Safety Factor Assessment

Plant McDonough-Atkinson
Ash Pond 3 (AP-3) and Ash Pond 4 (AP-4)

Prepared for:

Georgia Power Company

Prepared by:

Golder Associates Inc.

3730 Chamblee Tucker Road

Atlanta, Georgia, USA 30341

+1 770 496-1893

Table of Contents

1.0 CERTIFICATION **1**

2.0 INTRODUCTION **2**

3.0 SLOPE STABILITY ASSESSMENT METHODOLOGY **2**

3.1 Maximum Pool Storage 2

3.2 Maximum Pool Surcharge 2

3.3 Seismic Loading Conditions 2

3.4 Liquefaction Assessment 3

4.0 SLOPE STABILITY ASSESSMENT RESULTS **3**

5.0 CONCLUSION **3**

6.0 REFERENCES **3**

APPENDICES

APPENDIX A

Stability Analysis Figures for AP-3 and AP-4

1.0 CERTIFICATION

This Safety Factor Assessment for Georgia Power Company (Georgia Power)'s Ash Pond 3 (AP-3) and Ash Pond 4 (AP-4), located at Plant McDonough-Atkinson (Plant McDonough) in Cobb County, Georgia was prepared by Golder Associates Inc. (Golder).

I certify that this Safety Factor Assessment for AP-3 and AP-4 was prepared in accordance with §257.73(e) of the United States Environmental Protection Agency's "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments" (40 CFR 257).

Gregory L. Hebeler, PhD, P.E.

Georgia Licensed Professional Engineer No. 034749

Golder Associates Inc.

2.0 INTRODUCTION

The United States Environmental Protection Agency (EPA)'s "Disposal of Coal Combustion Residuals from Electric Utilities" Final Rule (40 C.F.R. Part 257, the "CCR Rule") §257.73(e) requires the owner or operator of a CCR surface impoundment to conduct initial and periodic safety factor assessments. The owner or operator of the CCR unit must conduct an assessment and document whether the minimum safety factors outlined in §257.73(e)(1)(i) through (iv) for the critical cross section of the embankment are achieved. The interim (October 2017) construction condition of AP-3 and AP-4 was analyzed. In the interim condition, AP-3 and AP-4 are being consolidated and closed in-place as combined unit AP-3/4. According to section § 257.73(e) of the rule, stability of earth structures must be assessed under four loading conditions:

- Maximum Pool Storage (§ 257.73(e)(i))
- Maximum Pool Surcharge (§ 257.73(e)(ii))
- Seismic Loading Conditions (§ 257.73(e)(iii))
- Post-Seismic Liquefaction Conditions (when liquefaction susceptible materials are present; § 257.73(e)(iv)).

3.0 SLOPE STABILITY ASSESSMENT METHODOLOGY

Embankment stability safety factors were evaluated for each of the loading scenarios using the computer program SLIDE 7.0 Version 7.031 (2018). As required by the CCR Rule, a general limit equilibrium (GLE) method (Morgenstern and Price) was used to calculate factors of safety, and the factor of safety is calculated by dividing the resisting forces by the driving forces along the calculated critical slip surface.

Stability was evaluated along two cross-sections deemed the most critical for AP-3 and AP-4 as shown in Figure 1 of Appendix A. Subsurface stratigraphy at each cross-section was developed from data collected during subsurface explorations from October 2015 to January 2016. Similarly, material properties were developed for the dike, foundation, and impounded materials from this data. The conditions modeled in stability analyses are reflective of the (October 2017) interim conditions for AP-3 and AP-4.

3.1 Maximum Pool Storage

The safety factor analyses represent the pool storage conditions for the interim condition (October 2017). At the time of this demonstration, some areas of AP-3 and AP-4 are covered with liner and others remain as open construction areas. The interim pool storage condition calculated in the Inflow Design Flood Control calculations was used for the maximum pool storage stability calculations.

3.2 Maximum Pool Surcharge

The 100-year 24-hour rain event was used for the maximum pool surcharge scenario.

For AP-3 and AP-4, the interim condition rain event will cause stormwater flow in a combination of lined channels and open working areas. Thus, the stability of AP-3 and AP-4 slopes were evaluated with applicable water levels to the calculated flow depths for the rain event.

3.3 Seismic Loading Conditions

Factors of safety for stability under seismic loading conditions were calculated based on the earthquake hazard corresponding to a probability of exceedance of 2% in 50 years (2,475 year return period). The Bray and

Travasarou displacement-based seismic slope stability screening method was used to evaluate the seismic stability. For this method, a pseudo-static coefficient corresponding to an allowable displacement of six inches (15 cm) is applied as a horizontal force in the static stability model. The pseudo-static coefficient for the above stated criteria was calculated to be 0.029g (g = standard gravity).

3.4 Liquefaction Assessment

The CCR Rule specifies a required factor of safety of 1.2 against liquefaction for pond impoundment structures in section § 257.73(e)(iv). The dikes and foundation soils at the location of the AP-3 and AP-4 analysis sections were evaluated for liquefaction susceptibility and were found to have calculated factors of safety against liquefaction above 1.2.

4.0 SLOPE STABILITY ASSESSMENT RESULTS

The table below presents the results of the slope stability analyses for the AP-3 and AP-4 dikes. For all cases analyzed, the calculated factors of safety are in excess of those required in Sections § 257.73(e)(i) to (iii) of the CCR Rule. The detailed stability result figures are presented in Figures 2a-2c and 3a-3c of Appendix A.

Interim Condition Stability Analysis Results				
Analysis Case	Max. Storage Pool	Max. Surcharge Pool	Seismic	Post Liquefaction
Rule Section	§ 257.73(e)(i)	§ 257.73(e)(ii)	§ 257.73(e)(iii)	§ 257.73(e)(iv)
Target Factor of Safety	1.5	1.4	1.0	1.2
Cross-Sections	**Factor of Safety**			
AP-4 North	1.7	1.7	1.6	Not Applicable
AP-4 East	1.6	1.6	1.5	

5.0 CONCLUSION

Golder evaluated the stability of the dikes surrounding AP-3 and AP-4 in the four loading conditions in accordance with section § 257.73(e) of the CCR Rule:

- Maximum Pool Storage (§ 257.73(e)(i))
- Maximum Pool Surcharge (§ 257.73(e)(ii))
- Seismic Loading Conditions (§ 257.73(e)(iii))
- Post-Seismic Liquefaction Conditions (when liquefaction susceptible materials are present; § 257.73(e)(iv))

For each loading case, the dikes were calculated to meet the target factor of safety presented in the CCR Rule.

6.0 REFERENCES

Bray, J. D., and Travasarou, T. 2007. Simplified Procedure for Estimating Earthquake-Induced Deviatoric Slope Displacements. Journal of Geotechnical and Geoenvironmental Engineering, Vol. 133, No. 4, pp. 381-392.

Bray, J.D., and Travasarou, T. 2009. Pseudostatic Coefficient for Use in Simplified Seismic Slope Stability Evaluation. Journal of Geotechnical and Geoenvironmental Engineering, Vol. 135, No. 9: pp. 1336-1340.

Rocscience (2016), SLIDE Version 7.017.

USEPA (2015), Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, § 40 CFR Parts 257 and 261.

APPENDIX A

Stability Analysis Figures for AP-3 and AP-4

LEGEND

2 FOOT CONTOURS, OCTOBER 2017 CONDITIONS

300 200 100 0 300 Feet

CLIENT
GEORGIA POWER COMPANY

PROJECT
PLANT MCDONOUGH
AP-3 AND AP-4

TITLE
STABILITY SECTION PLAN
10-2017 INTERIM CONDITIONS

CONSULTANT

Golder Associates

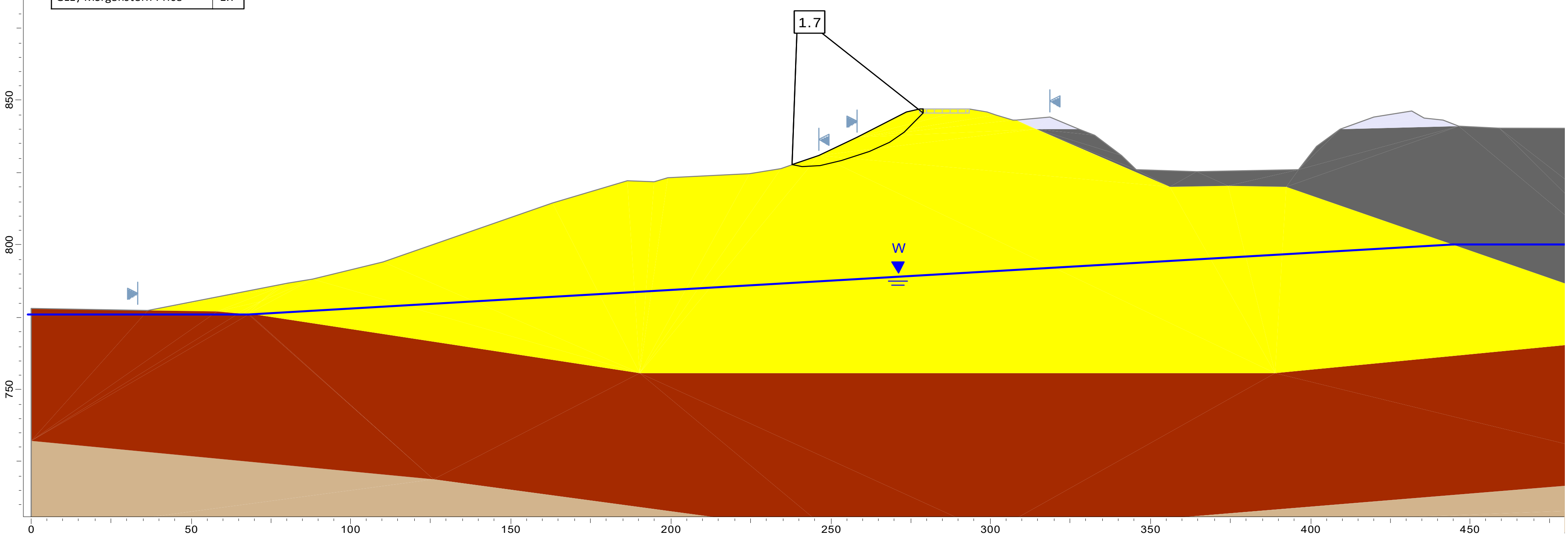
YYYY-MM-DD	2018-03-23
PREPARED	JDG
DESIGN	---
REVIEW	LS
APPROVED	GLH

PROJECT No.	CONTROL	Rev.	FIGURE
1777449		0	1

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

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Water Surface	Hu Type	Hu
Staked Ash Drained		110	Mohr-Coulomb	0	30		Water Surface	Custom	1
Sluiced Ash Drained		90	Mohr-Coulomb	0	24		Water Surface	Custom	1
Dike Fill Soil Drained		125	Mohr-Coulomb	100	30		Water Surface	Custom	1
Residuum Soil Drained		125	Mohr-Coulomb	100	30		Water Surface	Custom	1
PWR		140	Undrained	10000		Constant	Water Surface	Custom	0

Method Name	Min FS
GLE / Morgenstern-Price	1.7



GOLDER

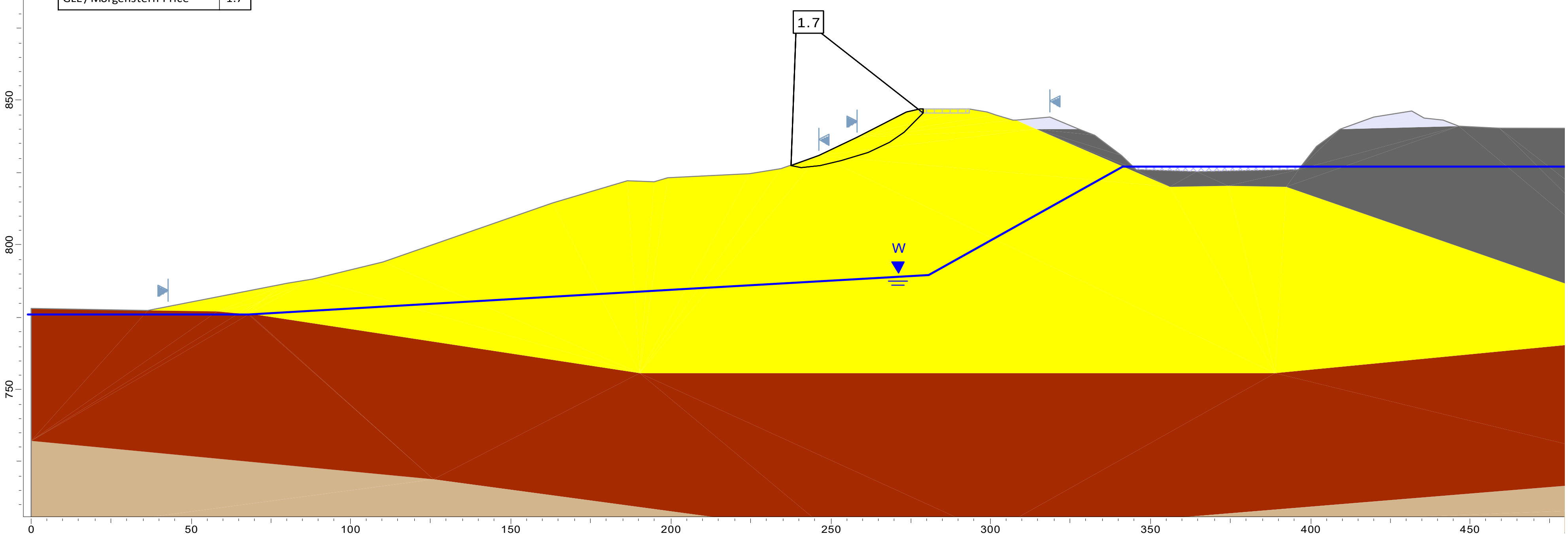
SCALE	AS SHOWN	PROJECT	McDonough AP-3 and AP-4
DATE	Apr 2018	TITLE	Section AP-4 (North) Interim Condition (Drained), Normal Storage Pool
MADE BY	LJ		
CAD	-		
CHECK	JGM	CLIENT	Georgia Power Company
REVIEW	GLH	FIGURE	2(a)

FILE STABILITY

PROJECT No. 1777449 REV. 0

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Water Surface	Hu Type	Hu
Staked Ash Drained		110	Mohr-Coulomb	0	30		Water Surface	Custom	1
Sluiced Ash Drained		90	Mohr-Coulomb	0	24		Water Surface	Custom	1
Dike Fill Soil Drained		125	Mohr-Coulomb	100	30		Water Surface	Custom	1
Residuum Soil Drained		125	Mohr-Coulomb	100	30		Water Surface	Custom	1
PWR		140	Undrained	10000		Constant	Water Surface	Custom	0

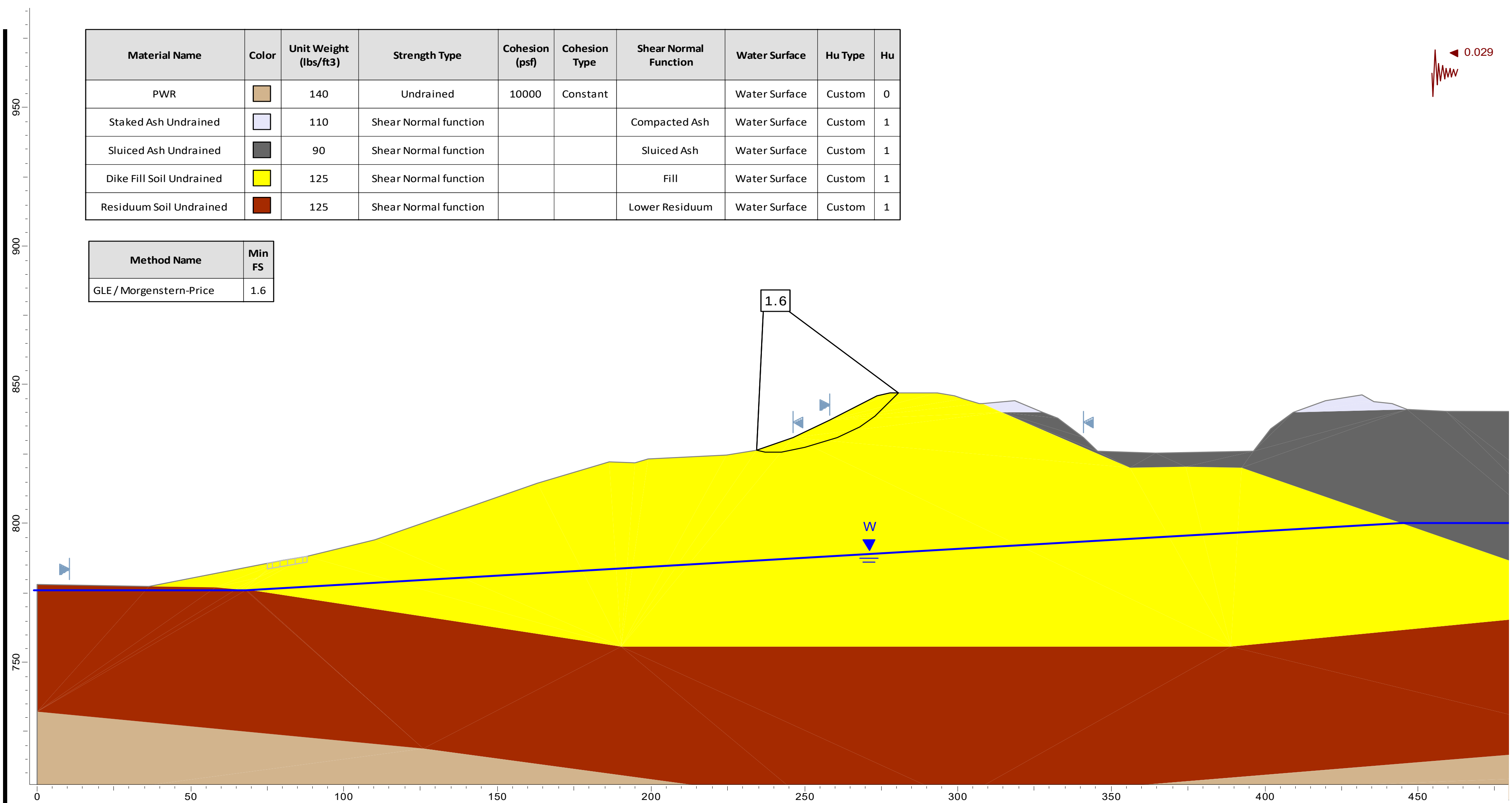
Method Name	Min FS
GLE / Morgenstern-Price	1.7



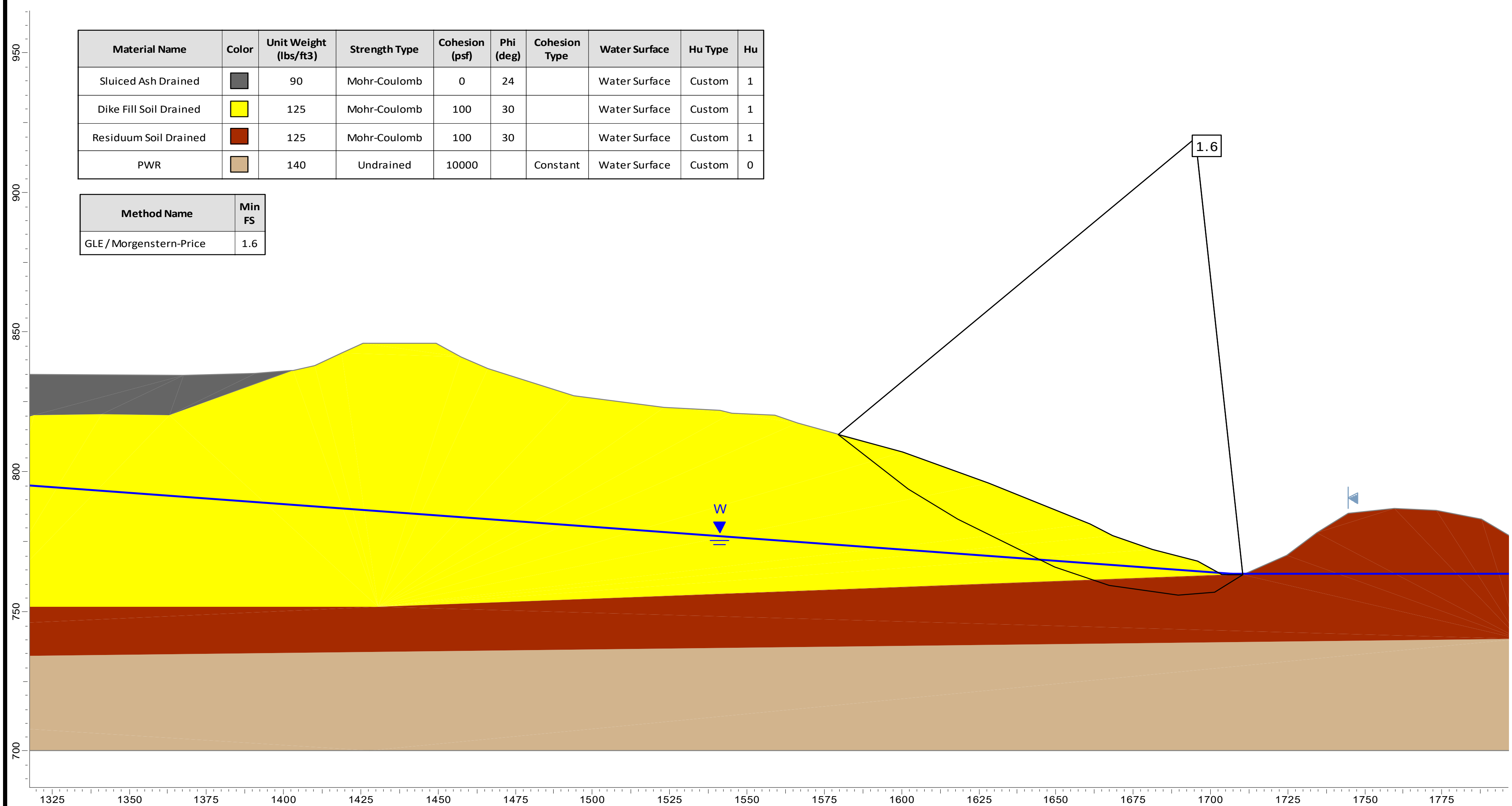
GOLDER	SCALE AS SHOWN	PROJECT	McDonough AP-3 and AP-4
	DATE Apr 2018	TITLE	Section AP-4 (North) Maximum Surchage Pool
	MADE BY LJ		
	CAD -		
FILE STABILITY	CHECK JGM	CLIENT	Georgia Power Company
PROJECT No. 1777449 REV. 0	REVIEW GLH	FIGURE	2(b)

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Cohesion Type	Shear Normal Function	Water Surface	Hu Type	Hu
PWR		140	Undrained	10000	Constant		Water Surface	Custom	0
Staked Ash Undrained		110	Shear Normal function			Compacted Ash	Water Surface	Custom	1
Sluiced Ash Undrained		90	Shear Normal function			Sluiced Ash	Water Surface	Custom	1
Dike Fill Soil Undrained		125	Shear Normal function			Fill	Water Surface	Custom	1
Residuum Soil Undrained		125	Shear Normal function			Lower Residuum	Water Surface	Custom	1

Method Name	Min FS
GLE / Morgenstern-Price	1.6



GOLDER	SCALE AS SHOWN	PROJECT	**McDonough AP-3 and AP-4**
	DATE Apr 2018	TITLE	**Section AP-4 (North) Seismic Screening**
	MADE BY LJ		
	CAD -		
FILE STABILITY	CHECK JGM	CLIENT	**Georgia Power Company**
PROJECT No. 1777449 REV. 0	REVIEW GLH	FIGURE	2(c)



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Water Surface	Hu Type	Hu
Sluiced Ash Drained		90	Mohr-Coulomb	0	24		Water Surface	Custom	1
Dike Fill Soil Drained		125	Mohr-Coulomb	100	30		Water Surface	Custom	1
Residuum Soil Drained		125	Mohr-Coulomb	100	30		Water Surface	Custom	1
PWR		140	Undrained	10000		Constant	Water Surface	Custom	0

Method Name	Min FS
GLE / Morgenstern-Price	1.6

GOLDER

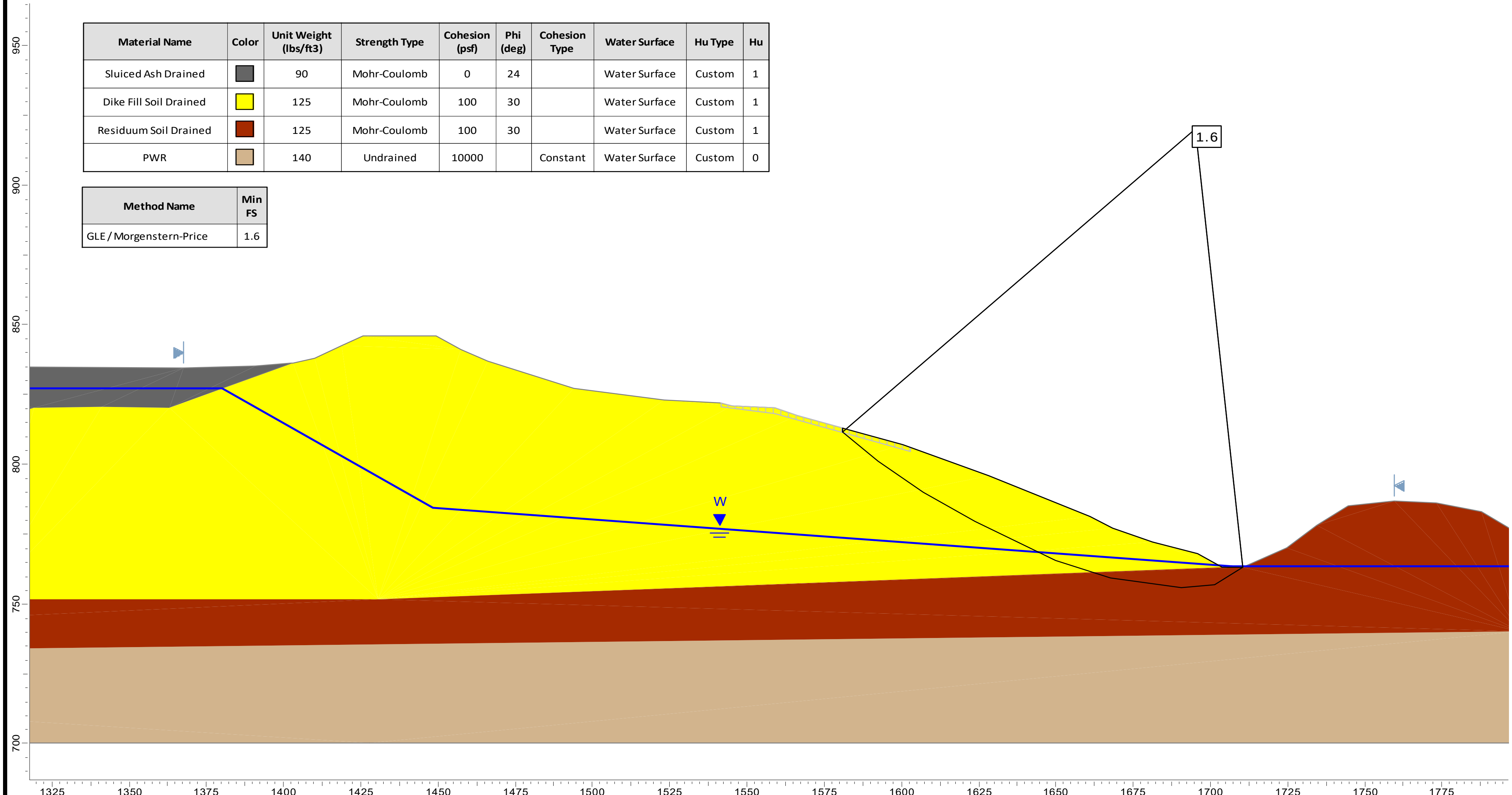
SCALE	AS SHOWN	PROJECT	**McDonough AP-3 and AP-4**
DATE	Apr 2018	TITLE	**Section AP-4 (South) Interim Condition (Drained), Normal Storage Pool**
MADE BY	LJ		
CAD	-		
CHECK	JGM	CLIENT	**Georgia Power Company**
REVIEW	GLH	FIGURE	3(a)

FILE STABILITY

PROJECT No. 1777449 REV. 0

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion Type	Water Surface	Hu Type	Hu
Sluiced Ash Drained		90	Mohr-Coulomb	0	24		Water Surface	Custom	1
Dike Fill Soil Drained		125	Mohr-Coulomb	100	30		Water Surface	Custom	1
Residuum Soil Drained		125	Mohr-Coulomb	100	30		Water Surface	Custom	1
PWR		140	Undrained	10000		Constant	Water Surface	Custom	0

Method Name	Min FS
GLE / Morgenstern-Price	1.6

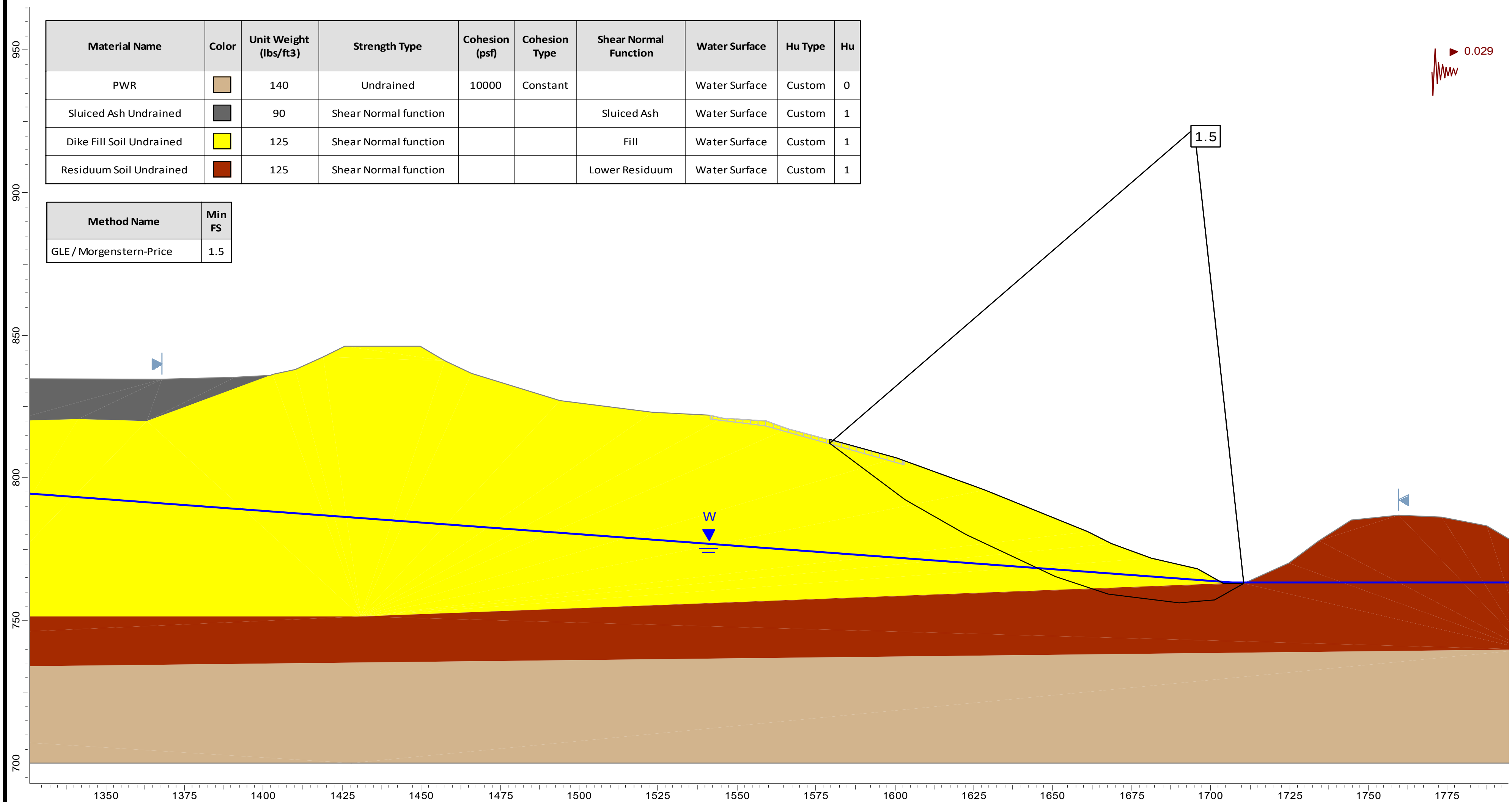


GOLDER

SCALE	AS SHOWN	PROJECT	**McDonough AP-3 and AP-4**
DATE	Apr 2018	TITLE	**Section AP-4 (South) Maximum Surchage Pool**
MADE BY	LJ		
CAD	-		
FILE	STABILITY		
CHECK	JGM	CLIENT	**Georgia Power Company**
PROJECT No.	1777449	REV.	0
REVIEW	GLH	FIGURE	3(b)

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Cohesion Type	Shear Normal Function	Water Surface	Hu Type	Hu
PWR		140	Undrained	10000	Constant		Water Surface	Custom	0
Sluiced Ash Undrained		90	Shear Normal function			Sluiced Ash	Water Surface	Custom	1
Dike Fill Soil Undrained		125	Shear Normal function			Fill	Water Surface	Custom	1
Residuum Soil Undrained		125	Shear Normal function			Lower Residuum	Water Surface	Custom	1

Method Name	Min FS
GLE / Morgenstern-Price	1.5



GOLDER

SCALE	AS SHOWN
DATE	Apr 2018
MADE BY	LJ
CAD	-
CHECK	JGM
REVIEW	GLH
FILE	STABILITY
PROJECT No.	1777449
REV.	0

PROJECT **McDonough AP-3 and AP-4**

TITLE **Section AP-4 (South) Seismic Screening**

CLIENT **Georgia Power Company**

FIGURE **3(c)**