



Prepared for

Georgia Power Company
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Atlanta, Georgia 30308

REMEDY SELECTION REPORT

GEORGIA POWER COMPANY

PLANT HAMMOND ASH POND 2 (AP-2)

Prepared by

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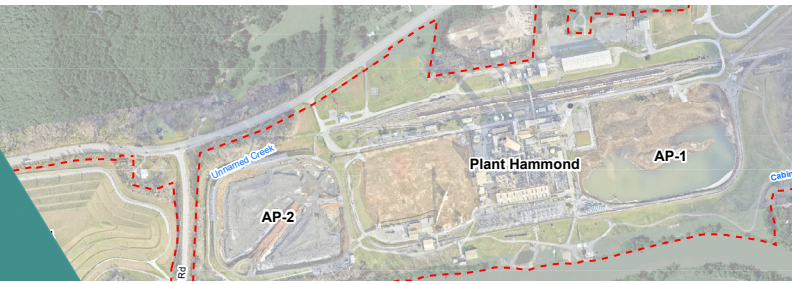
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Plant Hammond AP-2 : Executive Summary



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 2 (AP-2) in accordance with federal and state regulations and completed a detailed evaluation of corrective measures to remove cobalt above the Groundwater Protection Standard (GWPS) at AP-2 at Plant Hammond.

ASH POND CLOSURE

Georgia Power closed AP-2 through the removal of approximately 870,000 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-2 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. 057-024D(CCR). The closure by removal approach provides source control benefits that reduce the potential for migration of CCR constituents to groundwater.

GROUNDWATER MONITORING AND ASSESSMENT

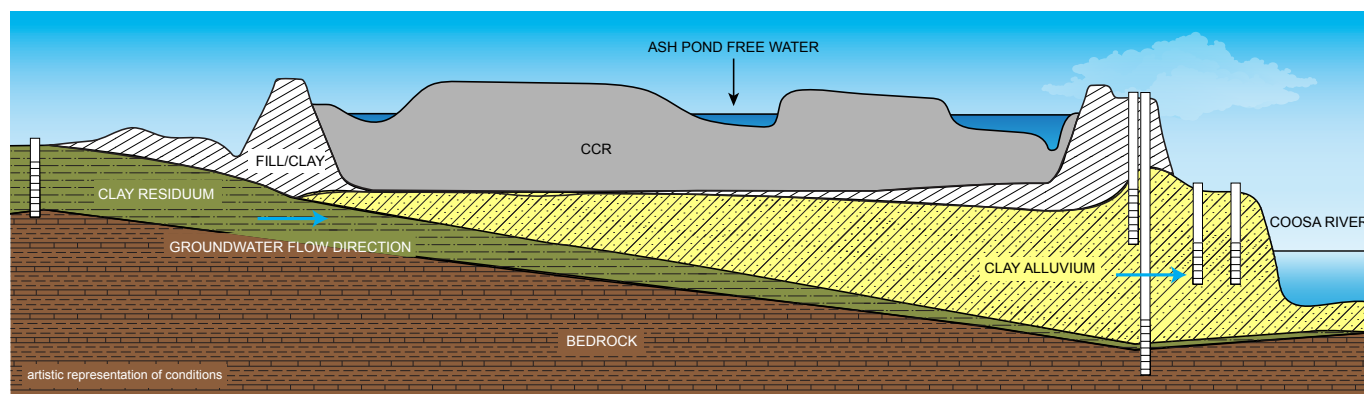
Georgia Power has performed CCR groundwater monitoring at AP-2 since May 2016. Over the period of Georgia Power’s monitoring, concentrations of cobalt (Co) were identified above the GWPS in only three wells (HGWC-18, MW-33, MW-35) downgradient of AP-2. The Co groundwater concentrations above the GWPS are located wholly on Georgia Power property and do not move off-site. Characterization studies indicate that Co in groundwater is directly influenced by groundwater pH, and localized decreases in pH mobilize naturally occurring Co from the aquifer matrix to groundwater.

RISK EVALUATION FOR HUMAN HEALTH & ENVIRONMENT

Georgia Power completed a risk evaluation that confirmed that Co identified on-site is not expected to pose a risk to human health or the environment. Extended groundwater monitoring indicates the Co groundwater concentrations identified in HGWC-18, MW-33, and MW-35 are horizontally and vertically delineated on-site to levels below their respective GWPS. Cobalt concentrations are limited in extent due to natural physical and chemical processes currently occurring in the aquifer which reduce dissolved concentrations.

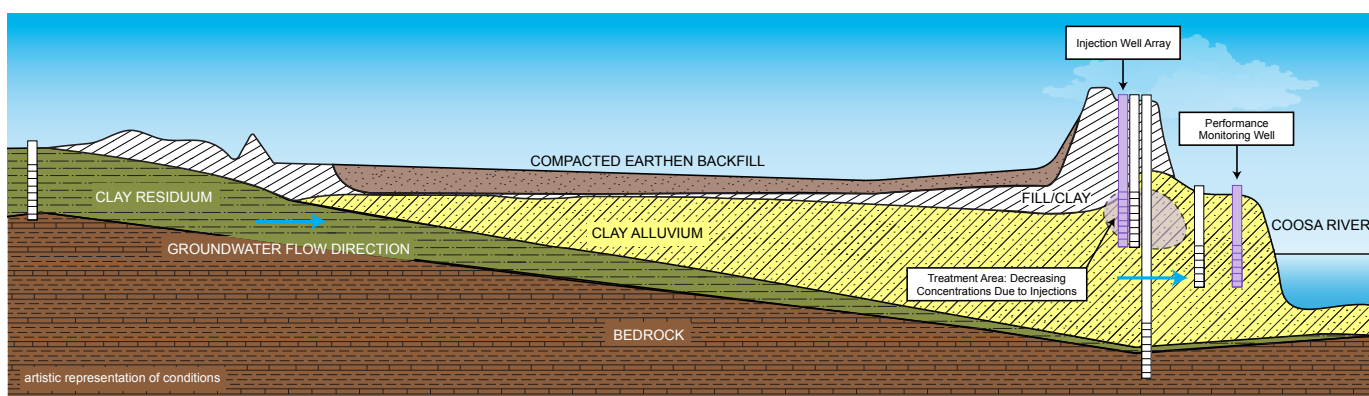
¹. 40 Code of Federal Regulations (CFR) § 257.53

CURRENT PRE-CLOSURE CONDITIONS



PROPOSED CORRECTIVE MEASURES FOR GROUNDWATER

Geochemical manipulation of in-situ conditions and Monitored Natural Attenuation



Georgia Power initiated an assessment of corrective measures (ACM) program for AP-2 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 Co 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 Injection):** 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 Co to immobilize the constituent. Groundwater monitoring will be performed to confirm the effectiveness of the in-situ injections.
- **Monitored Natural Attenuation (MNA):** Natural attenuation of Co in groundwater at the site is primarily due to adsorption and co-precipitation of the dissolved metal 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
ASD	Alternate Source Demonstration
AP	ash pond
CCR	coal combustion residuals
CFR	Code of Federal Regulations
Co	cobalt
CSM	conceptual site model
DO	dissolved oxygen
DPT	direct-push technology
EPRI	Electric Power Research Institute
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
MCL	Maximum Contaminant Level
mg/L	milligram per liter
MNA	monitored natural attenuation
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 (Geosyntec) prepared this Remedy Selection Report on behalf of Georgia Power Company (Georgia Power) for Plant Hammond Ash Pond 2 (AP-2, or the CCR unit). As documented here, Georgia Power has completed a detailed evaluation of corrective measures to address one or more 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), *Semiannual Remedy Selection and Design Progress Report* ((Semiannual Progress Reports) (Geosyntec, 2019b), and *Groundwater Monitoring and Corrective Action Reports* (Geosyntec, 2020a; 2020c; 2021b; 2021c; 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; 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-2 is a 21-acre surface impoundment. Dewatered ash from AP-2 was excavated and transported to the nearby Huffaker Road facility, a permitted solid waste disposal location owned and operated by Georgia Power.

2.3 Unit Closure

CCR placement in AP-2 ceased in 2019. Closure activities in accordance with § 257.100 were initiated under GA EPD approved closure permit No. 057-024D(CCR). Closure construction activities for AP-2 consist of closure by removal.

AP-2 CCR removal activities are complete, and a certification was submitted to GA EPD on September 24, 2024. On December 23, 2024, GA EPD acknowledged that removal activities within the identified boundaries of AP-2 are complete. Following closure completion, AP-2 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-2 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-2 since May 2016 in accordance with the CCR Rule. The following Appendix IV SSL constituent and well pairs are the subject of this report:

Appendix IV SSL Constituent ¹	Well
Cobalt (Co)	HGWC-18, MW-33, MW-35

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.

In accordance with §257.95(g)(3), an alternate source demonstration (ASD) was prepared and submitted to GA EPD on January 14, 2020; however, GA EPD issued a letter on June 26, 2020, indicating non-concurrence at that time based on the presence of Appendix III

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.

constituents at HGWC-18 and other monitoring wells in the groundwater monitoring network. The ASD asserted that naturally occurring Co was mobilized due to acidic pH conditions caused by the oxidation of naturally occurring pyritic minerals and was not associated with a release from AP-2 (Geosyntec, 2020b). GA EPD noted the agency is willing to reevaluate a revised ASD should new supporting data become available at a later date. Co is 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-2. 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-2 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-2 is underlain by the lower units of the Cambrian age Conasauga Formation, consisting of mostly calcareous shale. Based on review of subsurface investigations at AP-2, the bedrock was identified as predominantly calcareous shale and fissile black shale. AP-2 is underlain primarily by five lithologic units: (i) terrace alluvium; (ii) colluvium; (iii) residuum; (iv) partially weathered shale bedrock; and (v) unweathered shale bedrock. Geologic cross-sections proximal to AP-2 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 2 (AP-2)* (HAR Rev 01) (Geosyntec, 2019c).

3.2 Hydrogeology and Groundwater Flow

The uppermost aquifer at AP-2 is a regional unconfined groundwater aquifer that occurs primarily in the alluvial, colluvial, and residuum soils and within the underlying weathered and fractured bedrock. The movement of groundwater in the soil can be characterized as low-to moderate permeability porous media flow based on hydraulic field testing at the Site (slug testing). The groundwater flow in the shallow underlying weathered bedrock is characterized as fracture flow and is expected to be very low due to the preponderance of low permeability shale beneath AP-2. The regional groundwater flow direction is expected to be from north to south; however, the local flow direction

beneath AP-2 is predominantly east to west with an additional southerly component. Under post-closure conditions, the groundwater flow direction is anticipated to more closely resemble the regional flow regime (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-2 area flows under the influence of topography from higher elevations on the northern and eastern side of the Site in a westerly direction beneath AP-2 toward the unnamed creek, with a southerly flow component toward the Coosa River. Based on water level measurements collected on August 4, 2025, the hydraulic gradient is 0.0085 feet per foot (ft/ft) across the central portion of AP-2 (between HGWC-17 and MW-18) yielding an average groundwater flow velocity of 0.085 ft/day underneath AP-2 (Geosyntec, 2026).

3.3 Geochemical CSM

Cobalt is present in groundwater at SSLs above GWPS at HGWC-18, MW-33, and MW-35. As detailed in the *Geochemical Conceptual Site Model Report (Appendix A)* (Geochemical CSM Report), historical literature (Pierce, 1944) and site-specific data indicate Co is naturally occurring in the geologic formations at the Site.

The concentration of Co in groundwater is directly influenced by groundwater pH, and localized decreases in pH are likely the primary driver for Co mobilization from the aquifer matrix to groundwater. Several mechanisms may explain the localized acidity observed in the vicinity of HGWC-18, MW-33, and MW-35. Geochemical data support oxidative dissolution of pyrite and sulfide minerals, which have been identified in background and downgradient soils, as a likely natural source of localized acidity and Co. Other mechanisms that may contribute to acidity include microbially mediated dissolution of sulfides or cation exchange.

Groundwater monitoring data confirm that Co is limited to a small area due to localized acidity present in the aquifer. The primary mechanisms of natural attenuation of Co include adsorption (surface complexation) and co-precipitation with iron and manganese oxides under neutral to alkaline pH conditions.

3.4 Nature and Extent of Groundwater Above the GWPS

Based on statistical analysis of Appendix IV groundwater data, the Co SSLs identified in the compliance wells HGWC-18, MW-33, and MW-35 are horizontally and vertically delineated to levels below GWPS. Due to the presence of a surface water feature in the downgradient direction of HGWC-18, installation of additional wells to horizontally characterize this area is infeasible. Based on Co data collected from the unnamed tributary west of AP-2 to date, horizontal delineation of HGWC-18 is complete and ongoing semiannual sampling will continue until GWPS have been achieved. Please refer to the August 2025 iso-concentration maps for Co presented in **Figure 6**. 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 Sample Location IDs
Co	0.038	HGWC-18	0.070	Horizontal: AP-2 MID Vertical: MW-21D
		MW-33	0.041	Horizontal: MW-51 Vertical: MW-34D
		MW-35	0.048	Horizontal: MW-51 Vertical: MW-34D

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 40 CFR §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)
- 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 7**). 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 evaluation and refinement of the groundwater corrective measures were presented in the Semiannual Progress Reports submitted since the ACM Report in 2019. Hydraulic containment (“Pump and Treat”) was screened from consideration subsequent to the submittal of the previous Semiannual Progress Report (Geosyntec, 2022a) to GA EPD on January 31, 2022, based on refinements to the CSM. Although “pump and treat” is applicable to a variable mix of inorganic constituents, including dissolved Co, it is not typically used to address acidification or control groundwater pH. Extended periods of pumping may aerate the aquifer and otherwise exacerbate acidification at AP-2, further mobilizing Co. The corrective measures identified for AP-2 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 Progress Reports, is summarized on **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 well 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. Given the demonstrated relationship between low pH and elevated Co concentrations in groundwater at AP-2, geochemical strategies will likely rely on pH adjustments to address localized acidity. Geochemical injections are a proven groundwater remediation technology for CCR constituents (including Co) and are especially effective in treating smaller, localized areas, such as those present at AP-2.
- **Monitored Natural Attenuation (MNA):** MNA relies on natural attenuation processes to achieve site-specific GWPS by effectively reducing dissolved concentrations of inorganic constituents. Attenuation mechanisms for inorganic constituents at CCR sites, including Co at AP-2, 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 in **Appendix A**, natural attenuation of Co occurs under circumneutral pH by 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 two 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, 2021a) was prepared for AP-2 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-2 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, Co concentrations observed in groundwater at AP-2 are not expected to pose a risk to human health or the environment².

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-2 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 remedies would each attain the GWPS at the compliance boundary (waste boundary) and throughout the area of groundwater SSL exceedances if circumneutral-to-alkaline pH conditions in groundwater prevail following closure of AP-2. Constituent transport evaluations were used to predict and assess changes in constituent concentrations in groundwater over time following closure of AP-2. 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-2. 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 8 to 15 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.

² The 2021 Risk Evaluation Report also considered molybdenum (Mo) as it was identified as an SSL-related constituent using the background-based GWPS established for AP-2 pursuant to the State CCR Rule, Ga. Comp. R. & Regs. 391-3-4-.10 (EPD, 2018). The Risk Evaluation Report concluded that all constituents considered, including Mo, were not expected to pose a risk to human health or the environment.

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-2. Physical removal of the CCR would, over time, be supportive of declining concentrations of Appendix IV constituents in groundwater downgradient of AP-2 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 compliance 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 constituents, thereby removing them from the dissolved phase in groundwater and controlling contaminant release/movement.
- **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 contaminant release/movement. The primary mechanisms governing attenuation and immobilization of Co at AP-2 include sorption under neutral-to-alkaline pH conditions 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 and ACM updates would be effective at removing Appendix IV constituents from groundwater, either through processes of physical removal, immobilization, or chemical attenuation in groundwater. The corrective measures considered herein remove contaminated material from dissolved-phase groundwater as follows:

- **Geochemical Approaches (In-Situ Injection)** – Geochemical processes can be altered to immobilize contaminants, thereby removing them from the dissolved phase in groundwater.
- **Monitored Natural Attenuation** – Natural attenuation processes act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in 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)	Monitored Natural Attenuation (MNA)
Be protective of human health and the environment	✓	✓
Attain the groundwater protective standard	✓	✓
Control the source of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of Appendix IV constituents into the environment	✓	✓
Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems	✓	✓
Management of waste to comply with all applicable RCRA requirements	✓	✓

5.2 Comparative Criteria (§257.97(c))

This section compares the corrective measures 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 is 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-2 are not expected to pose a risk to human health or the environment. Therefore, this criterion is considered equally 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 will 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 a 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 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 or additional maintenance injections to suppress rebounds in acidity may be required.

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 in short-term mobilization of other pH-sensitive constituents; however, this risk can be mitigated based on previously completed bench- and pilot-scale testing which have 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 in areas proximal to the unnamed creek, which can be mitigated with appropriate engineering controls. Geochemical injections are therefore considered favorable under this criterion.

5.2.1.5 Time until full protection is achieved

Receptors are already protected because Appendix IV constituents in groundwater at AP-2 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 that lie 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 8 to 15 years (**Appendix B**). Corrective measures that require less time to achieve GWPS are considered more favorable under this criterion.

In-Situ Injection is considered highly favorable as pH adjustments are likely to achieve GWPS in a shorter amount of time. A preliminary “proof of concept” geochemical injection evaluation included in **Appendix B** suggests that GWPS can be achieved at compliance wells within one year. Reduction of constituent concentrations within a treatment area may proceed very quickly based on data collected during a previously completed field-scale pilot study. However, the total time to achieve GWPS will be dependent on many factors, including the time to complete distribution of amendments throughout the subsurface and any time associated with maintenance injections which may be required to suppress rebounds in acidification.

MNA is considered less favorable under this criterion as it is predicted to require more time to achieve GWPS. While localized acidity is expected to decrease following closure of AP-2, some acidification processes, such as oxidative dissolution of pyrite, may result in longer than predicted remediation times under MNA.

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.

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 equally favorable under this criterion as minimal long-term engineering controls would be required.

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, however, this corrective measure may prove unsustainable if ongoing maintenance injections are required to suppress natural acidification (and resulting Co remobilization) after the closure of AP-2. Field data from a pilot study confirms that the long-term performance of in-situ injections is favorable.

Natural attenuation processes are expected to decrease Co concentrations in groundwater following closure without further intervention, reducing the likelihood that a replacement remedy would be required. Although the longer time 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 less favorably under this criterion.

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-2 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 further reducing groundwater impacts of Co that have been detected above GWPS at or beyond the compliance boundary. Closure by removal is an effective source control measure that will address any potential for further releases of CCR constituents. However, some localized acidification processes, such as oxidative dissolution of pyrite, that mobilize Co in groundwater may continue following closure of AP-2.

In-Situ Injection long- and short-term effectiveness is considered favorable. Although there would be some short-term uncertainty during implementation, the primary favorability stems from the shorter time to achieve GWPS. Long-term uncertainty associated with the sustainability of alkaline conditions post-closure would be evaluated and addressed during remedy design.

MNA long- and short-term effectiveness is considered less favorable as the longer time likely required to achieve GWPS introduces inherent uncertainty of remedy success.

Category 1 – Long- and Short-Term Effectiveness Summary

	In-Situ Injection	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. Physical removal of the CCR would, over time, be supportive of declining concentrations of Appendix IV constituents in groundwater downgradient of AP-2 and improve overall groundwater quality. Closure by removal includes excavation and removal of the CCR material from AP-2. 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-2. Since the source material will be removed at the time of AP-2 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-2'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-2 and, over time, be supportive of declining concentrations of Appendix IV constituents in groundwater downgradient of AP-2 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	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 using common means and methods for well 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. Ongoing localized acidification and mobilization of Co is assumed to impact the operational reliability of all corrective measures equally.

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 amendments 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.

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 perform favorably as an Underground Injection Control (UIC) permit will be required.

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 favorably 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. However, well construction techniques are common. In-situ Injection is therefore considered 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 equally 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.

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. Ongoing localized acidification, which currently mobilizes Co at AP-2, is assumed to equally impact the ease of implementation of all corrective measures equally.

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, the available means and methods to construct the remedy, and the available capacity and supporting services.

Category 3 – Ease of Implementation

	In-Situ Injection	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 of this comparison are included in the following table for all of the comparative criteria.

In-Situ Injection is considered favorable under long- and short-term effectiveness (Category 1). While In-situ Injections entail some short-term uncertainties, this corrective measure is expected to achieve GWPS in the shortest time. Although MNA is considered reliable and entails minimal short-term uncertainties, a substantially longer time to achieve GWPS will be required following closure of AP-2.

Source control (Category 2) will be supported at AP-2 through closure by removal of CCR, which over time, will support declining concentrations of Appendix IV constituents in groundwater downgradient of AP-2 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.

	In-Situ Injection	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 7**.

6.1 Summary of Proposed Remedy Selection

The closure by removal of AP-2 will provide effective source control that minimizes potential 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-2 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 points or wells will be installed and utilized to introduce reagents to the subsurface to promote attenuation of Co. Initial geochemical modeling results (presented in **Appendix B**) support the feasibility of adjusting pH with in-situ injections to immobilize Co and are indicative of relatively short times to achieve GWPS at or beyond the compliance boundary. Laboratory treatability studies and field 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 and confirm the efficacy of adjusting pH to immobilize Co. Injections will target acidified areas to locally increase groundwater pH and immobilize and sequester Co in-situ. 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 of Co in areas outside of localized acidity, coupled with monitoring, are already ongoing at the Site. As detailed in the Geochemical CSM Report provided in **Appendix A**, natural attenuation of Co in groundwater is primarily due to adsorption and co-precipitation under circumneutral to alkaline pH conditions. It is anticipated that acidification will dissipate following closure of AP-2. Groundwater monitoring will continue to document natural attenuation processes, which is expected to be enhanced by the in-situ injections. Attenuation mechanisms and reductions in constituent concentrations 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 8**. Conceptual injection location and corrective action monitoring well construction details are summarized in **Table 3** and **Table 4**, respectively. The MNA component will rely on the same monitoring infrastructure associated as the in-situ injections. The number and location of injection and 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 extents 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), 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 well 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 or 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 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 Co in groundwater at AP-2 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, Co is not expected to pose a risk to human health or the environment. As such, considerations related to alternative drinking water supply or interim remedial measure, 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-2 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 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 of performance monitoring (approximately two years) 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 2
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
HGWA-4	Detection	Upgradient	1549930.45	1939385.45	584.94	587.60	572.24	562.24	25.76	Overburden	12/03/2014
HGWA-5	Detection	Upgradient	1548633.33	1937184.17	580.52	583.24	564.92	554.92	28.72	Overburden	12/10/2015
HGWA-6	Detection	Upgradient	1548636.35	1937177.73	580.72	583.38	543.72	533.72	49.66	PWR	12/11/2015
HGWA-42D	Detection	Upgradient	1549363.72	1938443.86	583.39	586.17	528.39	518.39	65.25	Bedrock	08/27/2020
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
HGWC-14	Detection	Downgradient	1547998.96	1938406.27	594.67	597.25	564.67	554.67	42.98	Overburden	10/16/2014
HGWC-15	Detection	Downgradient	1547875.33	1937854.92	578.73	581.49	553.93	543.93	37.96	Overburden	10/20/2014
HGWC-16	Detection	Downgradient	1548209.83	1937540.33	577.36	580.02	557.36	547.36	33.06	Overburden	10/21/2014
HGWC-17	Detection	Downgradient	1548449.71	1937538.98	581.51	584.30	566.91	556.91	27.79	Overburden/PWR	10/22/2014
HGWC-18	Detection	Downgradient	1548821.27	1937558.32	581.36	584.18	566.86	556.86	27.71	Overburden/PWR	10/22/2014
MW-21D	Assessment	Downgradient	1548814.86	1937555.78	581.16	583.84	542.36	532.36	51.88	Bedrock	11/19/2018
MW-22	Piezometer ⁽⁴⁾	Downgradient	1547854.68	1937832.04	576.05	578.51	551.45	541.45	37.47	Overburden	11/15/2018
MW-23D	Piezometer ⁽⁴⁾	Downgradient	1547876.55	1937843.89	579.06	581.30	529.46	519.46	62.24	Bedrock	11/15/2018
MW-33	Assessment	Downgradient	1547973.50	1938412.13	591.19	593.92	566.60	556.60	37.72	Overburden	11/21/2019
MW-34D	Assessment	Downgradient	1547996.82	1938392.20	593.83	596.51	530.48	520.48	73.68	Bedrock	05/06/2020
MW-35	Assessment	Downgradient	1547905.33	1938417.82	571.88	574.40	558.70	548.70	23.52	Overburden	05/13/2020
MW-37D	Piezometer ⁽⁴⁾	Downgradient	1548803.01	1937551.05	580.95	583.58	514.65	504.65	76.63	Bedrock	05/08/2020
MW-51	Assessment	Downgradient	1547872.35	1938421.46	571.57	574.54	556.47	546.47	25.10	Overburden	07/22/2021
MW-8	Piezometer	Downgradient	1548171.86	1940016.70	584.25	586.93	565.05	555.05	32.28	Overburden	10/29/2014
MW-9	Piezometer	Downgradient	1548131.38	1938922.16	588.42	590.95	569.12	559.12	32.95	Overburden	10/29/2014
MW-12	Piezometer	Downgradient	1547853.78	1937525.46	580.59	583.27	555.84	545.84	37.83	Overburden	10/21/2014
MW-16	Piezometer	Upgradient	1549104.17	1937940.06	571.70	574.22	562.20	552.20	23.42	Bedrock	10/27/2014
MW-17	Piezometer	Upgradient	1549163.28	1938345.81	583.68	586.78	568.98	558.98	29.09	Overburden	10/28/2014
MW-18	Piezometer	Upgradient	1548984.15	1938712.73	589.75	592.28	571.05	561.05	32.42	Overburden	10/29/2014
MW-36D	Piezometer	Downgradient	1548435.43	1937538.19	581.44	584.10	534.12	524.12	57.65	Bedrock	05/07/2020
MW-52	Piezometer	Upgradient	1549277.59	1938398.82	583.25	586.11	573.29	563.29	23.15	Overburden	01/25/2022
MW-55 ⁽³⁾	Corrective Action Piezometer	Downgradient	1548823.40	1937575.72	582.78	582.49	566.72	556.72	26.10	PWR	06/13/2023
MW-56 ⁽³⁾	Corrective Action Piezometer	Downgradient	1547906.81	1938260.81	570.60	573.47	559.60	549.60	24.27	Overburden	06/16/2023
MW-57 ⁽³⁾	Corrective Action Piezometer	Downgradient	1547895.53	1938349.49	571.30	574.28	560.30	550.30	24.18	PWR	06/16/2023
MW-58 ⁽³⁾	Corrective Action Piezometer	Downgradient	1547931.46	1938592.55	572.96	575.87	559.46	549.46	26.81	Overburden/PWR	06/17/2023
MW-59 ⁽³⁾	Corrective Action Piezometer	Downgradient	1547971.14	1938344.65	589.52	592.20	559.52	549.52	42.58	Overburden	06/14/2023
INW-01 ⁽³⁾	Corrective Action Piezometer	Downgradient	1547921.52	1938350.62	571.04	573.90	561.04	551.04	23.26	Overburden	06/16/2023
INW-02 ⁽³⁾	Corrective Action Piezometer	Downgradient	1548915.00	1937643.89	580.78	580.56	555.78	545.78	35.40	Overburden	06/06/2023
PT-01 ⁽³⁾	Corrective Action Piezometer	Downgradient	1547916.85	1938348.81	571.14	574.13	561.24	551.24	23.29	Overburden	06/17/2023
PT-02 ⁽³⁾	Corrective Action Piezometer	Downgradient	1547917.68	1938353.52	571.10	574.06	561.10	551.10	23.36	Overburden	06/16/2023
PT-03 ⁽³⁾	Corrective Action Piezometer	Downgradient	1547910.57	1938352.13	571.10	574.09	559.10	549.10	23.39	Overburden	06/17/2023
PT-04 ⁽³⁾	Corrective Action Piezometer	Downgradient	1548918.26	1937641.91	580.50	580.26	556.70	546.70	34.21	PWR	06/06/2023
PT-05 ⁽³⁾	Corrective Action Piezometer	Downgradient	1548913.06	1937638.48	580.83	580.54	555.73	545.73	35.50	Overburden	06/12/2023
PT-06 ⁽³⁾	Corrective Action Piezometer	Downgradient	1548916.95	1937634.25	580.68	580.36	555.18	545.18	35.39	Overburden	06/07/2023

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 completed by GEL Solutions dated May 19, 2020 and April 11, 2022 (for MW-52), and July 17 and August 30, 2023 (for MW-55 through MW-59, INW-01, INW-02, PT-01 through PT-06).

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

(3) Piezometers INW-01, INW-02, MW-55 through MW-59, and PT-01 through PT-06 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-22, MW-23D, and MW-37D were reclassified as piezometers following approval of the 5 Year Permit Review on May 28, 2025.

Table 2
Summary of Corrective Measures Screening
Georgia Power Company
Plant Hammond AP-2
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>Not Retained</u> ⁽¹⁾ (i) Not typically used to address acidification or control pH. (ii) Pumping may aerate or otherwise exacerbate ongoing acidification.
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.

Notes:

(1) Hydraulic Containment was screened from consideration subsequent to the submittal of the 2021 Annual Groundwater Monitoring and Corrective Action Report based on further refinement of the conceptual site model.

Table 3
Conceptual Injection Location Construction Details
Georgia Power Company
Plant Hammond - Ash Pond 2
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-14-A-01	1548004	1938268	597	564	549	Overburden
IP-14-A-02	1548005	1938278	597	564	549	Overburden
IP-14-A-03	1548005	1938288	596	564	549	Overburden
IP-14-A-04	1548006	1938297	595	564	549	Overburden
IP-14-A-05	1548006	1938307	594	564	549	Overburden
IP-14-A-06	1548007	1938317	594	564	549	Overburden
IP-14-A-07	1548007	1938327	593	564	549	Overburden
IP-14-A-08	1548008	1938337	593	564	549	Overburden
IP-14-A-09	1548008	1938347	594	564	549	Overburden
IP-14-A-10	1548009	1938357	593	564	549	Overburden
IP-14-A-11	1548009	1938367	593	564	549	Overburden
IP-14-A-12	1548010	1938377	593	564	549	Overburden
IP-14-A-13	1548010	1938387	593	564	549	Overburden
IP-14-A-14	1548011	1938397	594	564	549	Overburden
IP-14-A-15	1548011	1938407	595	564	549	Overburden
IP-14-A-16	1548012	1938417	596	564	549	Overburden
IP-14-A-17	1548012	1938427	597	564	549	Overburden
IP-14-A-18	1548013	1938437	598	564	549	Overburden
IP-14-A-19	1548013	1938447	598	564	549	Overburden
IP-14-A-20	1548014	1938457	599	564	549	Overburden
IP-14-A-21	1548014	1938467	599	564	549	Overburden
IP-14-A-22	1548015	1938477	599	564	549	Overburden
IP-14-B-01	1547969	1938240	590	562	547	Overburden
IP-14-B-02	1547969	1938250	591	562	547	Overburden
IP-14-B-03	1547970	1938260	591	562	547	Overburden
IP-14-B-04	1547970	1938270	591	562	547	Overburden
IP-14-B-05	1547971	1938280	591	562	547	Overburden
IP-14-B-06	1547971	1938290	591	562	547	Overburden
IP-14-B-07	1547972	1938300	591	562	547	Overburden
IP-14-B-08	1547972	1938310	591	562	547	Overburden
IP-14-B-09	1547973	1938320	591	562	547	Overburden
IP-14-B-10	1547973	1938330	591	562	547	Overburden
IP-14-B-11	1547974	1938340	591	562	547	Overburden
IP-14-B-12	1547974	1938350	591	562	547	Overburden
IP-14-B-13	1547975	1938360	592	562	547	Overburden
IP-14-B-14	1547976	1938370	592	562	547	Overburden
IP-14-B-15	1547976	1938380	592	563	548	Overburden
IP-14-B-16	1547977	1938390	592	563	548	Overburden
IP-14-B-17	1547977	1938400	592	563	548	Overburden
IP-14-B-18	1547978	1938410	592	564	549	Overburden
IP-14-B-19	1547978	1938420	593	564	549	Overburden
IP-14-B-20	1547979	1938430	594	564	549	Overburden
IP-14-B-21	1547979	1938440	595	564	549	Overburden
IP-14-B-22	1547980	1938450	595	564	549	Overburden
IP-14-B-23	1547980	1938460	596	563	548	Overburden
IP-14-B-24	1547981	1938470	597	563	548	Overburden

Table 3
Conceptual Injection Location Construction Details
Georgia Power Company
Plant Hammond - Ash Pond 2
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-14-B-25	1547981	1938480	597	563	548	Overburden
IP-14-B-26	1547982	1938490	597	563	548	Overburden
IP-14-C-01	1547941	1938362	577	562	547	Overburden
IP-14-C-02	1547941	1938372	577	562	547	Overburden
IP-14-C-03	1547941	1938382	576	562	547	Overburden
IP-14-C-04	1547941	1938392	576	562	547	Overburden
IP-14-C-05	1547941	1938432	576	562	547	Overburden
IP-14-C-06	1547941	1938442	575	562	547	Overburden
IP-14-C-07	1547941	1938452	575	562	547	Overburden
IP-14-D-01	1547931	1938308	576	562	547	Overburden
IP-14-D-02	1547931	1938318	576	562	547	Overburden
IP-14-D-03	1547931	1938328	575	562	547	Overburden
IP-14-D-04	1547931	1938338	574	562	547	Overburden
IP-14-D-05	1547931	1938348	574	562	547	Overburden
IP-14-D-06	1547931	1938358	573	562	547	Overburden
IP-14-D-07	1547931	1938368	573	562	547	Overburden
IP-14-D-08	1547931	1938378	574	562	547	Overburden
IP-14-D-09	1547931	1938388	573	562	547	Overburden
IP-14-D-10	1547931	1938398	573	562	547	Overburden
IP-14-D-11	1547931	1938408	574	562	547	Overburden
IP-14-D-12	1547931	1938418	574	562	547	Overburden
IP-14-D-13	1547931	1938428	573	562	547	Overburden
IP-14-D-14	1547931	1938438	573	562	547	Overburden
IP-14-D-15	1547931	1938448	573	562	547	Overburden
IP-14-D-16	1547931	1938458	573	562	547	Overburden
IP-14-D-17	1547931	1938468	573	562	547	Overburden
IP-14-D-18	1547931	1938478	574	562	547	Overburden
IP-14-D-19	1547931	1938488	574	562	547	Overburden
IP-14-E-01	1547921	1938242	573	562	547	Overburden
IP-14-E-02	1547921	1938252	573	562	547	Overburden
IP-14-E-03	1547921	1938262	574	562	547	Overburden
IP-14-E-04	1547921	1938272	574	562	547	Overburden
IP-14-E-05	1547921	1938282	573	562	547	Overburden
IP-14-E-06	1547921	1938292	573	562	547	Overburden
IP-14-E-07	1547921	1938302	573	562	547	Overburden
IP-14-E-08	1547921	1938312	574	562	547	Overburden
IP-14-E-09	1547921	1938322	573	562	547	Overburden
IP-14-E-10	1547921	1938332	572	562	547	Overburden
IP-14-E-11	1547921	1938342	573	562	547	Overburden
IP-14-E-12	1547921	1938352	572	562	547	Overburden
IP-14-E-13	1547921	1938362	572	562	547	Overburden
IP-14-E-14	1547921	1938372	573	562	547	Overburden
IP-14-E-15	1547921	1938382	573	562	547	Overburden
IP-14-E-16	1547921	1938392	573	562	547	Overburden
IP-14-E-17	1547921	1938402	574	562	547	Overburden
IP-14-E-18	1547921	1938412	573	562	547	Overburden

Table 3
Conceptual Injection Location Construction Details
Georgia Power Company
Plant Hammond - Ash Pond 2
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-14-E-19	1547921	1938422	573	562	547	Overburden
IP-14-E-20	1547921	1938432	572	562	547	Overburden
IP-14-E-21	1547921	1938442	573	562	547	Overburden
IP-14-E-22	1547921	1938452	573	562	547	Overburden
IP-14-E-23	1547921	1938462	573	562	547	Overburden
IP-14-E-24	1547921	1938472	573	562	547	Overburden
IP-14-E-25	1547921	1938482	573	562	547	Overburden
IP-14-F-01	1547911	1938238	571	562	547	Overburden
IP-14-F-02	1547911	1938248	571	562	547	Overburden
IP-14-F-03	1547911	1938258	572	562	547	Overburden
IP-14-F-04	1547911	1938268	572	562	547	Overburden
IP-14-F-05	1547911	1938278	571	562	547	Overburden
IP-14-F-06	1547911	1938288	572	562	547	Overburden
IP-14-F-07	1547911	1938298	572	562	547	Overburden
IP-14-F-08	1547911	1938308	572	562	547	Overburden
IP-14-F-09	1547911	1938318	572	562	547	Overburden
IP-14-F-10	1547911	1938328	572	562	547	Overburden
IP-14-F-11	1547911	1938338	572	562	547	Overburden
IP-14-F-12	1547911	1938348	573	562	547	Overburden
IP-14-F-13	1547911	1938358	572	562	547	Overburden
IP-14-F-14	1547911	1938368	572	562	547	Overburden
IP-14-F-15	1547911	1938378	573	562	547	Overburden
IP-14-F-16	1547911	1938388	573	562	547	Overburden
IP-14-F-17	1547911	1938398	572	562	547	Overburden
IP-14-F-18	1547911	1938408	572	562	547	Overburden
IP-14-F-19	1547911	1938418	573	562	547	Overburden
IP-14-F-20	1547911	1938428	573	562	547	Overburden
IP-14-F-21	1547911	1938438	573	562	547	Overburden
IP-14-F-22	1547911	1938448	573	562	547	Overburden
IP-14-F-23	1547911	1938458	573	562	547	Overburden
IP-14-F-24	1547911	1938468	573	562	547	Overburden
IP-14-G-01	1547901	1938242	573	562	547	Overburden
IP-14-G-02	1547901	1938252	572	562	547	Overburden
IP-14-G-03	1547901	1938262	572	562	547	Overburden
IP-14-G-04	1547901	1938272	572	562	547	Overburden
IP-14-G-05	1547901	1938282	571	562	547	Overburden
IP-14-G-06	1547901	1938292	572	562	547	Overburden
IP-14-G-07	1547901	1938302	572	562	547	Overburden
IP-14-G-08	1547901	1938312	572	562	547	Overburden
IP-14-G-09	1547901	1938322	572	562	547	Overburden
IP-14-G-10	1547901	1938332	572	562	547	Overburden
IP-14-G-11	1547901	1938342	572	562	547	Overburden
IP-14-G-12	1547901	1938352	572	562	547	Overburden
IP-14-G-13	1547901	1938362	573	562	547	Overburden
IP-14-G-14	1547901	1938372	572	562	547	Overburden
IP-14-G-15	1547901	1938382	572	562	547	Overburden

Table 3
Conceptual Injection Location Construction Details
Georgia Power Company
Plant Hammond - Ash Pond 2
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-14-G-16	1547901	1938392	572	562	547	Overburden
IP-14-G-17	1547901	1938402	572	562	547	Overburden
IP-14-G-18	1547901	1938412	572	562	547	Overburden
IP-14-G-19	1547901	1938422	573	562	547	Overburden
IP-14-G-20	1547901	1938432	573	562	547	Overburden
IP-14-G-21	1547901	1938442	573	562	547	Overburden
IP-14-G-22	1547901	1938452	573	562	547	Overburden
IP-14-H-01	1547891	1938258	572	562	547	Overburden
IP-14-H-02	1547891	1938268	573	562	547	Overburden
IP-14-H-03	1547891	1938278	572	562	547	Overburden
IP-14-H-04	1547891	1938288	572	562	547	Overburden
IP-14-H-05	1547891	1938298	573	562	547	Overburden
IP-14-H-06	1547891	1938308	573	562	547	Overburden
IP-14-H-07	1547891	1938318	573	562	547	Overburden
IP-14-H-08	1547891	1938328	573	562	547	Overburden
IP-14-H-09	1547891	1938338	573	562	547	Overburden
IP-14-H-10	1547891	1938348	572	562	547	Overburden
IP-14-H-11	1547891	1938358	573	562	547	Overburden
IP-14-H-12	1547891	1938368	572	562	547	Overburden
IP-14-H-13	1547891	1938378	574	562	547	Overburden
IP-14-H-14	1547891	1938388	573	562	547	Overburden
IP-14-H-15	1547891	1938398	573	562	547	Overburden
IP-14-H-16	1547891	1938408	573	562	547	Overburden
IP-18-A-01	1548886	1937615	583	565	555	Overburden
IP-18-A-02	1548879	1937608	583	565	555	Overburden
IP-18-A-03	1548871	1937602	583	565	555	Overburden
IP-18-A-04	1548863	1937595	583	565	555	Overburden
IP-18-A-05	1548855	1937590	583	565	555	Overburden
IP-18-A-06	1548846	1937585	583	565	555	Overburden
IP-18-A-07	1548838	1937580	584	565	555	Overburden
IP-18-A-08	1548828	1937576	584	565	555	Overburden
IP-18-A-09	1548819	1937572	583	565	555	Overburden
IP-18-A-10	1548810	1937569	584	565	555	Overburden
IP-18-A-11	1548800	1937566	583	565	555	Overburden
IP-18-A-12	1548791	1937563	583	565	555	Overburden
IP-18-A-13	1548781	1937560	583	565	555	Overburden
IP-18-A-14	1548771	1937558	584	565	555	Overburden
IP-18-A-15	1548761	1937557	583	565	555	Overburden
IP-18-B-01	1548887	1937606	583	565	555	Overburden
IP-18-B-02	1548880	1937599	582	565	555	Overburden
IP-18-B-03	1548872	1937592	582	565	555	Overburden
IP-18-B-04	1548864	1937586	583	565	555	Overburden
IP-18-B-05	1548855	1937579	583	565	555	Overburden
IP-18-B-06	1548846	1937574	583	565	555	Overburden
IP-18-B-07	1548837	1937569	583	565	555	Overburden
IP-18-B-08	1548828	1937565	583	565	555	Overburden

Table 3
Conceptual Injection Location Construction Details
Georgia Power Company
Plant Hammond - Ash Pond 2
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-18-B-09	1548817	1937561	582	565	555	Overburden
IP-18-B-10	1548807	1937557	582	565	555	Overburden
IP-18-B-11	1548798	1937554	582	565	555	Overburden
IP-18-B-12	1548788	1937551	582	565	555	Overburden
IP-18-B-13	1548779	1937549	582	565	555	Overburden
IP-18-B-14	1548769	1937546	582	565	555	Overburden
IP-18-B-15	1548759	1937544	582	565	555	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.

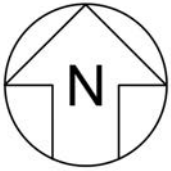
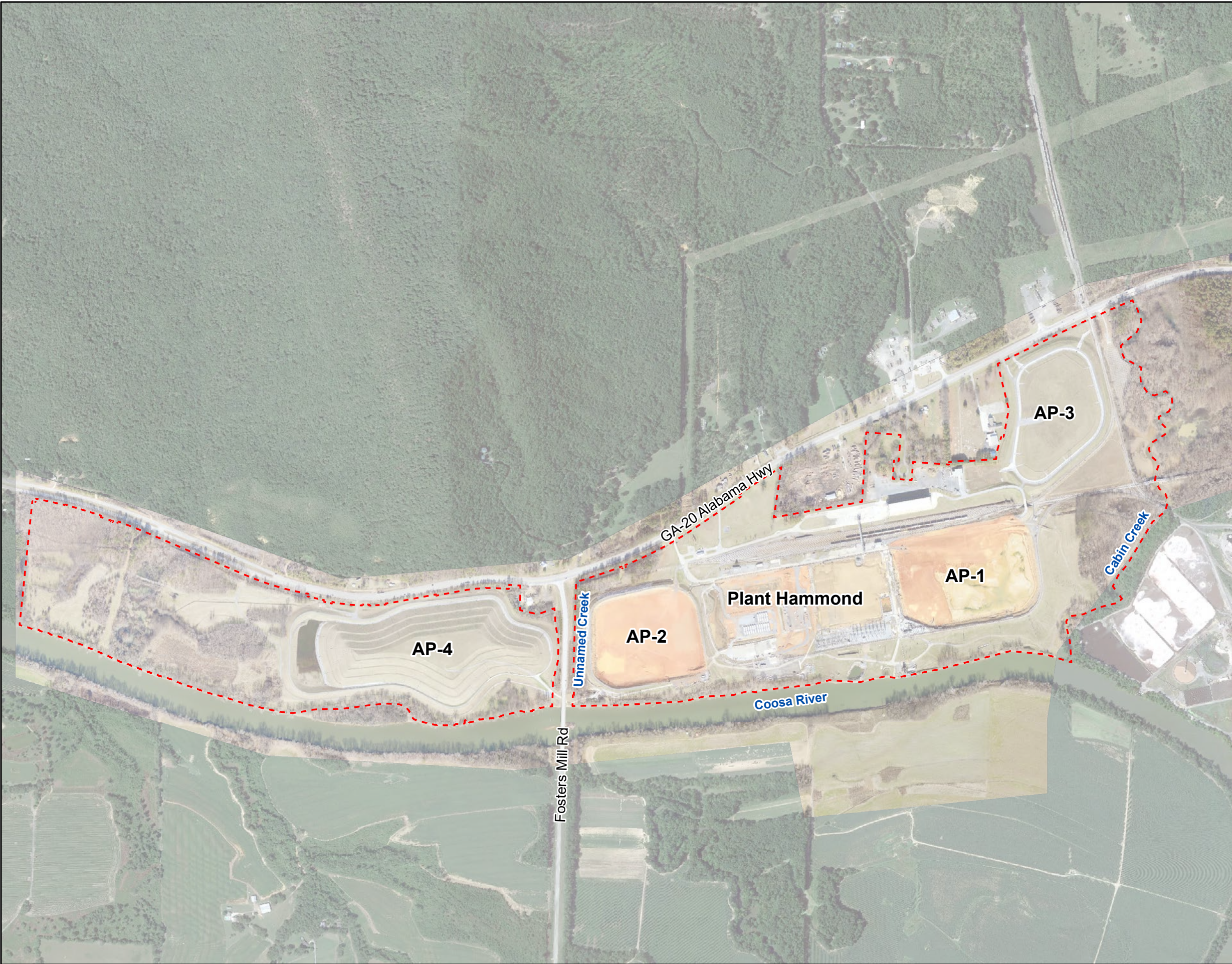
Table 4
Conceptual Corrective Action Monitoring Well Construction Details
Georgia Power Company
Plant Hammond - Ash Pond 2
Floyd County, GA

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-16	1548850	1937580	583	565	555	Overburden
PT-17	1548874	1937585	582	565	555	Overburden
PT-18	1548777	1937539	582	565	555	Overburden
PT-19	1547867	1938351	573	562	552	Overburden
PT-20	1548778	1937555	583	565	555	Overburden
PT-21	1548743	1937550	582	565	555	Overburden
PT-22	1547887	1938218	572	562	552	Overburden
PT-23	1547876	1938257	572	562	552	Overburden
PT-24	1547911	1938492	573	562	552	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.

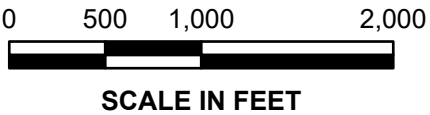
FIGURES



LEGEND
[Red dashed line] Plant Hammond Property Boundary



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



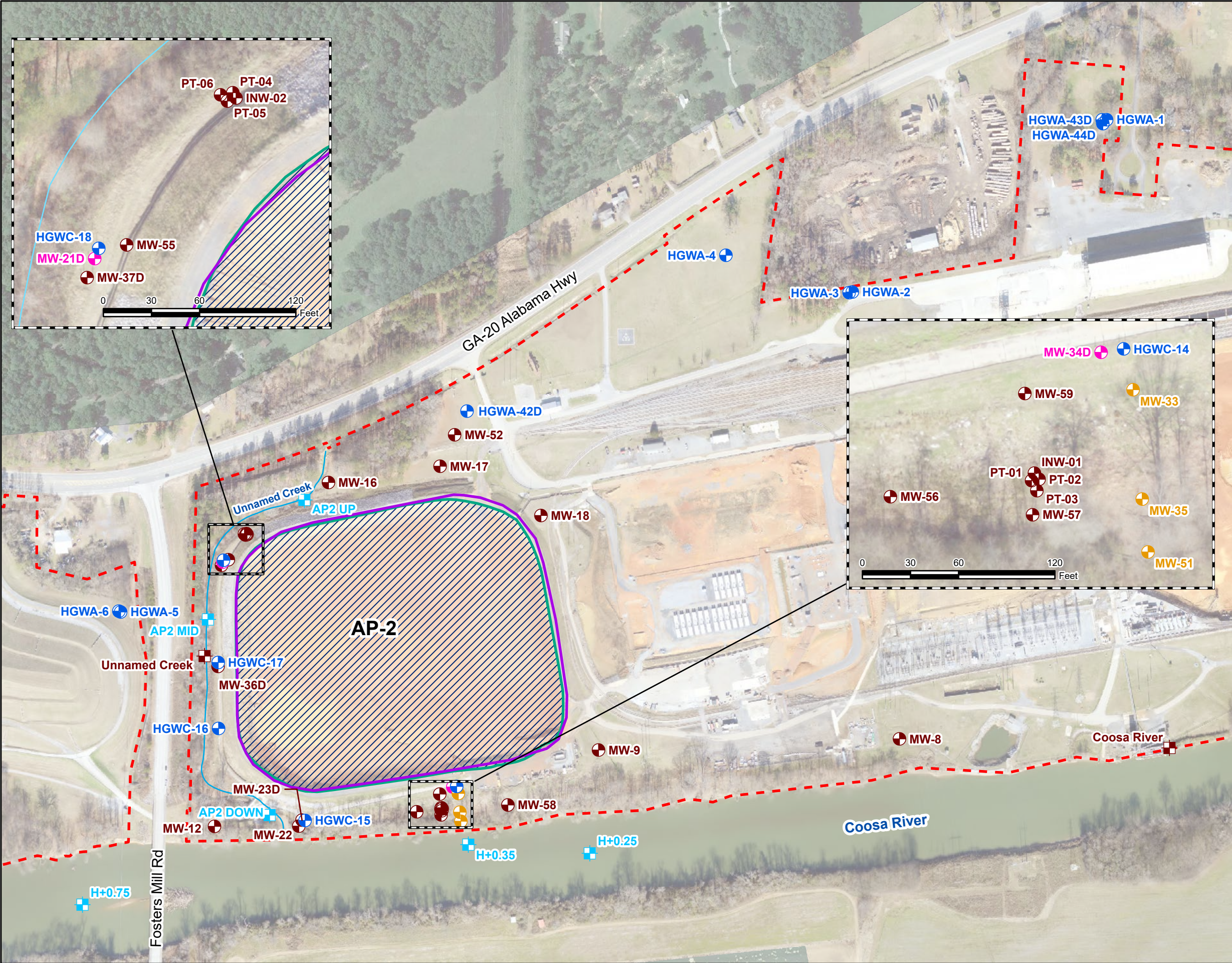
SITE LOCATION MAP

GEORGIA POWER COMPANY
PLANT HAMMOND AP-2
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
 - Creek
 - Approximate AP-2 Boundary
 - Area where ash removal was certified complete by GA EPD (December 23, 2024)
 - Plant Hammond Property Boundary

Notes:

- Piezometers INW-01, INW-02, MW-55 through MW-59, and PT-01 through PT-06 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-23D and MW-37D, and Horizontal Assessment Monitoring Well MW-22, 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**

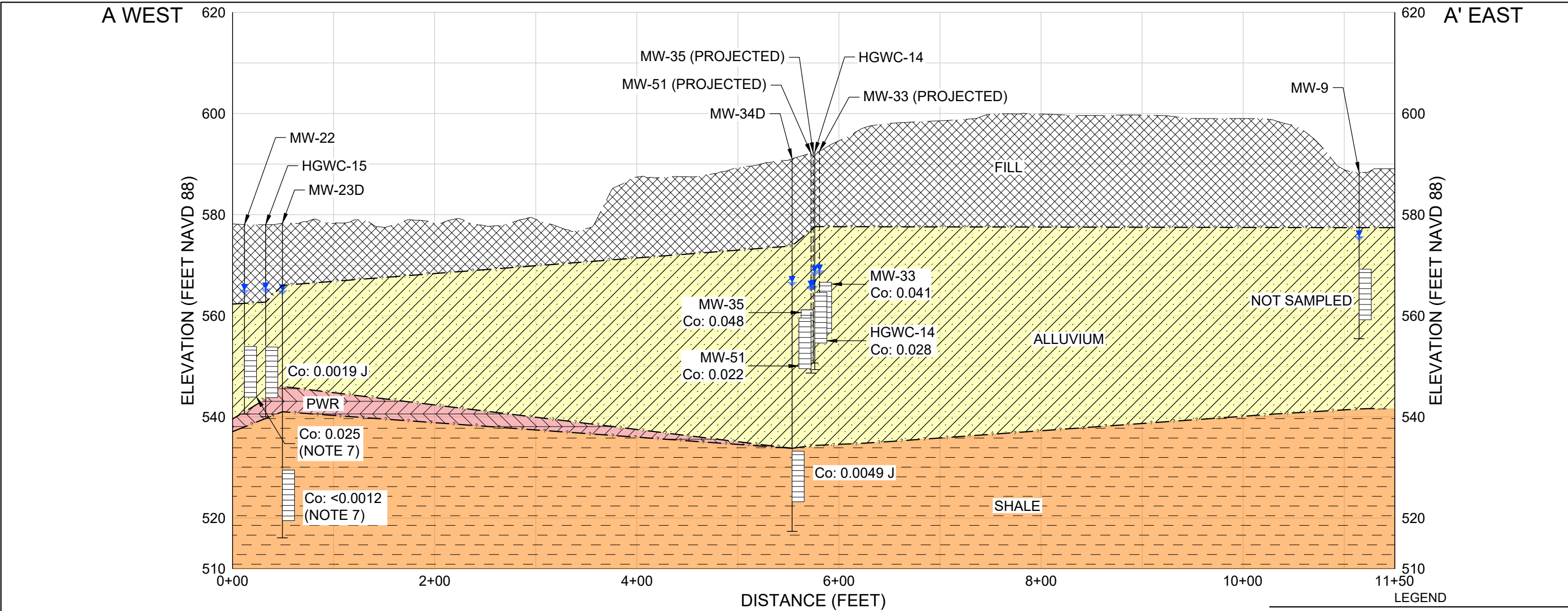
GEORGIA POWER COMPANY
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For: Georgia Power

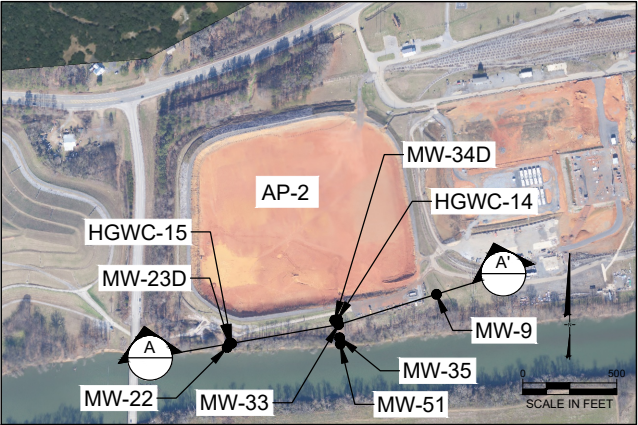
Prepared By: Geosyntec
consultants

KENNESAW, GA JUNE 2026

**FIGURE
2**

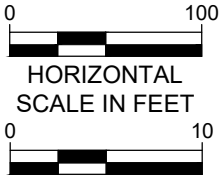


- NOTES:
- SUBSURFACE LITHOLOGIC ELEVATIONS BETWEEN BORINGS ARE BASED ON ENVIRONMENTAL VISUALIZATION SYSTEM (EVS) 3D MODEL KRIGING AND SHOULD BE CONSIDERED APPROXIMATE.
 - ELEVATION PROVIDED IN FEET REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).
 - ELEVATIONS OF LITHOLOGIC UNITS WERE 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.
 - COBALT (CO) CONCENTRATION DATA ARE FROM FEBRUARY 2022 SEMI-ANNUAL GROUNDWATER MONITORING EVENT. CONCENTRATIONS ARE REPORTED IN MILLIGRAMS PER LITER. A "<" INDICATES THE CONSTITUENT WAS NOT DETECTED ABOVE THE ANALYTICAL METHOD DETECTION LIMIT (MDL). A "J" INDICATES THE CONSTITUENT WAS ESTIMATED AND DETECTED BETWEEN THE MDL AND THE REPORTING LIMIT.
 - ASSESSMENT MONITORING WELLS MW-22 AND MW-23D HAVE PREVIOUSLY BEEN RECLASSIFIED FROM ASSESSMENT WELLS TO PIEZOMETERS AND WERE NOT SAMPLED IN AUGUST 2025. SHOWN CONCENTRATION DATA ARE FROM THE FEBRUARY 2025 SEMI-ANNUAL MONITORING EVENT.
 - THE GROUNDWATER PROTECTION STANDARD (GWPS) FOR COBALT IS 0.038 MG/L.

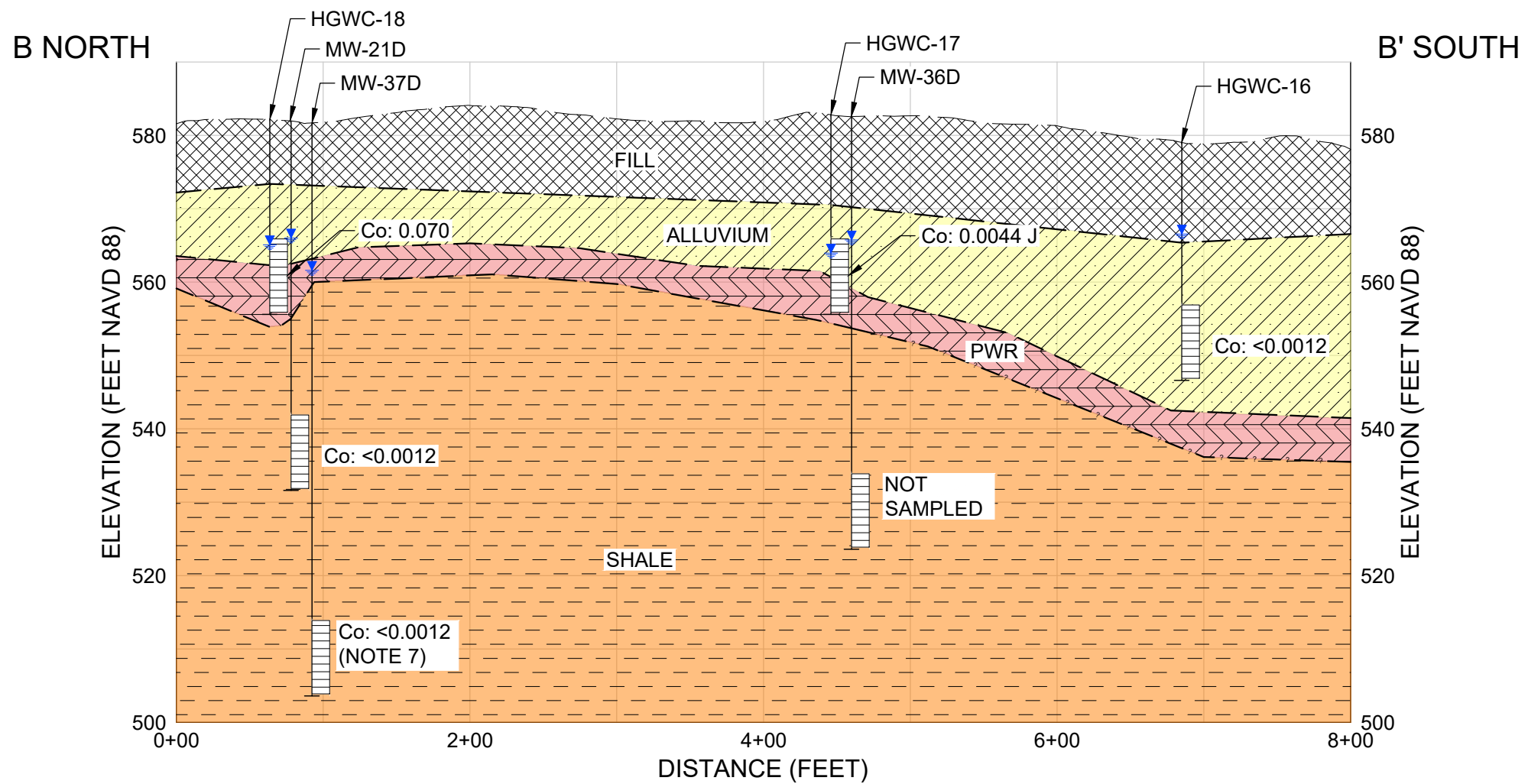


SECTION A-A' KEY MAP

- LEGEND
- ESTIMATED LITHOLOGICS
 - EXTRAPOLATED SURFACE
 - WELL
 - PROJECTED WELL
 - SCREEN INTERVAL
 - GROUNDWATER LEVEL (NOTE 5)
 - FILL: SILTY CLAY, LEAN CLAY, SANDY CLAY WITH SOME GRAVEL
 - ALLUVIUM: CLAY, SILT, SANDY CLAY, CLAYEY GRAVEL, GRAVELLY CLAY
 - PARTIALLY WEATHERED ROCK (PWR)
 - SLIGHTLY TO MODERATELY WEATHERED SHALE

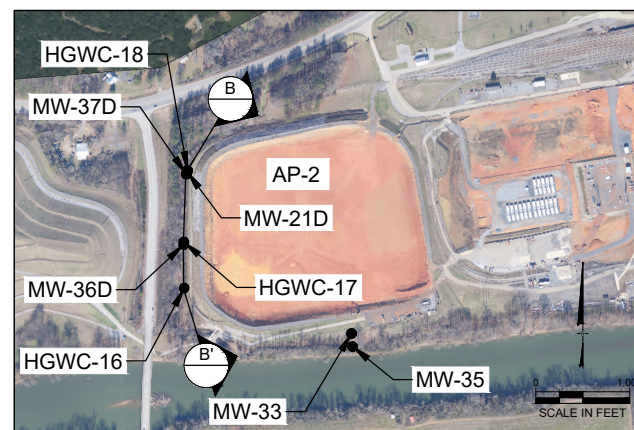


GEOLOGIC SECTION A-A' GEORGIA POWER COMPANY PLANT HAMMOND ASH POND 2 (AP-2) ROME, FLOYD COUNTY, GEORGIA	
Geosyntec consultants	
KENNESAW, GA	JUNE 2026
FIGURE 3	



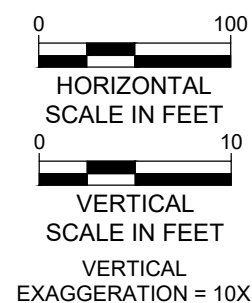
NOTES:

- 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.
- COBALT (CO) CONCENTRATION DATA ARE FROM FEBRUARY 2022 SEMIANNUAL GROUNDWATER MONITORING EVENT. CONCENTRATIONS ARE REPORTED IN MILLIGRAMS PER LITER. A "<" INDICATES THE CONSTITUENT WAS NOT DETECTED ABOVE THE ANALYTICAL METHOD DETECTION LIMIT (MDL). A "J" INDICATES THE CONSTITUENT WAS ESTIMATED AND DETECTED BETWEEN THE MDL AND THE REPORTING LIMIT.
- ASSESSMENT MONITORING WELLS MW-37D WAS PREVIOUSLY RECLASSIFIED FROM AN ASSESSMENT WELL TO A PIEZOMETERS AND WAS NOT SAMPLED IN AUGUST 2025. SHOWN CONCENTRATION DATA IS FROM THE FEBRUARY 2025 SEMIANNUAL MONITORING EVENTS.
- THE GROUNDWATER PROTECTION STANDARD (GWPS) FOR COBALT IS 0.038 MG/L.



SECTION B-B' KEY MAP

LEGEND	
	ESTIMATED LITHOLOGICS
	EXTRAPOLATED SURFACE
	WELL
	SCREEN INTERVAL
	GROUNDWATER LEVEL (NOTE 5)
	FILL: SILTY CLAY, LEAN CLAY, SANDY CLAY WITH SOME GRAVEL
	ALLUVIUM: CLAY, SILT, SANDY CLAY, CLAYEY GRAVEL, GRAVELLY CLAY
	PARTIALLY WEATHERED ROCK (PWR)
	SLIGHTLY TO MODERATELY WEATHERED SHALE



GEOLOGIC SECTION B-B'
GEORGIA POWER COMPANY
PLANT HAMMOND ASH POND 2 (AP-2)
ROME, FLOYD COUNTY, GEORGIA

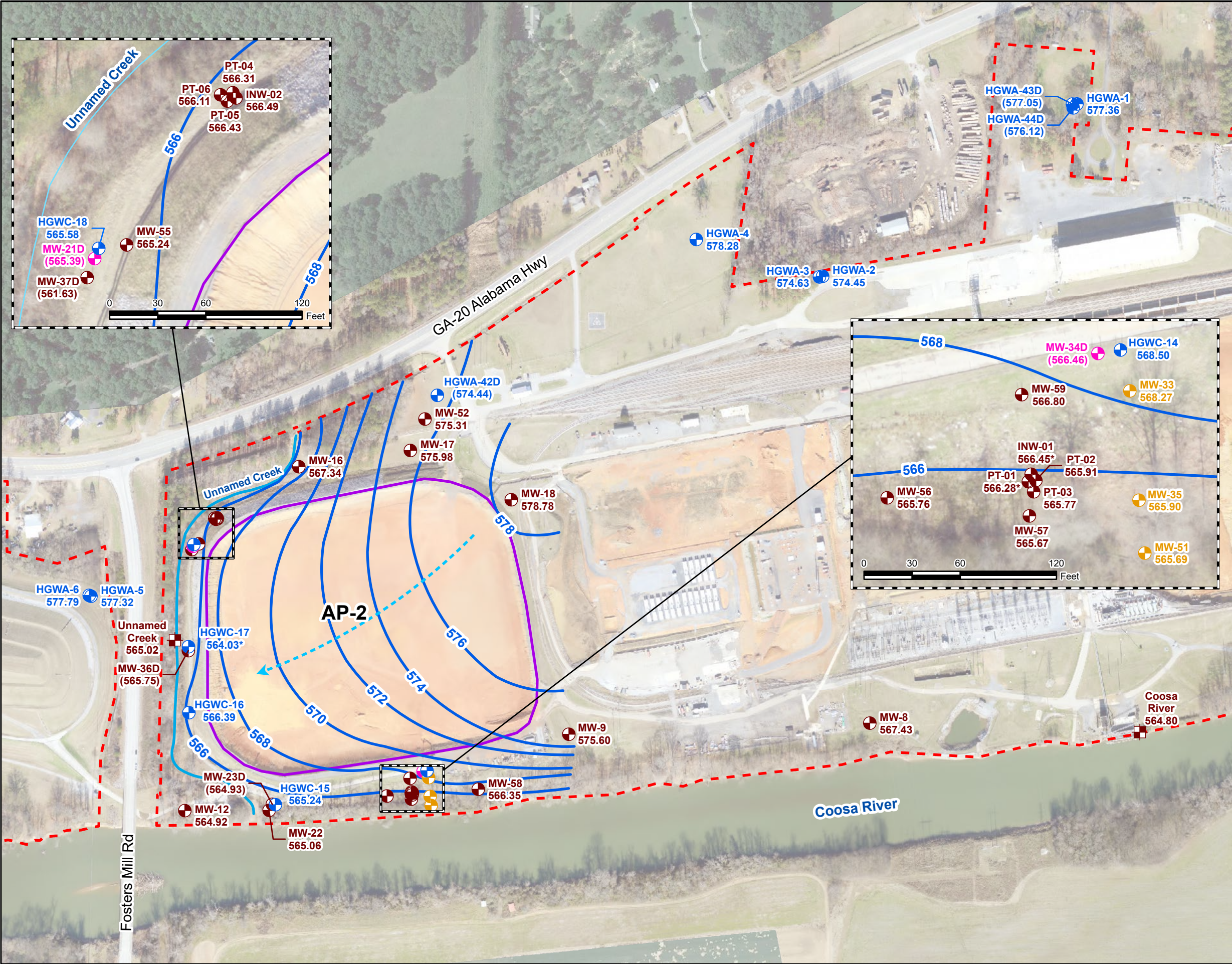
Geosyntec
consultants

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
 - Creek
 - Approximate AP-2 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. Wells marked with an * were not used to make groundwater contours due to potential erroneous readings.
4. Vertical Assessment Monitoring Wells MW-23D and MW-37D, and Horizontal Assessment Monitoring Well MW-22, were reclassified as Piezometers after the 2025 semiannual groundwater monitoring event.
5. Aerial photograph source: Google Earth Pro August 2019 and Georgia Power Company, January 2026.

0 175 350 700
SCALE IN FEET

**POTENTIOMETRIC SURFACE
CONTOUR MAP - AUGUST 2025**

GEORGIA POWER COMPANY
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

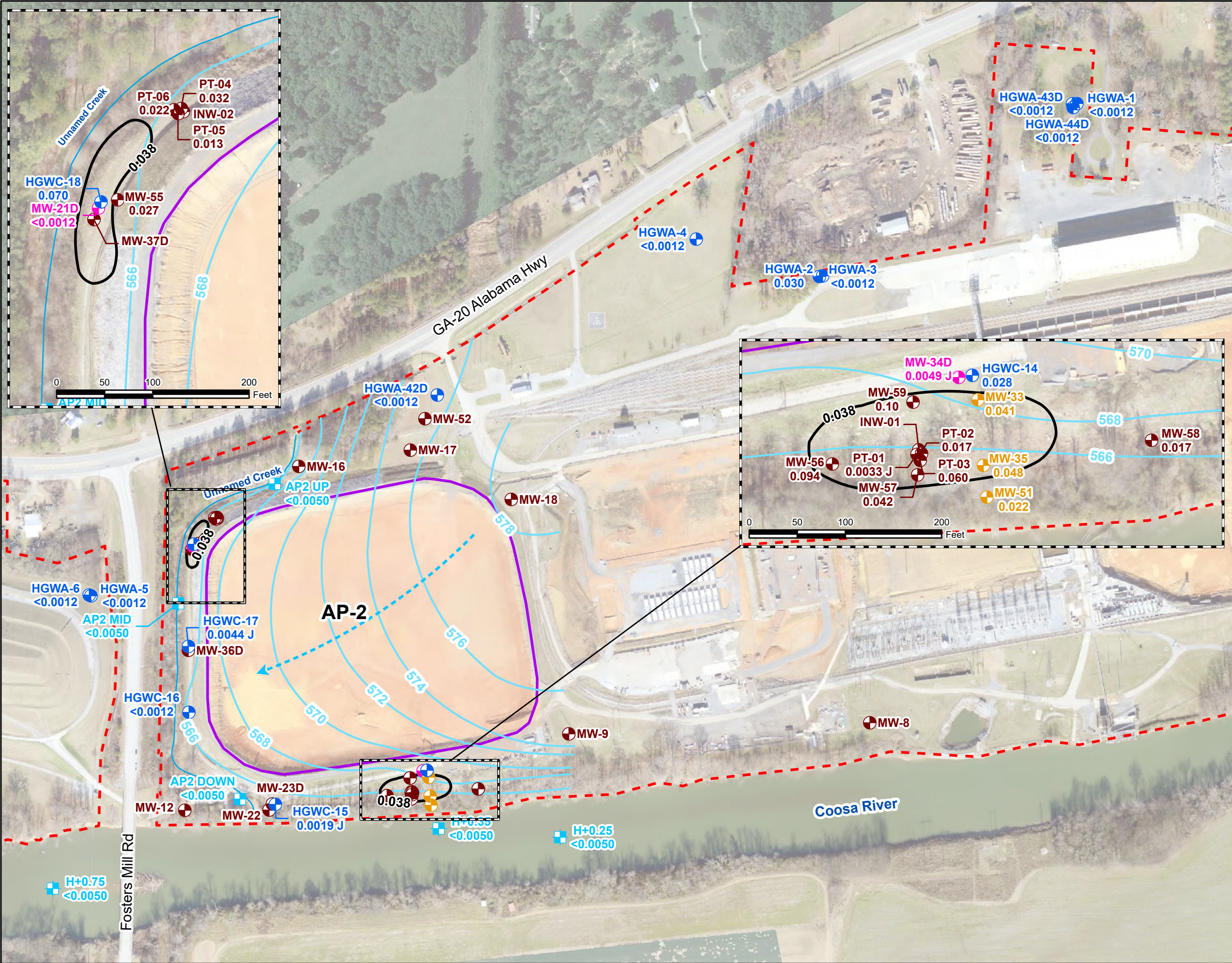
Prepared For:  **Georgia Power**

Prepared By:  **Geosyntec**
consultants

KENNESAW, GA

JUNE 2026

**FIGURE
5**

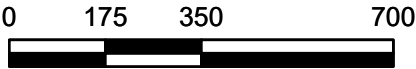


LEGEND

- Detection Monitoring Well
- Horizontal Assessment Monitoring Well
- Vertical Assessment Monitoring Well
- Piezometer
- Surface Water Sample Point
- GWPS Cobalt Iso-Concentration Contour (mg/L)
- Groundwater Elevation Contour
- Approximate Groundwater Flow Direction
- Creek
- Approximate AP-2 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-42D, HGWA-43D, HGWA-44D, MW-21D, MW-23D, MW-34D, MW-37D). 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 cobalt is 0.038 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-23D and MW-37D, and Horizontal Assessment Monitoring Well MW-22, 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.



SCALE IN FEET

**ISO-CONCENTRATION MAP
COBALT - AUGUST 2025**

GEORGIA POWER COMPANY
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

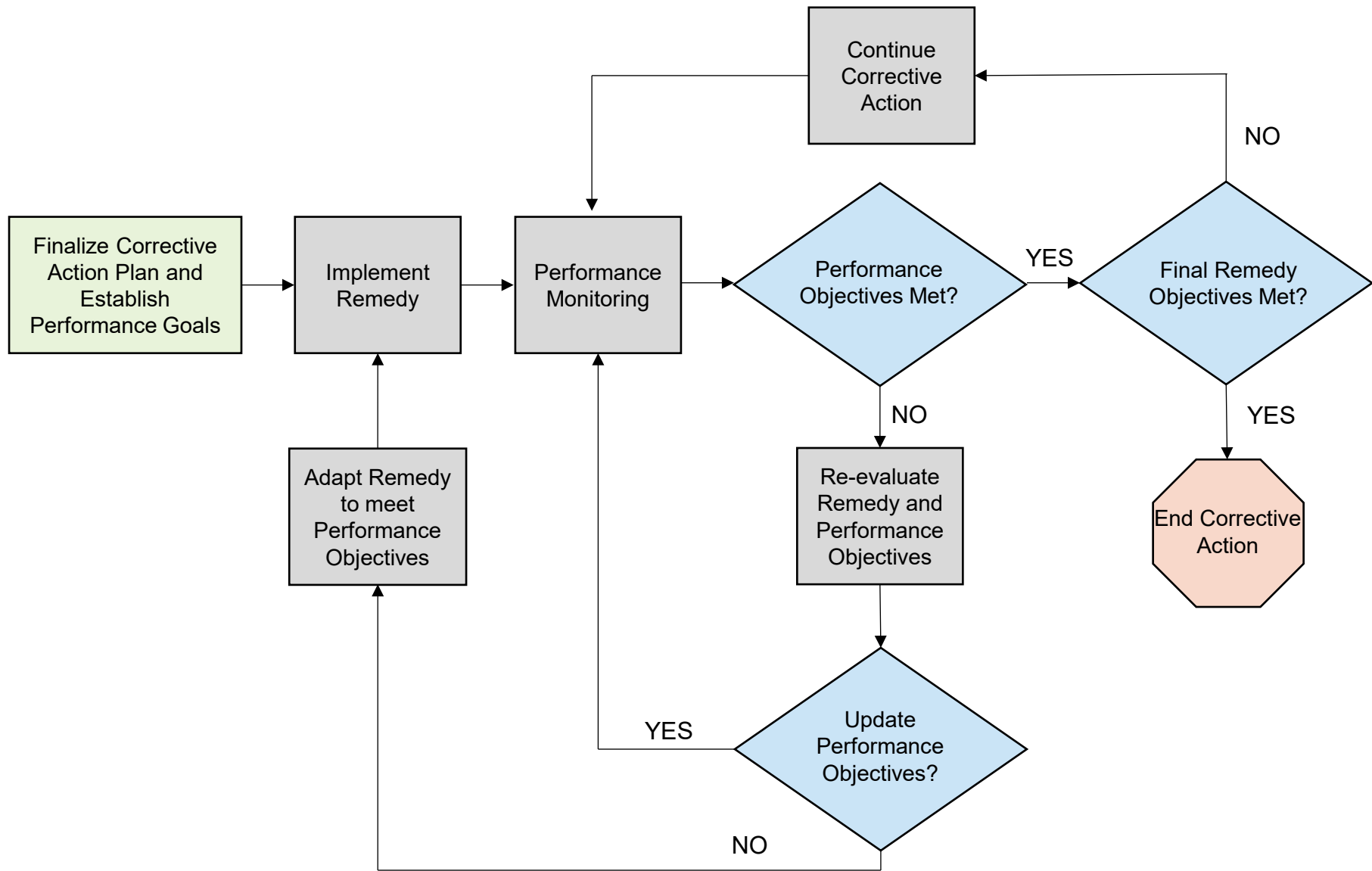
Prepared For: Georgia Power

Prepared By: Geosyntec
consultants

KENNESAW, GA

JUNE 2026

**FIGURE
6**



Notes:

REMEDY ADAPTIVE SITE MANAGEMENT

GEORGIA POWER COMPANY
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For:



KENNESAW, GA

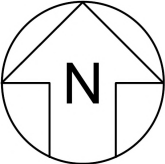
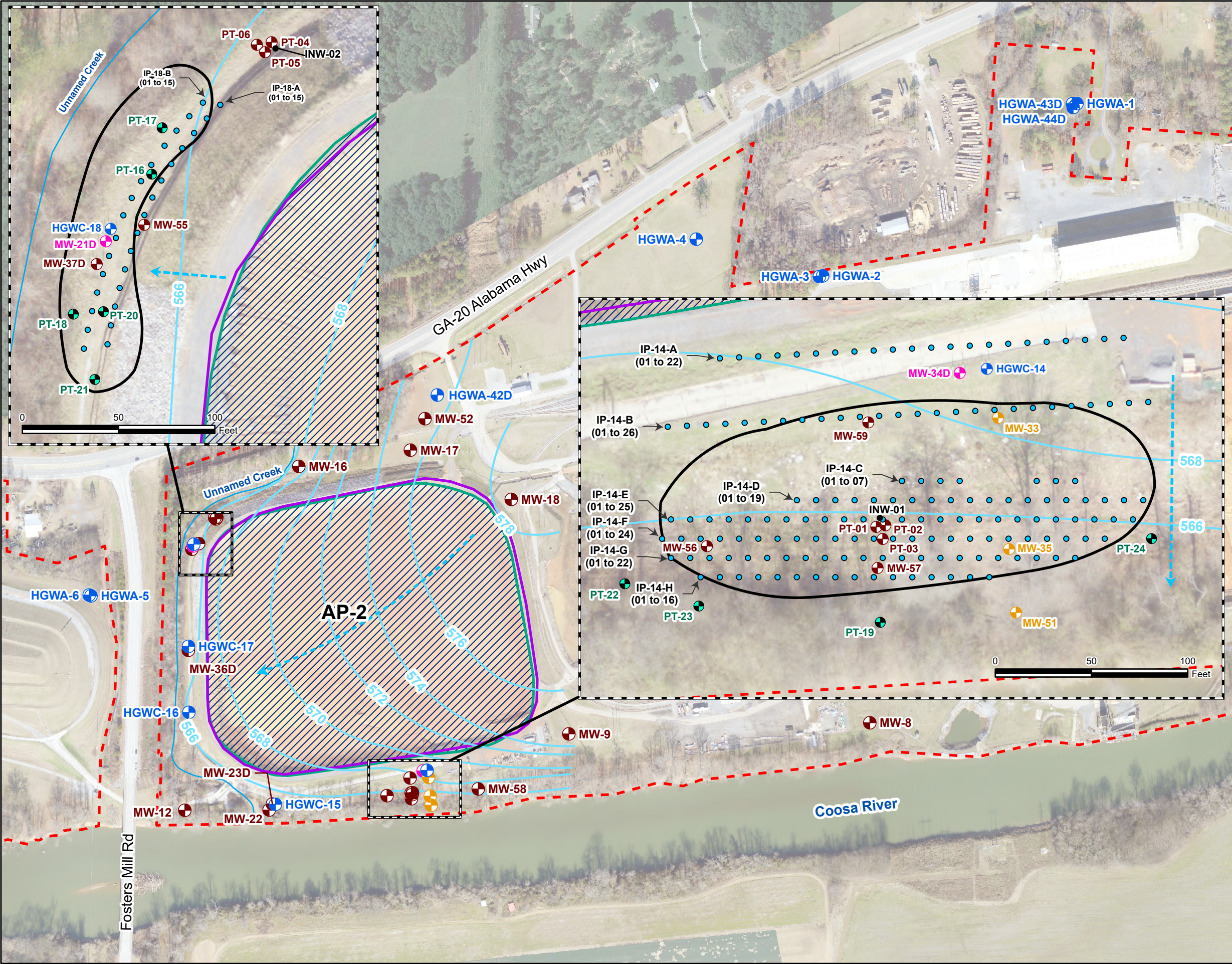
Prepared By:



JUNE 2026

FIGURE

7



- 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
 - Creek
 - Proposed Treatment Area Boundary
 - Approximate AP-2 Boundary
 - Area where ash removal was certified complete by GA EPD (December 23, 2024)
 - Plant Hammond Property Boundary

IP-14-A (01 to 22) 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 cobalt 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.



REMEDY CONCEPTUAL DESIGN

GEORGIA POWER COMPANY
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For: Georgia Power

Prepared By: Geosyntec consultants

KENNESAW, GA

JUNE 2026

FIGURE
8

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 2 (AP-2)

Prepared by

Geosyntec 
consultants

engineers | scientists | innovators

1255 Roberts Boulevard, Suite 200
Kennesaw, Georgia 30144

Project Number GW7300

August 2022

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------------	---------------------------

LIST OF ACRONYMS AND ABBREVIATIONS

AP-2	Ash Pond 2
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
Co	Cobalt
CSM	Conceptual Site Model
GA EPD	Georgia Environmental Protection Division
GCSM	Geochemical Conceptual Site Model
GWPS	Groundwater Protection Standard
HAR	Hydrogeologic Assessment Report
HFO	hydrous ferric oxide
HX	Proton Exchange
MNA	Monitored Natural Attenuation
SEP	Sequential Extraction Procedure
SSL	Statistically Significant Levels
XRD	X-Ray Diffraction

1.0 INTRODUCTION

1.1 Purpose

This reactive transport model report (Report) has been prepared for the Georgia Power Company (Georgia Power) Plant Hammond Ash Pond 2 (AP-2 or Site) and is included as Appendix B to the *Draft Remedy Selection Report – Plant Hammond Ash Pond 2 (AP-2)* (Remedy Selection Report) (Geosyntec, 2022b). The purpose of this report is to document the reactive transport model developed to evaluate potential remediation approaches to address statistically significant levels (SSLs) of cobalt (Co) above groundwater protection standards (GWPS) at certain locations at AP-2.

1.2 Site Background and Overview of AP-2 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-2 is a 21-acre surface impoundment constructed in 1969 and was used primarily as a dewatering facility for coal combustion residuals (CCR) including fly ash and bottom ash. CCR placement in AP-2 ceased in 2019. Georgia Power initiated closure activities on January 4, 2021, in accordance with Georgia Environmental Protection Division (GA EPD) approved Closure permit No. 057-024D(CCR). Closure activities for AP-2 consist of closure by removal. Closure details can also be found at the GA EPD CCR permit website¹.

1.3 Site Geology and Hydrogeologic Setting

The following section summarizes the geologic and hydrogeologic conditions at the Site as described in the *Hydrogeologic Assessment Report Revision 01 – Ash Pond 2 (AP-2)* (HAR Rev 01) submitted to GA EPD in December 2019 in support of the AP-2 solid waste handling permit (Geosyntec, 2019b).

¹ <https://epd.georgia.gov/hammond-ap-2-permit>

1.3.1 Site Geology

AP-2 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. AP-2 is underlain primarily by five lithologic units: (i) terrace alluvium, (ii) colluvium, (iii) residuum, (iv) partially weathered shale bedrock, and (v) unweathered shale 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-2 is a regional unconfined 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 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 AP-2 is predominantly east to west toward the Unnamed Creek with an additional southwesterly component toward the Coosa River. Groundwater elevation data and potentiometric surface contours that depict groundwater flow direction are provided in the Remedy Selection Report (**Figure 5**, Geosyntec, 2022b). Monitoring well construction details are provided in the Remedy Selection Report (**Table 1**, Geosyntec, 2022b).

1.4 Groundwater Exceedances

At AP-2, Georgia Power has performed CCR groundwater monitoring-related activities since May 2016². As discussed in the Remedy Selection Report (Geosyntec, 2022b), the concentration of Co in groundwater exceeds the GWPS at HGWC-18, MW-33, and MW-35. Cobalt in groundwater has been horizontally and vertically delineated as shown in **Figure 6** of the Remedy Selection Report. Groundwater monitoring data confirm that Co is not migrating offsite, and impacts are likely limited in extent due to natural attenuation processes in the aquifer.

² 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 (GA EPD'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 Co to support the remedy selection process for AP-2. 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 transport modeling effort are to:

- Develop a predictive reactive transport model for Co in the vicinity of HGWC-18 and MW-33/MW-35 under post-closure conditions;
- Assess the feasibility of monitored natural attenuation (MNA) processes to achieve the Co GWPS at or beyond the compliance boundary under predicted post-closure conditions; and
- Evaluate the feasibility of geochemical injections to achieve the Co GWPS at or beyond the compliance boundary under predicted post-closure conditions.

The geochemical conceptual site model (CSM), flow model, and transport model are described in detail in later sections.

2.0 GEOCHEMICAL CONCEPTUAL SITE MODEL

The following section summarizes the geochemical conceptual site model for AP-2, as described in the *Geochemical Conceptual Site Model Report – Plant Hammond Ash Pond 2 (AP-2)* (GCSM Report) included as **Appendix A** of the Remedy Selection Report (Geosyntec 2022a).

2.1 Cobalt Occurrence, Geochemistry, and Fate and Transport Properties

As discussed in detail in the GCSM Report, the presence of Co in soil samples collected from background locations at the Site indicates that Co occurs naturally in soils in the vicinity of AP-2. Additional soil characterization data generated through sequential extraction procedure (SEP) indicates that Co in Site soils is likely associated with metal oxyhydroxides, non-crystalline phases, and sulfide minerals. The fraction of Co associated with each of these phases is likely to be variable and uncertain at this time. For the purposes of this reactive transport model and to assess potential remedial alternatives, the primary source of Co was assumed to be Co associated with sulfide minerals. As additional data are collected as part of the remedy design and implementation process, the source of Co will continue to be evaluated and the CSM revised as appropriate.

Analysis of groundwater data indicates that Co in groundwater is strongly correlated with pH, with Co concentrations above the GWPS observed when the pH of the groundwater is less than 5.6 standard units (s.u.). The pH in temporary porewater piezometers within the AP-2 were 7.99 at PMW-04 and 5.59 to 5.73 in PMW-03 in 2021. In general, the Co exceedances in groundwater appear to be localized to areas of high acidity. At low pH (i.e., below 5.6 s.u.), Co from Site soils associated with oxyhydroxides, non-crystalline phases, or sulfide mineral phases, is likely mobilized to groundwater through dissolution of Co bearing mineral phases. Under Site pH and redox conditions, Co in groundwater is predominantly present as Co^{2+} , while geochemical conditions are generally favorable for the dissolution of Fe/Mn oxides and pyrite when low pH conditions are encountered.

Three potential sources of localized high acidity were identified at the Site: (i) oxidative dissolution of sulfide minerals such as pyrite (Larsen and Postma, 1997); (ii) biogeochemical reduction of Fe and Mn oxides (Gounot, 1994); and (iii) proton exchange with surfaces in the aquifer (Holmberg, 1986). Irrespective of the source of localized acidity, low pH groundwater likely leads to the mobilization of naturally occurring Co from Site soils. As additional data are collected as part of the remedy design and implementation process, the source of acidity will continue to be evaluated and the GCSM revised as appropriate. Based on data collected to date, pyrite oxidation and proton

exchange were assumed to be the primary sources of localized acidity in this transport model.

Adsorption (surface complexation) of Co on Fe and Mn-hydroxides under neutral to alkaline pH conditions and co-precipitation of Co are expected to drive the attenuation of Co in the overburden soils. Alkaline pH conditions induce a negative surface charge on these mineral surfaces, allowing Co cations to adsorb; this process appears to have been counter-acted at AP-2 due to the localized acidifying processes observed at the Site. Total metals, mineralogical and SEP data indicate that clay minerals and Al/Fe/Mn-hydroxides are present in significant amounts to favor adsorption and attenuation of Co. Iron and Mn hydroxides, due to their high surface area, tend to be excellent sorbents of trace elements (e.g., As, Co, Ni and Zn) and subsequently control their mobility, fate and transport in water (e.g., Herbert, 1996; Schemel et al., 2000).

In addition to adsorption, Co initially complexed with the mineral surfaces of Fe/Mn oxides and oxyhydroxides become entrained in the crystal structure as the mineral continues to grow. This process more commonly occurs with poorly crystalline, fast growing iron and manganese oxyhydroxides that precipitate under oxidizing conditions.

In summary, the GCSM Report suggests that as groundwater impacted by AP-2 interacts with sulfide minerals (such as pyrite) and proton exchange surfaces, localized acidity is generated leading to the subsequent release of Co associated with Site soils. As such, after closure of AP-2, the source of localized acidity is anticipated to be removed, leading to a reduction in Co concentrations to below GWPS. As additional data are collected as part of the remedy design and implementation process, the groundwater pH will continue to be monitored and the GCSM revised as appropriate. **Figure 1** and **Figure 2** present schematics of Co mobilization and attenuation at the Site, respectively.

Data in support of the CSM and associated analysis are described in detail in the GCSM Report included as **Appendix A** of the Remedy Selection Report (Geosyntec 2022a).

3.0 GROUNDWATER MODEL DESCRIPTIONS

Two reactive transport models were developed to evaluate the feasibility of MNA and geochemical injections as potential corrective measures for Co exceedances of GWPSs. A groundwater flow model was utilized to provide groundwater flow directions and velocities as inputs to the reactive transport models. The following sections describe the flow and transport model setups, scenarios, and results.

3.1 Groundwater Flow Model

To support the reactive transport models (described below), an updated version of the sitewide groundwater flow model (originally described in Geosyntec, 2019a) was utilized to simulate and provide steady state post-closure groundwater flow directions and velocities as inputs into the reactive transport models.

The closure design for AP-2 includes i) removal of existing CCR by excavation, ii) removing the western and northern dikes, and iii) grading the interior of AP-2 to direct stormwater runoff toward the southwestern corner of AP-2. To simulate post-closure groundwater conditions, model hydraulic conductivity and recharge were modified to represent the above summarized AP-2 closure design.

Inside the footprint of AP-2, model cells were updated to represent earthen backfill by assigning a horizontal hydraulic conductivity (K_h) and vertical hydraulic conductivity (K_v) of 2.9×10^{-2} feet per day (ft/d) and 5.2×10^{-3} ft/d, respectively (**Figure 3a**). These conductivity values were used as they represent a calibrated set of values for fill from the updated sitewide model. To simulate anticipated decreases in infiltration related to the earthen backfill and post closure final grades, recharge inside AP-2 and along the remaining southern and eastern dikes was reduced to assumed rates of 0.75 in/yr and 0.38 in/yr, respectively (**Figure 3b**).

Simulated post-closure groundwater contours and flow direction are shown in **Figure 4**. Under post-closure conditions, groundwater flow is predicted to flow from the north to the south toward the Coosa River.

Given the very localized impacts of Co at HGWC-18 and MW-33/MW-35, and large extent of the updated sitewide flow model, localized post-closure velocities were calculated for the areas of interest. Simulated post-closure hydraulic gradients, hydraulic conductivities estimated from recent slug test data (not available during the development of the updated sitewide model) from wells located within the areas of interest, and literature porosity values were used to calculate groundwater input velocities for the

reactive transport models. Simulated hydraulic gradients, hydraulic conductivity values estimated from slug testing, and calculated velocities are shown on **Table 1**.

3.2 Reactive Transport Model

One dimensional (1D) reactive transport models were developed for two areas where groundwater Co concentrations currently exceed the GWPS. The two areas of interest are: (i) West Area in the vicinity of monitoring well HGWC-18; and (ii) South Area in the vicinity of wells MW-33 and MW-35. The following sections describe the Co reactive transport model setup, scenarios, results, and sensitivity analysis.

3.2.1 Modeling Approach and Groundwater Velocities

As described in later sections, the 1D model was developed on a standalone geochemical modeling program. As such, transport information required by the model were derived from the groundwater flow model described above. A pre-closure reactive transport scenario was developed to select geochemical parameters that would result in Co concentrations similar to those measured at the site for use in the predictive post-closure reactive transport model. The post-closure scenario was developed based on the selected parameters from the pre-closure model to assess the potential viability of different remedial options, in accordance with the model objectives.

The geochemical models rely on groundwater direction and estimated groundwater velocities pre- and post-closure. **Table 1** presents a summary of simulated hydraulic gradients, measured hydraulic conductivities, and calculated post-closure groundwater velocities. **Table 2** presents a summary of pre-closure gradients, measured hydraulic conductivities, and calculated pre-closure groundwater velocities.

3.2.2 Reactive Transport Model Setup

The 1D reactive transport was developed using the PHREEQC version 3 geochemical modeling software (Parkhurst and Appelo, 2013). Equilibrium constants from the MINTEQA4 thermodynamic database (USEPA, 1999) were used for the Co model. Input parameters for the flow components of the reactive transport model were calculated from the results of the groundwater flow model described above (Section 3.1).

The following sections describe the reactive transport model setup for both the West and South Areas, and includes information on source areas and solid phases, groundwater composition, groundwater recharge, and applicable boundary conditions.

3.2.2.1 West Area (HGWC-18)

1D Model Setup

The advective-dispersive transport capabilities of PHREEQC are derived from a formulation of 1D, advective-dispersive transport presented by Appelo and Postma (1993). The 1D column is defined by a series of cells with the same pore volume. Lengths are defined for each cell and the time step provides the time necessary for a pore volume of water to move through each cell. The velocity of water in each cell is determined by the length of the cell divided by the time step.

A schematic of the 1D model for the West Area is presented in **Figure 5**. As depicted in the figure, the localized model extends from the temporary piezometer (TPZ-02) to Unnamed Creek with a total distance of approximately 120 ft. The 1D column consists of 10 cells, each 12 ft in length.

Simulation Settings – Duration & Closure Phasing

The model was run for a total simulation time of 100 years with distinct periods corresponding to pond status as shown on **Table 3**. The first period corresponds with pre-closure conditions. The primary purpose of this first period was to select solid phase parameters such that the observed concentrations of key constituents in groundwater (e.g., Co and pH) match with measured concentrations in groundwater samples collected from HGWC-18. The selection of solid phased parameters was informed by the GCSM. The second and third periods correspond with closure and post-closure, predictive simulations. Once the solid phases were selected based on results from the first period in the model, the extent, and concentration of solid phases was held constant over the duration of the model (i.e., for all three periods).

The first 50 years of the simulation correspond to pre-closure conditions where the time steps in the model (i.e., residence time in a single cell) were calculated based on pre-closure groundwater velocity in the vicinity of HGWC-18. Years 50 to 54 correspond to the closure period and the residence time in each cell was calculated assuming no change in groundwater velocity. Years 54 to 100 correspond to post-closure conditions with time steps calculated based on anticipated post-closure groundwater velocity in the vicinity of HGWC-18. Post-closure groundwater velocity was obtained from the results of the groundwater flow model.

The post-closure simulation has two distinct parts: (i) background groundwater replacement; and (ii) post-closure groundwater flow. Under the background groundwater

replacement part of the reactive transport model, the time for potentially impacted groundwater in the model to be replaced by unimpacted background groundwater was calculated based on post-closure groundwater velocity. As presented in the groundwater flow model results (**Figure 4**), the flow direction is anticipated to change post-closure. As a conservative assumption groundwater up to 100 ft upgradient (as defined based on post-closure groundwater flow direction) of HGWC-18 was assumed to be impacted by AP-2 (i.e., background groundwater would need to travel a distance of 100 ft to HGWC-18 before potentially impacted water in the model is replaced by background water).

HGWA-4 has the lowest pH among background wells and was selected as the source of background groundwater in the model. The time for background groundwater to reach HGWC-18 post-closure was calculated as described above. Calculations on simulation time frame and associated data used are presented in **Table 3**.

Source Definition and Solid Phases – Initial Conditions

As discussed in Section 2, the primary driver for Co mobilization at the Site is a localized increase in acidity and decrease in pH attributed to pyrite dissolution and proton exchange. The West source area was defined based on data collected from HGWC-18, the temporary piezometer TPZ-02, and Unnamed creek. Based on groundwater data, Co concentrations above GWPS appear to be localized to HGWC-18, with concentrations below the GWPS at TPZ-02 and the Unnamed creek. The distribution of solid phases and associated concentrations in the 1D column are presented in **Table 4**. A schematic of the solid phases in the model is presented in **Figure 5**.

Solid phases were selected based on available groundwater and solid characterization data to best match observed concentrations of pH and Co in well HGWC-18. The concentration and extent of solid phases were selected based on the results generated in the first period of the model (i.e., pre-closure). These results were compared to observed groundwater monitoring data to identify appropriate concentrations at the beginning of the model such that at the end of the first period (i.e., pre-closure period), the remaining solid phase concentrations in the model match with observed Site-specific solid characterization data. For example, the model assumes that the source of acidity is proton exchange and pyrite oxidation. As time progresses, cations in groundwater exchange for proton from the solid surface thereby depleting solid phase concentration of proton exchange surfaces. Similarly, pyrite in the aquifer is anticipated to dissolve over time and concentrations in the solid phase will reduce. As such the concentrations of proton exchange sites and pyrite were selected such that at the end of the pre-closure period of the model, the modeled pH of groundwater matches observed pH and the proton exchange

surfaces and pyrite mass remaining in the model are consistent with solid characterization data. Note that the model assumes that pyrite oxidation and proton exchange are the sole source of acidity in groundwater. Similarly, a source of cobalt was selected such that the modeled pre-closure concentrations are consistent with existing groundwater data. The remaining concentrations of solid phase species were then utilized for the second and third period in the model (i.e., closure and post-closure). The solid phase definition was therefore held constant over the duration of the model.

Four solid phases were defined for the West Area: (i) pyrite; (ii) proton exchange species; (iii) cobalt sulfide (CoS); and (iv) hydrous ferric oxide (HFO). Although pyrite was detected by x-ray diffraction (XRD) in site soils at a concentration of up to 1.3% by weight, pyrite was not detected by XRD in the soil sample collected in the vicinity of HGWC-18. However, pyrite in the vicinity of HGWC-18 was detected with electron microscopy. As such, the pyrite concentration was defined to be at the detection limit of XRD (approximately 0.1 % by volume), with a saturation index of 0. Given the importance of acidity induced by pyrite dissolution, a sensitivity analysis on the effect of pyrite concentration on groundwater pH was performed. The sensitivity of the reactive transport model to pyrite is discussed in detail in **Section 3.2.4**. A proton exchange species was defined in the model based on observed cation exchange capacity data. Note, that for the purposes of this model, the source of Co was assumed to be CoS. In reality, as presented in the GCSM Report, Co is likely associated with multiple phases including as adsorbed species on mineral surfaces. As such, CoS was used as a proxy source of Co and the equilibrium constant, and mass of CoS were selected to best match observed concentrations of Co and pH in wells HGWC-18. As additional data are collected as part of the remedy design and implementation process, the source of Co will be refined in the model as necessary. Since Co concentrations in samples from Unnamed Creek have been non-detects, a HFO surface was included between well HGWC-18 and Unnamed Creek to provide Co attenuation capacity. The mass of HFO was selected based on whole rock analysis in the vicinity of HGWC-18, and strong and weak sites of HFO were selected based on the Dzombak and Morel model (1990). As additional data are collected as part of the remedy design and implementation process, the extent of HFO will be refined in the model as necessary.

Groundwater Composition – Initial & Boundary Conditions

A summary of initial groundwater definitions in the reactive transport model are presented in **Table 5**. Groundwater chemistry data from the temporary piezometer TPZ-02 was used as the filling solution in the 1D column. Under initial conditions, groundwater from TPZ-02 is in equilibrium with the solid phases defined above. As the

model is run, groundwater from TPZ-02 flows through the column, reacting with the selected solid phases resulting in geochemical changes to the composition of water. HGWC-18 is defined at the effluent end of the column. Note that the 1D reactive transport model in PHREEQC does not include a recharge parameter and as such the effect of rainwater was not modeled.

3.2.2.2 *South Area (MW-33 and MW-35)*

1-D Model Setup

The advective-dispersive transport capabilities of PHREEQC are derived from a formulation of 1D, advective-dispersive transport presented by Appelo and Postma (1993). The 1D column is defined by a series of cells with the same pore volume. Lengths are defined for each cell and the time step provides the time necessary for a pore volume of water to move through each cell. The velocity of water in each cell is determined by the length of the cell divided by the time step.

A schematic of the 1D model for the South Area is presented in **Figure 6**. As depicted in the figure, the localized model extends from the compliance well HGWC-14 to the delineation well MW-51 with a total distance of approximately 208 ft. The 1D column also includes delineation wells MW-33, and MW-35. The 1D column consists of 8 cells, each 26 ft in length.

Simulation Settings – Duration & Closure Phasing

The model was run for a total simulation time of 100 years with distinct periods corresponding to pond status as shown on **Table 3**. The primary purpose of this approach is to select solid phase parameters such that the observed concentrations of key constituents in groundwater (e.g., Co and pH) match with measured concentrations in groundwater samples collected from MW-33, MW-35, and MW-51.

The first 50 years of the simulation correspond to pre-closure conditions where the time steps in the model (i.e., residence time in a single cell) were calculated based on pre-closure groundwater velocity in the vicinity of HGWC-14. Years 50 to 54 correspond to the closure period and the residence time in each cell was calculated assuming no change in groundwater velocity. Years 54 to 100 correspond to post-closure conditions with time steps calculated based on anticipated post-closure groundwater velocity in the vicinity of MW-33/MW-35. Post-closure groundwater velocity was obtained from the results of the groundwater flow model.

The post-closure simulation has two distinct parts: (i) background groundwater replacement; and (ii) post-closure groundwater flow. Under the background groundwater replacement part of the reactive transport model, the time for potentially impacted groundwater in the model to be replaced by unimpacted background groundwater was calculated based on post-closure groundwater velocity. As a conservative assumption, groundwater up to 1000 ft upgradient of HGWC-14 was assumed to be impacted (i.e., background unimpacted groundwater would need to travel a distance of 1000 ft to HGWC-14 before potentially impacted water in the model is replaced by background water).

HGWA-4 has the lowest pH among background wells and was conservatively selected as the source of background water in the model. The time for background water to reach HGWC-14 post-closure was calculated as described above. Calculations on simulation time frame and associated data used are presented in **Table 3**.

Source Definition and Solid Phases – Initial Conditions

As discussed in Section 2, the primary driver for Co mobilization at the Site is a localized increase in acidity and decrease in pH attributed to pyrite dissolution and proton exchange. The South source area was defined based on data collected from HGWC-14, MW-33, MW-35, and MW-51. The Co concentrations are below the GWPS at HGWC-14 but above GWPS at MW-33 and MW-35 and drop to below GWPS at MW-51. The pH of groundwater is generally at or below 5 s.u. at HGWC-14, MW-33, and MW-35 but rises to 6.1 s.u. at MW-51. The distribution of solid phases and associated concentrations in the 1D column are presented in **Table 4**. A schematic of the solid phases in the model is presented in **Figure 6**.

Solid phase minerals were selected based on available groundwater and solid characterization data to best match observed concentrations of pH and Co in wells MW-33, MW-35, and MW-51. The concentration and extent of solid phases were selected based on the results generated in the first period of the model (i.e., pre-closure). These results were compared to observed groundwater monitoring data to identify appropriate concentrations at the beginning of the model such that at the end of the first period (i.e., pre-closure period), the remaining solid phase concentrations in the model match with observed Site-specific solid characterization data. For example, the model assumes that the source of acidity is proton exchange and pyrite oxidation. As time progresses, cations in groundwater exchange for proton from the solid surface thereby depleting solid phase concentration of proton exchange surfaces. Similarly, pyrite in the aquifer is anticipated to dissolve over time and concentrations in the solid phase will reduce. As such the

concentrations of proton exchange sites and pyrite were selected such that at the end of the pre-closure period of the model, the modeled pH of groundwater matches observed pH and the proton exchange surfaces and pyrite mass remaining in the model are consistent with solid characterization data. Note that the model assumes that pyrite oxidation and proton exchange are the sole source of acidity in groundwater. Similarly, a source of cobalt was selected such that the modeled pre-closure concentrations are consistent with existing groundwater data. The remaining concentrations of solid phase species were then utilized for the second and third period in the model (i.e., closure and post-closure). The solid phase definition was therefore held constant over the duration of the model.

Five solid phases were defined based on groundwater data collected from HGWC-14, MW-33, MW-35, and MW-51. The solid phases defined were: (i) pyrite; (ii) proton exchange species; (iii) CoS as a source of Co similar to the West Area; (iii) calcite as a pH buffer in the vicinity of MW-51; and (v) HFO surface for surface complexation in the vicinity of MW-51

Similar to the West area, the concentration of pyrite was defined to be equal to the detection limit of XRD (0.1% by volume) with a saturation index of 0. Given the importance of pyrite and the acidity induced by pyrite dissolution, a sensitivity analysis of pyrite concentration on groundwater pH was performed. The sensitivity of the reactive transport model to pyrite is discussed in detail in **Section 3.2.4**. A proton exchange surface was defined in the model based on observed cation exchange capacity data. Note, that for the purposes of this model, the source of Co was assumed to be CoS. In reality, as presented in the GCSM Report, Co is likely associated with multiple phases including as adsorbed species on mineral surfaces. As such, the equilibrium constant and mass of CoS were selected to best match observed concentrations of Co and pH in wells MW-33, MW-35, and MW-51. As additional data are collected as part of the remedy design and implementation process, the source of Co will be refined in the model as necessary. HFO was defined as a reactive phase for surface complexation of Co around MW-51.

Groundwater Composition – Initial & Boundary Conditions

A summary of initial groundwater definitions in the reactive transport model are presented in **Table 5**. Groundwater chemistry data from the monitoring well HGWC-14 was used as the filling solution in the 1D column. Under initial conditions, groundwater from HGWC-14 is in equilibrium with the solid phases defined above. As the model is run, groundwater from HGWC-14 flows through the column, reacting with the selected solid phases resulting in geochemical changes to the composition of water. MW-51 was

defined at the effluent end of the column. Note that the 1D reactive transport model in PHREEQC does not include a recharge parameter and as such the effect of rainwater was not modeled.

3.2.3 Model Scenarios

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

3.2.3.1 MNA Scenario

Under the MNA scenario, the reactive transport model was run for 50 years under ambient post-closure conditions. The source of acidity and Co in groundwater was defined as described in earlier sections. Additional manipulations of groundwater gradient or geochemistry were not performed under this scenario.

3.2.3.2 Injection Scenario

Under the injection scenario, groundwater injection wells were simulated by mixing a selected injectate with the groundwater in the PHREEQC model. At a proof-of-concept level, pure sodium bicarbonate was selected as the injectate to evaluate the feasibility of this remedial approach. In the model, sodium bicarbonate is added at a concentration of 0.10 moles to amend the pH of groundwater upgradient of the wells of interest. PHREEQC was then allowed to calculate the theoretical composition of groundwater amended with sodium bicarbonate. The geochemical composition of the injectate in the model is presented in **Table 6**. Note that other potential injectates may be viable alternatives and the injectate type, composition, and location of injection wells will be evaluated as part of the remedy design and implementation process.

The model assumes that a single injection well upgradient of each well of interest will inject sodium bicarbonate into the aquifer. In practice, a network of injection wells will likely be designed and installed. Injection was assumed to achieve a steady state concentration of injectate (controlling the pH of groundwater) in the groundwater and assumed to begin as soon as closure is complete. **Figure 7** presents a schematic of the injection scenario.

Note that the primary purpose of the injection model is to assess the viability and feasibility of geochemical injections for Co remediation. As a result, the simulated injection parameters defined in the model (e.g., location of wells, injectate 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.

3.2.4 Model Results

3.2.4.1 Pre-Closure Results

Figure 8 shows the pre-closure modeled and measured results for pH and Co at monitoring well HGWC-18. The modeled concentrations over the last six years pre-closure (i.e., 2016 to 2022) were compared against measured concentrations. The pre-closure results suggest that the 1D model setup and selected initial parameters are largely consistent with observed data with a root mean square error (RMSE) in the West Area of 0.14 s.u., and 0.025 mg/L for pH and Co, respectively. Note that the RMSE of Co is lower than the Site-specific GWPS of 0.038 mg/L.

Figure 8 shows the pre-closure modeled and measured results for pH and Co at delineation wells MW-33. The modeled concentrations over the last six years pre-closure (i.e., 2016 to 2022) were compared against measured concentrations. The pre-closure results suggest that the 1D model setup and selected initial parameters are largely consistent with observed data. The RMSE at MW-33 was calculated to be 0.08 s.u., and 0.01 mg/L for pH and Co, respectively. The RMSE at well MW-35 (not shown in **Figure 8**) was calculated to be 0.83 s.u., and 0.01 mg/L for pH and Co, respectively. Note that the model marginally underestimates Co concentration at MW-33 likely due to uncertainties associated with solid phase concentrations. Note that the RMSE of Co at both wells is lower than the Site-specific GWPS of 0.038 mg/L. RMSE analysis was not performed for monitoring well MW-51 due to limited observed data.

3.2.4.2 MNA Model

Figure 9 presents time series charts of pH and Co concentration in HGWC-18 for the MNA scenario. As depicted in the figure, the pH at HGWC-18 continues to be below 5 s.u. for an extended period of time post-closure. This trend in pH can be attributed to potentially impacted water being replaced by the background groundwater in the vicinity of HGWC-18. After background groundwater replacement is complete, the pH begins to increase to background groundwater quality levels. The pH at HGWC-18 is anticipated to reach background levels approximately 15 years after the closure of AP-2. Correspondingly, the Co concentration at HGWC-18 continues to be above GWPS over

the duration of the background groundwater replacement period. After approximately 15 years following the closure of AP-2 the concentration of Co at HGWC-18 is predicted to decrease to below the GWPS. The duration to achieve GWPS is largely controlled by the anticipated low groundwater velocity post-closure.

Figure 9 presents time series charts of Co concentration in MW-33, MW-35, and MW-51 for the MNA scenario. Similar to the West Side model, the pH continues to be below 5 s.u for an extended period of time following the closure of AP-2. This trend in pH can be attributed to potentially impacted water being replaced by the background groundwater in the vicinity of MW-35. After background groundwater replacement is complete, the pH begins to increase to background groundwater quality levels. Approximately 8 years post-closure the pH at MW-33 and MW-35 is anticipated to reach background levels. Correspondingly, the Co concentration at MW-33 and MW-35 continues to be above GWPS over the duration of the background water replacement period. Approximately 8 years after the closure of AP-2 the Co concentration at MW-33 and MW-35 is predicted to decrease to below the GWPS. The duration to achieve the GWPS is largely controlled by the anticipated low groundwater velocity post-closure. Note that in the vicinity of MW-51 the solid phase concentrations were not adjusted to better match observed groundwater results (RMSE analysis not performed as indicated earlier) to avoid over-fitting the model to limited available groundwater data from MW-51. As such, MW-51 appears to show an increase in Co concentrations to above GWPS post-closure followed by a decrease. As additional groundwater monitoring data at MW-51 are collected, the solid phase concentrations in the vicinity of MW-51 may be adjusted to better match observed data.

The reactive transport model indicates that the dissolution pyrite and proton exchange caused by the interaction of impacted groundwater with the aquifer matrix can result in localized areas of high acidity that subsequently mobilizes Co from aquifer materials. As closure is completed and the source of impacts to groundwater are removed, the pH is anticipated to increase resulting in a decrease in Co concentrations to below the GWPS. The primary driver for time to achieve the GWPS is post-closure groundwater velocity. Groundwater monitoring data will continue to be evaluated following closure of AP-2, and the CSM will be refined, as necessary.

3.2.4.3 *Injection Model*

Figure 10 presents time series charts of modeled Co concentrations in HGWC-18, MW-33, and MW-35 under the injection scenario. **Figure 11** presents a comparison of modeled Co concentrations between the MNA and injection scenarios at the wells of interest.

In the West area, the injection model shows the concentration of Co at the compliance well HGWC-18 decreases to below the GWPS in less than 5 years. This proof-of-concept model shows that the injection of a buffering agent such as bicarbonate is likely to be a viable groundwater corrective measure in the West Area. The time required to achieve the GWPS is primarily driven by the location of injection wells, and concentration of buffer solution injected into the aquifer. As additional data are collected as part of remedy design and implementation, the number of injection wells, composition and selected concentration of injectate will be revised in the model, as appropriate.

In the South Area, the injection model shows that the concentration of Co at well MW-35 decreases to below the GWPS in less than 2 years of injection. This proof-of-concept model suggests that geochemical injection of a buffering agent is likely to be a viable corrective measure for the South Area. Similar to the West Area, the time required to achieve the GWPS is primarily driven by the location of injection wells, groundwater velocity, and concentration of buffer solution injected into the aquifer. As additional data are collected as part of remedy design and implementation, the number of injection wells, composition and selected concentration of injectate will be revised.

In general, the injection models show that geochemical injection is a viable remedy for accelerated Co cleanup at the Site. Injection of a buffer counteracts the acidity generated by pyrite dissolution and proton exchange. Compared to MNA, injection of sodium bicarbonate significantly accelerates the time to reduce Co concentrations to below GWPS at HGWC-18, MW-33, and MW-35 (**Figure 11**). For both the West and South Areas, the time to achieve cleanup of the Co plume is ultimately dependent on remedy design parameters such as composition and concentration of the buffering agent, and the location of the injection wells. As remedy design progresses, these design parameters will be incorporated into the model, as necessary.

3.2.5 Model Sensitivity Analysis

The dissolution of pyrite, proton exchange, and associated decrease in pH is a critical component of the model. To better assess the effect of initial pyrite and proton exchange surface concentrations on pH decrease, a sensitivity analysis was performed. **Figure 12** presents charts of pH as a function of initial pyrite and proton exchange surface concentrations over a 20-year MNA period. As presented in the figure, even if the pyrite concentration was two log orders lower than the current assumed concentration (i.e., pyrite at 0.001% by volume in the aquifer), the pH of groundwater would consistently remain below 5 s.u., resulting in the mobilization of Co from aquifer materials to groundwater. Conversely, the mass of proton exchange surface available in the aquifer

matrix appears to be a critical parameter that controls pH. As depicted in the figure, a decrease in concentration of 25% in proton exchange species on the surface of the aquifer matrix results in an appreciable change in pH. As such, data collected as part of the remedy design and implementation process will continue to be evaluated and used to refine the CSM and update this model, as necessary.

3.2.6 Model Uncertainty and Limitations

The reactive transport model was developed 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:

- The transport model was developed for post-closure conditions. Post-closure, the flow velocity, and direction are anticipated to be significantly different from current conditions. As such, the transport model could not be calibrated aside from comparing modeled concentrations to measured concentrations of Co under pre-closure conditions.
- Typically, sulfide minerals including pyrite and trace metal sulfides (e.g., CoS) are anticipated to be heterogenous in the subsurface. The distribution of these mineral phases in the model is based on available groundwater and soil characterization data. The distribution of mineral phases is a source of uncertainty and may be refined based on additional data collected as part of the remedy design process.
- CoS is assumed to be the primary source of Co in the subsurface of AP-2. Although the concentration of CoS was defined based on available data, the speciation of Co in solid materials is uncertain. Additional data collected as part of remedy design and implementation may be evaluated to refine the source of Co in the CSM and this model.
- The primary mechanism of localized acidity assumed in this model is pyrite oxidation and proton exchange with surfaces. Although oxidative dissolution of pyrite and proton exchange are consistent with available geochemical data, other mechanisms including biogeochemical reactions may contribute to acidity. As

additional data are collected as part of the remedy design process, the mechanisms for acidity may be refined in the CSM and this model, as appropriate.

- Time frames predicted in this model are based on assumptions developed using available data. As such, refinements to the CSM may affect predicted timeframes to achieve Co concentration below GWPS.
- The model and associated CSM 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 injection regime was assumed to develop a proof-of-concept injection model. The injection model assumes one injection wells in the vicinity of HGWC-18 and one injection well in the vicinity of MW-33/MW-35. In practice, the number of injection wells, location of wells, injectate composition, and injection regime will be evaluated in the design phase and selected to accelerate cleanup goals.

4.0 REACTIVE TRANSPORT MODEL CONCLUSION

4.1 Model Findings

The reactive transport modeling presented here indicates that pyrite oxidation and proton exchange could lead to naturally occurring cobalt mobilization at levels similar to those measured at the Site. The model suggests that MNA alone will likely result in concentrations of Co decreasing to below GWPS in approximately 15 years in the West Area and approximately 8 years in the South Area post-closure. Post-closure, the mechanisms causing localized acidity are anticipated to decrease resulting in a corresponding decrease in Co concentrations. The time to achieve GWPS under MNA is likely governed by the low groundwater velocity post closure, and the time taken for unimpacted background groundwater to replace potentially impacted groundwater in the vicinity of the wells of interest. In areas outside the zones of localized acidity, Co is likely to be attenuated through surface complexation to reactive surfaces such as ferrihydrite.

The reactive transport models indicate that injecting a buffer such as sodium bicarbonate is a viable remedy for reducing Co concentrations in groundwater at AP-2. The models suggest that the system responds favorably to buffer injection and Co concentrations are reduced to below GWPS within 5 years in the West Area, and within 2 years in the South Area. Injection of a buffer reduces the dissolution of Co from sulfide minerals and enhances the effectiveness of natural attenuation processes (e.g., surface complexation to ferrihydrite). The time to achieve cleanup goals is ultimately dependent on the mass of buffer supplied to the system, the source of localized acidity, and groundwater velocity post-closure. As additional data are collected as part of the remedy design and implementation, the source of acidity and optimum buffering agents, concentrations, and number of injection wells will continue to be evaluated.

Overall, this modeling study suggests that localized acidity could be caused by the dissolution of pyrite and proton exchange which could lead to the release of Co from Site soils. While MNA would require approximately 8 to 15 years to achieve GWPS at AP-2, the injection of a buffer such as sodium bicarbonate could reduce the concentration of Co in groundwater to below the GWPS in approximately 2 to 5 years.

4.2 Conclusions

This reactive transport model supports the CSM and suggests that the likely mechanism of Co mobilization to groundwater at AP-2 is the dissolution of naturally occurring sulfide minerals. The dissolution of Co bearing sulfide minerals is enhanced by localized acidity created by the oxidative dissolution of pyrite and proton exchange with surfaces in the

aquifer. The model shows that pyrite, even when present at much lower concentrations than the detection limit of XRD, could result in localized areas of high acidity with pH less than 5 s.u. even after the closure of AP-2. In areas outside of zones of localized acidity, Co is likely attenuated to reactive surfaces such as ferrihydrite.

The reactive transport model shows MNA or the injection of a buffer solution, such as sodium bicarbonate, would result in a decrease in Co concentration to below the GWPS. While MNA would likely require between 8 and 15 years to achieve GWPS in the West and South Areas, respectively, geochemical injections could achieve Co in approximately 5 years in the West Area and in approximately 2 years in the South Area. Ultimately, the time to achieve Co concentrations below GWPS is dependent on the source of localized acidity and the time required for background groundwater to replace potentially impacted groundwater following closure of AP-2. Additional data collected during the remedy design and implementation process will be evaluated to further assess the source of localized acidity at the Site. Treatability studies and pilot studies will be required prior to any injection-based remedy. These studies will provide vital information on the number of injection wells, optimum well locations, injectate composition, and injection rates required to achieve remediation objectives.

5.0 REFERENCES

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TABLES

Table 1
AP-2 Calculated Post-Closure Flow Velocities
Plant Hammond AP-2, Floyd County, Georgia

Calculated Groundwater Velocities For West Area					
Modeled Post-Closure Gradient (ft/ft)	Slug Tested Well	Slug Test Derived K (ft/d)	Effective Porosity	Groundwater Velocity (ft/d)	Mean Calculated Groundwater Velocity (ft/d)
0.008	HGWC-18	0.33	0.1	0.03	0.02
			0.15	0.02	
			0.2	0.01	
Calculated Groundwater Velocities For South Area					
Modeled Post-Closure Gradient (ft/ft)	Slug Tested Well	Slug Test Derived K (ft/d)	Effective Porosity	Groundwater Velocity (ft/d)	Mean Calculated Groundwater Velocity (ft/d)
0.0067	HGWC-14	6.59	0.2	0.22	1.64
			0.1	0.44	
			0.03	1.47	
			0.01	4.41	
0.0067	MW-33	1.97	0.2	0.07	0.49
			0.1	0.13	
			0.03	0.44	
			0.01	1.32	
0.0067	MW-51	0.23	0.2	0.01	0.06
			0.1	0.02	
			0.03	0.05	
			0.01	0.15	

Notes:

1. ft/d = feet per day.
2. K = hydraulic conductivity.
3. Modeled post-closure gradients were derived from the last stress period of updated version of the 50 year Site-wide groundwater flow model (Geosyntec, 2019a) where groundwater flow has achieved steady state.

Sources For Slug Test Derived K Values:

- A. HGWC-14 & HGWC-18: *SemiAnnual Remedy Selection & Design Progress Report. Plant Hamond Ash Pond 2. Geosyntec, August 2020.*
- B. MW-33 & MW-51: Geosyntec slug testing field event, October 2021.

Sources/Rationale For Effective Porosity:

C. Effective porosities are literature values from Domenico & Schwartz (1990). Given the heterogeneity of the alluvial subsurface beneath AP-2, a range of effective porosity values were used to calculate mean groundwater velocity. For each well, the various effective porosities selected were based on the lithologies (fine sand, sandy clay, and clay) observed in the screen interval of the well.

Table 2
AP-2 Calculated Pre-Closure Flow Velocities
Plant Hammond AP-2, Floyd County, Georgia

Calculated Groundwater Velocities For West Area					
Pre-Closure Gradient (ft/ft)	Slug Tested Well	Slug Test Derived K (ft/d)	Effective Porosity	Groundwater Velocity (ft/d)	Mean Calculated Groundwater Velocity (ft/d)
0.28	HGWC-18	0.33	0.1	0.92	0.67
			0.15	0.62	
			0.2	0.46	
Calculated Groundwater Velocities For South Area					
Pre-Closure Gradient (ft/ft)	Slug Tested Well	Slug Test Derived K (ft/d)	Effective Porosity	Groundwater Velocity (ft/d)	Mean Calculated Groundwater Velocity (ft/d)
0.026	HGWC-14	6.59	0.2	0.86	6.35
			0.1	1.71	
			0.03	5.71	
			0.01	17.13	
0.026	MW-33	1.97	0.2	0.26	1.90
			0.1	0.51	
			0.03	1.71	
			0.01	5.12	
0.026	MW-51	0.23	0.2	0.03	0.22
			0.1	0.06	
			0.03	0.20	
			0.01	0.60	

Notes:

1. ft/d = feet per day.
2. K = hydraulic conductivity.
3. Pre-closure gradients derived from water level data collected in August 2021.

Sources For Slug Test Derived K Values:

- A. HGWC-14 & HGWC-18: *Semiannual Remedy Selection & Design Progress Report. Plant Hamond Ash Pond 2. Geosyntec, August 2020.*
- B. MW-33 & MW-51: Geosyntec slug testing field event, October 2021.

Sources/Rationale For Effective Porosity:

C. Effective porosities are literature values from Domenico & Schwartz (1990). Given the heterogeneity of the alluvial subsurface beneath AP-2, a range of effective porosity values were used to calculate mean groundwater velocity. For each well, the various effective porosities selected were based on the lithologies (fine sand, sandy clay, and clay) observed in the screen interval of the well.

Table 3
1D Reactive Transport Model - Simulation Duration and Calculations
Plant Hammond AP-2, Floyd County, Georgia

Time Period (years)	Closure Condition	Groundwater Velocity (ft/day)	Notes
West Area			
0-50	Pre-Closure	0.67	Refer to Table 2
50-54	Closure in Progress	0.67	Assumes no change in velocity during closure
54-100	Post-Closure	0.02	Refer to Table 1
South Area			
0-50	Pre-Closure	1.9	Refer to Table 2; median velocity based on MW-33
50-54	Closure in Progress	1.9	Assumes no change in velocity during closure
54-100	Post-Closure	0.49	Refer to Table 1; median velocity based on MW-33
Background Water Replacement Duration Calculations - Post Closure			
Assumed Distance from Background (ft)	Groundwater Velocity (ft/day)	Time to Background Replacement (days)	Notes
West Area			
100	0.02	5000	Approximately 14 years to background groundwater replacement post closure
South Area			
1000	0.49	2041	Approximately 6 years to background groundwater replacement post closure

Notes:

1. ft/day indicates feet per day.
2. ft indicates feet.

Table 4
1D Reactive Transport Model - Aquifer Solid Phase Composition
Plant Hammond AP-2, Floyd County, Georgia

Model Area	Solid Phase	Concentration (mol/kg _{water})	Concentration (mg/kg)	Saturation Index	Rationale
West Area (HGWC-18)	HX (Proton Exchange)	1.50E-01	150	--	Approximately 15 mEq/100 gram prior to closure
	Pyrite	8.33E-03	6.06E+02	0	Pyrite concentration at XRD Detection Limit
	CoS	4.50E-04	2.00E+01	-1.55	Assumed total CoS of approximately 20 mg/Kg prior to closure
	HFO	--	3.90E+04	--	Whole rock analysis (WRA) - 100% of total Fe.
South Area (MW-33/MW-35)	Pyrite	8.33E-03	6.06E+02	0	Pyrite concentration at XRD Detection Limit
	CoS	2.90E-04	1.71E+01	-1.55	Assumed total CoS of approximately 20 mg/Kg prior to closure
	HX	1.50E-01	150	--	Approximately 15 mEq/100 gram prior to closure
	HFO	--	6.23E+04	--	Whole rock analysis (WRA) - 100% of total Fe.

Notes:

1. mol/kg_{water} indicates moles per kilogram of groundwater. mg/kg indicates milligrams per kg; mEq indicates milliequivalents
2. XRD indicates X-Ray Diffraction. WRA indicates Whole Rock Analysis.
3. Pyrite concentration calculated based on XRD detection limit of 0.1% by volume.
4. Hydrous ferric oxide (HFO) concentration based on WRA of samples in the vicinity of wells of interest.
5. Soil characterization data including XRD and WRA are presented in Appendix A of the Draft Remedy Selection Report.

Table 5
1D Reactive Transport Model - Geochemical Composition of Aqueous Phase
Plant Hammond AP-2, Floyd County, Georgia

Well	Calcium		Chloride		Sulfur, S (VI)		Cobalt		Magnesium		Manganese		Potassium		Sodium		Oxygen O(0)		pH
	mol/l	mg/L	mol/l	mg/L	mol/l	mg/L	mol/l	mg/L	mol/l	mg/L	mol/l	mg/L	mol/l	mg/L	mol/l	mg/L	mol/l	mg/L	(s.u.)
HGWC-18	9.93E-03	398	2.59E-03	91.9	1.08E-02	347	2.41E-06	0.142	1.75E-03	42.6	5.74E-05	3.2	2.62E-04	10.2	5.17E-04	11.9	1.60E-05	0.26	4.55
TPZ-02	1.07E-02	430	3.98E-03	141	1.39E-02	444	--	--	3.35E-03	81.3	7.41E-05	4.1	3.33E-04	13.0	1.07E-03	25	1.60E-05	0.26	6.75
HGWA-4	1.48E-04	5.9	6.46E-04	22.9	1.25E-05	0.40	--	--	1.08E-04	2.6	--	--	1.67E-05	0.65	7.83E-05	1.8	1.60E-05	0.26	5.28
HGWC-14	2.17E-03	87.0	1.81E-02	642	7.99E-03	256	5.60E-07	0.0330	2.02E-03	49.1	9.10E-05	5.0	3.22E-04	12.6	4.74E-04	10.9	1.60E-05	0.26	7.4

Notes:

1. mol/L indicates moles per liter, s.u indicates standard units.
2. HGWC-18 composition was used to define solid phases in the vicinity of the well of interest in the West Area model.
3. TPZ-02 composition was used to define the filling solution in the 1D column for the West Area model.
4. HGWC-14 composition was used to define the filling solution in the 1D column for the South Area model.
5. HGWA-4 was used to define the composition of background water in West Area and South Area models.

Table 6
1D Reactive Transport Model - Geochemical Composition of Injectate
Plant Hammond AP-2, Floyd County, Georgia

	Calculated Concentration										
Constituent	Bicarbonate (HCO ₃)		Sodium		Calcium		Chloride		Sulfate (SO ₄)		pH
Units	mol/L	mg/L	mol/L	mg/L	mol/L	mg/L	mol/L	mg/L	mol/L	mg/L	s.u.
West Area	9.10E-02	5553	1.00E-01	2299	1.07E-02	429	2.20E-03	78	1.38E-02	1326	7.88
South Area	8.90E-02	5431	1.00E-01	2299	1.46E-02	585	1.81E-02	642	7.90E-03	759	7.70

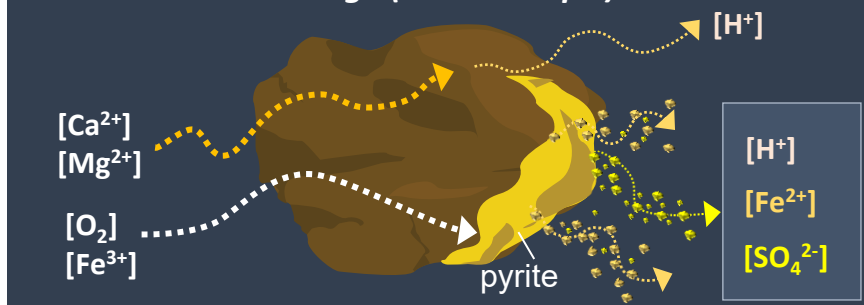
Notes:

1. mol/L indicates moles per liter, s.u. indicates standard units.
2. Equilibrium composition calculated using a batch PHREEQC model.
3. Chloride calculation calculated to achieve charge balance.
4. Concentrations presented based on output of PHREEQC simulation.
5. Only major constituents presented in Table 6.

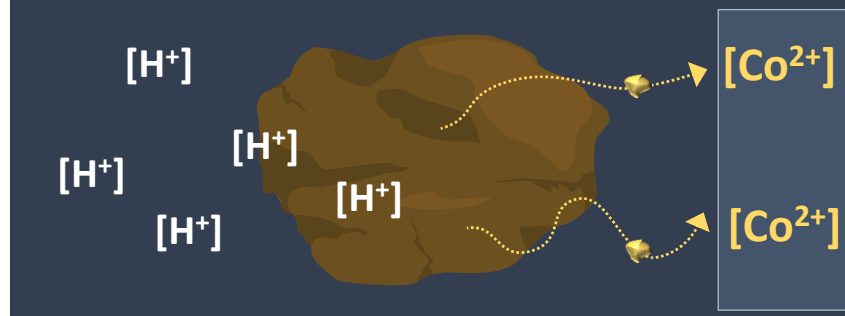
FIGURES

Cobalt Mobilization Mechanisms

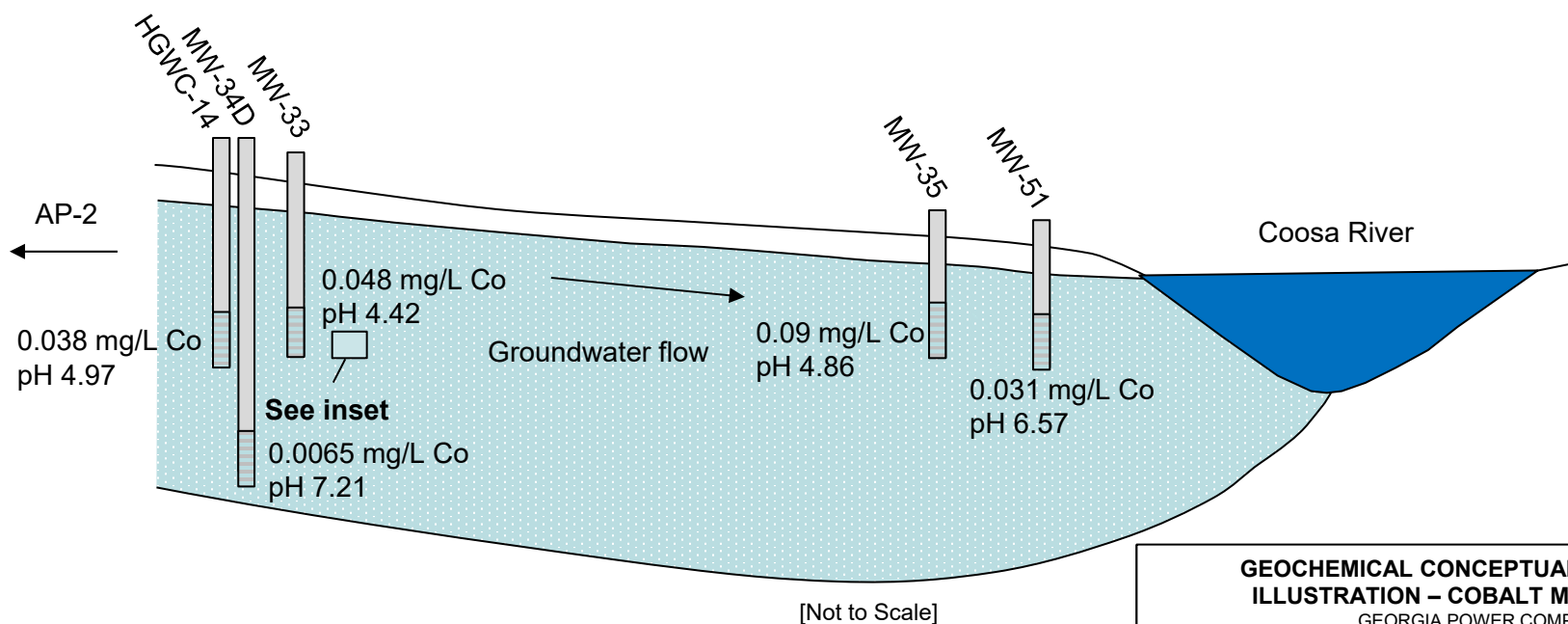
Step 1: Pyrite (FeS_2) dissolution and cation exchange (decreases pH)



Step 2: pH driven dissolution



pH driven desorption not pictured



Notes:

1. Cobalt (Co) concentrations in milligrams per liter (mg/L) and pH values in standard units (s.u.) measured in February 2022.

GEOCHEMICAL CONCEPTUAL SITE MODEL ILLUSTRATION – COBALT MOBILIZATION

GEORGIA POWER COMPANY
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Geosyntec
consultants

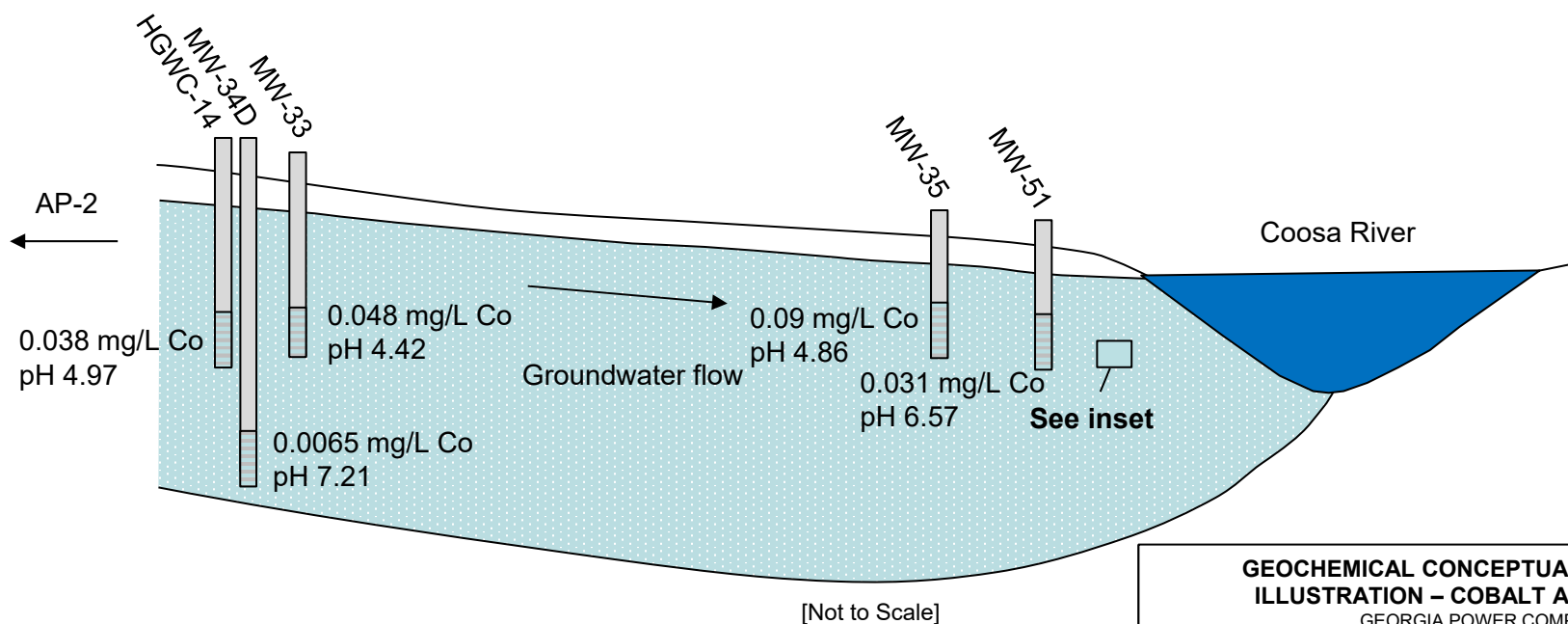
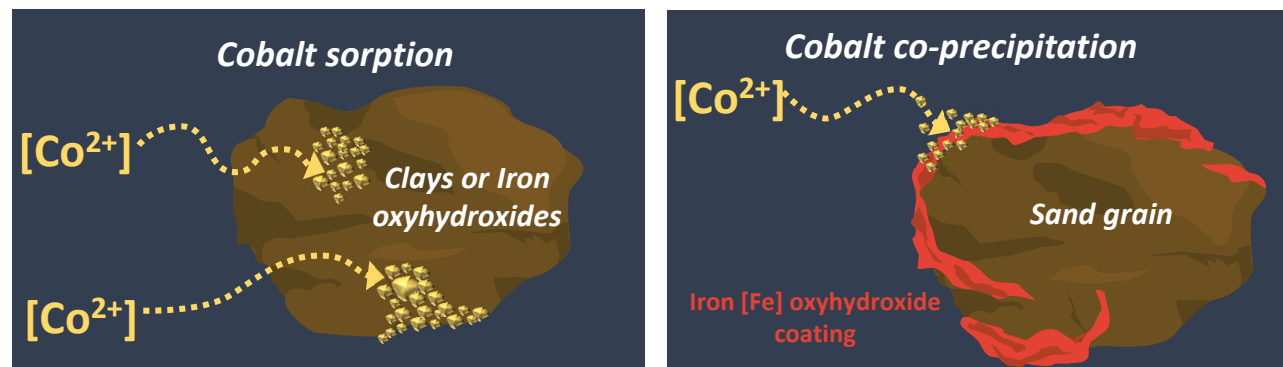
Georgia Power

FIGURE
1

KENNESAW, GA

AUGUST 2022

Cobalt Attenuation Mechanisms



Notes:

1. Cobalt (Co) concentrations in milligrams per liter (mg/L) and pH values in standard units (s.u.) measured in February 2022.

GEOCHEMICAL CONCEPTUAL SITE MODEL ILLUSTRATION – COBALT ATTENUATION

GEORGIA POWER COMPANY
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

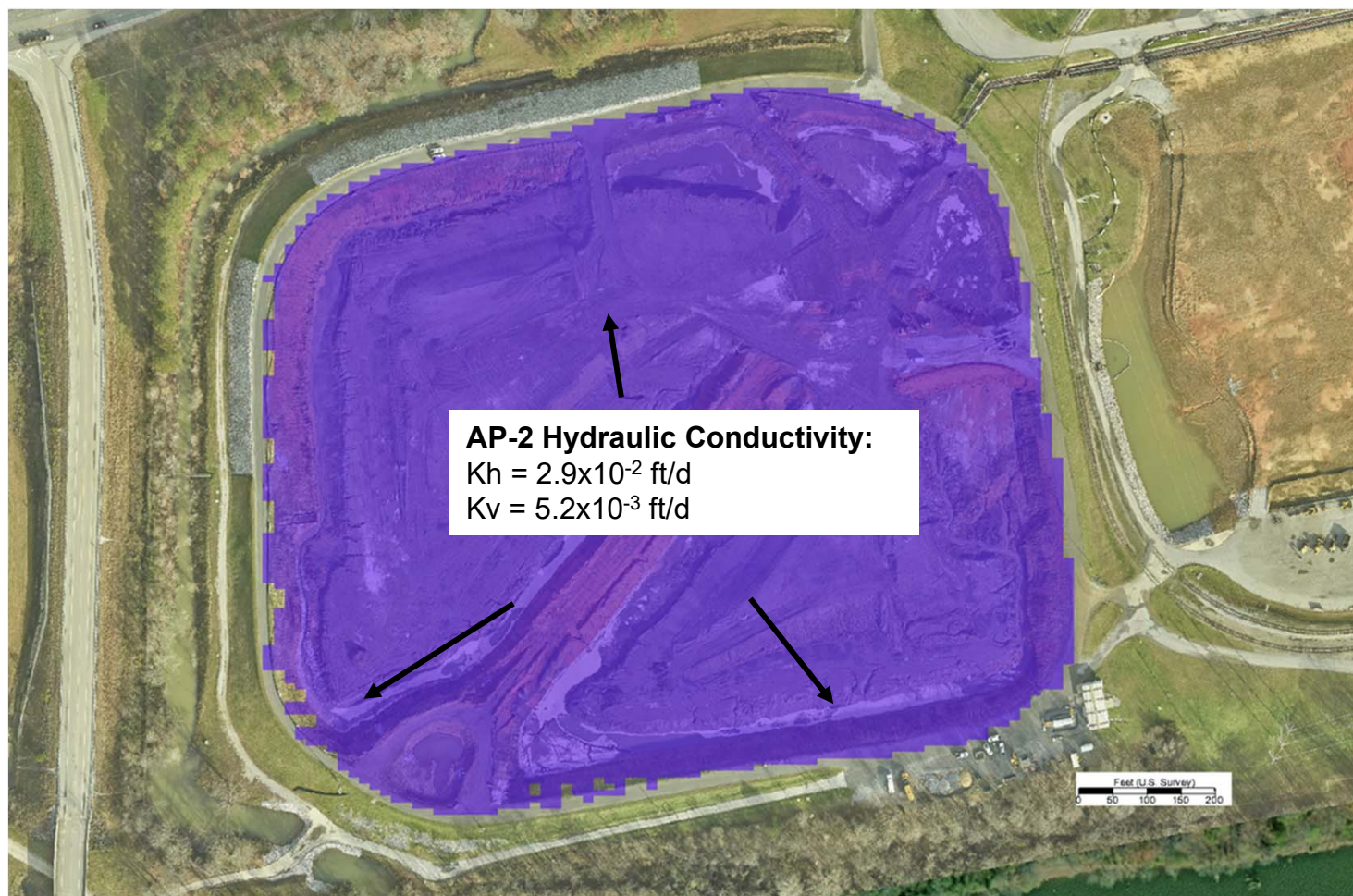
Geosyntec
consultants

 **Georgia Power**

**FIGURE
2**

KENNESAW, GA

AUGUST 2022



Notes:

1. K_h = Horizontal Hydraulic Conductivity
2. K_v = Vertical Hydraulic Conductivity
3. ft/d = feet per day.
4. Hydraulic conductivity values above represent assumed values for clean earthen fill that will be placed inside AP-2, after Coal Combustion Residuals (CCR) have been removed from AP-2.

**AP-2 POST CLOSURE SIMULATED
HYDRAULIC CONDUCTIVITY**

GEORGIA POWER COMPANY
 PLANT HAMMOND AP-2
 ROME, FLOYD COUNTY, GEORGIA

Prepared For:



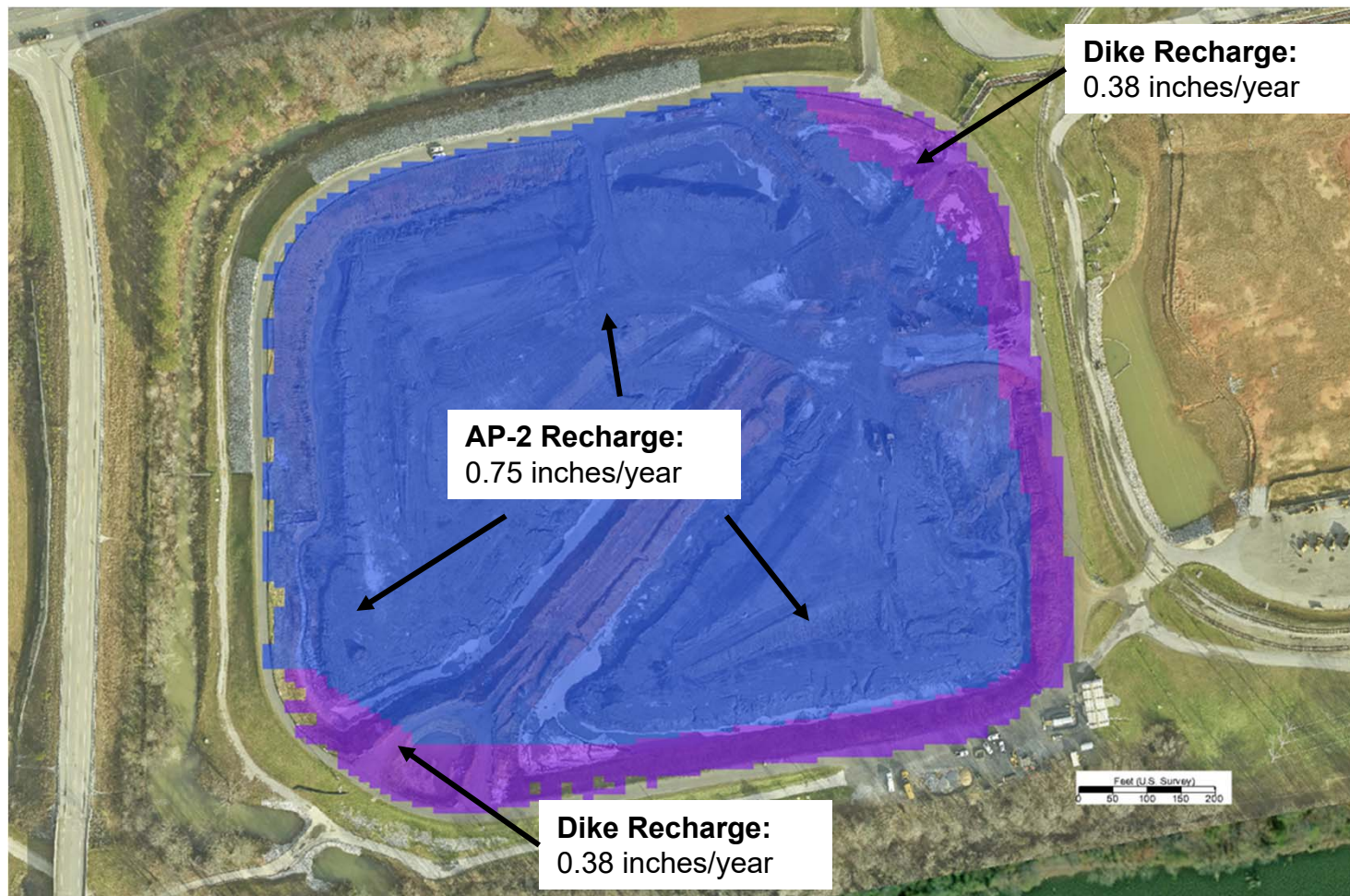
KENNESAW, GA

Prepared By:



AUGUST 2022

**Figure
3a**



AP-2 POST CLOSURE SIMULATED RECHARGE RATES

GEORGIA POWER COMPANY
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For:



KENNESAW, GA

Prepared By:



AUGUST 2022

Figure

3b

Legend

● Monitoring Well

→ Modeled Groundwater
Flow Direction

Simulated Post-Closure
Groundwater Elevation (ft)

■ 565.4 - 566.0

■ 566.1 - 568.0

■ 568.1 - 570.0

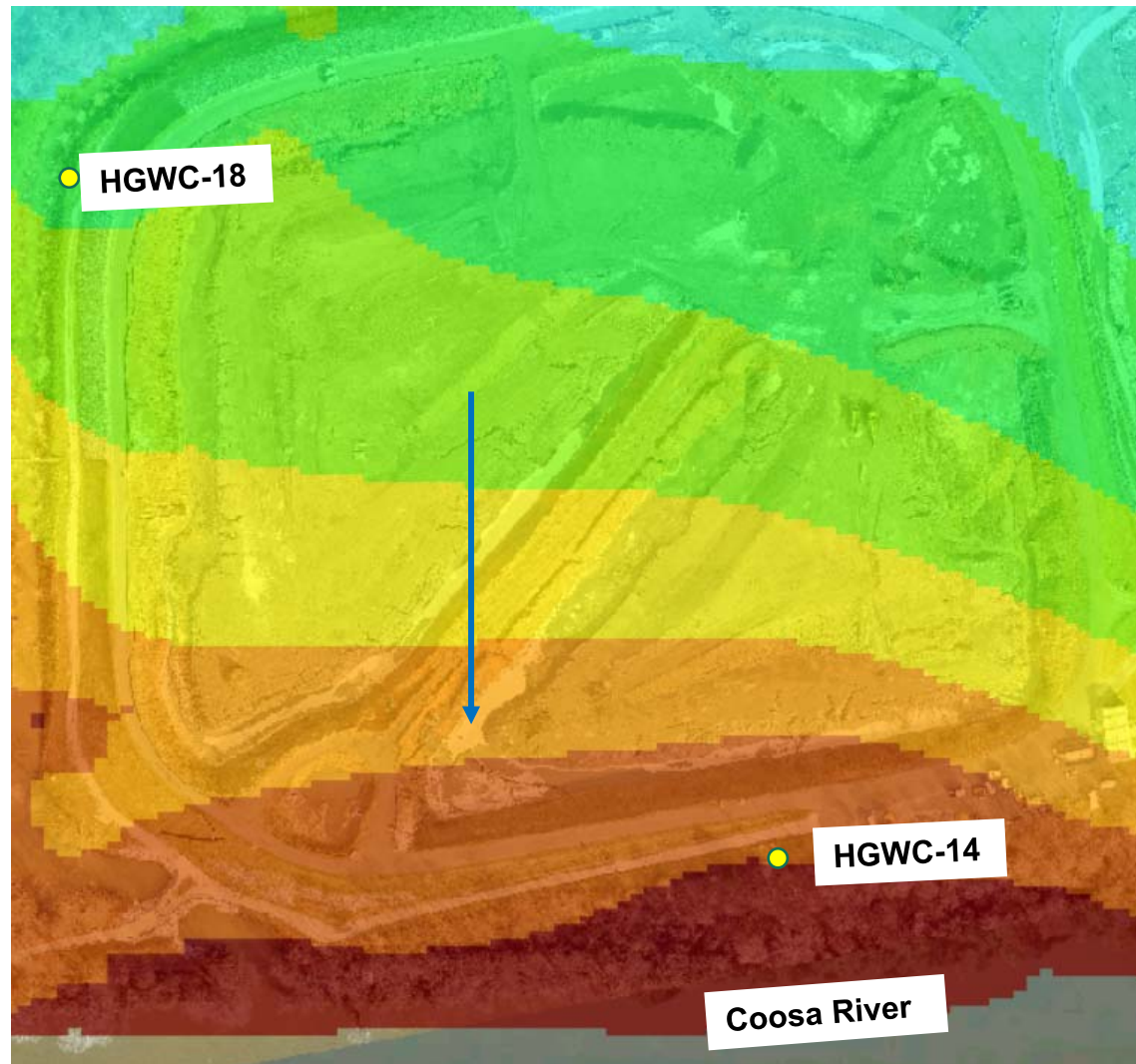
■ 570.1 - 572.0

■ 572.1 - 574.0

■ 574.1 - 576.0

■ 576.1 - 578.0

■ 578.1 - 580.0



Notes:

1. Groundwater elevation contour interval is 2ft.

AP-2 POST CLOSURE SIMULATED GROUNDWATER ELEVATIONS

GEORGIA POWER COMPANY
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For:

 Georgia Power

Prepared By:

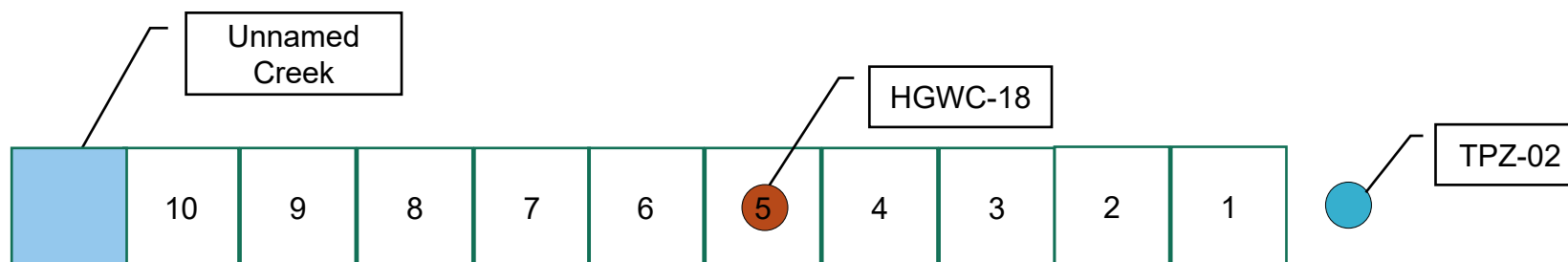
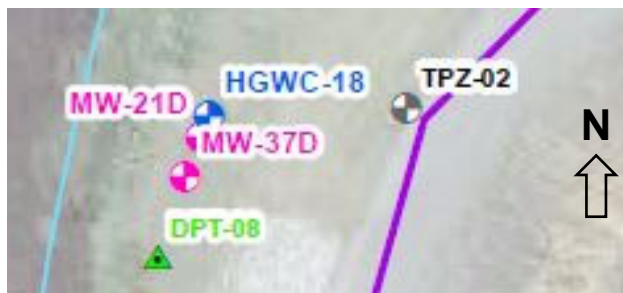
 Geosyntec
consultants

KENNESAW, GA

AUGUST 2022

Figure

4



Cells	Solid Phase	Concentration
1-5	Pyrite	6.06E+02 mg/Kg
1-5	Cobalt Sulfide	30 mg/Kg
3-5	Proton Exchange Surface	20 mEq/100 g
7	Hydrous Ferric Oxide	3.9 E+04 mg/Kg

Notes:

1. mg/Kg indicates milligrams per kilogram.
2. Cobalt Sulfide (CoS) is the assumed Co phase in the aquifer. Initial CoS concentration and equilibrium constants conservatively selected to achieve observed pre-closure Co concentrations at HGWC-18.
3. Initial pyrite concentration based on detection limit of XRD (0.1% by volume).
4. Other solid phases including quartz, and kaolinite not considered in this model.
5. Proton exchange surface concentration selected based on cation exchange capacity data. Equilibrium constants modified to match observed pre-closure pH at HGWC-18.
6. Hydrous Ferric Oxide (HFO) concentration selected based on total Fe observed in Whole Rock Analysis at DPT-08.

WEST AREA – 1D MODEL SETUP SCHEMATIC

GEORGIA POWER COMPANY
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For:



Prepared By:

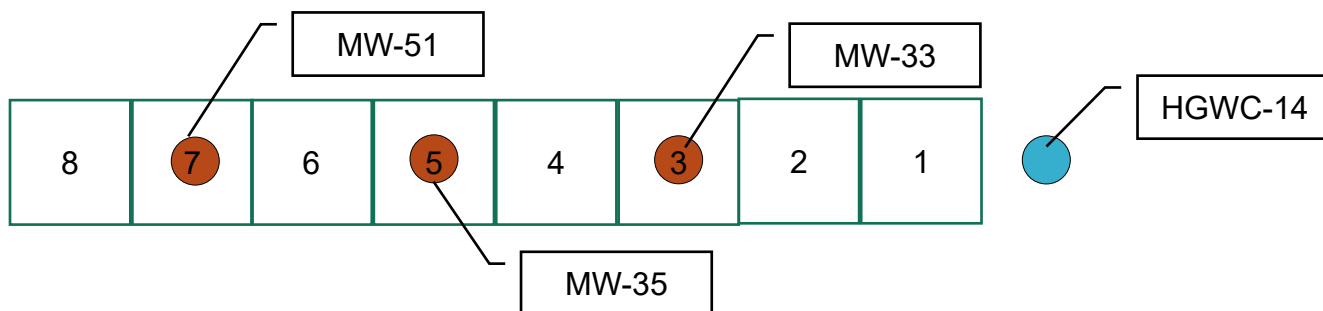
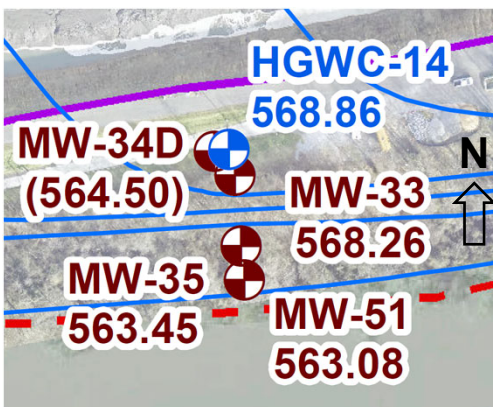


KENNESAW, GA

AUGUST 2022

FIGURE

5



Cells	Solid Phase	Concentration
1-5	Pyrite	6.06E+02 mg/Kg
1-4	Cobalt Sulfide	15 mg/Kg
1-5	Proton Exchange Surface	20 mEq/100 g
7-8	Hydrous Ferric Oxide	6.23 E+04 mg/Kg

Notes:

1. mg/Kg indicates milligrams per kilogram.
2. Cobalt Sulfide (CoS) is the assumed Co phase in the aquifer. Initial CoS concentration and equilibrium constants conservatively selected to achieve observed pre-closure Co concentrations at MW-33 and MW-35.
3. Initial pyrite concentration based on detection limit of XRD (0.1% by volume).
4. Other solid phases including quartz, and kaolinite not considered in this model.
5. Proton exchange surface concentration selected based on cation exchange capacity data. Equilibrium constants modified to match observed pre-closure pH at MW-33 and MW-35.
6. Hydrous Ferric Oxide (HFO) concentration selected based on total Fe observed in Whole Rock Analysis at DPT-11.

SOUTH AREA – 1D MODEL SETUP SCHEMATIC

GEORGIA POWER COMPANY
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For:



KENNESAW, GA

Prepared By:

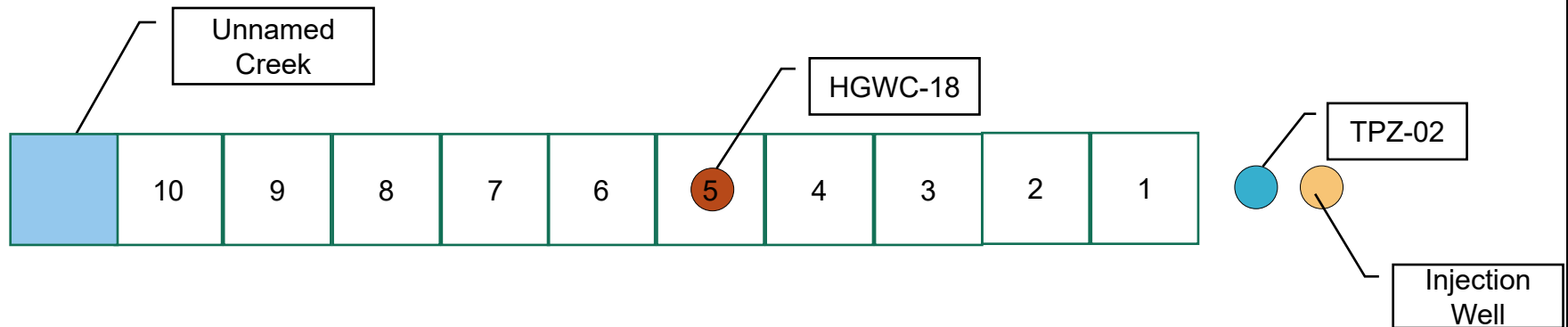


AUGUST 2022

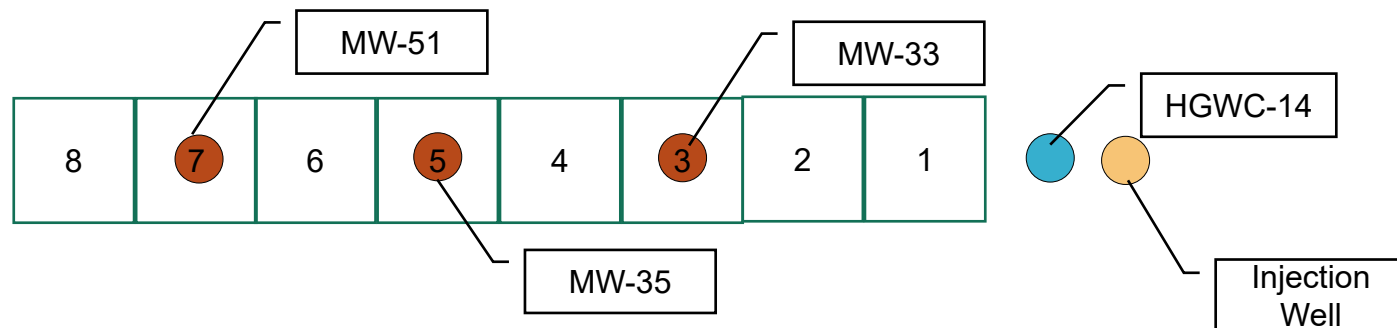
FIGURE

6

West Area



South Area



Notes:

1. Proof of concept injection model considers placement of a single injection well upgradient of wells of interest.
2. Actual number of wells and flow rates to be evaluated as part of remedy design and implementation.

1D MODEL INJECTION SETUP SCHEMATIC

GEORGIA POWER COMPANY
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For:



Prepared By:



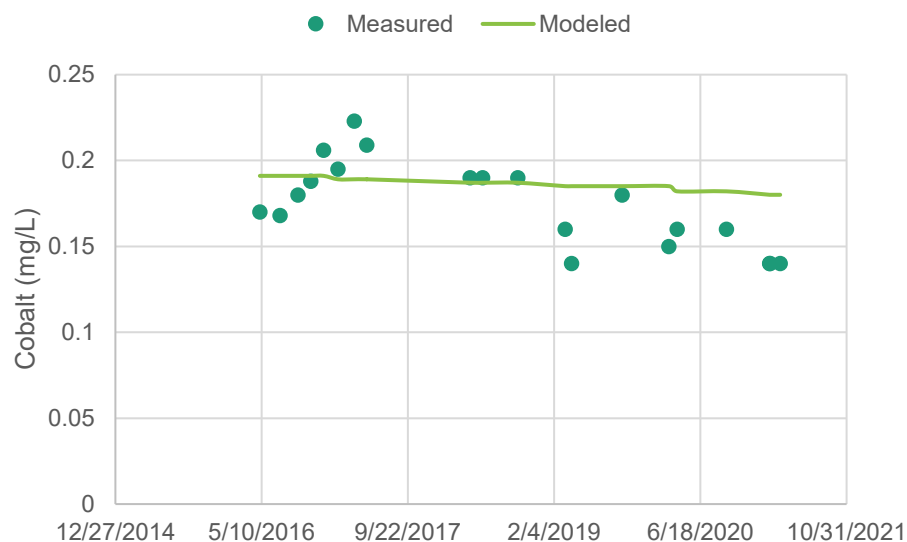
KENNESAW, GA

AUGUST 2022

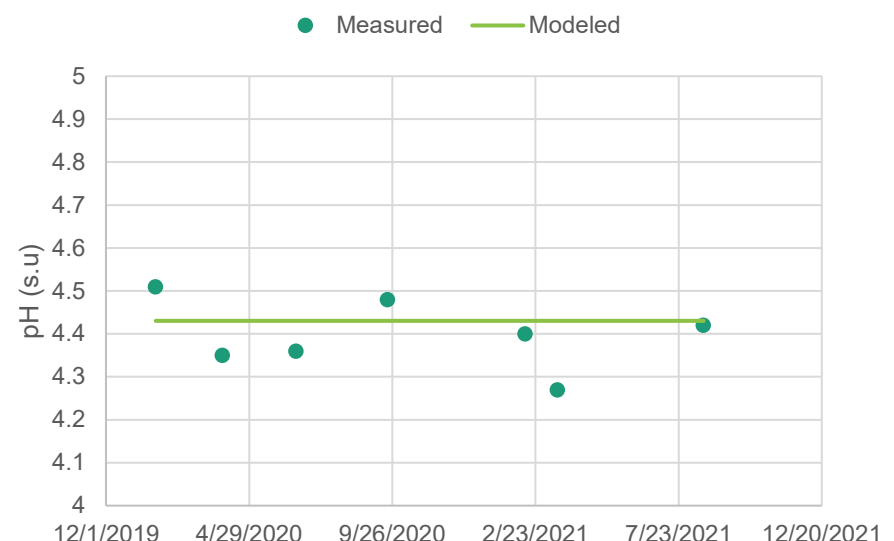
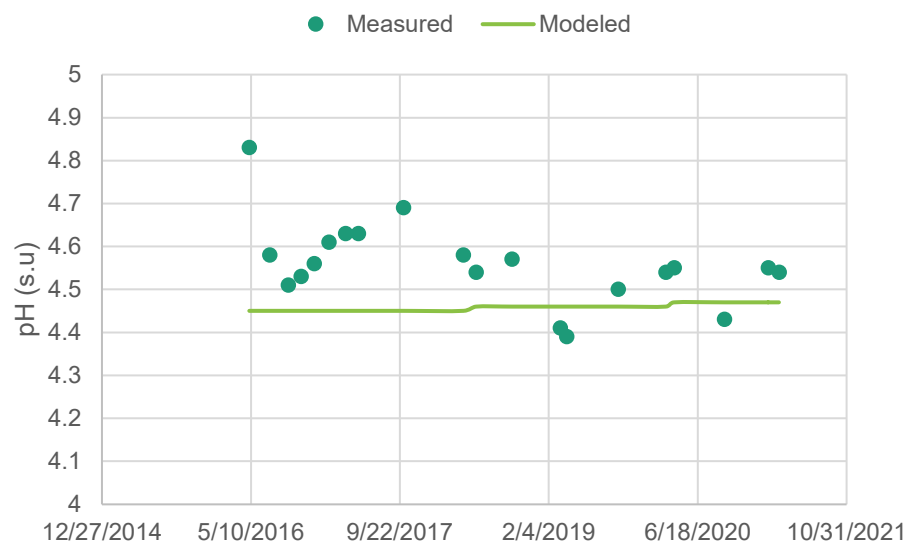
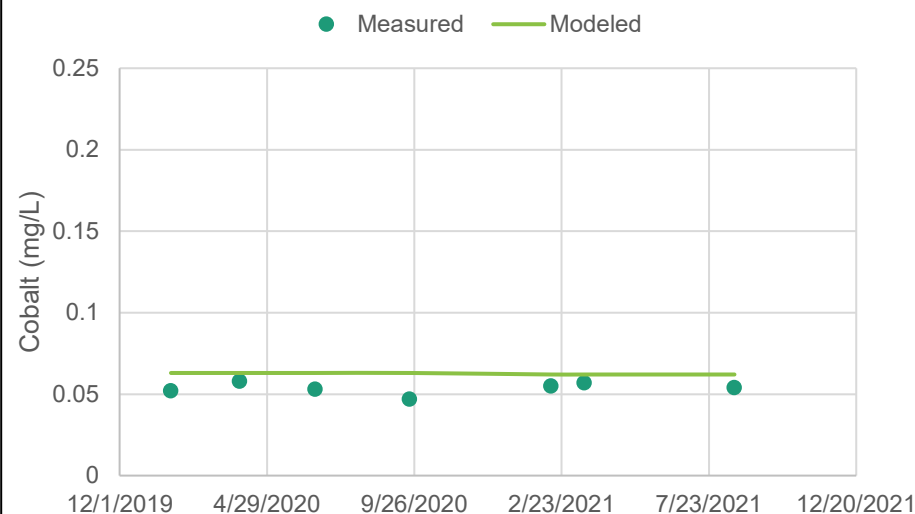
FIGURE

7

West Area – HGWC 18



South Area – MW-33



Notes:

1. GWPS indicates groundwater protection standard. Cobalt GWPS at AP-2 = 0.038 mg/L.
2. mg/L indicated milligrams per liter.
3. s.u. indicate standard units.

PREDICTED PRE-CLOSURE CONCENTRATION OF COBALT AND pH VS. TIME

GEORGIA POWER COMPANY
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For:

Prepared By:



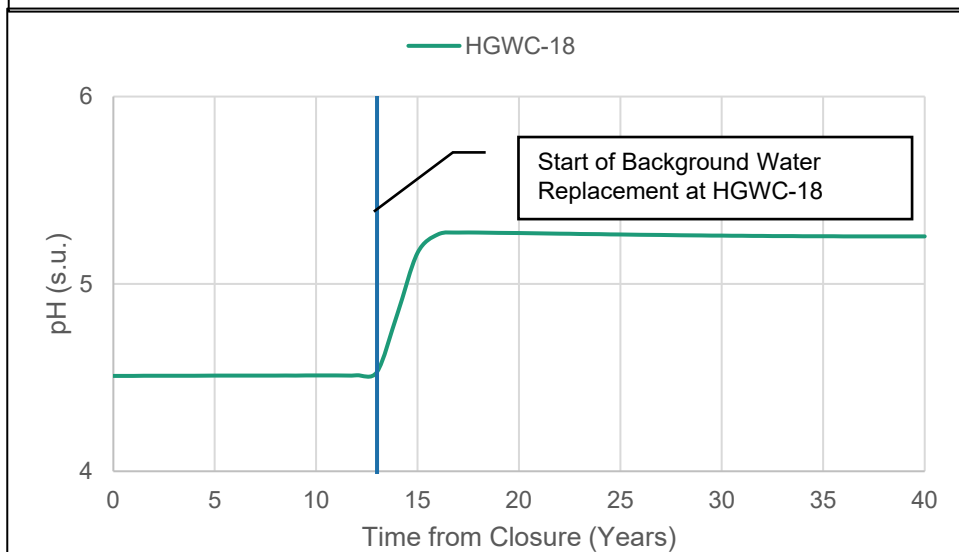
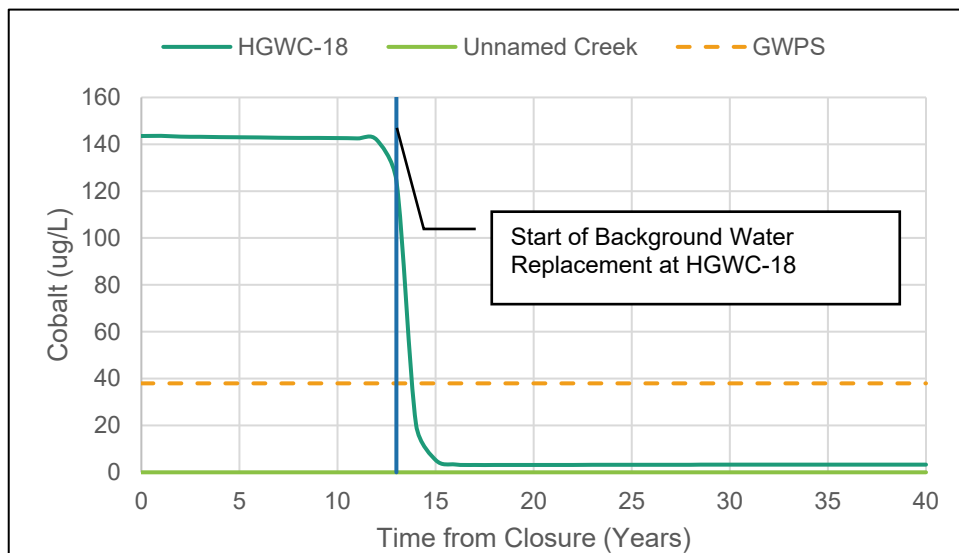
KENNESAW, GA

AUGUST 2022

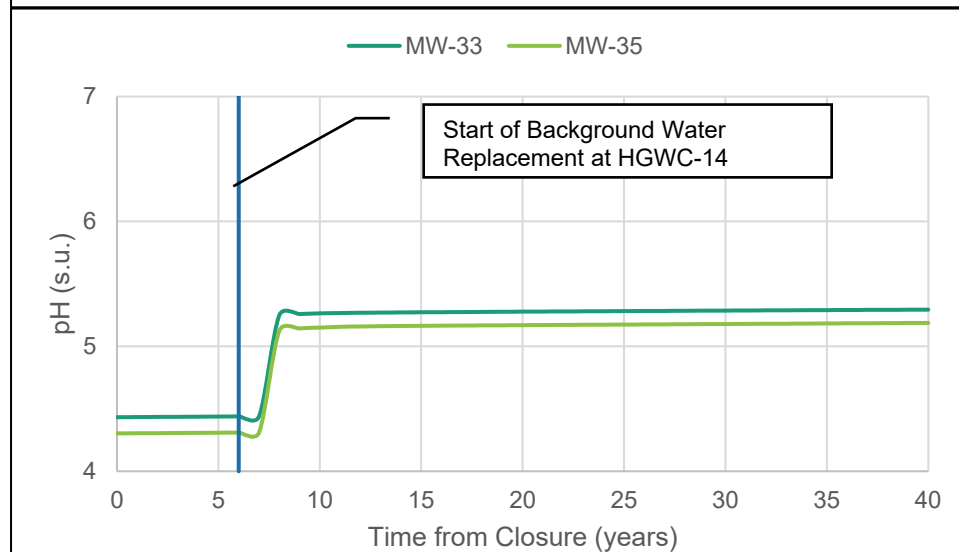
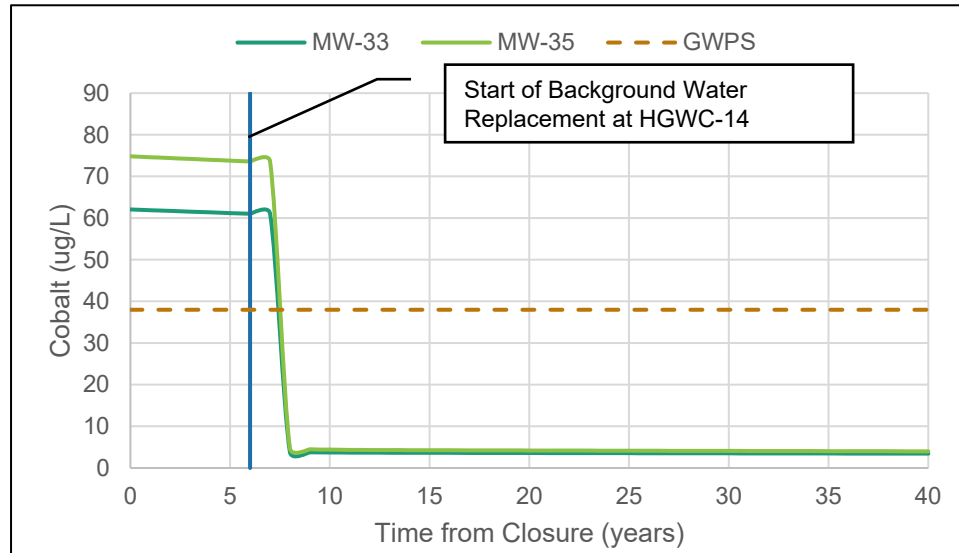
FIGURE

8

West Area



South Area



Notes:

1. GWPS indicates groundwater protection standard. Cobalt GWPS at AP-2 = 38 ug/L.
2. ug/L indicated micrograms per liter.
3. s.u. indicate standard units.
4. Time 0 indicates completion of closure.
5. In the South Area model, concentration of Co at MW-51 is marginally over estimated likely due to the conservative assumption on CoS concentration.

PREDICTED CONCENTRATION OF COBALT AND pH VS. TIME – MONITORED NATURAL ATTENUATION

GEORGIA POWER COMPANY
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For:

Prepared By:



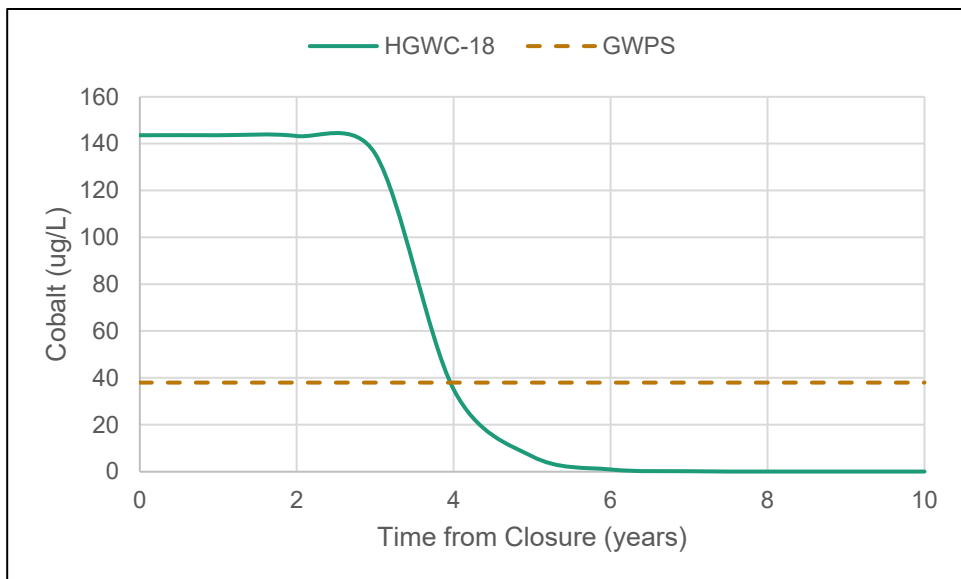
KENNESAW, GA

AUGUST 2022

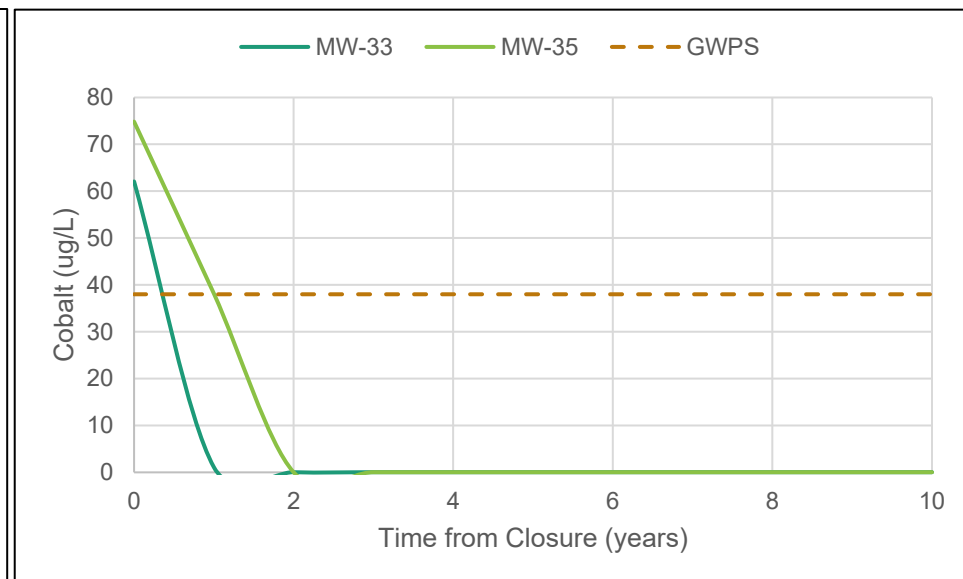
FIGURE

9

West Area



South Area



Notes:

1. GWPS indicates groundwater protection standard. Cobalt GWPS at AP-2 = 0.038 mg/L.
2. ug/L indicates micrograms per liter.
3. Model assumes injection starts at time 0 (i.e., as soon as closure is complete). Injection is continuous to amend pH of the water.

PREDICTED CONCENTRATION OF COBALT VS. TIME – GEOCHEMICAL INJECTION

GEORGIA POWER COMPANY
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For:



Prepared By:



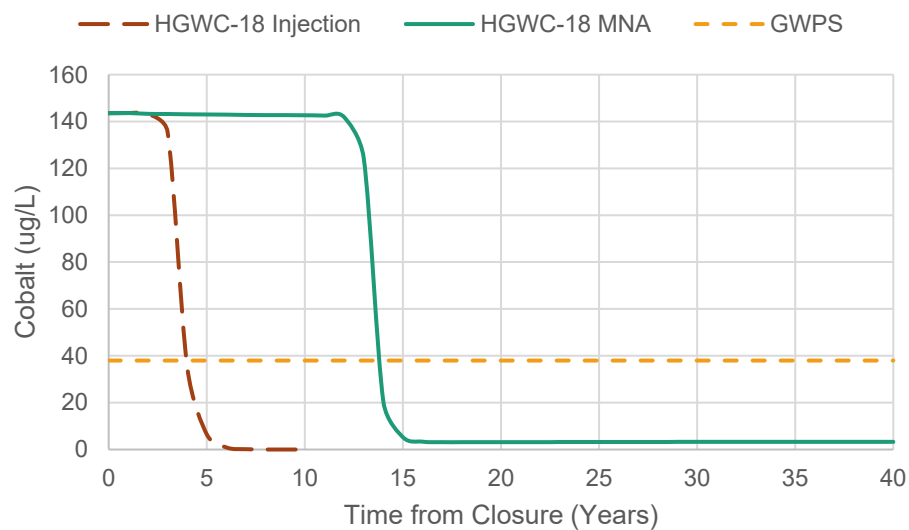
KENNESAW, GA

AUGUST 2022

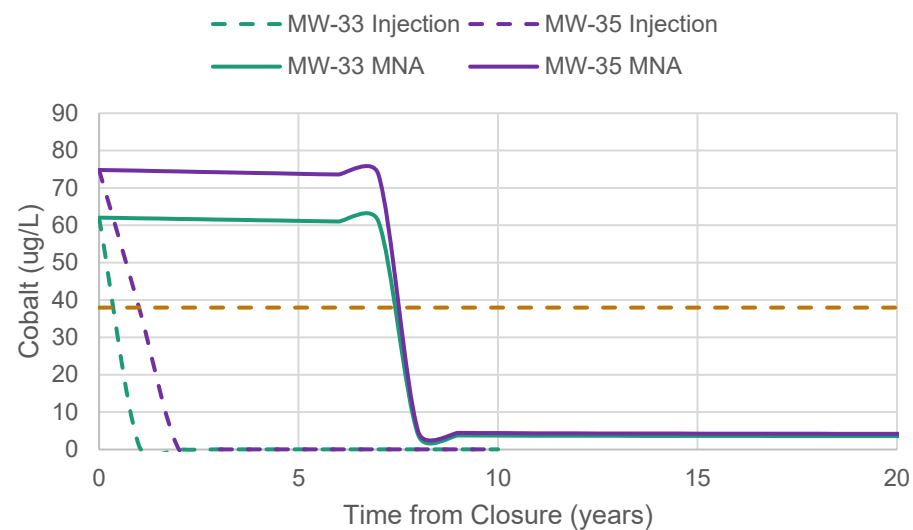
FIGURE

10

West Area



South Area



Notes:

1. GWPS indicates groundwater protection standard. Cobalt GWPS at AP-2 = 0.038 mg/L.
2. ug/L indicated micrograms per liter.
3. Injection is assumed continuous to amend pH of the water.

COMPARISON OF PREDICTED COBALT CONCENTRATIONS – MONITORED NATURAL ATTENUATION AND GEOCHEMICAL INJECTION

GEORGIA POWER COMPANY
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For:

Prepared By:



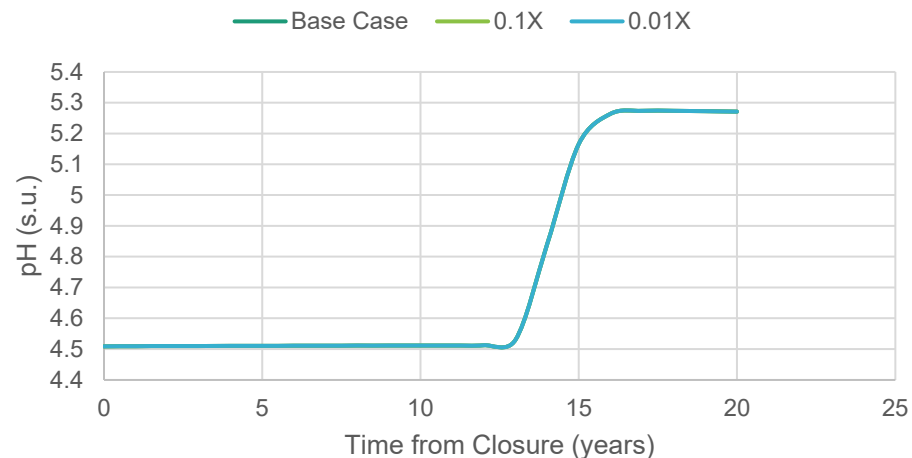
KENNESAW, GA

AUGUST 2022

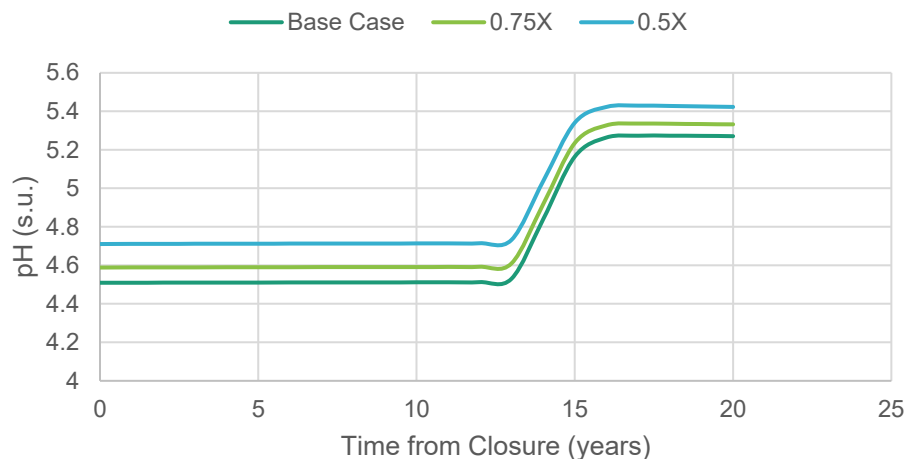
FIGURE

11

Sensitivity to Pyrite - HGWC-18



Sensitivity to Proton Exchange - HGWC-18



Notes:

1. mol/L indicates moles per liter.
2. The legend indicates the range of pyrite concentrations (in mol/L) modeled for sensitivity analysis. 8.33×10^{-2} mol/L the base case scenario (0.1% by volume of pyrite in the aquifer matrix). 0.1x and 0.01X indicate multiplier to pyrite initial concentrations. Model appears to have low sensitivity to pyrite in the range of concentrations tested.
3. s.u. indicates standard units.
4. Proton exchange base case concentration selected to achieve 20 meq/100 g of cation exchange capacity. 0.75X and 0.5X indicate multipliers to initial proton exchange surface concentration.

SENSITIVITY OF GROUNDWATER pH TO INITIAL PYRITE AND PROTON EXCHANGE SURFACE CONCENTRATIONS

GEORGIA POWER COMPANY
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For:

Prepared By:



KENNESAW, GA

AUGUST 2022

FIGURE

12

APPENDIX A

PHREEQC Model Input Files

West Area MNA

DATABASE C:\Program Files (x86)\USGS\Phreeqc Interactive 3.4.0-12927\database\minteq.v4.dat

SOLUTION 0 TPZ-02 # Filling solution under current conditions

temp 16.4
pH 6.75
pe 1.23
redox pe
units mg/kgw
density 1
C(4) 108.75 as Ca0.5(CO3)0.5
Ca 429
Cl 109 charge
Co 0.009
Fe 55
K 13
Mg 80
Mn 4
Na 24.6
O(0) 0.27
S(6) 1330
-water 1 # kg

SOLUTION 1-10 TPZ-02 # Filling solutions under current conditions

temp 16.4
pH 6.75
pe 1.23
redox pe
units mg/kgw
density 1
C(4) 108.75 as Ca0.5(CO3)0.5
Ca 429
Cl 109 charge
Co 0.0091
Fe 55
K 13
Mg 80
Mn 4
Na 24.6
S(6) 1330
O(0) 0.27
-water 1 # kg

EXCHANGE_MASTER_SPECIES

X X-

EXCHANGE_SPECIES

X- = X-

log_k 0

$\text{Ca}^{+2} + 2\text{X}^- = \text{CaX}_2$

log_k 0.66 #literature CAJ Apello 1994

$\text{Na}^+ + \text{X}^- = \text{NaX}$

log_k 0 #literature CAJ Apello 1994

K+ + X- = KX

log_k 1.1 #literature CAJ Apello 1994

H+ + X- = HX

log_k 3.95 #calibrated

END

EXCHANGE 3-5

HX 0.2 #calibrated to post-simulation value of approx 15-20 mEq per 100 g SiREM Value 10-20 mEq per 100g
-pitzer_exchange_gammas true

EQUILIBRIUM_PHASES 1

CoS(beta) -2.55 0.002 #Calibrated to post-simulation value of approx 30 mg/Kg

pyrite 0 0.008 #calibrated for pH control

Goethite -4 1 precipitate_only #calibrated for iron and pH control

EQUILIBRIUM_PHASES 2-5

CoS(beta) -2.55 0.002 #Calibrated to post-simulation value of approx 30 mg/Kg

pyrite 0 0.008 #calibrated for pH control

SURFACE 7

Hfo_sOH 0.93 600 39

Hfo_wOH 0.02

TRANSPORT

-cells 5

-shifts 1091

-time_step 1560422 # seconds

-boundary_conditions constant flux

-lengths 5*3.66

-dispersivities 5*0.1

-correct_disp true

-diffusion_coefficient 1e-09

-thermal_diffusion 2 1e-09

-print_cells 2-5

-punch_cells 2-5

-punch_frequency 20

-warnings false

SELECTED_OUTPUT

-file C:\Users\hParthasarathy\Desktop\Geochem Modeling\PHREEQC\Simple Transport Model\Final
Report Model - 07012022\Transport_Cation_18CLPeriod.sel

-high_precision true

-distance true

-time true

-step true

-pH true

-totals Ca S(6) Na Cl Co

-active true

-user_punch true

USER_PUNCH 1

-headings Ca(mg/L) SO4(mg/L) Na(mg/L) Cl(mg/L) Co(ug/L) Fe(mg/L)

-start

```

10 PUNCH TOT("Ca")*40.1*1000, TOT("S(6)")*96.1*1000, TOT("Na")*23*1000,TOT("Cl")*35.4*1000,
TOT("Co")*58.9*1000000, TOT("Fe")*56*1000
-end
END

```

TRANSPORT

```

-cells      10
-shifts     8
-time_step  54532638 # seconds
-boundary_conditions  constant flux
-lengths    10*3.66
-dispersivities  10*0.1
-correct_disp  true
-diffusion_coefficient 1e-09
-thermal_diffusion  2 1e-09
-print_cells  2-10
-punch_cells  2-10
-punch_frequency  1
-warnings     false

```

SELECTED_OUTPUT

```

-file      C:\Users\hParthasarathy\Desktop\Geochem Modeling\PHREEQC\Simple Transport Model\Final
Report Model - 07012022\Transport_Cation_18BGPeriod.sel
-high_precision  true
-distance      true
-time          true
-step          true
-pH            true
-totals        Ca S(6) Na Cl Co
-active        true
-user_punch    true

```

USER_PUNCH 1

```

-headings Ca(mg/L) SO4(mg/L) Na(mg/L) Cl(mg/L) Co(ug/L) Fe(mg/L)
-start

```

```

10 PUNCH TOT("Ca")*40.1*1000, TOT("S(6)")*96.1*1000, TOT("Na")*23*1000,TOT("Cl")*35.4*1000,
TOT("Co")*58.9*1000000, TOT("Fe")*56*1000
-end

```

END

SOLUTION 0 HGWA-4 # Filling solution under bg conditions

```

temp  16.4
pH    5.26
pe    1.23
redox  pe
units  mg/kgw
density  1
C(4)   108.75 as Ca0.5(CO3)0.5
Ca     5.4
Cl     2.4 charge
Co     0.0007
Fe     1
K      1

```

Mg 1
Mn 4
Na 2
O(0) 2 #assumed
S(6) 1
-water 1 # kg

TRANSPORT

-cells 10
-shifts 31
-time_step 54532638# seconds
-lengths 10*3.66
-dispersivities 10*0.1
-correct_disp true
-diffusion_coefficient 1e-09
-thermal_diffusion 2 1e-09
-print_cells 2-10
-punch_cells 2-10
-punch_frequency 1
-warnings false

SELECTED_OUTPUT 2

-file C:\Users\hParthasarathy\Desktop\Geochem Modeling\PHREEQC\Simple Transport Model\Final
Report Model - 07012022\Transport_Cation_18MNAPeriod.sel
-high_precision true
-distance true
-time true
-step true
-pH true
-totals Ca S(6) Na Cl Co
-active true
-user_punch true

USER_PUNCH 2

-headings Ca(mg/L) SO4(mg/L) Na(mg/L) Cl(mg/L) Co(ug/L) Fe(mg/L)
-start

10 PUNCH TOT("Ca")*40.1*1000, TOT("S(6)")*96.1*1000, TOT("Na")*23*1000,TOT("Cl")*35.4*1000,
TOT("Co")*58.9*1000000, TOT("Fe")*56*1000
-end

END

South Area MNA Model

DATABASE C:\Program Files (x86)\USGS\Phreeqc Interactive 3.4.0-12927\database\minteq.v4.dat

SOLUTION 0 HGWC-14 # Filling solution under current conditions

temp 16.4
pH 4.7
pe 1.23
redox pe
units mg/kgw
density 1
C(4) 108.75 as Ca0.5(CO3)0.5
Ca 583
Cl 141 charge
Co 0.033
Fe 0.9
K 12.6
Mg 49.2
Mn 5
Na 10.9
O(0) 0.27
S(6) 768
-water 1 # kg

SOLUTION 1-8 HGWC-14 # Filling solutions under current conditions

temp 16.4
pH 4.7
pe 1.23
redox pe
units mg/kgw
density 1
C(4) 108.75 as Ca0.5(CO3)0.5
Ca 583
Cl 141 charge
Co 0.033
Fe 0.9
K 12.6
Mg 49.2
Mn 5
Na 10.9
O(0) 0.27
S(6) 768
-water 1 # kg

EXCHANGE_MASTER_SPECIES

X X-

EXCHANGE_SPECIES

X- = X-

log_k 0

Ca+2 + 2X- = CaX2

log_k 0.66 #literature CAJ Apello 1994

Na+ + X- = NaX

```

log_k    0          #literature CAJ Apello 1994

K+ + X- = KX
log_k 1.1 #literature CAJ Apello 1994

H+ + X- = HX
log_k    3.95 #calibrated for pH control

END

EXCHANGE 1-5
  HX      0.2 #calibrated to post-simulation value of approx 10 mEq per 100 g SiREM Value 10-20 mEq per
100g
  -pitzer_exchange_gammas true

EQUILIBRIUM_PHASES 1-4
  CoS(beta) -2.55 0.001 #Calibrated to post-simulation value of approx 30 mg/Kg
  pyrite    0 0.008 #calibrated to post-simulation value of approx 12000 mg/Kg

EQUILIBRIUM_PHASES 5
  pyrite    0 0.008

SURFACE 7-8
  Hfo_sOH   2.225    600    62.3
  Hfo_wOH   0.055

TRANSPORT
  -cells      8
  -shifts     1441
  -time_step   1181541 # seconds
  -boundary_conditions constant flux
  -lengths     8*7.924
  -dispersivities 8*0.1
  -correct_disp true
  -diffusion_coefficient 1e-09
  -thermal_diffusion 2 1e-09
  -print_cells 2 3 5 8
  -punch_cells 2 3 5 8
  -punch_frequency 27
  -warnings    false

SELECTED_OUTPUT 1
  -file        C:\Users\hParthasarathy\Desktop\Geochem Modeling\PHREEQC\Simple Transport
Model\Final Report Model - 07012022\Transport_Cation_14CLPeriod.sel
  -high_precision true
  -distance     true
  -time         true
  -step         true
  -pH          true
  -totals       Ca S(6) Na Cl Co Fe
  -active       true
  -user_punch   true

USER_PUNCH 1

```

-headings Ca(mg/L) SO4(mg/L) Na(mg/L) Cl(mg/L) Co(ug/L) Fe(mg/L)
-start

10 PUNCH TOT("Ca")*40.1*1000, TOT("S(6)")*96.1*1000, TOT("Na")*23*1000,TOT("Cl")*35.4*1000,
TOT("Co")*58.9*1000000, TOT("Fe")*56*1000

-end

END

TRANSPORT #rechargeperiod

-cells 8
-shifts 42
-time_step 4581484 # seconds
-boundary_conditions constant flux
-lengths 8*7.924
-dispersivities 8*0.1
-correct_disp true
-diffusion_coefficient 1e-09
-thermal_diffusion 2 1e-09
-print_cells 2 3 5 8
-punch_cells 2 3 5 8
-punch_frequency 7
-warnings false

SELECTED_OUTPUT 1

-file C:\Users\hParthasarathy\Desktop\Geochem Modeling\PHREEQC\Simple Transport
Model\Final Report Model - 07012022\Transport_Cation_14BGPeriod.sel
-high_precision true
-distance true
-time true
-step true
-pH true
-totals Ca S(6) Na Cl Co Fe
-active true
-user_punch true

USER_PUNCH 1

-headings Ca(mg/L) SO4(mg/L) Na(mg/L) Cl(mg/L) Co(ug/L) Fe(mg/L)
-start

10 PUNCH TOT("Ca")*40.1*1000, TOT("S(6)")*96.1*1000, TOT("Na")*23*1000,TOT("Cl")*35.4*1000,
TOT("Co")*58.9*1000000, TOT("Fe")*56*1000

-end

END

SOLUTION 0 HGWA-4 # Filling solution under bg conditions

temp 16.4
pH 5.26
pe 1.23
redox pe
units mg/kgw
density 1
C(4) 108.75 as Ca0.5(CO3)0.5
Ca 5.4
Cl 2.4 charge
Co 0.0007
Fe 1

K 1
Mg 1
Mn 4
Na 2
O(0) 2 #assumed
S(6) 1
-water 1 # kg

TRANSPORT

-cells 8
-shifts 275
-time_step 4581454# seconds
-lengths 8*3.66
-dispersivities 8*0.1
-correct_disp true
-diffusion_coefficient 1e-09
-thermal_diffusion 2 1e-09
-print_cells 2 3 5 8
-punch_cells 2 3 5 8
-punch_frequency 7
-warnings false

SELECTED_OUTPUT 2

-file C:\Users\hParthasarathy\Desktop\Geochem Modeling\PHREEQC\Simple Transport Model\Final
Report Model - 07012022\Transport_Cation_14MNAPeriod.sel
-high_precision true
-distance true
-time true
-step true
-pH true
-totals Ca S(6) Na Cl Co
-active true
-user_punch true

USER_PUNCH 2

-headings Ca(mg/L) SO4(mg/L) Na(mg/L) Cl(mg/L) Co(ug/L) Fe(mg/L)
-start

10 PUNCH TOT("Ca")*40.1*1000, TOT("S(6)")*96.1*1000, TOT("Na")*23*1000, TOT("Cl")*35.4*1000,
TOT("Co")*58.9*1000000, TOT("Fe")*56*1000
-end

END

West Area Injection Model

DATABASE C:\Program Files (x86)\USGS\Phreeqc Interactive 3.4.0-12927\database\minteq.v4.dat

SOLUTION 0 TPZ-02 # Filling solution under current conditions

temp 16.4
pH 6.75
pe 1.23
redox pe
units mg/kgw
density 1
C(4) 108.75 as Ca0.5(CO3)0.5
Ca 429
Cl 109 charge
Co 0.009
Fe 55
K 13
Mg 80
Mn 4
Na 24.6
O(0) 0.27
S(6) 1330
-water 1 # kg

SOLUTION 1-10 TPZ-02 # Filling solutions under current conditions

temp 16.4
pH 6.75
pe 1.23
redox pe
units mg/kgw
density 1
C(4) 108.75 as Ca0.5(CO3)0.5
Ca 429
Cl 109 charge
Co 0.0091
Fe 55
K 13
Mg 80
Mn 4
Na 24.6
S(6) 1330
O(0) 0.27
-water 1 # kg

EXCHANGE_MASTER_SPECIES

X X-

EXCHANGE_SPECIES

X- = X-

log_k 0

$\text{Ca}^{+2} + 2\text{X}^- = \text{CaX}_2$

log_k 0.66 #literature CAJ Apello 1994

$\text{Na}^+ + \text{X}^- = \text{NaX}$

log_k 0 #literature CAJ Apello 1994

K+ + X- = KX

log_k 1.1 #literature CAJ Apello 1994

H+ + X- = HX

log_k 3.95 #calibrated

END

EXCHANGE 3-5

HX 0.2 #calibrated to post-simulation value of approx 15-20 mEq per 100 g SiREM Value 10-20 mEq per 100g
-pitzer_exchange_gammas true

EQUILIBRIUM_PHASES 1

CoS(beta) -2.55 0.002 #Calibrated to post-simulation value of approx 30 mg/Kg

pyrite 0 0.008 #calibrated for pH control

Goethite -4 1 precipitate_only #calibrated for iron and pH control

EQUILIBRIUM_PHASES 2-5

CoS(beta) -2.55 0.002 #Calibrated to post-simulation value of approx 30 mg/Kg

pyrite 0 0.008 #calibrated for pH control

SURFACE 7

Hfo_sOH 0.93 600 39

Hfo_wOH 0.02

TRANSPORT

-cells 5

-shifts 1091

-time_step 1560422 # seconds

-boundary_conditions constant flux

-lengths 5*3.66

-dispersivities 5*0.1

-correct_disp true

-diffusion_coefficient 1e-09

-thermal_diffusion 2 1e-09

-print_cells 2-5

-punch_cells 2-5

-punch_frequency 20

-warnings false

SELECTED_OUTPUT

-file C:\Users\hParthasarathy\Desktop\Geochem Modeling\PHREEQC\Simple Transport Model\Final
Report Model - 07012022\Transport_Cation_18BicCLPeriod.sel

-high_precision true

-distance true

-time true

-step true

-pH true

-totals Ca S(6) Na Cl Co

-active true

-user_punch true

USER_PUNCH 1

-headings Ca(mg/L) SO4(mg/L) Na(mg/L) Cl(mg/L) Co(ug/L) Fe(mg/L)

```

-start

10 PUNCH TOT("Ca")*40.1*1000, TOT("S(6)")*96.1*1000, TOT("Na")*23*1000,TOT("Cl")*35.4*1000,
TOT("Co")*58.9*1000000, TOT("Fe")*56*1000
-end
END

```

SOLUTION 0 TPZ-02 # Filling solution under bg conditions

```

temp    16.4
pH      6.75
pe      1.23
redox   pe
units   mg/kgw
density 1
C(4)    108.75 as Ca0.5(CO3)0.5
Ca       429
Cl      109 charge
Co      0.009
Fe       55
K        13
Mg       80
Mn        4
Na      24.6
O(0)    0.27
S(6)   1330
-water  1 # kg

```

REACTION

```

NaHCO3      1
0.1 moles

```

TRANSPORT

```

-cells      10
-shifts     31
-time_step   54532638# seconds
-lengths     10*3.66
-dispersivities 10*0.1
-correct_disp true
-diffusion_coefficient 1e-09
-thermal_diffusion 2 1e-09
-print_cells 2-10
-punch_cells 2-10
-punch_frequency 1
-warnings    false

```

SELECTED_OUTPUT 2

```

-file      C:\Users\hParthasarathy\Desktop\Geochem Modeling\PHREEQC\Simple Transport Model\Final
Report Model - 07012022\Transport_Cation_18BiCPeriod.sel
-high_precision true
-distance   true
-time       true
-step       true
-pH         true
-totals     Ca S(6) Na Cl Co
-active     true
-user_punch true

```


USER_PUNCH 2

-headings Ca(mg/L) SO4(mg/L) Na(mg/L) Cl(mg/L) Co(ug/L) Fe(mg/L)

-start

10 PUNCH TOT("Ca")*40.1*1000, TOT("S(6)")*96.1*1000, TOT("Na")*23*1000,TOT("Cl")*35.4*1000,
TOT("Co")*58.9*1000000, TOT("Fe")*56*1000

-end

END

South Area Injection Model

DATABASE C:\Program Files (x86)\USGS\Phreeqc Interactive 3.4.0-12927\database\minteq.v4.dat

SOLUTION 0 HGWC-14 # Filling solution under current conditions

temp 16.4
pH 4.7
pe 1.23
redox pe
units mg/kgw
density 1
C(4) 108.75 as Ca0.5(CO3)0.5
Ca 583
Cl 141 charge
Co 0.033
Fe 0.9
K 12.6
Mg 49.2
Mn 5
Na 10.9
O(0) 0.27
S(6) 768
-water 1 # kg

SOLUTION 1-8 HGWC-14 # Filling solutions under current conditions

temp 16.4
pH 4.7
pe 1.23
redox pe
units mg/kgw
density 1
C(4) 108.75 as Ca0.5(CO3)0.5
Ca 583
Cl 141 charge
Co 0.033
Fe 0.9
K 12.6
Mg 49.2
Mn 5
Na 10.9
O(0) 0.27
S(6) 768
-water 1 # kg

EXCHANGE_MASTER_SPECIES

X X-

EXCHANGE_SPECIES

X- = X-

log_k 0

Ca+2 + 2X- = CaX2

log_k 0.66 #literature CAJ Apello 1994

Na+ + X- = NaX

```

log_k    0          #literature CAJ Apello 1994

K+ + X- = KX
log_k 1.1 #literature CAJ Apello 1994

H+ + X- = HX
log_k    3.95 #calibrated for pH control

END

EXCHANGE 1-5
  HX      0.2 #calibrated to post-simulation value of approx 10 mEq per 100 g SiREM Value 10-20 mEq per
100g
  -pitzer_exchange_gammas true

EQUILIBRIUM_PHASES 1-4
  CoS(beta) -2.55 0.001 #Calibrated to post-simulation value of approx 30 mg/Kg
  pyrite    0 0.008 #calibrated to post-simulation value of approx 12000 mg/Kg

EQUILIBRIUM_PHASES 5
  pyrite    0 0.008

SURFACE 7-8
  Hfo_sOH   2.225    600    62.3
  Hfo_wOH   0.055

TRANSPORT
  -cells      8
  -shifts     1441
  -time_step   1181541 # seconds
  -boundary_conditions constant flux
  -lengths     8*7.924
  -dispersivities 8*0.1
  -correct_disp true
  -diffusion_coefficient 1e-09
  -thermal_diffusion 2 1e-09
  -print_cells 2 3 5 8
  -punch_cells 2 3 5 8
  -punch_frequency 27
  -warnings    false

SELECTED_OUTPUT 1
  -file        C:\Users\hParthasarathy\Desktop\Geochem Modeling\PHREEQC\Simple Transport
Model\Final Report Model - 07012022\Transport_Cation_14BicCLPeriod.sel
  -high_precision true
  -distance     true
  -time         true
  -step         true
  -pH           true
  -totals       Ca S(6) Na Cl Co Fe
  -active       true
  -user_punch   true

USER_PUNCH 1

```

-headings Ca(mg/L) SO4(mg/L) Na(mg/L) Cl(mg/L) Co(ug/L) Fe(mg/L)
-start

10 PUNCH TOT("Ca")*40.1*1000, TOT("S(6)")*96.1*1000, TOT("Na")*23*1000,TOT("Cl")*35.4*1000,
TOT("Co")*58.9*1000000, TOT("Fe")*56*1000

-end

END

SOLUTION 0 HGWC-14 # Filling solution under bg conditions

temp 16.4
pH 4.7
pe 1.23
redox pe
units mg/kgw
density 1
C(4) 108.75 as Ca0.5(CO3)0.5
Ca 583
Cl 141 charge
Co 0.033
Fe 0.9
K 12.6
Mg 49.2
Mn 5
Na 10.9
O(0) 0.27
S(6) 768
-water 1 # kg

REACTION

NaHCO3 1
0.1 moles

TRANSPORT

-cells 8
-shifts 275
-time_step 4581454# seconds
-lengths 8*3.66
-dispersivities 8*0.1
-correct_disp true
-diffusion_coefficient 1e-09
-thermal_diffusion 2 1e-09
-print_cells 2 3 5 8
-punch_cells 2 3 5 8
-punch_frequency 7
-warnings false

SELECTED_OUTPUT 2

-file C:\Users\hParthasarathy\Desktop\Geochem Modeling\PHREEQC\Simple Transport Model\Final
Report Model - 07012022\Transport_Cation_14BiCPeriod.sel
-high_precision true
-distance true
-time true
-step true
-pH true
-totals Ca S(6) Na Cl Co

-active true
-user_punch true

USER_PUNCH 2

-headings Ca(mg/L) SO4(mg/L) Na(mg/L) Cl(mg/L) Co(ug/L) Fe(mg/L)
-start

10 PUNCH TOT("Ca")*40.1*1000, TOT("S(6)")*96.1*1000, TOT("Na")*23*1000,TOT("Cl")*35.4*1000,
TOT("Co")*58.9*1000000, TOT("Fe")*56*1000
-end

END

APPENDIX C

Risk Evaluation Report

RISK EVALUATION REPORT

PLANT HAMMOND

ASH POND 2

ROME, GEORGIA

Prepared for

Georgia Power

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Atlanta, Georgia 30308

Prepared by

Geosyntec Consultants, Inc.

1255 Roberts Blvd. Suite 200
Kennesaw, GA 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
ISWQC	Georgia In-Stream Water Quality Criteria
MCL	Maximum Contaminant Level
mg/L	Milligrams per liter
NAWQC	National Ambient Water Quality Criteria
ProUCL	ProUCL software version 5.1
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-2.

AP-2 was constructed in 1969, and CCR sluicing and placement began upon its commission. AP-2 was used as a dewatering facility for fly ash and bottom ash. To support operations, dewatered ash was excavated and transported to the Huffaker Road Landfill, a permitted solid waste disposal facility owned and operated by Georgia Power and located approximately five miles northeast of Plant Hammond. Georgia Power will close AP-2 through removal of the CCR material from the unit. The CCR material will be disposed in a permitted landfill or transported off-site for beneficial use. AP-2 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. 057-024D (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-2's Closure Permit.

This report presents the results of a risk evaluation for CCR constituents¹ exhibiting statistically significant levels (SSLs) in groundwater at AP-2 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 2 (AP-2)* (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. Cobalt has been identified as an SSL-related constituent using the groundwater protection standard (GWPS) established for AP-2 in accordance with the Federal and State CCR Rules (Geosyntec, 2022a).

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-2.

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

2. Initial groundwater risk screening: Compare 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 any 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. Surface water risk screening: For constituents identified as groundwater constituents of interest (COIs), comparison of surface water concentrations to conservative, health-protective criteria to assess whether they pose a potential risk to human health or the environment as an additional line of evidence.
5. Development of risk conclusions and identification of associated uncertainties.

Using this approach that includes multiple conservative assumptions, SSL-related constituent, cobalt, identified at AP-2 is not expected to pose a risk to human health or the environment; therefore, no further risk evaluation for groundwater or surface water is warranted. Compliance monitoring for AP-2 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-2 at 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-2 is located on the west side of the site and is bounded to the west by an unnamed creek and to the south by the Coosa River. Georgia Power will close AP-2 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-2 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 closure of AP-2 with respect to constituent concentrations in groundwater identified at SSLs above 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, lead, lithium, and molybdenum 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; EPD, 2009) and components of the Risk Assessment Guidance for Superfund (RAGS) as included in the USEPA Regional Screening Level (RSL) 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-2. Cobalt was identified as an SSL-related constituent under the Federal and State CCR Rules in HGWC-18, MW-33, and MW-35 (Geosyntec, 2022a).

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, Groundwater 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 process for refined evaluation of groundwater COPIs, including calculation of exposure point concentrations (EPCs) and analysis of concentration trends over time as well as the risk screening process for those constituents evaluated for surface water in the nearest adjacent downgradient surface water bodies.
- ***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 AP-2 documents, including the *Hydrogeologic Assessment Report (HAR) (Revision 01) for Ash Pond 2* (Geosyntec, 2019), *2021 Semiannual Groundwater Monitoring & Corrective Action Report – Plant Hammond - Ash Pond 2* (Geosyntec, 2021); *2021 Annual Groundwater Monitoring & Corrective Action Report – Plant Hammond - Ash Pond 2* (Geosyntec, 2022b). The CEM includes a conservative evaluation of assumed potential transport pathways, potential 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 about 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 and a detailed site map is included as **Figure 1**.

AP-2 was constructed in 1969, and CCR sluicing and placement began upon its commission. AP-2 was used as a dewatering facility for fly ash and bottom ash. To support operations, dewatered ash was excavated and transported to the Huffaker Road Landfill, a permitted solid waste disposal facility owned and operated by Georgia Power. Georgia Power will close AP-2 through removal of the CCR material from the 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-2'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-2's Closure Permit.

As detailed in the *2022 Semiannual Groundwater Monitoring & Corrective Action Report – Plant Hammond - Ash Pond 2* (Geosyntec, 2022a), the groundwater monitoring network at AP-2 consists of 14 compliance wells for the upgradient and downgradient groundwater monitoring system at the site. Nine of these wells (HGWA-1, HGWA-2, HGWA-3, HGWA-4, HGWA-5, HGWA-6, HGWA-42D, HGWA-43D, and HGWA-44D) are designated for monitoring of background conditions upgradient of the ash ponds, five compliance wells (HGWC-14, HGWC-15, HGWC-16, HGWC-17, and HGWC-18) are intended for monitoring of conditions downgradient of AP-2, and 12 piezometers (MW-8, MW-9, MW-12, MW-16, MW-17, MW-18, MW-33, MW-34D, MW-35, MW-36D, MW-51, and MW-52) have been

installed for groundwater elevation monitoring. As part of the assessment monitoring program, four additional groundwater delineation wells (MW-21D, MW-22, MW-23D, and MW-37D) have been installed since 2018 to characterize groundwater quality and flow conditions downgradient of AP-2.

The monitoring well network for AP-2 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 southern and western 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-2 is located in the western portion of the Plant Hammond property. The area surrounding AP-2 slopes gently south towards the Coosa River and southwest towards the unnamed creek. Topographic relief across the site is approximately 30 feet (ft), with a natural topographic high at an elevation of nearly 600 ft above mean sea level (amsl) north of AP-2, and with a topographic low approximately 570 ft amsl south of AP-2 at the banks of the Coosa River (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 2* (Geosyntec, 2022b).

The Site is located in the Valley and Ridge Physiographic Province 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. Geologic mapping performed at the Site by Petrologic Solutions, Inc. under the direction of Golder (Golder, 2018) indicates that AP-2 is underlain by the lower units of the Cambrian age Conasauga Formation, consisting of mostly calcareous shale. Based on review of subsurface investigations at AP-2, the bedrock was identified as predominantly calcareous shale and fissile black shale. AP-2 is underlain primarily by five lithologic units; (i) terrace alluvium, (ii) colluvium, (iii) residuum, (iv) partially weathered shale bedrock, and (v) unweathered shale bedrock.

. . . .

The uppermost aquifer at AP-2 is a regional groundwater aquifer that occurs primarily in the residuum and within the weathered and fractured bedrock. Based on observations of residuum soil types and horizontal conductivity values, 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 fracture flow, and due to the preponderance of shale beneath AP-2, is expected to be very low permeability. The regional groundwater flow direction is expected to be from north to south; however, the local flow direction beneath AP-2 is predominantly east to west with an additional southwesterly component.

The potentiometric surface contours provided in the 2022 *Semiannual Groundwater Monitoring & Corrective Action Report – Plant Hammond - Ash Pond 2* (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**.

The unnamed creek and the Coosa River abut AP-2 to the west and south, respectively. The surface water flow direction for the unnamed creek is south where it enters the Coosa River which flows from east to west. A conservative assumption for this assessment was made that groundwater from the site flows to either the unnamed creek or the Coosa River. In addition, for the purposes of this evaluation, both the unnamed creek and the Coosa River were assumed to represent a hydraulic discharge boundary for groundwater flow in the upper aquifer from the nearby region.

2.3 Potential Exposure Pathways and Receptors

The exposure pathways for groundwater assumed to be complete for purposes of this risk evaluation 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 unnamed creek or the Coosa River, which for the purpose of this risk evaluation were assumed to represent hydraulic discharge boundaries for groundwater downgradient of AP-2.

Concentrations of the SSL-related constituent cobalt in on-site groundwater monitoring wells and piezometers was either below health-protective screening levels in wells on-site or was not detected above health-protective screening criteria in the adjacent downgradient surface water body (i.e., the unnamed creek). As a conservative measure, hypothetical off-site residential exposure to cobalt was evaluated using data collected from on-site groundwater wells between 2016 and February 2022 downgradient of AP-2. This comparison makes the conservative assumption that on-site groundwater may potentially migrate to off-site drinking water wells through advective transport in groundwater without any attenuation within the aquifer media through factors such as dilution, dispersion, or adsorption, and disregards the presence of the unnamed creek and the Coosa River which represent assumed hydraulic discharge boundaries for groundwater downgradient of AP-2. Accordingly, the risk evaluation screening assumed the hypothetical off-site residential receptor could be exposed by ingestion and

dermal contact with cobalt in groundwater through its use as a future potable water source.

- Recreational surface water receptor: The potentially complete surface water exposure pathway for hypothetical recreational receptors was addressed quantitatively through the evaluation of surface water data collected from the unnamed creek in two events in 2020 and 2021 and one event in 2022. The surface water risk evaluation conservatively assumed that hypothetical recreators' exposure included ingestion of aquatic organisms (mainly fish) and potential incidental ingestion and dermal contact with surface water by hypothetical adult and child recreational receptors.
- Ecological surface water receptors: The potential surface water exposure pathway for hypothetical ecological receptors was addressed quantitatively through the evaluation of surface water data collected from the unnamed creek in two events in 2020 and 2021 and one event in 2022. Ecological receptors were assumed to be exposed to surface water through direct contact to surface water as well as through the food chain pathway.

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 or background. 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 EPD allows for the evaluation of risk to support site-specific remedial approaches 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 of SSL-related constituents in groundwater samples from wells determined to have SSL-related constituents to appropriate health-protective screening criteria and/or background. These criteria included the risk reduction standards (RRS)² established under the Hazardous Site Response Act (HSRA) for drinking water and the site-specific background levels for the protection of human health. If the maximum concentration of an 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 assessment 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* (Geosyntec, 2022a) with SSL-related constituents identified under the Federal and State CCR Rules is as follows:

- Cobalt: HGWC-18, MW-33, and MW-35

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

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

Groundwater data used in the risk evaluation screening 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-1**. 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 are 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-2; background values are routinely updated under the program. Six monitoring wells in the certified monitoring well network are designated as upgradient (background) locations for AP-2, including HGWA-1, HGWA-2, HGWA-3, HGWA-4, HGWA-5, HGWA-6, HGWA-42D, HGWA-43D, and HGWA-44D. The statistical analyses performed on the groundwater data were described in the *2021 Annual Groundwater Monitoring & Corrective Action Report* (Geosyntec, 2022b); and text from that document is presented below.

The Sanitas groundwater statistical software was used to perform the 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 are formally tested using Tukey's box plot method and, when identified, flagged in the computer database with "o" and deselected prior to construction of 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 RRS for cobalt

evaluated under the VRP approach presented herein is consistent with the Type 2 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 industry standards and 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.
- In accordance with standard methodologies approved by the Georgia EPD and because an RRS for cobalt has not already been established under HSRA, 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. The toxicity value for cobalt used in the calculation was the USEPA-preferred value contained in the RSL Calculator (USEPA, 2022). The risk-based screening value was calculated using USEPA’s RSL Calculator assuming a target hazard quotient of 1, consistent with Georgia EPD guidance applicable in other contexts (EPD, 2018). The calculation of the risk-based screening value for cobalt is presented in **Appendix C**. As noted below, the site-specific background concentration was used for cobalt.
- If the site-specific background concentrations are greater than the criterion 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). Accordingly, in this evaluation, the background concentration was used as a screening level for cobalt.

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 or the relevant background concentration.

Table 1 presents the maximum detected concentration of cobalt (0.22 milligrams per liter (mg/L)) which was used to represent potential off-site groundwater quality for comparison to the selected background-based screening level for cobalt (0.038 mg/L), for hypothetical off-site residential receptors. As noted in **Table 1**, cobalt was detected at a concentration that

exceeded its screening level and was retained for further evaluation in the refined risk evaluation.

4 REFINED RISK EVALUATION

A refined risk evaluation was conducted for the groundwater COPI (cobalt) that was detected at concentrations that exceeded the site-specific background value. The refined risk evaluation identified EPCs for cobalt in groundwater for the purposes of characterizing potential risk to human and ecological receptors. Due to cobalt being identified as a COPI in multiple wells with different groundwater flow directions (HGWC-18 due west and MW-33 and MW-35 due south), two exposure units (West and South) were used in the refined risk evaluation. A cobalt EPC was developed for each exposure unit and if the EPC is greater than the screening level, then the constituent is identified as having the potential for risk that warrants additional evaluation (e.g., performing a surface water evaluation). Cobalt was evaluated in the adjacent downgradient surface water body (i.e., the unnamed creek) for the west exposure unit because it was identified as a groundwater COI in the refined groundwater risk evaluation.

4.1 Refined Groundwater Risk Evaluation

Potential risk associated with exposure to cobalt 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, 2015a) 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 (HGWC-18, MW-33, and MW-35) that were identified to have an 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-1**.

4.1.1 Groundwater Exposure Point Calculation

The refined risk evaluation for cobalt included the development of an EPC. 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, 2015a).

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

- UCL for the individual well with an SSL-related constituent;
- UCL 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
- UCL based on the combined data from the farthest downgradient well(s)/piezometers(s) that are hydraulically downgradient of the well(s) with an SSL-related constituent.

Other assumptions made in the calculations 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 the sole groundwater COPI, cobalt. **Appendix D-3** provides the input and output files associated with the ProUCL software.

Table 2 summarizes the groundwater EPCs selected for cobalt. 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 cobalt. 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-18, MW-33, MW-34D and MW-35 for cobalt to evaluate the trends in concentrations over time. The tests were conducted using the USEPA ProUCL 5.1 software (USEPA, 2016).

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

- There is a statistically significant decreasing trend in cobalt concentrations over time in HGWC-18.
- There are no statistical trends in cobalt concentrations over time in MW-33, MW-34D, and MW-35.

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

Cobalt was identified as a groundwater COPI in the initial risk screening. In the refined risk evaluation, comparison of the calculated EPC to the screening level was used to identify 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) in an exposure unit 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). Cobalt was identified as a groundwater COI in the west exposure unit and was further evaluated with surface water samples collected from the unnamed creek.

4.1.3.1 West Exposure Unit

Cobalt was detected in 21 out of 21 groundwater samples in well HGWC-18 at concentrations that exceeded the groundwater screening level for hypothetical off-site residential receptors. For the refined risk evaluation, the following EPCs were calculated for cobalt using the monitoring wells shown in **Appendices D-1** and **D-2a**:

- Data from HGWC-18 was used to determine if the UCL is less than the screening level (EPC Step 1 in **Appendix D-1**).
- Data from HGWC-18 and the downgradient monitoring wells MW-21D and MW-37D were combined to represent groundwater exposure in the same hydraulically downgradient direction (EPC Step 2 in **Appendix D-1**).
- A third UCL was not calculated for the cobalt exceedance in HGWC-18. There is no well between the unnamed creek and HGWC-18, and therefore, a hydraulically downgradient well could not be used to represent groundwater downgradient of the exceedance.

Both the EPC Step 1 (0.18 mg/L) and the EPC Step 2 (0.16 mg/L) exceeded the applicable screening level.

Table 3 presents the results of the refined screening comparing the EPC Step 2 to the screening level. Cobalt was identified as a COI in groundwater and is further evaluated in Section 4.2, below.

4.1.3.2 South Exposure Unit

Cobalt was detected in 14 out of 14 groundwater samples in monitoring wells MW-33 and MW-35 at concentrations that exceeded the groundwater screening level for hypothetical off-site residential receptors. For the refined risk evaluation, the following EPCs were calculated for cobalt using the monitoring wells shown in **Appendices D-1** and **D-2b**:

- Data from MW-33 and MW-35 was used to determine if the UCL is less than the screening level (EPC Step 1 in **Appendix D-1**).
- Data from MW-33 and MW-35 and the downgradient monitoring wells MW-34D and MW-51 were combined to represent groundwater exposure in the same hydraulically downgradient direction (EPC Step 2 in **Appendix D-1**).
- Data from MW-51 was used to represent exposure using the well that is the farthest hydraulically downgradient of wells MW-33 and MW-35 (EPC Step 3 in **Appendix D-1**).

The Step 1 (0.079 mg/L), Step 2 (0.065 mg/L) EPCs for cobalt exceeded the applicable screening level. However, and Step 3 (0.031 mg/L) EPC for cobalt was below the applicable screening level of 0.038 mg/L.

Table 3 presents the results of the refined screening comparing the farthest hydraulically downgradient EPC to the screening level. As cobalt was not detected above the applicable screening level in the farthest hydraulically downgradient well on the site, cobalt in the south exposure unit 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.

4.2 Surface Water Screening Evaluation

A surface water screening evaluation was conducted for samples collected from the unnamed creek for the groundwater COI cobalt, identified in the refined groundwater risk evaluation for the west exposure unit. The surface water screening process is discussed below and presented in **Figure 9**.

Both human and ecological receptors have the potential to come into contact with surface water. Routes of exposure include ingestion of aquatic organisms (mainly fish) and potential incidental ingestion and dermal contact with surface water by adult and child recreational receptors. Potential routes of exposure for ecological receptors include direct contact to surface water and ingestion by aquatic receptors.

4.2.1 Surface Water Data

Surface water data for cobalt were collected during two events in 2020 and 2021 and one event in 2022 at three locations in the unnamed creek. The surface water sample locations are shown on **Figure 10**. The surface water dataset used in the risk evaluation is presented in **Appendix B-2**.

4.2.2 Human Health Screening

The following hierarchy of sources was considered in the process of selecting the surface water human health screening value for cobalt:

- Georgia In-Stream Water Quality Criteria (ISWQC) for human health (EPD, 2015b).
- National Ambient Water Quality Criteria (NAWQC) for human health protective through ingestion of water and organisms (USEPA, 2015b). For select constituents for which no numerical values for surface water are provided, USEPA (2015b) states that “*EPA has issued an MCL [Maximum Contaminant Level] which may be more stringent*” suggesting the use of the MCL for surface water screening. This is a conservative approach.
- In accordance with standard practice using methodologies approved by the Georgia EPD, the higher of the residential groundwater screening levels described in Section 3.2.2 was used for the remaining constituents due to lack of human health surface water screening levels for these constituents, which is a conservative approach.
- Maximum detected upstream concentration if the maximum upstream surface water concentration is greater than the surface water screening value. Upstream concentrations were not used in this evaluation.

The Type 2 RRS of 0.006 mg/L was used as a surface water screening value for cobalt. It is worth noting that the site-specific use of drinking water screening levels for surface water is a conservative approach likely to overestimate risk as domestic use of the unnamed creek surface water downgradient of the site for human receptors is an incomplete exposure pathway.

Cobalt was not detected in the surface water samples from the unnamed creek and the reporting limit was below the surface water human health screening level of 0.006 mg/L as shown in

Table 4. Therefore, cobalt was not retained as a human health COPI for further evaluation in surface water and is not expected to pose a risk to human health.

4.2.3 Ecological Screening

Surface water screening values for aquatic ecological receptors were selected from the following order of hierarchy for cobalt:

- Chronic freshwater Georgia ISWQC (EPD, 2015b), when available.
- USEPA Region 4 chronic freshwater screening levels (USEPA, 2018).
- Maximum detected upstream concentration if the maximum upstream surface water concentration is greater than the surface water screening value. Upstream concentrations were not used in this evaluation.

Because cobalt does not have chronic freshwater Georgia ISWQC (EPD, 2015b), the USEPA Region 4 chronic freshwater ecological screening value of 0.019 mg/L for total cobalt (USEPA, 2018) was used in the surface water screening for aquatic ecological receptors.

Cobalt was not detected in the surface water samples from the unnamed creek and the reporting limit was below the surface water ecological screening level of 0.019 mg/L as shown in **Table 5**. Therefore, cobalt was not retained as an ecological COPI for further evaluation in surface water and is not expected to pose a risk to ecological receptors.

4.2.4 Refined Risk Evaluation Summary and Conclusions

Detections of cobalt were reported at concentrations above the corresponding groundwater screening value. However, the results of the refined groundwater and surface water risk evaluations indicate the following:

- The individual data points in the south exposure unit used to calculate the cobalt EPC to represent potential groundwater exposure for hypothetical off-site residential receptors based on the farthest hydrologically downgradient monitoring well were below the background screening level.
- Cobalt was identified as a groundwater COI for hypothetical off-site residential receptors in the west exposure unit and was evaluated further in adjacent surface water in the unnamed creek for potential exposure to human and ecological receptors.
- Cobalt was not detected in surface water samples from the unnamed creek and the analytical reporting limits were below health-protective surface water screening criteria for human and ecological receptors. Therefore, cobalt was not retained as a COPI in

surface water for further evaluation and is not expected to pose a risk to human or ecological receptors.

Accordingly, based on the multiple lines of evidence and various conservative assumptions, further risk evaluation for groundwater and surface water 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, a background-based value equivalent to a Type 2 RRS was considered as a screening criterion for cobalt. Selection of the screening criteria is considered appropriate for risk quantification for AP-2. Georgia EPD 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”.
- Screening criteria based on RRSs represent the reasonable maximum exposure (RME), which are the highest exposures that are reasonably expected to occur at a site. The USEPA risk assessment guidance defines the RME 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). The same guidance document 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 cobalt were compared to background-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 and used in the screening process, 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-2. 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 the site was conducted by NewFields in 2020 and updated in January of 2022 which 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 SSL-related constituents are either delineated in on-site groundwater or below health-protective screening levels in adjacent surface water.

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. For metals, humans, other animals, and plants have evolved in the presence of metals and are adapted to various levels of exposure (EPA, 2007). Therefore, a screening level exceedance does not necessarily equate to an adverse effect.

6 CONCLUSIONS

This risk evaluation for the SSL-related constituents in groundwater at AP-2 was conducted using methods consistent with Georgia EPD and USEPA guidance and included multiple conservative assumptions. Based on this evaluation, the SSL-related constituent cobalt is not expected to pose a risk to human health or the environment.

Accordingly, no further risk evaluation of groundwater or surface water is warranted. Compliance monitoring for AP-2 under the Federal and State CCR Rules will continue. Georgia Power will proactively evaluate the data and update this evaluation, if necessary

7 REFERENCES

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TABLES

Table 1
SSL-Related Constituent Groundwater Screening
Plant Hammond AP-2 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	Cobalt	7440-48-4	35 / 35	30 / 35	0.22	0.038	Background	0.038	Y	ASL

Notes:

[1] Evaluation includes 2016 to February 2022 groundwater analytical data from wells HGWC-18, MW-33, and MW-35.

[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 for cobalt were calculated as described in the document "*Statistical Analysis Method Certification, 40 CFR §257.93(f), Plant Hammond- Ash Pond 2 (AP-2)*" (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-2 Risk Evaluation Report
Plant Hammond, Rome, GA

CCR Rule Designation	Constituent	CAS No.	Exposure Unit	Detection Frequency ^[1]	Maximum Concentration (mg/L)	Wells Included in 95% UCL Calculation	95% UCL ^[1] (mg/L)	Recommended UCL Method	Selected EPC (mg/L)
Appendix IV	Cobalt	7440-48-4	West	24 / 38	0.22	HGWC-18, MW-21D, and MW-37D	0.16	95% KM (Chebyshev) UCL	0.16
	Cobalt	7440-48-4	South	20 / 20	0.1	MW-33, MW-35, MW-35D, and MW-51	0.031	Maximum	0.031

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.

Definitions:

CAS = Chemical Abstract Service

CCR = Coal Combustion Residuals

COPI = Constituent of Potential Interest

EPA = United States Environmental Protection Agency

mg/L = milligrams per liter

Table 3
Downgradient Groundwater Refined Evaluation
Plant Hammond AP-2 Risk Evaluation Report
Plant Hammond, Rome, GA

CCR Rule Designation	Constituent	CAS No.	Exposure Unit	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	Cobalt	7440-48-4	West	24 / 38	21 / 38	0.16	0.038	Background	0.038	Y	ASL
	Cobalt	7440-48-4	South	20 / 20	14 / 20	0.031	0.038	Background	0.038	N	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 2 (AP-2)*" (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:

Grey shading indicates that the constituent is a COI in groundwater

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

Table 4
Surface Water Human Health Screening
Plant Hammond AP-2 Risk Evaluation Report
Plant Hammond, Rome, GA

CCR Rule Designation	Constituents	CAS No.	Detection Frequency ^[1]	Exceedance Frequency ^[2]	Maximum Concentration ^[3] (mg/L)	Screening Level ^[4] (mg/L)	Screening Level Source ^[4]	Site-Specific Background ^[5] (mg/L)	COP? (Y/N)	Rationale ^[6]
Appendix IV	Cobalt	7440-48-4	0 / 10	0 / 10	<0.005	0.006	Type 2 RRS	<0.005	N	ND/BSL

Notes:

[1] Evaluation includes surface water analytical data from the unnamed creek (AP-Up, AP-2 Mid and AP-2 Down).

[2] Selected exceedance frequency is for the specific constituent that exceeds the screening level presented in the table.

[3] Maximum detected concentration of total (unfiltered) results. Selected screening levels for COPs are applicable to total results; therefore, no total-to-dissolved conversion was necessary for this evaluation.

[4] Screening levels were selected from the sources listed below, in the order of preference in which they are listed. If site-specific surface water background concentrations are greater than other applicable screening values, the site-specific background value is used for screening.

1. GA ISWQC = Georgia Instream Water Quality Criteria
2. NRWQC = National Recommended Water Quality Criteria
3. The maximum drinking water screening values from the following sources:
 - Type 1 RRS for drinking water listed in HSRA Appendix III, Table 1 (HSRA-regulated substances only).
 - Type 2 RRS for drinking water that are calculated by the EPA RSL calculator with exposure factors inputs from HSRA Appendix III.
 - Site-Specific values calculated using the EPA Regional Screening Level (RSL) calculator with default residential exposure factor listed in the RSL Users Guide.
 - EPA Maximum Contaminant Levels (MCLs).

[5] The site-specific background value is either the maximum detected concentration or maximum reporting limit in the unnamed creek upstream sample (AP-2 UP) collected in July 2020.

[6] Rationale for classification of constituent as a COP or exclusion as a COP:

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

COP = Constituent of Potential 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

ND = not detected

RRS = [GA EPD] Risk Reduction Standard

Table 5
Freshwater Surface Water Ecological Screening
Plant Hammond AP-2 Risk Evaluation Report
Plant Hammond, Rome, GA

CCR Rule Designation	Constituents	CAS No.	Detection Frequency ^[1]	Exceedance Frequency ^[2]	Maximum Concentration ^[3] (mg/L)	Screening Level ^[4]		Hardness Dependent? (Y/N)	Screening Level Source ^[4]	Site-Specific Background ^[5] (mg/L)	COP? (Y/N)	Rationale ^[6]
						Total (mg/L)	Dissolved (mg/L)					
Appendix IV	Cobalt	7440-48-4	0 / 10	0 / 10	<0.005	0.019	--	N	EPA Reg. 4	<0.005	N	ND/BSL

Notes:

[1] Evaluation includes surface water analytical data from the unnamed creek (AP-Up, AP-2 Mid and AP-2 Down).

[2] Selected exceedance frequency is for the specific constituent that exceeds the screening level presented in the table.

[3] Maximum detected concentration of total (unfiltered) results. Selected screening levels for COPs are applicable to total results; therefore, no total-to-dissolved conversion was necessary for this evaluation.

[4] Screening levels were selected from the sources listed below, in the order of preference in which they are listed. If site-specific surface water background concentrations are greater than other applicable screening values, the site-specific background value is used for screening.

1. Georgia Instream Water Quality Criteria (GA ISWQC) from GA Administrative Code 391-3-6-.0 (5)(e)(iii).

2. EPA Region 4 screening values are from Table 1a of the Region 4 Ecological Risk Assessment Supplemental Guidance (EPA, 2018).

[5] The site-specific background value is either the maximum detected concentration or maximum reporting limit in the unnamed creek upstream sample (AP-2 UP) collected in July 2020.

[6] Rationale for classification of constituent as a COP or exclusion as a COP:

ASL = Above respective screening level

BSL = Below respective screening level

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

Definitions:

-- = Not applicable

CAS = Chemical Abstract Service

CCR = Coal Combustion Residuals

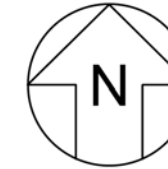
COP = Constituent of Potential Interest

EPA = United States Environmental Protection Agency

mg/L = milligram(s) per liter

FIGURES

N:\GA Power\CCR Risk Evaluations\GIS\Hammond\MDAP2\202208\Figure 1_SiteMap.mxd 7/8/2022 8:56:29 AM



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



SITE LOCATION MAP

GEORGIA POWER
PLANT HAMMOND AP-2
FLOYD COUNTY, GEORGIA

Prepared For:  Georgia Power

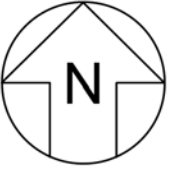
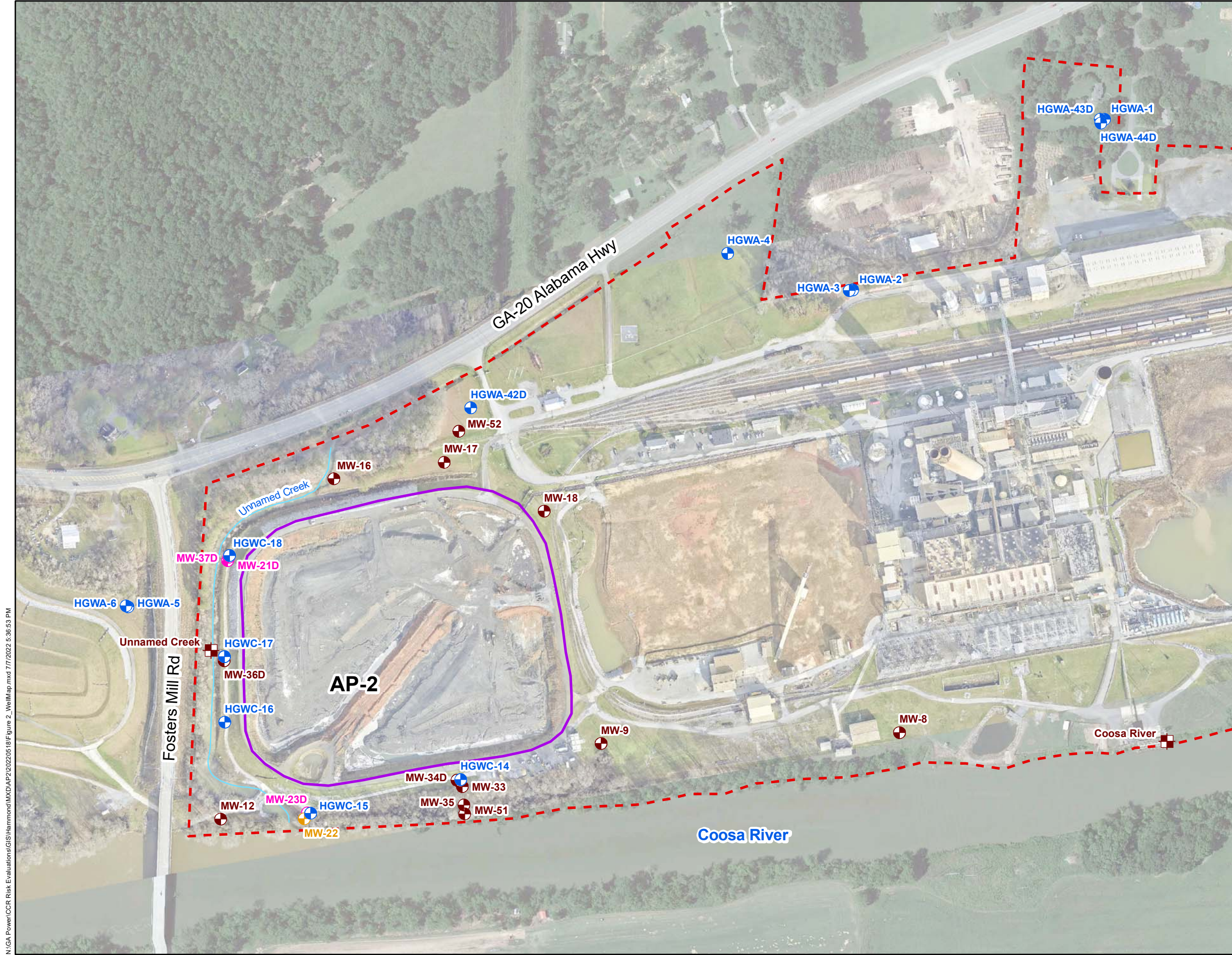
Prepared By: 

KENNESAW, GA

AUGUST 2022

FIGURE
1

N:\GA Power\CCR Risk Evaluations\GIS\Hammond\MDAP20220518\Figure 2_WellMap.mxd 7/7/2022 5:36:53 PM



- LEGEND**
- Compliance Monitoring Well
 - Horizontal Delineation Well
 - Vertical Delineation Well
 - Piezometer
 - Surface Water Level Gauge Point
 - Unnamed Creek
 - Approximate AP-2 Boundary
 - Plant Hammond Property Boundary



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

0 175 350 700
Feet

**SITE LAYOUT AND
MONITORING WELL NETWORK**

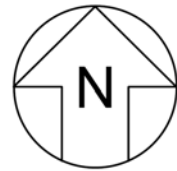
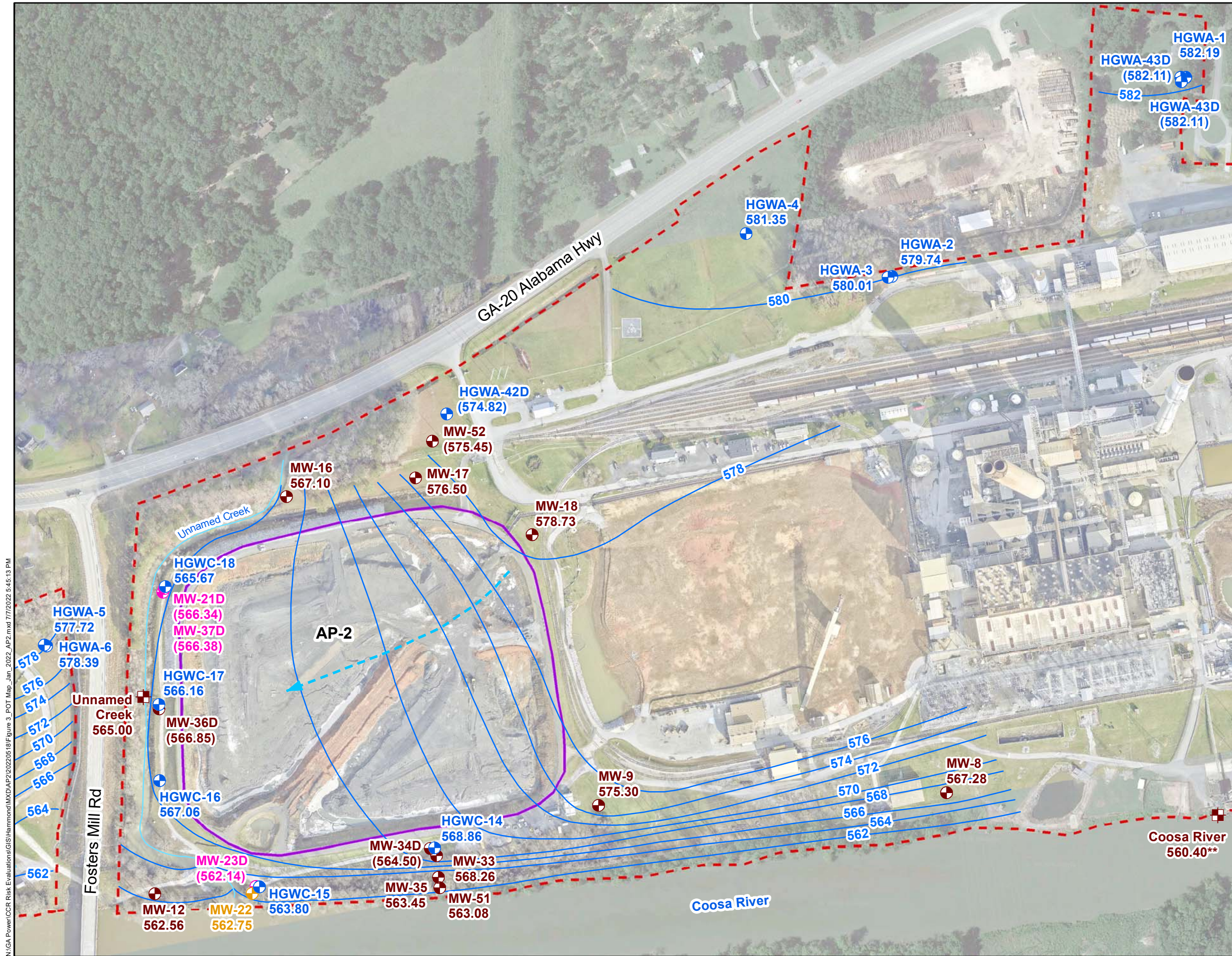
GEORGIA POWER
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For:  Georgia Power

Prepared By: 

KENNESAW, GA AUGUST 2022

**FIGURE
2**



- LEGEND**
- Compliance Monitoring Well
 - Horizontal Delineation Well
 - Vertical Delineation Well
 - Piezometer
 - Staff Gauge
 - Groundwater Elevation Iso-Contour
 - Approximate Groundwater Flow Direction
 - Unnamed Creek
 - Approximate AP-2 Boundary
 - Plant Hammond Property Boundary

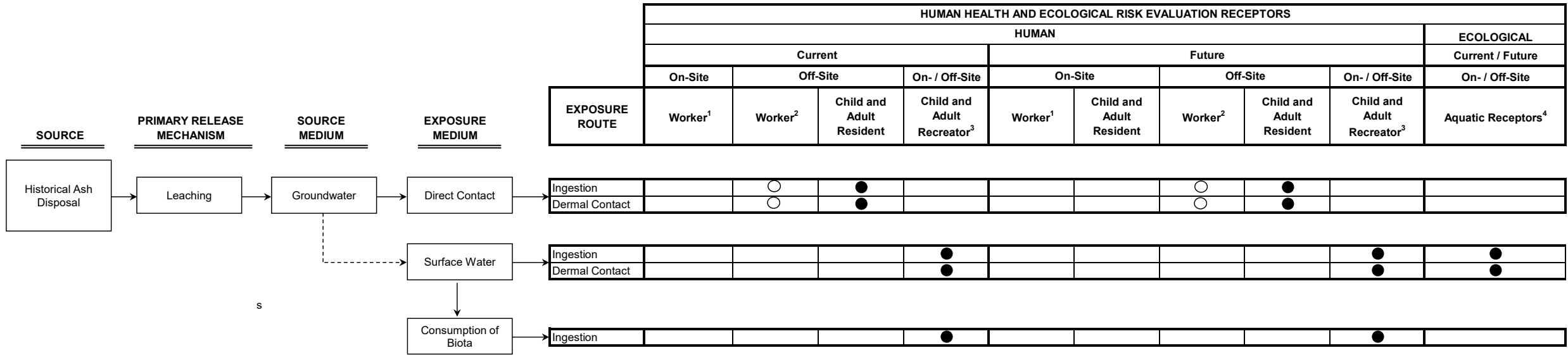


- Notes:**
- Water level elevation recorded on January 31, 2022. Elevation provided in feet (ft) referenced to the North American Vertical Datum of 1988 (NAVD 88).
 - Groundwater elevations in parentheses were not used to make the groundwater contours because these wells are screened at a different elevation in the formation/aquifer.
 - A double asterisk (**) denotes the water level for the Coosa River was gauged approximately 950 feet upstream of MW-8 at the staff gauge near AP-1.
 - Aerial photograph source: Google Earth Pro, August 2019 and Georgia Power Company, January 2022.
- 0 150 300 600 Feet

**POTENTIOMETRIC SURFACE CONTOUR
MAP - JANUARY 2022**

GEORGIA POWER
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For:	Georgia Power	FIGURE 3
Prepared By:	Geosyntec consultants	
KENNESAW, GA	AUGUST 2022	



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. Data from surface water samples collected in the unnamed creek were used to evaluate potential recreators.
4. Generalized receptor for ecological health risk evaluation.

Conceptual Exposure Model

Georgia Power
Plant Hammond AP-2

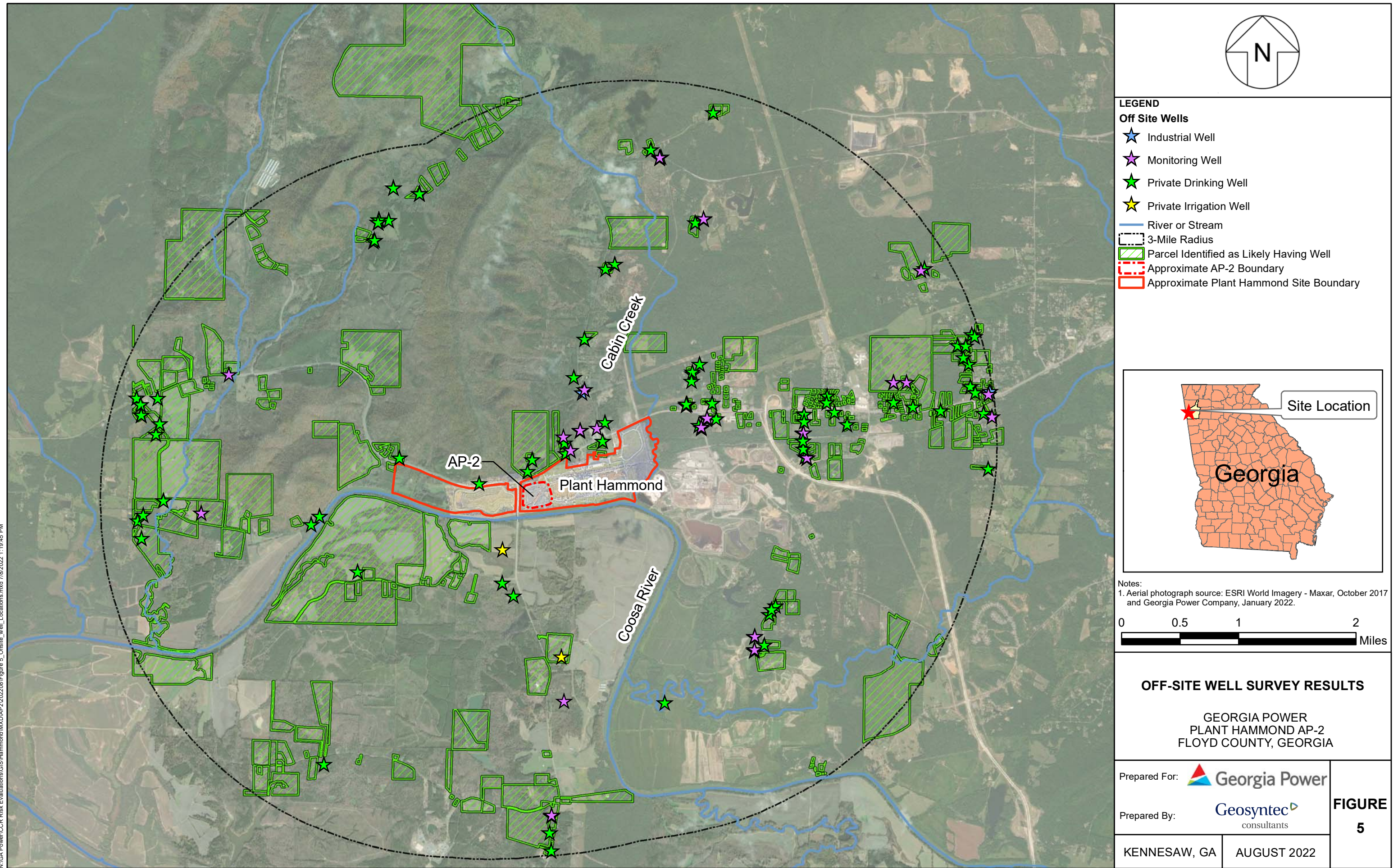
Geosyntec
consultants

Kennesaw, GA

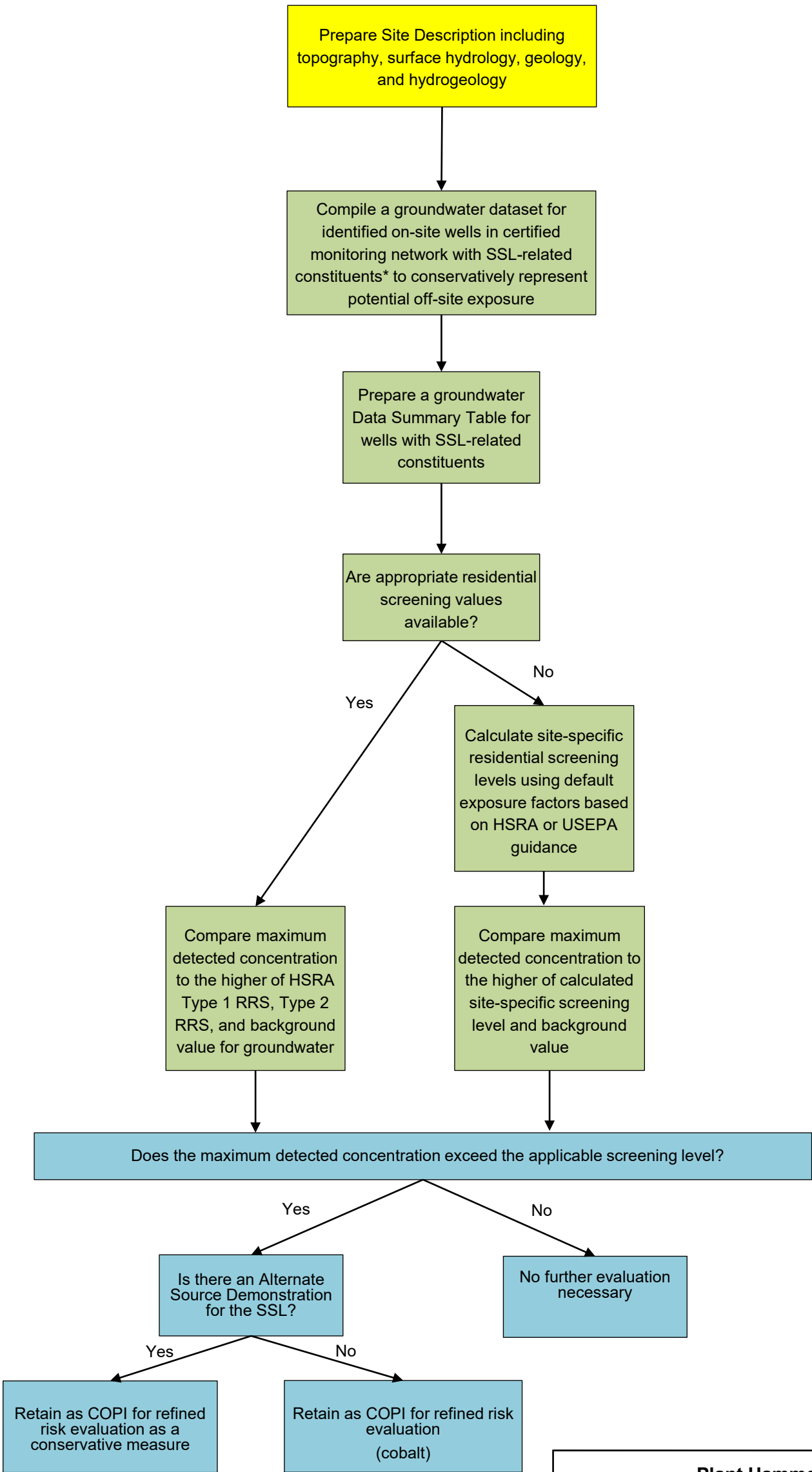
Figure
4

August 2022

N:\GA Power\CCR Risk Evaluations\GIS\Hammond\MDAP2\202208\Figure 5_Offsite_well_Locations.mxd 7/8/2022 1:19:45 PM



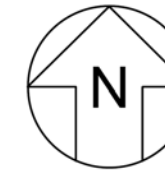
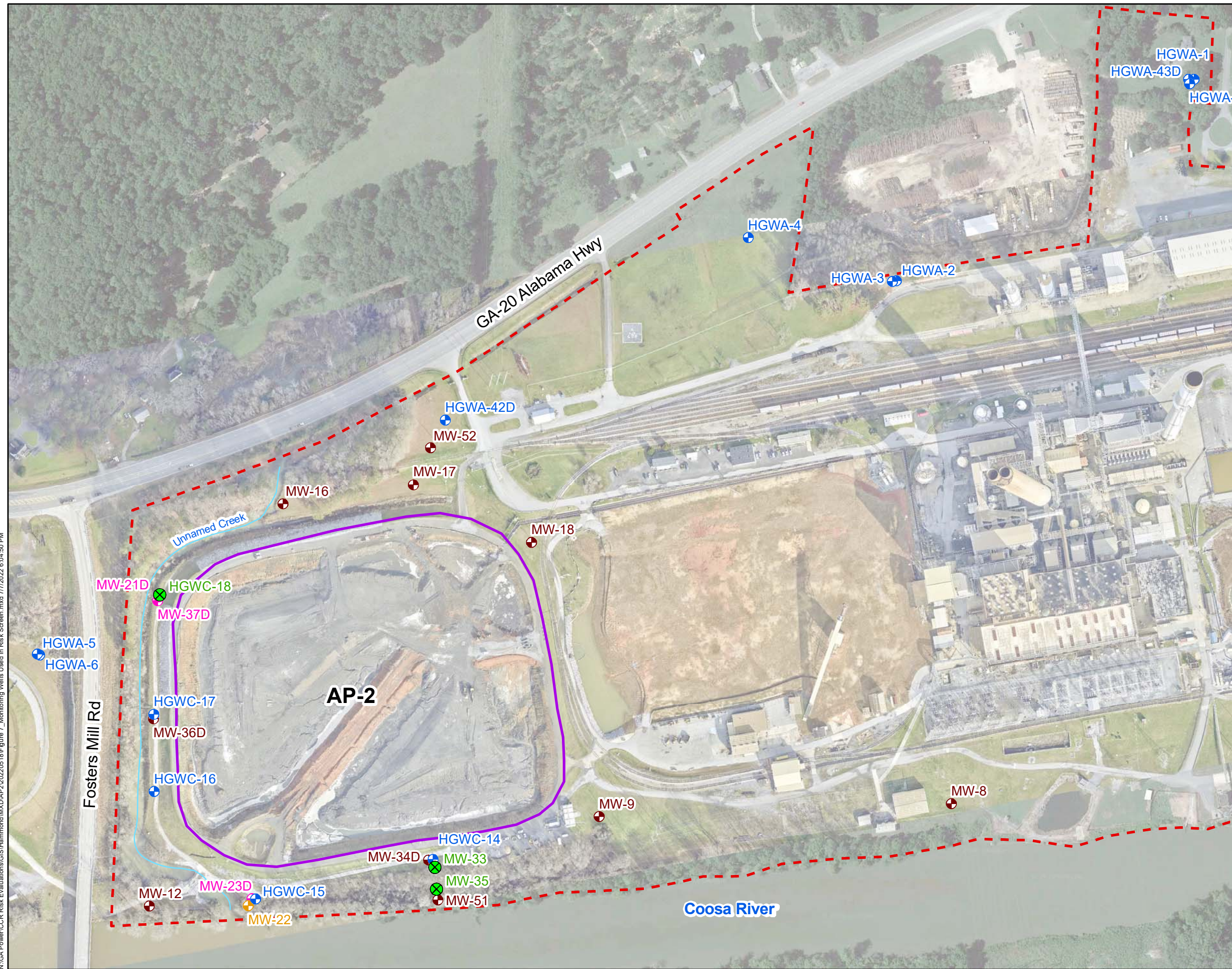
Initial Risk Screening Approach (Groundwater) for AP-2



Notes:

- Initial screen evaluates cobalt in HGWC-18, MW-33, and MW-35
- SSL = Statistically Significant Level
- COPI = Constituent of Potential Interest
- HSRA = Hazardous Site Response Act
- RRS = Risk Reduction Standard
- USEPA = United States Environmental Protection Agency

N:\GA Power\CCR Risk Evaluations\GIS\Hammond\MDAP20220518\Figure 7_Monitoring Wells Used in Risk Screen.mxd 7/7/2022 6:04:50 PM



LEGEND

- Federal and State CCR Rule SSL Related Constituents
- Compliance Monitoring Well
- Horizontal Delineation Well
- Vertical Delineation Well
- Piezometer
- Unnamed Creek
- Approximate AP-2 Boundary
- Plant Hammond Property Boundary



Note:
1. Cobalt Federal and State CCR Rules SSL-Related Constituent: HGWC-18, MW-33, and MW-35
2. Aerial photograph source: Google Earth Pro, August 2019 and Georgia Power Company, January 2022.

0 150 300 600
Feet

MONITORING WELLS USED IN RISK SCREEN

GEORGIA POWER
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For: Georgia Power

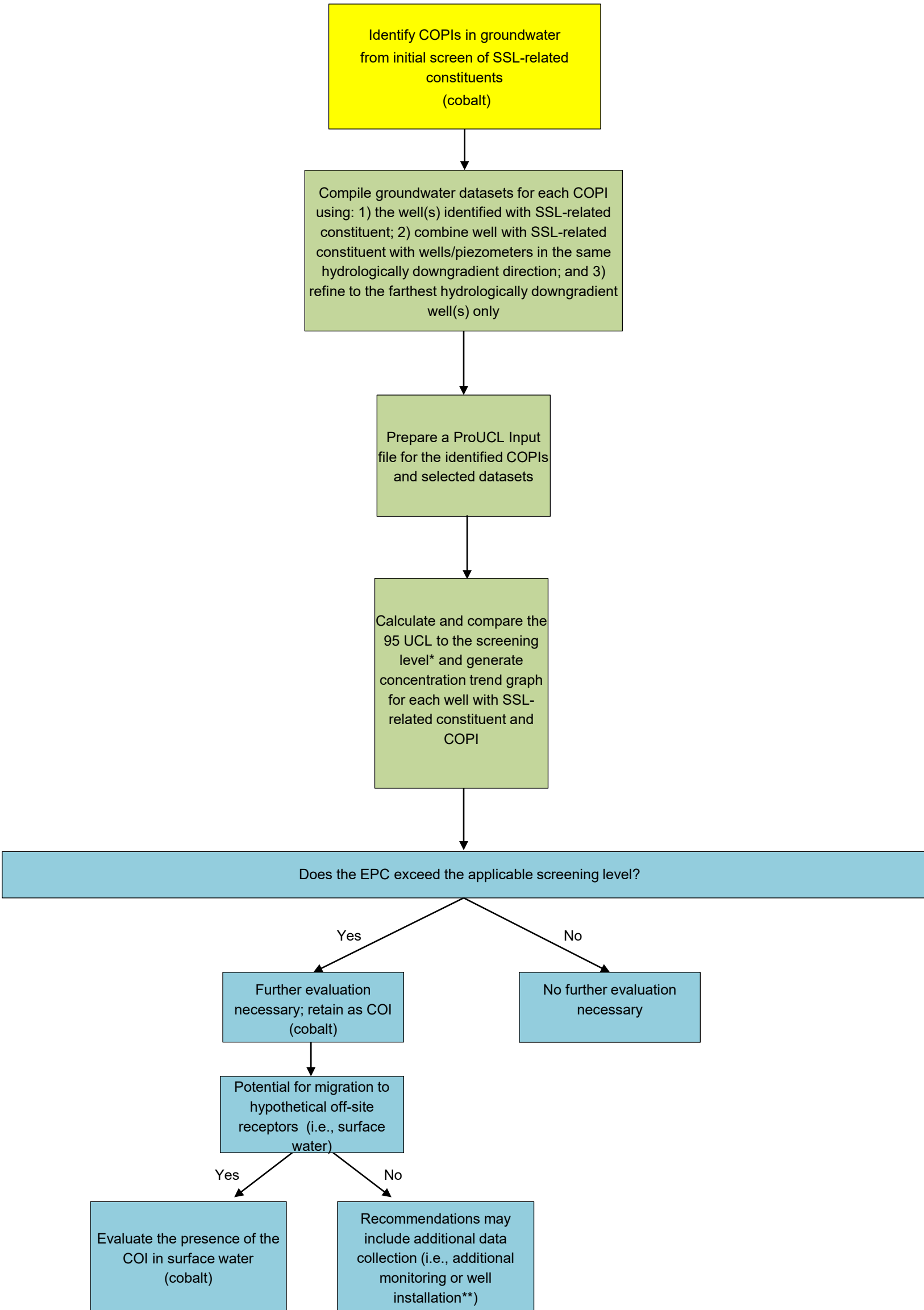
Prepared By: Geosyntec
consultants

KENNESAW, GA

AUGUST 2022

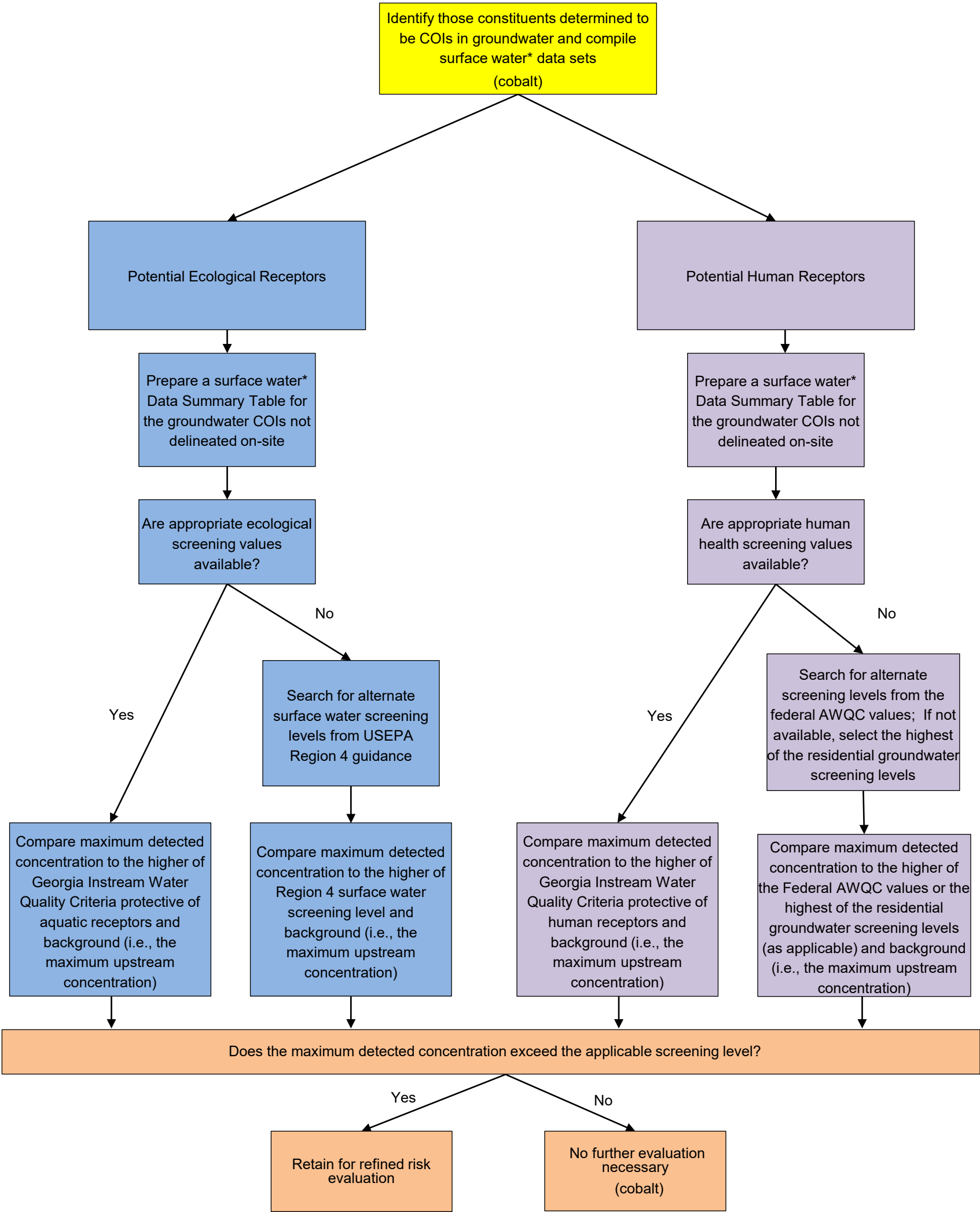
FIGURE
7

Approach for Refined Risk Evaluation (Groundwater) for AP-2



Notes:
*If the 95 UCL exceeds the maximum concentration, use the maximum as the EPC.
**This step is not necessary for Hammond AP-2.
SSL = Statistically Significant Level
COPI = Constituent of Potential Interest
EPC = Exposure Point Concentration
UCL = Upper Confidence Limit
COI = Constituent of Interest

Risk Screening Approach (Surface Water) for AP-2

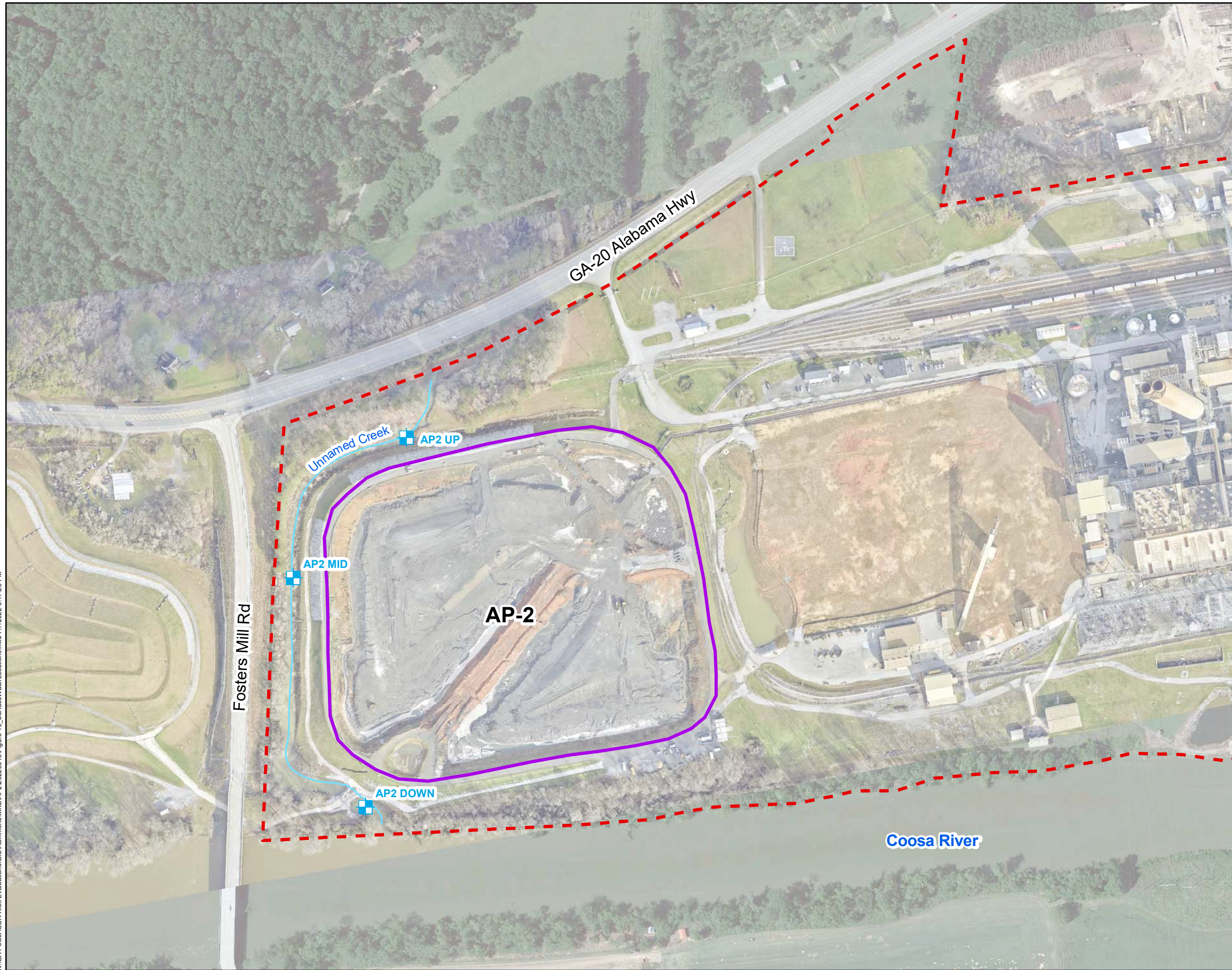


* Surface water data collected from the unnamed creek.

SSL = Statistically Significant Level
AWQC = Ambient Water Quality Criteria
COI = Constituent of Interest
COPI = Constituent of Potential Interest

Plant Hammond AP-2 Surface Water Risk Screening Approach	
Figure 9	
Project Number: GZ7112H	August 2022

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LEGEND

- Surface Water Sample Point
- Unnamed Creek
- Approximate AP-2 Boundary
- Plant Hammond Property Boundary



Site Location

Georgia

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

0 150 300 600
Feet

**SURFACE WATER SAMPLE
LOCATIONS**

GEORGIA POWER
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For: Georgia Power

Prepared By: Geosyntec
consultants

KENNESAW, GA

AUGUST 2022

**FIGURE
10**

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.

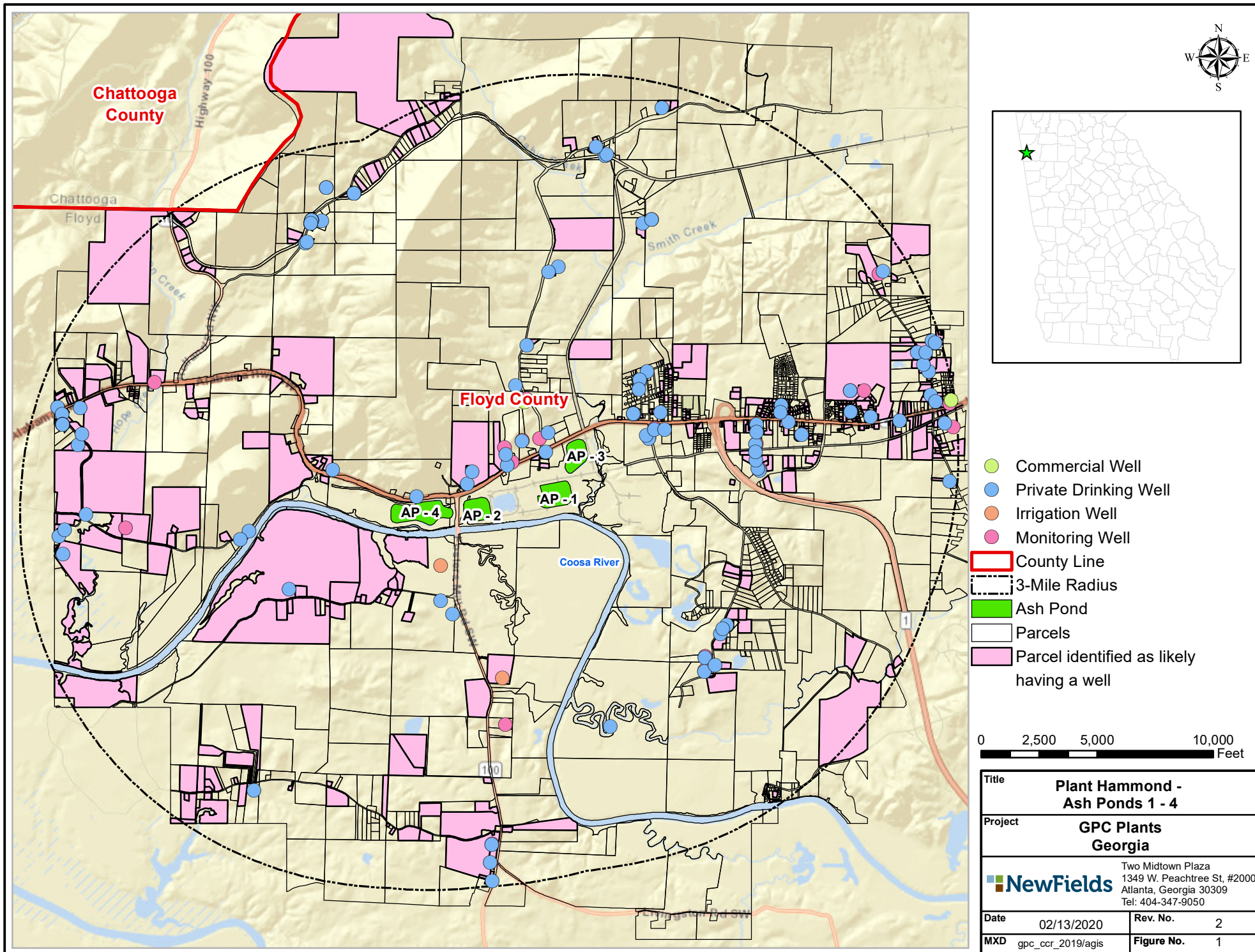
Summary

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
Appendix B-1
Groundwater Data
Plant Hammond AP-2 Risk Evaluation Report
Plant Hammond, Rome, GA

Well ID	Sample Date	Constituent	Cobalt
		Units	mg/L
		Ash Pond	
HGWC-18	5/24/2016	AP-2	0.17
HGWC-18	7/12/2016	AP-2	0.17
HGWC-18	9/1/2016	AP-2	0.18
HGWC-18	10/25/2016	AP-2	0.19
HGWC-18	12/8/2016	AP-2	0.21
HGWC-18	1/26/2017	AP-2	0.20
HGWC-18	3/23/2017	AP-2	0.22
HGWC-18	5/25/2017	AP-2	0.21
HGWC-18	4/3/2018	AP-2	0.19
HGWC-18	6/5/2018	AP-2	0.19
HGWC-18	10/3/2018	AP-2	0.19
HGWC-18	3/14/2019	AP-2	0.16
HGWC-18	4/5/2019	AP-2	0.14
HGWC-18	9/25/2019	AP-2	0.18
HGWC-18	3/3/2020	AP-2	0.15
HGWC-18	3/31/2020	AP-2	0.16
HGWC-18	9/15/2020	AP-2	0.16
HGWC-18	2/11/2021	AP-2	0.14
HGWC-18	3/18/2021	AP-2	0.14
HGWC-18	8/19/2021	AP-2	0.15
HGWC-18	2/8/2022	AP-2	0.16
MW-21D	3/15/2019	AP-2	<0.01
MW-21D	4/4/2019	AP-2	0.00034
MW-21D	9/25/2019	AP-2	<0.0025
MW-21D	3/3/2020	AP-2	<0.005
MW-21D	4/1/2020	AP-2	<0.005
MW-21D	6/17/2020	AP-2	<0.005
MW-21D	9/21/2020	AP-2	< 0.0038
MW-21D	2/11/2021	AP-2	< 0.0038
MW-21D	3/18/2021	AP-2	< 0.0038
MW-21D	8/19/2021	AP-2	< 0.0039
MW-21D	2/8/2022	AP-2	< 0.0039
MW-37D	6/18/2020	AP-2	0.0015
MW-37D	9/23/2020	AP-2	< 0.00038
MW-37D	2/11/2021	AP-2	0.00048
MW-37D	3/12/2021	AP-2	< 0.00038
MW-37D	8/18/2021	AP-2	< 0.00039
MW-37D	2/8/2022	AP-2	< 0.00039

Appendix B
Appendix B-1
Groundwater Data
Plant Hammond AP-2 Risk Evaluation Report
Plant Hammond, Rome, GA

Well ID	Sample Date	Constituent	Cobalt
		Units	mg/L
		Ash Pond	
MW-33	1/22/2020	AP-2	0.052
MW-33	4/1/2020	AP-2	0.058
MW-33	6/17/2020	AP-2	0.053
MW-33	9/21/2020	AP-2	0.047
MW-33	2/12/2021	AP-2	0.055
MW-33	3/18/2021	AP-2	0.057
MW-33	8/18/2021	AP-2	0.054
MW-33	2/8/2022	AP-2	0.048
MW-34D	6/18/2020	AP-2	0.011
MW-34D	9/23/2020	AP-2	0.0056
MW-34D	8/16/2021	AP-2	0.0093
MW-34D	2/9/2022	AP-2	0.0065
MW-35	6/18/2020	AP-2	0.091
MW-35	9/21/2020	AP-2	0.084
MW-35	2/15/2021	AP-2	0.095
MW-35	3/19/2021	AP-2	0.10
MW-35	8/18/2021	AP-2	0.085
MW-35	2/8/2022	AP-2	0.09
MW-51	8/18/2021	AP-2	0.030
MW-51	2/8/2022	AP-2	0.031

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

Appendix B

Appendix B-2

Surface Water Data

Plant Hammond AP-2 Risk Evaluation Report

Plant Hammond, Rome, GA

			Constituent	Cobalt
			Units	mg/L
Sample ID	Sample Location	River Sampled	Sample Date	
AP-2 DOWN	Downstream	Unnamed Creek	7/17/2020	< 0.005
AP-2 DOWN	Downstream	Unnamed Creek	12/14/2020	< 0.005
AP-2 DOWN	Downstream	Unnamed Creek	3/8/2021	< 0.005
AP-2 DOWN	Downstream	Unnamed Creek	9/13/2021	< 0.005
AP-2 DOWN	Downstream	Unnamed Creek	1/24/2022	< 0.005
AP-2 MID	Downstream	Unnamed Creek	7/17/2020	< 0.005
AP-2 MID	Downstream	Unnamed Creek	12/14/2020	< 0.005
AP-2 MID	Downstream	Unnamed Creek	3/8/2021	< 0.005
AP-2 MID	Downstream	Unnamed Creek	9/13/2021	< 0.005
AP-2 MID	Downstream	Unnamed Creek	1/24/2022	< 0.005
AP-2 UP	Upstream	Unnamed Creek	7/17/2020	< 0.005
AP-2 UP	Upstream	Unnamed Creek	12/14/2020	< 0.005
AP-2 UP	Upstream	Unnamed Creek	3/8/2021	< 0.005
AP-2 UP	Upstream	Unnamed Creek	9/13/2021	< 0.005
AP-2 UP	Upstream	Unnamed Creek	1/24/2022	< 0.005

Notes:

Bold = the constituent was detected in the sample

mg/L = milligrams(s) per liter

< = 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 AP-2 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-2 Risk Evaluation Report

Plant Hammond, Rome, GA

Chemical	Cobalt
CAS Number	7440-48-4
Mutagen?	No
Volatile?	No
Chemical Type	Inorganics
Sfo (mg/kg-day)-1	-
Sfo Ref	
IUR (ug/m3)-1	0.009
IUR Ref	P
RfD (mg/kg-day)	0.0003
RfD Ref	P
RfC (mg/m3)	0.000006
RfC Ref	P
GIABS	1
Kp (cm/hr)	0.0004
MW	58.9
B (unitless)	0.00118
t* (hr)	0.54
tevent (hr/event)	0.225
FA (unitless)	1
In EPD?	Yes
DAevent (ca)	-
DAevent (nc child)	0.000737
DAevent (nc adult)	0.00127
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)	6.02
Dermal SL Child THQ=1 (ug/L)	3410
Inhalation SL Child THQ=1 (ug/L)	-
Noncarcinogenic SL Child THI=1 (ug/L)	6.01
Ingestion SL Adult THQ=1 (ug/L)	10
Dermal SL Adult THQ=1 (ug/L)	4480
Inhalation SL Adult THQ=1 (ug/L)	-
Noncarcinogenic SL Adult THI=1 (ug/L)	9.99
Screening Level (ug/L)	6.01E+00 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 Details^[1]

Plant Hammond AP-2 Risk Evaluation Report

Plant Hammond, Rome, GA

CCR Rule Designation	Constituent	Exposure Unit	Well IDs Included	Maximum Concentration (mg/L)	Detection Frequency	Exceedance Frequency	EPC Step 1	EPC Step 2	EPC Step 3
							Individual Target Well(s) 2016-2022 (mg/L)	Target Well(s) & Downgradient Well(s) 2016-2022 (mg/L)	Farthest Downgradient Well(s) 2016-2022 (mg/L)
Appendix IV	Cobalt	West	HGWC-18	0.22	21 / 21	21 / 21	0.18		
			HGWC-18 MW-21D MW-37D	0.22	24 / 38	21 / 38		0.16	
			[2]		--	--			Not Calculated ^[2]
		South	MW-33 MW-35	0.10	14 / 14	14 / 14	0.079		
			MW-33 MW-34D MW-35 MW-51	0.10	20 / 20	14 / 20		0.065	
			MW-51	0.031	2 / 2	0 / 2			0.031

Notes:

Highlighted value is the EPC selected for the refined screening.

[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>

[2] The Step 3 EPC was not calculated for this constituent because there was no well located downgradient of the well with the exceedance.

Definitions:

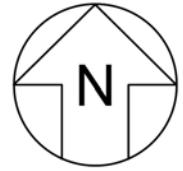
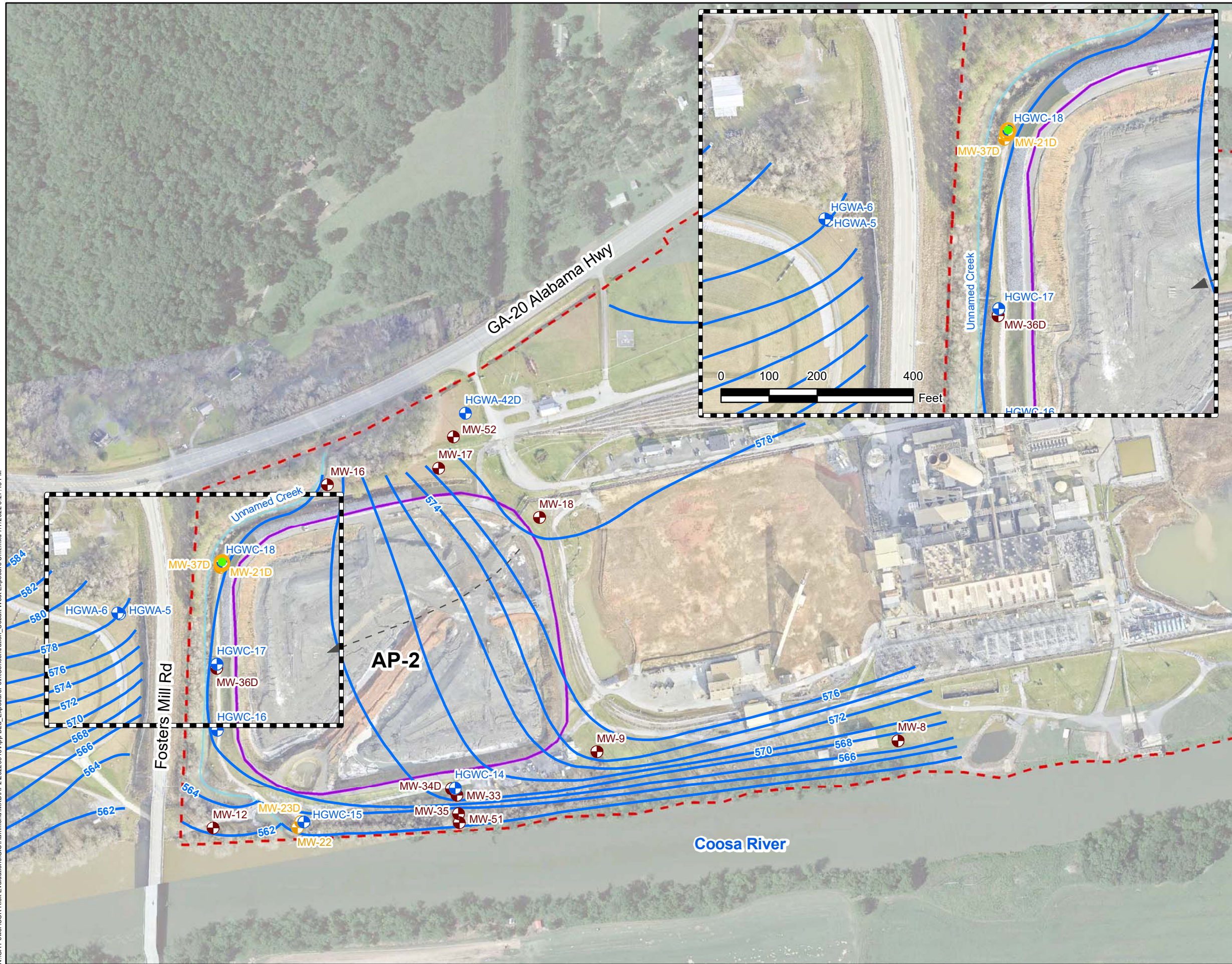
EPC = Exposure Point Concentration

mg/L = milligrams per liter

Appendix D-2

Exposure Point Concentration Figures

N:\GA Power\CCR Risk Evaluations\GIS\Hammond\MDAP20220518\Map_D2a_ExposurePointConcentration_Cobalt West Exposure Unit.mxd 7/7/2022 6:27:15 PM



LEGEND

- Compliance Monitoring Well
- Delineation Monitoring Well
- Groundwater Level Monitoring Piezometer
- Unnamed Creek
- Groundwater Elevation Iso-Contour
- Approximate Groundwater Flow Direction
- Approximate AP-2 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.

0 175 350 700
Feet

**EXPOSURE POINT CONCENTRATION MAP
COBALT WEST EXPOSURE UNIT**

GEORGIA POWER
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For: Georgia Power

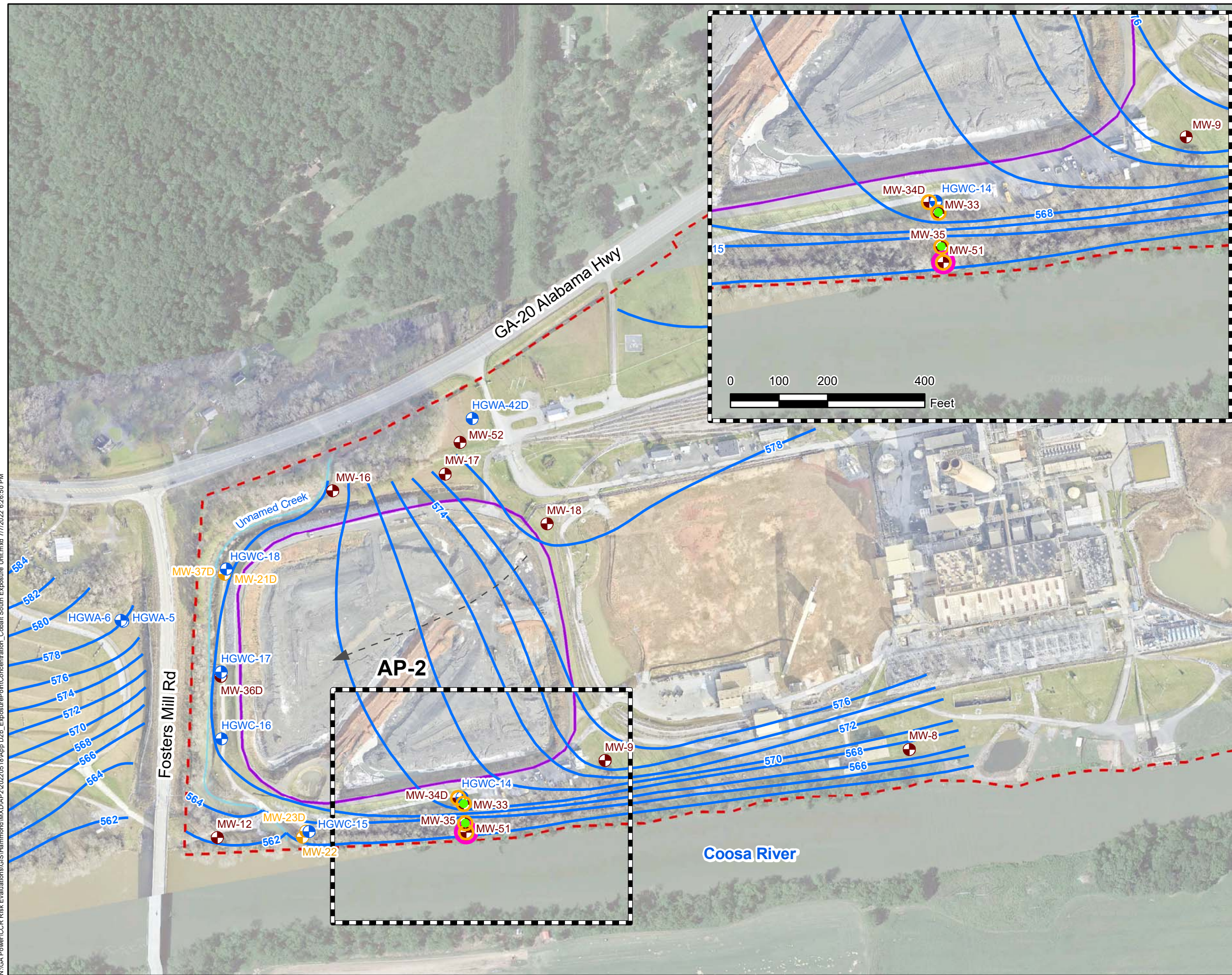
Prepared By: Geosyntec
consultants

KENNESAW, GA

AUGUST 2022

**APPENDIX
D-2a**

N:\GA Power\CCR Risk Evaluations\GIS\Hammond\MDAP20220518\Map D2b_ ExposurePointConcentration_Cobalt South Exposure_Unit.mxd 7/7/2022 5:26:50 PM



LEGEND

- Compliance Monitoring Well
- Delineation Monitoring Well
- Groundwater Level Monitoring Piezometer
- Unnamed Creek
- Groundwater Elevation Iso-Contour
- Approximate Groundwater Flow Direction
- Approximate AP-2
- 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.

0 175 350 700
Feet

EXPOSURE POINT CONCENTRATION MAP COBALT SOUTH EXPOSURE UNIT

GEORGIA POWER
PLANT HAMMOND AP-2
ROME, FLOYD COUNTY, GEORGIA

Prepared For: 

Prepared By: 

KENNESAW, GA

AUGUST 2022

APPENDIX
D-2b

Appendix D-3

ProUCL Input / Output Files

Appendix D
Appendix D-3
ProUCL Input
Plant Hammond AP-2 Risk Evaluation Report
Plant Hammond, Rome, GA

West Exposure Unit				South Exposure Unit			
Step 1 EPC Calculation Input		Step 2 EPC Calculation Input		Step 1 EPC Calculation Input		Step 2 EPC Calculation Input	
Step1_Cobalt_West	D_Step1_Cobalt_West	Step2_Cobalt_West	D_Step2_Cobalt_West	Step1_Cobalt_South	D_Step1_Cobalt_South	Step2_Cobalt_South	D_Step2_Cobalt_South
0.17	1	0.17	1	0.052	1	0.052	1
0.168	1	0.168	1	0.058	1	0.058	1
0.18	1	0.18	1	0.053	1	0.053	1
0.188	1	0.188	1	0.047	1	0.047	1
0.206	1	0.206	1	0.055	1	0.055	1
0.195	1	0.195	1	0.057	1	0.057	1
0.223	1	0.223	1	0.054	1	0.054	1
0.209	1	0.209	1	0.048	1	0.048	1
0.19	1	0.19	1	0.091	1	0.011	1
0.19	1	0.19	1	0.084	1	0.0056	1
0.19	1	0.19	1	0.095	1	0.0093	1
0.16	1	0.16	1	0.1	1	0.0065	1
0.14	1	0.14	1	0.085	1	0.091	1
0.18	1	0.18	1	0.09	1	0.084	1
0.15	1	0.15	1			0.095	1
0.16	1	0.16	1			0.1	1
0.16	1	0.16	1			0.085	1
0.14	1	0.14	1			0.09	1
0.14	1	0.14	1			0.03	1
0.15	1	0.15	1			0.031	1
0.16	1	0.16	1				
		0.01	0				
		0.00034	1				
		0.0025	0				
		0.005	0				
		0.005	0				
		0.005	0				
		0.0038	0				
		0.0038	0				
		0.0038	0				
		0.0039	0				
		0.0039	0				
		0.0015	1				
		0.0038	0				
		0.00048	1				
		0.0038	0				
		0.0039	0				
		0.0039	0				

Notes:

EPC= Exposure point Concentration

Appendix D

Appendix D-3

ProUCL Output

Plant Hammond AP-2 Risk Evaluation Report

Plant Hammond, Rome, GA

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation ProUCL 5.15/17/2022 7:43:21 PM
 From File ap2.xls
 Full Precision OFF
 Confidence Coefficient 95%
 Number of Bootstrap Operations 2000

Step1_Cobalt_West

General Statistics

Total Number of Observations	21	Number of Distinct Observations	12
		Number of Missing Observations	0
Minimum	0.14	Mean	0.174
Maximum	0.223	Median	0.17
SD	0.0241	Std. Error of Mean	0.00525
Coefficient of Variation	0.138	Skewness	0.276

Normal GOF Test

Shapiro Wilk Test Statistic 0.954
 5% Shapiro Wilk Critical Value 0.908
 Lilliefors Test Statistic 0.145
 5% Lilliefors Critical Value 0.188

Shapiro Wilk GOF Test

Data appear Normal at 5% Significance Level

Lilliefors GOF Test

Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 0.183

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 0.183
 95% Modified-t UCL (Johnson-1978) 0.183

Gamma GOF Test

A-D Test Statistic 0.362
 5% A-D Critical Value 0.741
 K-S Test Statistic 0.141
 5% K-S Critical Value 0.189

Anderson-Darling Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	55.16	k star (bias corrected MLE)	47.31
Theta hat (MLE)	0.00315	Theta star (bias corrected MLE)	0.00367
nu hat (MLE)	2317	nu star (bias corrected)	1987
MLE Mean (bias corrected)	0.174	MLE Sd (bias corrected)	0.0253
		Approximate Chi Square Value (0.05)	1884
Adjusted Level of Significance	0.0383	Adjusted Chi Square Value	1877

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$)	0.183	95% Adjusted Gamma UCL (use when $n < 50$)	0.184
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.955
5% Shapiro Wilk Critical Value	0.908
Lilliefors Test Statistic	0.131
5% Lilliefors Critical Value	0.188

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.966	Mean of logged Data	-1.759
Maximum of Logged Data	-1.501	SD of logged Data	0.138

Assuming Lognormal Distribution

95% H-UCL	0.183	90% Chebyshev (MVUE) UCL	0.19
95% Chebyshev (MVUE) UCL	0.197	97.5% Chebyshev (MVUE) UCL	0.207
99% Chebyshev (MVUE) UCL	0.226		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.182	95% Jackknife UCL	0.183
95% Standard Bootstrap UCL	0.182	95% Bootstrap-t UCL	0.183
95% Hall's Bootstrap UCL	0.183	95% Percentile Bootstrap UCL	0.182
95% BCA Bootstrap UCL	0.183		
90% Chebyshev(Mean, Sd) UCL	0.19	95% Chebyshev(Mean, Sd) UCL	0.197
97.5% Chebyshev(Mean, Sd) UCL	0.207	99% Chebyshev(Mean, Sd) UCL	0.226

Suggested UCL to Use

95% Student's-t UCL	0.183
---------------------	-------

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.

General Statistics			
Total Number of Observations	38	Number of Distinct Observations	20
Number of Detects	24	Number of Non-Detects	14
Number of Distinct Detects	15	Number of Distinct Non-Detects	5
Minimum Detect	3.4000E-4	Minimum Non-Detect	0.0025
Maximum Detect	0.223	Maximum Non-Detect	0.01
Variance Detects	0.00392	Percent Non-Detects	36.84%
Mean Detects	0.152	SD Detects	0.0626
Median Detects	0.164	CV Detects	0.411
Skewness Detects	-1.812	Kurtosis Detects	2.564
Mean of Logged Detects	-2.461	SD of Logged Detects	1.916

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.733	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.916	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.298	Lilliefors GOF Test
5% Lilliefors Critical Value	0.177	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	0.0964	KM Standard Error of Mean	0.0145
KM SD	0.0878	95% KM (BCA) UCL	0.119
95% KM (t) UCL	0.121	95% KM (Percentile Bootstrap) UCL	0.121
95% KM (z) UCL	0.12	95% KM Bootstrap t UCL	0.121
90% KM Chebyshev UCL	0.14	95% KM Chebyshev UCL	0.16
97.5% KM Chebyshev UCL	0.187	99% KM Chebyshev UCL	0.241

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	5.859	Anderson-Darling GOF Test
5% A-D Critical Value	0.772	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.477	Kolmogorov-Smirnov GOF
5% K-S Critical Value	0.183	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)	0.998	k star (bias corrected MLE)	0.901
Theta hat (MLE)	0.152	Theta star (bias corrected MLE)	0.169
nu hat (MLE)	47.91	nu star (bias corrected)	43.26
Mean (detects)	0.152		

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	3.4000E-4	Mean	0.13
---------	-----------	------	------

Maximum	0.223	Median	0.14
SD	0.0575	CV	0.441
k hat (MLE)	1.414	k star (bias corrected MLE)	1.32
Theta hat (MLE)	0.0921	Theta star (bias corrected MLE)	0.0986
nu hat (MLE)	107.5	nu star (bias corrected)	100.3
Adjusted Level of Significance (β)	0.0434		
Approximate Chi Square Value (100.33, α)	78.22	Adjusted Chi Square Value (100.33, β)	77.41
95% Gamma Approximate UCL (use when $n \geq 50$)	0.167	95% Gamma Adjusted UCL (use when $n < 50$)	0.169

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.0964	SD (KM)	0.0878
Variance (KM)	0.0077	SE of Mean (KM)	0.0145
k hat (KM)	1.206	k star (KM)	1.128
nu hat (KM)	91.63	nu star (KM)	85.73
theta hat (KM)	0.0799	theta star (KM)	0.0854
80% gamma percentile (KM)	0.153	90% gamma percentile (KM)	0.215
95% gamma percentile (KM)	0.277	99% gamma percentile (KM)	0.418

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (85.73, α)	65.39	Adjusted Chi Square Value (85.73, β)	64.65
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	0.126	95% Gamma Adjusted KM-UCL (use when $n < 50$)	0.128

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.469	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.916	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.477	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.177	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	0.0992	Mean in Log Scale	-3.386
SD in Original Scale	0.0859	SD in Log Scale	1.987
95% t UCL (assumes normality of ROS data)	0.123	95% Percentile Bootstrap UCL	0.123
95% BCA Bootstrap UCL	0.123	95% Bootstrap t UCL	0.124
95% H-UCL (Log ROS)	0.823		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-4.272	KM Geo Mean	0.0139
KM SD (logged)	2.827	95% Critical H Value (KM-Log)	5.009
KM Standard Error of Mean (logged)	0.492	95% H-UCL (KM -Log)	7.78
KM SD (logged)	2.827	95% Critical H Value (KM-Log)	5.009
KM Standard Error of Mean (logged)	0.492		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	0.0969
SD in Original Scale	0.0884

DL/2 Log-Transformed

Mean in Log Scale	-3.824
SD in Log Scale	2.363

95% t UCL (Assumes normality) 0.121

95% H-Stat UCL 1.886

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 0.16

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_Cobalt_South

General Statistics

Total Number of Observations	14	Number of Distinct Observations	14
		Number of Missing Observations	0
Minimum	0.047	Mean	0.0692
Maximum	0.1	Median	0.0575
SD	0.02	Std. Error of Mean	0.00534
Coefficient of Variation	0.289	Skewness	0.374

Normal GOF Test

Shapiro Wilk Test Statistic	0.829	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.874	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.284	Lilliefors GOF Test
5% Lilliefors Critical Value	0.226	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL	95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.0787	95% Adjusted-CLT UCL (Chen-1995) 0.0786
		95% Modified-t UCL (Johnson-1978) 0.0788

Gamma GOF Test

A-D Test Statistic	1.124	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.734	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.274	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.229	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	13.25	k star (bias corrected MLE)	10.46
Theta hat (MLE)	0.00522	Theta star (bias corrected MLE)	0.00662

nu hat (MLE)	370.9	nu star (bias corrected)	292.8
MLE Mean (bias corrected)	0.0692	MLE Sd (bias corrected)	0.0214
		Approximate Chi Square Value (0.05)	254.2
Adjusted Level of Significance	0.0312	Adjusted Chi Square Value	249.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.0797	95% Adjusted Gamma UCL (use when n<50)	0.0813
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.841	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.874	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.258	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.226	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.058	Mean of logged Data	-2.709
Maximum of Logged Data	-2.303	SD of logged Data	0.285

Assuming Lognormal Distribution

95% H-UCL	0.0805	90% Chebyshev (MVUE) UCL	0.0852
95% Chebyshev (MVUE) UCL	0.0924	97.5% Chebyshev (MVUE) UCL	0.102
99% Chebyshev (MVUE) UCL	0.122		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	0.078	95% Jackknife UCL	0.0787
95% Standard Bootstrap UCL	0.0776	95% Bootstrap-t UCL	0.0794
95% Hall's Bootstrap UCL	0.0772	95% Percentile Bootstrap UCL	0.0774
95% BCA Bootstrap UCL	0.0778		
90% Chebyshev(Mean, Sd) UCL	0.0852	95% Chebyshev(Mean, Sd) UCL	0.0925
97.5% Chebyshev(Mean, Sd) UCL	0.103	99% Chebyshev(Mean, Sd) UCL	0.122

Suggested UCL to Use

95% Student's-t UCL	0.0787	or 95% Modified-t UCL	0.0788
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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_Cobalt_South

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	0.0056	Mean	0.0531
Maximum	0.1	Median	0.0535
SD	0.0308	Std. Error of Mean	0.00688
Coefficient of Variation	0.579	Skewness	-0.0965

Normal GOF Test

Shapiro Wilk Test Statistic	0.923	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.905	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.142	Lilliefors GOF Test
5% Lilliefors Critical Value	0.192	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL

95% UCLs (Adjusted for Skewness)

0.065	95% Adjusted-CLT UCL (Chen-1995)	0.0643
	95% Modified-t UCL (Johnson-1978)	0.065

Gamma GOF Test

A-D Test Statistic	1.063	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.753	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.231	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.196	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.933	k star (bias corrected MLE)	1.677
Theta hat (MLE)	0.0275	Theta star (bias corrected MLE)	0.0317
nu hat (MLE)	77.33	nu star (bias corrected)	67.07
MLE Mean (bias corrected)	0.0531	MLE Sd (bias corrected)	0.041
		Approximate Chi Square Value (0.05)	49.22
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	48.01

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.0724	95% Adjusted Gamma UCL (use when n<50)	0.0742
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.817	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.905	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.269	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.192	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-5.185	Mean of logged Data	-3.216
Maximum of Logged Data	-2.303	SD of logged Data	0.912

Assuming Lognormal Distribution

95% H-UCL	0.103	90% Chebyshev (MVUE) UCL	0.0991
95% Chebyshev (MVUE) UCL	0.117	97.5% Chebyshev (MVUE) UCL	0.142
99% Chebyshev (MVUE) UCL	0.192		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0644	95% Jackknife UCL	0.065
95% Standard Bootstrap UCL	0.0641	95% Bootstrap-t UCL	0.0651
95% Hall's Bootstrap UCL	0.0636	95% Percentile Bootstrap UCL	0.064
95% BCA Bootstrap UCL	0.0641		
90% Chebyshev(Mean, Sd) UCL	0.0738	95% Chebyshev(Mean, Sd) UCL	0.0831
97.5% Chebyshev(Mean, Sd) UCL	0.0961	99% Chebyshev(Mean, Sd) UCL	0.122

Suggested UCL to Use

95% Student's-t UCL 0.065

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.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be reliable. Chen's and Johnson's methods provide adjustments for positively skewed data sets.

Step3_Cobalt_South

General Statistics			
Total Number of Observations	6	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	0.084	Mean	0.0908
Maximum	0.1	Median	0.0905
SD	0.00605	Std. Error of Mean	0.00247
Coefficient of Variation	0.0666	Skewness	0.44

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.

For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).

Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.951	Data appear Normal at 5% Significance Level	
5% Shapiro Wilk Critical Value	0.788		

Lilliefors Test Statistic	0.166	Lilliefors GOF Test
5% Lilliefors Critical Value	0.325	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	0.0958	95% Adjusted-CLT UCL (Chen-1995)	0.0954
		95% Modified-t UCL (Johnson-1978)	0.0959

Gamma GOF Test

A-D Test Statistic	0.24	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.696	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.19	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	273.5	k star (bias corrected MLE)	136.9
Theta hat (MLE)	3.3206E-4	Theta star (bias corrected MLE)	6.6357E-4
nu hat (MLE)	3283	nu star (bias corrected)	1643
MLE Mean (bias corrected)	0.0908	MLE Sd (bias corrected)	0.00776
		Approximate Chi Square Value (0.05)	1549
Adjusted Level of Significance	0.0122	Adjusted Chi Square Value	1516

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.0963	95% Adjusted Gamma UCL (use when n<50)	0.0984
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Lognormal GOF Test

Shapiro Wilk Test Statistic	0.953	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.788	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.169	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.325	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.477	Mean of logged Data	-2.401
Maximum of Logged Data	-2.303	SD of logged Data	0.0661

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	0.0982
95% Chebyshev (MVUE) UCL	0.102	97.5% Chebyshev (MVUE) UCL	0.106
99% Chebyshev (MVUE) UCL	0.115		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0949	95% Jackknife UCL	0.0958
95% Standard Bootstrap UCL	0.0945	95% Bootstrap-t UCL	0.0971
95% Hall's Bootstrap UCL	0.0971	95% Percentile Bootstrap UCL	0.0945
95% BCA Bootstrap UCL	0.095		
90% Chebyshev(Mean, Sd) UCL	0.0982	95% Chebyshev(Mean, Sd) UCL	0.102
97.5% Chebyshev(Mean, Sd) UCL	0.106	99% Chebyshev(Mean, Sd) UCL	0.115

Suggested UCL to Use

95% Student's-t UCL 0.0958

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.

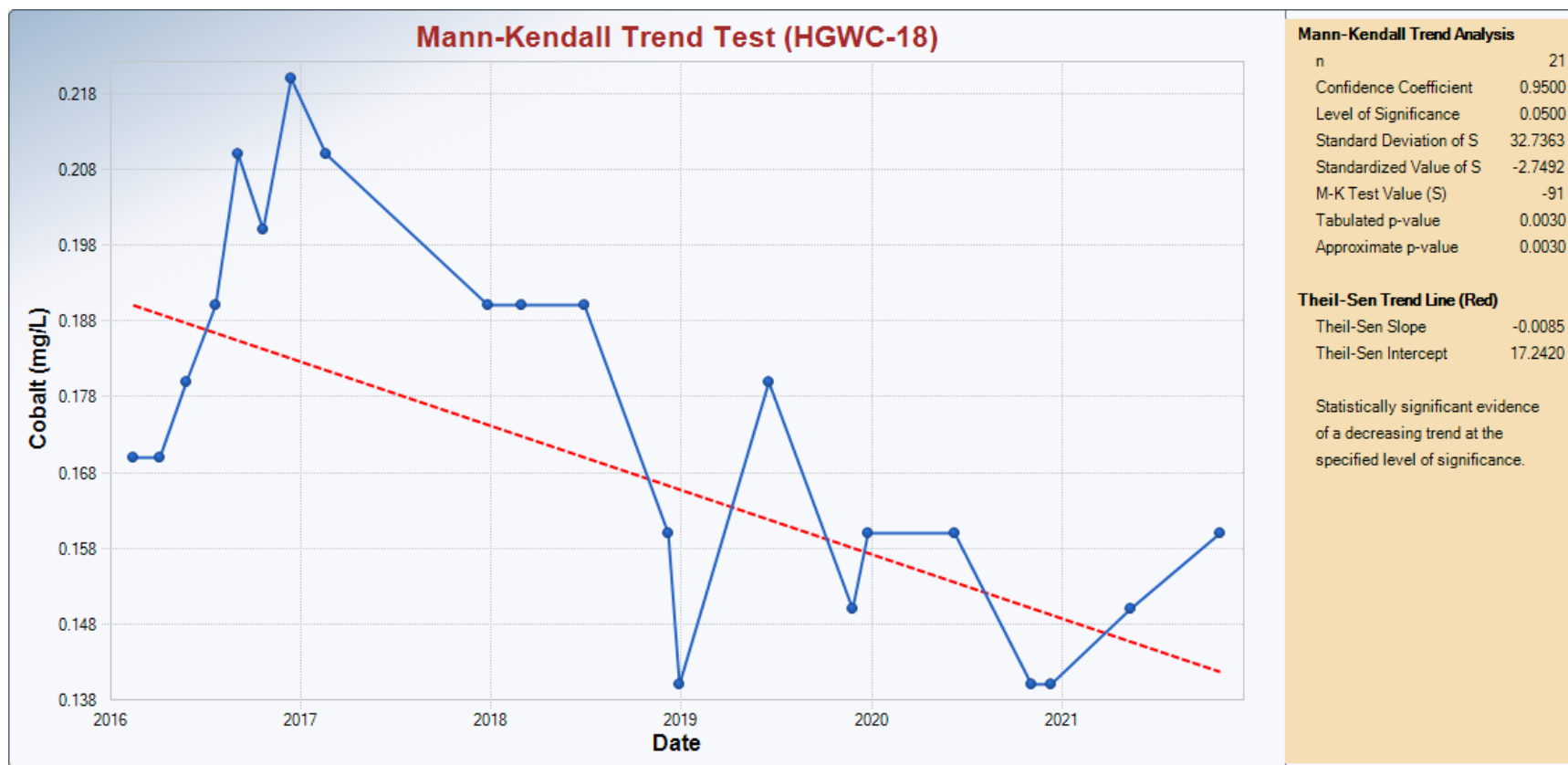
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

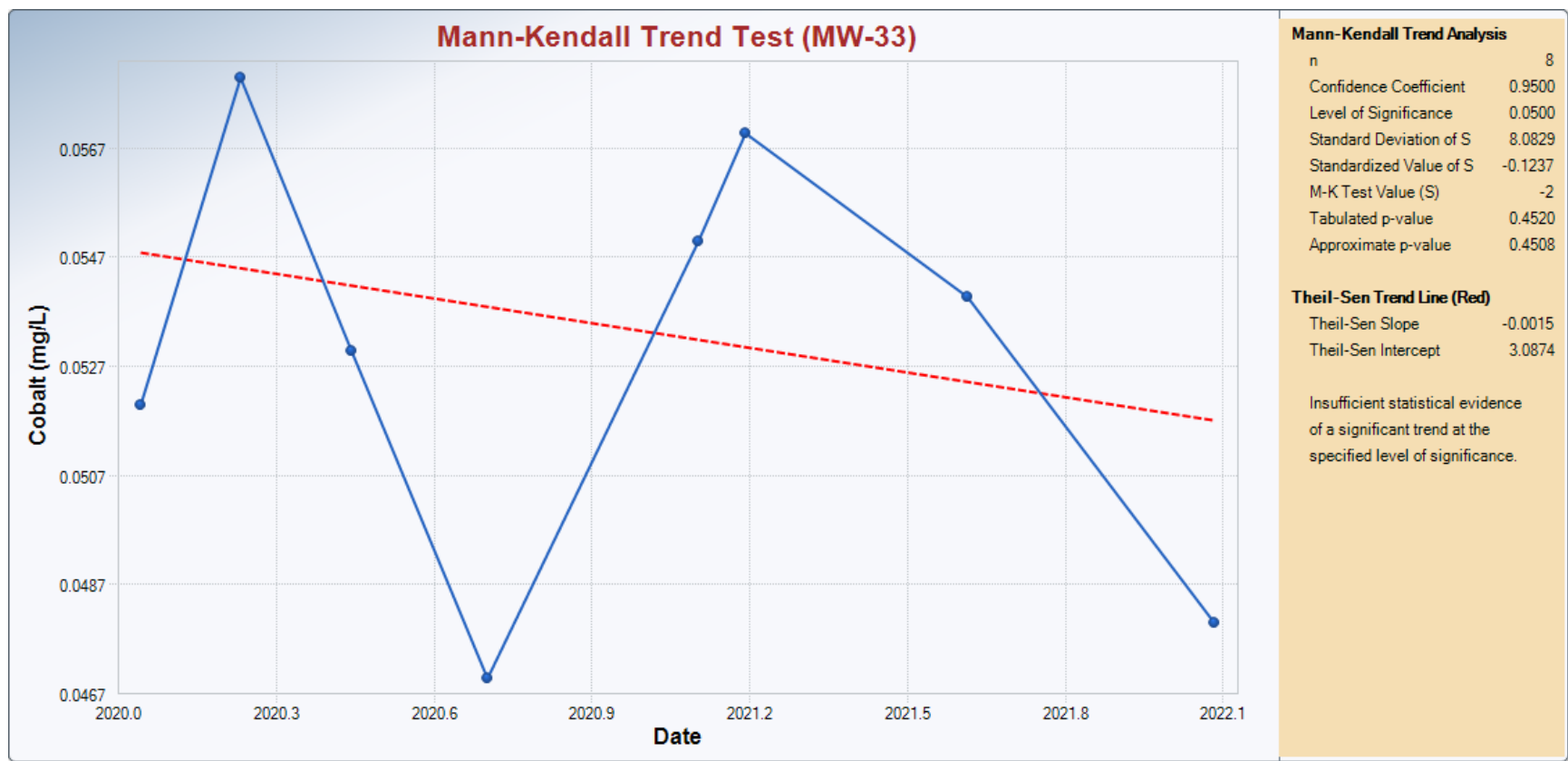
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

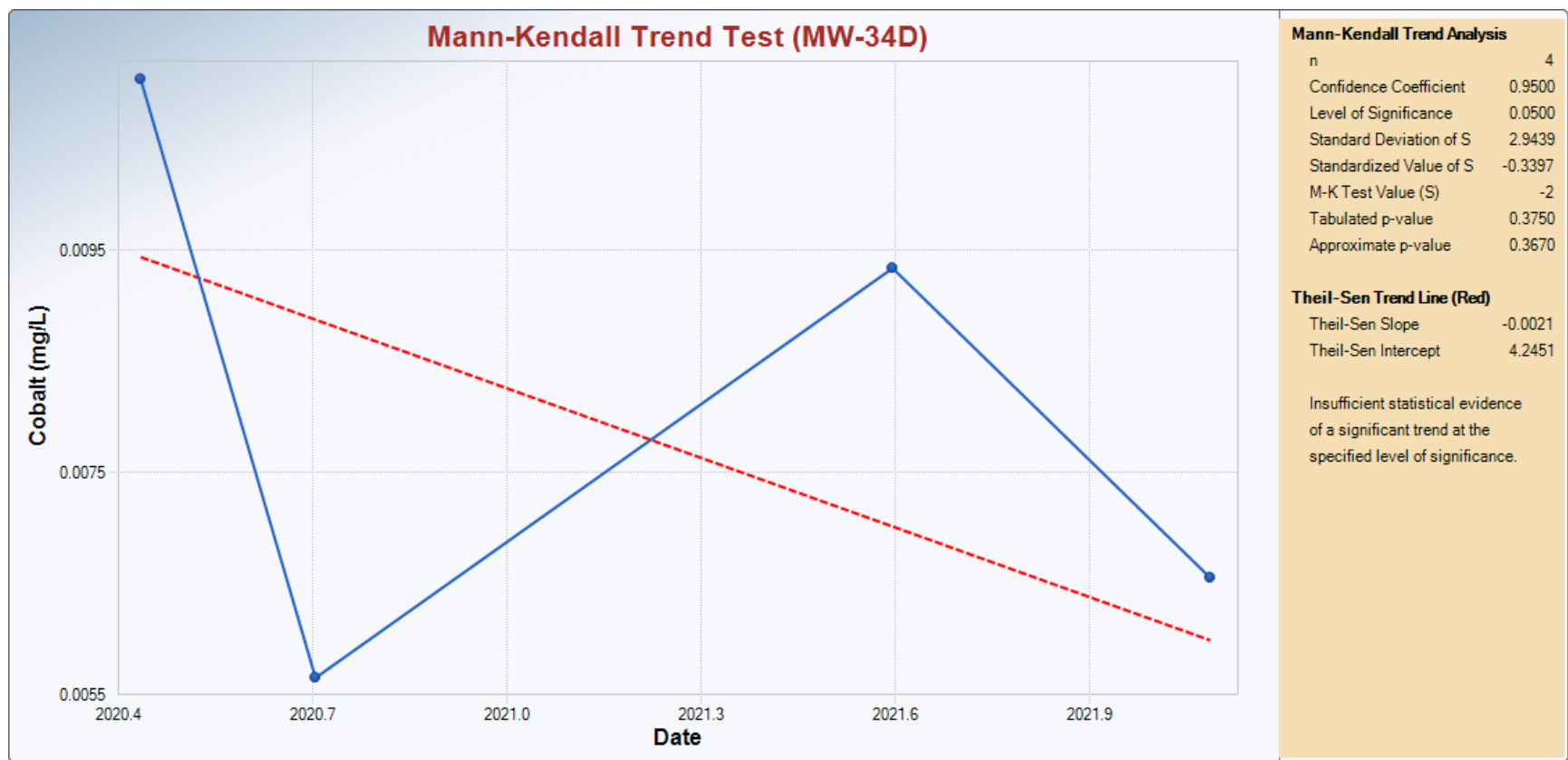
Appendix D-4

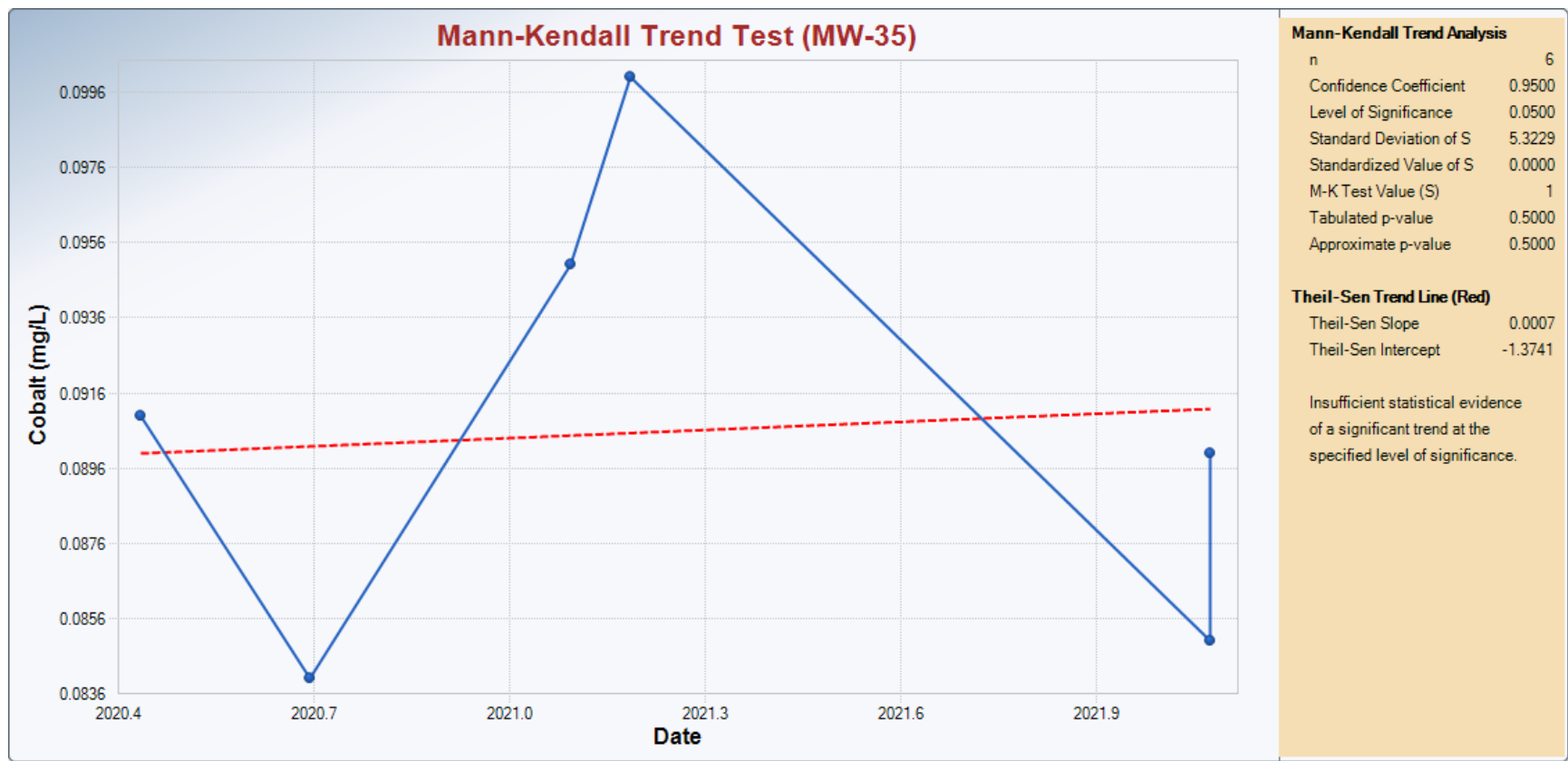
Groundwater Trend Graphs

Appendix D
Appendix D-4
Groundwater Trend Graphs
Plant Hammond AP-2 Risk Evaluation Report
Plant Hammond, Rome, GA









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