INITIAL STRUCTURAL STABILITY ASSESSMENT

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Bremo Power Station CCR Surface Impoundment: East Ash Pond

Submitted To: Bremo Power Station
1038 Bremo Bluff Road
Bremo Bluff, VA 23022

Submitted By: Golder Associates Inc.
2108 W. Laburnum Avenue, Suite 200
Richmond, VA 23227

April 2018

Project No. 15-20347

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Table of Contents

Tables

Appendices

1.0 CERTIFICATION

This Initial Structural Stability Assessment for the Bremo Power Station's East 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 Energy 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)], as well as with the requirements in §257.100 resulting from the EPA's "Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals From Electric Utilities; Extension of Compliance Deadlines for Certain Inactive Surface Impoundments; Response to Partial Vacatur" published in the Federal Register on August 5, 2016 with an effective date of October 4, 2016 (40 CFR §257.100).

The use of the word "certification" and/or "certify" 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.

Daniel McGrath	Associate and Senior Consultant
Print Name	Title
Daniel McGrath	4/13/18
Signature	Date

COMMONWEALTH OF VIRGINIA
Daniel McGrath
DANIEL P. McGRATH
Lic. No. 040703
4/13/18
PROFESSIONAL ENGINEER

2.0 INTRODUCTION

This Initial Structural Stability Assessment was prepared for the Bremo Power Station's (Station) inactive Coal Combustion Residuals (CCR) surface impoundment, the East Ash Pond (EAP). This Initial 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) and 40 CFR §257.100(e)(3)(v).

The Station, owned and operated by Virginia Electric and Power Company d/b/a Dominion Energy Virginia (Dominion), is located in Fluvanna County at 1038 Bremo Road, east of Route 15 (James Madison Highway) and north of the James River. The Station includes an inactive CCR surface impoundment, the EAP, as defined by the Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule and Direct Final Rule (40 CFR §257; the CCR rule). All elevations noted in this report are in feet relative to the North American Vertical Datum of 1988 (NAVD-88).

3.0 STRUCTURAL STABILITY

3.1 Foundation and Abutments

The Station lies on an alluvial terrace in a geologically stable area with no active (Holocene) faults, karst (limestone, dolomite, or marble) potential, or other geologic conditions of concern. The EAP was constructed on the natural, alluvial soils, generally consisting of clayey silts and locally exposed underlying gravel channels or residual materials. The EAP is roughly triangular in shape and is generally defined by the rising natural ground along the north and northeast side and by a western and southern earth dike that begins at a steep east abutment and extends about 1,900 feet to the west before turning north about 700 feet to meet the rising ground in the right or northwest abutment. The EAP embankments were constructed of mostly alluvial soils excavated from within the footprint of the pond. Material properties within the EAP foundation and abutments were interpreted based on subsurface data and site reconnaissance taken from previous Golder investigations, analyses, and reports included in Golder's March 2017 Virginia Department of Conservation and Recreation (DCR) Impounding Structure Geotechnical Design Report Supporting Documents (Golder 2017), and are presented in Table 1 below.

Table 1: Summary of Geotechnical Strength Properties

Material	Total Unit Weight (pound per cubic foot, pcf)	Strength Properties		
		Peak φ' (°)	Cohesion (pound per square foot, psf)	Su (ton per square foot, tsf)
Dike Fill Soils	125	> 214 ft-msl: 31 < 214 ft-msl: 28	50	1.5
Alluvium	115	28	50	depth < 75 ft-bgs: 1.0 depth > 75 ft-bgs: 1.75

3.2 Slope Protection

The eastern portion of the south dike, for a distance of about 1,300 feet from the left or south abutment, is thickly wooded and locally steep [nominally 1.5 horizontal to 1 vertical (1.5H:1V)]. Trees have grown on the perimeter dike and the tree boles are curved, indicating the slope is likely creeping. It is anticipated that these trees will be removed as part of the EAP closure and repurposing as a stormwater management pond. Moderate erosion is evident at several locations. Toward the western end of the south dike is an approximately 175-foot long line of timber piles, driven immediately adjacent to each other and parallel to the dike crest in response to stability concerns with the dike in that area. An apparent tension crack and minor seepage was noted in the slope above the piles during Golder's 2015 geotechnical exploration. The west dike appears in similar condition to the wooded portions of the south dike.

3.3 Compaction of Dikes

The following tables summarize the primary geotechnical laboratory results and basic cone penetrometer testing (CPT)-based interpretations (Table 2), and secondary laboratory data (Table 3) from the EAP dike laboratory soil tests and CPTs completed during the 2015 geotechnical exploration program.

Table 2: Summary of Primary Geotechnical Testing Data for the EAP Dike Soil Fills

Property	Number of Tests	Minimum	Maximum	Average	Median
Depth Range *(ft)*	-	9	49.6	22.3	17
Water Content *(%)*	8	12	30	24	24
Gravel (> 4.75 millimeters) *(%)*	5	0	6	1	0
Sand *(%)*	5	5	49	26	27
Fines (< 0.075 millimeters) *(%)*	6	51	95	74	75
Specific Gravity	2	2.71	2.76	2.74	2.74
Liquid Limit (LL) *(%)*	8	19	44	33	32
Plastic Limit (PL) *(%)*	8	15	33	22	22
Plasticity Index (PI)	8	4	18	11	11
Non-Plastic Results	1	1 of 8			

Table 3: Summary of Secondary Geotechnical Data for the EAP Dike Soil Fills

<table>
<tr><th colspan="2">Property</th><th>Number of Points</th><th>Minimum</th><th>Maximum</th><th>Average</th><th>Median</th></tr>
<tr><td>Drilling</td><td>Standard Penetration Test (SPT) N (blows per foot, bpf)</td><td>40</td><td>0</td><td>18</td><td>8</td><td>8</td></tr>
<tr><td rowspan="4">CPT Based</td><td>Peak φ' (°)</td><td rowspan="4">1539</td><td>23.1</td><td>47.1</td><td>33.8</td><td>33.5</td></tr>
<tr><td>Su (tsf)</td><td>0.4</td><td>8.3</td><td>2.4</td><td>2.1</td></tr>
<tr><td>SPT N_{60} (bpf)</td><td>2</td><td>69</td><td>18</td><td>15</td></tr>
<tr><td>Normalized CPT Tip Resistance (Qtn)</td><td>3.2</td><td>481.4</td><td>48.2</td><td>27.8</td></tr>
</table>

Embankment fills in the EAP dikes generally consist of low-plasticity fines (CL and ML) with increasing amounts of sand with fines (SM and SC) encountered in the eastern portion of the embankment. Some trace ash in the dike fills were noted, but are suggestive of incidental inclusion rather than deliberate construction. In contrast, the vertical expansion dikes used as internal and upper dike fills on the eastern half of the EAP are generally comprised of compacted ash. The following table summarizes the geotechnical data for the compacted CCR fills:

Table 4: Summary of Secondary Geotechnical Data for the EAP Dike CCR Fills

Property		Number of Points	Minimum	Maximum	Average	Median
CPT Based	*Peak φ' (°)*	960	33.3	46.9	42.4	43.1
	Su *(tsf)*		1.9	4.8	2.4	2.2
	SPT N_{60} *(bpf)*		9	67	35	36
	Normalized CPT Tip Resistance *(Qtn)*		26.7	460.8	209.1	207.7

3.4 Spillways

The EAP's primary spillway is an intake tower and 24-inch diameter reinforced concrete pipe, which regulated the pool elevation in the eastern portion of the EAP. The intake tower, in the eastern end of the impoundment area, is constructed of concrete and regulated by concrete stop logs. The current lowest stoplog elevation is approximately 229.0. A 24-inch diameter pipe extends from the structure under the EAP dike to a drainage channel and ultimately through a permitted outfall. As of mid-2017, the EAP has been dewatered for closure activities and the 24-inch diameter pipe has been temporarily plugged to satisfy discharge permit requirements.

As shown in the April 2018 Inflow Design Flood Control System Plan for the EAP, the structure has adequate capacity to store the flow from the 1,000-year storm event. The analysis of the spillway capacity is included in the April 2018 Inflow Design Flood Control System Plan for the EAP. Surface water and pore water within the EAP are pumped to the on-site CSWTS for treatment and discharge. There is no auxiliary spillway. The analysis of the spillway capacity is included in Appendix B of the Inflow Design Flood Control System Plan.

3.5 Hydraulic Structures

The primary spillway passes through the dike of the EAP. The primary spillway is a 24-inch diameter pipe connected to a concrete riser structure that is anchored within the footprint of the pond. The existing spillway structure will be reconfigured as part of the repurposing of the EAP to a stormwater management pond. The primary spillway is adequate and will be maintained during and after the closure activities. There is no record or knowledge of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, or debris associated with the primary spillway. In accordance with 40 CFR §257.83, the pipe systems will be monitored and inspected periodically for clogging, leaks, erosion around the pipes, movements, or other issues.

3.6 Inundation of Slopes

The EAP dike is located approximately 325 feet north of the James River. The top of the embankment at the lowest point is elevation 230 feet above mean sea level (ft amsl). The calculated water surface elevation of the James River resulting from the 100-year storm event is 228.1 ft amsl, therefore significant inundation of the southern exterior slopes of the EAP can be expected. Golder's evaluation of slope stability under rapid drawdown conditions after a 100-year flood event shows the embankments exhibit satisfactory factors of safety, with the exception of Section B-B. For more details on the rapid drawdown analysis, please refer to the Rapid Drawdown Methodology Package (Appendix A).

In recognition of Section B-B not meeting the target factor of safety, routine weekly inspections are conducted to observe any changes in the embankment. Water is removed through diversion and pumping and not impounded behind the EAP embankment, and monitoring will continue until the pond achieves final closure through removal of CCR and reduction in the embankment height.

4.0 CONCLUSIONS

Based upon a review of available information and the additional analyses performed for this and other assessments, areas of the EAP dikes, similar to Section B-B, require regrading to ensure global stability. The EAP will be closed by removal of CCR materials. Following the removal of CCR, the area will be repurposed and the existing perimeter dikes will have the trees removed and be regraded to a 3H:1V slope to improve stability.

It is Golder's opinion that the surface impoundment design, construction, operations, and maintenance procedures are consistent with good engineering practices, and meets the requirements of 40 CFR 257.73(d) based upon pond operations as discussed above.

APPENDIX A

Rapid Drawdown Methodology Package

Golder Associates

CALCULATIONS

Date:	April 17, 2018	**Made by:**	G. Martin
Project No.:	15-20347	**Checked by:**	L. Jin
Subject:	Rapid Drawdown Methodology Package	**Reviewed by:**	G. Hebeler
Project Title:	**BREMO POWER STATION – EAST ASH POND**		

1.0 INTRODUCTION

This document describes the methodology Golder used to evaluate the stability of East Ash Pond (EAP) dike slopes under rapid drawdown conditions at Dominion Energy's Bremo Power Station.

Rapid drawdown takes place when free water outside a slope draws down quickly such that the pore pressure in the slope does not have sufficient time to dissipate. The water level drop removes a stabilizing force outside the slope and reduces the stability factor of safety from steady-state conditions.

2.0 METHODOLOGY AND ASSUMPTIONS

Golder used the design procedures and criteria described in the Engineer Manual (EM) 1110-2-1902 from the United States Army Corps of Engineers (USACE, 2003) to evaluate stability under rapid drawdown conditions. For the conditions considered in this package, the USACE lists a minimum target factor of safety of 1.1. Thus, a minimum target factor of safety of 1.1 was adopted for this analysis.

Additionally, the following has been assumed for this analysis:

- The slope is subject to an elevated water level long enough to become saturated
- Drawdown from the elevated water level is rapid
- No drainage occurs out of the slope when the water level drops

USACE lists two methods for performing rapid drawdown analysis but identifies one as the recommended method. Golder used the recommended method for analysis which was developed by Lowe and Karafiath (1959) and later modified by Wright and Duncan (1987) and by Duncan, Wright, and Wong (1990). These procedures are described in whole in the book *Soil Strength and Slope Stability* (Duncan et al. 2014). Golder used the computer program SLIDE's built-in rapid drawdown tool which includes the reference method (Rockscience 2018).

Factors of safety were calculated using the general limit equilibrium (GLE) method developed by Morgenstern and Price (Abramson et al. 2002). The factor of safety is calculated by dividing the resisting forces by the driving forces along the critical slip surface.

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The rapid drawdown method differs from steady-state stability analyses in the application of material strengths. The rapid drawdown method uses two strength envelopes.

The first strength envelope represents the isotropic consolidation condition where the stress ratio is one (Kc = 1) and is determined from isotropically consolidated-undrained triaxial shear tests by plotting the undrained shear strength (τ_{ff}) versus the effective stress on the failure plane at consolidation (σ'_{fc}). The slope and intercept of the shear strength envelope are $\psi_{Kc=1}$ and $d_{Kc=1}$ as shown below in Figure 1.

The second strength envelope used in rapid drawdown analysis represents the effective shear strength at on the maximum effective principal stress ratio ($Kc = K_{failure} = K_f$). The slope and intercept of the strength envelope are the defined by the effective friction angle (ϕ') and the effective cohesion (c') determined from isotropically consolidated-undrained triaxial shear tests as shown in Figure 2.

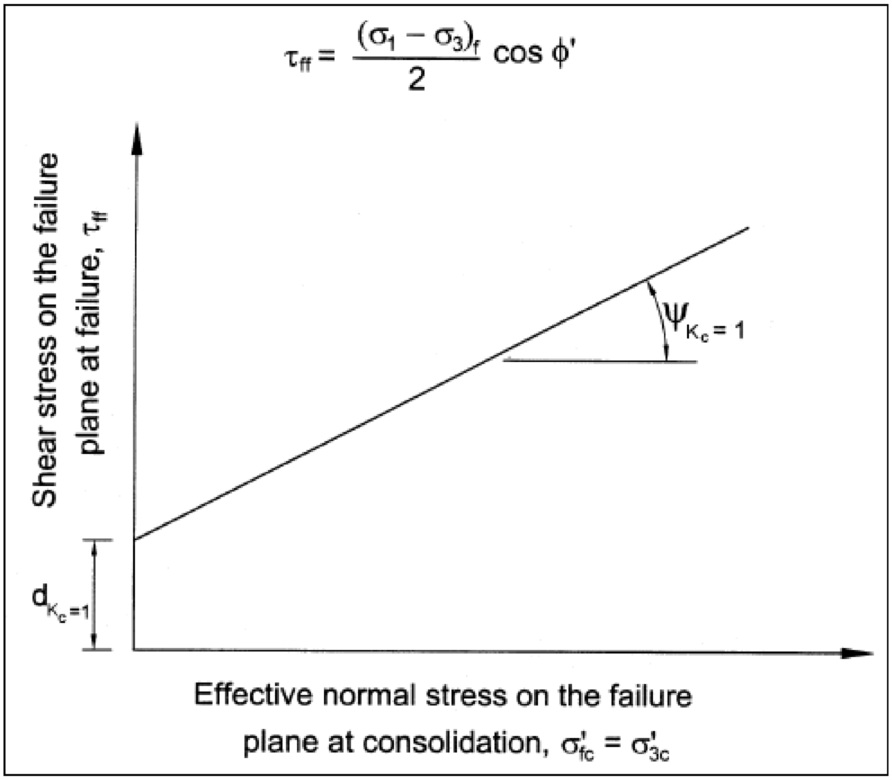

Figure 1. Estimation of Undrained Shear Strength Kc = 1

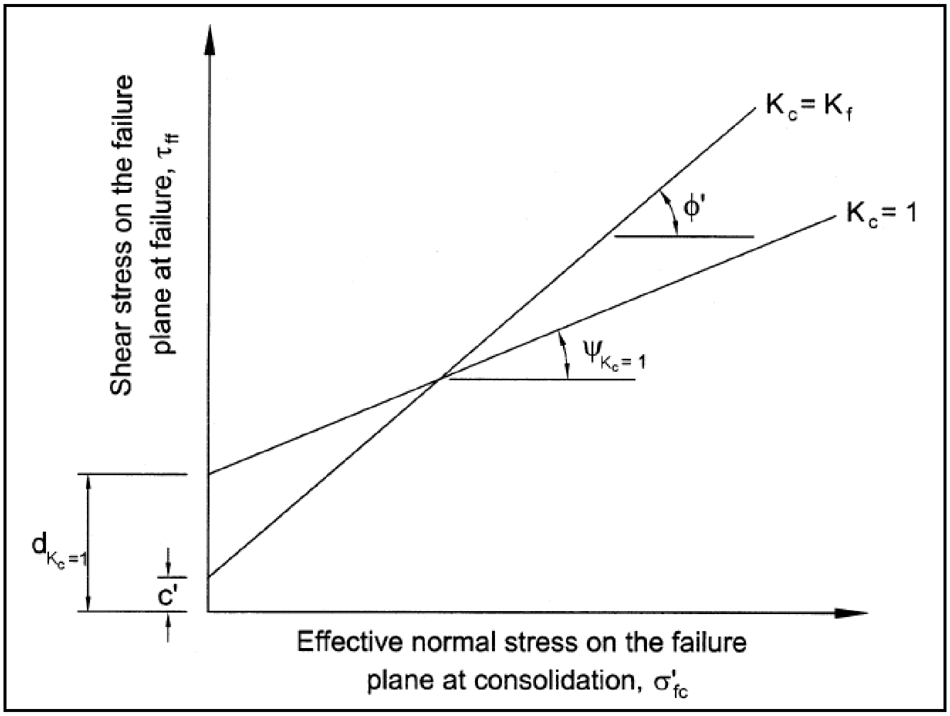

Figure 2. Shear Strength Envelopes for Rapid Drawdown Computations

3.0 SITE-SPECIFIC ANALYSIS

Based on the geotechnical exploration at the site, the EAP and West Ash Pond (WAP) dikes at Bremo Power Station are composed of alluvial soils excavated from the interior portions of the ponds. These materials are primarily described as a mix of fine sandy silt and sandy clay (ML and CL) and silty fine sand (SM) (Golder 2016).

3.1 Shear Strength of Embankment Fill

For the rapid drawdown analysis, results from isotropically consolidated undrained triaxial compression tests (CIU) are needed to develop the two strength envelopes described above. Two samples of EAP dike fill material and one sample of WAP dike fill material were subjected to such testing (summarized in the below table).

Table 1: Summary of Dike Samples Subject to CIU Testing

Sample ID	Sample Depth (ft)	Pond	USCS	Liquid Limit	Plasticity Index	Fines Content (%)
GB-2 UD-01	8 – 10	EAP	CL	38	13	82
GB-3 UD-01	16 - 18	EAP	CL-ML	19	4	51
WB-01 UD-01	20.6 – 21.9	WAP	ML	36	11	90

Data from these samples have been synthesized to estimate the shear strength envelopes of the dike under rapid drawdown conditions since the material for the dikes was obtained from the site and belongs to the same general soil unit. Table 2 lists the results of the triaxial tests and the calculated stresses.

Table 2: Summary of CIU Triaxial Results

Sample ID	σ'_{fc} (psi)	σ_{1f} (psi)	σ_{3f} (psi)	u_f (psi)	σ'_{1f} (psi)	σ'_{3f} (psi)	ϕ' (deg)	σ'_f (psi)	τ_{ff} (psi)
GB-2 UD-01	4.0	15.405	4.0	1.329	14.076	2.671	42.9	4.490	4.176
	8.0	19.835	8.0	3.840	15.995	4.160	36.0	6.603	4.790
	16.0	38.850	16.0	6.490	32.360	9.510	33.1	14.700	9.574
GB-3 UD-01	7.0	17.038	7.0	3.008	14.030	3.992	33.8	6.215	4.168
	15.0	28.801	15.0	5.984	22.817	9.016	25.7	12.925	6.218
	30.0	59.343	30.0	13.378	45.966	16.622	28.0	24.415	12.959
WB-1 UD-1	7.4	16.481	7.4	3.660	12.821	3.740	33.3	5.791	3.797
	14.8	31.806	14.8	6.592	25.214	8.208	30.6	12.384	7.320
	29.6	69.222	29.6	8.926	60.296	20.674	29.3	30.791	17.277

Strength envelopes were developed for the undrained ($K_c = 1$) condition and the effective strength condition ($K_c = K_f$) by fitting lines to the data as shown in Figure 3 and 4, respectively.

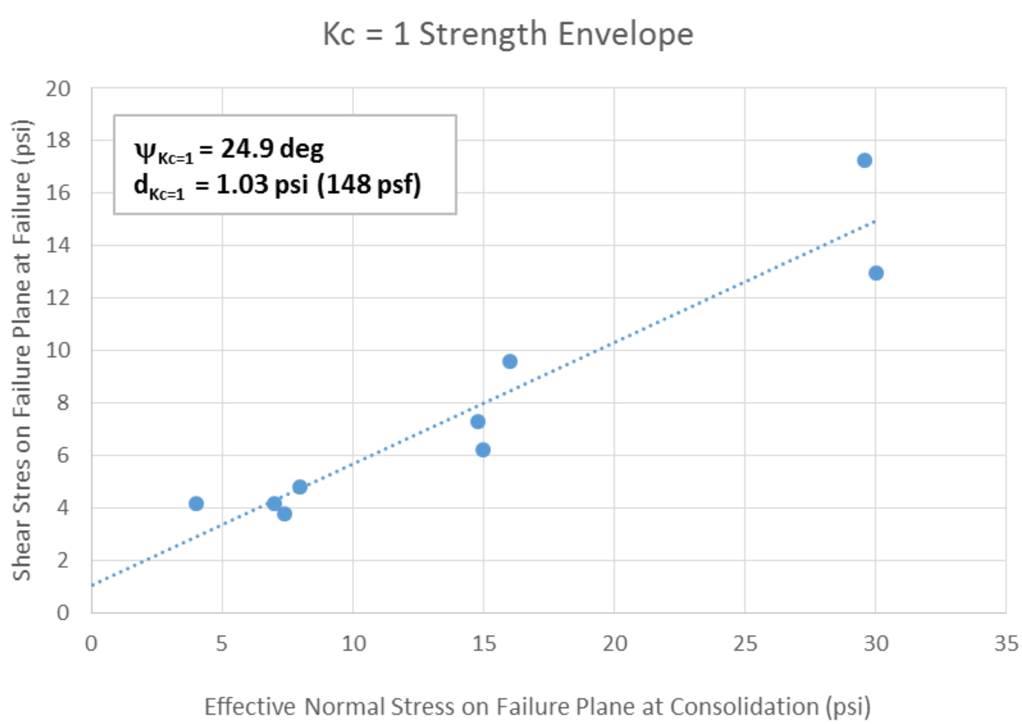

Figure 3. $K_c = 1$ Shear Strength Envelope for Rapid Drawdown Computations

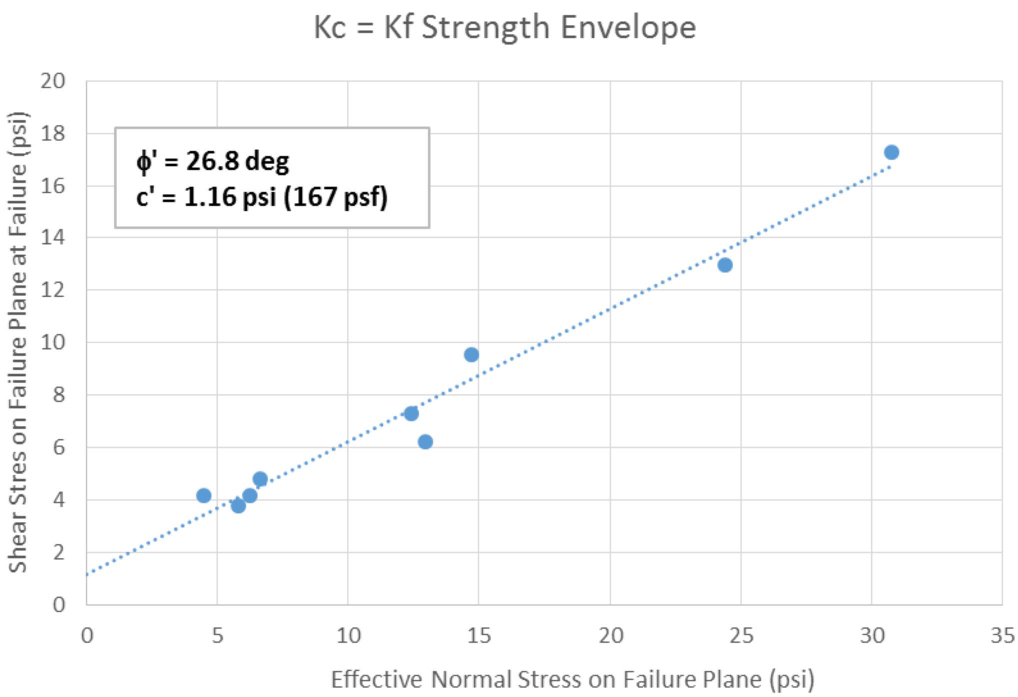

Figure 4. K_c = K_f Shear Strength Envelope for Rapid Drawdown Computations

3.2 Water Levels

The initial (pre-drawdown) water level was set at 228.1 ft-msl which corresponds to the 100-yr flood event. Golder assumed that the rapid drawdown condition would occur until the water level reached the toe of the dike.

4.0 RESULTS

Using the process described above, Golder evaluated the stability of the EAP dikes under rapid drawdown conditions resulting from the site 100-year flood event. The table below presents the results of the analysis of the dikes surrounding the EAP. For all sections analyzed, the calculated factors of safety are in excess of those required, with the exception of Section B-B. The detailed stability result figures are available in the pages following this text.

Table 1. Rapid Drawdown Analysis Results

Cross-Sections	Factor of Safety
A-A	1.1
B-B	1.0
C-C	1.4
D-D	1.8

5.0 REFERENCES

Abramson, L.W., Lee, T.S., Sharma, S., and Boyce, G.M. (2002) Slope Stability and Stabilization Methods, 2nd Edition, John Wiley & Sons, Inc.

Duncan, J.M., Wright, S.G., and Brandon, T. L. (2014) Soil Strength and Slope Stability 2nd Ed., John Wiley & Sons, Inc., Hoboken, NJ.

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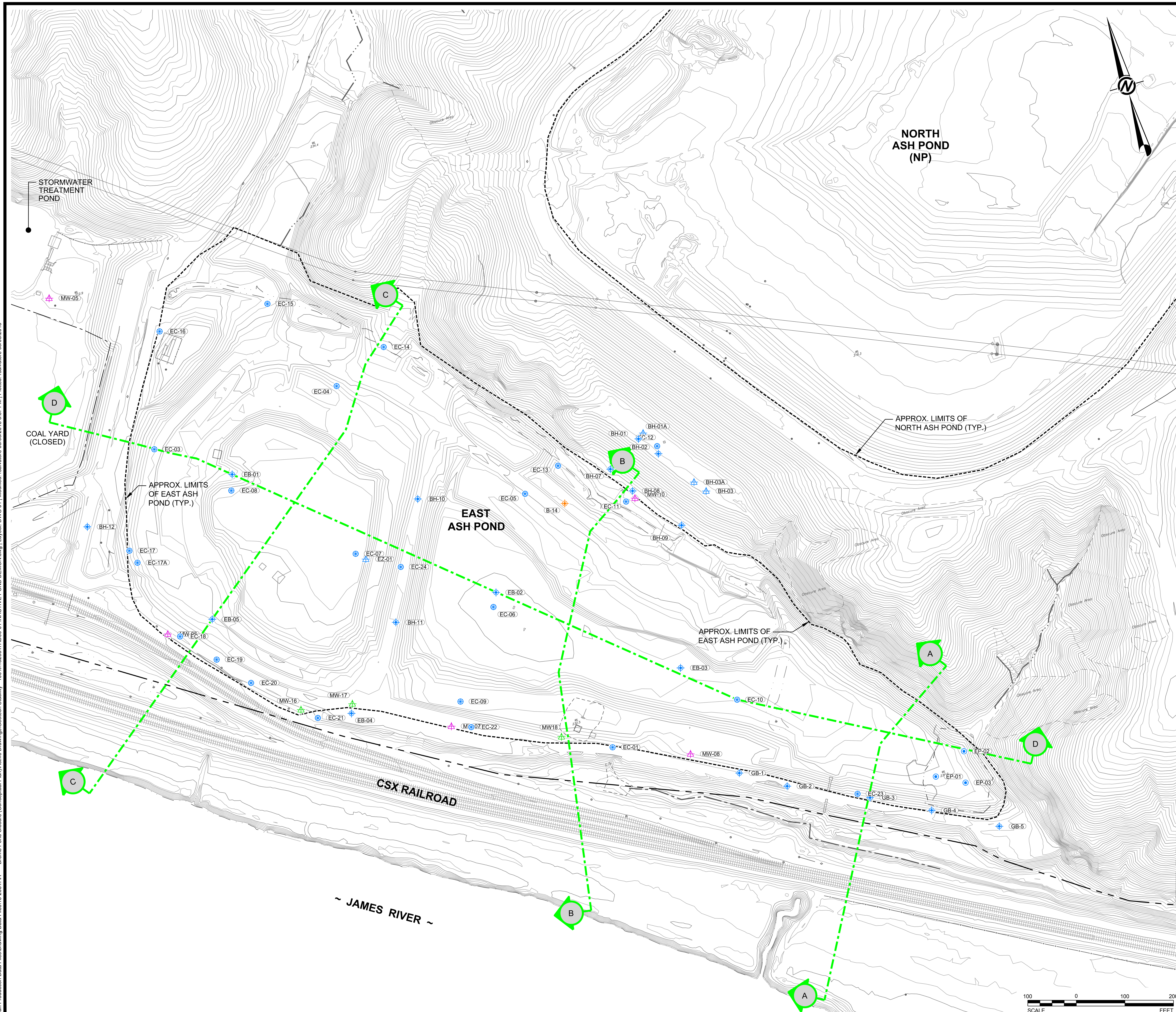
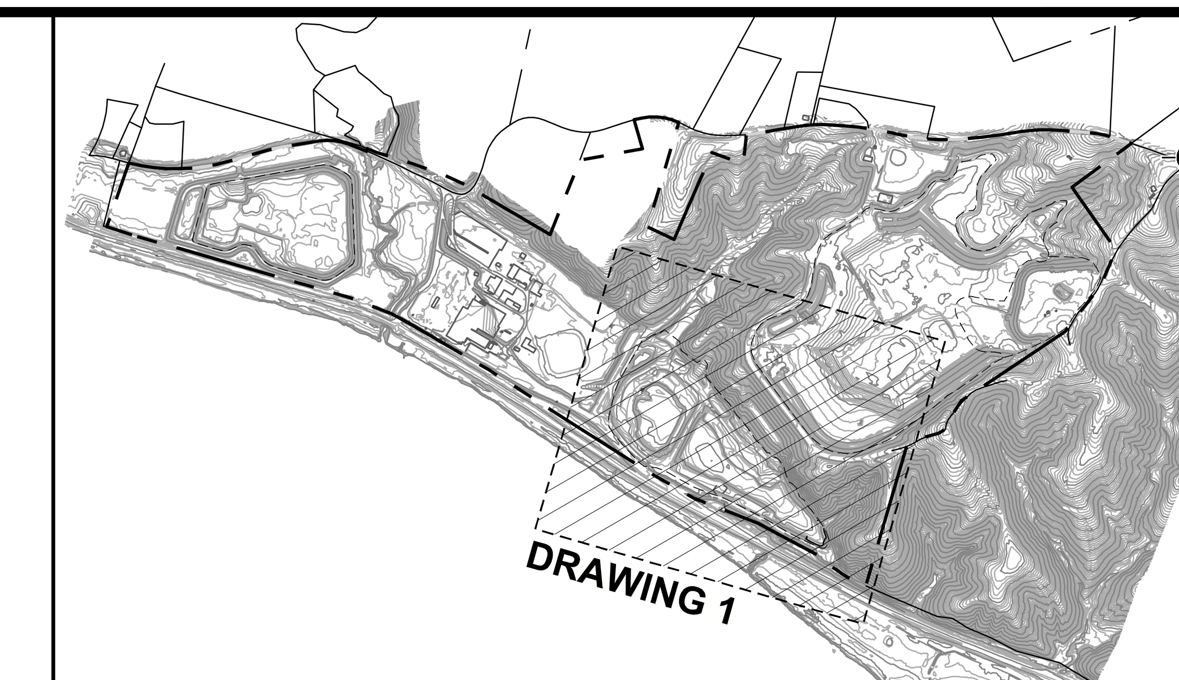
Wright, S. G., and Duncan, J. M. (1987). An Examination of Slope Stability Computation Procedures for Sudden Drawdown, Miscellaneous Paper GL-87-25, Geotechnical Laboratory, U. S. Army Waterways Experiment Station, Vicksburg, MI, Sept.





SITE KEY

NOT TO SCALE

LEGEND

- DOMINION PROPERTY BOUNDARY
- ADJACENT PROPERTY BOUNDARY
- APPROXIMATE LIMITS OF EXISTING ASH PONDS
- EXISTING TOPOGRAPHIC CONTOURS (2' INTERVALS)
- DESIGN SURFACE CONTOURS (2' INTERVALS)
- EXISTING PAVED ROAD
- EXISTING RAILROAD
- CREEK CENTERLINE
- EXISTING FENCE
- DENOTES AREAS OF TOPOGRAPHY THAT DO NOT MEET MINIMUM ACCURACY STANDARDS FOR AERIAL SURVEYING
- GES MONITORING WELL (2013)
- HALEY AND ALDRICH BORING (2015)
- GOLDER BORING
- GOLDER PIEZOMETER
- GOLDER CONE PENETRATION TEST (CPT)
- GOLDER PROBE HOLE
- GOLDER HAND AUGER
- EP-B — SLOPE STABILITY SECTIONS
- SLOPE STABILITY DRAWING LOCATIONS - SEE APPENDIX D

REFERENCES

1. TOPOGRAPHY DERIVED FROM THE MONTHLY EXCAVATION SURVEY PREPARED BY H&B SURVEYING AND MAPPING LLC., COLLECTED ON JANUARY 31, 2018.

REV	DATE	REVISION DESCRIPTION	DES	CADD	CHK	RVW
	01/04/17	ADDED 2016 TOPO; UPDATED DESIGN GRADES, NOTATION, SECTION LOCATIONS	-	SEP	JGM	GLH

PROJECT

DOMINION
BREMO POWER STATION
CCR IMPOUNDMENT CLOSURE
FLUVANNA COUNTY, VIRGINIA

TITLE

INACTIVE POND DEMONSTRATION GEOTECHNICAL PLAN (EAST ASH POND)

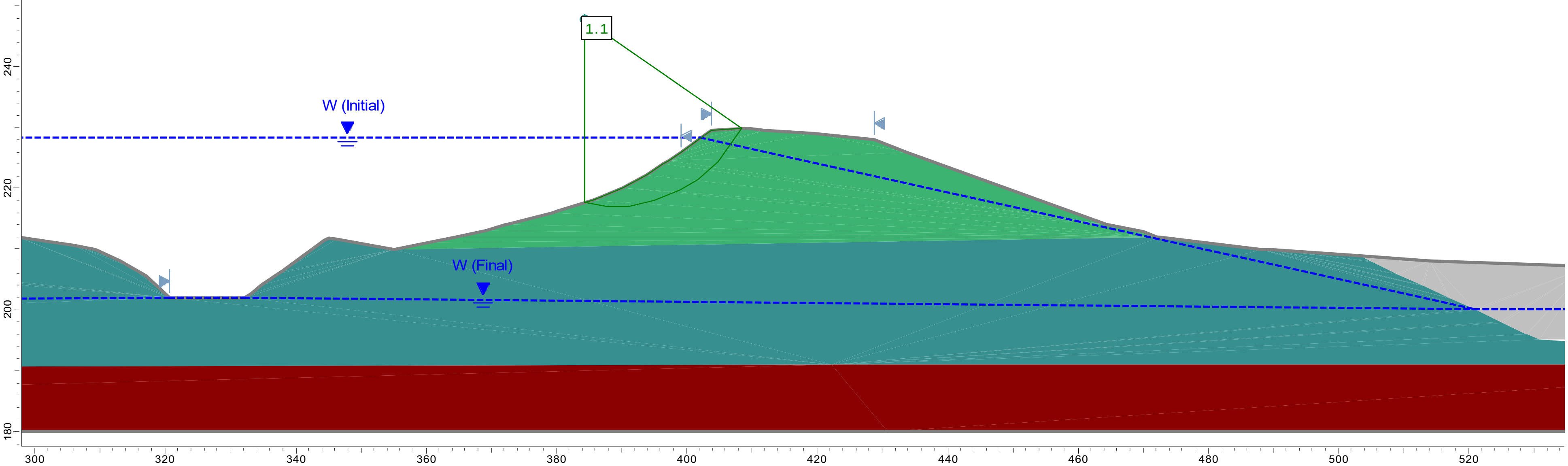
Golder Associates

PROJECT No.		15-20347	FILE No.	152034 7AD00-01 INACTIVE POND DEMON
DESIGN	LJ	03/05/2018	SCALE	AS SHOWN
CADD	RMS	03/05/2018		
CHECK	JGM	03/05/2018		1
REVIEW	GLH	03/05/2018		

G:\Plan Production Data Files\Drawing Data Files\15-20347A - Bremo Pond Closure (Conceptual Plan)\Active Drawings\Geotech Stability - 100%\152034 7AD00-01 INACTIVE POND DEMON.dwg | Layout: DWG 01 | Modified: rsalvatore 03/05/2018 3:37 PM | Plotted: rsalvatore 03/05/2018

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Rapid Drawdown (RD) Undrained Strength	RD Envelope Type	RD d (psf)	RD Psi (deg)	Water Surface	Hu Type	Hu
Uncompacted CCR		90	Mohr-Coulomb	0	28	No	Total stress R linear			Water Surface	Custom	1
Dike Fills-WAP/EAP Upper 20'		125	Mohr-Coulomb	50	31	Yes	Kc = 1 linear	147.6	24.9	Water Surface	Custom	1
Alluvium		115	Mohr-Coulomb	50	28	No	Total stress R linear			Water Surface	Custom	1
Distentegrated Rock		140	Mohr-Coulomb	1000	31	No	Total stress R linear			Water Surface	Custom	1
RR Fill		120	Mohr-Coulomb	50	28	No	Total stress R linear			Water Surface	Custom	1

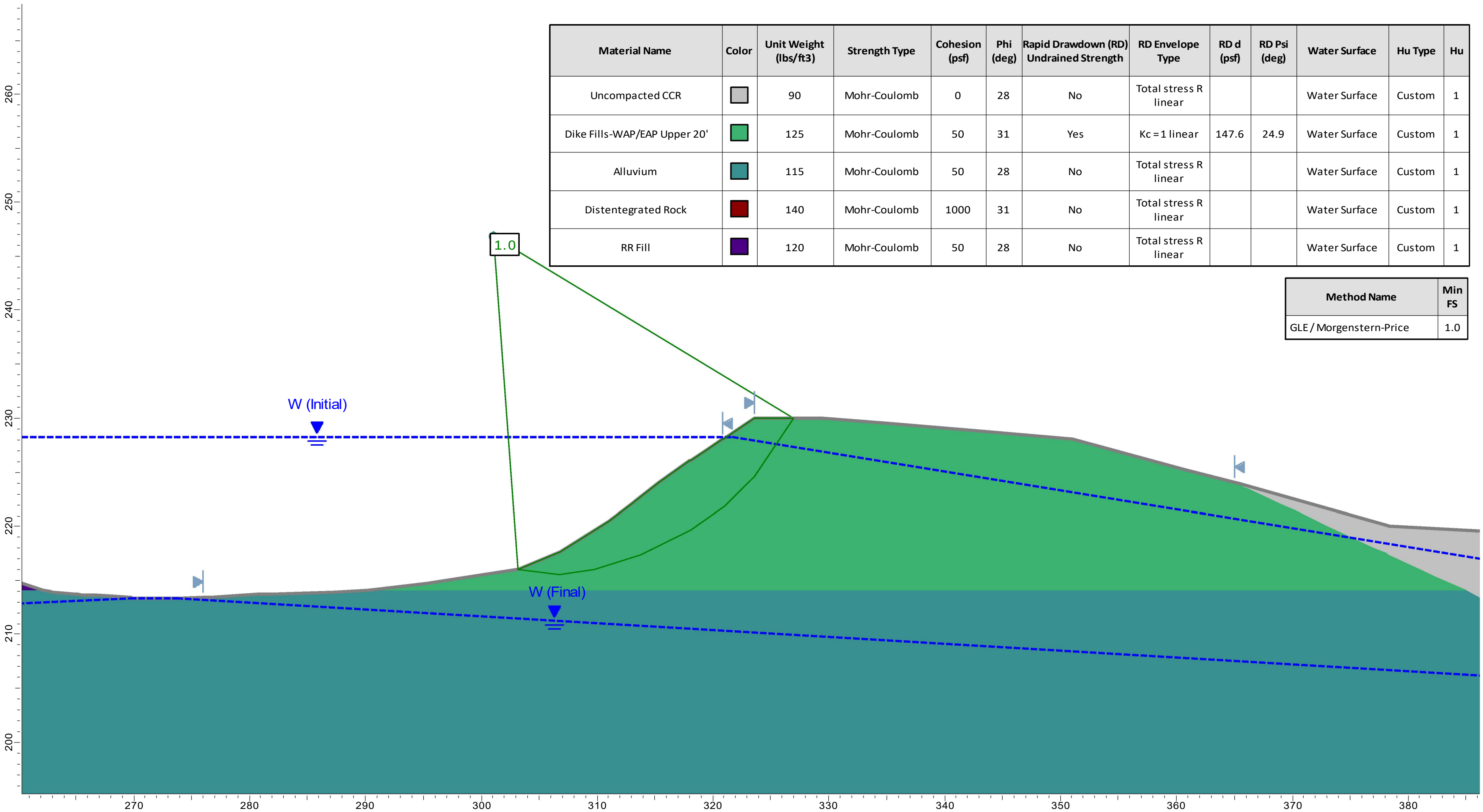
Method Name	Min FS
GLE / Morgenstern-Price	1.1



Golder Associates	SCALE: AS SHOWN	PROJECT	Bremo East Pond - Inactive Pond Demonstration
	DATE: Mar 2018	TITLE	Section A-A Rapid Drawdown
	MADE BY: LJ		
	CAD: -		
FILE: STABILITY	CHECK: JGM	CLIENT: Dominion Energy	FIGURE: 2(d)
PROJECT No. 1520347 / REV. 0	REVIEW: GLH		

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Rapid Drawdown (RD) Undrained Strength	RD Envelope Type	RD d (psf)	RD Psi (deg)	Water Surface	Hu Type	Hu
Uncompacted CCR		90	Mohr-Coulomb	0	28	No	Total stress R linear			Water Surface	Custom	1
Dike Fills-WAP/EAP Upper 20'		125	Mohr-Coulomb	50	31	Yes	Kc = 1 linear	147.6	24.9	Water Surface	Custom	1
Alluvium		115	Mohr-Coulomb	50	28	No	Total stress R linear			Water Surface	Custom	1
Distentegrated Rock		140	Mohr-Coulomb	1000	31	No	Total stress R linear			Water Surface	Custom	1
RR Fill		120	Mohr-Coulomb	50	28	No	Total stress R linear			Water Surface	Custom	1

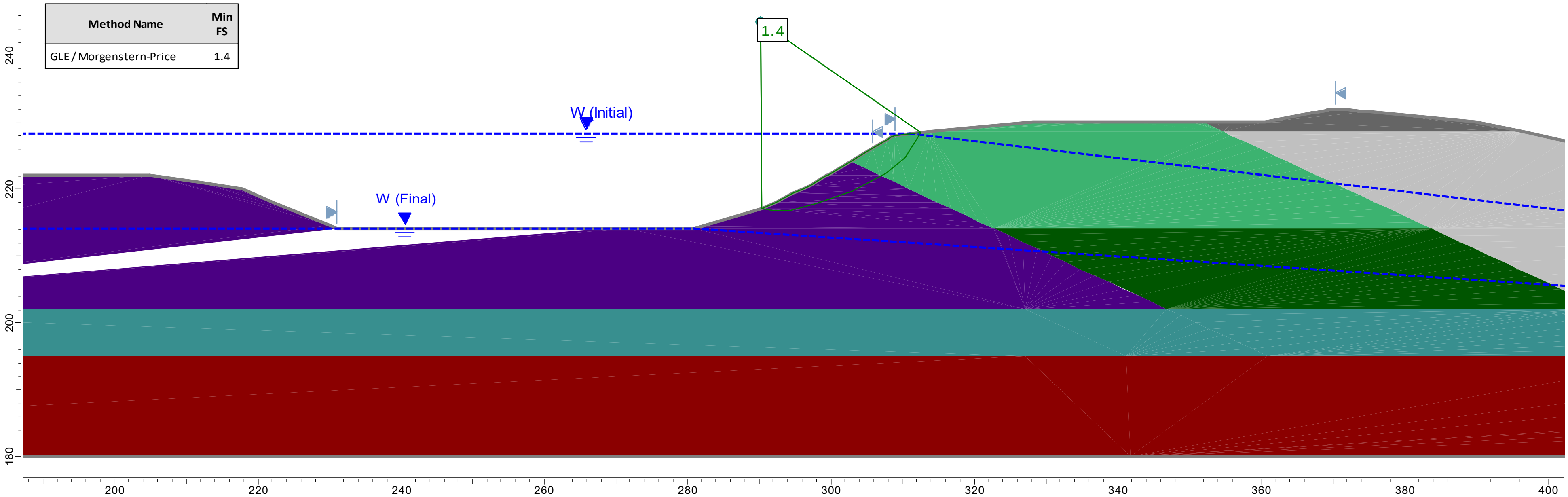
Method Name	Min FS
GLE / Morgenstern-Price	1.0



Golder Associates	SCALE AS SHOWN	PROJECT	**Bremo East Pond - Inactive Pond Demonstration**
	DATE Mar 2018	TITLE	**Section B-B Rapid Drawdown**
	MADE BY LJ		
	CAD -		
FILE STABILITY	CHECK JGM	CLIENT **Dominion Energy**	FIGURE **3(d)**
PROJECT No. 1520347 REV. 0	REVIEW GLH		

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Rapid Drawdown (RD) Undrained Strength	RD Envelope Type	RD d (psf)	RD Psi (deg)	Water Surface	Hu Type	Hu
Uncompacted CCR		90	Mohr-Coulomb	0	28	No	Total stress R linear			Water Surface	Custom	1
Compacted CCR		110	Mohr-Coulomb	0	34	No	Total stress R linear			Water Surface	Custom	1
Dike Fills-WAP/EAP Upper 20'		125	Mohr-Coulomb	50	31	Yes	Kc = 1 linear	147.6	24.9	Water Surface	Custom	1
Dike Fills-WAP/EAP Below 20'		125	Mohr-Coulomb	50	28	No	Total stress R linear			Water Surface	Custom	1
Alluvium		115	Mohr-Coulomb	50	28	No	Total stress R linear			Water Surface	Custom	1
Distentegrated Rock		140	Mohr-Coulomb	1000	31	No	Total stress R linear			Water Surface	Custom	1
RR Fill		120	Mohr-Coulomb	50	28	No	Total stress R linear			Water Surface	Custom	1

Method Name	Min FS
GLE / Morgenstern-Price	1.4



Golder Associates

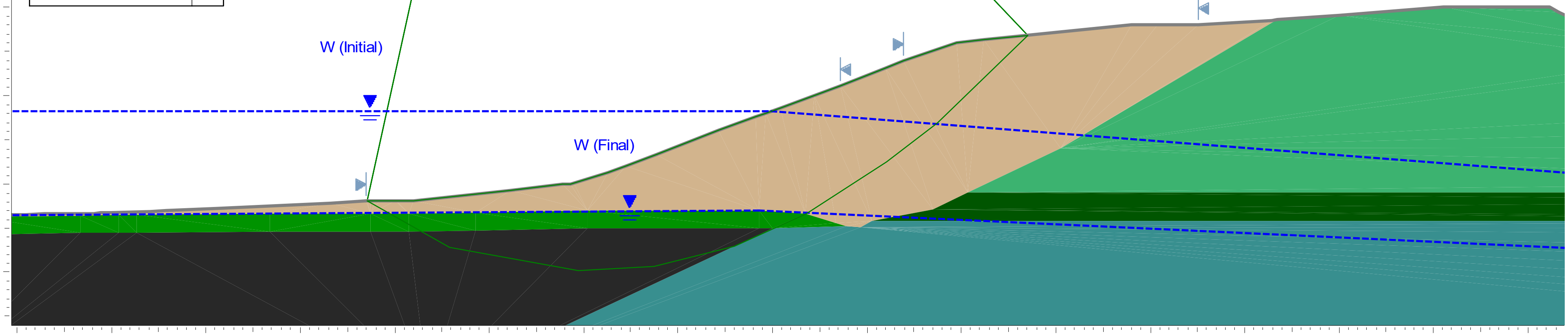
SCALE	AS SHOWN	PROJECT	Bremo East Pond - Inactive Pond Demonstration
DATE	Mar 2018	TITLE	Section C-C Rapid Drawdown
MADE BY	LJ		
CAD	-		
CHECK	JGM	CLIENT	Dominion Energy
REVIEW	GLH	FIGURE	4(d)

FILE STABILITY

PROJECT No. 1520347 REV. 0

Uncompacted CCR		90	Mohr-Coulomb	0	28	No	Total stress R linear			Water Surface	Custom	1	
Dike Fills-WAP/EAP Upper 20'		125	Mohr-Coulomb	50	31	Yes	Kc = 1 linear	147.6	24.9	Water Surface	Custom	1	
Dike Fills-WAP/EAP Below 20'		125	Mohr-Coulomb	50	28	No	Total stress R linear			Water Surface	Custom	1	
Alluvium		115	Mohr-Coulomb	50	28	No	Total stress R linear			Water Surface	Custom	1	
Distentegrated Rock		140	Mohr-Coulomb	1000	31	No	Total stress R linear			Water Surface	Custom	1	
New Fill		120	Mohr-Coulomb	50	31	No	Total stress R linear			Water Surface	Custom	1	
Liner		120	Mohr-Coulomb	50	24.5	No	Total stress R linear			Water Surface	Custom	1	
Closed Fill		90	Mohr-Coulomb	0	28	No	Total stress R linear			None			0

GLE / Morgenstern-Price	1.8



Golder Associates	SCALE: AS SHOWN	PROJECT	Bremo East Pond - Inactive Pond Demonstration
	DATE: Mar 2018	TITLE	**Section D-D** **Rapid Drawdown**
	MADE BY: LJ		
	CAD: -		
FILE: STABILITY	CHECK: JGM	CLIENT: Dominion Energy	FIGURE: 5(d)
PROJECT No. 1520347, REV. 0	REVIEW: GLH		

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