



Prepared for

Georgia Power Company
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REMEDY SELECTION REPORT

GEORGIA POWER COMPANY

PLANT HAMMOND ASH POND 1 (AP-1)

Prepared by

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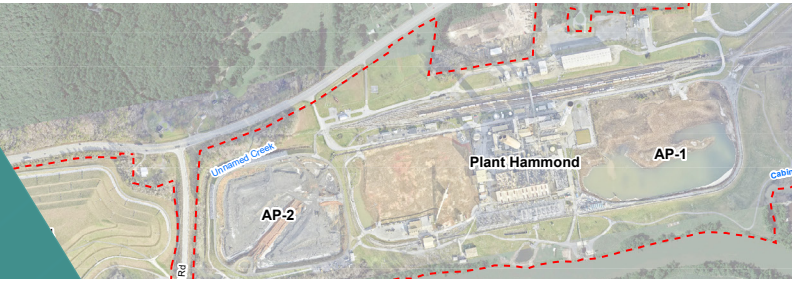
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Plant Hammond AP-1 : Executive Summary



Plant Hammond is a former coal-fired electric generation facility, located 10-miles west of Rome, Georgia, that was decommissioned in July 2019. A component of the facility are man-made surface impoundments, or “ash ponds”, historically used to hold coal combustion residuals (CCR). “CCR”, commonly referred to as “coal ash”, is a non-hazardous material generated from burning coal for the purpose of generating electricity by electric utilities¹. Ash ponds were designed, installed, and operated to function as a treatment system for power plant wastewaters, and they have effectively served in this capacity for decades in compliance with the National Pollutant Discharge Elimination System (NPDES) permits under which they were regulated. As part of a comprehensive approach to managing CCR, Georgia Power has undertaken actions to close Ash Pond 1 (AP-1) in accordance with federal and state regulations and completed a detailed evaluation of corrective measures to remove arsenic and molybdenum above the Groundwater Protection Standard (GWPS) at AP-1 at Plant Hammond.

ASH POND CLOSURE

Georgia Power closed AP-1 through the removal of approximately 565,000 cubic yards of CCR material from the CCR unit for disposal at an off-site, permitted lined solid waste disposal facility. The closure of AP-1 is regulated by the United States Environmental Protection Agency (USEPA) and the Georgia Environmental Protection Division (GA EPD). Closure activities are authorized under GA EPD approved closure permit No. 057-023D(CCR). The proposed closure by removal approach provides source control benefits that reduce the potential for migration of CCR constituents to groundwater.

GROUNDWATER MONITORING AND ASSESSMENT

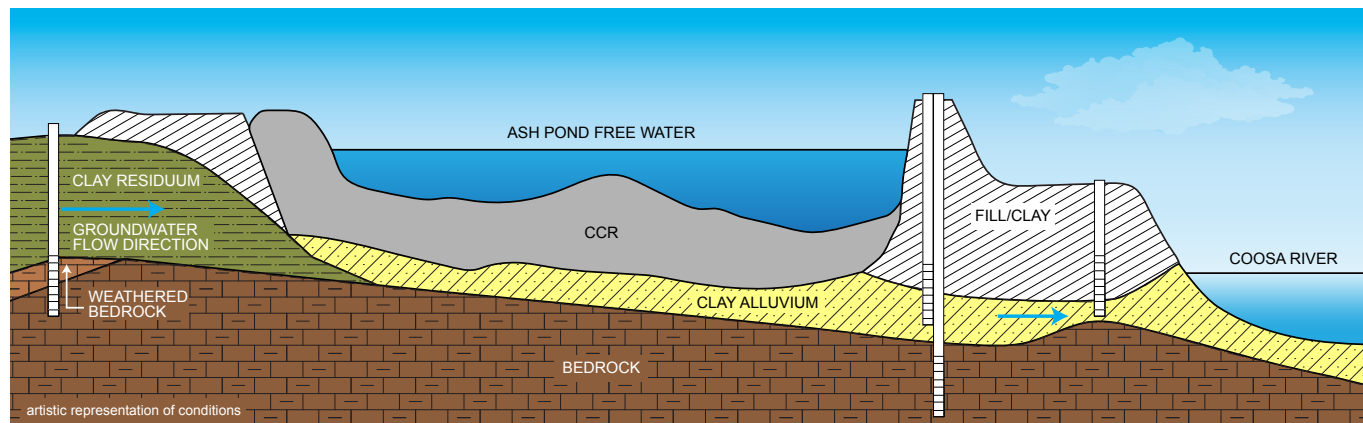
Georgia Power has performed CCR groundwater monitoring at AP-1 since May 2016. Over the period of Georgia Power’s monitoring, concentrations of arsenic (As) and molybdenum (Mo) were identified above the GWPS in only two wells (HGWC-8, HGWC-13) downgradient of AP-1. The As and Mo groundwater concentrations above the GWPS are located wholly on Georgia Power property and do not move offsite.

RISK EVALUATION FOR HUMAN HEALTH & ENVIRONMENT

Georgia Power completed a risk evaluation that confirmed that As and Mo identified on-site are not expected to pose a risk to human health or the environment. Extended groundwater monitoring indicates the As and Mo groundwater concentrations identified in HGWC-13 and HGWC-8, respectively, are horizontally and vertically delineated within the plant’s property to levels below their respective GWPS. Arsenic and Mo concentrations are limited in extent due to natural physical and chemical processes currently occurring in the aquifer which reduce dissolved concentrations.

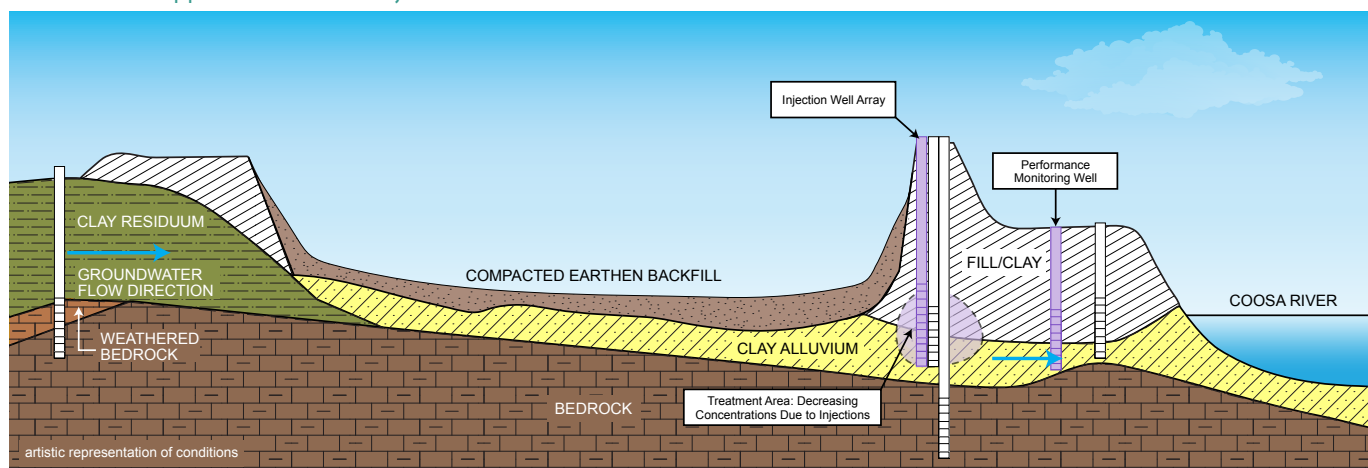
¹. 40 Code of Federal Regulations (CFR) § 257.53

CURRENT PRE-CLOSURE CONDITIONS



PROPOSED CORRECTIVE MEASURES FOR GROUNDWATER

Geochemical Approaches (In-situ Injection) and Monitored Natural Attenuation



Georgia Power initiated an assessment of corrective measures (ACM) program for AP-1 in January 2019. Since initiating the ACM program, Georgia Power has worked with GA EPD to adhere to regulations and select a comprehensive and technically sound approach for implementing corrective measures to address As and Mo in groundwater. Using the criteria described in the CCR Rule, 40 Code of Federal Regulations (CFR) Part 257.97, the remedy proposed includes:

- Geochemical Approaches (In-situ Injections):** In-situ injections are a well-recognized remediation approach utilizing a network of injection wells to introduce reagents into the subsurface to improve groundwater quality. Georgia Power will work with GA EPD on the permitting and approval of the reagent prior to use at the site. Injections will target the areas of highest groundwater concentrations of As and Mo to immobilize these constituents. Groundwater monitoring will be performed to confirm the effectiveness of the in-situ injections.
- Monitored Natural Attenuation (MNA):** Natural attenuation of As and Mo in groundwater at the site is primarily due to adsorption and co-precipitation of the dissolved metals into the aquifer matrix. These mechanisms have been demonstrated to be occurring at the site through extensive laboratory testing and study. Groundwater monitoring will continue to document natural attenuation, which is expected to be enhanced by the geochemical in-situ injections.

ADAPTIVE SITE MANAGEMENT

The remedy performance will be monitored and evaluated, and if needed, the remedy will be adjusted or augmented to meet remedial objectives.

LONG-TERM GROUNDWATER MONITORING

Georgia Power will monitor the performance of applied corrective measures in accordance with regulatory requirements.

CERTIFICATION STATEMENT

I, Whitney B. Law, am a professional engineer and licensed in the State of Georgia. I hereby certify that this Remedy Selection Report was prepared by, or under the direct supervision of, a Qualified Groundwater Scientist, in accordance with the Georgia Environmental Protection Division Rules of Solid Waste Management. According to 391-3-4-.01, a Qualified Groundwater Scientist is “a professional engineer or geologist registered to practice in Georgia who has received a baccalaureate or post-graduate degree in the natural sciences or engineering and has sufficient training and experience in groundwater hydrology and related fields that enable individuals to make sound professional judgments regarding groundwater monitoring, contaminant fate and transport, and corrective action.” By affixing my professional seal and signature, I hereby acknowledge that this report has been prepared in conformance with the United States Environmental Protection Agency coal combustion residual rule [40 Code of Federal Regulations (CFR) 257 Subpart D] and the Georgia Environmental Protection Division Rules for Solid Waste Management 391-3-4-.10.



Whitney B. Law
Georgia Professional Engineer No. 36641

June 30, 2026

Date

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LIST OF ACRONYMS AND ABBREVIATIONS

ACM	Assessment of Corrective Measures
AP	ash pond
As	arsenic
CCR	coal combustion residuals
CFR	Code of Federal Regulations
CSM	conceptual site model
DPT	direct-push technology
EPRI	Electric Power Research Institute
F	fluoride
Fe	iron
FeS ₂	pyrite
ft/day	feet per day
ft/ft	feet per foot
ft MSL	feet above mean sea level
GA EPD	Georgia Environmental Protection Division
Georgia Power	Georgia Power Company
Geosyntec	Geosyntec Consultants, Inc.
Golder	Golder Associates, Inc.
GWPS	Groundwater Protection Standard
HAR	Hydrogeologic Assessment Report
HRSC	high-resolution site characterization
Li	lithium
MCL	maximum contaminant level
mg/L	milligrams per liter
MNA	monitored natural attenuation
Mo	molybdenum
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
PRB	permeable reactive barrier
RCRA	Resource Conservation and Recovery Act
RSL	Regional Screening Level
SSL	statistically significant level
UIC	Underground Injection Control
USEPA	United States Environmental Protection Agency

1.0 INTRODUCTION

Geosyntec Consultants, Inc. (Geosyntec) prepared this *Remedy Selection Report* on behalf of Georgia Power Company (Georgia Power) for Plant Hammond Ash Pond 1 (AP-1, or the CCR unit). As documented herein, Georgia Power has completed a detailed evaluation of corrective measures to address constituents in groundwater at statistically significant levels (SSLs) above the Groundwater Protection Standards (GWPS). The evaluation was completed in accordance with the United States Environmental Protection Agency's (USEPA's) Coal Combustion Residuals (CCR) Rule, 40 Code of Federal Regulations (CFR) Parts 257 effective October 19, 2015 (CCR Rule) including subsequent revisions and Georgia Environmental Protection Division's (GA EPD's) Rule for Solid Waste Management Rule 391-3-4-.10 for CCR.

This *Remedy Selection Report* includes an overview of ongoing geologic and hydrogeologic investigations to refine the conceptual site model (CSM), identifies Appendix IV constituents detected in groundwater at SSLs above the GWPS, discusses the nature and extent of these inorganic constituents in groundwater, evaluates potential corrective measures to address SSLs in groundwater, and presents geochemical approaches (in-situ injections) coupled with monitored natural attenuation (MNA) as the proposed groundwater remedy. The *Draft Remedy Selection Report* (Geosyntec, 2022) was submitted to GA EPD for preliminary review in August 2022. This Remedy Selection Report has been submitted following a public meeting held by Georgia Power, in accordance with state and federal CCR regulations (391-3-4-.10(6), §257.96(e)), on March 24, 2026 to discuss the assessment of corrective measures and proposed remedy. Once a remedy is selected and implemented, the remediation will be monitored routinely and is subject to potential modification based on adaptive management strategies, as appropriate.

2.0 BACKGROUND

2.1 Remedy Selection Process

The remedy selection process involves assessment of potentially applicable groundwater remediation approaches. To date, this process has occurred as reported in previous submittals including the *Assessment of Corrective Measures Report (ACM Report)* (Geosyntec, 2019a) and *Semiannual Remedy Selection and Design Progress Reports* (Semiannual Progress Reports) (Geosyntec, 2019b), and *Groundwater Monitoring and Corrective Action Reports* (Geosyntec, 2020a; 2020b; 2021c; 2021d; 2022a; 2022b; 2023a; 2023b; 2024a; 2024b; 2025a; 2025b; 2026).

The remedy selected for the CCR unit must meet the following required criteria:

§257.97 Selection of Remedy [Required Criteria]

(b) Remedies must:

- (1) Be protective of human health and the environment;*
- (2) Attain the groundwater protection standard as specified pursuant to §257.95(h);*
- (3) Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in Appendix IV to this part into the environment;*
- (4) Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems;*
- (5) Comply with standards for management of wastes as specified in §257.98(d).*

Technologies that meet the required criteria are then evaluated using the following comparative criteria:

§257.97 Selection of remedy [Comparative Criteria]

(c) In selecting a remedy that meets the standards of paragraph (b) of this section, the owner or operator of the CCR unit shall consider the following evaluation factors:

- (1) The long- and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful based on consideration of the following:*
 - (i) magnitude of reduction of existing risks;*
 - (ii) magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy;*
 - (iii) the type and degree of long-term management required, including monitoring, operation, and maintenance;*

- (iv) short-term risks that might be posed to the community or the environment during implementation of such a remedy, including potential threats to human health and the environment associated with excavation, transportation, and re-disposal of contaminant;*
- (v) time until full protection is achieved;*
- (vi) potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment;*
- (vii) long-term reliability of the engineering and institutional controls; and*
- (viii) potential need for replacement of the remedy.*
- (2) The effectiveness of the remedy in controlling the source to reduce further releases based on consideration of the following factors:*
 - (i) the extent to which containment practices will reduce further releases; and*
 - (ii) the extent to which treatment technologies may be used.*
- (3) The ease or difficulty of implementing a potential remedy(s) based on consideration of the following types of factors:*
 - (i) degree of difficulty associated with constructing the technology;*
 - (ii) expected operational reliability of the technologies;*
 - (iii) need to coordinate with and obtain necessary approvals and permits from other agencies;*
 - (iv) availability of necessary equipment and specialists; and*
 - (v) available capacity and location of needed treatment, storage, and disposal services.*
- (4) The degree to which community concerns are addressed by a potential remedy(s).*

Using the above criteria, this document evaluates the potential remedies identified in the ACM Report and subsequent updates to identify an appropriate groundwater remedy for the CCR unit. Selection of an appropriate groundwater remedy is significantly influenced by CCR constituent chemistry and characteristics of Appendix IV constituents, which are inorganic trace elements – metals and metalloids that have unique attenuation and remediation characteristics. Common chemical mechanisms of attenuation for CCR constituents include adsorption to, or coprecipitation with, oxides and hydrous oxides (oxyhydroxides) of iron and manganese; coprecipitation with, and adsorption to, iron sulfides such as pyrite (FeS₂); and precipitation as carbonates, sulfides, sulfates, and/or phosphates (USEPA, 2007; EPRI, 2018). The attenuation capacity can be evaluated through site-specific field and lab testing and geochemical modeling. Processes such as precipitation/co-precipitation and adsorption and other methods such as groundwater extraction and treatment and engineered plant uptake (phytoremediation) are also evaluated for the remediation of Appendix IV constituents. The selected remedy will meet the criteria of §257.97(b) and the effectiveness of criteria specified in §257.97(c).

An evaluation of the degree to which community concerns are addressed by a potential remedy is included in this Remedy Selection Report. A discussion of this criterion has been informed by a public meeting and is included in section 5.3.

2.2 Unit Location and Description

Plant Hammond (Site) is located in Floyd County, Georgia, approximately 10 miles west of Rome and is bordered by Georgia Highway 20 (GA-20) on the north, the Coosa River on the south, Cabin Creek and industrial land on the east, and sparsely populated, forested, rural and industrial land on the west (**Figure 1**). The physical address of the plant is 5963 Alabama Highway, Rome, Georgia, 30165.

Plant Hammond was a four-unit, coal-fired electric generating facility. All four units at Plant Hammond were retired on July 29, 2019, and no longer produce electricity.

AP-1 is a 35-acre surface impoundment located in the southeast corner of the Plant and was cut into the natural topography along the northern and western perimeter to an elevation of approximately 565 ft above mean sea level (ft MSL), with dikes constructed along the remaining perimeter. AP-1 received CCR material from its commission in 1952 until the construction of AP-2 in 1969. After 1969, AP-1 was utilized as a co-treatment pond to handle return water flows from the other ponds and for recycling of process water for plant operations. As of April 17, 2019, all process plant flows to AP-1 ceased.

2.3 Unit Closure

CCR placement in AP-1 ceased in 1969. Closure activities in accordance with §257.100 were initiated under closure permit No. 057-023D(CCR), which was issued by GA EPD on June 22, 2020. Closure construction activities for AP-1 consist of closure by removal.

AP-1 CCR removal activities are complete, and a certification was submitted to GA EPD on September 26, 2025. On November 26, 2025, GA EPD acknowledged that removal activities within the identified boundaries of AP-1 are complete. Following closure completion, AP-1 has entered into post-removal monitoring. Post-removal monitoring is detailed in the closure permit. Georgia Power will retain ownership of the Site following closure.

2.4 Groundwater Monitoring

The current groundwater monitoring network associated with AP-1 includes the background/upgradient and downgradient monitoring wells, as summarized in **Table 1** and shown on **Figure 2**.

CCR groundwater monitoring-related activities have been performed at AP-1 since May 2016 in accordance with the CCR Rule. The following Appendix IV SSL constituent and well pairs have previously been identified:

Appendix IV SSL Constituent ¹	Well
Arsenic (As)	HGWC-13
Molybdenum (Mo)	HGWC-8
Lithium (Li)	MW-30D, MW-25D
Fluoride (F)	MW-30D

Additional details regarding the statistical analyses are provided in the annual and semiannual *Groundwater and Corrective Action Monitoring Reports* submitted to GA EPD and posted on Georgia Power's website.

¹ An Appendix IV SSL Constituent is determined by comparing the confidence intervals developed to either the constituent's maximum contaminant level (MCL), if available, the USEPA Regional Screening Level (RSL), if no MCL is available, or the calculated background interwell tolerance limit in cases where background concentrations are higher than the MCL or RSL values.

In accordance with §257.95(g)(3), an alternate source demonstration (ASD) was prepared and submitted to GA EPD in January 2021 to address the F and Li SSLs reported for MW-30D. The evaluation demonstrated that natural variation in groundwater quality is due to (i) slow recharge encountered within the deeper delineation wells installed in less fractured bedrock zones; (ii) starkly different groundwater elevations in these wells compared to other site wells; and (iii) very different geochemical (Geosyntec, 2021b). A second ASD was prepared and submitted to GA EPD in August 2022, demonstrating that the Li SSL identified in MW-25D is not affected by AP-1 and observed geochemical conditions are similar to background and other deep wells with low recharge (Geosyntec, 2022c). Secondly, all previous SSLs of lithium reported in MW-25D have at all times complied with the current GWPS of 0.064 mg/L. Subsequent routine groundwater monitoring data indicates that the conclusions of these ASDs remain valid.

Consequently, only As at HGWC-13 and Mo at HGWC-8 are the subject of this Remedy Selection Report.

3.0 GROUNDWATER CONCEPTUAL SITE MODEL

A CSM is a dynamic tool that contextualizes available geological, hydrogeological, and geochemical information at a site to convey how groundwater and constituents (Appendix III and IV constituents) travel in a given geologic setting. A CSM is not static and may evolve as data are collected and more is known about the setting. A CSM was developed for AP-1. As data were gathered during the ACM process, the CSM was refined and used to pre-screen remedial technologies, retaining technologies that were suitable for consideration in remedial alternatives for groundwater or adaptive site management based on site-specific conditions. The CSM for AP-1 is summarized below.

3.1 Geology

The Site is located within the Great Valley District of the Valley and Ridge Physiographic Province (Valley and Ridge) in northwest Georgia. The Valley and Ridge is characterized by Paleozoic sedimentary rocks that have been folded and faulted into the ridges and valleys that gave this region its name. Geologic mapping performed at the Site by Petrologic Solutions, Inc., under the direction of Golder Associates, Inc. (Golder, 2018), indicates that AP-1 is underlain by the middle units of the Cambrian age Conasauga Formation, consisting of mostly shaley limestone. AP-1 is underlain primarily by five units: (i) fill; (ii) terrace alluvium; (iii) residuum; (iv) partially weathered bedrock; and; (v) competent shaley limestone bedrock. Geologic cross-sections proximal to AP-1 are included as **Figures 3** and **4**, and additional details on Site geology and hydrogeology can be found in the *Hydrogeologic Assessment Report Revision 01 – Ash Pond 1 (AP-1)* (HAR Rev 01) (Geosyntec, 2019c).

3.2 Hydrology and Groundwater Flow

The uppermost aquifer at AP-1 is a regional groundwater aquifer that occurs primarily in the terrace alluvium, residuum, and the weathered and fractured bedrock. The uppermost aquifer is considered to be unconfined; however, localized, semi-confined conditions may be encountered due to the low-permeability clayey nature of the residual soils, or as a result of perched groundwater or poorly interconnected fracture networks in the bedrock. The movement of groundwater in the uppermost aquifer can be characterized as low-to moderate permeability porous media flow. Groundwater flow in the more competent underlying bedrock is characterized as fracture flow. The regional groundwater flow direction is expected to be from north to south; however, the local flow direction proximal to AP-1 is to both the east and south under current pre-closure conditions. Under post-closure conditions, the groundwater flow direction is anticipated to resemble the regional flow regime more closely (north to south toward the Coosa River).

A potentiometric surface map from August 2025 (**Figure 5**) presents groundwater elevations measured from the existing monitoring wells and piezometers in addition to surface water elevations from existing staff gages. Groundwater in the AP-1 area flows under the influence of topography from higher elevations on the north side of the Site to a southeasterly direction toward Cabin Creek and the Coosa River. Based on water level measurements collected on August 4, 2025, the hydraulic gradient is approximately 0.005 feet per foot (ft/ft) south (between HGWC-13 and MW-7) and 0.012 ft/ft to the east (between HGWC-8 and MW-20) yielding an average groundwater flow velocity of 0.7 feet per day (ft/day) in the vicinity of AP-1 (Geosyntec, 2026).

3.3 Geochemical CSM

It appears that the SSLs of As in HGWC-13 and Mo in HGWC-8 may be influenced by the presence of AP-1, as groundwater geochemical compositions are similar to CCR pore water at these locations. Groundwater monitoring data confirm that As and Mo are not migrating, and impacts are likely limited in extent due to natural attenuation processes in the aquifer, which are supported by laboratory studies.

As detailed in the *Geochemical Conceptual Site Model Report (Appendix A)* (Geochemical CSM Report), the primary mechanisms governing attenuation and immobilization include adsorption of negatively charged As and Mo oxyanions to positively charged aquifer matrix minerals, and co-precipitation and entrainment with fast growing iron and manganese oxyhydroxide crystals, which precipitate under oxidizing conditions. Characterization of aquifer solids around AP-1 confirm mineral phases present in aquifer media provide substantial attenuation capacity, and sorption and desorption studies confirm that As and Mo are strongly sorbed to aquifer solids.

3.4 Nature and Extent of Groundwater Above the GWPS

Based on statistical analysis of Appendix IV groundwater data, the As and Mo SSLs identified in the compliance wells HGWC-13 and HGWC-8, respectively, are horizontally and vertically delineated to levels below GWPS. Please refer to the August 2025 iso-concentration maps for As and Mo presented on **Figures 6** and **7**. Compliance wells with SSLs and the pertinent horizontal and vertical delineation wells are also provided below:

Detected Constituent	GWPS ⁽¹⁾ (mg/L)	Monitoring Well ID	Concentration ⁽²⁾ (mg/L)	Delineation Well IDs
As	0.010	HGWC-13	0.48	Horizontal: MW-19 Vertical: MW-24D
Mo	0.10	HGWC-8	0.047	Horizontal: MW-20 Vertical: MW-27D

Notes:

mg/L = milligrams per liter

1. §257.95 Federal GWPS.

2. Reported concentration is from the August 2025 semiannual monitoring event (Geosyntec, 2026).

4.0 ASSESSMENT OF CORRECTIVE MEASURES SUMMARY

An ACM Report was completed on June 12, 2019, in accordance with §257.96 and identified the following corrective measures as potentially applicable to remediate groundwater at the Site:

- Geochemical Approaches (In-Situ Injection)
- Hydraulic Containment (“Pump and Treat”)
- Monitored Natural Attenuation (MNA)
- Permeable Reactive Barrier (PRB)
- Phytoremediation
- Subsurface Vertical Barrier Walls

Georgia Power plans to proactively utilize adaptive site management to support the remedial strategy and address potential changes in site conditions as appropriate (**Figure 8**). Under an adaptive site management strategy, a remedial approach will be selected whereby: (1) a remedy will be installed or implemented to address current conditions; (2) the performance of the remedy will be monitored, evaluated, and reported semiannually; (3) the CSM will be updated as more data are collected; and (4) adjustments and augmentations will be made to the remedy, as warranted, to meet remedial objectives

Further evaluations and refinements of the groundwater corrective measures were presented in the Semiannual Progress Reports submitted since the ACM Report in 2019. The corrective measures identified for AP-1 in the ACM Report have been further evaluated using the criteria outlined in §257.96(c) and GA EPD Rule 391-3-4.10(6)(a). The screening of the corrective measures, as presented in the Semiannual Progress Reports, is summarized in **Table 2**.

The corrective measures that were not screened out and were retained for further evaluation under the §257.97 remedy selection criteria in this document include the following:

- **Geochemical Approaches (In-Situ Injection):** Geochemical approaches rely on a temporary or permanent injection network to introduce reagents or air into the subsurface to promote either anerobic or aerobic attenuation of inorganic constituents either as a sparingly soluble mineral or through sorption mechanisms. Geochemical injections are a proven groundwater remediation technology for CCR constituents (including As and Mo), and are especially effective in treating smaller localized areas, such as those present at AP-1.

- **Hydraulic Containment (“Pump and Treat”):** Hydraulic containment refers to the use of groundwater extraction to induce a hydraulic gradient for hydraulic capture or to control the migration of groundwater. This approach uses extraction to capture groundwater, which may subsequently require above-ground treatment and permitted discharge to a receiving water feature, reinjection into the groundwater, or reuse (e.g., land application, CCR conditioning, etc.). Hydraulic containment is applicable to a variable mix of inorganic constituents, including dissolved As and Mo at AP-1. It is commonly referred to as “pump and treat” when applied to recover constituent mass and achieve GWPS throughout a plume.
- **Monitored Natural Attenuation (MNA):** MNA relies on natural attenuation processes to achieve site-specific GWPS within a reasonable time frame relative to more active methods by effectively reducing dissolved concentrations of inorganic constituents. Attenuation mechanisms for inorganic constituents at CCR sites, including Mo and As at AP-1, are either physical (e.g., dilution, dispersion, flushing, and related processes) or chemical (sorption, mineral precipitation, or oxidation reduction reactions) (USEPA, 2007; USEPA, 2015). As detailed in the Geochemical CSM Report provided in **Appendix A**, natural attenuation of As and Mo is primarily due to adsorption and co-precipitation, and does not rely solely on physical means of attenuation.

5.0 CORRECTIVE MEASURES EVALUATION

The purpose of this section is to evaluate and rank the three corrective measures using the required criteria described in §257.97(b) and the comparative criteria described in §257.97(c).

5.1 Required Criteria (§257.97(b))

As described in §257.97(b), for a groundwater corrective measure to be selected it must meet the following criteria:

1. Be protective of human health and the environment;
2. Attain the GWPS as specified pursuant to §257.95(h);
3. Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in Appendix IV to this part into the environment;
4. Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems; and
5. Comply with standards for management of wastes as specified in §257.98(d).

Below, the corrective measure options are evaluated against the required criteria.

5.1.1 Protective of Human Health and the Environment (§257.97(b)(1))

CCR is classified as a non-hazardous Resource Conservation and Recovery Act (RCRA) solid waste, a determination confirmed in 40 CFR §257 Preamble part III.A. Nevertheless, Georgia Power conservatively and protectively conducted a risk evaluation. A groundwater *Risk Evaluation Report* (Geosyntec, 2021d) was prepared for AP-1 and included as an appendix to the Semiannual Progress Report submitted to GA EPD in January 2021. The Risk Evaluation Report has subsequently been updated to include groundwater monitoring data collected through February 2022, and is included as **Appendix C**. Subsequent routine groundwater monitoring data has been consistent with data previously evaluated as part of the Risk Evaluation Report. This evaluation is one of many lines of evidence used herein and factored into the remedy selection process. The risk evaluation for the SSL-related constituents in groundwater at AP-1 was conducted using methods generally consistent with GA EPD and USEPA guidance and included multiple conservative assumptions. Based on the evaluation, which assessed potential receptors and exposure pathways, As and Mo concentrations observed in groundwater at AP-1 are not expected to pose a risk to human health or the environment.

Accordingly, no further risk evaluation of groundwater or surface water is warranted in connection with the remedy selection process. Human health and the environment will be protected through implementation of any of the corrective measures being considered, and groundwater conditions at AP-1 are not expected to pose a risk to human health or the environment.

5.1.2 Attain the Groundwater Protection Standards (§257.97(b)(2))

The proposed corrective measures would each attain the GWPS at the compliance boundary (waste boundary) and throughout the area of groundwater SSL exceedances. Constituent transport evaluations were used to predict and assess changes in constituent concentrations in groundwater over time following closure of AP-1. These transport evaluations assessed attenuation rates under varying assumed conditions in the aquifer and provide an additional line of evidence on natural attenuation mechanisms at AP-1. These evaluations demonstrate that natural attenuation is expected to achieve GWPS and provide a baseline for comparing the other corrective action options, which would attain GWPS in less time. The groundwater flow and constituent transport evaluations, and associated input parameters, are described in detail in the *Reactive Transport Model Report* included in **Appendix B**. These evaluations suggest that the GWPS can be met at the compliance boundary within 20 to 65 years in the absence of a more active remedy.

5.1.3 Control the Source of Release (§257.97(b)(3))

In connection with a remedy, the source of the contamination must be controlled to reduce or eliminate, to the maximum extent feasible, further releases by identifying and locating the cause of the release. The following section describes how the source control required criterion is met in connection with each evaluated alternative.

Closure by removal will be completed safely, in compliance with applicable federal and state regulations, and is protective of public health and the environment. Closure by removal includes excavation and removal of the CCR material from AP-1. Physical removal of the CCR would, over time, be supportive of declining concentrations of Appendix IV constituents in groundwater downgradient of AP-1 and improve overall groundwater quality.

As noted above, Georgia Power also plans to proactively utilize adaptive site management to support the remedial strategy and address potential changes in site conditions as appropriate.

The control provided by the closure ensures that, for purpose of remedy selection, the control requirement is met for all corrective measures being evaluated. None of the remedies being evaluated will interfere with the control provided by the closure, and Appendix IV constituents at and beyond the waste boundary that are present within the groundwater plume will be controlled by the selected groundwater corrective measure(s):

- **Geochemical Approaches (In-Situ Injection)** – Geochemical processes can be altered to immobilize As and Mo in groundwater through precipitation and sorption, thereby removing them from the dissolved phase in groundwater and controlling contaminant release/movement.
- **Hydraulic Containment (“Pump and Treat”)** – Inducing a hydraulic gradient to capture or control the migration of impacted groundwater would limit potential contaminant release/movement from the capture zone.
- **Monitored Natural Attenuation (MNA)** – Natural attenuation processes act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of constituents in groundwater. These in-situ processes effectively attenuate the movement of inorganic CCR constituents in groundwater, thereby controlling constituent release/movement. The primary mechanisms governing attenuation and immobilization of As and Mo at AP-1 include sorption and co-precipitation with naturally occurring minerals in the aquifer.

5.1.4 Removal of Contaminated Material from the Environment (§257.97(b)(4))

The groundwater corrective measures retained for further consideration in the ACM Progress Reports would be effective at removing Appendix IV constituents from groundwater, either through processes of physical removal, immobilization, or attenuation in groundwater. The corrective measures considered herein remove contaminated material as follows:

- **Geochemical Approaches (In-Situ Injection)** – Geochemical processes can be altered to immobilize contaminants by sorption and precipitation, thereby removing them from the dissolved phase in groundwater.
- **Hydraulic Containment (“Pump and Treat”)** – Extracting groundwater would physically remove contamination from the environment by reducing the presence of contaminants in groundwater through withdrawal from the aquifer.

- **Monitored Natural Attenuation (MNA)** – Natural attenuation processes act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants groundwater. Sorption and precipitation can immobilize contaminants, thereby removing them from the dissolved phase in groundwater.

5.1.5 Comply with Waste Management Standards (§257.97(b)(5))

In accordance with §257.98(d), waste generated during the implementation of any of the remedies under consideration would be managed in a manner that complies with applicable requirements of the RCRA and the Georgia Comprehensive Solid Waste Management Act.

REQUIRED CRITERIA	Corrective Measures		
	Geochemical Approaches (In-Situ Injections)	Hydraulic Containment ("Pump and Treat")	Monitored Natural Attenuation (MNA)
Be protective of human health and the environment	✓	✓	✓
Attain the groundwater protection standard	✓	✓	✓
Control the source of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of Appendix IV constituents into the environment	✓	✓	✓
Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems	✓	✓	✓
Management of waste to comply with all applicable RCRA requirements	✓	✓	✓

5.2 Comparative Criteria (§257.97(c))

This section compares the corrective measure options using the comparative criteria listed in §257.97(c). Each of the comparative criteria consists of several sub-criteria listed in the CCR Rule, which are considered in this remedy selection below. The goal of this analysis is to further evaluate the corrective measures that meet the required criteria to support remedy selection. Consistent with §257.98(b), the selected and implemented remedy will be continually evaluated and, if warranted, modified consistent with adaptive management practices.

A graphic is presented at the conclusion of each subsection to provide a visual depiction of the favorability of each corrective measure, where dark green represents that the “option performs *highly favorably* under this criterion”, medium green represents that the “option performs *favorably* under this criterion,” and light green represents that the “option performs *less favorably* under this criterion.”

5.2.1 Long- and Short-Term Effectiveness and Protectiveness

This comparative criterion takes into consideration the following sub-criteria relative to the long-term and short-term effectiveness of each corrective measure. Long-term effectiveness means that the remedy will protect human health and the environment after GWPS have been met and prior to completion of the remedy, as defined by §257.98(c). The completed remedy will be permanent, meaning that the remedy will protect human health and the environment after the remedial objectives have been met.

The short-term effectiveness of a potential remedy is related to the protectiveness of human health and the environment during construction and implementation. The time to achieve remedial action objectives are also considered.

5.2.1.1 *Magnitude of reduction of existing risks*

As indicated by the nature and extent evaluation, the most recent groundwater sampling results, and the Risk Evaluation Report summarized in Section 5.1.1, Appendix IV constituents in groundwater from AP-1 are not expected to pose a risk to human health or the environment. Therefore, this criterion is considered favorable for each of the corrective measures. In addition, each groundwater corrective measure retained for this comparative analysis will be effective at reducing concentrations to levels below the GWPS, as described in section 5.1.2 above.

5.2.1.2 *Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy*

CCR unit closure through closure by removal provides effective source control, as described in Section 5.1.3 above and prevent further releases. Consequently, each of the remedies are considered equally favorable under this criterion.

5.2.1.3 *The type and degree of long-term management required, including monitoring, operations, and maintenance*

In accordance with §257.97(c)(1)(iii), this sub-criterion considers the long-term management of each groundwater corrective measure.

MNA is highly favorable with respect to this criterion, as it requires the least amount of long-term management. MNA long-term management would be limited to monitoring only as the lack of any mechanical systems avoids operations and maintenance (O&M) requirements. In-Situ Injection is considered favorable as some limited longer-term management may be required in addition to monitoring. For example, redevelopment of injection wells due to screen fouling, blower maintenance if oxygen injections are required, and potential maintenance injections may be required. “Pump and Treat” is the least favorable corrective measure under this criterion due to required O&M of the pumping and treatment system along with management of extracted groundwater and treatment residuals.

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

In accordance with §257.97(c)(1)(iv), this sub-criterion relates to the potential for threats to human health (including, but not limited to, worker safety and the community) and the environment associated with remedy implementation.

Community impacts include general impacts, such as potentially increased truck traffic on public roads during construction of the remedies, as well as increased vehicle emissions, resource consumption, and noise.

MNA is considered highly favorable as no additional construction activities will be required beyond the existing monitoring well network. In-Situ Injection will require minor construction activities to install injection and performance monitoring wells. In-Situ Injection may result short-term mobilization of other redox- or pH-sensitive constituents; however, this risk can be mitigated based on data collected from previously

completed bench- and pilot-scale testing which has been used to screen out unfavorable amendments and approaches prior to full scale field implementation. There is an additional short-term risk of spills or releases of geochemical amendments during injections, which can be mitigated with appropriate engineering controls. As such, geochemical injections are considered favorable. “Pump and Treat” is considered less favorable as implementation will require substantial importation of materials and construction activities. Similar to In-situ Injection, implementation of “Pump and Treat” entails short-term risks related to management of extracted groundwater, for example due to leaks in conveyance piping, which can be mitigated with appropriate engineering controls.

5.2.1.5 Time until full protection is achieved

Receptors are already protected because Appendix IV constituents in groundwater at AP-1 are not expected to pose a risk to human health or the environment. However, in accordance with §257.98(c)(1) and (2), a remedy is considered fully complete when the GWPS is achieved at all points within the plume at and beyond the compliance boundary for three consecutive years.

The time to achieve GWPS at the compliance boundary under MNA was considered a baseline for comparison purposes and is estimated to be approximately 20 to 65 years (**Appendix B**). Other corrective measures are qualitatively compared to this baseline timeframe. Corrective measures that require less time to achieve GWPS are considered more favorable under this criterion.

In-Situ Injection is considered highly favorable as it is likely to achieve GWPS in the shortest amount of time, as evidenced by the “proof of concept” geochemical injection evaluation included in **Appendix B**. The mass of dissolved As was predicted to decrease by 87% after 5 years of simulated injection and performance monitoring, while approximately 30 years of simulated MNA was required to achieve a similar decrease in dissolved mass (approximate 89%). The mass of dissolved Mo was predicted to decrease by 57% after 5 years of simulated injection and performance monitoring, while approximately 65 years of simulated MNA was required to achieve a similar decrease in dissolved mass (approximately 52%). Actual reductions of constituent concentrations (and dissolved mass) within a treatment area are likely to proceed very quickly based on data collected during previously completed field-scale pilot studies. However, the total time to achieve GWPS will be dependent on many factors, including the size of the plume, the time to complete distribution of amendments throughout the subsurface, and the attenuation kinetics of the targeted constituents.

“Pump and Treat” is considered favorable. Although hydraulic control will be achieved quickly (within 1- to 2- months of sustained pumping), achieving GWPS at all points outside of the waste boundary will take substantially longer than In-situ Injection. The recovery of impacted groundwater will likely be very slow during “Pump and Treat” and require substantial flushing of unimpacted groundwater because As and Mo strongly sorb to the aquifer matrix. This same phenomenon which is presently naturally attenuating As and Mo will result in “Pump and Treat” requiring marginally shorter cleanup times than MNA.

MNA is considered less favorable under this criterion as it is likely to take the longest time to achieve GWPS at all points within the plume.

5.2.1.6 *Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment*

In accordance with §257.97(c)(1)(vi), this sub-criterion considers elements such as the generation and handling of wastes or potentially impacted media encountered during construction and operation of the remedy.

MNA is considered highly favorable under this criterion as no construction waste will be generated and exposure to potentially impacted groundwater would be minimal. In-Situ Injection is considered favorable as some minor quantities of construction waste would be generated during implementation although exposure to potentially impacted media would also be minimal.

“Pump and Treat” will generate similar quantities of potentially impacted construction waste as In-situ Injection. However, “Pump and Treat” is considered less favorable as extraction of potentially impacted groundwater will require ongoing management of multiple waste streams (e.g., extracted groundwater, spent treatment system components, and treatment residuals).

5.2.1.7 Long-term reliability of the engineering and institutional controls

The following describes the overall long-term reliability for each of the proposed groundwater corrective measures for purposes of comparison. Of note, the reliability of each of the corrective measures is bolstered by the long-term reliability of the closure method and its expected positive effect on groundwater conditions.

In-Situ Injection and MNA are considered highly favorable under this criterion as minimal long-term engineering controls would be required. “Pump and Treat” is favorable under this criterion as engineering controls will be required throughout the lifetime of the remedy (for example, leak detection systems in conveyance piping).

5.2.1.8 Potential need for replacement of the remedy

Any need to replace a remedy would be based on a systematic site review during the remedy implementation process if warranted to improve remedy protectiveness, effectiveness, or facilitate progress toward meeting remedy objectives. In accordance with §257.98(b), adaptive site management practices will be used to modify or replace the remedy if the requirements of §257.97(b) are not being achieved.

In-Situ Injection is considered favorable under this criterion. While a replacement remedy is unlikely to be necessary, changes in groundwater chemistry and flow conditions may promote limited short-term mobilization or remobilization of other Appendix IV constituents in groundwater. Bench scale treatability studies and field scale pilot studies have been used to screen out unfavorable amendments and evaluate the long-term performance of In-situ Injection.

Natural processes are predicted to decrease the As and Mo concentrations in groundwater over time following closure without further intervention, reducing the likelihood that a replacement remedy would be required. Although the longer time likely required to achieve GWPS introduces inherent uncertainty on remedy success, natural attenuation will still play a role in achieving GWPS under alternate corrective measures under consideration. MNA therefore ranks as less favorable under this criterion.

“Pump and Treat” has the greatest risk of requiring replacement and is thus considered less favorable. For example, a substantial change in the groundwater flow direction or velocity may render pump and treat less effective at lowering constituent concentrations at the edges of a plume despite remaining protective. “Pump and Treat” wells could potentially be repurposed as injection wells in accordance with adaptive site management practices.

All corrective measures will be evaluated for effectiveness following implementation, and modified if remedial objectives are not being met, in accordance with adaptive site management practices and §257.98(b).

5.2.1.9 Long- and short-term effectiveness summary

This section provides a summary of the eight §257.97(c)(1) sub-criteria relative to long- and short-term effectiveness that are discussed in Sections 5.2.1.1 to 5.2.1.8 above, and includes a summary table.

Appendix IV constituents in groundwater from AP-1 are not expected to pose an adverse risk to human health or the environment under current conditions and each of the corrective measures will be effective in reducing As and Mo groundwater concentrations to below GWPS. Closure by removal is an effective source control measure that will address any potential for further releases of CCR constituents. As such, relative ranking between corrective measures is driven primarily by potential short-term impacts to the community during implementation, reliability and O&M, potential exposure of receptors to incidental environmental risks during implementation of the remedy, and time to achieve GWPS.

MNA is considered favorable due to its certainty of success, reliability, and the minimal potential for short-term impacts to the community or environment during implementation. It is considered less favorable by the criterion of time to achieve GWPS. The longer time likely required to achieve GWPS introduces inherent uncertainty of remedy success. Therefore, MNA is considered less favorable under the potential need for a replacement remedy criterion, despite being considered favorable overall under this category.

In-Situ Injection is considered favorable but would entail some short-term uncertainty during implementation. The primary favorability of this corrective measure stems from the shorter time to achieve GWPS downgradient of the groundwater monitoring system.

“Pump and Treat” will have less favorable short- and long-term effectiveness primarily due to the higher O&M requirements, the marginally higher likelihood of potential exposure of receptors to potentially impacted groundwater during transport and treatment, and the time to achieve GWPS.

Category 1 – Long- and Short-term Effectiveness Summary

	In-Situ Injection	“Pump and Treat”	Monitored Natural Attenuation
<i>Sub-Criterion i</i> Magnitude of reduction of risks			
<i>Sub-Criterion ii</i> Magnitude of residual risk in terms of likelihood of further release			
<i>Sub-criterion iii</i> Type and degree of long-term management required			
<i>Sub-criterion iv</i> Short term risk to community or environment during implementation			
<i>Sub-criterion v</i> Time until full protection is achieved			
<i>Sub-criterion vi</i> Potential for exposure of humans and environmental receptors to remaining wastes			
<i>Sub-criterion vii</i> Long-term reliability of engineering and institutional controls			
<i>Sub-criterion viii</i> Potential need for replacement of the remedy			
Category 1 Summary			

Color Legend:

	Option performs <i>highly favorably</i> under this criterion
	Option performs <i>favorably</i> under this criterion
	Option performs <i>less favorably</i> under this criterion

5.2.2 Source Control Effectiveness

This comparative criterion takes into consideration the ability of the remedy to control a future release and the extensiveness of treatment technologies that will be required. Closure by removal will be completed safely, in compliance with applicable federal and state regulations, and is protective of public health and the environment. Closure by removal includes excavation and removal of the CCR material from AP-1. Physical removal of the CCR would, over time, be supportive of declining concentrations of Appendix IV constituents in groundwater downgradient of AP-1 and improve overall groundwater quality. None of the corrective measures under consideration would interfere with or diminish the anticipated benefits of the closure method.

5.2.2.1 The extent to which containment practices will reduce further releases

Through closure by removal, CCR material will be removed from AP-1. Since the source material will be removed at the time of AP-1's closure, there will be no further potential for release from the CCR unit. Appendix IV constituents that are currently present in groundwater at or beyond the waste boundary will be controlled by the selected groundwater remedy. Therefore, each of the groundwater corrective measures are considered equally favorable for this sub-criterion.

5.2.2.2 The extent to which treatment technologies may be used

In accordance with §257.97(c)(2)(ii), corrective measures that include more limited treatment approaches for source control may be considered less favorable. Corrective measures that rely on more extensive treatment approaches may be considered more favorable.

No treatment technologies are under consideration since the source material will be removed at the time of AP-1's closure. Therefore, all groundwater remedy alternatives are considered equally favorable for this sub-criterion.

5.2.2.3 Source Control Effectiveness Summary

This section provides a summary of the two §257.97(c)(2) sub-criteria relative to effectiveness that are discussed in Sections 5.2.2.1 and 5.2.2.2 above. Adaptive site management strategies will be implemented to ensure remedial objectives are met.

As described above source control will be achieved at AP-1 and, over time, be supportive of declining concentrations of Appendix IV constituents in groundwater downgradient of AP-1 and improve the overall groundwater quality. The corrective measures are therefore equally favorable under source control effectiveness criteria, as summarized in the following table.

Category 2 – Source Control Effectiveness

	In-Situ Injection	“Pump and Treat”	Monitored Natural Attenuation
<i>Sub-criterion i</i> Extent to which containment practices will reduce further releases			
<i>Sub-criterion ii</i> Extent to which treatment technologies may be used			
Category 2 Summary			

Color Legend:

	Option performs <i>highly favorably</i> under this criterion
	Option performs <i>favorably</i> under this criterion
	Option performs <i>less favorably</i> under this criterion

5.2.3 Ease of Implementation

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

5.2.3.1 Degree of difficulty associated with constructing the technology

This sub-criterion considers the relative technical difficulty between implementing each of the remedies.

MNA is considered highly favorable as a monitoring system is already in place and no additional construction would be required. In-Situ Injection is considered favorable under this criterion as some construction would be required for the full-scale injection network. “Pump and Treat” is considered less favorable as it would require construction of dewatering wells and supporting conveyance lines, which may require more contractors and time to construct. Depending on effluent discharge limits for certain constituents found in groundwater, above-ground water treatment infrastructure would likely be required for treatment of extracted groundwater under “Pump and Treat.” However, both In-situ Injection and “Pump and Treat” can be constructed using common means and methods for well and utility installation.

5.2.3.2 Expected operational reliability of the technologies

This section compares the operational reliability of each of the proposed remedies in accordance with §257.97(c)(3)(ii). Typically, simple remedies that do not require the installation of significant infrastructure are generally more reliable and do not require significant O&M; however, more complex remedies that rely on groundwater flow or geochemical manipulation or mechanical systems would be considered less favorable.

MNA has a proven history of operational reliability and ranks highly favorable under this criterion. It requires little infrastructure and/or ongoing O&M.

In-Situ Injection is considered favorable under this criterion. In-Situ Injection is reliable assuming injected materials can be distributed throughout the aquifer. Pilot testing has provided valuable data on amendment distribution that will be used in remedy design to minimize potential reliability issues. However, injection wells may be subject to fouling over time and require reconditioning to maintain performance.

“Pump and Treat” is considered less favorable under the operational reliability criterion. Pumping mechanical systems may fail and otherwise need to be temporarily shut down to conduct preventative maintenance, and as with In-Situ Injection, well screens may require reconditioning if they become fouled. Groundwater treatment systems will also require ongoing operational maintenance and will need to be monitored to reliably meet discharge permit criteria.

5.2.3.3 Need to coordinate with and obtain necessary approvals and permits from other agencies

Section §257.97(c)(3)(iii) requires consideration be given and compared between remedies regarding the various agencies and type of permits that would be required for implementation of the groundwater remedy. A corrective measure that could require several permits would be considered less favorable when compared to a corrective measure that would require fewer permits.

MNA ranks highly favorable under this criterion, as no permits or additional approvals from other agencies will be required. In-Situ Injection and “Pump and Treat” perform favorably as some permitting will be required. In-Situ Injection will require an Underground Injection Control (UIC) permit, while “Pump and Treat” will likely require modifications to the Site National Pollutant Discharge Elimination System (NPDES) permit to discharge treated groundwater.

5.2.3.4 Availability of necessary equipment and specialists

Generally speaking, remedies that could be implemented by local contractors and without specialty contractors or experts may be considered more favorable. Consideration should be given to specialty contractor/consultant proximity to the CCR unit, contractor or equipment availability, and the effectiveness of the proposed remedy on similar sites.

MNA ranks highly favorable under this criterion as no specialty equipment or personnel will be required to implement this remedy at the Site. In-Situ Injection would require equipment for drilling and well installation, and may require specialists to conduct injections. “Pump and Treat” would require drilling equipment, well installation equipment, and equipment to install supporting pumping and conveyance features. Although the construction techniques required for both corrective measures are common, “Pump and Treat” would require available above-ground treatment equipment throughout the lifetime of the corrective measure. As such, In-Situ Injection is considered favorable, and “Pump and Treat” is considered less favorable under this criterion.

5.2.3.5 Available capacity and location of needed treatment, storage, and disposal services

This sub-criterion (§257.97(c)(3)(v)) considers disposal options for materials generated by the groundwater remedy and land area that is available for implementation of the remedy.

MNA and In-situ Injection are considered highly favorable as no additional treatment, storage, and disposal services will be required and adequate land area is available to conduct in-situ treatment with injections. “Pump and Treat” is considered less favorable under this criterion. While the existing treatment system associated with the ongoing closure has sufficient capacity, the need to maintain this infrastructure will result in an ongoing waste stream of treatment residuals. Further, extracted groundwater will need to be managed, potentially requiring temporary storage areas for treated or untreated groundwater.

5.2.3.6 Ease of implementation summary

This section provides a summary of the five §257.97(c)(3) sub-criteria relative to the ease or difficulty of implementing this remedy that are discussed in Sections 5.2.3.1 to 5.2.3.5 above, and includes a summary table.

The MNA ease of implementation is ranked highly favorable, as the infrastructure for this remedy is already in place. In-Situ Injection is considered favorable based on the relative ease of construction, anticipated operational performance, limited permitting requirements, available means and methods to construct the remedy, and the available capacity and supporting services. “Pump and Treat” is considered less favorable based on the higher difficulty to construct, lower reliability of mechanical systems, and the limitations associated with treatment, storage, disposal services required.

Category 3 – Ease of Implementation

	In-Situ Injection	“Pump and Treat”	Monitored Natural Attenuation
<i>Sub-criterion i</i> Degree of difficulty associated with constructing the technology			
<i>Sub-criterion ii</i> Expected operational reliability of the technologies			
<i>Sub-criterion iii</i> Need to coordinate with and obtain necessary approvals and permits from other agencies			
<i>Sub-criterion iv</i> Availability of necessary equipment and specialists			
<i>Sub-criterion v</i> Available capacity and location of needed treatment, storage, and disposal services			
Category 3 Summary			

Color Legend:

	Option performs <i>highly favorably</i> under this criterion
	Option performs <i>favorably</i> under this criterion
	Option performs <i>less favorably</i> under this criterion

5.2.4 Evaluation of Comparison Criteria

The various sub-criteria were evaluated, and relative comparisons were made between the corrective measures to determine which remedy would be expected to be the most and least favorable regarding the certainty of success. The results are included in the following table for all of the comparative criteria.

In-Situ Injection and MNA are both considered favorable under long- and short-term effectiveness (Category 1). While In-situ Injections entail some short-term uncertainties as compared to MNA, this corrective measure is expected to achieve GWPS in the shortest time. Conversely, MNA is considered very reliable and entails minimal short-term uncertainties but will require a substantially longer time to achieve GWPS. “Pump and Treat” is considered less favorable primarily due to short-term construction impacts, higher O&M requirements, and long time periods required to achieve GWPS.

Source control (Category 2) will be supported at AP-1 through closure by removal of CCR, which over time, will support declining concentrations of Appendix IV constituents in groundwater downgradient of AP-1 and improve overall groundwater quality. None of the corrective measures under consideration will interfere with or diminish the anticipated benefits of the closure method. Each of the corrective measures therefore rank equally with respect to source control.

The ease of implementation (Category 3) of MNA is highly favorable as the required infrastructure already in place. In-Situ Injection is considered favorable based the relative ease of construction and operational performance. “Pump and Treat” is considered less favorable due to the higher difficulty to construct and the lower reliability of mechanical systems.

	In-Situ Injection	“Pump and Treat”	Monitored Natural Attenuation
Category 1 Long- and Short-Term Effectiveness, Protectiveness, and Certainty of Success			
Category 2 Effectiveness in controlling the source to reduce further releases			
Category 3 Ease of implementation			

Color Legend:

	Option performs <i>highly favorably</i> under this criterion
	Option performs <i>favorably</i> under this criterion
	Option performs <i>less favorably</i> under this criterion

5.3 Public Meeting and Community Engagement

In accordance with state and federal CCR regulations, a public meeting was held by Georgia Power in Rome, Georgia, on March 24, 2026 to discuss the assessment of corrective measures and proposed remedy. Prior to the meeting, a public notice was placed in the Rome News Tribune and posted to Georgia Power's publicly available website for 30-days (**Appendix D**). The meeting was attended by members of the local community. No comments were submitted by meeting attendees or members of the community, and community acceptance of the remedy is expected to be highly favorable.

6.0 PROPOSED REMEDY SELECTION

This section provides a summary of the proposed groundwater remedy and provides a schedule for remedy implementation in accordance with §257.97(d). Georgia Power will proactively utilize adaptive site management to support the remedial strategy and address potential changes in site conditions as appropriate. Under an adaptive site management strategy, a remedial approach will be selected whereby: (1) a corrective measure will be installed or implemented to address current conditions; (2) the performance of the corrective measure will be monitored, evaluated, and reported semiannually; (3) the conceptual site model will be updated as more data are collected; and (4) adjustments and augmentations will be made to the corrective measure(s), as needed, to meet performance criteria and site remedial objectives. The remedy adaptive site management framework is included as **Figure 8**.

6.1 Summary of Proposed Remedy Selection

The closure by removal of AP-1 will provide effective source control that precludes further releases as no CCR will remain in place. Closure of the CCR unit will, over time, be supportive of declining concentrations of Appendix IV constituents in groundwater downgradient of AP-1 and improve the overall groundwater quality. The proposed corrective measures will address exceedance of the GWPS at and beyond the compliance boundary. Based on the evaluation of comparative criteria included in §257.97(c), the proposed remedy comprises the following two corrective measures:

- **Geochemical Approaches (In-Situ Injections):** A network of either temporary or permanent injection wells will be installed and utilized to introduce reagents to the subsurface to promote attenuation of constituents. Initial geochemical modeling results (presented in **Appendix B**) support the feasibility of in-situ injections and are indicative of shorter remediation times as compared to MNA alone. Laboratory treatability studies and pilot studies have been completed to aid in selection of an appropriate injection composition, dosing, and protocol. These studies serve as a basis of design for this component of the selected remedy. Injections will target areas with highest concentrations of As and Mo in groundwater to immobilize and sequester these constituents in situ, accelerating already ongoing attenuation processes to achieve GWPS more rapidly than other corrective measure options. This remedial approach is tailored to areas around HGWC-8 and HGWC-13. A performance monitoring program will be implemented to assess treatment performance and groundwater quality within and downgradient of the proposed treatment areas for the duration of the remedy.

- **Monitored Natural Attenuation (MNA):** Natural attenuation processes, coupled with monitoring, are already ongoing at the Site. As detailed in the Geochemical CSM Report provided in **Appendix A**, natural attenuation of As and Mo in groundwater is primarily due to adsorption and co-precipitation. Groundwater monitoring will continue to document natural attenuation, which is expected to be enhanced by the in-situ injections. Attenuation mechanisms and reductions in constituent concentrations and attenuation mechanisms will continue to be monitored and documented for the duration of the remedy.

A conceptual remedy layout for in-situ injection arrays is shown on **Figure 9**. Conceptual injection location and corrective action monitoring well construction details are summarized in **Table 3** and **Table 4**, respectively. The MNA component of the remedy will rely on the same monitoring infrastructure as the in-situ injections. The number and location of injection and performance monitoring wells will be assessed during the remedy design and phased implementation. Remedy performance will be monitored to document that remedial objectives are being met in accordance with adaptive site management practices.

6.2 Schedule

In accordance with §257.97(d), the following factors were considered when developing the schedule:

- Extent and nature of contamination: The horizontal and vertical extent of Appendix IV constituents present in groundwater are delineated. Additional characterization and refinement of the treatment area was completed as part of high-resolution site characterization (HRSC) activities (Geosyntec, 2023c; 2023d), which supports the design and implementation of the remedy. The selected remedy will address the impacts to groundwater and adaptive site management practices will be utilized to evaluate whether to modify the remedial approach.
- Reasonable probabilities of remedial technologies in achieving compliance with the GWPS and other remedial objectives: The selected remedy is expected to achieve compliance with the GWPS within 10 years of the initiation of injections. As considered in Section 5 of this report, the selected remedy is expected to address Appendix IV constituents in groundwater. If adequate progress is not being made toward addressing groundwater and achieving the GWPS at and beyond the compliance boundary, Georgia Power will enlist adaptive management strategies to modify the remedial approach, in accordance with

§257.98(b). Site and remedy-specific performance metrics will be developed and documented in the Corrective Action Groundwater Monitoring Plan.

- Availability of treatment or disposal capacity for CCR managed during remedy implementation: Because CCR is not expected to be managed during remedy implementation, this factor should not have a material impact on the project schedule.
- Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy: As described in Section 5 of this report, the risk evaluation for As and Mo in groundwater at AP-1 was conducted using methods consistent with GA EPD and USEPA guidance, included multiple conservative assumptions, and concluded that groundwater conditions are not expected to pose a risk to human health or the environment. Thus, this factor should not have a material impact on the project schedule. Additional risks that may be present during remedy implementation were considered in Section 5 of this report, as required under §257.97(c)(1).
- Resource value of the aquifer: As summarized in Section 5 of this report and detailed in the Risk Evaluation Report, As and Mo are not expected to pose a risk to human health or the environment. As such, considerations related to alternative drinking water supply or interim remedial measures, as outlined in §257.98(a)(3), are not currently necessary or expected to become so. Further, Georgia Power will retain ownership of the Site and future development for non-industrial purposes is not currently anticipated. Because AP-1 constituents are not expected to pose a risk to human health or the environment, this factor should not have a material impact on the project schedule.

The general approach and implementation schedule may be modified based on new groundwater quality data obtained during the remedial implementation process, following adaptive site management practices and in accordance with §257.98(b).

6.2.1 Planning and Design

Approximately 3 months will be required to design the selected remedy and develop a corrective action monitoring plan. Significant planning and design activities include:

- UIC Permitting: Concurrent with the preparation of this Remedy Selection Report, a UIC permit application has been prepared and will be submitted to GA EPD for review and approval (1 month total) prior to remedy implementation.

- Finalize Design and Corrective Action Monitoring Plan: A corrective action monitoring plan, including detailed remedy design will be developed and submitted to GA EPD for approval (2 months total). The corrective action monitoring plan will be submitted to GA EPD within 90 days of GA EPD approval of the Remedy Selection Report.

6.2.2 Construction and Implementation

Construction of the injection and performance monitoring well network will occur in phases. For example, a subset of locations will be installed and sampled for baseline characterization. Construction phases are anticipated to take approximately 6 to 8 months, with initial geochemical injections occurring over the following 2 to 3 months. In accordance with adaptive site management, this multi-phase approach supports the modification of remedy implementation to address current conditions based on the evaluation corrective action performance data. Additionally, actual construction and implementation times may vary substantially based on design activities and subcontractor availability.

6.2.3 Operation

While the estimated timeframe will be refined during design, it is anticipated that the geochemical injection phase of the remedy may require 6 months to a year of operation followed by a longer period (approximately two years) of performance monitoring coupled with monitored natural attenuation for the areas downgradient and/or outside of the injection areas. In total, it is estimated that less than 10 years from the initiation of injections will be required to achieve GWPS within all points of the plumes at and beyond the compliance boundary.

The groundwater remedy will be considered complete when applicable requirements listed under §257.98(c) and 391-3-4-.10(6) are satisfied. In accordance with adaptive site management practices and §257.98(b), the groundwater remedy will be modified if it is determined that GWPS are not being met or will not be met.

6.3 Reporting

In accordance with §257.105(h), Georgia Power will place the Remedy Selection Report into the Site operating record. Thereafter, Georgia Power will develop a corrective action

monitoring plan and implement and report on the selected remedy in accordance with applicable regulatory requirements.

7.0 REFERENCES

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TABLES

Table 1
Monitoring Well Network Summary
Georgia Power Company
Plant Hammond - Ash Pond 1
Floyd County, GA

Well ID	Well Designation	Hydraulic Location	Northing ⁽¹⁾	Easting ⁽¹⁾	Ground Surface Elevation ⁽¹⁾ (feet)	Top of Casing Elevation ⁽¹⁾ (feet)	Top of Screen Elevation ⁽¹⁾ (feet)	Bottom of Screen Elevation ⁽¹⁾ (feet)	Total Well Depth from (Feet Below Top of Casing) ⁽²⁾	Groundwater Zone Screened	Installation Date
HGWA-1	Detection	Upgradient	1550423.32	1940770.00	592.32	595.21	573.12	563.12	32.49	Bedrock	12/03/2014
HGWA-2	Detection	Upgradient	1549796.87	1939845.15	585.29	587.92	570.29	560.29	27.95	Overburden	12/02/2015
HGWA-3	Detection	Upgradient	1549794.41	1939833.39	585.23	587.74	553.23	543.23	44.51	PWR	12/02/2015
HGWC-7	Detection	Downgradient	1549520.67	1942319.75	576.55	579.18	561.55	551.55	27.96	Overburden/PWR	12/03/2015
HGWC-8	Detection	Downgradient	1549114.61	1942392.56	577.14	579.82	564.64	554.64	25.51	Overburden	12/08/2015
HGWC-9	Detection	Downgradient	1548693.30	1942215.03	577.72	580.36	543.72	533.72	46.97	Overburden/PWR/Bedrock	12/09/2015
HGWC-10	Detection	Downgradient	1548469.25	1941644.43	576.76	579.37	566.76	556.76	22.94	Overburden	12/08/2015
HGWC-11	Detection	Downgradient	1548477.91	1941146.79	578.12	580.67	565.19	555.19	25.78	Overburden/Bedrock	12/15/2015
HGWC-12	Detection	Downgradient	1548476.53	1941152.34	578.14	580.73	555.64	545.64	35.42	Overburden/Bedrock	12/09/2015
HGWC-13	Detection	Downgradient	1548628.03	1940900.60	592.94	595.76	560.94	550.94	45.15	Overburden	12/10/2015
HGWA-43D	Detection	Upgradient	1550422.85	1940753.80	592.08	595.08	544.08	534.08	61.25	Bedrock	08/26/2020
HGWA-44D	Detection	Upgradient	1550409.13	1940756.18	592.01	594.79	491.76	481.76	113.28	Bedrock	08/25/2020
MW-5	Piezometer ⁽⁴⁾	Downgradient	1548436.02	1942448.85	578.00	581.14	560.70	550.70	30.84	Overburden	11/04/2014
MW-6	Piezometer ⁽⁴⁾	Downgradient	1548383.12	1941689.01	579.18	581.84	559.28	549.28	32.96	Overburden	11/04/2014
MW-7	Piezometer ⁽⁴⁾	Downgradient	1548230.47	1941087.44	574.94	577.73	561.24	551.24	26.89	Overburden	10/30/2014
MW-19	Assessment	Downgradient	1548422.94	1940943.01	577.46	580.65	561.45	551.45	29.53	Overburden	09/26/2018
MW-20	Assessment	Downgradient	1549029.68	1942736.85	575.96	579.00	554.96	544.96	34.37	Overburden	09/27/2018
MW-24D	Assessment	Downgradient	1548638.80	1940900.37	592.91	595.68	532.91	522.91	72.77	Bedrock	11/07/2018
MW-25D	Piezometer ⁽⁴⁾	Downgradient	1548473.00	1941162.20	577.71	580.59	527.71	517.71	63.21	Bedrock	11/06/2018
MW-26D	Piezometer ⁽⁴⁾	Downgradient	1548699.91	1942222.36	577.63	580.41	512.63	502.63	78.11	Bedrock	11/14/2018
MW-27D	Assessment	Downgradient	1549103.57	1942390.80	576.84	579.70	526.84	516.84	63.19	Bedrock	11/08/2018
MW-28D	Piezometer ⁽⁴⁾	Downgradient	1549510.90	1942321.14	576.20	579.08	531.20	521.20	58.21	Bedrock	11/13/2018
MW-29	Piezometer ⁽⁴⁾	Downgradient	1549437.67	1942633.60	572.14	575.06	557.14	547.14	28.25	PWR	11/13/2018
AP1A-1	Piezometer	Upgradient	1550080.01	1941614.12	584.78	587.44	575.84	565.84	21.93	Overburden	12/15/2015
AS-01 ⁽³⁾	Corrective Action Piezometer	Downgradient	1549048.28	1942388.06	577.46	577.08	548.46	546.46	30.92	Overburden	05/07/2024
AS-02 ⁽³⁾	Corrective Action Piezometer	Downgradient	1549049.08	1942400.03	577.14	576.72	547.14	545.14	31.89	Overburden	05/06/2024
AS-03 ⁽³⁾	Corrective Action Piezometer	Downgradient	1548670.10	1940933.87	591.98	591.60	545.98	543.98	47.92	Overburden/Bedrock	04/28/2024
AS-04 ⁽³⁾	Corrective Action Piezometer	Downgradient	1548680.80	1940930.83	591.97	591.50	544.97	542.97	48.83	Overburden/Bedrock	04/28/2024
INW-03 ⁽³⁾	Corrective Action Piezometer	Downgradient	1549052.75	1942388.28	577.38	577.07	560.28	550.28	27.10	Overburden	05/06/2024
INW-04 ⁽³⁾	Corrective Action Piezometer	Downgradient	1548671.73	1940929.98	592.01	591.58	557.01	547.01	44.87	Overburden	04/28/2024
INW-05 ⁽³⁾	Corrective Action Piezometer	Downgradient	1548680.07	1940935.89	591.81	591.31	556.81	546.81	44.80	Overburden	04/28/2024
MW-1	Piezometer	Upgradient	1549938.24	1941589.06	585.63	588.66	567.93	557.93	31.06	PWR/Bedrock	12/02/2014
MW-8	Piezometer	Downgradient	1548171.86	1940016.70	584.25	586.93	565.05	555.05	32.28	Overburden	10/29/2014
PT-07 ⁽³⁾	Corrective Action Piezometer	Downgradient	1548675.24	1940933.39	592.00	591.75	554.40	544.40	48.00	Overburden	06/03/2023
PT-08 ⁽³⁾	Corrective Action Piezometer	Downgradient	1548666.82	1940929.58	592.10	591.83	560.20	550.20	42.20	Overburden	06/03/2023
PT-09 ⁽³⁾	Corrective Action Piezometer	Downgradient	1549049.74	1942393.11	577.33	580.35	560.18	550.18	27.45	Overburden	06/01/2023
PT-10 ⁽³⁾	Corrective Action Piezometer	Downgradient	1549040.34	1942413.88	577.39	580.44	560.29	550.29	27.40	Overburden	06/01/2023
PT-11 ⁽³⁾	Corrective Action Piezometer	Downgradient	1549055.61	1942390.89	577.35	576.96	560.75	550.75	26.51	Overburden	05/07/2024
PT-12 ⁽³⁾	Corrective Action Piezometer	Downgradient	1549045.43	1942391.10	577.34	576.84	560.34	550.34	26.81	Overburden	05/07/2024
PT-13 ⁽³⁾	Corrective Action Piezometer	Downgradient	1548676.04	1940939.23	591.88	591.47	556.88	546.88	44.89	Overburden	04/28/2024
PT-14 ⁽³⁾	Corrective Action Piezometer	Downgradient	1548673.63	1940926.52	592.06	591.62	557.06	547.06	44.86	Overburden	04/28/2024
PT-15 ⁽³⁾	Corrective Action Piezometer	Downgradient	1548668.35	1940937.45	591.90	591.37	556.90	546.90	44.77	Overburden	04/28/2024
MW-30D	Piezometer	Downgradient	1549530.00	1942318.45	576.20	578.59	481.20	471.20	107.72	Bedrock	06/19/2019
MW-40D	Piezometer	Downgradient	1549542.29	1942316.55	576.41	578.92	450.41	440.41	138.84	Bedrock	04/29/2020
MW-53	Corrective Action Piezometer	Downgradient	1548835.51	1942399.62	577.64	580.59	554.54	544.54	33.40	Overburden	06/02/2023
MW-54	Corrective Action Piezometer	Downgradient	1548699.51	1940805.03	592.98	592.66	564.98	554.98	38.30	Overburden	06/02/2023

Notes:

PWR = Partially weathered rock.

(1) Coordinates in North American Datum (NAD) 1983, State Plane, Georgia-West, feet. Elevations are referenced to the North American Vertical Datum of 1988 (NAVD88). Survey points measured at nail or known reference point.

Survey data certified by GEL Solutions May 19, 2020. Survey data for HGWA-43D and HGWA-44D certified by GEL Solutions September 10, 2020. Survey data for MW-53, MW-54, PT-07 through PT-10 certified by GEL Solutions July 13, 2023, and August 30, 2023.

(2) Total well depth accounts for sump if data provided on well construction logs.

(3) Piezometers INW-03, INW-04, INW-05, MW-53, MW-54, PT-07 through PT-015, and AS-01 through AS-04 were installed in support of an Assessment of Corrective Measures pre-design investigation and are not included in the monitoring well network.

(4) Assessment wells MW-5, MW-6, MW-7, MW-25D, MW-26D, MW-28D, and MW-29 were reclassified as piezometers following approval of the 5 Year Permit Review on June 10, 2025.

Table 2
Summary of Corrective Measures Screening
Georgia Power Company
Plant Hammond AP-1
Floyd County, Georgia

Corrective Measure	Description	Screening Status
Geochemical Approaches (In-Situ Injection)	Geochemical approaches rely on an injection well network to introduce reagents or air into the subsurface to promote either anaerobic or aerobic attenuation of constituents as a sparingly-soluble mineral or through sorption mechanisms.	<u>Retained</u>
Hydraulic Containment ("Pump and Treat")	Hydraulic containment refers to the use of groundwater extraction to induce a hydraulic gradient for hydraulic capture to control the migration of impacted groundwater. This approach uses extraction wells or trenches to capture groundwater, which may subsequently require above-ground treatment and permitted discharge to a receiving water feature, reinjection into the groundwater, or reuse (e.g., land application, CCR conditioning, etc.).	<u>Retained</u>
Monitored Natural Attenuation (MNA)	MNA relies on natural attenuation processes to achieve site-specific remediation objectives within a reasonable time frame relative to more active methods. Under certain conditions (e.g., through sorption, mineral precipitation or oxidation-reduction reactions), MNA effectively reduces the dissolved concentrations of inorganic constituents in groundwater. Natural attenuation mechanisms for inorganic constituents at CCR sites are either physical (e.g., dilution, dispersion, flushing, and related processes) or chemical (sorption or oxidation reduction reactions).	<u>Retained</u>
Permeable Reactive Barrier	Permeable reactive barrier (PRB) technology typically involves the installation of a permeable subsurface wall constructed with reactive media for the removal of constituents as groundwater passes through.	<u>Not retained</u> (i) Does not address downgradient groundwater when installed along the compliance boundary; (ii) Limited construction feasibility due to variability in depth to competent bedrock; (iii) Potential for increased maintenance due to potential biofouling and mineral precipitation.
Phytoremediation	Phytoremediation uses trees and other plants to degrade or immobilize constituents or achieve hydraulic control without the need for an above-ground treatment system and infrastructure.	<u>Not retained</u> (i) Insufficient available area for tree plantings due to presence of high voltage lines.
Subsurface Vertical Barrier Walls	This approach involves placing a barrier to groundwater flow in the subsurface, frequently around a source area, to prevent future migration of dissolved constituents in groundwater from beneath the source to downgradient areas by providing containment.	<u>Not retained</u> (i) Does not address downgradient groundwater when installed along the compliance boundary; and (ii) Limited construction feasibility due to variability in depth to competent bedrock.

Table 3
Conceptual Injection Location Construction Details
Georgia Power Company
Plant Hammond - Ash Pond 1
Floyd County, GA

Injection Location	Northing ⁽¹⁾	Easting ⁽¹⁾	Ground Surface Elevation (feet) ⁽¹⁾	Top of Screen Elevation (feet) ⁽¹⁾	Bottom of Screen Elevation (feet) ⁽¹⁾	Proposed Groundwater Zone Screened
IP-08-A-01	1549277	1942250	591	564	554	Overburden
IP-08-A-02	1549282	1942256	592	564	554	Overburden
IP-08-A-03	1549287	1942262	592	565	555	Overburden
IP-08-A-04	1549293	1942268	593	565	555	Overburden
IP-08-A-05	1549298	1942274	590	565	555	Overburden
IP-08-A-06	1549303	1942279	589	565	555	Overburden
IP-08-B-01	1549246	1942262	592	564	554	Overburden
IP-08-B-02	1549251	1942268	593	564	554	Overburden
IP-08-B-03	1549257	1942274	592	564	554	Overburden
IP-08-B-04	1549262	1942281	591	564	554	Overburden
IP-08-B-05	1549267	1942287	590	564	554	Overburden
IP-08-B-06	1549272	1942293	588	564	554	Overburden
IP-08-B-07	1549277	1942299	586	564	554	Overburden
IP-08-B-08	1549282	1942305	585	564	554	Overburden
IP-08-B-09	1549287	1942311	583	564	554	Overburden
IP-08-C-01	1549199	1942267	592	564	554	Overburden
IP-08-C-02	1549204	1942273	593	564	554	Overburden
IP-08-C-03	1549210	1942278	592	564	554	Overburden
IP-08-C-04	1549215	1942284	591	564	554	Overburden
IP-08-C-05	1549221	1942290	590	564	554	Overburden
IP-08-C-06	1549226	1942296	589	564	554	Overburden
IP-08-C-07	1549232	1942302	588	564	554	Overburden
IP-08-C-08	1549237	1942308	587	564	554	Overburden
IP-08-C-09	1549243	1942314	584	564	554	Overburden
IP-08-C-10	1549248	1942319	583	564	554	Overburden
IP-08-C-11	1549254	1942325	581	564	554	Overburden
IP-08-C-12	1549259	1942331	580	564	554	Overburden
IP-08-C-13	1549264	1942337	579	564	554	Overburden
IP-08-D-01	1549162	1942276	592	564	554	Overburden
IP-08-D-02	1549167	1942282	592	564	554	Overburden
IP-08-D-03	1549172	1942288	592	564	554	Overburden
IP-08-D-04	1549178	1942294	590	564	554	Overburden
IP-08-D-05	1549183	1942300	589	564	554	Overburden
IP-08-D-06	1549188	1942306	589	564	554	Overburden
IP-08-D-07	1549193	1942312	587	564	554	Overburden
IP-08-D-08	1549199	1942318	586	564	554	Overburden
IP-08-D-09	1549204	1942324	583	564	554	Overburden
IP-08-D-10	1549209	1942330	582	564	554	Overburden
IP-08-D-11	1549215	1942336	581	564	554	Overburden
IP-08-D-12	1549220	1942342	580	564	554	Overburden
IP-08-D-13	1549225	1942348	579	564	554	Overburden
IP-08-D-14	1549231	1942354	578	564	554	Overburden
IP-08-D-15	1549236	1942360	577	564	554	Overburden
IP-08-D-16	1549241	1942366	577	564	554	Overburden
IP-08-E-01	1549119	1942278	591	563	553	Overburden
IP-08-E-02	1549125	1942284	593	563	553	Overburden
IP-08-E-03	1549130	1942290	593	564	554	Overburden
IP-08-E-04	1549135	1942296	591	563	553	Overburden
IP-08-E-05	1549141	1942302	590	564	554	Overburden
IP-08-E-06	1549146	1942308	589	564	554	Overburden

Table 3
Conceptual Injection Location Construction Details
Georgia Power Company
Plant Hammond - Ash Pond 1
Floyd County, GA

Injection Location	Northing ⁽¹⁾	Easting ⁽¹⁾	Ground Surface Elevation (feet) ⁽¹⁾	Top of Screen Elevation (feet) ⁽¹⁾	Bottom of Screen Elevation (feet) ⁽¹⁾	Proposed Groundwater Zone Screened
IP-08-E-07	1549151	1942314	588	564	554	Overburden
IP-08-E-08	1549156	1942320	587	564	554	Overburden
IP-08-E-09	1549162	1942326	585	564	554	Overburden
IP-08-E-10	1549167	1942332	584	564	554	Overburden
IP-08-E-11	1549172	1942338	583	564	554	Overburden
IP-08-E-12	1549177	1942344	580	564	554	Overburden
IP-08-E-13	1549183	1942350	580	564	554	Overburden
IP-08-E-14	1549188	1942356	579	564	554	Overburden
IP-08-E-15	1549193	1942362	578	564	554	Overburden
IP-08-E-16	1549199	1942368	578	564	554	Overburden
IP-08-E-17	1549204	1942374	577	564	554	Overburden
IP-08-E-18	1549209	1942380	577	564	554	Overburden
IP-08-F-01	1549088	1942290	592	563	553	Overburden
IP-08-F-02	1549093	1942296	592	563	553	Overburden
IP-08-F-03	1549098	1942302	592	563	553	Overburden
IP-08-F-04	1549103	1942308	590	563	553	Overburden
IP-08-F-05	1549108	1942314	589	563	553	Overburden
IP-08-F-06	1549114	1942321	588	563	553	Overburden
IP-08-F-07	1549119	1942327	587	563	553	Overburden
IP-08-F-08	1549124	1942333	585	563	553	Overburden
IP-08-F-09	1549129	1942339	583	563	553	Overburden
IP-08-F-10	1549134	1942345	582	563	553	Overburden
IP-08-F-11	1549139	1942351	581	563	553	Overburden
IP-08-F-12	1549144	1942357	580	563	553	Overburden
IP-08-F-13	1549150	1942363	579	563	553	Overburden
IP-08-F-14	1549155	1942370	578	563	553	Overburden
IP-08-F-15	1549160	1942376	578	564	554	Overburden
IP-08-F-16	1549165	1942382	577	564	554	Overburden
IP-08-F-17	1549170	1942388	577	564	554	Overburden
IP-08-G-01	1549040	1942289	592	563	553	Overburden
IP-08-G-02	1549046	1942295	593	563	553	Overburden
IP-08-G-03	1549051	1942301	592	563	553	Overburden
IP-08-G-04	1549056	1942307	591	563	553	Overburden
IP-08-G-05	1549061	1942313	590	563	553	Overburden
IP-08-G-06	1549067	1942319	589	563	553	Overburden
IP-08-G-07	1549072	1942325	588	563	553	Overburden
IP-08-G-08	1549077	1942331	587	563	553	Overburden
IP-08-G-09	1549082	1942337	585	563	553	Overburden
IP-08-G-10	1549088	1942343	584	563	553	Overburden
IP-08-G-11	1549093	1942349	582	563	553	Overburden
IP-08-G-12	1549098	1942355	581	563	553	Overburden
IP-08-G-13	1549104	1942361	580	563	553	Overburden
IP-08-G-14	1549109	1942367	580	563	553	Overburden
IP-08-G-15	1549114	1942373	579	563	553	Overburden
IP-08-G-16	1549119	1942379	578	563	553	Overburden
IP-08-G-17	1549125	1942385	578	563	553	Overburden
IP-08-G-18	1549130	1942391	577	563	553	Overburden
IP-08-G-19	1549135	1942397	577	563	553	Overburden
IP-08-H-01	1549008	1942291	592	563	553	Overburden
IP-08-H-02	1549013	1942297	592	563	553	Overburden

Table 3
Conceptual Injection Location Construction Details
Georgia Power Company
Plant Hammond - Ash Pond 1
Floyd County, GA

Injection Location	Northing ⁽¹⁾	Easting ⁽¹⁾	Ground Surface Elevation (feet) ⁽¹⁾	Top of Screen Elevation (feet) ⁽¹⁾	Bottom of Screen Elevation (feet) ⁽¹⁾	Proposed Groundwater Zone Screened
IP-08-H-03	1549018	1942304	591	563	553	Overburden
IP-08-H-04	1549023	1942310	591	563	553	Overburden
IP-08-H-05	1549028	1942316	590	563	553	Overburden
IP-08-H-06	1549033	1942322	589	563	553	Overburden
IP-08-H-07	1549038	1942329	588	563	553	Overburden
IP-08-H-08	1549043	1942335	586	563	553	Overburden
IP-08-H-09	1549048	1942341	585	563	553	Overburden
IP-08-H-10	1549053	1942347	584	563	553	Overburden
IP-08-H-11	1549058	1942354	582	563	553	Overburden
IP-08-H-12	1549063	1942360	581	563	553	Overburden
IP-08-H-13	1549068	1942366	580	563	553	Overburden
IP-08-H-14	1549073	1942372	580	563	553	Overburden
IP-08-H-15	1549078	1942379	579	563	553	Overburden
IP-08-H-16	1549083	1942385	578	563	553	Overburden
IP-08-H-17	1549088	1942391	578	563	553	Overburden
IP-08-H-18	1549093	1942397	578	563	553	Overburden
IP-08-H-19	1549098	1942404	578	563	553	Overburden
IP-08-I-01	1548976	1942312	590	562	552	Overburden
IP-08-I-02	1548981	1942318	589	562	552	Overburden
IP-08-I-03	1548986	1942324	587	562	552	Overburden
IP-08-I-04	1548991	1942330	586	562	552	Overburden
IP-08-I-05	1548996	1942337	585	561	551	Overburden
IP-08-I-06	1549001	1942343	585	561	551	Overburden
IP-08-I-07	1549006	1942349	583	561	551	Overburden
IP-08-I-08	1549012	1942355	582	561	551	Overburden
IP-08-I-09	1549017	1942362	582	561	551	Overburden
IP-08-I-10	1549022	1942368	581	561	551	Overburden
IP-08-I-11	1549027	1942374	579	561	551	Overburden
IP-08-I-12	1549032	1942380	579	561	551	Overburden
IP-08-I-13	1549037	1942386	578	561	551	Overburden
IP-08-I-14	1549042	1942393	579	561	551	Overburden
IP-08-I-15	1549047	1942399	578	561	551	Overburden
IP-08-I-16	1549052	1942405	578	561	551	Overburden
IP-08-J-01	1548883	1942246	591	560	550	Overburden
IP-08-J-02	1548888	1942252	592	560	550	Overburden
IP-08-J-03	1548893	1942258	593	560	550	Overburden
IP-08-J-04	1548898	1942265	592	560	550	Overburden
IP-08-J-05	1548902	1942271	592	560	550	Overburden
IP-08-J-06	1548907	1942278	592	560	550	Overburden
IP-08-J-07	1548912	1942284	591	560	550	Overburden
IP-08-J-08	1548917	1942290	590	560	550	Overburden
IP-08-K-01	1548865	1942270	589	557	547	Overburden
IP-08-K-02	1548869	1942277	589	557	547	Overburden
IP-08-K-03	1548874	1942284	588	557	547	Overburden
IP-08-K-04	1548878	1942290	587	558	548	Overburden
IP-08-K-05	1548883	1942297	586	558	548	Overburden
IP-08-K-06	1548888	1942303	585	558	548	Overburden
IP-08-K-07	1548892	1942310	584	558	548	Overburden
IP-08-K-08	1548897	1942317	584	558	548	Overburden
IP-08-K-09	1548901	1942323	582	558	548	Overburden

Table 3
Conceptual Injection Location Construction Details
Georgia Power Company
Plant Hammond - Ash Pond 1
Floyd County, GA

Injection Location	Northing ⁽¹⁾	Easting ⁽¹⁾	Ground Surface Elevation (feet) ⁽¹⁾	Top of Screen Elevation (feet) ⁽¹⁾	Bottom of Screen Elevation (feet) ⁽¹⁾	Proposed Groundwater Zone Screened
IP-08-K-10	1548906	1942330	582	558	548	Overburden
IP-08-L-01	1548951	1942381	579	560	550	Overburden
IP-08-L-02	1548956	1942387	579	560	550	Overburden
IP-08-L-03	1548962	1942393	579	560	550	Overburden
IP-08-L-04	1548967	1942398	579	560	550	Overburden
IP-08-M-01	1548836	1942296	582	555	545	Overburden
IP-08-M-02	1548840	1942302	582	555	545	Overburden
IP-08-M-03	1548845	1942309	581	555	545	Overburden
IP-08-M-04	1548850	1942315	580	556	546	Overburden
IP-08-M-05	1548855	1942321	580	556	546	Overburden
IP-08-M-06	1548860	1942328	580	556	546	Overburden
IP-08-M-07	1548864	1942334	579	557	547	Overburden
IP-08-M-08	1548869	1942341	579	557	547	Overburden
IP-08-M-09	1548874	1942347	579	557	547	Overburden
IP-08-M-10	1548879	1942353	579	558	548	Overburden
IP-08-M-11	1548884	1942360	578	558	548	Overburden
IP-08-M-12	1548888	1942366	579	558	548	Overburden
IP-08-N-01	1548817	1942352	579	554	544	Overburden
IP-08-N-02	1548822	1942358	578	554	544	Overburden
IP-08-N-03	1548827	1942365	578	554	544	Overburden
IP-08-N-04	1548832	1942371	578	555	545	Overburden
IP-08-N-05	1548837	1942377	578	556	546	Overburden
IP-08-N-06	1548842	1942383	578	557	547	Overburden
IP-08-N-07	1548847	1942390	579	558	548	Overburden
IP-08-N-08	1548851	1942396	579	558	548	Overburden
IP-08-N-09	1548856	1942402	578	558	548	Overburden
IP-13-A-01	1548735	1940823	594	546	544	Overburden
IP-13-A-02	1548733	1940827	594	546	544	Overburden
IP-13-A-03	1548731	1940833	594	546	544	Overburden
IP-13-A-04	1548728	1940839	593	545	543	Overburden
IP-13-A-05	1548725	1940846	593	545	543	Overburden
IP-13-A-06	1548722	1940853	594	546	544	Overburden
IP-13-A-07	1548719	1940860	593	545	543	Overburden
IP-13-A-08	1548716	1940868	593	545	543	Overburden
IP-13-A-09	1548713	1940875	594	546	544	Overburden
IP-13-A-10	1548709	1940882	593	545	543	Overburden
IP-13-A-11	1548706	1940890	592	544	542	Overburden
IP-13-A-12	1548703	1940897	593	545	543	Overburden
IP-13-A-13	1548700	1940904	592	544	542	Overburden
IP-13-A-14	1548697	1940912	592	544	542	Overburden
IP-13-A-15	1548694	1940919	591	543	541	Overburden
IP-13-A-16	1548690	1940926	592	544	542	Overburden
IP-13-A-17	1548687	1940934	592	544	542	Overburden
IP-13-A-18	1548684	1940941	591	543	541	Overburden
IP-13-A-19	1548681	1940949	592	544	542	Overburden
IP-13-A-20	1548678	1940956	592	544	542	Overburden
IP-13-A-21	1548675	1940963	591	543	541	Overburden
IP-13-A-22	1548671	1940971	591	543	541	Overburden
IP-13-A-23	1548668	1940978	592	544	542	Overburden
IP-13-A-24	1548665	1940985	592	544	542	Overburden

Table 3
Conceptual Injection Location Construction Details
Georgia Power Company
Plant Hammond - Ash Pond 1
Floyd County, GA

Injection Location	Northing ⁽¹⁾	Easting ⁽¹⁾	Ground Surface Elevation (feet) ⁽¹⁾	Top of Screen Elevation (feet) ⁽¹⁾	Bottom of Screen Elevation (feet) ⁽¹⁾	Proposed Groundwater Zone Screened
IP-13-A-25	1548662	1940993	592	544	542	Overburden
IP-13-A-26	1548658	1941000	591	543	541	Overburden
IP-13-A-27	1548655	1941007	592	544	542	Overburden
IP-13-A-28	1548652	1941014	592	544	542	Overburden
IP-13-A-29	1548649	1941022	591	543	541	Overburden
IP-13-B-01	1548687	1940813	594	546	544	Overburden
IP-13-B-02	1548684	1940821	594	546	544	Overburden
IP-13-B-03	1548680	1940828	595	547	545	Overburden
IP-13-B-04	1548677	1940835	594	546	544	Overburden
IP-13-B-05	1548674	1940843	594	546	544	Overburden
IP-13-B-06	1548671	1940850	596	548	546	Overburden
IP-13-B-07	1548668	1940857	597	549	547	Overburden
IP-13-B-08	1548665	1940865	595	547	545	Overburden
IP-13-B-09	1548661	1940872	595	547	545	Overburden
IP-13-B-10	1548658	1940880	594	546	544	Overburden
IP-13-B-11	1548655	1940887	593	545	543	Overburden
IP-13-B-12	1548652	1940894	593	545	543	Overburden
IP-13-B-13	1548649	1940902	593	545	543	Overburden
IP-13-B-14	1548646	1940909	594	546	544	Overburden
IP-13-B-15	1548643	1940916	593	545	543	Overburden
IP-13-B-16	1548639	1940924	593	545	543	Overburden
IP-13-B-17	1548636	1940931	594	546	544	Overburden
IP-13-B-18	1548633	1940938	594	546	544	Overburden
IP-13-B-19	1548630	1940946	593	545	543	Overburden
IP-13-B-20	1548627	1940953	593	545	543	Overburden
IP-13-B-21	1548624	1940960	593	545	543	Overburden
IP-13-B-22	1548620	1940968	593	545	543	Overburden
IP-13-B-23	1548617	1940975	593	545	543	Overburden
IP-13-B-24	1548614	1940982	593	545	543	Overburden
IP-13-B-25	1548611	1940990	593	545	543	Overburden
IP-13-B-26	1548608	1940997	593	545	543	Overburden

Notes:

⁽¹⁾ Coordinates in North American Datum (NAD) 1983, State Plane, Georgia-West, feet. Elevations referenced to the North American Vertical Datum of 1988 (NAVD88). Construction details are conceptual.

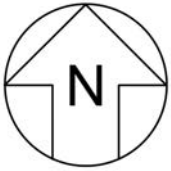
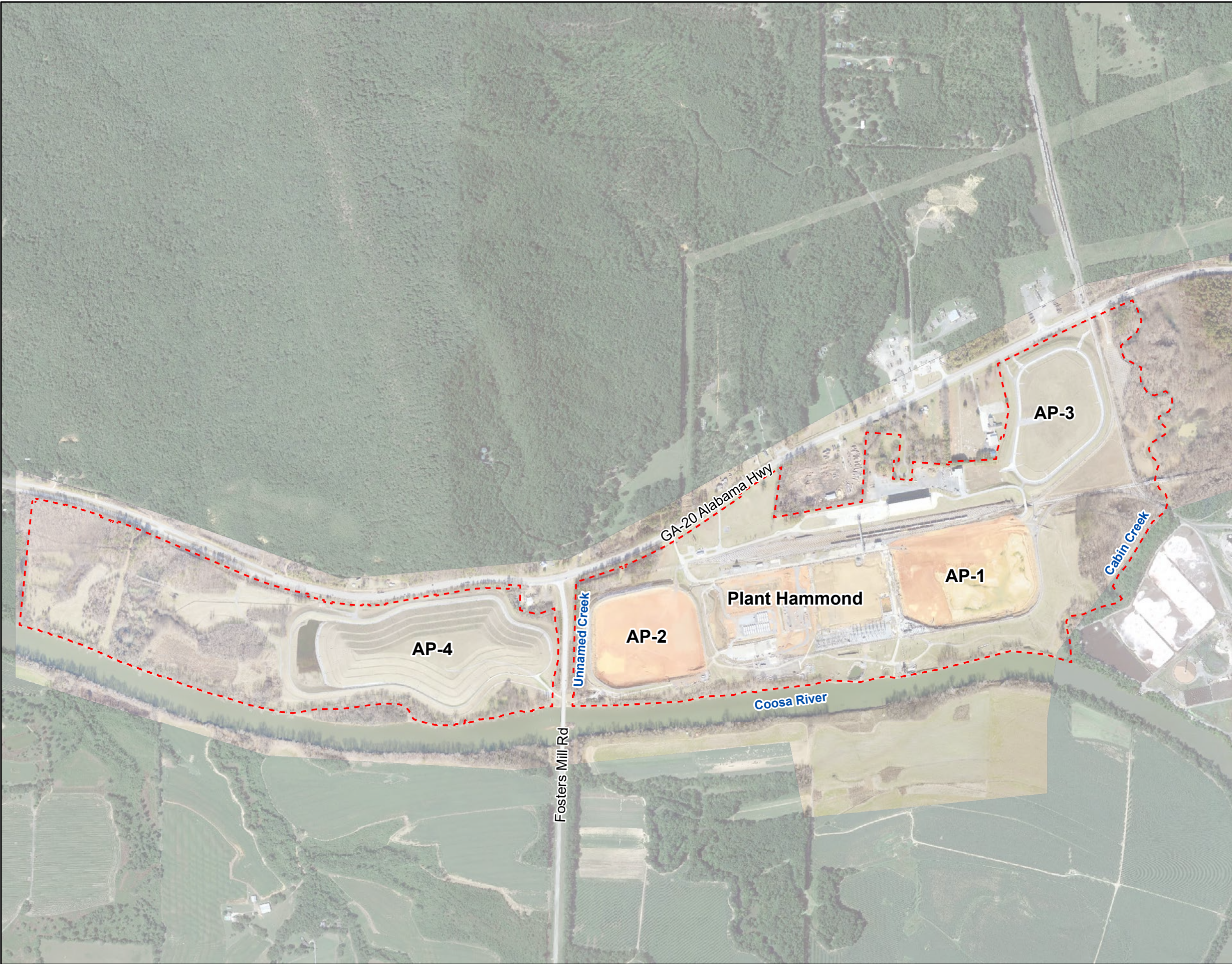
Table 4
Conceptual Corrective Action Monitoring Well Construction Details
Georgia Power Company
Plant Hammond - Ash Pond 1
Floyd County, GA

Well ID	Northing ⁽¹⁾	Easting ⁽¹⁾	Ground Surface Elevation (feet) ⁽¹⁾	Top of Screen Elevation (feet) ⁽¹⁾	Bottom of Screen Elevation (feet) ⁽¹⁾	Proposed Groundwater Zone Screened
PT-25	1548691	1940878	593	560	550	Overburden
PT-26	1548663	1940839	597	560	550	Overburden
PT-27	1548630	1940842	593	560	550	Overburden
PT-28	1548549	1940934	594	560	550	Overburden
PT-29	1548567	1941039	592	560	550	Overburden
PT-30	1549286	1942282	590	565	555	Overburden
PT-31	1549129	1942306	590	564	554	Overburden
PT-32	1549167	1942408	577	564	554	Overburden
PT-33	1548643	1941006	592	565	555	Overburden
PT-34	1549224	1942306	587	564	554	Overburden
PT-35	1549171	1942353	580	564	554	Overburden
PT-36	1549194	1942326	584	564	554	Overburden
PT-37	1549100	1942420	578	563	553	Overburden
PT-38	1549005	1942365	580	561	551	Overburden
PT-39	1548873	1942361	578	558	548	Overburden
PT-40	1548938	1942409	579	560	550	Overburden
PT-41	1548897	1942283	590	560	550	Overburden
PT-42	1548804	1942297	580	558	548	Overburden
PT-43	1548606	1940811	594	560	550	Overburden
PT-44	1548645	1941029	592	560	550	Overburden

Notes:

⁽¹⁾ Coordinates in North American Datum (NAD) 1983, State Plane, Georgia-West, feet. Elevations referenced to the North American Vertical Datum of 1988 (NAVD88). Construction details are conceptual.

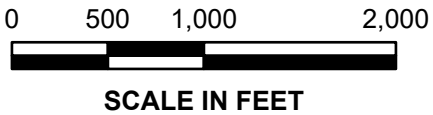
FIGURES



LEGEND
[Red dashed line] Plant Hammond Property Boundary



Note:
1. Aerial photograph source: Google Earth Pro August 2019 and Georgia Power Company, January 2026.



SITE LOCATION MAP

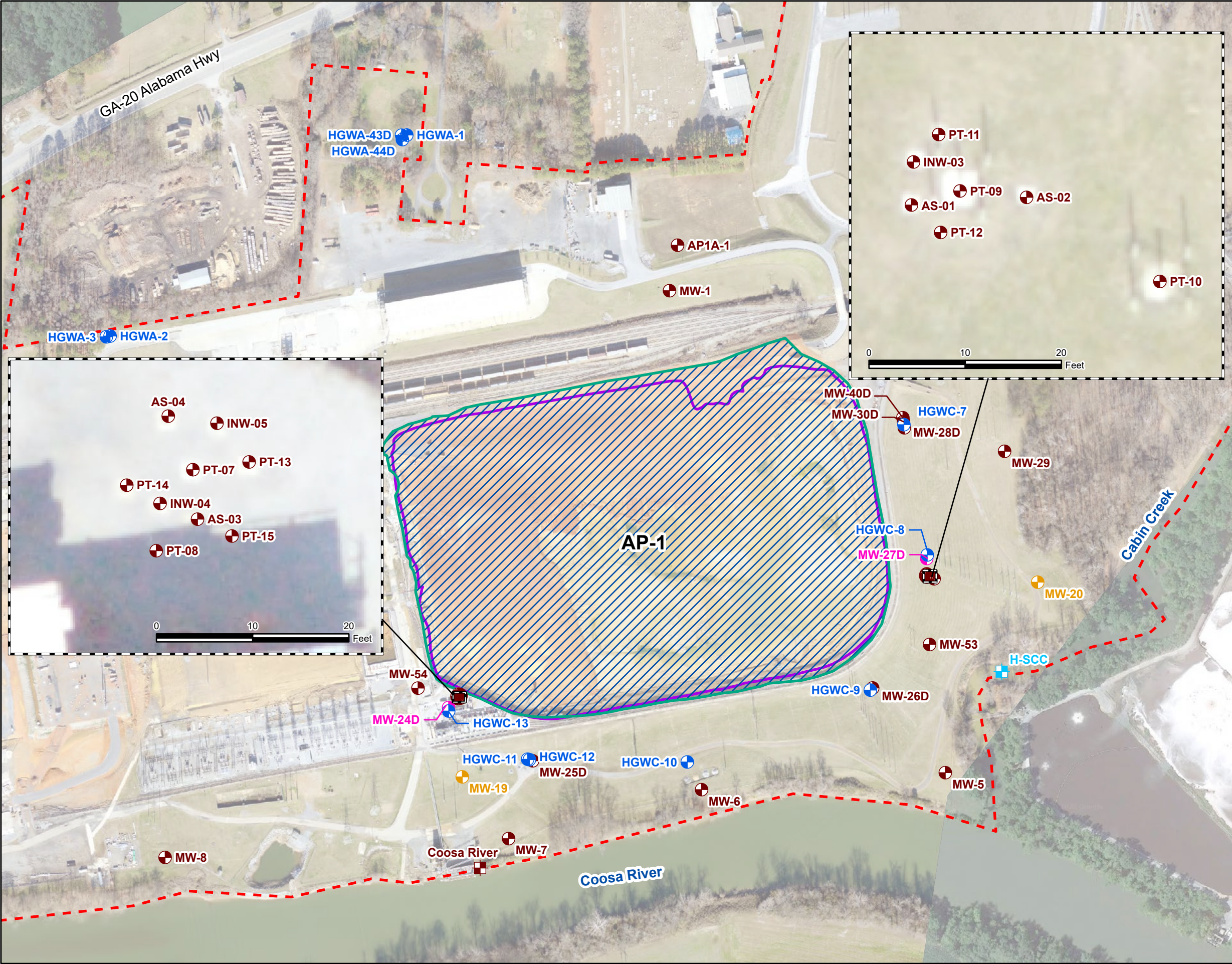
GEORGIA POWER COMPANY
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

Prepared For:  **Georgia Power**

Prepared By: 

KENNESAW, GA JUNE 2026

FIGURE
1



- LEGEND**
- Detection Monitoring Well
 - Horizontal Assessment Monitoring Well
 - Vertical Assessment Monitoring Well
 - Piezometer
 - Surface Water Level Gauge Point
 - Surface Water Sample Point
 - Approximate AP-1 Boundary
 - Area where ash removal was certified complete by GA EPD (November 26, 2025)
 - Plant Hammond Property Boundary

Notes:

- Piezometers AS-01, AS-02, AS-03, AS-04, INW-03, INW-04, INW-05, PT-07, PT-08, PT-09, PT-10, PT-11, PT-12, PT-13, PT-14, PT-15, MW-53 and MW-54 were installed in support of an Assessment of Corrective Measures pre-design investigation and are not included in the monitoring well network.
- Vertical Assessment Monitoring Wells MW-25D, MW-26D, and MW-28D, and Horizontal Assessment Monitoring Wells MW-5, MW-6, MW-7, and MW-29, were reclassified as Piezometers after the 2025 semiannual groundwater monitoring event.
- Aerial photograph source: Google Earth Pro, August 2019 and Georgia Power Company, January 2026.



**MONITORING WELL NETWORK
AND SAMPLING LOCATION MAP**

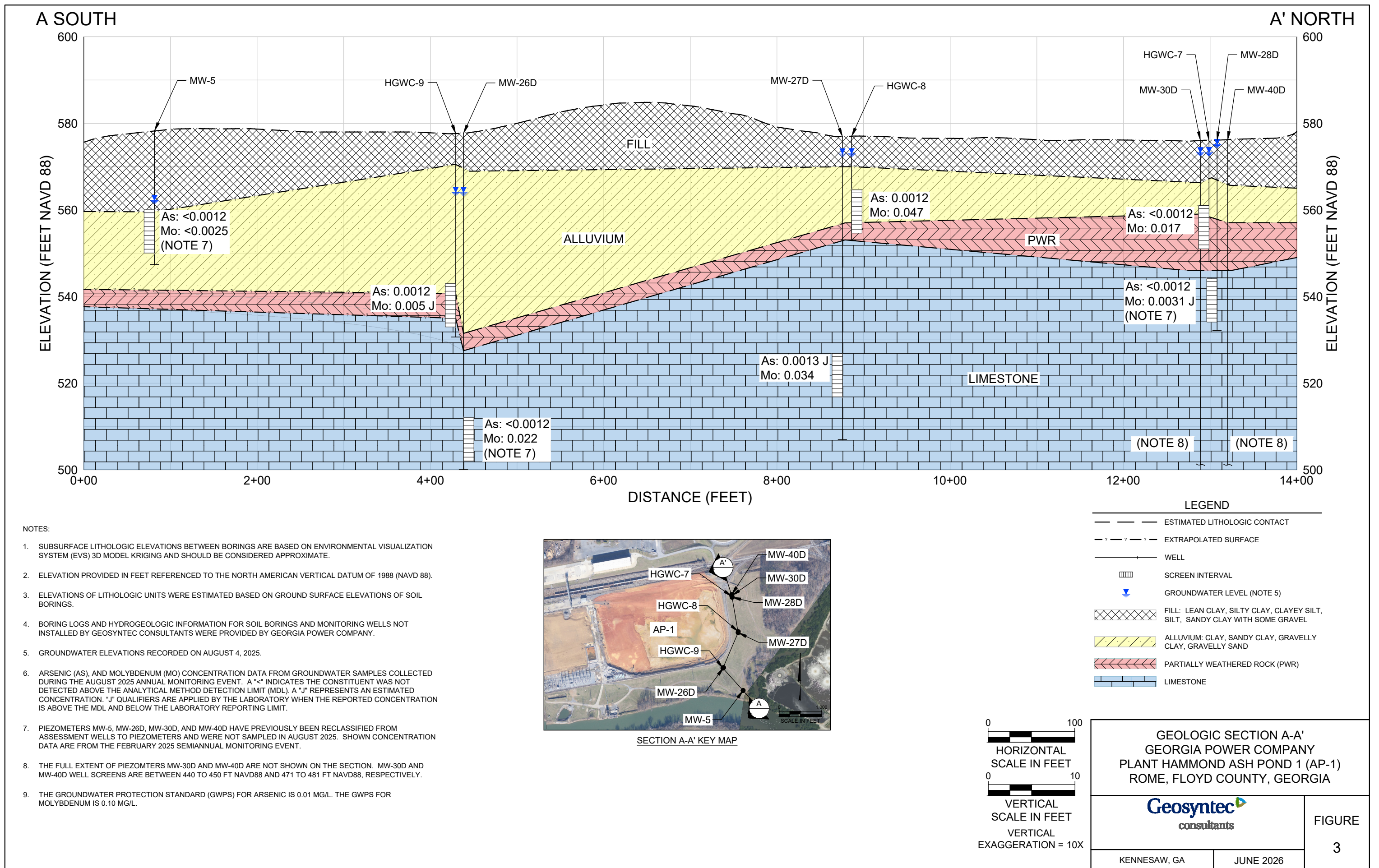
GEORGIA POWER COMPANY
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

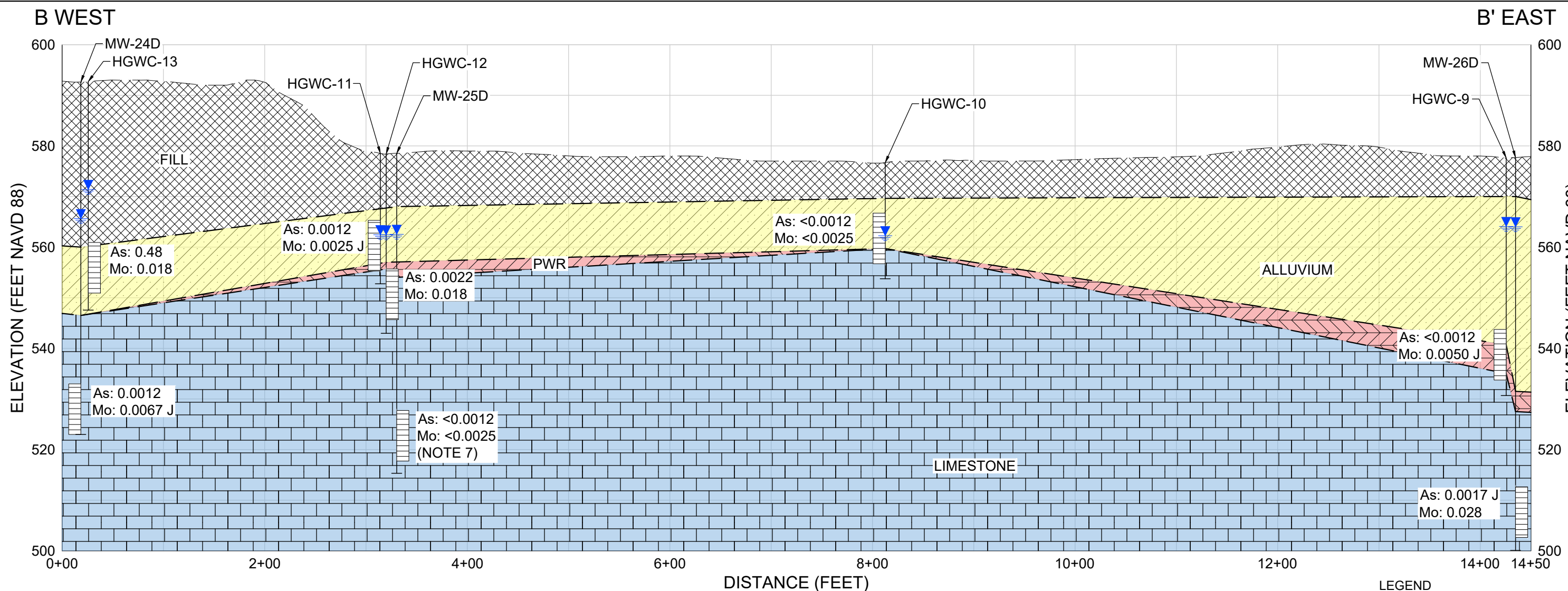
Prepared For: Georgia Power

Prepared By: Geosyntec
consultants

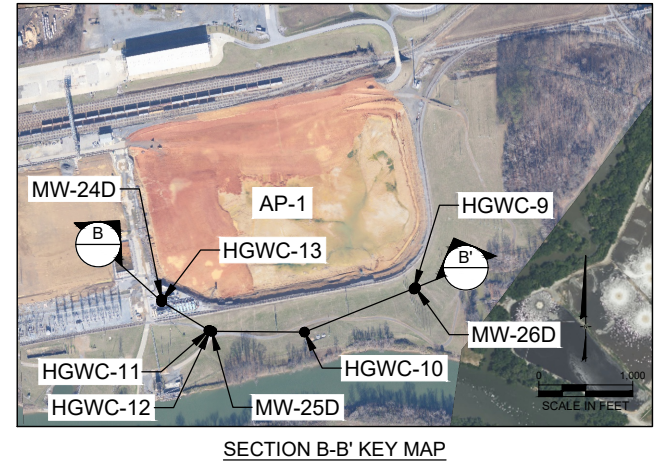
KENNESAW, GA JUNE 2026

**FIGURE
2**

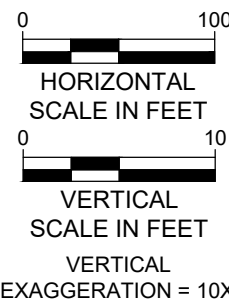




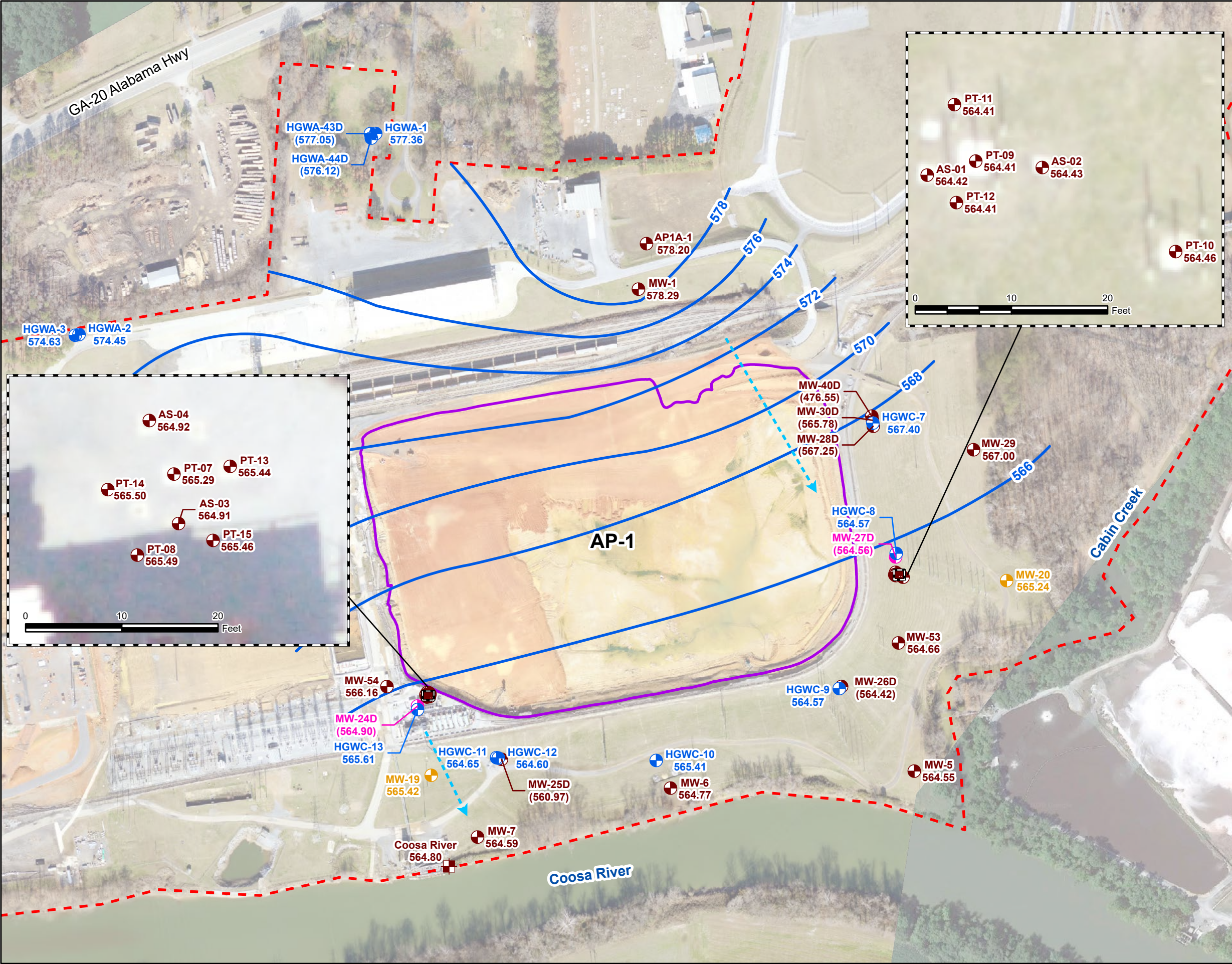
- NOTES:
- SUBSURFACE LITHOLOGIC ELEVATIONS BETWEEN BORINGS ARE BASED ON ENVIRONMENTAL VISUALIZATION SYSTEM (EVS) 3D MODEL KRIGING AND SHOULD BE CONSIDERED APPROXIMATE.
 - ELEVATION PROVIDED IN FEET REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
 - ELEVATIONS OF LITHOLOGIC UNITS WERE ESTIMATED BASED ON GROUND SURFACE ELEVATIONS OF SOIL BORINGS.
 - BORING LOGS AND HYDROGEOLOGIC INFORMATION FOR SOIL BORINGS AND MONITORING WELLS NOT INSTALLED BY GEOSYNTEC CONSULTANTS WERE PROVIDED BY GEORGIA POWER COMPANY.
 - GROUNDWATER ELEVATIONS RECORDED ON AUGUST 4, 2025.
 - ARSENIC (AS), AND MOLYBDENUM (MO) CONCENTRATION DATA FROM GROUNDWATER SAMPLES COLLECTED DURING THE AUGUST 2025 ANNUAL MONITORING EVENT. A "<" INDICATES THE CONSTITUENT WAS NOT DETECTED ABOVE THE ANALYTICAL METHOD DETECTION LIMIT (MDL). A "J" REPRESENTS AN ESTIMATED CONCENTRATION. "J" QUALIFIERS ARE APPLIED BY THE LABORATORY WHEN THE REPORTED CONCENTRATION IS ABOVE THE MDL AND BELOW THE LABORATORY REPORTING LIMIT.
 - PIEZOMETERS MW-25D WAS PREVIOUSLY RECLASSIFIED FROM ASSESSMENT WELLS TO A PIEZOMETER AND WAS NOT SAMPLED IN AUGUST 2025. SHOWN CONCENTRATION DATA ARE FROM THE FEBRUARY 2025 SEMI-ANNUAL MONITORING EVENT.
 8. THE GROUNDWATER PROTECTION STANDARD (GWPS) FOR ARSENIC IS 0.01 MG/L. THE GWPS FOR MOLYBDENUM IS 0.10 MG/L.



- LEGEND
- ESTIMATED LITHOLOGIC CONTACT
 - EXTRAPOLATED SURFACE
 - WELL
 - SCREEN INTERVAL
 - GROUNDWATER LEVEL (NOTE 5)
 - FILL: LEAN CLAY, SILTY CLAY, CLAYEY SILT, SILT, SANDY CLAY WITH SOME GRAVEL
 - ALLUVIUM: CLAY, SANDY CLAY, GRAVELLY CLAY, GRAVELLY SAND
 - PARTIALLY WEATHERED ROCK (PWR)
 - LIMESTONE



GEOLOGIC SECTION B-B' GEORGIA POWER COMPANY PLANT HAMMOND ASH POND 1 (AP-1) ROME, FLOYD COUNTY, GEORGIA	
Geosyntec consultants	
KENNESAW, GA	JUNE 2026
FIGURE 4	



- LEGEND**
- Detection Monitoring Well
 - Horizontal Assessment Monitoring Well
 - Vertical Assessment Monitoring Well
 - Piezometer
 - Surface Water Level Gauge Point
 - Groundwater Elevation Contour
 - Approximate Groundwater Flow Direction
 - Approximate AP-1 Boundary
 - Plant Hammond Property Boundary

Notes:

1. Water level elevation recorded on August 4, 2025. Elevation provided in feet (ft) referenced to the North American Vertical Datum of 1988 (NAVD 88).
2. Groundwater elevations in parentheses were not used to make the groundwater contours because these wells are screened at a different elevation in the formation/aquifer.
3. Vertical Assessment Monitoring Wells MW-25D, MW-26D, and MW-28D, and Horizontal Assessment Monitoring Wells MW-5, MW-6, MW-7, and MW-29, were reclassified as Piezometers after the 2025 semiannual groundwater monitoring event.
4. Aerial photograph source: Google Earth Pro, August 2019 and Georgia Power Company, January 2026.

0 150 300 600
SCALE IN FEET

**POTENTIOMETRIC SURFACE
CONTOUR MAP - AUGUST 2025**

GEORGIA POWER COMPANY
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

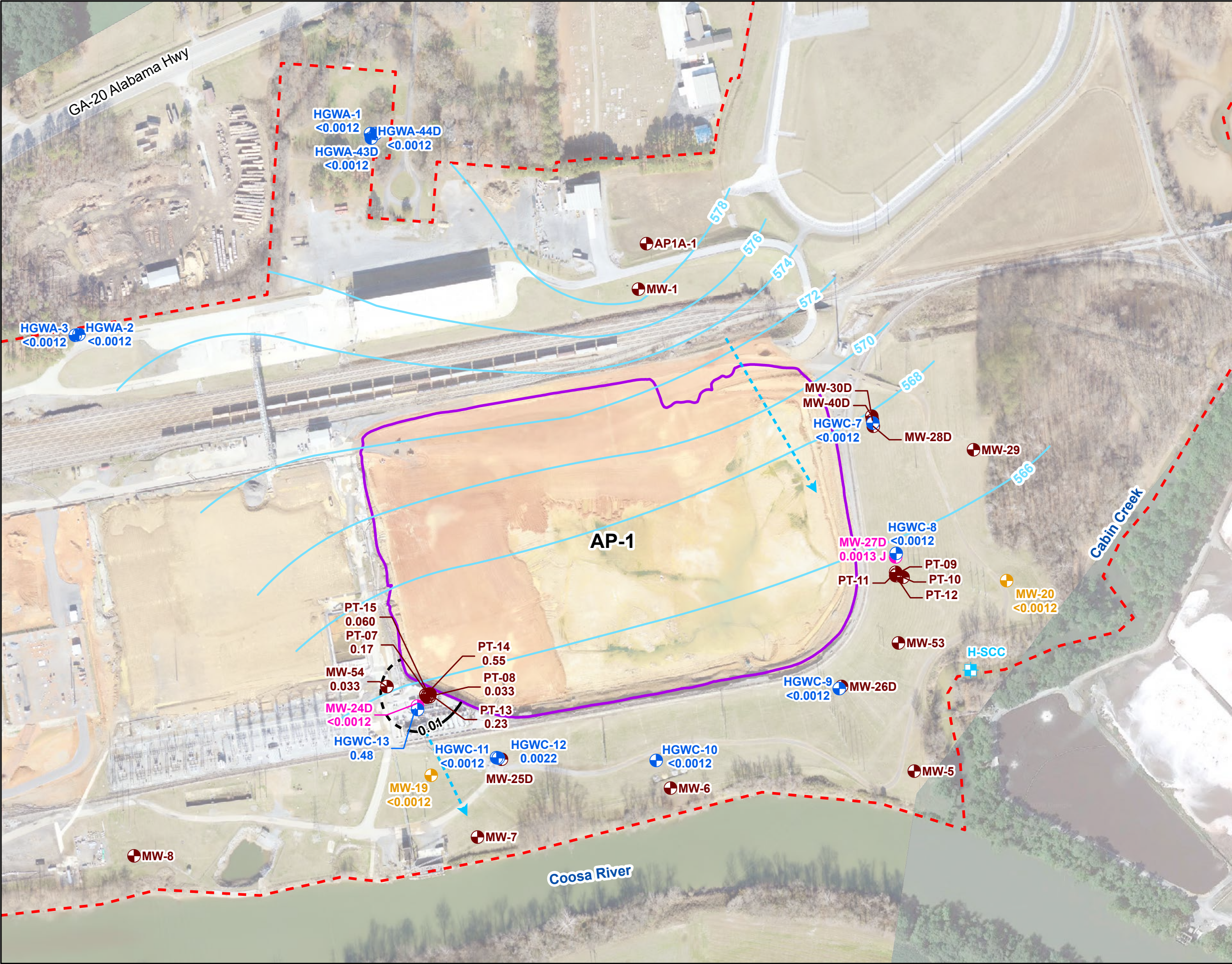
Prepared For: Georgia Power

Prepared By: Geosyntec
consultants

KENNESAW, GA

JUNE 2026

**FIGURE
5**



- LEGEND**
- Detection Monitoring Well
 - Horizontal Assessment Monitoring Well
 - Vertical Assessment Monitoring Well
 - Piezometer
 - Surface Water Sample Point
 - GWPS Arsenic Iso-Concentration Contour (mg/L) (dashed where inferred)
 - Groundwater Elevation Contour
 - Approximate Groundwater Flow Direction
 - Approximate AP-1 Boundary
 - Plant Hammond Property Boundary

Notes:

1. Concentration data from groundwater samples collected during the August 2025 annual monitoring event. Data reported for wells screened deeper in the aquifer were not used to generate the iso-concentration contour (HGWA-43D, HGWA-44D, MW-24D, MW-25D, MW-26D, MW-27D, MW-28D). Concentrations are reported in mg/L.
2. Water level elevation recorded on August 4, 2025. Elevation provided in feet (ft) referenced to the North American Vertical Datum (NAVD) 88.
3. The Groundwater Protection Standard (GWPS) for arsenic is 0.01 mg/L.
4. Piezometers may be sampled as needed for constituent specific site characterization.
5. J - The result is an estimated concentration. "J" qualifiers are applied by the laboratory when the concentration reported is above the method detection limit, but below the laboratory reporting limit.
6. Vertical Assessment Monitoring Wells MW-25D, MW-26D, and MW-28D, and Horizontal Assessment Monitoring Wells MW-5, MW-6, MW-7, and MW-29, were reclassified as Piezometers after the 2025 semiannual groundwater monitoring event.
7. Aerial photograph source: Google Earth Pro, August 2019 and Georgia Power Company, January 2026.



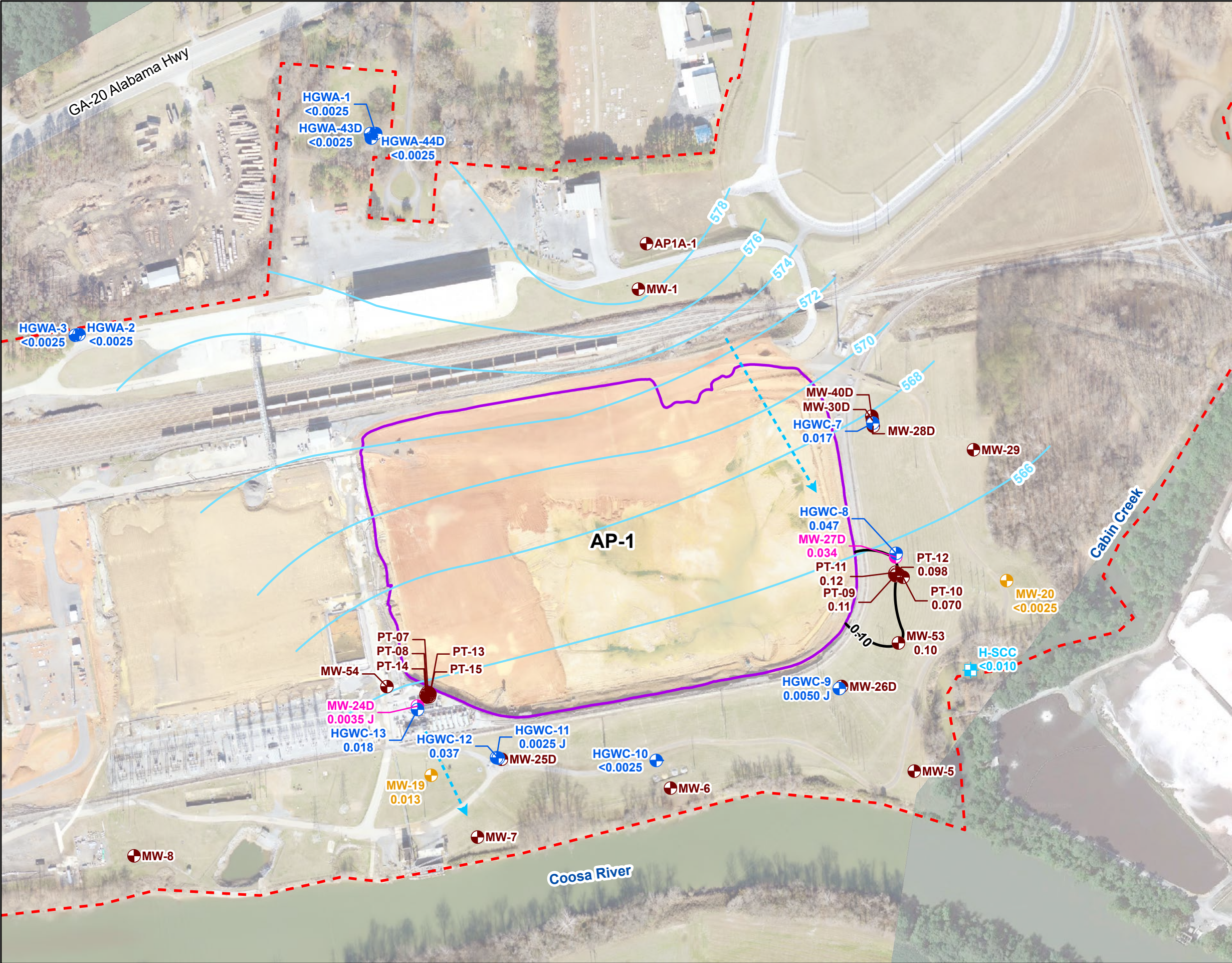
**ISO-CONCENTRATION MAP
ARSENIC - AUGUST 2025**

GEORGIA POWER COMPANY
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

Prepared For: Georgia Power

Prepared By: Geosyntec
consultants

KENNESAW, GA JUNE 2026



- LEGEND**
- Detection Monitoring Well
 - Horizontal Assessment Monitoring Well
 - Vertical Assessment Monitoring Well
 - Piezometer
 - Surface Water Sample Point
 - GWPS Molybdenum Iso-Concentration Contour (mg/L)
 - Groundwater Elevation Contour
 - Approximate Groundwater Flow Direction
 - Approximate AP-1 Boundary
 - Plant Hammond Property Boundary

- Notes:**
- Concentration data from groundwater samples collected during the August 2025 annual monitoring event. Data reported for wells screened deeper in the aquifer were not used to generate the iso-concentration contour (HGWA-43D, HGWA-44D, MW-25D, MW-26D, MW-27D, MW-28D). Concentrations are reported in mg/L.
 - Water level elevation recorded on August 4, 2025. Elevation provided in feet (ft) referenced to the North American Vertical Datum (NAVD) 88.
 - The Groundwater Protection Standard (GWPS) for arsenic is 0.01 mg/L.
 - Piezometers may be sampled as needed for constituent specific site characterization.
 - J - The result is an estimated concentration. "J" qualifiers are applied by the laboratory when the concentration reported is above the method detection limit, but below the laboratory reporting limit.
 - Vertical Assessment Monitoring Wells MW-25D, MW-26D, and MW-28D, and Horizontal Assessment Monitoring Wells MW-5, MW-6, MW-7, and MW-29, were reclassified as Piezometers after the 2025 semiannual groundwater monitoring event.
 - Aerial photograph source: Google Earth Pro, August 2019 and Georgia Power Company, January 2026.



**ISO-CONCENTRATION MAP
MOLYBDENUM - AUGUST 2025**

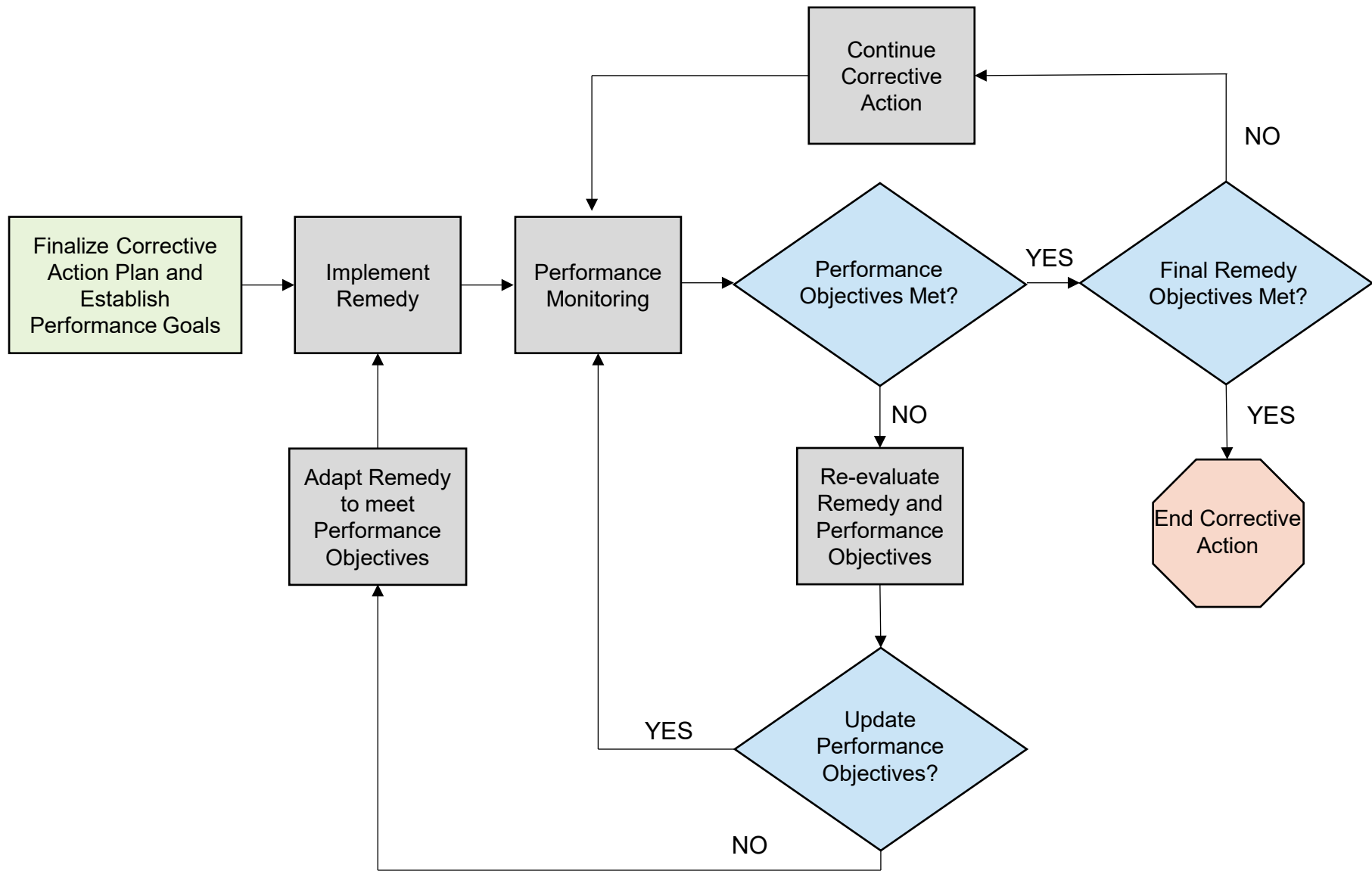
GEORGIA POWER COMPANY
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

Prepared For: Georgia Power

Prepared By: Geosyntec
consultants

KENNESAW, GA JUNE 2026

**FIGURE
7**



Notes:

REMEDY ADAPTIVE SITE MANAGEMENT

GEORGIA POWER COMPANY
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

Prepared For:



Prepared By:

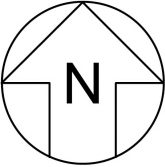
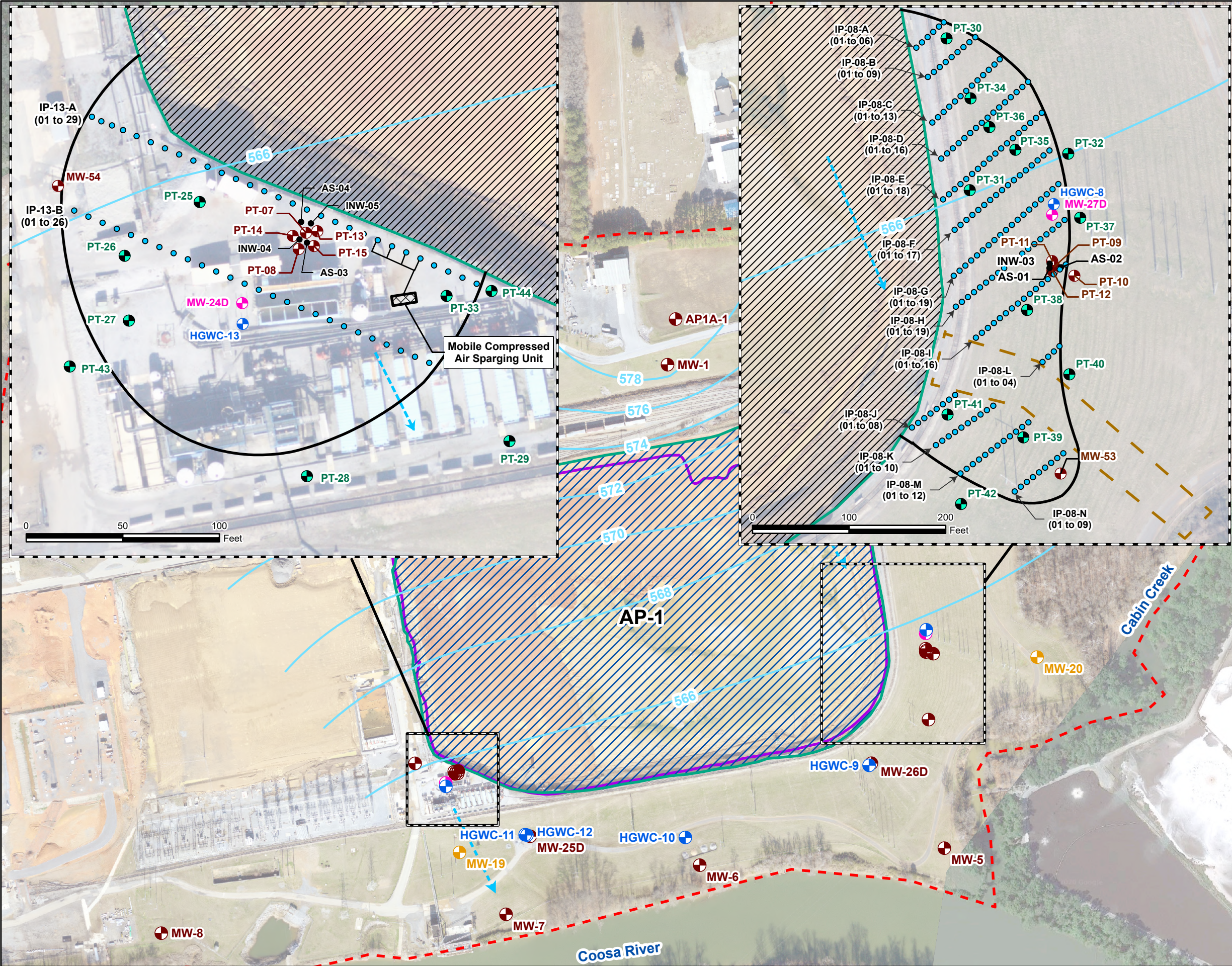


KENNESAW, GA

JUNE 2026

FIGURE

8



- LEGEND**
- Proposed Injection Location
 - Existing Injection Location
 - Proposed Corrective Action Performance Monitoring Well
 - Existing Well**
 - Detection Monitoring Well
 - Horizontal Assessment Monitoring Well
 - Vertical Assessment Monitoring Well
 - Piezometer
 - Groundwater Elevation Contour
 - Approximate Groundwater Flow Direction
 - Proposed Treatment Area Boundary
 - Proposed Outfall Location
 - Approximate AP-1 Boundary
 - Area where ash removal was certified complete by GA EPD (November 26, 2025)
 - Plant Hammond Property Boundary

IP-08-A (01 to 06) Proposed Injection Location Transect Name

- Notes:
- Existing wells and piezometers are from the December 2024 Groundwater Monitoring Plan (GWMP). See the most recent GWMP for the current monitoring network.
 - Proposed treatment area boundary corresponds to the area of impacted groundwater above the arsenic and molybdenum groundwater protection standard delineated by August 2025 data presented in the 2025 Annual Groundwater Monitoring Report and historical monitoring data.
 - Proposed corrective action performance monitoring wells and injection locations are approximate and may be adjusted based on access constraints.
 - Existing wells and piezometers may be utilized for corrective action performance monitoring.
 - Water level elevation recorded on August 4, 2025. Elevation provided in feet (ft) referenced to the North American Vertical Datum (NAVD) 88.
 - Aerial photograph source: Google Earth Pro, August 2019 and Georgia Power Company, January 2026.



SCALE IN FEET

REMEDY CONCEPTUAL DESIGN

GEORGIA POWER COMPANY
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

Prepared For: Georgia Power

Prepared By: Geosyntec consultants

KENNESAW, GA JUNE 2026

FIGURE
9

APPENDIX B

Reactive Transport Model Report



Prepared for

Georgia Power Company
241 Ralph McGill Blvd NE
Atlanta, Georgia 30308

REACTIVE TRANSPORT MODEL REPORT

PLANT HAMMOND ASH POND 1 (AP-1)

Prepared by

Geosyntec 
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engineers | scientists | innovators

1255 Roberts Boulevard, Suite 200
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Project Number GW7300

August 2022

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LIST OF ACRONYMS AND ABBREVIATIONS

AP-1	Ash Pond 1
AP-2	Ash Pond 2
As	Arsenic
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
Co	Cobalt
CSM	Conceptual Site Model
DPT	Direct Push Technology
EDXA	Energy Dispersive X-Ray Analysis
GAEPD	Georgia Environmental Protection Division
GCSM	Geochemical Conceptual Site Model
GHB	General Head Boundary
GWPS	Ground Water Protection Standard
HAR	Hydrogeologic Assessment Report
MNA	Monitored Natural Attenuation
Mo	Molybdenum
mV	Millivolts
ORP	Oxidation-Reduction Potential
PZC	Point of Zero Charge
SEM	Scanning Electron Microscopy
SEP	Sequential Extraction Procedure
SSL	Statistically Significant Levels
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
USEPA	United States Environmental Protection Agency
XRD	X-Ray Diffraction
WRA	Whole Rock Analysis

1.0 INTRODUCTION

1.1 Purpose

This reactive transport model report (Report) has been prepared for Georgia Power Company (Georgia Power) Plant Hammond Ash Pond 1 (AP-1 or Site) and is included as Appendix B of the *Draft Remedy Selection Report – Plant Hammond Ash Pond 1 (AP-1)* (Remedy Selection Report) (Geosyntec, 2022b). The purpose of this model report is to document the reactive transport models developed to evaluate potential remediation approaches to address statistically significant levels (SSLs) of arsenic (As) and molybdenum (Mo) above groundwater protection standards (GWPS) at certain locations at or beyond the AP-1 compliance boundary.

1.2 Site Background and Overview of AP-1 Pond Closure

Plant Hammond is located in Floyd County, Georgia, approximately 10 miles west of Rome and is bordered by Georgia Highway 20 (GA-20) on the north, the Coosa River on the south, Cabin Creek and industrial land on the east, and sparsely populated, forested, rural and industrial land on the west. A Site location map is included in the Remedy Selection Report (**Figure 1**, Geosyntec, 2022b).

AP-1 is a 35-acre surface impoundment that will be closed by removal and disposal of CCR to an offsite lined-landfill in accordance with Closure permit No. 057-023D(CCR), which was approved by GA EPD on June 22, 2020.

1.3 Site Geology and Hydrogeologic Setting

The following section summarizes the geologic and hydrogeologic conditions at the Site as described in the AP-1 *Hydrogeologic Assessment Report Revision 01 – Ash Pond 1 (AP-1)* (HAR Rev 01) submitted to GA EPD as supporting documents for the closure permit application (Geosyntec, 2019b).

1.3.1 Site Geology

AP-1 is located within the Great Valley District of the Valley and Ridge Physiographic Province (Valley and Ridge) of northwest Georgia which is characterized by Paleozoic sedimentary rocks that have been folded and faulted into the ridges and valleys that gave this region its name. In the vicinity of AP-1, the following anthropogenic and geologic units are encountered: (i) CCR, (ii) Fill/Dike materials, (iii) terrace alluvium, (iv) residuum (which can be discontinuous), (v) highly weathered/partially weathered

fractured shaley limestone bedrock (PWR), and (vi) competent shaley limestone bedrock of the Cambrian Conasauga Formation. Additional lithology descriptions of these units can be found in the HAR Rev 01 (Geosyntec, 2019b).

1.3.2 Hydrogeology and Groundwater Flow

The uppermost aquifer at AP-1 is a regional groundwater aquifer that occurs primarily in the alluvial and residuum soils, and within the weathered and fractured bedrock. The movement of groundwater in the soil can be characterized as low-to moderate permeability, porous media flow. The groundwater flow in the shallow underlying bedrock is characterized as predominantly fracture flow. The regional groundwater flow direction is expected to be from north to south. However, under current conditions, the local groundwater flow direction beneath the western portion of AP-1 is predominantly north to south toward the Coosa River, and west to east toward Cabin Creek in the eastern portion of AP-1. Groundwater elevation data and potentiometric surface contours that depict groundwater flow direction are provided in the Remedy Selection Report (**Figure 5**, Geosyntec, 2022b) and in **Figure 1** & **Figure 2** of this report. Monitoring well construction details are provided in the Remedy Selection Report (**Table 1**, Geosyntec, 2022b).

1.4 Groundwater Exceedances

At AP-1, Georgia Power has performed CCR groundwater monitoring-related activities since May 2016¹. As discussed in the Remedy Selection Report (Geosyntec, 2022b), the concentration of As and Mo in groundwater exceed the GWPS at HGWC-13 and HGWC-8, respectively.

Groundwater monitoring data confirm that As and Mo have been vertically and horizontally delineated. Data also shows that the As and Mo plumes remain within the property boundary and are not migrating beyond the delineated downgradient plume edge due to natural attenuation processes in the aquifer (**Figure 1** and **Figure 2**).

¹ Monitoring activities have been performed in accordance with the United States Environmental Protection Agency's (USEPA's) Coal Combustion Residuals (CCR) Rule, 40 Code of Federal Regulations (CFR) Parts 257 effective October 19, 2015 (CCR Rule) including subsequent revisions and Georgia Environmental Protection Division's (GAEPD's) Rule for Solid Waste Management Rule 391-3-4-10 for CCR.

1.5 Model Scope & Objectives

Geosyntec has developed a reactive transport model for As and Mo to support the remedy selection process for AP-1. The Georgia Environmental Protection Division (GAEPD) Groundwater Contaminant Fate and Transport Modeling Guidance (GAEPD, 2016) was used as a guide for development of both models, where appropriate.

The primary objectives of the modeling effort are to:

Develop a predictive reactive transport model for As and Mo in the vicinity of HGWC-13 and HGWC-8 (respectively) under post-closure conditions.

Assess the feasibility of monitored natural attenuation (MNA) processes to achieve the As and Mo GWPS at or beyond the compliance boundary under model predicted post-closure conditions.

Evaluate the feasibility of geochemical injections to achieve the As and Mo GWPS at the compliance boundary under anticipated post-closure conditions.

The geochemical conceptual site model, groundwater flow models, and transport models used to meet the above objectives are summarized below.

2.0 GEOCHEMICAL CONCEPTUAL SITE MODEL

The following section summarizes the geochemical conceptual site model for AP-1, as described in the AP-1 *Geochemical Conceptual Site Model Report – Plant Hammond Ash Pond 1 (AP-1)* (GCSM Report) (Geosyntec 2022a) included as **Appendix A** of the Remedy Selection Report (Geosyntec 2022b).

2.1 Arsenic Geochemistry and Fate and Transport Properties

Dissolved As in groundwater systems is typically stable as As(III) (arsenite, often as HAsO_2) or As(V) (arsenate, often as the oxyanion H_2AsO_4^-). In general, As(V) is less mobile and more readily attenuated compared to As(III) under acidic to circumneutral pH; however, this generalization is dependent on pH, dissolved oxygen, and the presence of other ionic species (Campbell and Nordstrom, 2014).

Equilibrium speciation indicates that under the conditions present in groundwater upgradient and downgradient of Hammond AP-1, As exists as As(V) in the forms of H_2AsO_4^- and HAsO_4^{2-} (Geosyntec, 2022a).

The mobility of these phases in groundwater is strongly controlled by sorption processes, in which As either forms bonds (adsorption) or breaks bonds (desorption) with chemical species on mineral surfaces present in the aquifer. Sorption reactions are strongly dependent on the composition of the aquifer matrix (i.e., the type of minerals and/or organic material), pH, and the presence of competitively adsorbing ions. The As(V) form of As is much 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 and Kinniburgh, 2002).

2.2 Molybdenum Geochemistry and Fate and Transport Properties

Like As, Mo in groundwater under oxidizing conditions is present as the molybdate oxyanion (MoO_4^{2-}) (Smedley and Kinniburgh, 2017). While Mo can also form Mo(V) and Mo(IV) species, Mo(VI)O_4^{2-} is predicted to be the predominant species at the Site, including at HGCW-8, based on groundwater conditions (Geosyntec, 2022a). Mo tends to be more mobile under alkaline conditions with increasing sorption under neutral to acidic conditions (due to the formation of positively charged surface sites in lower pH conditions). Molybdenum strongly binds to organic matter and readily sorbs to oxyhydroxide minerals (Goldberg et. al., 1996; ATSDR, 2020).

2.3 Summary of Geochemical CSM (GCSM)

Under current conditions, As and Mo are attenuated by aquifer materials, and groundwater exceedances are contained on-site. Illustrations depicting the GCSM for As and Mo are provided on **Figure 3** and **Figure 4**, respectively. Key details to support the GCSM include:

The characterization of aquifer solids around AP-1 indicates the presence of mineral phases that provide substantial attenuation capacity (i.e., iron oxyhydroxides and clay minerals).

The Sequential Extraction Procedure (SEP) conducted for select aquifer solids samples representative of conditions at AP-1 suggests that site-specific constituents are associated with amorphous and crystalline metal oxides and oxyhydroxides. This observation indicates strong sorption and/or incorporation of site-specific constituents into immobile mineral phases.

Sorption and desorption studies confirm that site-specific constituents are sorbed, with some limited desorption occurring under the experimental conditions of these batch studies. Measured partition coefficients for Mo (i.e., 175 L/kg) were within the range of values reported in the literature and indicative of significant aquifer attenuation capacity for these constituents. Moreover, all six concentration levels of As up to 1.7 mg/L were completely removed from the aqueous phase during the batch sorption study. The partition coefficient could not be determined since the sorption capacity of arsenic was higher than the range of test conditions. This suggests that As is strongly sorbed to the aquifer matrix and that there is large sorption capacity even when subjected to higher As concentrations than those observed at the Site (e.g., highest observed concentrations of 0.99 mg/L at PMW-02 in September 2019).

The laboratory studies presented to date are consistent with groundwater monitoring results that indicate attenuation of site-specific constituents is occurring downgradient of AP-1.

3.0 GROUNDWATER FLOW MODEL

Groundwater flow and reactive transport models were developed to evaluate the feasibility of MNA and geochemical injections as potential corrective measures for As and Mo exceedances of GWPS. The following sections summarize the flow models setup, layering, boundaries, and parameterization.

3.1 Groundwater Flow Models

Two focused groundwater flow models were created to simulate post-closure groundwater flow. The first focused model simulates post-closure groundwater flow on the western side of AP-1, in the vicinity of HGWC-13. The second focused model simulates post-closure groundwater flow on the eastern side of AP-1, in the vicinity of HGWC-8. Both focused models are based on and informed by an updated version of the site wide groundwater flow model that was originally developed by Geosyntec (Geosyntec, 2019a). For the purposes of the feasibility level remedy selection, layer elevations, flow parameters, and flow boundaries were adjusted from the site wide model to better reflect local flow conditions. In both focused flow models, flow was simulated under steady state conditions. Both flow models utilize MODFLOW (Harbaugh, 2005) and were created using the software Processing MODFLOW version 8.0.47 (Simcore, 2012). A summary of flow model setup and output is provided below.

3.1.1 Flow Model Grid Extent & Layering

Model grid extents and layering for the HGWC-13 focused model and HGWC-8 focused model are shown on **Figures 5a** and **6a**, respectively. Model extents were designed to focus primarily on the portion of AP-1 where groundwater concentrations of As (at HGWC-13) and Mo (at HGWC-8) are detected above the GWPS. Both models use a uniform model grid cell size of 10x10 feet. For both focused models, model layering is consistent with the CSM described in the HAR (Geosyntec, 2019b) and based on a 3D site wide geologic model developed for Plant Hammond. However, model layer elevations were updated from the original site wide geologic model based on new data and an updated interpretation of site geology. Post-closure design grades were not incorporated into model layering since the purpose of the model is to evaluate groundwater contaminant transport in the underlying alluvium. An example cross section of layering for both focused models is provided on **Figures 5a** and **6a**, respectively.

3.1.2 Flow Model Boundaries

Model flow boundaries and input parameters for the HGWC-13 focused model and HGWC-8 focused model are shown on **Figures 5b** and **6b**, respectively. Model

boundaries representing Cabin Creek and Coosa River were derived from the updated version of the calibrated site wide model. The general head boundaries were informed by post-closure groundwater elevation contours simulated by the updated version of the site wide model.

In both models, recharge was assumed to be low under post-closure conditions and assigned an assumed value of 0.06 inches/year. Inside the footprint of AP-1, the assumption of low recharge is based on the AP-1 post-closure design which indicates that the interior of AP-1 will be replaced with fill (for the purposes of this modeling effort, conservatively assumed to be silt to silty sand) and graded to divert surface water runoff. The basis for low recharge outside the AP-1 footprint is based on boring log data which indicates that the upper portion of the subsurface in the area of AP-1 is composed of low permeability silts and clays.

Simulated groundwater elevation contours representing predicted post-closure flow conditions are shown on **Figures 5b** and **6b**.

3.1.3 Flow Model Parameters

Model parameters are shown in **Table 1a** and **Table 1b**. Inside AP-1, in layer 1, an assumed horizontal conductivity (K_h) and vertical conductivity (K_v) value of 0.29 ft/d and 0.029 ft/d, respectively, were assigned to both models, to represent the clean fill material that will be placed inside the AP-1 footprint as part of the closure. These values for the clean fill are assumed and based on silt to silty sand conductivities from Domenico and Schwartz (1990), as specific design level conductivity values were not available at the time of model development. For the dike, assumed low K_h and K_v values of 0.025 and 0.0025 ft/d were assigned based on silt and clay conductivities from Domenico and Schwartz (1990). For the other subsurface materials in the model domain, hydraulic conductivity is approximately based on calibrated values from the updated version of the sitewide model or slug test data. For the purposes of the feasibility level remedy selection and transport modeling effort, hydraulic conductivity zones in the focused model that represent the aquifer were simplified so that conductivity was homogenous per layer. Effective porosity and bulk density values were assigned to the models based on literature values (USEPA, 1998; Kresic, 2006). Longitudinal dispersivity was selected based on a mixture of best professional judgement and the USEPA On-line Tools for Site Assessment Calculation (USEPA, 2021). Transverse and vertical dispersivity were based on guidance from USEPA (1998) and standard modeling practice where transverse and vertical dispersivity are 10 and 100 times smaller than longitudinal dispersivity.

4.0 REACTIVE TRANSPORT MODEL: ARSENIC

A reactive transport model was developed for the area around monitoring well HGWC-13, where groundwater As concentrations currently exceed the GWPS. The objective of the reactive transport model is to evaluate the feasibility of MNA and geochemical injections to achieve the GWPS, under predicted post-closure conditions. The relative remedial time frame to reach the GWPS can be used to compare remedial alternatives including MNA and geochemical injections. For the purposes of this model, it was assumed that under post-closure conditions, the source of As within the footprint of AP-1 will be removed due to closure by removal activities, and the remaining As will be limited to dissolved As and As that had previously adsorbed to the aquifer matrix materials, in the immediate vicinity of HGWC-13.

The following sections describe the As reactive transport model objectives, setup, scenarios, results, and sensitivity analysis.

4.1 Model Setup

The reactive transport model utilizes the three-dimensional (3D) reactive multicomponent transport code PHT3D (Prommer and Post, 2010). PHT3D incorporates the programs MT3DMS (Zheng and Wang, 1999) for 3D advective-dispersive multi-species transport modeling and PHREEQC (Parkhurst and Appelo, 2000) for geochemical reaction modeling. PHT3D uses MODFLOW (Harbaugh, 2005) to provide the groundwater flow field for transport simulations.

Transport model construction and parameterization was performed in the Processing MODFLOW pre- and post-processing software package (Simcore, 2012). Equilibrium constants from the MINTEQ.V4 thermodynamic database (USEPA, 1999) were used for the As model.

4.1.1 Geochemical Properties

This section describes the key geochemical reactions and properties included in the reactive transport model: aqueous complexation, mineral precipitation/dissolution, adsorption/desorption to mineral surfaces, and reduction-oxidation (redox) reactions.

Aqueous Complexation

At each time step, PHT3D uses PHREEQC to calculate equilibrium aqueous speciation. The MINTEQ.V4 database of equilibrium constants was used for aqueous speciation calculations.

Mineral Precipitation/Dissolution

At each time step, minerals specified within the model setup are allowed to precipitate or dissolve to achieve equilibrium with groundwater. To identify the relevant minerals, PHREEQC was used to calculate mineral saturation indices (SI) using the results of the September 2020 semiannual groundwater sampling event for monitoring wells HGWC-13, HGWC-1, MW-24D, and MW-19. Data from the September 2020 semiannual groundwater sampling event was used because the dataset is more comprehensive than datasets from more recent sampling events; results from the September 2020 sampling event are consistent with results from sampling events performed in 2022.

Barite was determined to be supersaturated ($SI > 0$), and gypsum, calcite, and aragonite were determined to be close to equilibrium (SI between -1.0 and 0). Therefore, the following minerals were set to precipitate/dissolve to achieve equilibrium with groundwater in PHT3D (i.e., $SI = 0$): gypsum, barite, calcite, aragonite, and ferrihydrite. Ferrihydrite was included based on solid-phase soil analyses that indicated iron oxides are abundant at the site (3.21% by whole rock analysis, Geosyntec, 2022a). While a mixture of different iron oxides and oxyhydroxides are commonly found in aquifers due to variations in crystallinity, crystal size, solid solution, and crystallization kinetics, ferrihydrite was the only iron oxide included in the model for simplicity.

Adsorption/Desorption

Adsorption and desorption of dissolved species to and from ferrihydrite surfaces was modeled using the non-electrostatic hydrous ferric oxide (HFO) surface complexation model developed by Dzombak and Morel (1990) and included in the MINTEQA4 database. Other mineral surfaces were not included in the model because their contribution to As adsorption is assumed to be significantly less than that of iron oxides based on the abundance of iron-bearing minerals in site soil and the strong affinity of As to adsorption on iron oxides. This approach is conservative for evaluating attenuation. The surface complexation model describes adsorption to HFO using two surface sites (strong and weak). The concentration of surface sites was dynamically linked to the concentration of ferrihydrite using a strong site density of 0.005 moles per mole (mol/mol) iron and a weak site density 0.2 mol/mol iron (Dzombak and Morel, 1990).

Redox Reactions

Groundwater monitoring data collected at AP-1 indicates that the average field oxidation-reduction potential (ORP) for compliance monitoring and horizontal delineation

monitoring wells is 41.4 millivolts (mV) (ranging from -130.7 mV to 484.0 mV between 2016 and 2022). The average field ORP for deeper vertical delineation wells is -35.2 mV (ranging from -274.2 mV to 413.1 mV between 2016 and 2022). Equilibrium speciation modeling indicates that As is present as As(V) in the forms of H_2AsO_4^- and HAsO_4^{2-} (Geosyntec, 2022a). Arsenic (As) is a redox-active species and can exist in multiple oxidation states (e.g., As(V), As(III), As(-III)); however, generally positive ORP values in the alluvium and residuum and a lack of organic carbon or other reductants such as sulfide support the assumption that As(V) is the dominant species of As used in the model system. Aquifer matrix samples collected in the vicinity of HGWC-13 contained less than 0.07% total organic carbon, and dissolved organic carbon (DOC) measured in groundwater from HGWC-13 was below the laboratory analytical detection limit (Geosyntec, 2022a). Similarly, total sulfide was not detected in any of the eight aquifer matrix samples collected at AP-1, and sulfide in groundwater from HGWC-13 were below detection limits (Geosyntec, 2022a). Redox transformations between As(V) and As(III) were assumed to be kinetically controlled, and due to the lack of reductants, arsenate and arsenite were decoupled from redox equilibrium (Rawson et. al., 2016; Wallis et.al., 2010).

4.1.2 Initial Geochemical Conditions

This section describes the initial geochemical conditions and assumptions related to using Site data in the reactive transport model. The initial groundwater composition for each area of the model domain discussed below is presented in **Table 2**.

Groundwater and Recharge Composition

Groundwater monitoring results from the September 2020 semiannual sampling event (Geosyntec, 2022a) were used to define initial groundwater composition within the model domain. Data from the September 2020 semiannual groundwater sampling event was used because the dataset is more complete than datasets from more recent sampling events; results from the September 2020 sampling event are consistent with results from sampling events performed in 2022.

Three areas with distinct initial groundwater compositions were defined:

The plume (Plume A, **Figure 7**) was defined within Layer 3 (Alluvium) based on an iso-concentration contour equal to the GWPS (0.01 mg/L) drawn using September 2020 groundwater monitoring data (**Appendix A**). Note that concentrations from September 2020 are consistent with data from 2022 (**Figure 1**). The initial groundwater composition

within the plume area was based on groundwater monitoring results at HGWC-13. Monitoring well HGWC-13 is screened within Layer 3.

In Layers 5 through 6 model cells representing unimpacted subsurface materials were assigned an initial groundwater composition based on groundwater monitoring results at vertical delineation well MW-24D. Monitoring well MW-24D is screened within Layer 6 (un-weathered bedrock).

In Layers 1 through 4, the initial groundwater composition of model cells outside the plume was defined based on groundwater monitoring results at downgradient delineation well MW-19. Monitoring well MW-19 is screened within Layer 3 (alluvium).

Values for the following constituents were used to define the initial groundwater compositions within the model: pH, pe (reduction potential), and molar concentrations of dissolved oxygen, As (III and V), boron, calcium, chloride, fluoride, sulfate (represented in PHREEQC as sulfur), barium, bicarbonate (represented in PHREEQC as C(4)), magnesium, potassium, sodium, iron (II and III), and manganese (II and III). pe was calculated from measured ORP values using a reference electrode correction (+200 millivolts (mV)) and then converting Eh to pe. Bicarbonate was calculated from measured total alkalinity results assuming alkalinity is entirely attributed to bicarbonate. If an analyte was not detected at the laboratory reporting limit, the initial concentration was assumed to be zero.

To ensure that the initial groundwater composition was electrochemically neutral (i.e., charge-balanced), the geochemical composition of each source of groundwater, along with the mineralogy and adsorption parameters described below, was input into PHREEQC and equilibrated using sodium or chloride to balance the charge of each solution. The results of this speciation calculation was used as the initial groundwater concentration for the transport model.

The initial concentration of As in groundwater was assumed to be highest at HGWC-13 (0.39 mg/L), where As exceeded the GWPS in September 2020, and decrease radially in accordance with the results of the September 2020 semiannual sampling event (**Appendix A**). To represent the groundwater As plume, initial dissolved As concentrations of 0.39 mg/L (5.21E06 mols per liter [mol/L]) and 0.01 mg/L (1.3E07 mol/L) were assigned to areas within Layer 3 (Plume A in **Figure 7**). The plume was assumed to extend into the inner edge of the pond dike. The concentration of As in groundwater upgradient of HGWC-13 is unknown, and therefore, the As plume was not extended farther upgradient. The concentration of As outside of the plume is assumed to be 0 (as is consistent with

non-detections in downgradient groundwater monitoring wells). As (III) concentrations were also defined as 0 outside of the plume footprint and $2.5\text{E-}11$ mol/L within the plume (determined from PHREEQC speciation calculations). The sensitivity of the model to the initial As plume size was evaluated as part of the sensitivity analysis (**Section 4.3.3**).

Mineralogy

Initial concentrations of ferrihydrite, barite, gypsum, and calcite were defined based on groundwater monitoring results and results of solid phase characterization of site soil (Geosyntec, 2022a). Barite is supersaturated in groundwater at HGWC-13 based on geochemical equilibrium modeling using PHREEQC (see above). Inclusion of calcite was necessary to achieve realistic pH buffering capacity of the groundwater. Initial concentrations of barite, gypsum, and calcite were defined as 0.5 wt% (equivalent to $4.8\text{E-}02$ mol/L_{bulk} gypsum and $8.0\text{E-}02$ mol/L_{bulk} calcite) and 1 wt% (equivalent to $7.1\text{E-}02$ mol/L_{bulk} barite, **Table 2**), approximately the detection limit of the XRD analysis performed on site soil samples. These reactive minerals may occupy very small percentages of the overall soil matrix and are not detected with XRD but are geochemically important within the aquifer system. Aragonite was also included in the model based on PHREEQC SI, but an initial concentration was not defined.

The initial concentration of ferrihydrite varied within the model domain. Before initiating the transport model, PHT3D equilibrates the surface sites (described below) with groundwater to generate the initial concentrations of adsorbed species. Therefore, the initial concentration of ferrihydrite determines the initial concentration of sorbed As in the model system. Two areas with discrete ferrihydrite concentrations were defined: 1) the area within the groundwater As plume (Layer 3), and 2) the area outside of the groundwater As plume (Layers 1 through 6). The initial concentration of ferrihydrite assigned to each area was based on results of solid phase analyses performed on site soils and professional judgement.

The initial concentration of ferrihydrite was calibrated based on the mobile fraction of As determined from SEP experiments performed on AP-1 site soils in the vicinity of HGWC-13. SEPs are chemical extractions used to remove metals from specific solid phases and use progressively stronger reagents to mobilize metals from increasingly stable phases (Geosyntec, 2022a). SEPs are standard practice for evaluating attenuation of inorganic contaminants (USEPA, 2015). Step 1 (exchangeable phase) and Step 2 (carbonate phase) of the procedure represent the fraction of As that may be reversibly sorbed or desorbed onto solid phases. This approach assumes that As measured in later steps of the SEP represents more recalcitrant solid-phase species (e.g., co-precipitated, incorporated) that

are unlikely to mobilize to groundwater under anticipated post-closure aquifer conditions. The sum of the As associated with Steps 1 and 2 was used as the amount of adsorbed As used to determine the initial concentration of ferrihydrite. As was not detected above laboratory detection limits during Steps 1 and 2 of the SEP, and therefore, one half of the analytical method detection limit was used as the As concentration of each step (0.47 mg/kg). The initial concentration of ferrihydrite within the groundwater As plume was defined as $5.2\text{E-}05 \text{ mol/L}_{\text{bulk}}$. This concentration represents the amount of ferrihydrite needed to achieve the measured concentration of adsorbed As (0.47 mg/kg) when ferrihydrite is modeled to be in equilibrium with groundwater within the plume area using PHREEQC.

Although most of the As measured in the SEP was associated with Step 3 (non-crystalline phase) and Step 4 (metal hydroxide phase), these phases, which are amorphous and crystalline metal oxides and oxyhydroxides, are considered to be relatively stable under the expected AP-1 post-closure geochemical conditions (i.e., slightly positive to slightly negative average ORP values and circum-neutral pH). As associated with these phases would most likely only be released upon mineral dissolution under low pH and/or reducing conditions or some other change in pH/redox conditions. While clay minerals may provide some surface sites for additional attenuation capacity at AP-1 (Geosyntec, 2022a), the model takes a conservative approach and only includes adsorption to iron oxides.

The initial concentration of ferrihydrite outside of the groundwater As plume was defined as $0.372 \text{ mol/L}_{\text{bulk}}$, based on x-ray fluorescence spectroscopy (whole-rock analysis) of soil at boring DPT04XRF (Geosyntec, 2022a). X-ray fluorescence is a standard analytical method for determining mineralogy when evaluating attenuation of inorganic contaminants (USEPA, 2015). This ferrihydrite concentration assumes that the measured solid-phase iron concentration at boring DPT04XRF (2.41 wt% by whole-rock analysis) is entirely represented by ferrihydrite. This concentration represents the upper end of expected ferrihydrite concentrations within the aquifer. The initial ferrihydrite concentration outside of the groundwater As plume is evaluated further in the sensitivity analysis (Section 4.3.3).

4.1.3 Boundary Conditions

Two transport boundary conditions were defined: i) a general head boundary (GHB) with specified concentration which represents the inflow of upgradient groundwater, and ii) a recharge boundary condition with specified concentration representing infiltration from precipitation.

The groundwater composition of the general head boundary was defined based on groundwater monitoring results at HGWA-1, a background monitoring well upgradient of AP-1. The geochemical composition of recharge (precipitation) was defined using 2020 precipitation-weighted mean concentrations reported by the National Atmospheric Deposition Program for the monitoring site in Williamson, Georgia, approximately 90 miles southeast of AP-1 (National Atmospheric Deposition Program, 2021). Model parameters are shown on **Table 2**.

4.2 Model Scenarios

The reactive transport model described above was used to evaluate the feasibility of two different remediation scenarios under post-closure conditions: i) monitored natural attenuation (MNA) and ii) in-situ geochemical injections followed by performance monitoring.

Both model scenarios assume that As originated only from AP-1, and that the source of As inside AP-1 will be removed as part of the closure of AP-1. Therefore, additional loading of As from other sources was not included in the model. Both scenarios also use concentrations from September 2020 as initial or starting concentrations for the beginning of each post-closure scenario and assume that concentrations from September 2020 are representative of conditions immediately following closure of AP-1.

4.2.1 MNA Scenario

Under the MNA scenario, the reactive transport model was run for 80 years under post-closure conditions. The As attenuation mechanism is adsorption onto naturally occurring ferrihydrite surfaces as described above. Additional manipulations of groundwater gradient or geochemistry were not performed under this scenario.

4.2.2 Injection Scenario

Under the injection scenario, boundary cells representing groundwater injection wells were inserted into the reactive transport model to simulate injection of an iron amendment that would promote the attenuation of As via adsorption to iron oxide mineral surfaces, effectively accelerating ongoing natural attenuation processes through the precipitation of additional reactive surface sites. For the injection scenario, aqueous ferric iron (Fe(III)) was selected as the injectate for the purposes of this model to evaluate the feasibility and to provide a proof of concept for this remedial approach. Fe(III) was selected because i) injection of a solid amendment (e.g., ferrihydrite) is not possible using PHT3D and ii) it does not require a change in oxidation state to precipitate. If geochemical injections are

selected as a component of the remedy, the results of treatability and pilot testing will be used to evaluate and select an injectate as part of the remedy design process.

Three rounds of injection were simulated with a period of performance monitoring following each round:

Simulated Event	Duration (days)	Cumulative Days	Cumulative Years
Injection Round #1	20	1-20	< 1
Monitoring (no injection)	365	21-385	1
Injection Round #2	20	386-405	1.1
Monitoring (no injection)	365	406-770	2.1
Injection Round #3	20	771-790	2.2
Monitoring (no injection)	1035	791-1825	5

Note that during the simulated performance monitoring periods, natural attenuation continues to occur as dissolved As is transported into the injection area and adsorbs to iron mineral surfaces.

The injection solution consisted of 0.1 mol/L Fe(III). The pH was defined as 6.5 s.u., and the pe was defined as 13. The injection rate was defined as 0.5 gallons per minute (gpm). Injections were limited to Layer 3 (alluvium), in which the As plume is present. PHT3D simulates injection across the entire layer thickness.

Note that the primary purpose of the injection model is to assess the viability and feasibility of geochemical injections for As remediation. Therefore, the simulated injection wells, the parameters defined in the injection model (e.g., number of wells, flow rate, injection regime, and injectate composition), and simulated results should be considered preliminary and “proof of concept”. If geochemical injections are selected as a component of the remedy, the results of treatability and pilot testing will be used to evaluate and select the actual injectate, number of injection wells, injection regime and injection rate as part of the remedy design process.

4.3 Model Results

4.3.1 MNA Model Results

A time series of modeled groundwater As concentrations at HGWC-13 under the MNA model scenario is shown in **Figure 8**. Modeled As concentrations are predicted to decrease to below the GWPS at HGWC-13 after approximately 20 years of MNA.

In the core of the plume, there is an initial period of As desorption from the solid phase, during which dissolved As concentrations increase to levels above the initial concentration. This As desorption is likely due to flushing through the model system (simulating pore water replacement) and equilibrating with As-bearing aquifer solids. As desorption may also be related to the relatively higher pH within the initial plume area (7.34 standard units [s.u.]) (discussed further in model sensitivity analysis **Section 4.3.3**). Predicted groundwater As concentrations within the plume increase up to 1.85 mg/L (2.47E-05 mol/L). This desorption is not apparent in **Figure 8**, because of the location of HGWC-13 at the edge of the plume footprint.

Following this initial increase, the modeled groundwater plume steadily decreases in size, and As concentrations decrease within the plume area indicating that the plume is naturally attenuating. During the model simulation period, the plume is predicted to remain relatively stationary and does not migrate downgradient beyond its initial plume extent.

The model predicts that the plume is completely attenuated to concentrations less than the GWPS after approximately 60 years of MNA. The time to achieve GWPS is primarily driven by initial As desorption from the aquifer solids and the aquifer solids acting as a secondary source of As to groundwater.

4.3.2 Injection Model Results

A time series of modeled groundwater As concentrations at HGWC-13 under the injection scenario is shown in **Figure 8**. At HGWC-13, the modeled groundwater As concentration decreases significantly during the first round of injections. As concentrations are predicted to rebound slightly above the GWPS after the second round, but again drop and remain below the GWPS after the third round of injections. Overall, at the compliance well HGWC-13, As concentrations are simulated to fall below the GWPS within 2.5 years after injections are simulated to commence (including one year of performance monitoring in between the first two rounds of injection). This remedial time frame is significantly faster than that predicted by MNA alone.

Dissolved As concentrations in locations in between injection wells increase during the first round of injections (likely due to desorption discussed in **Section 4.3.1** and in the sensitivity analysis **Section 4.3.3**). However, following each subsequent round of injections, the modeled groundwater plume progressively decreases in size and As concentrations.

Following the third round of injection, the model is run for ~2.8 years under performance monitoring conditions, during which the plume continues to decrease in size as As is attenuated via adsorption to ferrihydrite. A smaller plume with As concentrations greater than the GWPS is predicted to remain within the footprint of the initial plume, after 5 years. The smaller plume is predicted to not migrate and to remain within the original plume footprint.

The mass of dissolved As was calculated for both the MNA and injection model scenarios to compare the amount of mass reduction achieved with each remedial technology. The mass of dissolved As was reduced by approximately 87% after three rounds of injection and 2.8 years of performance monitoring (total of 5 years of remediation). In comparison, the MNA approach required approximately 30 years to achieve a similar reduction in dissolved mass (approximately 89% mass reduction).

Overall, this scenario demonstrates the feasibility of the injection approach for accelerating As attenuation in comparison to an MNA scenario.

4.3.3 Model Sensitivity Analysis

A sensitivity analysis was performed on three model parameters: 1) the size and concentration of the initial groundwater As plume, 2) the attenuation capacity of the aquifer (i.e., the concentration of ferrihydrite surface sites) outside of the initial plume footprint, and 3) the initial pH within the plume footprint. The results of the sensitivity analysis are discussed below.

Initial Groundwater Plume

Within the reactive transport model, the size and concentration of the initial groundwater As plume determines the total mass of As in the system. Modeled ferrihydrite surface sites are equilibrated with the groundwater at timestep 0 (before transport steps commence). This step ‘pre-loads’ ferrihydrite surfaces with As. As described in **Section 4.1**, the initial concentration of ferrihydrite within the plume area was calibrated so that the modeled As concentrations match the As concentrations measured in SEP experiments performed on aquifer matrix materials in the vicinity of the exceedance well

HGWC-13. Therefore, a larger initial groundwater As plume or an initial groundwater plume with higher As concentrations results in both a larger mass of dissolved As in groundwater and a larger mass of As adsorbed on ferrihydrite surfaces. Although the dissolved As groundwater plume is delineated, the precise dimensions of the plume requires further characterization during the pre-design phase.

To evaluate the sensitivity of the reactive transport model to the size and concentration of the initial groundwater As plume, the model was run under the MNA scenario described in **Section 4.3.1** using a ‘limited footprint’ plume (Plume B in **Figure 7**). Under the limited footprint scenario, the groundwater As concentration exceeding the GWPS is assumed to be limited to the area immediately around HGWC-13. As concentrations outside of the limited plume footprint are assumed to be 0. The limited footprint plume scenario represents a lower estimate of initial dissolved and adsorbed, solid-associated As mass within the system. In contrast, the plume described in **Section 4.3.1** represents a more conservative estimate of dissolved and solid-associated As mass within the system. Both groundwater plume scenarios are consistent with the September 2020 groundwater monitoring results.

A time series of modeled groundwater As concentrations at HGWC-13 under the MNA scenario using the limited footprint plume is shown in **Figure 9**. In the limited footprint plume scenario, the groundwater As concentration at HGWC-13 is predicted to decrease below the GWPS within approximately 15 years, slightly faster than the 20 years predicted for HGWC-13 using the larger plume configuration. The limited footprint plume, however, is predicted to be completely attenuated below the GWPS within approximately 22.5 years, substantially faster than the 60 years attenuation simulated for the plume considered in **Section 4.3.1**. These results reflect the relatively high sensitivity of the reactive transport model to the size and concentration of the initial groundwater As plume and emphasize the importance of further plume characterization as part of the design and implementation of any groundwater remedy.

Attenuation Capacity

The attenuation capacity of the aquifer determines the extent to which dissolved As in groundwater can be sequestered via adsorption to mineral surfaces. Higher attenuation capacities can limit groundwater plume migration because more surface sites are available to adsorb As from the groundwater. Lower attenuation capacities may result in substantial plume migration because surface sites quickly become saturated with As, allowing dissolved As to be transported downgradient.

The attenuation capacity of the aquifer is represented in the model by the concentration of ferrihydrite sites, which is defined as a function of ferrihydrite concentration. In reality, numerous iron oxide phases with a range of attenuation capacities are likely present in site soil. The concentration of acid-extractable solid-phase iron and whole rock analysis (WRA) of soil samples collected from boring DPT04XRF provide data on the iron content of site soil within the vicinity of exceedance well HGWC-13. However, the precise composition of soil iron is unknown. Additionally, heterogeneities in soil iron concentration are likely to exist across the site, and many other soil properties affect the degree to which As adsorbs to naturally occurring iron oxides (e.g., surface area, mineral impurities).

To evaluate the sensitivity of the reactive transport model to the attenuation capacity of soil outside the initial groundwater plume footprint, two model scenarios were run. The first model scenario is identical to the one described in **Section 4.2.1** and represents an upper estimate of site attenuation capacity by assuming that the initial ferrihydrite concentration is equal to 100% of iron measured by WRA (0.372 mol/L_{bulk}). The second model scenario is similar to the first, except the initial ferrihydrite concentration outside of the plume area is assumed to be two orders of magnitude lower (0.00372 mol/L_{bulk}). This scenario represents a lower estimate of ferrihydrite soil concentration.

Time series of modeled groundwater As concentration at HGWC-13 under the MNA scenario with a high and low soil attenuation capacity outside of the larger plume area is shown in **Figure 9**. Groundwater As concentrations at HGWC-13 are predicted to decrease below the GWPS within approximately 45 years, more than twice as long as the higher attenuation capacity scenario. After 50 years, groundwater As concentrations have decreased within the plume; however, the size of the plume remains approximately the same, and the edge of the plume has migrated approximately 70 feet downgradient (to the southeast) beyond its initial boundaries. The plume however remains on-site. These results demonstrate that the remedial time frame is sensitive to the attenuation capacity outside the plume area, particularly at locations downgradient of HGWC-13.

Initial pH

Because As exists as a negatively charged oxyanion in the conditions present in AP-1 groundwater (i.e., H_2AsO_4^- or HAsO_4^{2-} , Geosyntec, 2022a), pH plays a critical role in the amount of As adsorption onto ferrihydrite surfaces. Consistent with the initial geochemical conditions described in **Section 4.1.1**, the initial pH of model cells within the plume footprint was defined as the pH measured in HGWC-13 in September 2020 (7.34 s.u.), and the pH of model cells outside of the plume footprint was defined as the

pH measured in downgradient delineation well MW-19 (6.41 s.u.). This range of pH values observed inside and outside the plume straddles a value known as the point of zero charge (PZC) for ferrihydrite. The PZC is a pH value at which the charge of a mineral surface is equal to zero. At pH values higher than the PZC, the mineral surface maintains a negative net charge due to the abundance of hydroxide ions (OH^-), while at pH values lower than the PZC, the mineral surface is positively charged due to the abundance of protons (H^+) and protonation of the surface. This suggests that As will more strongly adsorb to surfaces in conditions with pH values less than the PZC and potentially desorb from surfaces when the pH is greater than the PZC. In the reactive transport model, the PZC for ferrihydrite defined in the database is 7.29 s.u. (Dzombak and Morel, 1990), which is less than the pH at HGWC-13, the plume area. This PZC is consistent with other published PZC values for ferrihydrite, which range from 7.3 to 8.4. The PZC for other types of iron oxide minerals generally ranges from 5.6 to 9 (Kosmulski, 2018).

To evaluate the sensitivity of the initial pH in the plume footprint, the model was run with the initial pH within the larger plume footprint (Plume A, **Figure 7**) equal to the pH in the downgradient well (6.41 s.u.). All other geochemical parameters remained the same, and the HGWC-13 water chemistry with the lower pH was input into PHREEQC with chloride used to balance the charge of the solution. The model results show that groundwater As concentrations do not increase above the initial input value of 0.39 mg/L and that significant desorption does not occur. As concentrations at HGWC-13 are predicted to decrease to below the GWPS within 15 years (**Figure 9**). This result however does not significantly change the overall plume MNA remedial time frame: As concentrations in groundwater are not predicted to decrease to below GWPS until after 40 years of MNA.

5.0 REACTIVE TRANSPORT MODEL: MOLYBDENUM

A reactive transport model was developed for the area around monitoring well HGWC-8, where groundwater Mo concentrations currently exceed the GWPS. The objective of the reactive transport model is to evaluate the feasibility of MNA and geochemical injections to achieve the GWPS, under predicted post-closure conditions. The relative remedial time frame to reach the GWPS can be used to compare remedial alternatives including MNA and geochemical injections. For the purposes of this model, it was assumed that under post-closure conditions, the source of Mo within the footprint of AP-1 will be removed due to closure by removal activities, and the remaining Mo will be limited to dissolved Mo and Mo that had previously adsorbed to the aquifer matrix materials, in the immediate vicinity of HGWC-8.

5.1 Model Setup

The reactive transport model utilizes the three-dimensional (3D) reactive multicomponent transport code PHT3D (Prommer and Post, 2010). PHT3D incorporates the programs MT3DMS (Zheng and Wang, 1999) for 3D advective-dispersive multi-species transport modeling and PHREEQC (Parkhurst and Appelo, 2000) for geochemical reaction modeling. PHT3D uses MODFLOW (Harbaugh, 2005) to provide the groundwater flow field for transport simulations.

Transport model construction and parameterization was performed in the Processing MODFLOW pre- and post-processing software package (Simcore, 2012). Equilibrium constants from the MINTEQ.V4 thermodynamic database (USEPA, 1999) were used for the Mo model.

5.1.1 Geochemical Properties

This section describes the key geochemical reactions included in the reactive transport model: aqueous complexation, mineral precipitation & dissolution, and adsorption/desorption to mineral surfaces.

Aqueous Complexation

At each time step, PHT3D uses PHREEQC to calculate equilibrium aqueous speciation. The MINTEQ.V4 database of equilibrium constants was used for aqueous speciation

calculations. Sodium was defined as the charge balancing ion to obtain an electrochemically neutral solution at the initial time step.

Mineral Precipitation/Dissolution

At each time step, minerals specified within the model setup are allowed to precipitate or dissolve to achieve equilibrium with groundwater. To identify the relevant minerals, PHREEQC was used to calculate mineral SI using the results of the September 2020 semiannual groundwater sampling event for monitoring wells HGWC-8, HGWC-1, MW-27D, and MW-20. Data from the September 2020 semiannual groundwater sampling event was used because the dataset is more comprehensive than datasets from more recent sampling events; results from the September 2020 sampling event are consistent with results from sampling events performed in 2022.

Barite was determined to be supersaturated ($SI > 0$), and anhydrite, calcite, and dolomite were determined to be close to equilibrium (SI between -1.0 and 0). Therefore, the following minerals were set to precipitate/dissolve to achieve equilibrium with groundwater in PHT3D (i.e., $SI = 0$): anhydrite, barite, calcite, dolomite, and ferrihydrite. Ferrihydrite was included based on solid-phase soil analyses that indicated iron oxides are abundant at the site (Geosyntec, 2022a). While a mixture of different iron oxides and oxyhydroxides are commonly found in aquifers due to variations in crystallinity, crystal size, solid solution, and crystallization kinetics, ferrihydrite was the only iron oxide included in the model for simplicity.

Adsorption/Desorption

Adsorption and desorption of dissolved species to and from ferrihydrite surfaces were modeled using the non-electrostatic HFO surface complexation model developed by Dzombak and Morel (1990) and included in the MINTEQA4 database. Other mineral surfaces were not included in the model because their contribution to Mo adsorption is assumed to be significantly less than that of iron oxides based on the abundance of iron-bearing minerals in site soil and the strong affinity of Mo to adsorption on iron oxides (Geosyntec, 2022a). The surface complexation model describes adsorption to HFO using two surface sites (strong and weak). The concentration of surface sites was dynamically linked to the concentration of ferrihydrite using a strong site density of 0.005 moles per mole (mol/mol) iron and a weak site density of 0.2 mol/mol iron (Dzombak and Morel, 1990).

5.1.2 Initial Geochemical Conditions

This section describes the model parameters for groundwater composition and mineralogy used to define the initial geochemical conditions of the model domain.

Groundwater Composition

Groundwater monitoring results from the September 2020 semiannual sampling event (Geosyntec, 2022a) were used to define initial groundwater composition within the model domain. Data from the September 2020 semiannual groundwater sampling event was used because the dataset is more complete than datasets from more recent sampling events; results from the September 2020 sampling event are consistent with results from sampling events performed in 2022.

Three areas with distinct initial groundwater compositions were defined:

The plume area (Plume A in **Figure 10**) was defined within Layer 2 (alluvium) based on an iso-concentration contour equal to the GWPS (0.1 mg/L) drawn using September 2020 groundwater monitoring data (**Appendix A**). The initial groundwater composition within the plume area was based on groundwater monitoring results at HGWC-8. Monitoring well HGWC-8 is screened within Layer 2.

The non-impacted alluvium/residuum in Layer 3 (beneath the plume in Layer 2) was defined based on groundwater monitoring results at downgradient delineation well MW-20. Layer 3 was assumed to be non-impacted based on the co-located vertical delineation well MW-27D (screened in bedrock), as no well is screened within the residuum in the immediate vicinity of HGWC-8. Since no groundwater monitoring wells within the vicinity of HGWC-8 are screened in Layer 3, MW-20 (being the closest non-impacted and non-bedrock well) was used to define layer 3.

The non-impacted area beneath the plume in Layer 4 (weathered bedrock/PWR) and Layer 5 (un-weathered bedrock) was defined based on the areal extent of the plume area described above. The initial groundwater composition within this area was based on groundwater monitoring results at vertical delineation well MW-27D (**Figure 2** and **Appendix A**). Groundwater Mo concentrations at well MW-27D do not exceed the GWPS. Monitoring well MW-27D is screened within Layer 5.

The area outside of the plume area was defined within Layers 1 through 5 and encompasses the entire groundwater model domain, except for the areas described above. The initial groundwater composition within this area was based on groundwater

monitoring results at downgradient delineation well MW-20. Monitoring well MW-20 is screened within Layer 2 (alluvium).

Values for the following constituents were used to define the initial groundwater and recharge compositions within the model: pH, pe, and molar concentrations of dissolved oxygen, molybdenum, boron, calcium, chloride, fluoride, sulfate (represented in PHREEQC as sulfur), barium, bicarbonate (represented in PHREEQC as C(4)), magnesium, potassium, sodium, iron(II), and manganese(II). pe was calculated from measured oxidation-reduction potential values using the Nernst equation. Bicarbonate was calculated from measured total alkalinity results assuming alkalinity is entirely attributed to bicarbonate at circumneutral pH, consistent with pH measurements of site groundwater. Results for total iron and manganese were used as the initial concentration of iron(II) and manganese(II), respectively, assuming that the concentrations of other insoluble or minor oxidation states (i.e., iron(III), manganese(III,IV)) in groundwater are negligible. If an analyte was not detected at the laboratory reporting limit, the initial concentration was assumed to be zero.

To ensure that the initial groundwater composition was electrochemically neutral (i.e., charge-balanced), the geochemical composition of each water, along with the mineralogy and adsorption parameters described below, was input into PHREEQC and equilibrated using sodium or chloride to balance the charge of each solution. The charge-balanced solution composition was used as the initial groundwater concentration for the transport model. The initial groundwater composition for each area of the model domain is presented in **Table 3**.

The initial concentration of Mo in groundwater was assumed to be highest at HGWC-8 (0.43 mg/L, equivalent to 4.5 μ M), where Mo exceeded the GWPS in September 2020, and decrease radially, consistent with the plume shown in **Figure 2**. To represent the groundwater Mo plume, initial Mo concentrations of 1.0, 2.0, 3.0, 4.0, and 4.5 μ M were prescribed to areas within Layer 2 (Plume A in **Figure 10**). The plume was assumed to extend to the inner edge of the pond dike. The concentration of Mo in groundwater upgradient of HGWC-8 remains unknown; therefore, the Mo plume was not extended further upgradient. It is assumed that Mo originated only from AP-1, and that the source of Mo inside AP-1 will be removed as part of the closure of AP-1. Therefore, additional loading of Mo from other sources was not included in the model. The sensitivity of the model to the size and concentration of the Mo plume was evaluated during the sensitivity analysis (**Section 5.3.3**).

Mineralogy

Initial concentrations of ferrihydrite, barite, and calcite were defined based on groundwater monitoring results and results of solid phase characterization of site soil (Geosyntec, 2022a). Barite is supersaturated in groundwater at HGWC-8 based on geochemical equilibrium modeling using PHREEQC. Inclusion of calcite was necessary to achieve realistic pH buffering capacity of the groundwater. Initial concentrations of barite and calcite were defined as 0.5 wt% (equivalent to 0.04 mol/L_{bulk} barite and 0.08 mol/L_{bulk} calcite, **Table 3**), approximately the detection limit of the XRD analysis performed on site soil samples.

The initial concentration of ferrihydrite varied within the model domain. Before initiating the transport model, PHT3D equilibrates the surface sites (described below) with groundwater to generate the initial concentrations of adsorbed species. Therefore, the initial concentration of ferrihydrite determines the initial concentration of solid-phase Mo in the model system, an important determinant of plume longevity. Two areas with discrete ferrihydrite concentrations were defined: i) the area within the groundwater Mo plume (Layer 2), and ii) the area outside of the groundwater Mo plume (Layers 1 through 5). The initial concentration of ferrihydrite assigned to each area was based on results of solid phase analyses performed on site soils.

The initial concentration of ferrihydrite within the groundwater Mo plume was calibrated based on the mobile fraction of Mo determined from SEP experiments performed on AP-1 site soils in the vicinity of HGWC-8. SEPs are chemical extractions used to remove metals from specific solid phases and use progressively stronger reagents to mobilize metals from increasingly stable phases (Geosyntec, 2022a). SEPs are standard practice for evaluating attenuation of inorganic contaminants (USEPA, 2015). Step 1 (exchangeable phase) and Step 2 (carbonate phase) of the procedure represent the fraction of Mo that may be reversibly adsorbed or desorbed onto solid phases. This approach assumes that Mo measured in later steps of the SEP represents more recalcitrant solid-phase species (e.g., co-precipitated, incorporated) that are unlikely to mobilize to groundwater under anticipated post-closure aquifer conditions. Molybdenum was not detected during Steps 1 and 2 of the SEP, and therefore, one half of the analytical method detection limit was used as the Mo concentration of each step, based on professional judgement, for a total adsorbed Mo concentration of 0.36 mg/kg (Geosyntec, 2022a). The initial concentration of ferrihydrite within the groundwater Mo plume was defined as 0.047 mol/L_{bulk}. This concentration represents the amount of ferrihydrite needed to achieve the defined concentration of adsorbed Mo when ferrihydrite is modeled to be in equilibrium with groundwater within the plume area using PHREEQC.

The initial concentration of ferrihydrite outside of the groundwater Mo plume was defined as 0.574 mol/L_{bulk}, based on x-ray fluorescence spectroscopy (whole-rock analysis) of soil at boring DPT02 (Geosyntec, 2022a). X-ray fluorescence is a standard analytical method for determining mineralogy when evaluating attenuation of inorganic contaminants (USEPA, 2015). This ferrihydrite concentration assumes that the measured solid-phase iron concentration at boring DPT02 (3.72 wt% by whole-rock analysis) is entirely represented by ferrihydrite. This concentration represents the upper end of expected ferrihydrite concentrations within the aquifer and falls within the range of solid-phase iron concentrations measured at the site (2.41% to 7.24% by whole-rock analysis) (Geosyntec, 2022a). The initial ferrihydrite concentration outside of the groundwater Mo plume is evaluated further in the sensitivity analysis (**Section 5.3.3**). While clay minerals may provide some surface sites for additional attenuation capacity at AP-1 (Geosyntec, 2022a), the model takes a conservative approach and only includes adsorption to iron oxides.

5.1.3 Boundary Conditions

Two reactive transport boundary conditions were defined: i) a general head boundary (GHB) with specified concentration which represents the inflow of upgradient groundwater, and ii) a recharge boundary condition with specified concentration representing infiltration from precipitation.

The groundwater composition of the general head boundary was defined based on groundwater monitoring results at HGWA-1, a background monitoring well upgradient of AP-1. The geochemical composition of recharge (precipitation) was defined using 2020 precipitation-weighted mean concentrations reported by the National Atmospheric Deposition Program for the monitoring site in Williamson, Georgia, approximately 90 miles southeast of AP-1 (National Atmospheric Deposition Program, 2021). Model parameters are shown on **Table 3**.

5.2 Model Scenarios

The reactive transport model described above was used to evaluate the feasibility of two different remediation scenarios under post-closure conditions: i) monitored natural attenuation (MNA) and ii) in-situ geochemical injections followed by performance monitoring.

Both model scenarios assume that Mo originated only from AP-1, and that the source of Mo inside AP-1 will be removed as part of the closure of AP-1. Therefore, additional loading of Mo from other sources was not included in the models. Both scenarios also

use concentrations from September 2020 as initial or starting concentrations for the beginning of each post-closure scenario and assume that concentrations from September 2020 are representative of conditions immediately following closure of AP-1.

5.2.1 MNA Scenario

Under the MNA scenario, the reactive transport model was run for 80 years under ambient post-closure conditions. The Mo attenuation mechanism is adsorption onto naturally occurring ferrihydrite surfaces as described in **Section 5.1.1**. Additional manipulations of groundwater gradient or geochemistry were not performed under this scenario.

5.2.2 Injection Scenario

Under the injection scenario, boundary cells representing groundwater injection wells were added to the reactive transport model to simulate injection of an iron amendment that would promote attenuation of Mo via adsorption to iron oxide mineral surfaces, effectively accelerating ongoing natural attenuation processes. For the injection scenario, aqueous ferric iron (Fe(III)) was selected as the injectate for the purposes of this model to evaluate the feasibility and to provide a “proof of concept” for this remedial approach. Fe(III) was selected because 1) injection of a solid amendment (e.g., ferrihydrite) is not possible using PHT3D, and 2) it does not require a change in oxidation state to precipitate.

Three rounds of injection were simulated with a period of performance monitoring after each round:

Event	Duration (days)	Cumulative Days	Cumulative Years
Injection Round #1	30	1-30	< 1
Monitoring (no injection)	365	31-395	1
Injection Round #2	30	396-425	1.1
Monitoring (no injection)	365	426-790	2.1
Injection Round #3	30	791-820	2.2
Monitoring (no injection)	1,005	821-1,825	5

Note that during the performance monitoring periods, natural attenuation continues to occur as dissolved Mo is transported into the injection area and adsorbs to iron mineral surfaces.

The injection solution consisted of 0.1 M Fe(III), and the pH and pe of the injection solution were defined as 7 and 13, respectively. The injection rate was defined as 1.0 gallon per minute (gpm). Injection wells were placed in the vicinity of the Mo plume and were inserted only into Layer 2 (Alluvium), the layer in which the groundwater Mo plume is located. Note that PHT3D simulates injection across the entire layer thickness. During each round of injection, all injection wells were simulated to operate simultaneously. Due to the large volume of solution injected during each round, the number of injection wells and the injection rate were selected to ensure that water table mounding did not exceed the ground surface (i.e., flooding).

Note that the primary purpose of the injection model is to assess the viability and feasibility of geochemical injections for Mo remediation. Therefore, the simulated injection wells, the parameters defined in the injection model (e.g., number of wells, flow rate, injection regime, and injectate composition), and the simulated results should be considered preliminary and “proof of concept”. If geochemical injections are selected as a component of the remedy, the results of treatability and pilot testing will be used to evaluate and select the actual injectate, number of injection wells, injection regime and injection rate as part of the remedy design process.

5.3 Model Results

5.3.1 MNA Model Results

A time series of modeled groundwater Mo concentrations at HGWC-8 under the MNA model scenario is shown in **Figure 11**. Groundwater Mo concentration at HGWC-8 is predicted to decrease below the GWPS in approximately 65 years. This estimated remedial time frame is less than the >80-year time frame estimated for the entire plume due to the location of HGWC-8 in relation to the assumed groundwater Mo plume.

Model simulation results indicate that the groundwater plume steadily decreases in size and Mo concentration over time. However, a small groundwater plume that exceeds the GWPS is predicted to remain within the initial plume footprint (initial footprint shown in Plume A, **Figure 10**) after 80 years of MNA. The attenuation time is primarily driven by aquifer solids acting as a secondary source of Mo to groundwater; adsorbed Mo is mobilized to groundwater as background groundwater with a lower Mo concentration flows through the soil within the plume area. The modeled groundwater Mo plume is not predicted to migrate downgradient of the initial plume footprint.

5.3.2 Injection Model Results

A time series of modeled groundwater Mo concentrations at HGWC-8 under the injection model scenario is shown in **Figure 11**. The modeled groundwater Mo concentration at HGWC-8 decreases significantly in response to the first and third rounds of injection because HGWC-8 is within the radius of influence of a simulated injection well. The groundwater Mo concentration at HGWC-8 decreases below the GWPS after the third round of injections; the decrease in groundwater Mo concentration occurs in two stages due to changes in groundwater pH induced by the third round of injection. By the end of the simulation (5 years after the initiation of injections), the modeled Mo concentration at HGWC-8 is approximately 80% lower than the initial concentration. A smaller plume with Mo concentrations greater than the GWPS is predicted to remain within the footprint of the initial plume, after 5 years. The smaller plume is predicted to not migrate and to remain within the original plume footprint.

The mass of dissolved Mo was calculated for both the MNA and injection model scenarios to compare the amount of mass reduction achieved with each remedial technology. The mass of dissolved Mo was reduced by approximately 57% after three rounds of injection and 2.8 years of performance monitoring (total of 5 years of remediation). In comparison, the MNA approach required approximately 65 years to achieve a similar reduction in dissolved mass (52%).

Overall, this scenario demonstrates the feasibility of the injection approach for accelerating Mo attenuation in comparison to an MNA scenario.

5.3.3 Model Sensitivity Analysis

A sensitivity analysis was performed on two model parameters: 1) the size and concentration of the initial groundwater Mo plume, and 2) the aquifer attenuation capacity (i.e., the concentration of ferrihydrite surface sites) outside the initial plume footprint. The results of the sensitivity analysis are discussed below.

Initial Groundwater Plume

Within the reactive transport model, the size and concentration of the initial groundwater Mo plume determines the total mass of Mo in the system. Modeled ferrihydrite surface sites are equilibrated with the groundwater before the transport steps commence, which ‘pre-loads’ ferrihydrite surface sites with Mo. Thus, an initial groundwater Mo plume with a larger footprint or higher Mo concentrations results in a larger mass of Mo both in groundwater and adsorbed on ferrihydrite surfaces. Although the dissolved Mo

groundwater plume is delineated, the precise dimensions of the plume requires further characterization during the pre-design phase.

To evaluate the sensitivity of the model to the size and concentration of the initial groundwater Mo plume, the model was run under the MNA scenario described in **Section 5.2.1** but using a ‘limited footprint’ plume (Plume B in **Figure 10**) instead of the original plume A configuration (Plume A in **Figure 10**). Under the limited footprint plume scenario, the groundwater Mo concentration is assumed to decline linearly between the exceedance and delineation wells. The limited footprint plume scenario represents a lower estimate of initial dissolved and solid-associated Mo mass within the system. In contrast, the contoured groundwater Mo plume scenario described in **Section 5.2.1** (Plume A in **Figure 10**) represents a more conservative estimate of dissolved and solid-associated Mo mass within the system.

A time series of modeled groundwater Mo concentration at HGWC-8 under the MNA scenario using the limited footprint plume is shown in **Figure 12**. Model results indicate that when using the limited footprint plume, the groundwater Mo concentration at HGWC-8 is predicted to decrease below the GWPS within approximately 20 years. This estimated remedial time frame is less than the 65-year remedial time frame estimated at HGWC-8 using the contoured groundwater Mo plume. These results reflect the high sensitivity of the reactive transport model to the size and concentration of the initial groundwater Mo plume and emphasize the importance of further plume characterization as part of the design and implementation of any groundwater remedy.

Attenuation Capacity

The attenuation capacity of the aquifer determines the extent to which dissolved Mo in groundwater can be sequestered via adsorption to mineral surfaces. Higher attenuation capacities inhibit the groundwater plume from migrating downgradient because there are more available surface sites on which Mo can adsorb. Lower attenuation capacities may result in substantial plume migration because surface sites quickly become saturated with Mo, allowing dissolved Mo to be transported downgradient.

The attenuation capacity of the aquifer is represented in the model by the concentration of ferrihydrite surface sites, which is defined as a function of ferrihydrite concentration. In reality, numerous iron oxide phases with a range of attenuation capacities are likely present in site soil. The concentration of acid-extractable solid-phase iron and WRA of soil samples collected from boring DPT02 provide data on the iron content of site soil within the vicinity of exceedance well HGWC-8. However, the precise composition of soil iron is unknown. Additionally, heterogeneities in soil iron concentration are likely to

exist across the site, and many other soil properties affect the degree to which Mo adsorbs to naturally occurring iron oxides (e.g., surface area, mineral impurities).

To evaluate the sensitivity of the model to the attenuation capacity of soil outside the initial groundwater plume footprint, two model scenarios were run. The first model scenario is identical to the one described in **Section 5.2.1** and represents an upper estimate of site attenuation capacity by assuming that the initial ferrihydrite concentration outside of the plume area is equal to 100% of iron measured by WRA (0.574 mol/L_{bulk}). The second model scenario is similar to the first, except the initial ferrihydrite concentration outside of the plume area is assumed to be the same as within the plume area (0.047 mol/L_{bulk}). This scenario represents a lower estimate of ferrihydrite soil concentration, based on the concentration of ferrihydrite needed to achieve the measured concentration of adsorbed Mo at boring DPT02 when equilibrated with HGWC-8 groundwater in PHREEQC. Both scenarios are consistent with measured solid-phase data collected at boring DPT02.

Time series of modeled groundwater Mo concentration at HGWC-8 under the MNA scenario with a high and low soil attenuation capacity outside of the plume area is shown in **Figure 12**. Model results indicate that groundwater Mo concentration at HGWC-8 is predicted to decrease below the GWPS within approximately 70 years, regardless of the attenuation capacity outside of the plume area. After 80 years, an area with groundwater Mo concentrations in excess of the GWPS exists downgradient of HGWC-8 under both attenuation capacity scenarios. The groundwater Mo plume under the high attenuation capacity scenario after 80 years remains within the initial plume footprint. After 80 years, the groundwater Mo plume under the low attenuation capacity scenario is approximately double the size and extends further downgradient than the groundwater Mo plume under the higher attenuation capacity scenario. Under both scenarios, the groundwater Mo plume is predicted to remain within the property boundary. These results demonstrate that the remedial time frame is sensitive to the attenuation capacity outside the plume area, particularly at locations downgradient of HGWC-8.

6.0 MODEL UNCERTAINTY & LIMITATIONS

The reactive transport model was constructed in accordance with standard industry practices, using the best information available at the time of model development, and widely accepted and publicly available numerical modeling software. However, reactive transport models are necessarily simplified mathematical representations of complex natural systems. Therefore, all models have associated uncertainties in model predictions and limits to their accuracy. Some of the primary limitations and sources of uncertainty in this model are:

Post-closure, the groundwater flow velocity and flow direction are expected to be significantly different from current conditions. The flow models were developed to predict post-closure conditions based on current data and reasonable assumptions. However, given the uncertainty surrounding what groundwater post-closure conditions will actually be, the predicted flow velocities and directions may vary from actual future field conditions.

In general, both the As and Mo groundwater plumes at AP-1 are horizontally and vertically delineated. However, a more refined delineation that provides a better understanding of plume concentration and mass was not available at the time of model development, adding uncertainty to the model results. Higher resolution plume characterization near HGWC-13 and HGWC-8 will help inform the model.

Although aquifer characterization data indicates the presence of iron oxides (and clay minerals) which suggest significant attenuation capacity, the attenuation capacity of the aquifer (including iron oxide concentrations and distribution) represents another source of uncertainty. Higher resolution site characterization near HGWC-13 and HGWC-8 conducted as part of the design and implementation of the selected groundwater remedy will provide additional information on the attenuation capacity of the aquifer.

Reactions rates have not been included in the models due to both uncertainty and for simplicity; the model assumes instantaneous equilibrium conditions. The sorption and desorption studies with AP-1 aquifer materials suggest fast kinetics for both As and Mo sorption and desorption (i.e., on the order of days) (Geosyntec, 2022a); however, the reaction rate uncertainty associated with the injection scenarios may affect predicted remedial time frames. Additional data collected during the design of the remedy will help refine remedial timeframes.

Injection parameters were assumed to serve as a proof of concept. In practice, the number of injection wells, locations of wells, injectate composition, and injection regime will be evaluated in the design phase and selected to accelerate remediation goals.

Remedial time frames predicted in this model are based on assumptions developed using available data. As such, refinements to the GCSM may affect predicted time frames to achieve As and Mo concentration below GWPS.

The model and associated GCSM assumes that closure activities do not significantly change the geochemistry of groundwater at the Site. As closure progresses, groundwater monitoring data will be evaluated to assess geochemical changes to groundwater composition.

The objective of the reactive transport modeling is to assess potential remediation approaches to As and Mo exceedances at AP-1. These models were not calibrated to existing conditions and are intended as a feasibility-level tool to compare and forecast the relative differences between post-closure remediation scenarios.

7.0 FINDINGS & CONCLUSIONS

Findings & conclusions drawn from the results of the As and Mo reactive transport models are summarized below.

7.1 Model Findings – Arsenic

The reactive transport model described in **Section 4** was used to estimate the remedial feasibility for groundwater As concentrations to decrease below the GWPS under two scenarios: i) MNA, and ii) in situ injections followed by performance monitoring.

Under the MNA scenario described in **Section 4.2.1**, the groundwater As concentration at HGWC-13 is predicted to decrease below the GWPS in approximately 20 years (**Figure 8**). The model predicts that the plume is completely attenuated below the GWPS after approximately 60 years of MNA.

Injection of an iron-based amendment followed by MNA is predicted to decrease the remedial time frame compared to MNA alone. Under the injection scenario described in **Section 4.2.2**, the groundwater As concentration at HGWC-13 is predicted to decrease below the GWPS in approximately 2 years (**Figure 8**). These results represent a proof of concept evaluation of injection as a remedial technology and do not represent an actual estimate of remedial time frame. The mass of dissolved As is reduced by approximately 86% after 3 rounds of injections. In comparison, the same amount of mass reduction takes approximately 30 years of MNA (approximately 88% mass reduction). These results demonstrate the feasibility of the injection approach for accelerating As attenuation in comparison to an MNA scenario.

Note that these results represent a “proof of concept” evaluation of injection as a remedial technology and do not represent an actual estimate of remedial time frame. If geochemical injections are selected as part of the remedy, the time to achieve groundwater As concentrations below the GWPS will depend on the amendment selected during the design phase and how the injection remedy is implemented.

A sensitivity analysis was performed on three model parameters: 1) the size and concentration of the initial groundwater As plume, 2) the attenuation capacity of the aquifer outside of the initial plume footprint, and 3) the initial pH within the plume footprint. These parameters represent model uncertainties related to limited groundwater and soil data within the vicinity of the As exceedance well (HGWC-13). The results of the sensitivity analysis indicate that the remedial time frame at HGWC-13 is highly sensitive to the size and concentration of the initial groundwater As plume and less

sensitive to the attenuation capacity of soil outside the initial plume footprint. The amount of As desorption that occurs is also sensitive to the initial pH within the plume area due to the PZC of ferrihydrite used in the model.

7.2 Model Findings – Molybdenum

The reactive transport model described in **Section 5** was used to estimate the remedial feasibility for groundwater Mo concentrations to decrease below the GWPS under two scenarios: i) MNA, and ii) in situ injections followed by performance monitoring.

Under the MNA scenario described in **Section 5.2.1**, the groundwater Mo concentration at HGWC-8 is predicted to decrease below the GWPS in approximately 65 years (**Figure 11**). However, a small groundwater plume downgradient of HGWC-8 that exceeds the GWPS is expected to remain after 80 years of MNA; the residual plume is predicted to remain within the initial plume footprint. Under the MNA scenario, 52% of dissolved Mo in groundwater is attenuated after 65 years. Under the injection scenario described in **Section 5.2.2**, injection of an iron-based amendment followed by MNA is predicted to attenuate 57% of dissolved Mo in groundwater within 5 years and decrease the remedial time frame compared to MNA alone. These results demonstrate the feasibility of the injection approach for accelerating Mo attenuation in comparison to an MNA scenario.

Note that these results represent a “proof of concept” evaluation of injection as a remedial technology and do not represent an actual estimate of remedial time frame. If geochemical injections are selected as part of the remedy, the time to achieve groundwater Mo concentrations below the GWPS will depend on the amendment selected during the design phase and how the injection remedy is implemented.

A sensitivity analysis was performed on two model parameters: 1) the size and concentration of the initial groundwater Mo plume, and 2) the attenuation capacity of soil outside the original plume footprint. These parameters represent model uncertainties related to limited groundwater and soil data within the vicinity of the Mo exceedance well (HGWC-8). The results of the sensitivity analysis indicate that the remedial time frame at HGWC-8 is highly sensitive to the size and concentration of the initial groundwater Mo plume and less sensitive to the attenuation capacity of soil outside the initial plume footprint. The remedial time frames of areas outside of the initial groundwater Mo plume footprint, particularly areas downgradient of HGWC-8, are more sensitive to the attenuation capacity parameter than areas within the original plume footprint.

7.3 Conclusions

The reactive transport models support the GCSM and suggests that As and Mo attenuation in groundwater at AP-1 is likely due to adsorption onto naturally occurring iron oxide minerals. Within each plume area, As and Mo are present in both the dissolved phase and associated with the solid phase, which acts as a secondary source of As and Mo to groundwater as background groundwater moves through the model system. The models show that while the expected attenuation capacity of the aquifer is sufficient to prevent downgradient plume migration, some mass of both As and Mo above the GWPS is predicted to persist after long time periods.

The reactive transport models show that injection of an Fe(III)-based amendment would result in a decrease in groundwater As and Mo concentrations. The addition of iron creates additional sorption sites and attenuation capacity within the plume to adsorb dissolved As and Mo. Under the simulated injection scenarios described herein, the size and concentration of the plumes decrease faster than when MNA alone is implemented. These results demonstrate the feasibility of the injection approach for accelerating As and Mo attenuation in comparison to an MNA approach.

Ultimately, the time to achieve As and Mo concentrations below the GWPS is dependent on the size and concentration of the plume area, the amount of reactive iron oxide surfaces available for attenuation, and for As, the pH within the plume footprint. Additional data collected during the design and remedy implementation process will be evaluated to further refine these parameters. Treatability studies and pilot studies will provide vital information on the number of injection wells, optimum well locations, injectate composition, and injection rates required to achieve remediation objectives.

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TABLES

Table 1a
HGWC-13 Focused Flow Model Parameters
Plant Hammond AP-1, Floyd County, Georgia

Material	Model Layer	Kh (ft/d)	Kv (ft/d)	Effective Porosity	Dispersivity (ft): Longitudinal/Transverse/Vertical
Clean Fill Inside AP-1	1	0.29	0.029	0.1	15/1.5/0.15
Fill Outside AP-1	1 and 2	0.029	0.005	0.1	15/1.5/0.15
Dike	1 and 2	0.025	0.0025	0.085	15/1.5/0.15
Alluvium	2 and 3	2.1 to 2.22	0.21 to 0.22	0.18	15/1.5/0.15
Alluvium & Residuum	4	0.625	0.095	0.15	15/1.5/0.15
PWR	5	9.6	0.958	0.09	15/1.5/0.15
Bedrock	6	9.6	0.958	0.05	15/1.5/0.15

Notes:

1. Kh = Horizontal Conductivity.
2. Kv = Vertical Conductivity.
3. ft = feet.
4. ft/d = feet per day.
5. PWR = Partially Weathered Rock.

Sources/Rationale for Kh & Kv parameters:

- A. Clean Fill Inside AP-1: No data was available for the clean fill material that will be placed inside AP-1, so an assumed Kh value based on silt and silty sand conductivities from Domenico and Schwartz (1990) was used. Kv was assumed to be 1/10 lower than Kh.
- B. Dike: An assumed value based on silt and clay conductivities from Domenico and Schwartz (1990) was used. Kv was assumed to be 1/10 lower than Kh.
- C. Fill outside AP-1, Alluvium, Residuum, PWR, & Bedrock: Kh & Kv values are approximately based on calibrated values from the updated version of the sitewide model or slug test data.

Sources/Rationale for all other parameters:

- D. Effective Porosity: For the Dike material, a low value was used based on the assumption that the dikes are comprised of compacted silts and clays. For all other materials, effective porosity literature values from EPA were used (Table C.3.2, USEPA, 1998).
- E. Dispersivity: For longitudinal dispersivity, the value was selected based on a mixture of best professional judgement and the USEPA On-line Tools for Site Assessment Calculation (USEPA, 2021). Transverse and vertical dispersivity were based on guidance from USEPA (1998) and standard modeling practice where transverse and vertical dispersivity are 10 and 100 times smaller than longitudinal dispersivity.

Table 1b
HGWC-8 Focused Flow Model Parameters
Plant Hammond AP-1, Floyd County, Georgia

Material	Model Layer	Kh (ft/d)	Kv (ft/d)	Effective Porosity	Dispersivity (ft): Longitudinal/Transverse/Vertical
Clean Fill Inside of AP-1	1	0.29	0.029	0.1	15/1.5/0.15
Fill Outside of AP-1	1	0.29	0.029	0.1	15/1.5/0.15
Dike	1	0.025	0.0025	0.005	15/1.5/0.15
Alluvium	2	5.2	1.66	0.18	15/1.5/0.15
Alluvium & Residuum	3	6	2	0.15	15/1.5/0.15
PWR	4	9.6	0.96	0.09	15/1.5/0.15
Bedrock	5	9.59	0.959	0.05	15/1.5/0.15

Notes:

1. Kh = Horizontal Conductivity.
2. Kv = Vertical Conductivity.
3. ft = feet.
4. ft/d = feet per day.
5. PWR = Partially Weathered Rock.

Sources/Rationale for Kh & Kv parameters:

A. Clean Fill Inside AP-1: No data was available for the clean fill material that will be placed inside AP-1, so an assumed Kh value based on silt and silty sand conductivities from Domenico and Schwartz (1990) was used. Kv was assumed to be 1/10 lower than Kh.

B. Fill Outside AP-1: No data was available for the fill material outside and to the east of AP-1. Boring logs for locations east of AP-1 often did not have data for the upper most portion of the subsurface. However boring log data from deeper subsurface intervals showed that lithologies ranged from clay to silt to sand. Therefore, for the purposes of the transport modeling effort, it was assumed that the fill material was present east of AP-1. Fill outside of AP-1 was assigned an assumed Kh value based on silt and silty sand conductivities from Domenico and Schwartz (1990). Kv was assumed to be 1/10 lower than Kh.

C. Dike: An assumed value based on silt and clay conductivities from Domenico and Schwartz (1990) was used. Kv was assumed to be 1/10 lower than Kh.

D. Alluvium, Residuum, PWR, & Bedrock: Kh & Kv values are approximately based on calibrated values from the updated version of the sitewide model or slug test data.

Sources/Rationale for all other parameters:

E. Effective Porosity: For the Dike material, a low value was used based on the assumption that the dikes are comprised of compacted silts and clays. For all other materials, effective porosity literature values from EPA were used (Table C.3.2, USEPA, 1998).

F. Dispersivity: For longitudinal dispersivity, the value was selected based on a mixture of best professional judgement and the USEPA On-line Tools for Site Assessment Calculation (USEPA, 2021). Transverse and vertical dispersivity were based on guidance from USEPA (1998) and standard modeling practice where transverse and vertical dispersivity are 10 and 100 times smaller than longitudinal dispersivity.

Table 2
Arsenic Model Initial Parameters
 Plant Hammond AP-1, Floyd County, Georgia

Model Parameter	Model Area									
	General Head Boundary		Plume area (layer 3)		Beneath plume area (layers 5-6)		Outside of plume (all layers)		Recharge (precipitation)	
Units	mol/L	mg/L	mol/L	mg/L	mol/L	mg/L	mol/L	mg/L	mol/L	mg/L
Groundwater and Recharge Composition										
pH	7.15		7.34		7.65		6.41		5.30	
pe	2.57		2.03		3.50		2.60		--	
DO	4.6E-05	7.4E-01	8.1E-06	1.30E-01	1.1E-05	1.70E-01	8.8E-06	1.4E-01	2.2E-04	7.0E+00
Arsenic (III)	0.0E+00	0.0E+00	2.5E-11	8.97E-08	0.0E+00	0.00E+00	0.0E+00	0.0E+00	--	--
Arsenic (V)	0.0E+00	0.0E+00	5.2E-06	3.90E-01	0.0E+00	0.00E+00	0.0E+00	0.0E+00	--	--
Boron	1.6E-06	1.70E-02	1.5E-04	1.60E+00	4.2E-05	4.50E-01	8.2E-05	0.89	--	--
Calcium	2.6E-03	1.03E+02	4.3E-03	1.73E+02	2.2E-03	8.76E+01	3.4E-03	135	1.2E-06	5.0E-02
Chloride	2.4E-03	1.34E+01	1.8E-03	4.12E+01	1.9E-03	4.52E+01	1.3E-03	35	8.1E-06	2.0E-01
Fluoride	4.3E-06	8.20E-02	2.3E-05	4.40E-01	0.0E+00	0.00E+00	9.0E-06	0.17	--	--
Sulfur (VI)	4.9E-04	4.73E+01	3.7E-03	3.59E+02	1.2E-03	1.14E+02	3.2E-03	305	3.1E-06	3.0E-01
Barium	2.6E-07	3.50E-02	3.8E-07	5.20E-02	3.9E-07	5.30E-02	4.1E-07	0.056	--	--
Alkalinity	3.1E-03	1.87E+02	1.2E-03	6.95E+01	1.1E-03	6.40E+01	9.0E-04	5.5E+01	--	--
Magnesium	1.8E-04	4.30E+00	6.4E-04	1.56E+01	3.5E-07	4.90E+00	6.4E-04	15.5	8.2E-07	2.0E-02
Potassium	8.7E-06	3.40E-01	1.2E-04	4.60E+00	1.3E-05	5.00E-01	1.1E-04	4.2	--	--
Sodium	9.2E-04	2.11E+01	2.8E-04	6.40E+00	5.2E-04	1.20E+01	2.9E-04	6.7	5.2E-06	1.2E-01
Iron (total)	--	8.70E-02	--	8.70E-01	--	7.60E-02	--	0.16	--	--
Iron (II)	1.4E-06	--	1.5E-05	--	1.4E-07	--	2.9E-06	--	--	--
Iron (III)	1.2E-07	--	7.6E-07	--	1.4E-07	--	8.1E-09	--	--	--
Manganese (total)	--	1.80E-01	--	2.10E+00	--	1.30E-01	--	3.3	--	--
Manganese (II)	3.3E-06	--	3.8E-05	--	2.4E-06	--	6.0E-05	--	--	--
Manganese (III)	3.0E-29	--	1.3E-28	--	2.3E-28	--	9.6E-28	--	--	--
Source	HGWA-1, September 2020 groundwater monitoring event (Geosyntec, 2022a)		HGWC-13, September 2020 groundwater monitoring event (Geosyntec, 2022a)		MW-24D, September 2020 groundwater monitoring event (Geosyntec, 2022a)		MW-19, September 2020 groundwater monitoring event (Geosyntec, 2022a)		National Atmospheric Deposition Program, 2021	
Soil Composition										
Units	mol/L _{bulk}	g/L	mol/L _{bulk}	g/L	mol/L _{bulk}	g/L	mol/L _{bulk}	g/L	--	--
Ferrihydrite	3.7E-01	4.0E+01	5.2E-05	5.6E-03	3.7E-01	4.0E+01	3.7E-01	4.0E+01	--	--
Gypsum	4.8E-02	8.3E+00	4.8E-02	8.3E+00	4.8E-02	8.3E+00	4.8E-02	8.3E+00	--	--
Barite	7.1E-02	1.7E+01	7.1E-02	1.7E+01	7.1E-02	1.7E+01	7.1E-02	1.7E+01	--	--
Calcite	8.0E-02	8.3E+00	8.0E-02	8.3E+00	8.0E-02	8.3E+00	8.0E-02	8.3E+00	--	--
Source	Ferrihydrite: Iron whole-rock analysis (Geosyntec, 2022a) Barite and calcite: approximate XRD detection limits		Ferrihydrite: Sequential extraction procedure (Geosyntec, 2022a) Barite and calcite: approximate XRD detection limits		Ferrihydrite: Iron whole-rock analysis (Geosyntec, 2022a) Barite and calcite: approximate XRD detection limits		Ferrihydrite: Iron whole-rock analysis (Geosyntec, 2022a) Barite and calcite: approximate XRD detection limits			

Notes:

1. The geochemical composition of each area, along with mineralogy and adsorption parameters, was input into PHREEQC and equilibrated using sodium or chloride to the balance charge. The charge-balanced solution composition was used as the initial groundwater concentration for the model (shown above).
2. Dissolved constituent concentrations are reported in moles per liter of groundwater (mol/L), the input unit of PHT3D.
3. Solid constituent concentrations are reported in moles per liter of bulk saturated soil (mol/L_{bulk}), the input unit of PHT3D.
4. PHREEQC speciations calculations were used to determine iron(II), iron(III), manganese(II), and manganese(III) concentrations from total dissolved iron and manganese concentrations measured in groundwater in September 2020.

Abbreviations:

-- = not applicable mg/L = milligrams per liter

°C = degrees Celsius g/L = grams per liter

DO = dissolved oxygen

mol/L = moles per liter

mol/L_{bulk} = moles per liter bulk saturated soil

S.U. = standard unit

T = temperature

Table 3
Molybdenum Model Initial Parameters
Plant Hammond AP-1, Floyd County, Georgia

Model Parameter	Model Area											
	General Head Boundary		Plume area (layer 2)		Plume area (layer 3)		Plume area (layers 4 and 5)		Outside of plume (all layers)		Recharge (precipitation)	
	Units	mol/L	mg/L	mol/L	mg/L	mol/L	mg/L	mol/L	mg/L	mol/L	mg/L	
Groundwater and Recharge Composition												
pH	7.15		6.92		6.78		7.51		6.78		5.3	
pe	2.57		2.81		2.01		3.99		2.01		--	
DO	2.3E-05	7.4E-01	1.25E-05	4.0E-01	1.34E-05	4.3E-01	3.91E-05	1.3E+00	1.34E-05	4.3E-01	2.2E-04	7.0E+00
Molybdenum	0.0E+00	0.0E+00	4.5E-06	4.3E-01	0.0E+00	0.0E+00	1.9E-08	1.8E-03	0.0E+00	0.0E+00	--	--
Boron	1.6E-06	0.017	1.8E-04	1.9E+00	1.0E-05	1.2E-01	1.1E-05	1.2E-01	1.0E-05	1.2E-01	--	--
Calcium	2.6E-03	1.0E+02	3.0E-03	1.2E+02	2.7E-03	2.5E+01	6.2E-04	2.5E+01	2.7E-03	2.5E+01	1.2E-06	5.0E-02
Chloride	2.4E-03	1.3E+01	2.5E-03	7.5E+01	2.2E-03	3.0E+01	2.0E-03	3.0E+01	2.2E-03	3.0E+01	8.1E-06	2.0E-01
Fluoride	4.3E-06	8.2E-02	2.8E-05	5.3E-01	2.6E-06	5.0E-02	1.2E-05	2.2E-01	2.6E-06	5.0E-02	--	--
Sulfur	1.5E-03	4.7E+01	6.1E-03	1.9E+02	3.4E-03	1.1E+02	2.3E-04	7.5E+00	3.4E-03	1.1E+02	3.1E-06	3.0E-01
Barium	2.5E-07	3.5E-02	4.4E-07	6.0E-02	7.0E-07	9.6E-02	7.3E-06	1.0E+00	7.0E-07	9.6E-02	--	--
Alkalinity	3.1E-03	1.9E+02	1.3E-03	8.1E+01	2.3E-03	1.4E+02	1.7E-03	1.0E+02	2.3E-03	1.4E+02	--	--
Magnesium	1.8E-04	4.3E+00	6.7E-04	1.6E+01	3.5E-04	8.5E+00	7.0E-04	1.7E+01	3.5E-04	8.5E+00	8.2E-07	2.0E-02
Potassium	8.7E-06	3.4E-01	1.8E-04	7.1E+00	5.6E-06	2.2E-01	2.4E-05	9.5E-01	5.6E-06	2.2E-01	--	--
Sodium	9.2E-04	2.1E+01	3.7E-04	8.5E+00	4.5E-04	1.0E+01	1.2E-03	2.7E+01	4.5E-04	1.0E+01	5.2E-06	1.2E-01
Iron	1.6E-06	8.7E-02	5.4E-06	3.0E-01	5.0E-05	2.8E+00	2.7E-06	1.5E-01	5.0E-05	2.8E+00	--	--
Manganese	3.3E-06	1.8E-01	4.0E-06	2.2E-01	4.4E-06	2.4E-01	2.4E-06	1.3E-01	4.4E-06	2.4E-01	--	--
Source	HGWA-1, September 2020 groundwater monitoring event (Geosyntec, 2022)		HGW-8, September 2020 groundwater monitoring event (Geosyntec, 2022)		MW-20, September 2020 groundwater monitoring event (Geosyntec, 2022)		MW-27D, September 2020 groundwater monitoring event (Geosyntec, 2022)		MW-20, September 2020 groundwater monitoring event (Geosyntec, 2022)		National Atmospheric Deposition Program, 2021	
Soil Composition												
Units	mol/L _{bulk}	g/L	mol/L _{bulk}	g/L	mol/L _{bulk}	g/L	mol/L _{bulk}	g/L	mol/L _{bulk}	g/L	--	--
Ferrihydrite	5.7E-01	6.1E+01	4.7E-02	5.0E+00	5.7E-01	6.1E+01	5.7E-01	6.1E+01	5.7E-01	6.1E+01	--	--
Barite	4.0E-02	8.3E+00	4.0E-02	8.3E+00	4.0E-02	8.3E+00	4.0E-02	8.3E+00	4.0E-02	8.3E+00	--	--
Calcite	8.0E-02	8.3E+00	8.0E-02	8.3E+00	8.0E-02	8.3E+00	8.0E-02	8.3E+00	8.0E-02	8.3E+00	--	--
Source	Ferrihydrite: Iron whole-rock analysis (Geosyntec, 2022) Barite and calcite: approximate XRD detection limits		Ferrihydrite: Sequential extraction procedure (Geosyntec, 2022) Barite and calcite: approximate XRD detection limits		Ferrihydrite: Iron whole-rock analysis (Geosyntec, 2022) Barite and calcite: approximate XRD detection limits		Ferrihydrite: Iron whole-rock analysis (Geosyntec, 2022) Barite and calcite: approximate XRD detection limits		Ferrihydrite: Iron whole-rock analysis (Geosyntec, 2022) Barite and calcite: approximate XRD detection limits			

Notes:

1. The geochemical composition of each area, along with mineralogy and adsorption parameters, was input into PHREEQC and equilibrated using sodium or chloride to the balance charge. The charge-balanced solution composition was used as the initial groundwater concentration for the model (shown above).
2. Dissolved constituent concentrations are reported in moles per liter of groundwater (mol/L), the input unit of PHT3D.
3. Solid constituent concentrations are reported in moles per liter of bulk saturated soil (mol/L_{bulk}), the input unit of PHT3D.

Abbreviations:

-- = not applicable

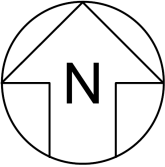
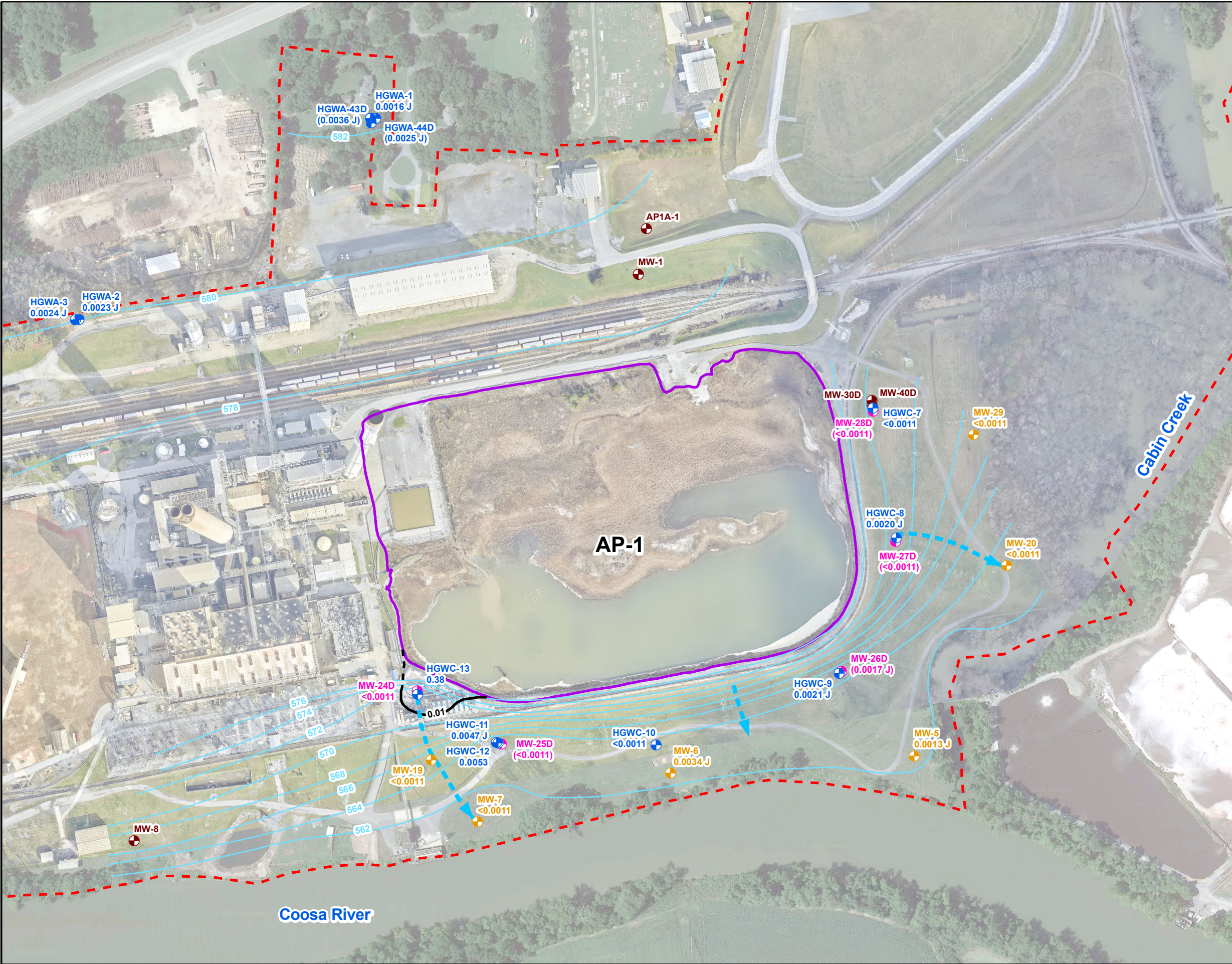
DO = dissolved oxygen

mol/L = moles per liter

mol/L_{bulk} = moles per liter bulk saturated soil

S.U. = standard unit

FIGURES



LEGEND

- Compliance Monitoring Well
- Horizontal Delineation Well
- Vertical Delineation Well (Not Used for Contouring)
- Piezometer
- GWPS Arsenic Iso-Concentration Contour (mg/L) (dashed where inferred)
- Groundwater Elevation Iso-Contour
- Approximate Groundwater Flow
- Approximate AP-1 Boundary
- Plant Hammond Property Boundary

- Notes:
- Concentration data from groundwater samples collected during the February 2022 semiannual monitoring event. Data reported for wells screened deeper in the aquifer were not used to generate the iso-concentration contour (HGWA-43D, HGWA-44D, MW-24D, MW-25D, MW-26D, MW-27D, MW-28D). Concentrations are reported in mg/L.
 - Water level elevation recorded on January 31, 2022. Elevation provided in feet (ft) referenced to the North American Vertical Datum (NAVD) 88.
 - The Groundwater Protection Standard (GWPS) for arsenic is 0.01 mg/L.
 - Aerial photograph source: Google Earth Pro, August 2019, And Georgia Power Company, January 2022.

0 150 300 600
SCALE IN FEET

**ISO-CONCENTRATION MAP
ARSENIC - FEBRUARY 2022**

GEORGIA POWER COMPANY
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

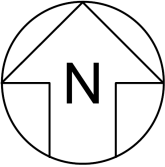
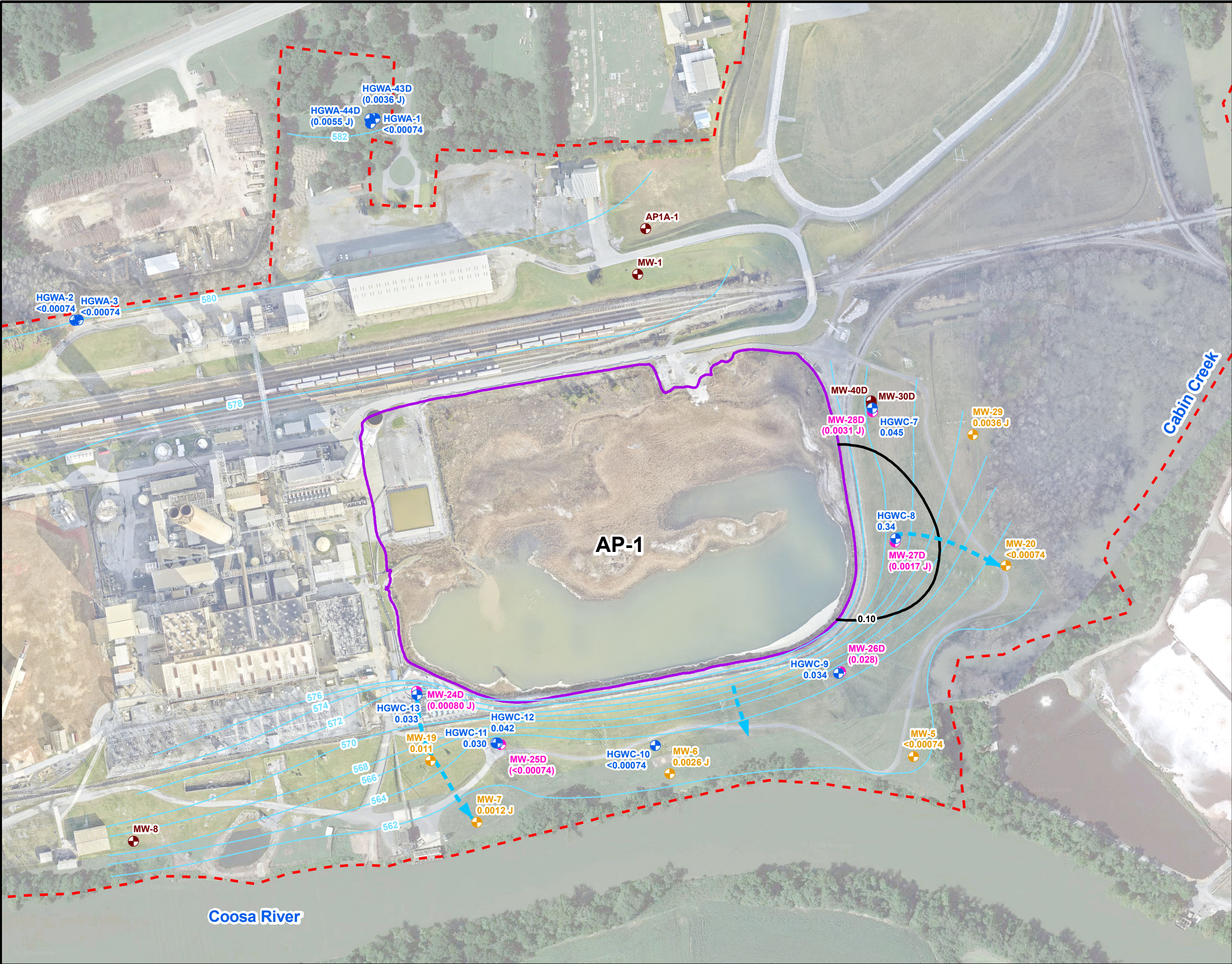
Prepared For: Georgia Power

Prepared By: Geosyntec
consultants

KENNESAW, GA

AUGUST 2022

**FIGURE
1**



- LEGEND**
- Compliance Monitoring Well
 - Horizontal Delineation Well
 - Vertical Delineation Well (Not Used for Contouring)
 - Piezometer
 - GWPS Molybdenum Iso-Concentration Contour (mg/L)
 - Groundwater Elevation Iso-Contour
 - Approximate Groundwater Flow
 - Approximate AP-1 Boundary
 - Plant Hammond Property Boundary

Notes:

- Concentration data from groundwater samples collected during the February 2022 semiannual monitoring event. Data reported for wells screened deeper in the aquifer were not used to generate the iso-concentration contour (HGWA-43D, HGWA-44D, MW-24D, MW-25D, MW-26D, MW-27D, MW-28D). Concentrations are reported in mg/L.
- Water level elevation recorded on January 31, 2022. Elevation provided in feet (ft) referenced to the North American Vertical Datum (NAVD) 88.
- The Groundwater Protection Standard (GWPS) for molybdenum is 0.10 mg/L.
- Aerial photograph source: Google Earth Pro, August 2019, And Georgia Power Company, January 2022.



**ISO-CONCENTRATION MAP
MOLYBDENUM - FEBRUARY 2022**

GEORGIA POWER COMPANY
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

Prepared For:  Georgia Power

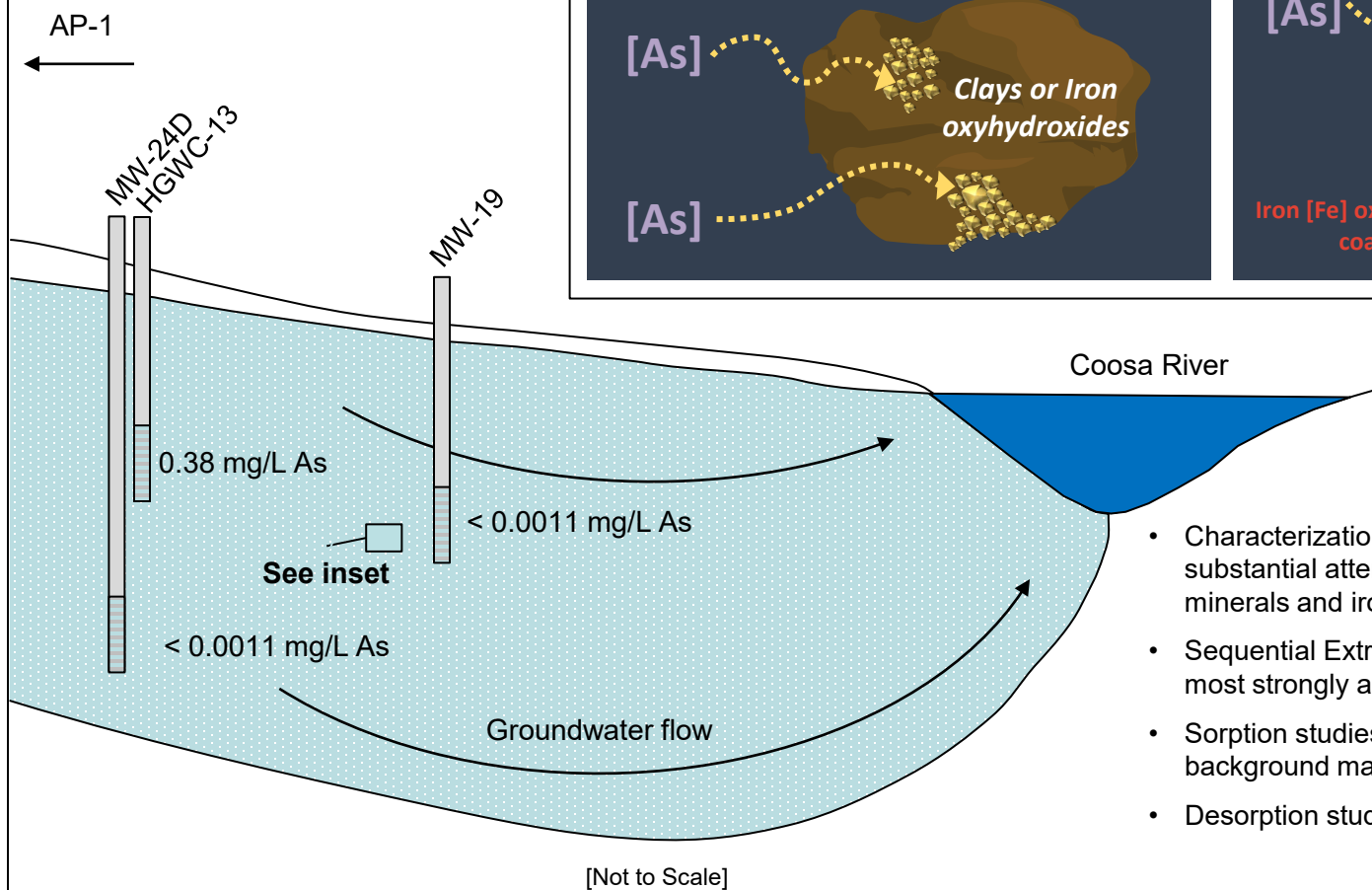
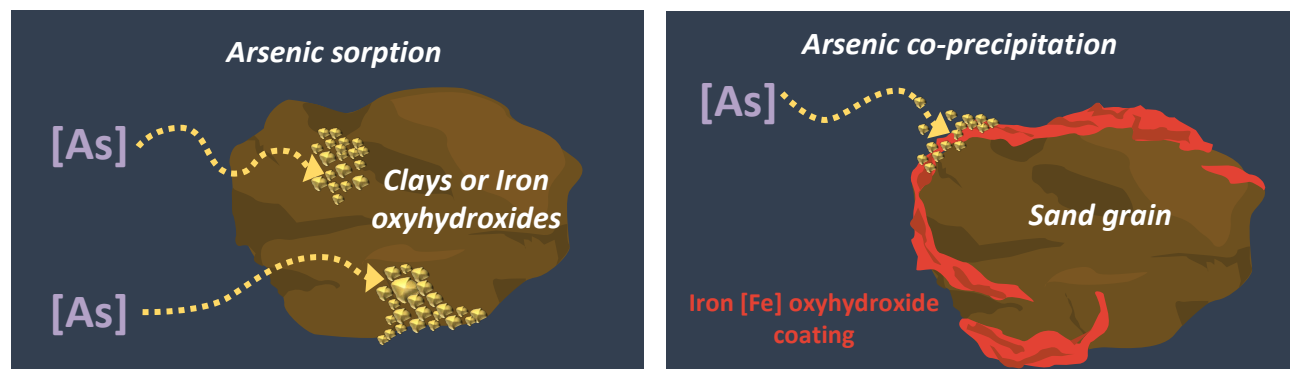
Prepared By:  Geosyntec
consultants

KENNESAW, GA

AUGUST 2022

**FIGURE
2**

Arsenic Attenuation Mechanisms



- Characterization of aquifer solids around AP-1 indicates substantial attenuation capacity (presence of clay minerals and iron oxyhydroxides)
- Sequential Extraction Procedure (SEP) suggests As is most strongly associated with metal oxyhydroxides
- Sorption studies confirm As is strongly sorbed by background materials
- Desorption studies confirm desorption of As is occurring

GEOCHEMICAL CONCEPTUAL SITE MODEL ILLUSTRATION - ARSENIC

GEORGIA POWER COMPANY
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

Geosyntec
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Georgia Power

FIGURE
3

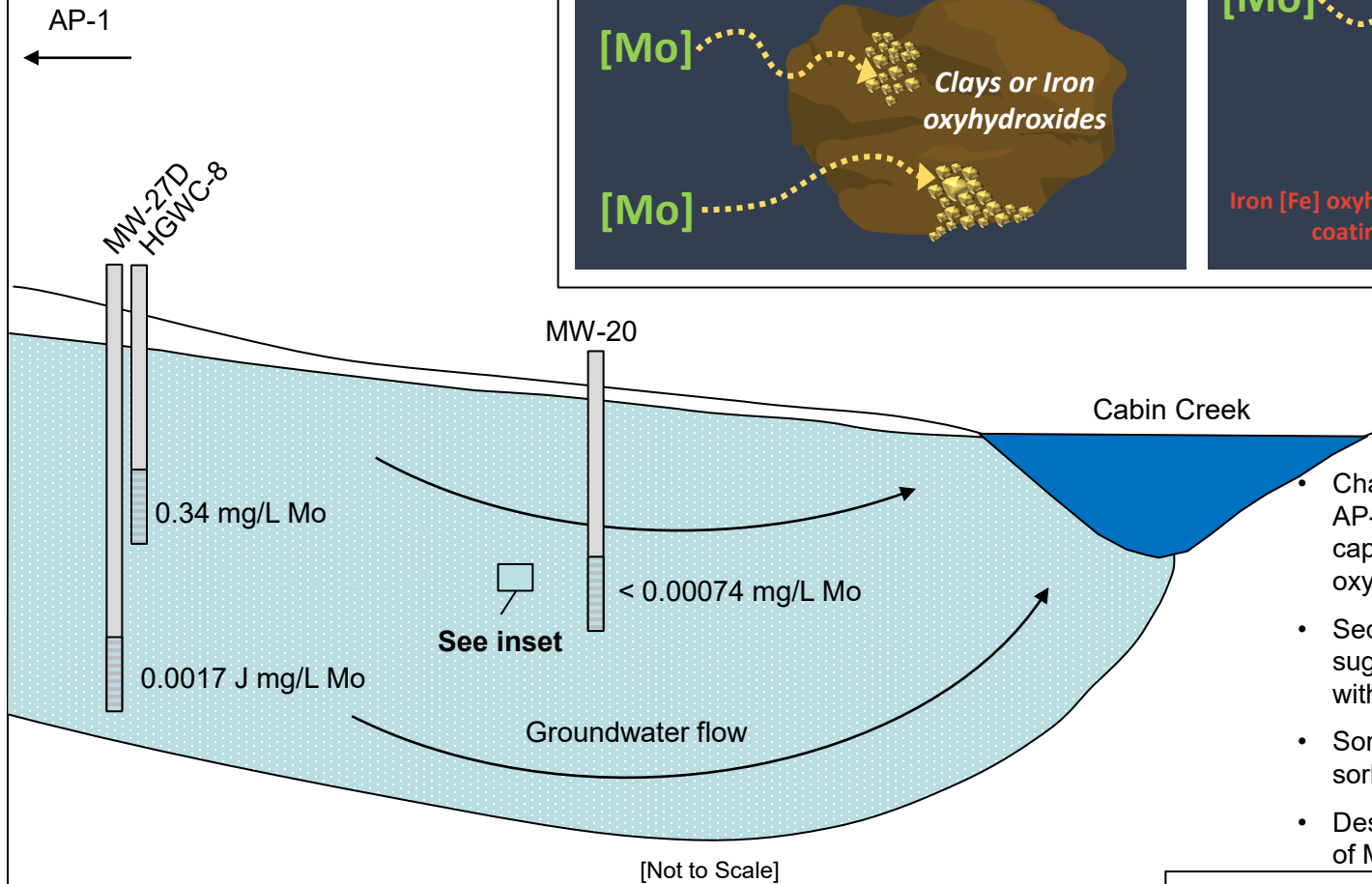
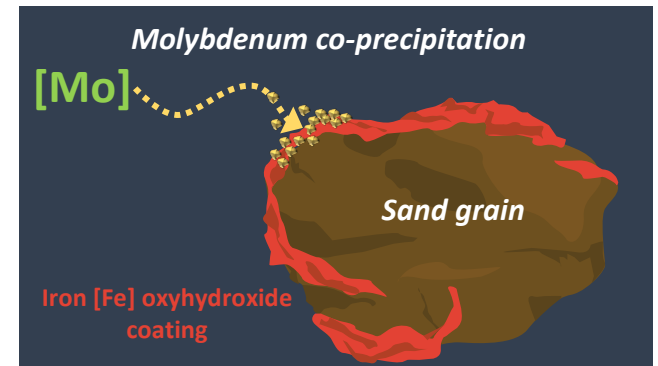
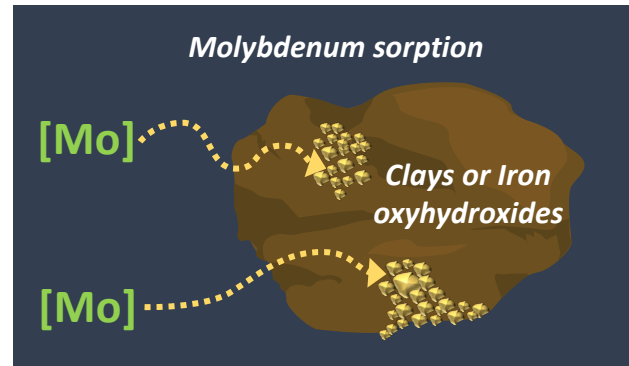
KENNESAW, GA

AUGUST 2022

Notes:

1. Arsenic (As) concentrations in milligrams per liter (mg/L) measured in February 2022

Molybdenum Attenuation Mechanisms



- Characterization of aquifer solids around AP-1 indicates substantial attenuation capacity (presence of clay minerals and iron oxyhydroxides)
- Sequential Extraction Procedure (SEP) suggests Mo is most strongly associated with metal oxyhydroxides
- Sorption studies confirm Mo is strongly sorbed by background materials
- Desorption studies confirm some desorption of Mo is occurring

Notes:

1. Molybdenum (Mo) concentrations in milligrams per liter (mg/L) measured in February 2022
2. J = estimated (detected between the method detection limit and reporting limit)

GEOCHEMICAL CONCEPTUAL SITE MODEL ILLUSTRATION - MOLYBDENUM

GEORGIA POWER COMPANY
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

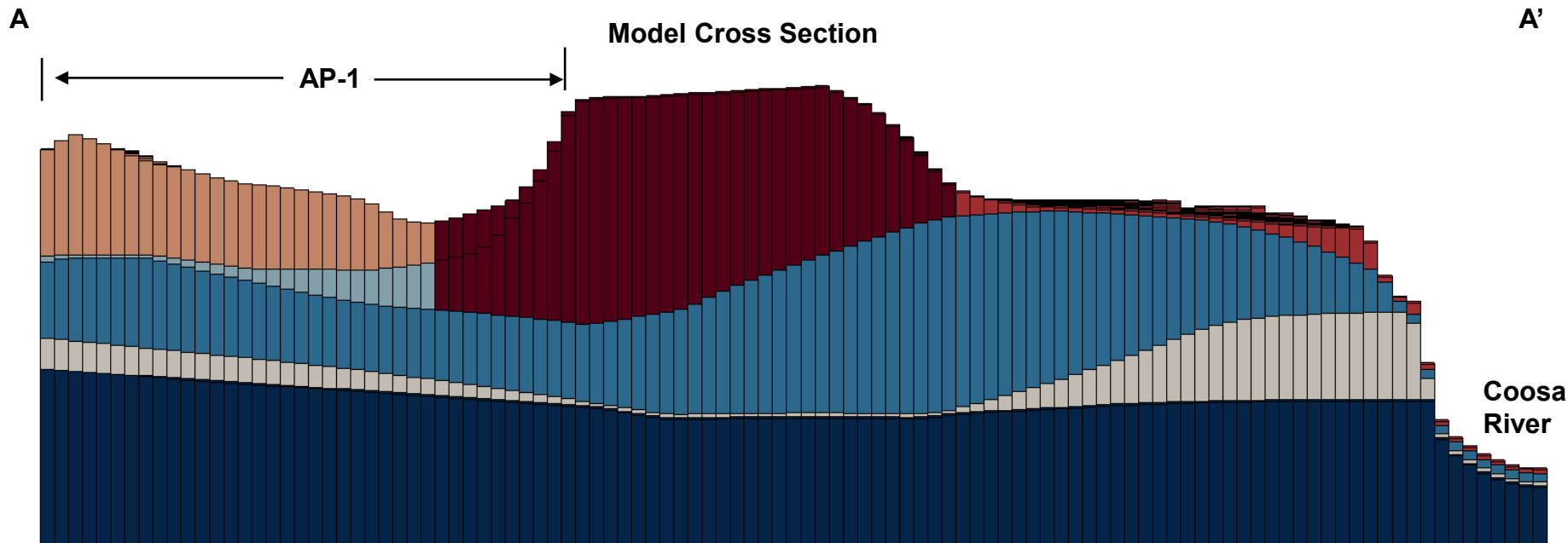
Geosyntec
consultants

Georgia Power

FIGURE
4

KENNESAW, GA

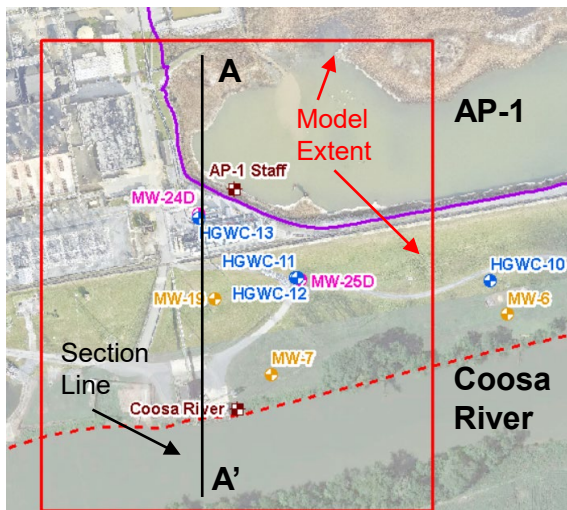
AUGUST 2022



Notes:

- 1.) PWR = Partially Weathered Rock.
- 2.) Layer 5 is present in the cross section above. However, at the location shown above, it is a very thin layer and not easily distinguishable at the scale presented.

Model Cross Section Location Map



Model Cross Section Legend

	Layer 1: Clean Fill Inside AP-1
	Layer 1 & 2 : Fill Outside AP-1
	Layer 1 & 2: Dike
	Layer 2: Alluvium
	Layer 3: Alluvium
	Layer 4: Alluvium & Residuum
	Layer 5 & 6: PWR & Bedrock

Model Layering	
Material	Model Layer
Clean Fill Inside of AP-1	1
Fill Outside of AP-1	1 & 2
Dike	1 & 2
Alluvium	2 & 3
Alluvium & Residuum	4
PWR	5
Bedrock	6

**HGWC-13 FOCUSED FLOW MODEL:
LAYERING & CROSS SECTION**

GEORGIA POWER COMPANY
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

Prepared For:



KENNESAW, GA

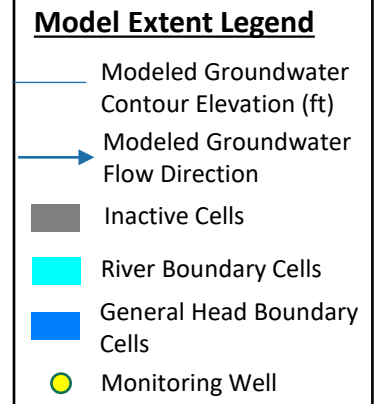
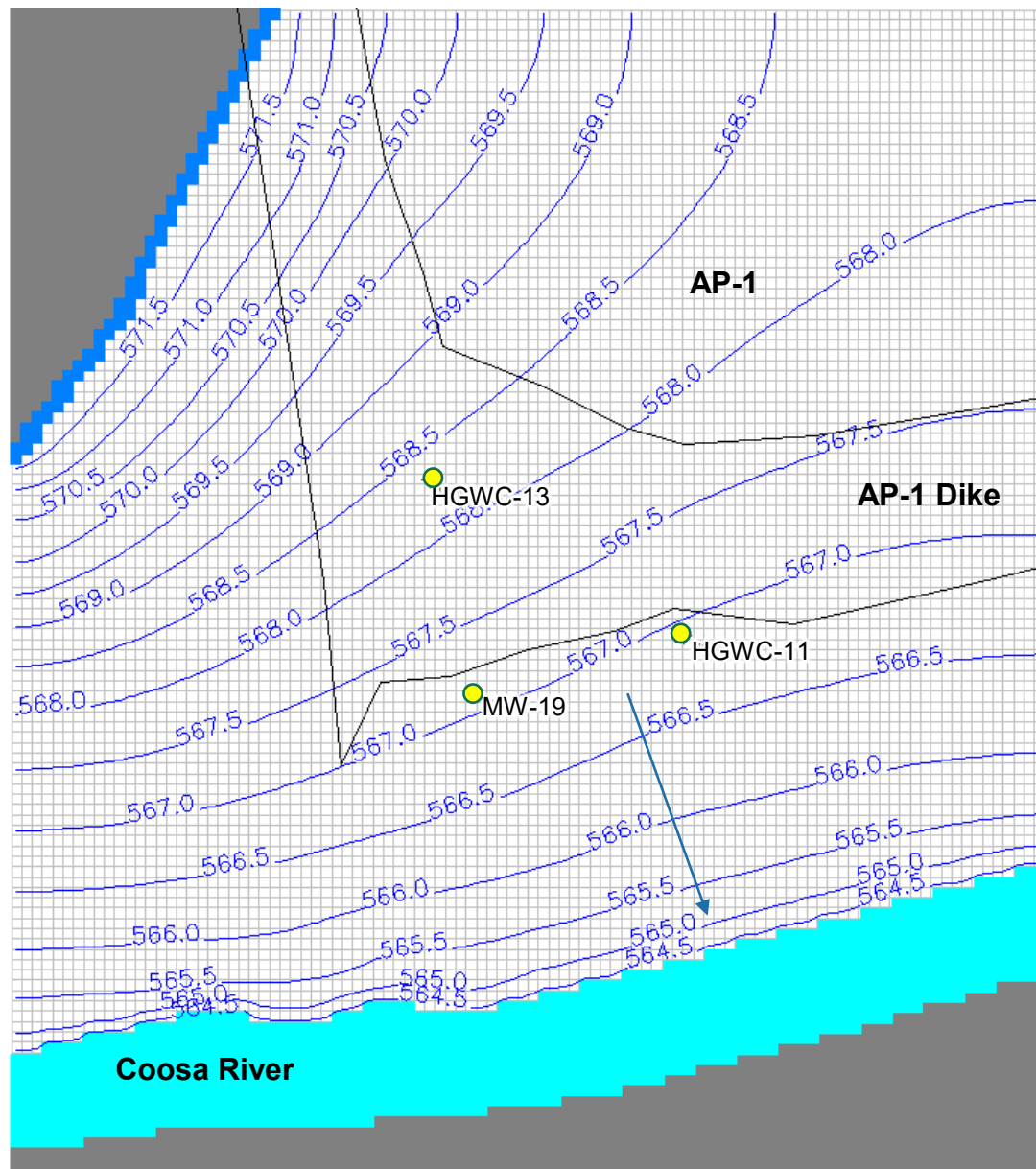
Prepared By:



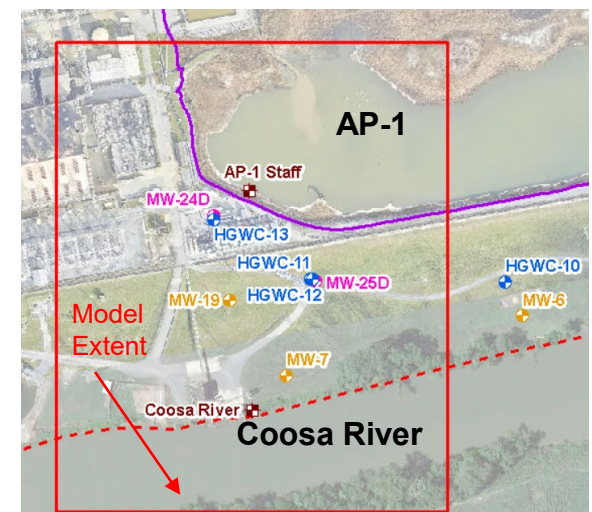
AUGUST 2022

FIGURE

5a



Model Location Map



Boundary	MODFLOW Package	Model Layer	Elevation (ft)	Conductance (ft ² /d)
General Head	General Head	1 to 2	576	10 to 100
General Head	General Head	3	572	100
General Head	General Head	4	571	100
General Head	General Head	5 to 6	570	100
Coosa River	River	1 to 3	564.1	1400 to 144

Notes:
 1.) Contour Interval is 0.5 ft.
 2.) Model extent shown above is from layer 3.

**HGWC-13 FOCUSED FLOW MODEL:
BOUNDARY CONDITIONS**

GEORGIA POWER COMPANY
 PLANT HAMMOND AP-1
 ROME, FLOYD COUNTY, GEORGIA

Prepared For:



KENNESAW, GA

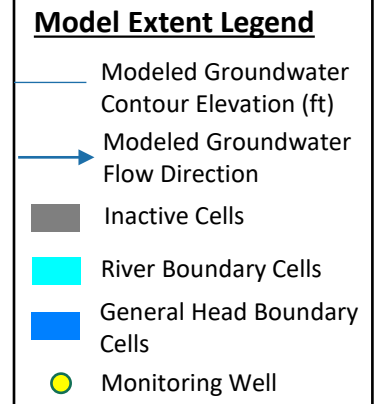
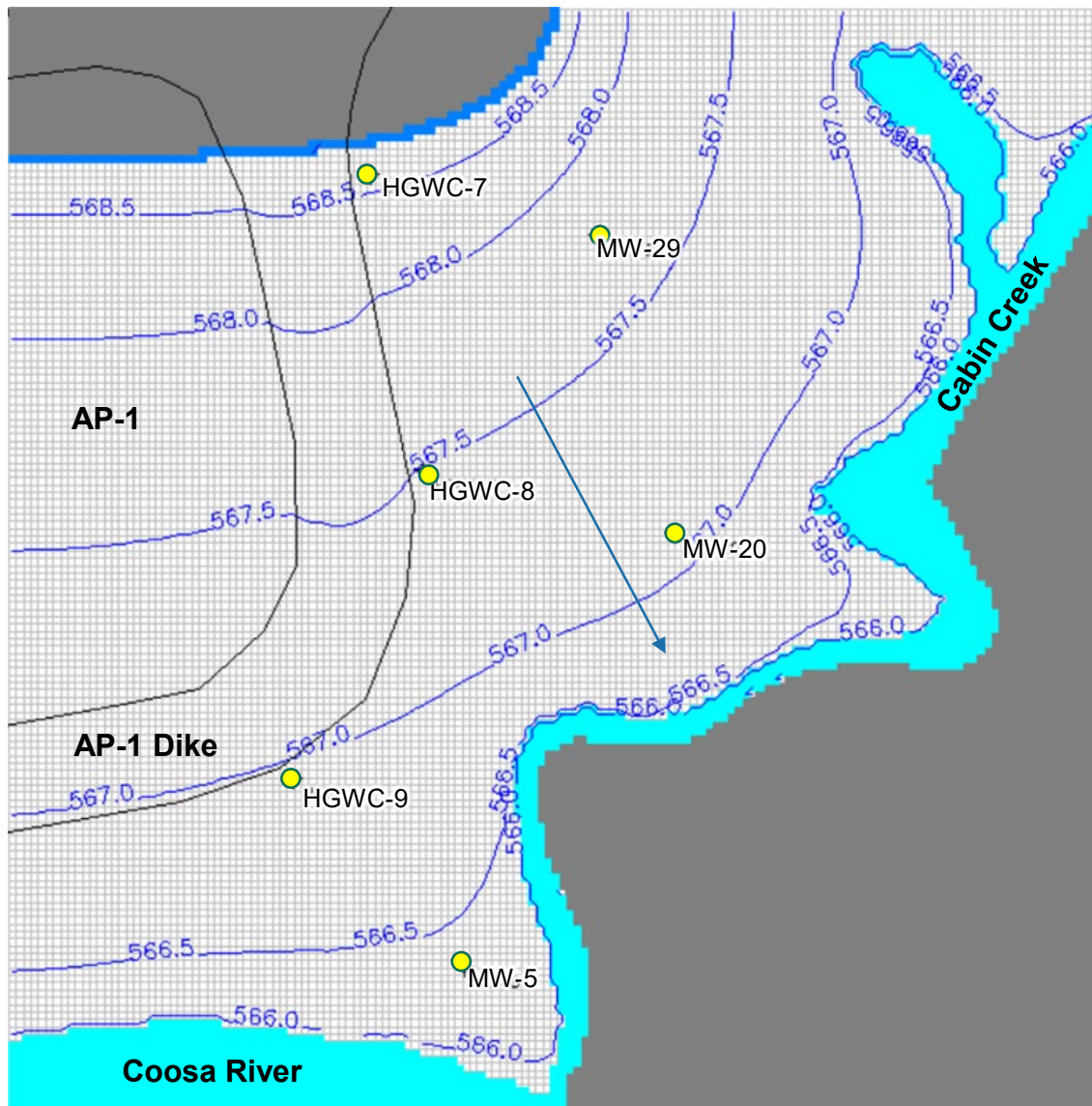
Prepared By:



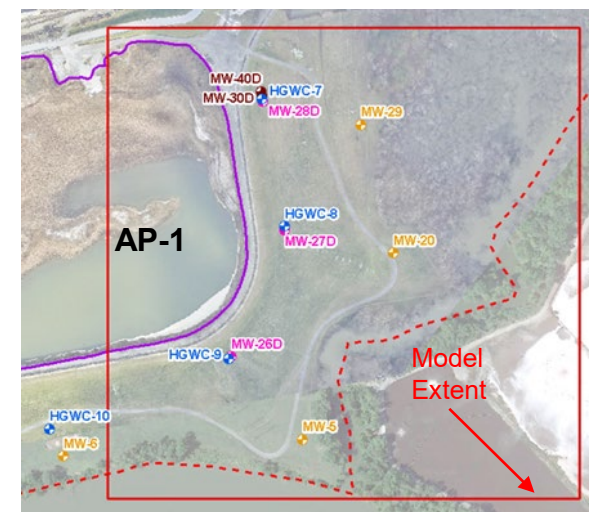
AUGUST 2022

FIGURE

5b



Model Location Map



Boundary	MODFLOW Package	Model Layer	Elevation (ft)	Conductance (ft ² /d)
General Head	General Head	1 to 5	569	50
Cabin Creek	River	1	565.7	14
Coosa River	River	1	565.3	144

Notes:
 1.) Contour Interval is 0.5 ft.
 2.) Model extent shown above is from layer 1.

**HGWC-8 FOCUSED FLOW MODEL:
BOUNDARY CONDITIONS**

GEORGIA POWER COMPANY
 PLANT HAMMOND AP-1
 ROME, FLOYD COUNTY, GEORGIA

Prepared For:



KENNESAW, GA

Prepared By:

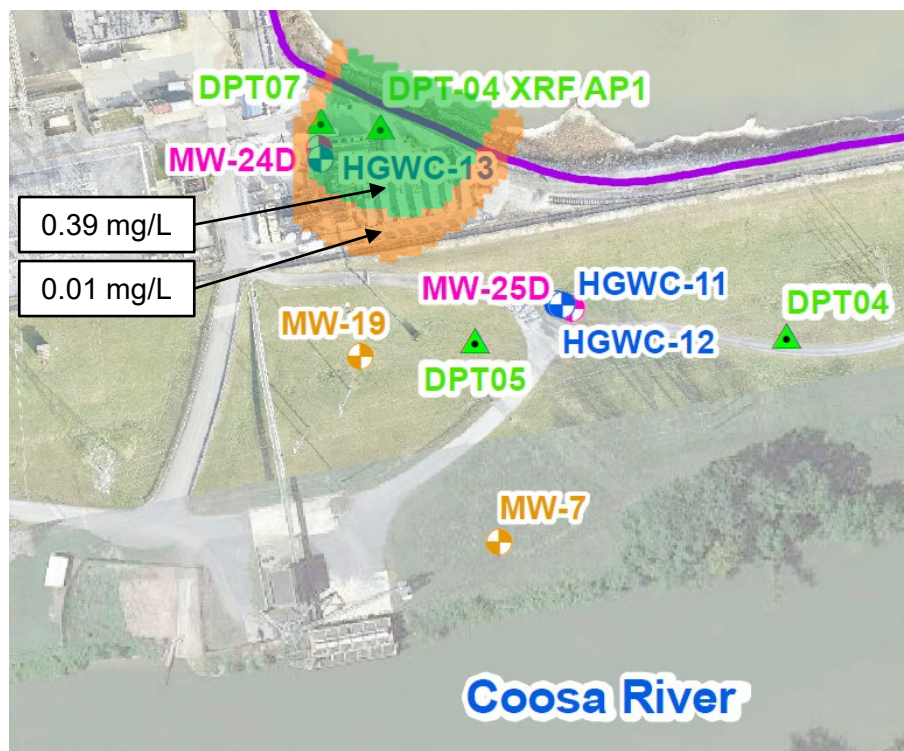


AUGUST 2022

FIGURE

6b

Plume A: Contoured Groundwater Arsenic Plume



Plume B: Limited Footprint Groundwater Arsenic Plume



Abbreviations:
mg/L = milligrams per liter

INITIAL GROUNDWATER PLUME LAYOUTS – ARSENIC MODEL

GEORGIA POWER COMPANY
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

Prepared For:
 Georgia Power

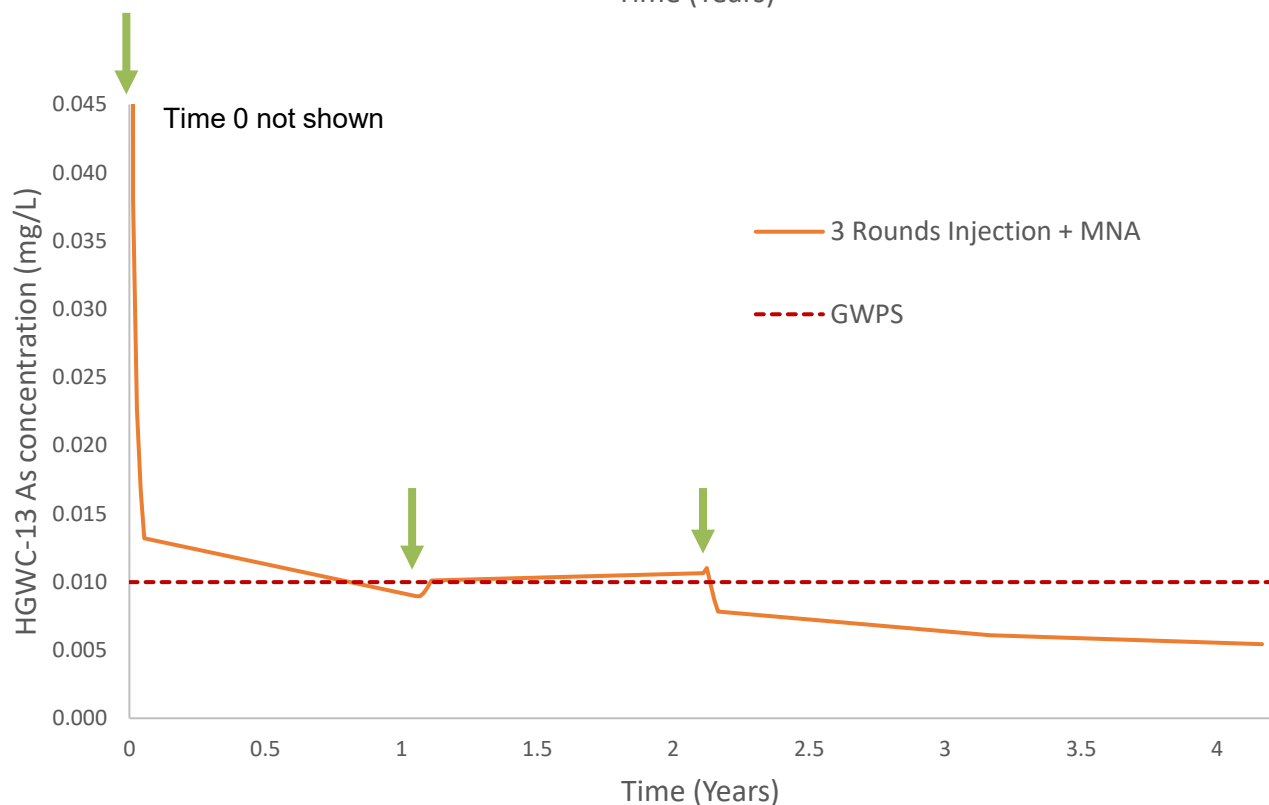
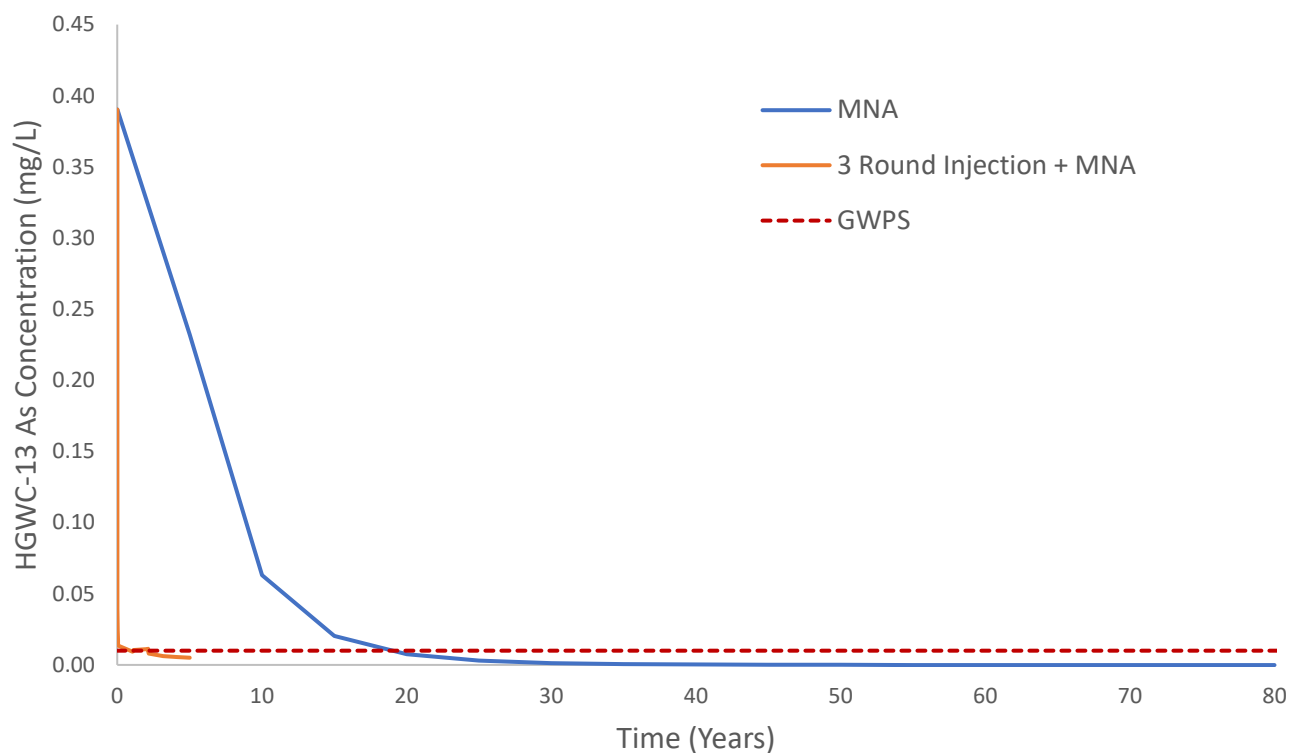
Prepared By:
 Geosyntec
consultants

KENNESAW, GA

AUGUST 2022

FIGURE

7



Notes:
 The arsenic GWPS is 0.01 mg/L.
 Green vertical arrows indicate the initiation of each round of injection.
 The results shown in the plots above are the same although presented with two different time scales to show a shorter time frame for the injection model scenario.

Abbreviations:
 GWPS = groundwater protection standard mg/L = milligrams per liter
 As = arsenic
 MNA = monitored natural attenuation

MODEL RESULTS – ARSENIC CONCENTRATION TIME SERIES

GEORGIA POWER COMPANY
 PLANT HAMMOND AP-1
 ROME, FLOYD COUNTY, GEORGIA

Prepared For:
Georgia Power

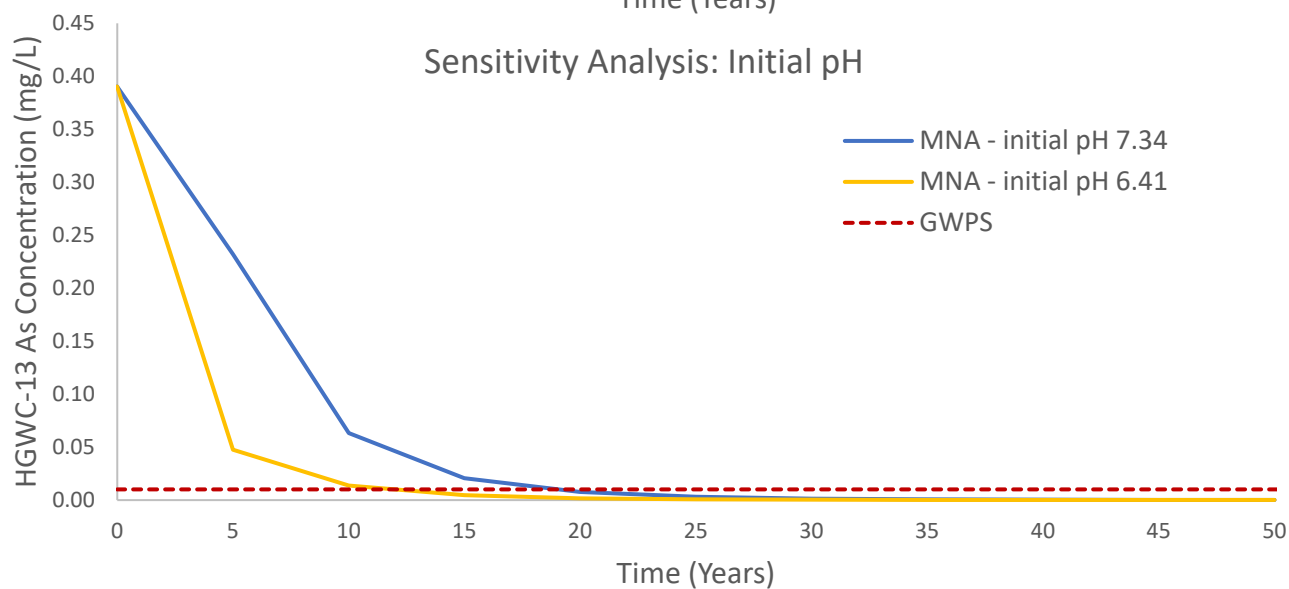
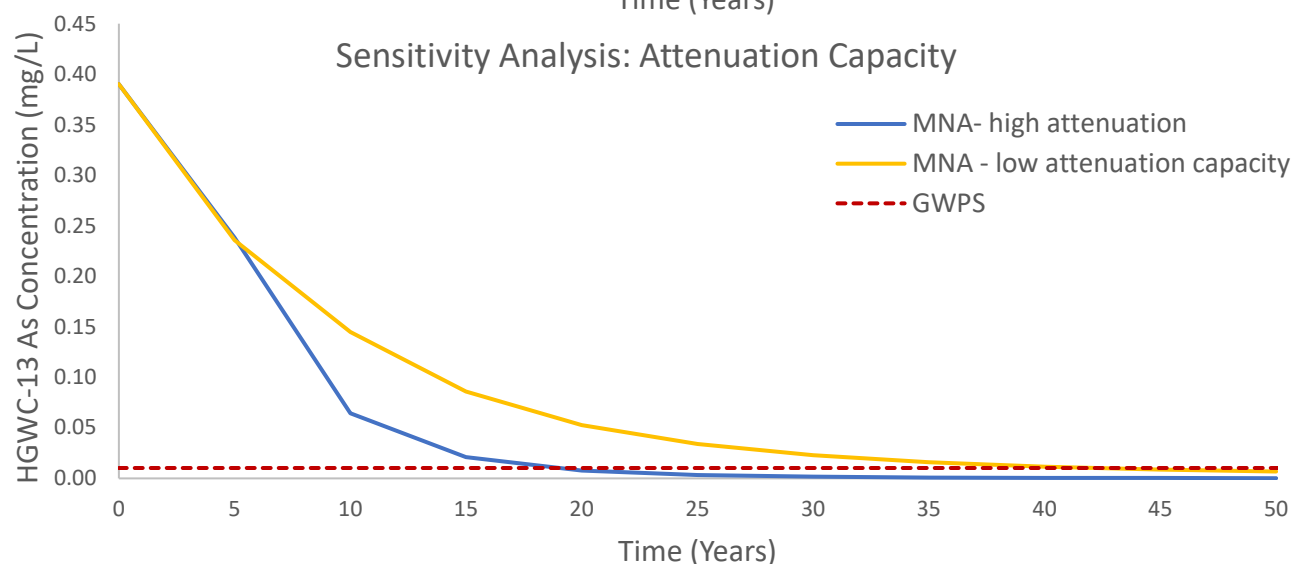
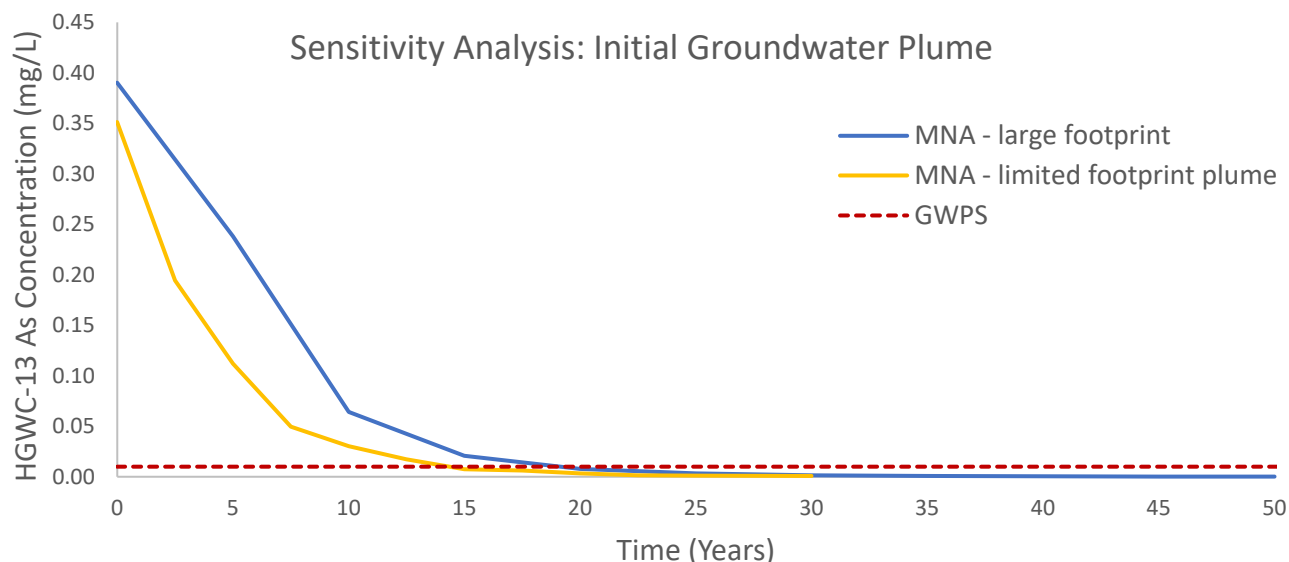
Prepared By:
Geosyntec
 consultants

KENNESAW, GA

AUGUST 2022

FIGURE

8



Notes:
The arsenic GWPS is 0.01 mg/L.

Abbreviations:
GWPS = groundwater protection standard
As = arsenic
MNA = monitored natural attenuation
mg/L = milligrams per liter

SENSITIVITY ANALYSIS RESULTS – ARSENIC CONCENTRATION TIME SERIES

GEORGIA POWER COMPANY
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

Prepared For:
 Georgia Power

Prepared By:
 Geosyntec consultants

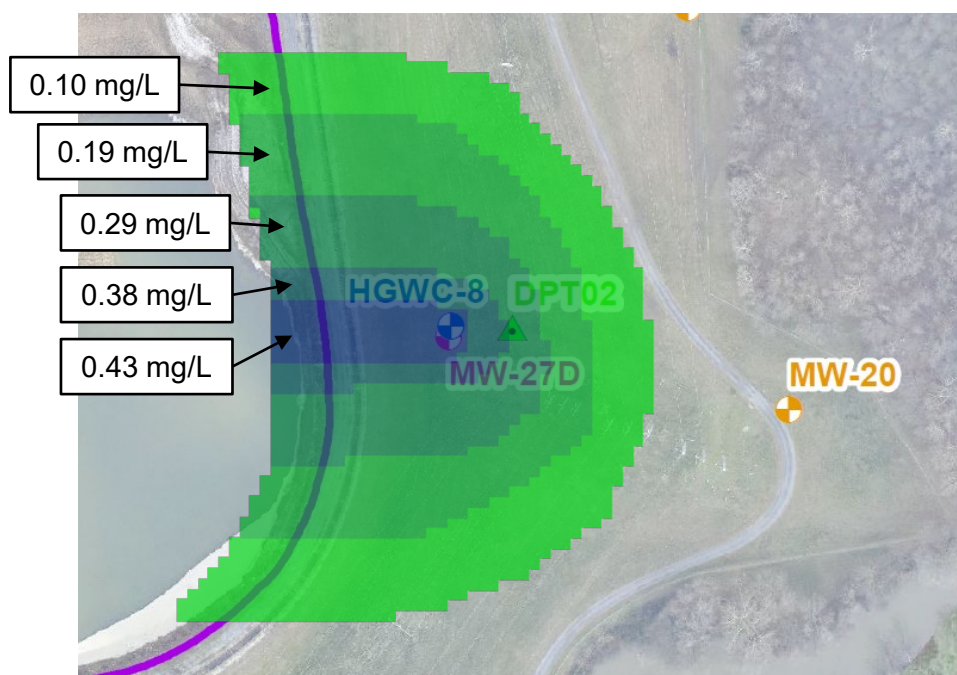
KENNESAW, GA

AUGUST 2022

FIGURE

9

Plume A: Contoured Groundwater Molybdenum Plume



Plume B: Limited Footprint Groundwater Molybdenum Plume



Abbreviations:
mg/L = milligrams per liter

INITIAL GROUNDWATER PLUME LAYOUTS – MOLYBDENUM MODEL

GEORGIA POWER COMPANY
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

Prepared For:
 Georgia Power

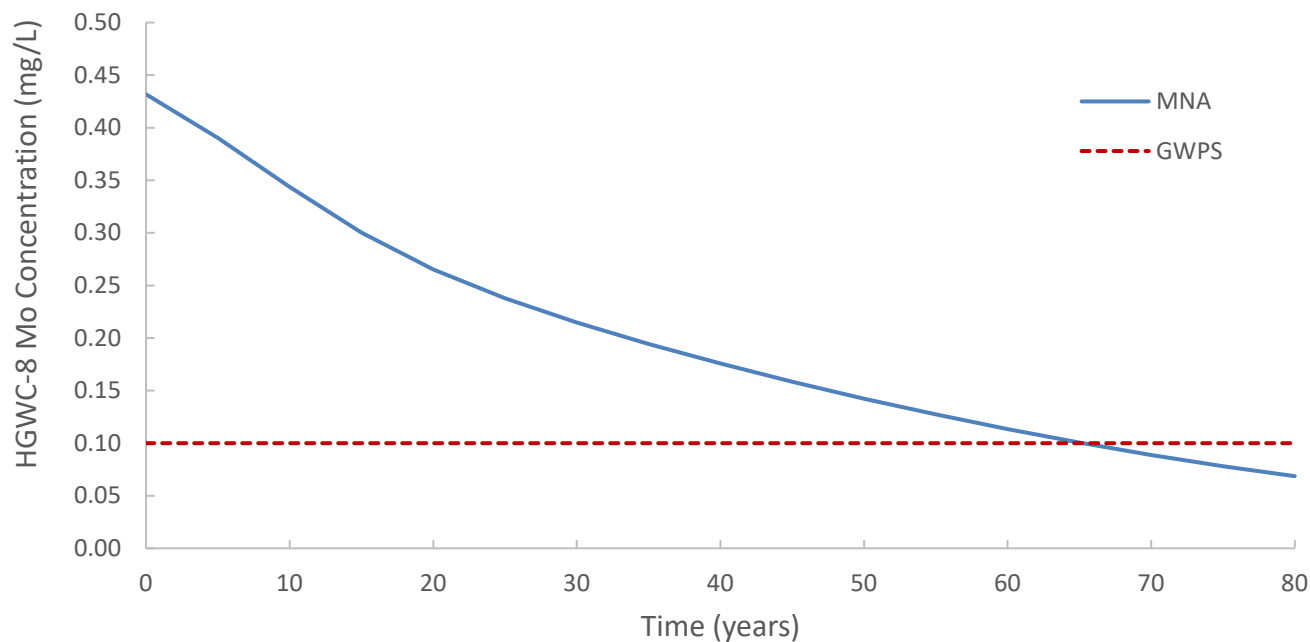
Prepared By:
 Geosyntec
consultants

KENNESAW, GA

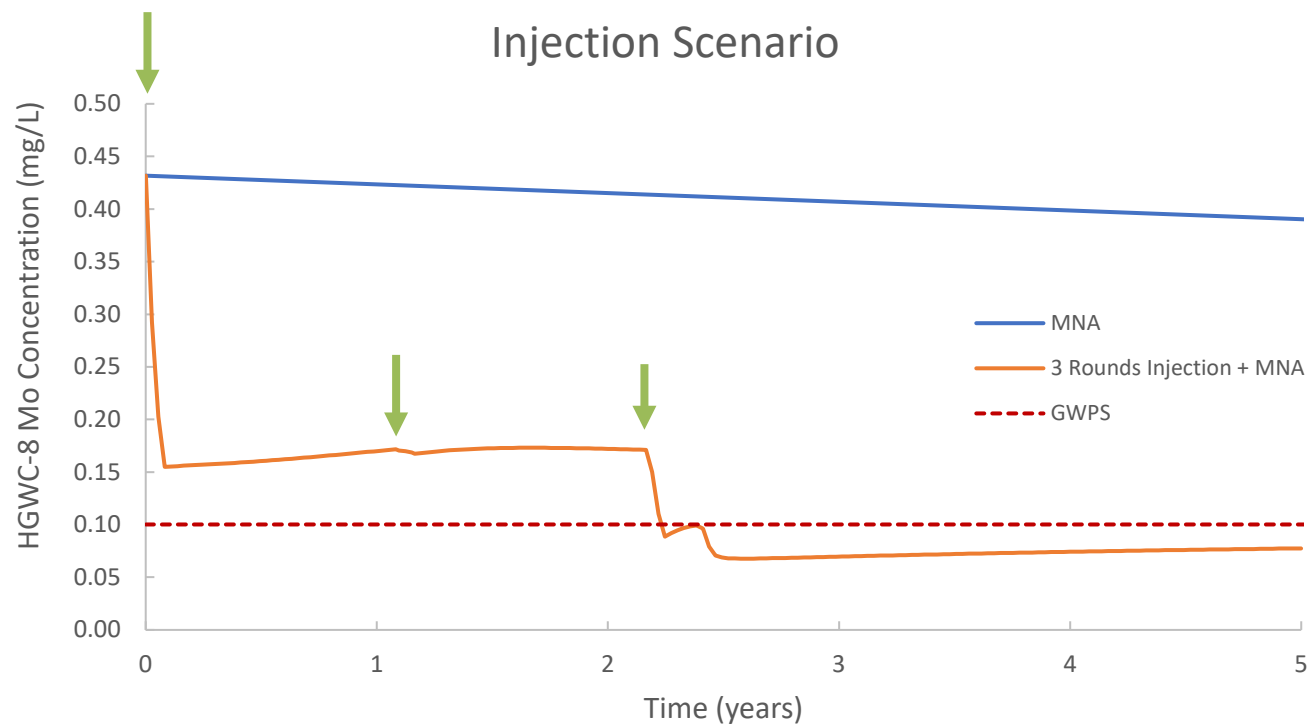
AUGUST 2022

FIGURE
10

MNA Scenario



Injection Scenario



Notes:
The molybdenum GWPS is 0.1 mg/L.
Green vertical arrows indicate the initiation of each round of injection.

Abbreviations:
GWPS = groundwater protection standard
Mo = molybdenum
MNA = monitored natural attenuation
mg/L = milligrams per liter

MODEL RESULTS – MOLYBDENUM CONCENTRATION TIME SERIES

GEORGIA POWER COMPANY
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

Prepared For:

Georgia Power

Prepared By:

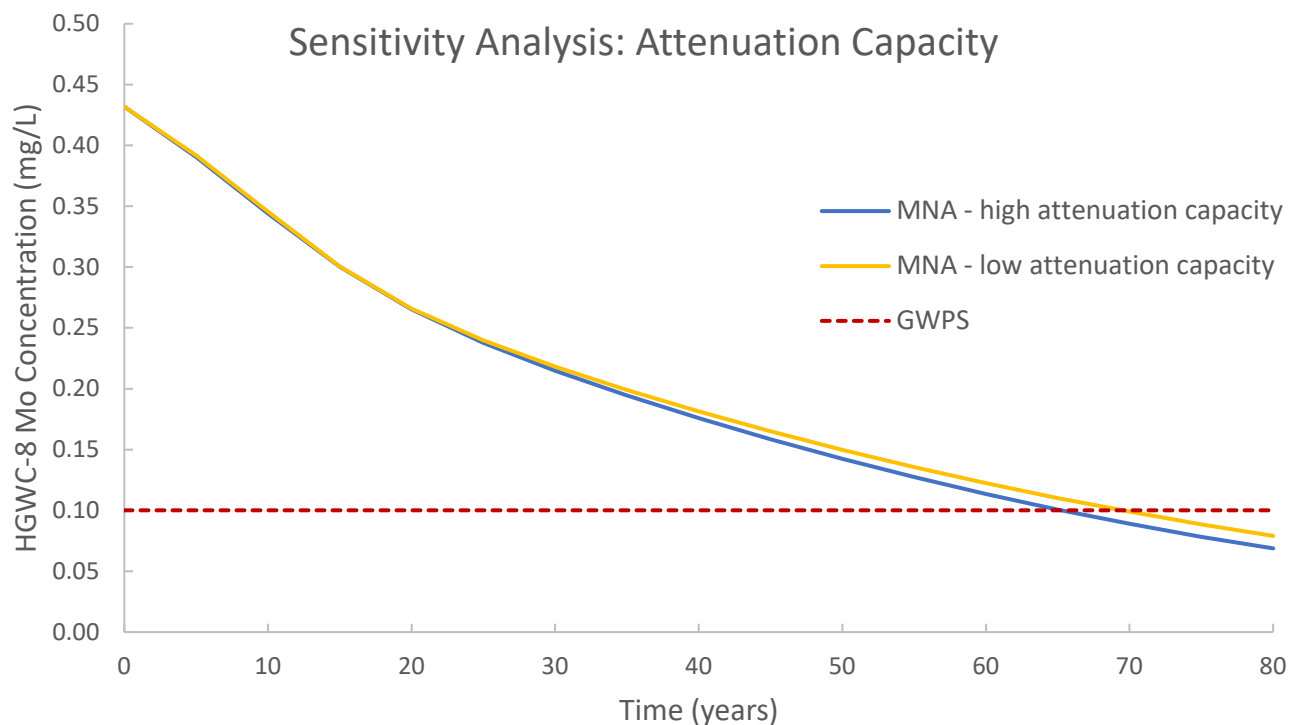
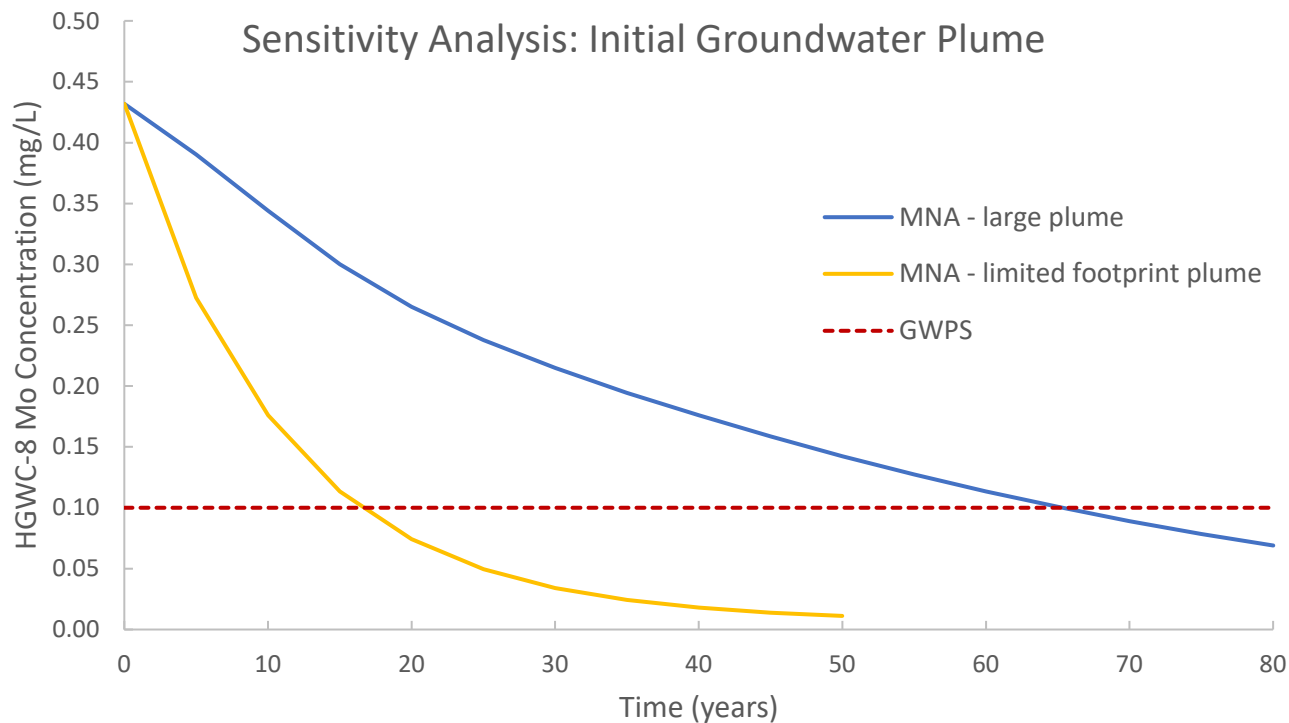
Geosyntec
consultants

KENNESAW, GA

AUGUST 2022

FIGURE

11



Notes:
The molybdenum GWPS is 0.1 mg/L.

Abbreviations:
GWPS = groundwater protection standard
Mo = molybdenum
MNA = monitored natural attenuation
mg/L = milligrams per liter

SENSITIVITY ANALYSIS RESULTS – MOLYBDENUM CONCENTRATION TIME SERIES

GEORGIA POWER COMPANY
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

Prepared For:
 Georgia Power

Prepared By:
 Geosyntec
consultants

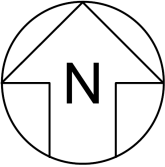
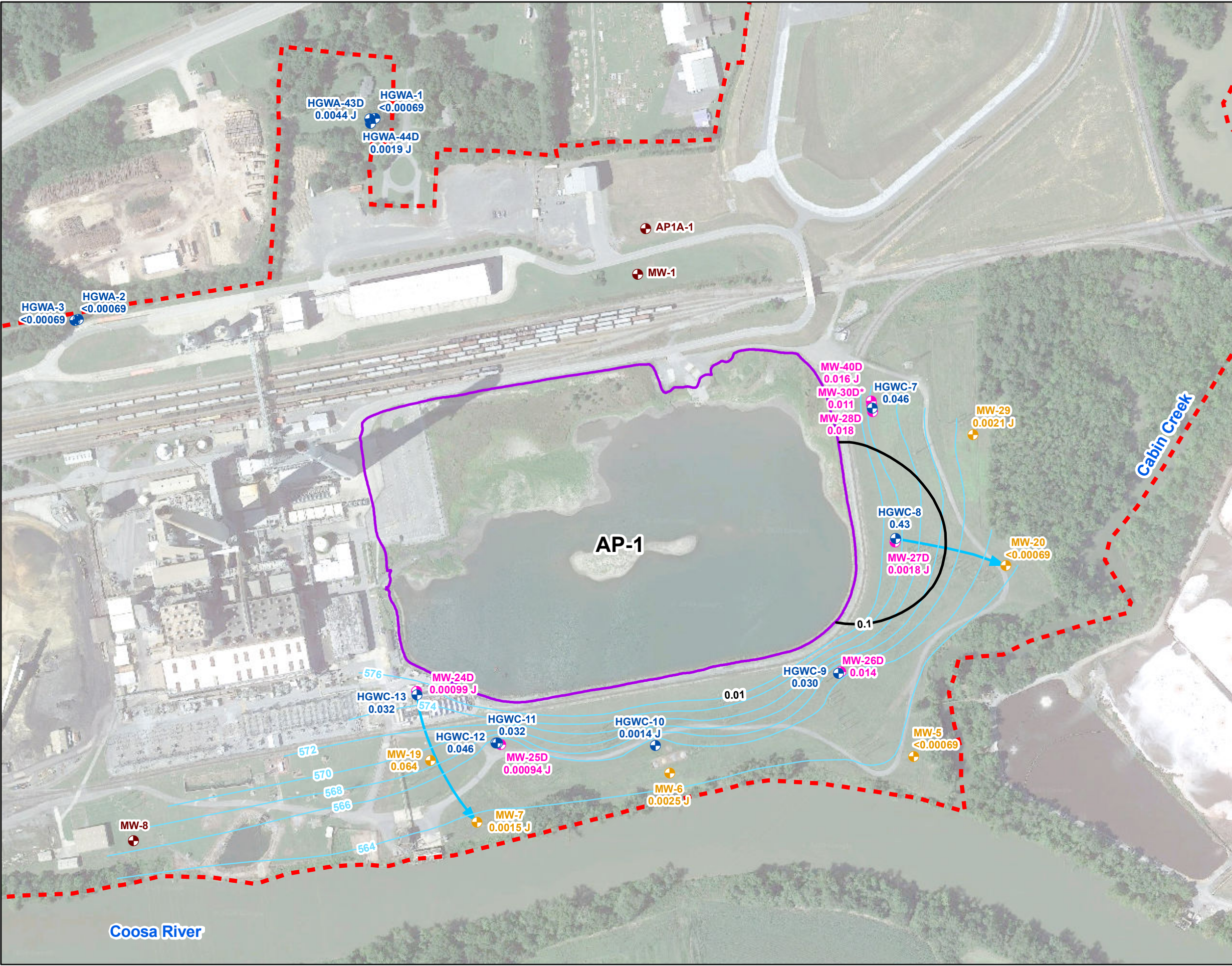
KENNESAW, GA

AUGUST 2022

**FIGURE
12**

APPENDIX A

September 2020 Iso-Concentration Maps for Arsenic and Molybdenum



- LEGEND**
- Compliance Monitoring Well
 - Horizontal Delineation Monitoring Well
 - Vertical Delineation Monitoring Well (not used for contouring)
 - Piezometer
 - GWPS Molybdenum Iso-Concentration Contour (mg/L)
 - September 2020 Groundwater Elevation Iso-Contour (ft)
 - Approximate Groundwater Flow Direction
 - Approximate AP-1 Boundary
 - Approximate Plant Hammond Property Boundary
 - Boundary

Notes:

- Concentration data is from the September 2020 semiannual groundwater monitoring event. Concentrations are reported in mg/L.
- The Groundwater Protection Standard (GWPS) for molybdenum is 0.10 mg/L.
- "*" - The molybdenum concentration reported in well MW-30D is believed to originate from a natural source rather than AP-1 based on available data. Additional analyses are being pursued in support of preparing an Alternate Source Demonstration for the well.
- Aerial photograph source: Google Earth Pro, August 2019.



**ISO-CONCENTRATION MAP
MOLYBDENUM- SEPTEMBER 2020**

GEORGIA POWER COMPANY
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

Prepared For: Georgia Power

Prepared By: Geosyntec consultants

KENNESAW, GA AUGUST 2022

**FIGURE
A-2**

APPENDIX C

Risk Evaluation Report

RISK EVALUATION REPORT PLANT HAMMOND ASH POND 1 ROME, FLOYD COUNTY, GEORGIA

Prepared for

Georgia Power

241 Ralph McGill Boulevard
Atlanta, Georgia 30308

Prepared by

Geosyntec Consultants

1255 Roberts Blvd., Suite 200,
Kennesaw, Georgia 30144

Project Number GZ7112H

August 2022

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LIST OF ACRONYMS AND ABBREVIATIONS

Amsl	Above Mean Sea Level
AP	Ash Pond
CCR	Coal Combustion Residual
CEM	Conceptual Exposure Model
CFR	Code of Federal Regulations
COI	Constituent of Interest
COPI	Constituent of Potential Interest
EPC	Exposure Point Concentration
EPD	[Georgia] Environmental Protection Division
ft	feet
GWPS	Groundwater Protection Standard
HAR	Hydrogeologic Assessment Report
HSRA	Hazardous Site Response Act
IRIS	Integrated Risk Information System
MCL	Maximum Contaminant Level
mg/L	Milligrams per liter
ProUCL	ProUCL software version 5.1
PZ	Piezometer
RAGS	Risk Assessment Guidance for Superfund
RME	Reasonable Maximum Exposure
RRS	Risk Reduction Standards
RSL	Regional Screening Level
SSL	Statistically Significant Level
UCL	95 Percent Upper Confidence Limit of the Arithmetic Mean
USEPA	United States Environmental Protection Agency
VRP	Voluntary Remediation Program

EXECUTIVE SUMMARY

Georgia Power's Plant Hammond (site) is a former four-unit coal-fired, electric generating facility owned and operated by Georgia Power that was retired on July 29, 2019. The site is located along the Coosa River, approximately 10 miles west of Rome, Floyd County, Georgia. Coal combustion residual (CCR) material resulting from such power generation has historically been transferred and stored in four ash ponds (AP) AP-1, AP-2, AP-3, and AP-4 and the Huffaker Road Landfill in compliance with applicable regulations. This report focuses on AP-1.

AP-1 is a 35-acre surface impoundment located at Plant Hammond that received CCR material from its commission in 1952 until 1969. After 1969, AP-1 was utilized as a cotreatment pond to handle return water flows from the other ponds and for recycling of process water for plant operations. Georgia Power will close AP-1 through removal of the CCR material from the unit. The CCR material will be disposed of in a permitted landfill or transported off-site for beneficial use. AP-1 is subject to the Federal CCR Rule, 40 C.F.R. § 257, Subpart D (USEPA, 2020) and the State CCR Rule, Ga. Comp. R. & Regs. 391-3-4-.10 (EPD, 2022). Closure permit No. 057-023D (CCR) (Closure Permit) was approved by Georgia Environmental Protection Division (EPD) on June 22, 2020. Semiannual groundwater monitoring and reporting is required for at least 5 years following CCR removal per AP-1's Closure Permit.

This report presents the results of a risk evaluation for CCR constituents¹ exhibiting statistically significant levels (SSLs) in groundwater at AP-1 from samples collected by Georgia Power in compliance with the Federal and State CCR Rules between 2016 and February 2022. The risk evaluation was performed in support of the *Draft Remedy Selection Report*, which is an attachment to the *2022 Semiannual Groundwater Monitoring & Corrective Action Report – Plant Hammond - Ash Pond 1 (AP-1)* (Geosyntec, 2022a). A conservative, health-protective approach was used that is consistent with United States Environmental Protection Agency (USEPA) risk assessment guidance, Georgia EPD regulations and guidance, and standard practice for risk assessment in the State of Georgia. Arsenic and molybdenum have been identified as SSL-related constituents using the groundwater protection standards (GWPS) established for AP-1 in accordance with the Federal and State CCR Rules (Geosyntec, 2022a).

¹ The constituents included in the risk evaluation also occur naturally in the site geologic setting.

Consistent with USEPA guidance, this risk evaluation used a tiered approach to evaluate potential risks, which included the following steps:

1. Development of a conceptual exposure model (CEM) for AP-1.
2. Initial groundwater risk screening: Comparison of groundwater concentrations of SSL-related constituents to conservative, health-protective criteria and/or background concentrations to assess whether they pose a risk to human health.
3. Refined groundwater risk evaluation: Perform a more refined analysis of Constituents of Potential Interest (COPIs) that were not screened out in the initial risk screening to assess whether they pose a potential risk to human health.
4. Development of risk conclusions and identification of associated uncertainties.

Using this approach that includes multiple conservative assumptions, SSL-related constituents evaluated from AP-1 are not expected to pose a risk to human health or the environment. The SSL-related constituents are delineated to concentrations below analytical detection limits that are less than the applicable health-protective screening levels in on-site groundwater monitoring wells. Therefore, no further risk evaluation for groundwater is warranted. In addition, because SSL-related constituents in groundwater were delineated within the plant property boundary, evaluation of off-site ecological receptors associated with the surface water pathway was not necessary. Compliance monitoring for AP-1 will continue pursuant to the requirements of the Federal and State CCR Rules. Georgia Power will proactively evaluate the data and update this evaluation, if necessary.

1 INTRODUCTION

This report summarizes a risk evaluation of AP-1 at Georgia Power's Plant Hammond (site) located in Rome, Georgia (**Figure 1**). The risk evaluation was performed in support of the *Draft Remedy Selection Report* and is used to ensure that the proposed remedy will protect human health and the environment. AP-1 is located on the southeast side of the Plant and is bounded to the east by Cabin Creek and to the south by the Coosa River. Georgia Power will close AP-1 through removal of the CCR material from the CCR unit. Closure activities will be conducted in accordance with the Federal and State CCR Rules and as described in the AP-1 Closure Permit which was approved by EPD on June 22, 2020.

This risk evaluation provides additional technical review of the human health and environmental protectiveness associated with the planned closure of AP-1 with respect to constituent concentrations in groundwater identified at SSLs above the GWPS. USEPA revised the Federal CCR Rule on July 30, 2018, updating the GWPS for cobalt, lead, lithium, and molybdenum values. On February 22, 2022, EPD adopted the federal GWPS for cobalt, molybdenum, lithium, and lead under 40 CFR §257.95(h) (EPD, 2022), which established the GWPS for these constituents as the higher of background concentrations or 0.006 mg/L, 0.015 mg/L, 0.040 mg/L, and 0.100 mg/L, respectively.

The risk evaluation relies on a conservative, health-protective approach that is consistent with the risk approaches outlined in Voluntary Remediation Program (VRP) (Georgia Voluntary Remediation Act, O.C.G.A. § 12-8-100) and components of the Risk Assessment Guidance for Superfund (RAGS) as included in the USEPA Regional Screening Levels (RSLs) User's Guide (USEPA, 2022a). This evaluation also incorporates principles and assumptions consistent with the Federal and State CCR Rules.

The risk evaluation includes the development of a site-specific CEM and a stepwise risk screening process for identified SSL-related constituents for AP-1. Arsenic and molybdenum were identified as SSL-related constituents under the Federal and State CCR Rules in the following wells:

- Arsenic: HGWC-13; and
- Molybdenum: HGWC-8.

The remainder of the report is organized as follows:

- ***Section 2, Basis and Background for the Development of the Conceptual Exposure Model*** – Presents site-specific information related to the site history, monitoring network, topography and surface hydrology, geology and hydrogeology, potential transport pathways, and receptors that could potentially be exposed to SSL-related constituents.
- ***Section 3, Risk Evaluation Screening*** – Describes the process for the initial risk-based screening of SSL-related constituents to identify COPIs in groundwater.
- ***Section 4, Refined Risk Evaluation*** – Describes the risk screening process for the COPIs identified in groundwater, including calculation of exposure point concentrations (EPCs) and analysis of concentration trends over time.
- ***Section 5, Uncertainty Assessment*** – Describes the uncertainties associated with the risk screening process.
- ***Section 6, Conclusions*** – Presents the conclusions of the risk evaluation.
- ***Section 7, References*** – Provides reference information for the sources cited in this document.

2 BASIS AND BACKGROUND FOR THE DEVELOPMENT OF THE CONCEPTUAL EXPOSURE MODEL

This section provides a brief overview of the site location and operational history, site regulatory status, and geology/hydrogeology. A CEM representing the site-specific processes and conditions that are relevant to the potential migration of groundwater and potential exposure to SSL-related constituents has been developed based on a review and compilation of information previously presented in site documents, including the *Hydrogeologic Assessment Report (HAR) Revision 1 - Ash Pond 1* (Geosyntec, 2019), *2021 Semiannual Groundwater Monitoring & Corrective Action Report – Plant Hammond - Ash Pond 1 (AP-1)* (Geosyntec, 2021); *2021 Annual Groundwater Monitoring & Corrective Action Report – Plant Hammond - Ash Pond 1 (AP-1)* (Geosyntec, 2022b). The CEM includes a conservative evaluation of assumed potential transport pathways, exposure pathways and potential human and ecological receptors.

2.1 Site Description

The site is located in Floyd County, Georgia, approximately 10 miles west of the city of Rome. The site occupies approximately 1,100 acres and is bordered by Georgia Highway 20 (GA 20) on the north, the Coosa River on the south, Cabin Creek and industrial land on the east, and sparsely populated, forested, rural and industrial land on the west. A site location map is included as **Figure 1**.

AP-1 is a 35-acre surface impoundment located at Plant Hammond that received CCR material from its commission in 1952 until 1969. After 1969, AP-1 was utilized as a cotreatment pond to handle return water flows from the other ponds and for recycling of process water for plant operations. Georgia Power will close AP-1 through removal of the CCR material from the CCR unit; closure activities will be conducted in accordance with 40 C.F.R. § 257.102 and corresponding Georgia EPD Rule 391-3-4-.10(7)(b). The CCR material will be disposed of in a permitted landfill or transported off-site for beneficial use. AP-1's Closure Permit was approved by EPD on June 22, 2020. Details of the closure approach are provided in the Closure Permit. Semiannual groundwater monitoring and reporting is required for at least 5 years following CCR removal per AP-1's Closure Permit.

As detailed in the *2021 Annual Groundwater Monitoring & Corrective Action Report – Plant Hammond - Ash Pond 1* (Geosyntec, 2022b), the groundwater monitoring network at AP-1 consists of 28 monitoring wells for the upgradient and downgradient groundwater monitoring system at the site. Five of these wells (HGWA-1, HGWA-2, HGWA-3, HGWA-43D, and HGWA-44D) are designated for monitoring of background conditions upgradient of the the ash ponds, seven compliance monitoring wells (HGWC-7, HGWC-8, HGWC-9, HGWC-10, HGWC-11, HGWC-12, and HGWC-13), and 11 delineation monitoring wells (MW-5, MW-6, MW-7, MW-19, MW-20, MW-24D, MW-25D, MW-26D, MW-27D, MW-28D, and MW-29).

are designated for monitoring downgradient of AP-1. There are five wells (AP1A-1, MW-1, MW-8, MW-30D, and MW-40D) that are designated as piezometers.

The monitoring well network for AP-1 is shown on **Figure 2**. Based on the conceptual site model and the observed hydrogeologic conditions at the site, downgradient well locations are distributed along the eastern and southern perimeter of the site in the direction of groundwater flow. Both background and downgradient wells are screened in the same water-bearing horizon along the zone of primary groundwater transport within the highly weathered bedrock and upper portion of the competent bedrock.

2.1.1 Topography and Surface Hydrology

AP-1 is located in the eastern portion of the Plant Hammond property. The area surrounding AP-1 slopes gently south towards the Coosa River and southeast towards Cabin Creek. Topographic relief across the site is approximately 13 feet (ft), with a natural topographic high at an elevation of nearly 592 ft above mean sea level (amsl) occurring at the upgradient well HGWA-1, and with a topographic low at the banks of the Coosa River and Cabin Creek at approximately 575 ft amsl (Geosyntec, 2019).

2.1.2 Geology and Hydrogeology

The following information is provided in the *2021 Annual Groundwater Monitoring & Corrective Action Report – Plant Hammond - Ash Pond 1* (Geosyntec, 2022b) and presented below:

The Site is located within the Great Valley District of the Valley and Ridge Physiographic Province (Valley and Ridge) in northwest Georgia. The Valley and Ridge is characterized by Paleozoic sedimentary rocks that have been folded and faulted into the ridges and valleys that gave this region its name. Geologic mapping performed at the Site by Petrologic Solutions, Inc. under the direction of Golder (Golder, 2018), indicates that AP-1 is underlain by the middle units of the Cambrian age Conasauga Formation, consisting of mostly shaley limestone. Subsurface investigations at AP-1 describe the bedrock as limestone or shaley limestone. AP-1 is underlain primarily by five lithologic units: (i) fill, (ii) terrace alluvium, (iii) residuum, (iv) highly weathered/fractured shaley limestone bedrock, and (v) competent shaley limestone bedrock.

....

The uppermost aquifer at AP-1 is a regional groundwater aquifer that occurs in the terrace alluvium, residuum, and the weathered and fractured bedrock. The uppermost aquifer is considered to be unconfined; however, localized, semi-confined conditions may be encountered due to the low-permeability clayey nature of the residual soils, or as a result of perched groundwater or poorly interconnected fracture networks in the

bedrock. Based on observations of soil types and horizontal conductivity values, the movement of groundwater in the soil, and to some degree the highly weathered bedrock zone, can be characterized as low-to moderate permeability, porous media flow. Groundwater flow in the more competent underlying bedrock is characterized as fracture flow. Groundwater flow in the vicinity of AP-1 is to the east and south.

The potentiometric surface contours provided in the 2022 *Semiannual Groundwater Monitoring & Corrective Action Report – Plant Hammond - Ash Pond 1* (Geosyntec, 2022a) are provided on **Figure 3**.

2.2 Potential Transport Pathways

A variety of geologic, hydrogeologic, and geochemical mechanisms can occur in the subsurface and serve to attenuate constituent concentrations in groundwater such as soil or rock characteristics, the local geology and hydrogeology, and the distance the groundwater must travel before reaching a potential receptor. A summary of the potential transport pathways is shown on the CEM in **Figure 4**.

Cabin Creek and the Coosa River abut AP-1 to the east and south, respectively. The surface water flow direction for Cabin Creek is south where it enters the Coosa River which flows from east to west. A conservative assumption for this assessment was made that the groundwater from the site flows to either Cabin Creek or the Coosa River. In addition, for the purposes of this evaluation, both Cabin Creek and the Coosa River were assumed to represent a hydraulic discharge boundary for groundwater flow in the upper aquifer from the nearby region.

Concentrations of SSL-related constituents were below the health-protective screening levels in wells on-site and upgradient of surface water bodies, as shown by the findings of the risk evaluation in Section 4.1.4. Therefore, evaluation of surface water was not necessary.

2.3 Potential Exposure Pathways and Receptors

The exposure pathways for groundwater were assumed to be complete for purposes of this risk evaluation and were used to identify potential receptors and estimate potential risk. The CEM (**Figure 4**) depicts the conservative potential exposure pathways and receptors included in the risk evaluation.

The following potential exposure pathways and receptors were considered:

- On-site industrial worker: The groundwater exposure pathway for the on-site industrial worker was considered incomplete because there are no wells on-site that are classified for use as potable wells.

- On-site construction worker: While there is a potential for limited exposure to groundwater by a future construction worker through dermal contact with on-site shallow groundwater during subsurface activities, future construction workers would be expected to have little to no direct contact with on-site groundwater due to safety procedures outlined in their site-specific health and safety plans.
- On-site resident: The groundwater exposure pathway for on-site residents was considered incomplete because the site is zoned heavy-industrial and there is no residential use on-site under current site conditions and future residential use of the site is considered unlikely (Floyd County, 2022).
- Off-site industrial/construction worker: The potential for off-site worker exposure through direct contact with groundwater was addressed qualitatively through the evaluation of hypothetical off-site residential receptors. Health-protective screening levels for residential receptors would be more conservative than industrial and construction worker screening levels.
- Off-site resident: The groundwater exposure pathway for hypothetical off-site residential receptors was conservatively assumed to be potentially complete. Nearby zoning is Agricultural Residential with the exception of some Community Commercial zoning across Alabama Highway to the north of the site (Floyd County, 2022). An off-site well survey of potential groundwater wells within a three-mile radius of the site (AP-1, AP-2, AP-3, and AP-4) was conducted and consisted of reviewing federal, state, and county records and online sources, in addition to conducting a windshield survey of the area (Newfields, 2020). The off-site well survey is included as **Appendix A**. A desktop review was performed in January 2022 to search for additional wells added since 2020. Results of the survey and the January 2022 update are presented on **Figure 5**. Hypothetical off-site residential receptors in the downgradient groundwater flow direction identified in the well survey are located on the opposite side of the Coosa River or Cabin Creek, which for the purpose of this risk evaluation were assumed to represent hydraulic discharge boundaries for groundwater downgradient of AP-1.

Concentrations of SSL-related constituents in on-site groundwater monitoring wells and piezometers are below health-protective screening levels in wells on-site and upgradient of surface water bodies at AP-1. As a conservative measure, hypothetical off-site residential exposure to the SSL-related constituents was evaluated using data collected from on-site groundwater wells between 2016 and February 2022 downgradient of AP-1. This comparison makes the conservative assumption that on-site groundwater has the potential to migrate to off-site drinking water wells through advective transport in groundwater without any attenuation in the aquifer media through factors such as dilution, dispersion, or adsorption, and disregards the presence of Cabin Creek and the

Coosa River which represent assumed hydraulic discharge boundaries for groundwater downgradient of AP-1. Accordingly, the risk evaluation screening assumed the hypothetical off-site residential receptor could be exposed by ingestion and dermal contact with SSL-related constituents in groundwater through its use as a future potable water source.

- Recreational surface water receptors: The surface water exposure pathway for hypothetical recreational receptors was addressed qualitatively through the evaluation of on-site groundwater data. SSL-related constituent concentrations are below the health-protective screening criteria in on-site groundwater. Therefore, evaluation of the surface water pathway was not necessary.
- Ecological surface water receptors: The surface water exposure pathway for off-site ecological receptors was addressed qualitatively through the evaluation of on-site groundwater data. SSL-related constituent concentrations are below health-protective screening criteria in on-site groundwater. Therefore evaluation of the surface water pathway was not necessary.

3 RISK EVALUATION SCREENING

The CEM developed in Section 2 was used to identify the potential exposure pathways to human receptors that should be considered in the risk evaluation. The initial step in the risk evaluation is the comparison of SSL-related constituent concentrations from groundwater samples collected between 2016 and February 2022 to relevant, health-protective levels. The approach used is consistent with the Georgia EPD regulations and guidance, USEPA guidance, and standard practice for risk assessment in the State of Georgia. The Georgia EPD allows for the site-specific evaluation of risk in programs such as the Voluntary Remediation Program (VRP) (EPD, 2009).

The initial risk evaluation screening was performed for the potential groundwater exposure pathway by comparing the concentrations of SSL-related constituents in groundwater samples from wells determined to have SSL-related constituents to appropriate health-protective screening criteria. These criteria included the risk reduction standards (RRS)² established under the Hazardous Site Response Act (HSRA) for drinking water and site-specific background for the protection of human health. If the maximum concentration of a SSL-related constituent exceeded the screening criterion, the constituent was identified as a COPI for further evaluation in the refined risk evaluation. The methodology and screening criteria used were identified in accordance with regulatory guidance and standard risk assessments practices using an approach designed to conservatively overestimate possible exposures and risks, providing an additional level of confidence in the conclusions. The methodology is summarized on **Figure 6** and discussed in more detail below.

3.1 Data Used in Risk Evaluation Screening

This section provides information on the groundwater dataset used in the risk evaluation screening.

3.1.1 Groundwater Data

For the initial risk screening evaluation, groundwater data from samples collected between 2016 and February 2022 from the on-site wells that were identified to have SSL-related constituents were used in the risk screening evaluation for hypothetical off-site residential exposure.

The list of wells identified in the *2022 Semiannual Groundwater Monitoring & Corrective Action Report – Plant Hammond Ash Pond 1 (AP-1)* with SSL-related constituents identified under the Federal and State CCR Rules is as follows:

- Arsenic: HGWC-13; and

² HSRA was amended in 2018 to make the methods used for calculating RRSs consistent with USEPA's RAGS for the calculation of RSLs.

- Molybdenum: HGWC-8.

The data for the wells were screened against the relevant health-protective screening criteria. The location of wells with SSL-related constituents included in the risk screen are provided on **Figure 7**.

Groundwater data used in the risk screening level evaluation were collected from the uppermost aquifer and are considered to be representative of groundwater conditions at the site. The groundwater dataset used in the risk evaluation is presented in **Appendix B**. Method detection limits for the groundwater datasets used in the risk evaluation were reviewed and confirmed to be less than the screening levels.

3.1.2 Background Groundwater Quality

Statistical analysis of groundwater monitoring data is performed at the site pursuant to §257.93-95 following the professional engineer certified Statistical Analysis Method Certification (October, 2017, revised January 2020) (Geosyntec, 2020) and the Unified Guidance (USEPA, 2009) for AP-1; background values are routinely updated under the program. For the data set presented, five monitoring wells in the certified monitoring well network are designated as upgradient (background) locations for AP-1, HGWA-1, HGWA-2, HGWA-3, HGWA-43D, and HGWA-44D. The statistical analyses performed on the groundwater data were described in the *2021 Annual Groundwater Monitoring & Corrective Action Report Plant Hammond Ash Pond 1* (Geosyntec, 2022b); and text from that document is presented below.

The Sanitas groundwater statistical software was used to perform the statistical analyses. Sanitas is a decision-support software package, that incorporates the statistical tests required of Subtitle C and D facilities by USEPA regulations and guidance as recommended in the USEPA document Statistical Analysis of Groundwater Data at RCRA Facilities Unified Guidance (Unified Guidance) (USEPA, 2009). Time series plots generated by Sanitas are used to identify suspected outliers, or extreme values that would result in limits that are not representative of the current background data population. Suspected outliers at all wells for Appendix III and Appendix IV parameters are formally tested using Tukey's box plot method and not used to establish statistical limits. Background well data were updated following the Unified Guidance recommendation, evaluating recent background data using Tukey's box plot method for outliers and Sen's Slope/Mann-Kendall methods for potential trends.

3.2 Groundwater Screening Evaluation

The process of screening constituents detected in groundwater against human health screening levels for groundwater is discussed below and presented in **Figure 6**. The HSRA RRSs

evaluated under the VRP approach presented herein include Type 1 (arsenic) and Type 2 (molybdenum) RRS for off-site residential receptors. The Hazardous Site Response Act Rule 391-3-19.07(1) notes that “[a]ll risk reduction standards will, when implemented, provide adequate protection of human health and the environment.” In addition, Rule 391--3--19-.07(3) notes a corrective action, if needed, may be considered complete when “a site meets any or a combination of the applicable risk reduction standards described in Rule 391--3--19-.07.”

In accordance with standard methodologies approved by the Georgia EPD, the screening level hierarchy for the SSL-related constituents is as follows:

- The higher of the Type 1 or Type 2 RRS for hypothetical off-site residential exposure, which are considered protective of human health for those constituents regulated under HSRA. The Type 1 RRS was used for arsenic in the evaluation which is the Georgia drinking water criteria presented in Appendix III, Table 1 of the HSRA rule (EPD, 2018).
- In accordance with standard methodologies approved by the Georgia EPD and because an RRS for molybdenum has not already been established under HSRA, a site-specific risk-based screening value was calculated using the default exposure factors for residential receptors and the methodology found in Appendix III of the HSRA rule (EPD, 2018). Accordingly, the calculated screening value is equivalent to a Type 2 groundwater RRS protective of residential exposures. Toxicity values for molybdenum used in the calculations were identified in the Integrated Risk Information System (IRIS) (USEPA, 2022b). The risk-based screening value was calculated using USEPA’s RSL calculator (USEPA, 2022a) assuming a target hazard quotient of 1, consistent with Georgia EPD guidance applicable in other contexts (EPD, 2018). The calculation of a risk-based screening value for molybdenum is presented in **Appendix C**. Based on the foregoing, the site-specific screening level was used for molybdenum.
- If site-specific background concentrations are greater than the criteria described above, then the site-specific background concentration is used as the screening level in accordance with the CCR methodology for development of groundwater protection standards (USEPA, 2020). Background was not used as a screening level in this evaluation.

In summation, based on the hierarchy above, groundwater data collected from the wells identified to have SSL-related constituents were compared to residential screening criteria for groundwater.

Table 1 presents the maximum detected concentration of each SSL-related constituent, arsenic 0.52 milligrams per liter (mg/L) and molybdenum (0.55 mg/L), which was used to represent potential off-site groundwater quality for comparison to the selected screening levels for arsenic

(0.01 mg/L) and molybdenum (0.1 mg/L), for hypothetical off-site residential receptors. As noted in **Table 1**, arsenic and molybdenum were detected at concentrations that exceeded their screening levels and were retained as COPIs for further evaluation in a refined risk evaluation.

4 REFINED RISK EVALUATION

A refined risk evaluation was conducted for the groundwater COPIs (arsenic and molybdenum) that were detected at concentrations that exceeded the health-protective screening criteria. The refined risk evaluation identified EPCs for arsenic and molybdenum for the purposes of characterizing potential risk to human receptors.

4.1 Refined Groundwater Risk Evaluation

Potential risk associated with exposure to arsenic and molybdenum by hypothetical off-site residential receptors was refined using the methodology described in HSRA and VRP and other supporting guidance (EPD, 2018; EPD, 2009, EPD, 2015) and is presented in the following section and on **Figure 8**.

For the refined risk evaluation, groundwater data from samples collected between 2016 and February 2022 from the on-site wells that were identified to have a SSL-related constituent and downgradient monitoring wells/piezometers that represent groundwater flow in the same hydraulically downgradient direction were used to evaluate hypothetical off-site residential exposure.

As noted above, groundwater data used in the risk screening level evaluation were collected from the uppermost aquifer and are considered to be representative of groundwater conditions at the site. The groundwater dataset used in the refined risk evaluation is presented in **Appendix B**.

4.1.1 Groundwater Exposure Point Calculation

The refined risk evaluation for arsenic and molybdenum included the development of an EPC for each constituent. The EPC is a conservative estimate of potential exposure that is selected to address uncertainty and variability in the dataset (USEPA, 2002). Consistent with guidance for developing groundwater EPCs (USEPA, 2014), 95 percent upper confidence limits of the arithmetic mean (UCLs) were calculated using USEPA ProUCL 5.1 software (ProUCL) (USEPA, 2016) and ProUCL user's guide (USEPA, 2015).

For the refined risk evaluation, the UCLs for the COPIs in groundwater were calculated for datasets with the following characteristics:

- UCLs for the individual well(s) with an SSL-related constituent;
- UCLs based on combined data from the well(s) with an SSL-related constituent and other well(s)/piezometer(s) in the general vicinity to include additional downgradient monitoring well(s)/piezometer(s) that represent groundwater flow in the same hydraulically downgradient direction; and

- UCLs based on the combined data from the farthest downgradient well(s)/piezometer(s) that are hydraulically downgradient of the well(s) with an SSL-related constituent.

Other assumptions made in the calculation of the UCLs include:

- Primary samples (no duplicates) were used to calculate EPCs as duplicate samples were analyzed for quality assurance purposes.
- If the calculated UCL exceeded the maximum detected concentration, then the maximum detected concentration was used as the EPC.

ProUCL software calculates multiple UCLs and provides a recommended UCL which was selected as the EPC. If there were multiple UCLs recommended by ProUCL, the maximum UCL value was selected as a conservative assumption. **Appendix D-1** provides a detailed summary of the UCLs calculated using the methods described above, and **Appendix D-2** presents figures showing the wells used in the calculation of the EPCs for each groundwater COPI. **Appendix D-3** provides the input and output files associated with the ProUCL software.

Table 2 summarizes the groundwater EPCs selected for the COPIs. This table shows the number of samples, the maximum detected concentrations, the UCLs recommended by ProUCL software, and the selected EPCs.

4.1.2 COPI Concentration Trend Analysis

Concentration trends over time were evaluated as one line of evidence in the refined risk evaluation for arsenic and molybdenum. The Mann-Kendall trend test with an alpha value equal to 0.05 and the Theil-Sen line test were conducted on the data from HGWC-13 for arsenic and HGWC-8 and MW-27D for molybdenum to evaluate the trends in concentrations over time. The tests were conducted using the USEPA ProUCL 5.1 software (USEPA, 2016).

The Mann-Kendall and Thiel-Sen test results are presented on time series graphs in **Appendix D-4** and indicated:

- There is a statistically significant increasing trend in arsenic concentrations over time in HGWC-13. However as discussed in Section 4.1.3.1, arsenic concentrations in samples collected from MW-24D (the deep delineation well for HGWC-13) and MW-7 (the farthest hydraulically downgradient delineation well for HGWC-13) are below analytical detection limits that are less than the screening level;
- There are no statistical trends in molybdenum concentrations over time in HGWC-8. Additionally, as discussed in Section 4.1.3.2, molybdenum concentrations in samples

collected from MW-20 (the farthest hydraulically downgradient well for HGWC-8), are below analytical detection limits that are less than the screening level; and

- There is a statistically significant decreasing trend in molybdenum concentrations over time in MW-27D (the deep delineation well for HGWC-8). The detected molybdenum concentrations and the analytical detection limits have all been less than the screening level.

Mann Kendall trend analysis requires four data points with at least three detections. Trends may be evaluated at the farthest downgradient piezometers from the well(s) with SSL-related constituents, if necessary, after additional sampling events are conducted at downgradient locations.

4.1.3 Refined Groundwater Risk Evaluation Results

Arsenic and molybdenum were identified as groundwater COPIs in the initial risk screening. In the refined risk evaluation, comparison of the calculated EPC to the screening level was used to identify constituents of interest (COIs) that may pose a potential risk to hypothetical off-site residential receptors exposed through the potential use of groundwater as potable water. If the EPC from the farthest downgradient well(s) is greater than the respective screening level, then the constituent is identified as having the potential for risk that warrants additional evaluation (e.g., performing a surface water evaluation).

4.1.3.1 Arsenic

Arsenic concentrations were detected in 21 out of 21 groundwater samples in well HGWC-13 at concentrations that exceeded the off-site groundwater screening level for residential receptors. For the refined risk evaluation, the following EPCs were calculated for arsenic using the wells shown in **Appendices D-1** and **D-2a**:

- Data from HGWC-13 were used to determine if the UCL is less than the screening level (EPC Step 1 in **Appendix D-1**).
- Data from HGWC-13 and the downgradient wells MW-24D, MW-19 and MW-7 were combined to represent potential groundwater exposure associated with the SSL well and hydraulically downgradient wells (EPC Step 2 in **Appendix D-1**).
- Data from MW-7 were used to represent groundwater exposure using the well that is the farthest hydraulically downgradient of well HGWC-13 (EPC Step 3 in **Appendix D-1**).

Although the EPC Step 1 (0.41 mg/L) and the EPC Step 2 (0.28 mg/L) exceeded the screening level, the EPC Step 3 (< 0.005 mg/L), which includes the farthest downgradient well³, was less than the health-protective screening level.

Table 3 presents the results of the refined screening comparing the farthest hydraulically downgradient EPC to the screening criterion. As arsenic was non-detect, with a maximum reporting limit half the screening level, in the farthest hydraulically downgradient well on the site, arsenic was not identified as a COI in groundwater for hypothetical off-site residential receptors and is not expected to pose a risk to human health through potable water use.

4.1.3.2 Molybdenum

Molybdenum concentrations were detected in 22 out of 22 groundwater samples in well HGWC-8 at concentrations that exceeded the off-site groundwater screening level for residential receptors. For the refined risk evaluation, the following EPCs were calculated for molybdenum using the wells shown in **Appendices D-1** and **D-2b**:

- Data from HGWC-8 were combined to determine if the UCL is lower than the screening level (EPC Step 1 in **Appendix D-1**).
- Data from HGWC-8 and the downgradient wells MW-27D and MW-20 were combined to represent groundwater potential exposure associated with the SSL well and hydraulically downgradient wells (EPC Step 2 in **Appendix D-1**).
- Data from MW-20 were combined to represent groundwater exposure using the well that is the farthest hydraulically downgradient of well HGWC-8 (EPC Step 3 in **Appendix D-1**).

Although the EPC Step 1 (0.48 mg/L) and the EPC Step 2 (0.47 mg/L) exceeded the screening level, the EPC Step 3 (< 0.01 mg/L), which includes the farthest downgradient well, was less than the health-protective screening level.

Table 3 presents the results of the refined screening comparing the farthest hydraulically downgradient EPC to the screening criterion. As molybdenum was not detected, with a maximum reporting limit approximately ten times less than the screening level in the farthest hydraulically downgradient wells on the site, molybdenum was not identified as a groundwater COI for hypothetical off-site residential receptors and is not expected to pose a risk to human health through potable water use.

³ All of the samples collected from MW-7, the farthest downgradient well, were non-detect for arsenic and the reporting limit was below the screening level.

4.1.4 Refined Groundwater Risk Evaluation Summary and Conclusions

Detections of the SSL-related constituents arsenic and molybdenum were reported at concentrations above the applicable groundwater screening values. However, the results of the refined groundwater risk evaluation indicate the following:

- Arsenic and molybdenum are not expected to pose a risk to hypothetical off-site residential receptors.
- The individual data points used to calculate the arsenic and molybdenum EPCs to represent potential groundwater exposure for hypothetical off-site residential receptors based on the farthest hydrologically downgradient monitoring wells were below the health-protective screening level.

Accordingly, based on the multiple lines of evidence and various conservative assumptions, further risk evaluation for groundwater is not warranted. Compliance monitoring under the Federal and State CCR Rules will continue.

5 UNCERTAINTY ASSESSMENT

USEPA guidance stresses the importance of providing an analysis of uncertainties so that risk managers are better informed when evaluating risk assessment conclusions (USEPA, 1989). The uncertainty assessment provides a better understanding of the key uncertainties that are most likely to affect the risk assessment results and conclusions.

The potential uncertainties associated with the risk evaluation are as follows:

Health-Protective Screening Criteria Uncertainties:

- In accordance with standard methodologies approved by the Georgia EPD, the higher of the Type 1 or Type 2 standard was selected for screening criteria. Selection of the screening criteria per industry standards is considered appropriate for risk quantification for Plant Hammond. The Hazardous Site Response Act, Rule 391-3-19.07(1) notes that “[a]ll risk reduction standards will, when implemented, provide adequate protection of human health and the environment”. Thus, this approach is likely to overestimate hypothetical risks for off-site receptors.
- Screening criteria based on RRSs, including arsenic and molybdenum, represent the reasonable maximum exposure (RME), which are the highest exposures that are reasonably expected to occur at a site. The RME is defined as “*the highest exposure that is reasonably expected to occur at a site but that is still within the range of possible exposures*” (USEPA, 1989). Further, USEPA (1989) states that the “*intent of the RME is to estimate a conservative exposure case (i.e., well above the average case) that is still within the range of possible exposures.*” Potential receptors will likely have lower exposures than those presented in this risk evaluation (i.e., a majority of the site concentrations will be less than the UCL), which overestimates potential exposure.

Exposure Uncertainties:

- The maximum detected concentrations of arsenic and molybdenum were compared to conservative risk-based screening criteria to identify the COPIs. Use of the maximum detected concentration is consistent with standard practice; however, use of the maximum detected concentration for exposure likely overestimates potential risk.
- The constituents included in the risk evaluation may occur naturally in the site geologic setting. Although background concentrations were evaluated, contributions to exposure and risk were assumed to be entirely CCR-related and natural

background sources were not quantified. Thus, SSL concentration-related exposures were likely overestimated.

- Hypothetical off-site residential exposure was evaluated using on-site groundwater data from wells around the perimeter and downgradient of AP-1. This comparison makes the conservative assumption that on-site groundwater may potentially migrate to off-site drinking water wells through advective transport in groundwater, but without any attenuation within the aquifer media through factors such as dilution, dispersion, or adsorption. This assumption may overestimate potential exposure and risk to hypothetical off-site receptors.
- EPCs for metals in groundwater were assumed to be 100 percent bioavailable by ingestion and dermal contact. This assumption may tend to overestimate risk.
- An off-site well survey of potential groundwater wells within a three-mile radius of Plant Hammond was conducted by NewFields in 2020 and updated in January of 2022. The survey consisted of reviewing publicly available federal, state, and county records as well as a windshield survey of the area (**Appendix A**). Geosyntec relied on the data collected by NewFields.
- The evaluation used on-site groundwater data to represent hypothetical off-site exposure, which is a conservative approach that likely results in overestimation of assumed exposure and assumed potential risk. Although off-site potable wells identified in the well survey were not included in the risk evaluation, the presence of these wells do not appear to impact the conclusions of the risk evaluation because concentrations of COPIs are delineated in on-site groundwater.

Toxicity Uncertainties:

- Toxicity factors used to calculate health-protective criteria are established at conservative levels to account for uncertainties and often result in criteria that are many times lower than the levels observed to cause effects in human or animal studies. Therefore, a screening level exceedance does not necessarily equate to an adverse effect.

6 CONCLUSIONS

This risk evaluation for SSL-related constituents in groundwater at AP-1 was conducted using methods consistent with Georgia EPD and USEPA guidance and included multiple conservative assumptions. Based on this evaluation, constituents evaluated from AP-1 (arsenic and molybdenum) are not expected to pose a risk to human health or the environment.

Accordingly, no further risk evaluation of groundwater is warranted. Compliance monitoring for AP-1 under the Federal and State CCR Rules will continue. Georgia Power will proactively evaluate the data and update this evaluation, if necessary.

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TABLES

Table 1**SSL-Related Constituent Groundwater Screening****Plant Hammond AP-1 Risk Evaluation Report^[1]****Plant Hammond, Rome, GA**

CCR Rule Designation	Constituent	CAS No.	Detection Frequency	Exceedance Frequency ^[2]	Maximum Concentration (mg/L)	Screening Level (mg/L)	Screening Level Source ^[3]	Site-Specific Background (mg/L)	COPI? (Y/N)	Rationale ^[4]
Appendix IV	Arsenic	7440-38-2	21 / 21	21 / 21	0.52	0.01	Type 1 RRS	0.005	Y	ASL
	Molybdenum	7439-98-7	22 / 22	22 / 22	0.547	0.1	Site-Specific	0.01	Y	ASL

Notes:

[1] Evaluation includes 2016 to February 2022 groundwater analytical data from wells HGWC-13 (for arsenic) and HGWC-8 (for molybdenum).

[2] The exceedance frequency is based on the number of samples with detected concentrations that exceed the identified screening level.

[3] The screening levels are the maximum value from the following sources:

- Type 1 RRSs listed in HSRA Appendix III, Table 1 (HSRA-regulated substances only).
- Type 2 RRSs calculated using the EPA RSL calculator with default residential exposure factors listed in the RSL Users Guide (HSRA-regulated substances only).
- Site-Specific values calculated using the EPA RSL calculator with default residential exposure factors listed in the RSL Users Guide.
- EPA Maximum Contaminant Levels (MCLs).
- Site-specific background levels were calculated as described in the document "Statistical Analysis Method Certification, 40 CFR §257.93(f), Plant Hammond- Ash Pond 1 (AP-1)" (Geosyntec, 2020).

[4] Rationale for classification of constituent as a COPI or exclusion as a COPI:

- ASL = Above respective screening level
- BSL = Below respective screening level

Definitions:

Grey shading = Constituent concentration(s) exceeded its respective screening level in the dataset.

CAS = Chemical Abstract Service

CCR = Coal Combustion Residuals

COPI = Constituent of Potential Interest

EPA = United States Environmental Protection Agency

GA EPD= Georgia Environmental Protection Division

GWPS = Groundwater Protection Standard

HSRA = [GA EPD] Hazardous Site Response Act

mg/L = milligram(s) per liter

RRS = [GA EPD] Risk Reduction Standard

RSL = [EPA] Regional Screening Level

Table 2
Groundwater Exposure Point Concentration Summary
Plant Hammond AP-1 Risk Evaluation Report
Plant Hammond, Rome, GA

CCR Rule Designation	Constituent	CAS No.	Detection Frequency	Maximum Concentration (mg/L)	Wells Included in 95% UCL Calculation	95% UCL ^[1,2] (mg/L)	Recommended UCL Method	Selected EPC (mg/L)
Appendix IV	Arsenic	7440-38-2	0 / 10	<0.005	MW-7	NA	NA	<0.005
	Molybdenum	7440-48-4	0 / 10	<0.01	MW-20	NA	NA	<0.01

Notes:

[1] EPCs calculated in accordance with USEPA, 2014. Memorandum for Determining Groundwater Exposure Point Concentrations, Supplemental Guidance. OSWER Directive 9283.1-42, February 2014. Located at: <https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236917>. For further detail on the selected EPC, refer to Appendix D-1.

[2] NA = Not available. The 95% upper confidence limit on the mean (UCL) was not calculated because the dataset had fewer than 5 values or fewer than 4 detections.

[3] The presented value is the method detection limit (MDL) for the constituent.

Definitions:

CAS = Chemical Abstract Service

CCR = Coal Combustion Residuals

COP1 = Constituent of Potential Interest

EPA = United States Environmental Protection Agency

EPC = Exposure Point Concentration

mg/L = milligrams per liter

"<" = Constituent was not detected at the shown reporting limit

Table 3
Downgradient Groundwater Refined Evaluation
Plant Hammond AP-1 Risk Evaluation Report
Plant Hammond, Rome, GA

CCR Rule Designation	Constituent	CAS No.	Detection Frequency	Exceedance Frequency ^[1]	Selected EPC (mg/L)	Screening Level (mg/L)	SL Source ^[2]	Site-Specific Background (mg/L)	COI? (Y/N)	Rationale ^[3]
Appendix IV	Arsenic	7440-38-2	0 / 10	0 / 10	<0.005	0.01	Type 1 RRS	0.005	N	ND/BSL
	Molybdenum	7440-48-4	0 / 10	0 / 10	<0.01	0.1	Site-Specific	0.01	N	ND/BSL

Notes:

[1] The exceedance frequency is based on the number of samples with detected concentrations that exceed the identified screening level.

[2] The screening values are the maximum value from the following sources:

- Type 1 RRSs listed in HSRA Appendix III, Table 1 (HSRA-regulated substances only).
- Type 2 RRSs calculated using the USEPA RSL calculator with default residential exposure factor listed in the RSL Users Guide (HSRA-regulated substances only).
- Site-Specific values calculated using the USEPA RSL calculator with default residential exposure factor listed in the RSL Users Guide.
- Site-specific background levels for each constituent were calculated as described in the document "Statistical Analysis Method Certification, 40 CFR §257.93(f), Plant Hammond - Ash Pond 1 (AP-1)" (Geosyntec, 2020).

[3] Rationale for classification of constituent as a COI:

- ASL = Above respective screening level
- BSL = Below respective screening level
- ND/BSL = Non-detect and below respective screening level

Definitions:

CAS = Chemical Abstract Service

CCR = Coal Combustion Residuals

COI = Constituent of Interest

EPA = United States Environmental Protection Agency

GA EPD= Georgia Environmental Protection Division

HSRA = [GA EPD] Hazardous Site Response Act

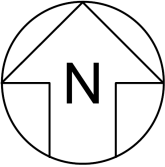
mg/L = milligram(s) per liter

RRS = [GA EPD] Risk Reduction Standard

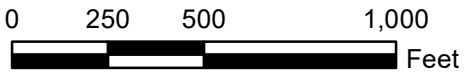
RSL = [EPA] Regional Screening Level

"<" = Constituent was not detected at the shown reporting limit

FIGURES



Notes:
1. Aerial photograph source: Google Earth Pro, August 2019
and Georgia Power Company, January 2022.



SITE LOCATION MAP

GEORGIA POWER
PLANT HAMMOND AP-1
FLOYD COUNTY, GEORGIA

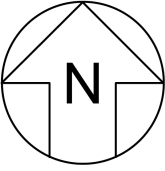
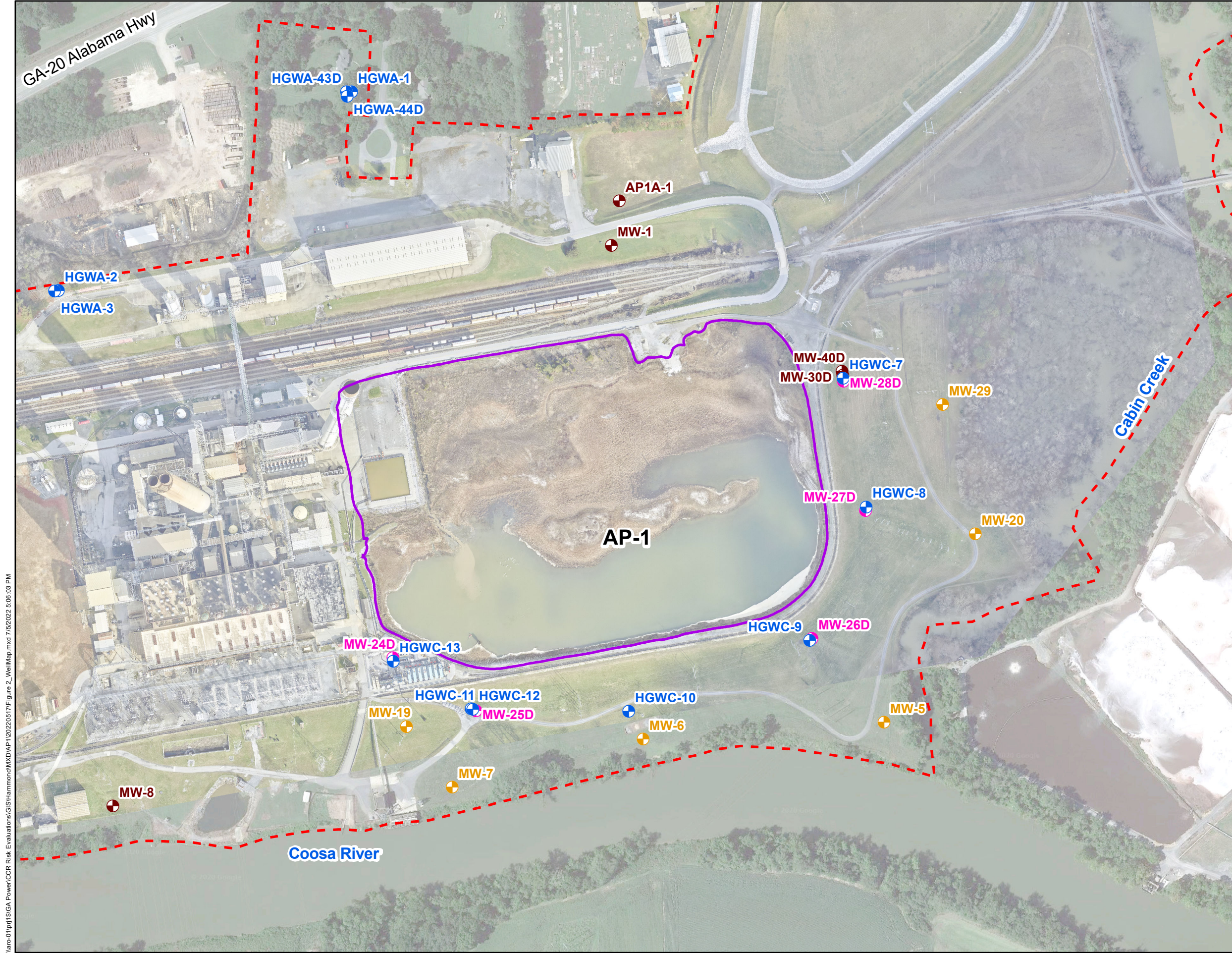
Prepared For:  **Georgia Power**

Prepared By: 

KENNESAW, GA

AUGUST 2022

**FIGURE
1**



- LEGEND**
- Compliance Monitoring Well
 - Horizontal Delineation Well
 - Vertical Delineation Well
 - Piezometer
 - Approximate AP-1 Boundary
 - Plant Hammond Property Boundary



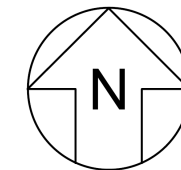
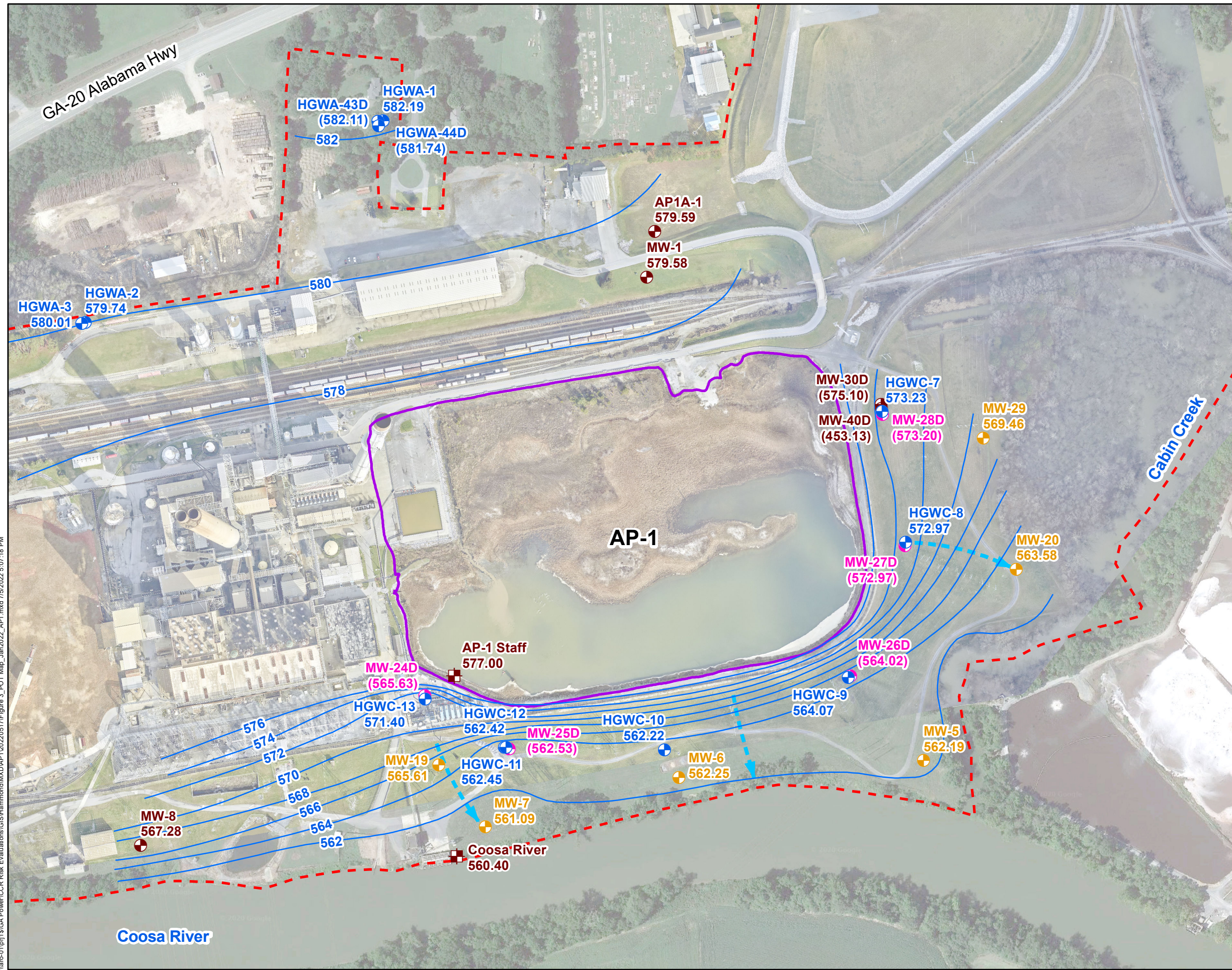
Note:
1. Aerial photograph source: Google Earth Pro, August 2019
and Georgia Power Company, January 2022.

0 150 300 600 Feet

SITE LAYOUT AND MONITORING WELL NETWORK MAP	
GEORGIA POWER PLANT HAMMOND AP-1 ROME, FLOYD COUNTY, GEORGIA	
Prepared For: 	FIGURE 2
Prepared By: 	
KENNESAW, GA AUGUST 2022	

\\arc-01\prj1\GA Power\CCF Risk Evaluations\GIS\Hammond\MDAP1\20220517\Figure 2_WellMap.mxd 7/5/2022 5:06:03 PM

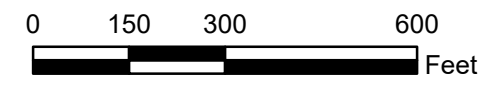
\\ars-01\prj1\GA Power\CCFR Risk Evaluations\GIS\Hammond\MDAP1\20220517\Figure 3_POT Map_Jan2022_AP1.mxd 7/5/2022 5:07:18 PM



- LEGEND**
- Compliance Monitoring Well
 - Horizontal Delineation Well
 - Vertical Delineation Well
 - Piezometer
 - Staff Gauge
 - Groundwater Elevation Iso-Contour
 - Approximate Groundwater Flow Direction
 - Approximate AP-1
 - Plant Hammond Property Boundary

Notes:

1. Water level elevation recorded on January 31, 2022. Elevation provided in feet (ft) referenced to the North American Vertical Datum of 1988 (NAVD 88).
2. Water elevation in parentheses were not used in development of groundwater contours due to wells being screened at a different elevation in the formation/aquifer.
3. Aerial photograph source: Google Earth Pro, August 2019 and Georgia Power Company, January 2022.



**POTENTIOMETRIC SURFACE ELEVATION
CONTOURS - JANUARY 2022**

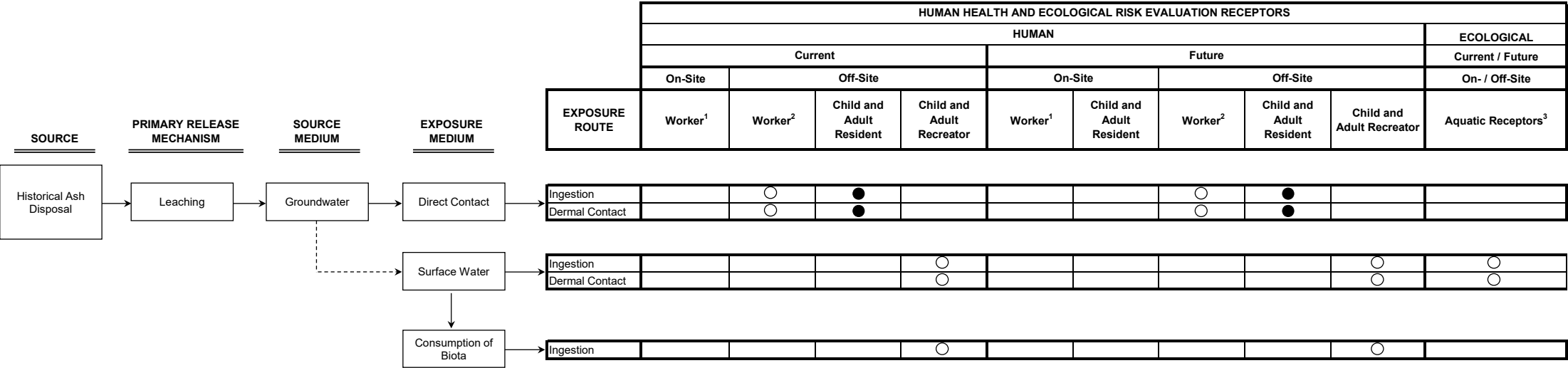
GEORGIA POWER
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

Prepared For:  Georgia Power

Prepared By: 

KENNESAW, GA AUGUST 2022

**FIGURE
3**



Legend

- > A conservative assumption for this assessment was made that groundwater from the site flows to the downgradient surface water.
- Indicates potentially complete pathway to receptors, which are evaluated quantitatively.
- Indicates potentially complete pathway to receptors, which are evaluated qualitatively.

Footnotes

1. Industrial worker was considered to have no complete pathways because there are no wells on-site that are classified for use as potable wells. On-site construction workers would be expected to have little to no direct contact with on-site groundwater due to safety procedures outlined in their site-specific health and safety plans.
2. Off-site industrial/construction worker addressed through the evaluation of hypothetical off-site residential receptors as health-protective screening levels for residential receptors would be more conservative than industrial and construction worker screening levels.
3. Generalized receptor for ecological health risk evaluation.

Conceptual Exposure Model

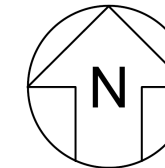
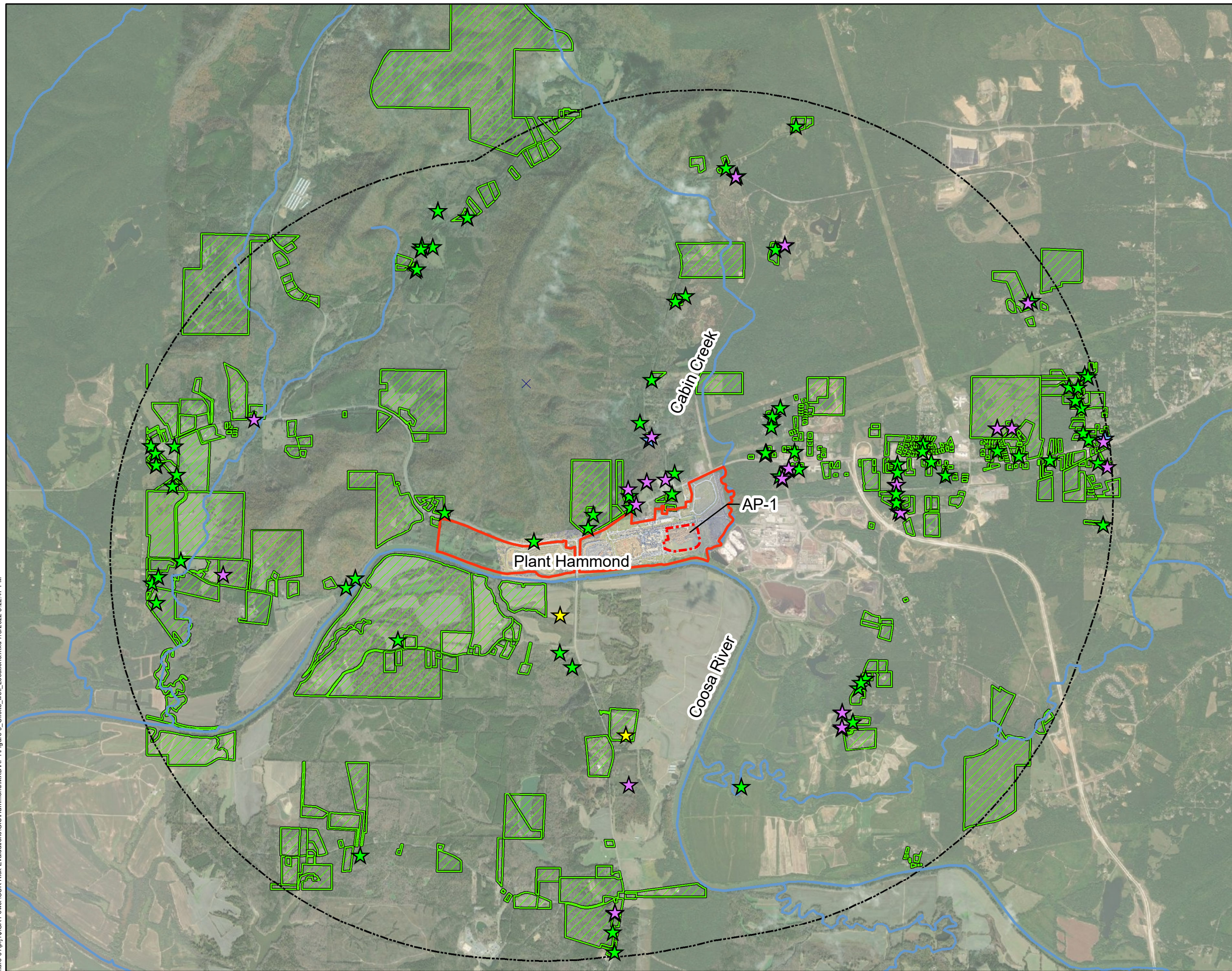
Georgia Power
Plant Hammond AP-1

Geosyntec
consultants

Kennesaw, GA August 2022

Figure
4

\\arc-01\proj1\GA Power\CCF Risk Evaluations\GIS\Hammond\MDAP1\Figure 9_Offsite_well_Locations.mxd 7/5/2022 5:22:47 PM



LEGEND

Off Site Wells

- ★ Industrial Well
- ★ Monitoring Well
- ★ Private Drinking Well
- ★ Private Irrigation Well
- River or Stream
- - - 3-Mile Radius
- ▨ Parcel Identified as Likely Having Well
- . - . - . Approximate AP-1 Boundary
- Approximate Plant Hammond Site Boundary



Notes:
1. Aerial photograph source: ESRI World Imagery - Maxar, October 2017
and Georgia Power Company, January 2022.



OFF-SITE WELL SURVEY RESULTS

GEORGIA POWER
PLANT HAMMOND AP-1
FLOYD COUNTY, GEORGIA

Prepared For:  Georgia Power

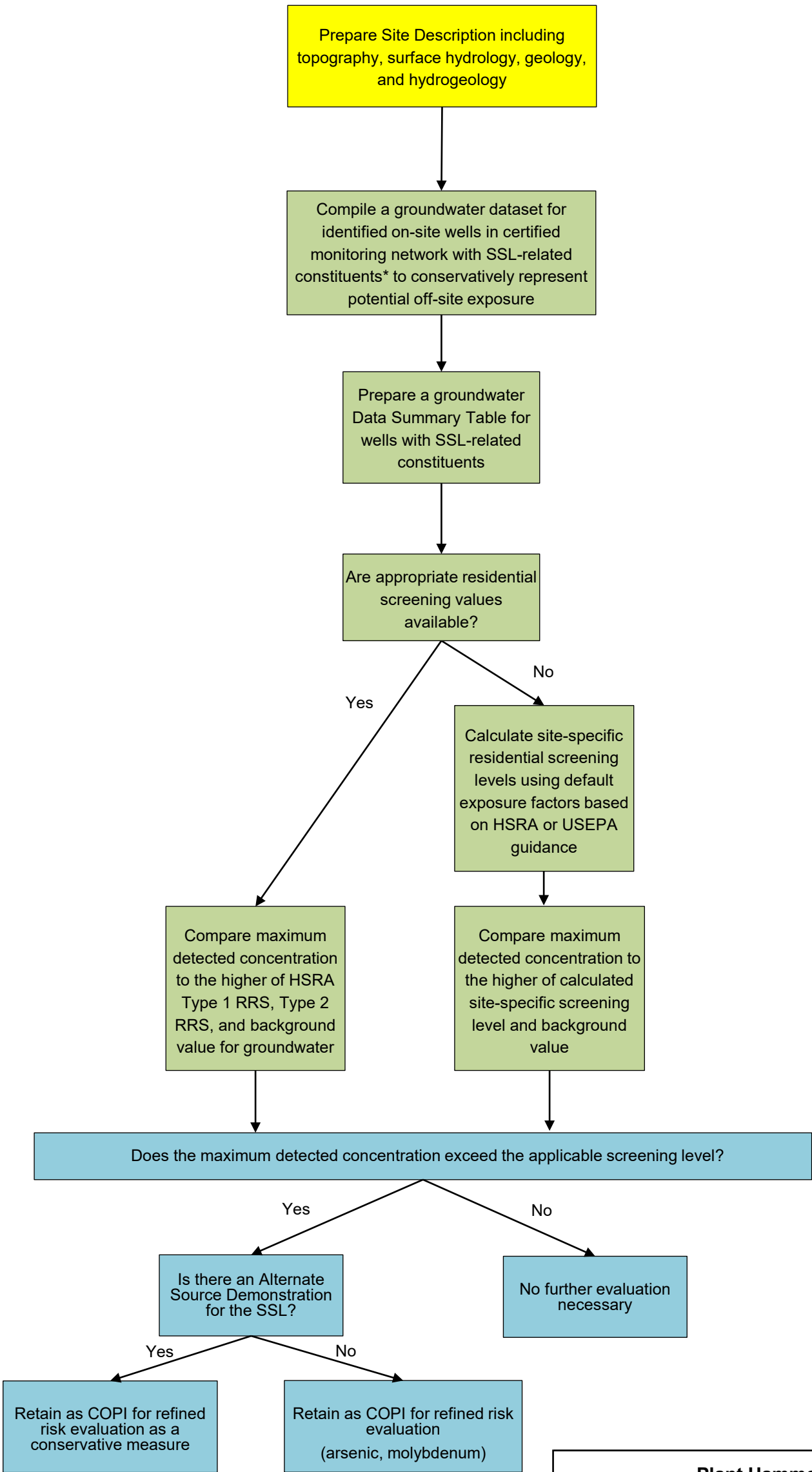
Prepared By:  Geosyntec
consultants

KENNESAW, GA

AUGUST 2022

FIGURE
5

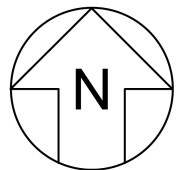
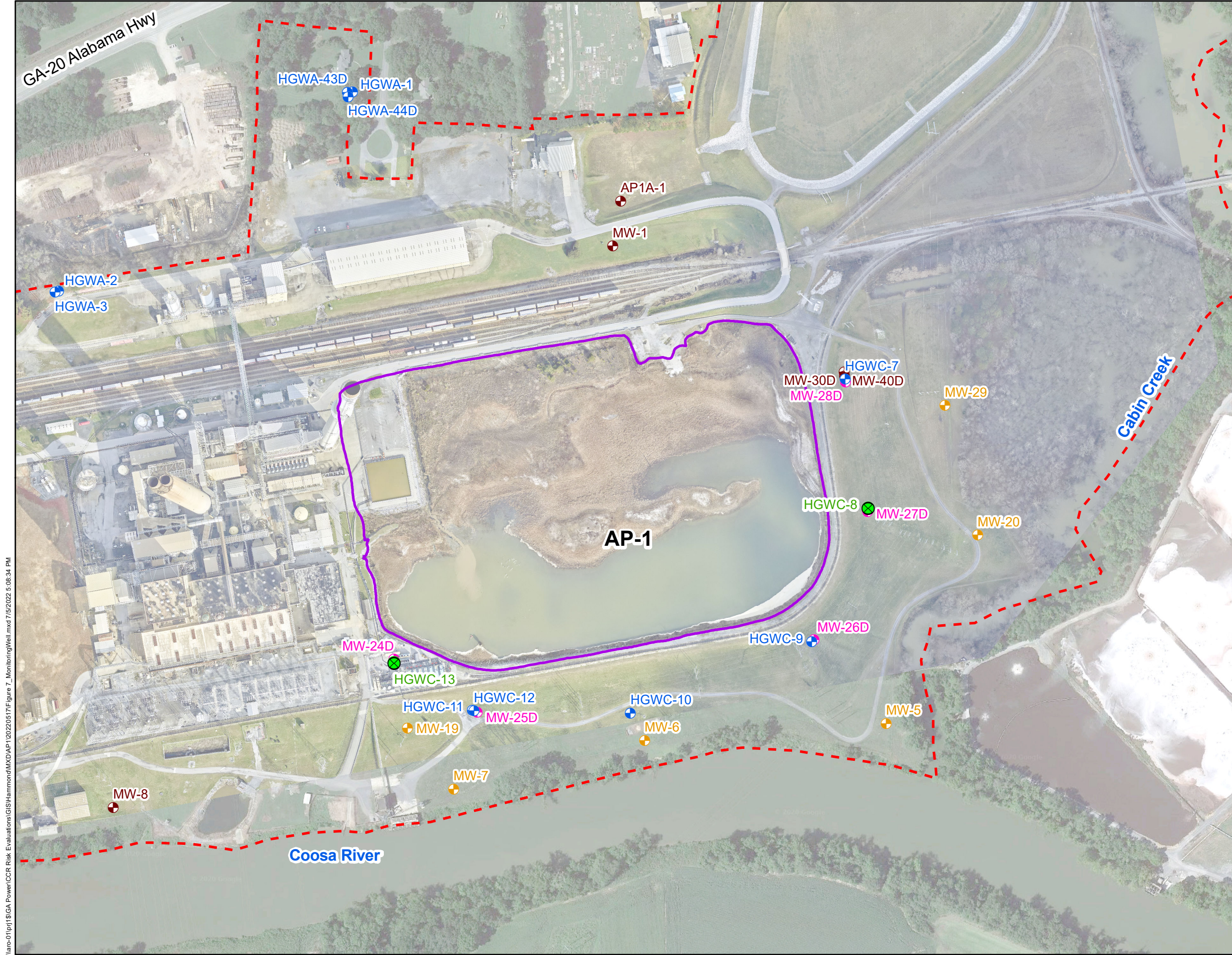
Initial Risk Screening Approach (Groundwater) for AP-1



Notes:

- Initial screen evaluates wells at AP-1 with SSL-related constituents arsenic and molybdenum
- SSL = Statistically Significant Level
- COPI = Constituent of Potential Interest
- HSRA = Hazardous Site Response Act
- RRS = Risk Reduction Standard
- USEPA = United States Environmental Protection Agency

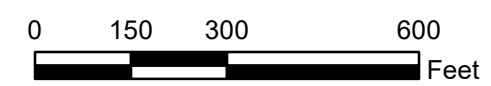
\\arc-01\prj1\GA Power\CCR Risk Evaluations\GIS\Hammond\MDAP1\20220517\Figure 7_MonitoringWell.mxd 7/5/2022 5:08:34 PM



- LEGEND**
- Wells with SSL Related Constituents
 - Compliance Monitoring Well
 - Horizontal Delineation Well
 - Vertical Delineation Well
 - Piezometer
 - Approximate AP-1
 - Plant Hammond Property Boundary



- Note:**
- Arsenic Federal and State CCR Rules SSL-Related Constituent: HGWC-13.
 - Molybdenum Federal and State CCR Rules SSL-Related Constituent: HGWC-8.
 - Aerial photograph source: Google Earth Pro, August 2019 and Georgia Power Company, January 2022.

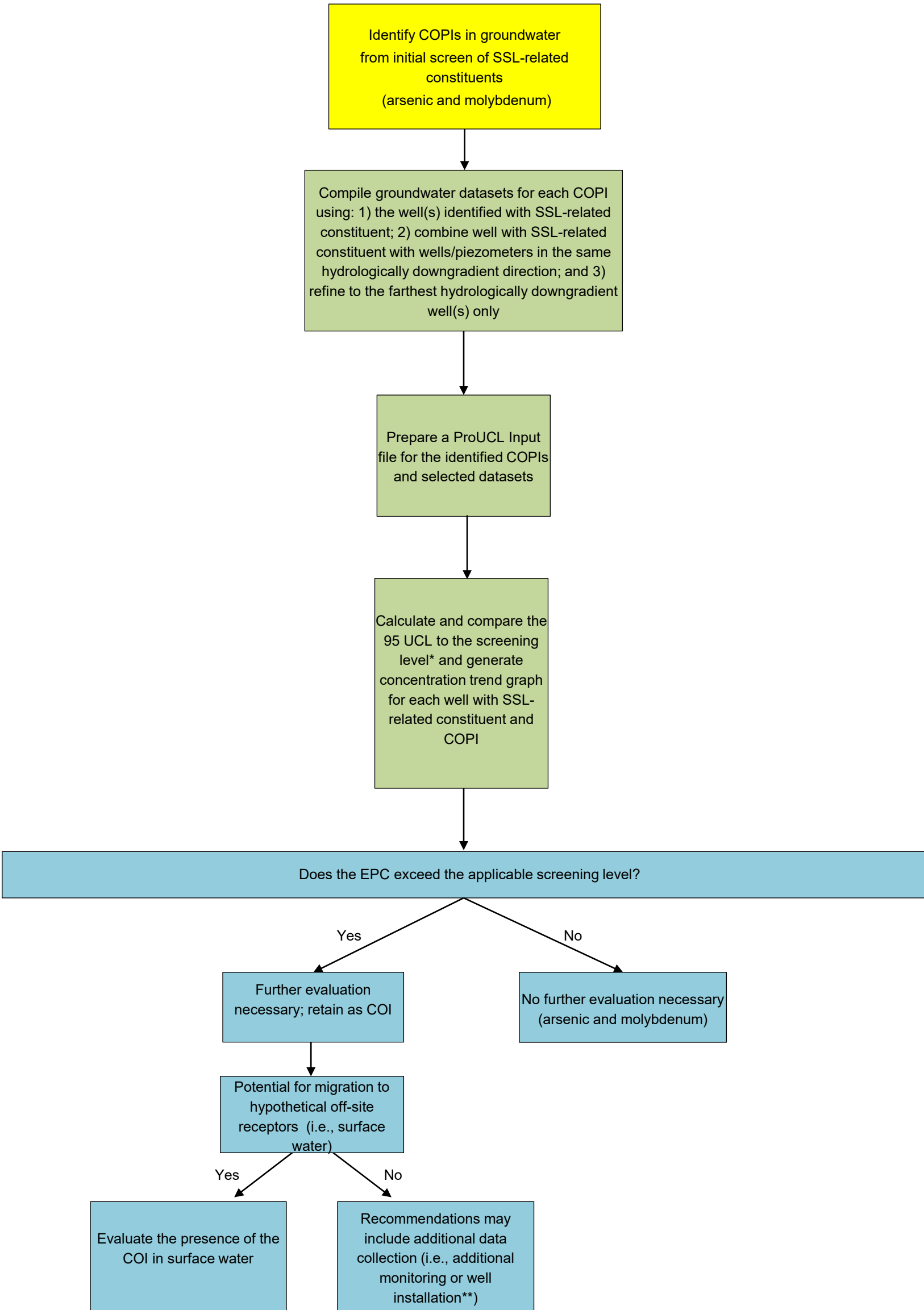


**MONITORING WELLS INCLUDED
IN RISK SCREEN**

GEORGIA POWER
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

Prepared For:	Georgia Power	FIGURE 7
Prepared By:	Geosyntec consultants	
KENNESAW, GA	AUGUST 2022	

Approach for Refined Risk Evaluation (Groundwater) for AP-1



Notes:
*If the 95 UCL exceeds the maximum concentration, use the maximum as the EPC.
**This step is not necessary for Hammond AP-1.
SSL = Statistically Significant Level
COPI = Constituent of Potential Interest
EPC = Exposure Point Concentration
UCL = Upper Confidence Limit
COI = Constituent of Interest

APPENDIX A

Plant Hammond Well Survey (Off-Site)

Well Survey

Plant Hammond

Ash Pond 1, Ash Pond 2, Ash Pond 3, Ash Pond 4

Rome, GA

Prepared for

Georgia Power Company

241 Ralph McGill Blvd., Atlanta, GA 30308

Prepared by

NewFields Companies, LLC

1349 W. Peachtree Street, Suite 2000

Atlanta, GA 30309

March 5, 2020

Introduction

Plant Hammond is located at 5963 Alabama Highway SW, Rome, GA 30165 and situated on an approximately 430-acre parcel along the Coosa River.

The Plant has four current and former ash ponds. Newfields conducted a well survey of potential drinking water wells within a three-mile radius of Ash Pond 1 (AP-1), Ash Pond 2 (AP-2), Ash Pond 3 (AP-3), and Ash Pond 4 (AP-4). This area, referred to in this report as the Investigated Area, is shown on Figure 1.

As part of the survey, NewFields reviewed information from a number of Federal, State, and County records and online sources, as well as a windshield survey of the Investigated Area. Information from each identified well was then compiled into a geographic information system (GIS) database.

Information Collection

This section summarizes the sources utilized to identify potential drinking water wells within the Investigated Area.

1. Federal Sources

- a. **United States Geological Survey (USGS).** The USGS maintains an inventory database of wells sampled by a USGS-affiliated program for ground-water levels or water quality parameters at any time in the past.¹ Well information and coordinates were downloaded for the state of Georgia and compiled into the GIS database. All of the wells in this database in the Investigated Area were identified in the database simply as ‘monitoring wells’; however, many of these appear to be co-located with drinking water wells. Some of these USGS monitoring wells may in fact be private drinking water wells utilized for monitoring purposes by USGS.
- b. **Safe Drinking Water Information System (SDWIS).** This EPA database has listings of public water systems but does not have well location information. SDWIS information was used to help identify the suppliers of public water in the vicinity of each facility. The water supplier for the Investigated Area is the Floyd County Water Utility.

2. State Sources

Georgia Environmental Protection Division (EPD)

- a. **Drinking Water Branch.** EPD Drinking Water Branch maintains records about municipal and industrial wells, whose presence or absence within a radius of a site can be ascertained by contacting the agency. NewFields contacted Vicki Trent of EPD on October 3rd, 2019 requesting information about wells in the Investigated Area. Ms. Trent confirmed that there were no wells in the Investigated Area.

¹ <http://waterdata.usgs.gov/ga/nwis/inventory?introduction>

- b. **EPD Pesticide Sampling Project.** From 2000 to 2004, EPD undertook a project to sample private drinking water wells for pesticides. EPD solicited volunteers state-wide to participate in the well sampling program. The final report includes the list of private water wells sampled, their coordinates, and depths when available.² Information about wells within the Investigated Area were compiled into the GIS database.
 - c. **Hazardous Site Inventory (HSI) Files.** EPD maintains files for Hazardous Site Inventory files for site which are undergoing state-led corrective action. These files usually contain groundwater data and well surveys. The EPD's online, interactive HSI map was reviewed. The only nearby HSI site is the Berryhill Landfill, 1.3 miles to the northwest of the northern impoundment. This site was added to the GIS databases. Reports associated with this site were reviewed, and wells identified in site files were added to the GIS database.
 - d. **Hazardous Site Response Act (HSRA) Notifications.** EPD maintains non-HSI HSRA notification reports (i.e., notifications submitted after releases of reportable substances). NewFields reviewed reports associated with sites in Floyd County within a 5-mile radius of Plant Hammond were scanned. Wells identified on these surveys were compiled into the GIS database. NewFields omitted the four monitoring wells shown to be located on Plant Hammond's property by past non-HSI well surveys, as we considered it unlikely Georgia Power would be utilizing their monitoring wells for irrigation or drinking purposes.
3. Floyd County Sources
- a. **Health Department Records.** Floyd County Health Department (DOH) maintains records of the permits for "on-site sewage management systems" (septic tanks). These permits indicate whether the permittee has private or public water supply, and often identify the exact location of the well on a map. NewFields communicated with Timothy Hendrix with the Department of Environmental Health, who stated that it was not feasible for the DOH to search the septic records themselves, and they would not allow NewFields direct access to the files. However, Mr. Hendrix said he did not believe there was any public water available to the west of Huffaker Road.
 - b. **Floyd County Water Department.** NewFields communicated with Floyd County Utilities Administrator Stephen Hulsey who stated, "[w]e have nothing in the Coosa area west from Hwy 100 South." Hwy 100 South, also known as Foster Mill Road, is the road that runs between AP-2 and AP-4 and is the next major road to the west of Huffaker Rd. Mr. Hulsey stated he was not sure exactly how long the water system has been in place, but that he believed it was operating "since the 1970s."
 - c. **Tax Assessor Records.** Floyd County GIS department provided parcel data for the county that was joined with full WINGap data from the tax assessor's office. The tax assessor's data included improvement values for parcels (indicating the presence of a structure) and the

² https://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/PR-55.pdf

year of construction. Parcels with structures built prior to 1970 were identified as potentially containing active or abandoned drinking water wells.

4. Windshield Surveys

- a. A windshield survey of the Investigated Area was conducted on October 9th, 2019. During the survey a number of wells were visually identified, which were subsequently compiled into the GIS database. It is impossible to determine whether the wells seen are irrigation wells, drinking water wells, or are currently active.

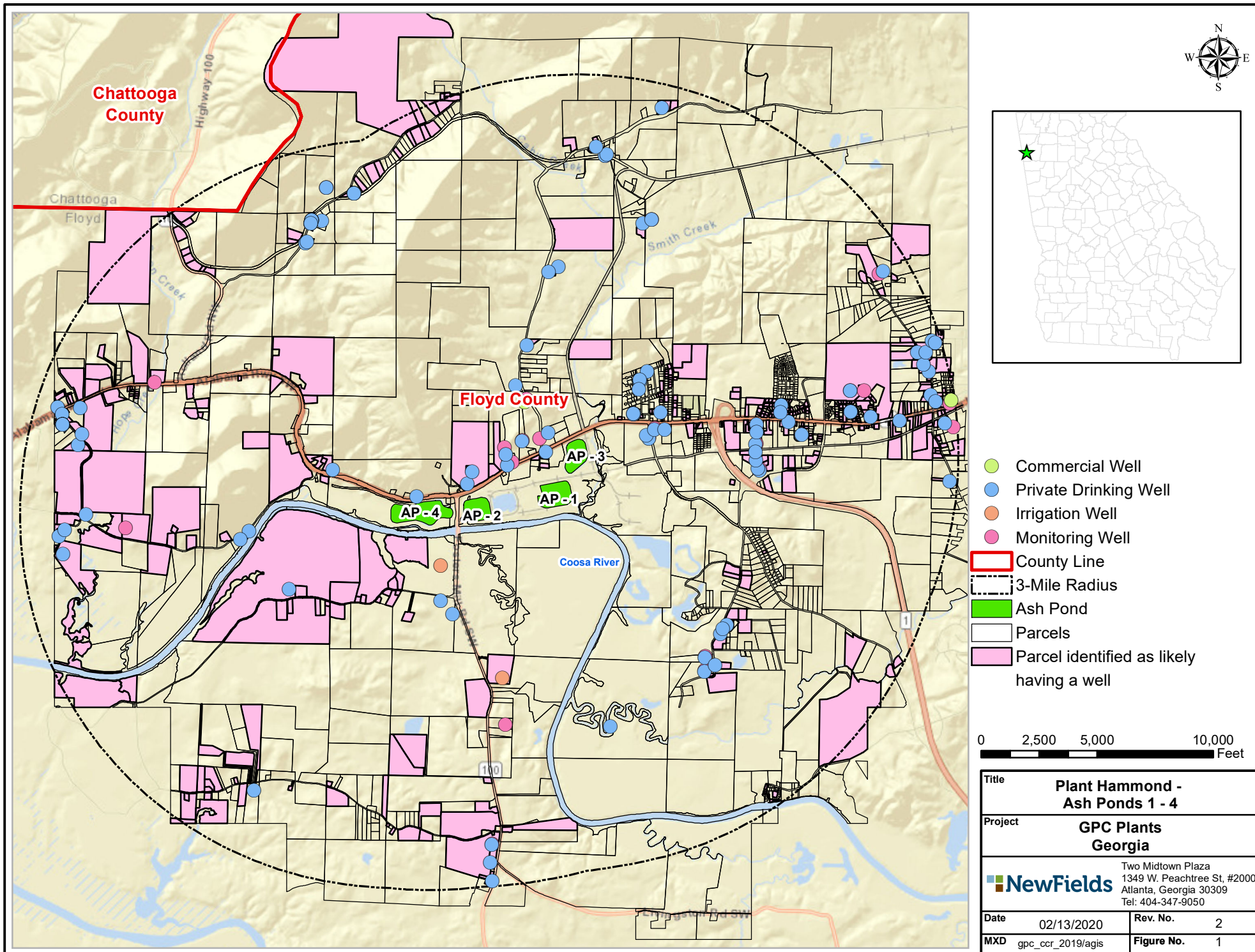
Summary

In addition to identifying specific wells from the above listed sources, NewFields used a combination of parcel data and information about the presence and age of public water infrastructure to identify parcels that most likely are using well water as their drinking water source or had drinking water wells at some time. Parcels may be (or have been) sharing wells, so a well may not exist for each identified parcel. These wells may or may not be active for drinking water and/or irrigation. Many wells were visible in the windshield surveys.

NewFields identified 707 actual and potential wells within the Investigated Area, the majority of which are likely private drinking water wells, but also some monitoring wells and commercial wells.³ There were no public drinking water wells within the Investigated Area.

Figure 1 shows points for identified wells in the Investigated Area. The shaded parcels are parcels that were identified from parcel data as likely to contain wells. When viewed as a PDF file, the figure is interactive, and wells identified using different sources can be turned on and off.

³ USGS monitoring wells located on Georgia Power property were considered not to be drinking water wells and omitted from the figures and tables in this report.



APPENDIX B

Data Used in Risk Evaluation

Appendix B
Groundwater Data
Plant Hammond AP-1 Risk Evaluation Report
Plant Hammond, Rome, GA

Well ID	Sample Date	Constituent	Arsenic	Molybdenum
		Units	mg/L	mg/L
		Ash Pond		
HGWC-13	5/23/2016	Ash Pond 1	0.329	0.027
HGWC-13	7/12/2016	Ash Pond 1	0.297	0.0316
HGWC-13	9/1/2016	Ash Pond 1	0.314	0.0336
HGWC-13	10/24/2016	Ash Pond 1	0.334	0.0352
HGWC-13	12/7/2016	Ash Pond 1	0.35	0.0383
HGWC-13	1/26/2017	Ash Pond 1	0.424	0.041
HGWC-13	3/22/2017	Ash Pond 1	0.419	0.0426
HGWC-13	5/24/2017	Ash Pond 1	0.393	0.04
HGWC-13	4/4/2018	Ash Pond 1	0.49	0.027
HGWC-13	6/5/2018	Ash Pond 1	0.38	0.027
HGWC-13	10/5/2018	Ash Pond 1	0.34	0.033
HGWC-13	3/13/2019	Ash Pond 1	0.42	0.033
HGWC-13	4/5/2019	Ash Pond 1	0.36	0.03
HGWC-13	9/26/2019	Ash Pond 1	0.44	0.026
HGWC-13	3/4/2020	Ash Pond 1	0.52	0.03
HGWC-13	3/30/2020	Ash Pond 1	0.47	0.029
HGWC-13	9/21/2020	Ash Pond 1	0.39	0.032
HGWC-13	2/22/2021	Ash Pond 1	0.45	0.036
HGWC-13	3/17/2021	Ash Pond 1	0.39	0.035
HGWC-13	8/19/2021	Ash Pond 1	0.31	0.032
HGWC-13	2/10/2022	Ash Pond 1	0.38	0.033
HGWC-8	5/20/2016	Ash Pond 1	<0.005 (ND)	0.446
HGWC-8	7/12/2016	Ash Pond 1	<0.005 (ND)	0.455
HGWC-8	9/1/2016	Ash Pond 1	<0.005 (ND)	0.481
HGWC-8	10/20/2016	Ash Pond 1	<0.005 (ND)	0.472
HGWC-8	12/6/2016	Ash Pond 1	<0.005 (ND)	0.52
HGWC-8	1/25/2017	Ash Pond 1	<0.005 (ND)	0.478
HGWC-8	3/21/2017	Ash Pond 1	<0.005 (ND)	0.547
HGWC-8	5/23/2017	Ash Pond 1	<0.005 (ND)	0.482
HGWC-8	4/3/2018	Ash Pond 1	<0.005 (ND)	0.44
HGWC-8	6/6/2018	Ash Pond 1	<0.005 (ND)	0.49
HGWC-8	10/2/2018	Ash Pond 1	<0.005 (ND)	0.47
HGWC-8	3/12/2019	Ash Pond 1	<0.005 (ND)	0.5
HGWC-8	4/3/2019	Ash Pond 1	<0.005 (ND)	0.5
HGWC-8	9/24/2019	Ash Pond 1	<0.005 (ND)	0.54
HGWC-8	3/3/2020	Ash Pond 1	<0.005 (ND)	0.44
HGWC-8	3/27/2020	Ash Pond 1	<0.005 (ND)	0.42
HGWC-8	6/16/2020	Ash Pond 1	--	0.45
HGWC-8	9/16/2020	Ash Pond 1	<0.00078 (ND)	0.43
HGWC-8	2/16/2021	Ash Pond 1	<0.00078 (ND)	0.46
HGWC-8	3/15/2021	Ash Pond 1	<0.00078 (ND)	0.41
HGWC-8	8/18/2021	Ash Pond 1	<0.0011 (ND)	0.48
HGWC-8	2/10/2022	Ash Pond 1	0.002 JB	0.34
MW-19	3/14/2019	Ash Pond 1	<0.005 (ND)	0.057
MW-19	4/3/2019	Ash Pond 1	<0.005 (ND)	0.04
MW-19	9/27/2019	Ash Pond 1	<0.005 (ND)	0.063
MW-19	3/4/2020	Ash Pond 1	0.00045 J	0.032
MW-19	3/26/2020	Ash Pond 1	<0.005 (ND)	0.033
MW-19	9/21/2020	Ash Pond 1	<0.00078 (ND)	0.064
MW-19	2/12/2021	Ash Pond 1	<0.00078 (ND)	0.046
MW-19	3/17/2021	Ash Pond 1	<0.00078 (ND)	0.043
MW-19	8/18/2021	Ash Pond 1	<0.0011 (ND)	0.032
MW-19	2/9/2022	Ash Pond 1	<0.0011 (ND)	0.011

Appendix B
Groundwater Data
Plant Hammond AP-1 Risk Evaluation Report
Plant Hammond, Rome, GA

Well ID	Sample Date	Constituent	Arsenic	Molybdenum
		Units	mg/L	mg/L
		Ash Pond		
MW-20	3/13/2019	Ash Pond 1	0.0023 J	<0.01 (ND)
MW-20	4/2/2019	Ash Pond 1	<0.005 (ND)	<0.01 (ND)
MW-20	9/25/2019	Ash Pond 1	<0.005 (ND)	<0.01 (ND)
MW-20	3/2/2020	Ash Pond 1	0.00038 J	<0.01 (ND)
MW-20	3/27/2020	Ash Pond 1	<0.005 (ND)	<0.01 (ND)
MW-20	9/17/2020	Ash Pond 1	<0.00078 (ND)	<0.00069 (ND)
MW-20	2/11/2021	Ash Pond 1	0.00094 J	<0.00069 (ND)
MW-20	3/15/2021	Ash Pond 1	<0.00078 (ND)	<0.00069 (ND)
MW-20	8/17/2021	Ash Pond 1	<0.0011 (ND)	<0.00074 (ND)
MW-20	2/10/2022	Ash Pond 1	<0.0011 (ND)	<0.00074 (ND)
MW-24D	3/13/2019	Ash Pond 1	<0.005 (ND)	<0.01 (ND)
MW-24D	4/8/2019	Ash Pond 1	<0.005 (ND)	0.00027 J
MW-24D	9/26/2019	Ash Pond 1	<0.005 (ND)	<0.01 (ND)
MW-24D	3/4/2020	Ash Pond 1	<0.005 (ND)	<0.01 (ND)
MW-24D	3/30/2020	Ash Pond 1	<0.005 (ND)	<0.01 (ND)
MW-24D	9/21/2020	Ash Pond 1	<0.00078 (ND)	0.00099 J
MW-24D	2/16/2021	Ash Pond 1	<0.00078 (ND)	0.00096 J
MW-24D	3/17/2021	Ash Pond 1	<0.00078 (ND)	0.001 J
MW-24D	8/19/2021	Ash Pond 1	<0.0011 (ND)	0.00087 J
MW-24D	2/10/2022	Ash Pond 1	<0.0011 (ND)	0.0008 J
MW-27D	3/13/2019	Ash Pond 1	<0.005 (ND)	<0.01 (ND)
MW-27D	4/4/2019	Ash Pond 1	0.0002 J	0.0018 J
MW-27D	9/26/2019	Ash Pond 1	<0.005 (ND)	0.0042 J
MW-27D	3/4/2020	Ash Pond 1	0.00069 J	0.0058 J
MW-27D	4/2/2020	Ash Pond 1	<0.005 (ND)	0.003 J
MW-27D	9/18/2020	Ash Pond 1	<0.00078 (ND)	0.0018 J
MW-27D	2/16/2021	Ash Pond 1	0.001 J	0.0019 J
MW-27D	3/12/2021	Ash Pond 1	<0.00078 (ND)	0.0008 J
MW-27D	8/17/2021	Ash Pond 1	<0.0011 (ND)	0.0016 J
MW-27D	2/10/2022	Ash Pond 1	<0.0011 (ND)	0.0017 J
MW-7	3/13/2019	Ash Pond 1	<0.005 (ND)	<0.01 (ND)
MW-7	4/3/2019	Ash Pond 1	<0.005 (ND)	<0.01 (ND)
MW-7	9/26/2019	Ash Pond 1	<0.005 (ND)	0.0033 J
MW-7	3/3/2020	Ash Pond 1	<0.005 (ND)	<0.01 (ND)
MW-7	3/30/2020	Ash Pond 1	<0.005 (ND)	<0.01 (ND)
MW-7	9/21/2020	Ash Pond 1	<0.00078 (ND)	0.0015 J
MW-7	2/15/2021	Ash Pond 1	<0.00078 (ND)	0.0015 J
MW-7	3/15/2021	Ash Pond 1	<0.00078 (ND)	0.0015 J
MW-7	8/17/2021	Ash Pond 1	<0.0011 (ND)	0.003 J
MW-7	2/8/2022	Ash Pond 1	<0.0011 (ND)	0.0012 J

Notes:

Bold = the constituent was detected in the sample.

"--" = No analysis conducted.

mg/L milligrams(s) per liter

< = Non-detect result; the reporting limit is presented

J = Estimated value; the presented value is below the reporting limit but above the method detection limit

(ND) = Non-detect result; the reporting limit is presented

APPENDIX C

USEPA RSL Calculator Generated Residential Screening Levels

Appendix C
USEPA RSL Calculator Generated Residential Screening Levels
Plant Hammond AP1 Risk Evaluation Report
Plant Hammond, Rome, GA

Variable	Value
THQ (target hazard quotient) unitless	1
TR (target risk) unitless	0.00001
LT (lifetime) years	70
K (volatilization factor of Andelman) L/m3	0.5
Isc (apparent thickness of stratum corneum) cm	0.001
EDres (exposure duration - resident) years	26
EDres-c (exposure duration - child) years	6
EDres-a (exposure duration - adult) years	20
ED0-2 (mutagenic exposure duration first phase) years	2
ED2-6 (mutagenic exposure duration second phase) years	4
ED6-16 (mutagenic exposure duration third phase) years	10
ED16-26 (mutagenic exposure duration fourth phase) years	10
EFres (exposure frequency) days/year	350
EFres-c (exposure frequency - child) days/year	350
EFres-a (exposure frequency - adult) days/year	350
EF0-2 (mutagenic exposure frequency first phase) days/year	350
EF2-6 (mutagenic exposure frequency second phase) days/year	350
EF6-16 (mutagenic exposure frequency third phase) days/year	350
EF16-26 (mutagenic exposure frequency fourth phase) days/year	350
ETevent-res-adj (age-adjusted exposure time) hours/event	0.67077
ETevent-res-madj (mutagenic age-adjusted exposure time) hours/event	0.67077
ETres (exposure time) hours/day	24
ETres-c (dermal exposure time - child) hours/event	0.54
ETres-a (dermal exposure time - adult) hours/event	0.71
ETres-c (inhalation exposure time - child) hours/day	24
ETres-a (inhalation exposure time - adult) hours/day	24
ET0-2 (mutagenic inhalation exposure time first phase) hours/day	24
ET2-6 (mutagenic inhalation exposure time second phase) hours/day	24
ET6-16 (mutagenic inhalation exposure time third phase) hours/day	24
ET16-26 (mutagenic inhalation exposure time fourth phase) hours/day	24
ET0-2 (mutagenic dermal exposure time first phase) hours/event	0.54
ET2-6 (mutagenic dermal exposure time second phase) hours/event	0.54
ET6-16 (mutagenic dermal exposure time third phase) hours/event	0.71
ET16-26 (mutagenic dermal exposure time fourth phase) hours/event	0.71
BWres-a (body weight - adult) kg	80
BWres-c (body weight - child) kg	15
BW0-2 (mutagenic body weight) kg	15
BW2-6 (mutagenic body weight) kg	15
BW6-16 (mutagenic body weight) kg	80
BW16-26 (mutagenic body weight) kg	80
IFWres-adj (adjusted intake factor) L/kg	327.95
IFWres-adj (adjusted intake factor) L/kg	327.95
IFWMres-adj (mutagenic adjusted intake factor) L/kg	1019.9
IFWMres-adj (mutagenic adjusted intake factor) L/kg	1019.9
IRWres-c (water intake rate - child) L/day	0.78
IRWres-a (water intake rate - adult) L/day	2.5
IRW0-2 (mutagenic water intake rate) L/day	0.78
IRW2-6 (mutagenic water intake rate) L/day	0.78
IRW6-16 (mutagenic water intake rate) L/day	2.5
IRW16-26 (mutagenic water intake rate) L/day	2.5
EVres-a (events - adult) per day	1
EVres-c (events - child) per day	1
EV0-2 (mutagenic events) per day	1
EV2-6 (mutagenic events) per day	1
EV6-16 (mutagenic events) per day	1
EV16-26 (mutagenic events) per day	1
DFWres-adj (age-adjusted dermal factor) cm2-event/kg	2610650
DFWMres-adj (mutagenic age-adjusted dermal factor) cm2-event/kg	8191633
SAres-c (skin surface area - child) cm2	6365
SAres-a (skin surface area - adult) cm2	19652
SA0-2 (mutagenic skin surface area) cm2	6365
SA2-6 (mutagenic skin surface area) cm2	6365
SA6-16 (mutagenic skin surface area) cm2	19652
SA16-26 (mutagenic skin surface area) cm2	19652

Output generated 17MAY2022:13:42:16

Appendix C

USEPA RSL Calculator Generated Residential Screening Levels

Plant Hammond AP-1 Risk Evaluation Report

Plant Hammond, Rome, GA

Chemical	Molybdenum
CAS Number	7782-49-2
Mutagen?	No
Volatile?	No
Chemical Type	Inorganics
Sfo (mg/kg-day)-1	-
Sfo Ref	
IUR (ug/m3)-1	-
IUR Ref	
RfD (mg/kg-day)	0.005
RfD Ref	I
RfC (mg/m3)	0.002
RfC Ref	C
GIABS	1
Kp (cm/hr)	0.001
MW	95.94
B (unitless)	0.00377
t* (hr)	0.87
tevent (hr/event)	0.362
FA (unitless)	1
In EPD?	Yes
DAevent (ca)	-
DAevent (nc child)	0.0123
DAevent (nc adult)	0.0212
MCL (ug/L)	-
Ingestion SL TR=1E-05 (ug/L)	-
Dermal SL TR=1E-05 (ug/L)	-
Inhalation SL TR=1E-05 (ug/L)	-
Carcinogenic SL TR=1E-05 (ug/L)	-
Ingestion SL Child THQ=1 (ug/L)	100
Dermal SL Child THQ=1 (ug/L)	22800
Inhalation SL Child THQ=1 (ug/L)	-
Noncarcinogenic SL Child THI=1 (ug/L)	99.8
Ingestion SL Adult THQ=1 (ug/L)	167
Dermal SL Adult THQ=1 (ug/L)	29900
Inhalation SL Adult THQ=1 (ug/L)	-
Noncarcinogenic SL Adult THI=1 (ug/L)	166
Screening Level (ug/L)	9.98E+01 nc

Notes

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

APPENDIX D

Support for Refined Risk Evaluation

Appendix D-1

Exposure Point Concentration Calculation Results

Appendix D.
Appendix D-1
Exposure Point Concentration Calculation Results^[1]
Pland Hammond AP-1 Risk Evaluation Report
Plant Hammond, Rome, GA

CCR Rule Designation	Constituent	Well IDs Included	Maximum Concentration (mg/L)	Detection Frequency	Exceedance Frequency	EPC Step 1	EPC Step 2	EPC Step 3
						Target Well(s) 2016-2022 (mg/L)	Target Well(s) + Nearby Well(s) + Downgradient Well(s) 2016-2022 (mg/L)	Farthest Downgradient Well(s) ^[2] 2016-2022 (mg/L)
Appendix IV	Arsenic	HGWC-13	0.52	21 / 21	21 / 21	0.41		
		HGWC-13 MW-19 MW-24D MW-7	0.52	22 / 51	21 / 51		0.28	
		MW-7	<0.005	0 / 10	0 / 10			<0.005
	Molybdenum	HGWC-8	0.55	22 / 22	22 / 22	0.48		
		HGWC-8 MW-20 MW-27D MW-20	0.55	31 / 42	22 / 42		0.47	
			<0.01	0 / 10	0 / 10			<0.01

Notes:

Highlighted cells indicate the EPCs selected in the refined risk evaluation.

[1] EPCs calculated in accordance with USEPA, 2014. Memorandum for Determining Groundwater Exposure Point Concentrations, Supplemental Guidance. OSWER Directive 9283.1-42, February 2014. Located at <https://cfpub.epa.gov/ncea/risk/recorddisplay.cfm?deid=236917>

[2] The presented value is the method detection limit (MDL) for the constituent.

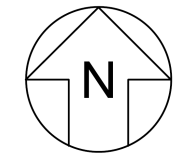
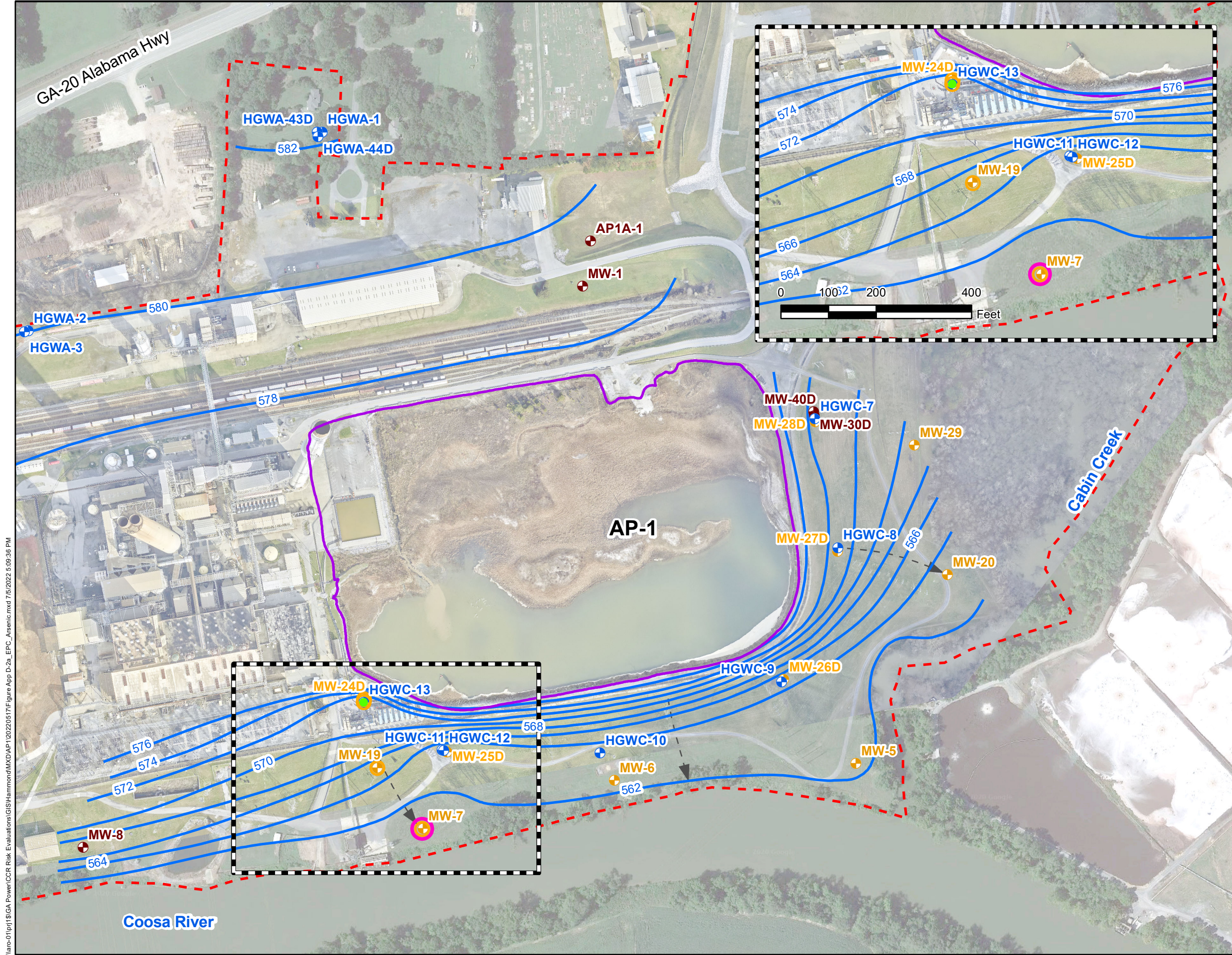
Definitions:

EPC = Exposure Point Concentration

mg/L = milligrams per liter

Appendix D-2

Exposure Point Concentration Figures



LEGEND

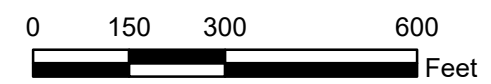
- Compliance Monitoring Well
- Delineation Monitoring Well
- Groundwater Level Monitoring Piezometer
- Groundwater Elevation Iso-Contour
- Approximate Groundwater Flow Direction
- Approximate AP-1 Boundary
- Plant Hammond Property Boundary

Exposure Point Concentration Wells

- Step 1 Well
- Step 2 Well
- Step 3 Well

Notes:

- Exposure Point Concentration (EPC).
- EPC Step 1 - Individual Target Well(s) 2016-2022.
- EPC Step 2 - Target Well(s) & Adjacent Well(s) & Downgradient Well(s) 2016-2022.
- EPC Step 3 - Farthest Downgradient Well(s) 2016-2022.
- Water elevation contours are based on measurements shown on Figure 3. Elevation provided in feet above mean sea level (ft AMSL) in North American Vertical Datum (NAVD) 88.
- Aerial photograph source: Google Earth Pro, August 2019 and Georgia Power Company, January 2022.



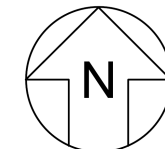
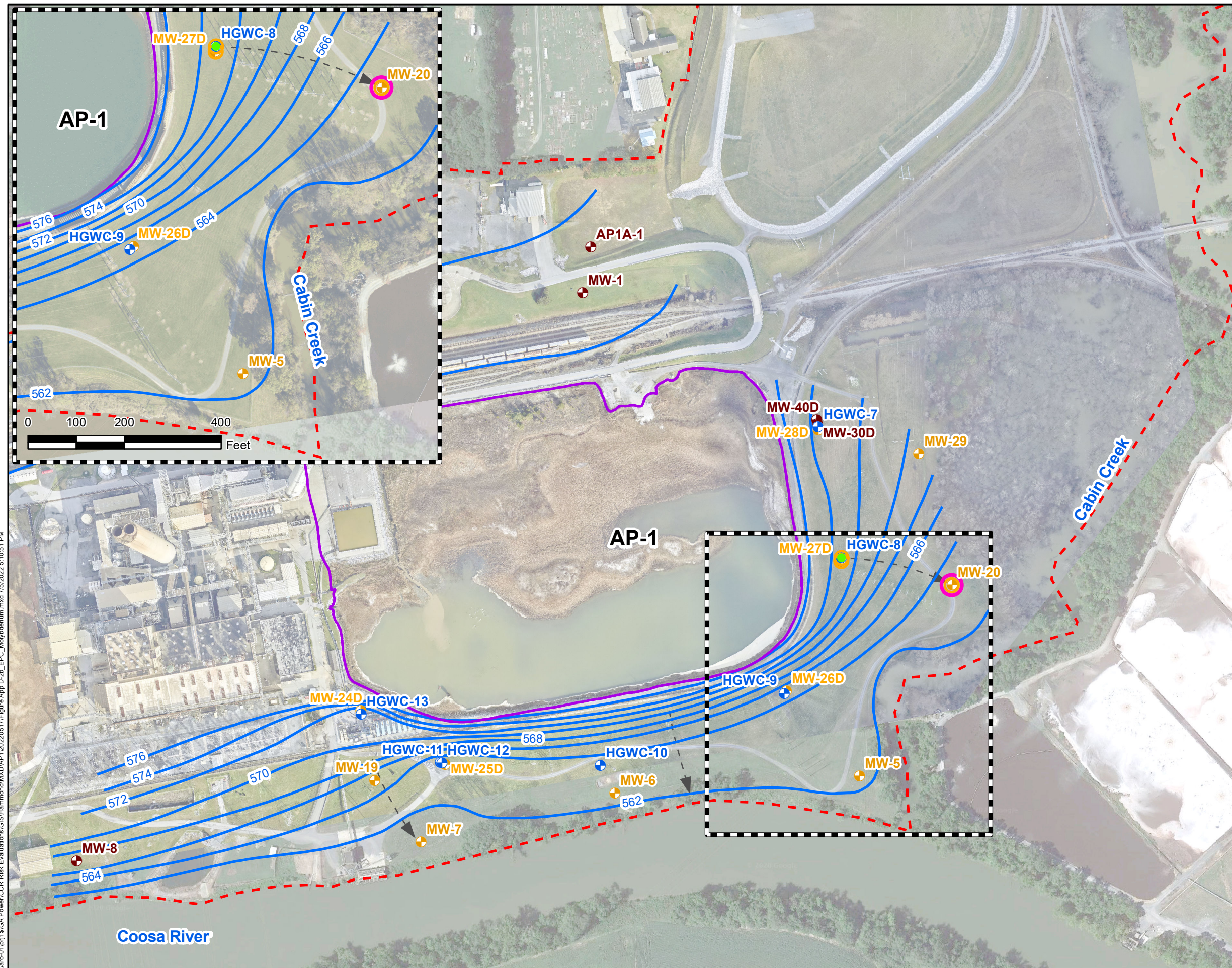
EXPOSURE POINT CONCENTRATION MAP
ARSENIC

GEORGIA POWER
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

Prepared For:	FIGURE D-2a
Prepared By:	
KENNESAW, GA AUGUST 2022	

\\ars-01\prj1\GA Power\CCFR Risk Evaluations\GIS\Hammond\MDAP1\20220517\Figure App D-2a_EPC_Arsenic.mxd 7/5/2022 5:09:36 PM

\\arc-01\prj1\GA Power\CCFR Risk Evaluations\GIS\Hammond\MDAP1\20220517\Figure App D-2b_EPC_Molybdenum.mxd 7/5/2022 5:10:51 PM



LEGEND

- Compliance Monitoring Well
- Delineation Monitoring Well
- Groundwater Level Monitoring Piezometer
- Groundwater Elevation Iso-Contour
- Approximate Groundwater Flow Direction
- Approximate AP-1 Boundary
- Plant Hammond Property Boundary

Exposure Point Concentration Wells

- Step 1 Well
- Step 2 Well
- Step 3 Well

Notes:
1. Exposure Point Concentration (EPC).
2. EPC Step 1 - Individual Target Well(s) 2016-2022.
3. EPC Step 2 - Target Well(s) & Adjacent Well(s) & Downgradient Well(s) 2016-2022.
4. EPC Step 3 - Farthest Downgradient Well(s) 2016-2022.
5. Water elevation contours are based on measurements shown on Figure 3. Elevation provided in feet above mean sea level (ft AMSL) in North American Vertical Datum (NAVD) 88.
6. Aerial photograph source: Google Earth Pro, August 2019 and Georgia Power Company, January 2022.

0 150 300 600 Feet

EXPOSURE POINT CONCENTRATION MAP MOLYBDENUM

GEORGIA POWER
PLANT HAMMOND AP-1
ROME, FLOYD COUNTY, GEORGIA

Prepared For:  Georgia Power

Prepared By:  Geosyntec
consultants

KENNESAW, GA

AUGUST 2022

FIGURE
D-2b

Appendix D-3

ProUCL Input/Output Files

Appendix D
Appendix D-3
ProUCL Input
Plant Hammond AP-1 Risk Evaluation Report
Plant Hammond, Rome, GA

Step 1 EPC Calculation Input				Step 2 EPC Calculation Input			
Step1_Arsenic_AP1	D_Step1_Arsenic_AP1	Step1_Molybdenum_AP1	D_Step1_Molybdenum_AP1	Step2_Arsenic_AP1	D_Step2_Arsenic_AP1	Step2_Molybdenum_AP1	D_Step2_Molybdenum_AP1
0.329	1	0.446	1	0.329	1	0.446	1
0.297	1	0.455	1	0.297	1	0.455	1
0.314	1	0.481	1	0.314	1	0.481	1
0.334	1	0.472	1	0.334	1	0.472	1
0.35	1	0.52	1	0.35	1	0.52	1
0.424	1	0.478	1	0.424	1	0.478	1
0.419	1	0.547	1	0.419	1	0.547	1
0.393	1	0.482	1	0.393	1	0.482	1
0.49	1	0.44	1	0.49	1	0.44	1
0.38	1	0.49	1	0.38	1	0.49	1
0.34	1	0.47	1	0.34	1	0.47	1
0.42	1	0.5	1	0.42	1	0.5	1
0.36	1	0.5	1	0.36	1	0.5	1
0.44	1	0.54	1	0.44	1	0.54	1
0.52	1	0.44	1	0.52	1	0.44	1
0.47	1	0.42	1	0.47	1	0.42	1
0.39	1	0.45	1	0.39	1	0.45	1
0.45	1	0.43	1	0.45	1	0.43	1
0.39	1	0.46	1	0.39	1	0.46	1
0.31	1	0.41	1	0.31	1	0.41	1
0.38	1	0.48	1	0.38	1	0.48	1
		0.34	1	0.005	0	0.34	1
		0.005	0	0.005	0	0.01	0
		0.005	0	0.005	0	0.01	0
		0.005	0	0.00045	1	0.01	0
		0.005	0	0.005	0	0.01	0
		0.005	0	0.00078	0	0.01	0
		0.00078	0	0.00078	0	0.00069	0

Appendix D
Appendix D-3
ProUCL Input
Plant Hammond AP-1 Risk Evaluation Report
Plant Hammond, Rome, GA

Step 1 EPC Calculation Input				Step 2 EPC Calculation Input			
Step1_Arsenic_AP1	D_Step1_Arsenic_AP1	Step1_Molybdenum_AP1	D_Step1_Molybdenum_AP1	Step2_Arsenic_AP1	D_Step2_Arsenic_AP1	Step2_Molybdenum_AP1	D_Step2_Molybdenum_AP1
		0.00078	0	0.00078	0	0.00069	0
		0.00078	0	0.0011	0	0.00069	0
		0.0011	0	0.0011	0	0.00074	0
		0.0011	0	0.005	0	0.00074	0
				0.005	0	0.01	0
				0.005	0	0.0018	1
				0.005	0	0.0042	1
				0.005	0	0.0058	1
				0.00078	0	0.003	1
				0.00078	0	0.0018	1
				0.00078	0	0.0019	1
				0.0011	0	0.0008	1
				0.0011	0	0.0016	1
				0.005	0	0.0017	1
				0.005	0		
				0.005	0		
				0.005	0		
				0.005	0		
				0.00078	0		
				0.00078	0		
				0.00078	0		
				0.0011	0		
				0.0011	0		

Notes:

EPC= Exposure point Concentration

Appendix D
Appendix D-3
ProUCL Output
Plant Hammond AP-1 Risk Evaluation Report
Plant Hammond, Rome, GA

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.16/14/2022 10:25:07 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Step1_Arsenic_AP1

General Statistics

Total Number of Observations	21	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	0.297	Mean	0.39
Maximum	0.52	Median	0.39
SD	0.0613	Std. Error of Mean	0.0134
Coefficient of Variation	0.157	Skewness	0.397

Normal GOF Test

Shapiro Wilk Test Statistic	0.971	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.908	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.103	Lilliefors GOF Test
5% Lilliefors Critical Value	0.188	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL	95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.414	95% Adjusted-CLT UCL (Chen-1995)
		95% Modified-t UCL (Johnson-1978)
		0.414

Gamma GOF Test

A-D Test Statistic	0.182	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0849	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.189	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	43.28	k star (bias corrected MLE)	37.13
Theta hat (MLE)	0.00902	Theta star (bias corrected MLE)	0.0105
nu hat (MLE)	1818	nu star (bias corrected)	1559
MLE Mean (bias corrected)	0.39	MLE Sd (bias corrected)	0.0641
		Approximate Chi Square Value (0.05)	1469
Adjusted Level of Significance	0.0383	Adjusted Chi Square Value	1462

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.415	95% Adjusted Gamma UCL (use when n<50)	0.417
---	-------	--	-------

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.98	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.908	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0819	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.188	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level**Lognormal Statistics**

Minimum of Logged Data	-1.214	Mean of logged Data	-0.952
Maximum of Logged Data	-0.654	SD of logged Data	0.156

Assuming Lognormal Distribution

95% H-UCL	0.415	90% Chebyshev (MVUE) UCL	0.43
95% Chebyshev (MVUE) UCL	0.449	97.5% Chebyshev (MVUE) UCL	0.474
99% Chebyshev (MVUE) UCL	0.523		

Nonparametric Distribution Free UCL Statistics**Data appear to follow a Discernible Distribution at 5% Significance Level****Nonparametric Distribution Free UCLs**

95% CLT UCL	0.412	95% Jackknife UCL	0.414
95% Standard Bootstrap UCL	0.412	95% Bootstrap-t UCL	0.415
95% Hall's Bootstrap UCL	0.413	95% Percentile Bootstrap UCL	0.412
95% BCA Bootstrap UCL	0.415		
90% Chebyshev(Mean, Sd) UCL	0.431	95% Chebyshev(Mean, Sd) UCL	0.449
97.5% Chebyshev(Mean, Sd) UCL	0.474	99% Chebyshev(Mean, Sd) UCL	0.524

Suggested UCL to Use

95% Student's-t UCL 0.414

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Step1_Molybdenum_AP1**General Statistics**

Total Number of Observations	32	Number of Distinct Observations	23
Number of Detects	22	Number of Non-Detects	10
Number of Distinct Detects	20	Number of Distinct Non-Detects	3
Minimum Detect	0.34	Minimum Non-Detect	7.80E-04
Maximum Detect	0.547	Maximum Non-Detect	0.005
Variance Detects	0.00206	Percent Non-Detects	31.25%
Mean Detects	0.466	SD Detects	0.0454
Median Detects	0.471	CV Detects	0.0975
Skewness Detects	-0.651	Kurtosis Detects	1.793
Mean of Logged Detects	-0.768	SD of Logged Detects	0.102

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.957	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.911	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.102	Lilliefors GOF Test
5% Lilliefors Critical Value	0.184	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**

KM Mean	0.321	KM Standard Error of Mean	0.0396
---------	-------	---------------------------	--------

KM SD	0.219	95% KM (BCA) UCL	0.378
95% KM (t) UCL	0.388	95% KM (Percentile Bootstrap) UCL	0.38
95% KM (z) UCL	0.386	95% KM Bootstrap t UCL	0.384
90% KM Chebyshev UCL	0.439	95% KM Chebyshev UCL	0.493
97.5% KM Chebyshev UCL	0.568	99% KM Chebyshev UCL	0.714

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.361	Anderson-Darling GOF Test	
5% A-D Critical Value	0.741	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.111	Kolmogorov-Smirnov GOF	
5% K-S Critical Value	0.185	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	104.2	k star (bias corrected MLE)	89.99
Theta hat (MLE)	0.00447	Theta star (bias corrected MLE)	0.00518
nu hat (MLE)	4583	nu star (bias corrected)	3960
Mean (detects)	0.466		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.335	Mean	0.436
Maximum	0.547	Median	0.443
SD	0.0601	CV	0.138
k hat (MLE)	53.25	k star (bias corrected MLE)	48.28
Theta hat (MLE)	0.00818	Theta star (bias corrected MLE)	0.00902
nu hat (MLE)	3408	nu star (bias corrected)	3090
Adjusted Level of Significance (β)	0.0416		
Approximate Chi Square Value (N/A, α)	2961	Adjusted Chi Square Value (N/A, β)	2955
95% Gamma Approximate UCL (use when $n \geq 50$)	0.454	95% Gamma Adjusted UCL (use when $n < 50$)	0.455

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.321	SD (KM)	0.219
Variance (KM)	0.0478	SE of Mean (KM)	0.0396
k hat (KM)	2.148	k star (KM)	1.968
nu hat (KM)	137.5	nu star (KM)	125.9
theta hat (KM)	0.149	theta star (KM)	0.163
80% gamma percentile (KM)	0.481	90% gamma percentile (KM)	0.626
95% gamma percentile (KM)	0.764	99% gamma percentile (KM)	1.072

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (125.93, α)	101	Adjusted Chi Square Value (125.93, β)	99.82
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.4	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.404

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.925	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.911	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.122	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.184	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.436	Mean in Log Scale	-0.839
SD in Original Scale	0.0591	SD in Log Scale	0.137

95% t UCL (assumes normality of ROS data)	0.454	95% Percentile Bootstrap UCL	0.453
95% BCA Bootstrap UCL	0.453	95% Bootstrap t UCL	0.453
95% H-UCL (Log ROS)	0.455		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-2.765	KM Geo Mean	0.063
KM SD (logged)	2.962	95% Critical H Value (KM-Log)	5.357
KM Standard Error of Mean (logged)	0.536	95% H-UCL (KM -Log)	87.49
KM SD (logged)	2.962	95% Critical H Value (KM-Log)	5.357
KM Standard Error of Mean (logged)	0.536		

DL/2 Statistics

DL/2 Normal	DL/2 Log-Transformed		
Mean in Original Scale	0.321	Mean in Log Scale	-2.669
SD in Original Scale	0.222	SD in Log Scale	2.908
95% t UCL (Assumes normality)	0.387	95% H-Stat UCL	74.52

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.388

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Step2_Arsenic_AP1

General Statistics

Total Number of Observations	51	Number of Distinct Observations	23
Number of Detects	22	Number of Non-Detects	29
Number of Distinct Detects	20	Number of Distinct Non-Detects	3
Minimum Detect	4.50E-04	Minimum Non-Detect	7.80E-04
Maximum Detect	0.52	Maximum Non-Detect	0.005
Variance Detects	0.0105	Percent Non-Detects	56.86%
Mean Detects	0.373	SD Detects	0.102
Median Detects	0.385	CV Detects	0.275
Skewness Detects	-2.233	Kurtosis Detects	8.091
Mean of Logged Detects	-1.259	SD of Logged Detects	1.448

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.8	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.911	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.184	Lilliefors GOF Test
5% Lilliefors Critical Value	0.184	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.161	KM Standard Error of Mean	0.0281
KM SD	0.196	95% KM (BCA) UCL	0.207
95% KM (t) UCL	0.208	95% KM (Percentile Bootstrap) UCL	0.206
95% KM (z) UCL	0.207	95% KM Bootstrap t UCL	0.209
90% KM Chebyshev UCL	0.245	95% KM Chebyshev UCL	0.283
97.5% KM Chebyshev UCL	0.336	99% KM Chebyshev UCL	0.44

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic
 5% A-D Critical Value
 K-S Test Statistic
 5% K-S Critical Value

5 Anderson-Darling GOF Test

0.756 Detected Data Not Gamma Distributed at 5% Significance Level
 0.428 **Kolmogorov-Smirnov GOF**
 0.188 Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level**Gamma Statistics on Detected Data Only**

k hat (MLE)	1.988 k star (bias corrected MLE)	1.747
Theta hat (MLE)	0.188 Theta star (bias corrected MLE)	0.213
nu hat (MLE)	87.46 nu star (bias corrected)	76.87
Mean (detects)	0.373	

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	4.50E-04 Mean	0.282
Maximum	0.52 Median	0.252
SD	0.107 CV	0.381
k hat (MLE)	3.201 k star (bias corrected MLE)	3.025
Theta hat (MLE)	0.088 Theta star (bias corrected MLE)	0.0931
nu hat (MLE)	326.5 nu star (bias corrected)	308.6
Adjusted Level of Significance (β)	0.0453	
Approximate Chi Square Value (308.59, α)	268.9 Adjusted Chi Square Value (308.59, β)	267.8
95% Gamma Approximate UCL (use when $n \geq 50$)	0.323 95% Gamma Adjusted UCL (use when $n < 50$)	0.325

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.161 SD (KM)	0.196
Variance (KM)	0.0383 SE of Mean (KM)	0.0281
k hat (KM)	0.677 k star (KM)	0.65
nu hat (KM)	69.04 nu star (KM)	66.31
theta hat (KM)	0.238 theta star (KM)	0.248
80% gamma percentile (KM)	0.265 90% gamma percentile (KM)	0.411
95% gamma percentile (KM)	0.563 99% gamma percentile (KM)	0.927

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (66.31, α)	48.57 Adjusted Chi Square Value (66.31, β)	48.13
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.22 95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.222

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic
 5% Shapiro Wilk Critical Value
 Lilliefors Test Statistic
 5% Lilliefors Critical Value

0.313 Shapiro Wilk GOF Test

0.911 Detected Data Not Lognormal at 5% Significance Level

0.467 Lilliefors GOF Test

0.184 Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level**Lognormal ROS Statistics Using Imputed Non-Detects**

Mean in Original Scale	0.183 Mean in Log Scale	-2.547
SD in Original Scale	0.181 SD in Log Scale	1.592
95% t UCL (assumes normality of ROS data)	0.225 95% Percentile Bootstrap UCL	0.224
95% BCA Bootstrap UCL	0.225 95% Bootstrap t UCL	0.227
95% H-UCL (Log ROS)	0.545	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.925 KM Geo Mean	0.00726
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KM SD (logged)	3.326	95% Critical H Value (KM-Log)	5.423
KM Standard Error of Mean (logged)	0.477	95% H-UCL (KM -Log)	23.46
KM SD (logged)	3.326	95% Critical H Value (KM-Log)	5.423
KM Standard Error of Mean (logged)	0.477		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.162	Mean in Log Scale	-4.456
SD in Original Scale	0.197	SD in Log Scale	3.038
95% t UCL (Assumes normality)	0.208	95% H-Stat UCL	10.03

DL/2 Log-Transformed

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL 0.283

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Step2_Molybdenum_AP1

General Statistics

Total Number of Observations	42	Number of Distinct Observations	31
Number of Detects	31	Number of Non-Detects	11
Number of Distinct Detects	28	Number of Distinct Non-Detects	3
Minimum Detect	8.00E-04	Minimum Non-Detect	6.90E-04
Maximum Detect	0.547	Maximum Non-Detect	0.01
Variance Detects	0.0472	Percent Non-Detects	26.19%
Mean Detects	0.331	SD Detects	0.217
Median Detects	0.446	CV Detects	0.655
Skewness Detects	-0.871	Kurtosis Detects	-1.185
Mean of Logged Detects	-2.329	SD of Logged Detects	2.5

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.702	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.929	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.319	Lilliefors GOF Test
5% Lilliefors Critical Value	0.156	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.245	KM Standard Error of Mean	0.0367
KM SD	0.234	95% KM (BCA) UCL	0.305
95% KM (t) UCL	0.307	95% KM (Percentile Bootstrap) UCL	0.303
95% KM (z) UCL	0.305	95% KM Bootstrap t UCL	0.31
90% KM Chebyshev UCL	0.355	95% KM Chebyshev UCL	0.405
97.5% KM Chebyshev UCL	0.474	99% KM Chebyshev UCL	0.61

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	6.078	Anderson-Darling GOF Test
5% A-D Critical Value	0.808	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.41	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.167	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.516 k star (bias corrected MLE)	0.488
Theta hat (MLE)	0.642 Theta star (bias corrected MLE)	0.679
nu hat (MLE)	32.01 nu star (bias corrected)	30.24
Mean (detects)	0.331	

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	8.00E-04 Mean	0.295
Maximum	0.547 Median	0.375
SD	0.196 CV	0.663
k hat (MLE)	0.656 k star (bias corrected MLE)	0.625
Theta hat (MLE)	0.45 Theta star (bias corrected MLE)	0.472
nu hat (MLE)	55.1 nu star (bias corrected)	52.5
Adjusted Level of Significance (β)	0.0443	
Approximate Chi Square Value (52.50, α)	36.85 Adjusted Chi Square Value (52.50, β)	36.39
95% Gamma Approximate UCL (use when $n \geq 50$)	0.42 95% Gamma Adjusted UCL (use when $n < 50$)	0.426

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.245 SD (KM)	0.234
Variance (KM)	0.0548 SE of Mean (KM)	0.0367
k hat (KM)	1.096 k star (KM)	1.033
nu hat (KM)	92.05 nu star (KM)	86.81
theta hat (KM)	0.224 theta star (KM)	0.237
80% gamma percentile (KM)	0.393 90% gamma percentile (KM)	0.559
95% gamma percentile (KM)	0.725 99% gamma percentile (KM)	1.11

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (86.81, α)	66.33 Adjusted Chi Square Value (86.81, β)	65.69
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.321 95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.324

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.632 Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.929 Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.401 Lilliefors GOF Test	
5% Lilliefors Critical Value	0.156 Detected Data Not Lognormal at 5% Significance Level	

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.246 Mean in Log Scale	-3.347
SD in Original Scale	0.236 SD in Log Scale	2.825
95% t UCL (assumes normality of ROS data)	0.307 95% Percentile Bootstrap UCL	0.305
95% BCA Bootstrap UCL	0.305 95% Bootstrap t UCL	0.308
95% H-UCL (Log ROS)	16.34	

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-3.521 KM Geo Mean	0.0296
KM SD (logged)	2.928 95% Critical H Value (KM-Log)	5.026
KM Standard Error of Mean (logged)	0.462 95% H-UCL (KM -Log)	21.4
KM SD (logged)	2.928 95% Critical H Value (KM-Log)	5.026
KM Standard Error of Mean (logged)	0.462	

DL/2 Statistics

DL/2 Normal

Mean in Original Scale
SD in Original Scale
95% t UCL (Assumes normality)

DL/2 Log-Transformed

0.245 Mean in Log Scale
0.236 SD in Log Scale
0.307 95% H-Stat UCL

-3.421
2.913
22.12

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL 0.474

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix D-4

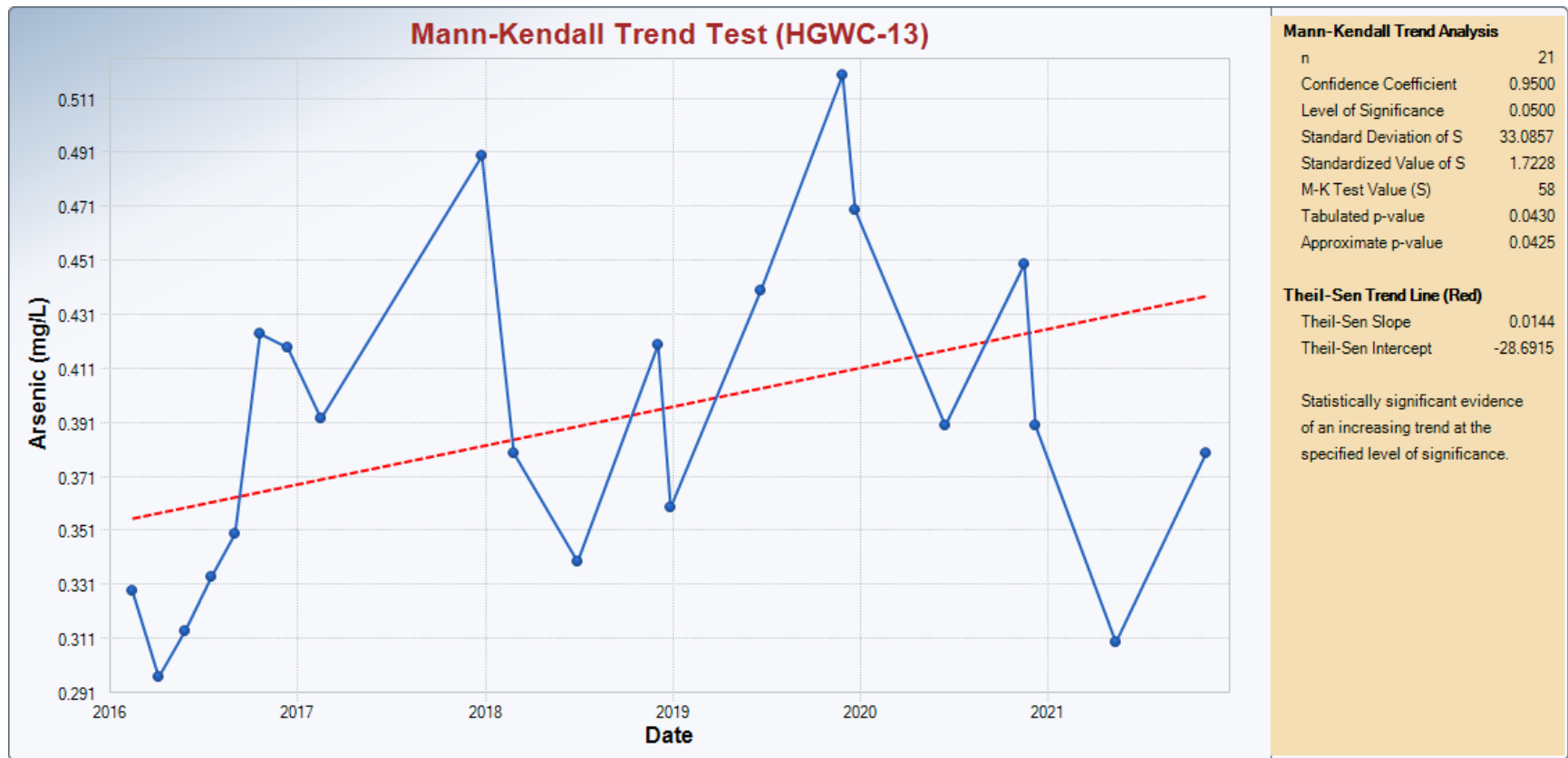
Groundwater Trend Graphs

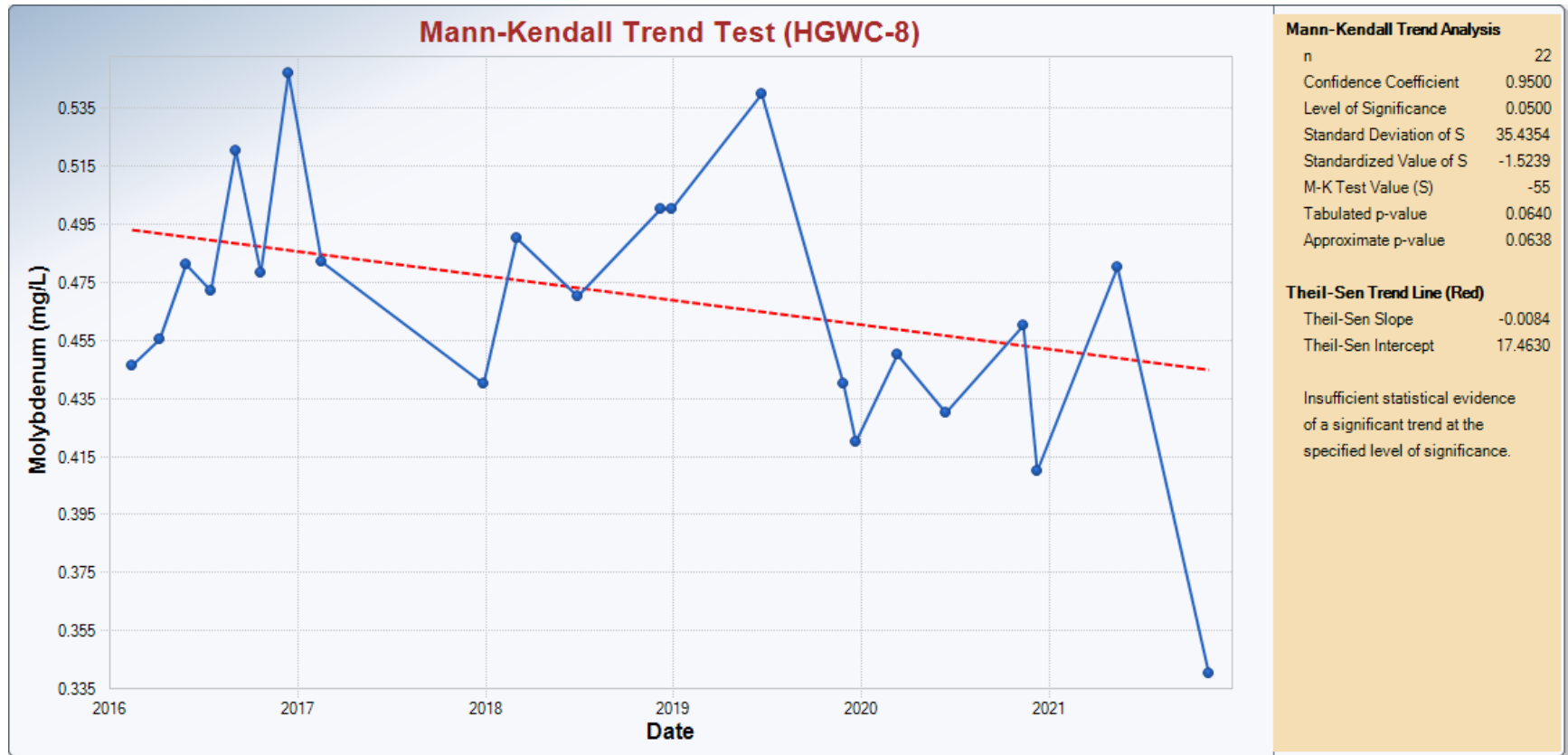
Appendix D

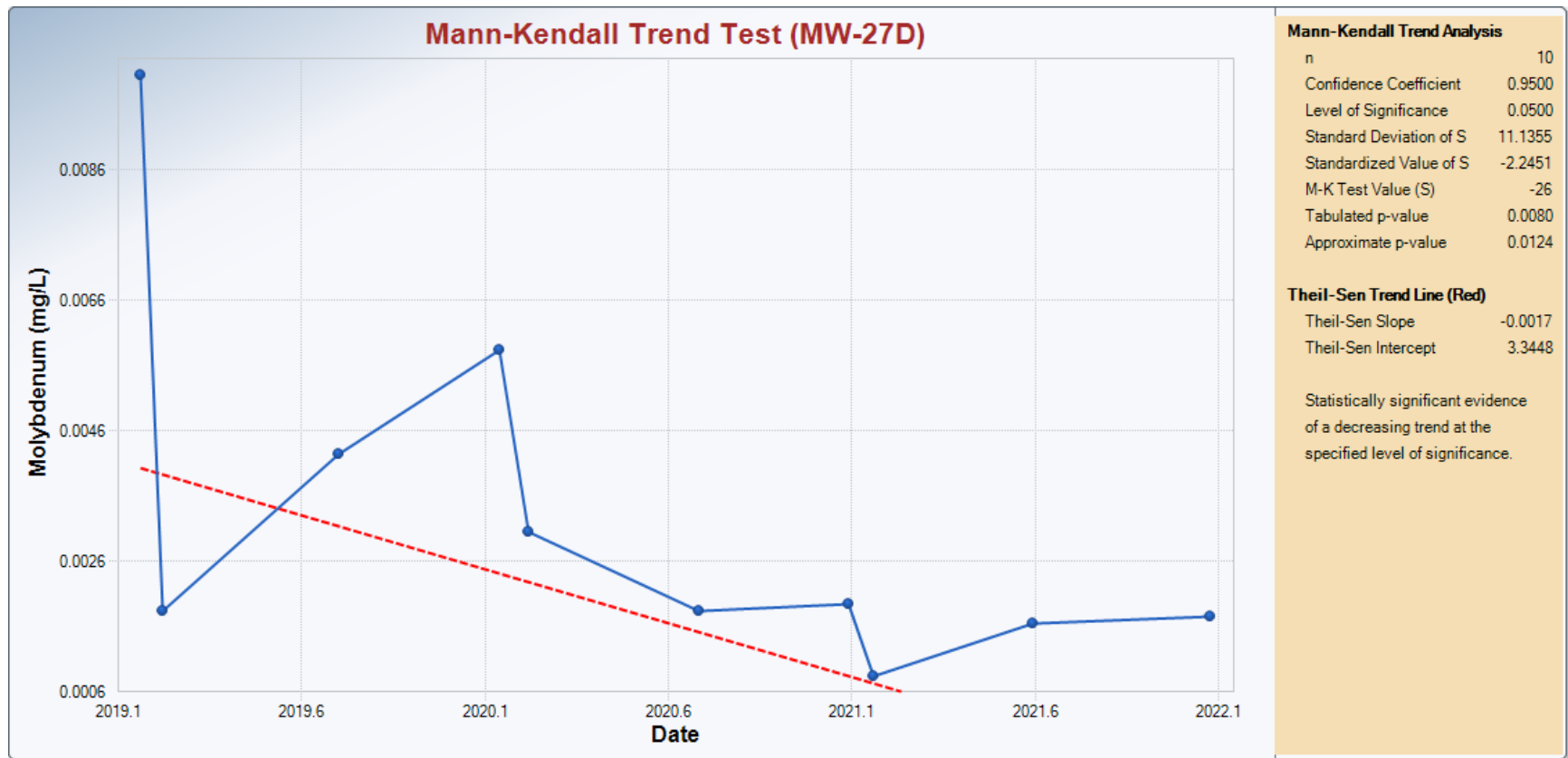
Appendix D-4

Groundwater Trend Graphics

Hammond AP-1







APPENDIX D

Public Meeting Notice

RN5040

gpn16

PUBLIC MEETING NOTICE Georgia Power will hold a public meeting on March 24th, 2026, from 5:30 PM to 7:30 PM at the Rome-Floyd E.C.O. Center, 393 Riverside Parkway NE to discuss the results of the groundwater assessment of corrective measures (ACM) at Plant Hammond Ash Pond 1 and Ash Pond 2 and to accept public comments. The results of the ACM are documented in the Draft Remedy Selection Reports for Hammond AP-1 and Hammond AP-2, which Georgia Power submitted to the Georgia Environmental Protection Division (EPD) on August 31, 2022. The documents are available at: <https://www.georgiapower.com/hammondAP1> and <https://www.georgiapower.com/hammondAP2> under the Groundwater tab for Hammond AP-1 and AP-2. The Georgia EPD reviewed the reports, concurred with the evaluation, and authorized Georgia Power to hold a public meeting. The public comment period will end at 6:00 PM on March 25th, 2026. Written comments may be submitted electronically at <https://www.georgiapower.com/ccrgwpubliccomments> or in person at the public meeting.

2:20,27;3:6,13,20,2026