Periodic Structural Stability Assessment

Chesterfield Power Station CCR Surface Impoundment: Lower Ash Pond

Submitted to:

Chesterfield Power Station

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Project No. 21466315

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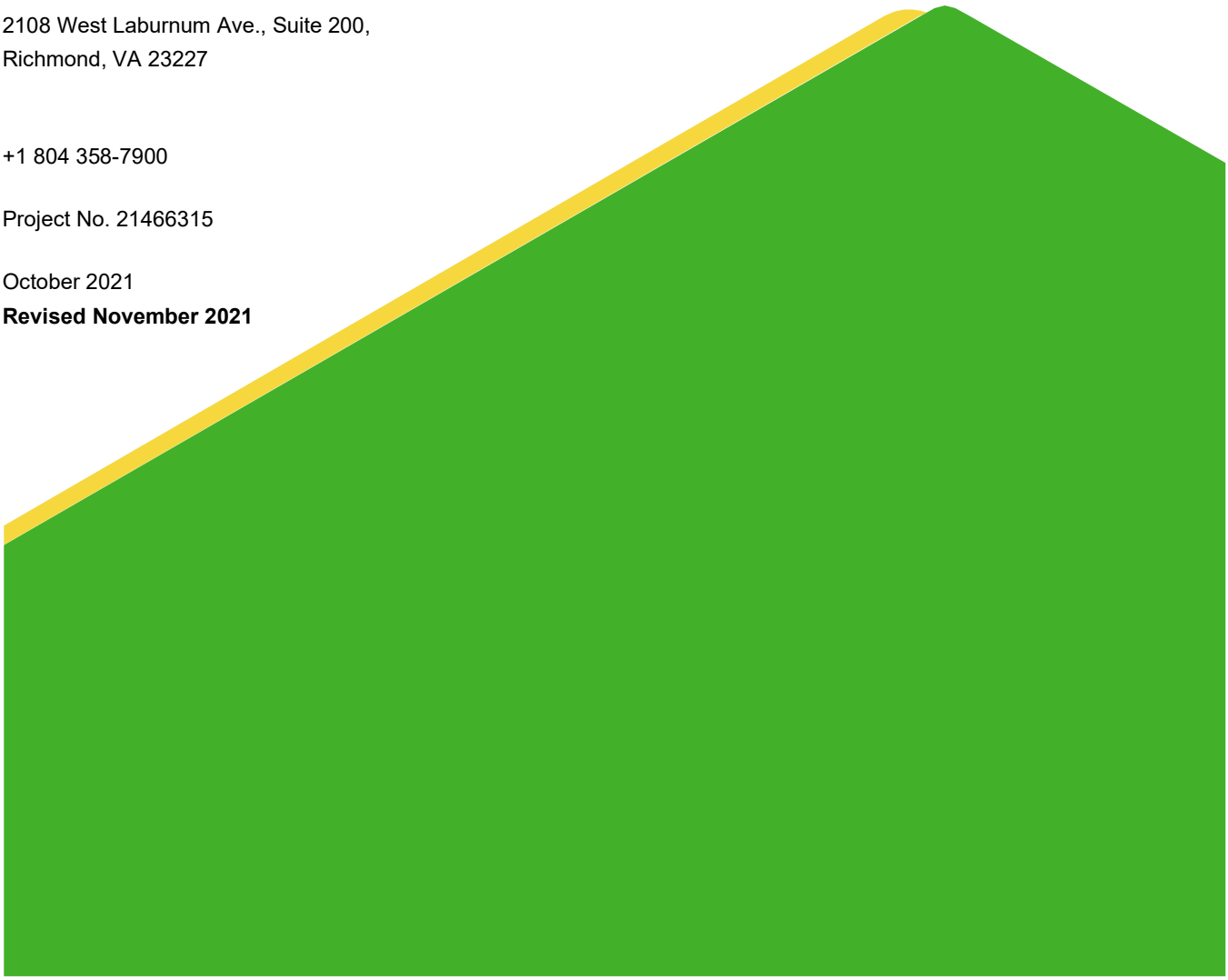

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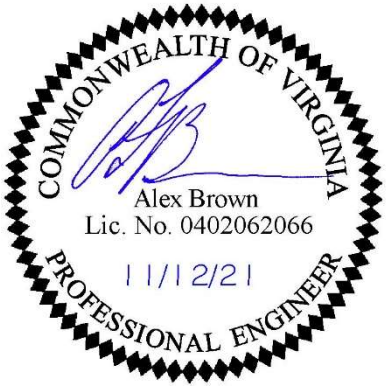
1.0 CERTIFICATION

This Structural Stability Assessment for the Chesterfield Power Station's Lower Ash Pond was prepared by Golder Associates Inc. (Golder). The document and Certification/Statement of Professional Opinion are based on and limited to information that Golder has relied on from Dominion and others, but not independently verified, as well as work products produced by Golder.

On the basis of and subject to the foregoing, it is my professional opinion as a Professional Engineer licensed in the Commonwealth of Virginia that this document has been prepared in accordance with good and accepted engineering practices as exercised by other engineers practicing in the same discipline(s), under similar circumstances, at the same time, and in the same locale. It is my professional opinion that the document was prepared consistent with the requirements in §257.73(d) of the United States Environmental Protection Agency's "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments," published in the Federal Register on April 17, 2015, with an effective date of October 19, 2015 [40 CFR §257.73(d)].

The use of the word "Certification" in this document shall be interpreted and construed as a Statement of Professional Opinion and is not and shall not be interpreted or construed as a guarantee, warranty, or legal opinion.

Alex Brown, P.E.	Senior Project Geotechnical Engineer
Print Name	Title
	11/12/2021
Signature	Date



2.0 INTRODUCTION

This periodic Structural Stability Assessment (Assessment) was prepared for the Chesterfield Power Station's (Station) existing Coal Combustion Residuals (CCR) surface impoundment known as the Lower Ash Pond (LAP). This Structural Stability Assessment was prepared in accordance with 40 CFR Part §257, Subpart D and is consistent with the requirements of 40 CFR §257.73(d).

The Station, owned and operated by Virginia Electric and Power Company d/b/a Dominion Energy Virginia (Dominion), is located in Chesterfield County, Virginia, at 500 Coxendale Road, east of I-95 (Richmond-Petersburg Turnpike) and south of the James River. The Station includes an existing CCR surface impoundment, the LAP, as defined by the Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule (40 CFR §257; the CCR rule). The LAP is also regulated as a dam by the Virginia Department of Conservation and Recreation (DCR) with Inventory Number 041031 (DCR Dam Permit).

3.0 PURPOSE

This periodic Assessment is prepared pursuant to the requirements in the CCR Rule, §257.73(d)(1) [40 CFR § 257.73(d)(1)]. The initial Structural Stability Assessment was completed on October 17, 2016 and is required to be updated every five (5) years pursuant to 40 CFR 257.73(f)(3).

4.0 STRUCTURAL STABILITY ASSESSMENT REQUIREMENTS

In accordance with §257.73(d)(1), the owner or operator of a CCR surface impoundment must conduct periodic structural stability assessments and document whether the design, construction, operation, and maintenance of the CCR surface impoundment is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein. The assessment must, at a minimum, document whether the CCR unit has been designed, constructed, operated, and maintained with:

- Stable foundations and abutments;
- Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown;
- Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit;
- Vegetated slopes of dikes and surrounding areas not to exceed a height of six inches above the slope of the dike, except for slopes which have an alternate form or forms of slope protection;
- A single spillway or a combination of spillways that is designed, constructed, operated, and maintained to adequately manage flow during and following the peak discharge from the 1,000-year flood;
    - All spillways must be either of non-erodible construction and designed to carry sustained flows or Earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected;
- Hydraulic structures underlying the base of the CCR unit or passing through the dike of the CCR unit that maintain structural integrity and are free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation of the hydraulic structure; and
- For CCR units with downstream slopes which can be inundated by the pool of an adjacent water body, such as a river, stream or lake, downstream slopes that maintain structural stability during low pool of the adjacent water body or sudden drawdown of the adjacent water body.

5.0 STRUCTURAL STABILITY ASSESSMENT

5.1 Foundation and Abutments

The Station lies in a geologically stable area with no active (Holocene) faults, karst (limestone, dolomite, or marble) potential, or other geologic conditions of concern. The LAP is constructed on alluvial and terrace soils associated with the James River. These soils consist of Clayey Sand (SC), Silty Sand (SM), Poorly Graded Sand with Silt (SP-SM), Poorly Graded Sand (SP), and Silty Gravel (GM). Material properties within the LAP foundation and abutments were interpreted based on subsurface data and site reconnaissance taken from previous investigations, analyses, and reports included in Geosyntec's Field Investigation and Laboratory Testing Report (Geosyntec, 2016a). The LAP has embankments on the east, south, and west sides and abutments on the eastern and western ends of the north side. The embankment foundation is constructed of material excavated from within the LAP footprint.

Golder's assessment of embankment stability in the Periodic Safety Factor Assessment (Golder, 2021a) show that the LAP does not meet the minimum factor of safety requirements in CCR Rule § 257.73(e)(1). The LAP has been routinely inspected and monitored by Station and Dominion personnel in accordance with the requirements in the DCR Dam Permit. Areas of concern are evaluated by professional engineers with corrective actions proposed and documented.

5.2 Slope Protection

The LAP external embankment was built at slopes of up to 1.5H:1V, which are vegetated. The vegetation on the embankment is maintained to prevent brush, trees, and clumping of weeds, with the exception of the southern embankment which is wooded adjacent to the Farrar Gut. The vegetation along the southern embankment acts as an alternate form of slope protection.

Dominion performs annual inspections in accordance with the requirements of the DCR Dam Permit. Dominion evaluates the vegetation on the slopes of the impoundment embankment as part of the annual inspections. The slope vegetation for the upstream slope and downstream slopes of the embankment were observed to be well maintained.

5.3 Compaction of Dikes

Geosyntec reviewed cone penetrometer testing (CPT) through the embankment of the LAP (Geosyntec, 2016a). This data was used to evaluate embankment compaction, calculating the approximate unit weights and percent compaction of the material within the embankment. The unit weights were estimated to be between 115 and 120 pounds per cubic foot (pcf), depending on the soil layer, with compaction percentages ranging from 93 to 100 percent. The soils within and below the embankment are likely silty sands and sandy silts, based on these and other previous investigations. Standard penetration test (SPT) data from other previous investigations indicate the embankment fill varies from loose to dense (Geosyntec, 2016c). No visible indications of weakened embankment (e.g., tension cracks, slumps, sinkholes, etc.) have been observed at the LAP over the past five years during Golder's annual CCR inspections. Slope stability analyses were performed by Golder as part of the periodic Safety Factor Assessment based on data collected from various Geosyntec reports. According to the Safety Factor Assessment, the embankments surrounding the LAP do not meet minimum safety criteria outlined by the CCR rules (Golder, 2021a).

5.4 Vegetated Slopes

As required by § 257.73(d)(1)(iv), vegetation on slopes and surrounding areas are not to exceed a height of six inches above the slope of the dike, except for slopes which have an alternate form of slope protection. Current operations at the LAP call for grass to be mowed 2-3 times per year to control vegetation height, with the exception of the southern embankment which is wooded adjacent to the Farrar Gut, which acts as an alternate form of slope protection. The vegetated slopes are operated and maintained to be stable and to provide for visual observation of any instability.

5.5 Spillways

The LAP currently has a temporary geomembrane rain cover over the surface to prevent stormwater contact with CCR. The principal spillway system, located on the western edge of the LAP, consists of a 17-foot long rectangular, sharp-crested concrete weir (6.5 ft amsl), an 11-inch dewatering orifice set within the weir structure (5.2 ft amsl), and two 58-inch HDPE pipes (4.0 ft amsl) (Geosyntec, 2021). Non-contact stormwater collected in the LAP discharges through the principal spillway to an outfall regulated by the Virginia Stormwater Management Program (Geosyntec, 2021).

The emergency spillway is located on the southwest side of the LAP and consists of a low point in the existing asphalt access road at approximately elevation 17 ft amsl. The emergency spillway does not engage during the inflow design storm.

The size and capacity of the emergency spillway are adequate to convey the runoff from the probable maximum flood (PMF) event without overtopping the embankment or eroding the spillway. Analysis of the spillway capacity is described in the Periodic Inflow Design Flood Control System Plan (Golder, 2021b).

5.6 Hydraulic Structures

The principal spillway passes through the dike of the LAP. The principal spillway system consists of a 17-foot long rectangular, sharp-crested concrete weir (6.5 ft amsl), an 11-inch dewatering orifice set within the weir structure (5.2 ft amsl), and two 58-inch HDPE pipes (4.0 ft amsl) (Geosyntec, 2021). The system is anchored within the main dike segment. There is no record or knowledge of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, or debris associated with the principal spillway.

5.7 Adjacent Water Bodies

The downstream slopes of the embankment on the southwestern side of the LAP border an old channel of the James River called Farrar Gut. The embankment surrounding the LAP is subject to the 100-year flood event as defined by FEMA, with a flood elevation of 16 feet above mean sea level (ft-amsl). A rapid drawdown assessment was performed on Section B shown in Figure 1 using the 100-year flood event as the starting water level and a final water level equal to sea level (see Appendix A). The target factor of safety for a rapid drawdown condition is 1.1 to 1.3 (USACE, 2003). The factor of safety for a rapid drawdown condition is 1.1, which meets the U.S. Army Corps of Engineers (USACE) minimum requirement. The location of the cross section analyzed for rapid drawdown is included in Figure 1, and calculations for the rapid drawdown assessment are included in Appendix A.

6.0 CORRECTIVE MEASURES

Results of the safety factor assessment referenced in this structural stability assessment indicate that the embankment surrounding the LAP does not meet the minimum requirements as outlined in the CCR rule § 257.73(e)(1). Because factors of safety do not meet the minimum requirements, a more rigorous analysis of the

embankment surrounding the LAP should be performed to determine the severity of the potential failure modes analyzed and the extents of the embankment that may also be susceptible to stability concerns.

7.0 CONCLUSIONS

Based on known site conditions, review of available information and the current analyses performed for the LAP, the LAP surface impoundment design, construction, operations, and maintenance procedures are consistent with good engineering practices for the volume of CCR and CCR wastewater that is impounded and meets the requirements of 40 CFR 257.73(d)(1)(ii), (iii), (iv), (v) (vi), and (vii). Due to the conditions described in previous sections of this assessment, the LAP does not meet the requirements of 40 CFR 257.73(d)(1)(i).

In response to this evaluation, Dominion Energy plans to enhance the strength of the southwest corner of the Lower Ash Pond berm by installing deep soil mixing shear panels (or similar type enhancements). Engineering efforts are ongoing through the end of this year and construction is expected to begin in the first quarter of 2022 with an estimated completion in mid-2022.

8.0 REFERENCES

Geosyntec Consultants. Field Investigation and Laboratory Testing Report: Lower Ash Pond Closure. August 2016a.

Geosyntec Consultants. Coal Combustion Residuals Structural Stability Assessment, Chesterfield Power Station, Lower Ash Pond. October 2016b.

Geosyntec Consultants. Chesterfield Power Station Lower and Upper Ash Ponds Catalog of Subsurface Data, Appendix D, 2017 Geotechnical Parameters Data Package. June 16, 2016c.

Geosyntec Consultants. Dam Breach Inundation Analysis, Lower Ash Pond and Upper Ash Pond Embankments. April 2021.

Golder Associates. Periodic Safety Factor Assessment, Chesterfield Power Station CCR Surface Impoundment: Lower Ash Pond. October 2021a.

Golder Associates. Periodic Inflow Design Flood Control System Plan, Chesterfield Power Station CCR Surface Impoundment: Lower Ash Pond. October 2021b.

Morgenstern, N. R., and Price, V. E. (1965). "The Analysis of the Stability of General Slip Surfaces," Geotechnique Vol 15 1, p. 79.

RocScience (2021). Slide Version 9.017. Build date: June 2, 2021.

U.S. Army Corps of Engineers (USACE). Engineering and Design, Engineer Manual, Slope Stability. October 31, 2003.

Virginia DCR Dam Permit, Inventory No. 041031.

LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- EXISTING TOPOGRAPHIC CONTOURS (1' INTERVALS)
- APPROXIMATE LIMITS OF EXISTING ASH PONDS
- LIMITS OF 100-YR FLOOD PLAIN
- MW-22R — GROUNDWATER MONITORING WELL LOCATION AND IDENTIFICATION
- DM1 — GROUNDWATER MONITORING/OBSERVATION WELL
- B1 — EXISTING SOIL BORING LOCATION AND IDENTIFICATION (APPROXIMATE LOCATION)

SCALE: 350 0 350 FEET

NOTES

1. EXISTING CONDITIONS COMPILED BY TUCK MAPPING SOLUTIONS USING PHOTOGRAMMETRIC METHODS, FROM AERIAL PHOTOGRAPHY DATED MAY 11, 2018.

LOWER ASH POND (LINED)

UPPER ASH POND

TIDAL JAMES RIVER OLD CHANNEL

APPROXIMATE LIMITS OF LAP EMBANKMENT

B52, B51, BF-4, MW-20, MW-20I TO BE DECOMMISSIONED, B17, MW-21, MW-21I TO BE DECOMMISSIONED, MW-28, MW-21R, MW-B50, MW-22R, MW-22 TO BE DECOMMISSIONED, B18, MP-2, MW-27, MW-32, MW-B42A, MW-32SR, OW-32B TO BE DECOMMISSIONED, MW-26, MW-23R, MW-23 TO BE DECOMMISSIONED, B3, B30A, DM8 / 8A, MW-10, MW-33, MW-33R TO BE DECOMMISSIONED, MW-B19, B1, MW-33IR, OW-33I TO BE DECOMMISSIONED, B2, MW-11, MW-11I, OW-33D TO BE DECOMMISSIONED, MW-12, B20, OW-33B TO BE DECOMMISSIONED, B21, B22, MW-B41A, MW-34, B23, MW-25, MW-B40A, MW-24, MW-13, B11, B12, B13, MW-14

B

B'

CLIENT	DOMINION ENERGY
	CHESTERFIELD POWER STATION
	CHESTERFIELD COUNTY, VIRGINIA
CONSULTANT	GOLDER, MEMBER OF WSP
PROJECT	PERIODIC SAFETY FACTOR ASSESSMENT
	STABILITY ANALYSIS
	LOWER ASH POND
TITLE	**STABILITY**
	CROSS SECTION LOCATION
PROJECT NO.	21-466315
REV.	0
FIGURE	1

	YYYY-MM-DD	
DESIGNED	2021-08-18	ATN
PREPARED		SIB
REVIEWED		ATN
APPROVED		JRD

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

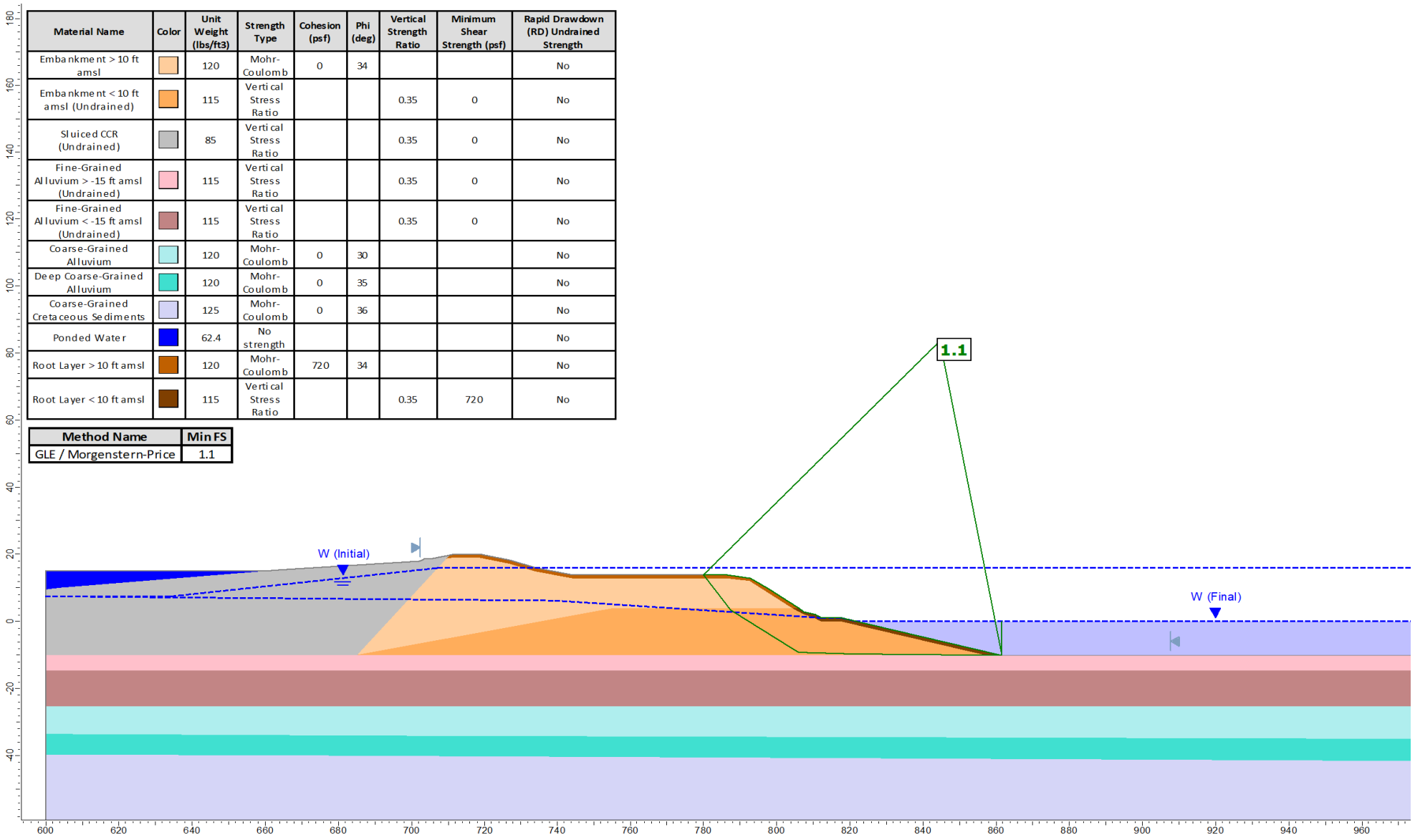
Path: G:\Plan Production Data Files\Drawing Data Files\21-466315\020_CPS 5-yr Assessments\Active Drawings\g21466315-020-01.dwg

APPENDIX A

Rapid Drawdown Stability Assessment, Chesterfield Power Station, Lower Ash Pond

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)	Rapid Drawdown (RD) Undrained Strength
Embankment > 10 ft amsl		120	Mohr-Coulomb	0	34			No
Embankment < 10 ft amsl (Undrained)		115	Vertical Stress Ratio			0.35	0	No
Sluiced CCR (Undrained)		85	Vertical Stress Ratio			0.35	0	No
Fine-Grained Alluvium > -15 ft amsl (Undrained)		115	Vertical Stress Ratio			0.35	0	No
Fine-Grained Alluvium < -15 ft amsl (Undrained)		115	Vertical Stress Ratio			0.35	0	No
Coarse-Grained Alluvium		120	Mohr-Coulomb	0	30			No
Deep Coarse-Grained Alluvium		120	Mohr-Coulomb	0	35			No
Coarse-Grained Cretaceous Sediments		125	Mohr-Coulomb	0	36			No
Ponded Water		62.4	No strength					No
Root Layer > 10 ft amsl		120	Mohr-Coulomb	720	34			No
Root Layer < 10 ft amsl		115	Vertical Stress Ratio			0.35	720	No

Method Name	Min FS
GLE / Morgenstern-Price	1.1



Note: GLE/Morgenstern Price method results displayed.

GOLDER
MEMBER OF WSP

SCALE	AS SHOWN
DATE	Oct 2021
MADE BY	SDRM
CAD	-
CHECK	ALB
REVIEW	ATN

PROJECT: **Chesterfield Power Station**

TITLE: **Lower Ash Pond**
Section B-B'
Rapid Drawdown

FILE: SAFETY FACTOR ASSESSMENT

PROJECT No. 21466315 REV. 0

CLIENT: **Dominion Energy**

FIGURE 1

golder.com