Prepared for

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ASSESSMENT OF CORRECTIVE MEASURES REPORT

PLANT WANSLEY ASH POND 1

Prepared by

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ASSESSMENT OF CORRECTIVE MEASURES REPORT

Plant Wansley

CERTIFICATION STATEMENT

I, Lauren Fitzgerald, am a professional engineer and licensed in the State of Georgia. I hereby certify that this *Assessment of Corrective Measures Report, Georgia Power Company – Plant Wansley – Ash Pond 1 (AP-1)* 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.

GEORGIA REGISTERED No. PE048960 PROFESSIONAL ENGINEER LAUREN E. FITZGERALD

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ACM	Assessment of Corrective Measures
ANS	Applied Natural Sciences
AP	ash pond
ASD	Alternate Source Demonstration
Be	beryllium
CCR	coal combustion residuals
CFR	Code of Federal Regulations
GA EPD	GA Environmental Protection Division
Georgia Power	Georgia Power Company
Geosyntec	Geosyntec Consultants, Inc.
GWPS	Groundwater Protection Standard
HAR	Hydrogeologic Assessment Report
ISCO	in-situ chemical oxidation
ISCR	in-situ chemical reduction
ISS	in-situ solidification/stabilization
LDA	large diameter auger
Li	lithium
MNA	monitored natural attenuation
O&M	operations and maintenance
P&T	pump and treat
PE	professional engineer
PG	professional geologist
PRB	permeable reactive barriers
PWR	partially weathered rock
RCRA	Resource Conservation and Recovery Act
SSL	statistically significant level
US EPA	United States Environmental Protection Agency
ZVI	zero-valent iron

1.0 INTRODUCTION

In accordance with the United States Environmental Protection Agency (US EPA) Coal Combustion Residual Rule (federal CCR Rule) (40 Code of Federal Regulations [CFR] Part 257, Subpart D) and the Georgia Environmental Protection Division (GA EPD) Rules for Solid Waste Management 391-3-4-.10, Geosyntec Consultants, Inc. (Geosyntec) has prepared this *Assessment of Corrective Measures (ACM) Report* for Georgia Power Company (Georgia Power) Plant Wansley (Plant) Ash Pond 1 (AP-1 or Site). Pursuant to 40 CFR § 257.96 and Georgia Rule 391-3-4-.10(6)(a), this ACM Report evaluates potential corrective measures to address statistically significant levels (SSLs) of lithium (Li) and beryllium (Be) identified at AP-1.

The SSLs of lithium and beryllium were identified following statistical analysis of analytical groundwater data from the August 2022 semiannual assessment monitoring event (Geosyntec, 2023). Georgia Power initiated ACM for AP-1 on October 27, 2022. Two assessment groundwater monitoring wells, installed to assess the extent of lithium and beryllium in groundwater downgradient of AP-1, show that lithium and beryllium are horizontally delineated and contained within the property boundary. Beryllium is also vertically delineated while vertical delineation efforts for lithium are ongoing. This ACM Report is the first step in identifying viable corrective measures to address SSLs in groundwater associated with AP-1. Based on the results of the ACM, further evaluation may be performed, site-specific studies completed, and a corrective action plan developed and implemented pursuant to § 257.97 and § 257.98.

Georgia Power conducted a human health and ecological risk evaluation to evaluate constituents that exhibit SSLs in groundwater (i.e., lithium and beryllium) at AP-1. The risk evaluation used a conservative, health-protective approach that is consistent with US EPA risk assessment guidance, GA EPD regulations and guidance, and standard practice for risk assessment in the State of Georgia. As part of the risk evaluation, a well survey of potential groundwater wells within a three-mile radius of AP-1 was conducted which consisted of reviewing federal, state, and county records and online sources in addition to conducting a windshield survey of the area. The risk evaluation relied on groundwater and surface water data collected by Georgia Power between November 2016 and October 2022 in compliance with the federal and state CCR rules. The results of this risk evaluation are presented in the *Risk Evaluation Report – Georgia Power Company – Plant Wansley Ash Pond 1* included as **Appendix A**.

1.1 Purpose

The purpose of this ACM is to begin the process of selecting corrective measure(s) for groundwater. This process is typically iterative and may be composed of multiple steps to analyze the effectiveness of corrective measures to address the potential migration of CCR constituents in groundwater at AP-1.

Once potential corrective measures are identified in this ACM, they are further evaluated using the criteria outlined in § 257.96 (c), which state that corrective measures assessment should include an analysis of the effectiveness of potential corrective measures that considers the following:

- Performance;
- Reliability;
- Ease of implementation;
- Potential impacts (including safety, cross-media, and exposure);
- The time required to begin and complete the remedy; and
- Any institutional requirements (e.g., permitting or environmental and public health requirements) that could affect implementation of the remedy.

These evaluation criteria are considered for each potential corrective measure. Further evaluation of the technologies will be required to select a corrective measure(s).

1.2 Site Location and Description

Plant Wansley is a former electric generating facility owned and operated by Georgia Power. The Plant is located adjacent to the west bank of the Chattahoochee River, in Heard and Carroll counties near Carrollton, Georgia. The physical address of the Plant is 1371 Liberty Church Road, Carrollton, Georgia, 30116. During operations, the Plant contained two coal fired units. Constructed in the early 1970s, the Plant operated one CCR pond identified as AP-1. **Figure 1** shows a plan view of the Site.

Northwest of the main Plant, two ponds were constructed as valley fill impoundments separated by a 3,000-foot long, 105-foot-high earthen dam (Separator Dike) to support operations. A 590-acre pond (Storage Water Pond) was used to provide water to the Plant for use in the electric generating process whereas a 343-acre CCR pond (AP-1) was used for water treatment and disposal of CCR from electrical generation operations. AP-1 began receiving process water containing fly ash and bottom ash in 1976. In 2008, two temporary gypsum storage cells were constructed on top of the CCR delta in AP-1, adjacent to the Separator Dike (**Figure 1**).

1.3 Pond Closure

As of April 2019, all process-related flows from the Plant to AP-1 have ceased. As part of the *2022 Integrated Resource Plan*, the Georgia Public Service Commission approved decommissioning of the Plant Wansley coal fired units on August 31, 2022. In this plan, Georgia Power has elected to close Plant Wansley AP-1 by removal of the CCR material. Removed CCR will be consolidated in the onsite existing landfill. The closure of AP-1 in this manner provides a source control measure that reduces the potential for migration of CCR constituents to groundwater. Corrective measures discussed in this ACM Report are being evaluated to address SSLs in groundwater at the compliance boundary of AP-1.

2.0 CONCEPTUAL SITE MODEL

The following section summarizes the geologic and hydrogeologic conditions at AP-1 as described in the *Hydrogeologic Assessment Report Revision 03 – Plant Wansley Ash Pond 1 (AP-1)* (HAR Rev 03) submitted to GA EPD in November 2022 to provide information regarding the hydrogeologic conditions and the groundwater monitoring well network associated with AP-1 (Geosyntec, 2022a). Additional details regarding the hydrogeologic conditions in the vicinity of AP-1 are provided in the HAR Rev 03 (Geosyntec, 2022a).

2.1 Site Geology

AP-1 is located in the Piedmont Physiographic Province of western Georgia, which is characterized by gently rolling hills and narrow valleys with locally pronounced linear ridges. Geologic mapping indicates that the Site is underlain by schist, amphibolite, gneiss, and quartzite. AP-1 is underlain primarily by four lithologic units; (i) alluvial deposits (ii) residual soils and saprolite, (iii) partially weathered rock (PWR), and (iv) metamorphic crystalline bedrock. Historically, AP-1 received sluiced CCR until April 2019, and CCR material is present across the bottom of AP-1 at variable thickness.

Based on subsurface investigations, the CCR material consists of fly ash, generally described as dark to medium gray, soft, and loose to very loose fine sand and silts with some clay. Discontinuous lenses of coarser bottom ash are present throughout the unit, generally described as dark gray, well-graded, fine to coarse sand and fine gravel. Alluvial deposits related to stream and drainage processes are present but not laterally continuous across the Site and likely correspond with former stream channels buried during the construction of the surface impoundment. Alluvium consists of organic silt and fine sand over-bank deposits and fine to coarse sand channel deposits. Residual and saprolitic soils (residual soil/saprolite) resulting from the in-situ weathering of the parent bedrock material make up a large portion of the Site subsurface and is generally encountered across the Site. Residual soils and saprolite are described primarily as sandy silt, silty sand, sandy clay, and silty clay. As the saprolite transitions to more rock-like material approaching the bedrock surface, a zone referred to as PWR is encountered. The PWR unit is the hard, semi-consolidated, weathered to intensely fractured rock interface. PWR may include hard, but friable, decomposed rock, as well as gravel to cobble-size rock fragments bound by clay and silt saprolite matrix. The bedrock at the Site is composed primarily of graphitic schist, muscovite schist, biotite schist, schist with interlayered mafic units, amphibolite/hornblende gneiss, granitic gneiss (Long Island Creek Gneiss), and feldspathic quartzite. The ridges to the northwest and southeast of the surface impoundment are underlain by muscovite schist and Long Island Creek Gneiss, respectively, both of which are relatively resistant to weathering. AP-1 and the Storage Water Pond, however, are underlain by schist with interlayered mafic units and feldspathic quartzite, which are more susceptible to weathering, and, thus, the layer of saprolite and PWR is thicker.

2.2 Site Hydrogeology

While the aquifer characteristics of each lithologic unit may vary, the groundwater is interconnected between these units, and they effectively act as one, unconfined aquifer. The uppermost aquifer at AP-1 occurs primarily in PWR and fractured bedrock. According to previous site investigations, the potentiometric surface is a subdued reflection of the topography. The top of bedrock surface also generally follows topography and likely controls groundwater flow direction in the uppermost aquifer. Because of the steep topography at the Site and variable lithologic framework, the depth to the water table is variable, ranging from approximately 1 to 50 feet below ground surface (ft bgs). The regional groundwater flow direction is expected to be to the southeast; however, in topographically high areas south of AP-1, shallower water table elevations are noted within the saprolite and PWR, and hydraulic gradients indicate localized flow northward (or inward) toward the pond.

Groundwater in the saprolite and PWR is hydraulically connected to the bedrock via fractures and deeply weathered areas of the rock. Recharge is by precipitation infiltrating through the saprolite to the bedrock. Based on observations of soil types and horizontal conductivity values, the movement of groundwater in the saprolite is very slow and likely acts as flow through a low-permeability porous media. Groundwater flow in the transition zone, as defined in the HAR, is expected to be greater than in the overlying saprolite and the underlying fractured bedrock. Groundwater flow in the bedrock is restricted entirely to flow through fractures. Visual observations and geophysical logging during field investigations indicate a trend of decreasing fracture aperture and density with depth, consistent with regional geologic trends.

3.0 NATURE AND EXTENT OF APPENDIX IV CONSTITUENTS

The following describes monitoring-related field and assessment activities performed to date in support of (i) delineating the nature and extent of SSLs in groundwater and (ii) evaluating potential corrective measures to address them.

3.1 Groundwater Monitoring & Appendix IV Constituents

3.1.1 Groundwater Monitoring Program

In accordance with § 257.91, a groundwater monitoring system was installed at AP-1 that consists of a sufficient number of wells installed at appropriate locations and depths to yield groundwater samples from the uppermost aquifer to represent the groundwater quality both upgradient of AP-1 (i.e., background conditions) and passing the waste boundary of AP-1. The number, spacing, and depths of the groundwater monitoring wells were selected based on the characterization of site-specific hydrogeologic conditions.

As part of the assessment monitoring program, assessment monitoring wells were installed in September 2022 to characterize the nature and extent of lithium and beryllium in groundwater downgradient of AP-1. Pursuant to § 257.95(g)(1)(iv), the wells classified as “assessment monitoring wells” will continue to be sampled concurrently with the detection monitoring well network (formerly known as “compliance monitoring wells”) as part of the ongoing assessment groundwater monitoring program.

An onsite network of piezometers is used in combination with the detection and assessment monitoring well networks to gauge groundwater levels to define groundwater flow direction and gradients. The piezometers may be sampled as needed to support the ACM program.

The locations of the detection monitoring wells, assessment monitoring wells, and piezometers are shown on **Figure 2**; well and piezometer construction details are listed in **Table 1**.

3.1.2 Statistically Significant Levels of Appendix IV Constituents

Groundwater monitoring data collected during the August 2022 semiannual assessment monitoring event (**Table 2**) were statistically analyzed pursuant to § 257.93(f) and in general accordance with the US EPA document *Statistical Analysis of Groundwater Data at RCRA Facilities Unified Guidance* (Unified Guidance) (US EPA, 2009). Following federal and state rule requirements, groundwater protection standards (GWPS; **Table 3**) are established for statistical comparisons of Appendix IV assessment monitoring parameters[1]. Appendix IV parameters detected during the August 2022 event were statistically evaluated with the GWPS to assess if concentrations in detection monitoring wells statistically exceeded the GWPS. Details regarding the statistical analyses of the August 2022 sampling event are provided in the *2022 Annual Groundwater and Corrective Action Monitoring Report* (Geosyntec, 2023).

The statistical analyses of the August 2022 analytical groundwater data from AP-1 identified the following SSLs:

- Lithium: WGWC-19 and WGWC-20
- Beryllium: WGWC-20

The SSL of lithium in WGWC-19 is addressed with the alternate source demonstration (ASD) and the ASD Addendums previously submitted to GA EPD (ACC, 2019; Geosyntec, 2020; Geosyntec, 2021). Therefore, WGWC-19 will not be discussed in this ACM Report.

3.2 Assessment of SSL Constituents

Assessment monitoring wells WGWC-26D and WGWC-27 were installed in September 2022 to provide additional data to characterize flow conditions downgradient of AP-1 and to horizontally and vertically delineate SSLs of lithium and beryllium in groundwater proximal to WGWC-20. WGWC-26D is utilized for vertical delineation, and WGWC-27 is utilized for horizontal delineation of detection well WGWC-20. Detailed boring and well construction logs for these assessment wells were provided in the well installation report submitted in December 2022 (Geosyntec, 2022b). The locations of these assessment wells are shown on **Figure 3** and well construction details are also provided in **Table 1**.

Pursuant to § 257.96, groundwater in the vicinity of AP-1 continues to be monitored during the ACM phase in accordance with the assessment monitoring program established for the CCR unit in 2018. Groundwater samples were collected from the detection wells in August 2022 and two assessment wells in October 2022 (i.e., following their installation in September 2022) and analyzed for the complete lists of Appendix III[2]

[1] Antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, fluoride, lead, lithium, mercury, molybdenum, selenium, thallium, and radium 226 + 228

[2] Boron, calcium, chloride, fluoride, pH, sulfate, and total dissolved solids (TDS)

and IV parameters per § 257.95(b). The groundwater analytical results from these events are summarized in **Table 2**. Laboratory reports associated with the August and October 2022 results are provided in the *2022 Annual Groundwater and Corrective Action Monitoring Report* (Geosyntec, 2023).

Groundwater samples collected in October 2022 from WGWC-26D and WGWC-27 represent the first event to assess delineation of the SSLs observed at WGWC-20 at AP-1. To statistically compare groundwater data to GWPS, confidence intervals are constructed for each of the detected Appendix IV constituents in each downgradient detection and assessment monitoring well once a minimum of four samples have been collected. In accordance with Section 21.1.1 of the Unified Guidance (USEPA, 2009), four independent data are the minimum population size recommended to construct confidence intervals required to assess SSLs for Appendix IV constituents and statistically determine if delineation is achieved.

Review of the October 2022 analytical results reported for WGWC-27 suggest that SSLs of lithium and beryllium identified in WGWC-20 are horizontally delineated to below their GWPS (i.e., 0.040 mg/L; 0.004 mg/L, respectively) and contained within the property boundary. Similarly, the initial October 2022 beryllium result reported for WGWC-26D vertically delineates WGWC-20 to below the GWPS. Vertical delineation of lithium in WGWC-20 is ongoing and pending additional sample data from WGWC-26D. Iso-concentration maps illustrating delineation for the lithium and beryllium concentrations observed in WGWC-20 are provided on **Figures 4** and **5**, respectively. In addition, cross-sections both perpendicular and parallel to groundwater flow in this area of interest are provided in **Figure 6**.

4.0 GROUNDWATER CORRECTIVE MEASURES

4.1 Objectives of the Corrective Measures

In evaluating the effectiveness of potential corrective measures using the criteria listed in § 257.96(c), including performance, reliability, ease of implementation, potential impacts, time required, and institutional and public health requirements, the following criteria listed in § 257.97(b) must be met by the corrective measure when selected:

- Be protective of human health and the environment;
- Attain applicable groundwater protection standards as specified pursuant to § 257.95(h);
- Control the sources of releases to reduce or eliminate, to the maximum extent feasible, further releases of constituents in Appendix IV to this part to 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; and
- Comply with standards for management of CCR as specified in § 257.98(d).

Corrective measures selected for evaluation herein for potential use at AP-1 are anticipated to satisfy the above criteria to varying degrees of effectiveness.

4.2 Summary of Corrective Measures

The closure of AP-1 via removal of CCR materials as described in Section 1.3 is a source control measure that reduces the potential for migration of CCR constituents to groundwater. Corrective measures discussed in this ACM are being evaluated to address SSLs in groundwater at and downgradient of the compliance boundary.

This section presents potential corrective measures capable of remediating the Appendix IV groundwater constituents (i.e., lithium and beryllium) at AP-1. Each corrective measure is evaluated relative to criteria specified in § 257.96(c) and § 257.97(b). **Table 4** provides a comparative screening of the corrective measures discussed in Section 4.

The following potential corrective measures are considered in this ACM:

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

ISS, also known as deep soil mixing, is a method for solidifying soil, immobilizing constituents of interest in the solid matrix. ISS technology was not retained as it is less effective or not applicable to dilute concentrations of lithium and beryllium in groundwater beyond the facility boundary as compared to the other options being evaluated. As such, no detailed evaluation on ISS is provided in **Table 4**.

4.2.1 Geochemical Approaches (In-Situ Injection)

Beryllium can be precipitated and/or immobilized under different combinations of pH and redox conditions. A variety of pH and/or redox-altering technologies are available which can incorporate biological processes, chemical oxidants and reductants, and/or mechanical processes such as air sparging. These processes can be used to decrease the mobility of beryllium. For example, beryllium can be sorbed to iron and manganese oxides or co-precipitated with sulfide minerals. Lithium is often a conservative inorganic species in many environmental conditions, and the application of in-situ injection treatment for immobilization will require site-specific investigation.

To understand the geochemical processes that would effectively immobilize beryllium and potentially lithium in groundwater, site-specific bench-scale and potentially field pilot-scale treatability studies would be needed to identify an effective amendment to create the appropriate conditions for the precipitation and/or sorption of these constituents without mobilizing other naturally-occurring constituents. Once precipitated, these minerals are often stable even if geochemical conditions revert back to a different redox environment. However, if not properly designed and implemented, manipulating redox conditions without forming the desired compounds may increase the mobility of naturally occurring constituents.

Air sparging can be used to provide oxygen to the subsurface in an attempt to precipitate out (or make more “sorptive”) compounds that are generally more soluble and mobile under reducing conditions. This can also support the precipitation of iron and manganese oxides, which would provide additional sorption sites for constituents such as beryllium.

Furthermore, in-situ chemical oxidation (ISCO) or in-situ chemical reduction (ISCR) can be used to chemically alter the redox or pH environment in the subsurface to affect the mobility and/or bioavailability of certain inorganic compounds.

The main limiting process in these in-situ remedial approaches is the delivery of the compounds within the area of interest. Mixing and contact with the target constituents are necessary and can be difficult to target in shallow bedrock environments like that encountered in the vicinity of WGWC-20, where quartzite bedrock is encountered less than five feet below ground surface and impacted groundwater likely travels through competent bedrock fractures.

The attenuation of beryllium is expected to occur under both aerobic (via sorption to manganese or iron oxides) and anaerobic conditions (via formation of sulfide minerals). Therefore, in-situ injections would be considered a potentially viable corrective measure to address beryllium in groundwater at AP-1, especially in smaller, more localized areas. However, application of this technology to lithium is limited due to the conservative nature of the species and lack of investigation into applicable remedial alternatives as a result of absence in other regulatory frameworks. Therefore, further testing would be required to determine the efficacy of this treatment for lithium removal. In addition, effective delivery of amendment compounds will require further evaluation in the vicinity of WGWC-20. This technology is a potentially viable corrective measure and will be retained for further evaluation.

4.2.2 Hydraulic Containment (Pump and Treat)

Generally, hydraulic containment (or control) refers to the use of groundwater extraction to artificially induce a hydraulic gradient and capture or control the migration of impacted groundwater. One example, groundwater pump and treat (P&T), is often considered to be a viable remedial technology at many sites (US EPA, 1996). 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 or sewer system, reinjection into the aquifer, or reuse. Groundwater P&T can be effective as an interim measure, or combined with another measure, to provide hydraulic containment to limit constituent migration toward a potential receptor.

Groundwater extraction for hydraulic control can often effectively address the variety of inorganic constituents encountered at CCR sites, including beryllium and lithium. Extraction technologies also have the ability to overcome the limitations of in situ injection-based technologies (e.g., mixing and contact with affected materials). Space constraints are mainly limited to the above-ground conveyance and treatment component of a P&T system since extraction wells can generally be fit into relatively tight spaces at the edge of waste or other points of compliance.

Extracted groundwater may need to be treated prior to discharge (depending on discharge permit requirements) but does have the potential to be used for irrigation (e.g., of a cover system or other vegetated areas at the Site) or dust suppression purposes. It could also be used as moisture conditioning of dry ash that is being landfilled. Therefore, P&T is a potentially viable corrective measure for beryllium and lithium in groundwater at AP-1 and will be retained for further evaluation.

4.2.3 Monitored Natural Attenuation

The US EPA defines monitored natural attenuation (MNA) as the reliance on natural attenuation processes (within the context of a carefully controlled and monitored site cleanup approach) to achieve site-specific remediation objectives within a time frame that is reasonable compared to that offered by other more active methods. The natural attenuation processes that are at work in such a remediation approach include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. These in-situ processes include biodegradation; dispersion; dilution; sorption; volatilization; radioactive decay; and chemical or biological stabilization, transformation, or destruction of contaminants (US EPA, 2015).

Attenuation mechanisms for inorganic constituents, such as beryllium and lithium, are either physical or chemical. Physical attenuation mechanisms such as dilution and dispersion may be appropriate as a polishing step (e.g., at the boundaries of impacted groundwater, when source control is complete, a separate active remedy is being used, and appropriate land use and groundwater controls are in place). Source control measures planned for AP-1 include closure by removal of CCR materials from AP-1 and placement into the onsite existing landfill. Chemical attenuation mechanisms through sorption or oxidation reduction reactions discussed in more detail below may be viable as a stand-alone corrective measure.

As stated by US EPA (2015): “MNA may, under certain conditions (e.g., through sorption or oxidation-reduction reactions), effectively reduce the dissolved concentrations and/or toxic forms of inorganic contaminants in groundwater and soil. Both metals and non-metals (including radionuclides) may be attenuated by sorption reactions such as precipitation, adsorption on the surfaces of soil minerals, absorption into the matrix of soil minerals, or partitioning into organic matter. Oxidation-reduction (redox) reactions can transform the valence states of some inorganic contaminants to less soluble and thus less mobile forms (e.g., hexavalent uranium to tetravalent uranium) and/or to less toxic forms (e.g., hexavalent chromium to trivalent chromium).” Beryllium has been observed to undergo sorption to iron and manganese oxides and, depending on specific redox conditions, may also form sparingly soluble sulfide minerals via abiotic or biotic processes. However, lithium is characterized as a generally conservative compound and removal via chemical attenuation processes may be limited. Application of MNA to beryllium and lithium removal may also be used as a polishing step used in conjunction with source control or other groundwater corrective measures.

The US EPA uses four phases to establish whether MNA can be successfully implemented at a given site. The phases (or steps) include:

- Phase I: Demonstration that the groundwater plume is *not expanding*.
- Phase II: Determination that the *mechanism and rate* of the attenuation process are sufficient.
- Phase III: Determination that the *capacity* of the aquifer is sufficient to attenuate the mass of contaminant within the plume and the *stability* of the immobilized contaminant is sufficient to resist re-mobilization.
- Phase IV: Design of a *performance monitoring program* based on an understanding of the mechanism of the attenuation process, and establishment of contingency remedies tailored to site-specific characteristics.

Physical and chemical MNA mechanisms for beryllium and lithium, including dilution, dispersion, sorption, and precipitation, can be operational without the potential for additional mass of beryllium or lithium migrating to downgradient groundwater. Even under current conditions, attenuation processes for beryllium and lithium are already occurring as evidenced by groundwater data from assessment wells, which indicates reduction in beryllium and lithium concentrations to below GWPS at a short distance downgradient of WGWC-20 in WGWC-27. In the August 2022 statistical analysis, beryllium and lithium do not show statistically significant trends in concentration, however visually the concentrations appear to be stable and decreasing for beryllium and lithium, respectively, over time in WGWC-20 (**Figure 7**). Therefore, MNA is a potentially viable corrective measure for beryllium and lithium in groundwater at AP-1 and will be retained for further evaluation.

4.2.4 Permeable Reactive Barriers

Permeable reactive barriers (PRBs) can present a viable alternative for in-situ treatment of many inorganic CCR constituents. The technology typically involves the installation of a subsurface wall constructed with reactive media such as zero-valent iron (ZVI), biologically active media (to induce oxidizing or reducing conditions), or clays, apatite, zeolites, and/or peat moss (to promote ionic exchange and/or sorption). PRBs have proven to be effective in passively treating several inorganic constituents found at CCR sites, including arsenic, selenium, and chromium (e.g., ITRC, 2011). However, there is limited information and precedent available to show successful removal of beryllium and lithium. Further research and additional testing will be required to identify if an appropriate PRB material exists for the attenuation of beryllium and lithium.

PRBs can be installed in downgradient locations using conventional excavation methods or one-pass trenching methods. Excavated trenches get back-filled with reactive media to create a barrier that treats dissolved constituents as they passively flow through the PRB with the groundwater (e.g., ITRC, 2011). These systems can either be constructed as continuous “walls” or as “funnel-and-gate” systems where (impermeable) slurry walls create a “funnel” that directs groundwater to permeable “treatment gates” filled with reactive materials. Since the costs for reactive materials (e.g., ZVI or similar) are generally higher than bentonite-based slurry wall construction, these configurations with a smaller treatment area help to lower construction and maintenance costs.

The installation depths of a PRB unit are generally limited to about 90 ft below ground surface (ft bgs), which is suitable for AP-1 where SSLs are observed less than 40 ft bgs. However, quartzite bedrock is shallow in the vicinity of WGWC-20 (less than five feet below ground surface), which would make installation of a PRB more complex, requiring either removal of bedrock or injection of the PRB material into the bedrock fracture zones. Further evaluation of amenable installation techniques for the AP-1 subsurface geology would be needed. The installation of a PRB generally requires more space than extraction wells, but the system does not require above-ground treatment components and therefore, the overall treatment footprint is likely to be smaller compared to a P&T system.

Additional subsurface investigations, aquifer testing, reactive media testing, and compatibility testing of groundwater and a potential slurry wall component of a PRB are a few considerations for application of this technology to address beryllium and lithium in groundwater at AP-1. However, the measure is potentially viable and will be retained for further evaluation.

4.2.5 Phytoremediation

Phytoremediation is the use of plants to degrade, immobilize, or contain constituents in soil, groundwater, surface water, and sediments. Over recent decades, phytoremediation has emerged as a viable alternative to more active and costly environmental cleanup technologies, especially for large areas with relatively low levels of constituents in shallow soils or groundwater. The effectiveness of groundwater remediation using traditional phytoremediation approaches may be limited by compacted soil conditions that impede root penetration, or target groundwater that is too deep for root access. Given that WGWC-20 is screened between 30 and 40 ft bgs, traditional plantings for phytoremediation are not expected to be successful. However, more recently, an engineered approach to phytoremediation, the *TreeWell*® system (which is a proprietary system developed by Applied Natural Sciences [ANS]), has been shown to overcome these constraints by utilizing a specialized lined planting unit constructed with optimum planting media designed to promote downward root growth, encourage constituent treatment, and focus groundwater extraction from a targeted depth interval (e.g., Gatliff et al., 2016).

By installing a cased "well" for tree planting using large diameter auger (LDA) technology, extraction of deeper groundwater zones (i.e., in excess of 50 ft bgs) can be achieved since the surface of the "well" is sealed and only groundwater from a targeted zone is allowed into the cased-off borehole. This type of system mirrors a traditional mechanical extraction system using the trees as pumps. The *TreeWell* system can be used for both hydraulic control of groundwater and for treatment of constituents via degradation (for organic constituents) or immobilization/containment mechanisms (for organic and inorganic constituents). With respect to the site-specific conditions, the system would be applied for hydraulic control, but beryllium and lithium are expected to be either immobilized within the root zone or incidentally taken up into the tree biomass. While the SSL constituents are likely amenable to this corrective measure, subsurface geology in the vicinity of WGWC-20 may prove challenging. Quartzite bedrock is shallow in the vicinity of WGWC-20 (less than five feet below ground surface) and impacted groundwater is observed to travel through bedrock fracture zones. Targeting such zones with an appropriate *TreeWell* system may be difficult. Further evaluation of amenable installation techniques for the AP-1 subsurface geology would be needed to utilize this approach.

The advantage of the system includes no above-ground water management needs and limited long-term operations and maintenance (O&M) requirements following the establishment of the tree system. Such systems have been observed to meet design hydraulic control parameters typically by the end of the third growing season, when properly designed and spaced. The layout for a *TreeWell* remediation system is generally based on groundwater flow modeling assuming a design uptake rate of approximately 40 to 60 gallons per day per tree.

Based on the current understanding of groundwater flow velocities downgradient of AP-1 (approximately 35 feet/year), a phytoremediation approach may be feasible and will be retained for further evaluation.

4.2.6 Subsurface Vertical Barrier Walls

Subsurface vertical barrier walls (sometimes referred to as slurry walls) have been used for seep control and groundwater cutoff at impoundments and waste disposal units for more than three decades. In general, barrier walls are designed to provide containment; localized treatment achieved through sorption or chemical precipitation reactions from construction of the walls are incidental to the design objective.

This approach involves placing a barrier to groundwater flow in the subsurface, frequently around the source area (or the downgradient limits of the source area), to prevent future migration of dissolved constituents in groundwater from beneath the source to downgradient areas. Barrier walls can also be used in downgradient applications to limit discharge to a surface water feature or to reduce aquifer recharge from an adjacent surface water feature when groundwater extraction wells are placed near a surface water feature. A variety of barrier materials can be used, including cement and/or bentonite slurries or various mixtures of soil with cement or bentonite, geomembrane composite materials, or driven materials such as steel or vinyl sheet pile.

The installation of these low-permeability walls is similar to the methods described for PRBs above. In general, the applicability of slurry walls is limited by the depth of installation, which is approximately 90 ft below ground surface. However, site-specific geologic considerations may limit this depth to shallower installations given the shallow occurrence of bedrock in the vicinity of WGWC-20. Further evaluation would be needed to identify a potential installation method that would be applicable in the AP-1 geology where groundwater is traveling through bedrock fracture zones.

Groundwater pumping is generally required upgradient of the barrier wall to maintain an inward hydraulic gradient. The extracted groundwater would likely require treatment in an above-ground treatment system.

While additional subsurface investigations, aquifer testing, and wall compatibility testing with the groundwater chemistry will be needed to further evaluate the feasibility as well as the placement of a barrier wall at WGWC-20, the technology is currently considered to be a potentially viable corrective measure to address beryllium and lithium in groundwater at AP-1 and will be retained for further evaluation.

5.0 REMEDY SELECTION PROCESS

The purpose of this ACM is to begin the process of selecting corrective measure(s) for groundwater based on further evaluation using the criteria outlined in § 257.96. The following sections present the pond closure and site management strategy, additional data gathering, schedule, reporting, and next steps.

5.1 Pond Closure and Site Management Strategy

Georgia Power plans to close AP-1 via removal of the CCR materials from the unit for onsite disposal at the onsite existing landfill. During the pond closure, temporary changes in site conditions may occur. Additionally, the site conceptual model may need to be refined and/or updated from the current understanding as more data are collected. Georgia Power plans to 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 assure that performance criteria and site remedial goals are met.

5.2 Additional Data Gathering

Additional data, data analysis, and site-specific evaluation are necessary to refine the conceptual site model and to further evaluate the feasibility of each corrective measure presented herein such that an appropriate groundwater corrective measure may be selected. Some of the data needed to refine the conceptual site model may be collected concurrent with routine groundwater monitoring events under the assessment monitoring program, or during supplementary sampling, if required. However, additional data collection that includes aquifer testing, groundwater modeling, material compatibility testing, bench scale studies, and/or field pilot tests may require an estimated one to two additional years to complete. Once sufficient data are available to select a focused number of corrective measures or a combination of corrective measures that would provide an effective groundwater remedy, necessary steps will be taken to implement a remedy at the Site in accordance with § 257.98.

5.3 Schedule, Reporting, and Next Steps

Additional data collection will begin in 2023. Georgia Power will prepare semiannual progress reports to document Site groundwater conditions, results associated with additional data gathering identified in Section 5.2 and in **Table 4**, and the progress in selecting and designing the remedy in accordance with § 257.97(a) beginning in August 2023. These reports will be posted to Georgia Power's website.

A draft remedy selection report will be submitted to GA EPD for review and concurrence on the proposed remedy and, at least 30 days prior to the final selection of remedy or remedies, a public meeting to discuss the results of the corrective measures assessment will be held pursuant to § 257.96(e). The final remedy selection report will be developed as outlined in § 257.97(a). Once the remedy has been selected, the implementation of the remedy will be initiated in accordance with § 257.98.

6.0 REFERENCES

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TABLES

Table 1
Monitoring Well Network Summary
Plant Wansley AP-1, Heard and Carroll Counties, Georgia

Well ID	Hydraulic Location / Purpose	Installation Date	Northing (1)	Easting (1)	Ground Surface Elevation (1,2) (ft)	Top of Casing Elevation (1) (ft)	Top of Screen Elevation (1) (ft)	Bottom of Screen Elevation (1) (ft)	Well Depth (ft BTOC) (3)	Screen Interval Length (ft)
Detection Monitoring Well										
WGWA-1	Upgradient	10/21/2015	1250656.10	2035580.71	780.37	782.93	663.37	653.37	129.56	10
WGWA-2	Upgradient	10/16/2015	1251556.40	2035590.11	755.77	758.23	665.77	655.77	102.46	10
WGWA-3	Upgradient	12/15/2014	1240848.21	2022350.10	826.63	828.91	820.23	810.23	18.68	10
WGWA-4	Upgradient	01/13/2015	1240879.58	2022339.66	831.33	834.34	780.43	760.43	74.31	20
WGWA-5	Upgradient	12/23/2014	1241997.94	2022368.85	899.28	902.15	888.88	878.88	23.66	10
WGWA-6	Upgradient	01/13/2015	1241932.02	2022360.58	894.62	897.13	822.62	792.62	104.91	30
WGWA-7	Upgradient	12/22/2014	1243338.63	2023843.81	894.49	897.33	867.69	857.69	40.04	10
WGWA-18	Upgradient	12/16/2014	1244592.56	2025580.71	875.47	878.02	848.47	838.47	39.95	10
WGWC-8	Downgradient	10/29/2015	1242929.40	2029644.58	777.70	780.08	730.70	720.70	59.38	10
WGWC-9	Downgradient	12/4/2014	1242801.12	2029115.75	809.33	812.03	760.93	750.93	61.50	10
WGWC-10	Downgradient	10/27/2015	1240971.96	2026725.61	809.61	812.38	673.61	663.61	148.77	10
WGWC-11	Downgradient	12/8/2014	1240860.18	2025773.39	821.44	823.96	783.14	773.14	51.22	10
WGWC-12	Downgradient	10/22/2015	1240827.68	2025755.99	820.57	823.04	756.57	746.57	76.47	10
WGWC-13	Downgradient	11/4/2015	1240610.93	2024585.91	807.32	809.78	734.32	714.32	95.46	20
WGWC-14A	Downgradient	01/31/2017	1240604.54	2024599.63	808.20	810.94	778.20	768.20	42.74	10
WGWC-15	Downgradient	11/11/2015	1240483.16	2023912.92	802.03	804.69	758.53	748.53	56.16	10
WGWC-16	Downgradient	11/11/2015	1240480.46	2023903.77	801.72	804.21	779.72	769.72	34.50	10
WGWC-17	Downgradient	11/06/2015	1240052.06	2022623.82	813.36	816.00	730.36	720.36	95.94	10
WGWC-19	Downgradient	10/28/2015	1241851.51	2028949.19	780.60	783.42	698.60	688.60	94.82	10
WGWC-20	Downgradient	09/29/2020	1243350.76	2029769.43	804.88	807.95	775.18	765.18	43.17	10
WGWC-21	Downgradient	10/02/2020	1242139.33	2028512.65	831.79	834.41	773.11	763.11	71.70	10
WGWC-22	Downgradient	10/18/2020	1241695.25	2028116.05	807.00	810.37	776.92	766.92	43.85	10
WGWC-23	Downgradient	10/04/2020	1240769.79	2027414.58	820.50	823.80	780.40	770.40	53.80	10
WGWC-24	Downgradient	10/17/2020	1239916.68	2024139.82	802.22	804.80	774.43	764.43	40.77	10
WGWC-25	Downgradient	10/28/2020	1240184.18	2023616.69	805.98	808.98	779.51	769.51	39.87	10
Piezometer										
PZ-01	Piezometer	12/12/2014	1240249.86	2022319.93	853.91	856.72	817.81	807.81	49.31	10
PZ-04	Piezometer	12/22/2014	1242592.03	2023595.91	886.13	889.01	878.93	868.93	20.48	10
PZ-06	Piezometer	12/17/2014	1244382.89	2024661.39	912.30	915.15	898.60	888.60	26.95	10
PZ-08	Piezometer	12/15/2014	1245514.59	2026807.30	864.65	867.29	836.85	826.85	40.84	10
PZ-10	Piezometer	12/05/2014	1242058.41	2028554.29	829.26	832.02	810.46	800.46	31.96	10
PZ-11	Piezometer	12/05/2014	1240578.87	2026933.09	820.21	823.09	799.71	789.71	33.78	10
PZ-12	Piezometer	12/08/2014	1240837.96	2026731.01	816.17	818.74	779.37	769.37	49.78	10
PZ-15	Piezometer	12/10/2014	1240457.61	2025105.38	824.59	826.86	795.79	785.79	41.46	10
PZ-16	Piezometer	12/11/2014	1239419.77	2023662.22	798.05	800.70	785.05	775.05	26.15	10
PZ-17	Piezometer	12/11/2014	1239270.02	2023086.50	828.54	831.01	789.84	779.84	51.57	10
PZ-18	Piezometer	12/11/2014	1239569.52	2022299.20	812.10	814.51	788.20	778.20	36.71	10
PZ-20	Piezometer	01/31/2017	1243496.86	2030132.73	784.45	787.30	759.45	749.45	37.85	10
PZ-23D	Piezometer	10/02/2020	1242139.53	2028520.87	831.89	834.32	749.92	739.92	94.80	10
PZ-26D	Piezometer	10/12/2020	1239919.45	2024146.35	802.31	804.93	735.23	725.23	80.10	10
PZ-27D	Piezometer	10/15/2020	1240190.93	2023620.36	806.22	809.28	737.96	727.96	81.72	10
PZ-28	Piezometer	10/29/2020	1240066.02	2022624.73	813.57	816.18	753.68	743.68	72.90	10
PZ-29S	Piezometer	10/31/2020	1244317.13	2028839.68	805.80	805.30	770.28	760.28	45.42	10
PZ-29D	Piezometer	11/01/2020	1244304.90	2028853.29	805.77	805.24	688.69	678.69	126.95	10
WAMW-1	Piezometer	09/16/2018	1241843.66	2028944.63	780.05	782.66	668.40	658.40	124.60	10
WAMW-2	Piezometer	09/14/2018	1241547.56	2028806.27	768.39	770.82	694.19	684.19	86.92	10
Assessment Monitoring Well										
WGWC-26D	Assessment	9/26/2022	1243343.66	2029758.85	805.06	808.23	749.31	739.31	66.10	10
WGWC-27	Assessment	9/27/2022	1243215.51	2029878.92	778.05	780.54	749.15	739.15	39.20	10

Notes:
ft = feet
ft BTOC = feet below top of casing
(1) Coordinates in North American Datum (NAD) 1983, State Plane, Georgia-West, feet. Elevations referenced to the North American Vertical Datum of 1988 (NAVD88). Survey of WGWA-1 through WGWA-18, WGWC-8 through WGWC-19, WAMW-1 and WAMW-2, and PZ-01 through PZ-20 was completed by GEL Solutions and certified June 16, 2020. Survey of WGWC-20 through WGWC-25, and PZ-23D through PZ-29D was completed by GEL Solutions and certified on November 17, 2020. Survey of WGWC-26D and WGWC-27 was completed by GEL Solutions and certified on October 13, 2022.
(2) Ground surface elevation defined at the survey nail installed within the well pad.
(3) Total well depth accounts for sump if data provided on construction logs.

Table 2
Summary of Groundwater Analytical Data
Plant Wansley AP-1, Heard and Carroll Counties, Georgia

	Well ID:	WGWA-1	WGWA-2	WGWA-3	WGWA-4	WGWA-5	WGWA-6	WGWA-7	WGWA-18	WGWC-8	WGWC-9	WGWC-10	WGWC-11	WGWC-12	WGWC-13
	Sample Date:	8/15/2022	8/15/2022	8/16/2022	8/16/2022	8/15/2022	8/15/2022	8/16/2022	8/16/2022	8/16/2022	8/17/2022	8/19/2022	8/16/2022	8/18/2022	8/18/2022
	Constituent [1,2]														
Appendix III	Boron	<0.060	0.066 J	<0.060	<0.060	<0.060	<0.060	<0.060	<0.060	2.3	0.55	<0.060	<0.060	<0.060	<0.060
	Calcium	1.2	12	1.8	16	51	24	0.94	8.8	83	9.0	7.3	1.6	13	3.5
	Chloride	4.0	2.7	1.6	1.2	1.5	1.5	1.9	1.9	110	3.2	1.4	3.5	3.0	0.98 J
	Fluoride	<0.040	0.057 J	<0.040	0.12	<0.040	0.093 J	<0.040	0.060 J	0.21	0.90	0.10	<0.040	0.073 J	0.14
	pH [3]	5.28	6.04	5.46	6.92	6.54	7.76	5.32	6.19	5.40	5.80	6.20	5.56	6.52	6.15
	Sulfate	<0.40	0.54 J	0.52 J	6.9	1.6	7.5	<0.40	7.2	220	50	1.6	0.98 J	11	1.7
	TDS	45	100	30	110	140	120	22	60	580	150	63	33	88	89
Appendix IV	Antimony	<0.00051	<0.00051	<0.00051	0.00051 J B	<0.00051	<0.00051	<0.00051	<0.00051	0.011	0.0043	<0.00051	0.00053 J	<0.00051	<0.00051
	Arsenic	<0.00028	<0.00028	<0.00028	<0.00028	<0.00028	<0.00028	<0.00028	<0.00028	0.00097 J	<0.00028	<0.00028	<0.00028	<0.00028	0.00034 J
	Barium	0.045	0.022	0.014	0.0062 J	0.029	0.0069 J	0.011	0.012	0.0014 J	<0.00089	0.030	0.038	0.014	0.041
	Beryllium	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.0018 J	0.00033 J	<0.00020	<0.00020	<0.00020	<0.00020
	Cadmium	<0.000078	<0.000078	<0.000078	<0.000078	<0.000078	<0.000078	<0.000078	<0.000078	<0.000078	<0.000078	<0.000078	<0.000078	<0.000078	<0.000078
	Chromium	0.0063	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	0.0024	<0.0015	<0.0015	<0.0015
	Cobalt	0.0007 J	0.00045 J	<0.00022	<0.00022	0.00063 J	<0.00022	<0.00022	0.00075 J	0.00075 J	<0.00022	0.0014 J	<0.00022	0.00034 J	<0.00022
	Fluoride	<0.040	0.057 J	<0.040	0.12	<0.040	0.093 J	<0.040	0.060 J	0.21	0.90	0.10	<0.040	0.073 J	0.14
	Lead	<0.00017	<0.00017	<0.00017	<0.00017	<0.00017	0.00019 J	<0.00017	<0.00017	0.00041 J	<0.00017	0.00030 J	<0.00017	<0.00017	0.0011
	Lithium	0.0032 J	0.0070	<0.00083	0.0043 J	<0.00083	0.0047 J	<0.00083	<0.00083	0.014	0.028	0.0049 J	0.00092 J	0.0063	0.0024 J
	Mercury	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080
	Molybdenum	<0.00086	<0.00086	<0.00086	<0.00086	<0.00086	<0.00086	<0.00086	<0.00086	<0.00086	0.0027 J	<0.00086	<0.00086	<0.00086	0.00087 J
	Comb. Radium 226/228	0.559	0.725	0.628	2.02	2.38	9.58	0.653	1.18	2.40	0.139 U	0.497 U	0.500	0.279 U	0.719
	Selenium	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012	0.0075	0.0022 J	<0.0012	<0.0012	<0.0012	<0.0012
	Thallium	<0.00026	<0.00026	<0.00026	<0.00026	<0.00026	<0.00026	<0.00026	<0.00026	<0.00026	<0.00026	<0.00026	<0.00026	<0.00026	<0.00026

Notes:
TDS = total dissolved solids
< = Indicates the parameter was not detected above the analytical MDL
B = Compound was found in the blank and sample
J = Indicates the parameter was estimated and detected between the method detection limit (MDL) and the reporting limit (RL)
U = Indicates the parameter was not detected above the analytical minimum detectable concentration (MDC) (Specific to combined radium 226/228)
(1) Appendix III/IV parameter per 40 CFR 257 Subpart D. Parameters are reported in units of milligrams per liter (mg/L), except for pH reported as s.u. (standard units) and combined radium reported as picocuries per liter (pCi/L).
(2) Metals were analyzed by EPA Method 6020B and Method 7470A, anions were analyzed by EPA Method 300.0, TDS was analyzed by SM 2540C, and combined radium by EPA Methods 9315/9320.
(3) The pH value presented was recorded at the time of sample collection in the field.

Table 2

Summary of Groundwater Analytical Data

Plant Wansley AP-1, Heard and Carroll Counties, Georgia

	Well ID:	WGWC-14A	WGWC-15	WGWC-16	WGWC-17	WGWC-19	WGWC-20	WGWC-21	WGWC-22	WGWC-23	WGWC-24	WGWC-25	WGWC-26D	WGWC-27
	Sample Date:	8/19/2022	8/17/2022	8/17/2022	8/16/2022	8/17/2022	8/18/2022	8/16/2022	8/19/2022	8/17/2022	8/18/2022	8/17/2022	10/19/2022	10/19/2022
	Constituent [1,2]													
Appendix III	Boron	<0.060	<0.060	0.73	<0.060	<0.060	2.2	0.099	0.33	<0.060	0.44	0.82	2.9 B	0.098 B
	Calcium	0.64	29	20	5.6	9.8	110	55	18	4.6	16	15	130	5.9
	Chloride	2.1	1.2	35	1.3	2.8	140	41	4.2	3.2	27	77	200	5.0
	Fluoride	<0.040	0.68	0.062 J	0.060 J	0.28	2.0	1.8	0.31	0.043 J	0.24	<0.040	1.8	0.52
	pH [3]	5.25	7.54	5.24	6.02	6.60	5.29	6.72	5.34	5.64	4.42	5.28	6.27	5.93
	Sulfate	<0.40	14	49	3.4	2.8	280	240	87	5.5	49	25	290	12
	TDS	26	140	170	81	93	760	530	190	85	140	210	840	92
Appendix IV	Antimony	<0.00051	<0.00051	<0.00051	<0.00051	0.00058 J	<0.00051	0.00055 J B	<0.00051	<0.00051	<0.00051	<0.00051	<0.00051	<0.00051
	Arsenic	<0.00028	0.00052 J	<0.00028	<0.00028	<0.00028	<0.00028	0.00028 J	<0.00028	<0.00028	0.00028 J	<0.00028	<0.00028	<0.00028
	Barium	0.026	0.027	0.032	0.011	0.0012 J	0.00091 J	0.0039 J	0.023	0.0089 J	0.041	0.31	0.0069 J	0.0036 J
	Beryllium	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.0081	0.00022 J	0.00063 J	0.00078 J	0.0044	0.00022 J	0.0040	0.00054 J
	Cadmium	<0.000078	<0.000078	<0.000078	<0.000078	<0.000078	<0.000078	<0.000078	0.000090 J	<0.000078	0.00015 J	0.00012 J	0.00014 J	<0.000078
	Chromium	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	<0.0015	0.0024	<0.0015
	Cobalt	0.0020 J	<0.00022	<0.00022	<0.00022	<0.00022	<0.00022	0.00039 J	<0.00022	<0.00022	0.031	0.0037	0.0016 J	0.0020 J
	Fluoride	<0.040	0.68	0.062 J	0.060 J	0.28	2.0	1.8	0.31	0.043 J	0.24	<0.040	1.8	0.52
	Lead	0.00036 J	<0.00017	<0.00017	<0.00017	<0.00017	<0.00017	<0.00017	0.00037 J	<0.00017	0.00032 J	<0.00017	<0.00017	<0.00017
	Lithium	0.0021 J	0.0073	0.0042 J	0.0053	0.056	0.11	0.059	0.010 B	0.0017 J	0.0036 J	0.0036 J	0.16	0.0072
	Mercury	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080
	Molybdenum	<0.00086	0.0025 J	<0.00086	0.0024 J	0.0010 J	<0.00086	0.042	<0.00086	<0.00086	<0.00086	<0.00086	0.0087 J	<0.00086
	Comb. Radium 226/228	0.932	0.563	0.946	0.668	0.155 U	0.994	1.35	3.07	0.976	1.03	0.763	3.77	0.185 U
	Selenium	<0.0012	<0.0012	<0.0012	<0.0012	<0.0012	0.0027 J	<0.0012	0.0035 J	0.0013 J	<0.0012	<0.0012	0.0014 J	<0.0012
	Thallium	<0.00026	<0.00026	<0.00026	<0.00026	<0.00026	<0.00026	<0.00026	<0.00026	<0.00026	0.00030 J	<0.00026	<0.00026	<0.00026

Notes:

TDS = total dissolved solids

< = Indicates the parameter was not detected above the analytical MDL

B = Compound was found in the blank and sample

J = Indicates the parameter was estimated and detected between the method detection limit (MDL) and the reporting limit (RL)

U = Indicates the parameter was not detected above the analytical minimum detectable concentration (MDC) (Specific to combined radium 226/228)

(1) Appendix III/IV parameter per 40 CFR 257 Subpart D. Parameters are reported in units of milligrams per liter (mg/L), except for pH reported as s.u. (standard units) and combined radium reported as picocuries per liter (pCi/L).

(2) Metals were analyzed by EPA Method 6020B and Method 7470A, anions were analyzed by EPA Method 300.0, TDS was analyzed by SM 2540C, and combined radium by EPA Methods 9315/9320.

(3) The pH value presented was recorded at the time of sample collection in the field.

Table 3
Groundwater Protection Standards
Plant Wansley AP-1, Heard and Carroll Counties, Georgia

Constituent	Units	MCL	CCR-Rule Specified (1)	Background Limit(2)	GWPS(3)
Antimony	mg/L	0.006		0.0022	0.006
Arsenic	mg/L	0.01		0.0014	0.01
Barium	mg/L	2		0.062	2
Beryllium	mg/L	0.004		0.0025	0.004
Cadmium	mg/L	0.005		0.0025	0.005
Chromium	mg/L	0.1		0.0063	0.1
Cobalt	mg/L	N/A	0.006	0.013	0.013(3)
Fluoride	mg/L	4		0.284	4
Lead	mg/L	N/A	0.015	0.001	0.015(3)
Lithium	mg/L	N/A	0.040	0.009	0.040(3)
Mercury	mg/L	0.002		0.0002	0.002
Molybdenum	mg/L	N/A	0.100	0.015	0.100(3)
Selenium	mg/L	0.05		0.005	0.05
Thallium	mg/L	0.002		0.001	0.002
Combined Radium-226/228	pCi/L	5		10.4	10.4

Notes:
mg/L = milligrams per liter
pCi/L = picocuries per liter
MCL = Maximum Contaminant Level
CCR = Coal Combustion Residual
GWPS = Groundwater Protection Standard
N/A = Not Applicable
(1) On February 22, 2022, the Georgia Environmental Protection Division (GA EPD) adopted the federally promulgated GWPS for cobalt, lithium, lead, and molybdenum.
(2) The background limits were used when determining the GWPS under 40 CFR 257.95(h) and GA EPD Rule 391-3-4-.10(6)(a).
(3) Under 40 CFR 257.95(h)(1-3) the GWPS is: (i) the maximum contaminant level (MCL) established under § 141.62 and § 141.66 of this title; (ii) where an MCL has not been established a rule-specific GWPS; or (iii) background levels for constituents where the background level is higher than the MCL or rule-specified GWPS.

Table 4
Evaluation of Remedial Technologies
Plant Wansley AP-1, Heard and Carroll Counties, Georgia

	Regulatory Citation for Criteria:	40 CFR 257.96(C)(1)		40 CFR 257.96(C)(1)	40 CFR 257.96(C)(1)
Corrective Measure	**Description**	**Performance**	**Reliability**	**Ease of Implementation**	**Potential Impacts**
Geochemical Approaches (In-Situ Injection)	Use of an injection well network, or other means of introducing reagents or air into the subsurface, to promote either anaerobic or aerobic attenuation of beryllium (Be) and potentially lithium (Li), although further evaluation and testing would be needed to understand applicability to Li attenuation. The main attenuation mechanism for Be is sorption, which is more dependent on pH than redox. Under anaerobic conditions, Be would be attenuated within sparingly soluble sulfide minerals. Under aerobic conditions, soluble iron or manganese and oxygen (either via air sparging or through a chemical oxidant) would be injected to promote the formation of iron or manganese (oxy-) hydroxides for subsequent sorption of Be onto these mineral phases. If sufficient iron is present in groundwater, the use of air sparging alone may be considered to precipitate iron (oxy-) hydroxides for sorption. In-situ chemical oxidation (ISCO) or in-situ chemical reduction (ISCR) can be used to chemically alter the redox environment in the subsurface to affect the mobility of certain inorganic compounds, including Be.	The effective immobilization of Be at neutral to alkaline pH can be effective at achieving groundwater protection standards (GWPS) within a reasonable time frame. This immobilization has been shown at other sites under aerobic and anaerobic conditions; however, the anaerobic approach (involving the injection of an electron donor together with iron or manganese and sulfur) requires careful study and testing. While aerobic approaches are somewhat less complex, additional aquifer characterization is needed to further evaluate these options. Li is generally characterized as nonreactive, and the application of in-situ injection treatment for immobilization would need to be further investigated to evaluate efficacy.	Reliability dependent on permeability of the subsurface and the amount and distribution of secondary iron or manganese (oxy-) hydroxides (for aerobic approach), or electron donors and soluble iron or manganese and sulfur that can be consistently distributed (for anaerobic approach). Reliable technology if injected materials can be distributed throughout the impacted aquifer. Bench- and/or pilot-scale treatability testing programs are needed to understand the biogeochemical processes that would effectively reduce migration of Be and Li in groundwater.	Moderate. Installation of injection well network or other injection infrastructure would be required. Alternative installation approaches may be considered, such as along the downgradient edge of impacted groundwater, which would function similar to a PRB application. The potential for clogging of aquifer matrix and/or injection well infrastructure is an implementation consideration. Chemical distribution during injections (i.e., radius of influence) needs to be evaluated, especially given the shallow bedrock environment in the vicinity of WGWC-20.	Minimal impacts are expected if remedy works as designed, based on a thorough pre-design investigation, geochemical modeling, and bench/pilot study results. Redox-altering processes have the potential to mobilize naturally-occurring constituents as an unintended consequence if not properly studied and implemented.
Hydraulic Containment ("Pump and Treat")	Hydraulic containment refers to the use of groundwater extraction to induce a hydraulic gradient for hydraulic capture or 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.). It is applicable to a variable mix of inorganic constituents, including dissolved Be and Li.	Pump and treat (P&T) is effective at providing hydraulic control, but it is unclear whether full groundwater remediation can be achieved without further understanding attenuation mechanisms at the Site. At WGWC-20, implementation of the corrective measure is contingent on completing additional assessment activities (i.e., high-resolution site characterization, pump tests, flow modeling, and capture zone analysis). This is needed to refine the constituent distribution in the subsurface to target specific flow zones for pumping for improved mass recovery efficiency/effectiveness and to further evaluate the potential remedy performance.	Generally reliable for hydraulic containment, but uncertainty exists whether groundwater remediation goals can be achieved within a reasonable time frame without further understanding attenuation mechanisms.	Moderate. Proven approach, and supplemental installation of extraction wells/trenches is fairly straightforward. The extracted groundwater may potentially require an above-ground treatment system. A variety of sorption and precipitation approaches exist for ex-situ treatment of Be, while this would need to be further evaluated for Li. Operation and maintenance (O&M) requirements are expected to include upkeep of infrastructure components (pumps, pipes, tanks, instrumentation and controls, above-ground treatment system) and handling of treatment residuals.	Moderate. The main potential impacts are related to the presence and operation of an on-site above-ground water treatment facility and related infrastructure to convey and treat extracted groundwater. Pumping activity may unintentionally alter the geochemistry within the hydraulic capture zone.
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. Attenuation mechanisms for inorganic constituents at CCR sites, including Be and Li at WGWC-20, are either physical (e.g., dilution, dispersion, flushing, and related processes) or chemical (sorption or oxidation reduction reactions). Chemical attenuation processes include precipitation and sorption reactions such as adsorption on the surfaces of soil minerals, absorption into the matrix of soil minerals, or partitioning into organic matter. Further, oxidation-reduction (redox) reactions, via abiotic or biotic processes, can transform the valence states of some inorganic constituents to less soluble and thus less mobile forms. For Be, the main attenuation processes include sorption to iron and manganese oxides and for Li, physical attenuation. Further evaluation of chemical attenuation mechanisms for Li would need to be completed.	Physical and chemical MNA mechanisms for Be and Li, including dilution, dispersion, sorption, and oxidation reduction reactions, can be effective at achieving groundwater protection standards (GWPS) within a reasonable time frame. Attenuation processes for Be and Li are already occurring at the site as evidenced by data from the assessment wells. Source control will improve the mass balance such that the buffer capacity of the aquifer is unlikely to be exhausted. The attenuation processes already at work for Be and Li at WGWC-20 will further enhance the effectiveness of MNA.	Reliable as long as the aquifer conditions that result in Be and Li attenuation remain favorable (and/or are being enhanced) and sufficient attenuation capacity is present. MNA is reliable and can either be used as a stand-alone corrective measure for groundwater impacted by dissolved Be, or in combination with a second technology for Be or Li.	Reasonably implementable with respect to infrastructure, but moderate to complex with respect to documentation. Proven approach, but additional data are needed to show that the existing attenuation capacity is sufficient to meet site objectives within a reasonable timeframe. A monitoring well network already exists to implement future groundwater monitoring efforts.	None. MNA relies on the natural processes active in the aquifer matrix to reduce constituent concentrations without disturbing the surface or the subsurface.
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. The effectiveness of a PRB on the removal of Be and Li is relatively unknown. Further research and testing are required to see if Be and Li could be attenuated by a PRB. Exact placement of the PRB is contingent on finalization of the nature and extent characterization and subsurface geologic considerations. PRBs can also be constructed as "funnel and gate" systems, where a barrier wall directs groundwater to a smaller "treatment gate" filled with reactive media.	The PRB approach would be expected to achieve GWPS for Be and Li as impacted groundwater passes through the reactive barrier, if an appropriate reactive barrier can be identified in further evaluations. Additional testing is required to select the appropriate sorptive media mix for both Be and Li.	Reliable groundwater corrective measure, but loss of reactivity over time may require re-installation depending on the duration of the remedy. Additional data collection, including conducting a bench and/or pilot study, is needed to better characterize current attenuation mechanisms and/or select the appropriate reactive media mix for a PRB wall.	Difficult. Trenching at depth through bedrock (up to 40 feet) would be required to install a mix of reactive materials in the subsurface. Placement of reactive material in bedrock fracture zones to capture groundwater would be a complex construction method. Once installed, treatment will be passive and O&M requirements are minimal if replacement of the PRB is not necessary.	Minimal impacts are expected following the construction of the remedy. However, certain PRB methods have the potential to create anaerobic conditions downgradient of the PRB wall that may mobilize redox-sensitive naturally-occurring constituents. These conditions need to be carefully monitored. Short-term impacts during the construction of the remedy can be mitigated through appropriate planning and health and safety measures.
Phytoremediation / *TreeWells*	Phytoremediation uses trees and other plants to degrade or immobilize constituents or achieve hydraulic control without the need for an above-ground water treatment system and infrastructure. Within the context of AP-1, this corrective measure would likely use an engineered (proprietary) TreeWell phytoremediation system along the point of compliance or downgradient edge of the impacted groundwater for hydraulic control. The system promotes root development to the targeted groundwater zone (depth), allowing for hydraulic control of impacted groundwater. In addition, immobilization of Be and Li within the root zone as well as incidental uptake of dissolved Be and Li with groundwater is expected to occur concurrent with hydraulic control.	Once established (typically at the end of the third growing season), a TreeWell system is effective for providing hydraulic containment of groundwater, and potential reduction of Be and Li concentrations through immobilization and/or uptake and sequestration in the tree biomass; however, the main purpose is to provide hydraulic control. Additional aquifer testing and/or groundwater flow modeling would be needed to confirm the suitability of this technology in the shallow bedrock subsurface at WGWC-20.	Engineered phytoremediation is a proven technology where hydrogeologic factors are taken into account (e.g., hydraulic conductivity, flow velocity, depth to impacted groundwater zone, etc.). This is considered an active remedial approach through the use of trees as the "pumps" driving the system. Careful design will be needed to select the proper species, which will include consideration of groundwater chemistry, plant uptake of constituents, and groundwater flow modeling to evaluate the required number and placement of TreeWell units.	Reasonably implementable to moderate. Engineered approach has been proven effective, and specific depth zones can be targeted. Trees are installed as "tree wells" in a large diameter boring to get the roots deep enough to intercept impacted groundwater flow paths. Area must be clear of above and below-ground structures (i.e., power lines). The system, once established (approximately three growing seasons), is a self-maintaining, sustainable remedial system that has no external energy requirements and little maintenance (i.e., efforts normally associated with landscaping).	Minimal impacts are expected. In fact, there are several positive impacts expected, including enhanced aesthetics, wildlife habitat, and limited energy consumption.
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. In general, barrier walls are designed to provide containment; localized treatment achieved through the sorption or chemical precipitation reactions from construction of the walls are incidental to the design objective. A variety of barrier materials can be used, including cement and/or bentonite slurries, geomembrane composite materials, or driven materials such as steel or vinyl sheet pile. Groundwater extraction from upgradient of the barrier may be required to avoid groundwater mounding behind the barrier. A barrier wall might be used in conjunction with a "funnel and gate" system for a PRB rather than a stand-alone technology. Barrier walls can also be used in downgradient applications.	Barrier walls are a proven technology for seepage control and/or groundwater cutoff at impoundments. Slurry walls can be installed up to approximately 90 ft below ground surface (bgs), and groundwater impacts at the site are observed at depths less than 40 ft bgs. Within the context of WGWC-20, groundwater could either be directed to "treatment gates" for passive treatment (in a PRB) or migration of impacted groundwater could be minimized via barrier wall installation. Additional subsurface investigations, aquifer testing, and compatibility testing with site-specific groundwater will be needed to assess applicability in the shallow bedrock subsurface environment.	Generally reliable as a barrier to groundwater flow; however, treatment of downgradient groundwater is typically not the primary objective.	Moderate to difficult. Trenching will be required to fill in the various slurry mixes; alternatively, sheet pile installations can be accomplished without excavation of trenches. The application of barrier walls is limited by the depth of installation and subsurface geology, which will be a consideration at AP-1. Installation methods and materials are readily available. Once installed, above-ground infrastructure to pump and treat groundwater may be required. O&M requirements are expected to include upkeep of infrastructure components (pumps, pipes, tanks, instrumentation and controls, above-ground treatment system) and handling of treatment residuals.	Minimal impacts are expected following the construction of the remedy. Short-term impacts during the construction of the remedy can be mitigated through appropriate planning and health and safety measures. Changes to groundwater flow patterns due to installation of the barrier wall are expected, which can affect other aspects of groundwater corrective action. Pumping activity may unintentionally alter the geochemistry within the hydraulic capture zone that may result in the mobilization of other constituents that may require treatment.

Table 4
Evaluation of Remedial Technologies
Plant Wansley AP-1, Heard and Carroll Counties, Georgia

	40 CFR 257.96(C)(2)	40 CFR 257.96(C)(3)		
Corrective Measure	**Time Requirement to Begin/Complete**	**Institutional Requirements**	**Other Env or Public Health Requirements**	**Relative Costs**
Geochemical Approaches (In-Situ Injection)	Installation of the injection network can be accomplished relatively quickly (1 to 2 months). However, a thorough pre-design investigation, geochemical modeling, and/or bench- and/or pilot-testing will be required to obtain design parameters prior to design and construction of the corrective measure, which may take up to 24 months. Once installed, the time required to achieve GWPS within the treatment area may be relatively quick but depends on the attenuation process kinetics of each targeted constituent. The time for complete distribution of the injected materials throughout the treatment area is also variable.	Obtaining an underground injection control (UIC) permit may be needed.	Based on the results of the Risk Evaluation Report (Appendix A), SSL-related constituents (Li and Be) evaluated from AP-1 are not expected to pose a risk to human health and the environment; therefore, no further risk evaluation for groundwater is warranted based on the current data set. Georgia Power will proactively evaluate the data and update this evaluation, if necessary. Based on downgradient sampling results, there currently are no complete exposure pathways for potential receptors downgradient of WGWC-20. Potential for mobilization of redox-sensitive constituents exists during implementation of an anerobic attenuation approach. Following installation, the remedy is passive.	Medium to high (depending on expanse of injection network required, injection dispersion requirements in bedrock, and injectate volume required per derived design parameters).
Hydraulic Containment ("Pump and Treat")	Installation of extraction wells and/or trenches can be accomplished relatively quickly (1 to 2 months). However, additional aquifer testing, system design and installation, and permit approval may be required, which may take up to 24 months. The initiation of the approach would be contingent on the start-up of the wastewater treatment infrastructure. Hydraulic containment can be achieved relatively quickly after startup of the extraction system, but uncertainty exists with respect to the time to achieve GWPS without additional data collection to better understand attenuation mechanisms for Be and Li.	Depending on the effluent management strategy, modifications to the existing NPDES permit may be required, or obtaining a UIC permit may be needed if groundwater reinjection is chosen.	Based on the results of the Risk Evaluation Report (Appendix A), SSL-related constituents (Li and Be) evaluated from AP-1 are not expected to pose a risk to human health and the environment; therefore, no further risk evaluation for groundwater is warranted based on the current data set. Georgia Power will proactively evaluate the data and update this evaluation, if necessary. Based on downgradient sampling results, there currently are no complete exposure pathways for potential receptors downgradient of WGWC-20. Above-ground treatment components may need to be present for an extended period of time, generating residuals requiring management and disposal.	Medium to high (depending on remedy duration, complexity of above-ground treatment system, and volume of water processed).
Monitored Natural Attenuation (MNA)	The infrastructure to initiate MNA is already in place. Demonstrating attenuation mechanisms and capacity can be time-consuming and can take up to 24 months. MNA is expected to be successful within a reasonable time frame following pond closure. Engineering measures will be implemented to minimize potential impacts to the subsurface during closure activities and routine groundwater monitoring will be used to verify that groundwater impacts remain stable or decrease over time.	No institutional requirements are expected at this time.	Based on the results of the Risk Evaluation Report (Appendix A), SSL-related constituents (Li and Be) evaluated from AP-1 are not expected to pose a risk to human health and the environment; therefore, no further risk evaluation for groundwater is warranted based on the current data set. Georgia Power will proactively evaluate the data and update this evaluation, if necessary. Little to no physical disruption to remediation areas and no adverse construction-related impacts are expected on the surrounding community. Based on downgradient sampling results, there currently are no complete exposure pathways for potential receptors downgradient of WGWC-20.	Low.
Permeable Reactive Barrier	Installation of a PRB can be accomplished relatively quickly (6 to 12 months), depending on the final location and configuration. However, bench- and/or pilot-testing would be required to obtain design parameters prior to design and construction of the remedy, which may take up to 24 months. Once installed, the time to achieve GWPS downgradient of the PRB is anticipated to be relatively quick.	No institutional requirements are expected at this time.	Based on the results of the Risk Evaluation Report (Appendix A), SSL-related constituents (Li and Be) evaluated from AP-1 are not expected to pose a risk to human health and the environment; therefore, no further risk evaluation for groundwater is warranted based on the current data set. Georgia Power will proactively evaluate the data and update this evaluation, if necessary. Based on downgradient sampling results, there currently are no complete exposure pathways for potential receptors downgradient of WGWC-20. Following installation, the remedy is passive (but may require replacement). However, certain treatment media (such as ZVI) have the potential to mobilize naturally-occurring constituents downgradient of the PRB.	High (for installation) - minimal O&M requirements if replacement is not necessary.
Phytoremediation / *TreeWells*	The design phase will require groundwater modeling for optimal placement of the TreeWell units, which may take up to 6 months. Additional aquifer testing and design will likely be required, which may take up to 24 months. Depending on the number of required units, the installation effort is expected to last several weeks. Hydraulic capture/control is expected approximately three years after planting and system performance is expected to further improve over time.	No institutional requirements are expected at this time.	Based on the results of the Risk Evaluation Report (Appendix A), SSL-related constituents (Li and Be) evaluated from AP-1 are not expected to pose a risk to human health and the environment; therefore, no further risk evaluation for groundwater is warranted based on the current data set. Georgia Power will proactively evaluate the data and update this evaluation, if necessary. Based on downgradient sampling results, there currently are no complete exposure pathways for potential receptors downgradient of WGWC-20. Following installation, the remedy is passive and does not require external energy.	Medium to high (for installation) - minimal O&M requirements.
Subsurface Vertical Barrier Walls	Installation of a barrier wall can be accomplished relatively quickly (6 to 12 months), depending on the final location and configuration. However, design and additional aquifer and compatibility testing will be required, which may take up to 24 months. Once installed, preventing migration of constituents dissolved in groundwater is anticipated to be relatively quick. Since this approach does not treat the downgradient area of impacted groundwater but prevents migration from a source area, it will likely have to be maintained long-term and coupled with other approaches.	No institutional requirements are expected at this time.	Based on the results of the Risk Evaluation Report (Appendix A), SSL-related constituents (Li and Be) evaluated from AP-1 are not expected to pose a risk to human health and the environment; therefore, no further risk evaluation for groundwater is warranted based on the current data set. Georgia Power will proactively evaluate the data and update this evaluation, if necessary. Based on downgradient sampling results, there currently are no complete exposure pathways for potential receptors downgradient of WGWC-20. Due to the need for groundwater extraction associated with barrier walls, above-ground treatment components may need to be present for an extended period of time, generating residuals requiring management and disposal.	High (depending on length and depth of wall, subsurface geologic considerations, remedy duration and complexity of above-ground treatment system).

FIGURES

N

Legend

- Approximate Property Boundary
- Approximate AP-1 Boundary

Notes:
1. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, June 2018.

0 700 1,400 2,800

SCALE IN FEET

SITE LOCATION MAP

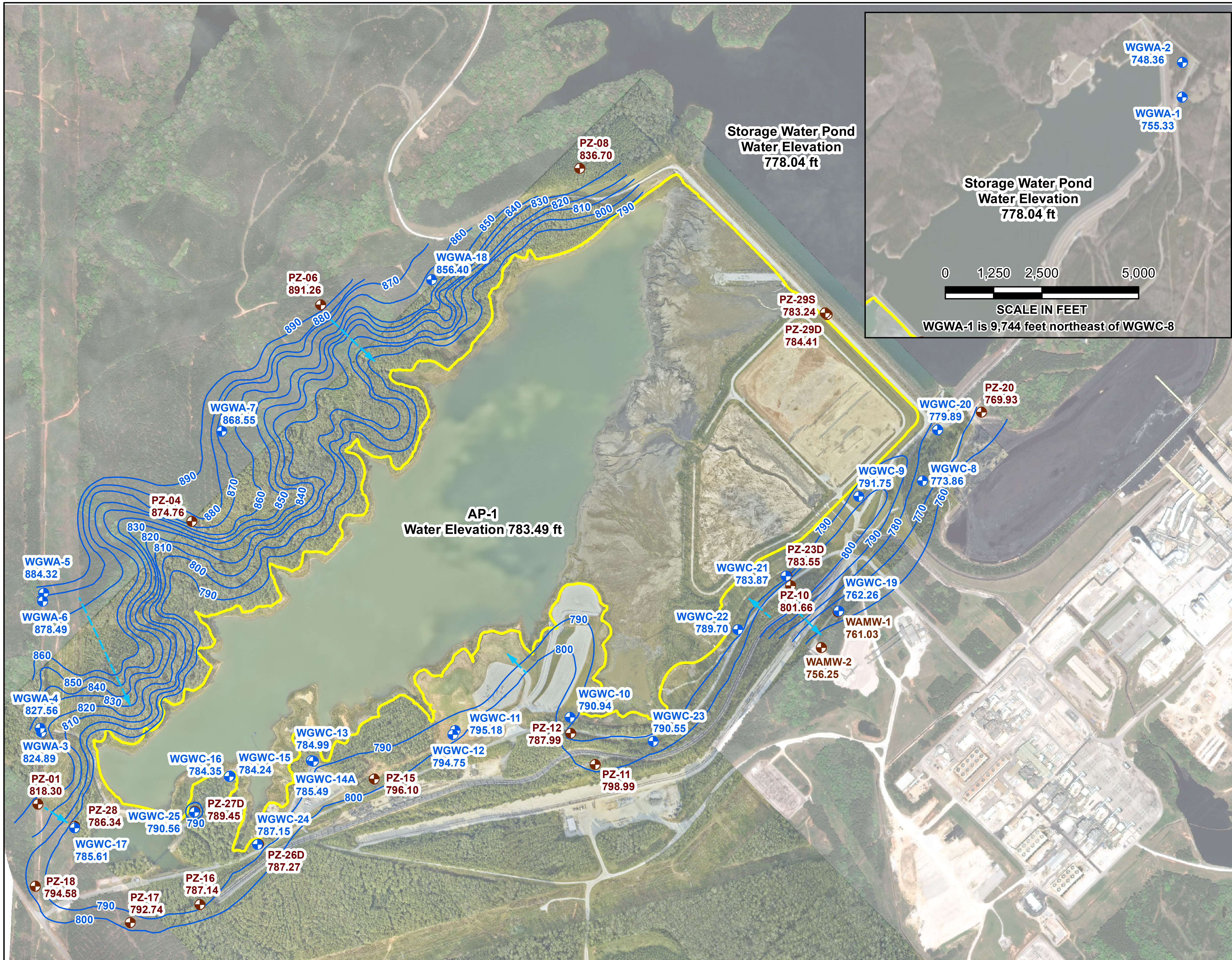
GEORGIA POWER COMPANY
PLANT WANSLEY AP-1
HEARD AND CARROLL COUNTIES, GEORGIA

Prepared For: Georgia Power

Prepared By: Geosyntec consultants

KENNESAW, GA | JANUARY 2023

FIGURE 1



Legend

- Detection Monitoring Well
- Piezometer
- Approximate AP-1 Boundary
- Groundwater Elevation Iso-Contour
- Approximate Groundwater Flow Direction

Notes:
1. Water level elevation recorded on August 8, 2022. Elevation provided in feet (ft) referenced to the North American Vertical Datum (NAVD) 88. The map shows only the wells/piezometers currently installed at the time of the gauging event.
2. Service Layer Credits for immediate vicinity of AP-1: Source: SAM LLC, September 9, 2022.
3. Service Layer Credits for surrounding area: 2020-04-05 Worldview Satellite imagery. Purchased from Harris Geospatial.
4. Piezometer PZ-29S is installed within dike material and may not be representative of actual groundwater conditions.

0 400 800 1,600
SCALE IN FEET

POTENTIOMETRIC SURFACE CONTOUR MAP - AUGUST 2022

GEORGIA POWER COMPANY
PLANT WANSLEY AP-1
HEARD AND CARROLL COUNTIES, GEORGIA

Prepared For: Georgia Power

Prepared By: Geosyntec consultants

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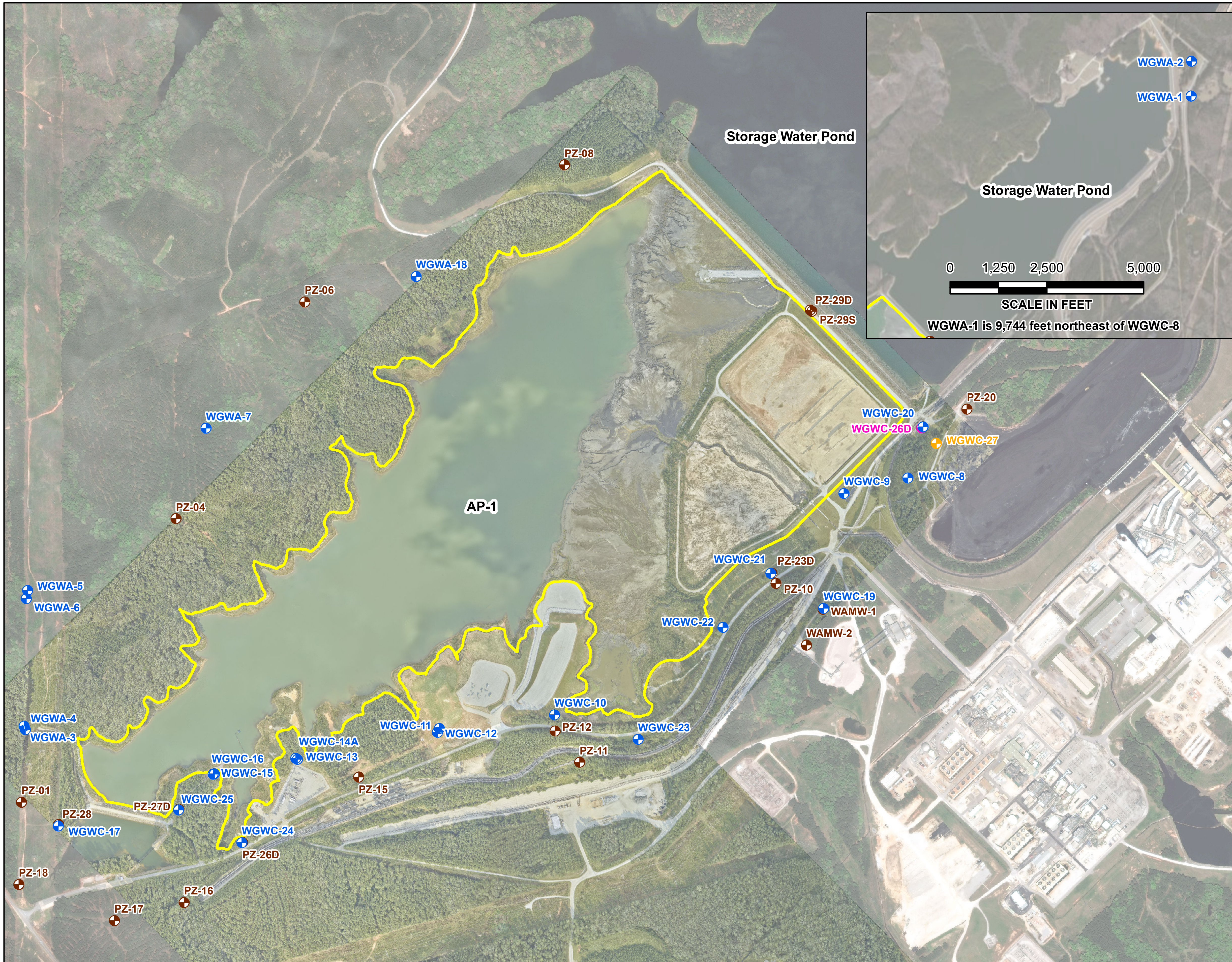
Figure 2



N

Legend

- Detection Monitoring Well
- Horizontal Assessment Monitoring Well
- Vertical Assessment Monitoring Well
- Piezometer
- Approximate AP-1 Boundary

Notes:
1. Service Layer Credits for immediate vicinity of AP-1: Source: SAM LLC, September 9, 2022.
2. Service Layer Credits for surrounding area: 2020-04-05 Worldview 3 Satellite imagery. Purchased from Harris Geospatial.
3. Assessment monitoring wells installed in September 2022.

0 400 800 1,600
SCALE IN FEET

GROUNDWATER MONITORING WELL NETWORK MAP

GEORGIA POWER COMPANY
PLANT WANSLEY AP-1
HEARD AND CARROLL COUNTIES, GEORGIA

Prepared For: Georgia Power

Prepared By: Geosyntec consultants

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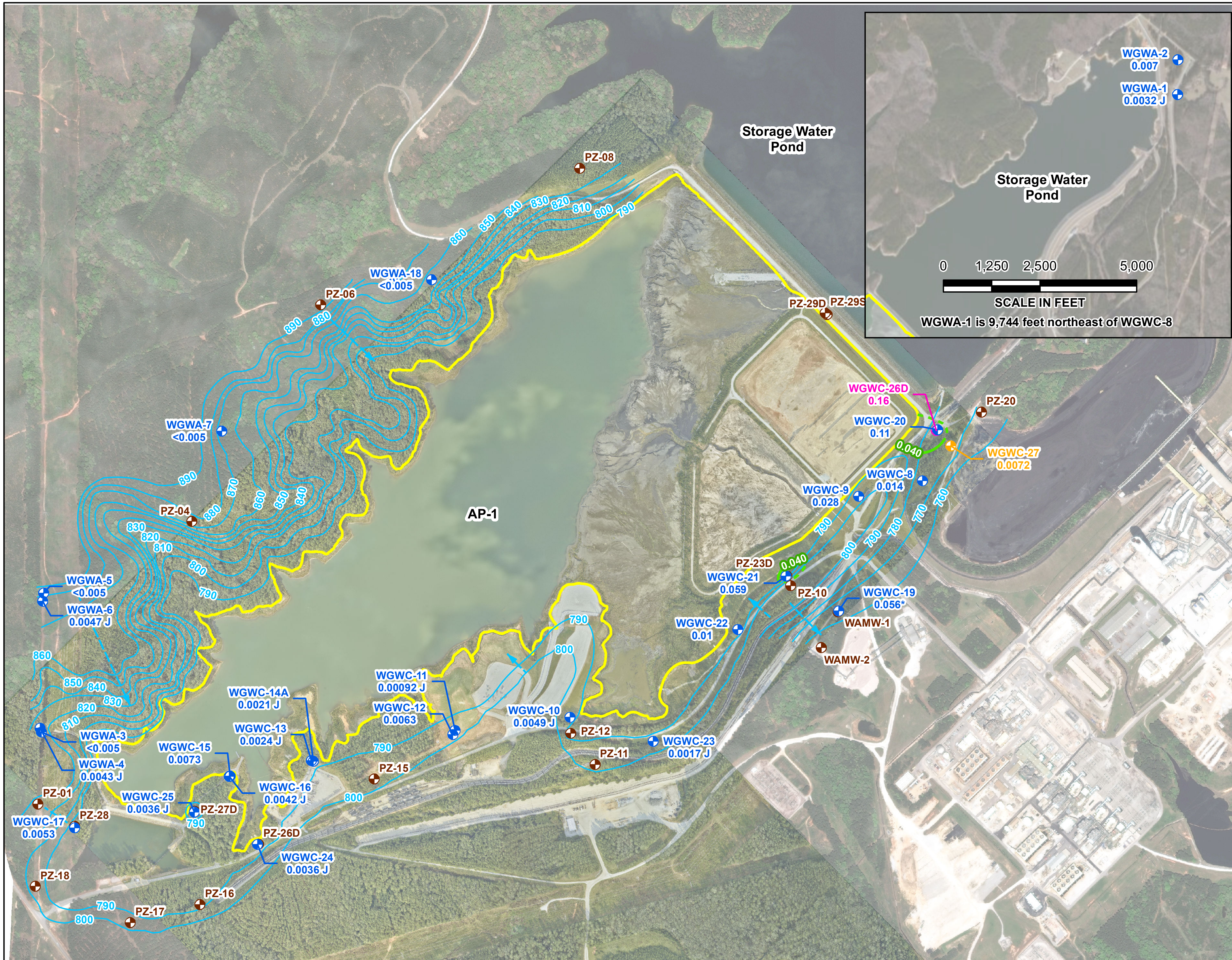
FIGURE 3



Legend

- Detection Monitoring Well
- Horizontal Assessment Monitoring Well
- Vertical Assessment Monitoring Well
- Piezometer
- Approximate AP-1 Boundary
- Groundwater Elevation Iso-Contour
- Approximate Groundwater Flow Direction
- 0.040 Lithium GWPS Iso-Concentration Contour (mg/L)
- Lithium GWPS Iso-Concentration Contour (mg/L) Inferred

Notes:
1. Concentration data from groundwater samples was collected during the August 2022 semiannual monitoring event and October 2022 (WGWC-26D and WGWC-27 after well installation).
2. Concentrations are reported in milligrams per liter (mg/L).
3. Water level elevation recorded on August 8, 2022. Elevation provided in feet (ft) referenced to the North American Vertical Datum (NAVD) 88. Assessment wells were installed in September 2022 and not used for potentiometric contouring.
4. The Groundwater Protection Standard (GWPS) for lithium is 0.040 mg/L.
5. J - Estimated value and detected between the analytical method detection limit and the reporting limit.
6. * - An alternate source demonstration (ASD) has been submitted for Li in WGWC-19 and is currently under review by GA EPD.
7. Data reported for wells screened deeper in the aquifer were not used for iso-concentration contour (WGWC-26D).
8. The most recent sampling event shows a lithium concentration at WGWC-21 above the GWPS for the Site; however there is currently not an SSL reported at this location.
9. Service Layer Credits for immediate vicinity of AP-1: Source: SAM LLC, September 9, 2022.
10. Service Layer Credits for surrounding area: 2020-04-05 Worldview Satellite imagery. Purchased from Harris Geospatial.

0 400 800 1,600
SCALE IN FEET

ISO-CONCENTRATION MAP, LITHIUM - AUGUST 2022

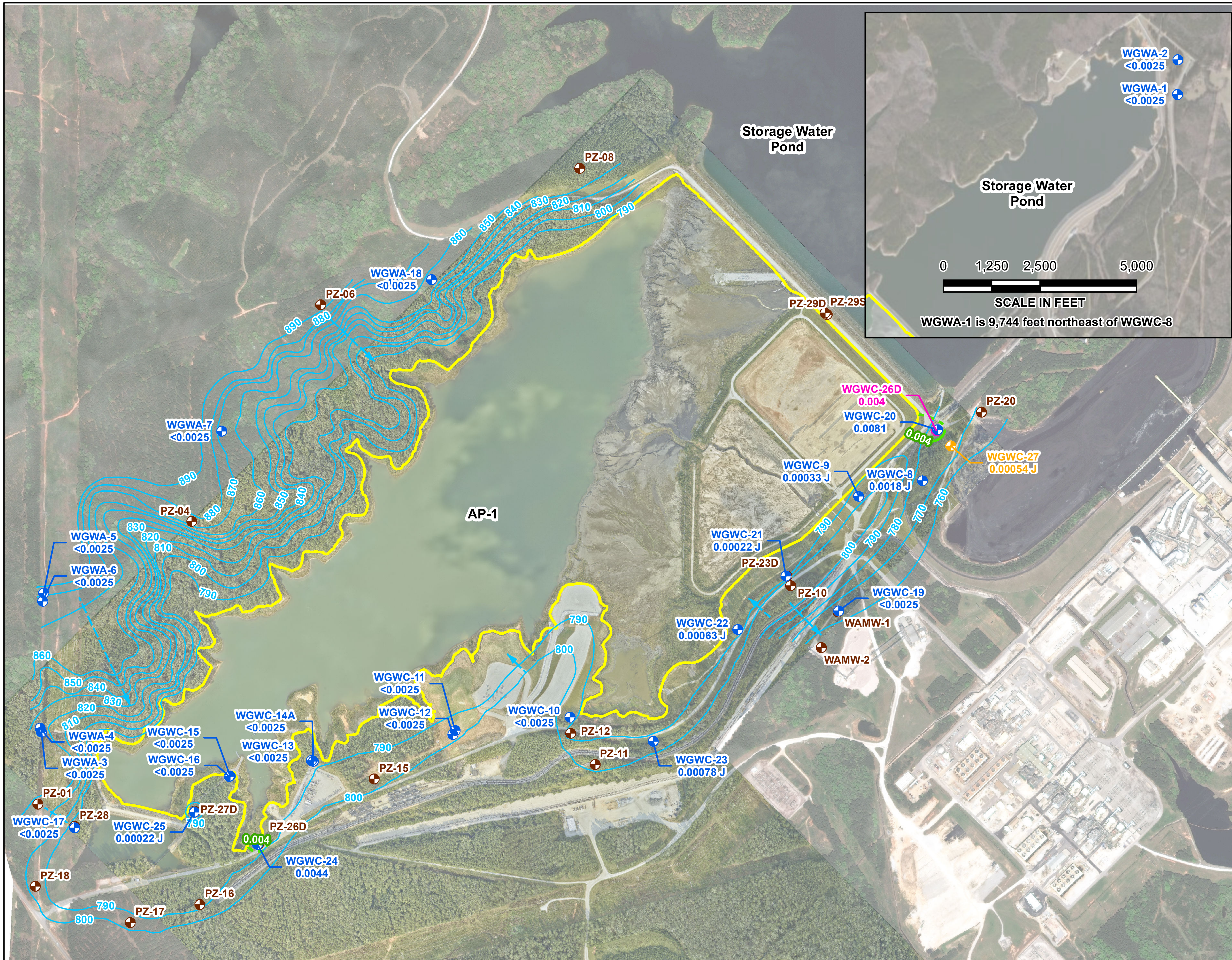
GEORGIA POWER COMPANY
PLANT WANSLEY AP-1
HEARD AND CARROLL COUNTIES, GEORGIA

Prepared For: Georgia Power

Prepared By: Geosyntec consultants

KENNESAW, GA | JANUARY 2023

Figure 4



N

Legend

- Detection Monitoring Well
- Horizontal Assessment Monitoring Well
- Vertical Assessment Monitoring Well
- Piezometer
- Approximate AP-1 Boundary
- Groundwater Elevation Iso-Contour
- Approximate Groundwater Flow Direction
- 0.004 Beryllium GWPS Iso-Concentration Contour (mg/L)
- Beryllium GWPS Iso-Concentration Contour (mg/L) Inferred

Notes:
1. Concentration data from groundwater samples was collected during the August 2022 semiannual monitoring event and October 2022 (WGWC-26D and WGWC-27 after well installation).
2. Concentrations are reported in milligrams per liter (mg/L).
3. Water level elevation recorded on August 8, 2022. Elevation provided in feet (ft) referenced to the North American Vertical Datum (NAVD) 88. Assessment wells were installed in September 2022 and not used for potentiometric contouring.
4. The Groundwater Protection Standard (GWPS) for beryllium is 0.004 mg/L.
5. J - Estimated value and detected between the analytical method detection limit and the reporting limit.
6. Data reported for wells screened deeper in the aquifer were not used for iso-concentration contour (WGWC-26D).
7. Service Layer Credits for immediate vicinity of AP-1: Source: SAM LLC, September 9, 2022.
8. Service Layer Credits for surrounding area: 2020-04-05 Worldview Satellite imagery. Purchased from Harris Geospatial.

0 400 800 1,600

SCALE IN FEET

ISO-CONCENTRATION MAP, BERYLLIUM - AUGUST 2022

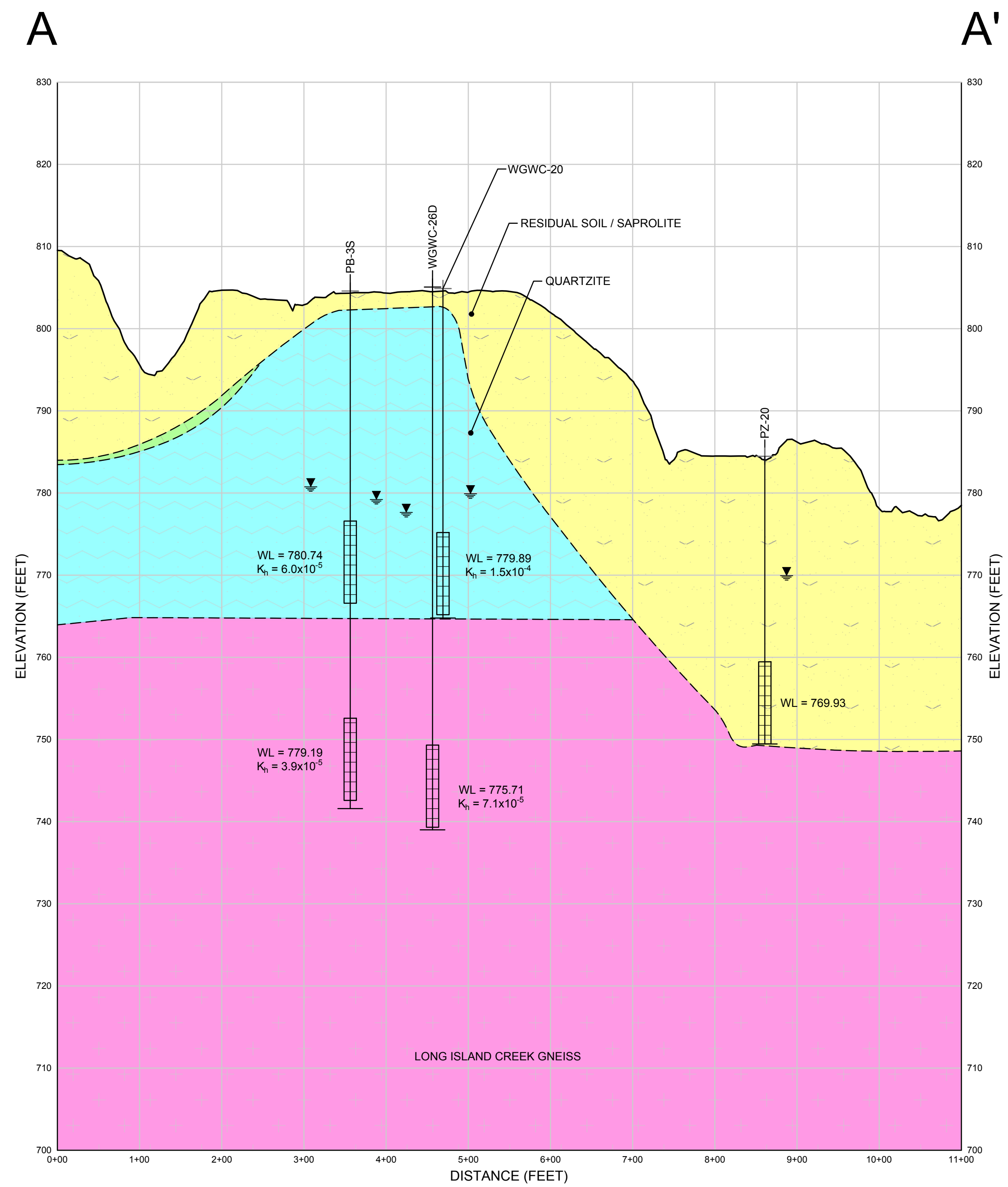
GEORGIA POWER COMPANY
PLANT WANSLEY AP-1
HEARD AND CARROLL COUNTIES, GEORGIA

Prepared For: Georgia Power

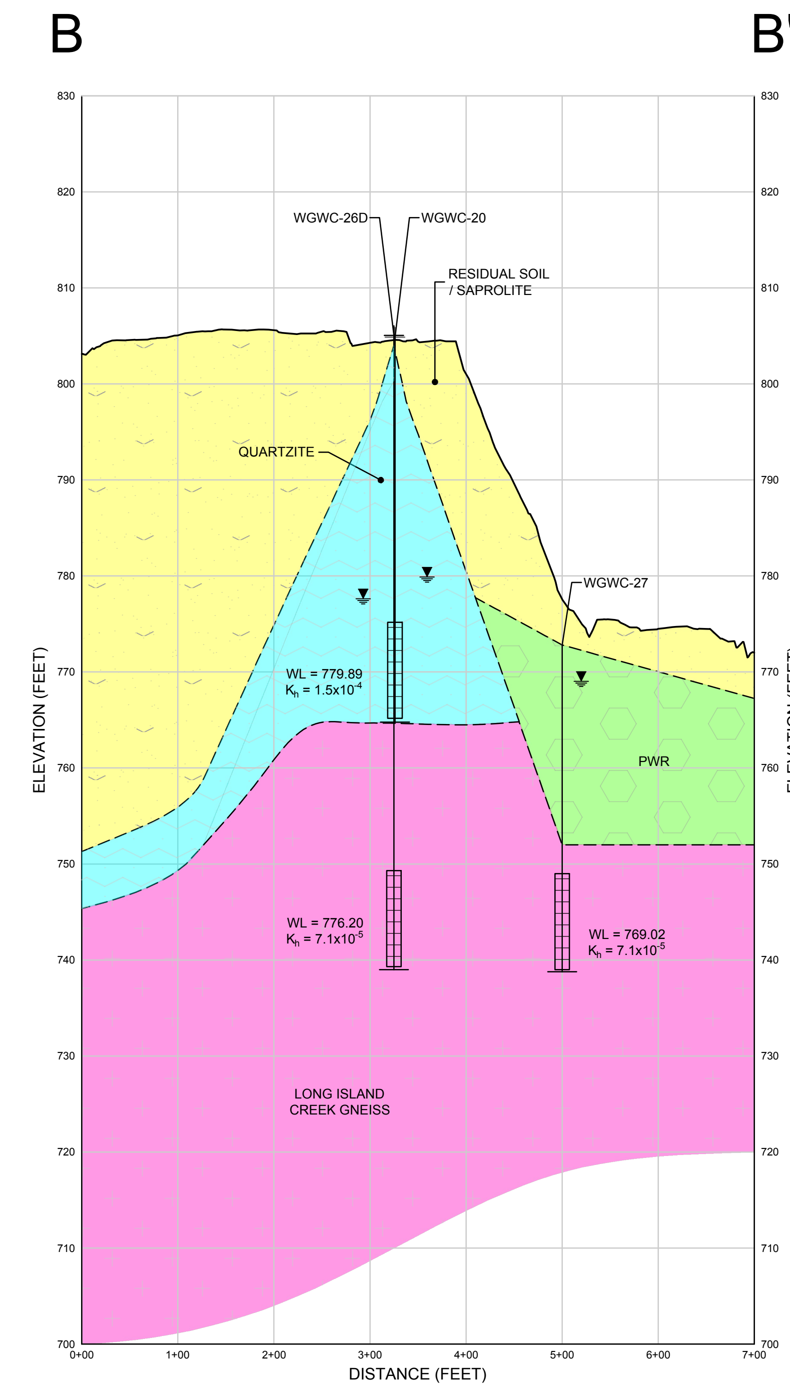
Prepared By: Geosyntec consultants

KENNESAW, GA | JANUARY 2023

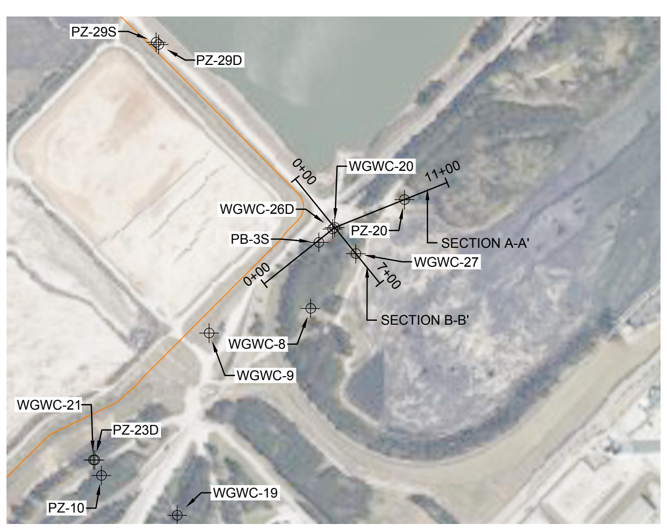
Figure 5



1 SECTION A - A'
SCALE: 1" = 100' (H), 1" = 10 (V)



2 SECTION B - B'
SCALE: 1" = 100' (H), 1" = 10 (V)



KEYMAP

0 500 1000
SCALE IN FEET (HORIZONTAL)

LEGEND

WL=787.99	WATER LEVEL (8 AUGUST 2022)		QUARTZITE
	GROUND WATER ELEVATION (8 AUGUST 2022)(NOTE 5)		LONG ISLAND CREEK GNEISS
	WELL SCREEN LOCATION		RESIDUAL AND SAPROLITIC SOILS: SILT, SANDY SILT, SILTY SAND
	SOIL BORING ON ALIGNMENT (GREY IF ABANDONED)		PARTIALLY WEATHERED ROCK (PWR)
	SOIL BORING PROJECTED TO PROFILE, PROJECTION DISTANCE IN PARENTHESES		
	EXISTING GROUND ELEVATION		
	BOTTOM OF CCR		
	LITHOLOGIC CONTACT		
	WELL		

NOTES:

1. ELEVATIONS REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88). ELEVATIONS PRESENTED IN FEET, NAVD. SEE BORING LOGS IN APPENDIX A FOR ADDITIONAL INFORMATION.
2. TOPOGRAPHY (I.E., EXISTING GROUND) BETWEEN BORING LOCATIONS WAS OBTAINED BY LIDAR SURVEY COMPLETED AND PROVIDED BY ARC SURVEYING AND MAPPING IN OCTOBER 2019. GROUND SURFACE ELEVATIONS AT BORING LOCATIONS BASED ON FIELD SURVEYS COMPLETED BY LAND SURVEYOR.
3. SUBSURFACE LITHOLOGIC ELEVATIONS BETWEEN BORINGS ARE INTERPRETED BASED ON AVAILABLE INFORMATION AND SHOULD BE CONSIDERED APPROXIMATE.
4. LITHOLOGIC UNITS SHOWN ON CROSS-SECTION BASED ON BORING LOGS FOR LOCATIONS ON THE CROSS-SECTION LINE. UNITS SHOWN MAY NOT MATCH DESCRIPTIONS IN BORING LOGS FOR LOCATIONS PROJECTED ONTO THE CROSS-SECTION LINE.
5. GROUNDWATER LEVELS MEASURED BY ATLANTIC COAST CONSULTING, INC. (ACC) ON 8 AUGUST, 2022. GROUNDWATER LEVEL IN WGWC-26D AND WGWC-27 MEASURED ON 19 OCTOBER 2022.
6. HORIZONTAL HYDRAULIC CONDUCTIVITY (K_h) IN CM/SEC AND ESTIMATED USING ISO-FLOW TESTING, STRADDLE PACKER TESTING, OR SLUG TESTING.
7. WHERE MULTIPLE WELL LOCATIONS COINCIDE, WELL DEPTHS CORRESPOND TO ORDER OF STACKED LABELS. TOP LABEL WILL BE THE SHALLOWEST WELL, BOTTOM LABEL WILL BE THE DEEPEST WELL.

0 100 200
SCALE IN FEET (HORIZONTAL)

0 100 200
SCALE IN FEET (VERTICAL)
VERTICAL EXAGGERATION=10X

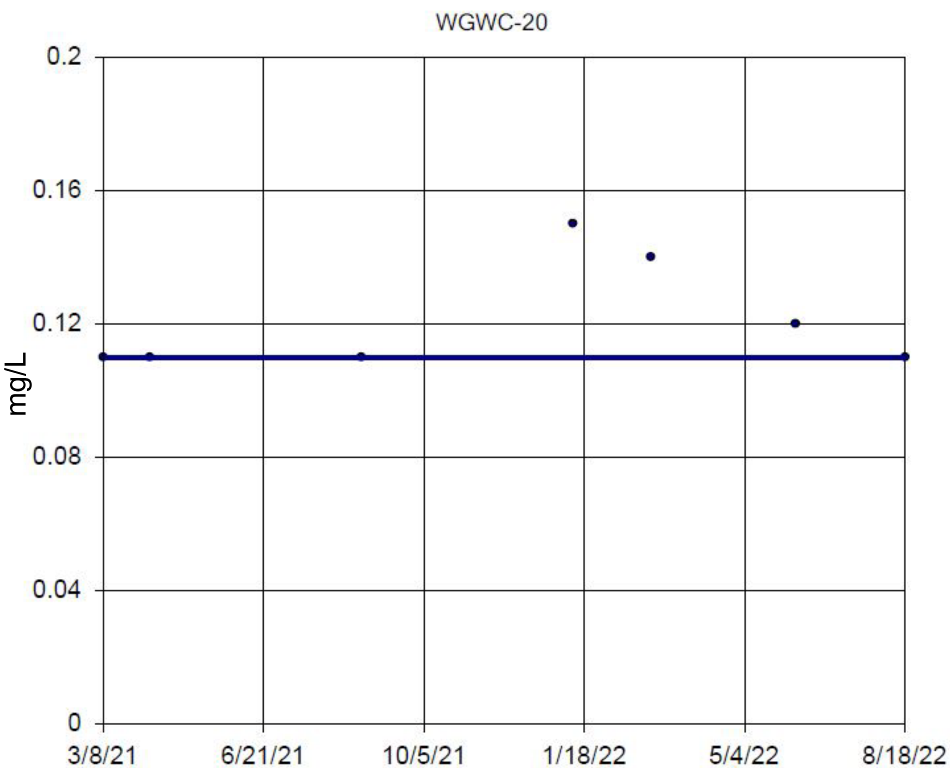
GEOLOGIC CROSS-SECTION A-A' AND B-B'
PLANT WANSLEY
GEORGIA POWER COMPANY
PLANT WANSLEY AP-1
HEARD AND CARROLL COUNTIES, GEORGIA

Geosyntec consultants

FIGURE 6

KENNESAW, GA | MARCH 2023

Lithium

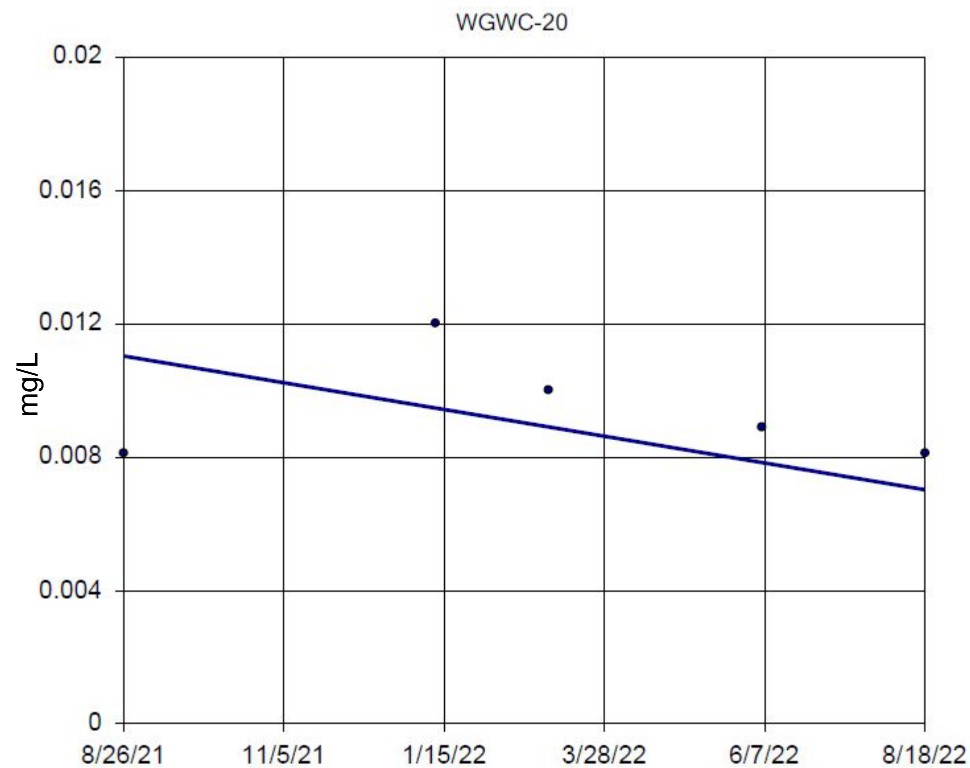


n = 7
Slope = 0
units per year.

Mann-Kendall
statistic = 3
critical = 18

Trend not significant at
99% confidence level
(α = 0.005 per tail).

Beryllium



n = 5
Slope = −0.004104
units per year.

Mann-Kendall
statistic = −3
critical = −12

Trend not significant at
99% confidence level
(α = 0.005 per tail).

Notes:
1. Groundwater trends completed by Groundwater Stats Consulting using groundwater data collected for the full monitoring period through the August 2022 semiannual sampling event.
2. Trends shown are in wells where statistically significant levels (SSLs) have been identified.
3. mg/L = milligrams per liter

Lithium and Beryllium Concentration Trends in WGWC-20

Georgia Power Company
Plant Wansley AP-1
Heard and Carroll Counties, Georgia

Prepared For: Georgia Power

Prepared By: Geosyntec consultants

Kennesaw, GA

January 2023

Figure 7

APPENDIX A

Risk Evaluation

RISK EVALUATION REPORT
PLANT WANSLEY
ASH POND 1
CARROLLTON, GEORGIA

Prepared for

Georgia Power
241 Ralph McGill Boulevard
Atlanta, Georgia 30308

Prepared by

Geosyntec Consultants, Inc.
1255 Roberts Blvd. Suite 200
Kennesaw, GA 30144

March 2023

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LIST OF ACRONYMS AND ABBREVIATIONS

AP	Ash Pond
ASD	Alternative Source Demonstration
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/kg	Milligrams per kilogram
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

Plant Wansley (site) is a two-unit, coal-fired, electric-generating facility that commenced operations in 1976 and is located approximately 12 miles southeast of Carrollton, Georgia. As of April 2019, all process-related flows from the plant to ash pond 1 (AP-1) have ceased and it no longer receives coal combustion residual (CCR) materials pursuant to the Federal CCR Rule, 40 CFR § 257, Subpt. D (USEPA, 2020) and the State CCR Rule, Ga. Comp. R. & Regs. 39134.10 (EPD, 2022). AP-1 is subject to the Federal CCR Rule, 40 C.F.R. § 257, Subpart D (USEPA, 2020) and the State CCR Rule, Ga. Comp. R. & Regs. 391-3-4-.10 (EPD, 2022). Georgia Power has elected to close Plant Wansley AP-1 by removal. Removed CCR will be consolidated in a new, permitted CCR landfill located on the plant property.

This report presents the results of a risk evaluation for CCR constituents[1] exhibiting statistically significant levels (SSLs) in groundwater at AP-1 from samples collected by Georgia Power in compliance with the Federal and State CCR Rules between November 2016 and October 2022. The risk evaluation was performed in support of the *Assessment of Corrective Measures Report*. A conservative, health-protective approach was used that is consistent with United States Environmental Protection Agency (USEPA) risk assessment guidance, Georgia Environmental Protection Division (EPD) regulations and guidance, and standard practice for risk assessment in the State of Georgia. Beryllium and lithium have been identified as SSL-related constituents using the groundwater protection standard (GWPS) established for AP-1 in accordance with the Federal and State CCR Rules (Geosyntec, 2023).

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

1. Development of a conceptual exposure model (CEM) for AP-1.
2. Initial groundwater risk screening: 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.

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

Using this approach that includes multiple conservative assumptions, the SSL-related constituents, beryllium and lithium, identified at AP-1 are 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-1 will continue pursuant to the requirements of the Federal and State CCR Rules. Georgia Power will proactively evaluate the data and update this evaluation, if necessary.

1 INTRODUCTION

This report summarizes a risk evaluation of AP-1 at Plant Wansley (site) located 12 miles southeast of Carrollton, Georgia (**Figure 1**). The risk evaluation was performed in support of the *Assessment of Corrective Measures Report*. The plant property is bounded on the east and southeast by the Chattahoochee River, and sparsely populated, forested, rural, and agricultural land to the north, south, and west. AP-1 is a 343-acre surface impoundment located northwest of the plant (**Figure 1**) which was designed to receive and store CCR materials. AP-1 began receiving process water containing fly ash and bottom ash in 1976. As of April 2019, AP-1 no longer receives CCR materials. As part of the *2022 Integrated Resource Plan*, the Georgia Public Service Commission approved decommissioning of the Plant Wansley coal fired units on August 31, 2022. In this plan, Georgia Power has elected to close Plant Wansley AP-1 by removal. Removed CCR will be consolidated in a new, permitted CCR landfill located on the plant property. The closure of AP-1 in this manner provides a source control measure that reduces the potential for migration of CCR constituents to groundwater.

This risk evaluation provides additional technical review of the human health and environmental protectiveness associated with the closure of AP-1 with respect to constituent concentrations in groundwater identified at statistically significant levels (SSLs) above groundwater protection standards (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 milligrams per liter (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-1. Lithium in WGWC-19 and beryllium and lithium in WGWC-20 were identified as SSL-related constituents under the Federal and State CCR Rules (Geosyntec, 2023). An alternate source demonstration (ASD) for lithium in WGWC-19 has been submitted to EPD and demonstrates, through multiple lines of evidence, that concentrations of lithium in WGWC-19 are naturally occurring. However, because EPD has not yet approved the ASD, lithium in WGWC-19 was evaluated in the risk evaluation as a conservative measure.

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-1 documents, including the *2022 Semiannual Groundwater Monitoring & Corrective Action Report – Plant Wansley - Ash Pond 1* (Geosyntec, 2022a), the *Hydrogeologic Assessment Report (HAR) (Revision 02) for Ash Pond 1* (Geosyntec, 2022b), and the *2022 Annual Groundwater Monitoring & Corrective Action Report – Plant Wansley - Ash Pond 1* (Geosyntec, 2023);. The CEM includes a conservative evaluation of assumed potential transport pathways, potential exposure pathways, and potential human and ecological receptors.

2.1 Site Description

Plant Wansley is located on approximately 5,200 acres about 12 miles southeast of the City of Carrollton, Georgia. Although the majority of the plant property lies within Heard County, the physical address of and entrance to the plant is 1371 Liberty Church Road, Carrollton, Carroll County, Georgia. The plant property is bounded on the east and southeast by the Chattahoochee River, and sparsely populated, forested, rural, and agricultural land to the north, south, and west. A site location map and a detailed site map is included as **Figure 1**.

AP-1 is a 343-acre surface impoundment located northwest of the plant which was designed to receive and store CCR materials. AP-1 began receiving process water containing fly ash and bottom ash in 1976. As of April 2019, all process-related flows from the plant to AP-1 have ceased. As part of the 2022 Integrated Resource Plan, the Georgia Public Service Commission approved decommissioning of the Plant Wansley coal fired units on August 31, 2022. As part of that plan, Georgia Power has elected to close Plant Wansley AP-1 by removal. The 2018 permit submittal will be updated to reflect these changes and submitted to EPD for further review.

The monitoring well network for AP-1 is shown on **Figure 2**. Based on the conceptual site model and the observed hydrogeologic conditions at the site, downgradient well locations are distributed along the southern perimeter of the site, which is the regional groundwater flow direction. However, localized groundwater flow direction is northward (or inward) toward the pond. Both background and downgradient wells are screened in the same water-bearing horizon along the zone of primary groundwater transport within the partially weathered rock and the transition zone between the partially weathered rock and the fractured bedrock.

2.1.1 Topography and Surface Hydrology

The Site has two pronounced ridges on the northwest and southeast sides of the pond, as well as smaller rolling hills along the western property boundary. Other than these ridges and hills, the Site slopes gently south and southeast toward the Chattahoochee River. The Site has a topographic relief of over 300 feet, with a high elevation of 960 feet relative to North American Vertical Datum of 1988 on the northwest ridge and a low elevation of less than 600 feet near the Chattahoochee River (Geosyntec, 2022b).

2.1.2 Geology and Hydrogeology

The following information is provided in the *2022 Annual Groundwater Monitoring & Corrective Action Report – Plant Wansley - Ash Pond 1* (Geosyntec, 2023).

> *"Plant Wansley is located within the Piedmont Physiographic Province (Piedmont) of western Georgia, which is characterized by gently rolling hills with locally pronounced low, linear ridges, trending northeast-southwest, and separated by valleys. Over geologic time, the Piedmont has been subjected to multiple events of uplift, folding and faulting, alternation, and erosion. The Piedmont Province is generally underlain by a variably thick blanket of overburden, which is comprised of residual and saprolitic soils derived from the in-place weathering of bedrock. Near the ground surface, soils are generally silt- and clay-rich, with fine-sand and sand becoming more prominent with depth. With increasing depth, the weathered materials tend to retain details of the structural features of the underlying bedrock. Occasional deposits of alluvium are present in valleys and drainage features. A mantle of partially weathered rock (PWR) and the upper fractured surface of the bedrock in the Piedmont comprises a zone often referred to as the "transition zone."*
>
> . . . .
>
> *"Groundwater in the saprolite and PWR is hydraulically connected to the bedrock via fractures and deeply weathered areas of the rock. Recharge is by precipitation infiltrating through the saprolite to the bedrock. Based on observations of soil types and horizontal conductivity values, the movement of groundwater in the saprolite is very slow and likely acts as flow through a low-permeability porous media. Groundwater flow in the PWR and the transition zone between the PWR and the fractured bedrock is expected to be greater than in the overlying saprolite and the underlying fractured bedrock. Groundwater flow in the bedrock is restricted entirely to flow through fractures."*
>
> . . . .
>
> *"The regional groundwater flow direction is expected to be to the southeast; however, in topographically high areas south of AP-1, shallower water table elevations are noted within the saprolite and PWR, and hydraulic gradients indicate localized flow northward (or inward) toward the pond."*

The potentiometric surface contours provided in the *2022 Annual Groundwater Monitoring & Corrective Action Report – Plant Wansley - Ash Pond 1* (Geosyntec, 2023) 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 Chattahoochee River is approximately one mile southeast of AP-1. The surface water flow direction for the Chattahoochee River is from northeast due south/southwest past the site. A conservative assumption for this assessment was made that regional groundwater flow is toward the Chattahoochee River. In addition, for the purposes of this evaluation, the Chattahoochee River was 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 (Heard County, 2006).

- 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 land use is planned as forestry with the exception of two parcels to the south of the Site that are planned residential and one that is planned for agriculture (Heard County, 2006). An off-site well survey of potential groundwater wells within a three-mile radius of the site 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 additonal 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 south of the Site and are side gradient of the regional groundwater flow direction (generally southeast toward the Chattahooche River).

  Concentrations of the SSL-related constituents beryllium and lithium in on-site groundwater monitoring wells and piezometers were either below health-protective screening levels in on-site wells or were not detected above health-protective screening criteria in the adjacent downgradient surface water body (i.e., the Chattahoochee River). As a conservative measure, hypothetical off-site residential exposure to beryllium and lithium was evaluated using data collected from on-site groundwater wells between 2016 and October 2022 downgradient of AP-1. This comparison makes the conservative assumption that on-site groundwater may potentially migrate to off-site drinking water wells through advective transport in groundwater without any attenuation within the aquifer media through factors such as dilution, dispersion, or adsorption, and disregards the presence of the Chattahoochee River which represents an assumed hydraulic discharge boundary for groundwater downgradient of AP-1. Accordingly, the risk evaluation screening assumed the hypothetical off-site residential receptor could be exposed by ingestion and dermal contact with beryllium and lithium 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 Chattahooche River during two events 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 Chattahoochee River during two events 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 October 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 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 October 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 Annual Groundwater Monitoring & Corrective Action Report* (Geosyntec, 2023) with SSL-related constituents identified under the Federal and State CCR Rules is as follows:

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

- Lithium: WGWC-19[3]
- Beryllium and lithium: WGWC-20

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-1; background values are routinely updated under the program. Eight monitoring wells in the certified monitoring well network are designated as upgradient (background) locations for AP-1, including WGWA-1, WGWA-2, WGWA-3, WGWA-4, WGWA-5, WGWA-6, WGWA-9, and WGWA-18. The statistical analyses performed on the groundwater data were described in the *2022 Semiannual Groundwater Monitoring & Corrective Action Report* (Geosyntec, 2022a); and a summary 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*

[3] An ASD for lithium in WGWC-19 has been submitted to EPD and demonstrates, through multiple lines of evidence, that concentrations of lithium in WGWC-19 are naturally occurring. However, because EPD has not yet approved the ASD, lithium in WGWC-19 was evaluated in the risk evaluation as a conservative measure.

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 Type 2 RRS for beryllium and the RRS for lithium 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 (i.e., beryllium).

- In accordance with standard methodologies approved by the Georgia EPD and because an RRS for lithium has not already been established under HSRA, a site-specific risk-based screening value was calculated using the default exposure factors for residential receptors and the methodology found in Appendix III of the HSRA rule (EPD, 2018). Accordingly, the calculated screening value is equivalent to a Type 2 groundwater RRS protective of residential exposures. The toxicity value for lithium used in the calculation was the USEPA-preferred value contained in the RSL Calculator (USEPA, 2022b). 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 lithium is presented in **Appendix C**.

- 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). Background was not used as a screening level in this evaluation.

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

Table 1 presents the maximum detected concentration of beryllium (0.012 mg/L) and lithium (0.15 mg/L) which was used to represent potential off-site groundwater quality for comparison to the selected screening level for beryllium (0.025 mg/L) and lithium (0.04 mg/L), for hypothethetical off-site residential receptors. As noted in **Table 1**, lithium was detected at a concentration that exceeded its screening level and was retained for further evaluation in the refined risk evaluation. However, beryllium was not detected at concentrations that exceeded its screening level and was not retained as a COPI and is not expected to pose a risk to human health or the environment.

3.3 Alternate Source Demonstration

In accordance with 40 CFR §257.95, an ASD was prepared for lithium in WGWC-19 and was submitted to EPD in January 2019 (ACC, 2019). An Addendum to the ASD was submitted in November 2020 (Geosyntec, 2020) and revised in February 2021 (Geosyntec, 2021). The ASD Addendum presents supplemental data collected since submittal of the ASD, which provide additional lines of evidence to demonstrate that the lithium SSL identified at WGWC-19 is associated with naturally occurring lithium within rock formations at the Site.

The following bullets summarize the lines of evidence presented in the 2019 ASD:

- There are several lithologic units present at AP-1, with rock units north and northwest of AP-1 differing from those southeast and south of the ash pond. Correspondingly, the lithium groundwater concentrations originating from natural geologic sources are expected to vary spatially across the Site with changing geologic units.

- Laboratory analysis of rock samples collected from locations southeast and south of AP-1 indicated naturally occurring lithium concentrations in the quartzite bedrock unit to be 430 milligrams per kilogram (mg/kg) and lithium concentrations as high as 116 mg/kg in the schist-amphibolite bedrock unit.

- Boron is an Appendix III constituent commonly used as a tracer to indicate CCR impacts to groundwater downgradient of a CCR unit. Groundwater data for sampling events conducted in 2016 and 2017 indicated no correlation between boron and lithium groundwater concentrations for select compliance wells.

- The lack of boron detections and low concentrations of other CCR indicator parameters (Appendix III constituents) at WGWC-19, the well with the highest lithium detections in groundwater, further indicated that lithium in groundwater did not originate from AP-1.

The ASD Addendum (Geosyntec, 2021) provides supplemental groundwater and rock sample laboratory analytical data collected since submittal of the 2019 ASD. The data support the conclusions of the 2019 ASD, specifically:

- The ASD Addendum includes an evaluation of the correlation between lithium and Appendix III constituents using groundwater data from compliance monitoring well samples collected between 2016 and 2020. Non-detect to intermittent low detections of boron consistent with background conditions at WGWC-19 further support an alternate source for lithium in groundwater.

- Laboratory analyses using sequential extraction procedures for rock core samples collected from boreholes corresponding to or in vicinity of WGWC-19 indicate lithium in rock cores is mostly associated with hydroxides of iron, manganese and/or aluminum as well as more recalcitrant fractions that will liberate lithium through mineral weathering. Saprolite and partially weathered rock derived through the weathering of the parent bedrock contains similar minerals and/or constituents as the parent bedrock. During the weathering process and as groundwater flows through saprolite, partially weathered rock, and bedrock fractures, the minerals/constituents can be liberated and will partially dissolve into groundwater.

- Using a literature-derived distribution coefficient of 300 liters per kilogram to calculate predicted groundwater concentrations of lithium based on lithium concentrations in rock indicates that observed groundwater concentrations, which are generally lower than predicted concentrations, can be explained by lithium originating from weathering of the natural formation.

The ASD demonstrates that concentrations of lithium in WGWC-19 are naturally occurring. However, because EPD has not yet approved the ASD, lithium in WGWC-19 was carried forward into the refined risk evaluation as a conservatve measure.

4 REFINED RISK EVALUATION

A refined risk evaluation was conducted for the groundwater COPI (lithium) that was detected at concentrations that exceeded the health-protective screening criteria. The refined risk evaluation identified EPCs for lithium in groundwater for the purposes of characterizing potential risk to human and ecological receptors. Due to lithium being identified as a COPI in multiple wells spatially separated from one another (WGWC-19 and WGWC-20), two exposure units (west and east, respectively) were used in the refined risk evaluation. A lithium 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). Lithium concentrations in the most downgradient well for the east exposure unit were below the screening level and a surface water evaluation was not necessary. Lithium was evaluated in the downgradient surface water body (i.e., the Chattahoochee River) 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 lithium 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 October 2022 from the on-site wells 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 lithium 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 (95% UCLs) were calculated using USEPA ProUCL 5.1 software (ProUCL) (USEPA, 2022c) and ProUCL User's Guide (USEPA, 2022d).

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, lithium. **Appendix D-3** provides the input and output files associated with the ProUCL software.

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

4.1.2 COPI Concentration Trend Analysis

Concentration trends over time were evaluated as one line of evidence in the refined risk evaluation for lithium. 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 WGWC-19 and WGWC-20 for lithium to evaluate the trends in concentrations over time. The tests were conducted using the USEPA ProUCL 5.2 software (USEPA, 2022c).

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

- There is no statistical trends in lithium concentrations over time in WGWC-20.
- There is a statistically increasing trend in lithium concentrations over time in WGWC-19. However, concentrations in lithium in surface water samples collected from the Chattahoochee River are below lithium's screening level.

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

4.1.3 Refined Groundwater Risk Evaluation Results

Lithium 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). Lithium was identified as a groundwater COI and was further evalated with surface water samples collected from the Chattahoochee River.

4.1.3.1 West Exposure Unit

Lithium was detected in 22 out of 22 groundwater samples in monitoring well WGWC-19 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 lithium using the monitoring wells shown in **Appendices D-1** and **D-2a**:

- Data from WGWC-19 was used to determine if the UCL is less than the screening level (EPC Step 1 in **Appendix D-1**).
- Data from WGWC-19 and the adjacent/nearby peizometers WAMW-1 and WAMW-2 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 lithium exceedance in WGWC-19. There is no well between the the Chattahoochee River and WGWC-19, and therefore, a hydraulically downgradient well could not be used to represent groundwater downgradient of the exceedance.

The EPC Step 1 (0.055 mg/L) and EPC Step 2 (0.054 mg/L) for lithium exceeded the applicable screening level of 0.04 mg/L.

Table 3 presents the results of the refined screening comparing the farthest hydraulically downgradient EPC to the screening level. Lithium in the west exposure unit was identifed as a COI in groundwater and is further evaluated in Section 4.2, below.

4.1.3.2 East Exposure Unit

Lithium was detected in five out of five groundwater samples in monitoring well WGWC-20 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 lithium using the monitoring wells shown in **Appendices D-1** and **D-2b**:

- Data from WGWC-20 was used to determine if the UCL is less than the screening level (EPC Step 1 in **Appendix D-1**).
- Data from WGWC-20 and the downgradient monitoring wells WGWC-26D and WGWC-27 were combined to represent groundwater exposure in the same hydraulically downgradient direction (EPC Step 2 in **Appendix D-1**).
- Data from WGWC-27 was used to represent exposure using the well that is the farthest hydraulically downgradient of well WGWC-20 (EPC Step 3 in **Appendix D-1**).

Although the EPC Step 1 (0.13 mg/L) and the EPC Step 2 (0.14 mg/L) exceeded the screening level, the EPC Step 3 (0.0072 mg/L), which includes the farthest downgradient well, was less than the health-protective screening level of 0.04 mg/L.

Table 3 presents the results of the refined screening comparing the farthest hydraulically downgradient EPC to the screening level. As lithium was not detected above the applicable screening level in the farthest hydraulically downgradient well on the site, lithium in the east exposure unit was not identified as a groundwater COI for hypothetical off-site residential receptors and is not expected to pose a risk to human health through potable water use.

4.2 Surface Water Screening Evaluation

A surface water screening evaluation was conducted for samples collected from the Chattahoochee River for the groundwater COI lithium, 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 lithium were collected during two events in 2022 at three locations in the Chattahoochee River. 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 lithium:

- 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, 2015). For select constituents for which no numerical values for surface water are provided, USEPA (2015) 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 (lithium).
- 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 site-specific value of 0.04 mg/L was used as a surface water screening value for lithium. 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 Chattahoochee River water downgradient of the site for human receptors is an incomplete exposure pathway.

Lithium was not detected in the surface water samples from the Chattahoochee River and the reporting limit was below the surface water human health screening level of 0.04 mg/L as shown in **Table 4**. Therefore, lithium 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 lithium:

- 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 lithium does not have chronic freshwater Georgia ISWQC (EPD, 2015b), the USEPA Region 4 chronic freshwater ecological screening value of 0.44 mg/L for total lithium (USEPA, 2018) was used in the surface water screening for aquatic ecological receptors.

Lithium was not detected in the surface water samples from the Chattahoochee River and the reporting limit was below the surface water ecological screening level of 0.44 mg/L as shown in **Table 5**. Therefore, lithium 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 lithium 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 east exposure unit used to calculate the lithium EPC to represent potential groundwater exposure for hypothetical off-site residential receptors based on the farthest hydrologically downgradient monitoring well were below the site-specific screening level.
- Lithium was identified as a groundwater COI for hypothetical off-site residential receptors in the west exposure unit and was evaluated further in the downgradient surface water in the Chattahoochee River for potential exposure to human and ecological receptors.
- Lithium was not detected in surface water samples from the Chattahoochee River and the analytical reporting limits were below health-protective surface water screening criteria for human and ecological receptors. Therefore, lithium 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, the higher of the Type 1 or Type 2 standard was selected for residential screening criteria. Selection of the screening criteria per industry standards is considered appropriate for risk quantification for Plant Wansley. The Hazardous Site Response Act, Rule 391-3-19.07(1) notes that *"[a]ll risk reduction standards will, when implemented, provide adequate protection of human health and the environment"*. Thus, this approach is likely to overestimate hypothetical risks for off-site receptors.

- Screening criteria based on RRSs represent the reasonable maximum exposure (RME), which are the highest exposures that are reasonably expected to occur at a site. The USEPA risk assessment gudance 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 lithium were compared to conservative risk based screening criteria to identify the COPIs. Use of the maximum detected concentration is consistent with standard practice; however, use of the maximum detected concentration for exposure likely overestimates potential risk.

- The constituents included in the risk evaluation may occur naturally in the site geologic setting. Although background concentrations were evaluated, contributions to exposure and risk were assumed to be entirely CCR-related and natural background sources were not quantified. Thus, SSL concentration-related exposures were likely overestimated.

- Hypothetical off-site residential exposure was evaluated using on-site groundwater data from wells around the perimeter and downgradient of AP-1. This comparison makes the conservative assumption that on-site groundwater may potentially migrate to off-site drinking water wells through advective transport in groundwater, but without any attenuation within the aquifer media through factors such as dilution, dispersion, or adsorption. This assumption may overestimate potential exposure and risk to hypothetical off-site receptors.

- EPCs for metals in groundwater were assumed to be 100 percent bioavailable by ingestion and dermal contact. This assumption may tend to overestimate risk.

- An off-site well survey of potential groundwater wells within a three-mile radius of the site was conducted by NewFields in 2020 which consisted of reviewing publicly available federal, state, and county records as well as a windshield survey of the area (**Appendix A**). Geosyntec conducted a desktop update of the survey in January of 2022. Geosyntec has relied on the 2020 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 (USEPA, 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-1 was conducted using methods consistent with Georgia EPD and USEPA guidance and included multiple conservative assumptions. Based on this evaluation, the SSL-related constituents beryllium and lithium are not expected to pose a risk to human health or the environment.

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

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TABLES

Table 1
SSL-Related Constituent Groundwater Screening
Plant Wansley AP-1 Risk Evaluation Report [1]
Plant Wansley, Carrollton, GA

CCR Rule Designation	Constituents	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	Beryllium	7440-41-7	5 / 5	0 / 5	0.012	0.025	Type 2 RRS	0.0025	N	BSL
	Lithium	7439-93-2	29 / 29	29 / 29	0.15	0.04	Site-Specific	0.009	Y	ASL

Notes:

[1] Evaluation includes 2016 to October 2022 groundwater analytical data from WGWC-19 (lithium) and WGWC-20 (beryllium and lithium).

[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 beryllium and lithium were calculated as described in the document "*2022 Annual Groundwater Monitoring and Corrective Action Report* " (Geosyntec, 2023).

[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 Wansley AP-1 Risk Evaluation Report
Plant Wansley, Carrollton, GA

CCR Rule Designation	Constituent	CAS No.	Exposure Unit	Detection Frequency [1]	Maximum Concentration (mg/L)	Wells Included in 95% UCL Calculation	95% UCL [1,2] (mg/L)	Recommended UCL Method	Selected EPC [3] (mg/L)
Appendix IV	Lithium	7439-93-2	West	24 / 24	0.072	WGWC-19, WAMW-1, WAMW-2	0.054	95% Student's-t UCL	0.054
			East	1 / 1	0.0072	WGWC-27	NA	NA	0.0072

Notes:

[1] For further detail on the selected EPC, refer to Appendix D-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] NA = Not available. The 95% upper confidence limit on the mean (UCL) was not calculated because the dataset had fewer than 4 detected values.

[3] West Exposure Unit: EPC Step 2; East Exposure Unit: EPC Step 3.

Definitions:

CAS = Chemical Abstract Service

CCR = Coal Combustion Residuals

COPI = Constituent of Potential Interest

EPA = United States Environmental Protection Agency

EU = Exposure Unit

mg/L = milligrams per liter

Table 3
Downgradient Groundwater Refined Evaluation
Plant Wansley AP-1 Risk Evaluation Report
Plant Wansley, Carrollton, GA

CCR Rule Designation	Constituent	CAS No.	Exposure Unit	Detection Frequency	Exceedance Frequency [1]	Selected EPC [2] (mg/L)	Screening Level (mg/L)	SL Source [3]	Site-Specific Background (mg/L)	COI? (Y/N)	Rationale [4]
Appendix IV	Lithium	7439-93-2	West	24 / 24	22 / 24	0.054	0.040	Site-Specific	0.009	Y	ASL
			East	1 / 1	0 / 1	0.0072				N	BSL

Notes:

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

[2] West Exposure Unit: EPC Step 2; East Exposure Unit: EPC Step 3. For further detail on the selected EPC, refer to Appendix D-1.

[3] 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 "*2022 Annual Groundwater Monitoring and Corrective Action Report*" *(Geosyntec, 2023)* .

[4] 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 Wansley AP-1 Risk Evaluation Report
Plant Wansley, Carrollton, GA

CCR Rule Designation	Constituent	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)	COPI? (Y/N)	Rationale [6]
Appendix IV	Lithium	7440-48-4	0 / 8	0 / 8	<0.005	0.04	Site-Specific	<0.005	N	ND/BSL

Notes:

[1] Evaluation includes surface water analytical data from the Chattahoochee River (WCR+1.9, WCR+0.1, WCR-0.6) in March and August 2022.

[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 COPIs 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 Chattahoochee River upstream sample (WCR+1.9) collected in March and August 2022.

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

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
COPI = 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 Wansley AP-1 Risk Evaluation Report
Plant Wansley, Carrollton, GA

CCR Rule Designation	Constituent	CAS No.	Detection Frequency [1]	Exceedance Frequency [2]	Maximum Concentration [3] (mg/L)	Screening Level (mg/L) [4]		Hardness Dependent? (Y/N)	Screening Level Source[4]	Site-Specific Background [5] (mg/L)	COPI? (Y/N)	Rationale [6]
						Total	Dissolved					
Appendix IV	Lithium	7440-48-4	0 / 8	0 / 8	<0.005	0.44	--	N	EPA Reg. 4	<0.005	N	ND/BSL

Notes:

[1] Evaluation includes surface water analytical data from the Chattahoochee River (WCR+1.9, WCR+0.1, WCR-0.6) in March and August 2022.

[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 COPIs 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 Chattahoochee River upstream sample (WCR+1.9) collected in March and August 2022.

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

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
COPI = Constituent of Potential Interest
EPA = United States Environmental Protection Agency
mg/L = milligram(s) per liter

FIGURES

N

Legend

- Approximate Property Boundary
- Approximate AP-1 Boundary

Notes:
1. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, June 2018.

0 700 1,400 2,800

SCALE IN FEET

SITE LOCATION MAP

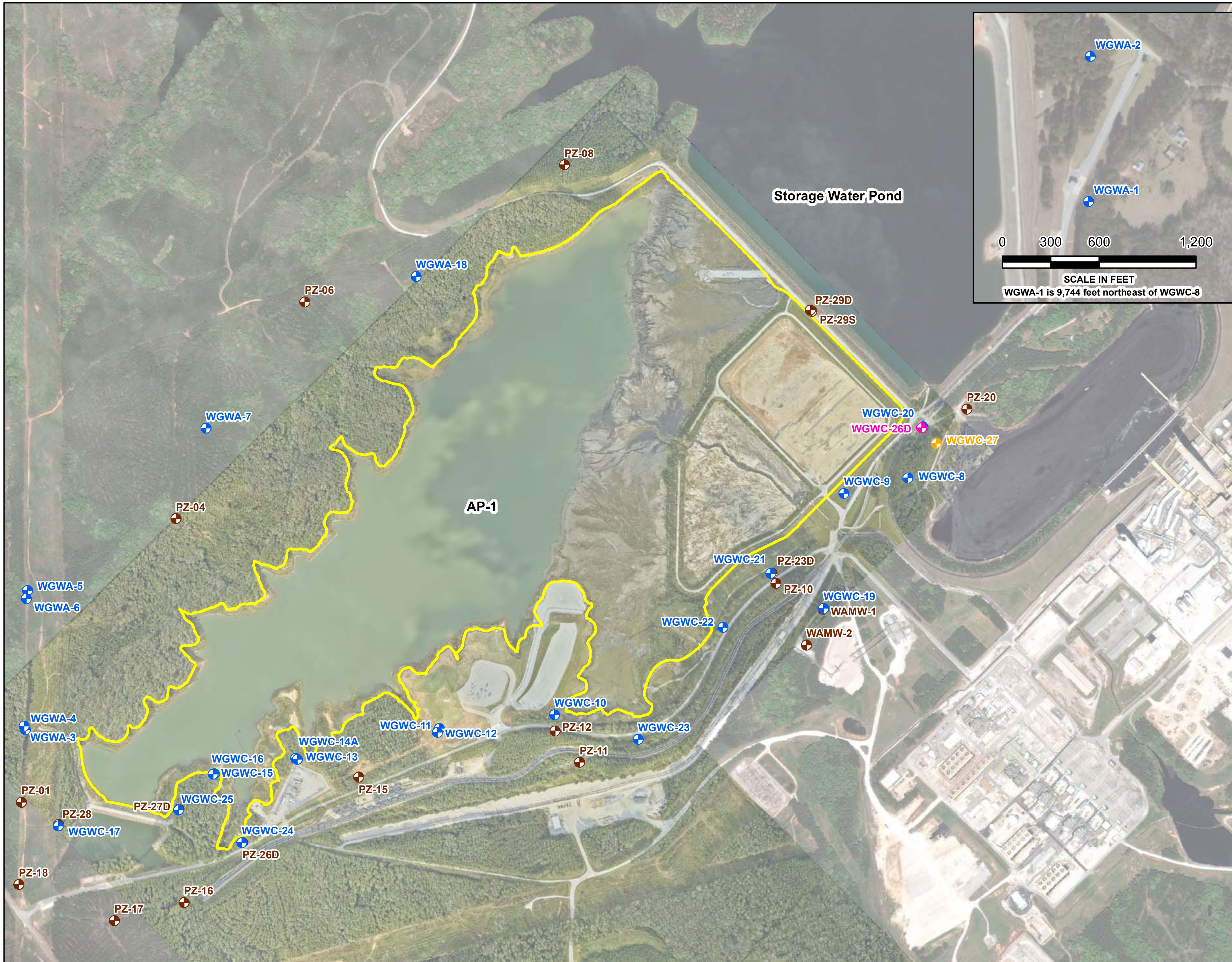
GEORGIA POWER
PLANT WANSLEY AP-1
HEARD AND CARROLL COUNTIES, GEORGIA

Prepared For: Georgia Power

Prepared By: Geosyntec consultants

KENNESAW, GA | MARCH 2023

FIGURE 1



N

Legend

- Detection Monitoring Well
- Horizontal Assessment Monitoring Well
- Vertical Assessment Monitoring Well
- Piezometer
- Approximate AP-1 Boundary

Notes:
1. Service Layer Credits for immediate vicinity of AP-1: Source: SAM LLC, September 9, 2022.
2. Service Layer Credits for surrounding area: 2020-04-05 Worldview 3 Satellite imagery. Purchased from Harris Geospatial.
3. Assessment monitoring wells installed in September 2022.

0 400 800 1,600

SCALE IN FEET

GROUNDWATER MONITORING WELL NETWORK MAP

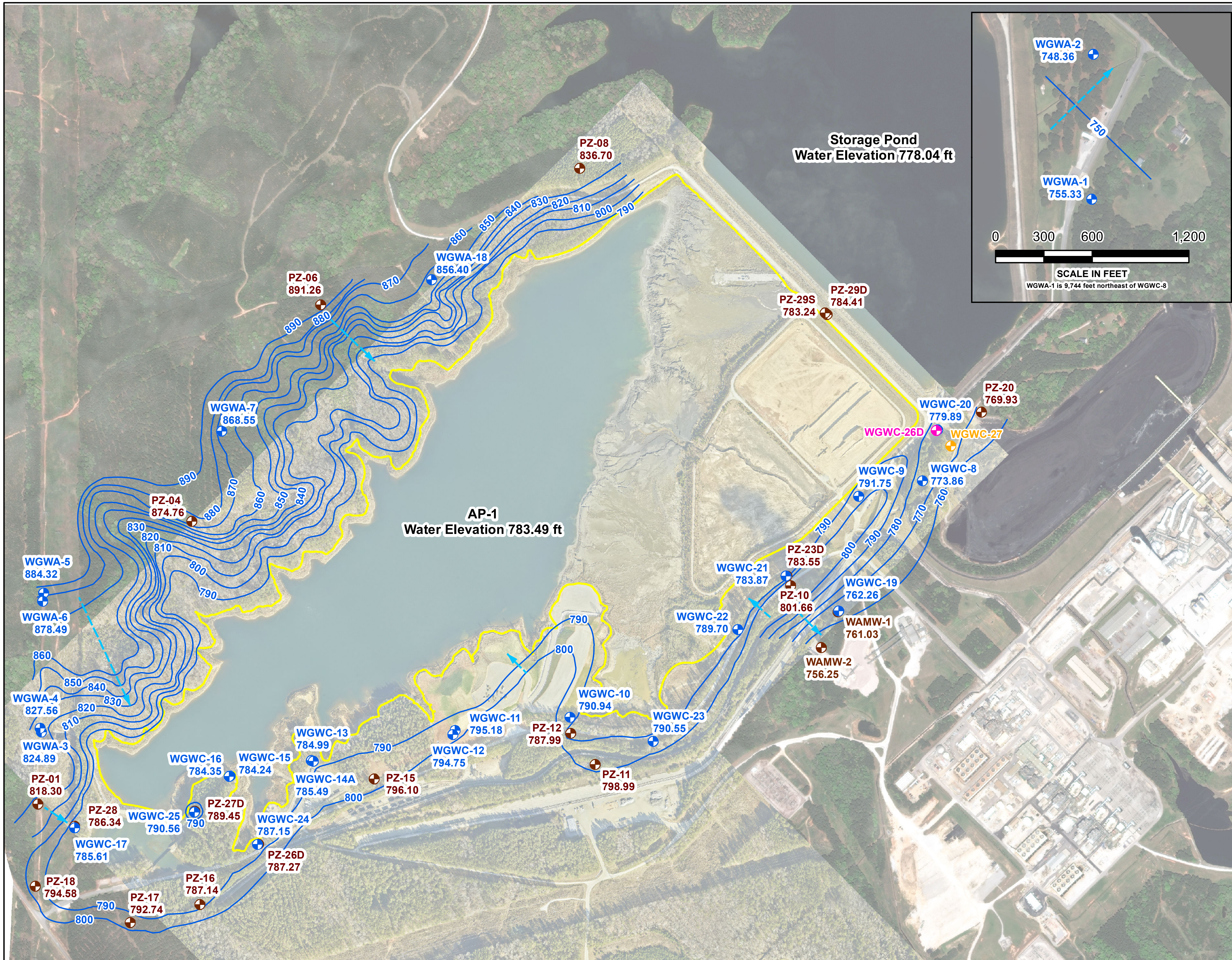
GEORGIA POWER
PLANT WANSLEY AP-1
HEARD AND CARROLL COUNTIES, GEORGIA

Prepared For: Georgia Power

Prepared By: Geosyntec consultants

KENNESAW, GA | MARCH 2023

FIGURE 2



Legend

- Detection Monitoring Well
- Horizontal Assessment Monitoring Well
- Vertical Assessment Monitoring Well
- Piezometer
- Approximate AP-1 Boundary
- Groundwater Elevation Iso-Contour
- Approximate Groundwater Flow Direction

Notes:
1. Water level elevation recorded on August 8, 2022. Elevation provided in feet (ft) referenced to the North American Vertical Datum (NAVD) 88. The map shows only the wells/piezometers currently installed at the time of the gauging event.
2. Service Layer Credits for immediate vicinity of AP-1: Source: SAM LLC, September 9, 2022.
3. Service Layer Credits for surrounding area: 2020-04-05 Worldview Satellite imagery. Purchased from Harris Geospatial.
4. Piezometer PZ-29S is installed within dike material and may not be representative of actual groundwater conditions.
5. Monitoring wells WGWC-26D and WGWC-27 were not used in the devleopment of the potentiometric surface contours.

0 400 800 1,600
SCALE IN FEET

POTENTIOMETRIC SURFACE CONTOUR MAP - AUGUST 2022

GEORGIA POWER
PLANT WANSLEY AP-1
HEARD AND CARROLL COUNTIES, GEORGIA

Prepared For: Georgia Power

Prepared By: Geosyntec consultants

Figure 3

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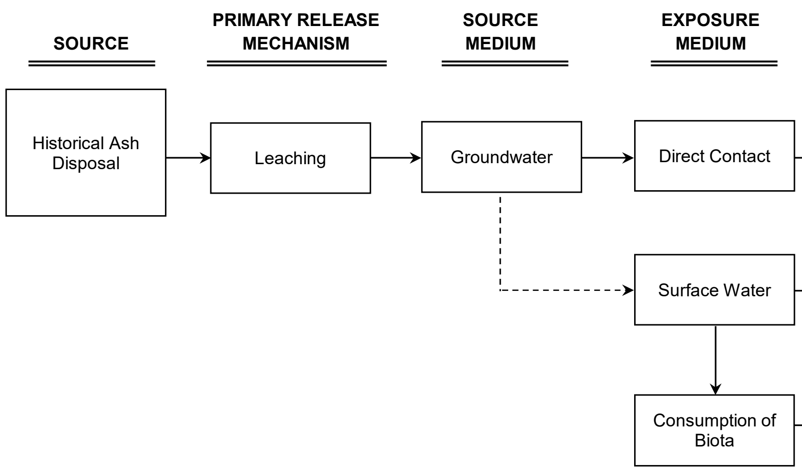


		HUMAN HEALTH AND ECOLOGICAL RISK EVALUATION RECEPTORS									
		HUMAN									ECOLOGICAL
		Current				Future					Current / Future
		On-Site	Off-Site		On- / Off-Site	On-Site		Off-Site		On- / Off-Site	On- / Off-Site
EXPOSURE MEDIUM	EXPOSURE ROUTE	Worker[1]	Worker[2]	Child and Adult Resident	Child and Adult Recreator[3]	Worker[1]	Child and Adult Resident	Worker[2]	Child and Adult Resident	Child and Adult Recreator[3]	Aquatic Receptors[4]
Direct Contact	Ingestion		○	●				○	●		
	Dermal Contact		○	●				○	●		
Surface Water	Ingestion				●					●	●
	Dermal Contact				●					●	●
Consumption of Biota	Ingestion				●					●	

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 Chattahoochee River were used to evaluate potential recreators.
4. Generalized receptor for ecological health risk evaluation.

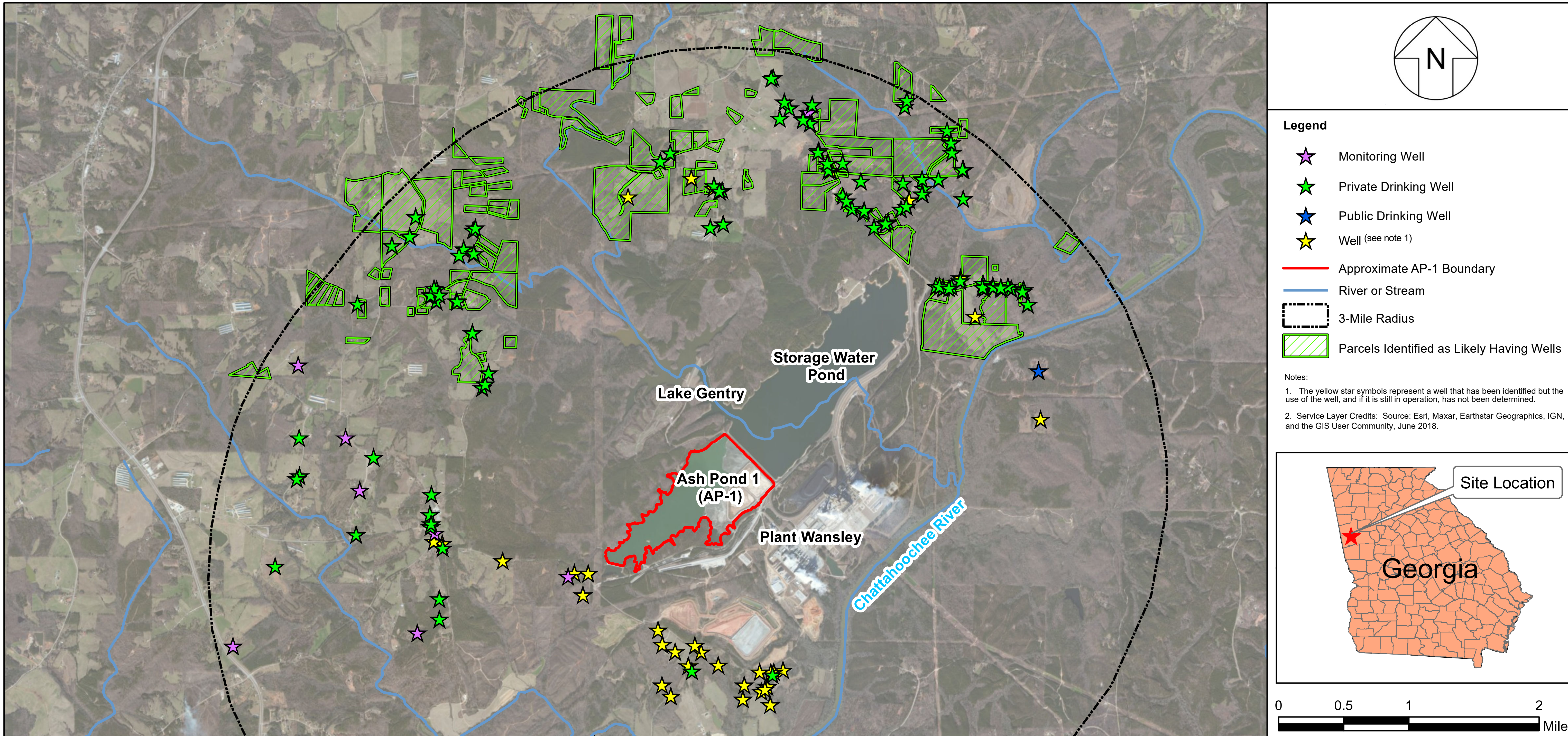
Conceptual Exposure Model

Georgia Power
Plant Wansley AP-1

Geosyntec consultants

Kennesaw, GA | March 2023

Figure 4



OFF-SITE WELL SURVEY RESULTS

GEORGIA POWER
PLANT WANSLEY AP-1
HEARD AND CARROLL COUNTIES, GEORGIA

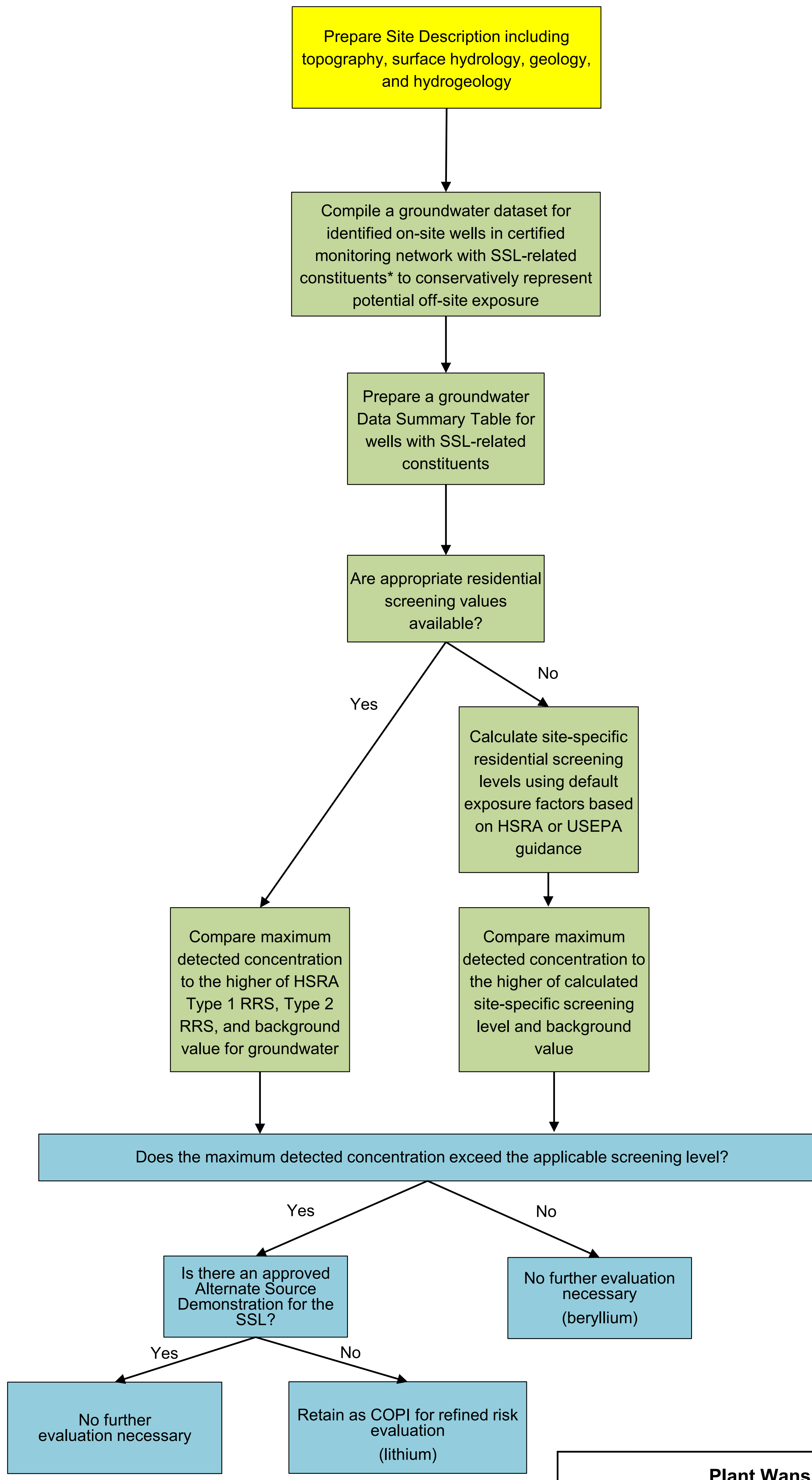
Prepared For: Georgia Power

Prepared By: Geosyntec consultants

KENNESAW, GA | MARCH 2023

FIGURE 5

Groundwater Risk Screening Approach for AP-1



Notes:

- Initial screen evaluates lithium in WGWC-19 and beryllium and lithium in WGWC-20

SSL = Statistically Significant Level
COPI = Constituent of Potential Interest
HSRA = Hazardous Site Response Act
RRS = Risk Reduction Standard
USEPA = United States Environmental Protection Agency

Plant Wansley AP-1
Groundwater Risk Screening Approach

Figure 6

March 2023

N

Legend

- Wells with SSL Related Constituents
- Detection Monitoring Well
- Horizontal Assessment Monitoring Well
- Vertical Assessment Monitoring Well
- Piezometer
- Approximate AP-1 Boundary

Notes:
1. Beryllium Federal and State CCR Rules SSL-Related Constituent: WGWC-20.
2. Lithium Federal and State CCR Rules SSL-Related Constituent: WGWC-19 and WGWC-20.
3. Service Layer Credits for immediate vicinity of AP-1: Source: SAM LLC, September 9, 2022.
4. Service Layer Credits for surrounding area: 2020-04-05 Worldview 3 Satellite imagery. Purchased from Harris Geospatial.
5. Assessment monitoring wells installed in September 2022.

0 400 800 1,600
SCALE IN FEET

MONITORING WELLS INCLUDED IN RISK SCREEN

GEORGIA POWER
PLANT WANSLEY AP-1
HEARD AND CARROLL COUNTIES, GEORGIA

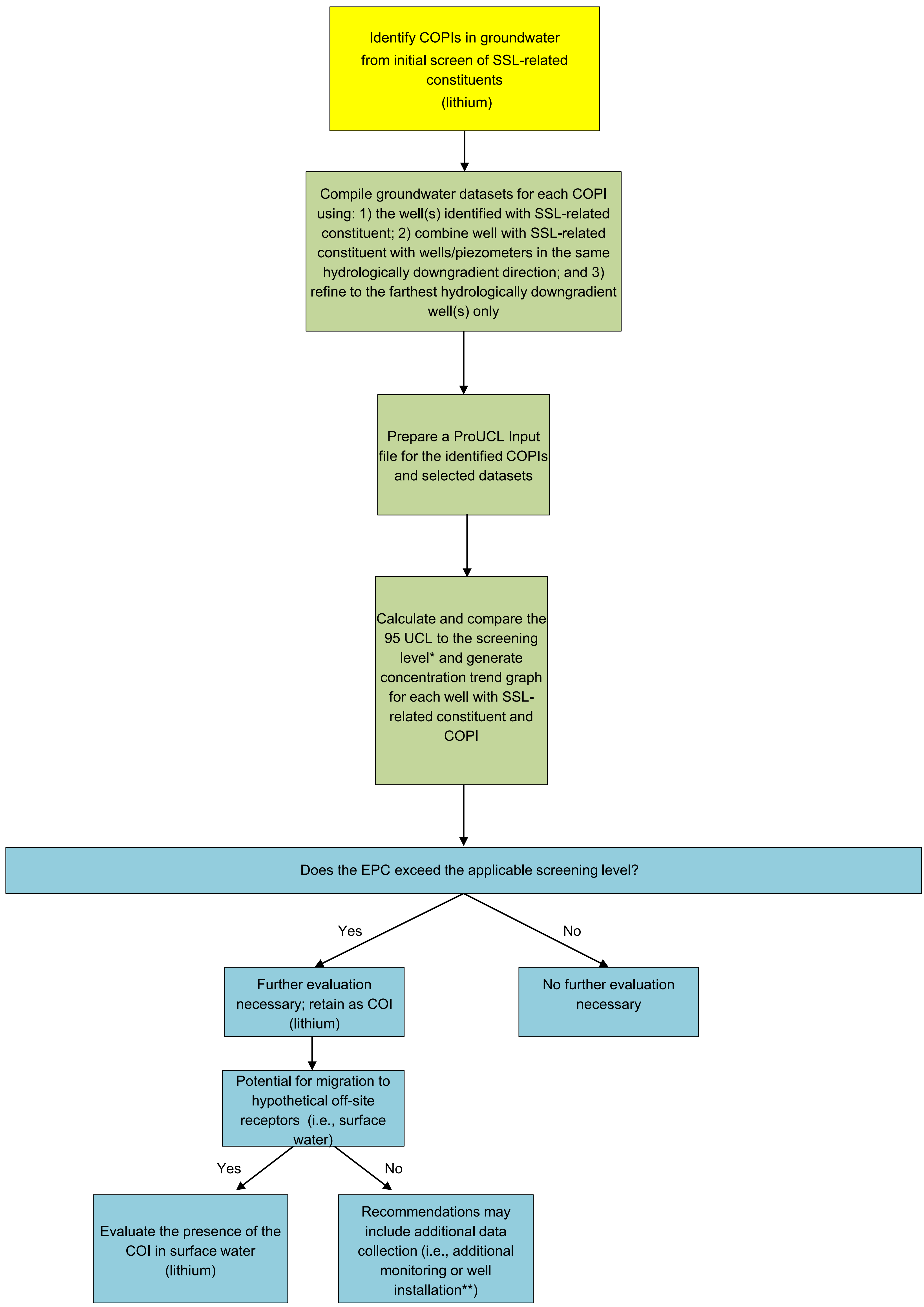
Prepared For: Georgia Power

Prepared By: Geosyntec consultants

FIGURE 7

KENNESAW, GA | MARCH 2023

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



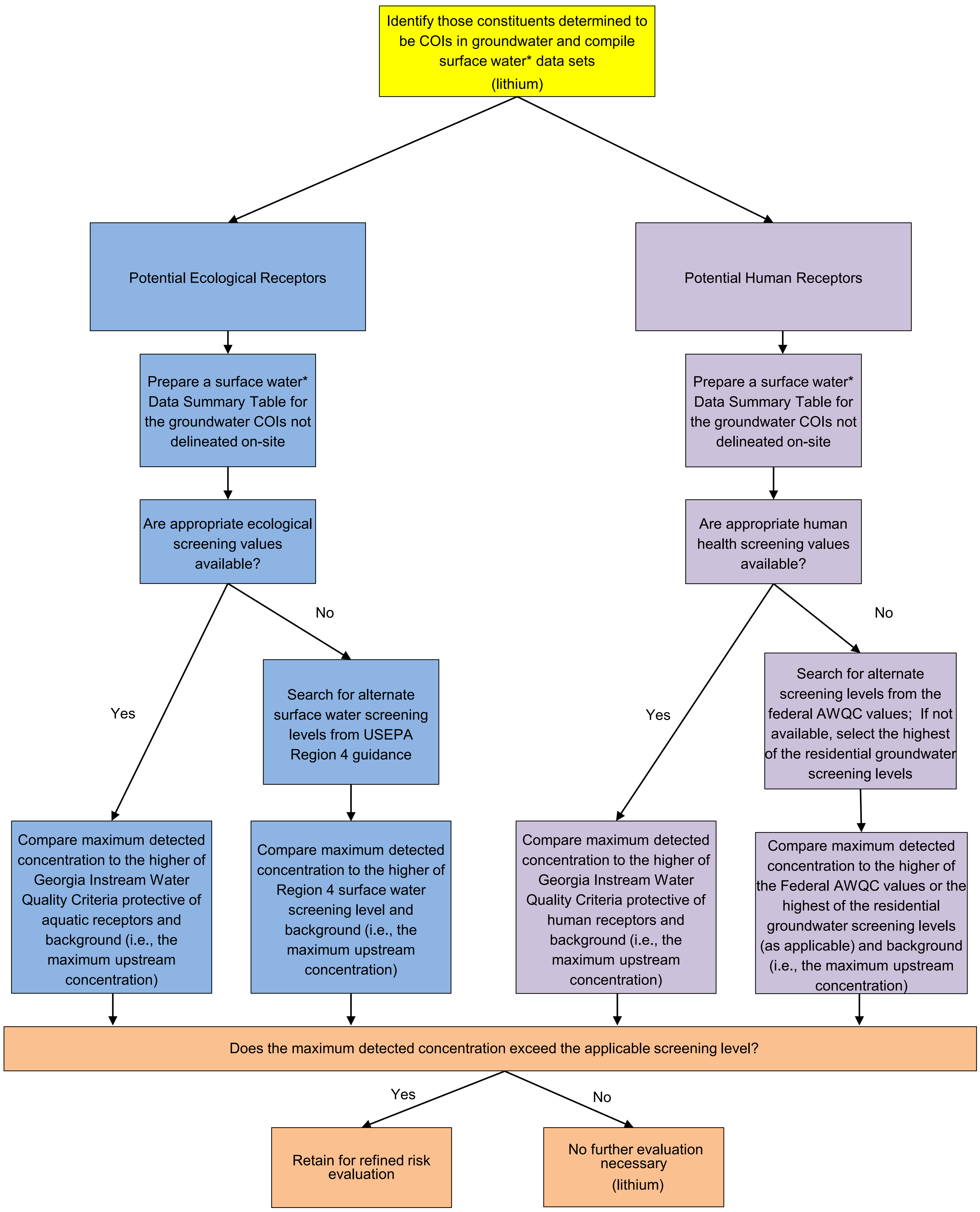
Notes:
*If the 95 UCL exceeds the maximum concentration, use the maximum as the EPC.
**This step is not necessary for Wansley AP-1.
SSL = Statistically Significant Level
COPI = Constituent of Potential Interest
EPC = Exposure Point Concentration
UCL = Upper Confidence Limit
COI = Constituent of Interest

Plant Wansley AP-1
Refined Groundwater Risk Evaluation Approach

Figure 8

March 2023

Risk Screening Approach (Surface Water) for AP-1



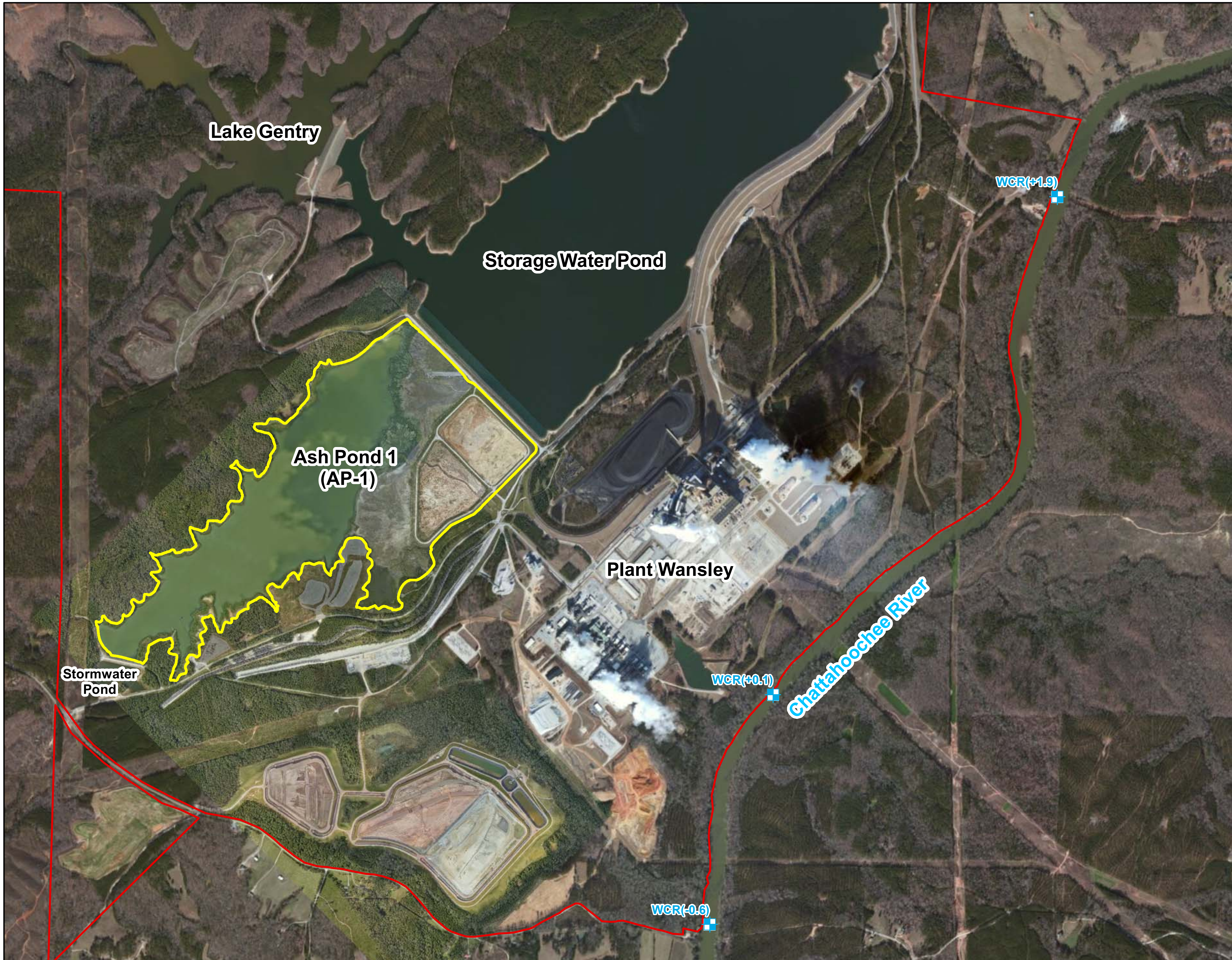
* Surface water data collected from the Chattahoochee River.

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

Plant Wansley AP-1
Surface Water Risk Screening Approach

Figure 9

March 2023



Legend

- Surface Water Sample Point
- Approximate Property Boundary
- Approximate AP-1 Boundary

Notes:
1. Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, June 2018.

0 750 1,500 3,000

SCALE IN FEET

SURFACE WATER SAMPLE LOCATIONS

GEORGIA POWER
PLANT WANSLEY AP-1
HEARD AND CARROLL COUNTIES, GEORGIA

Prepared For: Georgia Power

Prepared By: Geosyntec consultants

KENNESAW, GA | MARCH 2023

FIGURE 10

APPENDIX A

Plant Wansley Well Survey (Off-Site)

Well Survey

Plant Wansley

Ash Pond 1

Centralhatchee, GA

Prepared for

Georgia Power Company

241 Ralph McGill Blvd., Atlanta, GA 30308

Prepared by

NewFields

1349 W. Peachtree Street, Suite 2000

Atlanta, GA 30309

March 5, 2020

Introduction

Plant Wansley is located at 1371 Liberty Church Road in northeast Heard County, Georgia.

Plant Wansley operates one Coal Combustion Residuals (CCR) ash pond designated as Ash Pond 1 (AP-1). Newfields conducted a well survey of potential drinking water wells within a three-mile radius of AP-1 ("Investigated Area"). The Investigated Area is shown on Figure 1.

As part of this survey, NewFields accessed and 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).** USGS maintains an inventory database of wells sampled by a USGS-affiliated program for ground-water levels and/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. Wells in this database are labelled 'human drinking water wells' or 'monitoring wells'; however, many of the monitoring wells appear to be co-located with drinking water wells and may in fact be private drinking water wells utilized for monitoring purposes by USGS. Some listings in this database are over 50 years old and may be inactive.

    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 the facility. Public water suppliers in the Investigated Area include the Carroll County Water Authority, Heard County Water Authority, and Coweta County Water Department.

2. State Sources
    a. Georgia Environmental Protection Division (EPD)
        i. **Drinking Water Branch.** EPD 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 Michael Gillis of EPD on October 23rd, 2019 requesting information about wells in the Investigated Area. Mr. Gillis replied that there is one well within the Investigated Area, located at the Georgia Department of Natural Resources Chattahoochee Bend State Park Campground,

[1] http://waterdata.usgs.gov/ga/nwis/inventory?introduction

which is an RV park. The Drinking Water Branch Database reports that this well serves a transient population of about 156 people per year (i.e., the population changes and the system is not regularly serving the same people). The park was located using a combination of parcel data and aerial photography; the location of the well was estimated.

ii. **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. There are no HSI sites within the Investigated Area.

iii. **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 Carroll and Heard County. No wells were identified in the Investigated Area.

b. **Agricultural and Environmental Services Laboratory (AESL).** The University of Georgia's AESL Laboratory tests drinking water samples submitted by private individuals to their local county extension service. Maps of these sampling results can viewed online.[2] Precise coordinates are not available, but NewFields was able to use online images to find approximate locations.

3. County Sources

a. **County Health Departments.** County health departments (DOH) maintain 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. Many counties, including Heard and Coweta, do not maintain these records in a manner where they are easily searchable using geographic criteria. However, Carroll County Health Department conducted a search for permits along the major roads in the Investigated Area and provided copies of nearly three dozen permits from this area. These wells were geolocated based on address.

b. **Water Department Records.** NewFields attempted to contact the Heard County Water Authority regarding public water supply in Heard County. A representative of the Water Authority stated that public water was available throughout this portion of the county, however, "about 100 people in that part of the county still use private wells." The location of these wells could not be provided. Documentation about the Carroll County Water Authority found on the Internet indicates that waterlines in the area were built in the mid-2000s.

c. **Tax Assessor Records.** Multiple attempts were made to purchase full tax parcel data from the Heard County Tax Assessor's Office, but they did not respond. Basic parcel data was

[2] http://aesl.ces.uga.edu/water/map/

acquired from an online vendor, but it did not include information about improvements on parcels or whether wells were present. Carroll County Tax Assessor's office provided tax parcel shape and improvement data on October 23, 2019. The Carrol County Tax Assessor's Web site[3] lists information about the water source for each parcel. However, this data cannot be downloaded, but must be searched for parcels one at a time. NewFields used the Web site to check the water source for wells identified using all other sources. While some homes are using public water in this area, older homes appear to mostly be using private wells. Tax parcel shapefiles were acquired from the Coweta County GIS Department on October 2, 2019. Additional tax parcel data, including information about the age of structures on the property, was obtained on October 14, 2019 from the County Tax Assessor's Office.

4. Windshield Surveys
    a. A windshield survey of the area was conducted on October 15th, 2019. During the survey a number of wells were visually identified, which were subsequently compiled into the GIS database. The majority of wells identified during the survey were near residences.

Summary

In addition to identifying specific wells from the above listed sources, NewFields used a combination of Carroll County parcel data and information about the presence and age of public water infrastructure to identify parcels that may be using well water as their drinking water source or had drinking water wells at some time. Many of these parcels may be (or have been) sharing wells, so a well might not exist for each identified parcel. A large number of structures in Carroll County significantly predate the nearest waterlines. While these wells are listed in the table as 'drinking water wells', some of those may be inactive. Information from the Tax Assessor's Web site indicates that many of the older have drinking water wells.

NewFields did not use parcel data to identify potential wells in Heard County as the tax assessor did not provide information about the age of homes or the existence of structures. However, the Heard County Water Authority confirmed that there were approximately 100 people in this area utilizing private wells.

Public water is available throughout most of the Investigated Area, supplied by the Carroll County Water Authority and the Heard County Water Authority. Coweta Water Authority does not supply public water in the Investigated Area. A small area to the east is located in a part of Coweta County without public water service. There is one transient public well located nearly three miles northeast from Ash Pond 1. This well serves a transient population of 156 people at the Chattahoochee Bend State Park Campground.

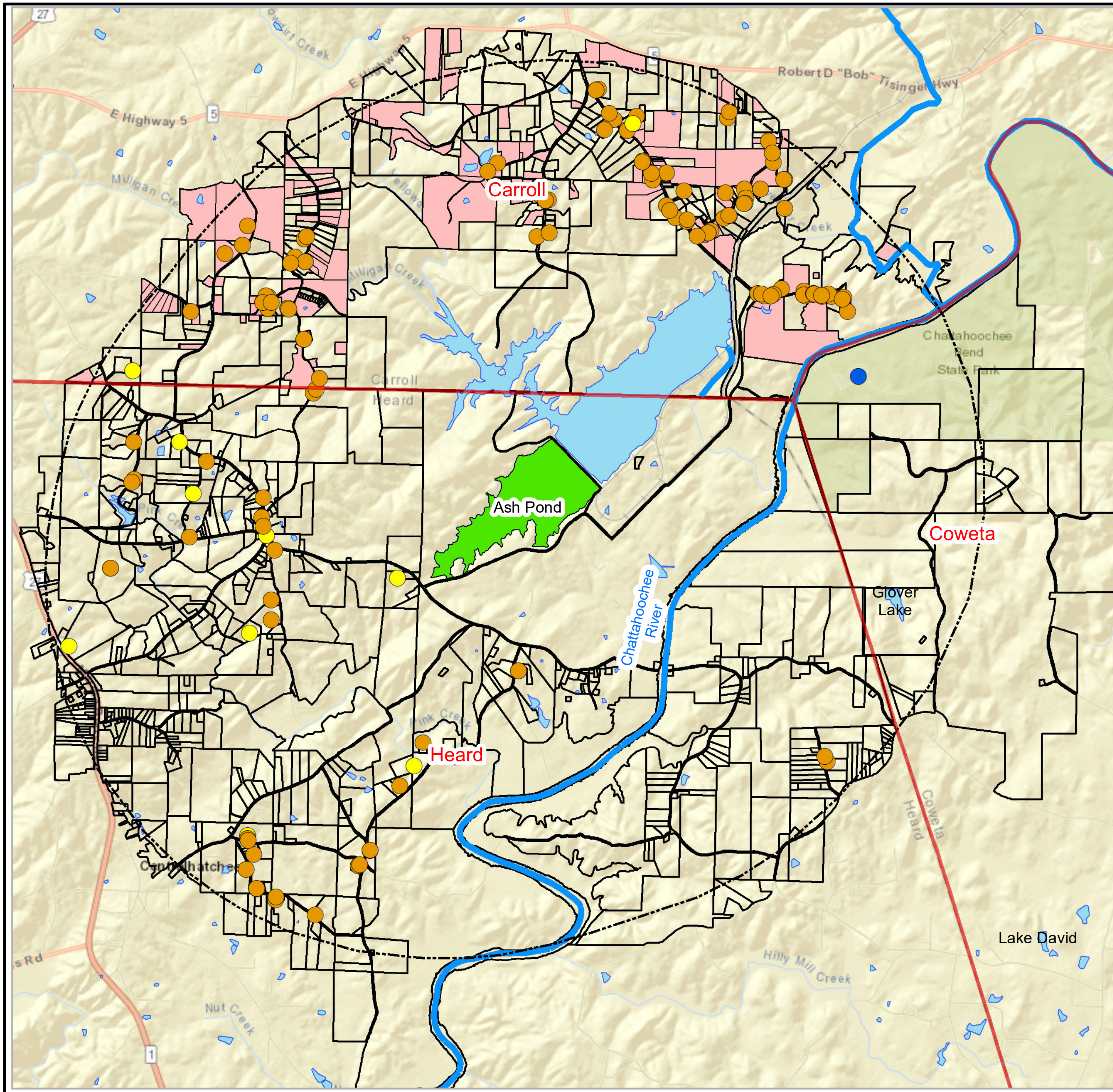
Combining well data from all sources with parcel data from Carroll County, NewFields identified 185 total parcels likely to be associated with an active or inactive private well within the Investigated Area. Of these, 112 parcels were identified as likely associated with an active or inactive private well using

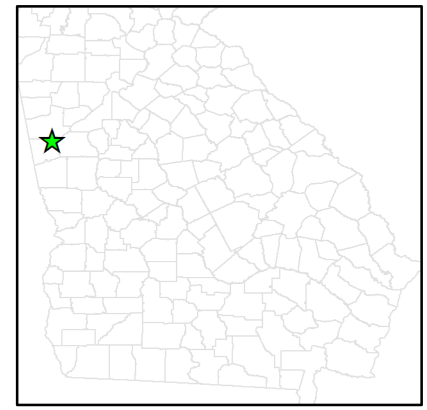
[3] https://qpublic.schneidercorp.com/Application.aspx?App=CarrollCountyGA&Layer=Parcels&PageType=Search

parcel data. Sixty-two (62) wells were documented during the windshield survey (one identified as an irrigation well, as it was in a field). Twenty-nine (29) wells were identified from Carroll County septic permits. Thirteen (13) wells were identified using USGS sources, three (3) from the EPD's Pesticide Sampling Project, and one (1) from UGA's Cooperative Extension Sampling program. Many wells were identified by multiple sources.[4]

Figure 1 shows points for identified wells, and shades parcels that were identified from parcel data as likely to are 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.

[4] USGS monitoring wells located on Georgia Power property were also considered not to be drinking water wells and omitted.





N
W E
S

- Monitoring Well
- Private Drinking Well
- Public Drinking Well
- Major Waterways
- Lakes and Ponds
- 3-Mile Radius
- Ash Pond
- Parcels Identified as likely having a well
- Parcels
- County Line

0 2,900 5,800 11,600 Feet

Title	Wansley Plant – Ash Pond 1		
Project	GPC Plants Georgia		
NewFields	Two Midtown Plaza 1349 W. Peachtree St, #2000 Atlanta, Georgia 30309 Tel: 404-347-9050		
Date	1/2/2019	Rev. No.	0
MXD	gpc_ccr_2019/agis	Figure No.	1

APPENDIX B
Data Used in Risk Evaluation

Appendix B
Appendix B-1
Groundwater Data
Plant Wansley AP-1 Risk Evaluation Report
Plant Wansley, Carrollton, GA

Well ID	Sample Date	Constituent	
		Beryllium (mg/L)	Lithium (mg/L)
WGWC-19	11/11/2016	< 0.0025 ND	**0.045**
WGWC-19	2/6/2017	< 0.0025 ND	**0.05**
WGWC-19	3/15/2017	< 0.0025 ND	**0.052**
WGWC-19	4/11/2017	< 0.0025 ND	**0.048**
WGWC-19	4/26/2017	< 0.0025 ND	**0.044**
WGWC-19	6/7/2017	< 0.0025 ND	**0.047**
WGWC-19	7/11/2017	< 0.0025 ND	**0.045**
WGWC-19	8/10/2017	< 0.0025 ND	**0.056**
WGWC-19	3/29/2018	< 0.0025 ND	**0.072**
WGWC-19	6/14/2018	< 0.0025 ND	**0.048**
WGWC-19	10/4/2018	< 0.0025 ND	**0.062**
WGWC-19	2/28/2019	< 0.0025 ND	**0.045**
WGWC-19	4/2/2019	< 0.00034 ND	**0.052**
WGWC-19	9/18/2019	< 0.00018 ND	**0.052**
WGWC-19	2/7/2020	< 0.00018 ND	**0.044**
WGWC-19	5/4/2020	< 0.00018 ND	**0.049**
WGWC-19	9/23/2020	< 0.00018 ND	**0.056**
WGWC-19	2/3/2021	< 0.00018 ND	**0.06**
WGWC-19	3/11/2021	< 0.00018 ND	**0.051**
WGWC-19	8/26/2021	< 0.00018 ND	**0.057**
WGWC-19	3/3/2022	< 0.0025 ND	**0.057**
WGWC-19	8/17/2022	< 0.0025 ND	**0.056**
WGWC-20	3/8/2021	NA	**0.11**
WGWC-20	4/8/2021	NA	**0.11**
WGWC-20	8/26/2021	**0.0081**	**0.11**
WGWC-20	1/12/2022	**0.012**	**0.15**
WGWC-20	3/4/2022	**0.01**	**0.14**
WGWC-20	6/7/2022	**0.0089**	**0.12**
WGWC-20	8/18/2022	**0.0081**	**0.11**
WGWC-26D	10/19/2022	**0.004**	**0.16**
WGWC-27	10/19/2022	**0.00054 J**	**0.0072**
WAMW-1	10/18/2018	< 0.0025 ND	**0.026**
WAMW-2	10/16/2018	< 0.0025 ND	**0.023**

Notes:
Bold = The constituent was detected in the sample.
NA = Constituent not analyzed on a given date in a specific well.
J = Estimated value; the presented value is below the reporting limit but above the method detection limit.
< = Non-detect result; value shown is the reporting limit.
ND = non-detect
mg/L milligrams(s) per liter

Appendix B
Appendix B-2
Surface Water Data
Plant Wansley AP-1 Risk Evaluation Report
Plant Wansley, Carrollton, GA

			Constituent:	Lithium
			Units	mg/L
Sample ID	Sample Location	River Sampled	Sample Date	
WCR(+0.1)_20220304	WCR(+0.1)	Chattahoochee	3/4/2022	< 0.005 ND
WCR(+0.1)_20220304Dis	WCR(+0.1)	Chattahoochee	3/4/2022	< 0.005 ND
(+0.1)_20220818	WCR(+0.1)	Chattahoochee	8/18/2022	< 0.005 ND
(+0.1)_20220818DIS	WCR(+0.1)	Chattahoochee	8/18/2022	< 0.005 ND
WCR(+1.9)_20220304	WCR(+1.9)	Chattahoochee	3/4/2022	< 0.005 ND
WCR(+1.9)_20220304Dis	WCR(+1.9)	Chattahoochee	3/4/2022	< 0.005 ND
(+1.9)_20220818	WCR(+1.9)	Chattahoochee	8/18/2022	< 0.005 ND
(+1.9)_20220818DIS	WCR(+1.9)	Chattahoochee	8/18/2022	< 0.005 ND
WCR(-0.6)_20220304	WCR(-0.6)	Chattahoochee	3/4/2022	< 0.005 ND
WCR(-0.6)_20220304Dis	WCR(-0.6)	Chattahoochee	3/4/2022	< 0.005 ND
(-0.6)_20220818	WCR(-0.6)	Chattahoochee	8/18/2022	< 0.005 ND
(-0.6)_20220818DIS	WCR(-0.6)	Chattahoochee	8/18/2022	< 0.005 ND

Notes:
mg/L = milligrams(s) per liter
< = Non-detect result; the reporting limit is presented
ND = non-detect

APPENDIX C

USEPA RSL Calculator Generated Residential Screening Levels

Appendix C
USEPA RSL Calculator Generated Residential Screening Levels
Plant Wansley AP-1 Risk Evaluation Report
Plant Wansley, Carrollton, 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
lsc (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 18JAN2023:15:00:58

Appendix C
USEPA RSL Calculator Generated Residential Screening Levels
Plant Wansley AP-1 Risk Evaluation Report
Plant Wansley, Carrollton, GA

Chemical	Lithium
CAS Number	7439-93-2
Mutagen?	No
Volatile?	No
Chemical Type	Inorganics
Sfo (mg/kg-day)-1	-
Sfo Ref	
IUR (ug/m3)-1	-
IUR Ref	
RfD (mg/kg-day)	0.002
RfD Ref	P
RfC (mg/m3)	-
RfC Ref	
GIABS	1
Kp (cm/hr)	0.001
MW	6.94
B (unitless)	0.00101
t* (hr)	0.276
τevent (hr/event)	0.115
FA (unitless)	1
In EPD?	Yes
DAevent (ca)	-
DAevent (nc child)	0.00492
DAevent (nc adult)	0.00849
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)	40.1
Dermal SL Child THQ=1 (ug/L)	9100
Inhalation SL Child THQ=1 (ug/L)	-
Noncarcinogenic SL Child THI=1 (ug/L)	39.9
Ingestion SL Adult THQ=1 (ug/L)	66.7
Dermal SL Adult THQ=1 (ug/L)	12000
Inhalation SL Adult THQ=1 (ug/L)	-
Noncarcinogenic SL Adult THI=1 (ug/L)	66.4
Screening Level (ug/L)	3.99E+01 nc

Notes

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

APPENDIX D

Support for Refined Risk Evaluation

Appendix D-1

Exposure Point Concentration Calculation Results

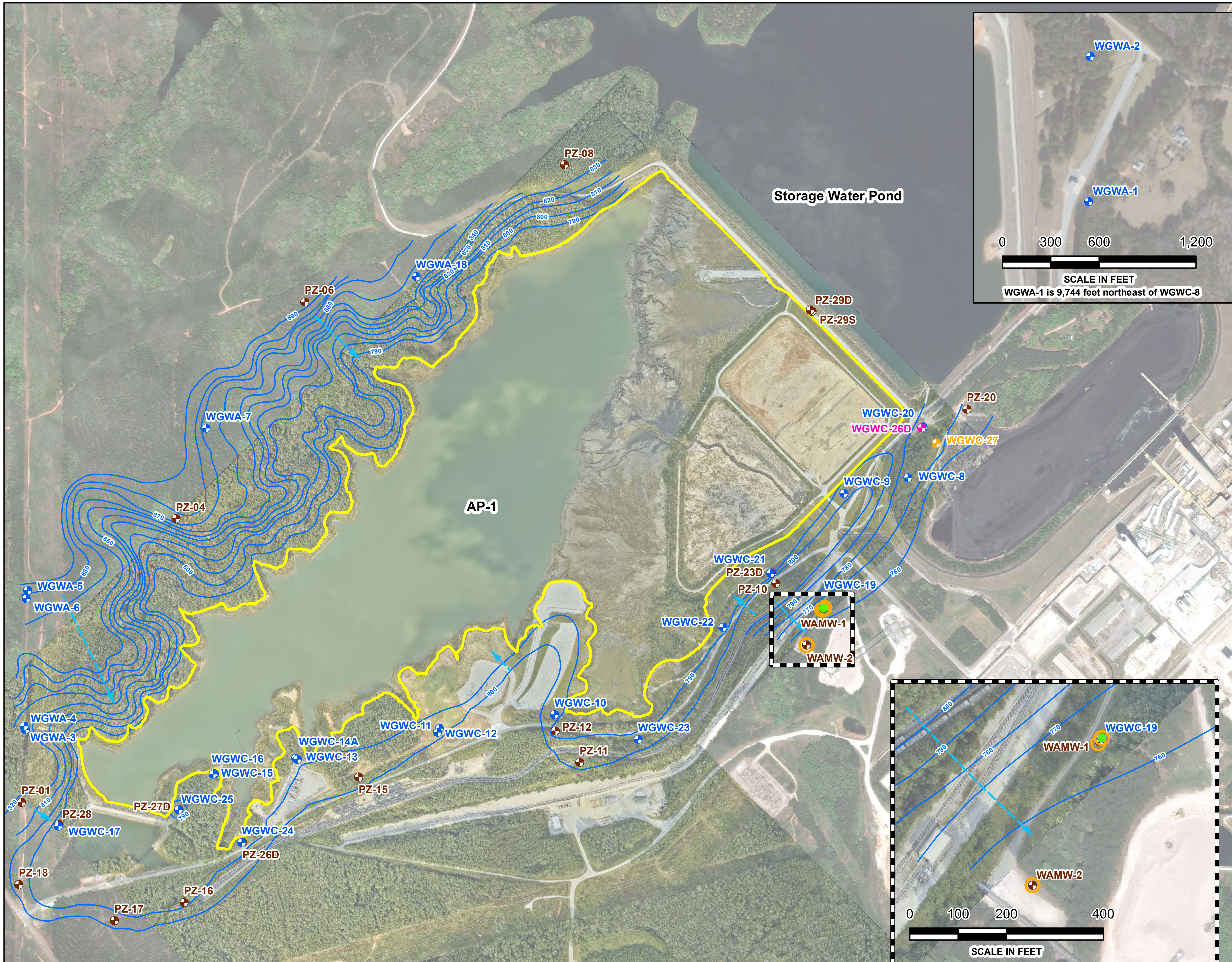
Appendix D
Appendix D-1
Groundwater Exposure Point Concentration Calculation Results
Plant Wansley AP-1 Risk Evaluation Report
Plant Wansley, Carrollton, GA

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)
Lithium	West	WGWC-19	0.072	22 / 22	22 / 22	0.055		
		WGWC-19 WAMW-1 WAMW-2	0.072	24 / 24	22 / 24		0.054	
		[2]		--	--			Not Calculated[2]
	East	WGWC-20	0.15	7 / 7	7 / 7	0.13		
		WGWC-20 WGWC-26D WGWC-27	0.16	9 / 9	8 / 9		0.14	
		WGWC-27	0.0072	1 / 1	0 / 1			0.0072

Notes
Highlighted cells indicate the EPCs selected in the refined risk evaluation.
[1] EPCs calculated in accordance with USEPA, 2014. Memorandum for Determining Groundwater Exposure Point Concentrations, Supplemental Guidance. OSWER Directive 9283.1-42, February 2014. Available at: https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236917
[2] The Step 3 EPC was not calculated for this constituent because there are no wells located downgradient of the well with the exceedance.

Appendix D-2

Exposure Point Concentration Figures



N

Legend

- Detection Monitoring Well
- Horizontal Assessment Monitoring Well
- Vertical Assessment Monitoring Well
- Piezometer
- Groundwater Elevation Iso-Contour
- Approximate Groundwater Flow Direction
- Approximate AP-1 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. Water level elevation recorded on August 8, 2022. Elevation provided in feet (ft) referenced to the North American Vertical Datum (NAVD) 88. The map shows only the wells/piezometers currently installed at the time of the gauging event.
4. Service Layer Credits for immediate vicinity of AP-1: Source: SAM LLC, September 9, 2022.
5. Service Layer Credits for surrounding area: 2020-04-05 Worldview 3 Satellite imagery. Purchased from Harris Geospatial.
6. Assessment monitoring wells installed in September 2022.

0 400 800 1,600
SCALE IN FEET

WEST
EXPOSURE POINT CONCENTRATION MAP
LITHIUM

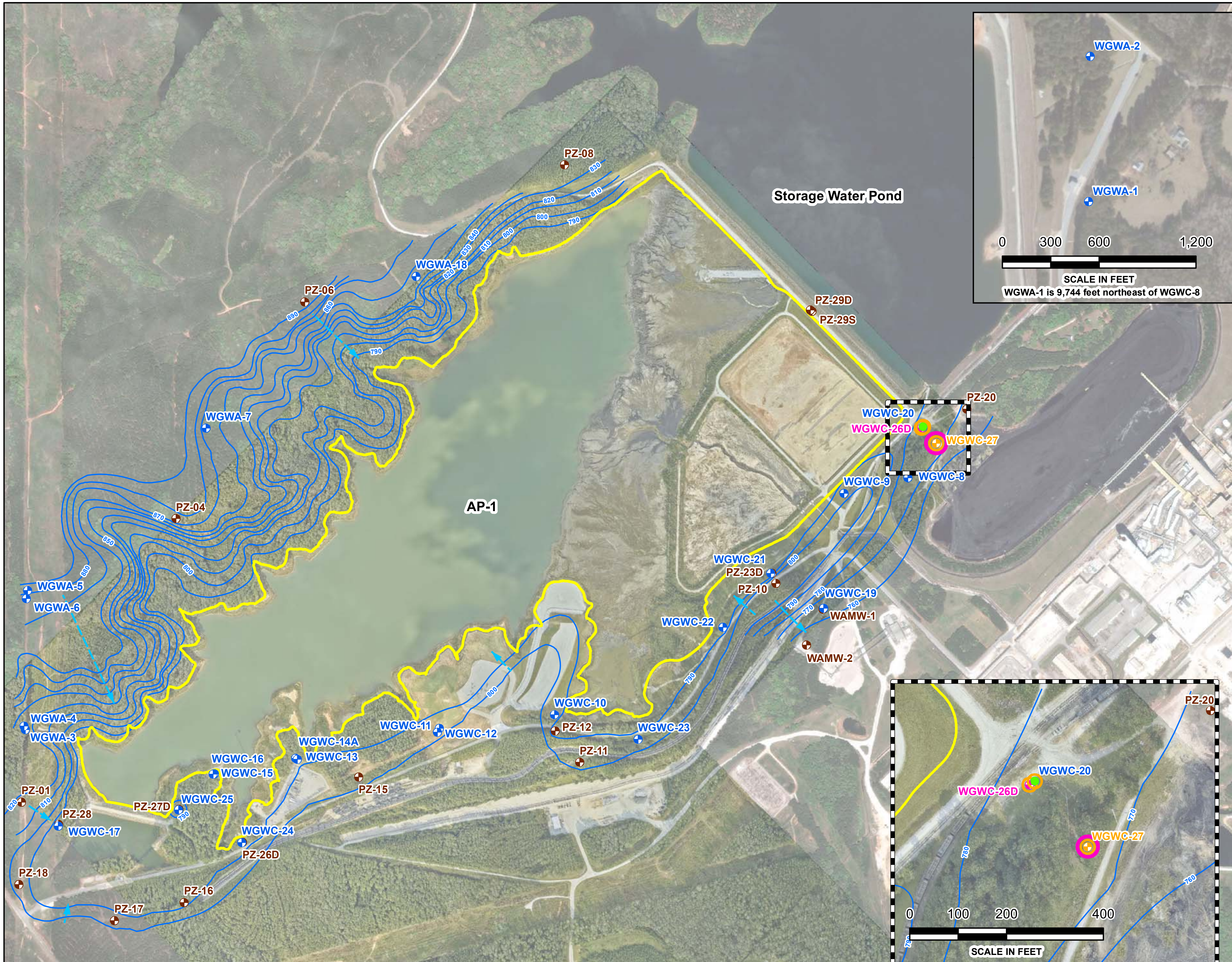
GEORGIA POWER
PLANT WANSLEY AP-1
HEARD AND CARROLL COUNTIES, GEORGIA

Prepared For: Georgia Power

Prepared By: Geosyntec consultants

KENNESAW, GA | MARCH 2023

FIGURE D-2a



Legend

- Detection Monitoring Well
- Horizontal Assessment Monitoring Well
- Vertical Assessment Monitoring Well
- Piezometer
- Groundwater Elevation Iso-Contour
- Approximate Groundwater Flow Direction
- Approximate AP-1 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 level elevation recorded on August 8, 2022. Elevation provided in feet (ft) referenced to the North American Vertical Datum (NAVD) 88. The map shows only the wells/piezometers currently installed at the time of the gauging event.
6. Service Layer Credits for immediate vicinity of AP-1: Source: SAM LLC, September 9, 2022.
7. Service Layer Credits for surrounding area: 2020-04-05 Worldview 3 Satellite imagery. Purchased from Harris Geospatial.
8. Assessment monitoring wells installed in September 2022.

0 400 800 1,600

SCALE IN FEET

EAST EXPOSURE POINT CONCENTRATION MAP LITHIUM

GEORGIA POWER
PLANT WANSLEY AP-1
HEARD AND CARROLL COUNTIES, GEORGIA

Prepared For: Georgia Power

Prepared By: Geosyntec consultants

KENNESAW, GA | MARCH 2023

FIGURE D-2b

Appendix D-3

ProUCL Input / Output Files

Appendix D
Appendix D-3
ProUCL Input
Plant Wansley AP1 Risk Evaluation Report
Plant Wansley, Carrollton, GA

Step 1 EPC Input Values				Step 2 EPC Input Values			
Step1_Lithium_West	D_Step1_Lithium_West	Step1_Lithium_East	D_Step1_Lithium_East	Step2_Lithium_West	D_Step2_Lithium_West	Step2_Lithium_East	D_Step2_Lithium_East
0.045	1	0.11	1	0.045	1	0.11	1
0.05	1	0.11	1	0.05	1	0.11	1
0.052	1	0.11	1	0.052	1	0.11	1
0.048	1	0.15	1	0.048	1	0.15	1
0.044	1	0.14	1	0.044	1	0.14	1
0.047	1	0.12	1	0.047	1	0.12	1
0.045	1	0.11	1	0.045	1	0.11	1
0.056	1			0.056	1	0.16	1
0.072	1			0.072	1	0.0072	1
0.048	1			0.048	1		
0.062	1			0.062	1		
0.045	1			0.045	1		
0.052	1			0.052	1		
0.052	1			0.052	1		
0.044	1			0.044	1		
0.049	1			0.049	1		
0.056	1			0.056	1		
0.06	1			0.06	1		
0.051	1			0.051	1		
0.057	1			0.057	1		
0.057	1			0.057	1		
0.056	1			0.056	1		
				0.026	1		
				0.023	1		

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.2 3/3/2023 10:21:09 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Step1_Lithium_West

General Statistics

Total Number of Observations	22	Number of Distinct Observations	13
		Number of Missing Observations	0
Minimum	0.044	Mean	0.0522
Maximum	0.072	Median	0.0515
SD	0.00693	Std. Error of Mean	0.00148
Coefficient of Variation	0.133	Skewness	1.114

Normal GOF Test

Shapiro Wilk Test Statistic	0.909	**Shapiro Wilk GOF Test**
1% Shapiro Wilk Critical Value	0.878	Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.147	**Lilliefors GOF Test**
1% Lilliefors Critical Value	0.214	Data appear Normal at 1% Significance Level

Data appear Normal at 1% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.0547	95% Adjusted-CLT UCL (Chen-1995)	0.055
		95% Modified-t UCL (Johnson-1978)	0.0548

Gamma GOF Test

A-D Test Statistic	0.436	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.131	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.185	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	63.56	k star (bias corrected MLE)	54.92
Theta hat (MLE)	8.2105E-4	Theta star (bias corrected MLE)	9.5016E-4
nu hat (MLE)	2796	nu star (bias corrected)	2416
MLE Mean (bias corrected)	0.0522	MLE Sd (bias corrected)	0.00704
		Approximate Chi Square Value (0.05)	2303
Adjusted Level of Significance	0.0386	Adjusted Chi Square Value	2295

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.0547	95% Adjusted Gamma UCL	0.0549

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk Lognormal GOF Test**	
10% Shapiro Wilk Critical Value	0.926	Data appear Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.123	**Lilliefors Lognormal GOF Test**	
10% Lilliefors Critical Value	0.169	Data appear Lognormal at 10% Significance Level	

Data appear Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-3.124	Mean of logged Data	-2.961
Maximum of Logged Data	-2.631	SD of logged Data	0.127

Assuming Lognormal Distribution

95% H-UCL	0.0548	90% Chebyshev (MVUE) UCL	0.0564
95% Chebyshev (MVUE) UCL	0.0583	97.5% Chebyshev (MVUE) UCL	0.061
99% Chebyshev (MVUE) UCL	0.0662		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0546	95% BCA Bootstrap UCL	0.055
95% Standard Bootstrap UCL	0.0546	95% Bootstrap-t UCL	0.0553
95% Hall's Bootstrap UCL	0.0558	95% Percentile Bootstrap UCL	0.0547
90% Chebyshev(Mean, Sd) UCL	0.0566	95% Chebyshev(Mean, Sd) UCL	0.0586
97.5% Chebyshev(Mean, Sd) UCL	0.0614	99% Chebyshev(Mean, Sd) UCL	0.0669

Suggested UCL to Use

95% Student's-t UCL	0.0547

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

Step1_Lithium_East

General Statistics

Total Number of Observations	7	Number of Distinct Observations	4
		Number of Missing Observations	0
Minimum	0.11	Mean	0.121
Maximum	0.15	Median	0.11
SD	0.0168	Std. Error of Mean	0.00634
Coefficient of Variation	0.138	Skewness	1.177

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

Normal GOF Test

Shapiro Wilk Test Statistic	0.744	**Shapiro Wilk GOF Test**	
1% Shapiro Wilk Critical Value	0.73	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.324	**Lilliefors GOF Test**	
1% Lilliefors Critical Value	0.35	Data appear Normal at 1% Significance Level	

Data appear Normal at 1% Significance Level

Note GOF tests may be unreliable for small sample sizes

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.134	95% Adjusted-CLT UCL (Chen-1995)	0.135
		95% Modified-t UCL (Johnson-1978)	0.134

Gamma GOF Test

A-D Test Statistic	0.943	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.708	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.343	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.311	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	65.47	k star (bias corrected MLE)	37.51
Theta hat (MLE)	0.00185	Theta star (bias corrected MLE)	0.00324
nu hat (MLE)	916.6	nu star (bias corrected)	525.1
MLE Mean (bias corrected)	0.121	MLE Sd (bias corrected)	0.0198
		Approximate Chi Square Value (0.05)	473
Adjusted Level of Significance	0.0158	Adjusted Chi Square Value	457.9

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.135	95% Adjusted Gamma UCL	0.139

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.748	**Shapiro Wilk Lognormal GOF Test**	
10% Shapiro Wilk Critical Value	0.838	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.327	**Lilliefors Lognormal GOF Test**	
10% Lilliefors Critical Value	0.28	Data Not Lognormal at 10% Significance Level	

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-2.207	Mean of logged Data	-2.116
Maximum of Logged Data	-1.897	SD of logged Data	0.131

Assuming Lognormal Distribution

95% H-UCL	0.135	90% Chebyshev (MVUE) UCL	0.14
95% Chebyshev (MVUE) UCL	0.148	97.5% Chebyshev (MVUE) UCL	0.159
99% Chebyshev (MVUE) UCL	0.181		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.132	95% BCA Bootstrap UCL	N/A
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
90% Chebyshev(Mean, Sd) UCL	0.14	95% Chebyshev(Mean, Sd) UCL	0.149
97.5% Chebyshev(Mean, Sd) UCL	0.161	99% Chebyshev(Mean, Sd) UCL	0.184

Suggested UCL to Use

95% Student's-t UCL	0.134

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

Step2_Lithium_West

General Statistics			
Total Number of Observations	24	Number of Distinct Observations	15
		Number of Missing Observations	0
Minimum	0.023	Mean	0.0499
Maximum	0.072	Median	0.0505
SD	0.0103	Std. Error of Mean	0.00209
Coefficient of Variation	0.206	Skewness	-0.824

Normal GOF Test			
Shapiro Wilk Test Statistic	0.905	**Shapiro Wilk GOF Test**	
1% Shapiro Wilk Critical Value	0.884	Data appear Normal at 1% Significance Level	
Lilliefors Test Statistic	0.2	**Lilliefors GOF Test**	
1% Lilliefors Critical Value	0.205	Data appear Normal at 1% Significance Level	
Data appear Normal at 1% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.0535	95% Adjusted-CLT UCL (Chen-1995)	0.0529
		95% Modified-t UCL (Johnson-1978)	0.0534

Gamma GOF Test			
A-D Test Statistic	1.334	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.742	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.234	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.178	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	20.02	k star (bias corrected MLE)	17.55
Theta hat (MLE)	0.00249	Theta star (bias corrected MLE)	0.00284
nu hat (MLE)	961.2	nu star (bias corrected)	842.3
MLE Mean (bias corrected)	0.0499	MLE Sd (bias corrected)	0.0119
		Approximate Chi Square Value (0.05)	776
Adjusted Level of Significance	0.0392	Adjusted Chi Square Value	771.5

Assuming Gamma Distribution			
95% Approximate Gamma UCL	0.0541	95% Adjusted Gamma UCL	0.0545

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.801	**Shapiro Wilk Lognormal GOF Test**	
10% Shapiro Wilk Critical Value	0.93	Data Not Lognormal at 10% Significance Level	
Lilliefors Test Statistic	0.258	**Lilliefors Lognormal GOF Test**	
10% Lilliefors Critical Value	0.162	Data Not Lognormal at 10% Significance Level	
Data Not Lognormal at 10% Significance Level			

Lognormal Statistics			
Minimum of Logged Data	-3.772	Mean of logged Data	-3.023
Maximum of Logged Data	-2.631	SD of logged Data	0.245

Assuming Lognormal Distribution			
95% H-UCL	0.0549	90% Chebyshev (MVUE) UCL	0.0576
95% Chebyshev (MVUE) UCL	0.0611	97.5% Chebyshev (MVUE) UCL	0.0658
99% Chebyshev (MVUE) UCL	0.0752		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.0533	95% BCA Bootstrap UCL	0.0529
95% Standard Bootstrap UCL	0.0532	95% Bootstrap-t UCL	0.0532
95% Hall's Bootstrap UCL	0.0533	95% Percentile Bootstrap UCL	0.0531
90% Chebyshev(Mean, Sd) UCL	0.0562	95% Chebyshev(Mean, Sd) UCL	0.059
97.5% Chebyshev(Mean, Sd) UCL	0.0629	99% Chebyshev(Mean, Sd) UCL	0.0707

Suggested UCL to Use

95% Student's-t UCL	0.0535

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 using results from simulation studies.
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 positvely skewed data sets.

Step2_Lithium_East

General Statistics

Total Number of Observations	9	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	0.0072	Mean	0.113
Maximum	0.16	Median	0.11
SD	0.0441	Std. Error of Mean	0.0147
Coefficient of Variation	0.391	Skewness	-1.889

Note: Sample size is small (e.g., <10), if data are collected using incremental sampling methodology (ISM) approach,
refer also to ITRC Tech Reg Guide on ISM (ITRC 2020 and ITRC 2012) for additional guidance,
but note that ITRC may recommend the t-UCL or the Chebyshev UCL for small sample sizes (n < 7).
The Chebyshev UCL often results in gross overestimates of the mean.
Refer to the ProUCL 5.2 Technical Guide for a discussion of the Chebyshev UCL.

Normal GOF Test

Shapiro Wilk Test Statistic	0.774	**Shapiro Wilk GOF Test**
1% Shapiro Wilk Critical Value	0.764	Data appear Normal at 1% Significance Level
Lilliefors Test Statistic	0.362	**Lilliefors GOF Test**
1% Lilliefors Critical Value	0.316	Data Not Normal at 1% Significance Level

Data appear Approximate Normal at 1% Significance Level
Note GOF tests may be unreliable for small sample sizes

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.14	95% Adjusted-CLT UCL (Chen-1995)	0.127
		95% Modified-t UCL (Johnson-1978)	0.139

Gamma GOF Test

A-D Test Statistic	1.731	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.728	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.457	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.282	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.453	k star (bias corrected MLE)	1.709
Theta hat (MLE)	0.0461	Theta star (bias corrected MLE)	0.0661
nu hat (MLE)	44.15	nu star (bias corrected)	30.77
MLE Mean (bias corrected)	0.113	MLE Sd (bias corrected)	0.0864
		Approximate Chi Square Value (0.05)	19.1
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	17.18

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.182	95% Adjusted Gamma UCL	0.202

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.53	**Shapiro Wilk Lognormal GOF Test**
10% Shapiro Wilk Critical Value	0.859	Data Not Lognormal at 10% Significance Level
Lilliefors Test Statistic	0.467	**Lilliefors Lognormal GOF Test**
10% Lilliefors Critical Value	0.252	Data Not Lognormal at 10% Significance Level

Data Not Lognormal at 10% Significance Level

Lognormal Statistics

Minimum of Logged Data	-4.934	Mean of logged Data	-2.398
Maximum of Logged Data	-1.833	SD of logged Data	0.962

Assuming Lognormal Distribution

95% H-UCL	0.423	90% Chebyshev (MVUE) UCL	0.27
95% Chebyshev (MVUE) UCL	0.331	97.5% Chebyshev (MVUE) UCL	0.415
99% Chebyshev (MVUE) UCL	0.581		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution

Nonparametric Distribution Free UCLs

95% CLT UCL	0.137	95% BCA Bootstrap UCL	0.13
95% Standard Bootstrap UCL	0.136	95% Bootstrap-t UCL	0.133
95% Hall's Bootstrap UCL	0.13	95% Percentile Bootstrap UCL	0.133
90% Chebyshev(Mean, Sd) UCL	0.157	95% Chebyshev(Mean, Sd) UCL	0.177
97.5% Chebyshev(Mean, Sd) UCL	0.205	99% Chebyshev(Mean, Sd) UCL	0.259

Suggested UCL to Use

95% Student's-t UCL	0.14

When a data set follows an approximate distribution passing only one of the GOF tests,
it is suggested to use a UCL based upon a distribution passing both GOF tests in ProUCL

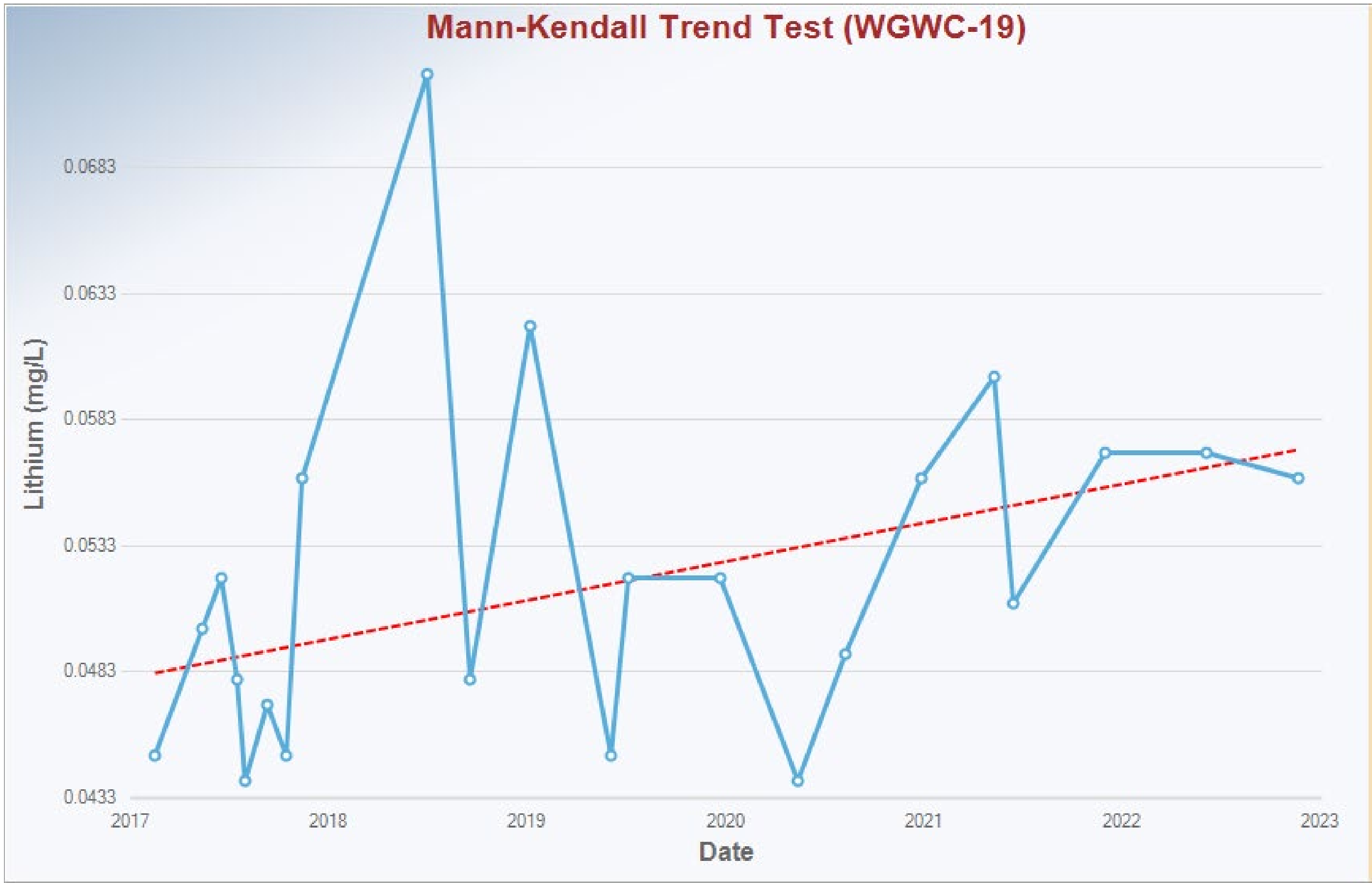
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness using results from simulation studies.
However, simulations results will not cover all Real World data 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 positvely skewed data sets.

Appendix D-4

Groundwater Trend Graphs

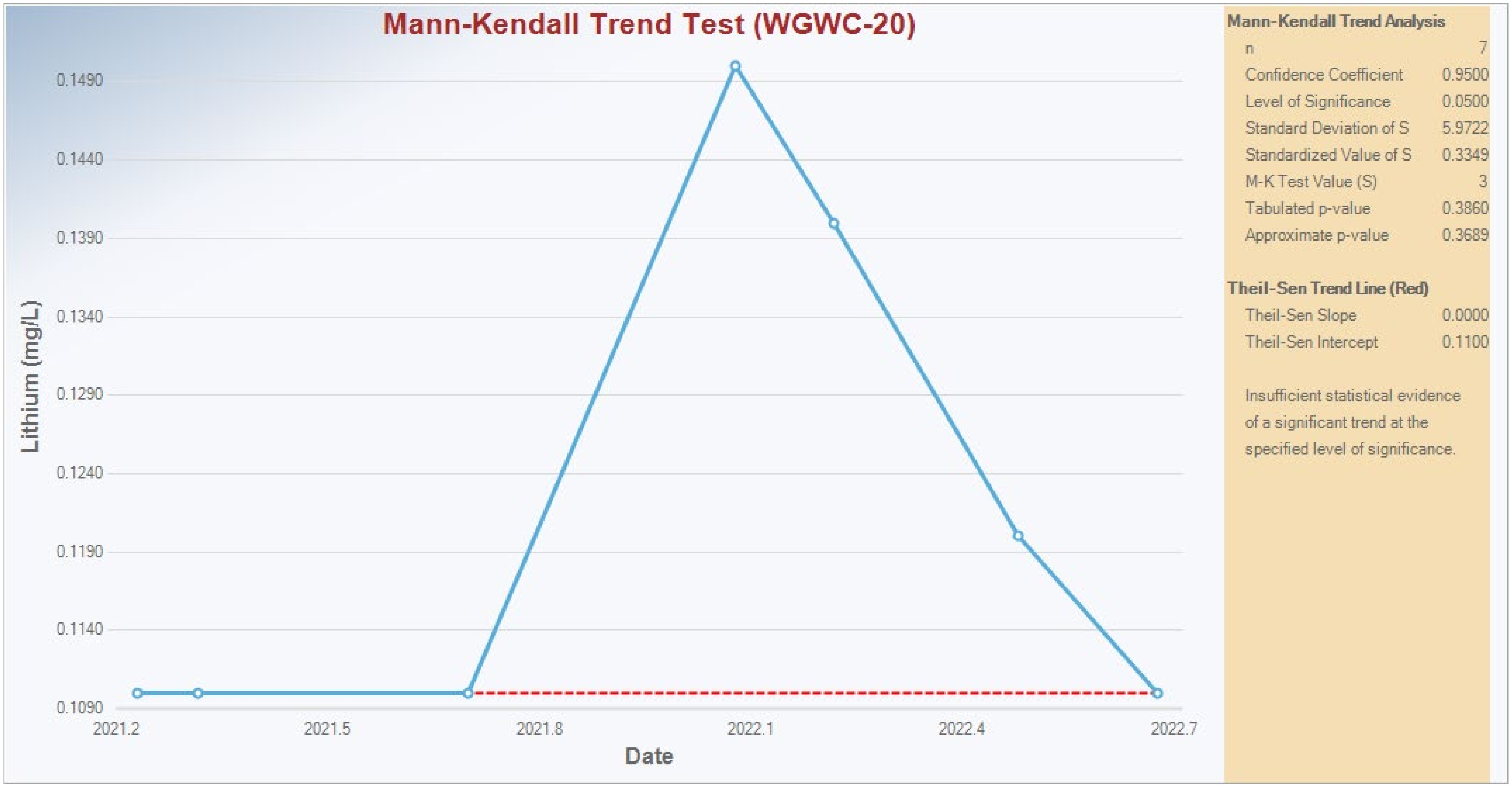
Appendix D
Appendix D-4
Groundwater Trend Graphs - Lithium
Plant Wansley AP-1 Risk Evaluation Report
Plant Wansley, Carrollton, GA



Mann-Kendall Trend Analysis	
n	22
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	35.2657
Standardized Value of S	1.9282
M-K Test Value (S)	69
Tabulated p-value	0.0270
Approximate p-value	0.0269

Theil-Sen Trend Line (Red)	
Theil-Sen Slope	0.0015
Theil-Sen Intercept	-3.0531

Statistically significant evidence of an increasing trend at the specified level of significance.



Mann-Kendall Trend Test (WGWC-20)
Lithium (mg/L)
0.1490
0.1440
0.1390
0.1340
0.1290
0.1240
0.1190
0.1140
0.1090
2021.2
2021.5
2021.8
2022.1
2022.4
2022.7
Date
Mann-Kendall Trend Analysis
n 7
Confidence Coefficient 0.9500
Level of Significance 0.0500
Standard Deviation of S 5.9722
Standardized Value of S 0.3349
M-K Test Value (S) 3
Tabulated p-value 0.3860
Approximate p-value 0.3689
Theil-Sen Trend Line (Red)
Theil-Sen Slope 0.0000
Theil-Sen Intercept 0.1100
Insufficient statistical evidence of a significant trend at the specified level of significance.