CLECO POWER LLC
BRAME ENERGY CENTER

5-YEAR PERIODIC REVIEW
SAFETY FACTOR ASSESSMENT

BOTTOM ASH POND

OCTOBER 2021

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Providence Project No: 002-292

PROVIDENCE

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1.0 INTRODUCTION

Providence was contracted by Cleco Power LLC (Cleco) to conduct the 5-year periodic review of the safety factor assessment of the Bottom Ash Pond at Cleco's Brame Energy Center. The Coal Combustion Residual (CCR) regulations at 40 CFR 257.73(e)(1) established requirements for owners and operators to conduct safety factor assessments to document whether the calculated factors of safety for the Bottom Ash Pond achieve the minimum safety factors specified below:

- 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.
- For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.

This 5-year periodic review of the safety factor assessment pertains to the Bottom Ash surface impoundment (Pond) that is utilized for the Rodemacher Unit 2 coal-fired generation unit. The Brame Energy center is located approximately 6 miles southeast of Lena, Rapides Parish, Louisiana. A site location map is included as **Figure 1**. The Bottom Ash Pond is shown on **Figure 2**.

2.0 FACTORS OF SAFETY

Providence performed a review of the 2016 safety factor analysis (slope stability analysis) for the levees surrounding the Bottom Ash Pond. The Bottom Ash Pond was initially constructed by excavating material from within the footprint of the pond and using that material for the construction of the perimeter levees. The northwest perimeter of the pond was cut out of an existing terrace area. This analysis required a review of the original permit and construction drawings for the Bottom Ash Pond, a review of the topographic survey of the perimeter levees of the Bottom Ash Pond, a review of borings in the perimeter levees for the soil conditions that exist within the perimeter levee system for these ponds, and a review of the safety factor models and calculations.

Providence mobilized to the Brame Energy Center in June of 2011 and again in April of 2016 to install geotechnical borings in the perimeter levees of the Bottom Ash Pond. Geotechnical Testing Laboratory, Inc. installed four borings spaced approximately 500 feet apart along the center line of the levee in 2011 and three additional borings in 2016. Soil profiles were generated for sections along the Bottom Ash Pond that shows the results of the geotechnical borings and the laboratory analysis. **Table 1** shows the soil profiles for each section and the characteristics used for the safety factor modeling.

Table 1 Subsurface Soil Classification and Parameters

	Soil	Depth (ft)	Unit Wt. (lb/ft^3)	Cohesion (lb/ft^2)	Friction Angle(Φ)
Bottom Ash Pond Section 1 B-13	**CL**	1.5	120	1,100	-
	CL-CH	2.0	120	550	-
	CH	9.5	106	250	-
	SP-SM	19.5	115	0	30
	SM	23.5	115	0	30
	CL	16.5	120	1,760	-
	SP-SM	6.5	115	0	30
Bottom Ash Pond Section 2 B-12	**Soil**	**Depth (ft)**	**Unit Wt. (lb/ft^3)**	**Cohesion (lb/ft^2)**	**Friction Angle(Φ)**
	SM	4.0	115	0	30
	CL	2.0	115	1,500	-
	SM	6.0	115	0	30
	SP-SM	11.5	115	0	30
	SP	8.5	115	0	30
	CL-CH	6.0	120	1,500	-
	SP	24.0	115	0	30
Bottom Ash Pond Section 3 B-3	**Soil**	**Depth (ft)**	**Unit Wt (lb/ft^3)**	**Cohesion (lb/ft^2)**	**Friction Angle(Φ)**
	Cl-ML	7.5	130	375	-
	SM-SC	9.0	115	250	24
	SP-SM	15.5	115	350	20
	CH	40.0	133	850	-
	SC	11.0	130	750	-
	CL-CH	17.0	121	1,000	-

The safety factor analysis uses the strength of the soil material of which the levee is made of and subgrade to assess levee stability in accordance with existing conditions. The Spencer Method for slope stability was used since it is the most conservative approach. The Spencer Method is a general method of slices developed on the basis of limit equilibrium. It requires satisfying equilibrium of forces and moments acting on individual blocks. The blocks are created by dividing the soil above the slip surface by dividing planes. Deep failure analysis evaluates the potential of the levees to fail through the bottom of the levees into the existing native soils. The analysis was based upon the following assumptions and input parameters.

- The subgrade stratigraphy was modeled using soil profiles from completed soil borings at the site with the soil profile condition at each section for each pond through the entire levee system. (**Table 1**)

- The height, interior, and exterior slopes of the levees were determined based on actual field surveys and previous permitting and design data. The bottom elevation was determined based on the previous permitting and design information provided by Cleco.
- The input parameters used in our analyses were based upon results from geotechnical investigations conducted for this safety factor analysis. **Appendix A** includes a copy of the geotechnical results as provided by the geotechnical contractor.
- The fill material in the pond was assumed to be water for the Bottom Ash Pond. Maximum water elevation in the Bottom Ash Pond is 103.5 feet NAVD 88.

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

In 2016, Providence modeled the pond under the long-term, maximum storage to the freeboard level for the Bottom Ash Pond. The current operational status of the Bottom Ash Pond has not changed since 2016, therefore, after a review of the results of the 2016 slope stability analysis Providence has determined that the following minimum factors of safety will remain the same:

Table 2 Long-Term Factors of Safety

Surface Impoundment	Section Number	Soil Boring No.	Maximum Water Elevation (feet NAVD 88)	Analysis	Factor of Safety
Bottom Ash	Section 1	B-13	103.5	Spencer Method Deep Failure	1.68
Bottom Ash	Section 2	B-12	103.5	Spencer Method Deep Failure	2.32
Bottom Ash	Section 3	B-3	103.5	Spencer Method Deep Failure	1.60

The calculated long-term static factor of safety under maximum storage pool loading conditions is greater than 1.50, therefore these safety factors are adequate.

The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40

In 2016, Providence modeled the pond using a scenario where the facility allows the pond to fill to the freeboard level for the Bottom Ash Pond. This scenario represents the flood/heavy rainfall conditions. The flood/heavy rainfall freeboard elevation was determined using 2.5 feet of freeboard from the lowest levee crown elevation for this pond.

The current operational status of the Bottom Ash Pond has not changed since 2016, therefore, after a review of the results of the 2016 slope stability analysis, Providence has determined that the following minimum factors of safety will remain the same:

Table 3 Short-Term Factors of Safety

Surface Impoundment	Section Number	Soil Boring No.	Maximum Water Elevation (feet NAVD 88)	Analysis	Factor of Safety
Bottom Ash	Section 1	B-13	103.5	Spencer Model Deep Failure	1.52
Bottom Ash	Section 2	B-12	103.5	Spencer Model Deep Failure	1.52
Bottom Ash	Section 3	B-3	103.5	Spencer Model Deep Failure	1.54

The calculated short-term static factor of safety under maximum surcharge pool loading conditions is greater than 1.40, therefore these safety factors are adequate.

<u>The calculated seismic factor of safety must equal or exceed 1.00</u>

The Brame Energy Center is not located in a seismic area. The Louisiana Geological Survey and the United States Geological Survey classifies the entire state of Louisiana as a low seismic risk area. This low seismic risk classification denotes that the levels of horizontal shaking that have a 2 in 100 chance of being exceeded in a 50-year period range from 0-8% g where g is the acceleration of a falling object due to gravity. The nearest published fault system to the Brame Energy Center is approximately 100 miles away. Therefore, the calculated seismic factor of safety is not applicable to the Bottom Ash Pond.

<u>For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.2</u>

The clayey sands and poorly graded sands in the Bottom Ash Pond levees have greater N values to resist earthquake motions and acceleration; and the relative densities are greater than 35 to 40 percent, therefore these soils are not subject to liquefaction.

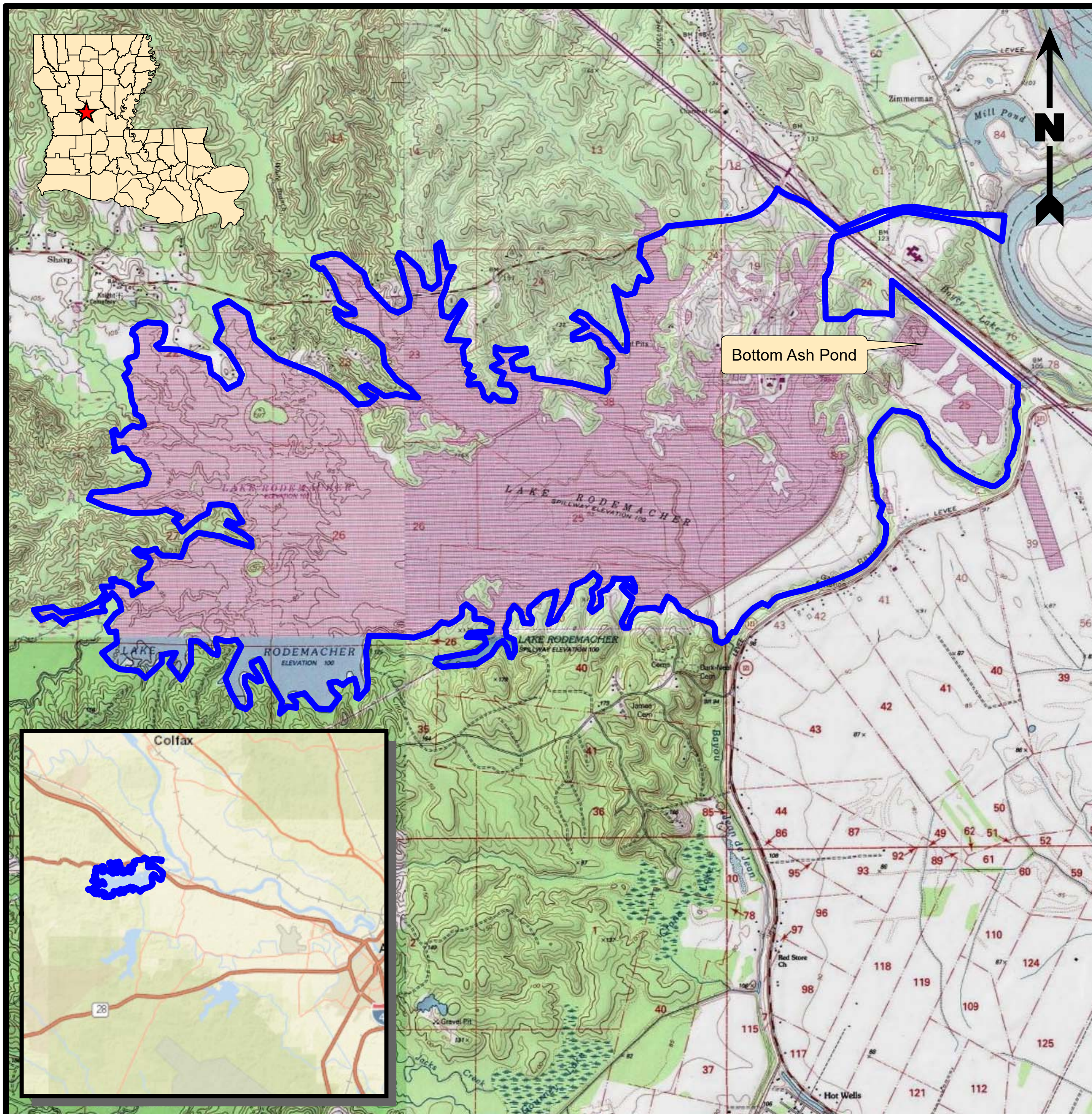
It must be noted that Cleco currently maintains the operating water levels in the Bottom Ash Pond at lower levels. The low operating levels for this pond will not adversely affect the structural stability of the perimeter levees around the Bottom Ash Pond. The normal operating water level in the Bottom Ash Pond ranges from 90 to 96 feet NAVD 88. These levels are significantly lower than the modeled flooded/heavy rainfall conditions.

3.0 CONCLUSIONS

After a review of the 2016 results from the safety factor analysis, the existing levee design for the Bottom Ash Pond achieves the minimum safety factor requirements of the 40 CFR 257.73(e)(1) CCR regulations. Results of the safety factor analysis and model input parameters can be found in **Appendix A**. **Appendix B** contains a P.E. Certification that attests to the 5-year periodic review of the safety factor assessment of the Bottom Ash Pond.

FIGURE 1

SITE LOCATION MAP



4,000 2,000 0 4,000 Feet

Legend

Property Boundary

Reference

Base map comprised of U.S.G.S. 7.5 minute topographic maps, "Lena, LA", "Boyce, LA", "Jericho, LA", and "Gardner, LA".

Site Location Map

5-Year Periodic Review
Safety Factor Assessment - Bottom Ash Pond
Boyce, Rapides Parish, Louisiana

Cleco Power LLC

Brame Energy Center

PROVIDENCE

Drawn By	LMH	09/21/21
Checked By	LMH	09/21/21
Approved By	CVH	09/21/21

Project Number
002-292

Drawing Number
002-292-A006

1
Figure

Providence Engineering and Environmental Group LLC

FIGURE 2

SITE MAP

Legend

Property Boundary

Reference

Base map comprised of Bing Maps aerial imagery from (c) 2021 Microsoft Corporation and its data suppliers.

1,000 500 0 1,000 Feet

Site Map

5-Year Periodic Review
Safety Factor Assessment - Bottom Ash Pond
Boyce, Rapides Parish, Louisiana

Cleco Power LLC
Brame Energy Center

PROVIDENCE

Drawn By	LMH	09/21/21
Checked By	LMH	09/21/21
Approved By	CVH	09/21/21

Project Number 002-292

Drawing Number 002-292-B007

2
Figure

APPENDIX A

SAFETY FACTOR ANALYSIS

APS Engineering and Testing

October 16, 2016

PROVIDENCE
1201 Main Street
Baton Rouge, LA 70802

Attn: Mr. Gary Leonards, P.E.

Re: Slope Stability Analysis of Bottom Ash Pond
Cleco Brame Energy Center
Lena, Louisiana

Dear Mr. Leonards:

APS Engineering and Testing, LLC has completed slope stability analysis of the Bottom Ash Pond located at Cleco Brame Energy Center in Lena, Louisiana. Authorization to proceed with this work was received from **Mr. Gary Leonards** via email on July 18, 2016. Our analysis was performed based on the soil boring log data provided by the client. Our scope of services included performing landside stability of the existing levee with maximum water elevation, as requested by the client. All sections were modeled and analyzed based on the survey data and soil boring data provided by the client. This report presents the results of Sections 1, 2 and 3 of the Bottom Ash Pond.

Background

The Bottom Ash Pond at the Brame Energy Center was initially constructed in 1981. The facility was expanded in 1982 when an additional coal fired boiler system (Unit #2) came on line. The bottom ash is sluiced to the Bottom Ash Pond. The Bottom Ash Pond is an existing unit that is essential for the management of solid residuals generated at the Brame Energy Center.

TABLE 1.0

Pond	Section #	Soil boring # (Report No.) *	Boring Depth (Feet)	Average Top of Levee Elevation (feet, NAVD88)	Pond Max. Water Elevation (feet, NAVD 88)
Bottom Ash	Section 1	B-13 (04-16-061)	80	109.8	103.5
	Section 2	B-12 (04-16-061)	80	123.3	103.5
	Section 3	B-3 (06-11-090)	80	107.9	103.5

*Boring data was obtained from Reports prepared by Geotechnical Testing Laboratory (GTL), Inc.

All three sections achieved the minimum desired factor of safety of 1.50. Please refer to *Attachments* of this report.

Assumptions and Observations:

- Soil layers are horizontal with uniform thickness.
- Soil layers encountered in Levee Centerline boring were used for the analysis.
- Cross section profiles limits were extended horizontally on the land side, whenever the failure plane passes the limits.

Slope Stability Analysis Results

Slope stability analysis was performed using Spencer method for both the short term and long term conditions as requested by the client. Changes in slopes, structural loadings, and other conditions may affect the results of slope stability analysis. Factors of safety (FoS) obtained from slope stability analysis results do meet 1.50 according to HSDRRS guidelines for Steady Water Level conditions.

TABLE 2.0

Soil Type	Phi	Cohesion (psf)
Silt (ML)	28°	0
Clay (CL/CH)	28°	0
Sand (SP / SM)	37°	0

TABLE 3.0

Pond	Section #	Condition	Flood Side Water Elevation (feet, NAVD88)	Factor of Safety Obtained	Notes
Bottom Ash Pond	1	Short Term	103.5	1.53	--
	1	Long Term	103.5	1.68	--
	2	Short Term	103.5	2.27	--
	2	Long Term	103.5	2.32	--
	3	Short Term	103.5	1.58	--
	3	Long Term	103.5	1.60	--

Based on the results presented in the above table, all three sections of the Bottom Ash Pond meet minimum required factor of safety with the projected maximum water elevation as shown in above table for both short term and long term conditions. This is based on the soil boring data provided by the client.

Liquefaction

Clayey sands and poorly graded sands present at the bottom ash project site have greater N values to resist the earthquake motions and acceleration. Also, the relative densities are more than 35 to 40 percent and therefore do not present susceptibility to liquefaction.

If you have any questions pertaining to this report, or if we may be of further service, please contact our office.

Respectfully submitted,
APS ENGINEERING AND TESTING, LLC

Sairam Eddanapudi, P.E.
Project Manager

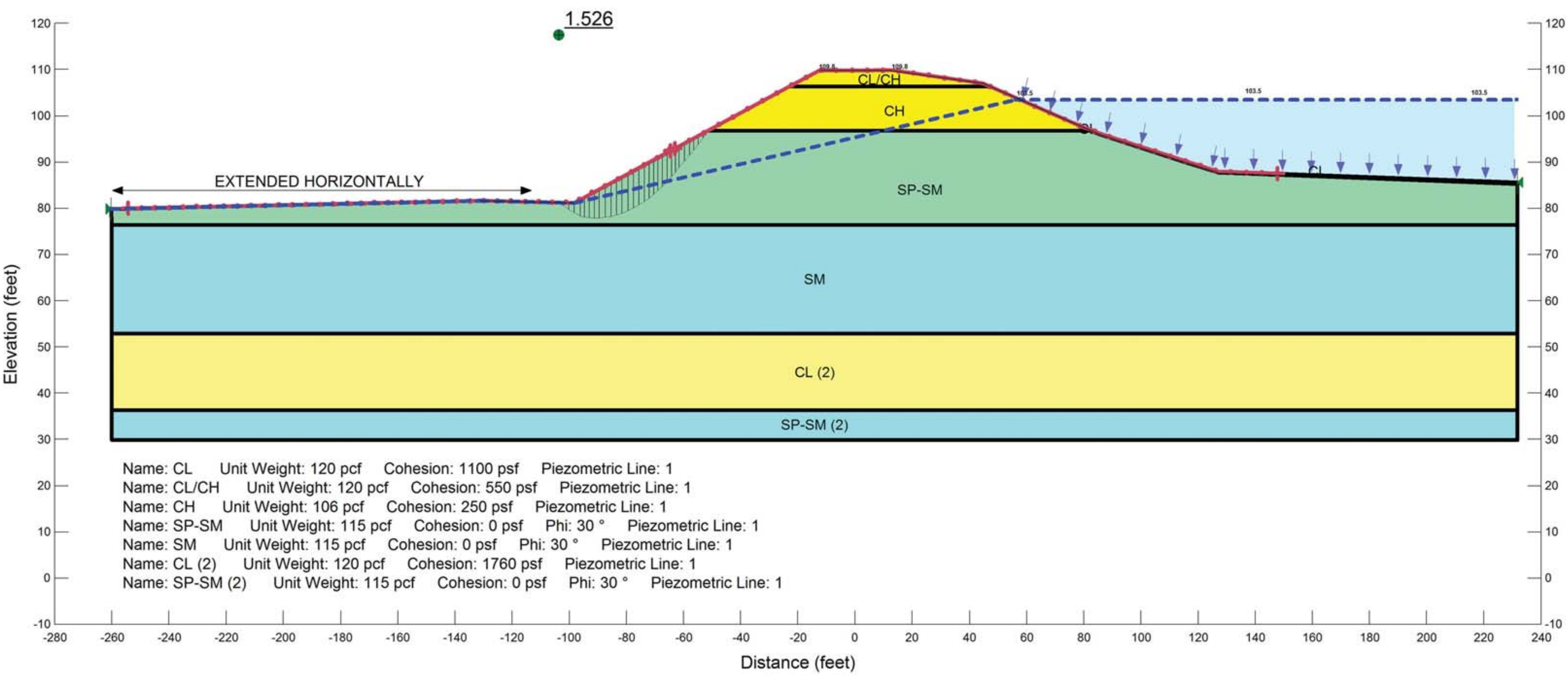
Sergio Aviles, P.E.
President

Attachments

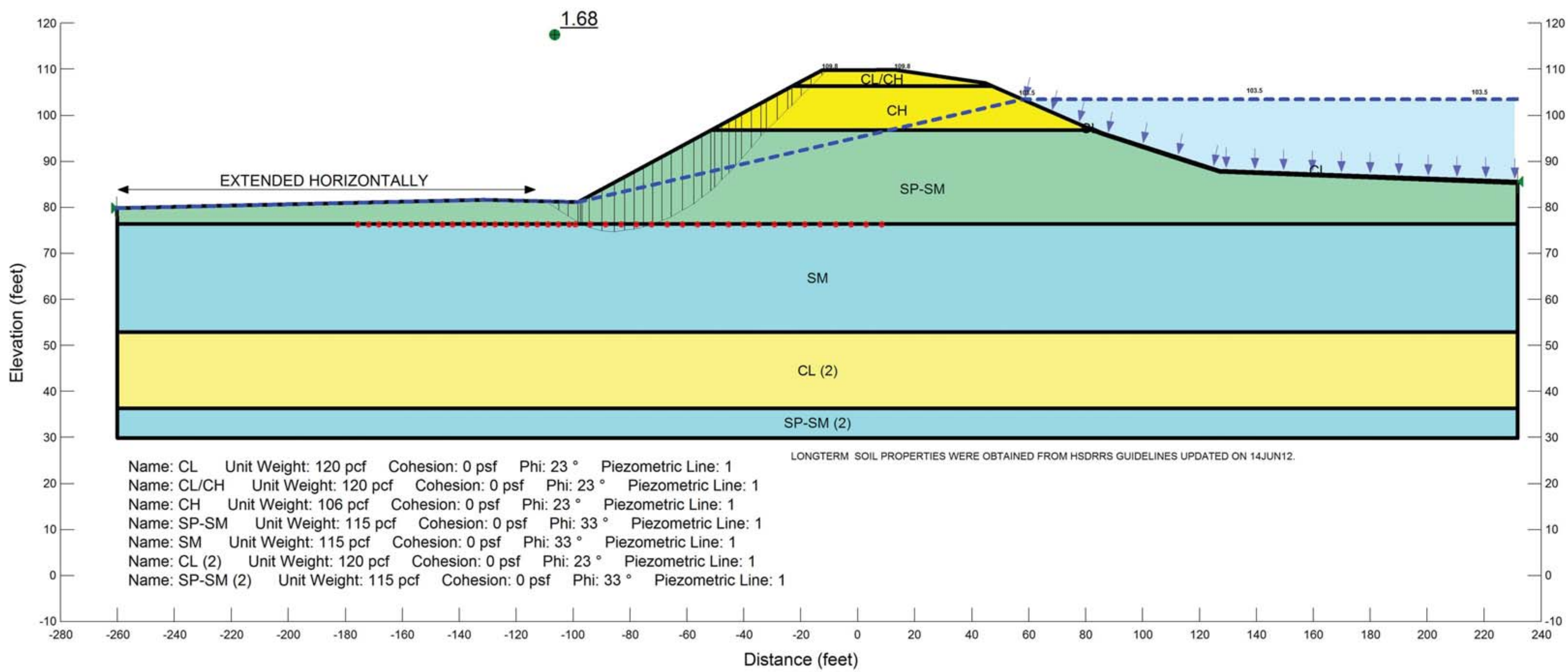
Boring Location Plan
Slope stability Analysis Results


B-1
B-2
B-3
B-4
B-5
B-6
B-7
B-8
B-9
B-10
B-11
B-12
B-13
B-14
B-15
TWO
THREE
ONE
Bottom Ash Pond
Fly Ash Pond
Ash Management Area
Leachate & Contact
Sorm Water Pond
LA Highway 1
Interstate 49
LA Highway 121
Image USDA Farm Service Agency

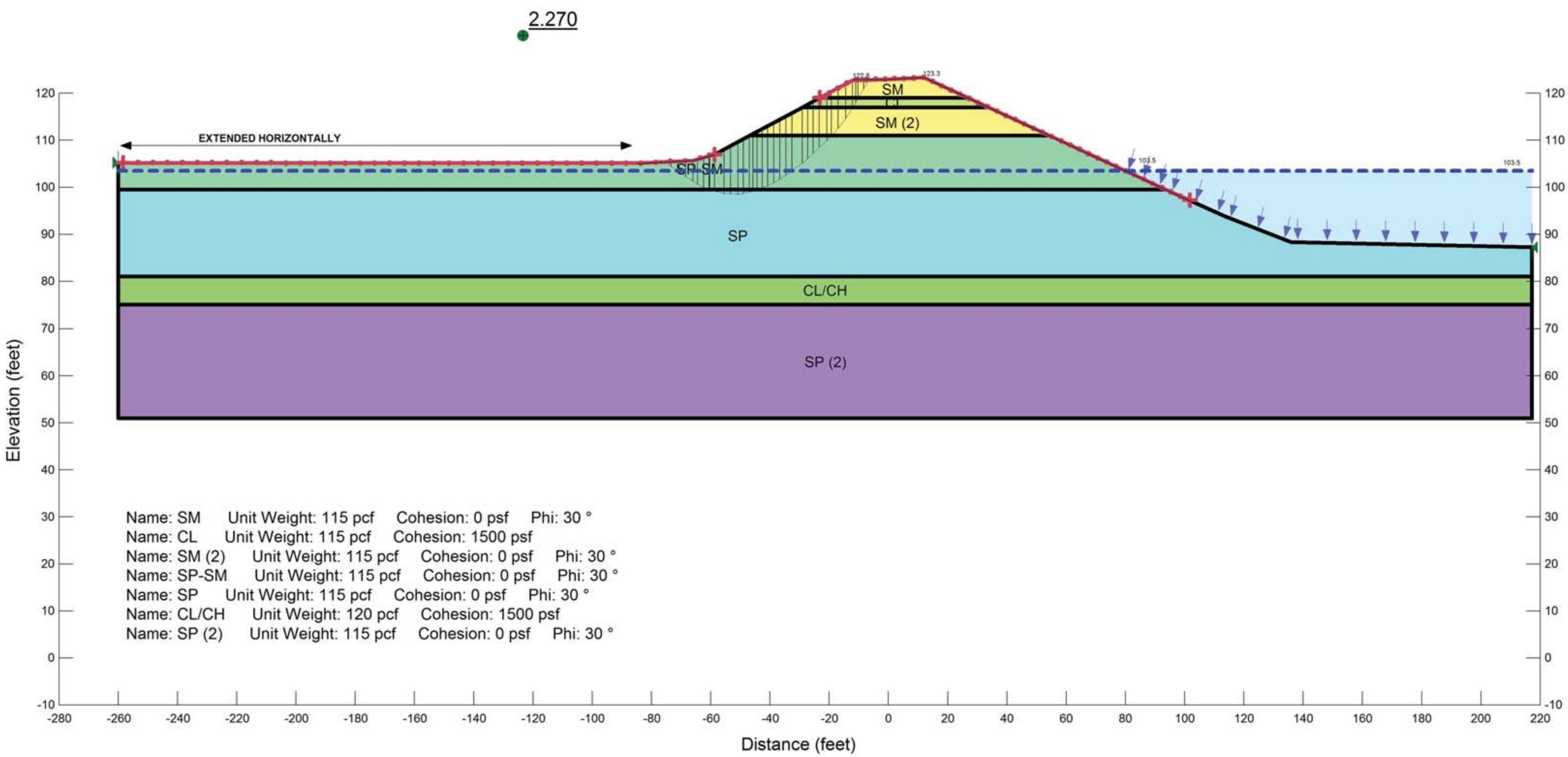
CLECO BRAME ENERGY CENTER
BOTTOM ASH POND - SECTION 1
SHORT TERM SLOPE STABILITY ANALYSIS
SOIL BORING B-13 (FROM GTL REPORT NO.: 04-16-061)



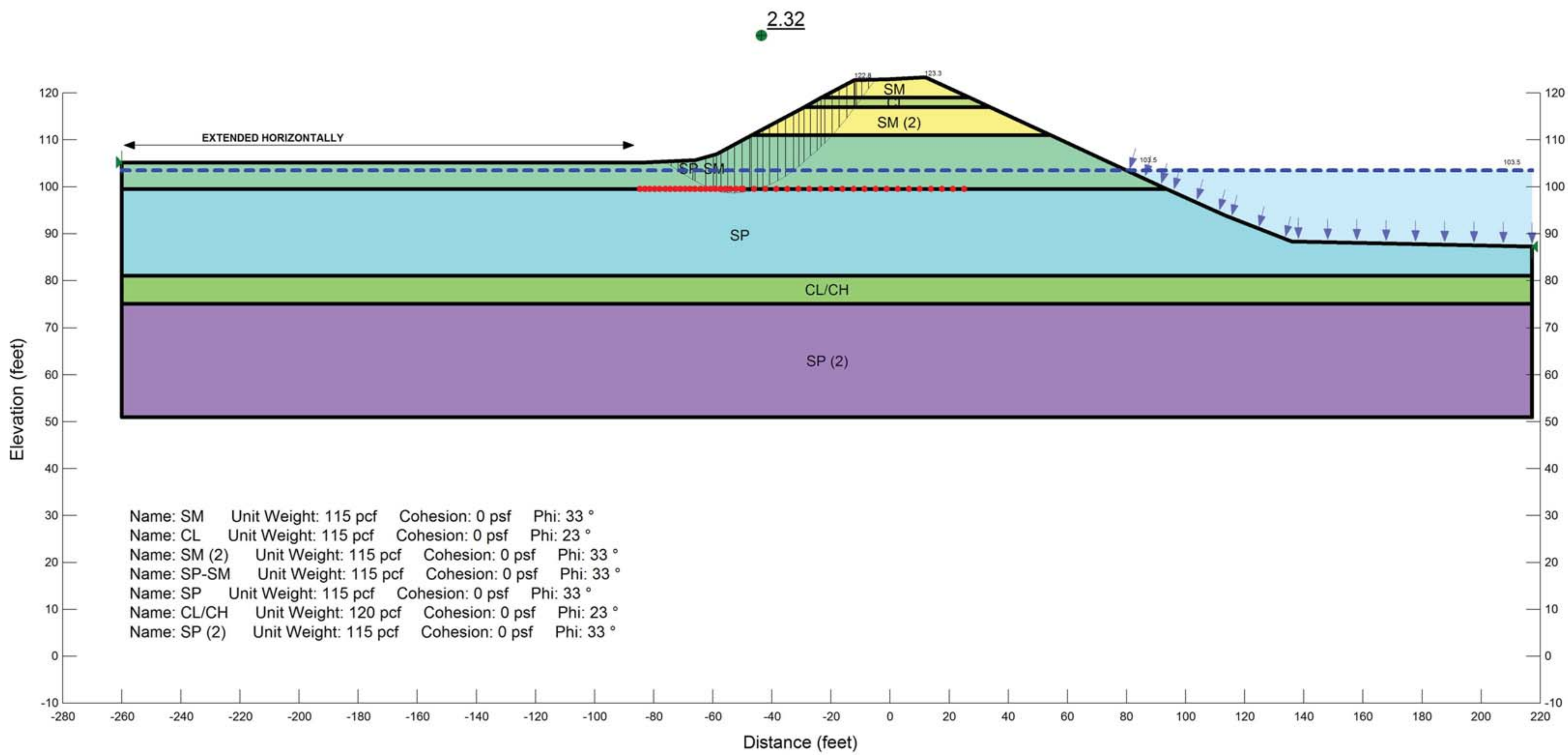
CLECO BRAME ENERGY CENTER
BOTTOM ASH POND - SECTION 1
LONG TERM SLOPE STABILITY ANALYSIS (S-CASE)
SOIL BORING B-13 (FROM GTL REPORT NO.: 04-16-061)



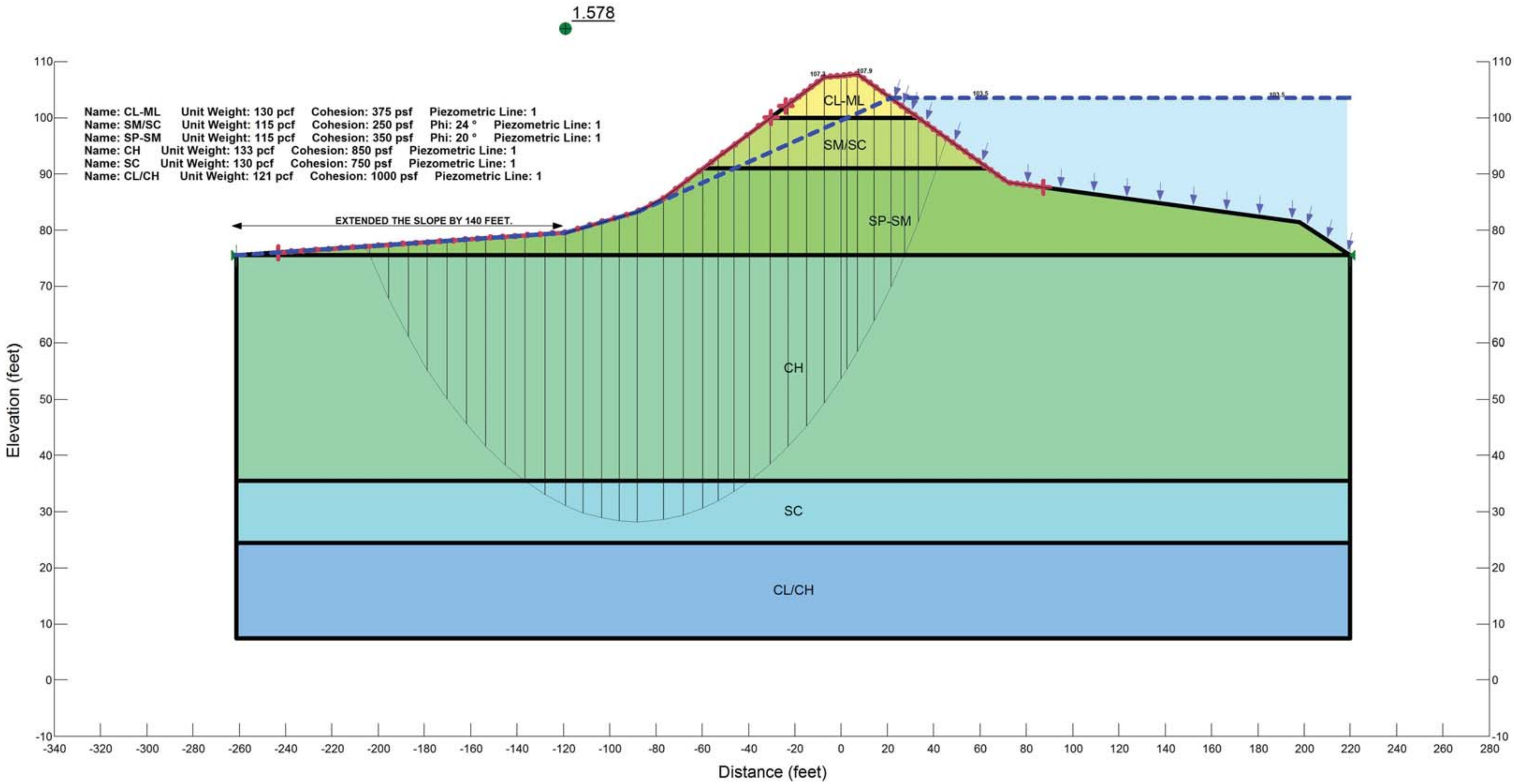
CLECO BRAME ENERGY CENTER
BOTTOM ASH POND - SECTION 2
SHORT TERM SLOPE STABILITY ANALYSIS
SOIL BORING B-12 (FROM GTL REPORT NO.: 04-16-061)



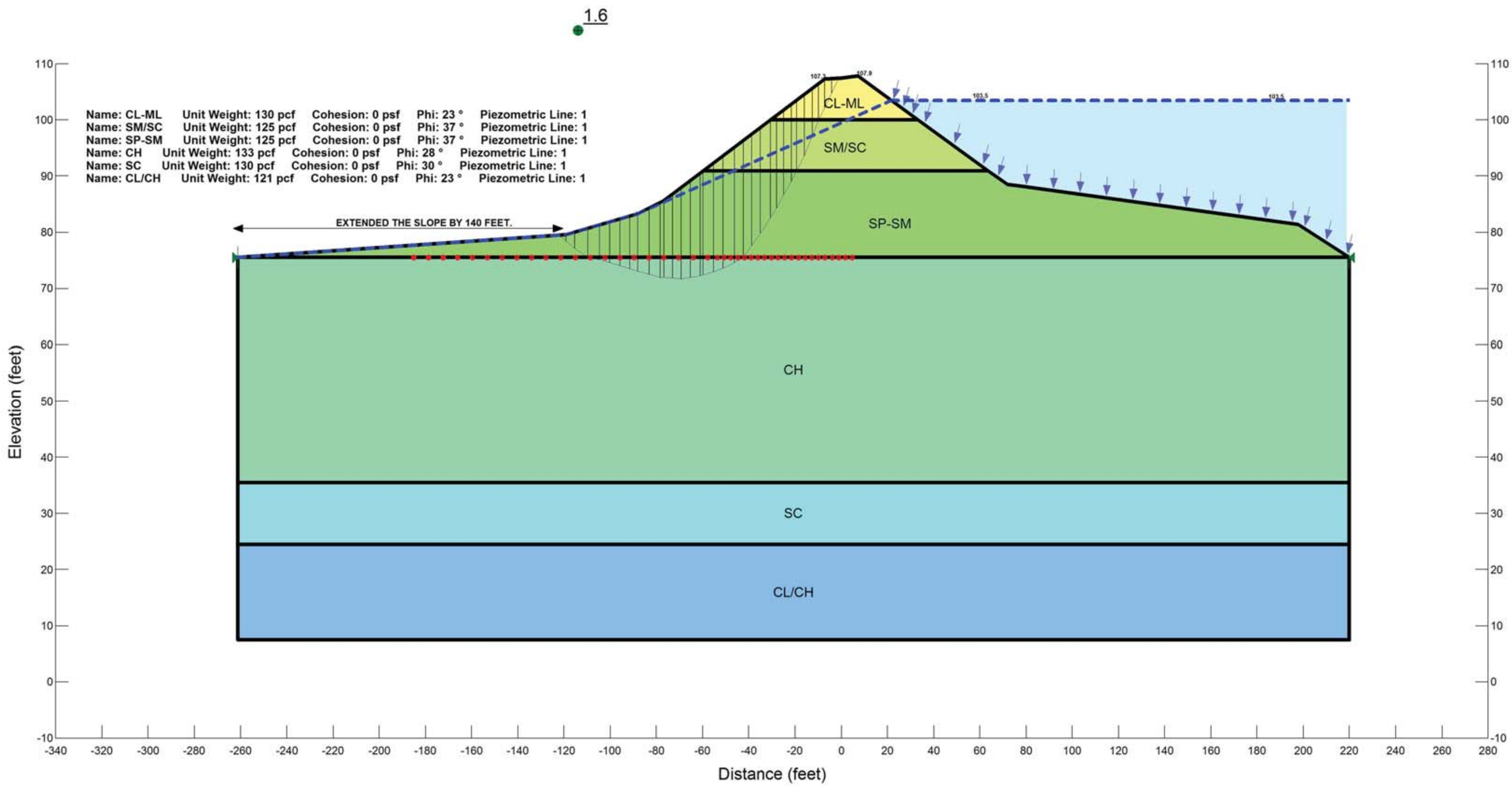
CLECO BRAME ENERGY CENTER
BOTTOM ASH POND - SECTION 2
LONG TERM SLOPE STABILITY ANALYSIS (S-CASE)
SOIL BORING B-12 (FROM GTL REPORT NO.: 04-16-061)



CLECO BRAME ENERGY CENTER
BOTTOM ASH POND - SECTION 3
SHORT TERM SLOPE STABILITY ANALYSIS
SOIL BORING B-3 (FROM GTL REPORT NO.: 06-11-090)



CLECO BRAME ENERGY CENTER
BOTTOM ASH POND - SECTION 3
LONG TERM SLOPE STABILITY ANALYSIS (S-CASE)
SOIL BORING B-3 (FROM GTL REPORT NO.: 06-11-090)



APPENDIX B

P.E. CERTIFICATION

CLECO BRAME ENERGY CENTER
BOTTOM ASH POND
5-YEAR PERIODIC REVIEW - CCR SAFETY FACTOR ASSESSMENT

PROFESSIONAL ENGINEER CERTIFICATION

I hereby certify that I have performed the 5-year periodic review of the safety factor assessment for Cleco's Brame Energy Center Bottom Ash Pond in accordance with the 40 CFR 257.73(e)(1) CCR requirements. This 5-year periodic review of the safety factor assessment has determined that the Bottom Ash Pond continues to meet the following requirements:

- 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.

And that these requirements were not applicable based on the findings:

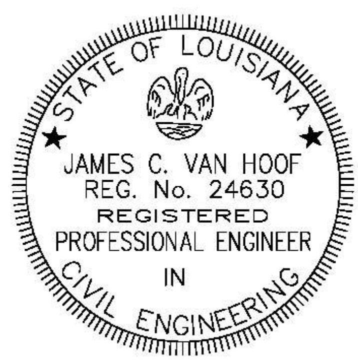
- The calculated seismic factor of safety must equal or exceed 1.00.
- For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.

James C. Van Hoof
Name

24630 — **LA**
Registration No. — State

James C. Van Hoof, P.E.
Signature

October 15, 2021
Date



(Seal)