REPORT

SAFETY FACTOR ASSESSMENT REPORT

Monticello Steam Electric Station

Submitted To: Luminant
1601 Bryan Street
Dallas, TX 75201

Submitted By: Golder Associates Inc.
500 Century Plaza Drive, Suite 190
Houston, TX 77073 USA

10/10/16

STATE OF TEXAS
JEFFREY B. FASSETT
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Registration Number F-2578

October 2016 **Project No. 164816403**

Golder Associates

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1.0 INTRODUCTION

1.1 Purpose

The “Disposal of Coal Combustion Residuals (CCR) from Electric Utilities rule” (40 Code of Federal Regulations (40 CFR) Part 257), effective October 19, 2015, requires that existing CCR surface impoundments meeting the requirements of §257.73(b) conduct initial and periodic safety factor assessments in accordance with §257.73(e). This letter provides the safety factor assessments for the Monticello Steam Electric Station’s (MOSES’s) CCR Impoundments, identified as the Bottom Ash Ponds (BAPs) – the Southwest Ash Settling Pond (SASP), the West Ash Settling Pond (WASP), and the Northeast Ash Water Retention Pond (NAWRP).

1.2 Site Background

The MOSES generates bottom ash, fly ash, boiler slag, and scrubber gypsum during electricity generation. The following surface impoundments, collectively referred to as the Bottom Ash Ponds (BAPs), shown on Figure 1, are in operation at the MOSES:

- Southwest Ash Settling Pond (SASP);
- West Ash Settling Pond (WASP); and
- Northeast Ash Water Retention Pond (NAWRP).

Each of these ponds are active, clay-lined, excavated impoundments surrounded and separated by engineered earthen berms. The WASP and NAWRP receive a slurry of bottom ash/boiler slag and water from the dewatering bins through two sets of pipes entering above the crest of the northern embankment. The WASP and NAWRP are used to separate the solids from the water using gravity sedimentation. A set of pipes pass above the crest near the northwestern corner of the SASP; however, these pipes are blanked off and have reportedly never been put into service. The SASP, connected to the WASP with two weirs, is used for overflow from the other two ponds. Water decanted from the WASP and the SASP ponds is returned to the power plant via the Low Pressure Ash Water (LPAW) pump station.

Four other surface impoundments are present at MOSES: the Rubber-lined Pond, (previously referred to as the scrubber pond), the North Operating Pond, the Low Volume Waste Pond, and the Runoff Collection Pond (RCP) which is located in the southeastern quadrant of the BAP area. The RCP collects stormwater runoff from the facility and is not hydraulically connected to the BAPs. These ponds are not subject to the CCR Rule.

1.3 Previous Slope Stability Evaluations

Golder performed previous evaluations on the BAPs as part of the reports listed below:

- Ash and Scrubber Pond Stability Investigation Report, Luminant Monticello SES, Titus County, Texas, dated December 2012
- Addendum to Ash and Scrubber Pond Stability Investigation Report, Luminant Monticello Power Plant, Titus County, Texas, dated March 2014.

These studies found the pond slopes to be adequately stable.

2.0 SUBSURFACE CONDITIONS

The MOSES site is located in the West Gulf Coastal Plain subprovince, in Titus County, Texas. The primary rock units in the region comprise sedimentary rocks of the Mesozoic and Cenozoic eras. The principal geologic unit in the region of the site is the Wilcox Group which is composed of interbedded sand, silt, silty shale, clay and lignite (Cook-Joyce Inc., 1985). The surficial soils of comprise of moderately well-drained to poorly drained loamy soils (USDA, 1990).

2.1 Site Geology

2.1.1 Subsurface Investigations and Laboratory Testing

Information from previous subsurface investigations was used to characterize the subsurface site conditions. Golder conducted a subsurface investigation for the surface impoundments in December 2012. Golder completed eight borings within the pond footprints with boring depths of 50 feet below ground surface (bgs). The boring map and select, representative boring logs are included in Appendix A.

As part of the investigation, laboratory testing was performed on selected samples, in accordance with commonly accepted methods and practices. Undisturbed and disturbed soil samples were tested to determine water content, Atterberg limits, grain size distribution, and shear strength. Water content determination was performed in accordance with ASTM D2216; Atterberg limits were determined in accordance with ASTM D4318; and grain size distribution was performed in accordance with ASTM D422. Shear strength testing consisted of unconsolidated-undrained (UU) and consolidated-undrained (CU) triaxial compression tests in general accordance with ASTM D2850 and D4767, respectively. Laboratory test results are presented in Appendix B. The test results can be found in Appendix C.

The findings from the above subsurface investigations were reviewed for their applicability to this study, and are summarized in the following sections.

2.1.2 Subsurface Site Conditions

All eight borings of the subsurface investigation, were drilled along the crest of the BAPs embankments at approximate elevation 386.5 feet mean sea level (ft-msl). Hence, the borings consisted of fill and native soils. The soils encountered in the borings generally consisted of stiff to hard sandy clays and compact to dense sands. The subsurface stratigraphy generally consisted of interchanging layers of clayey sand and sandy clay. The clayey sand layers ranged in thickness from 2 to 20 feet where encountered. The sandy clay and clay layers varied in thickness from 2 to 33 feet where encountered. Four of the borings terminated in a sandy clay/clayey sand layer, while a layer of compact to dense, silty or poorly graded sand was encountered beneath the sandy clay/clayey sand layers in four borings.

Water was encountered in each of the eight borings. Water elevations encountered during drilling ranged from EL 352.1 to 375.05 ft-msl with an average of El. 358.5 ft-msl.

Groundwater levels measured in 2015, from wells surrounding the BAPs, indicate that the groundwater level varies from approximately EL 364 ft-msl in the southeast corner to EL 358 ft-msl in the northwest corner.

3.0 STABILITY ANALYSIS - §257.73(e)

3.1 Safety Factor Assessment

According to the CCR rules, structural stability factors of safety need to be evaluated for the critical cross-section of each CCR facility under static and seismic loading for "Maximum Storage Pool" (3.5 feet of freeboard for this facility) and "Maximum Surcharge Pool" (no freeboard) conditions. Liquefaction potential analysis is only necessary when soil sampling, construction documentation or anecdotal evidence from personnel with knowledge about the facility, indicates that soils of the embankment are susceptible to liquefaction.

Slope stability analyses were performed using a limit-equilibrium-based commercial computer program, Slide v7.0 by Rocscience. The analyses used a searching routine to identify the potential failure surface with minimum factor of safety for a given set of geometry, ground and groundwater conditions. The Spencer method of analysis was used in the analyses, while the Morgenstern-Price method was used for verification. The factors of safety of numerous potential failure surfaces were computed to establish minimum factors of safety. Circular failure surfaces were considered for all cases. Stability analyses were performed for "Maximum Storage Pool" (freeboard of 3.5 feet) and "Maximum Surcharge Pool" (no freeboard) conditions for both the interior and exterior slopes of the ponds. In addition, the interior slopes were analyzed while the pond is empty. For each case, respective slopes were analyzed for both static and seismic loading conditions. The interior berms separating individual ponds were not analyzed since the failure of the interior berms will not result in any release of CCR materials beyond the embankment surrounding the BAPs.

3.2 Cross-Sections Analyzed

The BAPs (SASP, WASP and NAWRP) are contiguous ponds surrounded by a continuous embankment that was built using the same site soils. Hence, the embankment is considered as one structure and a critical cross-section was identified after considering multiple cross-sections across the entire embankment. The geometry of the slopes, soil profile, loading conditions and phreatic surface of each segment of the embankment were evaluated in identifying the critical cross-section. Cross-section A-A', located near the northwestern corner of the BAPs as shown on Figure 2, was identified as the critical cross-section for the BAPs and was selected for evaluation of factors of safety under the loading conditions identified in §257.74(e)(1)(i) - (iv).

3.3 Material Properties

Based on the previous subsurface investigations, appropriate material properties were selected for use in the stability analysis. Wright (2005) provides empirical correlations to estimate the drained peak friction angle of clays based on the Atterberg limits. A friction angle of 24° is estimated based on the Atterberg limits for the first soil layer comprising fat clay (mostly from the clay liner), at Section A-A'. For the succeeding sandy clay/clayey sand layer, the friction angle is estimated from the Atterberg limits to be at least 30°, using samples from boreholes close to Section A-A'. Consolidated-undrained (CU) triaxial testing was also performed on two samples from this soil layer. CU triaxial testing is ideally performed on each sample interval at a minimum of three different confining stresses to determine a shear strength envelope. Due to lack of available sample material, two samples from different depths were tested using different confining stresses. The CU results indicate a fiction angle of 31° and a cohesion of 500 psf. Based on the Atterberg limits and CU test results, a drained shear strength envelope of 30° and 500 psf was assigned to this material. A friction angle of 32° was assumed for the silty sand layer based on the grain size distribution and SPT blow counts. Table 1 summarizes the material properties used in the stability analysis.

Table 1: Soil Properties for Section A-A'

Soil Material	Description	Moist Unit Weight (lb/ft^3)	Saturated Unit Weight (lb/ft^3)	Drained Soil Properties	
				Cohesion, c' (lb/ft^2)	Friction Angle, ϕ' (°)
I	Fat Clay	105	110	0	24
II	Sandy Clay/Clayey Sand	127	132	500	30
III	Silty Sand	127	132	0	32

3.4 Phreatic Surface

For the stability analysis of both the interior and exterior embankment slope, the location of the phreatic surface is estimated by allowing steady state seepage conditions to develop based on the water level in the BAPs. The groundwater level is modeled at EL 358 ft-msl as measured in wells near the northwest corner of the BAPs (i.e. at Section A-A'.

Note that the phreatic surface elevations were conservatively assumed for stability analysis purposes -- they do not represent the elevation of the uppermost aquifer.

3.5 Seismic Loading

Based on the "US Seismic Hazard 2014 Map" prepared by the United States Geologic Survey (USGS) and the "2008 Interactive Deaggregations" (USGS), the peak ground acceleration (PGA) for a 2% probability of exceedance in 50 years (return period of 2,475 years) is 0.09g for the site location (including amplification factors for site soil conditions). Hence, a horizontal seismic load coefficient of 0.09g was used in the pseudostatic analysis.

3.6 Liquefaction Potential

Soil liquefaction describes a phenomenon whereby a saturated or partially saturated soil substantially loses strength and stiffness in response to an applied stress, usually earthquake shaking or other sudden change in stress condition, causing it to behave like a liquid. The phenomenon is most often observed in saturated, loose (low density or uncompacted), sandy soils. The embankment soils of the BAPs are all composed of clayey materials with significant fines content. The immediate foundation materials are also composed of soils containing a significant portion of fines, and are as well considerably dense. The subsurface investigations do not indicate the presence of any soils in the embankment or its foundation that are susceptible to liquefaction. Hence, failure of the pond slopes due to liquefaction is considered unlikely for the CCR surface impoundments at the MOSES.

3.7 Stability Analysis Results

Slope stability analyses were performed for long-term conditions for each of the critical cross-sections considered under static and seismic loading conditions. Both interior and exterior slopes were analyzed for “Maximum Storage Pool” (3.5 feet of freeboard) and “Maximum Surcharge Pool” (no freeboard) conditions. The interior slopes were analyzed for the condition where the pond is empty. The results of the slope stability analyses cases are presented in Table 5. The corresponding analysis outputs can be found in Appendix D. The results indicate that the pond slopes are sufficiently stable under all considered loading scenarios.

Table 2: Slope Stability Analysis Results

Cross-Section	Case #	Slope Location	Pond Pool level	Loading Condition	Req’d Safety Factor (1)	Calculated Safety Factor
A-A'	1a	Exterior	Storage	Static	1.50	1.70
	1b			Pseudostatic	1.00	1.34
	2a		Surcharge	Static	1.40	1.55
	2b			Pseudostatic	1.00	1.21
	3a	Interior	Storage	Static	1.50	3.71
	3b			Pseudostatic	1.00	2.37
	4a		Surcharge	Static	1.40	3.98
	4b			Pseudostatic	1.00	2.46
	5a		Empty	Static	1.50	2.82
	5b			Pseudostatic	1.00	2.15

Note: (1) Required safety factors per §257.73(e)(i)-(iii)

4.0 CONCLUSION

Based on our review of the information provided by Luminant, on information prepared by Golder Associates Inc., and on our analyses, the calculated factors of safety through the critical cross section in the surface impoundments exceed the values listed in §257.73(e)(1)(i)-(iv).

Golder appreciates the opportunity to assist Luminant with this project. If you have any questions, or require further assistance from Golder, please contact the undersigned at (281) 821-6868.

GOLDER ASSOCIATES INC.

Varenya Kumar
Staff Engineer

Jeffrey B. Fassett, PE
Associate Geotechnical Engineer

VK/JBF

5.0 CERTIFICATION

I hereby certify that this report has been prepared in general accordance with normally accepted civil engineering practices and in accordance with the requirements of 40 CFR 257.73(e).

10/10/16

Jeffrey B. Fassett, PE
Golder Associates Inc.
Firm Registration Number F-2578

6.0 REFERENCES

Cook-Joyce Inc. 1985, Geologic Investigation of the Monticello Steam Electric Station "West" Bottom Ash Pond.

Golder Associates Inc. 2012, Ash and Scrubber Pond Stability Investigation Report, Luminant Monticello SES, Titus County, Texas.

Golder Associates Inc. 2014, Addendum to Ash and Scrubber Pond Stability Investigation Report, Luminant Monticello Power Plant, Titus County, Texas.

Pastor, Behling & Wheeler, LLC, 2015. Annual Surface Impoundment Inspection Report. Luminant – Monticello Steam Electric Station, Bottom Ash Ponds, Titus County, Texas.

United States Department of Agriculture, Soil Conservation Service, 1990. Soil Survey of Camp, Franklin, Morris and Titus Counties, Texas.

REFERENCE(S)
AERIAL PHOTO SOURCED FROM GOOGLE EARTH PRO DATED 2015

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Professional Engineering Firm
Registration Number F-2578

0 300 600
1" = 600' FEET

CLIENT
LUMINANT POWER
MONTICELLO

CONSULTANT

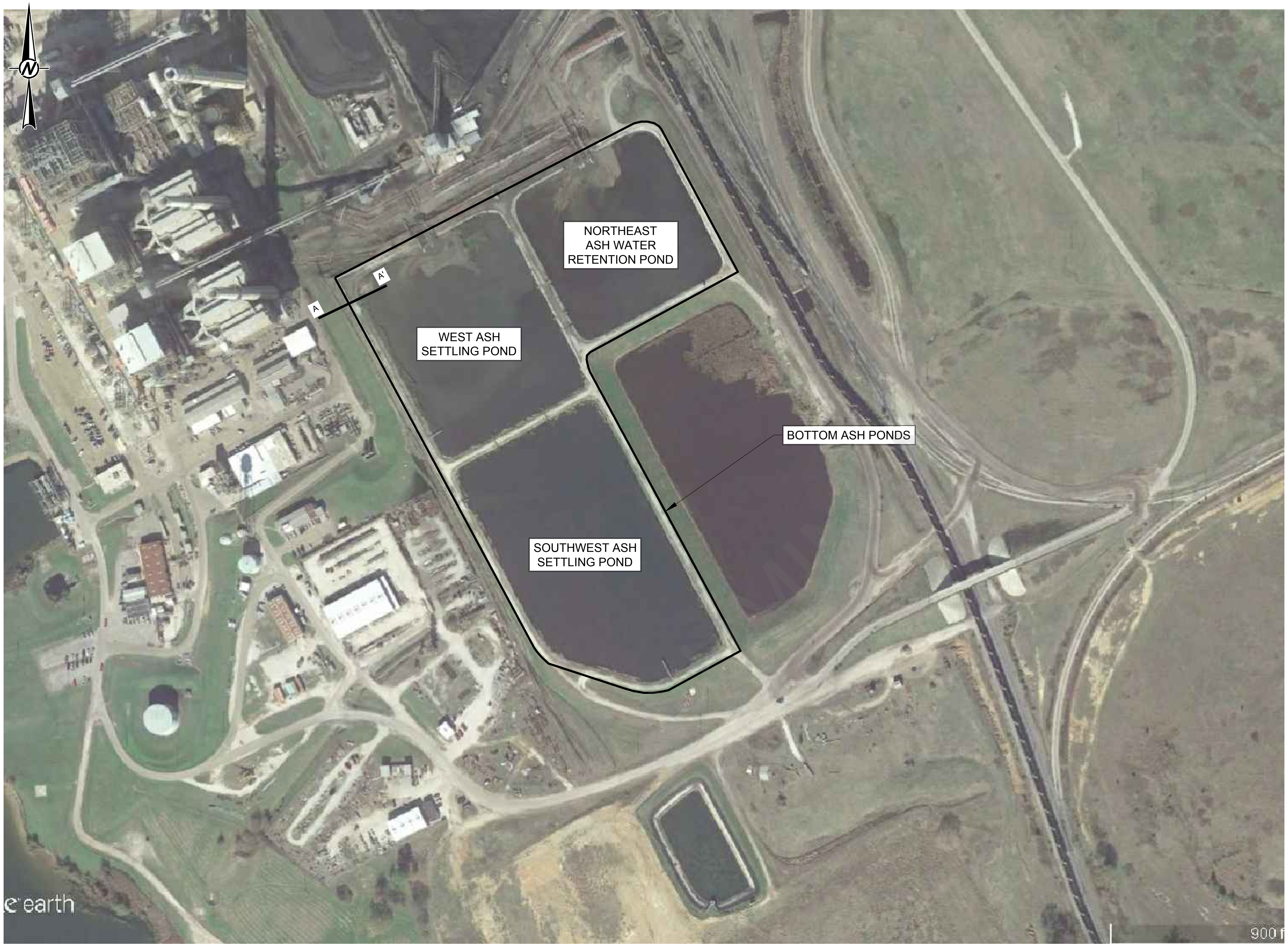
Golder Associates

YYYY-MM-DD	2016-09-26
DESIGNED	VK
PREPARED	TNB
REVIEWED	MX
APPROVED	JBF

PROJECT
2016 COAL COMBUSTION RESIDUALS
ENGINEERING SERVICES

TITLE
GENERAL SITE MAP

PROJECT NO.	REV.	FIGURE
164816403	----	1



REFERENCE(S)
AERIAL PHOTO SOURCED FROM GOOGLE EARTH PRO DATED 2015

10/10/16

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0 150 300
1" = 300' FEET

CLIENT
LUMINANT POWER
MONTICELLO

PROJECT
2016 COAL COMBUSTION RESIDUALS
ENGINEERING SERVICES

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-26
DESIGNED	VK
PREPARED	TNB
REVIEWED	MX
APPROVED	JBF

TITLE
CROSS SECTIONS FOR STABILITY

PROJECT NO.	REV.	FIGURE
164816403		2

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

APPENDIX A
BORING LOCATION MAP & BORING LOGS

LEGEND

BH-101 BORING LOCATION

REFERENCE

1.) AERIAL SHOWN LICENSED FROM GOOGLE EARTH PROFESSIONAL.

300 0 300

SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT

LUMINANT - MONTICELLO
ASH □ SCRUBBER SLOPE STABILITY INVESTIGATION REPORT
TITUS COUNTY, TEXAS

TITLE

BORING LOCATIONS

Golder Associates
Mt. Laurel, New Jersey
NJ Authorization #24GA28029100

PROJECT No.	123-94128		FILE No.	12394128A001
DESIGN	MGP	11/21/12	SCALE AS SHOWN	REV. 0
CADD	RG	11/21/12		
CHECK	MGP	11/21/12	**FIGURE 1**	
REVIEW	PCM	11/21/12		

Drawing file: 12394128A001.dwg Dec 04, 2012 - 1:42pm

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BORING NUMBER BH-101

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Monticello
DATE STARTED 10/22/12 **COMPLETED** 10/22/12
GROUND ELEVATION 386.5 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 11.45 ft / Elev 375.05 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
0		(CL) SANDY CLAY, low plasticity, some to little silt, tan and gray, dry, firm	SH 1	54		3.5		
			SH 2	54		3.25		
5		medium to low plasticity, dark gray sandy gravel seam at 4.0'	SH 3	56		4.0		
			SH 4	88		2.25		
		(SC) CLAYEY SAND, fine, uniform graded, subrounded, some silt, red and brown, dry	SH 5	75		3.0		
10		▽						
		(CL) SANDY CLAY, some to little silt, red and gray, mottled, moist, firm	SH 6	54		3.5		
15								
		medium plasticity at 18.0'	SH 7	63		2.0		
20								
		dark gray clayey sand seam, stiff to hard at 23.0'	SH 8	54		4.75		
25								
		(CH) Fat CLAY, grading to a sandy clay, some silt, red and gray, mottled, hard to stiff, moist	SH 9	58		2.0		
30								
		(CL) SANDY CLAY, fine, tan and brown, moist	SH 10	71		5.0		
35								

(Continued Next Page)

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BORING NUMBER BH-101

CLIENT Luminant **PROJECT NAME** Pond Slope Stability
PROJECT NUMBER 123-94128 **PROJECT LOCATION** Monticello

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
35		(CL) SANDY CLAY, fine, tan and brown, moist *(continued)*						
		(SC) CLAYEY SAND, low plasticity, some silt, brown and gray, moist	SH 11	63		2.5		
40								
		high plasticity clay seams, wet at 43.0'	SH 12	67		4.75		
45								
		decreased clay content at 48.0'	SH 13	75		1.0		
50								

Bottom of borehole at 50.0 feet.

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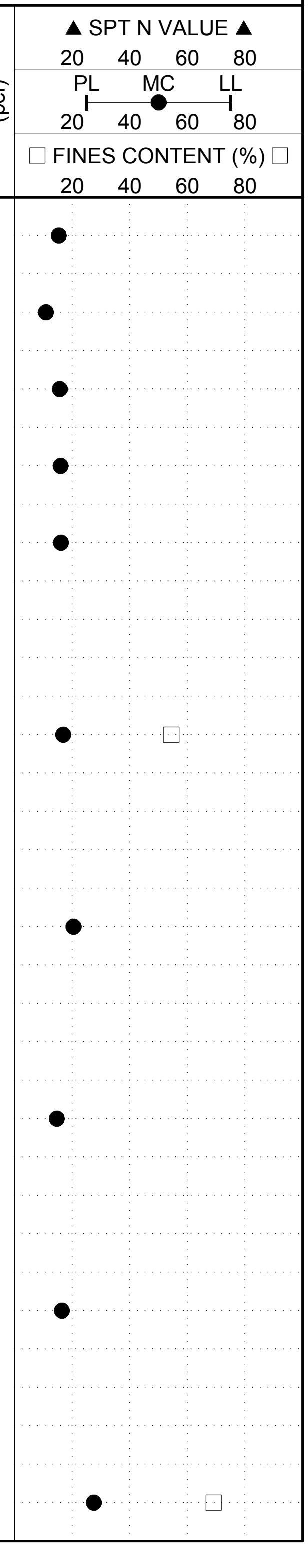
BORING NUMBER BH-102

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Monticello
DATE STARTED 10/22/12 **COMPLETED** 10/22/12
GROUND ELEVATION 386.5 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
∇ **AT TIME OF DRILLING** 31.20 ft / Elev 355.30 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(SC) CLAYEY SAND, fine sand, low plasticity clay, little organics, dark brown, dry	SH 1	56		5.0	
	subangular grains, some silt, little gravel, dark brown and tan at 2.0'	SH 2	33		5.0	
	low plasticity, red and brown at 4.0'	SH 3	42		5.0	
5	high plasticity, 3" clay seam, soft at 6.0'	SH 4	50		5.0	
	grading to sandy clay, tan and gray, mottled, stiff to hard at 8.0'	SH 5	63		3.5	
10						
	(CL) SANDY CLAY, find sand, low plasticity clay, tan and gray, very stiff	SH 6	50		3.5	
15	(SC) CLAYEY SAND, fine sand, low plasticity clays					
	red and gray, mottled, moist at 18.0'	SH 7	58		5.0	
20						
		SH 8	58		3.25	
25						
	decreased clay content, tan and brown at 28.0'	SH 9	58		3.5	
30	∇					
35	(CL) SANDY CLAY, fine, subangular, trace silt, gray and tan, moist, stiff to very stiff	SH 10	73		2.0	



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BORING NUMBER BH-102

CLIENT Luminant **PROJECT NAME** Pond Slope Stability

PROJECT NUMBER 123-94128 **PROJECT LOCATION** Monticello

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
35		(CL) SANDY CLAY, fine, subangular, trace silt, gray and tan, moist, stiff to very stiff *(continued)*						
			SH 11	58		2.0		●
40								
		wet at 43.0'	SH 12	75		0.5		●
45								
		(SC) CLAYEY SAND, fine, subangular, some clay seams, dark gray, wet	SH 13	65		3.5		●
50								

Bottom of borehole at 50.0 feet.

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BORING NUMBER BH-103

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Monticello
DATE STARTED 10/22/12 **COMPLETED** 10/22/12
GROUND ELEVATION 386.5 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 26.30 ft / Elev 360.20 ft no reading, cave in at 26
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	Roadway gravel removed					
	(CL) LEAN CLAY, low plasticity, some fine sand, tan and gray, dry, hard	SH 1	50		5.0	
		SH 2	65		5.0	
5	medium plasticity, sand and gravel seam, white at 4.0'	SH 3	65		5.0	
	(CL) SANDY CLAY, fine, subangular, low plasticity, brown and red, dry, hard	SH 4	63		4.0	
10		SH 5	50		5.0	
15	(SC) CLAYEY SAND, fine, subangular, low plasticity, little silt, gray and red, moist	SH 6	71		4.0	
20	(CH) SANDY CLAY, medium to high plasticity, gray and red, moist, hard	SH 7	50		4.5	
25	(SM) SILTY SAND, fine, sub angular, some clay, orange and tan, moist	SH 8	42			
	▽	SS 9	71	6-6-7 (13)		
30		SH 10	0			
	wet, compact at 30.0'	SS 11	100	7-5-6 (11)		
35	medium to fine at 33.0'	SS 12	100	4-9-19 (28)		

▲ SPT N VALUE ▲ 20 40 60 80
PL MC LL 20 40 60 80
□ FINES CONTENT (%) □ 20 40 60 80

(Continued Next Page)

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BORING NUMBER BH-103

CLIENT Luminant **PROJECT NAME** Pond Slope Stability

PROJECT NUMBER 123-94128 **PROJECT LOCATION** Monticello

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / □ FINES CONTENT (%) □ 20 40 60 80
35		(SM) SILTY SAND, fine, sub angular, some clay, orange and tan, moist *(continued)*						
		(SM) SILTY SAND, fine, little clay, gray and red, wet, compact	SS 13	89	4-7-10 (17)			▲ ●
40								
		some oxidation at 43.0'	SS 14	100	4-8-13 (21)			▲ ● □
45								
50			SS 15	94	6-9-12 (21)			▲●

Bottom of borehole at 50.0 feet.

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BORING NUMBER BH-104

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Monticello
DATE STARTED 10/23/12 **COMPLETED** 10/23/12
GROUND ELEVATION 386.5 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 25.20 ft / Elev 361.30 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	Remove gravel from road before drilling					
	(CL) LEAN CLAY, low plasticity, little to trace sand, brown and gray, dry, hard	SH 1	33		5.0	
		SH 2	40		5.0	
5	high plastic (CH), soft at 4.0'	SH 3	46		1.25	
	(CL) SANDY CLAY, low plasticity, some to little silt, red and gray, hard, dry at 6.0'	SH 4			1.0	
10	hard to stiff at 8.0'	SH 5	46		3.25	
15	(SC) CLAYEY SAND, fine, subangular, brown, moist	SH 6	46			
20	(CH) SANDY CLAY, fine, subangular, medium to high plasticity, red and gray, moist, hard	SH 7			4.5	
25	little silt, moist, soft at 23.0' ▽	SH 8	67		1.5	
30	(SC) CLAYEY SAND, fine, subangluar, low plasticity, red and gray, mottled, wet	SH 9	71		1.5	
35	(SP) SAND, fine, poorly graded, trace silt and clay, gray and red, wet, compact	SS 10	94	6-8-11 (19)		

▲ SPT N VALUE ▲ 20 40 60 80
PL MC LL 20 40 60 80
☐ FINES CONTENT (%) ☐ 20 40 60 80

(Continued Next Page)

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BORING NUMBER BH-104

CLIENT Luminant **PROJECT NAME** Pond Slope Stability

PROJECT NUMBER 123-94128 **PROJECT LOCATION** Monticello

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
35		(SP) SAND, fine, poorly graded, trace silt and clay, gray and red, wet, compact *(continued)*						
		(SP) SAND, medium to fine, subangular, poorly graded, some silt and fine gravel, red and brown, wet, compact	SS 11	100	6-12-12 (24)			
40								
		(SM) SILTY SAND, fine, subangular, some clay seams, tan and gray, wet, compact	SS 12		3-12-16 (28)			
45								
		some oxidation, trace clay seams at 48.0'	SS 13	89	7-9-13 (22)			
50								

Bottom of borehole at 50.0 feet.

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BORING NUMBER BH-105

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Monticello
DATE STARTED 10/23/12 **COMPLETED** 10/23/12
GROUND ELEVATION 386.5 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 34.40 ft / Elev 352.10 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(CH) FAT CLAY, high plastic, tan and red, dry, soft (OH) SILT, low plastic, organic, trace roots, black (GP) SANDY GRAVEL, fine, subangular, white	SH 1	33		1.0	
	(CL) LEAN CLAY, low plasticilty, some sand, tan and gray, dry, firm	SH 2	50		4.5	
5	(CL) SANDY CLAY, low plasticity, red and gray, mottled, dry, hard	SH 3	67		5.0	
	some sand seams at 6.0'	SH 4	92		3.0	
	(SC) CLAYEY SAND, fine, subangular, gray, dry	SH 5	54		1.5	
10	compact at 10.0'	SS 6	67	3-4-6 (10)		
15	(CL) SANDY CLAY, low plasticity, some clayey sand seams, gray and red, mottled, dry, hard	SH 7	54		5.0	
20		SH 8	60		3.75	
25	increased sand content, moist at 23.0'	SH 8	67		5.0	
30	(SC) CLAYEY SAND, fine, subangular, low plasticity, red and gray, moist, loose	SS 9	100	4-4-4 (8)		
35	some clay seams, trace fine gravel, tan and gray, wet, compact at 33.0'	SS 10	100	7-7-9 (16)		

▲ SPT N VALUE ▲ 20 40 60 80
PL MC LL 20 40 60 80
□ FINES CONTENT (%) □ 20 40 60 80

(Continued Next Page)

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BORING NUMBER BH-105

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Monticello

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
35		(SC) CLAYEY SAND, fine, subangular, low plasticity, red and gray, moist, loose *(continued)*						
		no gravel at 38.0'	SS 11	100	5-7-10 (17)			
40								
45			SS 12	100	5-6-9 (15)			
		(SM) SILTY SAND, fine with trace medium, subangular, little clay, tan, wet, compact	SS 14	100	5-7-9 (16)			
50								

Bottom of borehole at 50.0 feet.

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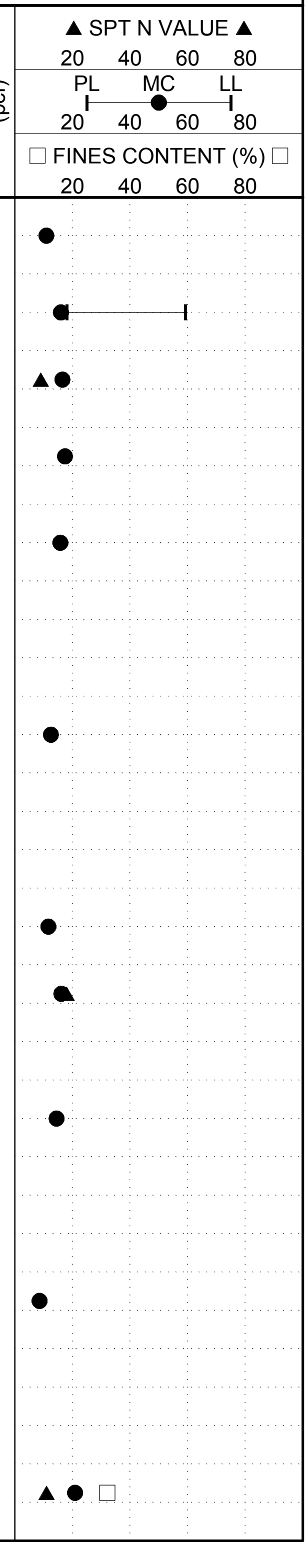
BORING NUMBER BH-106

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Monticello
DATE STARTED 10/23/12 **COMPLETED** 10/23/12
GROUND ELEVATION 386.5 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING 31.00 ft / Elev 355.50 ft no reading, cave in at 31
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(CL) GRAVELLY CLAY, low plastic, some sand, brown, dry, hard	SH 1	33		5.0	
	(CH) FAT CLAY, medium to high plasticity, little silt and sand, brown, dry, hard	SH 2	46		5.0	
5	(CL) SANDY CLAY, medium plasticity, trace silt, red and gray, dry	SS 3	33	3-4-5 (9)		
		SH 4	67		3.5	
		SH 5	67		3.0	
10	(SC) CLAYEY SAND, low plasticity for last 6", gray, dry					
	low to non plastic, dark gray at 13.0'	SH 6	46		5.0	
15						
	fine, subangular, tan and gray at 18.0'	SH 7	50		2.0	
20	little silt, red, compact at 20.0'	SS 8	100	5-7-11 (18)		
	(CL) SANDY CLAY, low plasticity, tan and gray, moist, firm to stiff	SH 9	67		3.5	
25						
	(SM) SILTY SAND, fine, subangular, nonplastic, trace to little clay, tan, moist	SH 10	67			
30						
	(SM) SILTY SAND, medium to fine, poorly graded, nonplastic, trace gravel, tan and red, wet, compact	SS 11	89	5-5-6 (11)		
35						



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BORING NUMBER BH-106

CLIENT Luminant | **PROJECT NAME** Pond Slope Stability

PROJECT NUMBER 123-94128 | **PROJECT LOCATION** Monticello

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
35		(SM) SILTY SAND, medium to fine, poorly graded, nonplastic, trace gravel, tan and red, wet, compact *(continued)*						
		(SC) CLAYEY SAND, fine, subangular, some clay seams, oxidation, tan and gray, mottled, wet, compact	SS 12	72	4-8-11 (19)			
40								
		no visible oxidation at 43.0'	SS 13	44	5-7-10 (17)			
45								
			SS 14	100	7-8-13 (21)			
50								

Bottom of borehole at 50.0 feet.

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BORING NUMBER BH-107

CLIENT Luminant

PROJECT NAME Pond Slope Stability

PROJECT NUMBER 123-94128

PROJECT LOCATION Monticello

DATE STARTED 10/23/12 **COMPLETED** 10/23/12

GROUND ELEVATION 386.5 ft **HOLE SIZE** 8 inches

DRILLING CONTRACTOR WEST Drilling

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger

AT TIME OF DRILLING 31.75 ft / Elev 354.75 ft

LOGGED BY FW **CHECKED BY** MP

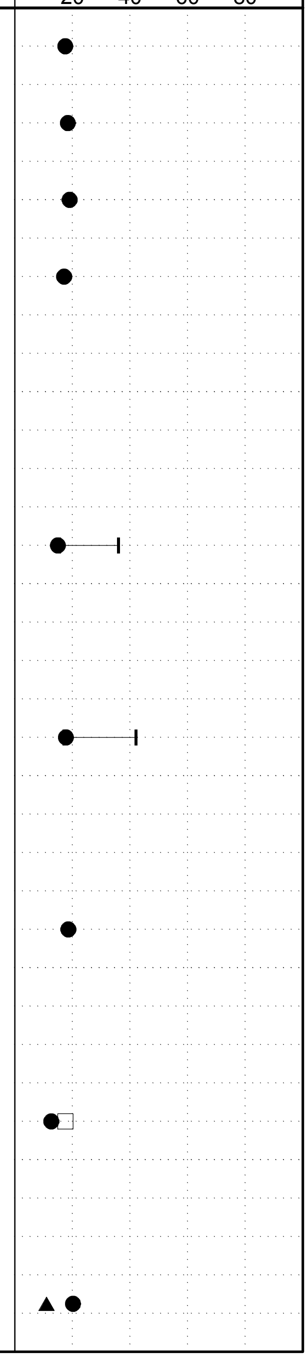
AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	remove 1' of sandy gravel from roadway					
	(CL) LEAN CLAY, low plasticity, some sand, gray, dry, hard	SH 1	42		5.0	
		SH 2	56		5.0	
5	some sand seams at 4.0'	SH 3	46		5.0	
	(CL) SANDY CLAY, low plasticity, some silt, gray and red, dry, hard	SH 4	71		4.25	
	(SC) CLAYEY SAND, fine, subangular, low plasticity, gray, dry	SH 5	54		1.75	
10						
15		SH 6	67		3.5	
	(CL) SANDY CLAY, low plasticity, little silt, red and gray, dry, firm to stiff	SH 7	54		2.75	
20						
	increased sand content, moist at 23.0'	SH 8	58		4.0	
25						
	(SP) SAND, nonplastic, poorly graded, some silt, little clay, tan, moist	SH 9	58			
30						
	(SM) SILTY SAND, fine with little medium, little clay, tan and gray, wet, compact	SS 10	89	5-5-6 (11)		
35						

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80



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BORING NUMBER BH-107

CLIENT Luminant **PROJECT NAME** Pond Slope Stability

PROJECT NUMBER 123-94128 **PROJECT LOCATION** Monticello

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / □ FINES CONTENT (%) □ 20 40 60 80
35		(SM) SILTY SAND, fine with little medium, little clay, tan and gray, wet, compact *(continued)*						
		3" dark gray clay seam (CL), little gravel at 38.0'	SS 11	89	5-5-9 (14)			
40								
		subangular, trace clay, oxidation, tan at 43.0'	SS 12		5-9-11 (20)			
45								
		some clay seams, tan and gray at 48.0'	SS 13	89	4-8-9 (17)			
50								

Bottom of borehole at 50.0 feet.

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BORING NUMBER BH-108

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Monticello
DATE STARTED 10/24/12 **COMPLETED** 10/24/12
GROUND ELEVATION 386.5 ft **HOLE SIZE** 8 inches
DRILLING CONTRACTOR WEST Drilling
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING 32.65 ft / Elev 353.85 ft
LOGGED BY FW **CHECKED BY** MP
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	remove 4" of gravel from roadway					
	(CL) LEAN CLAY, low plasticity, some to little sand, trace silt, brown, dry, firm	SH 1	38		2.5	
	some sand, tan and gray, firm to stiff at 2.0'	SH 2	75		2.75	
5	trace gravel, tan, red, and gray, stiff at 4.0'	SH 3	54		3.0	
	increased sand content, little silt, hard at 6.0'	SH 4	83		5.0	
	(CL) SANDY CLAY, low plasticity, some silt, gray and red, dry, stiff	SH 5	44		3.75	
10						
	(CL) SANDY CLAY, low plasticity, fine, subangular, dark gray, dry	SH 6	75			
15						
	some silt, tan and gray at 18.0'	SH 7	50			
20						
	(CL) SANDY CLAY, low plasticity, little silt, tan and gray, dry, hard	SH 8	83			
25						
	low plasticity, some silt, moist, firm at 28.0'	SS 9	89	6-3-4 (7)		
30						
	(SC) CLAYEY SAND, fine, subangular, low plasticity, little silt, some clay seams, tan and gray, moist	SH 10	46			
35						

▲ SPT N VALUE ▲ 20 40 60 80
PL MC LL 20 40 60 80
☐ FINES CONTENT (%) ☐ 20 40 60 80

(Continued Next Page)

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BORING NUMBER BH-108

CLIENT Luminant
PROJECT NAME Pond Slope Stability
PROJECT NUMBER 123-94128
PROJECT LOCATION Monticello

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
35		(SC) CLAYEY SAND, fine, subangular, low plasticity, little silt, some clay seams, tan and gray, moist *(continued)* little medium at 35.0'	SS 11	100	4-6-9 (15)			
			SS 12	100	3-7-9 (16)			
40								
		some silt, little oxidation, wet, compact at 43.0'	SS 13	100	4-8-11 (19)			
45								
			SS 14		6-9-15 (24)			
50								

Bottom of borehole at 50.0 feet.

APPENDIX B
LABORATORY TEST RESULTS SUMMARY

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SUMMARY OF LABORATORY RESULTS

CLIENT Luminant **PROJECT NAME** Pond Slope Stability

PROJECT NUMBER 123-94128 **PROJECT LOCATION** Monticello

Sample ID	Depth	Natural Moisture (%)	Atterberg Limits			%<#200 Sieve	Class-ification	Unit Weight		Permeability (cm/sec)	Additional Lab Testing
			Liquid Limit	Plastic Limit	Plasticity Index			Moisture Content (%)	Dry Density (psf)		
BH-101	0	17.0									
BH-101	2	22.6									
BH-101	4	23.4									
BH-101	6	15.7	36	14	22						
BH-101	8	16.6									
BH-101	13	19.0									
BH-101	18	12.4									
BH-101	23	16.2									
BH-101	28	14.8									
BH-101	33	17.1	28	13	15						
BH-101	38	17.5				34					
BH-101	43	28.5									
BH-101	48	27.0									
BH-102	0	15.3									
BH-102	2	10.9									
BH-102	4	15.7									
BH-102	6	16.0									
BH-102	8	16.1									
BH-102	13	16.9				54					
BH-102	18	20.4									
BH-102	23	14.6									
BH-102	28	16.4									
BH-102	33	27.5				69					
BH-102	38	25.6									
BH-102	43	28.6									
BH-102	48	27.7									
BH-103	0	19.4									
BH-103	2	19.2									
BH-103	4	16.5									
BH-103	6	11.4									
BH-103	8	16.5									
BH-103	13	15.5									
BH-103	18	23.1	60	19	41						
BH-103	23	22.3									
BH-103	25	20.4				21					
BH-103	30	24.0									
BH-103	33	21.0									
BH-103	38	26.7									
BH-103	43	28.4				35					
BH-103	48	26.1									
BH-104	0	17.6									

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SUMMARY OF LABORATORY RESULTS

CLIENT Luminant **PROJECT NAME** Pond Slope Stability

PROJECT NUMBER 123-94128 **PROJECT LOCATION** Monticello

Sample ID	Depth	Natural Moisture (%)	Atterberg Limits			%<#200 Sieve	Class-ification	Unit Weight		Permeability (cm/sec)	Additional Lab Testing
			Liquid Limit	Plastic Limit	Plasticity Index			Moisture Content (%)	Dry Density (psf)		
BH-104	2	19.5									
BH-104	4	23.7	55	17	38						
BH-104	6	17.6									
BH-104	8	12.2	27	13	14						
BH-104	13	13.8									
BH-104	18	17.1	50	16	34						
BH-104	23	20.0									
BH-104	28	18.6									
BH-104	33	22.5				7					
BH-104	38	18.8									
BH-104	43	29.1									
BH-104	48	28.9									
BH-105	0	12.9									
BH-105	2	21.6									
BH-105	4	12.3									
BH-105	6	15.5									
BH-105	8	9.8									
BH-105	10	16.9									
BH-105	13	16.7	44	15	29						
BH-105	18	15.1									
BH-105	23	14.3				66					
BH-105	28	16.7									
BH-105	33	19.7									
BH-105	38	26.6									
BH-105	43	28.7									
BH-105	48	26.9									
BH-106	0	11.0									
BH-106	2	16.0	59	18	41						
BH-106	4	16.5									
BH-106	6	17.4									
BH-106	8	15.8									
BH-106	13	12.5									
BH-106	18	11.7									
BH-106	20	16.1									
BH-106	23	14.5									
BH-106	28	8.6									
BH-106	33	20.9				32					
BH-106	38	30.6									
BH-106	43	28.9									
BH-106	48	28.2									
BH-107	0	17.5									

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SUMMARY OF LABORATORY RESULTS

CLIENT Luminant **PROJECT NAME** Pond Slope Stability

PROJECT NUMBER 123-94128 **PROJECT LOCATION** Monticello

Sample ID	Depth	Natural Moisture (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	%<#200 Sieve	Class-ification	Unit Weight: Moisture Content (%)	Unit Weight: Dry Density (psf)	Permeability (cm/sec)	Additional Lab Testing
BH-107	2	18.4									
BH-107	4	19.0									
BH-107	6	17.1									
BH-107	13	14.9	36	16	20						
BH-107	18	17.7	42	17	25						
BH-107	23	18.6									
BH-107	28	12.7				18					
BH-107	33	20.2									
BH-107	38	34.1									
BH-107	43	27.8									
BH-107	48	34.7									
BH-108	0	19.7									
BH-108	2	26.1									
BH-108	4	23.2									
BH-108	6	13.0									
BH-108	8	14.7									
BH-108	13	14.9				64					
BH-108	18	13.4									
BH-108	23	13.2	33	12	21						
BH-108	28	26.7									
BH-108	33	22.7									
BH-108	35	27.7									
BH-108	38	27.3									
BH-108	43	27.0									
BH-108	48	24.8									
BH-109	0	15.4									
BH-109	2	6.1									
BH-109	4	9.3									
BH-109	6	10.5				27					
BH-109	8	13.6									
BH-109	13	15.4									
BH-109	18	14.2	27	16	11						
BH-110	0	16.5									
BH-110	2	8.7									
BH-110	4	12.1									
BH-110	6	12.7				37					
BH-110	8	14.1									
BH-110	10	17.4	48	16	32						
BH-110	13	15.1									
BH-110	18	14.0									
BH-110	20	16.4									

APPENDIX C
LABORATORY TEST RESULTS

ATTERBERG LIMIT RESULTS

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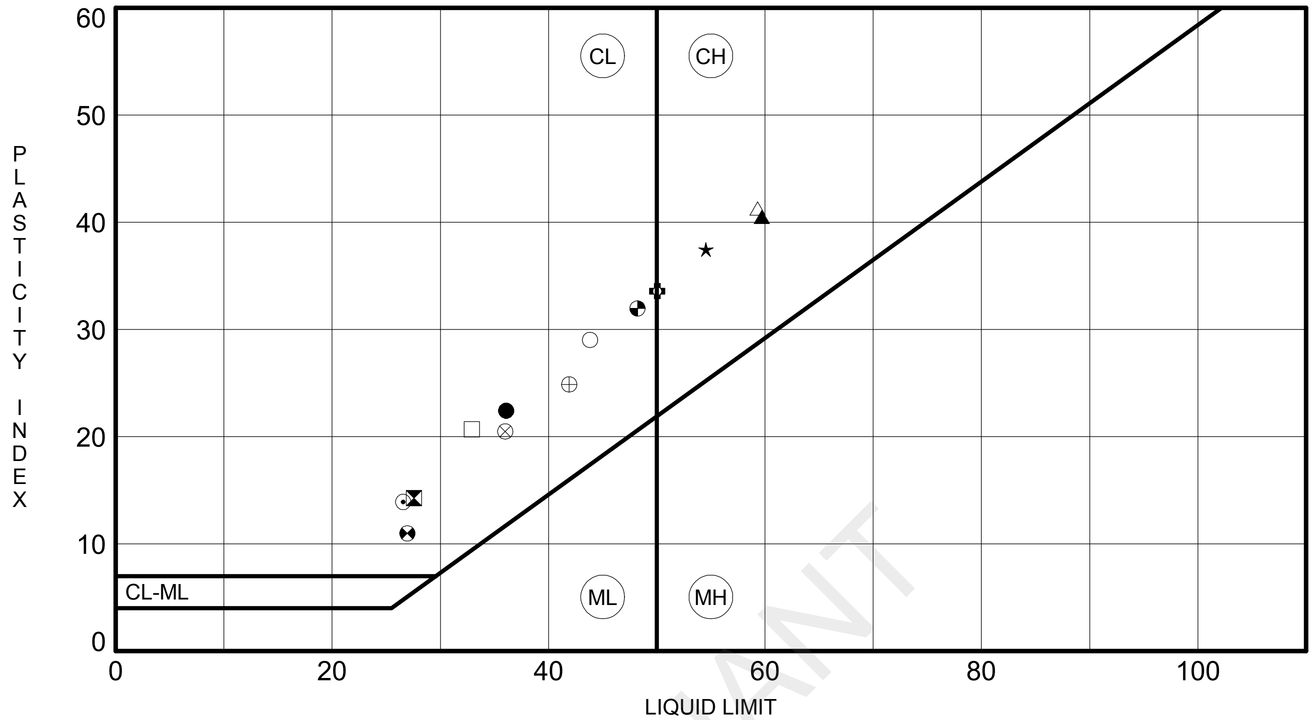
ATTERBERG LIMITS' RESULTS

CLIENT Luminant **PROJECT NAME** Pond Slope Stability

PROJECT NUMBER 123-94128 **PROJECT LOCATION** Monticello



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**BH-101**	**6**	**36**	**14**	**22**		
⧗	**BH-101**	**33**	**28**	**13**	**15**		
▲	**BH-103**	**18**	**60**	**19**	**41**		
★	**BH-104**	**4**	**55**	**17**	**38**		
⊙	**BH-104**	**8**	**27**	**13**	**14**		
✿	**BH-104**	**18**	**50**	**16**	**34**		
○	**BH-105**	**13**	**44**	**15**	**29**		
△	**BH-106**	**2**	**59**	**18**	**41**		
⊗	**BH-107**	**13**	**36**	**16**	**20**		
⊕	**BH-107**	**18**	**42**	**17**	**25**		
□	**BH-108**	**23**	**33**	**12**	**21**		
◉	**BH-109**	**18**	**27**	**16**	**11**		
◕	**BH-110**	**10**	**48**	**16**	**32**		

GRAIN SIZE ANALYSIS

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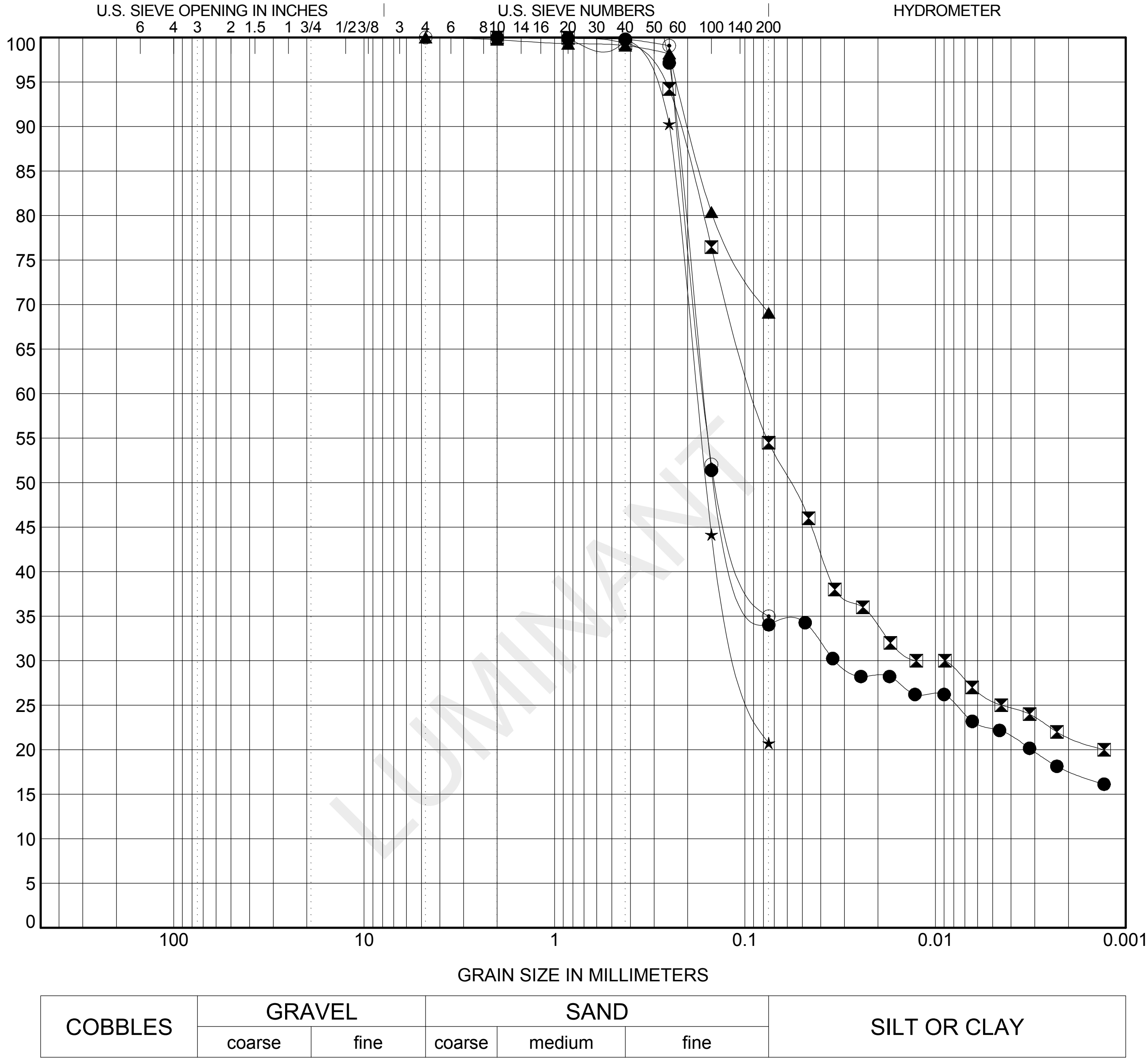
GRAIN SIZE DISTRIBUTION

CLIENT Luminant **PROJECT NAME** Pond Slope Stability

PROJECT NUMBER 123-94128 **PROJECT LOCATION** Monticello



	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**BH-101**	**38**						
⧗	**BH-102**	**13**						
▲	**BH-102**	**33**						
★	**BH-103**	**25**						
⊙	**BH-103**	**43**						

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH-101**	**38**	**2**	**0.165**	**0.033**		**0.0**	**66.0**	**11.6**	**22.4**
⧗	**BH-102**	**13**	**2**	**0.089**	**0.009**		**0.0**	**45.5**	**28.9**	**25.6**
▲	**BH-102**	**33**	**4.75**				**0.0**	**30.9**	**69.1**	
★	**BH-103**	**25**	**4.75**	**0.179**	**0.099**		**0.0**	**79.2**	**20.8**	
⊙	**BH-103**	**43**	**4.75**	**0.164**			**0.0**	**65.0**	**35.0**	

Golder Associates
500 Century Plaza Drive, Suite 190
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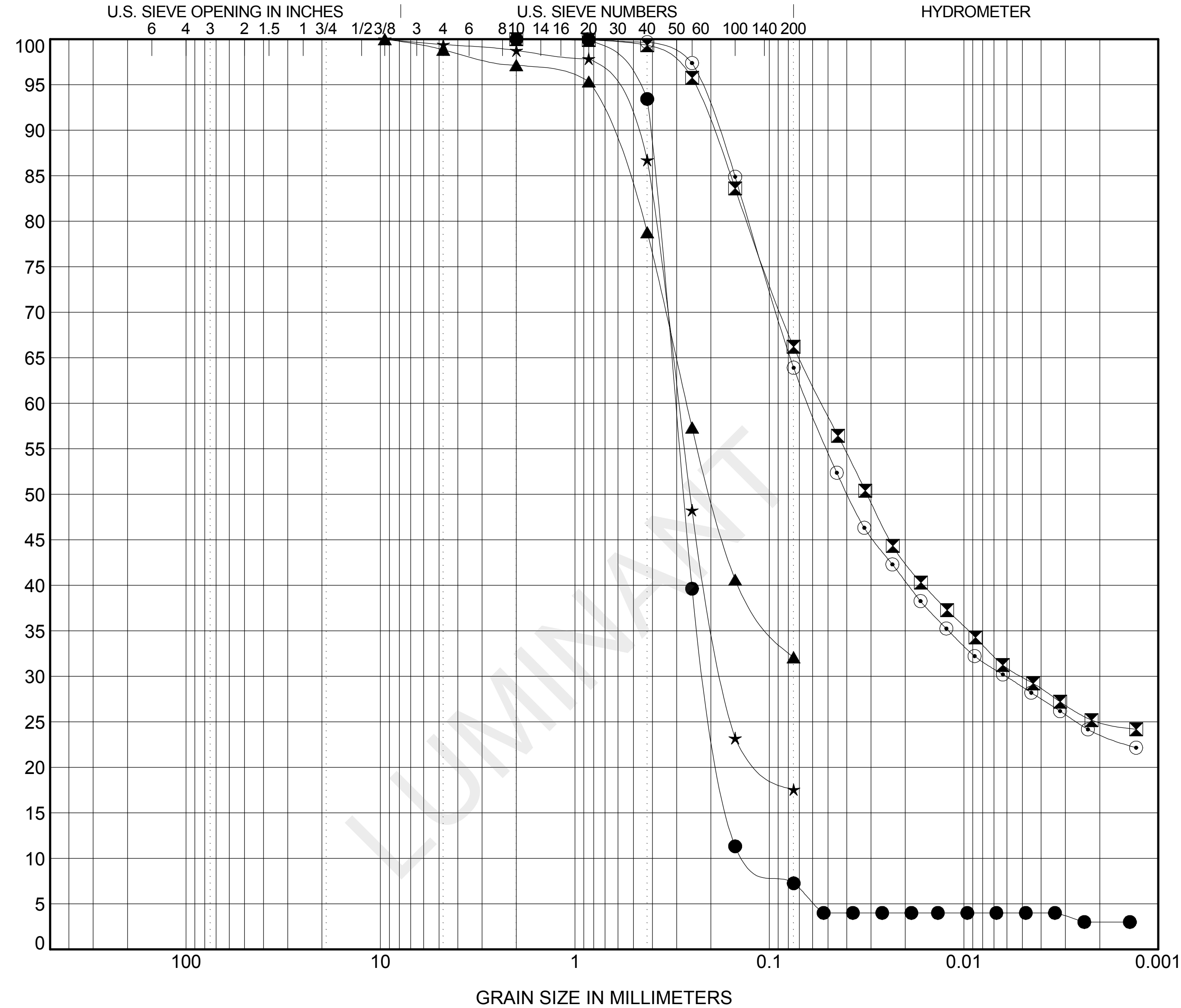
GRAIN SIZE DISTRIBUTION

CLIENT Luminant **PROJECT NAME** Pond Slope Stability

PROJECT NUMBER 123-94128 **PROJECT LOCATION** Monticello



	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**BH-104**	**33**					**1.21**	**2.55**
⧗	**BH-105**	**23**						
▲	**BH-106**	**33**						
★	**BH-107**	**28**						
⊙	**BH-108**	**13**						

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH-104**	**33**	**2**	**0.306**	**0.21**	**0.12**	**0.0**	**92.7**	**3.3**	**4.0**
⧗	**BH-105**	**23**	**2**	**0.054**	**0.005**		**0.0**	**33.8**	**36.3**	**29.9**
▲	**BH-106**	**33**	**9.5**	**0.267**			**1.2**	**66.7**	**32.1**	
★	**BH-107**	**28**	**9.5**	**0.294**	**0.172**		**0.6**	**81.9**	**17.6**	
⊙	**BH-108**	**13**	**0.85**	**0.063**	**0.006**		**0.0**	**36.1**	**35.1**	**28.8**

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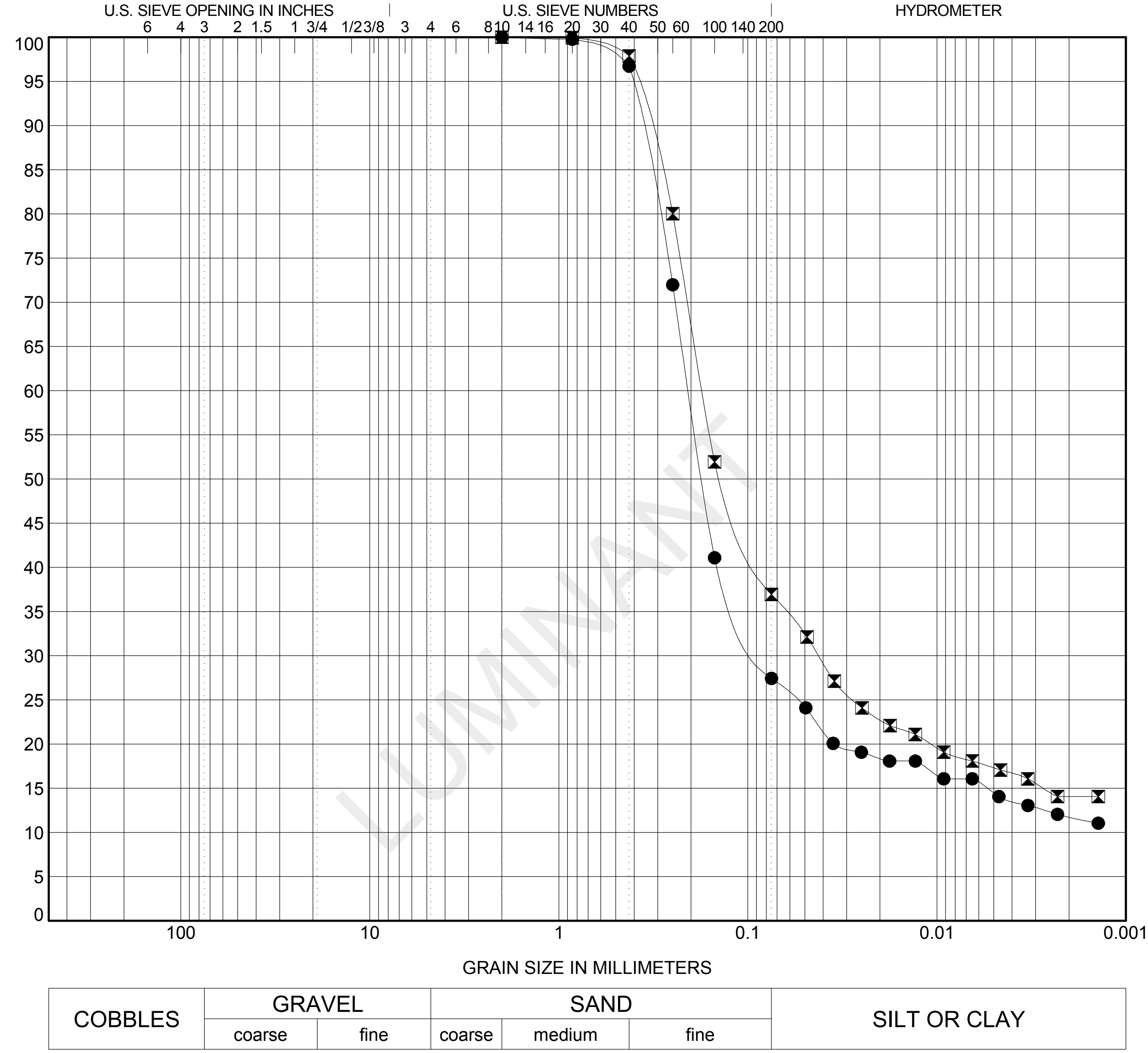
GRAIN SIZE DISTRIBUTION

CLIENT Luminant **PROJECT NAME** Pond Slope Stability

PROJECT NUMBER 123-94128 **PROJECT LOCATION** Monticello

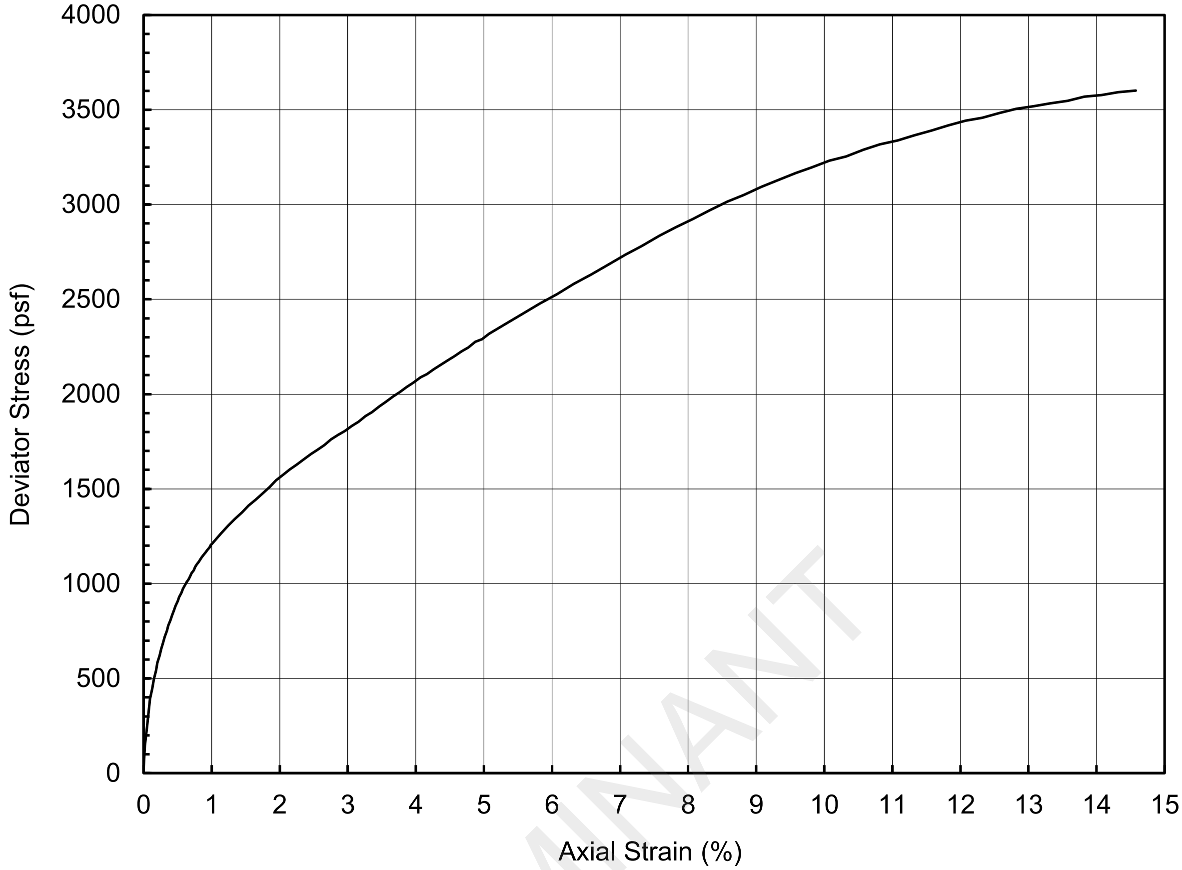


BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
● **BH-109**	**6**						
⧗ **BH-110**	**6**						

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **BH-109**	**6**	**2**	**0.205**	**0.085**		**0.0**	**72.6**	**13.0**	**14.4**
⧗ **BH-110**	**6**	**2**	**0.174**	**0.042**		**0.0**	**63.0**	**19.6**	**17.3**

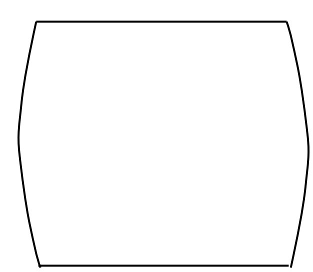
UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH (UU)

UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Reddish Gray Sandy Clay						
LL		PI		LI		USCS	

Depth (ft)	6.0	Confining Pressure (psf)	878
Specimen Height (inch)	4.9	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	3620
Initial Specimen Weight (g)	1018.2	Axial Strain at Peak Stress (%)	14.8
Moist Unit Weight (pcf)	128.3		
Initial Water Content (%)	17		
Initial Dry Unit Weight (pcf)	109.6		



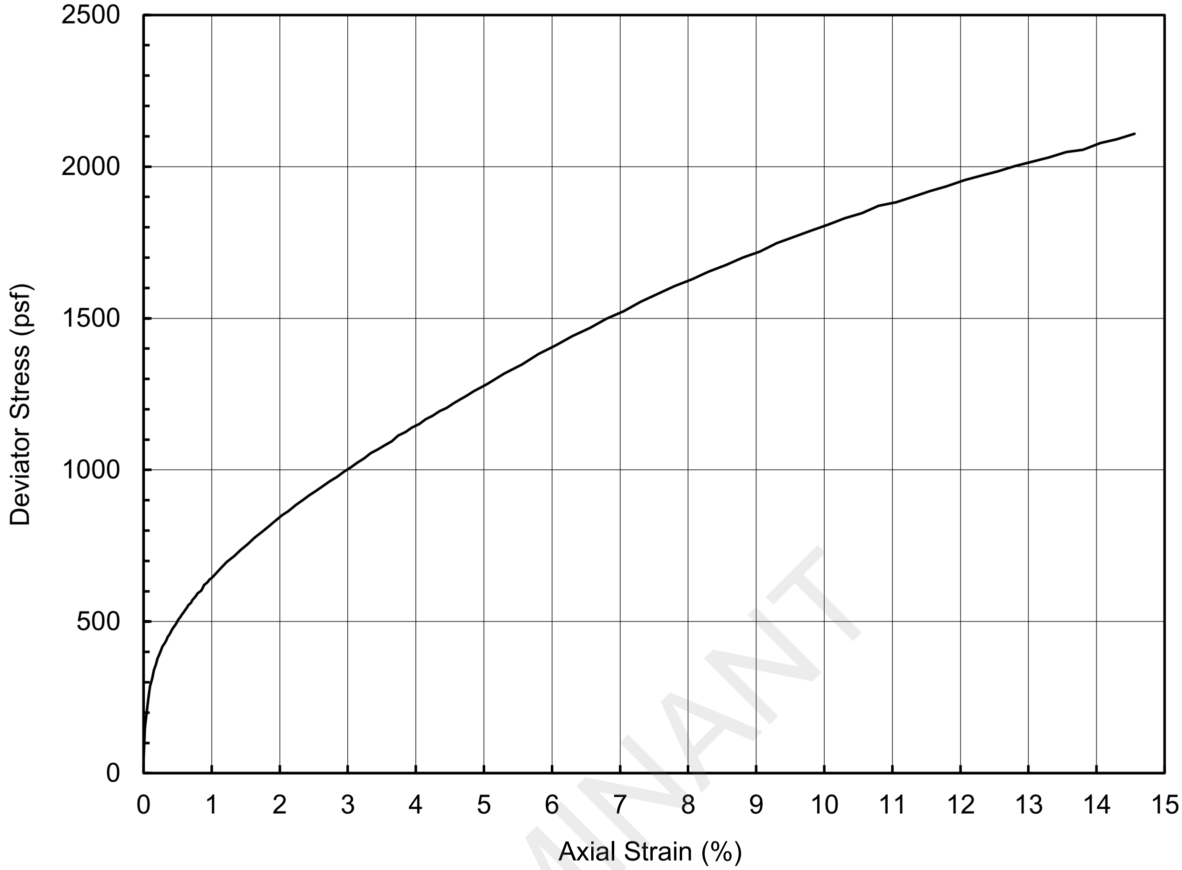
Failure Sketch

Project Title	Luminant - Monticello Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-101 TO-4
Comments	Sample L/D ratio < 2

Golder Associates

Performed by	**PN**
Date	**9-Nov-12**
Check	**HR**
Review	**PCM**

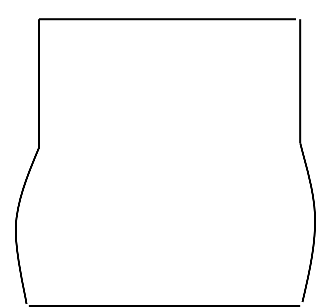
UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Reddish Gray Sandy Clay						
LL		PI		LI		USCS	

Depth (ft)	33.0	Confining Pressure (psf)	4026
Specimen Height (inch)	5.9	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	2122
Initial Specimen Weight (g)	1252.9	Axial Strain at Peak Stress (%)	15.0
Moist Unit Weight (pcf)	129.3		
Initial Water Content (%)	23		
Initial Dry Unit Weight (pcf)	104.9		

Project Title	Luminant - Monticello Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-101 TO-10
Comments	

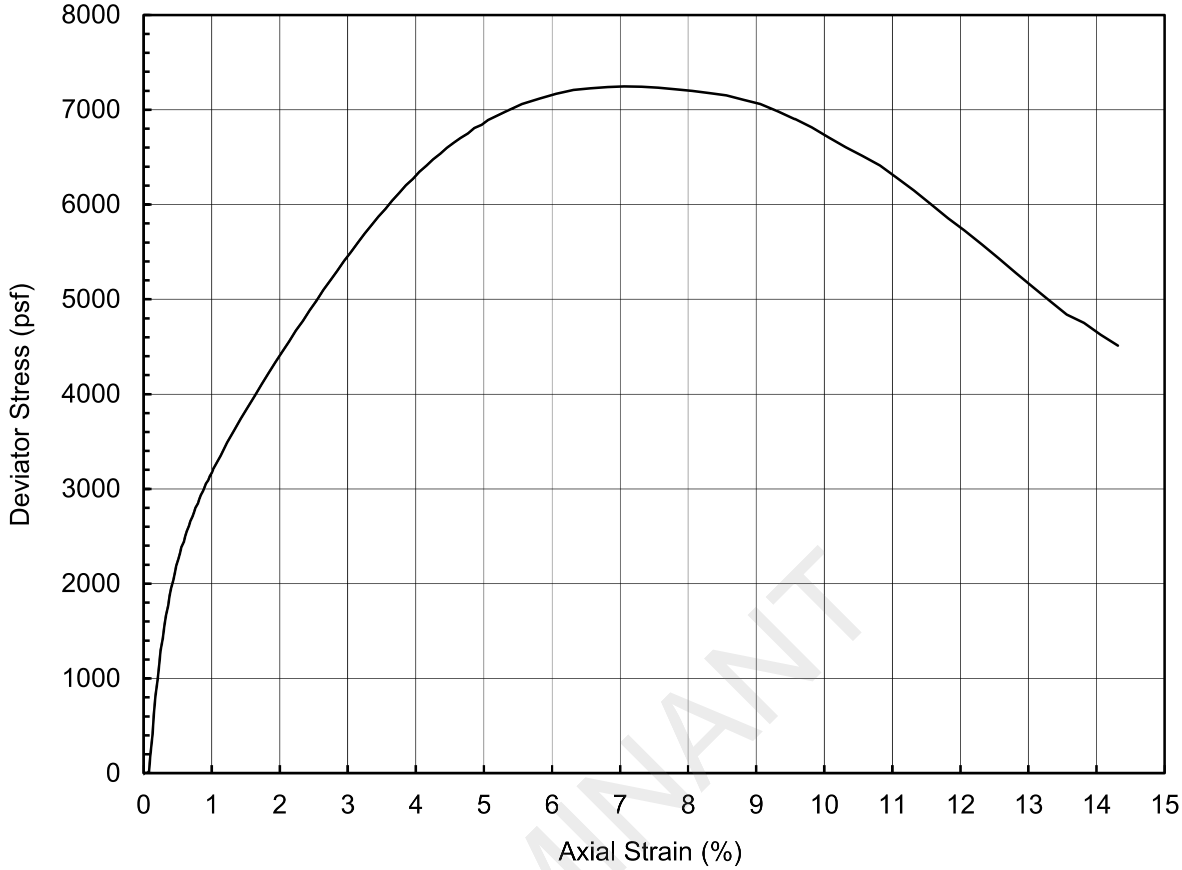


Failure Sketch

Golder Associates

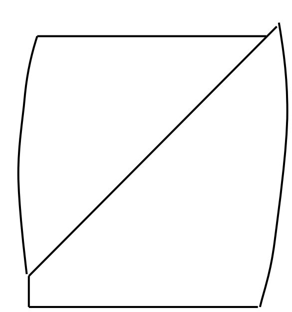
Performed by	**PN**
Date	**10-Nov-12**
Check	**HR**
Review	**PCM**

UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Reddish Gray Clay						
LL		PI		LI		USCS	

Depth (ft)	18.0	Confining Pressure (psf)	2251
Specimen Height (inch)	5.7	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	7245
Initial Specimen Weight (g)	1166.5	Axial Strain at Peak Stress (%)	7.1
Moist Unit Weight (pcf)	126.9		
Initial Water Content (%)	21		
Initial Dry Unit Weight (pcf)	104.5		



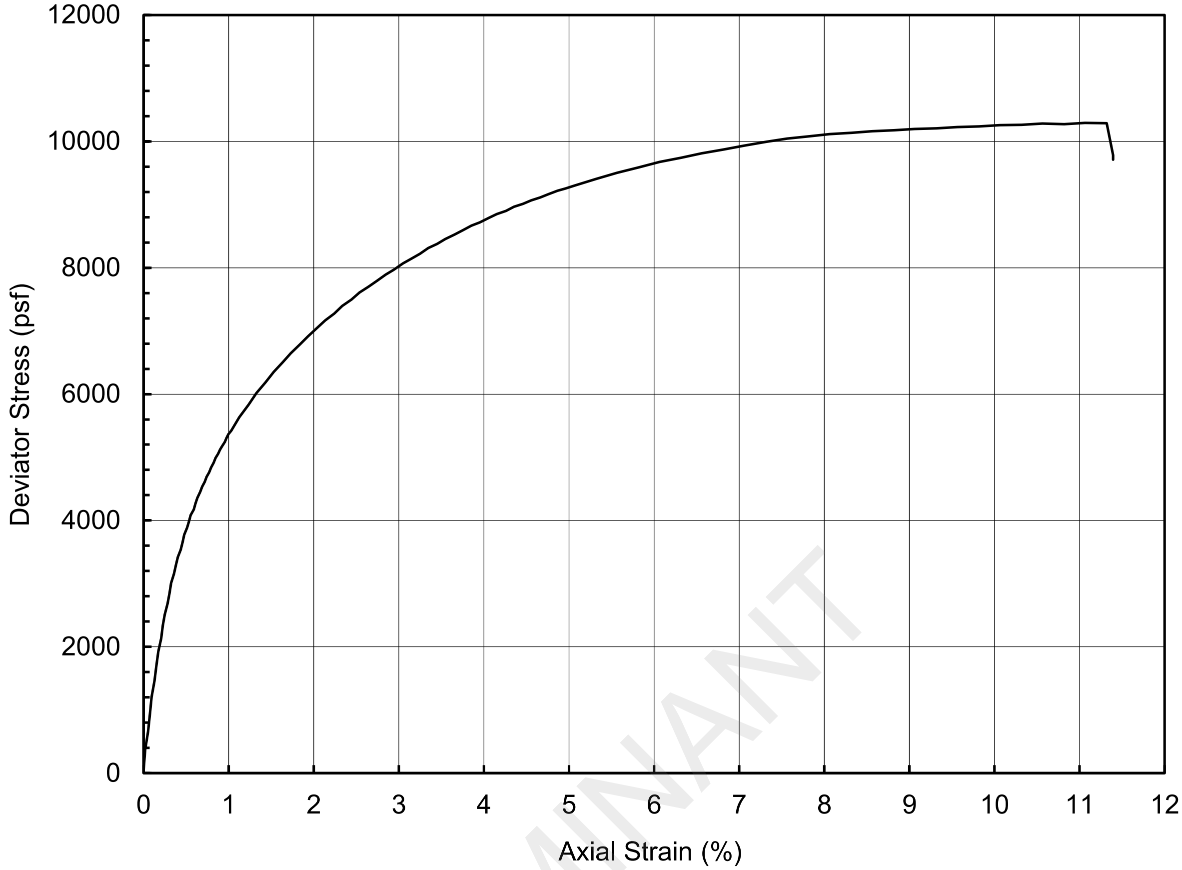
Failure Sketch

Project Title	Luminant - Monticello Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-103 TO-7
Comments	

Golder Associates

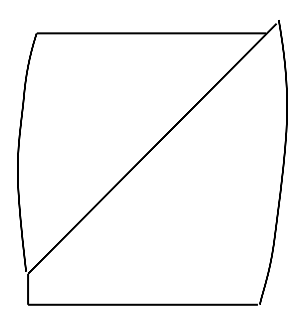
Performed by	**PN**
Date	**10-Nov-12**
Check	**HR**
Review	**PCM**

UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Reddish Gray Clay						
LL		PI		LI		USCS	

Depth (ft)	18.0	Confining Pressure (psf)	2873
Specimen Height (inch)	6.0	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	10292
Initial Specimen Weight (g)	1257.9	Axial Strain at Peak Stress (%)	11.1
Moist Unit Weight (pcf)	131.0		
Initial Water Content (%)	17		
Initial Dry Unit Weight (pcf)	112.3		



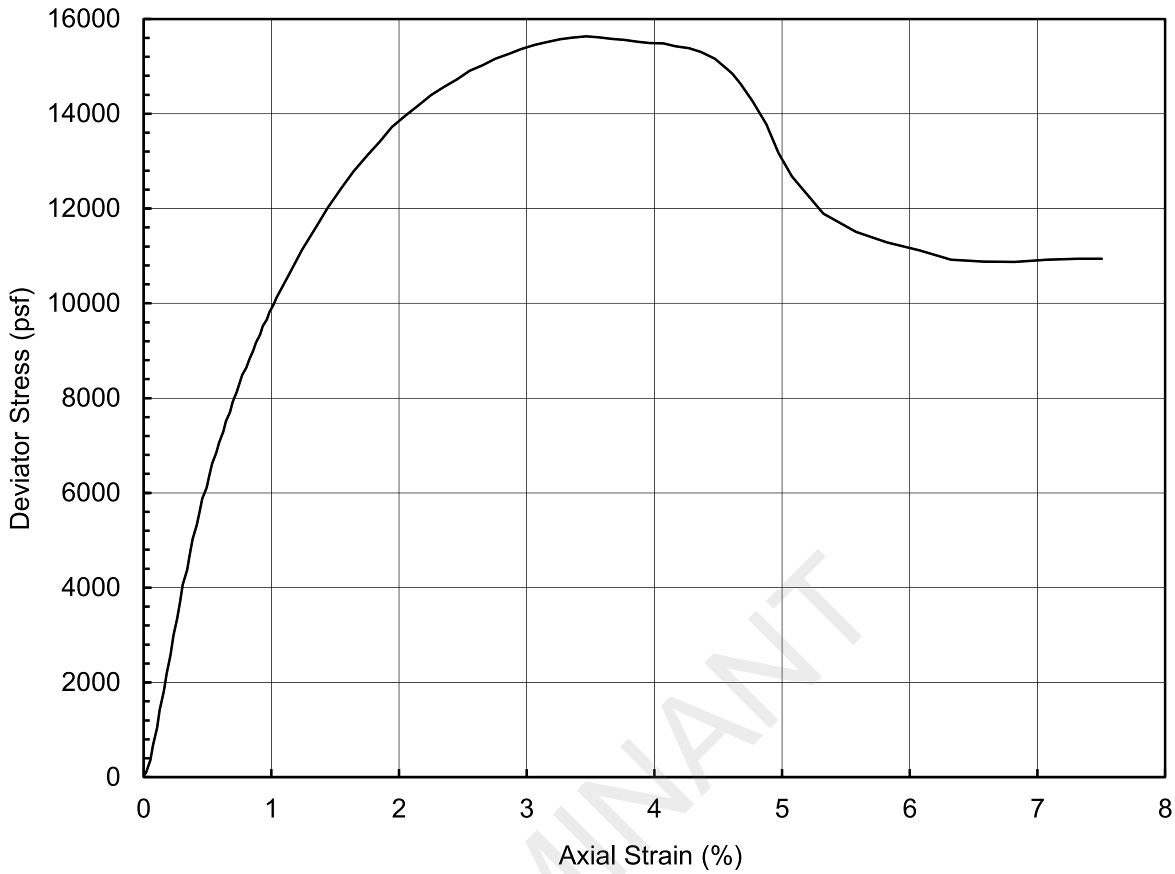
Failure Sketch

Project Title	Luminant - Monticello Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-104 TO-7
Comments	Load cell reached maximum capacity

Golder Associates

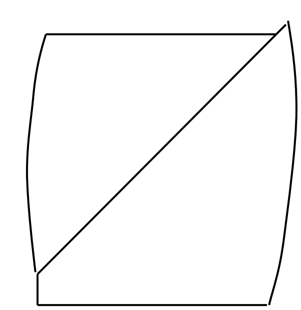
Performed by	**PN**
Date	**10-Nov-12**
Check	**HR**
Review	**PCM**

UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Reddish Gray Clay						
LL		PI		LI		USCS	

Depth (ft)	2.0	Confining Pressure (psf)	364
Specimen Height (inch)	6.0	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	15637
Initial Specimen Weight (g)	1242.3	Axial Strain at Peak Stress (%)	3.5
Moist Unit Weight (pcf)	129.1		
Initial Water Content (%)	17		
Initial Dry Unit Weight (pcf)	110.8		



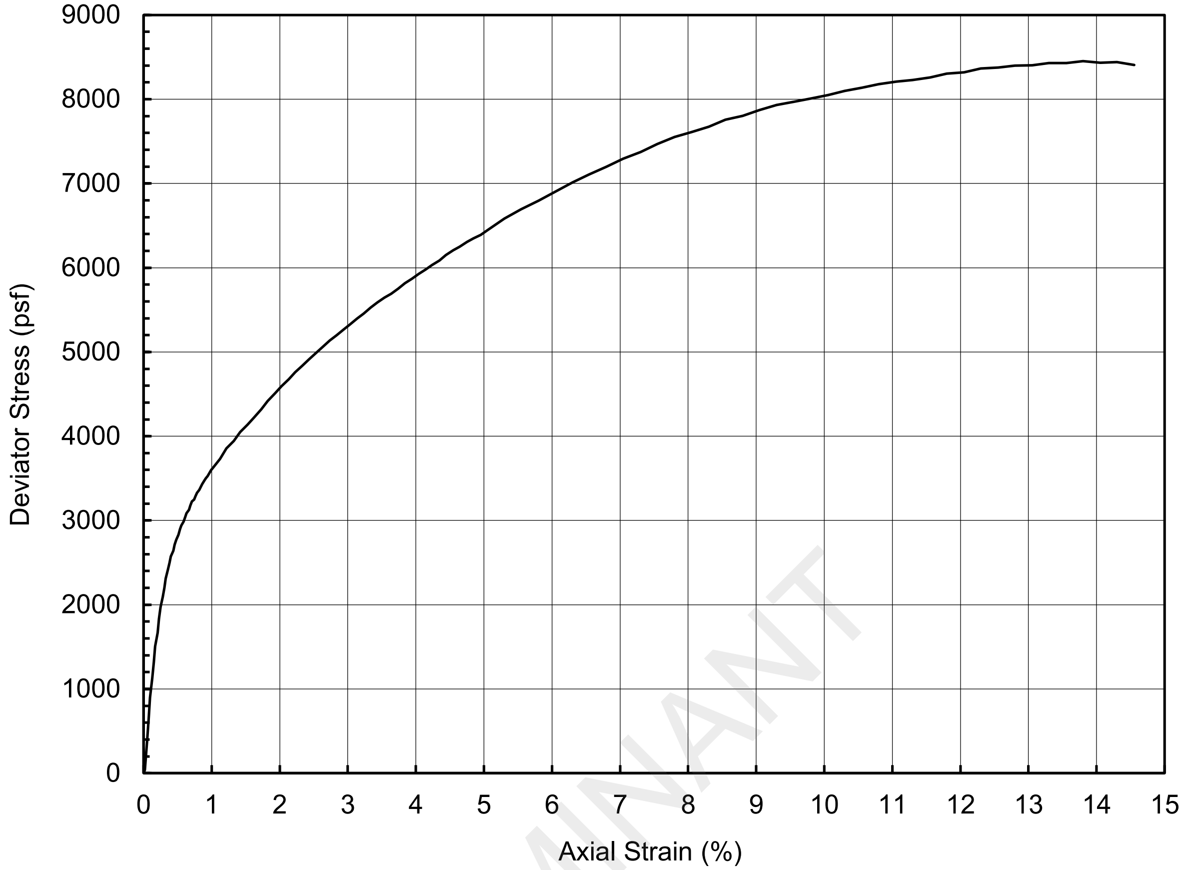
Failure Sketch

Project Title	Luminant - Monticello Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-106 TO-2
Comments	

Golder Associates

Performed by	**PN**
Date	**10-Nov-12**
Check	**HR**
Review	**PCM**

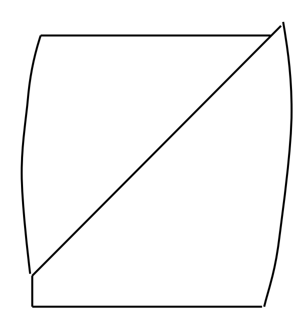
UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Reddish Yellow Sandy Clay						
LL		PI		LI		USCS	

Depth (ft)	18.0	Confining Pressure (psf)	2376
Specimen Height (inch)	5.9	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	8451
Initial Specimen Weight (g)	1281.6	Axial Strain at Peak Stress (%)	13.8
Moist Unit Weight (pcf)	136.8		
Initial Water Content (%)	15		
Initial Dry Unit Weight (pcf)	119.3		

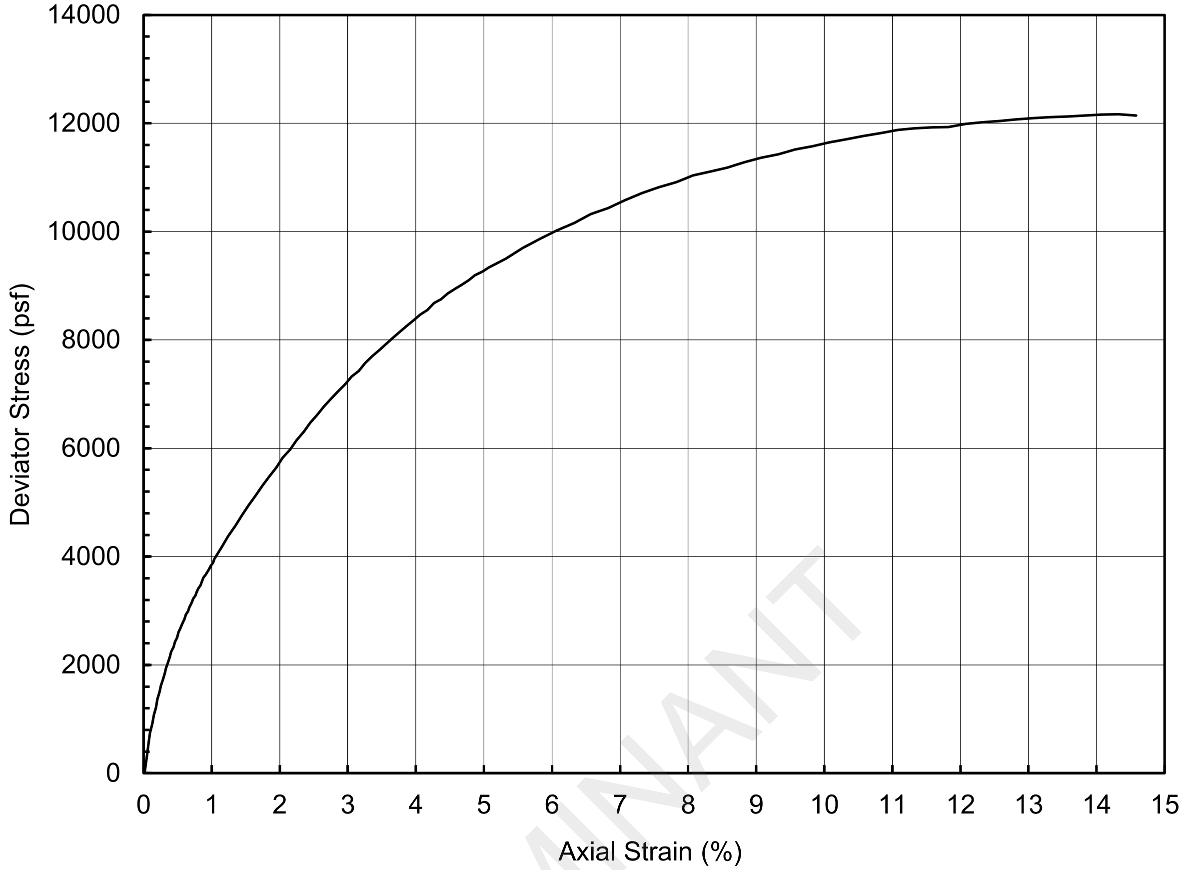
Project Title	Luminant - Monticello Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-107 TO-7
Comments	


Failure Sketch

Golder Associates

Performed by	**PN**
Date	**10-Nov-12**
Check	**HR**
Review	**PCM**

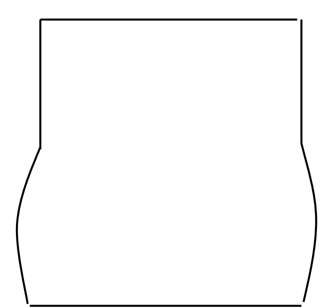
UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Light Grayish Brown Clay						
LL		PI		LI		USCS	

Depth (ft)	23.0	Confining Pressure (psf)	2876
Specimen Height (inch)	6.0	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	12167
Initial Specimen Weight (g)	1292.1	Axial Strain at Peak Stress (%)	14.3
Moist Unit Weight (pcf)	133.6		
Initial Water Content (%)	14		
Initial Dry Unit Weight (pcf)	116.9		

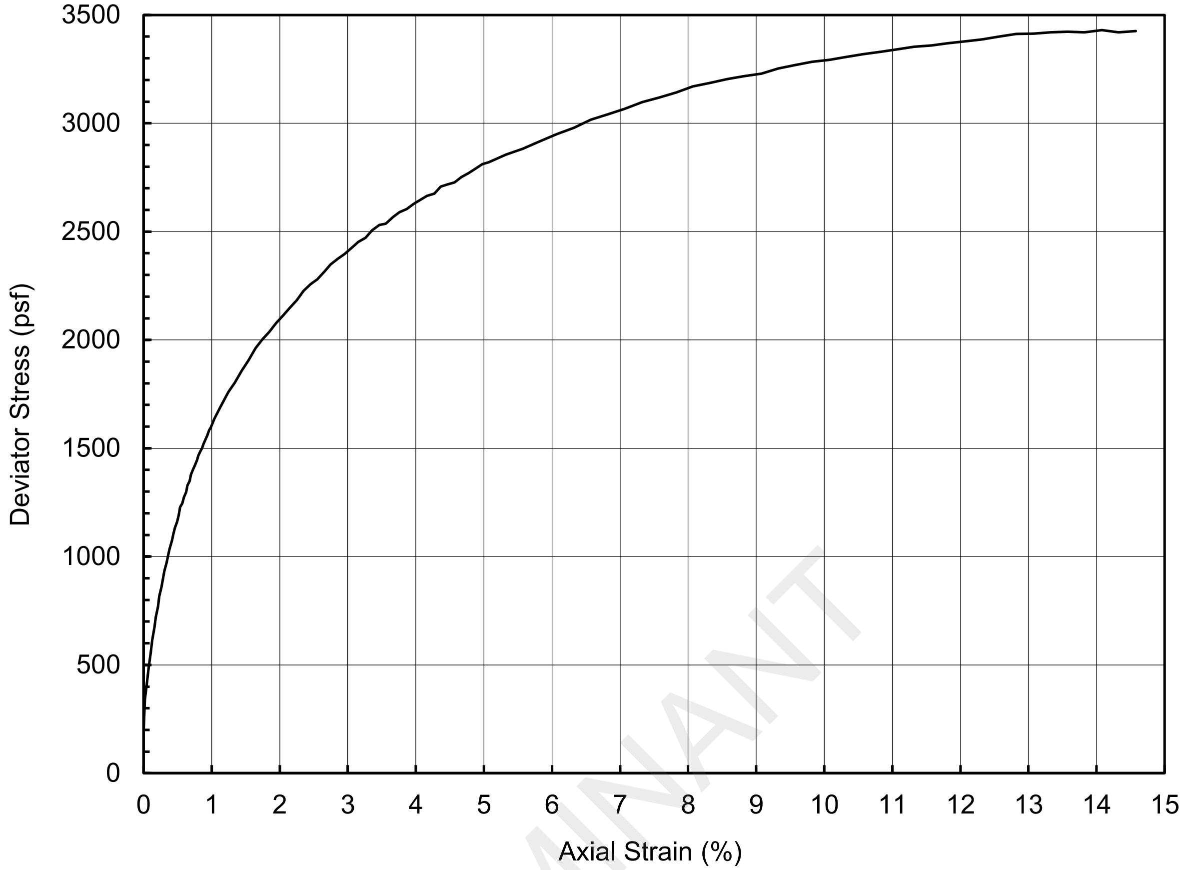
Project Title	Luminant - Monticello Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-108 TO-8
Comments	


Failure Sketch

Golder Associates

Performed by	**PN**
Date	**10-Nov-12**
Check	**HR**
Review	**PCM**

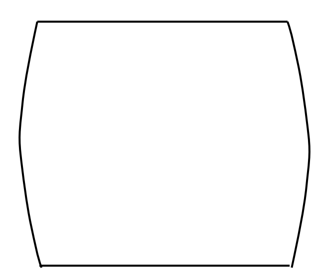
UNCONSOLIDATED / UNDRAINED COMPRESSIVE STRENGTH
ASTM D 2850



Specimen Description	Reddish Gray Clay						
LL		PI		LI		USCS	

Depth (ft)	10.0	Confining Pressure (psf)	1357
Specimen Height (inch)	5.9	Strain Rate (%/min)	1.0
Specimen Diameter (inch)	2.8	Peak Deviator Stress (psf)	3430
Initial Specimen Weight (g)	1191.6	Axial Strain at Peak Stress (%)	14.1
Moist Unit Weight (pcf)	124.9		
Initial Water Content (%)	19		
Initial Dry Unit Weight (pcf)	105.3		

Project Title	Luminant - Monticello Slope Stability
Project Number	123-94128
Sample Type	Shelby Tube
Sample ID	BH-110 TO-6
Comments	



Failure Sketch

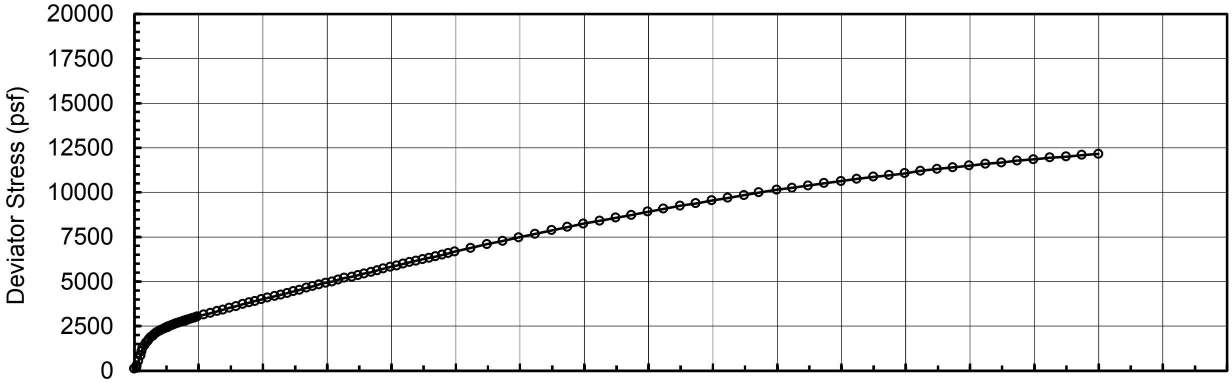
Golder Associates

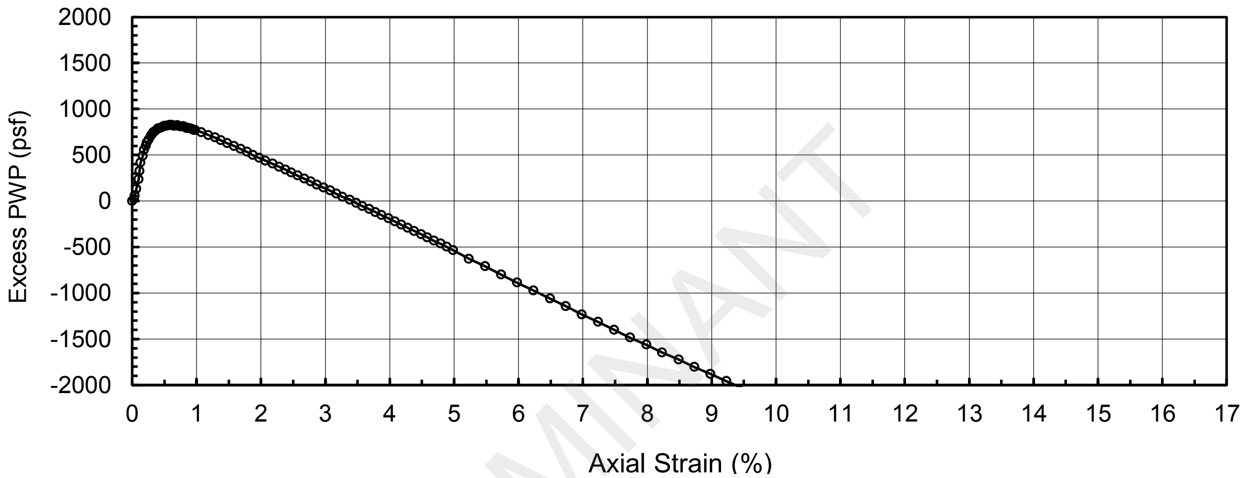
Performed by	**PN**
Date	**10-Nov-12**
Check	**HR**
Review	**PCM**

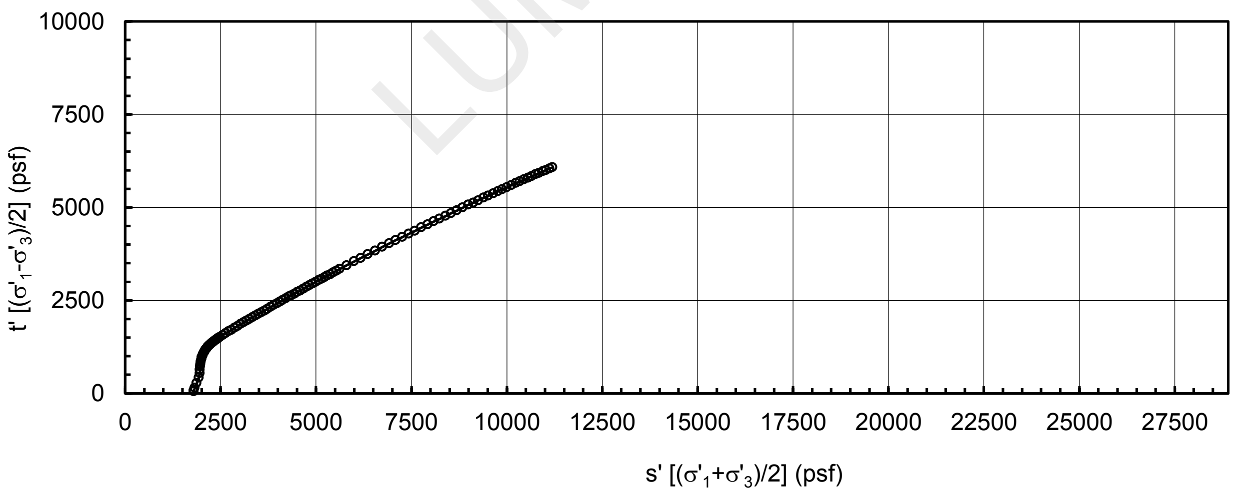
ISOTROPICALLY CONSOLIDATED UNDRAINED TRIAXIAL TEST (ICU)

Isotropically Consolidated Undrained Triaxial Test (ICU)

Project Title: Luminant **Project Number:** 123-94128 **Date:** 16-Nov-12
Boring Number: BH-107 **Specimen Name:** TO-6 **Depth (ft):** 13.0







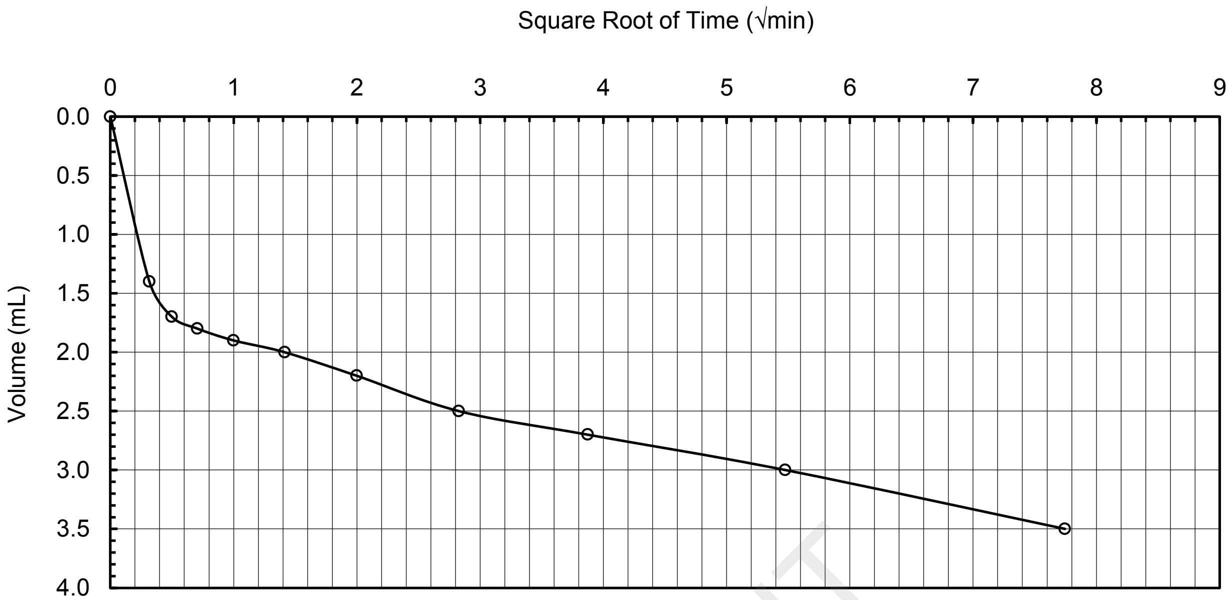
Specimen Description:	Reddish Gray Sandy Clay (visual classification)		
Initial Specimen Diameter (inch) =	2.81	Initial Specimen Height (inch) =	5.95
Initial Water Content (%) =	14.9	Water Content at End of Test (%) =	14.2
Initial Moist Unit Weight (pcf) =	134.9	B-value =	0.95
Back Pressure (BP, psf) =	5040.0	Consolidation Stress (σ'_3, psf) =	1743.9
Initial Lateral Stress (σ'_3, psf) =	1743.9	Consolidation t_{50} (min) =	9
Initial Deviator Stress (σ_1 - σ_3, psf) =	102.3	Rebound Stress (σ'_3, psf) =	NA
Test Strain Rate (%/hour) =	1.0	Rebound t_{50} (min) =	NA

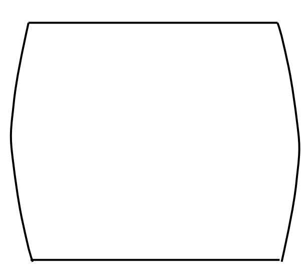
LL =	36	PI =	20	USCS	CL	**Performed by**	PN
Comments:						**Reviewed by**	HR

Golder Associates

Isotropically Consolidated Undrained Triaxial Test (ICU)

Project Title:	Luminant	**Project Number:**	123-94128	**Date:**	16-Nov-12
Boring Number:	BH-107	**Specimen Name:**	TO-6	**Depth (ft):**	13.0





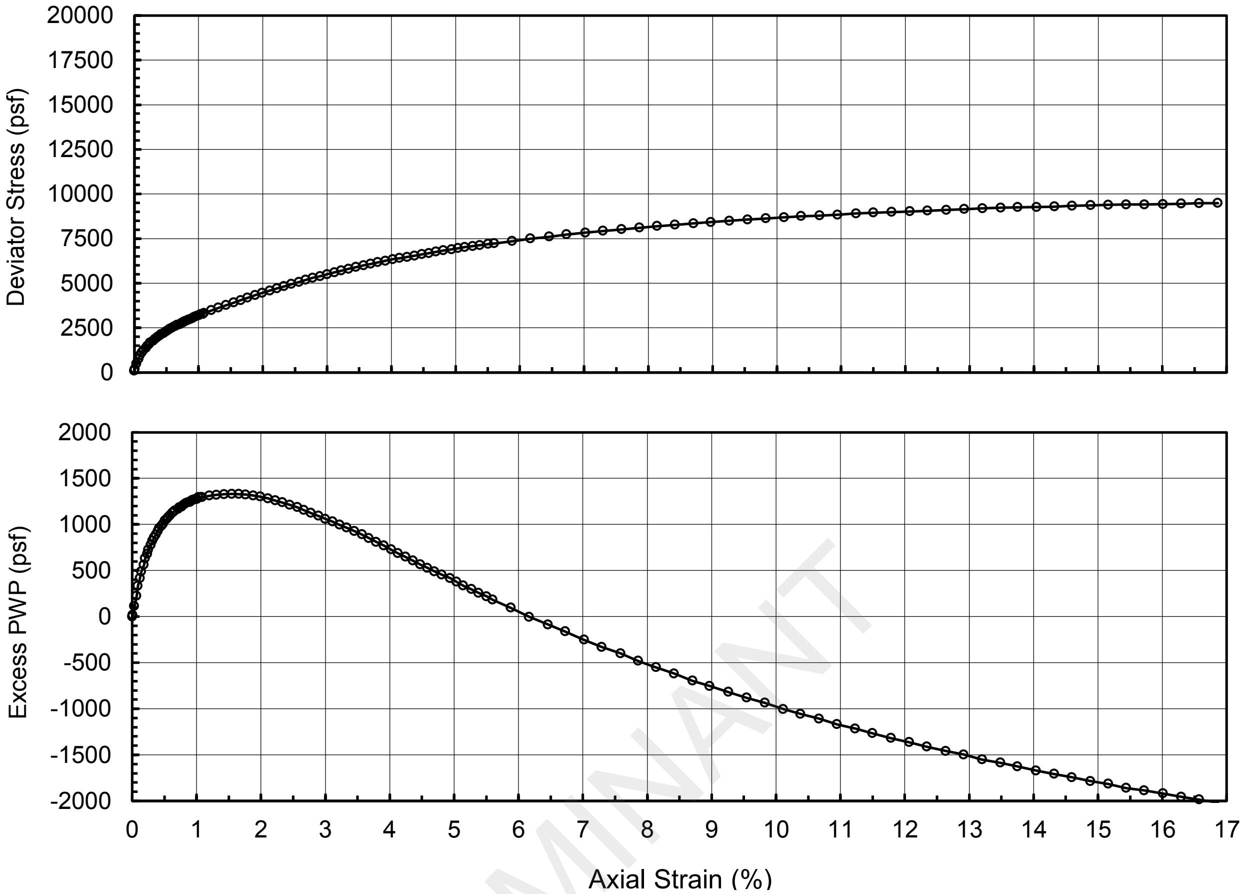
FAILURE SKETCH

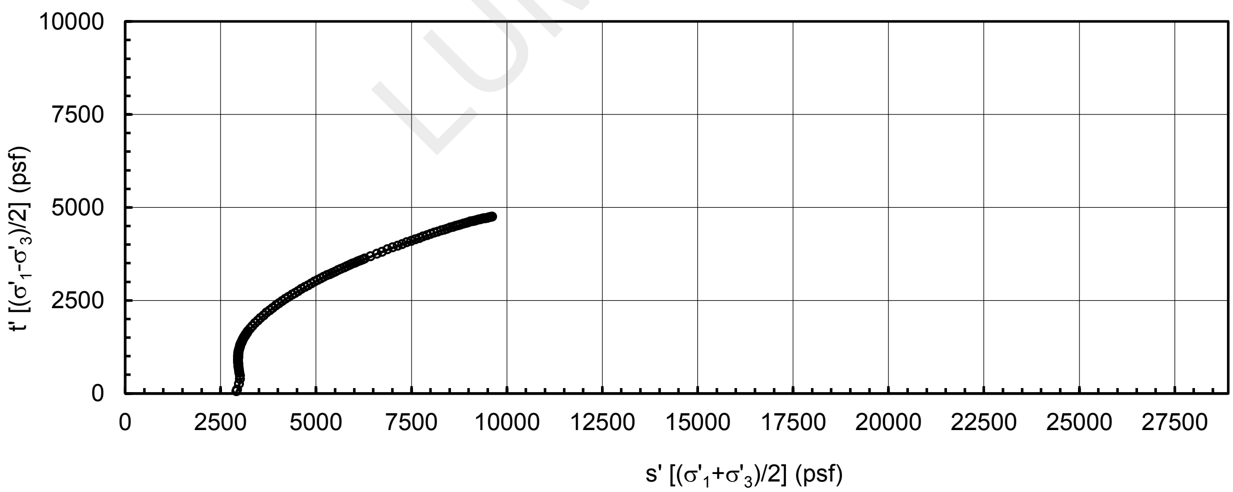
Consolidation Stress (σ'_3, psf) =			1743.9
Consolidation t_{50} (min) =			9
Consolidation Volume Change (mL) =			3.5
Unloading Stress (psf) =			NA
Unloading t_{50} (min) =			NA
Unloading Volume Change (mL) =			NA
LL =	36	PI =	20
USCS	CL		
Gs =	2.65	assumed	

Performed by	PN
Reviewed by	HR

Isotropically Consolidated Undrained Triaxial Test (ICU)

Project Title:	Luminant	**Project Number:**	123-94128	**Date:**	17-Nov-12
Boring Number:	BH-107	**Specimen Name:**	TO-8	**Depth (ft):**	23.0





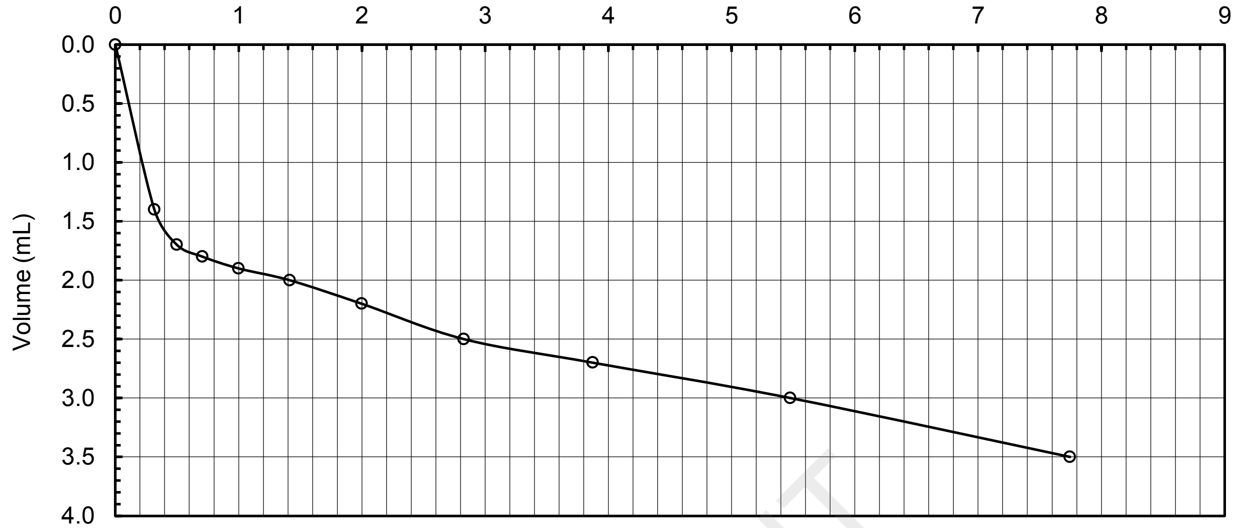
Specimen Description:	Light Gray Clay		
Initial Specimen Diameter (inch) =	2.84	Initial Specimen Height (inch) =	5.30
Initial Water Content (%) =	16.8	Water Content at End of Test (%) =	19.5
Initial Moist Unit Weight (pcf) =	141.6	B-value =	0.98
Back Pressure (BP, psf) =	5760.0	Consolidation Stress (σ'_3, psf) =	2867.8
Initial Lateral Stress (σ'_3, psf) =	2867.8	Consolidation t_{50} (min) =	9
Initial Deviator Stress (σ_1 - σ_3, psf) =	98.6	Rebound Stress (σ'_3, psf) =	NA
Test Strain Rate (%/hour) =	1.0	Rebound t_{50} (min) =	NA

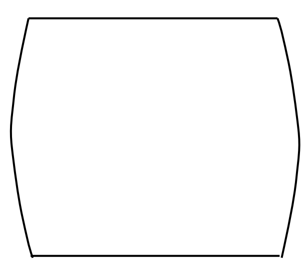
LL =	42	PI =	25	USCS	CL	**Performed by**	PN
Comments:						**Reviewed by**	HR

Golder Associates

Isotropically Consolidated Undrained Triaxial Test (ICU)

Project Title: Luminant **Project Number:** 123-94128 **Date:** 17-Nov-12
Boring Number: BH-107 **Specimen Name:** TO-8 **Depth (ft):** 23.0





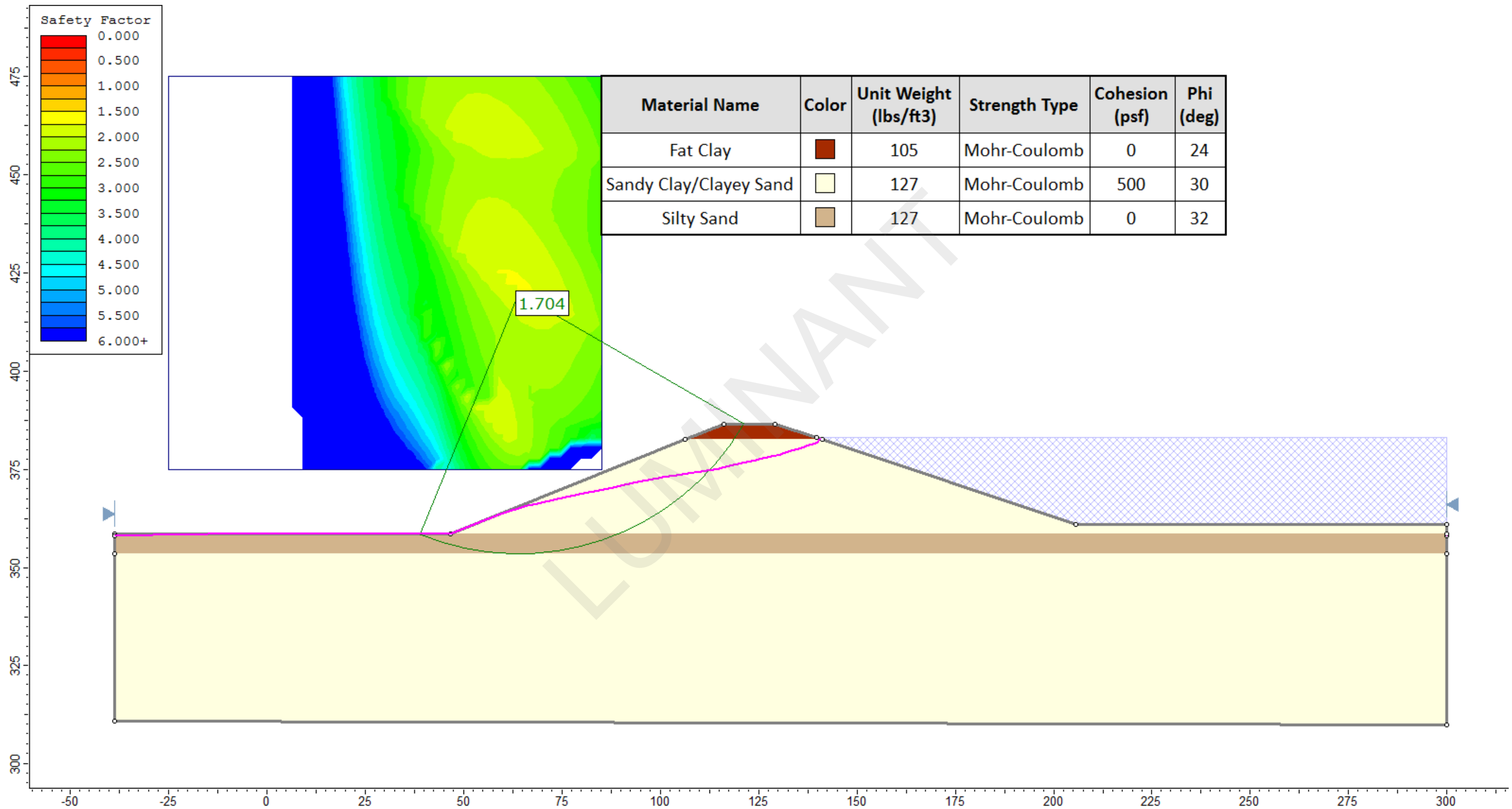
FAILURE SKETCH

Consolidation Stress (σ'_3, psf) =			2867.8
Consolidation t_{50} (min) =			9
Consolidation Volume Change (mL) =			9.7
Unloading Stress (psf) =			NA
Unloading t_{50} (min) =			NA
Unloading Volume Change (mL) =			NA
LL =	42	PI =	25
USCS	CL		
Gs =	2.65	assumed	

Performed by PN
Reviewed by HR

Golder Associates

APPENDIX D
SLOPE STABILITY ANALYSIS RESULTS

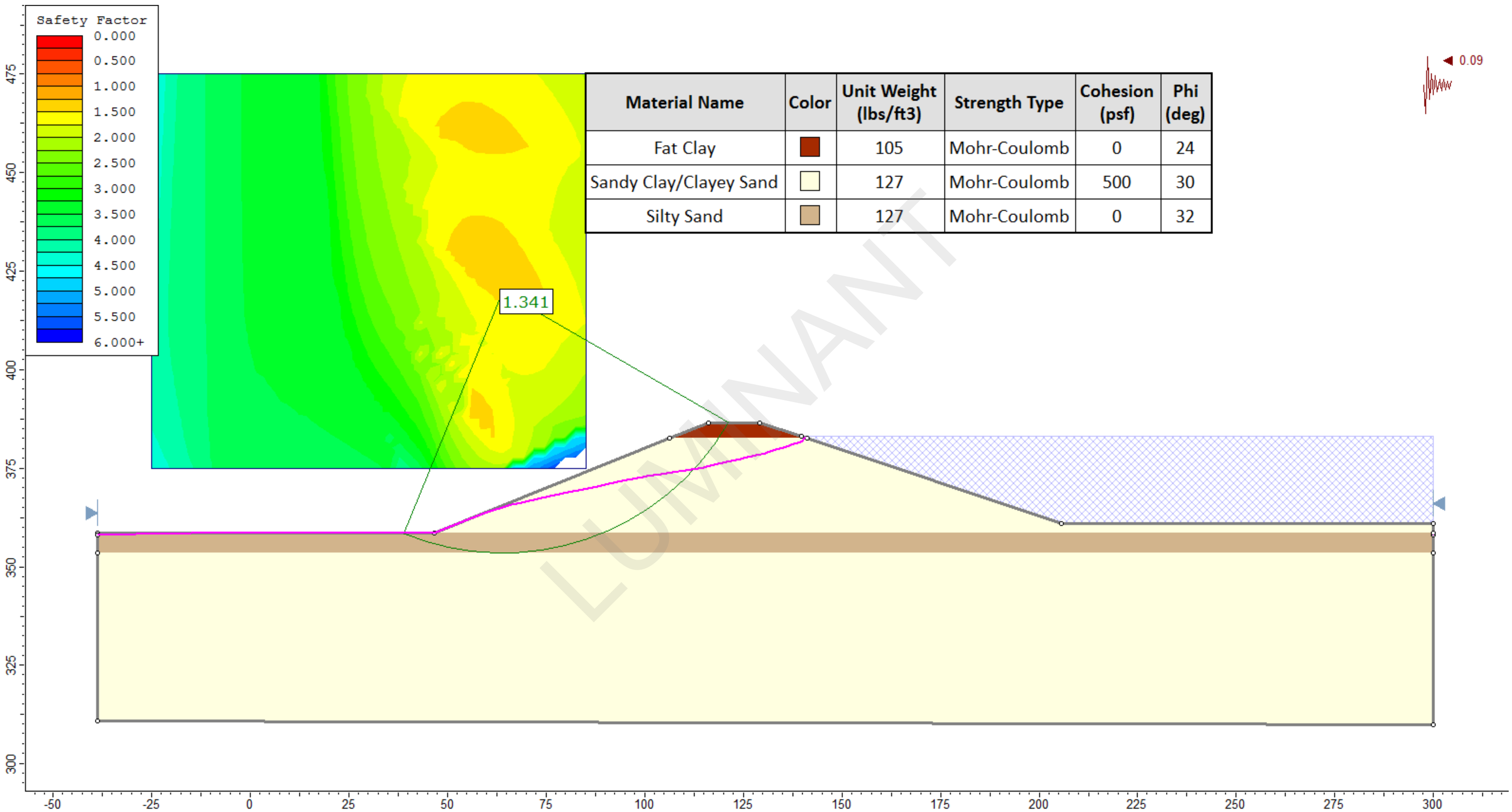


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fat Clay		105	Mohr-Coulomb	0	24
Sandy Clay/Clayey Sand		127	Mohr-Coulomb	500	30
Silty Sand		127	Mohr-Coulomb	0	32

FIGURE **C.1**

Results of Stability Analysis – BAP: A–A' – Case 1a

Stability and Safety Factor Assessment, Monticello SES

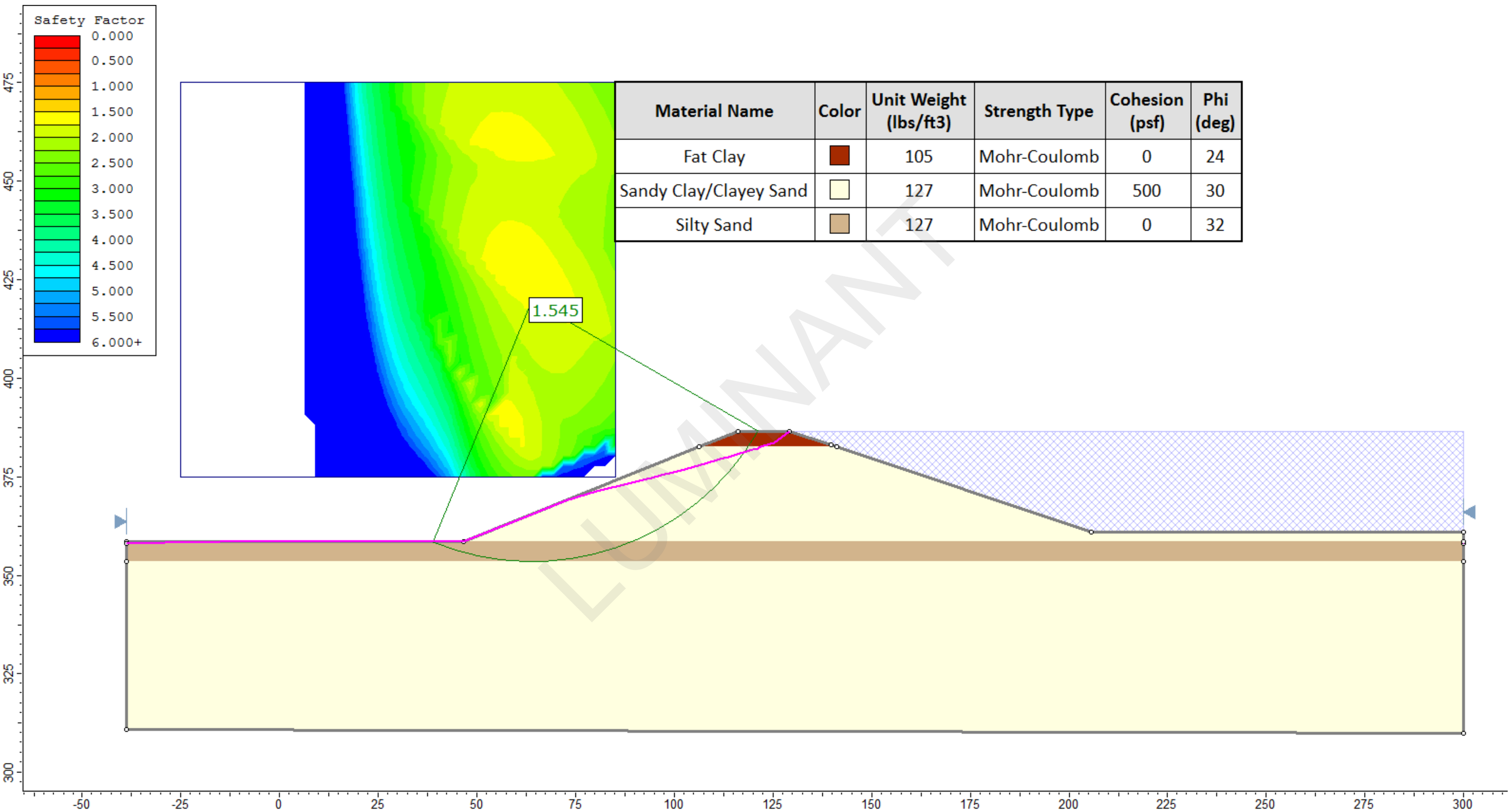


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fat Clay		105	Mohr-Coulomb	0	24
Sandy Clay/Clayey Sand		127	Mohr-Coulomb	500	30
Silty Sand		127	Mohr-Coulomb	0	32

FIGURE **C.2**

Results of Stability Analysis – BAP: A–A' – Case 1b

Stability and Safety Factor Assessment, Monticello SES

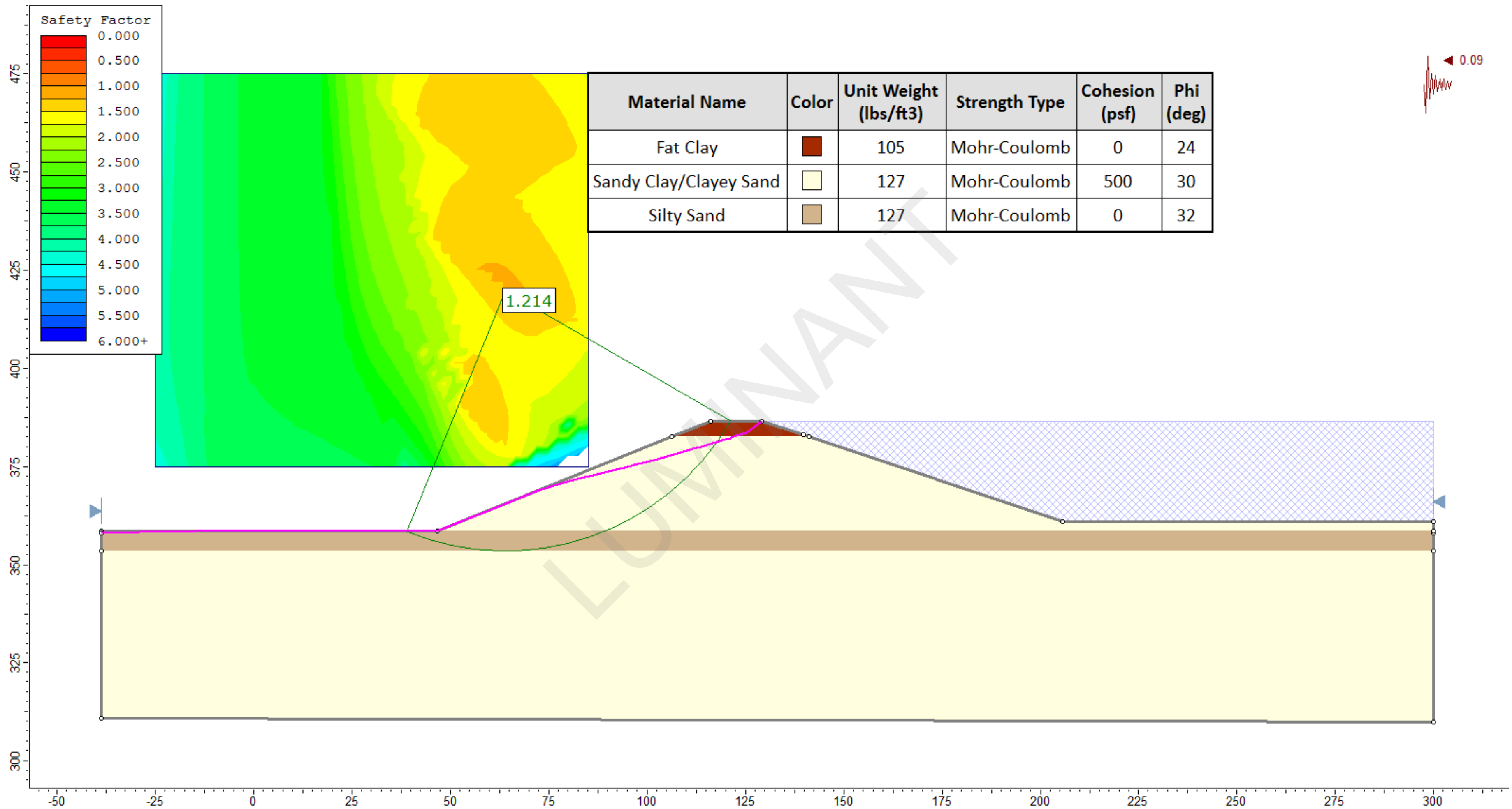


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fat Clay		105	Mohr-Coulomb	0	24
Sandy Clay/Clayey Sand		127	Mohr-Coulomb	500	30
Silty Sand		127	Mohr-Coulomb	0	32

FIGURE **C.3**

Results of Stability Analysis – BAP: A–A' – Case 2a

Stability and Safety Factor Assessment, Monticello SES

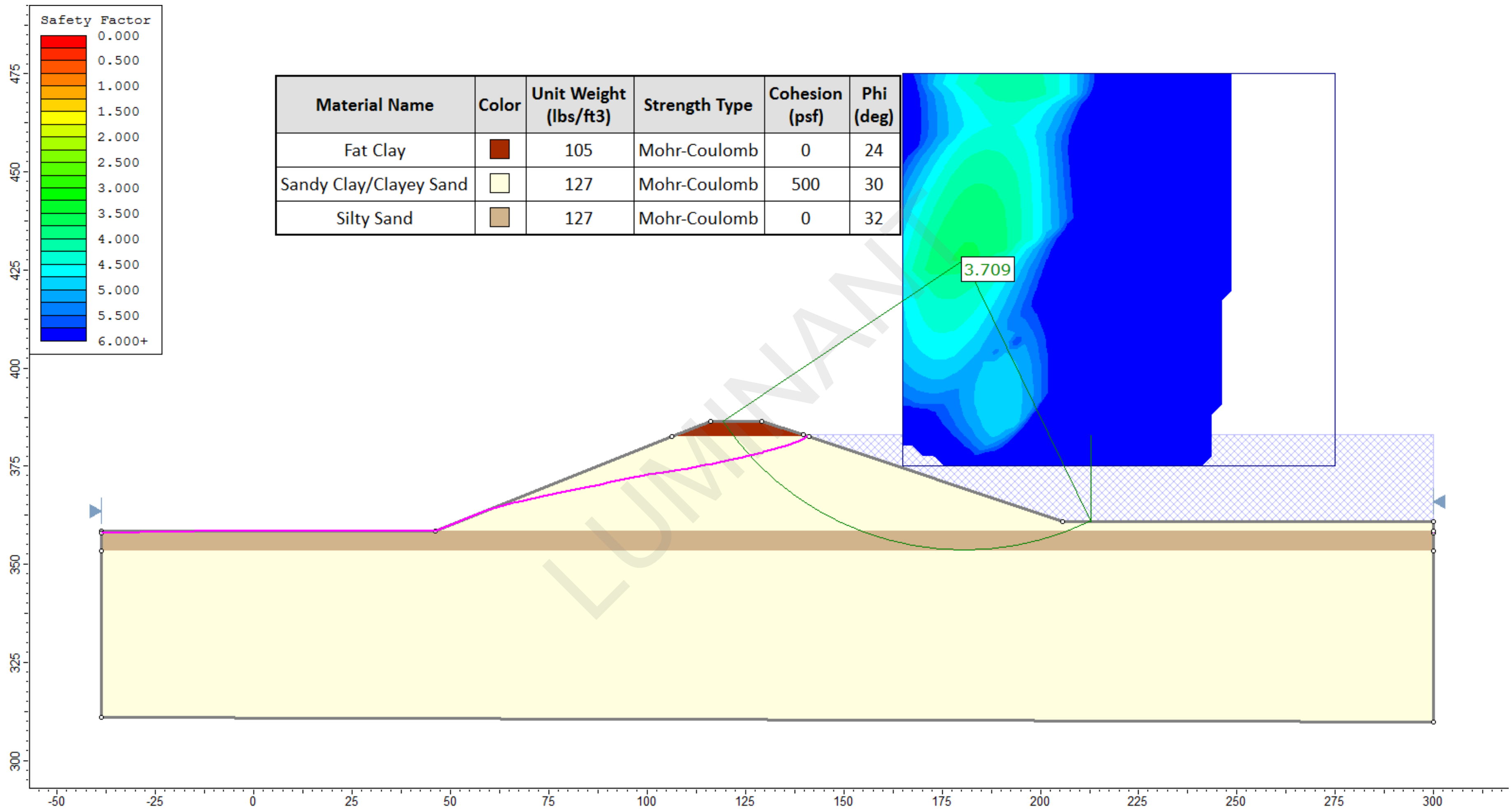


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fat Clay		105	Mohr-Coulomb	0	24
Sandy Clay/Clayey Sand		127	Mohr-Coulomb	500	30
Silty Sand		127	Mohr-Coulomb	0	32

FIGURE **C.4**

Results of Stability Analysis – BAP: A–A' – Case 2b

Stability and Safety Factor Assessment, Monticello SES

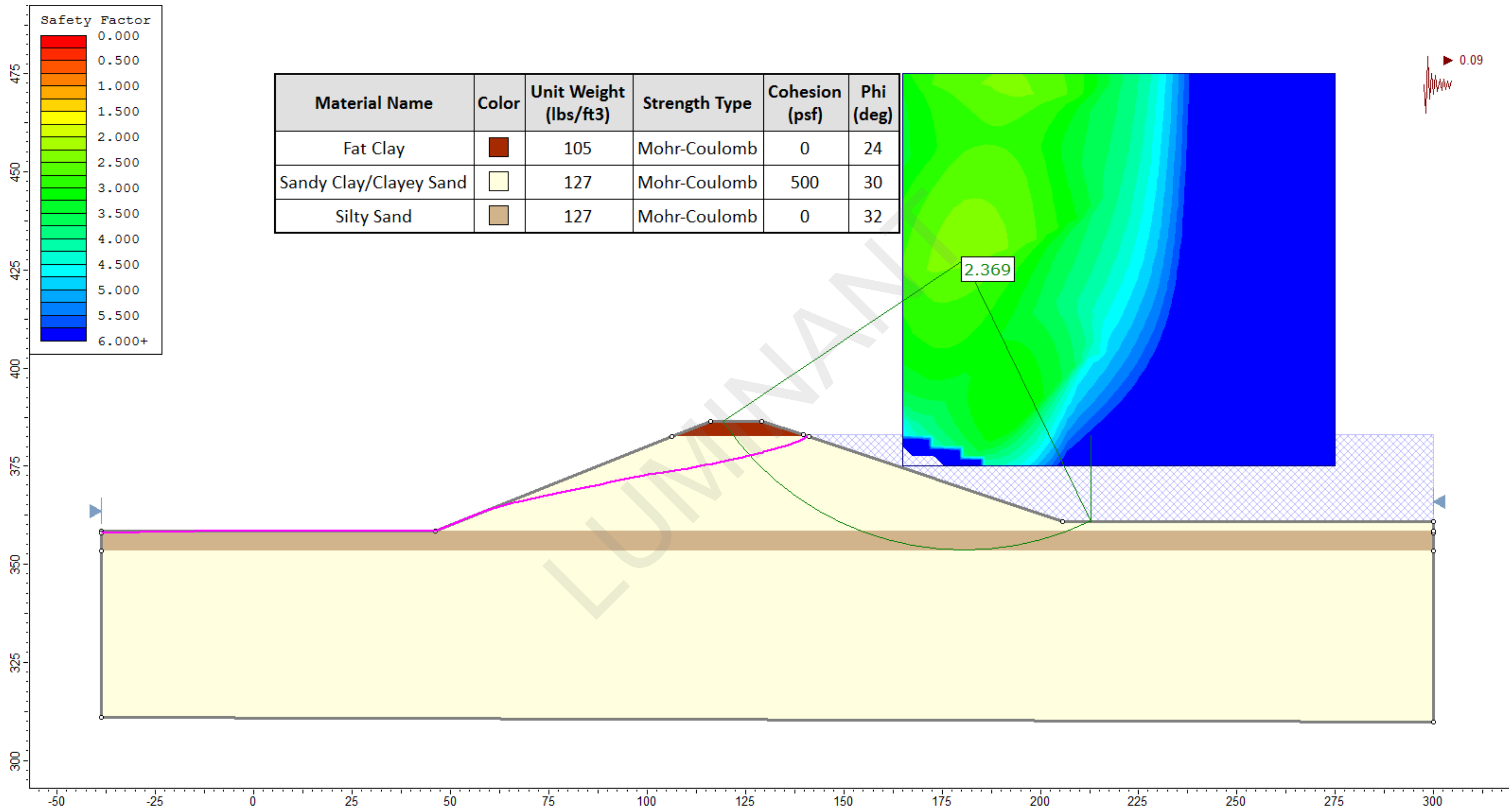


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fat Clay		105	Mohr-Coulomb	0	24
Sandy Clay/Clayey Sand		127	Mohr-Coulomb	500	30
Silty Sand		127	Mohr-Coulomb	0	32

FIGURE **C.5**

Results of Stability Analysis – BAP: A–A' – Case 3a

Stability and Safety Factor Assessment, Monticello SES

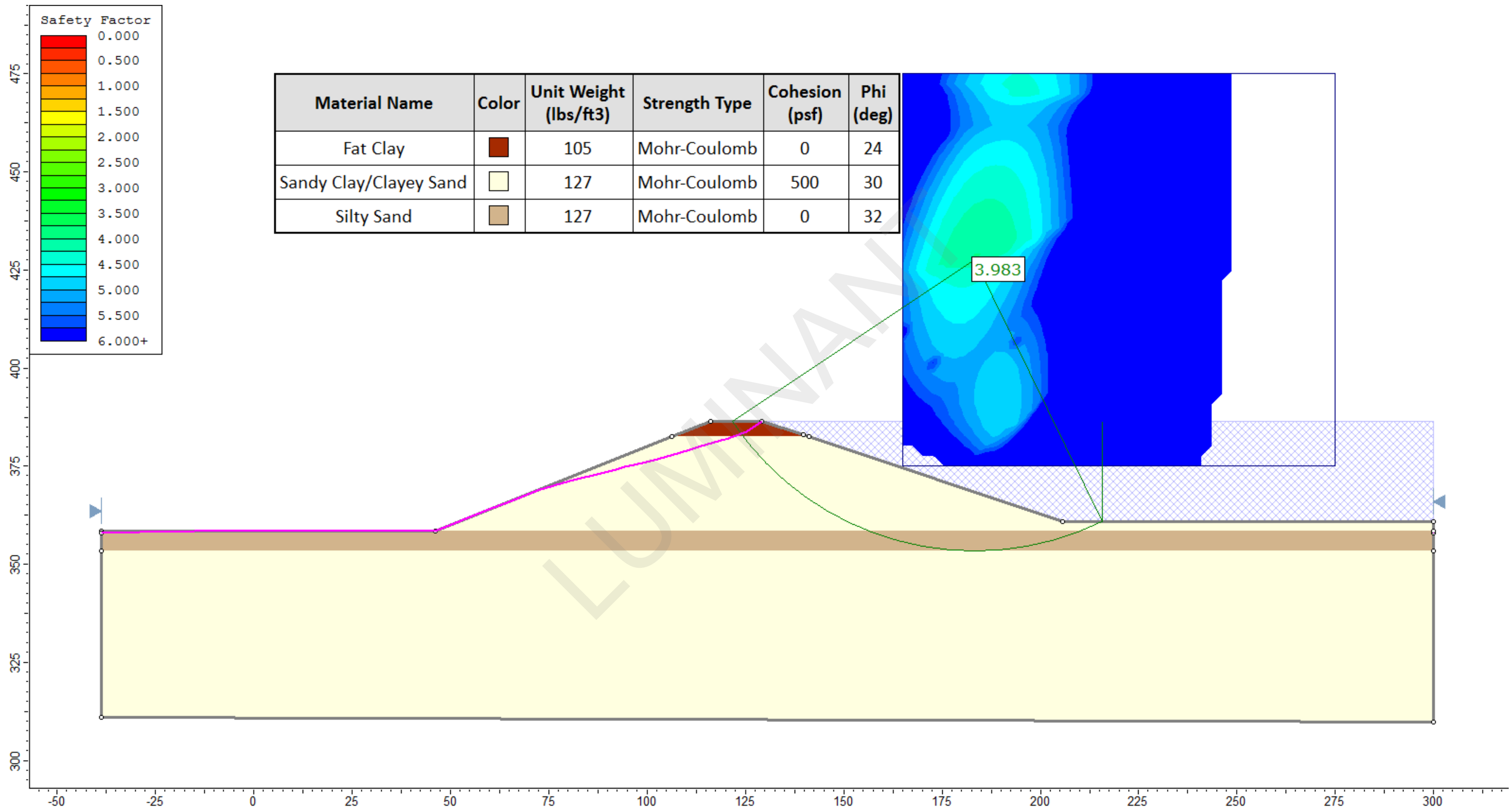


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fat Clay		105	Mohr-Coulomb	0	24
Sandy Clay/Clayey Sand		127	Mohr-Coulomb	500	30
Silty Sand		127	Mohr-Coulomb	0	32

FIGURE **C.6**

Results of Stability Analysis – BAP: A–A' – Case 3b

Stability and Safety Factor Assessment, Monticello SES

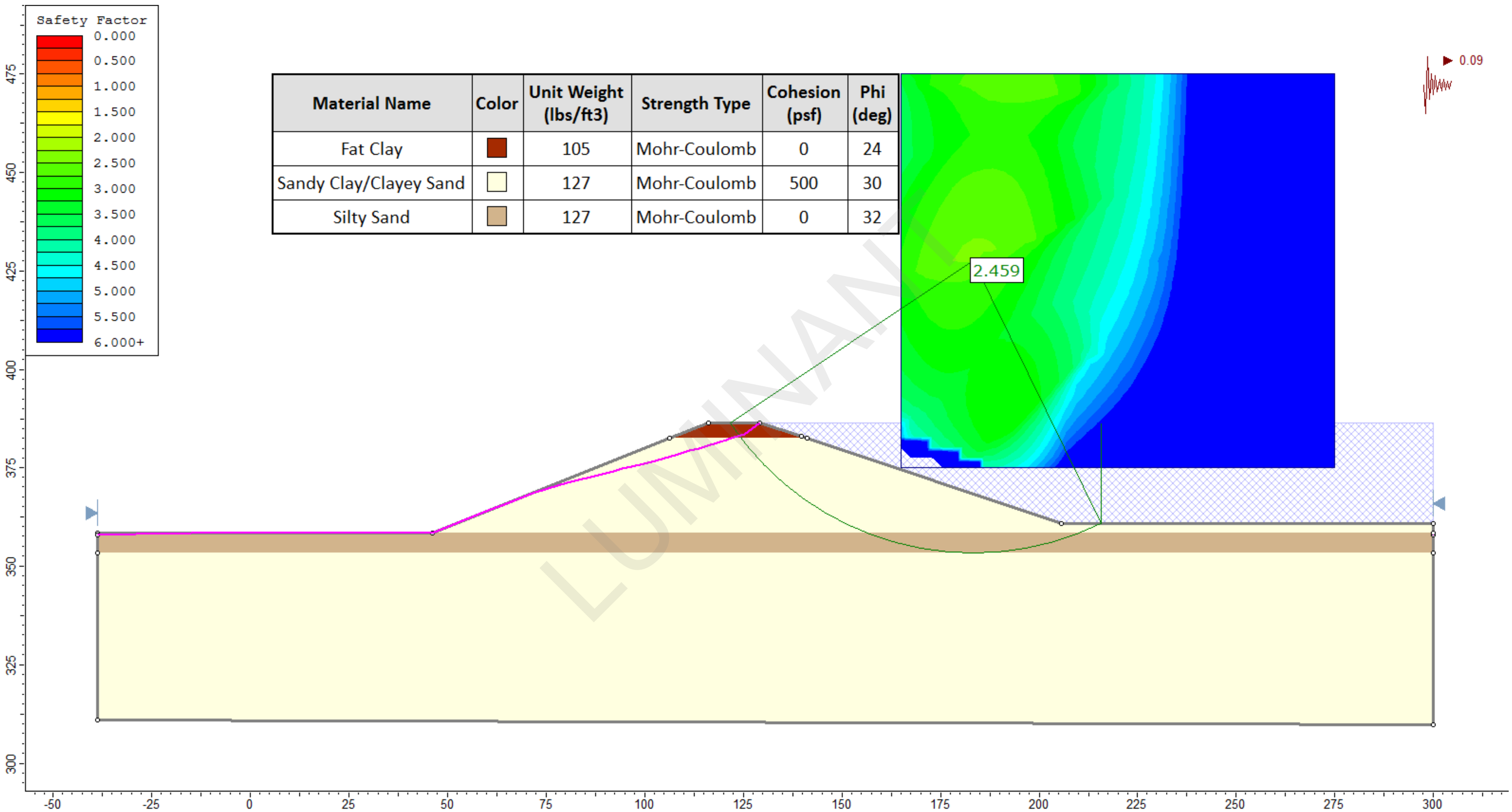


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fat Clay		105	Mohr-Coulomb	0	24
Sandy Clay/Clayey Sand		127	Mohr-Coulomb	500	30
Silty Sand		127	Mohr-Coulomb	0	32

FIGURE **C.7**

Results of Stability Analysis – BAP: A–A' – Case 4a

Stability and Safety Factor Assessment, Monticello SES

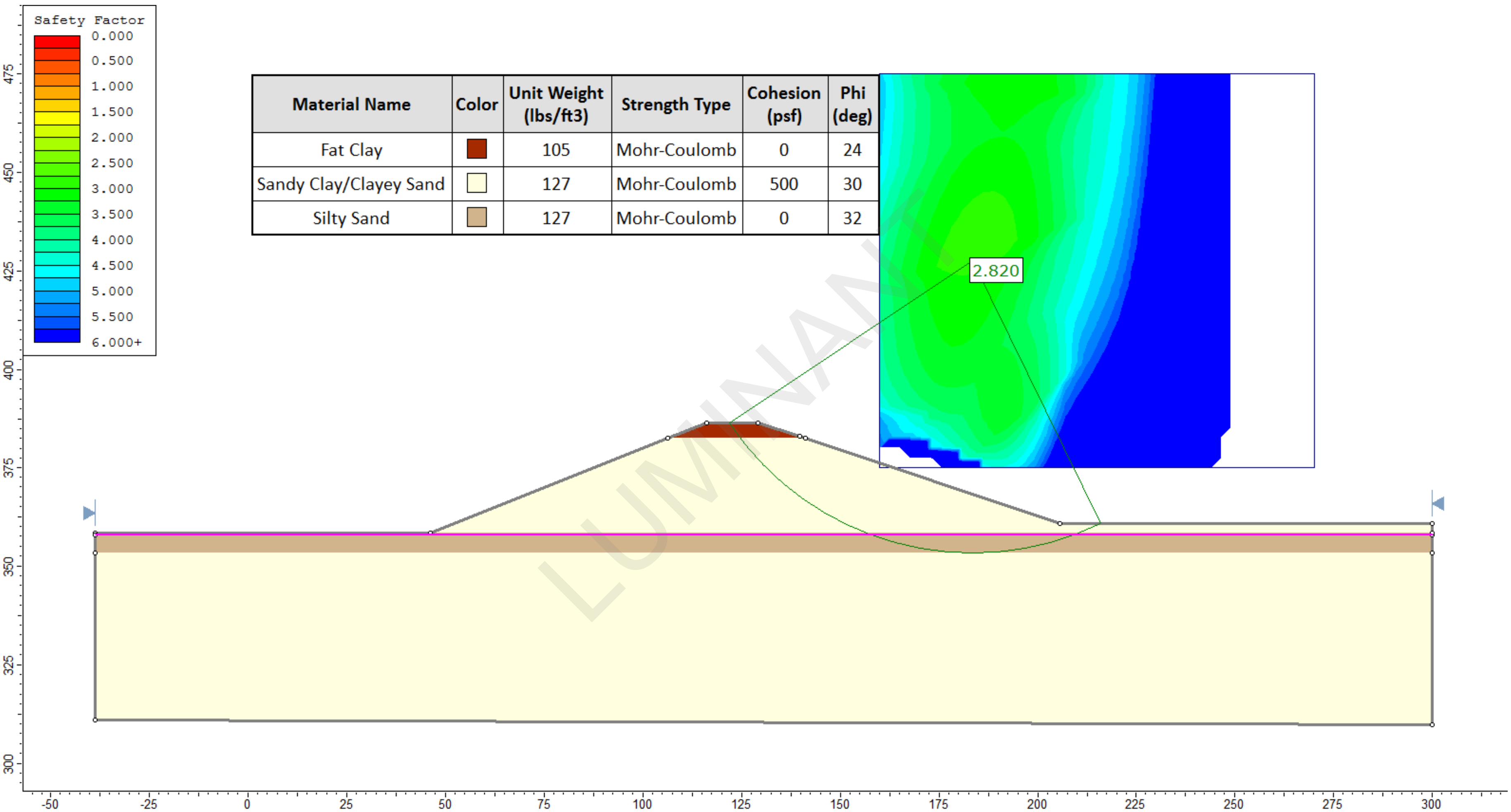


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fat Clay		105	Mohr-Coulomb	0	24
Sandy Clay/Clayey Sand		127	Mohr-Coulomb	500	30
Silty Sand		127	Mohr-Coulomb	0	32

FIGURE **C.8**

Results of Stability Analysis – BAP: A–A' – Case 4b

Stability and Safety Factor Assessment, Monticello SES

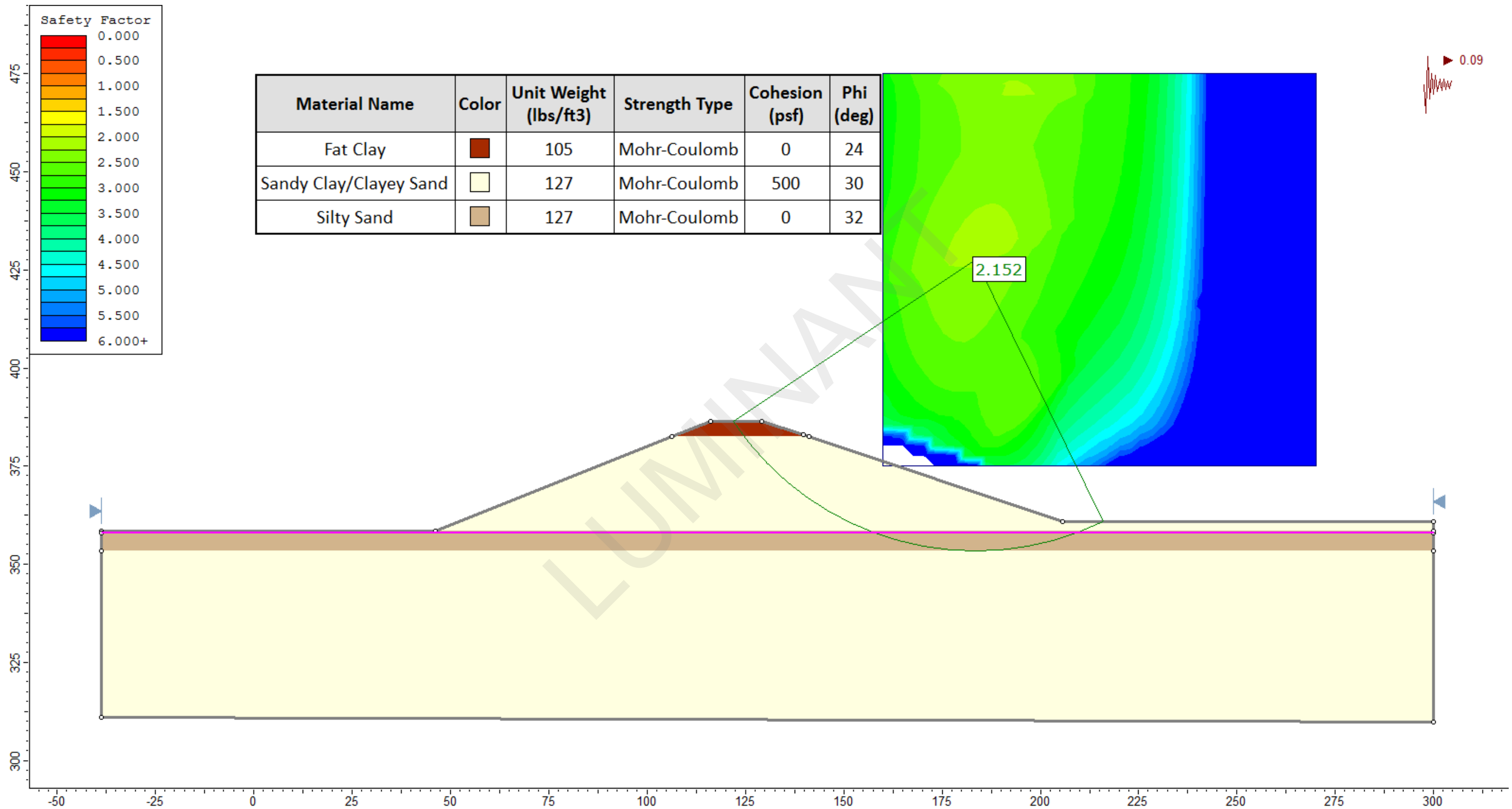


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fat Clay		105	Mohr-Coulomb	0	24
Sandy Clay/Clayey Sand		127	Mohr-Coulomb	500	30
Silty Sand		127	Mohr-Coulomb	0	32

FIGURE **C.9**

Results of Stability Analysis – BAP: A–A' – Case 5a

Stability and Safety Factor Assessment, Monticello SES



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fat Clay		105	Mohr-Coulomb	0	24
Sandy Clay/Clayey Sand		127	Mohr-Coulomb	500	30
Silty Sand		127	Mohr-Coulomb	0	32

FIGURE **C.10**

Results of Stability Analysis – BAP: A–A' – Case 5b

Stability and Safety Factor Assessment, Monticello SES

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