0	Dense red brown CLAY (CL), no odor, moist, trace coarse material -OVERBURDEN-	-	-	-	-	5	95				
15																	
20		U4 120	20.0 30.0	CL			Similar as above except more fine sand, increasing sand content with depth, moist	-	-	-	-	30	70				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	14:00	-	-	-	48.36

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 28.5
Rock Cored (ft) 31.5
Samples 8U

Boring No. CCR-LF-4

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. CCR-LF-4
File No. 42796-001
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
						453.6											
				SC		23.0	Red-brown yellow-brown clayey SAND (SC), moist, weathered bedrock	-	-	-	10	50	40				
25							-BEDROCK-										
						448.1											
						28.5	Yellow brown white red-brown SANDSTONE, mostly medium to fine sands, dry										
30		U5 120	30.0 40.0				Similar as above except yellow, tan, yellow-brown, white, and red										
35																	
40		U6 120	40.0 50.0				Similar as above except color variations Light brown SANDSTONE, dry										
							Yellow to yellow-brown SANDSTONE, dry										
							Brown light brown SANDSTONE, dry										
							Dark brown SANDSTONE, dry										
45																	
							Red brown, SANDSTONE, moist, trace clay										
						429.6											
						47.0	Gray to dark gray SHALE, fissile, no fossil or other identifiers										
							Black organic rich SHALE, no fossils or layering										
50		U7 36	50.0 53.0				Similar as above Gray SHALE, fissile, no other identifiers observed, dry										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-LF-4

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-LF-4
File No. 42796-001
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
		U8 84	53.0 60.0														
55						421.6 55.0	Gray SILTSTONE										
60						416.6 60.0	BOTTOM OF EXPLORATION 60.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-LF-4

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-LF-5

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	12 March 2016
Finish	12 March 2016
Driller	J. Gryska
H&A Rep.	S. Lewis
Elevation Datum	427.5 (est.)
Location	See Plan N 972228.16 E 2772003.91

	Casing	Sampler	Barrel
Type	HSA	S	Steel
Inside Diameter (in.)	4.25	1 3/8	6.0
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)		30	-

Drilling Equipment and Procedures

Rig Make & Model: Track CME 850 XR
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0				ML		Hand auger from 0.0 ft to 5.0 ft, brown SILT (ML), dry										
						-FILL-										
				ML		Gray and black SILT (ML), petroleum-like odor, moist										
5	4 9 7 6	S1 19	5.0 7.0	ML ML		Very stiff gray and black SILT (ML), petroleum-like odor, moist Very stiff brown SILT (ML), no odor, moist	- -	- -	- -	- -	5 5	95 95				
	2 2 3 5	S2 24	9.0 11.0	CL	418.5 9.0	Medium stiff brown lean CLAY (CL), no odor, moist	-	-	-	-	5	95				
10						-OVERBURDEN-										
	2 6 7 10	S3 24	14.0 16.0	ML	413.5 14.0	Stiff grayish brown SILT with gravel (ML), no odor, moist, organic matter present	-	15	5	5	5	70				
15				ML		Stiff orange black SILT with gravel (ML), no odor, moist, organic matter present	-	15	5	5	5	70				
	4 12 19 36	S4 24	19.0 21.0		408.5 19.0	Gray brown black SILTSTONE, dry, layers of organic matter and laminated less than a mm										
20						-BEDROCK-										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	11:01	-	-	-	20.50

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	19.0
Rock Cored (ft)	11.0
Samples	6S

Boring No. CCR-LF-5

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-LF-5
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	9 16 22 27	S5 24	24.0 26.0				Similar as above										
						398.5											
30	5 5 50/0	S6 no recovery	29.0 31.0			29.0 397.5 30.0	Similar as above, refusal at 30.0 ft, wet, dark gray limestone BOTTOM OF EXPLORATION 30.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-LF-5

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-LF-6

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 1
Start	11 March 2016
Finish	12 March 2016
Driller	J. Gryska
H&A Rep.	S. Lewis
Elevation Datum	409.2 (est.)
Location	See Plan N 972269.53 E 2771046.15

	Casing	Sampler	Barrel
Type	HSA	S	Steel
Inside Diameter (in.)	4.25	1 3/8	6.0
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)		30	-

Drilling Equipment and Procedures

Rig Make & Model: Track CME 850 XR
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Hand clear to 5.0 ft bgs, brown and gray SILT (ML), rock fragments -FILL-										
5	8 14 19 19	S1 17	5.0 7.0	ML		404.2 5.0	Hard brownish gray SILT (ML), no odor, moist	-	-	-	-	-	100				
						400.7 8.5	Dark gray LIMESTONE, no odor, wet -BEDROCK-										
10						399.2 10.0	BOTTOM OF EXPLORATION 10.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	10:00	-	-	-	12.15

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	10.0
Rock Cored (ft)	-
Samples	1S

Boring No. CCR-LF-6

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-PZ-5

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No. 42796-001
Sheet No. 1 of 3
Start 18 December 2015
Finish 18 December 2015
Driller B. Marshall
H&A Rep. T. Vanage
Elevation 484.1 (est.)
Datum
Location See Plan
N 965928.39
E 2772500.01

	Casing	Sampler	Barrel
Type	Sonic	S	Steel
Inside Diameter (in.)	4.5	1 3/8	6.0
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)		30	-

Drilling Equipment and Procedures

Rig Make & Model: Track Geoprobe 8140LS
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0		U1 30	0.0 5.0			Missing recovery - gravel										
				CL		Brown lean CLAY, no odor, moist -FILL-	-	-	-	-	-	100				
5		U2 32	5.0 10.0													
				ML	475.4 8.8	Brown SILT, no odor, dry, laminae bedding observed -OVERBURDEN-	-	-	-	-	-	100				
10		U3 55	10.0 15.0													
15																
20		U4 58	20.0 25.0													

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/20/15	-	-	-	-	Dry

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 40.3
Rock Cored (ft) 8.8
Samples 8U

Boring No. CCR-PZ-5

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-PZ-5
File No. 42796-001
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
							Moist at 21.0 ft										
				CL		459.6 24.5	Medium stiff brown lean CLAY with silt, no odor, dry to moist	-	-	-	-	-	100				
25		U5 60	25.0 30.0														
30		U6 36	30.0 35.0	CL			Similar as above										
35		U7 60	35.0 40.0	CL			Similar as above										
40		U8 120	40.0 50.0			443.9 40.3	Tan moderately weathered fine-grained SANDSTONE -BEDROCK-										
45																	
50						434.1 50.0	BOTTOM OF EXPLORATION 50.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-PZ-5

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-SP-1

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 1
Start	13 March 2016
Finish	13 March 2016
Driller	J. Gryska
H&A Rep.	S. Lewis
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	6.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer: -
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0				ML		Hand clear to 5.0 ft bgs, brown SILT (ML), dry -FILL-										
5	4 5 8 8	S1 15	5.0 7.0	ML	5.0	Stiff brown SILT (ML), no odor, moist	-	-	-	-	-	100				
10	3 5 7 5	S2 17	8.5 10.5	ML		Stiff dark gray SILT (ML), no odor, moist, trace wood fragments	-	-	-	-	-	100				
15	WOH WOH WOH 3	S3 24	13.5 15.5	ML		Very soft grayish brown SILT ML), no odor, wet	-	-	-	-	-	100				
20	WOH 2 1 2	S4 20	18.5 20.5	ML		Soft grayish brown SILT (ML), no odor, wet, mottled with orange/black colors	-	-	-	-	-	100				
					20.5	BOTTOM OF EXPLORATION 20.5 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	09:41	-	-	-	9.00

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	20.0
Rock Cored (ft)	-
Samples	4S

Boring No. CCR-SP-1

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. CCR-SP-2

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 2
Start	13 March 2016
Finish	13 March 2016
Driller	J. Gryska
H&A Rep.	S. Lewis
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel
Type	HSA	S	Steel
Inside Diameter (in.)	4.25	1 3/8	6.0
Hammer Weight (lb)	-	140	-
Hammer Fall (in.)		30	-

Drilling Equipment and Procedures

Rig Make & Model: Track CME 850 XR
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: -
PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							Hand auger from 0.0 ft to 5.0 ft 1.0 ft to 1.5 ft, crushed limestone and clay										
				CL		1.5	-FILL- Brown CLAY (CL), dry										
5	4 7 12 12	S1 18	5.0 7.0	ML		5.0	Very stiff grayish brown SILT (ML), no odor, moist	-	-	-	-	-	100				
10	3 4 6 6	S2 14	8.5 10.5	ML			Stiff gray SILT with sand (ML), no odor, moist -OVERBURDEN-	-	-	-	-	15	85				
15	1 2 2 2	S3 17	13.5 15.5	ML			Soft grayish brown SILT (ML), no odor, wet, trace clay present	-	-	-	-	5	95				
20	1 1 1 1	S4 18	18.5 20.5	ML			Very soft grayish brown SILT (ML), no odor, wet, trace clay present	-	-	-	-	5	95				

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	09:35	-	-	-	8.60

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	25.5
Rock Cored (ft)	-
Samples	5S

Boring No. CCR-SP-2

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-SP-2
File No. 42796-001
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
25	2 1 2 3	S5 24	23.5 25.5	ML			Soft gray SILT (ML), no odor, wet, trace wood fragments, trace clay present	-	-	-	-	5	95				
						25.5	BOTTOM OF EXPLORATION 25.5 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-SP-2

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

TEST BORING REPORT

Boring No. CCR-SP-3

Project	Vectren, A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling

File No.	42796-001
Sheet No.	1 of 1
Start	13 March 2016
Finish	13 March 2016
Driller	J. Gryska
H&A Rep.	S. Lewis
Elevation	
Datum	
Location	See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	Steel	Rig Make & Model: Track CME 850 XR
Inside Diameter (in.)	4.25	1 3/8	6.0	Bit Type: Cutting Head
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)		30	-	Casing: Spun
				Hoist/Hammer:
				PID Make & Model: -

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0				ML		Hand auger from 0.0 ft to 5.0 ft, brown SILT (ML), dry -FILL-										
5	1 1 2 3	S1 22	5.0 7.0	ML	5.0	Soft brownish gray mottled SILT (ML), no odor, wet -OVERBURDEN-	-	-	-	-	5	95				
10	1 1 2 2	S2 21	8.5 10.5	ML		Soft grayish brown mottled SILT (ML), no odor, wet	-	-	-	-	-	100				
15	WOH WOH WOH WOH	S3 24	13.5 15.5	CL	13.5	Very soft gray lean CLAY (CL), no odor, wet	-	-	-	-	-	100				
20	2 5 8 9	S4 24	18.5 20.5	ML	18.5	Stiff gray-brown lean CLAY (CL), no odor, moist, red mottling	-	-	-	-	-	100				
					20.5	BOTTOM OF EXPLORATION 20.5 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
3/15/16	09:28	-	-	-	3.44

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	20.5
Rock Cored (ft)	-
Samples	4S

Boring No. CCR-SP-3

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 REV HA-LIB09.GLB HA-TB+CORE+WELL-07-2 W FENCE.GDT \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-1

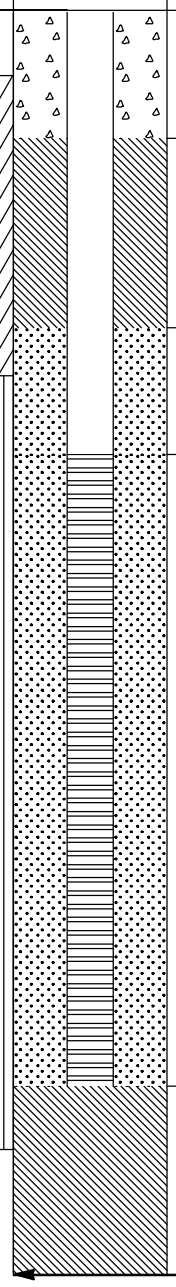
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	B. Marshall
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	18 Dec 2015
H&A Rep.	T. Vanage
Location	N 968260.82 E 2773560.71
Ground El. Datum	465.7 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
				2.0	463.7
	5			5.0	460.7
				7.0	458.7
OVERBURDEN	10				
	15			17.0	448.7
	18.0				
BEDROCK	20.0			20.0	445.7



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.0 ft
Height of top of riser above ground surface	2.8 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.0 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	7.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Bentonite	2.0	3.0
Sand	5.0	12.5
Bentonite	17.5	2.5
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	7.0 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	17.0 ft
Bottom of silt trap	-
Depth of bottom of borehole	20.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-1R

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

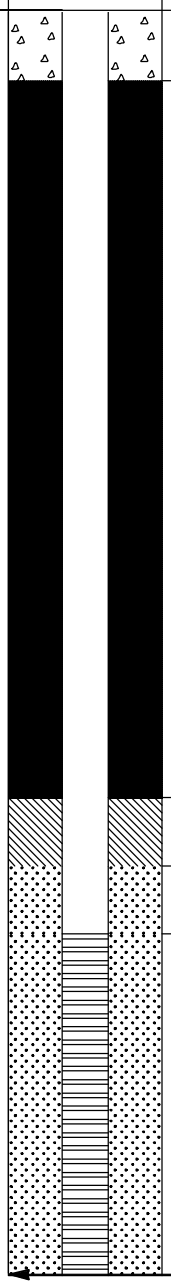
Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001
Date Installed 26 Jul 2016
H&A Rep. C. Toscano
Location See Plan

Ground El.
Datum

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
OVERBURDEN	0 – 18.0			2.0	
BEDROCK	18.0 – 37.0			23.0	
				25.0	
				27.0	
				37.0	



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.0 ft
Height of top of riser above ground surface	2.8 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.0 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	26.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	0.0	23.0
Bentonite	23.0	2.0
Sand	25.0	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	26.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	36.7 ft
Bottom of silt trap	37.0 ft
Depth of bottom of borehole	37.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-2

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	B. Marshall
Initial Water Level (depth bgs)	ft

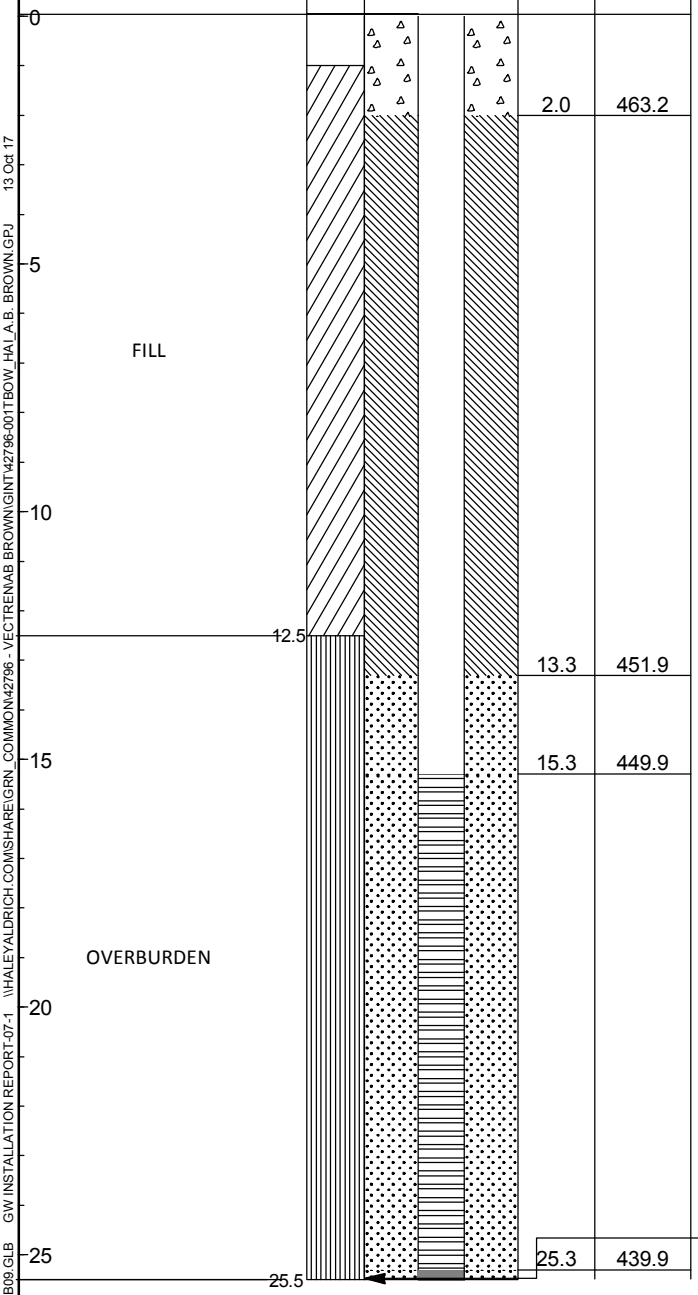
Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	17 Dec 2015
H&A Rep.	T. Vanage
Location	N 969079.16 E 2771922.52
Ground El. Datum	465.2 (est.)

SOIL/ROCK

CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
FILL	0			2.0	463.2
	12.5			13.3	451.9
OVERBURDEN				15.3	449.9
	25.5			25.3	439.9



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.2 ft
Height of top of riser above ground surface	2.8 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	2.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	15.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	2.0
Bentonite	2.0	10.5
Sand	12.5	13.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	15.0 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	25.5 ft
Bottom of silt trap	25.3 ft
Depth of bottom of borehole	25.5 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-2R

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

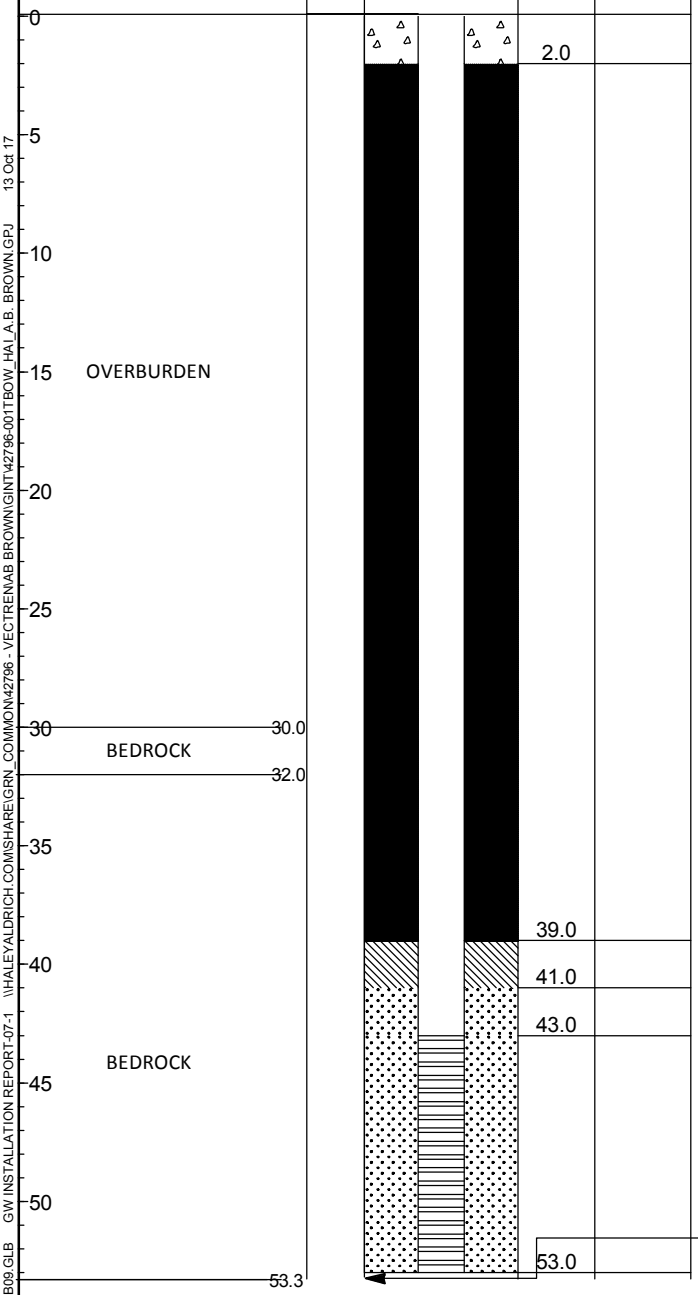
Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001
Date Installed 28 Jul 2016
H&A Rep. C. Toscano
Location See Plan

Ground El.
Datum

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
OVERBURDEN				2.0	
BEDROCK	30.0			39.0	
	32.0			41.0	
BEDROCK				43.0	
	53.3			53.0	



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.0 ft
Height of top of riser above ground surface	2.8 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.0 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	43.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	0.0	39.0
Bentonite	39.0	2.0
Sand	41.0	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	43.0 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	53.0 ft
Bottom of silt trap	53.3 ft
Depth of bottom of borehole	53.3 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-3

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	B. Marshall
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	20 Dec 2015
H&A Rep.	T. Vanage
Location	N 966865.12 E 2771404.27
Ground El. Datum	450.0 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
				2.0	448.0
	5				
	10			13.0	437.0
	15			15.0	435.0
	20				
	25			25.0	425.0
				26.0	424.0
OVERBURDEN					
	30				
	32.5				
BEDROCK					
	35.0			35.0	415.0

WELL CONSTRUCTION DETAILS

Type of protective cover	Flush Mount
Depth of Morrison Flush Mount below ground surface	0.0 ft
Height of top of riser above ground surface	0.3 ft
Type of protective casing	Morrison Flush Mount
Length	0.8 ft
Inside diameter	0.8 in.
Depth of bottom of Morrison Flush Mount	0.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	15.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Bentonite	2.0	11.0
Sand	13.0	13.0
Bentonite	26.0	9.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	15.0 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	25.0 ft
Bottom of silt trap	25.5 ft
Depth of bottom of borehole	35.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-3R

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	28 Jul 2016
H&A Rep.	S.Lewis
Location	See Plan
Ground El.	
Datum	

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
	5			2.0	
	10				
	15				
	20				
	25				
	30			33.0	
	35			35.0	
	40			37.0	
	45				
	47.0			47.0	

WELL CONSTRUCTION DETAILS

Type of protective cover	Flush Mount
Depth of Morrison Flush Mount below ground surface	0.0 ft
Height of top of riser above ground surface	0.2 ft
Type of protective casing	Morrison Flush Mount
Length	0.8 ft
Inside diameter	3.0 in.
Depth of bottom of Morrison Flush Mount	0.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	36.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	33.0
Bentonite	33.0	2.0
Sand	35.0	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	36.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	46.7 ft
Bottom of silt trap	47.0 ft
Depth of bottom of borehole	47.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-4

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

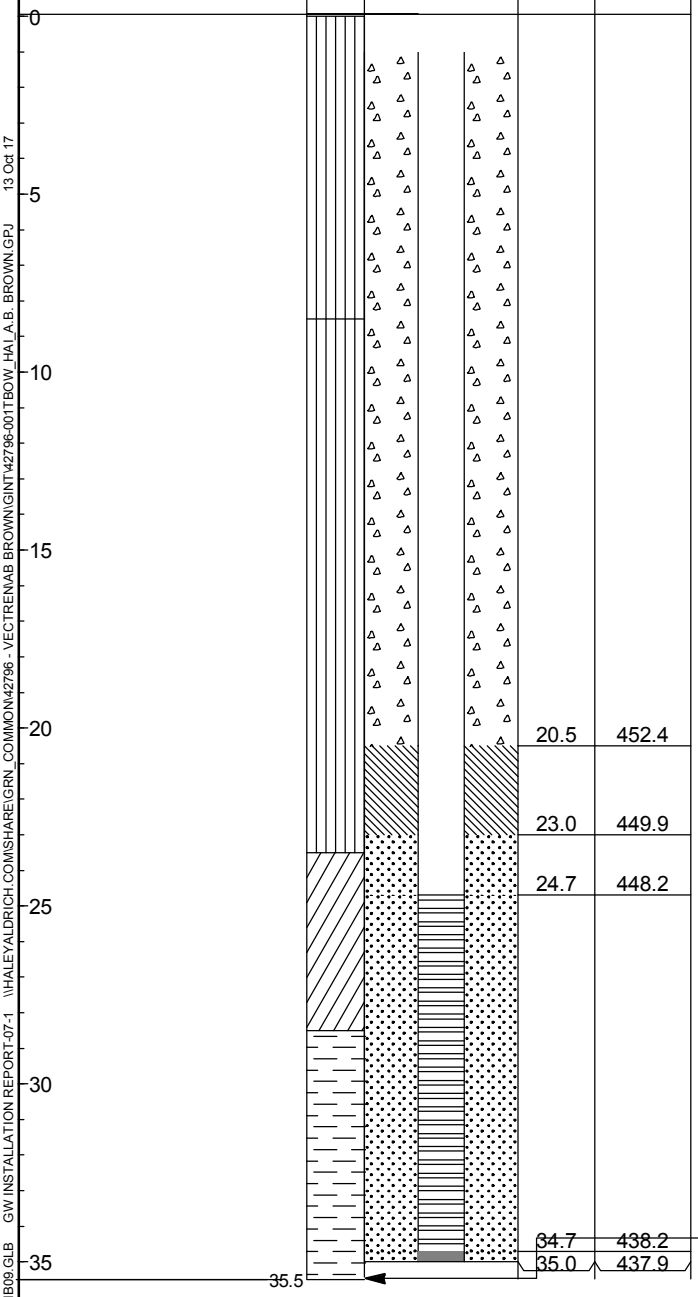
Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	14 Mar 2016
H&A Rep.	J. Yonts
Location	N 966741.47 E 2772827.01
Ground El. Datum	472.9 (est.)

SOIL/ROCK

CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
				20.5	452.4
				23.0	449.9
				24.7	448.2
				34.7	438.2
				35.0	437.9



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	2.8 ft
Height of top of riser above ground surface	2.5 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.3 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	24.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	1.0	19.5
Bentonite	20.5	2.5
Sand	23.0	12.0
	-	-

Diameter of borehole	8.0 in.
Depth to top of well screen	24.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	34.7 ft
Bottom of silt trap	35.0 ft
Depth of bottom of borehole	35.5 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-4R

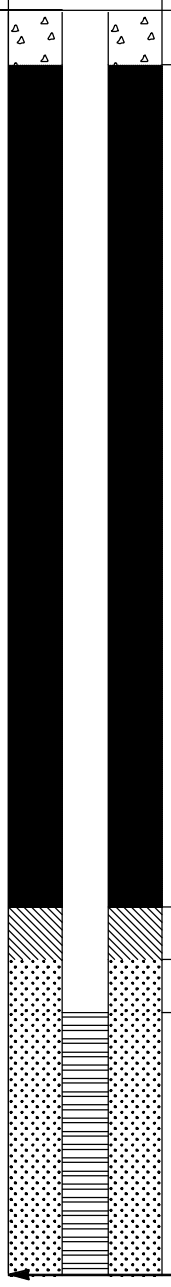
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	27 Jul 2016
H&A Rep.	C. Toscano
Location	See Plan
Ground El.	
Datum	

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
				2.0	
	5				
	10				
	15				
	20				
	25				
	28.0				
	30				
				34.0	
	35			36.0	
				38.0	
	40				
	45				
	48.0			48.0	



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.0 ft
Height of top of riser above ground surface	2.7 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.0 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	37.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	1.0	36.0
Bentonite	36.0	2.0
Sand	38.0	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	37.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	47.7 ft
Bottom of silt trap	48.0 ft
Depth of bottom of borehole	48.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-5

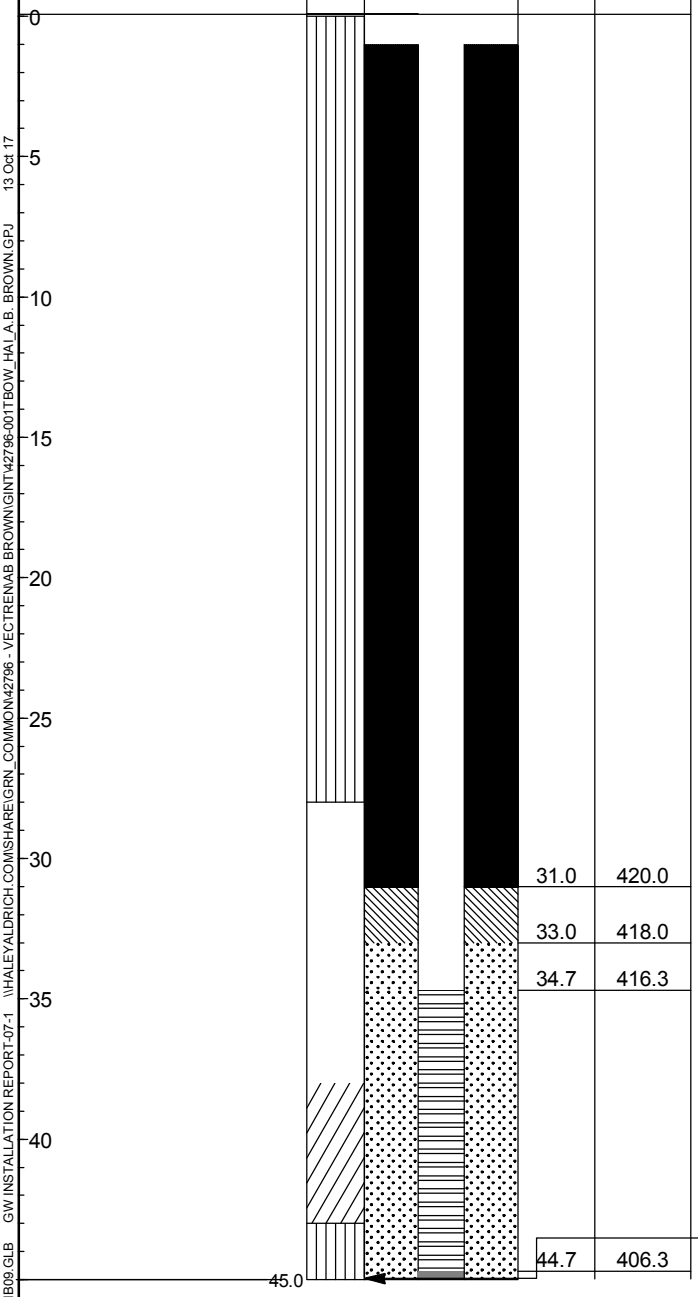
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	14 Mar 2016
H&A Rep.	S. Lewis
Location	N 968166.03 E 3771019.7
Ground El. Datum	451.0 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
	5				
	10				
	15				
	20				
	25				
	30			31.0	420.0
				33.0	418.0
	35			34.7	416.3
	40				
	45.0			44.7	406.3



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.0 ft
Height of top of riser above ground surface	2.7 ft
Type of protective casing	Steel
Length	5.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	2.0 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	34.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	1.0	30.0
Bentonite	31.0	2.0
Sand	33.0	12.0
	-	-

Diameter of borehole	8.0 in.
Depth to top of well screen	34.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	44.7 ft
Bottom of silt trap	45.0 ft
Depth of bottom of borehole	45.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-6

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	11 Mar 2016
H&A Rep.	S. Lewis
Location	N 969932.76 E 2771626.75
Ground El. Datum	458.9 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
	5				
ALLUVIUM	10				
	14.0				
	15				
BEDROCK	20				
	25			25.0	433.9
				27.0	431.9
	29.0			28.7	430.2
	30				
	35				
	39.0			38.7	420.2

WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.2 ft
Height of top of riser above ground surface	2.9 ft
Type of protective casing	Steel
Length	5.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	1.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	28.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	1.0	24.0
Bentonite	25.0	2.0
Sand	27.0	12.0
	-	-

Diameter of borehole	8.0 in.
Depth to top of well screen	28.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	39.0 ft
Bottom of silt trap	28.7 ft
Depth of bottom of borehole	39.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HA_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-7

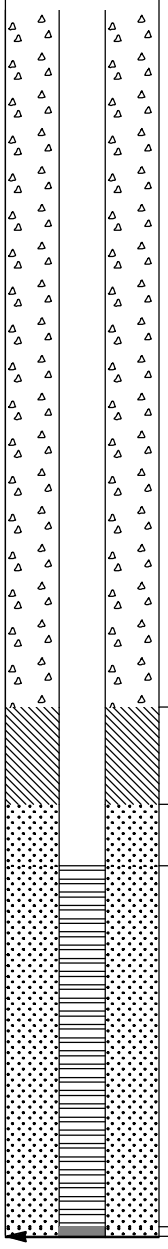
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	B. Marshall
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	14 Mar 2016
H&A Rep.	J. Yonts
Location	N 970758.7 E 2773501.63
Ground El.	486.0 (est.)
Datum	

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
	5				
	10				
	15	15.0			
	20			20.3	465.7
	22.0			23.0	463.0
	25			24.7	461.3
	26.0				
	28.0				
	30				
	35.0			34.7	451.3



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.0 ft
Height of top of riser above ground surface	2.7 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.1 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	24.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	1.0	19.3
Bentonite	20.3	2.7
Sand	23.0	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	24.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	34.7 ft
Bottom of silt trap	35.0 ft
Depth of bottom of borehole	35.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-AP-7R

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

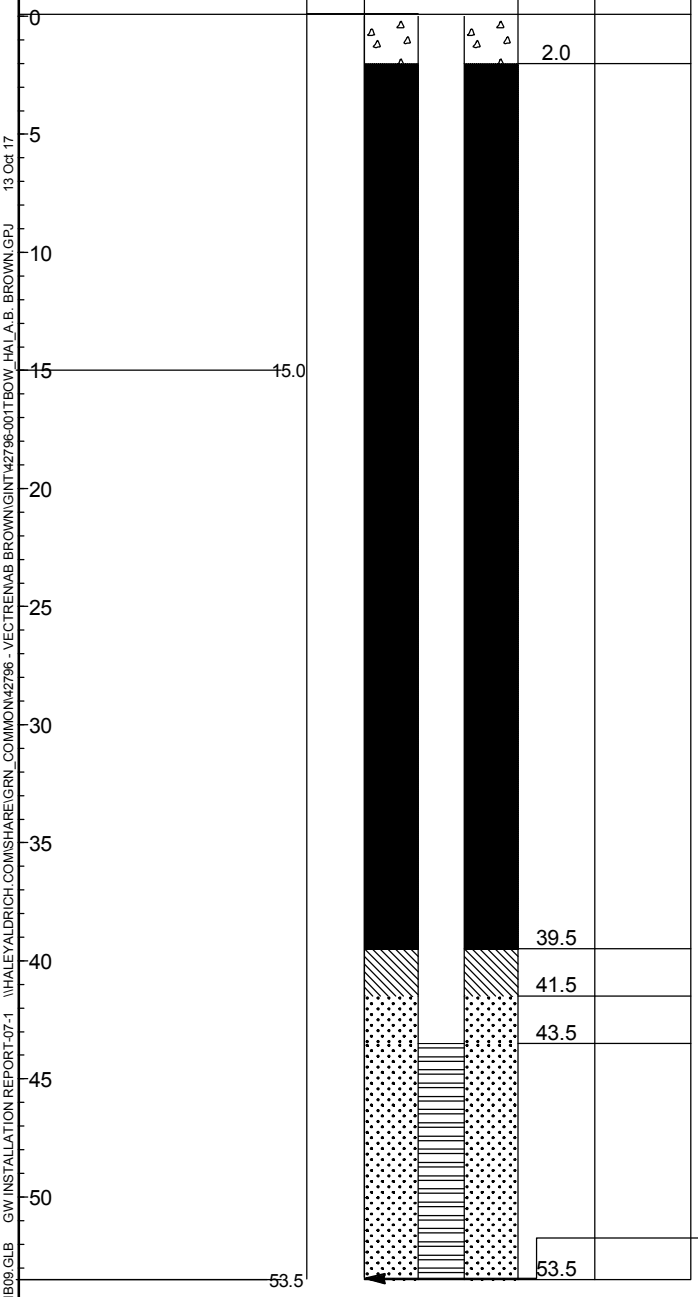
Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001
Date Installed 30 Jul 2016
H&A Rep. C. Toscano
Location See Plan

Ground El.
Datum

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0			2.0	
	15.0			39.5	
				41.5	
				43.5	
	53.5			53.5	



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.0 ft
Height of top of riser above ground surface	2.7 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.0 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	53.2 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	1.0	41.5
Bentonite	41.5	2.0
Sand	43.5	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	53.2 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	53.2 ft
Bottom of silt trap	53.5 ft
Depth of bottom of borehole	53.5 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-BK-1

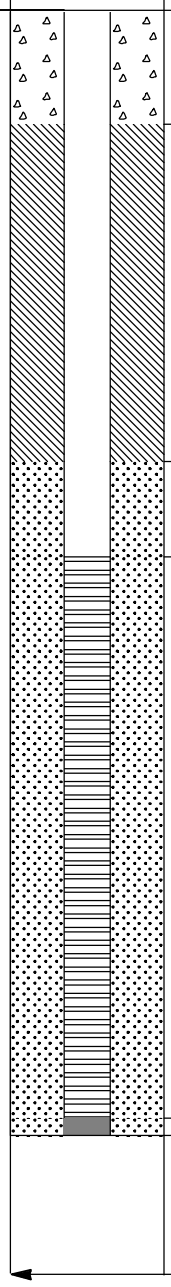
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	B. Marshall
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	10 Mar 2016
H&A Rep.	J. Yonts
Location	N 974083.4 E 2770919.08
Ground El. Datum	480.4 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
				2.0	478.4
	5				
TOPSOIL				8.0	472.4
				9.7	470.7
	10				
	15				
	16.0				
				19.7	460.7
	20			20.0	460.4
	22.5				



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.3 ft
Height of top of riser above ground surface	3.0 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	2.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	9.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	2.0
Bentonite	2.0	6.0
Sand	8.0	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	9.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	19.7 ft
Bottom of silt trap	20.0 ft
Depth of bottom of borehole	22.5 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-BK-1R

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

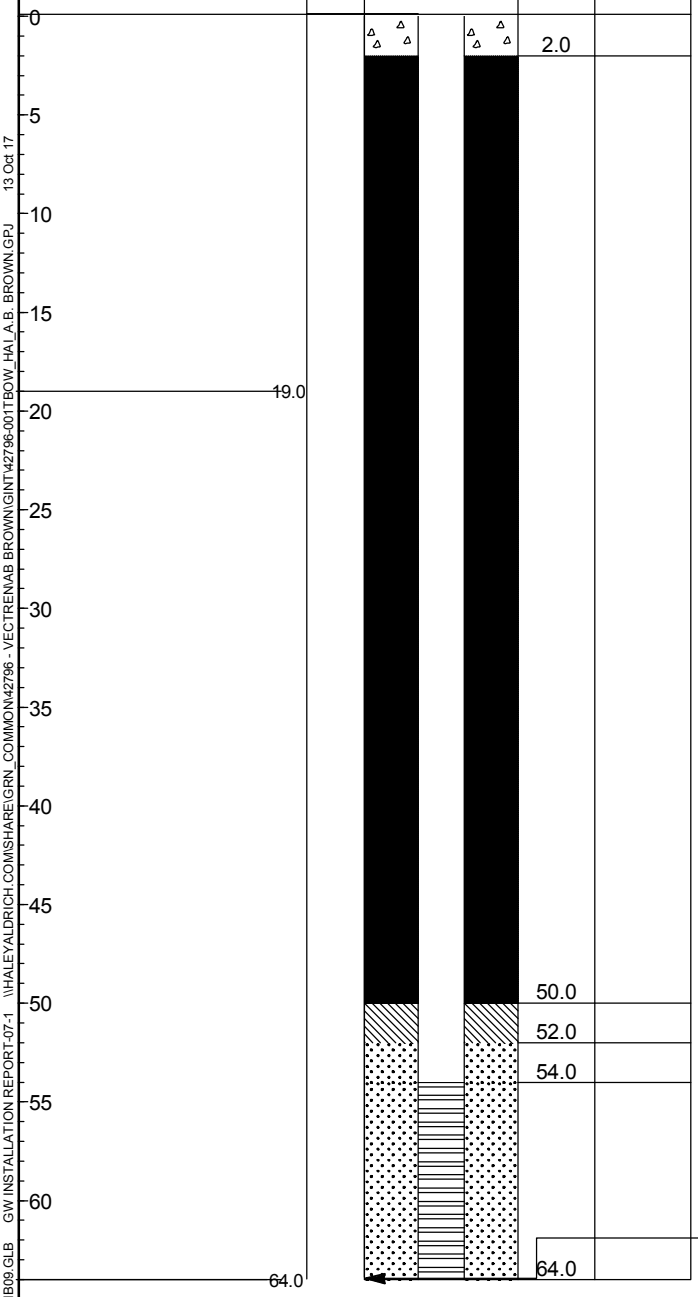
Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001
Date Installed 29 Jul 2016
H&A Rep. C. Toscano
Location See Plan

Ground El.
Datum

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	19.0			2.0	
	64.0			50.0	
				52.0	
				54.0	
				64.0	



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.0 ft
Height of top of riser above ground surface	2.7 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.0 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	53.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	1.0	50.0
Bentonite	50.0	2.0
Sand	52.0	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	53.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	63.7 ft
Bottom of silt trap	64.0 ft
Depth of bottom of borehole	64.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HA_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-BK-2

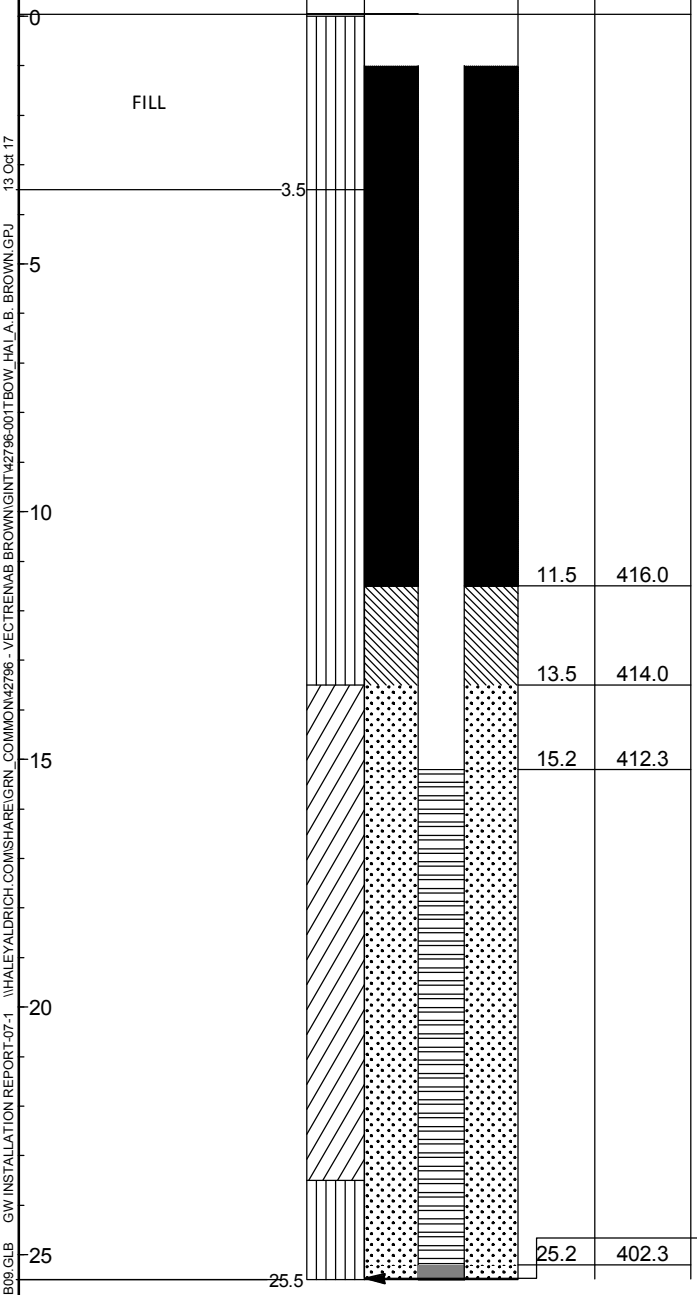
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	11 Mar 2016
H&A Rep.	S. Lewis
Location	N 972854.33 E 2769728.14
Ground El. Datum	427.5 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
FILL	0				
	3.5				
				11.5	416.0
				13.5	414.0
				15.2	412.3
	25.5			25.2	402.3



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.4 ft
Height of top of riser above ground surface	3.1 ft
Type of protective casing	Steel
Length	5.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	1.6 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	15.2 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	1.0	10.5
Bentonite	11.5	2.0
Sand	13.5	12.0
	-	-

Diameter of borehole	8.0 in.
Depth to top of well screen	15.2 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	25.5 ft
Bottom of silt trap	25.2 ft
Depth of bottom of borehole	25.5 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-LF-1

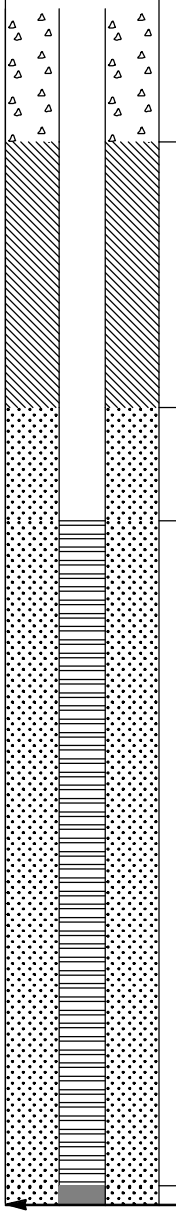
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	B. Marshall
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	10 Mar 2016
H&A Rep.	J. Yonts
Location	N 970812.18 E 2771247.76
Ground El. Datum	432.8 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
FILL				3.0	429.8
	4.0				
BEDROCK				7.0	425.8
				8.7	424.1
	9.0				
	9.5				
	12.0				
	13.0				
				18.7	414.1
	19.0			19.0	413.8



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.2 ft
Height of top of riser above ground surface	2.9 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	2.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	8.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	1.0	2.0
Bentonite	3.0	4.0
Sand	7.0	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	8.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	18.7 ft
Bottom of silt trap	19.0 ft
Depth of bottom of borehole	19.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HA_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-LF-2

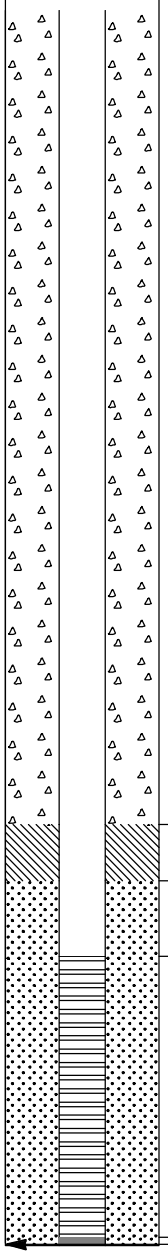
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	B. Marshall
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	12 Mar 2016
H&A Rep.	J. Yonts
Location	N 970681.32 E 2772205.05
Ground El. Datum	470.1 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
0 TOPSOIL	0.2				
FILL	3.0				
FILL	7.5				
	18.7				
	24.0				
				30.0	440.1
				32.0	438.1
				34.7	435.4
	45.0			44.7	425.4



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.2 ft
Height of top of riser above ground surface	2.9 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	2.9 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	34.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	1.0	29.0
Bentonite	30.0	2.0
Sand	32.0	13.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	34.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	44.7 ft
Bottom of silt trap	45.0 ft
Depth of bottom of borehole	45.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-LF-3

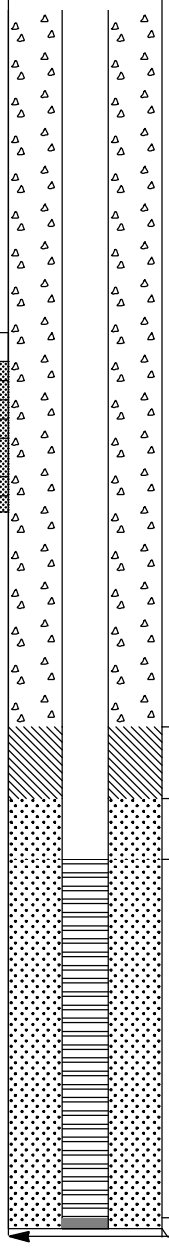
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	14 Mar 2016
H&A Rep.	J. Yonts
Location	N 970949.7 E 2773138.97
Ground El. Datum	482.0 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
	5				
	10				
BEDROCK	10.8				
	15.0				
	20				
				21.0	461.0
				23.0	459.0
				24.7	457.3
	25				
	30				
				34.7	447.3
	35			35.0	447.0
	35.3				



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.2 ft
Height of top of riser above ground surface	2.8 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	2.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	24.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	1.0	20.0
Bentonite	21.0	2.0
Sand	23.0	12.0
	-	-

Diameter of borehole	8.0 in.
Depth to top of well screen	24.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	34.7 ft
Bottom of silt trap	35.0 ft
Depth of bottom of borehole	35.3 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-LF-4

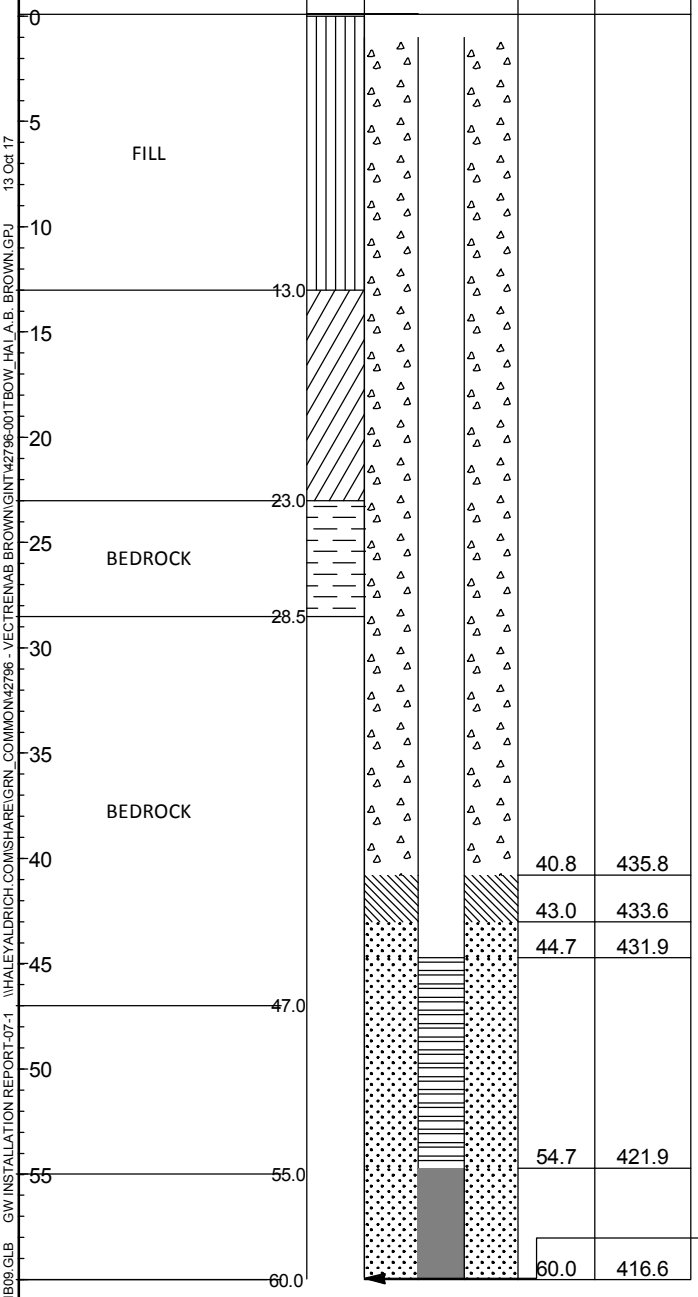
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	B. Marshall
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	11 Mar 2016
H&A Rep.	J. Yonts
Location	N 972312.24 E 2772876.83
Ground El. Datum	476.6 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
FILL	0				
	13.0				
BEDROCK	23.0				
	28.5				
BEDROCK				40.8	435.8
				43.0	433.6
				44.7	431.9
	47.0				
	55.0			54.7	421.9
	60.0			60.0	416.6



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	2.7 ft
Height of top of riser above ground surface	2.4 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.3 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	44.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	1.0	39.8
Bentonite	40.8	2.2
Sand	43.0	12.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	44.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	54.7 ft
Bottom of silt trap	55.0 ft
Depth of bottom of borehole	60.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-LF-5

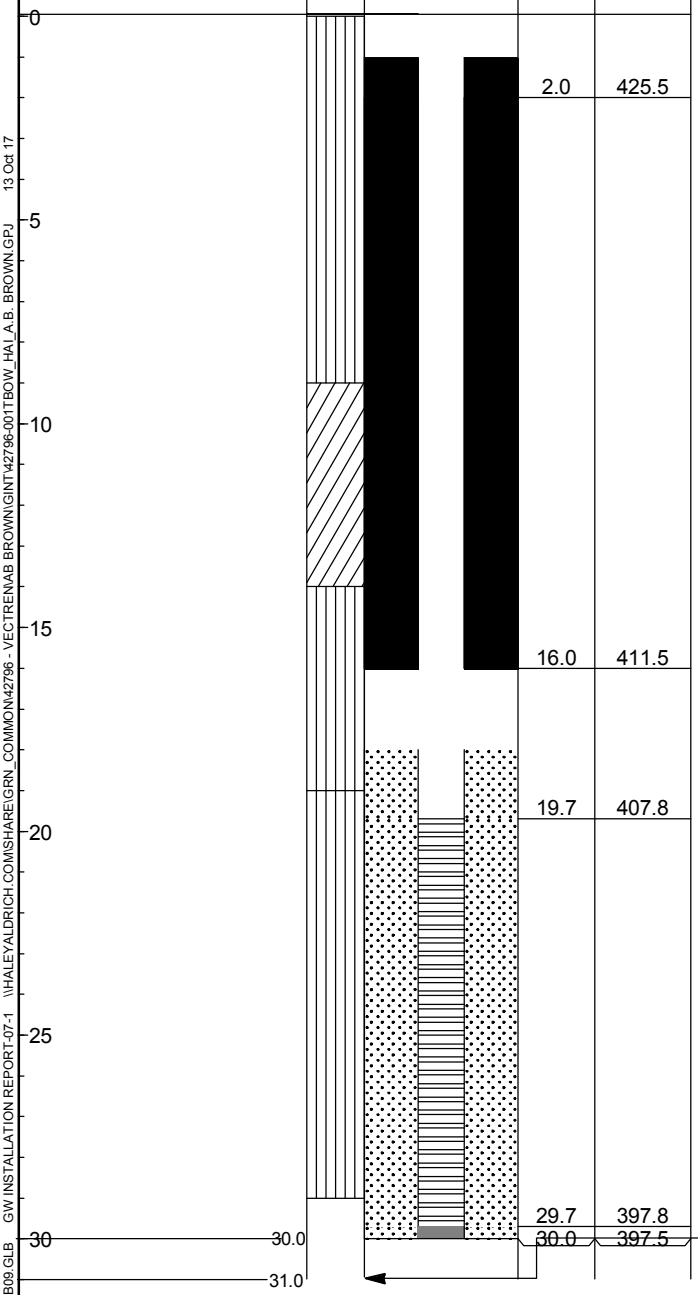
Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	12 Mar 2016
H&A Rep.	S. Lewis
Location	N 972228.16 E 2772003.91
Ground El. Datum	427.5 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
				2.0	425.5
	5				
	10				
	15			16.0	411.5
				19.7	407.8
	20				
	25				
				29.7	397.8
	30			30.0	397.5
	30.0				
	31.0				



WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.1 ft
Height of top of riser above ground surface	2.8 ft
Type of protective casing	Steel
Length	5.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	1.9 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	19.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	1.0	15.0
Bentonite	16.0	2.0
Sand	18.0	12.0
	-	-

Diameter of borehole	8.0 in.
Depth to top of well screen	19.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	30.0 ft
Bottom of silt trap	29.7 ft
Depth of bottom of borehole	31.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-LF-6

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	12 Mar 2016
H&A Rep.	S. Lewis
Location	N 972269.53 E 2771046.15
Ground El. Datum	409.2 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0				
				2.7	406.5
				4.4	404.8
	5				
	5.0				
	8.5				
				9.4	399.8
				9.7	399.5
	10.0				

WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	3.3 ft
Height of top of riser above ground surface	2.8 ft
Type of protective casing	Steel
Length	5.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	1.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	4.4 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Bentonite	1.0	1.7
Sand	2.7	7.0
	-	-
	-	-

Diameter of borehole	8.0 in.
Depth to top of well screen	4.4 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	9.66 ft
Bottom of silt trap	9.7 ft
Depth of bottom of borehole	10.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-PZ-5

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	B. Marshall
Initial Water Level (depth bgs)	ft

Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No.	42796-001
Date Installed	18 Dec 2015
H&A Rep.	T. Vanage
Location	N 965928.39 E 2772500.01
Ground El. Datum	484.1 (est.)

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
	0			1.0	483.1
				4.0	480.1
FILL	5				
	8.8				
ALLUVIUM	10, 15, 20				
	24.5				
ALLUVIUM	25, 30			31.5	452.6
				35.0	449.1
	35			37.0	447.1
	40.3				
SANDSTONE	45			47.0	437.1
	50.0			50.0	434.1

WELL CONSTRUCTION DETAILS

Type of protective cover	Stickup Guard Box
Height of Steel above ground surface	2.8 ft
Height of top of riser above ground surface	2.7 ft
Type of protective casing	Steel
Length	6.0 ft
Inside diameter	4.0 in.
Depth of bottom of Steel	3.2 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	37.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	4.0	27.5
Bentonite	31.5	3.5
Sand	35.0	15.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	37.0 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	47.0 ft
Bottom of silt trap	47.2 ft
Depth of bottom of borehole	50.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HA_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-SP-1

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska

Initial Water Level (depth bgs) ft

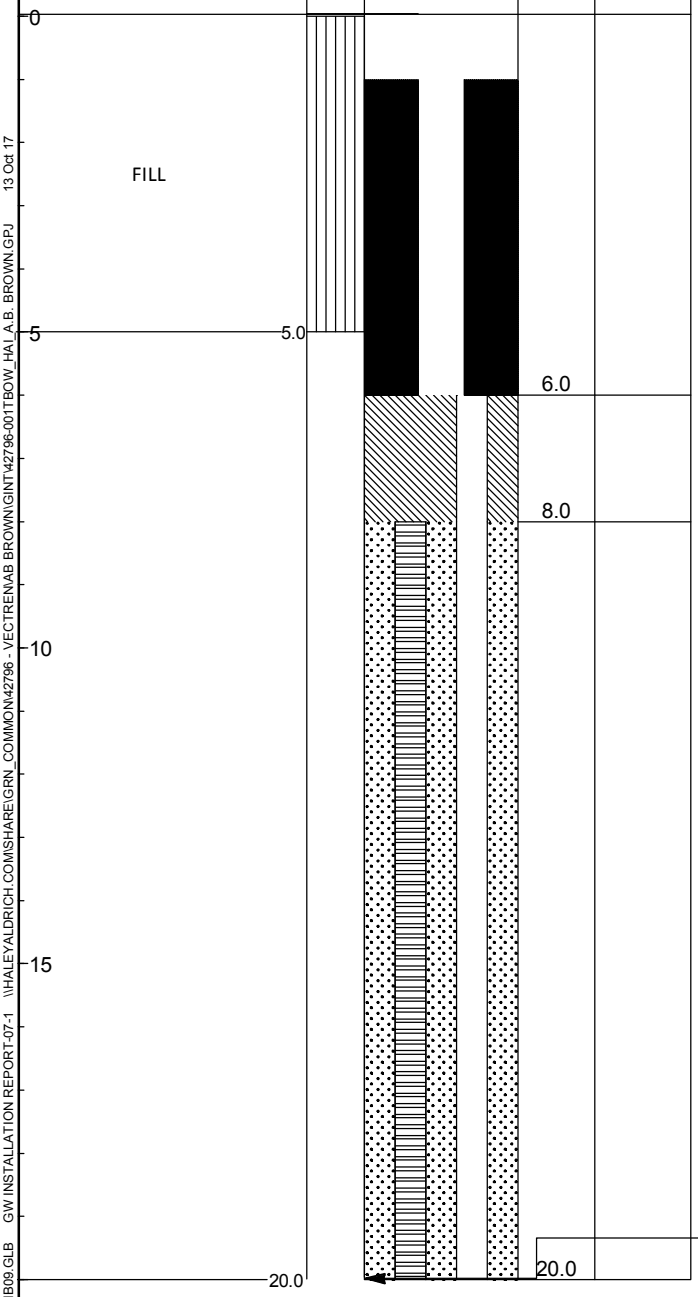
Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001
Date Installed 13 Mar 2016
H&A Rep. S. Lewis
Location See Plan

Ground El.
Datum

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
FILL	5.0			6.0	
				8.0	
	20.0			20.0	



WELL CONSTRUCTION DETAILS

Type of protective cover: Flush Mount

Depth of Morrison Flush Mount below ground surface: 0.0 ft

Height of top of riser above ground surface: 0.5 ft

Type of protective casing: Morrison Flush Mount

Length: 0.8 ft

Inside diameter: 9.0 in.

Depth of bottom of Morrison Flush Mount: 0.8 ft

Type of riser pipe: Schedule 40 PVC

Inside diameter of riser pipe: 2.0 in.

Depth of bottom of riser pipe: 9.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	1.0	5.0
Bentonite	6.0	2.0
Sand	8.0	12.0
	-	-

Diameter of borehole: 8.0 in.

Depth to top of well screen: 9.7 ft

Type of screen: Machine slotted Sch 40 PVC

Screen gauge or size of openings: 0.010 in.

Diameter of screen: 2.0 in.

Type of Backfill around Screen: Quartz Sand

Depth to bottom of well screen:

Bottom of silt trap: 20.0 ft

Depth of bottom of borehole: 20.0 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-SP-2

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

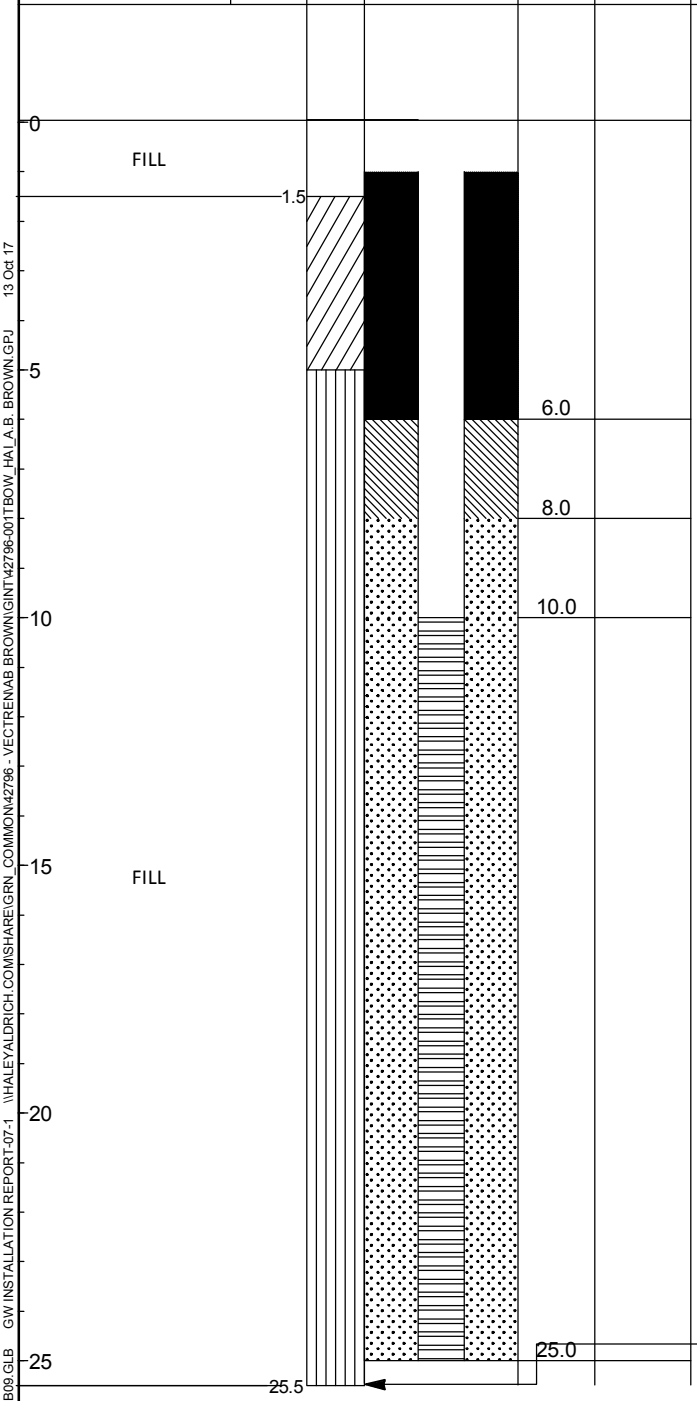
Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001
Date Installed 13 Mar 2016
H&A Rep. S. Lewis
Location See Plan

Ground El.
Datum

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
FILL	0				
	1.5				
	5			6.0	
				8.0	
	10			10.0	
FILL	15				
	20				
	25			25.0	
	25.5				



WELL CONSTRUCTION DETAILS

Type of protective cover	Flush Mount
Depth of Morrison Flush Mount below ground surface	0.0 ft
Height of top of riser above ground surface	0.4 ft
Type of protective casing	Morrison Flush Mount
Length	0.8 ft
Inside diameter	9.0 in.
Depth of bottom of Morrison Flush Mount	0.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	9.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	1.0	5.0
Bentonite	6.0	2.0
Sand	8.0	12.0
	-	-

Diameter of borehole	8.0 in.
Depth to top of well screen	9.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	20.0 ft
Bottom of silt trap	19.7 ft
Depth of bottom of borehole	25.5 ft

COMMENTS:

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GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.

Boring No. CCR-SP-3

Project	Vectren
Location	A. B. Brown Generating Station
Client	Southern Indiana Gas & Electric Company
Contractor	Stearns Drilling
Driller	J. Gryska
Initial Water Level (depth bgs)	ft

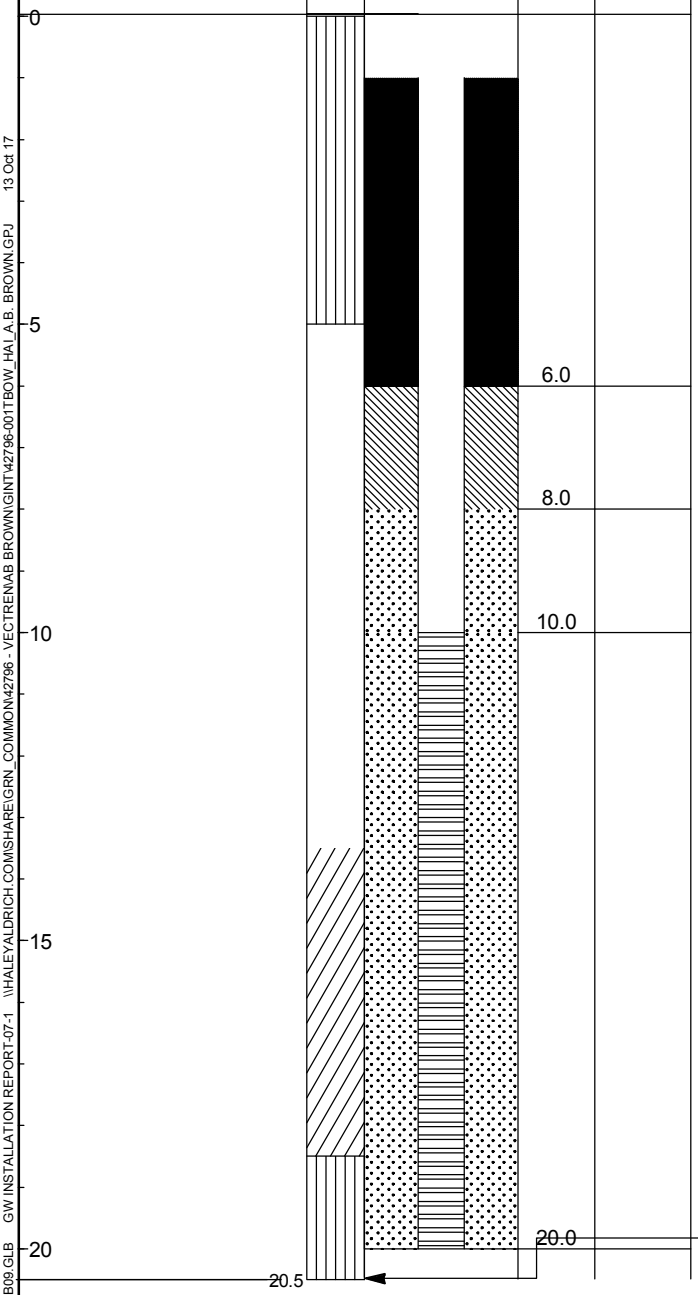
Well Diagram

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001
Date Installed 13 Mar 2016
H&A Rep. S. Lewis
Location See Plan

Ground El.
Datum

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)



WELL CONSTRUCTION DETAILS

Type of protective cover	Flush Mount
Depth of Morrison Flush Mount below ground surface	0.0 ft
Height of top of riser above ground surface	0.4 ft
Type of protective casing	Morrison Flush Mount
Length	0.8 ft
Inside diameter	9.0 in.
Depth of bottom of Morrison Flush Mount	0.8 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	9.7 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	1.0	5.0
Bentonite	6.0	2.0
Sand	8.0	12.0
	-	-

Diameter of borehole	8.0 in.
Depth to top of well screen	9.7 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Quartz Sand
Depth to bottom of well screen	20.0 ft
Bottom of silt trap	19.7 ft
Depth of bottom of borehole	20.5 ft

COMMENTS:

HA-LIB09.GLB GW INSTALLATION REPORT-07-1 \\HALEYALDRICH.COM\SHARE\GRN_COMMON\42796 - VECTREN\AB BROWN\GINT\42796-001TBOW_HAI_A.B. BROWN.GPJ 13 Oct 17

Appendix F
Sedimentation Pond Groundwater Monitoring and Corrective Action Reports

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REPORT ON

2017 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT A.B. BROWN GENERATING STATION WEST FRANKLIN, INDIANA

by Haley & Aldrich, Inc.
Greenville, South Carolina

for Southern Indiana Gas and Electric Company (SIGECO)
Evansville, Indiana

File No. 129420-003
January 2018

Annual Groundwater Monitoring Report Summary

Haley & Aldrich, Inc. (Haley & Aldrich) has prepared this 2017 Annual Groundwater Monitoring Corrective Action Report for the A.B. Brown Generating Station (ABB). This 2017 Annual Report was developed to comply with the United States Environmental Protection Agency (USEPA) Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals (CCR) from Electric Utilities, 40 CFR Part 257, Subpart D dated 17 April 2015 (Rule), specifically subsection §257.90(e)(1) through (5). Southern Indiana Gas and Electric Company (SIGECO) operates the existing coal combustion residuals (CCR) management unit referred to as Sedimentation pond at ABB located in Posey County, Indiana near the community of West Franklin. This CCR unit is subject to the Rule since it was active as of the effective date of the Rule.

This annual report addresses the CCR management unit, referred to as Sedimentation pond, at ABB, as described in the Groundwater Monitoring Program report, which was certified and placed in the facility's operating record on October 17, 2017 as required by §257.105(h)(2) and posted on the facility's website on November 16, 2017 as required by §257.107(h)(2).

To report on the activities conducted during the prior calendar year and document compliance with the Rule, the specific requirements listed in §257.90(e)(1) through (5) are provided below in bold/italic type followed by a short narrative addressing how that specific requirement was met.

§257.90 APPLICABILITY

§257.90(e) Annual groundwater monitoring and corrective action report. For existing CCR landfills and existing CCR surface impoundments, no later than January 31, 2018, and annually thereafter, the owner or operator must prepare an annual groundwater monitoring and corrective action report. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, the owner or operator must prepare the initial annual groundwater monitoring and corrective action report no later than January 31 of the year following the calendar year a groundwater monitoring system has been established for such CCR unit as required by this subpart, and annually thereafter. For the preceding calendar year, the annual report must document the status of the groundwater monitoring and corrective action program for the CCR unit, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year. For purposes of this section, the owner or operator has prepared the annual report when the report is placed in the facility's operating record as required by §257.105(h)(1).

> As required, this annual report documents the status of the groundwater monitoring program for the CCR management unit at ABB and summarizes key actions completed during the prior calendar year.

At a minimum, the annual groundwater monitoring and corrective action report must contain the following information, to the extent available:

§257.90(e)(1) AERIAL IMAGE OF GROUNDWATER MONITORING PROGRAM

§257.90(e)(1) A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;

As required by §257.90(e)(1), maps showing the location of the Sedimentation pond and associated upgradient and downgradient monitoring wells are included in this report as **Figure 1**. In addition, this information is presented in the Groundwater Monitoring Program report prepared for ABB, which was placed in the facility's operating record on October 17, 2017 as required by §257.105(h)(2).

§257.90(e)(2) ADJUSTMENTS TO GROUNDWATER MONITORING PROGRAM

§257.90(e)(2) Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;

To comply with the requirements of §257.91, a groundwater monitoring network of five (5) wells were installed for the Sedimentation pond at ABB. Details of the design, and construction of the monitoring wells are summarized in Table 1. Additional description of the monitoring network is presented in the Groundwater Monitoring Program report, which was placed in the facility's operating record on October 17, 2017, as required by §257.105(h)(2). None of the wells installed to monitor groundwater quality upgradient and downgradient of the Sedimentation pond were decommissioned in 2017.

§257.90(e)(3) SUMMARY OF GROUNDWATER ANALYSIS

§257.90(e)(3) In addition to all the monitoring data obtained under §257.90 through §257.98, a summary including the number of groundwater samples that were collected for analysis for each background [upgradient] ***and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;***

In accordance with §257.94(b), a minimum of eight independent samples from each upgradient and downgradient monitoring well were collected prior to October 17, 2017. A summary of the groundwater monitoring program for the Sedimentation pond, including the analytical results for the Appendix III and Appendix IV list of constituents, is presented in **Table 2** of this report. All the samples obtained were required by the detection monitoring program.

§257.90(e)(4) CURRENT GROUNDWATER MONITORING PROGRAM

§257.90(e)(4) A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels);

Consistent with §257.90(e), the 2017 annual report documents groundwater related activities conducted during the prior calendar year at the Sedimentation pond. The statistical analysis of the initial minimum eight rounds of groundwater sampling was completed by January 15, 2018 as required. This statistical analysis relied on the use of tolerance intervals as originally certified on October 17, 2017. The results of this statistical analysis identified statistically significant increases (SSI) of Appendix III constituents in one or more wells monitoring the uppermost aquifer downgradient of the Sedimentation pond. Consistent with §257.94(e)(2), SIGECO is evaluating options to demonstrate that a source other than the CCR unit caused the SSI and will provide a narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels), as appropriate, in subsequent annual reports.

§257.90(e)(5) OTHER REQUIRED INFORMATION

§257.90(e)(5) Other information required to be included in the annual report as specified in §257.90 through §257.98.

This initial Annual Report documents activities conducted to comply with Sections §257.90 through §257.94 of the Rule. There are no applicable requirements from Sections §257.95 through §257.98.

Attachments
Table 1. Groundwater Monitoring Well Location and Construction Details
Table 2. Summary of Analytical Results
Figure 1. Monitoring Well Network

\\haleyaldrich.com\share\grn_common\129420 Vectren\AB Brown\Annual Report\Sedimentation Pond\Text\ABB_SP_Annual_GW_Report_F.docx

TABLES

TABLE I
GROUNDWATER MONITORING WELL LOCATION AND CONSTRUCTUON DETAILS
A.B. BROWN GENERATING STATION SEDIMENTATION POND
MOUNT VERNON, INDIANA

Well	CCR Unit	Date Installed	Easting	Northing	Top of Pad Elevation (ft msl)	Top of Riser Elevation (ft msl)	Surface Grout (ft bgs)	Bentonite (ft bgs)	Sand Pack (ft bgs)	Screen Zone (ft bgs)	Screen Length (ft)	Well Radius (in)
CCR-SP-1	Sediment Pond	March 2016	2770030.26	970981.89	403.90	403.51	0.0 - 6.0	6.0 - 8.0	8.0 - 20.0	10.0 - 20.0	10	2.00
CCR-SP-2	Sediment Pond	March 2016	2769939.51	970887.25	403.60	403.23	0.0 - 6.0	6.0 - 8.0	8.0 - 20.0	10.0 - 20.0	10	2.00
CCR-SP-3	Sediment Pond	March 2016	2770027.64	970735.02	403.90	403.57	0.0 - 6.0	6.0 - 8.0	8.0 - 20.0	10.0 - 20.0	10	2.00
CCR-BK-1R	Background	March 2016	2770919.08	974083.40	480.10	483.39	0.0 - 50.0	50.0 - 52.0	52.0 - 64.0	54.0 - 64.0	10	2.00
CCR-BK-2	Background	March 2016	2769728.14	972854.33	427.50	430.60	0.0 - 11.5	11.5 - 13.5	13.5 - 25.5	15.5 - 25.5	10	2.00

Notes:
bgs = below ground surface
ft = feet
in = inches
msl = mean sea level
Datum of Elevations in NAVD 88

TABLE II
SUMMARY OF ANALYTICAL RESULTS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Upgradient								
Location Name	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R	CCR-BK-1R
Sample Name	CCR-BK-1-20160811	CCR-BK-1-20161027	CCR-BK-1R-20161107	CCR-BK-1R-20161206	CCR-BK-1R-20170207	CCR-BK-1R-20170407	CCR-BK-1R-20170606	CCR-BK-1R-20170928	CCR-BK-1R-20171116
Sample Date	08/11/2016	10/27/2016	11/07/2016	12/06/2016	02/07/2017	04/07/2017	06/06/2017	09/28/2017	11/16/2017
Lab Sample ID	180-57528-14	180-60271-6	180-60609-5	180-61491-18	180-63324-18	180-65040-1	180-67229-16	180-70809-15	180-72643-21
Water Level (ft amsl)	463.50	422.65	423.39	422.39	421.39	425.39	425.39	425.39	-
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**20.68**	**15.88**	**20.42**	**11.36**	**14.52**	**14.94**	**17.06**	**24.01**	**10.95**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**0.76**	-
Dissolved Oxygen, Field (mg/L)	**5.15**	**5.85**	**5.89**	**7.03**	**5.98**	**5.43**	**6.28**	**6**	**8.82**
Conductivity, Field (mS/cm)	**0.3475**	**0.38255**	**0.36566**	**0.32748**	**0.3703**	**0.31348**	**0.35539**	**0.35718**	**0.40797**
ORP, Field (mv)	**222**	**223.99**	**116.48**	**52.8**	**131.91**	**98.13**	**266.28**	**147.09**	**47.02**
Turbidity, Field (NTU)	**17.39**	**19.19**	**10.68**	**97.13**	**6.47**	**17.2**	**24.08**	-	**131.33**
pH, Field (su)	**6.8**	**6.95**	**7.02**	**7.14**	**6.87**	**7.22**	**6.95**	**6.88**	**7.13**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	0.014 U	0.02 U	0.023 U	0.02 U	0.08 U	**0.019 J**	**0.026 J**	**0.015 J+**	**0.041 J**
Calcium, Total	**36**	**41**	**38**	**36**	**34**	**35**	**34**	**35**	**39**
Chloride (mg/L)	R	**2.4**	**1.5**	**2.3**	**2.3**	**2.7**	**2.1**	**2.2**	**2.6**
Fluoride (mg/L)	R	**0.35**	**0.32**	**0.35**	**0.3**	**0.38**	**0.3**	**0.35 J+**	**0.3**
Sulfate (mg/L)	R	**26**	**21**	**26**	**27**	**28**	**25**	**25**	**26 J-**
pH (lab) (su)	**7.4 J**	**7.5 J**	**7 J**	**6.9 J**	**7.2 J**	**7.2 J**	**7.1 J**	**7.1 J**	**7.8 J**
Total Dissolved Solids (TDS) (mg/L)	**220**	**210**	**220**	**200**	**230**	**250**	**270**	**210**	**210**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	**0.000056 J**	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	**0.00045 J**
Arsenic, Total	**0.0011**	**0.00021 J**	0.001 U	**0.00031 J**	**0.00094 J**	**0.00095 J**	**0.00047 J**	**0.0025 J+**	**0.0015 J+**
Barium, Total	**0.048**	**0.035**	**0.037 J-**	**0.031 J-**	**0.038**	**0.04**	**0.038**	**0.032 J-**	**0.082 J-**
Beryllium, Total	**0.00012 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	**0.0025**	**0.00046 J**	**0.00087 J**	**0.00071 J**	**0.003**	**0.0026**	**0.0019 J**	R	**0.0027 J+**
Cobalt, Total	**0.0028**	**0.00076**	**0.00051**	0.0005 U	**0.0011**	**0.001**	**0.00062**	R	**0.0022**
Lead, Total	**0.00082 J**	**0.00024 J**	**0.000079 J**	**0.000096 J**	**0.00099 J**	**0.00092 J**	**0.00052 J**	0.001 U	**0.0008 J**
Lithium, Total	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	**0.0086 J**
Molybdenum, Total	**0.0025 J**	0.005 U	0.005 U	**0.0015 J**	**0.0017 J**	**0.0025 J**	**0.0015 J**	R	**0.0034 J**
Selenium, Total	**0.00067 J**	0.005 U	**0.00037 J**	**0.00051 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	**0.000038 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Mercury, Total	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	R	**0.35**	**0.32**	**0.35**	**0.3**	**0.38**	**0.3**	**0.35 J+**	**0.3**
Radiological (pCi/L)									
Radium-226	0.0484 U ± 0.104	0.0760 U ± 0.210	R	0.303 U ± 0.296	**0.142 ± 0.0913**	**0.280 ± 0.0981**	**0.177 J ± 0.0924**	R	**0.165 ± 0.0740**
Radium-228	0.0724 UJ ± 0.514	0.191 U ± 0.217	-0.0566 U ± 0.222	0.179 U ± 0.238	-0.0934 U ± 0.194	0.177 U ± 0.257	**0.337 ± 0.257**	0.171 U ± 0.226	0.388 U ± 0.268
Radium-226 & 228	0.121 UJ ± 0.525	0.267 U ± 0.302	R	**0.482 ± 0.380**	0.142 UJ ± 0.214	**0.457 J ± 0.275**	**0.515 J ± 0.273**	**0.426 J+ ± 0.243**	**0.553 J+ ± 0.278**

ABBREVIATIONS AND NOTES:
CCR: Coal Combustion Residuals
CFR: Code of Federal Regulations
ft amsl: feet above mean sea level
MCL: Maximum Contaminant Level
mg/L: milligram per liter
mS/cm: milliSiemen per centimeter
mv: millivolt
NA: Not Applicable
NTU: Nephelometric Turbidity Units
pCi/L: picoCurie per liter
su: standard units
USEPA: United States Environmental Protection Agency

QUALIFIERS:
J: value is estimated
J+: value is estimated with a potentially high bias
J-: value is estimated with a potentially low bias
R: value is rejected
U: Not detected value is the laboratory reporting limit

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https://www.epa.gov/coalash/coal-ash-rule

TABLE II
SUMMARY OF ANALYTICAL RESULTS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Upgradient								
Location Name	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2	CCR-BK-2
Sample Name	CCR-BK-2-20160608	CCR-BK-2-20160810	CCR-BK-2-20161027	CCR-BK-2-20161206	CCR-BK-2-20170210	CCR-BK-2-20170405	CCR-BK-2-20170606	CCR-BK-2-20170927	CCR-BK-2-20171116
Sample Date	06/08/2016	08/10/2016	10/27/2016	12/06/2016	02/10/2017	04/05/2017	06/06/2017	09/27/2017	11/16/2017
Lab Sample ID	180-55607-6	180-57528-15	180-60271-7	180-61491-19	180-63446-1	180-64974-1	180-67229-17	180-70809-16	180-72643-22
Water Level (ft amsl)	416.46	412.21	408.69	407.90	412.89	413.71	413.94	412.64	406.12
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**17.51**	**17.4**	**15.98**	**14.25**	**13.49**	**15.79**	**15.68**	**16.85**	**14.23**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	**167.49**	-
Dissolved Oxygen, Field (mg/L)	**0.42**	**0.22**	**0.38**	**0.33**	**0.35**	**1.08**	**0.14**	**0.43**	**0.47**
Conductivity, Field (mS/cm)	**0.6551**	**0.4173**	**0.40128**	**0.30961**	**0.38131**	**0.29739**	**0.41407**	**0.38594**	**0.38795**
ORP, Field (mv)	**28.72**	**144**	**234.6**	**87.3**	**120.09**	**200.74**	**212.67**	**212.04**	**108.47**
Turbidity, Field (NTU)	**17.85**	**1.751**	**858.51**	**336.44**	**11.66**	**-22.18**	**-1.12**	-	**181.78**
pH, Field (su)	**6.98**	**6.64**	**6.7**	**6.19**	**6.72**	**6.66**	**6.67**	**6.64**	**6.74**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	**0.018 J+**	0.014 U	0.02 U	0.02 U	0.08 U	0.016 U	**0.021 J**	**0.018 J+**	**0.02 J**
Calcium, Total	**53**	**39**	**46**	**36**	**34**	**45**	**37**	**37**	**35**
Chloride (mg/L)	**12**	**17**	**17**	**19**	**12 J+**	**19**	**14**	**19**	**19**
Fluoride (mg/L)	R	**0.14 J+**	**0.16**	**0.2 J+**	**0.14**	**0.16**	**0.13**	R	**0.13**
Sulfate (mg/L)	**61**	**30 J-**	**28**	**26**	**25 J+**	**29**	**27**	**24**	**23 J-**
pH (lab) (su)	**7.09 J**	**7.1 J**	**6.8 J**	**6.7 J**	**8.5 J**	**7.2 J**	**7 J**	**6.8 J**	**7.3 J**
Total Dissolved Solids (TDS) (mg/L)	**360**	**260**	**350**	**260**	**230**	**240**	**270**	**320**	**250**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	**0.00048 J**
Arsenic, Total	**0.00032 J**	0.001 U	**0.0013**	**0.00051 J**	**0.00031 J**	0.001 U	0.001 U	**0.0035 J+**	**0.0028**
Barium, Total	**0.041 J-**	**0.033**	**0.15**	**0.036 J-**	**0.033 J-**	**0.034 J-**	**0.035**	**0.048 J-**	**0.046 J-**
Beryllium, Total	0.001 U	0.001 U	**0.0004 J**	0.001 U	0.001 U	0.001 U	0.001 U	**0.00018 J**	0.001 U
Cadmium, Total	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	0.002 U	0.002 U	**0.0047**	**0.00076 J**	0.002 UJ	0.002 U	0.002 U	R	**0.0043 J+**
Cobalt, Total	**0.000096 J**	**0.0001 J**	**0.0062**	0.0005 U	0.0005 U	0.0005 U	0.0005 U	**0.0015 J+**	**0.0012**
Lead, Total	**0.000028 J**	0.001 U	**0.011**	**0.00057 J**	0.001 U	0.001 U	0.001 U	**0.0028 J+**	**0.0024**
Lithium, Total	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Molybdenum, Total	**0.0017 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	**0.00062 J**	0.005 U	**0.00068 J**
Selenium, Total	0.005 U	0.005 U	**0.00098 J**	**0.00047 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	**0.000059 J**
Mercury, Total	0.0002 UJ	0.0002 U	**0.0001 J**	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	R	**0.14 J+**	**0.16**	**0.2 J+**	**0.14**	**0.16**	**0.13**	R	**0.13**
Radiological (pCi/L)									
Radium-226	**0.102 J ± 0.0557**	0.0387 U ± 0.0693	**1.14 J ± 0.720**	0.346 U ± 0.284	0.0539 UJ ± 0.0753	0.0198 U ± 0.0619	0.00911 UJ ± 0.0490	R	**0.149 ± 0.0943**
Radium-228	0.0185 U ± 0.200	0.0797 UJ ± 0.324	0.764 U ± 0.727	R	0.163 U ± 0.253	0.102 U ± 0.198	**0.144 ± 0.284**	0.279 U ± 0.416	**2.98 ± 0.579**
Radium-226 & 228	0.120 U ± 0.207	0.118 UJ ± 0.331	**1.91 J ± 1.02**	**0.796 J ± 0.380**	0.217 UJ ± 0.264	0.122 U ± 0.208	0.153 U ± 0.288	0.525 UJ ± 0.436	**3.13 ± 0.587**

ABBREVIATIONS AND NOTES:
CCR: Coal Combustion Residuals
CFR: Code of Federal Regulations
ft amsl: feet above mean sea level
MCL: Maximum Contaminant Level
mg/L: milligram per liter
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TABLE II
SUMMARY OF ANALYTICAL RESULTS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Downgradient								
Location Name	CCR-SP-1	CCR-SP-1	CCR-SP-1	CCR-SP-1	CCR-SP-1	CCR-SP-1	CCR-SP-1	CCR-SP-1	CCR-SP-1
Sample Name	CCR-SP-1-20160609	CCR-SP-1-20160809	CCR-SP-1-20161027	CCR-SP-1-20170117	CCR-SP-1-20170206	CCR-SP-1-20170404	CCR-SP-1-20170605	CCR-SP-1-20170926	CCR-SP-1-20171115
Sample Date	06/09/2016	08/09/2016	10/27/2016	01/17/2017	02/06/2017	04/04/2017	06/05/2017	09/26/2017	11/15/2017
Lab Sample ID	180-55607-10	180-57528-9	180-60271-1	180-62677-1	180-63324-10	180-64974-17	180-67229-18	180-70809-17	180-72643-7
Water Level (ft amsl)	393.49	393.74	392.86	393.23	393.91	393.95	393.66	391.51	393.26
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**17.3**	**18.78**	**17.41**	-	**15.35**	**15.89**	**16.82**	**18.18**	**16.81**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	-	-
Dissolved Oxygen, Field (mg/L)	**0.2**	**0.17**	**0.29**	-	**0.06**	**0.04**	**0.01**	**-0.02**	**-0.01**
Conductivity, Field (mS/cm)	**1.12367**	**1.039**	**0.82285**	-	**0.97299**	**0.691**	**0.92488**	**1.17076**	**1.30724**
ORP, Field (mv)	**-69.41**	**-24**	**20**	-	**-25.92**	**-44.43**	**-87.99**	**-38.71**	**-85.51**
Turbidity, Field (NTU)	**13.23**	**33.26**	**-0.79**	-	**13.2**	**11.78**	**4.49**	**-0.14**	**0.07**
pH, Field (su)	**6.89**	**6.73**	**6.89**	-	**6.83**	**6.94**	**6.9**	**6.51**	**6.73**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	**0.038 J+**	**0.041 J+**	0.031 U	0.08 U	0.08 U	**0.038 J**	**0.03 J**	**0.039 J+**	**0.033 J**
Calcium, Total	**110**	**110**	**120**	**120**	**110**	**130**	**120**	**140**	**150**
Chloride (mg/L)	**54**	**47**	**39**	**47**	**46**	**51**	**42**	**64**	**74**
Fluoride (mg/L)	R	**0.27**	**0.24**	**0.27**	**0.22**	**0.27**	**0.28**	**0.28 J+**	**0.28**
Sulfate (mg/L)	**100**	**67 J-**	**46**	**54**	**50**	**64**	**55**	**150**	**220 J-**
pH (lab) (su)	**6.98 J**	**7.2 J**	**6.9 J**	**6.6 J**	**7 J**	**7.3 J**	**7.1 J**	**7.1 J**	**7.4 J**
Total Dissolved Solids (TDS) (mg/L)	**710**	**620**	**560**	**580**	**560**	**570**	**590**	**730**	**820**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	**0.0039**	**0.0042**	**0.0042**	**0.0051**	**0.0051**	**0.0064**	**0.0058**	**0.013 J+**	**0.0054**
Barium, Total	**0.1 J-**	**0.081**	**0.083**	**0.087**	**0.085**	**0.1 J-**	**0.093**	**0.095 J-**	**0.12 J-**
Beryllium, Total	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	R	0.002 U
Cobalt, Total	**0.0033**	**0.0031**	**0.0028**	**0.0029**	**0.0028**	**0.0027**	**0.0028**	**0.0032**	**0.0038**
Lead, Total	R	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium, Total	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Molybdenum, Total	**0.0014 J**	**0.0014 J**	**0.0021 J**	**0.0014 J**	**0.0019 J**	0.005 U	**0.0018 J**	**0.0015 J**	**0.0016 J**
Selenium, Total	0.005 U	**0.00036 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	**0.000026 J**	0.001 U	**0.000093 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Mercury, Total	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	R	**0.27**	**0.24**	**0.27**	**0.22**	**0.27**	**0.28**	**0.28 J+**	**0.28**
Radiological (pCi/L)									
Radium-226	**0.393 J ± 0.105**	**0.264 ± 0.101**	0.130 U ± 0.207	0.0940 U ± 0.0873	**0.170 ± 0.109**	**0.134 ± 0.0915**	**0.166 J ± 0.0787**	R	**0.165 ± 0.0740**
Radium-228	0.131 U ± 0.210	0.192 UJ ± 0.277	0.381 U ± 0.265	0.410 U ± 0.271	0.174 U ± 0.274	-0.0357 U ± 0.241	**0.185 ± 0.213**	**0.478 ± 0.233**	0.350 U ± 0.244
Radium-226 & 228	**0.525 ± 0.235**	0.456 UJ ± 0.295	**0.511 ± 0.336**	**0.504 ± 0.284**	0.344 UJ ± 0.294	0.134 UJ ± 0.258	**0.352 J ± 0.227**	R	**0.514 J ± 0.255**

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A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Downgradient								
Location Name	CCR-SP-2	CCR-SP-2	CCR-SP-2	CCR-SP-2	CCR-SP-2	CCR-SP-2	CCR-SP-2	CCR-SP-2	CCR-SP-2
Sample Name	CCR-SP-2-20160609	CCR-SP-2-20160809	CCR-SP-2-20161026	CCR-SP-2-20170126	CCR-SP-2-20170206	CCR-SP-2-20170404	CCR-SP-2-20170605	CCR-SP-2-20170926	CCR-SP-2-20171115
Sample Date	06/09/2016	08/09/2016	10/26/2016	01/26/2017	02/06/2017	04/04/2017	06/05/2017	09/26/2017	11/15/2017
Lab Sample ID	180-55607-11	180-57528-10	180-60193-12	180-62992-1	180-63324-11	180-64974-18	180-67229-8	180-70809-24	180-72643-8
Water Level (ft amsl)	393.61	393.92	392.23	393.53	393.73	394.02	393.55	389.56	393.41
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**16.74**	**18.73**	**18.69**	-	**15.89**	**15.71**	**16.39**	**19.24**	**17.38**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	-	-
Dissolved Oxygen, Field (mg/L)	**0.14**	**0.15**	**0.08**	-	**0.14**	**0.02**	**0.06**	**-0.01**	**-0.02**
Conductivity, Field (mS/cm)	**1.08**	**1.078**	**0.97799**	-	**1.43635**	**1.54536**	**1.52661**	**1.57587**	**1.59103**
ORP, Field (mv)	**29**	**93**	**0**	-	**105.02**	**28.2**	**54.35**	**85.1**	**16.7**
Turbidity, Field (NTU)	**19.14**	**33.01**	**10.16**	-	**49.45**	**1.51**	**6.38**	**3.42**	**35.67**
pH, Field (su)	**6.95**	**6.82**	**6.92**	-	**6.87**	**6.95**	**6.95**	**6.68**	**6.83**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	**0.08**	**0.093 J+**	**0.11 J+**	**0.19**	**0.21**	**0.34**	**0.37**	**0.32 J+**	**0.24**
Calcium, Total	**110**	**120**	**140**	**160**	**170**	**190**	**170**	**170**	**180**
Chloride (mg/L)	**46**	**42**	**50**	**67**	**67**	**71**	**63**	**72**	**73**
Fluoride (mg/L)	**0.38 J+**	**0.32**	**0.35**	**0.33**	**0.34**	**0.38**	**0.37**	**0.34 J+**	**0.31**
Sulfate (mg/L)	**180**	**160 J-**	**190 J-**	**360**	**370**	**430**	**390**	**470**	**460 J-**
pH (lab) (su)	**7.05 J**	**7.5 J**	**7.1 J**	**7 J**	**7.2 J**	**7.4 J**	**7.2 J**	**7.1 J**	**7.4 J**
Total Dissolved Solids (TDS) (mg/L)	**750**	**710**	**780**	**970**	**1000**	**1100**	**1200**	**1200**	**1100**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	**0.00046 J**	**0.0016**	**0.00064 J**	**0.0013**	**0.0016**	**0.00031 J**	**0.00027 J**	**0.0077 J+**	**0.0014 J+**
Barium, Total	**0.082 J-**	**0.084**	**0.089 J-**	**0.12**	**0.13**	**0.13 J-**	**0.14**	**0.12 J-**	**0.14 J-**
Beryllium, Total	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.001 U	0.001 U	0.001 U	**0.000098 J**	**0.00011 J**	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	0.002 U	**0.0012 J**	**0.00047 J**	**0.0014 J**	**0.0012 J**	0.002 U	0.002 U	R	0.002 U
Cobalt, Total	**0.0011**	**0.0014**	**0.00081**	**0.00083**	**0.00084**	**0.00039 J**	**0.00045 J**	**0.00086**	**0.0012**
Lead, Total	R	**0.00091 J**	**0.00033 J**	**0.00078 J**	**0.00097 J**	0.001 U	0.001 U	0.001 U	**0.0008 J**
Lithium, Total	0.05 U	0.05 U	0.05 U	**0.011 J**	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Molybdenum, Total	**0.0016 J**	**0.0015 J**	0.005 U	**0.0012 J**	**0.0014 J**	0.005 U	**0.0012 J**	**0.0015 J**	**0.0012 J**
Selenium, Total	0.005 U	**0.00063 J**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.001 U	0.001 U	**0.000049 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Mercury, Total	0.0002 UJ	0.0002 U	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	**0.38 J+**	**0.32**	**0.35**	**0.33**	**0.34**	**0.38**	**0.37**	**0.34 J+**	**0.31**
Radiological (pCi/L)									
Radium-226	**0.171 J ± 0.0737**	**0.265 ± 0.129**	0.189 U ± 0.237	R	**0.256 ± 0.129**	**0.112 ± 0.0818**	**0.172 J ± 0.0817**	R	**0.242 ± 0.0951**
Radium-228	0.103 U ± 0.219	0.581 UJ ± 0.562	0.241 U ± 0.253	**0.693 ± 0.285**	0.0457 U ± 0.282	**0.798 ± 0.379**	**0.100 ± 0.199**	**0.699 ± 0.293**	0.405 U ± 0.285
Radium-226 & 228	0.275 U ± 0.231	0.846 UJ ± 0.577	**0.431 ± 0.347**	**0.887 J+ ± 0.312**	0.302 UJ ± 0.310	**0.910 ± 0.388**	0.273 UJ ± 0.215	R	**0.647 J ± 0.300**

ABBREVIATIONS AND NOTES:
CCR: Coal Combustion Residuals
CFR: Code of Federal Regulations
ft amsl: feet above mean sea level
MCL: Maximum Contaminant Level
mg/L: milligram per liter
mS/cm: milliSiemen per centimeter
mv: millivolt
NA: Not Applicable
NTU: Nephelometric Turbidity Units
pCi/L: picoCurie per liter
su: standard units
USEPA: United States Environmental Protection Agency

QUALIFIERS:
J: value is estimated
J+: value is estimated with a potentially high bias
J-: value is estimated with a potentially low bias
R: value is rejected
U: Not detected value is the laboratory reporting limit

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257.
https://www.epa.gov/coalash/coal-ash-rule

TABLE II
SUMMARY OF ANALYTICAL RESULTS
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Downgradient								
Location Name	CCR-SP-3	CCR-SP-3	CCR-SP-3	CCR-SP-3	CCR-SP-3	CCR-SP-3	CCR-SP-3	CCR-SP-3	CCR-SP-3
Sample Name	CCR-SP-3-20160609	CCR-SP-3-20160809	CCR-SP-3-20161027	CCR-SP-3-20170117	CCR-SP-3-20170206	CCR-SP-3-20170404	CCR-SP-3-20170606	CCR-SP-3-20170926	CCR-SP-3-20171115
Sample Date	06/09/2016	08/09/2016	10/27/2016	01/17/2017	02/06/2017	04/04/2017	06/06/2017	09/26/2017	11/15/2017
Lab Sample ID	180-55607-12	180-57528-11	180-60193-11	180-62677-3	180-63324-12	180-64974-19	180-67229-9	180-70809-25	180-72643-9
Water Level (ft amsl)	398.81	397.25	392.77	398.41	398.92	398.61	396.10	390.91	394.01
Monitoring Program	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Baseline	Detection
Field Parameters									
Temperature (Deg C)	**16.72**	**18.6**	**17.88**	-	**14.5**	**14.85**	**15.29**	**24.11**	**16.63**
Turbidity, Field (FNU)	-	-	-	-	-	-	-	-	-
Dissolved Oxygen, Field (mg/L)	**0.12**	**0.13**	**0.06**	-	**0.05**	**0.04**	**0.05**	**0.99**	**0.01**
Conductivity, Field (mS/cm)	**0.67071**	**0.711**	**605.64**	-	**0.7003**	**1.04504**	**0.6691**	**0.69142**	**0.701**
ORP, Field (mv)	**-91.32**	**-100**	**-70**	-	**-100.6**	**-39.69**	**-125.53**	**-46.17**	**-143.1**
Turbidity, Field (NTU)	**17.26**	**176.1**	**256.05**	-	**20.72**	**13.82**	**25.67**	**19.05**	**77.41**
pH, Field (su)	**7.05**	**6.95**	**7.08**	-	**7.01**	**6.93**	**7.09**	**6.8**	**6.97**
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	**0.023 J+**	0.027 U	0.028 U	0.08 U	0.08 U	**0.026 J**	**0.042 J**	**0.024 J+**	**0.019 J**
Calcium, Total	**76**	**84**	**92**	**86**	**85**	**96**	**88**	**83**	**86**
Chloride (mg/L)	**4.1 J+**	**3.4**	**4.7**	**4.7**	**4**	**4.3**	**2.9**	**5.1**	**4.1**
Fluoride (mg/L)	**0.38 J+**	**0.33**	**0.41**	**0.39**	**0.4**	**0.38**	**0.34**	**0.38 J+**	**0.41**
Sulfate (mg/L)	R	1 U	**0.68 J-**	1 U	**1.1**	**0.81 J**	1 U	**4.4**	**0.63 J-**
pH (lab) (su)	**7.27 J**	**7.6 J**	**7.1 J**	**6.6 J**	**7.3 J**	**7 J**	**7.2 J**	**7.1 J**	**7.6 J**
Total Dissolved Solids (TDS) (mg/L)	**400**	**390**	**390**	**370**	**380**	**380**	**400**	**400**	**370**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	**0.016**	**0.026**	**0.043**	**0.019**	**0.024**	**0.017**	**0.024**	**0.012 J+**	**0.035**
Barium, Total	**0.072 J-**	**0.069**	**0.11 J-**	**0.077**	**0.078**	**0.069 J-**	**0.072**	**0.064 J-**	**0.074 J-**
Beryllium, Total	0.001 U	0.001 U	**0.00029 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.001 U	0.001 U	**0.00015 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	0.002 U	0.002 U	**0.0096**	0.002 U	0.002 U	0.002 U	0.002 U	R	0.002 U
Cobalt, Total	**0.0011**	**0.001**	**0.0054**	**0.00072**	**0.0008**	**0.00084**	**0.00067**	**0.00049 J**	**0.00066**
Lead, Total	R	**0.00013 J**	**0.0061**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium, Total	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Molybdenum, Total	**0.0046 J**	**0.0051**	**0.0062**	**0.0051**	**0.0055**	0.005 U	**0.005**	**0.0031 J**	**0.0057**
Selenium, Total	0.005 U	0.005 U	**0.00042 J+**	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	**0.000024 J**	0.001 U	**0.00014 J**	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Mercury, Total	0.0002 UJ	0.0002 U	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 UJ
Fluoride (mg/L)	**0.38 J+**	**0.33**	**0.41**	**0.39**	**0.4**	**0.38**	**0.34**	**0.38 J+**	**0.41**
Radiological (pCi/L)									
Radium-226	**0.198 J ± 0.0738**	**0.194 ± 0.0788**	0.661 U ± 0.654	0.0991 U ± 0.107	**0.151 ± 0.0962**	**0.132 ± 0.0878**	R	R	**0.123 ± 0.0675**
Radium-228	0.251 U ± 0.227	-0.0623 UJ ± 0.296	0.239 U ± 0.573	0.140 U ± 0.256	-0.00781 U ± 0.215	0.206 U ± 0.278	**0.166 ± 0.212**	-0.0314 U ± 0.230	0.293 U ± 0.230
Radium-226 & 228	**0.449 ± 0.239**	0.131 UJ ± 0.307	0.900 U ± 0.870	0.239 U ± 0.277	0.151 UJ ± 0.236	0.338 UJ ± 0.292	0.335 UJ ± 0.229	0.23 UJ ± 0.247	**0.416 J ± 0.240**

ABBREVIATIONS AND NOTES:
CCR: Coal Combustion Residuals
CFR: Code of Federal Regulations
ft amsl: feet above mean sea level
MCL: Maximum Contaminant Level
mg/L: milligram per liter
mS/cm: milliSiemen per centimeter
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https://www.epa.gov/coalash/coal-ash-rule

FIGURES

LEGEND

- UPGRADIENT MONITORING WELL
- DOWNGRADIENT MONITORING WELL
- TOPOGRAPHIC DIVIDE

NOTES

1. LOCATIONS DERIVED FROM THREE I DESIGN DATA.
2. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
3. AERIAL IMAGERY SOURCE: ESRI

N

0 500 1,000
SCALE IN FEET

HALEY ALDRICH

VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620

MONITORING WELL NETWORK
SEDIMENTATION POND

JANUARY 2018

FIGURE 1

GIS FILE PATH: \\haleyaldrich.com\share\boi_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2018_01\42796_000_002_AB_BROWN_WASTE_BOUNDARY_MONITORING.mxd — USER: ajaspe — LAST SAVED: 1/30/2018 10:35:59 AM

www.haleyaldrich.com

REPORT ON

ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
SEDIMENTATION POND
A.B. BROWN GENERATING STATION
POSEY COUNTY, INDIANA

by Haley & Aldrich, Inc.
Greenville, South Carolina

for Southern Indiana Gas and Electric Company
Evansville, Indiana

File No. 129420
January 2019

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1	Sedimentation Pond Monitoring Well Location Map

1. 40 CFR § 257.90 Applicability

1.1 40 CFR § 257.90(a)

Except as provided for in § 257.100 for inactive CCR surface impoundments, all CCR landfills, CCR surface impoundments, and lateral expansions of CCR units are subject to the groundwater monitoring and corrective action requirements under § 257.90 through § 257.98.

The Sedimentation Pond at A.B. Brown Generating Station (ABB) is subject to the groundwater monitoring and corrective action requirements described under Code of Federal Regulations Title 40 (40 CFR) § 257.90 through § 257.98 (Rule). This document addresses the requirement for the Owner/Operator to prepare an Annual Report per § 257.90(e).

1.2 40 CFR § 257.90(e) - SUMMARY

Annual groundwater monitoring and corrective action report. For existing CCR landfills and existing CCR surface impoundments, no later than January 31, 2018, and annually thereafter, the owner or operator must prepare an annual groundwater monitoring and corrective action report. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, the owner or operator must prepare the initial annual groundwater monitoring and corrective action report no later than January 31 of the year following the calendar year a groundwater monitoring system has been established for such CCR unit as required by this subpart, and annually thereafter. For the preceding calendar year, the annual report must document the status of the groundwater monitoring and corrective action program for the CCR unit, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year. For purposes of this section, the owner or operator has prepared the annual report when the report is placed in the facility's operating record as required by § 257.105(h)(1).

This Annual Report documents the activities completed in 2018 for the Sedimentation Pond as required by the Rule. Groundwater sampling and analysis was conducted per the requirements described in § 257.93, and the status of the groundwater monitoring program described in § 257.95 is provided in this report.

1.2.1 Status of the Groundwater Monitoring Program

As provided in the notification on January 15, 2018 statistically significant increases (SSI) of Appendix III constituents were identified downgradient of the Sedimentation Pond. An evaluation of Alternate sources (ASD) was conducted; however, a successful alternative source demonstration was not achieved at this time. As a result, an Assessment Monitoring program was initiated as required by § 257.94(e)(2). The notification was placed in the facility's operating record as required by 257.106(h)(4).

1.2.2 Key Actions Completed

The following key actions were completed in 2018:

- Conducted a statistical analysis of detection monitoring results to evaluate potential SSIs.
- Prepared 2017 Annual Report including:
    - The Annual Report was placed in the facility's operating record pursuant to § 257.105(h)(1);

- Pursuant to § 257.106(h)(1), the notification was sent to the relevant State Director and/or Tribal authority within 30 days of the Annual Report being placed in the facility's operating record [§ 257.106(d)];
- Pursuant to § 257.107(h)(1), the Annual Report was posted to the CCR Website within 30 days of the Annual Report being placed in the facility's operating record [§ 257.107(d)];

- Conducted an evaluation of possible alternate sources for Appendix III SSIs (Appendix A);
- Pursuant to § 257.106(h)(4), the notification was sent to the relevant State Director and/or Tribal authority within 30 days of establishing an assessment monitoring program;
- Collected and analyzed two rounds of Assessment Monitoring results in accordance with § 257.95(b) and § 257.95(d)(1) and recorded the concentrations in the facility's operating record as required by § 257.95(d)(1); and
- Established groundwater protection standards for those detected Appendix IV constituents in accordance with § 257.95(d)(2).

1.2.3 Problems Encountered

Problems such as damaged wells, issues with sample collection or lack of sampling, and problems with analytical analysis were not encountered at the ABB Sedimentation Pond in 2018.

1.2.4 Actions to Resolve Problems

Actions to resolve problems were not required.

1.2.5 Project Key Activities for Upcoming Year

Key activities to be completed in 2019 include the following:

- Statistical analysis of Assessment Monitoring analytical data to determine if statistically significant levels (SSLs) of the detected Appendix IV constituents are present;
- Based on the findings of the statistical analysis, conduct semi-annual groundwater monitoring and subsequent statistical analysis as required by § 257.94 or § 257.95; and
- Based on the findings of the statistical analysis, an evaluation of alternate sources, determination of nature and extent, and an assessment of corrective measures will be considered as required by § 257.95(g)(1) and § 257.95(g)(3).

1.3 40 CFR § 257.90(e) - INFORMATION

At a minimum, the annual groundwater monitoring and corrective action report must contain the following information, to the extent available:

1.3.1 40 CFR § 257.90(e)(1)

A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;

As required by § 257.90(e)(1), a map showing the locations of the CCR unit and associated upgradient and downgradient monitoring wells for the Sedimentation Pond is presented as Figure 1. In addition,

this information is presented in the CCR Groundwater Monitoring Plan, which was placed in the facility's operating record by October 17, 2017 as required by § 257.105(h)(2).

1.3.2 40 CFR § 257.90(e)(2)

Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;

Additional monitoring wells were not installed or decommissioned during 2018. However, location and construction details of the existing monitoring well network for the Sedimentation Pond is provided for reference as Table I.

1.3.3 40 CFR § 257.90(e)(3)

In addition to all the monitoring data obtained under § 257.90 through § 257.98, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;

In accordance with § 257.95(b) and § 257.95(d)(1), two independent samples from each background and downgradient monitoring well were collected and analyzed. A summary table including the sample names, dates of sample collection, reason for sample collection (detection or assessment), and monitoring data obtained for the groundwater monitoring program for the Sedimentation Pond is presented in Table II of this report.

1.3.4 40 CFR § 257.90(e)(4)

A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels); and

As required by § 257.93(h) a statistical analysis of the Appendix III constituents was completed by January 15, 2018. This statistical analysis determined that statistically significant increases of boron, calcium, chloride, fluoride, sulfate, and total dissolved solids were present downgradient of the Sedimentation Pond. An evaluation of alternate sources was initiated and completed on April 13, 2018 as required by § 257.94(e)(2). A source causing the SSI over background levels other than the CCR unit was not identified at that time and an Assessment Monitoring program was initiated. The Assessment Monitoring program has been established to meet the requirements of 40 CFR § 257.95.

1.3.5 40 CFR § 257.90(e)(5)

Other information required to be included in the annual report as specified in § 257.90 through § 257.98.

Other information including development of groundwater protection standards, recording groundwater monitoring results in the operating record, and an evaluation of alternate sources is discussed in preceding sections.

TABLES

TABLE I
GROUNDWATER MONITORING WELL LOCATION AND CONSTRUCTION DETAILS
A.B. BROWN GENERATING STATION - SEDIMENTATION POND
MOUNT VERNON, INDIANA

Well	CCR Unit	Date Installed	Easting	Northing	Top of Pad Elevation (ft msl)	Top of Riser Elevation (ft msl)	Surface Grout (ft bgs)	Bentonite (ft bgs)	Sand Pack (ft bgs)	Screen Zone (ft bgs)	Screen Length (ft)	Well Radius (in)	Status
CCR-BK-1R	Background	March 2016	2770919.08	974083.40	480.10	483.39	0.0 - 50.0	50.0 - 52.0	52.0 - 64.0	54.0 - 64.0	10	2.00	Active
CCR-BK-2	Background	March 2016	2769728.14	972854.33	427.50	430.60	0.0 - 11.5	11.5 - 13.5	13.5 - 25.5	15.5 - 25.5	10	2.00	Active
CCR-SP-1	Sediment Pond	March 2016	2770030.26	970981.89	403.90	403.51	0.0 - 6.0	6.0 - 8.0	8.0 - 20.0	10.0 - 20.0	10	2.00	Active
CCR-SP-2	Sediment Pond	March 2016	2769939.51	970887.25	403.60	403.23	0.0 - 6.0	6.0 - 8.0	8.0 - 20.0	10.0 - 20.0	10	2.00	Active
CCR-SP-3	Sediment Pond	March 2016	2770027.64	970735.02	403.90	403.57	0.0 - 6.0	6.0 - 8.0	8.0 - 20.0	10.0 - 20.0	10	2.00	Active

Notes:
bgs = below ground surface
ft = feet
in = inches
msl = mean sea level
Datum of Elevations in NAVD 88
Statuses could include active, available, or decommissioned

TABLE II
SUMMARY OF GROUNDWATER QUALITY DATA
SEDIMENTATION POND - JUNE THROUGH AUGUST 2018
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA
FILE NO. 129420

Location Group	Action Level	Upgradient			
Location Name	Maximum	CCR-BK-1R	CCR-BK-1R	CCR-BK-2	CCR-BK-2
Sample Name	Contaminant	CCR-BK-1R-20180608	CCR-BK-1R20180827	CCR-BK-2-20180608	CCR-BK-2-20180820
Sample Date	Level/Regional	06/08/2018	08/27/2018	06/08/2018	08/20/2018
Lab Sample ID	Screening Level	180-78556-5	180-81365-1	180-78556-6	180-81110-10
Detection Monitoring - EPA Appendix III Constituents (mg/L)					
Boron, Total	NA	-	0.08 U	-	0.08 U
Calcium, Total	NA	-	**34**	-	**36**
Chloride	NA	-	**1.9**	-	**15**
Fluoride	4	**0.37**	**0.31**	**0.16**	**0.13 J+**
Sulfate	NA	-	**21 J-**	-	**18 J-**
Total Dissolved Solids (TDS)	NA	-	**220**	-	**230**
pH (lab) (SU)	NA	-	**7.2 J**	-	**6.8 J**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)					
Antimony, Total	0.006	0.002 U	-	0.002 U	-
Arsenic, Total	0.01	R	**0.0011**	0.001 U	0.001 U
Barium, Total	2	**0.049 J-**	**0.041 J**	**0.037 J-**	**0.033 J**
Beryllium, Total	0.006	0.001 UJ	-	0.001 UJ	-
Cadmium, Total	0.005	0.001 UJ	0.001 U	0.001 UJ	0.001 U
Chromium, Total	0.1	**0.003 J+**	**0.0076**	0.002 U	0.002 U
Cobalt, Total	0.004	**0.0008 J**	**0.001**	**0.000098 J**	0.0005 U
Fluoride	4	**0.37**	**0.31**	**0.16**	**0.13 J+**
Lead, Total	0.015	**0.00063 J**	**0.0011**	0.001 UJ	0.001 U
Lithium, Total	0.04	**0.0036 J**	**0.0048 J**	0.005 U	0.05 U
Mercury, Total	0.002	0.0002 UJ	0.0002 U	0.0002 UJ	0.0002 U
Molybdenum, Total	0.1	**0.0014 J**	**0.0013 J**	**0.00051 J**	0.005 U
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.002	0.001 U	-	0.001 U	-
Radiological (pCi/L)					
Radium-226	NA	**0.223 ± 0.148**	R	0.0863 U ± 0.108	R
Radium-228	NA	0.263 U ± 0.217	0.285 U ± 0.313	0.230 U ± 0.194	0.0380 U ± 0.238
Radium-226 & 228	5	R	R	R	0.209 UJ ± 0.251

ABBREVIATIONS AND NOTES:

CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
SU: standard units.
USEPA: United States Environmental Protection Agency.
Results in **bold** are detected.

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257. https://www.epa.gov/coalash/coal-ash-rule

TABLE II
SUMMARY OF GROUNDWATER QUALITY DATA
SEDIMENTATION POND - JUNE THROUGH AUGUST 2018
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA
FILE NO. 129420

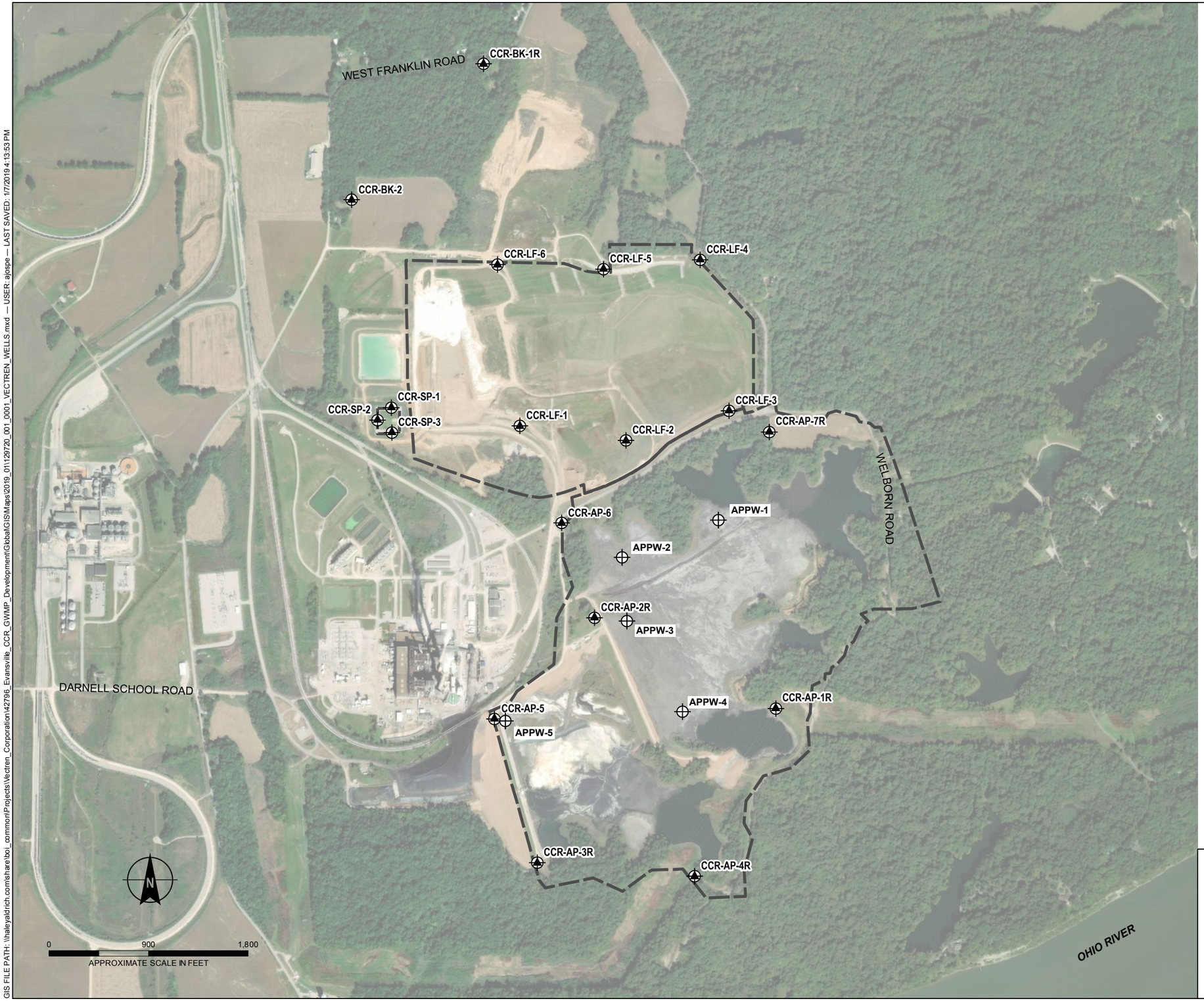
Location Group	Action Level	Downgradient							
Location Name	Maximum	CCR-SP-1	CCR-SP-1	CCR-SP-1	CCR-SP-1	CCR-SP-2	CCR-SP-2	CCR-SP-3	CCR-SP-3
Sample Name	Contaminant	CCR-SP-1-20180605	BLIND DUPLICATE 3-20180605	CCR-SP-1-20180823	BLIND DUPLICATE 3-20180823	CCR-SP-2-20180605	CCR-SP-2-20180823	CCR-SP-3-20180605	CCR-SP-3-20180823
Sample Date	Level/Regional	06/05/2018	06/05/2018	08/23/2018	08/23/2018	06/05/2018	08/23/2018	06/05/2018	08/23/2018
Lab Sample ID	Screening Level	180-78475-1	180-78475-4	180-81267-5	180-81267-8	180-78475-2	180-81267-6	180-78475-3	180-81267-7
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	NA	-	-	**0.14**	**0.16**	-	**0.18**	-	0.08 U
Calcium, Total	NA	-	-	**290**	**310**	-	**160**	-	**83**
Chloride	NA	-	-	**140**	**150**	-	**70**	-	**9.4**
Fluoride	4	**0.21**	**0.22**	**0.78 J+**	**0.37 J+**	**0.37**	**0.32 J+**	**0.3**	**0.25 J+**
Sulfate	NA	-	-	**1200 J-**	**1100 J-**	-	**380 J-**	-	**9.9 J-**
Total Dissolved Solids (TDS)	NA	-	-	**2300**	**2300**	-	**1100**	-	**390**
pH (lab) (SU)	NA	-	-	**6.9 J**	**6.8 J**	-	**7.1 J**	-	**7.3 J**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	0.002 U	0.002 U	-	-	0.002 U	-	0.002 U	-
Arsenic, Total	0.01	**0.0046 J**	**0.0039 J**	**0.0045**	**0.0046**	0.001 U	**0.00064 J**	**0.0048 J**	**0.0039**
Barium, Total	2	**0.081 J-**	**0.083 J-**	**0.066 J**	**0.071 J**	**0.13 J-**	**0.12 J**	**0.067 J-**	**0.068**
Beryllium, Total	0.006	0.001 UJ	0.001 UJ	-	-	0.001 UJ	-	0.001 UJ	-
Cadmium, Total	0.005	0.001 UJ	0.001 UJ	-	0.001 U	0.001 UJ	-	0.001 UJ	-
Chromium, Total	0.1	0.002 U	0.002 U	0.0017 U	0.0026 U	0.002 U	0.0021 U	0.002 U	0.0022 U
Cobalt, Total	0.004	**0.0071 J**	**0.0066 J**	**0.0072**	**0.0073**	**0.00065 J**	**0.00072**	**0.00079 J**	**0.00046 J**
Fluoride	4	**0.21**	**0.22**	**0.78 J+**	**0.37 J+**	**0.37**	**0.32 J+**	**0.3**	**0.25 J+**
Lead, Total	0.015	**0.000097 J**	0.001 UJ	0.001 U	**0.000099 J**	**0.00019 J**	**0.00026 J**	**0.0002 J**	**0.00012 J**
Lithium, Total	0.04	**0.0051 J**	**0.0053 J**	0.0064 U	0.007 U	**0.0069 J**	0.0073 U	**0.0031 J**	0.005 U
Mercury, Total	0.002	0.0002 UJ	0.0002 UJ	-	0.0002 U	0.0002 UJ	-	0.0002 UJ	-
Molybdenum, Total	0.1	**0.0013 J**	**0.0011 J**	**0.0011 J**	**0.0015 J**	**0.0012 J**	**0.0012 J**	**0.0027 J**	**0.0027 J**
Selenium, Total	0.05	0.005 U	0.005 U	-	0.005 U	0.005 U	-	0.005 U	-
Thallium, Total	0.002	0.001 U	0.001 U	-	-	0.001 U	-	0.001 U	-
Radiological (pCi/L)									
Radium-226	NA	0.0465 U ± 0.146	0.0918 U ± 0.165	R	R	**0.461 ± 0.296**	R	0.168 U ± 0.154	R
Radium-228	NA	-0.208 U ± 0.236	0.196 U ± 0.206	**0.542 ± 0.332**	0.246 U ± 0.244	0.118 U ± 0.282	**1.18 ± 0.361**	-0.0474 U ± 0.19	0.285 U ± 0.253
Radium-226 & 228	5	0.0465 U ± 0.278	0.288 U ± 0.264	R	R	**0.579 J ± 0.409**	R	0.168 U ± 0.245	R

ABBREVIATIONS AND NOTES:

CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
SU: standard units.
USEPA: United States Environmental Protection Agency.
Results in **bold** are detected.

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257. https://www.epa.gov/coalash/coal-ash-rule

FIGURES



LEGEND

- MONITORING WELL
- APPROXIMATE WASTE BOUNDARY
- PIEZOMETER WELL

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI
3. PIEZOMETER WELLS WILL BE SURVEYED IN THE FUTURE.

HALEY ALDRICH

VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, INDIANA

GROUNDWATER MONITORING WELL LOCATIONS FOR COMPLIANCE WITH FEDERAL CCR RULE

JANUARY 2018

FIGURE 1

GIS FILE PATH: \\haleyaldrich.com\share\bpi_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\GlobalGIS\Maps\2019_01\129720_001_0001_VECTREN_WELLS.mxd — USER: ajospe — LAST SAVED: 1/7/2019 4:13:53 PM

APPENDIX A – Alternate Source Demonstration

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REPORT ON

ALTERNATE SOURCE DEMONSTRATION
SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN - SEDIMENTATION POND
WEST FRANKLIN, INDIANA

by Haley & Aldrich, Inc.
Greenville, South Carolina

for Southern Indiana Gas and Electric Company (SIGECO)
West Franklin, Indiana

File No. 129420
April 2018

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Appendix A – EDR Reports

Appendix B – IDEM 2016 Integrated Water Monitoring and Assessment Report

List of Figures

Figure No.	Title
1	Site Location Map
2	Monitoring Well Network Sedimentation Pond
3	Potentiometric Surface Map
4	Decision Diagram for CCR Alternate Source Demonstration Evaluation

1. Introduction

Haley & Aldrich, Inc. (Haley & Aldrich) was retained by Southern Indiana Gas and Electric Company (SIGECO) to perform an alternate source evaluation for the Sedimentation Pond at the A.B. Brown Generating Station (ABB; Site) located near West Franklin, Indiana.

1.1 BACKGROUND

Consistent with §257.90 through §257.94, SIGECO has installed and certified a groundwater monitoring network for the Sedimentation Pond, collected a minimum of eight rounds of groundwater samples (nine rounds were collected for this unit) for the analysis of constituent lists as specified in the Coal Combustion Residual (CCR) Rule. In addition, interwell statistical analysis to determine if the Appendix III constituents in downgradient wells indicate a statistically significant increase (SSI) when compared to background (in this case upgradient wells). The statistical evaluation of the Appendix III constituents detected in groundwater downgradient of the Sedimentation Pond identified SSI's above background.

Pursuant to 40 CFR §257.94(e)(2), *The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality*. The CCR Rule provides 90-days from detecting a statistically significant increase over background to complete an Alternate Source Demonstration (ASD). If a successful demonstration is completed, and certified by a qualified professional engineer, the CCR unit may continue with detection monitoring (§257.94(e)(2)). If, however, an alternate source of any of the Appendix III SSI is not identified the owner or operator must, within 90-days, initiate an assessment monitoring program (§257.94(e)(3)). Supplemental site-specific and regional information may be reconsidered at a later date to re-evaluate apparent alternate sources for Appendix III SSI's and may result in potentially different outcomes than presented in this report.

This report documents the findings and conclusions of this alternate source demonstration completed for the Sedimentation Pond at the ABB.

1.2 SITE SETTING

The Site is located in Posey County near the community of West Franklin, Indiana. The location of the Site is shown on Figure 1. The Site is located approximately 0.5 miles north of the Ohio River. The Site varies in elevation with natural ground surface elevations varying from 380 to 520-feet above mean sea level (msl). The higher elevations are generally to the north of the Site with surface topography dominated by a series of ridges separated by ravines. In general, surface topography across the site generally slopes to the west towards the western property boundary then to the south toward the Ohio River. Surface water runoff occurs via sheet flow to low lying areas or ravines which eventually lead to the Ohio River.

1.3 SITE HISTORY

The Site began operations in 1978 with the construction of a 250 MW generating unit. In 1985, an additional generating unit was added. Both units burn southern Indiana coal. SIGECO currently owns

the land and operates the station for supplying electric power to industrial, commercial, and residential customers in its service territory.
Subsequent site-specific and regional information may be reconsidered at a later date to re-evaluate apparent alternate sources for Appendix III and may result in potentially different outcomes.

2. Site Geology and Hydrogeology

The Site geology and hydrogeology is described in numerous documents prepared by others and in the *Groundwater Monitoring Plan* prepared by Haley & Aldrich in October 2017.

2.1 SITE GEOLOGY

The Ohio River valley contains fill and loess (windblown) deposits derived indirectly from continental ice sheets. These were deposited from meltwater heavily loaded with entrained sediments accumulated in the area on the Pennsylvanian age shale, limestone and sandstone bedrock. Westerly winds simultaneously deposited silty sediments. As a result, base levels of the valley floor increased in elevation and created natural levees and outwashes. These natural levees produced slackwater lakes which deposited thick sequences of silt and clay. When the ice sheets retreated, the sediment load in the Ohio River diminished and lowered base levels. Consequently, the river incised the slackwater lake sediments, sculpted lacustrine terraces, and deposited silty and clayey stream alluvium.

Soil borings drilled at the Site indicates that the uppermost geologic unit is comprised of unconsolidated alluvial deposits consisting of primarily silts and clays with discontinuous layers of sand. This unit overlies Pennsylvanian age sandstone which is commonly identified as the Inglefield Sandstone. Underlying the Inglefield Sandstone is low-permeability weathered shale and siltstone. The sandstone and shale unit has been eroded on the north side of the landfill where the underlying limestone unit was encountered.

2.2 SITE HYDROGEOLOGY

Hydrogeologic units are defined based on their ability to transmit groundwater or serve as confining units between zones of groundwater saturation. The uppermost aquifer at the Site occurs within unconsolidated alluvial deposits which consist primarily of silty clay containing discontinuous layers of sand. Beneath upland areas, or ridgelines the uppermost aquifer occurs in weathered sandstone, shale, or siltstone. Recharge to the surficial aquifer occurs through direct surface infiltration.

Piezometric data recorded from the monitoring wells installed on-Site shows that the configuration of the uppermost aquifer is primarily controlled by surface topography with some influence from the underlying weathered bedrock. Groundwater flow across the eastern portion of the Landfill is to the north and northeast. Beneath the western portion of the Landfill groundwater flow shifts to the north and northwest into a trough that extends to the southwest beneath the Sedimentation Ponds (Figure 3). Groundwater flow in the vicinity of the Sedimentation Pond is predominantly to the west. Groundwater elevations vary seasonally but the groundwater flow patterns remain consistent.

Groundwater flow velocity in the uppermost aquifer beneath the CCR units was estimated using site-specific hydraulic conductivity obtained from slug testing and hydraulic gradients, and an assumed effective porosity of 25 percent. Hydraulic conductivity varied from 1E-3 cm/sec in the vicinity of the Landfill to 3E-4 cm/sec in the vicinity of the Sedimentation Ponds and the Ash Pond. The hydraulic gradient beneath and downgradient of the Landfill and the Ash Pond is 0.03 feet/foot and 0.04 feet/foot respectively. The hydraulic gradient lessens beneath and downgradient of the Sedimentation Pond dropping to 0.004 feet/foot. Using the site-specific hydraulic conductivity and hydraulic gradients, and assuming an effective porosity of 25 percent the groundwater flow velocity in the vicinity of the CCR

units is estimated as follows; 120 feet/year at the Landfill, 50 feet/year at the Ash Pond, and approximately 5 feet/year beneath and downgradient of the Sedimentation Pond.

3. Alternate Source Evaluation

Haley & Aldrich conducted an evaluation of potential alternate sources of Appendix III constituents in downgradient groundwater at the Sedimentation Pond as potential cause(s) of the statistically significant increases. These potential sources include:

1. Sampling procedures, laboratory procedures and statistical analyses to determine if potential errors may have been made that would result in the apparent statistically significant increase;
2. Potential point and non-point sources of contamination in the vicinity of the unit; or,
3. Observed natural geochemical conditions that affect the natural variability of groundwater quality.

Each of these analyses and the resulting findings are described below. The systematic approach used to conduct this evaluation is illustrated on Figure 5.

3.1 REVIEW OF SAMPLING, ANALYSIS, AND STATISTICAL EVALUATION

3.1.1 Field Sampling Procedures

In accordance with §257.93 of the CCR Rule, Haley & Aldrich prepared a Groundwater Sampling and Analysis Plan (GWSAP) for the ABB. The GWSAP identified the site-specific activities and methodologies for groundwater sampling for the groundwater monitoring program. The GWSAP included procedures for field data collection, sample collection, sample preservation and shipment, interpretation, laboratory analytical methods, and reporting for groundwater sampling for the Sedimentation Pond. The administrative procedures and frequency for collection of groundwater elevation measurements, determination of flow directions, and gradients were also provided in the GWSAP.

Haley & Aldrich has reviewed the field sampling and equipment calibration logs and the field indicator parameters and at this time did not identify deviations or errors in sampling.

3.1.2 Laboratory Quality Control

A project database that incorporates hydrogeologic and groundwater quality data was established to allow efficient management of chemical and physical data collected in the field and received from the laboratories. Laboratories conducting groundwater analyses for this program were supplied with specific formats for electronic data deliverables to ensure compatibility with the project database requirements.

Haley & Aldrich conducted quality assurance/quality control (QA/QC) reviews of the laboratory data generated for the Sedimentation Pond and at this time has not identified any laboratory errors.

3.1.3 Statistical Evaluation

SIGECO collected a total of nine groundwater samples from each monitoring well in the groundwater monitoring network. The data satisfy the CCR Rule requirement of collecting a minimum of eight rounds of hydrological and groundwater quality data from upgradient and downgradient wells. The Upper Tolerance Limit (UTL) statistical analysis was used as specified in the certification statement of 15 October 2017. The UTL is an accepted method under the CCR Rule and is the upper endpoint of a

tolerance interval that is designed to contain a pre-specified proportion (e.g. 95 percent) of the background dataset.

Data from the most recent sampling event from the downgradient monitoring wells for the Sedimentation Pond were compared to the UTL calculated from the background data Based on these comparisons, SSI's were identified in one or more of the downgradient wells.

Haley & Aldrich has reviewed the statistical evaluation for the Sedimentation Pond at ABB and at this time we have concluded that there were no errors in the statistical evaluation, the certified statistical evaluation met the performance standard of the certified statistical procedure and the evaluation complies with the requirements of the CCR Rule.

3.2 POTENTIAL POINT AND NON-POINT SOURCES

This evaluation includes an assessment of point and non-point sources of Appendix III constituents other than the regulated. Point sources could include units associated with the generating station. Non-point sources could include the leaching of inorganic constituents from the underlying subsurface soil and rock formations, runoff from parking areas or storm water conveyances or the application of agricultural chemicals. Both Point and Non-Point Sources are discussed below.

3.2.1 Point Sources

Haley & Aldrich has assessed possible point sources that may have produced the observed SSI's. At this time Haley & Aldrich was unable to identify an alternate point source that would produce an SSI of Appendix III constituent.

3.2.2 Non-Point Sources

At this time, no agricultural, mining, industrial, or other activities have been identified at the site that might constitute a non-point source of the observed Appendix III SSI's. Records used to evaluate the potential for non-point sources included historical topographic maps, historical aerial photographs and Site records. EDR's are provided in Appendix A. To date, there are no apparent non-point sources that could potentially be associated with the Appendix III SSI's for the Sedimentation Pond.

3.3 NATURAL VARIABILITY OF ON-SITE GROUNDWATER QUALITY

As presented in section 2.1, unconsolidated sediments consisting of clay and silt and consolidated sediments of limestone, sandstone and shale make up the unconfined uppermost aquifer beneath the site. To date, Haley & Aldrich did not identify natural variability of groundwater quality at ABB that could be associated with the SSI's identified for the Sedimentation Pond at this time.

3.4 REGIONAL WATER QUALITY OBSERVATIONS

3.4.1 Indiana Integrated Water Monitoring and Assessment Report 2016

Haley & Aldrich conducted a search of the Indiana Department of Environmental Management (IDEM) database including publicly available data describing groundwater quality in similar aquifers in Posey County. From the data reviewed to date, while many of the Appendix III constituents are naturally

occurring in groundwater, the reported concentrations are generally below the levels detected in the downgradient monitoring wells surrounding Sedimentation Pond. Relevant portions of the IDEM 2016 Integrated Water Monitoring and Assessment Report are presented in Appendix B.

4. Findings and Conclusions

Haley & Aldrich conducted an evaluation of groundwater quality at the Sedimentation Pond to identify alternate sources for the Appendix III SSI's observed downgradient of the unit. The evaluation included review of sampling procedures, laboratory procedures, and statistical analyses to determine if potential errors may have been made that could result in the apparent SSI's observed downgradient of the Sedimentation Pond. Haley & Aldrich also evaluated potential point and non-point sources of contamination in the vicinity and evaluated natural geologic conditions and the effect of those conditions on native groundwater chemistry.

At this time, this review did not identify contributing sources that could serve as an ASD for the SSI's observed in the CCR well network for the Sedimentation Pond. Supplemental site-specific and regional information may be reconsidered at a later date to re-evaluate apparent alternate sources for Appendix III SSI's and may result in potentially different outcomes than presented in this report.

References

1. United States Environmental Protection Agency (USEPA), 2000. Sampling and Analysis Plan Guidance and Template, R9QA/002.1. April 2000.

2. United States Environmental Protection Agency (USEPA), 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance, EPA 530/R-09-007. March 2009.

3. Haley & Aldrich, Inc. 2017. Groundwater Monitoring Report, SIGECO, A.B. Brown Station, West Franklin, Indiana.

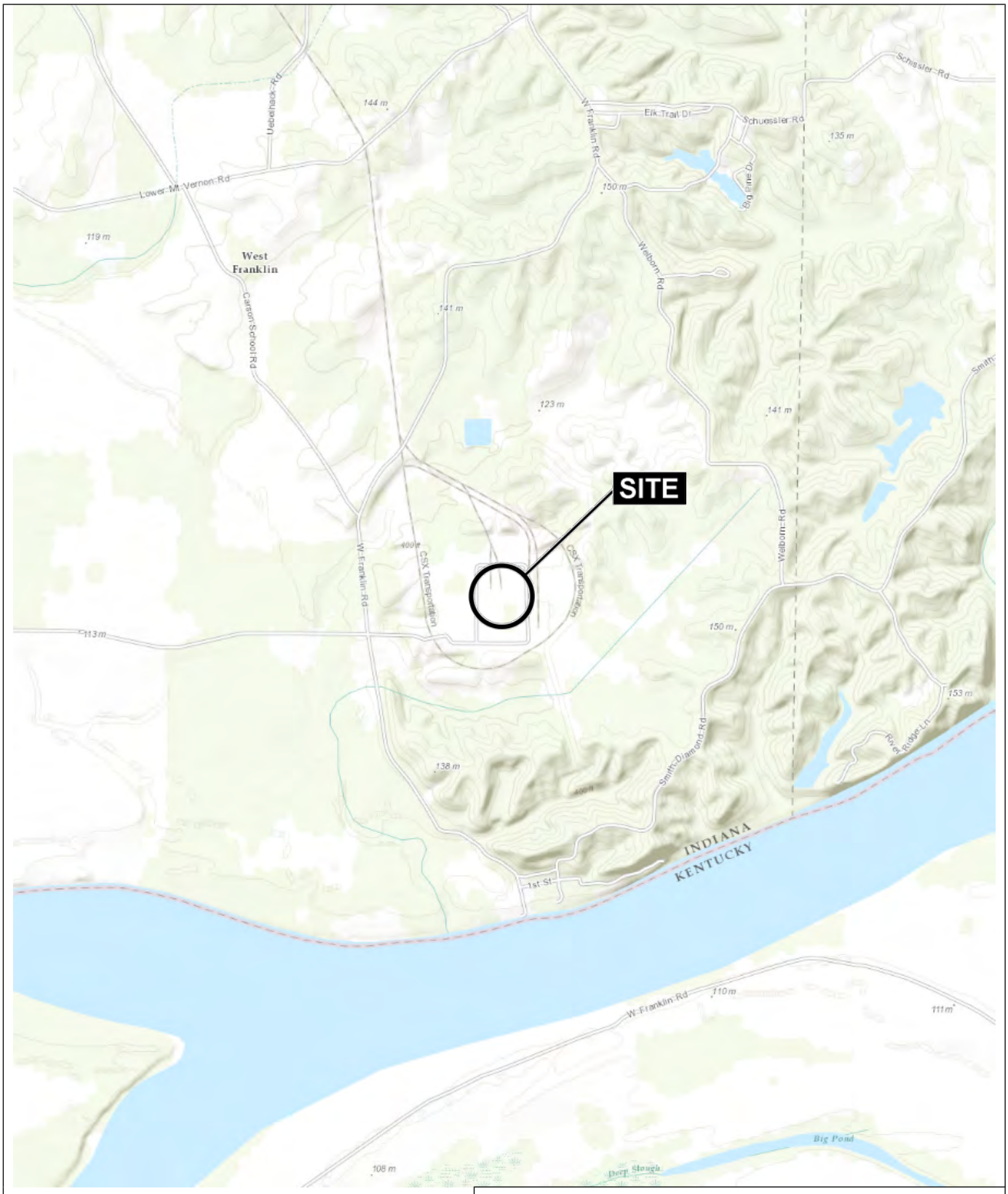
4. Haley & Aldrich, Inc. 2017. Sampling and Analysis Plan, SIGECO, A.B. Brown Station, West Franklin, Indiana.

5. Haley & Aldrich, Inc. 2017. Appendix III Statistical Results Memo, A.B. Brown Station, West Franklin, Indiana.

6. USGS. 2009. *Surficial Geologic Map of the Evansville Indiana, and Henderson, Kentucky, Area.*

https://hank.haleyaldrich.com/sites/communities/CCRASD/Client/Vectren/A.B. Brown/Sedimentation Pond/Documents/ASD Evaluation/ASD Evaluation_AB Brown_Sedimentation Pond_Vectren_2018_0413_F.docx

FIGURES



MAP SOURCE: ESRI

SITE COORDINATES: 37°54'25"N, 87°42'55"W

HALEY ALDRICH

VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MT. VERNON, INDIANA 47620

SITE LOCATION MAP

APPROXIMATE SCALE: 1 IN = 2000 FT
APRIL 2018

FIGURE 1

42796-000_1_LOCUS.PDF

LEGEND

- UPGRADIENT MONITORING WELL
- DOWNGRADIENT MONITORING WELL
- TOPOGRAPHIC DIVIDE

NOTES

1. LOCATIONS DERIVED FROM THREE I DESIGN DATA.
2. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
3. AERIAL IMAGERY SOURCE: ESRI

N

0 500 1,000
SCALE IN FEET

HALEY ALDRICH

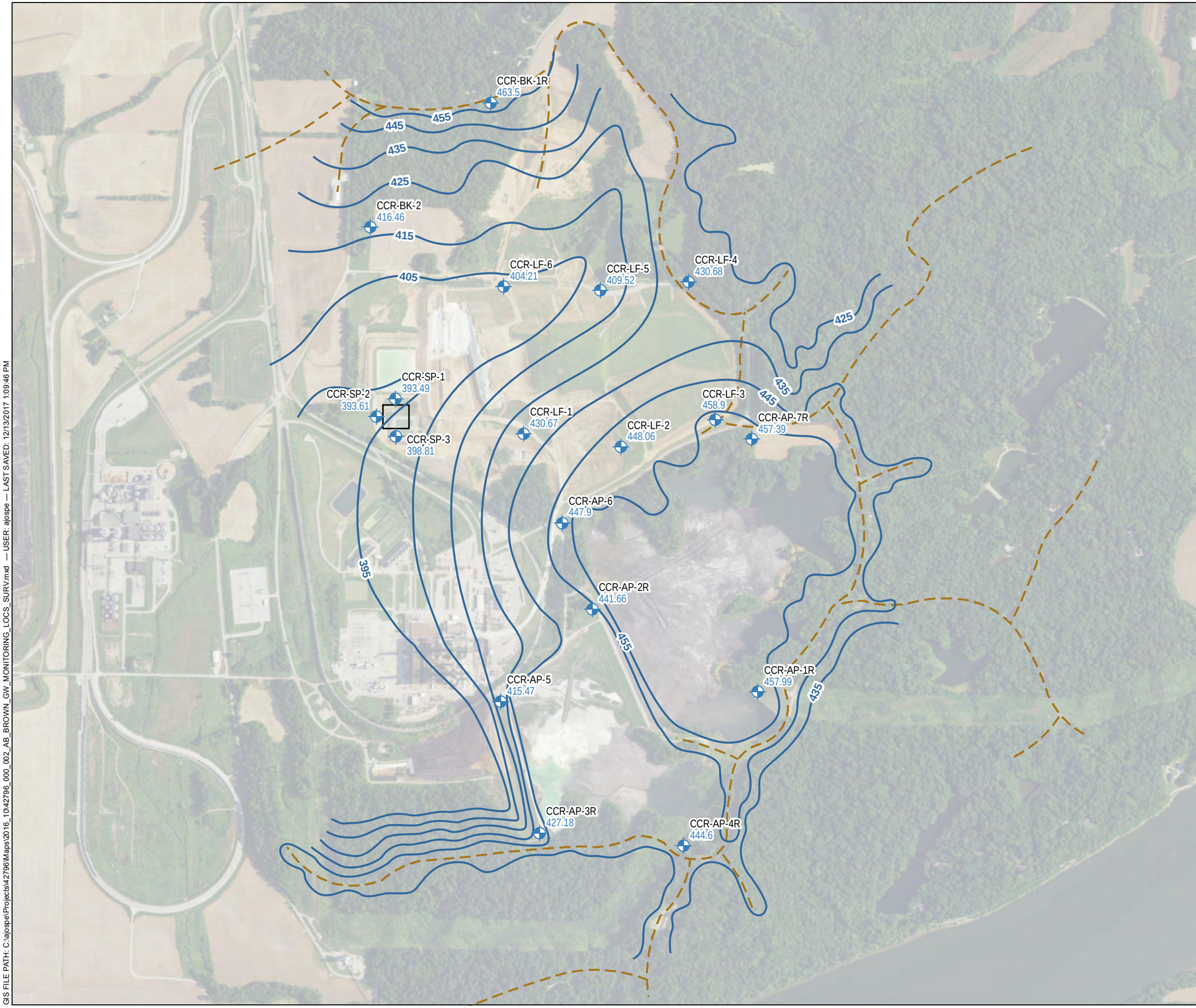
VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620

MONITORING WELL NETWORK
SEDIMENTATION POND

JANUARY 2018

FIGURE 2

GIS FILE PATH: \\haleyaldrich.com\share\boi_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2018_01\42796_000_002_AB_BROWN_WASTE_BOUNDARY_MONITORING.mxd — USER: ajaspe — LAST SAVED: 1/30/2018 10:35:59 AM



LEGEND

- MONITORING WELL
- GROUNDWATER ELEVATION CONTOUR, IN FEET
- TOPOGRAPHIC DIVIDE

NOTES

1. LOCATIONS DERIVED FROM THREE I DESIGN DATA.
2. WATER LEVELS MEASURED 6 JUNE 2017
3. AERIAL IMAGERY SOURCE: ESRI

N

0 500 1,000 1,500 2,000

SCALE IN FEET

HALEY ALDRICH

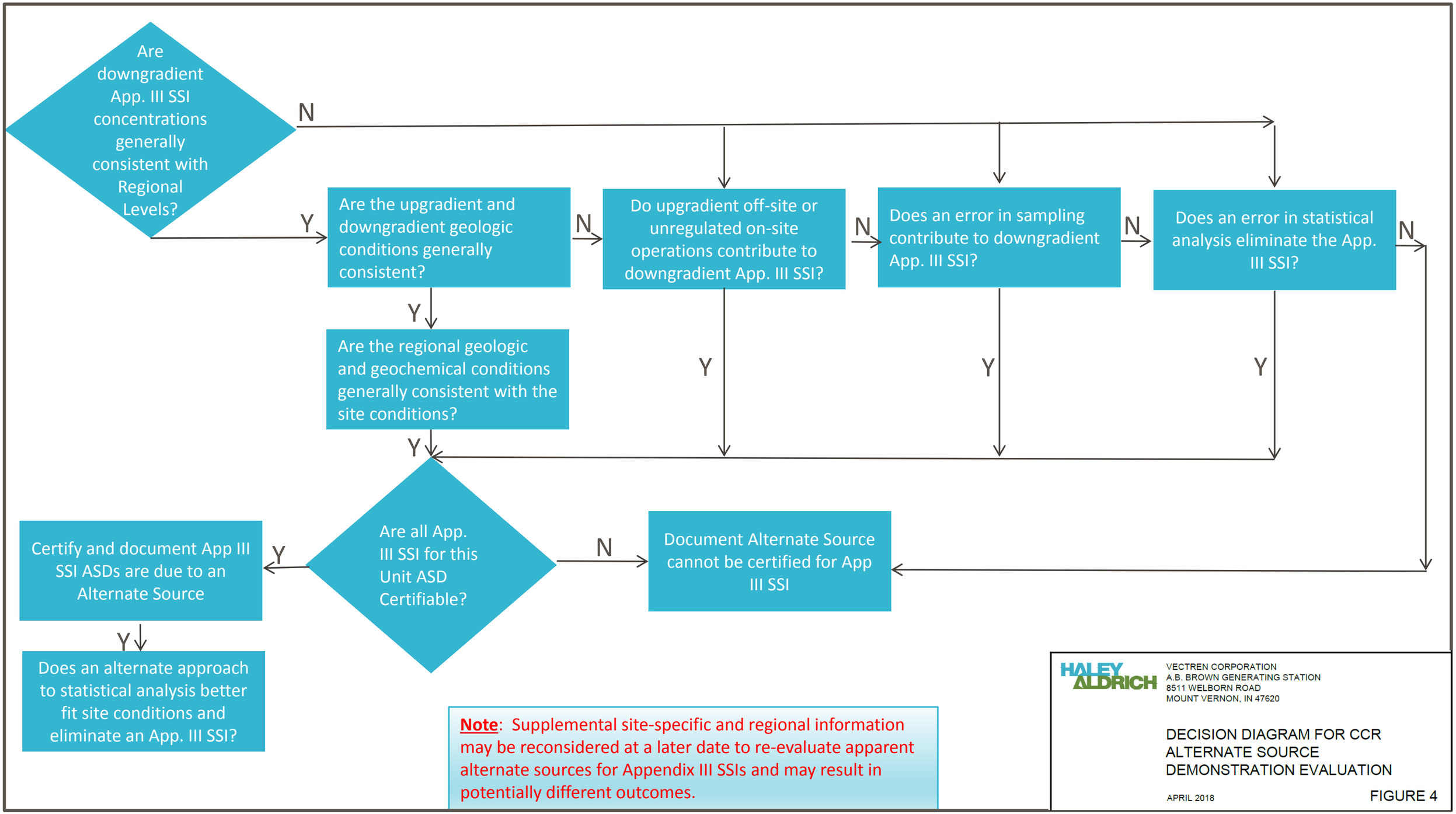
VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620

POTENTIOMETRIC SURFACE MAP

DECEMBER 2017

FIGURE 3

GIS FILE PATH: C:\ajospe\Projects\42796\Maps\2016_10\42796_000_002_AB_BROWN_GW_MONITORING_LOCS_SURV.mxd — USER: ajospe — LAST SAVED: 12/13/2017 1:09:46 PM


Are downgradient App. III SSI concentrations generally consistent with Regional Levels?
N
Y
Are the upgradient and downgradient geologic conditions generally consistent?
N
Do upgradient off-site or unregulated on-site operations contribute to downgradient App. III SSI?
N
Does an error in sampling contribute to downgradient App. III SSI?
N
Does an error in statistical analysis eliminate the App. III SSI?
N
Y
Are the regional geologic and geochemical conditions generally consistent with the site conditions?
Y
Y
Y
Y
Are all App. III SSI for this Unit ASD Certifiable?
Y
Certify and document App III SSI ASDs are due to an Alternate Source
N
Document Alternate Source cannot be certified for App III SSI
Y
Does an alternate approach to statistical analysis better fit site conditions and eliminate an App. III SSI?
Note: Supplemental site-specific and regional information may be reconsidered at a later date to re-evaluate apparent alternate sources for Appendix III SSIs and may result in potentially different outcomes.
HALEY ALDRICH
VECTREN CORPORATION
A.B. BROWN GENERATING STATION
8511 WELBORN ROAD
MOUNT VERNON, IN 47620
DECISION DIAGRAM FOR CCR ALTERNATE SOURCE DEMONSTRATION EVALUATION
APRIL 2018
FIGURE 4

APPENDIX A

EDR Reports

HALEY ALDRICH

A.B.Brown Generating Station
8511 Welborn Rd
Evansville, IN 47712

Inquiry Number: 05203791.2r
February 28, 2018

The EDR Radius Map™ Report with GeoCheck®

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

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Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

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EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-13), the ASTM Standard Practice for Environmental Site Assessments for Forestland or Rural Property (E 2247-16), the ASTM Standard Practice for Limited Environmental Due Diligence: Transaction Screen Process (E 1528-14) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

8511 WELBORN RD
EVANSVILLE, IN 47712

COORDINATES

Latitude (North):	37.9077760 - 37˚ 54' 27.99''
Longitude (West):	87.7079510 - 87˚ 42' 28.62''
Universal Tranverse Mercator:	Zone 16
UTM X (Meters):	437764.1
UTM Y (Meters):	4195613.5
Elevation:	453 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property Map:	5946019 WEST FRANKLIN, IN
Version Date:	2013

AERIAL PHOTOGRAPHY IN THIS REPORT

Portions of Photo from:	20140705
Source:	USDA

MAPPED SITES SUMMARY

Target Property Address:
8511 WELBORN RD
EVANSVILLE, IN 47712

Click on Map ID to see full detail.

MAP ID	SITE NAME	ADDRESS	DATABASE ACRONYMS	RELATIVE ELEVATION	DIST (ft. & mi.) DIRECTION
A1	SIGECO - A.B. BROWN	8511 WELBORN RD	EPA WATCH LIST		TP
A2	SOUTHERN INDIANA GAS	8511 WELBORN RD	IN SWF/LF, IN SPILLS, IN AIRS, IN NPDES, IN TIER 2		TP
A3	SIGECO FILTER CAKE D	8511 WELBORN RD	IN RGA LF		TP
A4	VECTREN- NEW SEDIMEN	8511 WELBORN RD	IN NPDES		TP
A5	SIGECO - A.B. BROWN	8511 WELLBORN ROAD	EPA WATCH LIST		TP
A6	ABB DAM MODIFICATION	8511 WELBORN RD	IN NPDES		TP
A7	SIGECO - A.B. BROWN	8511 WELBORN RD	EPA WATCH LIST		TP
A8	SIGECO AB BROWN GENE	8511 WELBORN RD	RCRA-CESQG, IN MANIFEST		TP
A9	SIGECO A B BROWN GEN	8511 WELBORN RD	TSCA, TRIS		TP
A10	AB BROWN RWS III DIS	8511 WELBORN RD	IN RGA LF		TP
A11		8511 WELBORN ROAD MO	IN SPILLS		TP
A12	A.B. BROWN GENERATIN	8511 WELBORN RD	IN NPDES		TP
A13	VECTREN - A.B. BROWN	8511 WELBORN RD	IN NPDES		TP
A14	VECTREN - A B BROWN	8511 WELBORN RD	IN NPDES		TP

EXECUTIVE SUMMARY

TARGET PROPERTY SEARCH RESULTS

The target property was identified in the following records. For more information on this property see page 8 of the attached EDR Radius Map report:

Site	Database(s)	EPA ID
SIGECO - A.B. BROWN 8511 WELBORN RD EVANSVILLE, IN 47620	EPA WATCH LIST Facility ID: 1812900010	N/A
SOUTHERN INDIANA GAS 8511 WELBORN RD MOUNT VERNON, IN 47620	IN SWF/LF IN SPILLS Facility Id: 200005087 Facility Id: 199902080 IN AIRS Status: Issued Status: Combined Status: Draft Status: Canceled Status: Withdrawn Permit ID: 129-6848-00010 Permit ID: 129-17032-00010 Permit ID: 129-12029-00010 Permit ID: 129-14441-00010 Permit ID: 129-14021-00010 **Additional key fields are available in the Map Findings section* IN NPDES Permit Status Desc: Effective NPDES Id: IN0052191 IN TIER 2 Facility Id: 11785	N/A
SIGECO FILTER CAKE D 8511 WELBORN RD MOUNT VERNON, IN	IN RGA LF Facility ID: 65-07	N/A
VECTREN- NEW SEDIMEN 8511 WELBORN RD MOUNT VERNON, IN 47620	IN NPDES Permit Status Desc: Effective NPDES Id: INR10K394	N/A
SIGECO - A.B. BROWN 8511 WELLBORN ROAD EVANSVILLE, IN 47620	EPA WATCH LIST Facility ID: 1812900010	N/A
ABB DAM MODIFICATION 8511 WELBORN RD MOUNT VERNON, IN 47620	IN NPDES	N/A

	Permit Status Desc: Effective NPDES Id: INR10L912	
SIGECO - A.B. BROWN 8511 WELBORN RD MOUNT VERNON, IN 47712	EPA WATCH LIST Facility ID: 1812900010	N/A
SIGECO AB BROWN GENE 8511 WELBORN RD MOUNT VERNON, IN 47620	RCRA-CESQG EPA ID:: IND000685800 IN MANIFEST EPA ID: IND000685800	IND000685800
SIGECO A B BROWN GEN 8511 WELBORN RD MOUNT VERNON, IN 47620	TSCA TRIS TRIS ID: 47620SGCBB8511W	47620SGCBB8511W
AB BROWN RWS III DIS 8511 WELBORN RD MOUNT VERNON, IN	IN RGA LF	N/A
8511 WELBORN ROAD MO 8511 WELBORN ROAD MO POSEY (County), IN	IN SPILLS Facility Id: 57793	N/A
A.B. BROWN GENERATIN 8511 WELBORN RD MOUNT VERNON, IN 47620	IN NPDES Permit Status Desc: Effective NPDES Id: INR10N110	N/A
VECTREN - A.B. BROWN 8511 WELBORN RD MOUNT VERNON, IN 47620	IN NPDES Permit Status Desc: Effective NPDES Id: INR10F189	N/A
VECTREN - A B BROWN 8511 WELBORN RD MOUNT VERNON, IN 47620	IN NPDES Permit Status Desc: Effective NPDES Id: INR10J646	N/A

EXECUTIVE SUMMARY

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the search radius around the target property for the following databases:

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL ..... National Priority List
Proposed NPL ..... Proposed National Priority List Sites
NPL LIENS ..... Federal Superfund Liens

Federal Delisted NPL site list

Delisted NPL ..... National Priority List Deletions

Federal CERCLIS list

FEDERAL FACILITY ..... Federal Facility Site Information listing
SEMS ..... Superfund Enterprise Management System

Federal CERCLIS NFRAP site list

SEMS-ARCHIVE ..... Superfund Enterprise Management System Archive

Federal RCRA CORRACTS facilities list

CORRACTS ..... Corrective Action Report

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF ..... RCRA - Treatment, Storage and Disposal

Federal RCRA generators list

RCRA-LQG ..... RCRA - Large Quantity Generators
RCRA-SQG ..... RCRA - Small Quantity Generators

Federal institutional controls / engineering controls registries

LUCIS ..... Land Use Control Information System
US ENG CONTROLS ..... Engineering Controls Sites List
US INST CONTROL ..... Sites with Institutional Controls

Federal ERNS list

ERNS ..... Emergency Response Notification System

State- and tribal - equivalent CERCLIS

IN SHWS ..... List of Hazardous Waste Response Sites Scored Using the Indiana Scoring Model

KY SHWS ..... State Leads List

State and tribal landfill and/or solid waste disposal site lists

IN OPEN DUMPS ..... Open Dump Waste Sites
KY SWF/LF ..... Solid Waste Facilities List

State and tribal leaking storage tank lists

IN LUST ..... Lust Leaking Underground Storage Tank List
INDIAN LUST ..... Leaking Underground Storage Tanks on Indian Land

State and tribal registered storage tank lists

FEMA UST ..... Underground Storage Tank Listing
IN UST ..... Indiana Registered Underground Storage Tanks
KY UST ..... Underground Storage Tank Database
IN AST ..... Above Ground Storage Tanks
INDIAN UST ..... Underground Storage Tanks on Indian Land

State and tribal institutional control / engineering control registries

IN AUL ..... Sites with Restrictions

State and tribal voluntary cleanup sites

IN VCP ..... Voluntary Remediation Program Site List
KY VCP ..... Voluntary Cleanup Program Sites
INDIAN VCP ..... Voluntary Cleanup Priority Listing

State and tribal Brownfields sites

IN BROWNFIELDS ..... Brownfields Site List
KY BROWNFIELDS ..... Kentucky Brownfield Inventory

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS ..... A Listing of Brownfields Sites

Local Lists of Landfill / Solid Waste Disposal Sites

IN SWTIRE ..... Waste Tire Sites Listing
IN SWRCY ..... Recycling Facilities
KY SWRCY ..... Recycling Facilities
INDIAN ODI ..... Report on the Status of Open Dumps on Indian Lands
DEBRIS REGION 9 ..... Torres Martinez Reservation Illegal Dump Site Locations
ODI ..... Open Dump Inventory
IHS OPEN DUMPS ..... Open Dumps on Indian Land

Local Lists of Hazardous waste / Contaminated Sites

US HIST CDL ..... Delisted National Clandestine Laboratory Register

IN CDL	Clandestine Drug Lab Listing
KY CDL	Clandestine Drub Lab Location Listing
IN DEL SHWS	Deleted Commissioner's Bulletin Sites List
US CDL	National Clandestine Laboratory Register

Local Land Records

LIENS 2	CERCLA Lien Information

Records of Emergency Release Reports

HMIRS	Hazardous Materials Information Reporting System
KY SPILLS	State spills
IN SPILLS 90	SPILLS 90 data from FirstSearch
IN SPILLS 80	SPILLS 80 data from FirstSearch

Other Ascertainable Records

RCRA NonGen / NLR	RCRA - Non Generators / No Longer Regulated
FUDS	Formerly Used Defense Sites
DOD	Department of Defense Sites
SCRD DRYCLEANERS	State Coalition for Remediation of Drycleaners Listing
US FIN ASSUR	Financial Assurance Information
2020 COR ACTION	2020 Corrective Action Program List
SSTS	Section 7 Tracking Systems
ROD	Records Of Decision
RMP	Risk Management Plans
RAATS	RCRA Administrative Action Tracking System
PRP	Potentially Responsible Parties
PADS	PCB Activity Database System
ICIS	Integrated Compliance Information System
FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
MLTS	Material Licensing Tracking System
COAL ASH DOE	Steam-Electric Plant Operation Data
COAL ASH EPA	Coal Combustion Residues Surface Impoundments List
PCB TRANSFORMER	PCB Transformer Registration Database
RADINFO	Radiation Information Database
HIST FTTS	FIFRA/TSCA Tracking System Administrative Case Listing
DOT OPS	Incident and Accident Data
CONSENT	Superfund (CERCLA) Consent Decrees
INDIAN RESERV	Indian Reservations
FUSRAP	Formerly Utilized Sites Remedial Action Program
UMTRA	Uranium Mill Tailings Sites
LEAD SMELTERS	Lead Smelter Sites
US AIRS	Aerometric Information Retrieval System Facility Subsystem
US MINES	Mines Master Index File
ABANDONED MINES	Abandoned Mines
FINDS	Facility Index System/Facility Registry System
UXO	Unexploded Ordnance Sites
DOCKET HWC	Hazardous Waste Compliance Docket Listing
ECHO	Enforcement & Compliance History Information
FUELS PROGRAM	EPA Fuels Program Registered Listing
KY AIRS	Permitted Airs Facility Listing
IN BULK	Registered Bulk Fertilizer and Pesticide Storage Facilities

EXECUTIVE SUMMARY

IN CFO ..... Confined Feeding Operations
IN COAL ASH ..... Coal Ash Disposal Sites
KY COAL ASH ..... Coal Ash Disposal Sites
IN DRYCLEANERS ..... Drycleaner Facility Listing
KY DRYCLEANERS ..... Drycleaner Listing
IN Financial Assurance ..... Financial Assurance Information Listing
KY Financial Assurance ..... Financial Assurance Information Listing
IN IND WASTE ..... Industrial Waste Sites Listing
KY NPDES ..... Permitted Facility Listing
IN OISC ..... Office of Indiana State Chemist Database
IN SCP ..... State Cleanup Program Sites
IN UIC ..... UIC Site Listing
KY UIC ..... UIC Information

EDR HIGH RISK HISTORICAL RECORDS

EDR Exclusive Records

EDR MGP ..... EDR Proprietary Manufactured Gas Plants
EDR Hist Auto ..... EDR Exclusive Historical Auto Stations
EDR Hist Cleaner ..... EDR Exclusive Historical Cleaners

EDR RECOVERED GOVERNMENT ARCHIVES

Exclusive Recovered Govt. Archives

IN RGA HWS ..... Recovered Government Archive State Hazardous Waste Facilities List
KY RGA HWS ..... Recovered Government Archive State Hazardous Waste Facilities List
KY RGA LF ..... Recovered Government Archive Solid Waste Facilities List
IN RGA LUST ..... Recovered Government Archive Leaking Underground Storage Tank

SURROUNDING SITES: SEARCH RESULTS

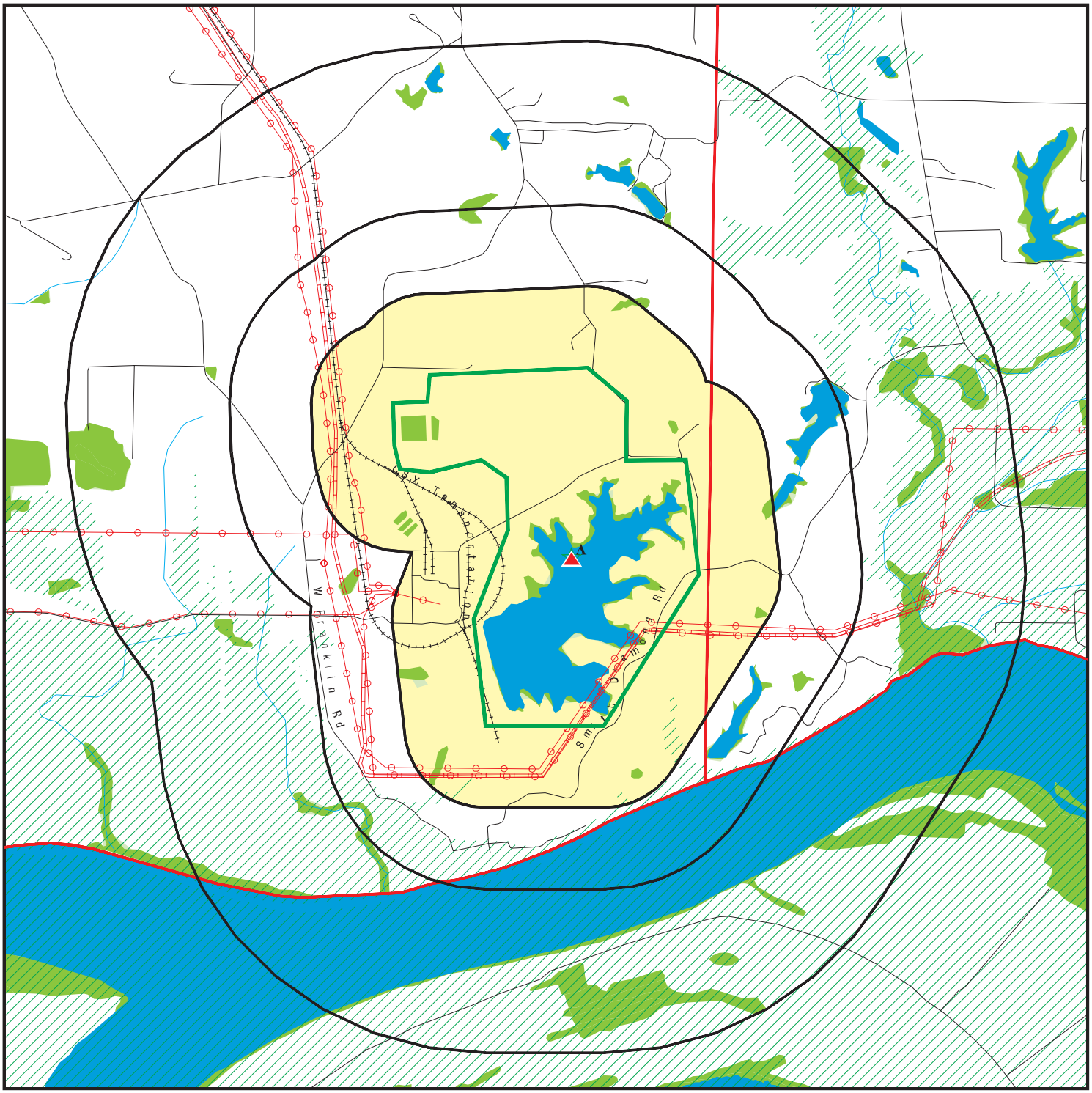
Surrounding sites were not identified.

Unmappable (orphan) sites are not considered in the foregoing analysis.

EXECUTIVE SUMMARY

There were no unmapped sites in this report.

OVERVIEW MAP - 05203791.2R



- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- National Priority List Sites
- Dept. Defense Sites

0 1/4 1/2 1 Miles

- Indian Reservations BIA
- County Boundary
- Power transmission lines
- Pipelines
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands
- Upgradient Area

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: A.B.Brown Generating Station	CLIENT: Haley & Aldrich, Inc.
ADDRESS: 8511 Welborn Rd Evansville IN 47712	CONTACT: Julia Scott INQUIRY #: 05203791.2r
LAT/LONG: 37.907776 / 87.707951	DATE: February 28, 2018 2:45 pm

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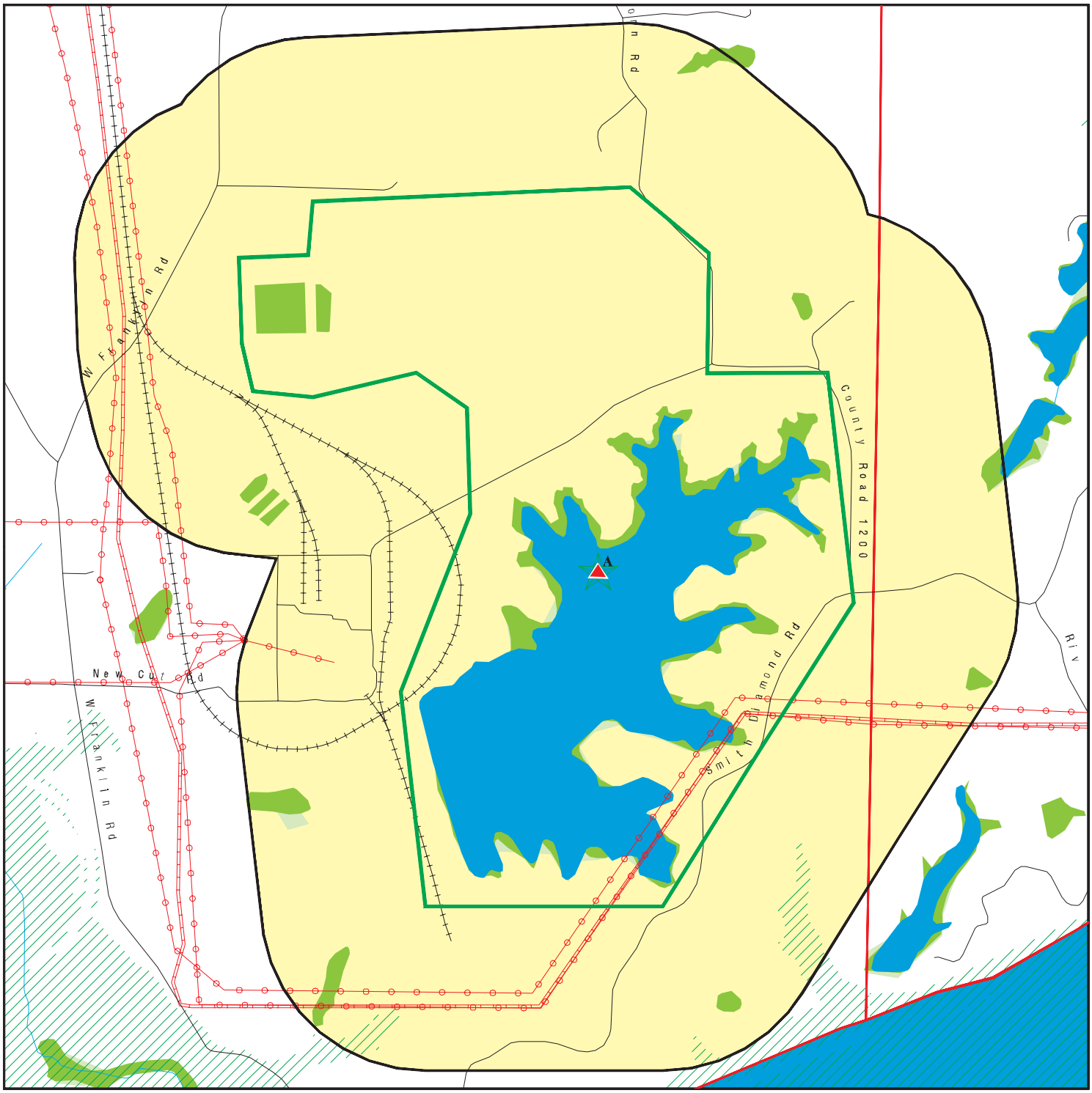
DETAIL MAP - 05203791.2R



0 1/8 1/4 1/2 Miles

- Target Property
- Sites at elevations higher than or equal to the target property
- Sites at elevations lower than the target property
- Manufactured Gas Plants
- Sensitive Receptors
- National Priority List Sites
- Dept. Defense Sites
- Indian Reservations BIA
- County Boundary
- Power transmission lines
- Pipelines
- 100-year flood zone
- 500-year flood zone
- National Wetland Inventory
- State Wetlands

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: A.B.Brown Generating Station ADDRESS: 8511 Welborn Rd Evansville IN 47712 LAT/LONG: 37.907776 / 87.707951	CLIENT: Haley & Aldrich, Inc. CONTACT: Julia Scott INQUIRY #: 05203791.2r DATE: February 28, 2018 2:46 pm

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MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
STANDARD ENVIRONMENTAL RECORDS								
Federal NPL site list								
NPL	1.000		0	0	0	0	NR	0
Proposed NPL	1.000		0	0	0	0	NR	0
NPL LIENS	TP		NR	NR	NR	NR	NR	0
Federal Delisted NPL site list								
Delisted NPL	1.000		0	0	0	0	NR	0
Federal CERCLIS list								
FEDERAL FACILITY	0.500		0	0	0	NR	NR	0
SEMS	0.500		0	0	0	NR	NR	0
Federal CERCLIS NFRAP site list								
SEMS-ARCHIVE	0.500		0	0	0	NR	NR	0
Federal RCRA CORRACTS facilities list								
CORRACTS	1.000		0	0	0	0	NR	0
Federal RCRA non-CORRACTS TSD facilities list								
RCRA-TSDF	0.500		0	0	0	NR	NR	0
Federal RCRA generators list								
RCRA-LQG	0.250		0	0	NR	NR	NR	0
RCRA-SQG	0.250		0	0	NR	NR	NR	0
RCRA-CESQG	0.250	1	0	0	NR	NR	NR	1
Federal institutional controls / engineering controls registries								
LUCIS	0.500		0	0	0	NR	NR	0
US ENG CONTROLS	0.500		0	0	0	NR	NR	0
US INST CONTROL	0.500		0	0	0	NR	NR	0
Federal ERNS list								
ERNS	TP		NR	NR	NR	NR	NR	0
State- and tribal - equivalent CERCLIS								
IN SHWS	1.000		0	0	0	0	NR	0
KY SHWS	1.000		0	0	0	0	NR	0
State and tribal landfill and/or solid waste disposal site lists								
IN OPEN DUMPS	0.500		0	0	0	NR	NR	0
IN SWF/LF	0.500	1	0	0	0	NR	NR	1
KY SWF/LF	0.500		0	0	0	NR	NR	0
State and tribal leaking storage tank lists								
IN LUST	0.500		0	0	0	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
INDIAN LUST	0.500		0	0	0	NR	NR	0
State and tribal registered storage tank lists								
FEMA UST	0.250		0	0	NR	NR	NR	0
IN UST	0.250		0	0	NR	NR	NR	0
KY UST	0.250		0	0	NR	NR	NR	0
IN AST	0.125		0	NR	NR	NR	NR	0
INDIAN UST	0.250		0	0	NR	NR	NR	0
State and tribal institutional control / engineering control registries								
IN AUL	0.500		0	0	0	NR	NR	0
State and tribal voluntary cleanup sites								
IN VCP	0.500		0	0	0	NR	NR	0
KY VCP	0.500		0	0	0	NR	NR	0
INDIAN VCP	0.500		0	0	0	NR	NR	0
State and tribal Brownfields sites								
IN BROWNFIELDS	0.500		0	0	0	NR	NR	0
KY BROWNFIELDS	0.500		0	0	0	NR	NR	0
ADDITIONAL ENVIRONMENTAL RECORDS								
Local Brownfield lists								
US BROWNFIELDS	0.500		0	0	0	NR	NR	0
Local Lists of Landfill / Solid Waste Disposal Sites								
IN SWTIRE	0.500		0	0	0	NR	NR	0
IN SWRCY	0.500		0	0	0	NR	NR	0
KY SWRCY	0.500		0	0	0	NR	NR	0
INDIAN ODI	0.500		0	0	0	NR	NR	0
DEBRIS REGION 9	0.500		0	0	0	NR	NR	0
ODI	0.500		0	0	0	NR	NR	0
IHS OPEN DUMPS	0.500		0	0	0	NR	NR	0
Local Lists of Hazardous waste / Contaminated Sites								
US HIST CDL	TP		NR	NR	NR	NR	NR	0
IN CDL	TP		NR	NR	NR	NR	NR	0
KY CDL	TP		NR	NR	NR	NR	NR	0
IN DEL SHWS	1.000		0	0	0	0	NR	0
US CDL	TP		NR	NR	NR	NR	NR	0
Local Land Records								
LIENS 2	TP		NR	NR	NR	NR	NR	0
Records of Emergency Release Reports								
HMIRS	TP		NR	NR	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
IN SPILLS	TP	2	NR	NR	NR	NR	NR	2
KY SPILLS	TP		NR	NR	NR	NR	NR	0
IN SPILLS 90	TP		NR	NR	NR	NR	NR	0
IN SPILLS 80	TP		NR	NR	NR	NR	NR	0
Other Ascertainable Records								
RCRA NonGen / NLR	0.250		0	0	NR	NR	NR	0
FUDS	1.000		0	0	0	0	NR	0
DOD	1.000		0	0	0	0	NR	0
SCRD DRYCLEANERS	0.500		0	0	0	NR	NR	0
US FIN ASSUR	TP		NR	NR	NR	NR	NR	0
EPA WATCH LIST	TP	3	NR	NR	NR	NR	NR	3
2020 COR ACTION	0.250		0	0	NR	NR	NR	0
TSCA	TP	1	NR	NR	NR	NR	NR	1
TRIS	TP	1	NR	NR	NR	NR	NR	1
SSTS	TP		NR	NR	NR	NR	NR	0
ROD	1.000		0	0	0	0	NR	0
RMP	TP		NR	NR	NR	NR	NR	0
RAATS	TP		NR	NR	NR	NR	NR	0
PRP	TP		NR	NR	NR	NR	NR	0
PADS	TP		NR	NR	NR	NR	NR	0
ICIS	TP		NR	NR	NR	NR	NR	0
FTTS	TP		NR	NR	NR	NR	NR	0
MLTS	TP		NR	NR	NR	NR	NR	0
COAL ASH DOE	TP		NR	NR	NR	NR	NR	0
COAL ASH EPA	0.500		0	0	0	NR	NR	0
PCB TRANSFORMER	TP		NR	NR	NR	NR	NR	0
RADINFO	TP		NR	NR	NR	NR	NR	0
HIST FTTS	TP		NR	NR	NR	NR	NR	0
DOT OPS	TP		NR	NR	NR	NR	NR	0
CONSENT	1.000		0	0	0	0	NR	0
INDIAN RESERV	1.000		0	0	0	0	NR	0
FUSRAP	1.000		0	0	0	0	NR	0
UMTRA	0.500		0	0	0	NR	NR	0
LEAD SMELTERS	TP		NR	NR	NR	NR	NR	0
US AIRS	TP		NR	NR	NR	NR	NR	0
US MINES	0.250		0	0	NR	NR	NR	0
ABANDONED MINES	0.250		0	0	NR	NR	NR	0
FINDS	TP		NR	NR	NR	NR	NR	0
UXO	1.000		0	0	0	0	NR	0
DOCKET HWC	TP		NR	NR	NR	NR	NR	0
ECHO	TP		NR	NR	NR	NR	NR	0
FUELS PROGRAM	0.250		0	0	NR	NR	NR	0
IN AIRS	TP	1	NR	NR	NR	NR	NR	1
KY AIRS	TP		NR	NR	NR	NR	NR	0
IN BULK	0.250		0	0	NR	NR	NR	0
IN CFO	TP		NR	NR	NR	NR	NR	0
IN COAL ASH	0.500		0	0	0	NR	NR	0
KY COAL ASH	0.500		0	0	0	NR	NR	0
IN DRYCLEANERS	0.250		0	0	NR	NR	NR	0
KY DRYCLEANERS	0.250		0	0	NR	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
IN Financial Assurance	TP		NR	NR	NR	NR	NR	0
KY Financial Assurance	TP		NR	NR	NR	NR	NR	0
IN IND WASTE	0.250		0	0	NR	NR	NR	0
IN MANIFEST	0.250	1	0	0	NR	NR	NR	1
IN NPDES	TP	6	NR	NR	NR	NR	NR	6
KY NPDES	TP		NR	NR	NR	NR	NR	0
IN OISC	0.250		0	0	NR	NR	NR	0
IN SCP	0.500		0	0	0	NR	NR	0
IN TIER 2	TP	1	NR	NR	NR	NR	NR	1
IN UIC	TP		NR	NR	NR	NR	NR	0
KY UIC	TP		NR	NR	NR	NR	NR	0
EDR HIGH RISK HISTORICAL RECORDS								
EDR Exclusive Records								
EDR MGP	1.000		0	0	0	0	NR	0
EDR Hist Auto	0.125		0	NR	NR	NR	NR	0
EDR Hist Cleaner	0.125		0	NR	NR	NR	NR	0
EDR RECOVERED GOVERNMENT ARCHIVES								
Exclusive Recovered Govt. Archives								
IN RGA HWS	TP		NR	NR	NR	NR	NR	0
KY RGA HWS	TP		NR	NR	NR	NR	NR	0
IN RGA LF	TP	2	NR	NR	NR	NR	NR	2
KY RGA LF	TP		NR	NR	NR	NR	NR	0
IN RGA LUST	TP		NR	NR	NR	NR	NR	0
- Totals --		20	0	0	0	0	0	20

NOTES:

TP = Target Property

NR = Not Requested at this Search Distance

Sites may be listed in more than one database

A1 Target Property | **SIGECO - A.B. BROWN (SOUTHERN INDIANA GA** | **EPA WATCH LIST** | **1016145509**
8511 WELBORN RD | **N/A**
EVANSVILLE, IN 47620

Site 1 of 14 in cluster A

Actual: 453 ft.

EPA WATCH LIST:

Facility ID:	1812900010
Program:	CAA Facilities
List date:	April 2013 CAA Watch List
Facility ID:	1812900010
Program:	CAA Facilities
List date:	June 2013 CAA Watch List
Facility ID:	1812900010
Program:	CAA Facilities
List date:	March 2013 CAA Watch List
Facility ID:	1812900010
Program:	CAA Facilities
List date:	May 2013 CAA Watch List

A2 Target Property | **SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN G** | **IN SWF/LF** | **S107706550**
8511 WELBORN RD | **IN SPILLS** | **N/A**
MOUNT VERNON, IN 47620 | **IN AIRS**
IN NPDES
Site 2 of 14 in cluster A | **IN TIER 2**

Actual: 453 ft.

LF:

Facility ID:	Not reported
Facility Type:	RESTRICTED WASTE SITE TYPE III
Facility Status:	Not reported
SR No:	177
Contact:	LISA MESSENGER
Operating Num:	65-07
Date Closed:	Not reported
Responsible Party:	NORMAN P WAGNER
RP Phone:	812-424-6411
RP Address:	20-24 NW FORUTH
RP City,St,Zip:	EVANSVILLE, IN 47741
Contact Phone:	812-491-4000
Owner Name:	SOUTHERN INDIANA GAS & ELECTRIC COMPANY
Owner Type:	P
Permanent Expiration:	10/31/2021
Open To Public:	N

SPILL:

Facility ID:	200005087
Incident Date:	05/10/2000
Report Date:	05/10/2000
Material:	Sulfuric acid
Spill Source:	Industrial
Recovered Amount:	Not reported
Recovered Units:	Not reported
Spilled Amount:	Not reported
Spilled Units:	Not reported
Contained:	Not reported
Water Affected:	Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Spill Type:	Air
Area Affected:	Not reported
Fish Killed:	Not reported
Water Supply Affected:	Not reported
Public Intake:	N
Incident Status:	Not reported

Facility ID:	199902080
Incident Date:	02/09/1999
Report Date:	02/09/1999
Material:	Sulfuric Acid
Spill Source:	Trans - Truck
Recovered Amount:	U
Recovered Units:	Not reported
Spilled Amount:	Not reported
Spilled Units:	U
Contained:	N
Water Affected:	Not reported
Spill Type:	Spill
Area Affected:	Not reported
Fish Killed:	Not reported
Water Supply Affected:	Not reported
Public Intake:	U
Incident Status:	Not reported

AIRS:

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Vickie Cordell
Responsible Official Phone:	317-233-1782
SIC Code:	4911
Permit ID:	129-6848-00010
Permit Level:	Title V
Subtype Qualifier:	Not reported
Issue Date:	12/15/2004
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	10/08/1996
Application Received End Date:	Not reported
Public Notice Begins Start Date:	12/24/2003
Public Notice Begins End Date:	01/23/2004
Proposed Internet Upload Start Date:	10/28/2004
Proposed Internet Upload End Date:	12/11/2004

Status:	Combined
Source ID:	129-00010
Responsible Official Name:	Rebecca Mason
Responsible Official Phone:	3-5692
SIC Code:	4911
Permit ID:	129-17032-00010
Permit Level:	Title V
Subtype Qualifier:	SPM - NOx Budget Permit
Issue Date:	Not reported
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	08/01/2003
Application Received End Date:	Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Vickie Cordell
Responsible Official Phone:	317-233-1782
SIC Code:	4911
Permit ID:	129-12029-00010
Permit Level:	Title V
Subtype Qualifier:	Significant Source Mod. (Major PSD/EO) (270)
Issue Date:	11/29/2001
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	03/13/2000
Application Received End Date:	Not reported
Public Notice Begins Start Date:	09/26/2001
Public Notice Begins End Date:	10/26/2001
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Not reported
Responsible Official Phone:	Not reported
SIC Code:	4911
Permit ID:	129-14441-00010
Permit Level:	Acid Rain
Subtype Qualifier:	Not reported
Issue Date:	11/19/2001
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	05/30/2001
Application Received End Date:	Not reported
Public Notice Begins Start Date:	09/26/2001
Public Notice Begins End Date:	10/26/2001
Proposed Internet Upload Start Date:	09/24/2001
Proposed Internet Upload End Date:	11/08/2001

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Gurinder Saini
Responsible Official Phone:	800-451-6027
SIC Code:	4911
Permit ID:	129-14021-00010
Permit Level:	Title V
Subtype Qualifier:	Significant Source Mod. (Major PSD/EO) (270)
Issue Date:	11/16/2001
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	03/05/2001
Application Received End Date:	Not reported
Public Notice Begins Start Date:	09/26/2001
Public Notice Begins End Date:	10/26/2001
Proposed Internet Upload Start Date:	Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Proposed Internet Upload End Date:	Not reported

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Robert W. Ondrusek
Responsible Official Phone:	800-451-6027
SIC Code:	4911
Permit ID:	129-10331-00010
Permit Level:	Acid Rain
Subtype Qualifier:	Administrative Amendment
Issue Date:	09/25/2001
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	11/06/1998
Application Received End Date:	Not reported
Public Notice Begins Start Date:	12/30/1998
Public Notice Begins End Date:	01/29/1999
Proposed Internet Upload Start Date:	12/14/1999
Proposed Internet Upload End Date:	12/22/1999

Status:	Draft
Source ID:	129-00010
Responsible Official Name:	Deena Patton
Responsible Official Phone:	317-234-5400
SIC Code:	4911
Permit ID:	129-37317-00010 (No Electronic File Exists)
Permit Level:	Title V
Subtype Qualifier:	Significant Permit Modification
Issue Date:	Not reported
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	06/21/2016
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Josiah Balogun
Responsible Official Phone:	317-234-5257
SIC Code:	4911
Permit ID:	129-36150-00010
Permit Level:	Acid Rain
Subtype Qualifier:	Renewal
Issue Date:	01/25/2016
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	08/11/2015
Application Received End Date:	Not reported
Public Notice Begins Start Date:	12/01/2015
Public Notice Begins End Date:	12/31/2015
Proposed Internet Upload Start Date:	01/06/2016
Proposed Internet Upload End Date:	01/21/2016

Status:	Issued

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Source ID:	129-00010
Responsible Official Name:	Deena Patton
Responsible Official Phone:	317-234-5400
SIC Code:	4911
Permit ID:	129-35974-00010
Permit Level:	Title V
Subtype Qualifier:	Significant Permit Modification
Issue Date:	12/28/2015
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	06/23/2015
Application Received End Date:	Not reported
Public Notice Begins Start Date:	10/28/2015
Public Notice Begins End Date:	11/27/2015
Proposed Internet Upload Start Date:	12/03/2015
Proposed Internet Upload End Date:	12/18/2015

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Anh Nguyen
Responsible Official Phone:	317-233-5334
SIC Code:	4911
Permit ID:	129-33047-00010
Permit Level:	Title V
Subtype Qualifier:	Renewal
Issue Date:	11/07/2014
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	04/04/2013
Application Received End Date:	Not reported
Public Notice Begins Start Date:	09/10/2014
Public Notice Begins End Date:	10/10/2014
Proposed Internet Upload Start Date:	10/21/2014
Proposed Internet Upload End Date:	11/05/2014

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Josiah Balogun
Responsible Official Phone:	317-234-5257
SIC Code:	4911
Permit ID:	129-29915-00010
Permit Level:	Acid Rain
Subtype Qualifier:	Renewal
Issue Date:	02/10/2011
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	11/22/2010
Application Received End Date:	Not reported
Public Notice Begins Start Date:	12/15/2010
Public Notice Begins End Date:	01/14/2011
Proposed Internet Upload Start Date:	01/24/2011
Proposed Internet Upload End Date:	02/08/2011

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	PR 2
Responsible Official Phone:	XXX-XXX-XXXX

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

SIC Code:	4911
Permit ID:	129-26321-00010
Permit Level:	Title V
Subtype Qualifier:	SPM - CAIR
Issue Date:	07/24/2009
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	03/24/2008
Application Received End Date:	Not reported
Public Notice Begins Start Date:	06/03/2009
Public Notice Begins End Date:	07/03/2009
Proposed Internet Upload Start Date:	07/07/2009
Proposed Internet Upload End Date:	07/22/2009

Status:	Canceled
Source ID:	129-00010
Responsible Official Name:	PR 2
Responsible Official Phone:	XXX-XXX-XXXX
SIC Code:	4911
Permit ID:	129-20365-00010 (No Electronic File Exists)
Permit Level:	Appeal Resolution
Subtype Qualifier:	Not reported
Issue Date:	Not reported
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	01/12/2005
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Josiah Balogun
Responsible Official Phone:	317-234-5257
SIC Code:	4911
Permit ID:	129-26415-00010
Permit Level:	Title V
Subtype Qualifier:	Renewal
Issue Date:	01/26/2009
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	04/14/2008
Application Received End Date:	Not reported
Public Notice Begins Start Date:	12/03/2008
Public Notice Begins End Date:	01/02/2009
Proposed Internet Upload Start Date:	01/09/2009
Proposed Internet Upload End Date:	01/24/2009

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Alexandra Yeung
Responsible Official Phone:	800-451-6027
SIC Code:	4911
Permit ID:	129-19748-00010
Permit Level:	Acid Rain

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Subtype Qualifier:	Renewal
Issue Date:	05/09/2006
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	04/22/2004
Application Received End Date:	Not reported
Public Notice Begins Start Date:	11/04/2004
Public Notice Begins End Date:	12/03/2004
Proposed Internet Upload Start Date:	03/23/2006
Proposed Internet Upload End Date:	05/07/2006

Status:	Canceled
Source ID:	129-00010
Responsible Official Name:	Walter Habeeb
Responsible Official Phone:	317-232-8422
SIC Code:	4911
Permit ID:	129-17709-00010 (No Electronic File Exists)
Permit Level:	Amendment
Subtype Qualifier:	Not reported
Issue Date:	Not reported
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	05/07/2003
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Vickie Cordell
Responsible Official Phone:	317-233-1782
SIC Code:	4911
Permit ID:	129-21413-00010
Permit Level:	Title V
Subtype Qualifier:	Administrative Amendment
Issue Date:	07/21/2005
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	06/10/2005
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Withdrawn
Source ID:	129-00010
Responsible Official Name:	Vickie Cordell
Responsible Official Phone:	317-233-1782
SIC Code:	4911
Permit ID:	129-12848-00010 (No Electronic File Exists)
Permit Level:	Title V
Subtype Qualifier:	Significant Permit Modification
Issue Date:	Not reported
End Date:	Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Source Contact:	Allen K. Rose
Application Received Start Date:	10/12/2000
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Combined
Source ID:	129-00010
Responsible Official Name:	Vickie Cordell
Responsible Official Phone:	317-233-1782
SIC Code:	4911
Permit ID:	129-11288-00010
Permit Level:	Title V
Subtype Qualifier:	Significant Source Mod. (Major PSD/EO) (270)
Issue Date:	Not reported
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	08/24/1999
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Withdrawn
Source ID:	129-00010
Responsible Official Name:	Bryan Sheets
Responsible Official Phone:	800-451-6027
SIC Code:	4911
Permit ID:	129-10856-00010 (No Electronic File Exists)
Permit Level:	Title V
Subtype Qualifier:	Significant Source Mod. (Major PSD/EO) (270)
Issue Date:	Not reported
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	04/13/1999
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Bryan Sheets
Responsible Official Phone:	800-451-6027
SIC Code:	4911
Permit ID:	129-11581-00010 (No Electronic File Exists)
Permit Level:	Review Request
Subtype Qualifier:	Not reported
Issue Date:	12/03/1999
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	11/23/1999
Application Received End Date:	Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Combined
Source ID:	129-00010
Responsible Official Name:	Not reported
Responsible Official Phone:	Not reported
SIC Code:	4911
Permit ID:	129-8930-00010
Permit Level:	Acid Rain
Subtype Qualifier:	Administrative Amendment
Issue Date:	Not reported
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	06/24/1997
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Tena Hopkins
Responsible Official Phone:	800-451-6027
SIC Code:	4911
Permit ID:	129-5153-00010
Permit Level:	Acid Rain
Subtype Qualifier:	Not reported
Issue Date:	12/31/1997
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	12/27/1995
Application Received End Date:	Not reported
Public Notice Begins Start Date:	10/29/1997
Public Notice Begins End Date:	11/28/1997
Proposed Internet Upload Start Date:	12/30/1997
Proposed Internet Upload End Date:	12/31/1997

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Holly Stockrahm
Responsible Official Phone:	800-451-6027
SIC Code:	4911
Permit ID:	129-4226-00010 (No Electronic File Exists)
Permit Level:	Construction
Subtype Qualifier:	Registration
Issue Date:	12/29/1994
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	11/16/1994
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Proposed Internet Upload End Date:	Not reported

Status:	Issued
Source ID:	129-00010
Responsible Official Name:	Holly Stockrahm
Responsible Official Phone:	800-451-6027
SIC Code:	4911
Permit ID:	129-4198-00010 (No Electronic File Exists)
Permit Level:	Construction
Subtype Qualifier:	Interim (Registration)
Issue Date:	11/30/1994
End Date:	Not reported
Source Contact:	Allen K. Rose
Application Received Start Date:	11/16/1994
Application Received End Date:	Not reported
Public Notice Begins Start Date:	Not reported
Public Notice Begins End Date:	Not reported
Proposed Internet Upload Start Date:	Not reported
Proposed Internet Upload End Date:	Not reported

NPDES:

Permit Number:	IN0052191
Primary Facility Sic Code:	Not reported
Major/Minor:	Major
Primary Facility Sic Desc:	Not reported
Facility Type Desc:	Privately Owned Facility
Permit Status Desc:	Effective
Issue Date:	02/28/2017
Expired Date:	03/31/2022
Effective Date:	04/01/2017
Terminated Date:	Not reported
DMR Cognizant Official:	DAVID REHERMAN, PLT DIR
DMR Cognizant Telephone:	812-491-4666
Waterbody:	OHIO RIVER
Total Actual Average Flow (MGD):	1.03
Total App. Design Flow (MGD):	Not reported
FRS HUC Code:	05140202
Latitude In Decimal Degrees:	37.969694
Longitude In Decimal Degrees:	-87.605389

TIER 2:

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Chlorine
Chemical Info:	CAS Num:7782505 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 100 - 499 Quantity: 365 Container Type: L - Cylinder
Location Description:	2x150-lb cylinder in chlorine bldg
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100 - 499

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	GE Betz PDC9325
Chemical Info:	CAS Num: Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

	Inside Building
Location Description:	Unit 1 boiler
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Mineral oil, light and heavy
Chemical Info:	CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	Electric transformers east of cooling tower #1
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Sodium Carbonate
Chemical Info:	CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	Unit 1 scrubber
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Fuel Oil # 2
Chemical Info:	CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	Landfill - 2 tanks
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Other Chemical 11
Chemical Info:	CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description:	Coal handling area
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Other Chemical 11
Chemical Info:	CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description:	6000 gal, Unit 2 main floor
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Calcium Oxide
Chemical Info: CAS Num:1305788 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000000-499999999 Quantity: 365 Container Type: H - Silo
Location Description: Storage silo 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000000-499999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: 260 gal, Unit #1 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 50000 - 74999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6 ton tank near entrance road
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 50000 - 74999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: De-energized transformer at plant entrance
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: D - Steel Drum
Location Description: Boiler Unit #2 drums
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Boiler Unit #2 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Landfill - 2 tanks
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfur
Chemical Info: CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 2 thickener tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Black Beauty Abrasive
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 75000 - 99999 Quantity: 365 Container Type: R - Other
Location Description: U2 absorber towers; Maintenance shop; SIMI Bldg; So side of U2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 75000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ferric Chloride
Chemical Info: CAS Num:7705080 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 150 Container Type: O - Tote Bin
Location Description: Ash Pond Chemical Building - 2 totes
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Steel Drum
Location Description: Boiler Unit #2 drums

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Other
Location Description: substation battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: Not reported
SIC Code: Not reported
Chemical Name: Not reported
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: Quantity: Container Type:
Location Description: Not reported
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt:

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Hydroxide
Chemical Info: CAS Num:1310732 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: #2 Cooling Tower - 1500 gal tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: R - Other
Location Description: Unit 1 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: 2-8000 gal tank at cooling towers
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: C - Tank I
Location Description: Boiler Unit #2 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: De-energized transformer at plant entrance
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Boiler Unit #1 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit #2 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Coal handling area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 06 Quantity: 365 Container Type: Above-Ground Tank
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt:

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

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Facility Id: 11785
SIC Code: Not reported
Chemical Name: 1-hydroxycthylidene-1, 1-diphosphonic acid
Chemical Info: CAS Num:2809214 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Tank Inside Building
Location Description: Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Chlorine
Chemical Info: CAS Num:7782505 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 02 Quantity: 365 Container Type: Cylinder
Location Description: 100 lb cylinder in chlorine bldg
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 02

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3
Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 25000 - 49999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 1500 gal, Unit 2 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 25000 - 49999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 50000 - 74999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 30 ton tank S of Unit 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 50000 - 74999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: GE Betz PDC9325
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Electric transformers east of cooling tower #1
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 1 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6000 gal, Unit 2 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Maintenance shop
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: substation battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfur

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Info: CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 1 thickener tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 5
Chemical Info: CAS Num:999005 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000000 - 9999999999 Quantity: 365 Container Type: R - Other
Location Description: coal pile
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000000 - 9999999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit #3
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: Maintenance shop
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Calcium Oxide
Chemical Info: CAS Num:1305788 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000000-499999999 Quantity: 365 Container Type: H - Silo

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Location Description: Storage silo 1
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000000-499999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Chlorine
Chemical Info: CAS Num:7782505 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100-999 Quantity: 365 Container Type: L - Cylind
Location Description: 100 lb cylinder in chlorine bldg
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100-999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 50000 - 74999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 30 ton tank S of Unit 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 50000 - 74999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 300 gal, Unit #2 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Two 50,000 gal tanks at Unit #3
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Coal handling area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ammonium hydroxide
Chemical Info: CAS Num:1336216 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 06 Quantity: 365 Container Type: Tank Inside Building
Location Description: Two 36,000-gal tanks on south side of pl
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 06

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: Unit #1 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Tank Inside Building
Location Description: Boiler Unit #1 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: 6000 gal, Unit 2 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Chlorine
Chemical Info: CAS Num:7782505 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100 - 999 Quantity: 365 Container Type: L - Cylinder
Location Description: 2x150-lb cylinder in chlorine bldg

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Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100 - 999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Boiler Unit #2 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6000 gal, Unit 1 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Calcium Oxide
Chemical Info: CAS Num:1305788 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 09 Quantity: 365 Container Type: Silo
Location Description: Storage silo 1
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 09

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Two 50,000 gal tanks at Unit #3
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 2-7000 gal tank at cooling towers
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ferric Chloride
Chemical Info: CAS Num:7705080 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 150 Container Type: O - Tote Bin
Location Description: Ash Pond Chemical Building - 2 totes
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Boiler Unit #2 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 7
Chemical Info: CAS Num:999007 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6000 gal, Unit 1 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 2-8000 gal tank at cooling towers
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: Unit #2 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 5
Chemical Info: CAS Num:999005 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000000-999999999 Quantity: 365 Container Type: R - Other
Location Description: coal pile
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000000-999999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 1000000-9999999 Quantity: 365 Container Type: A - Above-
Location Description: Unit 1 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 1000000-9999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Hydroxide
Chemical Info: CAS Num:1310732 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: #1 Cooling Tower - 1500 gal tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Oil water separator
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Location Description: 2-7000 gal tank at cooling towers
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: Unit 2 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: Unit 1 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ferric Chloride
Chemical Info: CAS Num:7705080 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 150 Container Type: O - Tote Bin
Location Description: Unit 2 Main Floor - max 4 totes
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfur
Chemical Info: CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 05 Quantity: 365 Container Type: Above-Ground Tank
Location Description: 15,000 gal Unit 1thickener tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 05

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Other
Location Description: gas turbine battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3
Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: 1500 gal, Unit 2 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Other
Location Description: Unit 2 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Hydroxide
Chemical Info: CAS Num:1310732 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: #2 Cooling Tower - 1500 gal tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: R - Other
Location Description: gas turbine battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Electric transformers east of cooling tower #1
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Location Description: Landfill - 2 tanks
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Crane bay
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ammonium hydroxide
Chemical Info: CAS Num:1336216 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: South side of plant
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Hydroxide
Chemical Info: CAS Num:1310732 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: #1 Cooling Tower - 1500 gal tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ammonium hydroxide
Chemical Info: CAS Num:1336216 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: South side of plant
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Calcium Oxide
Chemical Info: CAS Num:1305788 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 1000000 - 9999999 Quantity: 365 Container Type: H - Silo
Location Description: Storage Silo 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt:

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

1000000 - 9999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: 6000 gal, Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: Unit 1 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ferric Chloride
Chemical Info: CAS Num:7705080 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 150 Container Type: O - Tote Bin
Location Description: Unit 2 Main Floor - max 4 totes
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 50000 - 74999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 30 ton tank S of Unit 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 50000 - 74999

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: GE Betz PDC9325
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit #2 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: Unit 2 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: gas turbine battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: Landfill - 2 tanks
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: 1500 gal, Unit 1 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 1000000-9999999 Quantity: 365 Container Type: A - Above-
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 1000000-9999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ammonium hydroxide
Chemical Info: CAS Num:1336216 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 1000000-9999999 Quantity: 365 Container Type: C - Tank I
Location Description: Two 36,000-gal tanks on south side of plant
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 1000000-9999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Boiler Unit #1 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 5
Chemical Info: CAS Num:999005 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000000 - 9999999999 Quantity: 365 Container Type: R - Other
Location Description: coal pile
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000000 - 9999999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Location Description: Coal Handling Service Area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 300 gal, Unit #1 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Maintenance shop
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ferric Chloride
Chemical Info: CAS Num:7705080 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 150 Container Type: O - Tote Bin
Location Description: Cooling Tower Chemical Building - 2 totes
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: Oil water separator
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Hydroxide
Chemical Info: CAS Num:1310732 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: #1 Cooling Tower - 1500 gal tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: 260 gal, Unit #1 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: D - Steel
Location Description: Boiler Unit #2 drums
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Calcium Oxide
Chemical Info: CAS Num:1305788 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 1000000 - 9999999 Quantity: 365 Container Type: H - Silo
Location Description: Storage Silo 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 1000000 - 9999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 1000000 - 9999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 1000000 - 9999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Coal Handling Service Area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

More Chemical Info:	Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: R - Other
Location Description:	substation battery bank
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Sulfur
Chemical Info:	CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	Unit 1 thickener tank
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Sulfur
Chemical Info:	CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	Unit 2 thickener tank
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Fuel Oil # 2
Chemical Info:	CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	Unit #2 Compressor
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Fuel Oil # 2
Chemical Info:	CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	Unit #3
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	trixylenyl phosphate
Chemical Info:	CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Location Description: Boiler Unit #1 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Boiler Unit #2 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Coal Handling Service Area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 300 gal, Unit #1 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Coal handling area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: 6000 gal, Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt:

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: 6000 gal, Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Boiler Unit #1 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3
Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 25000 - 49999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 1500 gal, Unit 1 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 25000 - 49999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Black Beauty Abrasive
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 75000 - 99999 Quantity: 365 Container Type: R - Other
Location Description: U2 absorber towers; Maintenance shop; SIMI Bldg; So side of U2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 75000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: Unit #1 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

SIC Code: Not reported
Chemical Name: GE Betz PDC9325
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: C - Tank I
Location Description: Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: GE Betz PDC9325
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: C - Tank I
Location Description: Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 7
Chemical Info: CAS Num:999007 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000-999999 Quantity: 365 Container Type: C - Tank I
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000-999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Chlorine
Chemical Info: CAS Num:7782505 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100 - 499 Quantity: 365 Container Type: L - Cylinder
Location Description: 2x150-lb cylinder in chlorine bldg
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100 - 499

Facility Id: 11785
SIC Code: Not reported
Chemical Name: GE Betz PDC9325
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Location Description: Crane bay
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: 2-8000 gal tank at cooling towers
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: Unit #2 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 7
Chemical Info: CAS Num:999007 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 05 Quantity: 365 Container Type: Tank Inside Building
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 05

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: Coal Handling Service Area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: GE Betz PDC9325
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: 6000 gal, Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: D - Steel Drum
Location Description: Boiler Unit #2 drums
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit #2 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 260 gal, Unit #1 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 2-8000 gal tank at cooling towers
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: R - Other
Location Description: Unit 1 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: R - Other
Location Description: gas turbine battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Hydroxide
Chemical Info: CAS Num:1310732 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: #2 Cooling Tower - 1500 gal tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 06 Quantity: 365 Container Type: Above-Ground Tank
Location Description: Unit 1 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 06

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 05 Quantity: 365 Container Type: Tank Inside Building
Location Description: 6000 gal, Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 05

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 2-8000 gal tank at cooling towers

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Hydrogen Bromide
Chemical Info: CAS Num:10035106 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 25000 - 49999 Quantity: 60 Container Type: O - Tote Bin
Location Description: Unit 1&2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 25000 - 49999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 50000 - 74999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6 ton tank near entrance road
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 50000 - 74999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: 6000 gal, Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 5
Chemical Info: CAS Num:999005 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000000 - 9999999999 Quantity: 365 Container Type: R - Other
Location Description: coal pile
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000000 - 9999999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 300 gal, west side of Unit #1 near Potable Water Storage
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Crane bay
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ferric Chloride
Chemical Info: CAS Num:7705080 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 150 Container Type: O - Tote Bin
Location Description: Cooling Tower Chemical Building - 2 totes
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: De-energized transformer at plant entrance
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: D - Steel Drum
Location Description: Boiler Unit #2 drums
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6000 gal, Unit 2 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Maintenance shop
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: substation battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ammonium hydroxide
Chemical Info: CAS Num:1336216 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: South side of plant
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Hydrogen Bromide
Chemical Info: CAS Num:10035106 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 25000 - 49999 Quantity: 60 Container Type: O - Tote Bin
Location Description: Unit 1&2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 25000 - 49999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: Coal Handling Service Area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000-999999 Quantity: 365 Container Type: C - Tank

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

I
Location Description: 6000 gal, Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000-999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: 6 ton tank near entrance road
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: Unit #2 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: 6000 gal, Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 1 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 7
Chemical Info: CAS Num:999007 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 300 gal, Unit #1 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 300 gal, west side of Unit #1 near Potable Water Storage
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 300 gal near Guard Station
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: substation battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Ammonium hydroxide
Chemical Info: CAS Num:1336216 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: South side of plant
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Name: Sulfur
Chemical Info: CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 05 Quantity: 365 Container Type: Above-Ground Tank
Location Description: 5,000 gal Unit 2 thickener tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 05

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3
Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: 1500 gal, Unit 1 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: 1-hydroxycthylidene-1, 1-diphosphonic acid
Chemical Info: CAS Num:2809214 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Tank Inside Building
Location Description: Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Other
Location Description: Unit 1 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: Coal handling area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: Unit #2 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Hydroxide
Chemical Info: CAS Num:1310732 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: E - Plasti
Location Description: Reverse Osmosis Room - 330 gal tote
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: GE Betz PDC9325
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Carbonate
Chemical Info: CAS Num:497198 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 1000000 - 9999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 1 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 1000000 - 9999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 5
Chemical Info: CAS Num:999005 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000000 - 999999999 Quantity: 365 Container Type: R - Other
Location Description: coal pile
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000000 - 999999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit #3
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Oil water separator
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Maintenance shop
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: R - Other
Location Description: Unit 2 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sodium Hydroxide
Chemical Info: CAS Num:1310732 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: E - Plastic or Non-Metal Drum
Location Description: Reverse Osmosis Room - 330 gal tote
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3
Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 25000 - 49999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 1500 gal, Unit 1 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 25000 - 49999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A -

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

	Above-Ground Tank
Location Description:	Unit #2 Fuel Oil Tank
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Fuel Oil # 2
Chemical Info:	CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	260 gal, Unit #1 Fuel Oil Tank
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Fuel Oil # 2
Chemical Info:	CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	300 gal, Unit #1 Compressor
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Fuel Oil # 2
Chemical Info:	CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	300 gal near Guard Station
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Sulfuric Acid
Chemical Info:	CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description:	gas turbine battery bank
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Ammonium hydroxide
Chemical Info:	CAS Num:1336216 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description:	South side of plant

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 50000 - 74999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6 ton tank near entrance road
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 50000 - 74999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Calcium Oxide
Chemical Info: CAS Num:1305788 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 1000000 - 9999999 Quantity: 365 Container Type: H - Silo
Location Description: Storage Silo 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 1000000 - 9999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3
Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 25000 - 49999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 1500 gal, Unit 2 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 25000 - 49999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit #2 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: Unit 1 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfur
Chemical Info: CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 1 thickener tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3
Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: 1500 gal, Unit 2 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6000 gal, Unit 1 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Tank Inside Building
Location Description: Boiler Unit #2 EHC Reservoir
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfur
Chemical Info: CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000-999999 Quantity: 365 Container Type: A - Above-
Location Description: 5,000 gal Unit 2 thickener tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000-999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: R - Other
Location Description: Unit 2 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: R - Other
Location Description: substation battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 30 ton tank S of Unit 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit #1 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6000 gal, Unit 2 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Calcium Oxide
Chemical Info: CAS Num:1305788 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 09 Quantity: 365 Container Type: Silo
Location Description: Storage silo 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 09

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: 6 ton tank near entrance road
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: GE Betz PDC9325
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: De-energized transformer at plant entrance
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 7
Chemical Info: CAS Num:999007 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Landfill - 2 tanks
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Oil water separator
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfur
Chemical Info: CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 2 thickener tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Black Beauty Abrasive
Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 75000 - 99999 Quantity: 365 Container Type: R - Other
Location Description: U2 absorber towers; Maintenance shop; SIMI Bldg; So side of U2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 75000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Coal Handling Service Area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit #1 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Location Description: 260 gal, Unit #1 Fuel Oil Tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Oil water separator
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Coal handling area
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Crane bay
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfur
Chemical Info: CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit 2 thickener tank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000-999999 Quantity: 365 Container Type: C - Tank I
Location Description: 6000 gal, Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt:

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

100000-999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: Oil water separator
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: Crane bay
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: 6000 gal, Unit 1 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000-99999 Quantity: 365 Container Type: A - Above-
Location Description: 30 ton tank S of Unit 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Calcium Oxide
Chemical Info: CAS Num:1305788 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 1000000 - 9999999 Quantity: 365 Container Type: H - Silo
Location Description: Storage Silo 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 1000000 - 9999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: GE Betz PDC9325

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Info: CAS Num: Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Electric transformers east of cooling tower #1
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: 6000 gal, Unit 1 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6000 gal, Unit 2 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: gas turbine battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfur
Chemical Info: CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A -

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

	Above-Ground Tank
Location Description:	Unit 1 thickener tank
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Mineral oil, light and heavy
Chemical Info:	CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 05 Quantity: 365 Container Type: Tank Inside Building
Location Description:	6000 gal, Unit 1 boiler
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 05

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Sodium Hydroxide
Chemical Info:	CAS Num:1310732 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 04 Quantity: 365 Container Type: Plastic or Non-Metal Drum
Location Description:	Reverse Osmosis Room - 330 gal tote
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Other Chemical 11
Chemical Info:	CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description:	6000 gal, Unit 1 main floor
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	Sulfur
Chemical Info:	CAS Num:7704349 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 100000-999999 Quantity: 365 Container Type: A - Above-
Location Description:	15,000 gal Unit 1thickener tank
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000-999999

Facility Id:	11785
SIC Code:	Not reported
Chemical Name:	trixylenyl phosphate
Chemical Info:	CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info:	Max Daily Amt: 10000-99999 Quantity: 365 Container Type: C - Tank I
Location Description:	Boiler Unit #1 EHC Reservoir
Storage Info:	Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000-99999

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6 ton tank near entrance road
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Mineral oil, light and heavy
Chemical Info: CAS Num:8042475 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: 6000 gal, Unit 2 boiler
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3
Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 1500 gal, Unit 1 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 3
Chemical Info: CAS Num:999003 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 99999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 1500 gal, Unit 2 Circ Water pump
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10000 - 99999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 7
Chemical Info: CAS Num:999007 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 999999 Quantity: 365 Container Type: C - Tank Inside Building
Location Description: Unit 2 scrubber
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 999999

Facility Id: 11785
SIC Code: Not reported

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Chemical Name: Other Chemical 5
Chemical Info: CAS Num:999005 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10 Quantity: 365 Container Type: Other
Location Description: coal pile
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 10

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Carbon Dioxide
Chemical Info: CAS Num:124389 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: 30 ton tank S of Unit 2
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 04 Quantity: 365 Container Type: Above-Ground Tank
Location Description: Landfill - 2 tanks
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 04

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: Unit #1 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Chlorine
Chemical Info: CAS Num:7782505 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100 - 499 Quantity: 365 Container Type: L - Cylinder
Location Description: 2x150-lb cylinder in chlorine bldg
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100 - 499

Facility Id: 11785
SIC Code: Not reported
Chemical Name: trixylenyl phosphate
Chemical Info: CAS Num:25155231 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 10000 - 24999 Quantity: 365 Container Type: D - Steel Drum
Location Description: Boiler Unit #2 drums
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt:

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

10000 - 24999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Fuel Oil # 2
Chemical Info: CAS Num:68476302 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 500000 - 999999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 300 gal, Unit #2 Compressor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 500000 - 999999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Other Chemical 11
Chemical Info: CAS Num:999011 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: A - Above-Ground Tank
Location Description: 6000 gal, Unit 1 main floor
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: 11785
SIC Code: Not reported
Chemical Name: Sulfuric Acid
Chemical Info: CAS Num:7664939 Chemical Id: Submission Code:
More Chemical Info: Max Daily Amt: 100000 - 499999 Quantity: 365 Container Type: R - Other
Location Description: Unit 2 battery bank
Storage Info: Storage Loc: Storage Loc2: Storage Loc3: Storage Loc4 Max Daily Amt: 100000 - 499999

Facility Id: Not reported
Facility Id: 11785

Contact:
Contact Type: Primary Emergency Contact
Contact Name: JIM PECKENPAUGH
Mailing Address1: PO Box 209
Mailing Address2: Not reported
Mailing Address3: Not reported
Mailing City/State/Zip: Evansville, IN 47702
Phone: 812-305-5427
Type: Mobile

Contact Type: Secondary Emergency Contact
Contact Name: WAYNE GAMES
Mailing Address1: PO Box 209
Mailing Address2: Not reported
Mailing Address3: Not reported
Mailing City/State/Zip: Evansville, IN 47702
Phone: 812-305-4386
Type: Mobile

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Contact Type:	Secondary Emergency Contact
Contact Name:	WAYNE GAMES
Mailing Address1:	PO Box 209
Mailing Address2:	Not reported
Mailing Address3:	Not reported
Mailing City/State/Zip:	Evansville, IN 47702
Phone:	812-491-5508
Type:	Work

Contact Type:	Primary Emergency Contact
Contact Name:	JIM PECKENPAUGH
Mailing Address1:	PO Box 209
Mailing Address2:	Not reported
Mailing Address3:	Not reported
Mailing City/State/Zip:	Evansville, IN 47702
Phone:	812-491-5516
Type:	Work

Contact Type:	is primary emergency contact for
Contact Name:	JIM PECKENPAUGH
Mailing Address1:	PO Box 209
Mailing Address2:	Not reported
Mailing Address3:	Not reported
Mailing City/State/Zip:	Evansville, IN 47702
Phone:	812-491-5516
Type:	Not reported

Contact Type:	Business Owner
Contact Name:	SOUTHERN INDIANA GAS & ELECTRIC COMPANY
Mailing Address1:	PO Box 209
Mailing Address2:	ATTN: Environmental Affairs
Mailing Address3:	Not reported
Mailing City/State/Zip:	Evansville, IN 47702
Phone:	800-227-1376
Type:	Work

Contact Type:	is business owner for
Contact Name:	SOUTHERN INDIANA GAS & ELECTRIC COMPANY
Mailing Address1:	PO Box 209
Mailing Address2:	Not reported
Mailing Address3:	Not reported
Mailing City/State/Zip:	Evansville, IN 47702
Phone:	800-227-1376
Type:	Not reported

Contact Type:	is primary emergency contact for
Contact Name:	JIM PECKENPAUGH
Mailing Address1:	PO Box 209
Mailing Address2:	Not reported
Mailing Address3:	Not reported
Mailing City/State/Zip:	Evansville, IN 47702
Phone:	812-305-5427
Type:	Not reported

Contact Type:	is business owner for
Contact Name:	SOUTHERN INDIANA GAS & ELECTRIC COMPANY
Mailing Address1:	PO Box 209

SOUTHERN INDIANA GAS & ELECTRIC COMPANY AB BROWN GENERATING (Continued) **S107706550**

Mailing Address2:	Not reported
Mailing Address3:	Not reported
Mailing City/State/Zip:	Evansville, IN 47702
Phone:	812-424-6411
Type:	Not reported

A3 Target Property **SIGECO FILTER CAKE DISPOSAL RWS 3** **IN RGA LF** **S116016026**
8511 WELBORN RD **N/A**
MOUNT VERNON, IN

Site 3 of 14 in cluster A

Actual: 453 ft.

RGA LF:

2010	SIGECO FILTER CAKE DISPOSAL RWS 3	8511 WELBORN RD
2009	SIGECO FILTER CAKE DISPOSAL RWS 3	8511 WELBORN RD
2008	SIGECO FILTER CAKE DISPOSAL RWS 3	8511 WELBORN RD
2007	SIGECO FILTER CAKE DISPOSAL RWS 3	8511 WELBORN RD
2006	SIGECO FILTER CAKE DISPOSAL RWS 3	8511 WELBORN RD
2005	SIGECO FILTER CAKE DISPOSAL RWS 3	8511 WELBORN RD

A4 Target Property **VECTREN- NEW SEDIMENT BASIN, PERIMETER ACCESS BASI** **IN NPDES** **S121409611**
8511 WELBORN RD **N/A**
MOUNT VERNON, IN 47620

Site 4 of 14 in cluster A

Actual: 453 ft.

NPDES:

Permit Number:	INR10K394
Primary Facility Sic Code:	Not reported
Major/Minor:	Minor
Primary Facility Sic Desc:	Not reported
Facility Type Desc:	Not reported
Permit Status Desc:	Effective
Issue Date:	07/03/2015
Expired Date:	07/01/2020
Effective Date:	07/03/2015
Terminated Date:	Not reported
DMR Cognizant Official:	Not reported
DMR Cognizant Telephone:	Not reported
Waterbody:	Not reported
Total Actual Average Flow (MGD):	Not reported
Total App. Design Flow (MGD):	Not reported
FRS HUC Code:	Not reported
Latitude In Decimal Degrees:	37.9125
Longitude In Decimal Degrees:	-87.7167

A5 Target Property | **SIGECO - A.B. BROWN (SOUTHERN INDIANA GA** | **EPA WATCH LIST** | **1015769560**
8511 WELLBORN ROAD | **N/A**
EVANSVILLE, IN 47620

Site 5 of 14 in cluster A

Actual: 453 ft.

EPA WATCH LIST:

Facility ID:	1812900010
Program:	CAA Facilities
List date:	September 2012 Watch List
Facility ID:	1812900010
Program:	CAA Facilities
List date:	August 2012 Watch List
Facility ID:	1812900010
Program:	CAA Facilities
List date:	December 2012 Watch List
Facility ID:	1812900010
Program:	CAA Facilities
List date:	November 2012 Watch List
Facility ID:	1812900010
Program:	CAA Facilities
List date:	October 2012 Watch List

A6 Target Property | **ABB DAM MODIFICATION ACTIVITIES** | **IN NPDES** | **S121411056**
8511 WELBORN RD | **N/A**
MOUNT VERNON, IN 47620

Site 6 of 14 in cluster A

Actual: 453 ft.

NPDES:

Permit Number:	INR10L912
Primary Facility Sic Code:	Not reported
Major/Minor:	Minor
Primary Facility Sic Desc:	Not reported
Facility Type Desc:	Privately Owned Facility
Permit Status Desc:	Effective
Issue Date:	05/06/2016
Expired Date:	05/05/2021
Effective Date:	05/06/2016
Terminated Date:	Not reported
DMR Cognizant Official:	Not reported
DMR Cognizant Telephone:	Not reported
Waterbody:	Not reported
Total Actual Average Flow (MGD):	Not reported
Total App. Design Flow (MGD):	Not reported
FRS HUC Code:	Not reported
Latitude In Decimal Degrees:	37.9028
Longitude In Decimal Degrees:	-87.7128

A7 Target Property | **SIGECO - A.B. BROWN (SOUTHERN INDIANA GA**
8511 WELBORN RD
MOUNT VERNON, IN 47712 | **EPA WATCH LIST** | **1016461355**
N/A

Site 7 of 14 in cluster A

Actual: 453 ft.

EPA WATCH LIST:

Facility ID:	1812900010
Program:	CAA Facilities
List date:	August 2013 Watch List
Facility ID:	1812900010
Program:	CAA Facilities
List date:	July 2013 Watch List

A8 Target Property | **SIGECO AB BROWN GENERATING STATION**
8511 WELBORN RD
MOUNT VERNON, IN 47620 | **RCRA-CESQG**
IN MANIFEST | **1001213841**
IND000685800

Site 8 of 14 in cluster A

Actual: 453 ft.

RCRA-CESQG:

Date form received by agency:	03/01/2017
Facility name:	SIGECO AB BROWN GENERATING STATION
Facility address:	8511 WELBORN RD MOUNT VERNON, IN 47620
EPA ID:	IND000685800
Mailing address:	N MAIN ST PO BOX 209 EVANSVILLE, IN 47702
Contact:	BRANDIE RUCKER
Contact address:	PO BOX 209 EVANSVILLE, IN 47702
Contact country:	US
Contact telephone:	812-491-4787
Contact email:	BRUCKER@VECTREN.COM
EPA Region:	05
Land type:	Private
Classification:	Conditionally Exempt Small Quantity Generator
Description:	Handler: generates 100 kg or less of hazardous waste per calendar month, and accumulates 1000 kg or less of hazardous waste at any time; or generates 1 kg or less of acutely hazardous waste per calendar month, and accumulates at any time: 1 kg or less of acutely hazardous waste; or 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, of acutely hazardous waste; or generates 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, of acutely hazardous waste during any calendar month, and accumulates at any time: 1 kg or less of acutely hazardous waste; or 100 kg or less of any residue or contaminated soil, waste or other debris resulting from the cleanup of a spill, into or on any land or water, of acutely hazardous waste

Owner/Operator Summary:

Owner/operator name:	SO INDIANA GAS AND ELECTRIC COMPANY, INC
Owner/operator address:	NW RIVERSIDE DRIVE PO BOX 209 EVANSVILLE EVANSVILLE, IN 47702
Owner/operator country:	US

SIGECO AB BROWN GENERATING STATION (Continued) **1001213841**

Owner/operator telephone: 812-491-4000
Owner/operator email: Not reported
Owner/operator fax: Not reported
Owner/operator extension: Not reported
Legal status: Private
Owner/Operator Type: Operator
Owner/Op start date: 08/18/1980
Owner/Op end date: Not reported

Owner/operator name: SO INDIANA GAS AND ELECTRIC COMPANY, INC
Owner/operator address: NW RIVERSIDE DRIVE PO BOX 209 EVANSVILLE
EVANSVILLE, IN 47702
Owner/operator country: US
Owner/operator telephone: 812-491-4000
Owner/operator email: Not reported
Owner/operator fax: Not reported
Owner/operator extension: Not reported
Legal status: Private
Owner/Operator Type: Owner
Owner/Op start date: 08/18/1980
Owner/Op end date: Not reported

Handler Activities Summary:
U.S. importer of hazardous waste: No
Mixed waste (haz. and radioactive): No
Recycler of hazardous waste: No
Transporter of hazardous waste: No
Treater, storer or disposer of HW: No
Underground injection activity: No
On-site burner exemption: No
Furnace exemption: No
Used oil fuel burner: No
Used oil processor: No
User oil refiner: No
Used oil fuel marketer to burner: No
Used oil Specification marketer: No
Used oil transfer facility: No
Used oil transporter: No

. Waste code: D001
. Waste name: IGNITABLE WASTE

. Waste code: D002
. Waste name: CORROSIVE WASTE

. Waste code: D008
. Waste name: LEAD

. Waste code: D035
. Waste name: METHYL ETHYL KETONE

Historical Generators:
Date form received by agency: 02/26/2016
Site name: SIGECO AB BROWN GENERATING STATION
Classification: Conditionally Exempt Small Quantity Generator

SIGECO AB BROWN GENERATING STATION (Continued) **1001213841**

. Waste code: D001
. Waste name: IGNITABLE WASTE

. Waste code: D002
. Waste name: CORROSIVE WASTE

. Waste code: D008
. Waste name: LEAD

. Waste code: D035
. Waste name: METHYL ETHYL KETONE

Date form received by agency: 03/02/2015
Site name: SIGECO AB BROWN GENERATING STATION
Classification: Small Quantity Generator

. Waste code: D001
. Waste name: IGNITABLE WASTE

. Waste code: D002
. Waste name: CORROSIVE WASTE

. Waste code: D008
. Waste name: LEAD

. Waste code: D035
. Waste name: METHYL ETHYL KETONE

Date form received by agency: 08/29/2014
Site name: SIGECO AB BROWN GENERATING STATION
Classification: Small Quantity Generator

. Waste code: D001
. Waste name: IGNITABLE WASTE

. Waste code: D002
. Waste name: CORROSIVE WASTE

. Waste code: D008
. Waste name: LEAD

. Waste code: D035
. Waste name: METHYL ETHYL KETONE

Date form received by agency: 02/21/2014
Site name: SIGECO AB BROWN GENERATING STATION
Classification: Conditionally Exempt Small Quantity Generator

. Waste code: D001
. Waste name: IGNITABLE WASTE

. Waste code: D002
. Waste name: CORROSIVE WASTE

. Waste code: D008
. Waste name: LEAD

SIGECO AB BROWN GENERATING STATION (Continued) **1001213841**

. Waste code: D035
. Waste name: METHYL ETHYL KETONE

Date form received by agency: 02/14/2014
Site name: SIGECO AB BROWN GENERATING STATION
Classification: Large Quantity Generator

. Waste code: D001
. Waste name: IGNITABLE WASTE

. Waste code: D002
. Waste name: CORROSIVE WASTE

. Waste code: D008
. Waste name: LEAD

. Waste code: D035
. Waste name: METHYL ETHYL KETONE

Date form received by agency: 01/23/2013
Site name: SIGECO AB BROWN GEN STATION
Classification: Conditionally Exempt Small Quantity Generator

. Waste code: D001
. Waste name: IGNITABLE WASTE

Date form received by agency: 02/12/2008
Site name: SIGECO AB BROWN GEN STA
Classification: Conditionally Exempt Small Quantity Generator

Date form received by agency: 02/27/2006
Site name: SIGECO AB BROWN GEN STA
Classification: Small Quantity Generator

Date form received by agency: 02/08/2006
Site name: SIGECO AB BROWN GEN STA
Classification: Large Quantity Generator

Date form received by agency: 02/10/2005
Site name: SIGECO AB BROWN GEN STA
Classification: Small Quantity Generator

Date form received by agency: 01/07/2004
Site name: SIGECO AB BROWN GEN STA
Classification: Small Quantity Generator

Date form received by agency: 02/12/2003
Site name: SIGECO AB BROWN GEN STA
Classification: Small Quantity Generator

Date form received by agency: 08/19/1997
Site name: SIGECO A B BROWN GEN STA
Classification: Small Quantity Generator

. Waste code: D001
. Waste name: IGNITABLE WASTE

SIGECO AB BROWN GENERATING STATION (Continued) **1001213841**

. Waste code: D002
. Waste name: CORROSIVE WASTE

. Waste code: D003
. Waste name: REACTIVE WASTE

Violation Status: No violations found

Evaluation Action Summary:
Evaluation date: 05/31/2016
Evaluation: COMPLIANCE EVALUATION INSPECTION ON-SITE
Area of violation: Not reported
Date achieved compliance: Not reported
Evaluation lead agency: State

Evaluation date: 06/25/2002
Evaluation: COMPLIANCE EVALUATION INSPECTION ON-SITE
Area of violation: Not reported
Date achieved compliance: Not reported
Evaluation lead agency: State

IN MANIFEST:
Year: 2016
EPA ID: IND000685800
Tons Generated: 0.175
Tons Shipped OffSite: Not reported
Report Type: Annual
Page No: 1
Waste Desc: UN 1866, RESIN SOLUTION, 3, PG II
UOM: Short Tons
TSDF EPAID: MID980991566
Management code: 47620
Management Desc: Not reported

Manifest Handler:
EPA Id #: IND000685800
Generator Type: SQG
Generator Status: Active Handler
Transporter Type: Code no longer valid
Transporter Status: Non Active
TSD Type: Not reported
TSD Status: Not reported
Handler Mailing Address: PO BOX 209
Handler Mailing City/State/Zip: EVANSVILLE, IN 47702
Contact Name: LISA MESSINGER
Contact Telephone: 812-491-4666
Contact Type: Environmental Coordinator

Receiver Records:
Report Year: 2006.00000
TSD EPA Id: IND093219012
Page Number: 1446.00000
Sub Page: 2.00000
Generator EPA ID: IND000685800
Waste Description: CORROSION RESISTING MORTAR FROM UNUSED PRODUCT, OUT OF DATE
Quantity of Waste: 201
Quantity Rec Report Yrly Tons: 0.1005

SIGECO AB BROWN GENERATING STATION (Continued) **1001213841**

Unit of Measure: 1

Report Year: 2006.00000
TSD EPA Id: IND093219012
Page Number: 1446.00000
Sub Page: 3.00000
Generator EPA ID: IND000685800
Waste Description: SOLIDIFED CORROSION RESISTIN MORTAR&SOL' FROM UNUSED PRODUCT
Quantity of Waste: 253
Quantity Rec Report Yrly Tons: 0.1265
Unit of Measure: 1

Shipment Records:

Generator EPA Id: IND000685800
Actual Generator Type: 2
Waste Description Shipped: UNUSED, SOLIDIFIED CORROSION RESISTANT MORTAR (ACETONE, MEK)
Shipped File Page Number: 1
Number Of TSD Facilities: 1
Waste Codes on Page Number: 1
Waste Code: D001
Tons Of Waste Shipped Year: 0.12650
TSD Facility EPA ID: IND093219012
TSD Name: HERITAGE ENVIRONMENTAL SERVICES LLC

Generator EPA Id: IND000685800
Actual Generator Type: 2
Waste Description Shipped: UNUSED, SOLIDIFIED CORROSION RESISTANT MORTAR (ACETONE, MEK)
Shipped File Page Number: 1
Number Of TSD Facilities: 1
Waste Codes on Page Number: 2
Waste Code: D035
Tons Of Waste Shipped Year: 0.12650
TSD Facility EPA ID: IND093219012
TSD Name: HERITAGE ENVIRONMENTAL SERVICES LLC

Generator EPA Id: IND000685800
Actual Generator Type: 2
Waste Description Shipped: UNUSED. LIQUID CORROSION RESISTANT MORTAR (CORROSIVE, BASIC, INORGANIC)
Shipped File Page Number: 2
Number Of TSD Facilities: 1
Waste Codes on Page Number: 1
Waste Code: D002
Tons Of Waste Shipped Year: 0.10050
TSD Facility EPA ID: IND093219012
TSD Name: HERITAGE ENVIRONMENTAL SERVICES LLC

Transporter Records:

Report Year: 2006
Generator EPA ID: IND000685800
Page Number of Report: 2
TSD EPA Id: IND058484114
Num Of Tranporters Used: 1

Report Year: 2006
Generator EPA ID: IND000685800

SIGECO AB BROWN GENERATING STATION (Continued) **1001213841**

Page Number of Report: 1
TSD EPA Id: IND058484114
Num Of Tranporters Used: 1

Year: 2016
EPA ID: IND000685800
Tons Generated: 0.34
Tons Shipped OffSite: Not reported
Report Type: Annual
Page No: 8
Waste Desc: UN 3265, WASTE CORROSIVE LIQUID ACIDIC, ORGANIC, N.O.S., 8 PG III
UOM: Short Tons
TSDF EPAID: MID980991566
Management code: 47620
Management Desc: Not reported

Year: 2016
EPA ID: IND000685800
Tons Generated: 0.0055
Tons Shipped OffSite: Not reported
Report Type: Annual
Page No: 7
Waste Desc: UN 1873, WASTE PERCHLORIC ACID, 5.1, 8, PG I
UOM: Short Tons
TSDF EPAID: MID980991566
Management code: 47620
Management Desc: Not reported

Year: 2016
EPA ID: IND000685800
Tons Generated: 0.0065
Tons Shipped OffSite: Not reported
Report Type: Annual
Page No: 6
Waste Desc: UN 3264, CORROSIVE LIQUID, ACIDIC, INORGANIC, N.O.S., 8 PG III
UOM: Short Tons
TSDF EPAID: MID980991566
Management code: 47620
Management Desc: Not reported

Year: 2016
EPA ID: IND000685800
Tons Generated: 0.038
Tons Shipped OffSite: Not reported
Report Type: Annual
Page No: 5
Waste Desc: UN 3109, WASTE ORGANIC PEROXIDE, TYPE F, 5.2, PG II
UOM: Short Tons
TSDF EPAID: OHD980613541
Management code: 47620
Management Desc: Not reported

Click this hyperlink while viewing on your computer to access
12 additional IN MANIFEST: record(s) in the EDR Site Report.

A9 Target Property — **SIGECO A B BROWN GENERATING STATION**, **8511 WELBORN RD**, **MOUNT VERNON, IN 47620** — **TSCA** **1016951163**; **TRIS** **47620SGCBB8511W**

Site 9 of 14 in cluster A

Actual: 453 ft.

Click this hyperlink while viewing on your computer to access additional TSCA detail in the EDR Site Report.

TRIS:

Click this hyperlink while viewing on your computer to access 15 additional US_TRIS: record(s) in the EDR Site Report.

A10 Target Property — **AB BROWN RWS III DISPOSAL FACILITY**, **8511 WELBORN RD**, **MOUNT VERNON, IN** — **IN RGA LF** **S116015606**, **N/A**

Site 10 of 14 in cluster A

Actual: 453 ft.

RGA LF:

2012	AB BROWN RWS III DISPOSAL FACILITY	8511 WELBORN RD
2011	AB BROWN RWS III DISPOSAL FACILITY	8511 WELBORN RD

A11 Target Property — **8511 WELBORN ROAD MOUNT VERNON, IN POSEY**, **POSEY (County), IN** — **IN SPILLS** **S118360282**, **N/A**

Site 11 of 14 in cluster A

Actual: 453 ft.

SPILL:

Facility ID:	57793
Incident Date:	09/15/2015
Report Date:	09/17/2015
Material:	Not reported
Spill Source:	Not reported
Recovered Amount:	Not reported
Recovered Units:	Not reported
Spilled Amount:	Not reported
Spilled Units:	Not reported
Contained:	Not reported
Water Affected:	Not reported
Spill Type:	Emergency Response-Reportable Spill
Area Affected:	Not reported
Fish Killed:	Not reported
Water Supply Affected:	Not reported
Public Intake:	Not reported
Incident Status:	Assigned to Staff

A12 Target Property — **A.B. BROWN GENERATING STATION - STORM WATER MANAGE** — **IN NPDES** — **S121412173** / **N/A**
8511 WELBORN RD
MOUNT VERNON, IN 47620

Site 12 of 14 in cluster A

Actual: 453 ft.

NPDES:

Permit Number:	INR10N110
Primary Facility Sic Code:	Not reported
Major/Minor:	Minor
Primary Facility Sic Desc:	Not reported
Facility Type Desc:	Not reported
Permit Status Desc:	Effective
Issue Date:	12/06/2016
Expired Date:	12/05/2021
Effective Date:	12/06/2016
Terminated Date:	Not reported
DMR Cognizant Official:	Not reported
DMR Cognizant Telephone:	Not reported
Waterbody:	Not reported
Total Actual Average Flow (MGD):	Not reported
Total App. Design Flow (MGD):	Not reported
FRS HUC Code:	Not reported
Latitude In Decimal Degrees:	37.9055
Longitude In Decimal Degrees:	-87.7056

A13 Target Property — **VECTREN - A.B. BROWN STATION BORROW AREA LOCATIONS** — **IN NPDES** — **S121406760** / **N/A**
8511 WELBORN RD
MOUNT VERNON, IN 47620

Site 13 of 14 in cluster A

Actual: 453 ft.

NPDES:

Permit Number:	INR10F189
Primary Facility Sic Code:	Not reported
Major/Minor:	Minor
Primary Facility Sic Desc:	Not reported
Facility Type Desc:	Not reported
Permit Status Desc:	Effective
Issue Date:	06/30/2017
Expired Date:	06/29/2022
Effective Date:	06/30/2017
Terminated Date:	Not reported
DMR Cognizant Official:	Not reported
DMR Cognizant Telephone:	Not reported
Waterbody:	Not reported
Total Actual Average Flow (MGD):	Not reported
Total App. Design Flow (MGD):	Not reported
FRS HUC Code:	Not reported
Latitude In Decimal Degrees:	37.91
Longitude In Decimal Degrees:	-87.7122

A14 Target Property | **VECTREN - A B BROWN STATION NORTH BORROW AREA EXPA**
8511 WELBORN RD
MOUNT VERNON, IN 47620 | **IN NPDES** | **S121408905**
N/A

Site 14 of 14 in cluster A

Actual: 453 ft.

NPDES:

Permit Number:	INR10J646
Primary Facility Sic Code:	Not reported
Major/Minor:	Minor
Primary Facility Sic Desc:	Not reported
Facility Type Desc:	Not reported
Permit Status Desc:	Effective
Issue Date:	02/18/2015
Expired Date:	02/17/2020
Effective Date:	02/18/2015
Terminated Date:	Not reported
DMR Cognizant Official:	Not reported
DMR Cognizant Telephone:	Not reported
Waterbody:	Not reported
Total Actual Average Flow (MGD):	Not reported
Total App. Design Flow (MGD):	Not reported
FRS HUC Code:	Not reported
Latitude In Decimal Degrees:	37.9183
Longitude In Decimal Degrees:	-87.7122

Count: 0 records.

ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)
		NO SITES FOUND			

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Number of Days to Update: Provides confirmation that EDR is reporting records that have been updated within 90 days from the date the government agency made the information available to the public.

STANDARD ENVIRONMENTAL RECORDS

Federal NPL site list

NPL: National Priority List

National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC) and regional EPA offices.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/22/2017
Date Made Active in Reports: 01/05/2018
Number of Days to Update: 14

Source: EPA
Telephone: N/A
Last EDR Contact: 02/06/2018
Next Scheduled EDR Contact: 04/16/2018
Data Release Frequency: Quarterly

NPL Site Boundaries

Sources:

EPA's Environmental Photographic Interpretation Center (EPIC)
Telephone: 202-564-7333

EPA Region 1
Telephone 617-918-1143

EPA Region 6
Telephone: 214-655-6659

EPA Region 3
Telephone 215-814-5418

EPA Region 7
Telephone: 913-551-7247

EPA Region 4
Telephone 404-562-8033

EPA Region 8
Telephone: 303-312-6774

EPA Region 5
Telephone 312-886-6686

EPA Region 9
Telephone: 415-947-4246

EPA Region 10
Telephone 206-553-8665

Proposed NPL: Proposed National Priority List Sites

A site that has been proposed for listing on the National Priorities List through the issuance of a proposed rule in the Federal Register. EPA then accepts public comments on the site, responds to the comments, and places on the NPL those sites that continue to meet the requirements for listing.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/22/2017
Date Made Active in Reports: 01/05/2018
Number of Days to Update: 14

Source: EPA
Telephone: N/A
Last EDR Contact: 02/06/2018
Next Scheduled EDR Contact: 05/21/2018
Data Release Frequency: Quarterly

NPL LIENS: Federal Superfund Liens

Federal Superfund Liens. Under the authority granted the USEPA by CERCLA of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner received notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/1991
Date Data Arrived at EDR: 02/02/1994
Date Made Active in Reports: 03/30/1994
Number of Days to Update: 56

Source: EPA
Telephone: 202-564-4267
Last EDR Contact: 08/15/2011
Next Scheduled EDR Contact: 11/28/2011
Data Release Frequency: No Update Planned

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Federal Delisted NPL site list

Delisted NPL: National Priority List Deletions

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 12/11/2017	Source: EPA
Date Data Arrived at EDR: 12/22/2017	Telephone: N/A
Date Made Active in Reports: 01/05/2018	Last EDR Contact: 02/06/2018
Number of Days to Update: 14	Next Scheduled EDR Contact: 04/16/2018
	Data Release Frequency: Quarterly

Federal CERCLIS list

FEDERAL FACILITY: Federal Facility Site Information listing

A listing of National Priority List (NPL) and Base Realignment and Closure (BRAC) sites found in the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) Database where EPA Federal Facilities Restoration and Reuse Office is involved in cleanup activities.

Date of Government Version: 11/07/2016	Source: Environmental Protection Agency
Date Data Arrived at EDR: 01/05/2017	Telephone: 703-603-8704
Date Made Active in Reports: 04/07/2017	Last EDR Contact: 01/05/2018
Number of Days to Update: 92	Next Scheduled EDR Contact: 04/16/2018
	Data Release Frequency: Varies

SEMS: Superfund Enterprise Management System

SEMS (Superfund Enterprise Management System) tracks hazardous waste sites, potentially hazardous waste sites, and remedial activities performed in support of EPA's Superfund Program across the United States. The list was formerly know as CERCLIS, renamed to SEMS by the EPA in 2015. The list contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This dataset also contains sites which are either proposed to or on the National Priorities List (NPL) and the sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 12/11/2017	Source: EPA
Date Data Arrived at EDR: 12/22/2017	Telephone: 800-424-9346
Date Made Active in Reports: 01/12/2018	Last EDR Contact: 02/06/2018
Number of Days to Update: 21	Next Scheduled EDR Contact: 04/30/2018
	Data Release Frequency: Quarterly

Federal CERCLIS NFRAP site list

SEMS-ARCHIVE: Superfund Enterprise Management System Archive

SEMS-ARCHIVE (Superfund Enterprise Management System Archive) tracks sites that have no further interest under the Federal Superfund Program based on available information. The list was formerly known as the CERCLIS-NFRAP, renamed to SEMS ARCHIVE by the EPA in 2015. EPA may perform a minimal level of assessment work at a site while it is archived if site conditions change and/or new information becomes available. Archived sites have been removed and archived from the inventory of SEMS sites. Archived status indicates that, to the best of EPA's knowledge, assessment at a site has been completed and that EPA has determined no further steps will be taken to list the site on the National Priorities List (NPL), unless information indicates this decision was not appropriate or other considerations require a recommendation for listing at a later time. The decision does not necessarily mean that there is no hazard associated with a given site; it only means that. based upon available information, the location is not judged to be potential NPL site.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/22/2017
Date Made Active in Reports: 01/12/2018
Number of Days to Update: 21

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 02/06/2018
Next Scheduled EDR Contact: 04/30/2018
Data Release Frequency: Quarterly

Federal RCRA CORRACTS facilities list

CORRACTS: Corrective Action Report
CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/26/2017
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 45

Source: EPA
Telephone: 800-424-9346
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Quarterly

Federal RCRA non-CORRACTS TSD facilities list

RCRA-TSDF: RCRA - Treatment, Storage and Disposal
RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Transporters are individuals or entities that move hazardous waste from the generator offsite to a facility that can recycle, treat, store, or dispose of the waste. TSDFs treat, store, or dispose of the waste.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/26/2017
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 45

Source: Environmental Protection Agency
Telephone: 312-886-6186
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Quarterly

Federal RCRA generators list

RCRA-LQG: RCRA - Large Quantity Generators
RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Large quantity generators (LQGs) generate over 1,000 kilograms (kg) of hazardous waste, or over 1 kg of acutely hazardous waste per month.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/26/2017
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 45

Source: Environmental Protection Agency
Telephone: 312-886-6186
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Quarterly

RCRA-SQG: RCRA - Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Small quantity generators (SQGs) generate between 100 kg and 1,000 kg of hazardous waste per month.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/26/2017
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 45

Source: Environmental Protection Agency
Telephone: 312-886-6186
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Quarterly

RCRA-CESQG: RCRA - Conditionally Exempt Small Quantity Generators

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Conditionally exempt small quantity generators (CESQGs) generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/26/2017
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 45

Source: Environmental Protection Agency
Telephone: 312-886-6186
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Quarterly

Federal institutional controls / engineering controls registries

LUCIS: Land Use Control Information System

LUCIS contains records of land use control information pertaining to the former Navy Base Realignment and Closure properties.

Date of Government Version: 05/22/2017
Date Data Arrived at EDR: 06/13/2017
Date Made Active in Reports: 09/15/2017
Number of Days to Update: 94

Source: Department of the Navy
Telephone: 843-820-7326
Last EDR Contact: 02/09/2018
Next Scheduled EDR Contact: 05/28/2018
Data Release Frequency: Varies

US ENG CONTROLS: Engineering Controls Sites List

A listing of sites with engineering controls in place. Engineering controls include various forms of caps, building foundations, liners, and treatment methods to create pathway elimination for regulated substances to enter environmental media or effect human health.

Date of Government Version: 11/13/2017
Date Data Arrived at EDR: 11/27/2017
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 74

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 02/27/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Varies

US INST CONTROL: Sites with Institutional Controls

A listing of sites with institutional controls in place. Institutional controls include administrative measures, such as groundwater use restrictions, construction restrictions, property use restrictions, and post remediation care requirements intended to prevent exposure to contaminants remaining on site. Deed restrictions are generally required as part of the institutional controls.

Date of Government Version: 11/13/2017
Date Data Arrived at EDR: 11/27/2017
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 74

Source: Environmental Protection Agency
Telephone: 703-603-0695
Last EDR Contact: 02/27/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Varies

Federal ERNS list

ERNS: Emergency Response Notification System

Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 09/18/2017
Date Data Arrived at EDR: 09/21/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 22

Source: National Response Center, United States Coast Guard
Telephone: 202-267-2180
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Quarterly

State- and tribal - equivalent CERCLIS

IN SHWS: List of Hazardous Waste Response Sites Scored Using the Indiana Scoring Model

List of hazardous waste response sites scored utilizing the Indiana Scoring Model. The Indiana Scoring Model is a method of prioritizing, for state response actions, those hazardous substances response sites which are not on the National Priorities List. The ISM serves as the Commissioners management tool to address those sites which pose the most significant threat to human health and the environment in addition to assuring the departments resources are allocated accordingly.

Date of Government Version: 03/01/2007
Date Data Arrived at EDR: 08/27/2007
Date Made Active in Reports: 09/18/2007
Number of Days to Update: 22

Source: Department of Environmental Management
Telephone: 317-308-3052
Last EDR Contact: 02/22/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: No Update Planned

KY SHWS: State Leads List

State Hazardous Waste Sites. State hazardous waste site records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where cleanup will be paid for by potentially responsible parties. Available information varies by state.

Date of Government Version: 01/04/2018
Date Data Arrived at EDR: 01/09/2018
Date Made Active in Reports: 02/15/2018
Number of Days to Update: 37

Source: Department of Environmental Protection
Telephone: 502-564-6716
Last EDR Contact: 02/26/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Quarterly

State and tribal landfill and/or solid waste disposal site lists

IN OPEN DUMPS: Open Dump Waste Sites

Open Dumps are sites that are not regulated and are illegal dump sites of solid waste, as defined by IAC 10-2-28 329 and IAC 10-2-128 of the Indiana Administrative Code.

Date of Government Version: 06/26/2009
Date Data Arrived at EDR: 12/11/2013
Date Made Active in Reports: 01/20/2014
Number of Days to Update: 40

Source: Department of Environmental Management
Telephone: 317-232-8726
Last EDR Contact: 12/08/2017
Next Scheduled EDR Contact: 03/19/2018
Data Release Frequency: Varies

IN SWF/LF: Permitted Solid Waste Facilities

Solid Waste Facilities/Landfill Sites. SWF/LF type records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 10/31/2017
Date Data Arrived at EDR: 12/14/2017
Date Made Active in Reports: 01/23/2018
Number of Days to Update: 40

Source: Department of Environmental Management
Telephone: 317-232-0066
Last EDR Contact: 12/11/2017
Next Scheduled EDR Contact: 03/26/2018
Data Release Frequency: Semi-Annually

KY SWF/LF: Solid Waste Facilities List

Solid Waste Facilities/Landfill Sites. SWF/LF type records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 11/27/2017
Date Data Arrived at EDR: 11/28/2017
Date Made Active in Reports: 01/04/2018
Number of Days to Update: 37

Source: Department of Environmental Protection
Telephone: 502-564-6716
Last EDR Contact: 01/29/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Semi-Annually

State and tribal leaking storage tank lists

IN LUST: Lust Leaking Underground Storage Tank List

Leaking Underground Storage Tank Incident Reports. LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state.

Date of Government Version: 11/06/2017
Date Data Arrived at EDR: 11/28/2017
Date Made Active in Reports: 12/05/2017
Number of Days to Update: 7

Source: Department of Environmental Management
Telephone: 317-232-8900
Last EDR Contact: 11/28/2017
Next Scheduled EDR Contact: 03/12/2018
Data Release Frequency: Quarterly

INDIAN LUST R5: Leaking Underground Storage Tanks on Indian Land

Leaking underground storage tanks located on Indian Land in Michigan, Minnesota and Wisconsin.

Date of Government Version: 04/26/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 78

Source: EPA, Region 5
Telephone: 312-886-7439
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN LUST R8: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming.

Date of Government Version: 05/01/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 78

Source: EPA Region 8
Telephone: 303-312-6271
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN LUST R10: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Alaska, Idaho, Oregon and Washington.

Date of Government Version: 04/25/2017
Date Data Arrived at EDR: 11/07/2017
Date Made Active in Reports: 12/08/2017
Number of Days to Update: 31

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN LUST R9: Leaking Underground Storage Tanks on Indian Land

LUSTs on Indian land in Arizona, California, New Mexico and Nevada

Date of Government Version: 04/13/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 78

Source: Environmental Protection Agency
Telephone: 415-972-3372
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN LUST R7: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Iowa, Kansas, and Nebraska

Date of Government Version: 04/14/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/06/2017
Number of Days to Update: 71

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN LUST R6: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in New Mexico and Oklahoma.

Date of Government Version: 04/24/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/06/2017
Number of Days to Update: 71

Source: EPA Region 6
Telephone: 214-665-6597
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN LUST R4: Leaking Underground Storage Tanks on Indian Land
LUSTs on Indian land in Florida, Mississippi and North Carolina.

Date of Government Version: 10/14/2016
Date Data Arrived at EDR: 01/27/2017
Date Made Active in Reports: 05/05/2017
Number of Days to Update: 98

Source: EPA Region 4
Telephone: 404-562-8677
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Semi-Annually

INDIAN LUST R1: Leaking Underground Storage Tanks on Indian Land
A listing of leaking underground storage tank locations on Indian Land.

Date of Government Version: 04/14/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/06/2017
Number of Days to Update: 71

Source: EPA Region 1
Telephone: 617-918-1313
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

State and tribal registered storage tank lists

FEMA UST: Underground Storage Tank Listing
A listing of all FEMA owned underground storage tanks.

Date of Government Version: 05/15/2017
Date Data Arrived at EDR: 05/30/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 136

Source: FEMA
Telephone: 202-646-5797
Last EDR Contact: 01/09/2018
Next Scheduled EDR Contact: 04/23/2018
Data Release Frequency: Varies

IN UST: Indiana Registered Underground Storage Tanks
Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

Date of Government Version: 11/06/2017
Date Data Arrived at EDR: 11/28/2017
Date Made Active in Reports: 12/05/2017
Number of Days to Update: 7

Source: Department of Environmental Management
Telephone: 317-308-3008
Last EDR Contact: 11/28/2017
Next Scheduled EDR Contact: 03/12/2018
Data Release Frequency: Quarterly

KY UST: Underground Storage Tank Database
Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

Date of Government Version: 11/13/2017
Date Data Arrived at EDR: 11/28/2017
Date Made Active in Reports: 12/28/2017
Number of Days to Update: 30

Source: Department of Environmental Protection
Telephone: 502-564-5981
Last EDR Contact: 11/28/2017
Next Scheduled EDR Contact: 03/12/2018
Data Release Frequency: Quarterly

IN AST: Above Ground Storage Tanks

A listing of aboveground storage tank sites that reported under the emergency rule.

Date of Government Version: 01/25/2017
Date Data Arrived at EDR: 05/16/2017
Date Made Active in Reports: 09/06/2017
Number of Days to Update: 113

Source: N/A
Telephone: 317-232-2393
Last EDR Contact: 11/02/2017
Next Scheduled EDR Contact: 02/19/2018
Data Release Frequency: N/A

INDIAN UST R7: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 7 (Iowa, Kansas, Missouri, Nebraska, and 9 Tribal Nations).

Date of Government Version: 05/02/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/06/2017
Number of Days to Update: 71

Source: EPA Region 7
Telephone: 913-551-7003
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN UST R8: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 8 (Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming and 27 Tribal Nations).

Date of Government Version: 05/01/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 78

Source: EPA Region 8
Telephone: 303-312-6137
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN UST R6: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 6 (Louisiana, Arkansas, Oklahoma, New Mexico, Texas and 65 Tribes).

Date of Government Version: 04/24/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 12/08/2017
Number of Days to Update: 134

Source: EPA Region 6
Telephone: 214-665-7591
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN UST R5: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 5 (Michigan, Minnesota and Wisconsin and Tribal Nations).

Date of Government Version: 04/26/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/06/2017
Number of Days to Update: 71

Source: EPA Region 5
Telephone: 312-886-6136
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN UST R4: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 4 (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee and Tribal Nations)

Date of Government Version: 10/14/2016
Date Data Arrived at EDR: 01/27/2017
Date Made Active in Reports: 05/05/2017
Number of Days to Update: 98

Source: EPA Region 4
Telephone: 404-562-9424
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Semi-Annually

INDIAN UST R1: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 1 (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont and ten Tribal Nations).

Date of Government Version: 04/14/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/06/2017
Number of Days to Update: 71

Source: EPA, Region 1
Telephone: 617-918-1313
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN UST R10: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 10 (Alaska, Idaho, Oregon, Washington, and Tribal Nations).

Date of Government Version: 04/25/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 78

Source: EPA Region 10
Telephone: 206-553-2857
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

INDIAN UST R9: Underground Storage Tanks on Indian Land

The Indian Underground Storage Tank (UST) database provides information about underground storage tanks on Indian land in EPA Region 9 (Arizona, California, Hawaii, Nevada, the Pacific Islands, and Tribal Nations).

Date of Government Version: 04/13/2017
Date Data Arrived at EDR: 07/27/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 78

Source: EPA Region 9
Telephone: 415-972-3368
Last EDR Contact: 01/23/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

State and tribal institutional control / engineering control registries

IN AUL: Sites with Restrictions

Activity and use limitations include both engineering controls and institutional controls. A listing of Comfort/Site Status Letter sites that have been issued with controls.

Date of Government Version: 11/06/2017
Date Data Arrived at EDR: 11/27/2017
Date Made Active in Reports: 12/01/2017
Number of Days to Update: 4

Source: Department of Environmental Management
Telephone: 317-232-8603
Last EDR Contact: 02/26/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Varies

State and tribal voluntary cleanup sites

IN VCP: Voluntary Remediation Program Site List

A current list of Voluntary Remediation Program sites that are no longer confidential.

Date of Government Version: 08/22/2014
Date Data Arrived at EDR: 08/22/2014
Date Made Active in Reports: 09/12/2014
Number of Days to Update: 21

Source: Department of Environmental Management
Telephone: 317-234-0966
Last EDR Contact: 01/05/2018
Next Scheduled EDR Contact: 04/23/2018
Data Release Frequency: Semi-Annually

INDIAN VCP R7: Voluntary Cleanup Priority Lisitng
A listing of voluntary cleanup priority sites located on Indian Land located in Region 7.

Date of Government Version: 03/20/2008
Date Data Arrived at EDR: 04/22/2008
Date Made Active in Reports: 05/19/2008
Number of Days to Update: 27

Source: EPA, Region 7
Telephone: 913-551-7365
Last EDR Contact: 04/20/2009
Next Scheduled EDR Contact: 07/20/2009
Data Release Frequency: Varies

INDIAN VCP R1: Voluntary Cleanup Priority Listing
A listing of voluntary cleanup priority sites located on Indian Land located in Region 1.

Date of Government Version: 07/27/2015
Date Data Arrived at EDR: 09/29/2015
Date Made Active in Reports: 02/18/2016
Number of Days to Update: 142

Source: EPA, Region 1
Telephone: 617-918-1102
Last EDR Contact: 12/20/2017
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Varies

KY VCP: Voluntary Cleanup Program Sites
Sites that have been accepted into the Voluntary Cleanup Program or have submitted an application.

Date of Government Version: 01/05/2018
Date Data Arrived at EDR: 01/09/2018
Date Made Active in Reports: 02/20/2018
Number of Days to Update: 42

Source: Department of Environmental Protection
Telephone: 502-564-6716
Last EDR Contact: 02/26/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Varies

State and tribal Brownfields sites

IN BROWNFIELDS: Brownfields Site List
A brownfield site is an industrial or commercial property that is abandoned, inactive, or underutilized, on which expansion or redeveloopment is complicated due to the actual or perceived environmental contamination.

Date of Government Version: 11/15/2017
Date Data Arrived at EDR: 11/27/2017
Date Made Active in Reports: 12/01/2017
Number of Days to Update: 4

Source: Department of Environmental Management
Telephone: 317-233-2570
Last EDR Contact: 02/26/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Semi-Annually

KY BROWNFIELDS: Kentucky Brownfield Inventory
The Kentucky Brownfield Program has created an inventory of brownfield sites in order to market the properties to those interested in brownfield redevelopment. The Kentucky Brownfield Program is working to promote the redevelopment of these sites by helping to remove barriers that prevent reuse, providing useful information to communities, developers and the public and encouraging a climate that fosters redevelopment of contaminated sites.

Date of Government Version: 02/06/2018
Date Data Arrived at EDR: 02/07/2018
Date Made Active in Reports: 02/21/2018
Number of Days to Update: 14

Source: Division of Compliance Assistance
Telephone: 502-564-0323
Last EDR Contact: 01/16/2018
Next Scheduled EDR Contact: 04/30/2018
Data Release Frequency: Varies

ADDITIONAL ENVIRONMENTAL RECORDS

Local Brownfield lists

US BROWNFIELDS: A Listing of Brownfields Sites
Brownfields are real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant. Cleaning up and reinvesting in these properties takes development pressures off of undeveloped, open land, and both improves and protects the environment. Assessment, Cleanup and Redevelopment Exchange System (ACRES) stores information reported by EPA Brownfields grant recipients on brownfields properties assessed or cleaned up with grant funding as well as information on Targeted Brownfields Assessments performed by EPA Regions. A listing of ACRES Brownfield sites is obtained from Cleanups in My Community. Cleanups in My Community provides information on Brownfields properties for which information is reported back to EPA, as well as areas served by Brownfields grant programs.

Date of Government Version: 01/19/2018
Date Data Arrived at EDR: 01/19/2018
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 21

Source: Environmental Protection Agency
Telephone: 202-566-2777
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/02/2018
Data Release Frequency: Semi-Annually

Local Lists of Landfill / Solid Waste Disposal Sites

IN SWRCY: Recycling Facilities
A listing of recycling facilities located in the state of Indiana.

Date of Government Version: 10/01/2017
Date Data Arrived at EDR: 10/02/2017
Date Made Active in Reports: 10/31/2017
Number of Days to Update: 29

Source: Department of Environmental Management
Telephone: 317-234-4050
Last EDR Contact: 01/10/2018
Next Scheduled EDR Contact: 04/30/2018
Data Release Frequency: Varies

IN SWTIRE: Waste Tire Sites Listing
This listing consists of Tire Sites - sites which contain tires - either for processing, for storage, or transport - as well as some illegal tire dumps, as defined by IC 13-11-2-251, IC 13-11-2-252, and IC 13-11-250.5 of the Indiana Code.

Date of Government Version: 08/04/2015
Date Data Arrived at EDR: 09/09/2015
Date Made Active in Reports: 10/07/2015
Number of Days to Update: 28

Source: Department of Environmental Management
Telephone: 317-232-8726
Last EDR Contact: 12/08/2017
Next Scheduled EDR Contact: 03/19/2018
Data Release Frequency: Varies

KY SWRCY: Recycling Facilities
A listing of recycling facilities located in the state of Kentucky.

Date of Government Version: 07/20/2017
Date Data Arrived at EDR: 10/19/2017
Date Made Active in Reports: 10/31/2017
Number of Days to Update: 12

Source: Department of Environmental Protection
Telephone: 502-564-6716
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/30/2018
Data Release Frequency: Varies

INDIAN ODI: Report on the Status of Open Dumps on Indian Lands
Location of open dumps on Indian land.

Date of Government Version: 12/31/1998
Date Data Arrived at EDR: 12/03/2007
Date Made Active in Reports: 01/24/2008
Number of Days to Update: 52

Source: Environmental Protection Agency
Telephone: 703-308-8245
Last EDR Contact: 01/30/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Varies

ODI: Open Dump Inventory
An open dump is defined as a disposal facility that does not comply with one or more of the Part 257 or Part 258 Subtitle D Criteria.

Date of Government Version: 06/30/1985
Date Data Arrived at EDR: 08/09/2004
Date Made Active in Reports: 09/17/2004
Number of Days to Update: 39

Source: Environmental Protection Agency
Telephone: 800-424-9346
Last EDR Contact: 06/09/2004
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

DEBRIS REGION 9: Torres Martinez Reservation Illegal Dump Site Locations
A listing of illegal dump sites location on the Torres Martinez Indian Reservation located in eastern Riverside County and northern Imperial County, California.

Date of Government Version: 01/12/2009
Date Data Arrived at EDR: 05/07/2009
Date Made Active in Reports: 09/21/2009
Number of Days to Update: 137

Source: EPA, Region 9
Telephone: 415-947-4219
Last EDR Contact: 01/22/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: No Update Planned

IHS OPEN DUMPS: Open Dumps on Indian Land

A listing of all open dumps located on Indian Land in the United States.

Date of Government Version: 04/01/2014
Date Data Arrived at EDR: 08/06/2014
Date Made Active in Reports: 01/29/2015
Number of Days to Update: 176

Source: Department of Health & Human Serivces, Indian Health Service
Telephone: 301-443-1452
Last EDR Contact: 02/02/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Varies

Local Lists of Hazardous waste / Contaminated Sites

US HIST CDL: National Clandestine Laboratory Register

A listing of clandestine drug lab locations that have been removed from the DEAs National Clandestine Laboratory Register.

Date of Government Version: 01/19/2018
Date Data Arrived at EDR: 01/24/2018
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 16

Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 02/27/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: No Update Planned

IN CDL: Clandestine Drug Lab Listing

A listing of clandestine drub labs that have been cleaned up.

Date of Government Version: 08/29/2016
Date Data Arrived at EDR: 10/05/2016
Date Made Active in Reports: 10/20/2016
Number of Days to Update: 15

Source: Department of Environmental Management
Telephone: 317-416-5031
Last EDR Contact: 01/05/2018
Next Scheduled EDR Contact: 04/23/2018
Data Release Frequency: Quarterly

KY CDL: Clandestine Drub Lab Location Listing

Clandestine drug lab site locations.

Date of Government Version: 01/05/2018
Date Data Arrived at EDR: 01/09/2018
Date Made Active in Reports: 02/15/2018
Number of Days to Update: 37

Source: Department of Environmental Protection
Telephone: 502-564-6716
Last EDR Contact: 02/26/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Varies

IN DEL SHWS: Deleted Commissioner's Bulletin Sites List

A listing of sites deleted/removed from the Commissioner's Bulletin List

Date of Government Version: 04/03/2008
Date Data Arrived at EDR: 04/04/2008
Date Made Active in Reports: 04/14/2008
Number of Days to Update: 10

Source: Department of Environmental Management
Telephone: 317-234-0347
Last EDR Contact: 02/22/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Varies

US CDL: Clandestine Drug Labs

A listing of clandestine drug lab locations. The U.S. Department of Justice ("the Department") provides this web site as a public service. It contains addresses of some locations where law enforcement agencies reported they found chemicals or other items that indicated the presence of either clandestine drug laboratories or dumpsites. In most cases, the source of the entries is not the Department, and the Department has not verified the entry and does not guarantee its accuracy. Members of the public must verify the accuracy of all entries by, for example, contacting local law enforcement and local health departments.

Date of Government Version: 01/09/2018
Date Data Arrived at EDR: 01/24/2018
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 16

Source: Drug Enforcement Administration
Telephone: 202-307-1000
Last EDR Contact: 02/27/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Quarterly

Local Land Records

LIENS 2: CERCLA Lien Information

A Federal CERCLA ('Superfund') lien can exist by operation of law at any site or property at which EPA has spent Superfund monies. These monies are spent to investigate and address releases and threatened releases of contamination. CERCLIS provides information as to the identity of these sites and properties.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/22/2017
Date Made Active in Reports: 01/12/2018
Number of Days to Update: 21

Source: Environmental Protection Agency
Telephone: 202-564-6023
Last EDR Contact: 02/06/2018
Next Scheduled EDR Contact: 05/21/2018
Data Release Frequency: Semi-Annually

Records of Emergency Release Reports

HMIRS: Hazardous Materials Information Reporting System

Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 09/21/2017
Date Data Arrived at EDR: 09/21/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 22

Source: U.S. Department of Transportation
Telephone: 202-366-4555
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Quarterly

IN SPILLS: Spills Incidents

Oil, hazardous, or objectionable materials that may be released to soil and water.

Date of Government Version: 10/31/2017
Date Data Arrived at EDR: 11/28/2017
Date Made Active in Reports: 01/23/2018
Number of Days to Update: 56

Source: Department of Environmental Management
Telephone: 317-308-3038
Last EDR Contact: 11/28/2017
Next Scheduled EDR Contact: 03/12/2018
Data Release Frequency: Quarterly

KY SPILLS: State spills

A listing of spill and/or release related incidents.

Date of Government Version: 01/26/2018
Date Data Arrived at EDR: 02/09/2018
Date Made Active in Reports: 02/20/2018
Number of Days to Update: 11

Source: DEP, Emergency Response
Telephone: 502-564-2380
Last EDR Contact: 01/16/2018
Next Scheduled EDR Contact: 04/30/2018
Data Release Frequency: Varies

IN SPILLS 90: SPILLS90 data from FirstSearch

Spills 90 includes those spill and release records available exclusively from FirstSearch databases. Typically, they may include chemical, oil and/or hazardous substance spills recorded after 1990. Duplicate records that are already included in EDR incident and release records are not included in Spills 90.

Date of Government Version: 09/07/2012
Date Data Arrived at EDR: 01/03/2013
Date Made Active in Reports: 02/11/2013
Number of Days to Update: 39

Source: FirstSearch
Telephone: N/A
Last EDR Contact: 01/03/2013
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

IN SPILLS 80: SPILLS80 data from FirstSearch

Spills 80 includes those spill and release records available from FirstSearch databases prior to 1990. Typically, they may include chemical, oil and/or hazardous substance spills recorded before 1990. Duplicate records that are already included in EDR incident and release records are not included in Spills 80.

Date of Government Version: 09/11/2002
Date Data Arrived at EDR: 01/03/2013
Date Made Active in Reports: 02/28/2013
Number of Days to Update: 56

Source: FirstSearch
Telephone: N/A
Last EDR Contact: 01/03/2013
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

Other Ascertainable Records

RCRA NonGen / NLR: RCRA - Non Generators / No Longer Regulated

RCRAInfo is EPA's comprehensive information system, providing access to data supporting the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The database includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Non-Generators do not presently generate hazardous waste.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/26/2017
Date Made Active in Reports: 02/09/2018
Number of Days to Update: 45

Source: Environmental Protection Agency
Telephone: 312-886-6186
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Quarterly

FUDS: Formerly Used Defense Sites

The listing includes locations of Formerly Used Defense Sites properties where the US Army Corps of Engineers is actively working or will take necessary cleanup actions.

Date of Government Version: 01/31/2015
Date Data Arrived at EDR: 07/08/2015
Date Made Active in Reports: 10/13/2015
Number of Days to Update: 97

Source: U.S. Army Corps of Engineers
Telephone: 202-528-4285
Last EDR Contact: 02/21/2018
Next Scheduled EDR Contact: 06/04/2018
Data Release Frequency: Varies

DOD: Department of Defense Sites

This data set consists of federally owned or administered lands, administered by the Department of Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 11/10/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 62

Source: USGS
Telephone: 888-275-8747
Last EDR Contact: 10/13/2017
Next Scheduled EDR Contact: 01/22/2018
Data Release Frequency: Semi-Annually

FEDLAND: Federal and Indian Lands

Federally and Indian administrated lands of the United States. Lands included are administrated by: Army Corps of Engineers, Bureau of Reclamation, National Wild and Scenic River, National Wildlife Refuge, Public Domain Land, Wilderness, Wilderness Study Area, Wildlife Management Area, Bureau of Indian Affairs, Bureau of Land Management, Department of Justice, Forest Service, Fish and Wildlife Service, National Park Service.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 02/06/2006
Date Made Active in Reports: 01/11/2007
Number of Days to Update: 339

Source: U.S. Geological Survey
Telephone: 888-275-8747
Last EDR Contact: 10/11/2017
Next Scheduled EDR Contact: 01/22/2018
Data Release Frequency: N/A

SCRD DRYCLEANERS: State Coalition for Remediation of Drycleaners Listing

The State Coalition for Remediation of Drycleaners was established in 1998, with support from the U.S. EPA Office of Superfund Remediation and Technology Innovation. It is comprised of representatives of states with established drycleaner remediation programs. Currently the member states are Alabama, Connecticut, Florida, Illinois, Kansas, Minnesota, Missouri, North Carolina, Oregon, South Carolina, Tennessee, Texas, and Wisconsin.

Date of Government Version: 01/01/2017
Date Data Arrived at EDR: 02/03/2017
Date Made Active in Reports: 04/07/2017
Number of Days to Update: 63

Source: Environmental Protection Agency
Telephone: 615-532-8599
Last EDR Contact: 02/16/2018
Next Scheduled EDR Contact: 05/28/2018
Data Release Frequency: Varies

US FIN ASSUR: Financial Assurance Information

All owners and operators of facilities that treat, store, or dispose of hazardous waste are required to provide proof that they will have sufficient funds to pay for the clean up, closure, and post-closure care of their facilities.

Date of Government Version: 10/17/2017
Date Data Arrived at EDR: 11/01/2017
Date Made Active in Reports: 12/08/2017
Number of Days to Update: 37

Source: Environmental Protection Agency
Telephone: 202-566-1917
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 04/09/2018
Data Release Frequency: Quarterly

EPA WATCH LIST: EPA WATCH LIST

EPA maintains a "Watch List" to facilitate dialogue between EPA, state and local environmental agencies on enforcement matters relating to facilities with alleged violations identified as either significant or high priority. Being on the Watch List does not mean that the facility has actually violated the law only that an investigation by EPA or a state or local environmental agency has led those organizations to allege that an unproven violation has in fact occurred. Being on the Watch List does not represent a higher level of concern regarding the alleged violations that were detected, but instead indicates cases requiring additional dialogue between EPA, state and local agencies - primarily because of the length of time the alleged violation has gone unaddressed or unresolved.

Date of Government Version: 08/30/2013
Date Data Arrived at EDR: 03/21/2014
Date Made Active in Reports: 06/17/2014
Number of Days to Update: 88

Source: Environmental Protection Agency
Telephone: 617-520-3000
Last EDR Contact: 01/31/2018
Next Scheduled EDR Contact: 05/21/2018
Data Release Frequency: Quarterly

2020 COR ACTION: 2020 Corrective Action Program List

The EPA has set ambitious goals for the RCRA Corrective Action program by creating the 2020 Corrective Action Universe. This RCRA cleanup baseline includes facilities expected to need corrective action. The 2020 universe contains a wide variety of sites. Some properties are heavily contaminated while others were contaminated but have since been cleaned up. Still others have not been fully investigated yet, and may require little or no remediation. Inclusion in the 2020 Universe does not necessarily imply failure on the part of a facility to meet its RCRA obligations.

Date of Government Version: 04/22/2013
Date Data Arrived at EDR: 03/03/2015
Date Made Active in Reports: 03/09/2015
Number of Days to Update: 6

Source: Environmental Protection Agency
Telephone: 703-308-4044
Last EDR Contact: 02/08/2018
Next Scheduled EDR Contact: 05/21/2018
Data Release Frequency: Varies

TSCA: Toxic Substances Control Act

Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/2016
Date Data Arrived at EDR: 06/21/2017
Date Made Active in Reports: 01/05/2018
Number of Days to Update: 198

Source: EPA
Telephone: 202-260-5521
Last EDR Contact: 12/22/2017
Next Scheduled EDR Contact: 04/02/2018
Data Release Frequency: Every 4 Years

TRIS: Toxic Chemical Release Inventory System

Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/2016
Date Data Arrived at EDR: 01/10/2018
Date Made Active in Reports: 01/12/2018
Number of Days to Update: 2

Source: EPA
Telephone: 202-566-0250
Last EDR Contact: 02/23/2018
Next Scheduled EDR Contact: 06/04/2018
Data Release Frequency: Annually

SSTS: Section 7 Tracking Systems

Section 7 of the Federal Insecticide, Fungicide and Rodenticide Act, as amended (92 Stat. 829) requires all registered pesticide-producing establishments to submit a report to the Environmental Protection Agency by March 1st each year. Each establishment must report the types and amounts of pesticides, active ingredients and devices being produced, and those having been produced and sold or distributed in the past year.

Date of Government Version: 12/31/2009
Date Data Arrived at EDR: 12/10/2010
Date Made Active in Reports: 02/25/2011
Number of Days to Update: 77

Source: EPA
Telephone: 202-564-4203
Last EDR Contact: 01/25/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Annually

ROD: Records Of Decision

Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 12/11/2017
Date Data Arrived at EDR: 12/22/2017
Date Made Active in Reports: 01/12/2018
Number of Days to Update: 21

Source: EPA
Telephone: 703-416-0223
Last EDR Contact: 02/06/2018
Next Scheduled EDR Contact: 03/19/2018
Data Release Frequency: Annually

RMP: Risk Management Plans

When Congress passed the Clean Air Act Amendments of 1990, it required EPA to publish regulations and guidance for chemical accident prevention at facilities using extremely hazardous substances. The Risk Management Program Rule (RMP Rule) was written to implement Section 112(r) of these amendments. The rule, which built upon existing industry codes and standards, requires companies of all sizes that use certain flammable and toxic substances to develop a Risk Management Program, which includes a(n): Hazard assessment that details the potential effects of an accidental release, an accident history of the last five years, and an evaluation of worst-case and alternative accidental releases; Prevention program that includes safety precautions and maintenance, monitoring, and employee training measures; and Emergency response program that spells out emergency health care, employee training measures and procedures for informing the public and response agencies (e.g the fire department) should an accident occur.

Date of Government Version: 11/02/2017
Date Data Arrived at EDR: 11/17/2017
Date Made Active in Reports: 12/08/2017
Number of Days to Update: 21

Source: Environmental Protection Agency
Telephone: 202-564-8600
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

RAATS: RCRA Administrative Action Tracking System

RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/1995
Date Data Arrived at EDR: 07/03/1995
Date Made Active in Reports: 08/07/1995
Number of Days to Update: 35

Source: EPA
Telephone: 202-564-4104
Last EDR Contact: 06/02/2008
Next Scheduled EDR Contact: 09/01/2008
Data Release Frequency: No Update Planned

PRP: Potentially Responsible Parties
A listing of verified Potentially Responsible Parties

Date of Government Version: 10/25/2013
Date Data Arrived at EDR: 10/17/2014
Date Made Active in Reports: 10/20/2014
Number of Days to Update: 3

Source: EPA
Telephone: 202-564-6023
Last EDR Contact: 02/06/2018
Next Scheduled EDR Contact: 05/21/2018
Data Release Frequency: Quarterly

PADS: PCB Activity Database System
PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 06/01/2017
Date Data Arrived at EDR: 06/09/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 126

Source: EPA
Telephone: 202-566-0500
Last EDR Contact: 01/12/2018
Next Scheduled EDR Contact: 04/23/2018
Data Release Frequency: Annually

ICIS: Integrated Compliance Information System
The Integrated Compliance Information System (ICIS) supports the information needs of the national enforcement and compliance program as well as the unique needs of the National Pollutant Discharge Elimination System (NPDES) program.

Date of Government Version: 11/18/2016
Date Data Arrived at EDR: 11/23/2016
Date Made Active in Reports: 02/10/2017
Number of Days to Update: 79

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 01/09/2018
Next Scheduled EDR Contact: 04/23/2018
Data Release Frequency: Quarterly

FTTS: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25

Source: EPA/Office of Prevention, Pesticides and Toxic Substances
Telephone: 202-566-1667
Last EDR Contact: 08/18/2017
Next Scheduled EDR Contact: 12/04/2017
Data Release Frequency: Quarterly

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
A listing of FIFRA/TSCA Tracking System (FTTS) inspections and enforcements.

Date of Government Version: 04/09/2009
Date Data Arrived at EDR: 04/16/2009
Date Made Active in Reports: 05/11/2009
Number of Days to Update: 25

Source: EPA
Telephone: 202-566-1667
Last EDR Contact: 08/18/2017
Next Scheduled EDR Contact: 12/04/2017
Data Release Frequency: Quarterly

MLTS: Material Licensing Tracking System
MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 08/30/2016
Date Data Arrived at EDR: 09/08/2016
Date Made Active in Reports: 10/21/2016
Number of Days to Update: 43

Source: Nuclear Regulatory Commission
Telephone: 301-415-7169
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 05/21/2018
Data Release Frequency: Quarterly

COAL ASH DOE: Steam-Electric Plant Operation Data
A listing of power plants that store ash in surface ponds.

Date of Government Version: 12/31/2005
Date Data Arrived at EDR: 08/07/2009
Date Made Active in Reports: 10/22/2009
Number of Days to Update: 76

Source: Department of Energy
Telephone: 202-586-8719
Last EDR Contact: 12/05/2017
Next Scheduled EDR Contact: 03/19/2018
Data Release Frequency: Varies

COAL ASH EPA: Coal Combustion Residues Surface Impoundments List
A listing of coal combustion residues surface impoundments with high hazard potential ratings.

Date of Government Version: 07/01/2014
Date Data Arrived at EDR: 09/10/2014
Date Made Active in Reports: 10/20/2014
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: N/A
Last EDR Contact: 12/08/2017
Next Scheduled EDR Contact: 03/19/2018
Data Release Frequency: Varies

PCB TRANSFORMER: PCB Transformer Registration Database
The database of PCB transformer registrations that includes all PCB registration submittals.

Date of Government Version: 05/24/2017
Date Data Arrived at EDR: 11/30/2017
Date Made Active in Reports: 12/15/2017
Number of Days to Update: 15

Source: Environmental Protection Agency
Telephone: 202-566-0517
Last EDR Contact: 01/26/2018
Next Scheduled EDR Contact: 05/07/2018
Data Release Frequency: Varies

RADINFO: Radiation Information Database
The Radiation Information Database (RADINFO) contains information about facilities that are regulated by U.S. Environmental Protection Agency (EPA) regulations for radiation and radioactivity.

Date of Government Version: 10/02/2017
Date Data Arrived at EDR: 10/05/2017
Date Made Active in Reports: 10/13/2017
Number of Days to Update: 8

Source: Environmental Protection Agency
Telephone: 202-343-9775
Last EDR Contact: 01/04/2018
Next Scheduled EDR Contact: 04/16/2018
Data Release Frequency: Quarterly

HIST FTTS: FIFRA/TSCA Tracking System Administrative Case Listing
A complete administrative case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2007
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

HIST FTTS INSP: FIFRA/TSCA Tracking System Inspection & Enforcement Case Listing
A complete inspection and enforcement case listing from the FIFRA/TSCA Tracking System (FTTS) for all ten EPA regions. The information was obtained from the National Compliance Database (NCDB). NCDB supports the implementation of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) and TSCA (Toxic Substances Control Act). Some EPA regions are now closing out records. Because of that, and the fact that some EPA regions are not providing EPA Headquarters with updated records, it was decided to create a HIST FTTS database. It included records that may not be included in the newer FTTS database updates. This database is no longer updated.

Date of Government Version: 10/19/2006
Date Data Arrived at EDR: 03/01/2007
Date Made Active in Reports: 04/10/2007
Number of Days to Update: 40

Source: Environmental Protection Agency
Telephone: 202-564-2501
Last EDR Contact: 12/17/2008
Next Scheduled EDR Contact: 03/17/2008
Data Release Frequency: No Update Planned

DOT OPS: Incident and Accident Data

Department of Transporation, Office of Pipeline Safety Incident and Accident data.

Date of Government Version: 07/31/2012
Date Data Arrived at EDR: 08/07/2012
Date Made Active in Reports: 09/18/2012
Number of Days to Update: 42

Source: Department of Transporation, Office of Pipeline Safety
Telephone: 202-366-4595
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Varies

CONSENT: Superfund (CERCLA) Consent Decrees

Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: 09/30/2017
Date Data Arrived at EDR: 11/10/2017
Date Made Active in Reports: 01/12/2018
Number of Days to Update: 63

Source: Department of Justice, Consent Decree Library
Telephone: Varies
Last EDR Contact: 01/04/2018
Next Scheduled EDR Contact: 04/02/2018
Data Release Frequency: Varies

BRS: Biennial Reporting System

The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/31/2015
Date Data Arrived at EDR: 02/22/2017
Date Made Active in Reports: 09/28/2017
Number of Days to Update: 218

Source: EPA/NTIS
Telephone: 800-424-9346
Last EDR Contact: 02/23/2018
Next Scheduled EDR Contact: 06/04/2018
Data Release Frequency: Biennially

INDIAN RESERV: Indian Reservations

This map layer portrays Indian administered lands of the United States that have any area equal to or greater than 640 acres.

Date of Government Version: 12/31/2014
Date Data Arrived at EDR: 07/14/2015
Date Made Active in Reports: 01/10/2017
Number of Days to Update: 546

Source: USGS
Telephone: 202-208-3710
Last EDR Contact: 01/09/2018
Next Scheduled EDR Contact: 04/23/2018
Data Release Frequency: Semi-Annually

FUSRAP: Formerly Utilized Sites Remedial Action Program

DOE established the Formerly Utilized Sites Remedial Action Program (FUSRAP) in 1974 to remediate sites where radioactive contamination remained from Manhattan Project and early U.S. Atomic Energy Commission (AEC) operations.

Date of Government Version: 12/23/2016
Date Data Arrived at EDR: 12/27/2016
Date Made Active in Reports: 02/17/2017
Number of Days to Update: 52

Source: Department of Energy
Telephone: 202-586-3559
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 05/21/2018
Data Release Frequency: Varies

UMTRA: Uranium Mill Tailings Sites

Uranium ore was mined by private companies for federal government use in national defense programs. When the mills shut down, large piles of the sand-like material (mill tailings) remain after uranium has been extracted from the ore. Levels of human exposure to radioactive materials from the piles are low; however, in some cases tailings were used as construction materials before the potential health hazards of the tailings were recognized.

Date of Government Version: 06/23/2017
Date Data Arrived at EDR: 10/11/2017
Date Made Active in Reports: 11/03/2017
Number of Days to Update: 23

Source: Department of Energy
Telephone: 505-845-0011
Last EDR Contact: 02/23/2018
Next Scheduled EDR Contact: 06/04/2018
Data Release Frequency: Varies

LEAD SMELTER 1: Lead Smelter Sites
A listing of former lead smelter site locations.

Date of Government Version: 10/10/2017
Date Data Arrived at EDR: 11/03/2017
Date Made Active in Reports: 12/15/2017
Number of Days to Update: 42

Source: Environmental Protection Agency
Telephone: 703-603-8787
Last EDR Contact: 02/06/2018
Next Scheduled EDR Contact: 05/21/2018
Data Release Frequency: Varies

LEAD SMELTER 2: Lead Smelter Sites
A list of several hundred sites in the U.S. where secondary lead smelting was done from 1931and 1964. These sites may pose a threat to public health through ingestion or inhalation of contaminated soil or dust

Date of Government Version: 04/05/2001
Date Data Arrived at EDR: 10/27/2010
Date Made Active in Reports: 12/02/2010
Number of Days to Update: 36

Source: American Journal of Public Health
Telephone: 703-305-6451
Last EDR Contact: 12/02/2009
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

US AIRS (AFS): Aerometric Information Retrieval System Facility Subsystem (AFS)
The database is a sub-system of Aerometric Information Retrieval System (AIRS). AFS contains compliance data on air pollution point sources regulated by the U.S. EPA and/or state and local air regulatory agencies. This information comes from source reports by various stationary sources of air pollution, such as electric power plants, steel mills, factories, and universities, and provides information about the air pollutants they produce. Action, air program, air program pollutant, and general level plant data. It is used to track emissions and compliance data from industrial plants.

Date of Government Version: 10/12/2016
Date Data Arrived at EDR: 10/26/2016
Date Made Active in Reports: 02/03/2017
Number of Days to Update: 100

Source: EPA
Telephone: 202-564-2496
Last EDR Contact: 09/26/2017
Next Scheduled EDR Contact: 01/08/2018
Data Release Frequency: Annually

US AIRS MINOR: Air Facility System Data
A listing of minor source facilities.

Date of Government Version: 10/12/2016
Date Data Arrived at EDR: 10/26/2016
Date Made Active in Reports: 02/03/2017
Number of Days to Update: 100

Source: EPA
Telephone: 202-564-2496
Last EDR Contact: 09/26/2017
Next Scheduled EDR Contact: 01/08/2018
Data Release Frequency: Annually

US MINES: Mines Master Index File
Contains all mine identification numbers issued for mines active or opened since 1971. The data also includes violation information.

Date of Government Version: 10/29/2017
Date Data Arrived at EDR: 11/28/2017
Date Made Active in Reports: 01/12/2018
Number of Days to Update: 45

Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959
Last EDR Contact: 11/28/2017
Next Scheduled EDR Contact: 03/12/2018
Data Release Frequency: Semi-Annually

US MINES 2: Ferrous and Nonferrous Metal Mines Database Listing
This map layer includes ferrous (ferrous metal mines are facilities that extract ferrous metals, such as iron ore or molybdenum) and nonferrous (Nonferrous metal mines are facilities that extract nonferrous metals, such as gold, silver, copper, zinc, and lead) metal mines in the United States.

Date of Government Version: 12/05/2005
Date Data Arrived at EDR: 02/29/2008
Date Made Active in Reports: 04/18/2008
Number of Days to Update: 49

Source: USGS
Telephone: 703-648-7709
Last EDR Contact: 12/01/2017
Next Scheduled EDR Contact: 03/12/2018
Data Release Frequency: Varies

US MINES 3: Active Mines & Mineral Plants Database Listing

Active Mines and Mineral Processing Plant operations for commodities monitored by the Minerals Information Team of the USGS.

Date of Government Version: 04/14/2011
Date Data Arrived at EDR: 06/08/2011
Date Made Active in Reports: 09/13/2011
Number of Days to Update: 97

Source: USGS
Telephone: 703-648-7709
Last EDR Contact: 12/01/2017
Next Scheduled EDR Contact: 03/12/2018
Data Release Frequency: Varies

ABANDONED MINES: Abandoned Mines

An inventory of land and water impacted by past mining (primarily coal mining) is maintained by OSMRE to provide information needed to implement the Surface Mining Control and Reclamation Act of 1977 (SMCRA). The inventory contains information on the location, type, and extent of AML impacts, as well as, information on the cost associated with the reclamation of those problems. The inventory is based upon field surveys by State, Tribal, and OSMRE program officials. It is dynamic to the extent that it is modified as new problems are identified and existing problems are reclaimed.

Date of Government Version: 09/25/2017
Date Data Arrived at EDR: 09/26/2017
Date Made Active in Reports: 10/20/2017
Number of Days to Update: 24

Source: Department of Interior
Telephone: 202-208-2609
Last EDR Contact: 12/19/2017
Next Scheduled EDR Contact: 03/26/2018
Data Release Frequency: Quarterly

FINDS: Facility Index System/Facility Registry System

Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 07/23/2017
Date Data Arrived at EDR: 09/06/2017
Date Made Active in Reports: 09/15/2017
Number of Days to Update: 9

Source: EPA
Telephone: (312) 353-2000
Last EDR Contact: 02/23/2018
Next Scheduled EDR Contact: 03/19/2018
Data Release Frequency: Quarterly

UXO: Unexploded Ordnance Sites

A listing of unexploded ordnance site locations

Date of Government Version: 09/30/2016
Date Data Arrived at EDR: 10/31/2017
Date Made Active in Reports: 01/12/2018
Number of Days to Update: 73

Source: Department of Defense
Telephone: 703-704-1564
Last EDR Contact: 01/02/2018
Next Scheduled EDR Contact: 04/30/2018
Data Release Frequency: Varies

DOCKET HWC: Hazardous Waste Compliance Docket Listing

A complete list of the Federal Agency Hazardous Waste Compliance Docket Facilities.

Date of Government Version: 06/27/2017
Date Data Arrived at EDR: 11/21/2017
Date Made Active in Reports: 01/12/2018
Number of Days to Update: 52

Source: Environmental Protection Agency
Telephone: 202-564-0527
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 03/12/2018
Data Release Frequency: Varies

ECHO: Enforcement & Compliance History Information
ECHO provides integrated compliance and enforcement information for about 800,000 regulated facilities nationwide.

Date of Government Version: 09/02/2017
Date Data Arrived at EDR: 09/06/2017
Date Made Active in Reports: 10/20/2017
Number of Days to Update: 44

Source: Environmental Protection Agency
Telephone: 202-564-2280
Last EDR Contact: 01/19/2018
Next Scheduled EDR Contact: 03/19/2018
Data Release Frequency: Quarterly

FUELS PROGRAM: EPA Fuels Program Registered Listing
This listing includes facilities that are registered under the Part 80 (Code of Federal Regulations) EPA Fuels Programs. All companies now are required to submit new and updated registrations.

Date of Government Version: 11/20/2017
Date Data Arrived at EDR: 11/20/2017
Date Made Active in Reports: 01/12/2018
Number of Days to Update: 53

Source: EPA
Telephone: 800-385-6164
Last EDR Contact: 02/21/2018
Next Scheduled EDR Contact: 06/04/2018
Data Release Frequency: Quarterly

IN AIRS: Permitted Sources & Emissions Listing
Current permitted sources and emissions inventory information.

Date of Government Version: 08/03/2016
Date Data Arrived at EDR: 08/05/2016
Date Made Active in Reports: 08/23/2016
Number of Days to Update: 18

Source: Department of Environmental Management
Telephone: 317-233-0185
Last EDR Contact: 01/03/2018
Next Scheduled EDR Contact: 04/16/2018
Data Release Frequency: Varies

KY AIRS: Permitted Airs Facility Listing
A listing of permitted Airs facilities.

Date of Government Version: 01/02/2018
Date Data Arrived at EDR: 01/05/2018
Date Made Active in Reports: 02/20/2018
Number of Days to Update: 46

Source: Department of Environmental Protection
Telephone: 502-573-3382
Last EDR Contact: 01/29/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Semi-Annually

IN BULK: Registered Bulk Fertilizer and Pesticide Storage Facilities
A listing of registered dry or liquid bulk fertilizer and pesticide storage facilities.

Date of Government Version: 05/01/2017
Date Data Arrived at EDR: 05/11/2017
Date Made Active in Reports: 09/07/2017
Number of Days to Update: 119

Source: Office of Indiana State Chemist
Telephone: 765-494-0579
Last EDR Contact: 12/26/2017
Next Scheduled EDR Contact: 04/16/2018
Data Release Frequency: Varies

IN CFO: Confined Feeding Operations
This dataset consists of Confined Feeding Operations - i.e. A swine, chicken, turkey, beef or dairy agri-business that has large enough numbers of animals that IDEM regulates for environmental concerns, as defined by IC 13-18-10 of the Indiana Code.

Date of Government Version: 09/03/2013
Date Data Arrived at EDR: 12/11/2013
Date Made Active in Reports: 01/17/2014
Number of Days to Update: 37

Source: Department of Environmental Management
Telephone: 317-232-8726
Last EDR Contact: 12/12/2014
Next Scheduled EDR Contact: 03/23/2015
Data Release Frequency: Varies

IN COAL ASH: Coal Ash Disposal Sites
A listing of coal ash disposal site locations.

Date of Government Version: 11/19/2016
Date Data Arrived at EDR: 01/04/2017
Date Made Active in Reports: 01/20/2017
Number of Days to Update: 16

Source: Department of Environmental Management
Telephone: 317-233-4624
Last EDR Contact: 01/22/2018
Next Scheduled EDR Contact: 03/26/2018
Data Release Frequency: Varies

KY COAL ASH: Coal Ash Disposal Sites
A listing of coal ash pond site locations.

Date of Government Version: 12/09/2013
Date Data Arrived at EDR: 05/01/2014
Date Made Active in Reports: 07/07/2014
Number of Days to Update: 67

Source: Department of Environmental Protection
Telephone: 502-564-6716
Last EDR Contact: 01/29/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Varies

IN DRYCLEANERS: Drycleaner Facility Listing
A list of drycleaners involved in the Indiana 5-Star Environmental Recognition Program. It is a voluntary program that ranks participating drycleaners on a scale of one to five stars. The program recognizes those drycleaners willing to do more for the environment and worker safety than the rules require. These drycleaners are going above and beyond the rules to protect the environment, their employees and their neighbors and customers.

Date of Government Version: 06/27/2016
Date Data Arrived at EDR: 06/28/2016
Date Made Active in Reports: 08/15/2016
Number of Days to Update: 48

Source: Department of Environmental Management
Telephone: 800-988-7901
Last EDR Contact: 12/08/2017
Next Scheduled EDR Contact: 03/26/2018
Data Release Frequency: Varies

KY DRYCLEANERS: Drycleaner Listing
A listing of drycleaner facility locations.

Date of Government Version: 01/02/2018
Date Data Arrived at EDR: 01/05/2018
Date Made Active in Reports: 02/20/2018
Number of Days to Update: 46

Source: Department of Environmental Protection
Telephone: 502-573-3382
Last EDR Contact: 01/29/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Semi-Annually

IN Financial Assurance 1: Financial Assurance Information Listing
Financial assurance information.

Date of Government Version: 01/11/2018
Date Data Arrived at EDR: 01/11/2018
Date Made Active in Reports: 02/23/2018
Number of Days to Update: 43

Source: Department of Environmental Management
Telephone: 317-233-1052
Last EDR Contact: 01/10/2018
Next Scheduled EDR Contact: 04/16/2018
Data Release Frequency: Varies

KY Financial Assurance 1: Financial Assurance Information Listing
A listing of financial assurance information.

Date of Government Version: 11/27/2017
Date Data Arrived at EDR: 11/27/2017
Date Made Active in Reports: 12/28/2017
Number of Days to Update: 31

Source: Department of Environmental Protection
Telephone: 502-564-6716
Last EDR Contact: 01/29/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Varies

IN Financial Assurance 2: Financial Assurance Information Listing
Financial assurance information for solid waste facilities. Financial assurance is intended to ensure that resources are available to pay for the cost of closure, post-closure care, and corrective measures if the owner or operator of a regulated facility is unable or unwilling to pay.

Date of Government Version: 01/11/2018
Date Data Arrived at EDR: 01/11/2018
Date Made Active in Reports: 02/23/2018
Number of Days to Update: 43

Source: Department of Environmental Management
Telephone: 317-233-1052
Last EDR Contact: 01/10/2018
Next Scheduled EDR Contact: 04/16/2018
Data Release Frequency: Varies

KY Financial Assurance 2: Financial Assurance Information Listing

Financial Assurance information for underground storage tank facilities. Financial assurance is intended to ensure that resources are available to pay for the cost of closure, post-closure care, and corrective measures if the owner or operator of a regulated facility is unable or unwilling to pay.

Date of Government Version: 05/14/2014
Date Data Arrived at EDR: 06/06/2014
Date Made Active in Reports: 06/24/2014
Number of Days to Update: 18

Source: Department of Environmental Protection
Telephone: 502-564-5981
Last EDR Contact: 01/29/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Varies

KY Financial Assurance 3: Financial Assurance Information Listing

A listing of financial assurance information for solid waste facilities. Financial assurance is intended to ensure that resources are available to pay for the cost of closure, post-closure care, and corrective measures if the owner or operator of a regulated facility is unable or unwilling to pay.

Date of Government Version: 11/27/2017
Date Data Arrived at EDR: 11/28/2017
Date Made Active in Reports: 12/28/2017
Number of Days to Update: 30

Source: Department of Environmental Protection
Telephone: 502-564-6716
Last EDR Contact: 01/29/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Varies

IND WASTE: Industrial Waste Sites Listing

The listing contains industrial waste site locations in Indiana, provided by personnel of Indiana Department of Environmental Management, Office of Land Quality.

Date of Government Version: 08/04/2015
Date Data Arrived at EDR: 09/09/2015
Date Made Active in Reports: 10/07/2015
Number of Days to Update: 28

Source: Department of Environmental Management
Telephone: 317-232-8726
Last EDR Contact: 12/08/2017
Next Scheduled EDR Contact: 03/19/2018
Data Release Frequency: Quarterly

IN MANIFEST: Manifest Data

Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a tsd facility.

Date of Government Version: 12/31/2016
Date Data Arrived at EDR: 10/03/2017
Date Made Active in Reports: 12/05/2017
Number of Days to Update: 63

Source: Department of Environmental Management
Telephone: 317-233-4624
Last EDR Contact: 01/03/2018
Next Scheduled EDR Contact: 04/16/2018
Data Release Frequency: Annually

IN NPDES: NPDES Permit Listing

A listing of active NPDES Permit Section facility locations.

Date of Government Version: 10/29/2017
Date Data Arrived at EDR: 02/06/2018
Date Made Active in Reports: 02/27/2018
Number of Days to Update: 21

Source: Department of Environmental Management
Telephone: 317-233-0676
Last EDR Contact: 01/05/2018
Next Scheduled EDR Contact: 04/23/2018
Data Release Frequency: Varies

KY NPDES: Permitted Facility Listing

A listing of permitted wastewater facilities.

Date of Government Version: 11/29/2017
Date Data Arrived at EDR: 11/30/2017
Date Made Active in Reports: 12/28/2017
Number of Days to Update: 28

Source: Department of Environmental Protection
Telephone: 502-564-3410
Last EDR Contact: 02/05/2018
Next Scheduled EDR Contact: 05/21/2018
Data Release Frequency: Semi-Annually

IN OISC: Office of Indiana State Chemist Database
Restricted use pesticide dealers and pesticide & fertilizer applicators.

Date of Government Version: 12/18/2017
Date Data Arrived at EDR: 12/19/2017
Date Made Active in Reports: 01/24/2018
Number of Days to Update: 36

Source: Office of Indiana State Chemist & Seed
Telephone: 765-494-1492
Last EDR Contact: 12/19/2017
Next Scheduled EDR Contact: 04/02/2018
Data Release Frequency: Quarterly

IN SCP: State Cleanup Program Sites
The goals for the State Cleanup Section are to mitigate risk to human health and the environment.

Date of Government Version: 08/29/2016
Date Data Arrived at EDR: 08/29/2016
Date Made Active in Reports: 10/20/2016
Number of Days to Update: 52

Source: Department of Environmental Management
Telephone: 317-233-0068
Last EDR Contact: 01/05/2018
Next Scheduled EDR Contact: 04/23/2018
Data Release Frequency: Quarterly

IN TIER 2: Tier 2 Facility Listing
A listing of facilities which store or manufacture hazardous materials that submit a chemical inventory report.

Date of Government Version: 12/31/2016
Date Data Arrived at EDR: 07/25/2017
Date Made Active in Reports: 09/07/2017
Number of Days to Update: 44

Source: Department of Environmental Management
Telephone: 317-233-0066
Last EDR Contact: 02/22/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Varies

IN UIC: UIC Site Listing
A listing of class II well locations

Date of Government Version: 09/27/2017
Date Data Arrived at EDR: 09/27/2017
Date Made Active in Reports: 12/04/2017
Number of Days to Update: 68

Source: Department of Natural Resources
Telephone: 317-232-0045
Last EDR Contact: 02/23/2018
Next Scheduled EDR Contact: 06/11/2018
Data Release Frequency: Varies

KY UIC: UIC Information
A listing of wells identified as underground injection wells, in the Kentucky Oil & Gas Wells data base.

Date of Government Version: 12/15/2017
Date Data Arrived at EDR: 01/17/2018
Date Made Active in Reports: 02/20/2018
Number of Days to Update: 34

Source: Kentucky Geological Survey
Telephone: 859-323-0544
Last EDR Contact: 01/17/2018
Next Scheduled EDR Contact: 04/30/2018
Data Release Frequency: Quarterly

EDR HIGH RISK HISTORICAL RECORDS

EDR Exclusive Records

EDR MGP: EDR Proprietary Manufactured Gas Plants
The EDR Proprietary Manufactured Gas Plant Database includes records of coal gas plants (manufactured gas plants) compiled by EDR's researchers. Manufactured gas sites were used in the United States from the 1800's to 1950's to produce a gas that could be distributed and used as fuel. These plants used whale oil, rosin, coal, or a mixture of coal, oil, and water that also produced a significant amount of waste. Many of the byproducts of the gas production, such as coal tar (oily waste containing volatile and non-volatile chemicals), sludges, oils and other compounds are potentially hazardous to human health and the environment. The byproduct from this process was frequently disposed of directly at the plant site and can remain or spread slowly, serving as a continuous source of soil and groundwater contamination.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: No Update Planned

EDR Hist Auto: EDR Exclusive Historical Auto Stations

EDR has searched selected national collections of business directories and has collected listings of potential gas station/filling station/service station sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include gas station/filling station/service station establishments. The categories reviewed included, but were not limited to gas, gas station, gasoline station, filling station, auto, automobile repair, auto service station, service station, etc. This database falls within a category of information EDR classifies as "High Risk Historical Records", or HRHR. EDR's HRHR effort presents unique and sometimes proprietary data about past sites and operations that typically create environmental concerns, but may not show up in current government records searches.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

EDR Hist Cleaner: EDR Exclusive Historical Cleaners

EDR has searched selected national collections of business directories and has collected listings of potential dry cleaner sites that were available to EDR researchers. EDR's review was limited to those categories of sources that might, in EDR's opinion, include dry cleaning establishments. The categories reviewed included, but were not limited to dry cleaners, cleaners, laundry, laundromat, cleaning/laundry, wash & dry etc. This database falls within a category of information EDR classifies as "High Risk Historical Records", or HRHR. EDR's HRHR effort presents unique and sometimes proprietary data about past sites and operations that typically create environmental concerns, but may not show up in current government records searches.

Date of Government Version: N/A
Date Data Arrived at EDR: N/A
Date Made Active in Reports: N/A
Number of Days to Update: N/A

Source: EDR, Inc.
Telephone: N/A
Last EDR Contact: N/A
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

EDR RECOVERED GOVERNMENT ARCHIVES

Exclusive Recovered Govt. Archives

IN RGA HWS: Recovered Government Archive State Hazardous Waste Facilities List

The EDR Recovered Government Archive State Hazardous Waste database provides a list of SHWS incidents derived from historical databases and includes many records that no longer appear in current government lists. Compiled from Records formerly available from the Department of Environmental Management in Indiana.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 12/24/2013
Number of Days to Update: 176

Source: Department of Environmental Management
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

KY RGA HWS: Recovered Government Archive State Hazardous Waste Facilities List

The EDR Recovered Government Archive State Hazardous Waste database provides a list of SHWS incidents derived from historical databases and includes many records that no longer appear in current government lists.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 01/03/2014
Number of Days to Update: 186

Source: Department of Environmental Protection
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

IN RGA LF: Recovered Government Archive Solid Waste Facilities List

The EDR Recovered Government Archive Landfill database provides a list of landfills derived from historical databases and includes many records that no longer appear in current government lists. Compiled from Records formerly available from the Department of Environmental Management in Indiana.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 01/20/2014
Number of Days to Update: 203

Source: Department of Environmental Management
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

KY RGA LF: Recovered Government Archive Solid Waste Facilities List

The EDR Recovered Government Archive Landfill database provides a list of landfills derived from historical databases and includes many records that no longer appear in current government lists.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 01/15/2014
Number of Days to Update: 198

Source: Department of Environmental Protection
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

IN RGA LUST: Recovered Government Archive Leaking Underground Storage Tank

The EDR Recovered Government Archive Leaking Underground Storage Tank database provides a list of LUST incidents derived from historical databases and includes many records that no longer appear in current government lists. Compiled from Records formerly available from the Department of Environmental Management in Indiana.

Date of Government Version: N/A
Date Data Arrived at EDR: 07/01/2013
Date Made Active in Reports: 12/24/2013
Number of Days to Update: 176

Source: Department of Environmental Management
Telephone: N/A
Last EDR Contact: 06/01/2012
Next Scheduled EDR Contact: N/A
Data Release Frequency: Varies

OTHER DATABASE(S)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

CT MANIFEST: Hazardous Waste Manifest Data

Facility and manifest data. Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a tsd facility.

Date of Government Version: 11/11/2017
Date Data Arrived at EDR: 11/14/2017
Date Made Active in Reports: 12/18/2017
Number of Days to Update: 34

Source: Department of Energy & Environmental Protection
Telephone: 860-424-3375
Last EDR Contact: 02/14/2018
Next Scheduled EDR Contact: 05/28/2018
Data Release Frequency: No Update Planned

NJ MANIFEST: Manifest Information

Hazardous waste manifest information.

Date of Government Version: 12/31/2016
Date Data Arrived at EDR: 04/11/2017
Date Made Active in Reports: 07/27/2017
Number of Days to Update: 107

Source: Department of Environmental Protection
Telephone: N/A
Last EDR Contact: 01/05/2018
Next Scheduled EDR Contact: 04/23/2018
Data Release Frequency: Annually

NY MANIFEST: Facility and Manifest Data
Manifest is a document that lists and tracks hazardous waste from the generator through transporters to a TSD facility.

Date of Government Version: 10/01/2017
Date Data Arrived at EDR: 11/01/2017
Date Made Active in Reports: 11/13/2017
Number of Days to Update: 12

Source: Department of Environmental Conservation
Telephone: 518-402-8651
Last EDR Contact: 01/31/2018
Next Scheduled EDR Contact: 05/14/2018
Data Release Frequency: Quarterly

PA MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2016
Date Data Arrived at EDR: 07/25/2017
Date Made Active in Reports: 09/25/2017
Number of Days to Update: 62

Source: Department of Environmental Protection
Telephone: 717-783-8990
Last EDR Contact: 01/16/2018
Next Scheduled EDR Contact: 04/30/2018
Data Release Frequency: Annually

RI MANIFEST: Manifest information
Hazardous waste manifest information

Date of Government Version: 12/31/2013
Date Data Arrived at EDR: 06/19/2015
Date Made Active in Reports: 07/15/2015
Number of Days to Update: 26

Source: Department of Environmental Management
Telephone: 401-222-2797
Last EDR Contact: 02/21/2018
Next Scheduled EDR Contact: 06/04/2018
Data Release Frequency: Annually

VT MANIFEST: Hazardous Waste Manifest Data
Hazardous waste manifest information.

Date of Government Version: 01/12/2018
Date Data Arrived at EDR: 01/19/2018
Date Made Active in Reports: 02/13/2018
Number of Days to Update: 25

Source: Department of Environmental Conservation
Telephone: 802-241-3443
Last EDR Contact: 01/12/2018
Next Scheduled EDR Contact: 04/30/2018
Data Release Frequency: Annually

WI MANIFEST: Manifest Information
Hazardous waste manifest information.

Date of Government Version: 12/31/2016
Date Data Arrived at EDR: 04/13/2017
Date Made Active in Reports: 07/14/2017
Number of Days to Update: 92

Source: Department of Natural Resources
Telephone: N/A
Last EDR Contact: 12/11/2017
Next Scheduled EDR Contact: 03/26/2018
Data Release Frequency: Annually

Oil/Gas Pipelines
Source: PennWell Corporation
Petroleum Bundle (Crude Oil, Refined Products, Petrochemicals, Gas Liquids (LPG/NGL), and Specialty Gases (Miscellaneous)) N = Natural Gas Bundle (Natural Gas, Gas Liquids (LPG/NGL), and Specialty Gases (Miscellaneous)). This map includes information copyrighted by PennWell Corporation. This information is provided on a best effort basis and PennWell Corporation does not guarantee its accuracy nor warrant its fitness for any particular purpose. Such information has been reprinted with the permission of PennWell.

Electric Power Transmission Line Data
Source: PennWell Corporation
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Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

AHA Hospitals:
Source: American Hospital Association, Inc.
Telephone: 312-280-5991
The database includes a listing of hospitals based on the American Hospital Association's annual survey of hospitals.

Medical Centers: Provider of Services Listing
Source: Centers for Medicare & Medicaid Services
Telephone: 410-786-3000
A listing of hospitals with Medicare provider number, produced by Centers of Medicare & Medicaid Services, a federal agency within the U.S. Department of Health and Human Services.

Nursing Homes
Source: National Institutes of Health
Telephone: 301-594-6248
Information on Medicare and Medicaid certified nursing homes in the United States.

Public Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on elementary and secondary public education in the United States. It is a comprehensive, annual, national statistical database of all public elementary and secondary schools and school districts, which contains data that are comparable across all states.

Private Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on private school locations in the United States.

Daycare Centers: Child Care Listing
Source: Family & Social Services Administration
Telephone: 317-232-4740

Flood Zone Data: This data was obtained from the Federal Emergency Management Agency (FEMA). It depicts 100-year and 500-year flood zones as defined by FEMA. It includes the National Flood Hazard Layer (NFHL) which incorporates Flood Insurance Rate Map (FIRM) data and Q3 data from FEMA in areas not covered by NFHL.
Source: FEMA
Telephone: 877-336-2627
Date of Government Version: 2003, 2015

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002, 2005 and 2010 from the U.S. Fish and Wildlife Service.

State Wetlands Data: Wetland Inventory
Source: US Fish & Wildlife Service
Telephone: 703-358-2171

Current USGS 7.5 Minute Topographic Map
Source: U.S. Geological Survey

STREET AND ADDRESS INFORMATION

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GEOCHECK ®- PHYSICAL SETTING SOURCE ADDENDUM

TARGET PROPERTY ADDRESS

A.B.BROWN GENERATING STATION
8511 WELBORN RD
EVANSVILLE, IN 47712

TARGET PROPERTY COORDINATES

Latitude (North):	37.907776 - 37˚ 54’ 27.99’’
Longitude (West):	87.707951 - 87˚ 42’ 28.62’’
Universal Tranverse Mercator:	Zone 16
UTM X (Meters):	437764.1
UTM Y (Meters):	4195613.5
Elevation:	453 ft. above sea level

USGS TOPOGRAPHIC MAP

Target Property Map:	5946019 WEST FRANKLIN, IN
Version Date:	2013

EDR’s GeoCheck Physical Setting Source Addendum is provided to assist the environmental professional in forming an opinion about the impact of potential contaminant migration.

Assessment of the impact of contaminant migration generally has two principal investigative components:

1. Groundwater flow direction, and
2. Groundwater flow velocity.

Groundwater flow direction may be impacted by surface topography, hydrology, hydrogeology, characteristics of the soil, and nearby wells. Groundwater flow velocity is generally impacted by the nature of the geologic strata.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW DIRECTION INFORMATION

Groundwater flow direction for a particular site is best determined by a qualified environmental professional using site-specific well data. If such data is not reasonably ascertainable, it may be necessary to rely on other sources of information, such as surface topographic information, hydrologic information, hydrogeologic data collected on nearby properties, and regional groundwater flow information (from deep aquifers).

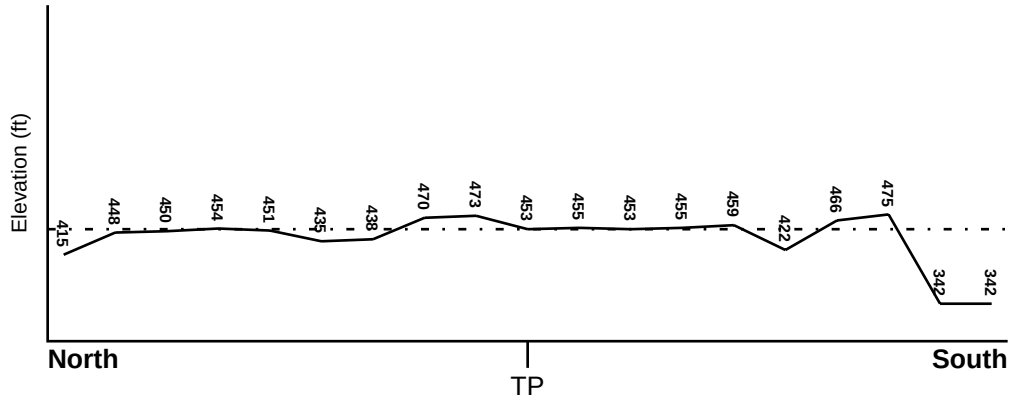
TOPOGRAPHIC INFORMATION

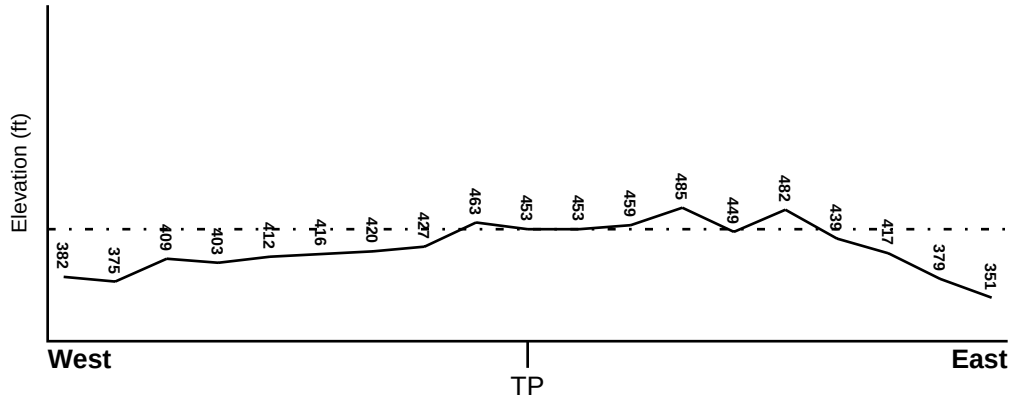
Surface topography may be indicative of the direction of surficial groundwater flow. This information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

TARGET PROPERTY TOPOGRAPHY

General Topographic Gradient: General South

SURROUNDING TOPOGRAPHY: ELEVATION PROFILES





Target Property Elevation: 453 ft.

0 1/2 1 Miles

Source: Topography has been determined from the USGS 7.5' Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

HYDROLOGIC INFORMATION

Surface water can act as a hydrologic barrier to groundwater flow. Such hydrologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Refer to the Physical Setting Source Map following this summary for hydrologic information (major waterways and bodies of water).

FEMA FLOOD ZONE

Flood Plain Panel at Target Property	FEMA Source Type
21101C0065E	FEMA FIRM Flood data

Additional Panels in search area:	FEMA Source Type
Not Reported	

NATIONAL WETLAND INVENTORY

NWI Quad at Target Property	NWI Electronic Data Coverage
WEST FRANKLIN	YES - refer to the Overview Map and Detail Map

HYDROGEOLOGIC INFORMATION

Hydrogeologic information obtained by installation of wells on a specific site can often be an indicator of groundwater flow direction in the immediate area. Such hydrogeologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

AQUIFLOW®

Search Radius: 1.000 Mile.

EDR has developed the AQUIFLOW Information System to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted by environmental professionals to regulatory authorities at select sites and has extracted the date of the report, groundwater flow direction as determined hydrogeologically, and the depth to water table.

MAP ID	LOCATION FROM TP	GENERAL DIRECTION GROUNDWATER FLOW
Not Reported		

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW VELOCITY INFORMATION

Groundwater flow velocity information for a particular site is best determined by a qualified environmental professional using site specific geologic and soil strata data. If such data are not reasonably ascertainable, it may be necessary to rely on other sources of information, including geologic age identification, rock stratigraphic unit and soil characteristics data collected on nearby properties and regional soil information. In general, contaminant plumes move more quickly through sandy-gravelly types of soils than silty-clayey types of soils.

GEOLOGIC INFORMATION IN GENERAL AREA OF TARGET PROPERTY

Geologic information can be used by the environmental professional in forming an opinion about the relative speed at which contaminant migration may be occurring.

ROCK STRATIGRAPHIC UNIT

Era:	Paleozoic
System:	Pennsylvanian
Series:	Missourian Series
Code:	PP3 *(decoded above as Era, System & Series)*

GEOLOGIC AGE IDENTIFICATION

Category: Stratifed Sequence

Geologic Age and Rock Stratigraphic Unit Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - a digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

DOMINANT SOIL COMPOSITION IN GENERAL AREA OF TARGET PROPERTY

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) leads the National Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps. The following information is based on Soil Conservation Service STATSGO data.

Soil Component Name:	ALFORD
Soil Surface Texture:	silt loam
Hydrologic Group:	Class B - Moderate infiltration rates. Deep and moderately deep, moderately well and well drained soils with moderately coarse textures.
Soil Drainage Class:	Well drained. Soils have intermediate water holding capacity. Depth to water table is more than 6 feet.

Hydric Status: Soil does not meet the requirements for a hydric soil.

Corrosion Potential - Uncoated Steel:	MODERATE
Depth to Bedrock Min:	> 60 inches
Depth to Bedrock Max:	> 60 inches

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Soil Layer Information							
	Boundary			Classification			
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil	Permeability Rate (in/hr)	Soil Reaction (pH)
1	0 inches	6 inches	silt loam	Silt-Clay Materials (more than 35 pct. passing No. 200), Silty Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), Lean Clay	Max: 2.00 Min: 0.60	Max: 7.30 Min: 4.50
2	6 inches	72 inches	silty clay loam	Silt-Clay Materials (more than 35 pct. passing No. 200), Clayey Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), Lean Clay	Max: 2.00 Min: 0.60	Max: 6.00 Min: 4.50
3	72 inches	80 inches	silt loam	Silt-Clay Materials (more than 35 pct. passing No. 200), Silty Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit less than 50%), silt.	Max: 2.00 Min: 0.60	Max: 6.50 Min: 5.10

OTHER SOIL TYPES IN AREA

Based on Soil Conservation Service STATSGO data, the following additional subordinant soil types may appear within the general area of target property.

Soil Surface Textures: No Other Soil Types

Surficial Soil Types: No Other Soil Types

Shallow Soil Types: No Other Soil Types

Deeper Soil Types: No Other Soil Types

LOCAL / REGIONAL WATER AGENCY RECORDS

EDR Local/Regional Water Agency records provide water well information to assist the environmental professional in assessing sources that may impact ground water flow direction, and in forming an opinion about the impact of contaminant migration on nearby drinking water wells.

WELL SEARCH DISTANCE INFORMATION

DATABASE	SEARCH DISTANCE (miles)
Federal USGS	1.000
Federal FRDS PWS	Nearest PWS within 1 mile
State Database	1.000

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

FEDERAL USGS WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No Wells Found		

FEDERAL FRDS PUBLIC WATER SUPPLY SYSTEM INFORMATION

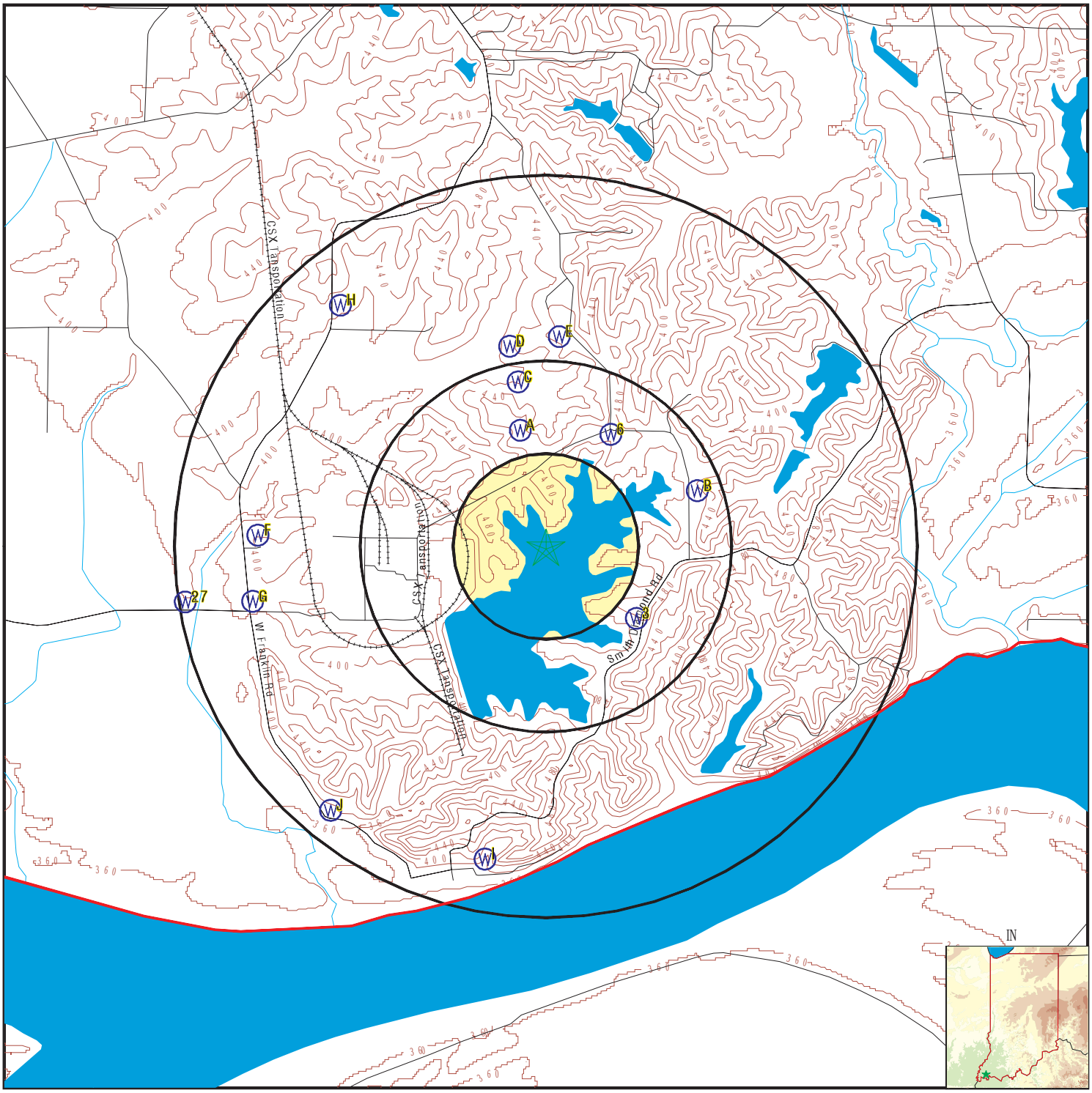
MAP ID	WELL ID	LOCATION FROM TP
No PWS System Found		

Note: PWS System location is not always the same as well location.

STATE DATABASE WELL INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
A1	INLIT2000000152	1/4 - 1/2 Mile North
A2	INDNR3000291930	1/4 - 1/2 Mile North
3	INDNR3000291753	1/4 - 1/2 Mile SE
A4	INDNR3000106930	1/4 - 1/2 Mile NNW
A5	INDNR3000115607	1/4 - 1/2 Mile NNW
6	INDNR3000166084	1/4 - 1/2 Mile NNE
B7	INDNR3000290940	1/4 - 1/2 Mile ENE
B8	INLIT2000000147	1/4 - 1/2 Mile ENE
C9	INLIT2000000160	1/4 - 1/2 Mile North
C10	INDNR3000291962	1/4 - 1/2 Mile North
D11	INLIT2000000176	1/2 - 1 Mile North
D12	INDNR3000290938	1/2 - 1 Mile North
E13	INLIT2000000182	1/2 - 1 Mile North
E14	INDNR3000291545	1/2 - 1 Mile North
F15	INDNR3000306433	1/2 - 1 Mile West
F16	INLIT2000000141	1/2 - 1 Mile West
F17	INDNR3000291307	1/2 - 1 Mile West
G18	INLIT2000000131	1/2 - 1 Mile West
G19	INDNR3000291707	1/2 - 1 Mile West
H20	INLIT2000000188	1/2 - 1 Mile NW
H21	INDNR3000291759	1/2 - 1 Mile NW
I22	INDNR3000291965	1/2 - 1 Mile South
I23	INLIT2000000109	1/2 - 1 Mile South
J24	INDNR3000291976	1/2 - 1 Mile SW
J25	INLIT2000000115	1/2 - 1 Mile SW
J26	INDNR3000290743	1/2 - 1 Mile SW
27	INDNR3000291314	1/2 - 1 Mile West

PHYSICAL SETTING SOURCE MAP - 05203791.2r



County Boundary
Major Roads
Contour Lines
Earthquake epicenter, Richter 5 or greater
Water Wells
Public Water Supply Wells
Cluster of Multiple Icons

0 1/4 1/2 1 Miles

Groundwater Flow Direction
GI Indeterminate Groundwater Flow at Location
GV Groundwater Flow Varies at Location

N

SITE NAME:	A.B.Brown Generating Station	CLIENT:	Haley & Aldrich, Inc.
ADDRESS:	8511 Welborn Rd Evansville IN 47712	CONTACT:	Julia Scott
		INQUIRY #:	05203791.2r
LAT/LONG:	37.907776 / 87.707951	DATE:	February 28, 2018 2:46 pm

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Map ID Direction Distance Elevation		Database	EDR ID Number
A1 **North** **1/4 - 1/2 Mile** **Higher**		**IN WELLS**	**INLIT2000000152**

Area:	0		
Perimeter:	0		
Lith 2:	152	Lith 2 id:	152
Index :	96555		
Alias :	233541		
Z:	0		
Z dem f:	467		
Z dem m:	142.397268		
Lith depth:	48		
Depth:	48		
Static:	0		
Comp date:	1979-10-29 00:00:00		
Owner addr:	20 NW 4TH ST EVANSVILLE IN		
Owner zip:	47741		
Driller na:	Goebel Brothers		
Entered by:	SCF		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	36		
Brdepth:	27		
Site id:	INLIT2000000152		
Edr latitude:	37.9120160981975		
Edr longitude:	-87.7089431575292		
Edr x:	-25613858.4046372		
Edr y:	11912067.7865137		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.9120160981975		
Longitude:	-87.7089431575292		
X coord:	-25613858.4046372		
Y coord:	11912067.7865137		

A2 **North** **1/4 - 1/2 Mile** **Higher**		**IN WELLS**	**INDNR3000291930**

Objectid:	291930
Dblrefno:	233541
Dblaquelv:	0
Dblbailerr:	0
Dblbedrock:	27
Dblpumprat:	0
Dblbedro 1:	418
Dblscreenl:	0
Dblstatic:	0
Dbldepth:	48

Strowner:	SIGECO	Strownerad:	20 NW 4TH ST EVANSVILLE IN
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	13		
Dblutmy:	4196085		
Dblutmx:	437680		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	4		
Dblcasingl:	50		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	29-OCT-79		
Dblgrndele:	445		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	437679.86774		
Utmy nad83:	4196295.16676		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233541&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291930		

3
SE **IN WELLS** **INDNR3000291753**
1/4 - 1/2 Mile
Higher

Objectid:	291753		
Dblrefno:	233562		
Dblaquelv:	0		
Dblbailerr:	3		
Dblbedrock:	25		
Dblpumprat:	0		
Dblbedro 1:	455		
Dblscreenl:	0		
Dblstatic:	50		
Dbldepth:	83		
Strowner:	BOB CARR	Strownerad:	R2 EVANSVILLE
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	24		
Dblutmy:	4195294		
Dblutmx:	438156		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	6.63		

Dblcasingl:	27		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	07-MAY-65		
Dblgrndele:	480		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	438155.883825		
Utmy nad83:	4195504.15023		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233562&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291753		

A4
NNW **IN WELLS** **INDNR3000106930**
1/4 - 1/2 Mile
Higher

Objectid:	106930		
Dblrefno:	233571		
Dblaquelv:	0		
Dblbailerr:	0		
Dblbedrock:	0		
Dblpumprat:	0		
Dblbedro 1:	458		
Dblscreenl:	10		
Dblstatic:	0		
Dbldepth:	50		
Strowner:	SOUTHERN IND GAS & ELECTRIC	Strownerad:	PO BOX 569 EVANSVILLE IN
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	13		
Dblutmy:	4196143		
Dblutmx:	437637		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	4		
Dblcasingl:	42		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	4		

Dtmcompdat:	09-OCT-81		
Dblgrndele:	476		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	437636.866462		
Utmy nad83:	4196353.16798		
Loc type:	Estimated Location/TRS_quarter sections_county		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233571&_from=SUMMARY&_action=Details		
Site id:	INDNR3000106930		

A5
NNW **IN WELLS** **INDNR3000115607**
1/4 - 1/2 Mile
Higher

Objectid:	115607		
Dblrefno:	264265		
Dblaquelv:	0		
Dblbailerr:	0		
Dblbedrock:	0		
Dblpumprat:	0		
Dblbedro 1:	0		
Dblscreenl:	0		
Dblstatic:	0		
Dbldepth:	0		
Strowner:	SOUTHERN INDIANA GAS/ELECTRIC	Strownerad:	8511 WELBORN RD, MT VERNON IN/ AB BROWN STATIO
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	13		
Dblutmy:	4196143		
Dblutmx:	437637		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	0		
Dblcasingl:	0		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	06-DEC-89		
Dblgrndele:	0		
Strpumptyp:	Not Reported	Strownertx:	(812)985-6225
Utmx nad83:	437636.866462		
Utmy nad83:	4196353.16798		
Loc type:	Estimated Location/TRS_quarter sections_county		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=264265&_from=SUMMARY&_action=Details		
Site id:	INDNR3000115607		

6
NNE **IN WELLS** **INDNR3000166084**
1/4 - 1/2 Mile
Higher

Objectid:	166084		
Dblrefno:	327916		
Dblaquelv:	0		
Dblbailerr:	0		
Dblbedrock:	0		
Dblpumprat:	0		
Dblbedro 1:	0		
Dblscreenl:	10		
Dblstatic:	7		
Dbldepth:	30		
Strowner:	SIGECO	Strownerad:	8511 WELLBORN RD., MT VERNON, IN
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	13		
Dblutmy:	4196092		
Dblutmx:	438051		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	4		
Dblcasingl:	20		
Strcasingm:	VPC		
Dblgroutt:	18		
Strgroutm:	BENT		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	4		
Dtmcompdat:	18-MAY-99		
Dblgrndele:	0		
Strpumptyp:	Not Reported	Strownertx:	(812)465-5434
Utmx nad83:	438050.872667		
Utmy nad83:	4196302.16719		
Loc type:	Estimated Location/Geocoding addresses		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=327916&_from=SUMMARY&_action=Details		
Site id:	INDNR3000166084		

B7
ENE
1/4 - 1/2 Mile
Higher

IN WELLS **INDNR3000290940**

Objectid:	290940
Dblrefno:	233561
Dblaquelv:	0
Dblbailerr:	0
Dblbedrock:	18
Dblpumprat:	0
Dblbedro 1:	452
Dblscreenl:	0
Dblstatic:	0
Dbldepth:	78

Strowner:	JEFF SCOTT	Strownerad:	Not Reported
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	13		
Dblutmy:	4195848		
Dblutmx:	438423		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	5.5		
Dblcasingl:	50		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	10-AUG-79		
Dblgrndele:	470		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	438422.880691		
Utmy nad83:	4196058.16228		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233561&_from=SUMMARY&_action=Details		
Site id:	INDNR3000290940		

B8
ENE **IN WELLS** **INLIT2000000147**
1/4 - 1/2 Mile
Higher

Area:	0		
Perimeter:	0		
Lith 2:	147	Lith 2 id:	147
Index :	96565		
Alias :	233561		
Z:	470		
Z dem f:	486		
Z dem m:	148.143199		
Lith depth:	78		
Depth:	78		
Static:	0		
Comp date:	1979-08-10 00:00:00		
Owner addr:	Not Reported		
Owner zip:	0		
Driller na:	Goebel Brothers		
Entered by:	RR		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	78		

Brdepth:	48		
Site id:	INLIT2000000147		
Edr latitude:	37.9099307776073		
Edr longitude:	-87.7004709595389		
Edr x:	-25611384.2478194		
Edr y:	11911299.1388152		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.9099307776073		
Longitude:	-87.7004709595389		
X coord:	-25611384.2478194		
Y coord:	11911299.1388152		

C9
North
1/4 - 1/2 Mile
Lower

IN WELLS **INLIT2000000160**

Area:	0		
Perimeter:	0		
Lith 2:	160	Lith 2 id:	160
Index :	96558		
Alias :	233551		
Z:	0		
Z dem f:	443		
Z dem m:	135.017358		
Lith depth:	48		
Depth:	48		
Static:	0		
Comp date:	1979-10-30 00:00:00		
Owner addr:	20 NW FOUTH ST. EVANSVILLE IN		
Owner zip:	47741		
Driller na:	Goebel Brothers		
Entered by:	RR		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	36		
Brdepth:	36		
Site id:	INLIT2000000160		
Edr latitude:	37.9141770039021		
Edr longitude:	-87.7093051886962		
Edr x:	-25613964.1294894		
Edr y:	11912864.3180111		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.9141770039021		
Longitude:	-87.7093051886962		
X coord:	-25613964.1294894		
Y coord:	11912864.3180111		

C10
North
1/4 - 1/2 Mile
Lower

IN WELLS **INDNR3000291962**

Objectid:	291962		
Dblrefno:	233551		
Dblaquelv:	0		
Dblbailerr:	6		
Dblbedrock:	36		
Dblpumprat:	0		
Dblbedro 1:	445		
Dblscreenl:	0		
Dblstatic:	0		
Dbldepth:	48		
Strowner:	SIGECO	Strownerad:	20 NW FOUTH ST., EVANSVILLE, IN
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	13		
Dblutmy:	4196325		
Dblutmx:	437650		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	4		
Dblcasingl:	50		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	30-OCT-79		
Dblgrndele:	481		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	437649.864447		
Utmy nad83:	4196535.1719		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233551&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291962		

D11
North **IN WELLS** **INLIT2000000176**
1/2 - 1 Mile
Lower

Area:	0		
Perimeter:	0		
Lith 2:	176	Lith 2 id:	176
Index :	96561		
Alias :	233556		
Z:	0		
Z dem f:	438		
Z dem m:	133.505377		
Lith depth:	48		
Depth:	48		

Static:	0		
Comp date:	1979-10-30 00:00:00		
Owner addr:	20 NW FOURTH ST EVANSVILLE IN		
Owner zip:	0		
Driller na:	Goebel Brothers		
Entered by:	CWY		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	0		
Brdepth:	0		
Site id:	INLIT2000000176		
Edr latitude:	37.9155715159231		
Edr longitude:	-87.7097167616912		
Edr x:	-25614084.3221635		
Edr y:	11913378.3616426		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.9155715159231		
Longitude:	-87.7097167616912		
X coord:	-25614084.3221635		
Y coord:	11913378.3616426		

D12
North
1/2 - 1 Mile
Lower

IN WELLS **INDNR3000290938**

Objectid:	290938		
Dblrefno:	233556		
Dblaquelv:	410		
Dblbailerr:	5		
Dblbedrock:	0		
Dblpumprat:	0		
Dblbedro 1:	0		
Dblscreenl:	0		
Dblstatic:	0		
Dbldepth:	48		
Strowner:	SIGECO	Strownerad:	20 NW FOURTH ST, EVANSVILLE, IN
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	13		
Dblutmy:	4196480		
Dblutmx:	437615		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	4		
Dblcasingl:	50		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		

Dtmcompdat:	30-OCT-79		
Dblgrndele:	458		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	437614.862115		
Utmy nad83:	4196690.17521		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233556&_from=SUMMARY&_action=Details		
Site id:	INDNR3000290938		

E13
North
1/2 - 1 Mile
Higher

IN WELLS **INLIT2000000182**

Area:	0		
Perimeter:	0		
Lith 2:	182	Lith 2 id:	182
Index :	96557		
Alias :	233546		
Z:	0		
Z dem f:	472		
Z dem m:	143.852251		
Lith depth:	52		
Depth:	45		
Static:	0		
Comp date:	1979-10-30 00:00:00		
Owner addr:	20 NW FOUTH ST. EVANSVILLE IN.		
Owner zip:	0		
Driller na:	Goebel Brothers		
Entered by:	RR		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	23		
Brdepth:	23		
Site id:	INLIT2000000182		
Edr latitude:	37.9159467338231		
Edr longitude:	-87.707274380796		
Edr x:	-25613371.0676632		
Edr y:	11913516.6757686		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.9159467338231		
Longitude:	-87.707274380796		
X coord:	-25613371.0676632		
Y coord:	11913516.6757686		

E14
North
1/2 - 1 Mile
Higher

IN WELLS **INDNR3000291545**

Objectid:	291545		
Dblrefno:	233546		
Dblaquelv:	0		
Dblbailerr:	1		
Dblbedrock:	23		
Dblpumprat:	0		
Dblbedro 1:	407		
Dblscreenl:	0		
Dblstatic:	0		
Dbldepth:	45		
Strowner:	SIGECO	Strownerad:	20 NW FOUTH ST., EVANSVILLE, IN.
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	13		
Dblutmy:	4196520		
Dblutmx:	437830		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	4		
Dblcasingl:	45		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	30-OCT-79		
Dblgrndele:	430		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	437829.864507		
Utmy nad83:	4196730.1762		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233546&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291545		

F15
West
1/2 - 1 Mile
Lower

IN WELLS **INDNR3000306433**

Objectid:	306433
Dblrefno:	313382
Dblaquelv:	0
Dblbailerr:	0
Dblbedrock:	0
Dblpumprat:	0
Dblbedro 1:	0
Dblscreenl:	0
Dblstatic:	0
Dbldepth:	18

Strowner:	RUDOLPH BOERNER	Strownerad:	Not Reported
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	14		
Dblutmy:	4195650		
Dblutmx:	436525		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	0		
Dblcasingl:	0		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	01-JUL-56		
Dblgrndele:	384		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	436524.857204		
Utmy nad83:	4195860.1564		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=313382&_from=SUMMARY&_action=Details		
Site id:	INDNR3000306433		

F16
West
1/2 - 1 Mile
Lower

IN WELLS **INLIT2000000141**

Area:	0		
Perimeter:	0		
Lith 2:	141	Lith 2 id:	141
Index :	96553		
Alias :	233536		
Z:	404		
Z dem f:	406		
Z dem m:	123.733495		
Lith depth:	120		
Depth:	120		
Static:	43		
Comp date:	1966-03-29 00:00:00		
Owner addr:	RRT. #1 MT. VERNON IN.		
Owner zip:	0		
Driller na:	Weinzapfel - Paul - Well Drilling		
Entered by:	RR		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	67		

Brdepth:	67		
Site id:	INLIT2000000141		
Edr latitude:	37.9082675085674		
Edr longitude:	-87.7221596357258		
Edr x:	-25617718.0452731		
Edr y:	11910686.0747691		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.9082675085674		
Longitude:	-87.7221596357258		
X coord:	-25617718.0452731		
Y coord:	11910686.0747691		

F17
West
1/2 - 1 Mile
Lower

IN WELLS **INDNR3000291307**

Objectid:	291307		
Dblrefno:	233536		
Dblaquelv:	0		
Dblbailerr:	2		
Dblbedrock:	25		
Dblpumprat:	0		
Dblbedro 1:	379		
Dblscreenl:	0		
Dblstatic:	43		
Dbldepth:	120		
Strowner:	JERRY BOERNER	Strownerad:	RRT. #1, MT. VERNON, IN.
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	14		
Dblutmy:	4195678		
Dblutmx:	436515		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	1		
Dblcasingd:	6.25		
Dblcasingl:	67		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	29-MAR-66		
Dblgrndele:	404		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	436514.856741		
Utmy nad83:	4195888.157		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233536&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291307		

Map ID Direction Distance Elevation	Database	EDR ID Number
G18 **West** **1/2 - 1 Mile** **Lower**	**IN WELLS**	**INLIT2000000131**

Area:	0		
Perimeter:	0		
Lith 2:	131	Lith 2 id:	131
Index :	96548		
Alias :	233526		
Z:	380		
Z dem f:	398		
Z dem m:	121.279525		
Lith depth:	95		
Depth:	95		
Static:	0		
Comp date:	1941-02-06 00:00:00		
Owner addr:	WEST FRANKLIN		
Owner zip:	0		
Driller na:	Dunvillle Inc.		
Entered by:	KRL		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	62		
Brdepth:	62		
Site id:	INLIT2000000131		
Edr latitude:	37.905607336997		
Edr longitude:	-87.7223838875196		
Edr x:	-25617783.534076		
Edr y:	11909705.5916402		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.905607336997		
Longitude:	-87.7223838875196		
X coord:	-25617783.534076		
Y coord:	11909705.5916402		

G19 **West** **1/2 - 1 Mile** **Lower**	**IN WELLS**	**INDNR3000291707**

Objectid:	291707
Dblrefno:	233526
Dblaquelv:	0
Dblbailerr:	0
Dblbedrock:	62
Dblpumprat:	0
Dblbedro 1:	318
Dblscreenl:	0
Dblstatic:	0
Dbldepth:	95

Strowner:	MRS. ANNA(RUDOLPH) BEERNER	Strownerad:	WEST FRANKLIN
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	14		
Dblutmy:	4195383		
Dblutmx:	436493		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	0		
Dblcasingl:	0		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	06-FEB-41		
Dblgrndele:	380		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	436492.859878		
Utmy nad83:	4195593.15054		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233526&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291707		

H20
NW **IN WELLS** **INLIT2000000188**
1/2 - 1 Mile
Lower

Area:	0		
Perimeter:	0		
Lith 2:	188	Lith 2 id:	188
Index :	96567		
Alias :	233566		
Z:	420		
Z dem f:	440		
Z dem m:	134.128369		
Lith depth:	120		
Depth:	120		
Static:	0		
Comp date:	1971-03-01 00:00:00		
Owner addr:	RRT. 2 MT. VERNON IN.		
Owner zip:	0		
Driller na:	Little - D.L. Drilling		
Entered by:	RR		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	42		

Brdepth:	15		
Site id:	INLIT2000000188		
Edr latitude:	37.9171702582587		
Edr longitude:	-87.7180599892739		
Edr x:	-25616520.815436		
Edr y:	11913967.7005399		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.9171702582587		
Longitude:	-87.7180599892739		
X coord:	-25616520.815436		
Y coord:	11913967.7005399		

H21
NW **IN WELLS** **INDNR3000291759**
1/2 - 1 Mile
Lower

Objectid:	291759		
Dblrefno:	233566		
Dblaquelv:	0		
Dblbailerr:	2		
Dblbedrock:	15		
Dblpumprat:	0		
Dblbedro 1:	405		
Dblscreenl:	0		
Dblstatic:	0		
Dbldepth:	120		
Strowner:	RICHARD FOLZ	Strownerad:	RRT. 2, MT. VERNON, IN.
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	13		
Dblutmy:	4196663		
Dblutmx:	436883		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	120		
Dblbailerh:	1		
Dblcasingd:	5.5		
Dblcasingl:	48		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	01-MAR-71		
Dblgrndele:	420		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	436882.850166		
Utmy nad83:	4196873.17871		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233566&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291759		

Map ID Direction Distance Elevation	Database	EDR ID Number
I22 **South** **1/2 - 1 Mile** **Lower**	**IN WELLS**	**INDNR3000291965**

Objectid:	291965		
Dblrefno:	233557		
Dblaquelv:	0		
Dblbailerr:	.75		
Dblbedrock:	15		
Dblpumprat:	0		
Dblbedro 1:	355		
Dblscreenl:	0		
Dblstatic:	18		
Dbldepth:	80		
Strowner:	CHARLES MCDONALD	Strownerad:	5200 FULLERTON, CHICAGO, IL
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	24		
Dblutmy:	4194258		
Dblutmx:	437491		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	6.25		
Dblcasingl:	30		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	01-MAR-73		
Dblgrndele:	370		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	437490.887087		
Utmy nad83:	4194468.12725		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233557&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291965		

I23 **South** **1/2 - 1 Mile** **Lower**	**IN WELLS**	**INLIT2000000109**

Area:	0		
Perimeter:	0		
Lith 2:	109	Lith 2 id:	109
Index :	96562		
Alias :	233557		
Z:	370		
Z dem f:	396		
Z dem m:	120.739532		
Lith depth:	80		
Depth:	80		

Static:	18		
Comp date:	1973-03-01 00:00:00		
Owner addr:	5200 FULLERTON CHICAGO IL		
Owner zip:	60639		
Driller na:	Richardville Well Drilling		
Entered by:	RR		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	30		
Brdepth:	15		
Site id:	INLIT2000000109		
Edr latitude:	37.8955375603513		
Edr longitude:	-87.7109346789822		
Edr x:	-25614439.9935456		
Edr y:	11905994.4080507		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.8955375603513		
Longitude:	-87.7109346789822		
X coord:	-25614439.9935456		
Y coord:	11905994.4080507		

J24
SW **IN WELLS** **INDNR3000291976**
1/2 - 1 Mile
Lower

Objectid:	291976		
Dblrefno:	233567		
Dblaquelv:	0		
Dblbailerr:	.5		
Dblbedrock:	50		
Dblpumprat:	0		
Dblbedro 1:	335		
Dblscreenl:	0		
Dblstatic:	48		
Dbldepth:	180		
Strowner:	J. BOERER	Strownerad:	Not Reported
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	24		
Dblutmy:	4194488		
Dblutmx:	436822		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	VANDERBURGH	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	132		
Dblbailerh:	0		
Dblcasingd:	6.25		
Dblcasingl:	44		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		

Dtmcompdat:	14-OCT-53		
Dblgrndele:	385		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	436821.874931		
Utmy nad83:	4194698.13139		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233567&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291976		

J25
SW **IN WELLS** **INLIT2000000115**
1/2 - 1 Mile
Lower

Area:	0		
Perimeter:	0		
Lith 2:	115	Lith 2 id:	115
Index :	96568		
Alias :	233567		
Z:	385		
Z dem f:	399		
Z dem m:	121.72352		
Lith depth:	180		
Depth:	180		
Static:	48		
Comp date:	1953-10-14 00:00:00		
Owner addr:	Not Reported		
Owner zip:	0		
Driller na:	Richardville - Edmond		
Entered by:	KRL		
Record sou:	IDNR		
Entry date:	Not Reported		
Project id:	Not Reported		
Location b:	85		
Brdepth:	50		
Site id:	INLIT2000000115		
Edr latitude:	37.8975642008719		
Edr longitude:	-87.7185632751526		
Edr x:	-25616667.791249		
Edr y:	11906741.2787029		
Edr ll src:	GOV	Edr tblname:	IN_WELLS_LITH_201209
Edr src:	SW		
Latitude:	37.8975642008719		
Longitude:	-87.7185632751526		
X coord:	-25616667.791249		
Y coord:	11906741.2787029		

J26
SW **IN WELLS** **INDNR3000290743**
1/2 - 1 Mile
Lower

Objectid:	290743		
Dblrefno:	233572		
Dblaquelv:	0		
Dblbailerr:	0		
Dblbedrock:	0		
Dblpumprat:	0		
Dblbedro 1:	0		
Dblscreenl:	2		
Dblstatic:	17		
Dbldepth:	36		
Strowner:	J. BOERNER	Strownerad:	WEST FRANKLIN
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	24		
Dblutmy:	4194445		
Dblutmx:	436828		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	2		
Dblcasingl:	0		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	0		
Dblpumphou:	0		
Dblscreend:	0		
Dtmcompdat:	02-JUL-56		
Dblgrndele:	365		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	436827.875521		
Utmy nad83:	4194655.13046		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233572&_from=SUMMARY&_action=Details		
Site id:	INDNR3000290743		

27
West
1/2 - 1 Mile
Lower

IN WELLS **INDNR3000291314**

Objectid:	291314
Dblrefno:	233531
Dblaquelv:	337
Dblbailerr:	0
Dblbedrock:	0
Dblpumprat:	7
Dblbedro 1:	0
Dblscreenl:	8
Dblstatic:	28
Dbldepth:	40

Strowner:	BOB BOERNER	Strownerad:	DARNELL SCHOOL RD.
Strrng1:	12W	Strtwn1:	7S
Dblsec1:	14		
Dblutmy:	4195380		
Dblutmx:	436202		
Intreserve:	0	Strreserve:	Not Reported
Strcounty:	POSEY	Strtopo:	WEST FRANKLIN, IN-KY
Dblbailerd:	0		
Dblbailerh:	0		
Dblcasingd:	6.63		
Dblcasingl:	36		
Strcasingm:	Not Reported		
Dblgroutt:	0		
Strgroutm:	Not Reported		
Dbllinerdi:	0		
Dbllinerto:	0		
Dblpumpset:	0		
Dblpumpdw:	5		
Dblpumphou:	1		
Dblscreend:	4		
Dtmcompdat:	15-MAR-79		
Dblgrndele:	377		
Strpumptyp:	Not Reported	Strownertx:	Not Reported
Utmx nad83:	436201.855911		
Utmy nad83:	4195590.1502		
Loc type:	Actual Location		
Report:	https://secure.in.gov/apps/dnr/water/dnr_waterwell?refNo=233531&_from=SUMMARY&_action=Details		
Site id:	INDNR3000291314		

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS
RADON

AREA RADON INFORMATION

State Database: IN Radon

Radon Test Results

Zipcode	Year	Test Type	Location	Result
47712	1994	Post-Mitigation	Other	3.4
47712	0	Unknown	Other	2.8
47712	0	Unknown	Other	2.8
47712	1999	Long Term	1st Floor	4.0
47712	1996	Short Term	Other	5.1
47712	1996	Short Term	Other	12.8
47712	1994	Short Term	Other	1.4
47712	2000	Short Term	Other	2.2
47712	2000	Short Term	Other	1.6
47712	2000	Short Term	Other	2.2
47712	2000	Short Term	Other	0.9
47712	2000	Short Term	Other	0.9
47712	2000	Short Term	Other	0.6
47712	2000	Short Term	Other	3.7
47712	1995	Short Term	Other	3.5
47712	1995	Short Term	Other	1.1
47712	1995	Short Term	Other	1.1
47712	1995	Short Term	Other	1.9
47712	1995	Short Term	Other	2.0
47712	1997	Short Term	1st Floor	0.4
47712	2000	Short Term	Basement	0.5
47712	1997	Short Term	Other	9.1
47712	2004	Short Term	Basement	5.3
47712	2004	Post-Mitigation	Basement	3.6
47712	2004	Short Term	Basement	4.3
47712	2004	Short Term	Basement	2.2
47712	2004	Short Term	Other	3.4
47712	2004	Short Term	Basement	4.5
47712	2004	Short Term	Basement	1.6
47712	2004	Short Term	Basement	6.4
47712	2004	Short Term	Basement	3.8
47712	2004	Short Term	Other	1.5
47712	2004	Short Term	Basement	3.9
47712	2004	Short Term	Other	0.7
47712	2004	Short Term	Other	0.7
47712	2001	Short Term	Basement	6.5
47712	2001	Short Term	Basement	4.8
47712	2001	Short Term	1st Floor	2.9
47712	2001	Short Term	1st Floor	9.2
47712	2001	Short Term	Basement	4.6
47712	2001	Short Term	1st Floor	6.6
47712	2000	Short Term	0	0.5
47712	2001	Long Term	1st Floor	1.7
47712	2002	Short Term	1st Floor	0.8
47712	2002	Short Term	1st Floor	1.2
47712	2002	Short Term	1st Floor	3.0
47712				

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS
RADON

AREA RADON INFORMATION

	2002	Short Term	1st Floor	2.4
47712	2002	Short Term	1st Floor	2.9
47712	2002	Short Term	1st Floor	2.9
47712	2002	Short Term	1st Floor	0.9
47712	2002	Short Term	1st Floor	7.3
47712	1996	Short Term	Other	5.2
47712	2000	Short Term	Other	2.8
47712	2000	Short Term	Other	3.7
47712	1999	Short Term	Other	3.9
47712	2004	Short Term	Basement	0.9
47712	2004	Short Term	Basement	4.8
47712	2004	Short Term	Other	1.5
47712	2000	Short Term	Basement	0.5
47712	2002	Short Term	1st Floor	1.0

Federal EPA Radon Zone for POSEY County: 2

Note: Zone 1 indoor average level > 4 pCi/L.
: Zone 2 indoor average level >= 2 pCi/L and <= 4 pCi/L.
: Zone 3 indoor average level < 2 pCi/L.

Federal Area Radon Information for Zip Code: 47712

Number of sites tested: 5

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	3.375 pCi/L	75%	25%	0%
Living Area - 2nd Floor	Not Reported	Not Reported	Not Reported	Not Reported
Basement	3.320 pCi/L	80%	20%	0%

PHYSICAL SETTING SOURCE RECORDS SEARCHED

TOPOGRAPHIC INFORMATION

USGS 7.5' Digital Elevation Model (DEM)
Source: United States Geologic Survey
EDR acquired the USGS 7.5' Digital Elevation Model in 2002 and updated it in 2006. The 7.5 minute DEM corresponds to the USGS 1:24,000- and 1:25,000-scale topographic quadrangle maps. The DEM provides elevation data with consistent elevation units and projection.

Current USGS 7.5 Minute Topographic Map
Source: U.S. Geological Survey

HYDROLOGIC INFORMATION

Flood Zone Data: This data was obtained from the Federal Emergency Management Agency (FEMA). It depicts 100-year and 500-year flood zones as defined by FEMA. It includes the National Flood Hazard Layer (NFHL) which incorporates Flood Insurance Rate Map (FIRM) data and Q3 data from FEMA in areas not covered by NFHL.
Source: FEMA
Telephone: 877-336-2627
Date of Government Version: 2003, 2015

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002, 2005 and 2010 from the U.S. Fish and Wildlife Service.

State Wetlands Data: Wetland Inventory
Source: US Fish & Wildlife Service
Telephone: 703-358-2171

HYDROGEOLOGIC INFORMATION

AQUIFLOW[R] Information System
Source: EDR proprietary database of groundwater flow information
EDR has developed the AQUIFLOW Information System (AIS) to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted to regulatory authorities at select sites and has extracted the date of the report, hydrogeologically determined groundwater flow direction and depth to water table information.

GEOLOGIC INFORMATION

Geologic Age and Rock Stratigraphic Unit
Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - A digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

STATSGO: State Soil Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Service (NRCS)
The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) leads the national Conservation Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps.

SSURGO: Soil Survey Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Service (NRCS)
Telephone: 800-672-5559
SSURGO is the most detailed level of mapping done by the Natural Resources Conservation Service, mapping scales generally range from 1:12,000 to 1:63,360. Field mapping methods using national standards are used to construct the soil maps in the Soil Survey Geographic (SSURGO) database. SSURGO digitizing duplicates the original soil survey maps. This level of mapping is designed for use by landowners, townships and county natural resource planning and management.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

LOCAL / REGIONAL WATER AGENCY RECORDS

FEDERAL WATER WELLS

PWS: Public Water Systems
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SDWIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

USGS Water Wells: USGS National Water Inventory System (NWIS)
This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on wells, springs, and other sources of groundwater.

STATE RECORDS

Public Water Supply Wells
Source: Department of Environmental Management
Telephone: 317-308-3323
Community and non-community drinking water wells.

Water Wells Database
Source: Indiana Geological Survey
Telephone: 812-855-7636
Shows data points that represent water wells contained in the Lithologic database, which is derived from the water well database of the Indiana Department of Natural Resources

OTHER STATE DATABASE INFORMATION

RADON

State Database: IN Radon
Source: Department of Health
Telephone: 317-233-7148
Radon Test Results

Area Radon Information
Source: USGS
Telephone: 703-356-4020
The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

EPA Radon Zones
Source: EPA
Telephone: 703-356-4020
Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

OTHER

Airport Landing Facilities: Private and public use landing facilities
Source: Federal Aviation Administration, 800-457-6656

Epicenters: World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

Earthquake Fault Lines: The fault lines displayed on EDR's Topographic map are digitized quaternary faultlines, prepared in 1975 by the United State Geological Survey

PHYSICAL SETTING SOURCE RECORDS SEARCHED

STREET AND ADDRESS INFORMATION

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A.B.Brown Generating Station

8511 Welborn Rd

Evansville, IN 47712

Inquiry Number: 5203791.3

February 28, 2018

Certified Sanborn® Map Report

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Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

Certified Sanborn® Map Report

02/28/18

Site Name:	Client Name:
A.B.Brown Generating Station	Haley & Aldrich, Inc.
8511 Welborn Rd	465 Medford Street
Evansville, IN 47712	Boston, MA 02129
EDR Inquiry # 5203791.3	Contact: Julia Scott

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The Sanborn Library is continually enhanced with newly identified map archives. This report accesses all maps in the collection as of the day this report was generated.

Certified Sanborn Results:

Certification # D212-494E-A6CC

PO # 129420

Project A.B.Brown

UNMAPPED PROPERTY

This report certifies that the complete holdings of the Sanborn Library, LLC collection have been searched based on client supplied target property information, and fire insurance maps covering the target property were not found.

Sanborn® Library search results

Certification #: D212-494E-A6CC

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- ✔ Library of Congress
- ✔ University Publications of America
- ✔ EDR Private Collection

The Sanborn Library LLC Since 1866™

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A.B.Brown Generating Station

8511 Welborn Rd

Evansville, IN 47712

Inquiry Number: 5203791.4

February 28, 2018

EDR Historical Topo Map Report

with QuadMatch™

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

EDR Historical Topo Map Report

02/28/18

Site Name:	Client Name:
A.B.Brown Generating Station	Haley & Aldrich, Inc.
8511 Welborn Rd	465 Medford Street
Evansville, IN 47712	Boston, MA 02129
EDR Inquiry # 5203791.4	Contact: Julia Scott

EDR Topographic Map Library has been searched by EDR and maps covering the target property location as provided by Haley & Aldrich, Inc. were identified for the years listed below. EDR's Historical Topo Map Report is designed to assist professionals in evaluating potential liability on a target property resulting from past activities. EDRs Historical Topo Map Report includes a search of a collection of public and private color historical topographic maps, dating back to the late 1800s.

Search Results:		*Coordinates:*	
P.O.#	129420	**Latitude:**	37.907776 37° 54' 28" North
Project:	A.B.Brown	**Longitude:**	-87.707951 -87° 42' 29" West
		UTM Zone:	Zone 16 North
		UTM X Meters:	437765.64
		UTM Y Meters:	4195818.89
		Elevation:	453.00' above sea level

Maps Provided:

2013
1981
1957
1916
1914

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Topo Sheet Key

This EDR Topo Map Report is based upon the following USGS topographic map sheets.

2013 Source Sheets

West Franklin
2013
7.5-minute, 24000

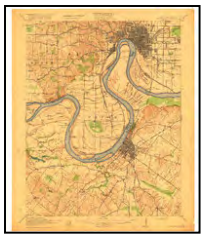
1981 Source Sheets

West Franklin
1981
7.5-minute, 24000
Aerial Photo Revised 1974

1957 Source Sheets

West Franklin
1957
7.5-minute, 24000
Aerial Photo Revised 1956

1916 Source Sheets

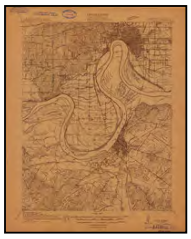


Henderson
1916
15-minute, 62500

Topo Sheet Key

This EDR Topo Map Report is based upon the following USGS topographic map sheets.

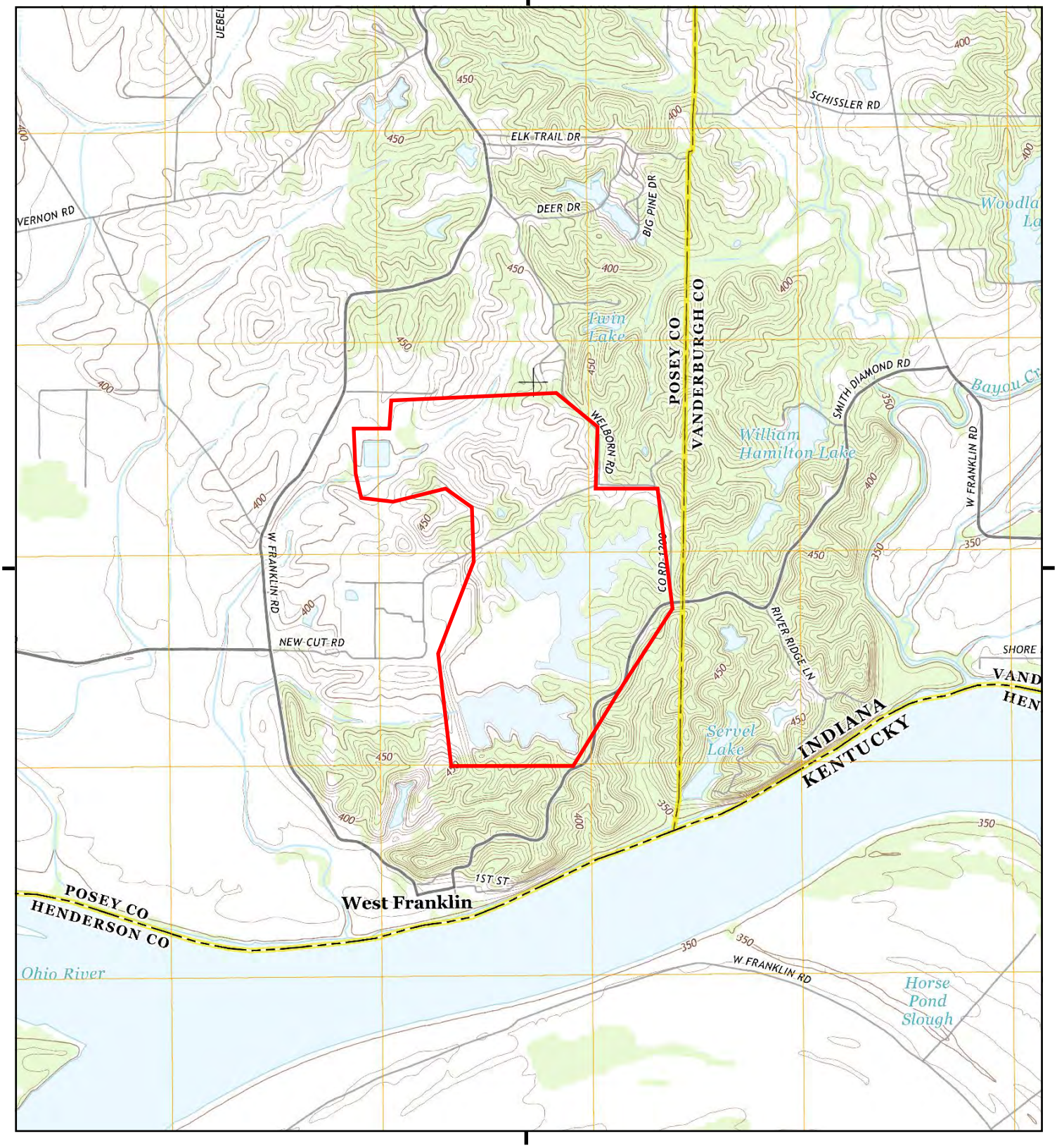
1914 Source Sheets



Henderson
1914
15-minute, 48000

Historical Topo Map

2013



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

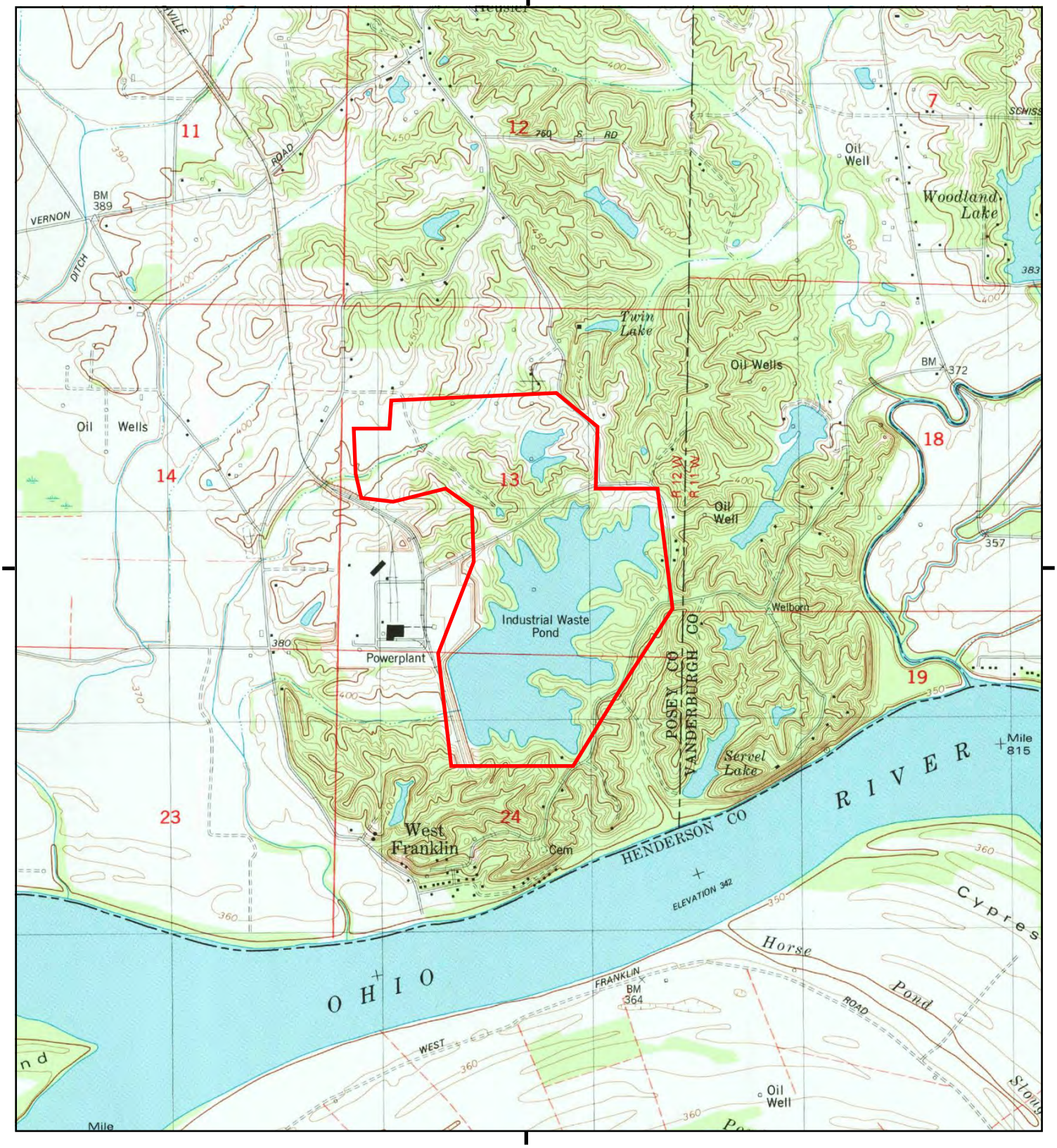
TP, West Franklin, 2013, 7.5-minute

SITE NAME: A.B.Brown Generating Station
ADDRESS: 8511 Welborn Rd
Evansville, IN 47712
CLIENT: Haley & Aldrich, Inc.

N

Historical Topo Map

1981



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

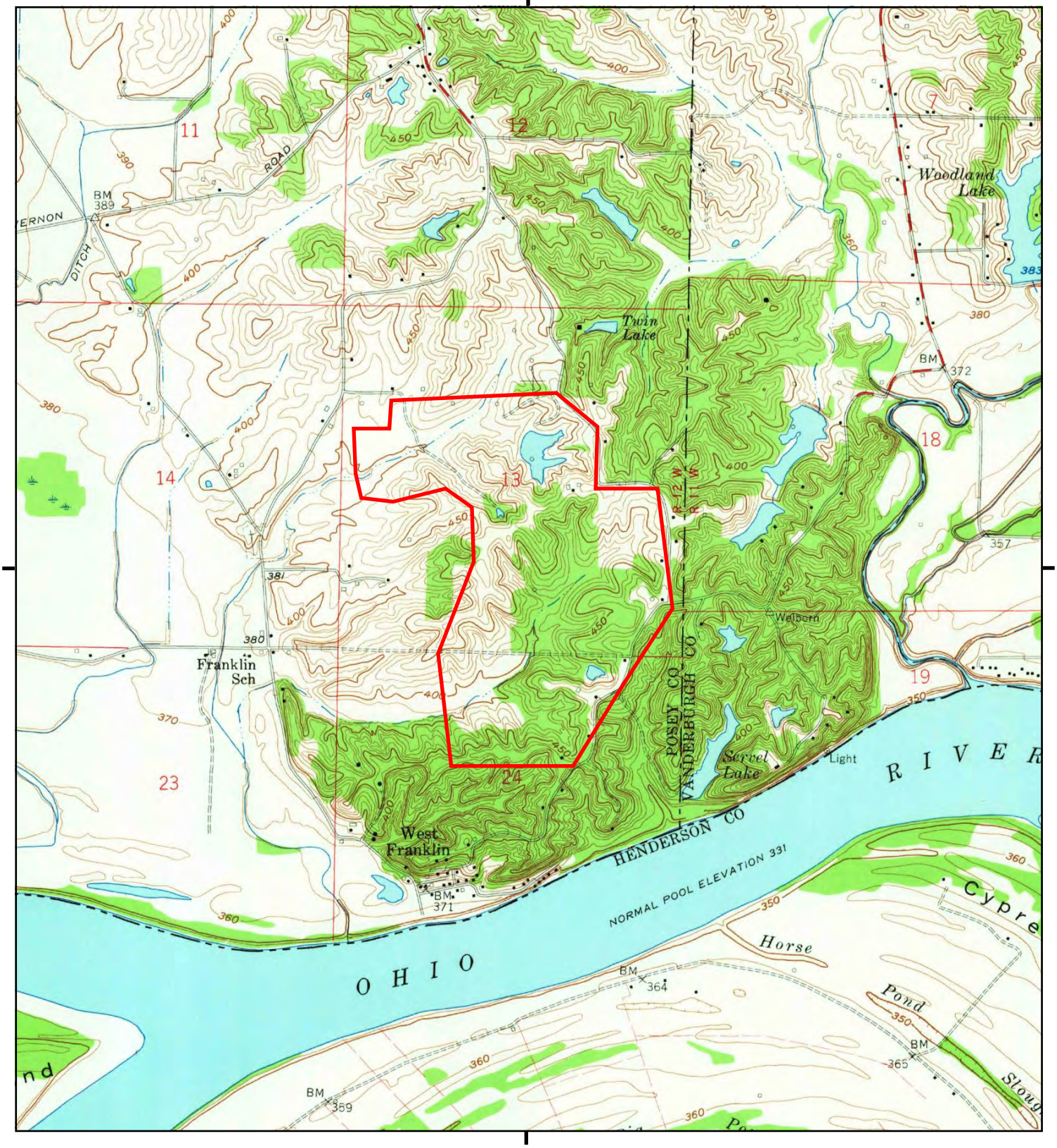
TP, West Franklin, 1981, 7.5-minute

SITE NAME: A.B.Brown Generating Station
ADDRESS: 8511 Welborn Rd
Evansville, IN 47712
CLIENT: Haley & Aldrich, Inc.

N

Historical Topo Map

1957



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

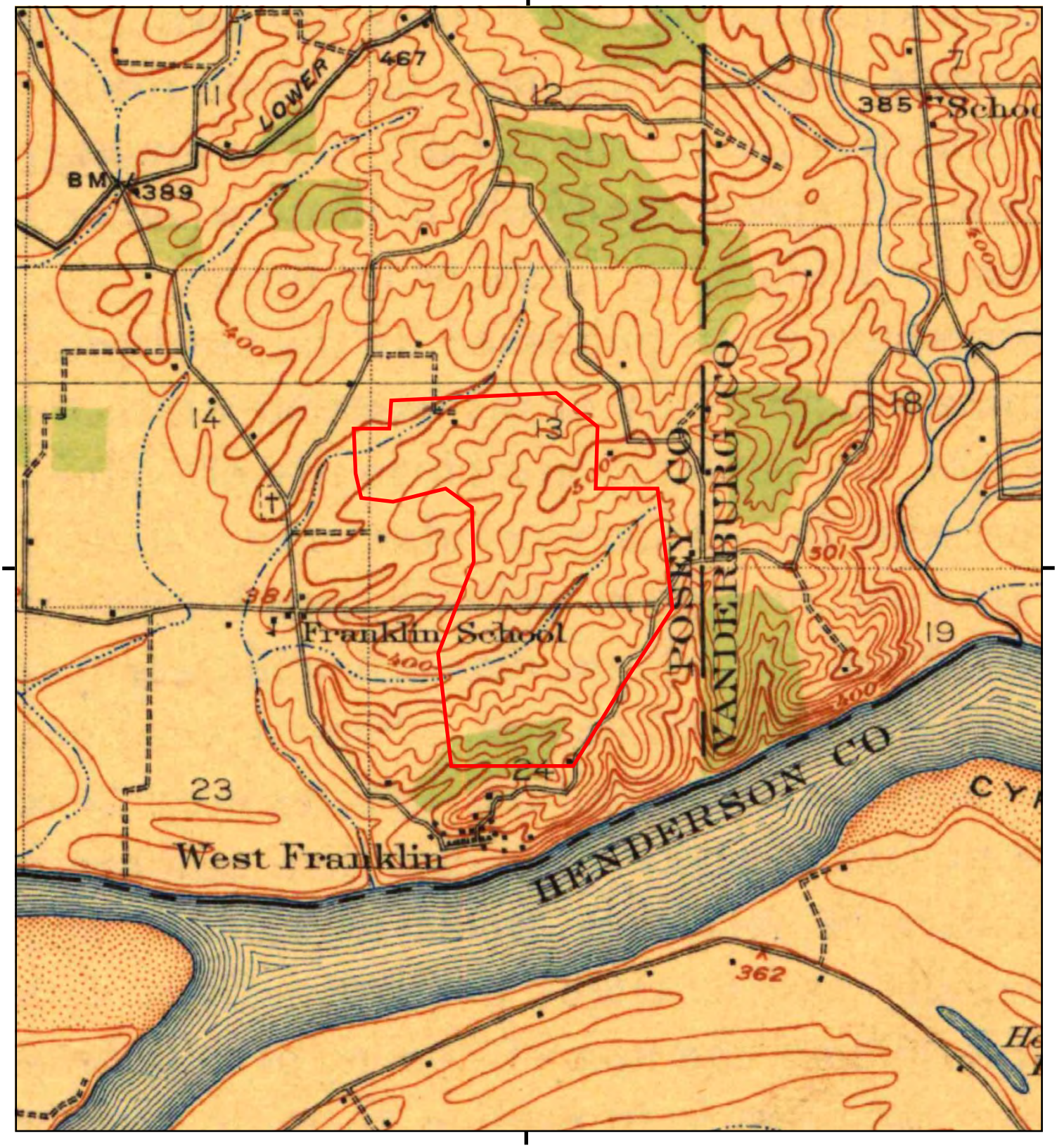
TP, West Franklin, 1957, 7.5-minute

SITE NAME: A.B.Brown Generating Station
ADDRESS: 8511 Welborn Rd
Evansville, IN 47712
CLIENT: Haley & Aldrich, Inc.

N

Historical Topo Map

1916



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

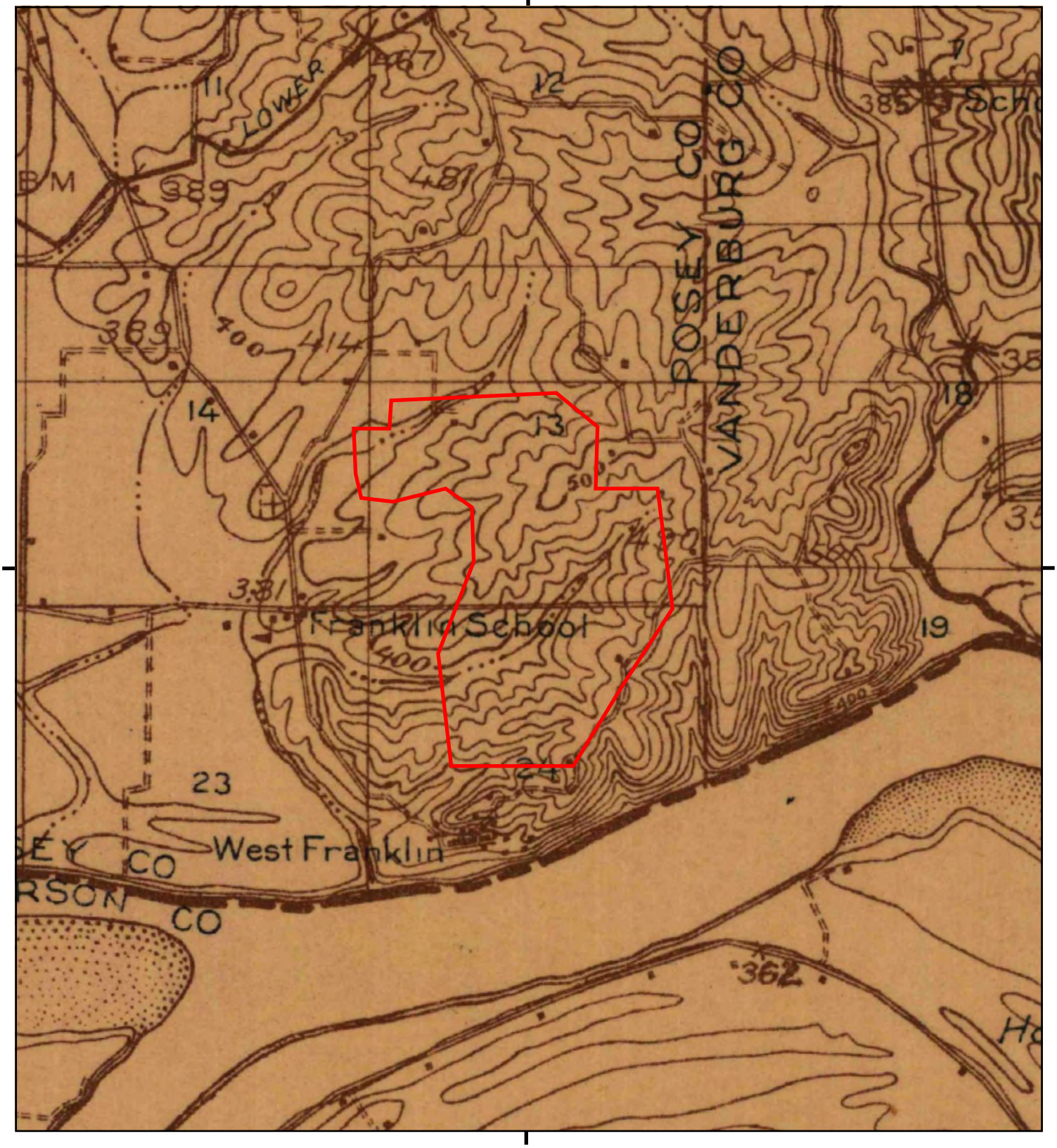
TP, Henderson, 1916, 15-minute

SITE NAME: A.B.Brown Generating Station
ADDRESS: 8511 Welborn Rd
Evansville, IN 47712
CLIENT: Haley & Aldrich, Inc.

N

Historical Topo Map

1914



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

TP, Henderson, 1914, 15-minute

SITE NAME: A.B.Brown Generating Station
ADDRESS: 8511 Welborn Rd
Evansville, IN 47712
CLIENT: Haley & Aldrich, Inc.

N

A.B.Brown Generating Station

8511 Welborn Rd

Evansville, IN 47712

Inquiry Number: 5203791.9

March 01, 2018

The EDR Aerial Photo Decade Package

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Toll Free: 800.352.0050
www.edrnet.com

EDR Aerial Photo Decade Package

03/01/18

Site Name:

A.B.Brown Generating Station
8511 Welborn Rd
Evansville, IN 47712
EDR Inquiry # 5203791.9

Client Name:

Haley & Aldrich, Inc.
465 Medford Street
Boston, MA 02129
Contact: Julia Scott

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Search Results:

Year	***Scale***	***Details***	***Source***
2014	1"=875'	Flight Year: 2014	USDA/NAIP
2010	1"=875'	Flight Year: 2010	USDA/NAIP
2007	1"=875'	Flight Year: 2007	USDA/NAIP
1998	1"=875'	Acquisition Date: April 06, 1998	USGS/DOQQ
1993	1"=875'	Flight Date: April 17, 1993	USGS
1983	1"=875'	Flight Date: March 14, 1983	USGS
1973	1"=875'	Flight Date: March 01, 1973	USGS
1956	1"=875'	Flight Date: April 05, 1956	USGS
1950	1"=875'	Flight Date: April 16, 1950	USGS

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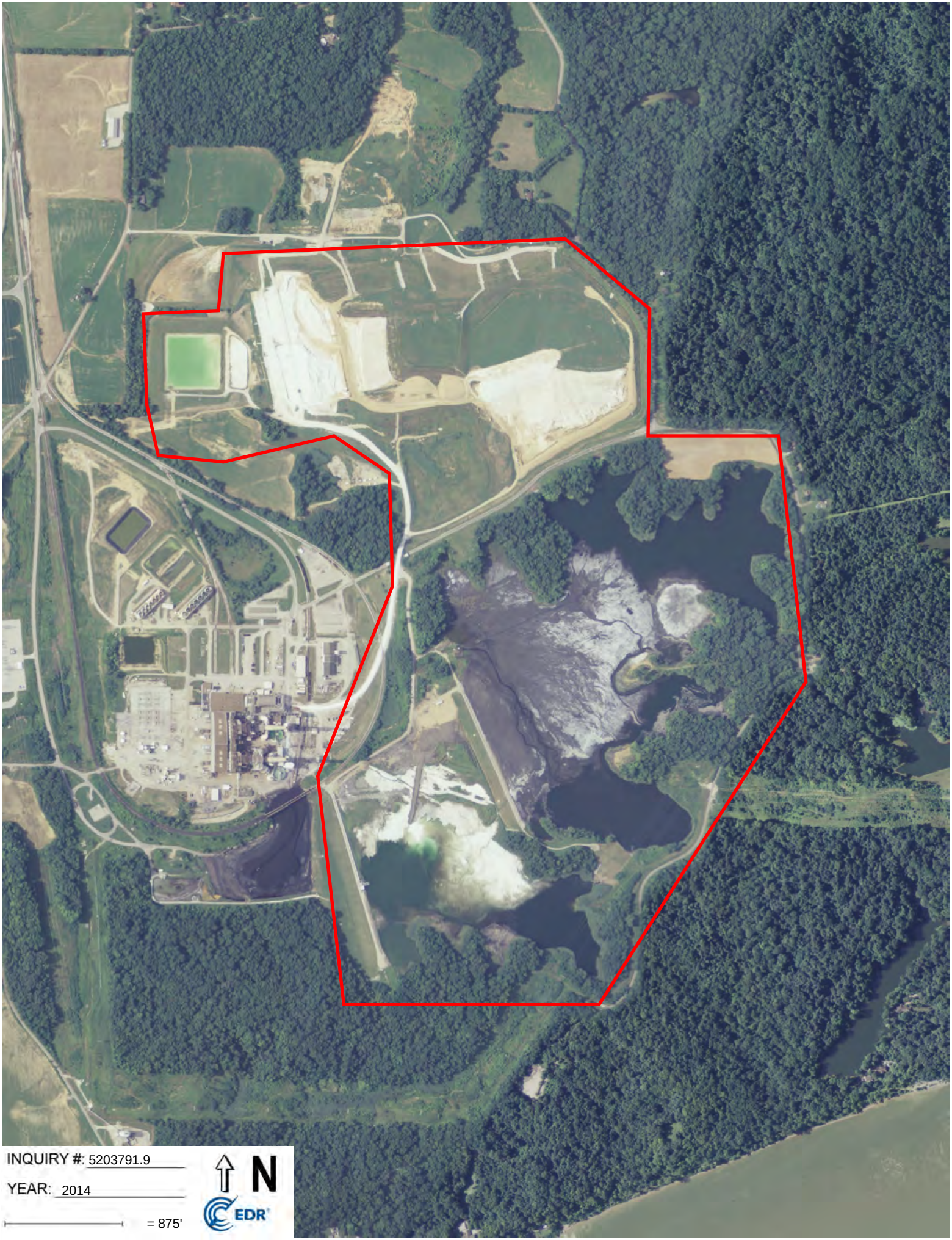
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EDR

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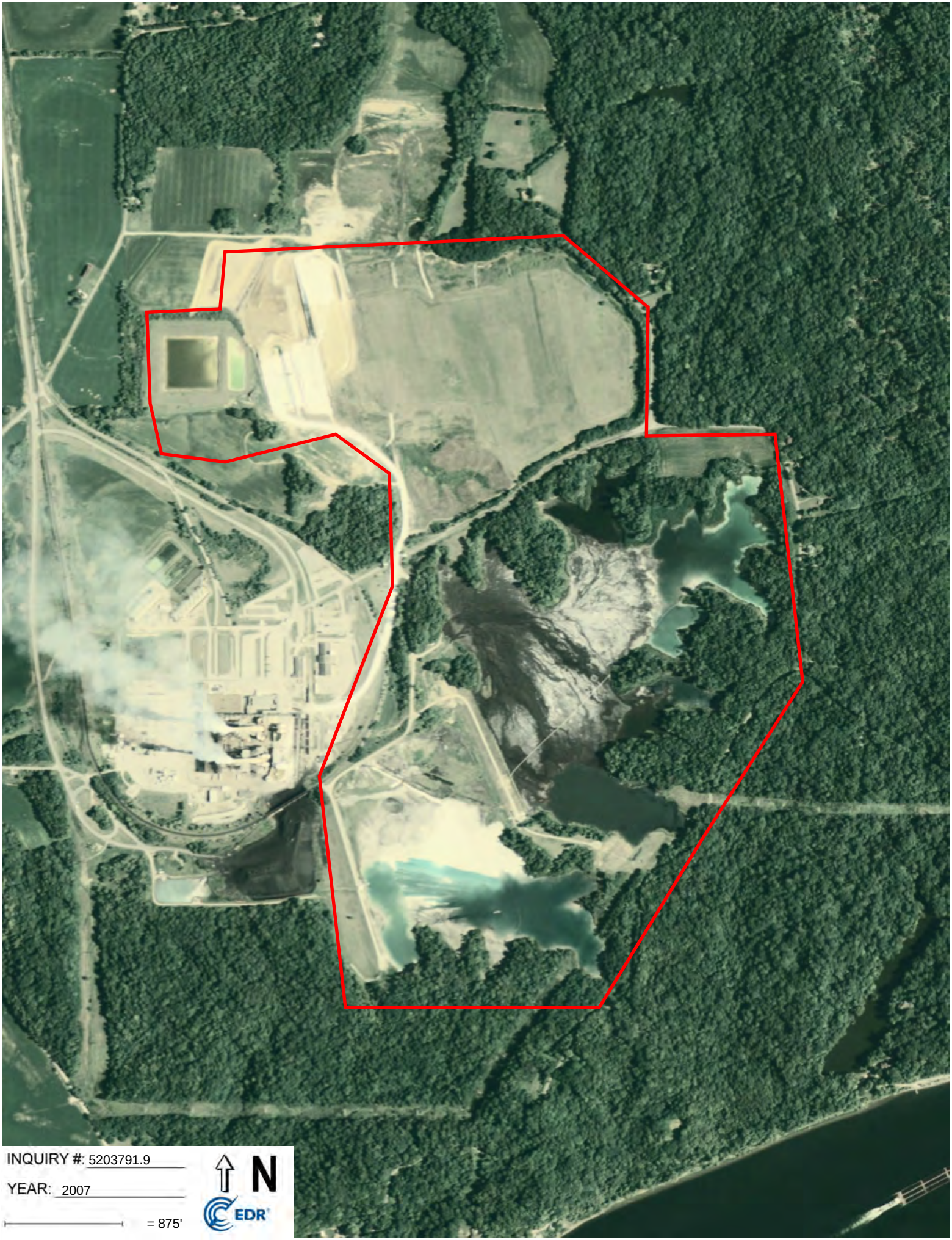
YEAR: 2010
= 875'
N
EDR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YEAR: 1993
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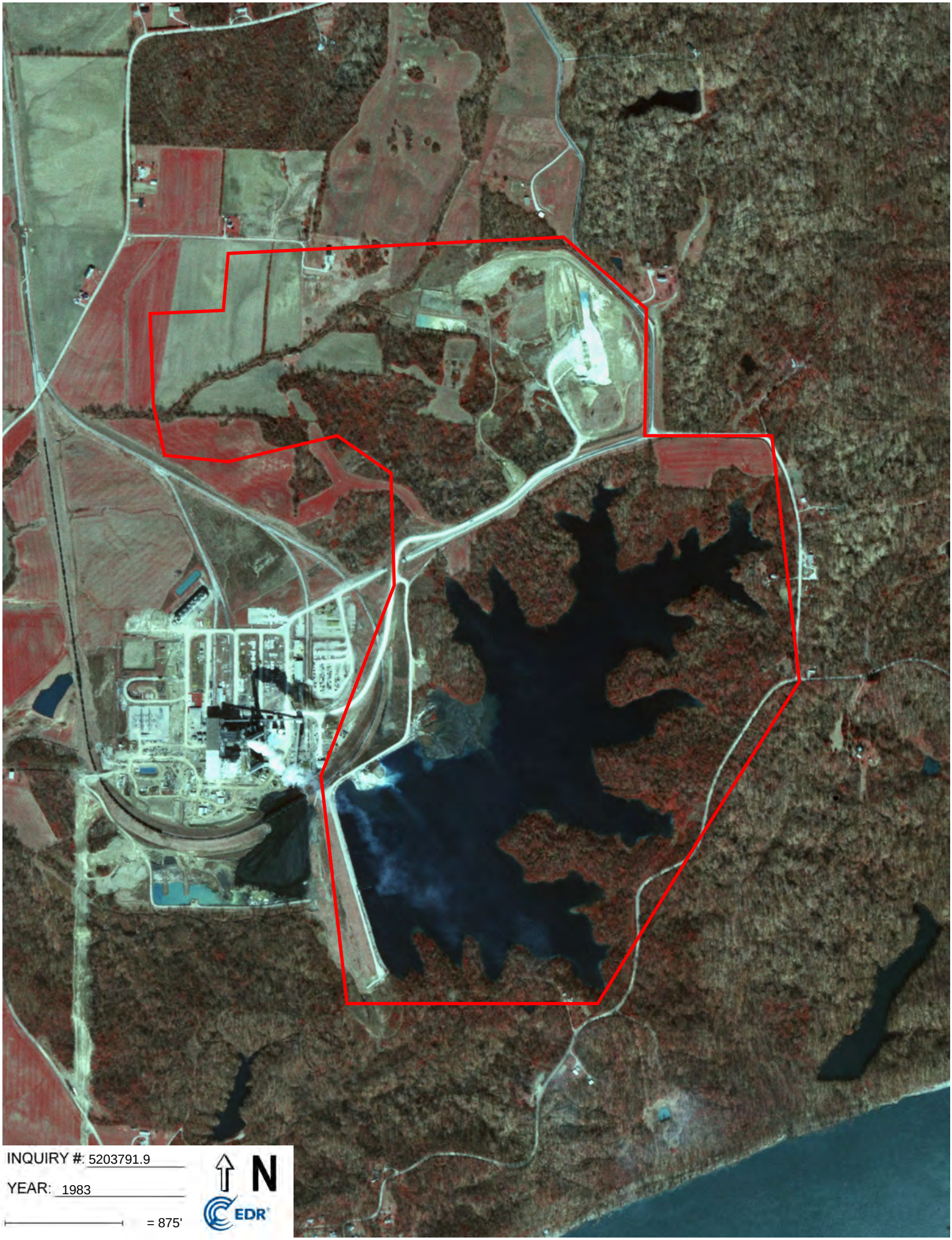
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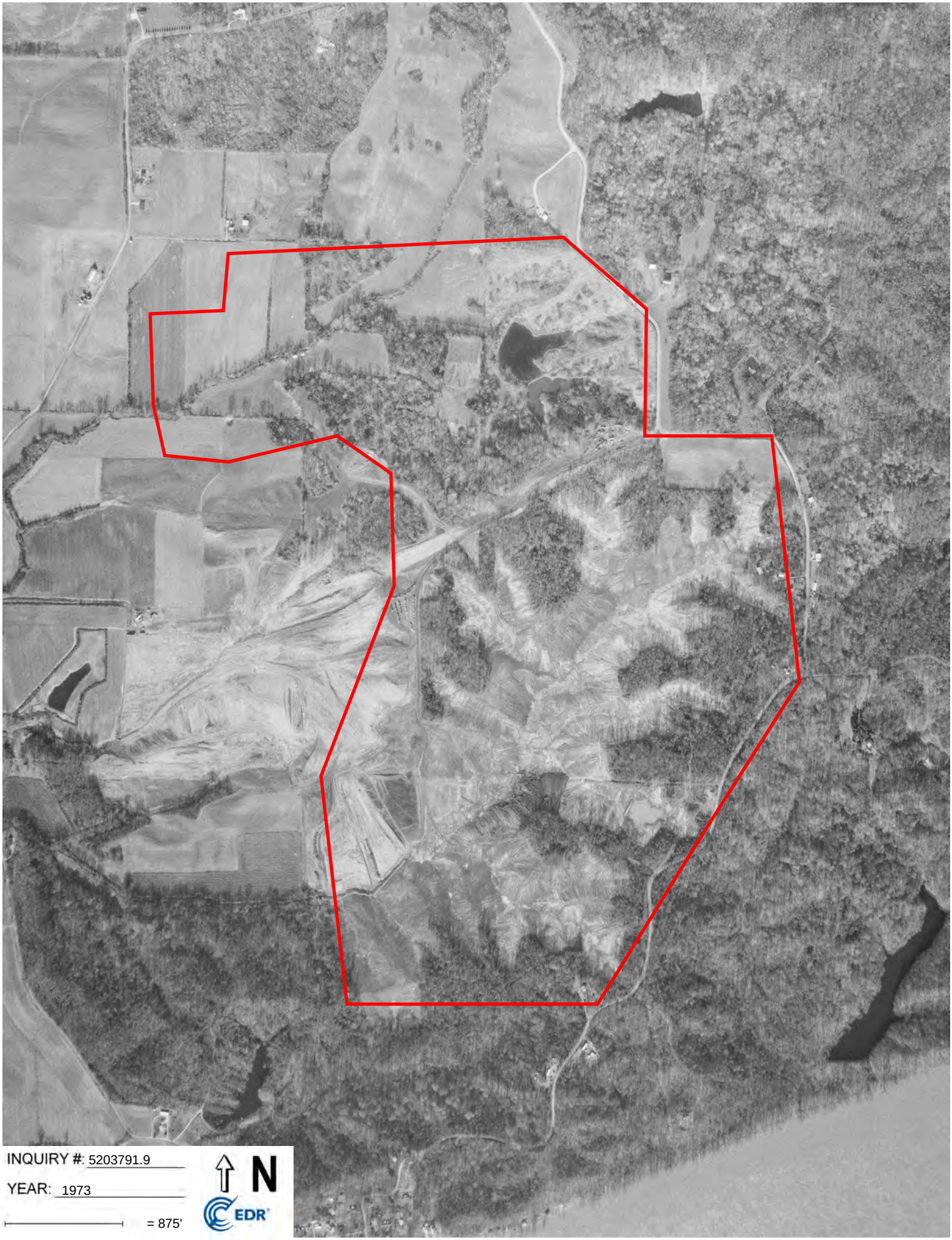
EDR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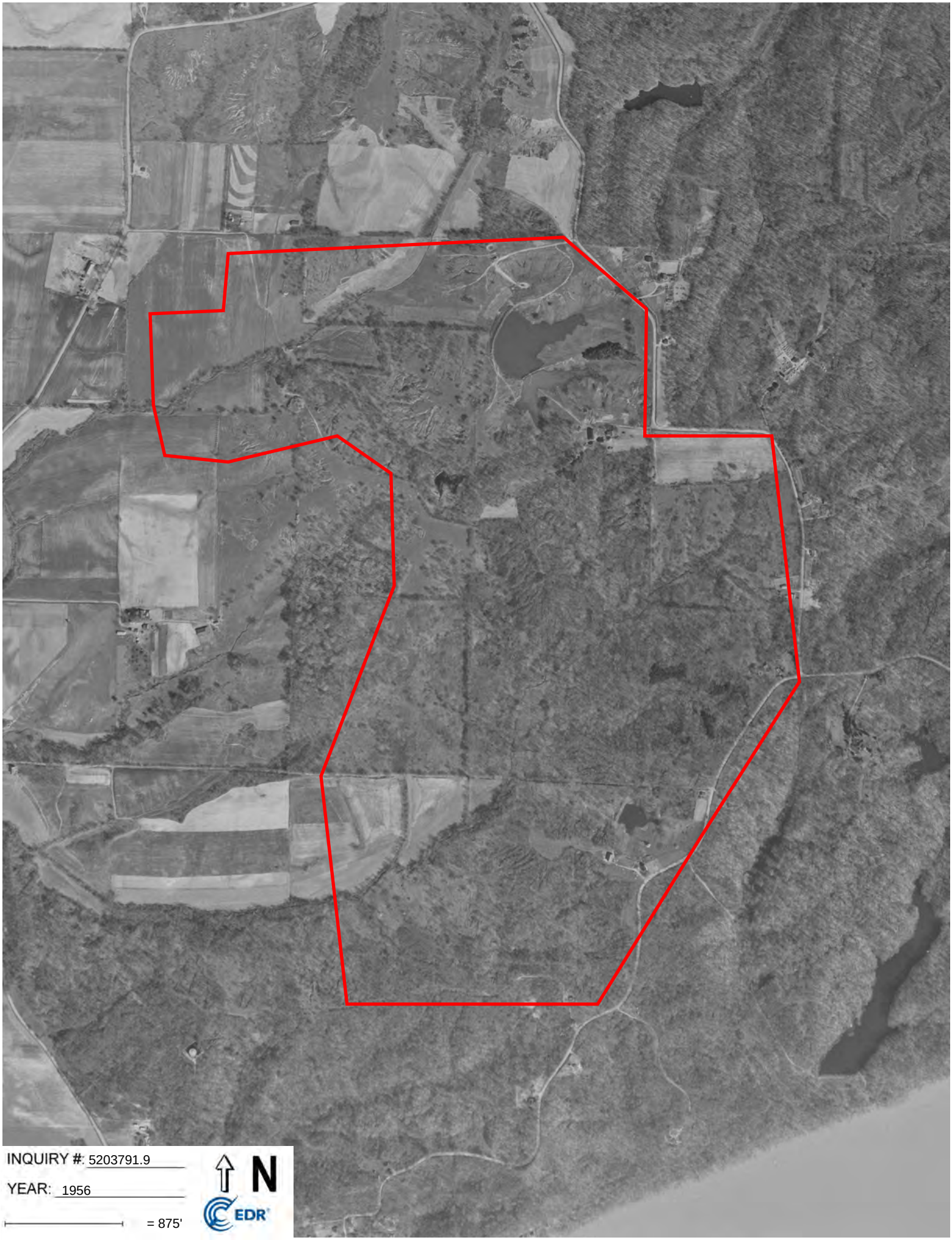
EDR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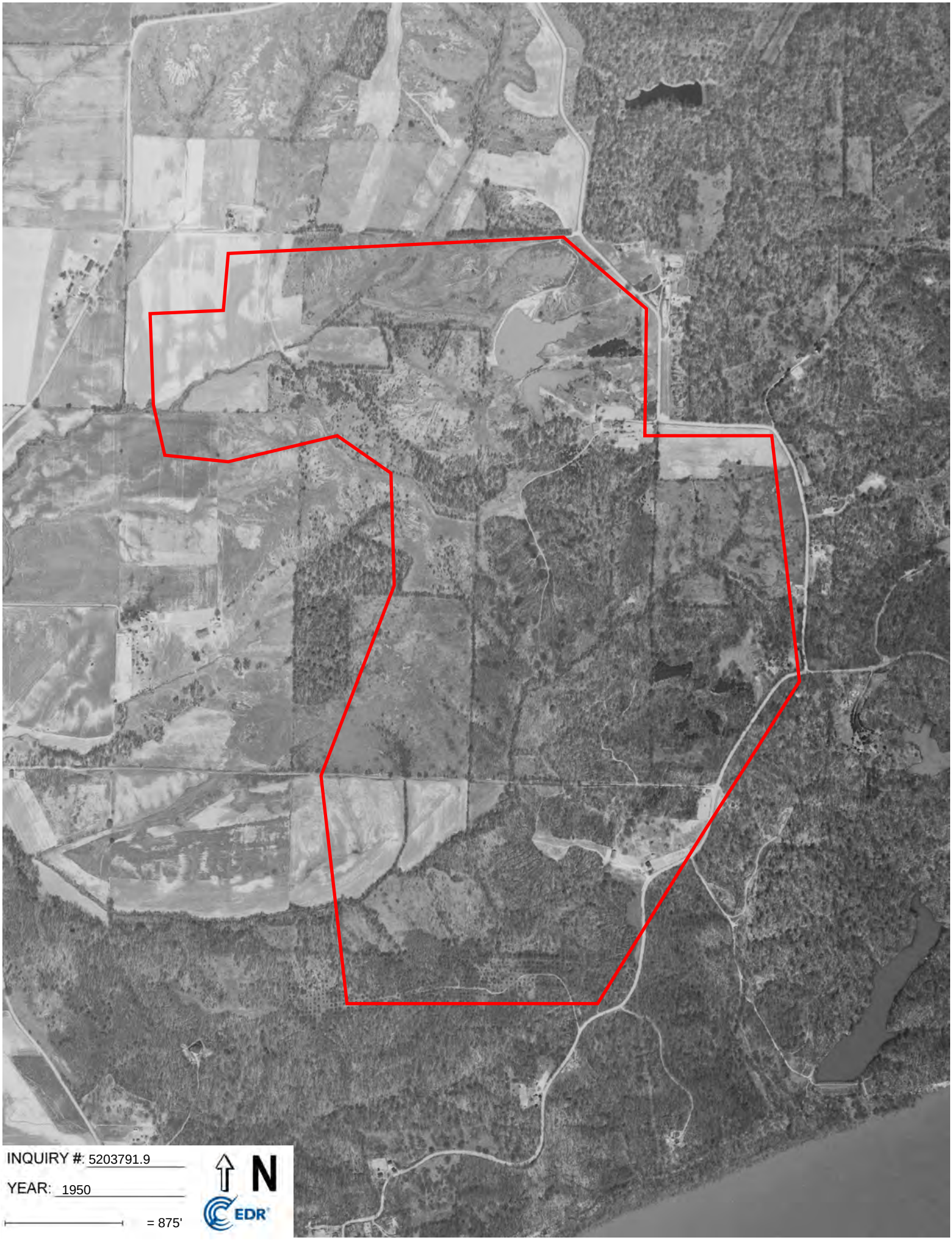
EDR


INQUIRY #: 5203791.9
YEAR: 1950
= 875'
N
EDR

A.B.Brown Generating Station
8511 Welborn Rd
Evansville, IN 47712

Inquiry Number: 5203791.5
March 05, 2018

The EDR-City Directory Image Report

Environmental Data Resources Inc

6 Armstrong Road
Shelton, CT 06484
800.352.0050
www.edrnet.com

TABLE OF CONTENTS

SECTION

Executive Summary

Findings

City Directory Images

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EXECUTIVE SUMMARY

DESCRIPTION

Environmental Data Resources, Inc.'s (EDR) City Directory Report is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's City Directory Report includes a search of available city directory data at 5 year intervals.

RECORD SOURCES

EDR's Digital Archive combines historical directory listings from sources such as Cole Information and Dun & Bradstreet. These standard sources of property information complement and enhance each other to provide a more comprehensive report.

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RESEARCH SUMMARY

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Year	Target Street	Cross Street	Source
2014	☑	☐	EDR Digital Archive
2010	☑	☐	EDR Digital Archive
2005	☑	☐	EDR Digital Archive
2000	☑	☐	EDR Digital Archive
1995	☑	☐	EDR Digital Archive
1992	☐	☐	EDR Digital Archive
1989	☐	☐	Polk's City Directory
1984	☐	☐	Polk's City Directory
1979	☐	☐	Polk's City Directory
1974	☐	☐	Polk's City Directory
1969	☐	☐	Polk's City Directory
1964	☐	☐	Polk's City Directory
1961	☐	☐	Polk's City Directory
1941	☐	☐	Bennett's City Directory
1924	☐	☐	Bennett's City Directory

EXECUTIVE SUMMARY

Year	Target Street	Cross Street	Source

FINDINGS

TARGET PROPERTY STREET

8511 Welborn Rd
Evansville, IN 47712

Year	CD Image	Source	
S WELBORN RD			
1995	pg A5	EDR Digital Archive	
1992	-	EDR Digital Archive	Street not listed in Source
1989	-	Polk's City Directory	Street not listed in Source
1984	-	Polk's City Directory	Street not listed in Source
1979	-	Polk's City Directory	Street not listed in Source
1974	-	Polk's City Directory	Street not listed in Source
1969	-	Polk's City Directory	Street not listed in Source
1964	-	Polk's City Directory	Street not listed in Source
1961	-	Polk's City Directory	Street not listed in Source
1941	-	Bennett's City Directory	Street not listed in Source
1924	-	Bennett's City Directory	Street not listed in Source
WELBORN RD			
2014	pg A1	EDR Digital Archive	
2010	pg A2	EDR Digital Archive	
2005	pg A3	EDR Digital Archive	
2000	pg A4	EDR Digital Archive	
1995	-	EDR Digital Archive	Street not listed in Source
1992	-	EDR Digital Archive	Street not listed in Source
1989	-	Polk's City Directory	Street not listed in Source
1984	-	Polk's City Directory	Street not listed in Source
1979	-	Polk's City Directory	Street not listed in Source
1974	-	Polk's City Directory	Street not listed in Source
1969	-	Polk's City Directory	Street not listed in Source
1964	-	Polk's City Directory	Street not listed in Source
1961	-	Polk's City Directory	Street not listed in Source
1941	-	Bennett's City Directory	Street not listed in Source
1924	-	Bennett's City Directory	Street not listed in Source

FINDINGS

CROSS STREETS

No Cross Streets Identified

City Directory Images

Target Street	Cross Street	Source
✓	-	EDR Digital Archive

WELBORN RD 2014

7940	OCCUPANT UNKNOWN,
8500	BURGDORF, PAULINE L
8520	THOMAS, RANDALL B
8590	JOSEY WILDER ENTERPRISES INC
	JOSEY, MICHAEL W
	STUCCO HOUSE
8600	BIRDWELL, WILLIAM B
8622	OCCUPANT UNKNOWN,

Target Street	Cross Street	Source
✓	-	EDR Digital Archive

WELBORN RD 2010

7940	JORDAN, KAREN M
8520	THOMAS, RANDALL B
8590	JOSEY MICHAEL
	JOSEY, MICHAEL W
	STUCCO HOUSE
8600	WILDER, DONNA E
8622	HINES, MARCIA L

Target Street	Cross Street	Source
✓	-	EDR Digital Archive

WELBORN RD 2005

7700	WIRTHWEIN, ERIC
7940	WILLIAMS, RICK A
8300	WEBB, M
8500	JOURDAN, TIM W
8590	JOSEY, MICHAEL W
8622	HINES, MARCIA L

Target Street	Cross Street	Source
✓	-	EDR Digital Archive

WELBORN RD 2000

7700	GIES, ANDREW
8300	MCCORMICK, JOHN
8311	SOUTHERN INDIANA MINERALS
8590	JOSEY, MICHAEL W
8600	DERRINGTON, ROB

Target Street	Cross Street	Source
✓	-	EDR Digital Archive

S WELBORN RD 1995

7701 SOUTHWIND OSTRICH RANCH INC

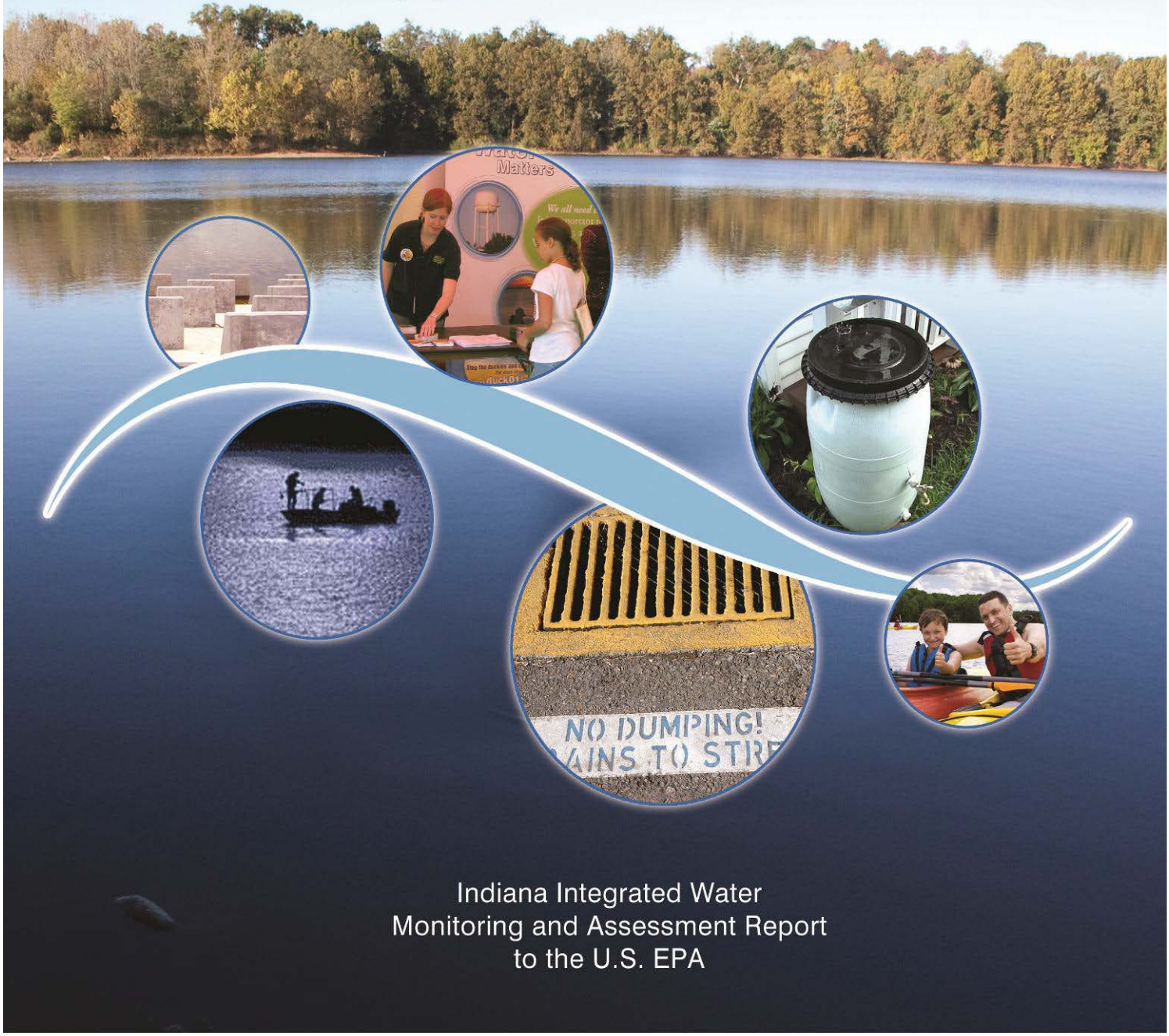
APPENDIX B

IDEM 2016 Integrated Water Monitoring and Assessment Report

HALEY ALDRICH

IDEM

Indiana Department of
Environmental Management



Indiana Integrated Water Monitoring and Assessment Report to the U.S. EPA

2016

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EXECUTIVE SUMMARY

Section 305(b) of the federal Clean Water Act (CWA) requires states to prepare and submit a water quality assessment report of state water resources to the U.S. Environmental Protection Agency (U.S. EPA) every two years. States are also required to develop and submit a list of impaired waters to U.S. EPA for approval under CWA Section 303(d).

IDEM used agency-collected data and other data collected by other organizations to develop this report. IDEM's solicitation, review and use of external data are described in detail in the section of this report entitled, Assessment Methodology and Summary Data. IDEM data used to develop this report were collected in accordance with IDEM's 2010 water quality monitoring strategy (WQMS), which describes a nine-year basin rotation approach to monitoring for CWA purposes. Using this strategy, one basin (approximately 10% of the state) is monitored each year, which provides a comprehensive statewide data set for assessments every nine years. The most current and readily existing available data were reviewed for the purposes of making 305(b) assessment and 303(d) listing decisions using IDEM's consolidated assessment and listing methodology (CALM).

A summary of IDEM's methods for determining support of beneficial uses is provided in the Assessment Methodology and Summary Data Section. IDEM's CALM is provided in its entirety in Appendix N. Indiana's water quality standards provide the basis for IDEM's CWA Section 305(b) water quality assessments, designating the beneficial uses that Indiana waters must support. Of the beneficial uses designated in the state's water quality standards, IDEM assesses aquatic life use support, recreational use support and drinking water for surface waters that serve as a public water supply. IDEM also assesses waterbodies for fish consumption. Although there are additional uses designated in Indiana's water quality standards, IDEM limits its assessments

to these four uses because the criteria in place to protect them are more stringent than those necessary to protect other uses. Thus, by protecting these four uses, other uses such as agricultural and industrial uses are also protected.

IDEM conducts water quality assessments using both statistical and empirical methods. Using data from its Probabilistic Monitoring Program, IDEM determines statistically for each of Indiana's nine major basins the percentage of river and stream miles that are meeting recreational and aquatic life uses and the percentage likely to be impaired. While the results from IDEM's comprehensive assessments cannot be applied to specific waterbodies, they provide important information regarding the overall water quality condition of waters in each basin. IDEM also uses the data it collects through its Probabilistic Monitoring Program and other available data to make reach-specific assessments of rivers and streams for recreational and aquatic life uses. Other empirical assessments include waterbody-specific assessments for fish consumption and public water supply.

IDEM completed its first comprehensive aquatic life use support assessments for the entire state in 2002 and reported similar information for recreational uses for the first time in 2012. IDEM published its first Integrated Report (IR) in 2002, which has been revised biennially since then. The 2016 IR provides the most recent comprehensive report on Indiana water quality to date.

Results from IDEM's comprehensive recreational and aquatic life use support assessments are provided in this report (Appendix E). Cumulative results for IDEM's stream-specific assessments are summarized in Table 1 (Appendix A). Approximately 68 percent of the 37,693 stream miles assessed for aquatic life use were found to be fully supporting. Approximately 26 percent of the 31,683 stream miles assessed support full body contact recreational use. Almost all of Indiana's 59 miles of Lake Michigan shoreline outside the Indiana Harbor fully supports aquatic life use, while only 7% of the shoreline waters support full body contact recreational use.

Causes of nonsupport (impairment) are included in this report for each waterbody type including flowing waters (rivers and streams) and non-flowing waters (lakes and reservoirs). Lake Michigan and its shoreline in Indiana are also discussed in this report. Pathogens are the top cause of stream impairments, impacting more than 23,000 miles of streams. Polychlorinated biphenyl (PCB) in fish tissue impacts more than 4,900 miles of streams while mercury in fish tissue impacts nearly 760 miles. Nearly 8,300 stream miles also have biological communities with measurable adverse response to pollutants.

Potential sources impacting Indiana waters include nonpoint sources that impact 16,040 miles of streams, while unknown sources impact almost 10,000 miles of streams. IDEM has several programs in place to address nonpoint source pollution. The Nonpoint Source Program and the Total Maximum Daily Load Program work together to facilitate restoration of impaired waters by locally-led groups committed to improving Indiana's water resources. IDEM's Watershed Specialists promote the holistic watershed approach by working closely with these groups to ensure they have the resources and information they need to succeed in their restoration efforts.

INTRODUCTION

States are required by the Clean Water Act (CWA) to prepare a water quality assessment report of state water resources and a list of impaired waters to submit to the U.S. Environmental Protection Agency (EPA) every two years. In 2002, the U.S. EPA encouraged states to combine the information that was previously submitted as two separate reports – the 305(b) water quality monitoring and assessment report and the 303(d) list of impaired waters – into one integrated report following the two-year schedule mandated in CWA Section 305(b).

The Indiana Department of Environmental Management (IDEM), Office of Water Quality (OWQ) publishes the Indiana Integrated Water Quality Monitoring and Assessment Report (IR) every two years. Using U.S. EPA's integrated format, Indiana's IR contains two lists – the Consolidated List and the 303(d) List of Impaired Waters. While they differ in purpose and scope, together they provide a comprehensive assessment of surface water quality conditions throughout the state of Indiana. The Consolidated List contains comprehensive statistical assessments for all major basins in the state, which is developed to fulfill CWA Section 305(b) requirements. The 303(d) List of Impaired Waters is a subset of the Consolidated List and identifies only those waters that are impaired and for which total maximum daily loads (TMDLs) are required per CWA Section 303(d). In accordance with U.S. EPA guidance, the IR also contains information on trends and trophic state of Indiana's lakes pursuant to CWA Section 314 as well as information pertaining to Indiana's ground water and wetland resources.

IDEM's OWQ prepared the 2016 IR following the guidelines provided by U.S. EPA (1997a, 1997b, 2005, 2006a, 2009a, 2011, 2013 & 2015). This report for 2016 meets the reporting requirements articulated in Sections 305(b), 303(d) and 314 of the CWA.

Most of the data used in this report come from IDEM's Probabilistic Monitoring Program, which employs a stratified random sampling (probabilistic) design to generate a representative set of sampling locations for each basin. IDEM uses probabilistic results to make comprehensive use support assessments, which are statistically valid statements about the overall water quality within a given watershed. The same data used to make comprehensive statistical assessments for a given basin are also applied to the specific stream or stream reach from which they were collected in order to make site-specific assessments.

In addition to data from the Probabilistic Monitoring Program, results from IDEM's targeted monitoring programs were used to make empirical, waterbody-specific assessments included in this report, including the Fixed Station Monitoring Program, the Watershed Characterization (formerly Baseline) Monitoring Program, the Fish Tissue Contaminant Program, and the Special Studies Program. Results from monitoring conducted by Indiana-University's Indiana Clean Lakes Program, which operates under a contractual agreement with funding from IDEM, were also used.

IDEM stores assessment information – decisions about water quality based on the data collected – in the Assessment Database. The Assessment Database is continually updated with new assessment information in order to facilitate the transmittal to U.S. EPA of the most up-to-date and accurate information concerning Indiana waters.

BACKGROUND

Indiana is located on the eastern edge of the North American great interior plains. The North - South continental divide traverses through northern Indiana, draining watersheds into the Great Lakes basin and the Mississippi River and Ohio River systems. Surface water in the northern one-quarter of the state flows north into the Great Lakes and then through the St. Lawrence River to the Atlantic Ocean. The southern three-quarters of the state drains into the Ohio River or Illinois River, flows into the Mississippi River and then south to the Gulf of Mexico. Indiana has approximately 63,130 miles of rivers, streams, ditches and drainage ways based on the Indiana Reach Index, which is keyed to the U.S. Geological Survey's high resolution (1:24,000 scale) National Hydrography Dataset (UGSG, 2014). State water types are described in Table 2 (Appendix A). Metadata and definitions for this report are located in Appendix C.

WATER POLLUTION CONTROL IN INDIANA

Water pollution control authority is shared by several agencies in Indiana. IDEM holds authority to carry out several Clean Water Act (CWA) programs, including Sections 305(b), 303(d), 314, and others. The Indiana State Department of Health (ISDH) has regulatory authority for septic systems, and the Office of the Indiana State Chemist (OISC) regulates pesticides and nutrients.

The State Soil Conservation Board (SSCB), Indiana State Department of Agriculture (ISDA), and the Indiana Department of Natural Resources (IDNR) – including its Lake and River Enhancement (LARE) Program and its Lake Michigan Coastal Program (LMCP) – administer voluntary and grant programs to help abate various types of nonpoint source pollution. Indiana also partners with many federal agencies and nonprofit organizations in order to accomplish its work, including assistance from the United States Geological Survey (USGS), the United States Environmental Protection Agency (USEPA), the United States Department of Agriculture (USDA), the United States Fish and Wildlife Service (USFWS), the United States Forest Service (USFS), and the National Park Service. Additional research, technical and funding assistance is provided by Purdue University and its Extension Service, Indiana University, The Nature Conservancy, the Indiana Water Monitoring Council, county soil and water conservation districts, and local non-profit and ad-hoc watershed groups.

IDEM'S WATERSHED APPROACH

IDEM employs a watershed approach in its Clean Water Act (CWA) programs. This approach is hydrologically well defined and geographically focused, providing an effective framework to address water quality issues by taking into account land, air and water stressors. Key benefits of the watershed approach are that it integrates multiple programs through coordination of public, private, and not-for-profit stakeholders and leverages limited resources to address priority concerns.

The foundation of IDEM's watershed approach is internal and external collaboration across program areas through timely and effective communication and adaptive management. IDEM's work with other state and federal agencies and other external organizations is described in more detail in later sections of this report.

Internally, IDEM's senior staff, including the commissioner, meets weekly to discuss progress on priorities as well as emerging concerns and then relays this information to IDEM's Office of Water Quality (OWQ) managers at their weekly meeting. Cross-program teams continually work to develop strategies and work plans that ensure internal resources are focused on addressing the most significant environmental issues affecting water quality.

IDEM's water quality monitoring also employs a watershed approach. IDEM adopted a statewide rotating basin approach to watershed monitoring in 1996 in order to regularly update the water quality information for the entire state. From 1996-2010, IDEM monitored watersheds throughout the state on a five-year rotation, which provided a complete update once every five years.

In 2010, IDEM revised its water monitoring strategy and began using a nine-year rotating basin approach in 2011, which will result in a comprehensive and updated data set for the entire state in 2019. The water quality assessments included in this report are cumulative and include all waterbodies that have been assessed to date in all basins of the state. Figure 1 (Appendix B) shows the monitoring locations for all of IDEM's surface water sampling programs and illustrates the sampling density achieved through IDEM's water quality monitoring strategy over

the past five years (2011-2015).

IDEM'S OFFICE OF WATER QUALITY PROGRAMS

IDEM's Clean Water Act (CWA) programs work together to protect and improve the quality of Indiana's surface waters. Indiana's water quality standards, which are developed by the Office of Water Quality (OWQ) Water Quality Standards (WQS) program, provide the foundation for implementation of many of IDEM's CWA programs. IDEM's water monitoring programs provide much of the data necessary to conduct CWA Section 305(b) water quality assessments and to support the development of Indiana's 303(d) List of Impaired Waters and total maximum daily loads (TMDLs) required under Section 303(d) of the CWA.

Nonpoint source (NPS) pollution is addressed primarily through non-regulatory watershed management planning and implementation projects funded through IDEM's NPS Program and through the development of TMDLs for impaired waters. The agency's National Pollution Discharge Elimination System (NPDES) provides a robust regulatory program to control point sources of pollution to Indiana surface waters.

IDEM also works with the Indiana Finance Authority (IFA) to issue low cost loans to communities for infrastructure improvements to their wastewater and drinking water facilities. Many of these loans go to municipalities in watersheds where water quality impairments have been identified and for which total maximum daily loads (TMDLs) have been approved by the U.S. Environmental Protection Agency (EPA). It is anticipated that in time these projects will result in measureable improvements in water quality.

Water Quality Standards Program

Indiana's WQS can be found in 327 IAC Article 2. They were first adopted into the Indiana Administrative Code (IAC) in 1986 and underwent significant revisions in 1990. At that time, Indiana adopted numeric criteria into its WQS for all pollutants for which U.S. EPA had developed ambient water quality criteria for the protection of either human health or aquatic life. Procedures for developing additional criteria were also included in these rules.

Beneficial uses, which are the uses that the waterbody should support, were also established at that time. With a few exceptions, all waters in Indiana were designated for warm water aquatic life use, full body contact recreational use, public water supply[1] (where there are drinking water

[1]There are 34 streams or stream reaches designated for limited use in 327 IAC 2-1-11(a) and 327 IAC 2-1-1.5-19(a). These waters so designated after use attainability analyses confirmed their inability to fully support aquatic life use due to natural low flow conditions throughout much of the year. In 2007, another limited use designation was added to Indiana's WQS in 327 IAC 2-1-3.1, which is applicable only to waters receiving wet weather discharges from combined sewer overflows (CSOs). Currently, no waters are so designated because to date, no communities with CSOs have completed the steps required to receive this designation. Indiana's WQS also include waters that are designated as outstanding state resources in 327 IAC 2-1.5-19(b), 327 IAC 2-1.3-3(d) and 327 IAC 2-1-11(b). Thus, all waters in the state are currently designated for uses consistent with the requirements of the CWA or U.S. EPA's implementing regulations and have criteria appropriate to determine support of these uses.

intakes from surface waters), industrial uses and agricultural uses. In addition, certain waters, where natural temperature conditions will support cold water fisheries, were designated for put-and-take (stocked) trout fishing. For those waters where multiple uses exist, the criteria that support the most stringent uses must be met. The most stringent criteria in Indiana's WQS are those established to protect aquatic life use, recreational uses for all Indiana waters and where applicable, public water supply. IDEM's water quality assessments focus primarily on these uses and are based on the narrative and numeric criteria in the WQS established to protect them.

NPDES permits are also based on Indiana's WQS. In 1993, the rules and regulations that guide the implementation of Indiana's WQS through NPDES permits were extensively revised. Although this revision resulted in significant changes to these rules, only minor changes were made to Indiana's WQS.

With the issuance of the final Great Lakes Water Quality Guidance in 1995, IDEM began the process of revising the WQS and implementation regulations for those waters in Indiana's Great Lakes system. These revisions incorporated the various criteria and procedures identified in the guidance into Indiana's WQS. As a part of this rulemaking, IDEM also developed procedures to implement the antidegradation policy for all substances discharged to waters in the Great Lakes system. These revisions adopted by the Indiana Water Pollution Control Board became effective in February, 1997 and were subsequently submitted to the U.S. Environmental Protection Agency (EPA) for approval.

Ground water quality standards became effective in March 2002. Drinking water from public water supplies is regulated through the Safe Drinking Water Act (SDWA). IDEM defines public water supplies in accordance with the SDWA and has established minimum requirements regarding the information included in consumer confidence reports, which public water suppliers must deliver to their customers annually.

WQS development is an ongoing process. For example, 2008, in order to begin using fish tissue data to make its fish consumption assessments, IDEM had to first derive a numeric criterion for polychlorinated biphenyls (PCBs) in fish tissue. IDEM used U.S. EPA guidance for calculating screening values for target analytes, which provides the basis for developing water quality criteria for the protection of human health.

In 2012, Indiana formally adopted antidegradation standards and implementation procedures applicable to all waters of the state. These rules supersede previous antidegradation rules established in 1997, which applied only to the Great Lakes Basin. And in 2013, Indiana adopted revised chloride criteria developed by the WQS Program based on hardness and sulfate concentrations.

U.S. EPA has required all states to develop numeric water quality criteria for nutrients to support CWA Assessments and permit development. The agency has also issued guidance that appears to give states flexibility in the development of nutrient criteria if the state and U.S. EPA have agreed on a plan to accomplish this goal. Indiana is actively participating in this effort and has submitted a nutrient criteria development plan to U.S. EPA that includes a schedule for the development of nutrient criteria. This plan has been approved by U.S. EPA and is kept updated.

In accordance with the approved plan, IDEM is working with U.S. EPA Region 5 and the United States Geological Survey (USGS) to develop nutrient criteria for different water body types throughout the state. IDEM has worked collaboratively with the USGS in Indianapolis over the last 14 years to collect and analyze relevant stream data from waters throughout the state. Recent analyses of these data indicate that another study is warranted, this time collecting diurnal dissolved oxygen in addition to nutrient parameters for flowing streams. For lakes and reservoirs, data analysis was completed in 2008 by LimnoTech, Inc. IDEM then performed additional analyses on the data set to refine the nutrient benchmarks developed by LimnoTech. On June 30, 2010, IDEM issued a first notice in the Indiana Register announcing a rulemaking to formally incorporate numeric nutrient water quality criteria for lakes and reservoirs into Indiana's water quality standards. IDEM also developed a non-rule policy that went into effect on 12/12/2014 to limit total phosphorus discharge to 1 mg/L for wastewater treatment plants discharging ≥1 million gallons per day.

Currently, IDEM is planning revisions to the metals criteria in the WQS for the protection of aquatic life and human health. On March 5, 2014, IDEM issued a first notice in the Indiana Register announcing a rulemaking to formally incorporate revised water quality criteria for dissolved metals into Indiana's water quality standards. More information about this rulemaking can be found on IDEM's WQS website at: http://in.gov/idem/cleanwater/2329.htm.

IDEM has also collected considerable data on the macroinvertebrate and fish communities for many Indiana waters. A 2014 evaluation of IDEM's biological monitoring program revealed a need to select reference sites that are based on quantitative descriptions of non-biological characteristics (primarily land use and landscape condition); to refine macroinvertebrate assessment techniques; to update biological indices; and to establish a biological condition gradient to characterize the state of aquatic communities in Indiana waters at a finer resolution. IDEM has begun this work through a Section 106 Monitoring Initiative grant from the U.S. EPA.

National Pollutant Discharge Elimination System Permit Program

Point source pollution in Indiana is controlled primarily through permits issued by IDEM for discharges to surface water under the National Pollutant Discharge Elimination System (NPDES) Permit Program in IDEM's Permits Branch. Regulated facilities which discharge to waters of the state must apply for and receive a NPDES permit. Limitations in each permit are determined based on water quality criteria developed to protect all designated and existing uses of the receiving water body.

The Permits Branch issues individual (municipal, semi-public and industrial) NPDES permits. The program also issues industrial wastewater pretreatment permits to industries that discharge to municipal wastewater treatment plants. In addition, the Permits Branch issues general permits for:

- Hydrostatic testing
- Non-contact cooling
- Sand and gravel operations
- Petroleum product terminals
- Groundwater petroleum remediation systems
- Coal mines

There are currently 1194 active individual NPDES permits, 180 pretreatment permits, and 300 facilities covered by general permits.

The Permits Branch is also responsible for the review and approval of long term control plans (LTCPs) submitted by communities to reduce discharges from combined sewers. All of the combined sewer overflow communities for which IDEM is the lead regulating agency are currently under one of three enforceable mechanisms (permit, agreed order or state judicial agreement). These mechanisms are in place to help implement the approved LTCP and/or to develop and implement an approvable LTCP. There are two remaining communities for which U.S. EPA is the lead regulating agency that have not yet entered into an enforceable mechanism for development and implementation of an approved LTCP. These communities are still in negotiations with U.S. EPA.

Compliance and Technical Assistance Program

The Compliance Branch in the Office of Water Quality is responsible for the following:

- Conducting routine inspections of wastewater treatment plants to evaluate operation and maintenance, as well as complaint investigations.
- Providing operator assistance and training.
- Administration of the wastewater operator continuing education and certification program.
- Entering a wide range of NPDES compliance data into the Federal ICIS data system.
- Tracking reported bypass and overflow events.
- Administration of the sewer ban and early warning program.
- Review of compliance data, including data quality assurance.
- Conducting informal enforcement actions through the issuance of violation letters, and assisting in the enforcement process.
- Oversight and auditing of municipal pretreatment programs in the 47 municipalities with U.S. EPA delegated pretreatment programs.
- Administering the laboratory proficiency program.

The Compliance Branch works closely with the Permits Branch and staff from the OWQ's Enforcement section to ensure that permit limits are adequate for protection of designated uses and dischargers remain in compliance with their permit requirements. For example, when unpermitted dischargers are identified, or when NPDES permit holders are found to be in violation of permit limitations or conditions, they may be referred to OWQ's Enforcement section for appropriate action.

Storm Water Program

Storm water run-off from urban, industrial, and rural areas contributes to water pollution in Indiana. IDEM's Stormwater Programs process permit applications and issue permits, conducts compliance inspections, and conducts audits for three program areas that together, help to mitigate the impacts of storm water to Indiana waters. These program areas target storm water discharges from construction site run-off, industrial storm water run-off, and municipal separate storm sewer systems.

Most of the activities that discharge storm water are regulated through general permits. General permits are issued through rulemaking and as such, become part of Indiana's Administrative Code. Unlike individual permits, which IDEM issues to individual permittees when needed, general permits apply universally to all entities required to operate in accordance with the rule.

Construction Site Run-off

Any activity that results in the disturbance of one acre or more of land requires a permit in accordance with 327 IAC 15-5 (commonly known as "Rule 5"). Rule 5 is intended to reduce pollutants, principally sediment, which is a result of soil erosion. Rule 5 also covers other activities associated with construction projects including, concrete washout; fueling, etc. Most construction projects in Indiana are regulated through the general Rule 5 permit. However, in cases where an adverse environmental impact from a project site is evident or if IDEM determines that the discharge will significantly lower water quality, an individual permit may be required.

Industrial Storm Water

Industrial storm water is managed through a general permit developed in accordance with 327 IAC 15-6 (commonly known as "Rule 6"). Rule 6 permits are required for certain categories of industrial activities that are exposed to storm water and where the run-off is discharged through a point source to one or more Indiana waters. There are at least 32 categories of industrial activities regulated under Rule 6. Most industrial activities in Indiana are covered by the Rule 6 general permit. However, under certain circumstances, an industrial facility may require an individual storm water permit. Individual permits are typically required only if a regulated industrial activity category has established effluent limitations under IDEM's NPDES Program or if IDEM determines the storm water discharge will significantly lower water quality.

Municipal Separate Storm Sewer Systems

Municipal separate storm sewer systems (MS4s) are entities that are required by IDEM under 327 IAC 15-13, or "Rule 13" to develop and implement a local storm water management program.

The first MS4s were designated in 1990 and included cities (and certain counties) with a population of 100,000 or more. In Indiana, the City of Indianapolis is the only designated Phase I MS4. The city has an individual storm water permit that was specifically written to address storm water quality and management.

Federal Phase II MS4 rules were complete in 1999 and designated small urbanized areas such as cities, towns, universities, colleges, correctional facilities, hospitals, conservancy districts, homeowner's associations and military bases located within urbanized areas, as delineated by the U.S. Census Bureau. Most of these MS4s are covered under a general permit and are required to develop a storm water quality management plan that must address six minimum control measures (public education, public involvement, illicit discharged detection and elimination, construction site run-off, post-construction run-off, and good housekeeping for MS4 owned and operated facilities). Indiana currently has 186 MS4 permittees implementing Storm Water Quality Management Plans under a general permit.

Wetlands Program

IDEM administers the federal Clean Water Act (CWA) Section 401 Water Quality Certification (WQC) Program and also administers Indiana's State Isolated Wetlands Law (IC 13-18-22) for those wetlands that are not under federal jurisdiction.

IDEM regulates the placement of fill materials, excavation (in certain cases) and mechanical clearing of wetlands and other waterbodies. IDEM draws its authority from the federal CWA, state law and rules for state-regulated wetlands, and from Indiana's water quality standards. IDEM regulates some activities in waterbodies in conjunction with the U.S. Army Corps of Engineers (ACOE).

Anyone who wants to place fill materials, use heavy equipment to excavate, dredge, or mechanically clear areas within a jurisdictional wetland, lake, river or stream must first apply to the ACOE for a CWA Section 404 permit. If the ACOE decides a permit is needed, then the person must also obtain a CWA Section 401 WQC from IDEM. Placement of fill into non-jurisdictional wetlands is also regulated by Indiana law (IC 13-18-22 and 327 IAC 17).

Under CWA Section 401, IDEM reviews the proposed activity to determine if it will comply with Indiana's water quality standards. The applicant may be required to avoid impacts, minimize impacts or mitigate for impacts to wetlands and other waters. IDEM will deny water quality certification if the activity will cause adverse impacts to water quality, the application is deficient, the wetland activities are not necessary, or compensatory mitigation does not offset impacts. A regulated project is not allowed to proceed until it has received a certification from

IDEM. A key goal of the program is to ensure that all activities regulated by IDEM meet the national no-net-loss of wetlands policy.

Development of Wetlands Program Plan

In March 2015, the Indiana Department of Environmental Management (IDEM), Office of Water Quality completed work on a long-term Wetlands Program Plan (WPP) for Indiana. A WPP is a voluntary plan that describes the goals a state or tribe wants to achieve related to its wetland resources over time. The WPP is not a rule-making or regulatory document, nor is it a strict commitment by the state to achieve all aspects of the plan. Rather, it serves to inform future prioritization and action. The planning effort was funded through a U.S. Environmental Protection Agency (EPA) Wetland Program Development grant and is intended to guide IDEM's wetland program activities through 2022. The WPP is available online at http://www.in.gov/idem/wetlands/files/program_plan.pdf.

In-lieu Fee Program

The Indiana Department of Natural Resources (IDNR) is developing, and seeking approval to sponsor (referred to as the "in-lieu fee program"), the Indiana Stream and Wetland Mitigation Program. The program requires the approval of the U.S. Army Corps of Engineers (USACE) and the Interagency Review Team and must meet the requirements laid out in the federal mitigation rule (33 CFR §332.8). The in-lieu program, once fully developed, will provide an additional option for permittees to meet mitigation requirements associated with a Section 404 permit from the USACE, a 401 Water Quality Certification and/or an Isolated Wetland Permit from IDEM. The IDNR hopes to have the program approved by the USACE before the end of 2016.

Integrity and Extent of Wetland Resources

Wetlands occur in and provide benefits to every county in Indiana. The lack of quantitative information on some aspects of Indiana's wetland resources is a major obstacle to improving wetland conservation efforts. The most extensive database of wetland resources in Indiana is the National Wetlands Inventory (NWI) developed by the U.S. Fish and Wildlife Service (USFWS). The original NWI maps were produced primarily from interpretation of high-altitude color infrared aerial photographs taken of Indiana during spring and fall 1980-87. These maps were updated at a much higher resolution during 2008-2009 through a grant to Ducks Unlimited. The updated maps indicate wetlands extent and type, using the Cowardin, *et al*. classification scheme (Cowardin 1979). A 2009 analysis of the state's wetlands compared with 1986 conditions indicates that:

- Indiana has experienced a net loss in the number of emergent, forested, shore, and scrub-shrub wetlands.
- Indiana has experienced a net loss in the extent (acres) of forested, scrub-shrub, and shore wetland sub-types.

The results of this study are available at http://www.fws.gov/wetlands/Data/SupMapInf/R03Y11P02.pdf.

IDEM uses the updated, higher resolution NWI inventory primarily in its Wetlands Program as a screening tool when evaluating applications for impacts to wetlands and streams and also to help identify wetland compensatory mitigation or restoration sites. It has also helped IDEM wetland staff to set priorities for complaint investigations.

Wetland Protection Activities

In addition to the review of applications for Section 401 WQC and state regulated wetland permits, IDEM's Wetlands Program works on additional projects devoted to wetland assessment and wetland protection:

- IDEM staff work closely with the ACOE, U.S. FWS, and IDNR to evaluate proposed projects to coordinate requirements for various state and federal permits related to wetlands.
- IDEM maintains a web page devoted to wetlands and water quality issues: http://www.in.gov/idem/wetlands/index.htm. This page includes information on the status of Indiana's wetlands, current laws and rules, conservation programs and links to other regulatory and non-regulatory wetland programs.
- IDEM maintains a web-based mapping tool for potential wetland restoration sites, including opportunities for compensatory mitigation and non-regulatory purposes: http://idemmaps.idem.in.gov/MitigationVolunteer/.
- Section 401 WQC Program staff conduct outreach events at various locations to promote the importance of wetlands and to educate the public on regulations protecting wetlands.
- IDEM continues to work closely with all partners in the Indiana wetland conservation plan.

Total Maximum Daily Load Program

Status of Total Maximum Daily Load Development

As of March 1, 2016, the Total maximum Daily Load (TMDL) program has developed 1224 TMDLs (individually counting each waterbody impairment that was evaluated), all of which have been approved by U.S. EPA. Appendix D provides an accounting of all TMDLs approved to date. Appendix E provides IDEM's short term TMDL schedule – those either planned or currently being developed for the 2018 cycle.

Two watersheds – the Upper Mississinewa and the South Fork Blue River – are in progress for the 2016 cycle. Previous TMDLs have focused on *E. coli* impairments. More recently, however, the TMDL program has worked to develop TMDLs to address other issues related to NPS pollution such as impaired biotic communities and nutrient impairments.

Long Term Total Maximum Daily Load Development Schedule

U.S. EPA announced its long term vision in 2013 to improve implementation of the CWA 303(d) Program through a new framework for managing program responsibilities. In order to achieve the goals of its vision, U.S. EPA required states to develop a new framework for prioritizing impaired waters for TMDL development.

IDEM developed its TMDL Program Priority Framework in 2015, which describes IDEM's methods for prioritizing waters for TMDL planning and watershed restoration and includes the agency's long term TMDL development schedule. This long term schedule identifies the watersheds in which TMDLs will be developed through the 2022 cycle (Appendix F). IDEM submitted the framework and its long term schedule to U.S. EPA on July 8, 2015. U.S. EPA has since reviewed IDEM's Priority Framework and in a letter to IDEM dated September 16, 2015, agreed that it meets the goals of its new long term vision. . IDEM's long term schedule for TMDL development can be found in Appendix F, while more detailed information on IDEM's 303(d) TMDL Program Priority Framework is provided in Appendix H, Attachment 3). The specific waterbodies identified on IDEM's long term schedule, like those identified in IDEM's short term schedule, may change based on unanticipated circumstances. Although the specific waterbodies may change, IDEM will follow the methods described in its Program Priority Framework when prioritizing impaired waters for TMDL development to help ensure ongoing consistency with U.S. EPA's long term vision.

Nonpoint Source Pollution Program

Nonpoint source (NPS) pollution in Indiana is addressed in many ways through a number of agencies and organizations in the state. IDEM's Watershed Planning and Restoration Section leads the agency's efforts to reduce nonpoint source pollution in Indiana waters in partnership with other agencies and organizations including the Natural Resources Conservation Service (NRCS), Indiana Association of Soil and Water Conservation Districts (IASWCD), Indiana State Department of Agriculture (ISDA), the Indiana Department of Natural Resources (IDNR) and the Indiana Finance Authority (IFA) State Revolving Fund (SRF) Loan Program. The Watershed Planning and Restoration Section also leads efforts to restore waters of the state that are identified on the 303(d) List of Impaired Waters. In addition to working with other state and federal agencies, IDEM employs four watershed specialists who work with local watershed groups to promote the watershed approach and assist them in their watershed planning and restoration activities.

Nonpoint Source Program Grants

The Watershed Planning and Restoration Section manages two federal pass-through grant programs aimed at improving water quality in the state – Section 205(j) and Section 319(h) – each named after the authorizing section of the CWA.

The Section 205(j) Grant Program is dedicated to water quality management planning. Funds are used to determine the nature, extent, and causes of point and nonpoint source pollution

problems and to develop plans to solve these problems. In federal fiscal year (FFY) 2014-15, U.S. EPA allocated to Indiana $681,000 in 205(j) funds. These funds were used to support five projects: three watershed management plan development projects (on the Browns-Wonder Sugar Creek, South Fork Blue River, and Upper Middle Eel River), one sampling project on the Kankakee River, and one database enhancement project.

The Section 319(h) Program is one of the primary resources for reducing NPS pollution in Indiana and receives a significantly larger allocation than that under CWA Section 205(j) (Table 3, Appendix A). In FFYs 2014 and 2015, U.S. EPA allocated $7,023,714 in Section 319(h) funds to Indiana, which funded a total of 18 projects. An additional $131,600 planning project was funded in FFY 2015 using remaining funds from FFY 2013. Several grant proposals are submitted to the program each year by eligible organizations. Proposals are reviewed internally by a committee comprised of OWQ staff and selected for funding based on the NPS Program's priorities and the quality of the proposal. Much of this funding goes to groups working to develop and/or implement a comprehensive watershed management plan which will lead to implementation of on-the-ground best management practices (BMPs) in critical areas of their watersheds.

Additional information about IDEM's 205(j) and 319(h) grant programs and their different requirements is available online at: http://www.in.gov/idem/nps/.

Nonpoint Source Program Focus

IDEM's NPS Program is built on the foundation of the Indiana State Nonpoint Source (NPS) Management Plan. The NPS management plan, required by Section 319(b) of the CWA, is a strategic document developed by state program staff and approved by U.S. EPA that identifies strategic priorities, goals, and milestones to more effectively address NPS problems in Indiana. The plan, which is updated every five years, provides the basis for funding decisions and programmatic direction for the state program and its partners. The current plan was last revised in FFY 2013 and approved by U.S. EPA on March 14, 2014.

The majority of Indiana's Section 319(h) grant funds provide for the development and implementation of watershed management plans (WMPs). Developing and implementing a comprehensive watershed management plan is an effective way to focus efforts and resources on a watershed and its particular problems and to implement solutions to those problems. In the planning process the watershed group identifies the problems, causes, sources, and critical or target areas in the watershed, then sets goals and chooses measures or best management practices (BMPs) to be implemented to achieve those goals. WMPs now under development must meet the required elements of IDEM's 2009 Watershed Management Plan Checklist before they can be implemented with CWA Section 319(h) funds. The checklist incorporates EPA's nine required components of a watershed-based plan and also provides comprehensive guidance on IDEM's Nonpoint Source Program expectations, as well as examples and direction on how to meet those expectations.

Many of the projects funded with NPS Program grants include the collection of water quality data for watershed planning and other purposes. In accordance with their grant agreements, these projects must develop a quality assurance project plan (QAPP) to ensure the data they collect will be reliable for their project needs. Once the QAPP is approved by the NPS Program, they may begin sampling and submitting their data – also a requirement for funding – to the NPS Program. These data are then entered into IDEM's Assessment Information Management System (AIMS) database. The AIMS database is continually maintained and was recently upgraded to make NPS Program data more readily available for internal and external use. In addition, the NPS Program also funded a recent project to update IDEM's Hoosier Riverwatch database in order to improve its ability to manage and display volunteer data and accept data submitted through Indiana's External Data Framework.

Nonpoint Source Program Priorities

Each year, IDEM identifies priority projects for Section 319(h) funds in order to more efficiently meet NPS Program goals, coordinate with TMDL Program efforts to identify and reduce NPS pollution, and focus more funding on impaired waters.

For FFYs 2014 and 2015, the NPS Program has focused funding on the following priorities:

- In order to continue to make measurable improvements in water quality in Indiana, and to prioritize watersheds for actions focused on reducing nutrient loading to the Gulf of Mexico in coordination with the Indiana Conservation Partnership, IDEM's Nonpoint Source Program has focused funding watershed management plan implementation projects addressing nutrients in the following watersheds:
    - White River, East Fork Basin
    - Upper Wabash River Basin
    - Lower Wabash River Basin
- In 2014 the NPS program prioritized funding to support the conditionally approved Lake Michigan Coastal Plan. Until this plan is finalized and meets the requirements of the Coastal Zone Act Reauthorization Amendments (CZARA), IDEM's NPS Program will continue to provide technical and financial assistance for watershed planning and/or implementation in the Coastal Zone Program area.
- The program has continued to prioritize funding for:
    - Watershed planning and/or implementation efforts in watersheds with one or more impaired waterbodies that have an approved TMDL.
    - Watershed planning and/or implementation in watersheds that include waterbodies in categories 5A or 4A of Indiana's Draft 2012 Integrated Report.
    - Implementation of watershed management plans that have met, or will soon meet, IDEM's Watershed Management Plan 2003 or 2009 Checklists.

In FFY 2016, the CWA Section 319(h) program tied its funding to the TMDL vision. IDEM continued in FFY 2016 to prioritize funding for implementation of watershed management plans that meet IDEM's 2009 watershed management plan checklist and in addition, targeted specific watersheds for the following three priorities in its solicitation:

- Develop a WMP or implement an IDEM approved WMP that contains a 10-digit HUC watershed with a public lake (a lake with public access) identified as having a high blue-green algae count when monitored by IDEM and/or the lake is influenced by waterbodies listed in category 5A of the then-draft 2014 303(d) List of Impaired Waters.
- Develop a WMP or implement an IDEM approved WMP in a watershed that includes waterbodies listed on the then-draft 2014 303(d) List of Impaired Waters for Impaired Biotic Communities (IBC).
- Develop a WMP or implement an IDEM approved WMP that includes a 10-digit HUC watershed with a surface water intake for public water supply and waters identified in category 5A of the then-draft 2014 303(d) List of Impaired Waters.

One important indicator of program and project success is the quantity of pollutants, such as sediment, phosphorus, nitrogen, and *E. coli,* prevented from entering waterbodies as a result of BMPs implemented. Most NPS Program projects in Indiana use the U.S. EPA Region 5 Load Estimation Model to estimate the pollutant load reductions for each BMP they implement and submit their data to IDEM. The total reported estimated pollutant load reductions in Indiana for FFY 2014 and 2015 combined are represented in Table 4 (Appendix A). Another program measure (commonly referred to as "WQ-10" or "success stories") tracks the number of waterbodies identified by states as being primarily NPS-impaired that have been partially or fully restored as a result of restoration efforts (5, Appendix A). More detail on Indiana's FFY 2014 and 2015 success stories can be found in the cost/Benefit Section of the report.

IDEM's Watershed Specialists

The NPS Program employs four watershed specialists who provide an important link between watershed groups and other interested stakeholders and OWQ programs. In 2014 and 2015, the watershed specialists assisted nearly 90 watershed groups on many levels including: meeting facilitation, reviewing draft and final watershed management plans, reviewing grant proposals, providing water quality data and watershed maps, connecting them with other local organizations and agencies to complement planning efforts, and assisting watershed coordinators with the overall watershed planning and implementation processes. The watershed specialists also work with the TMDL Program by attending TMDL public meetings to provide information on watershed planning and to build local partnerships to address water quality.

Volunteer Monitoring Programs

Hoosier Riverwatch

From 1999-2002, IDEM and IDNR worked cooperatively to develop and implement the Hoosier Riverwatch Program (HRW), a statewide volunteer stream water quality monitoring program. The mission of Hoosier Riverwatch is to involve the citizens of Indiana in becoming active stewards of Indiana's water resources through watershed education, water monitoring, and clean-up activities. The program accomplishes the first two parts of this goal by educating citizen volunteers in a variety of watershed and pollution issues, and providing them with training and equipment to conduct water quality monitoring. The HRW Program also maintains an online database which allows volunteers to enter their own data and view data collected by other volunteers. Volunteers are encouraged to enter their results into the database to make them available to other interested parties such as watershed groups, schools and IDEM technical staff for potential use in various OWQ programs. In addition to basic search functions, the visualization tools of the database also allow volunteers to view their data and that collected by others in comparison with state and watershed averages through simple graphics.

HRW resided at IDNR until late 2012, when the program moved to IDEM's OWQ to better integrate volunteer water monitoring with OWQ's watershed monitoring and planning activities. Over the past three years, HRW has become more fully integrated into the Watershed Assessment and Planning Branch within OWQ, allowing better coordination with NPS Program whose grantees commonly use HRW methods to meet the monitoring and outreach components of their funded projects and encouraging greater data sharing through OWQ's EDF. The HRW Program has also initiated planning discussions to determine how volunteer monitoring can become more fully involved in watershed planning and restoration efforts as a whole.

The move to IDEM also provides volunteer monitors more opportunities to interact with their professional counterparts. Since 2012, HRW program staff have worked with OWQ biologists and others to offer training to the program's corps of trained volunteer instructors in topics such as basic fish and advanced macroinvertebrate identification, introductions to IDEM's mobile *E. coli* van, the collection and analysis of fish tissue for consumption advisories, the use of various electrofishing gear, and the process of estimating pollutant loads using flow and concentration data.

Indiana Clean Lakes Program

The Indiana University School of Public and Environmental Affairs (IU-SPEA) has been working with IDEM's NPS Program since 1989 to administer the Indiana Clean Lakes Program (CLP). The Indiana CLP is funded through CWA Section 319(h) and provides a comprehensive, statewide public lake management program that includes public information and education, technical assistance, volunteer lake monitoring, and lake water quality assessment.

Indiana has more than 1,400 lakes, reservoirs, and ponds, many of which are under pressure from human activities such as poorly managed agriculture, suburbanization of lakeshores, boating

impacts, and septic system discharges. These activities can result in excessive nutrient concentrations reaching lakes which can lead to accelerated eutrophication and related undesirable effects including nuisance algae, excessive plant growth, murky water, odor, and fish kills.

Indiana's CLP, which is coordinated by IU-SPEA staff and students, includes the following components:

- Annual professional sampling of lakes and reservoirs.
- Training and support of a corps of volunteer lake monitors.
- Education and outreach through a quarterly newsletter
- Development of other educational materials such as brochures and fact sheets.
- Maintenance of the Indiana Clean Lakes Program website.
- Technical assistance and expertise on lake-related issues.

The Indiana CLP also participates in the annual Indiana Lake Management Conference as part of its education and outreach activities.

In 2012, IU-SPEA expanded its volunteer monitoring program to include aquatic invasive species monitoring with the goal of helping to detect the presence of invasive species early and to prevent their spread. In 2014, Zebra mussels were added to the program.

The program also holds workshops each year to help increase public understanding of the important zones of a lake that provide essential habitat and ecosystem services. Volunteers that participate in the workshops often expand their monitoring efforts becoming even better lake stewards. This program has been very well received and continues to improve with each workshop.

Volunteers enter their data on the Indiana CLP website. Volunteer data reports are available on the website for the years 1999-2011. Information regarding IDEM's use of the data collected by IU-SPEA staff and students for CWA Section 305(b) and Section 314 assessments can be found in a later section of this report.

COORDINATION WITH OTHER AGENCIES

Nonpoint source (NPS) pollution ranges from urban sources to construction and agricultural run-off which makes cooperation essential across political boundaries and disciplines. Many local, regional, state, and federal agencies play an essential part in addressing NPS pollution, especially at the watershed level. Various agencies in Indiana provide data, technical resources and grants to local watershed groups to assist with planning, infrastructure design review and implementation of best management practices (BMPs) to reduce and prevent NPS pollution. Through coordination and collaboration, IDEM and the other agencies can more effectively focus water quality protection efforts.

IDEM works closely with other state and federal agencies engaged in improving water quality. For example, IDEM serves as a member of the Indiana Conservation Partnership (ICP) – a partnership comprised of eight state and federal agencies and other organizations committed to the goal of promoting conservation.

IDEM also has four watershed specialists that act as liaisons for local, state and federal entities to integrate watershed planning into local level planning efforts. These specialists serve as Section 319(h) project managers and assist in a technical, managerial and financial advisory role for local watershed groups.

IDEM staff in the Wetlands and Storm Water Programs work cooperatively with the U.S. Army Corps of Engineers, IDNR, the U.S. Fish and Wildlife Service (USFWS), local soil and water conservation districts (SWCDs) and other agencies to provide technical assistance and to issue Clean Water Act (CWA) Section 401 water quality certifications, state permits for isolated wetlands, and construction /land disturbance permits to protect water quality.

Indiana Department of Natural Resources

Division of Reclamation, Abandoned Mine Lands Program

IDEM's total Maximum Daily Load (TMDL) and Nonpoint source (NPS) Programs work with IDNR's Abandoned Mine Lands (AML) Program on any TMDL development and potential water quality improvements in watersheds where abandoned coal mines exist. The AML Program contributes to these efforts by sharing water quality data and information regarding the costs and techniques involved in their reclamation projects. The AML Program has also helped educate IDEM's Office of Water Quality (OWQ) staff about areas impacted by acid mine drainage by touring reclamation projects with them at different points in the reclamation process.

Division of Fish and Wildlife, Lake and River Enhancement Program

The goal of the Lake and River Enhancement (LARE) Program in the IDNR Division of Fish and Wildlife is to reduce the amount of sediment and nutrients entering Indiana's lakes and rivers. Coincidental to this goal is an ongoing effort to utilize LARE-funded projects to protect and enhance aquatic habitat for fish and wildlife to ensure the continued viability of Indiana's publicly accessible lakes and streams for multiple uses, including recreational opportunities.

These goals are accomplished through the granting of funds to appropriate sponsoring entities to provide for technical and financial assistance to qualifying projects. These projects range from diagnostic studies of targeted sub-watersheds to determine the design and construction feasibility of measures to reduce erosion and sedimentation in lakes and streams. Indiana law dedicates a portion of LARE funding to the removal of sediment, logjams and other obstructions, and control of invasive aquatic species. And, the program also provides funding to county SWCDs to assist individual landowners in the use of BMPs in targeted watersheds.

In 2015, LARE grants totaled more than two million dollars to projects in numerous counties across the state. Funding for the program comes from a lake and river enhancement fee paid by boat owners annually to the Bureau of Motor Vehicles. LARE projects leverage these funds to benefit not only boaters but everyone who uses Indiana's publicly accessible lakes and streams. LARE-funded projects also help to improve aquatic habitat and reduce the amount of nutrients entering both the Great Lakes and the Mississippi River System.

Indiana Lake Michigan Coastal Program

The purpose of IDNR's Lake Michigan Coastal Program (LMCP) is to enhance the state's role in planning for and managing natural and cultural resources in the coastal region and to support partnerships between federal, state and local agencies, and other organizations.

The LMCP annually awards a variety of grants through its Coastal Grants Program to coastal municipalities, counties, nonprofit groups, and universities for projects that protect and restore natural, cultural and historic resources in Indiana's Lake Michigan coastal region. Examples of how these funds might be used include:

- Protection and restoration of significant natural and cultural resources.
- Programs to prevent the loss of life and property in coastal hazard areas.
- Improved public access for recreational purposes.
- Revitalized urban waterfronts and ports.
- Improved coordination among government agencies when making policy decisions.
- Pollution prevention initiatives, including NPS pollution into coastal water.

The Coastal Nonpoint Pollution Control Program, established in 1990 by Section 6217 of the Coastal Zone Act Reauthorization Amendments, is jointly administered by National Oceanic and Atmospheric Administration (NOAA) and the U.S. Environmental Protection Agency (EPA). The program establishes a set of management measures for states to use in controlling runoff from six main sources: agriculture, forestry, urban areas, marinas, hydromodification (shoreline and stream channel modification), wetlands, and riparian and vegetated treatment systems. The goal is to reduce polluted runoff to coastal waters. All coastal and Great Lakes states and territories that participate in the National Coastal Zone Management Program are required to develop coastal nonpoint pollution control programs. State authorities ensure implementation.

Indiana's Coastal Nonpoint Pollution Control Program received conditional U.S. EPA/NOAA approval in 2008. The LMCP is working closely with IDEM's NPS Program and other NPS program partners to implement management measures specified by U.S. EPA to prevent and mitigate NPS pollution in Lake Michigan coastal watersheds. Documentation indicating how Indiana meets all remaining Coastal NPS Pollution Control Program conditions must be submitted to U.S. EPA/NOAA by September 30, 2019.

The Septic System Coordination Work Group established and facilitated by the LMCP is an example of how coastal partners collaborate to address the management measure for inspection of potentially failing septic systems. The Indiana State Department of Health (ISDH), county

health departments, IDEM, the Northwest Indiana Federal Urban Waters Partnership, local municipal separate storm sewer systems (MS4s), watershed groups, and regional environmental agencies and organizations meet on a regular basis to share information on local conditions and ordinance development, address failing systems, and identify innovative funding mechanisms. In 2014 and 2015 the work group spearheaded adoption and promotion of U.S. EPA's SepticSmart Week by ISDH, IDEM, IDNR, and more than 40 coastal towns, agencies, and organizations.

Indiana Conservation Partnership

IDEM is one of eight agencies and organizations that comprise the Indiana Conservation Partnership (ICP). The ICP works to provide technical, financial, and educational assistance needed to implement conservation practices that are environmentally and economically compatible and that promote good stewardship of Indiana's soil and water resources. IDEM serves on the ICP with the following agencies and organizations:

- Natural Resources Conservation Service (NRCS)
- Farm Service Agency (FSA)
- State Soil Conservation Board
- Indiana State Department of Agriculture (ISDA)
- Indiana Department of Natural Resources (IDNR)
- Indiana Association of Soil and Water Conservation Districts (IASWCD)
- Purdue University Cooperative Extension Service

The ICP meets bimonthly for partner updates, to coordinate and collaborate where possible to optimize their resources – particularly their various cost-share and grant programs – and the technical training they can provide for achieving water quality objectives. The ICP also prepares an annual work plan that defines objectives for up to four conservation focus areas and includes the actions, responsible entities and deadlines for achieving them.

The ICP sponsors a number of initiatives that have the potential to improve water quality in Indiana. One example is the Conservation Cropping Systems Initiative, which provides education on the use of a system of practices that promote soil health. These include cover crops, nutrient and pest management, continuous no-till/strip-till, and precision farming, all of which can provide water quality benefits. Many of the agencies participating in the ICP also provide funding on a continuing or limited basis to address nonpoint source (NPS) pollution such as NRCS's Regional Conservation Partnership Program and ISDA's Clean Water Indiana (CWI) program.

Indiana's State Nutrient Reduction Strategy – a collaborative effort between ISDA and IDEM with contributions from other ICP partners – was developed in 2015 to provide a framework for reducing nutrients entering Indiana waters. As part of this strategy, the ICP has committed to report load reductions of sediment, nitrogen, and phosphorus achieved by the practices installed under various funding authorities of its participating agencies. ISDA technicians were trained by

IDEM NPS staff to use the U.S. EPA Region 5 model to calculate load reductions. For calendar years 2013 and 2014, the ICP has reported the following load reductions for the Indiana:

- Sediment – 2,658,398 tons/year
- Nitrogen – 4,901,344 pounds/year
- Phosphorus – 2,607,847 pounds/year

Indiana's State Nutrient Reduction Strategy along with maps showing the locations at which these reductions were achieved are available at: http://www.in.gov/isda/2991.htm. More detail information about the ICP and its activities can be found at: http://icp.iaswcd.org/.

National Water Quality Initiative

The U.S. Department of Agriculture (USDA) annually targets Farm Bill dollars to the NRCS National Water Quality Initiative (NWQI) Monitoring Project watersheds to promote the implementation of conservation practices. IDEM worked closely with NRCS to prioritize watersheds for the NWQI using the decision criteria of watersheds with impaired waters, high risk natural resource areas, active local watershed groups or conservation interests, and baseline water quality data. As a partner on the NWQI, the U.S. EPA requires IDEM, as the state agency in Indiana charged with implementing the CWA, to contribute monitoring resources to at least one NWQI watershed.

The watershed selected for NWQI monitoring is the School Branch watershed, a small (8.4 square miles) watershed located in northeastern Hendricks County, Indiana. School Branch is nested in the Eagle Creek watershed, which is located in the larger Upper White River Watershed. Land use in the watershed is predominately agricultural with interspersed residential areas. Soil classes in the School Branch watershed are predominantly poorly drained and the watershed is extensively tile drained. School Branch eventually drains into Eagle Creek Reservoir, a primary drinking water source for Indianapolis.

School Branch, Eagle Creek, and the Upper White River watersheds are on Indiana's 303d List of Impaired Waters due to high levels of nutrients. The size of the Eagle Creek and Upper White River watersheds (163 and 2,718 square miles, respectively) and the variety in land uses at these scales has made it difficult to evaluate the effects of conservation and land management strategies. Therefore, focusing on the much smaller School Branch watershed, in which 80% of the land use is agricultural, will allow researchers to adequately isolate water quality impacts from agriculture versus other sources.

Previous attempts to document water quality improvements from agricultural conservation practices at the watershed scale have proven particularly difficult due to the number of issues that can hinder the ability to attribute improvements to specific practices. These issues include:

- Insufficient baseline data
- Incomplete separation of agricultural influences from non-agricultural sources
- Inadequate sampling duration and intensity to account for "lag time", seasonal influences, and storm events
- Insufficient adoption of complete conservation systems within watersheds

A collaboration of federal, state, local, and academic entities along with dedicated conservation-minded farmers in the School Branch watershed has provided a unique monitoring opportunity to assess the chemical, physical, and biological impacts of conservation practices at the watershed, sub-watershed, and edge-of-field scales. The project is currently measuring water quality associated with conservation cropping systems that improve soil health in predominantly corn and soybean row crop agriculture.

The data collected in this watershed will allow evaluation of how production agriculture can complement sustainable water resources. In addition, because the School Branch watershed is nested within two successively larger watersheds of similar land use and hydrology, the project is monitoring and can model impacts of conservation at multiple scales. Historical data is also available to enhance the assessment of improvements over time.

Monitoring and evaluation efforts are being conducted at different scales by IDEM, the U.S. Geological Survey (USGS), the Indiana Geological Survey (IGS), the Marion County Health Department (MCHD), USDA-NRCS, and the Center for Earth and Environmental Services (CEES) at Indiana University - Purdue University, Indianapolis.

Through this monitoring – a collaborative effort without precedent in Indiana – these agencies and organizations are measuring streamflow and groundwater levels, collecting water samples from the stream and edge-of-field surface runoff, and monitoring sub-surface flows for nitrogen, phosphorus, and suspended sediment. Groundwater is also being monitored for nitrogen and phosphorus. Soils are being monitored as well, to determine moisture levels, water-holding capacity, and nutrient content. Supplementary biological indicators will used to evaluate factors affecting water quality and nutrient source tracking from field, in-stream bed and bank, and residential sources and sediment characteristics analyses will be conducted.

Thanks to conservation-minded farmers participating in this study, the research partners collaborating on this project will be better able to distinguish between the water quality effects associated with complete conservation cropping systems from other agricultural and non-agricultural sources of sediment and nutrients.

Indiana Water Monitoring Council

The Indiana Water Monitoring Council (InWMC), is a broad-based, state-wide organization whose primary mission is to enhance the communication, collaboration and coordination of professionals, organizations, and individuals involved in water monitoring within Indiana. As a charter member, IDEM has remained actively involved with the InWMC since its formation in 2008. IDEM staff serve on the board and on a number of InWMC committees to assist with activities to:

- Provide a forum for communication among groups involved in monitoring Indiana waters.
- Promote the sharing of monitoring data and information on effective procedures and protocols for sample collection.
- Facilitate the development of collaborative monitoring strategies.

The Ag Water Monitoring Forum is one example of the type of activities IDEM supports through its work on the InWMC. On August 28, 2015, the InWMC partnered with Indiana Farm Bureau, Purdue University's Agricultural Research Department, and the NRCS to convene a meeting of several leading researchers in the state who are focusing on the effects of conservation practices on water quality.

The meeting focused on the Indiana Nutrient Management and Soil Health Strategy, a 10-year plan developed through a collaborative effort of Indiana agricultural producers to help protect Indiana's soil and water resources through the optimization of nutrient management and implementation of practices to reduce nutrient loss from fields. Researchers and producers shared updates on the strategy and gathered input on recommended protocols and study designs for its continued implementation. The meeting agenda and presentations are available at the InWMC website: http://www.inwmc.org/event-1986971. The Indiana Nutrient Management and Soil Health Strategy, which is an addendum to the Indiana's State Nutrient Reduction Strategy, is also available online at: https://inagnutrients-public.sharepoint.com/.

Multiple state, federal, and local agencies and organizations are monitoring water quality within Indiana, each with its own mandate or reason for monitoring. Although each agency and organization is collecting potentially valuable data on Indiana's water resources, the lack of coordination can lead to duplication of efforts and important information that may be overlooked from the resulting lack of data sharing.

Members of the InWMC have overwhelmingly cited the need for a shared understanding among the water resources community of existing active monitoring networks within Indiana as critical to more effective management of water resources throughout the state. Shortly after its formation, the InWMC's Coordination and Collaboration Committee responded to this need by convening the Integrated Water Monitoring Network Optimization Taskforce to begin working toward a better understanding of the monitoring efforts going on throughout the state.

Soon, the InWMC will release the first product of the taskforce – a study of ongoing monitoring networks throughout Indiana to help environmental managers, researchers, and interested citizens find data from sampling sites with long periods of record. The study will highlight the existing river and stream water quality networks that can provide data and identify new sites that may be needed to augment existing networks and/or eliminate sites that are currently being monitored by more than one group. The paper is currently in draft and is expected to be published later in 2016. In the meantime, those wanting to learn more about the InWMC can find more information about its activities as well as a number of resources online at: www.InWMC.org.

Indiana State Revolving Fund Loan Program

The Indiana State Revolving Fund (SRF) Loan Program administers two different loan programs that provide low-interest loans to Indiana communities, one for projects that improve drinking water and the other for wastewater infrastructure projects. The Indiana Finance Authority administers these programs to protect public health and the environment. Cities, towns, counties, regional sewer/water districts, and conservancy districts are eligible for the programs. Private and not-for-profit public water systems and water authorities are alsoeligible for drinking water SRF loans.

Eligible projects include those that abate water pollution problems, provide greater protection for public health or ensure compliance with either the CWA or the Safe Water Drinking Act. Wastewater projects may include wastewater treatment plant construction or improvements, sewer line extensions to existing unsewered areas, decentralized treatment systems, combined sewer overflow elimination and infiltration/inflow corrections. Drinking water projects may include treatment plant construction and improvements, water storage facilities, water distribution systems and water supply. The program provides additional financial incentives to projects to include green technology, a Brownfields Program[2] project or a sustainable infrastructure component.

Both SRF Loan Programs offer a 20-year, fixed rate loan term. Interest rates on loans through the SRF Programs use a base interest rate, which is reset on the first business day of each January, April, July, and October. The base rate is calculated by using 90 percent of the average 20-year AAA-rated, general obligation bond Municipal Market Data composite index for the most recent calendar month. The base rate is then discounted further based upon a community's median household income from 2010 census data and projected user rates. As an incentive to communities to address nonpoint source water pollution, for projects with a NPS component or green/sustainable infrastructure components, the interest rate on their loans may be reduced by up to 0.5 percent. The program has established a floor of two percent as the lowest possible interest rate, including any reductions.

[2]The Indiana Brownfields Program works in partnership with the U.S. Environmental Protection Agency and other Indiana agencies to assist communities with redevelopment of "brownfield" properties where making productive use redevelopment is complicated due to actual or potential environmental contamination.

The SRF Loan Programs coordinate with state and federal programs, including IDEM's OWQ, to identify ways it might provide assistance to Indiana communities that will ultimately help to achieve common goals. For example, the Clean Water SRF ranking and scoring gives additional points for projects that remove a pollutant source from an impaired stream. This way of scoring increases the likelihood that projects with a water quality benefit will rank high on the SRF project priority list. The funds loaned for these removal projects can be documented as a match, when applicable, for projects submitting grant proposals to the NPS Program. Projects eligible for match must provide water quality benefits to their respective communities and may include, but are not limited to, one or more of the following:

- Wetland restoration/protection
- Erosion control measures
- Groundwater remediation
- Repair or replacement of failing septic systems or connection to sewer
- Storm water BMPs
- Source water and wellhead protection
- Conservation easements
- Agricultural and waste management BMPs

The SRF Loan Programs also serve on the Indiana Rural Wastewater Task Force's Environmental Infrastructure Working Group, which allows the SRF Program the opportunity to provide input and offer financing options to communities for their drinking water and/or wastewater infrastructure needs. The SRF Loan Programs work with communities addressing combined sewer overflows, enforcement issues or those with or nearing a sewer ban.

Over the State Fiscal Years (SFYs) 2014 and 2015, one project with a NPS component saved an additional $3,314,189 over the 20-year term of their loans. While these savings are realized over the longer term, these projects are typically completed within two years and the water quality benefits are achieved much sooner than 20 years.

Annex 4 of the Great Lakes Water Quality Agreement

The 2012 amendments to the Great Lakes Water Quality Agreement (GLWQA) included Annex 4 on nutrients. The Annex 4 binational subcommittee was established in 2013 to coordinate binational actions to manage phosphorus loadings and concentrations in the Great Lakes. Indiana has been an active member of this subcommittee since its inception. The GLWQA Lake Ecosystem Objectives include the following:

- Minimize the extent of hypoxic zones in the Great Lakes due to excessive phosphorous loading with emphasis on Lake Erie.
- Maintain levels of algal biomass below nuisance level conditions.
- Maintain algal species consistent with healthy aquatic ecosystems in nearshore waters.

- Maintain cyanobacteria biomass at levels that do not produce concentrations of toxins that pose a threat to human or ecosystem health.
- Maintain an oligotrophic state, relative algal biomass, and algal species consistent with healthy aquatic ecosystems in the open waters of Lakes Superior, Michigan, Huron and Ontario.
- Maintain mesotrophic conditions in the open waters of the western and central basins of Lake Erie, and oligotrophic conditions in the eastern basin of Lake Erie.

Commitments under the Nutrients Annex include the following:

- By February 2016, establish binational phosphorous objectives, loading targets and allocations for the nearshore and offshore waters to achieve the ecosystem objectives for each lake, starting with Lake Erie.
- Assess and where necessary, develop/implement regulatory and non-regulatory programs/measures to reduce phosphorous loadings from agricultural, rural non-farm, urban and industrial point and nonpoint sources.
- By 2018, develop a binational phosphorous reduction strategy and domestic action plans designed to meet nearshore and open water phosphorous objectives and loading targets for Lake Erie.

On February 22, 2016, the United States and Canada adopted new phosphorous reduction targets for Lake Erie, which are noted in Table 6 (Appendix A). Indiana's Domestic Action Plan (DAP) will be led by IDEM and developed by a steering committee comprised of representatives from different stakeholder sectors. The DAP will follow an outline that includes purpose, background, goals, objectives, tactics, and measuring and reporting progress.

Indiana's portion of the Western Lake Erie Basin is comprised of the St. Joseph, Maumee, Auglaize, and St. Marys watersheds. The St. Joseph River and the St. Marys River enter Indiana from Ohio and, at their confluence, form the Maumee River. The Maumee flows eastward into Ohio and into Lake Erie. The 40 percent reduction in spring-time total phosphorus and soluble reactive phosphorus noted in Table 6 for the Maumee River translates to a flow-weighted mean concentration of 0.23 milligrams per liter total phosphorus and 0.05 milligrams per liter soluble reactive phosphorus. Progress toward these target values will be measured on the Maumee River as close to the Indiana-Ohio border as feasible. A draft of the DAP will be available by December 31, 2016.

COST/BENEFIT ASSESSMENT

Water is a vital component of the economic health of Indiana, which is diverse in its agriculture, industry, population, and environmental resources. Finding the right balance between these often competing needs promises the benefits associated with a robust economy, high quality of life, and healthy ecosystems. However, the finances available to restore, enhance, and protect our water resources is limited in comparison to the work needed to ensure that balance. The following is a discussion of some of the revenue sources available to state, regional, and local

entities to achieve the objectives of the Clean Water Act (CWA) as well as case studies that illustrate improvements in water quality and their resulting benefits.

Funding Water Quality Improvements through Better Infrastructure

Since 1992, the State Revolving Fund (SRF) Programs have provided more than $3.7 billion dollars for more than 679 wastewater (Figure 2, Appendix B) and drinking water (Figure 3, Appendix B) infrastructure improvement projects. SRF Program assistance to communities is expected to result in water quality benefits for many Indiana rivers and streams.

In state fiscal years (SFYs) 2014 and 2015, the Wastewater SRF Program closed 34 loans totaling almost $300 million. This provided an estimated savings (compared to open market interest rates) of more than $64.5 million. In SFYs 2014 and 2015, the Drinking Water SRF Program closed on 22 loans for totaling almost $40 million with savings to Indiana communities estimated at more than $19 million (Table 7, Appendix A).

Successes in Water Quality Improvement through Strategic Measures

IDEM has reported improvements in water quality in almost 220 miles of streams in 12 different watersheds since 2007 to the U.S. Environmental Protection Agency (U.S. EPA) to meet measures outlined in U.S. EPA's strategic plan (Table 5). Measure SP-12 (commonly called "Measure W") is used by U.S. EPA to track improvements in water quality conditions in impaired watersheds resulting from watershed planning and restoration activities. For the purposes of meeting this measure, improvements may be demonstrated by the removal of at least 40 percent of the impairments or impaired miles/acres in the watershed from the state's 303(d) List of Impaired Waters or by valid scientific information that indicates significant watershed-wide improvement in one or more water quality parameters associated with impairments listed on Indiana's 2002 303(d) list. WQ-10 is a performance measure that requires states to develop Nonpoint Source (NPS) Program "Success Stories" and submit them to U.S. EPA for the purposes of tracking how NPS restoration efforts are improving water quality. To meet this measure, IDEM must identify nonpoint source-impaired waters that have been improved as a result of watershed restoration efforts funded in whole or in part by IDEM's NPS Program.

In 2014 and 2015, IDEM reported water quality improvements in the Emma Creek and Indian Creek watersheds, respectively. Two additional stories will be reported in 2016. These successes and others can be found on U.S. EPA's Nonpoint Source Success Stories website.

Reducing Livestock-Induced Pollution in Emma Creek

Emma Creek is a 38.2-mile tributary to the Little Elkhart River, which flows through southeastern Lagrange County in northeastern Indiana. IDEM monitored a small, 2.3-mile tributary to Emma Creek in 2000, collecting fish community and habitat data along with water chemistry samples. Analysis of fish community data showed an Index of Biotic Integrity score of 14, well below the score necessary to be considered supportive of the biological integrity. In addition, habitat and chemistry data collected by IDEM in 2000 revealed that siltation, excess

nutrients and low dissolved oxygen (particularly during the summer months) contributed to impaired biotic communities in the stream. IDEM's analyses of water samples also showed an ammonia level much higher than the state's water quality criterion for the protection of aquatic life. These results prompted IDEM to add the stream to the 303(d) list in 2002 for impaired biotic communities (IBC) and ammonia. Suspected pollutant sources included barnyard runoff, failing septic systems, and livestock access to the stream.

The Lagrange County Soil and Water Conservation District (SWCD) developed a watershed management plan (WMP) for the Little Elkhart River in 2007 using water quality data collected from June 2005 through December 2006 to guide the efforts. As part of the WMP implementation, the SWCD conducted a paired watershed study on the upper and lower Emma Creek subwatersheds from 2009 to 2011 (Figure 4, Appendix B). In the paired study, the lower watershed was used as the control watershed while project partners implemented best management practices (BMPs) in the upper watershed – the treatment watershed.

Between 2009 and 2010, landowners installed numerous BMPs in the Little Elkhart River watershed including the upper Emma Creek treatment watershed. As a result, water quality in the Emma Creek Tributary is improving. Data collected along the impaired segment (Figure 4) show that pollutant levels decreased in 2009–2010 as compared to 2007–2008 (Table 8, Appendix A).

Key to this restoration effort was the participation of members of the Amish community, which comprises about 75 percent of the agrarian population of the Emma Creek watershed. Participation in cost-share programs by this community has been traditionally low. Outreach and education proved to be a successful strategy in convincing the community to change their management practices to protect water quality, including installing some BMPs without financial assistance.

Data collected by the SWCD at the mouth of Emma Creek showed similar improvements in water quality, indicating that the benefits realized by the BMPs implemented in the upper watershed carry through the watershed and into the Little Elkhart River. Net load reductions in the Emma Creek watershed were 42 percent for *E. coli*, 20 percent for nitrates, 58 percent for total suspended solids, 63 percent for total phosphorus, and 89 percent for ammonia. With the exception of *E. coli*, all of these parameters are associated with watershed-based improvements eventually leading to healthier biological communities.

In 2011 IDEM returned to the Emma Creek tributary to monitor for improvements in the fish community. The IBI score indicated that no significant change in biological condition has yet occurred suggesting a time-lag between BMP implementation and the habitat recovery necessary to fully support a healthy fish community. Although the SWCD data appear to show that ammonia levels are meeting water quality standards, the stream cannot be removed from the 303(d) list for ammonia until data meeting IDEM's data quality requirements for CWA Section 305(b) assessments are available. The impaired segment must remain listed as impaired for both IBC and ammonia.

These water quality improvements are the result of collaboration between the Lagrange County SWCD, IDEM, Indiana Department of Natural Resources, the Great Lakes Commission and the Natural Resources Conservation Service (NRCS). The Lagrange County SWCD sponsored the development of the WMP and coordinated the implementation of the paired watershed study with funding and assistance from IDEM. IDEM also provided more than 1.7 million in CWA Section 319(h) funding to implement BMPs. The Indiana Department of Natural Resources and Great Lakes Commission provided additional funding for watershed land treatment practices and implementation of the WMP, with contributions of $75,000 and $515,000, respectively. NRCS provided engineering design and support. And, landowners in the watershed paid $30,000 out-of-pocket to install BMPs without the added incentive of cost-share funding.

Watershed Restoration Work Improved a Section of Indian Creek

The Devils Backbone section of Indian Creek is a 21-mile reach in Harrison County, Indiana, just upstream of Indian Creek's confluence with the Ohio River (Figure 5, Appendix B). Water quality data collected from this reach by IDEM in 2000 indicated that the geometric mean of the *E. coli* samples collected as well as the individual sample results exceeded the state's water quality criteria for recreational use. In addition, four out of the six dissolved oxygen results were below the levels set in the water quality standards for the protection of aquatic life use. Given these results, IDEM added the Devils Backbone section of Indian Creek to the 303(d) list in 2002 for and *E. coli* and low dissolved oxygen.

From 1996 to 2010, numerous state and federal partners and other organizations funded watershed planning and restoration efforts in the Indian Creek watershed. As a result, water quality conditions in the Devils Backbone reach have improved.

From 1996 to 2006 The Nature Conservancy (TNC) provided $210,000 is funding for stream restoration and outreach projects in the Indian Creek watershed. Then in 2006, IDEM awarded the Harrison County Regional Sewer District a CWA Section 205(j) almost $100 thousand in grant funds to develop a watershed management plan (WMP) for the Indian Creek watershed. The resulting WMP helped to inform the installation of numerous BMPs throughout the watershed, targeting areas where they might have the greatest impact.

Project partners in the Indian Creek watershed used $687,567 in financial and technical assistance provided through the NRCS' Environmental Quality Incentives Program (EQIP) to implement numerous conservation practices between 2003 and 2010. Additional practices were also installed during this time with $55,094 in Farm Service Agency (FSA) Conservation Reserve Program (CRP) funds. Harrison County also allocated $950,000 between 2002 and 2010 toward agricultural BMPs in the county and used funding from the Clean Water Indiana state fund to install additional BMPs in the Indian Creek watershed.

In 2010, IDEM returned to monitor the Devils Backbone reach of Indian Creek and found that water quality has improved, with results meeting the state's water quality standards for *E. coli* and dissolved oxygen. Based on these results, Indiana removed the Devils Backbone section of Indian Creek from its 2014 CWA section 303(d) impaired waters list.

Grand Calumet River Indiana Harbor Ship Canal Area of Concern

Prior to strict environmental regulations industries, factories, and municipal sanitary districts commonly discharged chemicals and contaminants directly into the Grand Calumet River in northwest Indiana. The accumulation of such pollution containing oils and greases in the river sediments caused drastic harm to the ecosystem. By the 1980s, new environmental regulations changed how municipalities and industries could operate, which reduced the amount of contaminants being discharged into the river. However, even with new operational standards the impacts of legacy contaminants – those discharge prior to the change in regulations – had already caused great harm to the river. The Grand Calumet River was highly impaired for human and wildlife use and as a result, was identified by the International Joint Commission as an Area of Concern (AOC). The Grand Calumet River Indiana Harbor Ship Canal AOC is one of 43 AOCs identified by the commission in its 1978 Great Lakes Water Quality Agreement (GLWQA). The GLWQA requires that each AOC have a Remedial Action Plan (RAP) developed for it to provide a blueprint for the remediation of 14 designated beneficial use impairments (BUIs) of the waterway.

1. Restrictions on fish and wildlife consumption
2. Tainting of fish and wildlife flavor
3. Degradation of fish and wildlife populations
4. Fish tumors or other deformities
5. Bird or animal deformities or reproduction problems
6. Degradation of benthos
7. Restriction on dredging activities
8. Eutrophication or undesirable algae
9. Restrictions on drinking water consumption, or taste and odor
10. Beach closings
11. Degradation of aesthetics
12. Added costs to agriculture and industry
13. Degradation of phytoplankton and zooplankton populations
14. Loss of fish and wildlife habitat

For Indiana this meant that IDEM would take the lead in developing the RAP with the aid of the Citizens Advisory for the Remediation of the Environment (CARE) Committee – a group of individuals selected by IDEM to provide input into the RAP planning process.

The RAP identifies key projects including sediment remediation for the entire river system as well as habitat restoration on over 900 acres. Through the assistance of the Great Lakes Legacy Act (GLLA) and the Great Lakes Restoration Initiative (GLRI) as well as funding from state and local sponsors, significant progress has been made toward the RAP restoration goals. In 2011 and 2012 respectively BUI #12 and BUI #9 were removed from the list of impairments for the Grand Calumet River Indiana Harbor Ship Canal AOC. Since the early 2000s more that 3.25 million cubic yards of contaminated sediments containing heavy metals, polycyclic aromatic hydrocarbons, and polychlorinated biphenyls have been removed. An additional 14,600 cubic

yards of sediment are expected to be removed by the end of 2016. Habitat restoration has also been a priority, with GLLA projects restoring 84 acres of wetland and riverine marshes including Roxana Marsh in East Chicago, Indiana and Seidner Dune and Swale in Hammond, Indiana. In addition, the GLRI has funded the restoration of more than 800 acres throughout the AOC including key dune and swale habitats such as Clark and Pine Nature Preserve, DuPont Natural Area and Gibson Woods Nature Preserve. GLRI-funded projects are expected to conclude in 2020.

Monitoring throughout the restoration process is essential to ensure work is on track to meet restoration goals. IDEM has implemented monitoring projects to assess fish and benthic communities, water chemistry and aesthetics and provides GLRI funds to universities and federal agencies to monitor algal and plankton populations in the river and conduct microbial source tracking at AOC beaches.

SPECIAL STATE CONCERNS AND RECOMMENDATIONS

Reductions in federal and state resources for data collection and analysis coupled with increased federal directives and competing policy and program objectives continue to strain IDEM's ability to optimize its limited resources to monitor Indiana waters in order to support Office of Water Quality (OWQ) programs and emerging state priorities.

IDEM acknowledges that fiscal responsibility may necessitate reductions in funding and staffing levels. In light of these constraints, IDEM recommends the following actions:

- Increase states' flexibility to allocate the federal funding it receives to take advantage of and optimize other funding sources.
- Combine supplemental and base funding to states provided through Clean Water Act (CWA) Section 106 funds so that in lean times, maintaining current monitoring efforts may be considered by the U.S. Environmental Protection Agency (U.S. EPA) as a valid use of supplemental funds.
- Eliminate the use of states' 2002 303(d) lists as the baseline for showing CWA program successes – this is a false construct that fails to recognize that other more recently listed waters may be better candidates for restoration in the short term.
- Acknowledge the continuum of progress demonstrated by social indicators or other factors in addition to measurable water quality improvements.

SURFACE WATER MONITORING AND ASSESSMENT

IDEM conducts most of its surface water monitoring through various programs in the Watershed Assessment and Planning Branch (WAPB). This section includes a discussion of IDEM's surface water monitoring strategy, a description of the assessment methodology for classifying all surface waters according to the degree to which they meet their designated uses, and the most current assessment results available. This section also provides a description of Indiana's Wetlands Program, an analysis of surface water quality trends, and information on public health issues.

SURFACE WATER MONITORING STRATEGY

The United States Environmental Protection Agency (U.S. EPA) recommends that states develop a comprehensive monitoring program strategy for collecting the data and information needed to address its water quality management needs. IDEM developed its first IDEM's Water Quality Monitoring Strategy (WQMS) in 1995 (IDEM, 1995), which has undergone a number of revisions, most recently in 2011 (IDEM, 2010). Table 10 shows the Office of Water Quality's (OWQ's) primary water quality monitoring objectives identified in IDEM WQMS and the types of monitoring needed to meet them.

IDEM's WQMS uses a watershed approach to prioritize water quality management needs and the monitoring activities intended to meet them. Most of IDEM's surface water monitoring is conducted by the WAPB within IDEM's Office of Water Quality (OWQ). The WAPB includes several Clean Water Act (CWA) programs and conducts both targeted and probabilistic (randomized) monitoring to meet the following objectives:

- To fulfill requirements of the CWA Sections 305(b), 303(d) and 314 to assess all waters of the state to determine if they are meeting their designated uses and to identify those waters that are not.
- To support OWQ programs including WQ standards development, NPDES permitting, and compliance.
- To support public health advisories and address emerging water quality issues.
- To support watershed planning and restoration activities.
- To determine WQ trends and evaluate performance of programs.

For its Probabilistic Monitoring Program, IDEM has divided the state into nine major water management basins and employs a rotating basin strategy that targets a different basin each year (Figure 6, Appendix B). IDEM's 305(b) assessment and 303(d) listing processes also follow this rotating basin approach, which ensures that all basins in the state are assessed at least once every nine years.

Probabilistic monitoring is conducted within a given basin and the results are reviewed for quality assurance and quality control in year one. In year two, the quality-assured data are used to make water quality assessments for the basin. These assessments and any waterbody impairments identified through these assessments are reported in the next biennial integrated reporting cycle. Appendix G provides a detailed schedule of IDEM's 305(b) assessment and reporting, and 303(d) listing activities before and after the change made to the rotating basin approach.

IDEM's targeted monitoring programs select sites based on their specific program objectives. Therefore, data collected from these programs in a given year may come from anywhere in the state, which may or may not include the basin monitored by the Probabilistic Monitoring Program that year. These data are likewise quality assured and are assessed as they become available.

The following monitoring programs are employed to achieve the above objectives:

- Probabilistic monitoring in one basin/year on a nine-year rotating basin cycle.
- Fixed station monitoring at 163 sites across the state.
- Fish tissue and sediment contaminants' monitoring on a five-year rotating basin cycle.
- Targeted monitoring for TMDL reassessments and development, watershed baseline planning, and performance measures.
- Cyanobacteria monitoring of 10-12 lakes.
- Special studies such as that conducted to support hydrographically controlled release facilities.

Lakes monitoring is conducted by the Indiana Clean Lakes Program (CLP) under contract for IDEM and is discussed in later sections of this report.

Probabilistic Monitoring Program

IDEM's Probabilistic Monitoring Program samples at least 38 randomly selected sites in a given basin and is the primary source of data used in IDEM's CWA assessments. This program, which focuses specifically on rivers and streams, is designed to characterize the overall water quality in each major river basin and to identify specific waterbodies within each basin that are not fully supporting their beneficial designated uses.

IDEM uses the data collected by the Probabilistic Monitoring Program to make water quality assessments of rivers and streams at two different spatial scales, reach-specific assessments and basin-wide assessments.

Reach-specific Use Support Assessments

IDEM uses the data collected by the Watershed Monitoring Program to make use support assessments of the stream or stream reach from which they were collected and any other reaches for which the results are representative. For these assessments, the water quality data are compared to applicable water quality criteria to determine whether or not the reach or reaches represented by the data are supporting one or more of their designated uses. Results from IDEM's reach-specific assessments are summarized in the "Rivers and Streams Water Quality Assessment" section of this report. In addition to data collected through the Watershed Monitoring program, IDEM also uses data collected by the agency's other water monitoring programs to make reach-specific assessments and may use data from external sources if they meet the necessary data quality requirements.

Comprehensive Use Support Assessments

Comprehensive assessments are statistical calculations that allow IDEM to predict with reasonable certainty the percentage of Indiana's rivers and streams within a given basin that are either impaired or supporting their designated uses. Comprehensive use support assessments are

based solely on the reach-specific assessment results from data collected by the Probabilistic Monitoring Program because, unlike data collected through other IDEM monitoring programs and most external organizations, these data are collected using a probability-based sampling design, which is necessary to make statistically valid calculations.

IDEM's comprehensive use support assessments and its reach-specific assessments of designated use support provide water quality information in two very different ways, and IDEM uses both types of assessments to meet different CWA requirements. The agency's comprehensive assessments, which rely on probabilistic data, provide statistically valid statements about the overall water quality throughout Indiana on a basin level, which allows IDEM to meet the CWA requirement to assess all the waters of the state. These results are stated as the percentage of the total stream miles in each basin meeting their designated uses and the percentage that are impaired. These percentages are statistically derived and cannot be applied to specific streams or stream reaches. Given this, they do not identify where specific impairments exist, which is required by Section 303(d) of the CWA. Information regarding the location of impairments is provided by IDEM's reach-specific results, which are based on data collected from a variety of sources including IDEM's Probabilistic Monitoring Program.

This report provides comprehensive assessments for watersheds in all of Indiana's major basins (Appendix H) in addition to summaries of results from IDEM reach-specific assessments (Appendix I). This report also includes the 2016 draft 303(d) List of Impaired Waters (N), which identifies waters that are impaired for one or more designated uses.

This report builds on the water quality assessment results reported in the 2014 Integrated Report and includes revised assessments for the Patoka River monitored in 2012 and the East Fork White River monitored in 2013. This report also contains assessment information based on total maximum daily loads developed in other basins throughout Indiana.

DATA QUALITY ASSURANCE AND QUALITY CONTROL

To ensure the quality of the data used in IDEM's Clean Water Act Section 305(b) assessments, all surface water monitoring is conducted in accordance with IDEM's quality assurance project plan (QAPP) for its surface water monitoring programs. This QAPP is part of IDEM's overall quality management plan approved by the U.S. Environmental Protection Agency (EPA). IDEM's surface water monitoring QAPP was most recently revised in October 2004 and complies with the 2002 U.S. EPA guidance (U.S. EPA, 2002).

The QAPP outlines specific data quality objectives and serves as a tool for planning for the collection of environmental data to support IDEM Office of Water Quality needs. Additionally, the QAPP describes a well-defined data quality assessment process for reviewing analytical data and categorizing analytical results in one of four levels of data quality. These data quality levels are used to determine the usability of the data for water quality assessments and other decisions.

DATA MANAGEMENT

Management of Water Quality Monitoring Data

IDEM's Watershed Assessment and Planning Branch (WAPB) in the Office of Water Quality (OWQ) maintains its surface water quality data in the Assessment Information Management System (AIMS) database. The AIMS houses several types of data including surface water chemistry data, fish and macroinvertebrate community data, assessments of habitat quality, results from algal monitoring, and fish tissue and sediment contaminant data.

Water chemistry and fish community results from water quality monitoring programs which were collected prior to 2014 have been uploaded into the new U.S. Environmental Protection Agency (EPA) EnviroFacts Data Warehouse through the Water Quality Exchange (WQX). IDEM is continuing modifications to the AIMS database that will improve quality control and usability of results uploaded through the WQX.

Recent modifications to the AIMS database now allow for more efficient datasheet upload and retrieval with additional search functions for faster query building through a user-friendly interface for staff members. AIMS also now allows for storage of additional water quality data from nonpoint source (NPS) projects (including estimated load reductions) and third-party datasets for potential use in assessing waters for the integrated report. IDEM is now receiving data from NPS projects for import into the AIMS database. IDEM is working to develop and implement standard operating procedures for receiving, assessing, and importing water quality data from third-party sources to make them more readily available for potential use in IDEM's water quality assessments.

The load reduction estimates provided by the NPS project sponsors, which are housed in AIMS and reported to U.S. EPA through its Grants Reporting and Tracking System are included in this report (Table 4). The load reductions are estimated using models and are used to assist in the evaluation of water quality sampling data collected by the project sponsors and IDEM WAPB staff.

Management of Water Quality Assessment Information

IDEM's WAPB maintains IDEM's assessment database (ADB). The assessment database houses the CWA Section 305(b) assessment decisions that have been made on the basis of the results stored in the AIMS database.

In the ADB, water quality assessment information is associated with a specific waterbody assessment unit (AU), which is assigned a unique assessment unit identifier (AUID). The geographical extent and location of each AU within a given watershed based on its 12- or 14-digit hydrologic unit code (HUC)[3] is defined for mapping purposes through a process called

[3] Hydrologic unit codes (HUCs) are a numbering system used to identify watersheds at various scales. The length of the code corresponds to the relative size of the watershed with 12- or 14-digit HUCs assigned to smaller watersheds that lie within larger watersheds, which are identified by 8- or 10-digit HUCs.

reach indexing. Reach indexing uses tools that work within geographical information systems (GIS) software to associate one or more reaches of a given waterbody to a single AU and to "key" these AUs to the National Hydrography Dataset (NHD)[4]. This "key" is called the Reach Index. By associating the information in the ADB to its geographic location, the Reach Index allows IDEM to display assessment information on a map through the use of GIS software.

Indiana lakes and reservoirs, including Lake Michigan, are each treated as a single AU and assigned an AUID based on the 12- or 14-digit watershed in which they are located. Sizes are reported in acres.

Indiana's Lake Michigan shoreline is divided into five separate AUs with AUIDs based on the 8-digit HUC in which each shoreline reach is located. The shoreline is measured and reported in miles.

All flowing waters are measured and reported in miles. The Ohio River is divided into 69 AUs ranging in size between 2-14 miles and with AUIDs that are likewise associated with the 8-digit HUCs in which they are located. Other Indiana rivers and streams in the Reach Index may be divided or combined into one or more AUs, each of which is assigned an AUID based on the 12-digit HUC in which it is located. The length of a stream AU can vary, and a single AU may or may not represent the entire stream to which it is associated. For example, large rivers are commonly broken into smaller, separate AUs while smaller streams may be grouped together into a single, "catchment" AU based on hydrology and other factors that can affect water quality. More detailed information on how IDEM determines the size extent of a given AU is provided in its Consolidated Assessment and Listing Methodology (Appendix N).

IDEM's biennial Integrated Report (IR) to U.S. EPA includes the ADB. U.S. EPA extracts the data contained in the ADB for incorporation into its Assessment, TMDL Tracking and Implementation System (ATTAINS). ATTAINS is a national database U.S. EPA uses to evaluate assessment data submitted by states and to make those data available to the public online.

In 2014, U.S. EPA convened four workgroups to redesign ATTAINS. These workgroups were comprised of headquarter and regional staff along with staff from several state agencies. IDEM participated in two of these workgroups to help:

- Define the data elements needed in the redesigned ATTAINS.
- Draft an extensible markup language schema for exchanging integrated reporting information between the states and U.S. EPA.
- Develop recommendations on data exchange approaches and system design.

[4] The NHD is a database created by the U.S. EPA and the United States Geological Survey that provides a comprehensive coverage of hydrographic data for the United States. It uniquely identifies and interconnects the stream segments that comprise the nation's surface water drainage system and contains information for other common surface waterbodies such as lakes, reservoirs, estuaries, and coastlines.

The new ATTAINS became available for states to begin using in late 2015. In 2016, IDEM will begin migrating the assessment data presently housed in its ADB to the new ATTAINS online. Once this process is complete and the data verified, IDEM will begin entering its water quality assessments and other integrated reporting information directly into ATTAINS instead of sending its ADB to U.S. EPA for upload into the system.

WATER QUALITY ASSESSMENTS

Indiana's water quality standards (WQS) provide the basis for IDEM's Clean Water Act (CWA) Section 305(b) water quality assessments and are intended to protect the beneficial uses for Indiana waters. IDEM's water quality assessments determine the degree to which Indiana's waterbodies are supporting aquatic life use, recreational uses, and fishable uses. IDEM also assesses drinking water use support on surface waters that serve as a public water supply. There are additional uses for Indiana waters described in the state's WQS. However, IDEM limits its assessments to these four because the criteria in place to protect them are more stringent than those necessary to protect other uses. Thus, by protecting these uses, other uses such as agricultural and industrial uses are also protected.

Water Quality Data Used to Make Designated Use Assessments

IDEM uses all existing and readily available data to make its CWA Section 305(b) water quality assessments, including data collected by IDEM's water quality monitoring programs as well as external sources whenever possible. Internally, IDEM draws from the following Office of Water Quality (OWQ) monitoring programs:

- Probabilistic Monitoring Program
- Fixed Station Monitoring Program
- Contaminants Monitoring Program
- Performance Measure Monitoring Program
- Special Studies Program
- Watershed Characterization Program

In addition to the water quality data IDEM collects, the agency reviews data from other sources for potential use in its CWA assessments, including data collected through partnerships with other state and federal agencies and by nonpoint source grant projects, including the Indiana Clean Lakes Program (CLP).

IDEM is committed to making greater use of external data not only in its CWA Section 305(b) assessments but wherever possible in all OWQ programs. On September 23, 2015, IDEM launched its External Data Framework (EDF) to provide a systematic, transparent, and voluntary means for external organizations to share the water quality data they collect with IDEM for possible use in its CWA assessment and listing processes and other OWQ programs.

A number of organizations submitted their data sets in response to solicitations conducted by IDEM when the EDF was still under development. IDEM was able to complete its review of

these data and found that the external data sets shown in Table 11 (Appendix A) met the necessary data quality requirements for the 305(b) and 303(d) assessment and listing processes that were in place at the time they were submitted. However, with continued development of EDF, these requirements have since been revised.

In addition, the data sets in Table 11 were not standardized in any way in terms of their format or the data quality documentation provided. The time and staff resources required to review data sets from varied sources in various formats and with various levels of data quality documentation have long been significant barriers to the use of external data in the development of state 303(d) lists. The EDF will remove these barriers going forward.

For the 2016 cycle, IDEM focused its resources on completing development of the EDF rather than investing the significant time that would be required to re-evaluate data sets that may no longer be representative of current conditions. Now that the EDF is complete, IDEM will contact early EDF participants and work with them directly to submit any more current data they might have through one of the three data submittal processes built into the EDF. These processes are designed to facilitate broader solicitation and more efficient data quality review of external data going forward. In cases where the data set originally submitted are the only data available for the waterbody in question, IDEM will evaluate the data set as time allows to determine if the results are reliable for assessment despite their age.

External organizations can learn more about the EDF and how to participate on the agency's EDF website at http://in.gov/idem/cleanwater/2485.htm. Those interested in sharing their water quality data through the EDF and may begin submitting data sets to IDEM in one of three ways through the Secondary Data Portal at: http://www.hoosierriverwatch.com/portal/

Water Quality Assessment Methodology

IDEM's CWA Section 305(b) water quality assessments are conducted in accordance with its Consolidated Assessment and Listing Methodology (CALM), which is provided in Appendix N.

Water quality assessments are made for each designated use and waterbody type by comparing the available with the applicable WQS following the methods articulated in the CALM and summarized in Table 12 (Appendix A). Assessment results are then entered into IDEM's Assessment Database, which IDEM uses to compile its Consolidated List and 303(d) List of Impaired Waters.

Assessment Methods for Public Water Supply

IDEM's methods for determining support of the public water supply (previously referred to as the "Drinking Water Use") have changed very little since 2002 when IDEM published its first CALM. While these methods provide the ability to make assessments for a wide variety of potential drinking water contaminants, generally, there is very little data available for use in making such assessments. In addition, for lakes and reservoirs, IDEM's method for determining whether the source water is supporting the public water supply use relies solely on whether or

not a facility has applied for a permit to apply chemicals on the waterbody to control algae – an indirect measure of use support lacking the follow-through necessary to determine whether the chemicals were in fact applied.

Given these issues, IDEM convened an internal work group in 2015 to review the current methodology and explore ways to improve the assessment of the quality of surface waters designated as source waters for public water supplies. The result of this effort is a new set of methods for determining use support for waters that serve as a source of public water supply.

IDEM has published these methods in its notice of comment period for the draft 2016 303(d) list (Appendix L). IDEM hopes to implement these methods beginning with the 2018 integrated reporting cycle. However, further refinements may be needed based on the information received during the public comment period. In the meantime, although IDEM currently lacks the resources to support a new monitoring program dedicated to monitoring source waters for public water supplies, IDEM is continuing to explore strategies for increasing the amount of available data for source water assessments. IDEM believes that these methods, coupled with more readily available data for assessments, will result in greater protection of Indiana's public water supplies going forward.

Assessment Methods for the Ohio River

For the Ohio River, IDEM collaborates with the Ohio River Sanitation Commission (ORSANCO) to conduct water quality assessments of the river reaches that border Indiana. ORSANCO is an interstate water pollution control agency for the Ohio River established through a compact agreement between member states and approved by Congress. Under the terms of the compact, member states cooperate in the control of water pollution in the Ohio River Basin.

ORSANCO collects most of the data used to make assessments and works with the compact states to determine the degree to which the Ohio River is meeting its designated uses. Based on the results of this collaborative assessment, ORSANCO produces a CWA Section 305(b) water quality assessment report for the Ohio River every two years. Member states then incorporate those results into their individual CWA 303(d) lists in accordance with their individual 303(d) listing methods. A more detailed discussion of the Ohio River assessments can be found in IDEM's CALM (Appendix NAppendix N).

Although the assessment methodology for the Ohio River differs somewhat from the methods IDEM uses to assess other Indiana rivers and streams, the assessment results for all rivers and streams in Indiana, including the Ohio River are combined for the purposes of this report.

REPORTING WATER QUALITY ASSESSMENT RESULTS

Indiana's Consolidated List

For the purposes of CWA 305(b) reporting, IDEM employs a multi-category approach to develop the state's Consolidated List, which provides a full inventory of all Indiana waters IDEM tracks in its ADB and information regarding the degree to which they are supporting their designated uses.

With a multi-category approach, every waterbody in the ADB is placed into one of five categories (or subcategories where applicable) for each of the following designated uses: aquatic life use, recreational use, fish consumption[5], and public water supply[6].

For each use, a waterbody is assessed as fully supporting when it is found to be meeting the WQS applicable to the use. When a waterbody is not meeting one or more of the applicable standards, it is considered impaired, meaning it is not fully supporting the use. Figure 7 in Appendix B illustrates the decision-making process IDEM uses to determine the appropriate category for each use for which a waterbody is designated. A more detailed explanation of the five categories and their subcategories is provided in IDEM's CALM (Appendix N). The following provides a summary:

Category 1	The available data and/or information indicate that all designated uses are supported and no use is threatened.
Category 2	The available data/or information indicate the individual designated use is supported.
Category 3	The available data and/or other information are insufficient data to determine if the individual designated use is supported.
Category 4	The available data and/or information indicate that the individual designated use is impaired or threatened but a total maximum daily load (TMDL) is not required.
Category 5	The available data and/or information indicate the individual designated use is impaired or threatened, and a TMDL is required.

Indiana's Consolidated List for 2016 is provided in Appendix I and includes the results of all assessments of Indiana waters to date.

[5]Fish consumption is not a designated use in Indiana's WQS. IDEM assesses Indiana waters for fish consumption pursuant to current U.S. EPA policy and in keeping with CWA goals, which are reflected in Indiana's WQS (327 IAC 2-1-1.5 and 2-1.5-3.

[6]Applicable only to waters that serve as a routine or emergency source of water for a public water system.

Indiana's 303(d) List of Impaired Waters

The 303(d) List of Impaired Waters is a subset of the Consolidated List and includes only Category 5 waters – those for which a TMDL is required. Unlike the Consolidated List, which is required under CWA Section 305(b), the CWA Section 303(d) List of Impaired Waters is subject to U.S. EPA approval.

On May 8, 2013, U.S. EPA partially approved Indiana's 2010 303(d) List of Impaired Waters. U.S. EPA's partial approval is based on concerns regarding IDEM's methods for evaluating metals data for the purposes of determining impairment. More detail about these concerns and IDEM's response to them can be found online at: http://www.in.gov/idem/nps/3889.htm.

The issues delaying full approval by U.S. EPA remain unresolved. In the meantime, IDEM has continued to conduct water quality assessments and remains committed to reporting the results of its assessments to the public.

To ensure that Indiana's 303(d) list contains the most up-to-date assessment information, each 303(d) list builds upon the list developed for the previous two-year reporting cycle. Therefore, to develop its 2012 303(d) List of Impaired Waters, IDEM used the approved portion of the 2010 303(d) list as a starting point. IDEM used the same approach to develop the 2014 303(d) list and now, the draft 2016 303(d) list, building each from the list submitted for the previous cycle.

The Notice of Public Comment Period, which includes the draft 2016 Section 303(d) Impaired Waters List (Category 5 of the Consolidated List) and the Consolidated Assessment and Listing Methodology used to develop it is included in Appendix L of this report. The draft 2016 303(d) list reflects the most current information IDEM has regarding the status of impairment of Indiana's surface waters.

CLEAN WATER ACT SECTION 305(B) ASSESSMENTS

This report provides summary assessment results for designated use support for waters throughout Indiana based on waterbody type. Lakes and reservoirs are each assigned a single AUID with sizes reported in acres. Due to its large size and unique characteristics as compared to other freshwater lakes in Indiana, Lake Michigan and its shoreline are each discussed in separate sections of this report. Results for Lake Michigan reported in acres, and results for the shoreline are reported in miles. Assessment information for rivers and streams are likewise discussed in a separate section of this report with results given in miles.

Each section provides a table summarizing designated use support by individual use and total size in miles or acres. It should be noted that these values are not additive because a single waterbody is typically designated for at least three uses and sometimes four. Thus, adding the total values reported for each use would result in far more stream miles and lake acres than what actually exists in Indiana.

Summary results regarding the causes/stressors and sources of impairment are also provided for each water body type. As with the values in the summary tables for designated use support, the summary values in each table should not be added because doing so will artificially inflate the number of miles or acres actually impaired. A summary of the total number of impaired waters in Indiana waters to date is provided in Appendix O.

Causes of impairment identified in the summary tables are those pollutants or other stressors that contribute to the actual or threatened impairment of designated uses in a waterbody. In some cases, only the symptom(s) of impairment can be identified. For example, IDEM may have evidence that biotic communities in a waterbody are impaired but the data are insufficient to determine the actual pollutant or stressor causing the impairment. In these cases, the symptom – impaired biotic communities – are treated as the cause of impairment for the purposes of this report.

The sources shown in the summary tables are the activities that contribute the pollutant(s) or create other stressors that result in impairment of a designated use. For most assessments, the sources identified at the time of assessment for a given impairment are not precisely known, this is because IDEM's monitoring and assessment processes are designed to identify impairments, not specific sources.

Accurately attributing a given impairment to specific sources is difficult at best without more detailed and resource intensive sampling and analyses than and is in many cases impossible to do with a high degree of certainty. This kind of monitoring is typically conducted with watershed characterization monitoring during total maximum daily load (TMDL) development, which must identify the sources of impairment to a waterbody and develop recommended loadings to support its restoration.

The sources identified during the assessment process and summarized in the following sections represent those sources determined by IDEM staff to be the most likely sources given a variety of factors, including but not limited to:

- Land uses (as indicated by field observations and land use data from published sources such as the U.S. Geological Survey Gap Analysis Program, aerial photography, etc.).
- Field observations of potential sources such as illegal straight pipes, tillage to the stream's edge, livestock in the stream, etc.
- The presence of permitted facilities within close proximity of the impaired waterbody in cases where the impairment is something that could reasonably be expected to be associated with the discharge of those facilities.
- Naturally occurring conditions that could contribute to impairment.

IDEM believes that by using best professional judgment, scientists can distinguish the most likely sources of impairment in the watershed and provide a starting point for a TMDL, watershed planning or other activities aimed at restoring the waterbody.

Rivers and Streams Water Quality Assessment

Rivers and streams are assessed for support of aquatic life use, recreational uses, and fish consumption. Where there is sufficient data, rivers and streams that serve as a source water for a public water supply are also assessed to determine the degree to which they support such use.

The number of stream miles in Indiana that have been assessed to date, and the number of miles fully supporting and impaired are shown for each individual use in Table 13 (Appendix A).

Table 14 (Appendix A) represents the total miles of streams affected by each cause/stressor in Indiana. These tables include identified causes of impairment and symptom of other unknown causes, including impaired biotic community status. For these impairments, the fish and/or benthic macroinvertebrate communities have been found to be impaired by substances or stressors not yet identified.

Table 15 (Appendix A) includes all the potential sources driving one or more of the impairments in Table 14, and the total stream miles impaired due to each. Potential sources include agricultural sources and sources resulting from urban activities and land development. Illicit connections identify "straight pipes" from buildings in unsewered areas that flow into state waters with no or insufficient treatment. Contaminated sediments are largely due to polychlorinated biphenyls (PCBs) that correlate with elevated PCB levels in fish tissue.

Great Lakes Shoreline Water Quality Assessment

Indiana's entire portion of the Lake Michigan shoreline was last assessed in 2001 and was found to be fully supporting of aquatic life use and fully supporting its use as a public water supply for the 33 miles so designated. All 59 miles of the shoreline in Indiana were assessed as impaired for recreational use and fish consumption.

The required total maximum daily loads for the shoreline's recreational uses have been approved by U.S. EPA in 2004: http://www.in.gov/idem/nps/2856.htm. As a result, the *E. coli* impairments for which the shoreline has been assessed now appear in Category 4 of Indiana's Consolidated List while the fish consumption impairments for PCBs and mercury in fish tissue remain in Category 5 (Indiana's 303(d) list).

IDEM's assessment results are summarized in Table 16 (Appendix A). The specific causes of impairment to Indiana's Lake Michigan shoreline are reported in Table 17 (Appendix A), and the potential sources are summarized in Table 18 (Appendix A).

Lake Michigan Water Quality Assessment

Because Lake Michigan is assessed as a single unit, any impairment identified in any part of the lake is applied to all 154,176 acres of Lake Michigan. Assessments made in the Indiana waters of Lake Michigan indicate impairment for mercury and PCBs in fish tissue. Tables 19-21 in Appendix A reflect the results of these assessments.

Lake Water Quality Assessment

IDEM conducts two types of assessments on Indiana Lakes and Reservoirs. CWA Section 314 requires states to report on the trophic status and trends of all publicly owned lakes in Indiana, and CWA Section 305(b) requires states to report on the degree to which Indiana's lakes and reservoirs are supporting their designated uses. Both types of assessments and the methods with which they are conducted are described in IDEM's CALM (Appendix N).

IDEM evaluates lakes primarily for recreational uses and fish consumption for the purposes of CWA Section 305(b) assessments. While IDEM monitors several lakes and reservoirs for fish consumption, other types of monitoring for CWA Section 305(b) designated use support assessments of Indiana lakes is limited. As a result, IDEM's assessments have relied primarily on external data collected through the Indiana Clean Lakes Program for the purposes of CWA Section 314 assessments.

The monitoring conducted by the Indiana CLP provides results for all the parameters necessary to calculate an Indiana trophic state index (TSI) score, which allows IDEM to make both CWA Section 314 trophic state assessments and some CWA Section 305(b) assessments for recreational use. However, neither the individual parameter results nor the TSI scores are considered sufficient for determining the condition of biological communities for the purposes of Section 305(b) assessments for aquatic life use support.

Use support assessments of lakes and reservoirs for public water supply are also limited but for different reasons. Compared to other designated uses, which apply to all waters of the state, these assessments are made only to the relatively few lakes and reservoirs in Indiana that are used directly or indirectly as source water for public water supplies.

IDEM's assessment methods for CWA Section 305(b) assessments of lakes and reservoirs are described in more detail in its CALM (Appendix N, Attachment 1). Summary assessment results for the 2016 cycle are provided in Tables 22-24 (Appendix A).

CLEAN WATER ACT SECTION 314 ASSESSMENTS

Section 314 of the federal Clean Water Act (CWA) requires states to report on the trophic status and trends of all publicly owned lakes in Indiana. To determine the trophic state for a given lake (the amount of biomass present at the time the measurement is taken), IDEM uses Carlson's Trophic State Index (TSI), which can be calculated for three variables, each of which can be used as independent indicators of the trophic state of the lake or reservoir in question. The three indicators used are Secchi depth (SD), total phosphorus (TP), and Chlorophyll-*a* (CHL). Although any of the three could be used to determine trophic state, IDEM uses the TSI for CHL to make its trophic state assessments because CHL concentrations provide a more direct measure of phytoplankton abundance than SD or TP. Lakes are classified based on their TSI (CHL) scores. Higher scores are an indicator of nutrient enrichment, which can come from both natural sources and sources related to human activities. Details on how the TSI (CHL) scores are calculated can be found in IDEM's CALM (Appendix N).

For the purposes of this report, Indiana lakes were placed into one of four classes based on their trophic state as measured by the Carlson TSI (CHL) score. These classes are shown in Table 25 (Appendix A). A summary of the trophic status information for lakes assessed to date is presented in Table 26 (Appendix A).

Lake trends based on changes in trophic status over time as indicated by TSI scores are summarized in Table 27 (Appendix A). Approximately 19 percent of the lakes assessed to date (20 percent of the acres assessed) show some water quality improvement as measured by a reduction in their trophic scores. Forty-one percent of the lakes assessed (23 percent of the acres assessed) appear to have relatively stable trophic conditions. Thirty-six percent of the lakes assessed to date (53% of the total acres assessed) show an increase in their trophic scores indicating that the trophic conditions are degrading.

The water quality trend is fluctuating for four percent of the lakes (four percent of the acres assessed). For these lakes, the lack of detectable trend may be due to abnormal seasonal effects or changing activities in the surrounding watershed. An unknown trend is used in this report in cases where the available data are insufficient to determine a trend.

Waterbody-specific results for trend and trophic status and trends for Indiana's lakes and reservoirs statewide are provided in Appendix J.

PUBLIC HEALTH/AQUATIC LIFE CONCERNS

The release of toxic materials into the aquatic environment can produce harmful impacts:

- Contaminants present in acutely toxic amounts can directly kill fish or other aquatic organisms.
- Substances present in lesser, chronically toxic amounts can reduce densities and growth rates of aquatic organisms and/or become concentrated in their body tissues. These substances can be further passed to humans through consumption of the organism.
- Toxic materials in the water could potentially affect human health by contaminating public water supplies.

Fish Consumption

In the last several years, advances in analytical capabilities and techniques and the generation of more frequent and higher quality toxicity information on chemicals have led to an increased concern about their presence in the aquatic environment and the associated effects on human health and other organisms. Because many pollutants are likely to be found in fish tissue and bottom sediments at levels higher than in the water column, much of the data on toxic substances used for fishable use assessments in this report were obtained through IDEM's Contaminants Monitoring Program.

While not all species of fish found in Indiana lakes and streams have been tested, carp are commonly found to be contaminated with both polychlorinated biphenyls (PCBs) and mercury at levels exceeding the state's benchmark criteria for these contaminants in fish tissue. Waterbodies in which exceedances are found are considered impaired for fish consumption and placed on Indiana's 303d) List of Impaired Waters.

Fish consumption assessments are reported separately from aquatic life use in order to provide more information about each individual use. Concerns related to fish consumption should be evaluated independently by referring to the Indiana State Department of Health (ISDH) fish consumption advisories online at: http://www.in.gov/isdh/23650.htm. The 303(d) List of Impaired Waters is not designed to provide public health information whereas the fish consumption advisory is and as such is far more reliable for using in deciding how much fish might safely be consumed from a given waterbody.

Cyanobacteria and Algal Toxins

Blue-green algae (cyanobacteria) continue to be a concern in Indiana lakes and reservoirs both with respect to recreational uses and public water supply for drinking water. Blue-green algae are common constituents of algal communities in lakes and many are known to produce potent toxins, which are now recognized as a potentially serious threat to human and animal health. Microcystin is the cyanotoxin most commonly monitored. In 2010, IDEM piloted a targeted monitoring effort to support the development of an interagency process for the development of public health advisories for blue green algae and algal toxins. Monitoring is conducted statewide at 14 swimming areas owned or managed by the Indiana Department of Natural Resources (IDNR) on a monthly basis from May through August. Sampling frequency is increased to biweekly for lakes where cyanobacteria densities are found to be greater than 100,000 cells per milliliter, as recommended by the World Health Organization.

The public is kept informed of the status of the sampled swimming areas by the www.algae.IN.gov website and the IDNR site for the specific property. IDEM's website also incorporates public health information related to blue-green algae from the ISDH and the Board of Animal Health (BOAH) as well as other relevant information from government agencies and educational institutions. When the two-year grant period for the pilot project ended, IDEM incorporated a blue-green algae monitoring program as a part of its overall water monitoring strategy.

In 2010, IDEM also contracted with Indiana University's School of Public and Environmental Affairs (SPEA) to conduct a different, but related, pilot project to monitor Microcystin at all of the same lakes to be monitored for the Indiana Clean Lakes Program (CLP). Like the Microcystin monitoring conducted by IDEM, it is anticipated that the results from this monitoring will help IDEM to better understand the environmental variables associated with blue-green algal blooms and Microcystin production. However, results from the CLP Microcystin monitoring are not used to support the development of public health advisories because they are collected for a different purpose and use different methods than those used by IDEM to conduct its sampling.

IDEM does not use information collected through these monitoring programs to make 305(b) assessments because the environmental factors that influence the occurrence and production of algal toxins are still not well understood, and there are no federal drinking water standards for blue-green algae. However, algal toxins now appear on U.S. Environmental Protection Agency's (EPA's) federal drinking water contaminant candidate list (CCL 3), which is used to prioritize federal research and data collection efforts to help determine whether a specific contaminant needs to be regulated. Details regarding U.S. EPA's CCL are available online at: http://water.epa.gov/scitech/drinkingwater/dws/ccl/ccl3.cfm#microbial. It is anticipated that as more scientific information becomes available, including the development of a federal water quality criteria for algal toxins, it may be possible to develop water quality assessment methods that will allow IDEM to determine the impact that algal toxins may be having on designated uses of Indiana waters.

Fish Kills and Chemical or Other Spills

A diverse and healthy fish community is considered an indication of good water quality. Serious public concern is often raised when dead and dying fish are noted in the aquatic environment because fish kills are sometimes evidence of a severe water quality problem. Fish kills also have the potential to impair the use of the waterbody in the short or long term. A fish kill can occur as a result of:

- An accidental or intentional spill of a toxic compound or oxygen depleting substance into the aquatic environment.
- A continuous industrial or municipal discharge due to a system upset which can result releases of atypical or unusually high concentrations of pollutants.
- Natural causes such as disease, extreme drought or depletion of dissolved oxygen from extreme weather conditions.

IDEM's Office of Land Quality tracks spills and fish kills that are reported to IDEM or discovered by agency staff. The total number of calls, spills, and kills recorded from 1998 to 2015 are listed in Table 28 (Appendix A).

GROUND WATER ASSESSMENT

In order to be eligible for Clean Water Act (CWA) Section 106 grant funds, Indiana is required to have the means to monitor water quality and to annually update water quality data and include the results in their biennial Integrated Reports (IR) to U.S. Environmental Protection Agency (EPA). While the IR requirement pertains primarily to navigable waters, U.S. EPA guidance suggests that state updates should also include ground waters to the extent practicable. This section provides a summary of Indiana's ground water monitoring and protection programs, ground water/surface water interactions within Indiana, and ground water quality and ground water contamination sources.

INTRODUCTION TO INDIANA GROUND WATER

Ground water is an important resource for Indiana citizens, agriculture and industry. The majority of Indiana's population relies on ground water for drinking water and other household uses. IDEM's 2014 Annual Compliance Report for Indiana public water supply (PWS) systems is online at: http://in.gov/idem/cleanwater/files/dw_compliance_report_2014.pdf.

Major Sources of Ground Water Contamination

The major contaminant sources impacting Indiana ground water are listed by general activity types in Table 29 (Appendix A). All sources listed are a potential threat to ground water. However, the degree to which the source is a threat to ground water depends on several factors with the most significant being hydrogeologic sensitivity. Other major risk factors include location of the contaminant source relative to drinking water sources, toxicity of the contaminant and the size of the population at risk. All risk factors listed in Table 29 were considered in the selection of the 10 priority contaminant sources, and those risk factors relevant to the highest priorities are identified. Classes of contaminants commonly associated with each high priority contaminant source are also given. Due to resource constraints, this information has not been significantly updated since the 2000 305(b) report. However, anecdotal evidence indicates the same major contaminant sources are impacting Indiana ground water now as they were at that time.

Fertilizers

Nitrate is a potential contaminant from commercial fertilizer and animal manure applications to farm land, and septic systems, all of which are considered high priority sources of potential contamination to Indiana ground water. Nitrate is a highly mobile and soluble contaminant and is most frequently detected in ground water contaminant in rural areas. However, determining the specific sources of nitrates detected in ground water can be difficult and costly.

When applied at the proper rate and time, commercial fertilizer poses little threat of contamination to ground water. Purdue University Cooperative Extension Service staff, Natural Resource Conservation Service staff, and private consultants assist crop producers in developing nutrient management plans that focus on meeting crop nutrient needs.

On July 28, 2010, the Indiana rule requiring certification for distributors and users of fertilizer materials (355 IAC 7-1-1) became effective and is administered through the Office of the Indiana State Chemist (OISC). The rule was supported by a variety of agricultural groups and other stakeholders who envisioned this as an opportunity for fertilizer material applicators and distributors to demonstrate their competency to handle and apply these materials safely and effectively. In addition, the rule provides a statewide standard for applicator certification and training.

For purposes of this rule, "fertilizer material" is defined to mean both commercial fertilizer and manure from a confined feeding operation (CFO). Any person hired to apply, handle, or

transport fertilizer material for the purposes of producing an agricultural crop must be certified and licensed by OISC. Alternatively, he or she must be trained and supervised by a certified applicator and be working for a licensed fertilizer business. Any person applying manure from a CFO (in excess of 10 cubic yards or 4,000 gallons per year) to his/her own property must be certified by OISC as a private fertilizer applicator. Any person, partnership, corporation, or business that only distributes but does not use fertilizer material must obtain a fertilizer distributor business license.

Confined Feeding Operations

Livestock and poultry confined feeding operations exist throughout Indiana and are an integral component of Indiana's agricultural economy. The primary concerns associated with CFOs are the proper storage and land application of the large volumes of manure produced by these operations. The manure is applied to farmland to recycle the nutrients to fertilize crops. Manure contains ammonia-nitrogen which is converted to nitrate through biological processes in the soil. Consequently, the rate of manure application to farmland is a major concern when the application provides more nitrogen than a crop will use. Because excess nitrogen can move beyond the crop root zone and potentially into underlying aquifers, Indiana's current regulations for CFOs require the proper design and construction of manure storage structures and the application of manure to land in a manner that protects ground and surface water quality. Crop nutrients contained in manure are available at a slower rate than commercial fertilizer nutrients due to the rate of decomposition of the manure. Therefore, when applied at the proper agronomic rate, manure poses little threat of contamination to ground water.

Septic Systems

Properly constructed and maintained septic systems provide satisfactory on-site treatment of domestic wastewater in rural and unsewered suburban areas of Indiana. However, improperly constructed or poorly maintained septic systems, as well as systems operating in areas of high seasonal water tables or other ground water sensitive areas, are also of concern as a source of nitrate contamination to ground water.

Landfills and Underground Storage Tanks

Landfills and underground storage tanks are a high priority concern for ground water largely due to practices or activities that occurred prior to construction standards and legislation established for the protection of ground water. Landfills constructed after 1988 have been required to adhere to stringent construction standards. Since then, all underground storage tank registrations, upgrades, closure activities and site assessments have been closely reviewed by the IDEM's Underground Storage Tank (UST) Section.

IDEM ensures that all regulated UST system owners and operators properly registered, upgraded and/or closed existing UST systems in accordance with state requirements. Currently, IDEM inspects all USTs systems at least once every three years to ensure that systems are properly designed and operated for corrosion protection, spill and overfill protection, and leak detection in

order to prevent releases or ensure early detection of releases. UST systems that are no longer in use are inspected to ensure they are properly closed. In addition, IDEM ensures that all confirmed releases to the environment of petroleum and hazardous substances are cleaned up as necessary to protect human health, including those released into ground water.

Underground Injection Wells

Class V underground injection wells are widespread throughout the state and occur in high concentration in several areas, including some areas where ground water is highly sensitive to contamination. Most Class V wells are shallow wells that are used by business and individuals to dispose of a wide variety of waste fluids into the ground. Under current regulation, Class V wells may be used to dispose of non-hazardous fluids only. However, this was not always the case.

Prior to 2000 when the U.S. Environmental Protection Agency (EPA) passed more intensive regulations and enforcement for Class V wells, they were sometimes used to dispose of potentially hazardous fluids. These older wells create the potential for groundwater contamination if the fluids they contain are hazardous and leach into or above aquifers supplying drinking water. These wells are regulated directly through the U.S. EPA Class V Underground Injection Control Program, which targets the wells that pose the greatest environmental risk.

Industrial Activities

Several cases of ground water contamination due to industrial facilities or their ancillary operations have been documented in Indiana. Although many contamination events occurred prior to the development of regulations for the storage and handling of industrial materials, ground water contamination still occurs as a result of either accidents or intentional dumping of waste. In 1998, Indiana's Secondary Containment of Above-Ground Storage Tanks Containing Hazardous Materials Rule (327 IAC 2-10) was adopted. This rule requires that new facilities provide secondary containment for storage of 660 gallons or more of hazardous wastes if the facility is located outside an approved delineated wellhead protection area. However, if the facility is located within an approved delineated wellhead protection area, the tank requires secondary containment if 275 gallons or more of hazardous materials are stored there. The secondary containment rule, along with outreach and education programs, has helped to prevent further ground water contamination from the storage and handling of industrial materials. However, these activities continue to be a potential source of contamination to ground water in Indiana.

Road Salts

The storage and extensive use of salt as a deicing agent during the winter months can also have an impact on ground water, and contamination from road salt has been documented in Indiana. Efforts are being made by the Indiana Department of Transportation (INDOT) to build salt storage facilities in areas where ground water is not sensitive to contamination and to upgrade existing facilities to protect ground water. Currently, all INDOT salt storage facilities are covered by domes or canopies, and several new facilities were built to contain all surface runoff

on-site to reduce ground water contamination. In addition, road salt use and application rates have been significantly reduced from past years through computerized weather forecasting and roadway temperature sensors.

Spills

Ground water contamination as a result of spills can be avoided or minimized if spills are reported to IDEM, which helps to ensure that they are handled and cleaned up properly. Indiana has a law in place to ensure that spills with the potential to contaminate ground water are reported and managed in a way that minimizes their impact (327 IAC 2-6.1).

Ground Water Protection Programs

Programs that conduct monitoring to evaluate and protect ground water resources in Indiana occur at all levels of government. At the state level, several ground water protection programs and activities have been implemented or are in the process of being implemented. Table 30 (Appendix A) lists key ground water protection programs and activities in Indiana, the developmental stage of the program or activity, and the agency or agencies responsible for the program's implementation and/or enforcement.

Classification of Indiana's Ground Water Resources

Indiana's ground water quality standards became effective in March 2002. The language of the rule includes numeric standards that provides ground water protection for wells and allows for the classification of ground water. The rule states that all ground water of the state shall be classified as drinking water class ground water unless it is classified as limited class ground water or impaired drinking water class ground water. IDEM may classify ground water as limited when ground water is shown to have a yield of less than 200 gallons per day or a total dissolved solids concentration of more than 10,000 parts per million (ppm). Additionally, ground water that is in the crop root zone, in a coal mined area, or in an injection zone of a permitted Class I, II or III injection well or gas storage well may be considered limited. IDEM may classify ground water as impaired when specific conditions are also met. These conditions include, but are not limited to:

- The ground water is not in a state approved wellhead protection area established pursuant to 327 IAC 8-4.1.
- The ground water has one or more contaminant concentrations above the numeric criteria established in the rule.
- The commissioner has approved a ground water remediation, closure, cleanup or corrective action plan that describes the nature and extent of contaminants exceeding the criteria.

Source Water Assessment Program

In 2000, U.S. EPA approved Indiana's Source Water Assessment Program developed by Indiana stakeholders. IDEM has prepared source water protection plans (SWAPs) for public water systems with the exception of community water systems that instead use ground water as their primary source of water. Those community ground water systems are required by the Indiana Wellhead Protection Rule (327 IAC 8.4.1) to prepare a wellhead protection plan for each well or well field that provides water to the public. Since 2000, source water areas for more than 3,600 public water systems have been delineated. IDEM has also inventoried the potential sources of contamination of these source water areas from regulated facilities and has assessed water system susceptibility to contamination. As of the end of 2008, IDEM distributed all SWAPs for Indiana's public water systems to their owners. As a result of this effort, IDEM's Source Water Assessment Program is completely implemented and satisfies the requirements of the Source Water Assessment Program as defined by IDEM and accepted by U.S. EPA Region 5.

Wellhead Protection Program

The Indiana Wellhead Protection Rule (327 IAC 8-4.1) became effective in March 1997. IDEM's Wellhead Protection Program implements this rule to proactively protect public water supplies from contamination. The Wellhead Protection Rule outlines the minimum requirements community public water supplies must meet to comply with the Wellhead Protection Program. As of October 2009, 633 (close to 98 percent) of Indiana's community water systems using ground water as their source of drinking water have an approved wellhead protection plan. Having an approved Wellhead Protection Plan indicates that a community has met the requirements of the Indiana Wellhead Protection Rule and has developed strategies to adequately protect their community water supplies from becoming contaminated.

Other Programs Working to Protect Indiana's Ground Water Resources

In addition to regulatory programs and other structured ground water protection activities listed in Table 30, there are several educational programs conducted in Indiana that place an emphasis on ground water protection. The Purdue University Extension Service's Safe Water for the Future Program serves as an umbrella program for several other programs that provide resources on drinking water protection for individuals and communities. The Farm*A*Syst and Home*A*Syst Programs are essentially wellhead protection programs for rural and domestic private wells. A series of publications and brochures on wellhead protection are also available to assist communities working on wellhead protection. "Watershed Connections" brings together local contacts to produce a community specific publication on water resources and their protection.

The Indiana Department of Natural Resources' Project WET (Water Education for Teachers) and Purdue University Extension Service's "Water Riches" Program are two general water education programs that provide information about ground water protection. The Purdue University Cooperative Extension Service's Water Quality Program has made more than 70 publications addressing specific topics for the general public available through its website.

Ground Water Monitoring for Public Water Supplies

The Compliance Section of the Drinking Water Branch at IDEM receives ground water compliance monitoring results reported by public water systems for volatile organic compounds (VOCs), synthetic organic compounds (SOCs), inorganic compounds (IOCs), nitrates (NO_3), and radionuclides.

Radionuclide monitoring consists of analysis for gross alpha particle activity. Public water supply systems collect samples from various points within their system including after the water is treated and before it enters the distribution system. Samples can be collected from a single well or blended from two or more wells.

Other parameters monitored by public water systems depend on the type of system. There are three types of public water systems: community, non-transient non-community, and transient non-community. Compliance monitoring results reported by public water systems are considered "treated water" and may not represent "source" or "raw water" results. Information reported to IDEM from public water systems may be viewed through the Safe Drinking Water Information System at: https://myweb.in.gov/IDEM/DWW/ .

The three types of public water systems are defined below:

- A community system is defined as a system that serves water to the public and has at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents. Examples of community water systems are municipal systems, mobile home parks, nursing homes and homeowners associations. Along with regular bacteria sampling, community systems are required to test for thirty regulated SOCs, 21 VOCs, 12 regulated IOCs, sodium, and radionuclides. Sampling for these parameters is required a minimum of once every three years depending on the levels of contaminants detected. As of this report, there are 788 community systems in Indiana.
- A non-transient non-community water system is defined as a public water system that is not a community water system and which regularly serves the same 25 or more persons at least six months per year. Examples of non-transient non-community water systems could include restaurants, factories, daycares and schools. Along with regular bacteria sampling, non-community non-transient systems are required to test for 30 regulated SOCs, 21 VOCs, 11 regulated IOCs (except sodium and fluoride), and radionuclides. Sampling for these parameters is required a minimum of once every three years depending on the levels of contaminants detected. As of this report, there are 582 non-transient non-community systems in Indiana.

- A transient non-community is defined as a non-community water system that does not serve at least the same 25 people for more than six months per year. Examples of transient non-community water systems include restaurants, rest stops and gas stations. Along with regular bacteria sampling, transient non-community systems are required to test for radionuclides. As of this report, there are 2677 transient non-community systems in Indiana.

Statewide Ground Water Monitoring Network

The Ground Water Section of the Drinking Water Branch manages a statewide ground water monitoring network (GWMN) consisting of private residential wells and non-community public water supplies (PWS), including schools, daycares, churches, and businesses. Sampling for the GWMN has been conducted annually since it was established. Seven complete rounds of sampling have been conducted to date. Although many of the sampling sites were revisited during multiple sampling rounds, the number of sites sampled each year varies based on site suitability, participant interest, availability of resources, and previous sampling results. Sites sampled for the sixth round of monitoring, which occurred between May 2013 and August 2016 are shown in Figure 15 (Appendix B).

The Indiana Geological Survey (IGS) has divided the state into hydrogeologic settings to "provide a conceptual model to help interpret the occurrence, movement, and sensitivity to contamination of ground water in relation to … the surface and subsurface environment" (Fleming, 1995). The IGS has identified more than 240 individual hydrogeologic settings across the state based largely on glacial activity. IGS and IDEM scientists then grouped these hydrogeologic settings into 20 generalized settings that are common throughout Indiana.

IDEM determined based on the 20 generalized hydrogeologic settings that 398 samples are needed to accurately represent ambient ground water quality across the state for each sampling round in the GWMN. These sampling sites were proportionally distributed throughout the 20 lumped hydrogeologic settings using a weighting procedure (also known as stratified sampling) based on the percentage of located wells in that setting. The weighted number of samples in the generalized settings ranged from 1 to 154 samples. Appendix I provides the descriptions of the 20 generalized hydrogeologic settings monitored and summary results for each.

Protocols and Methods

As part of its implementation of the GWMN, IDEM's Ground Water Section staff:

- Statistically analyzed previous study designs employed in earlier iterations of the GWMN.
- Randomly selected sampling sites in each general hydrogeologic setting.
- Collected ground water samples from drinking water wells for analysis at IDEM's contract laboratories.
- Reviewed analytical sampling results.
- Distributed sampling results to GWMN participants.
- Developed a program report.

IDEM's Ground Water Section collects most samples from April to August. Samples are generally collected from outdoor spigots that have not been treated or from source water sample taps in the case of public water supplies. Samples are analyzed for more than 200 parameters; including alkalinity, anions/cations, metals, nitrogen as nitrate-nitrite (N+N), synthetic organic compounds, volatile organic compounds and pesticide degradates.

Summary of Results

Table 31 (Appendix A) shows summary statistics for the analytical parameters that were detected in the ground water samples collected during the most recent round of sampling (with the exception of disinfection byproducts and plasticizers, which are not included in this analysis). If a particular analyte was not detected, it was not included in the table. Applicable U.S. EPA Maximum Contaminant Levels (MCLs), Secondary Maximum Contaminant Levels (SMCLs), or Recommended Levels are provided where applicable.

For all samples collected in the most recent round, analytes that had the most occurrences above a MCL included arsenic and nitrogen as nitrate-nitrite (hereafter referred to as simply "nitrogen") Parameters for with there were occurrences above the SMCL or U.S. EPA Recommended Level included iron, sulfate, and strontium. Several VOCs were detected, including methyl tert-butyl ether, tetrachloroethylene, toluene, and atrazine. These VOCs occurred in one sample each, at concentrations that did not exceed or approach an MCL. Appendix K provides the descriptions of the 20 generalized hydrogeologic settings and ground water quality summary results for each.

In the most recent round of sampling, 139 samples (about 36 percent) contained detectable levels of nitrogen. Nine of those samples exceeded the MCL of 10 milligrams per liter, and the highest reported concentration was 22 milligrams per liter. The locations of the sites sampled for nitrogen are displayed with their corresponding hydrogeologic sensitivity developed by Fleming *et al* (Figure 16, Appendix B) and aquifer sensitivity developed by Letsinger (2015) (Figure 17, Appendix B). Fleming's hydrogeologic sensitivity map is qualitative based on typical characteristics for the individual hydrogeologic settings, while the Letsinger aquifer sensitivities were quantitatively calculated from factors including slope, sand thickness, surficial clay thickness, percentage clay in soil, land cover, and vegetation. In highly sensitive areas, ground

water can be rapidly recharged by surficial infiltration, allowing potential contaminants (including nitrates and pesticides) found at the ground surface or shallow subsurface to be transported into the aquifer. Summary statistics were calculated for the nitrogen data for Indiana's generalized hydrogeologic settings (Table 32, Appendix A).

Average nitrogen concentrations for each hydrogeologic setting were also calculated for different well type and depth, aquifer conditions and aquifer sensitivity (Table 33, Appendix A). Oxidizing aquifers had significantly greater nitrogen levels and higher average concentrations than reducing aquifers. Previous studies (Freeze & Cherry, 1979) have shown that the distribution and mobility of nitrogen within aquifers can be influenced by groundwater redox conditions.

Additionally, 12 of the 19 general hydrogeologic settings had their highest average nitrogen concentrations in wells less than 100 feet deep. The averages calculated for this study suggest that nitrogen concentrations tend to be higher in shallow, unconsolidated wells in highly-sensitive, oxidizing aquifers. Additional geochemical and statistical analyses are needed to evaluate the causal relationship between these parameters.

Arsenic

Arsenic is a naturally occurring element found primarily in rocks, soil, water, and plants in many areas of the United States, including Indiana. Natural events, such as infiltration of water, dissolution of minerals from clay, and erosion of rocks, can release arsenic into water. Arsenic can also be released into the environment as a byproduct of industrial activities, such as wood preservation, mining, and smelting (IDEM, 2015).

In the most recent round of sampling, 147 samples (around 38%) contained detectable levels of arsenic. Forty-three of those samples (11%) contained arsenic concentrations above the MCL (10 micrograms per liter). The highest reported concentration was 68 micrograms per liter. Figure 18 (Appendix B) shows the location of the arsenic samples by hydrogeologic setting. Table 34 (Appendix A) shows summary statistics for arsenic samples by hydrogeologic setting, and Table 35 (Appendix A) provides an intra-setting comparison.

Reducing aquifers had significantly greater arsenic levels and higher averages concentrations than oxidizing aquifers. Geochemical modeling is needed to determine the species of arsenic found in Indiana ground water, and additional geochemical and statistical analyses are needed to evaluate the causal relationship between these parameters.

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APPENDIX A:

INTEGRATED REPORT TABLES (REVISED)

Table 1: Summary of designated use support by waterbody type.

Designated Beneficial Use	Total Size	Size Assessed	Size Fully Supporting	Size Not Supporting	Size Not Attainable
Rivers and Streams (Miles)					
Full Body Contact (Recreational Use)	63,130	31,683	8,122	23,561	0
Human Health and Wildlife (Fishable Use)	63,130	8,873	3,418	5,455	0
Public Water Supply[1]	354	25	0	25	0
Warm Water Aquatic Life (Aquatic Life Use)	63,130	37,693	25,793	11,900	122
Lake Michigan Shoreline (Miles)					
Full Body Contact (Recreational Use)	59	59	4	55	0
Human Health and Wildlife (Fishable Use)	59	59	0	59	0
Public Water Supply	35	31	31	0	0
Warm Water Aquatic Life (Aquatic Life Use)	59	59	59	0	0
Lake Michigan (Acres)					
Human Health and Wildlife (Fishable Use)	154,176	154,176	0	154,176	0
Lakes and Reservoirs (Acres)					
Full Body Contact (Recreational Use)	127,607	37,047	29,035	8,012	0
Human Health and Wildlife (Fishable Use)	127,607	77,845	27,290	50,555	0
Public Water Supply	29,541	16,615	230	16,385	0
Warm Water Aquatic Life (Aquatic Life Use)	127,607	10,379	3,754	6,625	0

Source: IDEM's assessment database

[1]While all waterbodies in Indiana are designated for aquatic life and recreational uses, not all are designated for public water supply. There are a total of 29,541 lake acres, 354 stream miles, and 35 miles along Lake Michigan's shoreline designated for public water supply in Indiana. The values for lake acres does not include the 154,176 acres of Lake Michigan.

Table 2: Atlas information.

Description	Value	Units
Indiana population[1]	6,483,802	People
Indiana surface area[2]	36,291	Square Miles
Total miles of rivers and streams[3]	63,130	Miles
Number of publicly-owned lakes, reservoirs and ponds[4]	575+	-
Publicly-owned lakes, reservoirs, and ponds[4]	106,205	Acres
Great Lakes[4]	154,176	Acres
Great Lakes shoreline[5]	59	Miles
Fresh water wetlands[6]	813,000	Acres

[1]U.S. Census Bureau, 2010 census [2]State Information Center [3]2014 Reach Index [4]U.S. EPA (1993) [5]Indiana Reach Index [6]Rolley (1991)

Table 3: 205(j) and 319(h) Investments in SFY 2003-2013. Table does not include an additional $434,328 from the American Recovery and Reinvestment Act of 2009, which was awarded through the SRF Program.

205(j)			319(h)		
FFY	Number of Projects	Amount Awarded	FFY	Number of Projects	Amount Awarded
2003	6	$507,054	2003*	34	$4,544,480
2004	6	$497,220	2004**	27	$4,159,332
2005	3	$254,430	2005***	21	$3,747,145
2006	2	$251,310	2006	18	$3,374,538
2007	2	$148,915	2007	12	$3,022,961
2008	0	0	2008	8	$2,967,181
2009	2	$271,432	2009	9	$2,759,609
2010	2	$293,753	2010	11	$3,653,209
2011	4	$699,775	2011	8	$2,457,215
2012	2	$331,250	2012	8	$2,221,471
2013	2	$337,750	2013	7	$2,276,973
2014	3	$341,000	2014	9	$2,628,234
2015	2	$340,000	2015	9	$2,317,768

* includes 2 in-house projects totaling $526,122
** includes 2 in-house projects totaling $248,792
*** includes 1 in-house project totaling $155,686

Table 4: Reductions in sediment, phosphorus, and nitrogen reaching Indiana waters.

FFY(s)	Sediment Reduction (tons/year)	Phosphorus Reduction (lbs/year)	Nitrogen Reduction (lbs/year)
2000-2003	35,870	42,662	85,710
2004	18,561	21,993	44,527
2005	33,415	39,347	79,349
2006	25,831	40,538	99,434
2007	23,279	126,529	125,848
2008	18,119	25,400	65,367
2009	7,965	15,479	15,319
2010	33,420	31,374	66,400
2011	28,880	33,434	70,450
2012	47,616	94,980	141,709
2013	54,507	92,360	170,376
2014	67,403	168,542	168,710
2015	97,212	132,737	228,334

Source: IDEM OWQ nonpoint source project tracking database

Table 5: Water quality improvements in Indiana watersheds reported to U.S. EPA for measures SP-12 and WQ-10.

Stream Name	Watershed Hydrologic Unit Code	Stream Miles Improved	Impairment Removed	Year Removed from 303(d) List
Pigeon	05140202	32	Chlordane	2002
Lower Clifty Creek	051202060107	8.12	E. coli	2010
West Fork Big Walnut	051202030104	34.64	E. coli	2010
East Fork Big Walnut	051202030102	15.76	E. coli	2010
Bull Run	071200011308	25.09	Impaired biotic communities	2012
Metcalf Ditch	041000030504	14.33	Impaired biotic communities	2012
North Prong Stotts Cr	051202011404	1.25	Impaired biotic communities	2012
South Prong Stotts Cr	051202011405	13.23	Impaired biotic communities	2012
Mill Creek	051201011404	13.14	Impaired biotic communities	2012
Jenkins Ditch	051201070308	2.13	Impaired biotic communities	2012
Emma Creek	040500011201	38.2	Ammonia	2014
Devils Backbone Indian Cr	051401040502	21	Impaired biotic communities	2015

Table: 6: Binational phosphorus load reduction targets for Lake Erie under the Great Lakes Water Quality Agreement, Annex 4.

Great Lakes Water Quality Agreement Lake Ecosystem Objectives	Annex 4 Phosphorus Reduction Goals	
Minimize the extent of hypoxic zones in the Waters of the Great Lakes associated with excessive phosphorus loading, with particular emphasis on Lake Erie	40 percent reduction in total phosphorus entering the Western Basin and Central Basin of Lake Erie – from the United States and from Canada – to achieve 600 metric-ton Central Basin load	
Maintain algal species consistent with healthy aquatic ecosystems in the nearshore Waters of the Great Lakes	40 percent reduction spring total and soluble reactive phosphorus loads from the following watersheds where localized algae is a problem:	
	Western Basin of Lake Erie	**Central Basin of Lake Erie**
	• Thames River (Canada) • Maumee River (U.S.) • River Raisin (U.S.). • Portage River (U.S.) • Toussaint Creek (U.S.) • Leamington Tributaries (Canada)	• Sandusky River (U.S.) • Huron River (U.S.)
Maintain cyanobacteria biomass at levels that do not produce concentrations of toxins that pose a threat to human or ecosystem health in the Waters of the Great Lakes	40 percent reduction in spring total (860 metric tons) and soluble reactive phosphorus (186 metric tons) loads from the Maumee River (U.S.)	N/A

Table 7. SRF investments in SFY 2014 and 2015.

SRF Program	Number of Projects	Loan Amount	Savings Realized
Clean Water	34	$297,390,310	$64,582,500
Drinking Water	22	$39,657,401	$19,243,179

Source: SRF tracking database

Table 8. A comparison of means for selected nonpoint source pollution-related parameters at two sites on Emma Creek, before (2007–2008) and after (2009–2010) BMP implementation. All parameters expressed as milligrams per liter unles otherwise noted.

Parameter	Site 1 (Tributary of Emma Creek)		Site 13 (Mouth of Emma Creek)	
	2007–2008	2009–2010	2007-2008	2009-2010
Turbidity (nephelometric turbidity units)	13	8.8	74	56
Total Suspended Solids	23.4	17.2	107	27
Nitrate	1.1	1.1	3.1	2.8
Total Phosphorus	0.497	0.287	2.01	0.57
Biological Oxygen Demand	1.31	0.72	2.05	1.15
Ammonia	0.15	0.11	0.11	0.09
E. coli (colony-forming units per 100 milliliters)	1,147	750	17,109	16,483

Table 9. Pathogen concentrations in colony-forming units per 100 milliters (cfu/100mL) and dissolved oxygen levels in milligrams per liter (mg/L) in the Devils Backbone segment of Indian Creek, 2000 and 2010. Values in bolded red font indicate exceedances of state water quality criteria.

Pre-project E. coli Data			Pre-project Dissolved Oxygen (DO) Data		
Sample Date	**Site Number**	**E. coli (cfu/100 mL)**	**Sample Date**	**Site Number**	**DO (mg/L)**
7/12/2000	OBS100-0006	**243**	5/16/2000	OBS100-0001	9.87
7/19/2000	OBS100-0006	**708**	7/12/2000	OBS100-0006	7.83
7/26/2000	OBS100-0006	40	7/19/2000	OBS100-0006	**3.98**
8/2/2000	OBS100-0006	20	7/26/2000	OBS100-0006	**4**
8/9/2000	OBS100-0006	**833**	8/2/2000	OBS100-0006	**2.52**
	Geometric Mean:	**162.88**	8/9/2000	OBS100-0006	**3.06**
Post-project E. coli Data			**Post-project Dissolved Oxygen Data**		
Sample Date	**Site Number**	**E. coli (cfu/100 mL)**	**Sample Date**	**Site Number**	**DO (mg/L)**
5/17/2010	OBS100-0010	35.5	5/17/2010	OBS100-0010	9.16
5/24/2010	OBS100-0010	142.1	6/1/2010	OBS100-0010	8.72
6/1/2010	OBS100-0010	20.9	6/7/2010	OBS100-0010	7.63
6/7/2010	OBS100-0010	12	6/14/2010	OBS100-0010	7.16
6/14/2010	OBS100-0010	16.9	7/28/2010	OBS100-0010	7.46
	Geometric Mean:	29.24			

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Table 10: OWQ's primary water quality monitoring objectives and the monitoring approaches needed to meet them.

Key	Monitoring Objective	Probabilistic	Targeted	Priority Rationale
A	Conduct water quality assessments pursuant to CWA Section 305(b) to support the development of Indiana's Integrated Report to U.S. EPA	X	X	Required for CWA Section 106 funding to meet CWA goals
B	Development of Indiana's CWA Section 303(d) List of Impaired Waters for Indiana's Integrated Report	X	X	Required for CWA Section 106 funding to meet CWA goals
C	Develop Total Maximum Daily Loads to address impairments identified on Indiana's 303(d) list	X	X	Required for CWA Section 106 funding to meet CWA goals
D	Determine trends and trophic status of Indiana's lakes and reservoirs under CWA Section 314		X	Required for CWA Section 106 funding to meet CWA goals
E	Develop water quality criteria, including nutrient criteria for lakes and reservoirs, rivers and streams	X	X	Required for CWA Section 106 funding to meet CWA goals
F	Support watershed planning and restoration efforts	X	X	Required for to CWA Section 319 funding and to meet performance measures in U.S. EPA's Strategic Plan
G	Identify water quality improvements accomplished by watershed restoration efforts funded through CWA programs		X	Required to meet performance measures in U.S. EPA's Strategic Plan
H	Support the development of public health advisories related to the use of Indiana's water resources, including fish consumption advisories and recreational use advisories		X	Supports protection of human health
I	Determine ambient ground water quality and extent of contaminated areas		X	Supports protection of human health
J	Support source water protection including both ground water and surface source water supplies		X	Supports protection of human health
K	Support development of National Pollutant Discharge Elimination System permit limits	X	X	Required for CWA Section 106 funding to meet CWA goals
L	Develop environmental indicators, including indices of biological integrity, for use in making water quality assessments	X		Supports primary monitoring objectives (A-C, E)
M	Responding to citizen complaints about activities that may be impacting private wells		X	Mandated by State Statute

Modified from IDEM OWQ's Surface Water Monitoring Strategy, 2011-2019.

Table 11: External data sets that met the data quality requirements for the 305(b) and 303(d) assessment and listing processes under the draft External Data Framework.

Source	Type of Assessment
American Water Company	Drinking water use support
City of Elkhart	Aquatic life use support; Fishable use support
City of Indianapolis	Recreational use support; Drinking water use support; Aquatic life use support
City of Muncie	Recreational use support; Drinking water use support; Aquatic life use support
City of South Bend	Recreational use support
City of Valparaiso	Recreational use support; Drinking water use support; Aquatic life use support
Marion County Health Department	Recreational use support; Drinking water use support; Aquatic life use support

Table 12: Summary of water quality assessment methodology for determining designated use support.

Aquatic Life Use Support - Rivers and Streams		
Toxicants	Dissolved metals, pesticides, polynuclear aromatic hydrocarbons (PAHs), free cyanide, and ammonia were evaluated on a site-by-site basis and judged according to the magnitude of the exceedance(s) of Indiana's WQS and the number of times the exceedance(s) occurred. For any one pollutant (grab or composite samples), the following assessment criteria are applied to data sets consisting of three or more measurements.	
	Fully Supporting	**Not Supporting**
	No more than one exceedance of the acute or chronic criteria for aquatic life within a three year period[1].	More than one exceedance of the acute or chronic criteria for aquatic life within a three year period.
Conventional inorganics	Dissolved oxygen, pH, sulfate, and chloride were evaluated for the exceedance(s) of Indiana's WQS. For any one pollutant, the following assessment criteria are applied to data sets consisting of three or more measurements.	
	Fully Supporting	**Not Supporting**
	Criteria are exceeded in less than or equal to 10% of measurements.	Criteria are exceeded in greater than10% of measurements.
Nutrients	Nutrient conditions were evaluated on a site-by-site basis using the benchmarks described below. In most cases, two or more of these conditions must be met on the same date in order to classify a waterbody as impaired. This methodology assumes a minimum of three sampling events: • Total Phosphorus -- One or more measurements greater than 0.3 mg/L • Nitrogen (measured as NO3 + NO2) – One or more measurements greater than 10.0 mg/L • Dissolved Oxygen (DO) – One or more measurements below the water quality standard of 4.0 mg/l or measurements that are consistently at/close to the standard, in the range of 4.0-5.0 mg/L or values greater than 12.0 mg/L • pH measurements – One or more measurements exceed the water quality standard of no more than 9.0 pH units or measurements are consistently at/close to the standard, in the range of 8.7- 9.0 pH units • Algal Conditions -- Algae are described as "excessive" based on field observations by IDEM scientists.	

Benthic aquatic macroinvertebrate Index of Biotic Integrity (mIBI) Scores (Range of possible scores is 12-60)	**Fully Supporting**	**Not Supporting**
	mIBI greater than or equal to 36	mIBI less than 36
Fish community (IBI) Scores (Range of possible scores is 0-60)	IBI greater than or equal to 36	IBI less than 36
Aquatic Life Use Support – Rivers and Streams		
Qualitative habitat use evaluation (QHEI) (Range of possible scores is 0-100)	The Qualitative Habitat Evaluation Index (QHEI) is not used to determine aquatic life- use support. Rather, the QHEI is an index designed to evaluate the lotic habitat quality important to aquatic communities and is used in conjunction with mIBI or IBI data, or both, to evaluate the role that habitat plays in waterbodies where impaired biotic communities (IBC) have been identified. QHEI scores are calculated using six metrics: substrate, instream cover, channel morphology, riparian zone, pool/riffle quality, and gradient. A higher QHEI score represents a more diverse habitat for colonization of aquatic organisms. IDEM has determined that a QHEI total score of <51 indicates poor habitat. For streams where the macroinvertebrate community (mIBI or mHab) or fish community (IBI) scores indicate IBC, QHEI scores are evaluated to determine if habitat is the primary stressor on the aquatic communities, or if there may be other stressors/pollutants causing the IBC.	
Aquatic Life Use Support – Lakes and Reservoirs		
Indiana Department of Natural Resources surveys of the status of sport fish communities in lakes and information on trout stocking.	**Fully Supporting**	**Not Supporting**
	Supports cold water fishery, including native Cisco and stocked trout, or both.	Native Cisco population is gone and/or the lake unable to support stocked trout and/or the lake's attributes appear to contribute to warm water fishery condition.
Temperature and pH	Lakes in which thermal modifications have caused an adverse effect on aquatic life and lakes that do not meet Indiana's WQS for pH have been assessed as not supporting of aquatic life use.	
Fish Consumption Use Support (Human Health) – All Waters		
Available fish tissue data for the most recent 12 years of data collection are evaluated. Only waters for which sufficient fish tissue data were available were assessed for fish consumption. All results from sampling locations considered representative of a given assessment unit (lake or reservoir; stream or stream reach) must be below the benchmarks for mercury and PCBs in order to be assessed as fully-supporting. For mercury, all waters with a trophic level weighted arithmetic mean result (calculated with all the samples collected during the same sampling event) that exceeds the applicable benchmark are classified as impaired. For PCBs, all waters with a single sample result for a given species exceeding the applicable benchmark are classified as impaired.		
Mercury in Fish Tissue	**Fully Supporting**	**Not Supporting**
	Trophic level weighted arithmetic mean concentration values for all sampling events are less than or equal to 0.3 mg/kg wet weight	Trophic level weighted arithmetic mean concentration values for one or more sampling events are greater than 0.3 mg/kg wet weight
PCBs in Fish Tissue	**Fully Supporting**	**Not Supporting**
	Actual concentration values for all samples are less than or equal to 0.02 mg/kg wet weight	Actual concentration values for one or more samples are greater than 0.02 mg/kg wet weight

Recreational Use Support (Human Health) – All Waters		
IDEM has two different methods for determining recreational use support, depending on the type of data set being used in making the assessment. For data sets consisting of five equally-spaced samples over a 30-day period, IDEM applies two tests, both of which are based on the U.S. EPA's Ambient Water Quality Criteria for Bacteria - 1986 (U.S. EPA, 1986), which provides the foundation for Indiana's WQS for recreational use. For data sets with 10 or more grab samples but without the five samples equally-spaced over the 30 days required to calculate a geometric mean, the 10% rule is applied. When both types of data sets are available, the assessment decision is based on the data set consisting of five samples, equally-spaced over a 30-day period.		
Bacteria (E. *coli*): at least five equally-spaced samples over 30 days. (cfu = colony forming units)	**Fully Supporting**	**Not Supporting**
	Geometric mean does not exceed 125 cfu/100mL	Geometric mean exceeds 125 cfu/100mL.
Bacteria (E. *coli*): grab samples (cfu = colony forming units)	Not more than 10% of measurements are greater than 576 cfu/100ml (for waters infrequently used for full body contact) or 235 cfu/100mL (for bathing beaches)[2]. And Not more than one sample is greater than 2,400 cfu/100mL.	More than 10% of samples are greater than 576 cfu/100mL or more than one sample is greater than 2,400 cfu/100mL.
Drinking Water Use Support – Rivers and Streams		
River and stream segments are designated for drinking water uses if a community water supply has a drinking water intake somewhere along the segment. When IDEM has data for a segment with a drinking water intake, those data are compared to the applicable ambient water quality criteria in Indiana's WQS to determine if the drinking water use is met. The appropriate water quality criteria are applied for specific substances identified in the WQS. Information regarding non-naturally occurring taste and odor-producing substances not specifically identified in the WQS are reviewed within the context of a water treatment facility's ability to meet Indiana's drinking WQS using conventional treatment.		
Toxicants	Dissolved metals, pesticides, PCBs, and free cyanide were evaluated on a site by site basis and judged according to magnitude of the exceedance(s) of Indiana's WQS for point-of-water intake and the number of times exceedance(s) occurred. For any one pollutant (grab or composite samples), the following assessment criteria are applied.	
	Fully Supporting	**Not Supporting**
	Not more than one exceedance of the acute or chronic criteria for human health within a three year period.	More than one exceedance of the acute or chronic criteria for human health within a three year period.
Conventional inorganics	Total dissolved solids, specific conductance, sulfate, chloride, nitrite-N and nitrogen (measured as NO_3 + NO_2) were evaluated for the exceedance(s) of Indiana's WQS for point-of-water intake and the number of times the exceedance(s) occurred. For any single pollutant (grab or composite samples), the following assessment criteria are applied to data sets consisting of three or more measurements.	
	Fully Supporting	**Not Supporting**
	Not more than one exceedance of the acute or chronic criteria for human health within a three year period.	More than one exceedance of the acute or chronic criteria for human health within a three year period.

Recreational Use Support (Aesthetics) – Lakes and Reservoirs		
	Fully Supporting	**Not Supporting**
Natural Lakes	Not more than 10% of all TP values greater than 54 ug/L and their associated Chlorophyll *a* values are less than or equal to20 ug/L	Less than 10% of all TP values are greater than 54 ug/L but their associated Chlorophyll *a* values are greater than 20 ug/L, and the TSI (CHL) score for the lake indicates eutrophic (50-70) or hypereutrophic (greater than 70) conditions Or More than 10% of all TP values are greater than 54 ug/L with associated Chlorophyll *a* values less than 4 ug/L, but the TSI (CHL) score for the lake indicates eutrophic (50-70) or hypereutrophic (greater than 70) conditions Or More than 10% of all TP values are greater than 54 ug/L with associated Chlorophyll *a* values greater than 4 ug/L
	Fully Supporting	**Not Supporting**
Reservoirs	Not more than 10% of all TP values greater than 51 ug/L and their associated Chlorophyll *a* values are less than 25 ug/L	Less than 10% of all TP values are greater than 51 ug/L but their associated Chlorophyll *a* values are greater than 25 ug/L and the TSI (CHL) score for the lake indicates eutrophic (50-70) or hypereutrophic (greater than 70) conditions Or More than 10% of all TP values are greater than 51 ug/L with associated Chlorophyll *a* values less than 2ug/L, but the TSI (CHL) score for the lake indicates eutrophic (50-70) or hypereutrophic (greater than 70) conditions Or More than 10% of all TP values are greater than 51 ug/L with associated Chlorophyll *a* values greater than 2 ug/L
Drinking Water Use Support – Lakes and Reservoirs		
	Fully Supporting	**Not Supporting**
Taste and odor-producing substances	Taste and odor substances not present in quantities sufficient to interfere with production of drinking water by conventional treatment	Taste and odor substances present in quantities requiring additional treatment by the public water supply to prevent taste and odor problems
Information on the application of pesticides to surface drinking water reservoirs	Reservoirs or lakes that serve as source water for public water supplies that received pesticide (algaecide) application permits for algae were classified as not supporting because additional treatment by the public water supply was required to prevent taste and odor problems.	

Other Assessments – Lakes and Reservoirs	
Carlson's Trophic State Index (TSI) for Chlorophyll *a* (CHL)	Chlorophyll *a* results were used to calculate Carlson TSI scores. Trophic scores were used to classify lakes according to their trophic state. Lake trends were also assessed for lakes with two or more trophic scores if at least one of the scores was less than five years old. Trophic scores and lake trends are not used to determine use support status. These assessments are conducted to fulfill Clean Water Act Section 314 reporting requirements for publicly owned lakes and reservoirs.

[1]For Indiana waters within the Great Lakes Basin, acute aquatic criteria refer to the "criterion maximum concentration (CMC) identified in 327 IAC 2-1.5, and the chronic aquatic criteria refer to the criterion continuous concentration (CCC) also described therein. For downstate waters (those located outside of the Great Lakes Basin, the acute aquatic criteria refer to the "AAC" values shown in 327 IAC 2-1 and the chronic aquatic criteria are shown as the "CAC" values.

[2]The value of 576 cfu/100mL comes from U.S. EPA's Ambient Water Quality Criteria for Bacteria - 1986 (U.S. EPA, 1986) and represents the single sample maximum applicable to waters infrequently used for full body recreation. For data collected from bathing beaches, the single day maximum value of 235 cfu/100mL is applied.

Source: IDEM OWQ 2016 Consolidated Assessment and Listing Methodology (Revised)

Table 13: Individual use support summary for Indiana streams.

Designated Beneficial Uses						
Designated Beneficial Use	**Total Size (Miles)**	**Size Assessed (Miles)**	**Percent Assessed**	**Size Fully Supporting (Miles)**	**Size Not Supporting (Miles)**	**Size Not Attainable* (Miles)**
Full Body Contact (Recreational Use)	63,130	32,730	52%	8,116	24,614	0
Human Health and Wildlife (Fishable Use)	63,130	8,935	14%	3,415	5,520	0
Public Water Supply	388	23	6%	0	0	0
Warm Water Aquatic Life (Aquatic Life Use)	63,130	38,043	60%	25,855	12,188	156

*"Size Not Attainable" refers to limited use waters as designated in Indiana's Water Quality Standards. See 327 IAC 2-1-11 and 2-1.5-8.
Source: IDEM 305(b) assessment database

Table 14: Summary of national and state causes impairing Indiana streams.

Causes of Impairment	Total Size (miles)
Pathogens	
Escherichia coli	24,437
Oxygen Depletion	
Oxygen, Dissolved	2,684
Flow Alterations	
Low flow alterations	91
Habitat alterations (Including Wetlands)	
Physical substrate habitat alterations	195
Thermal Impacts	
Temperature, water	103
Nutrients (Macronutrients/Growth Factors)	
Nutrient/Eutrophication Biological Indicators	3,064
Organic Enrichment (Sewage) Biological Indicators	97

Causes of Impairment	Total Size (miles)
Toxic Inorganics	
Ammonia (Un-ionized)	135
Chloride	228
Cyanide (as free cyanide)	158
Sulfate	439
Toxic Organics	
Dioxin (including 2,3,7,8-TCDD)	364
Hexachlorocyclohexane (mixture)	52
Polycyclic Aromatic Hydrocarbons (PAHs) (Aquatic Ecosystems)	20
PCB (Fish Tissue)	4,924
PCB (Water)	364
Metals	
Mercury (Fish Tissue)	768
Mercury (Water)	342
Pesticides	
Atrazine	7
pH/Acidity/Caustic Comditions	
pH	295
Sedimentation	
Sedimentation/Siltation	292
Oil and Grease	
Oil and Grease	22
Algae	
Chlorophyll-a	111
Biological Integrity (Bioassessments)	
Impaired Biotic Communities	8,539

Source: IDEM 305(b) assessment database

Table 15: Summary of national and state sources impairing Indiana streams.

Sources of Impairment	Total Size (miles)
Agriculture – Animal Feeding/Handling Operations (Nonpoint Source – Not Regulated)	
Animal Feeding Operations (NPS)	10,510
Managed Pasture Grazing	36
Permitted Runoff from Confined Animal Feeding Operations (CAFOs)	1,900
Agriculture	2,336
Livestock (Grazing or Feeding Operations)	6,300
Unrestricted Cattle Access	862
Agriculture – Crop Production	
Crop Production with Subsurface Drainage	2,660
Crop Production (Crop Land or Dry Land)	241

Sources of Impairment	Total Size (miles)
Construction	
Site Clearance (Land Development or Redevelopment)	49
Ground Water Loadings	
Contaminated Ground Water	13
Habitat Alterations (Not Directly Related to Hydromodification)	
Impacts from Hydrostructure Flow Regulation/modification	511
Loss of Riparian Habitat	1,357
Streambank Modifications/destabilization	488
Upstream Impoundments (e.g., PI-566 NRCS Structures)	15
Hydromodification	
Channelization	233
Dam Construction (Other than Upstream Flood Control Projects)	26
Industrial Permitted Discharge	
Industrial Point Source Discharge	342
RCRA Hazardous Waste Sites	3
Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO)	33
Land Application Waste Sites	
Illegal Dumps or Other Inappropriate Waste Disposal	680
On-site Treatment Systems (Septic Systems and Similar Decentralized Systems)	1,220
Legacy/Historical Pollutants	
Acid Mine Drainage	406
Contaminated Sediments	301
Historic Bottom Deposits (Not Sediment)	65
Impacts from Abandoned Mine Lands (Inactive)	18
Municipal Permitted Discharges (Direct and Indirect)	
Combined Sewer Overflows	1,652
Municipal Point Source Discharges	3,269
Package Plant or Other Permitted Small Flows Discharges	2,876
Sanitary Sewer Overflows (Collection System Failures)	20
Stormwater Permitted Discharges (Direct and Indirect)	
Unspecified Urban Stormwater	1,128
Natural Sources	
Waterfowl	3,975
Wildlife Other than Waterfowl	3,954
Upstream/Downstream Source	492
Natural Sources	1,420

Sources of Impairment	Total Size (miles)
Resource Extraction	
Dredge Mining	25
Reclamation of Inactive Mining	195
Spills and Unpermitted Discharges	
Sewage Discharges in Unsewered Areas	7,379
Urban-related Runoff/Stormwater (Other than Regulated Discharges)	
Golf Courses	60
Highways, Roads, Bridges, Infrastructure (New Construction)	14
Post-development Erosion and Sedimentation	19
Wastes from Pets	190
Impervious Surface/Parking Lot Runoff	461
Urban Runoff/Storm Sewers	205
Other Sources	
Source Unknown	10,182
Non-Point Source	16,035

Source: IDEM 305(b) assessment database

Table 16: Individual use support summary for Indiana's Great Lakes shoreline.

Designated Beneficial Uses						
Designated Beneficial Use	**Total Size (Miles)**	**Size Assessed (Miles)**	**Percent Assessed**	**Size Fully Supporting (Miles)**	**Size Not Supporting (Miles)**	**Size Not Attainable (Miles)**
Full Body Contact (Recreational Use)	59	59	100%	4	55	0
Human Health and Wildlife (Fishable Use)	59	59	100%	0	59	0
Public Water Supply	31	31	100%	31	0	0
Warm Water Aquatic Life (Aquatic Life Use)	59	59	100%	59	0	0

Source: IDEM 305(b) assessment database

Table 17: Summary of national and state causes impairing Indiana's Great Lakes shoreline.

Causes of Impairment	Total Size (Miles)
Pathogens	
Escherichia coli	55
Toxic Organics	
PCB (Fish Tissue)	59
Metals	
Mercury (Fish Tissue)	59

Source: IDEM 305(b) assessment database

Table 18: Summary of National and State Sources Impairing Great Lakes Shoreline.

Sources of Impairment	Total Size (Miles)
Land Application Waste Sites	
On-site Treatment Systems (Septic Systems and Similar Decentralized Systems)	19
Municipal Permitted Discharges (Direct and Indirect)	
Illicit Connections/Hook-ups to Storm Sewers	19
Other Sources	
Source Unknown	59
Non-Point Source	5

Source: IDEM 305(b) assessment database

Table 19: Individual use support summary for Lake Michigan.

Designated Beneficial Uses						
Designated Beneficial Use	**Total Size (Acres)**	**Size Assessed (Acres)**	**Percent Assessed**	**Size Fully Supporting (Acres)**	**Size Not Supporting (Acres)**	**Size Not Attainable (Acres)**
Aquatic life use	-	-	-	-	-	-
Fishable uses	154,176	154,176	100%	0	154,176	0
Drinking water supply	-	-	-	-	-	-
Recreational use (human health)	-	-	-	-	-	-

Source: IDEM 305(b) assessment database

Table 20: Summary of national and state causes impairing Lake Michigan.

Causes of Impairment	Total Size (Acres)
Bioaccumulative Chemicals of Concern	
PCBs (Fish Tissue)	154,176
Mercury (Fish Tissue)	154,176

Source: IDEM 305(b) assessment database

Table 21: Summary of national and state sources impairing Lake Michigan.

Sources of Impairment	Total Size (Acres)
Source Unknown (Applied to Fish Tissue Impairments)	154,176

Source: IDEM 305(b) assessment database

Table 22: Individual use support summary for Indiana lakes.

Designated Beneficial Uses						
Designated Beneficial Use	**Total Size (Acres)**	**Size Assessed (Acres)**	**Percent Assessed**	**Size Fully Supporting (Acres)**	**Size Not Supporting (Acres)**	**Size Not Attainable (Acres)**
Full Body Contact (Recreational Use)	127,607	37,047	29%	29,035	8,012	0
Human Health and Wildlife (Fishable Use)	127,607	77,845	61%	27,290	50,555	0
Public Water Supply Supply	29,541	16,615	56%	230	16,385	0
Warm Water Aquatic Life (Aquatic Life Use)	127,607	10,379	8%	3,754	6,625	0

Source: IDEM 305(b) assessment database

Table 23: Summary of national and state causes impairing lakes and reservoirs.

Causes of Impairment	Total Size (Acres)
Pathogens	
Escherichia coli	983
Thermal Impacts	
Temperature, water	1,556
Nutrients (Macronutrients/Growth Factors)	
Phosphorus (Total)	7,023
Toxic Organics	
PCB (Fish Tissue)	38,290
Metals	
Mercury (Fish Tissue)	14,736
Mineralization	
Taste and Odor	16,385
pH/Acidity/Caustic Conditions	
pH	105
Algae	
Chlorophyll-a	16,385
Other Causes	
Cause Unknown	6,520

Source: IDEM 305(b) assessment database

Table 24: Summary of national and state sources impairing lakes and reservoirs.

Sources of Impairment	Total Size (Acres)
Agriculture – Animal Feeding Operations (Nonpoint Source – Not Regulated)	
Agriculture	30
Industrial Permitted Discharges	
Industrial Point Source Discharge	1,556
Legacy/Historical Pollutants	
Acid Mine Drainage	105
Municipal Permitted Discharges (Direct and Indirect)	
Combined Sewer Overflows	30
Urban-related Runoff/Stormwater (Other than Regulated Discharges)	
Impervious Surface/Parking Lot Runoff	30
Other Sources	
Source Unknown	52,202
Nonpoint Source	7,054

Source: IDEM 305(b) assessment database

Table 25: Trophic states and predicted characteristics based on Carlson TSI scores for chlorophyll-*a* (CHL).

Trophic State	TSI (CHL)	Corresponding CHL values (ug/L)	Characteristics of Trophic State
Oligotrophic	Greater than 40	Less than 0.95 – 2.6	Low biological productivity • High transparency (clear water) • Low levels of nutrients • Low algal production and little/no aquatic vegetation • Well oxygenated hypolimnion year round; hypolimnion of shallower lakes may become anoxic at TSI scores >30
Mesotrophic	40-50*	2.6-7.3	Moderate biological productivity • Moderately transparency (moderately clear water) • Moderate levels of nutrients • Beds of submerged aquatic plants • Increasing possibility of anoxia in the hypolimnion during summer
Eutrophic	50-70	7.3-56	High biological productivity • Water has a low transparency • High levels of nutrients • Large amounts of aquatic plants or algae • At TSI scores >60, blue-green algae dominate and algal scums and excessive macrophytes possible • Hypolimnion commonly anoxic; fish kills possible
Hypereutrophic	Greater than 70	56-155	Very high biological productivity • Very low transparency, usually <3 feet • Very high levels of nutrients • Dense algae and aquatic vegetation; algal scums and few aquatic plants at TSI scores >80 • Fish kills and/or dead zones below the surface are common • Hypolimnion persistently anoxic; Fish kills and/or “dead zones” below the surface common

*Lakes with a TSI score of 50, which is on the boundary between mesotrophic and eutrophic conditions are evaluated with their corresponding TSI scores for TP and SD along with any other available information disk and classified in accordance to the best professional judgment of IDEM scientists.

Table 26: Trophic status of lakes assessed with Carlson Trophic State Index scores for Chlorophyll *a* 1990-2015.

Trophic Status	Number of Lakes	Total Size (Acres)*
Oligotrophic	95	19,000
Mesotrophic	130	24,061
Eutrophic	202	50,205
Hypereutrophic	28	5,267
Unknown	17	2,404

*Actual values are higher. These result do not reflect acres for non-indexed lakes for which size is currently unknown.
Source: IDEM 305(b) assessment database

Table 27: Trends in the trophic status of lakes assessed 1990-2015.

Trend	Number of Lakes	Total Size (Acres)*
Improving	46	13,773
Stable	100	1,6070
Fluctuating	89	36,314
Degrading	10	2,408
Unknown	227	32,372

*Actual values are higher. These result do not reflect acres for non-indexed lakes for which size is currently unknown.
Source: IDEM 305(b) assessment database

Table 28: Calls, spills and fish kills reported from 1998 to 2016.

Year	Calls	Spills	Fish Kills
1998	2,649	1,393	28
1999	2,507	1,246	41
2000	2,930	1,491	43
2001	3,093	1,591	51
2002	3,043	1,666	55
2003	3,026	1,551	30
2004	2,829	1,406	37
2005	3,319	1,271	40
2006	3,319	1,368	31
2007	2,852	1,354	36
2008	3,250	1,588	39
2009	2,889	1,226	39
2010	2,411	1,035	47
2011	2,160	934	10
2012	2,163	665	11
2013	2,162	653	38
2014	2026	788	9
2015	1931	1755	11
2016	206	170	

Source: IDEM TEMPO database

Table 29: Major sources of ground water contamination.

Contaminant Source	Highest Priority	Risk Factors*	Type of Contaminant**
Agricultural Activities			
Agricultural chemical facilities		A,C,H,I	5
Commercial fertilizer applications	X	A, C, D, E	5
Confined animal feeding operations	X	A, D, E	5, 9
Farmstead agricultural mixing and loading procedures			
Irrigation practices		A,C,H,I	1,2,5,8,9
Animal manure applications	X	A,C,H,I	5, 9
Pesticide applications		A,C,H,I	1,2
Storage and Treatment Activities			
Land application		A,C,H,I	5,9
Domestic and industrial residual applications		A,C,H,I	5,9
Material stockpiles		A,C,H,I	5,9
Storage tanks (above ground)		A,C,H,I	
Storage tanks (underground)	X	A, B, C, D, E, F	2, 3, 4
Surface impoundments			
Waste piles		A,C,H,I	5,9
Disposal Activities			
Deep injection wells			
Landfills (constructed prior to 1989)	X	A, B, C, D, E, F	1, 2, 3, 4, 5, 6, 7, 8, 9
Permitted landfills (constructed 1989- present)			
Septic systems	X	A, C, D, E, F, G	1, 2, 3, 4, 5, 7, 9
Shallow (Class V) injection wells	X	A, B, C, D, E, I	1, 2, 3, 4, 5, 7, 9
Other			
Hazardous waste generators		A	
Hazardous waste sites		A	
Industrial facilities	X	A, B, C, D, E, F	1, 2, 3, 4, 5, 7, 8, 9
Liquid transport pipelines (including sewer)		A	8
Materials spills (including during transport)	X	A, B, C, D, E, F	1, 2, 3, 4, 5, 7, 8, 9
Material transfer operations		A	
Small-scale manufacturing and repair shops		A, I	8
Mining and mine drainage		A	7,8
Salt storage (state and nonstate facilities) and road salting	X	A, C, D, E, F	6
Urban runoff		A, C, H, I	1, 2, 4, 5, 7, 8, 9

Source: U.S. EPA 2006a; 2007

*Factors considered in selecting the contaminant source: (A) human health and/or environmental risk (toxicity); (B) size of the population at risk; (C) location of source relative to drinking water source; (D) number and/or size of contaminant sources; (E) hydrogeologic sensitivity; (F) documented state findings, other findings; (G) high to very high priority in localized areas, but not over majority of Indiana; (H) geographic distribution/occurrence; and, (I) lack of information.

**Classes of contaminants associated with contamination source: (1) Inorganic pesticides; (2) Organic pesticides; (3) Halogenated solvents; (4) Petroleum compounds; (5) Nitrate; (6) Salinity/brine; (7) Metals; (8) Radionuclides; and, (9) Bacteria, protozoa and viruses.

Table 30: Ground water protection programs and activities currently established or under development in Indiana.

Program or Activity	Status	State Agency/Organization
Active SARA Title III Program	Fully established	IDEM-OLQ[1]
Ambient ground water monitoring program	Under development	IDEM-OWQ
Aquifer sensitivity assessment	Fully established	IDEM-OWQ, IDNR, IGS[2], OISC[3]
Aquifer mapping/basin studies	Under development	IDNR, IDEM-OWQ
Aquifer/ hydrogeologic setting characterization	Fully established	IGS, IDEM-OWQ, IDNR
Bulk storage program for agricultural chemicals	Fully established	OISC
Comprehensive data management system	Under development	IDEM-OWQ
Complaint response program for private wells	Fully established	IDEM-OWQ
Confined animal feeding program	Fully established	IDEM-OWQ
Ground water discharge permits for constructed wetlands	Under development	IDEM-OWQ
Ground water Best Management Practices	Under development	OISC*, IDEM-OWQ
Ground water legislation	Fully established	IDEM, IDNR, OISC, ISDH
Ground water classification	Fully established	IDEM-OWQ
Ground water quality standards	Fully established	IDEM-OWQ
Land application of domestic and industrial residuals	Fully established	IDEM-OLQ
Nonpoint source controls	Under development	IDEM-OWQ
Oil and Gas	Fully established	IDNR
Pesticide State Management Plan	Pending	OISC*, IDEM-OWQ, IDNR, IGS
Pollution Prevention Program	Fully established	IDEM-OPPTA[4]
Reclamation	Fully established	IDNR
Resource Conservation and Recovery Act (RCRA) Primacy	Fully established	IDEM-OLQ
Sensitivity assessment for drinking water/ wellhead protection	Fully established	IGS, IDEM-OWQ
Spill Monitoring	Fully established	IDEM-OWQ
State Superfund	Fully established	IDEM-OLQ
State RCRA Program incorporating more stringent requirements than RCRA primacy	Fully established	IDEM-OLQ
State septic system regulations	Fully established	ISDH
Underground storage tank installation requirements	Fully established	IDEM-OLQ
Underground Storage Tank Remediation Fund	Fully established	IDEM-OLQ
Underground Storage Tank Permit Program	Fully established	IDEM-OLQ
Underground Injection Control Program	Fully established for Class II wells	IDNR
Well abandonment regulations	Fully established	IDNR
Wellhead Protection Program	Fully established	IDEM-OWQ
Well installation regulations	Fully established	IDNR

*Indicates lead agency involved in enforcement or implementation.
"Pending" is used to describe those programs that have a written draft policy; "under development" is used to describe those programs still in the planning stage.
[1]OLQ, Office of Land Quality; [2]IGS, Indiana Geological Survey; [3]OISC, Office of the Indiana State Chemist; [4]OPPTA, Office of Pollution Prevention and Technical Assistance (IDEM).

Table 31: Indiana Ground Water Monitoring Network analytical results, 2012.

Analyte Measured as Milligrams per Liter (mg/L) or Micrograms per Liter (ug/L)	Number of Samples (n)	n Below Detection Limit (BDL)	% BDL	DL	Median	Mean	Min	Max	Standard Deviation	EPA Maximum Contaminant Level (MCL)	EPA Secondary Maximum Contaminant Level (SMCL) or Recommendation (REC)	n > MCL or SMCL	% > MCL or SMCL
Alkalinity and Anions/Cations													
Alkalinity (mg/L)	326	0	0.00	1	273	267.30	21.6	767	82.75	--	--		
Calcium (mg/L)	326	8	2.50	0.1	80	79.68	0.1	300	39.55	--	--		
Chloride (mg/L)	326	37	11.30	2	12	23.63	2	400	39.75	--	--		
Magnesium (mg/L)	326	12	3.70	0.1	28	28.94	0.1	200	19.37	--	--		
Potassium (mg/L)	326	4	1.20	0.2	1.4	2.06	0.2	40	3.01	--	--		
Sodium (mg/L)	326	0	0.00	0.1	11	35.62	1.3	660	66.90	--	200 mg/L (rec)	11	3.37
Sulfate (mg/L)	326	46	14.10	5	34	69.46	5	1500	159.28	--	250 mg/L	15	4.60
Metals and Minerals													
Arsenic (ug/L)	326	211	64.70	2	2	4.18	2	69	6.79	10 ug/L	--	23	7.06
Barium (ug/L)	326	14	4.30	2	82.5	129.25	2	1100	148.30	2000 ug/L	--	0	0.00
Boron (ug/L)	326	3	0.90	5	28	102.24	5	1400	193.09	--	--		
Bromide (mg/L)	326	20	6.10	10	27	65.98	10	4000	257.81	--	--		
Chromium (ug/L)	326	324	99.40	2	2	2.02	2	6.2	0.26	100 ug/L	--	0	0.00
Copper (ug/L)	326	147	45.10	1	1.3	4.11	1	97	8.65	1300 ug/L	--	0	0.00
Iron (mg/L)	326	104	31.90	0.02	0.49	0.91	0.02	7.2	1.15	--	0.3 mg/L	180	55.21
Lead (ug/L)	326	323	99.10	1	1	1.05	1	10	0.59	15 ug/L	--	0	0.00
Nickel (ug/L)	326	91	27.90	1	1.6	2.07	1	19	1.71	--	100 ug/L (rec)	0	0.00
Silicon (mg/L)	326	0	0.00	0.1	14	14.69	6.7	36	4.36	--	--		
Strontium (mg/L)	326	10	3.10	2	0.18	1.68	0.002	37	4.20	--	4 mg/L (rec)	35	10.74
Zinc (ug/L)	326	106	32.50	5	11	32.67	5	600	71.03	--	5000 ug/L	0	0.00

Analyte Measured as Milligrams per Liter (mg/L) or Micrograms per Liter (ug/L)	Number of Samples (n)	n Below Detection Limit (BDL)	% BDL	DL	Median	Mean	Min	Max	Standard Deviation	EPA Maximum Contaminant Level (MCL)	EPA Secondary Maximum Contaminant Level (SMCL) or Recommendation (REC)	n > MCL or SMCL	% > MCL or SMCL
Nitrogen, Nitrate-Nitrite													
Nitrogen, Nitrate-Nitrite (mg/L)	326	167	51.20	0.1	0.1	2.02	0.01	27	4.30	10 mg/L	--	17	5.21
Pesticides and Breakdown Products													
Acetochlor ESA (ug/L)	50	46	92.00	0.1	0.1	0.21	0.1	3.8	0.57	--	--		
Acetochlor OA (ug/L)	51	48	94.10	0.1	0.1	0.13	0.1	1.6	0.21	--	--		
Alachlor ESA (ug/L)	43	40	93.00	0.1	0.1	0.14	0.1	1.2	0.19	--	--		
Atrazine (ug/L)	325	324	99.70	0.1	0.1	0.10	0.1	0.3	0.01	3 ug/L	--	0	0.00
Metolochlor ESA (ug/L)	46	39	84.80	0.1	0.1	0.21	0.1	2	0.34	--	--		
Metolochlor OA (ug/L)	47	44	93.60	0.1	0.1	0.12	0.1	0.6	0.08	--	--		
Volatile Organic Compounds													
Benzo(a)pyrene (ug/L)	326	325	99.70	0.02	0.02	0.02	0.02	0.03	0.0005	0.2 ug/L	--	0	0.00
Methyl-t-butyl ether (MTBE) (ug/L)	325	324	99.70	0.5	0.5	0.51	0.5	3.8	0.18	--	20 ug/L	0	0.00
Tetrachloroethylene (ug/L)	325	324	99.70	0.5	0.5	0.51	0.5	4.7	0.23	5 ug/L	--	0	0.00
Toluene (ug/L)	325	324	99.70	0.6	0.5	0.50	0.5	0.6	0.01	1000 ug/L	--	0	0.00

***Disinfection Byproducts and plasticizers have been omitted from this list until further analysis and sampling can be conducted to determine the source

Table 32: Summary statistics calculated from nitrogen concentrations measured as milligrams per liter (mg/L) nitrate-nitrite for Indiana's generalized hydrogeologic settings.

Hydrogeologic Setting	Number of Samples (n)	n Above Detection Limit (ADL)	% ADL	n Above Maximum Contaminant Level (MCL)	% Above MCL	Median	Mean	Min	Max	Standard Deviation
Ablation Sequence	5	0	0	0	0	0.005	0.005	0.005	0.01	0.00
Alluvial Valley	5	2	40	0	0	0.005	0.473	0.005	1.60	0.71
Dissected Bedrock	4	2	50	0	0	0.068	0.070	0.005	0.14	0.08
Dissected Bedrock Thin Till	17	11	65	1	6	0.170	1.736	0.005	13.00	3.28
Fan Head Complex	5	1	20	0	0	0.005	0.080	0.005	0.38	0.17
Ice Contact Deposits	2	1	50	1	50	7.003	7.003	0.005	14.00	9.90
Karst Plain and Escarpment	9	7	78	0	0	0.530	2.235	0.005	7.90	2.92
Lake Deposits	5	3	60	0	0	0.051	1.610	0.005	7.70	3.41
Meltwater Channel	1	0	0	0	0	0.005	0.005	0.005	0.01	
Outwash Complex	6	2	33	0	0	0.005	0.127	0.005	0.45	0.20
Outwash Plain	22	8	36	2	9	0.005	2.627	0.005	22.00	5.47
Sand Plains and Loess Sands	30	17	57	1	3	0.012	1.638	0.005	16.00	3.54
Sluiceway or Discrete Channel	34	15	44	2	6	0.005	1.802	0.005	15.00	3.69
Till Capped Fan	9	4	44	0	0	0.005	0.467	0.005	4.00	1.33
Till Cored Moraine	44	9	20	0	0	0.005	0.088	0.005	2.80	0.42
Till Plain	151	40	26	0	0	0.005	0.180	0.005	6.40	0.79
Trough System	4	1	25	0	0	0.005	0.379	0.005	1.50	0.75
Tunnel Valley	10	3	30	0	0	0.005	0.532	0.005	4.30	1.35
Unconfined Outwash Fan	16	6	38	0	0	0.005	0.344	0.005	1.90	0.71
Wabash River Valley	11	7	64	2	18	1.100	5.023	0.005	17.00	6.57

Table 33 Average nitrogen concentrations measured as milligrams per liter (mg/L) nitrate-nitrite for each hydrogeologic setting calculated for different well type and depth, aquifer conditions and aquifer sensitivity.

Hydrogeologic Setting	Well Type		Well Depth				Aquifer Conditions	Aquifer Conditions				
	Bedrock	Unconsolidated	0-50	50-100	100-150	>150	Oxidizing	High	Moderate	Low	Variable	Low , High
Ablation Sequence	ND	ND	ND	ND	ND	--	ND	ND	--	--	--	--
Alluvial Valley	0.473	--	--	0.803	--	0.253	1.175	0.473	--	--	--	--
Dissected Bedrock	0.092	0.070	--	--	0.130	0.050	0.092	0.070	--	--	--	--
Dissected Bedrock Thin Till	0.447	3.576	4.972	0.045	1.104	0.279	3.130	0.869	0.038	4.410	--	0.280
Fan Head Complex	0.193	ND	--	0.130	ND	--	ND	0.380	ND	--	ND	--
Ice Contact Deposits	--	7.003	--	14.000	ND	--	--	ND	14.000	--	--	--
Karst Plain and Escarpment	2.472	0.340		6.000	1.762	1.770	2.152	2.235	--	--	--	--
Lake Deposits	ND	2.012	ND	7.700	0.115	--	0.115	ND	ND	2.680	--	--
Outwash Complex	0.370	ND	--	ND	0.148	0.450	0.370	0.127	--	--	--	--
Outwash Plain	ND	2.752	4.038	1.332	ND	ND	9.140	2.627	--	--	--	--
Sand Plains and Loess Sands	3.041	0.825	0.829	1.760	2.683	1.965	3.473	0.485	2.923	6.800	--	--
Sluiceway or Discrete Channel	0.017	2.184	3.869	1.594	0.610	0.038	4.699	1.856	ND	--	--	--
Till Capped Fan	--	0.467	--	0.008	1.040	--	1.385	ND	ND	0.078	0.807	--
Till Cored Moraine	0.050	0.096	1.403	0.036	0.030	0.006	0.135	ND	0.034	0.119	ND	--
Till Plain	0.139	0.203	0.595	0.177	0.148	0.085	0.975	0.219	0.047	0.244	ND	--
Trough System	--	0.379	ND	0.503	--	--	1.500	0.379	--	--	--	--
Tunnel Valley	1.735	0.016	0.303	0.873	0.021	--	1.735	ND	--	--	0.663	--
Unconfined Outwash Fan	--	0.344	0.006	0.345	0.624	0.011	0.855	0.240	1.900	--	--	--
Wabash River Valley	0.007	6.904	8.515	3.376	6.179	ND	6.368	5.525	--	--	ND	--

Note: ND = not detected. Detailed averages were not compiled for the Meltwater Channel Setting, which consisted of only one sample.

Table 34: Summary statistics calculated from arsenic concentrations in micrograms per liter (ug/L) for Indiana's generalized hydrogeologic settings.

Hydrogeologic Setting	Number of Samples (n)	n Above Detection Limit (ADL)	% ADL	n Above Maximum Contaminant Level (MCL)	% Above MCL	Median (ug/L)	Mean (ug/L)	Minimum (ug/L)	Maximum (ug/L)	Standard Deviation (ug/L)
Ablation Sequence	5	3	60	1	20	2.5	5.3	1.0	16.0	6.32
Alluvial Valley	5	1	20	1	20	1.0	6.6	1.0	29.0	12.52
Dissected Bedrock	4	1	25	0	0	1.0	1.8	1.0	4.2	1.60
Dissected Bedrock Thin Till	17	3	18	0	0	1.0	1.3	1.0	3.8	0.74
Fan Head Complex	5	1	20	0	0	1.0	1.4	1.0	3.2	0.98
Ice Contact Deposits	2	1	50	1	50	6.5	6.5	1.0	12.0	7.78
Karst Plain and Escarpment	9	0	0	0	0	1.0	1.0	1.0	1.0	0.00
Lake Deposits	5	2	40	1	20	1.0	5.9	1.0	21.0	8.66
Meltwater Channel	1	1	100	0	0	6.1	6.1	6.1	6.1	
Outwash Complex	6	2	33	0	0	1.0	2.4	1.0	8.0	2.80
Outwash Plain	22	7	32	2	9	1.0	3.1	1.0	19.0	4.51
Sand Plains and Loess Sands	30	7	23	3	10	1.0	4.4	1.0	63.0	11.61
Sluiceway or Discrete Channel	34	13	38	3	9	1.0	5.9	1.0	68.0	13.99
Till Capped Fan	9	3	33	1	11	1.0	4.7	1.0	28.0	8.90
Till Cored Moraine	44	20	45	2	5	1.0	3.2	1.0	16.0	3.44
Till Plain	151	67	44	25	17	1.0	5.2	1.0	65.0	7.81
Trough System	4	1	25	0	0	1.0	1.4	1.0	2.7	0.85
Tunnel Valley	10	4	40	1	10	1.0	4.1	1.0	21.0	6.41
Unconfined Outwash Fan	16	8	50	1	6	1.8	4.5	1.0	17.0	4.64
Wabash River Valley	11	2	18	1	9	1.0	3.6	1.0	27.0	7.80

Table 35: Average arsenic concentrations in micrograms per liter (ug/L) for each hydrogeologic setting calculated for different well type and depth, aquifer conditions and aquifer sensitivity.

Hydrogeologic Setting	Well Type		Aquifer Conditions		Hydrogeologic Sensitivity					Well Depth			
	Bedrock	Unconsolidated	Oxidizing	Reducing	High	Moderate	Low	Variable	Low , High	0-50	50-100	100-150	>150
Ablation Sequence	16.00	2.65	6.10	5.13	2.50	--	--	--	--	1.00	3.55	9.25	--
Alluvial Valley	6.60	--	ND	10.33	ND	--	--	--	--	--	ND	--	10.33
Dissected Bedrock	2.07	ND	ND	4.20	1.80	--	--	--	--	--	--	ND	2.07
Dissected Bedrock Thin Till	1.11	1.56	1.12	1.49	ND	1.78	ND	--	ND	1.22	1.78	ND	1.00
Fan Head Complex	ND	1.73	ND	1.55	ND	ND	--	2.10	--	--	1.73	ND	--
Ice Contact Deposits	--	6.50	--	6.50	12.00	ND	--	--	--	--	ND	12.00	--
Karst Plain and Escarpment	ND	ND	ND	ND	ND	--	--	--	--		ND	ND	ND
Lake Deposits	ND	7.18	9.23	ND	21.00	1.00	2.57	--	--	ND	ND	9.23	--
Outwash Complex	ND	3.15	ND	3.15	2.43	--	--	--	--	--	3.87	ND	ND
Outwash Plain	ND	3.23	ND	3.75	3.13	--	--	--	--	1.55	4.73	8.05	ND
Sand Plains and Loess Sands	ND	6.29	1.74	5.86	6.29	ND	ND	--	--	3.06	2.98	11.33	ND
Sluiceway or Discrete Channel	2.10	6.67	ND	8.87	5.85	6.40	--	--	--	1.61	9.68	2.26	2.65
Till Capped Fan	--	4.74	1.43	6.40	ND	ND	15.15	2.08	--	--	2.08	8.08	--
Till Cored Moraine	2.01	3.49	1.58	3.43	2.10	3.25	3.25	3.15	--	3.15	2.66	3.11	4.10
Till Plain	3.93	5.88	1.24	5.89	3.67	3.81	5.63	6.59	--	5.08	4.61	8.49	3.60
Trough System	--	1.43	ND	1.57	1.43	--	--	--	--	2.70	ND	--	--
Tunnel Valley	1.67	5.11	ND	5.40	4.85	--	--	3.89	--	3.57	5.62	ND	--
Unconfined Outwash Fan	--	4.47	ND	4.96	4.32	6.70	--	--	--	2.75	5.66	5.20	ND
Wabash River Valley	10.43	ND	1.38	6.20	1.23	--	--	27.00	--	ND	ND	1.58	1.58

Note: ND = not detected

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ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT

SEDIMENTATION POND
A.B. BROWN GENERATING STATION
POSEY COUNTY, INDIANA

by
Haley & Aldrich, Inc.
Greenville, South Carolina

for
Southern Indiana Gas and Electric Company
Evansville, Indiana

File No. 129420
January 2020

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1. 40 CFR § 257.90 Applicability

1.1 40 CFR § 257.90(a)

Except as provided for in § 257.100 for inactive CCR surface impoundments, all CCR landfills, CCR surface impoundments, and lateral expansions of CCR units are subject to the groundwater monitoring and corrective action requirements under § 257.90 through § 257.98.

The Sedimentation Pond at A.B. Brown Generating Station (ABB) is subject to the groundwater monitoring and corrective action requirements described under Code of Federal Regulations Title 40 (40 CFR) § 257.90 through § 257.98 (Rule). This document addresses the requirement for the Owner/Operator to prepare an Annual Groundwater Monitoring and Corrective Action Report per § 257.90(e).

1.2 40 CFR § 257.90(e) - SUMMARY

Annual groundwater monitoring and corrective action report. For existing CCR landfills and existing CCR surface impoundments, no later than January 31, 2018, and annually thereafter, the owner or operator must prepare an annual groundwater monitoring and corrective action report. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, the owner or operator must prepare the initial annual groundwater monitoring and corrective action report no later than January 31 of the year following the calendar year a groundwater monitoring system has been established for such CCR unit as required by this subpart, and annually thereafter. For the preceding calendar year, the annual report must document the status of the groundwater monitoring and corrective action program for the CCR unit, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year. For purposes of this section, the owner or operator has prepared the annual report when the report is placed in the facility's operating record as required by § 257.105(h)(1).

This Annual Groundwater Monitoring and Corrective Action Report documents the activities completed in 2019 for the Sedimentation Pond as required by the Rule. Groundwater sampling and analysis was conducted per the requirements described in § 257.93, and the status of the groundwater monitoring program described in § 257.95 is provided in this report.

1.2.1 Status of the Groundwater Monitoring Program

As provided in the notification on 15 January 2018 statistically significant increases (SSI) of Appendix III constituents were identified downgradient of the Sedimentation Pond. An evaluation of alternate sources was conducted; however, a successful alternate source demonstration (ASD) was not achieved at that time. As a result, an Assessment Monitoring program was initiated as required by § 257.94(e)(2). The notification was placed in the facility's operating record as required by 257.105(h)(5). Annual and semi-annual groundwater samples were collected as outlined in § 257.95(b) and 257.95(d)(1) and groundwater protection standards were established as required by § 257.95(d)(2). Statistical analysis was completed in January 2019 as described in § 257.93(h)(2) and statistically significant levels (SSL) of Appendix IV constituents were not identified downgradient of the Sedimentation Pond. As a result, the Sedimentation Pond remains in assessment monitoring.

1.2.2 Key Actions Completed

The following key actions were completed in 2019:

- Completed a statistical analysis of assessment monitoring results to evaluate potential SSLs;
- Prepared 2018 Annual Report including:
  - The Annual Report was placed in the facility's operating record pursuant to § 257.105(h)(1);
  - Pursuant to § 257.106(h)(1), the notification was sent to the relevant State Director and/or Tribal authority within 30 days of the Annual Report being placed in the facility's operating record [§ 257.106(d)];
  - Pursuant to § 257.107(h)(1), the Annual Report was posted to the CCR Website within 30 days of the Annual Report being placed in the facility's operating record [§ 257.107(d)] and 257.107(h)(1)];
- Collected and analyzed two rounds of groundwater samples in accordance with § 257.95

1.2.3 Problems Encountered

No problems such as damaged wells, issues with sample collection or lack of sampling, and problems with analytical analysis were encountered at the ABB Sedimentation Pond in 2019.

1.2.4 Actions to Resolve Problems

Actions to resolve problems were not required.

1.2.5 Project Key Activities for Upcoming Year

Key activities to be completed in 2020 include the following:

- Continue Assessment Monitoring as required by § 257.95.
- Complete statistical analysis of the semiannual groundwater sampling results as required by § 257.93(h)(2).

1.3 40 CFR § 257.90(e) - INFORMATION

At a minimum, the annual groundwater monitoring and corrective action report must contain the following information, to the extent available:

1.3.1 40 CFR § 257.90(e)(1)

A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;

As required by § 257.90(e)(1), a map showing the locations of the Sedimentation Pond and associated upgradient, and downgradient wells is presented as Figure 1.

1.3.2 40 CFR § 257.90(e)(2)

Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;

Additional monitoring wells were not installed or decommissioned during 2019. However, location and construction details of the existing monitoring well network for the Sedimentation Pond is provided for reference as Table I.

1.3.3 40 CFR § 257.90(e)(3)

In addition to all the monitoring data obtained under § 257.90 through § 257.98, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;

In accordance with § 257.95(b) and § 257.95(d)(1), two independent samples from each background and downgradient monitoring well were collected and analyzed. A summary table including the sample names, dates of sample collection, reason for sample collection (detection or assessment), and monitoring data obtained for the groundwater monitoring program for the Sedimentation Pond is presented in Table II of this report.

1.3.4 40 CFR § 257.90(e)(4)

A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels); and

As required by § 257.94(h) a statistical analysis of the Appendix IV constituents was completed by 15 January 2019. This statistical analysis determined that SSLs of Appendix IV constituents were not present downgradient of the Sedimentation Pond. As a result, this CCR Unit remains in assessment monitoring and semiannual sampling will continue in 2020.

1.3.5 40 CFR § 257.90(e)(5)

Other information required to be included in the annual report as specified in § 257.90 through § 257.98.

Other information including development of groundwater protection standards, recording groundwater monitoring results in the operating record, and an evaluation of alternate sources is discussed in preceding sections.

TABLES

TABLE I

GROUNDWATER MONITORING WELL LOCATION AND CONSTRUCTION DETAILS

A.B. BROWN GENERATING STATION - SEDIMENTATION POND

MOUNT VERNON, INDIANA

Well	CCR Unit	Date Installed	Easting	Northing	Top of Pad Elevation (ft msl)	Top of Riser Elevation (ft msl)	Surface Grout (ft bgs)	Bentonite (ft bgs)	Sand Pack (ft bgs)	Screen Zone (ft bgs)	Screen Length (ft)	Well Radius (in)	Status
CCR-SP-1	Sediment Pond	March 2016	2770030.26	970981.89	403.90	403.51	0.0 - 6.0	6.0 - 8.0	8.0 - 20.0	10.00 - 20.00	10	2	Active
CCR-SP-2	Sediment Pond	March 2016	2769939.51	970887.25	403.60	403.23	0.0 - 6.0	6.0 - 8.0	8.0 - 20.0	10.00 - 20.00	10	2	Active
CCR-SP-3	Sediment Pond	March 2016	2770027.64	970735.02	403.90	403.57	0.0 - 6.0	6.0 - 8.0	8.0 - 20.0	10.00 - 20.00	10	2	Active
CCR-BK-1R	Background	March 2016	2770919.08	974083.40	480.10	483.39	0.0 - 50.0	50.0 - 52.0	52.0 - 64.0	54.00 - 64.00	10	2	Active
CCR-BK-2	Background	March 2016	2769728.14	972854.33	427.50	430.60	0.0 - 11.5	11.5 - 13.5	13.5 - 25.5	15.50 - 25.50	10	2	Active

Notes:

bgs = below ground surface

ft = feet

in = inches

msl = mean sea level

Datum of Elevations in NAVD 88

TABLE II
SUMMARY OF GROUNDWATER QUALITY DATA
SEDIMENTATION POND - MAY THROUGH OCTOBER 2019
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Action Level	Background			
Location Name	Maximum Contaminant Level	CCR-BK-1R	CCR-BK-1R	CCR-BK-2	CCR-BK-2
Sample Name		CCR-BK-1R-20190521	CCR-BK-1R-20191014	CCR-BK-2-20190521	CCR-BK-2-20191014
Sample Date		05/21/2019	10/14/2019	05/21/2019	10/14/2019
Lab Sample ID		180-90467-7	180-97392-1	180-90467-8	180-97392-2
Detection Monitoring - EPA Appendix III Constituents (mg/L)					
Boron, Total	NA	0.08 U	**0.056 J**	**0.58**	**0.051 J**
Calcium, Total	NA	**37**	**34**	**71**	**35**
Chloride	NA	**2.3**	**2.4**	**4.6**	**17**
Fluoride	4	0.23 U	**0.2**	0.12 U	**0.07 J**
Sulfate	NA	**23**	**22**	**60**	**20**
Total Dissolved Solids (TDS)	NA	**230**	**210**	**440**	**230**
pH (lab) (SU)	NA	**7.4 J**	**7.2 HF**	**7.5 J**	**7 HF**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)					
Antimony, Total	0.006	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	**0.00034 J**	**0.00036 J**	**0.00041 J**	0.001 U
Barium, Total	2	**0.027 J**	**0.036**	**0.045 J-**	**0.032**
Beryllium, Total	0.004	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.005	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	0.1	0.002 U	0.002 U	**0.0087**	0.002 U
Cobalt, Total	0.006	**0.00012 J**	**0.00017 J**	**0.0005**	**0.00011 J**
Fluoride	4	0.23 U	**0.2**	0.12 U	**0.07 J**
Lead, Total	0.015	**0.00016 J**	**0.00023 J**	0.001 U	0.001 U
Lithium, Total	0.04	0.0065 U	0.005 U	0.0095 U	0.005 U
Mercury, Total	0.002	0.0002 U	-	0.0002 U	-
Molybdenum, Total	0.1	**0.00063 J**	**0.00075 J**	**0.0025 J**	0.005 U
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.002	0.001 U	0.001 U	0.001 U	0.001 U
Radiological (pCi/L)					
Radium-226	NA	**0.336 J ± 0.108**	0.0729 U ± 0.182	-0.0109 U ± 0.184	-0.0644 U ± 0.0992
Radium-228	NA	-0.0733 UJ ± 0.235	0.147 U ± 0.233	0.0733 U ± 0.246	0.323 U ± 0.292
Radium-226 & 228	5	0.336 UJ ± 0.259	0.220 U ± 0.296	0.0733 U ± 0.307	0.259 U ± 0.308
Field Parameters					
Temperature (Deg C)	NA	**15.78**	**15.72**	**14.47**	**16.04**
Dissolved Oxygen, Field (mg/L)	NA	**5.82**	**5.98**	**0.48**	**0.51**
Conductivity, Field (mS/cm)	NA	**0.34186**	**0.3542**	**0.72035**	**0.38427**
ORP, Field (mv)	NA	**43.3**	**104.9**	**47.9**	**72.1**
Turbidity, Field (NTU)	NA	**0.97**	**9.8**	**12.88**	**11.89**
pH, Field (SU)	NA	**7**	**6.34**	**7.2**	**6.54**

ABBREVIATIONS AND NOTES:

CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
SU: standard units.
USEPA: United States Environmental Protection Agency.
Results in **bold** are detected.

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257. https://www.epa.gov/coalash/coal-ash-rule

TABLE II
SUMMARY OF GROUNDWATER QUALITY DATA
SEDIMENTATION POND - MAY THROUGH OCTOBER 2019
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

Location Group	Action Level	Downgradient							
Location Name	Maximum Contaminant Level	CCR-SP-1	CCR-SP-1	CCR-SP-1	CCR-SP-2	CCR-SP-2	CCR-SP-2	CCR-SP-3	CCR-SP-3
Sample Name		CCR-SP-1-20190524	CCR-SP-1-20191015	BLIND DUPLICATE 3-20191015	CCR-SP-2-20190524	BLIND DUPLICATE 3-20190524	CCR-SP-2-20191017	CCR-SP-3-20190524	CCR-SP-3-20191015
Sample Date		05/24/2019	10/15/2019	10/15/2019	05/24/2019	05/24/2019	10/17/2019	05/24/2019	10/15/2019
Lab Sample ID		180-90606-1	180-97469-1	180-97469-4	180-90606-2	180-90606-6	180-97469-2	180-90606-3	180-97469-3
Detection Monitoring - EPA Appendix III Constituents (mg/L)									
Boron, Total	NA	**0.34 J+**	**0.46**	**0.47**	**0.15 J+**	**0.26 J+**	**0.22**	0.08 U	**0.04 J**
Calcium, Total	NA	**270**	**250**	**250**	**160**	**170**	**160**	**93**	**84**
Chloride	NA	**130**	**4.6**	**11**	**66**	**65**	**62**	**23**	**6.3**
Fluoride	4	0.2 U	0.1 U	0.25 U	**0.32 J+**	**0.29 J+**	**0.27**	0.25 U	**0.21**
Sulfate	NA	**1000**	**42**	**110**	**330**	**320**	**310**	**36**	**6.3**
Total Dissolved Solids (TDS)	NA	**2000**	**2300**	**2300**	**1100**	**1000**	**980**	**580**	**390**
pH (lab) (SU)	NA	**7 J**	**6.9 HF**	**7 HF**	**7.2 J**	**7.3 J**	**7.1 HF**	**7.5 J**	**7.4 HF**
Assessment Monitoring - EPA Appendix IV Constituents (mg/L)									
Antimony, Total	0.006	0.002 U	-	-	0.002 U	0.002 U	-	0.002 U	-
Arsenic, Total	0.01	**0.0036**	**0.0045**	**0.0047**	**0.0014**	**0.0021**	**0.0029**	**0.0017**	**0.0058**
Barium, Total	2	**0.089**	**0.053**	**0.053**	**0.12**	**0.13**	**0.1**	**0.057 J+**	**0.074**
Beryllium, Total	0.004	0.001 U	-	-	0.001 U	0.001 U	-	0.001 U	-
Cadmium, Total	0.005	0.001 U	-	-	0.001 U	0.001 U	-	0.001 U	-
Chromium, Total	0.1	0.002 U	**0.0017 JB**	**0.0017 JB**	**0.002**	**0.0025**	**0.0016 JB**	0.002 U	**0.0023 B**
Cobalt, Total	0.006	**0.0078**	**0.0067**	**0.0067**	**0.0021**	**0.0025**	**0.0011**	**0.00026 J**	**0.00075**
Fluoride	4	0.2 U	0.1 U	0.25 U	**0.32 J+**	**0.29 J+**	**0.27**	0.25 U	**0.21**
Lead, Total	0.015	**0.0002 J**	0.001 U	0.001 U	**0.00086 J**	**0.0015**	**0.00037 J**	**0.00015 J**	**0.00039 J**
Lithium, Total	0.04	**0.0059**	**0.0062**	**0.0054**	**0.007**	**0.0097**	**0.0064**	**0.004 J**	0.005 U
Mercury, Total	0.002	0.0002 U	-	-	0.0002 U	0.0002 U	-	0.0002 U	-
Molybdenum, Total	0.1	**0.0012 J**	**0.0011 J**	**0.0012 J**	**0.0014 J**	**0.0017 J**	**0.0013 J**	**0.0016 J**	**0.0028 J**
Selenium, Total	0.05	0.005 U	-	-	0.005 U	0.005 U	-	0.005 U	-
Thallium, Total	0.002	0.001 U	-	-	0.001 U	0.001 U	-	0.001 U	-
Radiological (pCi/L)									
Radium-226	NA	**0.149 ± 0.0922**	0.0158 U ± 0.0672	0.0435 U ± 0.0672	**0.258 ± 0.121**	**0.121 ± 0.0799**	0.0868 U ± 0.092	-0.0325 U ± 0.0465	0.101 U ± 0.084
Radium-228	NA	0.335 U ± 0.321	0.0447 U ± 0.218	0.398 U ± 0.266	0.320 U ± 0.273	0.188 U ± 0.324	0.419 U ± 0.302	0.174 U ± 0.345	0.215 U ± 0.256
Radium-226 & 228	5	0.483 UJ ± 0.334	0.0604 U ± 0.228	**0.441 ± 0.274**	**0.578 J ± 0.299**	0.309 UJ ± 0.334	**0.506 ± 0.316**	0.174 U ± 0.348	0.316 U ± 0.269
Field Parameters									
Temperature (Deg C)	NA	**14.64**	**18**	**18**	**15.83**	**15.83**	**16.15**	**15.32**	**17.97**
Dissolved Oxygen, Field (mg/L)	NA	**0**	**0.09**	**0.09**	**0**	**0**	**0.33**	**0.35**	**0.21**
Conductivity, Field (mS/cm)	NA	**2.4137**	**2.6609**	**2.6609**	**1.3062**	**1.3062**	**1.4095**	**0.74375**	**0.68722**
ORP, Field (mv)	NA	**1**	**51.2**	**51.2**	**-18.4**	**-18.4**	**37.7**	**10.3**	**28.4**
Turbidity, Field (NTU)	NA	**2.33**	**0.12**	**0.12**	**4.35**	**4.35**	**3.88**	**1.96**	**6.73**
pH, Field (SU)	NA	**6.92**	**6.64**	**6.64**	**6.99**	**6.99**	**6.7**	**7.24**	**6.88**

ABBREVIATIONS AND NOTES:

CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
SU: standard units.
USEPA: United States Environmental Protection Agency.
Results in **bold** are detected.

- USEPA. 2016. Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities. July 26. 40 CFR Part 257. https://www.epa.gov/coalash/coal-ash-rule

FIGURES

LEGEND

CCR MONITORING WELL

ASH POND UNIT BOUNDARY

NOTES

1. AERIAL IMAGERY SOURCE: ESRI
2. LOCATIONS DERIVED FROM THREE I DESIGN DATA.

0 1,000 2,000
SCALE IN FEET

HALEY ALDRICH

SOUTHERN INDIANA GAS AND ELECTRIC COMPANY
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

GROUNDWATER MONITORING WELL LOCATIONS - SEDIMENTATION POND

JANAURY 2020

FIGURE 1

GIS FILE PATH: \\haleyaldrich.com\share\boi_common\Projects\Vectren_Corporation\42796_Evansville_CCR_GWMP_Development\Global\GIS\Maps\2020_01\129420_001_0001_MONITORING_WELL_LOCATIONS_BROWN_SED_POND.mxd — USER: afeigl — LAST SAVED: 1/13/2020 10:54:31 AM

HALEY & ALDRICH, INC.
400 Augusta Street
Suite 130
Greenville, SC 29601
864.214.8750

24 September 2020
File No. 129420

TO: Southern Indiana Gas and Electric Company

FROM: Haley & Aldrich, Inc.
[Steven F. Putrich, P.E., Project Principal
Mark Miesfeldt, Lead Hydrogeologist]

SUBJECT: May 2020 Sampling Results and Assessment Monitoring Statistical Analysis Summary Pursuant to 40 CFR § 257.95
A.B. Brown Generating Station – Sedimentation Pond – West Franklin, Indiana

Southern Indiana Gas and Electric Company (SIGECO) is implementing the 17 April 2015 United States Environmental Protection Agency Federal Coal Combustion Residuals (CCR) Rule (40 CFR § 257 and 261) for the A.B. Brown Generating Station, in Posey County near West Franklin, Indiana. Detection monitoring events occurred in 2016 and 2017. The results of the sampling events were compared to background using appropriate statistical methods to determine if Appendix III constituents were present at concentrations above background. The result of the statistical analysis identified statistically significant increases of Appendix III constituents downgradient of the Sedimentation Pond thereby triggering Assessment Monitoring and respective notification of the same.

During the Assessment Monitoring phase, groundwater samples were collected from the downgradient monitoring wells. Samples were collected in June, and August 2018 and analyzed for the Appendix III and Appendix IV constituents as required by 40 CFR § 257.95(b) and 40 CFR § 257.95(d)(1). Concurrent with the second assessment sampling round, and as required by 40 CFR § 257.95(h), groundwater protection standards (GWPS) were established for the detected Appendix IV constituents. The assessment monitoring sampling results were compared to the GWPS and statistically significant levels (SSL) of Appendix IV constituents were not identified downgradient of the Sedimentation Pond at that time.

As required by 40 CFR § 257.95(b) and 40 CFR § 257.95(d)(1), semiannual groundwater sampling and analysis continued for the Sedimentation Pond in 2020. The first round of semiannual groundwater sampling was conducted in May 2020. Analytical results for the May 2020 semiannual sampling event are summarized in Table I. For the Sedimentation Pond, statistical analysis of the May 2020 analytical results was finalized within 90-days of completion of sampling and analysis as required by 40 CFR § 257.93(g). Downgradient wells were compared to each constituents' respective GWPS. The assessment monitoring statistical analysis summary is provided in Table II.

If the detected constituent was greater than the GWPS for that Unit, pursuant to 40 CFR § 257.93 (f)(5), the confidence interval method was used to evaluate if that Appendix IV constituent was present at a SSL. Based on the comparisons outlined above, the results of the statistical analyses conducted for

those detected Appendix IV constituents did not identify Appendix IV constituents downgradient of the Sedimentation Pond at statistically significant levels above GWPS. This information is being provided for SIGECO's records. Since no Appendix IV constituents were identified at SSLs above the GWPS, notifications associated with the statistical analysis of the May 2020 sampling results are not required.

Attachments:
Table I - Summary of Analytical Results – May 2020
Table II - Assessment Monitoring Statistical Analysis Summary – May 2020

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TABLE I
SUMMARY OF GROUNDWATER QUALITY DATA
SEDIMENTATION POND- MAY 2020
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA
FILE NO. 129420

Location Group	Action Level	Upgradient		Downgradient			
Location	Maximum	CCR-BK-1R	CCR-BK-2	CCR-SP-1	CCR-SP-2	CCR-SP-2	CCR-SP-3
Sample Date	Contaminant Level/	05/26/2020	05/26/2020	05/27/2020	05/27/2020	05/27/2020	05/27/2020
Sample Type	Regional Screening	N	N	N	N	FD	N
Sample Name	Levels	CCR-BK-1R-20200526	CCR-BK-2-20200526	CCR-SP-1-20200527	CCR-SP-2-20200527	BLIND DUPLICATE 3-20200527	CCR-SP-3-20200527
Detection Monitoring - EPA Appendix III							
Constituents (mg/L)							
Boron, Total	-	**0.11 B**	**0.091 B**	**0.38 B**	**0.14 B**	**0.17 B**	0.08 U
Calcium, Total	-	**41**	**56**	**210**	**160**	**160**	**87**
Chloride	-	**3.7**	**10**	**87**	**61**	**62**	**5.6**
Fluoride	4	**0.37**	**0.21**	**0.15**	**0.23**	**0.22**	**0.27**
Sulfate	-	**24**	**42**	**770**	**300**	**300**	**3.2**
Total Dissolved Solids (TDS)	-	**220**	**450**	**1500**	**910**	**900**	**500**
pH (lab) (SU)	-	**7 HF**	**7.1 HF**	**7 HF**	**7.1 HF**	**7.2 HF**	**7.1 HF**
Assessment Monitoring - EPA Appendix IV							
Constituents (mg/L)							
Antimony, Total	0.006	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic, Total	0.01	0.001 U	0.001 U	**0.003**	**0.0028**	**0.0019**	**0.0069**
Barium, Total	2	**0.031**	**0.038**	**0.063 B**	**0.1 B**	**0.1 B**	**0.079 B**
Beryllium, Total	0.004	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Cadmium, Total	0.005	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Chromium, Total	0.1	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt, Total	0.006	**0.00015 J**	0.0005 U	**0.0064**	**0.0019**	**0.0012**	**0.00075**
Fluoride	4	**0.37**	**0.21**	**0.15**	**0.23**	**0.22**	**0.27**
Lead, Total	0.015	**0.00023 J**	0.001 U	0.001 U	**0.00088 J**	**0.00038 J**	**0.00021 J**
Lithium, Total	0.04	0.005 U	**0.0036 J**	**0.0066**	**0.0073**	**0.0062**	0.005 U
Mercury, Total	0.002	0.0002 U	**0.0002**	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum, Total	0.1	**0.00079 J**	**0.0015 J**	**0.0011 J**	**0.0014 J**	**0.0013 J**	**0.0041 J**
Selenium, Total	0.05	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
Thallium, Total	0.002	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Radiological (pCi/L)							
Radium-226	-	0.0680 U ± 0.124	-0.0171 U ± 0.066	0.163 U ± 0.141	0.114 U ± 0.142	0.132 U ± 0.187	**0.229 ± 0.146**
Radium-228	-	0.141 U ± 0.307	-0.0790 U ± 0.213	**0.364 ± 0.24**	0.408 U ± 0.324	0.135 U ± 0.253	0.316 U ± 0.229
Radium-226 & 228	5	0.209 U ± 0.331	-0.0961 U ± 0.223	**0.527 ± 0.278**	**0.522 ± 0.354**	0.267 U ± 0.315	**0.545 ± 0.272**

ABBREVIATIONS AND NOTES:
CCR: Coal Combustion Residuals.
mg/L: milligram per liter.
pCi/L: picoCurie per liter.
SU: standard units.
USEPA: United States Environmental Protection Agency.
Results in **bold** are detected.

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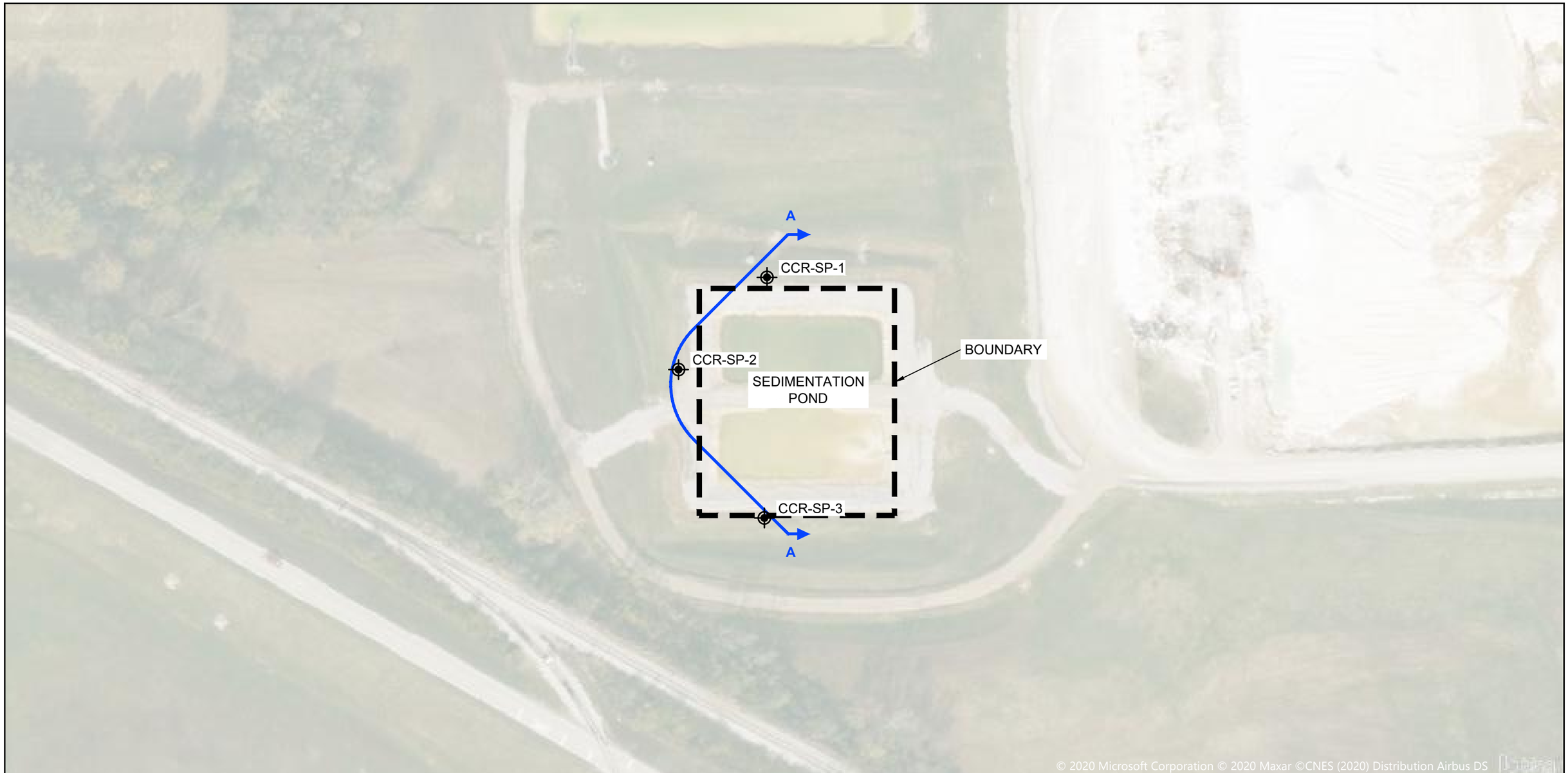
Table II
A.B. Brown Generating Station
Sedimentation Pond
Detection Monitoring Statistical Analysis Summary
Prepared: September 01, 2020

																				Inter-well Analysis					
Location Id	Frequency of Detection	Percent Non-Detects	Range of Non-Detect	Mean	50th Percentile (Median)	95th Percentile	Maximum Detect	Variance	Standard Deviation	Coefficient of Variance	CCR MCL/RSL	Report Result Unit	Detection Exceedances (Y/N)	Number of Detection Exceedances	Outlier Detected	Outlier Removed	Trend	Distribution Group*	Distribution Well*	May 2020 Concentrations	Detect?	Upper Tolerance Limit	Background Limit (Higher of MCL/RSL or Upper Tolerance Limit)	[2]Exceedance above Background at Individual Well	SSL
CCR Appendix-IV: Antimony, Total (mg/L)																									
CCR-BK-1	2/13	85%	0.002-0.002	0.00346	0.004	0.004	0.0009	8.388E-07	0.0012952	0.7482	0.006	mg/L	N	0	N	N	Stable	Non-parametric	Non-parametric			0.002	0.006		
CCR-BK-2	1/13	92%	0.002-0.002	0.00376	0.004	0.004	0.00096	3.412E-07	0.0008262	0.4388	0.006	mg/L	N	0	N	N	Stable		Non-parametric						
CCR-SP-1	0/12	100%	0.002-0.002	0.004	0.004	0.004		0	0	0	0.006	mg/L	N	0	N	N	NA		NA	0.002	N			N	FALSE
CCR-SP-2	0/12	100%	0.002-0.002	0.004	0.004	0.004		0	0	0	0.006	mg/L	N	0	N	N	NA		NA	0.002	N			N	FALSE
CCR-SP-3	0/12	100%	0.002-0.002	0.004	0.004	0.004		0	0	0	0.006	mg/L	N	0	N	N	NA		NA	0.002	N			N	FALSE
CCR Appendix-IV: Arsenic, Total (mg/L)																									
CCR-BK-1	12/14	14%	0.001-0.001	0.00184	0.00195	0.0043	0.005	6.922E-07	0.0011766	1.279	0.01	mg/L	N	0	Y	N	Stable	Non-parametric	Normal			0.004	0.010		
CCR-BK-2	7/14	50%	0.001-0.001	0.0023	0.002	0.00651	0.007	1.5966E-06	0.001787	1.549	0.01	mg/L	N	0	Y	N	Stable		Log-transformed						
CCR-SP-1	14/14	0%	-	0.01048	0.0091	0.02138	0.026	0.000011128	0.004718	0.901	0.01	mg/L	Y	2	Y	N	Stable		Non-parametric	0.0030	1.000			N	FALSE
CCR-SP-2	13/14	7%	0.001-0.001	0.00344	0.0027	0.01204	0.0154	0.000007002	0.003742	2.182	0.01	mg/L	N	0	N	N	Stable		Log-transformed	0.0028	1.000			N	FALSE
CCR-SP-3	14/14	0%	-	0.0342	0.033	0.0804	0.086	0.000295	0.02428	1.4222	0.01	mg/L	Y	18	N	N	Decrease		Normal	0.0069	1.000			N	FALSE
CCR Appendix-IV: Barium, Total (mg/L)																									
CCR-BK-1	14/14	0%	-	0.0808	0.075	0.1409	0.164	0.0003498	0.02646	0.6554	2	mg/L	N	0	Y	N	Stable	Non-parametric	Non-parametric			0.150	2.0		
CCR-BK-2	14/14	0%	-	0.0916	0.073	0.2286	0.3	0.0017864	0.05978	1.3056	2	mg/L	N	0	Y	N	Stable		Non-parametric						
CCR-SP-1	14/14	0%	-	0.1708	0.172	0.226	0.24	0.0005572	0.03338	0.3908	2	mg/L	N	0	N	N	Stable		Normal	0.063	1.000			N	FALSE
CCR-SP-2	14/14	0%	-	0.23	0.24	0.28	0.28	0.0007702	0.03924	0.3424	2	mg/L	N	0	N	N	Increase		Normal	0.100	1.000			N	FALSE
CCR-SP-3	14/14	0%	-	0.1472	0.144	0.1983	0.22	0.0002778	0.02358	0.3204	2	mg/L	N	0	Y	N	Stable		Non-parametric	0.079	1.000			N	FALSE
CCR Appendix-IV: Beryllium, Total (mg/L)																									
CCR-BK-1	1/13	92%	0.001-0.001	0.001864	0.002	0.002	0.00024	1.1438E-07	0.0004782	0.513	0.004	mg/L	N	0	N	N	Stable	Non-parametric	Non-parametric			0.001	0.004		
CCR-BK-2	2/13	85%	0.001-0.001	0.001782	0.002	0.002	0.0008	1.4036E-07	0.0005298	0.5948	0.004	mg/L	N	0	N	N	Stable		Non-parametric						
CCR-SP-1	0/12	100%	0.001-0.001	0.002	0.002	0.002		0	0	0	0.004	mg/L	N	0	N	N	NA		NA	0.001	0.000			N	FALSE
CCR-SP-2	0/12	100%	0.001-0.001	0.002	0.002	0.002		0	0	0	0.004	mg/L	N	0	N	N	NA		NA	0.001	0.000			N	FALSE
CCR-SP-3	1/12	92%	0.001-0.001	0.001882	0.002	0.002	0.00058	8.036E-08	0.000401	0.4262	0.004	mg/L	N	0	N	N	Stable		Non-parametric	0.001	0.000			N	FALSE
CCR Appendix-IV: Cadmium, Total (mg/L)																									
CCR-BK-1	0/14	100%	0.001-0.001	0.002	0.002	0.002		0	0	0	0.005	mg/L	N	0	N	N	Stable	Non-parametric	Non-parametric			0.001	0.005		
CCR-BK-2	0/14	100%	0.001-0.001	0.002	0.002	0.002		0	0	0	0.005	mg/L	N	0	N	N	Stable		Non-parametric						
CCR-SP-1	0/12	100%	0.001-0.001	0.002	0.002	0.002		0	0	0	0.005	mg/L	N	0	N	N	NA		NA	0.001	0.000			N	FALSE
CCR-SP-2	2/12	83%	0.001-0.001	0.001702	0.002	0.002	0.00022	2.328E-07	0.0006822	0.802	0.005	mg/L	N	0	N	N	Stable		Non-parametric	0.001	0.000			N	FALSE
CCR-SP-3	1/12	92%	0.001-0.001	0.001858	0.002	0.002	0.0003	1.1518E-07	0.00048	0.5166	0.005	mg/L	N	0	N	N	Stable		Non-parametric	0.001	0.000			N	FALSE
CCR Appendix-IV: Chromium, Total (mg/L)																									
CCR-BK-1	11/14	21%	0.002-0.002	0.00484	0.0045	0.01198	0.0152	0.000005574	0.003338	1.3772	0.1	mg/L	N	0	Y	N	Increase	Non-parametric	Normal			0.009	0.100		
CCR-BK-2	5/14	64%	0.002-0.002	0.0058	0.004	0.0146	0.0174	0.000007726	0.00393	1.3568	0.1	mg/L	N	0	Y	N	Stable		Non-parametric						
CCR-SP-1	1/14	93%	0.0017-0.002	0.00402	0.004	0.00465	0.005	4.994E-08	0.000316	0.1569	0.1	mg/L	N	0	N	N	NA		NA	0.0020	0.000			N	FALSE
CCR-SP-2	6/14	57%	0.002-0.0021	0.00352	0.004	0.00433	0.0044	4.726E-07	0.0009722	0.554	0.1	mg/L	N	0	N	N	Stable		Non-parametric	0.0020	0.000			N	FALSE
CCR-SP-3	2/14	86%	0.002-0.0023	0.00524	0.004	0.0143	0.0192	0.000007828	0.003956	1.5094	0.1	mg/L	N	0	Y	N	Stable		Non-parametric	0.0020	0.000			N	FALSE
CCR Appendix-IV: Cobalt, Total (mg/L)																									
CCR-BK-1	13/14	7%	0.0005-0.0005	0.000855	0.00069	0.00241	0.0028	0.000000607	0.0007791	0.9112	0.006	mg/L	N	0	Y	N	Stable	Non-parametric	Log-transformed			0.006	0.0062		
CCR-BK-2	8/14	43%	0.0005-0.0005	0.000915	0.0005	0.003145	0.0062	0.000002478	0.001574	1.721	0.006	mg/L	Y	1	Y	N	Stable		Log-transformed						
CCR-SP-1	14/14	0%	-	0.00447	0.00325	0.00741	0.0078	0.00000411	0.002027	0.4534	0.006	mg/L	Y	5	Y	N	Increase		Non-parametric	0.00640	1.000			N	FALSE
CCR-SP-2	14/14	0%	-	0.00102	0.00085	0.00197	0.0021	2.475E-07	0.0004975	0.4853	0.006	mg/L	N	0	N	N	Stable		Normal	0.00190	1.000			N	FALSE
CCR-SP-3	14/14	0%	-	0.00105	0.00075	0.002605	0.0054	0.000001613	0.00127	1.21	0.006	mg/L	N	0	Y	N	Decrease		Non-parametric	0.00075	1.000			N	FALSE
CCR Appendix-III: Fluoride (mg/L)																									
CCR-BK-1	13/14	7%	0.23-0.23	2.56	2.68	3.04	3.04	0.020944	0.40936	1.2792	4	mg/L	N	0	N	N	Stable	Non-parametric	Normal			0.380	4.0		
CCR-BK-2	13/14	7%	0.12-0.12	1.192	1.12	1.68	1.68	0.010456	0.2892	1.9464	4	mg/L	N	0	N	N	Decrease		Normal						
CCR-SP-1	11/14	21%	0.1-0.2	2.192	2.16	6.24	6.24	0.1836	1.212	4.4296	4	mg/L	N	0	Y	N	Stable		Non-parametric	0.15	0.000			N	FALSE
CCR-SP-2	14/14	0%	-	2.648	2.68	3.04	3.04	0.013432	0.32784	0.9912	4	mg/L	N	0	N	N	Decrease		Normal	0.23	1.000			N	FALSE
CCR-SP-3	13/14	7%	0.25-0.25	2.688	2.88	3.28	3.28	0.034992	0.52912	1.576	4	mg/L	N	0	N	N	Decrease		Normal	0.27	1.000			N	FALSE
CCR Appendix-IV: Lead, Total (mg/L)																									
CCR-BK-1	13/14	7%	0.001-0.001	0.001116	0.00115	0.00213	0.0022	2.752E-07	0.000742	1.3292	0.015	mg/L	N	0	N	N	Stable	Non-parametric	Normal			0.011	0.015		
CCR-BK-2	5/14	64%	0.001-0.001	0.00368	0.002	0.01626	0.022	0.00001428	0.005344	2.9	0.015	mg/L	N	0	Y	N	Stable		Non-parametric						
CCR-SP-1	3/14	79%	0.001-0.001	0.001632	0.002	0.002	0.0004	2.598E-07	0.0007208	0.8838	0.015	mg/L	N	0	N	N	Stable		Non-parametric	0.00100	0.000			N	FALSE
CCR-SP-2	11/14	21%	0.001-0.001	0.001368	0.00166	0.002	0.00194	2.056E-07	0.0006412	0.938	0.015	mg/L	N	0	N	N	Stable		Normal	0.00088	1.000			N	FALSE
CCR-SP-3	8/14	43%	0.001-0.001	0.001906	0.00139	0.00863	0.0122	0.000004562	0.00302	3.172	0.015	mg/L	N	0	Y	N	Stable		Non-parametric	0.00021	1.000			N	FALSE
CCR Appendix-IV: Lithium, Total (mg/L)																									
CCR-BK-1	3/14	79%	0.005-0.05	0.031	0.05	0.05	0.0086	0.0005215	0.02284	0.7375	0.04	mg/L	N	0	N	N	Stable	Non-parametric	Non-parametric			0.050	0.050		
CCR-BK-2	1/14	93%	0.005-0.05	0.0374	0.05	0.05	0.0036	0.0004314	0.02077	0.5559	0.04	mg/L	N	0	N	N	Stable		Non-parametric						
CCR-SP-1	4/14	71%	0.0064-0.05	0.0343	0.05	0.05	0.0066	0.0004779	0.02186	0.6374	0.04	mg/L	N	0	Y	N	Stable		Non-parametric	0.0066	1.000			N	FALSE
CCR-SP-2	5/14	64%	0.0073-0.05	0.0319	0.05	0.05	0.011	0.0004741	0.02177	0.6836	0.04	mg/L	N	0	N	N	Stable		Non-parametric	0.0073	1.000			N	FALSE
CCR-SP-3	2/14	86%	0.005-0.05	0.0337	0.05	0.05	0.004	0.0005139	0.02267	0.6723	0.04	mg/L	N	0	Y	N	Stable		Non-parametric	0.0050	0.000			N	FALSE

CCR Appendix-IV: Mercury, Total (mg/L)																									
CCR-BK-1	0/13	100%	0.0002-0.0002	0.0004	0.0004	0.0004		6.776E-23	1.1642E-11	5.82E-08	0.002	mg/L	N	0	N	N	Stable	Non-parametric	Normal			0.0002	0.002		
CCR-BK-2	2/13	85%	0.0002-0.0002	0.000384	0.0004	0.0004	0.0004	1.477E-09	0.00005434	0.2826	0.002	mg/L	N	0	N	N	Stable		Non-parametric						
CCR-SP-1	0/12	100%	0.0002-0.0002	0.0004	0.0004	0.0004		3.682E-23	8.582E-12	4.292E-08	0.002	mg/L	N	0	Y	N	Stable		Non-parametric	0.0002	0.000			N	FALSE
CCR-SP-2	0/12	100%	0.0002-0.0002	0.0004	0.0004	0.0004		3.682E-23	8.582E-12	4.292E-08	0.002	mg/L	N	0	Y	N	Stable		Non-parametric	0.0002	0.000			N	FALSE
CCR-SP-3	0/12	100%	0.0002-0.0002	0.0004	0.0004	0.0004		3.682E-23	8.582E-12	4.292E-08	0.002	mg/L	N	0	N	N	Stable		Normal	0.0002	0.000			N	FALSE
CCR Appendix-IV: Molybdenum, Total (mg/L)																									
CCR-BK-1	12/14	14%	0.005-0.005	0.00208	0.0015	0.005	0.0034	0.000002118	0.001455	0.7009	0.1	mg/L	N	0	N	N	Decrease	Non-parametric	Normal			0.005	0.100		
CCR-BK-2	6/14	57%	0.005-0.005	0.00339	0.005	0.005	0.0025	0.000003944	0.001986	0.5852	0.1	mg/L	N	0	N	N	Stable		Non-parametric						
CCR-SP-1	13/14	7%	0.005-0.005	0.00171	0.0014	0.003115	0.0021	0.000000993	0.0009965	0.5837	0.1	mg/L	N	0	Y	N	Decrease		Non-parametric	0.0011	1.000			N	FALSE
CCR-SP-2	12/14	14%	0.005-0.005	0.00186	0.0014	0.005	0.0016	0.000001782	0.001335	0.7161	0.1	mg/L	N	0	Y	N	Stable		Non-parametric	0.0014	1.000			N	FALSE
CCR-SP-3	13/14	7%	0.005-0.005	0.00423	0.0048	0.005875	0.0062	0.000001956	0.001399	0.3307	0.1	mg/L	N	0	N	N	Decrease		Normal	0.0041	1.000			N	FALSE
CCR Appendix-IV: Radium-226 & 228 (pCi/L)																									
CCR-BK-1	8/14	43%	0.366-5	2.96	1.001	10	1.59	7.032	3.75	2.526	5	pCi/L	N	0	Y	N	Increase	Non-parametric	Normal			0.005	5.0		
CCR-BK-2	4/14	71%	0.356-5	6.72	10	10	6.26	8.344	4.086	1.2148	5	pCi/L	N	0	N	N	Stable		Non-parametric						
CCR-SP-1	8/14	43%	0.46-5	3.6	1.052	10	1.474	8.508	4.124	2.292	5	pCi/L	N	0	N	N	Stable		Non-parametric	0.5	1.000			N	FALSE
CCR-SP-2	10/14	29%	0.376-5	2.04	1.226	7.494	2.84	2.684	2.318	2.28	5	pCi/L	N	0	Y	N	Stable		Non-parametric	0.5	1.000			N	FALSE
CCR-SP-3	4/14	71%	0.384-5	4.9	1.565	10	1.09	10.176	4.512	1.843	5	pCi/L	N	0	N	N	Stable		Non-parametric	0.5	1.000			N	FALSE
CCR Appendix-IV: Selenium, Total (mg/L)																									
CCR-BK-1	3/14	79%	0.005-0.005	0.00808	0.01	0.01	0.00134	0.000007026	0.003748	0.928	0.05	mg/L	N	0	N	N	Stable	Non-parametric	Non-parametric			0.005	0.050		
CCR-BK-2	2/14	86%	0.005-0.005	0.00878	0.01	0.01	0.00196	0.00000466	0.003054	0.6956	0.05	mg/L	N	0	Y	N	Stable		Non-parametric						
CCR-SP-1	1/12	92%	0.005-0.005	0.00922	0.01	0.01	0.00072	0.000003432	0.00262	0.568	0.05	mg/L	N	0	N	N	Stable		Non-parametric	0.005	0.000			N	FALSE
CCR-SP-2	1/12	92%	0.005-0.005	0.00928	0.01	0.01	0.00126	0.000003044	0.002468	0.5322	0.05	mg/L	N	0	N	N	Stable		Non-parametric	0.005	0.000			N	FALSE
CCR-SP-3	1/12	92%	0.005-0.005	0.00924	0.01	0.01	0.00084	0.000003344	0.002586	0.56	0.05	mg/L	N	0	N	N	Stable		Non-parametric	0.005	0.000			N	FALSE
CCR Appendix-IV: Thallium, Total (mg/L)																									
CCR-BK-1	1/13	92%	0.001-0.001	0.001852	0.002	0.002	0.000076	1.3668E-07	0.0005228	0.5646	0.002	mg/L	N	0	N	N	Stable	Non-parametric	Non-parametric			0.001	0.002		
CCR-BK-2	1/13	92%	0.001-0.001	0.001856	0.002	0.002	0.000118	1.3078E-07	0.0005114	0.5514	0.002	mg/L	N	0	N	N	Stable		Non-parametric						
CCR-SP-1	2/12	83%	0.001-0.001	0.001686	0.002	0.002	0.000186	2.568E-07	0.0007166	0.8498	0.002	mg/L	N	0	N	N	Stable		Non-parametric	0.001	0.000			N	FALSE
CCR-SP-2	1/12	92%	0.001-0.001	0.001842	0.002	0.002	0.000098	1.4418E-07	0.000537	0.5832	0.002	mg/L	N	0	N	N	Stable		Non-parametric	0.001	0.000			N	FALSE
CCR-SP-3	2/12	83%	0.001-0.001	0.001694	0.002	0.002	0.00028	2.454E-07	0.0007006	0.8272	0.002	mg/L	N	0	N	N	Stable		Non-parametric	0.001	0.000			N	FALSE

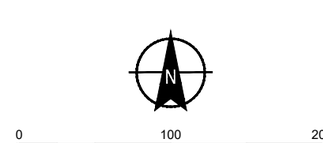
µg/L - micrograms per liter N/A - Not available NT- Not tested

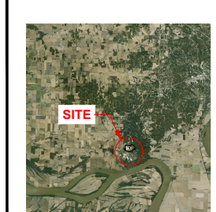
Appendix G
Sedimentation Pond Stratigraphic Cross Sections



NOTES

1. AERIAL IMAGERY OBTAINED FROM BING MAPS DATED JUN 2019.





PROJECT LOCATION

TOPO SOURCE: IMAGE DATED 2019 TAKEN ELECTRONICALLY FROM BING MAPS

PREPARED FOR:

VECTREN
A.B.BROWN GENERATING STATION
LANDFILL

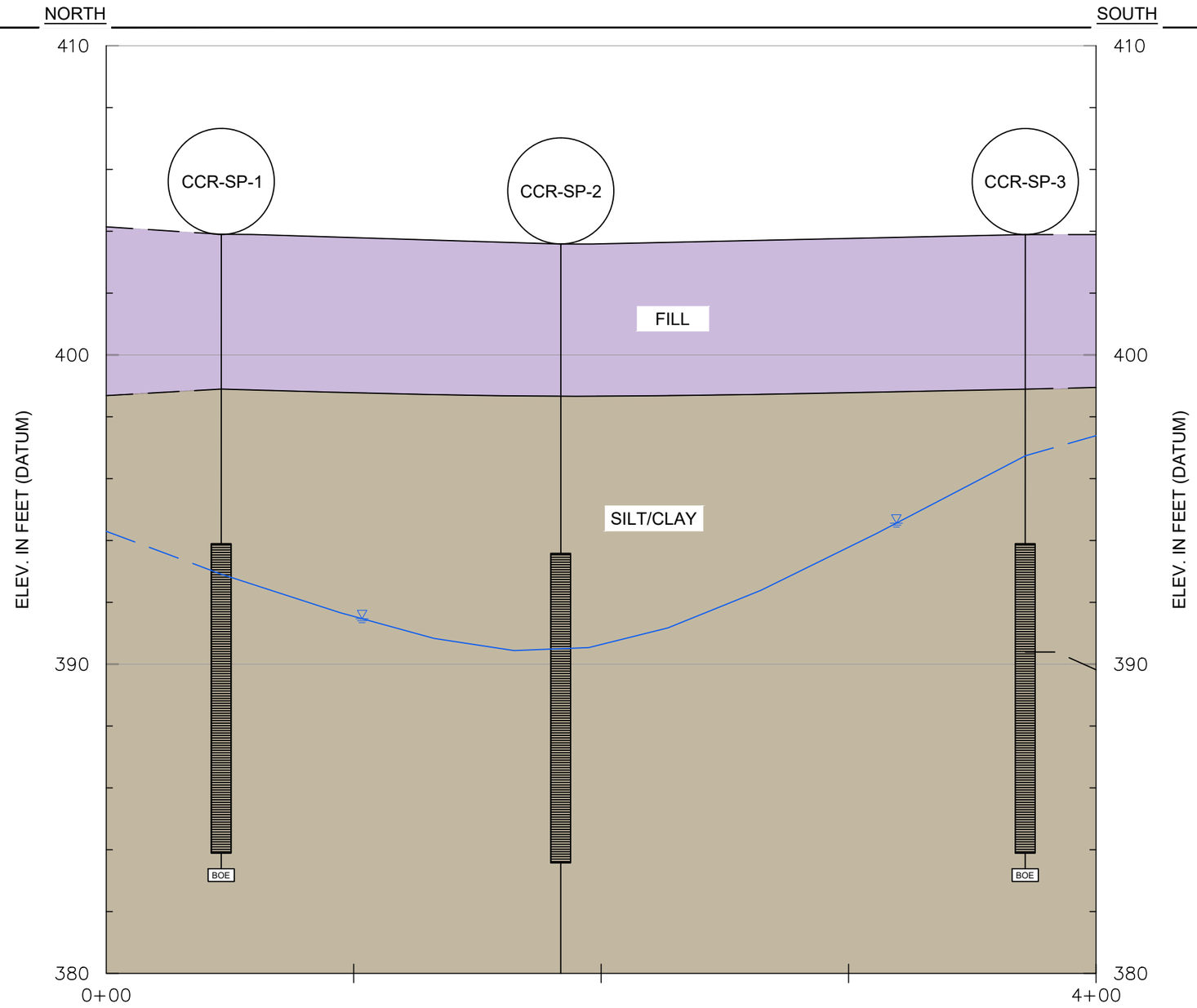
A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

FIGURE 4

EXISTING CONDITIONS
CROSS SECTIONS A-A'
SEDIMENTATION POND

PROJECT: 129420	BY: RY	REVISIONS:
DATE: NOV 2020	CHECKED: MM	

HALEY & ALDRICH



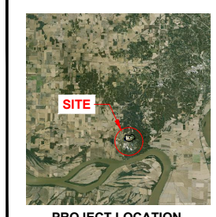
LEGEND

- FILL
- SILT/CLAY
- GROUNDWATER LEVEL
- INTERPRETED SOIL/BEDROCK LEVELS
- BORING ID/LOCATION WITH GROUND SURFACE ELEVATION
- SCREEN LOCATION
- BOE — BOTTOM OF EXPLORATION

NOTES

1. SOIL/BEDROCK STRATA DETERMINED FROM BORINGS DOCUMENTED BY H&A IN MARCH 2016.
2. GROUNDWATER DATA DETERMINED FROM GW SAMPLING EVENT MAY 2020.

HORIZ. 0 50 100
VERT. 0 4 8
SCALE IN FEET



PROJECT LOCATION
TOPO SOURCE: IMAGE DATED 2019 TAKEN ELECTRONICALLY FROM BING MAPS

PREPARED FOR:

VECTREN
A.B. BROWN GENERATING STATION
SEDIMENTATION POND

A.B. BROWN GENERATING STATION
MOUNT VERNON, INDIANA

FIGURE 5

EXISTING CONDITIONS
CROSS SECTIONS A-A'
SEDIMENTATION POND

PROJECT: 129420	BY: RY	REVISIONS:
DATE: NOV 2020	CHECKED: MM	

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