Prepared for

Dominion
5000 Dominion Boulevard
Glen Allen, Virginia 23060

COAL COMBUSTION RESIDUALS INITIAL SAFETY FACTOR ASSESSMENT

for

VIRGINIA ELECTRIC AND POWER COMPANY CHESTERFIELD POWER STATION LOWER ASH POND CHESTERFIELD COUNTY, VIRGINIA

Prepared by

9211 Arboretum Parkway, Suite 200
Richmond, Virginia 23236

MV1373
October 2016

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1. CERTIFICATION/STATEMENT OF PROFESSIONAL OPINION

The Initial Safety Factor Assessment for the Chesterfield Power Station Lower Ash Pond was prepared by Geosyntec Consultants, Inc. (Geosyntec). The Assessment was based on certain information that, other than for information Geosyntec originally prepared, Geosyntec has relied on but not independently verified. This Certification/Statement of Professional Opinion is therefore limited to the information available to Geosyntec at the time the Assessment was written. 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 the Assessment 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 Assessment was prepared consistent with the requirements of Section 257.73(e) of the United States Environmental Protection Agency's "Disposal of Coal Combustion Residuals From Electric Utilities," published in the Federal Register on April 17, 2015 with an effective date of October 19, 2015 (40 CFR 257 Subpart D).

The use of the words "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.

Geosyntec Consultants, Inc.

Scott Sheridan, P.E.
Principal

Date 10/17/2016

2. INTRODUCTION

The Chesterfield Power Station (Station) is owned by Virginia Electric and Power Company d/b/a Dominion Virginia Power (Dominion) and is located in Chesterfield County, Virginia. The Station includes the Lower Ash Pond (LAP) impoundment, which is a component of the Station's wastewater treatment system utilized to manage and settle solids, including CCRs.

The LAP is located on Dominion property at the Chesterfield Power Station in Chesterfield County, Virginia (coordinates 37.3737° North and 77.3795° West) and is bounded by the Old Channel of the James River and the Upper Pond on the south, Henricus Park Road on the east, Coxendale Road on the north, and the thermal channel to the west.

The LAP is regulated as an existing CCR surface impoundment under the Environmental Protection Agency's "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments" [40 CFR 257 Subpart D] published in the Federal Register on April 17, 2015 with an effective date of October 19, 2015 (CCR Rule).

3. PURPOSE

This Initial Safety Factor Assessment (Assessment) is prepared pursuant to § 257.73(e)(1) of the CCR Rule [40 CFR § 257.73(e)(1)].

4. FACTOR OF SAFETY ASSESSMENT REQUIREMENTS

In accordance with § 257.73(e)(1), a CCR surface impoundment owner or operator "must conduct initial and periodic safety factor assessments for each CCR unit and document whether the calculated factors of safety for each CCR unit achieve the minimum safety factor for the critical cross section of the embankment."

Furthermore, § 257.73(e)(1) requires that safety assessments be conducted for the following conditions of the impoundment and that the safety factor assessments be supported by appropriate engineering calculations:

- The calculated static factor of safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50;

- The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40;
- The calculated seismic factor of safety must equal or exceed 1.00; and
- For dikes constructed of soils that are susceptible to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.

This Assessment will document the factors of safety for the LAP as required by § 257.73(e)(1).

5. FACTOR OF SAFETY ASSESSMENT

The LAP receives CCR sluice water and other low volume wastewater streams from the Station. The western side of the LAP is operated to manage and settle solids prior to discharge of ponded surface water through the outfall structure. The LAP embankment along the western side of the pond, near the outfall, was determined to be the critical section for purposes of this Assessment. The material strength parameters used in the analyses were obtained from the *Field Investigation and Laboratory Testing Report* (Geosyntec, 2016a) which provides a compilation of historic and recent subsurface exploration and laboratory testing programs. The phreatic surface used in the analyses was dependent on the condition being assessed and is discussed for each analysis.

The factors of safety calculated for each condition are summarized in Table 1 and are summarized below.

Table 1
Calculated Factors of Safety

Factor of Safety Condition	Minimum Factor of Safety	Calculated Factor of Safety
Long-term, maximum storage pool loading	1.50	1.67
Maximum surcharge pool loading	1.40	1.44
Seismic factor of safety	1.00	1.03
Liquefaction factor of safety	1.20	1.21

Calculations results are included in Appendix A.

5.1 Critical Cross Sections

The critical cross sections are those on the western embankments (adjacent to the thermal channel) and the southern embankment. In the stability calculation package, Cross Sections B, D and E are identified as the critical cross sections: B is the critical cross section for liquefaction, D is the critical cross section for the maximum surcharge pool loading and E is the critical cross section for the drained and seismic conditions. Both cross sections have Factors of Safety within 10% of each other in all scenarios. The potential failure surfaces occur through the upper embankment and the lower embankment (Old Aiken Marsh Islet) layers, which consist of sandy silts and low and high plasticity clays; thus, these layers are considered the critical layers of the embankment.

5.2 Long-Term Maximum Storage Pool Loading Condition

According to the preamble of the CCR Rule, Section E.3.b.ii.b, the maximum storage pool loading is "the maximum water level that can be maintained that will result in full development of a steady-state seepage condition." The Rule goes on to state that "the maximum storage pool loading needs to consider a pool elevation in the CCR unit that is equivalent to the lowest elevation of the invert of the spillway, *i.e.*, the lowest overflow point of the perimeter of the embankment."

Ponded surface water from the LAP is discharged through a concrete outfall structure. The weir in the outfall structure is maintained at elevation 15.8 feet, and the normal pool elevation in the LAP is 16 feet; therefore, the long term maximum storage pool loading condition will have a phreatic surface elevation of 16 feet. The phreatic surface through the embankment is based on piezometric data collected as part of geotechnical investigations described in Geosyntec, 2016a. The thermal channel water surface varies slightly due to tidal fluctuations; however, the water surface elevation is typically 4 feet.

The calculated static factor of safety is 1.67 for the embankment and meets the requirement for the long term maximum storage pool condition (1.50).

5.3 Maximum Surcharge Pool Loading Conditions

The water elevation for the maximum surcharge pool loading condition is based on the 1,000-year flood event. Based on the design storm, the phreatic surface was modeled to be elevation 18 feet (Geosyntec, 2016b). The calculated static factor of safety is 1.44 for

the embankment and meets the requirement for the maximum surcharge pool condition (1.40).

5.4 Seismic Factor of Safety

The seismic factor of safety was analyzed with a seismic loading event with a 2% probability of exceedance in 50 years, based on United States Geological Survey (USGS) seismic hazard maps. A peak ground acceleration of 0.128g was used in the analyses (Geosyntec, 2016c).

The long term maximum storage pool loading condition was evaluated under seismic conditions. The calculated factor of safety of 1.03 for the embankment and meets the requirement for the maximum surcharge pool condition (1.00).

5.5 Liquefaction Factor of Safety

The liquefaction assessment includes an analysis of potentially liquefiable soils followed by a slope stability analysis using the residual shear strengths that result from a liquefied soil layer. Liquefaction analyses used boring logs from previous subsurface investigations and a design earthquake with a magnitude of 5.7. The calculated factor of safety of 1.21 for the soils in the embankment (Youd, 2001) meets the requirement (1.20).

6. CONCLUSION

In Geosyntec's opinion, the LAP meets or exceeds the minimum factors of safety as required by § 257.73(e)(1).

7. REFERENCES

Duncan, J.M. and Steven C. Wright (2005). "Soil Strength and Slope Stability", Hoboken, New Jersey. pp. 79.

Environmental Protection Agency (EPA) (2015). "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule. 40 CFR Parts 257 and 261: Part II. EPA–HQ–RCRA–2009– 0640; FRL–9919–44–OSWER.

Geosyntec Consultants Inc. *Field Investigation and Laboratory Testing Report, Lower Ash Pond, Chesterfield Power Station, Chesterfield County, Virginia.* 2016a.

Geosyntec Consultants Inc. *Coal Combustion Residuals Inflow Design Flood Control System Plan, Lower Ash Pond, Chesterfield Power Station, Chesterfield County, Virginia*. 2016b.

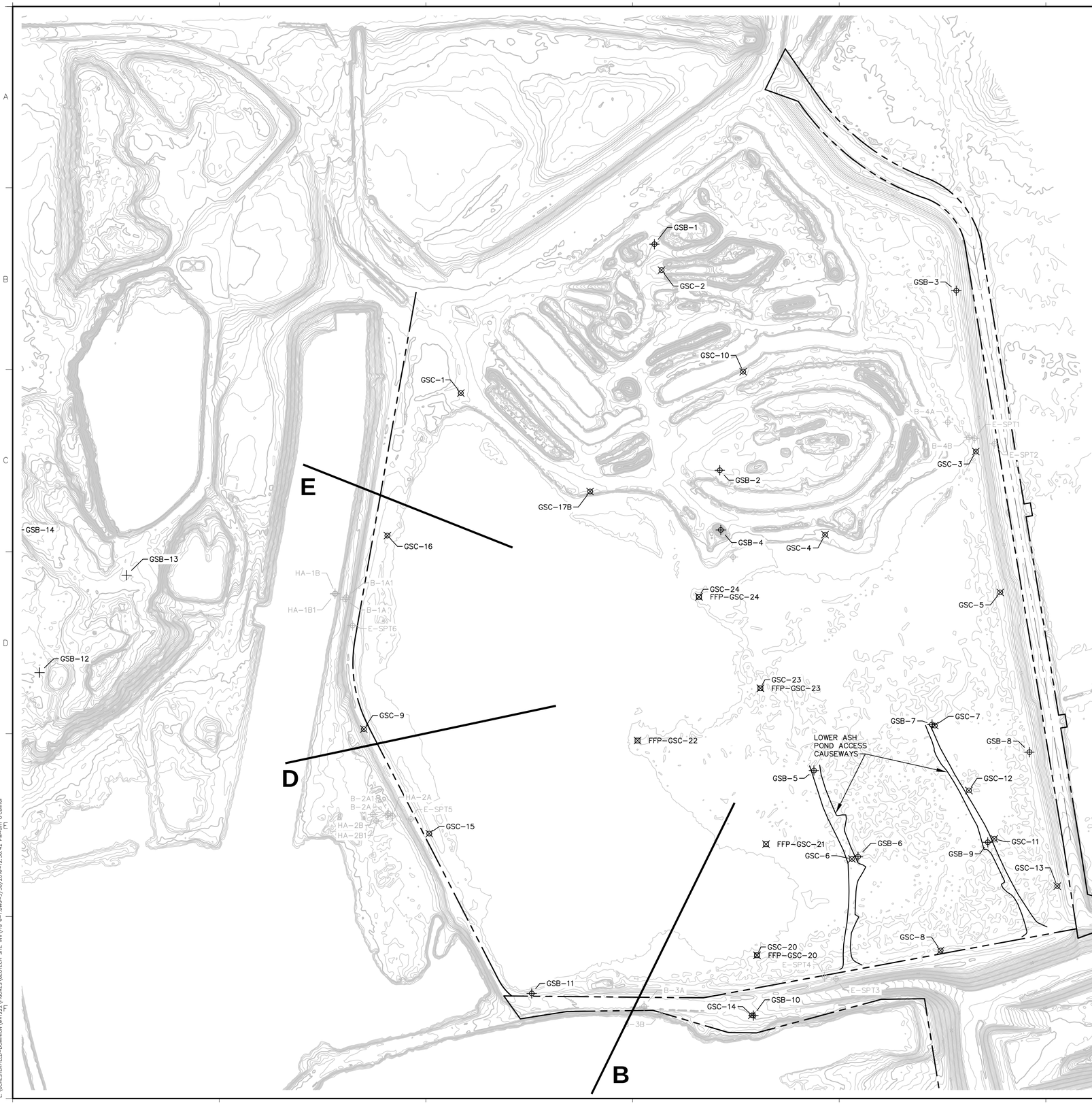
Geosyntec Consultants, 2016. *Memorandum – LAP and LVWWTS Seismic Design Data Analysis.* May 3, 2016c.

United States Environmental Protection Agency, 2015. *40 CFR Parts 257 and 261 Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule.* April 17, 2015.

Youd, T.L. *et. al.* "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils." *Journal of Geotechnical and Geoenvironmental Engineering*. October 2001: 817-833.

APPENDIX A

SLOPE STABILITY RESULTS



LEGEND

- B-1A – EXISTING SPT
- GSB-1 – AS-BUILT GEOSYNTEC LAP SPT
- GSB-12 – AS-BUILT GEOSYNTEC LVWWTS SPT
- GSC-1 – AS-BUILT GEOSYNTEC LAP CPT
- GSC-1F – AS-BUILT GEOSYNTEC LAP FFP CPT

150 0 150 300
SCALE IN FEET

REV	DATE	DESCRIPTION	DRN	APP

Geosyntec consultants
10220 OLD COLUMBIA ROAD, SUITE A
COLUMBIA, MARYLAND 21046 USA
PHONE: 410.381.4333

DOMINION VIRGINIA POWER
CHESTERFIELD POWER STATION
CHESTER, VIRGINIA

TITLE: CROSS SECTION LOCATIONS

PROJECT: LOWER ASH POND - CCR RULE REQUIREMENTS

SITE: CHESTERFIELD POWER STATION
CHESTER, VIRGINIA

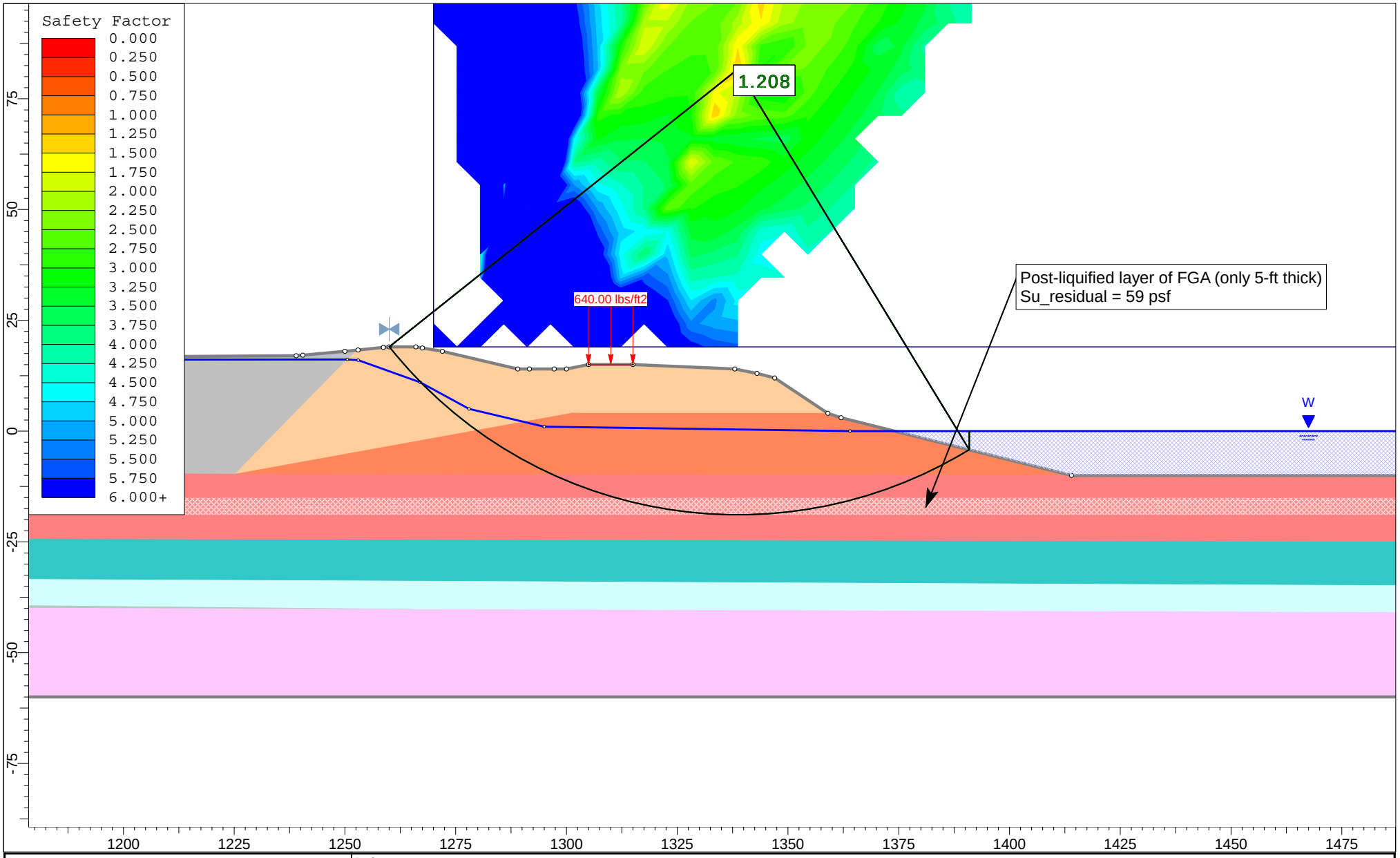
DESIGNED BY: KGW	DATE: September 2016		
DRAWN BY: JOC	PROJECT NO.: MV1373-08		
CHECKED BY: KGW	FILE:		
REVIEWED BY:			
APPROVED BY:	FIGURE NO.: 1		

SIGNATURE

L:\VChesterfield-dominion\MV1223\FIGURES\GEOTECH SITE INV\FIG 6-1.DWG-3/30/2016-12:36:42 PM-jim O'connor

L:\CHESTERFIELD-DOMINION\MV1223\FIGURES\GEOTECH SITE INV\FIG 6-1.dwg

CROSS SECTION B



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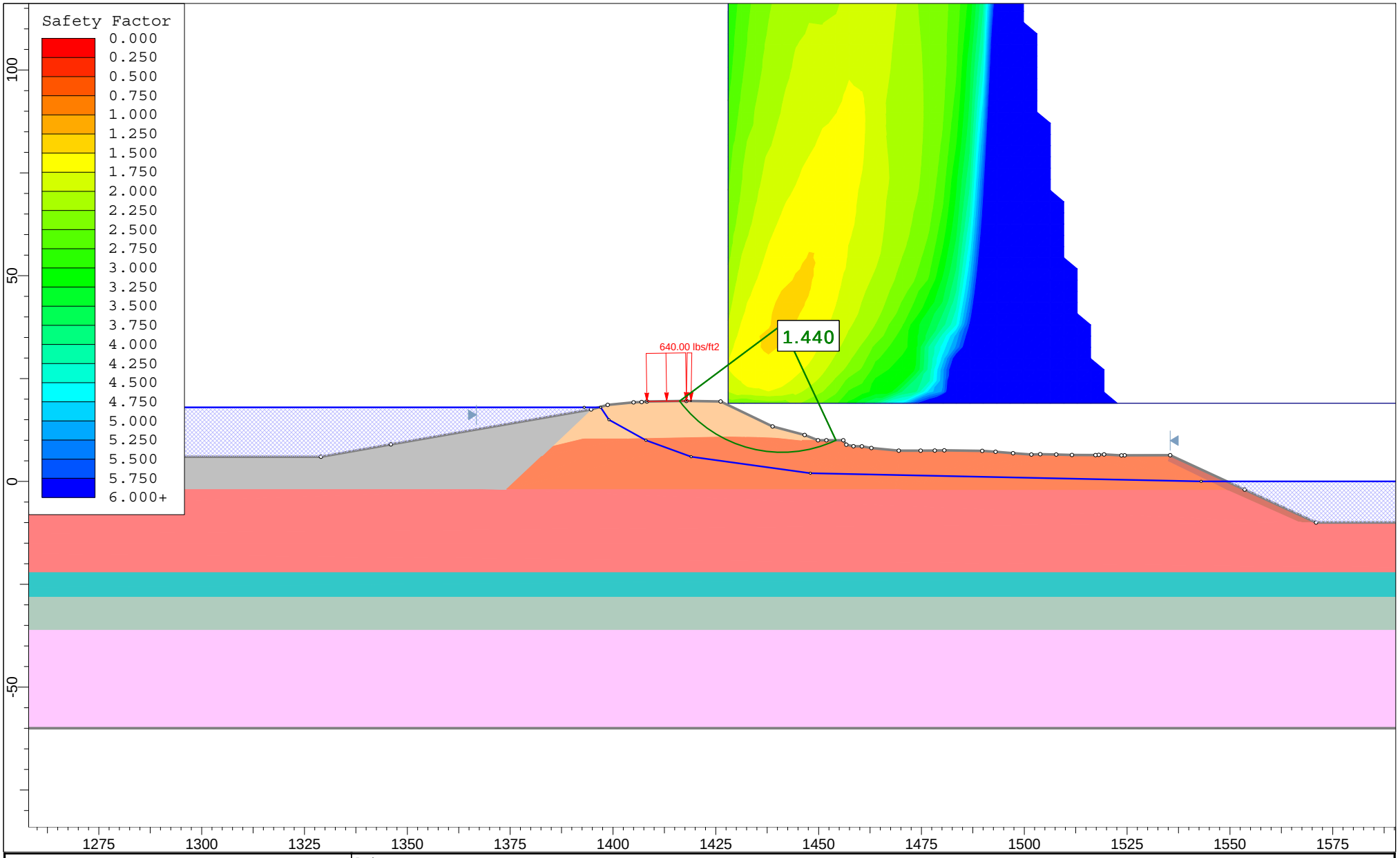
	Date	10/15/2016		File Name Cross Section B - Post Liquefaction Undrained.slim

SLIDEINTERPRET 7.017

CROSS SECTION D



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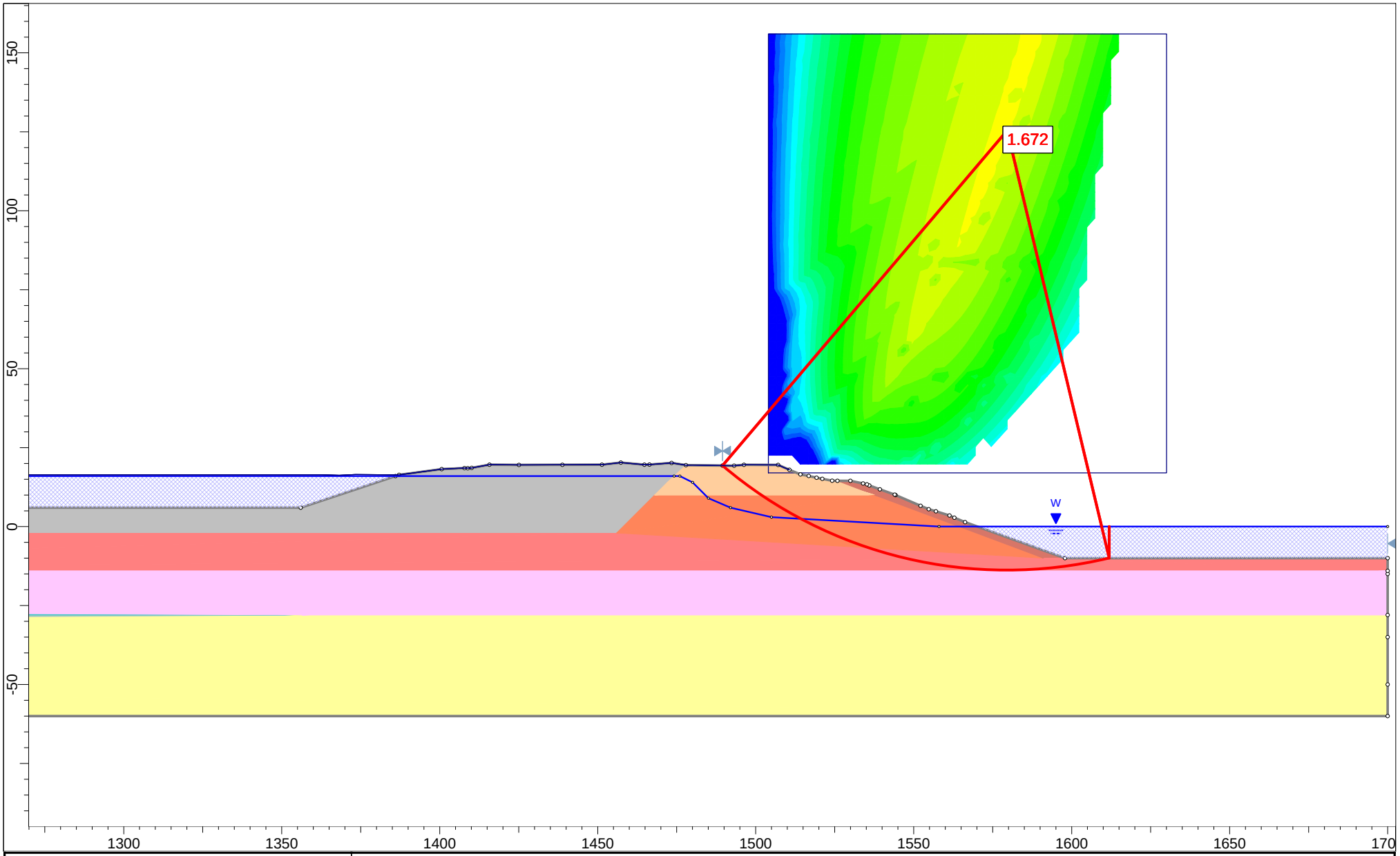
SLIDEINTERPRET 7.017

CROSS SECTION E



rocscience	Project: Chesterfield Power Station - Lower Ash Pond		
	Analysis Description: **Cross Section E - Drained**		
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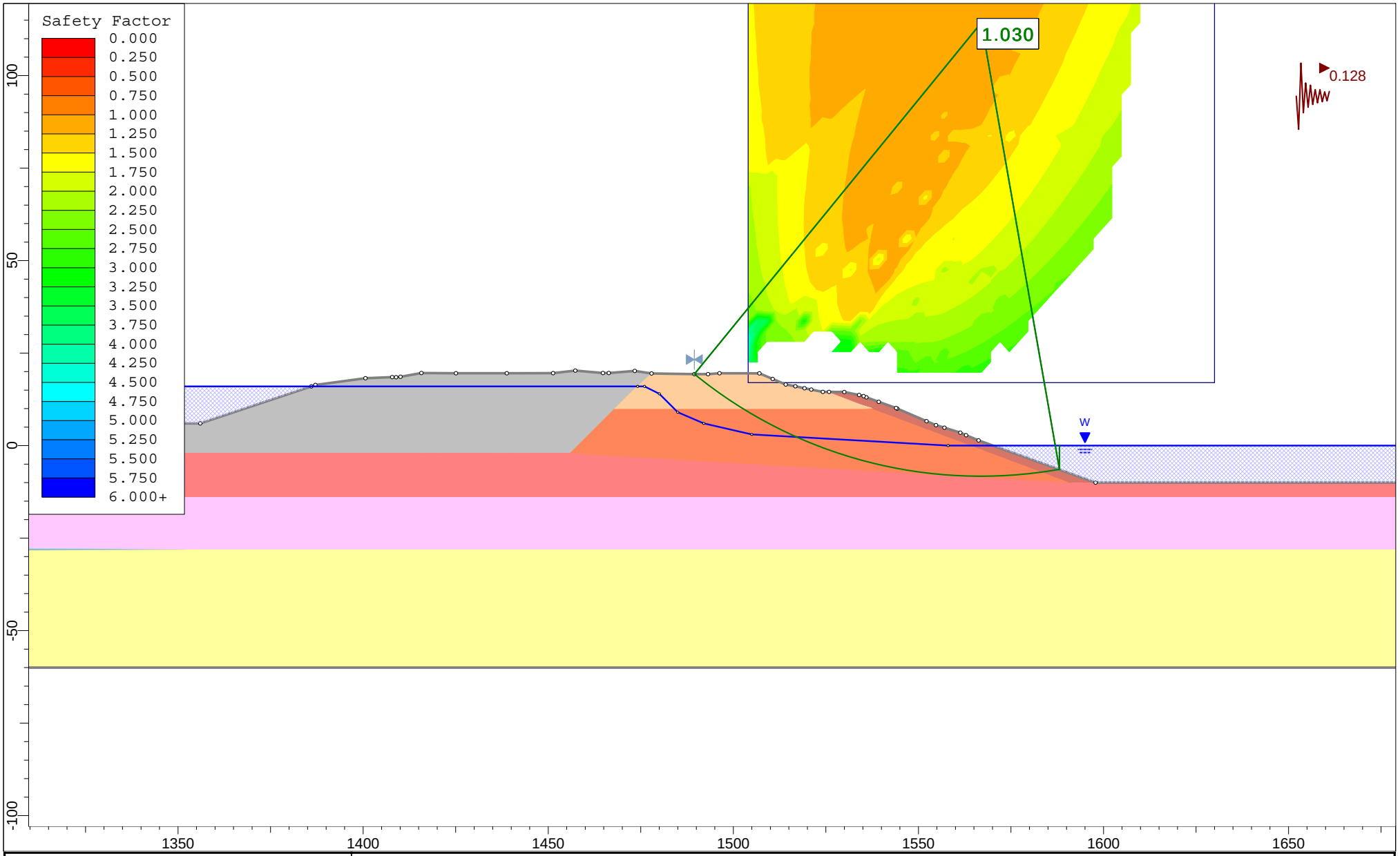
SLIDEINTERPRET 7.017



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SLIDEINTERPRET 7.017