Prepared for

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SELECTION OF REMEDY REPORT

FLORIDA POWER & LIGHT COMPANY PLANT SMITH ASH POND

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Project Number FR8308

July 29, 2022

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CERTIFICATION STATEMENT

This *Selection of Remedy Report, Florida Power & Light Company – Plant Smith – Ash Pond* has been prepared in general accordance with the requirements of the United States Environmental Protection Agency Coal Combustion Residuals Rule (40 Code of Federal Regulations Part 257, Subpart D) under the supervision of a State of Florida licensed Professional Engineer and Professional Geologist with Geosyntec Consultants, Inc.

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1.0 INTRODUCTION

1.1 Purpose and Scope

On behalf of Florida Power & Light Company (FPL), Geosyntec Consultants Inc. (Geosyntec) prepared this *Selection of Remedy Report* (Report) for FPL's Plant Lansing Smith (Plant Smith or Site) Ash Pond, a coal combustion residuals (CCR) unit.

Statistical analysis of data collected from the Ash Pond's CCR groundwater monitoring network indicate statistically significant levels (SSLs) of arsenic and lithium in groundwater downgradient of the Ash Pond. Arsenic and lithium are above their applicable groundwater protection standards (GWPSs) at MW-11 and MW-13, respectively (Geosyntec, 2022a). As documented herein, concentrations of arsenic and lithium are decreasing, and the arsenic and lithium plumes are: (i) small; (ii) isolated; (iii) delineated; and (iv) remain on-Site.

Pursuant to 40 Code of Federal Regulations (CFR) §257.96, FPL initiated an Assessment of Corrective Measures (ACM) for the Ash Pond in January 2019 as documented in the June 2019 *Assessment of Corrective Measures Report* (Geosyntec, 2019a). Semi-annual progress reports on remedy selection were completed from December 2019 to December 2021 to summarize the ongoing remedy evaluation and selection status.

The purpose of this Report is to document the selection of remedy for the Plant Smith Ash Pond in accordance with the requirements of 40 CFR §257.97 (hereinafter referred to as CCR Rule). As discussed herein, the selected remedy includes the following:

1. source control in accordance with the closure plan approved by the Florida Department of Environmental Protection (FDEP) (Gulf Power, 2016), consisting of:
    - dewatering, consolidation, and capping of CCR;
    - installation of a subsurface drain system;
2. a vertical barrier wall (referred to as a "slurry wall" herein)[1]; and
3. monitored natural attenuation (MNA).

The selection of source control is supported by the findings and evaluations by Golder Associates Inc. (Golder, 2022; **Appendix A**). Golder (2022) provides detailed descriptions of the FDEP-approved closure plan which includes: (i) dewatering of CCR;

[1] The slurry wall is part of the FDEP-approved closure plan. The addition of the slurry wall as a component of the closure plan was approved by FDEP on September 14, 2017.

(ii) consolidation of the footprint of the CCR unit; (iii) installation of an engineered cap; and (iv) installation of a subsurface toe drain system.

The selection of a slurry wall is based on findings and evaluations by Golder (2022; **Appendix A**) which details modeling results indicating that a slurry wall will limit migration of impacted groundwater beyond the final closure area.

The selection of MNA is supported by the findings and evaluations by Geosyntec (2022b; **Appendix B**) which documents the following: (i) field and laboratory data; (ii) the presence of small and isolated arsenic and lithium plumes that are delineated on-Site; (iii) decreasing concentration trends; and (iv) a tiered MNA evaluation that provides multiple lines of evidence of ongoing MNA at the Site.

1.2 <u>Requirements</u>

This Report describes the remedy selected to address the SSLs of arsenic and lithium in downgradient monitoring wells at the Ash Pond. Remedy selection was based on the standards listed in the CCR Rule [specifically, 40 CFR §257.97(b)], as summarized below:

(1) Be protective of human health and the environment.

(2) Attain the GWPS for arsenic and lithium.

(3) Control the source(s) of release so as to reduce or eliminate, to the maximum extent feasible, further release of Appendix IV constituents into the environment.

(4) Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems.

(5) Comply with the standards for management of wastes as specified in 40 CFR §257.98.

2.0 SITE BACKGROUND

2.1 Site Description

Plant Smith is an electric power generating facility located at 4300 County Road 2300, Bay County, Florida. The Plant Smith property is approximately 1,560 acres, and the former operational area is approximately 730 acres. Site topography is relatively flat. The Site is bordered by undeveloped land to the north and east, Alligator Bayou to the west, and North Bay to the south. A Site location map is presented as **Figure 1**.

Plant Smith consists of two retired coal-fired units (Units 1 and 2) that are undergoing demolition, a natural gas combined-cycle unit (Unit 3), and an oil-fired combustion turbine used for peak generation.

2.2 CCR Unit Description

The Ash Pond is located on the southern portion of the Site near North Bay and occupies approximately 193 acres. The Ash Pond was historically used to support coal-fired operations at Plant Smith; fly ash, bottom ash, and other low-volume waste associated with coal-fired operations were sluiced to the Ash Pond. In March 2016, the plant ceased coal-fired operations. As such, no CCR material was sent to the pond after second quarter 2016. In April 2021, FPL completed pre-closure activities, which included the construction of new wastewater ponds and ceased sending non-CCR wastewater to the Ash Pond. On May 9, 2021, the "Intent to Initiate Closure" for the Plant Smith Ash Pond was posted to FPL's CCR web-site.

The Ash Pond will be closed in accordance with the FDEP-approved closure plan. Closure activities, which are source control measures, are discussed further in Section 3.1.

2.3 Hydrogeologic Site Conditions

The principal aquifers beneath Bay County include the surficial aquifer system (SAS), the intermediate aquifer system (IAS), and the Floridan Aquifer System (FAS) (Pratt *et al.*, 1996). The SAS is the shallowest and is an unconfined system formed by recent terrace sands, the Citronelle Formation, and the upper portions of the Intracoastal Formation in hydraulic connection with these sediments. The general direction of groundwater flow is toward the south-southwest.

The IAS in Bay County is semi-confined and consists of the low permeability sediments of the Jackson Bluff and the Intracoastal Formations. Permeable portions of the

Intracoastal Formation provide sufficient quantities of water for potable use. Overall, the IAS acts as a confining unit for the underlying FAS. The FAS is a confined aquifer and the principal water bearing unit in Bay County that is consistent with the Bruce Creek Formation.

The monitoring wells and piezometers comprising the CCR groundwater monitoring network are screened in the uppermost water-bearing zone in the undifferentiated quaternary alluvium of the SAS overlaying the Jackson Bluff formation. The SAS at the Site is considered the uppermost aquifer for groundwater monitoring purposes. Site-specific lithology in the uppermost aquifer consists primarily of sand, silt, and clay mixtures. Groundwater in the SAS at the Site is encountered in a laterally-extensive water-bearing unit of predominantly fine sand from approximately 5 to -20 feet (ft) elevation relative to the North American Vertical Datum of 1988 (NAVD88). The CCR groundwater monitoring network wells installed in 2015 are screened in the uppermost aquifer between approximately 2 and -21 ft NAVD88. Well and piezometer locations installed in 2015 are illustrated on **Figure 2** and construction details are included in **Table 1**.

Groundwater generally flows toward Alligator Bayou on the west side of the Ash Pond and toward North Bay on the southern side of the Ash Pond, as evidenced by historic potentiometric surfaces (**Figure 3**).

Groundwater flow rates were calculated based on measured hydraulic gradients and hydraulic conductivity measured via slug tests (conductivity data are documented in **Appendix B**). The Site-specific hydraulic conductivity was calculated to be up to 0.47 ft/day (i.e., at PZ-14). The horizontal hydraulic gradient between MW-11 and MWI-12A and MW-13 and PZ-14 well pairs was calculated based on groundwater elevation data from three sampling events in 2019 and 2020, resulting in horizontal gradients of approximately 0.010 ft/ft for each well pair. An effective porosity of 0.25 was assumed.

Horizontal flow velocity was calculated using a form of Darcy's Law:

$V=(K*i)/n_e$

Where:

V=groundwater velocity (ft/day);

K=measured hydraulic conductivity (ft/day);

i=horizontal hydraulic gradient (ft/ft);

n_e=effective porosity (unitless).

The calculated horizontal groundwater velocities were 0.017 ft/day (6.1 ft/year) for well pair MW-11 and MWI-12A and 0.018 ft/day (6.7 ft/year) for well pair MW-13 and PZ-14.

2.4 Groundwater Monitoring Activities

2.4.1 General Groundwater Conditions

In 2015, FPL installed a CCR groundwater monitoring system for the Ash Pond within the uppermost aquifer at the Site (Southern Company, 2018). Monitoring wells in the 2015 CCR groundwater monitoring well network are listed below and illustrated in **Figure 2**:

- Background: MW-02, MW-03, and MW-12;
- Downgradient[2]: MW-06, MW-07, MW-08, MW-09, MW-10, MW-11, MW-13, and MW-14; and
- Piezometers: MW-01, MW-04, and MW-05.

FPL initiated an assessment monitoring program for the Ash Pond in March 2018. Statistical analysis of CCR groundwater monitoring data identified SSLs above GWPS for the following constituents at the Ash Pond:

- arsenic in MW-11; and
- lithium in MW-13.

SSLs for total radium were also identified. In accordance with the CCR Rule, FPL previously conducted an alternate source demonstration (ASD) which documented that the total radium SSLs are from a source other than the Ash Pond (Geosyntec, 2019b). As such, the ACM and this Report focus only on corrective measures for the arsenic SSL identified in MW-11 and the lithium SSL identified in MW-13.

2.4.2 Nature and Extent

Following identification of SSLs, FPL initiated characterization activities to evaluate the nature and extent of lithium and arsenic impacts downgradient of the Ash Pond.

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[2] MW-08, MW-09, MW-10, MW-11, MW-13, and MW-14 were abandoned in August 2020 to allow for pre-closure activities (i.e., removal of the perimeter dike system). As of March 2022, these wells have been replaced except for MW-11, which is anticipated to be replaced by October 1, 2022.

To delineate the nature and extent of arsenic near MW-11, samples were initially collected in March 2019 from a deep piezometer (PZ-11D) and a shallow well (MWI-12A). These locations were used to evaluate vertical and horizontal (downgradient) impacts, respectively. No arsenic was detected in groundwater from PZ-11D in two of three sampling events in 2019, and arsenic was 5-fold below the GPWS of 0.01 milligrams per liter (mg/L) in the third event. Arsenic concentrations were 2- to 20-fold below the GWPS in MWI-12A in three sampling events in 2019. Semi-annual sampling through 2020 (PZ-11D[3]) and 2021 (MWI-12A) confirmed concentrations continue to be below the GWPS. Collectively, these results indicate complete horizontal and vertical delineation of the arsenic at MW-11.

FPL sampled groundwater from piezometers in the vicinity of MW-13 to delineate the nature and extent of lithium. This included shallow (PZ-14) and deep (PZ-13D) piezometers to evaluate horizontal (downgradient) and vertical impacts, respectively. Groundwater results from 2019 from PZ-14 were either not detected or, if detected, 40-fold below the GWPS of 0.04 mg/L. In PZ-13D, lithium concentrations were approximately 2-fold below the GWPS. Semi-annual sampling through 2020 (PZ-13D[3]) and 2021 (PZ-14) confirmed concentrations continue to be below the GWPS. Collectively, these results indicate complete horizontal and vertical delineation of the lithium SSL at MW-13.

[3] PZ-11D and PZ-13D were abandoned in August 2020 to allow for pre-closure activities (i.e., removal of the perimeter dike system).

3.0 SELECTED REMEDY AND ACM OVERVIEW

This section discusses source control, a slurry wall, and MNA as the components of the selected remedy and is followed by an overview of the ACM process to evaluate the groundwater remedy component.

3.1 Source Control

3.1.1 Background

Source control at Plant Smith will be achieved by the closure of the Ash Pond in accordance with the FDEP-approved closure plan (Gulf Power, 2016). The plan for closure of the Ash Pond was approved by the FDEP's Northwest District Office Solid Waste Section on August 19, 2016. This section provides a summary of source control measures, with additional information provided in **Appendix A**. Golder serves as the Engineer of Record for the closure project and has certified that the closure design and closure plan meet the requirements for closure of surface impoundments specified in 40 CFR §257.102.

Fly ash, bottom ash, and other low-volume wastes associated with coal-fired operations were sluiced to the Ash Pond until March 2016 when the facility ceased coal-fired operations. In 2021, FPL completed necessary pre-closure activities and improvements in preparation to close the Ash Pond in accordance with the FDEP-approved closure plan. The discharge of non-CCR wastewater to the Ash Pond was terminated in April 2021. A *Notification of Intent to Initiate Closure* was completed on May 7, 2021, and posted to the FPL CCR Website.

Final closure certification is expected in the 2023-2024 timeframe. This in-place closure strategy will act to contain impacted materials (i.e., control the source of release) and reduce or eliminate future release of CCR constituents, consistent with the criteria for remedy selection outlined in Section 1.2 and Section 5. Completed source control can be coupled with any of the groundwater approaches considered in the ACM (Section 3.2).

The following subsections discuss (i) dewatering, consolidation, and capping of CCR, and (ii) installation of a subsurface drain system. Selection and design of the various components of the closure are based, in part, on the evaluation discussed in Section 4.1 and detailed in **Appendix A**.

3.1.2 Dewatering, Consolidation, and Capping

This section summarizes the dewatering, consolidation, and capping component of closure. For additional information, see **Appendix A**.

The proposed closure method consists of significantly consolidating the historical footprint of the CCR unit. In general, CCR will be dewatered and excavated from the southern and eastern areas of the Ash Pond and relocated to the upland northwest corner of the Ash Pond and placed over existing CCR.

Dewatering of CCR to be relocated to the final closure area and treatment of this water is considered a highly effective source control measure; that is, the water is not just contained but it is removed from the excavation areas, treated, and discharged in accordance with FDEP-issued permits for the Site.

The consolidated footprint is approximately 64 acres, resulting in an approximate 67% reduction in the overall footprint. **Figure 2** shows the approximate footprint of the consolidated area (i.e., it roughly coincides with the aerial extent of the illustrated slurry wall).

The entire final closure area, including the perimeter berm, will be capped with a ClosureTurf™ final cover system. The ClosureTurf™ system consists of the following layers from top to bottom:

- ClosureTurf™ consisting of a combined geotextile and engineered turf layer with sand infill or concrete infill (Hydrobinder®);
- A 40-mil linear low density polyethylene geomembrane over the final closure area;
- A 50-mil linear low density Supergripnet geomembrane liner over the slopes of the perimeter berm and the final perimeter access road; and
- Compacted CCR or earthen subgrade material.

The final closure design includes grading necessary for stormwater management. A perimeter channel will be located on the inside of the final perimeter berm and will direct stormwater runoff from the final closure area to industrial wastewater ponds located south and east of the final closure area.

The closure plan includes construction of three new industrial wastewater ponds located south and east of the final closure area. Construction of two lined ponds is complete and excavation of the third unlined pond is ongoing:

- The westernmost pond is double lined with an underdrain system and is designed to store industrial wastewater. This pond is not designed to receive the non-contact stormwater runoff from the final closure area.

- The center pond is single lined with an underdrain system and is designed to receive (i) non-contact stormwater runoff from approximately 23 acres of the final closure area and (ii) industrial wastewater and stormwater from the plant facility. Discharge from this pond is designed to route to the easternmost pond over a spillway between the two ponds. Water can also be pumped from this pond for use in plant operations in the future.
- The easternmost pond is designed to receive discharge from the center pond and non-contact stormwater runoff from the other approximately 41 acres of the final closure area. Water is designed to discharge from this pond through a spillway structure to a channel north of the final closure area, which discharges at the northwest corner of the final closure area. This discharge will be monitored in accordance with the facility's National Pollutant Discharge Elimination System (NPDES) permit.

3.1.3 Subsurface Drain

This section summarizes the subsurface drain component of closure. For additional information, see **Appendix A**.

Consolidation of the footprint requires a cut slope in the CCR around the perimeter of the final closure area. A geocomposite drainage layer will be placed on this slope to collect post-closure remnant drainage and direct the collected water to a toe drain system.

The toe drain will be installed at the toe of the cut slope around the entire perimeter of the final closure area. Along the toe drain, outlets are designed at a spacing of approximately 400 linear ft, with field adjustments to provide outlets at localized low points in the toe drain based on as-built survey information to facilitate collection of water.

The design includes a total of 24 outlets along the perimeter of the toe drain. These outlets consist of a solid pipe connection from the toe drain to a concrete manhole. At each manhole, a pneumatic pump capable of pumping up to 10 gallons per minute will be installed.

Water collected in the toe drain system will be pumped to a force main that will be installed around the perimeter of the final closure area. This force main is designed to discharge water to the center lined pond where it will mix with industrial wastewater and stormwater from the facility and ultimately be discharged in accordance with FDPE-issued permits for the Site.

3.2 Slurry Wall

This section summarizes the slurry wall component of the remedy. For additional information, see **Appendix A**. Design and construction of the slurry wall include the following:

- The slurry wall will be installed around the entire perimeter of the final closure area from elevation 10 to -15 ft NAVD88 (total depth of 25 ft).
- The maximum permeability of the slurry wall is designed to be 1×10^{-7} centimeters per second (cm/s).
- The wall is to be constructed by mixing natural subsurface soils and structural fill with a minimum three percent bentonite by weight using in-place mixing methods.
- A laboratory testing program was conducted as part of the slurry wall design process.
    - This program included mixing various percentages of bentonite with samples of subsurface soils and testing the permeability and grain size of the final mixture.
    - Confining pressures for the lab permeability tests were 5 pounds per square inch (psi).

Field construction quality assurance (CQA) will be conducted during installation of the slurry wall. The field CQA program involves obtaining samples of the soil-bentonite mixture at a rate of one sample per 20,000 cubic feet and testing a remolded sample for permeability in accordance with ASTM D5084.

3.3 MNA

This section summarizes the MNA component of the remedy. For additional information, see **Appendix B**. MNA relies on natural attenuation processes to reduce dissolved concentrations of inorganic constituents in groundwater below remediation standards within a reasonable timeframe. Attenuation processes include mineral precipitation, sorption reactions such as adsorption on the surfaces of soil minerals, absorption into the matrix of soil minerals, or partitioning into organic matter, dilution, dispersion, and radioactive decay. Further, oxidation-reduction (redox) reactions via abiotic or biotic processes, can transform the valence states of some inorganic constituents to less soluble and thus less mobile and/or less toxic forms. Attenuation mechanisms are constituent- and site-specific. MNA is most appropriate as a groundwater remedial component when coupled with source control and/or other remedial measures (e.g., slurry wall), which is ongoing at Plant Smith.

Implementation of MNA requires monitoring of groundwater through existing and potentially new wells to evaluate concentration data and, if needed, attenuation processes. The timeframe to achieve cleanup goals is highly variable (from years to decades); as such, MNA remedies often include a remedial decision framework for development of contingent remedies.

3.4 Summary of ACM

As documented in the ACM, the remedial technology evaluation process involved a step-wise identification, screening, and assessment of potentially applicable remedial technologies, culminating in development and analysis of corrective measures alternatives. First, several remedial technologies were screened for general technology advantages, limitations, and applicability to Site-specific conditions. Technologies retained from the initial screening evaluation were utilized to develop corrective measures alternatives, some of which consist of a combination of remedial technologies.

The initial screening process in the ACM focused on remedial technologies that are broadly applicable to CCR-related constituents and/or applied at CCR units, including the following:

- MNA
- Hydraulic Containment (Pump and Treat)
- In-Situ Injection
- Permeable Reactive Barrier (PRB)
- Slurry Wall
- Phytoremediation/TreeWell system

Corrective measures consisting of source control and one or more additional technologies were assembled in the ACM from the retained technologies from the initial screening evaluation. The range of corrective action alternatives developed in the ACM consists of the following:

- Alternative 1: source control, no slurry wall, and MNA
- Alternative 2: source control, no slurry wall, and hydraulic containment (pump and treat) and MNA

- Alternative 3: source control, a slurry wall, and MNA

The three alternatives were subject to a detailed Site-specific analysis, based on assessment of corrective measures criteria presented in 40 CFR §257.96. The remedy selection criteria in 40 CFR §257.97 were also considered in the ACM. A summary of the remedial alternatives, screening criteria, and detailed evaluation were documented in the ACM.

Following the ACM and in accordance with 40 CFR §257.96(e), a public meeting was held in December 2020 to discuss the ACM.

4.0 REMEDIAL EVALUATIONS

To support remedy selection, additional activities were completed to evaluate source control, a slurry wall, and MNA, as discussed in the following subsections.

4.1 Source Control and Slurry Wall Evaluation

Golder (2022; **Appendix A**) documents the evaluation of source control measures with and without a slurry wall using groundwater flow modeling. These evaluations are summarized in this section.

Initially, the following scenarios were modeled:

- Consolidation and capping only;
- Slurry wall only (multiple configurations and depths); and
- Subsurface drainage (multiple configurations) with and without various configurations of a slurry wall.

This initial modeling step indicated potential advantages of including a slurry wall as a component of the overall remedy to limit groundwater migration beyond the slurry wall boundary.

Based on this evaluation, additional modeling was performed to assess the performance of the slurry wall installed to various depths. Slurry wall depths to elevations of -5, -10, and -15 ft NAVD88 were evaluated. The results summarized in **Appendix A** indicated that a slurry wall installed to -15 ft NAVD88 limited groundwater migration beyond the slurry wall.

Based on findings from the modeling scenarios discussed above, three additional scenarios were further evaluated. These can generally be summarized as follows:

- Baseline: No slurry wall and no toe drain;
- Scenario 1: Perimeter slurry wall installed to an elevation of -15 ft NAVD88, without a toe drain; and
- Scenario 2: Perimeter slurry wall installed to an elevation of -15 ft NAVD88, with a perimeter toe drain.

Based on the modeling results, Scenario 2 was selected for design (the design is summarized in Section 3). Based on Golder's evaluations in **Appendix A**, this configuration best captured post-closure remnant drainage and limited migration of groundwater outside of the final closure area.

4.2 MNA Evaluation Summary

MNA evaluation activities included: (i) continued assessment monitoring; (ii) delineation activities; (iii) the review of temporal and spatial concentration trends; and (iv) the completion of a tiered MNA evaluation. The MNA evaluation is attached as **Appendix B** and is summarized in this section.

A tiered MNA evaluation was completed, consistent with applicable guidance documents (USEPA, 2015; ITRC, 2010; EPRI, 2018), and included bench-scale laboratory and desktop evaluations. The evaluation was performed to assess if Site conditions are favorable for the implementation of MNA as a corrective measure to address arsenic and lithium SSLs in groundwater downgradient of the Ash Pond. The evaluation indicated that MNA, in combination with ongoing source control measures and installation of the slurry wall, is a viable groundwater remedy for both arsenic and lithium based on multiple lines of evidence.

The separate arsenic and lithium plumes appear stable based on the following: (i) the plumes have been delineated, are spatially limited (localized), and remain on-Site; and (ii) concentrations are decreasing over time at MW-11 and MW-13, respectively.

For arsenic, batch testing indicates attenuation through either sorption and/or precipitation mechanisms. The aquifer was estimated to have excess capacity to attenuate arsenic through these processes. Desorption testing indicated that attenuation was relatively stable under both current Site conditions and those anticipated following closure. In addition, groundwater geochemistry becomes more favorable for arsenic attenuation as groundwater migrates to more oxidizing conditions downgradient. Finally, analysis of geologic materials indicated the presence of iron oxides, organic carbon, clays, and sulfides, all of which can contribute to arsenic attenuation.

For lithium, a one-dimensional analytical groundwater flow model, based on Site-specific input parameters, was used to evaluate attenuation processes. The model predicted lithium attenuation with distance and based on the non-detectable lithium concentration downgradient of MW-13 at PZ-14, the model output is a conservative representation of the lithium attenuation at the Site. The model estimated that lithium will decrease below the GWPS approximately 120 ft downgradient from the Ash Pond.

As documented in **Appendix B**, multiple lines of evidence based on Site-specific considerations indicate MNA (when coupled with the ongoing source control efforts and installation of the slurry wall) is a viable remedial alternative for arsenic and lithium in groundwater downgradient of the Ash Pond.

5.0 REMEDY SELECTION

5.1 Overview

FPL selected Alternative 3 (source control, slurry wall, and MNA) as the corrective action for the Ash Pond. Based on the information presented in the ACM (Geosyntec, 2019a), source control information presented in Section 3.1, and the remedial evaluations summarized in Section 4, the selected remedy (source control, slurry wall, and MNA) is a viable corrective measure. The following sections discuss the selected remedy compared to the standards and evaluation factors listed in the CCR Rule.

5.2 Standards for Remedy Selection

Standards for remedy selection are provided in 40 CFR §257.97(b). Although considered in the ACM, each standard is briefly introduced and discussed below for the selected remedy (slurry wall and MNA coupled with source control).

Protective of Human Health and the Environment

The selected remedy must *"be protective of human health and the environment"* [40 CFR §257.97(b)(1)]. The selected remedy is designed to meet this standard based on the following:

- Golder's source control and slurry wall assessments, presented in **Appendix A**, which indicate:
    - Capping prevents direct contact with CCR and limits surface infiltration of stormwater into the CCR;
    - The subsurface drain collects potential post-closure remnant drainage, limiting migration to groundwater; and
    - The slurry wall is designed to prevent groundwater migration beyond the final closure area.

  These measures are considered protective of human health and the environment because they are designed to isolate, contain, and collect CCR-contact water in the final closure area for management in accordance with FDEP-issued permits for the Site.
- The MNA evaluation presented in **Appendix B**:

  - The arsenic and lithium groundwater plumes are (i) small, (ii) isolated, (iii) delineated, (iv) remain on-Site, and (v) have decreasing concentration trends; and
  - The MNA evaluation documents ongoing natural attenuation processes and mechanisms for both arsenic and lithium.
- There is no current or anticipated long-term route of exposure to groundwater.

<u>Attain GWPS</u>

The selected remedy must "*attain the GWPS"* [40 CFR §257.97(b)(2)]. The selected remedy is designed to meet this standard based on the following:

- As detailed in Golder's assessments presented in **Appendix A**; source control measures are designed to prevent recharge to groundwater, which supports MNA processes and ultimately attainment of GWPSs; and
- As discussed in Section 4.2 and documented in **Appendix B**:
  - Concentrations are decreasing for arsenic at MW-11 and lithium at MW-13;
  - Temporal trends suggest that concentrations are already below GWPS (i.e., arsenic at MW-11) or expected to be below GWPS by the end of 2026 (i.e., lithium at MW-13).

  Therefore, MNA coupled with other selected remedial measures is expected to attain GWPSs.

<u>Control the Source(s) of Release</u>

The selected remedy must *"control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of Appendix IV constituents…into the environment"* [40 CFR §257.97(b)(3)]. Based on Golder's assessments presented in **Appendix A**, the selected remedy is designed to meet this standard as follows:

- The final cap system is designed to eliminate future surface infiltration; and
- Potential post-closure remnant drainage from the CCR material will be reduced or eliminated by the combination of the subsurface drain system and the slurry wall:
  - The toe drain system is designed to collect and pump water for ultimate monitoring at the facility's FDEP-permitted NPDES discharge point; and

  - The slurry wall is designed to prevent migration of any potentially impacted groundwater via a low permeability barrier.
- During construction, dewatering of CCR that is to be relocated to the final closure area and treatment of this water is considered a highly effective source control measure; that is, the water is not just contained but it is removed from the excavation areas, treated, and discharged in accordance with FDEP-issued permits for the Site.

Removal of Material Released from the CCR Unit

The selected remedy must *"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"* [40 CFR §257.97(b)(4)]. The components of the selected remedy are designed to meet this standard based on the following:

- As detailed in Golder's assessments presented in **Appendix A**:
  - The proposed closure plan includes reducing the existing footprint of the pond by approximately two-thirds;
  - Material removed from the areas surrounding the final closure area will first be dewatered prior to excavation; water removed from the CCR will be treated on-Site and discharged in accordance with FDEP-issued permits for the Site;
  - Following excavation, the CCR will be moisture conditioned and placed and compacted in the final closure area; and
  - The material will be capped once reaching final grades.
- As discussed in Section 4.2 and documented in **Appendix B**, MNA relies on the natural processes in the aquifer matrix to effectively remove the contaminants from the environment within a reasonable timeframe. For inorganic constituents, removal is the result of reduced toxicity and/or reduced mobility, which decreases dissolved phase concentrations. This occurs through various attenuation processes depending on constituent and Site conditions (see Section 4.2 and **Appendix B**).

Comply with Standards for Management of Waste

The selected remedy must *"comply with standards for the management of wastes as specified in §257.98(d)"* [40 CFR §257.97(b)(5)].

Based on Golder's assessments presented in **Appendix A**, waste materials that will be managed during closure construction include CCR materials as well as water in contact with CCR materials.

- CCR material that is handled during closure construction is first dewatered prior to excavation. Following excavation, the CCR is moisture conditioned and placed and compacted in the final closure area.
- Water that is removed or dewatered from the CCR materials during closure activity will be contained on-Site in pore water storage ponds for temporary storage. Water will be pumped from the pore water storage ponds to the on-Site treatment plant where it will be treated and discharged in accordance with FDEP-issued permits for the Site.
- Water collected in the toe drain system after closure is completed will be pumped to a force main that will be installed around the perimeter of the final closure area. This force main is designed to discharge water to the center lined pond where it will mix with industrial wastewater and stormwater from the facility and ultimately be discharged through the facility's FDEP-permitted NPDES discharge location.

Due to the nature of MNA, a significant volume of wastewater or solid waste is not expected during the implementation of the MNA component of the remedy. Management of waste during MNA will be conducted in accordance with applicable standards.

5.3 Evaluation Factors for Remedy Selection

Evaluation factors to be considered during remedy selection are provided in 40 CFR §257.97(c). Although considered in the ACM, each evaluation factor is briefly discussed below for the selected remedy of source control, slurry wall, and MNA.

Long- and Short-Term Effectiveness and Protectiveness [40 CFR §257.97(c)(1)]

MNA, the slurry wall, and source control measures are demonstrated technologies within the environmental remediation industry; they are expected to be reliable, effective, and maintain protectiveness.

Control of the source and installation of a slurry wall are considered key to long- and short-term effectiveness of the remedy, as discussed by Golder in **Appendix A**:

- In the short-term, dewatering and excavation of CCR during closure construction will remove potential sources to groundwater. The slurry wall and toe drain system installation are designed to further enhance short-term performance of the remedy within the final closure area.

- Over the long-term, the combination of the slurry wall and subsurface drainage system is designed to contain and capture potential post-closure remnant drainage from the final closure area, while the final capping system will significantly reduce future surface infiltration.

During the post-closure period, the closure design focuses on long-term reduction of surface infiltration and long-term management of post-closure remnant drainage from the reduced footprint of CCR.

MNA is anticipated to be effective in the long- and short-term. As discussed in **Appendix B**, the arsenic and lithium groundwater plumes are small, stable, and remain on-Site. In addition, the MNA evaluation documents ongoing natural attenuation processes and mechanisms for both arsenic and lithium, with the anticipated attainment of GWPS in relatively short order (estimated by 2026). Both MNA and the ongoing source control measures are demonstrated technologies within the environmental remediation industry; both are expected to be reliable, effective, and maintain protectiveness.

<u>Remedy Effectiveness in Controlling the Source to Reduce Further Releases [40 CFR §257.97(c)(2)]</u>

See discussion of *Control the Source(s) of Release* in Section 5.2 and additional discussion by Golder in **Appendix A**.

<u>Ease of Implementation [40 CFR §257.97(c)(3)]</u>

Source control and installation of the slurry wall at Plant Smith is ongoing in accordance with the FDEP-approved closure plan. Therefore, it is implementable with respect to construction technology, approvals/permitting, availability of equipment and construction specialists, etc. Synthetic turf is used in lieu of a vegetative soil layer to (i) limit the potential for short- and long-term erosion and (ii) eliminate the need for borrow soil. In addition, use of the synthetic turf is anticipated to decrease the overall construction duration compared to use of a vegetative soil layer.

MNA is readily implementable, as an existing monitoring network is in place which can be supplemented as needed. In addition, MNA processes have been documented to be ongoing. Finally, well permits for new wells, if required, are relatively straightforward to obtain.

Community Input [40 CFR §257.97(c)(4)]

A public meeting to discuss the ACM was held in accordance with 40 CFR §257.96(e) in Southport, Florida on December 18, 2020. Notice of the public meeting was provided on December 11, 2020 in the Panama City News Herald.

6.0 REMEDY SCHEDULE

This section discusses the anticipated schedule for the implementation of remedial activities. Schedule development considered, as applicable, the factors listed in §257.97(d).

Source control at the Ash Pond and installation of the slurry wall are underway according to the FDEP-approved closure plan. These efforts are anticipated to be completed in the 2023-2024 timeframe.

Within 90 days of completing this Report, a corrective action groundwater monitoring plan will be developed to outline the monitoring program. The corrective action groundwater monitoring plan will specify sampling locations, frequency, and analytes. The corrective action monitoring program is anticipated to largely align with the ongoing assessment monitoring program for the Ash Pond. As discussed in **Appendix B**, the corrective action groundwater monitoring plan will also describe the process to evaluate contingencies, which may be warranted based on changes to concentration trends and/or geochemical conditions.

As discussed in **Appendix B**, temporal trends suggest that concentrations are already below GWPS (i.e., arsenic at MW-11) or expected to be below GWPS by the end of 2026 (i.e., lithium at MW-13). FPL will continue monitoring groundwater conditions to assess concentration trends relative to GWPSs during and (if needed) following source control measures.

Monitoring data will be documented in each year's *Annual Groundwater Monitoring and Corrective Action Report*, which will include status updates on remedy implementation progress and any changes to the anticipated implementation schedule.

In accordance with 40 CFR §257.105(h)(12), this Report will be maintained until the remedy is complete.

7.0 REFERENCES

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Pratt, Thomas R., Christopher J. Richards, Katherine A. Milla, Jeffry R. Wagner, Jay L. Johnson, and Ross J. Curry, 1996. Hydrogeology of the Northwest Florida Water Management District. Water Resources Special Report 96-4. October.

Southern Company, 2018. 2017 Annual Groundwater Monitoring and Corrective Action Report. Gulf Power Company – Plant Smith Ash Pond. January.

USEPA, 2015. Use of Monitored Natural Attenuation for Inorganic Contaminants in Groundwater at Superfund Sites. Office of Solid Waste and Emergency Response, Directive 9283.1-36. August.

TABLE

TABLE 1: GROUNDWATER MONITORING LOCATION DETAILS
Florida Power & Light Company - Plant Smith Ash Pond, Bay County, Florida

Monitoring Location	Installation Date	Northing	Easting	Ground Elevation	Top of Casing Elevation	Top of Screen Elevation	Bottom of Screen Elevation	Designation
CCR Groundwater Monitoring Network								
MW-01	11/11/2015	464368.78	1589789.76	11.09	10.75	1.15	-8.85	Piezometer
MW-02	11/10/2015	464419.66	1592286.78	10.26	13.29	-2.71	-12.71	Background
MW-03	11/10/2015	464322.49	1594277.21	10.98	14.06	-8.94	-18.94	Background
MW-04	11/7/2015	464027.17	1591388.60	12.00	15.05	2.25	-7.75	Piezometer
MW-05	11/4/2015	463987.97	1592784.03	11.18	14.13	-1.97	-11.97	Piezometer
MW-06	11/17/2015	463858.80	1591389.13	24.18	23.82	-5.38	-15.38	Downgradient
MW-07	11/3/2015	463856.65	1592774.97	21.72	21.42	-7.88	-17.88	Downgradient
MW-08[3]	11/17/2015	461649.15	1590479.94	21.33	24.31	-8.39	-18.39	Downgradient
MW-09[3]	11/17/2015	460663.62	1590695.95	12.49	15.37	-6.73	-16.73	Downgradient
MW-10[3]	11/20/2015	461234.34	1592098.52	10.94	13.93	-8.67	-18.67	Downgradient
MW-11[3]	11/21/2015	462157.18	1593298.86	13.42	16.51	-6.49	-16.49	Downgradient
MW-12	11/11/2015	462362.00	1589322.96	8.21	11.14	-10.56	-20.56	Background
MW-13[3]	11/11/2015	462676.94	1590589.33	23.53	26.54	-6.36	-16.36	Downgradient
MW-14[3]	11/10/2015	460892.89	1590173.47	22.11	24.95	-5.69	-15.69	Downgradient
Groundwater Monitoring Locations for Delineation								
MWI-12A	Unknown	461669.34	1593482.68	Unknown	9.82	4.32	-5.68	Delineation Well
PZ-11D[3]	12/5/2018	462128.91	1593287.38	10.55	13.51	-34.45	-44.45	Delineation Piezometer
PZ-14	12/4/2018	462584.13	1590334.98	10.08	9.87	-4.92	-14.92	Delineation Piezometer
PZ-13D[3]	12/6/2018	462700.23	1590586.00	23.54	26.44	-20.46	-30.46	Delineation Piezometer

Notes:

1. Northing and easting are in feet relative to the State Plane Florida North Datum of 1983.
2. Elevations are in feet relative to the North American Vertical Datum of 1988.
3. Monitoring well/piezometer was abandoned in August 2020 to facilitate CCR unit closure.

FIGURES

Legend

Approximate Ash Pond Boundary (CCR Unit)

Approximate Property Boundary

Notes:
1. CCR indicates Coal Combustion Residuals.
2. Source of 2020 World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.
3. Source of inset World Street Map: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community.

Site Location Map

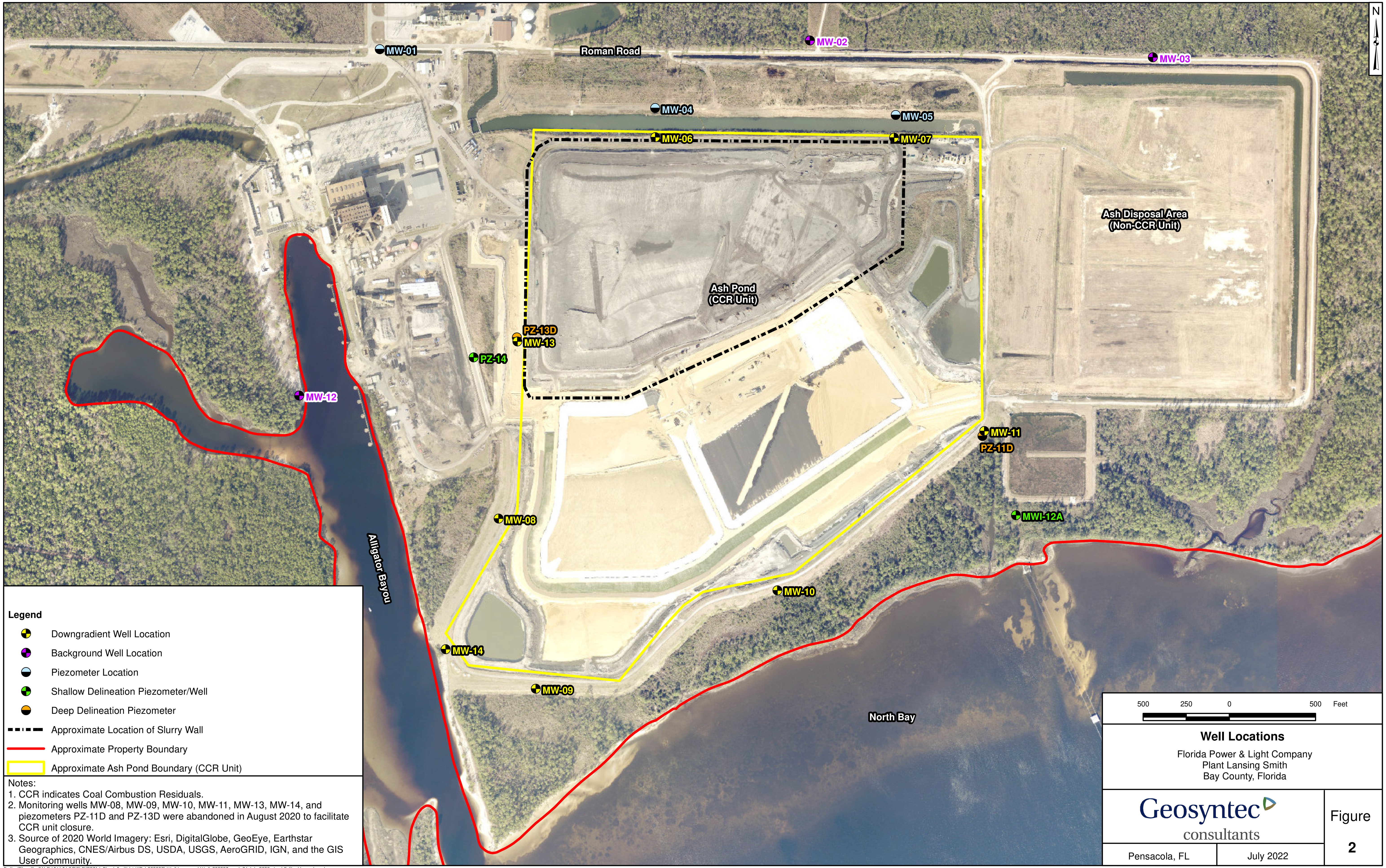
Florida Power & Light Company
Plant Lansing Smith
Bay County, Florida

Geosyntec consultants

Pensacola, FL | July 2022

Figure 1

Path: (Titusville-01\DATA) \\Titusville-01\Data\0GIS\TXR0714_Plant_Smith\MXDs\202010\SiteLocationMap_PlantSmith.mxd 10 November 2021. Last Edited by: CSaville



Legend

- Downgradient Well Location
- Background Well Location
- Piezometer Location
- Shallow Delineation Piezometer/Well
- Deep Delineation Piezometer
- Approximate Location of Slurry Wall
- Approximate Property Boundary
- Approximate Ash Pond Boundary (CCR Unit)

Notes:
1. CCR indicates Coal Combustion Residuals.
2. Monitoring wells MW-08, MW-09, MW-10, MW-11, MW-13, MW-14, and piezometers PZ-11D and PZ-13D were abandoned in August 2020 to facilitate CCR unit closure.
3. Source of 2020 World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

Well Locations

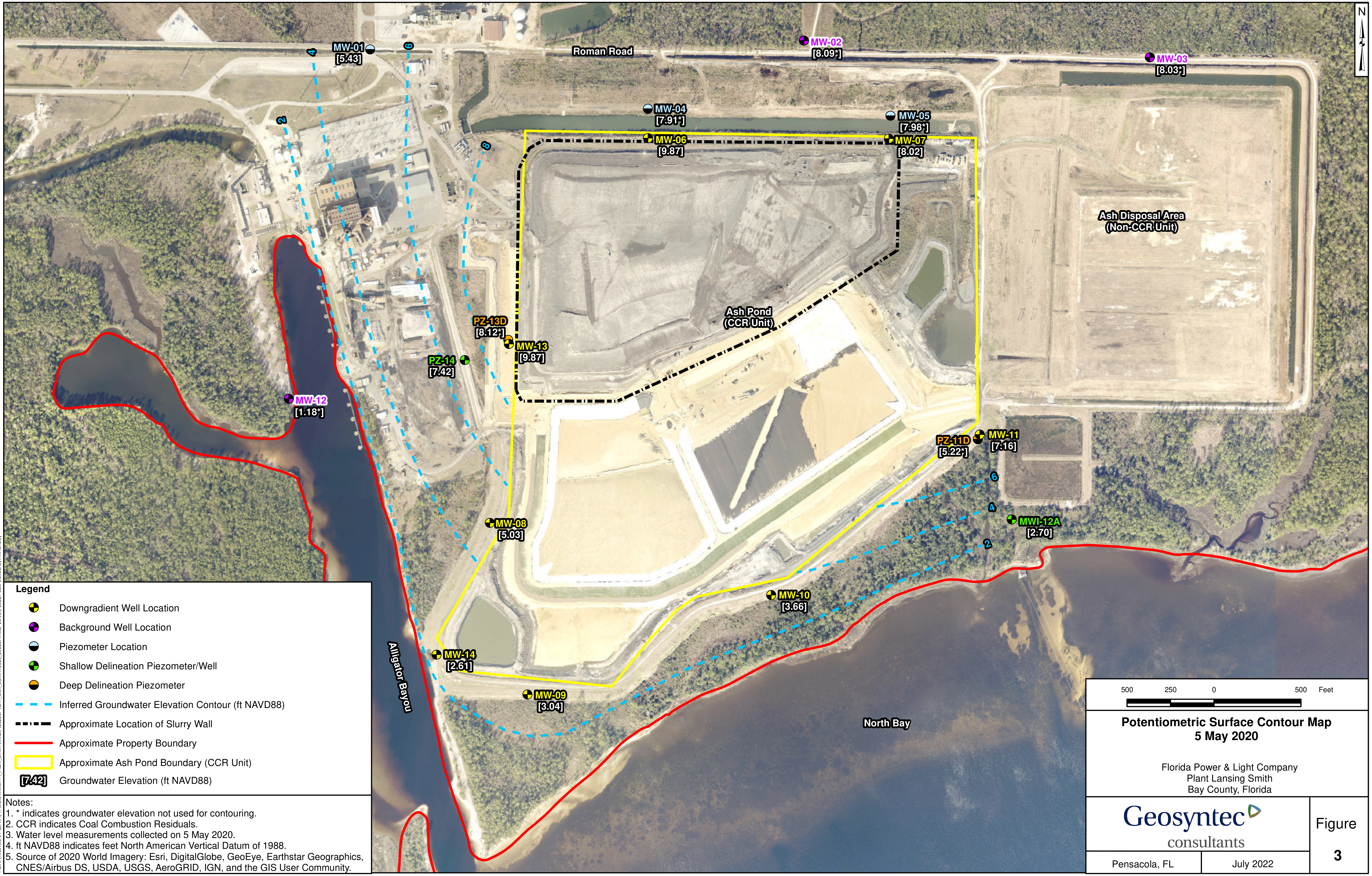
Florida Power & Light Company
Plant Lansing Smith
Bay County, Florida

Geosyntec consultants

Pensacola, FL | July 2022

Figure 2

Path: (Titusville-01\DATA) T:\0GIS\TXR0714_Plant_Smith\MXDs\202207\Well Locs and Wall_202207.mxd 26 July 2022. Last Edited by: mhensley



Legend

- Downgradient Well Location
- Background Well Location
- Piezometer Location
- Shallow Delineation Piezometer/Well
- Deep Delineation Piezometer
- Inferred Groundwater Elevation Contour (ft NAVD88)
- Approximate Location of Slurry Wall
- Approximate Property Boundary
- Approximate Ash Pond Boundary (CCR Unit)
- [7.42] Groundwater Elevation (ft NAVD88)

Notes:
1. * indicates groundwater elevation not used for contouring.
2. CCR indicates Coal Combustion Residuals.
3. Water level measurements collected on 5 May 2020.
4. ft NAVD88 indicates feet North American Vertical Datum of 1988.
5. Source of 2020 World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

Potentiometric Surface Contour Map
5 May 2020

Florida Power & Light Company
Plant Lansing Smith
Bay County, Florida

Geosyntec consultants

Pensacola, FL | July 2022

Figure 3

APPENDIX A
SUMMARY OF SOURCE CONTROL AND SLURRY WALL MEASURES (GOLDER, 2022)

REPORT

Summary of Source Control and Slurry Wall Measures

Plant Smith Ash Pond

Submitted to:

Florida Power & Light Company

Submitted by:

Golder Associates USA Inc.

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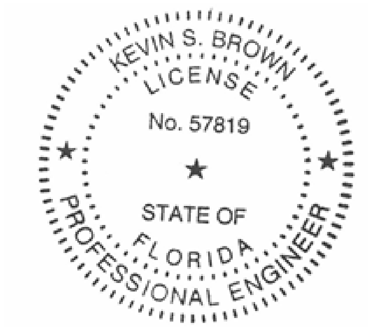
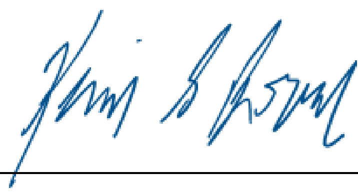
July 2022

Certification Statement

This *Supplemental Information for Remedy Selection Report Summary of Source Control Measures – Plant Smith Ash Pond* has been prepared in general accordance with the requirements of the United States Environmental Protection Agency Coal Combustion Residuals Rule (40 Code of Federal Regulations (C.F.R.) Part 257, Subpart D) under the supervision of a State of Florida licensed Professional Engineer with Golder Associates USA Inc. – Member of WSP.





7/29/2022

Kevin S. Brown, P.E.
Florida Professional Engineer No. 57819

Date

Table of Contents

1.0 INTRODUCTION

The purpose of this report is to provide supplemental information for the Remedy Selection Report (RSR) prepared by Geosyntec Consultants for the Smith Generating Electric Plant (Plant Smith) Ash Pond, located in Southport, Florida. WSP Golder serves as the Engineer of Record for the Ash Pond closure project and is responsible for the design aspects of the closure, which includes source control measures as discussed herein. The closure design and Closure Plan for Plant Smith were prepared in accordance with the United States Environmental Protection Agency's (EPA) "Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments" Final Rule (40 C.F.R. Part 257, Subpart D) and meets the requirements of 40 C.F.R. §257.102 for closure of CCR surface impoundments. The closure plan was submitted and approved by the Florida Department of Environmental Protection.

2.0 DESCRIPTION OF SOURCE CONTROL

2.1 Capping and Consolidation of Ash Footprint

The closure method for the facility consists of closure in place of CCR with a consolidated CCR footprint (final closure area) and closure is currently in progress. The total estimated volume of CCR in the ash pond is approximately 4,200,000 cubic yards, with approximately three million cubic yards to be relocated to the final closure area. In general, CCR is being excavated from the southern and eastern areas of the pond and relocated to the northwest corner over existing CCR materials. Areas where CCR is being relocated to the final closure area include the southwestern and southern perimeter dikes as well as areas east of the final closure area. The consolidated final closure area is approximately 64 acres, while the original ash pond footprint comprises about 193 acres (including perimeter berms). The consolidation results in an approximate 67% reduction in footprint of CCR.

Along the northern and eastern boundaries of the final closure area, the existing CCR perimeter berm is being excavated and replaced with structural fill as needed to maintain site grades necessary for stormwater management. The final perimeter berm in these areas includes placed and compacted structural fill.

The entire final closure area, including the perimeter berm, is to be capped with ClosureTurf™ final cover system such that all remaining CCR is covered. A perimeter channel is located on the inside of the final perimeter berm and directs stormwater runoff from the closure area to industrial wastewater ponds located south and east of the final closure area. The final closure grades are estimated to be eight percent, with potential revisions as required based on actual CCR quantities relocated, placed and compacted.

The ClosureTurf™ system consists of the following layers from top to bottom:

- ClosureTurf™ consisting of a combined geotextile and engineered turf layer with sand infill or concrete infill (Hydrobinder®)
- A 40-mil linear low density polyethylene geomembrane over the final closure area including the perimeter channel
- A 50-mil linear low density Supergripnet geomembrane liner over the slopes of the perimeter berm and the final perimeter access road
- Compacted CCR or earthen subgrade material

A schematic of the typical final cover system is shown on the following page. The perimeter channel side slopes include Hydrobinder® to minimize erosion of the sand infill, and the bottom of the perimeter channel includes no infill, and instead includes a one-foot layer of rip rap as ballast and drainage stone.

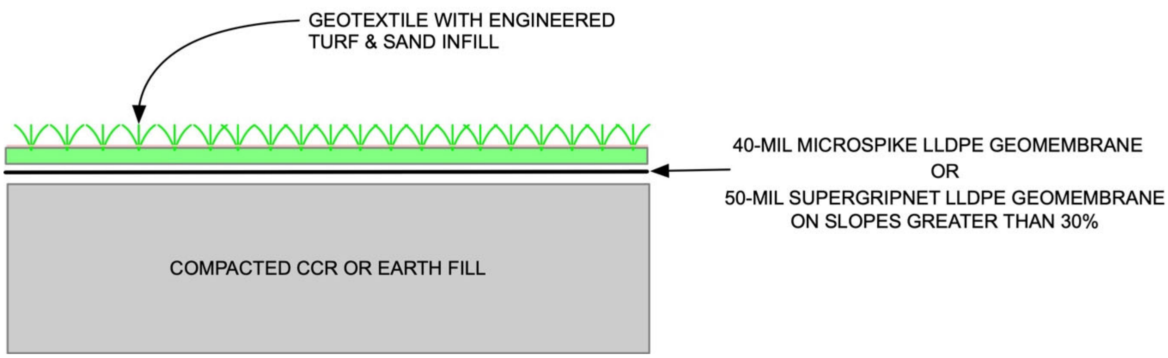


Figure 1 – Typical Final Cover System at Plant Smith

The closure plan includes construction of three new industrial wastewater ponds located south and east of the final closure area. Construction of two lined ponds is complete and excavation of the third unlined pond is ongoing. The westernmost pond (reclaim pond) is double lined (two geomembrane liners, a geosynthetic clay liner, and a leak detection system) with an underdrain system and was originally designed to store reclaim water for plant operations. The reclaim water project is no longer being implemented; thus, this pond currently stores industrial wastewater. This pond is not designed to receive stormwater runoff from the final closure area.

The center pond (lined wastewater pond) is lined with a single geomembrane and geosynthetic clay liner and underdrain system to prevent uplift pressure on the liner system. This pond will receive stormwater runoff from approximately 23 acres of the final closure area and is also designed to receive industrial wastewater and stormwater from the plant facility. Discharge from this pond is to the easternmost pond over a designed spillway between the two ponds. Water can also be pumped from this pond for use in plant operations in the future.

The easternmost pond (unlined wastewater pond) is unlined on the bottom and will receive discharge from the center pond and stormwater runoff from approximately 41 acres of the final closure area that is not routed to the center pond. The side slopes of this pond are lined with ClosureTurf™ and hydrobinder infill to protect the slopes from erosion due to wind and wave action during heavy storms. Water is discharged from this pond through a spillway structure to a designed channel north of the final closure area, which discharges from the site at the northwest corner of the final closure area. This discharge is authorized and is required to be monitored in accordance with the facility's NPDES permit issued by the Florida Department of Environmental Protection (FDEP) pursuant to Florida's EPA-approved NPDES permit program.

3.0 SUBSURFACE DRAIN

3.1 Toe Drain Collection System

Consolidation of the footprint requires a cut (excavation) slope in the CCR around the perimeter of the final closure area. This cut slope is designed as a 4H:1V (25 percent grade) to promote stability during construction of the structural fill perimeter berm. Remnant drainage may occur on this slope from the CCR materials; thus, a geocomposite drainage layer is placed on this slope to collect the remnant drainage and direct the collected water to the toe drain system.

The toe drain is installed at the toe of the cut slope around the entire perimeter of the closure area. The elevation of this toe drain is dependent on the actual bottom of the CCR materials as excavation progresses but is at a nominal elevation of –4 ft-Mean Sea Level (MSL). Along the toe drain, outlets are designed at a spacing of approximately 400 linear feet (LF), with localized adjustments based on actual bottom of CCR elevations. These adjustments are designed to provide outlets at localized low points in the toe drain based on as-built survey information to facilitate collection of post closure remnant drainage.

There are a total of 24 outlets along the perimeter of the toe drain. These outlets consist of a solid pipe connection from the toe drain to a concrete manhole. At each manhole, a pneumatic pump capable of pumping up to 10 gallons per minute is installed. These pumps are fitted with internal sensors to maintain a minimum level of water above the pump. These pumps only cycle when there is sufficient head pressure; thus, there is no risk of damage to the pumps from dry conditions.

The following schematic shows a typical cross-section of the perimeter of the final closure area.

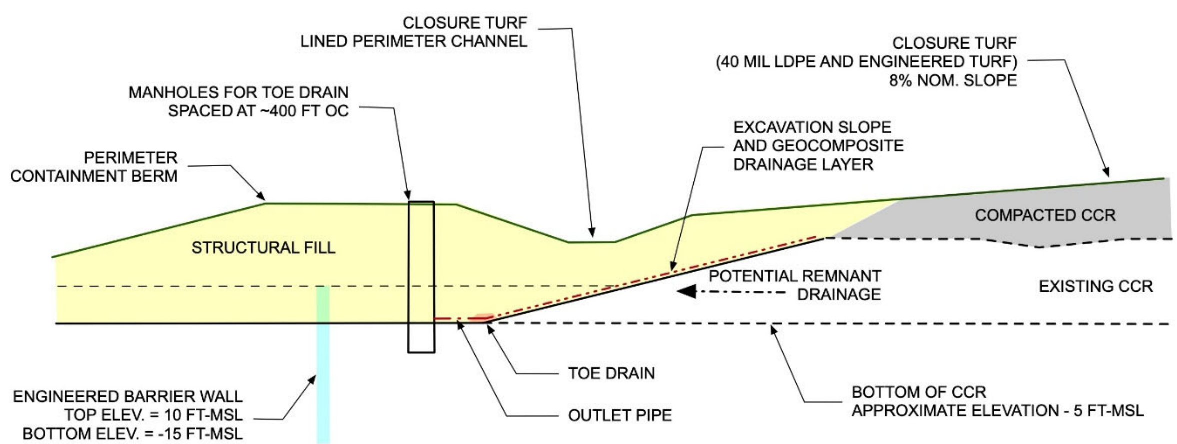


Figure 2 – Cross Section of Perimeter Final Closure Area at Plant Smith

3.2 Toe Drain Force Main

Water collected in the toe drain system is pumped to a force main that is installed around the perimeter of the closure area. This force main is designed to discharge water to the center lined pond where it will mix with stormwater and industrial wastewater before ultimately being discharged through the facility's NPDES permitted discharge location. The force main is installed within the perimeter berm between the ponds and the closure area and at the toe of the perimeter berm along the western and northern boundaries of the closure area.

4.0 ENGINEERED BARRIER WALL (SLURRY WALL)

The engineered subsurface perimeter barrier wall is designed as a slurry wall installed around the entire perimeter of the final closure area from elevation 10 ft-MSL to elevation -15 ft-MSL (total depth of 25 feet, see schematic in Section 3.1). The maximum permeability of the slurry wall is designed to be 1 x 10^{-7} cm/s and the wall is constructed by mixing natural subsurface soils and structural fill with a minimum three percent bentonite by weight using in-place mixing methods.

A laboratory testing program was conducted as part of the slurry wall design process. This program included mixing various percentages of bentonite with samples of subsurface soils and testing the permeability and grain size of the final mixture. Confining pressures for the lab permeability tests were 5 pounds per square inch (psi)

Field construction quality assurance (CQA) is conducted during installation of the slurry wall. The field CQA program involved obtaining samples of the soil-bentonite mixture at a rate of one sample per 20,000 cubic feet (approximately every 400 feet of wall length) and testing a remolded sample for permeability in accordance with ASTM D5084.

During construction, the slurry wall specification restricts crossing the wall except in designed locations to protect the integrity of the wall. In areas where additional perimeter berm structural fill is placed over the wall, a geogrid and two-foot-thick bridge layer is placed over the wall to protect the wall from damage by compactors and other construction equipment.

5.0 SOURCE CONTROL EVALUATIONS

5.1 Scenario Evaluations

Groundwater modeling was used to evaluate the potential interaction between the final closure area and the local aquifers. The analysis was completed using MODFLOW 2000 for flow direction and magnitude. This model uses a finite-difference approach to approximate the partial-differential flow equations and is based on flow through a three-dimensional array of cells. The graphic pre- and post-processor program, Groundwater Vistas Version 6 (Environmental Simulations, Inc.), was used to facilitate model input and output.

The existing conditions model was developed to match the general topography of the site, based on an existing conditions topographic survey from 2016 prior to pond closure activities. The stratigraphy is based on data collected from previous geotechnical investigations and field investigations. The top elevation of the model was generally set at 5 feet MSL, with elevations varying across the site based on the topographical data. The general thickness of each layer and the corresponding aquifer unit are as follows:

- Layer 1: Generally 5 feet, Holocene Sands and CCR (within the storage area),
- Layer 2: Generally 10 feet, Holocene Sands,
- Layer 3: 28 feet, Intracoastal Formation,
- Layer 4: 32 feet, Intracoastal Formation, and
- Layer 5: 218 feet, Upper Floridan Aquifer,

The layers yield a general total model thickness of 293 feet with some areas thicker depending on the surface topography. Layers 1 and 2 represent one stratigraphic unit that was subdivided to accurately model the thickness and presence of the CCR. Layers 3 and 4 also represent one stratigraphic unit that was subdivided to match observed differences in hydraulic conductivity within the unit. The developed conditions model adds a third subdivision to the Intracoastal Formation to allow partial penetration of the proposed slurry wall into the lower section of the unit.

Consistent with local geology, the model implicitly places no-flow boundaries at the bottom of the lowest layer.

The proposed design of the closure, including final cap, subsurface drainage system and slurry wall is discussed in Section 2.

5.1.1 Baseline Scenario (Capping & Consolidation Only)

The baseline scenario consists of the final closure conditions as described in Section 2.1 without any hydraulic controls (i.e., the slurry wall, toe-drain and pond underdrains).

5.1.2 Slurry Wall Only

Four different slurry wall configurations were modelled. The model configurations can be summarized as:

1) Slurry wall to elevation -38 ft NAVD88 south of North Drainage Canal (SW-1)
2) Slurry wall to elevation -38 ft NAVD88 spans perimeter of final closure area (SW-2)
3) Slurry wall to elevation -38 ft NAVD88 north of north drainage canal (SW-3)
4) A deeper slurry wall to elevation -50 ft NAVD88 that spans perimeter of final closure area (SW-4)

5.1.3 Slurry Wall and Subsurface Drainage

Additional models were developed that included a toe drain along the toe of the CCR excavation surface. These included a model with a toe drain only and the four slurry wall scenarios with a toe drain included. TD-1 scenario consisted of the final closure conditions but included a toe-drain along the east and south of the CCR storage area without a slurry wall. The same four slurry wall configurations modelled for the slurry wall only were run including a toe drain system.

TD-UD-1 scenario included both toe-drain and pond underdrains but no slurry wall. A single slurry wall configuration was modelled using the toe drain and underdrain: a slurry wall to elevation -38 ft NAVD88 spanning the permitter of proposed CCR storage area (i.e., the same slurry wall configuration as the second scenario modelled for Baseline #1 and #2).

5.1.4 Model Results

A summary of the results of the modelling are included in Table 1.

Table 1: Summary of results from modelling with differing slurry wall configurations for baseline conditions

Scenario	Configuration	Slurry Wall Depth (ft NAVD88)	Remnant Drainage (ft^3/day)	Remnant Drainage % Change from Baseline Condition	Toe Drain Outflow (ft^3/day)	Canal Outflow (ft^3/day)
Baseline	No hydraulic controls (slurry wall or drain)	NA	6.12	NA	NA	262
SW-1	Slurry wall covers south of North Drainage Canal	-38	4.47	-27	NA	380
SW-2	Slurry wall spans perimeter of proposed final closure area	-38	2.43	-60	NA	381
SW-3	Slurry wall north of north drainage canal and north slope of proposed final closure area	-38	5.43	-11	NA	230
SW-4	As SW-2 with deeper slurry wall	-50	2.35	-62	NA	386
TD-1	As Baseline with Toe Drain at 4ft MSL invert elev.	NA	82.72	1,252	1,989	262
SW-TD-1	As SW-1 with toe drain	-38	83.96	1,272	1,857	320
SW-TD-2	As SW-2 with toe drain	-38	6.46	6	1,514	325
SW-TD-3	As SW-3 with toe drain	-38	96.03	1,469	1,982	153
SW-TD-4	As SW-2 with toe drain and deeper slurry wall	-50	3.12	-49	1,513	330
TD-UD-1	As baseline with Toe Drain and pond underdrains	NA	67.02	995	1,614	234
SW-TD-UD-2	As SW-2 with toe drain and pond underdrains	-38	6.00	-2	1,137	302

The model results summarized in Table 1 indicate the following:

- SW-1: Adding a slurry wall north of the site between the north drainage canal and the final closure area results in moderate decrease in remnant drainage from baseline conditions because groundwater recharge to the CCR closure area is reduced by the slurry wall. This also increases outflow in the drainage canal as head builds up behind the slurry wall and eventually discharges to the canal.
- SW-2: Extending the slurry wall around the perimeter of the closure area further decreases remnant drainage and outflow from the canal remains unchanged from SW-1
- SW-3: Installing a slurry wall north of the north drainage canal only reduces remnant drainage by 11 percent and moderately reduces outflow from the canal.

- SW-4: Increasing the slurry wall depth from elevation -38 ft NAVD88 to -50 ft NAVD88 only provided a marginal benefit (2% to 4%) of reduced remnant drainage with no toe drain.
- TD-1: Installing a toe drain without a slurry wall increases remnant drainage from the baseline scenario because the toe drain lowers the hydraulic head in the downgradient areas of the CCR storage which induces an increase in flow from the upgradient areas. The toe drain also captures substantial groundwater flow from upgradient areas.
- SW-TD-1: Adding a toe drain to SW-1increases remnant drainage and canal outflow over TD-1 because the toe drain induces an increase in groundwater flank flow around SW-1.
- SW-TD-2: There is reduced remnant drainage compared to other toe drain – slurry wall configurations. The slurry wall extends around the entire perimeter of the CCR storage area and reduces upgradient and lateral inflows.

Adding toe drains generally increases the outflow of remnant drainage. This is because the toe drains induce a lower head in the downgradient areas resulting in an increase in flow from the CCR storage area and upgradient groundwater that migrates under the slurry wall; however, the groundwater model shows that this increased outflow is completely captured in the drainage system.

The greatest reduction in remnant drainage is provided by a perimeter slurry wall; however, though reduced, the remnant drainage is not being captured. Addition of a toe drain causes an increase in remnant drainage for all scenarios, but also provides capture of the remnant drainage. When a perimeter slurry wall is combined with a toe drain, this reduces remnant drainage when compared to other slurry wall – toe drain configurations. Note that the toe drain and slope drain “geocomposite” is also designed to improve structural stability of the perimeter berm as it serves as a pressure relief layer and prevents saturation of the perimeter berm.

The pond underdrain system is not part of the remediation system. The pond underdrain system is used to prevent uplift to the lined ponds; the underdrain does not provide any remedial benefits for the selected slurry wall and toe drain option.

As the toe-drain system was to be incorporated around the perimeter of the ash pond, and because of the lack of a confining layer, further modelling was completed to optimize the slurry wall depth.

The slurry wall depth was designed to contain groundwater that may potentially be in contact with CCR. Modelling was performed to optimize the slurry wall depth. Particle trace modelling was used for slurry walls to a depth of -5, -10 and -15 ft NAVD88 over a 50-year run period. The results showed that for a slurry wall to an elevation of -15 ft NAVD88 particles do not go beyond the slurry wall, i.e., according to the model, existing groundwater within the CCR does not move beyond the slurry wall over a 50-year time period. Upgradient groundwater flow will continue from the north and travel below slurry wall.

6.0 SELECTED SCENARIO

6.1.1 Slurry Wall Optimization

Following the optimized configuration and depth of the slurry wall, three additional scenarios were modelled. These included:

- Baseline: No wall, no toe drain (results provided in Table 1)
- Scenario 1: Perimeter slurry wall to el. -15 ft NAVD88, no toe drain
- Scenario 2: Perimeter slurry wall to el. -15 ft NAVD88, with toe drain

The slurry wall was modelled to a depth of el. -15 ft NAVD88. The toe drain was modelled at el. +5 ft NAVD88 and extended around the perimeter of the final closure area. In previous models the toe drain was installed in the east and south of the final closure area at an elevation of +4 ft NAVD88. The extension of the toe drain caused the model outputs to show increased outflows compared to previous models.

- Scenario 2 was selected for construction.
- Modelling results are included in Table 2:

Table 2: Results of final modelling scenarios. Remnant Drainage is higher than previous model runs because the toe drain is extended around the entire perimeter of the final closure area

Scenario	Extent of Slurry Wall	Toe Drain	Slurry Wall Depth (ft NAVD88)	Remnant Drainage (ft^3/day)	Remnant Drainage % Change from Baseline Conditions	Toe Drain Outflow (ft^3/day)	Canal Outflow (ft^3/day)
1	Perimeter slurry wall	No	-15	4.73	-23	NA	272
2	Perimeter slurry wall and toe drain	Yes	-15	159	2,498	1,740	145

6.1.2 Expected Performance

As mentioned above, the selected remedy included a perimeter slurry wall extended to el. -15 ft NAVD88 along with a perimeter toe drain at el. +5 ft NAVD88. Pond underdrains were also included but this was because of uplift to the pond liners rather than the remedial effort.

Based on the modelling, the anticipated performance flows are:

- Remnant drainage from the CCR: approximately 159 ft^3/day or 0.8 gallons per minute (gpm)
- Total Toe drain outflow: approximately 1,740 ft^3/day or 9 gpm

The toe drain is anticipated to intercept groundwater flow from upstream of the final closure area. Based on groundwater modeling runs spanning more than 50 years, particle tracing shows that the slurry wall and toe drain are anticipated to retain and collect remnant drainage.

7.0 SOURCE CONTROL SELECTION

7.1 Overview and Regulatory Requirements

The overall closure design is described in Section 2 of this report. Source control essentially includes reducing the footprint of the existing ash pond by two-thirds, installing a low permeability final cover over the remaining CCR, installing a subsurface drain to collect remnant drainage from the CCR materials, and installing an engineered barrier wall (slurry wall) around the entire footprint of the final closure area.

Performance criteria for selection of the remedy are provided in 40 C.F.R. §257.97(b). These criteria are discussed below in the context of the source control provided by the closure design for the Plant Smith Ash Pond.

8.0 STANDARDS FOR REMEDY SELECTION

Standards for remedy selection are provided in 40 CFR §257.97(b). Each standard is briefly discussed below.

8.1 Protective of Human Health and the Environment

§257.97(b)(1) – The selected remedy must be protective of human health and the environment.

Source control of the CCR is achieved through consolidating the footprint, capping the remaining CCR, installing a subsurface drain and slurry wall. Capping the material prevents direct contact with the CCR and restricts infiltration of stormwater into the CCR. Remnant drainage from the remaining CCR is collected in a perimeter toe drain system. This drainage is prevented from migrating offsite in the subsurface via a slurry wall. These measures are considered protective of human health and the environment because they are designed to isolate, contain, and collect water from the CCR in the final closure area so as to reduce or eliminate further releases of Appendix IV constituents into the environment.

8.2 Attain Groundwater Protection Standards

§257.97(b)(2) – The selected remedy must attain the groundwater protection standard (GWPS).

Containment and collection of remnant water draining from the CCR prevents recharge of this water to surrounding groundwater areas. Collectively, isolating and containing water within the closure area significantly supports monitored natural attenuation (MNA) and ultimately facilitates attainment of groundwater protection standards.

8.3 Control the Source of Release

§257.97(b)(3) – The selected remedy must control the source(s) so as to reduce or eliminate, to the maximum extent feasible, further releases of Appendix IV constituents into the environment.

The final cap system essentially eliminates future surface infiltration. Remnant drainage from the CCR will be controlled by the combination of the toe drain system and slurry wall that encompasses the final closure area. The geocomposite drain installed on the excavation slope of the CCR is designed to collect remnant drainage through the excavation face and direct the collected drainage to the toe drain system. The toe drain system is designed to collect and pump the collected drainage water for discharge and monitoring at the facility’s NPDES discharge point. Finally, the slurry wall prevents migration of groundwater impacted from CCR via a low permeability barrier. Groundwater that contacts the slurry wall will result in a build-up of head which will direct remnant drainage from the CCR to the perimeter toe drain system.

8.4 Removal of Material Released from the CCR Unit

§257.97(b)(4) – The selected remedy must 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.

The closure plan and associated source control measures include reducing the existing footprint of the CCR unit by two thirds. CCR material removed from the areas surrounding the final closure area is first dewatered prior to excavation. Dewatering is conducted via rim ditches and well points and water removed from the CCR is treated onsite and discharged in accordance with FDEP issued permits for the site. Following excavation, the CCR is

moisture conditioned and placed and compacted in the final closure area. The material is capped once reaching final grades.

8.5 Comply with Standards for Management of Waste

§257.97(b)(5) – The selected remedy must comply with standards for management of wastes as specified in § 257.98(d).

During closure construction, waste materials to be managed include the CCR as well as water in contact with the CCR. The CCR is contained within the limits of the final closure area and is placed and compacted in accordance with the approved closure plan prior to capping. Water that is removed or dewatered from the CCR is contained onsite in pore water storage ponds for temporary storage. Water is pumped from the pore water storage ponds to the onsite treatment plant where it is treated and discharged in accordance with the facility's FDEP issued permits.

9.0 EVALUATION FACTORS FOR REMEDY SELECTION

Evaluation factors to be considered during remedy selection are provided in 40 CFR § 357.97(c). Each evaluation factor is described below.

9.1 Long- and Short-Term Effectiveness

Control of the source is considered key to long- and short-term effectiveness of the remedy. In the short term, CCR outside of the final closure area is dewatered prior to excavation and relocation to the final closure area. Water removed from the CCR prior to excavation and relocation is treated onsite and discharged in accordance with FDEP issued permits for the site. This essentially removes potential sources for groundwater impacts in the short term from excavation areas during the closure period. Further, the slurry wall and toe drain system is installed as construction progresses, further enhancing short-term performance of the remedy within the final closure area.

Over the long term, the combination of the slurry wall and subsurface drainage system effectively contains and captures remnant drainage from the final closure area, while the final capping system significantly reduces future infiltration. During the post closure period, the closure design focuses on long term reduction of infiltration and long-term management of remnant drainage from the CCR.

9.2 Remedy Effectiveness in Controlling the Source to Reduce Further Releases

As discussed in prior sections, source control includes the following major features:

- Dewatering of the CCR to be relocated to the final closure area and treatment of this water in accordance with approved site permits. Removal of this water is considered a highly effective source control measure because the water is not just contained, it is effectively removed from the excavation areas;
- Consolidation of the CCR to a significantly smaller footprint that is capped to essentially eliminate infiltration, thereby reducing water levels within the CCR closure area over the long term;
- Installation of a subsurface drainage system that is designed to collect remnant drainage from the CCR and remove it via pumps for treatment through the onsite industrial wastewater ponds and ultimately discharged in accordance with the facility's FDEP issued permits;
- Installation of a slurry wall that is designed to contain remnant drainage from the CCR and cut-off infiltration of groundwater from areas north of the closure area.

Thus, the combination of eliminating water in contact with the CCR from the excavation areas, reducing future infiltration in the final closure area, and installing systems to contain and collect remnant drainage from the existing CCR provides an effective remedy in controlling the source and reducing further releases.

9.3 Ease of Implementation

The final cover system has been designed to facilitate installation and long-term performance. Synthetic turf is used in lieu of a vegetative soil layer that may be subject to frequent erosion during storm events. No borrow areas are available on the site without impacts to wetlands, which would need to include appropriate permits. If a two-foot-thick soil cover were used in lieu of the synthetic turf system, the volume of soil required for the closure would be over 200,000 cubic yards. This volume of material would take approximately five months to install if borrow soil could be procured and placed at a rate of 1,500 cubic yards per day. The closure turf system can be installed at a rate of approximately one acre per day, requiring about two months for the entire closure cover system installation.

The toe drain system is installed as the excavation slope progresses. This system includes a perforated pipe and associated gravel drainage layer that is installed along the toe of the excavation that connects to the geocomposite layer installed over the excavation slope face. Following installation of the toe drain, structural fill is placed over the toe drain to an elevation of 10 ft-MSL to provide a stable platform for installation of the slurry wall. This flat, consistent elevation facilitates access of the slurry wall equipment and provides for a consistent depth that can be easily tracked.

9.4 Community Input

A public meeting to discuss the *Assessment of Corrective Measures Report, Gulf Power Company – Plant Smith Ash Pond* (Geosyntec, 2019) was held in accordance with 40 C.F.R. §257.96(e) in Southport, Florida on December 18, 2020. Notice of the public meeting was provided on December 11, 2020, in the Panama City News Herald.

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APPENDIX B
MONITORED NATURAL ATTENUATION (MNA) EVALUATION

Prepared for

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MONITORED NATURAL ATTENUATION EVALUATION

FLORIDA POWER & LIGHT COMPANY PLANT SMITH ASH POND

Prepared by

Geosyntec consultants

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1120 North 12th Avenue
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Project Number FR8308

July 29, 2022

CERTIFICATION STATEMENT

This *Monitored Natural Attenuation Evaluation, Florida Power & Light Company Plant Smith – Ash Pond* has been prepared in under the supervision of a State of Florida licensed Professional Engineer and Professional Geologist with Geosyntec Consultants, Inc.

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1 INTRODUCTION

1.1 Purpose and Scope

On behalf of Florida Power & Light Company (FPL), Geosyntec Consultants, Inc. (Geosyntec) prepared this *Monitored Natural Attenuation (MNA) Evaluation Report* (Report) for FPL's Plant Lansing Smith (Site or Plant Smith) Ash Pond, a coal combustion residuals (CCR) unit.

The purpose of this Report is to document the applicability of MNA as a corrective measure for statistically significant levels (SSLs) of arsenic and lithium in groundwater downgradient of the Ash Pond. MNA was identified as a potential remedial component for groundwater in the *Assessment of Corrective Measures (ACM) Report* (Geosyntec, 2019). MNA relies on natural attenuation processes (e.g., mineral precipitation, sorption, dilution, dispersion, etc.) to reduce dissolved concentrations of inorganic constituents in groundwater below remediation standards within a reasonable timeframe. Attenuation mechanisms are constituent- and site-specific. MNA is most appropriate as a groundwater remedial component when coupled with source control measures, which is planned at Plant Smith.

The MNA evaluation was completed using a tiered approach, consistent with guidance for inorganic constituents by the United States Environmental Protection Agency (USEPA, 2015), the Interstate Technology and Regulatory Council (ITRC, 2010), and the Electric Power Research Institute (EPRI, 2018). In the tiered evaluation, multiple lines of evidence were considered to demonstrate the applicability of MNA for groundwater corrective action coupled with source control at Plant Smith.

1.2 Site Overview

Plant Smith is located at 4300 Highway 2300, Bay County, Florida and is situated on approximately 1,560 acres. A Site location map is provided in **Figure 1**. The Site is bordered by undeveloped land to the north and east, Alligator Bayou to the west, and North Bay to the south.

The Ash Pond is located on the southern portion of the Site near North Bay. Fly ash, bottom ash, and other low-volume waste associated with coal-fired operations were sluiced to the Ash Pond. In March 2016 the plant ceased coal-fired operations. As such, no CCR material was sent to the pond after second quarter 2016. In April 2021, FPL completed necessary pre-closure activities and improvements in preparation to close the Ash Pond in accordance with the closure plan approved by the Florida Department of

Environmental Protection (FDEP) (Gulf Power, 2016) and ceased receipt of non-CCR wastewater. On May 9, 2021, the "Intent to Initiate Closure" for the Plant Smith Ash Pond was posted to the CCR web-site.

1.3 Groundwater Monitoring

Groundwater in the vicinity of the Ash Pond flows toward Alligator Bayou on the west side of the Ash Pond and toward North Bay on the southern side of the Ash Pond, as evidenced by historic potentiometric surfaces (**Figure 2a**).

FPL installed groundwater monitoring wells and piezometers comprising the CCR groundwater monitoring network to monitor groundwater within the uppermost aquifer in the vicinity of the Ash Pond. The current monitoring network is shown in **Figure 2b**, with construction details provided in **Table 1**.

Arsenic and lithium SSLs were identified above applicable groundwater protection standards (GWPS) at MW-11 and MW-13, respectively. Arsenic was horizontally and vertically delineated at MWI-12A and PZ-11D, respectively, where arsenic concentrations have remained below GWPS. Similarly, lithium was horizontally and vertically delineated at PZ-14 and PZ-13D, respectively, where lithium concentrations have remained below the GWPS. Delineation results are reported elsewhere (e.g., Geosyntec, 2019, 2021) and not repeated herein. Based on Site data, arsenic and lithium exceedances are spatially limited (localized) and the arsenic and lithium plumes remain on-Site; collectively, these results suggest ongoing natural attenuation.

1.4 Other Remedial Activities

Fly ash, bottom ash, and other low-volume wastes associated with coal-fired operations were sluiced to the Ash Pond until March 2016 when the facility ceased coal-fired operations. In 2021, FPL completed necessary pre-closure activities and improvements in preparation to close the Ash Pond in accordance with the FDEP-approved closure plan. The discharge of non-CCR wastewater to the Ash Pond was terminated in April 2021. A *Notification of Intent to Initiate Closure* was completed on May 7, 2021 and posted to the FPL CCR Website.

Other remedial activities, either planned and/or ongoing, at Plant Smith include the following, with additional information provided by Golder Associates Inc. (Golder, 2022):

- source control consisting of:
    - dewatering, consolidation, and capping of CCR; and
    - installation of a subsurface drain system; and
- a vertical barrier wall (referred to as a "slurry wall" herein)[1].

The closure plan was approved by the FDEP Northwest District Office Solid Waste Section on August 19, 2016.

Final closure certification is expected in the 2023-2024 timeframe. This in-place closure strategy will act to contain impacted materials (i.e., control the source of release) and reduce or eliminate future release of CCR constituents. MNA is most appropriate as a groundwater remedial component when coupled with source control, which is ongoing at Plant Smith.

[1] The slurry wall is part of the FDEP-approved closure plan. The addition of the slurry wall as a component of the closure plan was approved by FDEP on September 14, 2017.

2 MNA EVALUATION – ARSENIC

The results of the tiered MNA evaluation for arsenic are summarized below.

2.1 Tier I Analysis

Three objectives were identified for Tier I of the MNA evaluation:

- The first objective was to assess if there are source control measures in place and other key initial considerations.
- The second objective was to evaluate if the arsenic plume is stable or receding.
- The third objective was to evaluate if attenuation of arsenic is likely to occur under Site conditions.

Each objective for Tier I analysis of arsenic is discussed in the following subsections.

2.1.1 Initial Considerations

The first aspect of the Tier I analysis was to assess key initial considerations, including source control measures. This step serves as an initial screening approach before moving to subsequent steps.

For the reasons outlined below, further evaluation of MNA for arsenic is warranted:

- As discussed in Section 1.3, the arsenic plume is spatially limited (localized) and remains on-Site.
- As discussed in Section 2.1.2, arsenic concentrations have a decreasing trend at MW-11.
- As discussed in Section 1.4, the Site is currently undergoing source control; MNA is most appropriate as a groundwater remedial component when coupled with source control.

2.1.2 Plume Stability

The second aspect of the Tier I analysis was to evaluate if the arsenic plume is stable or receding. Evaluation of plume stability considered spatial extent, delineation results, and concentration trends.

For the arsenic SSL at MW-11, piezometer PZ-11D and well MWI-12A were used to delineate the vertical and horizontal extent of the arsenic plume, respectively. As discussed in Section 1.3, arsenic concentrations remain below the GWPS in delineation locations (e.g., Geosyntec, 2019, 2021). Based on Site data, the arsenic plume remains on-Site and is spatially limited (localized), suggesting plume stability.

The time series graph of arsenic concentrations at MW-11 is shown in **Figure 3**, indicating a decreasing trend of arsenic from 2016 to 2020 (P-value = 0.004; Mann-Kendall analysis)[2]. The arsenic concentration was 0.011 milligrams per liter (mg/L) at MW-11 in May 2020, compared to a GWPS of 0.010 mg/L. Decreasing concentrations of arsenic at MW-11 indicate ongoing natural attenuation of arsenic at the Site. The observed concentration decreases may be due to cessation of sluicing of fly ash, bottom ash, and other low-volume waste associated with coal-fired operations in 2016, pre-closure activities, and/or closure activities.

The plume stability and trend analyses will be revisited as additional monitoring data become available as part of the corrective action [long-term monitoring (LTM)] program during and following completion of other ongoing remedial measures (e.g., closure) at the Site.

2.1.3 Constituent Attenuation Mechanisms

The third aspect of the Tier I analysis was to evaluate if attenuation of arsenic is likely to occur under Site conditions. Arsenic is a geochemically reactive species and can undergo sorption/desorption and/or precipitation/dissolution processes depending on oxidation-reduction potential (ORP) and pH conditions in groundwater. Dissolved arsenic in groundwater systems is typically stable as As(III) (arsenite, often as $As^{III}[OH]_3$) or As(V) (arsenate, often as the oxyanion $As^{V}O_4^{3-}$). The As(V) form of arsenic is more readily attenuated than As(III) due to the overall negative charge of the $H_2AsO_4^-$ and $HAsO_4^{2-}$ oxyanions, which can form chemical bonds or electrostatic interactions with positively charged clay or mineral surfaces (Campbell and Nordstrom, 2014; Smedley *et al.*, 2002).

Measured ORP for MW-11 was -364 to -188 millivolts (mV) from February 2016 through November 2019 (average of -285 mV). In contrast, ORP was substantially more oxidizing at MWI-12 with ORP values in the range of 65 to 173 mV for three sampling events in 2019 (average of 103 mV). The average pH values at MW-11 and MWI-12A were 6.5 and 5.3 respectively for the same periods as above.

[2] MW-11 was abandoned in August 2020 to allow for pre-closure activities (i.e., removal of the perimeter dike system). Additional data beyond August 2020 is not available from MW-11.

The Eh-pH diagram for arsenic under the average redox conditions at MW-11 is presented in **Figure 4**[3]. As groundwater migrates downgradient from MW-11 to MWI-12A, more oxidizing conditions develop such that the dominant arsenic species is predicted to change from As(III) to As(V). As(V) is more prone to sorption to positively charged surfaces, including iron oxides or clay minerals, as compared to As(III) at the pH ranges of 6 and lower (EPRI, 2018); therefore, downgradient conditions at MWI-12A are more favorable for natural attenuation of arsenic via sorption than at MW-11. This evaluation indicates that attenuation of arsenic is likely to occur under Site conditions. Therefore, the MNA evaluation for arsenic proceeded to Tier II.

2.2 Tier II Analysis – Attenuation Mechanism and Rate

Since the Tier I analysis indicated Site conditions are conducive to natural attenuation of arsenic, a Tier II analysis was initiated to characterize the predominant attenuation mechanism(s) of arsenic. This consisted of (i) collection of groundwater and aquifer materials; (ii) batch attenuation testing; and (iii) assessing the rate of attenuation.

2.2.1 Groundwater and Aquifer Material Collection and Baseline Data

Field investigations were completed in August 2020 to collect Site materials for the Tier II MNA evaluation. These materials were analyzed to support evaluation of attenuation mechanism(s).

Geologic material was collected in August 2020 via direct push technology (DPT) at DPT-02 (A) adjacent to MW-11, and, to represent background, at DPT-01 (A) adjacent to piezometer MW-02. Samples were collected from 16 to 21.2 feet below ground surface (ft bgs) at DPT-02 (A) and 14.4 to 19.67 ft bgs at DPT-01 (A). Sample intervals were selected to overlap with the screen elevations of MW-11 and MW-02, respectively, and in part based on observed lithology.

Soil cores from each location were selected for baseline analysis of total sulfur, arsenic, iron, total organic carbon (TOC), and X-ray diffraction (XRD). Groundwater samples were collected from MW-11 and MW-02 in August 2020 following methods outlined previously (e.g., Geosyntec, 2021). Soil and groundwater samples were shipped to SiREM Laboratory in Ontario, Canada for baseline analysis and batch testing described below. Soil samples were also shipped to TestAmerica Laboratory in Pensacola, Florida

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[3] The Eh-pH analysis was completed in early 2020 and included data from 2016 to 2019 for MW-11 and, since MWI-12A became a delineation location 2019, only 2019 data for MWI-12A. A similar contrast in geochemical conditions between MW-11 and MWI-12A remains in data collected in 2020 and/or 2021.

for analysis via sequential extraction procedure (SEP). SEP testing can provide insight into the attenuation mechanism, capacity, and reversibility under specific conditions.

Baseline results are presented in **Tables 2 and 3**. Total arsenic concentrations were similar between the downgradient and background location, with averages of 7.3 and 6.2 micrograms per gram (µg/g) in DPT-01(A) and DPT-02(A), respectively. TOC ranged from 0.08% to 9.55% in the background location DPT-01(A) compared to 0.72% to 0.97% in DPT-02(A). The loss on ignition (LOI) averaged 3 to 5.7% (**Table 3**).

XRD results demonstrated the dominance of quartz (>90%), consistent with the sandy geology at the Site (**Table 3**). However, quartz is not generally a reactive phase for arsenic immobilization. XRD data also indicated the presence of approximately 5% kaolinite in the samples. Kaolinite, an aluminosilicate clay mineral, can also serve as a sorbent, with the extent of sorption substantially higher for As(V) than As(III) (Smedley *et al.*, 2002; EPRI, 2018).

SEP data are summarized in **Table 4** and indicate that 44-61% of total detectable arsenic was bound to phases labile to strong oxidants, such as those typically associated with organic fractions including soil organic matter or clay minerals (e.g., kaolinite). These data, in combination with the prevalence of organic matter identified via TOC and LOI, suggest sorption to organic matter associated with clay fractions under oxic conditions as one potential mechanism for arsenic attenuation (EPRI, 2015).

A relatively high concentration of sulfur was also detected in the above-mentioned geologic materials (averages of 4,300 to 5,850 µg/g; **Table 2**). The presence of sulfur, and especially sulfide, in the aquifer materials may indicate whether metals prone to precipitation as sulfides or co-precipitation with sulfidic minerals might be present in the aquifer matrix. XRD analysis identified the presence of pyrite (**Table 3**), an iron sulfide mineral, in both the upgradient and downgradient locations. The SEP analysis indicated that 21 to 35% of total detectable arsenic were bound to the acid/sulfide fraction (**Table 4**). These results suggest that attenuation mechanisms at the Site may include co-precipitation of arsenic via arsenic sulfides (i.e., arsenopyrite [FeAsS]).

Total iron was detected in the aquifer solids samples at average concentrations of 4,950 to 8,050 µg/g (**Table 2**). Iron oxides are known to readily attenuate As(V) within the pH range of 5 to 6 (EPRI, 2018, Cornell & Schwertmann, 2003). Iron oxides were not identified via XRD analysis; however, XRD is only able to characterize crystalline mineral phases within aquifer solids. Thus, amorphous iron oxides (i.e., ferrihydrite) may be present within aquifer solids but were not identified via XRD. SEP analysis indicates that 5-7 % of total detectable arsenic was associated with non-crystalline materials such as amorphous iron and manganese oxides (**Table 4**). These results suggest that attenuation mechanisms for arsenic at the Site may include adsorption to amorphous iron oxides.

The results of the Tier I baseline analysis identified multiple geochemical mechanisms which could facilitate arsenic attenuation, including:

- Sorption to iron oxides – SEP analysis found detectable total arsenic associated with non-crystalline materials such as amorphous iron and manganese oxides. While XRD analysis is incapable of identifying amorphous minerals, total iron concentrations indicate the presence of iron-bearing minerals in the aquifer solids. Amorphous iron oxides are known to readily attenuate arsenic within pH ranges observed in downgradient groundwater.

- Adsorption to clay minerals (i.e., kaolinite) – Kaolinite was identified within the aquifer solids via XRD analysis and can serve as a sorbent for arsenic. Additionally, SEP analysis found total detectable arsenic associated with phases labile to strong oxidants, such as those typically associated with organic fractions including soil organic matter or clay minerals (e.g., kaolinite). LOI and TOC analysis provides further evidence for the presence of these organic fractions.

- Sorption to or co-precipitation with sulfide minerals – SEP analysis found detectable total arsenic associated with the sulfide fraction liberated via interaction with strong acids. Additionally, XRD identified the presence of pyrite in aquifer solids. These results suggest sorption to or co-precipitation of arsenic via arsenic sulfides (i.e., arsenopyrite [FeAsS]).

2.2.2 Batch Attenuation Testing

Batch attenuation testing was performed to further evaluate the Tier I and Tier II findings that arsenic potentially undergoes physical and chemical attenuation, as indicated in Sections 2.1.3 and 2.2.1. As part of the batch attenuation testing, a Site-specific partition coefficient (Kd) was calculated for arsenic. Kd represents the relative propensity for a constituent to be associated with the solid versus the aqueous phase. Therefore, understanding the magnitude of Kd is essential for estimating chemical attenuation of arsenic.

Homogenized geologic materials from DPT-02 (A) (adjacent to MW-11) and groundwater from MW-11 (the well of interest) were mixed at 1:1, 1:4, 1:10, 1:25, and 1:50 solid:liquid ratios. A set of groundwater-only controls were also constructed. During construction, the reactors were spiked to adjust the initial arsenic concentration to 100 micrograms per liter (µg/L) in the aqueous phase of each reactor. The aqueous dissolved-phase concentrations of arsenic, iron, sulfur, pH, and ORP were measured in attenuation test reactors after 7 days of incubation.

As summarized in **Table 5**, dissolved arsenic concentrations and pH tended to decrease with greater quantities of soil compared to water (i.e., more soil was available to support sorption). Dissolved iron, on the other hand, proportionally decreased at greater soil:water ratios. The proportional increase in dissolved iron in the batch reactors as the total soil:water ratio increased provides a line of evidence that iron minerals are abundant in the aquifer solids. Dissolved sulfur concentrations across all treatments and water samples remained unchanged and were in the range of 160 to 194 mg/L.

ORP values remained comparable in various treatments with and without soil added but increased compared to the day 0 groundwater sample. Higher ORP facilitates the oxidation of As(III) to As(V). As(V) oxyanions are negatively charged and are more amenable to sorption to positively charged surfaces (such as iron oxides or clays) and the extent of sorption is expected to increase with decrease in pH. While the oxic conditions in the batch tests deviate from current conditions at MW-11 they more closely resemble the downgradient conditions at MWI-12A (average pH of 5.3 and average ORP of 103 mV). Thus, the change in redox within the batch reactors during the duration of the test are similar to migration along the redox gradient present along the groundwater flow path from MW-11 towards more oxic conditions downgradient at MWI-12A. Additionally, more oxic conditions at MW-11 are expected once other ongoing remedial activities are completed at the Site.

The Site-specific Kd was calculated based on the adsorbed arsenic[4] in various treatments with different geologic material ratios, as illustrated in **Figure 5**. The Kd value, assuming linear sorption, was calculated as 14 liters per kilogram (L/kg) which is comparable with previously reported values for arsenic (EPRI, 2006).

The significant reduction in aqueous phase concentrations in batch tests indicate the potential for adsorption-mediated attenuation of arsenic at the Site. Sorption can potentially occur to multiple substrates (e.g., iron oxides, organic matter, clay, sulfides, etc.).

[4] Adsorbed arsenic per mass of sorbent (soil) was calculated by subtracting the mass of arsenic in the aqueous phase from that in corresponding soil free groundwater systems, and then dividing by the mass of the soil in each treatment system.

2.2.3 Rate of Attenuation Assessment

The impact of natural attenuation processes can be assessed by evaluating the rate at which contaminant concentrations are decreasing temporally (USEPA, 2002). Concentrations of arsenic have decreased substantially, as discussed in Section 2.1.2 and illustrated in **Figure 3**. A Site-specific first-order attenuation rate constant was calculated using temporal arsenic data from MW-11 using the method outlined by USEPA (2002). The attenuation rate constant was estimated using an exponential data fit to monitoring results from 2016 to 2020. The calculated attenuation rate constant (0.274/year) corresponded to a half-life (i.e., the time required for a 50% decrease in the initial concentration) of 2.5 years. Based on this half-life, the arsenic concentration is predicted to have decreased below the GWPS of 0.01 mg/L by the end of 2020. This is consistent with the observed arsenic concentrations of 0.011 mg/L the last time MW-11 was sampled in May 2020, which is just barely above the GWPS of 0.01 mg/L. A replacement well for MW-11 will be installed as closure activities allow and monitored to statistically evaluate concentrations relative to the GWPS.

If needed, the attenuation rate assessment will be revisited as additional monitoring data become available as part of the corrective action program during and following completion of other ongoing remedial measures (e.g., closure) at the Site.

In addition, the results of the batch attenuation testing described in Section 2.2.2 were used to understand short-term rates of chemical attenuation mechanisms. USEPA (2007) indicates that attenuation kinetics are fast relative to typical advective groundwater flow velocities. Groundwater velocities at the Site are estimated to be low and in the range of 6 to 7 ft/year in MW-11 and PZ-14. Similar observations were found in the batch tests using Site materials, where partitioning to aquifer solids was detected during a relatively short timeframe (i.e., one week). Based on the observed chemical attenuation rates and estimated groundwater flow velocities, the arsenic plume is expected to remain on-Site.

2.3 Tier III Analysis – Attenuation Capacity and Stability Assessment

The applicability of MNA and attenuation mechanisms were evaluated in the Tier I and Tier II assessments. Therefore, a Tier III assessment was performed to assess the Site-specific capacity for natural attenuation and if the attenuation processes are stable.

2.3.1 System Capacity

A review of system capacity was completed to understand if sufficient capacity is available in the downgradient aquifer to attenuate arsenic. The attenuation capacity of the system was estimated using the Kd (14 L/kg) calculated in Section 2.2.2 and assuming the following:

- a groundwater concentration of 0.011 mg/L as measured at MW-11 in May 2020;
- total soil porosity of 0.4;
- soil particle density of 2.65 grams per cubic centimeter;
- an aquifer thickness of 20 ft;
- a width of 750 ft along the Ash Pond; and
- a length up to 500 ft based on the distance from the edge of the Ash Pond to delineation well MWI-12A.

Based on these assumptions, approximately 9.34×10^5 mg of arsenic is calculated to be present in groundwater. The aquifer solids, however, are estimated to have the capacity to adsorb approximately 5.20×10^7 mg of arsenic using the Site-specific Kd. Therefore, <2% of the attenuation capacity of the aquifer solids is calculated to be currently utilized. This evaluation further confirms the suitability of MNA as a remedial component for the Site.

The attenuation capacity calculations do not account for any potential temporary releases during pond closure. Although this factor may reduce the available attenuation capacity, sufficient capacity is still anticipated given the calculation above, the decreasing concentrations of arsenic at MW-11, and that closure will be completed relatively quickly.

2.3.2 Batch Desorption Tests

Batch desorption testing was completed to evaluate the stability of the chemical attenuation mechanisms under variable redox conditions. Groundwater from MW-11 and geologic material from DPT-02 (A) (18.4 to 19.6 ft bgs) at a 1:25 ratio was selected for the desorption test.

The desorption test reactors were initially constructed with mixing homogenized geologic material and MW-11 groundwater at a 1:25 ratio. The water was initially spiked with sodium metaarsenite stock solution to target a final concentration of 100 µg/L. The materials were mixed for 7 days to allow arsenic partitioning between the aqueous and solid phases. The geologic material was then separated from the aqueous phase and amended with fresh groundwater from MW-11. Three treatments were tested including unamended slurry reactors (ambient), reactors under reducing conditions (purged with hydrogen gas daily), and reactors under oxidizing conditions (amended with oxygen gas daily). After incubation for 7 days, aqueous samples from each reactor were analyzed for pH, ORP, and dissolved arsenic, iron, and sulfur.

The results of the batch desorption tests are summarized in **Table 6** and **Figure 6** and outlined below:

- Following desorption, arsenic and sulfur concentrations in reactors under natural (unamended) conditions were similar to those in baseline groundwater. Iron concentrations, however, increased as compared to the baseline groundwater, potentially due to biologically-mediated dissolution of iron oxides (Jones *et al.*, 2002).
- Under oxidizing conditions, arsenic and iron concentrations decreased compared to baseline groundwater. The concentration of dissolved sulfur slightly increased which may have been the result of analytical variability and/or sulfur in the soil being oxidized to sulfate.
- Under reducing conditions, arsenic and iron concentrations increased substantially compared to baseline groundwater. These changes are expected since these constituents are generally more mobile under reducing conditions due to the dissolution of iron oxides and adsorbed arsenic. The concentration of dissolved sulfur was similar to baseline groundwater.

The relatively stable concentration of arsenic compared to baseline groundwater during desorption tests in unamended and oxidized reactors indicates limited desorption of arsenic under anticipated future Site conditions. This supports the suitability of MNA as remedial components for the Site, where oxidizing conditions exist downgradient of MW-11. In addition, geochemical conditions at MW-11 are anticipated, based on our professional experience, to return to natural conditions, presumably aerobic, following completion of other remedial measures (e.g., closure) at the Site.

Geochemical conditions (e.g., ORP, pH) will need to be evaluated as part of the corrective action monitoring program during and following completion of other ongoing remedial measures (e.g., closure) at the Site.

2.4 Tier IV – Corrective Action Monitoring and Contingency Plans

If MNA is selected as a component of the groundwater corrective action for arsenic, then a corrective action groundwater monitoring plan and contingency plan will be developed as part of Tier IV of the MNA evaluation. The corrective action groundwater monitoring plan is required to provide data to evaluate the performance of the MNA component of the remedy and the progress of the natural attenuation processes at the Site, particularly following completion of other ongoing remediation activities (e.g., closure) at the Site.

Tier IV of the MNA evaluation also calls for a consideration of a contingency plan if the observed decreases in arsenic groundwater concentrations do not continue. Alternatively, a contingent action may need to be considered if Site conditions that are key for MNA performance are no longer present. The contingency plan may specify a technology that is different from MNA or it may call for modifications to the selected MNA remedy depending on observed changes in Site conditions or performance.

3 MNA EVALUATION – LITHIUM

The results of the tiered MNA evaluation for lithium are summarized below.

3.1 Tier I Analysis

The Tier I MNA evaluation for lithium was performed to initially screen the applicability of MNA in relation to plume stability and other Site considerations (e.g., source control).

The first aspect of the Tier I analysis was to evaluate if the lithium plume is stable or receding. Evaluation of plume stability considered spatial extent, delineation results, and concentration trends. For the lithium SSL at MW-13, piezometers PZ-13D and PZ-14 were used to delineate the vertical and horizontal extent of the lithium plume, respectively. As discussed in Section 1.3, lithium concentrations remain below GWPS in delineation locations (e.g., Geosyntec, 2019, 2021). Based on Site data, the lithium plume is spatially limited (localized) and remains on-Site, all indicative of plume stability.

As discussed further in Section 3.2, lithium concentrations are decreasing at MW-13 toward the GWPS of 0.04 mg/L. The time series graph of lithium concentrations at MW-13 is shown in **Figure 7**, indicating a decreasing trend of lithium from 2017 to 2020 (P-value = 0.02; Mann-Kendall analysis)[5]. Decreasing concentrations at MW-13 indicate ongoing natural attenuation of lithium at the Site. The observed concentration decreases may be due to cessation of sluicing of fly ash, bottom ash, and other low-volume waste associated with coal-fired operations in 2016, pre-closure activities, and/or closure activities.

The plume stability and trend analyses will be revisited as additional monitoring data become available as part of the corrective action program during and following completion of other ongoing remedial measures (e.g., closure) at the Site.

In addition to the delineation results and decreasing concentration trends, the Site is currently undergoing source control. MNA is most appropriate as a groundwater remedial component when coupled with source control. Additional information on source control is provided in Section 1.4. Therefore, the Tier I analysis indicated the potential applicability of MNA for lithium at the Site.

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[5] MW-13 was abandoned in August 2020 to allow for pre-closure activities (i.e., removal of the perimeter dike system). Additional data beyond August 2020 is not available for MW-13.

3.2 Tier II Analysis – Attenuation Mechanism and Rate

Since the Tier I analysis indicated the potential applicability of MNA for lithium at the Site, a Tier II analysis was initiated to evaluate the rate of attenuation and the attenuation mechanism.

3.2.1 Attenuation Rate

As discussed above, concentrations of lithium have decreased substantially (**Figure 7**). A Site-specific first-order attenuation rate constant was calculated using temporal lithium data from MW-13 using the method outlined by USEPA (2002). The attenuation rate constant was estimated using an exponential data fit to monitoring results from 2017 to 2020. The calculated attenuation rate constant (0.216/year) corresponded to a half-life (i.e., the time required for a 50% decrease in the initial concentration) of 3.2 years. Based on this half-life, the lithium concentration is predicted to decrease below the GWPS of 0.04 mg/L by the end of 2026. A replacement well for MW-13 was installed in November 2021. The lithium SSL will be reassessed when enough monitoring data is available to perform statistical analysis on MW-13R. If needed, the attenuation rate assessment will be revisited as additional monitoring data become available as part of the corrective action program during and following completion of other ongoing remedial measures (e.g., closure) at the Site.

3.2.2 Initial Evaluation of Attenuation Mechanism

Lithium is generally a conservative species under environmentally relevant conditions, where natural attenuation processes are generally limited to dilution and dispersion. While lithium may undergo some attenuation via cation exchange processes with clay minerals (Eckstein *et al.*, 1970), other processes (e.g., sorption, precipitation, etc.) that are applicable to reactive species like arsenic are not applicable to lithium.

USEPA's 2015 guidance for MNA of inorganic constituents states that *"Dispersion and dilution…may be elements of an MNA response action for inorganic contaminants"* and *"Dilution and dispersion may be appropriate…when an active remedy is being used…"*. As discussed elsewhere, source control and other remedial measures are currently underway at Plant Smith and concentration trends and plume stability evaluations indicate natural attenuation is ongoing. Therefore, dispersion and dilution processes were evaluated further, consistent with USEPA guidance.

To initially evaluate lithium attenuation, a one-dimensional analytical groundwater flow model was used to estimate dilution downgradient of MW-13 toward the delineation piezometer PZ-14. A Domenico model (PA DEP, 2014), which includes dispersion and advection transport mechanisms, was used to evaluate lithium attenuation compared to observed groundwater concentrations. Input parameters included the following:

- A source concentration for lithium of 0.16 mg/L, based on data from MW-13 in November 2019.
- An estimated longitudinal dispersivity of 27 ft, which was calculated as 10% (recommended by PA DEP [2014]) of the distance from MW-13 to PZ-14.
- An estimated transverse dispersivity of 2.7 ft, which was calculated as 10% (recommended by PA DEP [2014]) of the longitudinal dispersivity.
- An estimated vertical dispersivity of 0.001 ft, which is a recommended value for a conservative approach to approximate two-dimensional transport (PA DEP, 2014).
- An assumed effective porosity of 0.25.
- An assumed source width of 20 ft.
- An assumed transport time of 30 years.
- An assumed source thickness of 23.23 ft, based on the depth of MW-13's screen and half the distance to the screen of the vertical delineation well PZ-13D.
- A range of hydraulic conductivities (K):
    - o 14.17 ft/day as a representative value for a sandy aquifer but within the range of previously reported K values for the Site (0.2 to 28 ft/day; Gulf Power, 1995); and
    - o an order of magnitude sensitivity analysis, with K ranging from 0.01417 ft/day to 141.7 ft/day.

The output of the preliminary model showing lithium concentration versus distance downgradient is shown in **Figure 8**. For comparison, measured concentrations at MW-13 and PZ-14 from November 2019 are included. The modeled concentration profile varied based on the assumed K. However, under all evaluated K, the predicted lithium concentrations at the downgradient PZ-14 are lower than the GWPS and lithium concentrations are projected to decrease below the GWPS approximately 210 ft downgradient of MW-13. This initial evaluation indicates that dilution and dispersion processes are sufficient to attenuate lithium at the Site. Based on the evaluation of Golder (2022), these processes are anticipated to be enhanced by the installation of a slurry wall as a remedial component. Additional Site-specific data was collected in Tier III to refine the model and above evaluation.

3.3 Tier III Analysis – Refined Evaluation of Attenuation Mechanism

To refine the initial evaluation of lithium attenuation using the Domenico model, Site-specific data for hydraulic conductivity was collected. Specifically, slug tests were performed at MW-13 and PZ-14 in August 2020 to estimate the *in situ* hydraulic conductivity. Three tests, each including a rising-head (slug-out) and falling-head (slug-in) test, were completed at each location by instantaneously submerging the slug and logging the resulting water level displacement. Slug tests were conducted using a 4.5-ft long by 1-inch (in) diameter polyvinyl chloride (PVC) slug. Water level responses during slug testing were measured using a transducer placed within the screened interval of the monitoring well.

Analytical methods used to estimate horizontal hydraulic conductivity were based on procedures described in Kruseman and de Ridder (2000). The slug test data measured by the transducer was imported into the AQTESOLV software (HydroSOLVE, Inc.; Duffield, 2017) to estimate hydraulic properties through curve matching using the Bouwer and Rice (1976) and Hvorslev (1951) analytical solutions. The solutions were matched to a recommended range of normalized head displacement data following procedures outlined in Butler (1998). The geometric mean of the results from each test and both analytical methods were calculated to produce a single horizontal hydraulic conductivity value for each monitoring well. Slug tests results are included in **Appendix A**.

The geometric mean hydraulic conductivity at both locations were comparable at 0.42 and 0.47 ft/day, respectively. The estimated values were more than 30-fold lower than the value (14.7 ft/day) assumed in the initial evaluation presented in Section 3.2. These measured values are on the lower end of the range of previously reported K values for the Site (0.2 to 28 ft/day; Gulf Power, 1995).

The Site-specific K data was used as an input parameter to refine the Domenico model. The output of the refined model after 30 years is shown in **Figure 9**, which illustrates lithium attenuation with distance. The model predicted a decrease in concentrations below the GWPS approximately 120 ft from the Ash Pond. The predicted concentrations at downgradient well PZ-14 are in the range of 0.005 to 0.007 mg/L. These values are higher than the non-detectable lithium concentration in PZ-14 (i.e., <0.00038 mg/L). This refined evaluation, which is based on Site-specific data, indicates that dilution and dispersion processes are sufficient to attenuate lithium at the Site.

Lithium attenuation will be revisited as additional monitoring data become available as part of the corrective action program during and following completion of other ongoing remedial measures (e.g., closure) at the Site.

3.4 Tier IV – Corrective Action Monitoring and Contingency Plans

If MNA is selected as a component of the groundwater corrective action for lithium, then a corrective action groundwater monitoring plan and contingency plan will be developed as part of Tier IV of the MNA evaluation. The corrective action groundwater monitoring plan is required to provide data to evaluate the performance of the MNA component of the remedy and the progress of the natural attenuation processes at the Site, particularly following completion of other ongoing remedial activities (e.g., closure) at the Site.

Tier IV of the MNA evaluation also calls for a consideration of a contingency plan if the observed decreases in lithium groundwater concentrations do not continue. Alternatively, contingent action may need to be considered if Site conditions that are key for MNA performance are no longer present. The contingency plan may specify a technology that is different from MNA or it may call for modifications to the selected MNA remedy depending on observed changes in Site conditions or performance.

4 SUMMARY

A tiered MNA evaluation was completed, consistent with USEPA, ITRC, and EPRI guidance documents, to assess if Site conditions are favorable for the implementation of MNA as a component of the corrective measure to address arsenic and lithium SSLs in groundwater downgradient of the Ash Pond. The evaluation indicated that MNA, in combination with other ongoing remedial measures at the Site, is a viable groundwater remedy for both arsenic and lithium based on multiple lines of evidence.

The separate arsenic and lithium plumes appear stable based on the following: (i) the plumes have been delineated, are spatially limited (localized), and remain on-Site; and (ii) concentrations are decreasing at MW-11 and MW-13, respectively. The decreasing concentration trends, described further below, indicate ongoing natural attenuation of arsenic and lithium at the Site:

- For arsenic, concentrations were slightly above the GWPS in MW-11 when the well was last sampled in May 2020. Based on an estimated half-life, arsenic concentrations were projected to decrease below the GWPS before the end of 2020.
- For lithium, concentrations were estimated to decrease below the GWPS in 2026.

For arsenic, batch attenuation testing to calculate a Site-specific Kd indicated arsenic is attenuated through either sorption or precipitation mechanisms. Based on current groundwater concentrations and the Site-specific Kd, less than 2% of Site's downgradient attenuation capacity is calculated to be currently utilized for arsenic attenuation. Desorption testing indicated that attenuation was relatively stable under both current Site conditions and those anticipated following completion of other ongoing remedial measures at the Site (e.g., source closure). In addition, groundwater geochemistry becomes more favorable for arsenic attenuation as groundwater migrates to more oxidizing conditions downgradient. Finally, analysis of geologic materials indicated the presence of iron oxides, organic carbon, clays, and sulfides, all of which can contribute to arsenic attenuation.

For lithium, a one-dimensional analytical groundwater flow model was used to evaluate attenuation processes. The model was based on Site-specific input parameters, including hydraulic conductivity values calculated from field data. The model predicts lithium attenuation with distance and based on the non-detectable lithium concentration downgradient of MW-13 at PZ-14, the model output is a conservative representation of lithium attenuation at site. This evaluation indicates that dilution and dispersion processes are sufficient to attenuate lithium at the Site, with lithium estimated to decrease below the GWPS in less than 120 ft downgradient from the Ash Pond.

This Report documents multiple lines of evidence, based on Site-specific considerations, that indicate MNA (when coupled with the other ongoing remedial activities [e.g., source control]) is a viable remedial alternative for arsenic and lithium in groundwater at Plant Smith. If MNA is selected as a component of the groundwater corrective action, a corrective action groundwater monitoring plan and contingency plan will be developed.

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TABLES

TABLE 1: GROUNDWATER MONITORING LOCATION DETAILS
Florida Power & Light Company - Plant Smith Ash Pond, Bay County, Florida

Monitoring Location	Installation Date	Northing	Easting	Ground Elevation	Top of Casing Elevation	Top of Screen Elevation	Bottom of Screen Elevation	Designation
CCR Groundwater Monitoring Network								
MW-01	11/11/2015	464368.78	1589789.76	11.09	10.75	1.15	-8.85	Piezometer
MW-02	11/10/2015	464419.66	1592286.78	10.26	13.29	-2.71	-12.71	Background
MW-03	11/10/2015	464322.49	1594277.21	10.98	14.06	-8.94	-18.94	Background
MW-04	11/7/2015	464027.17	1591388.60	12.00	15.05	2.25	-7.75	Piezometer
MW-05	11/4/2015	463987.97	1592784.03	11.18	14.13	-1.97	-11.97	Piezometer
MW-06	11/17/2015	463858.80	1591389.13	24.18	23.82	-5.38	-15.38	Downgradient
MW-07	11/3/2015	463856.65	1592774.97	21.72	21.42	-7.88	-17.88	Downgradient
MW-08[3]	11/17/2015	461649.15	1590479.94	21.33	24.31	-8.39	-18.39	Downgradient
MW-09[3]	11/17/2015	460663.62	1590695.95	12.49	15.37	-6.73	-16.73	Downgradient
MW-10[3]	11/20/2015	461234.34	1592098.52	10.94	13.93	-8.67	-18.67	Downgradient
MW-11[3]	11/21/2015	462157.18	1593298.86	13.42	16.51	-6.49	-16.49	Downgradient
MW-12	11/11/2015	462362.00	1589322.96	8.21	11.14	-10.56	-20.56	Background
MW-13[3]	11/11/2015	462676.94	1590589.33	23.53	26.54	-6.36	-16.36	Downgradient
MW-14[3]	11/10/2015	460892.89	1590173.47	22.11	24.95	-5.69	-15.69	Downgradient
Groundwater Monitoring Locations for Delineation								
MWI-12A	Unknown	461669.34	1593482.68	Unknown	9.82	4.32	-5.68	Delineation Well
PZ-11D[3]	12/5/2018	462128.91	1593287.38	10.55	13.51	-34.45	-44.45	Delineation Piezometer
PZ-14	12/4/2018	462584.13	1590334.98	10.08	9.87	-4.92	-14.92	Delineation Piezometer
PZ-13D[3]	12/6/2018	462700.23	1590586.00	23.54	26.44	-20.46	-30.46	Delineation Piezometer

Notes:
1. Northing and easting are in feet relative to the State Plane Florida North Datum of 1983.
2. Elevations are in feet relative to the North American Vertical Datum of 1988.
3. Monitoring well/piezometer was abandoned in August 2020 to facilitate CCR unit closure.

TABLE 2: SUMMARY OF ARSENIC, IRON, SULFUR AND TOC RESULTS
Florida Power & Light Company - Plant Smith Ash Pond, Bay County, Florida

Location	Sample Date	Depth (ft bgs)	Arsenic	Iron	Sulfur	TOC
			µg/g	µg/g	µg/g	%
01A	15-Sep-20	14.4-16.0	13	5,100	6,500	9.55
		16-17.2	13	8,800	7,600	0.20
		17.2-18.4	2.1	3,100	1,800	0.09
		18.4-19.67	1.2	2,800	1,300	0.08
		Average	7.3	4,950	4,300	2.48
02A	15-Sep-20	16-17.2	7.8	7,100	4,700	0.85
		17.2-18.4	5.7	7,100	5,100	0.78
		18.4-19.6	5.9	8,000	5,800	0.97
		20-21.2	5.5	10,000	7,800	0.72
		Average	6.2	8,050	5,850	0.83

Notes:
µg/g - micrograms per gram
% - percent
ft bgs refers to feet below ground surface.
TOC refers to total organic carbon.
01A and 02A refer to background and downgradient locations, respectively.

TABLE 3: SUMMARY OF BASELINE GEOLOGIC MATERIAL XRD RESULTS
Florida Power & Light Company - Plant Smith Ash Pond, Bay County, Florida

Site Material	Date	Geologic Material Depth (ft bgs)	Quartz	Pyrite	Kaolinite	Albite	Microcline	Calcite	Total	LOI
			wt. %	wt. %	wt. %	wt. %	wt. %	wt. %	wt. %	%
01A	15-Sep-20	14.4-16.0	93.2	0.71	3.92	1.03	1.10	-	100.0	17.3
		16-17.2	86.9	1.59	9.04	1.08	1.35	-	100.0	2.6
		17.2-18.4	93.2	0.23	3.97	0.79	1.79	-	100.0	1.4
		18.4-19.67	93.5	0.15	3.91	0.91	1.49	-	100.0	1.4
		Average Concentration	**91.7**	**0.67**	**5.21**	**0.95**	**1.43**	**--**	**100.0**	**5.7**
02A	15-Sep-20	16-17.2	92.0	0.69	4.4	0.73	2.18	-	100.0	2.9
		17.2-18.4	91.8	0.72	4.2	1.18	1.95	0.2	100.0	2.7
		18.4-19.6	90.8	0.88	5.0	1.17	2.16	-	100.0	3.4
		20-21.2	91.2	1.34	4.4	1.25	1.82	-	100.0	2.9
		Average Concentration	**91.5**	**0.91**	**4.49**	**1.08**	**2.03**	**0.2**	**100.0**	**3.0**

Notes:
01A and 02A refer to background and downgradient locations, respectively.
ft bgs refers to feet below ground surface.
-- - not applicable
% - percent
wt. % - weight percent
Dashes (-) indicate that the mineral was not identified by the analyst and not included in the refinement calculation for the sample; applicable only to Calcite.
The weight percent quantities indicated have been normalized to a sum of 100%. The quantity of amorphous material has not been determined.
LOI refers to loss on ignition.
X-ray diffraction (XRD) analysis is by Rietveld Refinement, except for LOI which was by whole-rock analysis.

TABLE 4: SEQUENTIAL EXTRACTION PROCEDURE RESULTS FOR ARSENIC
Florida Power & Light Company - Plant Smith Ash Pond, Bay County, Florida

SEP Fraction	01A (12-22 ft bgs)		02A (17-27 ft bgs)	
	mg/kg	%*	mg/kg	%*
Exchangeable	0.626 U		0.645 U	
Carbonate	0.469 U J3		0.484 U J3	
Non-crystalline Materials Fraction	**0.391 I**	**7**	**0.268 I**	**5**
Metal Hydroxide Fraction:	0.265 U		0.273 U	
Organic-bound Fraction	**3.39 I J3**	**61**	**2.62 I J3**	**44**
Acid/Sulfide Fraction	**1.18**	**21**	**2.09**	**35**
Residual Fraction	**0.627 I V**	**11**	**0.968 I V**	**16**
Total Detectable Arsenic	**5.58**		**5.95**	

Notes:

01A and 02A refer to background and downgradient locations, respectively.

ft bgs refers to feet below ground surface.

mg/kg refers to milligram of constituent per kilogram of total sample mass

* % was calculated by dividing each fraction by the sum of total detected fractions.

I The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

J3 Estimated value; value may not be accurate. Spike recovery or RPD outside of criteria.

U Indicates that the compound was analyzed for but not detected.

V Indicates that the analyte was detected at or above the method detection limit in both the sample and the associated method blank and the value of 10 times the blank value was equal to or greater than the associated sample value.

Bolded results indicate detected.

TABLE 5: SUMMARY OF ARSENIC ATTENUATION TEST RESULTS
Florida Power & Light Company - Plant Smith Ash Pond, Bay County, Florida

Site Material	Treatment*	Date	Day	Replicate	pH	ORP	Dissolved Arsenic	Dissolved Iron	Dissolved Sulfur
						mV	mg/L	mg/L	mg/L
MW-11 Groundwater	**Water Only Control**	21-Oct-20	0	MW11-1	6.21	-77	0.013	0.205	179
				MW11-2	6.31	-89	0.013	0.196	174
				Average	**6.26**	**-83**	**0.013**	**0.201**	**177**
		28-Oct-20	7	MW11-1	6.37	104	0.120	0.195	159
				MW11-2	6.39	99	0.117	0.187	160
				Average	**6.38**	**102**	**0.119**	**0.191**	**160**
MW-11 Groundwater 02A-3 (18.4-19.6') Geologic Material	**1:1 Soil: Water Ratio**	28-Oct-20	7	02A-3:MW-11 1:1-1	4.51	97	0.026	23.5	198
				02A-3:MW-11 1:1-2	4.41	103	0.021	18.0	190
				Average	**4.46**	**100**	**0.024**	**20.8**	**194**
	1:4 Soil: Water Ratio	28-Oct-20	7	02A-3:MW-11 1:4-1	4.96	100	0.005	2.110	174
				02A-3:MW-11 1:4-2	4.94	96	0.005	2.160	176
				Average	**4.95**	**98**	**0.005**	**2.135**	**175**
	1:10 Soil: Water Ratio	28-Oct-20	7	02A-3:MW-11 1:10-1	5.77	95	0.016	1.18	167
				02A-3:MW-11 1:10-2	5.78	89	0.017	1.57	168
				Average	**5.78**	**92**	**0.017**	**1.38**	**168**
	1:25 Soil: Water Ratio	28-Oct-20	7	02A-3:MW-11 1:25-1	6.05	83	0.046	0.631	164
				02A-3:MW-11 1:25-2	6.06	85	0.046	0.784	162
				Average	**6.06**	**84**	**0.046**	**0.708**	**163**
	1:50 Soil: Water Ratio	28-Oct-20	7	02A-3:MW-11 1:50-1	6.18	77	0.111	0.543	165
				02A-3:MW-11 1:50-2	6.20	79	0.096	0.301	160
				Average	**6.19**	**78**	**0.104**	**0.422**	**163**

Notes:
' - foot
ORP refers to oxidation-reduction potential.
mV refers to millivolt.
mg/L refers to milligrams pre liter.
*In all treatments groundwater was spiked with sodium meta-arsenite solution to a target concentration of 100 µg/L on day 0.

TABLE 6: SUMMARY OF ARSENIC DESORPTION TEST RESULTS
Florida Power & Light Company - Plant Smith Ash Pond, Bay County, Florida

Site Material	Treatment	Date	Day	Replicate	pH	ORP	Dissolved Arsenic	Dissolved Iron	Dissolved Sulfur
						mV	mg/L	mg/L	mg/L
MW-11 Groundwater	**Baseline Groundwater**	21-Oct-20	0	Baseline-1	6.21	-77	0.013	0.21	179
				Baseline-2	6.31	-89	0.013	0.20	174
				Average	**6.26**	**-83.00**	**0.0128**	**0.201**	**177**
MW-11 Groundwater 02A-3 (18.4-19.6') Geologic Material	**Unamended Control** (1,2)	30-Nov-20	7	Unamended-1	6.13	14	0.0158	1.13	175
				Unamended-2	6.12	17	0.0154	1.08	179
				Average	**6.13**	**16.00**	**0.0156**	**1.11**	**177**
	Oxygen Sparged (1,2,3)	30-Nov-20	7	Oxygen-1	5.8	33	0.0014	0.111	202
				Oxygen-2	5.86	49	0.0016	0.106	199
				Average	**5.83**	**41.00**	**0.0015**	**0.109**	**201**
	Hydrogen Sparged (1,2,4)	30-Nov-20	7	Hydrogen-1	6.25	8	0.0497	2.04	165
				Hydrogen-2	6.26	-8	0.0450	1.91	170
				Average	**6.26**	**0.00**	**0.0474**	**1.98**	**168**

Notes:

mg/L - milligrams per liter

µg/L- micrograms per liter

mg/kg- milligram per kilogram

mL-milliliter

mV - millivolts

(1) Soil was with mixed with 100 µg/L arsenic-spiked groundwater to target 6.3 mg/kg in the geologic material on day -7.

(2) Decanted spiked groundwater and replaced with unspiked groundwater on day 0.

(3) Began daily sparging with 5 mL of oxygen gas on day 0.

(4) Began daily sparging with 5 mL of hydrogen gas on day 0.

FIGURES

Legend

Approximate Ash Pond Boundary (CCR Unit)

Approximate Property Boundary

Notes:
1. CCR indicates Coal Combustion Residuals.
2. Source of 2020 World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.
3. Source of inset World Street Map: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community.

Site Location Map

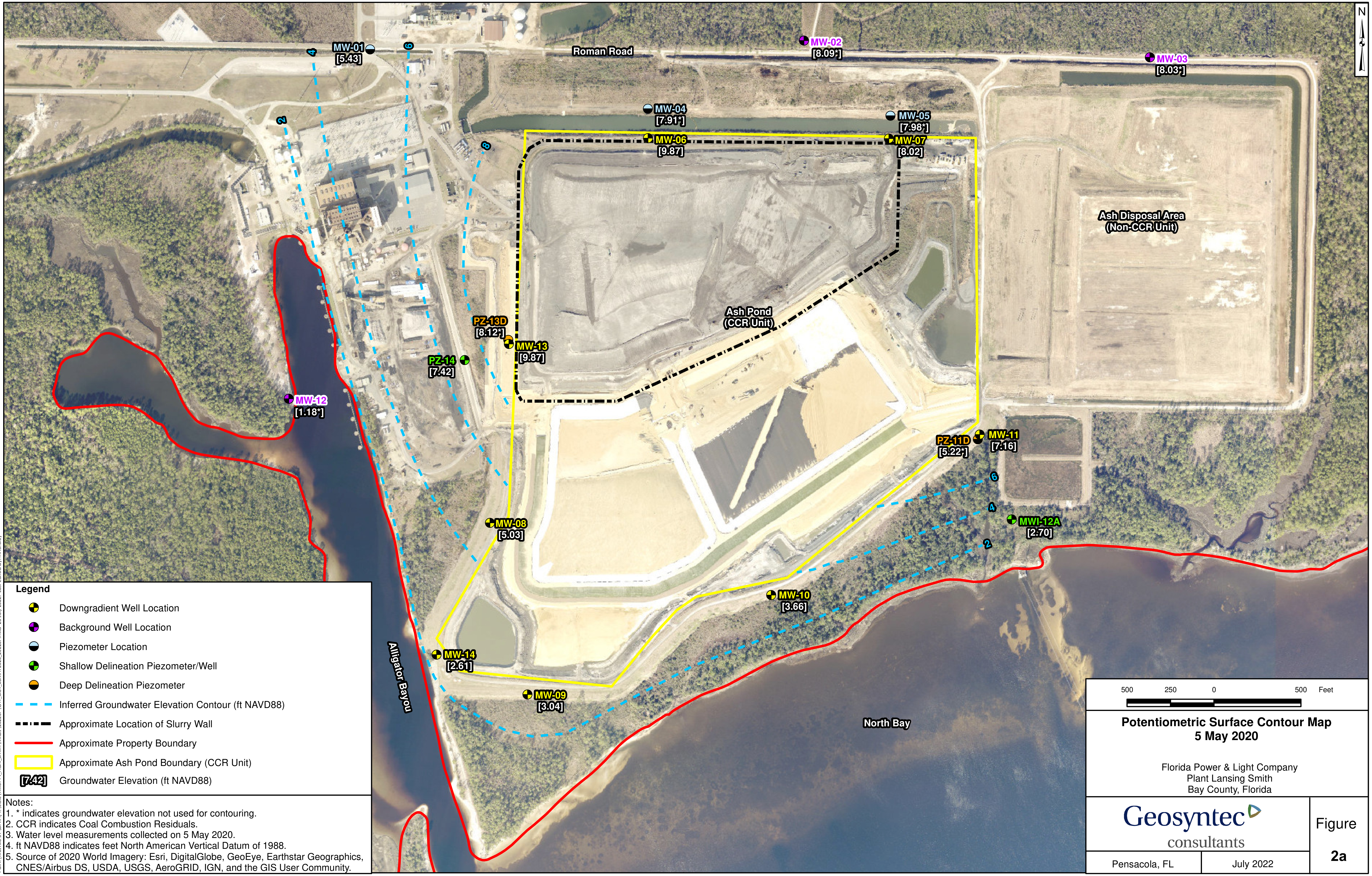
Florida Power & Light Company
Plant Lansing Smith
Bay County, Florida

Geosyntec consultants

Figure **1**

Pensacola, FL | July 2022

Path: (Titusville-01\DATA) \\Titusville-01\Data\0GIS\TXR0714_Plant_Smith\MXDs\202010\SiteLocationMap_PlantSmith.mxd 10 November 2021. Last Edited by: CSaville



Legend

- Downgradient Well Location
- Background Well Location
- Piezometer Location
- Shallow Delineation Piezometer/Well
- Deep Delineation Piezometer
- Inferred Groundwater Elevation Contour (ft NAVD88)
- Approximate Location of Slurry Wall
- Approximate Property Boundary
- Approximate Ash Pond Boundary (CCR Unit)
- [7.42] Groundwater Elevation (ft NAVD88)

Notes:
1. * indicates groundwater elevation not used for contouring.
2. CCR indicates Coal Combustion Residuals.
3. Water level measurements collected on 5 May 2020.
4. ft NAVD88 indicates feet North American Vertical Datum of 1988.
5. Source of 2020 World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

Potentiometric Surface Contour Map
5 May 2020

Florida Power & Light Company
Plant Lansing Smith
Bay County, Florida

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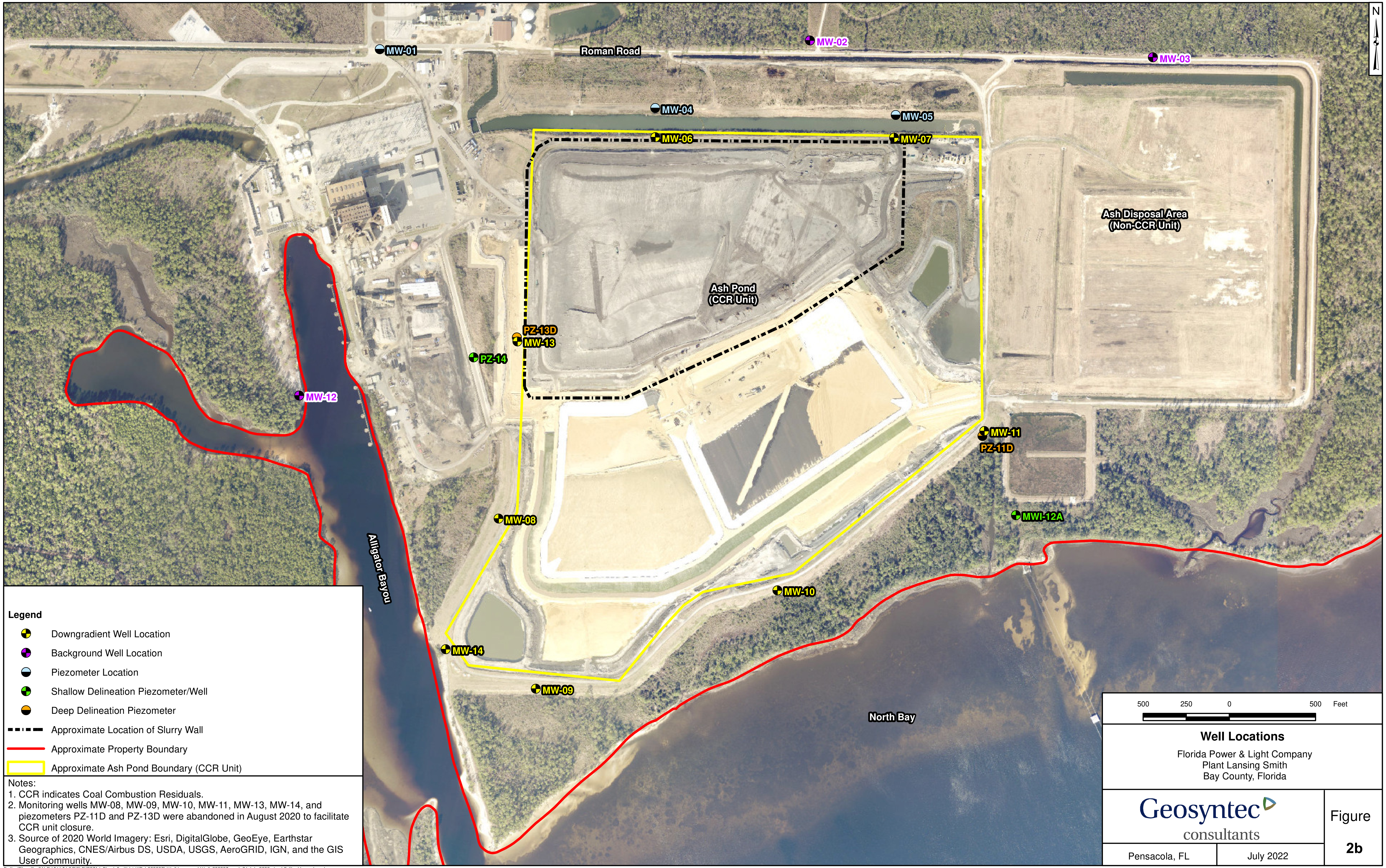
Pensacola, FL | July 2022

Figure **2a**



Legend

- Downgradient Well Location
- Background Well Location
- Piezometer Location
- Shallow Delineation Piezometer/Well
- Deep Delineation Piezometer
- Approximate Location of Slurry Wall
- Approximate Property Boundary
- Approximate Ash Pond Boundary (CCR Unit)

Notes:
1. CCR indicates Coal Combustion Residuals.
2. Monitoring wells MW-08, MW-09, MW-10, MW-11, MW-13, MW-14, and piezometers PZ-11D and PZ-13D were abandoned in August 2020 to facilitate CCR unit closure.
3. Source of 2020 World Imagery: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

500 250 0 500 Feet

Well Locations

Florida Power & Light Company
Plant Lansing Smith
Bay County, Florida

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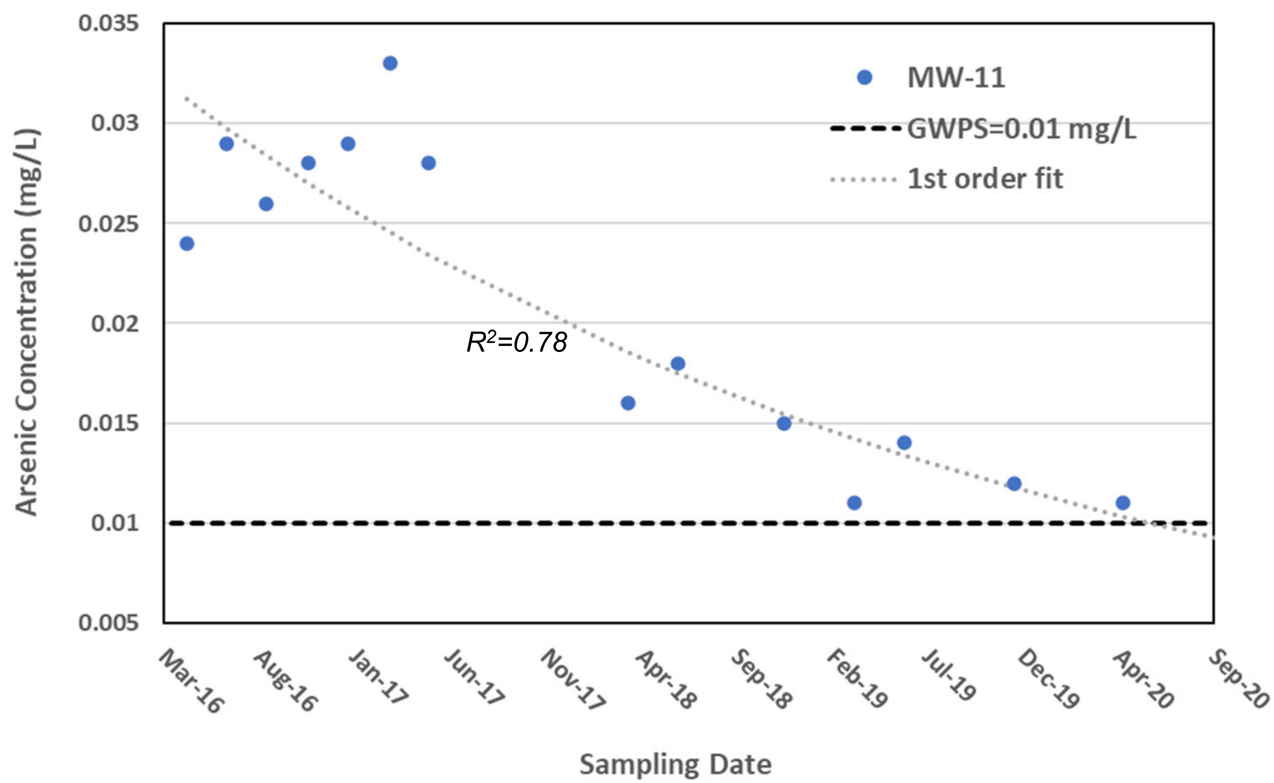
Figure **2b**

Pensacola, FL | July 2022

Path: [Titusville-01\DATA] T:\0GIS\TXR0714_Plant_Smith\MXDs\202207\Well Locs and Wall_202207.mxd 26 July 2022. Last Edited by: mhensley



Notes:
1. mg/L indicates milligrams per liter.
2. Graph based on groundwater data collected from 2016 through 2020.
3. MW-11 was abandoned in August 2020 to allow for pre-closure activities (i.e., removal of the perimeter dike system). Additional data beyond August 2020 is not available from MW-11.
4. Mann-Kendall analysis indicated a decreasing trend of arsenic from 2016 to 2020 (P-value = 0.004).
5. GWPS refers to groundwater protection standard level for arsenic.

Time Series Graph of Arsenic at MW-11

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Bay County, Florida

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Figure 3

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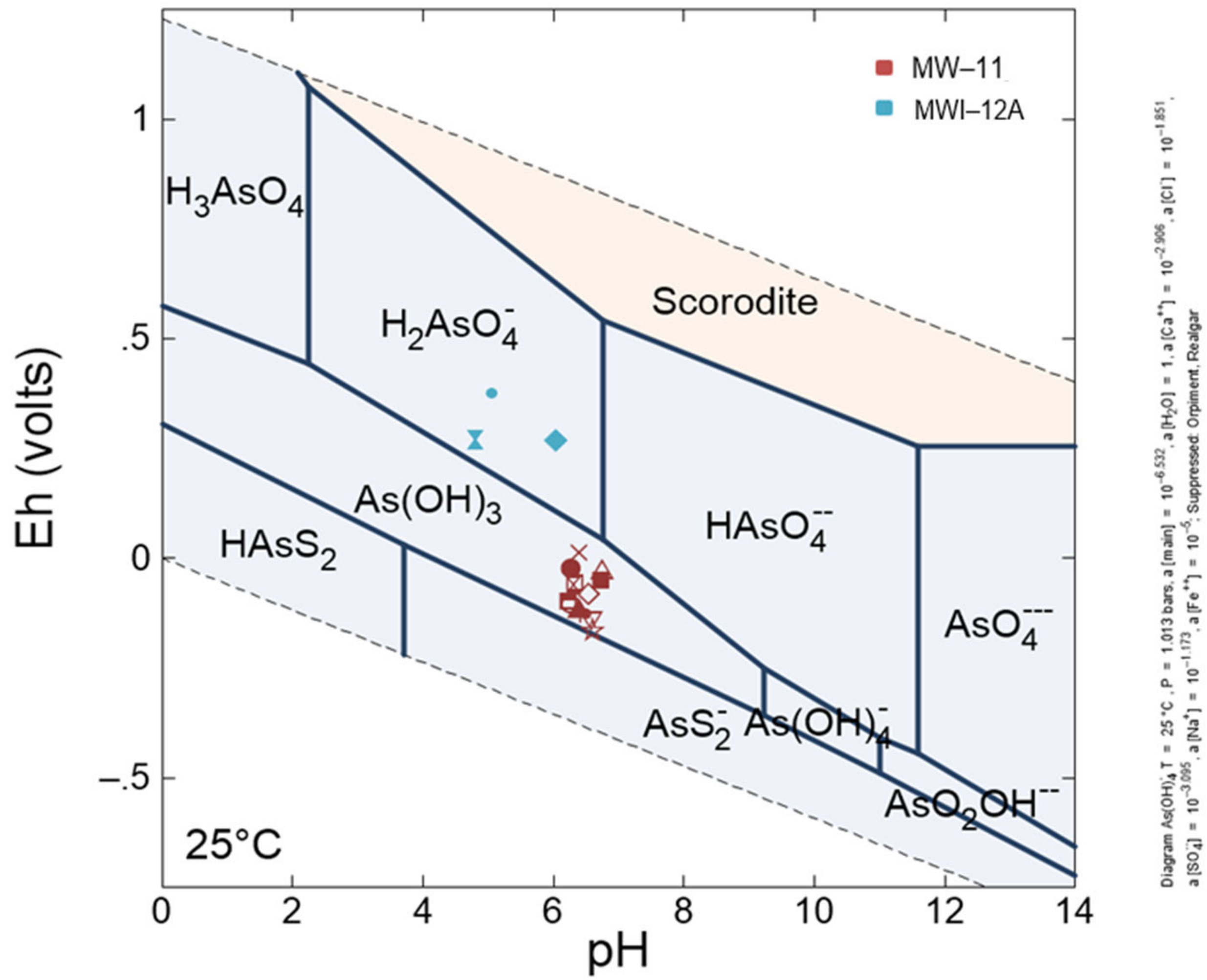

Notes:
1. The data used for modeling of arsenic speciation were from 2016-2019 for MW-11 and 2019 for MWI-12A.
2. Arsenic speciation was modeled using Geochemist's Workbench.
3. The graph demonstrates that conditions become more favorable for attenuation as groundwater migrates downgradient from MW-11 toward MWI-12A. The predicted arsenic species is As(III) under the reducing conditions at MW-11, which is more mobile than the predicted arsenic species As(V) under the more oxidizing conditions at MWI-12A.

Eh-pH Graph for Arsenic

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Plant Lansing Smith
Bay County, Florida

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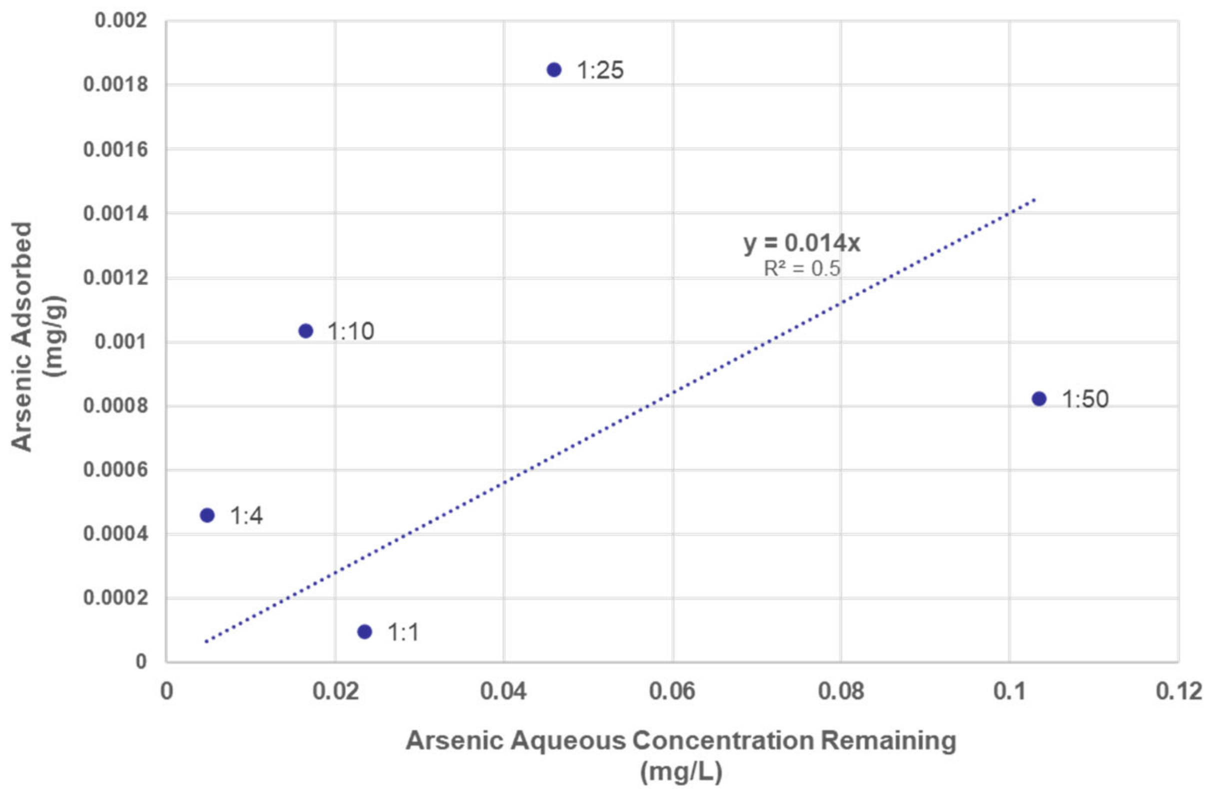
Figure 4

N:\Gulf Power\CCR Projects\Plant Smith\08_Remedy Selection\Remedy Selection Document\04_Appendices\02_Figures



Notes:
1. mg/L indicates milligrams per liter.
2. mg/g indicates milligrams per gram.
3. Graph based on 2020 laboratory batch test analysis.
4. X:X labels refers to the ratio of geologic materials to groundwater used for each analysis.
5. The site-specific partition coefficient (Kd= 14 L/kg) of arsenic between the geologic material and aqueous phase was estimated from linear regression, as shown in the graph.

Arsenic Batch Adsorption Test Results

Florida Power & Light Company
Plant Lansing Smith
Bay County, Florida

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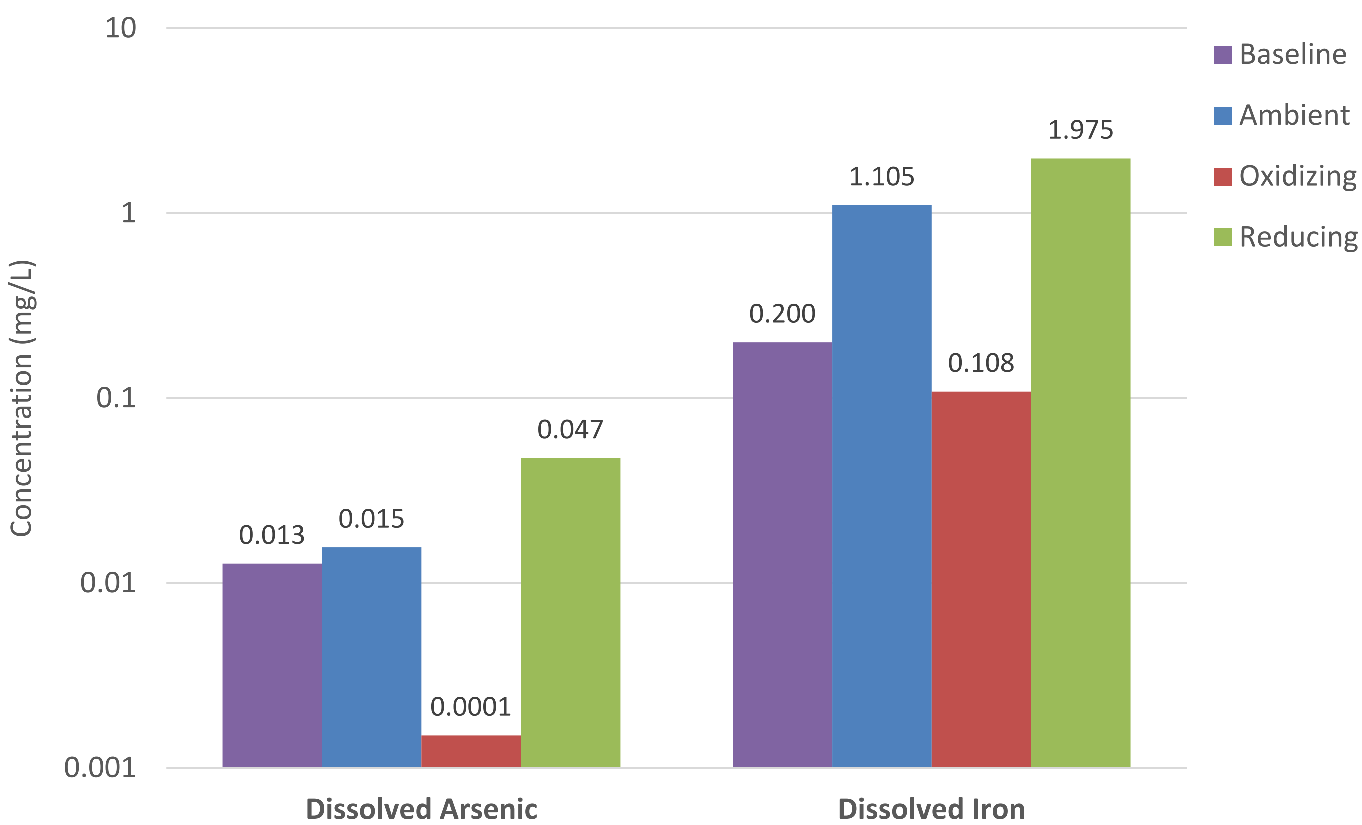
Pensacola, FL | July 2022

Figure 5

N:\Gulf Power\CCR Projects\Plant Smith\08_Remedy Selection\Remedy Selection Document\04_Appendices\02_Figures



Notes:
1. mg/L indicates milligrams per liter.
2. Graph based on 2020 laboratory batch test analysis.
3. The legend refers to different treatment conditions as follows:
   a. Baseline: groundwater concentrations before the batch test;
   b. Ambient: unamended slurry reactors of groundwater and geologic material at the ratio of 1:25;
   c. Oxidizing: slurry reactors amended with oxygen gas daily; and
   d. Reducing: slurry reactors purged with hydrogen gas daily.

Arsenic Batch Desorption Test Results

Florida Power & Light Company
Plant Lansing Smith
Bay County, Florida

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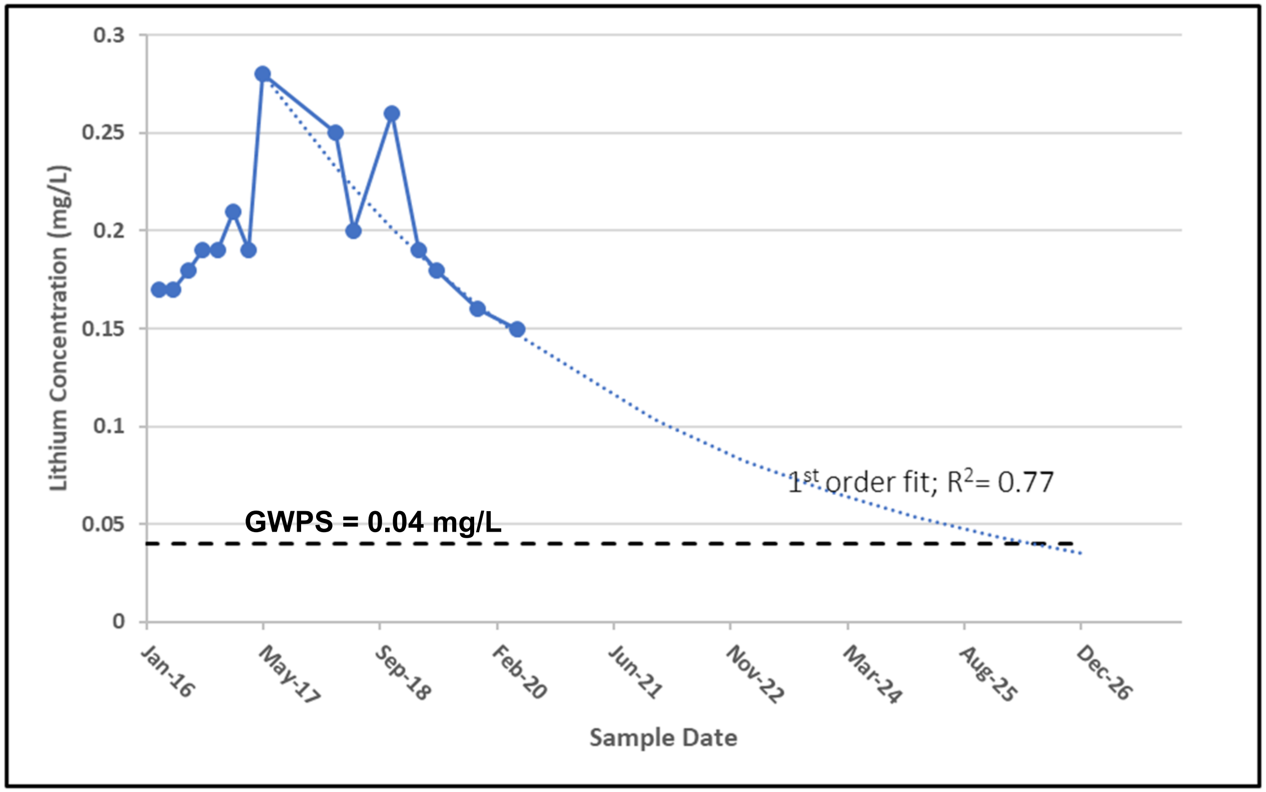
Pensacola, FL | July 2022

Figure 6



Notes:

1. mg/L indicates milligrams per liter.
2. GWPS refers to groundwater protection standard level which is 0.04 mg/L for lithium.
3. MW-13 was abandoned in August 2020 to allow for pre-closure activities (i.e., removal of the perimeter dike system). Additional data beyond August 2020 is not available from MW-13.

Time Series Graph of Lithium at MW-13

Florida Power & Light Company

Plant Lansing Smith

Bay County, Florida

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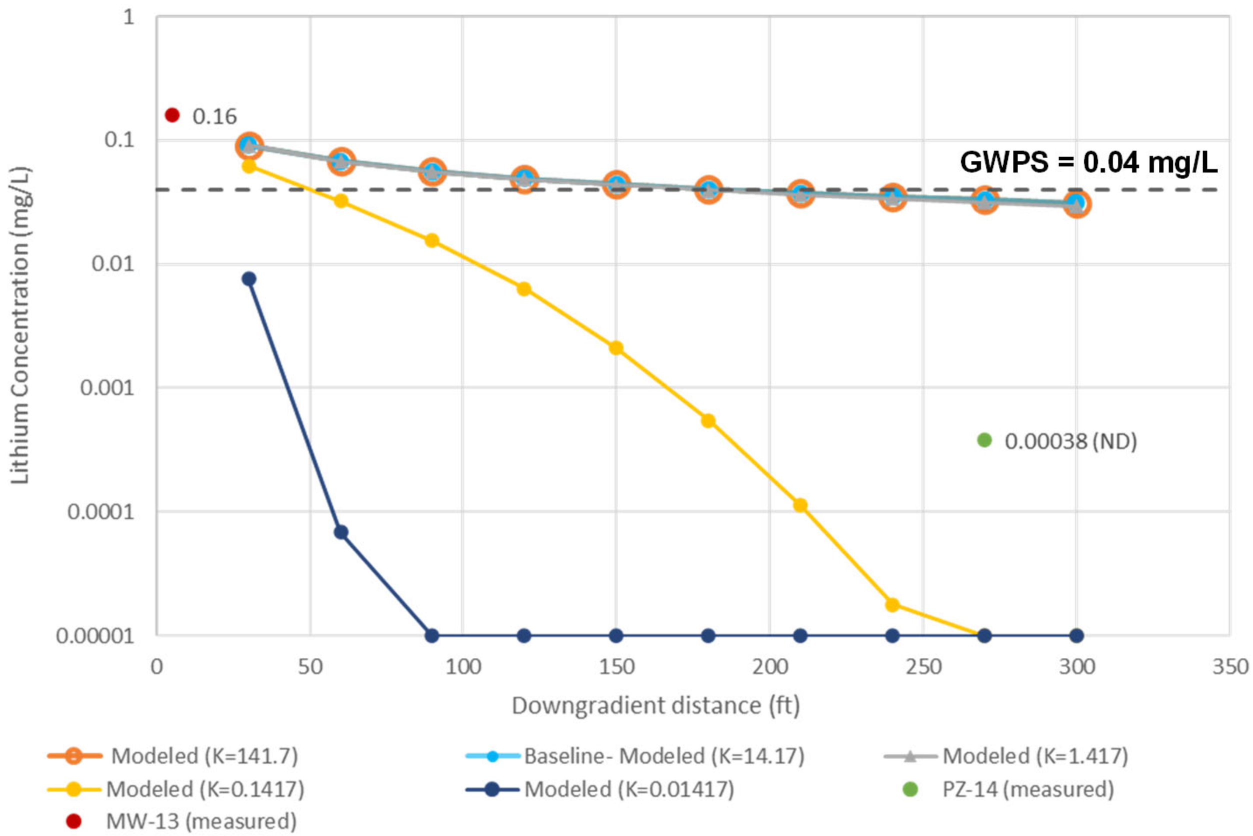
Figure 7

N:\Gulf Power\CCR Projects\Plant Smith\08_Remedy Selection\Remedy Selection Document\04_Appendices\02_Figures



Notes:

1. Concentration versus distance graphs are based on a Domenico model assuming different hydraulic conductivity (K) values.
2. mg/L indicates milligrams per liter.
3. ft indicates foot.
4. GWPS refers to groundwater protection standard level for lithium.
5. ND refers to non-detect.
6. Lithium data at MW-13 and PZ-14 are from November 2019.
7. Note the modeled lines for K=141.7 and K=14.17 and 1.417 ft/day overlap.

Preliminary Domenico Model of Lithium Concentrations Florida Power & Light Company Plant Lansing Smith Bay County, Florida		
Geosyntec consultants		**Figure 8**
Pensacola, FL	July 2022	

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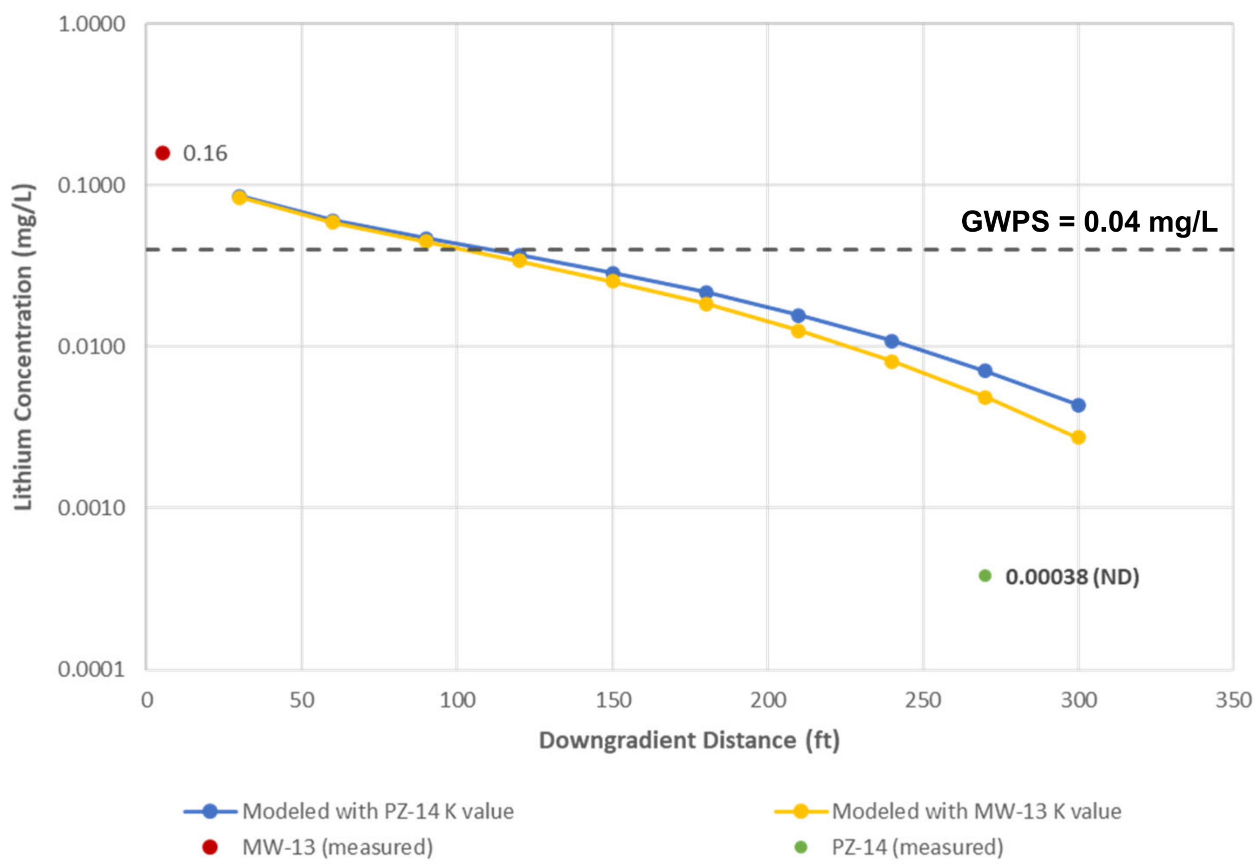


Notes:
1. Concentration versus distance graphs are based on a Domenico model using hydraulic conductivity (K) values calculated from slug tests at MW-13 and PZ-14.
2. mg/L indicates milligrams per liter.
3. ft indicates foot.
4. GWPS refers to groundwater protection standard level for lithium.
5. ND refers to non-detect.
6. Lithium data at MW-13 and PZ-14 are from November 2019.

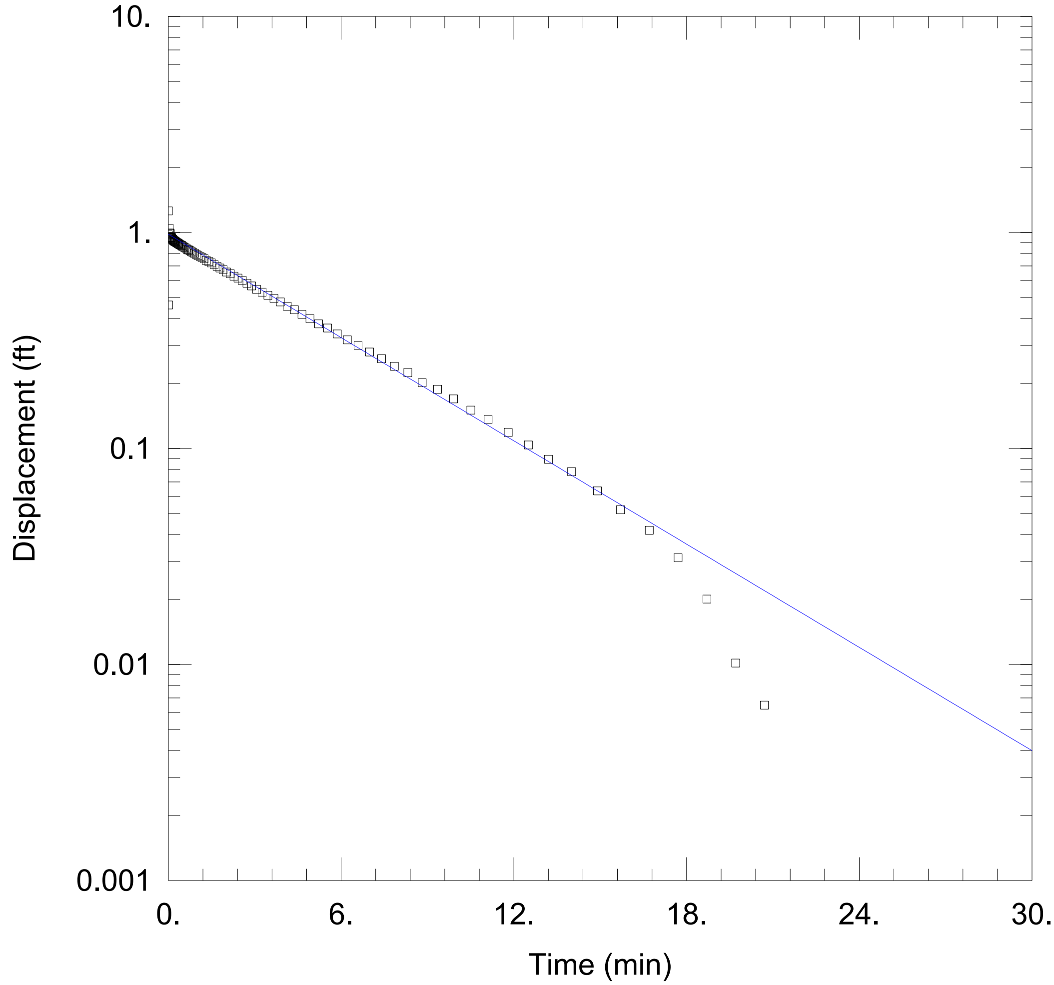
Comparison of Actual to Modeled Lithium Concentrations
Florida Power & Light Company
Plant Lansing Smith
Bay County, Florida

Geosyntec consultants

Pensacola, FL | July 2022

Figure 9

APPENDIX A
SLUG TEST RESULTS



MW-13

Data Set: A:\...\MW-13 test 1 (slug-in) BR.aqt
Date: 03/01/22 Time: 13:38:52

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: MW-13
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 26. ft Anisotropy Ratio (Kz/Kr): 0.1

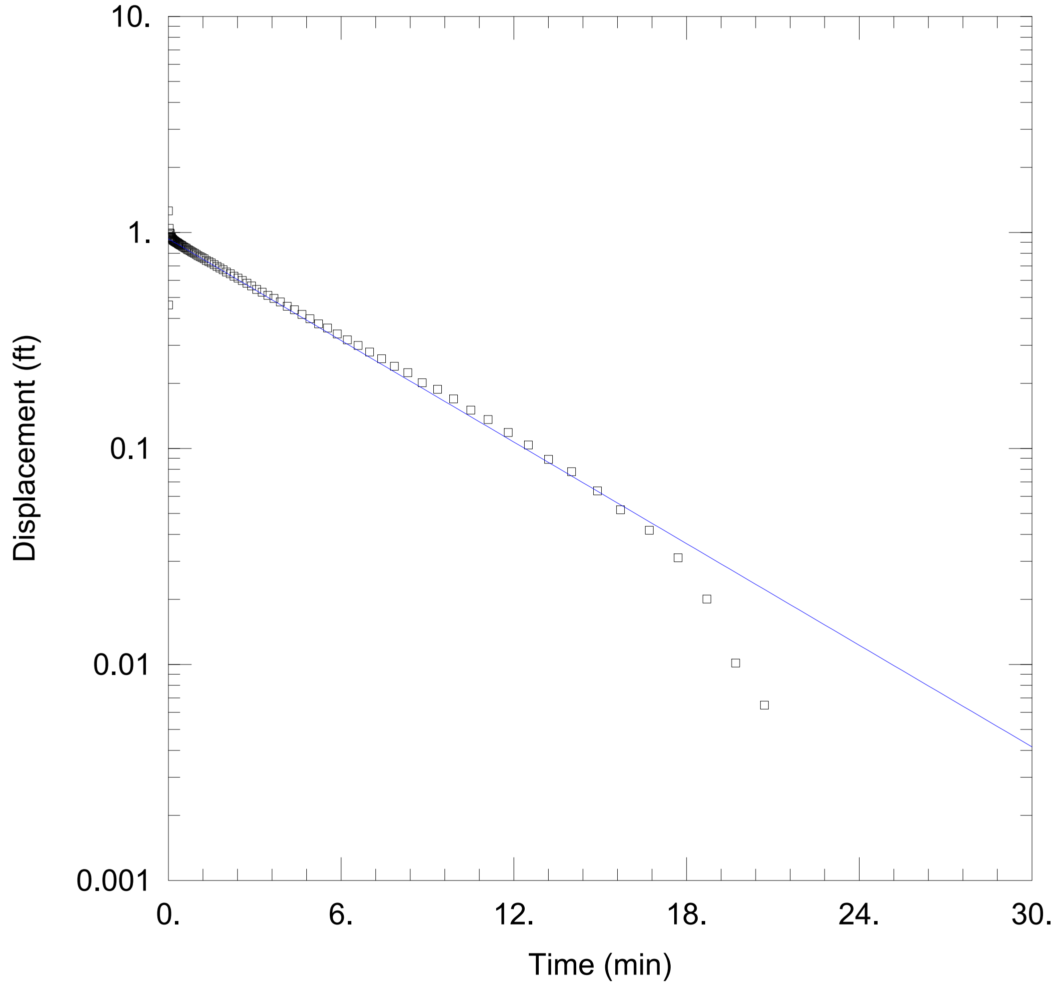
WELL DATA (MW-13 (test 1 slug in))

Initial Displacement: 1.257 ft
Total Well Penetration Depth: 27.86 ft
Casing Radius: 0.083 ft
Static Water Column Height: 27.86 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.3991 ft/day y0 = 0.9803 ft



MW-13

Data Set: A:\...\MW-13 test 1 (slug-in) HV.aqt
Date: 03/01/22 Time: 13:39:42

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: MW-13
Test Date: 8/25/2020

AQUIFER DATA

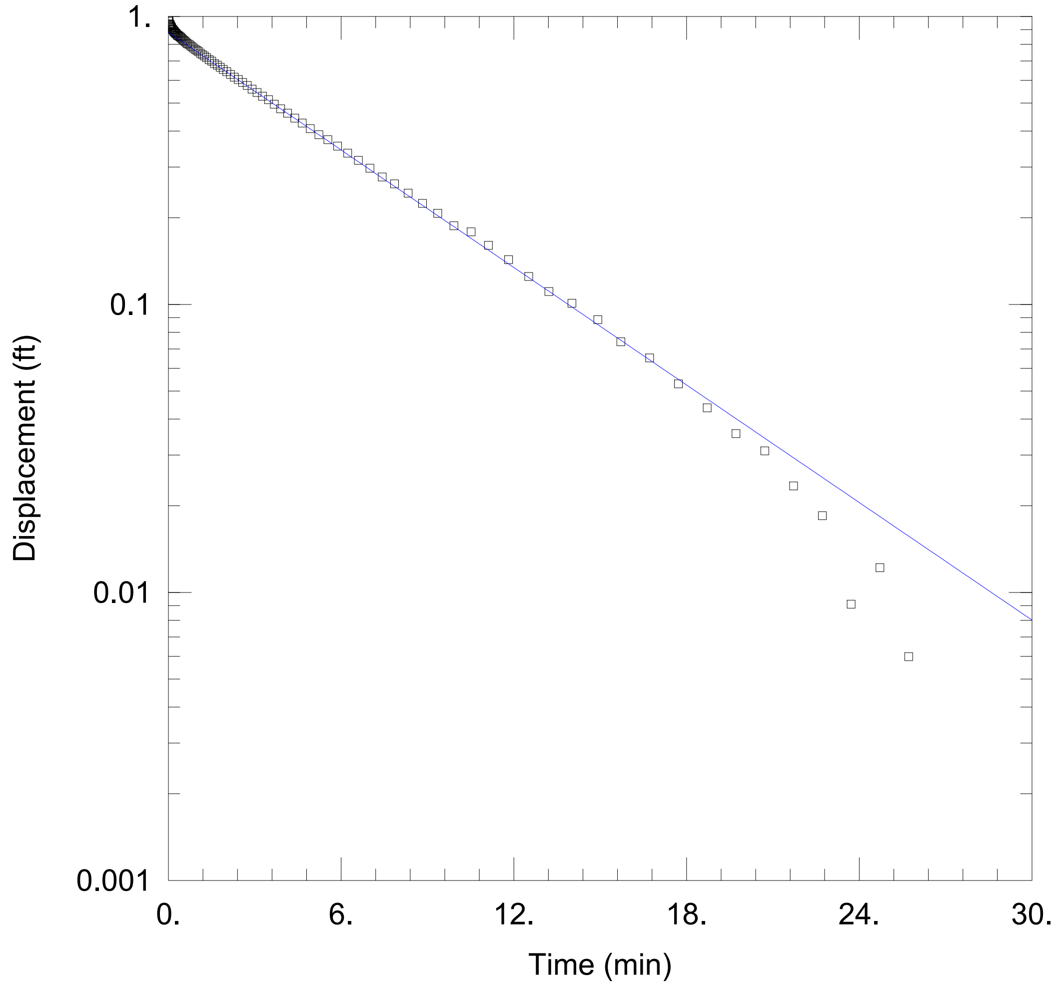
Saturated Thickness: 26. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW-13 (test 1 slug in))

Initial Displacement: 1.257 ft
Static Water Column Height: 27.86 ft
Total Well Penetration Depth: 27.86 ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.4954 ft/day
y0 = 0.9337 ft



MW-13

Data Set: A:\...\MW-13 test 1 (slug-out) BR.aqt
Date: 03/01/22
Time: 13:41:55

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: MW-13
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 26. ft
Anisotropy Ratio (Kz/Kr): 0.1

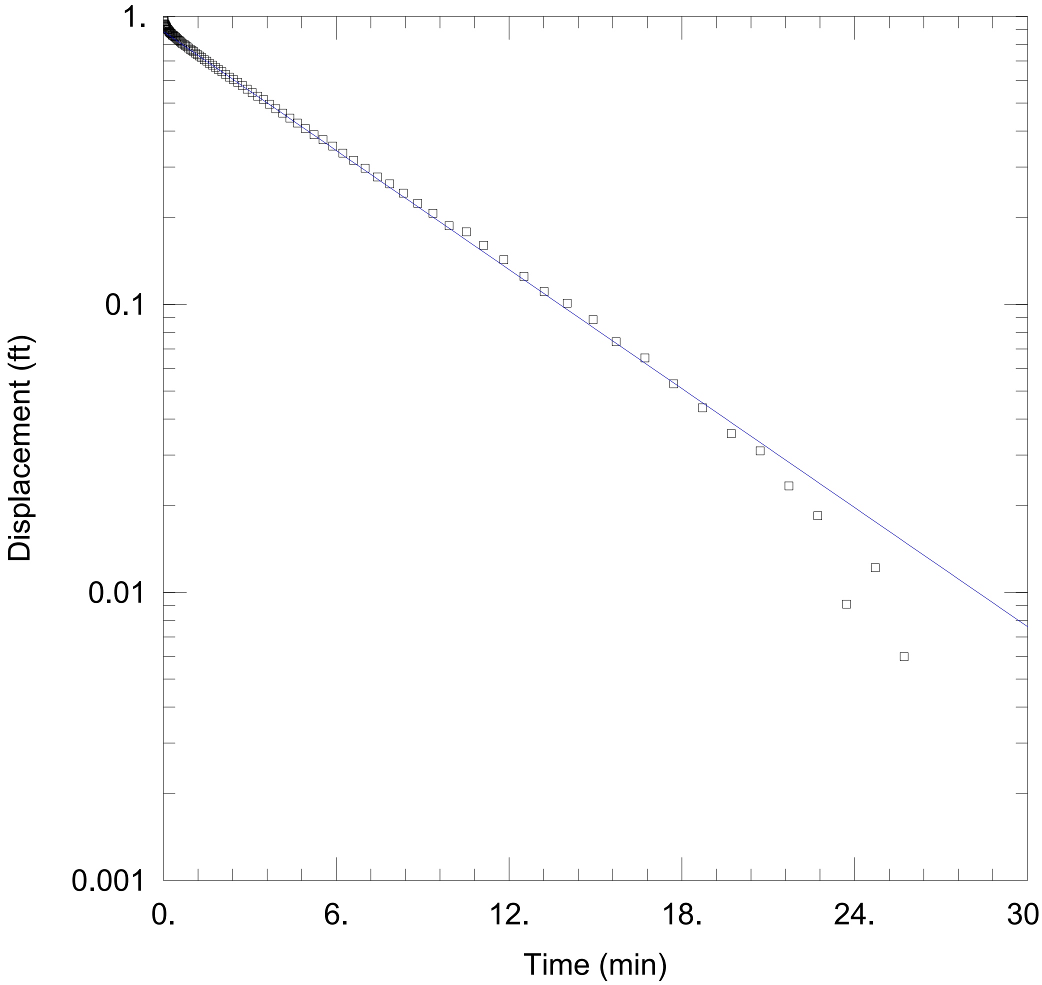
WELL DATA (MW-13 (test 1 slug out))

Initial Displacement: 1.003 ft
Static Water Column Height: 27.86 ft
Total Well Penetration Depth: 27.86 ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.3407 ft/day
y0 = 0.8802 ft



MW-13

Data Set: A:\...\MW-13 test 1 (slug-out) HV.aqt
Date: 03/01/22 Time: 13:42:48

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: MW-13
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 26. ft Anisotropy Ratio (Kz/Kr): 0.1

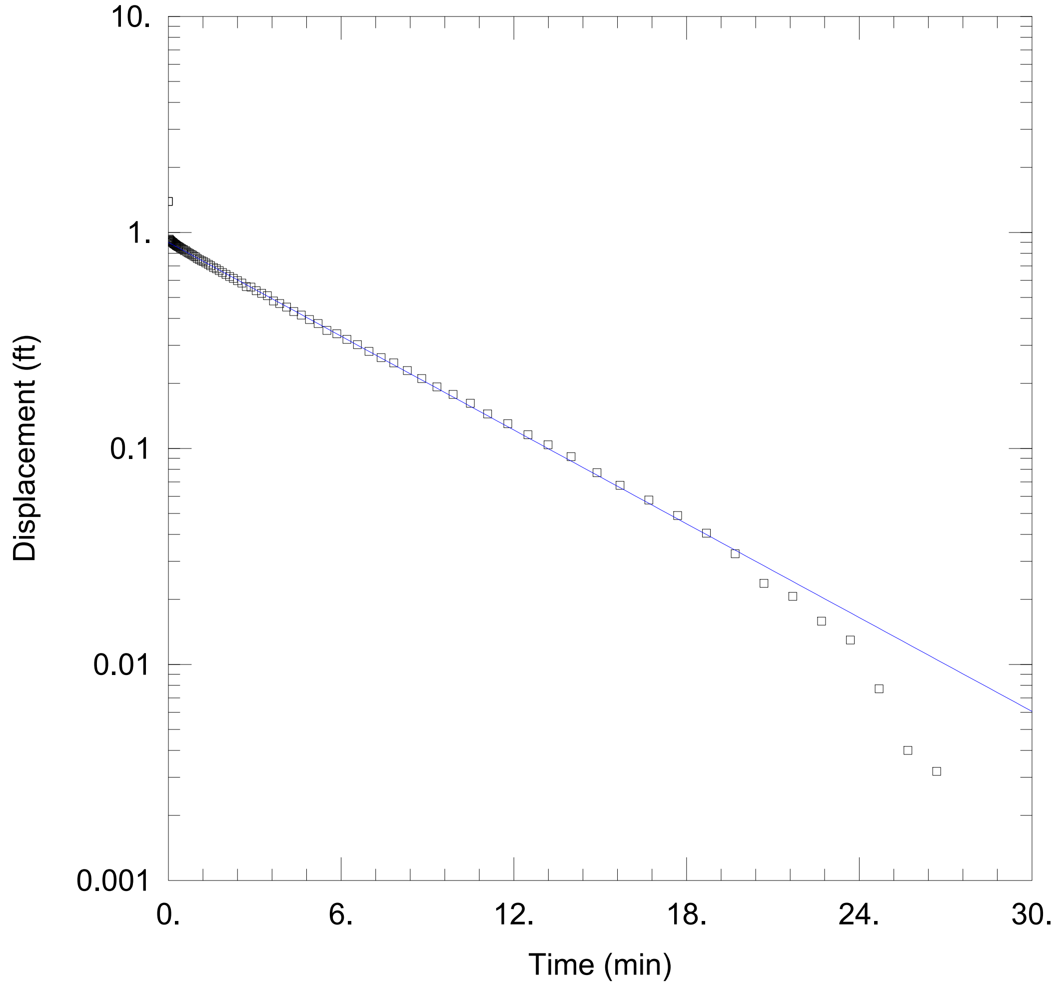
WELL DATA (MW-13 (test 1 slug out))

Initial Displacement: 1.003 ft
Total Well Penetration Depth: 27.86 ft
Casing Radius: 0.083 ft
Static Water Column Height: 27.86 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.4353 ft/day
y0 = 0.8864 ft



MW-13

Data Set: A:\...\MW-13 test 2 (slug-in) BR.aqt
Date: 03/01/22
Time: 13:44:05

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: MW-13
Test Date: 8/25/2020

AQUIFER DATA

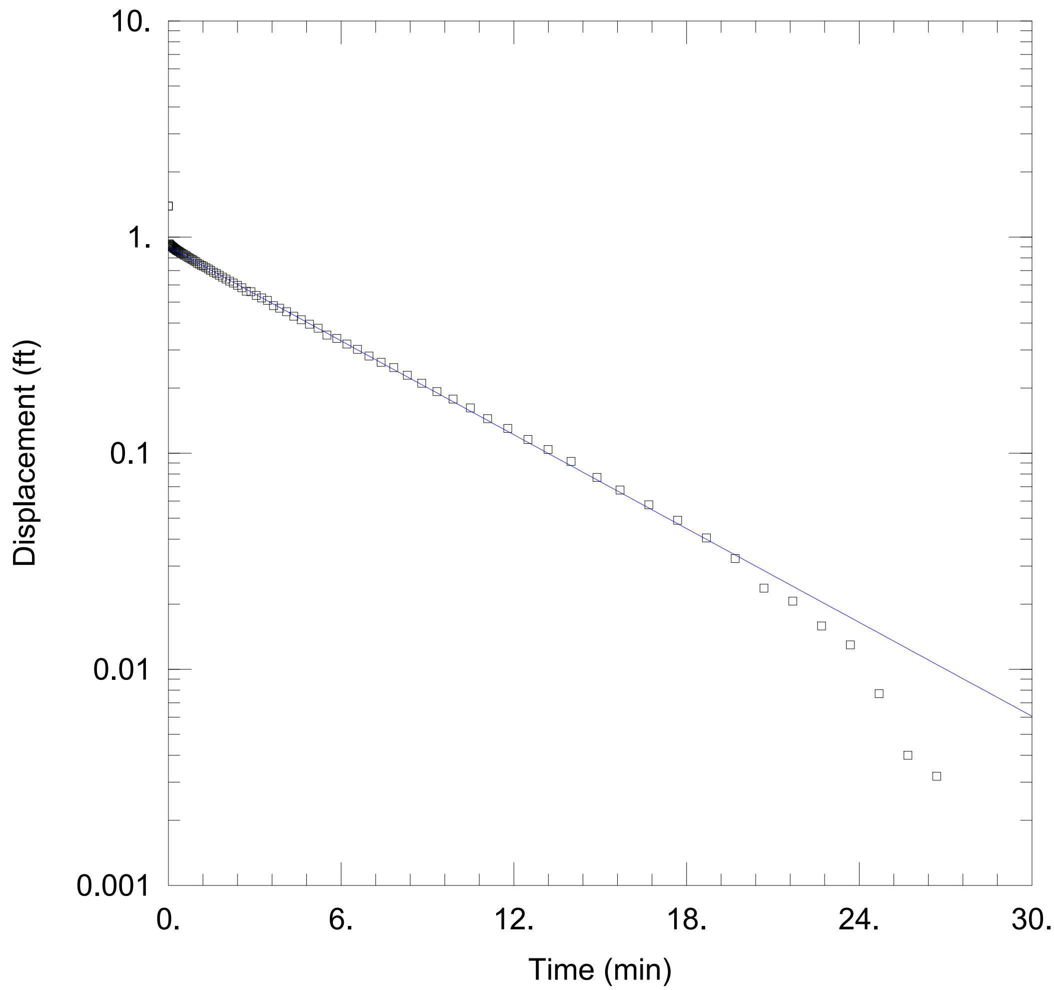
Saturated Thickness: 26. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (MW-13 (test 2 slug in))

Initial Displacement: 1.39 ft
Static Water Column Height: 27.86 ft
Total Well Penetration Depth: 27.86 ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.3625 ft/day
y0 = 0.8992 ft



MW-13

Data Set: A:\...\MW-13 test 2 (slug-in) HV.aqt
Date: 03/01/22
Time: 13:45:09

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: MW-13
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 26. ft
Anisotropy Ratio (Kz/Kr): 0.1

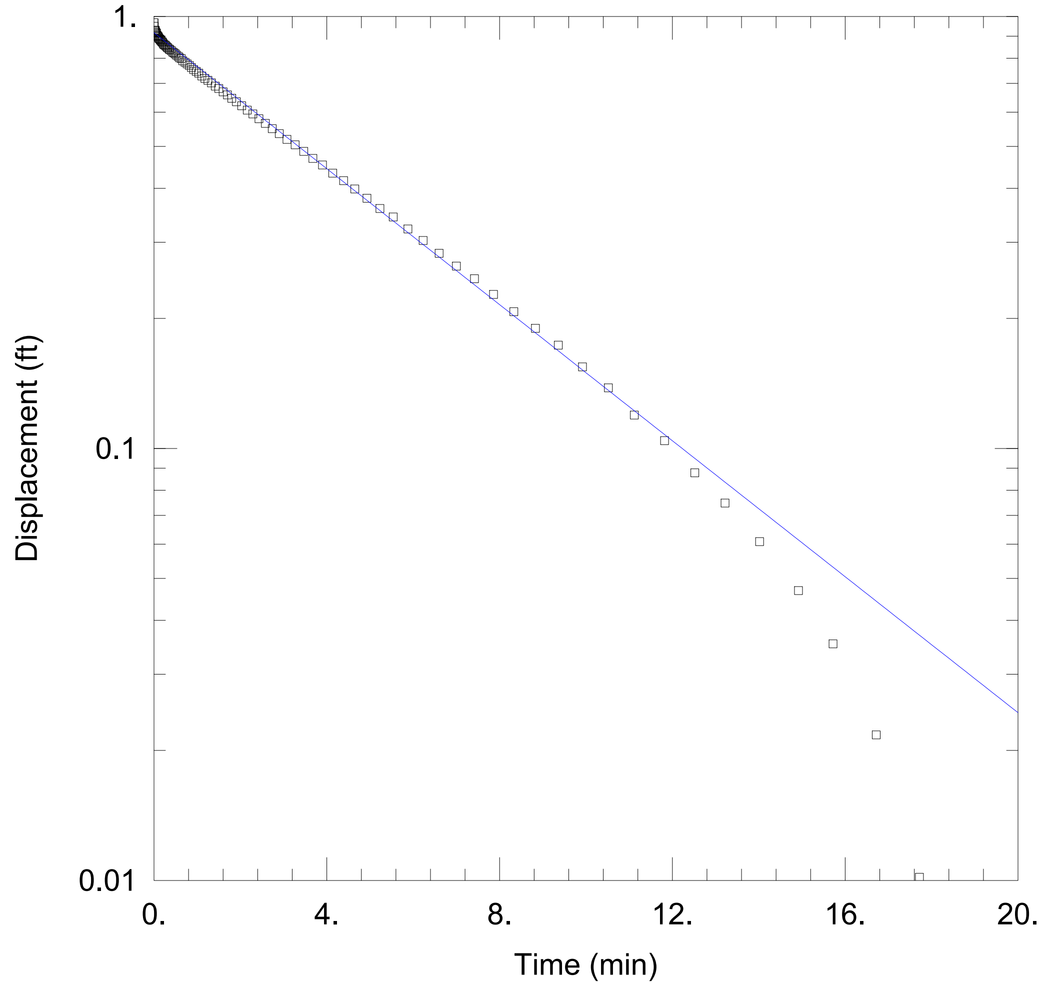
WELL DATA (MW-13 (test 2 slug in))

Initial Displacement: 1.39 ft
Static Water Column Height: 27.86 ft
Total Well Penetration Depth: 27.86 ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.4574 ft/day
y0 = 0.8992 ft



MW-13

Data Set: A:\...\MW-13 test 2 (slug-out) BR.aqt
Date: 03/01/22
Time: 13:46:30

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: MW-13
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 26. ft
Anisotropy Ratio (Kz/Kr): 0.1

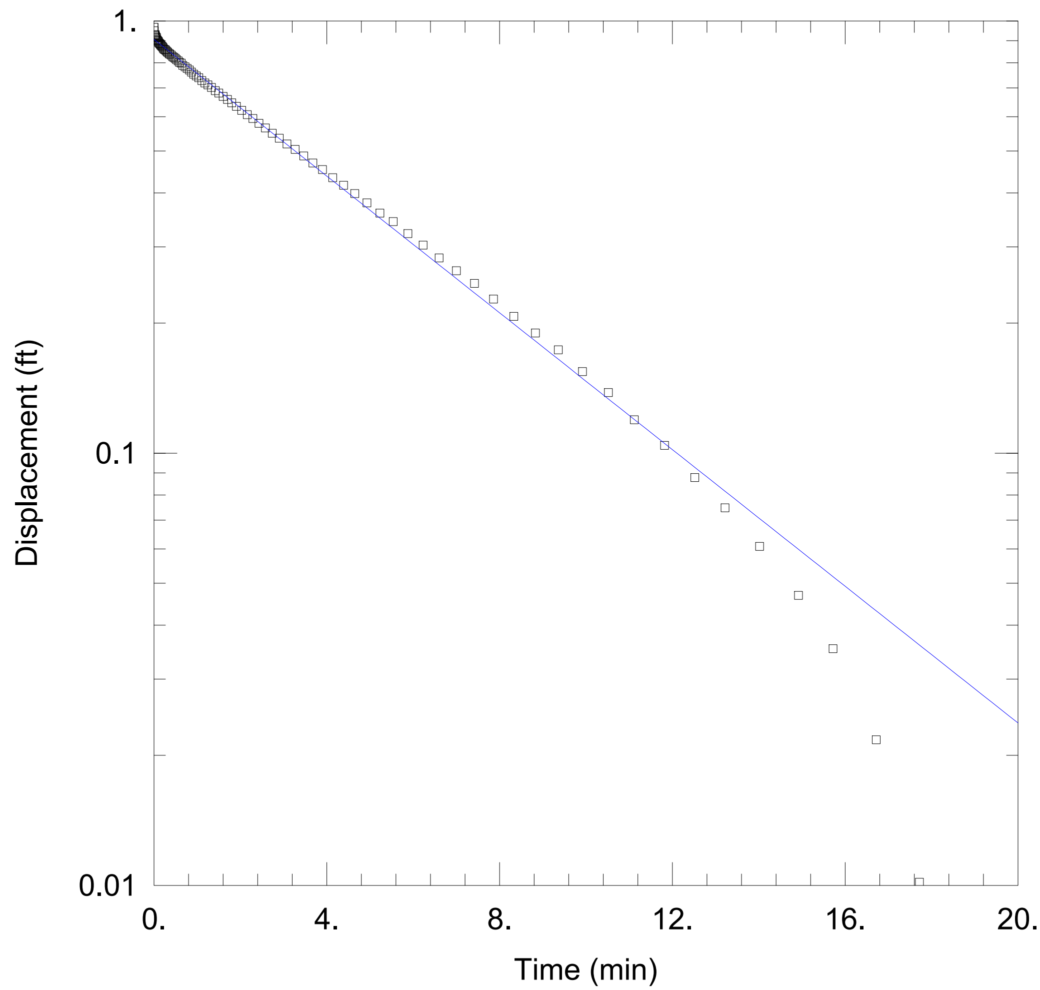
WELL DATA (MW-13 (test 2 slug out))

Initial Displacement: 0.9671 ft
Static Water Column Height: 27.86 ft
Total Well Penetration Depth: 27.86 ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.3941 ft/day
y0 = 0.9169 ft



MW-13

Data Set: A:\...\MW-13 test 2 (slug-out) HV.aqt
Date: 03/01/22 Time: 13:47:54

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: MW-13
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 26. ft
Anisotropy Ratio (Kz/Kr): 0.1

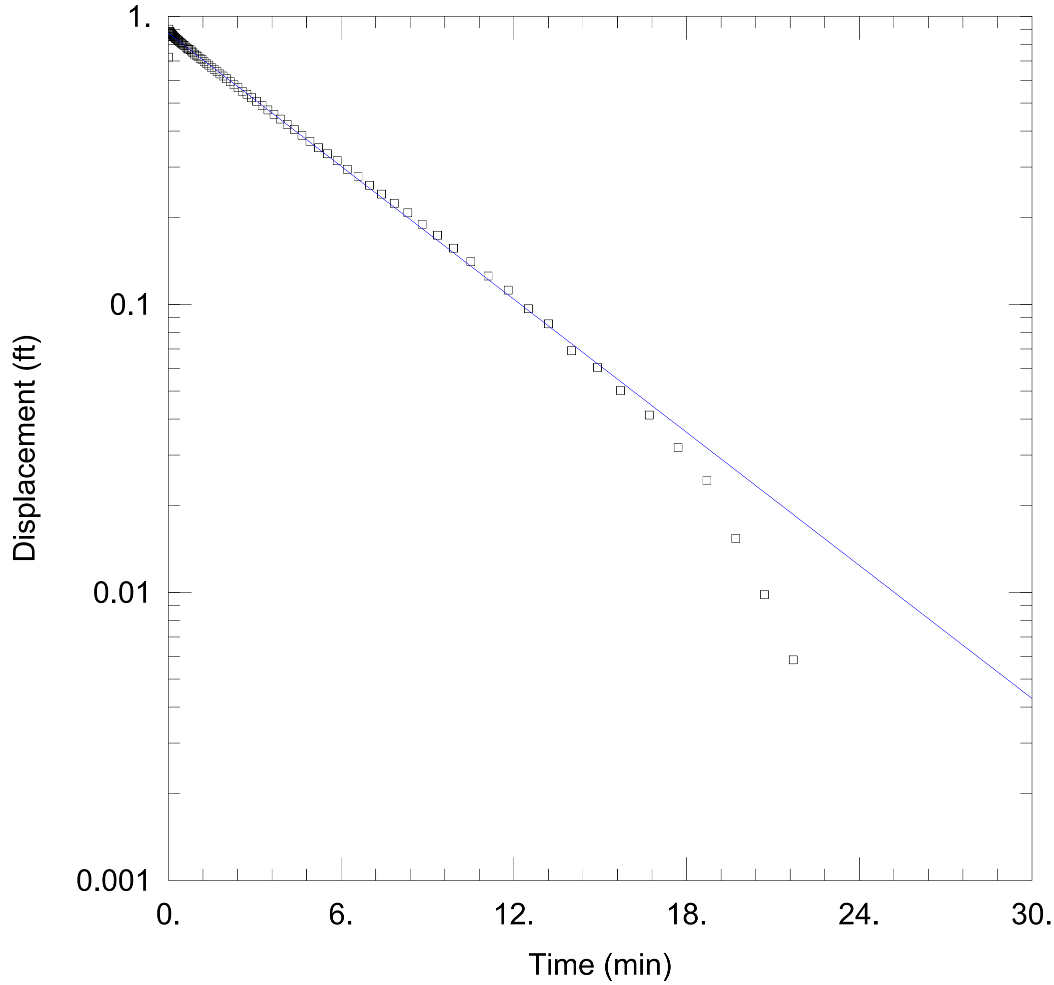
WELL DATA (MW-13 (test 2 slug out))

Initial Displacement: 0.9671 ft
Total Well Penetration Depth: 27.86 ft
Casing Radius: 0.083 ft
Static Water Column Height: 27.86 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.4997 ft/day
y0 = 0.9064 ft



MW-13

Data Set: A:\...\MW-13 test 3 (slug-in) BR.aqt
Date: 03/01/22 | Time: 13:48:21

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: MW-13
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 26. ft
Anisotropy Ratio (Kz/Kr): 0.1

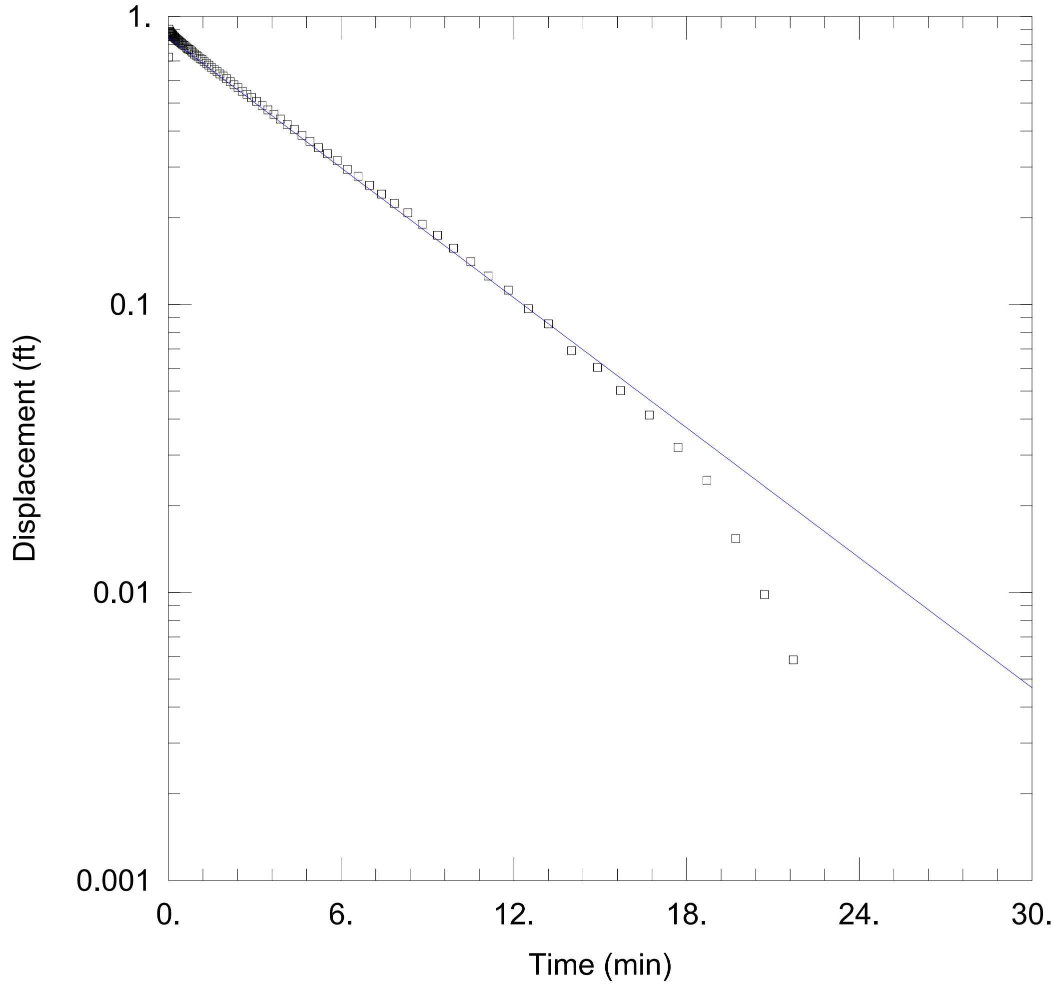
WELL DATA (MW-13 (test 3 slug in))

Initial Displacement: 1.291 ft
Static Water Column Height: 27.86 ft
Total Well Penetration Depth: 27.86 ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.3856 ft/day
y0 = 0.8747 ft



MW-13

Data Set: A:\...\MW-13 test 3 (slug-in) HV.aqt
Date: 03/01/22
Time: 13:49:08

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: MW-13
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 26. ft
Anisotropy Ratio (Kz/Kr): 0.1

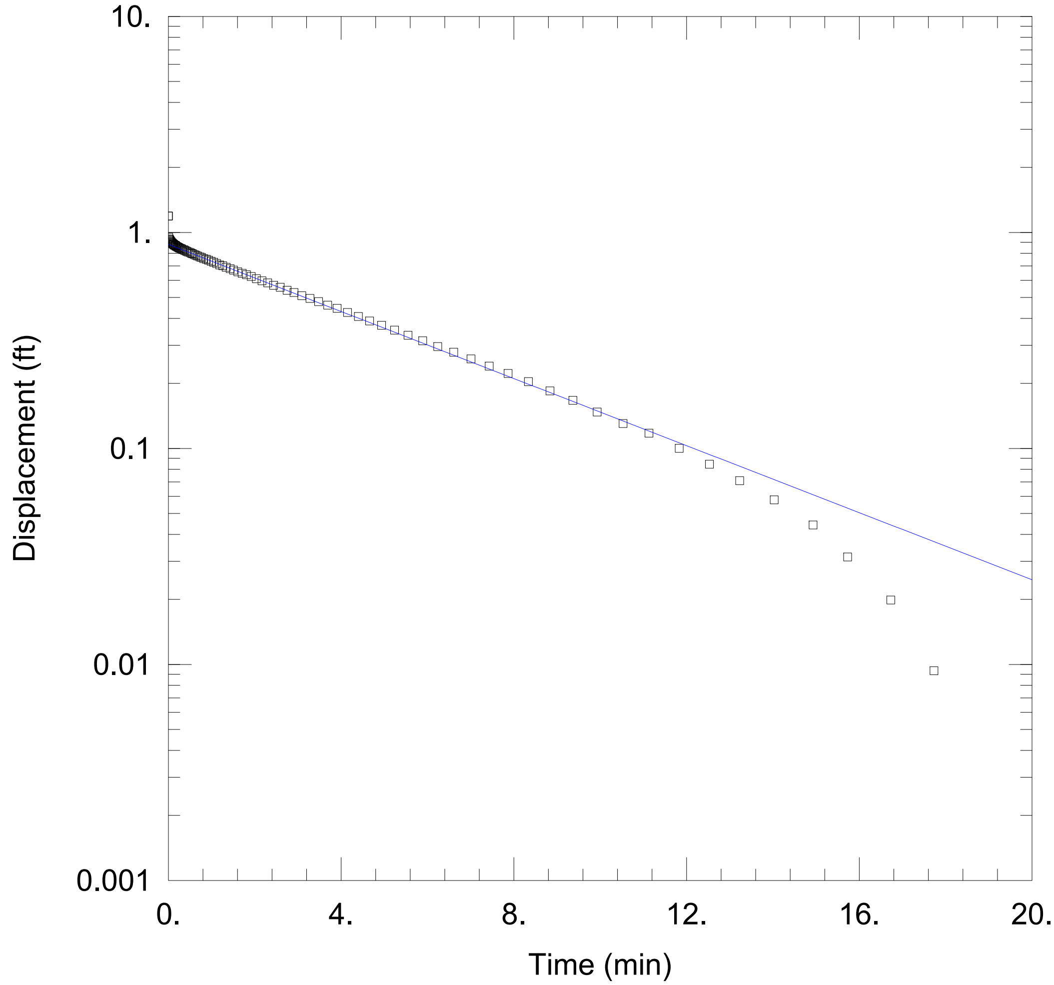
WELL DATA (MW-13 (test 3 slug in))

Initial Displacement: 1.291 ft
Static Water Column Height: 27.86 ft
Total Well Penetration Depth: 27.86 ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.4754 ft/day
y0 = 0.8432 ft



MW-13

Data Set: A:\...\MW-13 test 3 (slug-out) BR.aqt
Date: 03/01/22 Time: 13:49:38

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: MW-13
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 26. ft Anisotropy Ratio (Kz/Kr): 0.1

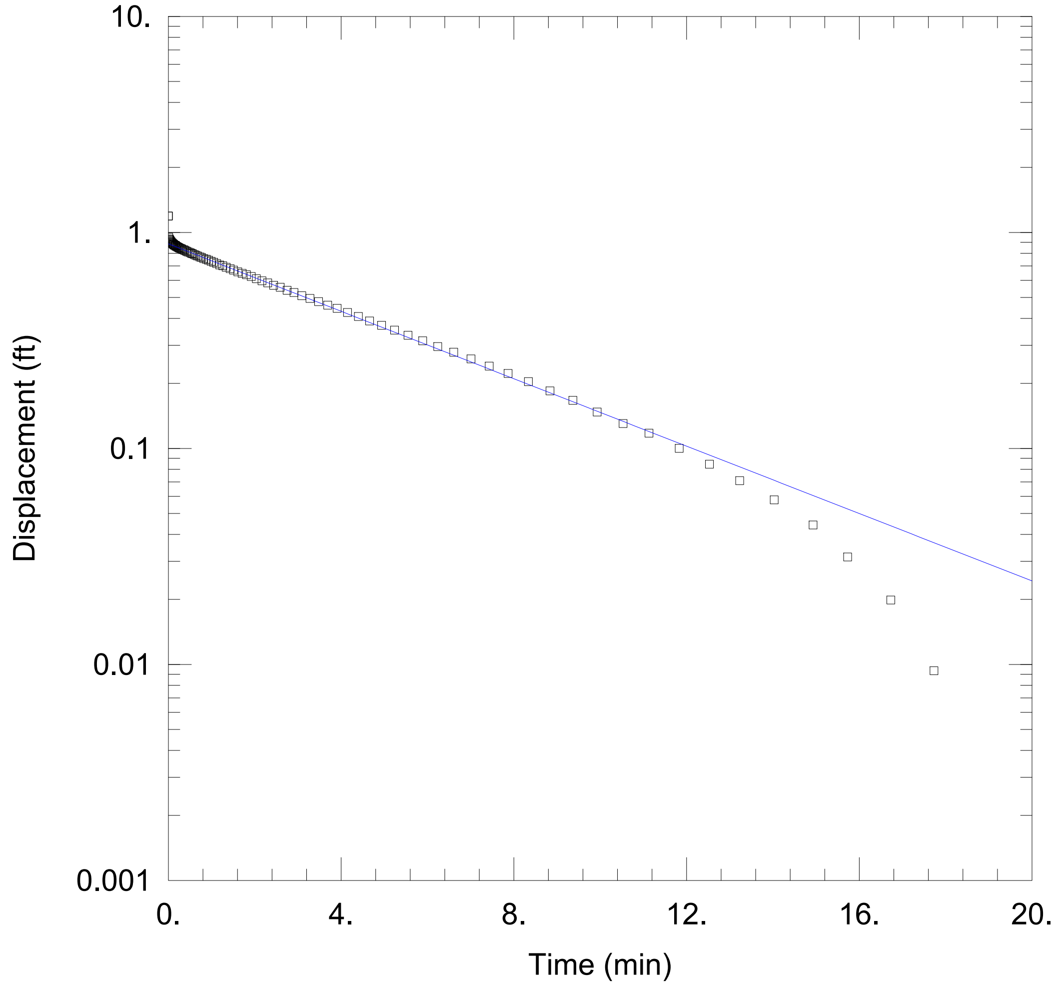
WELL DATA (MW-13 (test 3 slug out))

Initial Displacement: 1.19 ft
Total Well Penetration Depth: 27.86 ft
Casing Radius: 0.083 ft
Static Water Column Height: 27.86 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.3887 ft/day
y0 = 0.8799 ft



MW-13

Data Set: A:\...\MW-13 test 3 (slug-out) HV.aqt
Date: 03/01/22
Time: 13:51:03

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: MW-13
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 26. ft
Anisotropy Ratio (Kz/Kr): 0.1

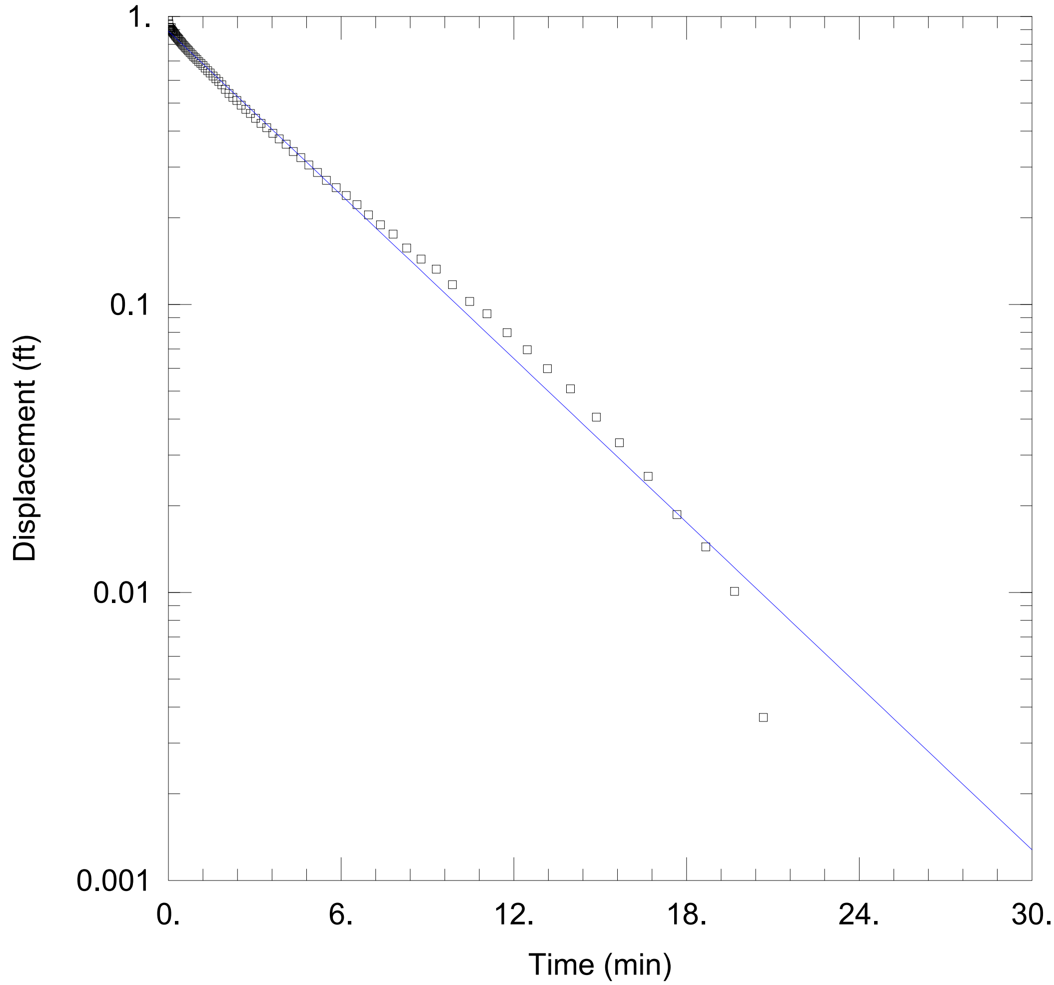
WELL DATA (MW-13 (test 3 slug out))

Initial Displacement: 1.19 ft
Static Water Column Height: 27.86 ft
Total Well Penetration Depth: 27.86 ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.4929 ft/day
y0 = 0.8848 ft



SLUG-IN

Data Set: A:\...\PZ-14 test 1 (slug-in) BR.aqt
Date: 03/01/22 Time: 13:52:32

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: PZ-14
Test Date: 8/25/2020

AQUIFER DATA

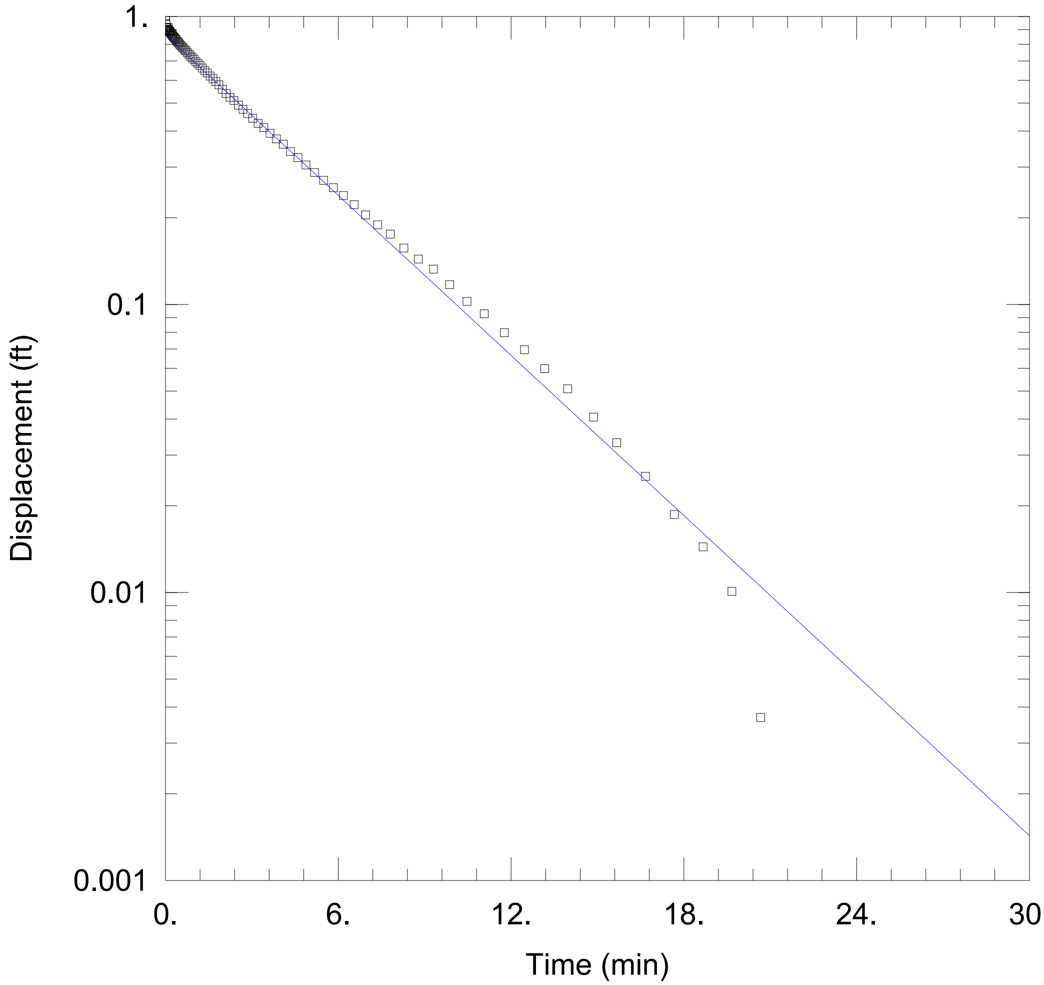
Saturated Thickness: 23. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (PZ-14 (test 1 slug in))

Initial Displacement: 0.9982 ft
Total Well Penetration Depth: 22.7 ft
Casing Radius: 0.083 ft
Static Water Column Height: 22.7 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.4462 ft/day
y0 = 0.8889 ft



SLUG-IN

Data Set: A:\...\PZ-14 test 1 (slug-in) HV.aqt
Date: 03/01/22 Time: 13:53:54

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: PZ-14
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 23. ft Anisotropy Ratio (Kz/Kr): 0.1

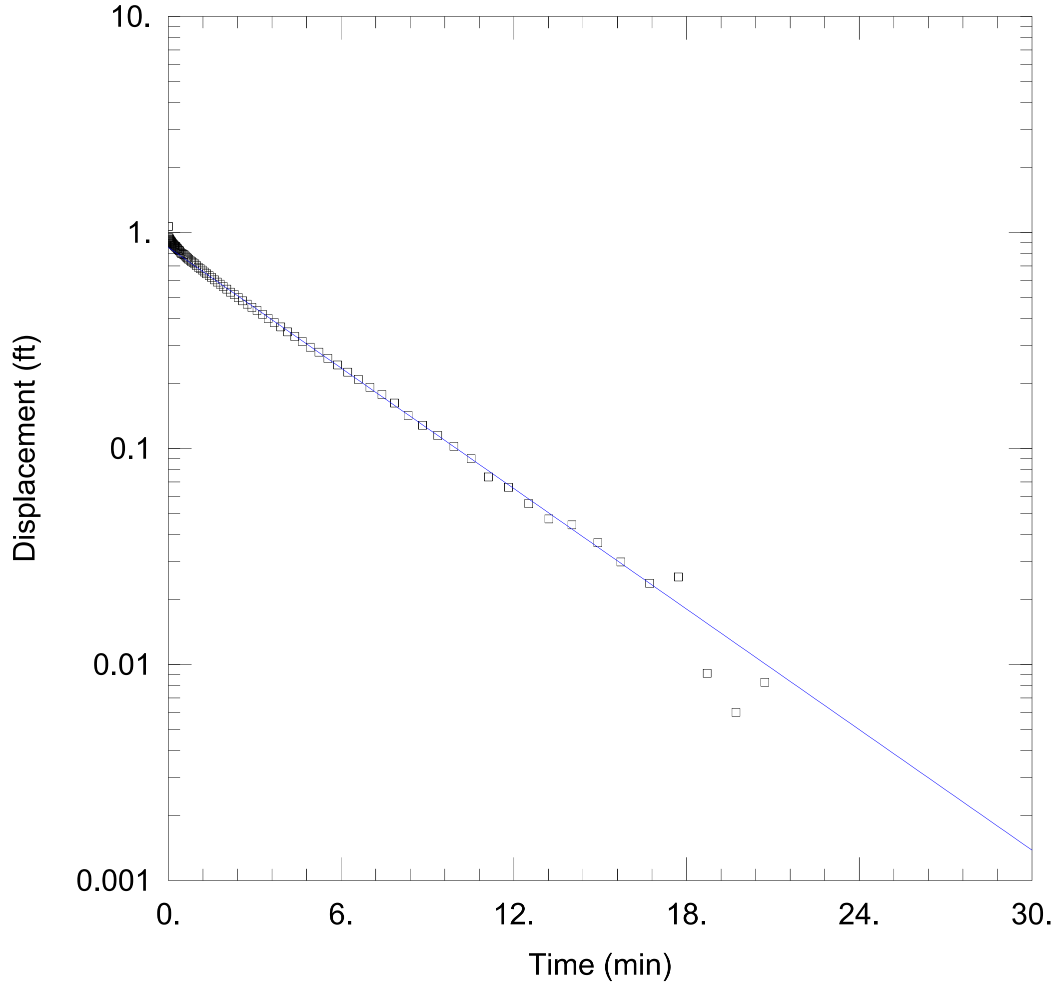
WELL DATA (PZ-14 (test 1 slug in))

Initial Displacement: 0.9982 ft
Total Well Penetration Depth: 22.7 ft
Casing Radius: 0.083 ft
Static Water Column Height: 22.7 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.5121 ft/day y0 = 0.86 ft



PZ-14

Data Set: A:\...\PZ-14 test 1 (slug-out) BR.aqt
Date: 03/01/22 Time: 13:54:41

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: PZ-14
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 23. ft Anisotropy Ratio (Kz/Kr): 0.1

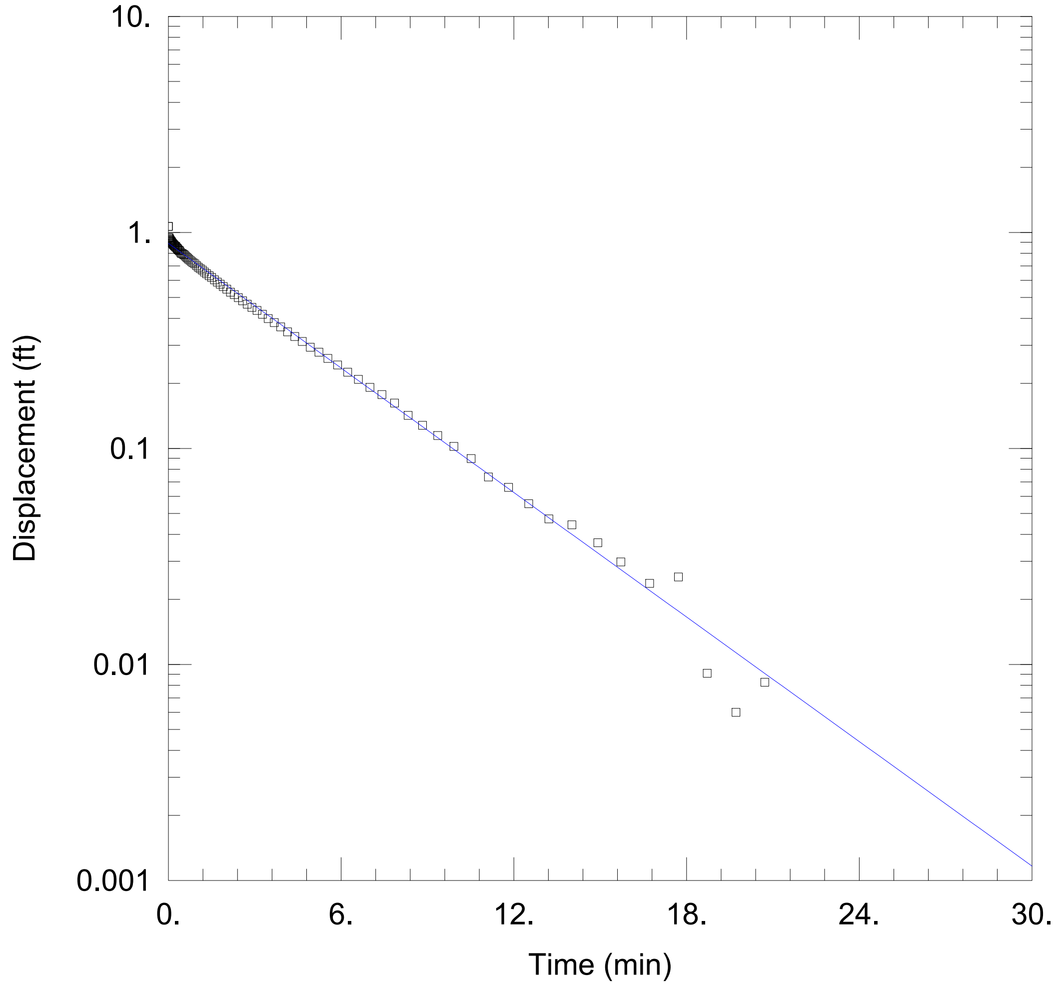
WELL DATA (PZ-14 (test 1 slug out))

Initial Displacement: 1.066 ft
Total Well Penetration Depth: 22.7 ft
Casing Radius: 0.083 ft
Static Water Column Height: 22.7 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.438 ft/day
y0 = 0.8516 ft



PZ-14

Data Set: A:\...\PZ-14 test 1 (slug-out) HV.aqt
Date: 03/01/22 Time: 13:55:32

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: PZ-14
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 23. ft Anisotropy Ratio (Kz/Kr): 0.1

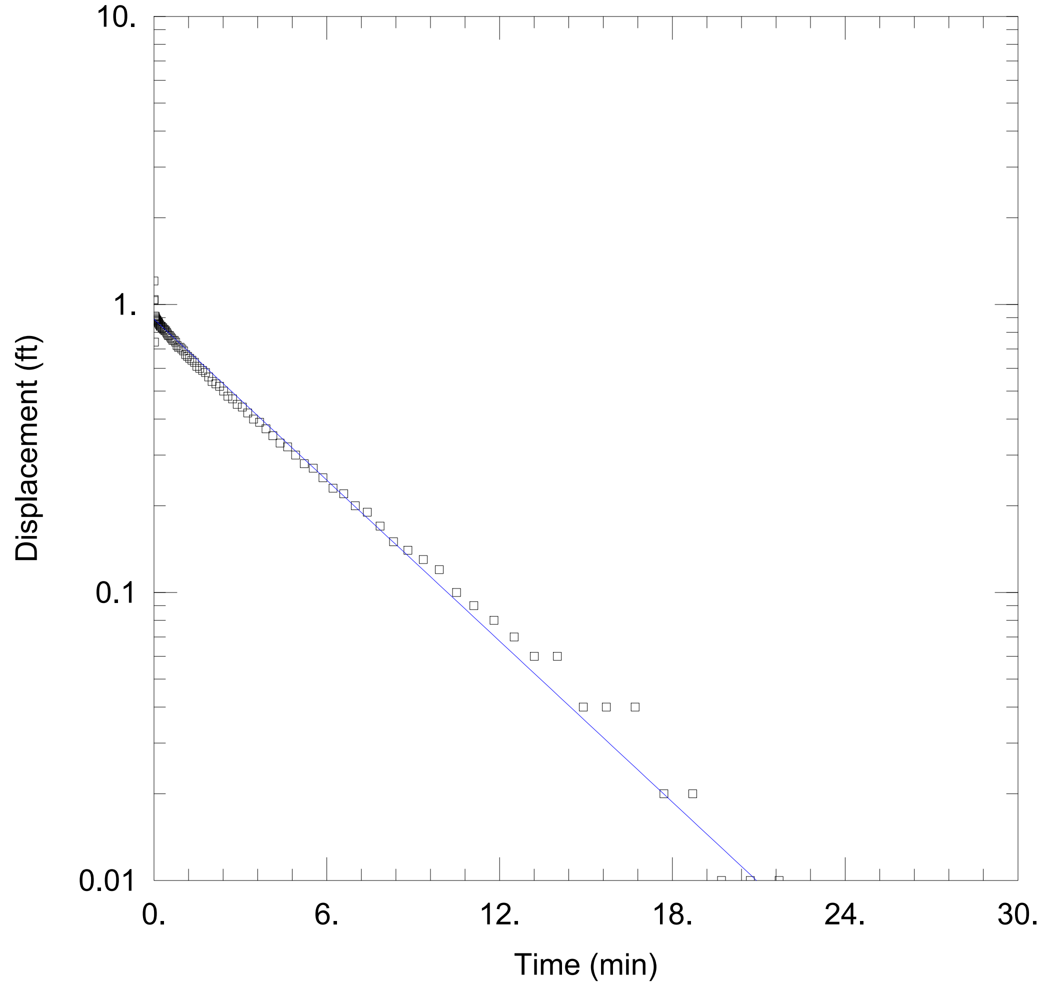
WELL DATA (PZ-14 (test 1 slug out))

Initial Displacement: 1.066 ft Static Water Column Height: 22.7 ft
Total Well Penetration Depth: 22.7 ft Screen Length: 10. ft
Casing Radius: 0.083 ft Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.5312 ft/day y0 = 0.889 ft



PZ-14

Data Set: A:\...\PZ-14 test 2 (slug-in) BR.aqt
Date: 03/01/22 Time: 13:56:28

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: PZ-14
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 23. ft Anisotropy Ratio (Kz/Kr): 0.1

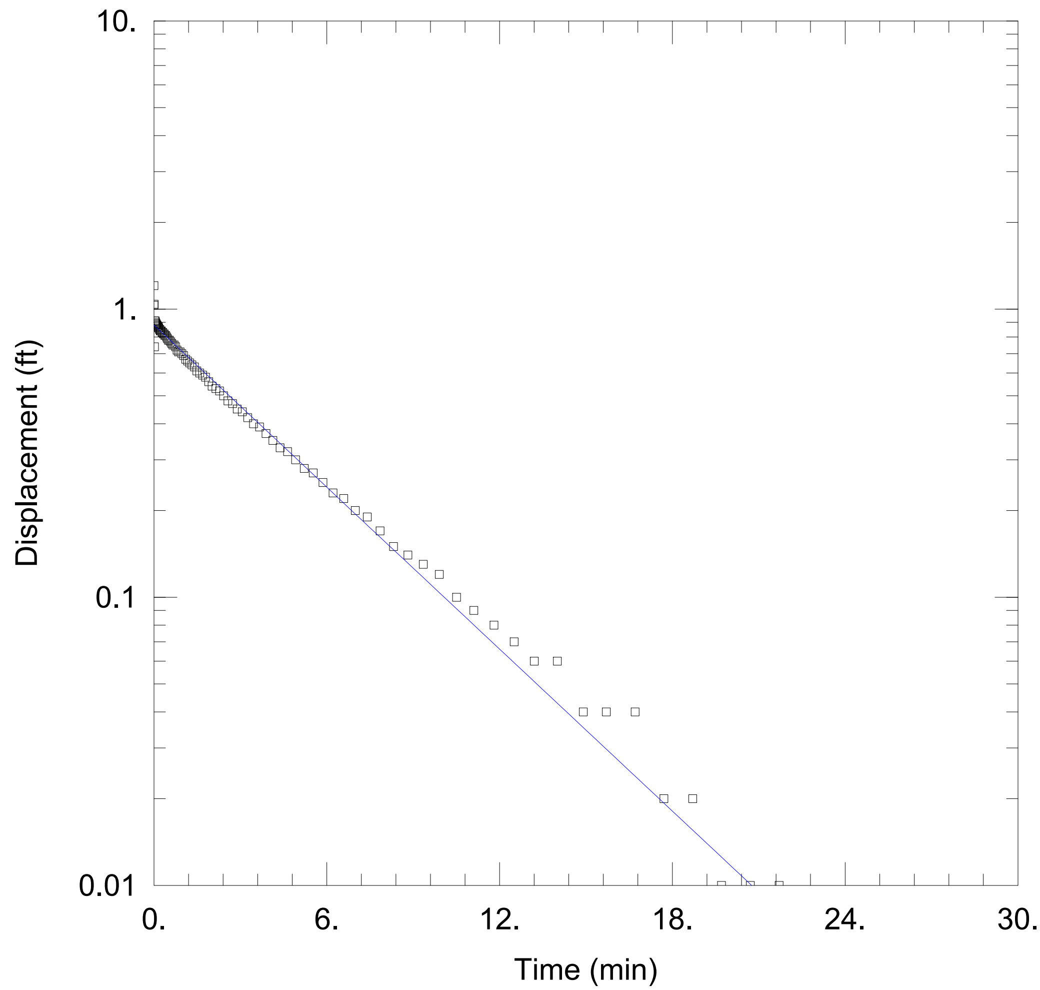
WELL DATA (PZ-14 (test 2 slug in))

Initial Displacement: 1.206 ft
Total Well Penetration Depth: 22.7 ft
Casing Radius: 0.083 ft
Static Water Column Height: 22.7 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.4386 ft/day y0 = 0.8887 ft



PZ-14

Data Set: A:\...\PZ-14 test 2 (slug-in) HV.aqt
Date: 03/01/22 Time: 13:57:32

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: PZ-14
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 23. ft Anisotropy Ratio (Kz/Kr): 0.1

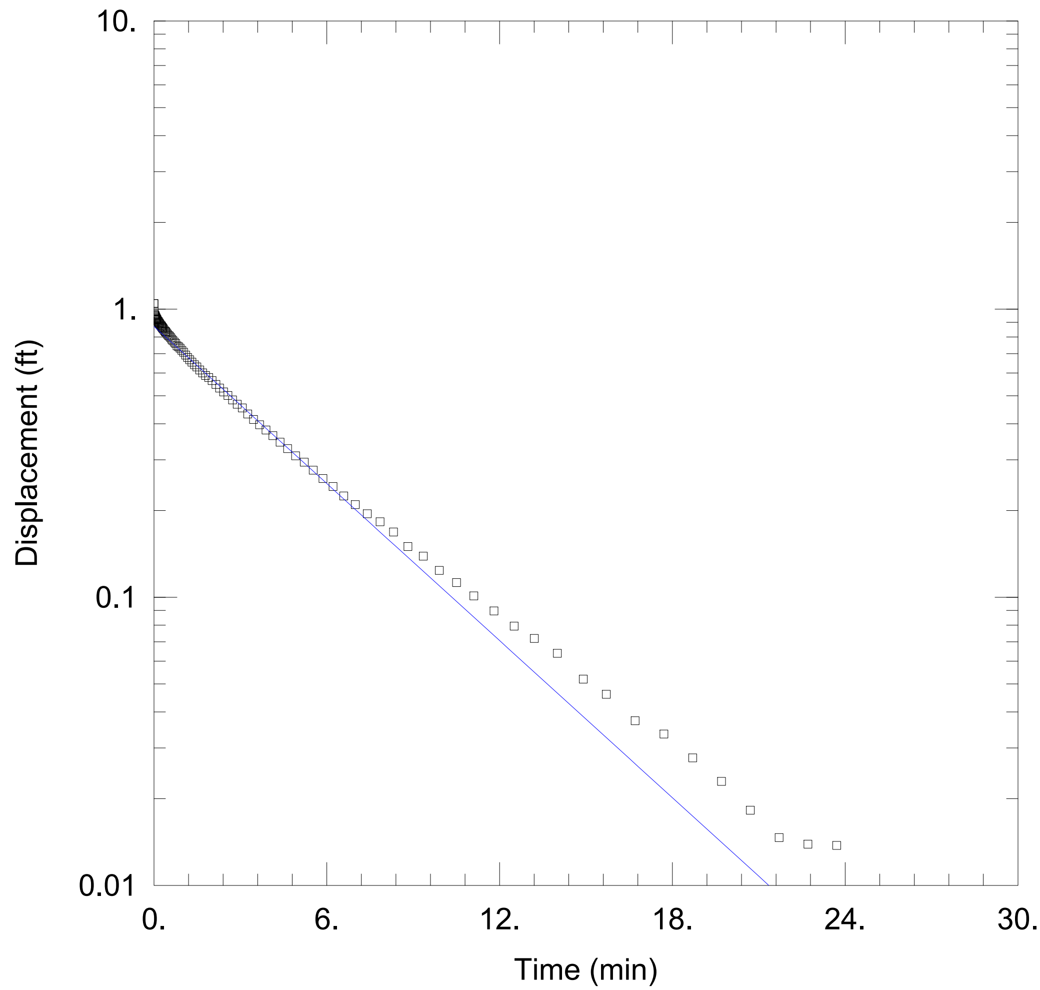
WELL DATA (PZ-14 (test 2 slug in))

Initial Displacement: 1.206 ft
Total Well Penetration Depth: 22.7 ft
Casing Radius: 0.083 ft
Static Water Column Height: 22.7 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.5179 ft/day y0 = 0.8793 ft



PZ-14

Data Set: A:\...\PZ-14 test 2 (slug-out) BR.aqt
Date: 03/01/22
Time: 13:59:29

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: PZ-14
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 23. ft
Anisotropy Ratio (Kz/Kr): 0.1

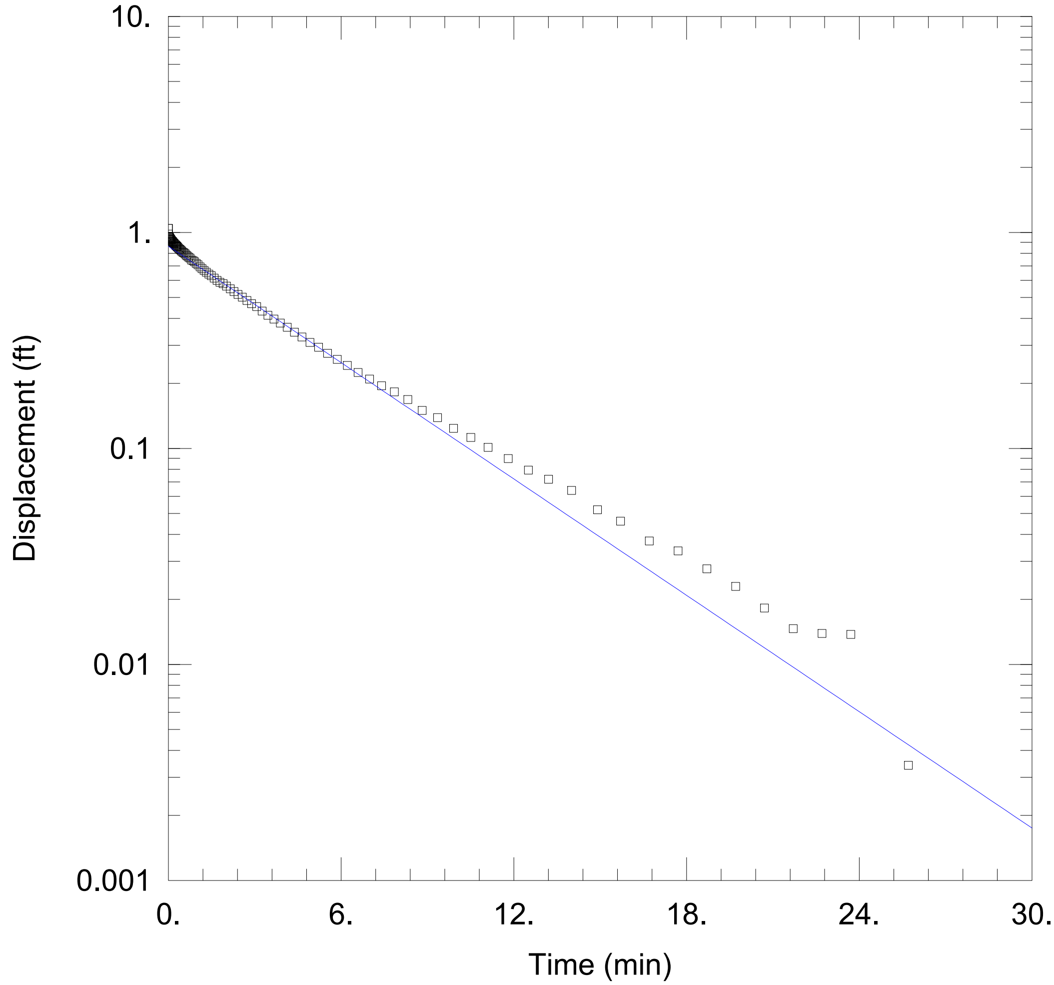
WELL DATA (PZ-14 (test 2 slug out))

Initial Displacement: 1.044 ft
Total Well Penetration Depth: 22.7 ft
Casing Radius: 0.083 ft
Static Water Column Height: 22.7 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.4279 ft/day
y0 = 0.8706 ft



PZ-14

Data Set: A:\...\PZ-14 test 2 (slug-out) HV.aqt
Date: 03/01/22 Time: 14:01:15

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: PZ-14
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 23. ft Anisotropy Ratio (Kz/Kr): 0.1

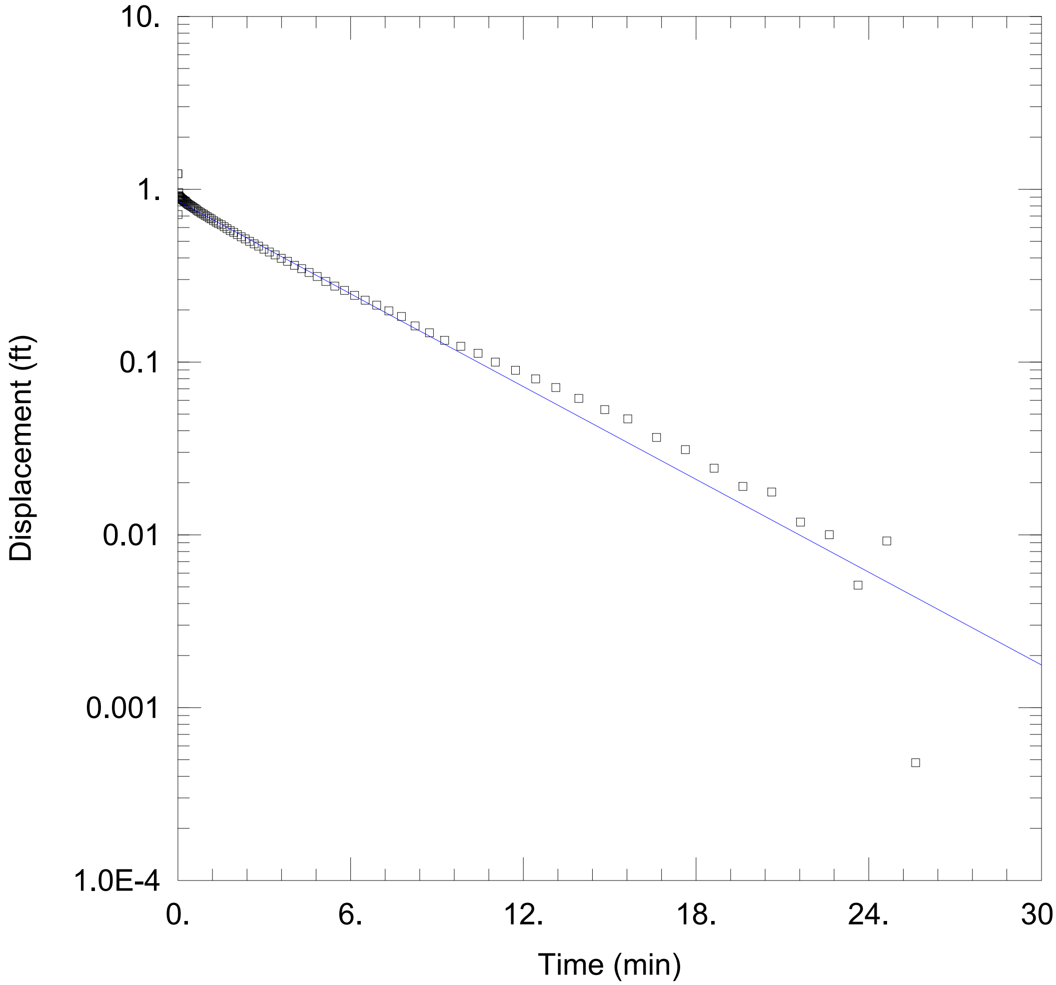
WELL DATA (PZ-14 (test 2 slug out))

Initial Displacement: 1.044 ft
Total Well Penetration Depth: 22.7 ft
Casing Radius: 0.083 ft
Static Water Column Height: 22.7 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.4964 ft/day y0 = 0.8635 ft



PZ-14

Data Set: A:\...\PZ-14 test 3 (slug-in) BR.aqt
Date: 03/01/22 Time: 14:01:47

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: PZ-14
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 23. ft Anisotropy Ratio (Kz/Kr): 0.1

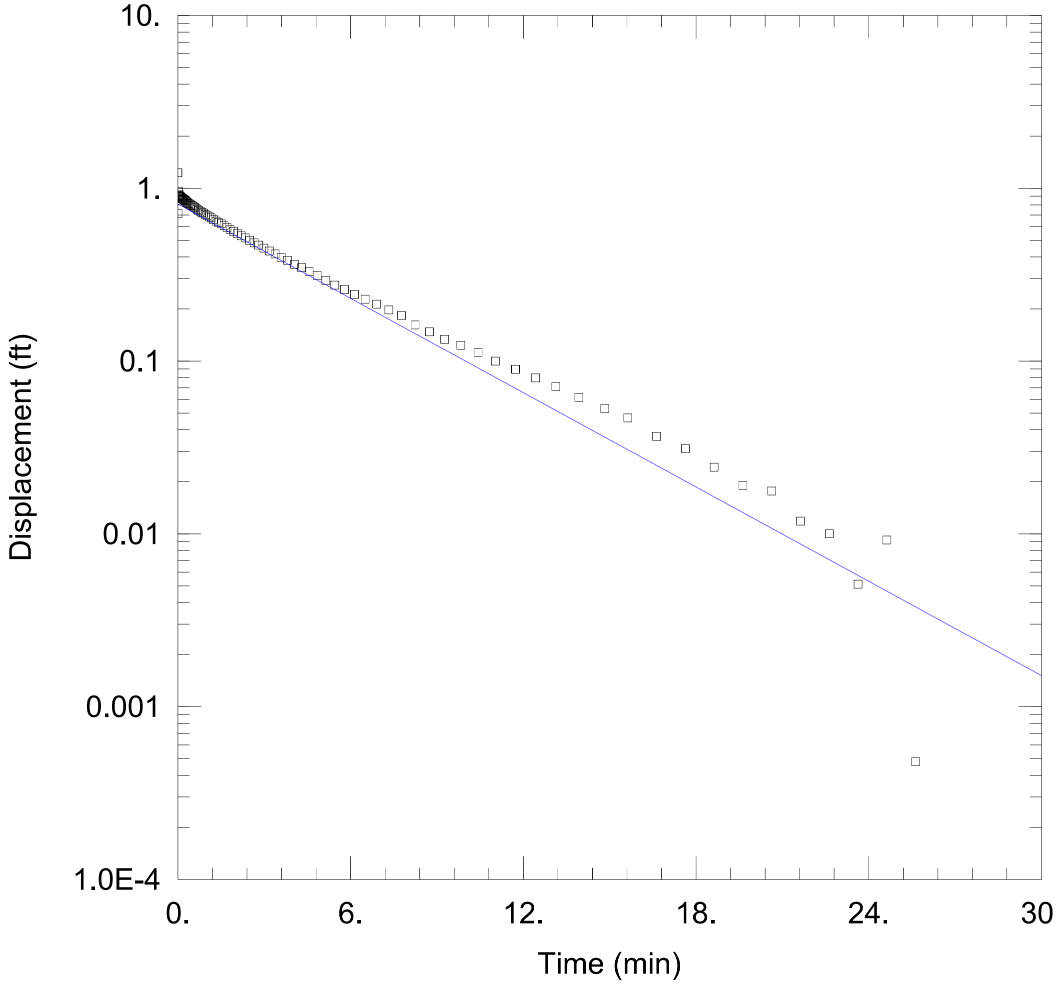
WELL DATA (PZ-14 (test 3 slug in))

Initial Displacement: 1.228 ft
Total Well Penetration Depth: 22.7 ft
Casing Radius: 0.083 ft
Static Water Column Height: 22.7 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.4214 ft/day
y0 = 0.8543 ft



PZ-14

Data Set: A:\...\PZ-14 test 3 (slug-in) HV.aqt
Date: 03/01/22 Time: 14:02:38

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: PZ-14
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 23. ft Anisotropy Ratio (Kz/Kr): 0.1

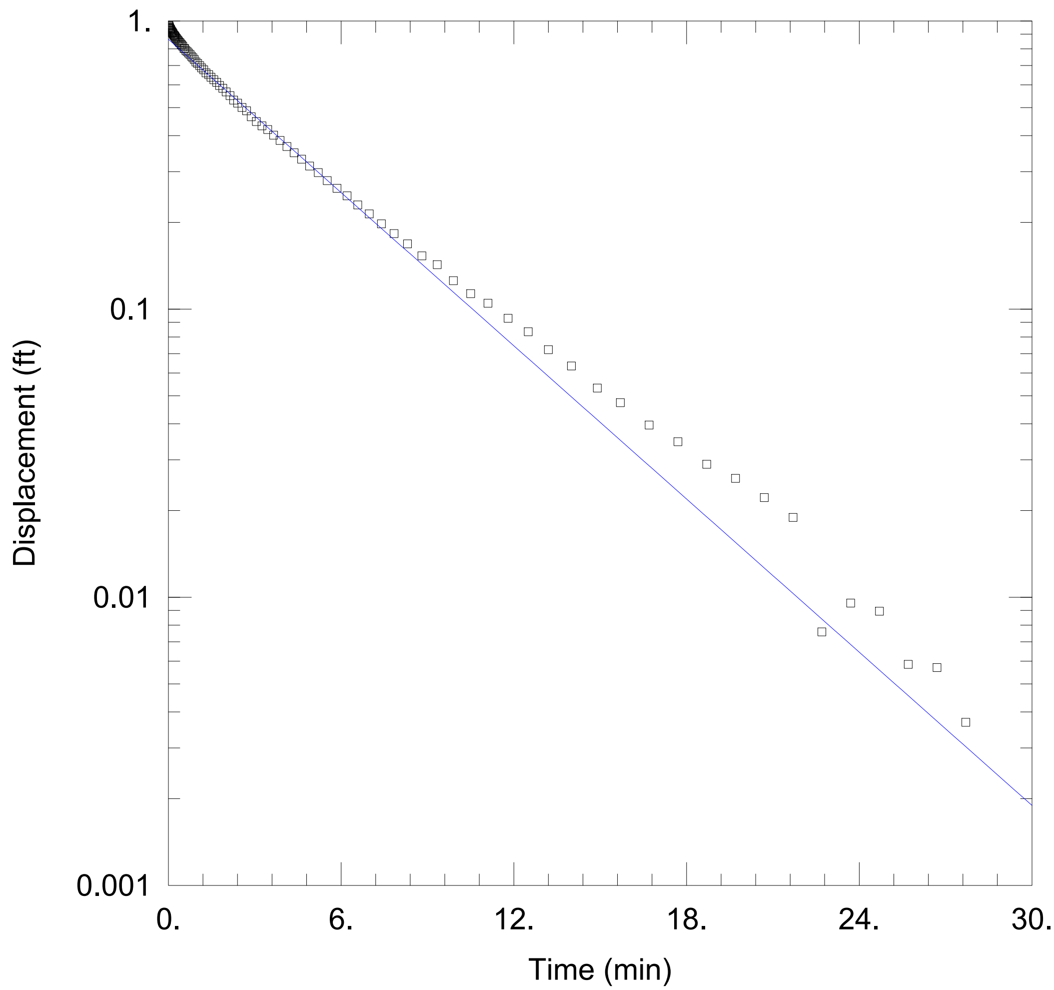
WELL DATA (PZ-14 (test 3 slug in))

Initial Displacement: 1.228 ft Static Water Column Height: 22.7 ft
Total Well Penetration Depth: 22.7 ft Screen Length: 10. ft
Casing Radius: 0.083 ft Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.5029 ft/day y0 = 0.8101 ft



PZ-14

Data Set: A:\...\PZ-14 test 3 (slug-out) BR.aqt
Date: 03/01/22 Time: 14:04:11

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: PZ-14
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 23. ft Anisotropy Ratio (Kz/Kr): 0.1

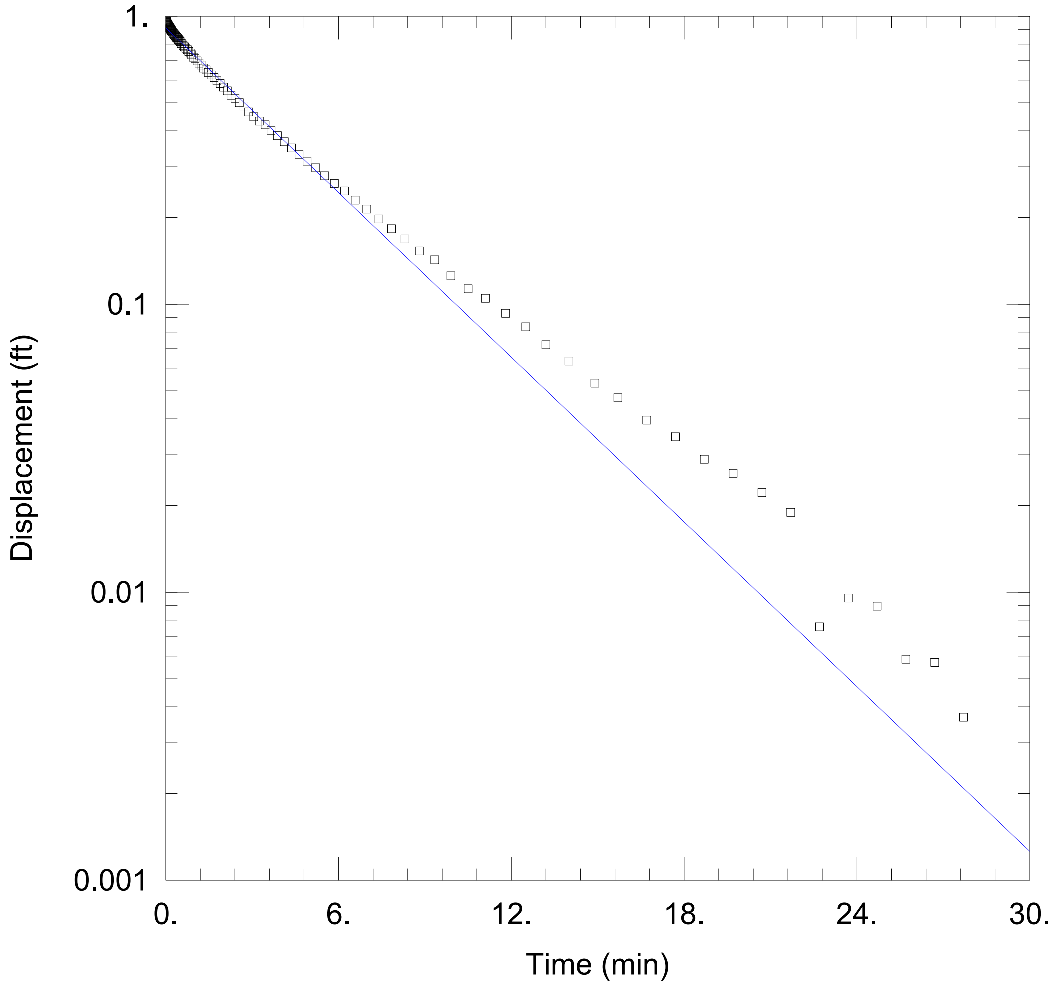
WELL DATA (PZ-14 (test 3 slug out))

Initial Displacement: 1.079 ft
Total Well Penetration Depth: 22.7 ft
Casing Radius: 0.083 ft
Static Water Column Height: 22.7 ft
Screen Length: 10. ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.4174 ft/day y0 = 0.8634 ft



PZ-14

Data Set: A:\...\PZ-14 test 3 (slug-out) HV.aqt
Date: 03/01/22
Time: 14:05:05

PROJECT INFORMATION

Company: Geosyntec
Location: Plant Smith
Test Well: PZ-14
Test Date: 8/25/2020

AQUIFER DATA

Saturated Thickness: 23. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (PZ-14 (test 3 slug out))

Initial Displacement: 1.079 ft
Static Water Column Height: 22.7 ft
Total Well Penetration Depth: 22.7 ft
Screen Length: 10. ft
Casing Radius: 0.083 ft
Well Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.5269 ft/day
y0 = 0.9108 ft