

**INITIAL SAFETY FACTOR ASSESSMENT**  
**40 C.F.R. § 257.100(f)(2)(iv) and 40 C.F.R. § 257.73(e)**  
**PLANT HARLLEE BRANCH ASH POND D (AP-D)**  
**GEORGIA POWER COMPANY**

A rule amendment to the Federal CCR Rule became effective on November 8, 2024. See Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; Legacy CCR Surface Impoundments, 89 Fed. Reg. 38950 (“Legacy Rule”). The Legacy Rule defines the term “legacy CCR surface impoundment” and establishes regulatory requirements for units that meet the definition of a legacy CCR surface impoundment. The Legacy Rule requires the owner or operator of a legacy CCR impoundment to conduct an initial and periodic safety factor assessments for each CCR unit and document whether the calculated factors of safety for each unit achieve the minimum safety factors specified in § 257.73(e)(1)(i) through (iv) for the critical section of the dam. See 40 C.F.R. Part 257, §257.100(f)(2)(iv) and §257.73(d). In addition, the Rules require a subsequent assessment be performed within 5 years of the previous assessment. See 40 C.F.R. § 257.73(f)(3).

The legacy CCR surface impoundment known as Ash Pond D (AP-D) at Georgia Power Company’s (Georgia Power) Plant Harllee Branch (Plant Branch) property is located on the northern shore of Lake Sinclair, off State Route 24 (US 441) near Milledgeville and Eatonton in Putnam County, Georgia. Construction of the AP-D dam was completed in September 1980, with CCR placement commencing thereafter. The dam was reportedly constructed using material borrowed from an area near the northeastern portion of AP-D. The “most impervious material” was placed at the center of the dam, with “less impervious” material positioned upstream and downstream of this zone. The upstream and downstream faces were compacted with slopes of approximately 2H:1V and 2.5H:1V, respectively. The AP-D dam is regulated as a Category II Dam under the Georgia Environmental Protection Agency Safe Dams Program. AP-D does not currently hold ponded water and is covered with surface vegetation. AP-D is currently not receiving any CCR.

The original slope stability analysis of the AP-D dam was performed by Southern Company in 1979 as part of the original design. In 2010, Southern Company reviewed the original slope stability analysis and performed updated analyses for the AP-D dam for maximum storage pool, maximum surcharge pool, rapid drawdown, and seismic loading conditions. The analyzed cross section is considered critical because it has the greatest height (approximately 65 feet). For the initial safety factor assessment, slope stability analyses were performed on the critical section under long-term maximum storage pool, maximum surcharge pool, and seismic loading conditions to calculate the minimum safety factors. The results of the slope stability analyses are summarized below:

Loading Condition	Minimum Calculated Safety Factor	Minimum Required Safety Factor
Long-Term, Maximum Storage Pool (Static)	1.55	1.50
Maximum Surcharge Pool (Static)	1.53	1.40
Seismic	1.42	1.00

The dam consists of compacted saprolite, which also forms its foundation, and is not susceptible to liquefaction. Therefore, the safety factor assessment did not include the liquefaction loading condition.

The safety factor assessment is supported by the attached engineering calculation packages.

I hereby certify that the safety factor assessment was conducted in accordance with 40 C.F.R. § 257.100(f)(2)(iv) and 40 C.F.R. § 257.73(e).



05/06/2026

Mehmet Iscimen, P.E.

Licensed State of GA, PE No. 034164

**ATTACHMENT A**  
**Ash Pond D Slope Stability Analysis**

**CALCULATION PACKAGE COVER SHEET**

**Client:** Georgia Power                      **Project:** Design and Operating Criteria                      **Project #:** GW11718  
Assessments for Plant Branch Legacy  
CCR Units

**TITLE OF PACKAGE:**                      **ASH POND D SLOPE STABILITY ANALYSIS**

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	<b>REVIEW</b>	<b>ASSUMPTIONS &amp; PROCEDURES CHECKED BY:</b> (Assumptions & Procedures Checker, APC)	Signature <u><i>M. Gizem Bozkurt</i></u> Name <u>M. Gizem Bozkurt, Ph.D., P.E.</u>
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<b>BACK-CHECK</b>	<b>BACK-CHECKED BY:</b> (Calculation Preparer, CP)	Signature <u><i>Camilo Guerrero</i></u> Name <u>Camilo Guerrero, Ph.D.</u>	<u>05/06/2026</u> Date
<b>APPROVAL</b>	<b>APPROVED BY:</b> (Calculation Approver, CA)	Signature _____ Name <u>Mehmet Iscimen, P.E.</u>	<u>05/06/2026</u> Date



**REVISION HISTORY:**

<u>NO.</u>	<u>DESCRIPTION</u>	<u>DATE</u>	<u>CP</u>	<u>APC</u>	<u>CC</u>	<u>CA</u>
<u>0</u>	<u>Final Issue</u>	<u>05/06/2026</u>	<u>CG</u>	<u>MGB</u>	<u>CPC</u>	<u>MI</u>

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## ASH POND D SLOPE STABILITY ANALYSIS

### INTRODUCTION AND PURPOSE

The purpose of this *Ash Pond D Slope Stability Analysis* calculation package (Package) is to present the methods and results of slope stability analyses for the Ash Pond D (AP-D) dam at Georgia Power Company's (Georgia Power) Plant Harlee Branch (Plant Branch) in Putnam County, Georgia. The slope stability analyses were performed to support the *Initial Safety Factor Assessment* report for AP-D in compliance with the United States Environmental Protection Agency's (USEPA's) Coal Combustion Residuals (CCR) Rule contained in 40 C.F.R. §257 (USEPA, 2015).

The remainder of this Package is organized to present: (i) minimum required safety factors; (ii) method of analysis; (iii) input parameters; (iv) results; and (v) conclusions and recommendations.

### MINIMUM REQUIRED SAFETY FACTORS

Slope stability analyses were performed to assess whether the AP-D dam satisfies the safety factor requirements in §257.73(e)(1) of the CCR Rule. §257.73(e)(1) requires that:

“The safety factor assessments must be supported by appropriate engineering calculations.

- (i) The calculated static factor of safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50.
- (ii) The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.
- (iii) The calculated seismic factor of safety must equal or exceed 1.00.
- (iv) For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.”

### METHOD OF ANALYSIS

Two-dimensional (2-D) slope stability analyses of non-circular slip surfaces were performed using Spencer's method (Spencer, 1973), as implemented in the software Slide2 version 9.040 (Rocscience, 2025). Spencer's method was used because the method satisfies vertical and horizontal force equilibrium and moment equilibrium. The Slide2 software generates potential slip surfaces, calculates the safety factor for each of these surfaces, and identifies the slip surface with the lowest calculated safety factor (termed as the critical slip surface). Slip

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surfaces with depths less than 5 feet (ft) were filtered out in the Slide2 software because such failures would be localized, could be repaired through standard maintenance procedures, and would not affect the overall stability of the dam. Searches for the critical slip surface in Slide2 were performed with the optimization feature enabled.

## INPUT PARAMETERS

### Subsurface Stratigraphy and Material Properties

The AP-D dam was constructed by excavating alluvium adjacent to Lake Sinclair and placing fill material on top of existing saprolite, as shown in the historical design drawings (Georgia Power, 1980a). The existing fill material, referred to as Dike Soil by SCS (2010), was reportedly borrowed from an area near the upstream toe of the dam (Georgia Power, 1980b). According to the design drawings (Georgia Power, 1980a), the dam cross section indicates that the “most impervious material” was placed at the center of the dam, while “less impervious” material was placed upstream and downstream of this zone. A Blanket Drain composed of concrete sand material was installed beneath the downstream toe of the central core (Georgia Power, 1980a). In addition, a 100-ft wide compacted fill labelled Toe Soil by SCS (2010) was constructed downstream of the dam, as shown in the historical design drawings (Georgia Power, 1980a). The subsurface stratigraphy beneath the AP-D dam consists of the following units, from top to bottom: (i) saprolite, classified under the Unified Soil Classification System (USCS) as sandy elastic silt and elastic silt with sand (MH), as well as silty sand (SM); (ii) partially weathered rock (PWR), which generally exhibits the same characteristics of the underlying bedrock and is classified as silty sand (SM), clayey sand (SC), or well-graded sand (SW); and (iii) competent bedrock consisting of poorly-jointed feldspathic biotite gneiss.

The geotechnical properties (unit weights and shear strengths) of the subsurface and dam materials used in the slope stability analysis are summarized in **Table 1**. Geotechnical properties for the Dike Soil, Toe Soil, and Blanket Drain were based on the *Slope Stability Analyses of Ash Pond Dikes B, C, D-1, and E* calculation package (SCS, 2010) and additional information obtained from various subsurface investigations at Plant Branch summarized in the *Summary of Geotechnical Design Parameters* calculation package (Geosyntec, 2023). The geotechnical properties for the CCR impounded by the AP-D dam were selected based on tests performed on CCR impounded at Plant Branch (Golder, 2014) and Geosyntec’s professional experience at Plant Branch and other CCR impoundments (Geosyntec, 2023). The geotechnical properties selected for the saprolite and PWR are based on the results of

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historical field and laboratory testing performed on the saprolite encountered at all Plant Branch ash ponds, as summarized in the *Summary of Geotechnical Design Parameters* calculation package (Geosyntec, 2023). The undrained shear strength ( $S_u$ ) for saprolite is defined as a linear function of effective vertical overburden pressure ( $\sigma'_v$ ). The bedrock represents the lowermost layer of the subsurface stratigraphy and was modeled as an “infinite strength material” in Slide2, which prevents potential slip surfaces from passing through this material.

### Cross Section

The location of the selected cross section is presented in **Figure 1**. The selected cross section represents the critical section for the slope stability analysis because it corresponds to the maximum height for the AP-D dam.

The ground surface for the top of CCR, the crest and downstream face of the AP-D dam, and downstream beyond the toe of the dam are based on a recent LiDAR survey conducted on January 22, 2024, and provided by SCS on March 5, 2024. Historical drawings for the AP-D dam indicate that the in-situ natural alluvium was removed to approximately elevation (El.) 338 ft to establish the base of the dam between Station 10+20 and Station 11+90, corresponding to the low area of the valley (Georgia Power, 1980a). The crest elevation is approximately El. 403 ft, and the downstream face has a slope of approximately 2.5 horizontal to 1 vertical (2.5H:1V), consistent with the historical design drawings shown in **Figure 2** (Georgia Power, 1980a). The upstream slope was modeled as 2.0H:1V, which is close to the 2.25H:1V slope from historical drawings (Georgia Power, 1980a). A 3-ft thick blanket drain was compacted simultaneously with the fill at El. 346 ft (**Figure 3**). Historical drawings show that the blanket drain extends 20 ft along the dam cross section (Georgia Power, 1979; 1980a). In addition, the drawings indicate a 15-ft wide, 6-ft deep trench along the centerline of the dam (Georgia Power, 1980a). The elevations for the top of the PWR and bedrock are based on the surfaces developed by Geosyntec for the Plant Branch hydrogeologic model (Geosyntec, 2021). The model for the AP-D dam used in the slope stability analysis is presented in **Figure 4**.

### Water Elevations

Seventeen piezometers monitor water elevations within the AP-D dam and its downstream toe, as shown in **Figure 5**. The phreatic surface used for the slope stability analyses was derived from the historical water level data collected between August 2013 and May 2025, provided by SCS on June 19, 2025, as shown in **Figure 6**.

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The selected cross section is located between two lines of piezometers along the slope of the AP-D dam. Average high-water levels ( $HW_{avg}$ ) prior to July 2021 were selected for piezometers J1, K1, I1, S1, S2, B1, D1, M1, and N1 to represent maximum storage pool elevations within the AP-D dam. The selected cross section is within a “valley” along the AP-D dam and thus, the ground surface has a lower elevation than the ground surface for the surrounding piezometers when projected onto the selected cross section (ground surface elevations at each piezometer location [ $G_{piezo}$ ] and projected locations [ $G_{proj}$ ] are presented in **Table 2**). To account for this difference and reflect the depth of the water level below ground surface, adjusted water levels at each projected location ( $HW_{proj}$ ) were computed as:

$$HW_{proj} = HW_{avg} + (G_{proj} - G_{piezo}) \quad (1)$$

These adjusted values are presented in **Table 2**. For each pair of piezometers along the cross section (i.e., J1/K1 and I1, S1 and S2, B1 and D1, and M1 and N1), the higher water level was generally used to model the phreatic surface for the maximum storage pool and maximum surcharge pool elevations.

Piezometers J1 and K1 are located adjacent to each other on the crest of the AP-D dam with J1 screened approximately 50 to 70 ft below ground surface and K1 screened approximately 20 to 30 ft below ground surface. Piezometer I1 is also located on the crest of the AP-D dam and is screened approximately 50 to 60 ft below ground surface. Piezometer K1 has historically measured much higher water elevations and was not considered because it is not consistent with the measurements of other piezometers along the crest of the dam (e.g., I1 and J1). The average reading from piezometers B1 and D1 was used to represent the water level at the downstream toe of the AP-D dam. This water level was also conservatively used to represent the water level farther downstream at piezometers M1 and N1. The water level farther downstream than piezometers M1 and N1 was conservatively modeled at approximately the ground surface though it is not expected to significantly impact the results of the slope stability analyses.

For the long-term, maximum storage pool loading condition, the water level within the AP-D impoundment was conservatively modeled at the existing CCR ground surface. For the maximum surcharge pool loading condition, the water level within the AP-D impoundment was modeled at El. 403 ft, which is approximately the crest elevation of the AP-D dam.

### **Pseudostatic Coefficient**

As detailed in the *Ash Pond D Pseudostatic Coefficient* calculation package included as

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Attachment B with this *Initial Safety Factor Assessment* report, the pseudostatic coefficient for the AP-D dam was estimated using the United States Geological Survey (USGS) Hazard Toolbox (USGS, 2025) and the Bray and Macedo (2019) approach. The pseudostatic coefficient estimated for the AP-D dam is 0.03.

### **Loading Conditions**

The following loading conditions must be analyzed to satisfy the safety factor requirements in §257.73(e)(1) of the CCR Rule.

- Static, long-term, maximum storage pool. This generally corresponds to normal operating conditions.
- Static, maximum surcharge pool. This generally corresponds to flood conditions.
- Seismic.
- Post-seismic liquefaction.

Drained shear strength properties were used for the Dike Soil, Toe Soil, CCR, Blanket Drain and PWR for all the loading conditions because these materials are granular and considered to be freely draining. The saprolite was modeled with drained shear strength properties for the static loading conditions representing steady-state conditions. However, undrained shear strength properties were used for the saprolite for the seismic loading condition, which is expected to be rapid and generate excess porewater pressures within the fine-grained saprolite. Although the Dike Soil is comprised of compacted saprolite, drained shear strength properties were used for this material for the seismic loading condition based on the properties reported in the design drawings and previous slope stability analyses (SCS, 2010) and no other information on the undrained shear strength properties being available.

The water levels within the AP-D dam and downstream selected to represent the maximum storage pool were used for both the long-term, maximum storage pool and seismic loading conditions. The water levels selected to represent the maximum surcharge pool were used for the maximum surcharge pool loading condition.

The pseudostatic coefficient was applied for the seismic loading condition only.

The liquefaction loading condition was not analyzed for the AP-D dam. As indicated in §257.73(e)(1)(iv) of the CCR Rule, only embankments constructed of soils that have susceptibility to liquefaction must satisfy the requirements for the liquefaction loading condition. The cement and granular materials comprising the Blanket Drain at the base of the AP-D dam are freely draining and not likely to undergo liquefaction during an earthquake

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event. Youd and Perkins (1978) indicate that residual saprolite soils have a very-low to low susceptibility to liquefaction because of their fine-grained nature. The AP-D dam is constructed of compacted saprolite and founded on native saprolite and thus, the dam and the saprolite foundation are not susceptible to liquefaction. Further supporting this point, safety factors against triggering liquefaction were calculated for cone penetration tests into the saprolite below Ash Pond E and the calculated safety factors were greater than 1.5 as shown in **Figure 7**.

## RESULTS

The results of the slope stability analyses for the AP-D dam are summarized in **Table 3**. **Figures 8** through **10** present the critical slip surfaces (i.e., lowest calculated safety factors) for each loading condition. As shown in **Figures 8** through **10**, shallower slip surfaces (approximately 10 ft deep or less) with lower calculated safety factors are observed within the Dike Soil at the downstream toe of the AP-D dam. These slip surfaces are not considered the most critical because they are not expected to affect the global stability of the AP-D dam and its ability to retain the impounded CCR. Additionally, the slip surfaces are small enough that, if observed during regular inspections (i.e., semi-annually by professional dam safety engineers, weekly by trained plant personnel or qualified staff, or after any unusual circumstances), standard maintenance procedures can be implemented to prevent additional movements.

Based on the results of the slope stability analyses, the AP-D dam meets the safety factor criteria for the loading conditions presented in §257.73(e)(i) through (iii) of the CCR Rule.

## CONCLUSIONS AND RECOMMENDATIONS

The results indicate that the AP-D dam meets the requirements for the initial safety factor assessment in §257.73(e) of the CCR Rule. If there is a change in the AP-D dam that affects the input parameters considered in this Package, additional analyses must be conducted to assess compliance with the CCR Rule. Currently, no changes to the AP-D dam are required to meet the safety factor criteria.

## REFERENCES

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# TABLES

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**Table 1. Summary of Material Properties Used in Slope Stability Analyses**

Material	Unit Weight [pcf]	Drained Shear Strength		Undrained Shear Strength, $S_u$ [psf]
		Cohesion [psf]	Friction Angle [degrees]	
Dike Soil <sup>[1,2]</sup>	127	0	32	-
Toe Soil <sup>[1,2]</sup>	120	0	30	-
Blanket Drain <sup>[1,2]</sup>	135	0	25	-
Coal Combustion Residuals (CCR) <sup>[3]</sup>	90	0	32	-
Saprolite <sup>[4]</sup>	115	0	35	$S_u = 500psf + 0.5\sigma'_v$
Partially Weathered Rock (PWR) <sup>[4]</sup>	125	0	40	-
Bedrock <sup>[5]</sup>	161	-	-	-

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Notes:

1. Material and name correspond to the *Slope Stability Analyses of Ash Pond Dikes B, C, D-1, and E* calculation package (SCS, 2010).
  2. Properties based on the *Slope Stability Analyses of Ash Pond Dikes B, C, D-1, and E* calculation package (SCS, 2010) and additional information obtained from various subsurface investigations at Plant Branch summarized in the *Summary of Geotechnical Design Parameters* calculation package (Geosyntec, 2023).
  3. Properties selected based on tests performed on CCR impounded at Plant Branch (Golder, 2014) and Geosyntec’s professional experience at Plant Branch and other CCR impoundments.
  4. Properties were obtained from the *Summary of Geotechnical Design Parameters* calculation package (Geosyntec, 2023).
  5. Bedrock was modeled as an “infinite strength material” to prevent potential slip surfaces from passing through this material.
- pcf = pounds per cubic foot; psf = pounds per square foot;  $\sigma_v'$  = vertical effective stress.

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**Table 2. Summary of Selected Piezometric Elevations for Phreatic Surface**

Piezometer	Location	Average High-Water Level Elevation (ft) $HW_{avg}^{[1]}$	Ground Surface Elevation at Piezometer Location (ft) $G_{piezo}^{[2]}$	Ground Surface Elevation at Projected Location (ft) $G_{proj}^{[2]}$	Average High-Water Level Elevation at Projected Location (ft) $HW_{proj}$
J1	AP-D Dam Crest	367.0	403.3	400.9	364.6 <sup>[3]</sup>
K1		392.0	403.3	401.1	389.8
I1		360.0	402.5	400.7	358.2
S1	AP-D Dam Downstream Slope	360.0	367.0	361.8	354.8 <sup>[3]</sup>
S2		353.0	363.8	360.1	349.3
B1	AP-D Dam Downstream Toe	350.0	354.6	346.4	341.8 <sup>[3,4]</sup>
D1		356.5	354.9	346.5	348.1 <sup>[3,4]</sup>
M1	AP-D Downstream	353.0	354.6	348.7	347.1
N1		349.0	350.3	348.7	347.4

Notes:

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1. Average high-water elevations obtained from historical data presented in **Figure 6**.
2. Ground surface elevations based on the LiDAR survey conducted on January 22, 2024.
3. Value was used for all loading conditions in the slope stability analysis model.
4. Given that piezometers B1 and D1 appear very close when projected onto the analyzed cross-section, their average reading was used at the downstream dam toe for all loading conditions.

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**Table 3. Results of Slope Stability Analyses**

<b>Loading Condition</b>	<b>Minimum Calculated Safety Factor</b>	<b>Minimum Required Safety Factor</b>	<b>Figure</b>
Long-term, Maximum Storage Pool (Static)	1.55	1.50	8
Maximum Surcharge Pool (Static)	1.53	1.40	9
Seismic	1.42	1.00	10

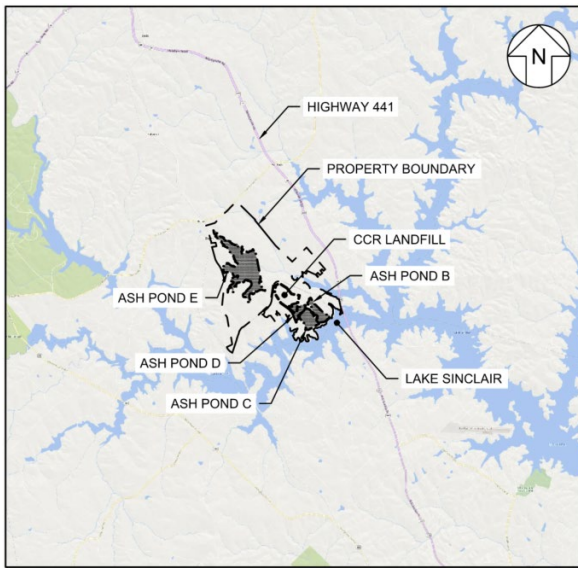
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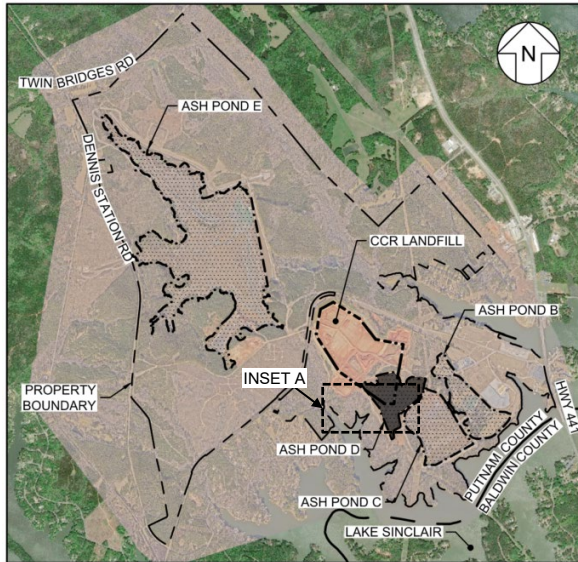
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## FIGURES



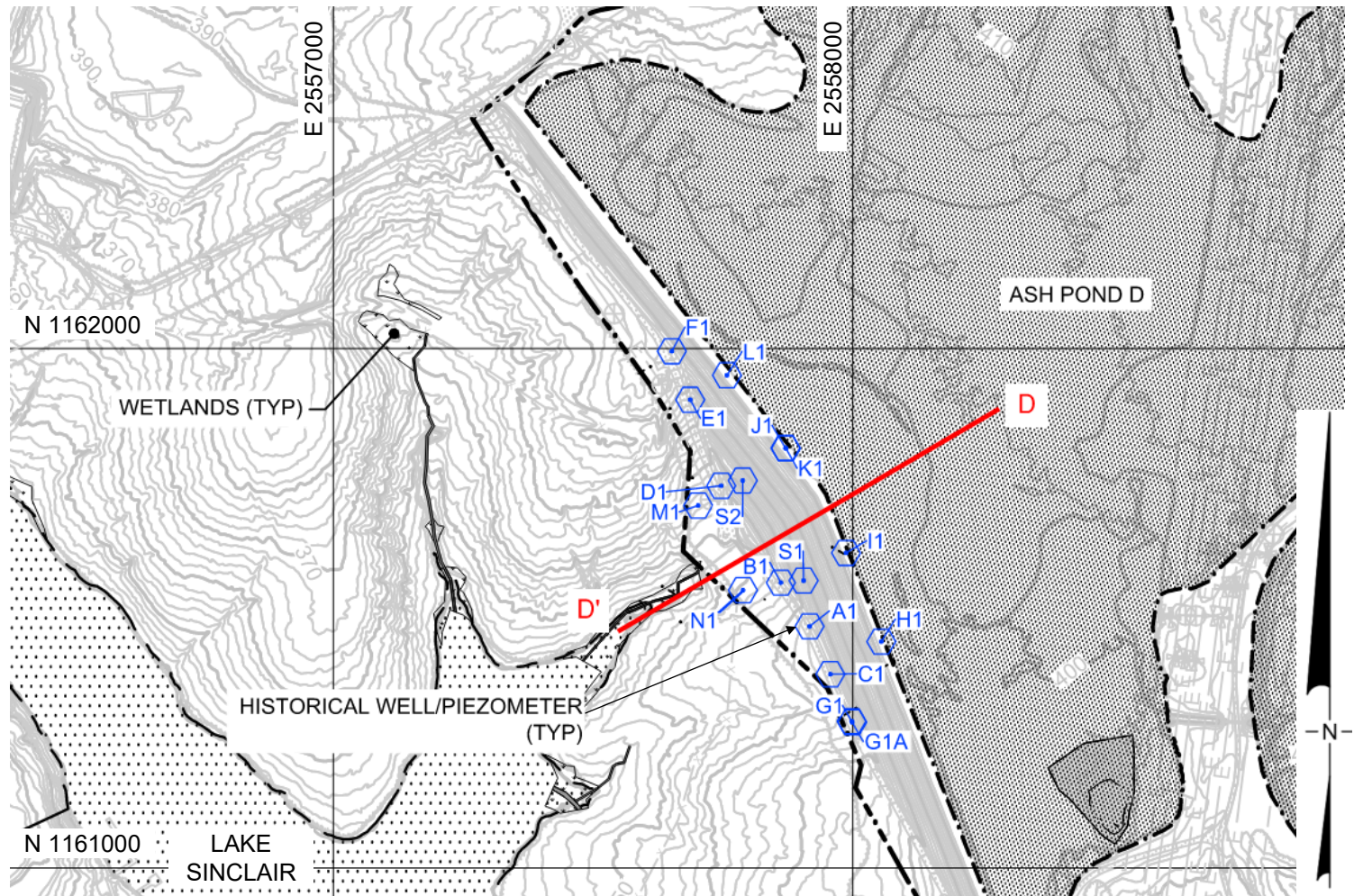
SOURCE: MICROSOFT CORPORATION BING MAPS 2017

LOCATION MAP



SOURCE: MICROSOFT CORPORATION BING MAPS 2017 AND GEORGIA POWER COMPANY 22 JANUARY 2024

VICINITY MAP



INSET A

— Analyzed Cross Section

**AP-D Dam**  
**Location of the Selected Cross Section**  
 Initial Safety Factor Assessment  
 Georgia Power Plant Branch

**Geosyntec**  
 consultants

Figure

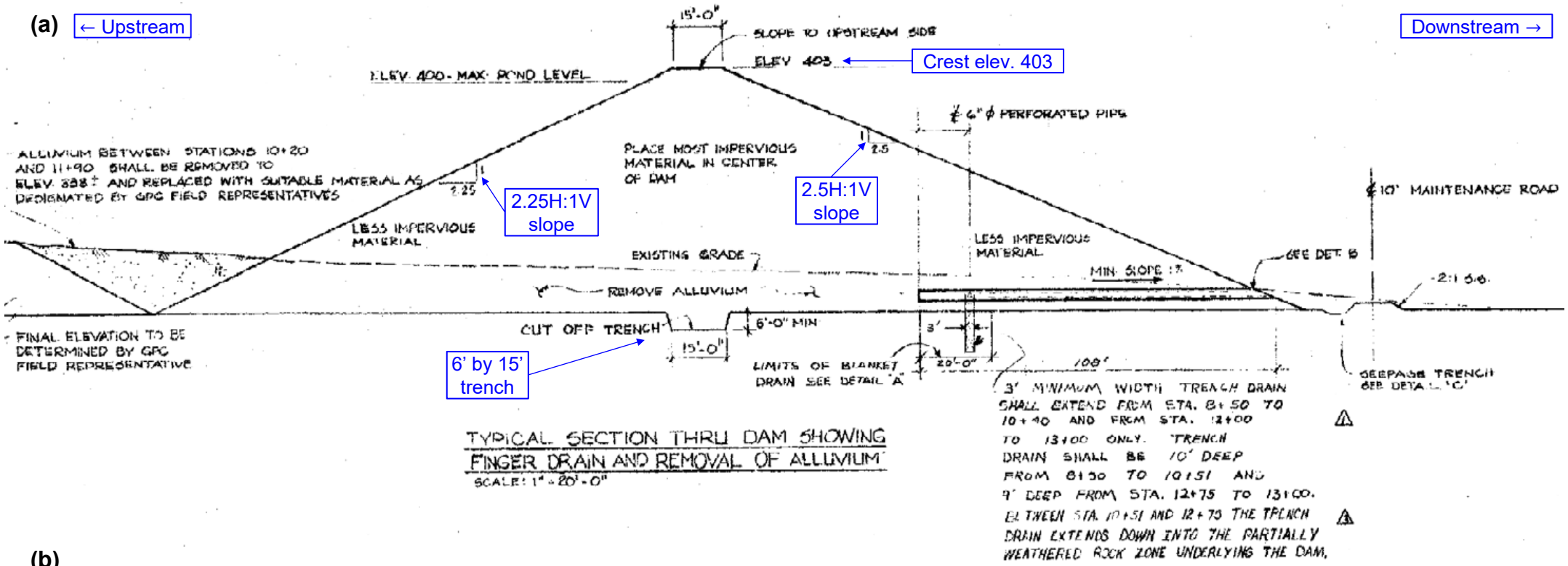
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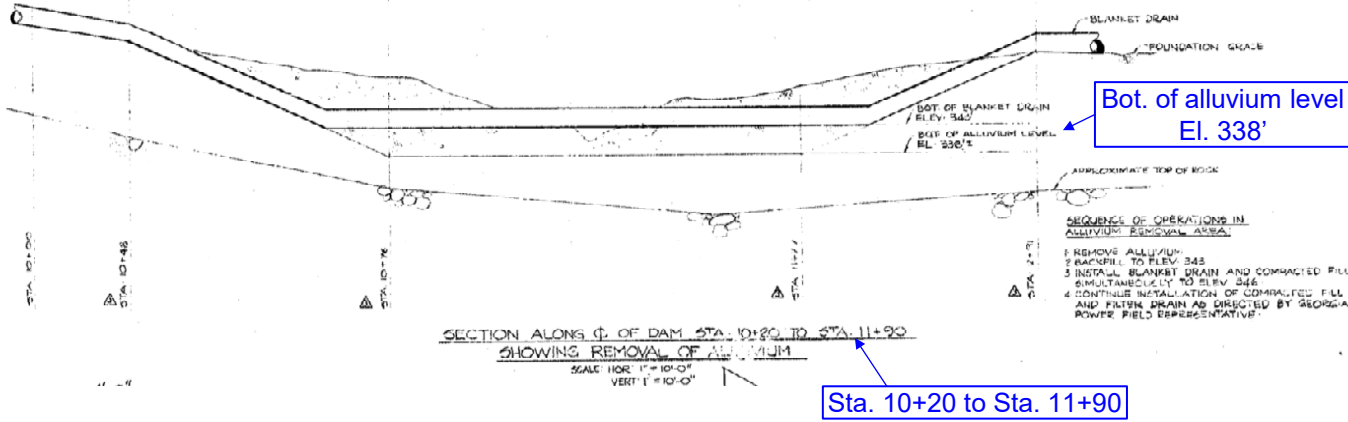
May 2026

(a) ← Upstream

Downstream →



(b)



**Historical Drawings: AP-D Dam Section**  
 Initial Safety Factor Assessment  
 Georgia Power Plant Branch

**Notes:**

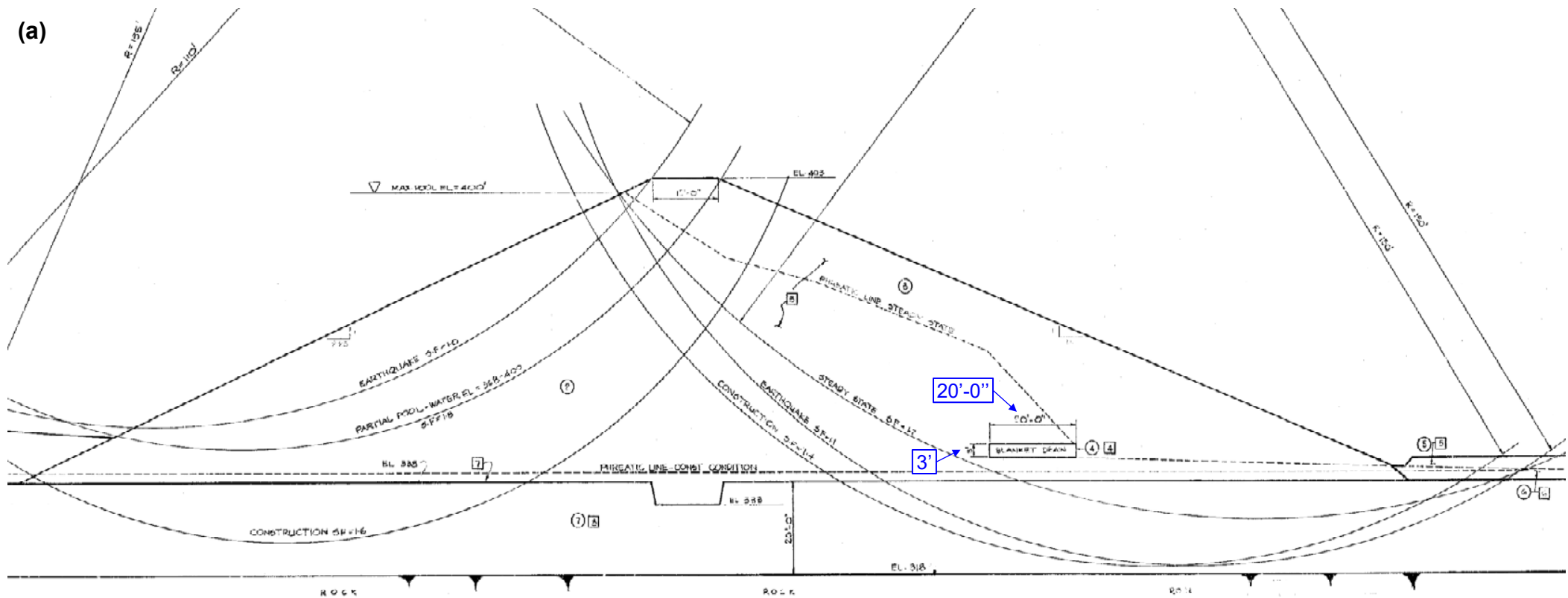
1. The cross section in (a) was obtained from Drawing E-12, Revision 4, dated 12/16/1980, Georgia Power Company (Georgia Power, 1980a).
2. The section along the center line of the dam in (b) was obtained from Drawing E-12, Revision 4, dated 12/16/1980, Georgia Power Company (Georgia Power, 1980a).
3. Additional notes in blue have been included solely to enhance readability.



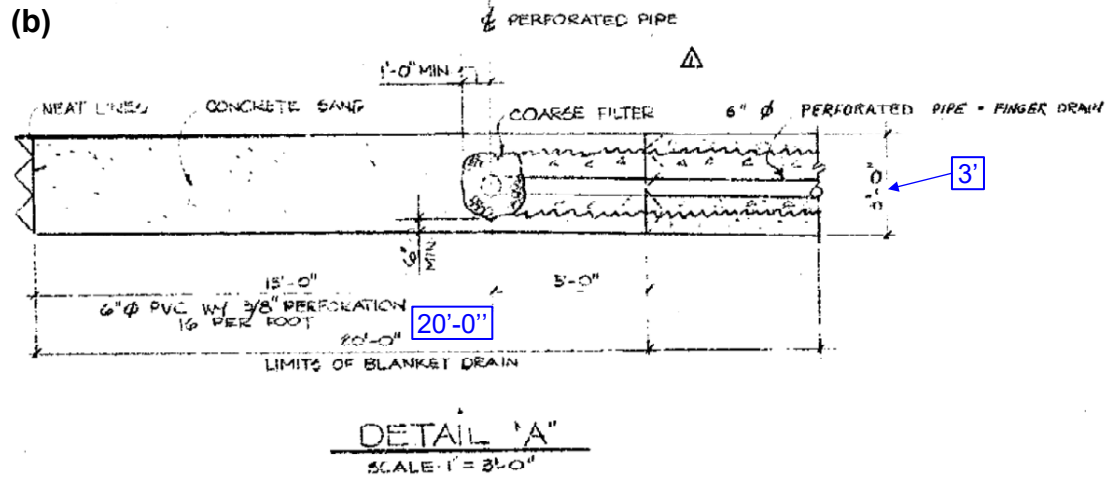
Figure  
2

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(a)



(b)



**Notes:**

1. Historical drawing (a) was obtained from Drawing E-14, Revision 0, dated 10/10/1979, Georgia Power Company (Georgia Power, 1979).
2. The blanket drain detail in (b) obtained from Drawing E-12, Revision 4, dated 12/16/1980, Georgia Power Company (Georgia Power, 1980a).
3. Additional notes in blue have been included solely to enhance readability.

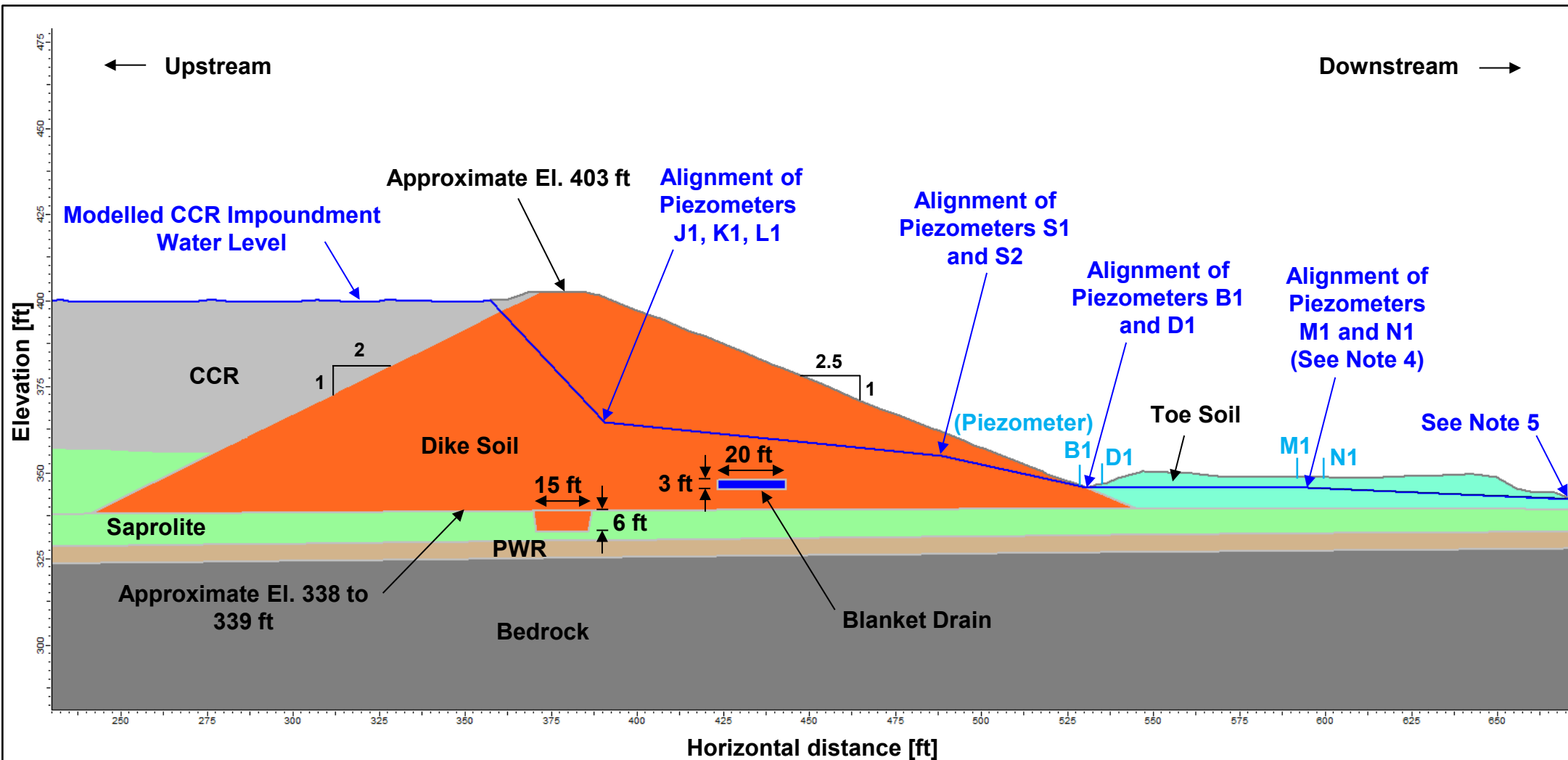
**Historical Drawings: AP-D Dam Slope Stability  
Analysis and Blanket Drain Detail  
Initial Safety Factor Assessment  
Georgia Power Plant Branch**

**Geosyntec**  
consultants

Figure  
3

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**Notes:**

1. The ground surface shown is obtained from a LiDAR survey conducted on January 22, 2024.
2. The AP-D dam geometry is derived from multiple sources, including historical drawings (Georgia Power, 1979 and 1980), previous slope stability models (SCS, 2010), and Geosyntec's site hydrogeologic model (2021).
3. Piezometer locations are shown as projected onto the analyzed cross section.
4. The projected water level between piezometers M1 and N1 was estimated using the average reading from piezometers B1 and D1. This approach conservatively considers zero head loss between these two locations.
5. Water levels farther downstream were conservatively modeled at ground surface elevations.

**Subsurface Stratigraphy and Geometry of the AP-D Dam along the Analyzed Cross Section**  
 Initial Safety Factor Assessment  
 Georgia Power Plant Branch



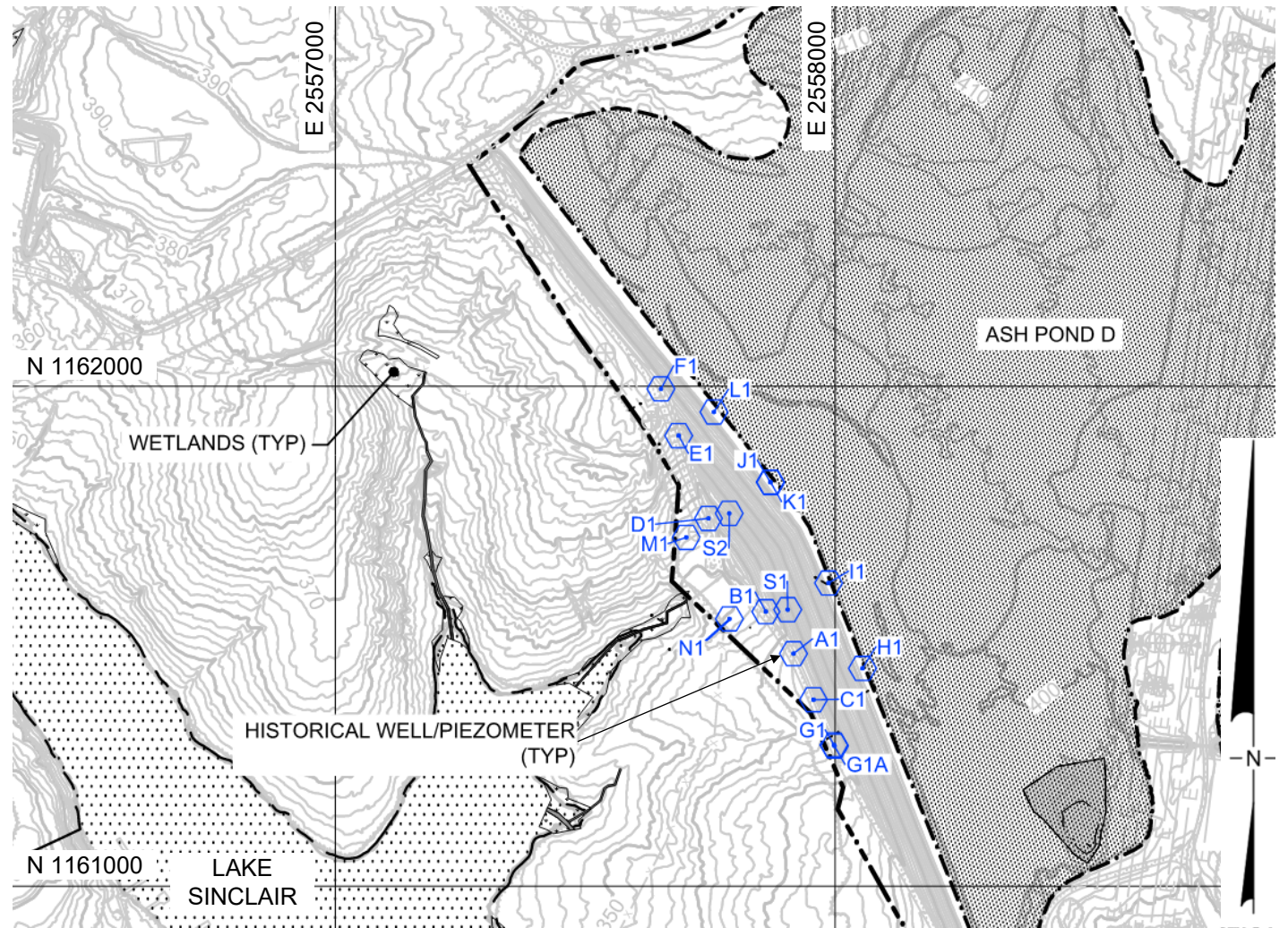
Figure

4

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HISTORICAL WELL ID	NORTHING	EASTING
A1	1161465.30	2557916.79
B1	1161549.41	2557861.53
C1	1161373.16	2557956.87
D1	1161735.81	2557746.68
E1	1161901.42	2557687.01
F1	1161994.86	2557651.63
G1	1161282.95	2557997.70
G1A	1161280.68	2557998.89
H1	1161435.93	2558054.85
I1	1161606.66	2557987.10
J1	1161808.65	2557870.31
K1	1161807.74	2557871.22
L1	1161948.52	2557757.65
M1	1161697.92	2557702.35
N1	1161534.83	2557788.64
S1	1161553.24	2557905.31
S2	1161745.90	2557788.18



**Piezometer Locations in the AP-D Dam**  
Initial Safety Factor Assessment  
Georgia Power Plant Branch



Figure

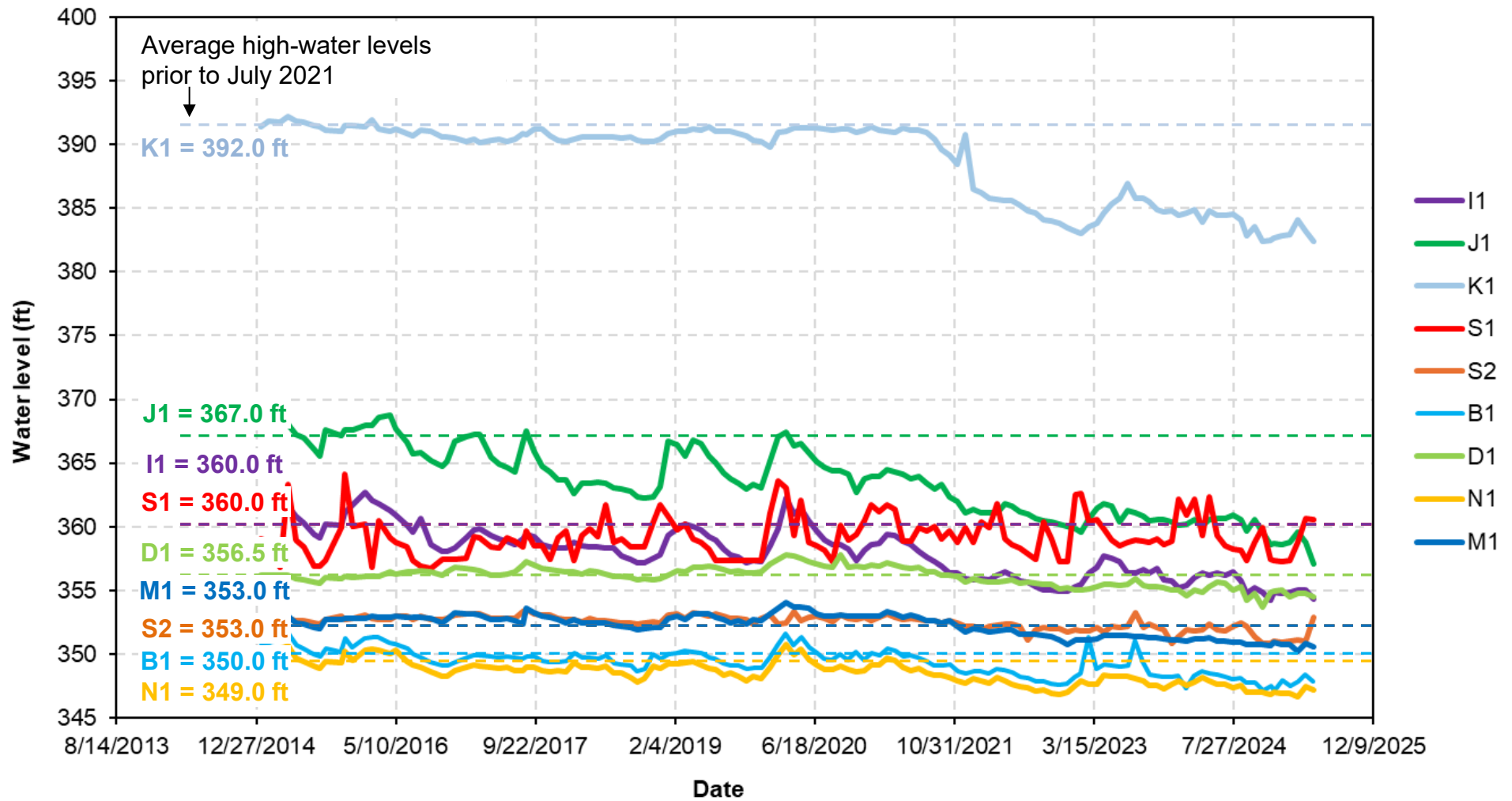
5

**Note:**

1. Piezometer location data was provided by SCS via email on March 27, 2025.

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**Note:**

1. Colored dashed lines represent the average high-water levels prior to July 2021.

**Historical Water Level Data  
Piezometers Within the AP-D Dam  
Initial Safety Factor Assessment  
Georgia Power Plant Branch**

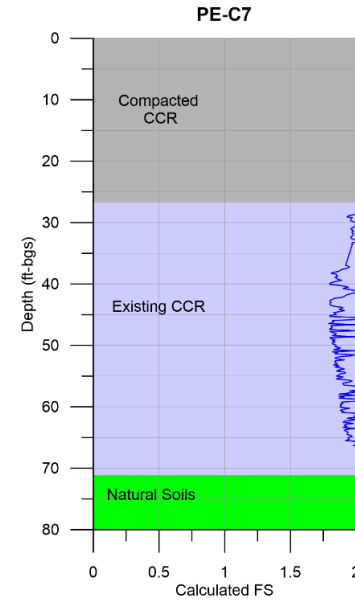
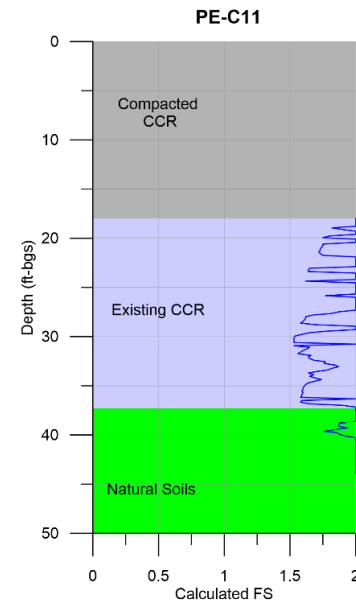
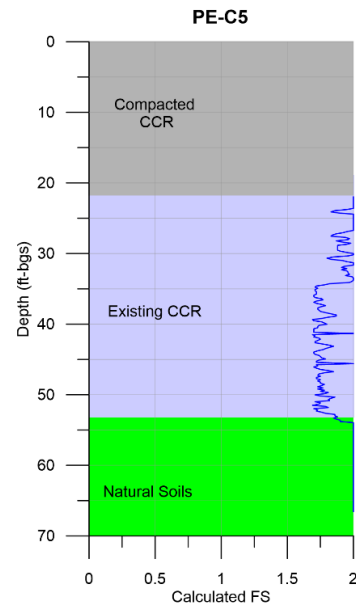
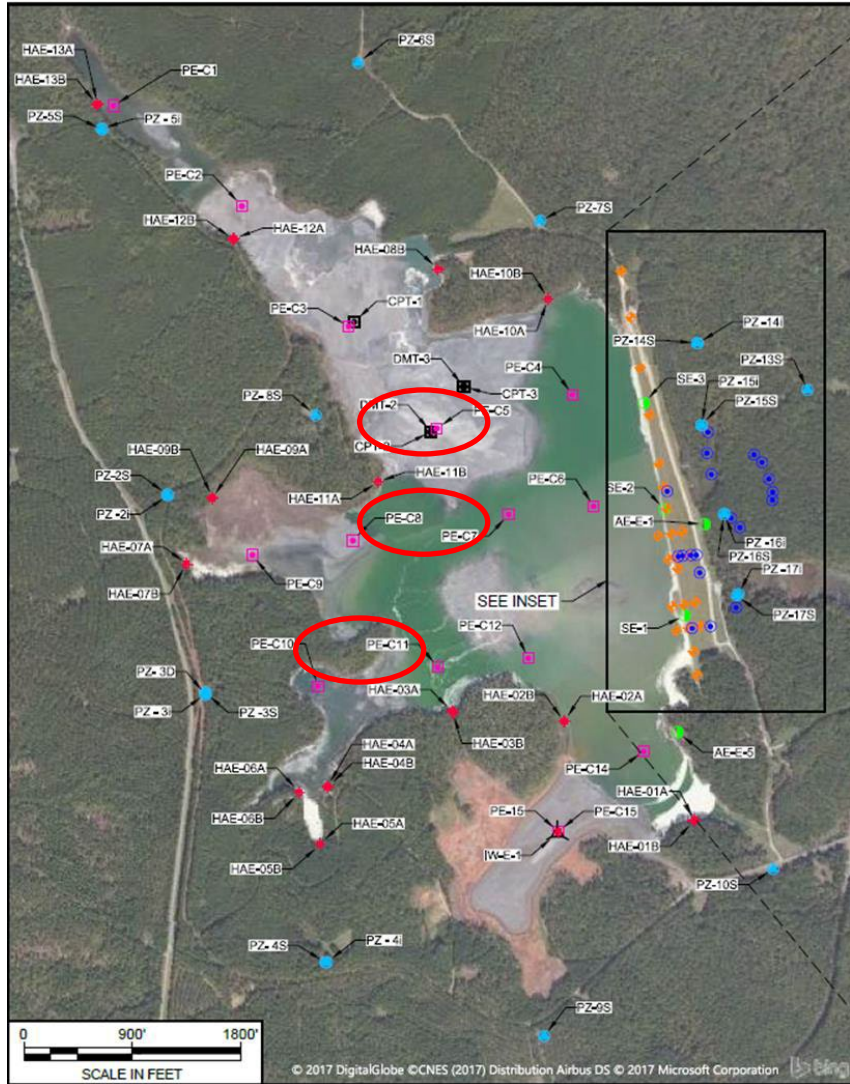


Figure

6

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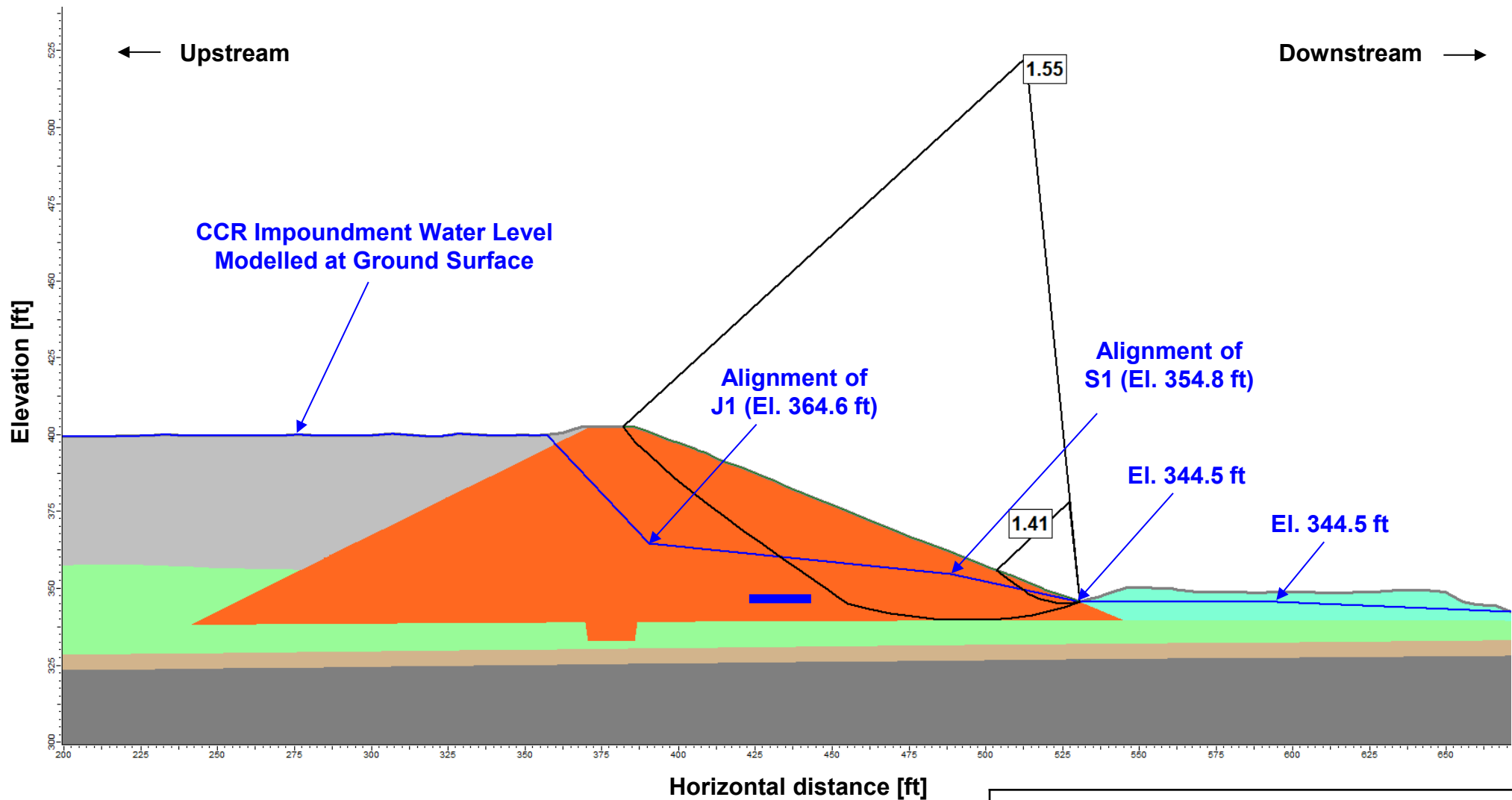


**Calculated Safety Factors Against Liquefaction at the Highlighted CPT Locations**  
 Initial Safety Factor Assessment  
 Georgia Power Plant Branch

**Notes:**

1. Calculated safety factors (FS) for the natural soils (saprolite) are greater than 1.5.

		Figure 7
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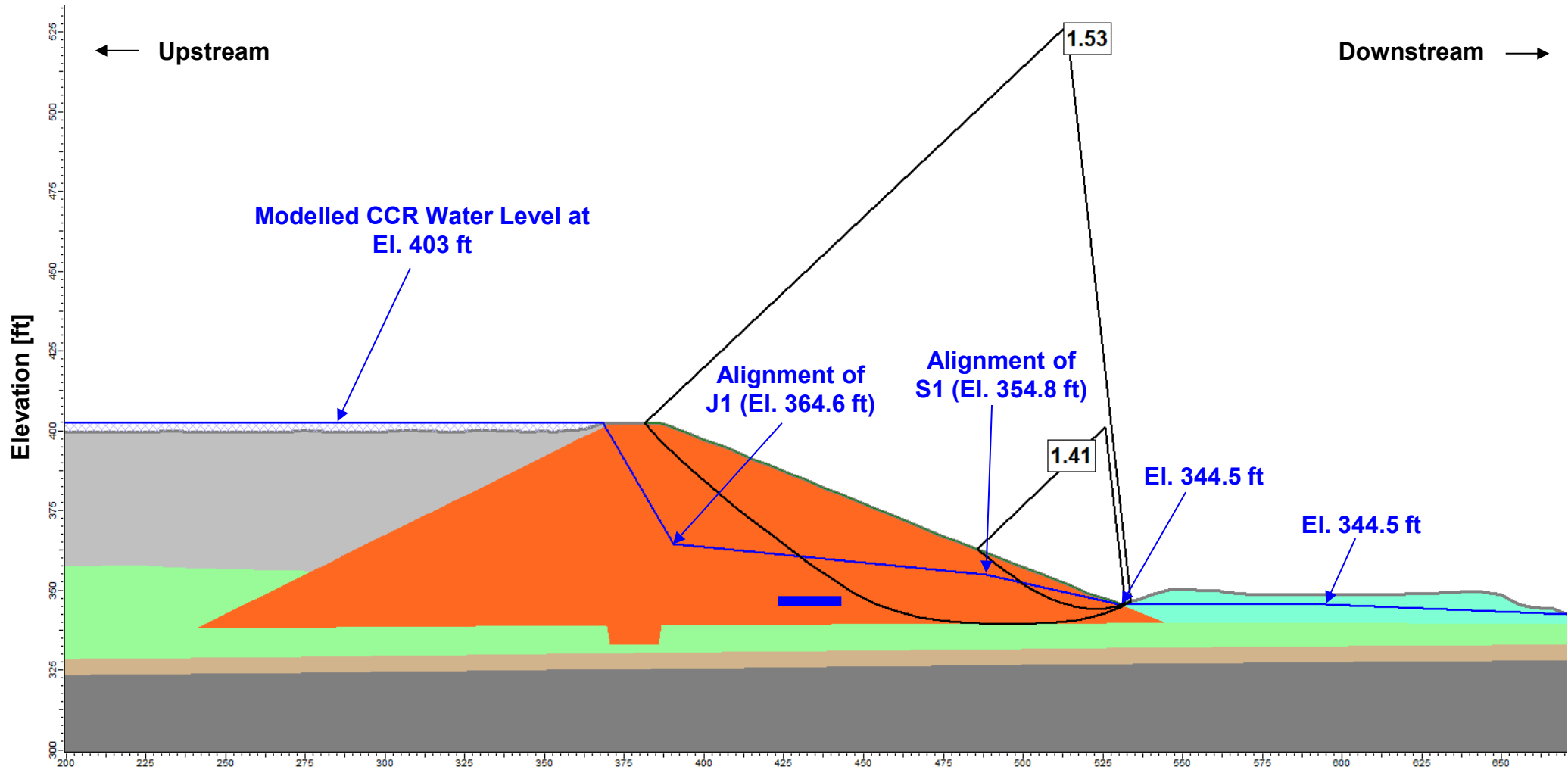
Material Name	Color	Unit Weight (lbs/ft <sup>3</sup> )	Strength Type	Cohesion (psf)	Phi (°)	Allow Sliding Along Boundary	Water Surface
Dike Soil		127	Mohr-Coulomb	0	32		Water Table
CCR		90	Mohr-Coulomb	0	32		Water Table
PWR		125	Mohr-Coulomb	0	40		Water Table
Bedrock		161	Infinite Strength			No	Water Table
Toe Soil		120	Mohr-Coulomb	0	30		Water Table
Blanket Drain		135	Mohr-Coulomb	0	25		Water Table
Saprolite Drained		115	Mohr-Coulomb	0	35		Water Table

**AP-D Dam**  
**Critical Slip Surface and Calculated Safety Factor**  
**Long-term Maximum Storage Pool Loading Condition**  
 Initial Safety Factor Assessment  
 Georgia Power Plant Branch

Geosyntec  
 consultants

Figure  
8

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Horizontal distance [ft]

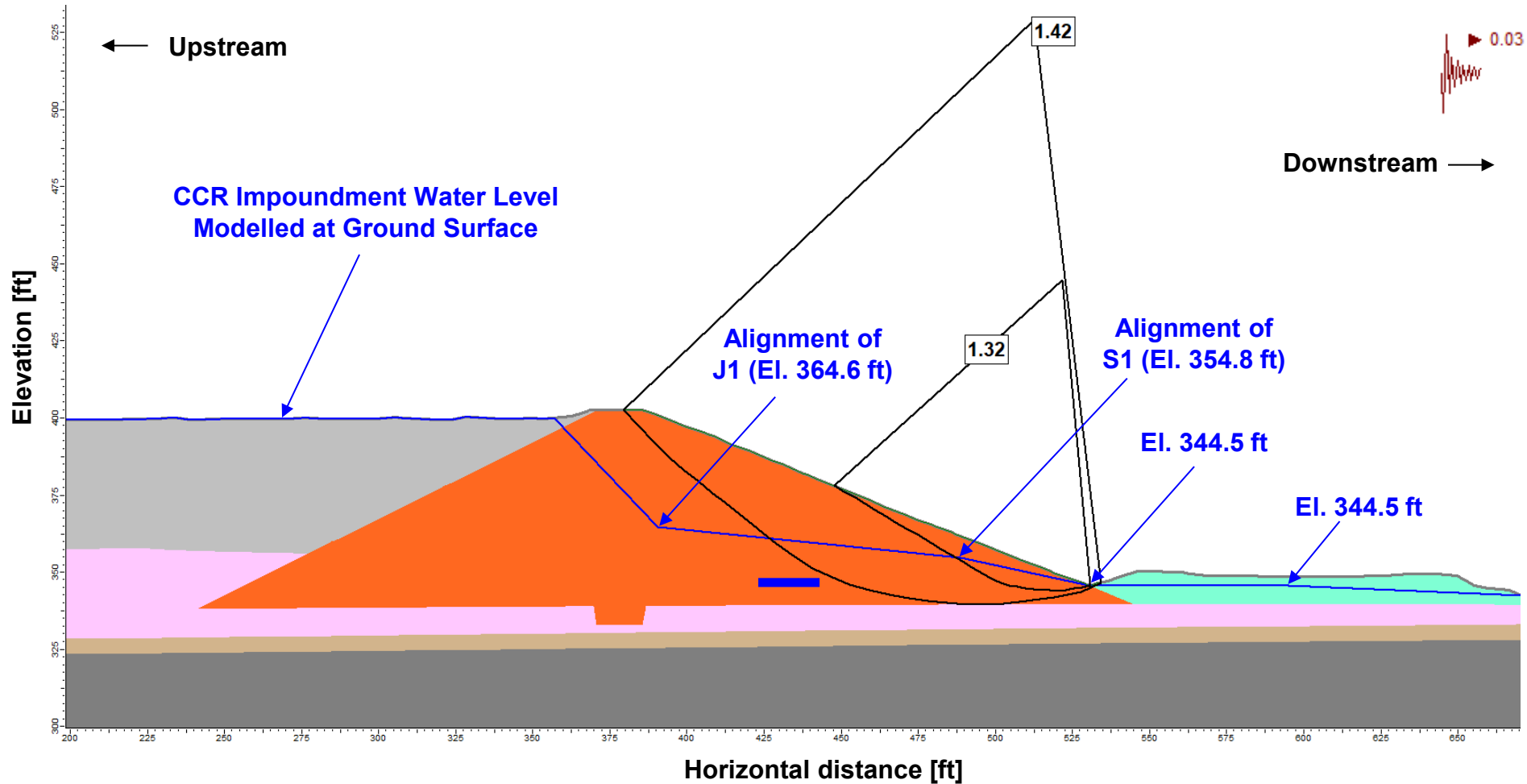
Material Name	Color	Unit Weight (lbs/ft <sup>3</sup> )	Strength Type	Cohesion (psf)	Phi (°)	Allow Sliding Along Boundary	Water Surface
Dike Soil	Orange	127	Mohr-Coulomb	0	32		Water Table
CCR	Grey	90	Mohr-Coulomb	0	32		Water Table
PWR	Brown	125	Mohr-Coulomb	0	40		Water Table
Bedrock	Dark Grey	161	Infinite Strength			No	Water Table
Toe Soil	Light Green	120	Mohr-Coulomb	0	30		Water Table
Blanket Drain	Blue	135	Mohr-Coulomb	0	25		Water Table
Saprolite Drained	Light Green	115	Mohr-Coulomb	0	35		Water Table

**AP-D Dam**  
**Critical Slip Surface and Calculated Safety Factors**  
**Maximum Surcharge Pool Loading Condition**  
 Initial Safety Factor Assessment  
 Georgia Power Plant Branch

**Geosyntec**   
 consultants

Figure  
9

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Material Name	Color	Unit Weight (lbs/ft <sup>3</sup> )	Strength Type	Cohesion (psf)	Phi (°)	Shear/Normal Function	Allow Sliding Along Boundary	Water Surface
Dike Soil	Orange	127	Mohr-Coulomb	0	32			Water Table
CCR	Grey	90	Mohr-Coulomb	0	32			Water Table
Saprolite 2	Pink	115	Shear/Normal Function			Saprolite 2		Water Table
PWR	Brown	125	Mohr-Coulomb	0	40			Water Table
Bedrock	Dark Grey	161	Infinite Strength				No	Water Table
Toe Soil	Light Green	120	Mohr-Coulomb	0	30			Water Table
Blanket Drain	Blue	135	Mohr-Coulomb	0	25			Water Table

**Note:**

- The undrained shear strength function *Saprolite2* for the saprolite material was simulated in Slide2 as  $S_u = 500psf + 0.5'\sigma_v$

<p><b>AP-D Dam</b>  <b>Critical Slip Surface and Calculated Safety Factor</b>  <b>Seismic Loading Condition</b>  <b>Initial Safety Factor Assessment</b>  <b>Georgia Power Plant Branch</b></p>	
<p><b>Geosyntec</b>          consultants</p>	
<p>Project No.: GW11718</p>	<p>May 2026</p>
<p>Figure 10</p>	

**ATTACHMENT B**  
**Ash Pond D Pseudostatic Coefficient Calculations**

**CALCULATION PACKAGE COVER SHEET**

**Client:** Georgia Power                      **Project:** Design and Operating Criteria                      **Project #:** GW11718  
Assessments for Plant Branch Legacy  
CCR Units

**TITLE OF PACKAGE:**                      **ASH POND D PSEUDOSTATIC COEFFICIENT CALCULATIONS**

<b>PREPARATION</b>	<b>CALCULATION PREPARED BY:</b> (Calculation Preparer, CP)	Signature <i>Camilo Guerrero</i>	05/06/2026
		Name Camilo Guerrero, Ph.D.	Date
<b>REVIEW</b>	<b>ASSUMPTIONS &amp; PROCEDURES CHECKED BY:</b> (Assumptions & Procedures Checker, APC)	Signature <i>Clinton Carlson</i>	05/06/2026
		Name Clinton Carlson, Ph.D.	Date
	<b>COMPUTATIONS CHECKED BY:</b> (Computation Checker, CC)	Signature <i>Clinton Carlson</i>	05/06/2026
		Name Clinton Carlson, Ph.D.	Date
<b>BACK-CHECK</b>	<b>BACK-CHECKED BY:</b> (Calculation Preparer, CP)	Signature <i>Camilo Guerrero</i>	05/06/2026
		Name Camilo Guerrero, Ph.D.	Date
<b>APPROVAL</b>	<b>APPROVED BY:</b> (Calculation Approver, CA)	Signature <i>Glenn J. Rix</i>	05/06/2026
		Name Glenn J. Rix, Ph.D., P.E.	Date



**REVISION HISTORY:**

<u>NO.</u>	<u>DESCRIPTION</u>	<u>DATE</u>	<u>CP</u>	<u>APC</u>	<u>CC</u>	<u>CA</u>
0	Final Issue	05/06/2026	CG	CPC	CPC	GJR

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Client: Georgia Power Project: Design and Operating Criteria Assessments for Plant Branch Legacy CCR Units Project No: GW11718

## ASH POND D PSEUDOSTATIC COEFFICIENT CALCULATIONS

### PURPOSE

The purpose of the *Ash Pond D Pseudostatic Coefficient Calculations* package (Package) is to present the pseudostatic coefficient estimates required for the slope stability analysis of the Ash Pond D (AP-D) dam at Georgia Power Company’s (Georgia Power) Plant Harllee Branch (Plant Branch) in Putnam County, Georgia under a seismic loading condition. The analyses were performed to support the *Initial Safety Factor Assessment* report for AP-D in compliance with the United States Environmental Protection Agency’s (USEPA’s) Coal Combustion Residuals (CCR) Rule contained in 40 C.F.R. §257 (USEPA, 2015).

The remainder of this Package is organized to present: (i) design criteria; (ii) methods for analysis; (iii) calculations; and (iv) conclusions.

### DESIGN CRITERIA

Plant Branch is located within a seismic impact zone per the USEPA CCR Rule. The USEPA CCR Rule (USEPA, 2015) defines a seismic impact zone as “an area having a 2 percent or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth’s gravitational pull (g), will exceed 0.10g in 50 years.” Under §257.73(e)(1), owners or operators are required to conduct initial and periodic safety factor assessments for each CCR unit. The seismic factor of safety calculated in slope stability analyses must equal or exceed 1.00.

The preamble to the USEPA CCR Rule (USEPA, 2015) states that the seismic design of existing CCR impoundments should be based on a “withstand without discharge” standard which they describe as requiring (Federal Register, Vol. 80, No. 74, p. 21366) “any new CCR unit located in a seismic impact zone to be designed to withstand seismic motion from a credible earthquake without damage to the foundation or to the structures that control leachate, surface drainage, or erosion.” In other words, “the CCR unit must be able to withstand an expected earthquake without discharging waste or contaminants.” The calculations presented in this Package address the “withstand without discharge” criterion by limiting permanent displacements of the AP-D dam to tolerable displacements for solid-waste containment facilities (**Table 1**; Kavazanjian, 1999), as referenced in the preamble of the USEPA CCR

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Rule (USEPA, 2015). A permanent displacement of 0.5 feet (ft), or 15 centimeters (cm), was considered tolerable for the calculations presented in this Package. The selected tolerable displacement is less than typical allowable displacements for embankments (1 to 3 ft) as shown in **Table 1**. The more stringent requirement for tolerable displacement was selected to account for the uncertainty in the properties of the AP-D dam materials.

## METHODS FOR ANALYSIS

### Seismic Hazard

The seismic hazard at the AP-D dam was defined by ground motions with 2 percent probability of exceedance in 50 years (i.e., return period of approximately 2,500 years), as represented by the uniform hazard spectrum (UHS). The United States Geological Survey (USGS) Hazard Toolbox (2025) based on the 2023 National Seismic Hazard Maps for the Conterminous United States was used to obtain the UHS at the base of the critical slip surface observed in the results of the slope stability analysis for the static, long-term maximum storage pool loading condition presented in the *Ash Pond D Slope Stability Analysis* calculation package included as Attachment A to this *Initial Safety Factor Assessment* report. The USGS Hazard Toolbox is able to estimate the UHS for a site-specific shear-wave velocity. The site-specific shear-wave velocity ( $V_{S,100}$ ) for the AP-D dam was estimated by calculating a travel-time-weighted average of the shear-wave velocity profile for a depth of 100 ft below the base of the critical slip surface using the equation below.

$$V_{S,100} = \frac{100ft}{\sum_i \frac{H_i}{V_{S,i}}} \quad (1)$$

where:

$H_i$  = thickness of subsurface layer,  $i$  (ft); and

$V_{S,i}$  = shear-wave velocity of subsurface layer,  $i$  (feet per second [ft/sec]).

Because no shear-wave velocity measurements are available for the AP-D dam, values for the AP-D dam and subsurface materials were selected based on observed data from materials with similar descriptions. The shear-wave velocity for the saprolite foundation was chosen as 850 ft/sec based on shear-wave velocity measurements from seismic cone penetration tests (SCPT)

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performed at Plant Branch (Geosyntec, 2023). **Figure 1** shows the location of the SCPT soundings performed and the measured shear-wave velocities within the saprolite. The materials composing the AP-D dam were characterized as having an average shear-wave velocity of 650 ft/sec based on shear-wave velocity measurements of compacted earth embankments at other sites. Similarly, the shear-wave velocity for the partially weathered rock (PWR) was estimated to be 1,750 ft/sec based on observed measurements at other Georgia Power sites. A shear-wave velocity of 2,300 ft/sec was used for the bedrock layer based on the lower bound value in the model presented by Frankel et al. (1996).

The USGS Hazard Toolbox was also used to obtain a design earthquake moment magnitude ( $M_w$ ) from a site-specific hazard disaggregation. The disaggregation was performed on approximately the degraded spectral period for the sliding mass of the critical slip surface (discussed in the next section) for a 2% probability of exceedance in 50 years. The design earthquake was selected as the mean earthquake event estimated by the disaggregation.

### **Pseudostatic Coefficient**

The approach suggested by Bray and Macedo (2019) was used to estimate the pseudostatic coefficient ( $k$ ) for a tolerable displacement of 0.5 ft (i.e., 15 cm) through the following equations:

$$k = \exp \left[ \frac{-a + \sqrt{b}}{0.49} \right] \quad (2)$$

$$a = 2.491 - 0.344 \ln(S_a(1.3T_s)) \quad (3)$$

For  $T_s \geq 0.10$  s:

$$b = a^2 - 0.98 \left\{ \ln(D_a) + 5.894 - 2.703 \ln(S_a(1.3T_s)) + 0.089 [\ln(S_a(1.3T_s))]^2 - 3.152T_s + 0.910T_s^2 - 0.6070M_w - \epsilon \right\} \quad (4)$$

For  $T_s < 0.10$  s:

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Client: Georgia Power Project: Design and Operating Criteria Assessments for Plant Branch Legacy CCR Units Project No: GW11718

$$b = a^2 - 0.98 \left\{ \ln(D_a) + 4.551 - 2.703 \ln(S_a(1.3T_s)) + 0.089 [\ln(S_a(1.3T_s))]^2 + 9.688T_s - 0.6070M_w - \epsilon \right\} \quad (5)$$

where:

$T_s$  = initial fundamental spectral period of the sliding mass (seconds [sec]);

$S_a(1.3T_s)$  = spectral acceleration for 5 percent damping, at a degraded spectral period (i.e.,  $1.3T_s$ ) (units of gravitational acceleration constant [g]);

$D_a$  = tolerable displacement = 15 cm;

$M_w$  = moment magnitude of design earthquake; and

$\epsilon$  = normally distributed random variable with a mean of zero and standard deviation of 0.74.

The initial fundamental spectral period of the sliding mass for the critical slip surface was calculated using the following equation:

$$T_s = C \frac{H}{V_s} \quad (6)$$

where:

$C$  = a coefficient of 4 for circular-type critical slip surfaces;

$H$  = height of sliding mass for observed critical slip surface (ft); and

$V_s$  = travel-time-weighted average shear-wave velocity for the height of the sliding mass (ft/sec).

The travel-time-weighted average shear-wave velocity for the sliding mass was calculated

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Client: Georgia Power Project: Design and Operating Criteria Assessments for Plant Branch Legacy CCR Units Project No: GW11718

using Equation 1 with the height of the sliding mass replacing the 100 ft in Equation 1.

The spectral acceleration and the moment magnitude were obtained from the site-specific UHS and disaggregation, respectively, detailed in Section 3.1. The pseudostatic coefficient was conservatively estimated as the plus one standard deviation value (i.e.,  $\epsilon = 0.74$ ) to account for the uncertainty in the shear-wave velocities of the AP-D dam and subsurface materials.

## CALCULATIONS

### Critical Slip Surface and Sliding Mass

The critical slip surface and sliding mass observed for the AP-D dam under the static, long-term maximum storage pool loading condition is presented in **Figure 2**. The depth of the critical slip surface and the thicknesses of the layers below the base of the critical slip surface are also shown on **Figure 2**. Based on the observed critical slip surface and selected shear-wave velocities for the AP-D dam, the estimated site-specific shear-wave velocity (Equation 1) is 1,996 ft/sec (608 meters per second) and the estimated fundamental spectral period of the sliding mass (Equation 6) is approximately 0.39 sec. The degraded spectral period of the sliding mass ( $1.3T_s$ ) is approximately 0.50 sec.

### Seismic Hazard

The seismic hazard for the AP-D dam was obtained at site coordinates of 33.196°N, - 83.315°W. These coordinates approximately correspond to a location at Plant Branch that is between Ash Ponds B, C, D, and E. The seismic hazard at the top of rock is not expected to vary significantly across Plant Branch.

The site-specific UHS for a shear-wave velocity of 1,996 ft/sec at the base of the critical slip surface and a hazard of 2% probability of exceedance in 50 years is shown in **Figure 3**. The spectral acceleration along the base of the critical slip surface at the degraded period for the sliding mass is approximately 0.17g.

The resulting site-specific disaggregation on a period of 0.50 sec for a hazard of 2% probability of exceedance in 50 years and the summary are presented in **Figure 4**. The mean moment magnitude is 6.9.

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### **Pseudostatic Coefficient**

The fundamental period for the sliding mass (0.39 sec), spectral acceleration at the degraded period for the sliding mass (0.17g), and the moment magnitude for the design earthquake event (6.9) were input to Equations 2 through 5 to estimate the pseudostatic coefficient. The estimated pseudostatic coefficient is approximately 0.03. This pseudostatic coefficient was applied in the slope stability analysis of the AP-D dam to represent the seismic loading condition.

### **CONCLUSIONS**

The pseudostatic coefficient for the AP-D dam was estimated using site-specific estimations for the seismic hazard and the Bray and Macedo (2019) method. For the critical slip surface observed in the slope stability analysis under the static, long-term maximum storage pool loading condition and a tolerable displacement of 0.5 ft, the estimated pseudostatic coefficient is **0.03**. This pseudostatic coefficient is used in the *Ash Pond D Slope Stability Analysis* calculation package included as Attachment A to this *Initial Safety Factor Assessment* report, to represent the seismic loading condition in the slope stability analysis of the AP-D dam.

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Client: Georgia Power Project: Design and Operating Criteria Assessments for Plant Branch Legacy CCR Units Project No: GW11718

## REFERENCES

Bray, J. D., and Macedo, J. (2019). Procedure for estimating shear-induced seismic slope displacement for shallow crustal earthquakes. *Journal of Geotechnical and Geoenvironmental engineering*, 145(12), 04019106.

Frankel, A., Mueller, C., Barnhard, T., Perkins, D., Leyendecker, E.V., Dickman, N., Hanson, S., and Hopper, M. (1996). "National Seismic Hazard Maps, June 1996, Documentation," United States Geological Survey Open-File Report 96-532, Reston, VA, 100 p.

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Kavazanjian, E. (1999). "Seismic Design of Solid Waste Containment Facilities," Proceedings of the 8<sup>th</sup> Canadian Conference on Earthquake Engineering, Vancouver, BC, June, pp. 51-89.

United States Environmental Protection Agency (USEPA) (2015). "40 CFR Parts 257 and 261: Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities," *Federal Register*, Vol. 80(74), April.

United States Geological Survey (USGS). National Seismic Hazard Model (NSHM) Hazard Tool. (2025). "Model: NSHM Conterminous U.S. 2023," <<https://earthquake.usgs.gov/nshmp/>>

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**TABLE**

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Client: Georgia Power Project: Design and Operating Criteria Assessments for Plant Branch Legacy CCR Units Project No: GW11718

**Table 1. Typical Tolerable Seismic Displacements for Solid Waste Containment Facilities (Kavazanjian, 1999)**

<b>Component</b>	<b>Allowable Calculated Displacement</b>	<b>Comment</b>
Liner System	150 to 300 mm	Actual expected deformation is very small.
Cover System	300 mm to 1 m	Damage is repairable.
Waste Mass	1 m	For displacement not impacting cover or liner.
Roadways, Embankments	1 m	Conventional geotechnical criteria.
Surface Water Controls	1 m	Conventional geotechnical criteria.
Gas Collection System	No Limit	Breakage common under normal operating conditions.

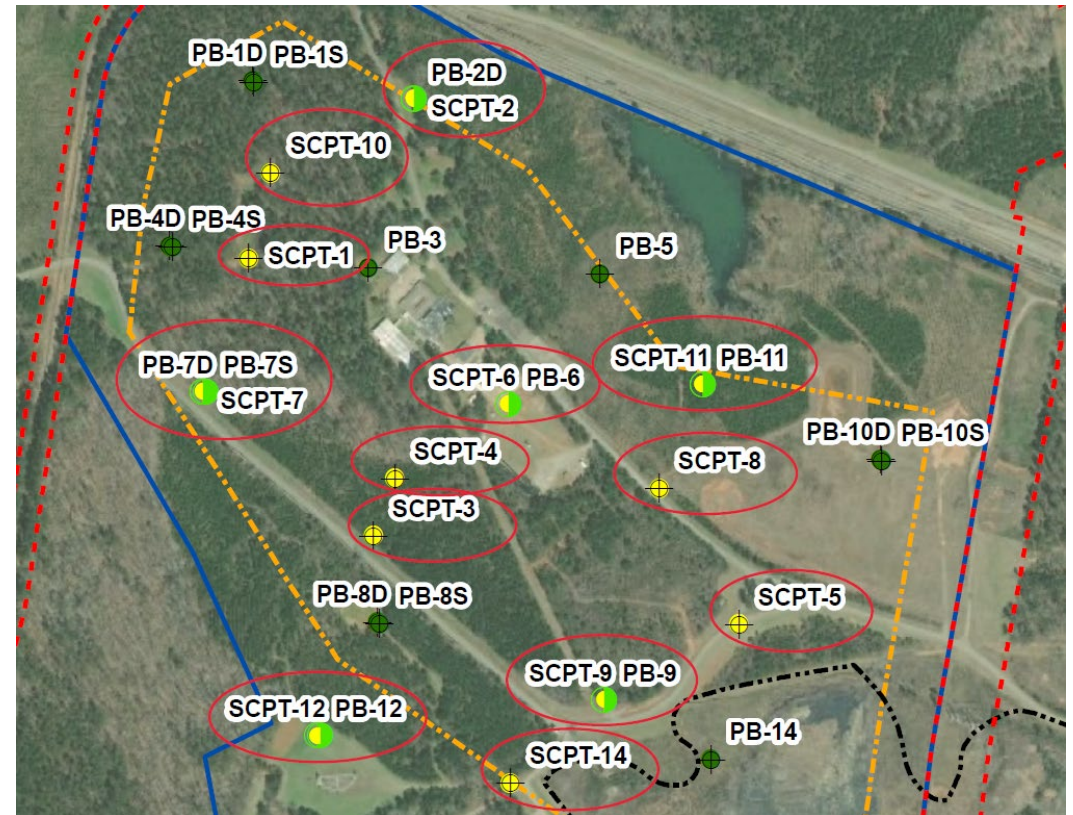
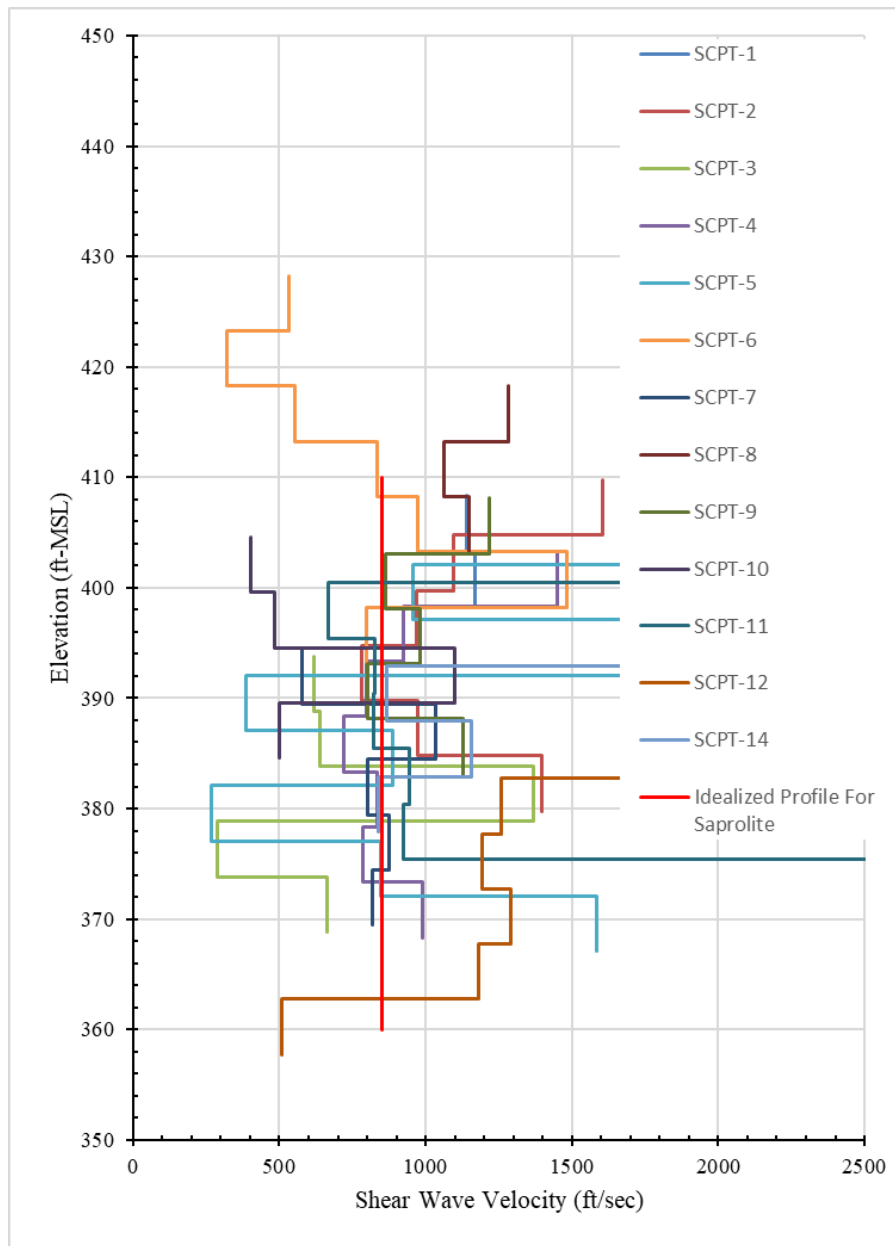
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CP: CG Date: 05/06/26 APC: CPC Date: 05/06/26 CC: CPC Date: 05/06/26

Client: Georgia Power Project: Design and Operating Criteria Assessments for Plant Branch Legacy CCR Units Project No: GW11718

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# FIGURES



**Notes:**

1. Idealized profile for saprolite indicates shear-wave velocity selected for saprolite (850 ft/sec).
2. Comprehensive information on the seismic cone penetration tests (SCPT) is provided in Geosyntec (2023).

**Locations of Seismic Cone Penetration Test (SCPT) Soundings and Measured Shear-Wave Velocities**  
Initial Safety Factor Assessment  
Georgia Power Plant Branch

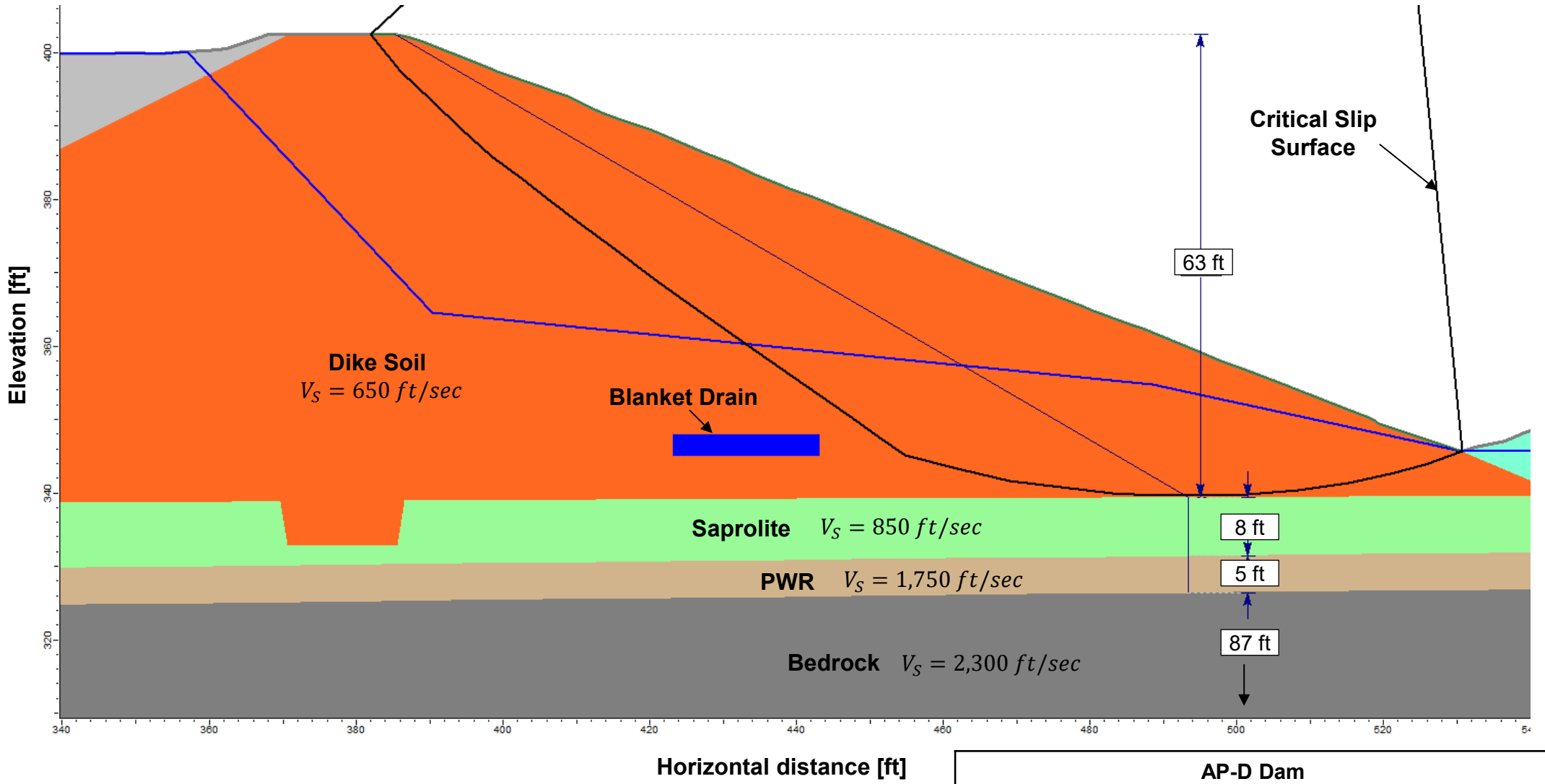


Figure

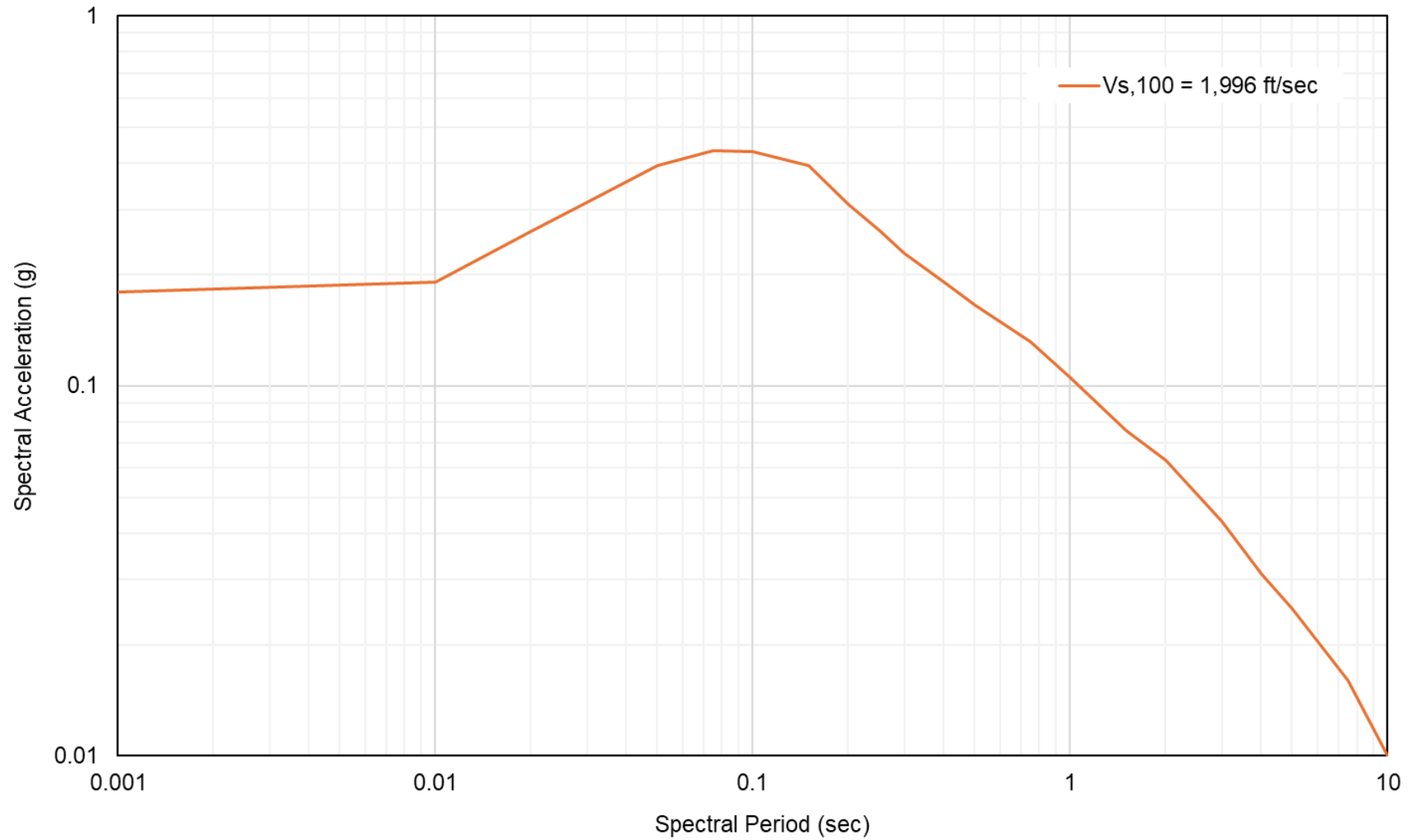
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<b>AP-D Dam</b> <b>Critical Slip Surface and Sliding Mass</b> <b>Static, Maximum Surcharge Pool Loading Condition</b> Initial Safety Factor Assessment Georgia Power Plant Branch	
Project No.: GW11718	May 2026
Figure 2	



**AP-D Site-Specific Uniform Hazard Spectrum at the Base of the Critical Slip Surface (5 percent Damping)**  
 Initial Safety Factor Assessment  
 Georgia Power Plant Branch



Figure

3

Project No.: GW11718

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Model \*  
NSHM Conterminous U.S. 2023

Latitude (\*) \*  
33.196

[24.4, 50]

Longitude (\*) \*  
-83.315

[-125, -65]

Select Site

Vs30 (<sup>m</sup>/s) \*  
608

Presets

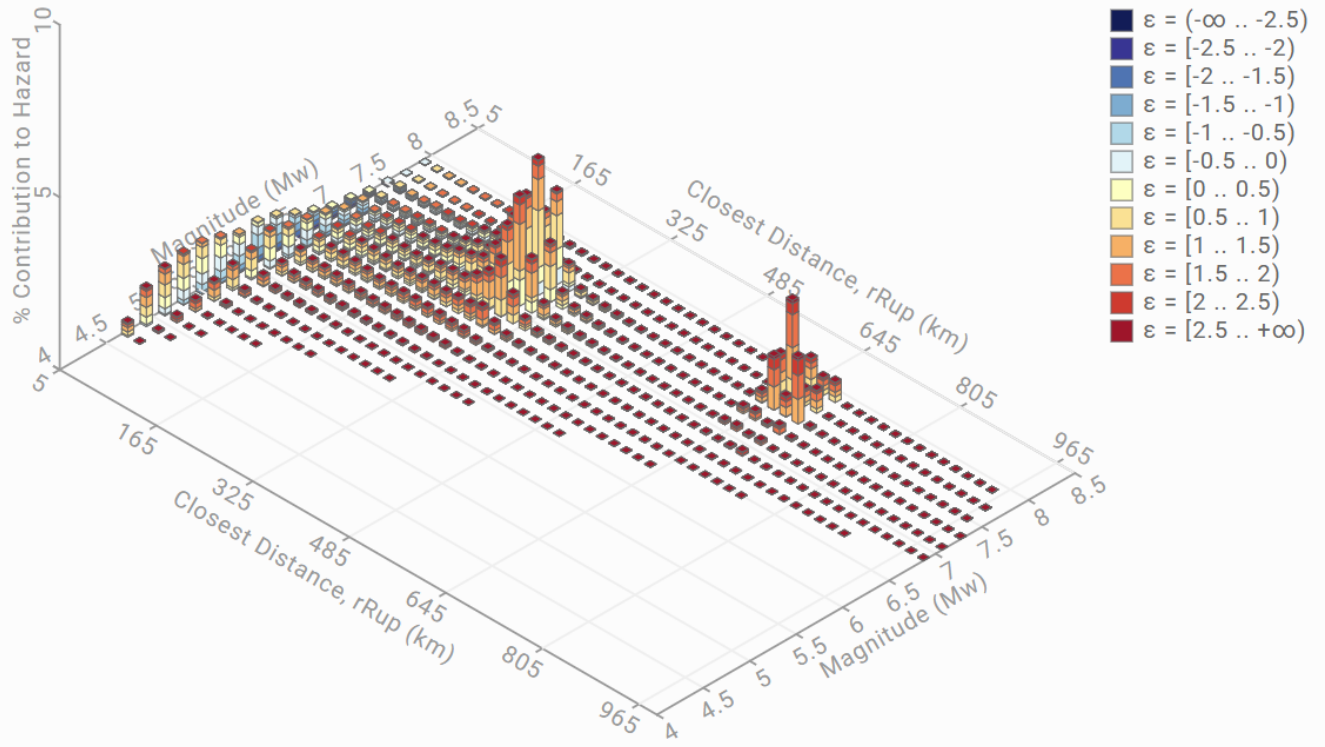
Intensity Measure Type \*  
0.5 s

Return Period (yr) \*  
2475

Presets

2475 (2% in 50)

Intensity Measure Level ( )  
Max Direction



Disaggregation targets

Return period : 2475 yrs

Exceedance rate : 4.040e-4 yr<sup>-1</sup>

0.5 s SA ground motion : 1.661e-1 g

Mode (largest m-r bin)

m : 7.3

r : 289.71 km

ε<sub>0</sub> : 0.9 σ

Contribution : 3.91 %

Recovered targets

Return period : 2456.725 yrs

Exceedance rate : 4.070e-4 yr<sup>-1</sup>

Mode (largest m-r-ε<sub>0</sub> bin)

m : 7.3

r : 289.54 km

ε<sub>0</sub> : 0.79 σ

Contribution : 1.65 %

Totals

Binned : 100 %

Residual : 0 %

Trace : 3.33 %

Discretization

r : min = 0.0, max = 1000.0, Δ = 20.0 km

m : min = 4.4, max = 9.4, Δ = 0.2

ε : min = -3.0, max = 3.0, Δ = 0.5 σ

Mean (over all sources)

m : 6.89

r : 246.34 km

ε<sub>0</sub> : 0.85 σ

Epsilon keys

ε0 : [-∞ .. -2.5)

ε1 : [-2.5 .. -2.0)

ε2 : [-2.0 .. -1.5)

ε3 : [-1.5 .. -1.0)

ε4 : [-1.0 .. -0.5)

ε5 : [-0.5 .. 0.0)

ε6 : [0.0 .. 0.5)

ε7 : [0.5 .. 1.0)

ε8 : [1.0 .. 1.5)

ε9 : [1.5 .. 2.0)

ε10 : [2.0 .. 2.5)

ε11 : [2.5 .. +∞)

**AP-D Site-specific Disaggregation on a Period of 0.50 sec for 2% Probability of Exceedance in 50 Years**  
Initial Safety Factor Assessment  
Georgia Power Plant Branch



Figure

4

**Note:**

1. Data obtained from the United States Geological Survey (USGS) Hazard Toolbox (2025).

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