MEMORANDUM

30 November 2020
File No. 129638-006

TO:	United States Environmental Protection Agency Andrew Wheeler - Administrator
C:	US EPA Richard Huggins, Kirsten Hillyer, Frank Behan
FROM:	Associated Electric Cooperative, Inc. Kenneth S. Wilmot Senior Vice President / Chief Operating Officer
SUBJECT:	Addendum to Report on Site Specific Alternate to Initiation of Closure Deadline for Pond 003 New Madrid Power Plant Marston, Missouri

Mr. Wheeler:

Associated Electric Cooperative, Inc. (AECI) is submitting the attached addendum response to the previously submitted “Report on Site Specific Alternate to Initiation of Closure Deadline for Pond 003, New Madrid Power Plant, Marston, Missouri” dated September 2020 (Report) in accordance with 40 CFR 257 Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; A Holistic Approach to Closure Part A: Deadline to Initiate Closure (CCR Rule Part A). Following AECI’s discussion of the United States Environmental Protection Agency (US EPA) on 15 October 2020, AECI submits the information in this addendum to provide further clarification of certain aspects provided in the Report for US EPA consideration in granting an approval of the closure extension for the subject CCR surface impoundments. AECI has made significant efforts in evaluating, locating, design, and constructing alternate capacity for CCR and non-CCR wastestreams which will allow for the discontinued use of Pond 003 at the facility. As evidence by the Report, and the supplemental information provided in this addendum, AECI’s request for a 31 May 2023 timeline extension based on the fastest technically feasible alternates is substantiated. AECI is nearing completion of a project to remove the light fly ash and associated wastewater from Pond 003 discharge. AECI will be making efforts to commission alternate capacity for the Unit 1 boiler slag and associated sluice water, coal pile runoff, and landfill sedimentation pond waters in 2021 to remove both source waters and wastestreams from Pond 003 well in advance of this extension date, thereby making substantial progress (approximately 60% reduction of flows) in ceasing the discharge of both CCR and non-CCR wastestreams to Pond 003.

Furthermore, AECI reiterates that the facility has been and remains in compliance with all requirements of 40 CFR 257, as attested in the certification in the Report. AECI has completed necessary documentation for compliance requirements including but not limited to location restrictions, structural integrity and safety factor assessments, and the groundwater monitoring program. Regarding the Pond 003 groundwater monitoring program, AECI is continuing the process of selecting a remedy under the corrective measures program and will select a remedy as soon as feasible, with the program remaining in compliance with the groundwater monitoring program requirements. Required documentation has been placed in the facility Operating Record in accordance with 40 CFR 257.105, and required documentation has been placed on the facility's public website in accordance with 40 CFR 257.107.

We are providing the following attachments for reference for the US EPA in consideration of this closure extension request and specifically as a follow up to support comments and additional information requested by US EPA on our 15 October 2020 conference call:

Attachment 1: "Report on Site Specific Alternate to Initiation of Closure Deadline for Pond 003, New Madrid Power Plant, Marston, Missouri" dated September 2020.

Attachment 2: Updated Appendix A – No Alternate Capacity Schedule

Attachment 3: CCR Groundwater Monitoring Network Description for the New Madrid Power Plant, New Madrid, Missouri dated April 2019.

Attachment 4: Pond 004 Groundwater Monitoring Constituent Concentrations Table.

Attachment 5: Utility Waste Landfill Groundwater Monitoring Constituent Concentrations Table.

Attachment 6: Lined Pond Groundwater Monitoring Constituent Concentrations Table.

Attachment 7: Pond 004 Stratigraphic Cross-Section.

Attachment 8: Utility Waste Landfill Stratigraphic Cross-Section.

Attachment 9: Lined Pond Stratigraphic Cross-Section.

Attachment 10: Pond 004 Structural Stability Assessment.

Attachment 11: Lined Pond Structural Stability Assessment.

Attachment 12: Lined Pond Safety Factor Assessment.

Attachment 13: Pond 003 Nature and Extent Wells Map and Cross-Section.

Attachment 14: Pond 003 Nature and Extent Well Construction Diagrams and Drilling Logs.

> Attachment 15: Pond 003 Nature and Extent Groundwater Monitoring Constituent Concentrations Table.

We appreciate US EPA's consideration of this closure deadline extension request for the subject facility and CCR surface impoundment.

Sincerely yours,

Kenneth S. Wilmot
Senior Vice President / Chief Operating Officer
Associated Electric Cooperative, Inc.

1) Supplemental Information to Section 2.2 Development of Alternative Capacity is Technically Infeasible and Section 2.2.1 Written Narrative

The CCR and non-CCR wastestream flows are sourced from several areas within the plant, but are comprised of four main sources: 1) Unit 1 and Unit 2 boiler slag sluice water totaling on average approximately 10.2 million gallons per day (MGD) discharged into Pond 003; 2) coal pile runoff and associated process flows including rotary car dumper wash water and conveyor wash water totaling on average approximately 0.3 MGD; 3) Unit 1 and Unit 2 hydroveyers including air heater ash and selective catalytic reduction (SCR) ash totaling on average approximately 2.2 MGD; and 4) Utility Waste Landfill (UWL) sedimentation ponds which are pumped intermittently a few times a year to maintain water levels within the sedimentation ponds. AECI evaluated several on-site options for alternate capacity for both CCR and non-CCR wastestreams at the New Madrid Power Plant (NMPP). First, there are significant limitations on available land near the power block due to site constraints with the Mississippi River and associated levee system, adjacent industrial facilities, and limitations in property ownership. Second, no wastewater treatment facility exists on-site. AECI made efforts to proceed on parallel project paths for multiple systems that would allow for the progressive removal of wastestreams from Pond 003 during the process.

In evaluation of alternate capacity for boiler slag CCR wastestreams currently managed by Pond 003, AECI evaluated under boiler and remote submerged flight conveyors (SFC) to manage the Unit 1 and Unit 2 generated boiler slag. Regarding under boiler SFCs, it was determined that there is sufficient space under the current boilers following modifications to boiler system making this option feasible. This requires conveyor systems to a new material load-out staging area to manage the boiler slag solids. In considering remote SFCs, limitations on siting options with suitable space for the SFC equipment, material load-out area, and limitations on conveyor system locations showed that this system was infeasible.

For wet handling options, a concrete dewatering tank was considered as well, which could have potentially managed flows and solids from both the Unit 1 and 2 boilers, air heater ash, and SCR ash. This option would have required the tank be placed over one (1) mile from the power block to allow for adequate space for the tank, chemical treatment building, and material load-out area. During initial considerations, the land was not owned by AECI where the tank was being proposed. For these reasons, a concrete dewatering tank was considered as a less favorable option. No other existing CCR surface impoundments exist on-site which would allow for a redirection of flows. AECI did previously operate Pond 004 which was smaller footprint impoundment with approximately 5-acres of usable wetspace. The impoundment was determined to be insufficient in size for an extended permanent use for CCR management of the light ash and boiler slag and their associated wastestreams. In addition, pursuit of new CCR compliant surface impoundment(s) would require several compliance related efforts that would extend the timeline of putting a new CCR surface impoundment online beyond that of the CDT timeline. Efforts related to siting, Missouri Department of Natural Resources (MDNR) permitting for both construction and NPDES operating discharge, installation of a new CCR compliance groundwater monitoring program including the time required to site compliant well locations, installation of the wells, and obtaining adequate background monitoring under the detection monitoring program led to the conclusion that a new CCR surface impoundment could not be constructed to adequately manage the 12.4 MGD of CCR sluice water from the slag tanks and the hydroveyers in less time than a CDT. In addition, the new impoundment(s) would need to be located over one (1) mile from the power block similar to a concrete dewatering tank based on estimated pond footprint needs.

For the air heater ash and SCR ash, AECI also considered a dry handling system including a silo for material storage to allow for conveyance to the on-site landfill. This was deemed as the preferred option based on the quicker timeframe that could be achieved, ability to locate the new silo adjacent to the two existing fly ash silos, and ability to manage the solids in the on-site landfill similar to the generated fly ash.

Regarding off-site alternative capacity considerations, the NMPP is located in rural New Madrid County. An existing off-site wastewater treatment plant manages raw sewage from the NMPP, but lacks capacity to manage the industrial wastewater flows. No other existing public wastewater treatment works, municipal sewer system, or other publicly managed alternate capacity exists for AECI to manage CCR and/or non-CCR flows. Likewise, no other private industrial wastewater treatment works exists near the facility. Even if off-site treatment capacity existed, no existing pipelines exist to convey this volume of wastewater. In the CCR Rule, the US EPA clearly states "while it is possible to transport dry ash off-site to alternate disposal facility that simply is not feasible for wet-generated CCR." To understand this concept, with over 12.7 MGD of wastewater needing to be managed (not accounting for peak flows which will add considerable volume), and accounting for the use of 10,000 gallon capacity tanker trucks, this would require over 1,270 tanker truck trips per day to haul this volume of waste water, increasing safety risk and concerns with over the road transport increase on local roads and highways. Likewise, temporary management (e.g. frac tanks) of these wastewater flows was deemed infeasible based on the volume and the need for same water to be discharged either on-site or off-site.

For the coal pile runoff and associated non-CCR wastestreams, AECI considered mechanical equipment, such as plate clarifiers, and additional new impoundment storage. Plate clarifiers required bench scale testing and optimization of the system, and AECI was concerned with the lead time for procurement, manufacturing, and delivery. In addition, since plate clarifiers are optimized with consistent flow types, they were determined to be less efficient in treating the effluent from the current coal pile runoff pond due to fluctuating water levels, solids loading, and impacts from rainfall events.

Similarly for coal pile runoff, AECI evaluated the sole use of a reconfigured Pond 004, but determined that the existing impoundment was undersized to manage the coal pile runoff and associated flows and provide adequate settling time. AECI evaluated the development of a new 10-acre non-CCR impoundment adjacent to the existing coal pile runoff pond. This new pond could be sited in an area near existing infrastructure (i.e. the existing pond and existing piping), adjacent to potential soil borrow sources, and located on the dry side of the Mississippi River levee system. AECI decided this option was feasible and could be constructed in the fastest amount of time while meeting the needs of the system. To complete this option, AECI was required to design and construct the new non-CCR impoundment under Missouri state guidelines and was required to obtain a construction permit from the MDNR. AECI evaluated discharge locations including adjacent ditches that flow west away from the river, ultimately determining the ditches were undersized and unpreferred for this industrial wastewater discharge. Evaluations of discharges to the Mississippi River were then considered including both new outfall locations as well as repurposing existing outfalls. AECI determined that Pond 004 could be closed under the CCR Rule and then reconfiguring the impoundment to utilize the already existing NPDES outfall. This would reduce permitting time related to 401/404 permitting, floodplain permitting, and other Army Corps of Engineers permitting associated with a new outfall location.

Lastly, AECI needed to consider the intermittent non-CCR flows from the UWL sedimentation ponds. These ponds do not discharge to an adjacent receiving stream and instead are pumped to Pond 003 to maintain water levels. Operationally, the plant observes water levels on a regular basis and makes the decision on when to operate the pumps manually. To cease these flows to Pond 003, AECI considered NPDES permitting alterations that would allow for direct discharge to an adjacent ditch, relocating flows to Pond 004, an alteration to existing outlet structure at Pond 003 bypassing discharge into the impoundment itself, and discharge to other existing non-CCR impoundment referred to as the Raw Water Pond and its associated Outfall 010. Following discussions with MDNR regarding these options, it was determined that discharge to the Mississippi River instead of the nearby ditch would be preferred. The distance from the UWL sedimentation ponds to Pond 004 is over 2 miles long and would require an additional booster pump station making this option less preferred due to length of time to construct, complications with siting associated with the existing levee system, and considerations for other Pond 004 uses as discussed above. Instead, AECI determined that an alteration of the Pond 003 outlet discharge was more feasible to allow for a quicker construction time and reuse of an existing NPDES outfall.

2) Supplemental Information to Section 2.2.2 Detailed Schedule

Based on the supplemental information provided below, a modified visual schedule is provided in Attachment 2 (Appendix A to the Report).

3) Supplemental Information to Section 2.2.3.1 Conversion to Dry Handling

Supplemental clarifications and information for several subsections below have been provided to add clarity for US EPA's consideration:

Planning and Alternatives Analysis – AECI notes that initial planning for the dry conversion occurred prior to the October 2018 trigger date and is not accordingly shown on the visual schedule.

Engineering Design and Data Collection – The 28 month timeline to complete engineering design and data collection is shown in several phases that overlap in the visual schedule between the light ash project and the Units 1 and 2 SFCs. Engineering design for the light ash project took approximately 14 months. For the SFCs, initial preliminary engineering was completed to support the mechanical design of the SFCs and evaluate integration of the existing plant boilers and infrastructure starting prior to and following the October 2018 trigger date. This included design of the mechanical systems, the structural design for foundations and structural steel, and conveyor system preliminary design. Following that initial design, unit-specific design was needed for both Unit 1 and Unit 2. Due to outage schedules, Unit 1 will be constructed first, therefore that design was completed first taking approximately 21 months. Unit 2 design is ongoing and is estimated to be completed within 16 months. The visual schedule shows the overlap of these various design activities to continue project completions in parallel to the extent feasible.

Bidding and Contractor Selection – AECI wants to make clear that multiple bidding and contractor selection activities were completed for both the light ash and the SFCs projects. Separate contracts were let for design, mechanical equipment, structural fabrication, and general construction. The Report focuses on contract issuances remaining, which are specifically focused on the Unit 2 construction. For Unit 2, contract letting has been revised to ten (10) months to account for the various components still be contracted based on updated procurement schedules.

Procurement – AECI has completed several procurement processes for the light ash and SFCs projects. Regarding the light ash project, the equipment has been fully procured and shipped to the site, and took approximately 17 months to procure plus three (3) months for procurement of the system installation. The SFC procurement processes have multiple stages for overall systems in addition to the individual Unit 1 and Unit 2 components. The structural components required three (3) months for procurement. The equipment for Unit 1 and Unit 2 both take over 2 years each to fully procure, including fabrication, shipping, electrical components, and related mechanical components including conveyor systems.

Construction Activities – AECI has revised the Unit 1 SFC and related equipment installation construction activities to take nine (9) months and the Unit 2 SFC and related equipment installation construction activities to take eight (8) months based on updated sequencing plans. To clarify, the light ash project construction schedule is a total of thirteen (13) active months over an 18-month timeframe to account for sequencing between civil/structural construction and the installation of the equipment.

Startup and Operational Transitioning – AECI has revised startup and operational transitioning of the light ash project, Unit 1 SFC, and Unit 2 SFC projects to each require three (3) months for startup and system optimization. More importantly, AECI notes that these projects will be completed in parallel to extent feasible and will incrementally reduce both the volume of wastestream flows and their associated solids loading to Pond 003. The light ash project is scheduled to be online in early 2021 and will remove an average of approximately 2.2 MGD of wastewater flows to Pond 003, representing a reduction of approximately 17% of average daily flows to Pond 003. Similarly, the Unit 1 SFC project is scheduled to be online in late 2021, reducing flows by another approximate average of 5.1 MGD of boiler slag sluice water which represent approximately 40% of the current flows. For these two wastestreams alone, by the end of 2021, Pond 003 will be receiving less than approximately 43% of the average daily flows that it currently receives.

4) Supplemental Information to Section 2.2.3.2 Narrative Discussion of Schedule – New Non-CCR Wastewater Basin and Reconfiguration of Existing CCR Surface Impoundment

Supplemental clarifications and information for several subsections below have been provided to add clarity for US EPA's consideration:

Planning / Alternative Analysis – The Report addressed the planning process for the coal pile runoff pond. Regarding the sedimentation pond flows to Pond 003, AECI needed to resolve how the coal pile runoff would be managed to determine whether the option of sending the sedimentation ponds water to Pond 004 would be feasible. Since the coal pile runoff pond will discharge flows from the new non-CCR surface impoundment to Pond 004, it was determined that the better option was to not comingle flows from the new impoundment with the sedimentation pond discharge. This extended the length of planning for approximately 21 months to then determine the final best option for discharge of the sedimentation ponds in a reconfigured Outfall 003. This effort included analysis of water chemistry and flow rates to better understand relationship with the outfall discharge limitations implications.

Engineering Design and Data Collection – The Report addressed engineering design of the new non-CCR impoundment and the reconfigured Pond 004. Regarding the utility waste landfill discharge relocation, the engineering design and data collection will be completed in approximately five (5) months including evaluation of piping, alignment, outlet structure modifications, and site civil considerations.

Procurement – AECI has updated the schedule to show the combined nine (9) month timeframe for procurement including fabrication of the pump station. These activities including procurement of the construction contractor in addition to the procurement and fabrication of the pump station for the new impoundment. AECI anticipates that it will take approximately one (1) month to complete procurement of the construction contractor for the sedimentation ponds discharge reconfiguration after the two (2) month bid letting and contractor selection process.

Construction Activities – Based on updated progress for the new non-CCR impoundment, AECI has revised the construction schedule to twelve (12) months based on expedited progress of construction in 2020. Final construction activities will need to be completed following winter related to final earthworks and procurement/delivery of the pump station.

Regarding the utility waste sedimentation ponds, it is estimated that construction will take up to five (5) months following procurement and bid letting. This will involve pipeline extension, alteration to outlet structure, and modifications at the sedimentation ponds. This has been modified based on the decision to discharge the flows at the Pond 003 outfall instead of Pond 004.

Startup and Operational Transitioning – Both projects non-CCR wastestream projects will require approximately four (4) months to startup and fully transition. First, calibration of pump systems and flows have to be completed. Following initial startup, water quality evaluations will be used to determine any needed alterations to the system to improve settling and treatment prior to final transition removing the flows to Pond 003.

5) Supplemental Information to Section 2.2.4 Narrative Discussion of Progress

AECI has made clear that significant efforts have been made to evaluate, design, and construct alternate capacity to replace Pond 003. AECI began the planning process to identify and evaluate alternatives for capacity since Pond 003 triggered closure. Since that time, AECI has completed:

- Resource planning specific to this decision to determine generation fleet operational impacts.
- Feasibility studies of alternatives for CCR and non-CCR flows to determine the fastest technically feasible alternative.
- Water mass balance evaluations to determine which flows needed to be or could be split to the different alternative capacity options.
- Siting and environmental evaluations to determine possible locations of alternative capacity facilities to expedite permitting and construction timeframes.
- Evaluations of current systems and internal plant configuration to determine accessibility for new equipment.
- Multiple engineering design and data collection activities including:
    - For the dry handling projects: geotechnical field investigations; equipment/silo/conveyor and appurtenant structures siting and sizing; structural engineering; evaluations of plant chemistry and operational impacts as part of the revised ash handling systems; material staging area sizing and design; and other utility and misc. design needs.
    - For the non-CCR impoundments and revised discharge locations: geotechnical field investigations for slope stability and for borrow soil/clay liner material; bottom liner system and protective cover design; stormwater and wastewater hydraulic capacity and flow rate analyses and associated design efforts; impoundments configuration and sizing; material staging area design; pump station design; conveyance pipe design; and other ancillary design activities in support of the new and reconfigured impoundments.
- NPDES construction permit development, submittal, and approvals for the non-CCR impoundments.
- Construction activities that have been completed already include:
    - For the dry handling projects: excavate soil and pour structural foundations; installation light ash equipment including silo and conveyance ductwork; construction of SFC material staging area including concrete walls and pad.
    - For the non-CCR surface impoundments: Clay borrow evaluation and completion of clay liner test pad; earthworks and berm development; clay liner system installation; geomembrane installation; and Pond 004 regrading and preparation for material staging area concrete pad.
- Procurement of major elements for the SFC including equipment and related components and procurement of the non-CCR surface impoundment pump station and associated components.

AECI has made significant progress toward obtaining alternative capacity for the CCR and non-CCR flows, and intends to continue the efforts in accordance with the current planned schedule. We also note the challenges faced during the COVID-19 pandemic that has impacted staffing availability, complications in communications, supply chain impacts, and overall health and safety of AECI's staff, consultants, contractors, and the community as a whole.

AECI wants to reiterate that efforts are being made to reduce both flows and solids discharge from both CCR and non-CCR wastestreams to Pond 003 as soon as feasible. The multiple projects discussed will incrementally remove these wastestream loads, with an expected reduction of lows to Pond 003 by over 60% by the end of 2021. The only remaining flows would then be related to Unit 2 sluice water until the SFC can be installed in 2023 based on procurement, and facility outage schedules.

6) Supplemental Information to Section 3 40 CFR §257 Subpart Compliance

New Madrid Power Plant Facility Compliance and CCR Units Supplemental Information
AECI understands that the 40 CFR 257.103(f)(1)(iii) compliance requirement and the associated certification made in the Report in accordance with 40 CFR 257.103(f)(1)(iv)(B)(1) is for the New Madrid Power Plant facility and the associated CCR units Pond 003, Pond 004, the Lined Pond, and the Utility Waste Landfill.

Although not required to be submitted by the CCR Rule Part A regulation, AECI is providing to US EPA a copy of the documentation placed in the facility Operating Record meeting the requirements of 40 CFR §257.105(h)(2) entitled "CCR Groundwater Monitoring Network Description for the New Madrid Power Plant, New Madrid, Missouri" dated 17 April 2019 (Network Description Report) in Attachment 3. This document was required to be placed in the facility Operating Record, but there is no reference to this document being required on the website in 40 CFR §257.107. This includes the documentation of the design, installation, development, and decommissioning of any monitoring wells, piezometers, and other measurement, sampling, and analytical devices for the groundwater monitoring network at the CCR surface impoundment. Within that document, the hydrogeologic characteristics are described including the unsaturated materials overlying the uppermost aquifer, the uppermost aquifer, and the formation below the uppermost aquifer. For each of these strata, the associated hydraulic conductivities and lithology are also further described. This Network Description Report document was used as the basis for defining the groundwater monitoring network, and was also the basis for the groundwater monitoring network certification. The Network Description Report document includes the noted information for Pond 003, Pond 004, the Utility Waste Landfill, and the Lined Pond at the New Madrid Power Plant. The 40 CFR 257.103(f)(1)(iv)(B)(2) demonstration submittal requirements for Pond 003 were provided in the Report appendices (also provided as Attachment 1). The Network Description Report provided in Attachment 3 also addresses the 40 CFR 257.103(f)(1)(iv)(B)(2) demonstration submittal requirements for Pond 004, the Utility Waste Landfill, and the Lined Pond including the following information:

- 40 CFR 257.103(f)(1)(iv)(B)(2)(i) – Maps of groundwater monitoring well locations in relation to the CCR units for Pond 004 (figures 4 and 5), the Utility Waste Landfill (Figure 6), and the Lined Pond (figures 7 and 8).
- 40 CFR 257.103(f)(1)(iv)(B)(2)(ii) – Well construction diagrams and drilling logs for all groundwater monitoring wells for Pond 004, the Utility Waste Landfill, and the Lined Pond are provided within Appendix A of the Network Description Report.
- 40 CFR 257.103(f)(1)(iv)(B)(2)(iii) – Maps that characterize the direction of groundwater flow accounting for seasonal variations for Pond 004 (figures 4 and 5), the Utility Waste Landfill (Figure 6), and the Lined Pond (figures 7 and 8).
- 40 CFR 257.103(f)(1)(iv)(B)(4) – A description of site hydrogeology for Pond 004 (narrative section pages 4 through 6), the Utility Waste Landfill (narrative section pages 6 through 8), and the Lined Pond (narrative section pages 8 through 10).

For supplemental information for the remaining 40 CFR 257.103(f)(1)(iv)(B) demonstration submittal requirements, AECI is providing the following documentation to demonstrate compliance:

- 40 CFR 257.103(f)(1)(iv)(B)(3) – Constituent concentrations, summarized in table form, at each groundwater monitoring well monitored during each sampling event for Pond 004 (Attachment 4), the Utility Waste Landfill (Attachment 5), and the Lined Pond (Attachment 6).
- 40 CFR 257.103(f)(1)(iv)(B)(4) – Stratigraphic cross-sections for Pond 004 (Attachment 7), the Utility Waste Landfill (Attachment 8), and the Lined Pond (Attachment 9).
- 40 CFR 257.103(f)(1)(iv)(B)(5) – Corrective measures assessments required at §257.97 have not been conducted or required for Pond 004, the Utility Waste Landfill, and the Lined Pond.
- 40 CFR 257.103(f)(1)(iv)(B)(6) – There was no requirement for corrective measures assessments for Pond 004, the Utility Waste Landfill, or the Lined Pond, and therefore progress reports on corrective action remedy selection and design and the report of final remedy selection required at §257.97(a) are not applicable.
- 40 CFR 257.103(f)(1)(iv)(B)(7) – Structural stability assessment required at §257.73(d) for Pond 004 (Attachment 10) and the Lined Pond (Attachment 11). There was no requirement to complete a structural stability assessment for the Utility Waste Landfill.
- 40 CFR 257.103(f)(1)(iv)(B)(8) – Safety factor assessment required at §257.73(e) for the Lined Pond (Attachment 12). The Pond 004 safety factor assessment was already provided in Appendix J of the Report. There was no requirement to complete a safety factor assessment for the Utility Waste Landfill.

Pond 003 Groundwater Monitoring Supplemental Information

AECI included required documentation in the Report for the completed assessment of corrective measures [40 CFR 257.103(f)(1)(iv)(B)(5)] as Report Appendix G and the semi-annual progress reports [40 CFR 257.103(f)(1)(iv)(B)(6)] as Report Appendix H meeting both of the submittal requirements. The assessment of corrective measures for Pond 003 was completed in accordance with the requirements of §257.96 and the semi-annual progress reports were prepared in accordance with the requirement of §257.97(a).

AECI further notes regarding the assessment of corrective measures that the analysis relied on the groundwater quality and aquifer characterization efforts completed during the well network design, baseline monitoring during detection monitoring, and the continued sampling program for both detection and then assessment monitoring program completed under §257.95. Given that there is no use of groundwater downgradient of the AECI site (i.e., between the subject CCR Unit and the Mississippi River), the ultimate point of exposure is the Mississippi River as discussed further in the assessment. The evaluation of the nature and extent of contamination has been based on additional wells installed to determine the lateral and vertical extent of the plume. The site-specific conditions required further evaluation of the influences from seasonal river level changes that are being used in support the selection of remedy in accordance with §257.97. AECI has provided information related to the nature and extent evaluation in the 2019 Annual Groundwater Monitoring and Corrective Action Report completed in January 2020. Following an industry call with US EPA on 23 November 2020 and an AECI follow-up call with US EPA on 24 November 2020, AECI is providing the following supplemental information related to the nature and extent monitoring wells and associated current compilation of analytical sampling results (to relate this nature and extent information to requests in the CCR Rule Part A rulemaking, regulatory references are provided for US EPA's consideration):

- 40 CFR 257.103(f)(1)(iv)(B)(2)(i) – Maps of groundwater monitoring well locations in relation to the CCR units. In addition to the map showing the compliance wells for Pond 003, a comprehensive figure is provided in Attachment 13 showing both the Pond 003 compliance wells and the wells installed for the nature and extent evaluation.
- 40 CFR 257.103(f)(1)(iv)(B)(2)(ii) – Well construction diagrams and drilling logs for all groundwater monitoring wells. AECI is providing to US EPA the well construction diagrams and drilling logs for the nature and extent wells in Attachment 14.
- 40 CFR 257.103(f)(1)(iv)(B)(3) – Constituent concentrations, summarized in table form, at each groundwater monitoring well monitored during each sampling event. AECI is also providing an updated table of constituent concentrations for the nature and extent wells. These wells were sampled several times after installation and then on a semi-annual basis to obtain further understanding of seasonal impacts to the plume associated with site-specific hydrogeologic conditions. This table is provided in Attachment 15 and includes the data previously provided in the 2019 Annual Groundwater Monitoring and Corrective Action Report and supplemental data collected in 2020 for Pond 003.
- 40 CFR 257.103(f)(1)(iv)(B)(4) – Stratigraphic cross-section for Pond 003 has been updated to include the nature and extent well and correlates to the map described previously. This cross section is also provided in Attachment 13.

The assessment of corrective measures evaluated multiple remedial technologies for the identified statistically significant levels detected at downgradient monitoring wells and the associated plume. Each remedial technology was evaluated for the regulatory requirements of §257.96(c) and related elements described under §257.97 addressing at least the following:

- The performance, reliability, ease of implementation, and potential impacts, including safety impacts, cross-media impacts, and control of exposure to any residual contamination;

- The time required to begin and 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.

Site-specific conditions were used to evaluate the remedies. At this point, AECI has not yet selected a remedy. The semi-annual corrective measures progress reports have included the steps AECI has taken and intends to take in selecting the remedy for Pond 003. This program has been and continues to remain in compliance with the requirements of the CCR Rule and the associated corrective measures program and the associated timing for completion of the associated actions.

ATTACHMENT 1

“REPORT ON SITE SPECIFIC ALTERNATE TO INITIATION OF CLOSURE DEADLINE FOR POND 003, NEW MADRID POWER PLANT, MARSTON, MISSOURI” DATED SEPTEMBER 2020

www.haleyaldrich.com

REPORT ON
SITE SPECIFIC ALTERNATE TO INITIATION OF CLOSURE DEADLINE FOR POND 003
NEW MADRID POWER PLANT
MARSTON, MISSOURI

by
Haley & Aldrich, Inc.
Cleveland, Ohio

for
Associated Electric Cooperative, Inc.
Springfield, Missouri

File No. 129638-007
September 2020

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KENNETH S. WILMOT
Name

Signature

SVP / COO
Title

29 SEPT 2020
Date

1. Introduction

Haley and Aldrich, Inc. (Haley & Aldrich) was retained by Associated Electric Cooperative, Inc. (AECI) to prepare this Site Specific Alternate to Initiate Closure Report related to a closure deadline extension for the coal combustion residual (CCR) management unit identified as Pond 003 at the New Madrid Power Plant (NMPP), located near Marston, Missouri. Pond 003 triggered closure in October 2018 based on the results of location restriction demonstration for groundwater separation under 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 (effective 19 October 2015) and subsequent regulatory revisions (CCR Rule).

AECI has actively been pursuing alternative disposal capacity for CCR generation and non-CCR wastestreams at the NMPP, but is requiring extended use of Pond 003 until **31 May 2023**, when alternative capacity can be brought online. The USEPA recently issued a revised CCR Rule rulemaking entitled *Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; A Holistic Approach to Closure Part A: Deadline to Initiate Closure* (effective 28 September 2020) providing AECI the opportunity to continue use of the CCR unit while alternative capacity is obtained. This Report documents the efforts AECI has made and continues to make to obtain alternative capacity including the schedule of activities to date and those planned moving forward.

1.1 REGULATORY REQUIREMENTS

The USEPA has published this referenced rulemaking to revise portions of the federal CCR regulations in Title 40 of the Code of Federal Regulations (CFR) Part 257 so that they accurately reflect the regulations as they now stand in light of the decision by the D.C. Circuit Court (D.C. Circuit) of Appeals in the case of *Utility Solid Waste Activities Group, et al. v. EPA,* 901 F.3d 414 (D.C. Circuit. 2018) (*USWAG* decision), on 21 August 2018. The D.C. Circuit vacated the provisions that permitted unlined impoundments to continue receiving CCR unless they leak (see 40 CFR §257.101(a)). In addition, this rulemaking addresses the 31 October 2020 deadline in §257.101(a) and (b)(1)(i), by which CCR surface impoundments must cease receipt of waste. These regulatory provisions were remanded back to EPA by the D.C. Circuit Court of Appeals for further reconsideration in light of the *USWAG* decision. See *Waterkeeper Alliance Inc, et al. v. EPA* No. 18-1289.

Specifically, as relates to this Report, USEPA is requiring a new deadline of 11 April 2021 to replace the current deadline of 31 October 2020 for CCR units to cease receipt of waste and initiate closure because the unit either (1) is an unlined or formerly "clay-lined" CCR surface impoundment (§257.101(a)) or (2) did not demonstrate compliance with the groundwater separation location restriction (§257.101(b)(1)). USEPA also revised the alternate closure provisions, §257.103(a), (b), (e), and (f). These revisions allow facilities to receive the necessary additional time to develop alternate capacity to manage plant wastestreams (both CCR and non-CCR), to cease receipt of waste, and initiate closure of a CCR surface impoundment.

1.2 BACKGROUND

AECI owns and operates the CCR surface impoundment known as Pond 003 which consists of two internal cells that manage (i.e., wet handle) site CCRs and CCR sluice water (primarily boiler slag and light fly ash) and non-CCR solids and process waters (e.g., coal pile runoff, plant process water, utility waste landfill [UWL] Sedimentation Ponds discharge) with discharge through the permitted National Pollutant Discharge Elimination System (NPDES) Outfall #003 located at the outlet structure of Pond 003.

Pond 003 has been triggered for closure based on the CCR Rule groundwater separation location restriction (40 CFR §257.60) requirements. Consequently, and consistent with the closure requirements listed in 40 CFR §257.102, AECI is required to cease placing CCR and non-CCR wastestreams into Pond 003 no later than 11 April 2020 and begin closure of the impoundment unless an alternative deadline of **31 May 2023** is approved.

1.3 CURRENT IMPOUNDMENT OPERATION

Currently, CCR (primarily boiler slag) and non-CCR flows are sluiced to the eastern portion of Pond 003. Light fly ash, coal pile runoff, and other non-CCR flows are sluiced to the western portion of Pond 003. Non-CCR flows consist of site stormwater runoff, coal handling equipment washdown, various wash waters, pumped water from the UWL Sedimentation Ponds, and miscellaneous low volume wastewater flows. CCRs are settled within Pond 003, removed by AECI operational staff and beneficially used, relocated within the impoundment footprint, or hauled and placed in the existing on-site Utility Waste Landfill. Flows from the permitted Pond 003 discharge enters a conveyance channel where it discharges east to the Mississippi River.

2. Development of Alternative Capacity

AECI cannot immediately cease the placement of CCR and non-CCR wastestreams into Pond 003 without causing potentially significant disruptions to plant operations and overall electric grid reliability and thus the provision of electricity to their customers, as they currently lack additional capacity to manage these CCRs and non-CCR wastestreams elsewhere. This Report provides the demonstration requested by USEPA under 40 CFR §257.103(f) to explain the reasons that CCR and non-CCR wastestreams cannot at this time be managed through alternative capacity through a technically feasible scenario by 11 April 2021, the actions being taken on an ongoing basis to pursue alternative capacity, and the justification of an operational deadline extension for these CCR unit. The following sections directly address the regulatory requirements of 40 CFR §257.103(f) and are formatted in a manner to allow USEPA to complete the Agency's review process of this required submittal conveniently and efficiently.

2.1 DEVELOPMENT OF ALTERNATIVE CAPACITY IS TECHNICALLY INFEASIBLE[1]

> ***40 CFR §257.103(f)(1) Development of Alternative Capacity is Technically Infeasible. Notwithstanding the provisions of §257.101(a) and (b)(1), a CCR surface impoundment may continue to receive the waste specified in paragraph (f)(1)(ii)(A) or (B) of this section, provided the owner or operator demonstrates the wastestream(s) must continue to be managed in that CCR surface impoundment because it was technically infeasible to complete the measures necessary to obtain alternative disposal capacity on or off-site of the facility by April 11, 2021.***
>
> ***40 CFR §257.103(f)(1)(i) No alternative disposal capacity is available on or off-site. An increase in costs or the inconvenience of existing capacity is not sufficient to support qualification under this section;***
>
> ***40 CFR §257.103(f)(1)(ii)(A) For units closing pursuant to §257.101(a) and (b)(1), CCR and non-CCR wastestreams must continue to be managed in that CCR surface impoundment because it was technically infeasible to complete the measures necessary to obtain alternative disposal capacity either on or off-site of the facility by April 11, 2021.***
>
> ***40 CFR §257.103(f)(1)(iii) The facility is in compliance with all of the requirements of this subpart.***

As mentioned previously, Pond 003 is required to close pursuant to §257.101(b)(1). AECI maintains compliance with all other requirements of the 40 CFR §257 subpart including the maintained CCR compliance website located at https://www.aeci.org/clean/ccr*.* There is no technically feasible on or off-site alternative disposal capacity currently available at the NMPP to manage the CCR and non-CCR flows that are discharged into Pond 003. There is currently no dry method of handling available for the boiler slag or other minor CCRs sluiced to the impoundment, and no other compliant CCR surface impoundment exists on-site that would provide an alternative wet handling option. Furthermore, the USEPA clearly states in the CCR Rule that "while it is possible to transport dry ash off-site to alternate disposal facility that simply is not feasible for wet-generated CCR." Therefore, AECI has no current

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[1] *Technically Infeasible* means "not possible to do in a way that would likely be successful" as defined in the 40 CFR 257 Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; A Holistic Approach to Closure Part A: Deadline to Initiate Closure.

alternative wet handling alternatives available for boiler slag or other CCRs directed to Pond 003 or their associated sluice water prior to 11 April 2021. To state clearly in this submittal, AECI has in good faith been developing plans and has already begun the process of pursuing alternative capacity for Pond 003 including alternative handling of CCRs that are currently conveyed to the subject CCR impoundment.

For other non-CCR wastestreams (e.g., coal pile runoff, boiler wash water, plant surface water, stormwater runoff, and other low volume waste sources), Pond 003 provides settling treatment and discharge of these waters through existing NPDES Outfall #003. A portion of stormwater runoff at the NMPP power block already discharges through an alternate NPDES permitted outfall. The northern portion of the plant, including coal yard and adjacent areas, are currently pumped to Pond 003. The Sedimentation Ponds at the Utility Waste Landfill are sufficiently sized volumetrically for stormwater management, but are only permitted to discharge through NPDES Outfall #003 via Pond 003. No alternative discharge locations are permitted for these flows and no sufficient treatment or volumetric capacity exists on-site to currently manage these flows with the current plant water management configuration. Therefore, no alternative capacity currently exists to manage the non-CCR wastestreams that Pond 003 currently manages prior to 11 April 2021. Similar to the CCR wastestreams currently flowing to Pond 003, AECI has in good faith been developing plans and has already begun the process of pursuing alternative capacity for Pond 003 non-CCR wastestreams.

Efforts include significant planning, engineering evaluations, and pre-emptive implementation steps necessary to provide alternative capacity for these referenced CCR and non-CCR wastestreams to allow for initiating closure of the CCR surface impoundment. The planned alternative capacity projects will provide the capacity needed in an implementable timeframe which falls within the USEPA identified reasonable timeframes for similar projects involving multiple technologies of between 36 and 55 months including cessation of some individual wastestreams well in advance of the reasonable timeframes. If required to immediately cease placement of CCR and non-CCR wastes into the surface impoundments, AECI would have to cease power production and there would be significant risks to grid reliability associated with the shut-down, as well as other notable adverse consequences that would arise if customers were left without power for an extended period of time. The schedule provided in **Appendix A** of this submittal (i.e., for the conversion to alternative disposal capacity for Pond 003 for wet CCRs and non-CCR flows) is reasonable and defensible, and allows for the streamlined management of power grid reliability and power provision to AECI's rural constituency.

2.2 ALTERNATIVE CLOSURE EXTENSION WORKPLAN

2.2.1 Written Narrative

40 CFR §257.103(f)(1)(iv)(A) To demonstrate that the criteria in paragraphs (f)(1)(i) and (ii) of this section have been met the owner or operator must submit a workplan that contains all of the following elements:

40 CFR §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:

- **(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;**
- **(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**
- **(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;**

Due to the significant quantity of process water sources currently flowing into Pond 003 (some being sourced within the power block and others from areas outside the power block), AECI – through the use of internal feasibility studies – has considered multiple technologies to develop alternative capacity for both the CCR and non-CCR wastestreams. For CCR wastestreams, AECI evaluated conversion to dry handling consisting of a remote drag chain conveyor system, an under-boiler drag chain conveyor system, a wastewater treatment facility consisting of a concrete dewatering tank, and a reconfiguration of an existing unlined CCR surface impoundment. Alternatives analyses were completed for these technologies and based on existing plant operations, limited land availability near the generating units, and outage schedule, AECI has selected conversion to dry handling consisting of an under-boiler drag chain conveyor system as the alternative capacity for boiler slag. For example, AECI evaluated remote drag chain conveyor systems, but due to limited availability of suitable space on-site to locate this system, significant concerns for distance to available space, and associated ability to adequately make the system close looped, AECI determined this option was not as viable as the under-boiler drag chain system. For light fly ash, AECI has selected conversion to dry handling consisting of a silo to allow for potential beneficial use of dry CCRs and/or hauling of CCRs to the on-site CCR UWL.

Similarly, AECI completed an alternatives analysis of non-CCR surface impoundment options to manage coal pile runoff and other low-volume wastewater flows. Based on the evaluations, AECI determined that construction of a new non-CCR wastewater basin and reconfiguration of an existing unlined CCR surface impoundment (i.e., Pond 004) can be used to adequately manage these flows. The new non-CCR wastewater basin requires supplemental geotechnical investigations and analyses, reconfiguration design of existing non-CCR wastewater conveyance systems (i.e., coal pile runoff ditches, pond, and pump stations), and earthwork construction including berm construction, installation of a liner system, construction of access roads and ramps, and installation and plumbing configurations for pump stations and associated piping. The Pond 004 reconfiguration require CCR removal and unit closure prior to the completion of the proposed earthworks including berm-raising construction, stormwater management features installation and NPDES permit alterations. Additional site-specific conditions were previously discussed in Section 2.1.

For the UWL Sedimentation Ponds, AECI is evaluating the discharge of flows to a nearby receiving stream through a new NPDES outfall, or a revised discharge to another existing NPDES outfall location. Anti-degradation evaluations, potential chemical treatment, and other technologies are being evaluated to allow for the redirection of these source flows to an alternate location other than Pond 003.

To accomplish these overall system developments and/or reconfigurations, the multiple technology system requires significant evaluations of water mass balance, solids loading, geotechnical investigations and analyses, water chemistry analyses, surface water sampling and analysis, and overall system operation impacts. For the different technologies being considered, the phases to complete the conversion include a planning, design and engineering phase, procurement and contractor bid phase, fabrication, and delivery of new equipment phase, and lastly, a construction and start-up phase. The timeframes for each of these phases are dependent on the site-specific circumstances and the integration of individual technologies into the master reconfiguration schedule. AECI has made notable efforts and progress associated with the planning and engineering evaluation in the pursuit of a variety of potential alternative technologies using a systematic process that allows for some steps to be completed in parallel while also managing the iterative nature of multiple component design.

AECI understands the need to develop alternative capacity in the fastest reasonable time possible. If required to immediately cease placement of CCR and non-CCR wastes into the surface impoundments, AECI would have to cease power production and there would be significant risks to grid reliability associated with the shut-down, as well as other notable adverse consequences that would arise if customers were left without power for an extended period of time. The plant relies on the existing CCR impoundments to manage not only generated CCR but also the multiple non-CCR wastestreams previously discussed. Based on discussions with state regulators, no alternative NPDES discharge outfalls would be able to manage the current flows without significant development of alternate impoundments or systems and the entire NPDES permitting process associated with those. Those alternates would not be available in a shorter period of time. In addition, AECI has experienced a slowdown and delay in the availability in construction supplies, materials, and labor force associated with the on-going COVID-19 coronavirus impacts.

AECI selected these technologies as a means of developing alternative capacity in the shortest period of time associated with the use of existing infrastructure (e.g. internal pump systems and sluice piping, existing embankments, and channels/conduits) and more available systems. AECI is implementing multiple technologies that will reduce the discharge of various wastestreams to Pond 003 between this report submittal and the requested extension date. AECI is actively constructing the alternate light fly ash system from both units which will remove both the solids and associated water from continuing to discharge into Pond 003 in late 2020. Non-CCR wastestreams related to coal pile runoff and UWL sedimentation basin water will be removed from the Pond 003 discharge in 2021. One generation unit will be converted to dry handling in 2021 as well. These projects will reduce the overall volume of flow to Pond 003 as well as the solids loading being discharged to the CCR unit. AECI is actively constructing the multiple technologies but will need additional time beyond the April 11, 2021 date to allow for adequate start-up of the overall system configuration, as well as individual components to ensure adequate operational integrity. To allow for full installation of the multiple technologies and additional start-up time, AECI is requesting an approval of closure extension for Pond 003 until **31 May 2023** which is reasonable and technically feasible to install and operate a fully functional multi-technology system at this site.

2.2.2 Detailed Schedule

40 CFR §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:

(i) How each phase and the steps within that phase interact with or are dependent on each other and the other phases;
(ii) All of the steps and phases that can be completed concurrently;
(iii) The total time needed to obtain the alternative capacity and how long each phase and step within each phase will take: and

(iv) At a minimum, the following phases: engineering and design, contractor selection, equipment fabrication and delivery, construction, and start up and implementation.;

A project schedule depicting the necessary and reasonable sequence and timing of the steps required to obtain the alternate capacity is provided as **Appendix A** and discussed in the narrative description that follows in this section. Steps are shown that are being completed in parallel to expedite the overall timeframe for completion.

2.2.3 Narrative Discussion of Schedule

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

(i) Why the length of time for each phase and step is needed and a discussion of the tasks that occur during each step;
(ii) Why each phase and step shown on the chart must happen in the order it is occurring;
(iii) The tasks that occur during each of the steps within the phase: and
(iv) Anticipated worker schedules; and

2.2.3.1 Conversion to Dry Handling

To address the cessation of using Pond 003 as required by the federal CCR Rule, conversion to dry handling for managing boiler slag from both generating units will be constructed at the NMPP. The critical tasks necessary to implement this project, along with an estimated and approximate timeframe for completing those tasks, is provided below.

Planning /Alternatives Analysis

An alternatives analysis was completed that evaluated multiple technologies for boiler slag handling. The planning and evaluation phase took approximately nine (9) months including water mass balance assessments, surface water sampling and analysis, surveying, and preliminary layout work.

Engineering Design and Data Collection

The engineering and design phase will take approximately twenty-eight (28) months to complete (some of this design is complete for Unit 1, but supplemental design will still be completed as relates to the Unit 2 conversion) and includes engineering and design of the equipment, survey, geotechnical and water chemistry data collection and analysis, structural design, geotechnical design, slag handling pad design, process equipment improvements in the plant/piping, site grading plans, stormwater management controls, and access to the staging area. To further explain, AECI began evaluations of dry conversion design and determined that during the course of the design process, the light ash alternative capacity project needed to be completed separate from the boiler slag dry conversion project to address chemical treatment and safety concerns. The design split then required a re-evaluation of upfront data collection including supplemental field investigation work for each project. The design also required re-evaluation of existing infrastructure and how it would be altered to accommodate the proposed two dry conversion projects. This iterative process has allowed AECI to then work in parallel on the boiler slag and light ash dry conversion projects, and has allowed for the light ash conversion project to be on path to be installed by the end of 2020.

USACE Permitting/Air Permitting/NPDES Permit Modification

AECI pursued and obtained U.S. Army Corps of Engineers (USACE) permits to allow for the construction of the ash handling and conveyor system and the slag staging area. In addition, AECI needed to obtain modifications to air permits and NPDES permits. For Missouri Department of Natural Resources (MDNR) permitting, the design was required to be at a level of substantial completion that the design engineer was able to provide sealed documents to MDNR, forcing these actions to move in series. These permits took approximately to six (6) months to complete.

Bidding and Contractor Selection

Consistent with AECI internal mandates and in the pursuit of the most cost-competitive pricing[2], AECI obtained multiple competitive bids for the design, site/civil construction, concrete work, conveyor systems, and boiler generation equipment. Once the engineering and design phase is complete for Unit 2, a contractor bidding package and procurement documents will be developed, and the completed bid package will be issued by AECI for bid. Following bid issuance and prior to contractor selection, substantial time will be needed for activities including, but not limited to, pre-bid meetings, contractor document review, clarifications, bid submittals, and contractor interviews. To add to the complexity, multiple contracts were let for different types of work (e.g. conveyor system contractor, site development contractor, etc.). This phase will require approximately six (6) months to complete.

Procurement

AECI's procurement process includes contractor selection justification and submittals to the internal management, followed by the AECI Board of Directors' packaged submittals. Board of Director meetings occur, in general, on a monthly basis. Assuming confirmation of the selected bidder, a purchase order will then be issued. This phase of the project timeline is estimated to require approximately three (3) months to complete.

Construction Activities

The approximate time to complete construction for the different components is approximately eight (8) months for the conveyor foundations, thirteen (13) months for the Unit 1 drag chain conveyor system, and nine (9) months for the Unit 2 drag chain conveyor system. For construction of the light fly ash components including mechanical equipment and silos, the construction timing is approximately eighteen (18) months. These timeframes – several which can overlap and occur simultaneously – include the site excavation, foundation construction, concrete forming, pouring, and finishing, utilities and mechanical controls, mass grading, access roads, and piping.

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[2] AECI is a rural cooperative which is a member-owned, member-governed entity that finds its strength in its mission to provide an economical, reliable power supply and support services to members. AECI has the responsibility to produce clean, affordable, and reliable electricity that as a core value and principle pursues the lowest cost energy production for their rural electrical users. More than 48 percent of those rural customers have annual incomes less than $75,000 and 60% of surveyed members are age 55 or older. See also section entitled "**Reliability and Outage Timing**" in this document for additional information on AECI's maintenance needs and overall outage programs of the multiple generating facilities in AECI's fleet.

Weather is another significant factor that impacts timing considerations for this project. Of primary impact is wet weather in late summer and fall months that will reduce productivity and require more substantial unwatering efforts. Seasonal changes can be planned for, though severe or off-season weather events cannot be controlled and can substantially affect project timing. Construction work that involves ground excavation, soil compaction, or filling or pouring concrete will be limited or impractical to perform during winter months (i.e., between late November and April).

Furthermore, following USACE permitting, the USACE has restricted investigation and construction activities adjacent to the Mississippi River levee system during periods when the river flood stage has been eclipsed (at a gage height of 34 feet). In 2019, the river first exceeded the flood stage elevation in early January and did not recede below flood stage until mid-July. This natural phenomenon limits the timeframes when related alternative capacity activities can be completed.

Reliability and Outage Timing

To manage the maintenance needs of the multiple generating facilities, AECI continually develops the schedule for maintenance outages for both units at the New Madrid Power Plant in conjunction with the overall outage program across the generation fleet. A long-range outage plan, consisting of outages for all five (5) coal combustion generator assets at two separate locations, determines the maintenance activities years in advance. The types of maintenance activities range from normal short-term cleaning activities to periodic longer-duration component overhauls. Scheduling when these outages can take place is dependent on the ability to properly provide load to member owners and grid reliability/stability, which are essential. For that reason, AECI limits the outage sequencing so that major generation assets are not offline together for a significant length of time. Another step that is taken to ensure load capacity to member owners and maintain grid reliability is to conduct outage activities in the fall and spring, avoiding the high demand periods of the summer and winter.

The dry boiler slag handling conversion at the NMPP will require approximately three (3) months of outage for each unit. Due to the outage schedule developed for the multiple generating assets of AECI, the only available time to conduct the dry handling conversions without endangering reliability of the grid is Spring of 2021 for the New Madrid Unit 1 generation asset and Spring of 2023 for the New Madrid Unit 2 generation asset. These scheduled outages are of sufficient length to install the dry slag handling equipment and will not negatively impact the reliability of generation.

Adding separate outages for the installation of the dry slag handling equipment would require those outages to be in peak generation periods and have a severe, negative impact to grid reliability and significantly impact AECI's ability to provide electricity to member owners.

Startup and Operational Transition

Startup will include use of the new piping and optimization of the boiler operation, conveyor system operation, boiler slag removal operations, and return flows back to the plant. This process may take up to seven (7) months to complete per generating unit. Also, AECI will need to implement any additional Effluent Limitation Guidelines regulations to meet allowable blowdown quantities and water chemistry, along with other plant activities such as boiler washes. Since EPA just issued the 2020 Reconsideration Rule on 31 August 2020, AECI is evaluating any associated impacts from that rulemaking as relates the CCR management and associated wastestreams. AECI anticipates that there may be potential impacts requiring alteration or redesign to certain components or system operations.

In addition, AECI maintains active beneficial use contracts with third-party vendors that allows for the off-site beneficial use of CCR materials instead of placement in the on-site utility waste landfill. The dry conversion project will involve constructing infrastructure that allows for the continued beneficial use practice. Once the system is operational, AECI will need to coordinate with the beneficial use contractors to determine access to new facilities, processing of materials, and subsequent conveyance off-site.

2.2.3.2 New Non-CCR Wastewater Basin and Reconfiguration of Existing CCR Surface Impoundment

AECI evaluated operational improvement options to cease the discharge of non-CCR flows (in particular, coal pile runoff and related low volume waste sources) into Pond 003 and still comply with the plant's NPDES permit and CCR Rule requirements. The range of options considered include upstream source improvements/ reductions (e.g., coal pile runoff) and midstream management controls (e.g., new non-CCR wastewater basin, reconfigured existing surface impoundment) to manage total suspended solids (TSS) loading and discharge routes in support of the objective to provide AECI with various options to consider as part of their overall long-term planning effort.

Planning / Alternatives Analysis

An alternatives analysis was completed that identified and developed supporting documentation for various upstream options (i.e., coal yard improvements), and a new non-CCR wastewater basin and Pond 004 reconfiguration with the potential for new or altered outfall locations for consideration of near-term and long-term non-CCR management flows that currently discharge through Pond 003. Upstream options are focused on areas and/or sources of discharge (e.g., coal pile) that contribute flow into the current coal pile runoff pond and Pond 003. Evaluations of operational impacts to coal yard management, pump station operations, and solids management were also considered. The planning and evaluation phase took approximately nine (9) months including water mass balance, surface water sampling and analysis, survey, and preliminary layout work.

Engineering Design and Data Collection

The engineering and design phase took approximately eleven (11) months to complete. The engineering phase includes engineering and design of the basins, geotechnical/ geologic/ hydrogeologic investigations including laboratory testing, soil borrow source evaluation, impoundment liner systems, stormwater runoff modeling, process water runoff, access to settling basin for sediment removal, material loading pad, channel linings, and conduit/piping. Supplemental flocculant/ coagulant injection is also still being evaluated based on the actual performance of the basins. The new non-CCR wastewater basin design and reconfiguration of existing Pond 004 is critical to determine that there is proper residence time and the construction materials selected are compatible with the water chemistry of the non-CCR wastestreams. The residence time is the necessary time for any reactions or settling to be completed before the wastewater is discharged.

NPDES Permit Modification

The primary planned discharge of flows currently being discharged to Pond 003 will be the existing Outfall #004 at current Pond 004. The existing NPDES permit requires compliance with pH, TSS, and oil and grease concentrations from Outfall #004 (located at the outlet structure of Pond 004). The primary loading of non-CCR TSS concentrations is related to coal pile runoff (i.e., coal fines that are conveyed in the sediment-laden water). To meet the TSS discharge requirements, reductions in TSS loading at the coal pile, considerations for alternate discharge locations, and options for reconfigured basins were evaluated to support NPDES permitting modifications. AECI is also identifying a preferred location of discharge from the UWL Sedimentation Ponds. AECI is actively working with MDNR to complete modification to the existing NPDES permit to allow for discharge from the reconfigured non-CCR surface basin (i.e., Pond 004). This process is ongoing and will be finalized upon completion of the construction of the basins.

NPDES Construction Permit

AECI was also required to obtain a NPDES related construction permit from MDNR to allow for construction of the new basin and allow for operation and discharge from the reconfigured impoundments. MDNR determined the proposed work was a major modification to the site, and therefore required a submittal, review, and response period to allow for construction activities to commence. For MDNR permitting, the design must be at a level of substantial completion that the design engineer is able to provide sealed documents to MDNR, forcing these actions to move in series and delaying the ability to complete on a parallel path. This delayed construction start by approximately two (2) months.

Bidding and Contractor Selection

Once the engineering and design phase was completed, the design drawings and contract documents are released for competitive bid. Following bid issuance and prior to contractor selection, substantial time will be needed for activities including, but not limited to, pre-bid meetings, contractor document review, clarifications, bid submittals, and contractor interviews. The bidding and contractor selection process required approximately three (3) months to complete.

Procurement

As stated previously, AECI's procurement process includes contractor selection justification and submittals to the internal management, followed by the AECI Board of Directors' packaged submittals. Board of Director meetings occur, in general, on a monthly basis. Following confirmation of the selected bidder, a purchase order was issued. This phase took approximately three (3) months to complete. Separate procurement of a pump station for the new non-ccr wastewater basin took approximately three (3) months to complete, and fabrication of the equipment will take up to six (6) months to complete.

Construction Activities

The approximate time to complete construction for the non-CCR wastewater basin (i.e., Secondary Settling Basin) and the closure and reconfiguration of Pond 004 is estimated to take approximately sixteen (16) months. This timeframe includes the unwatering of the impoundment, CCR removal and closure, soil borrow import, subgrade development, liner installations, protective cover installations, access layer (concrete/aggregate) installation, berm construction, access roads, channel lining, and conduits/piping.

As stated previously, weather and Mississippi River flood stages are two significant factors that impact timing considerations for this project. Of primary impact are wet weather in late summer and fall months that will reduce productivity and require more substantial unwatering efforts. Seasonal changes can be planned for, though severe or off-season weather events cannot be controlled and can substantially affect project timing. Construction work that involves ground excavation, soil compaction, or filling or pouring concrete will be limited or impractical to be performed during winter months (i.e., between late November and April). AECI is also limited in construction timing due to USACE restrictions associated with the flood stages along the Mississippi River levee system. In recent years, this has delayed start of projects until mid-July, losing out on prime construction season in late spring and early summer months, potentially causing substantial delays and a shorter overall construction season prior to the onset of the wetter fall and winter months.

Alterations to the UWL Sedimentation Ponds discharge will be based upon a potential need to construct a pump station and additional forcemain to a new permitted Outfall. This is anticipated to be completed in approximately fifteen (15) months after a decision is made. MDNR solid waste permitting associated with alterations to existing facilities will also be required.

2.2.3.3 Anticipated Worker Schedules

During construction of the dry handling systems, the anticipated worker schedules consists of 5 to 6 days per week, working approximately 40 to 50 hour per day. During construction of the new basin and impoundment reconfiguration, the anticipated worker schedules consists of five (5) days per week, working approximately ten (10) hours per day. If weather days are encountered, a weekend day may be worked to attempt to make up for lost construction days.

2.2.4 Narrative Discussion of Progress

> ***40 CFR §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 compiled. It must discuss where the facility currently is on the timeline and the efforts that are currently being undertaken to develop alternative capacity.***

AECI began the planning process to identify and evaluate alternatives for capacity upon the determination that location restriction demonstrations were not successful for Pond 003. Since that time, feasibility studies of alternatives for CCR and non-CCR flows have been evaluated and water mass balance evaluations, surface water sampling and analyses, geotechnical investigations, and overall system planning activities have been completed. AECI is also actively pursuing modifications to the NPDES operating permit to allow for discharge from the new and reconfigured facilities. As referenced previously, EPA issued the 2020 Reconsideration Rule on 31 August 2020. AECI continues to evaluate any associated impacts from that rulemaking as relates the CCR management and associated wastestreams. AECI anticipates that there may be potential impacts requiring alteration or redesign to certain components or system operations, in particular to manage boiler washes and associated operating plan.

AECI has commenced construction of infrastructure for new conveyor belts and storage areas. AECI completed the construction of the slag loadout area for the dry conversion project. Investigation drilling, and the installation of foundations and associated piles for the conveyor system have been installed. AECI has procured the equipment for the 2021 and 2023 conversion projects, and the materials in the process of being fabricated. AECI has also constructed onsite storage facilities for the outages and allow for preparation of installation during the outages in a streamlined fashion. For the light ash conversion project, AECI has installed the foundations for the new silo, and is in the process of installing the new silo and redirecting associated piping, and anticipates that this system will be online in 2020.

AECI pursued and obtained MDNR construction permits for the reconfigured impoundments in July 2020 and commenced construction thereafter. Construction completed to date includes AECI confirming suitable borrow soils, development of the proposed subgrade grades in the basin, partial installation of clay liner material, preparation for the geomembrane installation, procurement of pump station, procurement of baffles and piping. AECI has completed the installation of concrete floor and diversion walls in the upstream coal yard as well in improve settling efficiency and retention times for the system in August 2020. AECI is also actively pursuing modifications to the NPDES operating permit to discharge from the new and reconfigured facilities.

AECI is actively engineering the utility waste landfill alternate discharge location, and working with MDNR on permitting for this revised discharge location. Also, AECI is coordinating with the US Army Corps of Engineers and local floodplain administrator to confirm the discharge location.

3. 40 CFR §257 Subpart Compliance

The NMPP surface impoundment is in, and will remain in, compliance with all other CCR Rule requirements described under 40 CFR Part §257. AECI's CCR compliance website, located at https://www.aeci.org/clean/ccr, contains all the necessary notification postings including, but not limited to, Locations Restrictions, Annual CCR Unit Inspections, Annual Groundwater Monitoring and Corrective Action Reports. AECI has completed an internal review of the website and the CCR unit's Operating Record and has confirmed that necessary postings have been made in accordance with 40 CFR §257.105, §257.106, and §257.107.

> ***40 CFR §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:***
>
> ***(1) A certification signed by the owner or operator that the facility is in compliance with all of the requirements of this subpart;***

The required certification is provided in **Appendix 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 the following:***
>
> ***(i) Map(s) of the monitoring well locations in relation to the CCR unit(s);***
> ***(ii) Well construction diagrams and drilling logs for all groundwater monitoring wells; and***
> ***(iii) Maps that characterize the direction of groundwater flow accounting for seasonal variations;***

The required map showing monitoring well locations with flow direction are provided in **Appendix C**. Well construction diagrams and drilling logs are provided in **Appendix D**.

> ***(3) Constituent concentrations, summarized in table form, at each groundwater monitoring well monitored during each sampling event;***

The required table of constituent concentrations is provided in **Appendix E**.

> ***(4) A description of site hydrogeology including stratigraphic cross-sections;***

Pond 003 is located within the Southeastern Lowlands physiographic province. The Southeastern Lowlands is the northernmost extent of the larger Mississippi Alluvial Plain and is characterized by alluvial, fluvial, and deltaic deposits ranging in age from Cretaceous to Holocene. Pond 003 is underlain by an unnamed unconsolidated alluvium which constitutes a regionally extensive aquifer. Below the alluvial aquifer is the Wilcox Group which is comprised of sand deposits with interbedded clay and lignite.

The alluvial aquifer underlying Pond 003 is unconfined; unsaturated material above the uppermost aquifer is of the same alluvial materials as the saturated aquifer. The thickness of the unsaturated materials observed at Pond 003 is based on the observed static water level and corresponds to the linear distance from ground surface to the uppermost aquifer. Based on direct observations made during groundwater monitoring, the unsaturated material overlying the uppermost aquifer at the site is approximately up to 53 feet thick.

The water-bearing geologic formation nearest the natural ground surface at Pond 003 that is capable of yielding groundwater to wells or springs is alluvium consisting of moderately to poorly sorted clay, silt, sand, and gravel of Holocene age. The alluvium has been documented to be approximately 250 to 300 feet thick in the vicinity of the NMPP. The aquifer is used regionally for irrigation and domestic use. The depth to water ranges from approximately 17 to 45 feet below ground surface at Pond 003. The saturated thickness of the uppermost aquifer at the monitoring wells partially penetrating the aquifer beneath Pond 003 is approximately 6 to 37 feet thick based on observations made during groundwater monitoring. Locally, there is no use of groundwater downgradient of the AECI site (i.e., between the subject CCR Unit Pond 003 and the Mississippi River), and the ultimate point of exposure is the Mississippi River. Furthermore, the groundwater is unlikely to pose an exposure concern in groundwater or the Mississippi River due to a lack of receptors.

The Wilcox formation underlying the alluvial aquifer is comprised of sand deposits with interbedded clay and lignite. Because the alluvial aquifer provides a more accessible resource for groundwater production in the area, the Wilcox formation has not been developed locally as a source of groundwater. The clay and lignite present within the Wilcox formation represent lower hydraulic conductivity than the overlying alluvial aquifer. Published hydraulic conductivity values for the Wilcox formation are available from areas where it has been investigated that indicate the hydraulic conductivity as low as 9 to 25 feet per day. The Wilcox formation in the vicinity of Pond 003 is estimated to be approximately 400 to 500 feet thick.

Stratigraphic cross-sections are provided in **Appendix F**.

(5) Any corrective measures assessment conducted as required at §257.96;

The corrective measures assessment conducted for Pond 003 is provided in **Appendix G**.

(6) Any progress reports on corrective action remedy selection and design and the report of final remedy selection required at §257.97(a);

The progress reports on corrective action remedy selection for Pond 003 is provided in **Appendix H**. To date, AECI has not selected a remedy for the unit.

(7) The most recent structural stability assessment required at §257.73(d);

The most recent versions of the structural stability assessments are provided in **Appendix I**.

(8) The most recent safety factor assessment required at §257.73(e);

The most recent versions of the safety factor assessments are provided in **Appendix J**.

4. Summary of Actions Required During Alternative Capacity Pursuit

> ***40 CFR §257.103(f)(1)(vii) An owner or operator may seek additional time beyond the time granted in the initial approval by making the showing in paragraph (f)(1)(i) through (iv) of this section, provided that no facility may be granted time to operate the impoundment beyond the maximum allowable time frames provided in §257.103(f)(1)(vi).***
>
> ***40 CFR §257.103(f)(1)(vi)(A) Except as provided by paragraph (f)(1)(vi)(B) of this section, no later than October 15, 2023.***

AECI has demonstrated that additional time is necessary to complete the alternative capacity construction projects and obtain fully functional operational usage of the alternative capacity. AECI foresees that the projects will be completed, or key activities within the master project schedule will occur by **31 May 2023** to obtain alternative capacity and allow for AECI to cease use of Pond 003.

> ***40 CFR §257.103(f)(1)(x) The owner or operator must prepare semi-annual progress reports. The semi-annual progress reports must contain all of the following elements:***
>
> > ***(A) Discussion of the progress made to date in obtaining alternative capacity, including:***
> >
> > > ***(1) Discussion of the current stage of obtaining the capacity in refence to the timeline required under paragraph (f)(1)(iv)(A) of this section;***
> > > ***(2) Discussion of whether the owner or operator is on schedule for obtaining alternative capacity;***
> > > ***(3) If the owner or operator is not on or ahead of schedule for obtaining alternative capacity, the following must be included:***
> > > ***(i) Discussion of any problems encountered, and a description of the actions taken or planned to resolve the problems and get back on schedule; and***
> > > ***(ii) Discussion of the goals for the next six months and major milestones to be achieved for obtaining alternative capacity; and***
> >
> > ***(B) Discussion of any planned operational changes at the facility.***
>
> ***(xi) The progress reports are to be completed according to the following schedule:***
>
> > ***(A) The semi-annual progress reports are to be prepared no later than April 30 and October 31 of each year for the duration of the alternate cease receipt of waste deadline.***
> > ***(B) The first semi-annual progress report must be prepared by whichever date, April 30 or October 31, is soonest after receiving approval from the Administrator or the Participating State Director; and***
> > ***(C) The owner or operator has completed the progress reports specified in paragraph (f)(1)(x) of this section when the reports are placed in the facility's operating record as required by § 257.105(i)(17).***

AECI will complete the semi-annual progress reports in accordance with the CCR Rule.

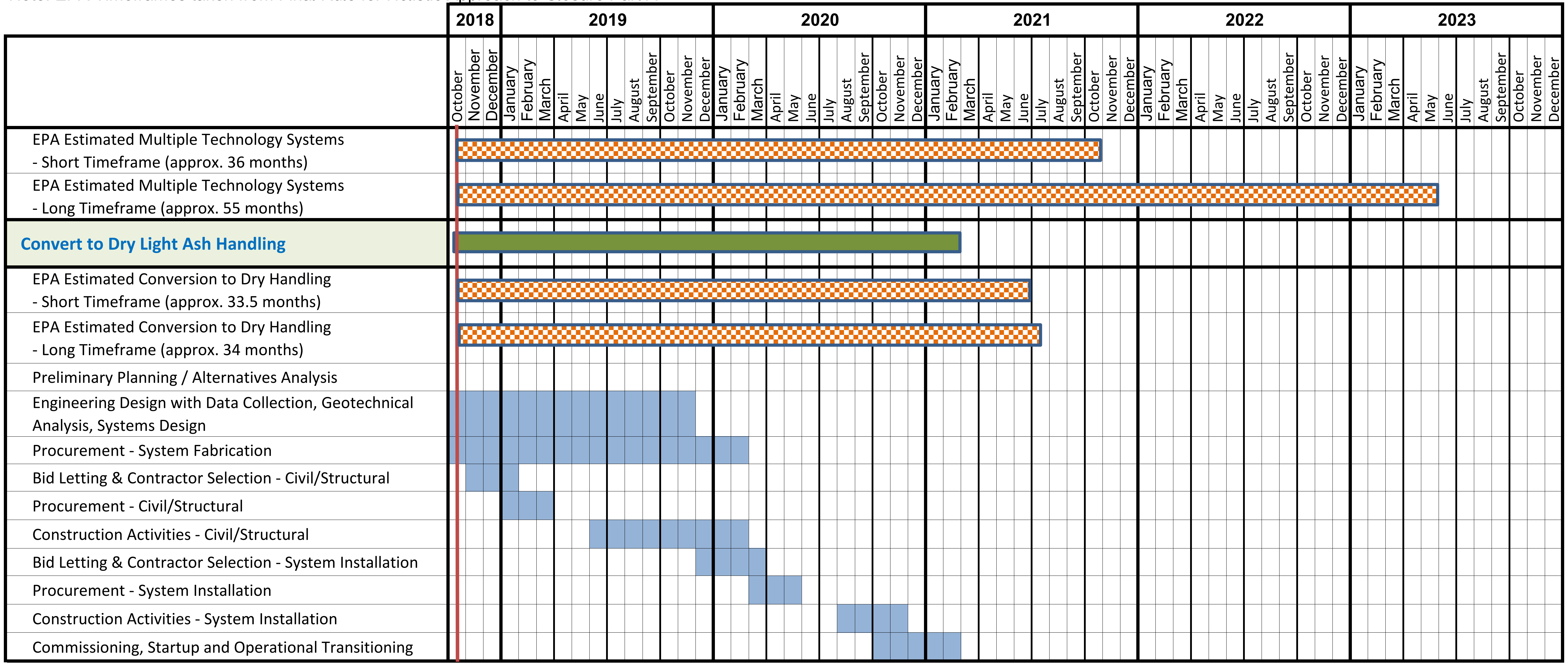
APPENDIX A

No Alternative Capacity Schedule

Associated Electric Cooperative, Inc.
New Madrid Power Plant
Marston, Missouri

Deadline to Initiate Closure
CCR and Non-CCR Alternative Capacity Extensions

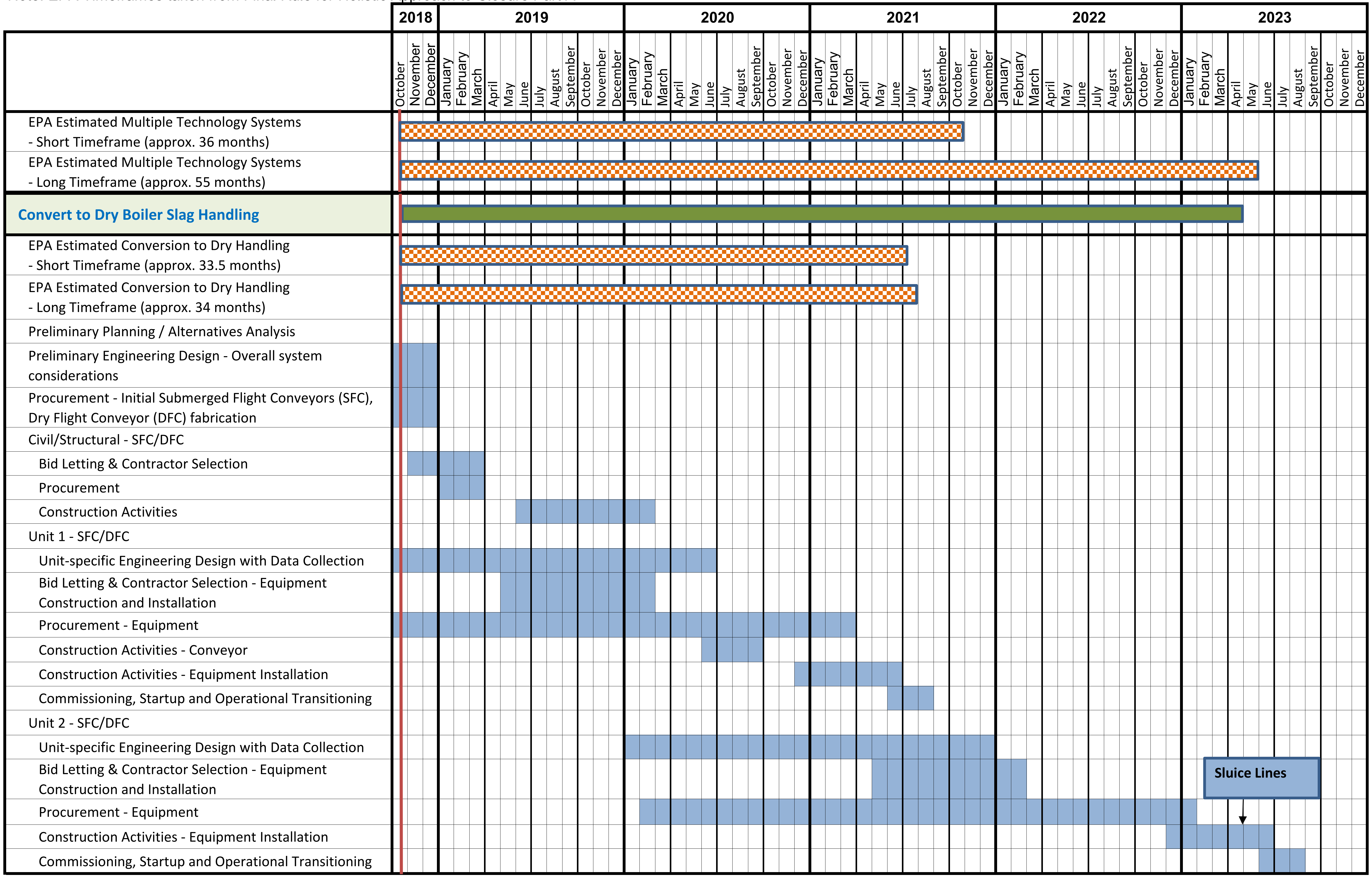
Note: EPA Timeframes taken from Final Rule for Holistic Approach to Closure Part A



Associated Electric Cooperative, Inc.
New Madrid Power Plant
Marston, Missouri

Deadline to Initiate Closure
CCR and Non-CCR Alternative Capacity Extensions

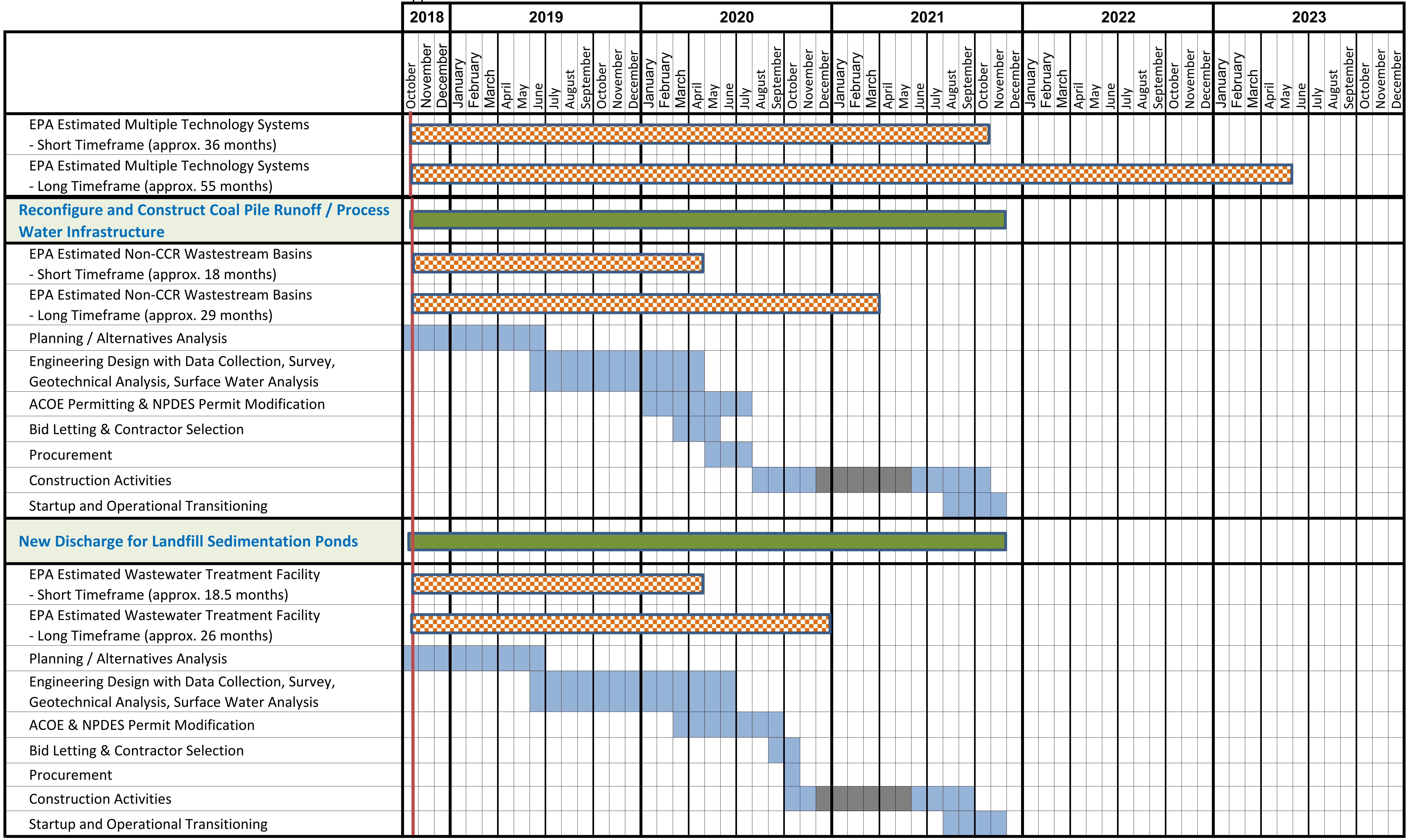
Note: EPA Timeframes taken from Final Rule for Holistic Approach to Closure Part A



Associated Electric Cooperative, Inc.
New Madrid Power Plant
Marston, Missouri

Deadline to Initiate Closure
CCR and Non-CCR Alternative Capacity Extensions

Note: EPA Timeframes taken from Final Rule for Holistic Approach to Closure Part A



09/28/2020

APPENDIX B

Compliance Certification

29 September 2020

SUBJECT: Site-specific Alternative Deadline to Initiate Closure of CCR Surface Impoundment
Certification of Facility Compliance with 40 CFR 257
Pond 003
New Madrid Power Plant – Marston, Missouri
Associated Electric Cooperative, Inc.

Associated Electric Cooperative, Inc. (AECI) operates the existing coal-fired power plant known as the New Madrid Power Plant (NMPP, facility) located near Marston, Missouri. AECI operates the coal combustion residuals (CCR) management unit referred to as Pond 003 at the NMPP. This CCR unit is required to cease receiving CCR and non-CCR wastestreams and commence closure. In support of a closure extension, this document addresses the requirements of 40 CFR §257.103(f)(1)(iv)(B)(1) of the U.S. Environmental Protection Agency (USEPA) Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, Code of Federal Regulations Title 40 CFR (40 CFR) Part 257 (CCR Rule) effective 19 October 2015, and subsequent rulemaking revisions. AECI has actively managed and completed necessary compliance activities to meet the requirements of the CCR Rule.

I, Kenneth S. Wilmot, being a qualified representative of Associated Electric Cooperative, Inc., do hereby certify, to the best of my knowledge, information, and belief, that the New Madrid Power Plant facility is in compliance with all of the requirements of the 40 CFR 257 subpart applicable to the facility. This certification is being prepared to meet the requirement of 40 CFR §257.103(f)(1)(iv)(B)(1).

Signed:

Print Name: Kenneth S. Wilmot

Title: SVP/COO

Date: 29 Sept 2020

APPENDIX C

Groundwater Wells Location Map and Flow Direction

LEGEND

● MONITORING WELL

▭ POND 003

0 1,500 3,000
SCALE IN FEET

NOTE
1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI, APRIL 21, 2019.

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
MARSTON, MISSOURI

POND 003
MONITORING WELL
LOCATION MAP

aeci

AUGUST 2020
SCALE: AS SHOWN

FIGURE C-1

GIS FILE PATH: G:\Projects\AECI\New Madrid\GIS\MXDs\2019_11\POND 3 WELL LOCATION MAP.mxd — USER: dzinsmaster — LAST SAVED: 8/26/2020 5:45:03 AM

LEGEND

⌖ MONITORING WELL

← GROUNDWATER FLOW DIRECTION

▭ POND 003

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

3. AERIAL IMAGERY SOURCE: ESRI, APRIL 21, 2019.

N

0 300 600

SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COPPERATIVE, INC.
NEW MADRID POWER GENERATING FACILITY
NEW MADRID COUNTY, MISSOURI

POND 003
FLOW DIRECTION MAP
FEBRUARY 19, 2020

aeci

AUGUST 2020

FIGURE C-2

GIS FILE PATH: G:\Projects\AECI\New Madrid\GIS\MXDs\GW CONTOUR MAPS\POND 003\128064_001_00C2_POND_3_GW_CONTOUR_MAP_FEB_2020.mxd — USER: dzinsmaster — LAST SAVED: 8/26/2020 2:27:27 PM

LEGEND

⌖	MONITORING WELL
←	GROUNDWATER FLOW DIRECTION
🟨	POND 003

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

3. AERIAL IMAGERY SOURCE: ESRI, APRIL 21, 2019.

N

0 300 600

SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COPPERATIVE, INC.
NEW MADRID POWER GENERATING FACILITY
NEW MADRID COUNTY, MISSOURI

POND 003
FLOW DIRECTION MAP
AUGUST 10-12, 2020

aeci

AUGUST 2020

FIGURE C-3

GIS FILE PATH: G:\Projects\AECI\New Madrid\GIS\MXDs\GW CONTOUR MAPS\POND 003\128064_001_0001_POND_3_FLOW_DIRECTION_MAP_AUG_2020.mxd — USER: dzinsmaster — LAST SAVED: 8/26/2020 5:35:12 AM

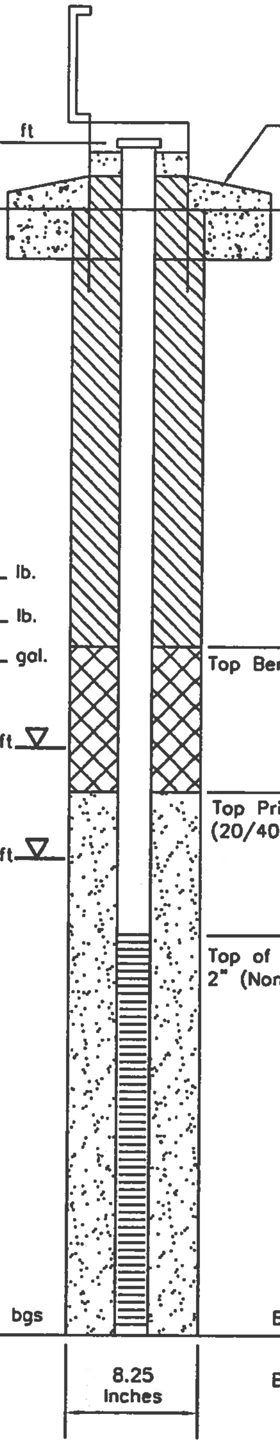
APPENDIX D

Groundwater Well Diagrams and Drilling Logs

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

Top Casing Elev: 292.70 ft

Ground Surface Elev: 290.12 ft



Piezometer Construction Quantities:

1. Primary Filter Sand – 450 lb.
2. Bentonite Seal – 75 lb.
3. Bentonite Slurry – 15 gal.

Remarks:

Max. Groundwater: 275.50 ft ▽

Min. Groundwater: 272.63 ft ▽

Top Bentonite Seal 278.1 ft

Top Primary Filter Pack (20/40 Sand): 274.3 ft

Top of Screen (10 – Slot): 270.54 ft
2" (Nominal) Schedule 40 PVC (10 ft Length)

Coordinates

N: 238222.73
E: 1088665.54

Bottom Hole Depth: 29.9' bgs

Base Sump: 32.49' btoc

Base Elev: 260.21 ft

B - 123

PIEZOMETER
CONSTRUCTION
DETAIL

GREDELL Engineering Resources, Inc.
ENVIRONMENTAL ENGINEERING
LAND AIR WATER
1505 E. High Street
Jefferson City, Missouri 65101
Telephone: (573) 659-9078
Facsimile: (573) 659-9079

Date Piezometer Completed:
10/7/03

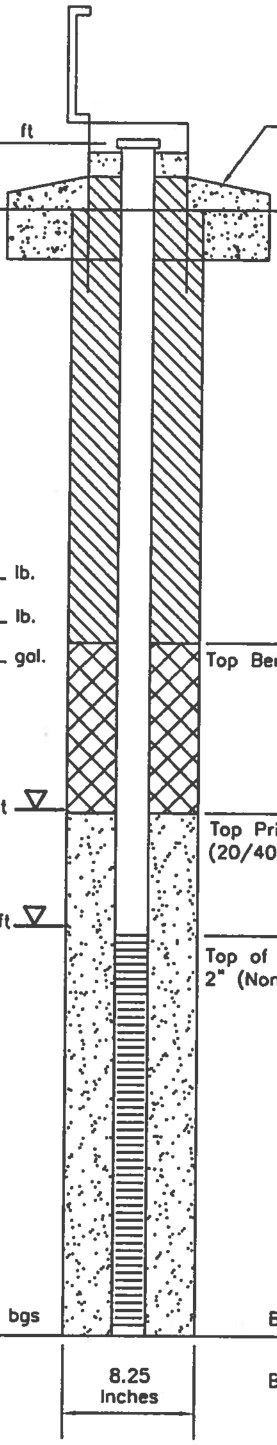
AECI
New Madrid Landfill DSI

DATE 10/2004
SCALE N.T.S.
FIGURE APPENDIX 10
REV
DRAWN BY: KNG
APPROVED BY: MCC
PROJECT NO. Task 1.21a

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

Top Casing Elev: 293.63 ft

Ground Surface Elev: 290.68 ft



Piezometer Construction Quantities:

1. Primary Filter Sand – 400 lb.
2. Bentonite Seal – 75 lb.
3. Bentonite Slurry – 40 gal.

Remarks:

Top Bentonite Seal 278.9 ft

Max. Groundwater: 274.69 ft ▽

Top Primary Filter Pack (20/40 Sand): 274.5 ft

Min. Groundwater: 271.68 ft ▽

Top of Screen (10 – Slot): 271.30 ft
2" (Nominal) Schedule 40 PVC (10 ft Length)

Coordinates

N: 238590.24

E: 1090633.44

Bottom Hole Depth: 29.7' bgs

Base Sump: 32.66' btoc

Base Elev: 260.97 ft

B - 126

PIEZOMETER
CONSTRUCTION
DETAIL

GREDELL Engineering Resources, Inc.
ENVIRONMENTAL ENGINEERING
LAND AIR WATER

1505 E. High Street
Jefferson City, Missouri 65101

Telephone: (573) 659-9078
Facsimile: (573) 659-9079

Date Piezometer Completed: **10/22/03**

AECI

New Madrid Landfill DSI

DATE 10/2004

SCALE N.T.S.

FIGURE APPENDIX 10

REV

DRAWN BY: KNG

APPROVED BY: MCC

PROJECT NO. Task 1.21a

HALEY& ALDRICH

BORING LOGS

Well No. MW-16

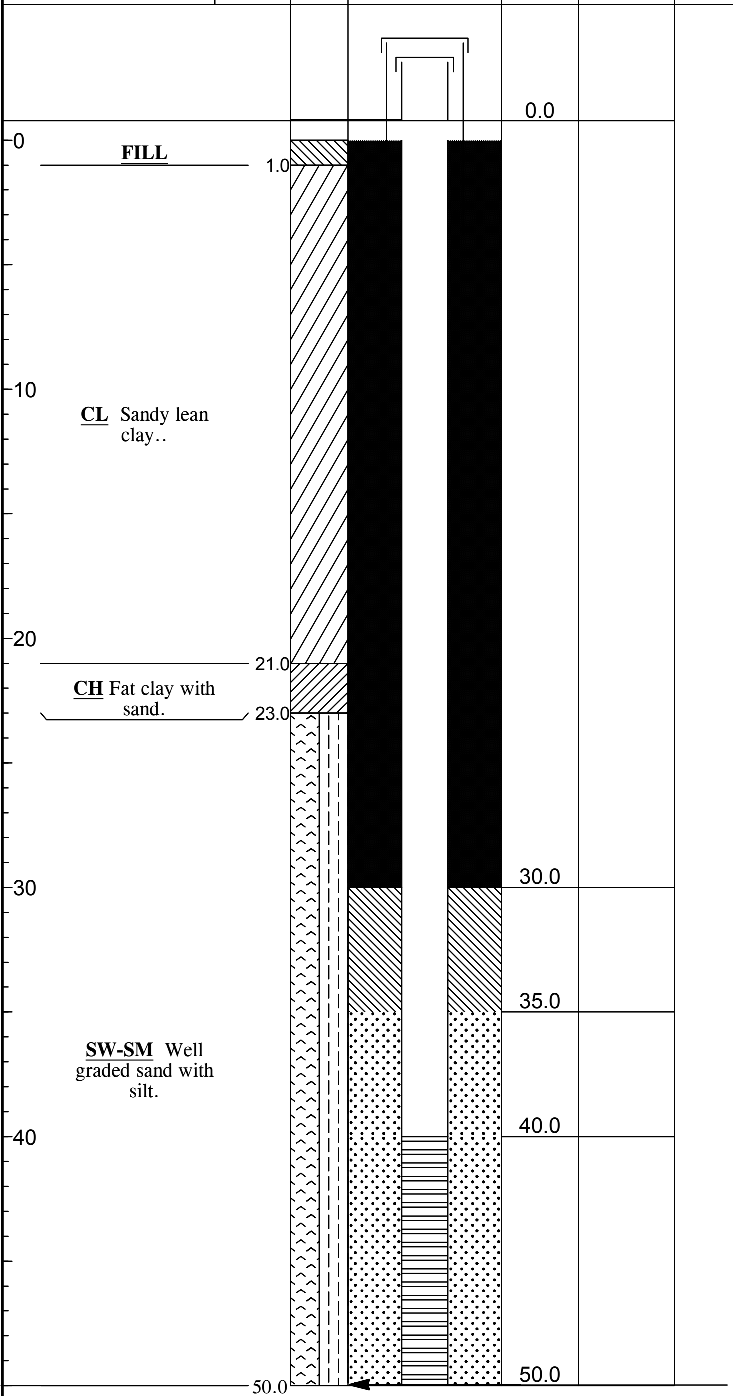
Project	New Madrid Energy Center
Location	Marston, MO
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling
Driller	

Well Diagram

◫	Riser Pipe
☰	Screen
░	Filter Sand
▒	Cuttings
■	Grout
⁖	Concrete
▨	Bentonite Seal

File No.	128064-001
Date Installed	06 Oct 2016
H&A Rep.	C. Price
Location	See Plan
Ground El.	
Datum	NGVD

SOIL/ROCK CONDITIONS	DEPTH (ft.)
FILL	1.0
CL Sandy lean clay..	21.0
CH Fat clay with sand.	23.0
SW-SM Well graded sand with silt.	50.0



WELL CONSTRUCTION DETAILS

Type of protective cover	LOCKING CAP
Height of Guard Pipe above ground surface	2.7 ft
Height of top of riser above ground surface	2.0 ft
Type of protective casing	Guard Pipe
Length	40.0 ft
Inside diameter	2.375 inch
Depth of bottom of Guard Pipe	37.4 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2 inch
Depth of bottom of riser pipe	40.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	0.0 ft	30.0 ft
Bentonite	30.0 ft	5.0 ft
	-	-

Diameter of borehole	8 inch
Depth to top of well screen	40.0 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2 inch
Type of Backfill around Screen	No. 12-20 silica sand
Depth to bottom of well screen	50 ft
Bottom of silt trap	NA
Depth of bottom of borehole	50.0 ft

HALEY& ALDRICH

BORING LOGS

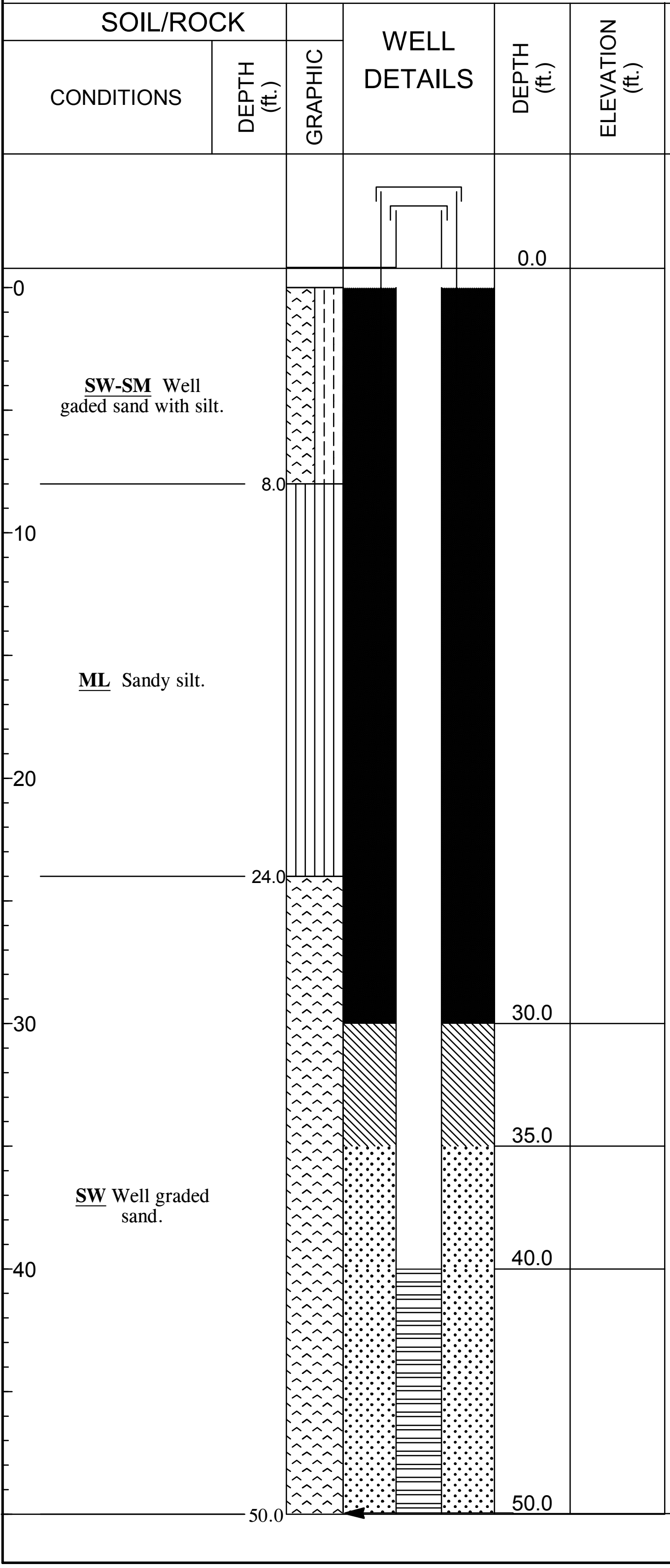
Well No. MW-6

Project	New Madrid Energy Center
Location	Marston, MO
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling
Driller	

Well Diagram

- ▥ Riser Pipe
- ▤ Screen
- ░ Filter Sand
- ▒ Cuttings
- ■ Grout
- ▨ Concrete
- ▧ Bentonite Seal

File No.	128064-001
Date Installed	23 Sep 2016
H&A Rep.	C. Price
Location	See Plan
Ground El.	
Datum	NGVD



SW-SM Well gaded sand with silt.

ML Sandy silt.

SW Well graded sand.

WELL CONSTRUCTION DETAILS

Type of protective cover	LOCKING CAP
Height of Guard Pipe above ground surface	2.6 ft
Height of top of riser above ground surface	2.0 ft
Type of protective casing	Guard Pipe
Length	40.0 ft
Inside diameter	2 inch
Depth of bottom of Guard Pipe	37.4 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2 inch
Depth of bottom of riser pipe	40.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	0.0 ft	30.0 ft
Bentonite	30.0 ft	5.0 ft
	-	-

Diameter of borehole	8 inch
Depth to top of well screen	40.0 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2 inch
Type of Backfill around Screen	No. 12-20 silica sand
Depth to bottom of well screen	50 ft
Bottom of silt trap	NA
Depth of bottom of borehole	50.0 ft

MONITORING WELL HA-LIB07-1-BOS1.GLB HA-TB+CORE+WELL-07-1.GDT C:\USERS\RMOORE\DOCUMENTS\PROJECTS\AEC\NEW MADRID\NEWMADRID_LOGS_103116_RM.GPJ Nov 4, 16

HALEY& ALDRICH

BORING LOGS

Well No. MW-7

Project New Madrid Energy Center
Location Marston, MO
Client Associated Electric Cooperative, Inc.
Contractor Bulldog Drilling
Driller

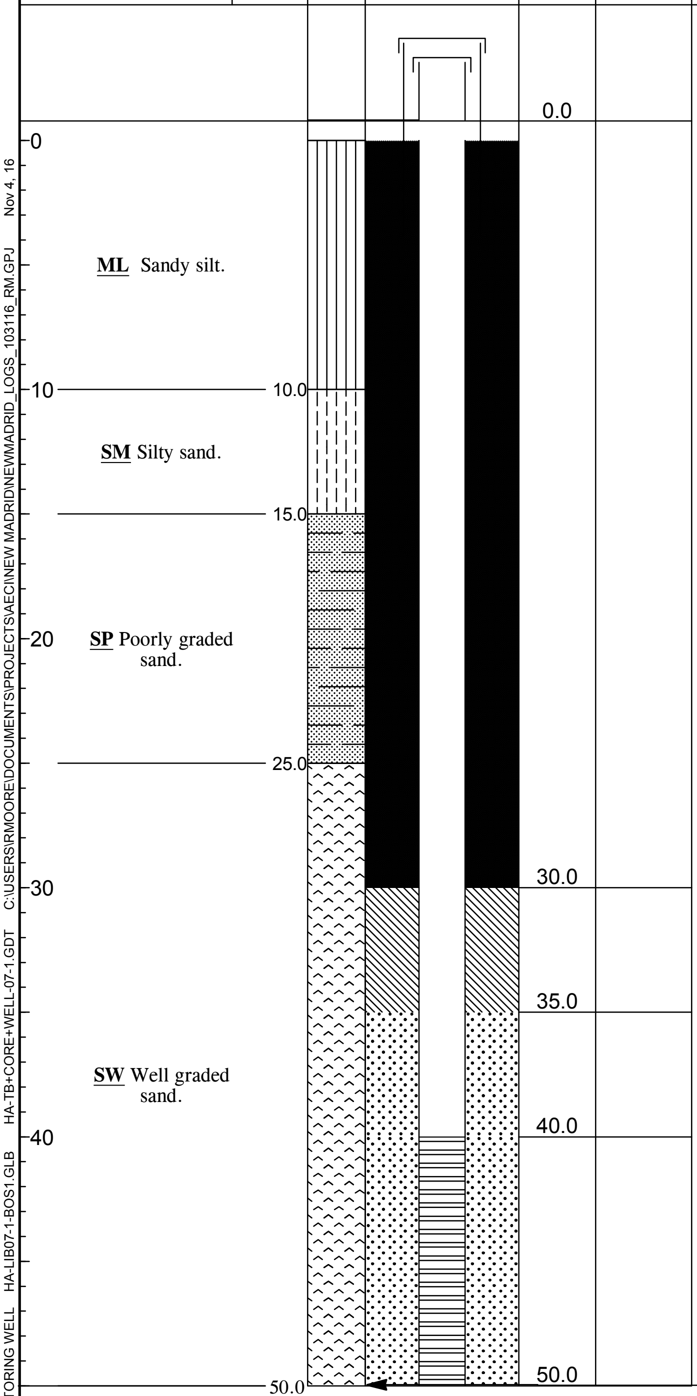
Well Diagram

- ▥ Riser Pipe
- ▤ Screen
- ▒ Filter Sand
- ▩ Cuttings
- ■ Grout
- ▦ Concrete
- ▧ Bentonite Seal

File No. 128064-001
Date Installed 27 Sep 2016
H&A Rep. P. Kroger
Location See Plan

Ground El.
Datum NGVD

SOIL/ROCK CONDITIONS	DEPTH (ft.)
ML Sandy silt.	10.0
SM Silty sand.	15.0
SP Poorly graded sand.	25.0
SW Well graded sand.	50.0



WELL CONSTRUCTION DETAILS

Type of protective cover LOCKING CAP

Height of Guard Pipe above ground surface 2.7 ft

Height of top of riser above ground surface 2.0 ft

Type of protective casing Guard Pipe

Length 40.0 ft

Inside diameter 2 inch

Depth of bottom of Guard Pipe 37.4 ft

Type of riser pipe Schedule 40 PVC

Inside diameter of riser pipe 2 inch

Depth of bottom of riser pipe 40.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	0.0 ft	30.0 ft
Bentonite	30.0 ft	5.0 ft
	-	-

Diameter of borehole 8 inch

Depth to top of well screen 40.0 ft

Type of screen Machine slotted Sch 40 PVC

Screen gauge or size of openings 0.010 in.

Diameter of screen 2 inch

Type of Backfill around Screen No. 12-20 silica sand

Depth to bottom of well screen 50 ft

Bottom of silt trap NA

Depth of bottom of borehole 50.0 ft

HALEY & ALDRICH

BORING LOGS

Well No. MW-8

Project	New Madrid Energy Center
Location	Marston, MO
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling
Driller	

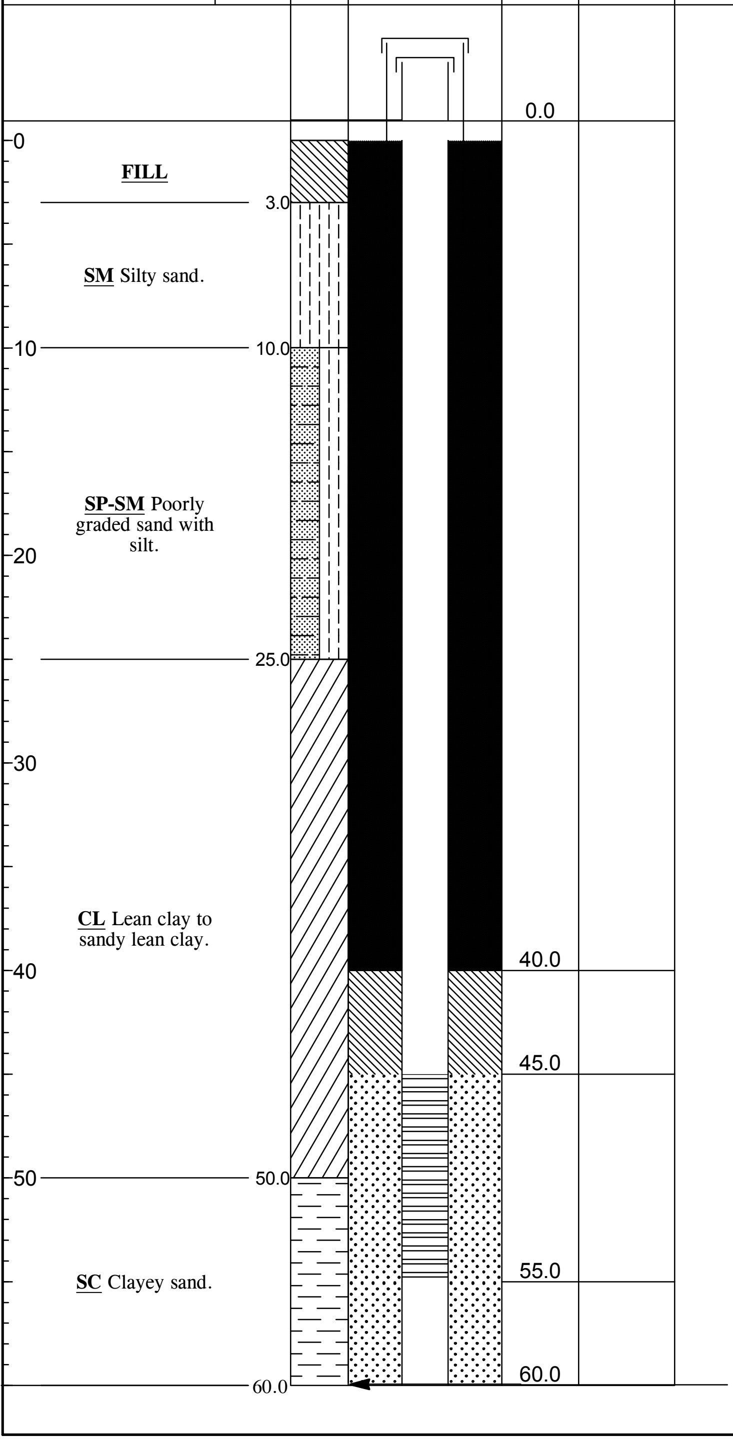
Well Diagram

- ◫ Riser Pipe
- ▤ Screen
- ░ Filter Sand
- ▒ Cuttings
- ■ Grout
- ⁘ Concrete
- ▧ Bentonite Seal

File No.	128064-001
Date Installed	27 Sep 2016
H&A Rep.	P. Kroger
Location	See Plan
Ground El.	
Datum	NGVD

SOIL/ROCK

CONDITIONS	DEPTH (ft.)
FILL	3.0
SM Silty sand.	10.0
SP-SM Poorly graded sand with silt.	25.0
CL Lean clay to sandy lean clay.	50.0
SC Clayey sand.	60.0



WELL CONSTRUCTION DETAILS

Type of protective cover	LOCKING CAP
Height of Guard Pipe above ground surface	2.5 ft
Height of top of riser above ground surface	2.0 ft
Type of protective casing	Guard Pipe
Length	50.0 ft
Inside diameter	2 inch
Depth of bottom of Guard Pipe	47.5 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2 inch
Depth of bottom of riser pipe	50.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	0.0 ft	40.0 ft
Bentonite	40.0 ft	5.0 ft
	-	-

Diameter of borehole	8 inch
Depth to top of well screen	50.0 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2 inch
Type of Backfill around Screen	No. 12-20 silica sand
Depth to bottom of well screen	60 ft
Bottom of silt trap	NA
Depth of bottom of borehole	60.0 ft

HALEY & ALDRICH

BORING LOGS

Well No. MW-9

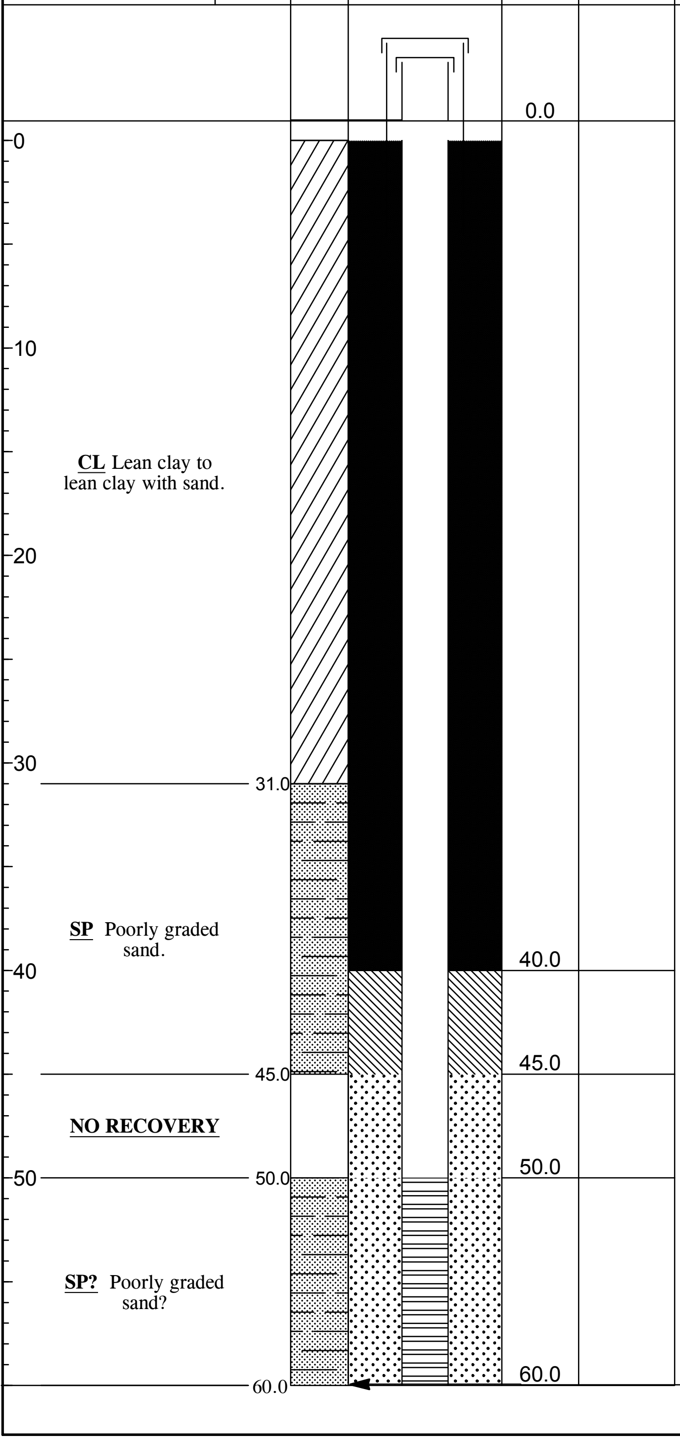
Project	New Madrid Energy Center
Location	Marston, MO
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling
Driller	

Well Diagram

◫	Riser Pipe
▤	Screen
▒	Filter Sand
▓	Cuttings
■	Grout
⁘	Concrete
▨	Bentonite Seal

File No.	128064-001
Date Installed	29 Sep 2016
H&A Rep.	P. Kroger
Location	See Plan
Ground El.	
Datum	NGVD

SOIL/ROCK CONDITIONS	DEPTH (ft.)
CL Lean clay to lean clay with sand.	31.0
SP Poorly graded sand.	45.0
NO RECOVERY	50.0
SP? Poorly graded sand?	60.0



WELL CONSTRUCTION DETAILS

Type of protective cover LOCKING CAP

Height of Guard Pipe above ground surface 2.4 ft

Height of top of riser above ground surface 2.0 ft

Type of protective casing Guard Pipe

Length 50.0 ft

Inside diameter 2 inch

Depth of bottom of Guard Pipe 47.6 ft

Type of riser pipe Schedule 40 PVC

Inside diameter of riser pipe 2 inch

Depth of bottom of riser pipe 50.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	0.0 ft	40.0 ft
Bentonite	40.0 ft	5.0 ft
	-	-

Diameter of borehole 8 inch

Depth to top of well screen 50.0 ft

Type of screen Machine slotted Sch 40 PVC

Screen gauge or size of openings 0.010 in.

Diameter of screen 2 inch

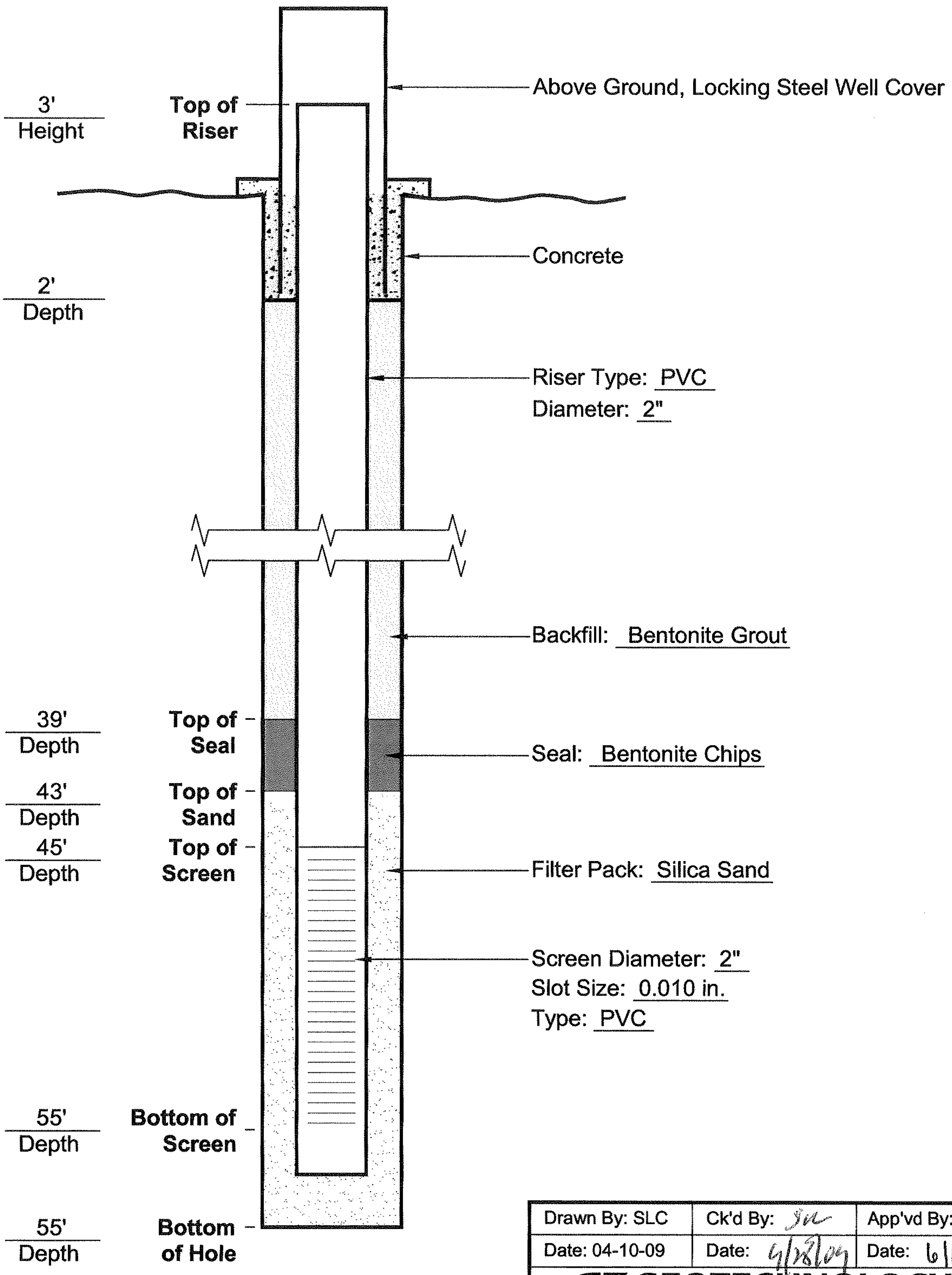
Type of Backfill around Screen No. 12-20 silica sand

Depth to bottom of well screen 60 ft

Bottom of silt trap NA

Depth of bottom of borehole 60.0 ft

Date Installed: March 2009



NOTE

1. Boring P-6 drilled to 85 feet and backfilled to 55 feet prior to installing the piezometer.

Drawn By: SLC	Ck'd By: Jn	App'vd By: MHM
Date: 04-10-09	Date: 4/28/09	Date: 6/12/09

GEOTECHNOLOGY INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
ST. LOUIS • COLLINSVILLE • KANSAS CITY

AECI New Madrid
Embankment Stability Evaluation
New Madrid County, Missouri

TYPICAL MONITORING WELL P1 THROUGH P6

Project Number 1011304.91IG	PLATE

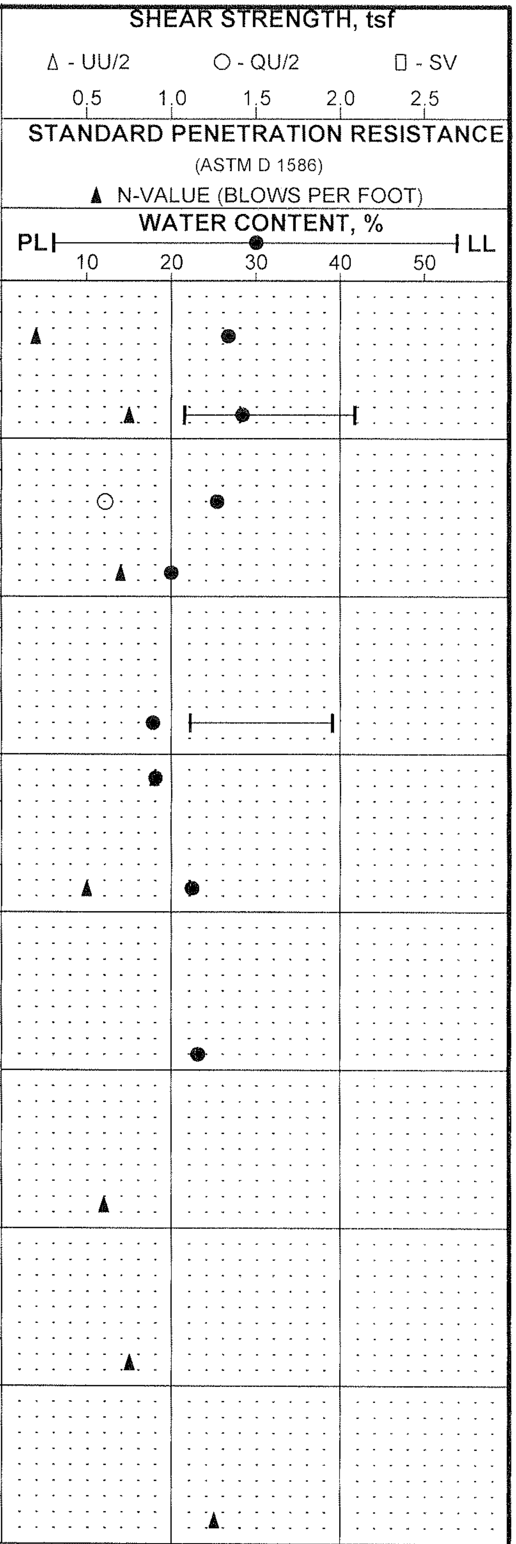
Surface Elevation 310

Datum msl

Completion Date: 3/17/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Topsoil		
	FILL: brown and black, silty clay, trace slag	1-1-3	SS1
	FILL: brown and gray, silty clay		
		6-7-8	SS2
5			
		98	ST3
		5-7-7	SS4
10			
			ST5
		103	ST6
15	Very stiff to stiff, brown, sandy SILT - ML 80 percent passing #200 sieve	8-8-10	SS7
		4-5-5	SS8
20			
		86	ST9
25			
	Medium dense, brown, fine SAND - SP		
		4-4-8	SS10
30			
		5-6-9	SS11
35			
		9-12-13	SS12

GRAPHIC LOG



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 26.2 FEET AFTER 80 DAYS ⊻

AT 30.8 FEET AFTER 105 DAYS ⊻

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 25.5 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS: Consolidated-Undrained Triaxial test performed on ST6.

Drawn by: KSA	Checked by: SM	App'vd. by: MHM
Date: 3/26/09	Date: 6/12/09	Date: 6/15/09

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
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AECI New Madrid
Embankment Stability Evaluation

LOG OF BORING: P-2

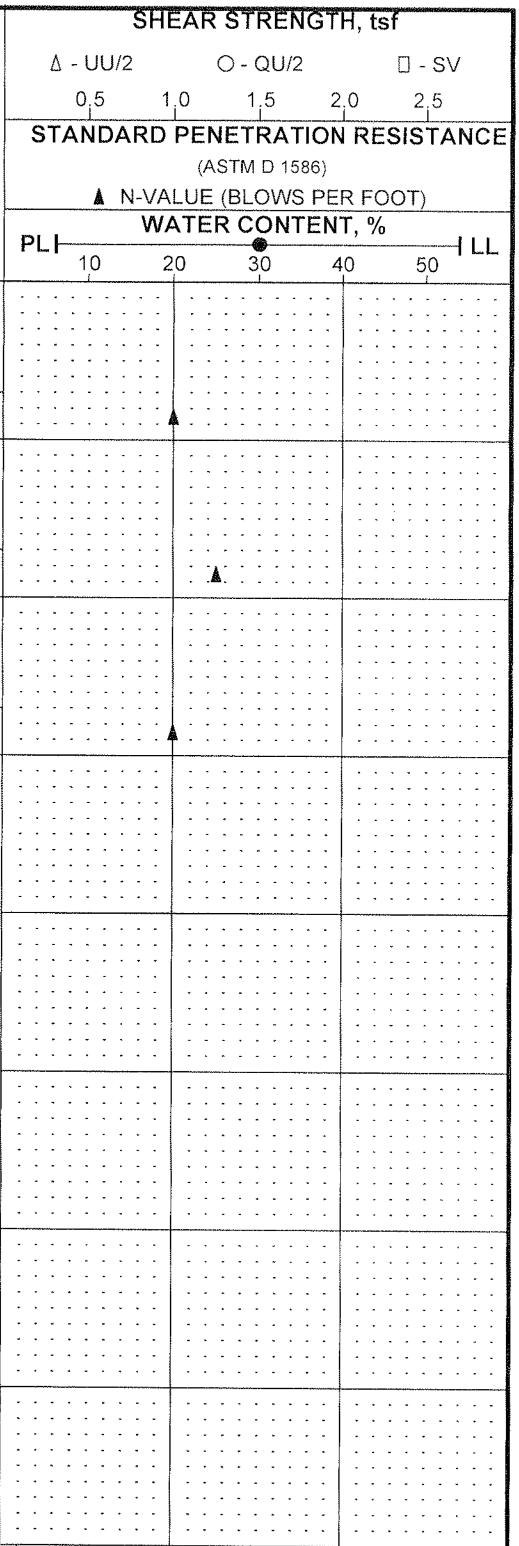
Project No. 1011304.91IG

Surface Elevation 310

Datum msl

Completion Date: 3/17/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium dense, brown, fine SAND - SP *(continued)*			
	Medium dense, brown, fine to coarse SAND - SP			
45			9-9-11	SS13
50			9-11-14	SS14
55			9-9-11	SS15
	Boring terminated at 55 feet.			
60				
65				
70				
75				



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GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 26.2 FEET AFTER 80 DAYS ▽

AT 30.8 FEET AFTER 105 DAYS ▼

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 25.5 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS: Consolidated-Undrained Triaxial test performed on ST6.

Drawn by: KSA	Checked by: Sh	App'vd. by: MHM
Date: 3/26/09	Date: 6/12/09	Date: 6/15/09

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ENGINEERING AND ENVIRONMENTAL SERVICES
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AECI New Madrid
Embankment Stability Evaluation

CONTINUATION OF
LOG OF BORING: P-2

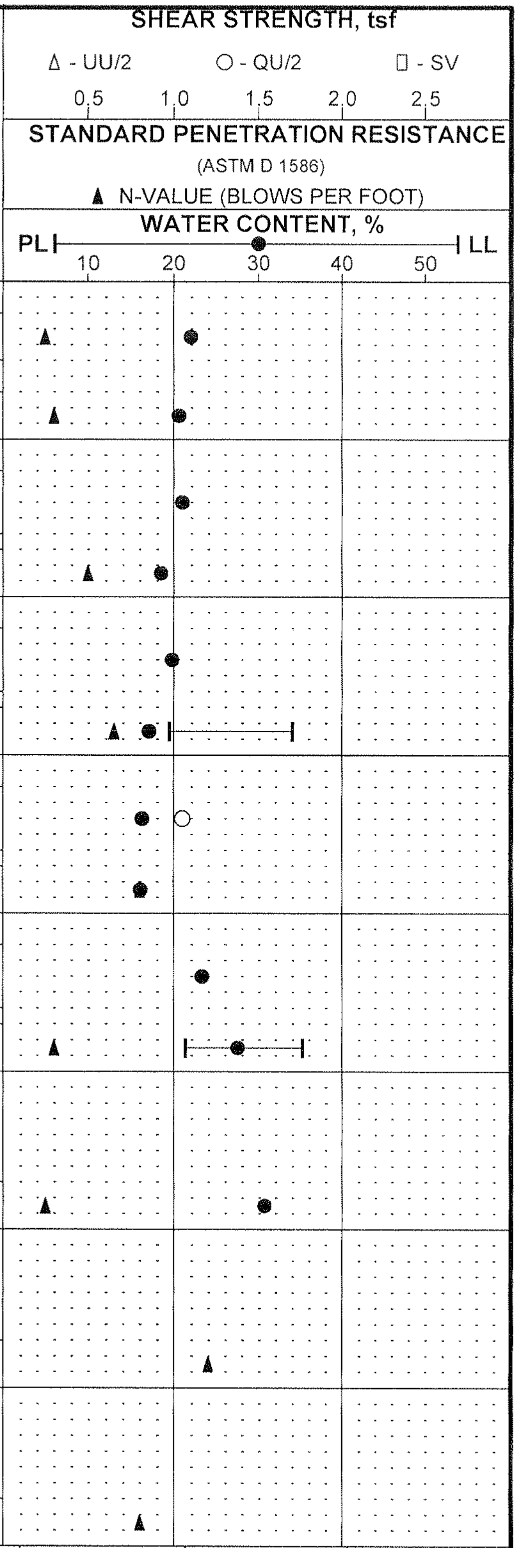
Project No. 1011304.91IG

Surface Elevation 311

Datum msl

Completion Date: 3/18/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Topsoil		
	FILL: brown and gray, silty clay	2-2-3	SS1
		2-3-3	SS2
5			
		104	ST3
		5-5-5	SS4
10			
		107	ST5
		5-7-6	SS6
15			
		113	ST7
		7-7-9	SS8
20			
		98	ST9
	Medium stiff, brown, silty CLAY, trace sand - (CL)	2-3-3	SS10
25			
	▼		
		1-2-3	SS11
30			
	▼		
	Medium dense, brown, medium to coarse SAND - SP		
		11-11-13	SS12
35			
		6-8-8	SS13



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 27.3 FEET AFTER 79 DAYS ▼

AT 31.5 FEET AFTER 104 DAYS ▼

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 19.5 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by: Sn	App'vd. by: MHM
Date: 3/26/09	Date: 6/12/09	Date: 6/15/09

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
ST. LOUIS • COLLINSVILLE • KANSAS CITY

AECI New Madrid
Embankment Stability Evaluation

LOG OF BORING: P-3

Project No. 1011304.91IG

Surface Elevation 311 Completion Date: 3/18/09

Datum msl

SHEAR STRENGTH, tsf

Δ - UU/2 ○ - QU/2 ▯ - SV

0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE

(ASTM D 1586)

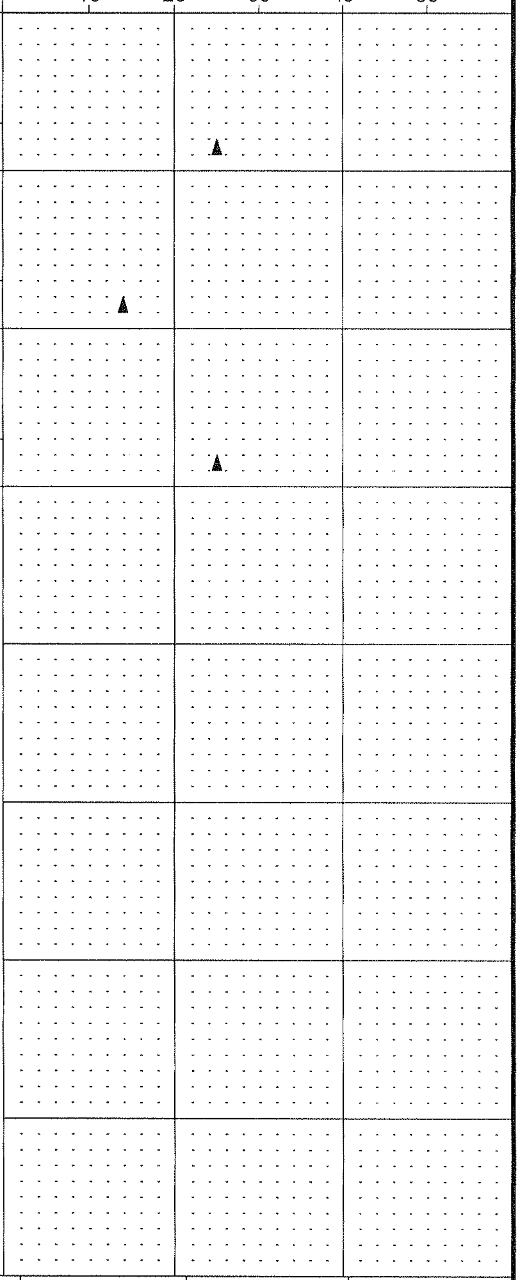
▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %

PL ├──●──┤ LL

10 20 30 40 50

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium dense, brown, medium to coarse SAND - SP *(continued)*			
			9-12-13	SS14
45				
	6 percent passing #200 sieve		5-6-8	SS15
50				
			9-12-13	SS16
55	Boring terminated at 55 feet.			
60				
65				
70				
75				



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GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 27.3 FEET AFTER 79 DAYS ▽

AT 31.5 FEET AFTER 104 DAYS ▼

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 19.5 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by: Su	App'vd. by: MHM
Date: 3/26/09	Date: 6/12/09	Date: 6/15/09

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
ST. LOUIS • COLLINSVILLE • KANSAS CITY

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Embankment Stability Evaluation

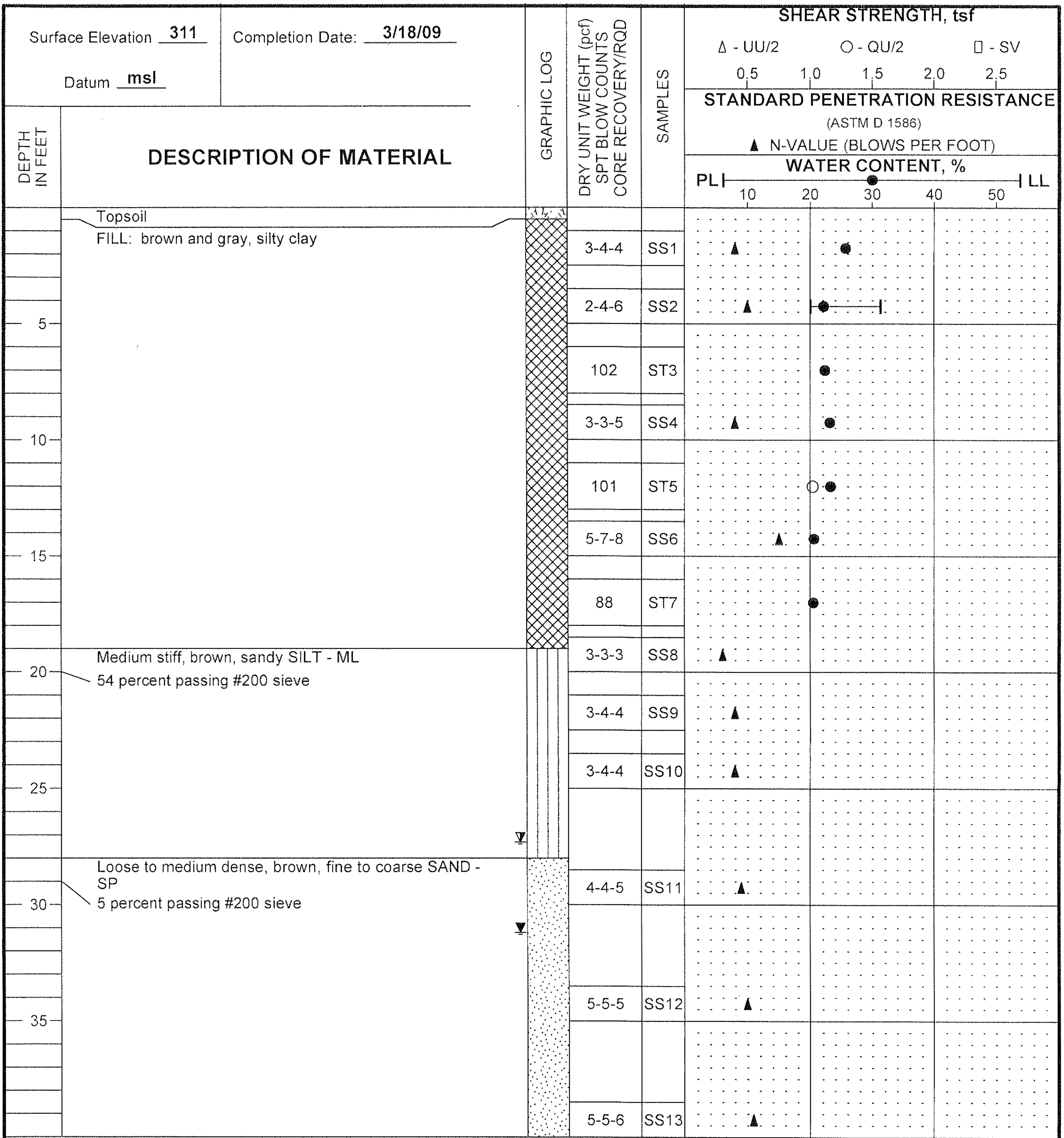
CONTINUATION OF
LOG OF BORING: P-3

Project No. 1011304.91IG

Surface Elevation 311

Datum msl

Completion Date: 3/18/09



DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
Topsoil		
FILL: brown and gray, silty clay	3-4-4	SS1
	2-4-6	SS2
	102	ST3
	3-3-5	SS4
	101	ST5
	5-7-8	SS6
	88	ST7
Medium stiff, brown, sandy SILT - ML 54 percent passing #200 sieve	3-3-3	SS8
	3-4-4	SS9
	3-4-4	SS10
Loose to medium dense, brown, fine to coarse SAND - SP 5 percent passing #200 sieve	4-4-5	SS11
	5-5-5	SS12
	5-5-6	SS13

NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 27.3 FEET AFTER 79 DAYS ▽

AT 31.2 FEET AFTER 104 DAYS ▼

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 20 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by: SM	App'vd. by: MHM
Date: 3/26/09	Date: 6/12/09	Date: 6/15/09

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
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AECI New Madrid
Embankment Stability Evaluation

LOG OF BORING: P-4

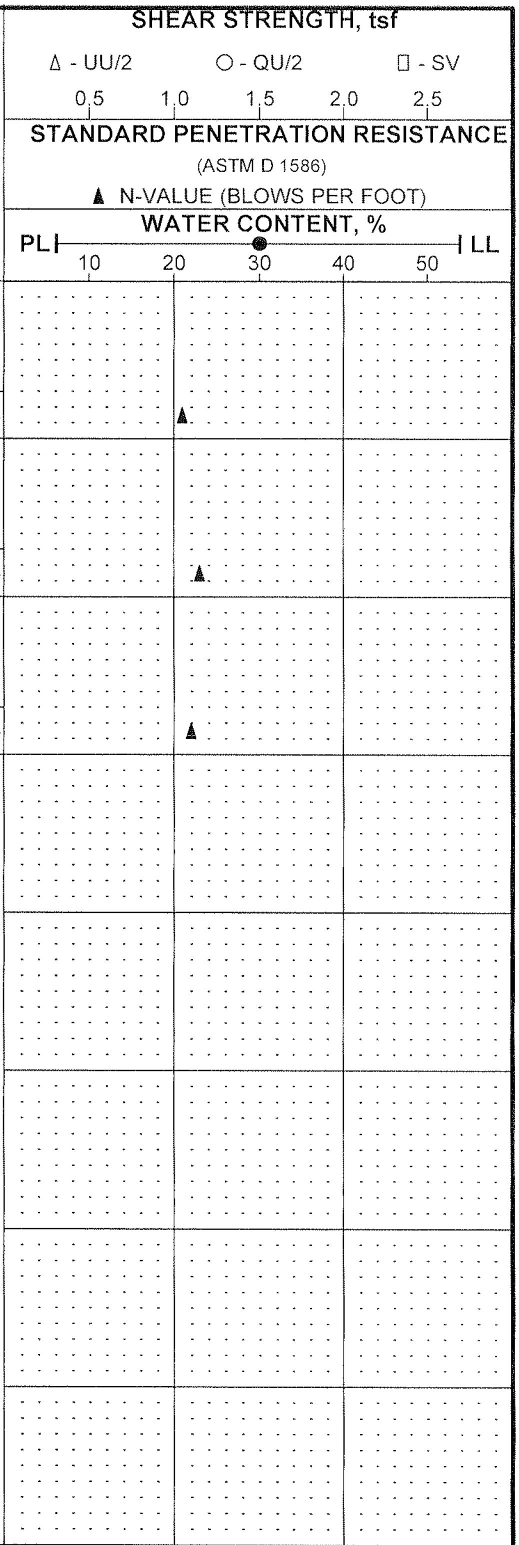
Project No. 1011304.91IG

Surface Elevation 311

Datum msl

Completion Date: 3/18/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Loose to medium dense, brown, fine to coarse SAND - SP *(continued)*			
			8-10-11	SS14
45				
			6-10-13	SS15
50				
			10-11-11	SS16
55	Boring terminated at 55 feet.			
60				
65				
70				
75				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 27.3 FEET AFTER 79 DAYS ▼

AT 31.2 FEET AFTER 104 DAYS ▼

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 20 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by:	App'vd. by: MHM
Date: 3/26/09	Date: 6/12/09	Date: 6/15/09

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
ST. LOUIS • COLLINSVILLE • KANSAS CITY

AECI New Madrid
Embankment Stability Evaluation

CONTINUATION OF
LOG OF BORING: P-4

Project No. 1011304.91IG

APPENDIX E

Table of Groundwater Constituent Concentrations

Appendix E
SUMMARY OF ANALYTICAL RESULTS
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
Marston, MO

Location	Date	Detection Monitoring - USEPA Appendix III Constituents (mg/L)							Assessment Monitoring - USEPA Appendix IV Constituents (mg/L)														
		Boron, Total	Calcium, Total	Chloride	Fluoride	Sulfate	pH (lab) (SU)	TDS	Antimony, Total	Arsenic, Total	Beryllium, Total	Barium, Total	Cadmium, Total	Chromium, Total	Cobalt, Total	Lead, Total	Lithium, Total	Molybdenum, Total	Selenium, Total	Thallium, Total	Mercury, Total	Fluoride	Radium-226 & 228, Combined (pCi/L)
B - 123	11/6/2016	**0.0261**	**94.3**	< 5	**0.52**	**34**	**7.16**	**394**	< 0.0010	**0.0024**	< 0.0010	**0.239**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0276**	< 0.010	< 0.0010	< 0.0010	< 0.00020	**0.52**	0.97 +/- 1.04
	12/12/2016	**0.0201**	**91.0**	< 5	**0.57**	**37**	**7.00**	**448**	< 0.0010	**0.0011**	< 0.0010	**0.206**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0274**	< 0.010	< 0.0010	< 0.0010	< 0.00020	**0.57**	**0.71 +/- 0.59**
	1/8/2017	**0.031**	**89.0**	**5.6**	**0.446**	**48**	**7.53**	**340**	< 0.0030	**0.0014**	< 0.0010	**0.21**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.033**	**0.0030**	< 0.0010	< 0.0010	< 0.00020	**0.446**	0.641 +/- 0.589 (1.06)
	1/24/2017	**0.014**	**87**	**2.8**	**0.523**	**35**	**7.88**	**410**	< 0.0030	**0.0017**	< 0.0010	**0.20**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.032**	**0.0035**	< 0.0010	< 0.0010	**0.00087**	**0.523**	1.06 +/- 0.898 (1.45)
	2/23/2017	**0.031**	**90**	**3.0**	**0.540**	**36**	**7.22**	**400**	< 0.0030	**0.0023**	< 0.0010	**0.22**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.031**	**0.0036**	< 0.0010	< 0.0010	< 0.00020	**0.540**	**1.37 +/- 0.747 (1.206)**
	4/25/2017	**0.032**	**83**	**3.4**	**0.532**	**36**	**7.36**	**400**	< 0.0030	**0.0025**	< 0.0010	**0.24**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.029**	**0.0036**	< 0.0010	< 0.0010	< 0.00020	**0.532**	0.827 +/- 0.851 (1.525)
	5/16/2017	**0.023**	**77**	**3.2**	**0.302**	**33**	**7.22**	**380**	< 0.0030	**0.0020**	< 0.0010	**0.21**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.030**	**0.0036**	< 0.0010	< 0.0010	< 0.00020	**0.302**	**1.35 +/- 0.824 (1.3)**
	6/21/2017	**0.029**	**78**	**3.1**	**0.429**	**32**	**7.28**	**380**	< 0.0030	**0.0017**	< 0.0010	**0.19**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.029**	**0.0036**	< 0.0010	< 0.0010	< 0.00020	**0.429**	0.668 +/- 0.909 (1.781)
	8/28/2017	**0.030**	**82**	**3.5**	**0.574**	**32**	**7.24**	**360**	< 0.0030	**0.0020**	< 0.0010	**0.20**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.029**	**0.0034**	< 0.0010	< 0.0010	< 0.00020	**0.574**	**1.926 +/- 1.09 (1.50)**
	3/14/2018	**0.023**	**79**	**3.3**	**0.547**	**32**	**7.35**	**370**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5/30/2018	-	-	-	**0.537**	-	-	-	< 0.0030	**0.0022**	< 0.0010	**0.21**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.026**	**0.0044**	< 0.0010	< 0.0010	< 0.00020	**0.537**	**1.80 +/- 0.979 (1.44)**
	9/11/2018	**0.027**	**87**	**3.7**	**0.521**	**31**	**7.36**	**330**	-	**0.0040**	-	**0.27**	-	< 0.0040	< 0.00086	< 0.0010	**0.019**	**0.0040**	< 0.0010	-	-	**0.521**	1.57 +/- 1.18 (1.99)
	10/24/2018	**0.034**	**88**	**3.9**	**0.390**	**33**	**7.71**	**370**	< 0.0030	**0.0029**	< 0.0010	**0.21**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.024**	**0.0041**	< 0.0010	< 0.0010	< 0.00020	**0.390**	0.818 +/- 0.817 (1.47)
	12/4/2018	**0.083**	**82**	**4.4**	**0.582**	**34**	**7.39**	**360**	< 0.0030	**0.0014**	< 0.0010	**0.18**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.027**	**0.0038**	< 0.0010	< 0.0010	< 0.00020	**0.582**	0.631 +/- 0.756 (1.31)
	12/17/2018	**0.036**	**78**	**3.2**	**0.647**	**36**	**7.41**	**380**	< 0.0030	**0.0016**	< 0.0010	**0.18**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.029**	**0.0046**	< 0.0010	< 0.0010	< 0.00020	**0.647**	0.494 +/- 0.751 (1.38)
	1/9/2019	**0.036**	**81**	**3.5**	**0.582**	**30**	**7.34**	**340**	< 0.0030	**0.0024**	< 0.0010	**0.21**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.023**	**0.0037**	< 0.0010	< 0.0010	< 0.00020	**0.582**	**1.01 +/- 0.649 (1.00)**
	1/14/2019	**0.026**	**83**	**3.6**	**0.565**	**30**	**7.22**	**430**	< 0.0030	**0.0027**	< 0.0010	**0.20**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.023**	**0.0040**	< 0.0010	< 0.0010	< 0.00020	**0.565**	0.745 +/- 0.779 (1.47)
	1/21/2019	**0.037**	**80**	**3.8**	**0.480**	**33**	**7.37**	**410**	< 0.0030	**0.0021**	< 0.0010	**0.18**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.023**	**0.0042**	< 0.0010	< 0.0010	< 0.00020	**0.480**	**0.998 +/- 0.631 (1.000)**
	2/8/2019	**0.028**	**78**	**3.1**	**0.515**	**31**	**7.29**	**450**	< 0.0030	**0.0026**	< 0.0010	**0.22**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.024**	**0.0044**	< 0.0010	< 0.0010	< 0.00020	**0.515**	0.998 +/- 0.848 (1.26)
	2/22/2019	**0.029**	**66**	**3.2**	**0.579**	**30**	**7.48**	**340**	< 0.0030	**0.0014**	< 0.0010	**0.18**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.023**	**0.0040**	< 0.0010	< 0.0010	< 0.00020	**0.579**	0.775 +/- 0.873 (1.78)
	3/4/2019	**0.040**	**80**	**3.2**	**0.634**	**30**	**7.36**	**350**	< 0.0030	**0.0021**	< 0.0010	**0.21**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.026**	**0.0041**	< 0.0010	< 0.0010	< 0.00020	**0.634**	**2.29 +/- 1.13 (1.50)**
	3/7/2019	**0.048**	**79**	< 5.0	**0.620**	**31**	**7.53**	**370**	< 0.0030	**0.0020**	< 0.0010	**0.20**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.025**	**0.0043**	< 0.0010	< 0.0010	< 0.00020	**0.620**	0.594 +/- 0.743 (1.38)
	6/5/2019	-	-	-	**0.625**	-	-	-	< 0.0030	**0.0079**	< 0.0010	**0.33**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.026**	**0.0042**	< 0.0010	< 0.0010	< 0.00020	**0.625**	**2.18 +/- 1.00 (0.950)**
	8/28/2019	**0.025**	**78**	**2.8**	**0.602**	**28**	**7.51**	**340**	-	**0.0022**	-	**0.20**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.031**	**0.0042**	< 0.0010	-	-	**0.602**	1.76 +/- 1.07 (1.83)
	10/4/2019	**0.043**	**83**	**3.1**	**0.598**	**29**	**7.26**	**360**	-	**0.0011**	-	**0.16**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.027**	**0.0059**	< 0.0010	-	-	**0.598**	0.0475 +/- 0.872 (1.97)
	10/15/2019	**0.052**	**83**	**3.2**	**0.580**	**28**	**7.29**	**340**	-	**0.0012**	-	**0.16**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.028**	**0.0040**	< 0.0010	-	-	**0.580**	1.56 +/- 1.04 (1.82)
	11/6/2019	**0.079**	**80**	**3.0**	**0.654**	**29**	**6.95**	**410**	-	**0.0018**	-	**0.18**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.026**	**0.0047**	< 0.0010	-	-	**0.654**	0.446 +/- 0.879 (1.79)
	11/6/2019	**0.039**	**80**	**2.9**	**0.598**	**29**	**7.46**	**390**	-	**0.0015**	-	**0.18**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.027**	**0.0040**	< 0.0010	-	-	**0.598**	0.136 +/- 0.654 (1.46)
	12/17/2019	**0.036**	**78**	**3.2**	**0.647**	**36**	**7.41**	**380**	< 0.0030	**0.0016**	< 0.0010	**0.18**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.029**	**0.0046**	< 0.0010	< 0.0010	< 0.00020	**0.647**	0.494 +/- 0.751 (1.38)
	12/18/2019	-	-	-	-	-	-	-	< 0.0030	**0.0018**	< 0.0010	**0.18**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.032**	**0.0040**	< 0.0010	< 0.0010	< 0.00020	-	0.194 +/- 0.601 (1.15)
	2/21/2020	**0.029**	**62**	**3.1**	**0.457**	**28**	**7.43**	**270**	-	**0.0041**	-	**0.18**	< 0.00089	< 0.0040	**0.00098**	< 0.0010	**0.017**	< 0.0010	< 0.0010	-	-	**0.457**	0.892 +/- 0.810 (1.39)
	5/20/2020	-	-	-	**0.518**	-	-	-	<0.0030	**0.0034**	<0.0010	**0.21**	<0.00089	<0.0040	<0.00086	<0.0010	**0.024**	**0.0037**	<0.0010	<0.0010	<0.00020	**0.518**	0.467 +/- 0.834 (1.72)
B-126	11/6/2016	**0.0342**	**140**	**8**	**0.39**	**57**	**6.90**	**560**	< 0.0010	**0.0099**	< 0.0010	**0.400**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0159**	< 0.010	< 0.0010	< 0.0010	< 0.00020	**0.39**	0.7 +/- 1.45
	12/12/2016	**0.0273**	**178**	**11**	**0.39**	**173**	**6.68**	**826**	< 0.0010	**0.0076**	< 0.0010	**0.447**	< 0.0010	**0.0013**	< 0.0050	< 0.0010	**0.0244**	< 0.010	< 0.0010	< 0.0010	< 0.00020	**0.39**	**1.11 +/- 0.62**
	1/8/2017	**0.034**	**72**	**6.4**	**0.376**	**43**	**7.49**	**240**	< 0.0030	**0.0063**	< 0.0010	**0.250**	< 0.0010	< 0.0040	**0.002**	**0.0011**	**0.016**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**0.376**	0.342 +/- 0.71 (1.38)
	1/24/2017	**0.018**	**64**	**3.4**	**0.457**	**26**	**7.37**	**290**	< 0.0030	**0.0050**	< 0.0010	**0.23**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.013**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**0.457**	-0.189 +/- 0.713 (1.49)
	2/23/2017	**0.034**	**85**	**7.4**	**0.525**	**58**	**7.00**	**340**	< 0.0030	**0.0067**	< 0.0010	**0.28**	< 0.0010	< 0.0040	**0.0021**	< 0.0010	**0.015**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**0.525**	1.156 +/- 0.854 (1.37)
	4/25/2017	**0.032**	**57**	**4.5**	**0.388**	**27**	**6.95**	**300**	< 0.0030	**0.0084**	< 0.0010	**0.21**	< 0.0010	**0.0047**	**0.0026**	**0.0020**	**0.013**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**0.388**	**1.267 +/- 0.807 (1.22)**
	5/16/2017	**0.022**	**35**	**1.7**	**0.258**	**5.6**	**6.93**	**170**	< 0.0030	**0.0085**	< 0.0010	**0.13**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	< 0.010	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**0.258**	**1.827 +/- 0.854 (1.053)**
	6/21/2017	**0.031**	**41**	**3.2**	**0.398**	**7.6**	**6.91**	**210**	< 0.0030	**0.0094**	< 0.0010	**0.16**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	< 0.010	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**0.398**	0.51 +/- 0.848 (1.663)
	8/28/2017	**0.036**	**63**	**4.6**	**0.493**	**20**	**6.94**	**270**	< 0.0030	**0.0097**	< 0.0010	**0.21**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.010**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**0.493**	**2.01+/- 1.13 (1.21)**
	3/14/2018	**0.032**	**82**	**3.6**	**0.369**	**26**	**7.00**	**280**	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.369**	-
	5/30/2018	-	-	-	**0.383**	-	-	-	< 0.0030	**0.0086**	< 0.0010	**0.24**	< 0.0010	**0.0094**	**0.0030**	**0.0043**	**0.013**	**0.0014**	**0.0012**	< 0.0010	< 0.00020	**0.383**	2.20 +/- 1.71 (3.20)
	9/11/2018	**0.034**	**130**	**1.0**	**0.284**	**90**	**7.00**	**440**	-	**0.0052**	-	**0.31**	-	< 0.0040	**0.0019**	< 0.0010	**0.011**	< 0.0010	< 0.0010	-	-	**0.284**	1.13 +/- 1.22 (2.05)
	10/24/2018	**0.065**	**67**	**4.4**	**0.280**	**28**	**7.17**	**280**	< 0.0030	**0.0052**	< 0.0010	**0.22**	< 0.00089	**0.0064**	**0.0015**	**0.0011**	**0.012**	**0.0038**	**0.0011**	< 0.0010	< 0.00020	**0.280**	1.07 +/- 0.975 (1.71)
	12/4/2018	**0.090**	**44**	**2.4**	**0.446**	**17**	**7.09**	**150**	< 0.0030	**0.0046**	< 0.0010	**0.19**	< 0.00089	**0.010**	**0.0017**	**0.0022**	**0.011**	**0.0016**	< 0.0010	< 0.0010	< 0.00020	**0.446**	0.739 +/- 0.911 (1.83)
	12/18/2018	**0.029**	**32**	**1.4**	**0.678**	**16**	**6.99**	**220**	< 0.0030	**0.0044**	< 0.0010	**0.16**	< 0.00089	**0.0078**	**0.0017**	**0.0029**	**0.014**	< 0.0010	**0.0018**	< 0.0010	< 0.00020	**0.678**	1.13 +/- 1.20 (2.15)
	1/8/2019	**0.051**	**50**	**2.5**	**0.501**	**13**	**7.04**	**410**	< 0.0030	**0.0059**	< 0.0010	**0.22**	< 0.00089	**0.012**	**0.0030**	**0.0041**	**0.011**	**0.0018**	**0.0013**	< 0.0010	< 0.00020	**0.501**	**2.33 +/- 1.30 (1.97)**
	1/14/2019	**0.025**	**24**	**1.1**	**0.551**	**7.1**	**6.97**	**230**	< 0.0030	**0.0041**	< 0.0010	**0.15**	< 0.00089	**0.0070**	**0.0018**	**0.0041**	< 0.010	**0.0011**	**0.0028**	< 0.0010	< 0.00020	**0.551**	1.05 +/- 1.01 (1.81)
	1/22/2019	**0.024**	**25**	**1.0**	**0.434**	**6.4**	**7.00**	**140**	< 0.0030	**0.0034**	< 0.0010	**0.11**	< 0.00089	**0.0041**	**0.0011**	**0.0020**	< 0.010	< 0.0010	**0.0012**	< 0.0010	< 0.00020	**0.434**	**1.50 +/- 0.792 (1.13)**
	2/8/2019	**0.019**	**17**	< 1.0	**0.400**	**6.5**	**6.70**	**440**	< 0.0030	**0.0038**	< 0.0010	**0.18**	< 0.00089	**0.014**	**0.0023**	**0.0078**	**0.012**	< 0.0010	**0.0031**	< 0.0010	< 0.00020	**0.400**	1.04 +/- 0.992 (1.16)
	3/4/2019	**0.026**	**16**	< 1.0	**0.556**	**6.4**	**6.85**	**420**	< 0.0030	**0.0054**	< 0.0010	**0.17**	< 0.00089	**0.015**	**0.0044**	**0.0090**	**0.011**	< 0.0010	**0.0012**	< 0.0010	< 0.00020	**0.556**	1.16 +/- 0.854 (1.35)
	3/7/2019	**0.023**	**29**	**1.2**	**0.543**	**11**	**7.22**	**180**	< 0.0030	**0.0043**	< 0.0010	**0.15**	< 0.00089	**0.0098**	**0.0030**	**0.0047**	< 0.010	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**0.543**	0.969 +/- 1.09 (2.01)
	6/5/2019	-	-	-	**0.516**	-	-	-	< 0.0030	**0.0092**	< 0.0010	**0.17**	< 0.00089	**0.0040**	**0.0023**	**0.0018**	**0.010**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**0.516**	1.55 +/- 1.60 (2.93)
	8/28/2019	**0.024**	**56**	**2.7**	**0.507**	**24**	**7.10**	**280**	-	**0.0051**	-	**0.24**	< 0.00089	< 0.0040	**0.0018**	**0.0022**	**0.015**	< 0.0010	**0.0010**	-	-	**0.507**	**2.20 +/- 1.05 (1.25)**
	10/4/2019	**0.037**	**140**	**8.8**	**0.409**	**130**	**6.98**	**580**	-	**0.0049**	-	**0.33**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.021**	< 0.0010	< 0.0010	-	-	**0.409**	0.884 +/- 1.10 (2.02)
	10/15/2019	**0.041**	**140**	**10**	**0.517**	**130**	**6.98**	**630**	-	**0.0046**	-	**0.30**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.022**	**0.0032**	< 0.0010	-	-	**0.517**	0.563 +/- 1.05 (2.22)
	11/6/2019	**0.050**	**67**	**4.2**	**0.508**	**38**	**7.07**	**320**	-	**0.0043**	-	**0.19**	< 0.00089	< 0.0040	**0.0012**	< 0.0010	< 0.020	< 0.0010	< 0.0010	-	-	**0.508**	**2.68 +/- 1.23 (1.80)**
	12/18/2019	**0.029**	**32**	**1.4**	**0.678**	**16**	**6.99**	**220**	< 0.0030	**0.0044**	< 0.0010	**0.16**	< 0.00089	**0.0078**	**0.0017**	**0.0029**	**0.014**	< 0.0010	**0.0018**	< 0.0010	< 0.00020	**0.678**	1.13 +/- 1.20 (2.15)
	2/21/2020	**0.031**	**62**	**3.9**	**0.376**	**27**	**7.07**	**230**	-	**0.0040**	-	**0.18**	< 0.00089	< 0.0040	**0.00086**	< 0.0010	**0.018**	< 0.0010	< 0.0010	-	-	**0.376**	0.469 +/- 0.556 (1.03)
	5/20/2020	-	-	-	**0.339**	-	-	-	<0.0030	**0.0037**	<0.0010	**0.20**	<0.00089	<0.0040	**0.0015**	<0.0010	**0.011**	<0.0010	<0.0010	<0.0010	<0.00020	**0.339**	1.08 +/- 0.841 (1.43)

Appendix E
SUMMARY OF ANALYTICAL RESULTS
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
Marston, MO

Location		Detection Monitoring - USEPA Appendix III Constituents (mg/L)							Assessment Monitoring - USEPA Appendix IV Constituents (mg/L)														
	Date	Boron, Total	Calcium, Total	Chloride	Fluoride	Sulfate	pH (lab) (SU)	TDS	Antimony, Total	Arsenic, Total	Beryllium, Total	Barium, Total	Cadmium, Total	Chromium, Total	Cobalt, Total	Lead, Total	Lithium, Total	Molybdenum, Total	Selenium, Total	Thallium, Total	Mercury, Total	Fluoride	Radium-226 & 228, Combined (pCi/L)
MW-6	11/3/2016	**0.421**	**139**	< 5	**0.36**	**63**	**6.78**	**486**	< 0.0010	< 0.0010	< 0.0010	**0.131**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0168**	< 0.010	< 0.0010	< 0.0010	< 0.00020	**0.36**	**0.77 +/- 0.6**
	11/3/2016	**0.433**	**141**	< 5	**0.36**	**62**	**6.77**	**468**	< 0.0010	< 0.0010	< 0.0010	**0.134**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0173**	< 0.010	< 0.0010	< 0.0010	< 0.00020	**0.36**	**0.74 +/- 0.71**
	12/6/2016	**0.486**	**136**	**8**	**0.32**	**84**	**6.92**	**530**	< 0.0010	**0.0022**	< 0.0010	**0.137**	< 0.0010	**0.0022**	< 0.0050	< 0.0010	**0.0181**	**0.0417**	< 0.0010	< 0.0010	< 0.00020	**0.32**	**2.099 +/- 1.051 (1.56)**
	1/4/2017	**0.530**	**120**	**6.7**	**0.536**	**95**	**7.39**	**570**	< 0.0030	**0.0012**	< 0.0010	**0.140**	< 0.0010	< 0.0040	**0.0036**	< 0.0010	**0.023**	**0.046**	< 0.0010	< 0.0010	< 0.00020	**0.536**	1.264 +/- 0.86 (1.39)
	1/26/2017	**0.75**	**150**	**4.5**	**0.564**	**91**	**7.44**	**340**	< 0.0030	**0.0019**	< 0.0010	**0.16**	< 0.0010	< 0.0040	**0.0033**	< 0.0010	**0.021**	**0.071**	< 0.0010	< 0.0010	< 0.00020	**0.564**	1.433 +/- 0.894 (1.567)
	2/21/2017	**0.75**	**140**	< 5.0	**0.308**	**63**	**6.90**	**500**	< 0.0030	**0.0010**	< 0.0010	**0.16**	< 0.0010	< 0.0040	**0.0047**	< 0.0010	**0.021**	**0.034**	< 0.0010	< 0.0010	< 0.00020	**0.308**	1.065 +/- 0.775 (1.38)
	3/28/2017	**0.86**	**130**	**7.0**	**0.519**	**100**	**6.78**	**600**	< 0.0030	< 0.0010	< 0.0010	**0.17**	< 0.0010	< 0.0040	**0.0046**	< 0.0010	**0.022**	**0.033**	< 0.0010	< 0.0010	< 0.00020	**0.519**	1.086 +/- 1.072 (1.955)
	4/27/2017	**1.6**	**170**	**9.0**	**0.328**	**140**	**7.05**	**680**	< 0.0030	**0.0016**	< 0.0010	**0.18**	< 0.0010	< 0.0040	**0.0041**	< 0.0010	**0.019**	**0.085**	< 0.0010	< 0.0010	< 0.00020	**0.328**	**1.333 +/- 0.793 (1.263)**
	4/27/2017	**1.4**	**160**	**9.1**	**0.314**	**140**	**7.05**	**620**	< 0.0030	**0.0014**	< 0.0010	**0.17**	< 0.0010	< 0.0040	**0.0040**	< 0.0010	**0.018**	**0.080**	< 0.0010	< 0.0010	< 0.00020	**0.314**	**1.339 +/- 0.753 (1.239)**
	5/18/2017	**1.8**	**150**	**10**	< 0.250	**150**	**6.90**	**660**	< 0.0030	< 0.0010	< 0.0010	**0.18**	< 0.0010	< 0.0040	**0.0050**	< 0.0010	**0.023**	**0.048**	< 0.0010	< 0.0010	< 0.00020	< 0.250	1.05 +/- 0.843 (1.391)
	6/20/2017	**1.7**	**150**	**11**	**0.362**	**150**	**6.94**	**640**	< 0.0030	**0.0012**	< 0.0010	**0.16**	< 0.0010	< 0.0040	**0.0054**	< 0.0010	**0.022**	**0.021**	**0.0010**	< 0.0010	< 0.00020	**0.362**	**2.39 +/- 1.251 (1.779)**
	8/16/2017	**1.0**	**170**	**7.0**	**0.316**	**89**	**6.84**	**500**	< 0.0030	< 0.0010	< 0.0010	**0.15**	< 0.0010	< 0.0040	**0.0060**	< 0.0010	**0.024**	**0.010**	< 0.0010	< 0.0010	< 0.00020	**0.316**	1.651 +/- 1.217 (1.901)
	3/15/2018	**2.1**	**120**	**9.0**	**0.446**	**110**	**7.05**	**540**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5/30/2018	-	-	-	**0.349**	-	-	-	< 0.0030	< 0.0010	< 0.0010	**0.16**	< 0.0010	< 0.0040	**0.0052**	< 0.0010	**0.018**	**0.063**	< 0.0010	< 0.0010	< 0.00020	**0.349**	0.680 +/- 0.919 (1.79)
	9/11/2018	**0.66**	**130**	**7.0**	**0.319**	**64**	**7.09**	**380**	-	< 0.0010	-	**0.11**	-	< 0.0040	**0.0028**	< 0.0010	< 0.010	**0.042**	< 0.0010	-	-	**0.319**	0.790 +/- 0.925 (1.68)
	3/8/2019	**2.0**	**150**	**17**	**0.430**	**150**	**7.05**	**680**	< 0.0030	< 0.0010	< 0.0010	**0.15**	< 0.00089	< 0.0040	**0.0058**	< 0.0010	**0.017**	**0.013**	< 0.0010	< 0.0010	< 0.00020	**0.430**	1.53 +/- 0.978 (1.63)
	6/7/2019	-	-	-	**0.394**	-	-	-	< 0.0030	< 0.0010	< 0.0010	**0.13**	< 0.00089	< 0.0040	**0.0041**	< 0.0010	**0.022**	**0.0025**	< 0.0010	< 0.0010	< 0.00020	**0.394**	0.952 +/- 0.738 (1.23)
	9/4/2019	**0.51**	**92**	**11**	**0.495**	**62**	**7.29**	**380**	-	< 0.0010	-	**0.10**	< 0.00089	< 0.0040	**0.0026**	< 0.0010	**0.018**	**0.011**	< 0.0010	-	-	**0.495**	0.322 +/- 1.15 (2.19)
	10/3/2019	**0.16**	**86**	**18**	**0.614**	**69**	**7.18**	**320**	-	< 0.0010	-	**0.078**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	< 0.020	**0.0092**	< 0.0010	-	-	**0.614**	1.52 +/- 0.956 (1.66)
	10/16/2019	**0.22**	**89**	**17**	**0.408**	**69**	**7.29**	**340**	-	< 0.0010	-	**0.075**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	< 0.020	**0.026**	< 0.0010	-	-	**0.408**	0.915 +/- 0.958 (1.66)
	11/9/2019	**0.19**	**89**	**15**	**0.568**	**71**	**7.34**	**380**	-	< 0.0010	-	**0.087**	< 0.00089	< 0.0040	**0.0020**	< 0.0010	< 0.020	**0.0067**	< 0.0010	-	-	**0.568**	0.950 +/- 0.813 (1.42)
	2/25/2020	**0.80**	**130**	**5.6**	**0.354**	**58**	**7.08**	**480**	-	< 0.0010	-	**0.12**	< 0.00089	< 0.0040	**0.0038**	< 0.0010	**0.020**	**0.0074**	< 0.0010	-	-	**0.354**	0.645 +/- 0.691 (1.22)
	5/20/2020	-	-	-	< 0.250	-	-	-	<0.0030	<0.0010	<0.0010	**0.13**	<0.00089	<0.0040	**0.0041**	<0.0010	**0.016**	**0.0085**	<0.0010	<0.0010	<0.00020	< 0.250	**3.08 +/- 1.37 (1.96)**
MW-7	11/3/2016	**19.9**	**232**	**7**	**0.34**	**409**	**6.75**	**1080**	< 0.0010	**0.0021**	< 0.0010	**0.181**	< 0.0010	< 0.0010	**0.0062**	< 0.0010	**0.0223**	**3.20**	< 0.0010	< 0.0010	< 0.00020	**0.34**	1.13 +/- 1.21
	12/6/2016	**18.4**	**207**	**6**	**0.33**	**320**	**6.88**	**952**	< 0.0010	**0.0032**	< 0.0010	**0.150**	**0.0011**	< 0.0010	**0.0098**	< 0.0010	**0.0227**	**3.24**	< 0.0010	< 0.0010	< 0.00020	**0.33**	**1.83 +/- 0.938 (1.097)**
	1/4/2017	**17.0**	**120**	**7.2**	**0.464**	**360**	**7.23**	**810**	< 0.0030	**0.0045**	< 0.0010	**0.11**	**0.0012**	< 0.0040	**0.0067**	< 0.0010	**0.031**	**2.8**	< 0.0010	< 0.0010	< 0.00020	**0.464**	**1.279 +/- 0.814 (1.271)**
	1/26/2017	**14**	**120**	**7.9**	**0.564**	**310**	**7.62**	**720**	< 0.0030	**0.0036**	< 0.0010	**0.12**	**0.0016**	< 0.0040	**0.0059**	< 0.0010	**0.027**	**2.9**	< 0.0010	< 0.0010	< 0.00020	**0.564**	0.775 +/- 0.945 (1.78)
	2/22/2017	**19**	**200**	**7.6**	**0.287**	**380**	**6.88**	**960**	< 0.0030	**0.0021**	< 0.0010	**0.15**	< 0.0010	< 0.0040	**0.0068**	< 0.0010	**0.030**	**3.4**	< 0.0010	< 0.0010	< 0.00020	**0.287**	**3.799 +/- 1.294 (1.122)**
	3/30/2017	**17**	**180**	**7.4**	**0.496**	**390**	**6.78**	**980**	< 0.0030	**0.0018**	< 0.0010	**0.15**	< 0.0010	< 0.0040	**0.0067**	< 0.0010	**0.028**	**3.4**	< 0.0010	< 0.0010	< 0.00020	**0.496**	**1.404 +/- 0.825 (1.384)**
	4/26/2017	**20**	**180**	**9.3**	**0.277**	**370**	**7.02**	**900**	< 0.0030	**0.0034**	< 0.0010	**0.14**	**0.0014**	< 0.0040	**0.0051**	< 0.0010	**0.027**	**3.9**	< 0.0010	< 0.0010	< 0.00020	**0.277**	**1.725 +/- 0.836 (1.169)**
	5/18/2017	**20**	**170**	**10**	< 0.250	**420**	**6.85**	**960**	< 0.0030	**0.0037**	< 0.0010	**0.14**	< 0.0010	< 0.0040	**0.0030**	< 0.0010	**0.034**	**3.9**	< 0.0010	< 0.0010	< 0.00020	< 0.250	**2.717 +/- 1.126 (1.213)**
	6/20/2017	**19**	**190**	**5.7**	**0.388**	**300**	**6.99**	**960**	< 0.0030	**0.0028**	< 0.0010	**0.15**	**0.0016**	< 0.0040	**0.0070**	**0.0018**	**0.028**	**3.5**	**0.0021**	**0.0020**	< 0.00020	**0.388**	**1.714 +/- 0.955 (1.454)**
	8/16/2017	**16**	**210**	**6.6**	**0.410**	**290**	**7.16**	**720**	< 0.0030	**0.0020**	< 0.0010	**0.17**	< 0.0010	< 0.0040	**0.0073**	< 0.0010	**0.031**	**3.6**	< 0.0010	< 0.0010	< 0.00020	**0.410**	1.544 +/- 1.152 (1.911)
	3/15/2018	**16**	**160**	**9.9**	**0.372**	**340**	**7.01**	**830**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5/30/2018	-	-	-	**0.431**	-	-	-	< 0.0030	**0.0023**	< 0.0010	**0.13**	< 0.0010	< 0.0040	**0.0058**	< 0.0010	**0.019**	**3.4**	< 0.0010	< 0.0010	< 0.00020	**0.431**	0.629 +/- 0.757 (1.48)
	9/11/2018	**19**	**200**	**13**	**0.330**	**470**	**7.20**	**880**	-	**0.0024**	-	**0.14**	-	< 0.0040	**0.0076**	< 0.0010	**0.014**	**3.0**	< 0.0010	-	-	**0.330**	1.36 +/- 0.956 (1.64)
	3/8/2019	**15**	**170**	**15**	**0.414**	**480**	**7.12**	**960**	< 0.0030	**0.0032**	< 0.0010	**0.11**	< 0.00089	< 0.0040	**0.0029**	< 0.0010	**0.025**	**2.7**	< 0.0010	< 0.0010	< 0.00020	**0.414**	1.23 +/- 0.995 (1.76)
	3/8/2019	**14**	**180**	**16**	**0.487**	**460**	**7.42**	**950**	< 0.0030	**0.0030**	< 0.0010	**0.12**	< 0.00089	< 0.0040	**0.0029**	< 0.0010	**0.023**	**2.8**	< 0.0010	< 0.0010	< 0.00020	**0.487**	1.52 +/- 1.04 (1.77)
	6/7/2019	-	-	-	**0.464**	-	-	-	< 0.0030	**0.0031**	< 0.0010	**0.11**	**0.0011**	< 0.0040	**0.0033**	< 0.0010	**0.039**	**2.6**	< 0.0010	< 0.0010	< 0.00020	**0.464**	**2.07 +/- 0.855 (0.706)**
	9/4/2019	**18**	**160**	**15**	**0.550**	**420**	**7.11**	**900**	-	**0.0035**	-	**0.12**	**0.0010**	< 0.0040	**0.0040**	< 0.0010	**0.031**	**2.4**	< 0.0010	-	-	**0.550**	1.54 +/- 1.17 (1.89)
	10/4/2019	**15**	**180**	**19**	**0.685**	**430**	**6.97**	**920**	-	**0.0033**	-	**0.12**	**0.0010**	< 0.0040	**0.0048**	< 0.0010	**0.024**	**2.4**	< 0.0010	-	-	**0.685**	2.22 +/- 1.38 (2.36)
	10/16/2019	**18**	**190**	**17**	**0.399**	**500**	**7.05**	**1000**	-	**0.0034**	-	**0.11**	< 0.0010	< 0.0040	**0.0033**	< 0.0010	**0.027**	**2.4**	< 0.0010	-	-	**0.399**	1.43 +/- 1.30 (2.26)
	11/9/2019	**18**	**190**	**19**	**0.410**	**530**	**7.12**	**1100**	-	**0.0045**	-	**0.13**	**0.00091**	< 0.0040	**0.0042**	< 0.0010	**0.027**	**2.3**	< 0.0010	-	-	**0.410**	**1.60 +/- 0.874 (1.39)**
	2/25/2020	**14**	**180**	**13**	**0.348**	**480**	**6.43**	**970**	-	**0.0039**	-	**0.12**	**0.0010**	< 0.0040	**0.0030**	< 0.0010	**0.033**	**2.2**	< 0.0010	-	-	**0.348**	0.873 +/- 0.701 (1.15)
	5/20/2020	-	-	-	**0.601**	-	-	-	<0.0030	**0.0032**	<0.0010	**0.15**	<0.00089	<0.0040	**0.0069**	<0.0010	**0.026**	**2.0**	<0.0010	<0.0010	<0.00020	**0.601**	0.893 +/- 0.847 (1.45)

Appendix E
SUMMARY OF ANALYTICAL RESULTS
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
Marston, MO

Location	Date	Detection Monitoring - USEPA Appendix III Constituents (mg/L)							Assessment Monitoring - USEPA Appendix IV Constituents (mg/L)														
		Boron, Total	Calcium, Total	Chloride	Fluoride	Sulfate	pH (lab) (SU)	TDS	Antimony, Total	Arsenic, Total	Beryllium, Total	Barium, Total	Cadmium, Total	Chromium, Total	Cobalt, Total	Lead, Total	Lithium, Total	Molybdenum, Total	Selenium, Total	Thallium, Total	Mercury, Total	Fluoride	Radium-226 & 228, Combined (pCi/L)
MW-8	11/4/2016	**17.4**	**233**	**7**	**0.29**	**419**	**6.99**	**1030**	< 0.0010	**0.0040**	< 0.0010	**0.115**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0197**	**0.737**	< 0.0010	< 0.0010	< 0.00020	**0.29**	1.36 +/- 2.05
	12/7/2016	**19.8**	**235**	**6**	**0.29**	**443**	**7.09**	**1050**	< 0.0010	**0.0026**	< 0.0010	**0.111**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0223**	**0.706**	< 0.0010	< 0.0010	< 0.00020	**0.29**	**1.485 +/- 0.903 (1.46)**
	1/5/2017	**12**	**140**	**12**	**0.366**	**230**	**7.59**	**570**	< 0.0030	**0.0046**	< 0.0010	**0.066**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.023**	**0.960**	< 0.0010	< 0.0010	< 0.00020	**0.366**	0.426 +/- 0.725 (1.575)
	1/5/2017	**12**	**120**	**12**	**0.367**	**220**	**7.52**	**550**	< 0.0030	**0.0049**	< 0.0010	**0.068**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.023**	**0.96**	< 0.0010	< 0.0010	< 0.00020	**0.367**	2.824 +/- 1.24 (1.43)
	1/26/2017	**12**	**130**	**12**	**0.538**	**300**	**7.80**	**690**	< 0.0030	**0.0045**	< 0.0010	**0.085**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.022**	**0.87**	< 0.0010	< 0.0010	< 0.00020	**0.538**	0.613 +/- 0.977 (2.04)
	2/21/2017	**14**	**190**	**9.6**	**0.288**	**320**	**7.11**	**840**	< 0.0030	**0.0057**	< 0.0010	**0.10**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.025**	**0.83**	< 0.0010	< 0.0010	< 0.00020	**0.288**	**2.291 +/- 1.291 (1.88)**
	3/30/2017	**15**	**180**	**8.8**	**0.475**	**360**	**7.03**	**940**	< 0.0030	**0.0054**	< 0.0010	**0.11**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.025**	**0.83**	< 0.0010	< 0.0010	< 0.00020	**0.475**	**1.354 +/- 0.798 (1.2)**
	4/26/2017	**14**	**160**	**11**	**0.300**	**270**	**7.26**	**660**	< 0.0030	**0.0050**	< 0.0010	**0.082**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.018**	**1.0**	< 0.0010	< 0.0010	< 0.00020	**0.300**	1.0124 +/- 0.666 (1.149)
	5/17/2017	**14**	**150**	**9.5**	**0.348**	**300**	**7.12**	**740**	< 0.0030	**0.0062**	< 0.0010	**0.098**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.022**	**1.2**	< 0.0010	< 0.0010	< 0.00020	**0.348**	**1.426 +/- 0.721 (0.966)**
	6/21/2017	**15**	**170**	**9.5**	**0.361**	**340**	**7.23**	**720**	< 0.0030	**0.0060**	< 0.0010	**0.10**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.022**	**0.93**	< 0.0010	< 0.0010	< 0.00020	**0.361**	1.421 +/- 0.963 (1.478)
	8/16/2017	**14**	**160**	**9.1**	**0.376**	**330**	**7.15**	**700**	< 0.0030	**0.0048**	< 0.0010	**0.10**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.025**	**1.0**	< 0.0010	< 0.0010	< 0.00020	**0.376**	0.913 +/- 1.158 (2.154)
	2/5/2018	**20**	**200**	**7.6**	**0.392**	**400**	**7.64**	**1000**	< 0.0030	**0.0066**	< 0.0010	**0.12**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.019**	**1.0**	< 0.0010	< 0.0010	< 0.00020	**0.392**	**1.35 +/- 0.902 (1.05)**
	3/15/2018	**12**	**120**	**10**	**0.354**	**180**	**7.32**	**540**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3/15/2018	**12**	**120**	**12**	**0.344**	**180**	**7.35**	**580**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5/30/2018	-	-	-	**0.343**	-	-	-	< 0.0030	**0.0053**	< 0.0010	**0.082**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.017**	**0.93**	< 0.0010	< 0.0010	< 0.00020	**0.343**	1.07 +/- 0.816 (1.51)
	9/12/2018	**16**	**180**	**10**	**0.290**	**320**	**7.20**	**700**	-	**0.0045**	-	**0.082**	-	< 0.0040	**0.0016**	< 0.0010	**0.012**	**0.86**	< 0.0010	-	-	**0.290**	0.840 +/- 0.855 (1.47)
	10/24/2018	**15**	**170**	**9.2**	**0.400**	**290**	**7.48**	**680**	< 0.0030	**0.0052**	< 0.0010	**0.080**	< 0.00089	< 0.0040	**0.00086**	< 0.0010	**0.016**	**0.92**	< 0.0010	< 0.0010	< 0.00020	**0.400**	1.08 +/- 0.906 (1.55)
	12/3/2018	**15**	**170**	**9.6**	**0.354**	**300**	**7.22**	**740**	< 0.0030	**0.0054**	< 0.0010	**0.082**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.021**	**0.92**	< 0.0010	< 0.0010	< 0.00020	**0.354**	1.27 +/- 0.947 (1.57)
	12/4/2018	**15**	**170**	**12**	**0.412**	**310**	**7.14**	**770**	< 0.0030	**0.0055**	< 0.0010	**0.083**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.018**	**0.93**	< 0.0010	< 0.0010	< 0.00020	**0.412**	0.387 +/- 0.807 (1.58)
	12/17/2018	**14**	**170**	**9.6**	**0.447**	**340**	**7.37**	**860**	< 0.0030	**0.0059**	< 0.0010	**0.089**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.021**	**0.99**	< 0.0010	< 0.0010	< 0.00020	**0.447**	0.264 +/- 0,782 (1.60)
	1/7/2019	**16**	**200**	**9.0**	**0.404**	**360**	**7.15**	**960**	< 0.0030	**0.0063**	< 0.0010	**0.098**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.016**	**1.0**	< 0.0010	< 0.0010	< 0.00020	**0.404**	**1.44 +/- 0.723 (0.965)**
	1/15/2019	**17**	**200**	**9.2**	**0.355**	**400**	**7.09**	**1000**	< 0.0030	**0.0060**	< 0.0010	**0.097**	< 0.00089	< 0.0040	< 0.00086	**0.0024**	**0.016**	**0.91**	< 0.0010	< 0.0010	< 0.00020	**0.355**	0.890 +/- 0.859 (1.51)
	1/22/2019	**18**	**200**	**9.6**	< 0.250	**380**	**7.12**	**940**	< 0.0030	**0.0062**	< 0.0010	**0.10**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.016**	**0.88**	< 0.0010	< 0.0010	< 0.00020	< 0.250	**1.81 +/- 0.948 (1.31)**
	2/22/2019	**26**	**170**	**5.9**	**0.305**	**410**	**7.18**	**1000**	< 0.0030	**0.0071**	< 0.0010	**0.12**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.017**	**1.1**	< 0.0010	< 0.0010	< 0.00020	**0.305**	1.51 +/- 0.973 (1.60)
	3/5/2019	**30**	**240**	**6.5**	**0.386**	**360**	**7.24**	**950**	< 0.0030	**0.016**	**0.0027**	**0.14**	**0.0067**	**0.0070**	**0.0036**	**0.014**	**0.020**	**1.1**	**0.0069**	**0.0061**	< 0.00020	**0.386**	1.05 +/- 0.949 (1.65)
	3/8/2019	**29**	**190**	**6.0**	**0.311**	**380**	**7.18**	**1000**	< 0.0030	**0.0080**	< 0.0010	**0.13**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.018**	**1.1**	< 0.0010	< 0.0010	< 0.00020	**0.311**	1.09 +/- 1.19 (1.95)
	6/7/2019	-	-	-	**0.330**	-	-	-	< 0.0030	**0.0071**	< 0.0010	**0.11**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.033**	**1.5**	< 0.0010	< 0.0010	< 0.00020	**0.330**	**1.42 +/- 0.675 (0.721)**
	9/3/2019	**22**	**120**	**7.2**	**0.408**	**380**	**7.18**	**1000**	-	**0.0048**	-	**0.11**	< 0.00089	< 0.0040	**0.0016**	< 0.0010	**0.027**	**0.92**	< 0.0010	-	-	**0.408**	0.969 +/- 0.982 (1.71)
	10/4/2019	**17**	**220**	**7.4**	**0.355**	**380**	**7.07**	**920**	-	**0.0044**	-	**0.098**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.021**	**0.93**	< 0.0010	-	-	**0.355**	0.341 +/- 1.12 (2.39)
	10/16/2019	**18**	**220**	**8.3**	**0.288**	**380**	**7.27**	**1000**	-	**0.0044**	-	**0.089**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.021**	**0.94**	< 0.0010	-	-	**0.288**	1.03 +/- 1.06 (1.89)
	11/6/2019	**17**	**230**	**8.9**	**0.305**	**370**	**6.81**	**1000**	-	**0.0050**	-	**0.10**	< 0.00089	< 0.0040	**0.0017**	< 0.0010	**0.021**	**0.93**	< 0.0010	-	-	**0.305**	1.32 +/- 0.848 (1.54)
	12/17/2019	**14**	**170**	**9.6**	**0.447**	**340**	**7.37**	**860**	< 0.0030	**0.0059**	< 0.0010	**0.089**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.021**	**0.99**	< 0.0010	< 0.0010	< 0.00020	**0.447**	0.264 +/- 0.782 (1.60)
	12/19/2019	-	-	-	-	-	-	-	< 0.0030	**0.0045**	< 0.0010	**0.095**	< 0.00089	< 0.0040	**0.0018**	< 0.0010	**0.029**	**0.87**	< 0.0010	< 0.0010	< 0.00020	-	0.852 +/- 0.823 (1.43)
	2/19/2020	**33**	**210**	**5.7**	**0.289**	**290**	**7.21**	**880**	-	**0.0064**	-	**0.097**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.024**	**1.5**	< 0.0010	-	-	**0.289**	0.902 +/- 0.689 (1.21)
	5/20/2020	-	-	-	-	-	-	-	<0.0030	**0.0045**	<0.0010	**0.093**	<0.00089	<0.0040	**0.0022**	<0.0010	**0.020**	**1.1**	<0.0010	<0.0010	<0.00020	<0.250	1.10 +/- 0.830 (1.48)
	5/20/2020	-	-	-	-	-	-	-	<0.0030	**0.0046**	<0.0010	**0.095**	<0.00089	<0.0040	**0.0013**	<0.0010	**0.020**	**1.0**	<0.0010	**0.0014**	<0.00020	<0.250	0.676 +/- 0.732 (1.39)

Appendix E
SUMMARY OF ANALYTICAL RESULTS
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
Marston, MO

Location	Date	Detection Monitoring - USEPA Appendix III Constituents (mg/L)							Assessment Monitoring - USEPA Appendix IV Constituents (mg/L)														
		Boron, Total	Calcium, Total	Chloride	Fluoride	Sulfate	pH (lab) (SU)	TDS	Antimony, Total	Arsenic, Total	Beryllium, Total	Barium, Total	Cadmium, Total	Chromium, Total	Cobalt, Total	Lead, Total	Lithium, Total	Molybdenum, Total	Selenium, Total	Thallium, Total	Mercury, Total	Fluoride	Radium-226 & 228, Combined (pCi/L)
MW-9	11/4/2016	**2.26**	**123**	**17**	**0.53**	**108**	**7.15**	**534**	< 0.0010	< 0.0010	< 0.0010	**0.0984**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0258**	**0.312**	< 0.0010	< 0.0010	< 0.00020	**0.53**	**3.12 +/- 1.09**
	12/7/2016	**3.08**	**119**	**16**	**0.49**	**109**	**7.22**	**476**	< 0.0010	< 0.0010	< 0.0010	**0.0842**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0296**	**0.337**	**0.0015**	< 0.0010	< 0.00020	**0.49**	**2.19 +/- 0.982 (1.395)**
	1/5/2017	**2.80**	**82**	**16**	**0.508**	**110**	**7.55**	**400**	< 0.0030	< 0.0010	< 0.0010	**0.075**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.034**	**0.320**	< 0.0010	< 0.0010	< 0.00020	**0.508**	**1.555 +/- 0.77 (0.78)**
	1/27/2017	**2.4**	**82**	**17**	**0.557**	**120**	**8.13**	**420**	< 0.0030	< 0.0010	< 0.0010	**0.072**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.030**	**0.35**	< 0.0010	< 0.0010	< 0.00020	**0.557**	0.530 +/- 0.803 (1.665)
	2/21/2017	**2.5**	**120**	**17**	**0.481**	**96**	**7.29**	**500**	< 0.0030	< 0.0010	< 0.0010	**0.089**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.031**	**0.33**	< 0.0010	< 0.0010	< 0.00020	**0.481**	**1.47 +/- 0.781 (1.13)**
	3/30/2017	**2.2**	**100**	**18**	**0.654**	**110**	**7.15**	**490**	< 0.0030	< 0.0010	< 0.0010	**0.080**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.030**	**0.33**	< 0.0010	< 0.0010	< 0.00020	**0.654**	**1.423 +/- 0.882 (1.396)**
	4/26/2017	**1.9**	**90**	**17**	**0.481**	**97**	**7.50**	**400**	< 0.0030	< 0.0010	< 0.0010	**0.069**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.025**	**0.42**	< 0.0010	< 0.0010	< 0.00020	**0.481**	1.052 +/- 0.701 (1.096)
	5/17/2017	**2.1**	**100**	**19**	< 0.250	**97**	**7.27**	**480**	< 0.0030	< 0.0010	< 0.0010	**0.098**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.034**	**0.44**	< 0.0010	< 0.0010	< 0.00020	< 0.250	**1.296 +/- 0.695 (0.976)**
	6/20/2017	**2.0**	**100**	**17**	**0.507**	**110**	**7.33**	**540**	< 0.0030	< 0.0010	< 0.0010	**0.092**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.029**	**0.36**	< 0.0010	< 0.0010	< 0.00020	**0.507**	0.709 +/- 0.885 (1.45)
	6/20/2017	**2.0**	**100**	**18**	**0.528**	**110**	**7.34**	**460**	< 0.0030	< 0.0010	< 0.0010	**0.092**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.030**	**0.35**	< 0.0010	< 0.0010	< 0.00020	**0.528**	0.4584 +/- 0.74 (1.361)
	8/16/2017	**2.2**	**120**	**16**	**0.561**	**110**	**7.23**	**430**	< 0.0030	< 0.0010	< 0.0010	**0.097**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.035**	**0.35**	< 0.0010	< 0.0010	< 0.00020	**0.561**	0.977 +/- 0.86 (1.513)
	3/15/2018	**2.1**	**110**	**20**	**0.386**	**100**	**7.41**	**410**	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.386**	-
	5/30/2018	-	-	-	**0.496**	-	-	-	< 0.0030	< 0.0010	< 0.0010	**0.089**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.026**	**0.34**	< 0.0010	< 0.0010	< 0.00020	**0.496**	0.599+/- 0.700 (1.38)
	9/12/2018	**2.4**	**110**	**20**	**0.440**	**110**	**7.34**	**470**	-	< 0.0010	-	**0.074**	-	< 0.0040	< 0.00086	< 0.0010	**0.021**	**0.34**	< 0.0010	-	-	**0.440**	0.216 +/- 0.875 (1.80)
	10/25/2018	**2.3**	**110**	**19**	**0.567**	**110**	**7.42**	**440**	< 0.0030	< 0.0010	< 0.0010	**0.071**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.024**	**0.34**	< 0.0010	< 0.0010	< 0.00020	**0.567**	0.466 +/- 0.708 (1.39)
	12/3/2018	**2.8**	**110**	**21**	**0.456**	**110**	**7.22**	**440**	< 0.0030	< 0.0010	< 0.0010	**0.076**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.029**	**0.35**	< 0.0010	< 0.0010	< 0.00020	**0.456**	0.635 +/- 0.846 (1.59)
	12/17/2018	**2.3**	**110**	**35**	**0.538**	**110**	**7.51**	**540**	< 0.0030	< 0.0010	< 0.0010	**0.077**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.030**	**0.35**	< 0.0010	< 0.0010	< 0.00020	**0.538**	0.906 +/- 0.898 (1.58)
	12/18/2018	**2.2**	**110**	**34**	**0.544**	**110**	**7.48**	**620**	< 0.0030	< 0.0010	< 0.0010	**0.078**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.030**	**0.35**	< 0.0010	< 0.0010	< 0.00020	**0.544**	0.790 +/- 0.945 (1.74)
	1/7/2019	**2.5**	**120**	**22**	**0.467**	**100**	**7.19**	**520**	< 0.0030	< 0.0010	< 0.0010	**0.082**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.025**	**0.33**	< 0.0010	< 0.0010	< 0.00020	**0.467**	0.931 +/- 0.695 (1.12)
	1/15/2019	**2.2**	**110**	**24**	**0.435**	**100**	**7.13**	**560**	< 0.0030	< 0.0010	< 0.0010	**0.074**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.023**	**0.30**	< 0.0010	< 0.0010	< 0.00020	**0.435**	1.05 +/- 0.901 (1.56)
	1/21/2019	**2.2**	**110**	**24**	**0.378**	**96**	**7.32**	**590**	< 0.0030	< 0.0010	< 0.0010	**0.077**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.022**	**0.33**	< 0.0010	< 0.0010	< 0.00020	**0.378**	**1.51+/- 0.834 (1.25)**
	1/22/2019	**2.0**	**110**	**23**	**0.382**	**100**	**7.39**	**510**	< 0.0030	< 0.0010	< 0.0010	**0.075**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.022**	**0.32**	< 0.0010	< 0.0010	< 0.00020	**0.382**	**1.57 +/- 0.818 (1.14)**
	2/5/2019	**2.5**	**110**	**24**	**0.399**	**100**	**7.57**	**540**	< 0.0030	< 0.0010	< 0.0010	**0.082**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.027**	**0.32**	< 0.0010	< 0.0010	< 0.00020	**0.399**	0.849 +/- 0.718 (1.22)
	2/22/2019	**2.5**	**92**	**21**	**0.361**	**100**	**7.24**	**540**	< 0.0030	< 0.0010	< 0.0010	**0.088**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.027**	**0.30**	< 0.0010	< 0.0010	< 0.00020	**0.361**	0.512 +/- 0.652 (1.29)
	3/5/2019	**2.7**	**120**	**21**	**0.483**	**100**	**7.32**	**520**	< 0.0030	< 0.0010	< 0.0010	**0.088**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.028**	**0.31**	< 0.0010	< 0.0010	< 0.00020	**0.483**	1.02 +/- 0.896 (1.55)
	3/5/2019	**2.5**	**130**	**22**	**0.467**	**100**	**7.25**	**540**	< 0.0030	< 0.0010	< 0.0010	**0.087**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.028**	**0.32**	< 0.0010	< 0.0010	< 0.00020	**0.467**	0.867 +/- 0.763 (1.35)
	3/11/2019	**3.0**	**120**	**20**	**0.426**	**100**	**7.15**	**500**	< 0.0030	< 0.0010	< 0.0010	**0.082**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.026**	**0.31**	< 0.0010	< 0.0010	< 0.00020	**0.426**	0.895 +/- 0.914 (1.80)
	6/7/2019	-	-	-	**0.429**	-	-	-	< 0.0030	< 0.0010	< 0.0010	**0.084**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.040**	**0.29**	< 0.0010	< 0.0010	< 0.00020	**0.429**	**1.13 +/- 0.711 (1.01)**
	9/3/2019	**2.2**	**110**	**20**	**0.533**	**100**	**7.32**	**520**	-	< 0.0010	-	**0.078**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.026**	**0.30**	< 0.0010	-	-	**0.533**	0.629 +/- 0.872 (1.64)
	10/4/2019	**2.4**	**120**	**24**	**0.573**	**99**	**7.14**	**450**	-	< 0.0010	-	**0.077**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.028**	**0.29**	< 0.0010	-	-	**0.573**	0.167 +/- 1.08 (2.32)
	10/16/2019	**2.7**	**120**	**20**	**0.358**	**95**	**7.34**	**510**	-	< 0.0010	-	**0.071**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.029**	**0.30**	< 0.0010	-	-	**0.358**	1.04 +/- 0.783 (0.978)
	11/6/2019	**2.5**	**110**	**19**	**0.472**	**97**	**6.76**	**490**	-	< 0.0010	-	**0.078**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.029**	**0.30**	< 0.0010	-	-	**0.472**	0.614 +/- 0.760 (1.52)
	12/17/2019	**2.3**	**110**	**35**	**0.538**	**110**	**7.51**	**540**	< 0.0030	< 0.0010	< 0.0010	**0.077**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.030**	**0.35**	< 0.0010	< 0.0010	< 0.00020	**0.538**	0.906 +/- 0.898 (1.58)
	12/18/2019	-	-	-	-	-	-	-	< 0.0030	< 0.0010	< 0.0010	**0.080**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.038**	**0.29**	< 0.0010	< 0.0010	< 0.00020	-	0.835 +/- 0.756 (1.35)
	2/19/2020	**2.9**	**130**	**22**	**0.380**	**100**	**7.12**	**480**	-	< 0.0010	-	**0.088**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.034**	**0.30**	< 0.0010	-	-	**0.380**	0.511 +/- 0.660 (1.39)
	5/20/2020	-	-	-	**0.499**	-	-	-	<0.0030	<0.0010	<0.0010	**0.086**	<0.00089	<0.0040	<0.00086	<0.0010	**0.029**	**0.28**	<0.0010	<0.0010	<0.00020	**0.499**	0.426 +/- 0.673 (1.37)

Appendix E
SUMMARY OF ANALYTICAL RESULTS
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
Marston, MO

Location	Date	Detection Monitoring - USEPA Appendix III Constituents (mg/L)							Assessment Monitoring - USEPA Appendix IV Constituents (mg/L)														
		Boron, Total	Calcium, Total	Chloride	Fluoride	Sulfate	pH (lab) (SU)	TDS	Antimony, Total	Arsenic, Total	Beryllium, Total	Barium, Total	Cadmium, Total	Chromium, Total	Cobalt, Total	Lead, Total	Lithium, Total	Molybdenum, Total	Selenium, Total	Thallium, Total	Mercury, Total	Fluoride	Radium-226 & 228, Combined (pCi/L)
MW-16	11/2/2016	**0.0425**	**157**	**11**	**1.22**	**118**	**6.82**	**516**	< 0.0010	**0.0026**	< 0.0010	**0.773**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0263**	< 0.010	< 0.0010	< 0.0010	< 0.00020	**1.22**	**1.85 +/- 0.91**
	12/9/2016	**0.0431**	**154**	**15**	**1.37**	**107**	**6.89**	**630**	< 0.0010	**0.0029**	< 0.0010	**0.783**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0274**	< 0.010	< 0.0010	< 0.0010	< 0.00020	**1.37**	**0.98 +/- 0.64**
	1/7/2017	**0.039**	**130**	**13**	**1.10**	**120**	**7.58**	**580**	< 0.0030	**0.0027**	< 0.0010	**0.800**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.033**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.10**	**2.34 +/- 1.05 (1.165)**
	1/30/2017	**0.037**	**130**	**11**	**1.55**	**120**	**7.40**	**570**	< 0.0030	**0.0026**	< 0.0010	**0.73**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.030**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.55**	**1.777 +/- 1.093 (1.668)**
	2/21/2017	**0.051**	**150**	**12**	**1.18**	**95**	**6.91**	**560**	< 0.0030	**0.0025**	< 0.0010	**0.76**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.031**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.18**	1.094 +/- 0.728 (1.32)
	3/28/2017	**0.047**	**130**	**11**	**1.44**	**100**	**6.88**	**580**	< 0.0030	**0.0025**	< 0.0010	**0.76**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.031**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.44**	**2.332 +/- 0.978 (1.216)**
	4/27/2017	**0.060**	**150**	**12**	**1.38**	**93**	**6.97**	**560**	< 0.0030	**0.0025**	< 0.0010	**0.76**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.030**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.38**	**1.843 +/- 0.862 (1.087)**
	5/18/2017	**0.046**	**150**	**13**	**1.59**	**97**	**6.88**	**600**	< 0.0030	**0.0027**	< 0.0010	**0.75**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.033**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.59**	**1.934 +/- 0.991 (1.312)**
	6/24/2017	**0.036**	**130**	**11**	**1.18**	**110**	**7.02**	**490**	< 0.0030	**0.0020**	< 0.0010	**0.72**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.030**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.18**	**1.787 +/- 1.083 (1.687)**
	8/15/2017	**0.052**	**140**	**10**	**1.27**	**98**	**6.89**	**500**	< 0.0030	**0.0021**	< 0.0010	**0.70**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.033**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.27**	1.396 +/- 1.106 (1.858)
	3/15/2018	**0.054**	**140**	**12**	**1.45**	**84**	**7.03**	**580**	-	-	-	-	-	-	-	-	-	-	-	-	-	**1.45**	-
	3/15/2018	**0.049**	**140**	**12**	**1.45**	**84**	**7.03**	**570**	-	-	-	-	-	-	-	-	-	-	-	-	-	**1.45**	-
	5/30/2018	-	-	-	**1.20**	-	-	-	< 0.0030	**0.0020**	< 0.0010	**0.72**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.025**	**0.0045**	< 0.0010	< 0.0010	< 0.00020	**1.20**	**2.60 +/- 1.10 (1.46)**
	9/12/2018	**0.051**	**150**	**16**	**1.20**	**73**	**6.99**	**400**	-	**0.0023**	-	**0.69**	-	< 0.0040	< 0.00086	< 0.0010	**0.019**	< 0.0010	< 0.0010	-	-	**1.20**	**2.78 +/- 1.35 (1.70)**
	10/25/2018	**0.034**	**140**	**14**	**1.22**	**67**	**7.10**	**510**	< 0.0030	**0.0021**	< 0.0010	**0.65**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.024**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.22**	**2.30 +/- 1.02 (1.30)**
	12/4/2018	**0.052**	**130**	**11**	**1.72**	**74**	**7.04**	**500**	< 0.0030	**0.0024**	< 0.0010	**0.61**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.027**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.72**	1.27 +/- 0.878 (1.41)
	12/17/2018	**0.067**	**130**	**11**	**1.65**	**120**	**7.25**	**560**	< 0.0030	**0.0022**	< 0.0010	**0.65**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.029**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.65**	0.752 +/- 0.772 (1.25)
	1/7/2019	**0.050**	**140**	**12**	**1.66**	**87**	**7.00**	**540**	< 0.0030	**0.0028**	< 0.0010	**0.67**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.021**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.66**	**1.46 +/- 0.694 (0.742)**
	1/15/2019	**0.071**	**140**	**12**	**1.71**	**95**	**6.97**	**580**	< 0.0030	**0.0022**	< 0.0010	**0.63**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.022**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.71**	**2.64 +/- 1.10 (0.855)**
	1/21/2019	**0.080**	**140**	**13**	**1.41**	**100**	**7.04**	**680**	< 0.0030	**0.0021**	< 0.0010	**0.65**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.023**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.41**	**2.37 +/- 1.01 (1.24)**
	2/9/2019	**0.082**	**130**	**15**	< 2.50	**99**	**6.98**	**690**	< 0.0030	**0.0018**	< 0.0010	**0.65**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.024**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	< 2.50	**1.91 +/- 1.20 (1.80)**
	2/22/2019	**0.055**	**120**	**13**	**1.67**	**90**	**7.12**	**520**	< 0.0030	**0.0024**	< 0.0010	**0.66**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.021**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.67**	**1.77+/- 1.06 (1.68)**
	2/22/2019	**0.052**	**120**	**14**	**1.68**	**92**	**7.01**	**520**	< 0.0030	**0.0023**	< 0.0010	**0.65**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.021**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.68**	1.45 +/- 1.20 (1.93)
	3/5/2019	**0.070**	**130**	**14**	**1.78**	**88**	**7.09**	**600**	< 0.0030	**0.0022**	< 0.0010	**0.63**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.023**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.78**	**1.47 +/- 0.937 (1.39)**
	3/7/2019	**0.078**	**130**	**14**	**1.71**	**85**	**7.08**	**570**	< 0.0030	**0.0023**	< 0.0010	**0.61**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.021**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.71**	0.225 +/- 0.901 (1.92)
	6/5/2019	-	-	-	**1.52**	-	-	-	< 0.0030	**0.0024**	< 0.0010	**0.56**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.024**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.52**	**2.09 +/- 1.02 (1.39)**
	8/28/2019	**0.046**	**120**	**16**	**1.69**	**73**	**7.19**	**520**	-	**0.0024**	-	**0.63**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.029**	< 0.0010	< 0.0010	-	-	**1.69**	**3.08 +/- 1.25 (1.67)**
	10/3/2019	**0.21**	**130**	**16**	**1.66**	**70**	**6.94**	**490**	-	**0.0022**	-	**0.65**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.025**	< 0.0010	< 0.0010	-	-	**1.66**	0.0972 +/- 0.959 (2.11)
	10/16/2019	**0.065**	**130**	**13**	**1.43**	**68**	**7.12**	**470**	-	**0.0020**	-	**0.58**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.026**	< 0.0010	< 0.0010	-	-	**1.43**	1.39 +/- 1.23 (2.08)
	11/9/2019	**0.056**	**120**	**14**	**1.47**	**75**	**7.22**	**520**	-	**0.0024**	-	**0.65**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.026**	< 0.0010	< 0.0010	-	-	**1.47**	0.809 +/- 0.659 (0.955)
	12/17/2019	**0.067**	**130**	**83**	**1.65**	**120**	**7.25**	**560**	< 0.0030	**0.0022**	< 0.0010	**0.65**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.029**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	**1.65**	0.752 +/- 0.772 (1.25)
	12/19/2019	-	-	-	-	-	-	-	< 0.0030	**0.0022**	< 0.0010	**0.59**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.031**	< 0.0010	< 0.0010	< 0.0010	< 0.00020	-	0.991 +/- 0.876 (1.50)
	2/21/2020	**0.064**	**120**	**13**	**1.68**	**56**	**7.08**	**510**	-	**0.0024**	-	**0.56**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.030**	< 0.0010	< 0.0010	-	-	**1.68**	**1.26 +/- 0.793 (1.19)**
	5/19/2020	-	-	-	**1.52**	-	-	-	<0.0030	**0.0021**	<0.0010	**0.53**	<0.00089	<0.0040	<0.00086	<0.0010	**0.022**	<0.0010	<0.0010	<0.0010	<0.00020	**1.52**	1.31 +/- 0.928 (1.61)

Appendix E
SUMMARY OF ANALYTICAL RESULTS
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
Marston, MO

Location	Date	Detection Monitoring - USEPA Appendix III Constituents (mg/L)							Assessment Monitoring - USEPA Appendix IV Constituents (mg/L)														
		Boron, Total	Calcium, Total	Chloride	Fluoride	Sulfate	pH (lab) (SU)	TDS	Antimony, Total	Arsenic, Total	Beryllium, Total	Barium, Total	Cadmium, Total	Chromium, Total	Cobalt, Total	Lead, Total	Lithium, Total	Molybdenum, Total	Selenium, Total	Thallium, Total	Mercury, Total	Fluoride	Radium-226 & 228, Combined (pCi/L)
P-1	11/5/2016	**2.04**	**153**	**19**	**0.38**	**178**	**7.05**	**632**	< 0.0010	< 0.0010	< 0.0010	**0.0533**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0221**	**0.0194**	**0.0014**	< 0.0010	< 0.00020	**0.38**	**1.48 +/- 1.18**
	12/8/2016	**1.99**	**152**	**19**	**0.44**	**170**	**7.25**	**610**	< 0.0010	< 0.0010	< 0.0010	**0.0552**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0248**	**0.0506**	< 0.0010	< 0.0010	< 0.00020	**0.44**	-
	12/8/2016	**1.92**	**145**	**18**	**0.43**	**157**	**7.19**	**610**	< 0.0010	< 0.0010	< 0.0010	**0.0534**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0240**	**0.0378**	< 0.0010	< 0.0010	< 0.00020	**0.43**	0.968 +/- 0.977 (1.68)
	1/6/2017	**2.00**	**140**	**20**	**0.552**	**180**	**7.76**	**540**	< 0.0030	< 0.0010	< 0.0010	**0.051**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.028**	**0.034**	< 0.0010	< 0.0010	< 0.00020	**0.552**	**1.29 +/- 0.805 (1.28)**
	1/28/2017	**1.9**	**130**	**20**	**0.516**	**220**	**7.68**	**560**	< 0.0030	< 0.0010	< 0.0010	**0.053**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.029**	**0.024**	**0.0062**	< 0.0010	< 0.00020	**0.516**	0.626 +/- 0.792 (1.64)
	2/21/2017	**1.8**	**170**	**17**	**0.364**	**220**	**7.24**	**720**	< 0.0030	< 0.0010	< 0.0010	**0.065**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.029**	**0.013**	**0.0051**	< 0.0010	< 0.00020	**0.364**	**1.275 +/- 0.699 (0.801)**
	3/30/2017	**1.7**	**160**	**15**	**0.519**	**220**	**7.04**	**760**	< 0.0030	< 0.0010	< 0.0010	**0.070**	< 0.0010	**0.018**	< 0.0020	< 0.0010	**0.030**	**0.011**	**0.0038**	< 0.0010	< 0.00020	**0.519**	**1.539 +/- 0.854 (1.313)**
	4/26/2017	**1.8**	**170**	**16**	**0.378**	**220**	**7.25**	**660**	**0.0031**	< 0.0010	< 0.0010	**0.063**	< 0.0010	**0.0051**	< 0.0020	< 0.0010	**0.026**	**0.013**	**0.0037**	< 0.0010	< 0.00020	**0.378**	0.783 +/- 0.598 (1.004)
	5/17/2017	**1.7**	**160**	**17**	< 0.250	**220**	**7.06**	**660**	< 0.0030	< 0.0010	< 0.0010	**0.068**	< 0.0010	**0.0071**	< 0.0020	< 0.0010	**0.031**	**0.015**	**0.0052**	< 0.0010	< 0.00020	< 0.250	**1.984 +/- 1.099 (1.498)**
	6/21/2017	**1.5**	**150**	**16**	**0.411**	**190**	**7.23**	**640**	< 0.0030	< 0.0010	< 0.0010	**0.062**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.027**	**0.011**	**0.0054**	< 0.0010	< 0.00020	**0.411**	1.34 +/- 0.953 (1.499)
	8/16/2017	**1.9**	**140**	**16**	**0.416**	**200**	**7.21**	**540**	< 0.0030	< 0.0010	< 0.0010	**0.055**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.030**	**0.011**	**0.0033**	< 0.0010	< 0.00020	**0.416**	0.629 +/- 0.785 (1.491)
	3/15/2018	**1.4**	**150**	**17**	**0.351**	**190**	**7.19**	**620**	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.351**	-
	5/29/2018	-	-	-	**0.420**	-	-	-	< 0.0030	< 0.0010	< 0.0010	**0.063**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.024**	**0.013**	**0.0054**	< 0.0010	< 0.00020	**0.420**	0.764 +/- 0.830 (1.49)
	9/12/2018	**1.6**	**160**	**18**	**0.340**	**160**	**7.22**	**520**	-	< 0.0010	-	**0.059**	-	**0.0071**	< 0.00086	< 0.0010	**0.020**	**0.023**	**0.0044**	-	-	**0.340**	0.663 +/- 0.834 (1.62)
	3/7/2019	**1.5**	**140**	**16**	**0.398**	**170**	**7.30**	**600**	< 0.0030	< 0.0010	< 0.0010	**0.066**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.020**	**0.013**	**0.0022**	< 0.0010	< 0.00020	**0.398**	0.733 +/- 0.989 (1.85)
	6/5/2019	-	-	-	-	-	-	-	< 0.0030	< 0.0010	< 0.0010	**0.074**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.025**	**0.016**	**0.0044**	< 0.0010	< 0.00020	**0.497**	**1.22 +/- 0.793 (1.13)**
	6/5/2019	-	-	-	-	-	-	-	< 0.0030	< 0.0010	< 0.0010	**0.072**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.028**	**0.017**	**0.0044**	< 0.0010	< 0.00020	**0.512**	**1.82 +/- 1.10 (1.72)**
	9/3/2019	**2.1**	**120**	**16**	**0.509**	**140**	**7.25**	**590**	-	< 0.0010	-	**0.064**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.028**	**0.014**	< 0.0010	-	-	**0.509**	1.45 +/- 0.907 (1.54)
	9/5/2019	**1.9**	**140**	**17**	**0.504**	**140**	**7.25**	**610**	-	< 0.0010	-	**0.063**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.021**	**0.016**	< 0.0010	-	-	**0.504**	0.448 +/- 0.971 (1.79)
	10/2/2019	**1.8**	**130**	**18**	**0.442**	**140**	**7.36**	**540**	-	< 0.0010	-	**0.056**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.022**	**0.014**	< 0.0010	-	-	**0.442**	0.665 +/- 0.847 (1.63)
	10/16/2019	**2.0**	**130**	**17**	**0.360**	**140**	**7.28**	**580**	-	< 0.0010	-	**0.054**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.023**	**0.014**	< 0.0010	-	-	**0.360**	0.253 +/- 1.22 (2.67)
	11/9/2019	**1.7**	**130**	**18**	**0.490**	**160**	**7.41**	**600**	-	< 0.0010	-	**0.060**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.024**	**0.018**	**0.0016**	-	-	**0.490**	0.638 +/- 0.709 (1.10)
	2/24/2020	**1.7**	**150**	**16**	**0.357**	**210**	**6.32**	**610**	-	< 0.0010	-	**0.069**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.028**	**0.016**	< 0.0010	-	-	**0.357**	0.529 +/- 0.690 (1.42)
	5/20/2020	-	-	-	-	-	-	-	<0.0030	<0.0010	<0.0010	**0.074**	<0.00089	<0.0040	<0.00086	<0.0010	**0.023**	**0.013**	**0.0020**	<0.0010	<0.00020	**0.348**	0.572 +/- 0.753 (1.54)

Appendix E
SUMMARY OF ANALYTICAL RESULTS
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
Marston, MO

Location	Date	Detection Monitoring - USEPA Appendix III Constituents (mg/L)							Assessment Monitoring - USEPA Appendix IV Constituents (mg/L)														
		Boron, Total	Calcium, Total	Chloride	Fluoride	Sulfate	pH (lab) (SU)	TDS	Antimony, Total	Arsenic, Total	Beryllium, Total	Barium, Total	Cadmium, Total	Chromium, Total	Cobalt, Total	Lead, Total	Lithium, Total	Molybdenum, Total	Selenium, Total	Thallium, Total	Mercury, Total	Fluoride	Radium-226 & 228, Combined (pCi/L)
P-2	11/4/2016	**3.18**	**181**	**17**	**0.52**	**384**	**7.03**	**816**	< 0.0010	< 0.0010	< 0.0010	**0.0963**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0188**	**0.279**	**0.0014**	< 0.0010	< 0.00020	**0.52**	0 +/- 4.36
	12/7/2016	**2.52**	**164**	**18**	**0.61**	**292**	**7.28**	**688**	< 0.0010	< 0.0010	< 0.0010	**0.0888**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0174**	**0.351**	**0.0010**	< 0.0010	< 0.00020	**0.61**	**2.898 +/- 1.35 (2.05)**
	1/5/2017	**1.6**	**110**	**21**	**0.643**	**310**	**7.55**	**560**	< 0.0030	< 0.0010	< 0.0010	**0.076**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.020**	**0.350**	< 0.0010	< 0.0010	< 0.00020	**0.643**	0.743 +/- 0.711 (1.29)
	1/28/2017	**1.7**	**130**	**19**	**0.662**	**300**	**7.62**	**620**	< 0.0030	< 0.0010	< 0.0010	**0.075**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.016**	**0.34**	**0.0011**	< 0.0010	< 0.00020	**0.662**	0.732 +/- 0.845 (1.613)
	1/28/2017	**1.7**	**130**	**21**	**0.767**	**350**	**7.75**	**650**	< 0.0030	< 0.0010	< 0.0010	**0.077**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.022**	**0.35**	< 0.0010	< 0.0010	< 0.00020	**0.767**	0.834 +/- 0.814 (1.52)
	2/21/2017	**2.4**	**160**	**18**	**0.512**	**310**	**7.23**	**770**	< 0.0030	< 0.0010	< 0.0010	**0.098**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.024**	**0.29**	**0.0012**	< 0.0010	< 0.00020	**0.512**	**1.146 +/- 0.717 (1.09)**
	3/30/2017	**2.3**	**150**	**18**	**0.679**	**320**	**7.09**	**780**	< 0.0030	< 0.0010	< 0.0010	**0.094**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.023**	**0.29**	**0.0011**	< 0.0010	< 0.00020	**0.679**	1.333 +/- 1.01 (1.697)
	4/26/2017	**2.2**	**150**	**19**	**0.566**	**310**	**7.32**	**630**	< 0.0030	< 0.0010	< 0.0010	**0.084**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.018**	**0.31**	< 0.0010	< 0.0010	< 0.00020	**0.566**	**1.007 +/- 0.599 (0.934)**
	5/17/2017	**2.1**	**130**	**19**	**0.306**	**300**	**7.20**	**660**	< 0.0030	< 0.0020	< 0.0010	**0.082**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.022**	**0.32**	< 0.0020	< 0.0010	< 0.00020	**0.306**	**0.451 +/- 0.700 (1.132)**
	6/20/2017	**2.3**	**140**	**18**	**0.534**	**310**	**7.26**	**780**	< 0.0030	**0.0010**	< 0.0010	**0.086**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.022**	**0.27**	**0.0022**	< 0.0010	< 0.00020	**0.534**	**1.471 +/- 0.847 (1.037)**
	8/16/2017	**2.7**	**160**	**14**	**0.520**	**350**	**7.18**	**680**	< 0.0030	< 0.0010	< 0.0010	**0.10**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.028**	**0.27**	**0.0014**	< 0.0010	< 0.00020	**0.520**	0.520 +/- 0.875 (1.836)
	3/15/2018	**2.0**	**170**	**19**	**0.519**	**350**	**7.33**	**800**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5/29/2018	-	-	-	**0.544**	-	-	-	< 0.0030	< 0.0010	< 0.0010	**0.096**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.020**	**0.32**	**0.0015**	< 0.0010	< 0.00020	**0.544**	1.04 +/- 1.02 (1.84)
	5/29/2018	-	-	-	**0.542**	-	-	-	< 0.0030	< 0.0010	< 0.0010	**0.095**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.019**	**0.32**	**0.0014**	< 0.0010	< 0.00020	**0.542**	0.395 +/- 0.714 (1.37)
	9/12/2018	**2.6**	**140**	**21**	**0.561**	**240**	**7.41**	**510**	-	< 0.0010	-	**0.067**	-	< 0.0040	< 0.00086	< 0.0010	< 0.010	**0.32**	< 0.0010	-	-	**0.561**	0.428 +/- 0.991 (1.94)
	9/12/2018	**2.4**	**120**	**20**	**0.555**	**250**	**7.40**	**540**	-	< 0.0010	-	**0.065**	-	< 0.0040	< 0.00086	< 0.0010	**0.011**	**0.32**	< 0.0010	-	-	**0.555**	0.816 +/- 0.804 (1.03)
	3/7/2019	**2.5**	**130**	**18**	**0.559**	**220**	**7.51**	**640**	< 0.0030	< 0.0010	< 0.0010	**0.070**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.016**	**0.29**	**0.0016**	< 0.0010	< 0.00020	**0.559**	1.08 +/- 0.967 (1.68)
	6/5/2019	-	-	-	-	-	-	-	< 0.0030	< 0.0010	< 0.0010	**0.076**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.027**	**0.27**	**0.0015**	< 0.0010	< 0.00020	**0.540**	0.728 +/- 0.779 (1.39)
	9/3/2019	**3.4**	**130**	**17**	**0.549**	**220**	**7.32**	**680**	-	< 0.0010	-	**0.084**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.028**	**0.24**	**0.0020**	-	-	**0.549**	1.26 +/- 0.884 (1.64)
	10/2/2019	**3.1**	**140**	**17**	**0.496**	**280**	**7.42**	**660**	-	< 0.0010	-	**0.074**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.021**	**0.26**	< 0.0010	-	-	**0.496**	0.926 +/- 0.875 (1.55)
	10/16/2019	**3.0**	**150**	**15**	**0.394**	**320**	**7.38**	**720**	-	< 0.0010	-	**0.073**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.020**	**0.26**	< 0.0010	-	-	**0.394**	0.493 +/- 1.01 (1.97)
	11/9/2019	**2.7**	**140**	**17**	**0.553**	**350**	**7.51**	**760**	-	< 0.0010	-	**0.080**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.020**	**0.25**	< 0.0010	-	-	**0.553**	**1.16 +/- 0.735 (0.971)**
	2/24/2020	**2.7**	**150**	**16**	**0.408**	**280**	**7.43**	**650**	-	< 0.0010	-	**0.079**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.024**	**0.27**	< 0.0010	-	-	**0.408**	0.302 +/- 0.615 (1.29)
	5/20/2020	-	-	-	-	-	-	-	<0.0030	<0.0010	<0.0010	**0.077**	<0.00089	<0.0040	<0.00086	<0.0010	**0.019**	**0.27**	<0.0010	<0.0010	<0.00020	**0.476**	0.271 +/- 0.754 (1.58)
P-3	11/4/2016	**8.83**	**179**	**15**	**0.36**	**138**	**6.91**	**712**	< 0.0010	< 0.0010	< 0.0010	**0.102**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0250**	**1.28**	**0.0041**	< 0.0010	< 0.00020	**0.36**	0.29 +/- 1.19
	12/7/2016	**12.8**	**191**	**11**	**0.48**	**155**	**7.03**	**750**	< 0.0010	< 0.0010	< 0.0010	**0.111**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0285**	**1.56**	**0.0080**	< 0.0010	< 0.00020	**0.48**	**0.142 +/- 0.727 (1.03)**
	1/5/2017	**13.0**	**150**	**15**	**0.481**	**190**	**7.29**	**680**	< 0.0030	< 0.0010	< 0.0010	**0.098**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.033**	**1.4**	**0.0046**	< 0.0010	< 0.00020	**0.481**	0.7151 +/- 0.686 (0.856)
	1/28/2017	**11**	**140**	**13**	**0.463**	**160**	**7.86**	**610**	< 0.0030	< 0.0010	< 0.0010	**0.10**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.027**	**1.3**	**0.0029**	< 0.0010	< 0.00020	**0.463**	0.771 +/- 0.824 (1.48)
	2/21/2017	**9.3**	**170**	**17**	**0.381**	**130**	**7.13**	**640**	< 0.0030	< 0.0010	< 0.0010	**0.10**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.030**	**1.2**	**0.0042**	< 0.0010	< 0.00020	**0.381**	**1.40 +/- 0.855 (0.542)**
	3/30/2017	**8.9**	**160**	**14**	**0.591**	**140**	**6.95**	**700**	< 0.0030	< 0.0010	< 0.0010	**0.10**	< 0.0010	< 0.0040	< 0.0020	**0.0047**	**0.030**	**1.1**	**0.0048**	< 0.0010	< 0.00020	**0.591**	0.15 +/- 0.68 (1.56)
	3/30/2017	**8.7**	**150**	**14**	**0.588**	**140**	**6.96**	**710**	< 0.0030	< 0.0010	< 0.0010	**0.10**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.030**	**1.1**	**0.0045**	< 0.0010	< 0.00020	**0.588**	0.766 +/- 0.808 (1.52)
	4/26/2017	**12**	**190**	**14**	**0.463**	**150**	**7.19**	**660**	< 0.0030	< 0.0010	< 0.0010	**0.10**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.027**	**1.4**	**0.0036**	< 0.0010	< 0.00020	**0.463**	0.487 +/- 0.614 (1.147)
	5/17/2017	**7.8**	**140**	**16**	< 0.250	**130**	**7.00**	**640**	< 0.0030	< 0.0010	< 0.0010	**0.093**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.032**	**1.1**	**0.0037**	< 0.0010	< 0.00020	< 0.250	0.859 +/- 0.732 (1.022)
	6/20/2017	**8.7**	**160**	**15**	**0.461**	**130**	**7.13**	**640**	< 0.0030	< 0.0010	< 0.0010	**0.095**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.029**	**1.0**	**0.0060**	< 0.0010	< 0.00020	**0.461**	1.649 +/- 1.389 (2.443)
	8/16/2017	**8.7**	**160**	**15**	**0.482**	**120**	**7.10**	**550**	< 0.0030	< 0.0010	< 0.0010	**0.098**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.031**	**1.3**	**0.0046**	< 0.0010	< 0.00020	**0.482**	1.003 +/- 0.919 (1.191)
	3/15/2018	**6.2**	**140**	**18**	**0.562**	**120**	**7.32**	**620**	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.562**	-
	5/29/2018	-	-	-	**0.560**	-	-	-	< 0.0030	< 0.0010	< 0.0010	**0.095**	< 0.0010	**0.0048**	< 0.0020	**0.0016**	**0.023**	**1.3**	**0.0054**	< 0.0010	< 0.00020	**0.560**	0.604 +/- 0.773 (1.44)
	9/12/2018	**8.5**	**170**	**21**	**0.426**	**120**	**7.14**	**600**	-	< 0.0010	-	**0.086**	-	< 0.0040	< 0.00086	< 0.0010	**0.018**	**1.4**	**0.0057**	-	-	**0.426**	0.125 +/- 0.840 (1.78)
	3/7/2019	**7.1**	**170**	**18**	**0.449**	**140**	**7.36**	**720**	< 0.0030	< 0.0010	< 0.0010	**0.10**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.021**	**1.0**	**0.013**	< 0.0010	< 0.00020	**0.449**	0.668 +/- 0.881 (1.75)
	6/6/2019	-	-	-	-	-	-	-	< 0.0030	< 0.0010	< 0.0010	**0.10**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.029**	**0.93**	**0.0096**	< 0.0010	< 0.00020	**0.454**	0.605 +/- 0.743 (1.41)
	9/3/2019	**9.0**	**250**	**15**	**0.530**	**270**	**7.17**	**1000**	-	< 0.0010	-	**0.14**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.033**	**1.0**	**0.011**	-	-	**0.530**	1.12 +/- 1.11 (1.97)
	10/2/2019	**7.3**	**230**	**14**	**0.362**	**240**	**7.20**	**880**	-	< 0.0010	-	**0.12**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.029**	**1.1**	**0.0080**	-	-	**0.362**	1.28 +/- 0.927 (1.62)
	10/16/2019	**10**	**210**	**14**	**0.447**	**190**	**7.15**	**820**	-	< 0.0010	-	**0.10**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.027**	**1.2**	**0.0064**	-	-	**0.447**	0.797 +/- 0.954 (2.09)
	11/9/2019	**9.0**	**200**	**17**	**0.435**	**190**	**7.30**	**880**	-	< 0.0010	-	**0.11**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.027**	**1.2**	**0.015**	-	-	**0.435**	0.420 +/- 0.851 (1.68)
	2/24/2020	**9.8**	**290**	**16**	**0.367**	**320**	**7.08**	**1000**	-	< 0.0010	-	**0.13**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.035**	**1.0**	**0.012**	-	-	**0.367**	0.987 +/- 0.802 (1.46)
	5/20/2020	-	-	-	**0.351**	-	-	-	<0.0030	<0.0010	<0.0010	**0.11**	<0.00089	<0.0040	<0.00086	<0.0010	**0.027**	**0.92**	**0.0086**	<0.0010	<0.00020	**0.351**	0.356 +/- 0.941 (2.11)

Appendix E
SUMMARY OF ANALYTICAL RESULTS
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
Marston, MO

Location	Date	Detection Monitoring - USEPA Appendix III Constituents (mg/L)							Assessment Monitoring - USEPA Appendix IV Constituents (mg/L)														
		Boron, Total	**Calcium, Total**	**Chloride**	**Fluoride**	**Sulfate**	**pH (lab) (SU)**	**TDS**	**Antimony, Total**	**Arsenic, Total**	**Beryllium, Total**	**Barium, Total**	**Cadmium, Total**	**Chromium, Total**	**Cobalt, Total**	**Lead, Total**	**Lithium, Total**	**Molybdenum, Total**	**Selenium, Total**	**Thallium, Total**	**Mercury, Total**	**Fluoride**	**Radium-226 & 228, Combined (pCi/L)**
P-4	11/4/2016	**0.419**	**131**	**20**	**0.34**	**81**	**7.10**	**530**	< 0.0010	< 0.0010	< 0.0010	**0.144**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0379**	**0.0320**	**0.0022**	< 0.0010	< 0.00020	**0.34**	0.53 +/- 1.25
	12/7/2016	**0.436**	**96.9**	**21**	**0.48**	**91**	**7.42**	**452**	< 0.0010	< 0.0010	< 0.0010	**0.109**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0251**	**0.0318**	**0.0010**	< 0.0010	< 0.00020	**0.48**	1.1546 +/- 0.796 (1.452)
	1/5/2017	**0.380**	**87.0**	**28**	**0.568**	**94**	**7.58**	**390**	< 0.0030	< 0.0010	< 0.0010	**0.120**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.031**	**0.033**	**0.0018**	< 0.0010	< 0.00020	**0.568**	0.674 +/- 0.727 (1.417)
	1/28/2017	**0.39**	**80**	**20**	**0.469**	**82**	**8.00**	**390**	< 0.0030	< 0.0010	< 0.0010	**0.11**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.029**	**0.031**	< 0.0010	< 0.0010	< 0.00020	**0.469**	0.479 +/- 0.821 (1.65)
	2/21/2017	**0.41**	**110**	**20**	**0.362**	**86**	**7.29**	**480**	< 0.0030	< 0.0010	< 0.0010	**0.13**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.043**	**0.029**	**0.0014**	< 0.0010	< 0.00020	**0.362**	0.4469 +/- 0.652 (1.205)
	3/30/2017	**0.40**	**100**	**19**	**0.543**	**91**	**7.17**	**520**	< 0.0030	< 0.0010	< 0.0010	**0.13**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.041**	**0.029**	**0.0019**	< 0.0010	< 0.00020	**0.543**	-0.193 +/- 0.899 (1.942)
	4/26/2017	**0.45**	**100**	**19**	**0.381**	**93**	**7.40**	**440**	< 0.0030	< 0.0010	< 0.0010	**0.12**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.032**	**0.030**	< 0.0010	< 0.0010	< 0.00020	**0.381**	0.758 +/- 0.601 (0.785)
	5/17/2017	**0.42**	**84**	**21**	< 0.250	**77**	**7.24**	**420**	< 0.0030	< 0.0010	< 0.0010	**0.11**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.038**	**0.027**	< 0.0010	< 0.0010	< 0.00020	< 0.250	**0.978 +/- 0.649 (0.808)**
	5/17/2017	**0.45**	**92**	**21**	< 0.250	**74**	**7.21**	**440**	< 0.0030	< 0.0020	< 0.0010	**0.12**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.038**	**0.029**	< 0.0020	< 0.0010	< 0.00020	< 0.250	**1.601 +/- 0.942 (1.526)**
	6/20/2017	**0.50**	**100**	**20**	**0.380**	**89**	**7.28**	**490**	< 0.0030	< 0.0010	< 0.0010	**0.12**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.043**	**0.026**	**0.0019**	< 0.0010	< 0.00020	**0.380**	1.091 +/- 0.746 (1.217)
	8/16/2017	**0.48**	**110**	**20**	< 0.250	**88**	**7.32**	**440**	< 0.0030	< 0.0010	< 0.0010	**0.14**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.050**	**0.030**	**0.0024**	< 0.0010	< 0.00020	< 0.250	0.862 +/- 0.829 (1.409)
	3/15/2018	**0.45**	**100**	**20**	**0.324**	**78**	**7.33**	**420**	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.324**	-
	5/29/2018	-	-	-	**0.357**	-	-	-	< 0.0030	< 0.0010	< 0.0010	**0.11**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.030**	**0.033**	**0.0030**	< 0.0010	< 0.00020	**0.357**	0.594 +/- 0.658 (1.28)
	9/12/2018	**0.43**	**120**	**23**	**0.369**	**57**	**6.71**	**460**	-	< 0.0010	-	**0.11**	-	< 0.0040	< 0.00086	< 0.0010	**0.028**	**0.025**	**0.0022**	-	-	**0.369**	0.297 +/- 0.829 (1.66)
	3/8/2019	**0.51**	**110**	**21**	**0.320**	**78**	**7.37**	**560**	< 0.0030	< 0.0010	< 0.0010	**0.13**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.035**	**0.022**	**0.0020**	< 0.0010	< 0.00020	**0.320**	0.570 +/- 0.887 (1.73)
	6/6/2019	-	-	-	-	-	-	-	< 0.0030	< 0.0010	< 0.0010	**0.11**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.041**	**0.024**	**0.0015**	< 0.0010	< 0.00020	**0.435**	1.34 +/- 0.877 (1.43)
	9/3/2019	**1.6**	**120**	**20**	**0.396**	**71**	**7.26**	**510**	-	< 0.0010	-	**0.15**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.048**	**0.020**	**0.0014**	-	-	**0.396**	0.661 +/- 0.808 (1.53)
	10/2/2019	**0.48**	**110**	**21**	**0.339**	**77**	**7.36**	**530**	-	< 0.0010	-	**0.11**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.035**	**0.021**	< 0.0010	-	-	**0.339**	0.889 +/- 0.976 (1.83)
	10/16/2019	**0.46**	**97**	**20**	**0.367**	**84**	**7.38**	**420**	-	< 0.0010	-	**0.098**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.030**	**0.023**	< 0.0010	-	-	**0.367**	0.634 +/- 0.776 (1.43)
	11/9/2019	**0.54**	**87**	**23**	**0.468**	**90**	**7.54**	**370**	-	< 0.0010	-	**0.10**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.028**	**0.024**	< 0.0010	-	-	**0.468**	0.972 +/- 0.709 (1.31)
	2/25/2020	**0.46**	**97**	**19**	**0.336**	**84**	**7.41**	**450**	-	< 0.0010	-	**0.10**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.033**	**0.028**	< 0.0010	-	-	**0.336**	0.446 +/- 0.684 (1.46)
	2/25/2020	**0.46**	**97**	**19**	**0.351**	**79**	**6.74**	**440**	-	< 0.0010	-	**0.10**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.035**	**0.027**	< 0.0010	-	-	**0.351**	1.22 +/- 0.722 (1.26)
	5/20/2020	-	-	-	-	-	-	-	<0.0030	<0.0010	<0.0010	**0.10**	<0.00089	<0.0040	<0.00086	<0.0010	**0.032**	**0.026**	<0.0010	<0.0010	<0.00020	<0.250	1.63 +/- 1.07 (1.71)
P-5	11/3/2016	**7.98**	**123**	**8**	**0.18**	**163**	**6.67**	**572**	< 0.0010	**0.0053**	< 0.0010	**0.125**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0179**	**0.235**	< 0.0010	< 0.0010	< 0.00020	**0.18**	**2 +/- 1.57**
	12/6/2016	**6.22**	**106**	**12**	**0.20**	**135**	**6.71**	**484**	< 0.0010	**0.0081**	< 0.0010	**0.110**	< 0.0010	< 0.0010	< 0.0050	< 0.0010	**0.0169**	**0.235**	< 0.0010	< 0.0010	< 0.00020	**0.20**	**2.664 +/- 1.083 (1.415)**
	1/4/2017	**8.20**	**110**	**8.2**	< 0.250	**170**	**7.48**	**550**	< 0.0030	**0.0056**	< 0.0010	**0.13**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.025**	**0.250**	< 0.0010	< 0.0010	< 0.00020	< 0.250	1.65 +/- 1.022 (1.72)
	1/26/2017	**7.0**	**110**	**5.4**	**0.364**	**210**	**7.73**	**630**	< 0.0030	**0.0068**	< 0.0010	**0.14**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.024**	**0.23**	< 0.0010	< 0.0010	< 0.00020	**0.364**	0.2838 +/- 0.822 (1.76)
	2/22/2017	**8.5**	**130**	**7.3**	< 0.250	**170**	**6.78**	**600**	< 0.0030	**0.011**	< 0.0010	**0.15**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.024**	**0.27**	< 0.0010	< 0.0010	< 0.00020	< 0.250	**1.226 +/- 0.733 (1.09)**
	3/30/2017	**7.5**	**120**	**6.8**	**0.438**	**180**	**6.73**	**640**	< 0.0030	**0.0089**	< 0.0010	**0.15**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.024**	**0.25**	< 0.0010	< 0.0010	< 0.00020	**0.438**	**2.057 +/- 1.078 (1.613)**
	4/26/2017	**8.7**	**140**	**6.2**	< 0.250	**210**	**6.88**	**680**	< 0.0030	**0.0099**	< 0.0010	**0.17**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.022**	**0.30**	< 0.0010	< 0.0010	< 0.00020	< 0.250	**1.988 +/- 1.034 (1.491)**
	5/18/2017	**9.7**	**140**	**6.7**	< 0.250	**230**	**6.80**	**720**	< 0.0030	**0.0069**	< 0.0010	**0.18**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.030**	**0.36**	< 0.0010	< 0.0010	< 0.00020	< 0.250	1.3 +/- 0.93 (1.549)
	6/20/2017	**11**	**140**	**5.3**	**0.272**	**260**	**6.79**	**780**	< 0.0030	**0.0083**	< 0.0010	**0.16**	< 0.0010	< 0.0040	**0.0020**	< 0.0010	**0.026**	**0.26**	**0.0015**	< 0.0010	< 0.00020	**0.272**	**2.16 +/- 1.176 (1.669)**
	8/16/2017	**9.1**	**130**	**4.9**	< 0.250	**180**	**6.69**	**520**	< 0.0030	**0.0064**	< 0.0010	**0.13**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.024**	**0.23**	< 0.0010	< 0.0010	< 0.00020	< 0.250	**1.219 +/- 0.924 (1.13)**
	3/15/2018	**8.2**	**140**	**5.4**	**0.266**	**180**	**6.94**	**650**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5/29/2018	-	-	-	< 0.250	-	-	-	< 0.0030	**0.0066**	< 0.0010	**0.17**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.022**	**0.28**	< 0.0010	< 0.0010	< 0.00020	< 0.250	**1.23 +/- 0.963 (1.50)**
	9/11/2018	**9.2**	**130**	**7.0**	< 0.250	**180**	**6.13**	**490**	-	**0.0066**	-	**0.12**	-	< 0.0040	**0.0012**	< 0.0010	**0.012**	**0.26**	< 0.0010	-	-	< 0.250	**2.40 +/- 1.21 (1.72)**
	3/8/2019	**14**	**160**	**8.9**	**0.312**	**330**	**7.13**	**900**	< 0.0030	**0.0056**	< 0.0010	**0.16**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.023**	**0.28**	< 0.0010	< 0.0010	< 0.00020	**0.312**	1.72 +/- 1.09 (1.91)
	6/7/2019	-	-	-	**0.315**	-	-	-	< 0.0030	**0.0055**	< 0.0010	**0.14**	< 0.00089	< 0.0040	< 0.00086	< 0.0010	**0.032**	**0.44**	< 0.0010	< 0.0010	< 0.00020	**0.315**	**2.67 +/- 1.02 (1.11)**
	9/4/2019	**20**	**140**	**4.1**	**0.326**	**290**	**6.80**	**840**	-	**0.0064**	-	**0.16**	< 0.00089	< 0.0040	**0.0018**	< 0.0010	**0.027**	**0.38**	< 0.0010	-	-	**0.326**	1.50 +/- 1.17 (1.98)
	10/2/2019	**13**	**150**	**5.6**	**0.254**	**240**	**6.82**	**750**	-	**0.0056**	-	**0.14**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.021**	**0.31**	< 0.0010	-	-	**0.254**	**1.52 +/- 0.894 (1.51)**
	10/16/2019	**14**	**150**	**8.6**	< 0.250	**250**	**6.90**	**760**	-	**0.0057**	-	**0.13**	< 0.0010	< 0.0040	< 0.0020	< 0.0010	**0.021**	**0.31**	< 0.0010	-	-	< 0.250	0.783 +/- 1.08 (2.06)
	11/9/2019	**14**	**150**	**5.6**	**0.291**	**300**	**7.06**	**890**	-	**0.0062**	-	**0.15**	< 0.00089	< 0.0040	**0.0013**	< 0.0010	**0.022**	**0.30**	< 0.0010	-	-	**0.291**	**1.37 +/- 0.882 (1.07)**
	2/25/2020	**16**	**160**	**5.1**	< 0.250	**290**	**6.85**	**860**	-	**0.0056**	-	**0.16**	< 0.00089	< 0.0040	**0.00086**	< 0.0010	**0.029**	**0.34**	< 0.0010	-	-	< 0.250	0.967 +/- 0.800 (1.41)
	5/20/2020	-	-	-	< 0.250	-	-	-	<0.0030	**0.0063**	<0.0010	**0.14**	<0.00089	<0.0040	**0.0023**	<0.0010	**0.018**	**0.44**	<0.0010	<0.0010	<0.00020	<0.250	**1.78 +/- 0.965 (1.46)**

No ABBREVIATIONS AND NOTES:

ND: "Non Detect," the report does not provide reporting limit and instead states "ND."

Bold Value: indicates a detection by the laboratory

mg *- 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*

pCi [a] - Sample erronesouly labeled MW7-032317

su [b] - Sample erroneously labeled MW4-041017

US [c] - Sample erroneously labeled MW2-071117

APPENDIX F

Stratigraphic Cross-Sections

LEGEND

MONITORING WELL

POND 003

CROSS SECTION PATH

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

3. AERIAL IMAGERY SOURCE: ESRI, APRIL 21, 2019.

N

0 300 600

SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COPPERATIVE, INC.
NEW MADRID POWER GENERATING FACILITY
NEW MADRID COUNTY, MISSOURI

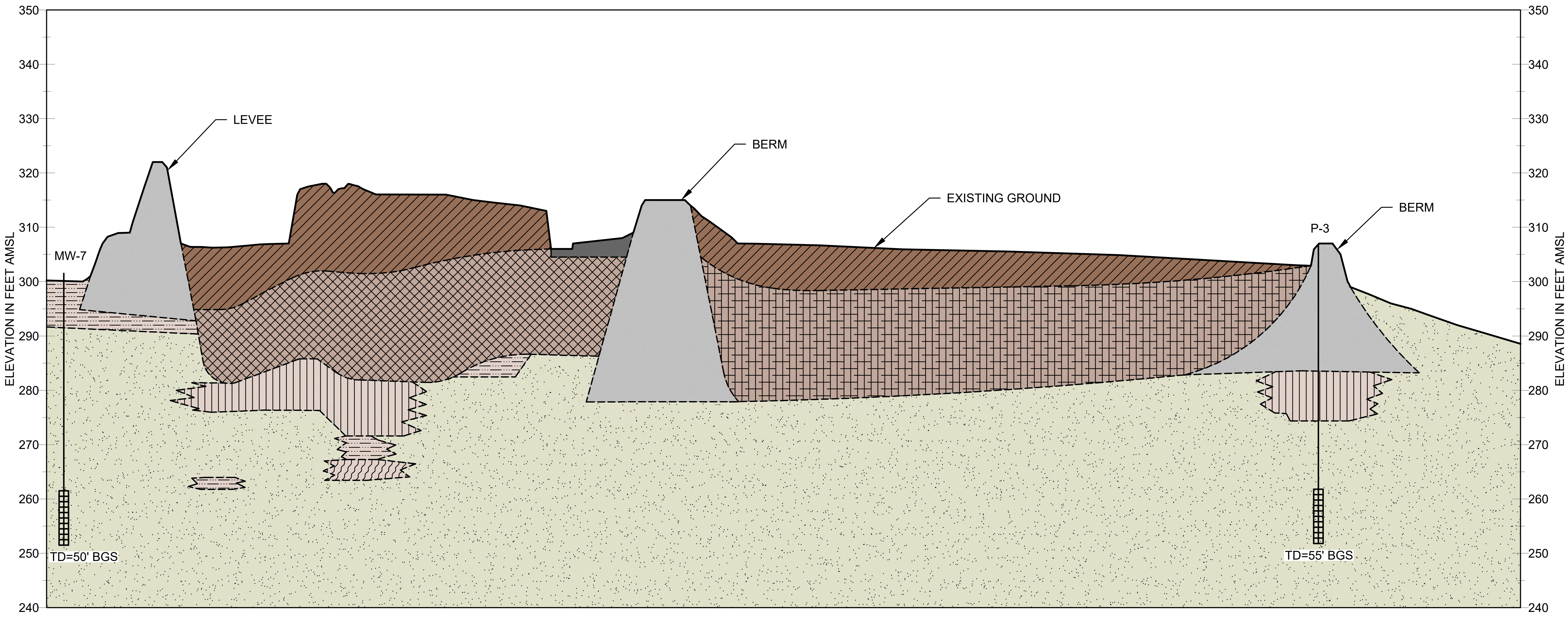
POND 003
A - A' CROSS SECTION

aeci

AUGUST 2020

FIGURE F-2

GIS FILE PATH: G:\Projects\AECI\New Madrid\GIS\MXDs\GW CONTOUR MAPS\POND 003\128064_001_0001_POND_3_A-A'_X-SECTION.mxd — USER: dzinsmaster — LAST SAVED: 8/26/2020 7:16:49 AM



LEGEND

- ▨ FLY ASH
- ▩ FLY ASH/COAL FINES
- ▦ BOILER SLAG/ CLAY
- ■ COAL FINES
- ░ SANDS
- ▤ SILT
- ▨ GREEN-GRAY CLAY
- ▥ CLAY
- ■ BERM/LEVEE MATERIAL

- ▬ SEDIMENT/SOIL SAMPLE LOCATION
- ▭ PORE WATER SAMPLE LOCATION

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. VERTICAL SCALE IS EXAGGERATED 10 TIMES.

HORIZ. 0 200 400
VERT. 0 20 40
SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
MARSTON, MISSOURI

POND 003 GENERALIZED
CROSS SECTION A-A'

SCALE: AS SHOWN
MARCH 2019

FIGURE F-1

SLIVNYAK, OLEG Printed: 8/26/2020 10:03 AM Layout: P0003_AA
\\HALEYALDRICH.COM\SHARE\PHX_COMMON\PROJECTS\AECI\NEW MADRID\CAD\129342_016_00F1_CROSSSECTIONAA.DWG

APPENDIX G

Corrective Measures Assessment

www.haleyaldrich.com

REPORT ON

CORRECTIVE MEASURES ASSESSMENT
FOR POND 003
NEW MADRID POWER PLANT
NEW MADRID, MISSOURI

by
Haley & Aldrich, Inc.
Cleveland, Ohio

for
Associated Electric Cooperative, Inc.
Springfield, Missouri

File No. 129342-020
September 2019
AMENDED October 11, 2019

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List of Acronyms and Abbreviations

Abbreviation	**Definition**
AECI	Associated Electric Cooperative, Inc.
CBR	Closure by Removal
CCR	Coal Combustion Residual
CIP	Closure in Place
COC	Constituent of Concern
CMA	Corrective Measures Assessment
CSM	Conceptual Site Model
FDM	Finite-Difference Method
GWPS	Groundwater Protection Standards
Gredell	Gredell Engineering Resources Inc.
Haley & Aldrich	Haley & Aldrich, Inc.
HC	Hydraulic Containment
HMOC	Hybrid Method of Characteristics
ISS	In-Situ Stabilization
Pond 003	CCR Management Unit
MDNR	Missouri Department of Natural Resources
MMOC	Modified Method of Characteristics
MNA	Monitored Natural Attenuation
MOC	Method of Characteristics
N&E	Nature and Extent
NMPP	New Madrid Power Plant
O&M	Operations and Maintenance
ONWI	Office of Nuclear Waste Isolation
RMS	Root Mean Square
RO	Reverse Osmosis
SAP	Sampling Analysis Plan
SDAP	Statistical Data Analysis Plan
SSI	Statistically Significant Increase
SSL	Statistically Significant Levels
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UWL	Utility Waste Landfill

1. Introduction

Haley and Aldrich, Inc. (Haley & Aldrich) was retained by Associated Electric Cooperative, Inc. (AECI) to prepare this Corrective Measures Assessment (CMA) for the Coal Combustion Residual (CCR) management unit identified as Pond 003 located at the New Madrid Power Plant (NMPP). AECI has conducted detailed geologic and hydrogeologic investigations under 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 (effective 19 October 2015) and subsequent regulatory revisions (CCR Rule).

This CMA includes a summary of the results of groundwater and site investigations at Pond 003. Groundwater impacted by Pond 003 exceeds the statistically-derived groundwater protection standards (GWPS) for molybdenum at six monitoring well locations surrounding Pond 003 based on statistical analyses completed for an assessment monitoring groundwater sampling event in September 2018. This report evaluates potential corrective measures to address these limited exceedances of the GWPS.

1.1 FACILITY DESCRIPTION/BACKGROUND

The NMPP is an active energy production facility that generates electricity through coal combustion (Figure 1-1). The CCR generated are byproducts of the combustion process and include fly ash and boiler slag material. Boiler slag, economizer ash, coal fines, and minor residual waste streams are sluiced from the power generating system to the northern end of Pond 003, where it travels south through maintained channels to the impoundment outlet. Historically, fly ash was also sluiced to this impoundment. Fly ash is now handled in a dry condition and hauled to the on-site Utility Waste Landfill (UWL). The slag is removed from Pond 003 for either beneficial use or disposal in the UWL. Site features are shown on **Figure 1-2**. Suspended economizer ash and coal fines are settled in a channel and stockpiled adjacent to the channel.

1.2 SITE CHARACTERIZATION WORK SUMMARY

Extensive subsurface investigations have occurred pursuant to the CCR Rule. In June 2009, a *Stability Evaluation of Slag Pond 1 and Ash Pond 2 Report* was prepared by Geotechnology, Inc. characterized the geology and evaluated stability of Pond 003. In October 2011, a *Hydrogeologic Characterization Report for Coal Ash Impoundment (Unlined)* was prepared by Gredell Engineering Resources, Inc. (Gredell) and characterized the geology and hydrogeology of Pond 003. In January 2012, Gredell prepared a *Well Development and Sampling Summary* that documents the development of the piezometers installed during the Stability Evaluation. In September 2015, an impoundment stability evaluation was conducted by Haley & Aldrich to further assess exterior dikes which frame the perimeter of Pond 003 as a compliance activity associated with the CCR Rule which included borings and cone penetration testing. In September 2016, Haley & Aldrich installed additional monitoring wells surrounding Pond 003 to develop the CCR groundwater monitoring network. Data from these site characterization activities were used to develop a hydrogeologic Conceptual Site Model (CSM), which included:

- Soil borings and sampling;
- Geotechnical testing;
- Well and piezometer installation;
- Slug testing; and

- Groundwater sampling.

The CSM has been further enhanced with ongoing CCR groundwater monitoring and supplemental subsurface investigation activities performed by Haley & Aldrich. Findings from these extensive and updated series of geologic and hydrogeologic investigations have been used to construct a robust 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 Sampling and Analysis Plan (SAP) and a Statistical Data Analysis Plan (SDAP) as required by the CCR Rule. The SAP and SDAP present the design of the groundwater monitoring system, groundwater sampling and analysis procedures, and groundwater statistical analysis methods.

Monitoring wells that make up the Pond 003 groundwater monitoring network were installed in October 2003, April 2009, and September 2016. The Pond 003 groundwater monitoring network includes three background wells (MW-16, B-123, and B-126) and nine downgradient monitoring wells (P-1 through P-5 and MW-6 through MW-9[1]) located around the perimeter of Pond 003. In general, the monitoring wells are screened in the alluvial aquifer zone approximately 50 feet below ground surface.

Detection monitoring sampling events occurred in 2017 and 2018. The results of the sampling events were then compared to background/upgradient concentrations, or natural groundwater values, using statistical methods to determine whether a statistically significant increase (SSI) of constituent concentrations above background concentrations in groundwater had occurred. Results of the detection monitoring statistical analyses completed in January 2018 identified SSI concentrations of Appendix III constituents in downgradient monitoring wells relative to concentrations observed in background concentrations. At the time of this report, no alternative source was identified for the SSI constituents. Accordingly, the groundwater monitoring program transitioned to an assessment monitoring program.

During the Assessment Monitoring phase, CCR groundwater monitoring well samples were collected during May and September 2018 and subsequently analyzed for Appendix IV constituents. Appendix IV analytical results for the baseline and Assessment Monitoring events are summarized in **Table I**.

1.4 CORRECTIVE MEASURES ASSESSMENT PROCESS

The CMA process involves development of groundwater remediation technologies that will satisfy the following threshold criteria: protection of human health and the environment, attainment of GWPS, source control, constituent of concern (COC) removal and compliance with standards for waste management. Once these technologies are demonstrated to satisfy these criteria, they are then compared to one another with respect to four balancing criteria: long- and short-term effectiveness, source control, and implementability. The fourth balancing criteria involves input from the community

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[1] Note that wells P-5, MW-6, and MW-7 are generally on the upgradient side of the unit with the predominant flow path being towards the east and the river, except when the river rises and causes a temporary reversal of flow to the east.

regarding the proposed remedial activities that will occur in compliance with the corrective measures plan as part of a public meeting. That meeting must be held at least 30 days prior to remedy selection by AECI.

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 evaluation factors listed here from §257.97 and discussed in **Section 4** are those that consider risk to human health or the environment including:

- (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;
- (d)(4) Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy[2];
- (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.

1.6 CMA AMENDMENTS

As additional information becomes available in the future, including future groundwater monitoring results or other site-specific or general information, or technological developments, this CMA is subject to change. Nature and Extent evaluations are still underway for the site and may influence the information in this report including the potential corrective measures and the analysis of the potential corrective measures. To the extent material changes to the CMA become necessary, such revised versions of the CMA will be posted to the facility CCR public website.

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[2] 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

To evaluate potential remedy options, the CSM was developed and evaluated based on data collected and associated with the AECI site. The CSM is summarized below.

2.1 SITE SETTING

The NMPP is located approximately two miles east of Marston, Missouri on the western bank of the Mississippi River in New Madrid County, Missouri. The site is located within the northernmost extent of the larger Mississippi Alluvial Plain and is characterized as a relatively flat alluvial plain with extensive agricultural use (Figure 1-1). Pond 003 is a surface impoundment that encompasses approximately 110 acres and is located approximately 0.3 miles southeast of the NMPP power plant site. Pond 003 has ground surface elevations varying from approximately 299 to 320 feet above mean sea level. The western boundary for Pond 003 is the Mississippi River levee which is operated and maintained by the St. Francis Levee District of Missouri and the United States Army Corps of Engineers (USACE).

2.2 GEOLOGY AND HYDROGEOLOGY

Geologic and hydrogeologic conditions beneath Pond 003 have been characterized based on information obtained during installation and testing of the monitoring wells installed around Pond 003 in 2009 and monitoring wells installed as part of the CCR groundwater monitoring network in 2016.

2.2.1 Site Geology

Pond 003 is located in the Southeastern Lowlands physiographic province. The Southeastern Lowlands is the northernmost extent of the larger Mississippi Alluvial Plain and is characterized by alluvial, fluvial, and deltaic deposits ranging in age from Cretaceous to Holocene. The plant site and Pond 003 are underlain by an unconsolidated alluvium which constitutes a regionally extensive aquifer.

In order from ground surface downward, Pond 003 is underlain by unconsolidated alluvium, the Wilcox Group, the Porters Creek Clay, and the Clayton, Owl Creek, and McNairy formations. Only the Tertiary formations (unconsolidated alluvium, Wilcox group, and Porters Creek group) are described below because they represent the uppermost and regional aquifer system.

Surficial geologic materials in the vicinity of and beneath Pond 003 include alluvium consisting of moderate to poorly sorted clay, silt, sand, and gravel of Holocene age (Miller and Vandike, 1997). The alluvium varies from approximately 250 to 300 feet thick in the vicinity of Pond 003 (Gredell Engineering Resources Inc. [Gredell], 2003). Alluvial sediments were predominantly deposited by the Mississippi and Ohio river systems. The alluvium yields substantial quantities of water to shallow wells, primarily for irrigation use, and is considered the primary local aquifer (Burns & McDonnell, 2006).

The Holocene alluvium is underlain by unconsolidated Tertiary strata. The uppermost Tertiary unit is the Wilcox Group consisting primarily of sand deposits with some interbedded clays and lignites (Burns & McDonnell, 2006). The Wilcox Group is 400 to 500 feet thick at the plant site, lying approximately 250 to 300 feet below ground surface, and stratigraphically overlies the Porters Creek Clay.

The Porters Creek Clay is approximately 650 feet in thickness in the vicinity of Pond 003. The Porters Creek Clay is composed entirely of light grey to black clay (Burns & McDonnell, 2006). The clay is a groundwater flow barrier and barrier to infiltration (Miller and Vandike, 1997). The Porters Creek Clay overlies the Clayton formation. The Clayton formation has a total thickness of approximately 30 feet near the plant site and is comprised of sand and limestone (Burns & McDonnell, 2006).

2.2.2 Site Hydrogeology and Hydrology

The water-bearing geologic formation nearest the natural ground surface at Pond 003 is alluvium consisting of moderately to poorly sorted clay, silt, sand, and gravel of Holocene age. The aquifer is used regionally for irrigation and domestic use (although no irrigation or domestic use wells exist adjacent to or downstream of Pond 003). Water levels in the uppermost aquifer are influenced by the Mississippi River stage.

Based on groundwater elevations measured between November 2016 and September 2018, the groundwater gradient in the upper aquifer unit is approximately 0.0008 to 0.003 feet per foot (feet/foot) representative of a very flat gradient. Pond 003 lies adjacent to the Mississippi River and the alluvial aquifer immediately beneath Pond 003 is unconfined and in communication with the river. Seasonal changes in river stage cause the groundwater flow direction to change and occasionally reverse. Due to the influence of the adjacent Mississippi River, the groundwater flow in the alluvial aquifer is generally to the southwest during high river stage and generally to the northeast during typical or lower river stages (Higher river stages generally occur during spring months of the year typically associated with elevated river levels in the Mississippi River). Due to the changing groundwater flow directions, monitoring wells were sited at locations to encircle Pond 003. A select number of those wells (primarily MW-16, B-123, and B-126, and during dominant groundwater flow to the northeast, wells P-5, MW-6, and MW-7) have been designated as upgradient to reflect the dominant groundwater flow towards the river for the majority of the calendar year. Monitoring Well locations are shown on **Figure 2-1**.

Hydraulic conductivity of the uppermost aquifer is based on data collected during slug testing of wells installed during development of the CCR monitoring network. The hydraulic conductivity was calculated to be 75 to 81 feet per day (approximately $3x10^{-2}$ cm/sec).

Because the alluvial aquifer provides a more accessible resource for groundwater production in the area, the Wilcox formation has not been developed locally as a source of groundwater. The clay and lignite present within the Wilcox formation represent lower hydraulic conductivity than the overlying alluvial aquifer. Published hydraulic conductivity values for the Wilcox formation indicate hydraulic in the range of 9 to 25 feet per day (approximately $3x10^{-3}$ to $9x10^{-3}$ cm/sec) (Office of Nuclear Waste Isolation [ONWI], 1982 and Prudic, 1991). The Wilcox formation in the vicinity of Pond 003 is estimated to be approximately 400 to 500 feet thick (Gredell, 2003).

2.3 GROUNDWATER PROTECTION STANDARDS

Haley & Aldrich completed a statistical evaluation of groundwater samples using the methods and procedures outlined in the Pond 003 Statistical Data Analysis Plan (Haley & Aldrich, 2019) to develop site-specific GWPS for each Appendix IV constituent.

Groundwater results were compared to the site-specific GWPS. Based on statistical analyses completed in January 2019, statistically significant levels (SSLs) above the GWPS are limited to six monitoring wells

(P-2, P-3, P-5, MW-7, MW-8, and MW-9) and only for one parameter (molybdenum). Monitoring well locations with SSLs are illustrated on Figure 2-2.

2.4 NATURE AND EXTENT OF GROUNDWATER IMPACTS

AECI initiated a nature and extent (N&E) investigation as required by the CCR Rule in 2019 and is currently installing a series of supplemental monitoring wells and piezometers (N&E wells) at strategic locations surrounding the impoundment. The N&E wells will be screened in two different, generalized zones of the alluvial aquifer: shallow zone at the uppermost aquifer and deep zone approximately 30 feet below the shallow zone.

Analytical results from the assessment wells indicate that molybdenum concentrations are limited in their extent. In the shallow alluvial aquifer zone, the results from monitoring wells surrounding Pond 003 indicate a dominant groundwater flow to the northeast towards the Mississippi River. The distance of the Mississippi River from the unit ranges from approximately 300 to 400 feet. N&E results will be used to supplement the evaluation of the extent of groundwater impacts, and wells are expected to be sampled in late September and October of 2019. Laboratory results will follow.

3. Risk Assessment and Exposure Evaluation

A “Groundwater Risk Evaluation” report has been prepared by Haley & Aldrich, as a supplement to this CMA document, and is presented in **Appendix A**. The purpose of the risk evaluation report is to provide the information needed to interpret and meaningfully understand the groundwater monitoring data collected and published for the NMPP under the CCR Rule. In addition, AECI has voluntarily taken the additional step of evaluating potential groundwater-to-surface water transport and exposure pathways in the risk evaluation.

The risk evaluation report was completed by developing a 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: What is the source of constituents? How can constituents be released from the source? What environmental media may be affected by constituent release? How and where do constituents travel within a medium? 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 exert a toxic effect?” by comparing constituent concentrations in groundwater to risk-based screening levels.

Screening levels are constituent concentrations in groundwater (and other media) that are considered to be protective of specific human exposures and ecological exposures. The USEPA and other regulatory agencies, including the Missouri Department of Natural Resources (MDNR), develop screening levels to provide a conservative estimate of the concentration to which a receptor (human or ecological) can be exposed without experiencing adverse health effects. Due to the conservative methods used to derive risk-based screening levels, it can be assumed with reasonable certainty that concentrations below screening levels will not result in adverse health effects, and that no further evaluation is necessary. Concentrations above conservative risk-based screening levels do not necessarily indicate that a potential risk exists but indicate that further evaluation may be warranted.

The results of the risk evaluation indicate that:

- Groundwater downgradient of Pond 003 is not used as a source of drinking water and is not flowing toward any groundwater supply wells. Therefore, despite some constituents in groundwater being detected at concentrations above GWPS at the waste boundary, the constituents do not pose any health risks associated with drinking water uses or exposures.

- If constituents in groundwater downgradient of the Pond 003 were assumed to flow into the Mississippi River, the concentrations in groundwater would need to be orders of magnitude higher than they are to be a potential concern to people who use the Mississippi River as a source of drinking water and for recreational purposes, and for ecological receptors that live in or use the Mississippi River.

Consequently, the risk evaluation demonstrates that there are no adverse impacts on human health or ecological receptors from groundwater uses resulting from coal ash management practices at Pond 003.

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 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 that do not exceed the GWPS for these Appendix IV constituents. The corrective measures evaluation that is discussed below and subsequent sections provides an analysis of the effectiveness of five 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. This assessment also meets the requirements promulgated in §257.96 which require the assessment to evaluate:

- 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 MODELING

A groundwater flow and solute transport model was constructed to evaluate and compare potential corrective measures in support of the CMA for the Site. 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.

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. 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 root mean square (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 and Woessner, 1992). Once the groundwater flow model was calibrated to the determined criteria, the model was set-up for solute transport.

Contaminant fate and transport modeling was conducted utilizing the three-dimensional, numerical model MT3DMS (Version 5 of MT3D) (Zheng, 1990). 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 (MOC), the modified method of characteristics (MMOC), a hybrid of these two methods (HMOC), and the standard finite-difference method (FDM). MT3D was originally released in 1990 as a public domain code from the USEPA 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 above 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 current dissolved-phase concentration distributions from groundwater monitoring data at the Site.

4.3 CORRECTIVE MEASURES ALTERNATIVES

Corrective measures can terminate when groundwater impacted by Pond 003 does not exceed the Appendix IV GWPS for three consecutive years of groundwater monitoring [per §257.98(c)(2)]. 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.

The remedial alternatives presented below contemplate both closure in place (CIP) (Alternatives 1 through 4) and closure by removal (CBR) (Alternative 5) of Pond 003. Both closure methods are expressly authorized under the CCR Rule. AECI has prepared a CCR Rule compliant closure plan for Pond 003 and intends to initiate closure of the unit within the allowable timeframes as stated in §257.101 of the CCR Rule.

4.3.1 Alternative 1 – Closure in Place with Capping and Monitored Natural Attenuation

Pond 003 would be closed in place with a geomembrane and soil protective cap system to reduce infiltration of precipitation to groundwater thereby isolating source material. This cap selection exceeds regulatory requirements by several orders of magnitude (conservatively, a geomembrane provides permeabilities <1 x 10^{-10} centimeters per second (cm/sec) as compared to 1 x 10-5 cm/sec required by the CCR Rule). Over time, depletion of COCs in CCR would allow the concentration of COCs in downgradient groundwater to decline and overall groundwater concentrations of COCs to attenuate. The dissolved phase plume of molybdenum remaining above the GWPS post-closure eventually attenuates, albeit slowly due to the low hydraulic gradient (i.e., the rate at which groundwater moves in the subgrade) in the aquifer underlying Pond 003.

CIP can be completed safely, in compliance with applicable federal and state regulations, and be protective of public health and the environment. In general, CIP consists of re-grading existing CCR and installing a cap system designed to significantly reduce infiltration from precipitation, resist erosion, contain CCR materials, and prevent exposures to CCR. At Pond 003, supplemental design investigations (as required) and engineering design activities along with associated permit pursuits would precede CIP construction activities. Construction of the pond closure is estimated to take approximately 2 years to complete following initiation of closure and are expected to be completed in approximately 2026.

Monitored Natural Attenuation (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 a low-permeability cap to address the source by limiting the infiltration of precipitation into and through the CCR, MNA can reduce concentrations of molybdenum in groundwater at the Pond 003 boundary, although the time required to achieve the GWPS would be lengthy due to the low gradient and the resultant groundwater flux.

Following the installation of the cap system, AECI would implement post-closure care activities. Post-closure care includes ongoing cap maintenance and periodic inspections, along with long-term groundwater monitoring until such time that groundwater conditions return to regulatory levels. No post-closure uses are currently planned.

4.3.2 Alternative 2 – CIP with In-Situ Stabilization, Capping and Monitored Natural Attenuation

In-situ stabilization (ISS) is a technique that uses mixing of the CCR with amendments to solidify the material in place. Amendments typically include Portland Cement or other reagents and the solidification is completed in-situ using large diameter augers. CCR in Pond 003 that has the potential to periodically come into contact with a fluctuating ground water table due to Mississippi River influence would be isolated by ISS, followed by capping of the surface impoundment. Groundwater impacts would be addressed through the processes of natural attenuation. This alternative would isolate the source (through solidification and installation of a low-permeability cap) and over time, allow the concentrations of COCs in downgradient groundwater to decline and overall groundwater concentrations of COCs to attenuate.

ISS of Pond 003 is predicted to take a number of years to complete, depending on the availability and scheduling of specialized contractors and equipment. Additionally, implementation of ISS will require a detailed design effort with bench scale testing to determine the appropriate amendment mix. Pilot testing will also be needed to verify the ability of equipment to solidify material at depth. ISS has not been commonly used to stabilize entire CCR units as part of a closure strategy, but has been used in larger industry to stabilize materials at depth. Changes to groundwater chemistry associated with the mobility of Appendix IV constituents following completion of ISS, where large volumes of cementitious amendments/reagents are added to the subsurface, are unknown and would require pilot testing. ISS and CIP construction activities are estimated to take approximately 5 years to complete following initiation of closure and are expected to be completed in approximately 2029.

Following the ISS completion and low-permeability final cap system (similar to Alternative 1) installation, AECI would implement post-closure care activities that includes long-term groundwater monitoring and periodic inspections with ongoing cap maintenance.

4.3.3 Alternative 3 – CIP with Capping and Hydraulic Containment through Groundwater Pumping and Ex-Situ Treatment

Pond 003 would be closed in place with a low-permeability cap similar to Alternative 1 to reduce infiltration and isolate source material. Pumping wells would be installed to hydraulically control the downgradient migration of molybdenum. However, pumping wells would generate effluent that would require ex-situ treatment, likely with an ion exchange or a reverse osmosis (RO) treatment system. Both treatment systems are considered advanced stage treatment technologies and require ongoing operation and maintenance and would generate a secondary waste stream – including regeneration/replacement of the ion exchange media or concentration reject water from the RO system. Approvals and permitting would be required for the construction and installation of the treatment systems and discharge of the treated groundwater.

Implementation of a large-scale hydraulic containment (HC) system will require a detailed design effort with bench scale testing to verify groundwater treatment. Pilot testing, such as pumping tests and additional groundwater modeling, will be needed to verify the hydraulic capture zone. While HC is a widely used remediation technology for contaminated industrial/commercial sites, it has not been commonly used as part of a large-scale CCR unit closure strategy. The HC system and associated ex-situ treatment would be planned to be installed during operation of the unit prior to initiation of closure. CIP construction activities are estimated to take approximately 2 years to complete following initiation of closure and are expected to be completed in approximately 2026.

Following the installation of the low-permeability cap, groundwater pumping well network, and ex-situ treatment system, AECI would implement post-closure care activities that includes operation and maintenance of the HC system, long-term groundwater sampling to monitor HC system performance, and cover system maintenance.

4.3.4 Alternative 4 – CIP with Capping and Hydraulic Containment through Groundwater Pumping and Ex-Situ Treatment and Barrier Wall

The configuration of this alternative would be identical to Alternative 3, with the addition of a low-permeability barrier wall between the pumping wells and the Mississippi River. The purpose of the wall is to reduce the flux of groundwater moving downgradient west to east from Pond 003 and minimize the intake of groundwater from the east (the Mississippi River) during groundwater pumping, therefore improving the pumping efficiency of the hydraulic containment system. Approvals and permitting would be required for the barrier wall installation adjacent to the Mississippi River in addition to permits required for discharge of the treated groundwater.

Similar to Alternative 3, implementation of a large-scale hydraulic containment system will require a detailed design effort with bench scale testing to verify groundwater treatment. Pilot testing, such as long-duration pumping tests and additional groundwater modeling, will be needed to verify the hydraulic capture zone. A detailed design will also be required for the barrier wall, given the target depth and horizontal length of the wall. Implementation of the barrier wall and hydraulic containment system will be particularly challenging given the proximity of the Mississippi River and limited work area. Installation of the barrier wall will likely require a variety of permits with work inside the USACE flood levee and near proximity to the Mississippi River. Similar to Alternative 3, the HC system and barrier wall would be planned to be installed during operation of the unit prior to initiation of closure. CIP construction activities are estimated to take approximately 2 years to complete following initiation of closure and are expected to be completed in approximately 2026.

Once implemented, the timeline for active treatment to achieve the GWPS is expected to be potentially shorter than other alternatives due to the enhanced effects of the pumping when combined with a barrier wall.

Following the installation of the low-permeability cap, subsurface barrier wall, groundwater pumping well network, and ex-situ treatment system, AECI would implement post-closure care activities that include operation and maintenance of the hydraulic containment system, long-term groundwater sampling to monitor hydraulic containment system performance, and cap system inspection and maintenance. No ongoing maintenance would be required for the subsurface barrier wall.

4.3.5 Alternative 5 – Closure by Removal with Monitored Natural Attenuation

This alternative evaluates the removal of CCR from Pond 003 followed by natural attenuation of molybdenum in groundwater. While this alternative would eliminate the source (ponded CCR) through removal, it takes multiple years to implement during which time the impounded CCR would remain open and subject to ongoing infiltration for the duration of the removal activities. Concentrations of molybdenum in downgradient groundwater would decline via natural attenuation processes once the removal is complete.

Excavated CCR material would likely be disposed on-site, following excavation and removal from Pond 003. The existing UWL would be laterally expanded to accommodate the CCR material removed from Pond 003. Under this scenario, transportation of CCR material over public roadways would be limited to access roads along the existing Mississippi River levee system. AECI already owns and maintains a dedicated haul road from the levee access road to the UWL site. Close proximity of the UWL to Pond 003 would also decrease the duration required for closure, when compared to off-site disposal options.

Ponded CCR materials would be limited in its beneficial use applications. Historically, boiler slag at the AECI facility has been processed at its point of entry into the impoundment for screening and off-site beneficial use. Rejected portions of the boiler slag that did not meet specific criteria remain in Pond 003. Also, fly ash was sluiced and comingled with coal fines and other generated waste streams rendering that portion of the ponded ash less usable. In addition, due to chemical reactions that occurred during the placement of class C fly ash via wet sluicing and the saturated condition of the ponded ash, higher end markets like ready-mix concrete are likely limited. With additional handling and processing (i.e., drying, screening/segregation, etc.), ponded ash can potentially be sourced for cement kiln feedstock and other supplemental beneficial use markets depending on current industry supplies, distance to target markets, competitive market price point, etc. More material characterization and market assessment is required to further evaluate beneficial use potentials for the Pond 003 CCRs.

The technical and logistical challenges of implementing a large-scale ash removal project need to be considered including the removal of CCR with excavations approximately 35-feet deep and CCR removal quantities in excess of 3.6 million cubic yards. Removal activities will be technically challenging and require a comprehensive dewatering and excavation strategy, decant water management, implementation of CCR stabilization methods and temporary staging of material for drying prior to transportation. These aspects of the removal process will affect productivity and must be considered in the planning for the overall removal process and duration. Excavation and construction safety during the removal operation is a major concern due to the use of heavy equipment (bulldozers, excavators, front end loaders, off-road trucks) and trucking/transport operations within the AECI plant site and adjacent to the Mississippi River levee system. Community impacts associated with the use of heavy equipment (equipment delivery, maintenance, etc.) and multi-year truck traffic associated with conveyance of ash removed from Pond 003 and transported to the on-site UWL are also a consideration for this alternative. Based on the volume of material, weather impacts associated with winter and wet weather months, and permitting timeframes associated with construction and operation of the UWL lateral expansions, CBR construction activities are estimated to take approximately 5 to 10 years to complete following initiation of closure and are expected to be completed in approximately 2033.

5. Comparison of Corrective Measures Alternatives

The purpose of this section is to evaluate, compare, and rank the five corrective measures alternatives relative to one another 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.

The fourth balancing criterion (i.e. the degree to which community concerns are addressed by a potential remedy) will be considered following a public information session to be held at least 30 days prior to remedy selection.

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 evaluate how each of the remedial alternatives are technologically feasible, relevant and readily implementable, provide adequate protection to human health and the environment, and minimizes impacts to the community.

A color-coded graphic (i.e., ribbons which are part of a comprehensive visual comparison tool (referred to as a stop light table with the comprehensive table is provided as **Table II**) is presented within each subsection below. These ribbons and associated stop light table provide a relative comparative snapshot of the favorability for each alternative against the other alternatives, where green represents favorable, yellow represents less favorable, and red represents least favorable.

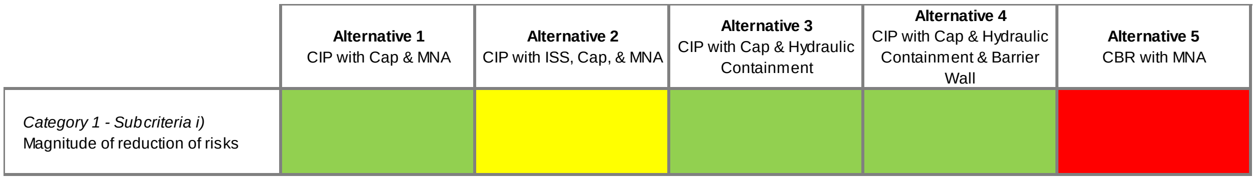
5.2.1 Balancing Criteria 1 - The Long- and Short-Term Effectiveness and Protectiveness of the Potential Remedy, along with the Degree of Certainty that the Remedy Will Prove Successful

This balancing criterion takes into consideration the following sub criteria relative to the 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 summarized in **Section 3**, no unacceptable risk to human health and the environment exists with respect to Pond 003. In spite of no adverse risk being present, compliance with the CCR Rule requires the evaluation of groundwater remedial alternatives (considered in this CMA) to address SSLs of molybdenum found in groundwater monitoring wells located at the point of compliance around Pond 003. As a result of implementing any of these remedial alternatives, other types of impacts and risks (i.e., the risk of implementing the remedies sometimes referred to as “risk of remedy”) are present to varying degrees.

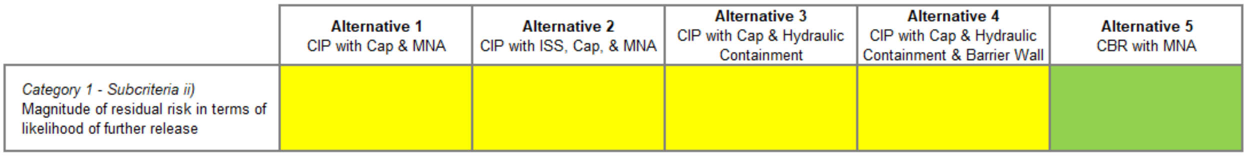
The remedial alternatives that pose the lowest risk of remedy to human health and the environment are Alternatives 1 (CIP with MNA) and 3 (CIP with HC) as they are implemented on-site and involve the least amount of construction, operations and maintenance activities, the least amount of material removal/large-scale excavation and/or in-situ activities and associated impacts. Alternative 5 (CBR with MNA) has the highest potential impact due to the proximity of Pond 003 to the Mississippi River and levee system, prolonged excavation equipment usage and heavy truck traffic for an extended period of time, which increases the likelihood of roadway accidents during the estimated 5 to 10 years needed to complete material removal. Construction and material transportation will also be required to implement Alternative 2 (CIP with ISS) to support the process of solidifying the CCR. Construction of the treatment system with barrier wall and cap will be required for Alternative 4 (CIP with HC and barrier), along with the management of a generated waste stream, which poses additional risk associated with handling and treatment and the management of treatment byproducts. Comparatively, Alternative 4 (like Alternatives 1 (CIP with MNA) and 3 (CIP with HC)), pose a lesser risk than Alternatives 2 (CIP with ISS) and 5 (CBR with MNA).



	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with ISS, Cap, & MNA	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** CIP with Cap & Hydraulic Containment & Barrier Wall	**Alternative 5** CBR with MNA
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

Alternative 5 (CBR with MNA) has the lowest long-term residual risk in that removal of the source material reduces the likelihood of future releases to groundwater. Following the implementation period of this alternative, the CCR material will be disposed in the on-site UWL and managed in accordance with applicable MDNR solid waste permits resulting in a low likelihood of further releases. For Alternatives 1 through 4, Pond 003 would be closed in place with the installation of a low permeability cap that would significantly reduce the infiltration of precipitation into Pond 003, however the CCR would remain in place. Alternatives 3 (CIP with HC) and 4 (CIP with HC and barrier) also provide additional mitigation measures. Due to CCR remaining in place for Alternatives 1 through 4, these alternatives are considered less favorable as compared to Alternative 5 (CBR with MNA) in terms of the likelihood of further releases following implementation.



	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with ISS, Cap, & MNA	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** CIP with Cap & Hydraulic Containment & Barrier Wall	**Alternative 5** CBR with MNA
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

Alternatives 1 (CIP with MNA), 2 (CIP with ISS), and 5 (CBR with MNA) are the most favorable alternatives with respect to this criterion because they require the least amount of long-term management and involve no mechanical systems as part of the remedy. Alternatives 1 (CIP with MNA) and 2 (CIP with ISS) will require long-term maintenance of the cover system and sampling during the MNA period. Alternative 5 (CBR with MNA) reduces long-term management at Pond 003, but the transported material will require long-term management at the on-site CCR landfill and groundwater sampling will continue to confirm natural attenuation. The remaining Alternatives 3 (CIP with HC) and 4 (CIP with HC and barrier) are least favorable because they involve more intensive systems to implement and/or maintain throughout their remediation life cycle, including operation of the pumping wells and an ex-situ treatment system.

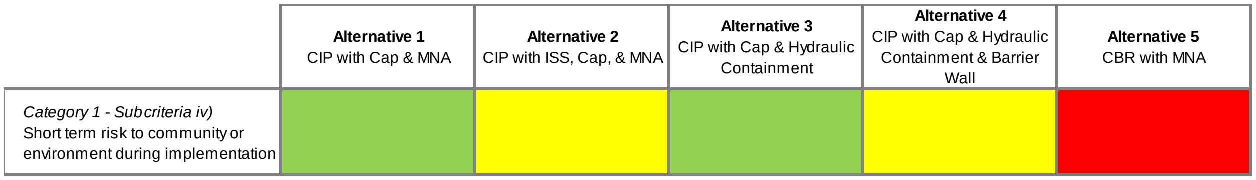
	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with ISS, Cap, & MNA	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** CIP with Cap & Hydraulic Containment & Barrier Wall	**Alternative 5** CBR with MNA
Category 1 - Subcriteria iii) Type and degree of long-term management required	🟩	🟩	🟥	🟥	🟩

5.2.1.4 Short-term risks that might be posed to the community or the environment during implementation of such a remedy

The highest short-term impact posed to the community or environment would be during implementation of Alternative 5 (CBR with MNA), which is considered least favorable. Potential environmental impacts include noise and emissions from heavy equipment, the potential for a release during excavation and construction, and fugitive dust emissions along with associated safety concerns. Community impacts include general impacts to the community due to increased truck traffic on public roads during the entire project duration, including construction of the on-site landfill, along with an increased potential for traffic accidents and fatalities, noise, and truck emissions. In addition, construction adjacent to the Mississippi River levee system has potential to impact levee stability. As noted, Alternative 5 (CBR with MNA) will require a substantial period of time when the CCR material will be open to the environment posing risk during implementation of this remedy.

Alternatives 2 (CIP with ISS) and 4 (CIP with HC and barrier) would include truck traffic to a lesser degree for remedy construction as compared to Alternative 5. The transport of ISS and barrier wall materials to the site make these two alternatives less favorable when compared to Alternatives 1 (CIP with MNA) and 3 (CIP with HC).

For Alternatives 1 (CIP with MNA) and 3 (CIP with HC), risk to the community during implementation is considered the same and would be minimal compared to the other alternatives. Long-term sampling of the monitoring well network to verify treatment system effectiveness will pose no risk to the community.



	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with ISS, Cap, & MNA	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** CIP with Cap & Hydraulic Containment & Barrier Wall	**Alternative 5** CBR with MNA
Category 1 - Subcriteria iv) Short term risk to community or environment during implementation	🟩	🟨	🟩	🟨	🟥

5.2.1.5 *Time until full protection is achieved*

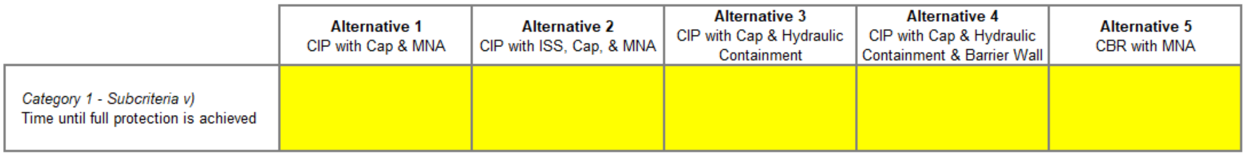
There is currently no unacceptable risk to human health and the environment associated with groundwater at Pond 003; therefore, protection is already achieved. Alternatives 1 (CIP with MNA), 4 (CIP with HC and barrier), and 5 (CBR with MNA) are anticipated to take a similar period of time until natural attenuation or active pumping and controls reduce COCs to GWPS concentrations. These three alternatives are considered comparable due to the similar timeframes for achieving GWPS associated with the low hydraulic gradient and/or reduction in flow associated with a barrier.

Alternative 5, (CBR with MNA), could take approximately 5 to 10 years or greater for construction once implementation begins. This timeframe includes the need to construct lateral expansions at the existing on-site CCR landfill. Removal construction would be followed by a period of groundwater monitoring to verify natural attenuation of the groundwater plume. The period for construction is limited mainly by the construction of the on-site CCR landfill expansions, the amount of material that can be handled per day, and the overall volume of CCR to be handled.

Alternative 3 (CIP with HC) improves the timeframe to achieve GWPS by increasing the hydraulic gradient, but the relative overall timeframe as compared to the Alternatives 1 (CIP with MNA), 4 (CIP with HC and barrier), and 5 (CBR with MNA) is not significantly improved to differentiate this alternative.

Alternative 2 (CIP with ISS) could take the longest amount of time due to the potential of reducing permeability of the upper limit of the aquifer as part of stabilization. Implementation of Alternative 2 (CIP with ISS) would require extensive engineering analysis and field testing. Assuming such studies confirm the viability of ISS technology at Pond 003 and equipment availability, field implementation could take a significant amount of time to implement. This would then be followed by a period of groundwater monitoring to verify natural attenuation of the groundwater plume.

Due to the extended time frame that will be required to achieve the GWPS for Alternatives 1 through 5, these Alternatives were given the same ranking for this balancing sub-criterion.



	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with ISS, Cap, & MNA	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** CIP with Cap & Hydraulic Containment & Barrier Wall	**Alternative 5** CBR with MNA
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*

Alternatives 1 (CIP with MNA), 3 (CIP with HC), and 4 (CIP with HC and barrier) all have similar, minimal potential for exposure to humans and environmental receptors during regrading and cap construction; monitoring well system installation; and installation of the barrier wall or HC system, respectively.

Alternative 1 (CIP with MNA) is the most favorable alternative since, aside from capping, no additional contact with CCR or impacted groundwater would be needed. A waste stream would be generated from the ex-situ treatment under Alternatives 3 (CIP with HC) and 4 (CIP with HC and barrier) and would need to be managed either onsite or offsite, which creates a potential for exposure/risk/impacts. Therefore, Alternatives 3 and 4 are considered less favorable when compared to Alternative 1.

Alternatives 2 (CIP with ISS) and 5 (CBR with MNA) have moderate and high potential for exposure, respectively, which makes them the least favorable remedy for this criterion. A high potential for exposure exists during the excavation and transport of the CCR if Alternative 5 (CBR with MNA) is implemented. A moderate potential to exposure exists during ISS construction (Alternative 2) if CCR needs to be disposed in the CCR landfill as part of the preliminary removal effort prior to ISS implementation.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with ISS, Cap, & MNA	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** CIP with Cap & Hydraulic Containment & Barrier Wall	**Alternative 5** CBR with MNA
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 5 (CBR with MNA) engineering and institutional controls would have high long-term reliability because the CCR will have been removed from Pond 003 and placed in the existing on-site CCR landfill. With the CCR no longer in place at Pond 003, no additional engineering and institutional controls are anticipated. Alternative 2 (CIP with ISS) is also expected to have a high long-term reliability because the CCR would be isolated within the ISS monolith. Alternatives 2 and 5 are considered favorable when compared to the other alternatives.

Alternatives 1 (CIP with MNA), 3 (CIP with HC), and 4 (CIP with HC and barrier) are all expected to be reliable, as capping and long-term monitoring are common methods for long-term waste management. However, for Alternative 1 (CIP with MNA) the relationship of the remaining CCR to the fluctuating levels of the Mississippi River without hydraulic controls in place could be considered a potential reduction in long-term reliability, making this alternative less favorable. Alternatives 3 and 4 include HC and ex-situ treatment which are considered proven and reliable technologies but still require bench scale and pilot testing and rely on mechanical systems to operate. Therefore, these two alternatives are considered less favorable when compared to Alternatives 2 and 5.

For Alternatives 1 through 4, which include CIP, institutional controls, such as recording of an environmental covenant restricting the use of groundwater can easily be implemented because Pond 003 is located on property owned by AECI.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with ISS, Cap, & MNA	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** CIP with Cap & Hydraulic Containment & Barrier Wall	**Alternative 5** CBR with MNA
Category 1 - Subcriteria vii) Long-term reliability of engineering and institutional controls	🟨	🟩	🟨	🟨	🟩

5.2.1.8 *Potential need for replacement of the remedy*

Closure in place of Pond 003 with ISS (Alternative 2) and closure by removal (Alternative 5) are both considered permanent and can be effective in appropriate circumstances. Detailed engineering assessments would need to be completed including field pilot testing to confirm the viability of such approaches for Pond 003. From the perspective of needing to replace the remedy, source removal (Alternative 5) is permanent but will take 5 to 10 years to complete once implemented. Since both remedies are permanent, Alternatives 2 (CIP with ISS) and 5 (CBR with MNA) are considered favorable.

Alternatives 1 (CIP with MNA), 3 (CIP with HC), and 4 (CIP with HC and barrier) are expected to have permanent closures with capping in place. The groundwater model results indicate that the GWPS will be achieved by all alternatives. Should long-term monitoring results indicate that the selected remedial alternative is not effective at reducing the concentration of COCs over time (or the rate of achieving the GWPS is significantly slower than the forecasted timeline), alternate and/or additional active remedial methods for groundwater may be considered in the future. This in particular applies to Alternative 1 (CIP with MNA) since no hydraulic controls would be in place making it least favorable in this criterion. A potential exists for the need to replace wells, pumping equipment, and treatment system components for Alternatives 3 (CIP with HC) and 4 (CIP with HC and barrier), which make these two alternatives less favorable when compared to Alternatives 2 (CIP with ISS) and 5 (CBR with MNA).

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with ISS, Cap, & MNA	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** CIP with Cap & Hydraulic Containment & Barrier Wall	**Alternative 5** CBR with MNA
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 following graphic 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 will prove successful. Alternative 1 (CIP with MNA) is the most favorable. There is an extended timeframe for all alternatives to meet the GWPS due to the low hydraulic gradient. In addition, Alternative 1 (CIP with MNA) does not include additional treatment technology aside from MNA, and therefore long-term management requirements are minimal. Alternative 1 (CIP with MNA) does not rely on mechanical systems aside from low-permeability capping. Alternatives 3 (CIP with HC) and 4 (CIP with HC and barrier) provide groundwater treatment at the waste boundary but require additional long-term operation and maintenance, generate a secondary waste stream, and rely on mechanical systems to operate. Alternative 5 (CBR with MNA) includes large-scale construction, and a lengthy implementation period, which adds the potential for exposure to humans and the environment during the construction period. Alternative 2 (CIP with ISS) also includes potential exposure to humans and environment during construction, although the construction duration is expected to be shorter than Alternative 5 (CBR with MNA).

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with ISS, Cap, & MNA	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** CIP with Cap & Hydraulic Containment & Barrier Wall	**Alternative 5** CBR with MNA
CATEGORY 1 Long- and Short Term Effectiveness, Protectiveness, and Certainty of Success	🟩	🟨	🟨	🟨	🟨

5.2.2 Balancing Criteria 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 extensiveness of treatment technologies that will be required.

5.2.2.1 The extent to which containment practices will reduce further releases

For remedial Alternatives 1 through 4, installation of the low permeability cap will reduce the infiltration of precipitation into Pond 003 and decrease the flux of molybdenum to groundwater over time. Groundwater mounding, and associated outward hydraulic gradient, present at Pond 003 during operation is expected to be reduced during the final operational period and dissipate after closure. Alternatives 3 (CIP with HC) and 4 (CIP with HC and barrier) are considered favorable because active ex-situ treatment technologies will be implemented to limit further down-gradient migration of molybdenum in groundwater prior to closure.

Under Alternatives 2 (CIP with ISS) and 5 (CBR with MNA), no further releases are anticipated following removal or stabilization of the CCR material. However, the implementation of Alternative 2 (CIP with ISS) is anticipated to require multiple years to complete with MNA monitoring following completion of construction. The potential hydrogeological impacts from a large stabilization project due to alterations to the geochemical conditions from the additives and mixing process differentiate this alternative from Alternative 5 (CBR with MNA).

For Alternatives 3 (CIP with HC) and 4 (CIP with HC and barrier), additional containment or treatment practices will address COCs in groundwater migrating downgradient from Pond 003, achieving the performance criteria at the waste boundary. Alternative 1 will not have an additional containment technology beyond natural attenuation making this less favorable in terms of overall containment under this criterion.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with ISS, Cap, & MNA	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** CIP with Cap & Hydraulic Containment & Barrier Wall	**Alternative 5** CBR with MNA
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

No groundwater treatment technologies, other than source isolation through capping and natural attenuation, will be used for Alternatives 1 (CIP with MNA) and 5 (CBR with MNA). There would be no ongoing operation and maintenance of a treatment technology, other than periodic groundwater monitoring. Alternative 1 (CIP with MNA) relies only on low-permeability capping with long-term groundwater monitoring, while Alternative 5 relies on source removal with groundwater monitoring to confirm natural attenuation. Both alternatives are considered favorable for this criterion.

Alternative 2 (CIP with ISS) uses solidification of the CCR below the water table to address COCs in groundwater, which adds to the complexity as compared to Alternative 1 (CIP with MNA). Capping will be required following completion of ISS. Therefore, this alternative is considered less favorable when compared to Alternatives 1 and 5.

Alternatives 3 (CIP with HC) and 4 (CIP with HC and barrier) will use two additional technologies, hydraulic controls via pumping and ex-situ treatment. Alternative 4 (CIP with HC and barrier) includes an additional technology for the barrier wall. The operation of an ex-situ treatment system will create a secondary waste stream, such as concentrated reject water (RO) requiring off-site disposal, or depleted resin (ion exchange) requiring regeneration or off-site disposal. Due to additional treatment technologies required, these two alternatives are considered less favorable when compared to Alternatives 1 and 5.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with ISS, Cap, & MNA	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** CIP with Cap & Hydraulic Containment & Barrier Wall	**Alternative 5** CBR with MNA
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. Further releases from Alternative 5 (CBR with MNA) will not be addressed until construction is complete, but there is no further potential for release in the long-term making this the most favorable alternative. Alternatives 1 (CIP with MNA), 3 (CIP with HC), and 4 (CIP with HC and barrier) are less favorable either due to the moderate degree of effectiveness in controlling further releases or due to the amount of technologies included. Further releases under Alternative 2 (CIP with ISS) will not be addressed until construction is complete and the complexity of the stabilization makes this alternative less favorable.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with ISS, Cap, & MNA	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** CIP with Cap & Hydraulic Containment & Barrier Wall	**Alternative 5** CBR with MNA
CATEGORY 2 Effectiveness in controlling the source to reduce further releases	🟨	🟨	🟨	🟨	🟩

5.2.3 Balancing Criteria 3 - The Ease or Difficulty of Implementing a Potential Remedy

This balancing criterion takes into consideration technical and logistical challenges required to implement a remedy, including practical considerations such as equipment availability and disposal facility capacity.

5.2.3.1 Degree of difficulty associated with constructing the technology

CIP with a low permeability cap will be straightforward and can be implemented with common construction methods for Alternatives 1 (CIP with MNA), 3 (CIP with HC), and 4 (CIP with HC and barrier). Typical/Normal construction difficulties are anticipated if Alternatives 1, 3, or 4 are implemented with Alternative 4 being the most complex of these noted alternatives. Specialty equipment or contractors are not required. For Alternative 1 (CIP with MNA), no additional treatment technology is needed other than monitoring wells for groundwater monitoring. Installation of groundwater pumping wells with an ex-situ treatment system (Alternative 3) is expected to be straightforward. Alternative 4 is more complex with the addition of the barrier wall and is considered less favorable.

Alternatives 2 (CIP with ISS) and 5 (CBR with MNA) will be difficult to implement due to technical and logistical challenges. Alternative 5 will include a deep excavation and require the excavation of a substantial volume of CCR materials, dewatering, CCR stabilization, seasonal impacts to construction due to wet weather and winter weather, and transportation. In addition, the excavation of CCR materials proximate to the USACE Mississippi River levee system will require additional diligence and controls to ensure levee stability. For the CCR disposal in on-site lateral expansion of the CCR landfill for Alternative 5 (CBR with MNA), additional effort will be required for the design, permitting, approval, and construction. Under Alternative 2 (CIP with ISS), the successful completion of ISS to target depths will be technically challenging and will require field pilot testing to confirm equipment reach and stabilizing mix. Stabilization work adjacent to the levee system also has a high degree of difficulty, but overall has less material movement when compared to Alternative 5 (CBR with MNA). Alternatives 2 and 5 will both include large-scale construction, extensive permitting, specialty equipment and contractors, longer project durations, and significant technical challenges. Therefore, these Alternatives 2 and 5 are least favorable when compared to Alternatives 1, 3, and 4.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with ISS, Cap, & MNA	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** CIP with Cap & Hydraulic Containment & Barrier Wall	**Alternative 5** CBR with MNA
Category 3 - Subcriteria i) Degree of difficulty associated with constructing the technology	🟩	🟥	🟩	🟨	🟥

5.2.3.2 Expected operational reliability of the technologies

Alternative 1, (CIP with MNA) is considered the most favorable from an operational perspective because capping with MNA has a proven track record and requires limited O&M. While alternative 2 (CIP with ISS) is a proven technology and isolates the ponded material, pilot testing would be required to ensure ISS will be able to solidify CCR at depth. The potential for geochemical impact on the groundwater aquifer from the solidification amendments would need to be evaluated. Assuming successful implementation, ISS is also expected to be operationally reliable and is considered favorable. Alternative 5 (CBR with MNA) is considered a reliable alternative as all CCR material would be removed, although implementation would be challenging. Alternatives 3 (CIP with HC) and 4 (CIP with HC and barrier) are expected to be reliable but will utilize additional groundwater treatment technologies that will require significant O&M and will rely on mechanical systems to operate. Therefore, Alternatives 3 (CIP with HC) and 4 (CIP with HC and barrier) are considered less favorable.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with ISS, Cap, & MNA	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** CIP with Cap & Hydraulic Containment & Barrier Wall	**Alternative 5** CBR with MNA
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, (CIP with MNA), is the most favorable since the implementation of the remedy is straightforward and only includes capping and MNA with minimal permitting needs. Alternatives 2 (CIP with ISS) and 4 (CIP with HC and barrier) will require extensive permitting for large-scale construction in below grade soils adjacent to the levee system) and are considered least favorable.

Alternative 5 (CBR with MNA) also will require permitting for the excavation of CCR adjacent to the levee system. The associated lateral expansion of the existing CCR landfill will require a moderate amount of regulating agency interaction, but a solid waste permit already exists for the UWL expansions. The agency will need to approve the construction efforts of the lateral expansions. This alternative is considered less favorable when compared to Alternative 1 (CIP with MNA).

Additional approval and permitting may be required for Alternative 3 (CIP with HC) for the construction and installation of treatment systems and discharge of treated groundwater, but not to the extent contemplated for Alternatives 2 (CIP with ISS) and 4 (CIP with HC and barrier).

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with ISS, Cap, & MNA	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** CIP with Cap & Hydraulic Containment & Barrier Wall	**Alternative 5** CBR with MNA
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, (CIP with MNA), is the most favorable since specialty equipment and specialists will not be required to implement the capping or MNA remedy. Alternative 3 (CIP with HC) also consists of well understood and routine treatment systems. Alternative 4 (CIP with HC and barrier) also includes well understood and routine treatment systems but does require the availability of necessary equipment for the barrier wall construction, so this alternative is less favorable than Alternatives 1 and 3.

Alternatives 2 (CIP with ISS) and 5 (CBR with MNA) are the least favorable since both will require specialty remediation contractors to implement full removal or ISS, respectively, which will include large-scale construction dewatering and effluent management and treatment, deep excavations adjacent to the river and levee system, transportation of material for disposal, and implementation of ISS at depth (for Alternative 2 only). These two alternatives are considered the least favorable.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with ISS, Cap, & MNA	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** CIP with Cap & Hydraulic Containment & Barrier Wall	**Alternative 5** CBR with MNA
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

Since Pond 003 will be closed in place for Alternatives 1 through 4, storage and disposal services for CCR material will not be needed. Temporary stockpiling of CCR during regrading and capping can be completed within the current boundaries of the CCR unit. Alternative 1 (CIP with MNA) is the most favorable alternative since no active treatment is needed. Likewise, Alternative 2 (CIP with ISS) does not require any treatment or disposal capacity. It is assumed that any excavated/relocated CCR for the ISS construction would be used in developing final grades of the closure in place. If needed, the existing CCR landfill has capacity to dispose of any necessary CCR materials. Amendments such as Portland Cement will be imported to solidify the material in-situ, with the expectation that Portland Cement will be readily available.

Both Alternatives 3 (CIP with HC) and 4 (CIP with HC and barrier) require treatment systems which do not currently exist at the facility. The ex-situ treatment system may generate a concentrated waste stream which would require onsite treatment or off-site transportation and disposal that the other alternatives would not require. With the treatment system waste stream, Alternatives 3 and 4 are considered less favorable when compared to Alternatives 1 and 2.

Alternative 5 (CBR with MNA) required an evaluation of available capacity at existing CCR landfill. The existing on-site landfill was designed and permitted to manage ongoing production at the NMPP and not ponded CCR material. For Alternative 5 (CBR with MNA), new lateral expansions of the on-site landfill would need to be designed, constructed, and approved since the existing on-site landfills were designed and permitted to manage production needs of the NMPP. Alternative 5 is considered less favorable than Alternatives 1 and 2 since it requires extensive handling, and disposal management of CCR.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with ISS, Cap, & MNA	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** CIP with Cap & Hydraulic Containment & Barrier Wall	**Alternative 5** CBR with MNA
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 color ribbon below provides a summary of the ease or difficulty that will be needed to implement each alternative. Alternative 1 (CIP with MNA) is the most favorable, while Alternatives 3 and 4 are considered less favorable with moderate degrees of difficulty in implementing the remedy. Alternatives 2 and 5 have significant degrees of difficulty related to large-scale construction and permitting and are therefore considered least favorable.

	Alternative 1 CIP with Cap & MNA	**Alternative 2** CIP with ISS, Cap, & MNA	**Alternative 3** CIP with Cap & Hydraulic Containment	**Alternative 4** CIP with Cap & Hydraulic Containment & Barrier Wall	**Alternative 5** CBR with MNA
CATEGORY 3 The ease or difficulty of implementation	🟩	🟥	🟨	🟨	🟥

6. Summary

This Corrective Measures Assessment has evaluated the following alternatives:

- Alternative 1: CIP with low permeability capping and MNA;
- Alternative 2: CIP with ISS, low permeability capping and MNA;
- Alternative 3: CIP with low permeability capping, HC of groundwater through groundwater pumping, and ex-situ groundwater treatment;
- Alternative 4: CIP with low permeability capping, HC of groundwater through groundwater pumping, ex-situ groundwater treatment, and barrier wall; and
- Alternative 5: CBR with MNA.

In accordance with §257.97, each of these alternatives has been evaluated in the context of 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 §257.96, each of the alternatives has been evaluated in the context of the following balancing criteria, noting that these balancing criteria consider the sub-criteria evaluation factors of §257.97(c):

- 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.

This Corrective Measures Assessment, and the degree to which public comments are addressed, will be used to identify and select a final corrective measure for implementation at Pond 003. AECI understands that risk assessment evaluations confirm that Pond 003, even prior to closure, presents no unacceptable risk to human health or the environment. Therefore, since no adverse risk currently exists to human health and the environment, implementation of any of the remedies must consider the risk incurred during the implementation of the potential remedy activities.

In accordance with §257.98, AECI will implement a groundwater monitoring program to document the effectiveness of the selected remedial alternative. Corrective measures are considered complete when monitoring reflects groundwater downgradient of Pond 003 does not exceed Appendix IV 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.

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TABLES

TABLE I
SUMMARY OF ANALYTICAL RESULTS
Corrective Measures Assessment
AECI New Madrid Power Plant
New Madrid, Missouri

Location		Sample Date	USEPA Appendix IV Constituents														
			Antimony, Total mg/l	Arsenic, Total mg/l	Barium, Total mg/l	Beryllium, Total mg/l	Cadmium, Total mg/l	Chromium, Total mg/l	Cobalt, Total mg/l	Lead, Total mg/l	Lithium, Total mg/l	Molybdenum, Total mg/l	Selenium, Total mg/l	Thallium, Total mg/l	Mercury, Total mg/l	Fluoride, Total mg/l	Radium-226 & 228 Combined pCi/L
		Site GWPS	*0.006*	*0.010*	*2.0*	*0.004*	*0.005*	*0.100*	*0.006*	*0.015*	*0.040*	*0.100*	*0.050*	*0.002*	*0.002*	*4.0*	*5*
Up Gradient	MW-16	11/2/2016	<0.0010	**0.0026**	**0.773**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.026**	<0.0100	<0.0010	<0.0010	<0.00020	**1.22**	**1.85**
		12/9/2016	<0.0010	**0.0029**	**0.783**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.027**	<0.0100	<0.0010	<0.0010	<0.00020	**1.37**	**0.98**
		1/7/2017	<0.0030	**0.0027**	**0.800**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.033**	<0.0010	<0.0010	<0.0010	<0.00020	**1.10**	**2.34**
		1/30/2017	<0.0030	**0.0026**	**0.730**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.030**	<0.0010	<0.0010	<0.0010	<0.00020	**1.55**	**1.78**
		2/21/2017	<0.0030	**0.0025**	**0.760**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.031**	<0.0010	<0.0010	<0.0010	<0.00020	**1.18**	**1.16**
		3/28/2017	<0.0030	**0.0025**	**0.760**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.031**	<0.0010	<0.0010	<0.0010	<0.00020	**1.44**	**2.33**
		4/27/2017	<0.0030	**0.0025**	**0.760**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.030**	<0.0010	<0.0010	<0.0010	<0.00020	**1.38**	**1.84**
		5/18/2017	<0.0030	**0.0027**	**0.750**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.033**	<0.0010	<0.0010	<0.0010	<0.00020	**1.59**	**1.93**
		6/24/2017	<0.0030	**0.0020**	**0.720**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.030**	<0.0010	<0.0010	<0.0010	<0.00020	**1.18**	**1.79**
		8/15/2017	<0.0030	**0.0021**	**0.700**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.033**	<0.0010	<0.0010	<0.0010	<0.00020	**1.27**	**1.4**
		5/30/2018	<0.0030	**0.0020**	**0.72**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.025**	**0.0045**	<0.0010	<0.0010	<0.00020	**1.20**	**2.60**
		9/12/2018	--	**0.0023**	**0.69**	--	--	<0.0040	<0.00086	<0.0010	**0.019**	<0.0010	<0.0010	--	--	**1.20**	**2.78**
	B-123	11/6/2016	<0.0010	**0.0024**	**0.239**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0276**	<0.0100	<0.0010	<0.0010	<0.00020	**0.52**	**0.97**
		12/12/2016	<0.0010	**0.0011**	**0.206**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0274**	<0.0100	<0.0010	<0.0010	<0.00020	**0.57**	**0.71**
		1/8/2017	<0.0030	**0.0014**	**0.21**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.033**	**0.0030**	<0.0010	<0.0010	<0.00020	**0.446**	**0.641**
		1/24/2017	<0.0030	**0.0017**	**0.20**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.032**	**0.0035**	<0.0010	<0.0010	**0.00087**	**0.523**	**1.06**
		2/23/2017	<0.0030	**0.0023**	**0.22**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.031**	**0.0036**	<0.0010	<0.0010	<0.00020	**0.540**	**1.37**
		4/25/2017	<0.0030	**0.0025**	**0.24**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.029**	**0.0036**	<0.0010	<0.0010	<0.00020	**0.532**	**0.83**
		5/16/2017	<0.0030	**0.0020**	**0.21**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.030**	**0.0036**	<0.0010	<0.0010	<0.00020	**0.302**	**1.35**
		6/21/2017	<0.0030	**0.0017**	**0.19**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.029**	**0.0036**	<0.0010	<0.0010	<0.00020	**0.429**	**0.668**
		8/28/2017	<0.0030	**0.0020**	**0.20**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.029**	**0.0034**	<0.0010	<0.0010	<0.00020	**0.574**	**1.93**
		5/30/2018	<0.0030	**0.0022**	**0.21**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.026**	**0.0044**	<0.0010	<0.0010	<0.00020	**0.537**	**1.80**
		9/11/2018	--	**0.0040**	**0.27**	--	--	<0.0040	<0.00086	<0.0010	**0.019**	**0.0040**	<0.0010	--	--	**0.521**	**1.57**
	B-126	11/6/2016	<0.0010	**0.0099**	**0.400**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0159**	<0.0100	<0.0010	<0.0010	<0.00020	**0.39**	**0.70**
		12/12/2016	<0.0010	**0.0076**	**0.447**	<0.0010	<0.0010	**0.0013**	<0.0050	<0.0010	**0.0244**	<0.0100	<0.0010	<0.0010	<0.00020	**0.39**	**1.11**
		1/8/2017	<0.0030	**0.0063**	**0.250**	<0.0010	<0.0010	<0.0040	**0.0020**	**0.0011**	**0.016**	<0.0010	<0.0010	<0.0010	<0.00020	**0.376**	**0.342**
		1/24/2017	<0.0030	**0.0050**	**0.23**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.013**	<0.0010	<0.0010	<0.0010	<0.00020	**0.457**	**0**
		2/23/2017	<0.0030	**0.0067**	**0.28**	<0.0010	<0.0010	<0.0040	**0.0021**	<0.0010	**0.015**	<0.0010	<0.0010	<0.0010	<0.00020	**0.525**	**1.16**
		4/25/2017	<0.0030	**0.0084**	**0.21**	<0.0010	<0.0010	**0.0047**	**0.0026**	**0.0020**	**0.013**	<0.0010	<0.0010	<0.0010	<0.00020	**0.388**	**1.27**
		5/16/2017	<0.0030	**0.0085**	**0.13**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	<0.010	<0.0010	<0.0010	<0.0010	<0.00020	**0.258**	**1.83**
		6/21/2017	<0.0030	**0.0094**	**0.16**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	<0.010	<0.0010	<0.0010	<0.0010	<0.00020	**0.398**	**0.51**
		8/28/2017	<0.0030	**0.0097**	**0.21**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.010**	<0.0010	<0.0010	<0.0010	<0.00020	**0.493**	**2.01**
		5/30/2018	<0.0030	**0.0086**	**0.24**	<0.0010	<0.0010	**0.0094**	**0.0030**	**0.0043**	**0.013**	**0.0014**	**0.0012**	<0.0010	<0.00020	**0.383**	**2.20**
		9/11/2018	--	**0.0052**	**0.31**	--	--	<0.0040	**0.0019**	<0.0010	**0.011**	<0.0010	<0.0010	--	--	**0.284**	**1.13**

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			Antimony, Total mg/l	Arsenic, Total mg/l	Barium, Total mg/l	Beryllium, Total mg/l	Cadmium, Total mg/l	Chromium, Total mg/l	Cobalt, Total mg/l	Lead, Total mg/l	Lithium, Total mg/l	Molybdenum, Total mg/l	Selenium, Total mg/l	Thallium, Total mg/l	Mercury, Total mg/l	Fluoride, Total mg/l	Radium-226 & 228 Combined pCi/L
		Site GWPS	*0.006*	*0.010*	*2.0*	*0.004*	*0.005*	*0.100*	*0.006*	*0.015*	*0.040*	*0.100*	*0.050*	*0.002*	*0.002*	*4.0*	*5*
Down Gradient	MW-6	11/3/2016	<0.0010	<0.0010	**0.131**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0168**	<0.0100	<0.0010	<0.0010	<0.00020	**0.36**	**0.77**
		11/3/2016	<0.0010	<0.0010	**0.134**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0173**	<0.0100	<0.0010	<0.0010	<0.00020	**0.36**	**0.74**
		12/6/2016	<0.0010	**0.0022**	**0.137**	<0.0010	<0.0010	**0.0022**	<0.0050	<0.0010	**0.0181**	**0.0417**	<0.0010	<0.0010	<0.00020	**0.32**	**1.56**
		1/4/2017	<0.0030	**0.0012**	**0.14**	<0.0010	<0.0010	<0.0040	**0.0036**	<0.0010	**0.023**	**0.046**	<0.0010	<0.0010	<0.00020	**0.536**	**1.26**
		1/26/2017	<0.0030	**0.0019**	**0.16**	<0.0010	<0.0010	<0.0040	**0.0033**	<0.0010	**0.021**	**0.071**	<0.0010	<0.0010	<0.00020	**0.564**	**1.92**
		2/21/2017	<0.0030	**0.0010**	**0.16**	<0.0010	<0.0010	<0.0040	**0.0047**	<0.0010	**0.021**	**0.034**	<0.0010	<0.0010	<0.00020	**0.308**	**1.07**
		3/28/2017	<0.0030	<0.0010	**0.17**	<0.0010	<0.0010	<0.0040	**0.0046**	<0.0010	**0.022**	**0.033**	<0.0010	<0.0010	<0.00020	**0.519**	**1.09**
		4/27/2017	<0.0030	**0.0016**	**0.18**	<0.0010	<0.0010	<0.0040	**0.0041**	<0.0010	**0.019**	**0.085**	<0.0010	<0.0010	<0.00020	**0.328**	**1.33**
		4/27/2017	<0.0030	**0.0014**	**0.17**	<0.0010	<0.0010	<0.0040	**0.0040**	<0.0010	**0.018**	**0.080**	<0.0010	<0.0010	<0.00020	**0.314**	**1.34**
		5/18/2017	<0.0030	<0.0010	**0.18**	<0.0010	<0.0010	<0.0040	**0.0050**	<0.0010	**0.023**	**0.048**	<0.0010	<0.0010	<0.00020	<0.250	**1.05**
		6/20/2017	<0.0030	**0.0012**	**0.16**	<0.0010	<0.0010	<0.0040	**0.0054**	<0.0010	**0.022**	**0.021**	**0.0010**	<0.0010	<0.00020	**0.362**	**2.39**
		8/16/2017	<0.0030	<0.0010	**0.15**	<0.0010	<0.0010	<0.0040	**0.0060**	<0.0010	**0.024**	**0.010**	<0.0010	<0.0010	<0.00020	**0.316**	**1.65**
		5/30/2018	<0.0030	<0.0010	**0.16**	<0.0010	<0.0010	<0.0040	**0.0052**	<0.0010	**0.018**	**0.063**	<0.0010	<0.0010	<0.00020	**0.349**	**0.68**
		9/11/2018	--	<0.0010	**0.11**	--	--	<0.0040	**0.0028**	<0.0010	<0.010	**0.042**	<0.0010	--	--	**0.319**	**0.790**
	MW-7	11/3/2016	<0.0010	**0.0021**	**0.181**	<0.0010	<0.0010	<0.0010	**0.0062**	<0.0010	**0.0223**	**3.20**	<0.0010	<0.0010	<0.00020	**0.34**	**1.13**
		12/6/2016	<0.0010	**0.0032**	**0.150**	<0.0010	**0.0011**	<0.0010	**0.0098**	<0.0010	**0.0227**	**3.24**	<0.0010	<0.0010	<0.00020	**0.33**	**1.10**
		1/4/2017	<0.0030	**0.0045**	**0.11**	<0.0010	**0.0012**	<0.0040	**0.0067**	<0.0010	**0.031**	**2.8**	<0.0010	<0.0010	<0.00020	**0.464**	**1.28**
		1/26/2017	<0.0030	**0.0036**	**0.12**	<0.0010	**0.0016**	<0.0040	**0.0059**	<0.0010	**0.027**	**2.9**	<0.0010	<0.0010	<0.00020	**0.564**	**0.78**
		2/22/2017	<0.0030	**0.0021**	**0.15**	<0.0010	<0.0010	<0.0040	**0.0068**	<0.0010	**0.030**	**3.4**	<0.0010	<0.0010	<0.00020	**0.287**	**3.80**
		3/30/2017	<0.0030	**0.0018**	**0.15**	<0.0010	<0.0010	<0.0040	**0.0067**	<0.0010	**0.028**	**3.4**	<0.0010	<0.0010	<0.00020	**0.496**	**1.40**
		4/26/2017	<0.0030	**0.0034**	**0.14**	<0.0010	**0.0014**	<0.0040	**0.0051**	<0.0010	**0.027**	**3.9**	<0.0010	<0.0010	<0.00020	**0.277**	**1.73**
		5/18/2017	<0.0030	**0.0037**	**0.14**	<0.0010	<0.0010	<0.0040	**0.0030**	<0.0010	**0.034**	**3.9**	<0.0010	<0.0010	<0.00020	<0.250	**2.72**
		6/20/2017	<0.0030	**0.0028**	**0.15**	<0.0010	**0.0016**	<0.0040	**0.0070**	**0.0018**	**0.028**	**3.5**	**0.0021**	**0.0020**	<0.00020	**0.388**	**1.71**
		8/16/2017	<0.0030	**0.0020**	**0.17**	<0.0010	<0.0010	<0.0040	**0.0073**	<0.0010	**0.031**	**3.6**	<0.0010	<0.0010	<0.00020	**0.410**	**1.54**
		5/30/2018	<0.0030	**0.0023**	**0.13**	<0.0010	<0.0010	<0.0040	**0.0058**	<0.0010	**0.019**	**3.4**	<0.0010	<0.0010	<0.00020	**0.431**	**0.63**
		9/11/2018	--	**0.0024**	**0.14**	--	--	<0.0040	**0.0076**	<0.0010	**0.014**	**3.0**	<0.0010	--	--	**0.330**	**1.36**
	MW-8	11/4/2016	<0.0010	**0.0040**	**0.115**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0197**	**0.737**	<0.0010	<0.0010	<0.00020	**0.29**	**1.36**
		12/7/2016	<0.0010	**0.0026**	**0.111**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0223**	**0.706**	<0.0010	<0.0010	<0.00020	**0.29**	**1.46**
		1/5/2017	<0.0030	**0.0046**	**0.066**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.023**	**0.96**	<0.0010	<0.0010	<0.00020	**0.366**	**0.56**
		1/5/2017	<0.0030	**0.0049**	**0.068**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.023**	**0.96**	<0.0010	<0.0010	<0.00020	**0.367**	**2.82**
		1/26/2017	<0.0030	**0.0045**	**0.085**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.022**	**0.87**	<0.0010	<0.0010	<0.00020	**0.538**	**0.822**
		2/21/2017	<0.0030	**0.0057**	**0.10**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.025**	**0.83**	<0.0010	<0.0010	<0.00020	**0.288**	**2.29**
		3/30/2017	<0.0030	**0.0054**	**0.11**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.025**	**0.83**	<0.0010	<0.0010	<0.00020	**0.475**	**1.35**
		4/26/2017	<0.0030	**0.0050**	**0.082**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.018**	**1.0**	<0.0010	<0.0010	<0.00020	**0.300**	**1.01**
		5/17/2017	<0.0030	**0.0062**	**0.098**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.022**	**1.2**	<0.0010	<0.0010	<0.00020	**0.348**	**1.43**
		6/21/2017	<0.0030	**0.0060**	**0.10**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.022**	**0.93**	<0.0010	<0.0010	<0.00020	**0.361**	**1.42**
		8/16/2017	<0.0030	**0.0048**	**0.10**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.025**	**1.0**	<0.0010	<0.0010	<0.00020	**0.376**	**0.91**
		5/30/2018	<0.0030	**0.0053**	**0.082**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.017**	**0.93**	<0.0010	<0.0010	<0.00020	**0.343**	**1.07**
		9/12/2018	--	**0.0045**	**0.082**	--	--	<0.0040	**0.0016**	<0.0010	**0.012**	**0.86**	<0.0010	--	--	**0.290**	**0.840**

TABLE I
SUMMARY OF ANALYTICAL RESULTS
Corrective Measures Assessment
AECI New Madrid Power Plant
New Madrid, Missouri

Location		Sample Date	USEPA Appendix IV Constituents														
			Antimony, Total mg/l	Arsenic, Total mg/l	Barium, Total mg/l	Beryllium, Total mg/l	Cadmium, Total mg/l	Chromium, Total mg/l	Cobalt, Total mg/l	Lead, Total mg/l	Lithium, Total mg/l	Molybdenum, Total mg/l	Selenium, Total mg/l	Thallium, Total mg/l	Mercury, Total mg/l	Fluoride, Total mg/l	Radium-226 & 228 Combined pCi/L
		Site GWPS	*0.006*	*0.010*	*2.0*	*0.004*	*0.005*	*0.100*	*0.006*	*0.015*	*0.040*	*0.100*	*0.050*	*0.002*	*0.002*	*4.0*	*5*
Down Gradient	MW-9	11/4/2016	<0.0010	<0.0010	**0.0984**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0258**	**0.312**	<0.0010	<0.0010	<0.00020	**0.53**	**3.12**
		12/7/2016	<0.0010	<0.0010	**0.0842**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0296**	**0.337**	**0.0015**	<0.0010	<0.00020	**0.49**	**1.40**
		1/5/2017	<0.0030	<0.0010	**0.075**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.034**	**0.32**	<0.0010	<0.0010	<0.00020	**0.508**	**1.56**
		1/27/2017	<0.0030	<0.0010	**0.072**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.030**	**0.35**	<0.0010	<0.0010	<0.00020	**0.557**	**0.53**
		2/21/2017	<0.0030	<0.0010	**0.089**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.031**	**0.33**	<0.0010	<0.0010	<0.00020	**0.481**	**1.47**
		3/30/2017	<0.0030	<0.0010	**0.080**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.030**	**0.33**	<0.0010	<0.0010	<0.00020	**0.654**	**1.42**
		4/26/2017	<0.0030	<0.0010	**0.069**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.025**	**0.42**	<0.0010	<0.0010	<0.00020	**0.481**	**0.65**
		5/17/2017	<0.0030	<0.0010	**0.098**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.034**	**0.44**	<0.0010	<0.0010	<0.00020	<0.250	**1.30**
		6/20/2017	<0.0030	<0.0010	**0.092**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.029**	**0.36**	<0.0010	<0.0010	<0.00020	**0.507**	**0.71**
		6/20/2017	<0.0030	<0.0010	**0.092**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.030**	**0.35**	<0.0010	<0.0010	<0.00020	**0.528**	**0.46**
		8/16/2017	<0.0030	<0.0010	**0.097**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.035**	**0.35**	<0.0010	<0.0010	<0.00020	**0.561**	**0.98**
		5/30/2018	<0.0030	<0.0010	**0.089**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.026**	**0.34**	<0.0010	<0.0010	<0.00020	**0.496**	**0.599**
		9/12/2018	--	<0.0010	**0.074**	--	--	<0.0040	<0.00086	<0.0010	**0.021**	**0.34**	<0.0010	--	--	**0.440**	**0.216**
	P-1	11/5/2016	<0.0010	<0.0010	**0.0533**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0221**	**0.0194**	**0.0014**	<0.0010	<0.00020	**0.38**	**1.48**
		12/8/2016	<0.0010	<0.0010	**0.0552**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0248**	**0.0506**	<0.0010	<0.0010	<0.00020	**0.44**	**NS**
		12/8/2016	<0.0010	<0.0010	**0.0534**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0240**	**0.0378**	<0.0010	<0.0010	<0.00020	**0.43**	**NS**
		1/6/2017	<0.0030	<0.0010	**0.051**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.028**	**0.034**	<0.0010	<0.0010	<0.00020	**0.552**	**1.29**
		1/28/2017	<0.0030	<0.0010	**0.053**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.029**	**0.024**	**0.0062**	<0.0010	<0.00020	**0.516**	**0.75**
		2/21/2017	<0.0030	<0.0010	**0.065**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.029**	**0.013**	**0.0051**	<0.0010	<0.00020	**0.364**	**1.28**
		3/30/2017	<0.0030	<0.0010	**0.070**	<0.0010	<0.0010	**0.018**	<0.0020	<0.0010	**0.030**	**0.011**	**0.0038**	<0.0010	<0.00020	**0.519**	**1.54**
		4/26/2017	**0.0031**	<0.0010	**0.063**	<0.0010	<0.0010	**0.0051**	<0.0020	<0.0010	**0.026**	**0.013**	**0.0037**	<0.0010	<0.00020	**0.378**	**0.78**
		5/17/2017	<0.0030	<0.0010	**0.068**	<0.0010	<0.0010	**0.0071**	<0.0020	<0.0010	**0.031**	**0.015**	**0.0052**	<0.0010	<0.00020	<0.250	**1.98**
		6/21/2017	<0.0030	<0.0010	**0.062**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.027**	**0.011**	**0.0054**	<0.0010	<0.00020	**0.411**	**1.34**
		8/16/2017	<0.0030	<0.0010	**0.055**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.030**	**0.011**	**0.0033**	<0.0010	<0.00020	**0.416**	**0.63**
		5/29/2018	<0.0030	<0.0010	**0.063**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.024**	**0.013**	**0.0054**	<0.0010	<0.00020	**0.420**	**0.76**
		9/12/2018	--	<0.0010	**0.059**	--	--	**0.0071**	<0.00086	<0.0010	**0.020**	**0.023**	**0.0044**	--	--	**0.340**	**0.663**
	P-2	11/4/2016	<0.0010	<0.0010	**0.0963**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0188**	**0.279**	**0.0014**	<0.0010	<0.00020	**0.52**	**0.00**
		12/7/2016	<0.0010	<0.0010	**0.0888**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0174**	**0.351**	**0.0010**	<0.0010	<0.00020	**0.61**	**2.05**
		1/5/2017	<0.0030	<0.0010	**0.076**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.020**	**0.35**	<0.0010	<0.0010	<0.00020	**0.643**	**0.74**
		1/28/2017	<0.0030	<0.0010	**0.075**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.016**	**0.34**	**0.0011**	<0.0010	<0.00020	**0.662**	**0.73**
		1/28/2017	<0.0030	<0.0010	**0.077**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.022**	**0.35**	<0.0010	<0.0010	<0.00020	**0.767**	**0.83**
		2/21/2017	<0.0030	<0.0010	**0.098**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.024**	**0.29**	**0.0012**	<0.0010	<0.00020	**0.512**	**1.15**
		3/30/2017	<0.0030	<0.0010	**0.094**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.023**	**0.29**	**0.0011**	<0.0010	<0.00020	**0.679**	**1.33**
		4/26/2017	<0.0030	<0.0010	**0.084**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.018**	**0.31**	<0.0010	<0.0010	<0.00020	**0.566**	**1.01**
		5/17/2017	<0.0030	<0.0020	**0.082**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.022**	**0.32**	<0.0020	<0.0010	<0.00020	**0.306**	**0.45**
		6/20/2017	<0.0030	**0.0010**	**0.086**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.022**	**0.27**	**0.0022**	<0.0010	<0.00020	**0.534**	**1.47**
		8/17/2016	<0.0030	<0.0010	**0.100**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.028**	**0.27**	**0.0014**	<0.0010	<0.00020	**0.520**	**0.52**
		6/1/2018	<0.0030	<0.0010	**0.096**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.020**	**0.32**	**0.0015**	<0.0010	<0.00020	**0.544**	**1.04**
		5/29/2018	<0.0030	<0.0010	**0.095**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.019**	**0.32**	**0.0014**	<0.0010	<0.00020	**0.542**	**0.395**
		9/12/2018	--	<0.0010	**0.067**	--	--	<0.0040	<0.00086	<0.0010	<0.010	**0.32**	<0.0010	--	--	**0.561**	**0.428**

TABLE I
SUMMARY OF ANALYTICAL RESULTS
Corrective Measures Assessment
AECI New Madrid Power Plant
New Madrid, Missouri

Location		Sample Date	USEPA Appendix IV Constituents														
			Antimony, Total mg/l	**Arsenic, Total mg/l**	**Barium, Total mg/l**	**Beryllium, Total mg/l**	**Cadmium, Total mg/l**	**Chromium, Total mg/l**	**Cobalt, Total mg/l**	**Lead, Total mg/l**	**Lithium, Total mg/l**	**Molybdenum, Total mg/l**	**Selenium, Total mg/l**	**Thallium, Total mg/l**	**Mercury, Total mg/l**	**Fluoride, Total mg/l**	**Radium-226 & 228 Combined pCi/L**
		Site GWPS	*0.006*	*0.010*	*2.0*	*0.004*	*0.005*	*0.100*	*0.006*	*0.015*	*0.040*	*0.100*	*0.050*	*0.002*	*0.002*	*4.0*	*5*
Down Gradient	P-3	11/4/2016	<0.0010	<0.0010	**0.102**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0250**	**1.28**	**0.0041**	<0.0010	<0.00020	**0.36**	**0.29**
		12/7/2016	<0.0010	<0.0010	**0.111**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0285**	**1.56**	**0.0080**	<0.0010	<0.00020	**0.48**	**1.03**
		1/5/2017	<0.0030	<0.0010	**0.098**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.033**	**1.4**	**0.0046**	<0.0010	<0.00020	**0.481**	**0.72**
		1/28/2017	<0.0030	<0.0010	**0.10**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.027**	**1.3**	**0.0029**	<0.0010	<0.00020	**0.463**	**0.77**
		2/21/2017	<0.0030	<0.0010	**0.10**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.030**	**1.2**	**0.0042**	<0.0010	<0.00020	**0.381**	**1.40**
		3/30/2017	<0.0030	<0.0010	**0.10**	<0.0010	<0.0010	<0.0040	<0.0020	**0.0047**	**0.030**	**1.1**	**0.0048**	<0.0010	<0.00020	**0.591**	**0.30**
		3/30/2017	<0.0030	<0.0010	**0.10**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.030**	**1.1**	**0.0045**	<0.0010	<0.00020	**0.588**	**0.77**
		4/26/2017	<0.0030	<0.0010	**0.10**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.027**	**1.4**	**0.0036**	<0.0010	<0.00020	**0.463**	**0.49**
		5/17/2017	<0.0030	<0.0010	**0.093**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.032**	**1.1**	**0.0037**	<0.0010	<0.00020	<0.250	**0.86**
		6/20/2017	<0.0030	<0.0010	**0.095**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.029**	**1.0**	**0.0060**	<0.0010	<0.00020	**0.461**	**1.65**
		8/16/2017	<0.0030	<0.0010	**0.098**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.031**	**1.3**	**0.0046**	<0.0010	<0.00020	**0.482**	**1.00**
		5/29/2018	<0.0030	<0.0010	**0.095**	<0.0010	<0.0010	**0.0048**	<0.0020	**0.0016**	**0.023**	**1.3**	**0.0054**	<0.0010	<0.00020	**0.560**	**0.604**
		9/12/2018	--	<0.0010	**0.086**	--	--	<0.0040	<0.00086	<0.0010	**0.018**	**1.4**	**0.0057**	--	--	**0.426**	**0.125**
	P-4	11/4/2016	<0.0010	<0.0010	**0.144**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0379**	**0.0320**	**0.0022**	<0.0010	<0.00020	**0.34**	**0.53**
		12/7/2016	<0.0010	<0.0010	**0.109**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0251**	**0.0318**	**0.0010**	<0.0010	<0.00020	**0.48**	**1.45**
		1/5/2017	<0.0030	<0.0010	**0.12**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.031**	**0.033**	**0.0018**	<0.0010	<0.00020	**0.568**	**0.89**
		1/28/2017	<0.0030	<0.0010	**0.11**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.029**	**0.031**	<0.0010	<0.0010	<0.00020	**0.469**	**0.48**
		2/21/2017	<0.0030	<0.0010	**0.13**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.043**	**0.029**	**0.0014**	<0.0010	<0.00020	**0.362**	**0.45**
		3/30/2017	<0.0030	<0.0010	**0.13**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.041**	**0.029**	**0.0019**	<0.0010	<0.00020	**0.543**	**0.11**
		4/26/2017	<0.0030	<0.0010	**0.12**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.032**	**0.030**	<0.0010	<0.0010	<0.00020	**0.381**	**0.76**
		5/17/2017	<0.0030	<0.0010	**0.11**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.038**	**0.027**	<0.0010	<0.0010	<0.00020	<0.250	**0.98**
		5/17/2017	<0.0030	<0.0020	**0.12**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.038**	**0.029**	<0.0020	<0.0010	<0.00020	<0.250	**1.60**
		6/20/2017	<0.0030	<0.0010	**0.12**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.043**	**0.026**	**0.0019**	<0.0010	<0.00020	**0.380**	**1.09**
		8/16/2017	<0.0030	<0.0010	**0.14**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.050**	**0.030**	**0.0024**	<0.0010	<0.00020	<0.250	**0.86**
		5/29/2018	<0.0030	<0.0010	**0.11**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.030**	**0.033**	**0.0030**	<0.0010	<0.00020	**0.357**	**0.594**
		9/12/2018	--	<0.0010	**0.11**	--	--	<0.0040	<0.00086	<0.0010	**0.028**	**0.025**	**0.0022**	--	--	**0.369**	**0.297**

TABLE I
SUMMARY OF ANALYTICAL RESULTS
Corrective Measures Assessment
AECI New Madrid Power Plant
New Madrid, Missouri

Location		Sample Date	USEPA Appendix IV Constituents														
			Antimony, Total mg/l	Arsenic, Total mg/l	Barium, Total mg/l	Beryllium, Total mg/l	Cadmium, Total mg/l	Chromium, Total mg/l	Cobalt, Total mg/l	Lead, Total mg/l	Lithium, Total mg/l	Molybdenum, Total mg/l	Selenium, Total mg/l	Thallium, Total mg/l	Mercury, Total mg/l	Fluoride, Total mg/l	Radium-226 & 228 Combined pCi/L
		Site GWPS	*0.006*	*0.010*	*2.0*	*0.004*	*0.005*	*0.100*	*0.006*	*0.015*	*0.040*	*0.100*	*0.050*	*0.002*	*0.002*	*4.0*	*5*
Down Gradient	P-5	11/3/2016	<0.0010	**0.0053**	**0.125**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0179**	**0.235**	<0.0010	<0.0010	<0.00020	**0.18**	**2.00**
		12/6/2016	<0.0010	**0.0081**	**0.110**	<0.0010	<0.0010	<0.0010	<0.0050	<0.0010	**0.0169**	**0.235**	<0.0010	<0.0010	<0.00020	**0.20**	**1.42**
		1/4/2017	<0.0030	**0.0056**	**0.13**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.025**	**0.25**	<0.0010	<0.0010	<0.00020	<0.250	**1.65**
		1/26/2017	<0.0030	**0.0068**	**0.14**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.024**	**0.23**	<0.0010	<0.0010	<0.00020	**0.364**	**0.28**
		2/22/2017	<0.0030	**0.011**	**0.15**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.024**	**0.27**	<0.0010	<0.0010	<0.00020	<0.250	**1.23**
		3/30/2017	<0.0030	**0.0089**	**0.15**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.024**	**0.25**	<0.0010	<0.0010	<0.00020	**0.438**	**2.06**
		4/26/2017	<0.0030	**0.0099**	**0.17**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.022**	**0.30**	<0.0010	<0.0010	<0.00020	<0.250	**1.99**
		5/18/2017	<0.0030	**0.0069**	**0.18**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.030**	**0.36**	<0.0010	<0.0010	<0.00020	<0.250	**1.30**
		6/20/2017	<0.0030	**0.0083**	**0.16**	<0.0010	<0.0010	<0.0040	**0.0020**	<0.0010	**0.026**	**0.26**	**0.0015**	<0.0010	<0.00020	**0.272**	**2.16**
		8/16/2017	<0.0030	**0.0064**	**0.13**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.024**	**0.23**	<0.0010	<0.0010	<0.00020	<0.250	**1.22**
		5/29/2018	<0.0030	**0.0066**	**0.17**	<0.0010	<0.0010	<0.0040	<0.0020	<0.0010	**0.022**	**0.28**	<0.0010	<0.0010	<0.00020	<0.250	**1.23**
		9/11/2018	--	**0.0066**	**0.12**	--	--	<0.0040	**0.0012**	<0.0010	**0.012**	**0.26** 🟨	<0.0010	--	--	<0.250	**2.40**

Notes:
Bold value: Detection above laboratory reporting limit
🟨 Statistically significant level concentration
GWPS: Groundwater Protection Standards
mg/L: milligram per liter
"-- " Constituent not analyzed
NS: No Sample, sample was lost in transit.
pCi/L: picoCurie per liter

TABLE II

SUMMARY OF CORRECTIVE MEASURES

CORRECTIVE MEASURES ASSESSMENT
AECI - NEW MADRID POWER PLANT- POND 003
NEW MADRID, MISSOURI

Alternative Number	Remedial Alternative Description	THRESHOLD CRITERIA					BALANCING CRITERIA																	
							CATEGORY 1 Long- and Short Term Effectiveness, Protectiveness, and Certainty of Success that the Remedy will Prove Successful	Sub-Category 1								**CATEGORY 2** Effectiveness in Controlling the Source to Reduce Further Releases	Sub-Cat. 2		**CATEGORY 3** The Ease or Difficulty of Implementation	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 all applicable RCRA requirements		*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*		*Extent to which containment practices will reduce further releases*	*Extent to which treatment technologies may be used*		*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	**Closure In Place (CIP) with Capping and Monitored Natural Attenuation (MNA)**	✓	✓	✓	✓	✓	🟩	🟩	🟨	🟩	🟩	🟨	🟩	🟨	🟨	🟨	🟨	🟩	🟩	🟩	🟩	🟩	🟩	🟩
2	**CIP with In-Situ Stabilization (ISS), Capping, and MNA**	✓	✓	✓	✓	✓	🟨	🟨	🟨	🟩	🟨	🟨	🟥	🟩	🟩	🟨	🟨	🟨	🟥	🟥	🟩	🟥	🟥	🟩
3	**CIP with Capping and Hydraulic Containment through Groundwater Pumping**	✓	✓	✓	✓	✓	🟨	🟩	🟨	🟥	🟩	🟨	🟨	🟨	🟨	🟨	🟩	🟨	🟨	🟩	🟨	🟨	🟩	🟨
4	**CIP with Capping and Hydraulic Containment through Groundwater Pumping and Barrier Wall**	✓	✓	✓	✓	✓	🟨	🟩	🟨	🟥	🟨	🟨	🟨	🟨	🟨	🟨	🟩	🟨	🟨	🟨	🟨	🟥	🟨	🟨
5	**Closure by Removal with 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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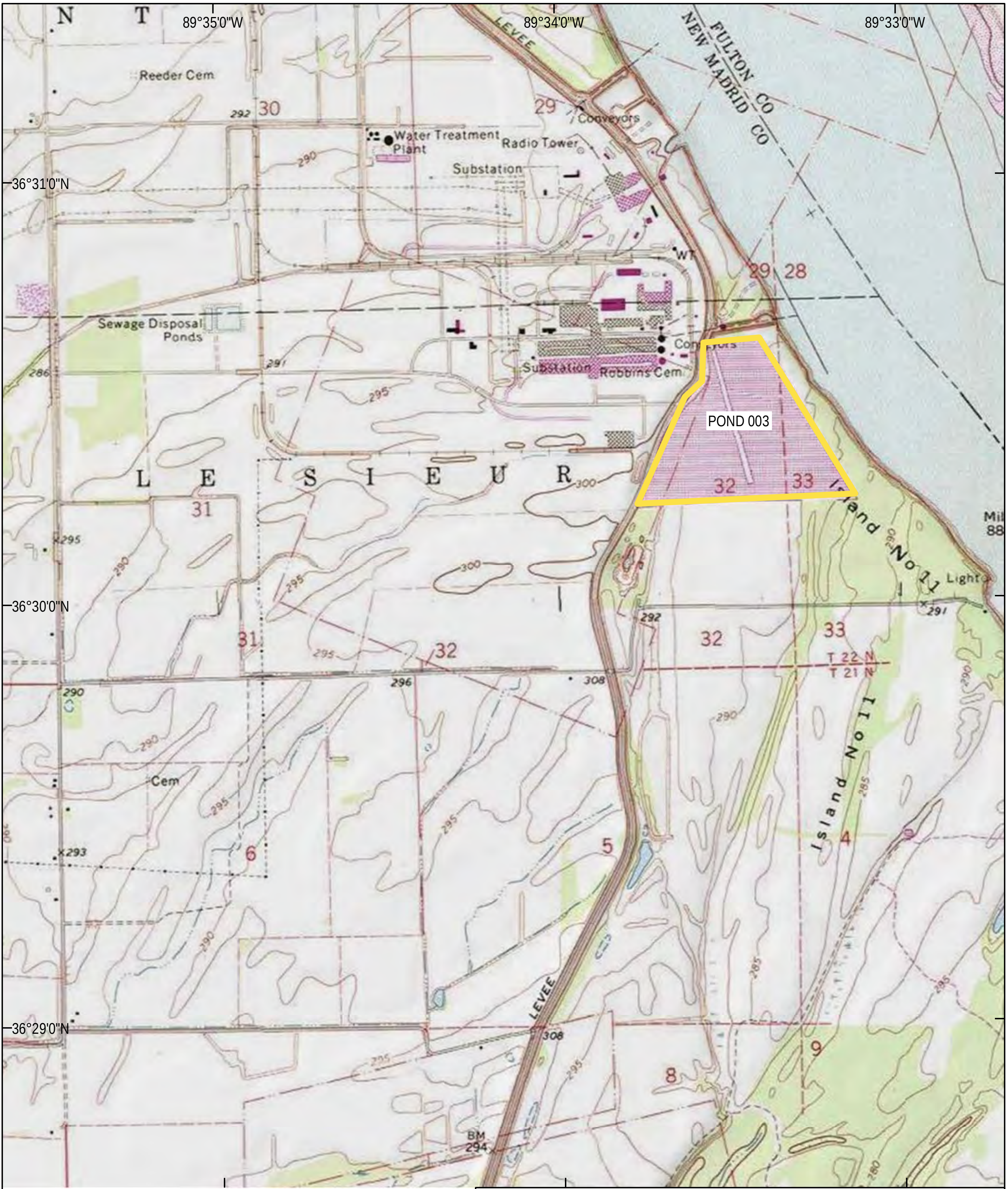
FIGURES



MAP SOURCE: ESRI
SITE COORDINATES: 36°30'23"N, 89°33'29"W

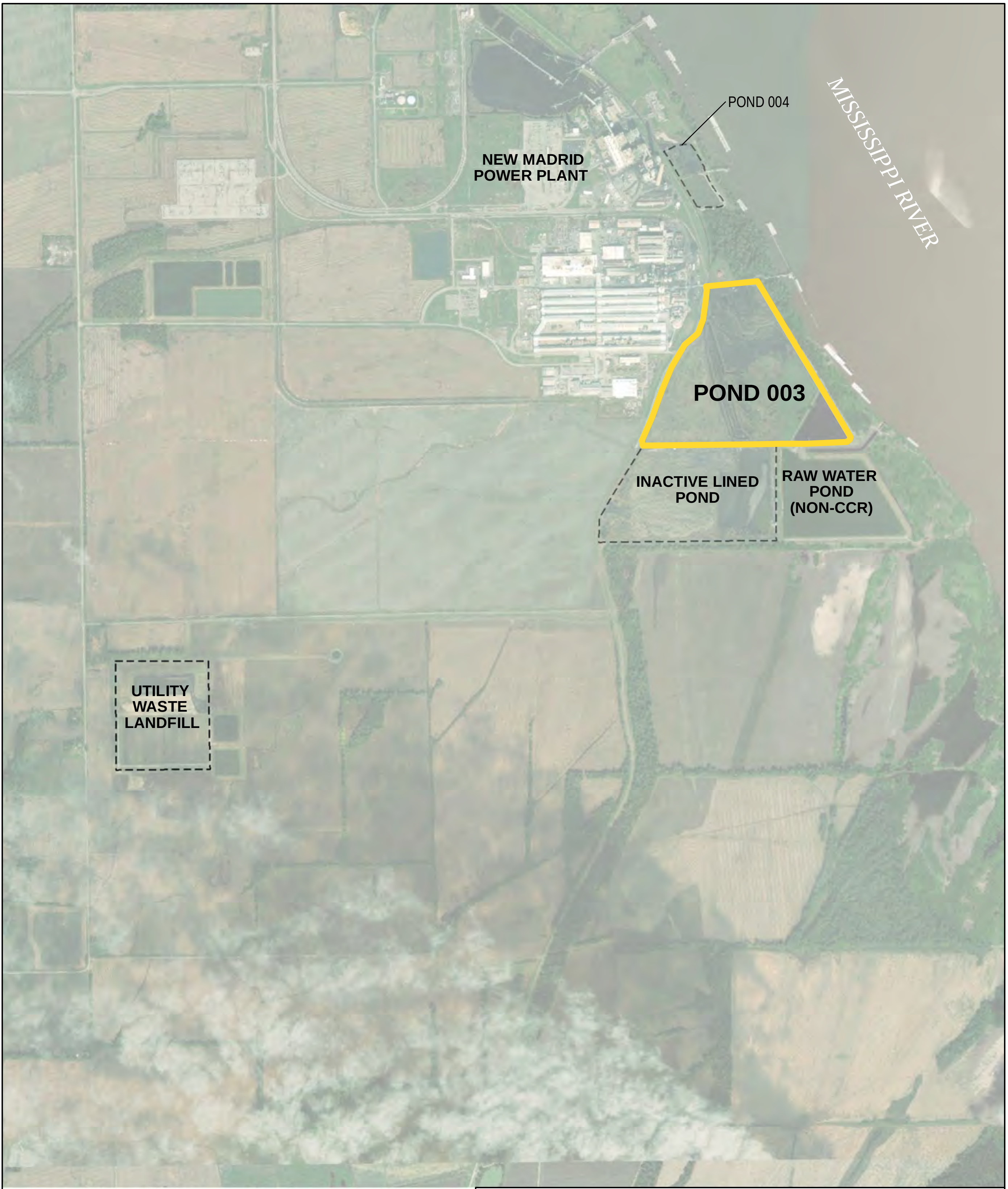
CORRECTIVE MEASURES ASSESSMENT
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT - POND 003
NEW MADRID, MISSOURI

SITE LOCATION MAP

APPROXIMATE SCALE: 1 IN = 2000 FT
SEPTEMBER 2019

FIGURE 1-1

GIS FILE PATH: \\haleyaldrich.com\share\phx_common\Projects\AECI\New Madrid\GIS\MXDs\2019_08\129342_020_0001_PROJECT_LOCUS.mxd — USER: hwachholz — LAST SAVED: 8/26/2019 11:35:20 AM



NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

2. AERIAL IMAGERY SOURCE: ESRI, 19 MAY 2016.

0 1,000 2,000
SCALE IN FEET

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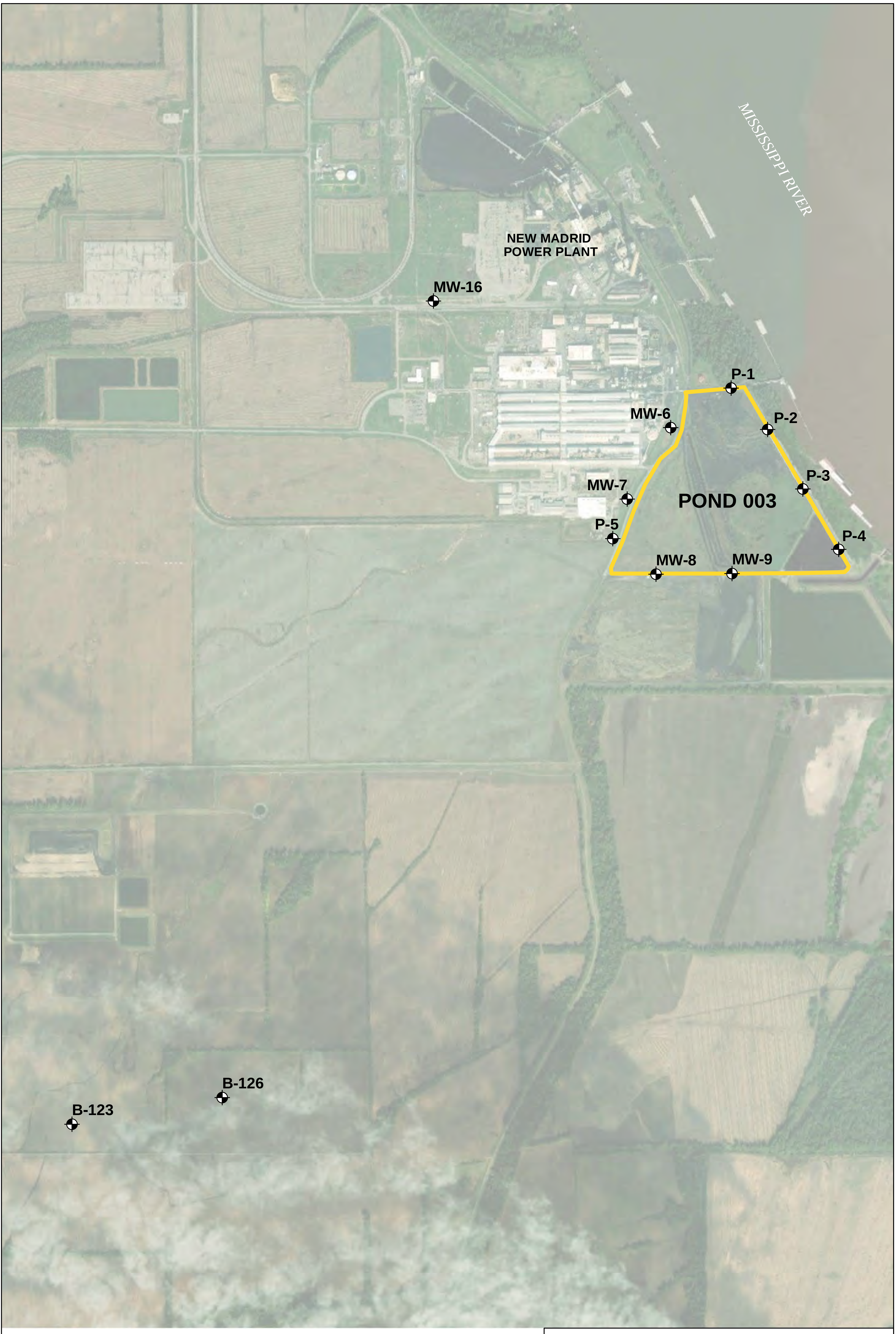
CORRECTIVE MEASURES ASSESSMENT
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT - POND 003
NEW MADRID, MISSOURI

SITE FEATURES MAP

SEPTEMBER 2019

FIGURE 1-2

GIS FILE PATH: \\haleyaldrich.com\share\phx_common\Projects\AECI\New Madrid\GIS\MXDs\2019_08\129342_020_0001-2_SITE_FEATURES_MAP_.mxd — USER: hwachholz — LAST SAVED: 9/11/2019 10:12:09 AM



LEGEND

⊕ MONITORING

▭ POND 003

NOTE
1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI, 19 MAY 2016.

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CORRECTIVE MEASURES ASSESSMENT
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT - POND 003
NEW MADRID, MISSOURI

MONITORING WELL LOCATION MAP

SEPTEMBER 2019
SCALE: AS SHOWN

FIGURE 2-1

GIS FILE PATH: \\haleyaldrich.com\share\phx_common\Projects\AECI\New Madrid\GIS\MXDs\2019_08\129342_020_0001_MONITORING_WELL_LOCATION.mxd — USER: hwachholz — LAST SAVED: 9/11/2019 10:09:03 AM

LEGEND

P-1 ⌖	MONITORING WELL
MW-8 ⌖	MONITORING WELL WITH MOLYBDENUM CONCENTRATION ABOVE THE GWPS
▭	UNIT BOUNDARY

NOTES

1. ALL LOCATIONS ARE APPROXIMATE
2. GWPS = GROUNDWATER PROTECTION STANDARDS
3. REFER TO TABLE I FOR GROUNDWATER ANALYTICAL RESULTS.
4. AERIAL IMAGERY SOURCE: ESRI

N

0 400 800
SCALE IN FEET

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CORRECTIVE MEASURES ASSESSMENT
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT - POND 003
NEW MADRID, MISSOURI

MONITORING WELL LOCATIONS WITH STATISTICALLY SIGNIFICANT LEVELS ABOVE GWPS

SEPTEMBER 2019

FIGURE 2-2

GIS FILE PATH: \\haleyaldrich.com\share\phx_common\Projects\AECI\New Madrid\GIS\MXDs\2019_08\129342_020_0002-2_WELL_LOCATION_WITH_GWPS.mxd — USER: hwachholz — LAST SAVED: 8/26/2019 11:39:45 AM

FIGURE 4-1
REMEDIAL ALTERNATIVE ROADMAP

CORRECTIVE MEASURES ASSESSMENT
ASSOCIATED ELECTRIC COOPERATIVE, INC
NEW MADRID POWER PLANT - POND 003
NEW MADRID, MISSOURI

Alternative Number	Remedial Alternative Description	Pond 003 Closure Description	Groundwater Remedy Components		
			A. Groundwater Remedy Approach	B. Groundwater Treatment Method	C. Post-Closure Actions
1	Closure In Place (CIP) with Capping and Monitored Natural Attenuation (MNA)	CIP with Low Permeability Cap	**Natural Attenuation with Monitoring** Mitigate off-site migration of groundwater with CCR constituents above GWPS through process of natural attenuation	**No Active Treatment** No active treatment technologies for groundwater to address CCR constituents	**MNA** Long-term groundwater monitoring to confirm reduction of CCR constituents
2	CIP with In-Situ Stabilization (ISS), Capping and MNA	CIP with ISS and Low Permeability Cap			
3	CIP with Capping and Hydraulic Containment through Groundwater Pumping and Ex-Situ Treatment	CIP with Low Permeability Cap	**Hydraulic Containment** Mitigate off-site migration of groundwater with CCR constituents above GWPS using extraction wells	**Ex-Situ Treatment** Treatment system (ion exchange or reverse osmosis) to remove CCR constituents from groundwater and discharge under applicable permits	**Pump & Treat Long-Term** Continue to operate hydraulic containment system to maintain reduction of CCR constituents in groundwater
4	CIP with Capping and Hydraulic Containment through Groundwater Pumping and Ex-Situ Treatment and Barrier Wall	CIP with Low Permeability Cap	**Barrier Wall with Hydraulic Containment** Mitigate off-site migration of groundwater with CCR constituents above GWPS using extraction wells and a low permeability barrier wall		
5	Closure by Removal (CBR) with MNA	CBR	**Natural Attenuation with Monitoring** Mitigate off-site migration of groundwater with CCR constituents above GWPS through process of natural attenuation	**No Active Treatment** No active treatment technologies for groundwater to address CCR constituents	**MNA** Long-term groundwater monitoring to confirm reduction of CCR constituents

APPENDIX A

Groundwater Risk Evaluation

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REPORT ON
GROUNDWATER RISK EVALUATION
NEW MADRID POWER PLANT
POND 003
NEW MADRID, MISSOURI

By

Haley & Aldrich, Inc.
Greenville, South Carolina

For

Associated Electric Cooperative, Inc.
Springfield, Missouri

File No. 129342-020
August 2019

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List of Common Acronyms

AECI	Associated Electric Cooperative, Inc.
AWQC	Ambient Water Quality Criteria
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
CMA	Corrective Measures Assessment
CSM	Conceptual Site Model
DAF	Dilution Attenuation Factor
Haley & Aldrich	Haley & Aldrich, Inc.
HI	Hazard Index
GWPS	Groundwater Protection Standards
MCL	Maximum Contaminant Level
MDNR	Missouri Department of Natural Resources
mg/L	Milligram per Liter
RSL	Regional Screening Level
SL	Screening Level
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

1. Introduction

The New Madrid Power Plant (NMPP) is a coal-fired power plant located on the Mississippi River in New Madrid, Missouri. The NMPP is an active energy production facility owned by Associated Electric Cooperative, Inc. (AECI) that generates electricity through coal combustion. The facility has been in operation since the 1970s. Pond 003 is a surface impoundment that encompasses approximately 110 acres and is located approximately 0.3 miles southeast of the NMPP plant site. **Figure 1** shows the location of the facility, and the location of Pond 003.

The U.S. Environmental Protection Agency (USEPA) issued a final rule for "Disposal of Coal Combustion Residuals from Electric Utilities" in 2015 (the CCR Rule) (USEPA, 2015). One of the requirements in the CCR Rule is that utilities monitor groundwater at coal ash management facilities, and that the data be reported publicly. NMPP is complying with the CCR Rule, and has posted the required information on their publicly-available website: https://www.aeci.org/clean/ccr/.

This "Groundwater Risk Evaluation" report has been prepared by Haley & Aldrich, Inc. (Haley & Aldrich), and is a companion document to the "Corrective Measures Assessment (CMA) for Pond 003 – New Madrid Power Plant." The purpose of this risk evaluation report is to provide the information needed to interpret and meaningfully understand the groundwater monitoring data collected and published for Pond 003 under the CCR Rule.

Beyond the specific monitoring requirements of the CCR Rule, NMPP has also voluntarily taken the additional step to evaluate potential groundwater-to-surface water transport and exposure pathways through the development of risk-based groundwater screening levels that are protective of surface water in the Mississippi River. Details about the evaluation are provided below.

2. Approach

The analysis presented in this report was conducted by evaluating the environmental setting of the New Madrid Power Plant, including its location and where ash management has occurred at the facility. Information on where groundwater is located at the facility, the rate(s) of groundwater flow, the direction(s) of groundwater flow, and where waterbodies may intercept groundwater flow are reviewed and summarized here.

A conceptual model was developed based on this physical setting information, and the model was used to identify what human populations could contact groundwater and/or surface water in the area of the facility. This information was also used to identify where ecological populations could come into contact with surface water.

Human health risk assessment is a process used to estimate the chance that contact with constituents in the environment may result in harm to people. Generally, there are four components to the process (USEPA, 1989): (1) Hazard Identification/Data Evaluation, (2) Toxicity Assessment, (3) Exposure Assessment, and (4) Risk Characterization.

The USEPA and other regulatory agencies, including the Missouri Department of Natural Resources (MDNR), develop "screening levels" of constituent concentrations in groundwater (and other media) that are considered to be protective of specific human exposures. In developing screening levels, USEPA uses a specific target risk level (component 4) combined with an assumed exposure scenario (component 3) and toxicity information from USEPA (component 2) to derive an estimate of a concentration of a constituent in an environmental medium, for example groundwater, (component 1) that is protective of a person in that exposure scenario (for example, drinking water). Similarly, ecological screening levels for surface water are developed by USEPA and MDNR to be protective of the wide range of potential aquatic ecological resources, or receptors.

Risk-based screening levels are designed to provide a conservative estimate of the concentration to which a receptor (human or ecological) can be exposed without experiencing adverse health effects. Due to the conservative methods used to derive risk-based screening levels, it can be assumed with reasonable certainty that concentrations below screening levels will not result in adverse health effects, and that no further evaluation is necessary. Concentrations above conservative risk-based screening levels do not necessarily indicate that a potential risk exists, but indicate that further evaluation may be warranted.

Human health risk-based and ecological risk-based screening levels drawn from USEPA and MDNR sources are used to determine if the concentration levels of constituents in groundwater could pose a risk to human health or the environment that warrants further evaluation.

2.1 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) is used to evaluate the potential for human or ecological exposure to constituents that may have been released to the environment. Some of the questions posed during the CSM evaluation include:

> What is the source? How can constituents be released from the source? What environmental media may be affected by constituent release? How and where do constituents travel within a medium? Is there a point where a receptor (human or ecological) could contact the constituents in the medium? Are the constituent concentrations high enough to potentially exert a toxic effect?

For the evaluation of the ash management operations at the NMPP, the coal ash stored in Pond 003 is the potential source. Constituents present in the coal ash can be dissolved into infiltrating water (either from precipitation or from groundwater intrusion) that flows to groundwater, and those constituents may then be present in shallow groundwater. Constituents could move with groundwater as it flows, usually in a downgradient/downhill direction.

The constituents derived from the coal ash could then be introduced to adjacent surface water bodies; here, that could be the Mississippi River. **Figure 1** shows the facility location and layout, identifies the location of Pond 003 and the adjacent surface water body, and shows the monitoring well locations. Thus, the environmental media of interest for this evaluation are:

- Groundwater on the facility; and
- Mississippi River surface water.

Pond 003 lies adjacent to the Mississippi River and the alluvial aquifer immediately beneath Pond 003 is in communication with the river. Seasonal changes in river stage cause the groundwater flow direction to change and occasionally reverse. Due to the influence of the adjacent Mississippi River, the groundwater flow in the alluvial aquifer is generally to the southwest during high river stage and generally to the northeast during low river stage. Due to the changing groundwater flow directions, monitoring wells were sited at locations to encircle Pond 003. **Figures 2 and 3** show the monitoring well networks and groundwater flow directions of the uppermost aquifer.

Groundwater downgradient of Pond 003 is not used for any purposes. An irrigation water supply well is located approximately 3500 feet to the south of Pond 003. However, that well is cross-gradient to primary groundwater flow direction and therefore would not receive groundwater discharge from Ponds 003 or 004. There are no construction activities presently occurring or planned within the uppermost aquifer in the foreseeable future. Therefore, there are no direct contact exposure pathways to groundwater downgradient of Pond 003.

The Mississippi River is not a source of drinking water in the downstream vicinity of NMPP; drinking water in New Madrid is provided by the City of New Madrid from groundwater wells. The nearest downstream water supply intake used for drinking water was identified at the Dow Chemical Plant in Iberville, Louisiana, approximately 675 miles downstream.

The Mississippi River can be used for human recreation – wading, swimming, boating, fishing and can serve as habitat for aquatic species – fish, amphibians, etc.

Thus, the potentially complete exposure pathways associated with CCR-related constituents in groundwater are:

- Direct contact with and ingestion of surface water (via migration of groundwater to surface water) during use of river water for a municipal water supply;
- Direct contact with surface water (via migration of groundwater to surface water) during recreational uses of the river; and
- Ingestion of biota (e.g., fish) that may uptake constituents that migrate from groundwater to surface water in the river.

A depiction of the conceptual site model is shown in **Figure 4**.

Based on this conceptual site model and the facility setting, samples collected from groundwater monitoring wells have been included in the evaluation. The samples have been analyzed for constituents that are commonly associated with CCR, as discussed below. However, it is recognized by the USEPA that all of these constituents can also be naturally occurring and can be found in rocks, soils, water and sediments; thus, it is necessary is to understand what the naturally occurring background levels are for these constituents. The CCR Rule requires sampling and analysis of upgradient and/or background groundwater just for this reason. The sampling is detailed in the next section.

To answer the question, “Are the constituent concentrations high enough to potentially exert a toxic effect?” health risk-based screening levels from USEPA and MDNR sources are used for comparison to the data, as described in Section 5.

3. Sample Collection and Analysis

3.1 GROUNDWATER SAMPLES

Twelve (12) groundwater monitoring wells were installed to evaluate shallow alluvial groundwater at Pond 003 under the CCR Rule: nine (9) monitoring wells were installed around the perimeter of Pond 003 to assess groundwater conditions at the ash management area, and three (3) monitoring wells were installed west of the facility to assess background groundwater conditions. **Figure 1** shows the locations of the monitoring wells. Each well is identified by a unique name. MW-6 through MW-9, and P-1 through P-5 are located around the perimeter of Pond 003, and B-123, B-126, and MW-16 are the three background wells that are used to identify upgradient/background conditions in groundwater. Each groundwater monitoring well was sampled thirteen (13) times[1].

3.2 SAMPLE ANALYSIS

The CCR Rule identifies the constituents that are included for groundwater testing; these are:

Boron
Calcium
Chloride
pH
Sulfate
TDS
Fluoride

Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt

Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226/228

The CCR Rule requires eight (8) rounds of groundwater sampling and analysis be conducted for all wells to provide a baseline for current conditions. CCR groundwater monitoring has been performed between November 2016 and September 2018. Groundwater samples have been collected from each of the wells in the CCR monitoring well network and analyzed for USEPA Detection (Appendix III) and Assessment (Appendix IV) Monitoring Parameters. The CCR Rule requires statistical methods be used to determine whether a statistically significant increase (SSI) above background exists for the Appendix III (first column above) constituents. Based on the SSI results from the groundwater monitoring, additional assessment monitoring has been conducted. Section 1.3 of the "Corrective Measures Assessment (CMA)" report provides more detail on the objectives of the rounds of groundwater sampling. Appendix III and IV analytical results for the baseline and Assessment Monitoring events are summarized in **Table 1**.

4. Risk-Based Screening Levels

A comprehensive set of risk-based screening levels have been compiled for this evaluation for the three types of potential exposures identified in the conceptual site model discussion above:

- Human health drinking water consumption;

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[1] The CCR Rule requires eight (8) rounds of sampling events to establish baseline conditions in each well. Under the CCR Rule, further rounds are defined as "Detection" sampling.

- Human health recreational use of surface water; and
- Aquatic ecological receptors for surface water.

It is important to note that the CCR Rule limits the evaluation of groundwater monitoring data of ash management areas to groundwater protection standards (GWPS), which are Federal primary drinking water standards, also known as Maximum Contaminant Levels or MCLs (USEPA, 2018a) that are enforceable for municipal drinking water supplies, or to a comparison with site-specific background. GWPS used to evaluate potential drinking water exposures for CCR monitoring wells are shown on **Table 1**.

Table 2 provides the human health drinking water and recreational screening levels for surface water available from the MDNR and USEPA sources. **Table 3** provides site-specific risk-based screening levels (RBSLs) derived for recreational exposure to surface water. **Table 4** provides the ecological surface water screening levels from MDNR and USEPA sources.

4.1 GROUNDWATER PROTECTION STANDARDS

The GWPS is defined in the CCR Rule at §257.95 Assessment monitoring program:

> (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.

USEPA published Amendments to the National Minimum Criteria Finalized in 2018 (Phase One, Part One) in the Federal Register on July 30, 2018 (USEPA, 2018b). This included revising the groundwater protection standard for constituents that do not have an established drinking water standard (or MCL) at §257.95 Assessment monitoring program (h) (2):

- Cobalt – 6 ug/L (micrograms per liter)
- Lead – 15 ug/L
- Lithium – 40 ug/L
- Molybdenum – 100 ug/l

GWPS used to evaluate potential drinking water exposures for CCR monitoring wells are shown on **Table 1**.

4.2 SCREENING LEVELS FOR THE PROTECTION OF SURFACE WATER

The GWPS are specific to the evaluation of groundwater at the CCR Rule monitoring wells. This section outlines the risk-based human health and ecological surface water screening levels that are protective of surface water in the Mississippi River.

Human health screening levels for surface water are identified for two exposure settings: 1) use of surface water as a drinking water source and the consumption of fish from a surface water body, and 2) recreational uses of surface water.

4.2.1 Drinking Water Screening Levels

The human health screening levels for drinking water are from Missouri state and USEPA sources and address the drinking water exposure pathway. The Missouri State drinking water supply levels are essentially the same as the Federal primary drinking water standards, also known as Maximum Contaminant Levels or MCLs (USEPA, 2018a). The Missouri State groundwater screening levels provide some additional screening levels not included on their list of drinking water screening levels (MDNR, 2019) (**Table 2**). USEPA risk-based Regional Screening Level (RSLs) for tapwater (drinking water, or untreated groundwater used as potable water) have also been included for constituents which do not have promulgated Missouri/MCL criteria. The tapwater RSLs are based on USEPA default assumptions for residential exposure to tapwater (USEPA, 2019a). Missouri drinking water supply screening levels were used and supplemented with Federal MCLs, then the USEPA risk-based levels for tapwater (RSLs), where MDNR values were unavailable.

4.2.2 Published Recreational Screening Levels

Published human health screening levels for surface water are generally derived to be protective of the use of surface water as a drinking water source and the consumption of fish from a surface water body. The drinking water screening levels are also protective of, but highly conservative for, recreational uses of a surface water body (such as swimming or boating) because drinking water exposure is of a higher magnitude and frequency. The drinking water screening levels used to evaluate surface water, as discussed above, are protective for other recreational uses of the river such as swimming, wading, and boating. Note that this evaluation of other uses of surface water are above and beyond the requirements of the CCR Rule.

The human health screening levels for surface water are from federal and state sources and address the fish consumption pathway (where such values are available from the state) (**Table 2**). MDNR administers water quality standards for aquatic life (Missouri Code of State Regulations Division 20 Chapter 7 Table A) (MDNR, 2019). The fish consumption values for protection of human health are used for this assessment, and where unavailable the USEPA Ambient Water Quality Criteria (AWQC) for Human Health Consumption of Water and Organism are used (USEPA, 2019b).

4.2.3 Calculated Recreational Risk-Based Screening Levels

Site-specific RBSLs are essentially refined screening levels to account for receptor population characteristics and exposure pathways. As such, the site-specific RBSLs are less conservative, (i.e., more realistic), than screening levels and are, therefore, useful for evaluating whether COPCs may have the potential to pose health risks in excess of risk thresholds. For example, whereas surface water that is used as a recreational water body for swimming could be evaluated using drinking water standards which assume that people are drinking and bathing in the water daily, site-specific RBSLs for surface water will reflect incidental ingestion and dermal contact at an exposure rate and magnitude commensurate with swimming activities.

Potential exposures to constituents in surface water could, in general, occur through ingestion and dermal contact. However, the specific nature of the potential exposures is dependent on the type of water body. Specifically:

- Incidental ingestion and dermal contact with shallow surface water (e.g., less than two feet in depth) can only occur via wading because the water is not deep enough to permit swimming. Wading exposures could potentially occur in Little Pigeon Creek.

- Incidental ingestion and dermal contact with deeper surface water (e.g., more than three feet in depth) could occur via swimming. Exposures during swimming could be potentially complete in the Mississippi River; the water in Little Pigeon Creek is not deep enough to allow for swimming.

- Dermal contact with surface water could occur during boating or fishing activities in the Mississippi River. Since these types of activities are not associated with intense exposures to water (such as is the case with swimming), incidental ingestion of surface water would be insignificant.

RBSLs derived for recreational exposures to surface water for a recreational swimmer, wader, and boater are presented in **Table 3**. The RBSLs were calculated using USEPA-derived exposure factors and equations, as well as site-specific inputs where appropriate using the USEPA RSL calculator (USEPA, 2019c). The RBSL presented is the lower of the noncancer RBSL at a target noncancer hazard index of 1 and a target cancer-based risk of 10^{-5}. The RSL calculator output, including the exposure parameters used, is provided in **Attachment A**.

4.2.4 Ecological Screening Levels

Ecological screening levels for surface water are published to provide a conservative estimate of the concentration to which an ecological receptor can be exposed without experiencing adverse effects. Due to the conservative methods used to derive published reference screening levels, it can be assumed with reasonable certainty that concentrations below screening levels will not result in any adverse effects to survival, growth and/or reproduction. Concentrations above ecological published screening levels for surface water, however, do not necessarily indicate that a potential ecological risk exists, but rather that further evaluation may be warranted.

Table 4 presents the ecological published risk-based screening levels for surface water. Some of the screening levels are based on the hardness of the water, a default hardness value of 100 mg/L has been used, in accordance with USEPA and MDNR guidance. Note that this ecological evaluation of surface water is above and beyond the requirements of the CCR Rule.

Water quality criteria are concentrations calculated from controlled laboratory tests on freshwater or marine organisms that are protective of the most sensitive organism (often zooplankton such as daphnids) for the most sensitive life stage (typically reproduction).

MDNR administers water quality standards for aquatic life protective of the most sensitive aquatic life, and therefore protective for both direct contact of surface water by aquatic life, and potential exposures to wildlife through food chain uptake (Missouri Code of State Regulations Division 20 Chapter 7 Table A) (MDNR, 2019). Where MDNR values are unavailable, the USEPA AWQC Freshwater Chronic and Acute values are used (USEPA,2019d).

4.2.5 Selected Screening Levels

Table 5 presents the selected human health and ecological screening levels (from **Tables 2 through 4**) and identifies the lowest selected screening level for surface water for the human health drinking water, human health recreational, and ecological potential exposure scenarios.

5. Results

The level of analysis and comparison to risk-based screening levels presented below is above and beyond the requirements of the CCR Rule. The analysis of the groundwater results required by the CCR Rule is presented in the "2018 Annual Groundwater Monitoring and Corrective Action Report" for NMPP Pond 003 [*https://www.aeci.org/media/4268/2019-0131_nmpp-annual-report_pond-003_final-cert.pdf*]. This report serves to supplement that report by providing the risk-based analysis of groundwater, so that the groundwater results can be understood in their broader environmental context.

5.1 SHALLOW ALLUVIAL AQUIFER GROUNDWATER – CCR RULE EVALUATION

AECI has filed reports and notification required by the federal CCR Rule on its website, as noted above, and additional reports will be prepared and posted on AECI's website per the CCR Rule. The statistical analysis of the data has indicated a statistically significant increased (SSI) concentration of Appendix III constituents in downgradient monitoring wells relative to concentrations observed in upgradient monitoring wells, for samples collected from monitoring wells MW-6 through MW-9, and P-1 through P-5 (see **Figure 1**) that monitor the shallow alluvial aquifer. Analytes exhibiting an SSI are a subset of the parameters identified in Section 4 and include boron, calcium, chloride, sulfate, and TDS. These results moved the groundwater sampling into the Assessment Monitoring phase.

Based on the assessment monitoring results, concentrations of molybdenum in some wells are statistically above the GWPS. These measured concentrations are then referred to as Statistically Significant Levels (SSLs). Therefore, the Assessment of Corrective Measures phase of the CCR Rule is triggered for these Appendix IV constituents.

Groundwater data from twelve rounds of sampling of the shallow alluvial aquifer groundwater were compared to the site-specific GWPS required by the CCR Rule. **Figure 1** shows that the monitoring wells are all located at the edge of Pond 003 and, therefore, provide worst-case groundwater results. **Table 1** compares the results of all CCR monitoring well sampling rounds to the GWPS. The vast majority of the results indicate concentration levels below the site-specific GWPS. A limited number of parameters are above the GWPS for some, but not all, sampling events.

The striking aspect of the analysis shown in **Table 1** is how few CCR monitoring well results are above a conservative GWPS based on MCLs, health-based GWPS, or background levels, given that the wells are located at the base of the ash management area, and the facility has been in operation for over 40 years Out of the 1,575 groundwater analyses conducted, only 85 results are above the GWPS (see **Table 1**). Put another way, approximately 95% of the groundwater results for the CCR Rule monitoring wells located at the edge of Pond 003 (MW-6 through MW-9, and P-1 through P-5) are below the GWPS. Even for the very few results that may be above screening values for some of the sampling events, including the SSI and SSL results identified under the CCR Rule, there is no complete drinking water exposure pathway to groundwater. Where there is no exposure, there is no risk.

The SSI and SSL values reflect a statistical evaluation that mathematically compares the results of the various rounds of samples to background water quality and GWPS as required under the CCR rule. However, such values without further evaluation do not establish that there is an actual adverse impact to human health or the environment. The CSM process and screening analysis described in this report provide the relevant context for such groundwater monitoring results and whether Pond 003 poses a true risk to human health and the environment. As explained in the remaining sections of this report, based upon the application of risk assessment principles uniformly adopted by USEPA, no such risk exists.

6. Derivation of Risk-Based Screening Levels for Groundwater

NMPP is located on the Mississippi River – a major river system with a massive and rapid river flow. In this section, we have attempted to illustrate how the groundwater – which is a fraction of the volume and flow rate of the river – may interact with the Mississippi River under an assumed set of criteria and conditions. Such an exercise in assumptions can help put in context whether a theoretical risk to river water and its uses exists.

However, impacts to groundwater do not mean that surface waters are impaired. The degree of interface between groundwater and surface waters is variable and complex and dependent upon a variety of factors including gradient and flow rate. It is possible, however, to determine the maximum concentration level that would need to be present on-site in groundwater and still be protective of the surface water environment, assuming gradient and flow rates are such that groundwater flows into the surface water. Groundwater and surface waters flow at very different rates and volumes. The Mississippi River is the largest river system in North America and as depicted on **Table 6** and **Section 6.1**, as groundwater flows into the river, it is diluted by more than 100,000 times.

6.1 DERIVATION OF DILUTION ATTENUATION FACTOR

To estimate river surface water concentrations, a dilution attenuation factor (DAF) that accounts for groundwater flux (at the river edge (land) and river interface)[2] and subsequent mixing with surface

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[2] Groundwater flux as defined by 10 CFR Part 960.2 is the rate of groundwater flow per unit area of porous media measured perpendicular to the direction of flow (in this case the Mississippi River down gradient of Pond 3).

water was calculated, and then applied to the representative groundwater concentrations.

The DAF was calculated using information for the upper most aquifer as provided in the site hydrological characterization report (Haley & Aldrich, 2017):

- Groundwater Flow ($Q_{groundwater}$): Approximately 3,114 ft^3/day
- River Flow (Q_{river}): Obtained from the USGS gauging station near New Madrid (Station #07024175). The station reported an annual average flow of 4.81 x 10^{10} ft^3/day.

Using these two values, the DAF is calculated to be 1.5 x 10^7 [i.e., meaning that the ratio of the volume of river flow is seven orders of magnitude greater than the flow volumes attributed to groundwater per unit area (Q_{river} / $Q_{groundwater}$)].

This calculation uses the most conservative values for groundwater flow (i.e., meaning the upper limits or reasonable maximum values of flow anticipated) because they use the maximum gradient, K values, and aquifer thicknesses, which in turn 'maximizes' the groundwater flux estimate. In addition, because the river stage is in direct connection with the aquifer unit, groundwater flow varies based on Low River Stage (groundwater flow toward river) and High River Stage (groundwater flow away from river). Consequently, groundwater does not migrate to the river year-round, but rather migrates to the river only during lower river stages. For the purposes of conservatism, this lower river stage (where groundwater flowing from Pond 003 to the river) was used in support of the subject risk screening. Although the calculations use conservative assumptions, the calculated dilution factor was rounded down to 100,000 as an additional measure of conservatism.

The representative surface water concentrations derived using the DAF are provided in **Table 6**. **Figure 5** provides an illustration of the DAF calculation and its relation to Pond 003.

6.2 RISK-BASED SCREENING LEVELS FOR GROUNDWATER

It is possible to calculate a protective screening level for groundwater based upon the amount of dilution that occurs under the above assumption. This calculated risk-based screening level for groundwater can be used to determine whether an on-site groundwater concentration level is protective of the river. Stated differently, at what concentration level does groundwater entering the river system pose a human health or ecological risk?

Table 6 is summarized below and shows the application of the dilution factor to calculate risk-based groundwater screening levels that are protective for surface water, for Appendix III and Appendix IV constituents with risk-based screening levels available. For each constituent, the selected human health drinking water and recreational screening levels, as well as the ecological screening levels (from **Table 5**) are presented. The lowest of the three screening levels is then identified for surface water. The dilution factor is then applied to this lowest screening level for surface water to result in the groundwater screening level that is protective for surface water, which is what is shown in the table below.

This evaluation is not limited to only those constituents for which SSIs and SSLs have been identified. The constituents listed in **Table 6** are those for which there is one or more detected groundwater result with available risk-based screening levels.

The groundwater risk-based screening levels are calculated in units of milligrams of constituent per liter of water (mg/L). One mg/L is equivalent to one million parts per million.

The table identifies the maximum groundwater concentration of each constituent detected in Pond 003 monitoring wells. The comparison between the target levels and the maximum concentrations indicates that there is a wide margin of safety between the two values. This margin is shown in the last column of the table. To illustrate, concentration levels of molybdenum would need to be more than 2,500 times higher than currently measured levels before an adverse impact in the river could occur.

CALCULATING RISK-BASED SCREENING LEVELS FOR GROUNDWATER (see Table 6)

Dilution Attenuation Factor		**100,000**			
Constituent	**Lowest of the Human Health and Ecological Screening Levels (mg/L)**	**Target Groundwater Screening Level - Mississippi River (mg/L)**	**Maximum Groundwater Concentration (mg/L)**		**Ratio Between Target Groundwater Screening Level and the Maximum Groundwater Concentration**
Detection Monitoring - USEPA Appendix III Constituents					
Boron	2	200,000	20	MW-7	10,000
Fluoride	4	400,000	0.679	P-2	>580,000
Assessment Monitoring - USEPA Appendix IV Constituents					
Antimony	0.006	600	0.0031	P-1	>190,000
Arsenic	0.00014	14	0.011	P-5	>1,000
Barium	2	200,000	0.181	MW-7	>1,000,000
Beryllium	0.004	400	0.001 U		NA
Cadmium	0.0007	72	0.0016	MW-7	>44,000
Chromium (Total)	0.07	7,411	0.018	P-1	>410,000
Cobalt	0.178	17,800	0.0098	MW-7	>1,000,000
Lead	0.0025	252	0.0047	P-3	>53,000
Lithium	0.04	4,000	0.05	P-4	80,000
Mercury	0.00077	77	<0.00020		NA
Molybdenum	0.1	10,000	3.9	MW-7	>2,500
Selenium	0.005	500	0.008	P-3	>62,000
Thallium	0.002	200	0.002	MW-7	100,000
Radiological (pCi/L)					
Radium-226 & 228	5	500,000	3.8	MW-7	>130,000

*** Where the Groundwater Risk-Based Screening Level = Screening Level x Dilution Factor.**

This means that not only do the present concentrations of constituents in groundwater at Pond 003 not pose a risk to human health or the environment, but even much higher concentrations in groundwater would not be harmful.

7. Summary

This comprehensive evaluation demonstrates that there are no adverse impacts on human health or the environment from groundwater uses resulting from coal ash management practices at the AECI NMPP.

These conclusions are supported by the analysis provided in this report, which indicates that:

- There are no uses or activities that would result in direct exposure to the groundwater that contains detections of Appendix IV constituents.
- The only potentially complete exposure pathways to constituents in groundwater are associated with migration of the groundwater to surface water in the Mississippi River; the surface water is used as a source of drinking water, for recreational uses including fishing, and as habitat for aquatic organisms. Assuming that groundwater migrates to river surface water, the calculated concentrations of groundwater constituents in river surface water are orders of magnitude lower than screening levels protective for use of the river as drinking water, consumption of fish, and protection of aquatic life.

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TABLES

TABLE 1
COMPARISON OF AECI NEW MADRID POWER PLANT POND 003 COMPLEX GROUNDWATER MONITORING RESULTS TO SITE GROUNDWATER PROTECTION STANDARDS – NOVEMBER 2016 THROUGH SEPTEMBER 2018 SAMPLING EVENTS
AECI NEW MADRID POWER PLANT - POND 003 COMPLEX
NEW MADRID, MISSOURI

Monitoring Well ID		Date Sampled	pH field	Chloride	Fluoride	Sulfate	Solids Total Dissolved	Antimony Total	Arsenic Total	Barium Total	Beryllium Total	Boron Total	Cadmium Total	Calcium Total	Chromium Total	Cobalt Total	Lead Total	Lithium Total	Mercury Total	Molybdenum Total	Selenium Total	Thallium Total	Radium-226	Radium-228	Combined Radium
			SU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	pCi/L	pCi/L
	Site GWPS (a)		NA	NA	4.0	NA	NA	0.006	0.01	2	0.004	NA	0.005	NA	0.1	0.006	0.015	0.04	0.002	0.1	0.05	0.002	NA	NA	5
Up Gradient	MW-16	11/2/2016	6.82	11	1.22	118	516	<0.0010	0.0026	0.773	<0.0010	0.0425	<0.0010	157	<0.0010	<0.0050	<0.0010	0.0263	<0.00020	<0.0100	<0.0010	<0.0010	0.26	1.59	1.85
		12/9/2016	6.89	15	1.37	107	630	<0.0010	0.0029	0.783	<0.0010	0.0431	<0.0010	154	<0.0010	<0.0050	<0.0010	0.0274	<0.00020	<0.0100	<0.0010	<0.0010	0.13	0.85	0.98
		1/7/2017	7.58	13	1.1	120	580	<0.0030	0.0027	0.8	<0.0010	0.039	<0.0010	130	<0.0040	<0.0020	<0.0010	0.033	<0.00020	<0.0010	<0.0010	<0.0010	1.46	0.883	2.343
		1/30/2017	7.4	11	1.55	120	570	<0.0030	0.0026	0.73	<0.0010	0.037	<0.0010	130	<0.0040	<0.0020	<0.0010	0.03	<0.00020	<0.0010	<0.0010	<0.0010	0.856	0.921	1.777
		2/21/2017	6.91	12	1.18	95	560	<0.0030	0.0025	0.76	<0.0010	0.051	<0.0010	150	<0.0040	<0.0020	<0.0010	0.031	<0.00020	<0.0010	<0.0010	<0.0010	-0.066	1.16	1.16
		3/28/2017	6.88	11	1.44	100	580	<0.0030	0.0025	0.76	<0.0010	0.047	<0.0010	130	<0.0040	<0.0020	<0.0010	0.031	<0.00020	<0.0010	<0.0010	<0.0010	0.702	1.63	2.332
		4/27/2017	6.97	12	1.38	93	560	<0.0030	0.0025	0.76	<0.0010	0.06	<0.0010	150	<0.0040	<0.0020	<0.0010	0.03	<0.00020	<0.0010	<0.0010	<0.0010	0.653	1.19	1.843
		5/18/2017	6.88	13	1.59	97	600	<0.0030	0.0027	0.75	<0.0010	0.046	<0.0010	150	<0.0040	<0.0020	<0.0010	0.033	<0.00020	<0.0010	<0.0010	<0.0010	0.814	1.12	1.934
		6/24/2017	7.02	11	1.18	110	490	<0.0030	0.002	0.72	<0.0010	0.036	<0.0010	130	<0.0040	<0.0020	<0.0010	0.03	<0.00020	<0.0010	<0.0010	<0.0010	0.825	0.962	1.787
		8/15/2017	6.89	10	1.27	98	500	<0.0030	0.0021	0.7	<0.0010	0.052	<0.0010	140	<0.0040	<0.0020	<0.0010	0.033	<0.00020	<0.0010	<0.0010	<0.0010	0.336	1.06	1.396
		3/15/2018	7.03	12	1.45	84	580					0.054		140											
		5/30/2018						<0.0030	0.002	0.72	<0.0010		<0.0010		<0.0040	<0.0020	<0.0010	0.025	<0.00020	0.0045	<0.0010	<0.0010	0.963	1.64	2.603
		9/12/2018	6.99	16	1.2	73	400	--	0.0023	0.69	--	0.051	--	150	<0.0040	<0.00086	<0.0010	0.019	--	<0.0010	<0.0010	--	2.19	0.594	2.78
	B-123	11/6/2016	7.16	<5	0.52	34	394	<0.0010	0.0024	0.239	<0.0010	0.0261	<0.0010	94.3	<0.0010	<0.0050	<0.0010	0.0276	<0.00020	<0.0100	<0.0010	<0.0010	0.38	0.59	0.97
		12/12/2016	7	<5	0.57	37	448	<0.0010	0.0011	0.206	<0.0010	0.0201	<0.0010	91	<0.0010	<0.0050	<0.0010	0.0274	<0.00020	<0.0100	<0.0010	<0.0010	0.07	0.64	0.71
		1/8/2017	7.53	5.6	0.446	48	340	<0.0030	0.0014	0.21	<0.0010	0.031	<0.0010	89	<0.0040	<0.0020	<0.0010	0.033	<0.00020	0.003	<0.0010	<0.0010	0.156	0.485	0.641
		1/24/2017	7.88	2.8	0.523	35	410	<0.0030	0.0017	0.2	<0.0010	0.014	<0.0010	87	<0.0040	<0.0020	<0.0010	0.032	0.00087	0.0035	<0.0010	<0.0010	0.542	0.518	1.06
		2/23/2017	7.22	3	0.54	36	400	<0.0030	0.0023	0.22	<0.0010	0.031	<0.0010	90	<0.0040	<0.0020	<0.0010	0.031	<0.00020	0.0036	<0.0010	<0.0010	0	1.37	1.37
		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		4/25/2017	7.36	3.4	0.532	36	400	<0.0030	0.0025	0.24	<0.0010	0.032	<0.0010	83	<0.0040	<0.0020	<0.0010	0.029	<0.00020	0.0036	<0.0010	<0.0010	0.429	0.398	0.827
		5/16/2017	7.22	3.2	0.302	33	380	<0.0030	0.002	0.21	<0.0010	0.023	<0.0010	77	<0.0040	<0.0020	<0.0010	0.03	<0.00020	0.0036	<0.0010	<0.0010	0.492	0.858	1.35
		6/21/2017	7.28	3.1	0.429	32	380	<0.0030	0.0017	0.19	<0.0010	0.029	<0.0010	78	<0.0040	<0.0020	<0.0010	0.029	<0.00020	0.0036	<0.0010	<0.0010	0	0.668	0.668
		8/28/2017	7.24	3.5	0.574	32	360	<0.0030	0.002	0.2	<0.0010	0.03	<0.0010	82	<0.0040	<0.0020	<0.0010	0.029	<0.00020	0.0034	<0.0010	<0.0010	0.896	1.03	1.926
		3/14/2018	7.35	3.3	0.547	32	370					0.023		79											
		5/30/2018						<0.0030	0.0022	0.21	<0.0010		<0.0010		<0.0040	<0.0020	<0.0010	0.026	<0.00020	0.0044	<0.0010	<0.0010	0.671	1.13	1.801
		9/11/2018	7.36	3.7	0.521	31	330	--	0.004	0.27	--	0.027	--	87	<0.0040	<0.00086	<0.0010	0.019	--	0.004	<0.0010	--	0.604	0.968	1.57
	B-126	11/6/2016	6.9	8	0.39	57	560	<0.0010	0.0099	0.4	<0.0010	0.0342	<0.0010	140	<0.0010	<0.0050	<0.0010	0.0159	<0.00020	<0.0100	<0.0010	<0.0010	0.7	-0.1	0.7
		12/12/2016	6.68	11	0.39	173	826	<0.0010	0.0076	0.447	<0.0010	0.0273	<0.0010	178	0.0013	<0.0050	<0.0010	0.0244	<0.00020	<0.0100	<0.0010	<0.0010	0.28	0.83	1.11
		1/8/2017	7.49	6.4	0.376	43	240	<0.0030	0.0063	0.25	<0.0010	0.034	<0.0010	72	<0.0040	0.002	0.0011	0.016	<0.00020	<0.0010	<0.0010	<0.0010	0	0.342	0.342
		1/24/2017	7.37	3.4	0.457	26	290	<0.0030	0.005	0.23	<0.0010	0.018	<0.0010	64	<0.0040	<0.0020	<0.0010	0.013	<0.00020	<0.0010	<0.0010	<0.0010	0	-0.189	0
		2/23/2017	7	7.4	0.525	58	340	<0.0030	0.0067	0.28	<0.0010	0.034	<0.0010	85	<0.0040	0.0021	<0.0010	0.015	<0.00020	<0.0010	<0.0010	<0.0010	0.578	0.578	1.156
		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		4/25/2017	6.95	4.5	0.388	27	300	<0.0030	0.0084	0.21	<0.0010	0.032	<0.0010	57	0.0047	0.0026	0.002	0.013	<0.00020	<0.0010	<0.0010	<0.0010	0.441	0.826	1.267
		5/16/2017	6.93	1.7	0.258	5.6	170	<0.0030	0.0085	0.13	<0.0010	0.022	<0.0010	35	<0.0040	<0.0020	<0.0010	<0.010	<0.00020	<0.0010	<0.0010	<0.0010	0.871	0.956	1.827
		6/21/2017	6.91	3.2	0.398	7.6	210	<0.0030	0.0094	0.16	<0.0010	0.031	<0.0010	41	<0.0040	<0.0020	<0.0010	<0.010	<0.00020	<0.0010	<0.0010	<0.0010	0.116	0.394	0.51
		8/28/2017	6.94	4.6	0.493	20	270	<0.0030	0.0097	0.21	<0.0010	0.036	<0.0010	63	<0.0040	<0.0020	<0.0010	0.01	<0.00020	<0.0010	<0.0010	<0.0010	1	1.01	2.01
		3/14/2018	7	3.6	0.369	26	280					0.032		82											
		5/30/2018						<0.0030	0.0086	0.24	<0.0010		<0.0010		0.0094	0.003	0.0043	0.013	<0.00020	0.0014	0.0012	<0.0010	0.079	2.12	2.199
		9/11/2018	7	1	0.284	11	440	--	0.0052	0.31	--	0.034	--	130	<0.0040	0.0019	<0.0010	0.011	--	<0.0010	<0.0010	--	1.01	0.116	1.126
Down Gradient	MW-6	11/3/2016	6.78	<5	0.36	63	486	<0.0010	<0.0010	0.131	<0.0010	0.421	<0.0010	139	<0.0010	<0.0050	<0.0010	0.0168	<0.00020	<0.0100	<0.0010	<0.0010	0.02	0.75	0.77
		12/6/2016	6.92	8	0.32	84	530	<0.0010	0.0022	0.137	<0.0010	0.486	<0.0010	136	0.0022	<0.0050	<0.0010	0.0181	<0.00020	0.0417	<0.0010	<0.0010	0.779	0.78	1.559
		1/4/2017	7.39	6.7	0.536	95	570	<0.0030	0.0012	0.14	<0.0010	0.53	<0.0010	120	<0.0040	0.0036	<0.0010	0.023	<0.00020	0.046	<0.0010	<0.0010	0.406	0.858	1.264
		1/26/2017	7.44	4.5	0.564	91	340	<0.0030	0.0019	0.16	<0.0010	0.75	<0.0010	150	<0.0040	0.0033	<0.0010	0.021	<0.00020	0.071	<0.0010	<0.0010	0.617	1.3	1.917
		2/21/2017	6.9	<5.0	0.308	63	500	<0.0030	0.001	0.16	<0.0010	0.75	<0.0010	140	<0.0040	0.0047	<0.0010	0.021	<0.00020	0.034	<0.0010	<0.0010	0.119	0.946	1.065
		3/28/2017	6.78	7	0.519	100	600	<0.0030	<0.0010	0.17	<0.0010	0.86	<0.0010	130	<0.0040	0.0046	<0.0010	0.022	<0.00020	0.033	<0.0010	<0.0010	0.279	0.807	1.086
		4/27/2017	7.05	9	0.328	140	680	<0.0030	0.0016	0.18	<0.0010	1.6	<0.0010	170	<0.0040	0.0041	<0.0010	0.019	<0.00020	0.085	<0.0010	<0.0010	0.323	1.01	1.333
		5/18/2017	6.9	10	<0.250	150	660	<0.0030	<0.0010	0.18	<0.0010	1.8	<0.0010	150	<0.0040	0.005	<0.0010	0.023	<0.00020	0.048	<0.0010	<0.0010	0.652	0.398	1.05
		6/20/2017	6.94	11	0.362	150	640	<0.0030	0.0012	0.16	<0.0010	1.7	<0.0010	150	<0.0040	0.0054	<0.0010	0.022	<0.00020	0.021	0.001	<0.0010	1.32	1.07	2.39
		8/16/2017	6.84	7	0.316	89	500	<0.0030	<0.0010	0.15	<0.0010	1	<0.0010	170	<0.0040	0.006	<0.0010	0.024	<0.00020	0.01	<0.0010	<0.0010	0.884	0.767	1.651
		3/15/2018	7.05	9	0.446	110	540					2.1		120											
		5/30/2018						<0.0030	<0.0010	0.16	<0.0010		<0.0010		<0.0040	0.0052	<0.0010	0.018	<0.00020	0.063	<0.0010	<0.0010	0.122	0.558	0.68
		9/11/2018	7.09	7	0.319	64	380	--	<0.0010	0.11	--	0.66	--	130	<0.0040	0.0028	<0.0010	<0.010	--	0.042	<0.0010	--	0.41	0.38	0.79

TABLE 1
COMPARISON OF AECI NEW MADRID POWER PLANT POND 003 COMPLEX GROUNDWATER MONITORING RESULTS TO SITE GROUNDWATER PROTECTION STANDARDS – NOVEMBER 2016 THROUGH SEPTEMBER 2018 SAMPLING EVENTS
AECI NEW MADRID POWER PLANT - POND 003 COMPLEX
NEW MADRID, MISSOURI

Monitoring Well ID		Date Sampled	pH field	Chloride	Fluoride	Sulfate	Solids Total Dissolved	Antimony Total	Arsenic Total	Barium Total	Beryllium Total	Boron Total	Cadmium Total	Calcium Total	Chromium Total	Cobalt Total	Lead Total	Lithium Total	Mercury Total	Molybdenum Total	Selenium Total	Thallium Total	Radium-226	Radium-228	Combined Radium
			SU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	pCi/L	pCi/L
	Site GWPS (a)		NA	NA	4.0	NA	NA	0.006	0.01	2	0.004	NA	0.005	NA	0.1	0.006	0.015	0.04	0.002	0.1	0.05	0.002	NA	NA	5
Down Gradient	MW-7	11/3/2016	6.75	7	0.34	409	1080	<0.0010	0.0021	0.181	<0.0010	19.9	<0.0010	232	<0.0010	**0.0062**	<0.0010	0.0223	<0.00020	**3.2**	<0.0010	<0.0010	0.09	1.04	1.13
		12/6/2016	6.88	6	0.33	320	952	<0.0010	0.0032	0.15	<0.0010	18.4	0.0011	207	<0.0010	**0.0098**	<0.0010	0.0227	<0.00020	**3.24**	<0.0010	<0.0010	0.175	0.922	1.097
		1/4/2017	7.23	7.2	0.464	360	810	<0.0030	0.0045	0.11	<0.0010	17	0.0012	120	<0.0040	**0.0067**	<0.0010	0.031	<0.00020	**2.8**	<0.0010	<0.0010	0.389	0.89	1.279
		1/26/2017	7.62	7.9	0.564	310	720	<0.0030	0.0036	0.12	<0.0010	14	0.0016	120	<0.0040	0.0059	<0.0010	0.027	<0.00020	**2.9**	<0.0010	<0.0010	0.345	0.43	0.775
		2/22/2017	6.88	7.6	0.287	380	960	<0.0030	0.0021	0.15	<0.0010	19	<0.0010	200	<0.0040	**0.0068**	<0.0010	0.03	<0.00020	**3.4**	<0.0010	<0.0010	2.97	0.829	3.799
		3/30/2017	6.78	7.4	0.496	390	980	<0.0030	0.0018	0.15	<0.0010	17	<0.0010	180	<0.0040	**0.0067**	<0.0010	0.028	<0.00020	**3.4**	<0.0010	<0.0010	0.244	1.16	1.404
		4/26/2017	7.02	9.3	0.277	370	900	<0.0030	0.0034	0.14	<0.0010	20	0.0014	180	<0.0040	0.0051	<0.0010	0.027	<0.00020	**3.9**	<0.0010	<0.0010	0.335	1.39	1.725
		5/18/2017	6.85	10	<0.250	420	960	<0.0030	0.0037	0.14	<0.0010	20	<0.0010	170	<0.0040	0.003	<0.0010	0.034	<0.00020	**3.9**	<0.0010	<0.0010	0.767	1.95	2.717
		6/20/2017	6.99	5.7	0.388	300	960	<0.0030	0.0028	0.15	<0.0010	19	0.0016	190	<0.0040	**0.007**	0.0018	0.028	<0.00020	**3.5**	0.0021	0.002	0.544	1.17	1.714
		8/16/2017	7.16	6.6	0.41	290	720	<0.0030	0.002	0.17	<0.0010	16	<0.0010	210	<0.0040	**0.0073**	<0.0010	0.031	<0.00020	**3.6**	<0.0010	<0.0010	0.544	1	1.544
		3/15/2018	7.01	9.9	0.372	340	830					16		160											
		5/30/2018						<0.0030	0.0023	0.13	<0.0010		<0.0010		<0.0040	0.0058	<0.0010	0.019	<0.00020	**3.4**	<0.0010	<0.0010	0.109	0.52	0.629
		9/11/2018	7.2	13	0.33	470	880	--	0.0024	0.14	--	19	--	200	<0.0040	**0.0076**	<0.0010	0.014	--	**3**	<0.0010	--	0.218	1.14	1.358
	MW-8	11/4/2016	6.99	7	0.29	419	1030	<0.0010	0.004	0.115	<0.0010	17.4	<0.0010	233	<0.0010	<0.0050	<0.0010	0.0197	<0.00020	**0.737**	<0.0010	<0.0010	0.67	0.693	1.363
		12/7/2016	7.09	6	0.29	443	1050	<0.0010	0.0026	0.111	<0.0010	19.8	<0.0010	235	<0.0010	<0.0050	<0.0010	0.0223	<0.00020	**0.706**	<0.0010	<0.0010	0.494	0.965	1.459
		1/5/2017	7.59	12	0.366	230	570	<0.0030	0.0046	0.066	<0.0010	12	<0.0010	140	<0.0040	<0.0020	<0.0010	0.023	<0.00020	**0.96**	<0.0010	<0.0010	-0.137	0.563	0.563
		1/26/2017	7.8	12	0.538	300	690	<0.0030	0.0045	0.085	<0.0010	12	<0.0010	130	<0.0040	<0.0020	<0.0010	0.022	<0.00020	**0.87**	<0.0010	<0.0010	-0.209	0.822	0.822
		2/21/2017	7.11	9.6	0.288	320	840	<0.0030	0.0057	0.1	<0.0010	14	<0.0010	190	<0.0040	<0.0020	<0.0010	0.025	<0.00020	**0.83**	<0.0010	<0.0010	0.871	1.42	2.291
		3/30/2017	7.03	8.8	0.475	360	940	<0.0030	0.0054	0.11	<0.0010	15	<0.0010	180	<0.0040	<0.0020	<0.0010	0.025	<0.00020	**0.83**	<0.0010	<0.0010	0.402	0.952	1.354
		4/26/2017	7.26	11	0.3	270	660	<0.0030	0.005	0.082	<0.0010	14	<0.0010	160	<0.0040	<0.0020	<0.0010	0.018	<0.00020	**1**	<0.0010	<0.0010	0.0534	0.959	1.0124
		5/17/2017	7.12	9.5	0.348	300	740	<0.0030	0.0062	0.098	<0.0010	14	<0.0010	150	<0.0040	<0.0020	<0.0010	0.022	<0.00020	**1.2**	<0.0010	<0.0010	0.45	0.976	1.426
		6/21/2017	7.23	9.5	0.361	340	720	<0.0030	0.006	0.1	<0.0010	15	<0.0010	170	<0.0040	<0.0020	<0.0010	0.022	<0.00020	**0.93**	<0.0010	<0.0010	0.884	0.537	1.421
		8/16/2017	7.15	9.1	0.376	330	700	<0.0030	0.0048	0.1	<0.0010	14	<0.0010	160	<0.0040	<0.0020	<0.0010	0.025	<0.00020	**1**	<0.0010	<0.0010	0.239	0.674	0.913
		3/15/2018	7.32	10	0.354	180	540					12		120											
		5/30/2018						<0.0030	0.0053	0.082	<0.0010		<0.0010		<0.0040	<0.0020	<0.0010	0.017	<0.00020	**0.93**	<0.0010	<0.0010	0.121	0.944	1.065
		9/12/2018	7.2	10	0.29	320	700	--	0.0045	0.082	--	16	--	180	<0.0040	0.0016	<0.0010	0.012	--	**0.86**	<0.0010	--	0.518	0.322	0.84
Down Gradient	MW-9	11/4/2016	7.15	17	0.53	108	534	<0.0010	<0.0010	0.0984	<0.0010	2.26	<0.0010	123	<0.0010	<0.0050	<0.0010	0.0258	<0.00020	**0.312**	<0.0010	<0.0010	-0.09	3.12	3.12
		12/7/2016	7.22	16	0.49	109	476	<0.0010	<0.0010	0.0842	<0.0010	3.08	<0.0010	119	<0.0010	<0.0050	<0.0010	0.0296	<0.00020	**0.337**	0.0015	<0.0010	0.547	0.848	1.395
		1/5/2017	7.55	16	0.508	110	400	<0.0030	<0.0010	0.075	<0.0010	2.8	<0.0010	82	<0.0040	<0.0020	<0.0010	0.034	<0.00020	**0.32**	<0.0010	<0.0010	0.275	1.28	1.555
		1/27/2017	8.13	17	0.557	120	420	<0.0030	<0.0010	0.072	<0.0010	2.4	<0.0010	82	<0.0040	<0.0020	<0.0010	0.03	<0.00020	**0.35**	<0.0010	<0.0010	0.064	0.466	0.53
		2/21/2017	7.29	17	0.481	96	500	<0.0030	<0.0010	0.089	<0.0010	2.5	<0.0010	120	<0.0040	<0.0020	<0.0010	0.031	<0.00020	**0.33**	<0.0010	<0.0010	0.37	1.1	1.47
		3/30/2017	7.15	18	0.654	110	490	<0.0030	<0.0010	0.08	<0.0010	2.2	<0.0010	100	<0.0040	<0.0020	<0.0010	0.03	<0.00020	**0.33**	<0.0010	<0.0010	0.403	1.02	1.423
		4/26/2017	7.5	17	0.481	97	400	<0.0030	<0.0010	0.069	<0.0010	1.9	<0.0010	90	<0.0040	<0.0020	<0.0010	0.025	<0.00020	**0.42**	<0.0010	<0.0010	0.32	0.334	0.654
		5/17/2017	7.27	19	<0.250	97	480	<0.0030	<0.0010	0.098	<0.0010	2.1	<0.0010	100	<0.0040	<0.0020	<0.0010	0.034	<0.00020	**0.44**	<0.0010	<0.0010	0.371	0.925	1.296
		6/20/2017	7.33	17	0.507	110	540	<0.0030	<0.0010	0.092	<0.0010	2	<0.0010	100	<0.0040	<0.0020	<0.0010	0.029	<0.00020	**0.36**	<0.0010	<0.0010	0.183	0.526	0.709
		8/16/2017	7.23	16	0.561	110	430	<0.0030	<0.0010	0.097	<0.0010	2.2	<0.0010	120	<0.0040	<0.0020	<0.0010	0.035	<0.00020	**0.35**	<0.0010	<0.0010	0.261	0.716	0.977
		3/15/2018	7.41	20	0.386	100	410					2.1		110											
		5/30/2018						<0.0030	<0.0010	0.089	<0.0010		<0.0010		<0.0040	<0.0020	<0.0010	0.026	<0.00020	**0.34**	<0.0010	<0.0010	0	0.599	0.599
		9/12/2018	7.34	20	0.44	110	470	--	<0.0010	0.074	--	2.4	--	110	<0.0040	<0.00086	<0.0010	0.021	--	**0.34**	<0.0010	--	0.147	0.0688	0.216
	P-1	11/5/2016	7.05	19	0.38	178	632	<0.0010	<0.0010	0.0533	<0.0010	2.04	<0.0010	153	<0.0010	<0.0050	<0.0010	0.0221	<0.00020	0.0194	0.0014	<0.0010	-0.12	1.48	1.48
		12/8/2016	7.25	19	0.44	170	610	<0.0010	<0.0010	0.0552	<0.0010	1.99	<0.0010	152	<0.0010	<0.0050	<0.0010	0.0248	<0.00020	0.0506	<0.0010	<0.0010	NS	NS	NS
		1/6/2017	7.76	20	0.552	180	540	<0.0030	<0.0010	0.051	<0.0010	2	<0.0010	140	<0.0040	<0.0020	<0.0010	0.028	<0.00020	0.034	<0.0010	<0.0010	0	1.29	1.29
		1/28/2017	7.68	20	0.516	220	560	<0.0030	<0.0010	0.053	<0.0010	1.9	<0.0010	130	<0.0040	<0.0020	<0.0010	0.029	<0.00020	0.024	0.0062	<0.0010	-0.125	0.751	0.751
		2/21/2017	7.24	17	0.364	220	720	<0.0030	<0.0010	0.065	<0.0010	1.8	<0.0010	170	<0.0040	<0.0020	<0.0010	0.029	<0.00020	0.013	0.0051	<0.0010	0.386	0.889	1.275
		3/30/2017	7.04	15	0.519	220	760	<0.0030	<0.0010	0.07	<0.0010	1.7	<0.0010	160	0.018	<0.0020	<0.0010	0.03	<0.00020	0.011	0.0038	<0.0010	0.419	1.12	1.539
		4/26/2017	7.25	16	0.378	220	660	0.0031	<0.0010	0.063	<0.0010	1.8	<0.0010	170	0.0051	<0.0020	<0.0010	0.026	<0.00020	0.013	0.0037	<0.0010	0.223	0.56	0.783
		5/17/2017	7.06	17	<0.250	220	660	<0.0030	<0.0010	0.068	<0.0010	1.7	<0.0010	160	0.0071	<0.0020	<0.0010	0.031	<0.00020	0.015	0.0052	<0.0010	0.974	1.01	1.984
		6/21/2017	7.23	16	0.411	190	640	<0.0030	<0.0010	0.062	<0.0010	1.5	<0.0010	150	<0.0040	<0.0020	<0.0010	0.027	<0.00020	0.011	0.0054	<0.0010	0.788	0.552	1.34
		8/16/2017	7.21	16	0.416	200	540	<0.0030	<0.0010	0.055	<0.0010	1.9	<0.0010	140	<0.0040	<0.0020	<0.0010	0.03	<0.00020	0.011	0.0033	<0.0010	0.25	0.379	0.629
		3/15/2018	7.19	17	0.351	190	620					1.4		150											
		5/29/2018						<0.0030	<0.0010	0.063	<0.0010		<0.0010		<0.0040	<0.0020	<0.0010	0.024	<0.00020	0.013	0.0054	<0.0010	0.434	0.33	0.764
		9/12/2018	7.22	18	0.34	160	520	--	<0.0010	0.059	--	1.6	--	160	0.0071	<0.00086	<0.0010	0.02	--	0.023	0.0044	--	0.228	0.435	0.663
	P-2	11/4/2016	7.03	17	0.52	384	816	<0.0010	<0.0010	0.0963	<0.0010	3.18	<0.0010	181	<0.0010	<0.0050	<0.0010	0.0188	<0.00020	**0.279**	0.0014	<0.0010	-0.19	-2.08	0
		12/7/2016	7.28	18	0.61	292	688	<0.0010	<0.0010	0.0888	<0.0010	2.52	<0.0010	164	<0.0010	<0.0050	<0.0010	0.0174	<0.00020	**0.351**	0.001	<0.0010	0.746	1.3	2.046
		1/5/2017	7.55	21	0.643	310	560	<0.0030	<0.0010	0.076	<0.0010	1.6	<0.0010	110	<0.0040	<0.0020	<0.0010	0.02	<0.00020	**0.35**	<0.0010	<0.0010	0.198	0.545	0.743
		1/28/2017	7.62	19	0.662	300	620	<0.0030	<0.0010	0.075	<0.0010	1.7	<0.0010	130	<0.0040	<0.0020	<0.0010	0.016	<0.00020	**0.34**	0.0011	<0.0010	0.183	0.549	0.732
		2/21/2017	7.23	18	0.512	310	770	<0.0030	<0.0010	0.098	<0.0010	2.4	<0.0010	160	<0.0040	<0.0020	<0.0010	0.024	<0.00020	**0.29**	0.0012	<0.0010	0.322	0.824	1.146
		3/30/2017	7.09	18	0.679	320	780	<0.0030	<0.0010	0.094	<0.0010	2.3	<0.0010	150	<0.0040	<0.0020	<0.0010	0.023	<0.00020	**0.29**	0.0011	<0.0010	0.64	0.693	1.333
		4/26/2017	7.32	19	0.566	310	630	<0.0030	<0.0010	0.084	<0.0010	2.2	<0.0010	150	<0.0040	<0.0020	<0.0010	0.018	<0.00020	**0.31**	<0.0010	<0.0010	0.16	0.847	1.007
		5/17/2017	7.2	19	0.306	300	660	<0.0030	<0.0020	0.082	<0.0010	2.1	<0.0010	130	<0.0040	<0.0020	<0.0010	0.022	<0.00020	**0.32**	<0.0020	<0.0010	0.104	0.347	0.451
		6/20/2017	7.26	18	0.534	310	780	<0.0030	0.001	0.086	<0.0010	2.3	<0.0010	140	<0.0040	<0.0020	<0.0010	0.022	<0.00020	**0.27**	0.0022	<0.0010	0.593	0.878	1.471
		8/17/2016	7.18	14	0.52	350	680	<0.0030	<0.0010	0.1	<0.0010	2.7	<0.0010	160	<0.0040	<0.0020	<0.0010	0.028	<0.00020	**0.27**	0.0014	<0.0010	0	0.52	0.52
		3/15/2018	7.33	19	0.519	350	800					2		170											
		6/1/2018						<0.0030	<0.0010	0.096	<0.0010		<0.0010		<0.0040	<0.0020	<0.0010	0.02	<0.00020	**0.32**	0.0015	<0.0010	0.385	0.657	1.042
		9/12/2018	7.41	21	0.561	240	510	--	<0.0010	0.067	--	2.6	--	140	<0.0040	<0.00086	<0.0010	<0.010	--	**0.32**	<0.0010	--	0.376	0.052	0.428

TABLE 1
COMPARISON OF AECI NEW MADRID POWER PLANT POND 003 COMPLEX GROUNDWATER MONITORING RESULTS TO SITE GROUNDWATER PROTECTION STANDARDS – NOVEMBER 2016 THROUGH SEPTEMBER 2018 SAMPLING EVENTS
AECI NEW MADRID POWER PLANT - POND 003 COMPLEX
NEW MADRID, MISSOURI

Monitoring Well ID		Date Sampled	pH field	Chloride	Fluoride	Sulfate	Solids Total Dissolved	Antimony Total	Arsenic Total	Barium Total	Beryllium Total	Boron Total	Cadmium Total	Calcium Total	Chromium Total	Cobalt Total	Lead Total	Lithium Total	Mercury Total	Molybdenum Total	Selenium Total	Thallium Total	Radium-226	Radium-228	Combined Radium
			SU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L	pCi/L	pCi/L
	Site GWPS (a)		NA	NA	4.0	NA	NA	0.006	0.01	2	0.004	NA	0.005	NA	0.1	0.006	0.015	0.04	0.002	0.1	0.05	0.002	NA	NA	5
Down Gradient	P-3	11/4/2016	6.91	15	0.36	138	712	<0.0010	<0.0010	0.102	<0.0010	8.83	<0.0010	179	<0.0010	<0.0050	<0.0010	0.025	<0.00020	**1.28**	0.0041	<0.0010	0.29	-0.06	0.29
		12/7/2016	7.03	11	0.48	155	750	<0.0010	<0.0010	0.111	<0.0010	12.8	<0.0010	191	<0.0010	<0.0050	<0.0010	0.0285	<0.00020	**1.56**	0.008	<0.0010	0.226	0.807	1.033
		1/5/2017	7.29	15	0.481	190	680	<0.0030	<0.0010	0.098	<0.0010	13	<0.0010	150	<0.0040	<0.0020	<0.0010	0.033	<0.00020	**1.4**	0.0046	<0.0010	0.0691	0.646	0.7151
		1/28/2017	7.86	13	0.463	160	610	<0.0030	<0.0010	0.1	<0.0010	11	<0.0010	140	<0.0040	<0.0020	<0.0010	0.027	<0.00020	**1.3**	0.0029	<0.0010	0.389	0.382	0.771
		2/21/2017	7.13	17	0.381	130	640	<0.0030	<0.0010	0.1	<0.0010	9.3	<0.0010	170	<0.0040	<0.0020	<0.0010	0.03	<0.00020	**1.2**	0.0042	<0.0010	0.927	0.473	1.4
		3/30/2017	6.95	14	0.591	140	700	<0.0030	<0.0010	0.1	<0.0010	8.9	<0.0010	160	<0.0040	<0.0020	0.0047	0.03	<0.00020	**1.1**	0.0048	<0.0010	-0.152	0.302	0.302
		4/26/2017	7.19	14	0.463	150	660	<0.0030	<0.0010	0.1	<0.0010	12	<0.0010	190	<0.0040	<0.0020	<0.0010	0.027	<0.00020	**1.4**	0.0036	<0.0010	0.181	0.306	0.487
		5/17/2017	7	16	<0.250	130	640	<0.0030	<0.0010	0.093	<0.0010	7.8	<0.0010	140	<0.0040	<0.0020	<0.0010	0.032	<0.00020	**1.1**	0.0037	<0.0010	0.449	0.41	0.859
		6/20/2017	7.13	15	0.461	130	640	<0.0030	<0.0010	0.095	<0.0010	8.7	<0.0010	160	<0.0040	<0.0020	<0.0010	0.029	<0.00020	**1**	0.006	<0.0010	0.439	1.21	1.649
		8/16/2017	7.1	15	0.482	120	550	<0.0030	<0.0010	0.098	<0.0010	8.7	<0.0010	160	<0.0040	<0.0020	<0.0010	0.031	<0.00020	**1.3**	0.0046	<0.0010	0.274	0.729	1.003
		3/15/2018	7.32	18	0.562	120	620					6.2		140											
		5/29/2018						<0.0030	<0.0010	0.095	<0.0010		<0.0010		0.0048	<0.0020	0.0016	0.023	<0.00020	**1.3**	0.0054	<0.0010	0.322	0.282	0.604
		9/12/2018	7.14	21	0.426	120	600	--	<0.0010	0.086	--	8.5	--	170	<0.0040	<0.00086	<0.0010	0.018	--	**1.4**	0.0057	--	0.0702	0.0544	0.125
	P-4	11/4/2016	7.1	20	0.34	81	530	<0.0010	<0.0010	0.144	<0.0010	0.419	<0.0010	131	<0.0010	<0.0050	<0.0010	0.0379	<0.00020	0.032	0.0022	<0.0010	0.1	0.43	0.53
		12/7/2016	7.42	21	0.48	91	452	<0.0010	<0.0010	0.109	<0.0010	0.436	<0.0010	96.9	<0.0010	<0.0050	<0.0010	0.0251	<0.00020	0.0318	0.001	<0.0010	0.6	0.852	1.452
		1/5/2017	7.58	28	0.568	94	390	<0.0030	<0.0010	0.12	<0.0010	0.38	<0.0010	87	<0.0040	<0.0020	<0.0010	0.031	<0.00020	0.033	0.0018	<0.0010	-0.211	0.885	0.885
		1/28/2017	8	20	0.469	82	390	<0.0030	<0.0010	0.11	<0.0010	0.39	<0.0010	80	<0.0040	<0.0020	<0.0010	0.029	<0.00020	0.031	<0.0010	<0.0010	0.128	0.351	0.479
		2/21/2017	7.29	20	0.362	86	480	<0.0030	<0.0010	0.13	<0.0010	0.41	<0.0010	110	<0.0040	<0.0020	<0.0010	**0.043**	<0.00020	0.029	0.0014	<0.0010	0.0649	0.382	0.4469
		3/30/2017	7.17	19	0.543	91	520	<0.0030	<0.0010	0.13	<0.0010	0.4	<0.0010	100	<0.0040	<0.0020	<0.0010	**0.041**	<0.00020	0.029	0.0019	<0.0010	0.107	-0.3	0.107
		4/26/2017	7.4	19	0.381	93	440	<0.0030	<0.0010	0.12	<0.0010	0.45	<0.0010	100	<0.0040	<0.0020	<0.0010	0.032	<0.00020	0.03	<0.0010	<0.0010	0.107	0.651	0.758
		5/17/2017	7.24	21	<0.250	77	420	<0.0030	<0.0010	0.11	<0.0010	0.42	<0.0010	84	<0.0040	<0.0020	<0.0010	0.038	<0.00020	0.027	<0.0010	<0.0010	0.416	0.562	0.978
		6/20/2017	7.28	20	0.38	89	490	<0.0030	<0.0010	0.12	<0.0010	0.5	<0.0010	100	<0.0040	<0.0020	<0.0010	**0.043**	<0.00020	0.026	0.0019	<0.0010	0.327	0.764	1.091
		8/16/2017	7.32	20	<0.250	88	440	<0.0030	<0.0010	0.14	<0.0010	0.48	<0.0010	110	<0.0040	<0.0020	<0.0010	**0.05**	<0.00020	0.03	0.0024	<0.0010	0.178	0.684	0.862
		3/15/2018	7.33	20	0.324	78	420					0.45		100											
		5/29/2018						<0.0030	<0.0010	0.11	<0.0010		<0.0010		<0.0040	<0.0020	<0.0010	0.03	<0.00020	0.033	0.003	<0.0010	0.13	0.464	0.594
		9/12/2018	6.71	23	0.369	57	460	--	<0.0010	0.11	--	0.43	--	120	<0.0040	<0.00086	<0.0010	0.028	--	0.025	0.0022	--	0.297	-0.0493	0.297
	P-5	11/3/2016	6.67	8	0.18	163	572	<0.0010	0.0053	0.125	<0.0010	7.98	<0.0010	123	<0.0010	<0.0050	<0.0010	0.0179	<0.00020	**0.235**	<0.0010	<0.0010	0.51	1.49	2
		12/6/2016	6.71	12	0.2	135	484	<0.0010	0.0081	0.11	<0.0010	6.22	<0.0010	106	<0.0010	<0.0050	<0.0010	0.0169	<0.00020	**0.235**	<0.0010	<0.0010	0.536	0.879	1.415
		1/4/2017	7.48	8.2	<0.250	170	550	<0.0030	0.0056	0.13	<0.0010	8.2	<0.0010	110	<0.0040	<0.0020	<0.0010	0.025	<0.00020	**0.25**	<0.0010	<0.0010	0.0669	1.58	1.6469
		1/26/2017	7.73	5.4	0.364	210	630	<0.0030	0.0068	0.14	<0.0010	7	<0.0010	110	<0.0040	<0.0020	<0.0010	0.024	<0.00020	**0.23**	<0.0010	<0.0010	0.0738	0.21	0.2838
		2/22/2017	6.78	7.3	<0.250	170	600	<0.0030	**0.011**	0.15	<0.0010	8.5	<0.0010	130	<0.0040	<0.0020	<0.0010	0.024	<0.00020	**0.27**	<0.0010	<0.0010	0.374	0.852	1.226
		3/30/2017	6.73	6.8	0.438	180	640	<0.0030	0.0089	0.15	<0.0010	7.5	<0.0010	120	<0.0040	<0.0020	<0.0010	0.024	<0.00020	**0.25**	<0.0010	<0.0010	0.797	1.26	2.057
		4/26/2017	6.88	6.2	<0.250	210	680	<0.0030	0.0099	0.17	<0.0010	8.7	<0.0010	140	<0.0040	<0.0020	<0.0010	0.022	<0.00020	**0.3**	<0.0010	<0.0010	0.808	1.18	1.988
		5/18/2017	6.8	6.7	<0.250	230	720	<0.0030	0.0069	0.18	<0.0010	9.7	<0.0010	140	<0.0040	<0.0020	<0.0010	0.03	<0.00020	**0.36**	<0.0010	<0.0010	0.555	0.745	1.3
		6/20/2017	6.79	5.3	0.272	260	780	<0.0030	0.0083	0.16	<0.0010	11	<0.0010	140	<0.0040	0.002	<0.0010	0.026	<0.00020	**0.26**	0.0015	<0.0010	0.95	1.21	2.16
		8/16/2017	6.69	4.9	<0.250	180	520	<0.0030	0.0064	0.13	<0.0010	9.1	<0.0010	130	<0.0040	<0.0020	<0.0010	0.024	<0.00020	**0.23**	<0.0010	<0.0010	0.27	0.949	1.219
		3/15/2018	6.94	5.4	0.266	180	650					8.2		140											
		5/29/2018						<0.0030	0.0066	0.17	<0.0010		<0.0010		<0.0040	<0.0020	<0.0010	0.022	<0.00020	**0.28**	<0.0010	<0.0010	1.02	0.213	1.233
		9/11/2018	6.13	7	<0.250	180	490	--	0.0066	0.12	--	9.2	--	130	<0.0040	0.0012	<0.0010	0.012	--	**0.26**	<0.0010	--	0.708	1.69	2.4

Notes:

Blank cells - Constituent not included in this analysis.
GW - Groundwater.
GWPS - Groundwater Protection Standard.
mg/L - milligrams per liter.

NA - Not Available.
NS - No Sample, sample was lost in transit.
pCi/L - picoCurie per liter.
su - standard units

Qualifiers:
< - Constituent was not detected, value is the reporting limit.

(a) - Site GWPS are the USEPA Maximum Contaminant Levels (MCLs), or where unavailable, the USEPA Tapwater Regional Screening Levels (RSLs).
USEPA 2018 Edition of the Drinking Water Standards and Health Advisories. Spring 2018.
http://water.epa.gov/drink/contaminants/index.cfm
USEPA Risk-Based Screening Levels (May 2019). Values for Tap Water. Hazard Index = 1.0.
https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

🟩 Detected Concentration > Groundwater Protection Standard.

TABLE 2
HUMAN HEALTH PUBLISHED SCREENING LEVELS FOR SURFACE WATER
AECI NEW MADRID POWER PLANT - POND 003 COMPLEX
NEW MADRID, MISSOURI

		Human Health Published Screening Level - Drinking Water			Human Health Published Screening Level - Surface Water		Selected Published Human Health Screening Levels for Surface Water	
Constituent	CAS RN	Missouri Drinking Water Supply (a) (mg/L)	Missouri Groundwater (a) (mg/L)	May 2019 USEPA Tap Water RSLs (b) (mg/L)	Missouri Human Health Fish Consumption (a) (mg/L)	USEPA NRWQC Human Health Consumption of Organism Only (c) (mg/L)	Selected Screening Level - Drinking Water (d) (mg/L)	Selected Screening Level - Surface Water Consumption of Organism Only (e) (mg/L)
Detection Monitoring - USEPA Appendix III Constituents (f)								
Boron	7440-42-8	NA	2	4	NA	NA	2	NA
Fluoride	16984-48-8	4	4	0.8	NA	NA	4	NA
Assessment Monitoring - USEPA Appendix IV Constituents								
Antimony	7440-36-0	0.006	0.006	0.0078	4.3	0.64	0.006	4.3
Arsenic	7440-38-2	0.05	0.05	0.000052	NA	0.00014	0.05	0.00014
Barium	7440-39-3	2	2	3.8	NA	NA	2	NA
Beryllium	7440-41-7	0.004	0.004	0.025	NA	NA	0.004	NA
Cadmium	7440-43-9	0.005	0.005	0.0092	NA	NA	0.005	NA
Chromium	7440-47-3	0.1	0.1	22	NA	NA	0.1	NA
Cobalt	7440-48-4	NA	1	0.006	NA	NA	1	NA
Lead	7439-92-1	0.015	0.015	0.015	NA	NA	0.015	NA
Lithium	7439-93-2	NA	NA	0.04	NA	NA	0.04	NA
Mercury	7439-97-6	0.002	0.002	0.0057	NA	NA	0.002	NA
Molybdenum	7439-98-7	NA	NA	0.1	NA	NA	0.1	NA
Selenium	7782-49-2	0.05	0.05	0.1	NA	4.2	0.05	4.2
Thallium	7440-28-0	0.002	0.002	0.0002	0.0063	0.00047	0.002	0.0063
Radiological (pCi/L)								
Radium-226 & 228	7440-14-4	5 (g)	NA	NA	NA	NA	5	NA

Notes:

CAS RN - Chemical Abstracts Service Registry Number.
mg/L - milligrams per liter.
NA - Not Available / Applicable.
NRWQC - National Recommended Water Quality Criteria.
pCi/L - picoCurie per liter.
RSL - Regional Screening Level.
USEPA - United States Environmental Protection Agency.

(a) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A1. Updated January 29, 2019. http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf. Missouri State Drinking Water and Groundwater Standards apply to total results, Human Health Fish Consumption values apply to dissolved results (except mercury, which applies to total results);

(b) - USEPA Risk-Based Screening Levels (May 2019). Values for Tap Water. Hazard Index = 1.0. http://www2.epa.gov/risk/risk-based-screening-table-generic-tables

(c) - USEPA National Recommended Water Quality Criteria - Human Health Criteria Table. USEPA Office of Water and Office of Science and Technology. https://www.epa.gov/wqc/national-recommended-water-quality-criteria-human-health-criteria-table

(d) - The hierarchy for selection among the Human Health Published Screening Levels for Drinking Water is:
1) Missouri Drinking Water Supply
2) Missouri Groundwater Supply
3) USEPA RSL - Tap Water

(e) - The hierarchy for selection among the Human Health Published Screening Values for Surface Water - Consumption of Organism Only is:
1) Missouri Human Health Fish Consumption
2) USEPA NRWQC - Consumption of Water and Organism.

(f) - Detection Monitoring - EPA Appendix III Constituents without health risk-based screening levels are not included.

(g) - USEPA Maximum Contaminant Level (MCL) used in the absence of a Missouri State value for radium in drinking water. USEPA, 2018. 2018 Edition of the Drinking Water Standards and Health Advisories. March. https://www.epa.gov/dwstandardsregulations/2018-drinking-water-standards-and-advisory-tables

TABLE 3
HUMAN HEALTH CALCULATED RISK BASED SCREENING LEVELS FOR SURFACE WATER
AECI NEW MADRID POWER PLANT - POND 003 COMPLEX
NEW MADRID, MISSOURI

		Human Health Calculated RBSL - Recreational Use of Surface Water (c)			
Constituent	**CAS RN**	**Current/Future Off-Site Recreational Swimmer Age-Adjusted (Ages 1 - 26) (a) (mg/L)**	**Current/Future Off-Site Recreational Wader Age-Adjusted (Ages 1 - 26) (a) (mg/L)**	**Current/Future Off-Site Recreational Boater (Adult) (a) (mg/L)**	**Selected Human Health Calculated RBSL - Recreational Use of Surface Water (b) (mg/L)**
Detection Monitoring - USEPA Appendix III Constituents (d)					
Boron	7440-42-8	114	120	11,200	114
Fluoride	16984-48-8	23.9	22.9	2,240	22.9
Assessment Monitoring - USEPA Appendix IV Constituents					
Antimony	7440-36-0	0.171	0.218	3.36	0.171
Arsenic	7440-38-2	0.0236 (e, f)	0.0389 (e, g)	2.61 (e, h)	0.0236
Barium	7440-39-3	63.7	97.1	784	63.7
Beryllium	7440-41-7	0.121	0.345	0.784	0.121
Cadmium	7440-43-9	0.134	0.225	1.4	0.134
Chromium (Total)	7440-47-3	155 (i)	386 (i)	1090 (i)	155
Cobalt	7440-48-4	0.178	0.181	42	0.178
Lead	7439-92-1	0.015 (j)	0.015 (j)	0.015 (j)	0.015
Lithium	7439-93-2	1.14	1.2	112	1.14
Mercury	7439-97-6	0.0956 (k)	0.146 (k)	1.18 (k)	0.0956
Molybdenum	7439-98-7	2.86	2.99	280	2.86
Selenium	7782-49-2	2.86	2.99	280	2.86
Thallium	7440-28-0	0.00572	0.00598	0.56	0.00572
Radiological (pCi/L)					
Radium-226 & 228	7440-14-4	NA	NA	NA	NA

Notes:

CAS RN - Chemical Abstracts Service Registry Number.
NA - Not Available.
pCi/L - picoCuries/liter.
mg/L - milligrams/liter.
RBSL - Risk-Based Screening Level.
USEPA - United States Environmental Protection Agency.

(a) - Documentation for the receptor-specific Human Health Calculated Screening Level for Recreational Use of Surface Water is provided in Attachment B.
(b) - The selected human health RBSL for recreational use of surface water is the minimum value from amongst the Current/Future Off-Site Recreational Swimmer, Current/Future Off-Site Recreational Wader, and Current/Future Off-Site Recreational Boater RBSLs.
(c) - Some calculated values may be above solubility limits.
(d) - Detection Monitoring - EPA Appendix III Constituents without health risk-based screening levels are not included.
(e) - Arsenic RBSLs are based on the lower of the values based on a hazard index of 1 and an excess lifetime cancer risk of 1E-05. Note that of the constituents evaluated, arsenic is the only constituent with an RSL based on potential carcinogenic effects.
(f) - RBSL based on cancer endpoint at 1E-5 (noncancer-based RBSL is 0.647 mg/L).
(g) - RBSL based on cancer endpoint at 1E-5 (noncancer-based RBSL is 3.04 mg/L).
(h) - RBSL based on cancer endpoint at 1E-5 (noncancer-based RBSL is 16.8 mg/L).
(i) - Value for chromium (III) used.
(j) - USEPA lead action level of 0.015 mg/L for lead in drinking water (USEPA, 2018) is used as the RBSL.
(k) - Value for mercuric chloride used.

TABLE 4
ECOLOGICAL SCREENING LEVELS FOR SURFACE WATER
AECI NEW MADRID POWER PLANT - POND 003 COMPLEX
NEW MADRID, MISSOURI

Constituent	CAS RN	Ecological Published Screening Levels - Surface Water				Selected Ecological Screening Level Acute (Dissolved) (c) (mg/L)	Selected Ecological Screening Level Chronic (Dissolved) (c) (mg/L)
		Missouri Protection of Aquatic Life Chronic (Dissolved) (a) (mg/L)	Missouri Protection of Aquatic Life Acute (Dissolved) (a) (mg/L)	USEPA NRWQC Aquatic Life Criteria CCC - Freshwater Chronic (Dissolved) (b) (mg/L)	USEPA NRWQC Aquatic Life Criteria CMC - Freshwater Acute (Dissolved) (b) (mg/L)		
Detection Monitoring - USEPA Appendix III Constituents (e)							
Boron	7440-42-8	NA	NA	NA	NA	NA	NA
Fluoride	16984-48-8	NA	NA	NA	NA	NA	NA
Assessment Monitoring - USEPA Appendix IV Constituents							
Antimony	7440-36-0	NA	NA	NA	NA	NA	NA
Arsenic	7440-38-2	0.15	0.34	0.15	0.34	0.34	0.15
Barium	7440-39-3	NA	NA	NA	NA	NA	NA
Beryllium	7440-41-7	0.005	NA	NA	NA	NA	0.005
Cadmium	7440-43-9	0.00072 (d)	0.0018 (d)	0.00072 (d)	0.0018 (d)	0.0018	0.0007
Chromium	7440-47-3	0.074 (d, e)	0.57 (d, e)	0.074 (d, e)	0.57 (d, e)	0.57	0.07
Cobalt	7440-48-4	NA	NA	NA	NA	NA	NA
Lead	7439-92-1	0.0025 (d)	0.065 (d)	0.0025 (d)	0.065 (d)	0.065	0.0025
Lithium	7439-93-2	NA	NA	NA	NA	NA	NA
Mercury	7439-97-6	0.00077	0.0014	0.00077	0.0014	0.0014	0.00077
Molybdenum	7439-98-7	NA	NA	NA	NA	NA	NA
Selenium	7782-49-2	0.005	NA	0.0031 (f)	NA	NA	0.005
Thallium	7440-28-0	NA	NA	NA	NA	NA	NA
Radiological (pCi/L)							
Radium-226 & 228	7440-14-4	NA	NA	NA	NA	NA	NA

Notes:

CAS RN - Chemical Abstracts Service Registry Number.
mg/L - milligrams per liter.
NA - Not Available / Applicable.
pCi/L - picoCurie per liter.

NRWQC - National Recommended Water Quality Criteria
CCC - Continuous Criterion Concentration
CMC - Criterion Maximum Concentration
USEPA - United States Environmental Protection Agency

(a) - 10 Missouri Code of State Regulations Division 20 Chapter 7 Table A1. Updated January 29, 2019. http://www.sos.mo.gov/adrules/csr/current/10csr/10c20-7a.pdf. Missouri State Protection of Aquatic Life Chronic values apply to dissolved results (except mercury, which applies to total results).

(b) - USEPA Water Quality Criteria. Current Water Quality Criteria Tables. National Recommended Water Quality Criteria - Aquatic Life Criteria Table. http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm

(c) - The hierarchy for the selection of ecological screening levels is:
1) Missouri Protection of Aquatic Life Criteria.
2) USEPA NRWQC. Aquatic Life Criteria - Freshwater.

(d) - Hardness dependent value for total metals adjusted for dissolved fraction. Default mean hardness value of 100 mg/L as CaCO3 used.

(e) - Value for trivalent chromium used.

(f) - USEPA Office of Water. Final Criterion: Aquatic Life Ambient Water Quality Criterion for Selenium - Freshwater. 30 June 2016. Freshwater value for chronic (30 day) water column concentration (mg/L) of dissolved selenium in lotic (flowing) surface water. The criterion is based on fish ovary concentrations, and in lieu of that, the water column values are used. https://www.epa.gov/sites/production/files/2016-07/documents/aquatic_life_awqc_for_selenium_-_freshwater_2016.pdf

TABLE 5
SELECTED SURFACE WATER SCREENING LEVELS
AECI NEW MADRID POWER PLANT - POND 003 COMPLEX
NEW MADRID, MISSOURI

Constituent	CAS RN	HH DW SL (a) (mg/L)	HH REC SL - Consumption of Organism Only (b) (mf/L)	HH Recreational Calculated RBSL (c) (mg/L)	ECO SL - Dissolved (acute) (d) (mg/L)	ECO SL - Dissolved (chronic) (d) (mg/L)
Detection Monitoring - USEPA Appendix III Constituents (e)						
Boron	7440-42-8	2	NA	114	NA	NA
Fluoride	16984-48-8	4	NA	22.9	NA	NA
Assessment Monitoring - USEPA Appendix IV Constituents						
Antimony	7440-36-0	0.006	4.3	0.171	NA	NA
Arsenic	7440-38-2	0.05	0.00014	0.236	0.34	0.15
Barium	7440-39-3	2	NA	63.7	NA	NA
Beryllium	7440-41-7	0.004	NA	0.121	NA	0.005
Cadmium	7440-43-9	0.005	NA	0.134	0.0018	0.0007
Chromium (Total)	7440-47-3	0.1	NA	155	0.57	0.07
Cobalt	7440-48-4	1	NA	0.178	NA	NA
Lead	7439-92-1	0.015	NA	0.015	0.065	0.0025
Lithium	7439-93-2	0.04	NA	1.14	NA	NA
Mercury	7439-97-6	0.002	NA	0.0956	0.0014	0.00077
Molybdenum	7439-98-7	0.1	NA	2.86	NA	NA
Selenium	7782-49-2	0.05	4.2	2.86	NA	0.005
Thallium	7440-28-0	0.002	0.0063	0.00572	NA	NA
Radiological (pCi/L)						
Radium-226 & 228	7440-14-4	5	NA	NA	NA	NA

Notes:

CAS RN - Chemical Abstracts Service Registry Number.	mg/L - milligram per liter.
ECO SL - Ecological Screening Level.	NA - Not Available.
HH DW SL - Human Health Drinking Water Screening Level.	RBSL - Risk-Based Screening Level.
HH REC SL - Human Health Recreational Use Screening Level.	

(a) - Drinking Water Screening Levels selected in Table 2 using the following hierarchy:
1) Missouri Drinking Water Supply
2) Missouri Groundwater Supply
3) USEPA RSL - Tap Water
(b) - Human Health Surface Water Screening Levels selected in Table 2 using the following hierarchy:
1) Missouri Human Health Fish Consumption
2) USEPA NRWQC - Consumption of Water and Organism.
(c) - The Human Health Calculated Screening Levels are presented in Table 3.
The minimum calculated value for the Off-Site Recreational Boater, Wader, and Swimmer was selected.
(d) - Ecological Screening Levels selected in Table 4 using the following hierarchy:
1) Missouri Protection of Aquatic Life Criteria.
2) USEPA NRWQC. Aquatic Life Criteria - Freshwater.
(e) - Detection Monitoring - EPA Appendix III Constituents without health risk-based screening levels are not included.

TABLE 6
DERIVATION OF RISK-BASED TARGET SCREENING LEVELS FOR GROUNDWATER
AECI NEW MADRID POWER PLANT - POND 003 COMPLEX
NEW MADRID, MISSOURI

							Dilution Attenuation Factor (e)	100,000			
Constituent	**CAS RN**	**HH DW SL (a) (mg/L)**	**HH REC SL - Consumption of Organism Only (b) (mg/L)**	**HH Recreational Calculated RBSL (c) (mg/L)**	**ECO SL - Dissolved (acute) (d) (mg/L)**	**ECO SL - Dissolved (chronic) (d) (mg/L)**	**Lowest of the Human Health and Ecological Screening Levels (mg/L)**	**Target Groundwater Screening Level - Mississippi River (f) (mg/L)**	**Maximum Groundwater Concentration (mg/L)**		**Ratio Between Target Groundwater Screening Level and the Maximum Groundwater Concentration**
Detection Monitoring - USEPA Appendix III Constituents (g)											
Boron	7440-42-8	2	NA	114	NA	NA	2	200,000	20	MW-7	10,000
Fluoride	16984-48-8	4	NA	22.9	NA	NA	4	400,000	0.679	P-2	>580,000
Assessment Monitoring - USEPA Appendix IV Constituents											
Antimony	7440-36-0	0.006	4.3	0.171	NA	NA	0.006	600	0.0031	P-1	>190,000
Arsenic	7440-38-2	0.05	0.00014	0.0236	0.34	0.15	0.00014	14	0.011	P-5	>1,000
Barium	7440-39-3	2	NA	63.7	NA	NA	2	200,000	0.181	MW-7	>1,000,000
Beryllium	7440-41-7	0.004	NA	0.121	NA	0.005	0.004	400	0.001 U		NA
Cadmium	7440-43-9	0.005	NA	0.134	0.0018	0.0007	0.0007	72	0.0016	MW-7	>44,000
Chromium (Total)	7440-47-3	0.1	NA	155	0.57	0.07	0.07	7,411	0.018	P-1	>410,000
Cobalt	7440-48-4	1	NA	0.178	NA	NA	0.178	17,800	0.0098	MW-7	>1,000,000
Lead	7439-92-1	0.015	NA	0.015	0.065	0.0025	0.0025	252	0.0047	P-3	>53,000
Lithium	7439-93-2	0.04	NA	1.14	NA	NA	0.04	4,000	0.05	P-4	80,000
Mercury	7439-97-6	0.002	NA	0.0956	0.0014	0.00077	0.00077	77	<0.00020		NA
Molybdenum	7439-98-7	0.1	NA	2.86	NA	NA	0.1	10,000	3.9	MW-7	>2,500
Selenium	7782-49-2	0.05	4.2	2.86	NA	0.005	0.005	500	0.008	P-3	>62,000
Thallium	7440-28-0	0.002	0.0063	0.00572	NA	NA	0.002	200	0.002	MW-7	100,000
Radiological (pCi/L)											
Radium-226 & 228	7440-14-4	5	NA	NA	NA	NA	5	500,000	3.8	MW-7	>130,000

Notes:

CAS RN - Chemical Abstracts Service Registry Number.	HH REC SL - Human Health Recreational Use Screening Level.
ECO SL - Ecological Screening Level.	mg/L - milligram per liter.
HH DW SL - Human Health Drinking Water Screening Level.	NA - Not Available.

(a) - Drinking Water Screening Levels selected in Table 2 using the following hierarchy:
1) Missouri Drinking Water Supply
2) Missouri Groundwater Supply
3) USEPA RSL - Tap Water

(b) - Surface Water Screening Levels selected in Table 2 using the following hierarchy:
1) Missouri Human Health Fish Consumption
2) USEPA NRWQC - Consumption of Water and Organism.

(c) - The Human Health Calculated Screening Levels are presented in Table 3.
The minimum calculated value for the Off-Site Recreational Boater, Wader, and Swimmer was selected.

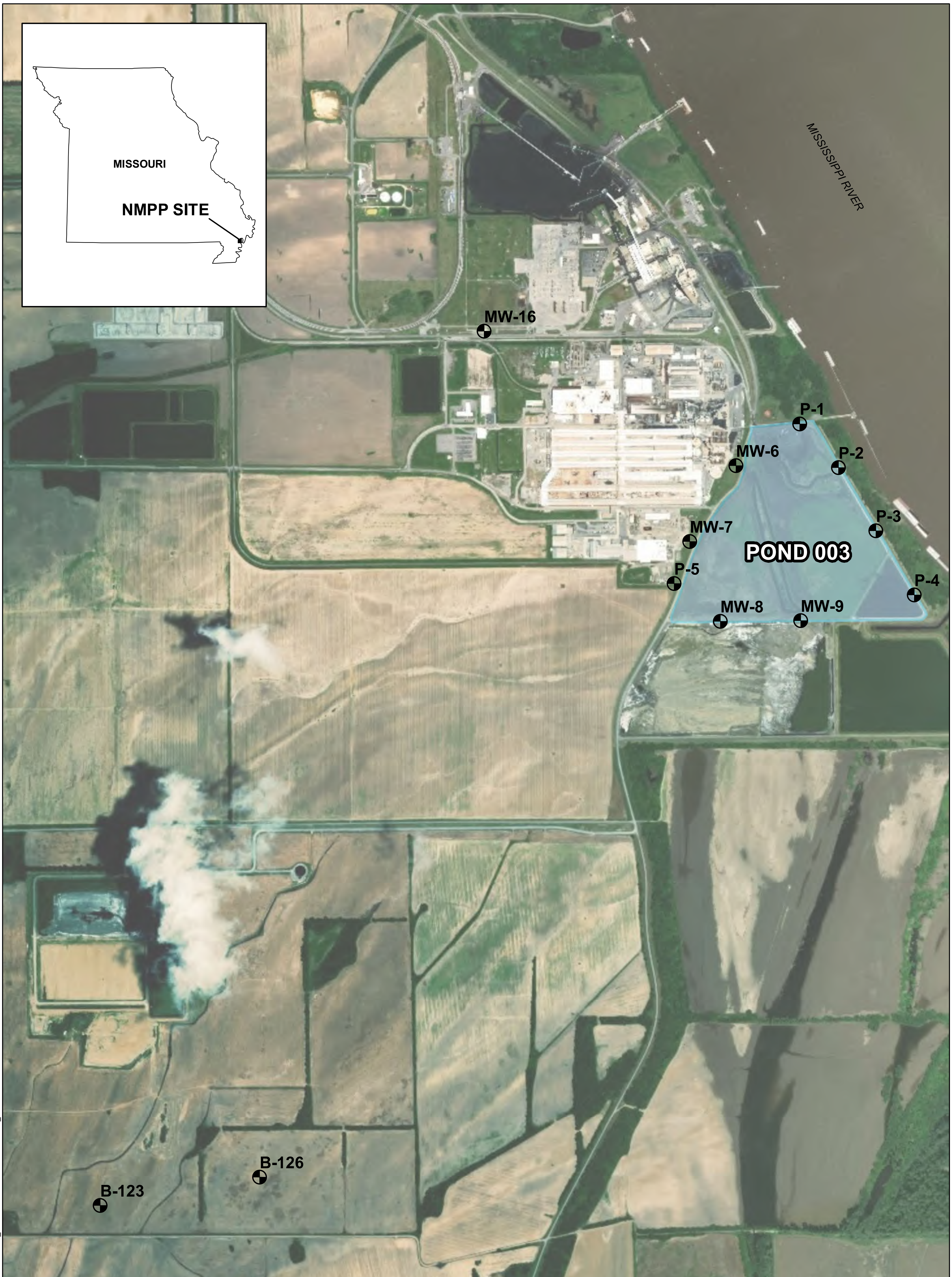
(d) - Ecological Screening Levels selected in Table 4 using the following hierarchy:
1) Missouri Protection of Aquatic Life Criteria.
2) USEPA NRWQC. Aquatic Life Criteria - Freshwater.

(e) - Estimated value, see text for derivation.

(f) - The Target Groundwater Screening Level = Minimum SL x Dilution Factor.

(g) - Detection Monitoring - EPA Appendix III Constituents without health risk-based screening levels are not included.

FIGURES



LEGEND

◐ MONITORING WELL

🟦 POND 003

NOTE
1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI, 19 MAY 2016.

N

0 1,500 3,000
SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
MARSTON, MISSOURI

POND 003 MONITORING WELL
LOCATION MAP

aeci

JANUARY 2019
SCALE: AS SHOWN

FIGURE 1

GIS FILE PATH: \\haleyaldrich.com\share\phx_common\Projects\AECI\New Madrid\GIS\MXDs\2018_1\POND 3 WELL LOCATION MAP_REV1.mxd — USER: DZinsmaster — LAST SAVED: 3/16/2018 10:00:14 AM

LEGEND

⊕ MONITORING WELL

🟦 POND 003

← GROUNDWATER FLOW DIRECTION

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI, 19 MAY 2016.

N

0 330 660

SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER GENERATING FACILITY
NEW MADRID COUNTY, MISSOURI

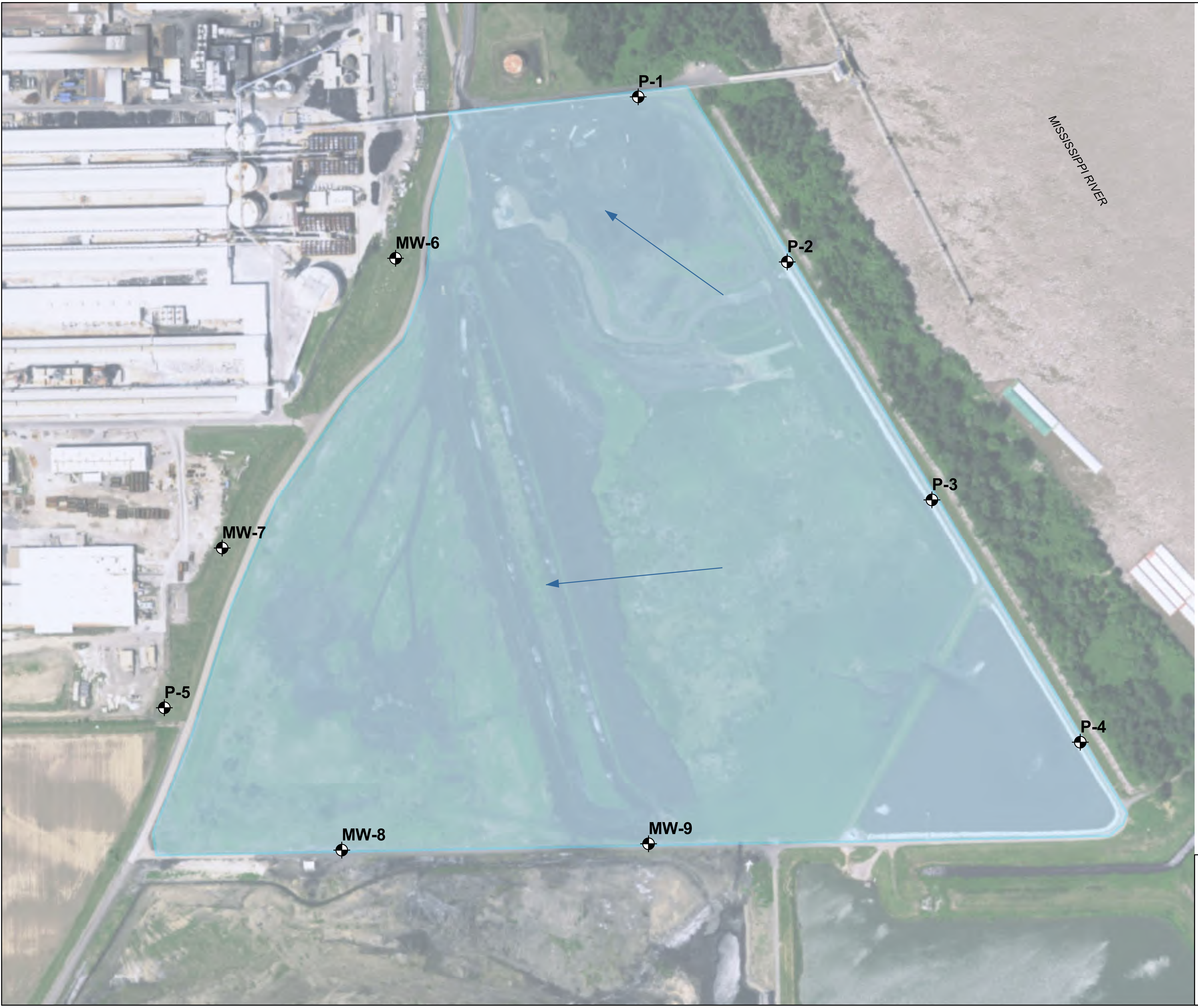
POND 003 - GROUNDWATER FLOW DIRECTION MAP
LOW RIVER STAGE
3/28/2017

aeci

OCTOBER 2017

FIGURE 2

GIS FILE PATH: G:\Projects\AECI\New Madrid\GIS\MXDs\2017_09\129342_003_0002_POND_003_GW_ELEV_CONTOURS_LOW.mxd — USER: kford — LAST SAVED: 10/16/2017 2:37:59 PM



LEGEND

⊕ MONITORING WELL

▨ POND 003

← GROUNDWATER FLOW DIRECTION

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI, 19 MAY 2016.

N

0 330 660
SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER GENERATING FACILITY
NEW MADRID COUNTY, MISSOURI

POND 003 - GROUNDWATER
FLOW DIRECTION MAP
HIGH RIVER STAGE
5/17/2017

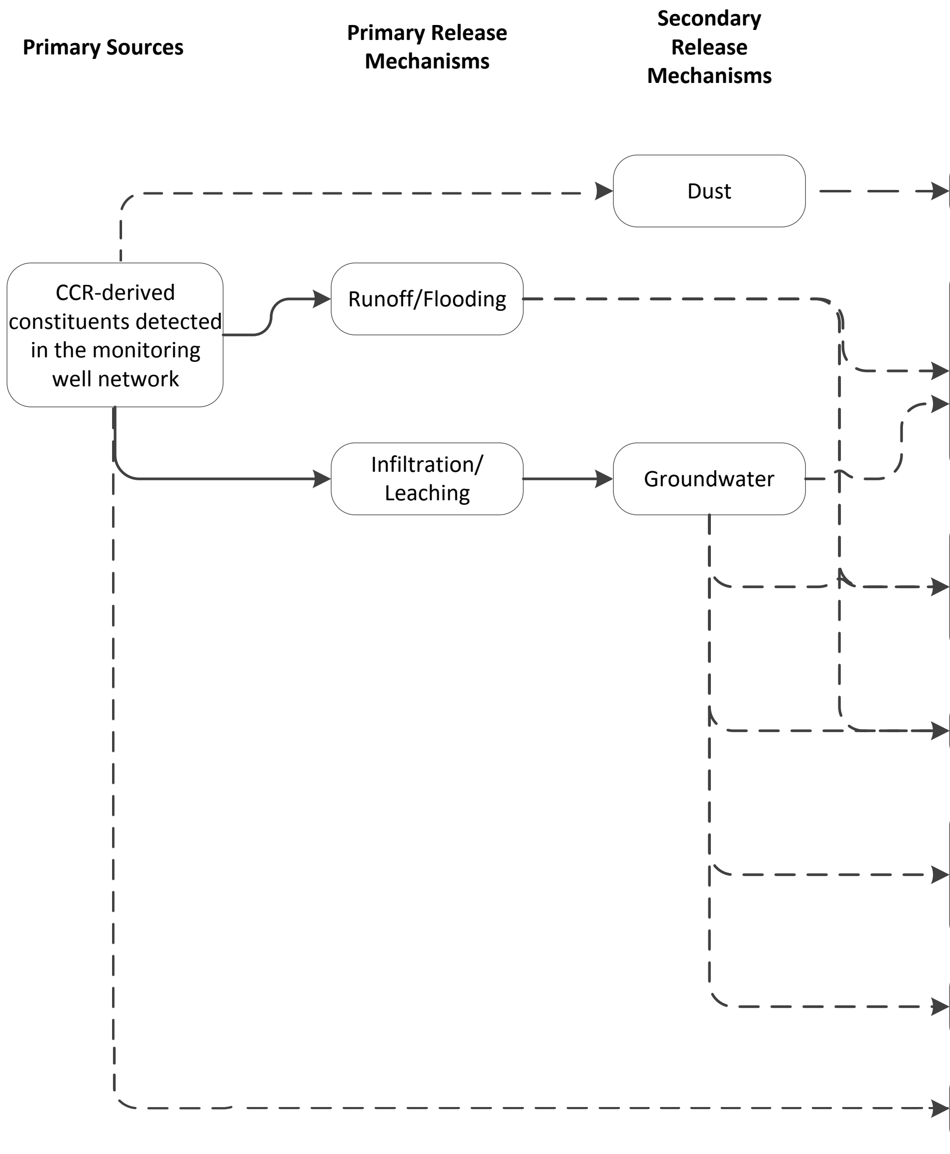
aeci

OCTOBER 2017

FIGURE 3

GIS FILE PATH: G:\Projects\AECI\New Madrid\GIS\MXDs\2017_09\129342_003_0002_POND_003_GW_ELEV_CONTOURS.mxd — USER: kford — LAST SAVED: 10/16/2017 2:40:28 PM

FIGURE 4
CONCEPTUAL SITE MODEL
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER GENERATING FACILITY
NEW MADRID COUNTY, MISSOURI



		Potential Receptors								
Potential Exposure Media	**Potential Exposure Route**	**Current/Future Commercial/ Industrial Worker**	**Current/Future On-Site Construction Worker**	**Current/Future On-Site Trespasser**	**Current/Future Off-Site Resident Adult/Child**	**Current/Future Off-Site Recreational User (a)**	**Benthic Invertebrates and Fish**	**Aquatic Birds and Mammals**	**Terrestrial Birds and Mammals**
Outdoor Air	Inhalation	○	○	○	○	○	○	○	○
Mississippi River Surface Water (Off-Site)	Drinking Water Use	○	○	○	●	○	○	○	○
	Plant/Incidental Ingestion	○	○	○	●	●	●	●	○
	Direct Contact	○	○	○	●	●	○	○	○
Sediment (Off-Site)	Plant/Incidental Ingestion	○	○	○	○	○	○	○	○
	Direct Contact	○	○	○	○	○	○	○	○
Fish Tissue	Ingestion	○	○	○	○	●	○	○	○
Groundwater (On-Site)	Incidental Ingestion	○	○	○	○	○	○	○	○
	Direct Contact	○	○	○	○	○	○	○	○
Groundwater (Off-Site)	Drinking Water Use	○	○	○	○	○	○	○	○
CCR Material	Direct Contact	○	○	○	○	○	○	○	○

(a) Includes Current/Future Off-Site Recreational Wader, Recreational Swimmer, Recreational Boater, and Recreational Fisher.

● Pathway potentially complete and evaluated in this assessment to determine if pathway would be associated with a significant risk to human health or the environment.

○ Pathway determined to be incomplete or insignificant and therefore not further evaluated in this assessment.

——▶ Potential complete migration pathway.

– – ▶ Incomplete/insignificant migration pathway.

CCR: Coal Combustion Residuals.

LEGEND

- ⌖ MONITORING WELL
- ○ POINT OF COMPLIANCE (POC)
- ∿ POINT OF EXPOSURE (POE)
- ← DISCHARGE DIRECTION
- ▭ POND 003

$$\text{CONCENTRATION AT POE} = \frac{\text{POC CONCENTRATION}}{Q_{RIVER} / Q_{GROUNDWATER}}$$

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI

N

0 330 660
SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER GENERATING FACILITY
NEW MADRID COUNTY, MISSOURI

POND 003 - DAF CALCULATION
LOW RIVER STAGE
3/28/2017

aeci

MARCH 2019

FIGURE 7

ATTACHMENT A

Calculated Recreator Risk-Based Screening Levels

TABLE A-1
HUMAN HEALTH EXPOSURE PARAMETERS FOR DERIVATION OF RISK BASED SCREENING LEVELS (RBSLs) - RECREATIONAL SURFACE WATER

			Current/Future Off-Site Recreational Swimmer								Current/Future Off-Site Recreational Wader								Current/Future Off-Site Recreational Boater Adult	
Exposure Parameter		Units	Child (Age <6)		Adolescent (6-<16 years)		Adult		Child, Adolescent and Adult (Ages 1 - 26)		Child (Age <6)		Adolescent (6-<16 years)		Adult		Child, Adolescent and Adult (Ages 1 - 26)			
Standard Parameters																				
Body Weight	BW	kg	15	USEPA, 2011 [1]	44	USEPA, 2011 [1]	80	USEPA, 2014a	NA		15	USEPA, 2011 [1]	44	USEPA, 2011 [1]	80	USEPA, 2014a	NA		80	USEPA, 2014a
Exposure Duration	ED	years	6	Ages <6	10	Ages 6 - <16	10	Balance of 26-yr exposure	26		6	Ages <6	10	Ages 6 - <16	10	Balance of 26-yr exposure	26		10	Balance of 26-yr exposure
Non–carcinogenic Averaging Time	Atnc	days	2190	ED expressed in days	3650	ED expressed in days	3650	ED expressed in days	9490	ED expressed in days	2190	ED expressed in days	3650	ED expressed in days	3650	ED expressed in days	9490	ED expressed in days	3650	ED expressed in days
Carcinogenic Averaging Time	Atc	days	25550	70 year lifetime	25550	70 year lifetime	25550	70 year lifetime	25550	70 year lifetime	25550	70 year lifetime	25550	70 year lifetime	25550	70 year lifetime	25550	70 year lifetime	25550	70 year lifetime
Incidental Ingestion of Surface Water																				
Exposure Frequency	EF	days/year	45	USEPA, 2014b	45	USEPA, 2014b	45	USEPA, 2014b	45	USEPA, 2014b	45	USEPA, 2014b	45	USEPA, 2014b	45	USEPA, 2014b	45	USEPA, 2014b	NA	
Water Ingestion Rate	IR	L/day	0.10	USEPA, 2014b [2]	0.10	USEPA, 2014b [2]	0.10	USEPA, 2014b [2]	NA		0.10	USEPA, 2014b [2]	0.02	USEPA, 2014b [2]	0.02	USEPA, 2014b [2]	NA		NA	
Fraction Ingested	FI	unitless	1.0	Assumption	1.0	Assumption	1.0	Assumption	1.0	Assumption	1.0	Assumption	1.0	Assumption	1.0	Assumption	1.0	Assumption	NA	
Age-Adjusted Water Ingestion Factor	IFWadj	L/kg	NA		NA		NA		3.39		NA		NA		NA		2.12		NA	
Age-Adjusted Water Ingestion Factor-Mutagenic	IFWM	L/kg	NA		NA		NA		13.23		NA		NA		NA		10.33		NA	
Dermal Exposure with Surface Water																				
Exposure Frequency	EF	days/year	45	USEPA, 2014b	45	USEPA, 2014b	45	USEPA, 2014b	45	USEPA, 2014b	45	USEPA, 2014b	45	USEPA, 2014b	45	USEPA, 2014b	45	USEPA, 2014b	45	USEPA, 2014b
Exposed Skin Surface Area	SA	cm^2	6365	USEPA, 2014a	13350	USEPA, 2011 [3]	19652	USEPA, 2014a	NA		1770	USEPA, 2011 [4]	3820	USEPA, 2011 [4]	5790	USEPA, 2011 [4]	NA		5790	USEPA, 2011 [4]
Exposure Time	t-event	hr/event	2	Site-specific [5]	2	Site-specific [5]	2	Site-specific [5]	2	Site-specific [5]	2	Site-specific [5]	2	Site-specific [5]	2	Site-specific [5]	2	Site-specific	2	Site-specific [5]
Events per Day	EV	event/day	1.0	Site-specific [5]	1.0	Site-specific [5]	1.0	Site-specific [5]	1.0	Site-specific [5]	1.0	Site-specific [5]	1.0	Site-specific [5]	1.0	Site-specific [5]	1.0	Site-specific	1	Site-specific [5]
Age-Adjusted Dermal Contact Factor	DFWadj	events-cm^2/kg	NA		NA		NA		361647		NA		NA		NA		103497		NA	
Age-Adjusted Dermal Contact Factor-Mutagenic	DFWM	events-cm^2/kg	NA		NA		NA		1131185		NA		NA		NA		319693		NA	

NOTES AND ABBREVIATIONS

USEPA, 2002 - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OWSWER 9355.4-24
USEPA, 2011 - Exposure Factors Handbook. USEPA/600/R-10/030. October, 2011.
USEPA, 2014a - Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER 9200.1-120. February 6, 201.
USEPA, 2014b - Region 4 Human Health Risk Assessment Supplemental Guidance. January 2014. Draft Final.
[1] - Table 8-1 of USEPA (2011).
[2] - Ingestion rate of 50 ml/hour of surface water is used for exposures to water during swimming. Intake rates for exposure to surface water during wading are 50 ml/hour for children 1-6, and 10 ml/hour for adolescents and adults.
The water ingestion rate in liters/day is calculated as follows: ingestion (ml/hr) x exposure time (hr/event)/1000 (ml/L).
[3] - Based on weighted average of mean values for 6-<16 years.
[4] - Based on surface area of hands, forearms, lower legs, and feet.
[5] - Assumes 2 hours per event and that on days when recreation in water occurs, all daily exposure to water is derived from locations at the Site.

Values based on a time-weighted average of child, adolescent, and adult exposure values are calculated as follows:
Water
IFWadj = (child ED [0-2] x child EF [0-2] x child IR [0-2] / child BW [0-2]) + (child ED [2-6] x child EF [2-6] x child IR [2-6] / child BW [2-6]) + (older child ED [6-16] x older child EF [6-16] x older child IR [6-16] / older child BW [6-16]) + (adult ED x adult EF x adult IR / adult BW)
DFWadj = (child EF [0-2] x child ED [0-2] x child SA [0-2] x child EV [0-2] / child BW [0-2]) + (child EF [2-6] x child ED [2-6] x child SA [2-6] x child EV [2-6] / child BW [2-6]) + (older child EF [6-16] x older child ED [6-16] x older child SA [6-16] x older child EV [6-16] / older child BW [6-16]) + (adult EF x adult ED x adult SA x adult EV / adult BW)
Water - mutagenic
IFWM = (child ED [0-2] x child EF [0-2] x child IR [0-2] x ADAF [0-2] / child BW [0-2]) + (child ED [2-6] x child EF [2-6] x child IR [2-6] x ADAF [2-6] / child BW [2-6]) + (older child ED [6-16] x child EF [6-16] x older child IR [6-16] x ADAF [6-16] / older child BW [6-16]) + (adult ED x adult EF x adult IR x adult ADAF / adult BW)
DFWM = (child EF [0-2] x child ED [0-2] x child SA [0-2] x child EV [0-2] x ADAF [0-2] / child BW [0-2]) + (child EF [2-6] x child ED [2-6] x child SA [2-6] x child EV [2-6] x ADAF [2-6] / child BW [2-6]) + (older child EF [6-16] x older child ED [6-16] x older child SA [6-16] x older child EV [6-16] x ADAF [6-16] / older child BW [6-16]) + (adult EF x adult ED x adult SA x adult EV x adult ADAF / adult BW)

USEPA guidance for early life exposure to carcinogens (USEPA, 2005) requires that risks for potentially carcinogenic constituents that are presumed to act by a mutagenic mode of action be calculated differently than for constituents that do not act via a mutagenic mode of action.
Therefore, the age-dependent adjustment factors (ADAF) will be applied for calculations involving children under the age of 16. The ADAFs are as follows:

Age 0 to 2 years (2 year interval from birth until 2nd birthday) – ADAF = 10
Ages 2 to 16 years (14 year interval from 2nd birthday to 16th birthday) – ADAF = 3
Ages 16 and up (after 16th birthday) – no adjustment - ADAF = 1

The exposure parameters for children ages <6 are applied to children 0 - 2 and 2- 6.

Site-specific

Recreator Equation Inputs for Surface Water

* Inputted values different from Recreator defaults are highlighted.

Variable	Recreator Surface Water Default Value	Form-input Value
BW_{0-2} (body weight) kg	15	0
BW_{2-6} (body weight) kg	15	0
BW_{6-16} (body weight) kg	80	0
BW_{16-30} (body weight) kg	80	80
BW_{a} (body weight - adult) kg	80	80
BW_{rec-a} (body weight - adult) kg	80	80
$DFW_{rec-adj}$ (age-adjusted dermal factor) cm^2-event/kg	0	32568.75
$DFWM_{rec-adj}$ (mutagenic age-adjusted dermal factor) cm^2-event/kg	0	32568.75
ED_{rec} (exposure duration - recreator) years	26	10
ED_{0-2} (exposure duration) years	2	0
ED_{2-6} (exposure duration) years	4	0
ED_{6-16} (exposure duration) years	10	0
ED_{16-30} (exposure duration) years	10	10
ED_{rec-a} (exposure duration - adult) years	20	10
EF_{rec-w} (exposure frequency) days/year	0	45
EF_{0-2} (exposure frequency) days/year	0	0
EF_{2-6} (exposure frequency) days/year	0	0
EF_{6-16} (exposure frequency) days/year	0	0
EF_{16-30} (exposure frequency) days/year	0	45
EF_{rec-a} (adult exposure frequency) days/year	0	45
ET_{0-2} (exposure time) hours/event	0	0
ET_{2-6} (exposure time) hours/event	0	0
ET_{6-16} (exposure time) hours/event	0	0
ET_{16-30} (exposure time) hours/event	0	2
ET_{rec-a} (adult exposure time) hours/event	0	2
EV_{0-2} (events) events/day	0	0
EV_{2-6} (events) events/day	0	0
EV_{6-16} (events) events/day	0	0
EV_{16-30} (events) events/day	0	1
EV_{rec-a} (adult) events/day	0	1
THQ (target hazard quotient) unitless	0.1	1
$IFW_{rec-adj}$ (age-adjusted water intake rate) L/kg	0	0
$IFWM_{rec-adj}$ (mutagenic age-adjusted water intake rate) L/kg	0	0
IRW_{0-2} (water intake rate) L/hour	0.12	0
IRW_{2-6} (water intake rate) L/hour	0.12	0
IRW_{6-16} (water intake rate) L/hour	0.071	0
IRW_{16-30} (water intake rate) L/hour	0.071	0
IRW_{rec} (water intake rate - adult) L/day	0.071	0
IRW_{rec-a} (water intake rate - adult) L/hr	0.071	0
LT (lifetime - recreator) years	70	70
SA_{0-2} (skin surface area) cm^2	6365	0
SA_{2-6} (skin surface area) cm^2	6365	0
SA_{6-16} (skin surface area) cm^2	19652	0
SA_{16-30} (skin surface area) cm^2	19652	5790
SA_{rec} (skin surface area - adult) cm^2	19652	5790
SA_{rec-a} (skin surface area - adult) cm^2	19652	5790
Apparent thickness of stratum corneum (cm)	0.001	0.001
TR (target risk) unitless	0.000001	0.00001

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Site-specific

Recreator Regional Screening Levels (RSL) for Surface Water

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	SF$_o$(mg/kg-day)$^{-1}$	SF$_o$ Ref	RfD (mg/kg-day)	RfD Ref	RfC (mg/m^3)	RfC Ref	RAGSe GIABS (unitless)	K$_p$ (cm/hr)	MW	FA (unitless)	In EPD?	DA$_{event(ca)}$	DA$_{event(nc child)}$	DA$_{event(nc adult)}$	Ingestion SL TR=1E-05 (ug/L)	Dermal SL TR=1E-05 (ug/L)	Carcinogenic SL TR=1E-05 (ug/L)	Ingestion SL (Child) THQ=1 (ug/L)	Dermal SL (Child) THQ=1 (ug/L)	Noncarcinogenic SL (Child) THQ=1 (ug/L)	Ingestion SL (Adult) THQ=1 (ug/L)	Dermal SL (Adult) THQ=1 (ug/L)	Noncarcinogenic SL (Adult) THQ=1 (ug/L)	Screening Level (ug/L)
Antimony (metallic)	7440-36-0	No	No	Inorganics	-		0.0004	I	-		0.1500	0.0010	121.7600	1.0000	Yes	-	-	0.0067	-	-	-	-	-	-	-	3360.0000	3360.0000	3.36E+03nc
Arsenic, Inorganic	7440-38-2	No	No	Inorganics	1.5000	I	0.0003	I	0.0000	C	1.0000	0.0010	74.9220	1.0000	Yes	0.0005	-	0.0336	-	2610.0000	2610.0000	-	-	-	-	16800.0000	16800.0000	2.61E+03ca*
Barium	7440-39-3	No	No	Inorganics	-		0.2000	I	0.0005	H	0.0700	0.0010	137.3300	1.0000	Yes	-	-	1.5690	-	-	-	-	-	-	-	784000.0000	784000.0000	7.84E+05nc
Beryllium and compounds	7440-41-7	No	No	Inorganics	-		0.0020	I	0.0000	I	0.0070	0.0010	9.0100	1.0000	Yes	-	-	0.0016	-	-	-	-	-	-	-	784.0000	784.0000	7.84E+02nc
Boron And Borates Only	7440-42-8	No	No	Inorganics	-		0.2000	I	0.0200	H	1.0000	0.0010	13.8400	1.0000	Yes	-	-	22.4141	-	-	-	-	-	-	-	11200000.0000	11200000.0000	1.12E+07nc
Cadmium (Water)	7440-43-9	No	No	Inorganics	-		0.0005	I	0.0000	A	0.0500	0.0010	112.4000	1.0000	Yes	-	-	0.0028	-	-	-	-	-	-	-	1400.0000	1400.0000	1.40E+03nc
Chromium(III), Insoluble Salts	16065-83-1	No	No	Inorganics	-		1.5000	I	-		0.0130	0.0010	52.0000	1.0000	Yes	-	-	2.1854	-	-	-	-	-	-	-	1090000.0000	1090000.0000	1.09E+06nc
Cobalt	7440-48-4	No	No	Inorganics	-		0.0003	P	0.0000	P	1.0000	0.0004	58.9300	1.0000	Yes	-	-	0.0336	-	-	-	-	-	-	-	42000.0000	42000.0000	4.20E+04nc
Fluoride	16984-48-8	No	No	Inorganics	-		0.0400	C	0.0130	C	1.0000	0.0010	38.0000	1.0000	Yes	-	-	4.4828	-	-	-	-	-	-	-	2240000.0000	2240000.0000	2.24E+06nc
Lithium	7439-93-2	No	No	Inorganics	-		0.0020	P	-		1.0000	0.0010	6.9400	1.0000	Yes	-	-	0.2241	-	-	-	-	-	-	-	112000.0000	112000.0000	1.12E+05nc
Mercuric Chloride	7487-94-7	No	No	Inorganics	-		0.0003	I	0.0003	S	0.0700	0.0010	271.5000	1.0000	Yes	-	-	0.0024	-	-	-	-	-	-	-	1180.0000	1180.0000	1.18E+03nc
Molybdenum	7439-98-7	No	No	Inorganics	-		0.0050	I	-		1.0000	0.0010	95.9400	1.0000	Yes	-	-	0.5604	-	-	-	-	-	-	-	280000.0000	280000.0000	2.80E+05nc
Selenium	7782-49-2	No	No	Inorganics	-		0.0050	I	0.0200	C	1.0000	0.0010	78.9600	1.0000	Yes	-	-	0.5604	-	-	-	-	-	-	-	280000.0000	280000.0000	2.80E+05nc
Thallium (Soluble Salts)	7440-28-0	No	No	Inorganics	-		0.0000	X	-		1.0000	0.0010	204.3800	1.0000	Yes	-	-	0.0011	-	-	-	-	-	-	-	560.0000	560.0000	5.60E+02nc

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Site-specific

Recreator Equation Inputs for Surface Water

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Variable	Recreator Surface Water Default Value	Form-input Value
BW_{0-2} (body weight) kg	15	15
BW_{2-6} (body weight) kg	15	15
BW_{6-16} (body weight) kg	80	44
BW_{16-30} (body weight) kg	80	80
BW_{a} (body weight - adult) kg	80	62
BW_{rec-a} (body weight - adult) kg	80	62
$DFW_{rec-adj}$ (age-adjusted dermal factor) cm^2-event/kg	0	354100.645
$DFWM_{rec-adj}$ (mutagenic age-adjusted dermal factor) cm^2-event/kg	0	1131184.77
ED_{rec} (exposure duration - recreator) years	26	26
ED_{0-2} (exposure duration) years	2	2
ED_{2-6} (exposure duration) years	4	4
ED_{6-16} (exposure duration) years	10	10
ED_{16-30} (exposure duration) years	10	10
ED_{rec-a} (exposure duration - adult) years	20	20
EF_{rec-w} (exposure frequency) days/year	0	45
EF_{0-2} (exposure frequency) days/year	0	45
EF_{2-6} (exposure frequency) days/year	0	45
EF_{6-16} (exposure frequency) days/year	0	45
EF_{16-30} (exposure frequency) days/year	0	45
EF_{rec-a} (adult exposure frequency) days/year	0	45
ET_{0-2} (exposure time) hours/event	0	2
ET_{2-6} (exposure time) hours/event	0	2
ET_{6-16} (exposure time) hours/event	0	2
ET_{16-30} (exposure time) hours/event	0	2
ET_{rec-a} (adult exposure time) hours/event	0	2
EV_{0-2} (events) events/day	0	1
EV_{2-6} (events) events/day	0	1
EV_{6-16} (events) events/day	0	1
EV_{16-30} (events) events/day	0	1
EV_{rec-a} (adult) events/day	0	1
THQ (target hazard quotient) unitless	0.1	1
$IFW_{rec-adj}$ (age-adjusted water intake rate) L/kg	0	6.503
$IFWM_{rec-adj}$ (mutagenic age-adjusted water intake rate) L/kg	0	26.461
IRW_{0-2} (water intake rate) L/hour	0.12	0.1
IRW_{2-6} (water intake rate) L/hour	0.12	0.1
IRW_{6-16} (water intake rate) L/hour	0.071	0.1
IRW_{16-30} (water intake rate) L/hour	0.071	0.1
IRW_{rec} (water intake rate - adult) L/day	0.071	0.1
IRW_{rec-a} (water intake rate - adult) L/hr	0.071	0.1
LT (lifetime - recreator) years	70	70
SA_{0-2} (skin surface area) cm^2	6365	6365
SA_{2-6} (skin surface area) cm^2	6365	6365
SA_{6-16} (skin surface area) cm^2	19652	13350
SA_{16-30} (skin surface area) cm^2	19652	19652
SA_{rec} (skin surface area - adult) cm^2	19652	16501
SA_{rec-a} (skin surface area - adult) cm^2	19652	16501
Apparent thickness of stratum corneum (cm)	0.001	0.001
TR (target risk) unitless	0.000001	0.00001

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Site-specific

Recreator Regional Screening Levels (RSL) for Surface Water

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	SF$_o$(mg/kg-day)^{1}	SF$_o$ Ref	RfD (mg/kg-day)	RfD Ref	RfC (mg/m^3)	RfC Ref	RAGSe GIABS (unitless)	K$_p$ (cm/hr)	MW	FA (unitless)	In EPD?	DA$_{event(ca)}$	DA$_{event(nc\ child)}$	DA$_{event(nc\ adult)}$	Ingestion SL TR=1E-05 (ug/L)	Dermal SL TR=1E-05 (ug/L)	Carcinogenic SL TR=1E-05 (ug/L)	Ingestion SL (Child) THQ=1 (ug/L)	Dermal SL (Child) THQ=1 (ug/L)	Noncarcinogenic SL (Child) THQ=1 (ug/L)	Ingestion SL (Adult) THQ=1 (ug/L)	Dermal SL (Adult) THQ=1 (ug/L)	Noncarcinogenic SL (Adult) THQ=1 (ug/L)	Screening Level (ug/L)
Antimony (metallic)	7440-36-0	No	No	Inorganics	-		0.0004	I	-		0.1500	0.0010	121.7600	1.0000	Yes	-	0.0011	0.0018	-	-	-	243.0000	573.0000	171.0000	1010.0000	914.0000	479.0000	1.71E+02nc
Arsenic, Inorganic	7440-38-2	No	No	Inorganics	1.5000	I	0.0003	I	0.0000	C	1.0000	0.0010	74.9220	1.0000	Yes	0.0000	0.0057	0.0091	26.2000	241.0000	23.6000	183.0000	2870.0000	172.0000	754.0000	4570.0000	647.0000	2.36E+01ca*
Barium	7440-39-3	No	No	Inorganics	-		0.2000	I	0.0005	H	0.0700	0.0010	137.3300	1.0000	Yes	-	0.2676	0.4267	-	-	-	122000.0000	##########	63700.0000	503000.0000	##########	150000.0000	6.37E+04nc
Beryllium and compounds	7440-41-7	No	No	Inorganics	-		0.0020	I	0.0000	I	0.0070	0.0010	9.0100	1.0000	Yes	-	0.0003	0.0004	-	-	-	1220.0000	134.0000	121.0000	5030.0000	213.0000	205.0000	1.21E+02nc
Boron And Borates Only	7440-42-8	No	No	Inorganics	-		0.2000	I	0.0200	H	1.0000	0.0010	13.8400	1.0000	Yes	-	3.8230	6.0953	-	-	-	122000.0000	##########	114000.0000	503000.0000	##########	432000.0000	1.14E+05nc
Cadmium (Water)	7440-43-9	No	No	Inorganics	-		0.0005	I	0.0000	A	0.0500	0.0010	112.4000	1.0000	Yes	-	0.0005	0.0008	-	-	-	304.0000	239.0000	134.0000	1260.0000	381.0000	292.0000	1.34E+02nc
Chromium(III), Insoluble Salt	16065-83-1	No	No	Inorganics	-		1.5000	I	-		0.0130	0.0010	52.0000	1.0000	Yes	-	0.3727	0.5943	-	-	-	913000.0000	##########	155000.0000	###########	##########	275000.0000	1.55E+05nc
Cobalt	7440-48-4	No	No	Inorganics	-		0.0003	P	0.0000	P	1.0000	0.0004	58.9300	1.0000	Yes	-	0.0057	0.0091	-	-	-	183.0000	7170.0000	178.0000	754.0000	11400.0000	708.0000	1.78E+02nc
Fluoride	16984-48-8	No	No	Inorganics	-		0.0400	C	0.0130	C	1.0000	0.0010	38.0000	1.0000	Yes	-	0.7646	1.2191	-	-	-	24300.0000	##########	22900.0000	101000.0000	##########	86300.0000	2.29E+04nc
Lithium	7439-93-2	No	No	Inorganics	-		0.0020	P	-		1.0000	0.0010	6.9400	1.0000	Yes	-	0.0382	0.0610	-	-	-	1220.0000	19100.0000	1140.0000	5030.0000	30500.0000	4320.0000	1.14E+03nc
Mercuric Chloride	7487-94-7	No	No	Inorganics	-		0.0003	I	0.0003	S	0.0700	0.0010	271.5000	1.0000	Yes	-	0.0004	0.0006	-	-	-	183.0000	201.0000	95.6000	754.0000	320.0000	225.0000	9.56E+01nc
Molybdenum	7439-98-7	No	No	Inorganics	-		0.0050	I	-		1.0000	0.0010	95.9400	1.0000	Yes	-	0.0956	0.1524	-	-	-	3040.0000	47800.0000	2860.0000	12600.0000	76200.0000	10800.0000	2.86E+03nc
Selenium	7782-49-2	No	No	Inorganics	-		0.0050	I	0.0200	C	1.0000	0.0010	78.9600	1.0000	Yes	-	0.0956	0.1524	-	-	-	3040.0000	47800.0000	2860.0000	12600.0000	76200.0000	10800.0000	2.86E+03nc
Thallium (Soluble Salts)	7440-28-0	No	No	Inorganics	-		0.0000	X	-		1.0000	0.0010	204.3800	1.0000	Yes	-	0.0002	0.0003	-	-	-	6.0800	95.6000	5.7200	25.1000	152.0000	21.6000	5.72E+00nc

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Site-specific

Recreator Equation Inputs for Surface Water

* Inputted values different from Recreator defaults are highlighted.

Variable	Recreator Surface Water Default Value	Form-input Value
BW_{0-2} (body weight) kg	15	15
BW_{2-6} (body weight) kg	15	15
BW_{6-16} (body weight) kg	80	44
BW_{16-30} (body weight) kg	80	80
BW_{a} (body weight - adult) kg	80	62
BW_{rec-a} (body weight - adult) kg	80	62
$DFW_{rec-adj}$ (age-adjusted dermal factor) cm^2-event/kg	0	101610
$DFWM_{rec-adj}$ (mutagenic age-adjusted dermal factor) cm^2-event/kg	0	319693.295
ED_{rec} (exposure duration - recreator) years	26	26
ED_{0-2} (exposure duration) years	2	2
ED_{2-6} (exposure duration) years	4	4
ED_{6-16} (exposure duration) years	10	10
ED_{16-30} (exposure duration) years	10	10
ED_{rec-a} (exposure duration - adult) years	20	20
EF_{rec-w} (exposure frequency) days/year	0	45
EF_{0-2} (exposure frequency) days/year	0	45
EF_{2-6} (exposure frequency) days/year	0	45
EF_{6-16} (exposure frequency) days/year	0	45
EF_{16-30} (exposure frequency) days/year	0	45
EF_{rec-a} (adult exposure frequency) days/year	0	45
ET_{0-2} (exposure time) hours/event	0	2
ET_{2-6} (exposure time) hours/event	0	2
ET_{6-16} (exposure time) hours/event	0	2
ET_{16-30} (exposure time) hours/event	0	2
ET_{rec-a} (adult exposure time) hours/event	0	2
EV_{0-2} (events) events/day	0	1
EV_{2-6} (events) events/day	0	1
EV_{6-16} (events) events/day	0	1
EV_{16-30} (events) events/day	0	1
EV_{rec-a} (adult) events/day	0	1
THQ (target hazard quotient) unitless	0.1	1
$IFW_{rec-adj}$ (age-adjusted water intake rate) L/kg	0	4.181
$IFWM_{rec-adj}$ (mutagenic age-adjusted water intake rate) L/kg	0	20.652
IRW_{0-2} (water intake rate) L/hour	0.12	0.1
IRW_{2-6} (water intake rate) L/hour	0.12	0.1
IRW_{6-16} (water intake rate) L/hour	0.071	0.02
IRW_{16-30} (water intake rate) L/hour	0.071	0.02
IRW_{rec} (water intake rate - adult) L/day	0.071	0.02
IRW_{rec-a} (water intake rate - adult) L/hr	0.071	0.02
LT (lifetime - recreator) years	70	70
SA_{0-2} (skin surface area) cm^2	6365	1770
SA_{2-6} (skin surface area) cm^2	6365	1770
SA_{6-16} (skin surface area) cm^2	19652	3820
SA_{16-30} (skin surface area) cm^2	19652	5790
SA_{rec} (skin surface area - adult) cm^2	19652	4805
SA_{rec-a} (skin surface area - adult) cm^2	19652	4805
Apparent thickness of stratum corneum (cm)	0.001	0.001
TR (target risk) unitless	0.000001	0.00001

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Site-specific

Recreator Regional Screening Levels (RSL) for Surface Water

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	SF_o(mg/kg-day)$^{-1}$	SF_o Ref	RfD (mg/kg-day)	RfD Ref	RfC (mg/m^3)	RfC Ref	RAGSe GIABS (unitless)	K_p (cm/hr)	MW	FA (unitless)	In EPD?	$DA_{event(ca)}$	$DA_{event(nc\ child)}$	$DA_{event(nc\ adult)}$	Ingestion SL TR=1E-05 (ug/L)	Dermal SL TR=1E-05 (ug/L)	Carcinogenic SL TR=1E-05 (ug/L)	Ingestion SL (Child) THQ=1 (ug/L)	Dermal SL (Child) THQ=1 (ug/L)	Noncarcinogenic SL (Child) THQ=1 (ug/L)	Ingestion SL (Adult) THQ=1 (ug/L)	Dermal SL (Adult) THQ=1 (ug/L)	Noncarcinogenic SL (Adult) THQ=1 (ug/L)	Screening Level (ug/L)
Antimony (metallic)	7440-36-0	No	No	Inorganics	-		0.0004	I	-		0.1500	0.0010	121.7600	1.0000	Yes	-	0.0041	0.0063	-	-	-	243.0000	2060.0000	218.0000	5030.0000	3140.0000	1930.0000	2.18E+02nc
Arsenic, Inorganic	7440-38-2	No	No	Inorganics	1.5000	I	0.0003	I	0.0000	C	1.0000	0.0010	74.9220	1.0000	Yes	0.0002	0.0206	0.0314	40.7000	838.0000	38.9000	183.0000	10300.0000	179.0000	3770.0000	15700.0000	3040.0000	3.89E+01ca*
Barium	7440-39-3	No	No	Inorganics	-		0.2000	I	0.0005	H	0.0700	0.0010	137.3300	1.0000	Yes	-	0.9623	1.4652	-	-	-	122000.0000	481000.0000	97100.0000	2510000.0000	733000.0000	567000.0000	9.71E+04nc
Beryllium and compounds	7440-41-7	No	No	Inorganics	-		0.0020	I	0.0000	I	0.0070	0.0010	9.0100	1.0000	Yes	-	0.0010	0.0015	-	-	-	1220.0000	481.0000	345.0000	25100.0000	733.0000	712.0000	3.45E+02nc
Boron And Borates Only	7440-42-8	No	No	Inorganics	-		0.2000	I	0.0200	H	1.0000	0.0010	13.8400	1.0000	Yes	-	13.7476	20.9319	-	-	-	122000.0000	6870000.0000	120000.0000	2510000.0000	10500000.0000	2030000.0000	1.20E+05nc
Cadmium (Water)	7440-43-9	No	No	Inorganics	-		0.0005	I	0.0000	A	0.0500	0.0010	112.4000	1.0000	Yes	-	0.0017	0.0026	-	-	-	304.0000	859.0000	225.0000	6290.0000	1310.0000	1080.0000	2.25E+02nc
Chromium(III), Insoluble Salt	16065-83-1	No	No	Inorganics	-		1.5000	I	-		0.0130	0.0010	52.0000	1.0000	Yes	-	1.3404	2.0409	-	-	-	913000.0000	670000.0000	386000.0000	18900000.0000	1020000.0000	968000.0000	3.86E+05nc
Cobalt	7440-48-4	No	No	Inorganics	-		0.0003	P	0.0000	P	1.0000	0.0004	58.9300	1.0000	Yes	-	0.0206	0.0314	-	-	-	183.0000	25800.0000	181.0000	3770.0000	39200.0000	3440.0000	1.81E+02nc
Fluoride	16984-48-8	No	No	Inorganics	-		0.0400	C	0.0130	C	1.0000	0.0010	38.0000	1.0000	Yes	-	2.7495	4.1864	-	-	-	24300.0000	1370000.0000	23900.0000	503000.0000	2090000.0000	405000.0000	2.39E+04nc
Lithium	7439-93-2	No	No	Inorganics	-		0.0020	P	-		1.0000	0.0010	6.9400	1.0000	Yes	-	0.1375	0.2093	-	-	-	1220.0000	68700.0000	1200.0000	25100.0000	105000.0000	20300.0000	1.20E+03nc
Mercuric Chloride	7487-94-7	No	No	Inorganics	-		0.0003	I	0.0003	S	0.0700	0.0010	271.5000	1.0000	Yes	-	0.0014	0.0022	-	-	-	183.0000	722.0000	146.0000	3770.0000	1100.0000	851.0000	1.46E+02nc
Molybdenum	7439-98-7	No	No	Inorganics	-		0.0050	I	-		1.0000	0.0010	95.9400	1.0000	Yes	-	0.3437	0.5233	-	-	-	3040.0000	172000.0000	2990.0000	62900.0000	262000.0000	50700.0000	2.99E+03nc
Selenium	7782-49-2	No	No	Inorganics	-		0.0050	I	0.0200	C	1.0000	0.0010	78.9600	1.0000	Yes	-	0.3437	0.5233	-	-	-	3040.0000	172000.0000	2990.0000	62900.0000	262000.0000	50700.0000	2.99E+03nc
Thallium (Soluble Salts)	7440-28-0	No	No	Inorganics	-		0.0000	X	-		1.0000	0.0010	204.3800	1.0000	Yes	-	0.0007	0.0010	-	-	-	6.0800	344.0000	5.9800	126.0000	523.0000	101.0000	5.98E+00nc

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APPENDIX H

Progress Reports on Corrective Action

HALEY & ALDRICH, INC.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
216.739.0555

MEMORANDUM

12 March 2020
File No. 129342-020

TO: Associated Electric Cooperative, Inc
Jenny Jones – Senior Environmental Analyst
Russ Weatherly – Supervisor, Land and Water Resources

FROM: Haley & Aldrich, Inc.
Steven F. Putrich, P.E., Senior Associate – Engineering Principal

SUBJECT: Semi-Annual Remedy Selection Progress Report Pursuant to 40 CFR § 257.96(a)
New Madrid Power Plant – Pond 003
New Madrid, Missouri

Associated Electric Cooperative, Inc. (AECI) has implemented the United States Environmental Protection Agency Federal Coal Combustion Residuals (CCR) Rule (Code of Federal Regulations Title 40 [40 CFR] §§ 257 and 261) effective 19 October 2015, along with subsequent revisions for the active CCR surface impoundment referred to as Pond 003 at the New Madrid Power Plant (NMPP) located in New Madrid, Missouri. Section 257.97(a) of the CCR Rule requires the owner or operator of a CCR management unit that has completed a Corrective Measures Assessment (CMA) for groundwater to 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 September 2019 through March 2020.

The CMA was initiated for Pond 003 on 15 May 2019 in response to a statistically significant level (SSL) of an Appendix IV constituent (molybdenum) exceeding Groundwater Protection Standards (GWPS). 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 CMA Report was completed and placed in the facility operating record on 13 September 2019, and subsequently amended on 11 October 2019, and posted to AECI's CCR public website. Based on the results of the CMA, AECI must, as soon as feasible in accordance with the CCR Rule, select a remedy that meets the standards listed in 40 CFR § 257.97(b). A summary of the progress in selecting a remedy in compliance with the CCR Rule is provided below.

SUMMARY OF ACTIONS COMPLETED

The following actions have been completed during this initial reporting period (September 2019 through March 2020):

- The determination of the nature and extent of the Appendix IV molybdenum in exceedance of the CCR Unit's GWPS was initiated pursuant to § 257.95(g). Fifteen additional groundwater monitoring wells were installed to assist with collecting additional groundwater data to define the nature and extent. Groundwater samples were collected from the nature and extent monitoring wells in September, October, and November 2019. Groundwater characterization of the nature and extent groundwater monitoring wells is ongoing.
- A public meeting was held on 14 November 2019 in Marston, Missouri to discuss the results of the CMA in accordance with § 257.96(e).
- Engineering, design, permitting, and construction have continued in an effort to convert to dry light ash and dry boiler slag handling that will reduce CCR and non-CCR flows into Pond 003 thus reducing the source material discharged into the unit.

PLANNED ACTIVITIES

Anticipated activities for the upcoming semi-annual corrective measures selection progress period (April 2020 through October 2020) include the following (subject to change):

- Continue engineering, design, permitting, and construction of CCR and non-CCR flow reductions to Pond 003;
- Evaluate the groundwater analytical data collected during the semi-annual sampling event that will include the nature and extent monitoring wells;
- Assess the outcomes of the public meeting (held on 14 November 2019 in Marston, Missouri;
- Continue to perform an engineering review of the five potential CMA alternatives in pursuit of the corrective measures remedy selection. For these reviews, emphases will be placed on understanding and reacting to impacts of newly gathered analytical results, identifying and researching applicability of emerging technologies and their impacts on the selection of remedy process; and
- Provide a semi-annual progress report that summarizes AECI's progress and status regarding a selection of remedy.

If you have any questions or comments regarding this first semi-annual remedy selection progress report, please contact Steve Putrich at 216.706.1322 or by email at sputrich@haleyaldrich.com.

HALEY & ALDRICH, INC.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
216.739.0555

MEMORANDUM

8 September 2020
File No. 129342-032

TO: Associated Electric Cooperative, Inc
Jenny Jones – Senior Environmental Analyst

FROM: Haley & Aldrich, Inc.
Steven F. Putrich, P.E., Senior Associate – Engineering Principal

SUBJECT: Semi-Annual Remedy Selection Progress Report Pursuant to 40 CFR § 257.96(a)
Fall 2020
New Madrid Power Plant – Pond 003
New Madrid, Missouri

Associated Electric Cooperative, Inc. (AECI) has implemented the United States Environmental Protection Agency Federal Coal Combustion Residuals (CCR) Rule (Code of Federal Regulations Title 40 [40 CFR] §§ 257 and 261) effective 19 October 2015, along with subsequent revisions for the active CCR surface impoundment referred to as Pond 003 at the New Madrid Power Plant (NMPP) located in New Madrid, Missouri. Section 257.97(a) of the CCR Rule requires the owner or operator of a CCR management unit that has completed a Corrective Measures Assessment (CMA) for groundwater to prepare a semi-annual report describing the progress in selecting and designing the remedy. This report provides the Fall 2020 semi-annual remedy selection progress report and is comprised of activities during the period of April 2020 through September 2020.

The CMA was initiated for Pond 003 on 15 May 2019 in response to a statistically significant level (SSL) of an Appendix IV constituent (molybdenum) exceeding Groundwater Protection Standards (GWPS). 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 CMA Report was completed and placed in the facility operating record on 13 September 2019, and subsequently amended on 11 October 2019, and posted to AECI's CCR public website. Based on the results of the CMA, AECI must, as soon as feasible in accordance with the CCR Rule, select a remedy that meets the standards listed in 40 CFR § 257.97(b). A summary of the progress between April 2020 and September 2020 in selecting a remedy in compliance with the CCR Rule is provided below.

SUMMARY OF ACTIONS COMPLETED

The following actions have been completed during this reporting period (April 2020 through September 2020):

- Continued Assessment Monitoring: Evaluated the results of the February (semi-annual sample) and May 2020 (annual) sampling events of compliance wells. The February 2020 groundwater monitoring compliance wells were evaluated for statistically significant exceedances and compared to GWPS. No new constituent parameters or compliance wells were determined to exceed GWPS, therefore no additional information was needed to be included in the remedy selection process.
- Efforts to continue evaluation of the nature and extent (N&E) of the Appendix IV molybdenum in exceedance of the CCR Unit's GWPS continued pursuant to § 257.95(g). Groundwater samples were collected from the fifteen N&E monitoring wells in August 2020. The analytical results will be used to supplement and enhance the evaluation of the extent of groundwater impacts, assessment of corrective measures, and selection of remedy. Groundwater characterization of the N&E groundwater monitoring wells is ongoing;
- Refinement of the site conceptual model and associated groundwater modeling with geochemical analyses continued based on N&E results from February 2020 and ongoing compliance monitoring to further refine the extents of the plume;
- Engineering, design, permitting, and construction have continued in an effort to convert to dry light ash and dry boiler slag handling that will reduce CCR and non-CCR flows into Pond 003 thus reducing the source material discharged into the unit.

PLANNED ACTIVITIES

Anticipated activities for the upcoming semi-annual corrective measures selection progress period (October 2020 through March 2021) include the following (subject to change):

- Continue engineering, design, permitting, and construction of CCR and non-CCR flow reductions to Pond 003;
- Continue efforts to evaluate N&E by evaluating the groundwater analytical data collected during the semi-annual assessment monitoring sampling event that will include the nature and extent monitoring wells from August 2020;
- As appropriate, refine the conceptual site model and associated groundwater modeling;
- Continue to perform an engineering review of the potential CMA alternatives in pursuit of the corrective measures remedy selection. For these reviews, emphases will be placed on understanding and reacting to impacts of newly gathered analytical results, identifying, and researching applicability of emerging technologies and their impacts on the CMA and selection of remedy process;

- Progress towards selecting a remedy that meets the standards of § 257.97(b) including the development of a final report which also contains a schedule for implementing and completing remedial activities as required by that § 257.97(d); and
- Provide a semi-annual progress report that summarizes AECI's progress and status regarding a selection of remedy.

APPENDIX I

Structural Stability Assessment

www.haleyaldrich.com

REPORT ON

INITIAL PERIODIC STRUCTURAL STABILITY ASSESSMENT
POND 003
NEW MADRID POWER PLANT
NEW MADRID, MISSOURI

by Haley & Aldrich, Inc.
Cleveland, Ohio

for Associated Electric Cooperative, Inc.
New Madrid, Missouri

File No. 40616-300
October 2016

HALEY & ALDRICH, INC.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
216.739.0555

16 October 2016
File No. 40616-300

Associated Electric Cooperative, Inc.
New Madrid Power Plant
P.O. Box 156
New Madrid, MO 63689

Attention: Ms. Jenny Burns
Environmental Analyst

Subject: Initial Periodic Structural Stability Assessment
Pond 003
New Madrid Power Plant
New Madrid, MO

Ms. Burns:

Enclosed please find our report on the Initial Periodic Structural Stability Assessment (Assessment) for the Associated Electric Cooperative, Inc. (AECI) coal combustion residuals (CCR) surface impoundment referred to as Pond 003 located at the New Madrid Power Plant (NMPP) in New Madrid, Missouri.

This work was performed by Haley & Aldrich, Inc. (Haley & Aldrich) on behalf of AECI in accordance with 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, specifically §257.73(d).

The scope of our work consisted of the following: 1) obtain and review readily available reports, investigations, plans and data pertaining to the Pond 003 surface impoundment; 2) visit the site to observe Pond 003; 3) evaluate whether the design, construction, operation, and maintenance of Pond 003 are consistent with recognized and generally accepted good engineering practices; and 4) prepare and submit this report presenting the results of our assessment including recommendations.

Thank you for inviting us to complete this assessment and please feel free to contact us if you wish to discuss the contents of the report.

Sincerely yours,
HALEY & ALDRICH, INC.

Steven F. Putrich, P.E.
Project Principal

Enclosures

Cc: Denis Bell-Haley & Aldrich

REPORT ON
INITIAL PERIODIC STRUCTURAL STABILITY ASSESSMENT
POND 003
NEW MADRID POWER PLANT
NEW MADRID, MISSOURI

by Haley & Aldrich, Inc.
Cleveland, Ohio

for Associated Electric Cooperative, Inc.
New Madrid, Missouri

File No. 40616-300
October 2016

Executive Summary

This report summarizes the results of our Initial Periodic Structural Stability Assessment for the Associated Electric Cooperative, Inc. (AECI) owned and operated Pond 003, including our site inspection of the unit. Pond 003 is designated as an existing coal combustion residuals (CCRs) surface impoundment, located at the New Madrid Power Plant in New Madrid, Missouri.

Our assessment was conducted in accordance with the US Environmental Protection Agency's (EPA's) Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, 40 CFR Parts 257 and 261 (CCR Rule).

The dike consists of an earthen embankment with a crest length of approximately 9,300 feet around the entire impoundment. However, part of the impoundment is incised on the northern side and includes the Mississippi River Levee to the west of the impoundment. Therefore, the constructed dike is considered to be the approximately 5,000 ft of the east side of the unit and portions of the north and south sides. The dike embankment is approximately 10 to 20 feet in height and according to records and survey information; the embankment is constructed of locally available silty clay. The impoundment has a surface area of approximately 110 acres

Pond 003 was constructed for the purpose of storing and managing CCR and plant process water.

Dam Inspection Assessment and Recommendations

Based on conditions observed during our visual inspection of Pond 003, discussions with site personnel, a review of available documents and subsequent site visits, the following deficiencies were noted:

- Vegetation exceeding 6 in. in height on the upstream slope.
- Vegetation exceeding 6 in. in height on the downstream slope.
- Vegetation exceeding 6 in. in height within the riprap on the upstream slope.
- Two (2) dead trees within 50 feet of toe of downstream slope of the dike.
- Mature trees in the downstream area of the dam.

Haley & Aldrich recommends the following actions:

- Cut/mow the embankments and routinely mow the embankment slopes (upstream and downstream) and downstream areas to maintain vegetation at a height of 6 in. or less.
- Cut the two (2) dead trees downstream of Pond 003.
- Monitor the mature trees downstream of Pond 003 for signs of decay and impact to the dike during the weekly and monthly inspections.
- Conduct a video inspection of outlet pipe from the drop inlet structures when flow is reduced to expose the downstream end of the pipe.

Structural Stability Assessment

In accordance with 40 CFR §257.73(d), the owner or operator of a CCR surface impoundment must conduct initial and periodic structural stability assessments to determine whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices.

Haley & Aldrich reviewed the information provided to us and inspected Pond 003 as described above. Based on our review of available information and observations during our inspection, we have concluded the following in accordance with 40 CFR §257.73(d):

1. §257.73(d)(1)(i) – Stable Foundations and Abutments:

   Based on our review of available or developed subsurface information, as-built records, survey data, and observations during our inspection, the impoundment was judged to have stable foundations and abutments.

2. §257.73(d)(1)(ii) – Adequate Slope Protection:

   Based on observations during our site visits, on the upstream slope, the top half of the slope was covered by grassy vegetation, some of which was overgrown. The bottom half of the slope, including below the water line, consisted of riprap. The downstream slope of the eastern and southern portion of the dike was graded to an approximate slope of 3H:1V, or flatter towards the north. Slope was covered in healthy grass cover about 8 to 12 in. in height and appeared to be regularly mowed. The southern portion of the impoundment shares a dike with an adjacent impoundment and is protected as well.

3. §257.73(d)(1)(iii) – Dikes Mechanically Compacted:

   Although records on the construction of the Pond 003 are not available, the test borings and laboratory testing performed by Haley & Aldrich and others, the results indicate that the berm fill was mechanically compacted during construction.

4. §257.73(d)(1)(iv) – Height of Vegetation:

   At the time of our impoundment inspection, portions of the north, east and south downstream slopes had vegetation taller than 6 inches in height, but this higher vegetation was sporadic and not excessively high. On the upstream slopes, some vegetation was higher as well, some as high as 36 inches.

5. §257.73(d)(1)(v)(A) – Spillway Cover:

   Pond 003 discharges through a concrete box intake structure located at the southeastern end of the impoundment. Being a concrete structure, the structure is non-erodible and appears to be in good condition. There is no emergency spillway.

6. §257.73(d)(1)(v)(B) – Spillway Capacity:

   The spillway capacity for the impoundment will be modeled and calculated in accordance with §257.82 Hydrologic and Hydraulic Capacity Requirements for CCR surface impoundments. AECI will complete that capacity requirement under separate cover, consistent with the CCR Rule Preamble reference to the same.

7. §257.73(d)(1)(vi) – Hydraulic Structures Underlying or Passing Through Embankment:

   Only limited portions of the intake and outlet structure was visible during our inspection. Regarding the 24-in. clay pipe, the pipe is buried below the dike and the downstream portion is submerged by the discharge channel. There were no signs of settlement or slope displacement above the pipe.

8. §257.73(d)(1)(vii) – Inundation of Downstream Slopes:

   The impoundment is located adjacent to the Mississippi River and has the potential to be inundated under higher than normal river elevations. Typically, the river has a gradual rise and fall over days and weeks, as opposed to a significant rapid drawdown on a much shorter timescale. To account for the unlikely event the Mississippi River experiences a significant low pool or sudden drawdown occurrence, a representative rapid drawdown review was considered to simulate the potential impact on the slopes. The results indicate that the impoundment will maintain adequate slope stability under this condition.

9. §257.73(d)(2) – Deficiencies and Recommendations:

   The Structural Stability Assessment did not identify any structural stability deficiencies for Pond 003.

PREFACE

The assessment of the general condition of Pond 003 is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations are beyond the scope of this report.

In reviewing this report, it should be realized that the described condition of Pond 003 is based on observations of field conditions at the time of inspection and other site visits, along with other data available. It is important to note that the condition of the structure depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the structure will continue to represent the condition of the structure at some point in the future.

CERTIFICATION

I certify that the Periodic Structural Stability Assessment for AECI's Pond 003 at the New Madrid Power Plant was conducted in accordance with the requirements of §257.73(d) of the USEPA's CCR Rule.

Signed:____________________________________
Certifying Engineer

Print Name: Steven F. Putrich
Missouri License No.: 2014035813
Title: Project Principal
Company: Haley & Aldrich, Inc.

Professional Engineer's Seal:

STEVEN F. PUTRICH
NUMBER
PE-2014035813
10-16-16

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1. Description of Project

1.1 GENERAL

1.1.1 Authority

Haley & Aldrich, Inc. (Haley & Aldrich) has been contracted by Associated Electric Cooperative, Inc. (AECI) to perform the Initial Periodic Structural Stability Assessment (Assessment) for the AECI Pond 003 coal combustion residuals (CCR) surface impoundment located at New Madrid Power Plant (NMPP) in New Madrid, Missouri. This work was completed in accordance with 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, specifically §257.73(d).

This report summarizes the results of our Initial Periodic Structural Stability Assessment for the Pond 003 and its dikes, including our 5 September 2015 visual inspection of the unit and additional site visits. Results of our inspection were also included in our Initial Annual CCR Surface Impoundment PE Inspection Report dated 15 January 2016.

1.1.2 Purpose of Work

The purpose of this assessment was to document whether the design, construction, operation, and maintenance of Pond 003 are consistent with recognized and generally accepted good engineering practices. The visual inspection is intended to identify signs of distress or malfunction of the existing CCR surface impoundment, should they exist. This report summarizes those findings and notes conditions observed that are disrupting or have the potential to disrupt the operation and safety of the surface impoundment.

The investigation is divided into four parts: 1) obtain and review readily available reports, investigations, plans and data pertaining to the Pond 003 surface impoundment; 2) perform a visual inspection of the surface impoundment dike; 3) evaluate whether the design, construction, operation, and maintenance of the impoundment and dike are consistent with generally accepted good engineering practices; and 4) prepare and submit this report presenting the results of our evaluation, including recommendations and remedial actions.

1.1.3 Definitions

To provide the reader a better understanding of the report, definitions of commonly used terms associated with dams/dikes are provided in Appendix C. Many of these terms may be included in this report. The terms are presented under common categories associated with surface impoundments which include: 1) orientation; 2) dam/dike components; 3) hazard potential classification; and 4) miscellaneous.

1.2 DESCRIPTION OF PROJECT

1.2.1 Location

Pond 003, also historically referred to as Slag Pond 1, Ash Pond 1, and the Unlined Ash Pond, is located at the New Madrid Power Plant (NMPP) in New Madrid, Missouri. The site is located about 3 miles east of Marston, Missouri. The Site is accessible from the west via State Highway EE (off US route 55) and from the north and south from Levee Road. Pond 003 is located adjacent to the power plant, which is located at North latitude 36° 30.4' and West longitude 89° 33.5', as shown on the attached Project Locus in Figure 1. The impoundments can be accessed by vehicles from earthen access roads from the NMPP. Access to the site and dikes is restricted by full time security and barriers/fences at the plant.

1.2.2 Owner/Operator

Pond 003 is owned and maintained by Associated Electric Cooperative, Inc.

	Dam Owner/Caretaker
Name	AECI New Madrid Power Plant
Mailing Address	P.O. Box 156
Town, State, Zip	New Madrid, MO 63869
Contact	Roger Neumeyer
Title	Plant Manager
Email Address	rneumeyer@aeci.org
Emergency Phone	911

1.2.3 Purpose of Pond 003

The NMPP is a two-unit coal-fired power plant, with a maximum generating capacity of approximately 1200 Megawatts. Unit 1 was constructed in 1972 and Unit 2 was constructed in 1977. As part of plant operations, two impoundments were constructed for the purpose of storing and managing CCR and plant process water. The impoundments are known as Pond 003 and Pond 004 as related to their NPDES Outfall discharge names.

Pond 003 was constructed in 1972 and Pond 004 was constructed in 1984. The dikes function to impound fly ash and boiler slag for sedimentation and storage.

1.2.4 Description of the Dam and Appurtenances

Pond 003 is located southeast of the NMPP and south of Pond 004 with a Site Plan shown on Figure 2.

The dike consists of an earthen embankment with a crest length of approximately 9,300 feet around the entire impoundment. However, part of the impoundment is incised on the northern side and includes the Mississippi River Levee to the west of the impoundment. In addition, much of the impoundment consists of settled/staged CCR which rises above the current water level, and at some locations the CCR rises above the dam crest elevation. Therefore, the constructed dike is considered to be the approximately 5,000 ft of the east side of the unit and portions of the north and south sides. The dike embankment is approximately 10 to 20 feet in height and according to records and survey information; the embankment is constructed of locally available silty clay.

The impoundment has a surface area of approximately 110 acres and the observed water level elevation was at approximately 301 feet NAVD88. A gravel access road is present on the dam crest at about El. 308. The upstream and downstream slopes are vegetated and the upstream shoreline is protected with riprap. Pond 003 embankments were designed with 3 horizontal on 1 vertical (3H:1V) upstream and downstream slopes.

Process water and CCR are discharged into Pond 003 via two pipelines located at the northern end of the impoundment. The discharged process water and CCR flow through a channel in the stockpiled/settled ash. Discharges from the impoundment flow to a concrete drop inlet structure with concrete stoplogs. A discharge pipe directs water through the dike and into a discharge channel which flows to the Mississippi River.

Pond 003 storage volume at the top of the dam is estimated to be about 1,700 acre-ft and the dam has a structural height of about 20 feet.

1.2.5 Standard Operational Procedures

The impoundment is operated and maintained by NMPP personnel. Operation of the impoundment includes using the stop logs at the drop inlet structures to regulate the water levels and removal/recovery of settled CCR for reuse. Maintenance of the dike includes regular mowing of the downstream upstream and downstream slopes and removing vegetation from the riprap on upstream slopes. Weekly inspections are also completed.

The NMPP personnel monitor and inspect the dike according to a series of informal, unwritten and written protocols. These protocols include:

- Observation of the impoundment embankments during normal operation;
- Inspecting the slope protection, including the vegetation and riprap;
- Monitoring the water levels; and
- Historic semi-annual inspection of the impoundments by NMPP personnel (now completed weekly).

1.2.6 Hazard Potential Classification

Hazard Potential Classification is being completed outside the scope of this report in accordance with the applicable regulations. Results will be provided under separate cover.

1.3 PERTINENT ENGINEERING DATA

1.3.1 Drainage Area

Based on the original design documents and observations from the site visit, Pond 003 does not receive drainage from the surrounding areas, only the immediate access roads on top of the dike and direct precipitation. Water is directed to the impoundment from the NMPP operations (i.e. discharge of process water).

1.3.2 Reservoir

Pond 003 has an estimated surface area of 110 acres and a storage volume of 1,700 acre-ft.

In general, the reservoir contains varying amounts of fly ash and boiler slag mixed with water. At some locations the CCR has settled, or been staged, to levels above water levels and abuts the dike.

The impoundment is located outside (on the river side) of the Mississippi River levee system. The top of embankment elevation of Pond 003 generally matches the elevation of the Mississippi River Levee.

1.3.3 Discharges from Pond 003

Process water discharged into Pond 003 flows from the north end of the impoundment through an open channel within the footprint. CCR is separated from the water through settling and decanting and flows to a concrete drop inlet structure at the southeastern end of the impoundment. Decant water is directed to a discharge pipe extending through the dike and into an earth lined discharge channel which flows to the Mississippi River.

1.3.4 Relevant Elevations

Elevations referenced in this report are in feet and are based on the North American Vertical Datum of 1988 (NAVD88).

The low point on crest elevation is at approximate El. 307 and the normal pool is generally at El. 299.

A.	Top of Dam	309
B.	Normal Pool	299
C.	Spillway Crest	307
D.	Upstream Water at Time of Inspection	301
E.	Spillway Type	Concrete Drop Inlet with VCP
F.	Spillway Invert	El. 282.8

1.3.5 Design and Construction Records

Pond 003 was constructed in 1972 to create a sedimentation and storage basin for fly ash and boiler slag. The dam was designed by Burns & McDonnell in 1970-1971.

1.3.6 Operating Records

Written operational records have not been historically maintained for the impoundment prior to the CCR Rule. AECI has been completing weekly inspections per the CCR Rule and maintains an operating record for required information.

2. Inspection

2.1 VISUAL INSPECTION

On 1 September 2015, Haley & Aldrich completed a visual inspection of the Pond 003. The following paragraphs describe the conditions of the dikes observed during the inspection. In addition, refer to the photographs and checklist forms included in Appendices A and B, respectively for additional comments.

2.1.1 General Findings

2.1.1.1 *Upstream Slope*

CCR has been staged to an elevation above the dam crest to the west and north, and above the water level for much of the upstream slope and the upstream slope was not observed at these locations. At locations were the upstream slope was observed, the slope appeared uniform, at an approximate 3H:1V slope, or flatter and protected from erosion and wave action. The top half of the slope was covered by grassy vegetation, some of which was overgrown. The bottom half of the slope, including below the water line, consisted of riprap. Isolated areas of the riprap contained vegetation less than about 3 ft in height. Misalignments, depressions, ruts, bulging, erosion, burrows or other signs of distress were not observed.

It should be noted that since the initial inspection, AECI relocated CCR that was staged to elevations above the dike when adjacent to the dike to other locations within the impoundment.

2.1.1.2 *Crest*

The crest of the western portion of the dike consists of a paved access road. This area of the dike crest also blends into the Mississippi River Levee crest. The crest of the eastern and southern portions of the dike consists of a gravel access road. The crest alignment appeared generally level, with no depressions, or irregularities observed. Minor rutting, less than 2 in. in depth, were observed on the gravel access road portion of the crest. This minor rutting was likely from vehicle traffic. The crest elevation was at approximately El. 310. Settlement or misalignment was not observed.

2.1.1.3 *Downstream Slope*

The downstream slope of the dike was generally graded to an estimated slope of about 3H:1V and healthy grass vegetation covered much of the slope. The western portion of the dam was also part of the Mississippi River Levee and was covered with grass about 6-10 in. in height. The grass appeared to be regularly mowed.

The downstream slope of the eastern and southern portion of the dike was graded to an approximate slope of 3H:1V, or flatter towards the north. Slope was covered in healthy grass cover about 8 to 12 in. in height and appeared to be regularly mowed. The downstream slope at the western portion of the south side was shared with the Lined Pond to the south, and that area of the Lined Pond was generally filled to the crest elevation. Therefore, there was no downstream slope at this location to observe. This area between Pond 003 and the Lined Pond was separated by an access road which is considered the western portion of the southern dam crest. The downstream slope consists of the Lined Pond which is lined with a Hyperflex© liner.

Misalignments, depressions, ruts, bulging, erosion, burrows or other signs of distress were not observed.

2.1.1.4 *Spillway and Emergency Spillway*

Two (2) 12 in. metal pipes discharge ash and water into the Unlined Ash Pond. Decant water flows out of Pond 003 through a concrete drop outlet at the southern end of the pond. The water level in the impoundment is controlled by concrete stop logs. Water flows over the stoplogs and into a 24 in. diameter discharge pipe to and unlined discharge channel that flows to the Mississippi River. The concrete drop inlet spillway appeared to have minor, isolated, concrete chips and weathering. Minor, surficial rusting was observed on the stoplog removal winch and frame. The discharge pipe was below the water level during the time of the site visit and was not visible.

No other emergency spillway exists.

2.1.1.5 *Downstream Area*

Downstream of the eastern portion of the dike mature trees exist within about 25 ft of the downstream toe of the dam. At the southern end of the eastern side, the trees exist within about 40 ft of the downstream toe of the dike. Between the toe of the dike and the trees, 12 in. to 36 in. tall grass existed during our inspection. During our site visit, we observed two (2) trees, approximately 30 in. diameter, which were dead and closest to the dike. Wet or soft spots were not observed.

2.2 CARETAKER INTERVIEW

On the day of the inspection, Haley & Aldrich met with AECI personnel familiar with the operations, maintenance and construction of Pond 003. Information provided by AECI personnel has been incorporated into this report.

2.3 OPERATION AND MAINTENANCE PROCEDURES

The impoundment is operated and maintained by NMPP personnel. Operation of the impoundment includes using the stop logs at the drop inlet structures to regulate the water levels and removal/recovery of settled CCR for reuse. Maintenance of the dike includes regular mowing of the downstream upstream and downstream slopes and removing vegetation from the riprap on upstream slopes. Weekly inspections are also completed. A formal operations and maintenance plan does not exist for the unit.

2.4 EMERGENCY ACTION PLAN

A written Emergency Action Plan (EAP) does not exist for unit; however, plant personnel are generally familiar with dam operations and construction. Also, the site is staffed full time and heavy earthmoving construction equipment is at the site. A communications plan is in place for the Plant.

2.5 OVERTOPPING POTENTIAL

Based on the inflow to the impoundment from only plant water and direct precipitation, the overtopping potential of the dam is low based on management of water within the impoundment. AECI installed a riprap cover over the upstream slope as well to provide protection of the slopes.

3. Impoundment Inspection Assessment and Recommendations

3.1 ASSESSMENT

We provide the following assessment of Pond 003. The following deficiencies were observed at Pond 003:

- Vegetation exceeding 6 in. in height on the upstream slope.
- Vegetation exceeding 6 in. in height on the downstream slope.
- Vegetation exceeding 6 in. in height within the riprap on the upstream slope.
- Two (2) dead trees within 50 feet of toe of downstream slope of the dike.
- Mature trees in the downstream area of the dam.

3.2 RECOMMENDATIONS

Maintenance of the dike is required and should include cutting/mowing of vegetation on the dike and embankments for continued ability to adequately inspect the impoundment. Mowing of the vegetation should be completed as needed to maintain healthy grass cover at less than 6 in. in height in the current CCR Rule requirements. Additional evaluation of the outlet pipe is recommended as well to confirm integrity.

3.3 REMEDIAL MEASURES

We recommend the following remedial measures be undertaken:

- Cut/mow the embankments and routinely mow the embankment slopes (upstream and downstream) and downstream areas to maintain vegetation at a height of 6 in. or less.
- Cut the two (2) dead trees downstream of Pond 003.
- Monitor the mature trees downstream of Pond 003 for signs of decay and impact to the dike during the weekly and monthly inspections.
- Conduct a video inspection of outlet pipe from the drop inlet structures when flow is reduced to expose the downstream end of the pipe.

4. Structural Stability Assessment

In accordance with 40 CFR §257.73(d), the owner or operator of a CCR surface impoundment must conduct initial and periodic structural stability assessments to determine whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices.

Haley & Aldrich reviewed the information provided to us and inspected Pond 003 as described above. Based on our review of available information and observations during our inspection, we have concluded the following in accordance with 40 CFR §257.73(d):

10. <u>§257.73(d)(1)(i) – Stable Foundations and Abutments:</u>

    Based on our review of available or developed subsurface information, as-built records, survey data, and observations during our inspection, the impoundment was judged to have stable foundations and abutments.

11. <u>§257.73(d)(1)(ii) – Adequate Slope Protection:</u>

    Based on observations during our site visits, on the upstream slope, the top half of the slope was covered by grassy vegetation, some of which was overgrown. The bottom half of the slope, including below the water line, consisted of riprap. The downstream slope of the eastern and southern portion of the dike was graded to an approximate slope of 3H:1V, or flatter towards the north. Slope was covered in healthy grass cover about 8 to 12 in. in height and appeared to be regularly mowed. The southern portion of the impoundment shares a dike with an adjacent impoundment and is protected as well.

12. <u>§257.73(d)(1)(iii) – Dikes Mechanically Compacted:</u>

    Although records on the construction of the Pond 003 are not available, the test borings and laboratory testing performed by Haley & Aldrich and others, the results indicate that the berm fill was mechanically compacted during construction.

13. <u>§257.73(d)(1)(iv) – Height of Vegetation:</u>

    At the time of our impoundment inspection, portions of the north, east and south downstream slopes had vegetation taller than 6 inches in height, but this higher vegetation was sporadic and not excessively high. On the upstream slopes, some vegetation was higher as well, some as high as 36 inches.

14. <u>§257.73(d)(1)(v)(A) – Spillway Cover:</u>

    Pond 003 discharges through a concrete box intake structure located at the southeastern end of the impoundment. Being a concrete structure, the structure is non-erodible and appears to be in good condition. There is no emergency spillway.

15. §257.73(d)(1)(v)(B) – Spillway Capacity:

    The spillway capacity for the impoundment will be modeled and calculated in accordance with §257.82 Hydrologic and Hydraulic Capacity Requirements for CCR surface impoundments. AECI will complete that capacity requirement under separate cover, consistent with the CCR Rule Preamble reference to the same.

16. §257.73(d)(1)(vi) – Hydraulic Structures Underlying or Passing Through Embankment:

    Only limited portions of the intake and outlet structure was visible during our inspection. Regarding the 24-in. clay pipe, the pipe is buried below the dike and the downstream portion is submerged by the discharge channel. There were no signs of settlement or slope displacement above the pipe.

17. §257.73(d)(1)(vii) – Inundation of Downstream Slopes:

    The impoundment is located adjacent to the Mississippi River and has the potential to be inundated under higher than normal river elevations. Typically, the river has a gradual rise and fall over days and weeks, as opposed to a significant rapid drawdown on a much shorter timescale. To account for the unlikely event the Mississippi River experiences a significant low pool or sudden drawdown occurrence, a representative rapid drawdown review was considered to simulate the potential impact on the slopes. The results indicate that the impoundment will maintain adequate slope stability under this condition.

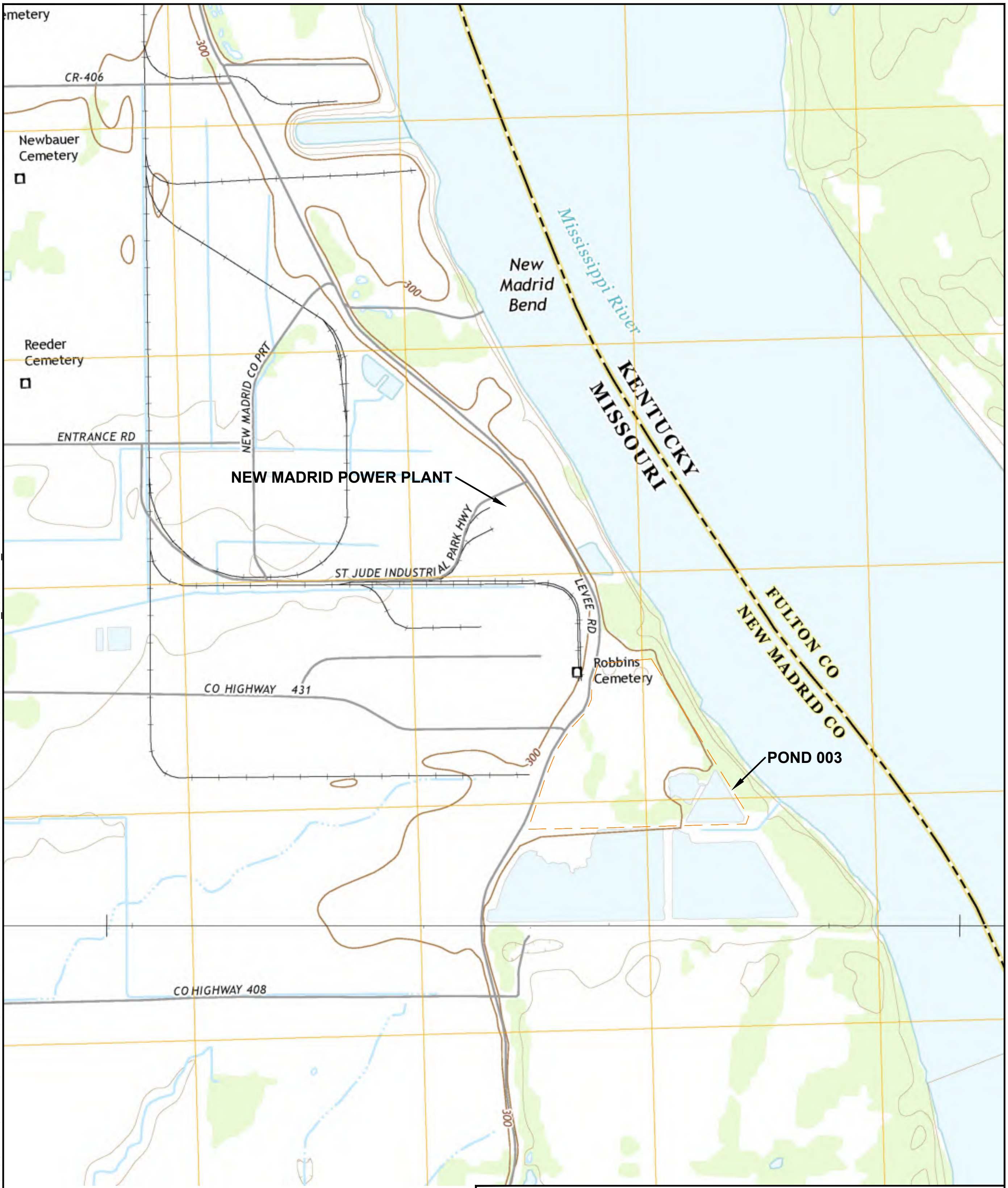
18. §257.73(d)(2) – Deficiencies and Recommendations:

    The Structural Stability Assessment did not identify any structural stability deficiencies for Pond 003.

AECI is performing a Safety Factor Assessment in accordance EPA's Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, 40 CFR Parts 257 and 261. The results of the Safety Factor Assessment will be provided under separate cover.

5. References

1. GZA GeoEnvironmental, Inc., “Round 7 Dam Assessment, Associated Electric Cooperative, Inc. New Madrid Power Plant Ash Pond 1 & 2 and Slag Pond 1 & 2 Impoundments,” June 2011.



MAPSOURCE: USGS
NEW MADRID, MO-KY
POINT PLEASANT, MO-TN-KY
2015

HALEY ALDRICH

ANNUAL CCR SURFACE IMPOUNDMENT PE INSPECTION
POND 003
NEW MADRID POWER PLANT
NEW MADRID, MO

PROJECT LOCUS

APPROXIMATE SCALE: 1" = 2000'
JANUARY 2016

FIGURE 1

LUCAS, ANDY Printed:1/15/2016 2:30 PM Layout: PROJECT LOCUS
\\CLE\COMMON\PROJECTS\40616_AECI-CCR ELG MANAGEMENT SUPPORT\CAD-NM\PONDS\FIGURES\ANNUAL INSPECTION 003\40616-300_003 FIG-1_PROJECT LOCUS.DWG

LEGEND

— — — APPROXIMATE LIMITS OF POND 003

NOTES

1. AERIAL IMAGERY PROVIDED BY AECI AND WAS CONDUCTED BY PICTOMETRY INTERNATIONAL CORP BETWEEN 4-8 OCTOBER 2014.

N

0 300 600

SCALE IN FEET

HALEY ALDRICH

ANNUAL CCR SURFACE IMPOUNDMENT PE INSPECTION
POND 003
NEW MADRID POWER PLANT
NEW MADRID, MO

SITE PLAN

SCALE: AS SHOWN
JANUARY 2016

FIGURE 2

LUCAS, ANDY Printed: 1/15/2016 2:43 PM Layout: SITE PLAN
\\CLE\COMMON\PROJECTS\40616_AECI-CCR ELG MANAGEMENT SUPPORT\CAD-NM\PONDS\FIGURES\ANNUAL INSPECTION 003\40616-300_003 FIG-2_SITE PLAN.DWG

LUCAS, ANDY Printed: 1/15/2016 2:42 PM Layout: PHOTO LOCATION PLAN
\\CLE\COMMON\PROJECTS\40616_AECI-CCR ELG MANAGEMENT SUPPORT\CAD-NMPONDS\FIGURES\ANNUAL INSPECTION 003\40616-300_003 FIG-3_PHOTO LOCATION PLAN.DWG

LEGEND

— — —	APPROXIMATE LIMITS OF POND 003
① ▶	PHOTO LOCATION/DIRECTION

NOTES

1. AERIAL IMAGERY PROVIDED BY AECI AND WAS CONDUCTED BY PICTOMETRY INTERNATIONAL CORP BETWEEN 4-8 OCTOBER 2014.

N

0 300 600
SCALE IN FEET

HALEY ALDRICH

ANNUAL CCR SURFACE IMPOUNDMENT PE INSPECTION
POND 003
NEW MADRID POWER PLANT
NEW MADRID, MO

PHOTO LOCATION PLAN

SCALE: AS SHOWN
JANUARY 2016

FIGURE 3

APPENDIX A

Photographs

Photograph No. 1
Pond 003 - two inlet pipes

Photograph No. 2
Pond 003
Crest and access road on northern embankment

Photograph No. 3
Pond 003
Downstream slope on eastern embankment

Photograph No. 4
Pond 003
Dead trees at downstream toe of eastern embankment

Photograph No. 5
Pond 003
Upstream slope with riprap and vegetation on eastern embankment

Photograph No. 6
Pond 003
Upstream slope of south end of eastern embankment with riprap and vegetation

Photograph No. 7
Pond 003
Vegetation at toe of downstream slope of south end of eastern embankment

Photograph No. 8
Pond 003
Downstream slope of southern embankment
Discharge channel at left

Photograph No. 9
Pond 003
Concrete drop inlet spillway with concrete stop logs

Photograph No. 10
Pond 003
Discharge Channel

Photograph No. 11
Pond 003
Crest on southern embankment

Photograph No. 12
Pond 003
Paved Crest on southern embankment

Photograph No. 13
Pond 003
Upstream slope on western embankment
Note vegetation growing on Ash stockpiled above water level to the right.

Photograph No. 14
Pond 003
Downstream slope of Mississippi River Levee/Unlined Ash Pond Dam

APPENDIX B

Inspection Checklist

DAM SAFETY INSPECTION CHECKLIST

NAME OF DAM: Pond 003

STATE ID #: MO-0001171

REGISTERED: (YES/NO) No

NID ID #: N/A

STATE SIZE CLASSIFICATION: N/A

STATE HAZARD CLASSIFICATION: TBD

CHANGE IN HAZARD CLASSIFICATION REQUESTED?: (YES/NO)

DAM LOCATION INFORMATION

CITY/TOWN: New Madrid

COUNTY/STATE: *New Madrid/Missouri*

DAM LOCATION: (street address if known) 41 St. Jude Park, Marston, MO

ALTERNATE DAM NAME: N/A

USGS QUAD.: New Madrid, MO-KY

LAT.: 36° 30.4' N

LONG.: 89° 33.5' W

DRAINAGE BASIN: N/A

RIVER: Mississippi River

IMPOUNDMENT NAME(S): Unlined Ash Pond (003 Pond)

GENERAL DAM INFORMATION

TYPE OF DAM: Earthen Incised and Bermed

OVERALL LENGTH (FT): 9300

PURPOSE OF DAM: Sedimentation and Storage Basin

NORMAL POOL STORAGE (ACRE-FT):

YEAR BUILT: 1972

MAXIMUM POOL STORAGE (ACRE-FT): 1707

STRUCTURAL HEIGHT (FT): 20

EL. NORMAL POOL (FT): 302.0

HYDRAULIC HEIGHT (FT): 8

EL. MAXIMUM POOL (FT): 307.0 (minimum crest elevation)

RESERVOIR SURFACE AREA (ACRES): 110

WINTER DRAWDOWN (FT BELOW NORMAL POOL) 0.0

PUBLIC ROAD ON CREST: No

DRAWDOWN VOL. (AC-FT) 0.0

PUBLIC BRIDGE OVER SPILLWAY: No

NAME OF DAM: Pond 003

STATE ID #: MO-0001171

INSPECTION DATE: September 1, 2015

NID ID #: N/A

INSPECTION SUMMARY

DATE OF INSPECTION: September , 2015

DATE OF PREVIOUS INSPECTION: October 6, 2010

TEMPERATURE/WEATHER: Sunny, 88

ARMY CORPS PHASE I: (YES/NO) No If YES, date

CONSULTANT: Haley & Aldrich, Inc.

PREVIOUS ALT. PHASE I: (YES/NO) No If YES, date

BENCHMARK/DATUM: NAVD88

OVERALL PHYSICAL CONDITION OF DAM:

DATE OF LAST REHABILITATION: N/A

SPILLWAY CAPACITY:

EL. POOL DURING INSP.: 302

EL. TAILWATER DURING INSP.: 302

PERSONS PRESENT AT INSPECTION

NAME	TITLE/POSITION	REPRESENTING
Denis Bell	Senior Engineer	Haley & Aldrich, Inc
Andy Lucas	Staff Engineer	Haley & Aldrich, Inc
Dennis Cox		AECI

NAME OF DAM: Pond 003

STATE ID #: MO-0001171

INSPECTION DATE: September 1, 2015

NID ID #: N/A

OWNER:	ORGANIZATION	Associated Electric Cooperative, I	CARETAKER:	ORGANIZATION	Associated Electric Cooperative, Inc.
	NAME/TITLE	Mr. Dennis Cox		NAME/TITLE	Mr. Dennis Cox
	STREET	P.O. Box 156		STREET	P.O. Box 156
	TOWN, STATE, ZIP	New Madrid, MO 63869		TOWN, STATE, ZIP	New Madrid, MO 63869
	PHONE			PHONE	
	EMERGENCY PH. #			EMERGENCY PH. #	
	FAX			FAX	
	EMAIL			EMAIL	
	OWNER TYPE	Private			

PRIMARY SPILLWAY TYPE Decant Structure

SPILLWAY LENGTH (FT) N/A

SPILLWAY CAPACITY (CFS) N/A

AUXILIARY SPILLWAY TYPE N/A

AUX. SPILLWAY CAPACITY (CFS) N/A

NUMBER OF OUTLETS One

OUTLET(S) CAPACITY (CFS) Unknown

TYPE OF OUTLETS One Decant

TOTAL DISCHARGE CAPACITY (CFS) Unknown

DRAINAGE AREA (SQ MI) 0.17

SPILLWAY DESIGN FLOOD (PERIOD/CFS) Unkown

HAS DAM BEEN BREACHED OR OVERTOPPED? (YES/NO): No

IF YES, PROVIDE DATE(S)

FISH LADDER (LIST TYPE IF PRESENT) Unkown

DOES CREST SUPPORT PUBLIC ROAD? (YES/NO) No

IF YES, ROAD NAME:

PUBLIC BRIDGE WITHIN 50' OF DAM? (YES/NO): No

IF YES, ROAD/BRIDGE NAME:

MHD BRIDGE NO. (IF APPLICABLE)

NAME OF DAM: Pond 003

STATE ID #: MO-0001171

INSPECTION DATE: September 1, 2015

NID ID #: N/A

EMBANKMENT (U/S SLOPE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S SLOPE	1. SLIDE, SLOUGH, SCARP	None observed	X		
	2. SLOPE PROTECTION TYPE AND COND.	None observed	X		
	3. SINKHOLE/ANIMAL BURROWS	None observed	X		
	4. EMB.-ABUTMENT CONTACT	None observed	X		
	5. EROSION	None observed	X		
	6. UNUSUAL MOVEMENT	None observed	X		
	7. VEGETATION (PRESENCE/CONDITION)	None observed	X		

ADDITIONAL COMMENTS: Ash has been stockpiled to an elevation equal to the embankment in the Northern portion of the Unlined Ash Pond. Therefore, the upstream slope was covered by ash and not visible for inspection.

NAME OF DAM: Pond 003
STATE ID #: MO-0001171

INSPECTION DATE: September 1, 2015
NID ID #: N/A

EMBANKMENT (CREST)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
CREST	1. SURFACE TYPE	Gravel access road, western crest was paved levee road	X		
	2. SURFACE CRACKING	None observed	X		
	3. SINKHOLES, ANIMAL BURROWS	None observed	X		
	4. VERTICAL ALIGNMENT (DEPRESSIONS)	None observed	X		
	5. HORIZONTAL ALIGNMENT	None observed	X		
	6. RUTS AND/OR PUDDLES	None observed	X		
	7. VEGETATION (PRESENCE/CONDITION)	Regularly mowed grass	X		
	8. ABUTMENT CONTACT	N/A	X		

ADDITIONAL COMMENTS:

NAME OF DAM: Pond 003

STATE ID #: MO-0001171

INSPECTION DATE: September 1, 2015

NID ID #: N/A

EMBANKMENT (D/S SLOPE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S SLOPE	1. WET AREAS (NO FLOW)	None observed	X		
	2. SEEPAGE	None observed	X		
	3. SLIDE, SLOUGH, SCARP	None observed	X		
	4. EMB.-ABUTMENT CONTACT	N/A	X		
	5. SINKHOLE/ANIMAL BURROWS	None observed	X		
	6. EROSION	None observed	X		
	7. UNUSUAL MOVEMENT	None observed	X		
	8. VEGETATION (PRESENCE/CONDITION)	Woody vegetation near toe of embankment			X

ADDITIONAL COMMENTS: Two dead trees within 50 ft. of embankment.

NAME OF DAM: Pond 003

STATE ID #: MO-000171

INSPECTION DATE: September 1, 2015

NID ID #: N/A

PRIMARY SPILLWAY

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
SPILLWAY	SPILLWAY TYPE	Decant structure	X		
	WEIR TYPE	Concrete stoplogs in decant structure	X		
	SPILLWAY CONDITION	Fair	X		
	TRAINING WALLS	None present	X		
	SPILLWAY CONTROLS AND CONDITION	None present	X		
	UNUSUAL MOVEMENT	None present	X		
	APPROACH AREA	Fair	X		
	DISCHARGE AREA	Fair	X		
	DEBRIS	None present	X		
	WATER LEVEL AT TIME OF INSPECTION	302	X		

ADDITIONAL COMMENTS:

NAME OF DAM: Pond 003

STATE ID #: MO-000171

INSPECTION DATE: September 1, 2015

NID ID #: N/A

OUTLET WORKS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
OUTLET WORKS	TYPE	Outlet unable to be inspected. Downstream submerged in unlined creek.	X		
	INTAKE STRUCTURE	Decant structure with stoplogs	X		
	TRASHRACK	N/A	X		
	PRIMARY CLOSURE	N/A	X		
	SECONDARY CLOSURE	N/A	X		
	CONDUIT	N/A	X		
	OUTLET STRUCTURE/HEADWALL	Fair	X		
	EROSION ALONG TOE OF DAM	None	X		
	SEEPAGE/LEAKAGE	None	X		
	DEBRIS/BLOCKAGE	None	X		
	UNUSUAL MOVEMENT	None	X		
	DOWNSTREAM AREA	Regularly mowed. Woody vegetation along unlined creek	X		
	MISCELLANEOUS				

ADDITIONAL COMMENTS:

NAME OF DAM: Pond 003

STATE ID #: MO-000171

INSPECTION DATE: September 1, 2015

NID ID #: N/A

DOWNSTREAM AREA

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S AREA	1. ABUTMENT LEAKAGE	None Present	X		
	2. FOUNDATION SEEPAGE	None Present	X		
	3. SLIDE, SLOUGH, SCARP	None Present	X		
	4. WEIRS	None Present	X		
	5. DRAINAGE SYSTEM	None Present	X		
	6. INSTRUMENTATION	None Present	X		
	7. VEGETATION	Grass less than 6"	X		
	8. ACCESSIBILITY	Gravel access road along crest. Full time security and fence	X		
	9. DOWNSTREAM HAZARD DESCRIPTION				
	10. DATE OF LAST EAP UPDATE				

ADDITIONAL COMMENTS:

NAME OF DAM: Pond 003

STATE ID #: MO-0001171

INSPECTION DATE: September 1, 2015

NID ID #: N/A

INSTRUMENTATION

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
INSTR.	1. PIEZOMETERS	P-1 through P-3	X		
	2. OBSERVATION WELLS	None present	X		
	3. STAFF GAGE AND RECORDER	None present	X		
	4. WEIRS	None present	X		
	5. INCLINOMETERS	None present	X		
	6. SURVEY MONUMENTS	None present	X		
	7. DRAINS	None present	X		
	8. FREQUENCY OF READINGS	No measurements are taken	X		
	9. LOCATION OF READINGS	N/A	X		

ADDITIONAL COMMENTS:

NAME OF DAM: Pond 003

STATE ID #: MO-000171

INSPECTION DATE: September 1, 2015

NID ID #: N/A

UNDERLYING HYDRAULIC STRUCTURES/PIPES

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
UNDERLYING HYDRAULIC STRUCTURES /PIPES	TYPE	Not observed	X		
	INLET				
	CONDUIT				
	OUTLET STRUCTURE/HEADWALL	Fair	X		
	EROSION ALONG STRUCTURE	None present	X		
	SEEPAGE/LEAKAGE	None present	X		
	DEBRIS/BLOCKAGE	None present	X		
	UNUSUAL MOVEMENT				
	DOWNSTREAM AREA				
	MISCELLANEOUS				

ADDITIONAL COMMENTS: Outlet pipe unable to be inspected. Downstream end of outlet was submerged in unlnied creek to Mississippi River.

Note: Use additional sheets for additional outlets.

APPENDIX C

Definitions

COMMON DAM SAFETY DEFINITIONS

For a comprehensive list of dam engineering terminology and definitions, refer to the U.S. Army Corps of Engineers, the Federal Energy Regulatory Commission, the Department of the Interior Bureau of Reclamation, or the Federal Emergency Management Agency.

Orientation

Upstream – Shall mean the side of the dam that borders the impoundment.

Downstream – Shall mean the high side of the dam, the side opposite the upstream side.

Right – Shall mean the area to the right when looking in the downstream direction.

Left – Shall mean the area to the left when looking in the downstream direction.

Dam Components

Dam – Shall mean any artificial barrier, including appurtenant works, which impounds or diverts water.

Embankment – Shall mean the fill material, usually earth or rock, placed with sloping sides, such that it forms a permanent barrier that impounds water.

Crest – Shall mean the top of the dam, usually provides a road or path across the dam.

Abutment – Shall mean that part of a valley side against which a dam is constructed. An artificial abutment is sometimes constructed as a concrete gravity section, to take the thrust of an arch dam where there is no suitable natural abutment.

Appurtenant Works – Shall mean structures, either in dams or separate there from including but not be limited to spillways; reservoirs and their rims; low level outlet works; and water conduits including tunnels, pipelines, or penstocks, either through the dams or their abutments.

Spillway – Shall mean a structure over or through which water flows are discharged. If the flow is controlled by gates or boards, it is a controlled spillway; if the fixed elevation of the spillway crest controls the level of the impoundment, it is an uncontrolled spillway.

Size Classification

Large – structure with a height greater than 40 feet or a storage capacity greater than 1,000 acre-feet.

Intermediate – structure with a height between 15 and 40 feet or a storage capacity of 50 to 1,000 acre-feet.

Small – structure with a height between 6 and 15 feet and a storage capacity of 15 to 50 acre-feet.

Non-Jurisdictional – structure less than 6 feet in height and having a storage capacity of less than 15 acre-feet.

Hazard Classification
(In the event the impoundment should fail, the following would occur):

Less Than Low Hazard Potential - Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

Low Hazard Potential - Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

Significant Hazard Potential - Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

High Hazard Potential - Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

General

EAP – Emergency Action Plan - Shall mean a predetermined plan of action to be taken to reduce the potential for property damage and/or loss of life in an area affected by an impending dam break.

O&M Manual – Operations and Maintenance Manual; Document identifying routine maintenance and operational procedures under normal and storm conditions.

Normal Pool – Shall mean the elevation of the impoundment during normal operating conditions.

Acre-foot – Shall mean a unit of volumetric measure that would cover one acre to a depth of one foot. It is equal to 43,560 cubic feet. On million U.S. gallons = 3.068 acre feet

Height of Dam – Shall mean the vertical distance from the lowest portion of the natural ground, including any stream channel, along the downstream toe of the dam to the crest of the dam.

Spillway Design Flood (SDF) – Shall mean the flood used in the design of a dam and its appurtenant works particularly for sizing the spillway and outlet works, and for determining maximum temporary storage and height of dam requirements.

Condition Rating

Unsafe - Major structural, operational, and maintenance deficiencies exist under normal operating conditions.

Poor - Significant structural, operation and maintenance deficiencies are clearly recognized for normal loading conditions.

Fair - Significant operational and maintenance deficiencies, no structural deficiencies. Potential deficiencies exist under unusual loading conditions that may realistically occur. Can be used when uncertainties exist as to critical parameters.

Satisfactory - Minor operational and maintenance deficiencies. Infrequent hydrologic events would probably result in deficiencies.

Good - No existing or potential deficiencies recognized. Safe performance is expected under all loading including SDF.

APPENDIX J

Safety Factor Assessment

REPORT ON

SAFETY FACTOR ASSESSMENT
POND 003 AND POND 004
NEW MADRID POWER PLANT
NEW MADRID, MISSOURI

by Haley & Aldrich, Inc.
Cleveland, Ohio

for Associated Electric Cooperative, Inc.
Springfield, Missouri

File No. 40616-300
October 2016

HALEY & ALDRICH, INC.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
216.739.0555

17 October 2016
File No. 40616-300

Associated Electric Cooperative, Inc.
2814 South Golden Avenue
P.O. Box 754
Springfield, Missouri 65801

Attention: Russ Weatherly
Supervisor, Land and Water Resources

Subject: Report on Safety Factor Assessment
Pond 003 and Pond 004
New Madrid Power Plant
New Madrid, Missouri

Mr. Weatherly:

We are pleased to submit herewith our report to Associated Electric Cooperative, Inc. (AECI) entitled, "Report on Safety Factor Assessment, Pond 003[1] and Pond 004[2], New Madrid Power Plant, New Madrid, Missouri." This report has been prepared in accordance with our agreed to scopes of work and your subsequent authorizations, and includes background information regarding the project, the results of our field investigation program, and the results of our safety factor assessment.

The purpose of this study was to evaluate the subsurface soil and water conditions at the coal combustion residuals (CCR) surface impoundments site and evaluate the stability of the subject impoundments in accordance with the Environmental Protection Agency (EPA) 40 CFR Parts 257 and 261, "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities" (CCR Rule). A subsurface exploration program was conducted in September 2015 at the project site to obtain subsurface information for engineering evaluations. The program consisted of drilling a total of nine (9) test borings and advancing ten (10) cone penetrometer soundings. A review of the subsurface information and laboratory test results revealed that the soils used to construct the impoundment dikes are not susceptible to liquefaction. A series of one-dimensional ground response analyses were performed to estimate the subsurface response to six (6) site-specific earthquake events at the New Madrid site. The results were used to perform Newmark displacement analyses and select the pseudostatic coefficient for use in the seismic stability analyses. The results of the stability analyses indicate that the static safety factors are above the minimum required values for all analyzed sections at each impoundment. Preliminary seismic stability analyses for the analyzed sections indicated acceptable safety factors for all sections except the section on the west side of Pond 003 where CCR had been

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[1] Pond 003 is also referred to as the 003 Unlined Pond
[2] Pond 004 is also referred to as the 004 Slag Dewatering Pond

staged directly adjacent to the dike within the impoundment footprint. AECI has since regraded that material along the west side of Pond 003 to a configuration that that has acceptable safety factors.

This report includes background information regarding the project, the results of our field investigation program, and the detailed results of our safety factor assessment.

Background

The project site is located at the New Madrid Power Plant located at 41 St. Jude Industrial Park Highway, New Madrid, Missouri as shown on **Figure 1**. The approximately 100-acre Pond 003 and 10-acre Pond 004 are located on the east side of the site, adjacent to the Mississippi River.

AECI is be required to meet the requirements of the Environmental Protection Agency (EPA) 40 CFR Parts 257 and 261, "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities" (CCR Rule) effective 19 October 2015. In particular for existing active CCR surface impoundments, AECI must demonstrate that specified slope stability safety factors are met in accordance with §257.73(e). This report satisfies that requirement.

Purpose and Scope

The purpose of this study was to investigate the subsurface soil and water conditions at the site and to perform the initial safety factor assessment in accordance with Section §257.73(e)(1) of the CCR Rule. To achieve the objective discussed above, the scope of work undertaken for this investigation included the tasks listed below.

- Planning and executing a field investigation program to obtain subsurface information for dike liquefaction and slope stability analyses. A total of nine (9) test borings were drilled to depths ranging from between approximately 25 and 100 ft below ground surface. Ten (10) cone penetrometer soundings (CPTs) were performed to depths ranging from approximately 50 to 100 ft below ground surface.

- Conducting a geotechnical laboratory testing program on soil, CCR and boiler slag samples recovered from subsurface explorations to aid in classification and for determination of engineering properties required for engineering analyses.

- Performing a site-specific seismic analysis to estimate the subsurface response to an earthquake event at the New Madrid site.

- Performing a Newmark displacement analysis to determine the amount of slope displacement for a given value of yield acceleration.

- Performing slope stability (static and seismic) and liquefaction analyses.

Field Investigation Program

SUBSURFACE EXPLORATION PROGRAM

A subsurface exploration program was conducted at the project site during the period 14 September 2015 to 22 September 2015 to obtain subsurface information for engineering evaluations. The program consisted of drilling a total of nine (9) test borings and advancing ten (10) CPTs. The borings were drilled by Bulldog Drilling, Inc. of Dupo, IL using an ATV-mounted CME 55 L6 drill rig. The CPT soundings were advanced by ConeTec, Inc. of West Berlin, New Jersey using a track-mounted rig. A Haley & Aldrich representative was present in the field to observe the subsurface explorations.

The locations of the subsurface explorations are shown on **Figure 2**. The as-drilled locations and elevations of the explorations were determined in the field by Smith & Company Engineers by optical survey. The locations and elevations of the explorations should be considered accurate only to the degree implied by the method used. A summary of the subsurface explorations is presented in **Table I**[3].

Test Borings

The test borings were drilled to depths ranging from approximately 25 ft to 100 ft below ground surface. The borings were advanced using 4-1/4-in. inside diameter (i.d.) hollow stem augers. Split-spoon samples were typically obtained continuously for the upper 15 ft at each test boring and at 5 ft intervals thereafter. In some instances, continuous split spoon sampling extended to depths up to 30 ft until natural soil was observed. The standard penetration resistance was determined at each sample level by counting the number of blows required to drive a standard split-spoon sampler (1-3/8-in. inside diameter, 2-in. outside diameter) a distance of either 18 in. or 24 in. into undisturbed soil and ash under the impact of a 140-lb hammer free-falling 30 in. The number of blows required to advance the sampler was recorded for each 6-in. interval. The standard penetration resistance N-value is determined by summing the number of blows required to advance the sampler the middle 12 in. of the 24-in. sampling range or by summing the number of blows required to advance the sampler the last 12 in. of the 18-in. sampling range.

Relatively undisturbed samples of ponded CCR were obtained from test borings HA-B4A and HA-B5A by pushing a 3-in. diameter thin-walled steel tube (Shelby tube) into the CCR at a planned sampling depth. A hydraulically operated stationary piston sampler attached to the drill rods was used to advance the tubes. The tubes were removed from the ground and sealed.

Samples recovered from the borings were taken to Shannon and Wilson, Inc. in Saint Louis, Missouri for laboratory testing. The boring logs are presented in **Appendix A**. The boring logs and related information depict subsurface conditions only at the specific locations and at the particular time designated on the logs. Subsurface conditions at other locations may differ from conditions occurring at the exploration locations. Also the passage of time may result in a change in the subsurface conditions at these exploration locations.

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[3] Note: a table that does not appear near its citation can be found in a separate table at the end of the report.

Cone Penetrometer Soundings

The majority of the CPT soundings were performed immediately adjacent to SPT borings to facilitate correlating the readings from the CPT sounding with the samples obtained from the split-spoon and Shelby tube samplers. The CPT soundings were advanced to depths of approximately 50 ft and 100 ft below ground surface. The CPT soundings were performed using a piezocone penetrometer that provides measurements of pore water pressure at one or more locations on the penetrometer surface in general conformance with ASTM D5778. CPT data, including pore pressure measurements, were collected at 2-cm depth intervals.

The rod string and cone were advanced in natural ground at the standard rate of 2 cm/sec. At HA-C8, the rod string was advanced through the existing stratum of fly ash/boiler slag at a rate of approximately 0.6 cm per second and through the underlying natural soil at the standard rate of 2 cm/sec. The slower advancement rate in the fly ash/boiler slag was utilized because research has shown that the slower penetration rate better simulates the drained condition and provides a better interpretation of the CCR friction angle.

Seismic cone penetration testing was used to obtain in-situ measurements of shear wave velocity at HA-C7 and HA-C8. Measurements were taken at 1-meter (3.3-ft) intervals, which correspond to the intervals at which additional rods needed to be added to the rod string. Pore water dissipation testing was also performed at select depths in all CPTs to estimate hydraulic conductivity/pore pressure dissipation properties. The CPT sounding results are presented in **Appendix B**.

LABORATORY TESTING PROGRAM

A laboratory testing program was conducted on selected soil and CCR samples recovered from subsurface explorations to aid in classification and for determination of engineering properties required for design. The primary purpose of the testing program was to evaluate the index and strength properties of the soil, CCR, and boiler slag materials. Testing included natural moisture contents, Atterberg limits, grain size distributions, percent passing the No. 200 sieve, unconsolidated-undrained (UU) triaxial strength, consolidation, and tube density. The tests were performed in general conformance with applicable ASTM test procedures. Results of the laboratory testing program are presented in **Appendix C** and are summarized in **Table II**.

Subsurface Soil and Water Conditions

GEOLOGY

The site is located within the New Madrid Seismic Zone. The new Madrid Seismic Zone lies at the north end of the Mississippi Embayment, which is a deep, low-lying basin filled with Cretaceous to recent sediments. The stratigraphy at our site is presented on **Figure 3** and is based on the general profile develop by Van Arsdale and TenBrink (2000). The project site is immediately underlain by imported embankment fill and levee fill associated with embankment and levee construction as well as various deposits of fly ash and boiler slag associated with coal burning operations.

The existing fill is underlain by Quaternary Mississippi River alluvium, which is characterized by silty clay and sand, Pleistocene Loess, which is characterized by silt and clayey silt, and Pliocene-Pleistocene Upland Complex Gravel consisting of fine to very coarse sand and gravel. These sediments are believed to be surficial deposits of fluvial or estuarine origin.

Underlying the Quaternary Deposits is the Jackson Formation, which is characterized by fluvial/deltaic medium to very fine grained silty sand, interbedded with clayey silt. The Jackson Formation overlies the Eocene Claiborne Group that consists of the Cockfield Formation over the Cook Mountain Formation over The Memphis Sand. The Cockfield formation is characterized by fluvial/deltaic silt and clay interbedded with medium to fine grained sand. The Cook Mountain Formation consists of silt and clay containing variable amounts of lignite and sand. The Memphis Sand is predominately described as consisting of fluvial/deltaic fine to very coarse grained quartzose sand containing rock fragments, pyrite and lignite.

Below the Eocene Claiborne Group is Paleocene consisting of the Wilcox Group and Midway Group. The Wilcox Group is comprised of the Flour Island Formation overlying the Fort Pillow Sand. The Flour Island formation is characterized by silty clay and clayey silt with lenses of fine grained sand. The Fort Pillow Sand is described as consisting of fine to very coarse grained quartzose sand. The Midway Group is comprised of Old Breastworks Formation, Porters Creek Clay and The Clayton Formation. Old Breastworks Formation is described as sandy, micaceous silty clay. The Porters Creek Clay is described as a micaceous clay. The Clayton Formation consists of glauconitic, fossiliferous clay.

Underlying the Wilcox and Midway groups is Upper Cretaceous soil consisting of McNairy Sand, Demopolis Formation and Coffee Formation. McNairy Sand is characterized by fine to coarse grained sand interbedded with silty clay. The Demopolis Formation is composed of calcareous clays, marls and some chalky materials. The Coffee Formation is made up of stratified and cross-bedded clays and fine grained sand.

Below the Upper Cretaceous lies the Paleozoic strata. The Paleozoic strata is described as fine to coarse crystalline dolomite. At the AECI site, the depth to the Paleozoic strata is approximately 1,900 ft below ground surface.

The geologic descriptions discussed herein are credited to various references entitled “General Geology of the Mississippi Embayment” (Cushing, Boswell, Hosman 1964), “Deep Shear Wave Velocity Profiles of Mississippi Embayment Sediments Determined From Surface Wave Measurements” (Rosenblad, 2007) and “Late Cretaceous and Cenozoic Geology of the New Madrid Seismic Zone” (Van Arsdale and TenBrink, 2000).

SUBSURFACE CONDITIONS

Descriptions of the soil conditions encountered during the subsurface exploration program conducted at the site are provided below in order of increasing depth below ground surface. Actual soil conditions between boring locations may differ from these typical descriptions. Refer to the test boring logs for specific descriptions of soil samples obtained from the borings.

The subsurface conditions identified by the CPT soundings do not represent material classifications based on grain-size distributions, index tests, or visual observation. Rather, the CPT soundings provide an indicator of relative behavior type based on the mechanical characteristics measured during the soundings. For this reason, the descriptions of subsurface conditions discussed below are based on our visual-manual classification of samples obtained from test borings and the results of laboratory testing.

- *ROADWAY FILL* - Below the ground surface there is a stratum of fill material primarily described as SAND and GRAVEL. This stratum was encountered only in HA-B1, HA-B2, and HA-B6 and was fully penetrated where encountered. The thickness of this stratum was approximately 1 ft.

- *FLY ASH* - Below the ground surface at HA-B5, there is a stratum of fill material primarily described as brown, dark-brown, and black SILT with sand (ML). This stratum was encountered only in HA-B5 and was fully penetrated. Where encountered and fully penetrated, the thickness of this stratum was approximately 17 ft.

- *FLY ASH INTERMIXED WITH BOILER SLAG* - Below the fly ash at HA-B5, there is a stratum of fill material primarily described as brown and dark-brown SILT with sand and slag particles (ML). This stratum was encountered only in HA-B5 and was fully penetrated. Where encountered, the thickness of this stratum was approximately 15 ft.

- *BOILER SLAG* - Below the ground surface at HA-B4, there is a stratum of fill material primarily described as brown and dark-brown SILT with sand and slag particles (ML). This stratum was encountered only in HA-B4 and was fully penetrated. Where encountered, the thickness of this stratum was approximately 15 ft.

- *FILL* – Below the ground surface in HA-B3 and HA-B7 and below the ROADWAY FILL in HA-B1, HA-B2, and HA-B6 a stratum of FILL material was encountered. The FILL is primarily described as lean CLAY (CL) and fat CLAY (CH). This stratum was encountered and fully penetrated in borings HA-B1, HA-B2, HA-B3, HA-B6, and HA-B7. Where encountered and fully penetrated, the thickness of the stratum ranged from approximately 10.0 ft to 25.0 ft. The density of cohesive, fine-grained soils encountered in this stratum ranged from soft to stiff, but was generally medium stiff to stiff.

- *ALLUVIAL DEPOSITS* – Below the FILL, FLY ASH, FLY ASH INTERMIXED WITH BOILER SLAG, and BOILER SLAG there is a stratum of natural soil primarily described as silty SAND (SM), poorly graded SAND (SP), SILT (ML), lean CLAY (CL), and fat CLAY (CH). This stratum was encountered in all borings. This stratum was fully penetrated in all borings with the exception of HA-B7. Where encountered and fully penetrated, the thickness of this stratum ranged from approximately 7 ft to 26 ft. The density of coarse-grained soils encountered in this stratum ranged from very loose to medium dense. The consistency of fine-grained soils encountered in this stratum ranged from soft to stiff.

- *FLUVIAL DEPOSITS* – Below the ALLUVIAL DEPOSITS, there is a stratum of natural soil primarily described as light brown and gray poorly-graded SAND (SP), and light brown well-graded sand (SW). This stratum was encountered in all borings except HA-B7, but was not fully penetrated by any of the test borings. The density of coarse-grained soils encountered in this stratum ranged from medium dense to dense.

Water levels were typically measured in the boreholes when water was encountered during drilling and after the test borings were completed. Measured water levels are summarized in **Table I**. Where encountered, water levels measured during drilling generally ranged from a depth of 18 to 43 ft below ground surface, which corresponds to a water level ranging between approximately El. 257 and 293 for geotechnical evaluation purposes. It should be noted that the water levels measured in borings HA-B3, HA-B5, and HA-B5A were significantly higher than the water levels measured in the other borings and likely represent localized water conditions within the impoundment footprint.

Water levels were also estimated by the cone penetrometer soundings and are also summarized in **Table I**. Water levels estimated during the soundings generally ranged from 30 to 48 ft below ground surface, which corresponds to a water level ranging between approximately El. 258 and El. 274. It should be noted that measurements estimated during the soundings did not involve physical observation of water levels, but rather an estimated water level based on pore pressure measurements. The estimates of water levels at each sounding should only be considered accurate to the degree implied by the determination method.

Water level readings have been made in the subsurface explorations at times and under conditions discussed herein. However, it must be noted that fluctuations in the level of the water may occur due to variations in power plant sluicing activities, season, rainfall, temperature, dewatering activities, and other factors not evident at the time measurements were made and reported herein.

Safety Factor Assessment

As mentioned previously, the purpose of this study was to perform the initial safety factor assessment in accordance with Section §257.73(e)(1) of the CCR Rule. As required by the CCR Rule, the initial safety factor assessment is performed for each applicable CCR unit to determine calculated factors of safety (using simple static and pseudo-static analysis) relative to the minimum prescribed safety factors for the critical cross section of the embankment. Those are defined as follows:

- For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.
- The calculated static factor of safety under the long-term, maximum storage pool loading conditions must equal or exceed 1.50.
- The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.
- The calculated seismic factor of safety must equal or exceed 1.00.

The results of our evaluation of the safety factors are presented in the following sections of the report.

LIQUEFACTION EVALUATION

During strong earthquake shaking, loose, saturated cohesionless soil deposits may experience a sudden loss of strength and stiffness, sometimes resulting in loss of bearing capacity, large permanent lateral displacements, and/or seismic settlement of the ground. This phenomenon is called soil liquefaction.

In accordance with the requirements of §257.73(e)(1)(iv), liquefaction evaluation required is to assess the potential for liquefaction of the impoundment dikes at the site in question. A variety of screening techniques exist to distinguish sites that are clearly safe with respect to liquefaction from those sites that require more detailed study. One of the most commonly used screening techniques used to make this assessment is the evaluation of fines content and plasticity index. In general, soils having greater than 15 percent (by weight) finer than 0.005 mm, a liquid limit greater than 35 percent, and an in-situ water content less than 90 percent of the liquid limit generally do not liquefy (Seed and Idriss, 1982).

The results of our subsurface investigation indicate that the impoundment dikes at Pond 003 and Pond 004 are primarily constructed of clay soils and have the following characteristics:

- 90 percent (by weight) finer than 0.005
- Liquid limits > 40
- In-situ moisture contents less than 50 percent of the liquid limit

In consideration of the clay soils used to construct the dikes, it is our opinion, in accordance with generally accepted standards, that the impoundment dikes are not constructed of soils that are susceptible to liquefaction.

GLOBAL STABILITY FACTORS OF SAFETY

Stability analyses have been performed in general conformance with the principles and methodologies described in the USACE Slope Stability Manual (U.S. Army Corps of Engineers, 2003). Conventional static and seismic stability analyses of the impoundment dike structures were performed for rotational and block failures using limit equilibrium methods. Limit equilibrium methods compare forces, moments, and stresses which cause instability of the mass of the dike to those which resist that instability. The principle of the limit equilibrium method is to assume that if the slope under consideration were about to fail, or at the structural limit of failure, then one must determine the resulting shear stresses along the expected failure surface. These determined shear stresses are then compared with the shear strength of the soils along the expected failure surface to determine the safety factor. The specific details of the analyses performed for Pond 003 and Pond 004 are presented in the following sections of this report.

DESIGN WATER LEVEL

As stated earlier, subsurface water levels measured during our subsurface exploration program indicated static water levels were generally 30 to 48 ft below the existing ground surface. In Pond 003, zones of perched water within the impoundment were encountered within the fly ash and boiler slag due to sluicing operations. Accordingly, the following static water levels were used in our analyses.

Location	Elevation
Pond 003	East Side – El. 262 West Side – El. 274
Pond 004 (North Portion)	East Side - El. 261
Pond 004 (Southern Portion)	East Side – El. 258 West Side – El. 262

The water retained in each impoundment must be modeled at the maximum storage pool level for the static drained and seismic undrained analyses. The maximum surcharge pool level must be used to model the ponded water for the static undrained analyses. This approach is consistent with the requirements of the CCR Rule. The specific pool levels used in our analyses are summarized below and chosen as the conservative values associated with each impoundment and cross sections.

Location	Maximum Storage Pool Level	Maximum Surcharge Pool Level
Pond 003 (max. storage)	El. 301	El. 309
Pond 004 (max. storage)	El. 294	El. 301

Given the prescribed impoundment pool levels and the design static groundwater levels mentioned above, a seepage analysis was performed to determine the piezometric head between the edge of the impoundment and the toe of the dike, which is where the static groundwater level was encountered. The computer software program, Slide 6.029, developed by RocScience, Inc., was used to perform the seepage analyses and the resulting piezometric head was used in the stability analyses discussed herein.

MATERIAL PROPERTIES

The material properties used in our analyses have been developed using the results of the referenced test borings, CPT soundings, and laboratory testing. When evaluating the CPT results, material strengths were typically determined by averaging the measurements in a particular stratum and choosing conservative strength properties equal to the average value minus one standard deviation. A summary of the material properties is provided below in **Table III**.

TABLE III
MATERIAL PROPERTIES

Material	Material Strength	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (degrees)
Embankment Fill	Drained	115	50	30
	Undrained	115	800	0
Levee Fill	Drained	115	50	30
	Undrained	115	800	0
Boiler Slag (Fill)	Drained	110	0	30
	Undrained	110	500	0
Fly Ash (Fill)	Drained	90	0	28
	Undrained	90	500	0
Fly Ash / Boiler Slag (Fill)	Drained	105	0	29
	Undrained	105	800	0
Alluvial Clay	Drained	110	50	28
	Undrained	110	1300	0
Alluvial Sand	Drained	108	0	36
	Undrained	108	0	36
Fluvial Sand	Drained	120	0	38
	Undrained	120	0	38

Seismic cone penetration testing was used to obtain in-situ measurements of shear wave velocity during the subsurface exploration program. The insitu measurements were performed to a depth of 95 ft below ground surface. Below that depth, shear wave velocity measurements of the underlying soils were approximated using published data specific to the Mississippi Embayment and the New Madrid Seismic Zone (Cramer, Hashash, Romero, Rosenblad, Van Arsdale). The site specific shear wave velocity profile is shown on **Figure 4**.

SITE SPECIFIC SEISMIC RESPONSE ANALYSIS

Introduction

As mentioned previously, the New Madrid Power Plant is located within the New Madrid Seismic Zone and the Mississippi embayment. The natural embayment soils underlying the impoundments are estimated to be 1,900-ft thick. It has been demonstrated that strong ground motions are significantly de-amplified at both the short and long periods due to the nonlinear behavior of the soils in the Mississippi embayment. It has also been shown that at short periods increasing soil thickness correlates with a decreasing hazard due the nonlinear soil behavior. Similarly, at long periods, increasing soil thickness correlates with increasing hazard due to soil resonance (Cramer, 2015).

Overview of Site-Specific Seismic Analysis

A one-dimensional ground response analysis was performed to estimate the subsurface response to an earthquake event at New Madrid. Due to the complex nature of the analyses required, Dr. Professor Edward Kavazanjian, Jr. at Arizona State University and Dr. Chris Cramer at the University of Memphis were retained as part of our team to assist with the site-specific seismic analyses.

It is important that the rock motions and soil characteristics are correlated to the site conditions at the New Madrid Power Plant. Properly conditioned bedrock strong ground motions (acceleration time histories) are required to perform a site-specific seismic analysis. Strong motion records for large magnitude events are not available for Central U.S. (Romero and Rix, 2001). Therefore, alternative records were obtained from other sources that approximate the spectral response characteristics at the site.

The bedrock at the site is classified as NEHRP Site Class A, hard rock. The USGS Uniform Hazard spectral response characteristics for a hypothetical Site Class A rock, based on the 2,500 –year return period ground motions, were used to identify the spectral characteristics of the time histories (i.e., the “Target Spectrum”) used for the site-specific evaluation.

USGS Deaggregation and Deterministic Target Spectrum

There is a great deal of uncertainty with regard to predicting the location, size, and shaking intensity of future earthquakes. Probabilistic Seismic Hazard Analysis (PSHA) aims to quantify these uncertainties, and combine them to produce a description of the distribution of future shaking that may occur at a site. The 2008 NSHMP PSHA interactive deaggregation web site was used to obtain the characteristics of the most significant earthquakes (the earthquakes that contribute the most to the seismic hazard) responsible for seismic activity at the New Madrid power plant. This website produces graphical representations of the characteristics of earthquake events most likely to affect the site within a given time span. The deaggregation plot for spectral response period T=0.1s is shown on **Figure D-1 located in Appendix D**. This plot suggests that the representative design earthquake for ground motions with a return period of 2,500 years should be between magnitude 7.5 and 8.0 at a distance of approximately 11 km from the site.

The significant characteristics of the earthquake such as magnitude and distance are used to select representative ground motions. The characteristics are also used to construct the deterministic target spectrum that is used for selecting ground motions.

A special type of target spectrum, called the conditional mean spectrum (CMS), was created for the study because it focuses the spectral response of all the ground motions to a particular period along the target spectrum (Baker, 2011). The particular target period selected is related to characteristics of the structure being analyzed such as shear wave velocity and height of sliding mass in the case of the impoundments. Based on the characteristics of general failure planes determined from slope stability analysis for the impoundment, a target period of 0.1s was chosen for the deterministic CMS target spectrum for the New Madrid Power Plant. The magnitude of the CMS target spectrum was then amplified to a mean plus one standard deviation target which is conservative (i.e., the approximately 84th percentile ground motion, rather than the median, or expected, ground motion) and is generally chosen to evaluate structures that are of critical importance.

The deterministic target spectrum is based on ground motion prediction equations (GMPEs) that use magnitude and distance to predict the spectral response of the ground motion. According to the USGS PSHA, the largest event predicted to affect New Madrid Power Plant is a magnitude 8 earthquake that is 10.5km from the site. The computer software program Shake 2000, developed by GeoMotions, provided the central and eastern U.S. (CEUS) GMPEs and the CMS algorithms used to create the target spectrum. Site-specific spectral responses were generated from five CEUS attenuation relationships using Shake 2000 as shown on **Figure D-2 in Appendix D**. These attenuation relationships were based on a magnitude 8 earthquake as a distance of 10.5 km from the source. The largest spectral response in the group (i.e., Campbell, 2003) was selected to produce the target spectrum for the site.

Conditional Mean Spectrum Groundmotions Scaled To Target Period T=0.1s

The CMS spectrum according to Baker, 2011 is to be constructed with the ground motions scaled so that their spectral response at the target period, T* matches the spectral response at the CMS Target spectrum. The target period, T* is chosen to approximate the fundamental frequency of the sliding mass which can be determined from the location of the failure plane within the slope at a condition of equilibrium (i.e., safety factor equal to 1.0). The shear wave velocity V_S of the sliding mass was estimated to range between 450 ft/sec to as much as 1000 ft/sec for the impoundments at the site based on our in-situ shear wave testing. Our analyses assumed the height of the sliding mass varies from 5ft to 21ft. Based on the anticipated variance of embankment height and shear wave velocity, an average fundamental frequency of T*=0.1s was used to scale the ground motions to the target spectrum

Shake 2000 was used to provide the CMS spectrum for Campbell 2003 CEUS GMPE using a target period T* = 0.1s and amplifying the CMS to correspond to a mean plus one standard deviation spectrum. The mean plus one standard deviation spectrum shown on **Figure D-3 in Appendix D** was used as the deterministic CMS target spectrum for the New Madrid Power Plant.

Rock Motions for The CMS

Six time history records were selected to match the target response spectrum for the site. Five of these rock motions were obtained from naturally occurring events and one rock motion was synthetically generated to match a magnitude 8 earthquake associated with the ground response for the Mississippi Embayment at Memphis, TN (Atkinson 2002). A primary focus was to match the ground motion spectra to the CMS target spectrum, as suggested by NEHRP (2011) when considering magnitude, distance, and focal mechanism. Rock motion records were selected from the Pacific Earthquake Engineering Research (PEER) Center’s Strong Motion Database. The motions are summarized below in **Table IV** and depicted graphically **Figure D-4 in Appendix D**. As shown on **Figure D-5 in Appendix D**, the arithmetic mean spectrum of the generated records closely matches the CMS bedrock spectrum over the period range of interest.

TABLE IV
EARTHQUAKE RECORDS

Event	Return Period	PEER File Name	Earthquake Record Used			
			Earthquake	M	Mechanism	Distance (km)
Conditional Mean Response	2,500-year	RSN497-Nahanni_S3270.AT2	Nahinni	6.76	Reverse	5.32
		RSN550_Chalfant.A_A-CPL070.AT2	Chalfant	6.19	Strike-slip	18.31
		RSN4481_L-Aquila_FA030XTE.AT2	L'Aquila	6.3	Normal	6.81
		RSN825_ CAPEMEND_CPM000.AT2	Cape Mendocino	7.1	Reverse	6.96
		RSN8158_CChurch_LPCCN10W.AT2	Christ Church	6.2	Reverse Oblique	6.12
		N/A	Synthetic (Atkinson and Beresnev)	8.0	N/A	N/A

Due to the unusually large magnitude and close proximity of the earthquake projected for the site, it is difficult to locate ground motions that effectively scale to the shorter period portion of the CMS target spectrum. Many of the selected ground motions have spectral response characteristics that are significantly lower than the target between periods ranging from 0.01s to 0.06s. According to the Federal Highway Administration, due to the low number of ground motions for central and eastern U.S., it is acceptable to spectrally match the ground motions to the lower period portions of the target spectrum (FHWA, 2011). For this reason, the ground motions were spectrally matched to the CMS target spectrum between T=0.02sec to 0.06sec as shown on **Figure D-6 in Appendix D.**

One-Dimensional Ground Response Analysis

As mentioned previously, a one-dimensional ground response analysis was performed to estimate the surface ground motion at the site. The soil column used as input into the model was constructed from the shear wave velocity profile at the site (from in-situ testing) along with other characteristics such as layer thickness, soil density and the dynamic behavior. The dynamic geotechnical properties (damping, modulus-damping curves, density, etc.) used in the ground response analysis were obtained from prior models developed by Dr. Chris Cramer and are representative of the non-linear, pressure dependent soil properties attributed to the Mississippi Embayment as described by Romero and Rix, 2005.

The computer software program Shake2000 was used to numerically simulate the propagation of rock motions applied to the base of the soil column up through the soil layers to the top of the soil column. Shake2000 uses an equivalent linear numerical technique to model the non-linear dynamic soil behavior in the soil column. **Figure D-7 included in Appendix D** shows the results of the Shake ground response analysis for the six representative rock motions. This figure compares the spectral response of the bedrock motions to the surface ground response and shows the transformation in response caused by wave propagation through the 1,900-ft thick soil column. **Table V** summarizes the surface PGA estimates at the New Madrid Power Plant.

TABLE V
PREDICTED SURFACE PGA AND NEWMARK MAGNITUDE CORRECTION FACTOR

Earthquake	Original Magnitude	CMS Scaled-Matched PGA	Shake Surface PGA	Newmark Magnitude Correction Factor[1]
Nahinni	6.76	1.60 g	0.33 g	1.41
Chalfant	6.19	1.77 g	0.33 g	1.65
L'Aquila	6.30	1.60 g	0.66 g	1.60
Cape Mendocino	7.01	1.40 g	0.41 g	1.32
Christ Church	6.25	2.00 g	0.41 g	1.65
Synthetic (Atkinson and Beresnev)	8.00	0.95 g	0.47 g	1.00

[1] Determined using the method developed by Bray and Traversarou

Newmark Displacement Analysis

The Newmark method predicts the amount of block displacement for a given value of yield acceleration. The Newmark displacement analysis is based on the shear stress time history acting along the failure plane within the slope. The yield acceleration is the minimum amount of ground acceleration necessary to initiate motion along the failure surface and is used to determine the appropriate pseudo-static coefficient for seismic stability analyses.

Shake2000 was used to perform the Newmark displacement analysis by incorporating the results of the one-dimensional ground response analysis to estimate slope displacement. Shake2000 incorporates several different variants of the Newmark block displacement method and the numerical approach known as YSLIP developed by Kavazanjian and Matasovic (1996) was chosen for our analysis. All six site-specific bedrock motions were used to evaluate relationships between the Newmark permanent displacements and the associated yield acceleration. Several impoundment cross-sections were evaluated and the most conservative location of the failure plane was determined to be 15 ft below the top of slope.

After performing the Newmark displacement analysis, it was necessary to adjust the displacement predictions to correspond to the difference between the magnitudes of the ground motions used in the analysis and the magnitude of the representative earthquake event established for the New Madrid Power Plant. Correction factors were applied to scale the displacements to the target magnitude 8 event. The correction factors were determined using the approach developed by Bray and Travasarou (2007), which relates permanent displacement from a Newmark analysis with the magnitude of the earthquake event (Bray, 2007). **Figure D-8 in Appendix D** presents the magnitude scaled permanent displacement versus yield acceleration.

DECOUPLED SEISMIC STABILITY ANALYSIS

Methodology for Analyses

The computer software program Slide 6.029 was used to evaluate the static and seismic stability of the impoundment dikes. Analyses were performed to evaluate static drained (long-term) and undrained (short-term) strength conditions for circular and block failures using Spencer's method of slices. Spencer's method of slices was selected because it fully satisfies the requirements of force and moment equilibrium (limit equilibrium method).

Seismic stability was evaluated using pseudo-static analyses and a 20 percent reduction in material strength to represent the approximate threshold between large and small strains induced by cyclic loading (Duncan, 2014). Pseudo-static analysis models the seismic shaking as a "permanent" body force that is added to the force-body diagram of a conventional static limit-equilibrium analysis; typically, only the horizontal component of earthquake shaking is modeled because the effects of vertical forces tend to average out to near zero (Jibson, 2011). This is a traditional approach for evaluating the stability of a slope during earthquake shaking and provides a simplified safety factor analysis for one earthquake pulse. A safety factor greater than or equal to one ($FS \geq 1.0$) indicates a slope is stable and a safety factor below one ($FS < 1.0$) indicates that the slope is unstable.

Pseudo-static Coefficient

The pseudo-static coefficient, k_s, used in our seismic analyses was selected using the results of the Newmark displacement analysis discussed previously. Accordingly, to the MSHA Impoundment Design Manual, the acceptable displacement of coal refuse impoundments is 25% of the upstream freeboard (MSHA, 2009). At each impoundment based observed conditions, that equates to:

- Pond 003 – 8 ft freeboard, acceptable displacement is 24 in.
- Pond 004 – 7-ft Freeboard, acceptable displacement is 21 in.

Assuming the most conservative case of 21-in. acceptable displacement, **Figure D-8 in Appendix D** shows that the yield acceleration corresponding to the most conservative earthquake motion is 0.25g. A pseudostatic coefficient lower than 0.25 will result in more than 21 in. deformation and one higher than 0.25 will result in less than 21 in. deformation. For the seismic stability analyses performed for the impoundments, we selected a pseudostatic coefficient of 0.28. This value was selected because it is slightly above the minimum value, which is conservative, and will result in displacements at each impoundment that are below MSHA acceptable values.

Results of Stability Evaluation

The critical cross section is defined as that which is anticipated to be most susceptible amongst all cross sections. To identify the critical cross sections at our project site, we examined the following conditions at several cross section locations at each impoundment:

a. the geometry of the upstream and downstream slopes;

b. phreatic surface levels within and below the cross sections;
c. subsurface soil conditions;
d. presence or lack of surcharge loads behind the crest of the dikes; and
e. presence or lack of reinforcing measures in front of the dikes.

Examination of the conditions noted above resulted in the identification of five (5) critical cross sections. Two (2) of the cross sections were located at Pond 003 and three (3) of the cross sections were located at the Pond 004. The results of our analyses are presented below in **Table VI** and are shown on the Slide output files included in **Appendix D**. As shown below, the static safety factors are above the minimum required values for all sections. The pseudo-static analyses for the analyzed sections indicate acceptable seismic safety factors for sections A-A’, B-B’, C-C’, and D-D’. Section E-E’ was originally modeled with its configuration as of 2015 with CCR staged near the dike on the west side of the Pond 004 impoundment. The preliminary static analyses for that scenario indicated acceptable factors of safety, but the seismic analyses did not. As noted previously, AECI revised the configuration of that staged material in 2016, and the results of the revised E-E’ configuration indicate acceptable seismic and static safety factors. The results of the analyses based on the revised configuration are presented in Table VI and Appendix D.

TABLE VI
SUMMARY OF STABILITY EVALUATIONS

Cross Section	Condition[1]	Earthquake Event	Soil Strength	Required Safety Factor	Safety Factor	
					Rotational Failure Surface	Block Failure Surface
A-A’ (Pond 004)	Static	-	Drained	1.5	4.3	4.9
			Undrained	1.4	4.3	4.5
	Seismic	2,500-year	Undrained[2]	1.0	1.2	1.1
B-B’ (Pond 004)	Static	-	Drained	1.5	3.8	4.3
			Undrained	1.4	7.6	6.4
	Seismic	2,500-year	Undrained[2]	1.0	1.2	1.3
C-C’ (Pond 004)	Static	-	Drained	1.5	3.6	4.3
			Undrained	1.4	3.9	4.5
	Seismic	2,500-year	Undrained[2]	1.0	1.1	1.2
D-D’ (Pond 003)	Static	-	Drained	1.5	2.3	3.7
			Undrained	1.4	5.0	6.3
	Seismic	2,500-year	Undrained[2]	1.0	1.2	1.3
E-E’ (Pond 003)	Static	-	Drained	1.5	3.1	4.1
			Undrained	1.4	4.1	4.3
	Seismic	2,500-year	Undrained[2]	1.0	1.1	1.3

1. Refer to Table III for material properties.
2. Shear strengths have been reduced by 20 percent for seismic analyses.

DISCUSSION AND RECOMMENDATIONS

The analyses associated with the safety factor assessment have been performed in accordance with the requirement of Section §257.73 of the CCR Rule. A summary of our conclusions and recommendations as they relate to the rule requirements are provided below.

- *For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.*

  The results of our subsurface investigation indicate that the impoundment dikes at the Pond 003 and Pond 004 are primarily constructed of clay soils that are not susceptible to liquefaction. Accordingly, this requirement has been met.

- *The calculated static factor of safety under the long-term, maximum storage pool loading conditions must equal or exceed 1.50.*

  As shown in **Table VI**, the static safety factors for the long-term (drained) maximum storage pool condition are above the minimum required values for all critical sections analyzed at Pond 003 and Pond 004. Accordingly, this requirement has been met.

- *The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.*

  As shown **in Table VI**, the static safety factors for the maximum surcharge pool loading condition (undrained) are above the minimum required values for all critical sections analyzed at Pond 003 and Pond 004. Accordingly, this requirement has been met.

- *The calculated seismic factor of safety must equal or exceed 1.00.*

  As shown in **Table VI**, the calculated seismic safety factors are above the minimum required value for all critical sections at Pond 003 and Pond 004. Accordingly, this requirement has been met.

CERTIFICATION

Based on our review of the information provided to us by AECI and the results of our field investigations and analyses, it is our opinion that the calculated factors of safety for the critical cross sections of the impoundment embankments for Pond 003 and Pond 004 meet the minimum factors of safety specified in §257.73(e)(1)(i) through (iv) of the EPA's CCR Rule.

Certification Statement – Pond 003

I certify that the Initial Safety Factor Assessment for AECI's Pond 003 at the New Madrid Power Plant meets the requirements of §257.73(e) of the EPA's CCR Rule.

Signed: ______________________
Certifying Engineer

Print Name: Steven F. Putrich
Missouri License No.: 2014035813
Title: Project Principal
Company: Haley & Aldrich, Inc.

Professional Engineer's Seal:

STEVEN F. PUTRICH
NUMBER
PE-2014035813
10-17-16

Certification Statement – Pond 004

I certify that the Initial Safety Factor Assessment for AECI's Pond 004 at the New Madrid Power Plant meets the requirements of §257.73(e) of the EPA's CCR Rule.

Signed: ______________________
Certifying Engineer

Print Name: Steven F. Putrich
Missouri License No.: 2014035813
Title: Project Principal
Company: Haley & Aldrich, Inc.

Professional Engineer's Seal:

STEVEN F. PUTRICH
NUMBER
PE-2014035813
10-17-16

CLOSING

We appreciate the opportunity to provide engineering services on this project to AECI.

Sincerely yours,
HALEY & ALDRICH, INC.

Dem A Shelton

Derrick A. Shelton
Geotechnical Program Manager | Senior Associate

Steven F. Putrich, P.E.
Project Principal

Enclosures:

- References
- Table I – Summary of Subsurface Explorations
- Table II – Summary of Laboratory Test Results
- Figure 1 – Project Locus
- Figure 2 – Subsurface Exploration Location Plan
- Figure 3 – Geologic Column for the New Madrid Seismic Zone
- Figure 4 – Design Shear Wave Velocity Profile
- Appendix A – Test Boring Logs
- Appendix B – CPT Sounding Logs and Related Information
- Appendix C – Laboratory Test Results
- Appendix D - Analyses

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TABLE I

SUMMARY OF SUBSURFACE EXPLORATIONS
ASSOCIATED ELECTRIC COOPEATIVE, INC.
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

Exploration Designation[1]	Ground Surface El.[2] (ft)	Northing[2]	Easting[2]	Total Exploration Depth (ft)	Water[3]	
					Depth Below Ground Surface (ft)	Elevation (ft)
HA-B1	309.3	249123.8	1096406.3	50.0	43.0	266.3
HA-B2	300.2	249425.1	1096677.9	95.0	40.5	259.7
HA-B3	308.8	247288.9	1096492.8	75.0	43.0	265.8
HA-B4	304.2	246728.8	1097737.1	95.0	13.0[4]	291.2
HA-B4A	304.2	246728.8	1097737.1	15.0	Not Encountered	--
HA-B5	316.1	246385.4	1096344.8	50.0	43.0	273.1
HA-B5A	316.1	246385.4	1096344.8	29.0	25.0[4]	291.1
HA-B6	307.4	245683.4	1098768.8	75.0	40.0	267.4
HA-B7	302.9	249818.4	1096496.9	27.0	Not Encountered	--
HA-C1	301.1	249768.9	1096418.4	50.0	41.0	260.1
HA-C2	309.2	249121.4	1096407.6	50.0	48.1	261.1
HA-C3	299.9	249422.8	1096674.6	95.1	41.8	258.1
HA-C4	296.5	249095.4	1096352.8	50.0	35.0	261.5
HA-C5	309.5	247296.2	1096499.1	75.1	43.4	266.1
HA-C6	296.7	247092.3	1096316.1	50.0	30.1	266.6
HA-C7	304.2	246735.4	1097740.8	95.1	41.8	262.4
HA-C8	315.8	246390.2	1096337.2	50.0	42.0	273.8
HA-C9	307.3	245688.2	1098766.8	75.1	47.2	260.1
HA-C10	303.0	249815.6	1096496.5	50.5	42.0	261.0

Notes:

1) Technical monitoring of subsurface explorations completed during the period 14 September 2015 through 2 September 2015 was performed by Haley & Aldrich, Inc.

2) Elevations are in feet and reference North American Vertical Datum of 1988 (NAVD88). Ground surface elevations of subsurface explorations were determined by optical survey. Survey performed by Smith & Company, Inc.

3) Water level readings represent the highest water level observed either during drilling, after completion of the boring, or as indicated by subsurface exploration instruments. Refer to the subsurface exploration logs for additional water level data. Water level readings have been made in the subsurface explorations at times and under conditions discussed herein. However, it must be noted that fluctuations in the level of the water may occur due to variations in season, rainfall, temperature, and other factors not evident at the time measurements were made and reported.

4) Possible perched water.

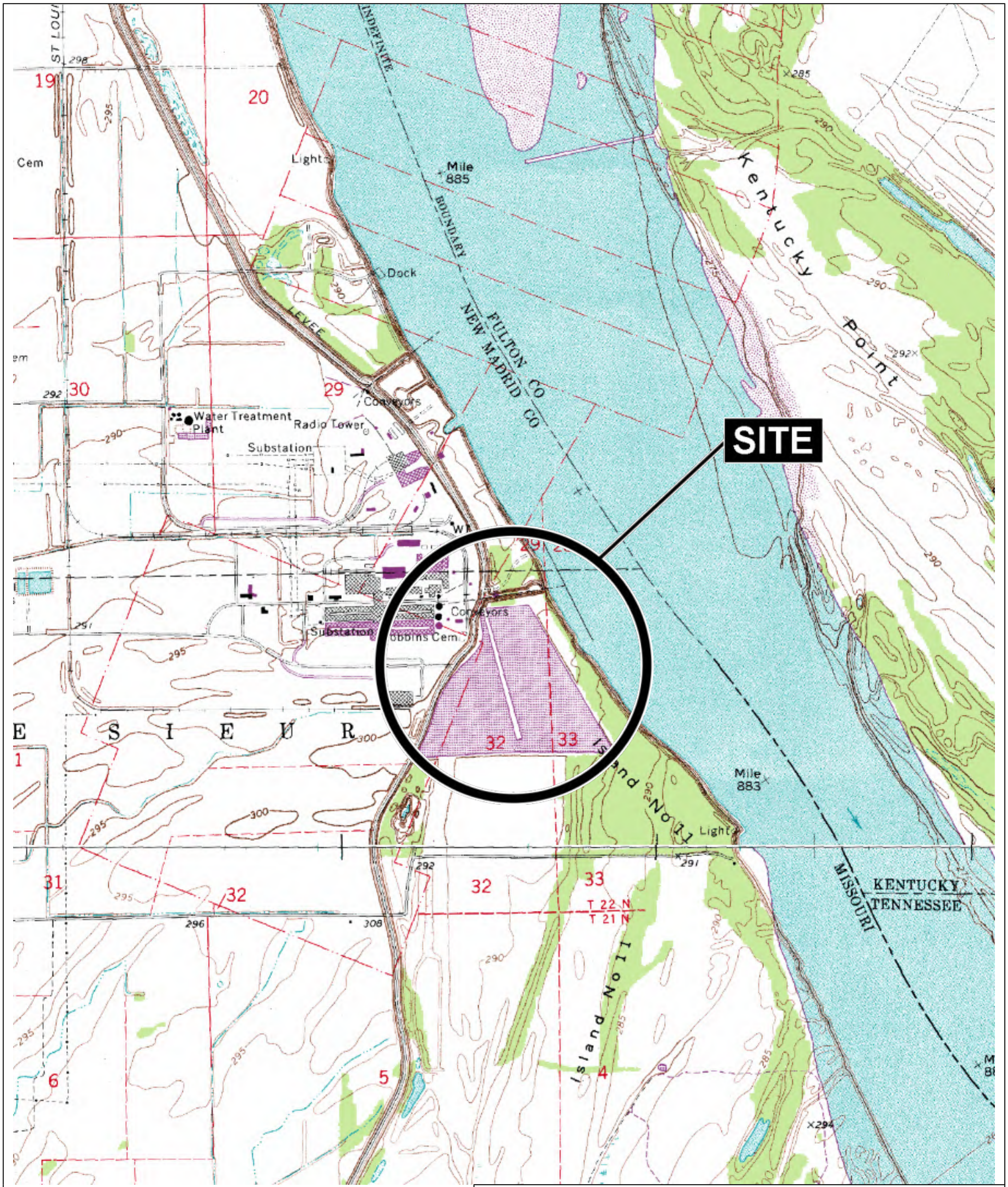
TABLE II
SUMMARY OF LABORATORY TEST RESULTS
ASSOCIATED ELECTRIC COOPEATIVE, INC.
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

Boring Designation	Sample Number	Sample Depth (ft)	USCS Symbol	Material Type	Moisture Content (%)	LL	PL	PI	% Gravel	% Sand	% Fines	Tube Dry Density (pcf)	UU Triaxial			Consolidation		
													Moisture Content (%)	Dry Density (pcf)	S_u (tsf)	e_o[1]	C_c[1]	P_c[1] (tsf)
HA-B1	S6	11.0-13.0	CL	Fill	22.8	42	20	22			92.7							
HA-B2	S11	28.0-30.0	SM	Natural Soil	20.7				0.0	67.9	32.1							
HA-B3	S3	5.0-7.0	CL	Fill	26.7				0.0	4.8	95.2							
HA-B3	S7	13.0-15.0	CL	Fill	22.8	47	22	25			95.5							
HA-B3	S10	28.0-30.0	CH	Natural Soil	36.1						98.4							
HA-B4	U2	5.0-7.0	ML	Boiler Slag	32.9				0	0.7	99.3	80.0				1.08	0.23	1.1
HA-B4	S15	48.0-50.0	SP	Natural Soil	18.1				0.5	95.1	4.4							
HA-B5	U1	10.0-12.0	ML	Fly Ash	38.3				0.0	1.4	98.6	71.7				1.04	0.18	2.0
HA-B5	U2	20.0-22.0	ML	Fly Ash	34.6							77.8	41.0	73.1	0.3	1.14	0.19	2.8
HA-B6	S4	7.0-9.0	CL	Fill	22.6	45	21	24			94.4							
HA-B6	S7	13.0-15.0	CL	Natural Soil	21.1	39	20	19			96.5							
HA-B7	S6	11.0-13.0	CH	Fill	22.5	59	20	39			87.3							

Notes:

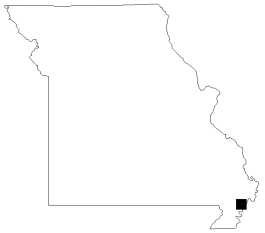
1. e_o = Void Ratio, C_c = Compression Ratio, P_c = Estimated Preconsolidation Pressure

11/6/2015



MAP SOURCE: USGS

SITE COORDINATES: 36°30'39"N, 89°33'29"W



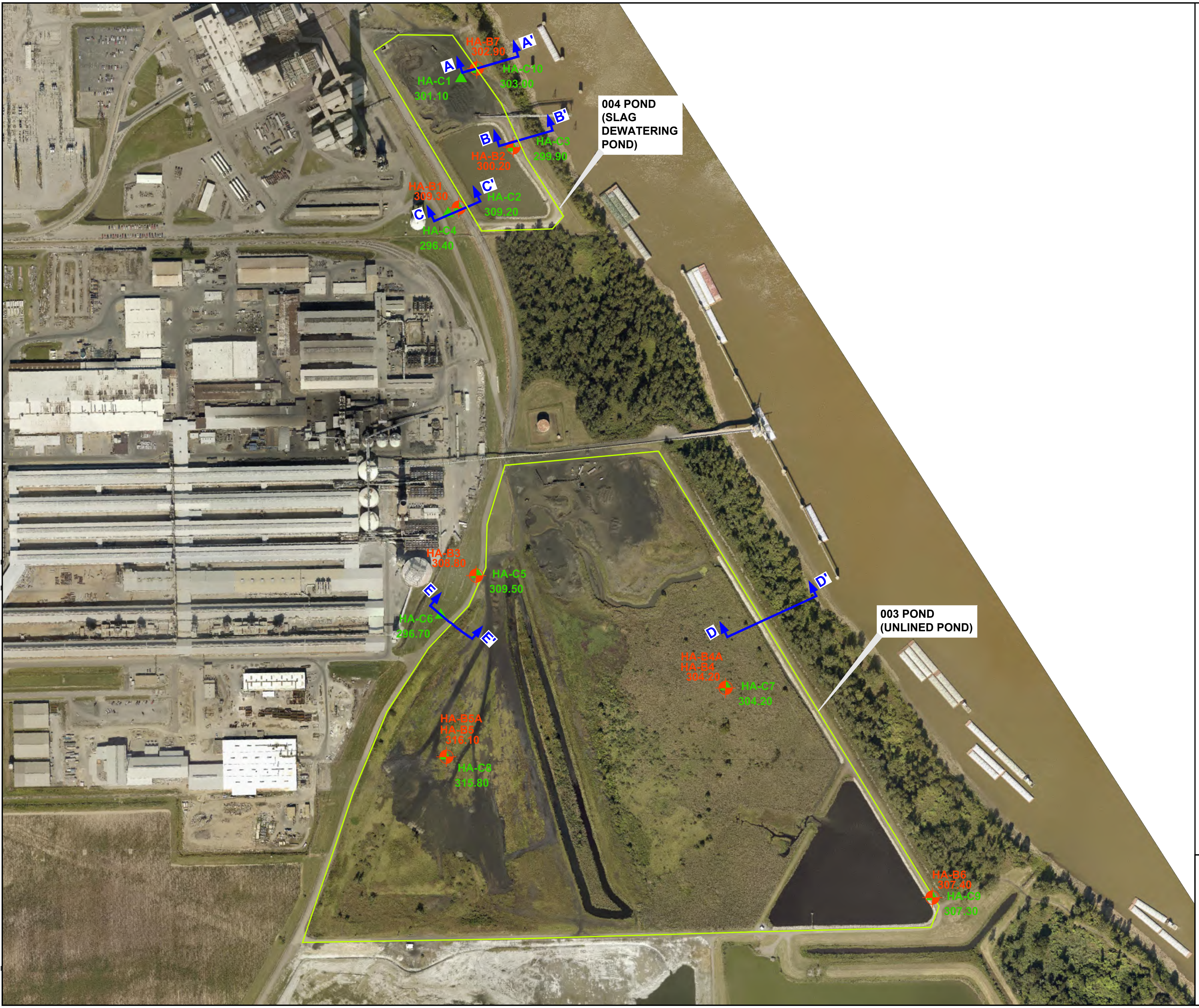
HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
003 UNLINED POND AND 004 SLAG DEWATERING POND
NEW MADRID POWER PLANT
MARSTON, MISSOURI

PROJECT LOCUS

APPROXIMATE SCALE: 1 IN = 2000 FT
FEBRUARY 2016

FIGURE 1

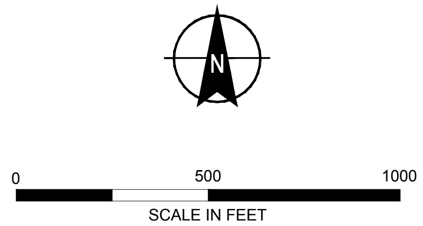


LEGEND

HA-B3 308.8	DESIGNATION, LOCATION AND GROUND SURFACE ELEVATION OF TEST BORINGS PERFORMED BY BULLDOG DRILLING, INC. OF DUPO, ILLINOIS DURING THE PERIOD 14 SEPTEMBER 2015 TO 22 SEPTEMBER 2015. DESIGNATIONS THAT INCLUDE AN "A" CORRESPOND TO OFFSET BORINGS PERFORMED IMMEDIATELY ADJACENT TO THE ORIGINAL BORING.
HA-C6 A 296.7	DESIGNATION, LOCATION AND GROUND SURFACE ELEVATION OF CONE PENETROMETER SOUNDINGS PERFORMED BY CONETEC, INC. OF WEST BERLIN, NEW JERSEY DURING THE PERIOD 15 SEPTEMBER 2015 TO 1□SEPTEMBER 2015.
A'	GEOLOGIC CROSS-SECTION LOCATION
	APPROXIMATE POND EXTENT

NOTES

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM AN AERIAL IMAGE PROVIDED BY AECI THAT WAS CONDUCTED BY PICTOMETRY INTERNATIONAL CORP BETWEEN OCTOBER 4-8, 2014.
2. ELEVATIONS INDICATED ON THIS DRAWING ARE IN FEET AND REFER TO NAVD 1□88 DATUM. HORI□ONTAL CONTROL IS BASED ON MISSOURI STATE PLANE COORDINATE SYSTEM - EAST □ONE.
3. TECHNICAL MONITORING OF TEST BORINGS AND CONE PENETROMETER SOUNDINGS COMPLETED DURING THE PERIOD 14 SEPTEMBER 2015 TO 22 SEPTEMBER 2015 WAS PERFORMED BY HALEY □ ALDRICH, INC.
4. AS DRILLED LOCATIONS AND GROUND SURFACE ELEVATIONS OF TEST BORINGS AND CONE PENETROMETER SOUNDINGS WERE DETERMINED IN THE FIELD BY SMITH □ COMPANY ENGINEERS OF POPLAR BLUFF, MISSOURI BY OPTICAL SURVEY.



HALEY ALDRICH

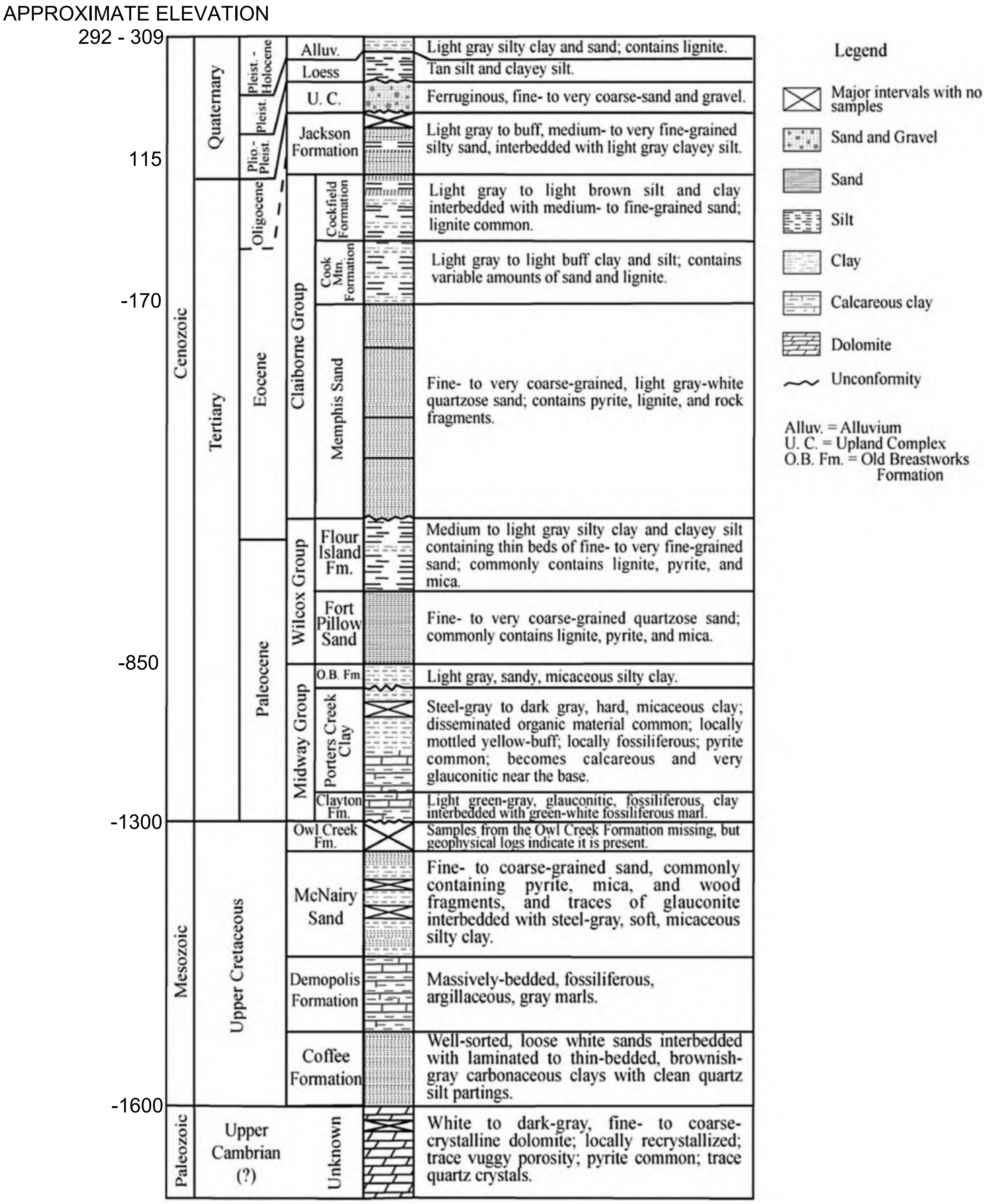
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MO

SUBSURFACE EXPLORATION LOCATION PLAN

SCALE: AS SHOWN
FEBRUARY 2016

FIGURE 2

VARI, □ATALIN Printed: 10/2□/2015 1:40 PM Layout: XS LOC
G:\40616_AECI-CCR ELG MANAGEMENT SUPPORT\CAD-NM\PONDS\FIGURES\EXPLORATION\40616-130_FIG-2_EXPLORATION LOCATION PLAN.DWG



Alluv.	Light gray silty clay and sand; contains lignite.
Loess	Tan silt and clayey silt.
U. C.	Ferruginous, fine- to very coarse-sand and gravel.
Jackson Formation	Light gray to buff, medium- to very fine-grained silty sand, interbedded with light gray clayey silt.
Cockfield Formation	Light gray to light brown silt and clay interbedded with medium- to fine-grained sand; lignite common.
Cook Mtn. Formation	Light gray to light buff clay and silt; contains variable amounts of sand and lignite.
Memphis Sand	Fine- to very coarse-grained, light gray-white quartzose sand; contains pyrite, lignite, and rock fragments.
Flour Island Fm.	Medium to light gray silty clay and clayey silt containing thin beds of fine- to very fine-grained sand; commonly contains lignite, pyrite, and mica.
Fort Pillow Sand	Fine- to very coarse-grained quartzose sand; commonly contains lignite, pyrite, and mica.
O.B. Fm	Light gray, sandy, micaceous silty clay.
Porters Creek Clay	Steel-gray to dark gray, hard, micaceous clay; disseminated organic material common; locally mottled yellow-buff; locally fossiliferous; pyrite common; becomes calcareous and very glauconitic near the base.
Clayton Fm.	Light green-gray, glauconitic, fossiliferous, clay interbedded with green-white fossiliferous marl.
Owl Creek Fm.	Samples from the Owl Creek Formation missing, but geophysical logs indicate it is present.
McNairy Sand	Fine- to coarse-grained sand, commonly containing pyrite, mica, and wood fragments, and traces of glauconite interbedded with steel-gray, soft, micaceous silty clay.
Demopolis Formation	Massively-bedded, fossiliferous, argillaceous, gray marls.
Coffee Formation	Well-sorted, loose white sands interbedded with laminated to thin-bedded, brownish-gray carbonaceous clays with clean quartz silt partings.
Unknown	White to dark-gray, fine- to coarse-crystalline dolomite; locally recrystallized; trace vuggy porosity; pyrite common; trace quartz crystals.

NOTES

1. IMAGE REFERENCE: VAN ARSDALE AND TENBRINK (2000).

2. ELEVATIONS SHOWN ARE SPECIFIC TO THE NEW MADRID POWER PLAN SITE AND WERE ESTIMATED USING FIGURES FROM VAN ARSDALE AND TENBRINK (2000) AND ROSENBLAD (2007).

3. ELEVATIONS INDICATED ON THIS DRAWING ARE IN FEET AND REFER TO NAVD 1988 DATUM.

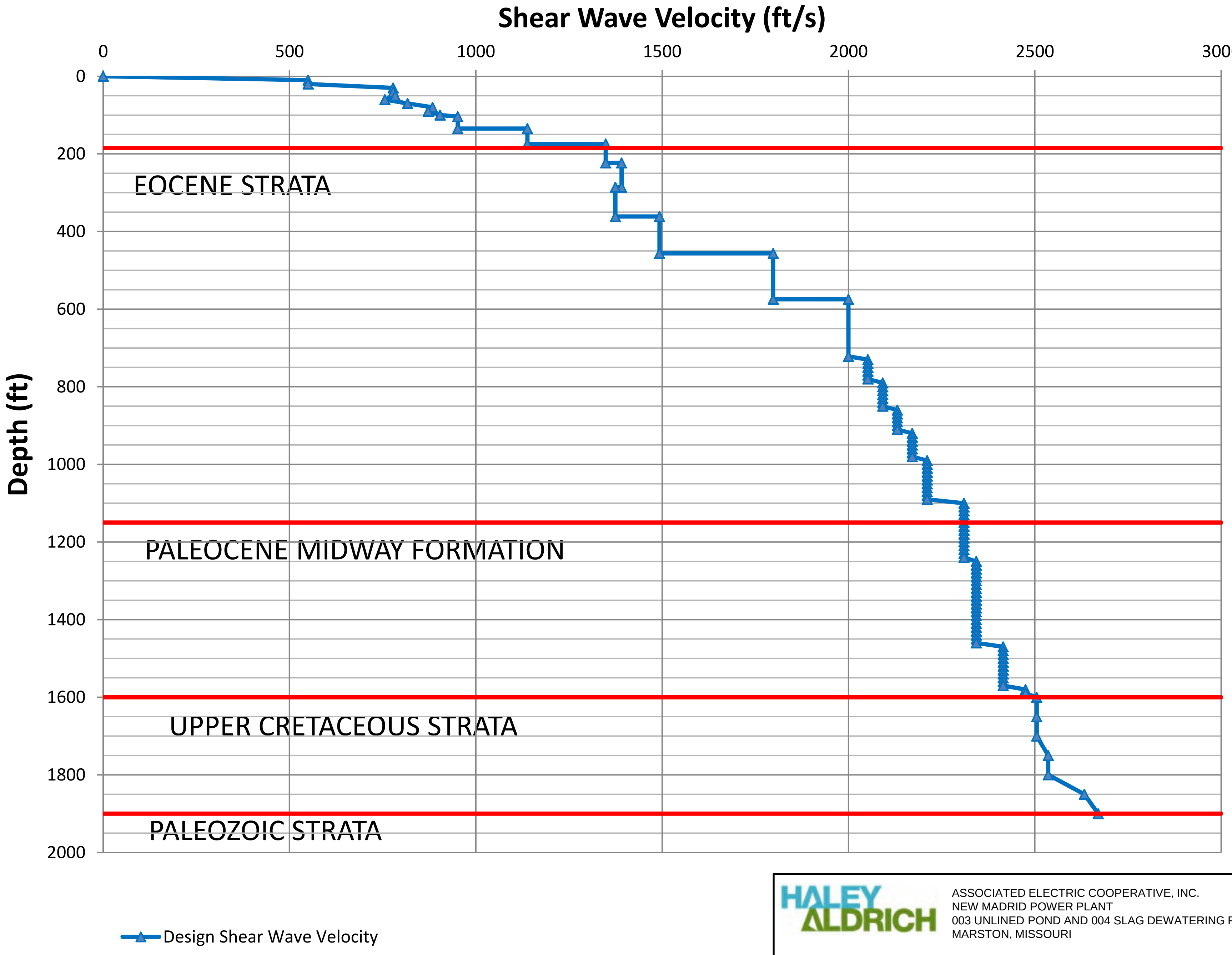
HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MO

GEOLOGIC COLUMN FOR THE NEW MADRID SEISMIC ZONE

APPROXIMATE SCALE: AS SHOWN
FEBRUARY 2016

FIGURE 3



ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

DESIGN SHEAR WAVE VELOCITY PROFILE

SCALE : AS SHOWN
FEBRUARY 2016

FIGURE 4

APPENDIX A

Test Boring Logs

TEST BORING REPORT

Boring No. HA-B1

Project: Slag Dewatering Pond and Unlined Pond, New Madrid Power Plant, Marston, Missouri
Client: Associated Electric Cooperative, Inc.
Contractor: Bulldog Drilling, Inc.

File No. 40616-300
Sheet No. 1 of 3
Start: 22 September 2015
Finish: 22 September 2015
Driller: J. Gates
H&A Rep.: C. Toscano

Elevation: 309.3
Datum: NAVD 88

Location: See Plan
N 249,124
E 1,096,406

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 55 L6
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: N/A

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	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						-SAND/GRAVEL ROADWAY FILL-										
	3 4 4 4	S1 12	1.0 3.0	308.3 1.0	SM	Loose brown to orange-brown silty SAND with gravel (SM) mps 20 mm, no odor, dry -FILL-	5	10	5	20	25	35				
	3 3 4 5	S2 20	3.0 5.0	306.3 3.0	CL	Medium stiff dark brown lean CLAY (CL) intermixed with pockets of silt and fine sandy silt, mps 1 mm, no odor, moist						100				
5	2 3 5 5	S3 20	5.0 7.0	304.3 5.0	ML	Loose dark brown sandy SILT (ML) intermixed with pockets of lean clay, mps 1 mm, no odor, moist					40	60				
	2 3 4 6	S4 24	7.0 9.0	302.3 7.0	CL	Medium stiff dark brown lean CLAY (CL), mps < 1 mm, no odor, moist						100	S	M	M	H
10	3 3 5 5	S5 15	9.0 11.0		CL	Similar to S4						100	S	M	M	H
	1 2 4 4	S6 24	11.0 13.0		CL	Similar to S4, except intermixed with pockets of silt and seams of fine sand					7	93				
	2 2 3 3	S7 24	13.0 15.0		CL	Similar to S4, except intermixed with pockets of silt and seams of fine sand						100				
15																
	1 3 4 7	S8 24	18.0 20.0		CL	Similar to S4, except gray-brown						100				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Water
9/22/15					43.0

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)	50.0
Rock Cored (ft)	--
Samples	14S

Boring No. HA-B1

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 (mps) 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.

TEST BORING REPORT

Boring No. HA-B1
File No. 40616-300
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
20																
	2 3 4 5	S9 24	23.0 25.0		CL	Similar to S4, except gray-brown -FILL-						100	S	M	M	H
25																
				283.3 26.0		Note: Drill cuttings indicate alluvial soils at 26.0 ft.										
	1 1 3 4	S10 20	28.0 30.0		CL	Soft light brown lean CLAY (CL) with interbedded seams of fine sandy silt, mps <1 mm, no odor, wet -ALLUVIAL DEPOSITS-						100				
30																
	6 6 12 17	S11 24	33.0 35.0	276.3 33.0	SM	Medium dense light brown silty SAND (SM), mps 1 mm, no odor, dry -FLUVIAL DEPOSITS-					60	40				
35																
	9 11 17 25	S12 20	38.0 40.0		SM	Medium dense light brown silty SAND (SM), mps 2 mm, well stratified, no odor, dry			5	70	25					
40																
						-FLUVIAL DEPOSITS-										
▽	11 11 12 14	S13 20	43.0 45.0		SM	Similar to S12			5	80	15					
45																
						Note: Drill action indicated possible gravel layer at approximately 46.0 ft. Lost approximately 100 gallons of drill fluid from 46.0 to 48.0 ft.										
	9 10 12 17	S14 24	48.0 50.0		SM	Similar to S12			5	75	20					

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

Boring No. HA-B1

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B1
File No. 40616-300
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
50				259.3 50.0		BOTTOM OF EXPLORATION 50.0 FT Note: Borehole grouted upon completion.										

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

Boring No. HA-B1

TEST BORING REPORT

Boring No. HA-B2

Project	Slag Dewatering Pond and Unlined Pond, New Madrid Power Plant, Marston, Missouri
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling, Inc.

File No.	40616-300
Sheet No.	1 of 4
Start	21 September 2015
Finish	21 September 2015
Driller	J. Gates
H&A Rep.	C. Toscano
Elevation	300.2
Datum	NAVD 88
Location	See Plan N 249,425 E 1,096,678

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 55 L6
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: N/A

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	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						SAND/GRAVEL ROADWAY FILL-										
	1 2 3 3	S1 20	1.0 3.0	299.2 1.0	CL	Medium stiff gray to gray-brown clean CLAY (CL), mps <1 mm, no odor, moist, trace organic fibers -FILL-						100				
	3 3 4 5	S2 20	3.0 5.0		CL	Similar to S1, except with 15% cinders and slag particles by volume						100				
5	3 3 5 7	S3 24	5.0 7.0		CL	Similar to S1, except trace cinders and slag particles						100	S	M	M	H
	3 4 5 9	S4 24	7.0 9.0		CL	Stiff gray-brown lean CLAY (CL), 5% cinders and slag particles by volume, mps 3 mm, no odor, moist						100				
10	2 3 4 6	S5 24	9.0 11.0		CL	Medium stiff gray to gray-brown lean CLAY (CL), mps < 1mm, no odor, moist, trace organic fibers						100	S	M	M	H
	2 3 5 7	S6 24	11.0 13.0		CL	Similar to S5						100	S	M	M	H
	2 3 4 5	S7 24	13.0 15.0		CL	Similar to S5						100	S	M	M	H
15	2 3 3 4	S8 24	15.0 17.0		CL	Similar to S5						100				
				282.2 18.0		Note: Sands observed on auger flights at approximately 18.0 to 19.0 ft. -ALLUVIAL DEPOSITS-										
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
9/21/15					43.0
9/22/15	06:45				40.5

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)	95.0
Rock Cored (ft)	--
Samples	23S

Boring No. HA-B2

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 (mps) 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-07-1 HA-LIB09.GLB HA-TB+CORE+WELL-07-1.GDT M:\GINT\40616-300_TEST BORINGS-2015 (2).GPJ Nov 2, 15

TEST BORING REPORT

Boring No. HA-B2
File No. 40616-300
Sheet No. 2 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	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
20	2 3 5 7	S9 24	20.0 22.0		SM	Loose light brown silty SAND (SM) with frequent interbedded layers of gray-brown silt, mps 1 mm, stratified, no odor, dry -ALLUVIAL DEPOSITS-					60	40				
	2 4 7 10	S10 18	23.0 25.0	277.2 23.0	CL	Medium dense gray-brown lean CLAY (CL) with frequent interbedded seams and layers of silty fine sand, mps 1 mm, well stratified, no odor, moist					5	95				
25				274.7 25.5												
	4 6 9 11	S11 20	28.0 30.0		SM	Medium dense light brown silty SAND (SM) with interbedded seams of silt and fine sand, mps 1 mm, no odor, moist					68	32				
30																
	11 14 15 17	S12 15	33.0 35.0	267.2 33.0	SP	Medium dense light brown poorly graded SAND (SP), mps 2 mm, no odor, moist -FLUVIAL DEPOSITS-				40	60					
35																
	7 10 11 13	S13 13	38.0 40.0		SP	Similar to S12, except with frequent seams of naturally occurring lignite particles to fragments			5	60	35					
40 ∇																
	9 10 10 13	S14 15	43.0 45.0	257.2 43.0	SM	Medium dense light brown silty SAND (SM) with interbedded seams of silt and fine sand, mps 1 mm, well stratified, no odor, wet					60	40				
45																
	3 4 8 9	S15 12	48.0 50.0		SM	Medium dense dark gray silty SAND (SM), no odor, wet					60	40				
				251.2 49.0	SP	Medium dense gray poorly graded SAND (SP), mps 3 mm, no odor, wet			80	20						

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

Boring No. HA-B2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	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
50						Note: Drill action indicated possible gravel at 52.0 to 53.0 ft.										
	6 7 8 12	S16 12	53.0 55.0	247.2 53.0	SM	Medium dense gray silty SAND (SM), trace coarse to fine gravel, mps 2 mm, no odor, wet			5	80	15					
55						-FLUVIAL DEPOSITS-										
	6 6 8 9	S17 12	58.0 60.0	242.2 58.0	SP	Medium dense gray poorly graded SAND (SP), trace limited fragments and particles, mps 3 mm, no odor, wet			10	90						
60																
	7 9 10 12	S18 14	63.0 65.0		SP	Similar to S17			30	65	5					
65						Note: Drill action indicated possible gravel from 67.0 to 68.0 ft.										
	6 6 8 10	NR	68.0 70.0			No Recovery										
70						Note: Drill action indicated possible gravel from 71.0 to 72.0 ft.										
	7 8 11 10	S19 20	73.0 75.0		SP	Similar to S17, trace coarse to fine gravel, mps 15 mm			10	80	5					
75																
	12 12 14	S20 15	78.0 80.0		SP	Similar to S17, no lignite			10	90						

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

TEST BORING REPORT

Boring No. HA-B2
File No. 40616-300
Sheet No. 4 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	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
	18															
80																
	12 15 18 23	S21 18	83.0 85.0		SP	Dense gray poorly graded SAND (SP), mps 3 mm, no odor, wet			5	90	5					
85																
						-FLUVIAL DEPOSITS-										
						Note: Drill action indicated possible gravel from 87.5 to 88.0 ft.										
	20 14 17 18	S22 15	88.0 90.0		SP	Dense gray well graded SAND with gravel (SP), mps 24 mm, no odor, wet		15	30	45	10					
90																
						Note: Drill action indicated possible gravel from 91.0 to 92.0 ft.										
	19 21 13 23	S23 24	93.0 95.0		SP	Dense gray poorly graded SAND (SP), mps 3 mm, no odor, wet				80	20					
95				205.2 95.0		BOTTOM OF EXPLORATION 95.0 FT										
						Note: Borehole grouted upon completion.										

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

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B3

Project	Slag Dewatering Pond and Unlined Pond, New Madrid Power Plant, Marston, Missouri
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling, Inc.

File No.	40616-300
Sheet No.	1 of 3
Start	14 September 2015
Finish	15 September 2015
Driller	J. Gates
H&A Rep.	C. Toscano
Elevation	308.8
Datum	NAVD 88
Location	See Plan N 247,289 E 1,096,493

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 55 L6
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: N/A

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	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																
	13 9 5 7	S1 12	1.0 3.0		CL	Stiff brown lean CLAY with sand (CL), trace coarse to fine gravel, mps 25 mm, no odor, dry					15	85				
						-FILL-										
	7 3 3 4	S2 15	3.0 5.0		CL	Similar to S1, except medium stiff, no gravel, fly ash coating on outer surface of soil sample					20	80				
5	2 2 3 5	S3 15	5.0 7.0		CL	Medium stiff brown lean CLAY (CL), trace organic fibers, mps <1 mm, no odor, moist				2	3	95				
	2 1 3 4	S4 12	7.0 9.0		CL	Similar to S3, except soft, mottled, fly ash coating on outer surface of soil sample										
10	2 1 3 4	S5 18	9.0 11.0		CL	Soft brown to gray lean CLAY (CL), mps <1 mm, mottled, no odor, moist						100				
	1 2 2 3	S6 15	11.0 13.0		CL	Soft brown lean CLAY (CL), trace organic fibers, mps <1 mm, no odor, moist					5	95				
	1 1 3 4	S7 18	13.0 15.0		CL	Soft orange-brown to gray-brown lean CLAY (CL), mps <1 mm, no odor, moist					4	96				
15																
	1 3 3 3	S8 16	17.0 19.0		CL	Medium stiff brown lean CLAY with sand (CL), mps 1 mm, no odor, wet					25	75				
				289.8 19.0												
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
9/14/15					43.0

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)	75.0
Rock Cored (ft)	--
Samples	19S

Boring No. HA-B3

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 (mps) 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.

TEST BORING REPORT

Boring No. HA-B3
File No. 40616-300
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
20																
						Note: Started mud rotary at 23.0 ft.										
	2 3 4 6	S9 18	23.0 25.0		CL	Medium stiff light brown lean CLAY (CL), trace coarse to fine sand, mps 2 mm, no odor, wet						100				
25																
						-ALLUVIAL DEPOSITS-										
	2 2 2 4	S10 20	28.0 30.0	280.8 28.0	CH	Soft brown to gray-brown fat CLAY (CH) with fine sand in occasional partings, mps 1 mm, no odor, dry					4	96	N	M	M	H
30																
	6 11 10 13	S11 24	33.0 35.0	275.8 33.0	SP	Medium dense brown poorly graded SAND (SP), mps 2 mm, no odor, moist, well stratified				10	90					
						-FLUVIAL DEPOSITS-										
35																
	6 7 11 15	S12 20	38.0 40.0		SP	Similar to S11, non stratified				75	25					
40																
				267.8 41.0		Note: Drill action indicated possible gravel at 41.0 ft.										
	▽															
	13 16 16 18	S13 20	43.0 45.0		SW	Dense brown well graded SAND (SW), mps 3 mm, no odor, wet (coarse to fine gravel found at top 4 in . of spoon sample)			15	60	25					
45																
						-FLUVIAL DEPOSITS-										
	11 11 17 22	S14 18	48.0 50.0		SW	Similar to S13, except medium dense			15	55	30					

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

TEST BORING REPORT

Boring No. HA-B3
File No. 40616-300
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	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
50																
	7 8 13 16	S15 18	53.0 55.0	255.8 53.0	SP	Medium dense gray-brown poorly graded SAND (SP), mps 2 mm, no odor, wet				20	80					
55						-FLUVIAL DEPOSITS-										
	10 10 13 13	S16 20	58.0 60.0	250.8 58.0	SW	Medium dense gray-brown well graded SAND (SW), mps 5 mm, no odor, wet			20	65	15					
60																
	11 13 14 18	S17 22	63.0 65.0	245.8 63.0	SP	Medium dense gray-brown poorly graded SAND (SP), mps 2 mm, no odor, wet				35	65					
65																
	15 16 16 12	S18 3	68.0 70.0		SP	Similar to S15, except dense, possibly pushing gravel (poor recovery)				20	80					
70																
	9 13 14 15	S19 18	73.0 75.0	235.8 73.0	SW	Medium dense gray-brown well graded SAND (SW), mps 3 mm, no odor, wet			15	60	25					
75				233.8 75.0		BOTTOM OF EXPLORATION 75.0 FT Note: Borehole grouted upon completion to ground surface.										

TEST BORING REPORT

Boring No. HA-B4

Project	Slag Dewatering Pond and Unlined Pond, New Madrid Power Plant, Marston, Missouri
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling, Inc.

File No.	40616-300
Sheet No.	1 of 4
Start	17 September 2015
Finish	18 September 2015
Driller	J. Gates
H&A Rep.	C. Toscano
Elevation	304.2
Datum	NAVD 88
Location	See Plan N 246,729 E 1,097,737

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 55 L6
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: N/A

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	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																
	1 2 1 1	S1 5	1.0 3.0		ML	Very loose brown to dark brown SILT with sand (ML) with frequent interbedded seams and layers of medium to fine grained cinders and slag, mps 3 mm, no odor, wet -BOILER SLAG-					15	85				
	2 2 1 2	S2 15	3.0 5.0		ML	Similar to S1				5	15	80				
5	2 1 1 2	S3 12	5.0 7.0		ML	Similar to S1					10	90				
	1 1 1 1	S4 15	7.0 9.0		ML	Similar to S1, except no sand, wet (perched groundwater)					5	95				
10	WOH/24"	S5 24	9.0 11.0		ML	Very loose dark brown SILT (ML), mps <1 mm, no odor, wet (outside of spoon dry)						100				
	1 1 1 1	S6 20	11.0 13.0	293.2 11.0	SM	Very loose black silty SAND (SM), mps 3 mm, no odor, wet, contains cinders and slag particles Note: Spoon completely wet, possible perched groundwater.			40	50	10					
▽	1 1 1 1	S7 15	13.0 15.0		SM	Similar to S6 (natural silt found in tip of spoon)			20	70	10					
15	WOH/24"	S8 24	15.0 17.0	289.2 15.0	CL	Very soft brown lean CLAY (CL), trace wood particles, mps 2 mm, no odor, wet -ALLUVIAL DEPOSITS-						100				
	1 1 2 2	S9 24	18.0 20.0		CL	Soft brown to orange-brown lean CLAY (CL), mps < 1 mm, no odor, moist					5	95				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
9/17/15					13.0

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)	95.0
Rock Cored (ft)	--
Samples	23S

Boring No. HA-B4

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 (mps) 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.

TEST BORING REPORT

Boring No. HA-B4
File No. 40616-300
Sheet No. 2 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
20																
	1 1 6 11	S10 24	23.0 25.0		CL	Similar to S9						100				
				280.2 24.0	SP	Medium dense light brown poorly graded SAND (SP), mps 2 mm, well stratified, no odor, moist -ALLUVIAL DEPOSITS-				40	60					
25																
	5 6 7 10	S11 24	28.0 30.0		SP	Medium dense light brown poorly graded SAND (SP) with frequent interbedded seams and layers of dark brown silty SAND, mps 1 mm, well stratified, no odor, moist				15	85					
30																
	3 4 7 8	S12 24	33.0 35.0		SP	Similar to S11				10	90					
35																
	7 8 13 19	S13 20	38.0 40.0	266.2 38.0	SP	Medium dense light brown poorly graded SAND (SP), mps 2 mm, no odor, moist -FLUVIAL DEPOSITS-				40	60					
40																
				263.2 41.0												
	8 10 11 12	S14 18	43.0 45.0		SW	Medium dense light brown well graded SAND (SW), mps 3 mm, no odor, wet			20	65	15					
45																
	10 10 15 15	S15 13	48.0 50.0	256.2 48.0	SP	Medium dense light brown poorly graded SAND (SP), mps 2 mm, no odor, wet			2	63	31	4				

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

Boring No. HA-B4

TEST BORING REPORT

Boring No. HA-B4
File No. 40616-300
Sheet No. 3 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	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
50																
	7 7 10 12	S16 20	53.0 55.0	251.2 53.0	SW	Medium dense light brown well graded SAND (SW), mps 5 mm, no odor, wet, trace fine gravel			20	65	15					
55																
						-FLUVIAL DEPOSITS-										
	7 10 10 12	S17 18	58.0 60.0	246.2 58.0	SP	Medium dense light brown poorly graded SAND (SP), mps 10 mm, no odor, wet, trace coarse to fine gravel			5	90	5					
60																
	10 10 16 18	S18 24	63.0 65.0		SP	Similar to S17				60	40					
65																
	10 10 12 13	S19 6	68.0 70.0	236.2 68.0	SW	Medium dense light brown well graded SAND (SW), mps 5 mm, no odor, wet, trace fine gravel			20	60	20					
70																
	16 17 18 22	S20 18	73.0 75.0	231.2 73.0	SP	Dense gray-brown poorly graded SAND (SP), mps 2 mm, stratified, no odor, wet				60	40					
75																
						Note: Drill action indicated possible occasional gravel layers up to 12 in. thick from 77.0 to 81.0 ft.										

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

Boring No. HA-B4

TEST BORING REPORT

Boring No. HA-B4
File No. 40616-300
Sheet No. 4 of 4

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
80																
	11 10 9 10	S21 20	83.0 85.0		SP	Medium dense gray poorly graded SAND (SP), trace coarse to fine gravel, mps 20 mm, no odor, wet			10	75	15					
85																
						-FLUVIAL DEPOSITS-										
	9 10 11 17	S22 18	88.0 90.0	216.2 88.0	SW	Medium dense gray well graded SAND (SW), trace coarse gravel, mps 20 mm, no odor, wet		5	45	40	10					
90																
	10 14 12 15	S23 20	93.0 95.0		SW	Similar to S22			55	35	10					
95				209.2 95.0		BOTTOM OF EXPLORATION 95.0 FT Note: Borehole grouted upon completion. Pushed four undisturbed shelby tube samples in offset hole. See Test Boring Report HA-B4A for details.										

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

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B4A

Project	Slag Dewatering Pond and Unlined Pond, New Madrid Power Plant, Marston, Missouri
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling, Inc.

File No.	40616-300
Sheet No.	1 of 1
Start	17 September 2015
Finish	18 September 2015
Driller	J. Gates
H&A Rep.	C. Toscano
Elevation	304.2
Datum	NAVD 88
Location	See Plan N 246,729 E 1,097,737

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 55 L6
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: N/A

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	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						Note: Augered to shelby tube sampling depths without collecting split-spoon samples.										
	PUSH	U1 12	3.0 5.0		ML	Brown SILT (ML)										
5	PUSH	U2 24	5.0 7.0		ML	Dark brown SILT (ML)										
	PUSH	U3 0	7.0 9.0			No Recovery										
10	PUSH	U4 0	9.0 11.0			No Recovery										
15				289.2 15.0		BOTTOM OF EXPLORATION 15.0 FT Note: Borehole grouted upon completion. See Test Boring Report HA-B4 for additional details.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
9/18/15					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)	15.0
Rock Cored (ft)	--
Samples	4U

Boring No. HA-B4A

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 (mps) 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.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B5

Project	Slag Dewatering Pond and Unlined Pond, New Madrid Power Plant, Marston, Missouri
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling, Inc.

File No.	40616-300
Sheet No.	1 of 2
Start	15 September 2015
Finish	15 September 2015
Driller	J. Gates
H&A Rep.	C. Toscano
Elevation	316.1
Datum	NAVD 88
Location	See Plan N 246,385 E 1,096,345

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 55 L6
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: N/A

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	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																
	5 7 7 9	S1 20	1.0 3.0		ML	Medium dense black SILT with sand (ML), mps 2 mm, no odor, dry -FLY ASH-					25	75				
	4 4 5 4	S2 24	3.0 5.0		ML	Similar to S1, except loose					25	75				
5	2 2 2 2	S3 20	5.0 7.0		ML	Similar to S1, except very loose				10	30	60				
	2 1 2 2	S4 18	7.0 9.0		ML	Very loose brown to dark brown SILT (ML) interbedded with seams of fine sand, mps 1 mm, no odor, moist, trace organic fibers (wet at tip of spoon)					10	90				
10	1 1 2 2	S5 18	9.0 11.0		ML	Similar to S4, except wet to moist					10	90				
	1 1 1 1	S6 18	11.0 13.0		ML	Similar to S4, except with frequent interbedded seams of medium to fine sand, mps 2 mm, wet					20	80				
	1 1 1 1	S7 20	13.0 15.0		ML	Similar to S4					10	90				
15	WOH 1 1 1	S8 24	15.0 17.0		ML	Similar to S4 Note: Sample moist to wet throughout entire sample. May be perched groundwater.					10	90				
	WOH 1 2 1	S9 16	17.0 19.0	299.1 17.0	ML	Similar to S4, except with interbedded layers of coarse to fine sand (boiler slag particles), mps 2 mm -FLY ASH/BOILER SLAG-				15	25	60				
	4 1	S10 18	19.0 21.0		ML	Similar to S4, except moist to wet					10	90				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
9/15/15					43.0

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)	50.0
Rock Cored (ft)	--
Samples	19S

Boring No. HA-B5

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 (mps) 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.

TEST BORING REPORT

Boring No. HA-B5
File No. 40616-300
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	**VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION** (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
20	2 1															
	2 3 1 1	S11 18	21.0 23.0		ML	Very loose brown to dark brown SILT (ML) with frequent interbedded layers of black coarse to fine grained cinders and slag particles, mps 3 mm, no odor, wet					5	95				
						-FLY ASH/BOILER SLAG-										
	1 1 2 3	S12 18	23.0 25.0		ML	Similar to S11					5	95				
25	1 2 1 1	S13 18	25.0 27.0		ML	Similar to S11					5	95				
	1 1 1 1	S14 24	27.0 29.0		ML	Similar to S11					5	95				
30	WOH WOH 1 1	S15 24	29.0 31.0		ML	Similar to S11					5	95				
				284.1 32.0												
	2 4 4 7	S16 24	33.0 35.0		CH	Medium stiff gray fat CLAY with fine sand in frequent partings (CH), mps 1 mm, no odor, moist					5	95	S	M	M	H
35																
						-ALLUVIAL DEPOSITS-										
	3 4 4 7	S17 24	38.0 40.0		CH	Similar to S16 Note: Medium to fine sand found in tip of spoon.					5	95	S	M	M	H
40				276.1 40.0												
	▽															
	14 20 18 16	S18 20	43.0 45.0		SP	Dense light brown poorly graded SAND (SP), mps 3 mm, no odor, wet				80	20					
45																
						-FLUVIAL DEPOSITS-										
	15 12 14 26	S19 15	48.0 50.0		SP	Similar to S18				80	20					

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

TEST BORING REPORT

Boring No. HA-B5
File No. 40616-300
Sheet No. 3 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	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
50				266.1 50.0		BOTTOM OF EXPLORATION 50.0 FT Note: Borehole grouted to 65 ft upon completion. Pushed three shelby tube samples in offset hole at depths of 10.0 to 12.0 ft, 20.0 to 22.0 ft, and 27.0 to 29.0 ft. See Test Boring Report HA-B5A for details.										

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

Boring No. HA-B5

TEST BORING REPORT

Boring No. HA-B5A

Project	Slag Dewatering Pond and Unlined Pond, New Madrid Power Plant, Marston, Missouri	File No.	40616-300
Client	Associated Electric Cooperative, Inc.	Sheet No.	1 of 2
Contractor	Bulldog Drilling, Inc.	Start	16 September 2015
		Finish	16 September 2015
		Driller	J. Gates
		H&A Rep.	C. Toscano

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 55 L6
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: N/A

Elevation 316.1
Datum NAVD 88
Location See Plan
N 246,385
E 1,096,345

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0						Note: Augered to shelby tube sampling depths without collecting split-spoon samples.										
5																
10	P U S H	U1 24	10.0 12.0		ML	Brown to dark brown SILT (ML)										
15																
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
9/16/15					25.0

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)	29.0
Rock Cored (ft)	--
Samples	3U

Boring No. HA-B5A

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 (mps) 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.

HALEY ALDRICH

TEST BORING REPORT

Boring No. HA-B5A
File No. 40616-300
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand				Field Test			
							% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
20	PUSH	U2 24	20.0 22.0		ML	Brown to dark brown SILT (ML)										
25 ▽																
	PUSH	U3 8	27.0 29.0	287.1 29.0	ML	Brown to dark brown SILT (ML) Poor recovery due to the presence of cinders and boiler slag.										
						BOTTOM OF EXPLORATION 29.0 FT Note: Borehole grouted upon completion. See Test Boring Report HA-B5 for additional details.										

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

Boring No. HA-B5A

TEST BORING REPORT

Boring No. HA-B6

Project	Slag Dewatering Pond and Unlined Pond, New Madrid Power Plant, Marston, Missouri
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling, Inc.

File No.	40616-300
Sheet No.	1 of 3
Start	16 September 2015
Finish	17 September 2015
Driller	J. Gates
H&A Rep.	C. Toscano
Elevation	307.4
Datum	NAVD 88
Location	See Plan N 245,683 E 1,098,769

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 55 L6
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: N/A

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	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						SAND/GRAVEL ROADWAY-										
	6 6 9 13	S1 24	1.0 3.0	306.4 1.0	CL	Stiff light brown lean CLAY (CL), mps 1 mm, no odor, dry -FILL-					10	90				
	5 4 6 7	S2 24	3.0 5.0		CL	Stiff gray lean CLAY (CL) interbedded with layers of brown SILT with sand (ML), mps 1 mm, no odor, dry					10	90				
5	3 3 5 8	S3 24	5.0 7.0		CL	Medium stiff gray lean CLAY with sand (CL), mps < 1 mm, no structure, no odor, dry					15	85				
	3 3 6 8	S4 24	7.0 9.0		CL	Medium stiff gray lean CLAY with sand (CL), mps <1 mm, no structure, no odor, dry					6	94				
10	3 6 6 8	S5 24	9.0 11.0		CL	Stiff light brown lean CLAY with sand (CL), mps 1 mm, no odor, dry					15	85				
	3 4 6 9	S6 24	11.0 13.0	296.4 11.0	CL	Stiff gray lean CLAY (CL), mps <1 mm, stratified, no odor, dry -ALLUVIAL DEPOSITS-						100				
	6 7 6 9	S7 24	13.0 15.0		CL	Stiff gray lean CLAY (CL) with sand and fine sand in frequent partings					3	97				
15	4 5 9 9	S8 24	15.0 17.0		CL	Similar to S7, trace organic fibers					5	95				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
9/16/15					40.0

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)	75.0
Rock Cored (ft)	--
Samples	20S

Boring No. HA-B6

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 (mps) 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.

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	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
20	10 10 12 15	S9 24	20.0 22.0		CL	Medium stiff gray lean CLAY (CL) with frequent interbedded layers of fine sand (SM), mps 1 mm, no odor, moist					60	40				
						-ALLUVIAL DEPOSITS-										
25	3 3 4 4	S10 24	25.0 27.0		CL	Medium stiff brown lean CLAY (CL) with interbedded layers and seams of silty sand, mps 1 mm, no odor, moist					5	95				
						Note: Switched to mud rotary at 20.0 ft.										
	2 1 1 2	S11 24	28.0 30.0		CL	Very soft yellow-brown to brown lean CLAY (CL), mps < 1 mm, no odor, moist						100				
30																
				276.4 31.0												
	4 4 5 10	S12 18	33.0 35.0		SP	Loose light brown poorly graded SAND (SP) with occasional layers of silt, mps 2 mm, well stratified, no odor, dry				20	80					
35																
				270.4 37.0												
	7 9 11 13	S13 20	38.0 40.0		SP	Medium dense light brown poorly graded SAND (SP), mps 2 mm, stratified, no odor Note: Wet at tip of spoon.				60	40					
▽ 40																
						-FLUVIAL DEPOSITS-										
	9 11 15 19	S14 16	43.0 45.0		SP	Similar to S13				90	10					
45																
	8 11 12 14	S15 18	48.0 50.0		SP	Similar to S13				90	10					

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

TEST BORING REPORT

Boring No. HA-B6
File No. 40616-300
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	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
50																
	13 13 13 16	S16 18	53.0 55.0		SP	Similar to S13				80	20					
55																
						-FLUVIAL DEPOSITS-										
	9 9 15 17	S17 18	58.0 60.0	249.4 58.0	SW	Medium dense light brown well graded SAND (SW), trace fine gravel, mps 5 mm, no odor, wet			20	60	20					
60																
	10 11 13 15	S18 18	63.0 65.0		SW	Similar to S17, except trace shell fragments, stratified			25	60	15					
65																
	10 11 8 11	S19 12	68.0 70.0		SW	Similar to S17, well stratified			25	55	20					
70																
	10 10 15 13	S20 15	73.0 75.0		SW	Similar to S17, except trace coarse to fine gravel, mps 20 mm			35	55	10					
75				232.4 75.0		BOTTOM OF EXPLORATION 75.0 FT Note: Borehole grouted upon completion.										

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

Boring No. HA-B6

TEST BORING REPORT

Boring No. HA-B7

Project	Slag Dewatering Pond and Unlined Pond, New Madrid Power Plant, Marston, Missouri
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling, Inc.

File No.	40616-300
Sheet No.	1 of 2
Start	22 September 2015
Finish	22 September 2015
Driller	J. Gates
H&A Rep.	C. Toscano
Elevation	302.9
Datum	NAVD 88
Location	See Plan N 249,818 E 1,096,497

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4.25	1.375	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: CME 55 L6
Bit Type: Cutting Head
Drill Mud: Polymer
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: N/A

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	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																
	12 12 7 4	S1 15	1.0 3.0		SM	Medium dense black silty SAND (SM), mps 2.0 mm, no odor, dry, contains cinders and slag particles				30	50	20				
						-FILL-										
				300.4 2.5	CL	Stiff gray lean CLAY (CL), trace cinders and slag, mps 4 mm, no odor, dry						100				
	3 5 5 5	S2 20	3.0 5.0		CL	Stiff gray lean CLAY (CL) intermixed with cinder and slag fragments to particles, mps 15 mm, no odor, dry		5	5	10	20	60				
5	3 4 7 8	S3 20	5.0 7.0		CL	Similar to S2, mps 5 mm			5	5	5	85				
	3 4 6 7	S4 24	7.0 9.0		CL	Similar to S2			10	5	5	80				
10	2 4 4 6	S5 20	9.0 11.0		CL	Similar to S2, except medium stiff, trace cinders and slag particles, mps 3 mm						100				H
	3 4 7 8	S6 24	11.0 13.0	291.9 11.0	CH	Medium stiff gray-brown fat CLAY with sand (CH), no odor, dry					13	87				H
	2 4 6 6	S7 24	13.0 15.0		CH	Similar to S6, except gray to gray-brown, no cinders and slag						100				H
15	2 3 3 3	S8 24	15.0 17.0		CH	Similar to S6, except medium stiff						100				H
	1 1 2 3	S9 24	17.0 19.0		CH	Similar to S6, except moist, soft						100				
	1 1	S10 24	19.0 21.0	283.9 19.0	CL	Very soft lean CLAY (CL), mps < 1 mm, no odor, wet					10	90				
20																

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Depth (ft) to: Bottom of Hole	Depth (ft) to: Water
9/22/15					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)	27.0
Rock Cored (ft)	--
Samples	12S

Boring No. HA-B7

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 (mps) 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.

TEST BORING REPORT

Boring No. HA-B7
File No. 40616-300
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	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
20	1 1															
	WOH 2 3 3	S11 24	21.0 23.0	281.9 21.0	SM	Loose brown silty SAND (SM), mps 1 mm, well stratified, no odor, dry					60	40				
						-ALLUVIAL DEPOSITS-										
25	2 3 6 7	S12 24	25.0 27.0		SM	Similar to S11, except with frequent seams of silt and fine sand, well stratified, moist					60	40				
				275.9 27.0		BOTTOM OF EXPLORATION 27.0 FT Note: Borehole grouted upon completion.										

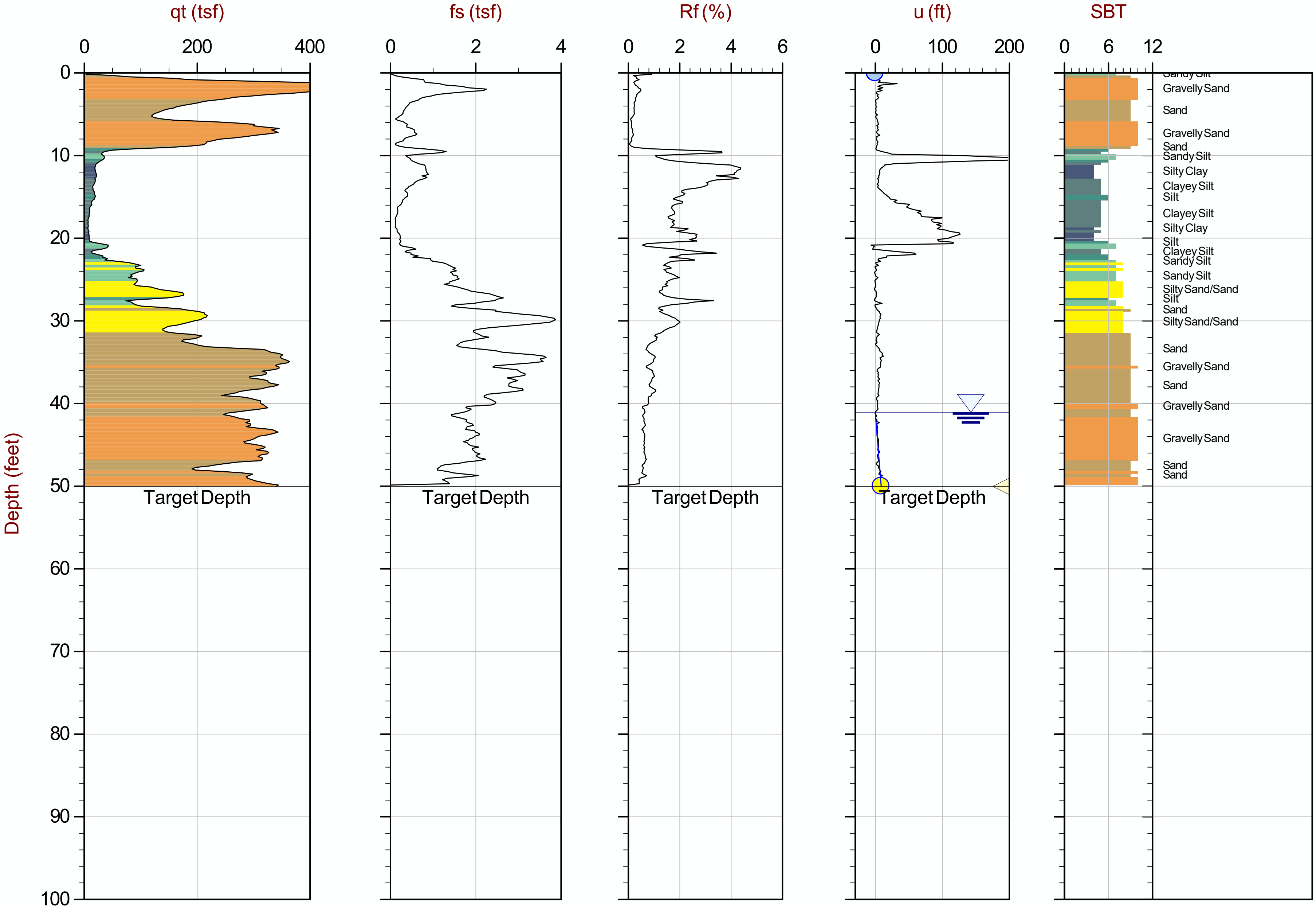
APPENDIX B

CPT Sounding Logs and Related Information

Haley & Aldrich

Job No: 15-53087
Date: 09:17:15 17:40
Site: AECI-New Madrid

Sounding: CPT15-HAC1
Cone: 419:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP01.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4044206m E: 270757m

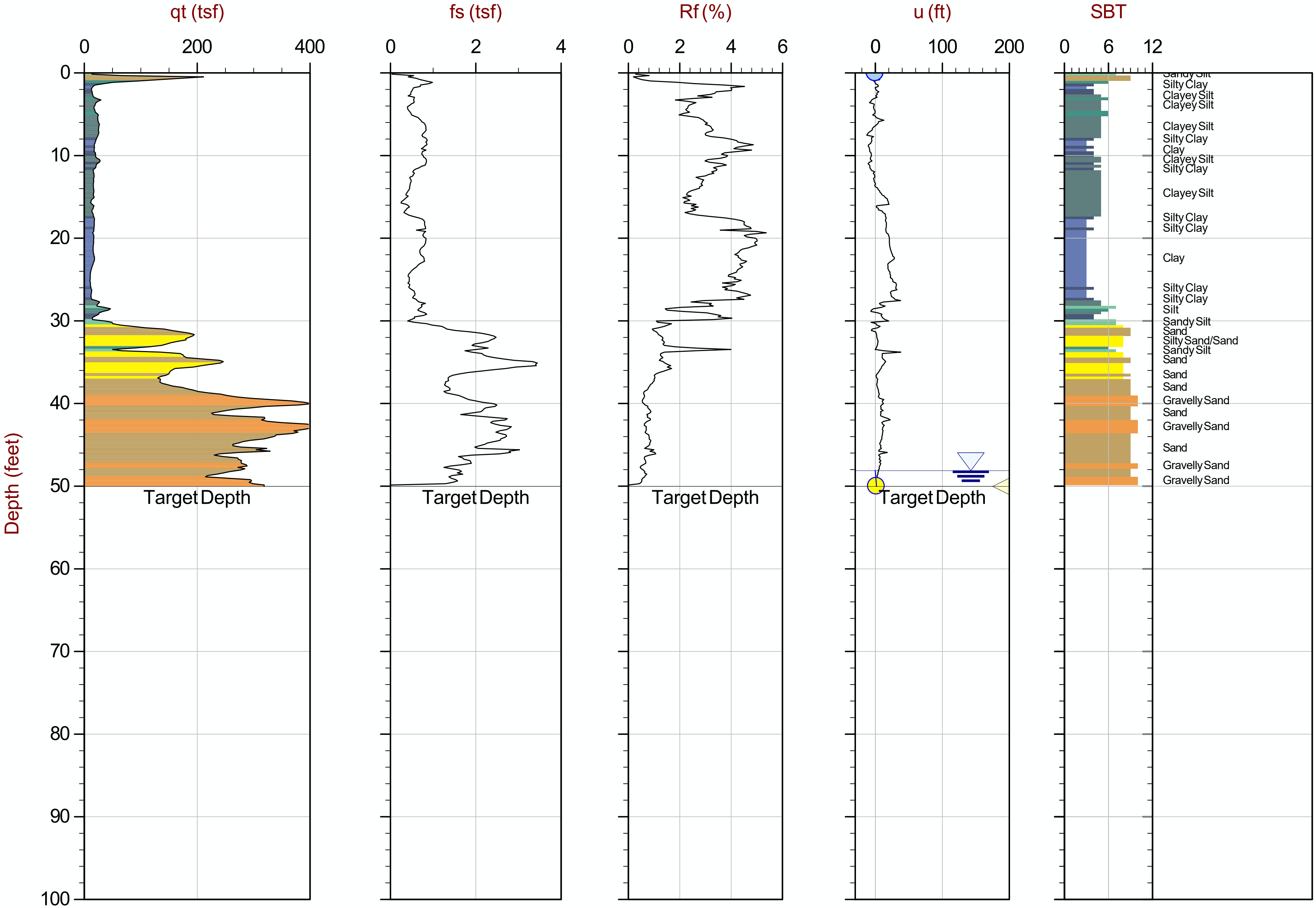
— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Haley & Aldrich

Job No: 15-53087
Date: 09:17:15 14:41
Site: AECI-New Madrid

Sounding: CPT15-HAC2
Cone: 419:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP02.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4044000m E: 270758m

Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

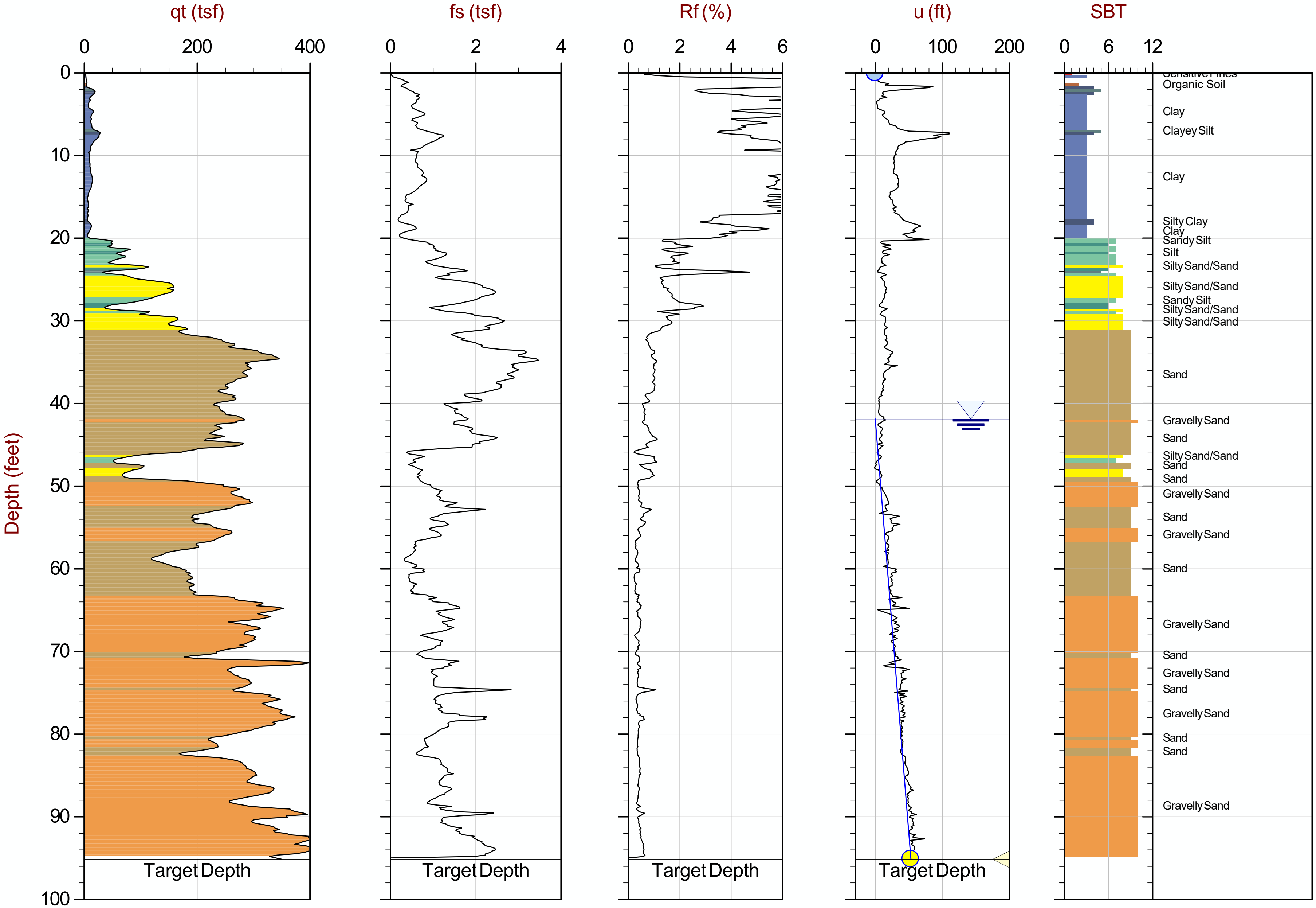
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:17:15 15:59
Site: AECI-New Madrid

Sounding: CPT15-HAC3
Cone: 419:T1500F15U500



Max Depth: 29.000 m / 95.14 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP03.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4044097m E: 270832m

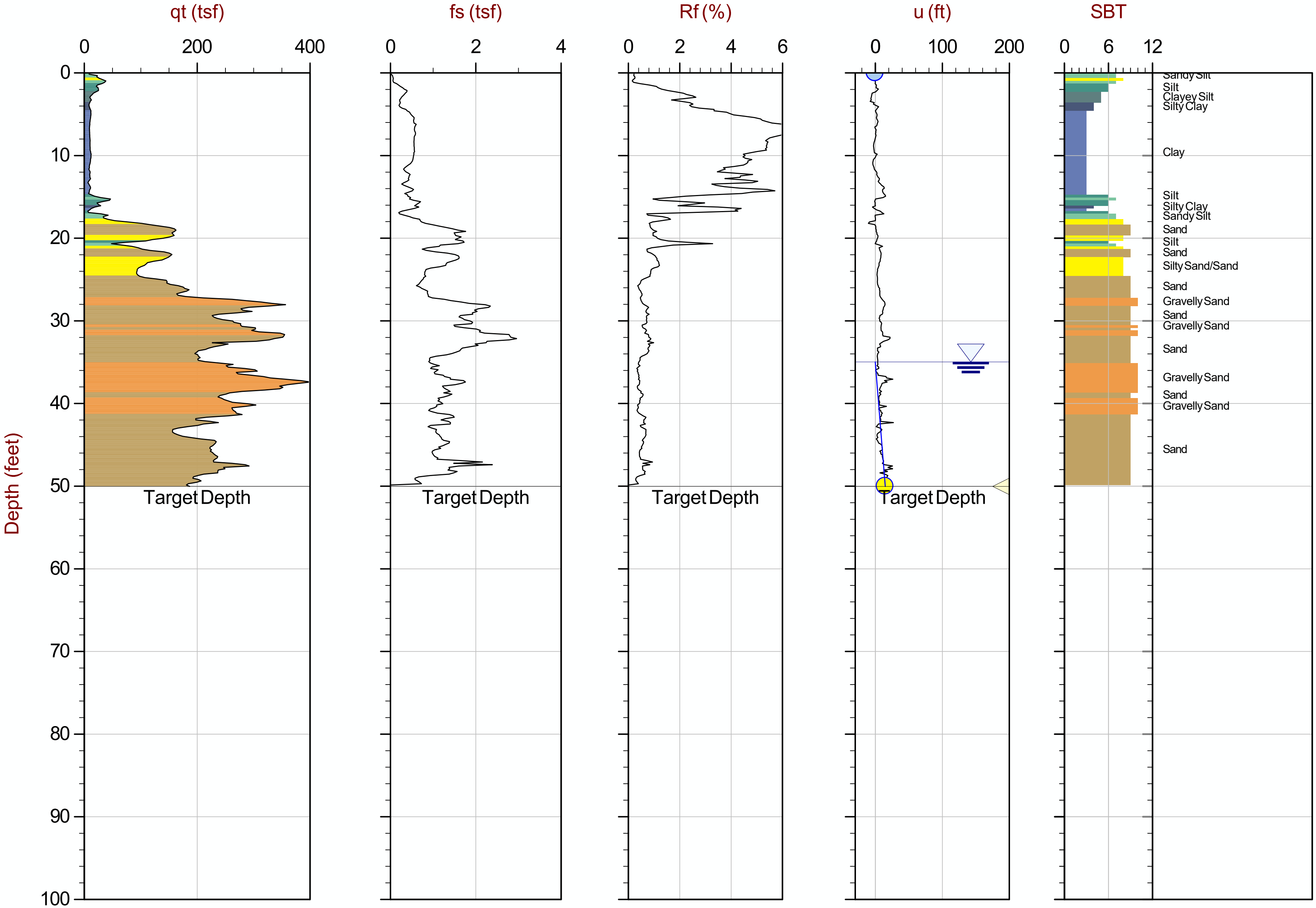
— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Haley & Aldrich

Job No: 15-53087
Date: 09:17:15 13:17
Site: AECI-New Madrid

Sounding: CPT15-HAC4
Cone: 419:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP04.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4044000m E: 270732m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

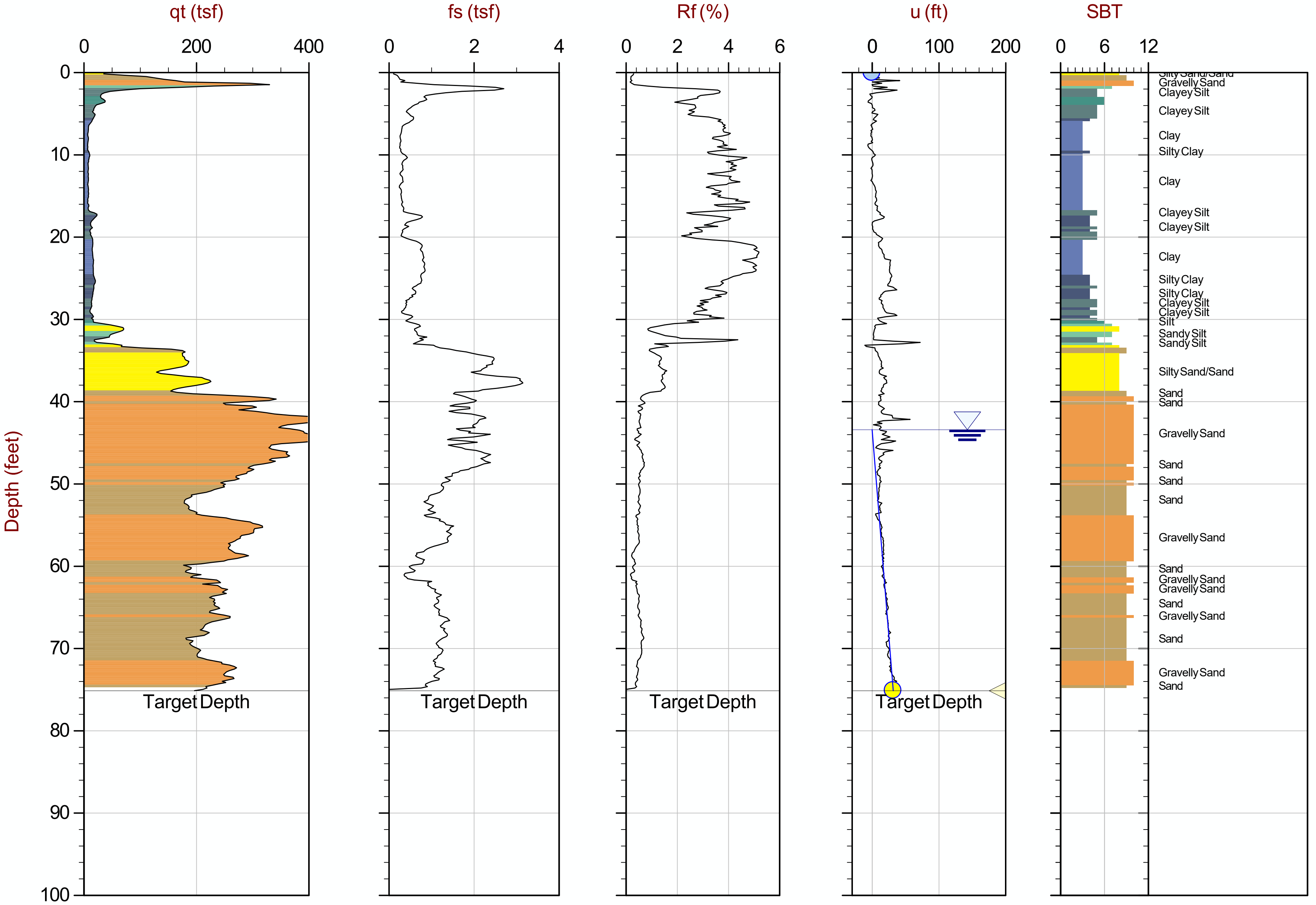
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

ConeTec

Haley & Aldrich

Job No: 15-53087
Date: 09:15:15 17:52
Site: AECI-New Madrid

Sounding: CPT15-HAC5
Cone: 419:T1500F15U500



Max Depth: 22.900 m / 75.13 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP05.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4043453m E: 270755m

Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

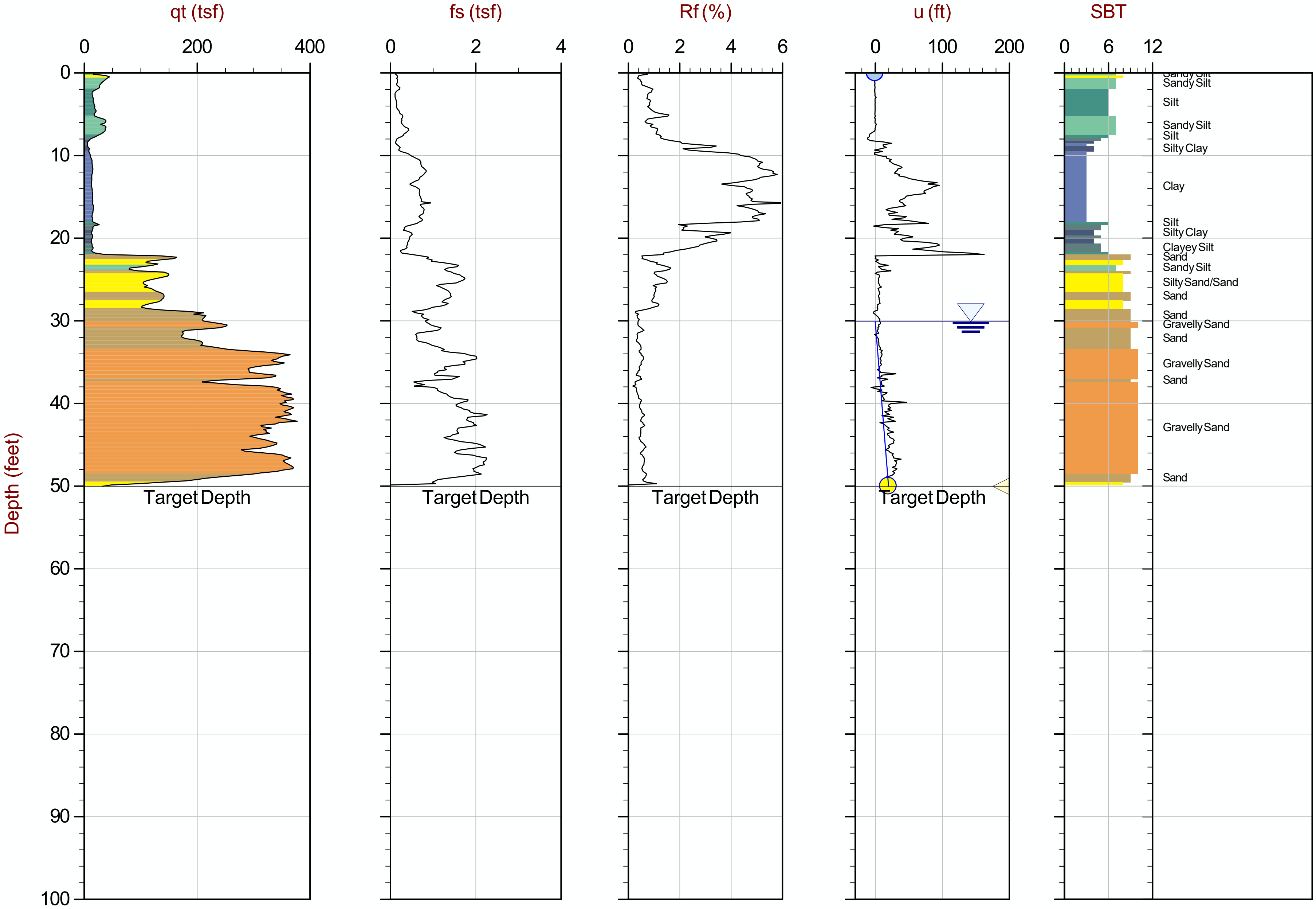
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:16:15 10:26
Site: AECI-New Madrid

Sounding: CPT15-HAC6
Cone: 419:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP06.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4043392m E: 270698m

Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

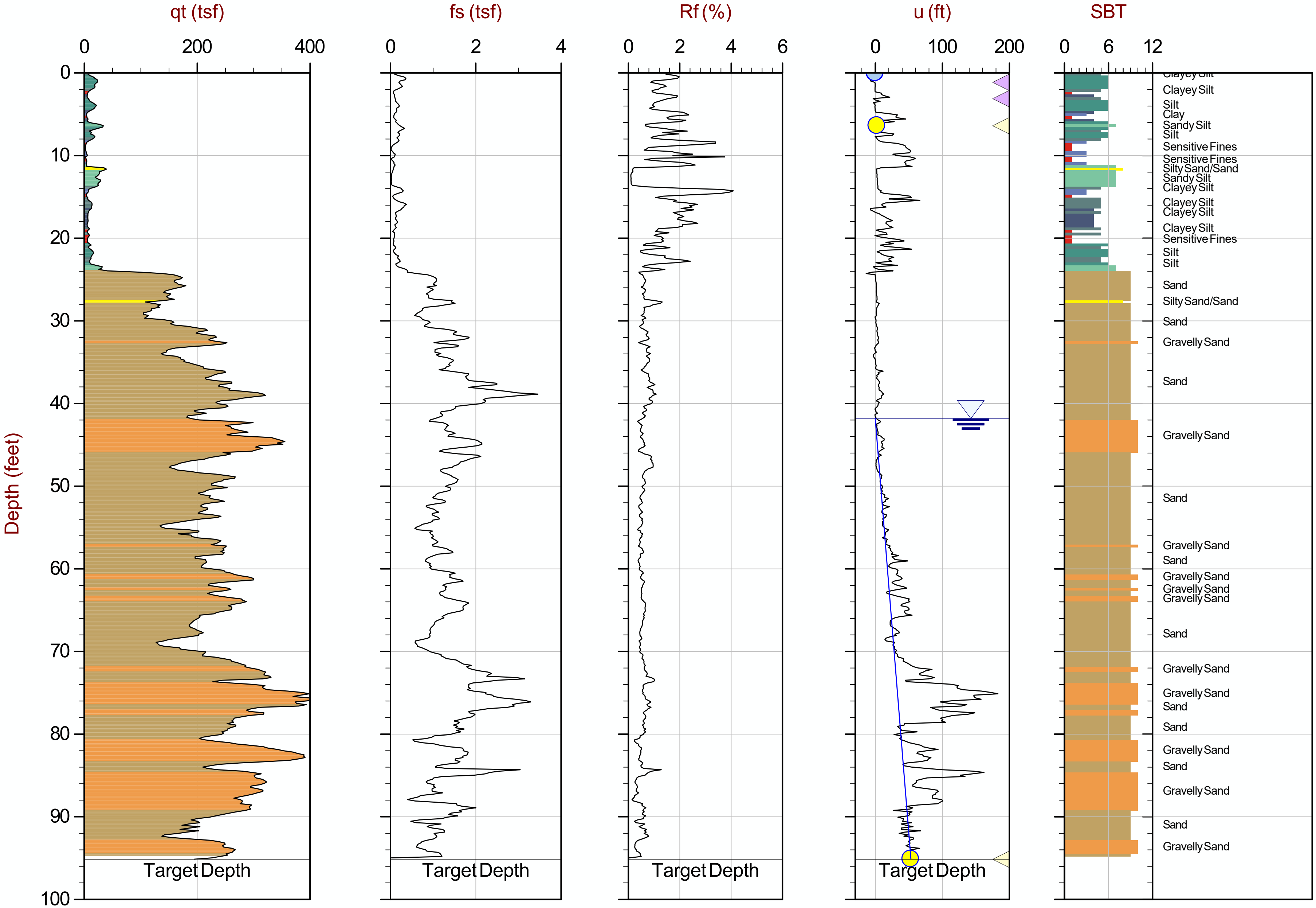
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:15:15 14:36
Site: AECI-New Madrid

Sounding: SCPT15-HAC7
Cone: 419:T1500F15U500



Max Depth: 29.000 m / 95.14 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_SP07.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4043266m E: 271126m

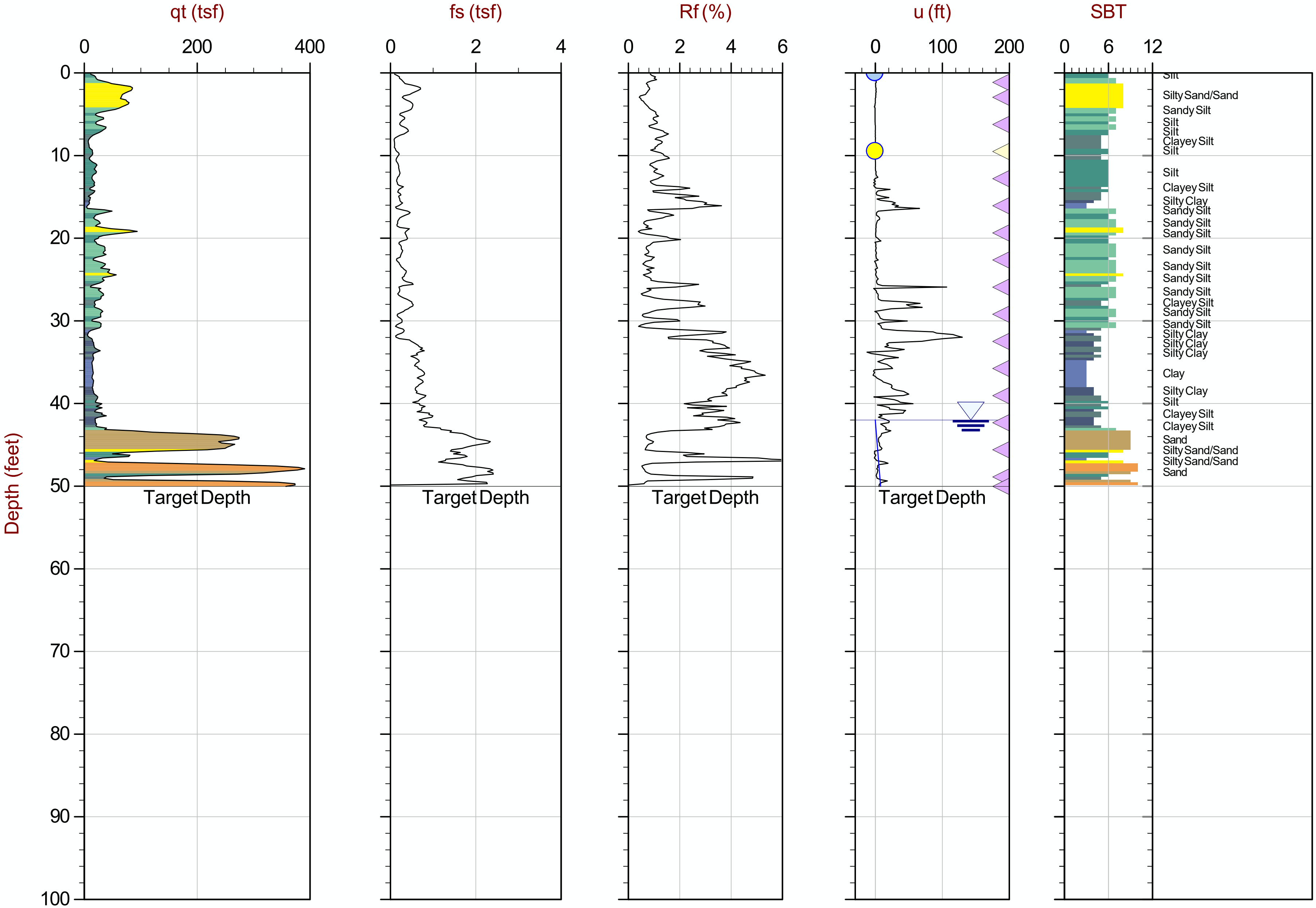
Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Haley & Aldrich

Job No: 15-53087
Date: 09:16:15 12:39
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: 419:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_SP08.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4043175m E: 270700m

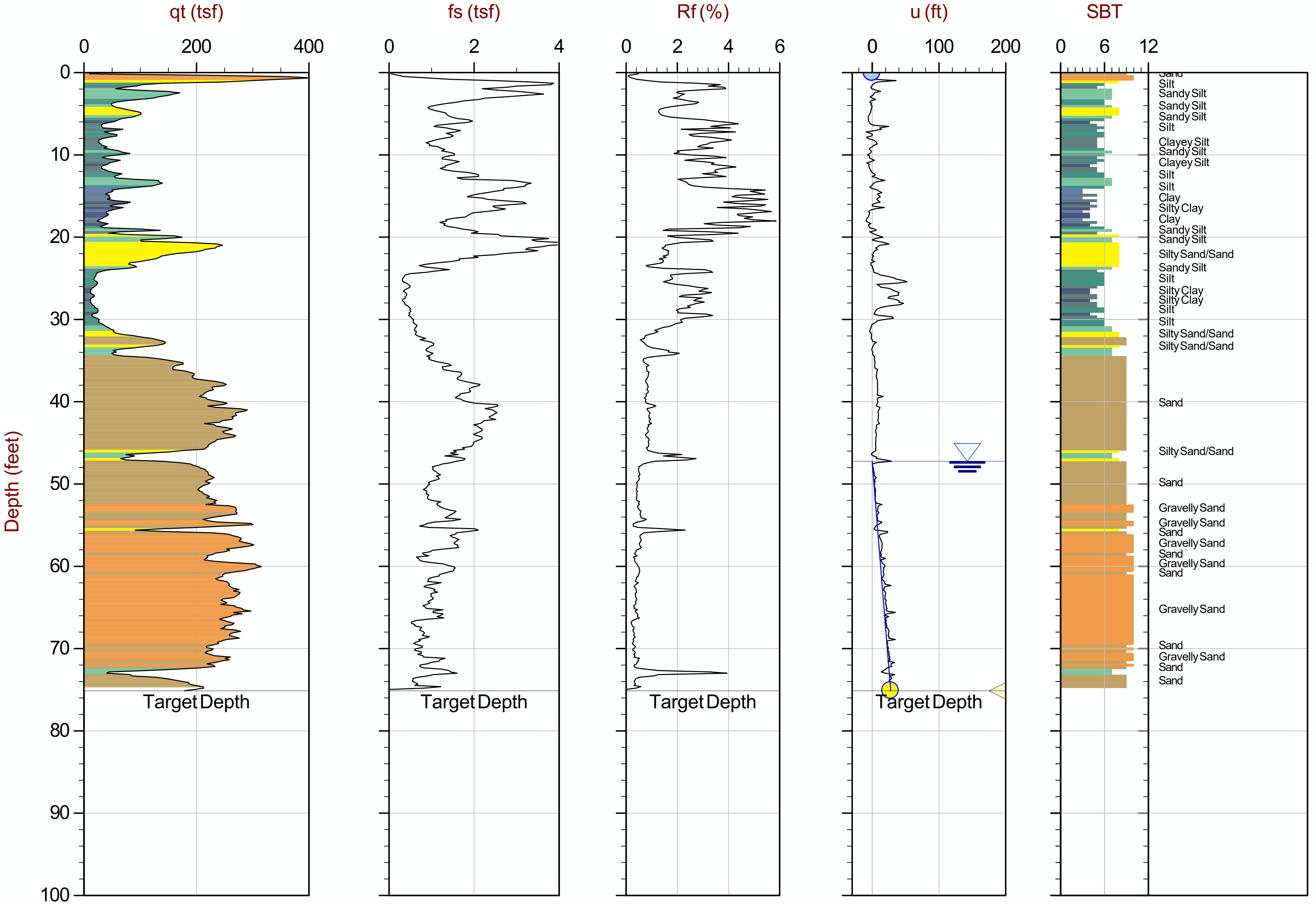
— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Haley & Aldrich

Job No: 15-53087
Date: 09:17:15 11:57
Site: AECI-New Madrid

Sounding: CPT15-HAC9
Cone: 419:T1500F15U500



Max Depth: 22.900 m / 75.13 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP09.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4042932m E: 271425m

Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

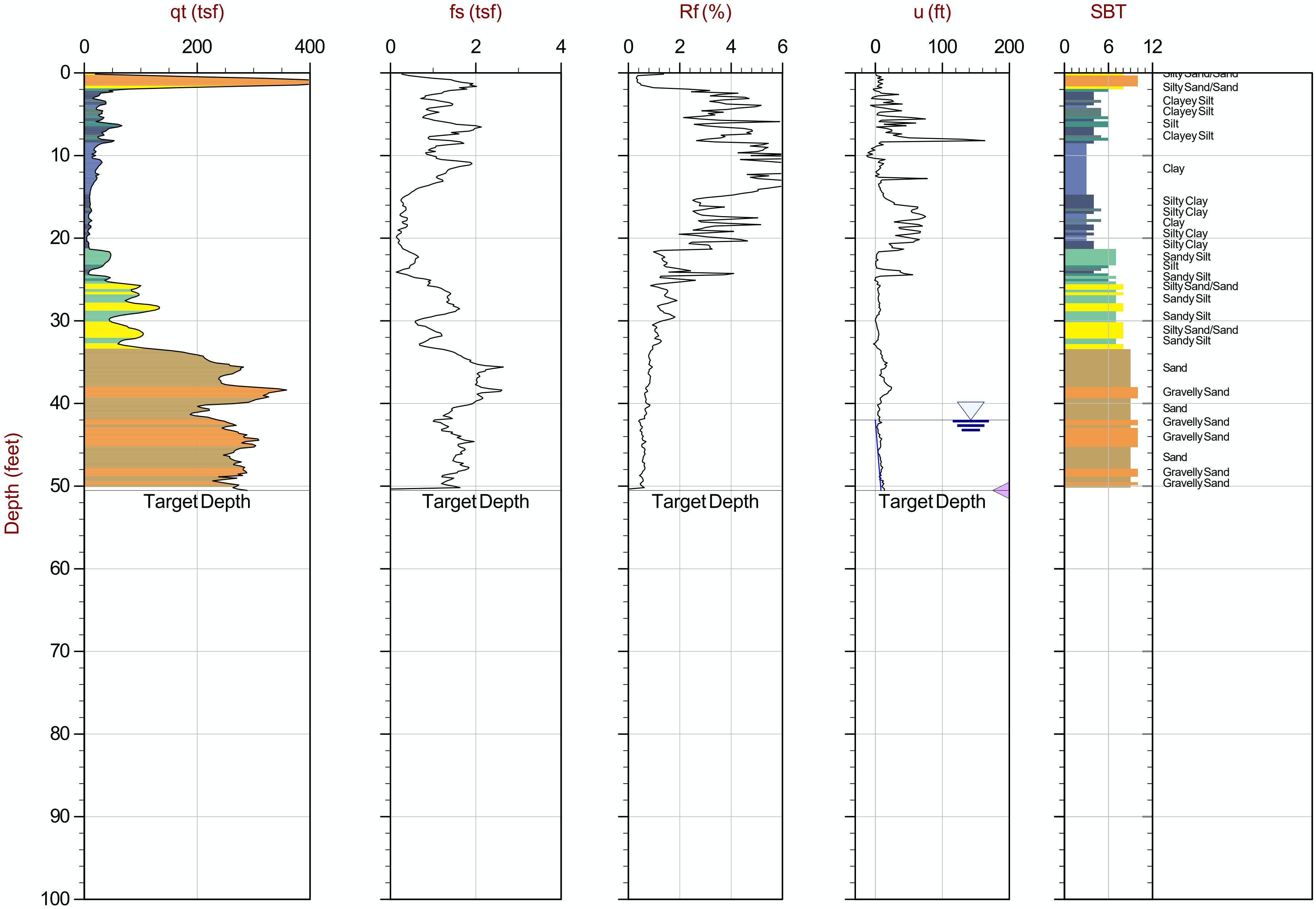
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:17:15 17:40
Site: AECI-New Madrid

Sounding: CPT15-HAC10
Cone: 419:T1500F15U500



Max Depth: 15.400 m / 50.52 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP10.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4044217m E: 270784m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◀ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

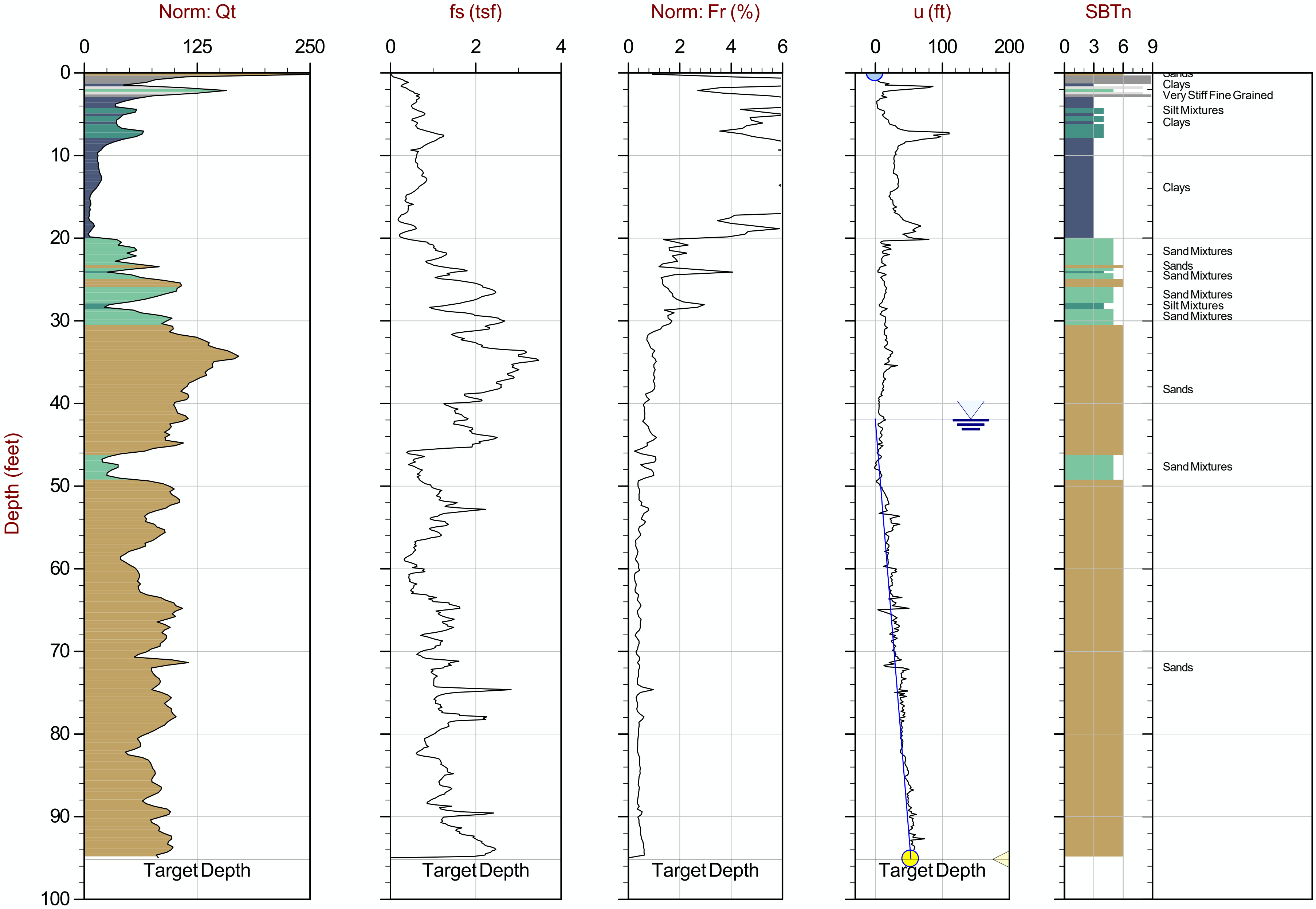
Normalized Cone Penetration Test Plots

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:17:15 15:59
Site: AECI-New Madrid

Sounding: CPT15-HAC3
Cone: 419:T1500F15U500



Max Depth: 29.000 m / 95.14 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP03.COR

SBT: Robertson, 1990
Coords: UTM Zone 16 N: 4044097m E: 270832m

Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

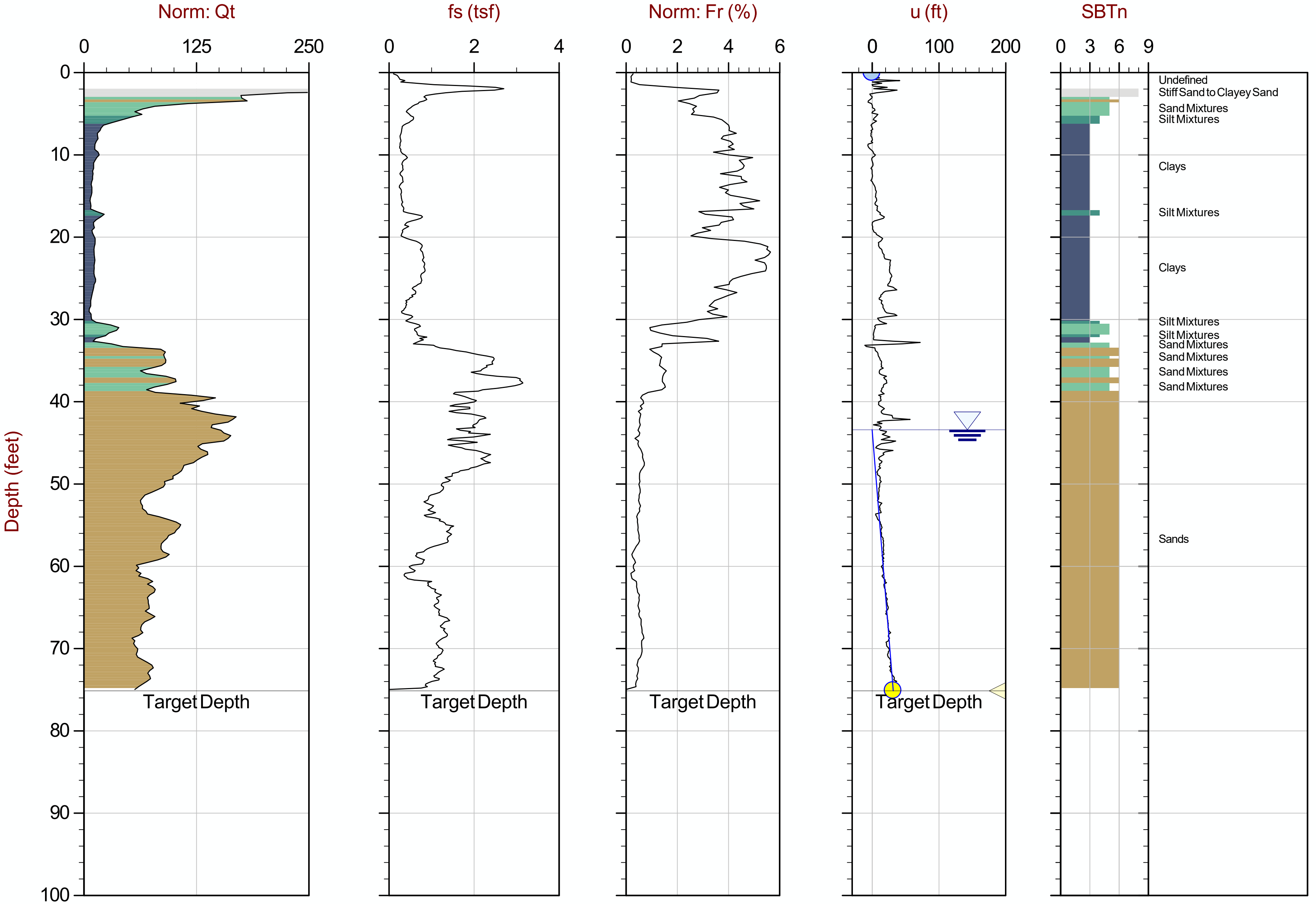
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:15:15 17:52
Site: AECI-New Madrid

Sounding: CPT15-HAC5
Cone: 419:T1500F15U500



Max Depth: 22.900 m / 75.13 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP05.COR

SBT: Robertson, 1990
Coords: UTM Zone 16 N: 4043453m E: 270755m

Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◀ PPD, Ueq not achieved

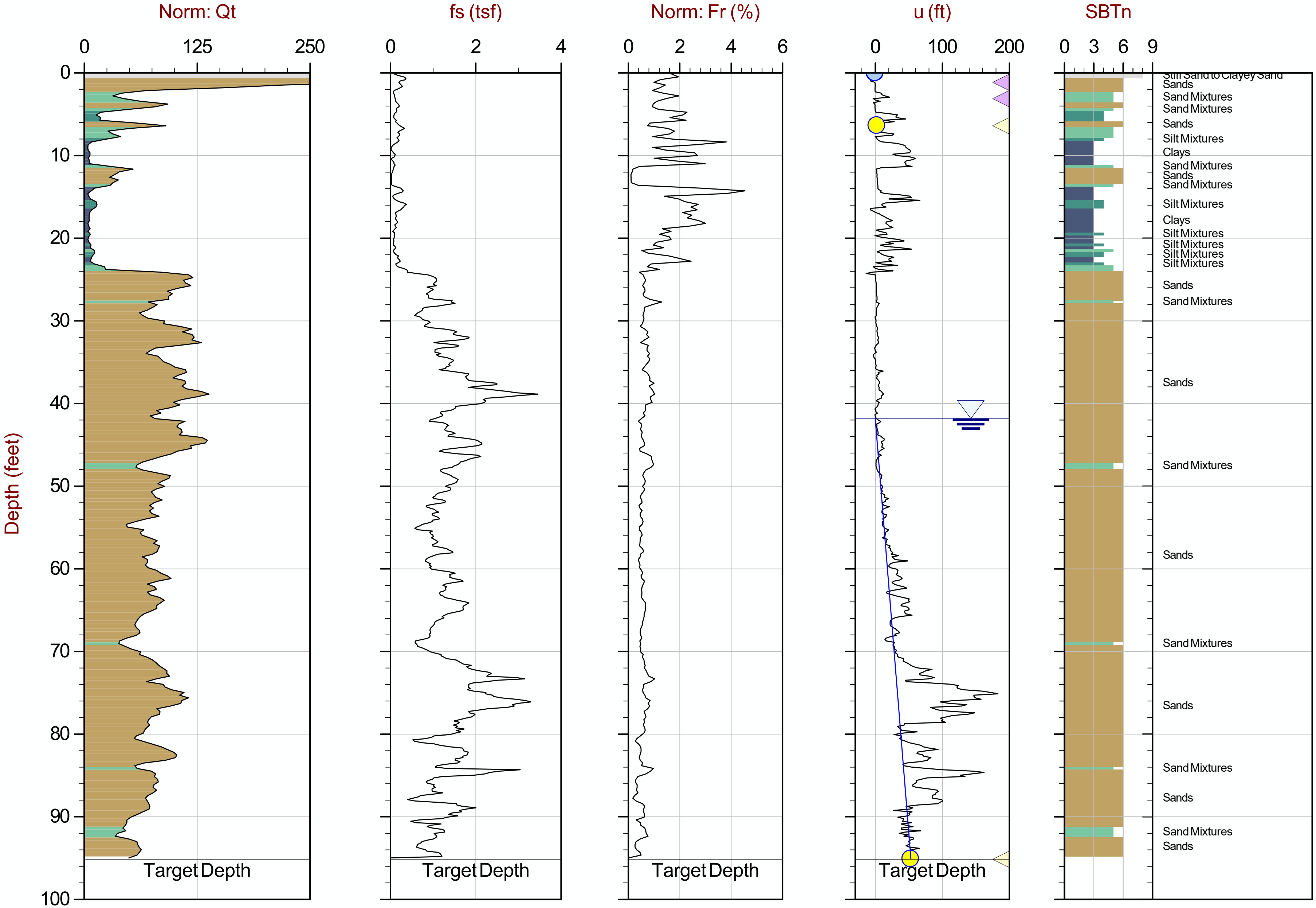
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:15:15 14:36
Site: AECI-New Madrid

Sounding: SCPT15-HAC7
Cone: 419:T1500F15U500



Max Depth: 29.000 m / 95.14 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_SP07.COR

SBT: Robertson, 1990
Coords: UTM Zone 16 N: 4043266m E: 271126m

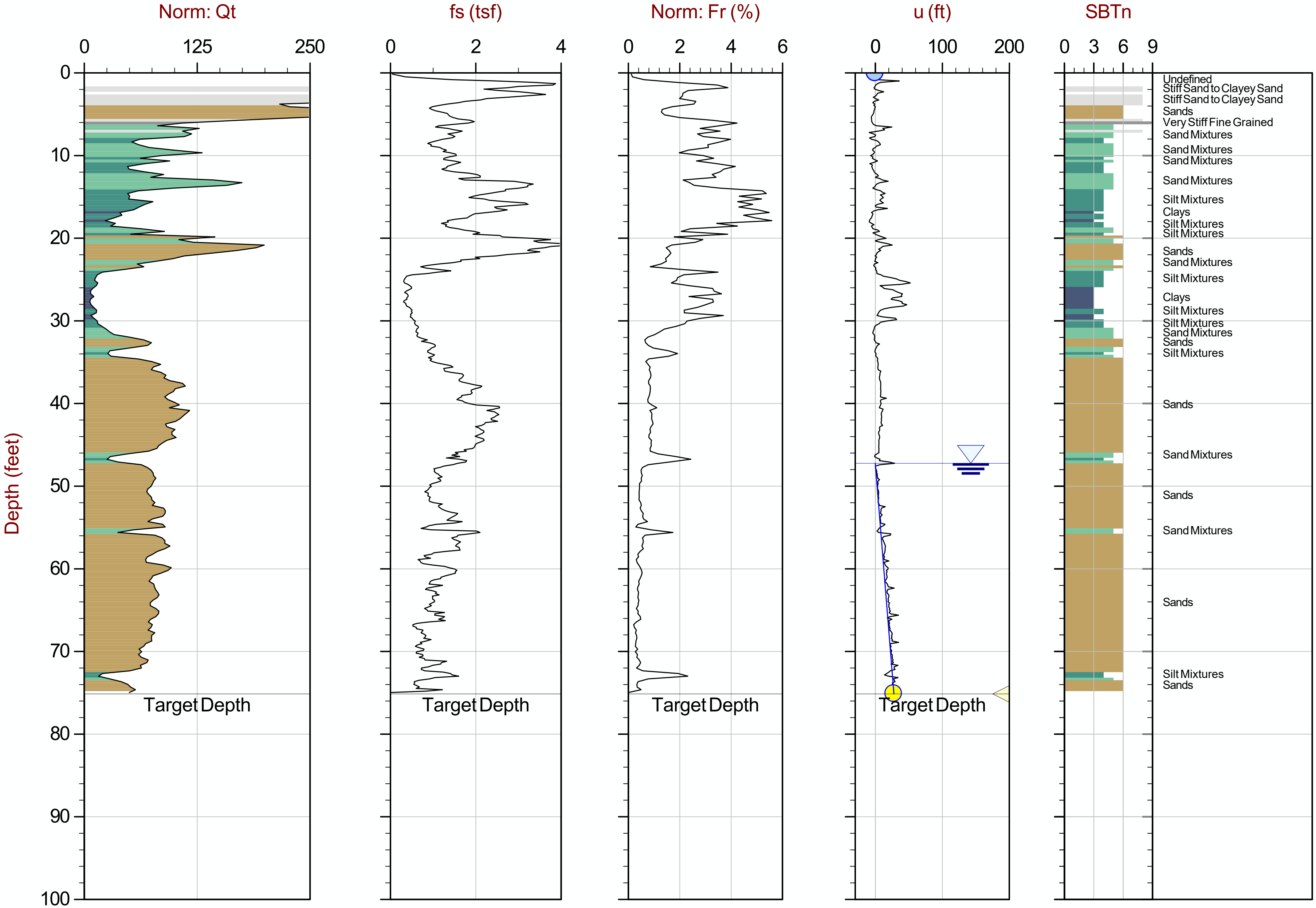
— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Haley & Aldrich

Job No: 15-53087
Date: 09:17:15 11:57
Site: AECI-New Madrid

Sounding: CPT15-HAC9
Cone: 419:T1500F15U500



Max Depth: 22.900 m / 75.13 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_CP09.COR

SBT: Robertson, 1990
Coords: UTM Zone 16 N: 4042932m E: 271425m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

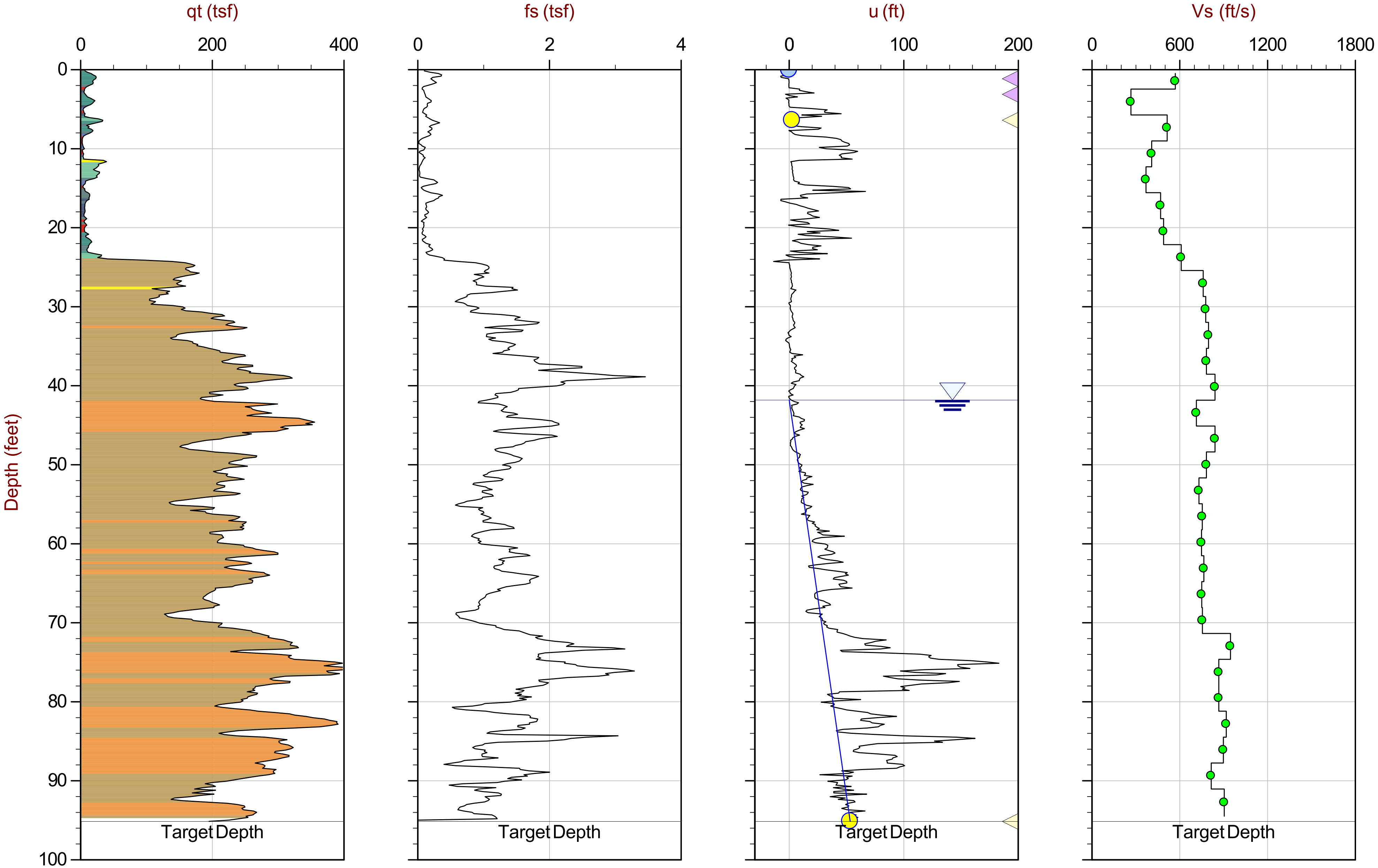
Seismic Cone Penetration Test Plots

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:15:15 14:36
Site: AECI-New Madrid

Sounding: SCPT15-HAC7
Cone: 419:T1500F15U500



Max Depth: 29.000 m / 95.14 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_SP07.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4043266m E: 271126m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◀ PPD, Ueq not achieved

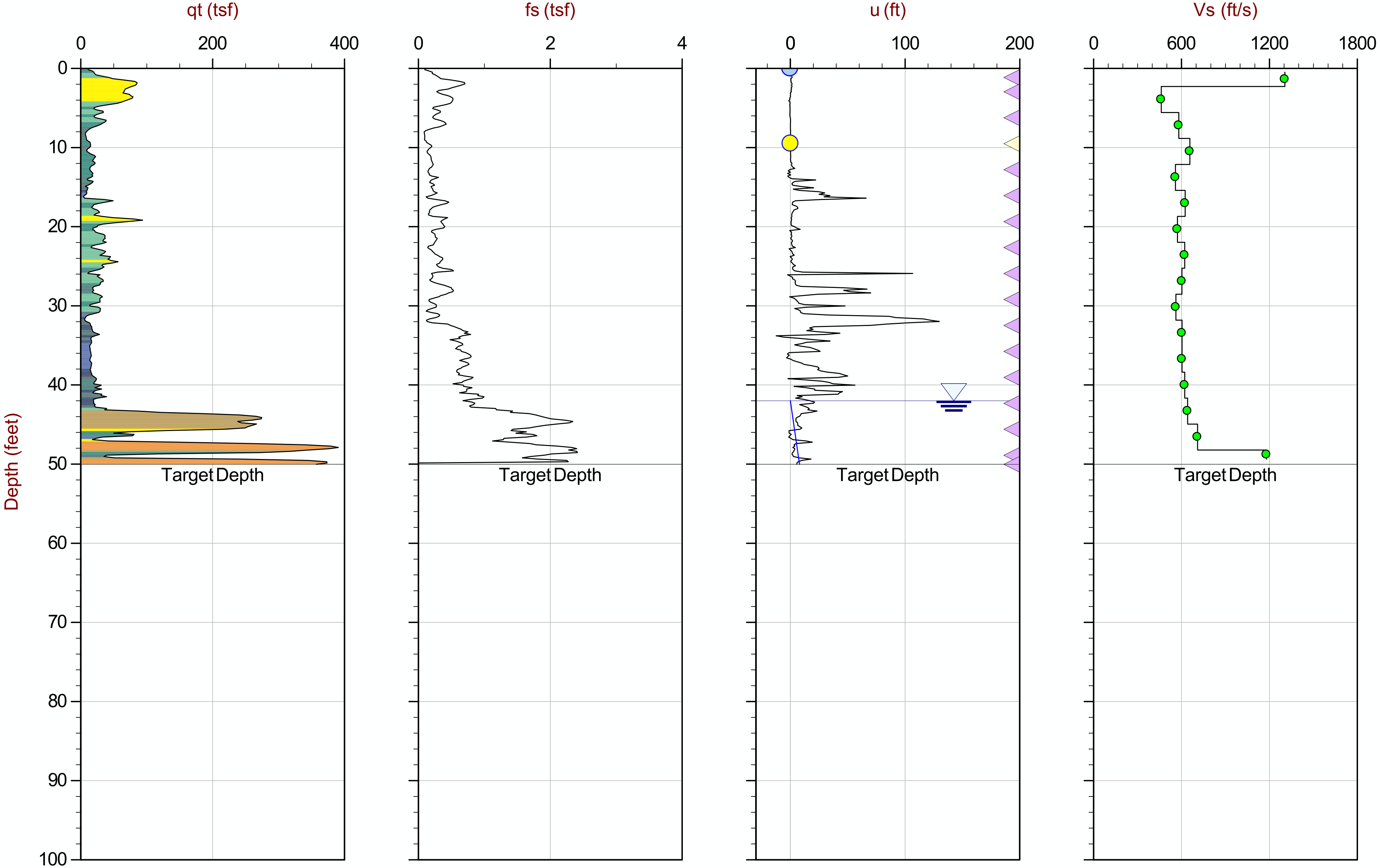
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 09:16:15 12:39
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: 419:T1500F15U500



Max Depth: 15.250 m / 50.03 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53087_SP08.COR

SBT: Robertson and Campanella, 1986
Coords: UTM Zone 16 N: 4043175m E: 270700m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Seismic Cone Penetration Test Tabular Results (Vs)

Job No: 15-53087
Client: Haley & Aldrich
Project: AECI - New Madrid
Sounding ID: SCPT15-HAC7
Date: 15-Sep-2015

Seismic Source: Beam
Source Offset (ft): 1.50
Source Depth (ft): 0.00
Geophone Offset (ft): 0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
1.15	0.49	1.58			
3.12	2.46	2.88	1.30	2.29	570
6.40	5.74	5.93	3.05	11.46	266
9.68	9.02	9.15	3.21	6.25	514
12.96	12.30	12.39	3.25	7.95	408
16.24	15.58	15.66	3.26	8.84	369
19.52	18.86	18.92	3.27	6.97	469
22.80	22.15	22.20	3.27	6.67	490
26.08	25.43	25.47	3.27	5.37	610
29.36	28.71	28.75	3.28	4.31	760
32.64	31.99	32.02	3.28	4.21	778
35.92	35.27	35.30	3.28	4.11	797
39.21	38.55	38.58	3.28	4.19	782
42.49	41.83	41.86	3.28	3.90	841
45.77	45.11	45.14	3.28	4.59	714
49.05	48.39	48.42	3.28	3.90	841
52.33	51.67	51.69	3.28	4.19	782
55.61	54.95	54.97	3.28	4.48	731
58.89	58.23	58.25	3.28	4.35	754
62.17	61.52	61.53	3.28	4.38	749
65.45	64.80	64.81	3.28	4.29	765
68.73	68.08	68.09	3.28	4.37	750
72.01	71.36	71.37	3.28	4.34	755
75.30	74.64	74.65	3.28	3.46	947
78.58	77.92	77.93	3.28	3.78	867
81.86	81.20	81.21	3.28	3.78	867
85.14	84.48	84.49	3.28	3.57	918
88.42	87.76	87.78	3.28	3.65	898
91.70	91.04	91.06	3.28	4.02	815
95.14	94.49	94.50	3.44	3.81	904

Job No:	15-53087
Client:	Haley & Aldrich
Project:	AECI - New Madrid
Sounding ID:	SCPT15-HAC8
Date:	16-Sep-2015

Seismic Source:	Beam
Source Offset (ft):	1.50
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
1.15	0.49	1.58			
2.95	2.30	2.74	1.16	0.89	1306
6.23	5.58	5.78	3.03	6.56	462
9.51	8.86	8.98	3.21	5.51	582
12.80	12.14	12.23	3.25	4.94	657
16.08	15.42	15.49	3.26	5.83	559
19.36	18.70	18.76	3.27	5.23	625
22.64	21.98	22.03	3.27	5.71	573
25.92	25.26	25.31	3.27	5.27	622
29.20	28.54	28.58	3.28	5.43	603
32.48	31.82	31.86	3.28	5.83	562
35.76	35.10	35.14	3.28	5.43	604
39.04	38.39	38.41	3.28	5.43	604
42.32	41.67	41.69	3.28	5.27	622
45.60	44.95	44.97	3.28	5.11	642
48.88	48.23	48.25	3.28	4.62	710
50.03	49.38	49.40	1.15	0.97	1181

Pore Pressure Dissipation Summary and

Pore Pressure Dissipation Plots

Job No:	15-53087
Client:	Haley & Aldrich
Project:	AECI - New Madrid, Marston, MO
Start Date:	15-Sep-2015
End Date:	17-Sep-2015

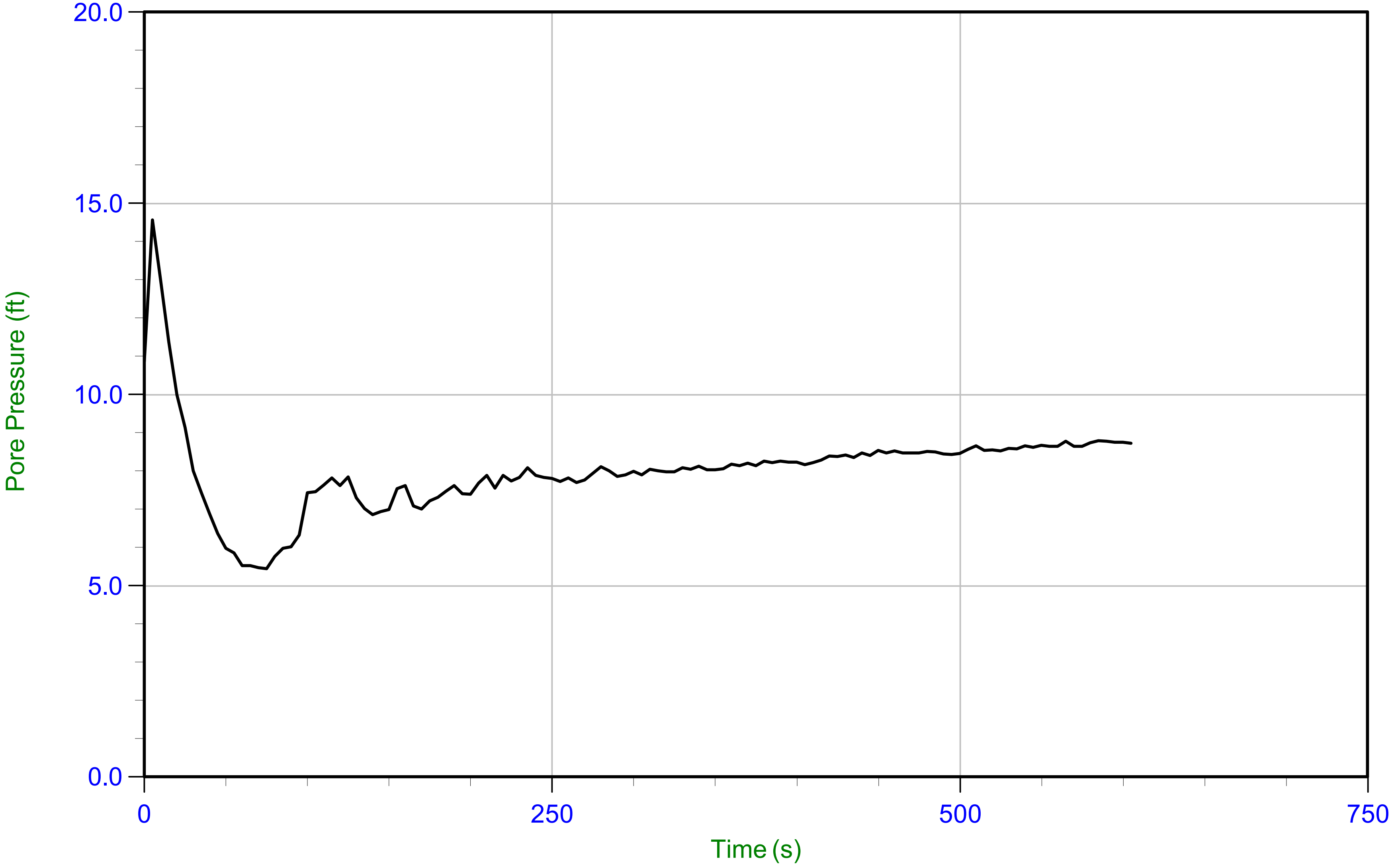
CPTu PORE PRESSURE DISSIPATION SUMMARY

Sounding ID	File Name	Cone Area (cm^2)	Duration (s)	Test Depth (ft)	Estimated Equilibrium Pore Pressure U_{eq} (ft)	Calculated Phreatic Surface (ft)	Estimated Phreatic Surface (ft)
CPT15-HAC1	15-53087_CP01	15	605	50.03	8.97	41.07	
CPT15-HAC2	15-53087_CP02	15	700	50.03	1.92	48.12	
CPT15-HAC3	15-53087_CP03	15	600	95.14	53.33	41.81	
CPT15-HAC4	15-53087_CP04	15	600	50.03	15.06	34.97	
CPT15-HAC5	15-53087_CP05	15	1000	75.13	31.73	43.40	
CPT15-HAC6	15-53087_CP06	15	300	50.03	19.92	30.11	
SCPT15-HAC7	15-53087_SP07	15	300	1.15			
SCPT15-HAC7	15-53087_SP07	15	300	3.12			
SCPT15-HAC7	15-53087_SP07	15	190	6.40	2.59	3.81	
SCPT15-HAC7	15-53087_SP07	15	600	95.14	53.33	41.81	
SCPT15-HAC8	15-53087_SP08	15	200	1.15			
SCPT15-HAC8	15-53087_SP08	15	150	2.95			
SCPT15-HAC8	15-53087_SP08	15	150	6.23			
SCPT15-HAC8	15-53087_SP08	15	150	9.51	0.34	9.17	
SCPT15-HAC8	15-53087_SP08	15	400	12.80			
SCPT15-HAC8	15-53087_SP08	15	600	16.08			
SCPT15-HAC8	15-53087_SP08	15	1700	19.36			
SCPT15-HAC8	15-53087_SP08	15	600	22.64			
SCPT15-HAC8	15-53087_SP08	15	400	25.92			
SCPT15-HAC8	15-53087_SP08	15	600	29.20			
SCPT15-HAC8	15-53087_SP08	15	7020	32.48			
SCPT15-HAC8	15-53087_SP08	15	5800	35.76			
SCPT15-HAC8	15-53087_SP08	15	900	39.04			
SCPT15-HAC8	15-53087_SP08	15	2400	42.32			
SCPT15-HAC8	15-53087_SP08	15	600	45.60			
SCPT15-HAC8	15-53087_SP08	15	200	48.88			
SCPT15-HAC8	15-53087_SP08	15	900	50.03			
CPT15-HAC9	15-53087_CP09	15	500	75.13	27.89	47.24	
CPT15-HAC10	15-53087_CP10	15	600	50.52			
Totals	29 dissipations		484.4 min				

Haley & Aldrich

Job No: 15-53087
Date: 17-Sep-2015 17:40:26
Site: AECI-New Madrid

Sounding: CPT15-HAC1
Cone: AD419
Cone Area: 15 sq cm

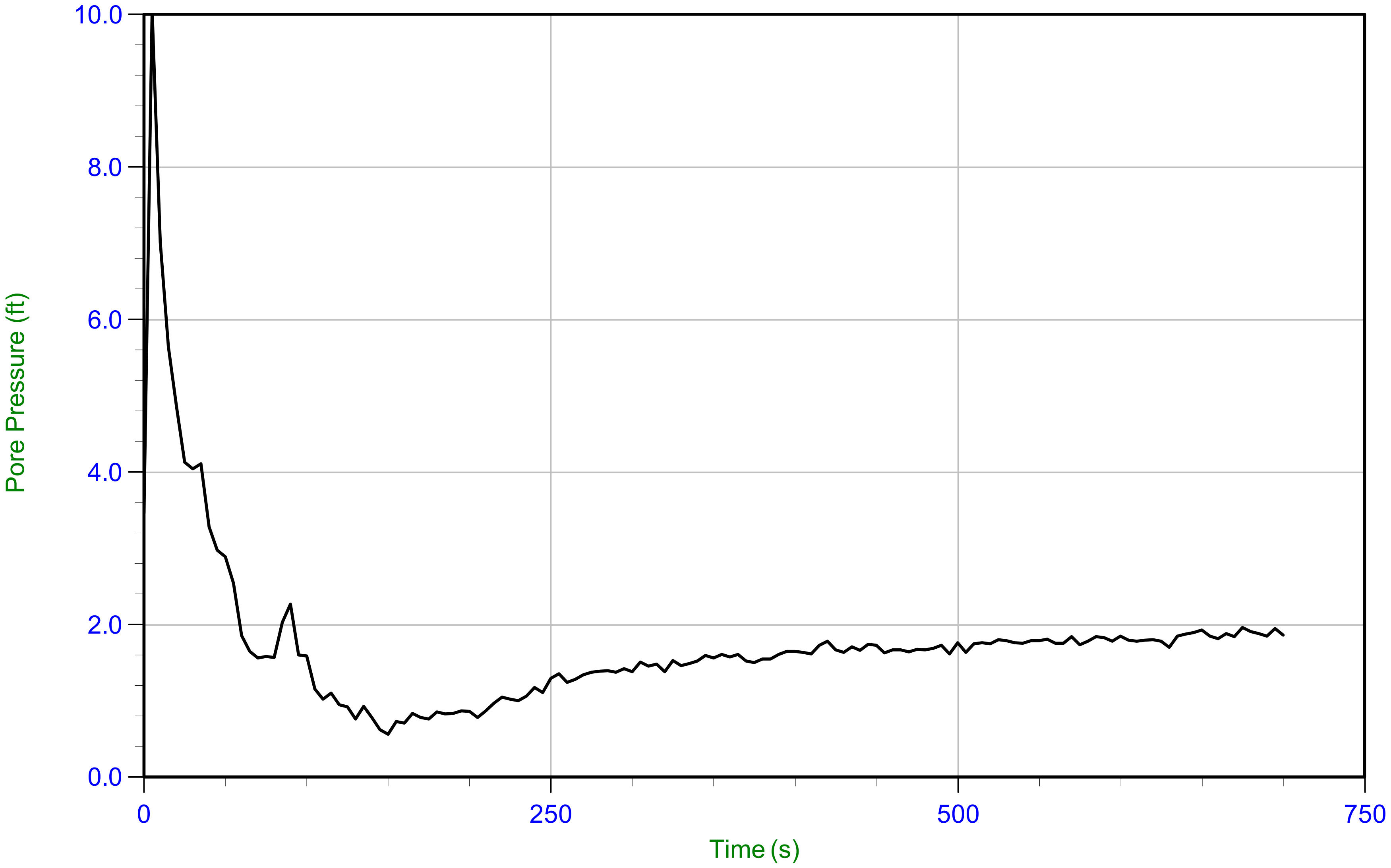


Trace Summary:

Filename: 15-53087_CP01.PPD
Depth: 15.250 m / 50.032 ft
Duration: 605.0 s

U Min: 5.4 ft
U Max: 14.6 ft

WT: 12.517 m / 41.066 ft
Ueq: 9.0 ft



Trace Summary:

Filename: 15-53087_CP02.PPD
Depth: 15.250 m / 50.032 ft
Duration: 700.0 s

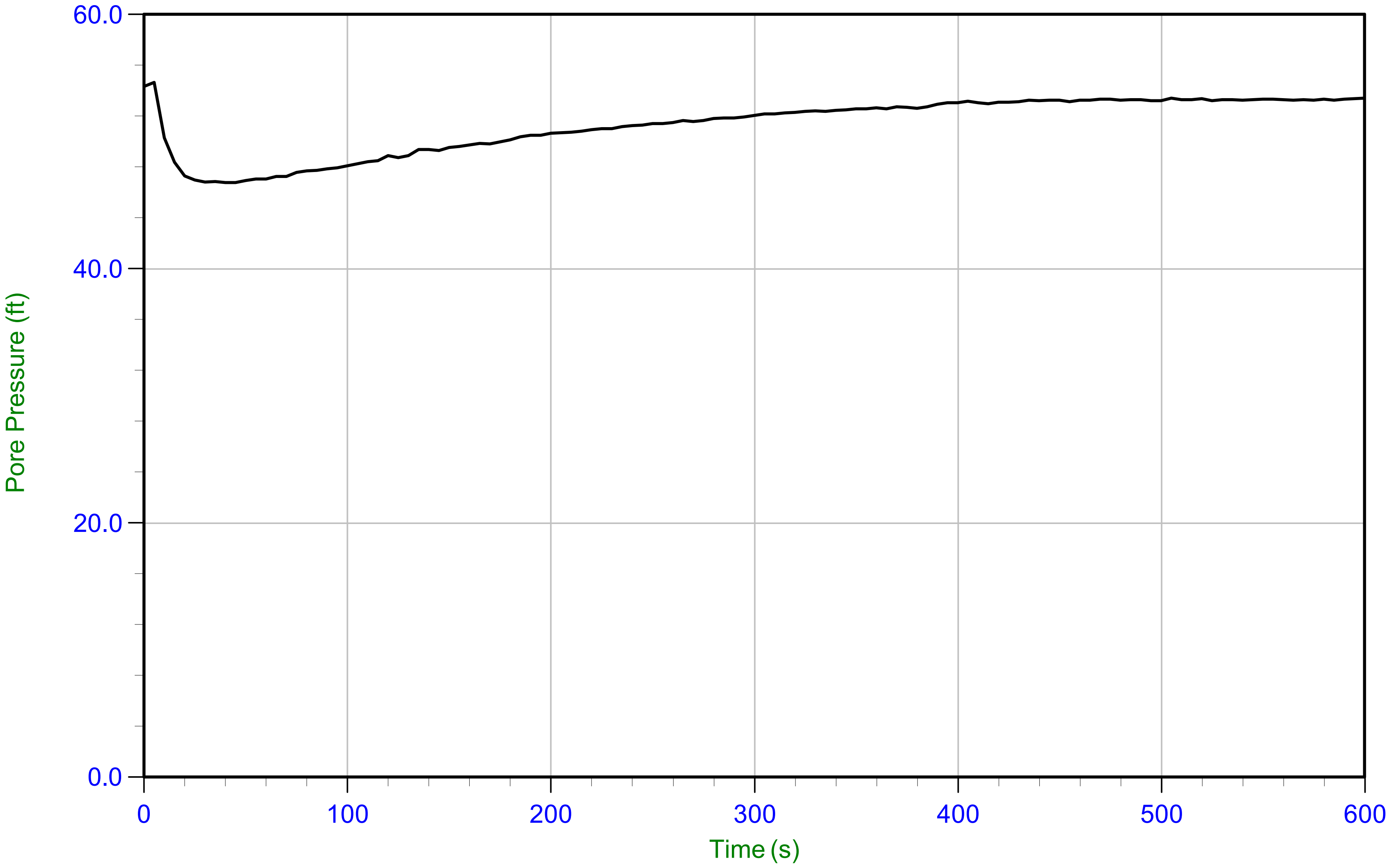
U Min: 0.6 ft
U Max: 10.1 ft

WT: 14.666 m / 48.116 ft
Ueq: 1.9 ft

Haley & Aldrich

Job No: 15-53087
Date: 17-Sep-2015 15:59:49
Site: AECI-New Madrid

Sounding: CPT15-HAC3
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_CP03.PPD
Depth: 29.000 m / 95.143 ft
Duration: 600.0 s

U Min: 46.8 ft
U Max: 54.7 ft

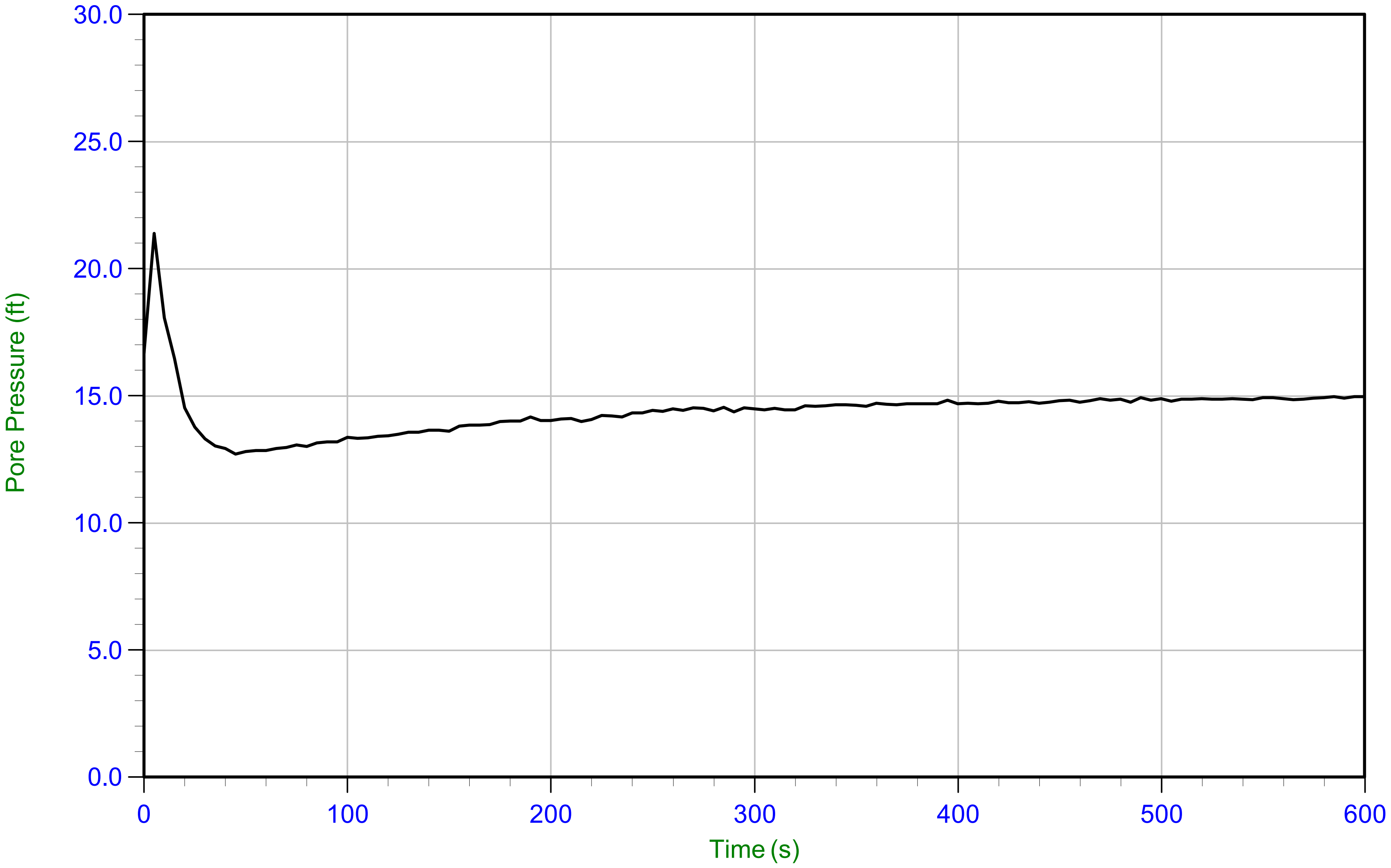
WT: 12.744 m / 41.811 ft
Ueq: 53.3 ft

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 17-Sep-2015 13:17:21
Site: AECI-New Madrid

Sounding: CPT15-HAC4
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_CP04.PPD
Depth: 15.250 m / 50.032 ft
Duration: 600.0 s

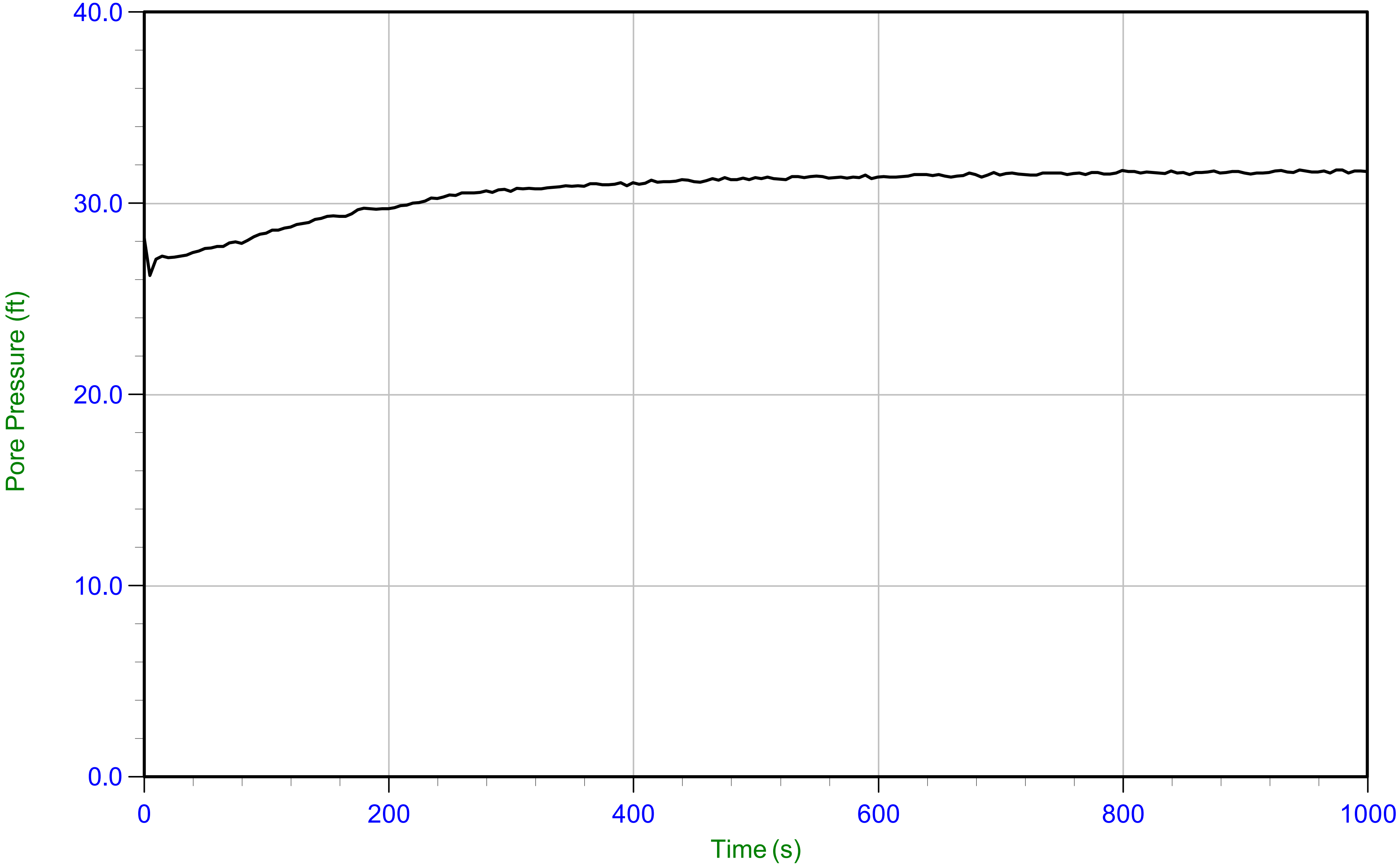
U Min: 12.7 ft
U Max: 21.4 ft

WT: 10.660 m / 34.973 ft
Ueq: 15.1 ft

Haley & Aldrich

Job No: 15-53087
Date: 15-Sep-2015 17:52:55
Site: AECI-New Madrid

Sounding: CPT15-HAC5
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_CP05.PPD
Depth: 22.900 m / 75.130 ft
Duration: 1000.0 s

U Min: 26.2 ft
U Max: 31.8 ft

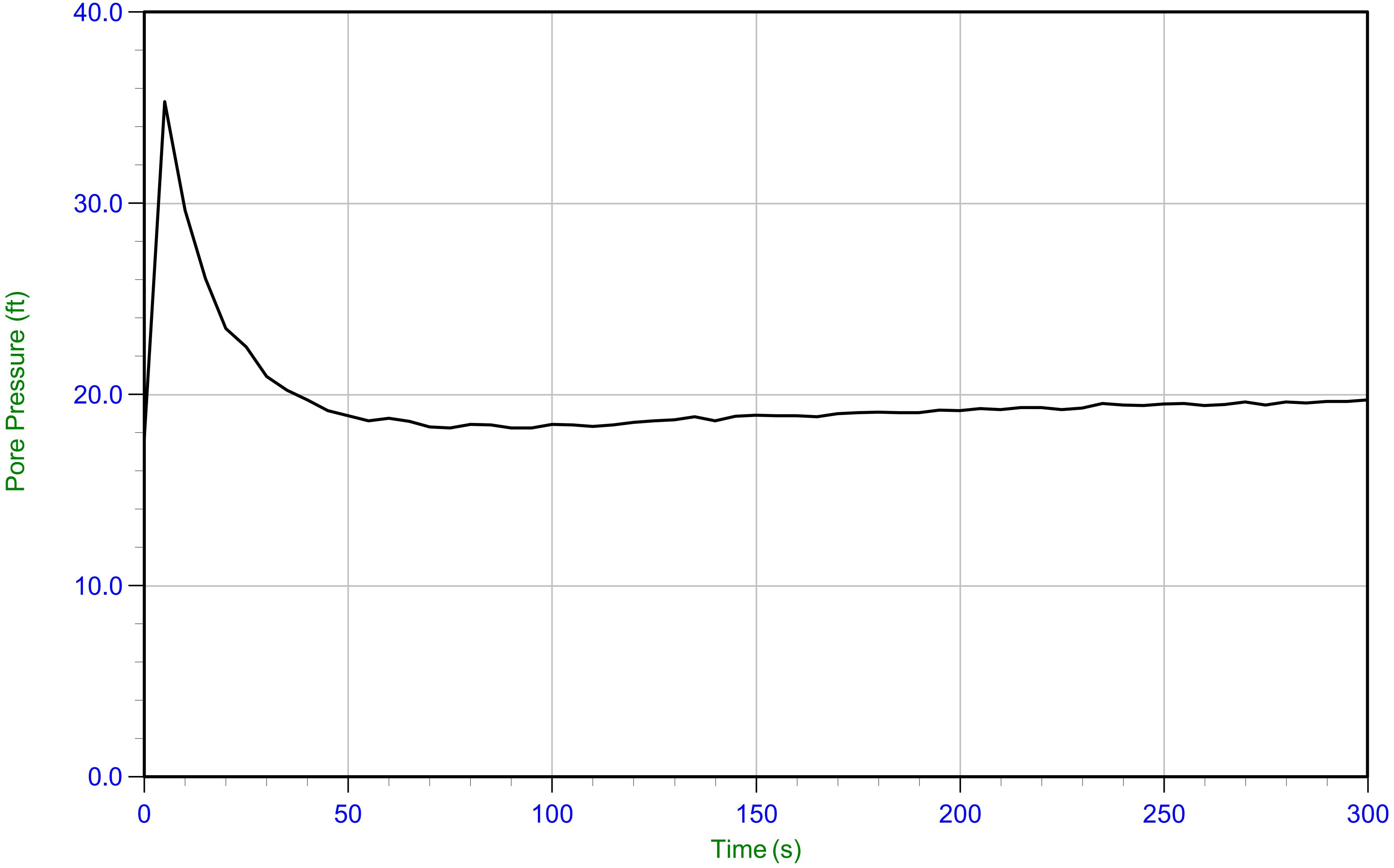
WT: 13.230 m / 43.405 ft
Ueq: 31.7 ft

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 10:26:29
Site: AECI-New Madrid

Sounding: CPT15-HAC6
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_CP06.PPD
Depth: 15.250 m / 50.032 ft
Duration: 300.0 s

U Min: 17.7 ft
U Max: 35.3 ft

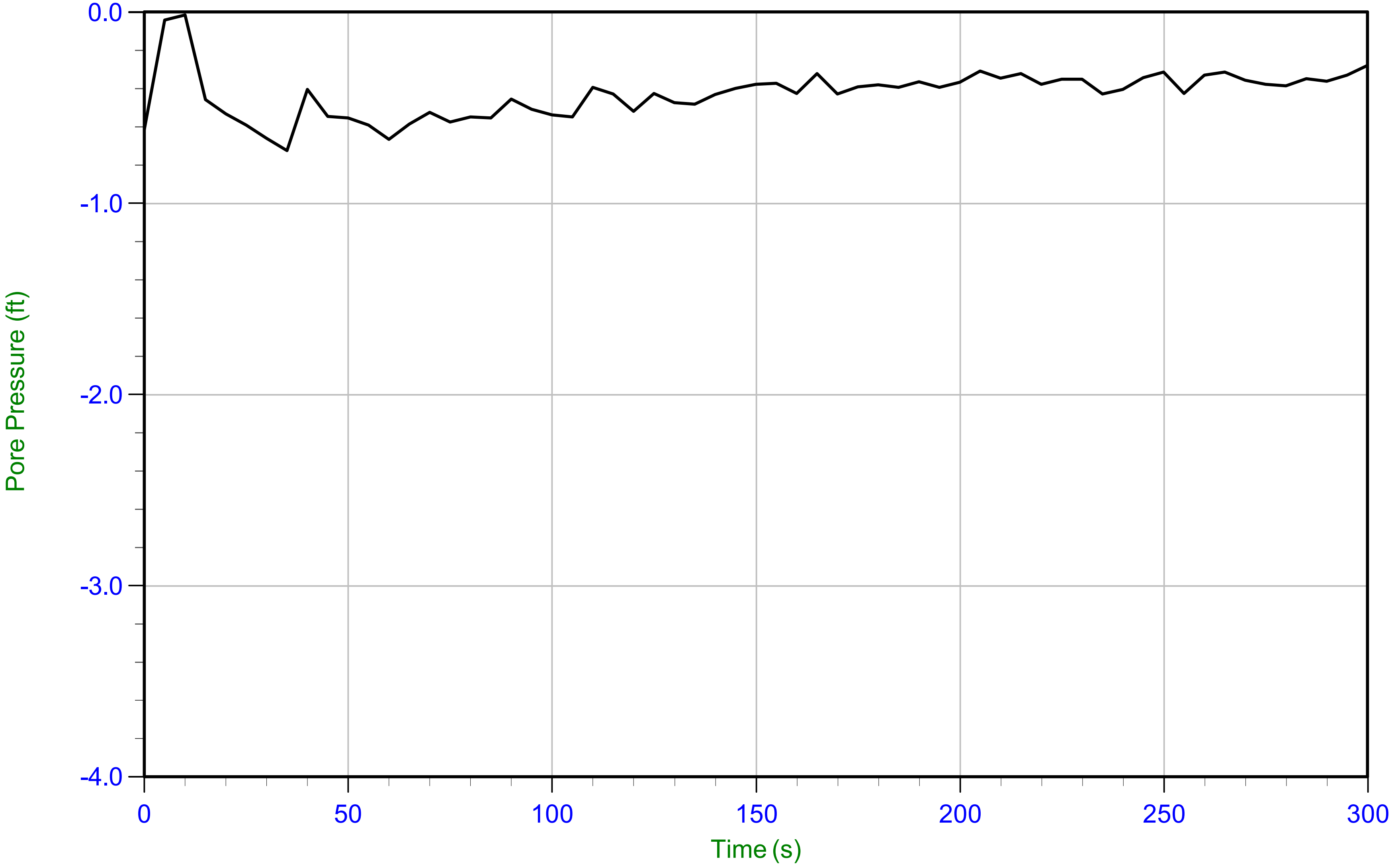
WT: 9.177 m / 30.108 ft
Ueq: 19.9 ft

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 15-Sep-2015 14:36:00
Site: AECI-New Madrid

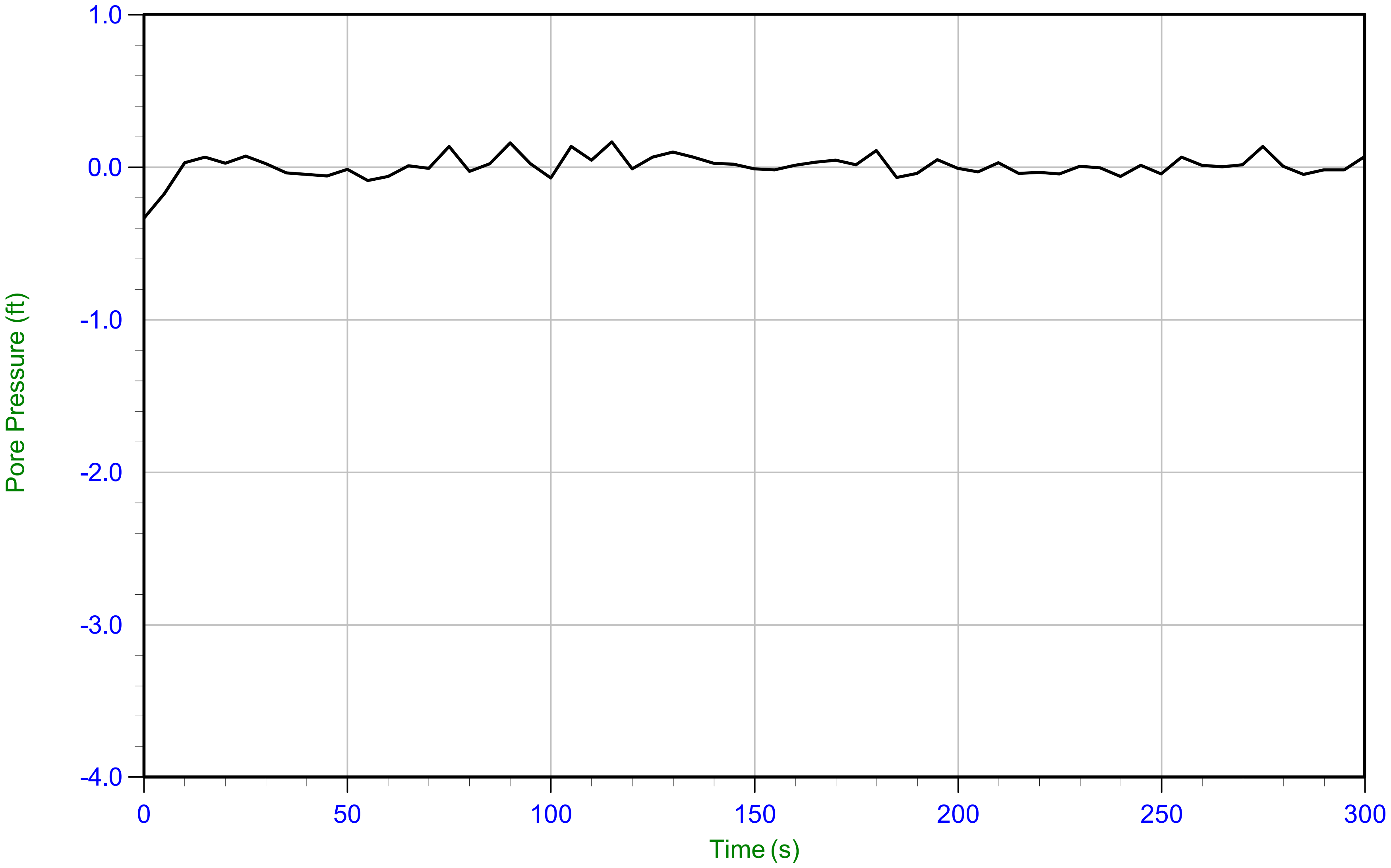
Sounding: SCPT15-HAC7
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_SP07.PPD
Depth: 0.350 m / 1.148 ft
Duration: 300.0 s

U Min: -0.7 ft
U Max: -0.0 ft



Trace Summary:

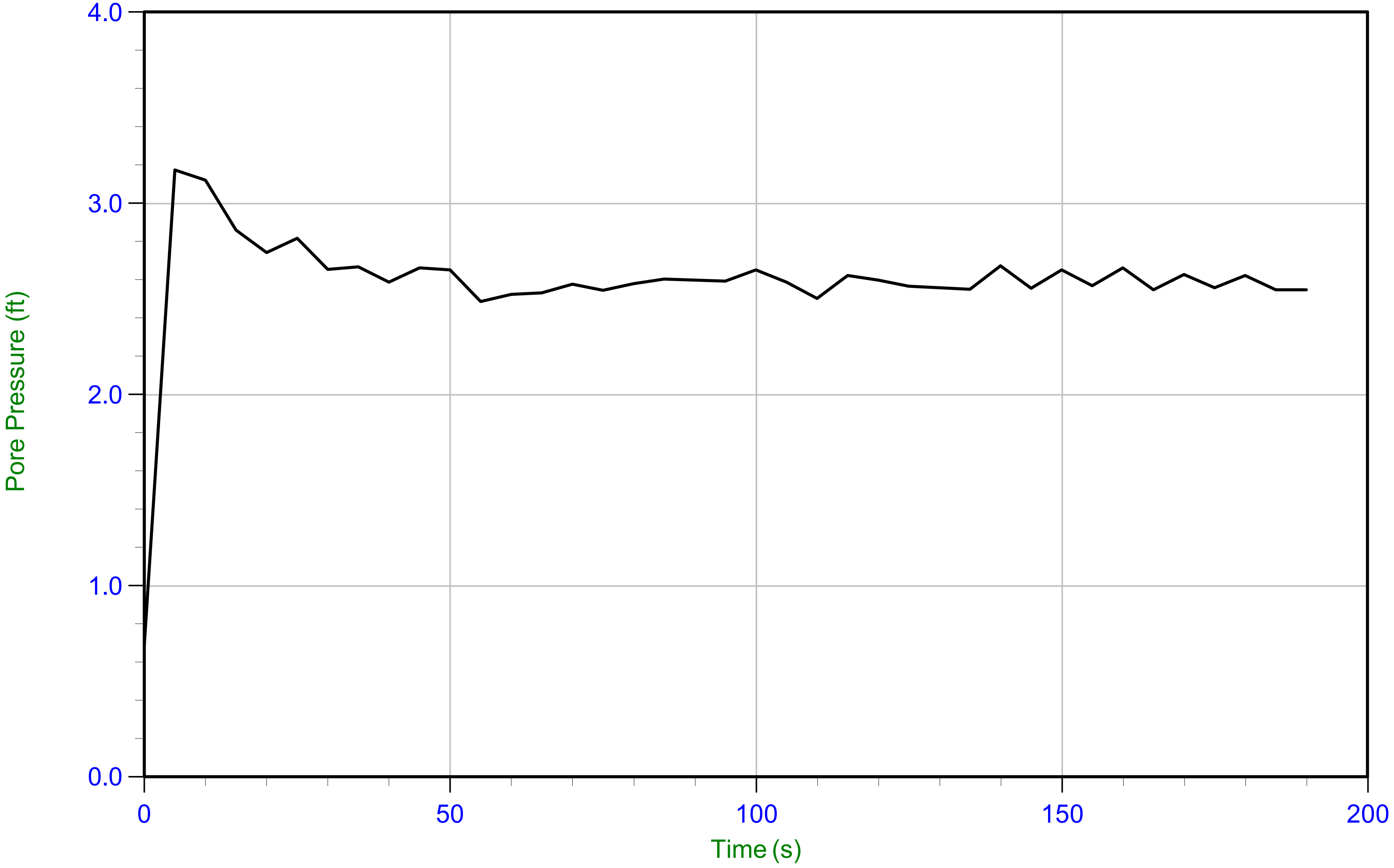
Filename: 15-53087_SP07.PPD
Depth: 0.950 m / 3.117 ft
Duration: 300.0 s

U Min: -0.3 ft
U Max: 0.2 ft

Haley & Aldrich

Job No: 15-53087
Date: 15-Sep-2015 14:36:00
Site: AECI-New Madrid

Sounding: SCPT15-HAC7
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_SP07.PPD
Depth: 1.950 m / 6.398 ft
Duration: 190.0 s

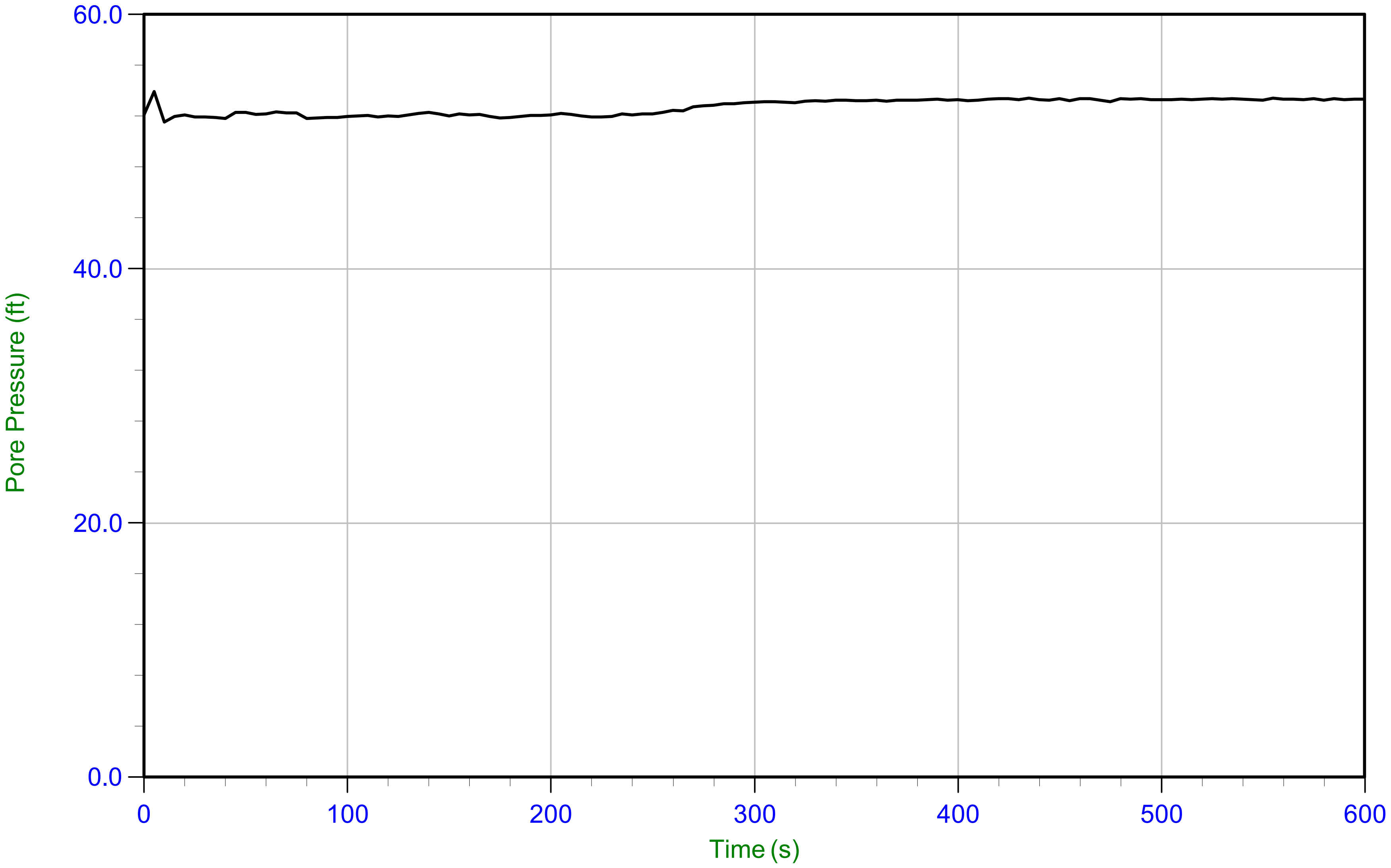
U Min: 0.7 ft
U Max: 3.2 ft

WT: 1.161 m / 3.809 ft
Ueq: 2.6 ft

Haley & Aldrich

Job No: 15-53087
Date: 15-Sep-2015 14:36:00
Site: AECI-New Madrid

Sounding: SCPT15-HAC7
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_SP07.PPD
Depth: 29.000 m / 95.143 ft
Duration: 600.0 s

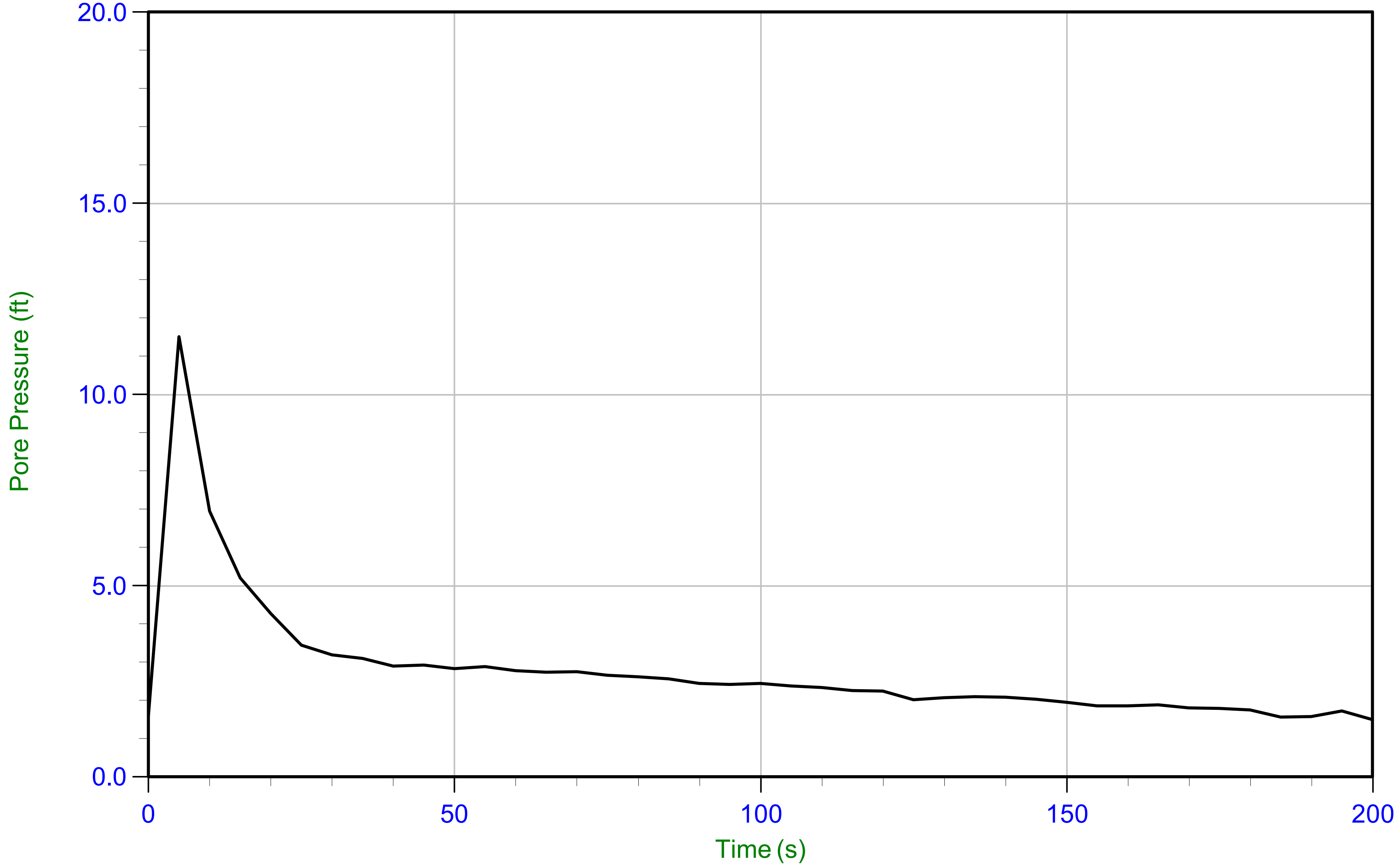
U Min: 51.5 ft
U Max: 53.9 ft

WT: 12.744 m / 41.811 ft
Ueq: 53.3 ft

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

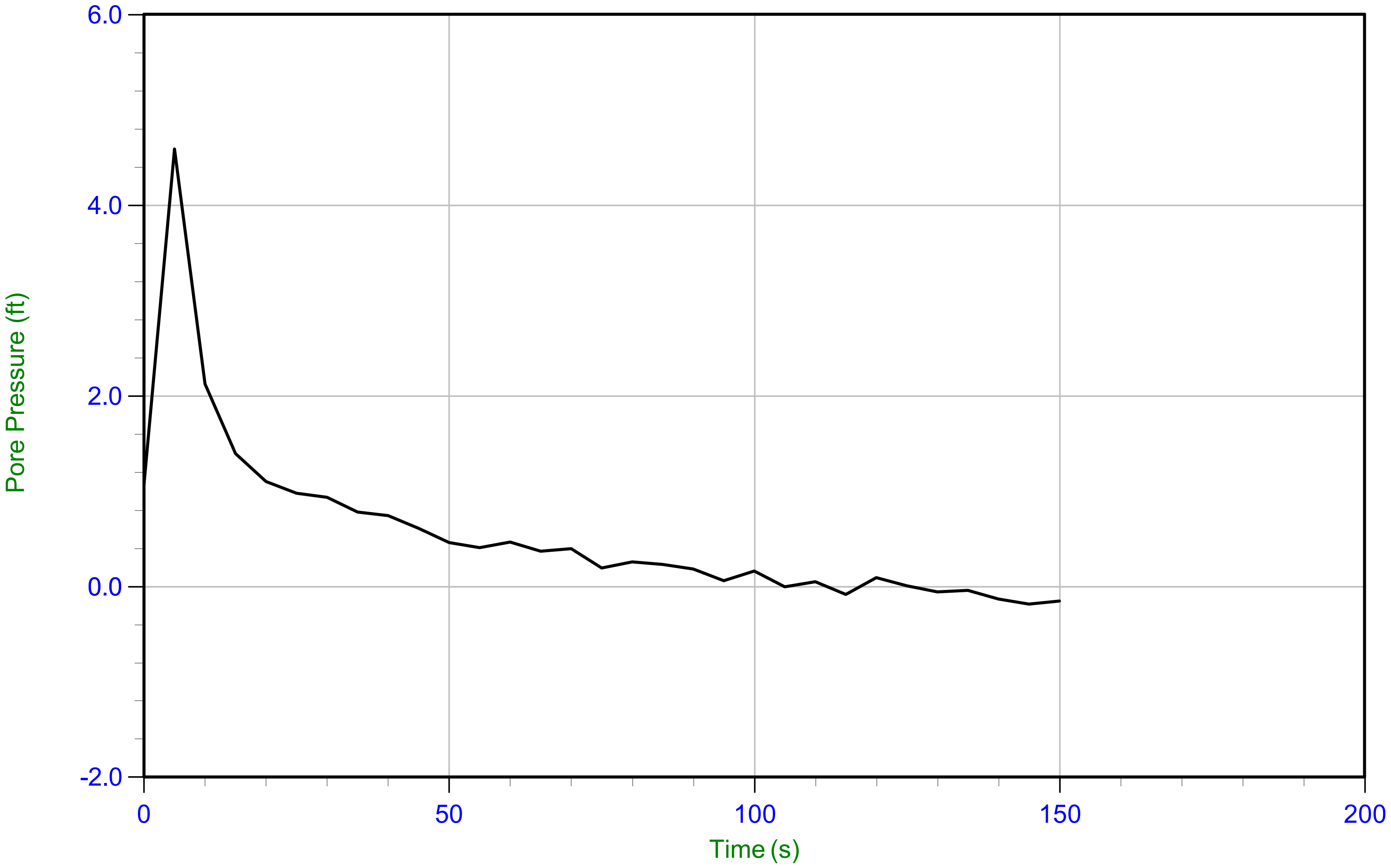
Filename: 15-53087_SP08.PPD
Depth: 0.350 m / 1.148 ft
Duration: 200.0 s

U Min: 1.5 ft
U Max: 11.5 ft

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

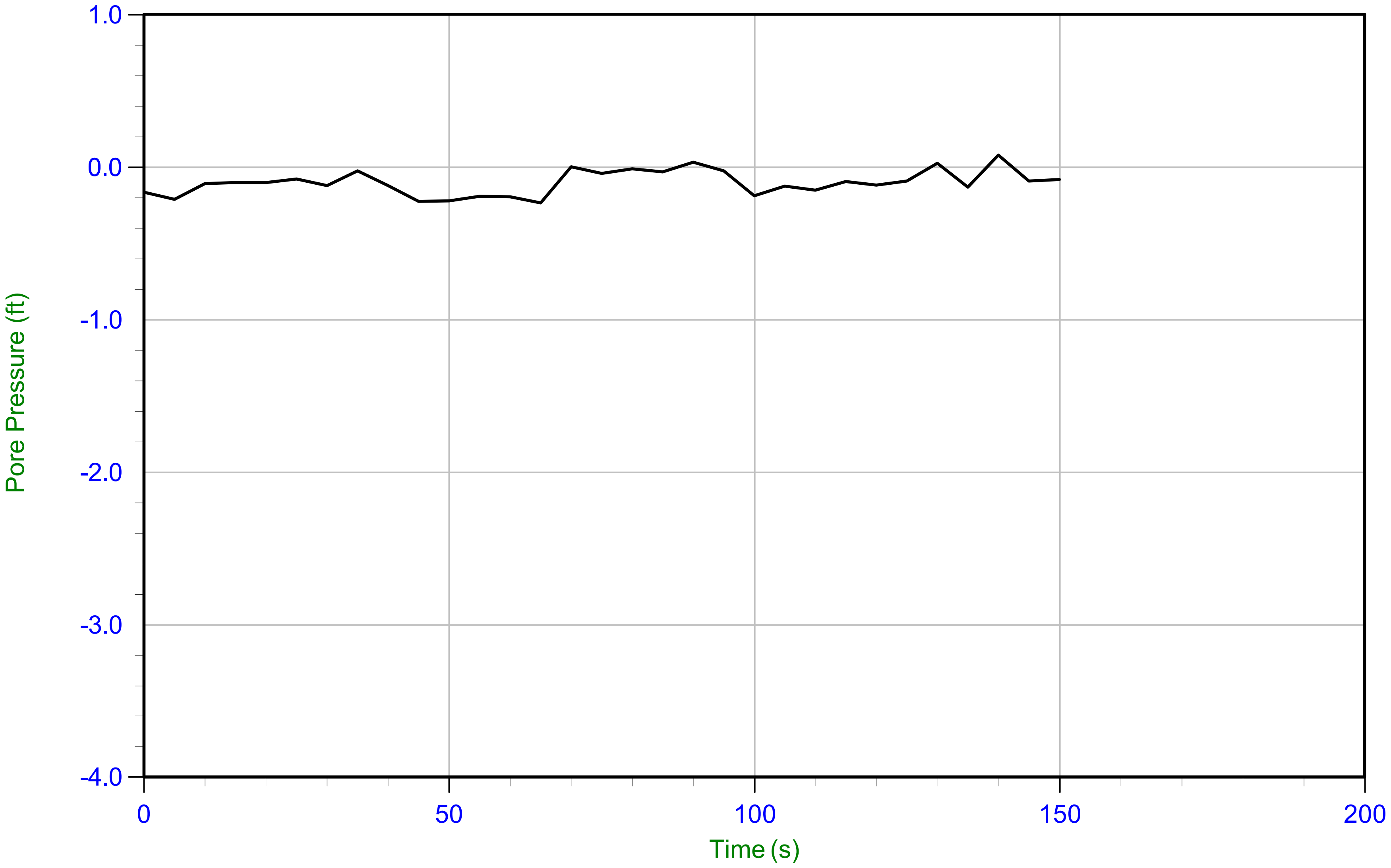
Filename: 15-53087_SP08.PPD
Depth: 0.900 m / 2.953 ft
Duration: 150.0 s

U Min: -0.2 ft
U Max: 4.6 ft

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm

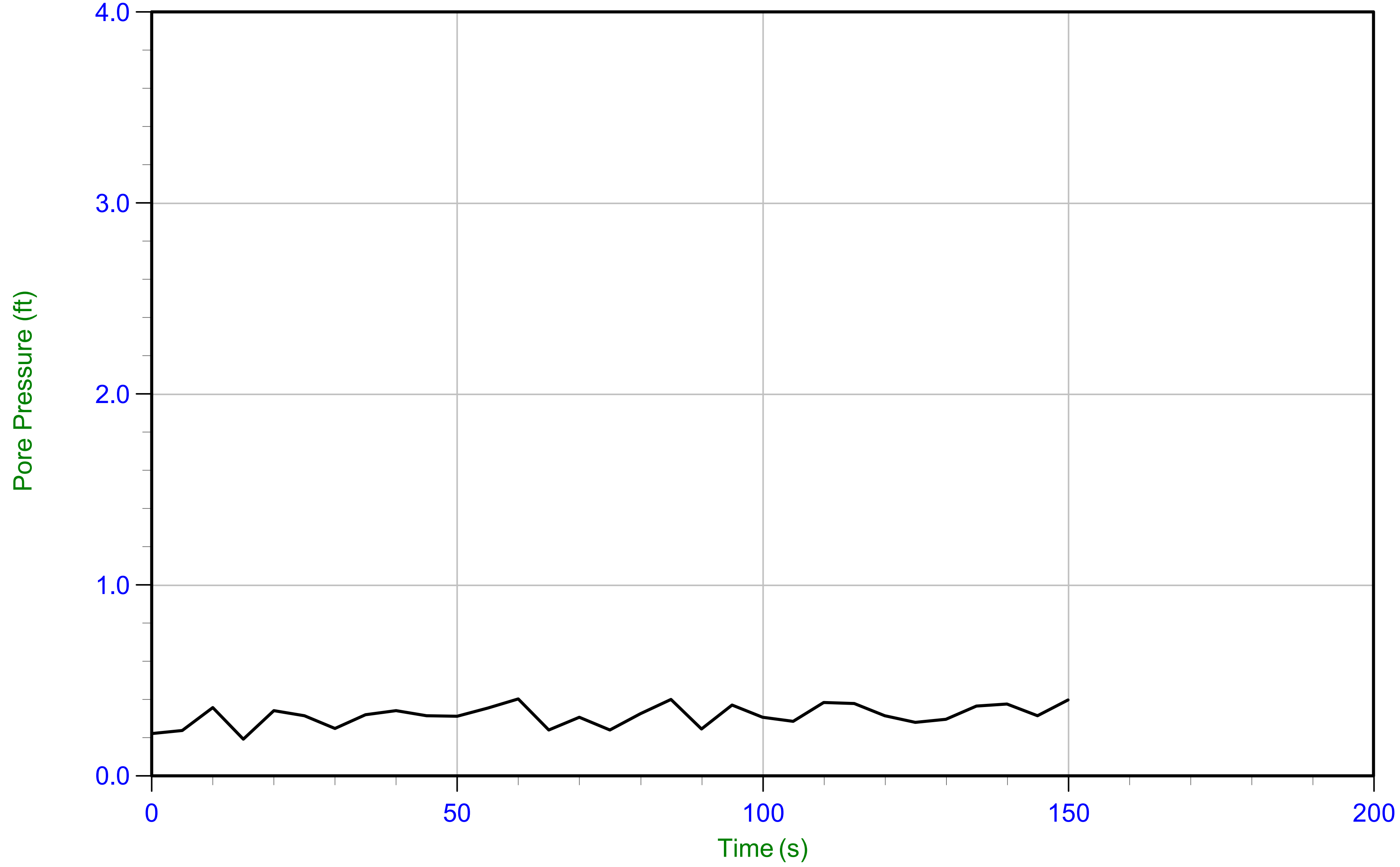


Trace Summary:

Filename: 15-53087_SP08.PPD
Depth: 1.900 m / 6.234 ft
Duration: 150.0 s

U Min: -0.2 ft
U Max: 0.1 ft

Haley & Aldrich	Job No: 15-53087 Date: 16-Sep-2015 12:39:09 Site: AECI-New Madrid	Sounding: SCPT15-HAC8 Cone: AD419 Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_SP08.PPD
Depth: 2.900 m / 9.514 ft
Duration: 150.0 s

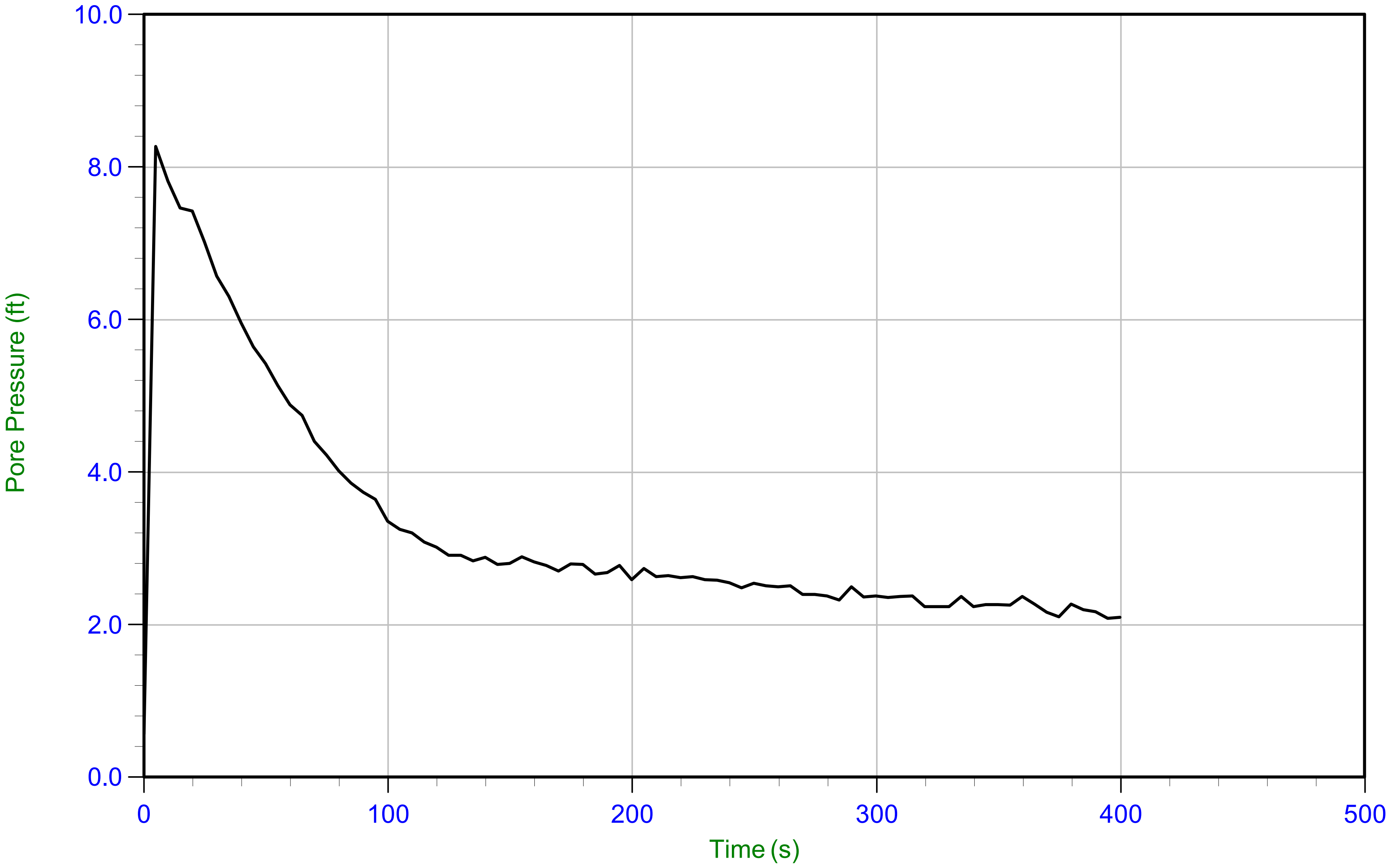
U Min: 0.2 ft
U Max: 0.4 ft

WT: 2.796 m / 9.172 ft
Ueq: 0.3 ft

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

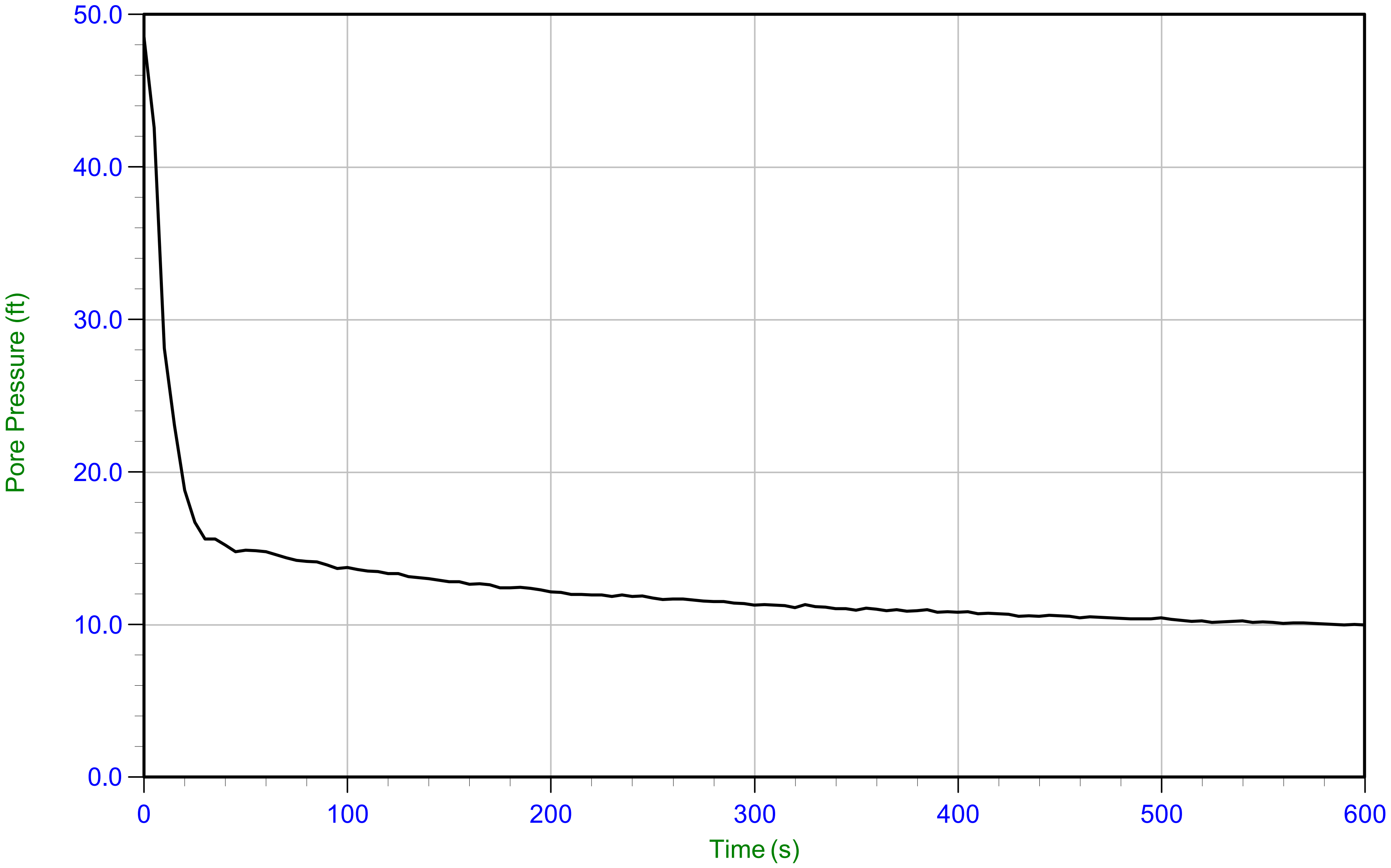
Filename: 15-53087_SP08.PPD
Depth: 3.900 m / 12.795 ft
Duration: 400.0 s

U Min: 0.6 ft
U Max: 8.3 ft

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

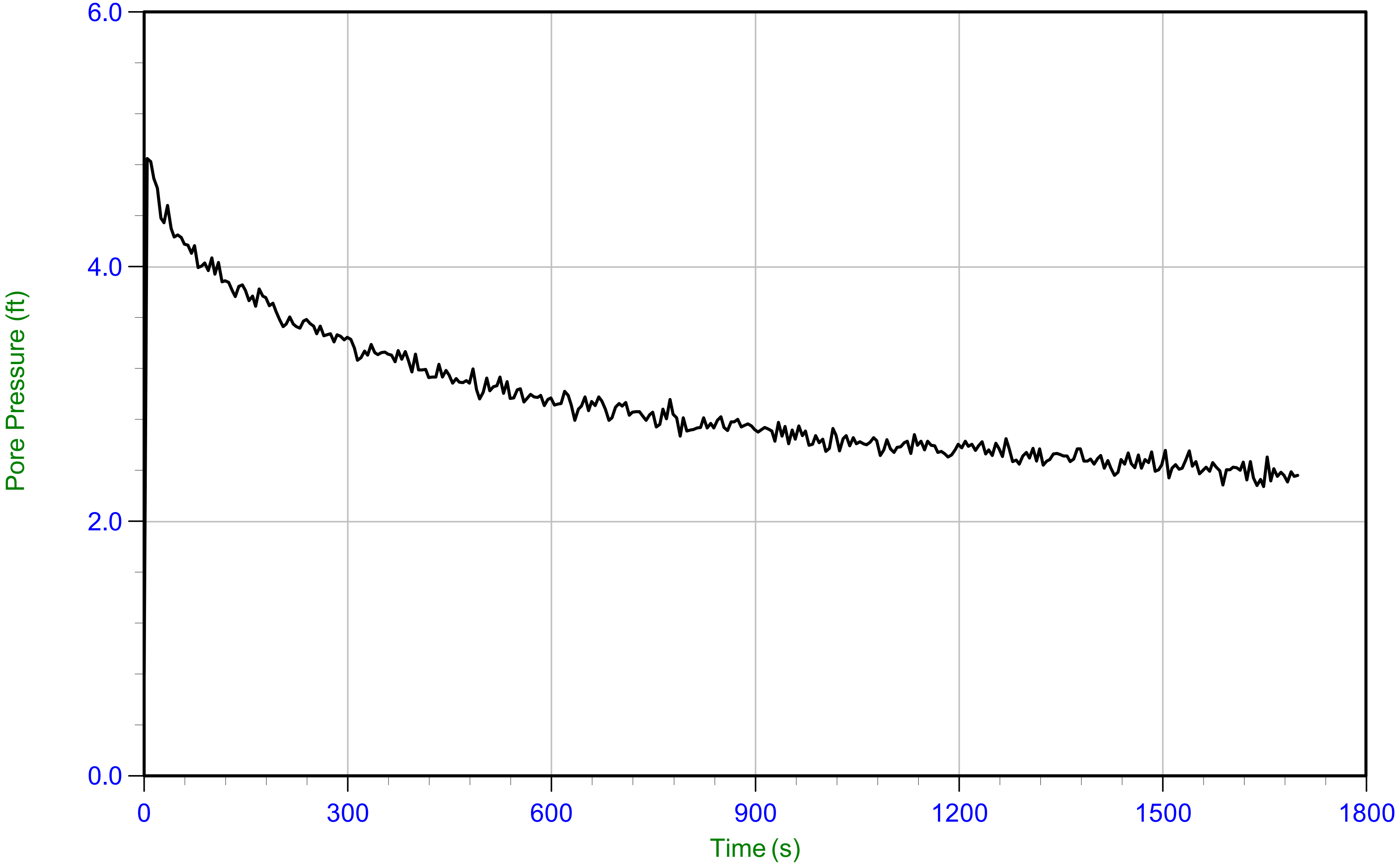
Filename: 15-53087_SP08.PPD
Depth: 4.900 m / 16.076 ft
Duration: 600.0 s

U Min: 10.0 ft
U Max: 48.5 ft

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_SP08.PPD
Depth: 5.900 m / 19.357 ft
Duration: 1700.0 s

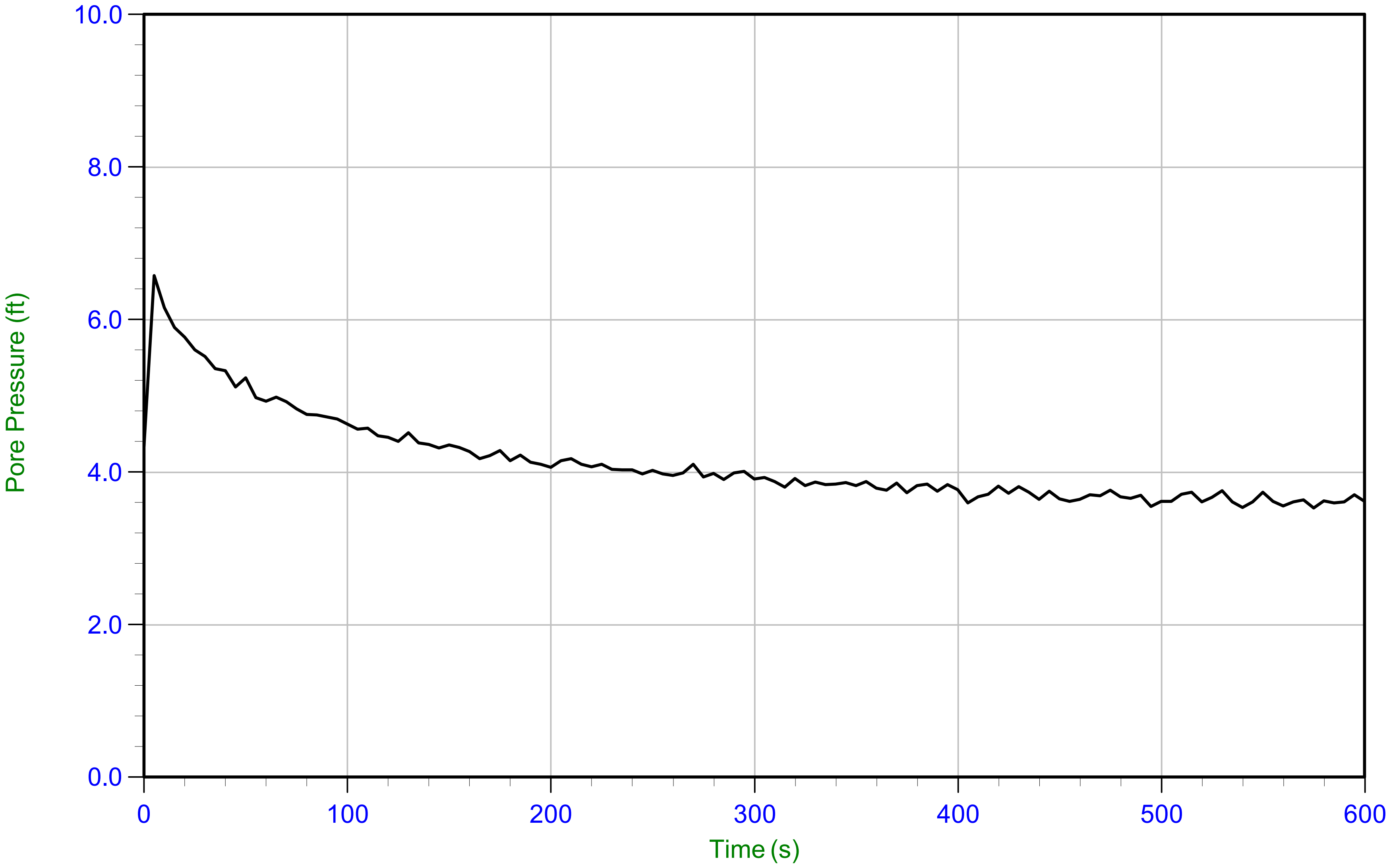
U Min: 0.8 ft
U Max: 4.9 ft

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

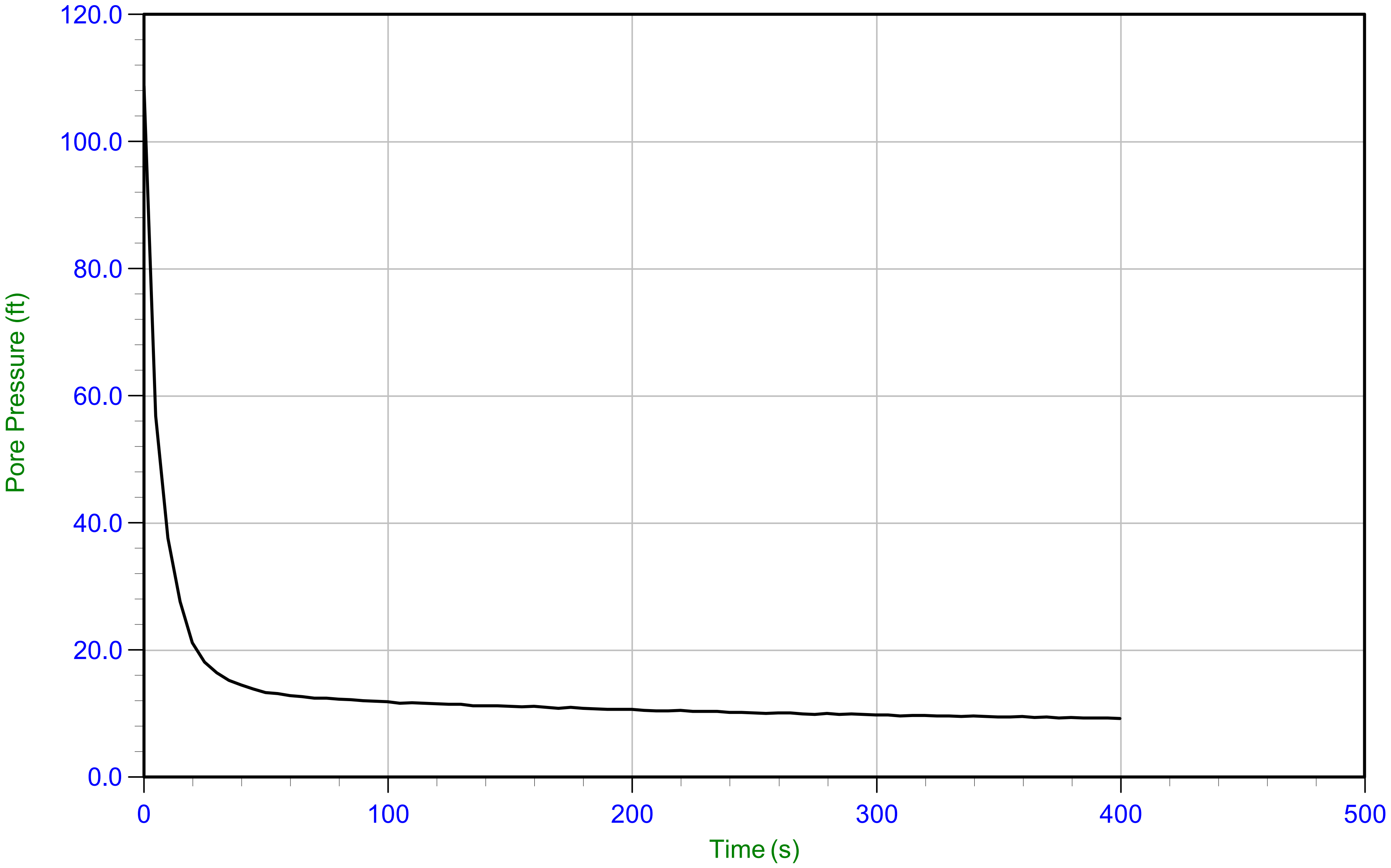
Filename: 15-53087_SP08.PPD
Depth: 6.900 m / 22.638 ft
Duration: 600.0 s

U Min: 3.5 ft
U Max: 6.6 ft

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_SP08.PPD
Depth: 7.900 m / 25.918 ft
Duration: 400.0 s

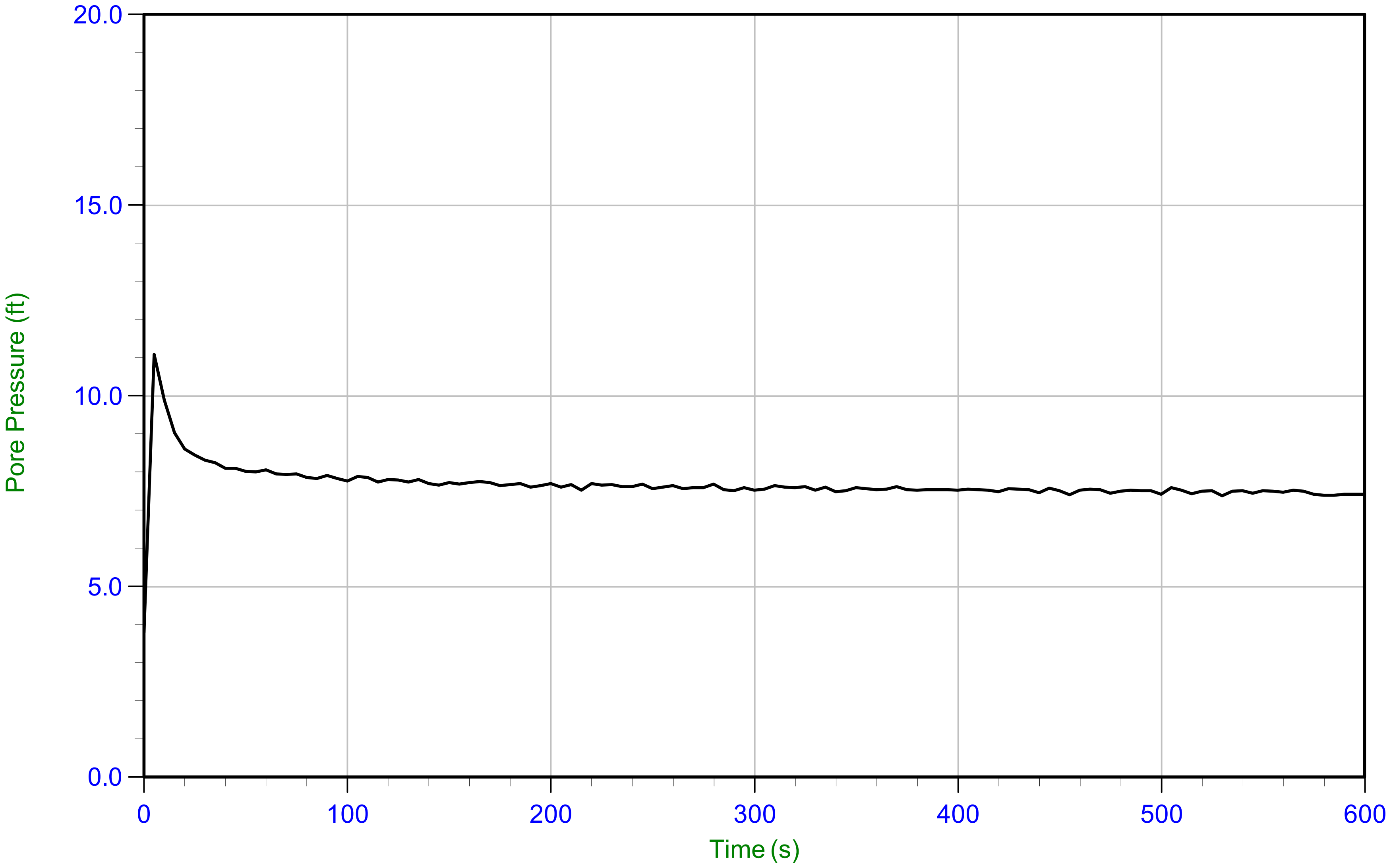
U Min: 9.2 ft
U Max: 108.8 ft

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm

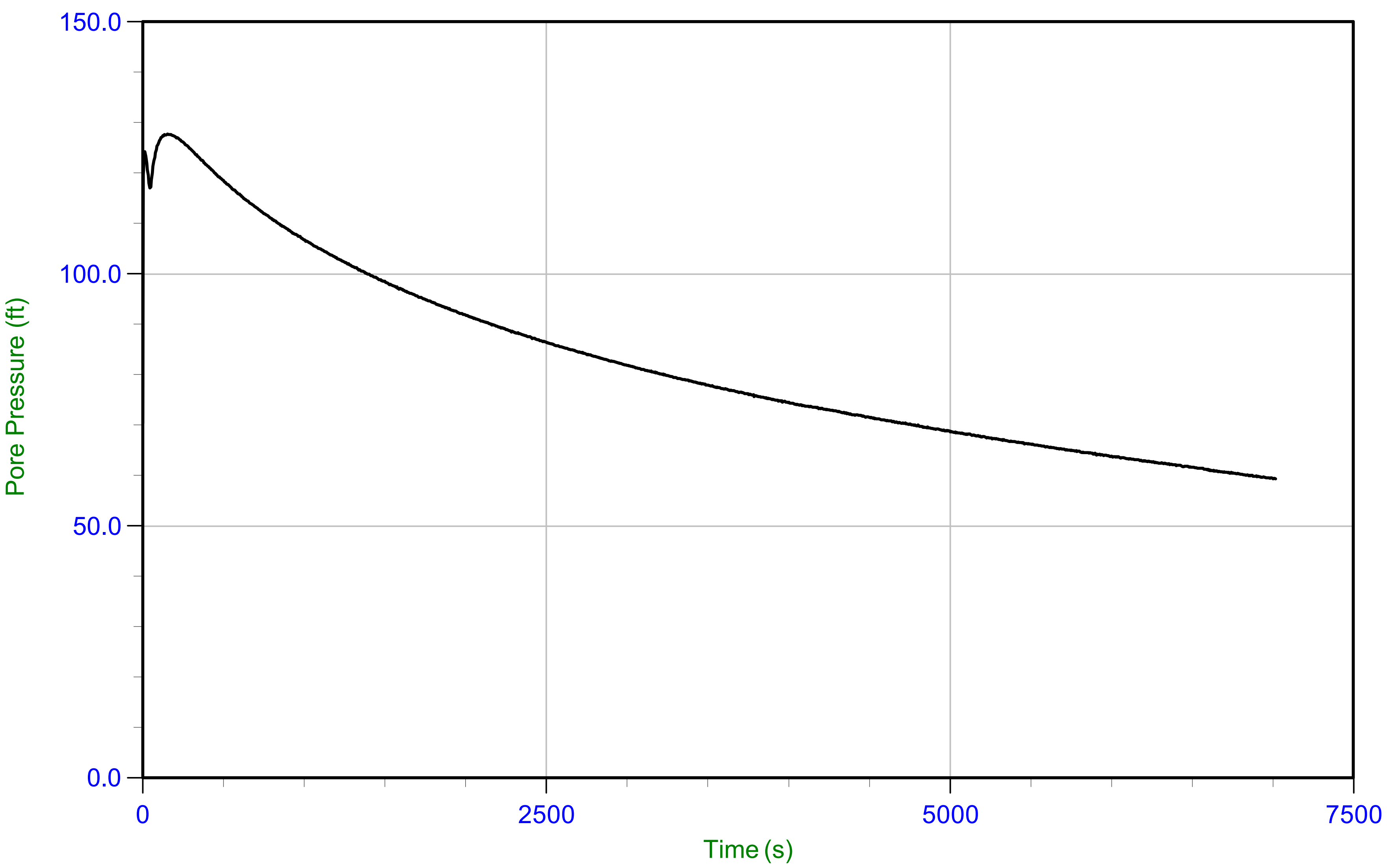


Trace Summary:

Filename: 15-53087_SP08.PPD
Depth: 8.900 m / 29.199 ft
Duration: 600.0 s

U Min: 3.8 ft
U Max: 11.1 ft

Haley & Aldrich	Job No: 15-53087	Sounding: SCPT15-HAC8
	Date: 16-Sep-2015 12:39:09	Cone: AD419
	Site: AECI-New Madrid	Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_SP08.PPD
Depth: 9.900 m / 32.480 ft
Duration: 7020.0 s

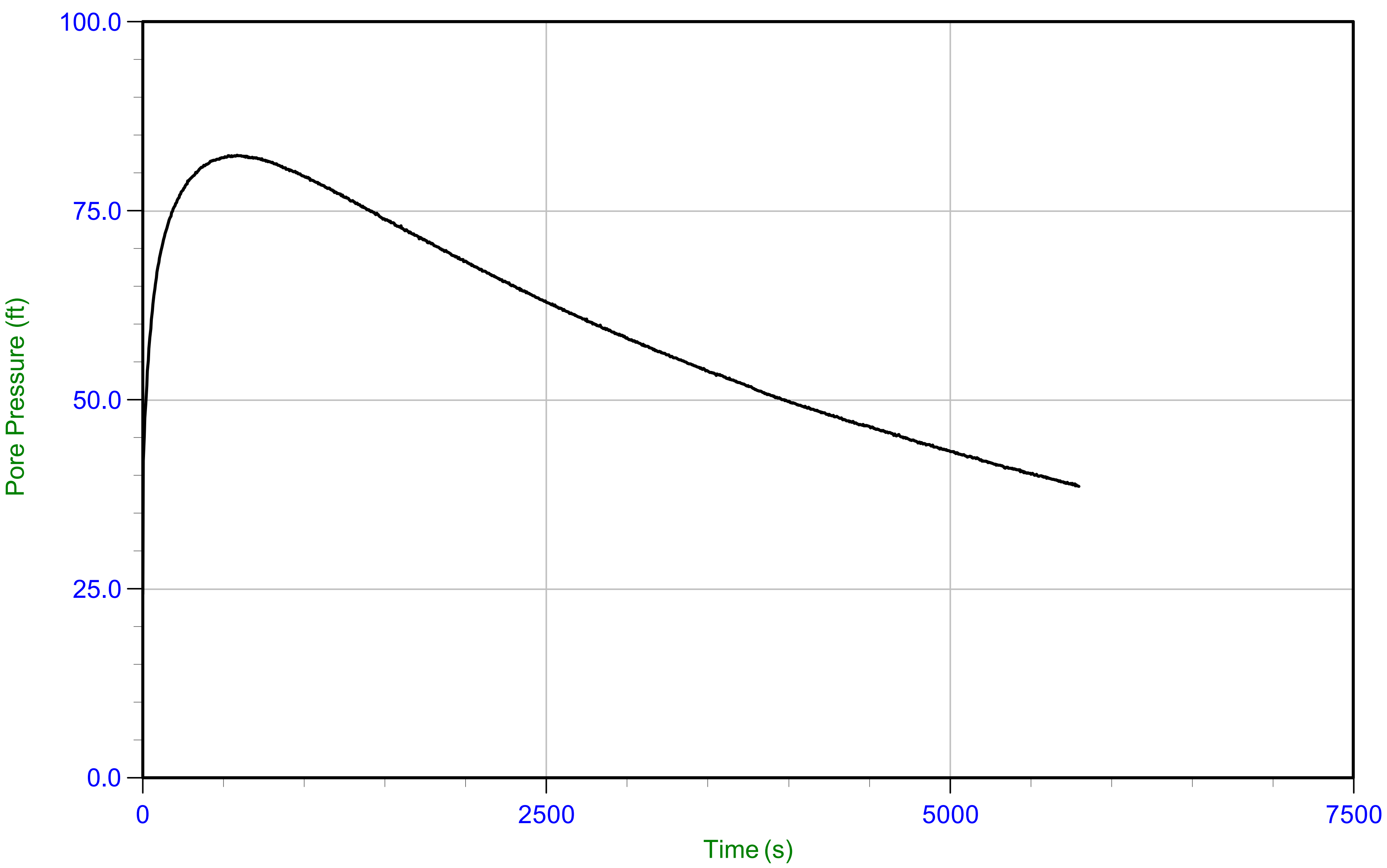
U Min: 59.3 ft
U Max: 127.7 ft

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_SP08.PPD
Depth: 10.900 m / 35.761 ft
Duration: 5800.0 s

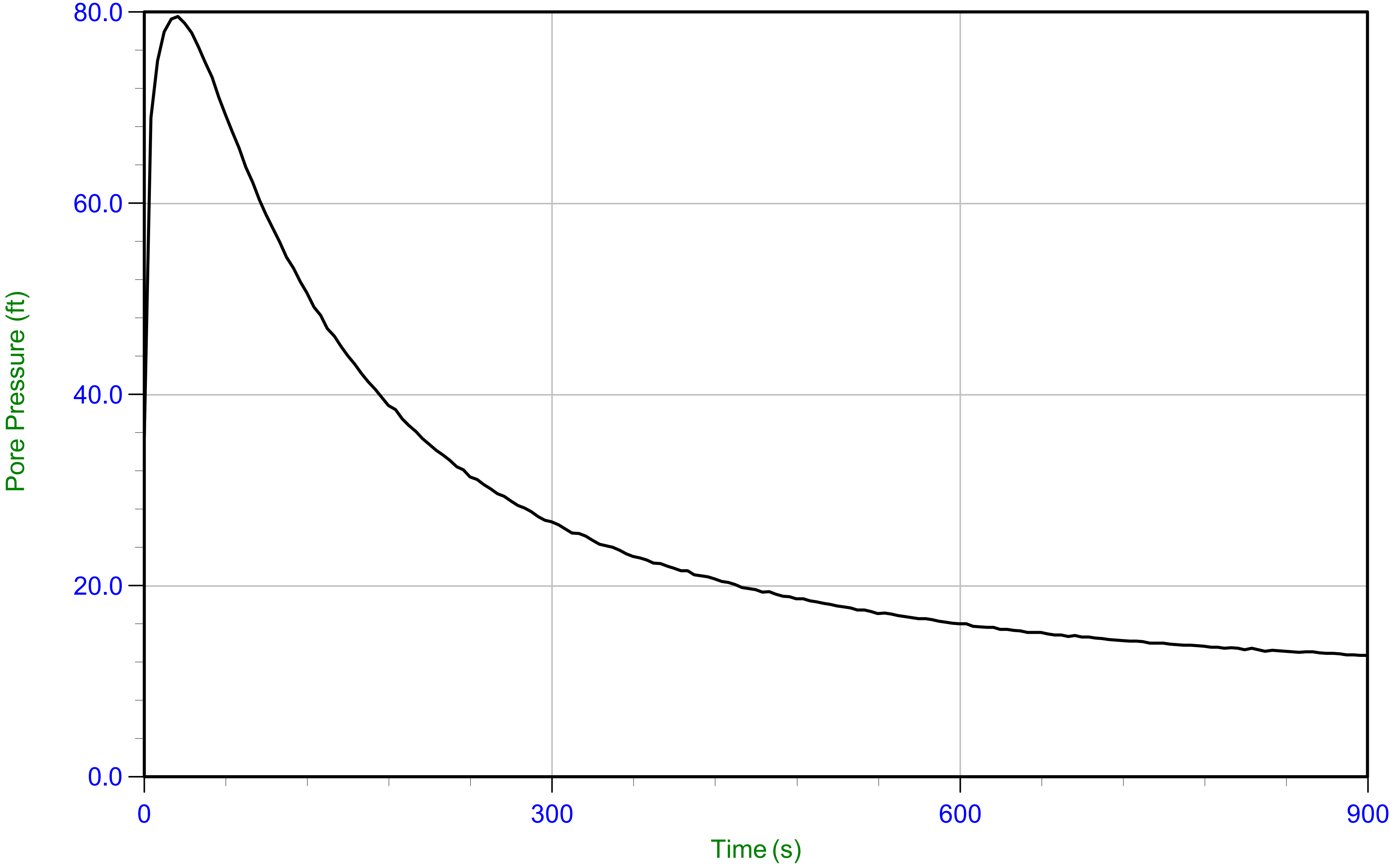
U Min: 24.3 ft
U Max: 82.4 ft

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_SP08.PPD
Depth: 11.900 m / 39.042 ft
Duration: 900.0 s

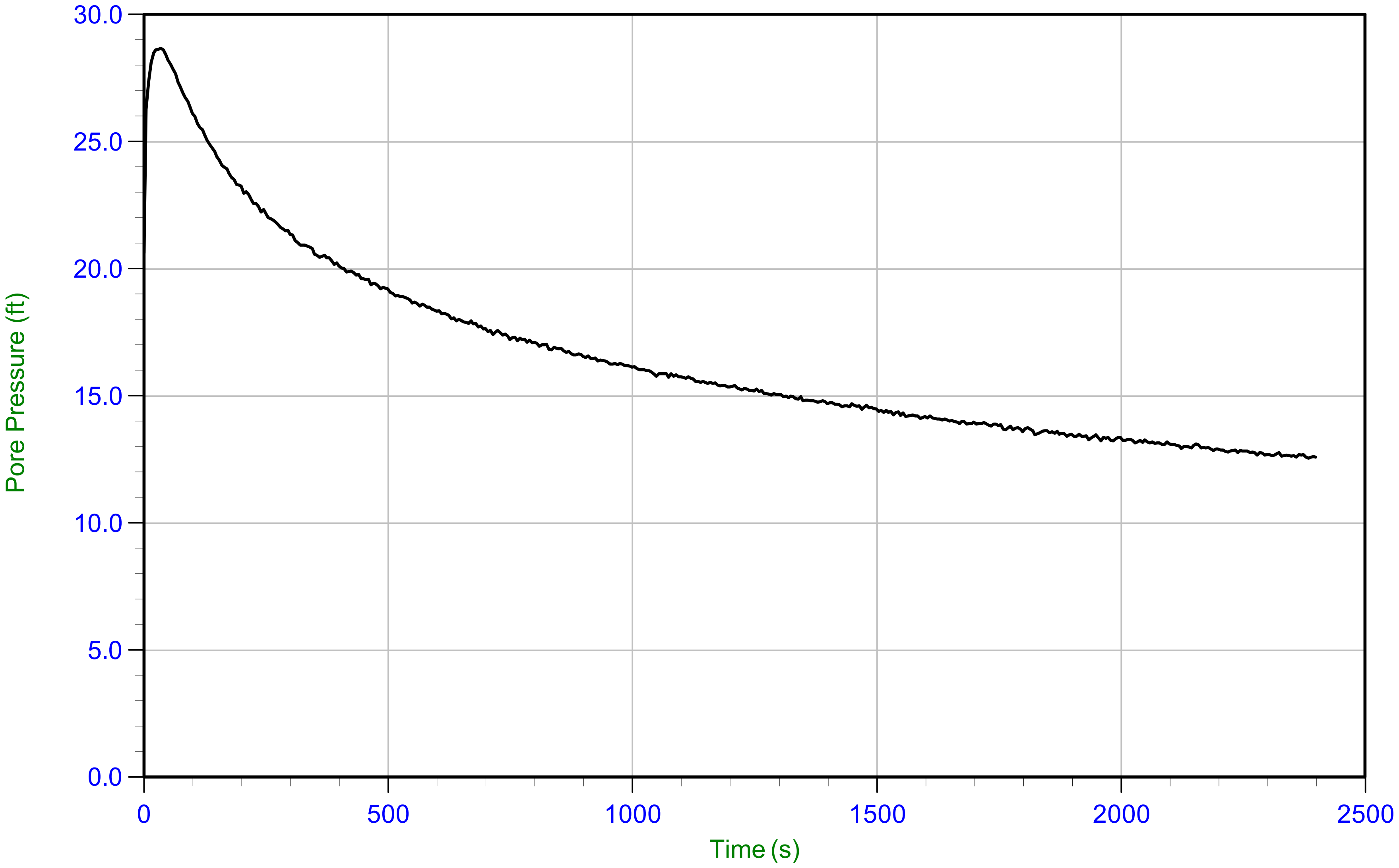
U Min: 12.7 ft
U Max: 79.6 ft

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

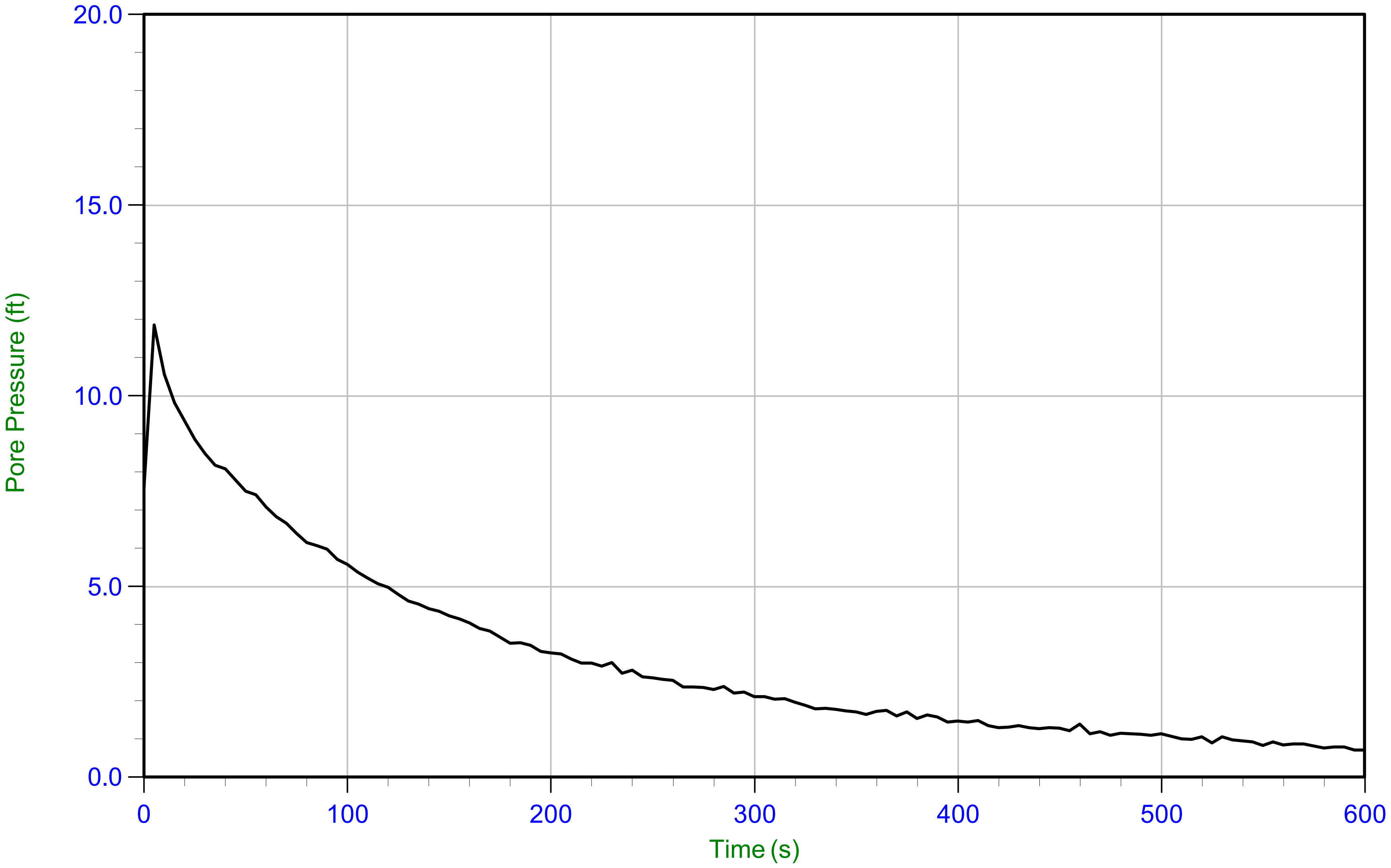
Filename: 15-53087_SP08.PPD
Depth: 12.900 m / 42.322 ft
Duration: 2400.0 s

U Min: 12.6 ft
U Max: 28.7 ft

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

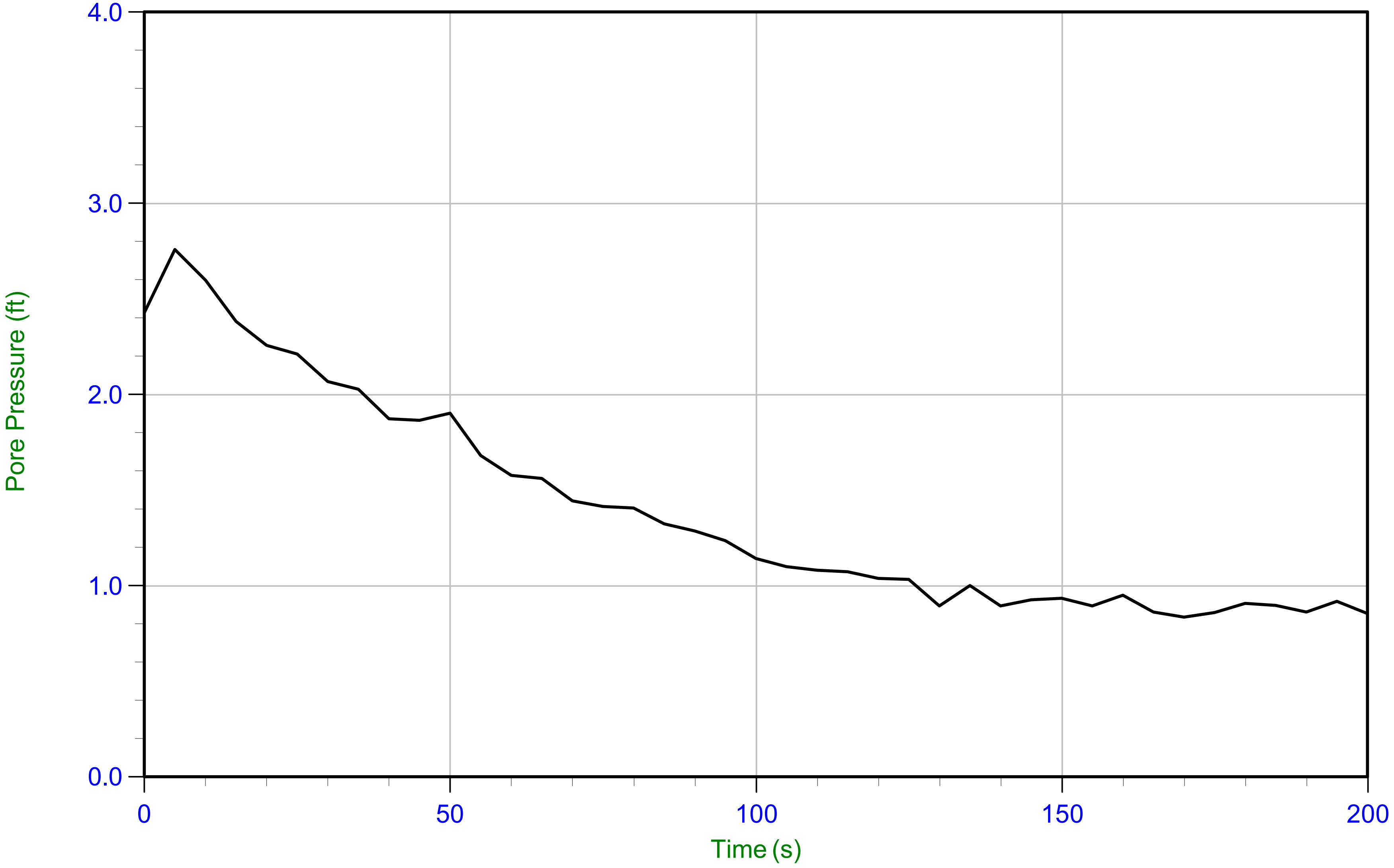
Filename: 15-53087_SP08.PPD
Depth: 13.900 m / 45.603 ft
Duration: 600.0 s

U Min: 0.7 ft
U Max: 11.9 ft

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_SP08.PPD
Depth: 14.900 m / 48.884 ft
Duration: 200.0 s

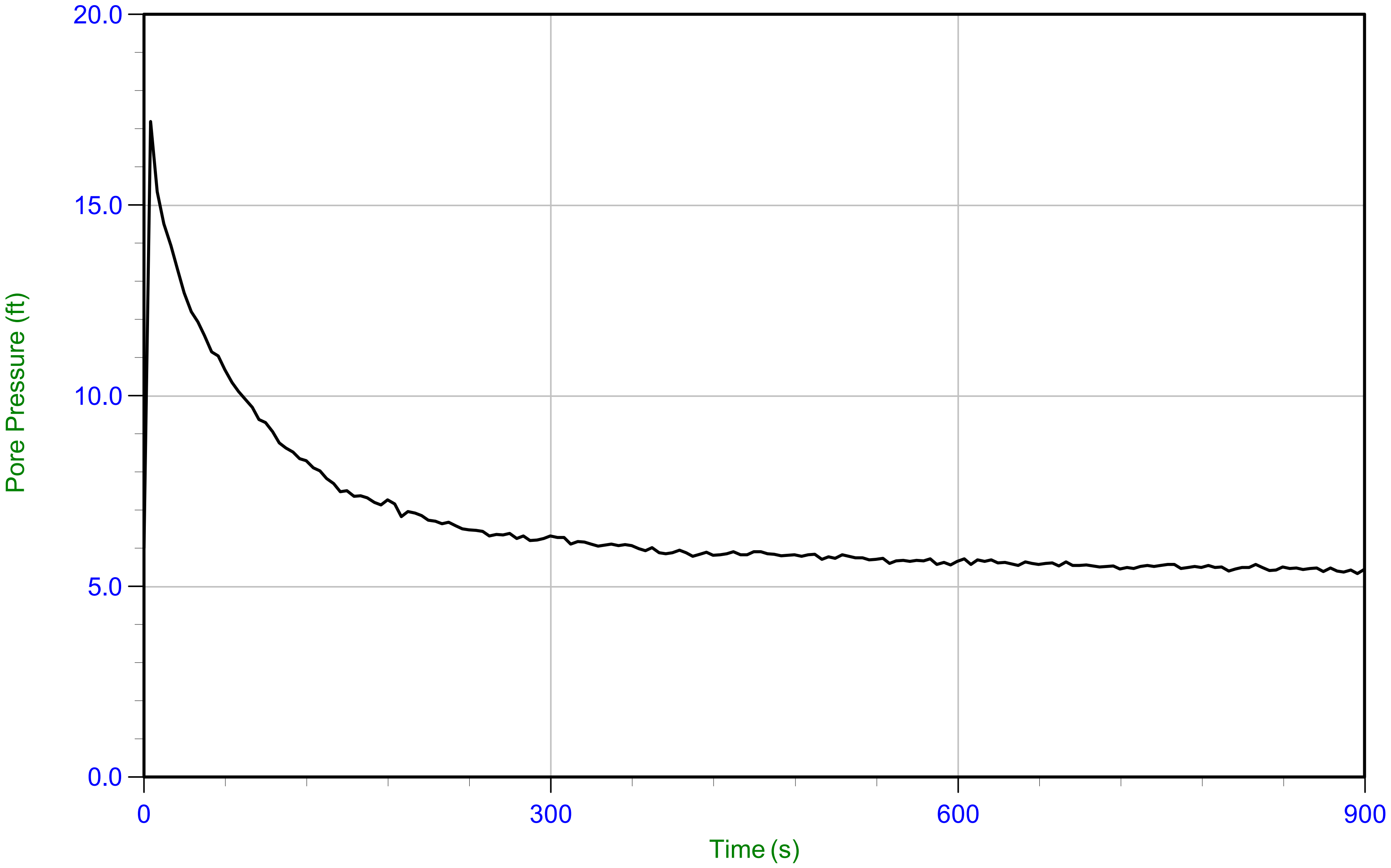
U Min: 0.8 ft
U Max: 2.8 ft

CONETEC

Haley & Aldrich

Job No: 15-53087
Date: 16-Sep-2015 12:39:09
Site: AECI-New Madrid

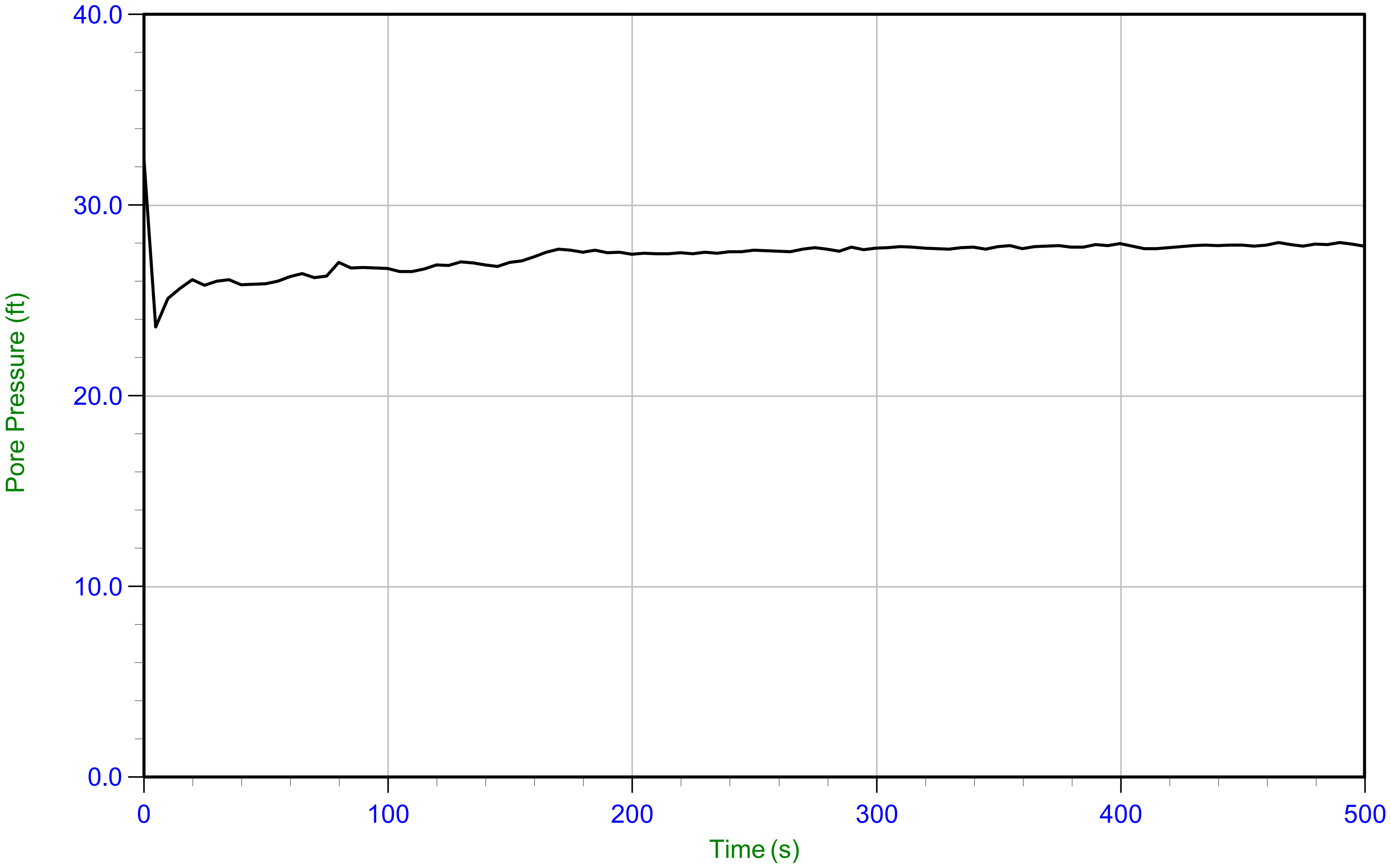
Sounding: SCPT15-HAC8
Cone: AD419
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53087_SP08.PPD
Depth: 15.250 m / 50.032 ft
Duration: 900.0 s

U Min: 5.3 ft
U Max: 17.2 ft



Trace Summary:

Filename: 15-53087_CP09.PPD
Depth: 22.900 m / 75.130 ft
Duration: 500.0 s

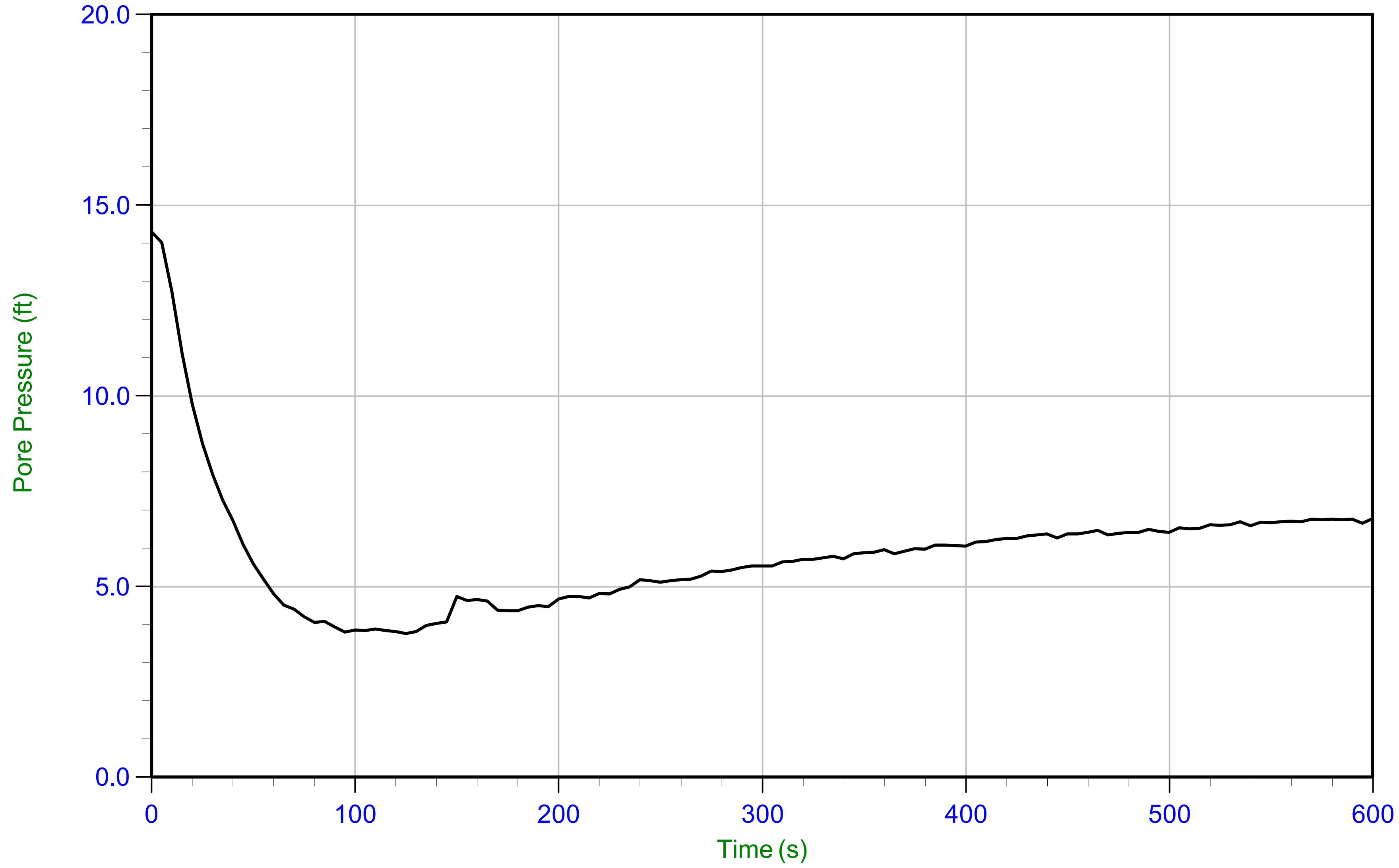
U Min: 23.6 ft
U Max: 32.4 ft

WT: 14.398 m / 47.237 ft
Ueq: 27.9 ft

Haley & Aldrich

Job No: 15-53087
Date: 17-Sep-2015 17:40:44
Site: AECI-New Madrid

Sounding: CPT15-HAC10
Cone: AD419
Cone Area: 15 sq cm



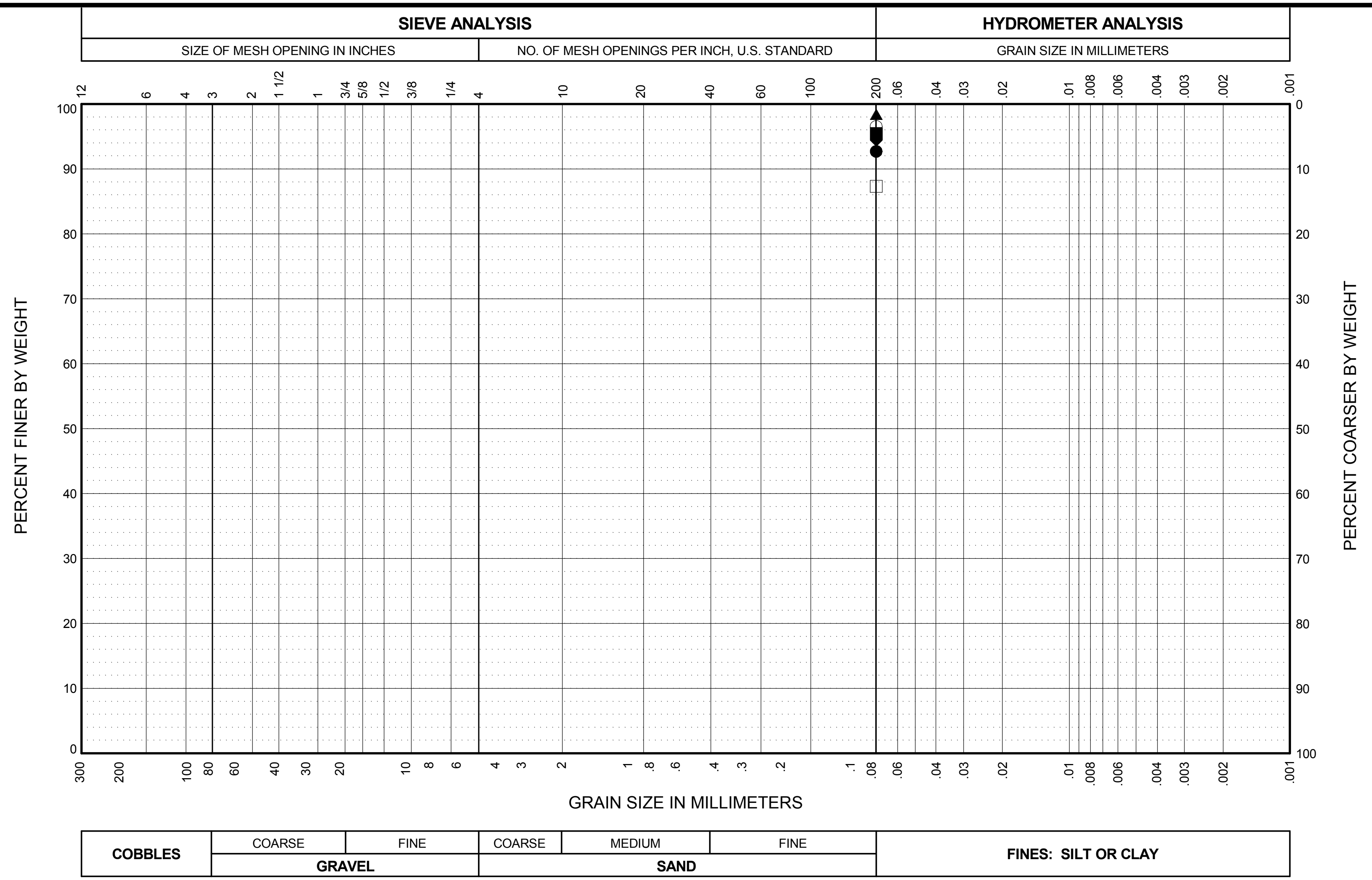
Trace Summary:

Filename: 15-53087_CP10.PPD
Depth: 15.400 m / 50.524 ft
Duration: 600.0 s

U Min: 3.8 ft
U Max: 14.3 ft

APPENDIX C

Laboratory Test Results



GSAMAIN2 41-1-37431-002 LAB DATA.GPJ SHAN_WIL.GDT 10/8/15

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B1, S6	11.0-13.0	CL	Gray-brown, Lean Clay.	92.7	22.8	42	20	22
■ HA-B3, S7	13.0-15.0	CL	Brown, Lean Clay.	95.5	22.8	47	22	25
▲ HA-B3, S10	28.0-30.0	CL	Light gray-brown, Lean Clay.	98.4	36.1			
◆ HA-B6, S4	7.0-9.0	CL	Gray-brown, Lean Clay.	94.4	22.6	45	21	24
○ HA-B6, S7	13.0-15.0	CL	Gray-brown, Lean Clay.	96.5	21.1	39	20	19
□ HA-B7, S6	11.0-13.0	CH	Light gray-brown, Fat Clay.	87.3	22.5	59	20	39

AECI Structural Integrity Assessments
Slag Dewatering Pond and Unlined Pond
Marston, Missouri

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October 2015 41-1-37431-003

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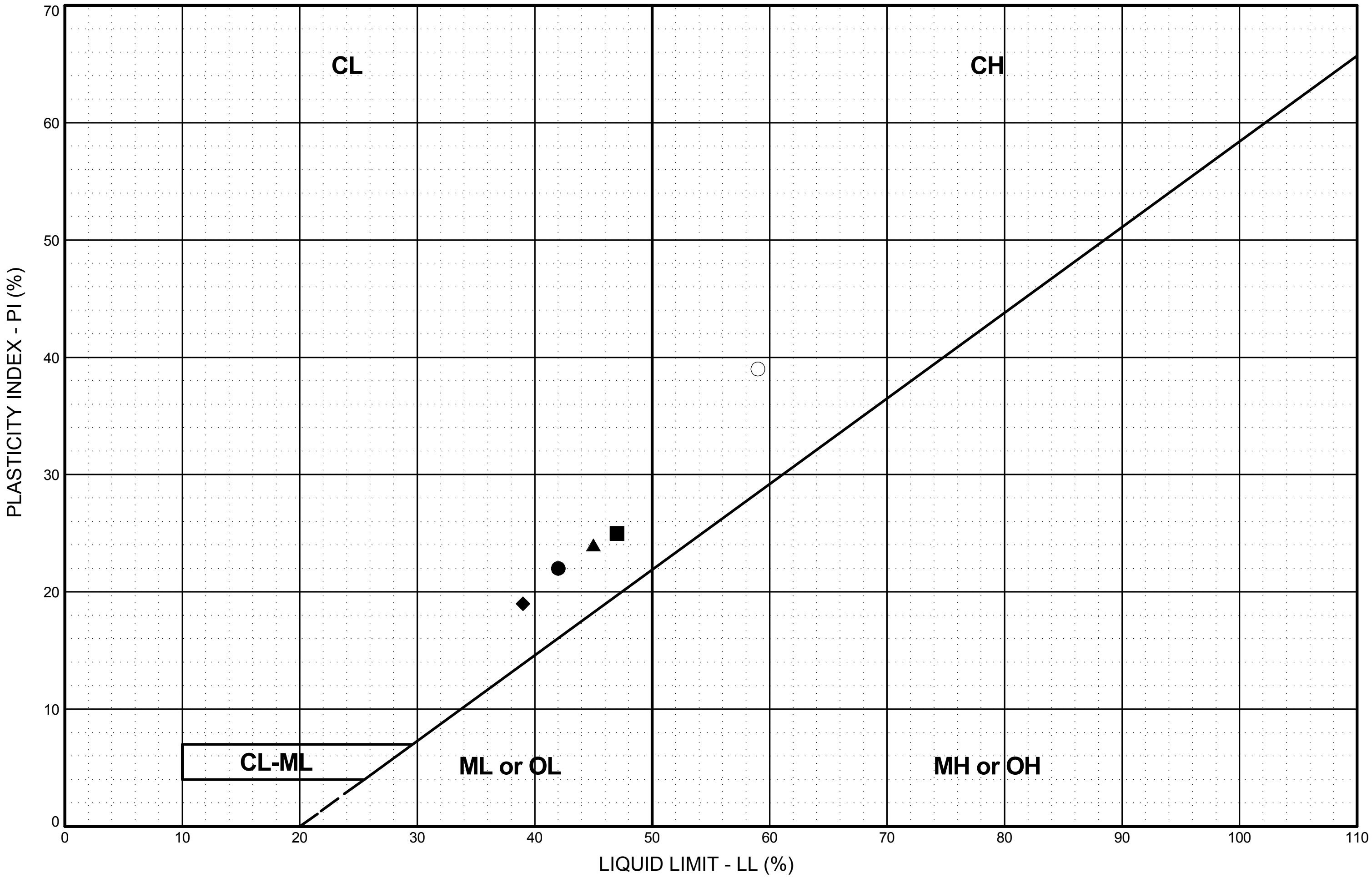
FIG.

FIG.



LEGEND

CL: Low plasticity inorganic clays; sandy and silty clays

CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● HA-B1, S6	11.0-13.0	CL	Gray-brown, Lean Clay.	42	20	22	22.8	92.7
■ HA-B3, S7	13.0-15.0	CL	Brown, Lean Clay.	47	22	25	22.8	95.5
▲ HA-B6, S4	7.0-9.0	CL	Gray-brown, Lean Clay.	45	21	24	22.6	94.4
◆ HA-B6, S7	13.0-15.0	CL	Gray-brown, Lean Clay.	39	20	19	21.1	96.5
○ HA-B7, S6	11.0-13.0	CH	Light gray-brown, Fat Clay.	59	20	39	22.5	87.3

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Marston, Missouri

PLASTICITY CHART

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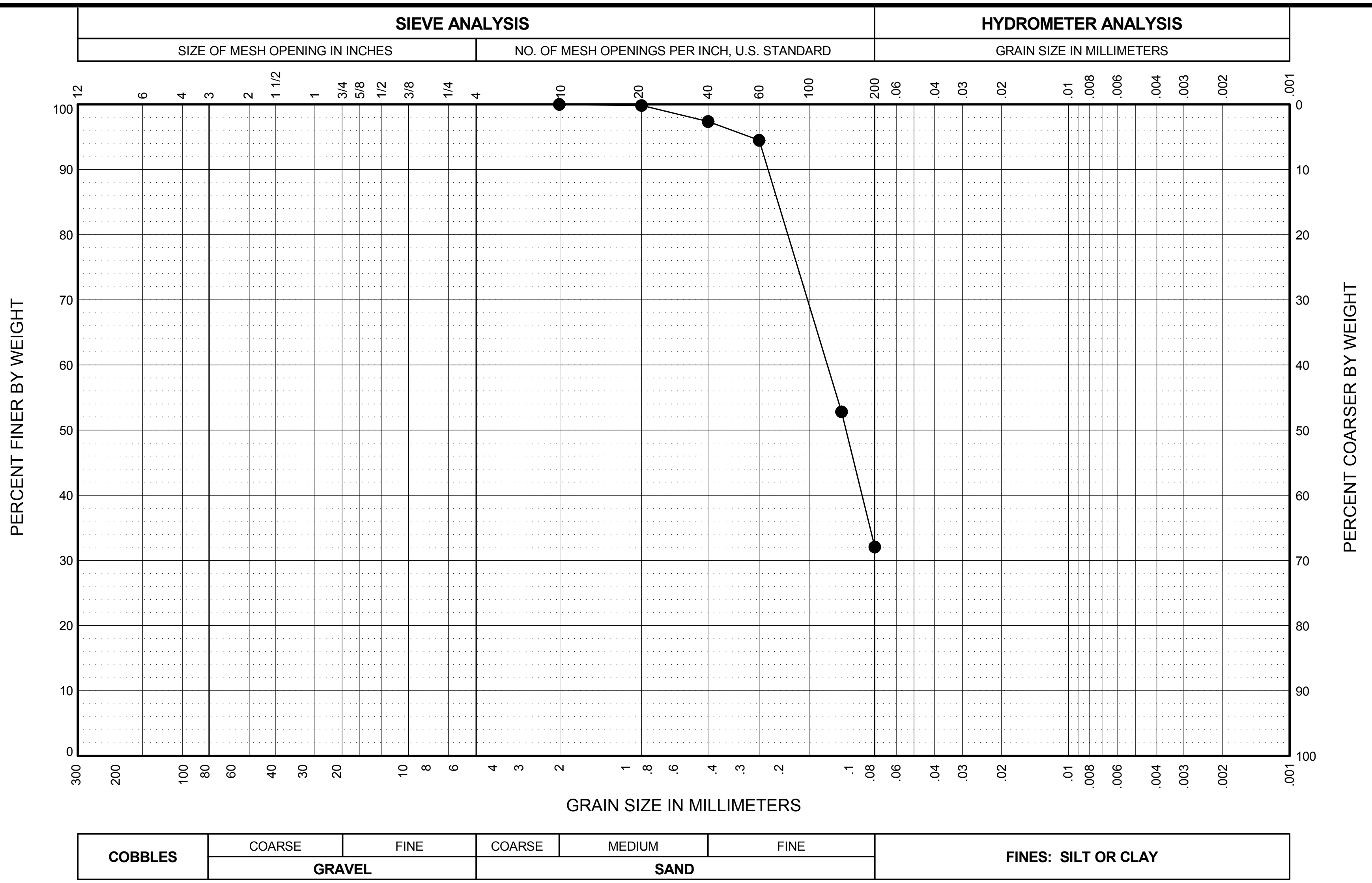
FIG.

ATTMAIN2 41-1-37431-002 LAB DATA.GPJ SHAN_WIL.GDT 10/8/15

FIG.



BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B2, S11	28.0-30.0	SM	Gray-brown, Silty Sand.	32.1	20.7			

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41-1-37431-003

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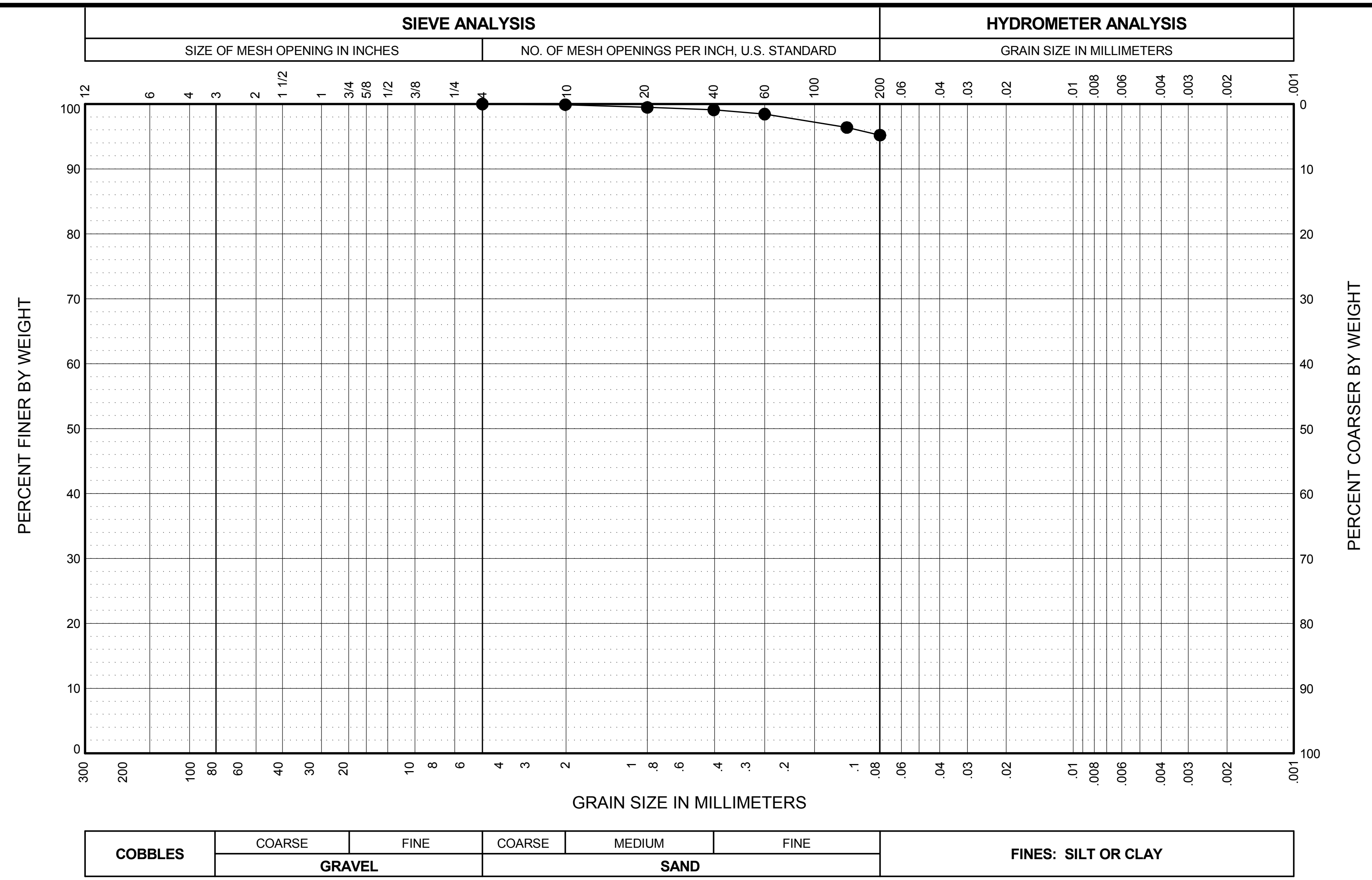
FIG.

FIG.



BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B3, S3	5.0-7.0	CL	Dark gray, Lean Clay.	95.2	26.7			

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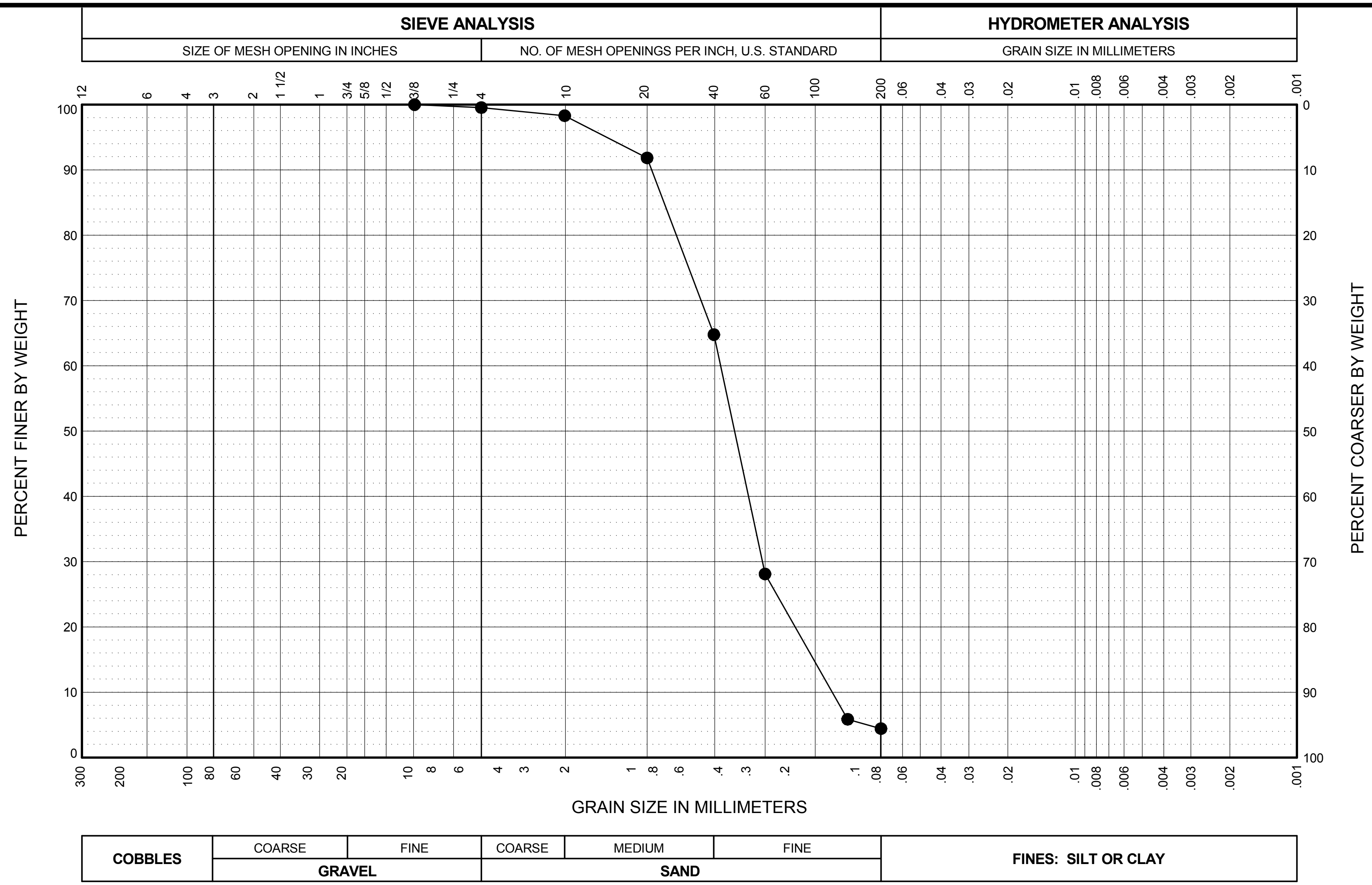
FIG.

FIG.

GSAMAIN2 41-1-37431-002 LAB DATA.GPJ SHAN_WIL.GDT 10/8/15



GSAMAIN2 41-1-37431-002 LAB DATA.GPJ SHAN_WIL.GDT 10/8/15

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B4, S15	48.0-50.0	SP	Brown, Poorly Graded Sand.	4.4	18.1			

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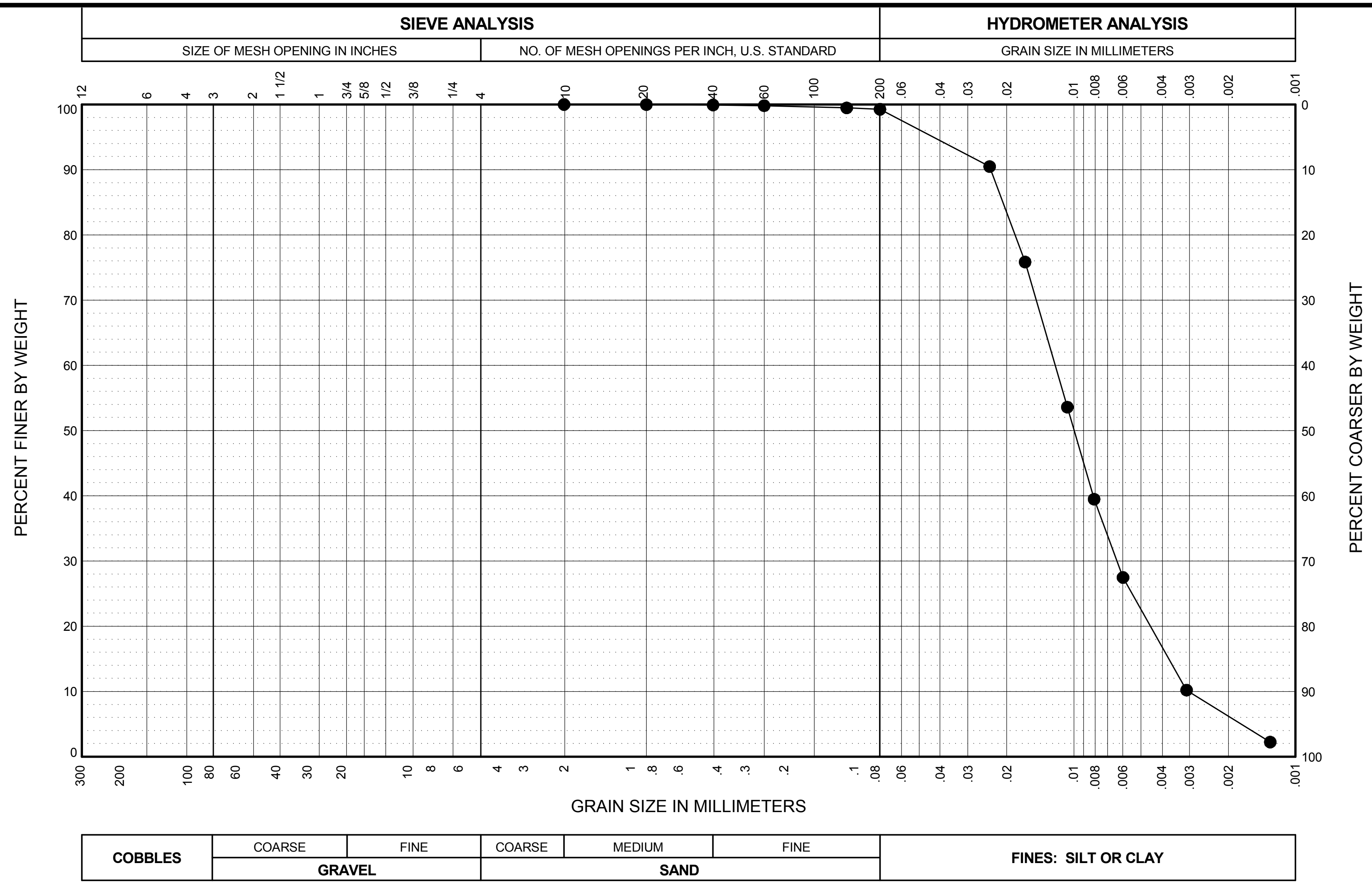
FIG.

FIG.

GSAMAIN2 41-1-37431-003 LAB DATA.GPJ SHAN_WIL.GDT 10/27/15



BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B4, U2	5.7	ML	Dark gray, Silt (Ash).	99.3	32.9			

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Slag Dewatering Pond and Unlined Pond
Marston, Missouri

GRAIN SIZE DISTRIBUTION

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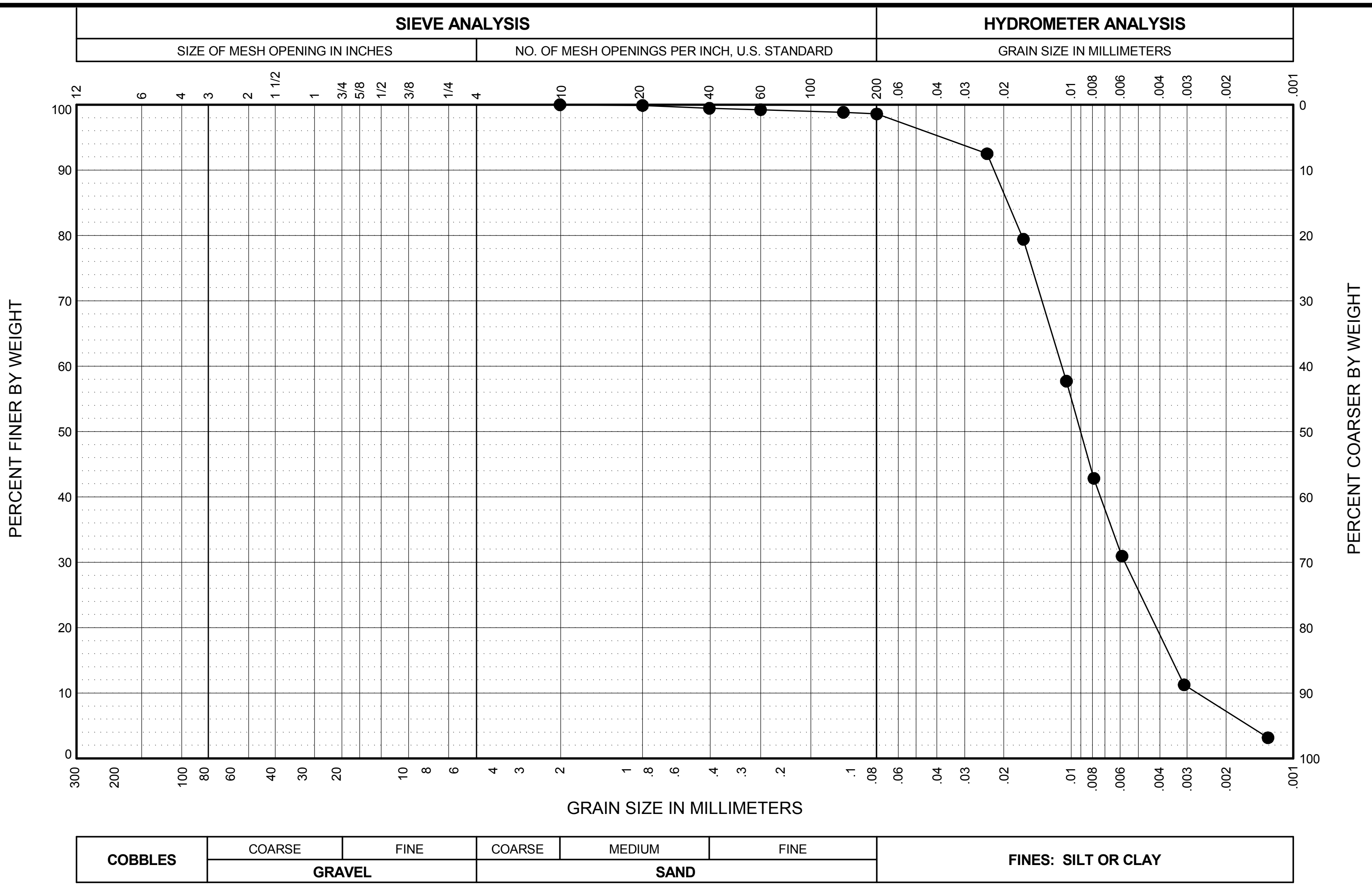
FIG.

FIG.



BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SAMPLE DESCRIPTION	FINES %	NAT. W.C. %	LL %	PL %	PI %
● HA-B5, U1	10.6	ML	Dark gray, Silt (Ash).	98.6	25.3			

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Marston, Missouri

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FIG.

GSAMAIN2 41-1-37431-003 LAB DATA.GPJ SHAN_WIL.GDT 10/27/15

FIG.

PROJECT AECI Structural Integrity Assessment DATE 10/12/15 BORING NO. HA-B4
JOB NO. 41-1-37431-003 SHEET NO. 1 TESTED BY CMB
CLIENT NAME Haley & Aldrich CHECKED BY

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U2 DEPTH (ft) 5.0-7.0
Sampling Method Push
Type of Sample Shelby Tube Inch 3"
Brass or [✓ Steel]

DEPTH FT.	NAT. W.C. Strength info.	W.C.	TYPE OF TEST	CLASSIFICATION
5.0				24 INCH RECOVERY Sample: [✓ Good] Fair Poor Disturbed
	PP=N/A	HAT-3	MC	Dark gray, Silt (ML) (ASH); moist; <10% fine sand, 90% low dry strength, rapid dilatancy, low plasticity.
			SAVED	
5.5			Consol/Hydro	
6.0			SAVED	
6.5				6.6 Dark gray, Silty Sand (SM) (Slag); moist; 20% low to no plasiticity fines; 80% fine to coarse grained, subangular, sand.
7.0	PP=N/A	HAT-4	MC	

Can/Tare No.	HAT-3	HAT-4
WET + TARE	74.43	73.65
DRY + TARE	58.35	56.61
TARE	2.54	2.57
% WATER	28.8	31.5

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

REMARKS:

Shannon & Wilson, Inc.
2043 Westport Center Drive
St. Louis, MO 63146

PROJECT AECI Structural Integrity Assessment
DATE 10/14/15
BORING NO. HA-B5
JOB NO. 41-1-37431-003
SHEET NO. 1
TESTED BY CMB
CLIENT NAME Haley & Aldrich
CHECKED BY

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U1
DEPTH (ft) 10.0-12.0
Sampling Method Push
Type of Sample Shelby Tube
Inch 3"
Brass or [✓ Steel]

DEPTH FT.	NAT. W.C. Strength info.	W.C.	TYPE OF TEST	CLASSIFICATION
				24 INCH RECOVERY Sample: [✓ Good] Fair Poor Disturbed
10.0	PP=N/A	HAT-5	MC	Dark gray, Silt (ML) (ASH); moist; <10% fine sand, 90% low dry strength, rapid dilatancy, low plasticity.
			SAVED	
10.5			Consol/Hydro	
			SAVED	-Sample below 10.8 feet very soft, seeped past extruder head during pushing.
11.0				
11.5				Moisture sample obtained from sample lining tube.
12.0	PP=N/A	HAT-6	MC	

Can/Tare No.	HAT-5	HAT-6
WET + TARE	45.03	35.53
DRY + TARE	35.54	24.87
TARE	2.56	2.54
% WATER	28.8	47.7

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

REMARKS:

Shannon & Wilson, Inc.
2043 Westport Center Drive
St. Louis, MO 63146

PROJECT AECI Structural Integrity Assessment DATE 10/9/15 BORING NO. HA-B5

JOB NO. 41-1-37431-003 SHEET NO. 1 TESTED BY CMB

CLIENT NAME Haley & Aldrich CHECKED BY

CLASSIFICATION OF UNDISTURBED SAMPLE

SAMPLE NO. U2 DEPTH (ft) 20.0-22.0

Sampling Method Push

Type of Sample Shelby Tube Inch 3"

Brass or [✓ Steel]

DEPTH FT.	NAT. W.C.		TYPE OF TEST	CLASSIFICATION
	Strength info.	W.C.		
				24 INCH RECOVERY Sample: [✓ Good] Fair Poor Disturbed
20.0	PP=N/A	HAT-1	MC SAVED	Dark gray, Silt (ML) (ASH) with fine to coarse Sand layers (slag), moist; 20% fine to coarse, subangualr sand; 80% low dry strength, rapid dilatancy, low plasticity.
20.5			UU	
21.0			SAVED	
21.5			Consol SAVED	
22.0	PP=N/A	HAT-2	MC	

Can/Tare No.	HAT-1	HAT-2
WET + TARE	61.95	76.46
DRY + TARE	48.31	58.13
TARE	2.52	2.54
% WATER	29.8	33.0

Procedure: ASTM D 2488

NOTE: Soil description is based on visual-manual procedure. This description is not meant for engineering purposes requiring precise classification of soils.

All sample percentages for cobbles and boulders are by volume.

REMARKS:

TUBE DENSITY
ASTM D2937

Project	AECI Structural Integrity Assessment	Client	Haley & Aldrich	
Location	Marston, Missouri	Tested By / Date	CMB	10/9-14/15
Job No.	41-1-37431-003	Calculated By / Date	CMB	10/16/15
File	41-1-37431-003 D2937	Checked By / Date	CMB	10/16/15

Sample Boring	HA-B4	HA-B5	HA-B5	
Sample Number	U2	U1	U2	
Sample Depth	5.0 - 7.0	10.0 - 12.0	20.0 - 22.0	
Height (in)	22.620	23.790	23.845	
Diameter (in)	2.881	2.862	2.884	
Weight (gms)	4030.5	3983	4280.00	
Tare ID				
Tare weight (gms)				
Wet Weight (gms)				
Dry Weight (gms)				
Moisture %	30.2	38.3	34.6	
Area (in^2)	6.52	6.43	6.53	0.00
Volume (in)	147.46	153.05	155.77	0.00
Volume (ft)	0.09	0.09	0.09	0.00
Volume (cm)	2416.41	2507.99	2552.58	0.00
Wet Density (pcf)	104.1	99.1	104.7	#DIV/0!
Dry Density (pcf)	80.0	71.7	77.8	#DIV/0!

CONSOLIDATION TEST

Sheet 1

Project	AECI Structural Integrity Assessment			Client		Haley & Aldrich, Inc.	
Location	Marston, Missouri			Tested By / Date		CMB	10/21/15
Job Number	41-1-37431-003			Calculated By / Date		CMB	10/30/15
Boring	HA-B4			Checked By / Date		JTB	11/2/15
Sample	U2			File		41-1-37431-003 HA-B4 U2 D2435	
Depth (ft)	5.7			Procedure		ASTM D2435	
	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.004	2.503	0.850	inches	Tare No.	C-1	
Measured Reading 2	1.003	2.502	0.850	inches	Tare Weight	2.51	
Measured Reading 3	1.005	2.505	0.849	inches	Wet Weight	50.82	
Measured Reading 4	1.004	2.503	0.849	inches	Dry Weight	38.60	
Average Reading	1.004	2.503	0.850	inches	M.C. %	33.9%	
Wet Weight + Ring	288.07	Wet+Ring+Tare	358.83	grams	*Trimmings #2*		
Weight of Ring	144.11	Dry+Ring+Tare	330.88	grams	Tare No.	C-2	
Specific Gravity	2.66	Tare Weight	82.92	grams	Tare Weight	2.56	
Sample Volume	80.97		66.97	cm^3	Wet Weight	43.76	
Height of Solids	0.484		0.484	inches	Dry Weight	33.77	
Void Ratio	1.08		0.72		M.C. %	32.0%	
Saturation	95.6		100.0	percent	Ring Number	410	
Weight of Water	40.11		27.95	grams	Inundated @	0.27	tsf
Moisture Content	38.6		26.9	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	111.0		122.9	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	80.1		96.8	pcf	Method Used	[✓ A] or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.830	inches

Load 1		Load 2		Load 3		Load 4	
Air Press.	1.6	Air Press.	2.4	Air Press.	3.9	Air Press.	7.1
Load, tsf	0.25	Load, tsf	0.5	Load, tsf	1.0	Load, tsf	2.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	77	0.1	120	0.1	183	0.1	390
0.25	79	0.25	123	0.25	191	0.25	421
0.5	80	0.5	124	0.5	198	0.5	443
1	81	1	126	1	201	1	459
2	82	2	128	2	204	2	471
4	83	4	130	4	209	4	480
8	85	8	131	8	212	8	488
17	87	15	133	15	216	15	495
30	88	30	135	30	220	30	501
60		60		60		60	506
120		120		120		120	512
240		240		240		240	517
480		480		480		370	520
1440		1440		1440		1305	528

Load 5		Load 6		Load 7		Load 8	
Air Press.	3.9	Air Press.	2.4	Air Press.	3.9	Air Press.	7.1
Load, tsf	1.0	Load, tsf	0.5	Load, tsf	1.0	Load, tsf	2.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	518	0.1	507	0.1	510	0.1	525
0.25	517	0.25	507	0.25	510	0.25	526
0.5	517	0.5	507	0.5	510	0.5	526
1	517	1	506	1	510	1	526
2	517	2	506	2	510	2	527
4	516	4	505	4	510	4	527
8	516	8	505	8	511	8	528
15	516	15	504	15	511	15	528
30		30		30		30	529
60		60		60		60	
120		120		120		120	
240		240		240		240	
480		480		480		480	
1440		1440		1440		1440	

CONSOLIDATION TEST

Sheet 2

Project	AECI Structural Integrity Assessment	Client	Haley & Aldrich, Inc.	
Location	Marston, Missouri	Tested By / Date	CMB	10/21/15
Job Number	41-1-37431-003	Calculated By / Date	CMB	10/30/15
Boring	HA-B4	Checked By / Date	JTB	11/2/15
Sample	U2	File	41-1-37431-003 HA-B4 U2 D2435	
Depth (ft)	5.7	Procedure	ASTM D2435	

	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.004	2.503	0.850	inches	Tare No.	C-1	
Measured Reading 2	1.003	2.502	0.850	inches	Tare Weight	2.51	
Measured Reading 3	1.005	2.505	0.849	inches	Wet Weight	50.82	
Measured Reading 4	1.004	2.503	0.849	inches	Dry Weight	38.60	
Average Reading	1.004	2.503	0.850	inches	M.C. %	33.9%	
Wet Weight + Ring	288.07	Wet+Ring+Tare	358.83	grams	*Trimmings #2*		
Weight of Ring	144.11	Dry+Ring+Tare	330.88	grams	Tare No.	C-2	
Specific Gravity	2.66	Tare Weight	82.92	grams	Tare Weight	2.56	
Sample Volume	80.97		66.97	cm^3	Wet Weight	43.76	
Height of Solids	0.484		0.484	inches	Dry Weight	33.77	
Void Ratio	1.08		0.72		M.C. %	32.0%	
Saturation	95.6		100.0	percent	Ring Number	410	
Weight of Water	40.11		27.95	grams	Inundated @	0.27	tsf
Moisture Content	38.6		26.9	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	111.0		122.9	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	80.1		96.8	pcf	Method Used	[✓ A] or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.830	inches

Load 9		Load 10		Load 11		Load 12	
Air Press.	13.3	Air Press.	25.9	Air Press.	50.8	Air Press.	101.3
Load, tsf	4.0	Load, tsf	8.0	Load, tsf	16.0	Load, tsf	32.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	707	0.1	1104	0.1	1473	0.1	1812
0.25	762	0.25	1147	0.25	1503	0.25	1830
0.5	788	0.5	1167	0.5	1518	0.5	1841
1	804	1	1180	1	1530	1	1851
2	817	2	1193	2	1540	2	1859
4	827	4	1203	4	1548	4	1867
8	838	8	1211	8	1556	8	1874
15	845	15	1219	15	1563	15	1880
30	851	30	1226	30	1570	30	1886
60	858	60	1232	60	1575	60	1891
120	863	120	1238	120	1580	120	1897
240	868	240	1243	240	1586	240	1902
410	871	480	1248	480	1591	480	1906
4245	884	1440	1255	1440	1598	1440	1913

CONSOLIDATION TEST

Sheet 3

Project	AECI Structural Integrity Assessment	Client	Haley & Aldrich, Inc.	
Location	Marston, Missouri	Tested By / Date	CMB	10/21/15
Job Number	41-1-37431-003	Calculated By / Date	CMB	10/30/15
Boring	HA-B4	Checked By / Date	JTB	11/2/15
Sample	U2	File	41-1-37431-003 HA-B4 U2 D2435	
Depth (ft)	5.7	Procedure	ASTM D2435	

	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.004	2.503	0.850	inches	Tare No.	C-1	
Measured Reading 2	1.003	2.502	0.850	inches	Tare Weight	2.51	
Measured Reading 3	1.005	2.505	0.849	inches	Wet Weight	50.82	
Measured Reading 4	1.004	2.503	0.849	inches	Dry Weight	38.60	
Average Reading	1.004	2.503	0.850	inches	M.C. %	33.9%	
Wet Weight + Ring	288.07	Wet+Ring+Tare	358.83	grams	*Trimmings #2*		
Weight of Ring	144.11	Dry+Ring+Tare	330.88	grams	Tare No.	C-2	
Specific Gravity	2.66	Tare Weight	82.92	grams	Tare Weight	2.56	
Sample Volume	80.97		66.97	cm^3	Wet Weight	43.76	
Height of Solids	0.484		0.484	inches	Dry Weight	33.77	
Void Ratio	1.08		0.72		M.C. %	32.0%	
Saturation	95.6		100.0	percent	Ring Number	410	
Weight of Water	40.11		27.95	grams	Inundated @	0.27	tsf
Moisture Content	38.6		26.9	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	111.0		122.9	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	80.1		96.8	pcf	Method Used	[✓ A] or B	
					Computed Ht.	0.830	inches

Notes: The specific gravity is computed assuming saturation at the end of the test.

CALIBRATION OF CONSOLIDATION DEFORMATION

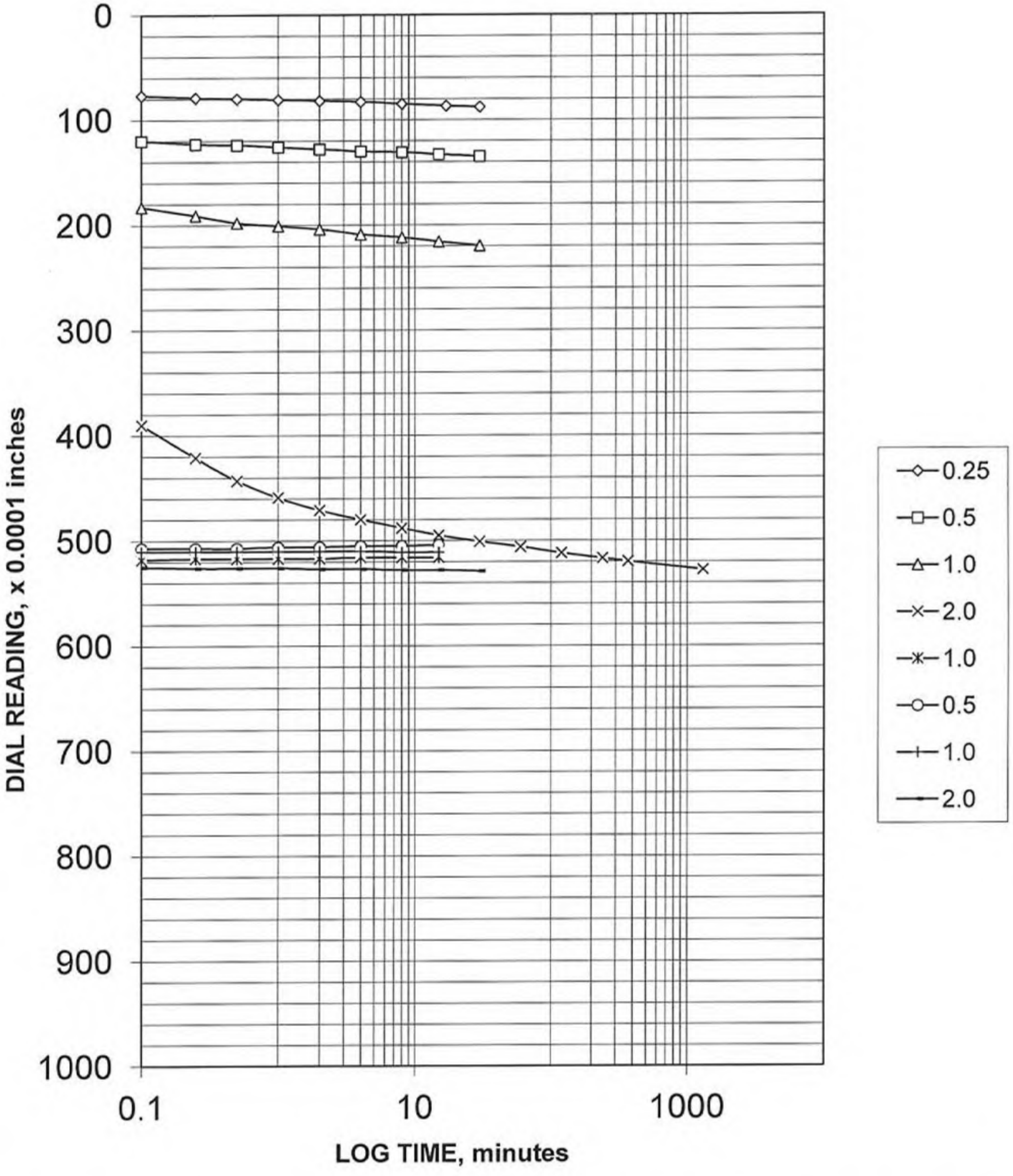
Procedure SWCP-15 (Reference ASTM D2435 AASHTO T216)

Equipment Calibrated:	Consolidation Deformation	Date Calibrated:	10/29/15
Reason for Calibration:	Test Completion	Next Calibration Due:	Next Test
Equipment Used:	Consolidation Appartus	Calibrated By:	CMB
	Steel Calibration Disk	Checked By:	CMB

Machine Number: 410

Load tsf	Machine Def x 10^{-4}	Correction Factor x 10^{-4}	U-100 x 10^{-4}	Corr. U-100 x 10^{-4}	Compression, Percent	C_v	Void Ratio
0.01	0	0	0	0	0.00%	0	1.08
0.25	41	0	79.0	38	0.38%	3.3E+00	1.07
0.5	56	0	123.0	67	0.67%	3.3E+00	1.06
1.0	72	0	198.0	126	1.26%	2.4E+00	1.05
2.0	92	0	485.0	393	3.93%	1.3E+00	0.99
1.0	84	43	517.0	390	3.90%	NA	0.99
0.5	77	43	506.0	386	3.86%	NA	1.00
1.0	81	43	511.0	387	3.87%	NA	1.00
2.0	83	43	526.0	400	4.00%	NA	0.99
4.0	113	0	838.0	725	7.25%	1.2E+00	0.93
8.0	136	0	1209.0	1073	10.73%	1.0E+00	0.85
16.0	158	0	1541.0	1383	13.83%	1.2E+00	0.79
32.0	177	0	1863.0	1686	16.86%	9.8E-01	0.73

CONSOLIDATION TEST



AECI Structural Integrity Assessment
Marston, Missouri

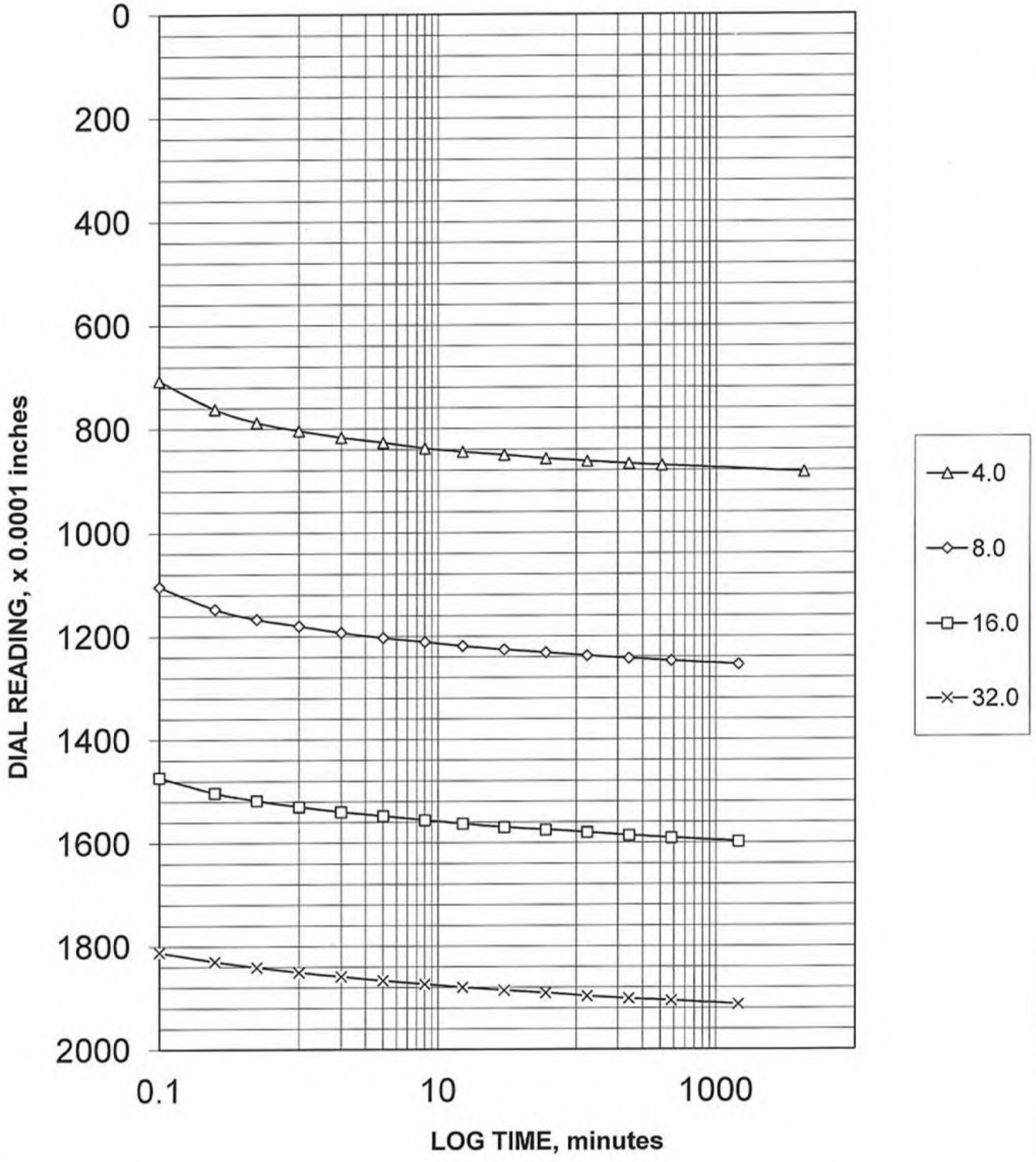
TIME PLOTS
HA-B4
U2

October 2015 41-1-37431-003

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG.

CONSOLIDATION TEST



AECI Structural Integrity Assessment
Marston, Missouri

TIME PLOTS
HA-B4
U2

October 2015 41-1-37431-003

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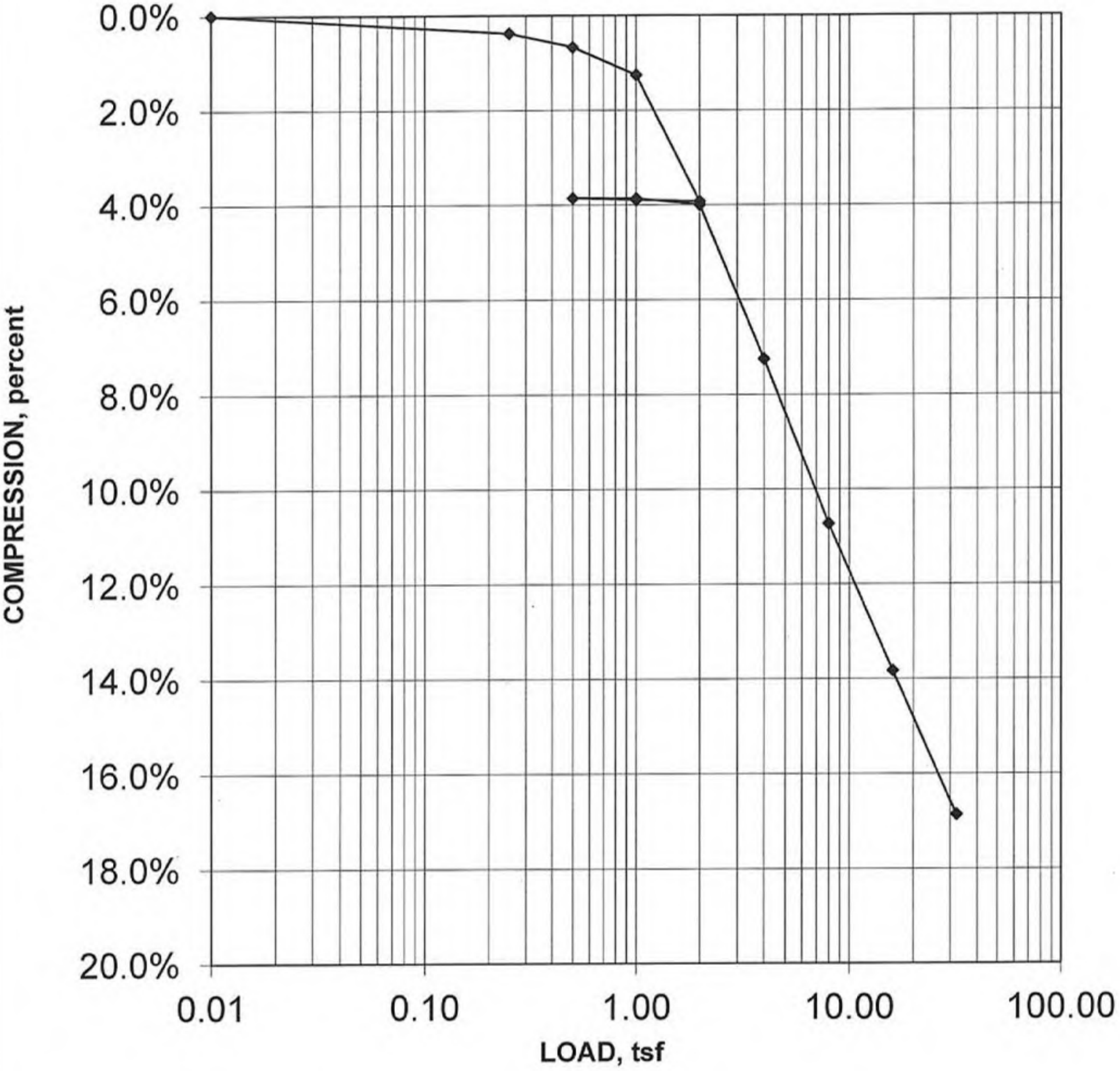
FIG.

P:\37xxx\37400\37431\Phase 003\41-1-37431-003 HA-B4 U2 D2435 10/30/2015

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.25	3.3E+00	2.0	NA
0.5	3.3E+00	4.0	1.2E+00
1.0	2.4E+00	8.0	1.0E+00
2.0	1.3E+00	16.0	1.2E+00
1.0	NA	32.0	9.8E-01
0.5	NA		
1.0	NA		

AECI Structural Integrity Assessment
Marston, Missouri

SETTLEMENT PLOTS

HA-B4

U2

October 2015 41-1-37431-003

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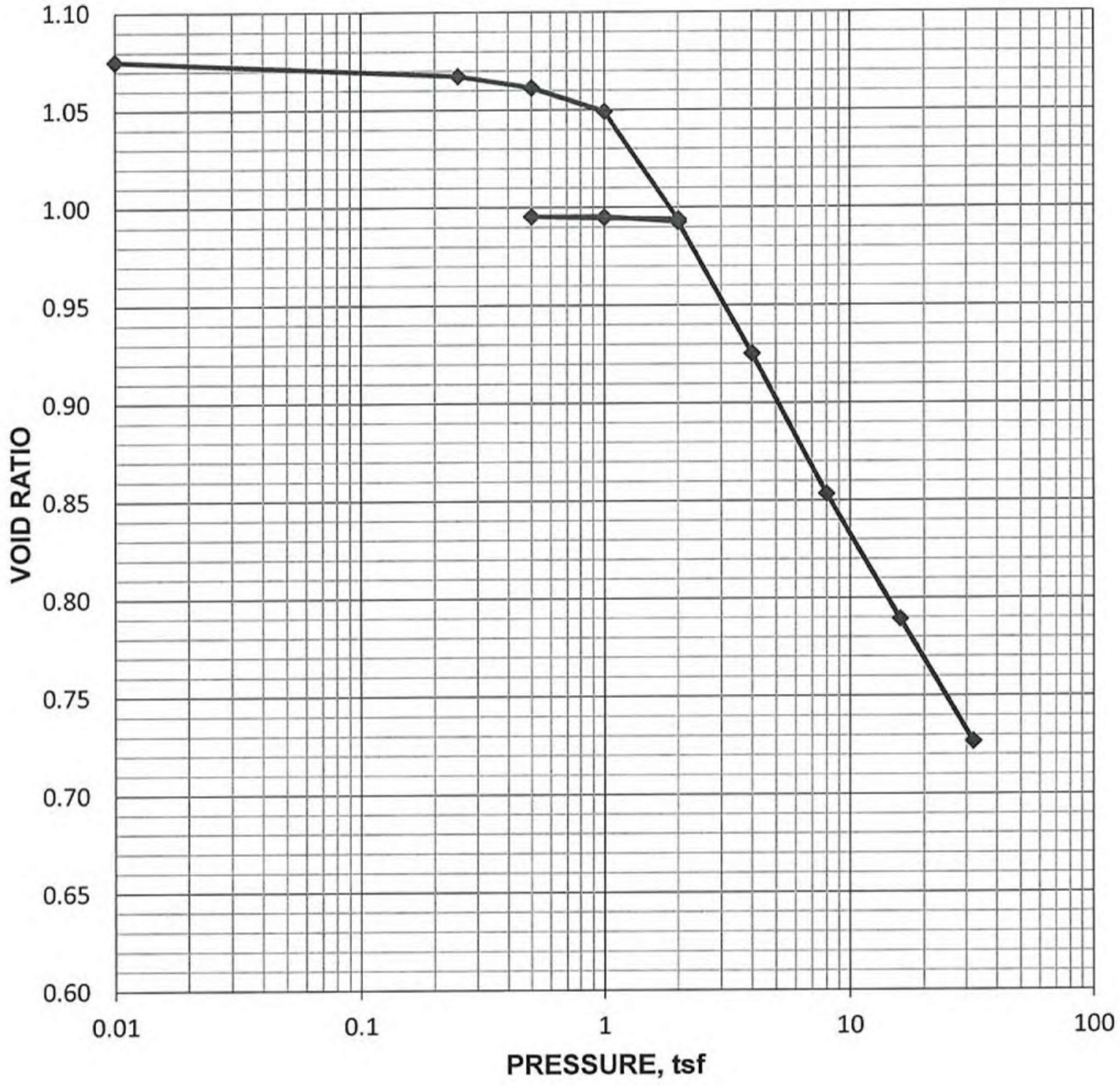
FIG.

P:\37xxx\37400\37431\Phase 003\41-1-37431-003 HA-B4 U2 D2435 10/30/2015

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm²/second	Load, tsf	Coefficient of Consolidation, mm²/second
0.25	3.3E+00	2.0	NA
0.5	3.3E+00	4.0	1.2E+00
1.0	2.4E+00	8.0	1.0E+00
2.0	1.3E+00	16.0	1.2E+00
1.0	NA	32.0	9.8E-01
0.5	NA		
1.0	NA		

AECI Structural Integrity Assessment
Marston, Missouri

VOID RATIO PLOT

HA-B4

U2

October 2015 41-1-37431-003

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FIG.

CONSOLIDATION TEST

Project	AECI Structural Integrity Assessment	Client	Haley & Aldrich, Inc.	
Location	Marston, Missouri	Tested By / Date	CMB	10/21/15
Job Number	41-1-37431-003	Calculated By / Date	CMB	10/30/15
Boring	HA-B5	Checked By / Date	JTB	11/2/15
Sample	U1	File	41-1-37431-003 HA-B5 U1 D2435	
Depth (ft)	10.6	Procedure	ASTM D2435	

	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.003	2.502	0.876	inches	Tare No.	C-3	
Measured Reading 2	1.002	2.504	0.878	inches	Tare Weight	2.50	
Measured Reading 3	1.004	2.503	0.887	inches	Wet Weight	60.74	
Measured Reading 4	1.003	2.502	0.880	inches	Dry Weight	48.80	
Average Reading	1.003	2.503	0.880	inches	M.C. %	25.8%	
Wet Weight + Ring	279.51	Wet+Ring+Tare	362.76	grams	*Trimmings #2*		
Weight of Ring	146.33	Dry+Ring+Tare	332.70	grams	Tare No.	C-4	
Specific Gravity	2.61	Tare Weight	83.07	grams	Tare Weight	2.49	
Sample Volume	80.86		69.71	cm^3	Wet Weight	51.79	
Height of Solids	0.492		0.492	inches	Dry Weight	41.96	
Void Ratio	1.04		0.76		M.C. %	24.9%	
Saturation	72.5		100.0	percent	Ring Number	411	
Weight of Water	29.88		30.06	grams	Inundated @	0.26	tsf
Moisture Content	28.9		29.1	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	102.8		119.4	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	79.8		92.5	pcf	Method Used	[✓ A] or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.865	inches

Load 1		Load 2		Load 3		Load 4	
Air Press.	1.6	Air Press.	2.4	Air Press.	4.0	Air Press.	7.1
Load, tsf	0.26	Load, tsf	0.5	Load, tsf	1.0	Load, tsf	2.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	150	0.1	267	0.1	430	0.1	590
0.25	154	0.25	276	0.25	438	0.25	598
0.5	159	0.5	281	0.5	443	0.5	604
1	162	1	286	1	447	1	609
2	169	2	289	2	451	2	614
4	173	4	292	4	454	4	618
8	176	8	296	8	458	8	623
17	179	15	300	15	462	15	627
30	182	30	303	30	465	30	631
60		60		60		60	635
120		120		120		120	639
240		240		240		240	643
480		480		480		370	645
1440		1440		1440		1305	654
Load 5		Load 6		Load 7		Load 8	
Air Press.	4.0	Air Press.	2.4	Air Press.	4.0	Air Press.	7.1
Load, tsf	1.0	Load, tsf	0.5	Load, tsf	1.0	Load, tsf	2.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	644	0.1	630	0.1	634	0.1	651
0.25	644	0.25	630	0.25	635	0.25	652
0.5	643	0.5	629	0.5	635	0.5	652
1	643	1	629	1	635	1	653
2	643	2	628	2	635	2	653
4	643	4	627	4	635	4	653
8	642	8	626	8	635	8	654
15	642	15	626	15	636	15	654
30		30		30		30	655
60		60		60		60	
120		120		120		120	
240		240		240		240	
480		480		480		480	
1440		1440		1440		1440	

CONSOLIDATION TEST

Sheet 2

Project	AECI Structural Integrity Assessment			Client		Haley & Aldrich, Inc.	
Location	Marston, Missouri			Tested By / Date		CMB	10/21/15
Job Number	41-1-37431-003			Calculated By / Date		CMB	10/30/15
Boring	HA-B5			Checked By / Date		JTB	11/2/15
Sample	U1			File		41-1-37431-003 HA-B5 U1 D2435	
Depth (ft)	10.6			Procedure		ASTM D2435	
	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.003	2.502	0.876	inches	Tare No.	C-3	
Measured Reading 2	1.002	2.504	0.878	inches	Tare Weight	2.50	
Measured Reading 3	1.004	2.503	0.887	inches	Wet Weight	60.74	
Measured Reading 4	1.003	2.502	0.880	inches	Dry Weight	48.80	
Average Reading	1.003	2.503	0.880	inches	M.C. %	25.8%	
Wet Weight + Ring	279.51	Wet+Ring+Tare	362.76	grams	*Trimmings #2*		
Weight of Ring	146.33	Dry+Ring+Tare	332.70	grams	Tare No.	C-4	
Specific Gravity	2.61	Tare Weight	83.07	grams	Tare Weight	2.49	
Sample Volume	80.86		69.71	cm^3	Wet Weight	51.79	
Height of Solids	0.492		0.492	inches	Dry Weight	41.96	
Void Ratio	1.04		0.76		M.C. %	24.9%	
Saturation	72.5		100.0	percent	Ring Number	411	
Weight of Water	29.88		30.06	grams	Inundated @	0.26	tsf
Moisture Content	28.9		29.1	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	102.8		119.4	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	79.8		92.5	pcf	Method Used	[✓ A] or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.865	inches

Load 9		Load 10		Load 11		Load 12	
Air Press.	13.3	Air Press.	25.9	Air Press.	51.1	Air Press.	101.7
Load, tsf	4.0	Load, tsf	8.0	Load, tsf	16.0	Load, tsf	32.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	774	0.1	994	0.1	1245	0.1	1521
0.25	783	0.25	1006	0.25	1259	0.25	1534
0.5	790	0.5	1013	0.5	1267	0.5	1543
1	796	1	1021	1	1277	1	1552
2	802	2	1028	2	1285	2	1561
4	807	4	1034	4	1291	4	1569
8	814	8	1041	8	1298	8	1576
15	820	15	1046	15	1304	15	1582
30	825	30	1052	30	1310	30	1588
60	830	60	1058	60	1316	60	1594
120	834	120	1062	120	1321	120	1600
240	839	240	1068	240	1326	240	1605
410	842	480	1072	480	1332	480	1611
4245	855	1440	1080	1440	1340	1440	1619

CONSOLIDATION TEST

Sheet 3

Project	AECI Structural Integrity Assessment			Client		Haley & Aldrich, Inc.	
Location	Marston, Missouri			Tested By / Date		CMB	10/21/15
Job Number	41-1-37431-003			Calculated By / Date		CMB	10/30/15
Boring	HA-B5			Checked By / Date		JTB	11/2/15
Sample	U1			File		41-1-37431-003 HA-B5 U1 D2435	
Depth (ft)	10.6			Procedure		ASTM D2435	
	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.003	2.502	0.876	inches	Tare No.	C-3	
Measured Reading 2	1.002	2.504	0.878	inches	Tare Weight	2.50	
Measured Reading 3	1.004	2.503	0.887	inches	Wet Weight	60.74	
Measured Reading 4	1.003	2.502	0.880	inches	Dry Weight	48.80	
Average Reading	1.003	2.503	0.880	inches	M.C. %	25.8%	
Wet Weight + Ring	279.51	Wet+Ring+Tare	362.76	grams	*Trimmings #2*		
Weight of Ring	146.33	Dry+Ring+Tare	332.70	grams	Tare No.	C-4	
Specific Gravity	2.61	Tare Weight	83.07	grams	Tare Weight	2.49	
Sample Volume	80.86		69.71	cm^3	Wet Weight	51.79	
Height of Solids	0.492		0.492	inches	Dry Weight	41.96	
Void Ratio	1.04		0.76		M.C. %	24.9%	
Saturation	72.5		100.0	percent	Ring Number	411	
Weight of Water	29.88		30.06	grams	Inundated @	0.26	tsf
Moisture Content	28.9		29.1	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	102.8		119.4	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	79.8		92.5	pcf	Method Used	[✓ A] or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.865	inches

CALIBRATION OF CONSOLIDATION DEFORMATION

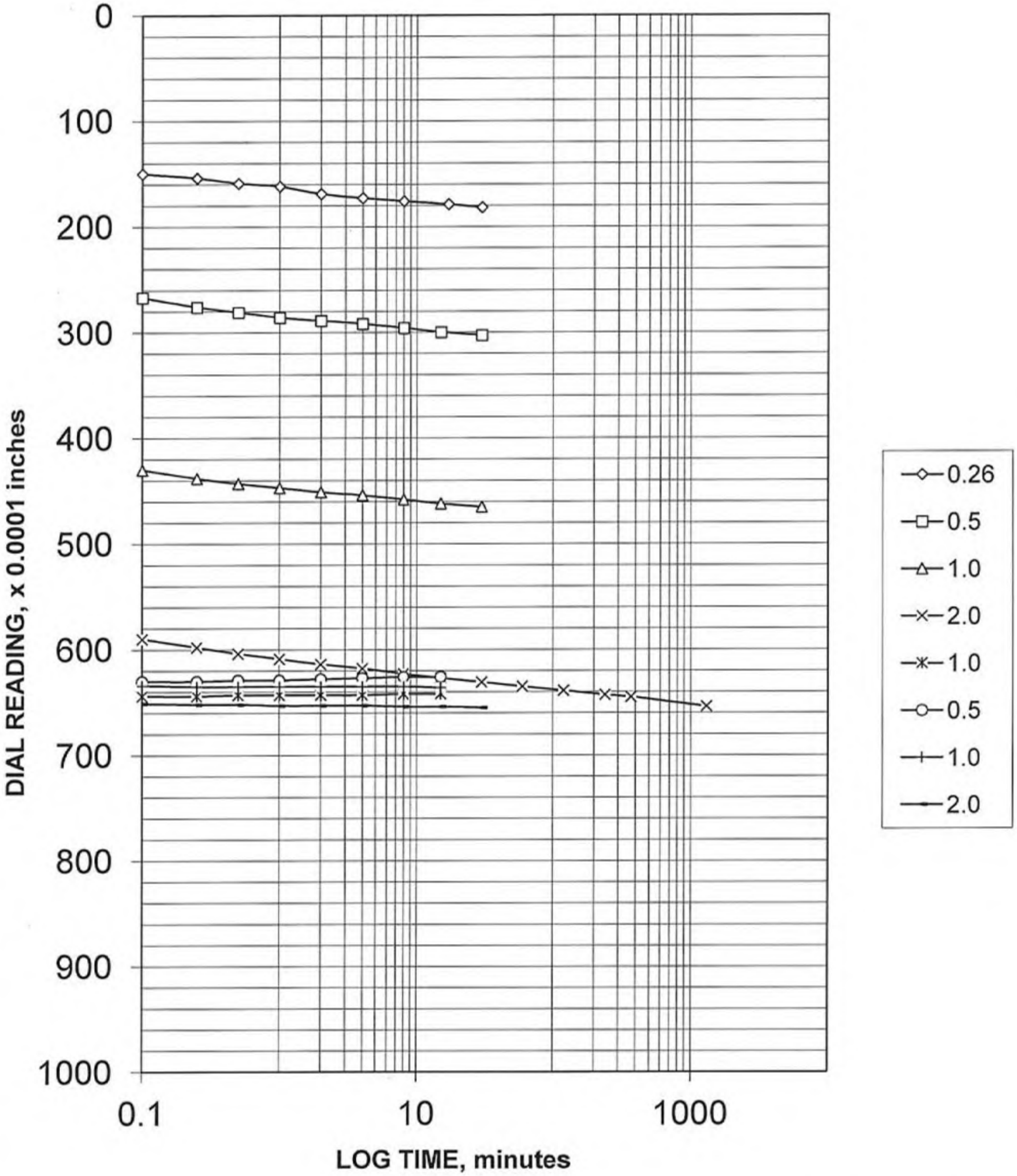
Procedure SWCP-15 (Reference ASTM D2435 AASHTO T216)

Equipment Calibrated:	Consolidation Deformation	Date Calibrated:	10/29/15
Reason for Calibration:	Test Completion	Next Calibration Due:	Next Test
Equipment Used:	Consolidation Appartus	Calibrated By:	CMB
	Steel Calibration Disk	Checked By:	CMB

Machine Number: 411

Load tsf	Machine Def x 10^{-4}	Correction Factor x 10^{-4}	U-100 x 10^{-4}	Corr. U-100 x 10^{-4}	Compression, Percent	C_v	Void Ratio
0.01	0	0	0	0	0.00%	0	1.039
0.26	62	0	159.0	97	0.97%	2.9E+00	1.020
0.5	85	0	283.5	199	1.99%	2.3E+00	0.999
1.0	108	0	445.5	338	3.38%	2.1E+00	0.971
2.0	132	0	607.0	475	4.75%	2.1E+00	0.943
1.0	122	47	643.0	474	4.74%	NA	0.943
0.5	109	47	629.0	473	4.73%	NA	0.943
1.0	119	47	635.0	469	4.69%	NA	0.944
2.0	133	47	652.0	472	4.72%	NA	0.943
4.0	158	0	797.0	639	6.39%	1.7E+00	0.909
8.0	188	0	1020.0	832	8.32%	1.8E+00	0.870
16.0	215	0	1279.0	1064	10.64%	1.5E+00	0.823
32.0	236	0	1575.0	1339	13.39%	6.3E-01	0.767

CONSOLIDATION TEST



AECI Structural Integrity Assessment
Marston, Missouri

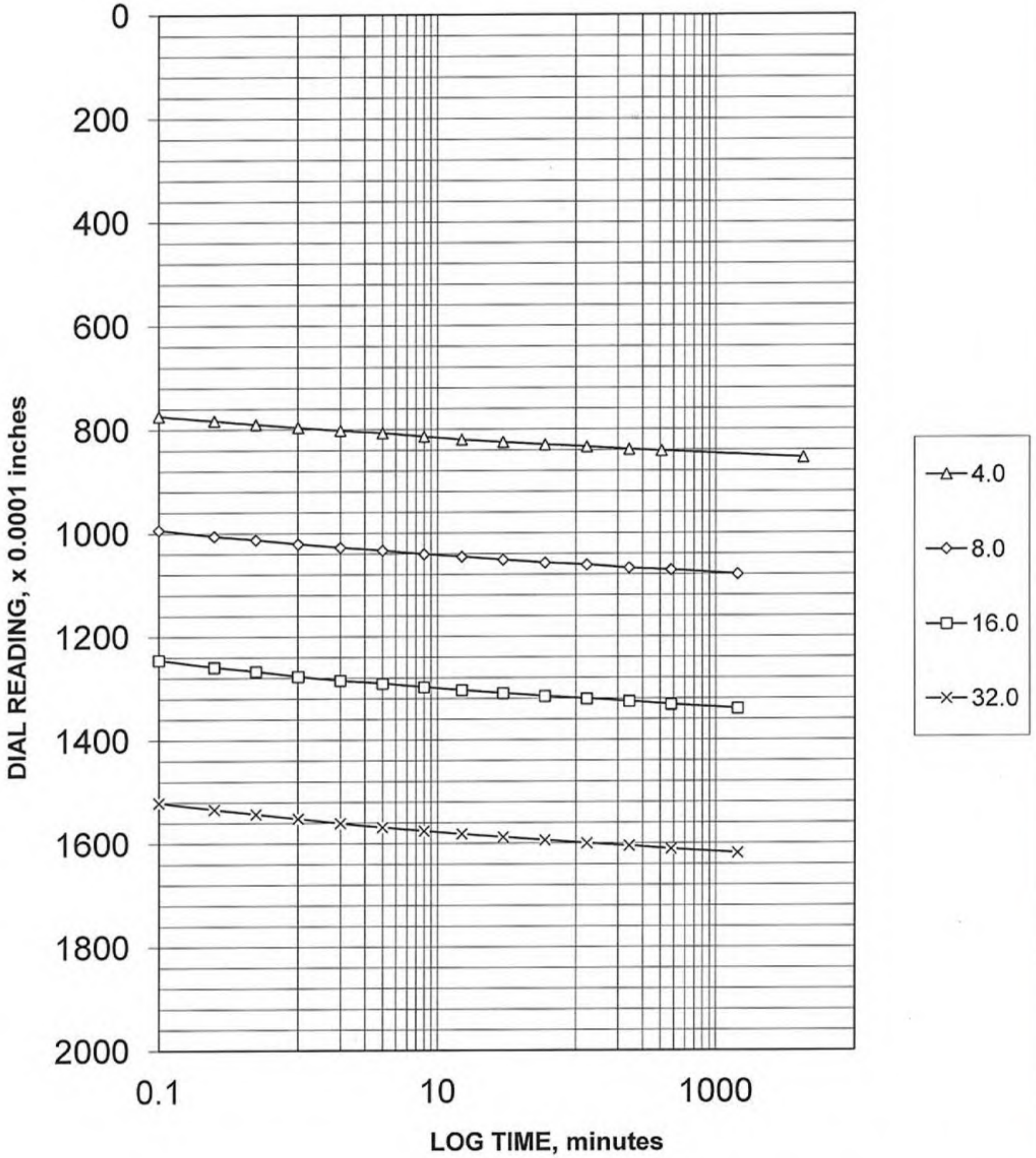
TIME PLOTS
HA-B5
U1

October 2015 41-1-37431-003

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG.

CONSOLIDATION TEST



AECI Structural Integrity Assessment
Marston, Missouri

TIME PLOTS
HA-B5
U1

October 2015 41-1-37431-003

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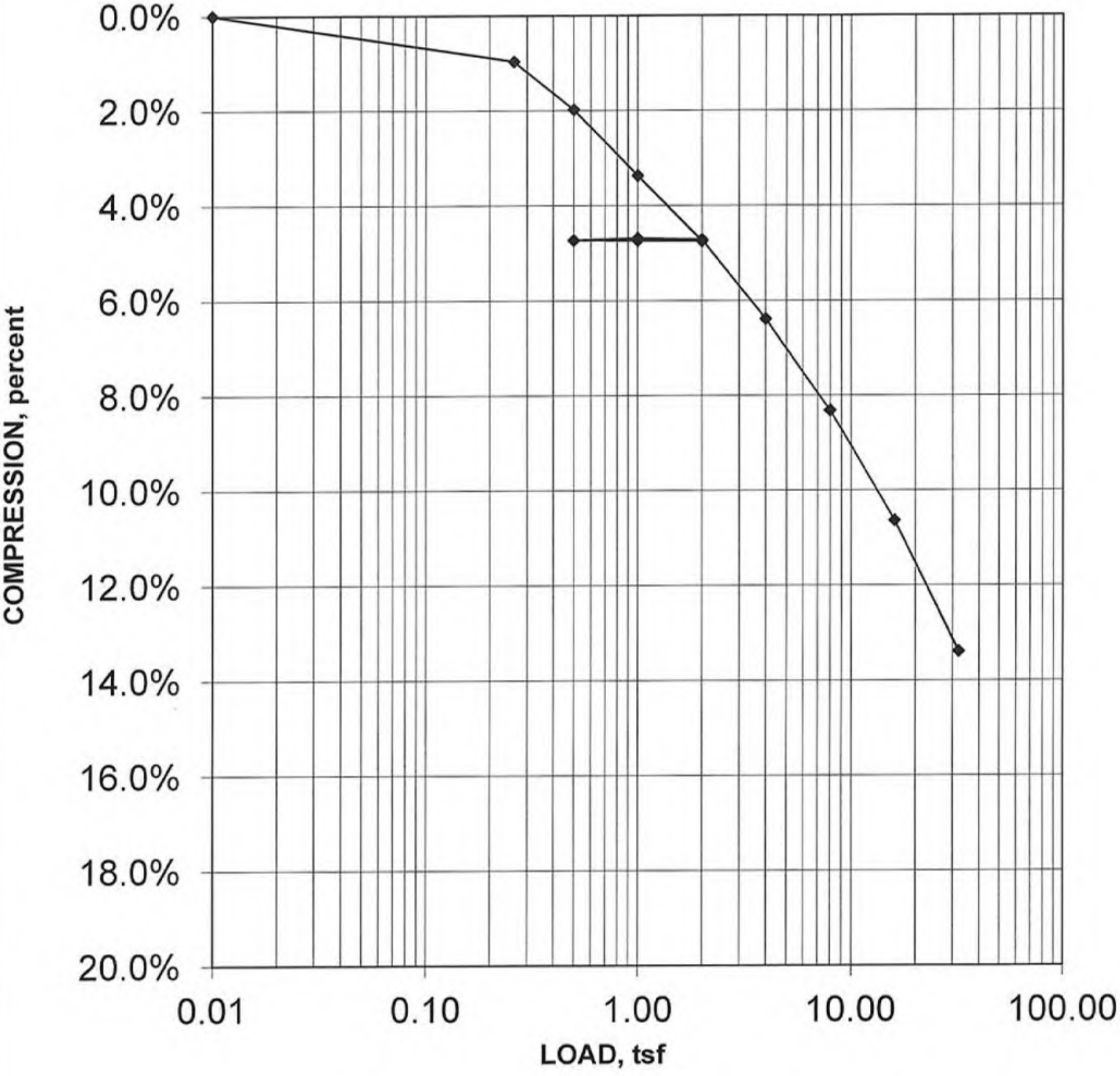
FIG.

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.26	2.9E+00	2.0	NA
0.5	2.3E+00	4.0	1.7E+00
1.0	2.1E+00	8.0	1.8E+00
2.0	2.1E+00	16.0	1.5E+00
1.0	NA	32.0	6.3E-01
0.5	NA		
1.0	NA		

AECI Structural Integrity Assessment
Marston, Missouri

SETTLEMENT PLOTS

HA-B5

U1

October 2015 41-1-37431-003

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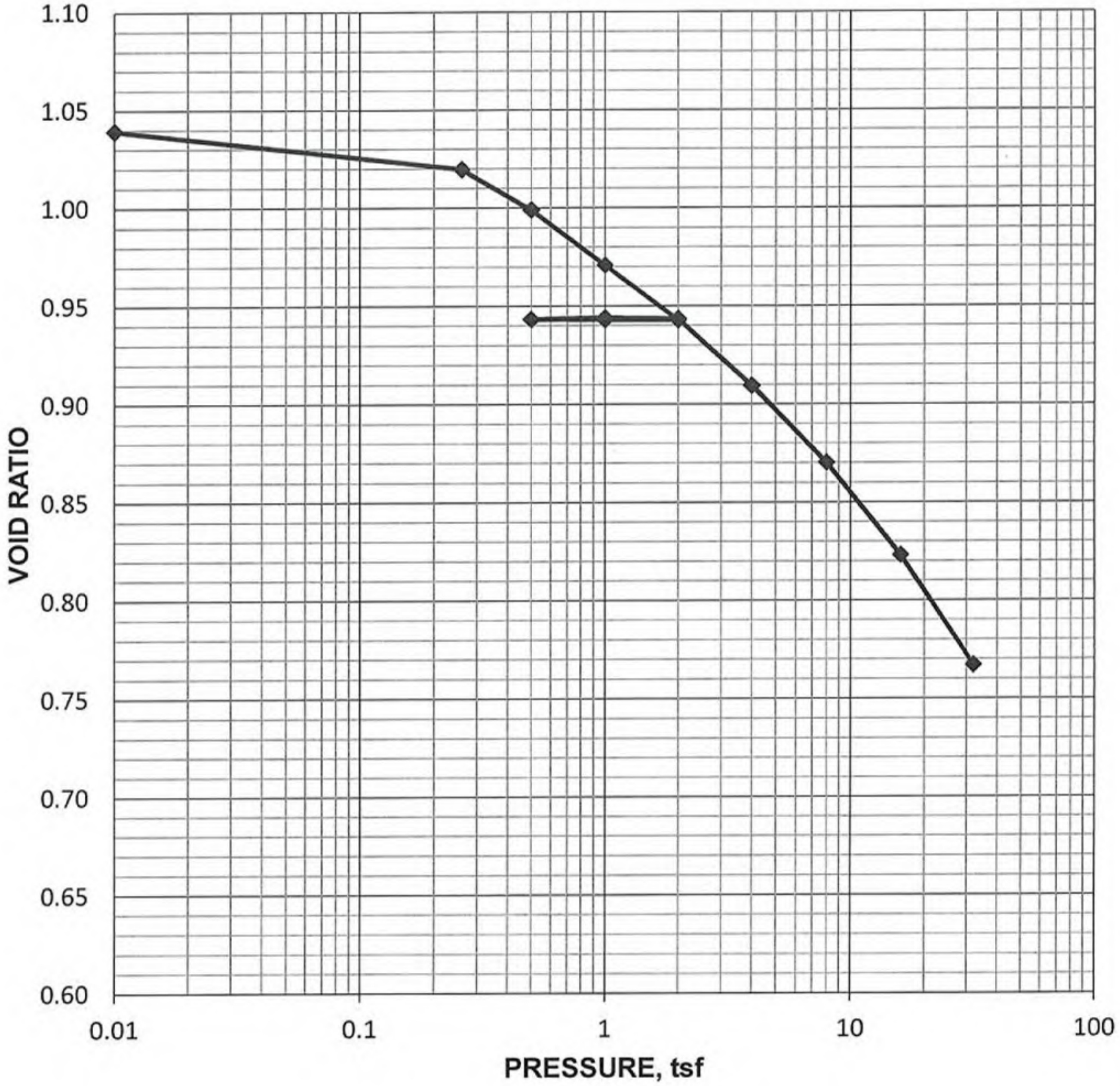
FIG.

P:\37xxx\37400\37431\Phase 003\41-1-37431-003 HA-B5 U1 D2435 10/30/2015

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.26	2.9E+00	2.0	NA
0.5	2.3E+00	4.0	1.7E+00
1.0	2.1E+00	8.0	1.8E+00
2.0	2.1E+00	16.0	1.5E+00
1.0	NA	32.0	6.3E-01
0.5	NA		
1.0	NA		

AECI Structural Integrity Assessment
Marston, Missouri

VOID RATIO PLOT

HA-B5

U1

October 2015 41-1-37431-003

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FIG.

CONSOLIDATION TEST

Sheet 1

Project	AECI Structural Integrity Assessment	Client	Haley & Aldrich, Inc.
Location	Marston, Missouri	Tested By / Date	CMB 10/21/15
Job Number	41-1-37431-003	Calculated By / Date	CMB 10/30/15
Boring	HA-B5	Checked By / Date	JTB 11/2/15
Sample	U2	File	41-1-37431-003 HA-B5 U2 D2435
Depth (ft)	21.4	Procedure	ASTM D2435

	Initial Data		Final Data				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.005	2.504	0.903	inches	Tare No.	C-5	
Measured Reading 2	1.004	2.502	0.908	inches	Tare Weight	2.49	
Measured Reading 3	1.004	2.505	0.909	inches	Wet Weight	36.19	
Measured Reading 4	1.006	2.506	0.902	inches	Dry Weight	26.35	
Average Reading	1.005	2.504	0.906	inches	M.C. %	41.2%	
Wet Weight + Ring	289.07	Wet+Ring+Tare	366.23	grams	*Trimmings #2*		
Weight of Ring	146.30	Dry+Ring+Tare	332.71	grams	Tare No.	C-6	
Specific Gravity	2.70	Tare Weight	84.36	grams	Tare Weight	2.56	
Sample Volume	81.10		71.38	cm^3	Wet Weight	36.74	
Height of Solids	0.469		0.469	inches	Dry Weight	26.99	
Void Ratio	1.14		0.89		M.C. %	39.9%	
Saturation	94.2		100.0	percent	Ring Number	440	
Weight of Water	40.72		33.52	grams	Inundated @	0.26	tsf
Moisture Content	39.9		32.8	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	109.9		118.6	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	78.6		89.3	pcf	Method Used	[✓ A] or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.884	inches

Load 1		Load 2		Load 3		Load 4	
Air Press.	1.7	Air Press.	2.5	Air Press.	4.0	Air Press.	7.2
Load, tsf	0.26	Load, tsf	0.5	Load, tsf	1.0	Load, tsf	2.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	41	0.1	86	0.1	142	0.1	247
0.25	43	0.25	88	0.25	145	0.25	252
0.5	46	0.5	89	0.5	147	0.5	256
1	47	1	90	1	151	1	261
2	48	2	93	2	153	2	265
4	49	4	95	4	154	4	270
8	50	8	97	8	158	8	273
17	51	15	98	15	160	15	278
30	54	30	101	30	162	30	281
60		60		60		60	286
120		120		120		120	289
240		240		240		240	293
480		480		480		370	295
1440		1440		1440		1305	303

Load 5		Load 6		Load 7		Load 8	
Air Press.	4.0	Air Press.	2.5	Air Press.	4.0	Air Press.	7.2
Load, tsf	1.0	Load, tsf	0.5	Load, tsf	1.0	Load, tsf	2.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	294	0.1	281	0.1	282	0.1	301
0.25	293	0.25	280	0.25	282	0.25	302
0.5	293	0.5	280	0.5	282	0.5	302
1	292	1	279	1	282	1	302
2	291	2	278	2	283	2	303
4	291	4	278	4	283	4	303
8	290	8	278	8	283	8	304
15	290	15	277	15	284	15	304
30		30		30		30	305
60		60		60		60	
120		120		120		120	
240		240		240		240	
480		480		480		480	
1440		1440		1440		1440	

CONSOLIDATION TEST

Sheet 2

Project	AECI Structural Integrity Assessment	Client	Haley & Aldrich, Inc.	
Location	Marston, Missouri	Tested By / Date	CMB	10/21/15
Job Number	41-1-37431-003	Calculated By / Date	CMB	10/30/15
Boring	HA-B5	Checked By / Date	JTB	11/2/15
Sample	U2	File	41-1-37431-003 HA-B5 U2 D2435	
Depth (ft)	21.4	Procedure	ASTM D2435	

	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.005	2.504	0.903	inches	Tare No.	C-5	
Measured Reading 2	1.004	2.502	0.908	inches	Tare Weight	2.49	
Measured Reading 3	1.004	2.505	0.909	inches	Wet Weight	36.19	
Measured Reading 4	1.006	2.506	0.902	inches	Dry Weight	26.35	
Average Reading	1.005	2.504	0.906	inches	M.C. %	41.2%	
Wet Weight + Ring	289.07	Wet+Ring+Tare	366.23	grams	*Trimmings #2*		
Weight of Ring	146.30	Dry+Ring+Tare	332.71	grams	Tare No.	C-6	
Specific Gravity	2.70	Tare Weight	84.36	grams	Tare Weight	2.56	
Sample Volume	81.10		71.38	cm^3	Wet Weight	36.74	
Height of Solids	0.469		0.469	inches	Dry Weight	26.99	
Void Ratio	1.14		0.89		M.C. %	39.9%	
Saturation	94.2		100.0	percent	Ring Number	440	
Weight of Water	40.72		33.52	grams	Inundated @	0.26	tsf
Moisture Content	39.9		32.8	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	109.9		118.6	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	78.6		89.3	pcf	Method Used	[✓ A] or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.884	inches

Load 9		Load 10		Load 11		Load 12	
Air Press.	12.9	Air Press.	26.2	Air Press.	51.2	Air Press.	101.8
Load, tsf	4.0	Load, tsf	8.0	Load, tsf	16.0	Load, tsf	32.0
Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4	Time, min.	Def x10-4
0.1	404	0.1	678	0.1	966	0.1	1274
0.25	414	0.25	690	0.25	978	0.25	1287
0.5	421	0.5	698	0.5	988	0.5	1294
1	426	1	707	1	997	1	1302
2	433	2	716	2	1005	2	1310
4	439	4	723	4	1011	4	1316
8	445	8	730	8	1018	8	1322
15	449	15	737	15	1025	15	1329
30	455	30	744	30	1032	30	1336
60	458	60	751	60	1039	60	1343
120	464	120	757	120	1044	120	1347
240	470	240	762	240	1050	240	1353
410	473	480	769	480	1056	480	1360
4245	489	1440	777	1440	1065	1440	1369

CONSOLIDATION TEST

Sheet 3

Project	AECI Structural Integrity Assessment			Client		Haley & Aldrich, Inc.	
Location	Marston, Missouri			Tested By / Date		CMB	10/21/15
Job Number	41-1-37431-003			Calculated By / Date		CMB	10/30/15
Boring	HA-B5			Checked By / Date		JTB	11/2/15
Sample	U2			File		41-1-37431-003 HA-B5 U2 D2435	
Depth (ft)	21.4			Procedure		ASTM D2435	
	Initial Data		*Final Data*				
	Sample Height	*Ring Diameter*	*Sample Height*		*Trimmings #1*		
Measured Reading 1	1.005	2.504	0.903	inches	Tare No.	C-5	
Measured Reading 2	1.004	2.502	0.908	inches	Tare Weight	2.49	
Measured Reading 3	1.004	2.505	0.909	inches	Wet Weight	36.19	
Measured Reading 4	1.006	2.506	0.902	inches	Dry Weight	26.35	
Average Reading	1.005	2.504	0.906	inches	M.C. %	41.2%	
Wet Weight + Ring	289.07	Wet+Ring+Tare	366.23	grams	*Trimmings #2*		
Weight of Ring	146.30	Dry+Ring+Tare	332.71	grams	Tare No.	C-6	
Specific Gravity	2.70	Tare Weight	84.36	grams	Tare Weight	2.56	
Sample Volume	81.10		71.38	cm^3	Wet Weight	36.74	
Height of Solids	0.469		0.469	inches	Dry Weight	26.99	
Void Ratio	1.14		0.89		M.C. %	39.9%	
Saturation	94.2		100.0	percent	Ring Number	440	
Weight of Water	40.72		33.52	grams	Inundated @	0.26	tsf
Moisture Content	39.9		32.8	percent	Trimming Method		Cutting Shoe
Wet Unit Weight	109.9		118.6	pcf	[Cutting Shoe / Turntable / None (Ring)]		
Dry Unit Weight	78.6		89.3	pcf	Method Used	[✓ A] or B	
Notes: The specific gravity is computed assuming saturation at the end of the test.					Computed Ht.	0.884	inches

CALIBRATION OF CONSOLIDATION DEFORMATION

Procedure SWCP-15 (Reference ASTM D2435 AASHTO T216)

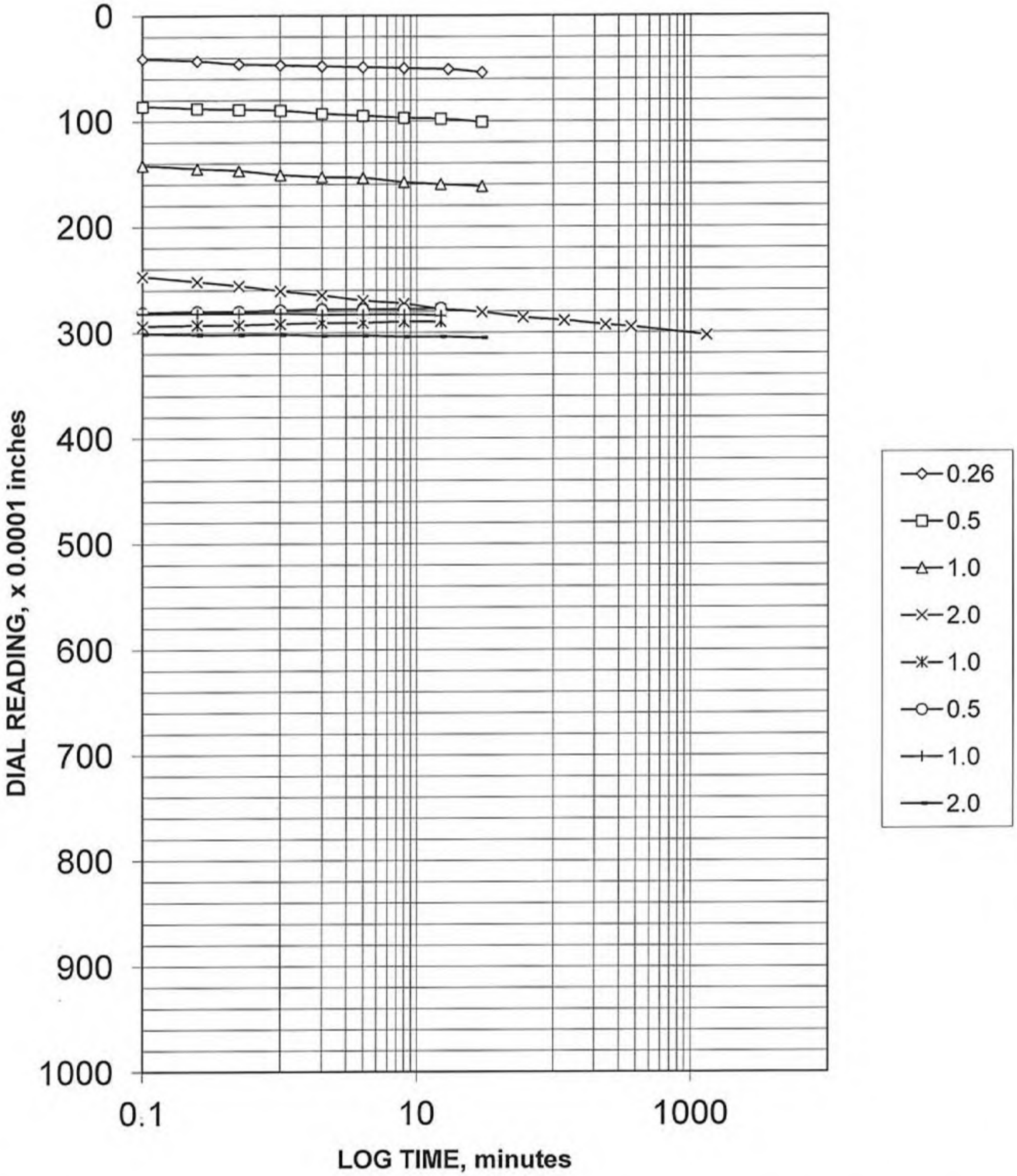
Equipment Calibrated: Consolidation Deformation
Reason for Calibration: Test Completion
Equipment Used: Consolidation Appartus
Steel Calibration Disk

Date Calibrated: 10/29/15
Next Calibration Due: Next Test
Calibrated By: CMB
Checked By: CMB

Machine Number: 440

Load tsf	Machine Def x 10^{-4}	Correction Factor x 10^{-4}	U-100 x 10^{-4}	Corr. U-100 x 10^{-4}	Compression, Percent	C_v	Void Ratio
0.01	0	0	0	0	0.00%	0	1.14
0.26	23	0	46.0	23	0.23%	2.7E+00	1.14
0.5	38	0	88.0	50	0.50%	3.3E+00	1.13
1.0	55	0	145.0	90	0.90%	5.2E+00	1.12
2.0	74	0	261.0	187	1.87%	2.0E+00	1.10
1.0	70	42	293.0	181	1.81%	NA	1.10
0.5	62	42	280.0	176	1.76%	NA	1.10
1.0	66	42	283.0	175	1.75%	NA	1.10
2.0	78	42	302.0	182	1.82%	NA	1.10
4.0	96	0	420.0	324	3.24%	2.6E+00	1.07
8.0	119	0	710.0	591	5.91%	1.6E+00	1.02
16.0	139	0	1000.0	861	8.61%	1.6E+00	0.96
32.0	165	0	1299.0	1134	11.34%	1.8E+00	0.90

CONSOLIDATION TEST



AECI Structural Integrity Assessment
Marston, Missouri

TIME PLOTS
HA-B5
U2

October 2015 41-1-37431-003

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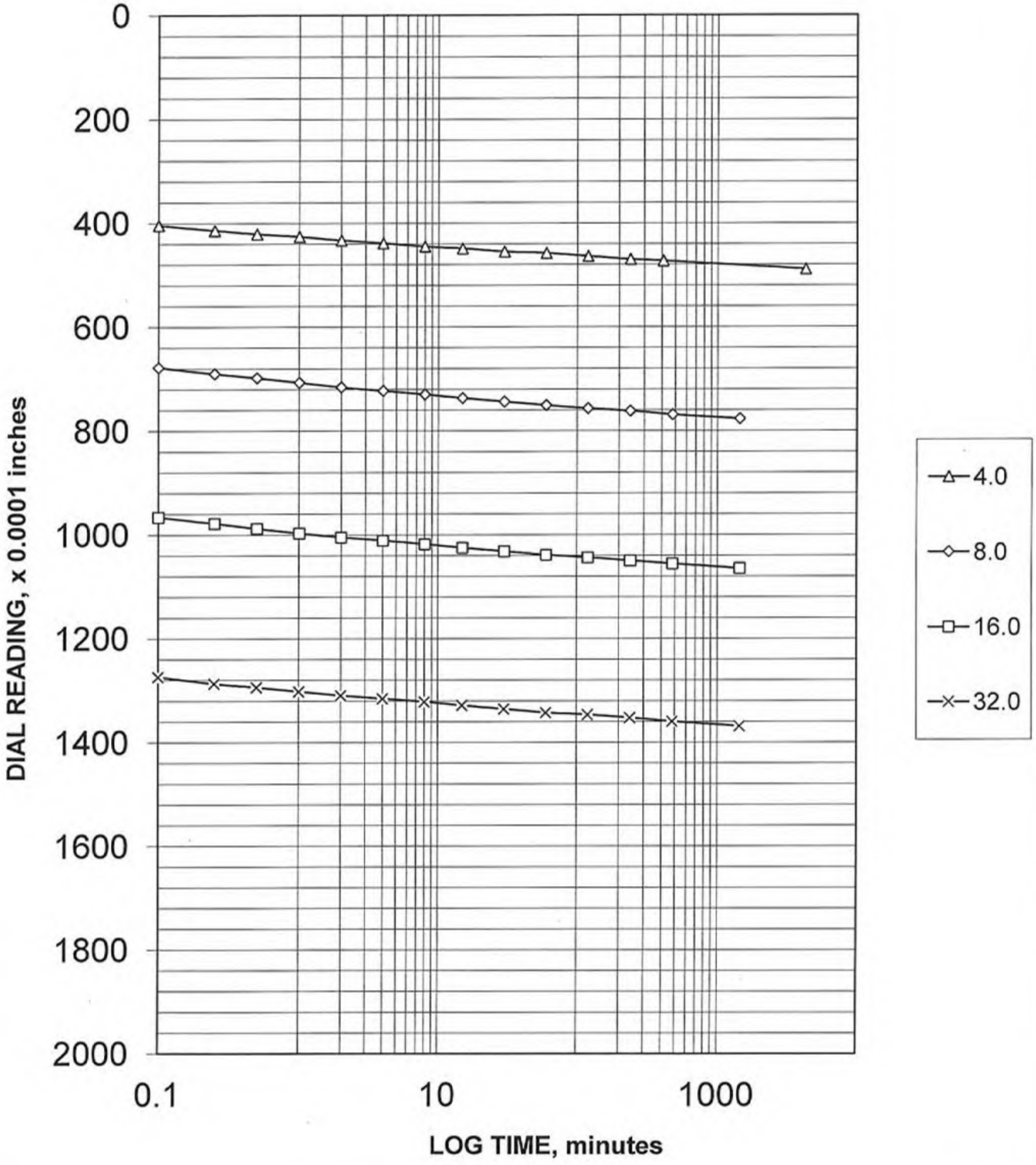
FIG.

CONSOLIDATION TEST



AECI Structural Integrity Assessment
Marston, Missouri

TIME PLOTS
HA-B5
U2

October 2015 41-1-37431-003

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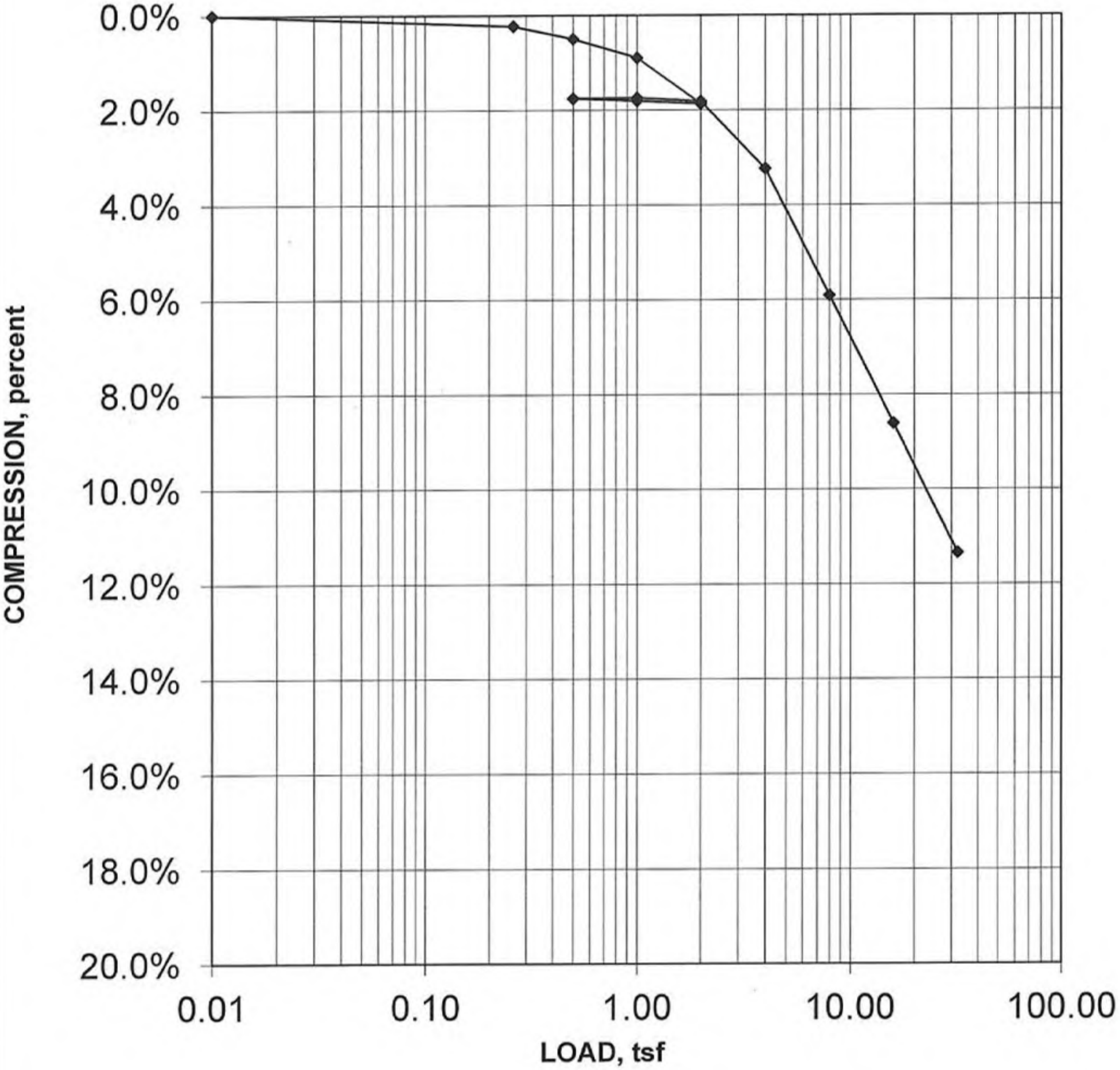
FIG.

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.26	2.7E+00	2.0	NA
0.5	3.3E+00	4.0	2.6E+00
1.0	5.2E+00	8.0	1.6E+00
2.0	2.0E+00	16.0	1.6E+00
1.0	NA	32.0	1.8E+00
0.5	NA		
1.0	NA		

AECI Structural Integrity Assessment
Marston, Missouri

SETTLEMENT PLOTS

HA-B5

U2

October 2015 41-1-37431-003

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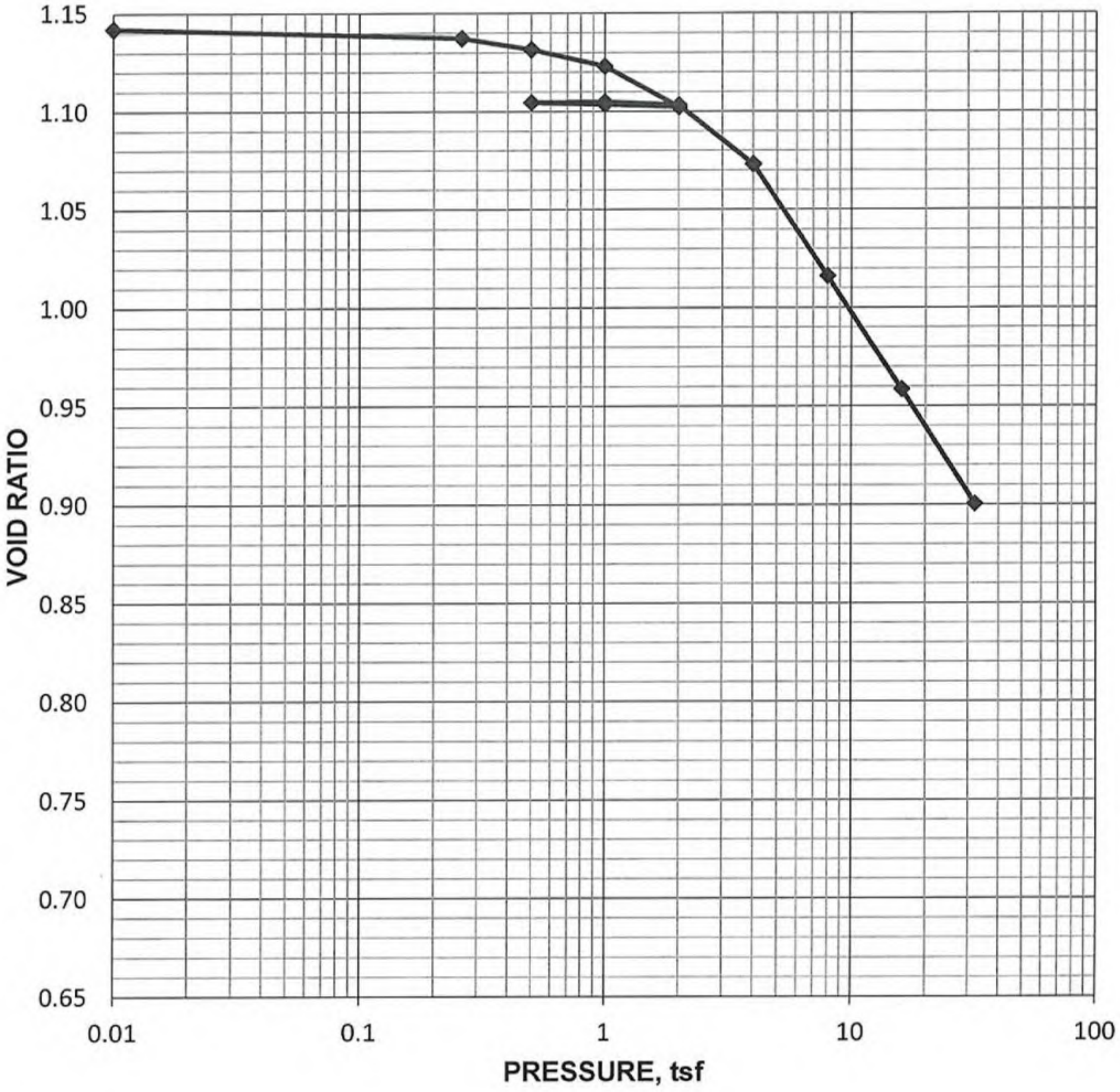
FIG.

P:\37xxx\37400\37431\Phase 003\41-1-37431-003 HA-B5 U2 D2435 10/30/2015

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.26	2.7E+00	2.0	NA
0.5	3.3E+00	4.0	2.6E+00
1.0	5.2E+00	8.0	1.6E+00
2.0	2.0E+00	16.0	1.6E+00
1.0	NA	32.0	1.8E+00
0.5	NA		
1.0	NA		

AECI Structural Integrity Assessment
Marston, Missouri

VOID RATIO PLOT

HA-B5

U2

October 2015 41-1-37431-003

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG.

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION

Project	AECI Structural Integrity Assessment	Client	Haley & Aldrich	
Location	Marston, Missouri			Date
Job No.	41-1-37431-003	Tested by	CMB	10/09/15
Boring	HA-B5	Calculated by	CMB	10/12/15
Sample	U2	Checked by	CMB	10/12/15
Depth (ft)	20.3 - 20.8	File	41-1-37431-003-HA-B5-U2 D2850	
Undisturbed/Remold	Undisturbed	Procedure	ASTM D2850	
Description (D2487 + symbol)	Dark gray, Silt (ML) (Ash).			

Sample Data

Diameter	2.862	inches
Height	6.001	inches
Wet wt.	1045.11	grams

Initial Deflection (Before Confinement)

0.000 inches

Initial Deflection (After Confinement)

0.000 inches

Height Change (After Confinement)

0.000 inches

Test Setup Data

Confinement	7.5	psi
Deflection	0.001	inch/division
Load Cons.	1	lb/division

After Test Data

Tare No.	4	
Tare Wt.	103.53	grams
Wet wt.	1128.14	grams
Dry wt.	830.38	grams
Sp. Gravity	2.68	*assumed*

Photograph of Failure

Test Data

Time	Cell Pressure	Deflection	Load
hr-min	psi	div (in 0.001 in.)	div
0:00:00	7.5	0	0
0:00:08	7.5	5	5.6
0:00:15	7.5	10	8.4
0:00:23	7.5	15	11.1
0:00:30	7.5	20	13.5
0:00:45	7.5	30	17.7
0:01:15	7.5	50	22.3
0:01:53	7.5	75	29.3
0:02:30	7.5	100	34.8
0:03:23	7.5	135	42.8
0:03:45	7.5	150	44.9
0:04:23	7.5	175	47.9
0:05:00	7.5	200	50.6
0:05:53	7.5	235	53.0
0:06:15	7.5	250	54.2
0:07:30	7.5	300	56.7
0:08:45	7.5	350	59.1
0:10:00	7.5	400	60.1
0:11:15	7.5	450	61.7
0:12:30	7.5	500	62.8
0:13:45	7.5	550	63.0
0:15:00	7.5	600	63.3
0:16:15	7.5	650	64.2
0:17:30	7.5	700	64.5
0:18:45	7.5	750	64.8
0:20:00	7.5	800	64.8
0:21:15	7.5	850	66.1
0:22:30	7.5	900	67.0

REMARKS:

NOTE: The moisture content is taken from the entire sample after testing is completed.

P:\37xxx\37400\37431\Phase 003\41-1-37431-003 HA-B5 U2 D2850 10/12/2015

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Boring	HA-B5		By	Date
Sample	U2	Tested by	CMB	10/09/15
Depth (ft)	20.3 - 20.8	Calculated by	CMB	10/12/15
Description	Dark gray, Silt (ML) (Ash).	Checked by	CMB	10/12/15

Specimen Data			*Instrument Constants*		
Height	6.001	inches	Deformation	0.001	inches/div
Diameter	2.862	inches	Load	1	lb/div.
H/D ratio	2.097		Confinment	7.5	psi
Volume	632.6	cc			
Wet wt.	1045.11	grams	*Peak values*		
Bulk Density	103.1	pcf	p	0.866	tsf
Dry Density	73.1	pcf	q	0.326	tsf
M.C.	41.0%	percent	strain	15.0%	%
Saturation	85.3%	percent	strain rate	0.040	in. per min.
Void ratio	1.287				
Gs	2.68	assumed			

Deformation div.	Load div.	Strain %	Load lb	Stress tsf	p tsf	q tsf
0.000	0	0.0%	0	0.000	0.540	0.000
0.005	5.6	0.1%	5.6	0.063	0.571	0.031
0.010	8.4	0.2%	8.4	0.094	0.587	0.047
0.015	11.1	0.2%	11.1	0.124	0.602	0.062
0.020	13.5	0.3%	13.5	0.151	0.615	0.075
0.030	17.7	0.5%	17.7	0.197	0.639	0.099
0.050	22.3	0.8%	22.3	0.248	0.664	0.124
0.075	29.3	1.2%	29.3	0.324	0.702	0.162
0.100	34.8	1.7%	34.8	0.383	0.732	0.192
0.135	42.8	2.2%	42.8	0.468	0.774	0.234
0.150	44.9	2.5%	44.9	0.490	0.785	0.245
0.175	47.9	2.9%	47.9	0.521	0.800	0.260
0.200	50.6	3.3%	50.6	0.548	0.814	0.274
0.235	53.0	3.9%	53.0	0.571	0.825	0.285
0.250	54.2	4.2%	54.2	0.582	0.831	0.291
0.300	56.7	5.0%	56.7	0.604	0.842	0.302
0.350	59.1	5.8%	59.1	0.625	0.852	0.312
0.400	60.1	6.7%	60.1	0.631	0.855	0.315
0.450	61.7	7.5%	61.7	0.642	0.861	0.321
0.500	62.8	8.3%	62.8	0.649	0.864	0.324
0.550	63.0	9.2%	63.0	0.646	0.863	0.323
0.600	63.3	10.0%	63.3	0.644	0.862	0.322
0.650	64.2	10.8%	64.2	0.648	0.864	0.324
0.700	64.5	11.7%	64.5	0.646	0.863	0.323
0.750	64.8	12.5%	64.8	0.645	0.862	0.322
0.800	64.8	13.3%	64.8	0.640	0.860	0.320
0.850	66.1	14.2%	66.1	0.648	0.864	0.324
0.900	67	15.0%	67.0	0.652	0.866	0.326

AECI Structural Integrity Assessment
Marston, Missouri

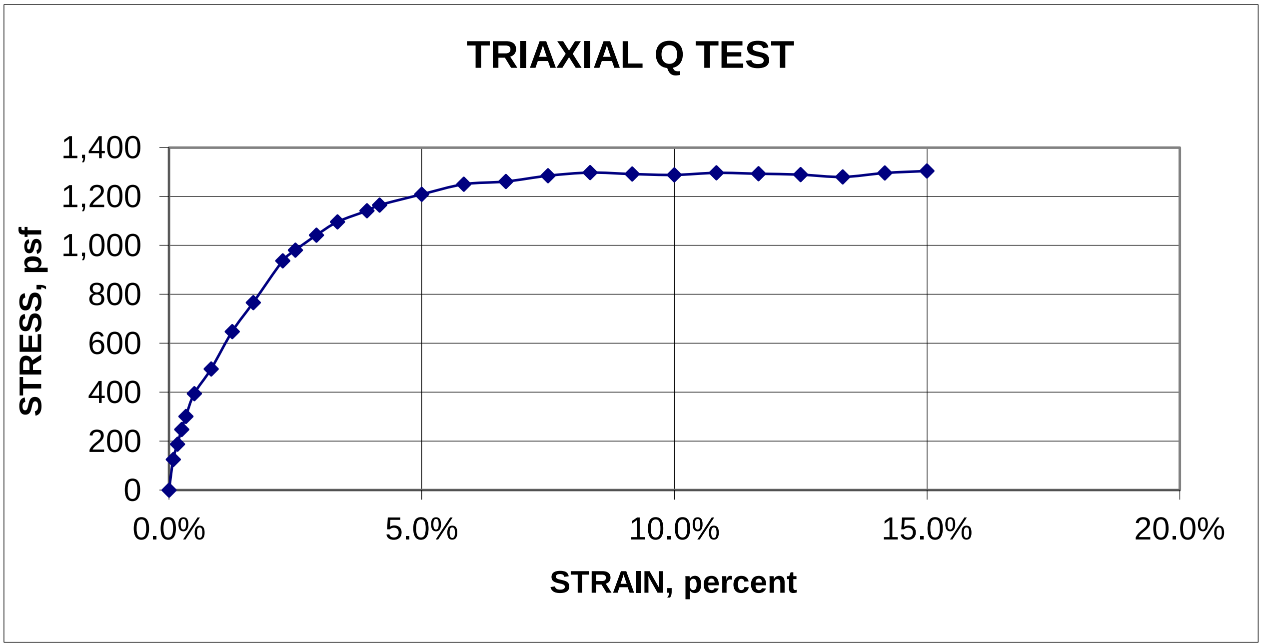
UNCONSOLIDATED, UNDRAINED STRENGTH
IN TRIAXIAL COMPRESSION
BORING - HA-B5 : SAMPLE - U2

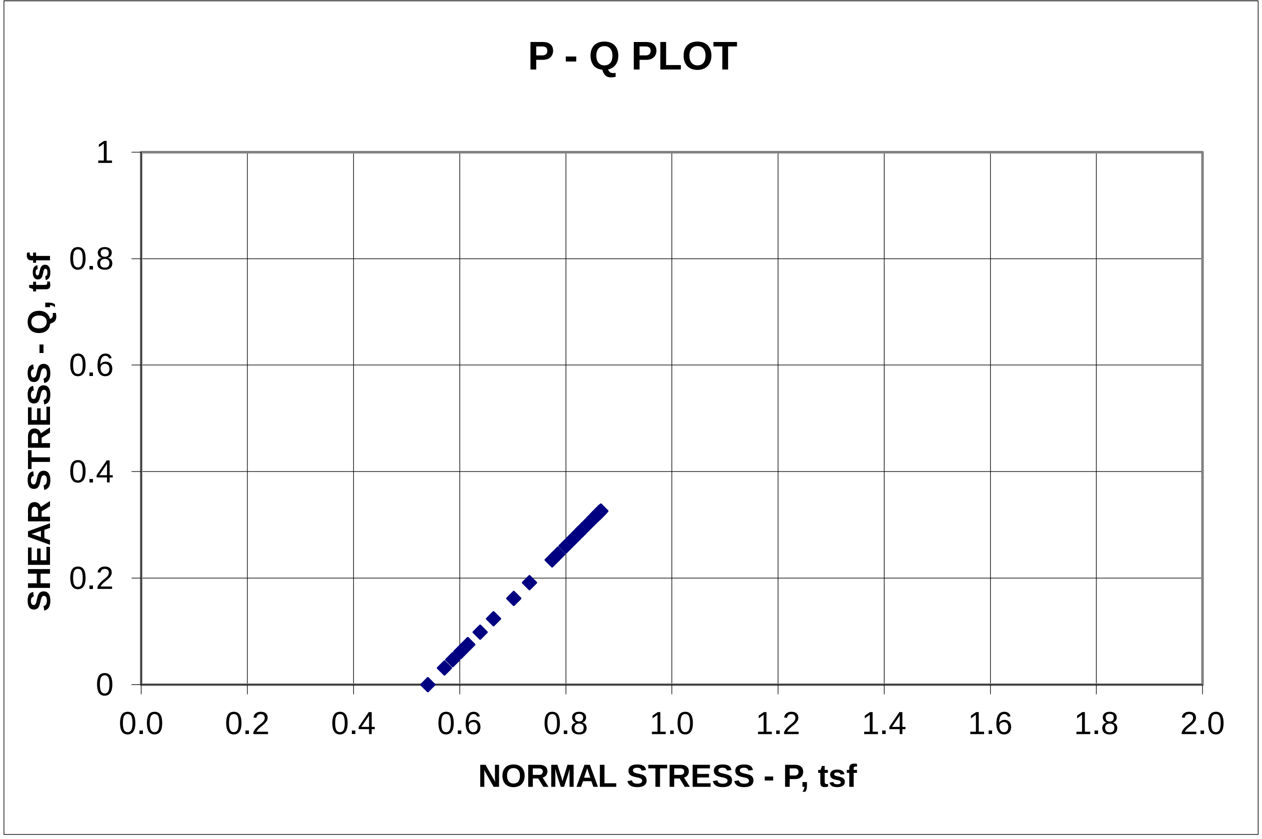
October 2015 41-1-37431-003

SHANNON & WILSON, INC.
Geotechnical and Environmental

FIG.

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION PLOT OF TEST DATA





AECI Structural Integrity Assessment
Marston, Missouri

UNCONSOLIDATED, UNDRAINED STRENGTH
IN TRIAXIAL COMPRESSION
BORING - HA-B5 : SAMPLE - U2

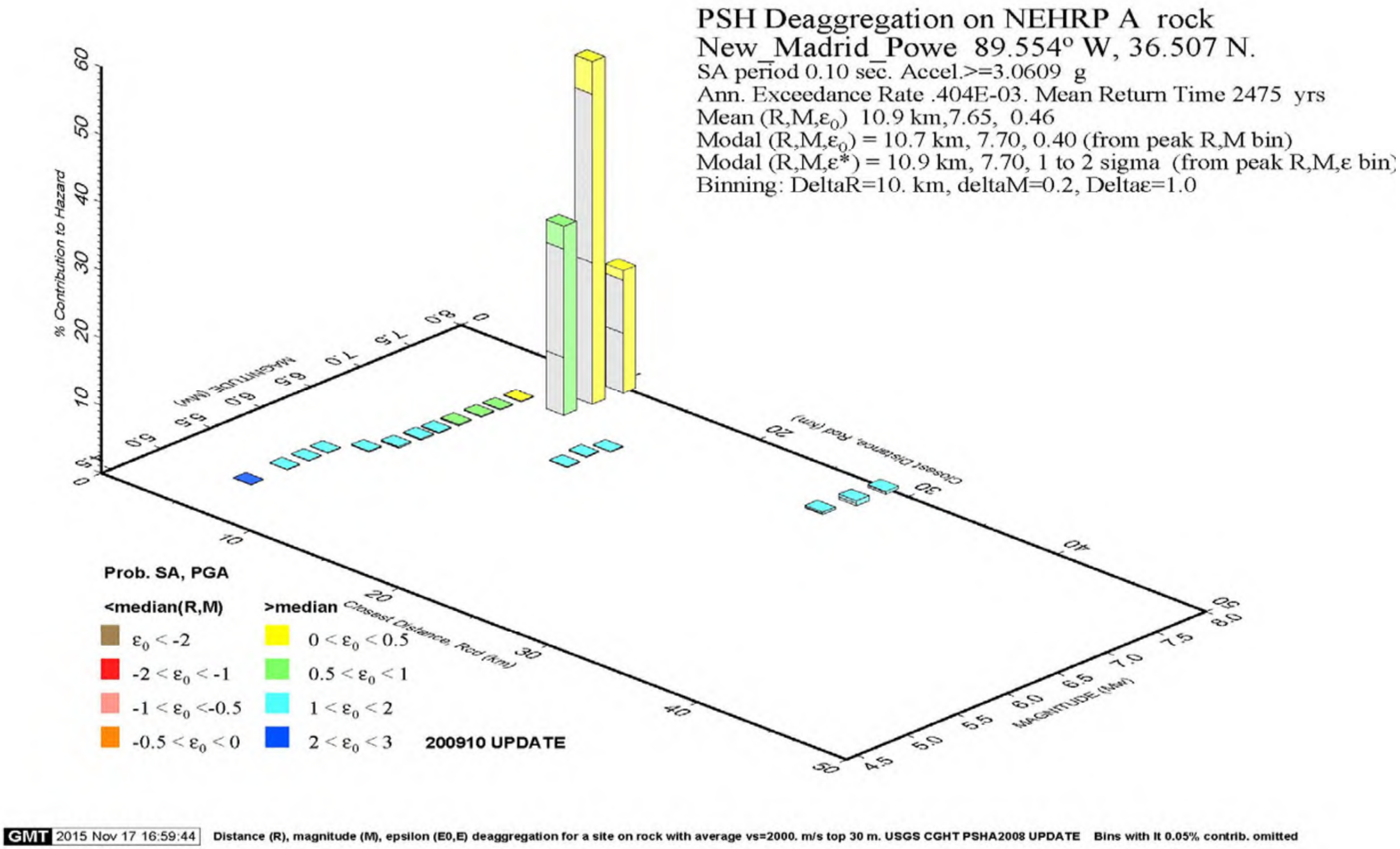
October 2015 41-1-37431-003

SHANNON & WILSON, INC.
Geotechnical and Environmental

FIG.

APPENDIX D

Analyses



HALEY ALDRICH

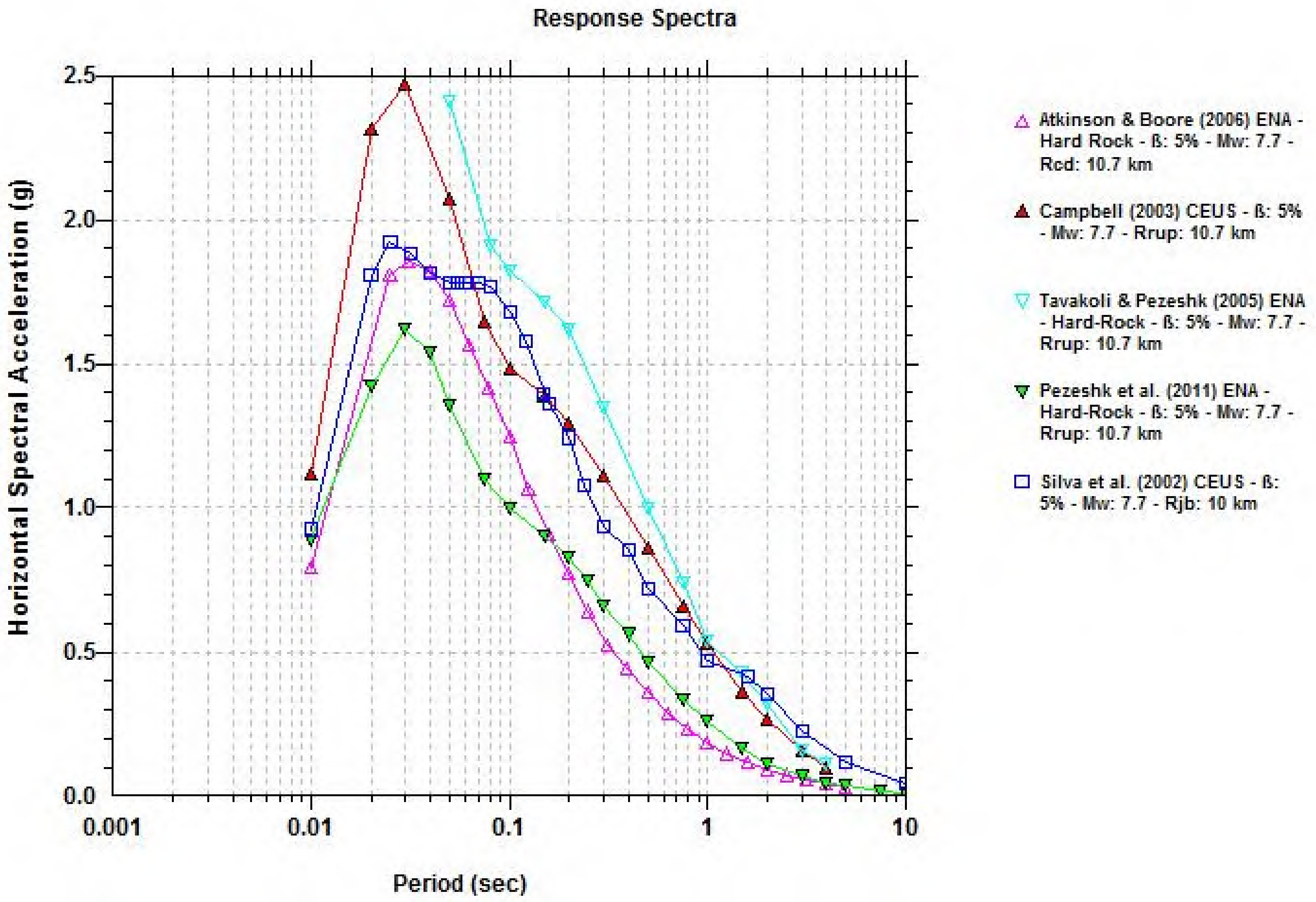
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

DEGRADATION PLOT AT PERIOD T=0.1s

SCALE : AS SHOWN
FEBRUARY 2016

FIGURE D-1

40616-300_FIG_D1.PPT



NOTES

1. Reference: SHAKE 2000

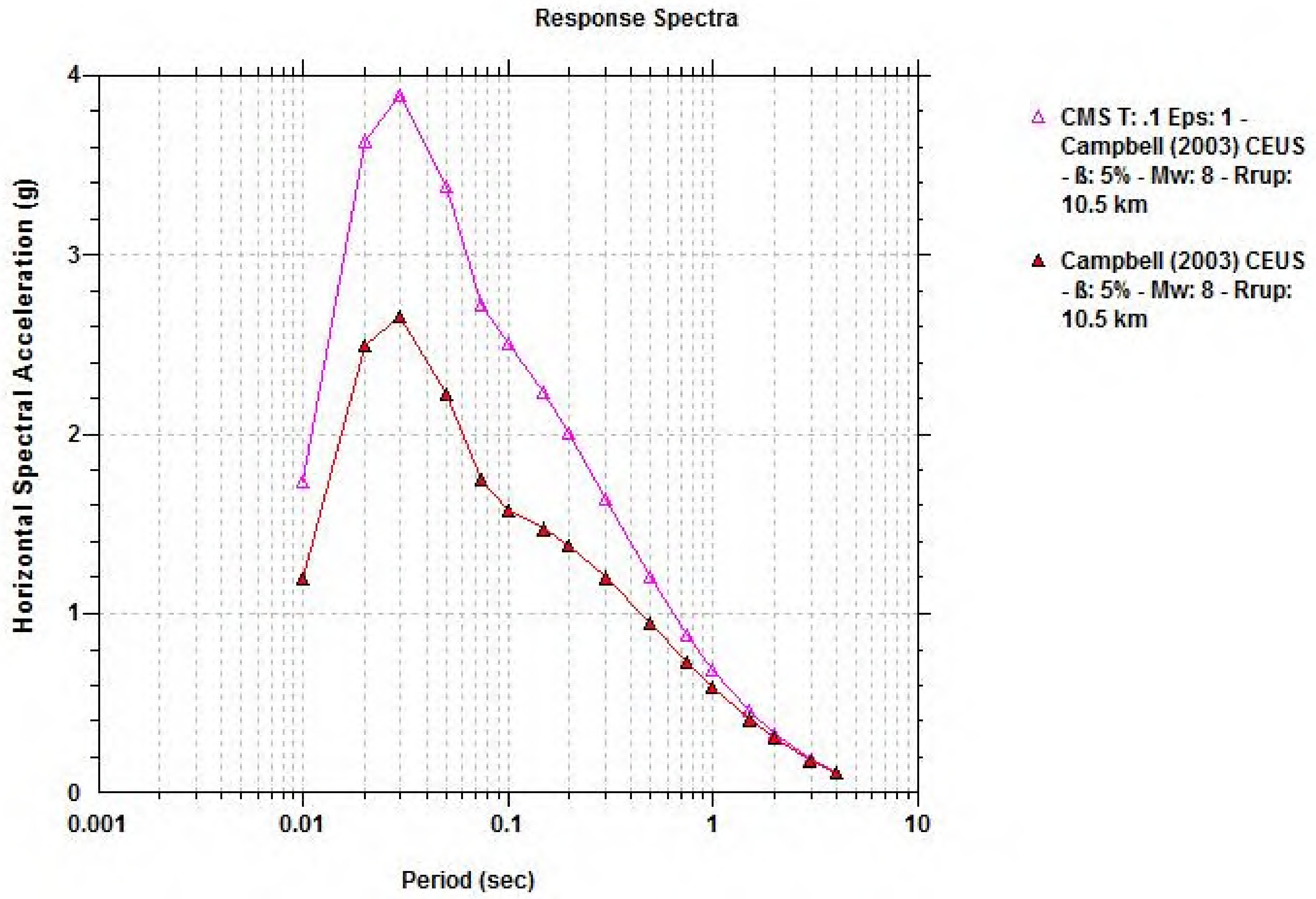
HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

CENTRAL AND EASTERN U.S. GROUND MOTION ATTENUATION MODELS

SCALE : AS SHOWN
FEBRUARY 2016

FIGURE D-2



NOTES

1. Reference: SHAKE 2000

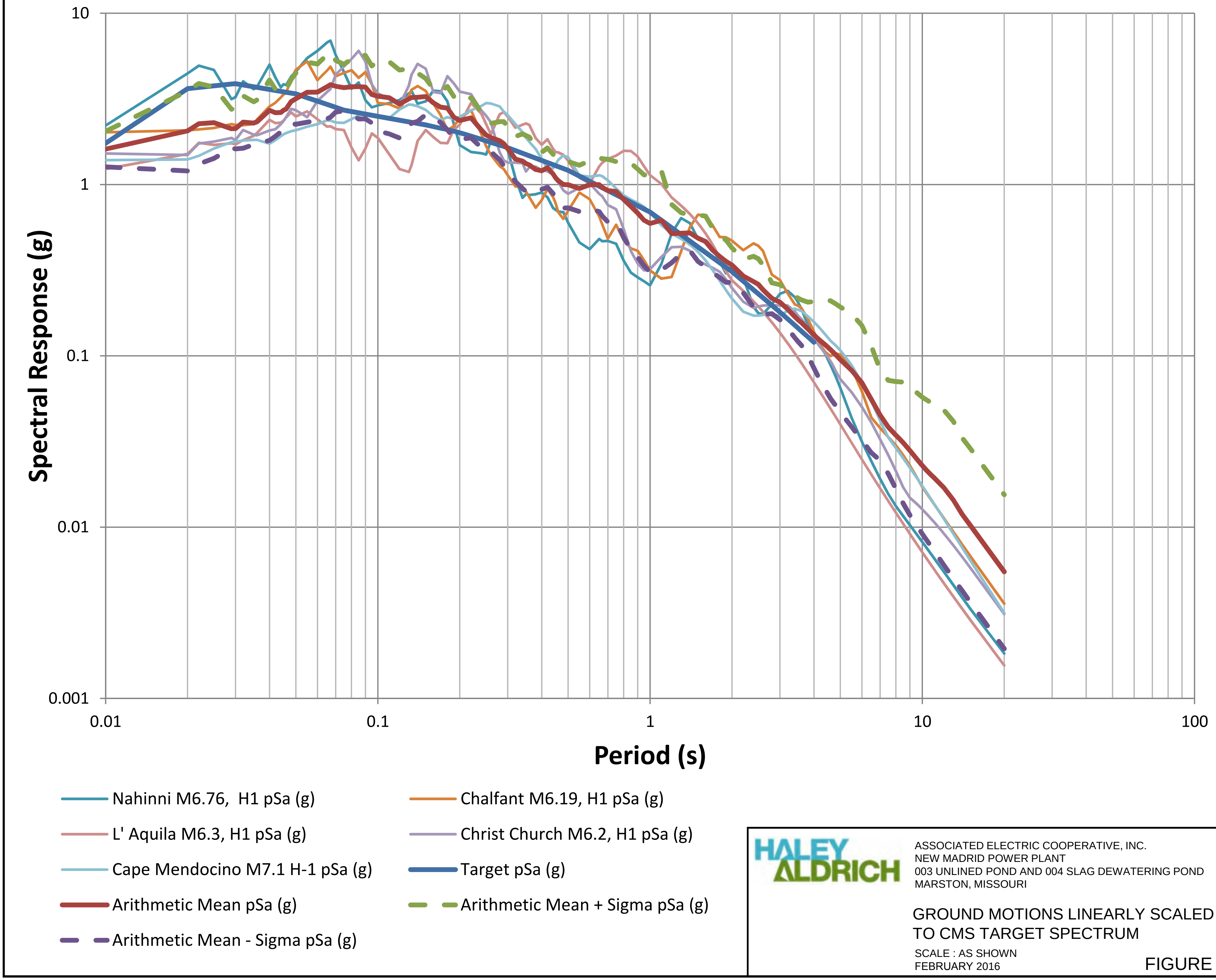
HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

DETERMINISTIC CONDITIONAL MEAN SPECTRUM (CMS)

SCALE : AS SHOWN
FEBRUARY 2016

FIGURE D-3



HALEY ALDRICH

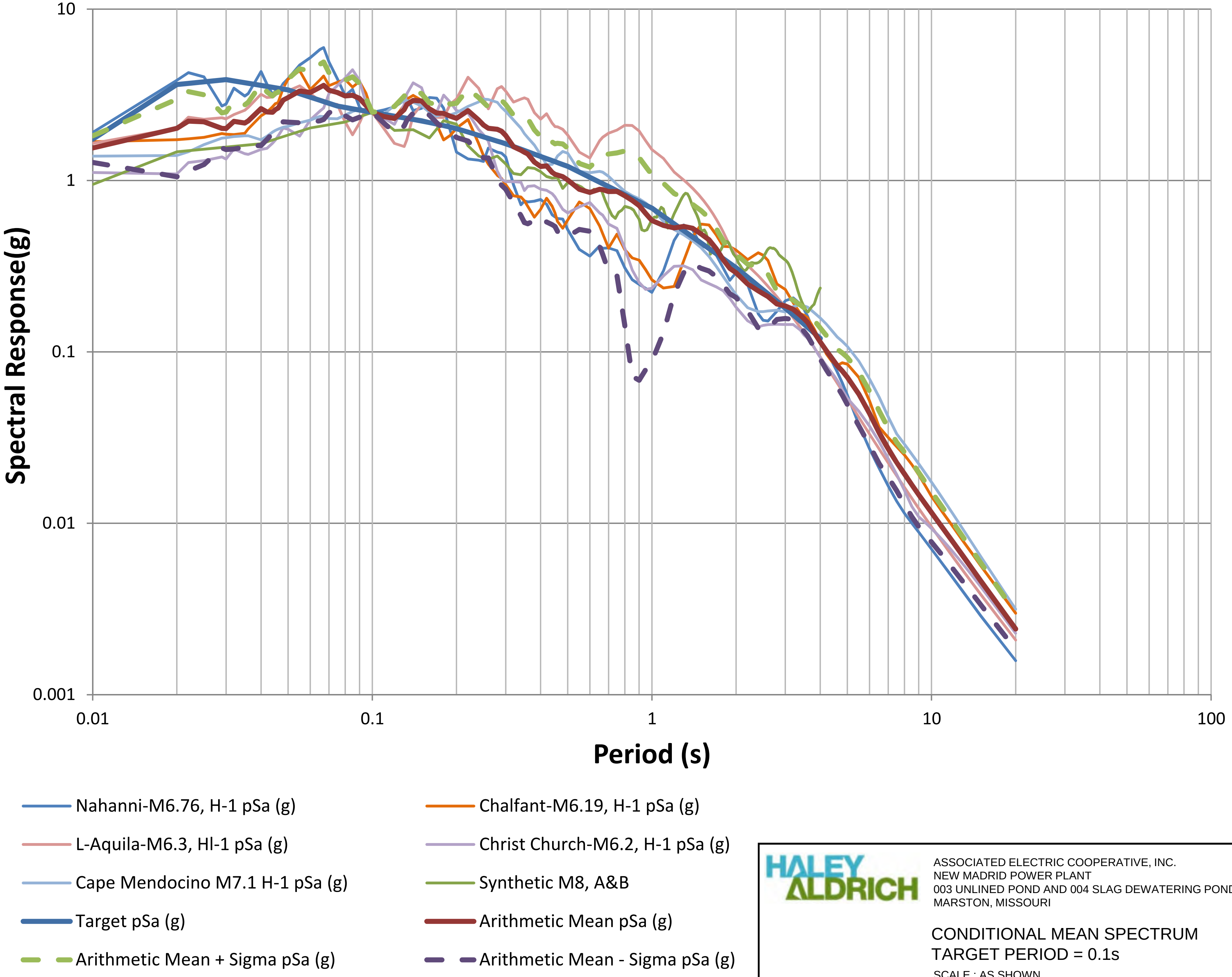
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

GROUND MOTIONS LINEARLY SCALED
TO CMS TARGET SPECTRUM

SCALE : AS SHOWN
FEBRUARY 2016

FIGURE D-4

40616-300_FIG D4.PPT



HALEY ALDRICH

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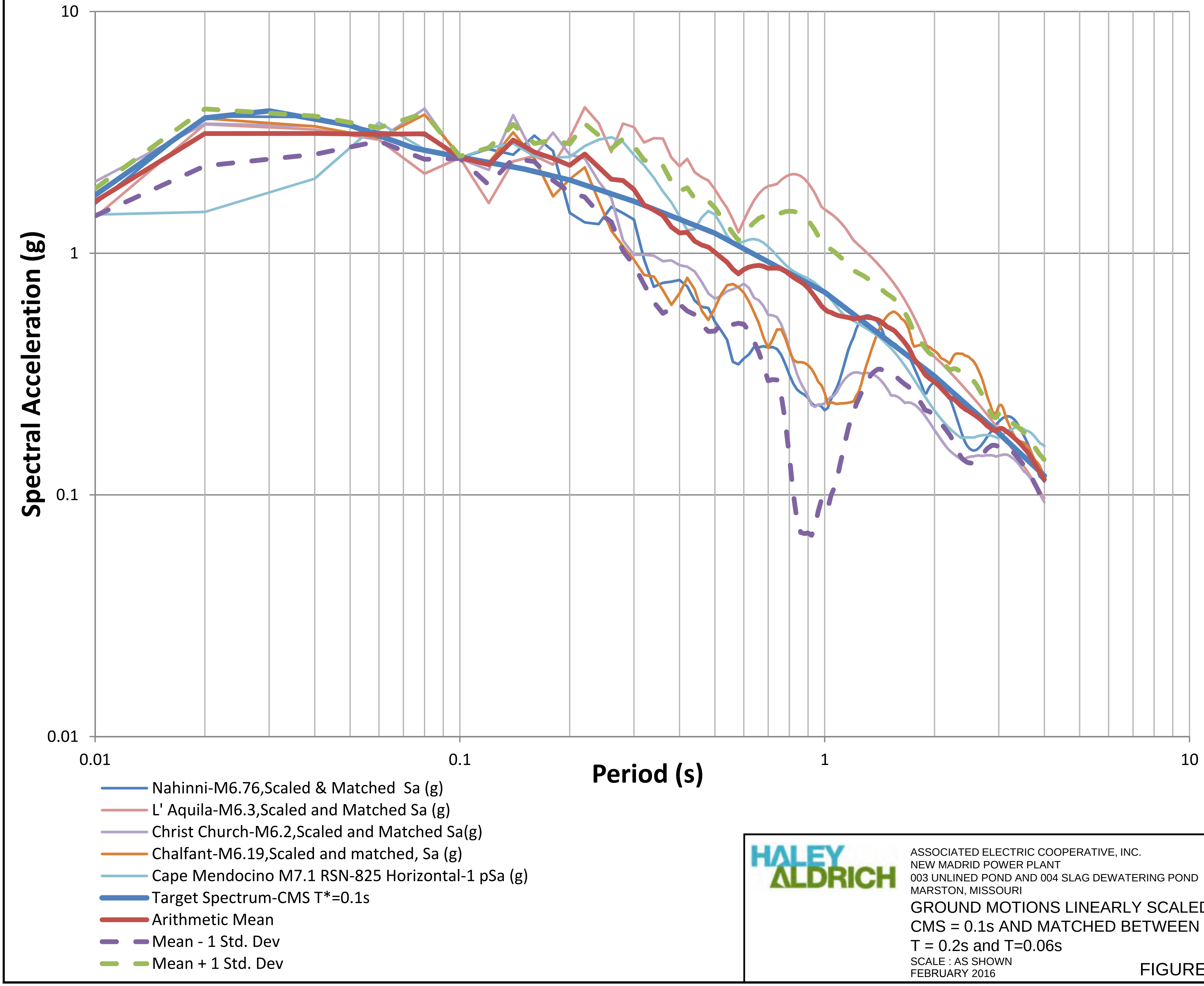
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

CONDITIONAL MEAN SPECTRUM
TARGET PERIOD = 0.1s

SCALE : AS SHOWN
FEBRUARY 2016

FIGURE D-5



HALEY ALDRICH

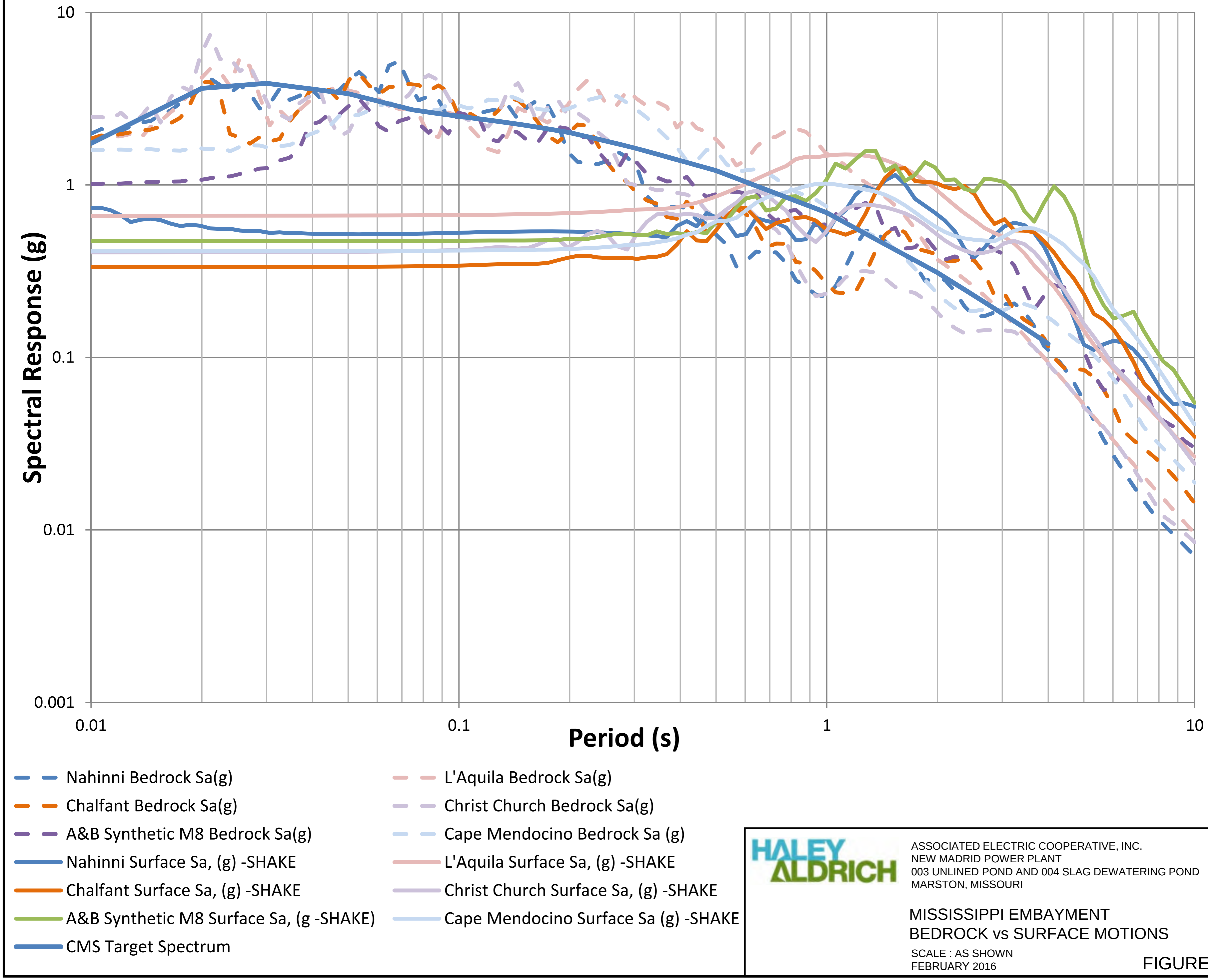
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

GROUND MOTIONS LINEARLY SCALED TO
CMS = 0.1s AND MATCHED BETWEEN
T = 0.2s and T=0.06s

SCALE : AS SHOWN
FEBRUARY 2016

FIGURE D-6

40616-300_FIG D6.PPT



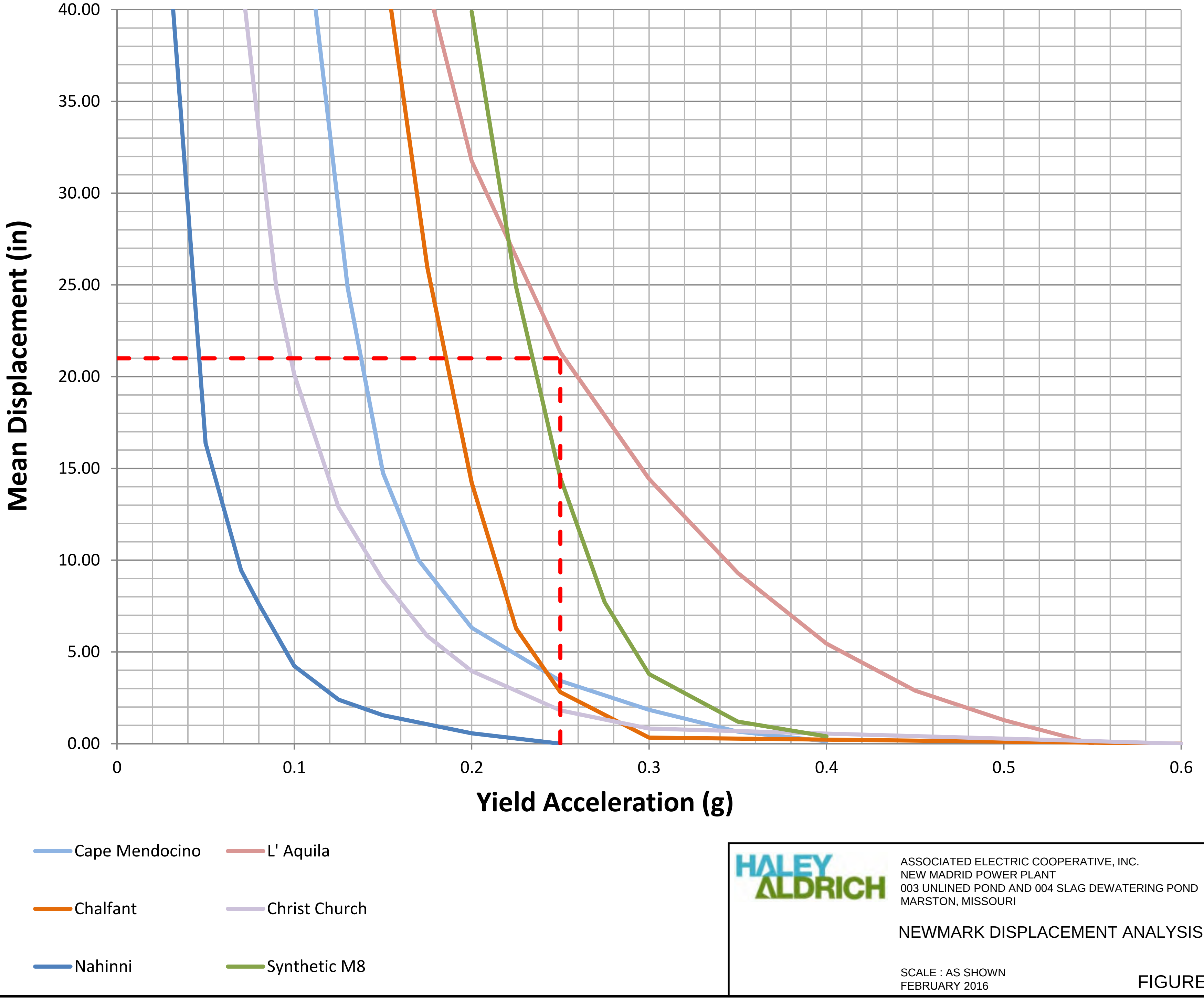
HALEY
ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

MISSISSIPPI EMBAYMENT
BEDROCK vs SURFACE MOTIONS

SCALE : AS SHOWN
FEBRUARY 2016

FIGURE D-7



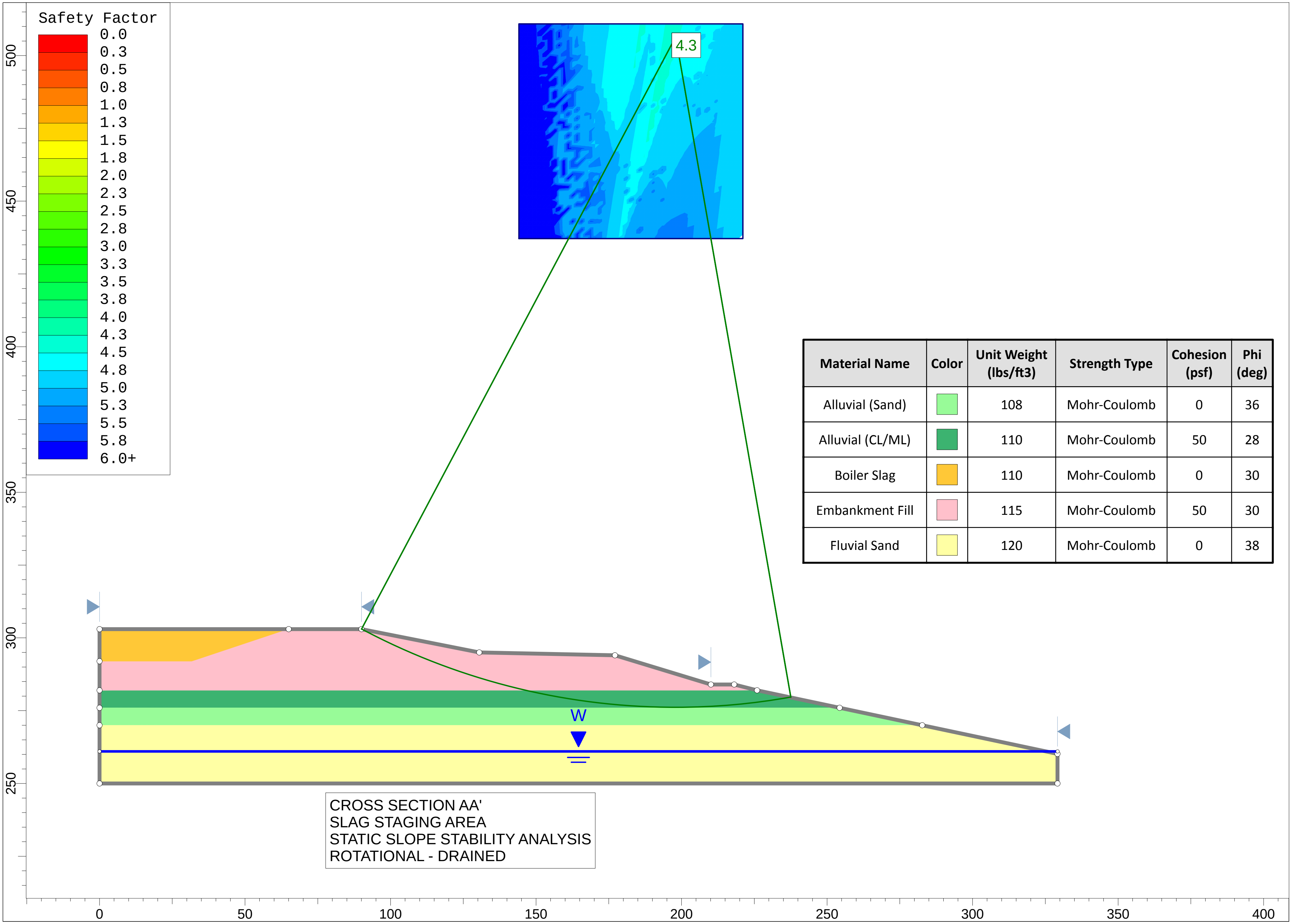
HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
003 UNLINED POND AND 004 SLAG DEWATERING POND
MARSTON, MISSOURI

NEWMARK DISPLACEMENT ANALYSIS

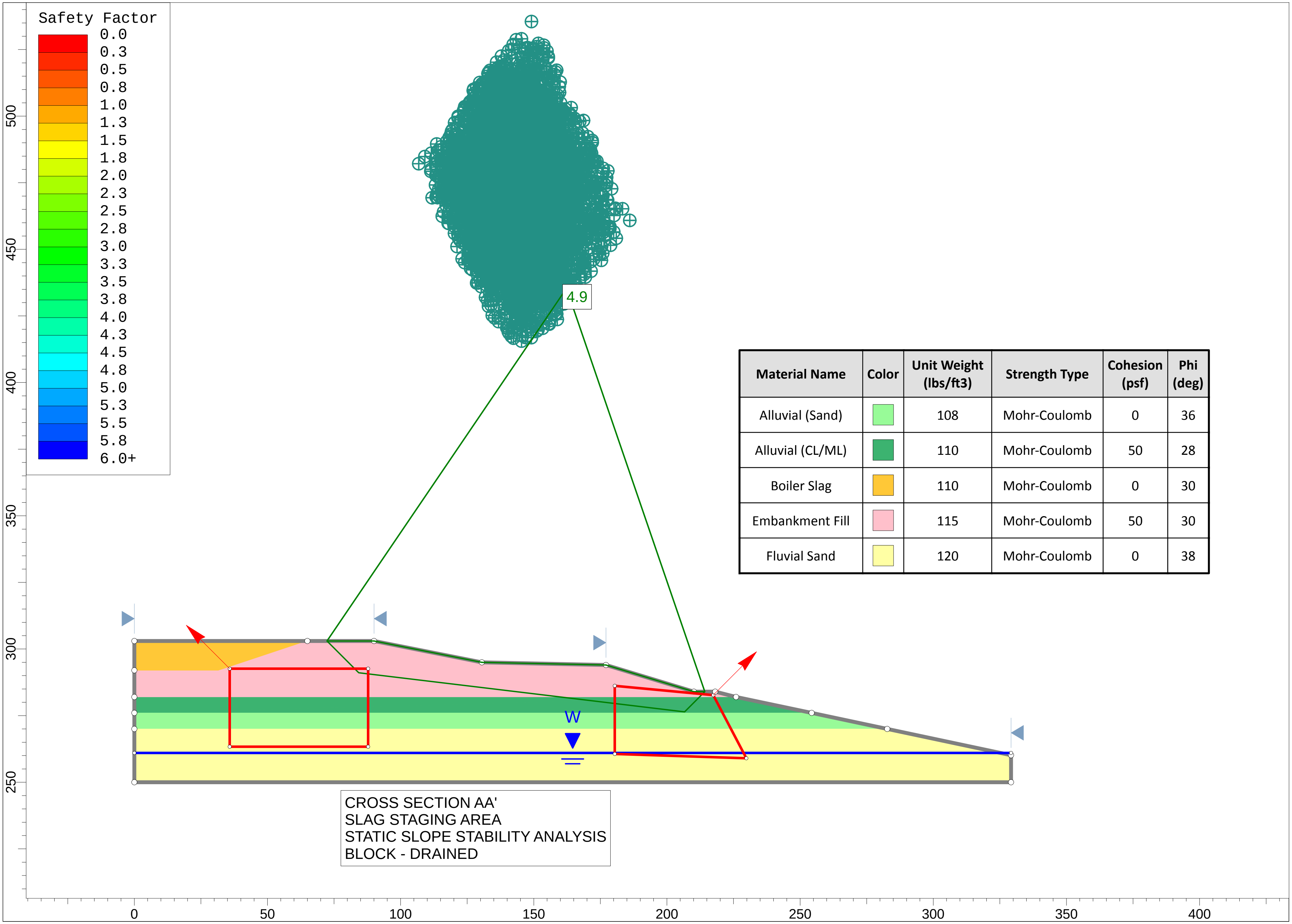
SCALE : AS SHOWN
FEBRUARY 2016

FIGURE D-8



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	36
Alluvial (CL/ML)	🟩	110	Mohr-Coulomb	50	28
Boiler Slag	🟧	110	Mohr-Coulomb	0	30
Embankment Fill	🟥	115	Mohr-Coulomb	50	30
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION AA'
SLAG STAGING AREA
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - DRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
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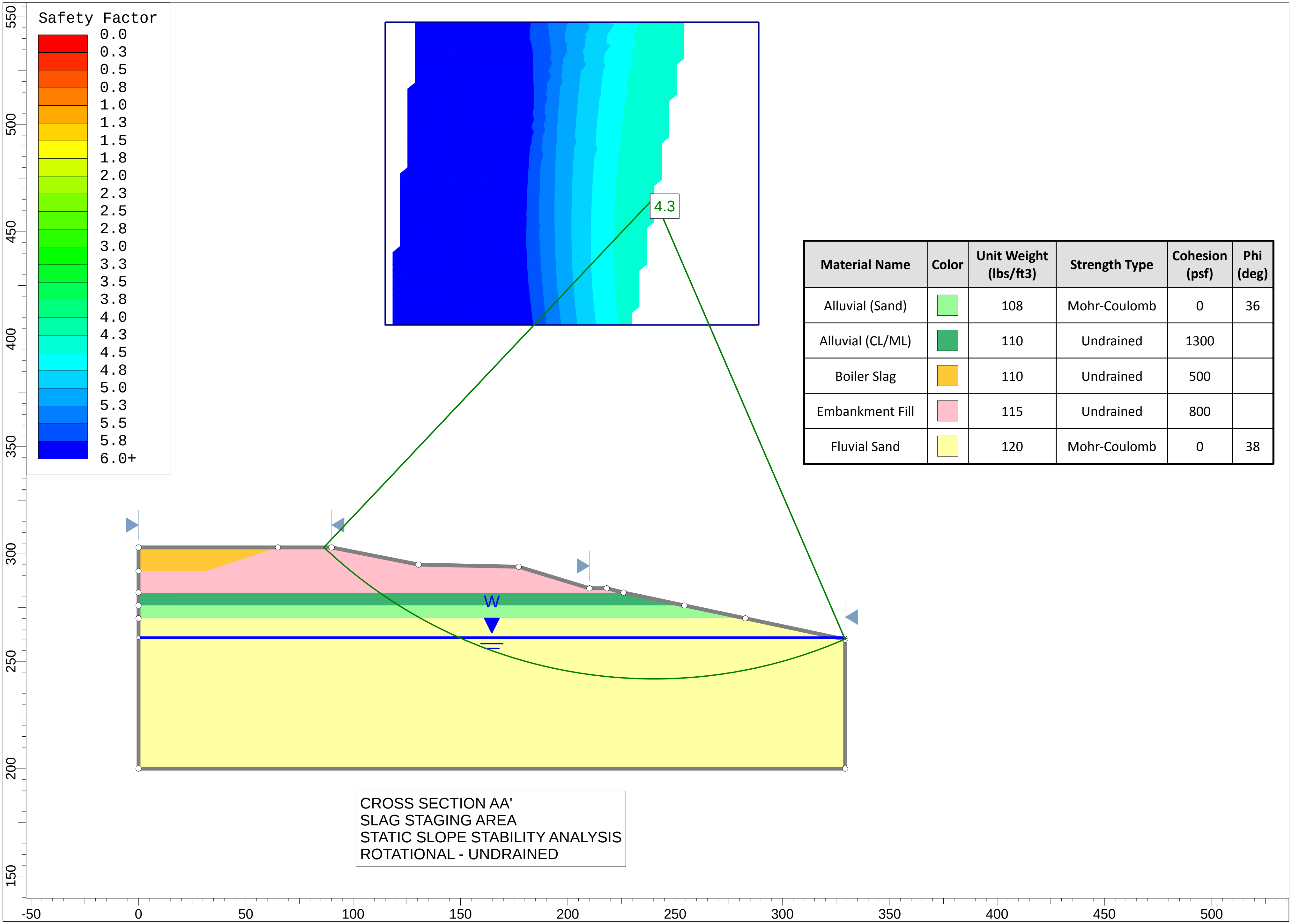
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION AA'
SLAG STAGING AREA
STATIC SLOPE STABILITY ANALYSIS
BLOCK - DRAINED



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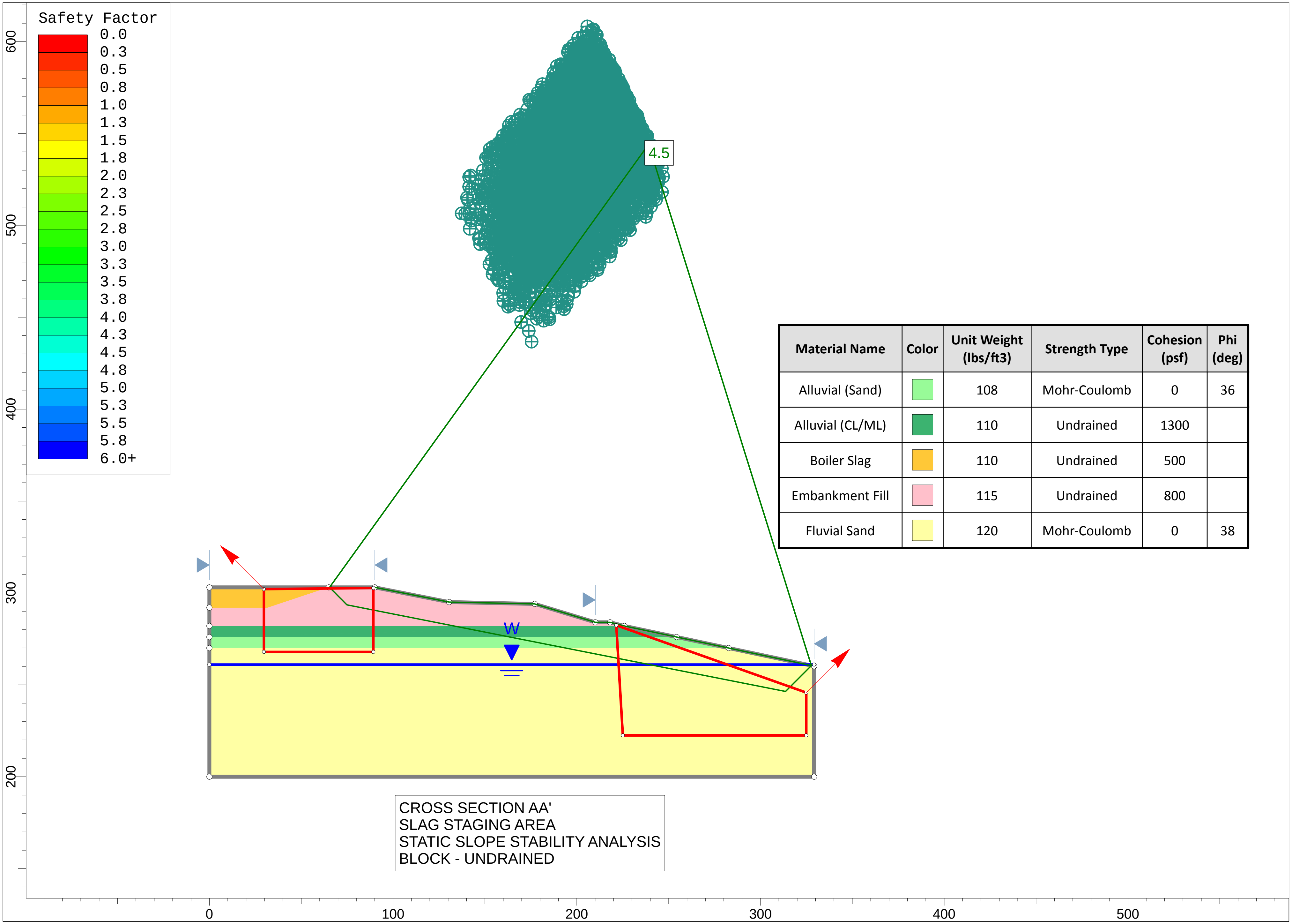
CROSS SECTION AA'
SLAG STAGING AREA
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
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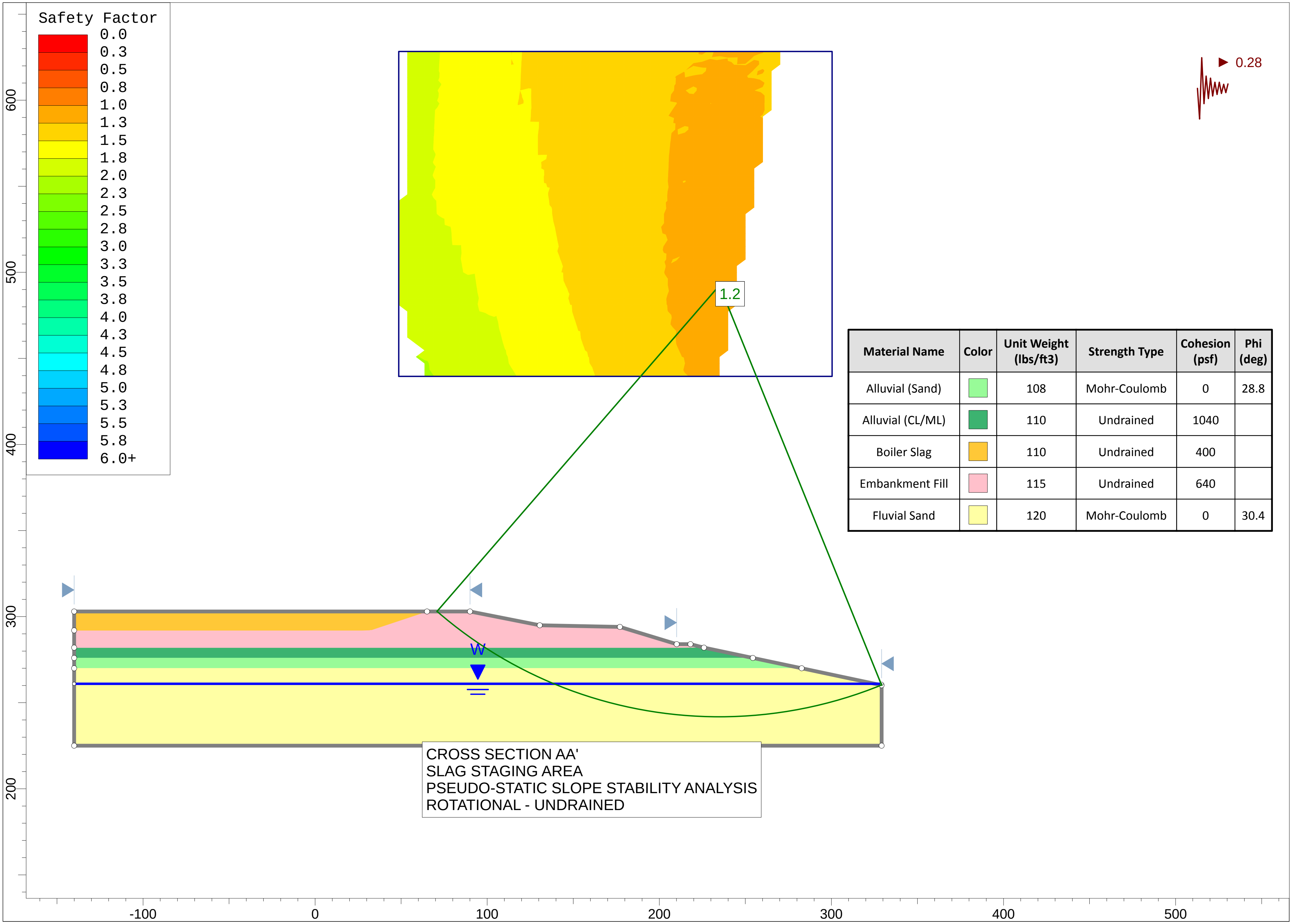
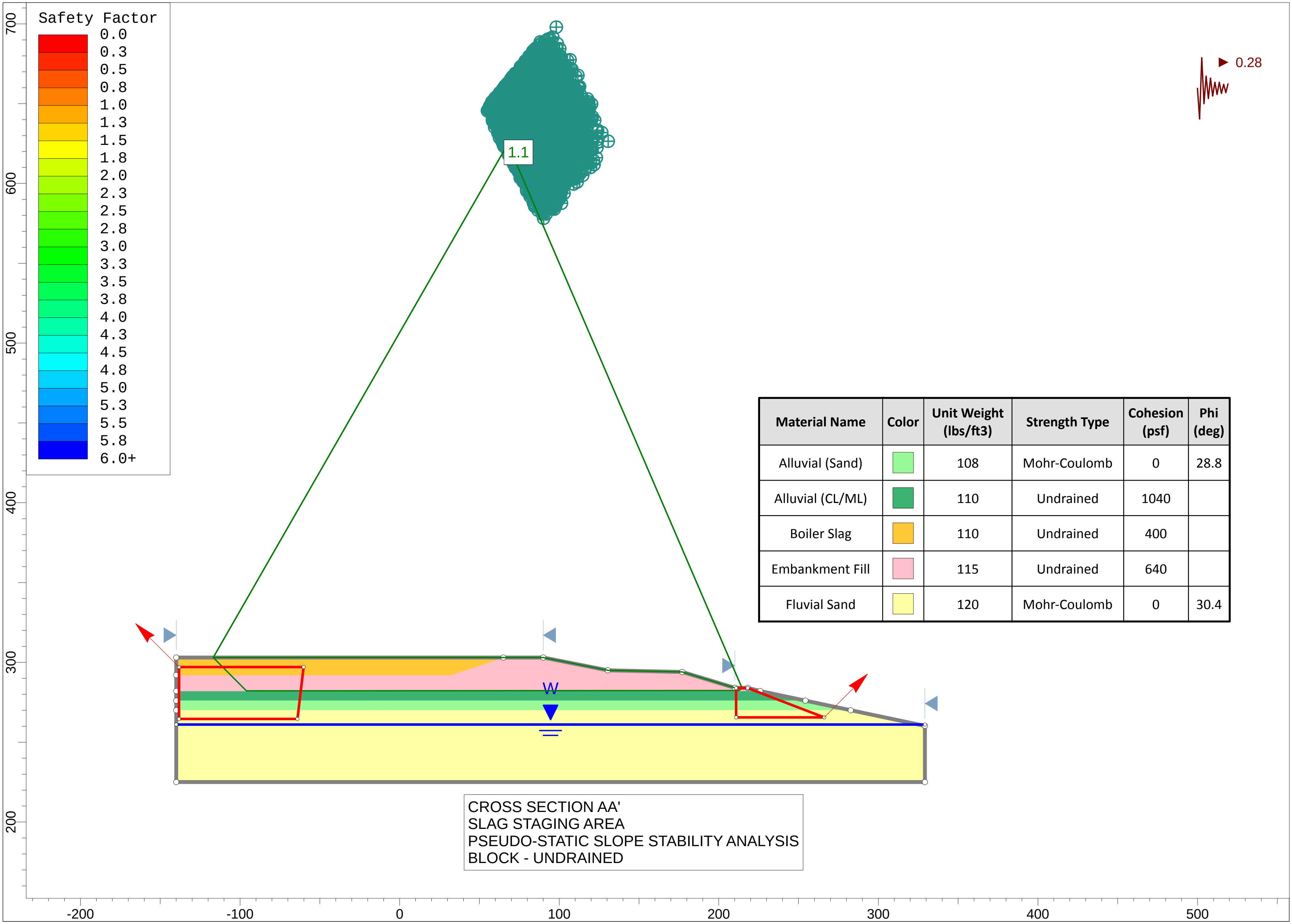
CROSS SECTION AA'
SLAG STAGING AREA
STATIC SLOPE STABILITY ANALYSIS
BLOCK - UNDRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	28.8
Alluvial (CL/ML)	🟩	110	Undrained	1040	
Boiler Slag	🟧	110	Undrained	400	
Embankment Fill	🟥	115	Undrained	640	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	30.4

CROSS SECTION AA'
SLAG STAGING AREA
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
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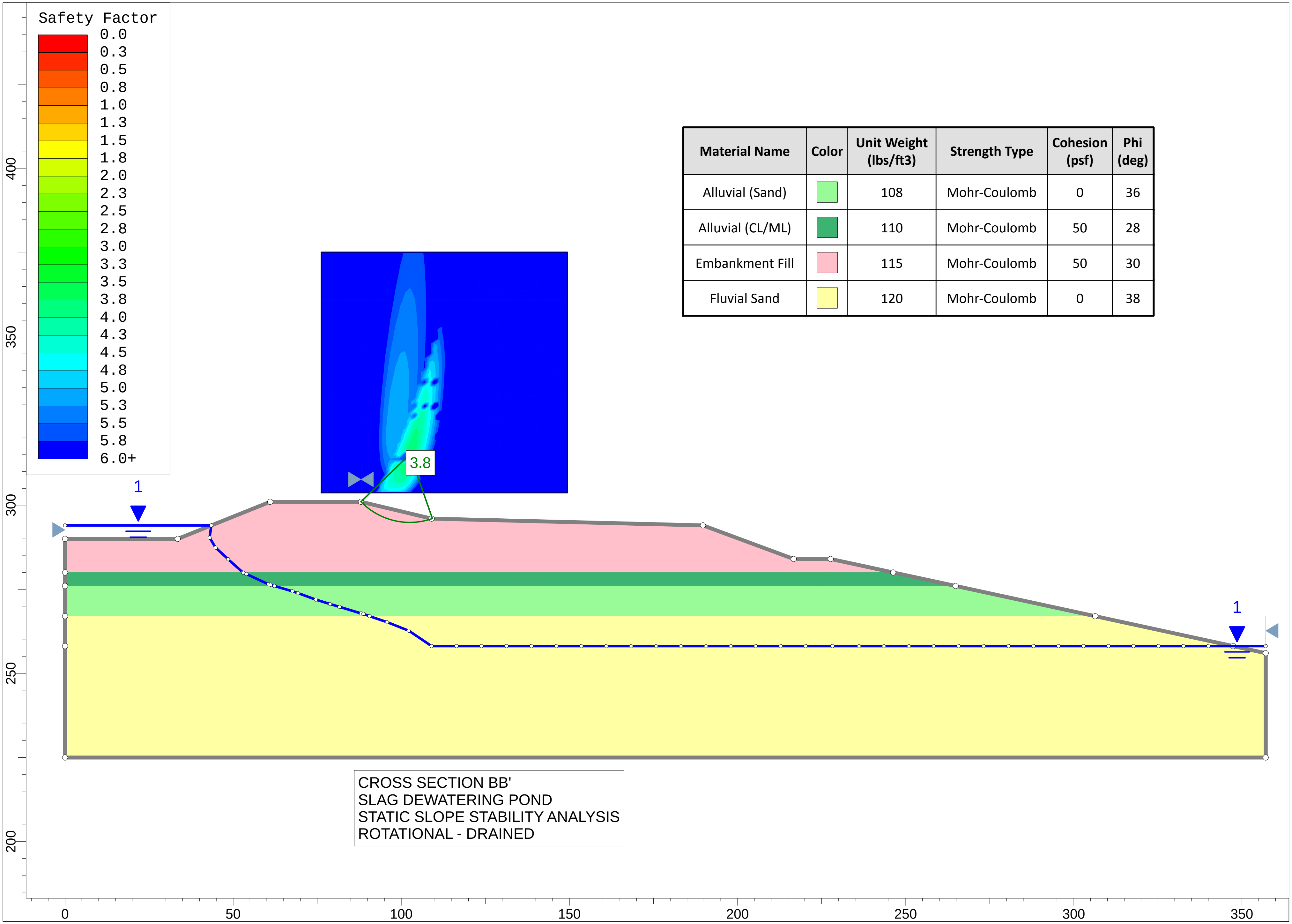
CROSS SECTION AA'
SLAG STAGING AREA
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
BLOCK - UNDRAINED



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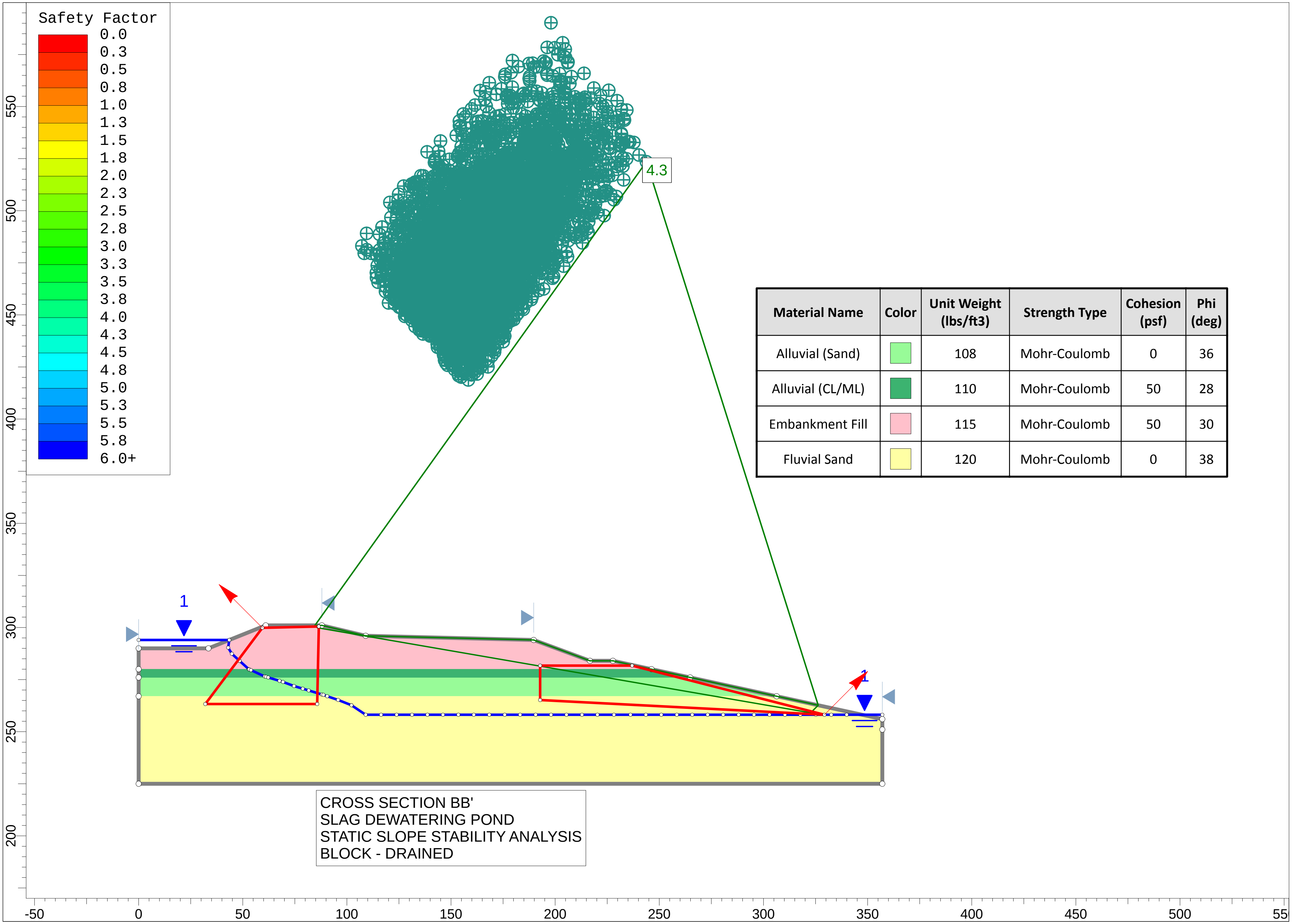
CROSS SECTION BB'
SLAG DEWATERING POND
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - DRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
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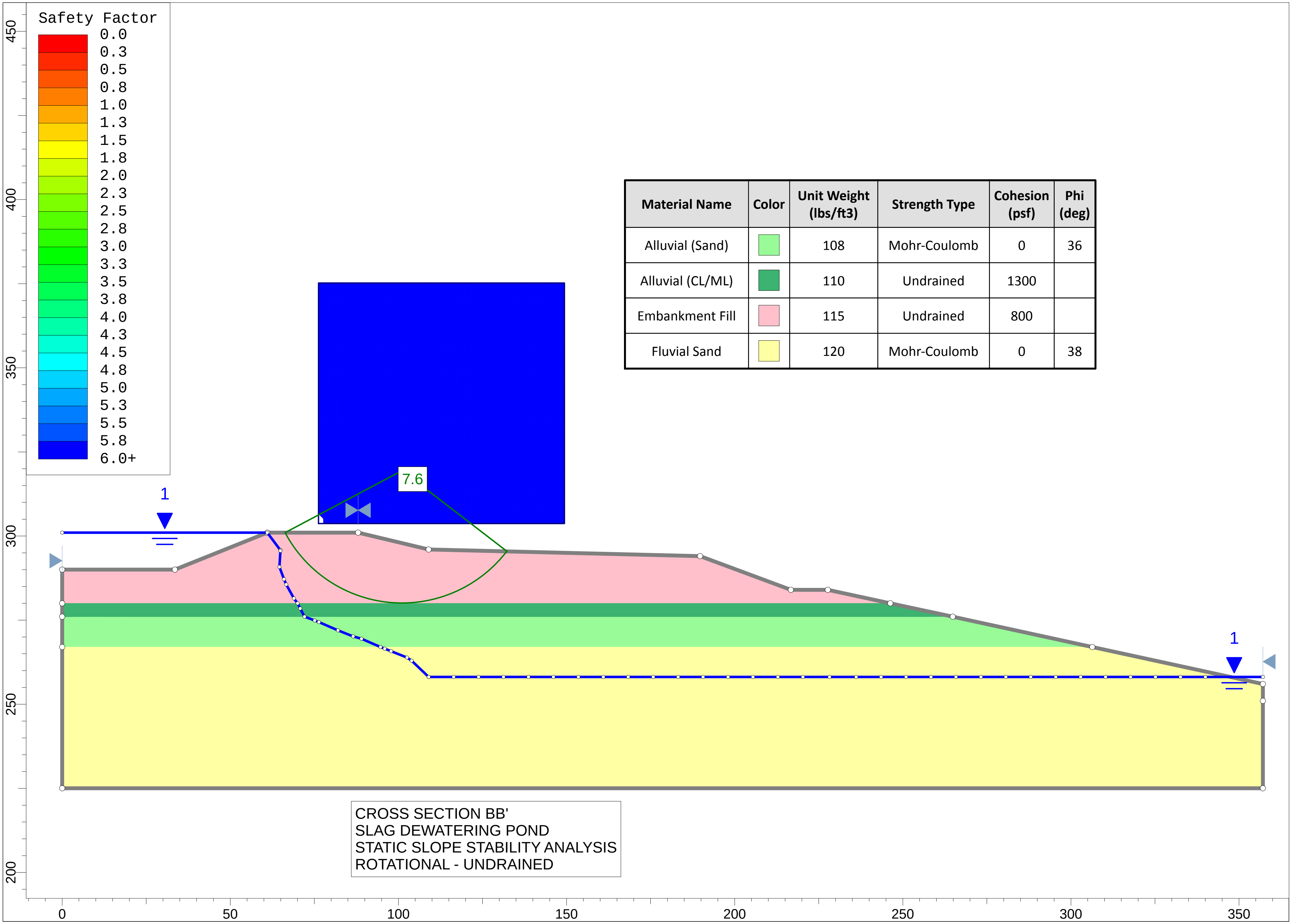
CROSS SECTION BB'
SLAG DEWATERING POND
STATIC SLOPE STABILITY ANALYSIS
BLOCK - DRAINED



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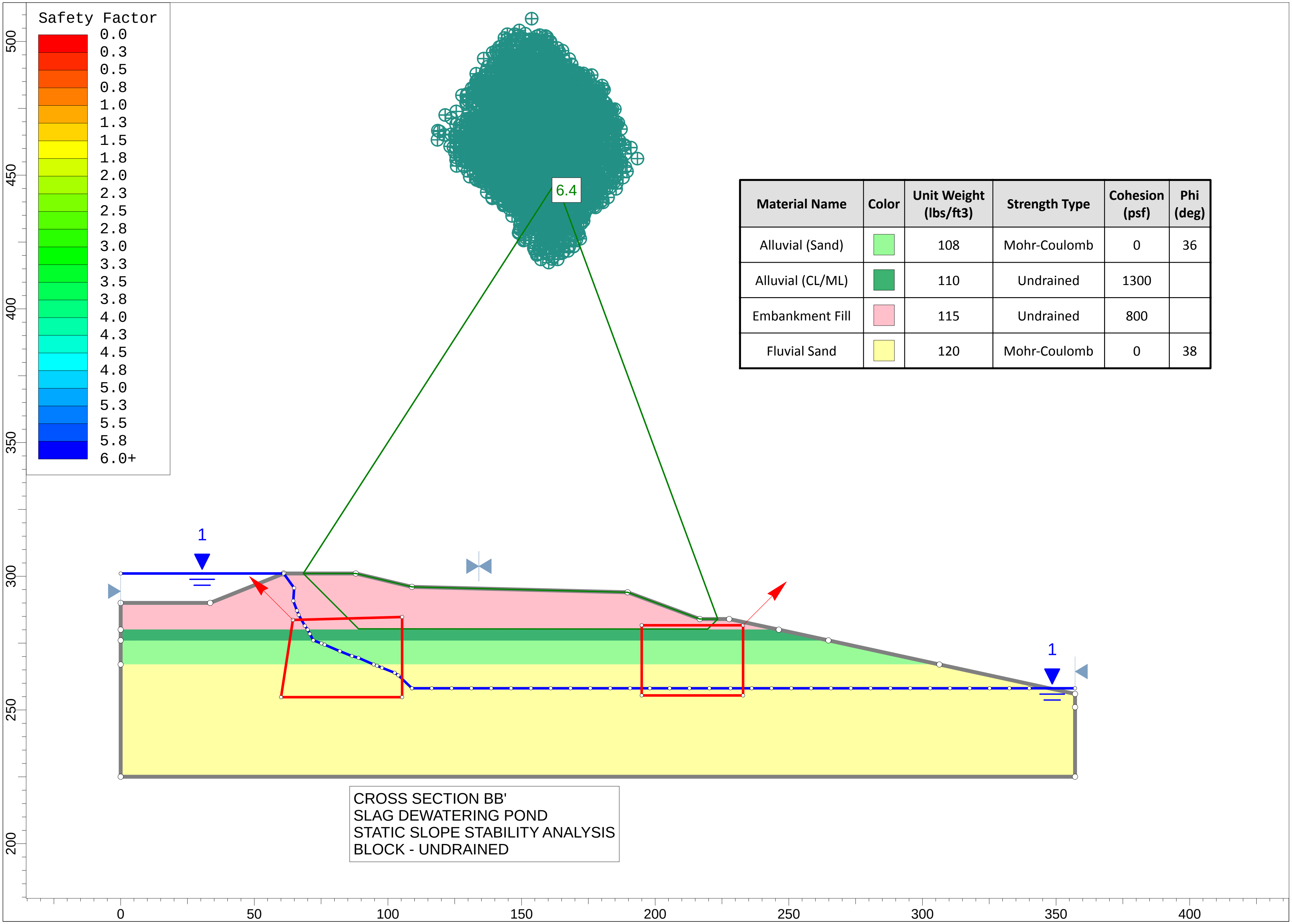
CROSS SECTION BB'
SLAG DEWATERING POND
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



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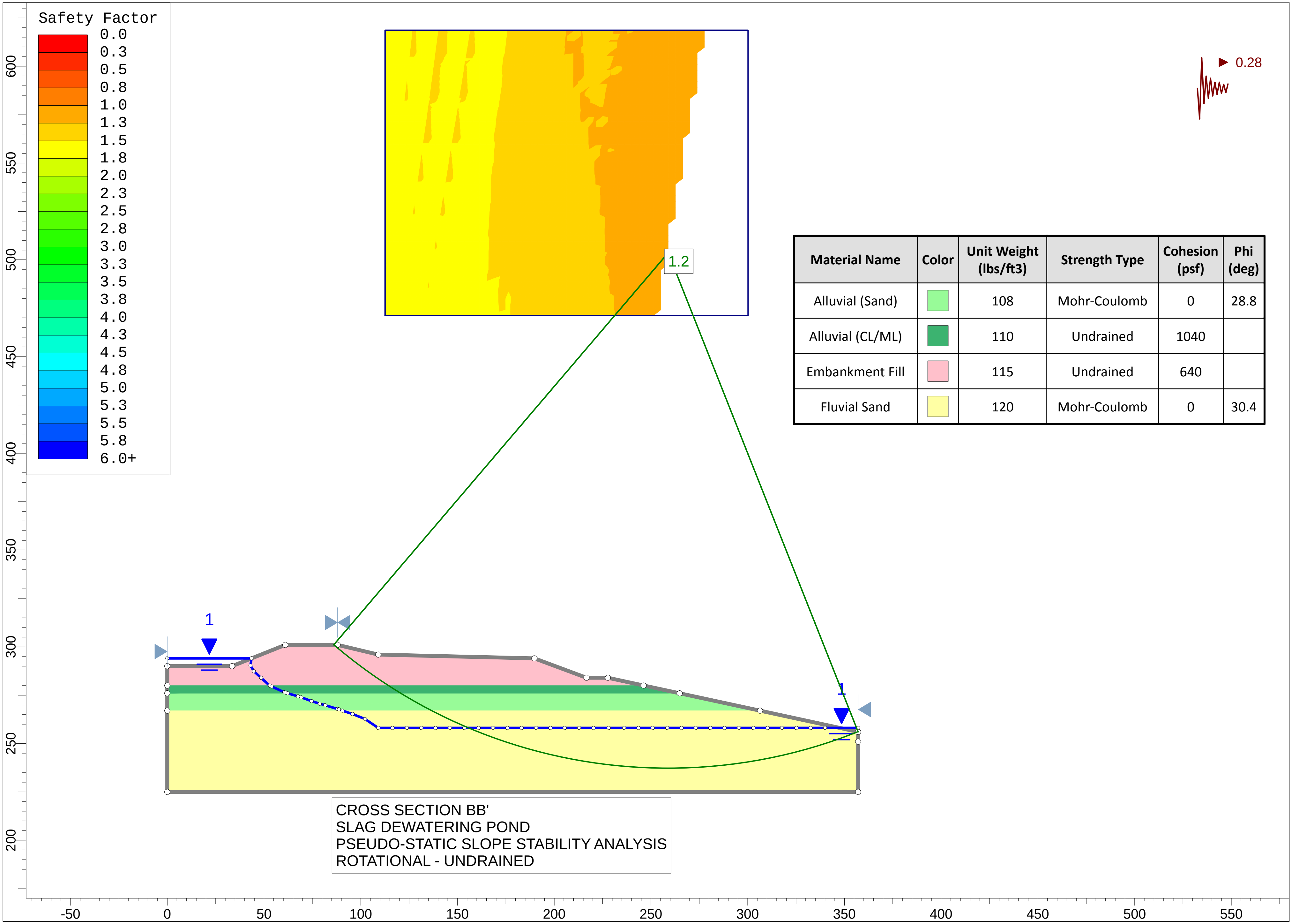
CROSS SECTION BB'
SLAG DEWATERING POND
STATIC SLOPE STABILITY ANALYSIS
BLOCK - UNDRAINED



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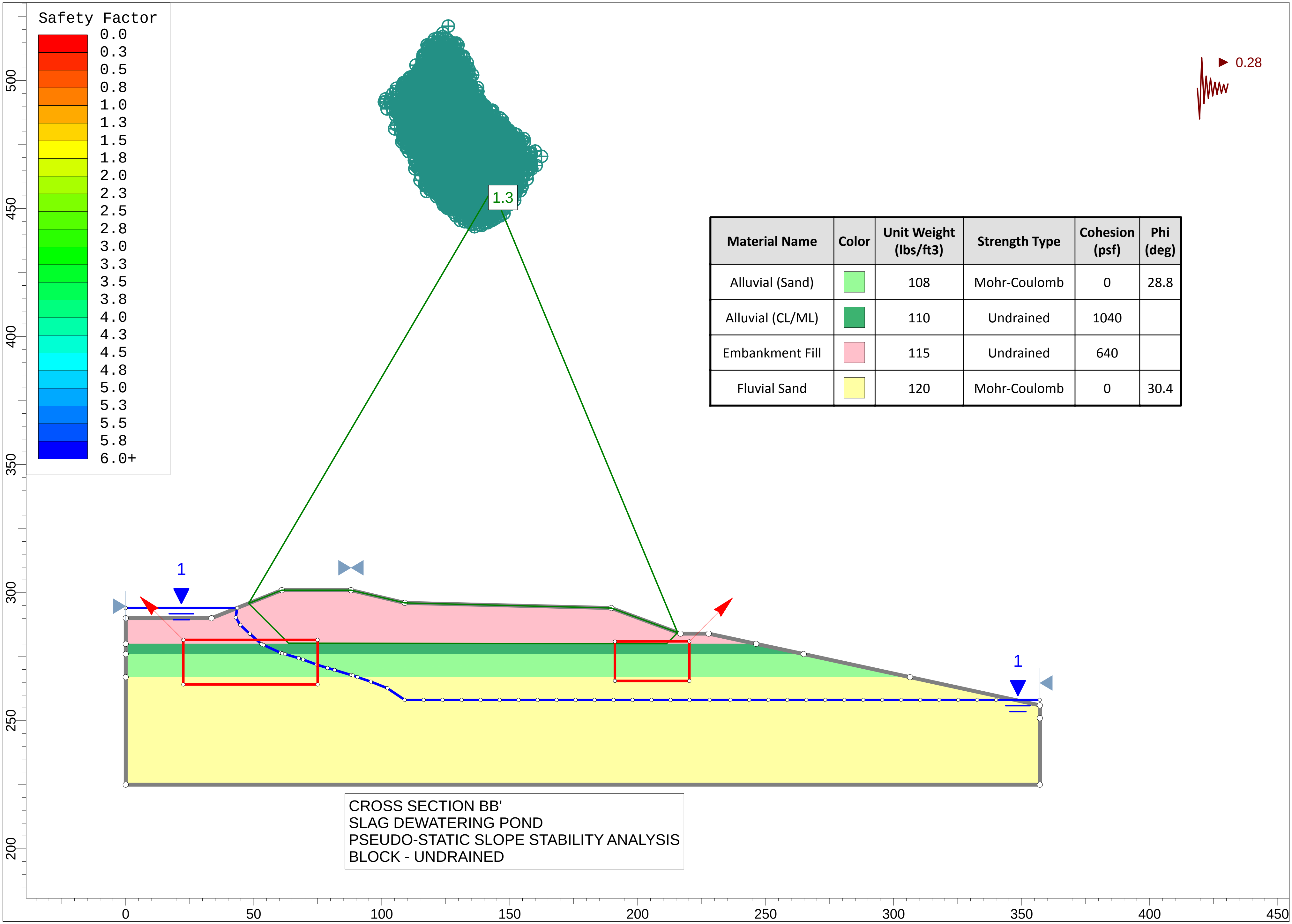
CROSS SECTION BB'
SLAG DEWATERING POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



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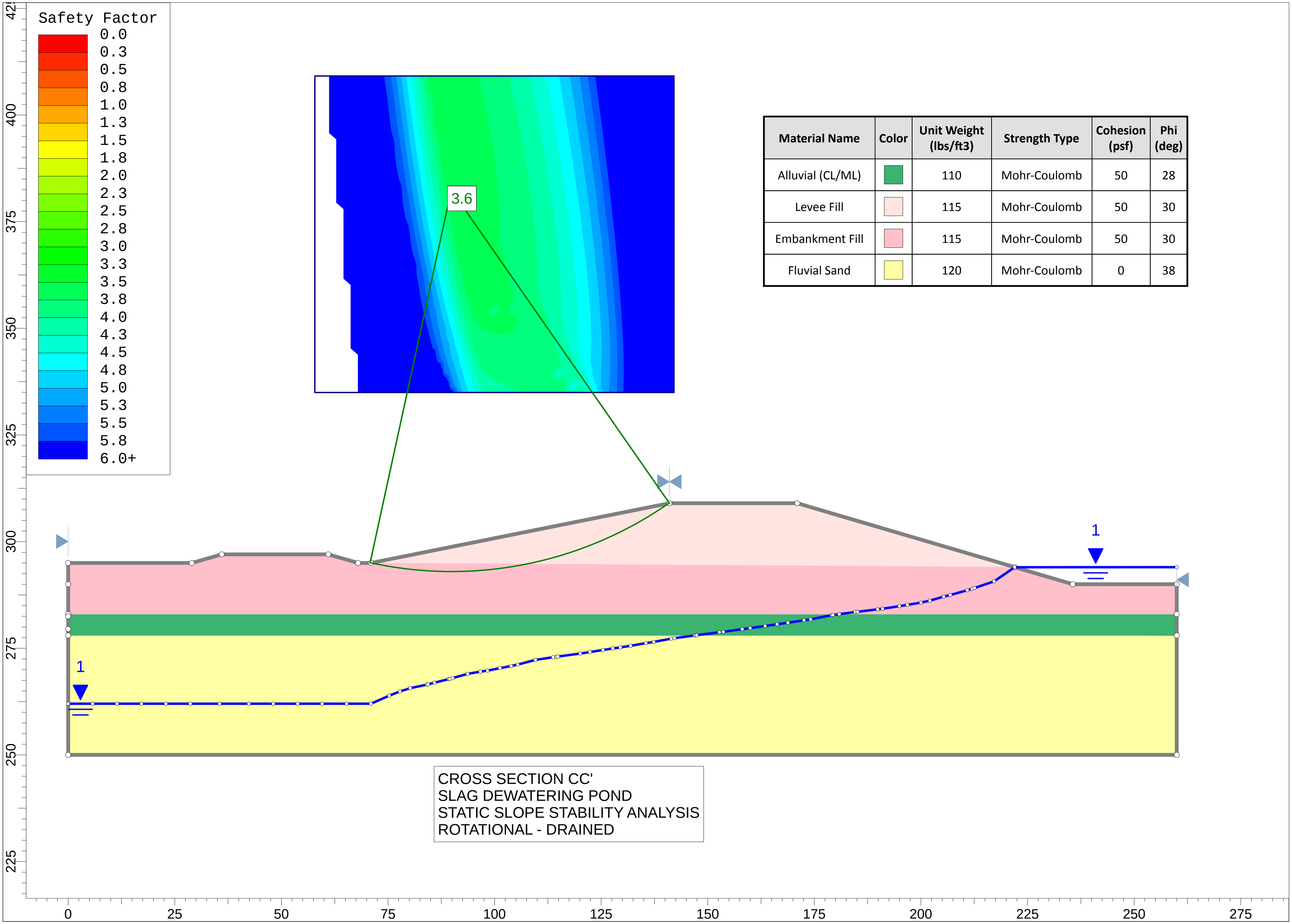
CROSS SECTION BB'
SLAG DEWATERING POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
BLOCK - UNDRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
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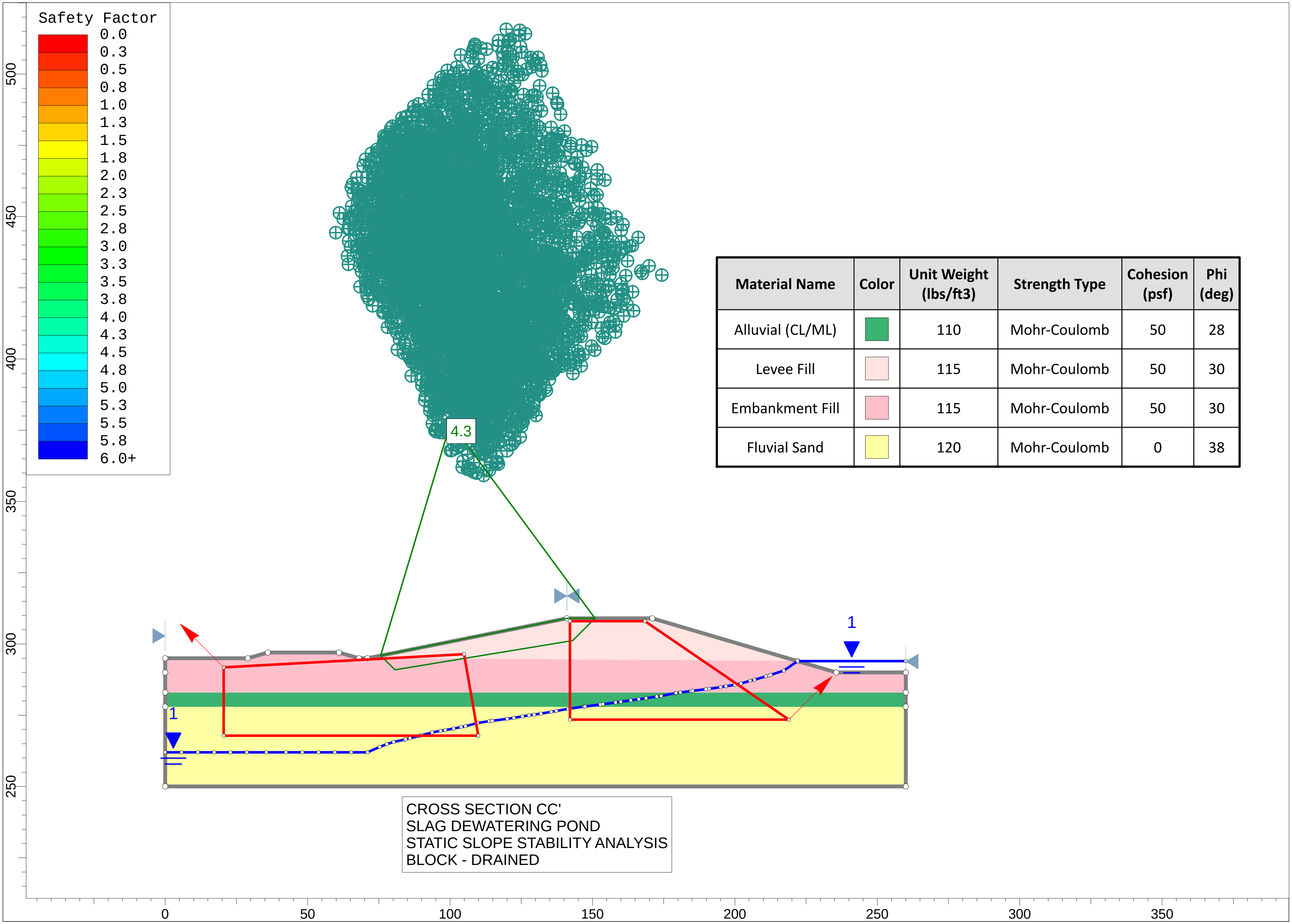
CROSS SECTION CC'
SLAG DEWATERING POND
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - DRAINED



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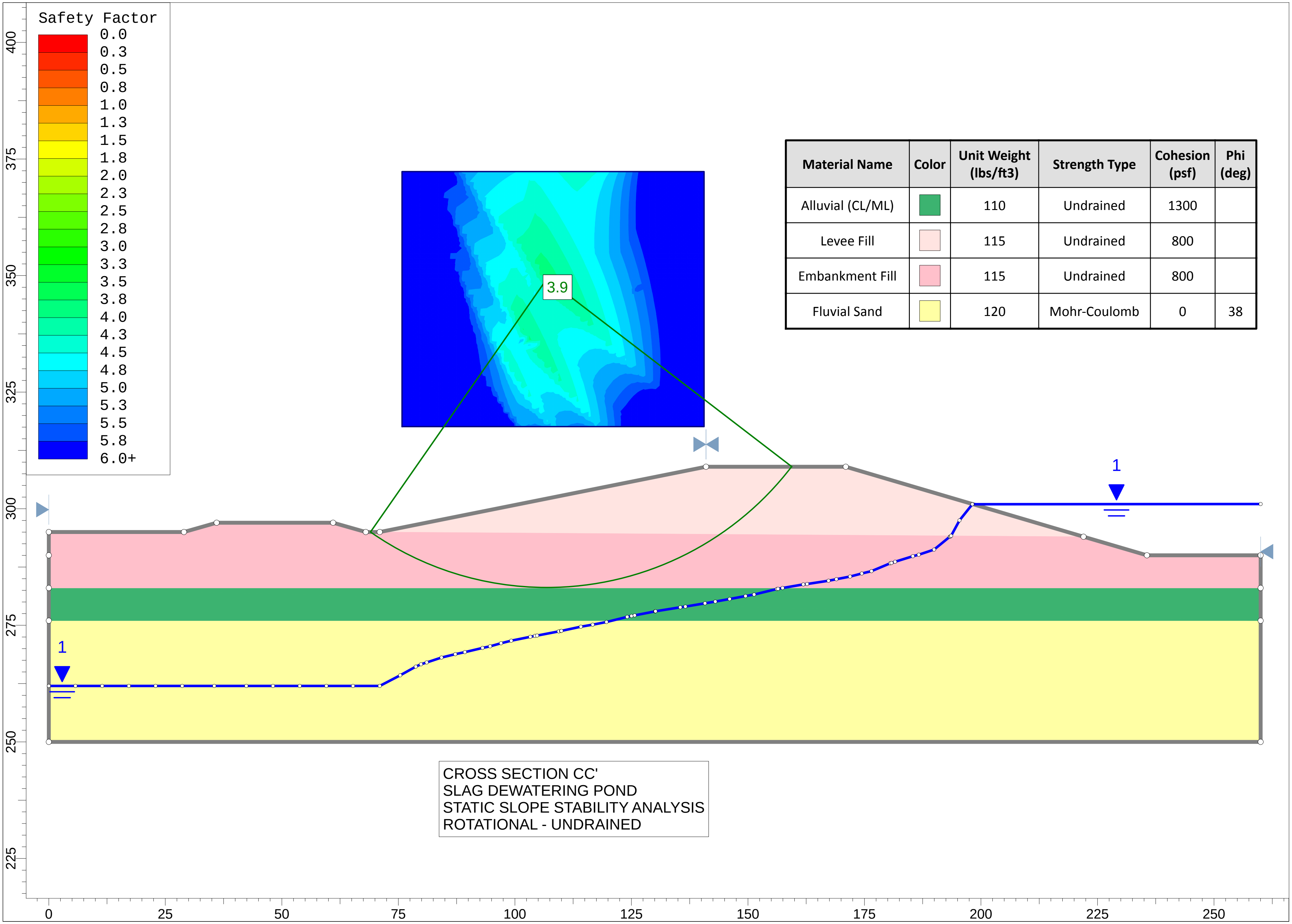
CROSS SECTION CC'
SLAG DEWATERING POND
STATIC SLOPE STABILITY ANALYSIS
BLOCK - DRAINED



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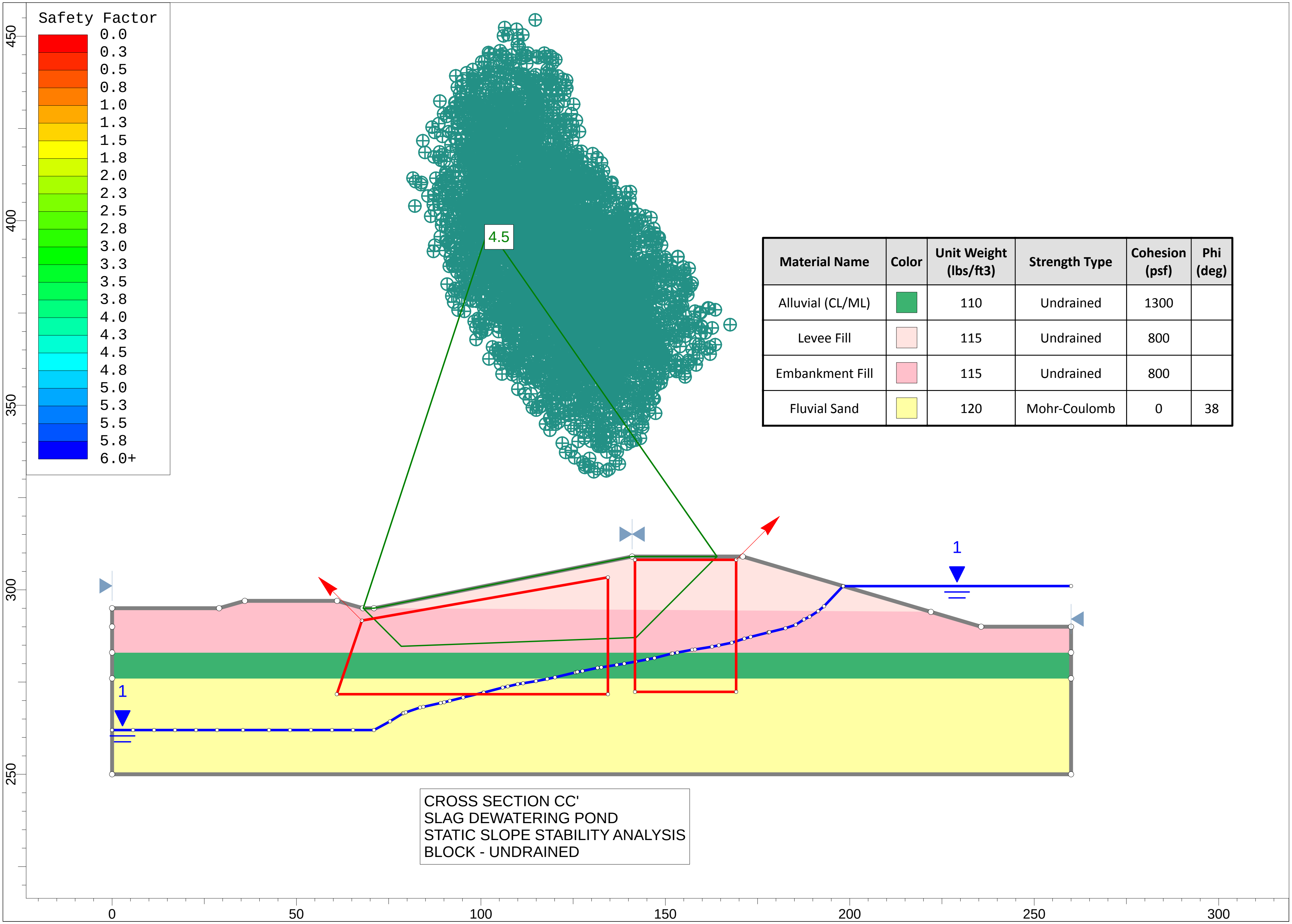
CROSS SECTION CC'
SLAG DEWATERING POND
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



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Levee Fill	⬜	115	Undrained	800	
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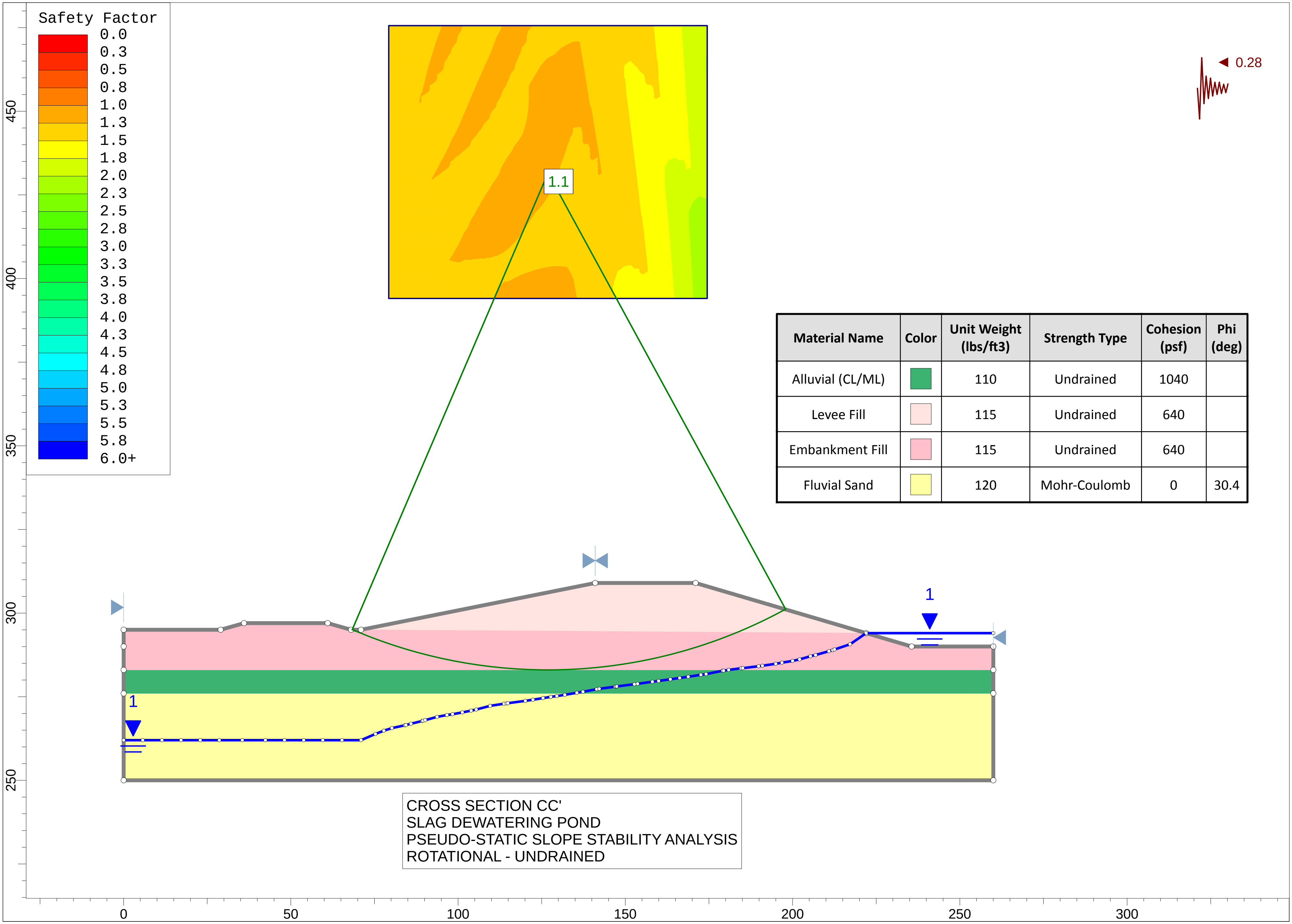
CROSS SECTION CC'
SLAG DEWATERING POND
STATIC SLOPE STABILITY ANALYSIS
BLOCK - UNDRAINED



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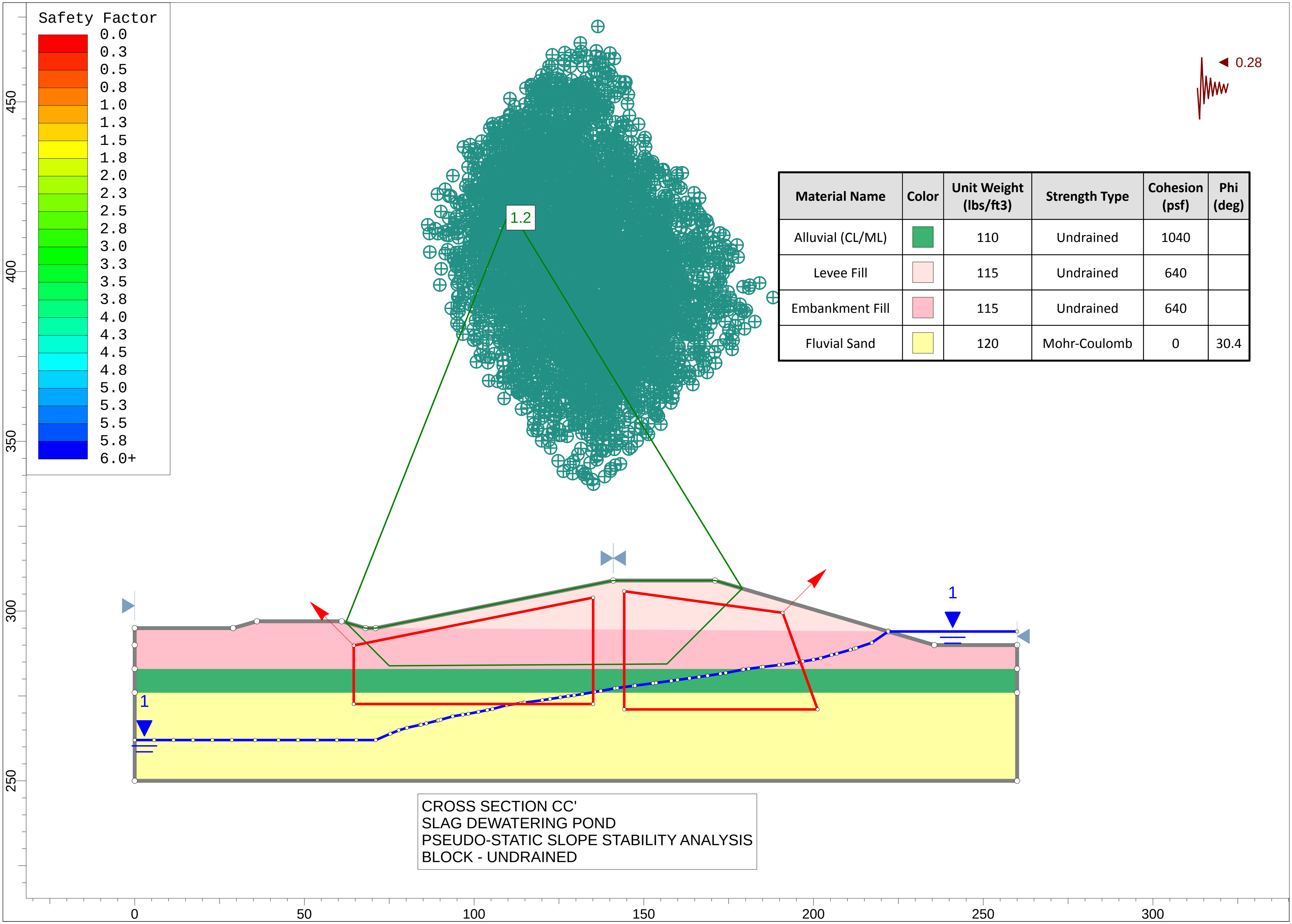
CROSS SECTION CC'
SLAG DEWATERING POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



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Levee Fill	▨	115	Undrained	640	
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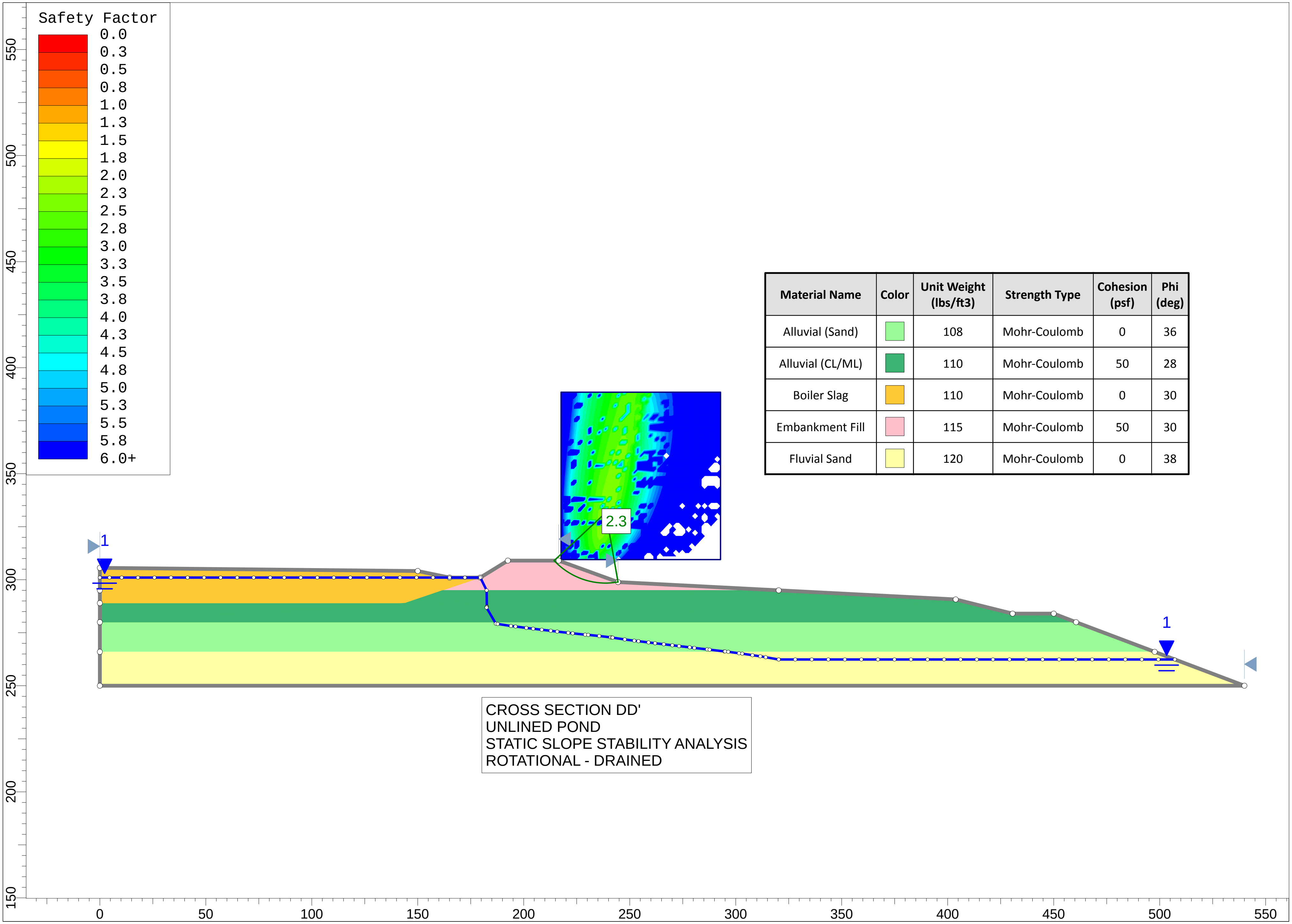
CROSS SECTION CC'
SLAG DEWATERING POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
BLOCK - UNDRAINED



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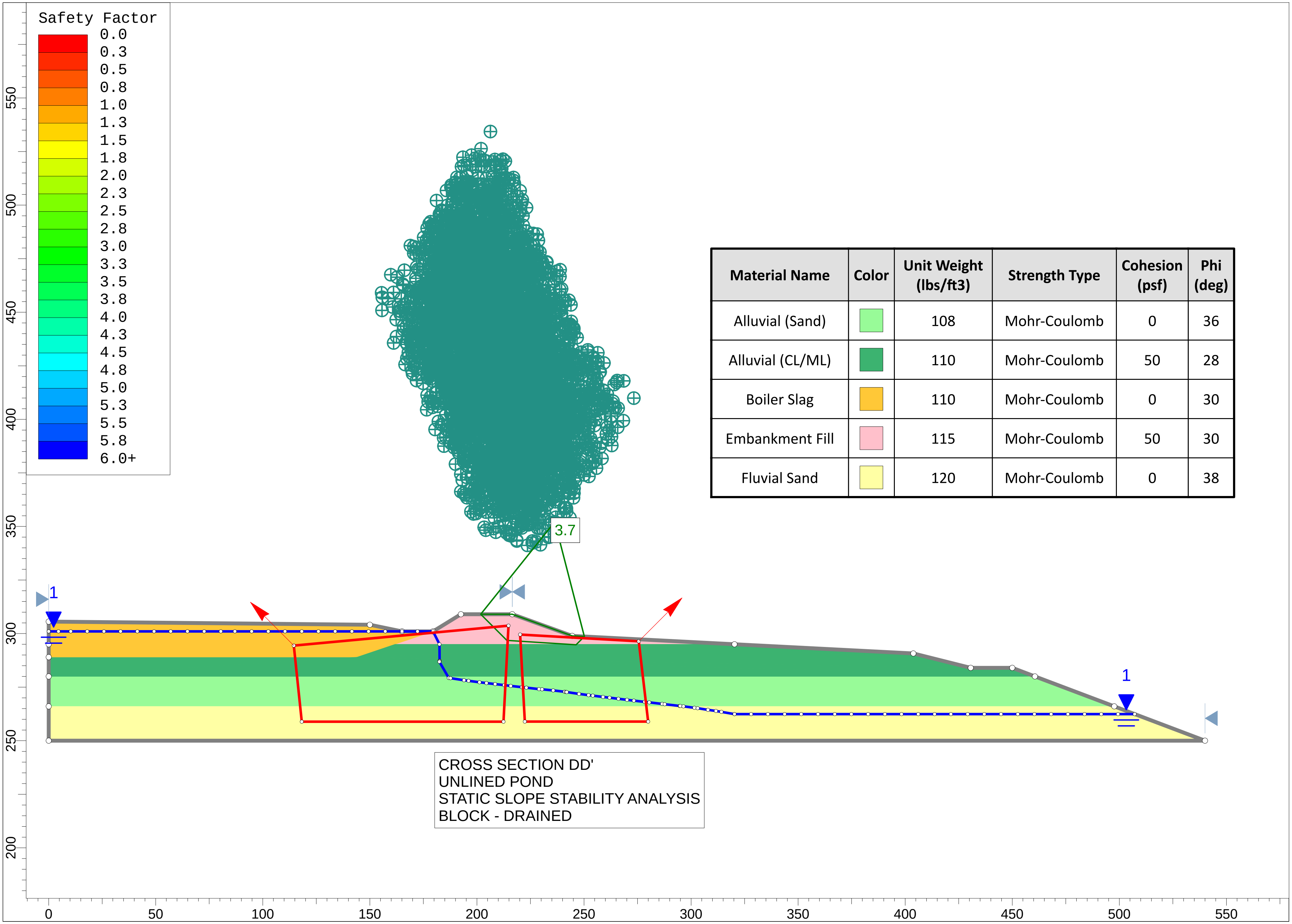
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION DD'
UNLINED POND
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - DRAINED



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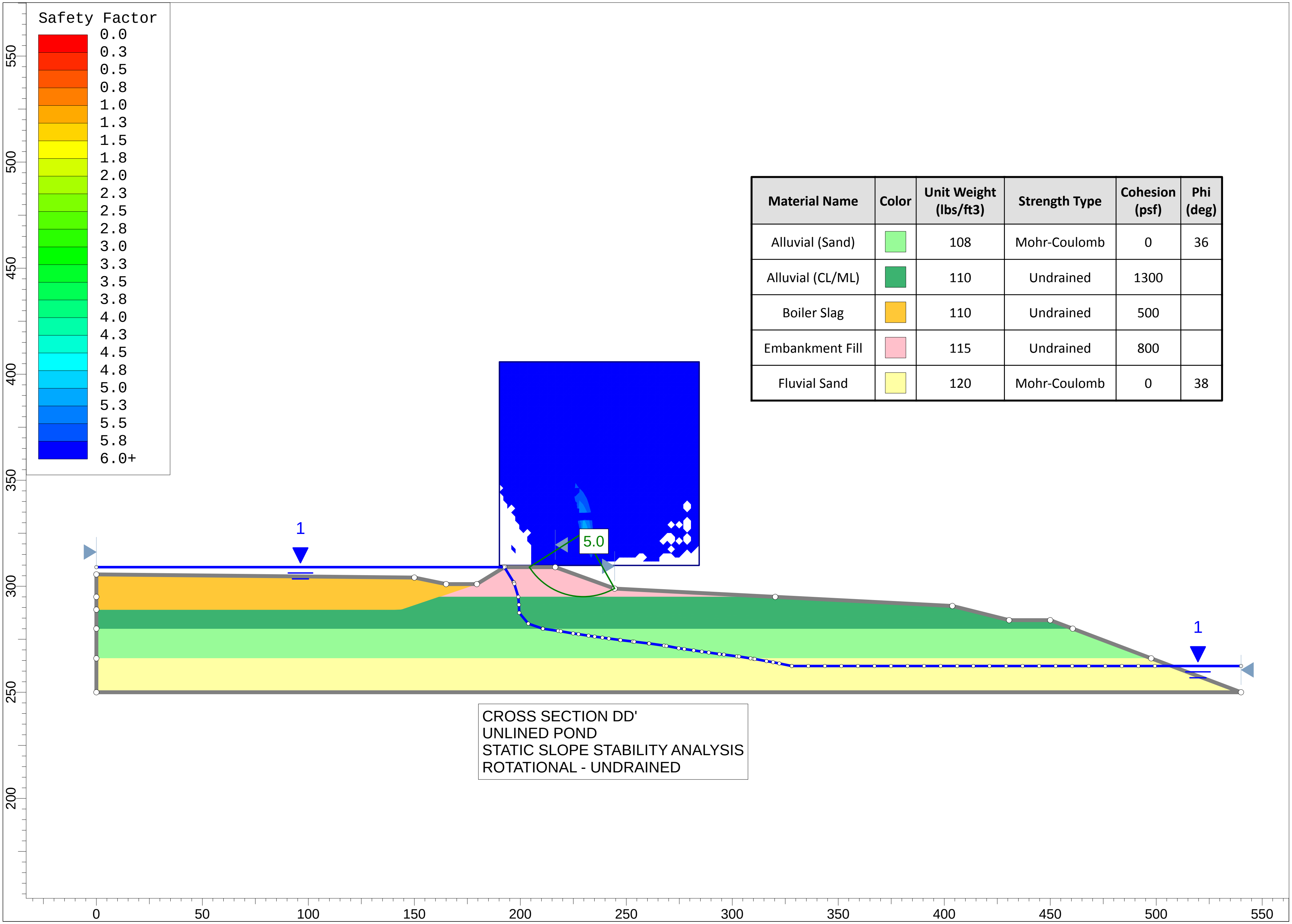
CROSS SECTION DD'
UNLINED POND
STATIC SLOPE STABILITY ANALYSIS
BLOCK - DRAINED



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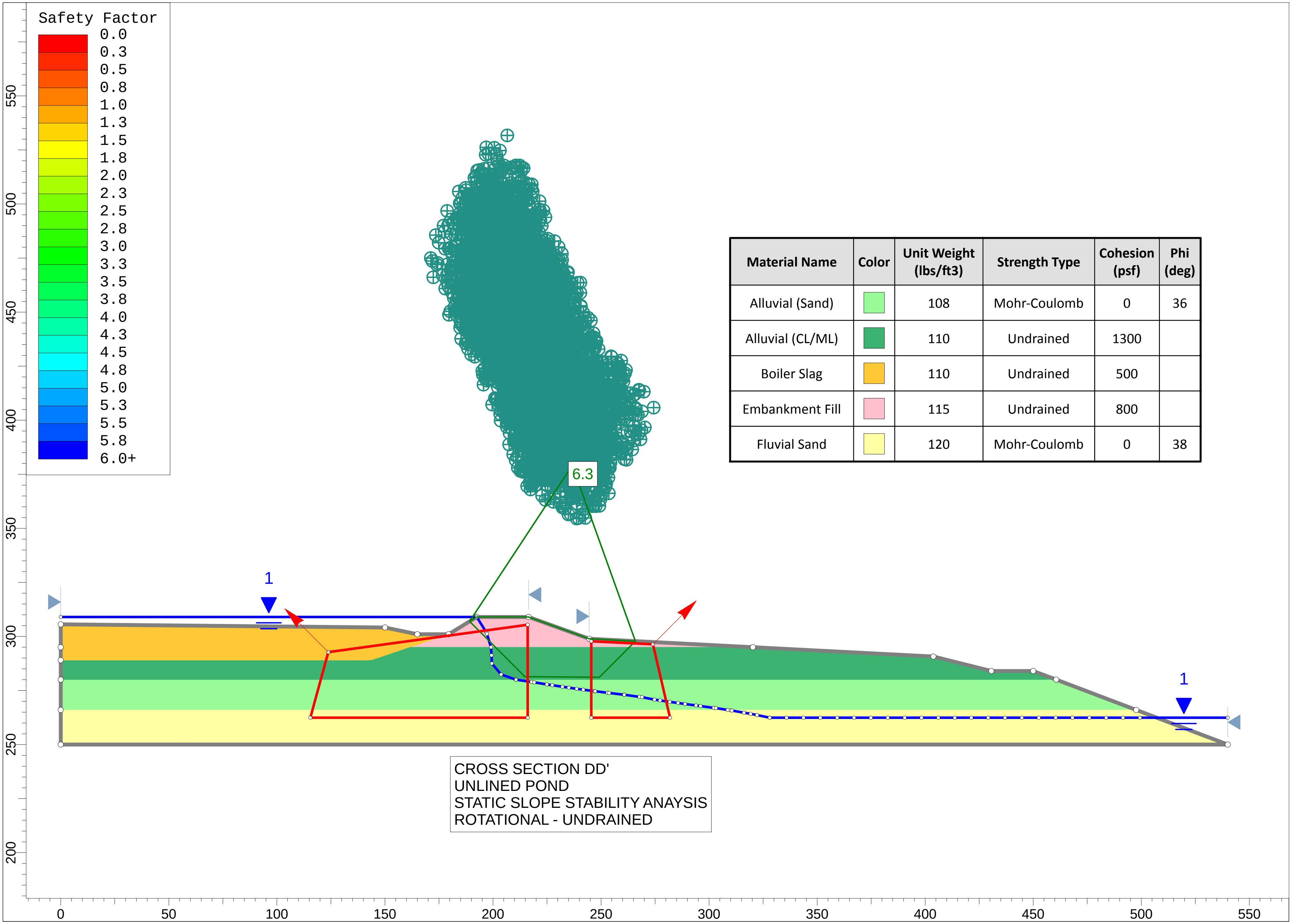
CROSS SECTION DD'
UNLINED POND
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



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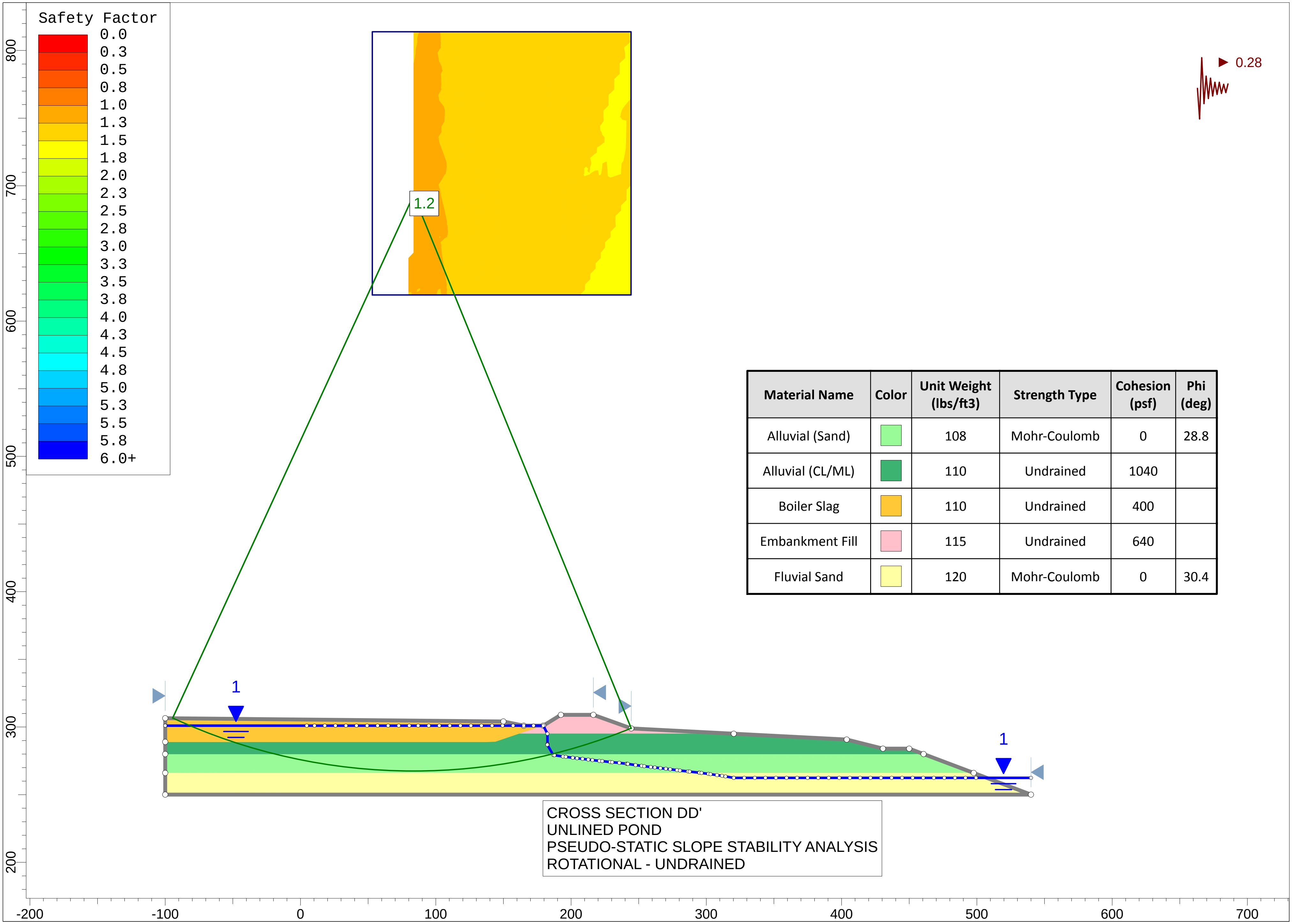
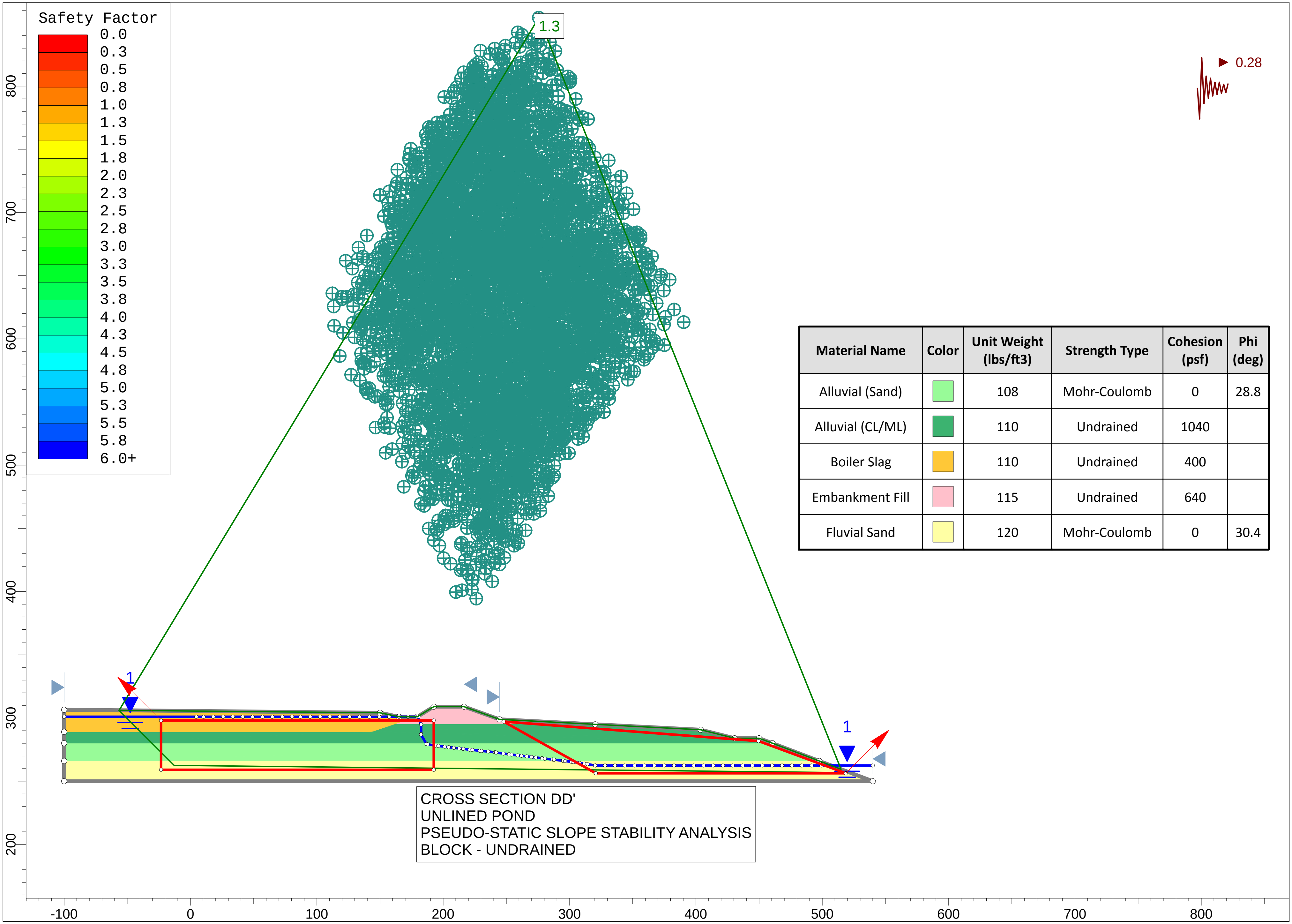
Boiler Slag	🟧	110	Undrained	500	
Embankment Fill	🟪	115	Undrained	800	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38

CROSS SECTION DD'
UNLINED POND
STATIC SLOPE STABILITY ANAYSIS
ROTATIONAL - UNDRAINED



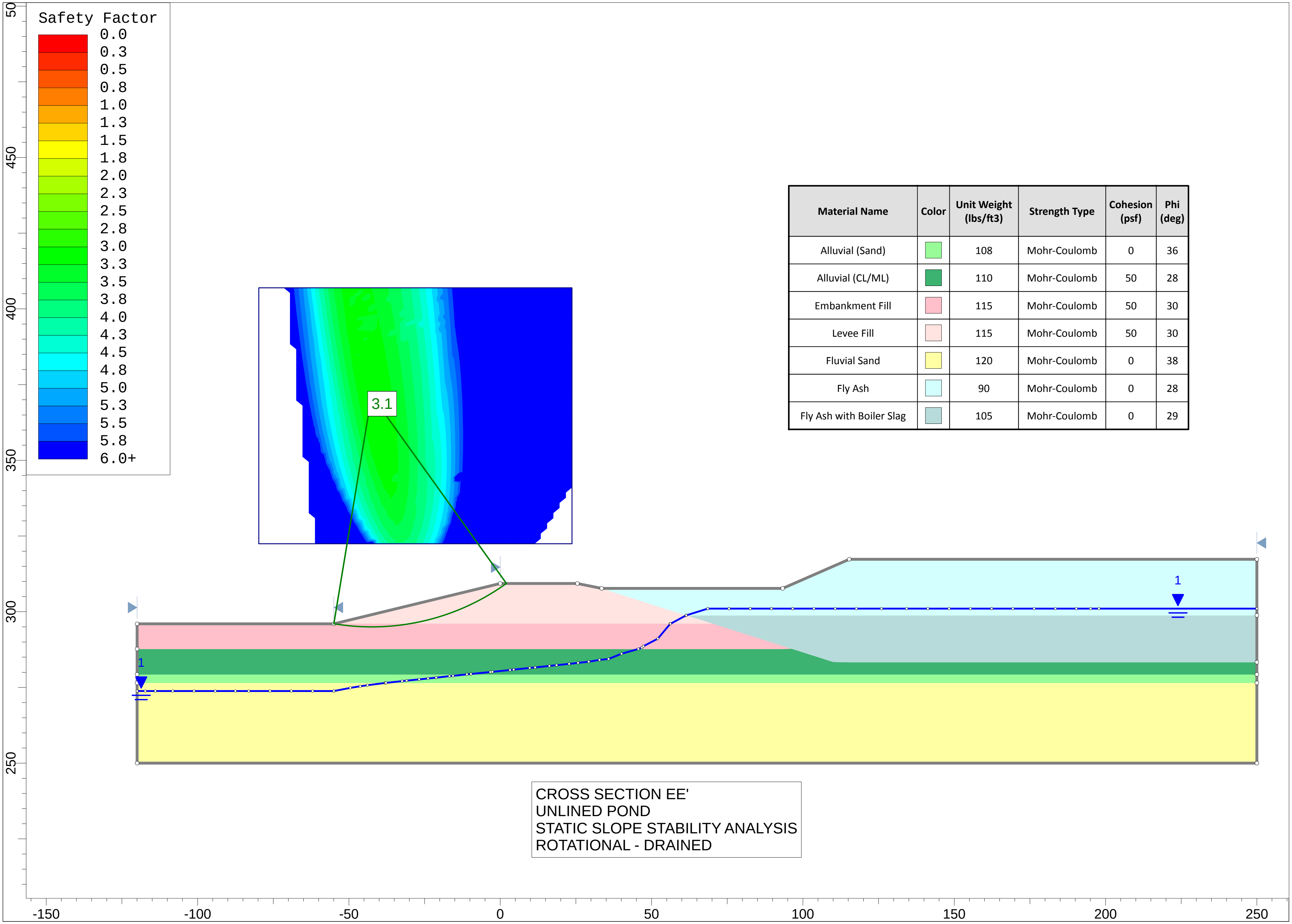
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	28.8
Alluvial (CL/ML)	🟩	110	Undrained	1040	
Boiler Slag	🟧	110	Undrained	400	
Embankment Fill	🟥	115	Undrained	640	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	30.4

CROSS SECTION DD'
UNLINED POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



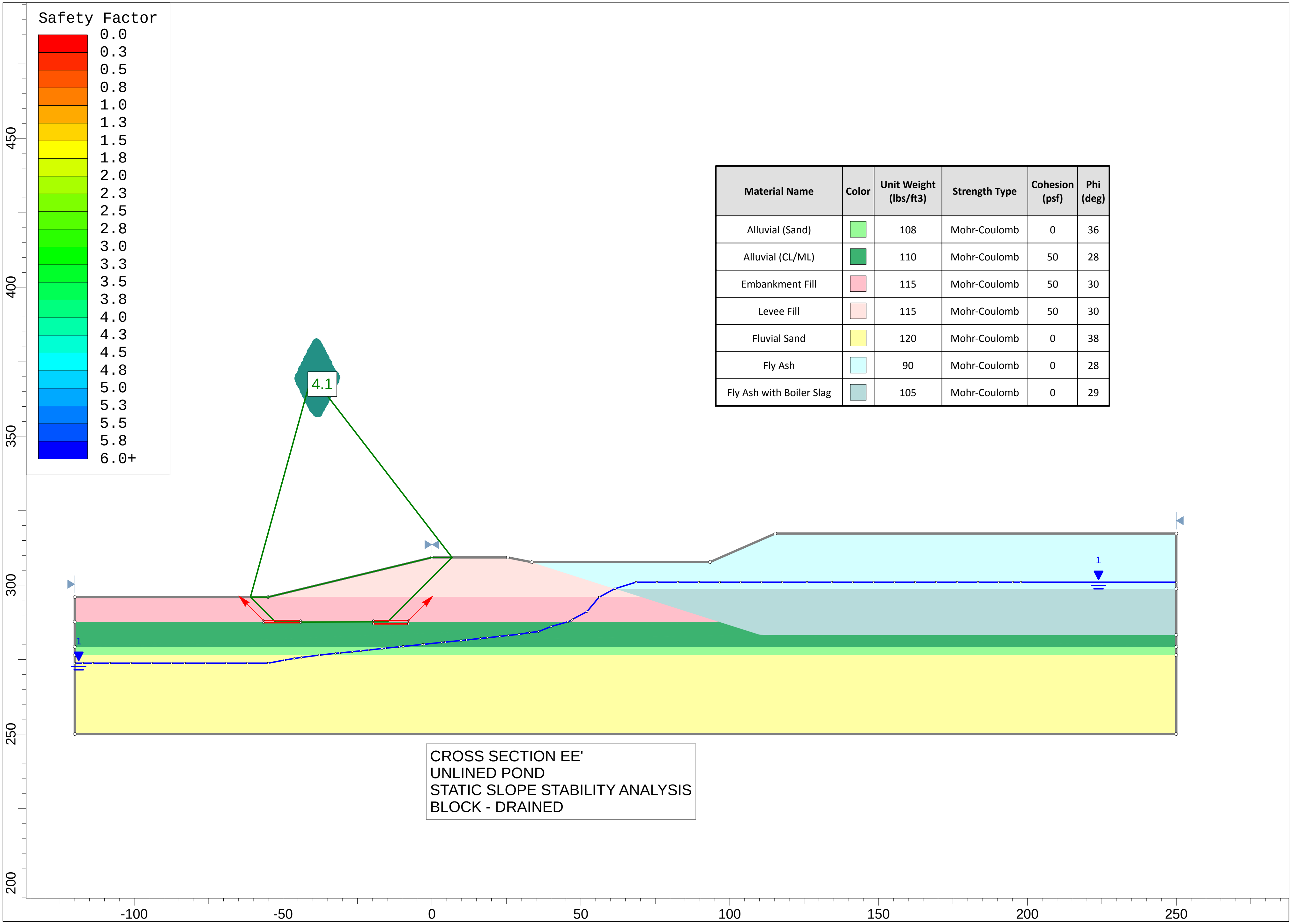
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	28.8
Alluvial (CL/ML)	🟩	110	Undrained	1040	
Boiler Slag	🟧	110	Undrained	400	
Embankment Fill	🟥	115	Undrained	640	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	30.4

CROSS SECTION DD'
UNLINED POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
BLOCK - UNDRAINED



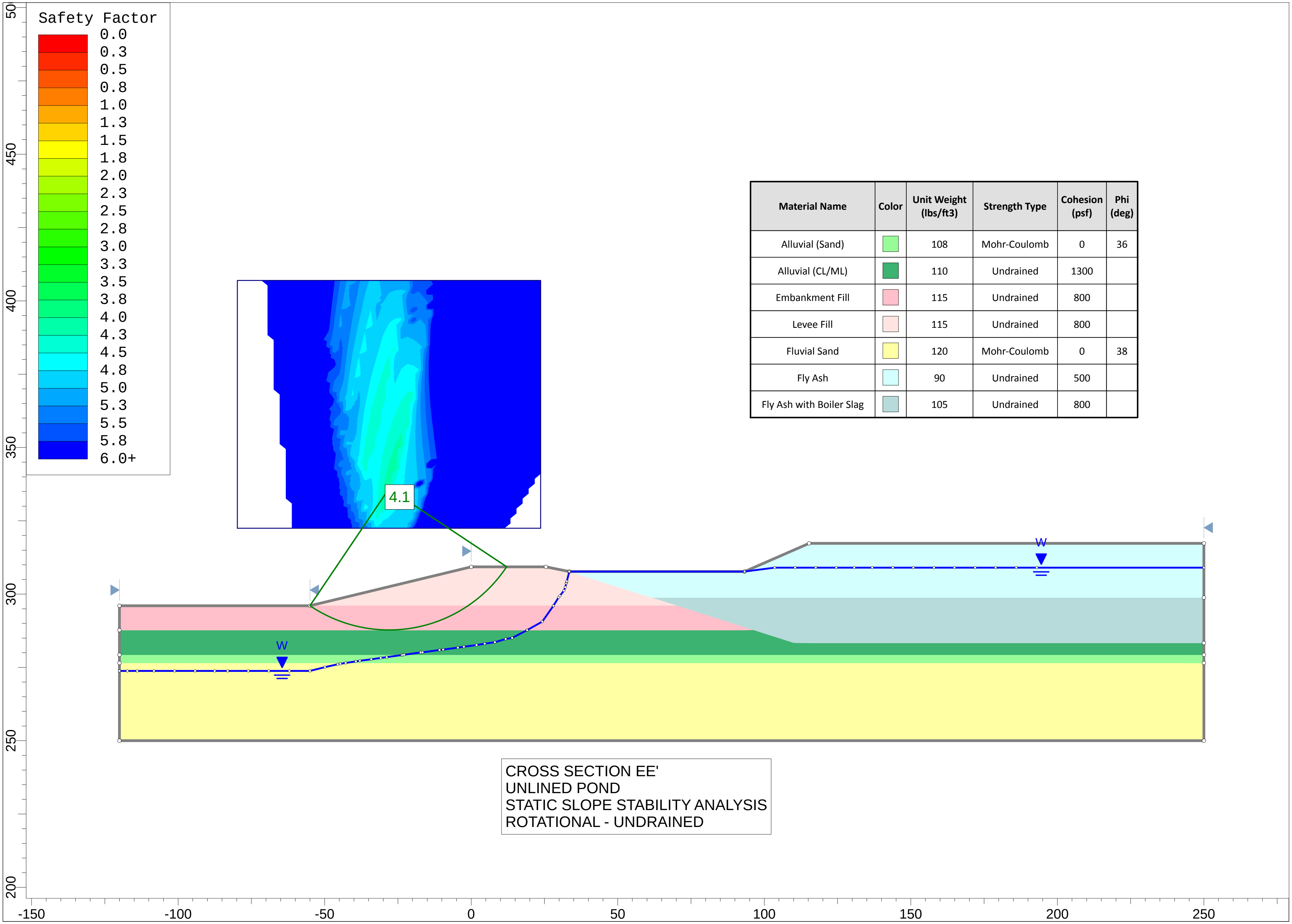
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	36
Alluvial (CL/ML)	🟩	110	Mohr-Coulomb	50	28
Embankment Fill	🟥	115	Mohr-Coulomb	50	30
Levee Fill	🟥	115	Mohr-Coulomb	50	30
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38
Fly Ash	🟦	90	Mohr-Coulomb	0	28
Fly Ash with Boiler Slag	🟦	105	Mohr-Coulomb	0	29

CROSS SECTION EE'
UNLINED POND
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - DRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	36
Alluvial (CL/ML)	🟩	110	Mohr-Coulomb	50	28
Embankment Fill	🟥	115	Mohr-Coulomb	50	30
Levee Fill	🟥	115	Mohr-Coulomb	50	30
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38
Fly Ash	🟦	90	Mohr-Coulomb	0	28
Fly Ash with Boiler Slag	🟦	105	Mohr-Coulomb	0	29

CROSS SECTION EE'
UNLINED POND
STATIC SLOPE STABILITY ANALYSIS
BLOCK - DRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
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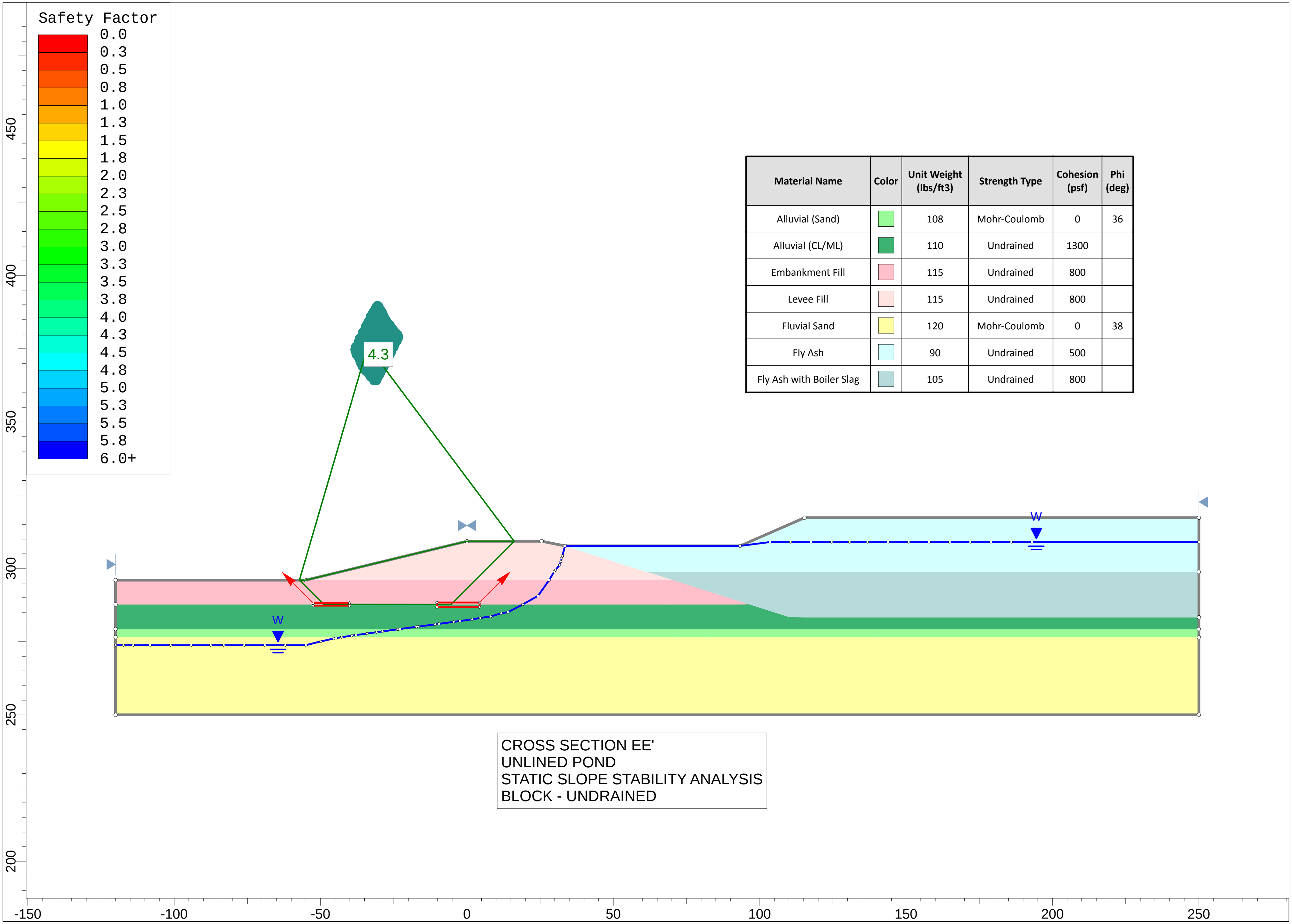
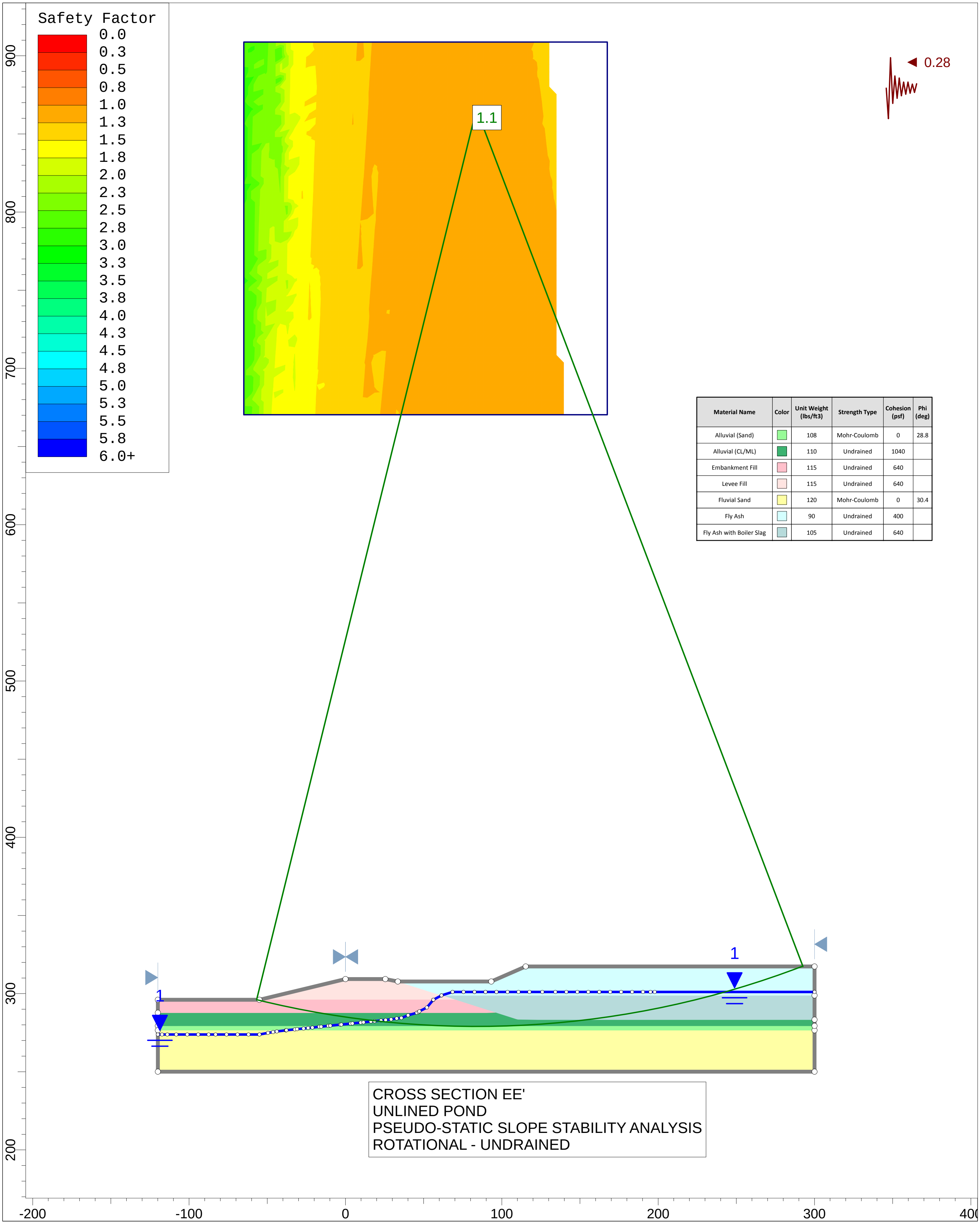
Alluvial (CL/ML)	🟩	110	Undrained	1300	
Embankment Fill	🟥	115	Undrained	800	
Levee Fill	🟥	115	Undrained	800	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38
Fly Ash	🟦	90	Undrained	500	
Fly Ash with Boiler Slag	🟦	105	Undrained	800	

CROSS SECTION EE'
UNLINED POND
STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



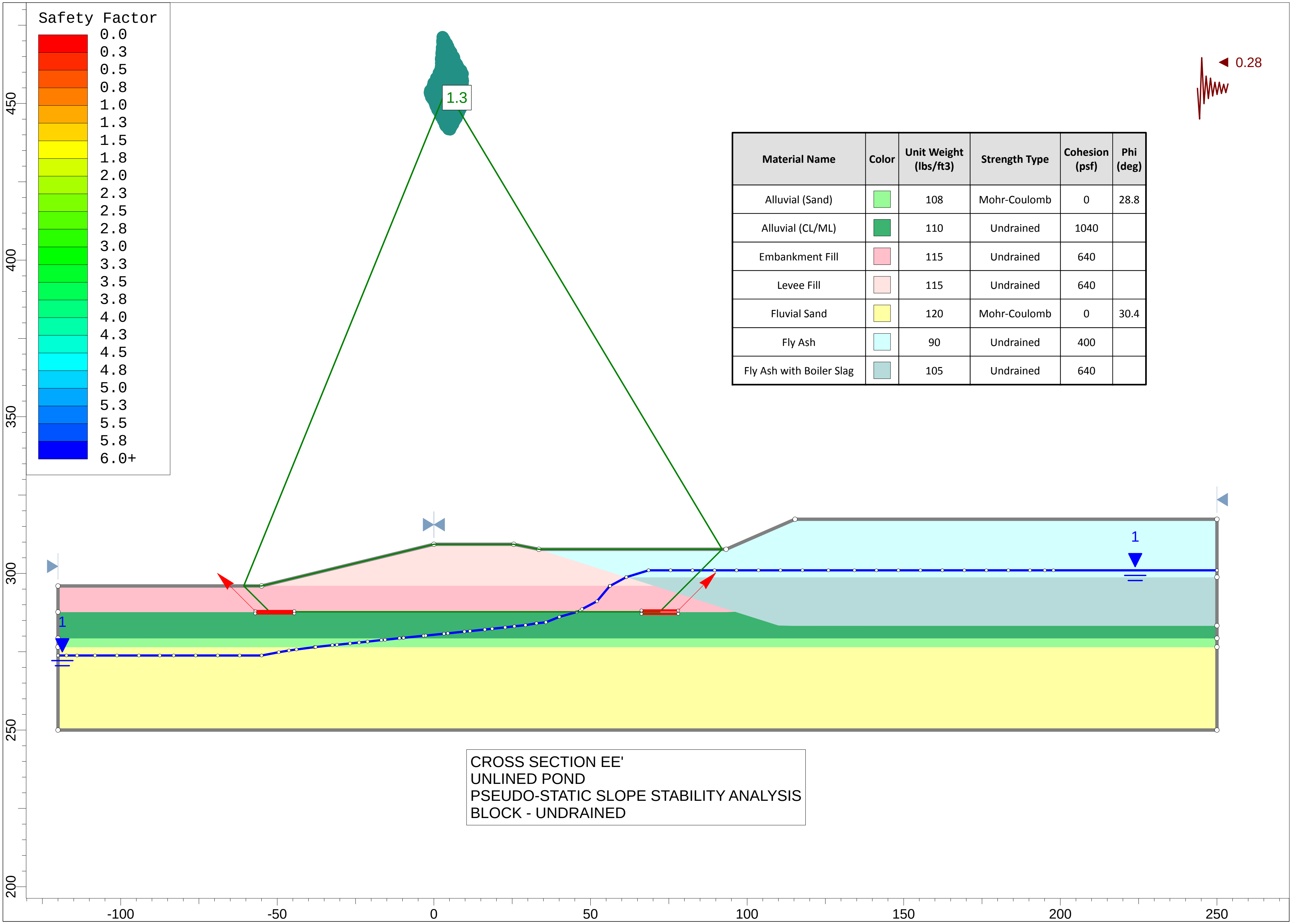
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	36
Alluvial (CL/ML)	🟩	110	Undrained	1300	
Embankment Fill	🟥	115	Undrained	800	
Levee Fill	⬜	115	Undrained	800	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	38
Fly Ash	🟦	90	Undrained	500	
Fly Ash with Boiler Slag	🟦	105	Undrained	800	

CROSS SECTION EE'
UNLINED POND
STATIC SLOPE STABILITY ANALYSIS
BLOCK - UNDRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	28.8
Alluvial (CL/ML)	🟩	110	Undrained	1040	
Embankment Fill	🟥	115	Undrained	640	
Levee Fill	🟥	115	Undrained	640	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	30.4
Fly Ash	🟦	90	Undrained	400	
Fly Ash with Boiler Slag	🟦	105	Undrained	640	

CROSS SECTION EE'
UNLINED POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
ROTATIONAL - UNDRAINED



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Alluvial (Sand)	🟩	108	Mohr-Coulomb	0	28.8
Alluvial (CL/ML)	🟩	110	Undrained	1040	
Embankment Fill	🟥	115	Undrained	640	
Levee Fill	🟥	115	Undrained	640	
Fluvial Sand	🟨	120	Mohr-Coulomb	0	30.4
Fly Ash	🟦	90	Undrained	400	
Fly Ash with Boiler Slag	🟦	105	Undrained	640	

CROSS SECTION EE'
UNLINED POND
PSEUDO-STATIC SLOPE STABILITY ANALYSIS
BLOCK - UNDRAINED

ATTACHMENT 2

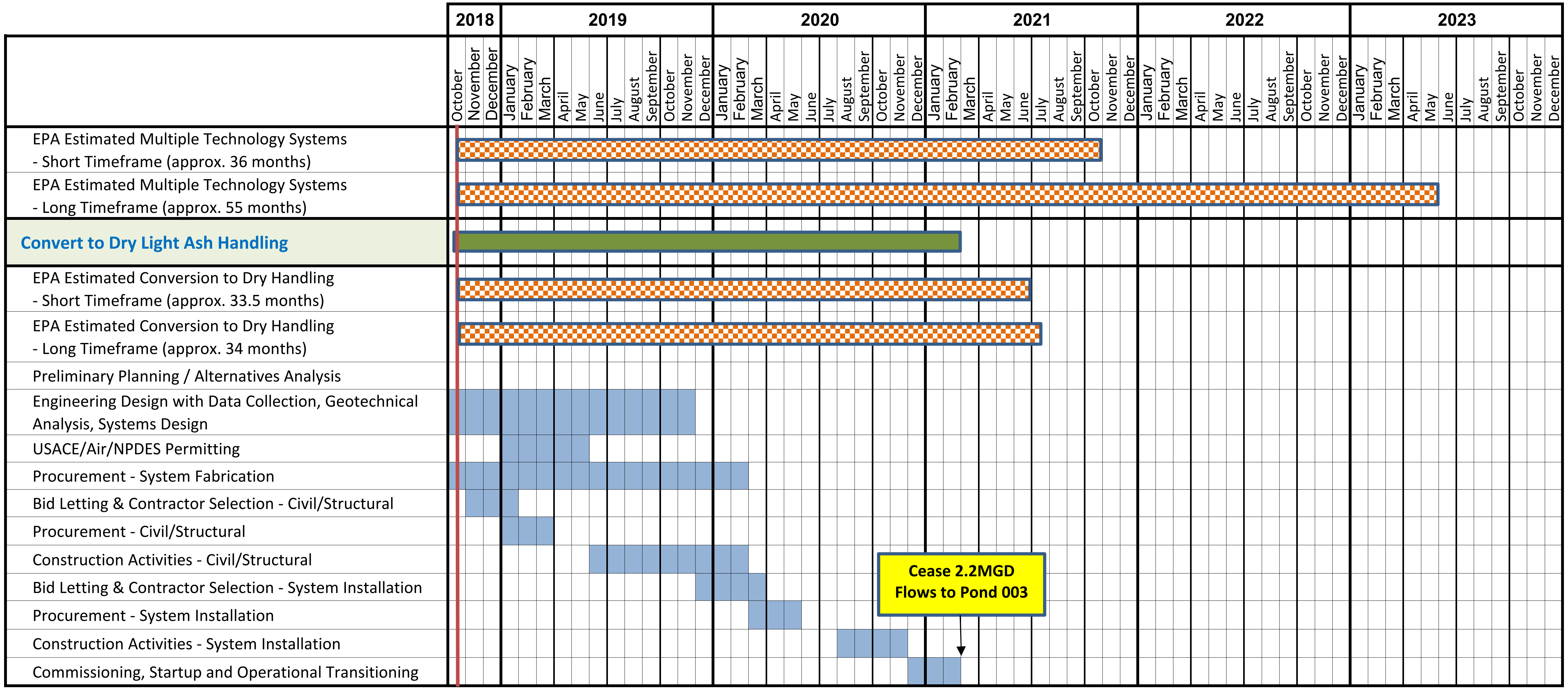
UPDATED APPENDIX A – NO ALTERNATE CAPACITY SCHEDULE

Associated Electric Cooperative, Inc.
New Madrid Power Plant
Marston, Missouri

Deadline to Initiate Closure
CCR and Non-CCR Alternative Capacity Extensions

Note: EPA Timeframes taken from Final Rule for Holistic Approach to Closure Part A

Legend:
- 🟦 Project Phases
- ⬜ Project Tasks
- ▨ Winter months during construction (expected delays, reduced construction efficiency due to potential precipitation and/or other weather events and associated conditions).

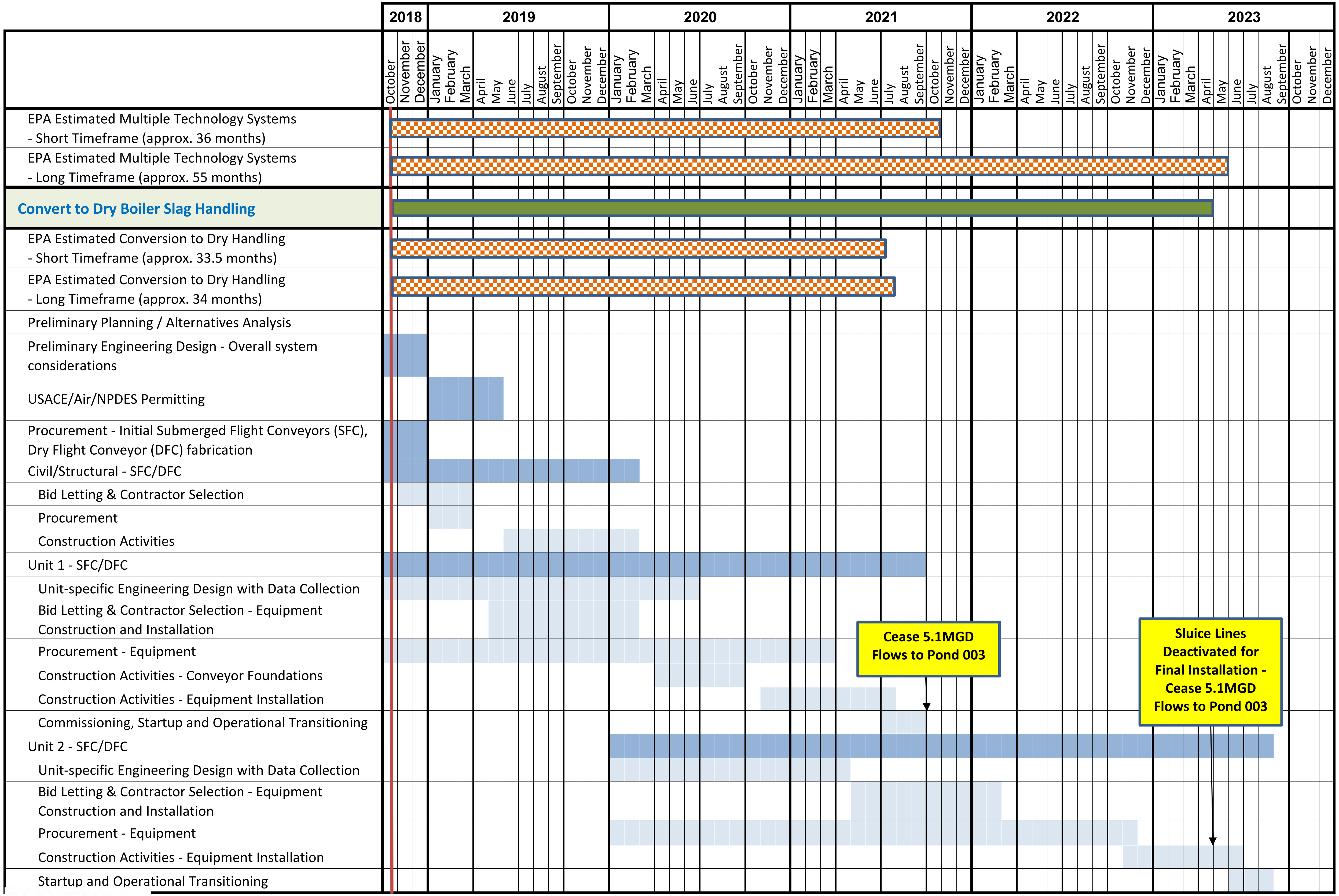


Associated Electric Cooperative, Inc.
New Madrid Power Plant
Marston, Missouri

Deadline to Initiate Closure
CCR and Non-CCR Alternative Capacity Extensions

Note: EPA Timeframes taken from Final Rule for Holistic Approach to Closure Part A

Legend:
- ▨ Project Phases
- ▨ Project Tasks
- ▩ Winter months during construction (expected delays, reduced construction efficiency due to potential precipitation and/or other weather events and associated conditions).



Cease 5.1MGD Flows to Pond 003

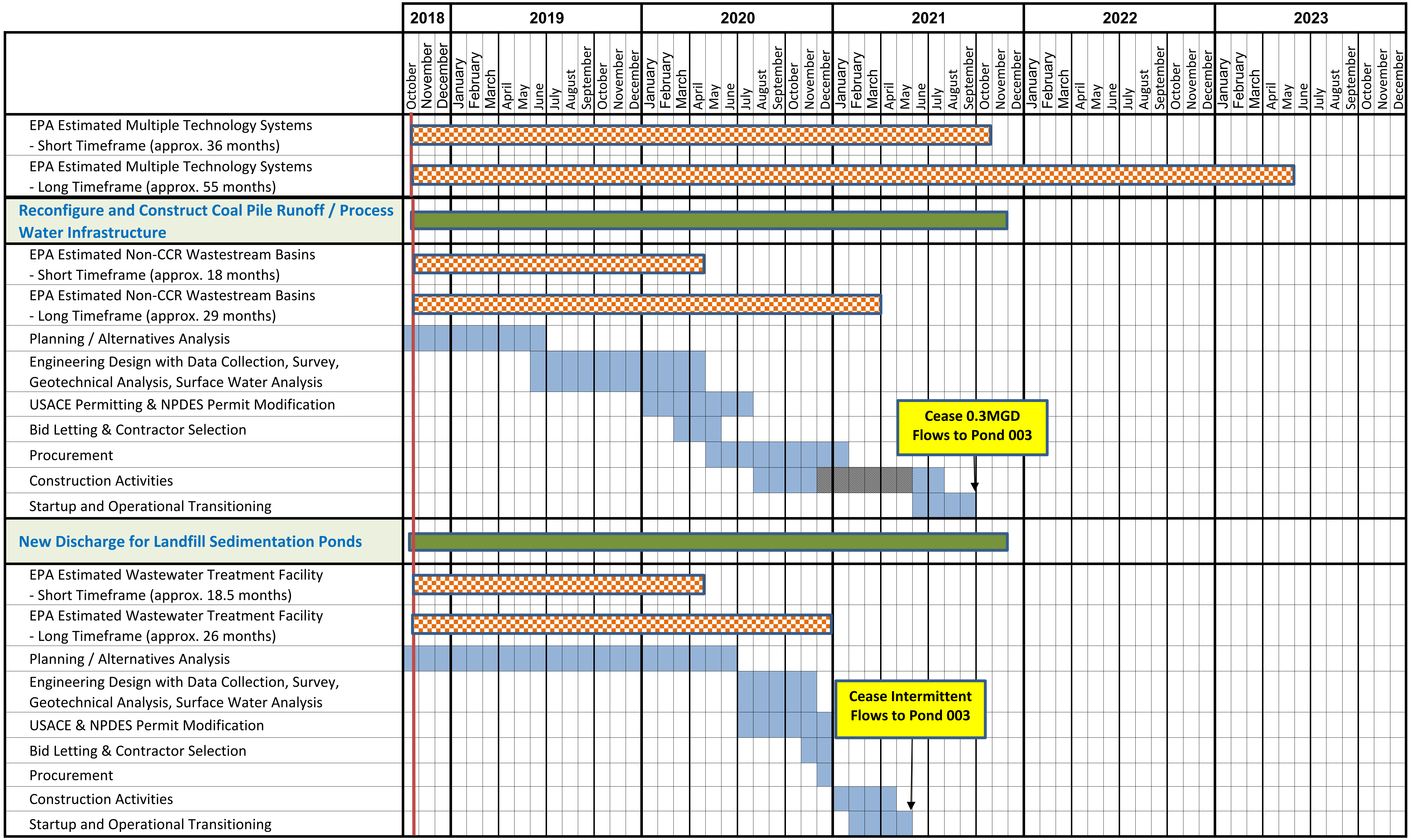
Sluice Lines Deactivated for Final Installation - Cease 5.1MGD Flows to Pond 003

Associated Electric Cooperative, Inc.
New Madrid Power Plant
Marston, Missouri

Deadline to Initiate Closure
CCR and Non-CCR Alternative Capacity Extensions

Note: EPA Timeframes taken from Final Rule for Holistic Approach to Closure Part A

Legend:
- 🟦 Project Phases
- ☐ Project Tasks
- ▨ Winter months during construction (expected delays, reduced construction efficiency due to potential precipitation and/or other weather events and associated conditions).



ATTACHMENT 3

CCR GROUNDWATER MONITORING NETWORK DESCRIPTION FOR THE NEW MADRID POWER PLANT, NEW MADRID, MISSOURI DATED APRIL 2019

HALEY & ALDRICH, INC.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
216.706.1303

17 April 2019
File No. 129342-003

Associated Electric Cooperative, Inc.
2814 South Golden Avenue
PO Box 754
Springfield, Missouri 65801-0754

Attention: Jenny Burns
Senior Environmental Analyst

Subject: CCR Groundwater Monitoring Network Description for the New Madrid Power Plant, New Madrid, Missouri

Dear Ms. Burns:

Haley & Aldrich, Inc. (Haley & Aldrich) has prepared this letter for Associated Electric Cooperative, Inc. (AECI) to provide a summary description of the hydrogeologic units beneath the coal combustion residual (CCR) management units Pond 003, Pond 004, the Utility Waste Landfill (UWL), and the inactive Lined Pond at the New Madrid Power Plant (NMPP), and the groundwater monitoring network established to monitor groundwater quality beneath the CCR units. NMPP is located in New Madrid, Missouri. The location of the NMPP facility and the CCR management units are shown on Figure 1. This document also describes the site-specific data used to support design and installation of the groundwater monitoring network. The site-specific data were developed during previous studies, recent monitoring well installation efforts, and recent aquifer characterization activities. The groundwater monitoring system has been designed and installed in accordance with the requirements of the U.S. Environmental Protection Agency (USEPA) rule regulating the disposal of CCRs as solid waste under Subtitle D of the Resource Conservation and Recovery Act, published in the Federal Register on 17 April 2015 and effective 19 October 2015 (CCR Rule) and subsequent rulemaking revisions.

Due to the USEPA Response to Partial Vacatur effective 4 October 2016, AECI is required to install a CCR Rule compliant groundwater monitoring network at the inactive Lined Pond at NMPP. The purpose of updating this Groundwater Monitoring Network Description is to provide information demonstrating that the inactive Lined Pond groundwater monitoring network is compliant with the CCR Rule.

CCR Management Units

AECI operates three active individual CCR management units and one inactive CCR management unit at NMPP. The active CCR management units at NMPP are Pond 003, Pond 004, and the UWL and the inactive CCR management unit is the inactive Lined Pond. The NMPP CCR management units are shown on Figures 2, 4, 6, and 7, respectively.

Pond 003 Hydrogeologic Units

Pond 003 is located within the Southeastern Lowlands physiographic province. The Southeastern Lowlands is the northernmost extent of the larger Mississippi Alluvial Plain and is characterized by alluvial, fluvial, and deltaic deposits ranging in age from Cretaceous to Holocene. Pond 003 is underlain by an unnamed unconsolidated alluvium which constitutes a regionally extensive aquifer. Below the alluvial aquifer is the Wilcox Group which is comprised of sand deposits with interbedded clay and lignite.

UNSATURATED MATERIAL OVERLYING THE UPPERMOST AQUIFER

The alluvial aquifer underlying Pond 003 is unconfined; unsaturated material above the uppermost aquifer is of the same alluvial materials as the saturated aquifer. The thickness of the unsaturated materials observed at Pond 003 is based on the observed static water level and corresponds to the linear distance from ground surface to the uppermost aquifer. Haley & Aldrich has made direct observation of the unsaturated material overlaying the uppermost aquifer based on recent drilling (September 2009, November 2016, and May 2017) conducted at Pond 003. Based on direct observations made during groundwater monitoring conducted between November 2016 and May 2017, the unsaturated material overlying the uppermost aquifer at the site is approximately up to 53 feet thick.

UPPERMOST AQUIFER

Section §257.53 of the CCR Rule defines an aquifer as a geologic formation, group of formations, or portion of a formation capable of yielding usable quantities of groundwater to wells or springs. The uppermost aquifer is defined in Section §257.53 of the CCR Rule as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility boundary.

The water-bearing geologic formation nearest the natural ground surface at Pond 003 that is capable of yielding groundwater to wells or springs is alluvium consisting of moderately to poorly sorted clay, silt, sand, and gravel of Holocene age. The alluvium has been documented to be approximately 250 to 300 feet thick in the vicinity of the NMPP (Gredell Engineering Resources Inc. [Gredell], 2003). The aquifer is used regionally for irrigation and domestic use. The depth to water ranges from approximately 17 to 45 feet below ground surface (bgs) at Pond 003. The saturated thickness of the uppermost aquifer at the monitoring wells partially penetrating the aquifer beneath Pond 003 is approximately 6 to 37 feet thick based on observations made during groundwater monitoring conducted between November 2016 and August 2017.

Review of the Missouri Department of Natural Resources (MDNR) Well Information Management System (WIMS) Database indicates that the alluvial aquifer is used for water supply wells in the vicinity of Pond 003. The nearest water well (well #00332117) listed in the WIMS Database is an irrigation well located approximately 0.6 miles south of Pond 003 and appears to be set in the alluvial aquifer that underlies Pond 003. It is reported to be completed at a depth of 95 feet bgs, producing groundwater at a reported rate of 1,200 gallons per minute (gpm). There are no apparent drinking water wells within a 2-mile radius of Pond 003. Although the alluvial aquifer is not locally used as a drinking water aquifer in the immediate vicinity of Pond 003, the formation does contain sufficient water to support low to high yield wells and springs. The formation also contains sufficient water to facilitate consistent groundwater monitoring of the saturated formation directly beneath the pond area and is therefore characterized as the uppermost aquifer beneath Pond 003.

The materials comprising the upper aquifer unit were observed directly during drilling and installation of piezometers and monitoring wells at the site. Figure 2 shows the location of the Pond 003 wells installed and boring logs with well construction details for the recently installed wells are included in Appendix A. The drilling, completion, and testing of these monitoring wells yielded site-specific geologic data that were used in combination with site-specific data from previous characterization activities and well installation activities to determine the appropriate number, depth, and spacing of the monitoring wells at Pond 003.

Based on groundwater elevations measured between November 2016 and August 2017, the groundwater gradient in the upper aquifer unit is approximately 0.0008 to 0.003 feet per foot (feet/foot) and is unconfined. This groundwater gradient reflects temporal variability in flow direction. Pond 003 lies adjacent to the Mississippi River and the alluvial aquifer immediately beneath Pond 003 is in communication with the river. Seasonal changes in river stage cause the groundwater flow direction to change and occasionally reverse. Due to the influence of the adjacent Mississippi River, the groundwater flow in the alluvial aquifer is generally to the southwest during high river stage and generally to the northeast during low river stage. Due to the changing groundwater flow directions, monitoring wells were sited at locations to monitor both downgradient directions. This indicates that the river is in hydraulic communication with the local groundwater system. Groundwater flow direction in the vicinity of Pond 003 during low river stage is shown on Figure 2 and during high river stage is shown on Figure 3.

Hydraulic conductivity of the uppermost aquifer is based on data collected during slug testing of wells installed during development of the CCR monitoring network. The hydraulic conductivity was calculated to be 75 to 81 feet per day (feet/day).

The groundwater flow rate was calculated using the site-specific hydraulic conductivity values, effective porosity values obtained from published sources, and groundwater elevation data measured between November 2016 and August 2017. Based on estimates for similar material, effective porosity of the alluvial material is estimated to be 0.2 to 0.3 percent (Morris, 1967). The calculated groundwater flow velocity is approximately 135 to 440 feet per year (feet/year). The velocity values do not account for changing groundwater flow directions.

CONFINING LAYER BELOW THE UPPERMOST AQUIFER

The Wilcox formation underlying the alluvial aquifer is comprised of sand deposits with interbedded clay and lignite. Because the alluvial aquifer provides a more accessible resource for groundwater production in the area, the Wilcox formation has not been developed locally as a source of groundwater. The clay and lignite present within the Wilcox formation represent lower hydraulic conductivity than the overlying alluvial aquifer. Published hydraulic conductivity values for the Wilcox formation are available from areas where it has been investigated that indicate the hydraulic conductivity as low as 9 to 25 feet/day (ONWI, 1982 and Prudic, 1991). The Wilcox formation in the vicinity of Pond 003 is estimated to be approximately 400 to 500 feet thick (Gredell, 2003).

The hydrogeologic characterization data for Pond 003 described above are summarized in Table I.

Pond 004 Hydrogeologic Units

Pond 004 is located within the Southeastern Lowlands physiographic province. The Southeastern Lowlands is the northernmost extent of the larger Mississippi Alluvial Plain and is characterized by alluvial, fluvial, and deltaic deposits ranging in age from Cretaceous to Holocene. Pond 004 is underlain by an unnamed unconsolidated alluvium which constitutes a regionally extensive aquifer. The Wilcox Group underlies the unnamed alluvial formation and is comprised of sand deposits with interbedded clay and lignite.

UNSATURATED MATERIAL OVERLYING THE UPPERMOST AQUIFER

The alluvial aquifer underlying Pond 004 is unconfined; unsaturated material above the uppermost aquifer is composed of the same alluvial materials as the saturated aquifer. The thickness of the unsaturated materials observed at Pond 004 is based on the observed static water level and corresponds to the linear distance from ground surface to the uppermost aquifer. Haley & Aldrich has made direct observation of the unsaturated material overlaying the uppermost aquifer based on recent drilling (September and October 2016) conducted at Pond 004. Based on direct observation made during groundwater monitoring conducted between November 2016 and August 2017, the unsaturated material overlying the uppermost aquifer at the site is approximately up to 43 feet thick.

UPPERMOST AQUIFER

The water-bearing geologic formation nearest the natural ground surface at Pond 004 that is capable of yielding groundwater to wells or springs is alluvium consisting of moderately to poorly sorted clay, silt, sand, and gravel of Holocene age. The alluvium has been documented to be approximately 250 to 300 feet thick in the vicinity of the NMPP (Gredell, 2003). The aquifer is used locally for irrigation and domestic use. The saturated thickness of the uppermost aquifer at the monitoring wells partially penetrating the aquifer beneath Pond 004 is approximately 14 to 52 feet thick based on observations made during groundwater monitoring conducted between November 2016 and August 2017.

Review of the MDNR WIMS Database indicates that the alluvial aquifer is used for water supply wells in the vicinity of Pond 4. The nearest water wells (wells #00158473, #00158474, and # 00158475) listed in the WIMS Database are a cluster of wells of unknown use located approximately 0.4 miles northwest of Pond 004, with the wells appearing to be set in the same alluvial aquifer that underlies Pond 004. They are reported to be completed at depths of 95 feet, 100 feet, and 106 feet bgs, respectively; each producing groundwater at a reported rate of 100 gpm. There are no apparent drinking water wells within a 2-mile radius of Pond 004. Although the alluvial aquifer is not locally used as a drinking water aquifer in the immediate vicinity of Pond 004, the formation does contain sufficient water to support low to high yield wells and springs. The formation also contains sufficient water to facilitate consistent groundwater monitoring of the saturated formation directly beneath the impoundment area and is therefore characterized as the uppermost aquifer beneath Pond 004.

The materials comprising the uppermost aquifer unit were observed directly during drilling and installation of temporary piezometers and monitoring wells at the site. Figure 4 shows the location of the Pond 004 wells installed and boring logs with well construction details for the recently installed wells are included in Appendix A. The drilling, completion, and testing of these monitoring wells yielded site-specific geologic data that were used in combination with site-specific data from previous characterization activities and well installation activities to determine the appropriate number, depth, and spacing of the monitoring wells at Pond 004.

Based on groundwater elevations measured between November 2016 and August 2017, the groundwater gradient in the upper aquifer unit is approximately 0.0002 to 0.001 feet/foot and is unconfined. This groundwater gradient reflects temporal variability in flow direction. Pond 004 lies adjacent to the Mississippi River and the alluvial aquifer immediately beneath Pond 004 is in communication with the river. Seasonal changes in river stage cause the groundwater flow direction to change and occasionally reverse. Due to the influence of the adjacent Mississippi River the groundwater flow in the alluvial aquifer is to the southwest during high river stage and to the northeast during low river stage. Due to the changing groundwater flow directions, monitoring wells were sited at locations to monitor both downgradient directions. This indicates that the river is in hydraulic communication with the local groundwater system. Groundwater flow direction in the vicinity of Pond 004 during low river stage is shown on Figure 4 and during high river stage is shown on Figure 5.

Hydraulic conductivity of the uppermost aquifer is based on data collected during slug testing of wells installed during development of the CCR monitoring network. The hydraulic conductivity was calculated to be 37 to 101 feet/day.

The groundwater flow rate was calculated using the site-specific hydraulic conductivity values, effective porosity values obtained from published sources, and groundwater elevation data measured between November 2016 and August 2017. Based on estimates for similar material, effective porosity of the alluvial material is estimated to be 0.2 to 0.3 percent (Morris, 1967). The calculated groundwater flow velocity is approximately 80 to 590 feet/year. The velocity values do not account for changing groundwater flow directions.

CONFINING LAYER BELOW THE UPPERMOST AQUIFER

The Wilcox formation underlies the alluvial aquifer and is comprised of sand deposits with interbedded clay and lignite. Because the alluvial aquifer provides a more accessible resource for groundwater production in the area, the Wilcox formation has not been developed locally as a source of groundwater. The clay and lignite present within the Wilcox formation represent lower hydraulic conductivity than the overlying alluvial aquifer. Published hydraulic conductivity values for the Wilcox formation are available from areas where it has been investigated that indicate the hydraulic conductivity as low as 9 to 25 feet/day (ONWI, 1982 and Prudic, 1991). The Wilcox formation in the vicinity of Pond 004 is estimated to be approximately 400 to 500 feet thick (Gredell, 2003).

The hydrogeologic characterization data for Pond 004 described above are summarized in Table II.

Utility Waste Landfill Hydrogeologic Units

The UWL is located within the Southeastern Lowlands physiographic province. The Southeastern Lowlands is the northernmost extent of the larger Mississippi Alluvial Plain and is characterized by alluvial, fluvial, and deltaic deposits ranging in age from Cretaceous to Holocene. The UWL is underlain by an unnamed unconsolidated alluvium which constitutes a regionally extensive aquifer. The Wilcox Group underlies the unnamed alluvial formation and is comprised of sand deposits with interbedded clay and lignite.

UNSATURATED MATERIAL OVERLYING THE UPPERMOST AQUIFER

The alluvial aquifer underlying the UWL is unconfined; unsaturated material above the uppermost aquifer is composed of the same alluvial materials as the saturated aquifer. The thickness of the unsaturated materials observed at the UWL is based on the observed static water level and corresponds to the linear distance from ground surface to the uppermost aquifer. Haley & Aldrich has made direct observation of the unsaturated material overlaying the uppermost aquifer based on recent drilling (September 2016) conducted at the UWL. Based on direct observation made during groundwater monitoring conducted between November 2016 and August 2017, the unsaturated material overlying the uppermost aquifer at the site is approximately up to 28 feet thick.

UPPERMOST AQUIFER

The water-bearing geologic formation nearest the natural ground surface at the UWL that is capable of yielding groundwater to wells or springs is alluvium consisting of moderately to poorly sorted clay, silt, sand, and gravel of Holocene age. The alluvium has been documented to be approximately 250 to 300 feet thick in the vicinity of the NMPP (Gredell, 2003). The aquifer is used locally for irrigation and domestic use. The saturated thickness of the uppermost aquifer at the monitoring wells partially penetrating the aquifer beneath the UWL is approximately 8 to 29 feet thick based on observations made during groundwater monitoring conducted between November 2016 and August 2017.

Review of the MDNR WIMS Database indicates that the alluvial aquifer is used for water supply wells in the vicinity of the UWL. The nearest water well (well #00397137) listed in the WIMS Database is an irrigation well located approximately 0.2 miles northeast of the UWL, and appears to be set in the alluvial aquifer that underlies the UWL. It is reported to be completed at a depth of 80 feet bgs, producing groundwater at a reported rate of 1,000 gpm. There are no apparent drinking water wells within a 2-mile radius of the UWL. Although the alluvial aquifer is not locally used as a drinking water aquifer in the immediate vicinity of the UWL, the formation does contain sufficient water to support low to high yield wells and springs. The formation also contains sufficient water to facilitate consistent groundwater monitoring of the saturated formation directly beneath the impoundment area and is therefore characterized as the uppermost aquifer beneath the UWL.

Materials comprising the upper aquifer unit were observed directly during drilling and installation of temporary piezometers and monitoring wells at the site. Figure 6 shows the location of the UWL wells installed and boring logs with well construction details for the recently installed wells are included in Appendix A. The drilling, completion, and testing of these monitoring wells yielded site-specific geologic data that were used in combination with site-specific data from previous characterization activities and well installation activities to determine the appropriate number, depth, and spacing of the monitoring wells at the UWL.

Based on groundwater elevations measured between November 2016 and August 2017, the groundwater gradient in the upper aquifer unit is approximately 0.0005 to 0.006 feet/foot and is unconfined. The groundwater flow direction is primarily to the northeast but at times flows to the east.

Hydraulic conductivity of the uppermost aquifer is based on data collected during slug testing of wells installed during development of the CCR monitoring network. The hydraulic conductivity was calculated to be 53 to 101 feet/day.

The groundwater flow rate was calculated using the site-specific hydraulic conductivity values, effective porosity values obtained from references, and groundwater elevation data measured between November 2016 and August 2017. Based on estimates for similar material, effective porosity of the alluvial material is estimated to be 0.2 to 0.3 percent (Morris, 1967). The calculated groundwater flow velocity is approximately 58 to 184 feet/year.

The UWL is located approximately 1.75 miles from the Mississippi River. Seasonal changes in river stage cause the groundwater flow direction to change periodically indicating that the river is in hydraulic communication with the local groundwater system. Groundwater flow direction in the vicinity of the UWL is shown on Figure 6.

CONFINING LAYER BELOW THE UPPERMOST AQUIFER

The Wilcox formation underlies the unnamed alluvial formation and is comprised of sand deposits with interbedded clay and lignite. Because the alluvial aquifer provides a more accessible resource for groundwater production in the area, the Wilcox formation has not been developed locally as a source of groundwater. The clay and lignite present within the Wilcox formation reduce the hydraulic conductivity of that formation. Published hydraulic conductivity values for the Wilcox formation are available from areas where it has been investigated that indicate the hydraulic conductivity as low as 9 to 25 feet/day (ONWI, 1982 and Prudic, 1991).

The hydrogeologic characterization data for the UWL described above are summarized in Table III.

Inactive Lined Pond Hydrogeologic Units

The inactive Lined Pond is located within the Southeastern Lowlands physiographic province. The Southeastern Lowlands are the northernmost extent of the larger Mississippi Alluvial Plain and are characterized by alluvial, fluvial, and deltaic deposits ranging in age from Cretaceous to Holocene. The inactive Lined Pond is underlain by an unnamed unconsolidated alluvium which constitutes a regionally extensive aquifer. Below the alluvial aquifer is the Wilcox Group which is comprised of sand deposits with interbedded clay and lignite.

UNSATURATED MATERIAL OVERLYING THE UPPERMOST AQUIFER

The alluvial aquifer underlying the inactive Lined Pond is unconfined; unsaturated material above the uppermost aquifer is of the same alluvial materials as the saturated aquifer. The thickness of the unsaturated materials observed at the inactive Lined Pond is based on the observed static water level and corresponds to the linear distance from ground surface to the uppermost aquifer. Haley & Aldrich has made direct observation of the unsaturated material overlaying the uppermost aquifer based on recent drilling (September 2016 and December 2018) conducted at the inactive Lined Pond. Based on direct observations made during groundwater monitoring conducted between December 2018 and March 2019, the unsaturated material overlying the uppermost aquifer at the site is up to 43 feet thick.

UPPERMOST AQUIFER

Section §257.53 of the CCR Rule defines an aquifer as a geologic formation, group of formations, or portion of a formation capable of yielding usable quantities of groundwater to wells or springs. The uppermost aquifer is defined in Section §257.53 of the CCR Rule as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility boundary.

The water-bearing geologic formation nearest the natural ground surface at the inactive Lined Pond that is capable of yielding groundwater to wells or springs is alluvium consisting of moderately to poorly sorted clay, silt, sand, and gravel of Holocene age. The alluvium has been documented to be approximately 250 to 300 feet thick in the vicinity of the NMPP (Gredell, 2003). The aquifer is used regionally for irrigation and domestic use. The depth to water ranges from approximately 9 to 43 feet bgs at the inactive Lined Pond. The saturated thickness of the uppermost aquifer at the monitoring wells which partially penetrate the aquifer beneath the inactive Lined Pond is approximately 11 to 44 feet thick based on observations made during groundwater monitoring conducted between October 2018 and March 2019.

Review of the MDNR WIMS Database indicates that the alluvial aquifer is used for water supply wells in the vicinity of the inactive Lined Pond. The nearest water well (well #00332117) listed in the WIMS Database is an irrigation well located approximately 0.6 miles south of the inactive Lined Pond and appears to be set in the alluvial aquifer that underlies the inactive Lined Pond. It is reported to be completed at a depth of 95 feet bgs and produces groundwater at a rate of 1,200 gpm. There are no apparent drinking water wells within a 2-mile radius of the inactive Lined Pond. Although the alluvial aquifer is not locally used as a drinking water aquifer in the immediate vicinity of the inactive Lined Pond, the formation does contain sufficient water to support low to high yield wells and springs. The formation also contains sufficient water to facilitate consistent groundwater monitoring of the saturated formation directly beneath the pond area and is therefore the uppermost aquifer beneath the inactive Lined Pond.

The materials comprising the upper aquifer unit were observed directly during drilling and installation of piezometers and monitoring wells at the site. Figure 7 shows the location of the inactive Lined Pond wells installed and boring logs with well construction details for the recently installed wells are included in Appendix A. The drilling, completion, and testing of these monitoring wells yielded site-specific geologic data that were used in combination with site-specific data from previous characterization activities and well installation activities to determine the appropriate number, depth, and spacing of the monitoring wells at the inactive Lined Pond.

Based on groundwater elevations measured between October 2018 and March 2019, the groundwater gradient in the upper aquifer unit is approximately 0.0008 to 0.001 feet/foot and is unconfined. This groundwater gradient reflects temporal variability in flow direction. The inactive Lined Pond lies adjacent to the Mississippi River and the alluvial aquifer immediately beneath the inactive Lined Pond is in communication with the river. Consequently, seasonal changes in river stage cause the groundwater flow direction to change and occasionally reverse. Due to the influence of the adjacent Mississippi River, the groundwater flow in the alluvial aquifer is generally to the southwest during high river stage and generally to the northeast during low river stage. Due to the changing groundwater flow directions, monitoring wells were sited at locations to monitor both downgradient directions. Groundwater flow direction in the vicinity of the inactive Lined Pond during low river stage is shown on Figure 7 and during high river stage is shown on Figure 8.

Hydraulic conductivity of the uppermost aquifer is based on data collected during slug testing of CCR monitoring wells. The hydraulic conductivity was calculated to be 75 to 81 feet/day.

The groundwater flow rate was calculated using the site-specific hydraulic conductivity values, effective porosity values obtained from published sources, and groundwater elevation data measured between October 2018 and March 2019. Based on estimates for similar material, effective porosity of the alluvial material is estimated to be 0.2 to 0.3 percent (Morris, 1967). The calculated groundwater flow velocity is approximately 135 to 440 feet per year. The velocity values do not account for changing groundwater flow directions.

CONFINING LAYER BELOW THE UPPERMOST AQUIFER

The Wilcox formation underlying the alluvial aquifer is comprised of sand deposits with interbedded clay and lignite. Because the alluvial aquifer provides a more accessible resource for groundwater production in the area, the Wilcox formation has not been developed locally as a source of groundwater. The clay and lignite present within the Wilcox formation represent lower hydraulic conductivity than the overlying alluvial aquifer. Published hydraulic conductivity values for the Wilcox formation are available from areas where it has been investigated that indicate the hydraulic conductivity as low as 9 to 25 feet/day (ONWI, 1982 and Prudic, 1991). The Wilcox formation in the vicinity of the inactive Lined Pond is estimated to be approximately 400 to 500 feet thick (Gredell, 2003).

The hydrogeologic characterization data for the inactive Lined Pond described above are summarized in Table IV.

Pond 003 Groundwater Monitoring System

The groundwater monitoring system at Pond 003 was designed to monitor the uppermost aquifer beneath this CCR unit which consists of the alluvial aquifer. Because of the seasonally variable groundwater flow direction, monitoring wells on both sides of the impoundment are treated as down gradient wells. Pond 003 has a total of 12 monitoring wells. The up-gradient wells used to provide background data for the unit are MW-16, B-123, and B-126. The down gradient monitoring wells (P-1, P-2, P-3, P-4, P-5, MW-6, MW-7, MW-8, and MW-9) were sited based on site-specific conditions at locations that are representative of groundwater flowing beneath Pond 003. The monitoring wells are sited at locations to detect migration of groundwater along representative flow paths in the uppermost aquifer beneath Pond 003 based on the groundwater flow directions observed at the site. The locations of Pond 003 monitoring wells are shown on Figure 2. The monitoring wells were cased and the annular space sealed in conformance with MDNR Monitoring Well Construction Code standards. Monitoring well construction details are included in Table V.

Pond 004 Groundwater Monitoring System

The groundwater monitoring system at Pond 004 was designed to monitor the uppermost aquifer beneath this CCR unit which consists of the alluvial aquifer. Because of the seasonally variable groundwater flow direction, monitoring wells on both sides of the impoundment are treated as down gradient wells. Pond 004 has a total of 9 monitoring wells. The up-gradient wells used to provide background data for the unit are MW-16, B-123, and B-126. The down gradient monitoring wells (MW-10, MW-11, MW-12, MW-13, MW-14, and MW-15) are sited based on site-specific conditions at locations that are representative of groundwater flowing beneath Pond 004. The monitoring wells were sited at locations to detect migration of groundwater along representative flow paths in the uppermost aquifer beneath Pond 004 based on the groundwater flow directions observed. The locations of Pond 004 monitoring wells are shown on Figure 4. The monitoring wells were cased and the annular space sealed in conformance with MDNR Monitoring Well Construction Code standards. Monitoring well construction details are included in Table V.

Utility Waste Landfill Groundwater Monitoring System

The groundwater monitoring system at the UWL was designed to monitor the uppermost aquifer beneath this CCR unit which consists of the alluvial aquifer. The UWL has a total of 11 monitoring wells. The up-gradient wells used to provide background data for the unit are MW-16, B-123, and B-126. The down gradient monitoring wells (B-2, B-41, B-5R, MW-1, MW-2, MW-3, MW-4, and MW-5) are sited based on site-specific conditions at locations that are representative of groundwater flowing beneath the UWL. The groundwater flow direction is to the northeast and east. The monitoring wells are sited at locations to detect migration of groundwater along representative flow paths in the uppermost aquifer beneath the UWL based on the groundwater flow directions. The locations of the UWL monitoring wells are shown on Figure 6. The monitoring wells were cased and the annular space sealed in conformance with MDNR Monitoring Well Construction Code standards. Monitoring well construction details are included in Table V.

Inactive Lined Pond Groundwater Monitoring System

The groundwater monitoring system at the inactive Lined Pond was designed to monitor the uppermost aquifer beneath this CCR unit which consists of the alluvial aquifer. Because of the seasonally variable groundwater flow direction, monitoring wells on both sides of the impoundment are treated as down gradient wells. The inactive Lined Pond has a total of 9 monitoring wells. The up-gradient wells used to provide background data for the unit are MW-16, B-123, and B-126. The down gradient monitoring wells (P-6, P-7, MW-8, MW-9, MW-17, and MW-18) were sited based on site-specific conditions at locations that are representative of groundwater flowing beneath the inactive Lined Pond. The monitoring wells are sited at locations to detect migration of groundwater along representative flow paths in the uppermost aquifer beneath the inactive Lined Pond based on the groundwater flow directions observed at the site. The locations of the inactive Lined Pond monitoring wells are shown on Figure 7. The monitoring wells were cased and the annular space sealed in conformance with MDNR Monitoring Well Construction Code standards. Monitoring well construction details are included in Table V.

Measurement, Sampling, and Analytical Devices

AECI has installed dedicated sampling pumps in Pond 003, Pond 004, the UWL, and the inactive Lined Pond single-unit groundwater monitoring systems. The monitoring wells and other measurement, sampling, and analytical devices are in good operating order and will be maintained so that they perform to the design specifications throughout the life of the monitoring program. The measurement, sampling, and other analytical devices are described in the Sampling and Analysis Plan established for NMPP.

Summary

This letter provides a hydrogeologic description of the uppermost aquifer, unsaturated materials, and confining units underlying the CCR units at the NMPP. The hydrogeologic description is based on site-specific characterization data collected during recent drilling and characterization activities and previous investigations. These data have been used to develop a groundwater monitoring system at the CCR management unit with an appropriate number of wells intersecting groundwater flow paths that are representative of groundwater flowing beneath the CCR management unit. The number, spacing, and depth of the monitoring wells are based on site-specific data, and the resultant groundwater monitoring system is compliant with the CCR Rule.

Sincerely yours,
HALEY & ALDRICH, INC.

Steve Putrich
Principal Consultant

Mark Nicholls, P.G.
Lead Hydrogeologist

Attachments:
- Table I: Hydrogeologic Characterization Data for Pond 003 CCR Management Unit
- Table II: Hydrogeologic Characterization Data for Pond 004 CCR Management Unit
- Table III: Hydrogeologic Characterization Data for the Utility Waste Landfill CCR Management Unit
- Table IV: Hydrogeologic Characterization Data for inactive Lined Pond CCR Management Unit
- Table V: Groundwater Monitoring Well Construction Information
- Figure 1: Site Location Map New Madrid Power Plan
- Figure 2: Pond 003 – Groundwater Flow Direction Map – Low River Stage 3/28/2017
- Figure 3: Pond 003 – Groundwater Flow Direction Map – High River Stage 5/17/2017
- Figure 4: Pond 004 – Groundwater Flow Direction Map – Low River Stage 12/6/2016
- Figure 5: Pond 004 – Groundwater Flow Direction Map – High River Stage 5/17/2017 – 5/18/2017
- Figure 6: Utility Waste Landfill – Groundwater Flow Direction Map 5/16/2017 – 5/17/2017
- Figure 7: Inactive Lined Pond – Groundwater Flow Direction Map – Low River Stage 12/17/2018
- Figure 8: Inactive Lined Pond – Groundwater Flow Direction Map – High River Stage 3/5/2019
- Appendix A: Monitoring Well As-Built Diagrams and Boring Logs

References

1. Gredell Engineering Resources, Inc., 2003. *Detailed Site Investigation Work Plan, Proposed AECI New Madrid Utility Waste Landfill*. 13 June.

2. Morris, D.A. and A.I. Johnson, 1967. Summary of hydrologic and physical properties of rock and soil materials as analyzed by the Hydrologic Laboratory of the U.S. Geological Survey, U.S. Geological Survey Water-Supply Paper 1839-D, 42p.

3. Office of Nuclear Waste Isolation (ONWI), 1982. Gulf Coast Salt Domes Geologic Area Characterization Report Mississippi Study Area, Volume VI Technical Report.

4. Prudic, David E., United States Geological Survey, 1991. Estimates of Hydraulic Conductivity from Aquifer-Test Analyses and Specific-Capacity Data, Gulf Coast Regional Aquifer Systems, South-Central United States. Water Resources Investigations Report 90-4121.

5. U.S. Environmental Protection Agency, 2015. 40 CFR Parts 257 and 261, *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule.* 17 April.

TABLES

TABLE I
HYDROGEOLOGIC CHARACTERIZATION DATA FOR POND 003 CCR MANAGEMENT UNIT

CCR GROUNDWATER MONITORING NETWORK DESCRIPTION
NEW MADRID POWER PLANT
NEW MADRID, MISSOURI

Material Overlaying Uppermost Aquifer Characteristics	
Stratigraphic Unit	Alluvium
Lithology	Clay, silt, sand, and gravel
Unit Thickness	Up to 53 feet[a]
Hydraulic Conductivity	Not saturated
Uppermost Aquifer Characteristics	
Stratigraphic Unit	Alluvium
Lithology	Clay, silt, sand, and gravel
Aquifer Thickness	6 to 37 feet[a]
Groundwater Gradient	0.0015 to 0.003[a]
Hydraulic Conductivity	75 to 81 feet/day[b]
Effective Porosity	0.2 - 0.3[c]
Groundwater Flow Direction	Northeast and southwest
Groundwater Flow Velocity	135 to 440 feet/year[d]
Confining Unit Below the Uppermost Aquifer Characteristics	
Stratigraphic Unit	Clay and lignites of the Wilcox Group
Lithology	Sand deposits with interbedded clay
Unit Thickness	400 to 500 feet[e]
Hydraulic Conductivity	9 feet per day[f]
Effective Porosity	Not available

Notes:

[a] *= Data based groundwater elevation data between November 2016 and August 2017*

[b] *= Hydraulic conductivity values from Haley & Aldrich, 2017*

[c] *= Morris, D.A. and A.I. Johnson, 1967. Summary of hydrologic and physical properties of rock and soil materials as analyzed by the Hydrologic Laboratory of the U.S. Geological Survey, U.S. Geological Survey Water-Supply Paper 1839-D, 42p.*

[d] *= Results estimated based on the hydraulic parameters above and Darcy's law; the velocity values estimated do not take into account the effects of changes of groundwater flow direction with time.*

[e] *= Data from Gredell, 2003.*

[f] *= Data from ONWI, 1982.*

TABLE II
HYDROGEOLOGIC CHARACTERIZATION DATA
FOR POND 004 CCR MANAGEMENT UNIT
CCR GROUNDWATER MONITORING NETWORK DESCRIPTION
NEW MADRID POWER PLANT
NEW MADRID, MISSOURI

Material Overlaying Uppermost Aquifer Characteristics	
Stratigraphic Unit	Alluvium
Lithology	Clay, silt, sand, and gravel
Unit Thickness	Up to 43 feet[a]
Hydraulic Conductivity	Not saturated
Uppermost Aquifer Characteristics	
Stratigraphic Unit	Alluvium
Lithology	Clay, silt, sand, and gravel
Aquifer Thickness	14 to 52 feet[a]
Groundwater Gradient	0.0002 to 0.001[a]
Hydraulic Conductivity	37 to 101 feet/day[b]
Effective Porosity	0.2 - 0.3[c]
Groundwater Flow Direction	Northeast and southwest
Groundwater Flow Velocity	80 to 590 feet/year[d]
Confining Unit Below the Uppermost Aquifer Characteristics	
Stratigraphic Unit	Wilcox Group
Lithology	Sand deposits with interbedded clay
Unit Thickness	400 to 500 feet[e]
Hydraulic Conductivity	9 feet per day[f]
Effective Porosity	Not available

Notes:

[a] *= Data based groundwater elevation data between November 2016 and August 2017*

[b] *= Hydraulic conductivity values from Haley & Aldrich, 2017*

[c] *= Morris, D.A. and A.I. Johnson, 1967. Summary of hydrologic and physical properties of rock and soil materials as analyzed by the Hydrologic Laboratory of the U.S. Geological Survey, U.S. Geological Survey Water-Supply Paper 1839-D, 42p.*

[d] *= Results estimated based on the hydraulic parameters above and Darcy's law; the velocity values estimated do not take into account the effects of changes of groundwater flow direction with time.*

[e] *= Data from Gredell, 2003.*

[f] *= Data from ONWI, 1982.*

TABLE III
HYDROGEOLOGIC CHARACTERIZATION DATA FOR THE UTILITY WASTE LANDFILL CCR MANAGEMENT UNIT

CCR GROUNDWATER MONITORING NETWORK DESCRIPTION
NEW MADRID POWER PLANT
NEW MADRID, MISSOURI

Material Overlaying Uppermost Aquifer Characteristics	
Stratigraphic Unit	Alluvium
Lithology	Clay, silt, sand, and gravel
Unit Thickness	Up to 28 feet[a]
Hydraulic Conductivity	Not saturated
Uppermost Aquifer Characteristics	
Stratigraphic Unit	Alluvium
Lithology	Clay, silt, sand, and gravel
Aquifer Thickness	8 to 28 feet[a]
Groundwater Gradient	0.0005 to 0.006[a]
Hydraulic Conductivity	53 to 101 feet/day[b]
Effective Porosity	0.2 - 0.3[c]
Groundwater Flow Direction	Northeast to east
Groundwater Flow Velocity	58 to 184 feet/year[d]
Confining Unit Below the Uppermost Aquifer Characteristics	
Stratigraphic Unit	Wilcox Group
Lithology	Sand deposits with interbedded clay
Unit Thickness	400 to 500 feet[e]
Hydraulic Conductivity	Not available
Effective Porosity	Not available

Notes:

[a] *= Data based groundwater elevation data between November 2016 and August 2017*

[b] *= Hydraulic conductivity values from Haley & Aldrich, 2017*

[c] *= Morris, D.A. and A.I. Johnson, 1967. Summary of hydrologic and physical properties of rock and soil materials as analyzed by the Hydrologic Laboratory of the U.S. Geological Survey, U.S. Geological Survey Water-Supply Paper 1839-D, 42p.*

[d] *= Results estimated based on the hydraulic parameters above and Darcy's law*

[e] *= Data from Gredell, 2003.*

TABLE IV
HYDROGEOLOGIC CHARACTERIZATION DATA FOR THE INACTIVE LINED POND CCR MANAGEMENT UNIT

CCR GROUNDWATER MONITORING NETWORK DESCRIPTION
NEW MADRID POWER PLANT
NEW MADRID, MISSOURI

Material Overlaying Uppermost Aquifer Characteristics	
Stratigraphic Unit	Alluvium
Lithology	Clay, silt, sand, and gravel
Unit Thickness	Up to 43 feet[a]
Hydraulic Conductivity	Not saturated
Uppermost Aquifer Characteristics	
Stratigraphic Unit	Alluvium
Lithology	Clay, silt, sand, and gravel
Aquifer Thickness	11 to 44 feet[a]
Groundwater Gradient	0.0008 to 0.001[a]
Hydraulic Conductivity	75 to 81 feet/day[b]
Effective Porosity	0.2 - 0.3[c]
Groundwater Flow Direction	Northeast to east
Groundwater Flow Velocity	135 to 440 feet/year[d]
Confining Unit Below the Uppermost Aquifer Characteristics	
Stratigraphic Unit	Wilcox Group
Lithology	Sand deposits with interbedded clay
Unit Thickness	400 to 500 feet[e]
Hydraulic Conductivity	Not available
Effective Porosity	Not available

Notes:

[a] *= Data based groundwater elevation data between October 2018 and March 2019*
[b] *= Hydraulic conductivity values from Haley & Aldrich, 2017*
[c] *= Morris, D.A. and A.I. Johnson, 1967. Summary of hydrologic and physical properties of rock and soil materials as analyzed by the Hydrologic Laboratory of the U.S. Geological Survey, U.S. Geological Survey Water-Supply Paper 1839-D, 42p.*
[d] *= Results estimated based on the hydraulic parameters above and Darcy's law; the velocity values estimated do not take into account the effects of changes of groundwater flow direction with time.*
[e] *= Data from Gredell, 2003.*

TABLE V
GROUNDWATER MONITORING WELL CONSTRUCTION INFORMATION
CCR GROUNDWATER MONITORING NETWORK DESCRIPTION
NEW MADRID POWER PLANT
NEW MADRID, MISSOURI

Location	Well Identification	Well Installation Date	Casing Diameter (inches)	Blank Casing Type	Screened Casing Type	Slot Size (inch)	Top of Screen (feet btoc)	Bottom of Screen (feet btoc)	Well Depth (feet btoc)	Depth to Water* (feet btoc)	Water Level Elevation (feet amsl)	Water Column Depth (feet)	Northing (SP NAD83)	Easting (SP NAD83)	Ground Surface Elevation (feet amsl)	Top of Casing Elevation (feet amsl) (NAVD29)
Pond 003 Complex																
Down Gradient	P-1**	3/17/2009	2	Schd 40 PVC	Schd 40 PVC	0.010	48.44	58.44	58.44	24.09	289.16	34.35	247923.640	1097225.586	309.64	313.250
	P-2**	3/17/2009	2	Schd 40 PVC	Schd 40 PVC	0.010	47.39	57.39	57.39	17.59	292.25	39.8	247387.236	1097708.209	306.45	309.838
	P-3**	3/18/2009	2	Schd 40 PVC	Schd 40 PVC	0.010	48.50	58.50	58.50	17.28	293.44	41.22	246616.360	1098177.592	306.826	310.724
	P-4**	3/18/2009	2	Schd 40 PVC	Schd 40 PVC	0.010	48.40	58.40	58.40	17.3	293.77	41.1	245831.537	1098659.047	307.355	311.067
	P-5**	3/19/2009	2	Schd 40 PVC	Schd 40 PVC	0.010	47.70	57.70	57.70	13.87	288.10	43.83	245943.273	1095688.915	298.071	301.968
	MW-6	9/23/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	42.6	52.6	52.6	10.33	289.94	42.27	247399.920	1096438.167	297.626	300.270
	MW-7	9/27/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	42.65	52.65	52.65	12.71	288.79	39.94	246460.920	1095876.073	298.768	301.501
	MW-8	9/27/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	52.54	62.54	62.54	21.25	289.38	41.29	245482.271	1096262.497	307.997	310.628
	MW-9	9/29/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	52.40	62.40	62.40	19.75	290.49	42.65	245502.963	1097257.294	307.715	310.237
Up Gradient	MW-16	10/6/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	42.65	52.65	52.65	8.52	284.33	44.13	249024.878	1093306.896	290.159	292.853
	B-123	10/7/2003	2	Schd 40 PVC	Schd 40 PVC	0.010	22.16	32.16	32.16	15.3	277.40	16.86	238223.526	1088665.402	290.120	292.700
	B-126	10/22/2003	2	Schd 40 PVC	Schd 40 PVC	0.010	22.33	32.33	32.33	16.55	277.08	15.78	238590.954	1090633.482	290.680	293.630
Pond 004 Complex																
Down Gradient	MW-10	9/29/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	42.60	52.60	52.60	6.20	291.61	46.4	249194.960	1096197.334	295.121	297.806
	MW-11	10/4/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	39.54	49.54	49.54	4.73	291.05	44.81	249549.844	1096043.427	296.080	295.782
	MW-12	10/5/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	49.68	59.68	59.68	6.70	291.27	52.98	250047.981	1095744.028	298.306	297.968
	MW-13	9/30/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	52.54	62.54	62.54	12.08	291.97	50.46	249948.998	1096433.722	301.368	304.045
	MW-14	10/3/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	42.46	52.46	52.46	5.72	292.29	46.74	249654.502	1096630.510	295.406	298.008
	MW-15	10/5/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	52.66	62.66	62.66	6.45	292.33	56.21	249252.172	1096842.328	296.050	298.777
Up Gradient	MW-16	10/6/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	42.65	52.65	52.65	8.52	284.33	44.13	249024.878	1093306.896	290.159	292.853
	B-123	10/7/2003	2	Schd 40 PVC	Schd 40 PVC	0.010	22.16	32.16	32.16	15.3	277.40	16.86	238223.526	1088665.402	290.120	292.700
	B-126	10/22/2003	2	Schd 40 PVC	Schd 40 PVC	0.010	22.33	32.33	32.33	16.55	277.08	15.78	238590.954	1090633.482	290.680	293.630
UWL Complex																
Down Gradient	B-2	10/8/2003	2	Schd 40 PVC	Schd 40 PVC	0.010	22.21	32.21	32.21	14.2	277.71	18.01	242468.168	1088952.789	288.730	291.910
	B-5R	6/21/2017	2	Schd 40 PVC	Schd 40 PVC	0.010	43.00	53.00	53.00	14.33	274.39	38.67	242120.009	1087767.721	288.424	288.724
	B-41	10/7/2003	2	Schd 40 PVC	Schd 40 PVC	0.010	22.25	32.25	32.25	17.98	276.60	14.27	240999.437	1087771.084	291.370	294.580
	MW-1	9/20/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	36.79	46.79	46.79	20.92	277.16	25.87	241891.229	1089212.771	295.059	298.083
	MW-2	9/20/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	42.33	52.33	52.33	20.82	276.87	31.51	242280.056	1088338.026	295.238	297.693
	MW-3	9/22/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	39.92	49.92	49.92	16.62	276.36	33.30	240596.532	1088283.871	292.992	292.982
	MW-4	9/22/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	37.75	47.75	47.75	16.1	277.84	31.65	240611.927	1088962.479	294.140	293.942
	MW-5	9/28/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	42.56	52.56	52.56	19.7	276.93	32.86	240778.875	1089239.816	293.932	296.631
Up Gradient	MW-16	10/6/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	42.65	52.65	52.65	8.52	284.33	44.13	249024.878	1093306.896	290.159	292.853
	B-123	10/7/2003	2	Schd 40 PVC	Schd 40 PVC	0.010	22.16	32.16	32.16	15.3	277.40	16.86	238223.526	1088665.402	290.120	292.700
	B-126	10/22/2003	2	Schd 40 PVC	Schd 40 PVC	0.010	22.33	32.33	32.33	16.55	277.08	15.78	238590.954	1090633.482	290.680	293.630
Inactive Lined Pond																
Down Gradient	P-6**	3/20/2009	2	Schd 40 PVC	Schd 40 PVC	0.010	47.81	57.81	57.81	18.27	292.61	39.54	244800.808	1097683.774	253.070	310.880
	P-7**	3/23/2009	2	Schd 40 PVC	Schd 40 PVC	0.010	44.41	54.41	54.41	17.35	290.71	37.06	244055.518	1096890.943	253.650	308.060
	MW-8	9/27/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	52.54	62.54	62.54	21.49	289.14	41.05	245482.271	1096262.497	307.997	310.628
	MW-9	9/29/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	52.40	62.40	62.40	18.8	291.44	43.60	245502.963	1097257.294	307.715	310.237
	MW-17	12/6/2018	2	Schd 40 PVC	Schd 40 PVC	0.010	45	55	55	12.66	286.54	42.34	245075.194	1095281.028	296.647	299.197
	MW-18	12/6/2018	2	Schd 40 PVC	Schd 40 PVC	0.010	45.5	55.5	55.5	15.72	285.47	39.78	244571.425	1095025.010	298.840	301.190
Up Gradient	MW-16	10/6/2016	2	Schd 40 PVC	Schd 40 PVC	0.010	42.65	52.65	52.65	8.52	284.33	44.13	249024.878	1093306.896	290.159	292.853
	B-123	10/7/2003	2	Schd 40 PVC	Schd 40 PVC	0.010	22.16	32.16	32.16	15.3	277.40	16.86	238223.526	1088665.402	290.120	292.700
	B-126	10/22/2003	2	Schd 40 PVC	Schd 40 PVC	0.010	22.33	32.33	32.33	16.55	277.08	15.78	238590.954	1090633.482	290.680	293.630

NOTES:

**Depth to water elevations from 5 March 2019 - 12 March 2019 groundwater elevation survey, with the exception of B-4 (26 March 2019).*

***Data from Well Development & Sampling Report, Coal Ash Impoundment 1 (Unlined), Gredell Engineering Resources, Inc., January 24, 2012.*

amsl - above mean sea level

bgs - below ground surface

btoc - below top of casing

NA - Data not available

NAD 83 - North American Datum of 1983

NAVD 29 - National Geodetic Vertical Datum of 1929

Schd 40 PVC - Schedule 40 polyvinyl chloride

HALEY ALDRICH

FIGURES

LEGEND

- 🟦 POND 003
- 🟩 POND 004
- 🟨 UTILITY WASTE LANDFILL (UWL) BOUNDARY
- 🟪 Lined Pond

NOTE

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI, 19 MAY 2016.

N

0 1,500 3,000
SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
MARSTON, MISSOURI

SITE LOCATION MAP
NEW MADRID POWER PLANT

aeci

APRIL 2019
SCALE: AS SHOWN

FIGURE 1

GIS FILE PATH: \\haleyaldrich\share\phx_common\Projects\AECI\New Madrid\GIS\MXDs\2017_09\129342_003_0001_SITE_LOCATION_MAP.mxd — USER: kmunsey — LAST SAVED: 4/16/2019 3:54:59 PM

LEGEND

⊕ MONITORING WELL

🟦 POND 003

◀ GROUNDWATER FLOW DIRECTION

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI, 19 MAY 2016.

N

0 330 660
SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER GENERATING FACILITY
NEW MADRID COUNTY, MISSOURI

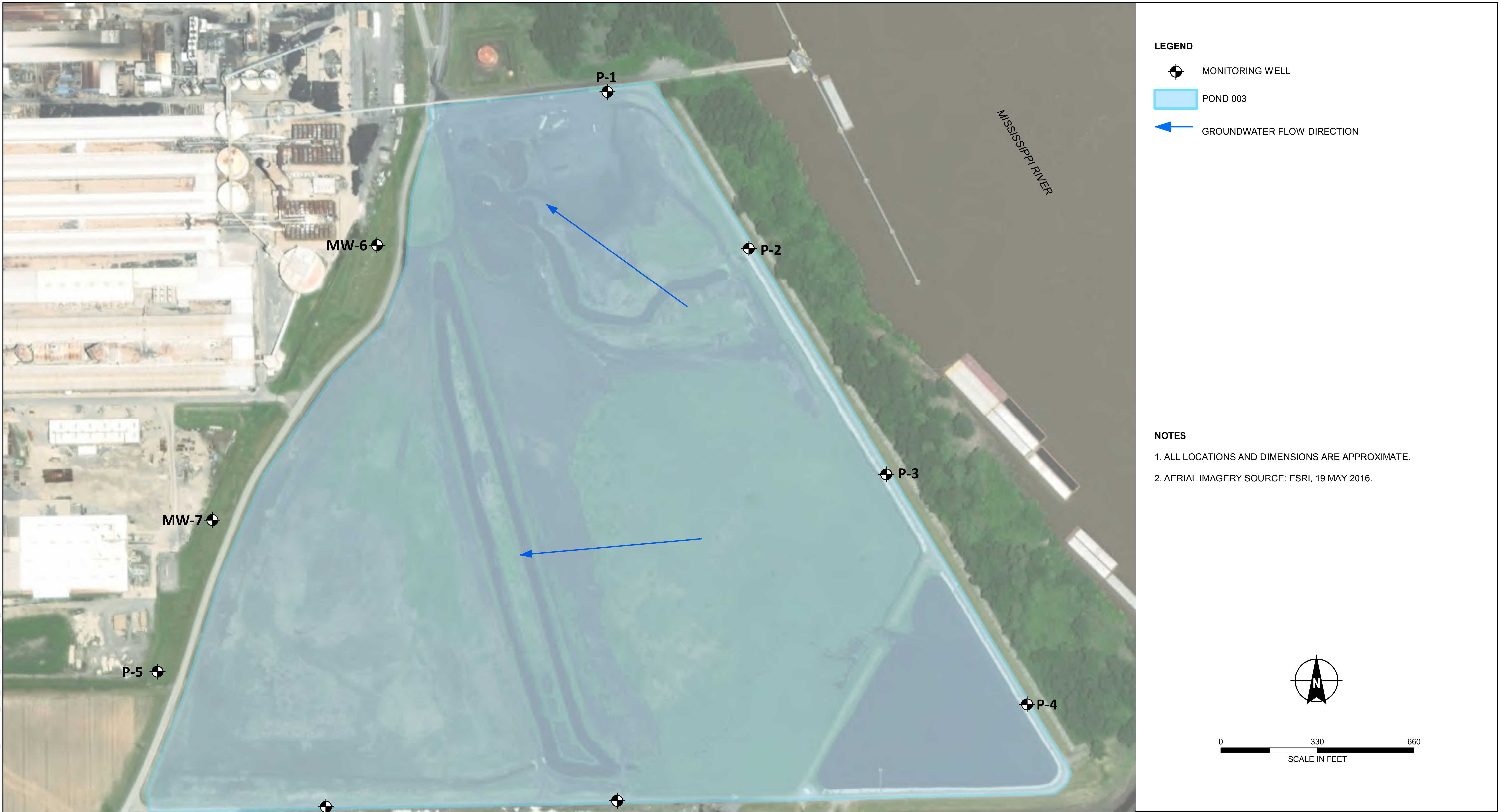
POND 003 - GROUNDWATER
FLOW DIRECTION MAP
LOW RIVER STAGE
3/28/2017

aeci

APRIL 2019

FIGURE 2

GIS FILE PATH: G:\Projects\AECI\New Madrid\GIS\MXDs\2017_09\129342_003_0002_POND_003_GW_ELEV_CONTOURS_LOW.mxd — USER: DZinsmaster — LAST SAVED: 10/16/2017 2:37:59 PM



NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

2. AERIAL IMAGERY SOURCE: ESRI, 19 MAY 2016.

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER GENERATING FACILITY
NEW MADRID COUNTY, MISSOURI

POND 003 - GROUNDWATER FLOW DIRECTION MAP HIGH RIVER STAGE 5/17/2017

aeci

APRIL 2019

FIGURE 3

GIS FILE PATH: G:\Projects\AECI\New Madrid\GIS\MXDs\2017_09\129342_003_0002_POND_003_GW_ELEV_CONTOURS.mxd — USER: DZinsmaster — LAST SAVED: 10/16/2017 2:40:28 PM

LEGEND

⊕ MONITORING WELL

🟩 POND 004

← GROUNDWATER FLOW DIRECTION

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI, 19 MAY 2016.

N

0 330 660

SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER GENERATING FACILITY
NEW MADRID COUNTY, MISSOURI

POND 004 - GROUNDWATER
FLOW DIRECTION MAP
LOW RIVER STAGE
12/6/2016

aeci

APRIL 2019

FIGURE 4

GIS FILE PATH: G:\Projects\AECI\New Madrid\GIS\MXDs\2017_091129342_003_0003_POND_004_GW_ELEV_CONTOURS_LOW.mxd — USER: DZinsmaster — LAST SAVED: 10/16/2017 2:43:21 PM

LEGEND

⊕ MONITORING

🟩 POND 004

← GROUNDWATER FLOW DIRECTION

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI, 19 MAY 2016.

N

0 330 660
SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER GENERATING FACILITY
NEW MADRID COUNTY, MISSOURI

POND 004 - GROUNDWATER
FLOW DIRECTION MAP
HIGH RIVER STAGE
5/17/2017 - 5/18/17

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APRIL 2019

FIGURE 5

GIS FILE PATH: G:\Projects\AECI\New Madrid\GIS\MXDs\2017_091129342_003_0003_POND_004_GW_ELEV_CONTOURS.mxd — USER: DZinsmaster — LAST SAVED: 10/16/2017 2:45:18 PM

LEGEND

⊕	MONITORING WELL
▭	UTILITY WASTE LANDFILL (UWL) BOUNDARY
←	GROUNDWATER FLOW DIRECTION

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

2. AERIAL IMAGERY SOURCE: ESRI, 19 MAY 2016.

N

0 500 1,000

SCALE IN FEET

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER GENERATING FACILITY
NEW MADRID COUNTY, MISSOURI

UTILITY WASTE LANDFILL GROUNDWATER FLOW DIRECTION MAP
5/16/2017 - 5/17/2017

OCTOBER 2017

FIGURE 6

GIS FILE PATH: G:\Projects\AECI\New Madrid\GIS\MXDs\2017_09\129342_003_0004_UWL_GW_ELEV_CONTOURS.mxd — USER: kford — LAST SAVED: 10/16/2017 2:48:48 PM

LEGEND

⊕ MONITORING WELL

← GROUND WATER FLOW DIRECTION

🟪 LINED POND

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI, 19 MAY 2016.
3. GROUNDWATER CONTOUR DATA TAKEN FROM 17 DECEMBER 2018.

N

0 420 840
SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER GENERATING FACILITY
NEW MADRID COUNTY, MISSOURI

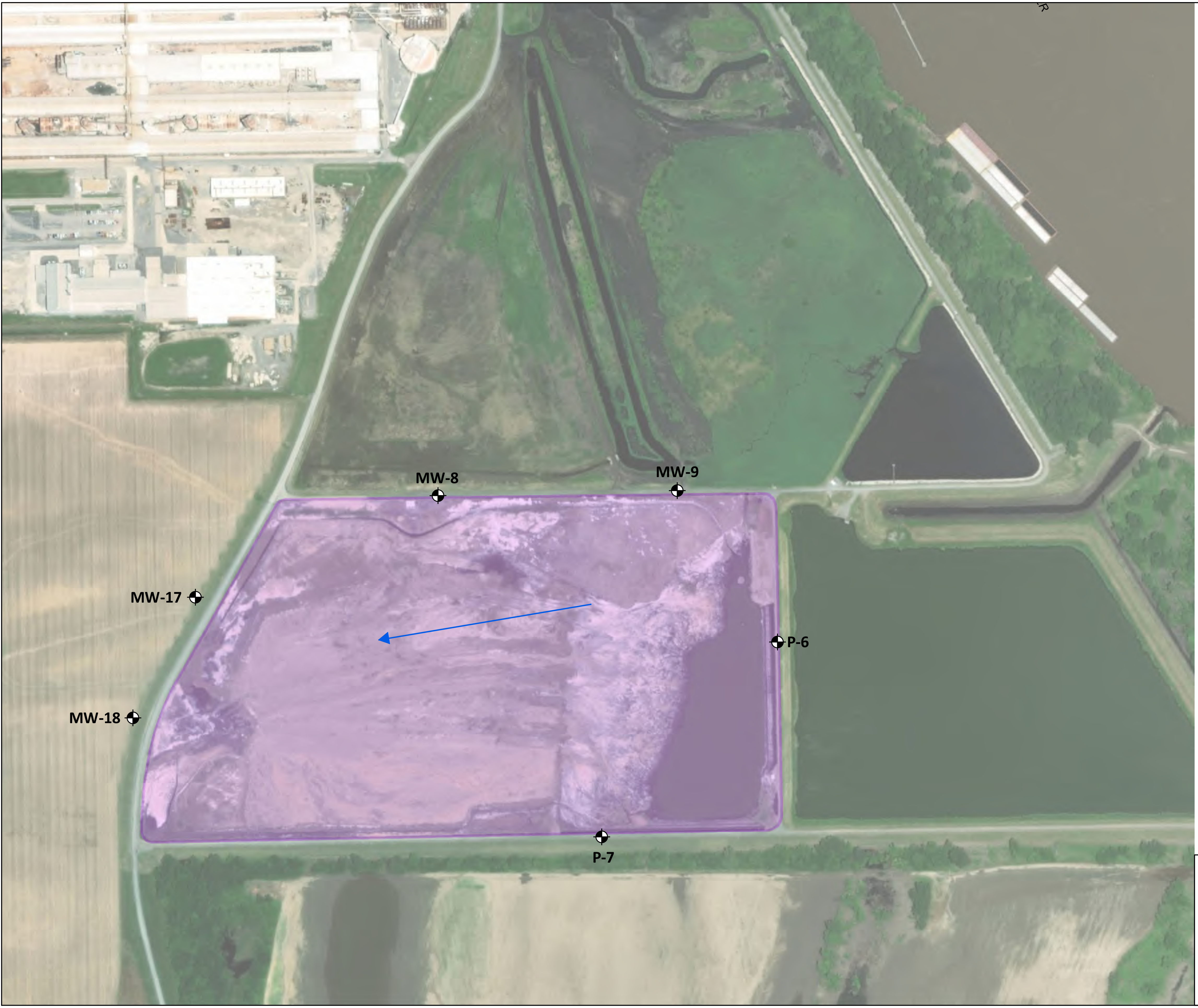
INACTIVE LINED POND - GROUNDWATER FLOW DIRECTION MAP - LOWER RIVER STAGE 12/17/2018

aeci

APRIL 2019

FIGURE 7

GIS FILE PATH: G:\Projects\AECI\New Madrid\GIS\MXDs\2019_04\Figure7_InactiveLPFlowDirection_041619.mxd — USER: DZinsmaster — LAST SAVED: 4/16/2019 5:47:28 PM



LEGEND

⊕ MONITORING WELL

← GROUND WATER FLOW DIRECTION

🟪 LINED POND

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI, 19 MAY 2016.
3. GROUNDWATER DATA TAKEN FROM 05 MARCH 2019.

N

0 420 840
SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER GENERATING FACILITY
NEW MADRID COUNTY, MISSOURI

INACTIVE LINED POND -
GROUNDWATER FLOW DIRECTION
MAP - HIGH RIVER STAGE 3/05/2019

aeci

APRIL 2019

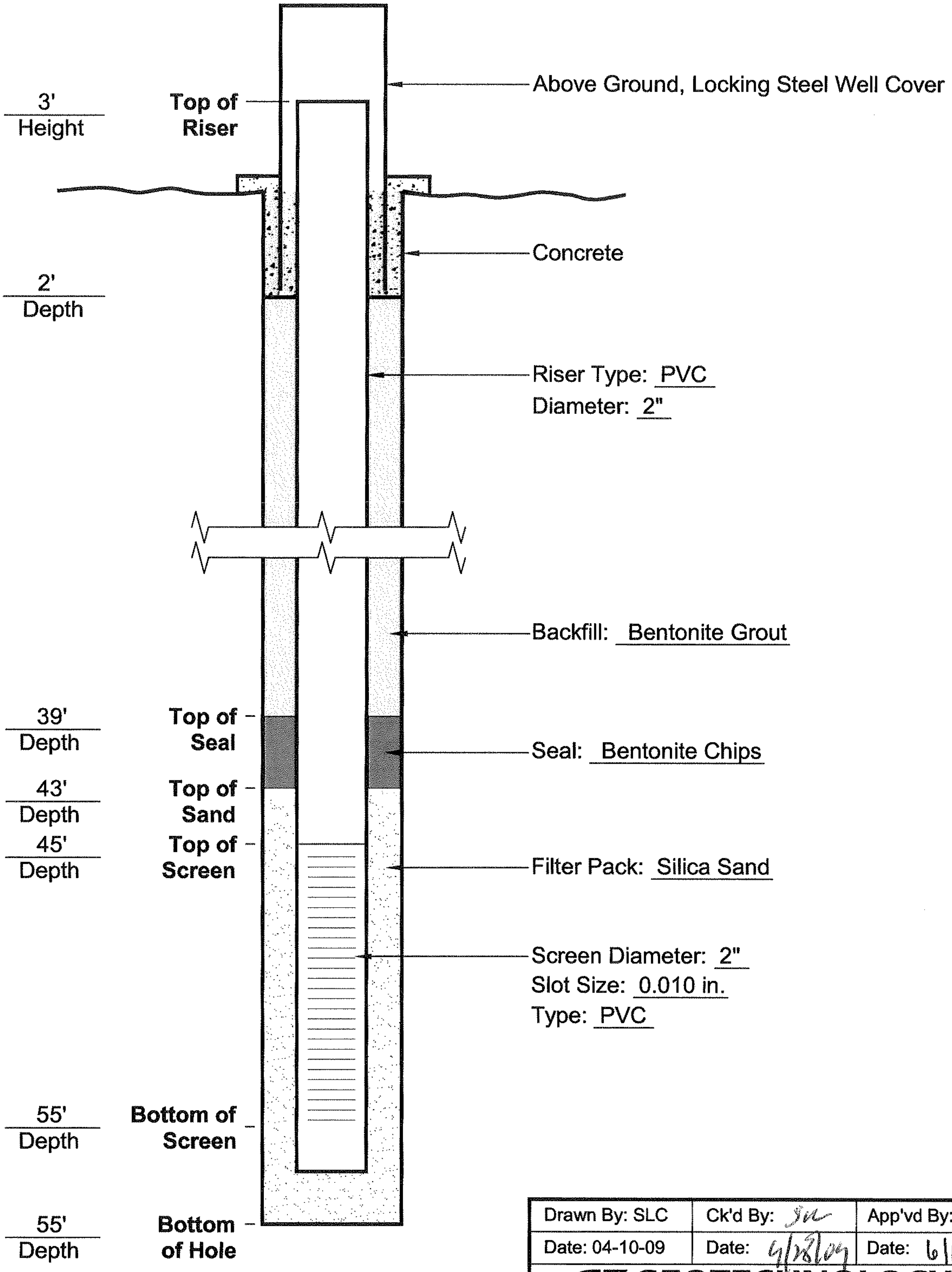
FIGURE 8

GIS FILE PATH: G:\Projects\AECI\New Madrid\GIS\MXDs\2019_04\Figure8_InactiveLPFlowDirection_041619.mxd — USER: DZinsmaster — LAST SAVED: 4/16/2019 5:45:56 PM

APPENDIX A

Monitoring Well As-Built Diagrams and Boring Logs

Date Installed: March 2009



NOTE

1. Boring P-6 drilled to 85 feet and backfilled to 55 feet prior to installing the piezometer.

Drawn By: SLC	Ck'd By:	App'vd By: MHM
Date: 04-10-09	Date: 4/28/09	Date: 6/12/09

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ENGINEERING AND ENVIRONMENTAL SERVICES
ST. LOUIS • COLLINSVILLE • KANSAS CITY

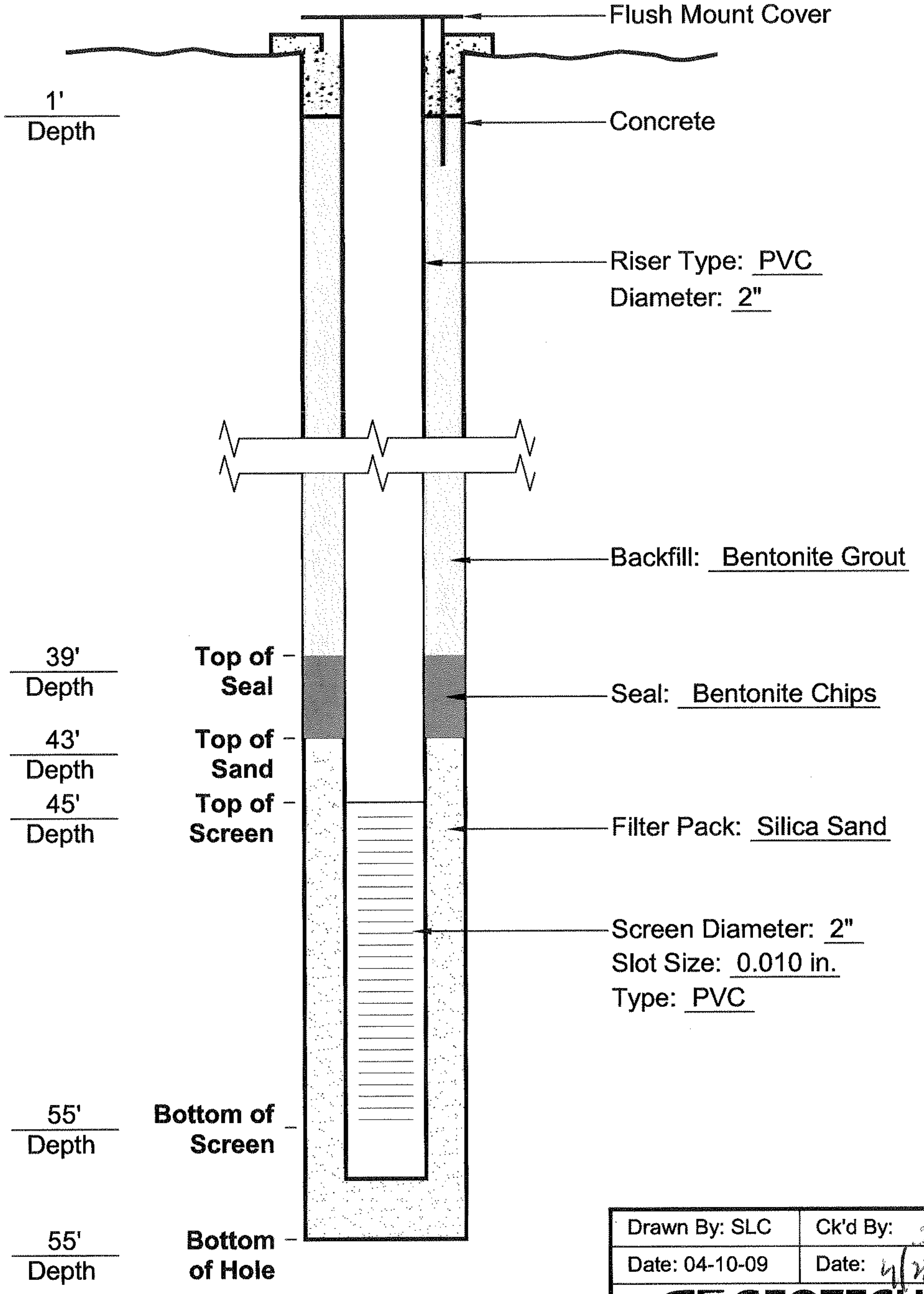
AECI New Madrid
Embankment Stability Evaluation
New Madrid County, Missouri

TYPICAL MONITORING WELL
P1 THROUGH P6

Project Number
1011304.91IG

PLATE

Date Installed: March 2009



Drawn By: SLC	Ck'd By: SR	App'vd By: MHM
Date: 04-10-09	Date: 4/28/09	Date: 6/12/09

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AECI New Madrid
Embankment Stability Evaluation
New Madrid County, Missouri

TYPICAL MONITORING WELL
P7 AND P8

Project Number
1011304.91IG

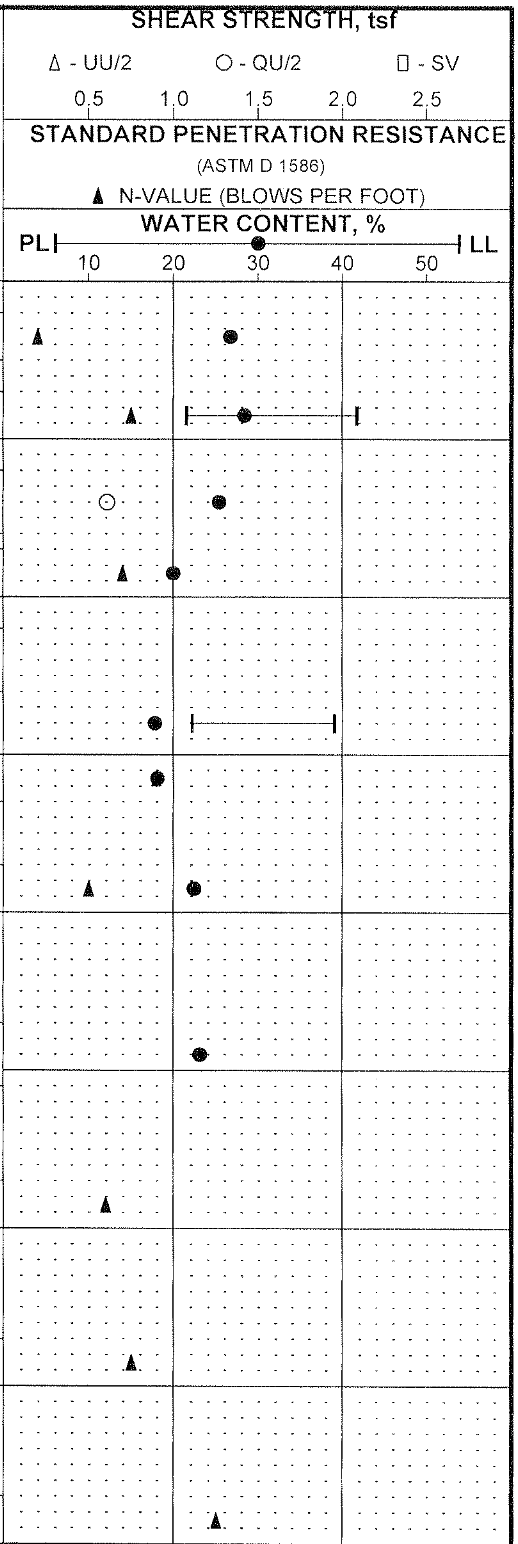
PLATE

Surface Elevation 310

Datum msl

Completion Date: 3/17/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Topsoil		
	FILL: brown and black, silty clay, trace slag	1-1-3	SS1
5	FILL: brown and gray, silty clay	6-7-8	SS2
		98	ST3
10		5-7-7	SS4
			ST5
		103	ST6
15	Very stiff to stiff, brown, sandy SILT - ML 80 percent passing #200 sieve	8-8-10	SS7
20		4-5-5	SS8
25	▼	86	ST9
30	Medium dense, brown, fine SAND - SP ▼	4-4-8	SS10
35		5-6-9	SS11
		9-12-13	SS12



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 26.2 FEET AFTER 80 DAYS ▼

AT 30.8 FEET AFTER 105 DAYS ▼

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 25.5 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS: Consolidated-Undrained Triaxial test performed on ST6.

Drawn by: KSA	Checked by: SN	App'vd. by: MHM
Date: 3/26/09	Date: 6/12/09	Date: 6/15/09

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AECI New Madrid
Embankment Stability Evaluation

LOG OF BORING: P-2

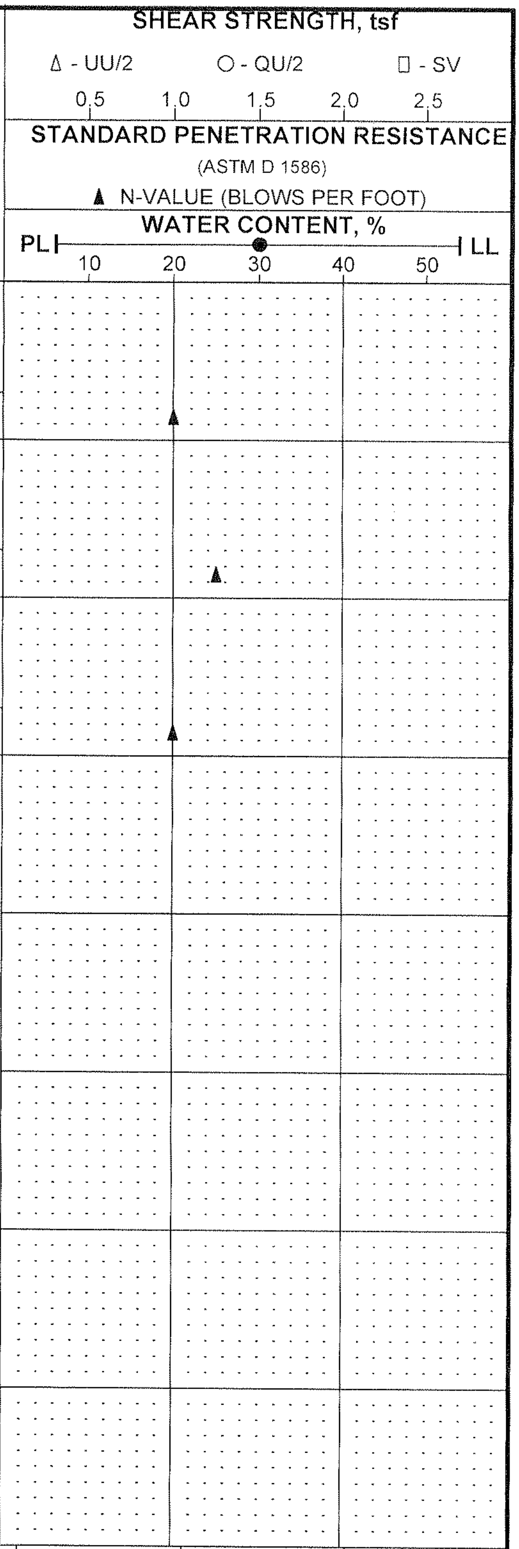
Project No. 1011304.91IG

Surface Elevation 310

Datum msl

Completion Date: 3/17/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium dense, brown, fine SAND - SP *(continued)*			
	Medium dense, brown, fine to coarse SAND - SP			
45			9-9-11	SS13
50			9-11-14	SS14
55			9-9-11	SS15
55	Boring terminated at 55 feet.			
60				
65				
70				
75				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 26.2 FEET AFTER 80 DAYS ▽

AT 30.8 FEET AFTER 105 DAYS ▼

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 25.5 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS: Consolidated-Undrained Triaxial test performed on ST6.

Drawn by: KSA	Checked by: SK	App'vd. by: MHM
Date: 3/26/09	Date: 6/12/09	Date: 6/15/09

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AECI New Madrid
Embankment Stability Evaluation

CONTINUATION OF
LOG OF BORING: P-2

Project No. 1011304.91IG

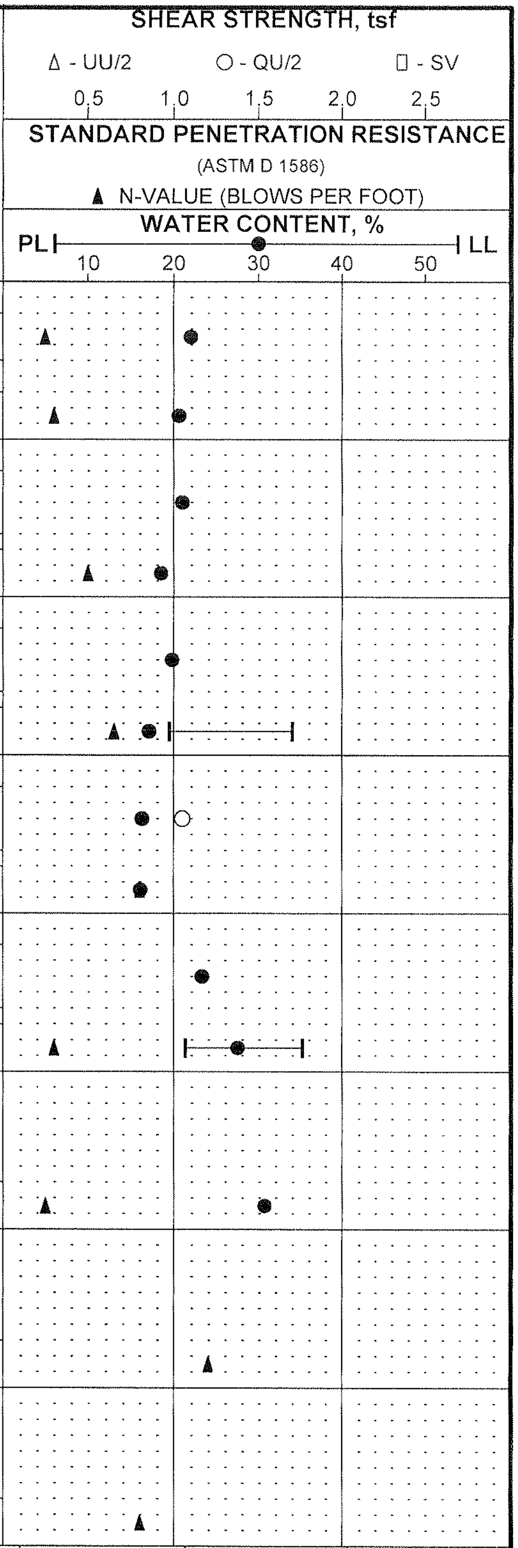
Surface Elevation 311

Datum msl

Completion Date: 3/18/09

DESCRIPTION OF MATERIAL

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Topsoil		
	FILL: brown and gray, silty clay	2-2-3	SS1
		2-3-3	SS2
5		104	ST3
10		5-5-5	SS4
		107	ST5
15		5-7-6	SS6
		113	ST7
20		7-7-9	SS8
		98	ST9
25	Medium stiff, brown, silty CLAY, trace sand - (CL)	2-3-3	SS10
30		1-2-3	SS11
35	Medium dense, brown, medium to coarse SAND - SP	11-11-13	SS12
		6-8-8	SS13



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 27.3 FEET AFTER 79 DAYS ▽

AT 31.5 FEET AFTER 104 DAYS ▼

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 19.5 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by: SM	App'vd. by: MHM
Date: 3/26/09	Date: 6/12/09	Date: 6/15/09

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
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AECI New Madrid
Embankment Stability Evaluation

LOG OF BORING: P-3

Project No. 1011304.91IG

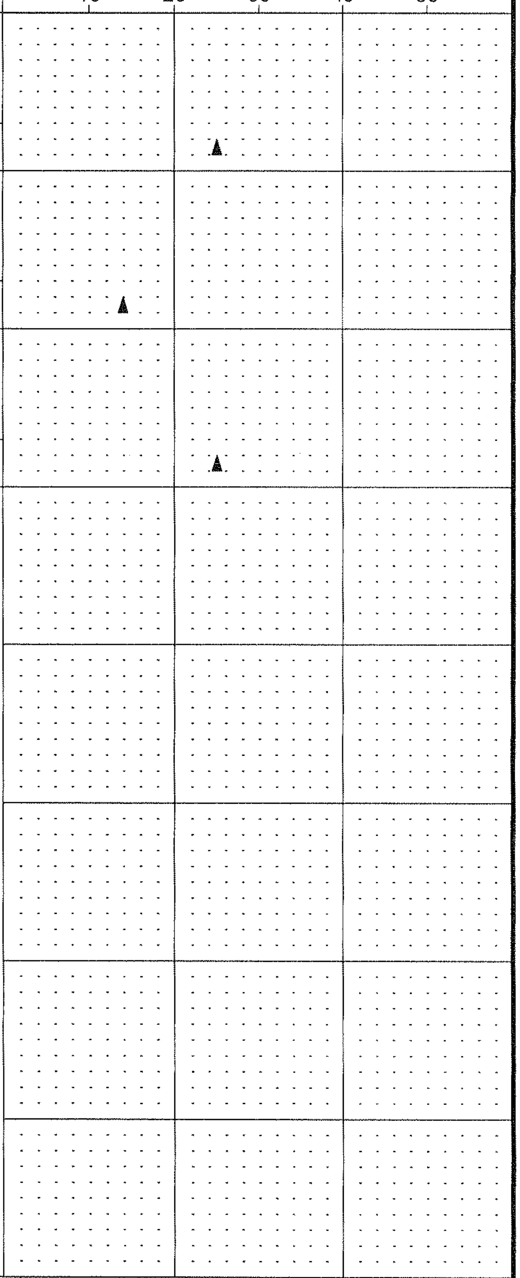
Surface Elevation 311
Datum msl
Completion Date: 3/18/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium dense, brown, medium to coarse SAND - SP *(continued)*			
			9-12-13	SS14
45				
	6 percent passing #200 sieve		5-6-8	SS15
50				
			9-12-13	SS16
55	Boring terminated at 55 feet.			
60				
65				
70				
75				

SHEAR STRENGTH, tsf
Δ - UU/2 ○ - QU/2 ▯ - SV
0.5 1.0 1.5 2.0 2.5

STANDARD PENETRATION RESISTANCE
(ASTM D 1586)
▲ N-VALUE (BLOWS PER FOOT)

WATER CONTENT, %
PL ├──●──┤ LL
10 20 30 40 50



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING
AT 27.3 FEET AFTER 79 DAYS ▽
AT 31.5 FEET AFTER 104 DAYS ▼

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM
WASHBORING FROM 19.5 FEET
MB DRILLER RFW LOGGER
CME 550X DRILL RIG
HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by: SY	App'vd. by: MHM
Date: 3/26/09	Date: 6/12/09	Date: 6/15/09

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
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AECI New Madrid
Embankment Stability Evaluation

CONTINUATION OF
LOG OF BORING: P-3

Project No. 1011304.91IG

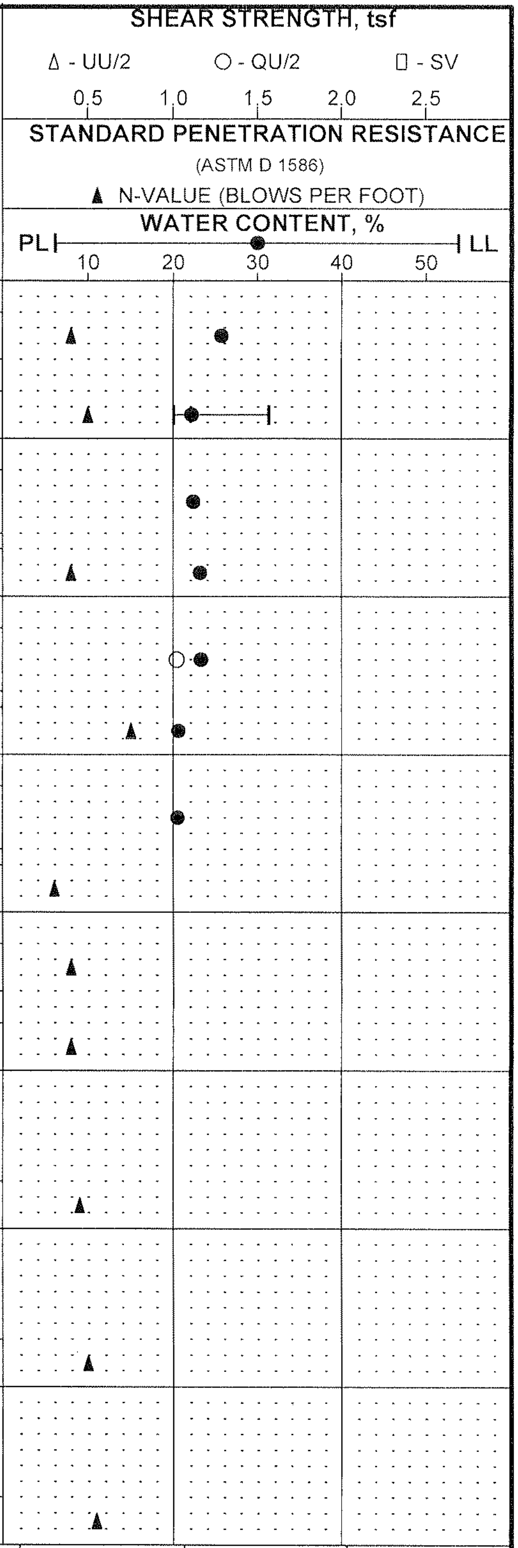
Surface Elevation 311

Datum msl

Completion Date: 3/18/09

DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
Topsoil		
FILL: brown and gray, silty clay	3-4-4	SS1
	2-4-6	SS2
	102	ST3
	3-3-5	SS4
	101	ST5
	5-7-8	SS6
	88	ST7
Medium stiff, brown, sandy SILT - ML 54 percent passing #200 sieve	3-3-3	SS8
	3-4-4	SS9
	3-4-4	SS10
Loose to medium dense, brown, fine to coarse SAND - SP 5 percent passing #200 sieve	4-4-5	SS11
	5-5-5	SS12
	5-5-6	SS13

DEPTH IN FEET: 5, 10, 15, 20, 25, 30, 35



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 27.3 FEET AFTER 79 DAYS ▼

AT 31.2 FEET AFTER 104 DAYS ▼

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 20 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by: SN	App'vd. by: MHM
Date: 3/26/09	Date: 6/12/09	Date: 6/15/09

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
ST. LOUIS • COLLINSVILLE • KANSAS CITY

AECI New Madrid
Embankment Stability Evaluation

LOG OF BORING: P-4

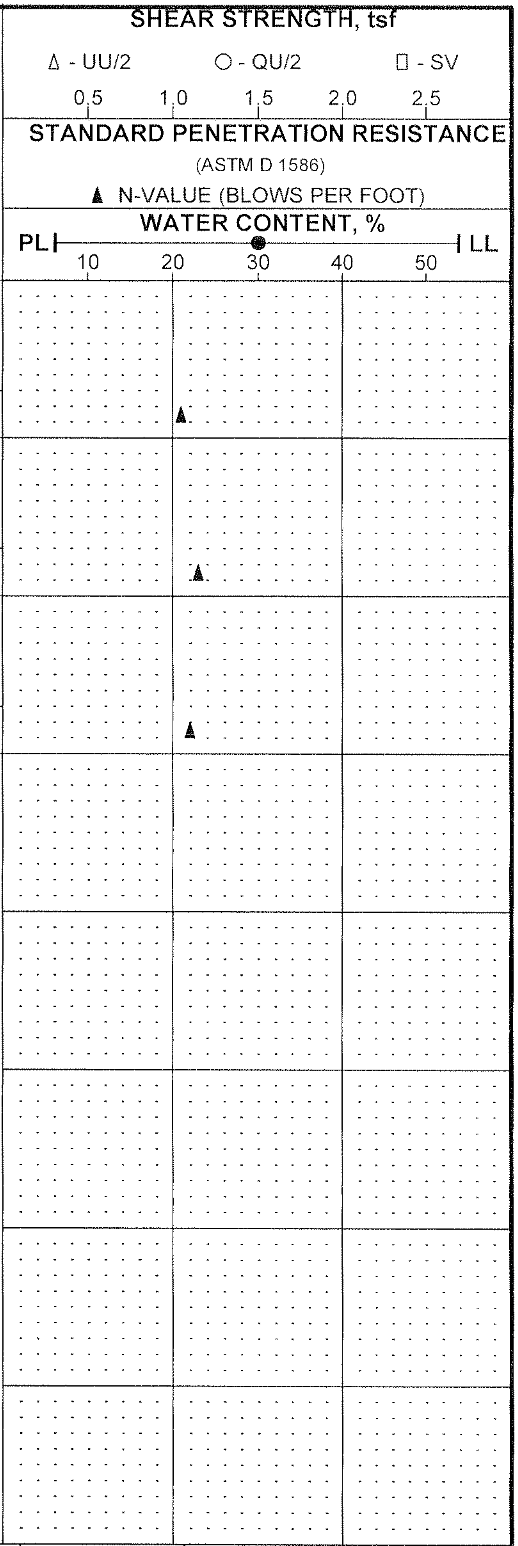
Project No. 1011304.91IG

Surface Elevation 311

Datum msl

Completion Date: 3/18/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Loose to medium dense, brown, fine to coarse SAND - SP *(continued)*			
			8-10-11	SS14
45				
			6-10-13	SS15
50				
			10-11-11	SS16
55	Boring terminated at 55 feet.			
60				
65				
70				
75				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 27.3 FEET AFTER 79 DAYS ▼

AT 31.2 FEET AFTER 104 DAYS ▼

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 20 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by:	App'vd. by: MHM
Date: 3/26/09	Date: 6/12/09	Date: 6/15/09

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
ST. LOUIS • COLLINSVILLE • KANSAS CITY

AECI New Madrid
Embankment Stability Evaluation

CONTINUATION OF
LOG OF BORING: P-4

Project No. 1011304.91IG

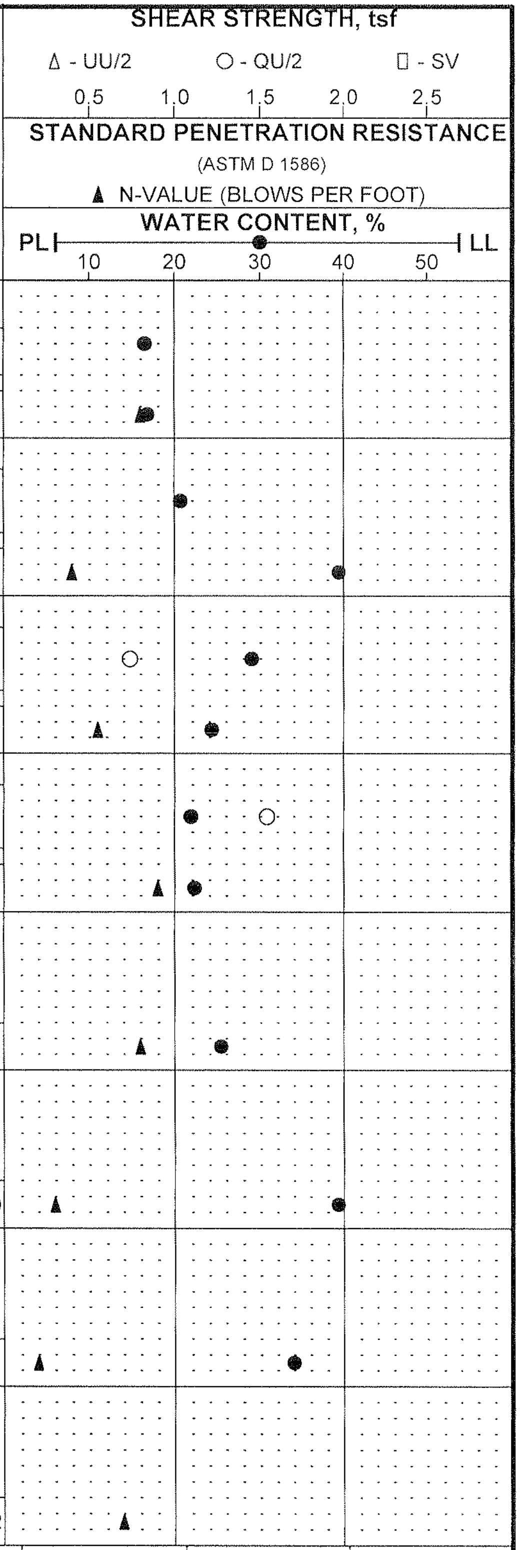
Surface Elevation 311

Datum msl

Completion Date: 3/23/09

DESCRIPTION OF MATERIAL

DEPTH IN FEET	DESCRIPTION OF MATERIAL	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Topsoil		
	FILL: brown, silty clay with gravel and sand		GB1
		5-8-8	SS2
5		106	ST3
	FILL: gray clay	2-3-5	SS4
10	FILL: brown and gray, silty clay	90	ST5
		4-5-6	SS6
15		100	ST7
		5-8-10	SS8
20	Very stiff to soft, brown and gray, silty CLAY - CL		
		6-8-8	SS9
25		3-3-3	SS10
30			
		2-2-2	SS11
35	Medium dense, occasionally dense, brown to gray SAND, trace silt - SP	5-6-8	SS12



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 31.8 FEET AFTER 74 DAYS ▼

AT 30.2 FEET AFTER 99 DAYS ▼

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 20 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by: SV	App'vd. by: MHM
Date: 3/29/09	Date: 6/12/09	Date: 6/15/09

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
ST. LOUIS • COLLINSVILLE • KANSAS CITY

AECI New Madrid
Embankment Stability Evaluation

LOG OF BORING: P-6

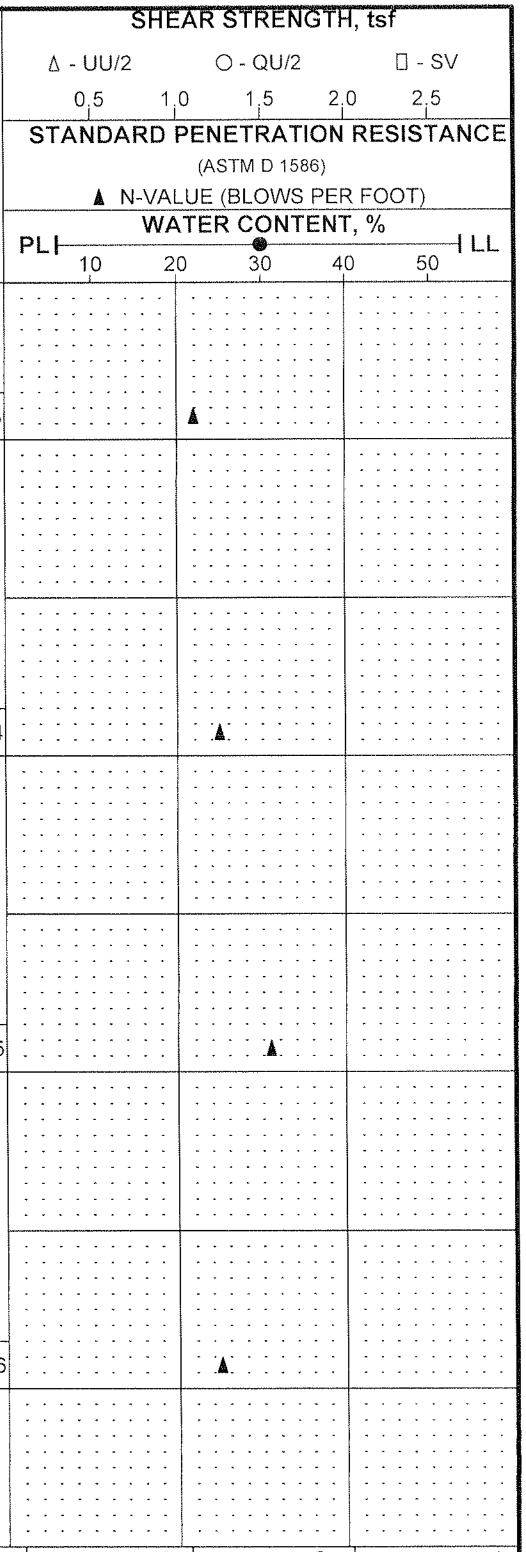
Project No. 1011304.91IG

Surface Elevation 311

Datum msl

Completion Date: 3/23/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium dense, occasionally dense, brown to gray SAND, trace silt - SP *(continued)*			
			11-11-11	SS13
45				
50				
			12-12-13	SS14
55				
60				
	3 percent passing #200 sieve		12-14-17	SS15
65				
70	Medium dense, gray, fine to coarse SAND - SP			
			8-9-16	SS16
75				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 31.8 FEET AFTER 74 DAYS ⊻

AT 30.2 FEET AFTER 99 DAYS ⊻

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 20 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by: SA	App'vd. by: MHM
Date: 3/29/09	Date: 6/12/09	Date: 6/15/09

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
ST. LOUIS • COLLINSVILLE • KANSAS CITY

AECI New Madrid
Embankment Stability Evaluation

CONTINUATION OF
LOG OF BORING: P-6

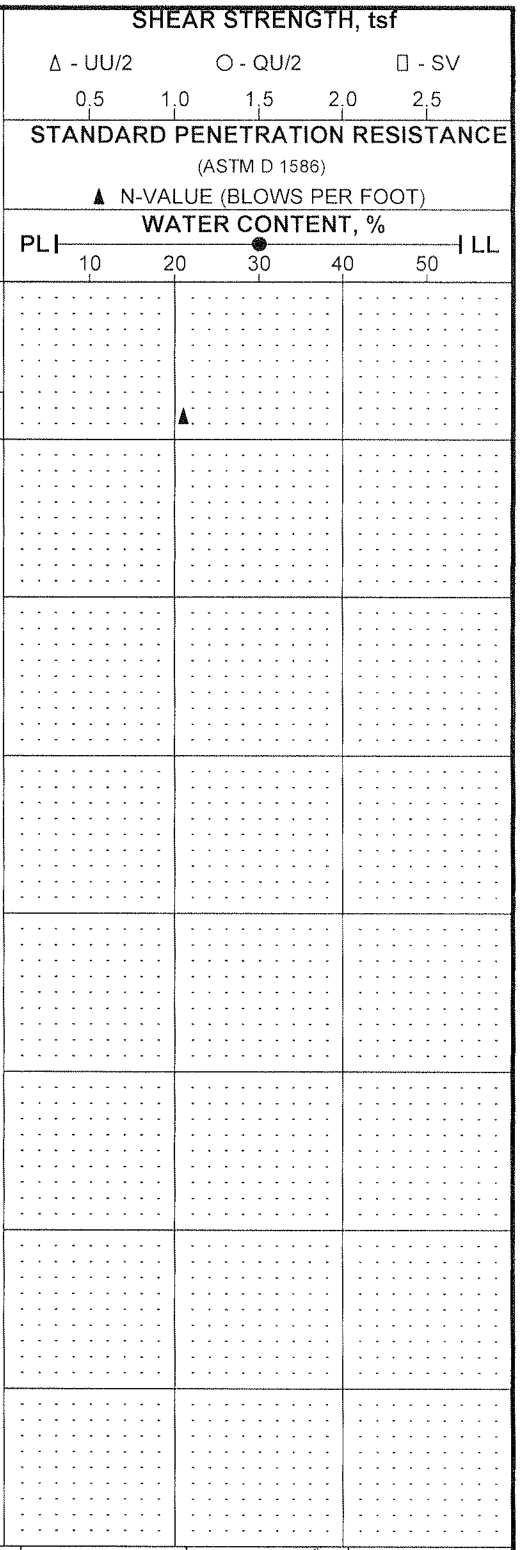
Project No. 1011304.91IG

Surface Elevation 311

Datum msl

Completion Date: 3/23/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Medium dense, gray, fine to coarse SAND - SP *(continued)*	▨	9-10-11	SS17
85	Boring terminated at 85 feet.			
90				
95				
100				
105				
110				
115				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 31.8 FEET AFTER 74 DAYS ▽

AT 30.2 FEET AFTER 99 DAYS ▼

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 20 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS:

Drawn by: KSA	Checked by: SG	App'vd. by: MHM
Date: 3/29/09	Date: 6/12/09	Date: 6/15/09

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
ST. LOUIS • COLLINSVILLE • KANSAS CITY

AECI New Madrid
Embankment Stability Evaluation

CONTINUATION OF
LOG OF BORING: P-6

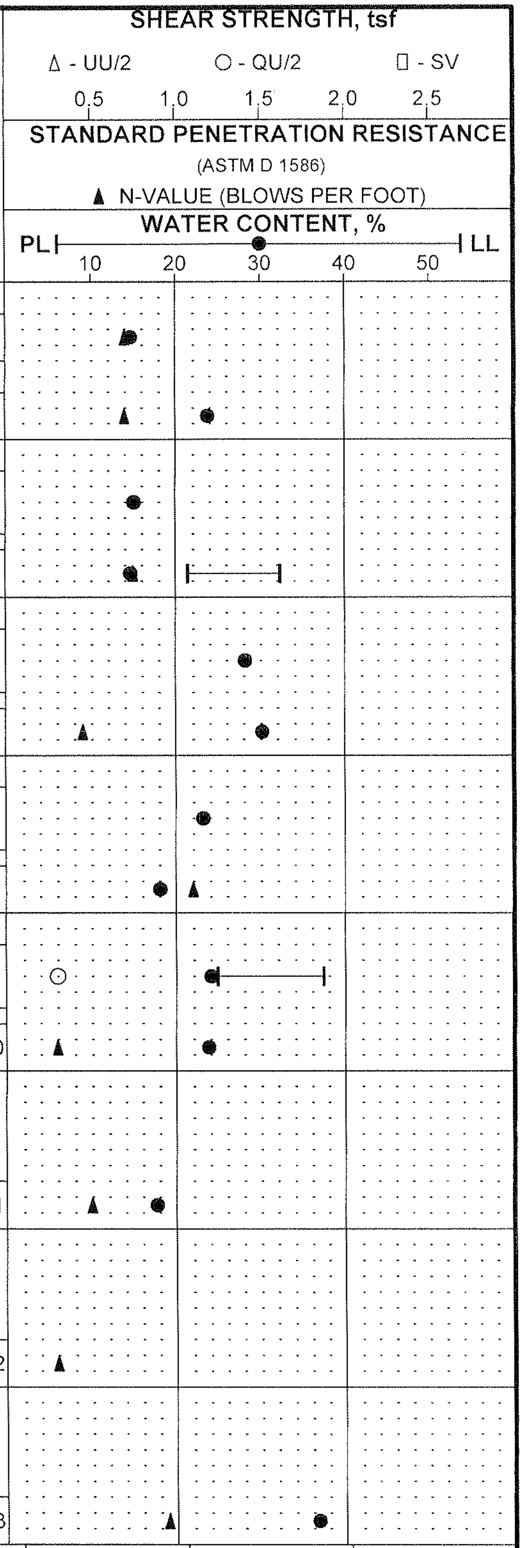
Project No. 1011304.91IG

Surface Elevation 308

Datum msl

Completion Date: 3/24/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Crushed rock road bed			
	FILL: brown, silty clay, trace sand and gravel		5-6-8	SS1
			4-5-9	SS2
5				
			*	ST3
			5-7-8	SS4
10				
			92	ST5
			3-4-5	SS6
15				
			97	ST7
	Very stiff, gray, silty CLAY - CL		6-11-11	SS8
20				
	Medium stiff, brown SILT - (ML)		86	ST9
	Stiff, brown, sandy SILT - ML		2-3-3	SS10
25				
			3-5-5	SS11
30				
	Loose, brown, silty SAND - SM		6-3-3	SS12
35				
	Very stiff, brown, sandy SILT - ML		6-9-10	SS13



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 30.6 FEET AFTER 73 DAYS ▽

AT 27.4 FEET AFTER 98 DAYS ▼

DRILLING DATA

___ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 30 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS: * Poor sample recovery.

Drawn by: KSA	Checked by: SA	App'vd. by: MHM
Date: 3/29/09	Date: 6/12/09	Date: 6/15/09

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
ST. LOUIS • COLLINSVILLE • KANSAS CITY

AECI New Madrid
Embankment Stability Evaluation

LOG OF BORING: P-7

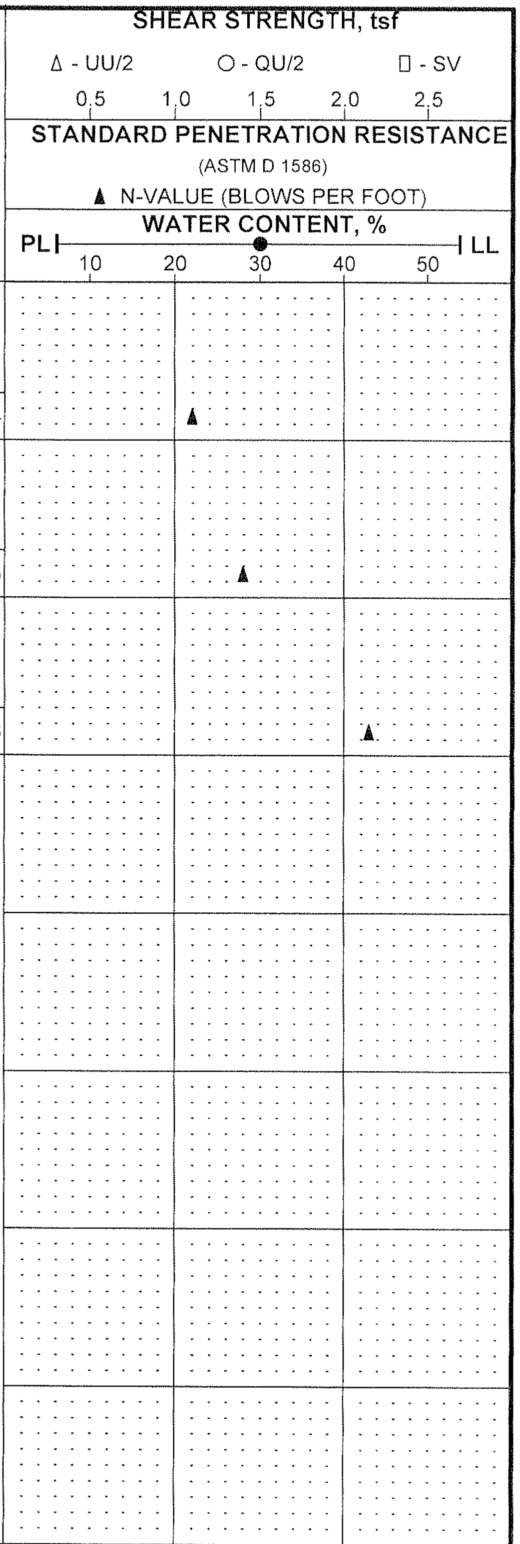
Project No. 1011304.91IG

Surface Elevation 308

Datum msl

Completion Date: 3/24/09

DEPTH IN FEET	DESCRIPTION OF MATERIAL	GRAPHIC LOG	DRY UNIT WEIGHT (pcf) SPT BLOW COUNTS CORE RECOVERY/RQD	SAMPLES
	Very stiff, brown, sandy SILT - ML *(continued)*			
	Medium dense to dense, brown and gray SAND - SP			
	6 percent passing #200 sieve		10-11-11	SS14
45				
			10-12-16	SS15
50				
			16-24-19	SS16
55	Boring terminated at 55 feet.			
60				
65				
70				
75				



NOTE: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. GRAPHIC LOG FOR ILLUSTRATION PURPOSES ONLY.

GROUNDWATER DATA

X FREE WATER NOT ENCOUNTERED DURING DRILLING

AT 30.6 FEET AFTER 73 DAYS ▼

AT 27.4 FEET AFTER 98 DAYS ▼

DRILLING DATA

__ AUGER 3 3/4" HOLLOW STEM

WASHBORING FROM 30 FEET

MB DRILLER RFW LOGGER

CME 550X DRILL RIG

HAMMER TYPE Auto

REMARKS: * Poor sample recovery.

Drawn by: KSA	Checked by: SN	App'vd. by: MHM
Date: 3/29/09	Date: 6/12/09	Date: 6/15/09

GEOTECHNOLOGY, INC.
ENGINEERING AND ENVIRONMENTAL SERVICES
ST. LOUIS • COLLINSVILLE • KANSAS CITY

AECI New Madrid
Embankment Stability Evaluation

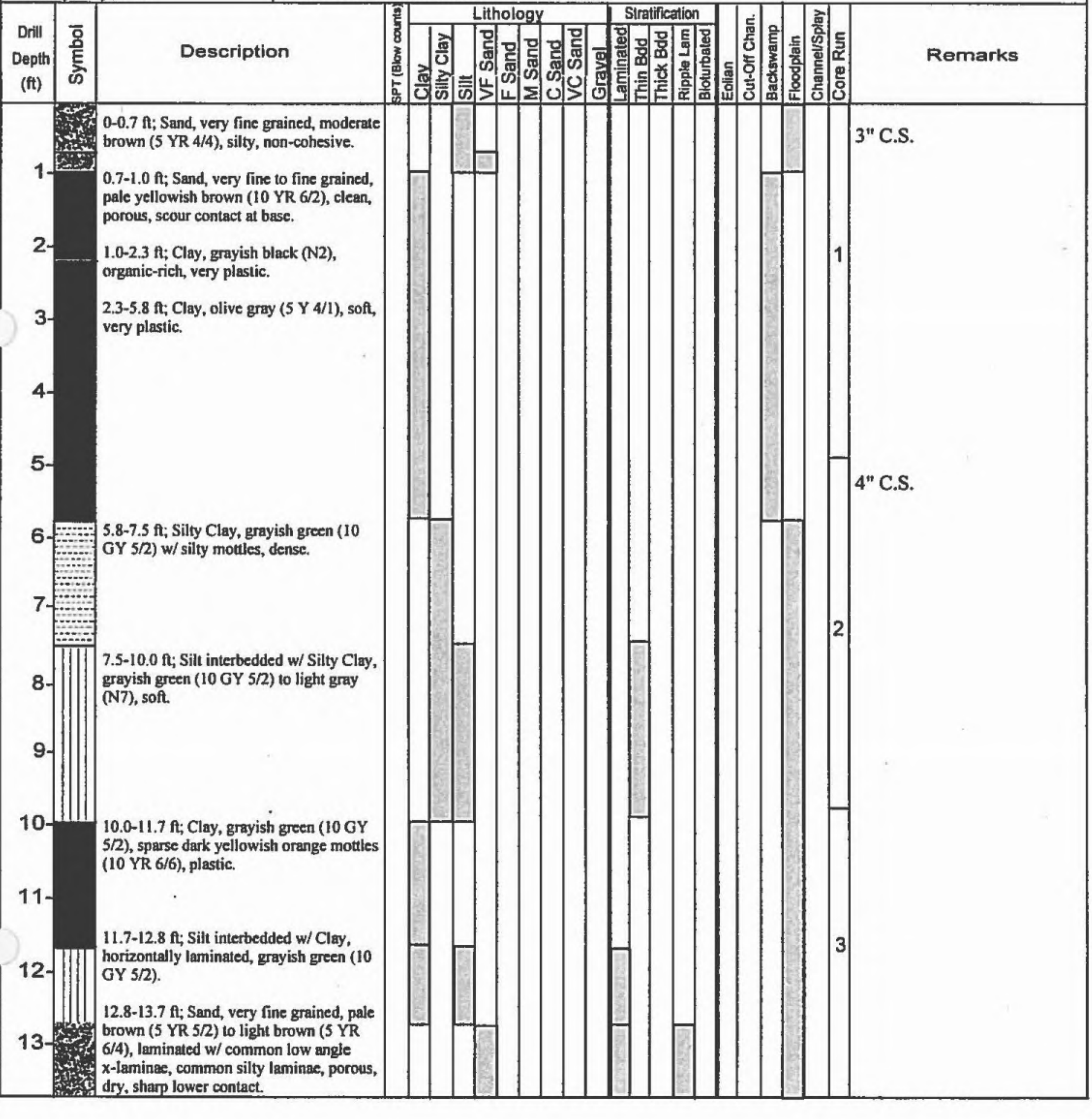
CONTINUATION OF
LOG OF BORING: P-7

Project No. 1011304.91IG

Boring Log

Page 1 of 3

Project: New Madrid DSI
Job No.: 1.21a
Boring I.D.: **B-2**
Boring Location: Outside Northern Limits of Anticipated Waste Disposal Area
Ground Surface Elev.: 288.73
Top Of Casing Elev.: 291.91
Boring Location Coordinates: 242467N/1088952E
Total Depth: 30'
Drilling Method(s): C.S./HSA
Hole Diameter: 8 1/4"
Overburden Footage: 30'
Bedrock Footage: N/A
No. Samples: 2
No. Core Boxes:
Depth To Water: 19'
Drilling Company: Max's Enterprises
Drill Rig: Mobile B-57
Drillers: Robert H.
Logged By: M.C. Carlson
Date/Time Started: 10/8/03; 16:35
Date/Time Completed: 10/8/03; 18:05
Type Of Sampler: Continuous to 22.3'; Grab to T.D.
Weather: Cloudy, dry, 70's
Remarks: Converted to Piezometer



Description

0-0.7 ft; Sand, very fine grained, moderate brown (5 YR 4/4), silty, non-cohesive.

0.7-1.0 ft; Sand, very fine to fine grained, pale yellowish brown (10 YR 6/2), clean, porous, scour contact at base.

1.0-2.3 ft; Clay, grayish black (N2), organic-rich, very plastic.

2.3-5.8 ft; Clay, olive gray (5 Y 4/1), soft, very plastic.

5.8-7.5 ft; Silty Clay, grayish green (10 GY 5/2) w/ silty mottles, dense.

7.5-10.0 ft; Silt interbedded w/ Silty Clay, grayish green (10 GY 5/2) to light gray (N7), soft.

10.0-11.7 ft; Clay, grayish green (10 GY 5/2), sparse dark yellowish orange mottles (10 YR 6/6), plastic.

11.7-12.8 ft; Silt interbedded w/ Clay, horizontally laminated, grayish green (10 GY 5/2).

12.8-13.7 ft; Sand, very fine grained, pale brown (5 YR 5/2) to light brown (5 YR 6/4), laminated w/ common low angle x-laminae, common silty laminae, porous, dry, sharp lower contact.

Remarks

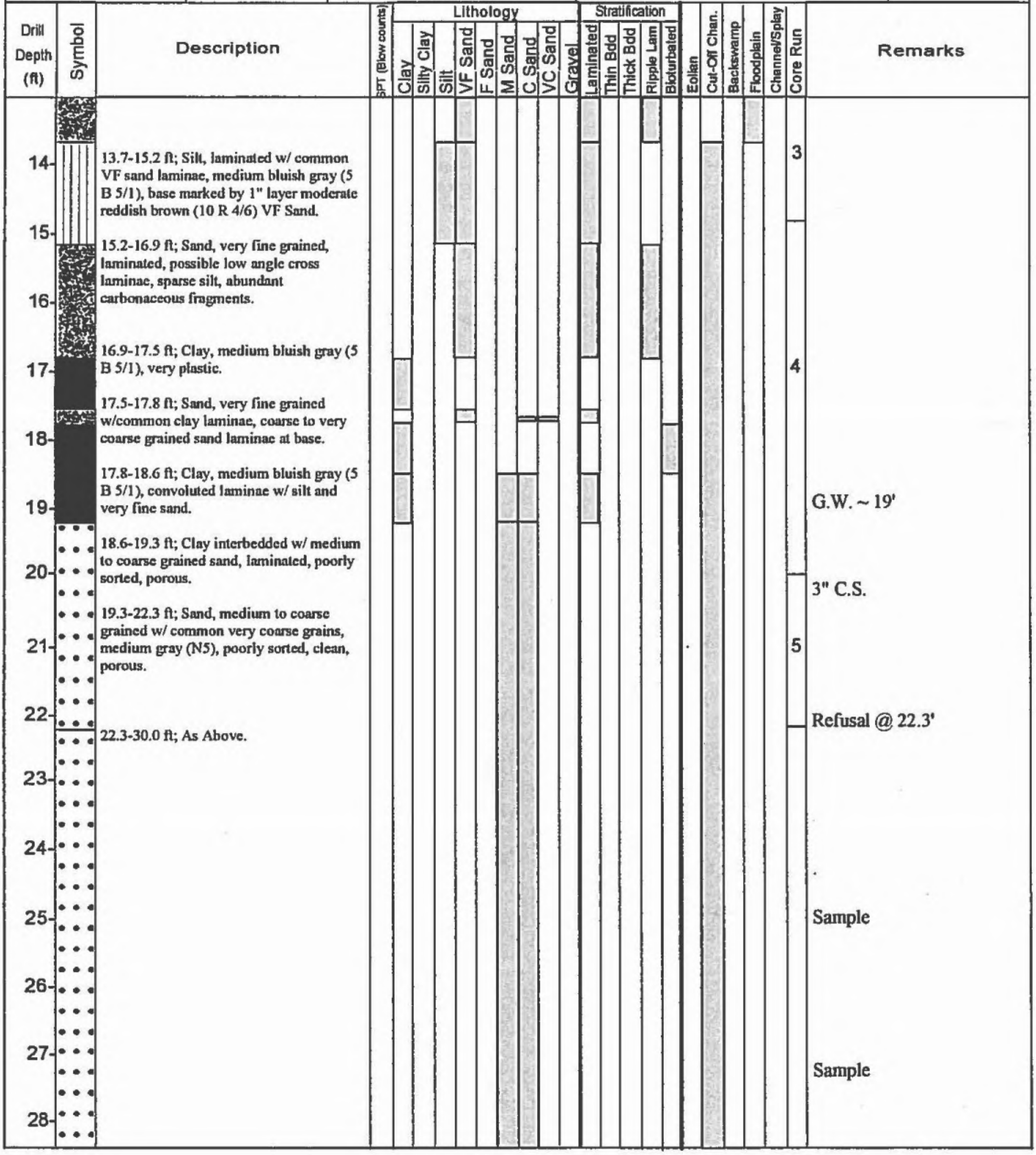
3" C.S.

4" C.S.

Boring Log

Page 2 of 3

Project New Madrid DSI		Job No. 1.21a	Boring I.D. B-2
Boring Location Outside Northern Limits of Anticipated Waste Disposal Area			
Ground Surface Elev. 288.73	Top Of Casing Elev. 291.91	Boring Location Coordinates 242467N/1088952E	Total Depth 30'



13.7-15.2 ft; Silt, laminated w/ common VF sand laminae, medium bluish gray (5 B 5/1), base marked by 1" layer moderate reddish brown (10 R 4/6) VF Sand.

15.2-16.9 ft; Sand, very fine grained, laminated, possible low angle cross laminae, sparse silt, abundant carbonaceous fragments.

16.9-17.5 ft; Clay, medium bluish gray (5 B 5/1), very plastic.

17.5-17.8 ft; Sand, very fine grained w/common clay laminae, coarse to very coarse grained sand laminae at base.

17.8-18.6 ft; Clay, medium bluish gray (5 B 5/1), convoluted laminae w/ silt and very fine sand.

18.6-19.3 ft; Clay interbedded w/ medium to coarse grained sand, laminated, poorly sorted, porous.

19.3-22.3 ft; Sand, medium to coarse grained w/ common very coarse grains, medium gray (N5), poorly sorted, clean, porous.

22.3-30.0 ft; As Above.

Remarks:

G.W. ~ 19'

3" C.S.

Refusal @ 22.3'

Sample

Sample

Boring Log

Page 3 of 3

Project: New Madrid DSI
Job No.: 1.21a
Boring I.D.: **B-2**
Boring Location: Outside Northern Limits of Anticipated Waste Disposal Area
Ground Surface Elev.: 288.73
Top Of Casing Elev.: 291.91
Boring Location Coordinates: 242467N/1088952E
Total Depth: 30'

Drill Depth (ft)	Symbol	Description	SPT (Blow counts)	Lithology									Stratification											Remarks
				Clay	Silty Clay	Silt	VF Sand	F Sand	M Sand	C Sand	VC Sand	Gravel	Laminated	Thin Bdd	Thick Bdd	Ripple Lam	Bioturbated	Eolian	Cut-Off Chan.	Backswamp	Floodplain	Channel/Splay	Core Run	
	• • •	22.3-30.0 ft; As Above.							▨	▨									▨					End of boring. Construct piezometer through interior of HSA's. Completed 10/8/03; 18:25 (see Construction Detail).
29	• • •								▨	▨									▨					
30		T.D.																						
31																								
32																								
33																								
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HALEY&
ALDRICH

BORING LOGS

Well No. B-5R

Project New Madrid Energy Center
Location Marston, MO
Client Associated Electric Cooperative, Inc.
Contractor Bulldog Drilling
Driller

Well Diagram

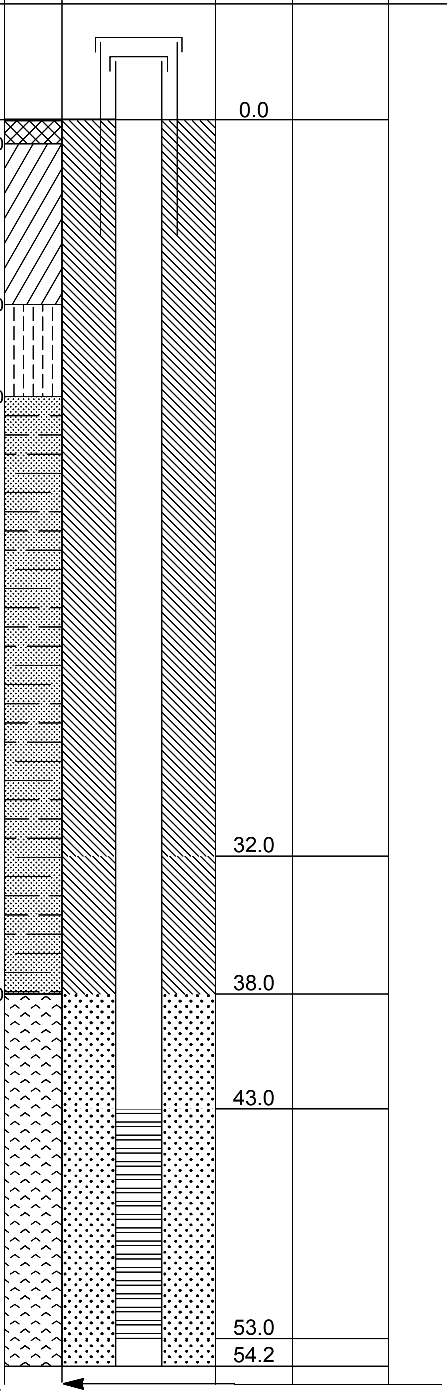
▥	Riser Pipe
▤	Screen
░	Filter Sand
▒	Cuttings
■	Grout
⁘	Concrete
▧	Bentonite Seal

File No. 128064-001
Date Installed 21 Jun 2017
H&A Rep. P. Kroger
Location See Plan

Ground El.
Datum NGVD

SOIL/ROCK

CONDITIONS	DEPTH (ft.)
OL Organic silt and sand.	1.0
CL Sandy lean clay.	8.0
SM Silty sand.	12.0
SP Poorly graded sand.	38.0
SW Well graded sand.	54.2



WELL CONSTRUCTION DETAILS

Type of protective cover LOCKING CAP

Height of Guard Pipe above ground surface 0.3 ft

Height of top of riser above ground surface 0.3 ft

Type of protective casing Guard Pipe

Length 55.7 ft

Inside diameter 2 inch

Depth of bottom of Guard Pipe 55.4 ft

Type of riser pipe Schedule 40 PVC

Inside diameter of riser pipe 2 inch

Depth of bottom of riser pipe 43.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Bentonite Grout	0.0 ft	32.0 ft
Bentonite	32.0 ft	5.0 ft
	-	-

Diameter of borehole 8.25 inch

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 inch

Type of Backfill around Screen No. 12-20 silica sand

Depth to bottom of well screen 53 ft

Bottom of silt trap NA

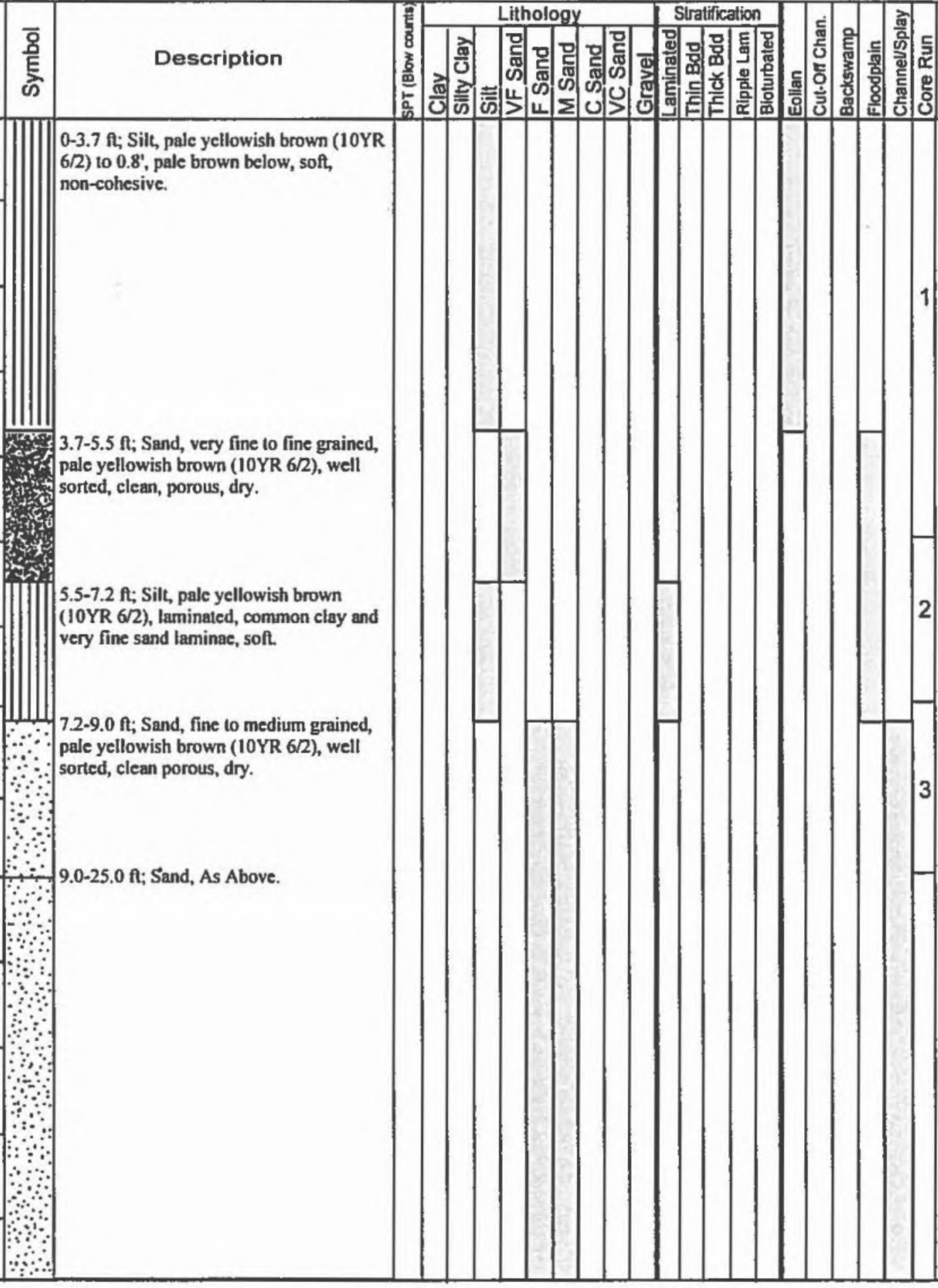
Depth of bottom of borehole 54.2 ft

Boring Log

Page 1 of 3

Project New Madrid DSI		Job No. 1.21a			Boring I.D. B-41
Boring Location Eastern Limits of Anticipated Waste Disposal Area					
Ground Surface Elev. 291.37	Top Of Casing Elev. 294.58	Boring Location Coordinates 240998N/1087771E		Total Depth 30'	
Drilling Method(s) C.S./HSA	Hole Diameter 8 1/4"	Overburden Footage 30'	Bedrock Footage N/A	No. Samples 4	No. Core Boxes	Depth To Water 22'
Drilling Company Max's Enterprises		Drill Rig Mobile B-57		Drillers Robert H.	
Logged By M.C. Carlson	Date/Time Started 10/07/03; 16:35	Date/Time Completed 10/07/03; 18:40		Type Of Sampler Continuous to 9.0'; Grab to T.D.	
Weather Sunny, dry, 80's	Remarks Converted to Piezometer				

Drill Depth (ft)	Description	Core Run	Remarks
0	0-3.7 ft; Silt, pale yellowish brown (10YR 6/2) to 0.8', pale brown below, soft, non-cohesive.		3" C.S.
2		1	
3.7	3.7-5.5 ft; Sand, very fine to fine grained, pale yellowish brown (10YR 6/2), well sorted, clean, porous, dry.		
5			4" C.S.
5.5	5.5-7.2 ft; Silt, pale yellowish brown (10YR 6/2), laminated, common clay and very fine sand laminae, soft.	2	
7			3" C.S.
7.2	7.2-9.0 ft; Sand, fine to medium grained, pale yellowish brown (10YR 6/2), well sorted, clean porous, dry.	3	
9	9.0-25.0 ft; Sand, As Above.		Refusal @ 9.0'
12.5			Sample



Boring Log

Page 2 of 3

Project New Madrid DSI	Job No. 1.21a		Boring I.D. B-41
Boring Location Eastern Limits of Anticipated Waste Disposal Area			
Ground Surface Elev. 291.37	Top Of Casing Elev. 294.58	Boring Location Coordinates 240998N/1087771E	Total Depth 30'

Drill Depth (ft)	Symbol	Description	SPT (Blow counts)	Lithology									Stratification											Remarks
				Clay	Silty Clay	Silt	VF Sand	F Sand	M Sand	C Sand	VC Sand	Gravel	Laminated	Thin Bdd	Thick Bdd	Ripple Lam	Bioturbated	Eolian	Cut-Off Chan.	Backswamp	Floodplain	Channel/Splay	Core Run	
	░	9.0-25.0 ft; Sand, As Above.						▨	▨													▨		
14	░							▨	▨													▨		
15	░							▨	▨													▨		
16	░							▨	▨													▨		
17	░							▨	▨													▨		Sample
18	░							▨	▨													▨		
19	░							▨	▨													▨		
20	░							▨	▨													▨		
21	░							▨	▨													▨		
22	░							▨	▨													▨		G.W. ~ 22' Sample
23	░							▨	▨													▨		
24	░							▨	▨													▨		
25	☰	25.0-30.0 ft; Silt, dark gray (N3), common clay, laminated.		▨		▨							▨						▨					
26	☰			▨		▨							▨						▨					
27	☰			▨		▨							▨						▨					Sample
28	☰			▨		▨							▨						▨					

Boring Log

Page 3 of 3

Project New Madrid DSI		Job No. 1.21a		Boring I.D. B-41
Boring Location Eastern Limits of Anticipated Waste Disposal Area				
Ground Surface Elev. 291.37	Top Of Casing Elev. 294.58	Boring Location Coordinates 240998N/1087771E	Total Depth 30'	

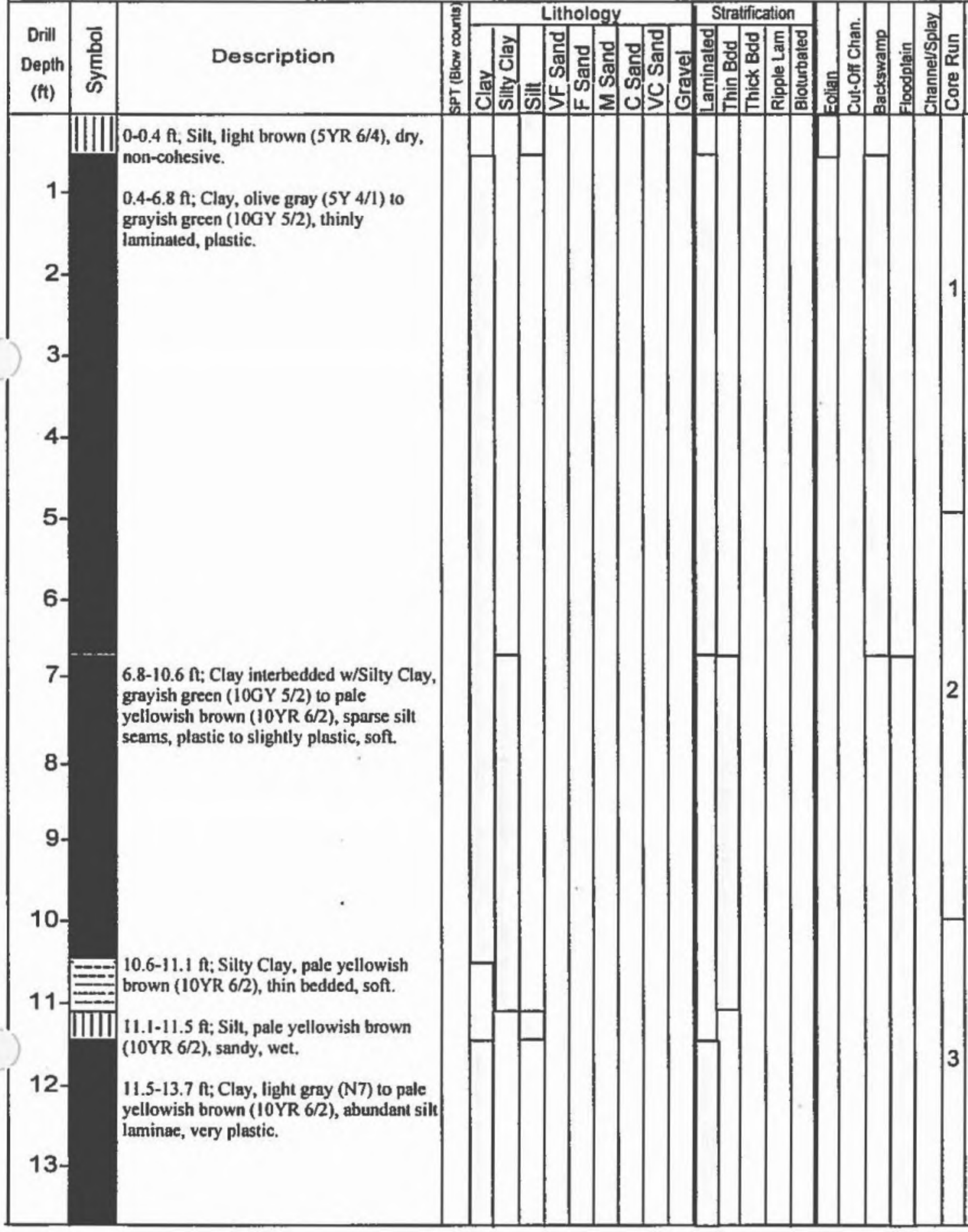
Drill Depth (ft)	Symbol	Description	SPT (Blow counts)	Lithology Clay	Silty Clay	Silt	VF Sand	F Sand	M Sand	C Sand	VC Sand	Gravel	Stratification Laminated	Thin Bdd	Thick Bdd	Ripple Lam	Bioturbated	Eolian	Cut-Off Chan.	Backswamp	Floodplain	Channel/Splay	Core Run	Remarks
	▤	25.0-30.0 ft; Silt, dark gray (N3), common clay, laminated.		▨		▨							▨						▨					
29	▤			▨		▨							▨						▨					
30		T.D.																						End of boring. Construct piezometer through interior of HSA's. Completed 10/7/03; 18:40 (see Construction Detail).
31																								
32																								
33																								
34																								
35																								
36																								
37																								
38																								
39																								
40																								
41																								
42																								
43																								

Boring Log

Page 1 of 3

Project: New Madrid DSI
Job No.: 1.21a
Boring I.D.: B-123
Boring Location: Outside Southern Margin of Anticipated Waste Disposal Limits
Ground Surface Elev: 290.12
Top Of Casing Elev: 292.70
Boring Location Coordinates: 238222N/1088665E
Total Depth: 30'
Drilling Method(s): C.S./HSA
Hole Diameter: 8 1/4"
Overburden Footage: 30'
Bedrock Footage: N/A
No. Samples: 2
No. Core Boxes:
Depth To Water: 18'
Drilling Company: Max's Enterprises
Drill Rig: Mobile B-57
Drillers: Robert H.
Logged By: M.C. Carlson
Date/Time Started: 10/7/03; 7:05
Date/Time Completed: 10/7/03; 9:40
Type Of Sampler: Continuous to 23.9'; Grab to T.D.
Weather: Sunny, dry, 70's
Remarks: Converted to Piezometer

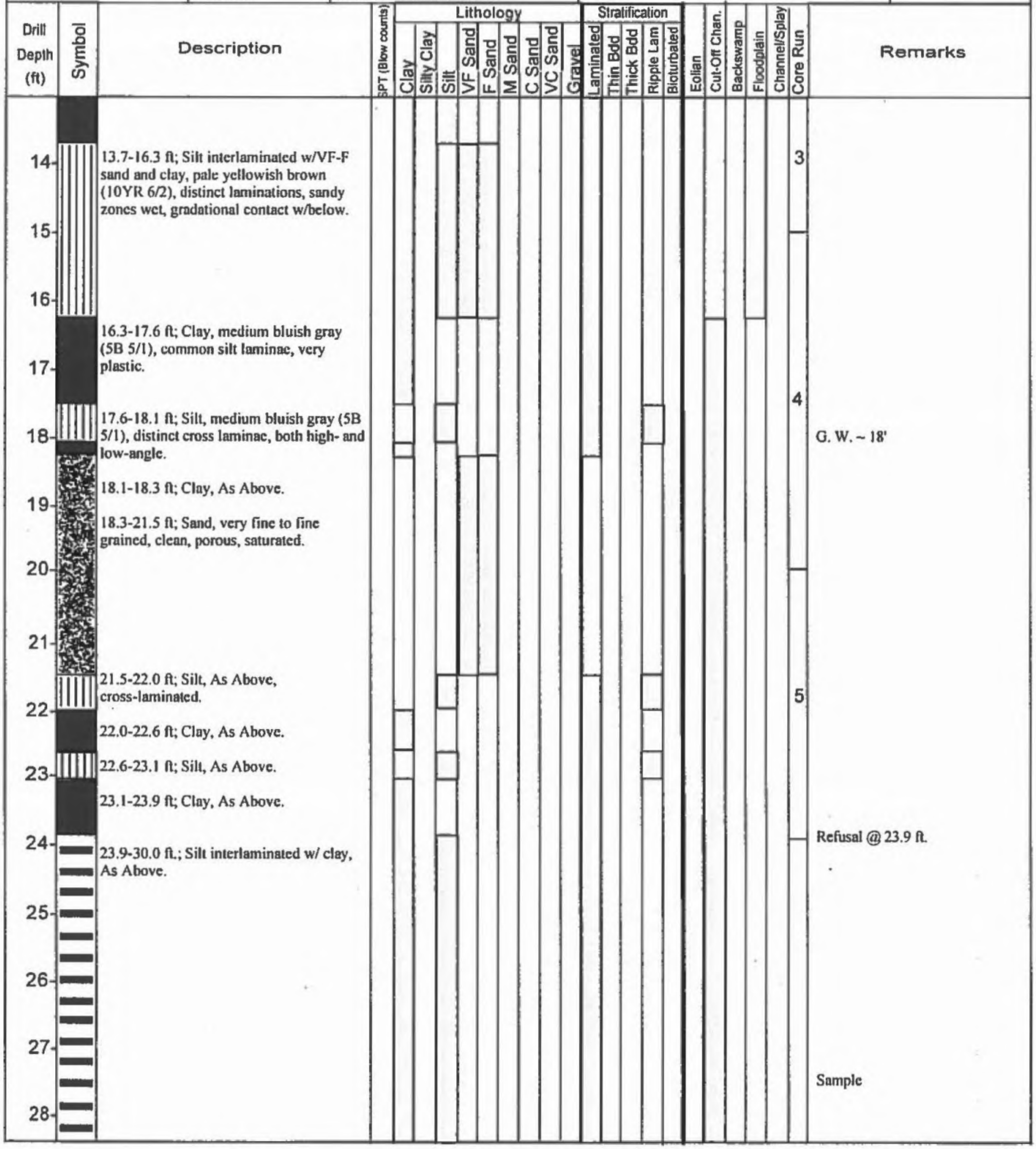
Drill Depth (ft)	Description	Core Run	Remarks
0	0-0.4 ft, Silt, light brown (5YR 6/4), dry, non-cohesive.		3" C. S.
0.4	0.4-6.8 ft; Clay, olive gray (5Y 4/1) to grayish green (10GY 5/2), thinly laminated, plastic.	1	
5			4" C. S.
6.8	6.8-10.6 ft; Clay interbedded w/Silty Clay, grayish green (10GY 5/2) to pale yellowish brown (10YR 6/2), sparse silt seams, plastic to slightly plastic, soft.	2	
10.6	10.6-11.1 ft; Silty Clay, pale yellowish brown (10YR 6/2), thin bedded, soft.	3	
11.1	11.1-11.5 ft; Silt, pale yellowish brown (10YR 6/2), sandy, wet.		Perched water zone.
11.5	11.5-13.7 ft; Clay, light gray (N7) to pale yellowish brown (10YR 6/2), abundant silt laminae, very plastic.		



Boring Log

Page 2 of 3

Project New Madrid DSI	Job No. 1.21a		Boring I.D. B-123
Boring Location Outside Southern Margin of Anticipated Waste Disposal Limits			
Ground Surface Elev 290.12	Top Of Casing Elev 292.70	Boring Location Coordinates 238222N/1088665E	Total Depth 30'



13.7-16.3 ft; Silt interlaminated w/VF-F sand and clay, pale yellowish brown (10YR 6/2), distinct laminations, sandy zones wet, gradational contact w/below.

16.3-17.6 ft; Clay, medium bluish gray (5B 5/1), common silt laminae, very plastic.

17.6-18.1 ft; Silt, medium bluish gray (5B 5/1), distinct cross laminae, both high- and low-angle.

18.1-18.3 ft; Clay, As Above.

18.3-21.5 ft; Sand, very fine to fine grained, clean, porous, saturated.

21.5-22.0 ft; Silt, As Above, cross-laminated.

22.0-22.6 ft; Clay, As Above.

22.6-23.1 ft; Silt, As Above.

23.1-23.9 ft; Clay, As Above.

23.9-30.0 ft.; Silt interlaminated w/ clay, As Above.

G. W. ~ 18'

Refusal @ 23.9 ft.

Sample

Boring Log

Project	Job No.	Boring I.D.
New Madrid DSI	1.21a	B-123

Boring Location: Outside Southern Margin of Anticipated Waste Disposal Limits

Ground Surface Elev.	Top Of Casing Elev.	Boring Location Coordinates	Total Depth
290.12	292.70	238222N/1088665E	30'

Drill Depth (ft)	Symbol	Description	SPT (Blow counts)	Lithology										Stratification					Eolian	Cut-Off Chan.	Backswamp	Floodplain	Channel/Splay	Core Run	Remarks
				Clay	Silty Clay	Silt	VF Sand	F Sand	M Sand	C Sand	VC Sand	Gravel		Laminated	Thin Bdd	Thick Bdd	Ripple Lam	Bioturbated							
	▬	23.9-30.0 ft.; Silt interlaminated w/ clay, As Above.		▮		▮								▮						▮					Sample
29	▬			▮		▮								▮						▮					
30		T. D.																							End of boring. Construct piezometer through interior of HSA's. Completed 10/7/03; 10:15 (see Construction Detail Detail).
31																									
32																									
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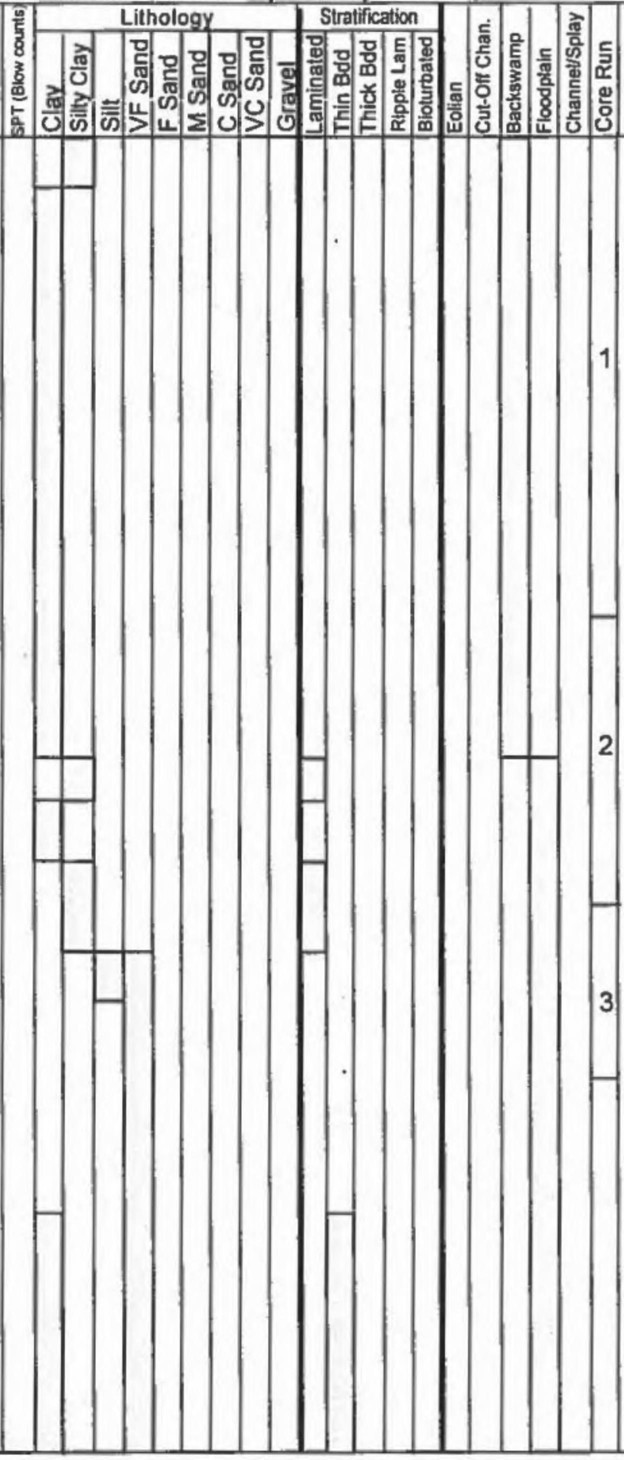
43																									

Boring Log

Project: New Madrid DSI
Job No.: 1.21a
Boring I.D.: B-126
Boring Location: Outside Southeastern Limits of Anticipated Waste Disposal Area: in cornfield
Ground Surface Elev.: 290.68
Top Of Casing Elev.: 293.63
Boring Location Coordinates: 238590N/1090633E
Total Depth: 30'
Drilling Method(s): C.S./HSA
Hole Diameter: 8 1/4"
Overburden Footage: 30'
Bedrock Footage: N/A
No. Samples: 4
No. Core Boxes:
Depth To Water: 18'
Drilling Company: Max's Enterprises
Drill Rig: Mobile B-57
Drillers: D.H.
Logged By: M.C. Carlson
Date/Time Started: 10/22/03; 15:30
Date/Time Completed: 10/22/03; 16:30
Type Of Sampler: Continuous to 9.9'; Grab to T.D.
Weather: Sunny, dry, 60's
Remarks: Converted to Piezometer (Add on requested by GSRAD)

Drill Depth (ft)	Description	Core Run	Remarks
0	0-0.5 ft; Silty Clay, moderate brown (5YR 4/4), slightly plastic.		4" C.S.
1	0.5-6.6 ft; Clay, grayish green (10GY 5/2) w/ dark yellowish orange overtones, plastic, stiff.		
2		1	
5			
6	6.6-7.0 ft; Silty Clay, pale yellowish brown (10YR 6/2), faint silty laminae, stiff.	2	
7	7.0-7.6 ft; Clay, grayish green (10GY 5/2), plastic, stiff.		
8	7.6-8.5 ft; Silty Clay, As Above.		3" C.S.
9	8.5-9.9 ft; Sand, very fine grained, pale yellowish brown (10YR 6/2), clean, porous, dry, silty upper 0.5'.	3	
10	9.9-11.3 ft; Sand, As Above.		Refusal @ 9.9 ft.
11	11.3-15.0 ft; Sand, very fine grained, clayey.		
12			Sample
13			



Boring Log

Page 2 of 2

Project: New Madrid DSI

Job No.: 1.21a

Boring I.D.: B-126

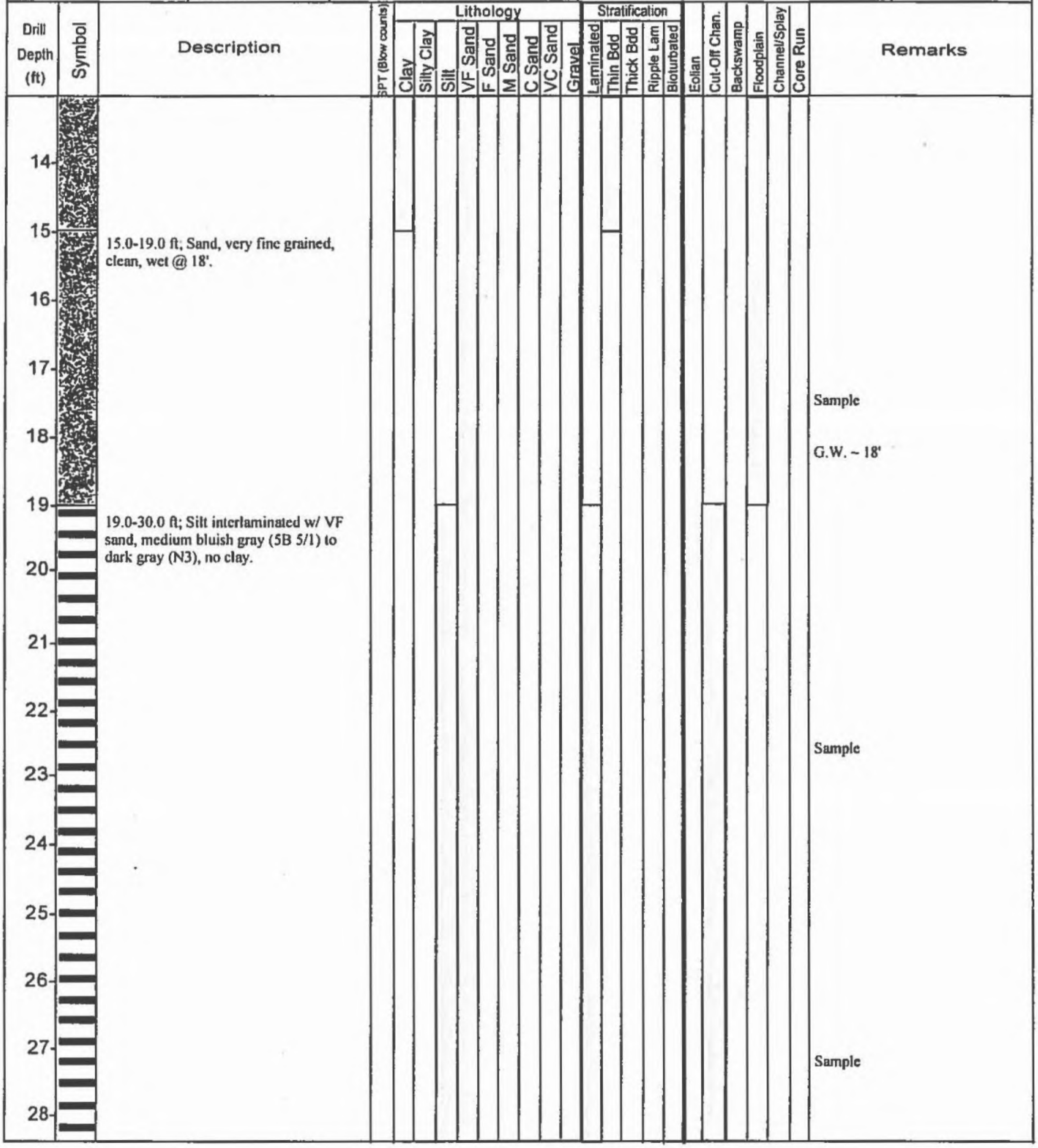
Boring Location: Outside Southeastern Limits of Anticipated Waste Disposal Area: in cornfield

Ground Surface Elev: 290.68

Top Of Casing Elev: 293.63

Boring Location Coordinates: 238590N/1090633E

Total Depth: 30'



15.0-19.0 ft; Sand, very fine grained, clean, wet @ 18'.

19.0-30.0 ft; Silt interlaminated w/ VF sand, medium bluish gray (5B 5/1) to dark gray (N3), no clay.

Sample

G.W. ~ 18'

Sample

Sample

Boring Log

Project	Job No.	Boring I.D.
New Madrid DSI	1.21a	B-126

Boring Location: Outside Southeastern Limits of Anticipated Waste Disposal Area: in cornfield

Ground Surface Elev	Top Of Casing Elev.	Boring Location Coordinates	Total Depth
290.68	293.63	238590N/1090633E	30'

Drill Depth (ft)	Symbol	Description	SPT (Blow counts)	Lithology									Stratification					Eolian	Cut-Off Chan.	Backswamp	Floodplain	Channel/Splay	Core Run	Remarks
				Clay	Silty Clay	Silt	VF Sand	F Sand	M Sand	C Sand	VC Sand	Gravel	Laminated	Thin Bdd	Thick Bdd	Ripple Lam	Bioturbated							
29	▬	19.0-30.0 ft; Silt interlaminated w/ VF sand, medium bluish gray (5B 5/1) to dark gray (N3), no clay.				✓	✓						✓						✓					
30		T.D.																						End of boring. Construct piezometer through interior of HSA's. Completed 10/22/03; 17:27 (see Construction Detail).
31																								
32																								
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HALEY& ALDRICH

BORING LOGS

Well No. MW-1

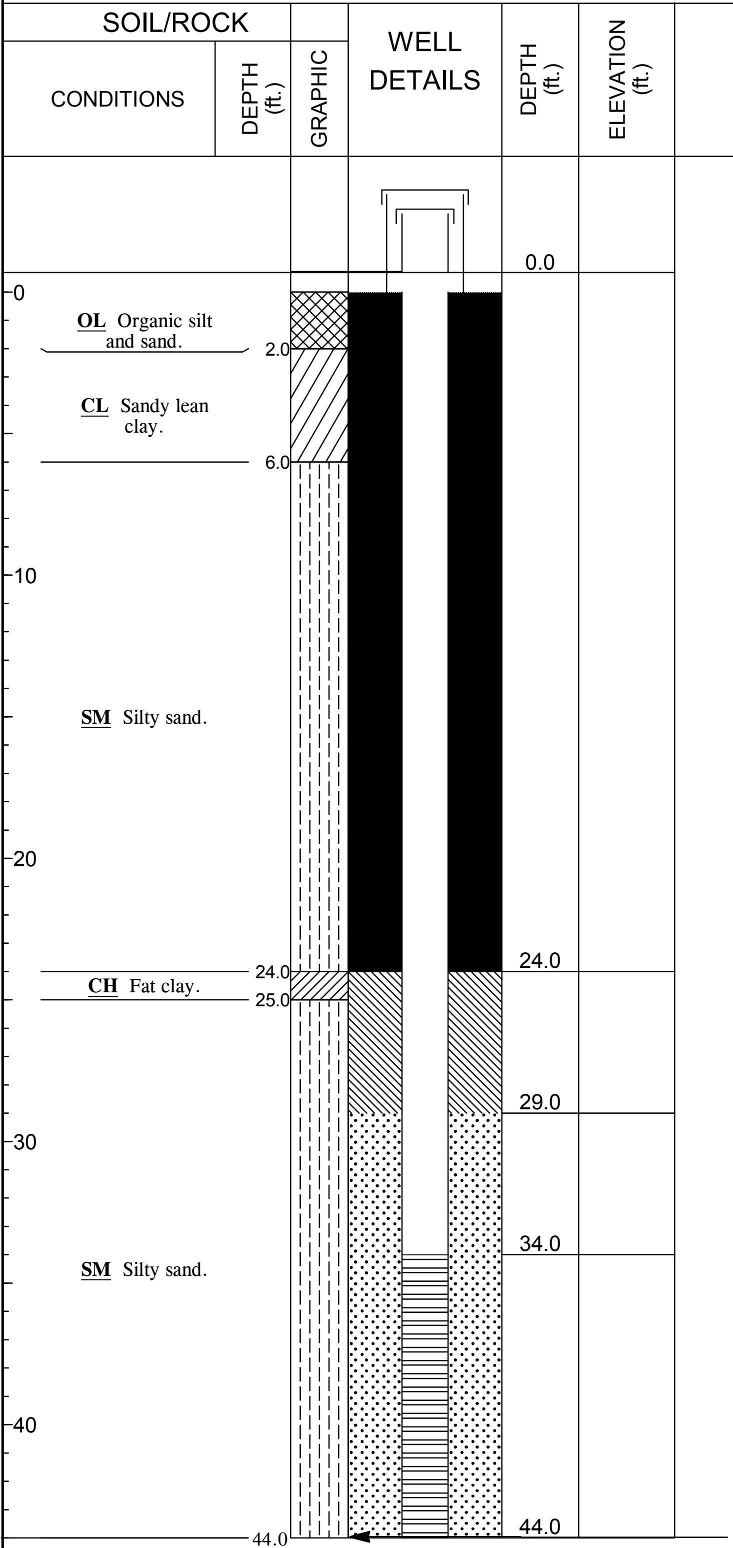
Project New Madrid Energy Center
Location Marston, MO
Client Associated Electric Cooperative, Inc.
Contractor Bulldog Drilling
Driller

Well Diagram

◫	Riser Pipe
☰	Screen
░	Filter Sand
▓	Cuttings
■	Grout
⁘	Concrete
▧	Bentonite Seal

File No. 128064-001
Date Installed 19 Sep 2016
H&A Rep. C. Price
Location See Plan

Ground El.
Datum NGVD



WELL CONSTRUCTION DETAILS

Type of protective cover LOCKING CAP

Height of Guard Pipe above ground surface 2.8 ft

Height of top of riser above ground surface 2.0 ft

Type of protective casing Guard Pipe

Length 34.0 ft

Inside diameter 2 inch

Depth of bottom of Guard Pipe 31.2 ft

Type of riser pipe Schedule 40 PVC

Inside diameter of riser pipe 2 inch

Depth of bottom of riser pipe 34.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	0.0 ft	29.0 ft
Bentonite	29.0 ft	5.0 ft
	-	-

Diameter of borehole 8 inch

Depth to top of well screen 34.0 ft

Type of screen Machine slotted Sch 40 PVC

Screen gauge or size of openings 0.010 in.

Diameter of screen 2 inch

Type of Backfill around Screen No. 12-20 silica sand

Depth to bottom of well screen 44 ft

Bottom of silt trap NA

Depth of bottom of borehole 44.0 ft

HALEY&
ALDRICH

BORING LOGS

Well No. MW-2

Project New Madrid Energy Center
Location Marston, MO
Client Associated Electric Cooperative, Inc.
Contractor Bulldog Drilling
Driller

Well Diagram

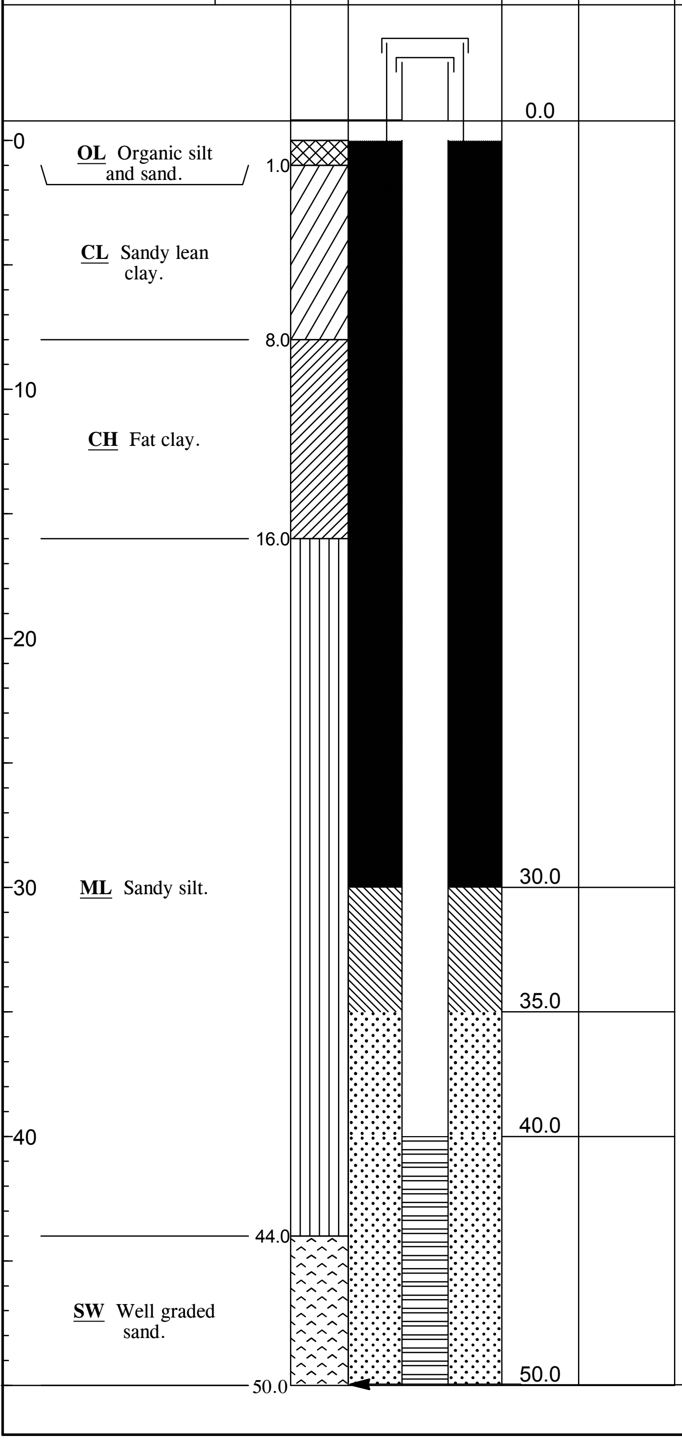
▥	Riser Pipe
▤	Screen
▒	Filter Sand
▩	Cuttings
■	Grout
▦	Concrete
▨	Bentonite Seal

File No. 128064-001
Date Installed 20 Sep 2016
H&A Rep. C. Price
Location See Plan

Ground El.
Datum NGVD

SOIL/ROCK

CONDITIONS	DEPTH (ft.)
OL Organic silt and sand.	1.0
CL Sandy lean clay.	8.0
CH Fat clay.	16.0
ML Sandy silt.	44.0
SW Well graded sand.	50.0



WELL CONSTRUCTION DETAILS

Type of protective cover LOCKING CAP

Height of Guard Pipe above ground surface 2.3 ft

Height of top of riser above ground surface 2.0 ft

Type of protective casing Guard Pipe

Length 40.0 ft

Inside diameter 2 inch

Depth of bottom of Guard Pipe 37.7 ft

Type of riser pipe Schedule 40 PVC

Inside diameter of riser pipe 2 inch

Depth of bottom of riser pipe 40.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	0.0 ft	30.0 ft
Bentonite	30.0 ft	5.0 ft
	-	-

Diameter of borehole 8 inch

Depth to top of well screen 40.0 ft

Type of screen Machine slotted Sch 40 PVC

Screen gauge or size of openings 0.010 in.

Diameter of screen 2 inch

Type of Backfill around Screen No. 12-20 silica sand

Depth to bottom of well screen 50 ft

Bottom of silt trap NA

Depth of bottom of borehole 50.0 ft

MONITORING WELL HA-LIB07-1-BOS1.GLB HA-TB+CORE+WELL-07-1.GDT G:\PROJECTS\AEC\NEW MADRID\PROJECT DATA\GINT\NEWMADRID_LOGS_103116_RM.GPJ Nov 8, 16

HALEY & ALDRICH

BORING LOGS

Well No. MW-3

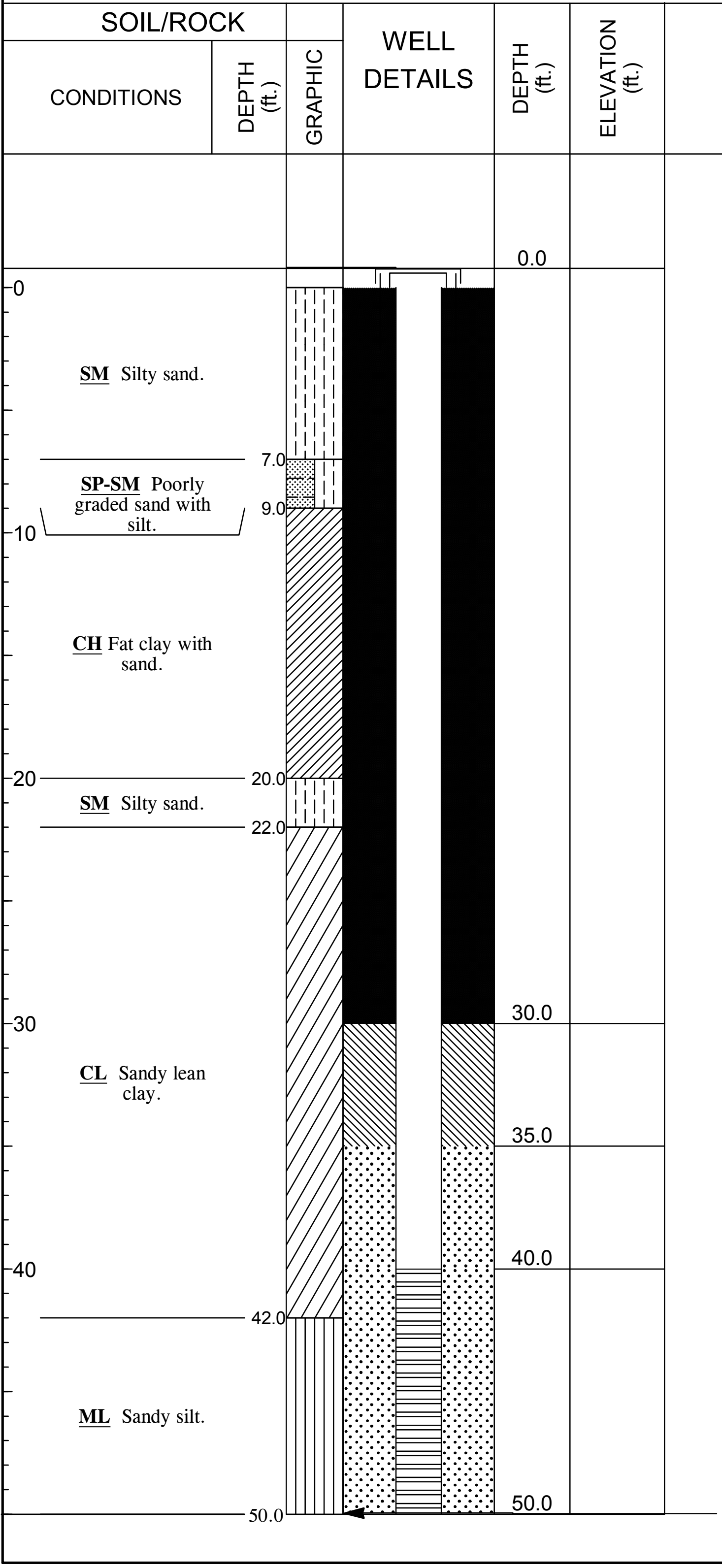
Project New Madrid Energy Center
Location Marston, MO
Client Associated Electric Cooperative, Inc.
Contractor Bulldog Drilling
Driller

Well Diagram

◫	Riser Pipe
▤	Screen
░	Filter Sand
▩	Cuttings
■	Grout
⁘	Concrete
▧	Bentonite Seal

File No. 128064-001
Date Installed 21 Sep 2016
H&A Rep. C. Price
Location See Plan

Ground El.
Datum NGVD



WELL CONSTRUCTION DETAILS

Type of protective cover LOCKING CAP

Depth of Roadway Box below ground surface 0.1 ft

Height of top of riser above ground surface 2.0 ft

Type of protective casing Flush

Length 40.0 ft

Inside diameter 2 inch

Depth of bottom of Roadway Box 40.1 ft

Type of riser pipe Schedule 40 PVC

Inside diameter of riser pipe 2 inch

Depth of bottom of riser pipe 40.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	0.0 ft	30.0 ft
Bentonite	30.0 ft	5.0 ft
	-	-

Diameter of borehole 8 inch

Depth to top of well screen 40.0 ft

Type of screen Machine slotted Sch 40 PVC

Screen gauge or size of openings 0.010 in.

Diameter of screen 2 inch

Type of Backfill around Screen No. 12-20 silica sand

Depth to bottom of well screen 50 ft

Bottom of silt trap NA

Depth of bottom of borehole 50.0 ft

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BORING LOGS

Well No. MW-4

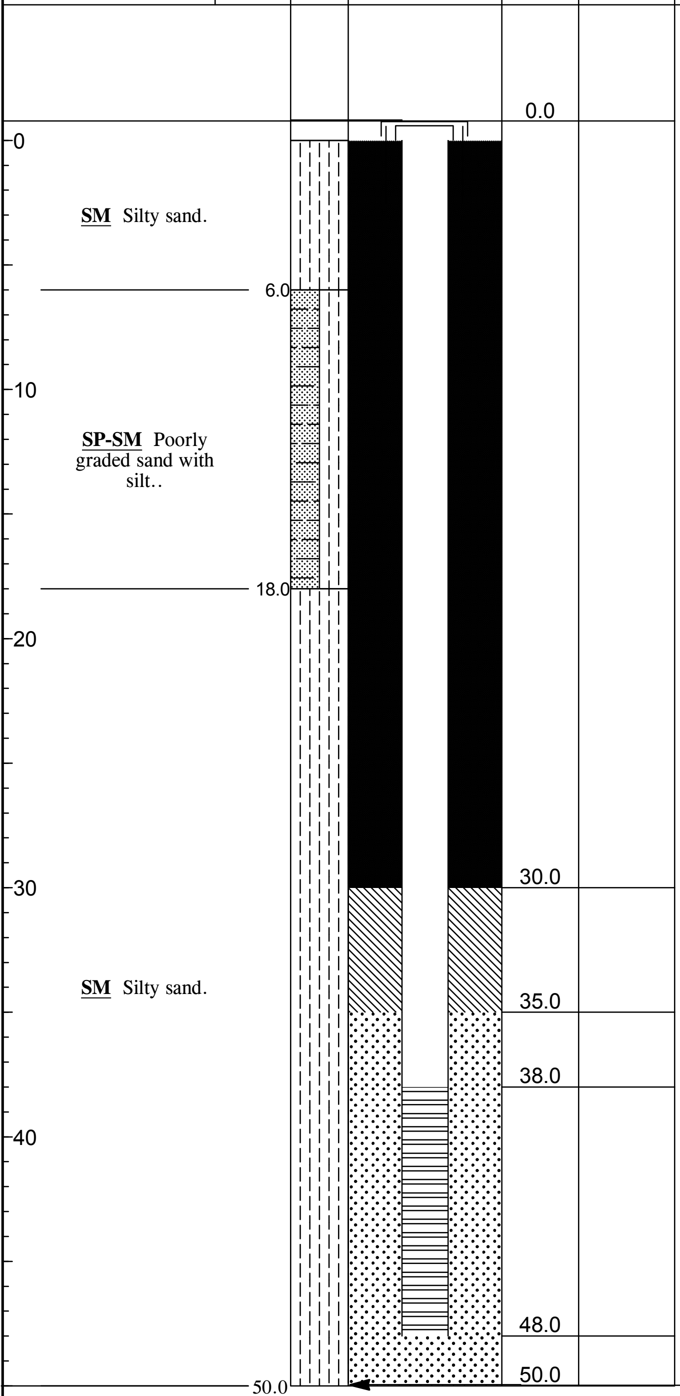
Project	New Madrid Energy Center
Location	Marston, MO
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling
Driller	

Well Diagram

◫	Riser Pipe
☰	Screen
▒	Filter Sand
▩	Cuttings
■	Grout
⁘	Concrete
▧	Bentonite Seal

File No.	128064-001
Date Installed	22 Sep 2016
H&A Rep.	C. Price
Location	See Plan
Ground El.	
Datum	NGVD

SOIL/ROCK CONDITIONS	DEPTH (ft.)
SM Silty sand.	6.0
SP-SM Poorly graded sand with silt..	18.0
SM Silty sand.	50.0



WELL CONSTRUCTION DETAILS

Type of protective cover LOCKING CAP

Depth of Roadway Box below ground surface 0.3 ft

Height of top of riser above ground surface 2.0 ft

Type of protective casing Flush

Length 40.0 ft

Inside diameter 2 inch

Depth of bottom of Roadway Box 40.3 ft

Type of riser pipe Schedule 40 PVC

Inside diameter of riser pipe 2 inch

Depth of bottom of riser pipe 38.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	0.0 ft	30.0 ft
Bentonite	30.0 ft	5.0 ft
	-	-

Diameter of borehole 8 inch

Depth to top of well screen 38.0 ft

Type of screen Machine slotted Sch 40 PVC

Screen gauge or size of openings 0.010 in.

Diameter of screen 2 inch

Type of Backfill around Screen No. 12-20 silica sand

Depth to bottom of well screen 48 ft

Bottom of silt trap NA

Depth of bottom of borehole 50.0 ft

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BORING LOGS

Well No. MW-5

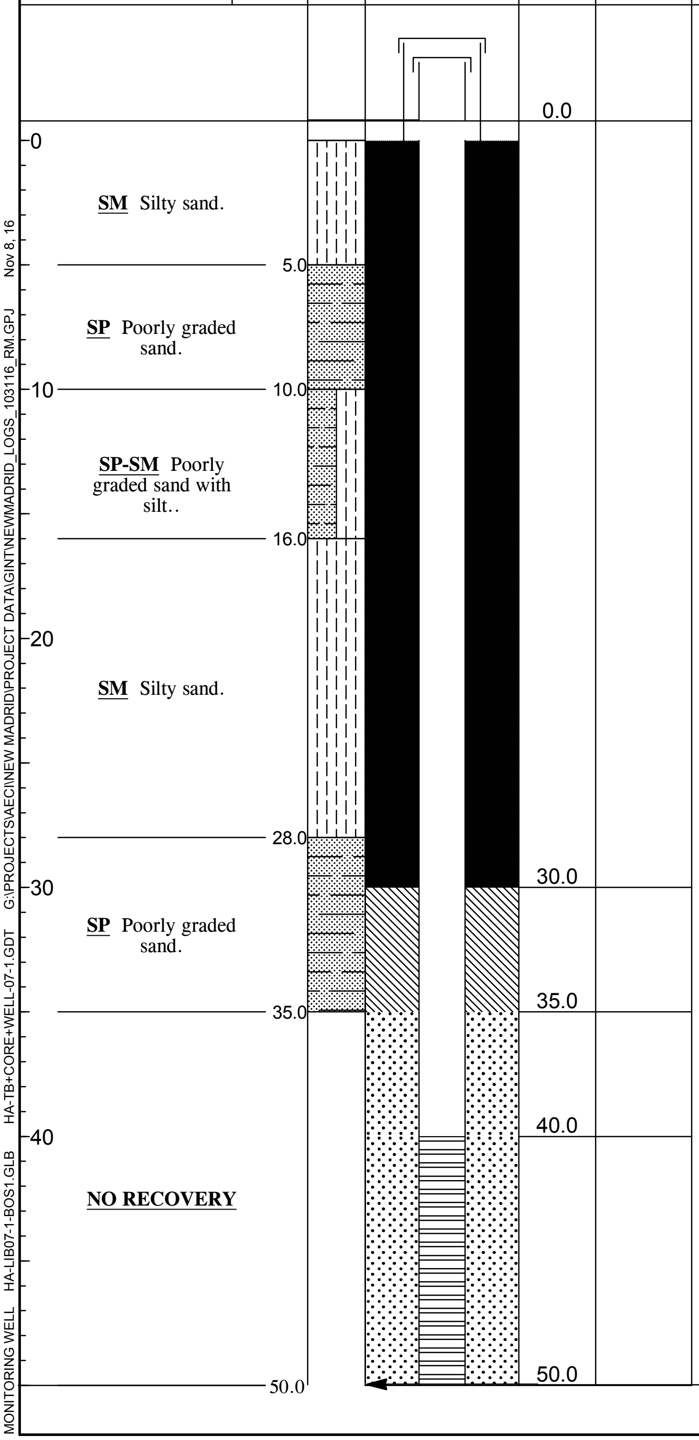
Project	New Madrid Energy Center
Location	Marston, MO
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling
Driller	

Well Diagram

- ☐ Riser Pipe
- ▤ Screen
- ░ Filter Sand
- ▒ Cuttings
- ■ Grout
- ⁘ Concrete
- ▨ Bentonite Seal

File No.	128064-001
Date Installed	28 Sep 2016
H&A Rep.	P. Kroger
Location	See Plan
Ground El.	
Datum	NGVD

SOIL/ROCK CONDITIONS	DEPTH (ft.)
SM Silty sand.	5.0
SP Poorly graded sand.	10.0
SP-SM Poorly graded sand with silt..	16.0
SM Silty sand.	28.0
SP Poorly graded sand.	35.0
NO RECOVERY	50.0



WELL CONSTRUCTION DETAILS

Type of protective cover LOCKING CAP

Height of Guard Pipe above ground surface 2.6 ft

Height of top of riser above ground surface 2.0 ft

Type of protective casing Guard Pipe

Length 40.0 ft

Inside diameter 2 inch

Depth of bottom of Guard Pipe 37.4 ft

Type of riser pipe Schedule 40 PVC

Inside diameter of riser pipe 2 inch

Depth of bottom of riser pipe 40.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	0.0 ft	30.0 ft
Bentonite	30.0 ft	5.0 ft
	-	-

Diameter of borehole 8 inch

Depth to top of well screen 40.0 ft

Type of screen Machine slotted Sch 40 PVC

Screen gauge or size of openings 0.010 in.

Diameter of screen 2 inch

Type of Backfill around Screen No. 12-20 silica sand

Depth to bottom of well screen 50 ft

Bottom of silt trap NA

Depth of bottom of borehole 50.0 ft

HALEY& ALDRICH

BORING LOGS

Well No. MW-6

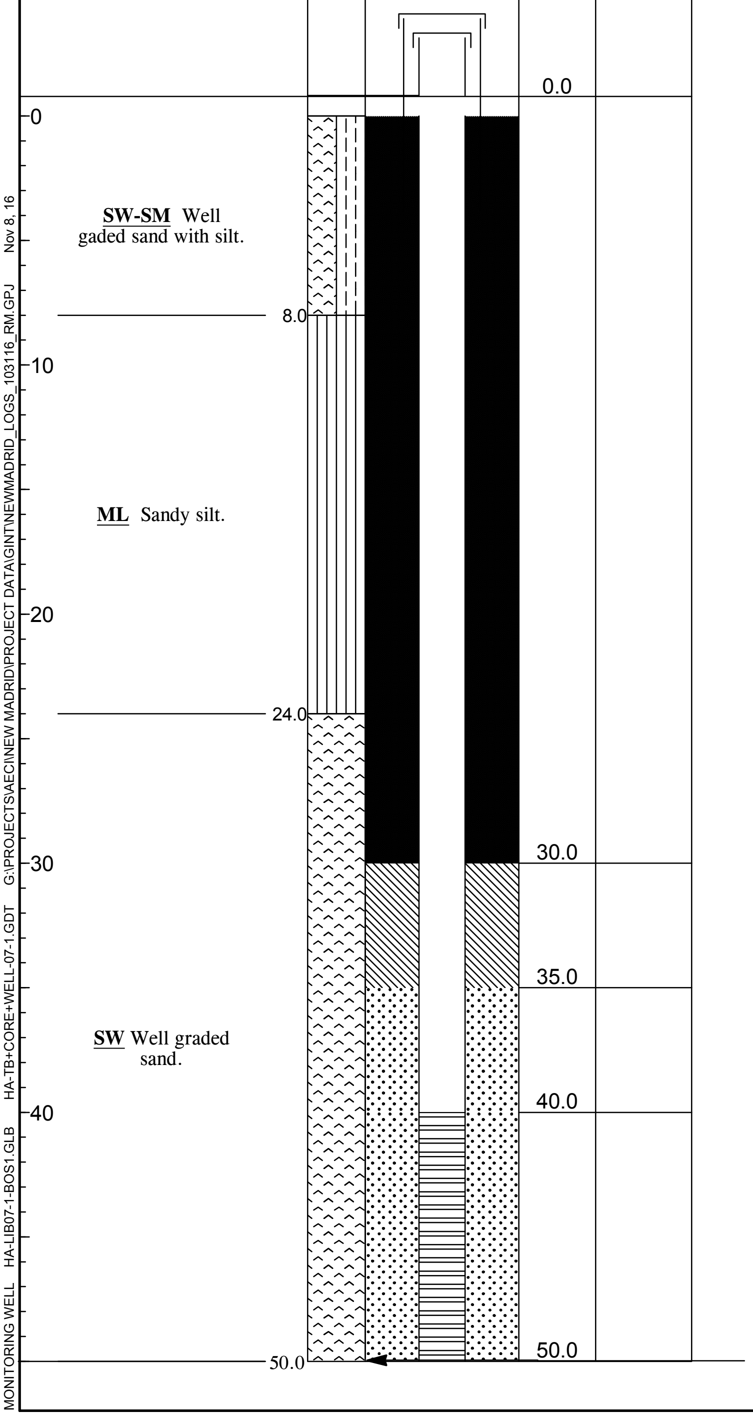
Project	New Madrid Energy Center
Location	Marston, MO
Client	Associated Electric Cooperative, Inc.
Contractor	Bulldog Drilling
Driller	

Well Diagram

▥	Riser Pipe
▤	Screen
▨	Filter Sand
▩	Cuttings
■	Grout
▦	Concrete
▧	Bentonite Seal

File No.	128064-001
Date Installed	23 Sep 2016
H&A Rep.	C. Price
Location	See Plan
Ground El.	
Datum	NGVD

SOIL/ROCK CONDITIONS	DEPTH (ft.)
SW-SM Well gaded sand with silt.	8.0
ML Sandy silt.	24.0
SW Well graded sand.	50.0



WELL CONSTRUCTION DETAILS

Type of protective cover	LOCKING CAP
Height of Guard Pipe above ground surface	2.6 ft
Height of top of riser above ground surface	2.0 ft
Type of protective casing	Guard Pipe
Length	40.0 ft
Inside diameter	2 inch
Depth of bottom of Guard Pipe	37.4 ft
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2 inch
Depth of bottom of riser pipe	40.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	0.0 ft	30.0 ft
Bentonite	30.0 ft	5.0 ft
	-	-

Diameter of borehole	8 inch
Depth to top of well screen	40.0 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2 inch
Type of Backfill around Screen	No. 12-20 silica sand
Depth to bottom of well screen	50 ft
Bottom of silt trap	NA
Depth of bottom of borehole	50.0 ft

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ALDRICH

BORING LOGS

Well No. MW-7

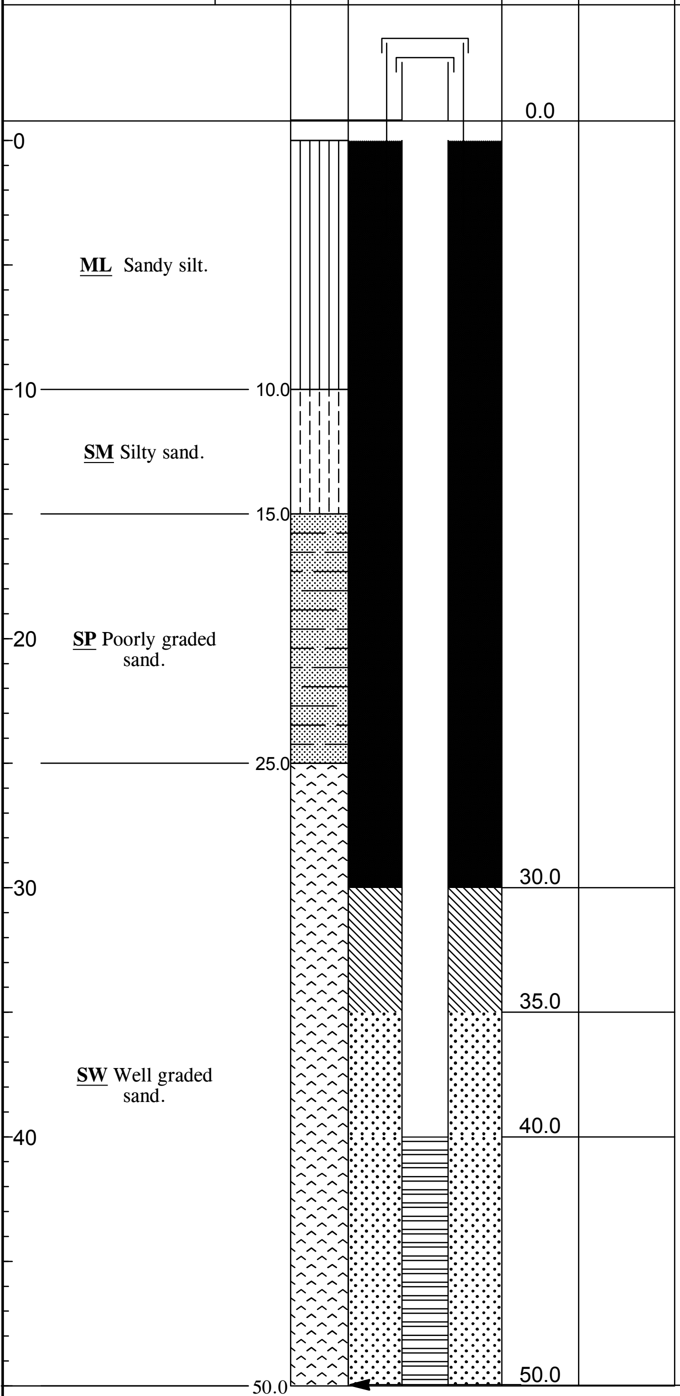
Project New Madrid Energy Center
Location Marston, MO
Client Associated Electric Cooperative, Inc.
Contractor Bulldog Drilling
Driller

Well Diagram
▥ Riser Pipe
▤ Screen
░ Filter Sand
▒ Cuttings
■ Grout
⁘ Concrete
▧ Bentonite Seal

File No. 128064-001
Date Installed 27 Sep 2016
H&A Rep. P. Kroger
Location See Plan

Ground El.
Datum NGVD

SOIL/ROCK CONDITIONS	DEPTH (ft.)
ML Sandy silt.	10.0
SM Silty sand.	15.0
SP Poorly graded sand.	25.0
SW Well graded sand.	50.0



WELL CONSTRUCTION DETAILS

Type of protective cover LOCKING CAP

Height of Guard Pipe above ground surface 2.7 ft

Height of top of riser above ground surface 2.0 ft

Type of protective casing Guard Pipe

Length 40.0 ft

Inside diameter 2 inch

Depth of bottom of Guard Pipe 37.4 ft

Type of riser pipe Schedule 40 PVC

Inside diameter of riser pipe 2 inch

Depth of bottom of riser pipe 40.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	0.0 ft	30.0 ft
Bentonite	30.0 ft	5.0 ft
	-	-

Diameter of borehole 8 inch

Depth to top of well screen 40.0 ft

Type of screen Machine slotted Sch 40 PVC

Screen gauge or size of openings 0.010 in.

Diameter of screen 2 inch

Type of Backfill around Screen No. 12-20 silica sand

Depth to bottom of well screen 50 ft

Bottom of silt trap NA

Depth of bottom of borehole 50.0 ft

MONITORING WELL HA-LIB07-1-BOS1.GLB HA-TB+CORE+WELL-07-1.GDT G:\PROJECTS\AEC\NEW MADRID\PROJECT DATA\GINT\NEWMADRID_LOGS_103116_RM.GPJ Nov 8, 16