solutions and action

**Interstate Power and Light Company**
Lansing Generating Station
CCR Surface Impoundment Safety Factor Assessment
154.018.029.002
Report issued: August 10, 2026 – Revision 2

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09/09/2026 - Classification: Internal - ECRM13805385

# Executive Summary

This Safety Factor Assessment (Report) for the former Lansing Generating Station (LAN) has been prepared in accordance with the requirements of the United States Environmental Protection Agency rules for Hazardous and Solid Waste Management System – Disposal of CCR from Electric Utilities (40 CFR Parts 257 and 261, also known as CCR Rule).

This Report serves as the second update of the safety factors assessment for the CCR impoundments in Lansing, Iowa in accordance with §257.73(b) and §257.73(e) of the CCR Rule. Primarily, this Report is focused on assessing if the LAN Upper Ash Pond achieves the minimum safety factors, which include:

- Static factor of safety under long-term, maximum storage pool loading condition,
- Static factor of safety under the maximum surcharge pool loading condition,
- Seismic factor of safety; and,
- Post-Liquefaction factor of safety for embankments constructed of soils that have susceptibility to liquefaction.



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**Appendix A** Soil Borings
**Appendix B** Soil Laboratory Testing
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**Appendix D** Slope Stability Analysis



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# 1. INTRODUCTION

The owner or operator of the Coal Combustion Residual (CCR) unit must conduct an initial and periodic safety factor assessment to determine if each CCR surface impoundment achieves the minimum safety factors, which include:

- Static factor of safety under long-term, maximum storage pool loading condition,
- Static factor of safety under the maximum surcharge pool loading condition,
- Seismic factor of safety; and,
- Post-Liquefaction factor of safety for embankments constructed of soils that have susceptibility to liquefaction.

Revision 2 of this Report has been prepared in accordance with the requirements of §257.73(b) and §257.73(e) of the CCR Rule.

## 1.1 CCR Rule Requirements

The CCR Rule requires a periodic safety factor assessment by a qualified professional engineer (PE) for existing, inactive, and legacy CCR surface impoundments with a height of 5 feet or more and a storage volume of 20 acre-feet or more; or the existing, inactive or legacy CCR surface impoundment has a height of 20 feet or more (40 CFR §§ 257.73(b) and 257.73(e)).

## 1.2 Safety Factor Assessment Applicability

The Interstate Power and Light Company (IPL), Lansing Generating Station (LAN) in Lansing, Iowa (Figure 1) has one existing CCR surface impoundment (identified as the LAN Upper Ash Pond) that meets the requirements of §257.73(b)(1) and/or §257.73(b)(2) of the CCR Rule.



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## 2. FACILITY DESCRIPTION

LAN is located approximately three miles southeast of Lansing, Iowa on the western shore of the Mississippi River in Allamakee County, at 2320 Power Plant Drive, Lansing, Iowa (Figure 1). LAN was a fossil-fueled electric generating station that had used four steam turbine electric generating units throughout its history. Unit 1, Unit 2, and Unit 3 were retired by 2014 and at that time, Unit 4 was the only remaining operating unit. Sub-bituminous coal was the primary fuel for producing steam at LAN. The CCR at LAN was categorized into three types: bottom ash, fly ash, and scrubber byproduct. Fly ash was collected by electrostatic precipitators and pneumatically conveyed to an onsite fly ash silo, which was equipped with a baghouse for dust control. The fly ash was then either transported off-site for beneficial reuse, landfilled (in the case of high loss on ignition), or sluiced to the former LAN Upper Ash Pond (typically during startup and shutdown). Bottom ash was sluiced to the former LAN Upper Ash Pond where it was dredged, dewatered, and transported to the onsite landfill. The former LAN Upper Ash Pond was located south of the generating plant. Scrubber byproduct consisted of fly ash, unreacted lime, and activated carbon. Scrubber byproduct was collected in the byproduct silo prior to being landfilled onsite.

A historical CCR surface impoundment at LAN, identified as the Lower Ash Pond, was located west of the generating plant and north of Power Plant Drive. The Lower Ash Pond was closed in September 2015 by removing the CCR from the surface impoundment via hydraulic dredge and sluicing the CCR to the south end of the former LAN Upper Ash Pond. CCR was removed from the Lower Ash Pond prior to backfilling the surface impoundment.



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In mid-2023, Unit 4 was retired and the facility terminated all operations. In 2022 and 2023, closure construction activities were conducted for the former LAN Upper Ash Pond. In 2024, the LAN buildings were decommissioned and demolished. Currently, IPL is building a battery energy storage system (BESS) project on the former plant site and adjacent to the existing electrical substation.

General Facility Information:

| | |
|---|---|
| Date of Initial Facility Operations: | 1946 |
| Historical NPDES Permit Number: | IA0300100 |
| Latitude / Longitude: | 41°56’38.43”N91°38’22.39”W |
| Unit Nameplate Ratings: | Unit 1 (1948): 16.6 MW (Retired) |
| | Unit 2 (1949): 11.4 MW (Retired) |
| | Unit 3 (1957): 35.8 MW (Retired) |
| | Unit 4 (1977): 270 MW (Retired) |

## 2.1 LAN Upper Ash Pond

The former LAN Upper Ash Pond was located southwest of the generating plant and south of Power Plant Drive. The former LAN Upper Ash Pond received influent flows from the Unit 4 boiler floor sumps, water treatment sumps, fly ash hydroveyor system, storm water runoff from the active dry ash landfill and hillside east of the impoundment, as well as sluiced fly ash and bottom ash. The former LAN Upper Ash Pond was the only receiver of sluiced CCR at LAN. The CCR was sluiced from the generating plant to the southeast corner of the former LAN Upper Ash Pond where the majority of the CCR settled. Ongoing maintenance dredging was conducted in the southern portion of the former LAN Upper Ash Pond. The dredged CCR was temporarily stockpiled and dewatered prior to being transported to the on-site active dry ash landfill located south of the former LAN Upper Ash Pond.



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The sluiced water that was discharged into the former LAN Upper Ash Pond flowed to the west prior to flowing north through a series of five interconnected settling ponds separated by intermediate dikes. The intermediate dikes had 30-inch diameter corrugated metal pipes on the west and east sides, which hydraulically connected the five settling ponds. The water from each settling pond flowed north until it entered the large open settling area of the former LAN Upper Ash Pond.

In the Fall of 2021, a new concrete outlet Weir Box structure was commissioned for the former LAN Upper Ash Pond, while the previous discharge structure (Weir Box #1) was retrofitted to become an emergency stormwater overflow structure for sizeable precipitation events. The new outfall structure was in the northeast corner of the impoundment and equipped with fiberglass stoplogs to adjust the operating elevation of the former LAN Upper Ash Pond. Discharge was directed north in a 16-inch diameter HDPE pipe below Power Plant Drive. There it transitioned to a 20-inch diameter HDPE pipe and continued below the railroad tracks and then headed east where National Pollution Discharge Elimination System (NPDES) Outfall 010 discharged into the Mississippi River.

Emergency Overflow Weir Box #1, located at the north end of the former LAN Upper Ash Pond, where during an emergency, water overflowed a concrete weir into the concrete structure, and then through a 24-inch diameter corrugated metal pipe under Power Plant Drive and into Weir Box #2. The water left Weir Box #2 through a 24-inch diameter high density polyethylene pipe and into Weir Box #3 in the backfilled, former LAN Lower Ash Pond. The water flowed through Weir Box #3 and discharged to the west through a 24-inch diameter corrugated metal pipe into Unnamed Creek #1. Unnamed Creek #1 flowed to the north into Unnamed Creek #2 which then discharged into the Mississippi River.



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The total surface area of the former LAN Upper Ash Pond was approximately 11.5 acres and had an embankment height of approximately 20 feet from the crest to the toe of the downstream slope at its greatest height. The area of the entire CCR Unit inclusive of the impoundment and the dredging, staging, and dewatering area was approximately 17 acres. The interior storage depth of the former LAN Upper Ash Pond was approximately 28 feet.

During the closure construction activities in 2022 and 2023, a stabilized berm was constructed and bisected the former LAN Upper Ash Pond. This allowed for hydraulic dredging of the CCR from the northern portion of the Pond into the southern portion. The dredged CCR was pumped into geotubes and allowed to dewater. CCR was completely removed from the northern portion of the Pond. After CCR removal and dewatering of the impoundment was completed, a cap was placed over the CCR. The previous discharge structures (Weir Boxes 1 through 3 and the concrete discharge box constructed in 2021) were demolished and a portion of the western embankment was removed to allow for stormwater drainage to sheet drain into ditch lines that discharge directly into the Unnamed Creek #1 without retention within the former LAN Upper Ash Pond. SCS Engineers estimated the total volume of CCR post closure as 622,000 cubic yards.



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# 3. SAFETY FACTOR ASSESSMENT- §257.73(e)

This Report documents whether each CCR surface impoundment achieves the minimum safety factors, which are identified in the table below.

| Safety Factor Assessment | Minimum Safety Factor |
|---|---|
| Static Safety Factor Under Maximum Storage Pool Loading | 1.50 |
| Static Safety Factor Under Maximum Surcharge Pool Loading | 1.40 |
| Seismic Safety Factor | 1.00 |
| Liquefaction Safety Factor | 1.20 |

## 3.1 Safety Factor Assessment Methods

The 2023 closure construction activities changed the geometry of the former LAN Upper Ash Pond (see Figure 3). As part of the closure design, SCS Engineers conducted a slope stability analysis[1] of the CCR surface impoundments which accounted for the elimination of process water, elimination of stormwater retention from the CCR surface impoundment, CCR consolidation, grading of the CCR for overland drainage, and capping of the CCR materials within the southern end of the former LAN Upper Ash Pond. The relevant sections of the referenced slope stability analysis have been included within Appendix D.

The safety factor assessment was completed with the two-dimensional limit-equilibrium slope stability analyses program GeoStudio 2016. The program analyzes many potential failure circles

[1] Updated Geotechnical Slope Stability Analysis Summary – LAN Upper Ash Pond Closure, SCS Engineers Technical Memorandum, December 8, 2022



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or block slides by random generation of failure surfaces using toe and crest search boundaries set for each analysis. The solution occurs by balancing the resisting forces along the failure plane due to Mohr-Columb failure strength parameters of friction angle and cohesion against the gravity forces. The gravity driving forces are divided into resisting forces to produce a safety factor for the slope. The minimum value from hundreds of searches is presented as the applicable safety factor of the embankment.

There are both total stress and effective stress friction angle and cohesion values for soil. In the case of cohesionless soil (gravel, sand and silt), the values are the same. For clay, the total stress value is cohesion only. At the former LAN Upper Ash Pond, only cohesionless soil is present in and under the embankments.

### 3.1.1 Soil Conditions

The former LAN Upper Ash Pond is constructed in the valley of Unnamed Creek #1 south of the LAN Generating Station. The Unnamed Creek #1 was rerouted to the west side of the valley in the northern half of the former LAN Upper Ash Pond when the impoundment was constructed in 1974. At the north end of the former LAN Upper Ash Pond, Unnamed Creek #1 drops over a manmade riffle structure under the power plant road bridge losing approximately 14 feet of elevation to reach the elevation of Pool #9 of the Mississippi River. The drop structure prevents backwater flooding of the Mississippi River from encroaching on the toe of the former LAN Upper Ash Pond embankment.

In early 2015, four soil borings were installed at the locations shown on Figure 2, to determine the types of and density of soil present in the embankments and foundation of the former LAN Upper Ash Pond. The soil borings logs SB-1, SB-3, SB-5 and SB-7 including the penetration



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resistance measured by the Standard Split Spoon (SPT) (ASTM D 1556) are enclosed in Appendix A. The results of laboratory testing on selected soil samples for grain size, water content and Atterberg limits are shown in Appendix B.

The test results indicate that the embankment is constructed of uniform fine to medium sand (SP). The sand was compacted to medium dense-to-dense consistency as shown by the SPT results. Below the embankment, the two northern borings SB-1 and SB-7, Figure 2, show that a very loose-to-loose silt is present under the embankment overlying a medium dense gravel. In borings SB-3 and SB-5, Figure 2, the silt is thin and overlies the same gravel. The silt deposit in the two northern borings is from backwater deposition by the Mississippi River prior to the installation of the former LAN Upper Ash Pond and the thin silt layer to the south is natural deposition from flooding of the Unnamed Stream #1. The Iowa Bedrock Survey Map available from the Iowa Geology and Water Survey, July 2013 indicates that bedrock is at elevation 564 (a depth of 90 feet below top of embankment) in the northern part of the former LAN Upper Ash Pond and rises in elevation moving south up the valley of the Unnamed Stream #1.

A cement-bentonite slurry wall was installed in the West embankment of the former LAN Upper Ash pond in the summer of 2015. The cement-bentonite wall prevented water from the former LAN Upper Ash Pond from flowing through the embankment sand and discharging as surface seepage at the toe of the embankment. During installation of the wall, it was observed that the sand below the normal water elevation in the embankment had higher strength than sand above the water table, likely due to cementation of the sand particles by calcium hydroxide in the impoundment water. The observation was used along with the SPT values in the boring logs to



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assign soil properties to the embankment and foundation soils using NAVFACS DM-7[2]. The internal friction angles selected based on the SPT results are:

| Soil Type | Internal Friction Angle | Total Unit Weight (lb/ft3) |
|---|---|---|
| Embankment Sand above GW | 32 | 110 |
| Embankment Sand below GW | 36 | 108 |
| River Silt | 26 | 100 |
| Valley Gravel | 35 | 120 |

The ground water elevation in the embankment is monitored by piezometers installed on both sides of the cement-bentonite wall in 2015. The monitoring results, prior to closure, showed that the water elevation in the embankment dropped 17 feet across the cement-bentonite cut off wall at the north end of the west embankment.

During the 2023 closure construction activities, a section of the west embankment was removed, so that the final grading, atop the engineered cap, promotes surface runoff without ponding or pooling of stormwater within the embankment (see Figure 3). As result, the groundwater will likely be near or slightly above the creek elevation under normal conditions.

### 3.1.2 Design Water Surface for Max Normal Pool and Max Pool

The former LAN Upper Ash Pond water elevation was controlled by stop logs in the concrete overflow structure, Figure 2. The normal pool at that time was elevation 647.0 feet that occurred

[2] Naval Facilities Engineering Command Design Manual DM-7, Figure 3-7 "Density versus Angle of Internal Friction for Cohesionless Soils", March 1971



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when operating with stop logs installed to elevation 646.5 feet and with the normal process water flow to the former LAN Upper Ash Pond of 3.88 cubic feet per second.

During the 2023 closure construction activities, all process flows were eliminated, and discharge structures were demolished. A section of the west embankment was removed, so the final grading promotes surface runoff without ponding or pooling of stormwater within the embankment, Figure 3. As a result, there is no longer a normal pool or max pool elevation.

### 3.1.3 Selection of Seismic Design Parameters and Description of Method

The design earthquake ground acceleration is selected from the United States Geologic Survey (USGS) detailed seismic design maps based on the latitude and longitude of the station. The peak ground acceleration (PGA) value is selected for a 2% probability of exceedance in 50 years (2,500-year return period) as required by 40 CFR 257.53. Since the site soils, with the exception of the river silt layer, are medium dense to dense sand and gravel and extend to bedrock at 90 feet, the site class as defined in the 2009 International Building Code 1613.5.5 is Site Class D. For Site Class D the ground surface PGA for slope stability and liquefaction assessment is 0.044 g (see Appendix C).

### 3.1.4 Liquefaction Assessment Method and Parameters

Certain soils may have zero effective stress (liquefaction) during an earthquake from static shear of a saturated embankment slope. Soils that will liquefy include loose or very loose uniform fine sand or silt, and low plasticity clay (plastic index of less than 12). The liquefaction resistance of a soil is based on its strength and effective confining stress. The strength of the saturated embankment sand, river silt and valley gravel are measured by the SPT results shown on the borings in Appendix A.



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The test results for SB-1 located on the west embankment, Figure 1, at the highest embankment height and with the lowest river silt strength measured indicate the silt is very loose (blowcounts weight of rod only).

The simplified assessment of liquefaction procedure as first proposed by Seed and most recently updated and published by Idriss and Boulanger[3] is used to assess the potential for liquefaction of the river silt. The procedure uses the strengths determined by the SPT test, adjusted to normalize for overburden pressure and for fines content, to determine the cyclic resistance ratio for the soil at earthquake magnitude 7.5 and at 1 atmosphere pressure. The cyclic resistance ratio is then adjusted for the actual earthquake magnitude of the design event which is 7.7 for a New Madrid Fault source earthquake[4]. The cyclic stress ratio caused by the design surface PGA is then used to determine the actual cyclic stress ratio at 65% of maximum strain at depth in the soil profile. The cyclic resistance ratio is divided by the cyclic stress ratio to determine the factor of safety for liquefaction.

The results for the soil profile of SB-1 at the north end of the west embankment of the former LAN Upper Ash Pond are shown in Appendix C. The results indicate that the river silt layer will not liquefy during the site design earthquake.

[3] Idriss I. M. and R. W. Boulanger, "Soil Liquefaction During Earthquakes", EERI MNO-12, 2008.
[4] Elnashi et al, "Impact of Earthquakes on the Central USA", FEMA Report 8-02, Mid-American Earthquake Center, 2002



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## 3.2 LAN Upper Ash Pond

The former LAN Upper Ash Pond is incised on the east and south sides of the impoundment. The north and west sides the impoundment were created by construction of medium-to-fine sand embankments, reported to be sand from maintenance dredging of the Mississippi River. All of the embankments have the same outer slope of 3 horizontal to 1 vertical. The southern end of the west embankment has lower embankment height and sits on more competent foundation soil and is not the critical section of the embankment.

The northern embankment and the north half of the west embankment sit on a layer of loose-to-very loose river silt. After closure of the former LAN Lower Ash Pond, the north embankment height was reduced and has more confinement on the river silt layer than the west embankment. In addition, the north embankment has a much wider crest to accommodate Power Plant Road.

During the 2023 closure construction activities, all process flows were eliminated, and discharge structures were demolished. A section of the west embankment was removed, so the final grading promotes surface runoff without ponding or pooling of stormwater within the embankment (see Figure 3). The CCR was consolidated to the south end of the former LAN Upper Ash Pond and capped.

For all the above reasons, the west embankment in the vicinity of boring SB-5 in Figure 2 is the critical embankment slope for the former LAN Upper Ash Pond, Appendix D.

### 3.2.1 Static Safety Factor Assessment Under Max Storage Pool - §257.73(e)(1)(i)

During the 2023 closure construction activities, all process flows were eliminated, and discharge structures were demolished. A section of the west embankment was removed, so the final grading promotes surface runoff without ponding or pooling of stormwater within the



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embankment, Figure 3. Analysis for a circular sliding surface, Appendix D, shows a minimum factor of safety of 1.775.

### 3.2.2 Static Safety Factor Assessment Under Max Surcharge Pool - §257.73(e)(1)(ii)

During the 2023 closure construction activities, all process flows were eliminated, and discharge structures were demolished. A section of the west embankment was removed, so the final grading promotes surface runoff without ponding or pooling of stormwater within the embankment, Figure 3. Therefore, there is no longer a maximum surcharge pool and is not applicable to the LAN Upper Ash Pond.

### 3.2.3 Seismic Safety Factor Assessment - §257.73(e)(1)(iii)

The former LAN Upper Ash Pond was assigned a pseudo-static earthquake coefficient equal to 0.04 g and a vertical upward component equal to $^2/_3$ of the horizontal component (0.027 g) as recommended by Newmark[5]. Analysis for both circular and block slide surfaces, Appendix D, shows a minimum factor of safety of 1.458 for a block slide surface.

### 3.2.4 Liquefaction Safety Factor Assessment - §257.73(e)(1)(iv)

The embankment and foundation soils of the former LAN Upper Ash Pond will not liquefy during the design earthquake. No post-liquefaction slope stability assessment is required.

[5] Newmark, N. M. and W. J. Hall, "Earthquake Spectra and Design", EERI Monograph, Earthquake Engineering Research Institute, Berkeley, California, 1982



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## 4. RESULTS SUMMARY

The results of the safety factor assessment indicate that the embankment of the former LAN Upper Ash Pond meets the requirements of 40 CFR 257.73(e). The results are summarized as:

| | Static Stability Normal Water Elevation | Static Stability Flood Water Elevation | Pseudo-Static Earthquake with Normal Water Elevation | Liquefaction Potential | Post-Earthquake Static Stability Normal Water Elevation |
|---|---|---|---|---|---|
| Required Safety Factor | ≥ 1.5 | ≥ 1.4 | ≥ 1.0 | | ≥ 1.2 |
| LAN Upper Ash Pond West Slope | 1.775 | N/A | 1.458 | no | N/A |
| LAN Upper Ash Pond North Slope | 1.752 | N/A | 1.300 | no | N/A |



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## 5. QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

To meet the requirements of 40 CFR 257.73(e)(2), I Mark W. Loerop hereby certify that I am a licensed professional engineer in the State of Iowa; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in 40 CFR 257.73(b) and 40 CFR 257.73(e).

By: _____

Name: MARK LOEROP

Date: 8/10/2026

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## FIGURES

Alliant Energy
Interstate Power and Light Company
Lansing Generating Station
Lansing, Iowa

Safety Factor Assessment



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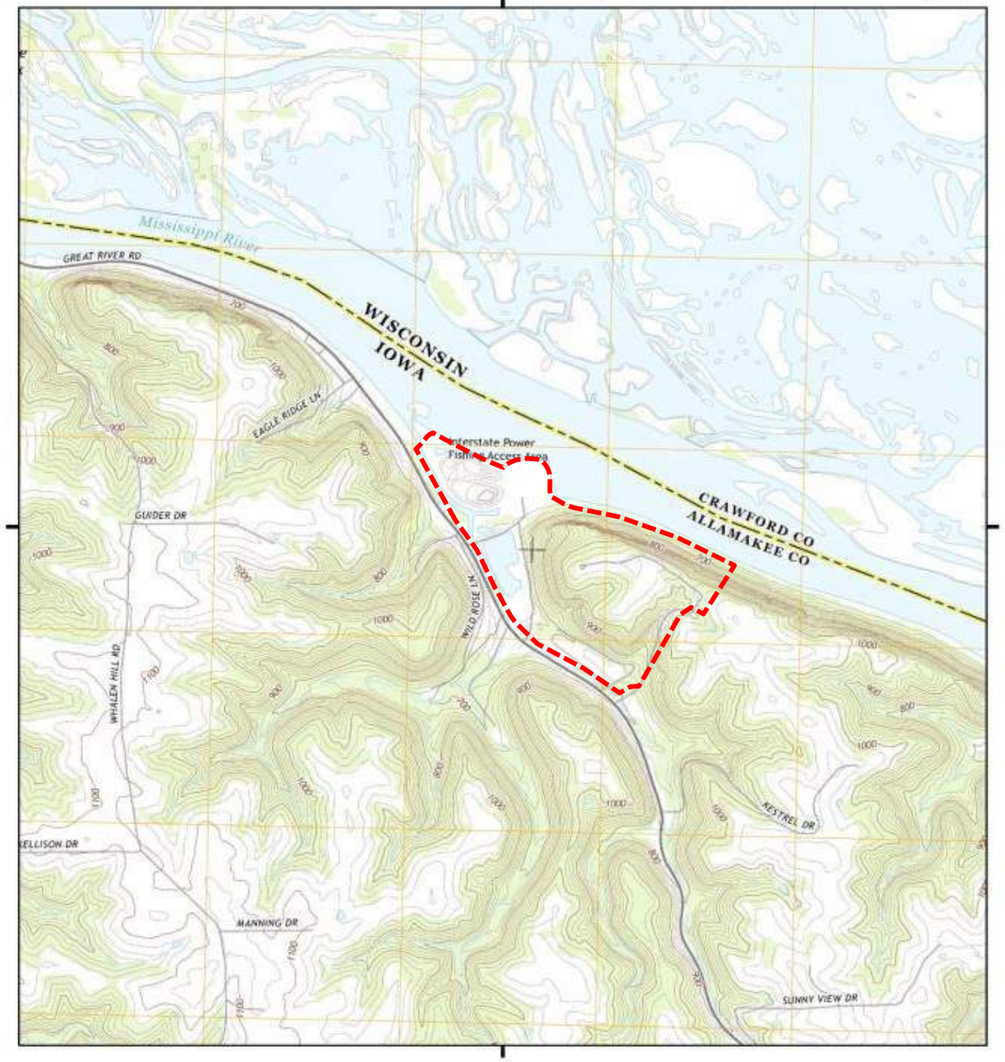
## Historical Topo Map

2013




This report includes information from the following map sheet(s).

Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

TP, Lansing, 2013, 7.5-minute

SITE NAME: Lasing Generating Station
ADDRESS: 2364-2366 Power Plant Dr
Lansing, IA 52151
CLIENT: Environmental Site Assessors

N

4555570 - 1 page 5

## Historical Aerial Photo

Approximate Property Boundary

hard hat SERVICES

Site Location
Lansing Generating Station
Intersate Power and Light Company

Drawing: Figure 1
Date: 8/6/2026

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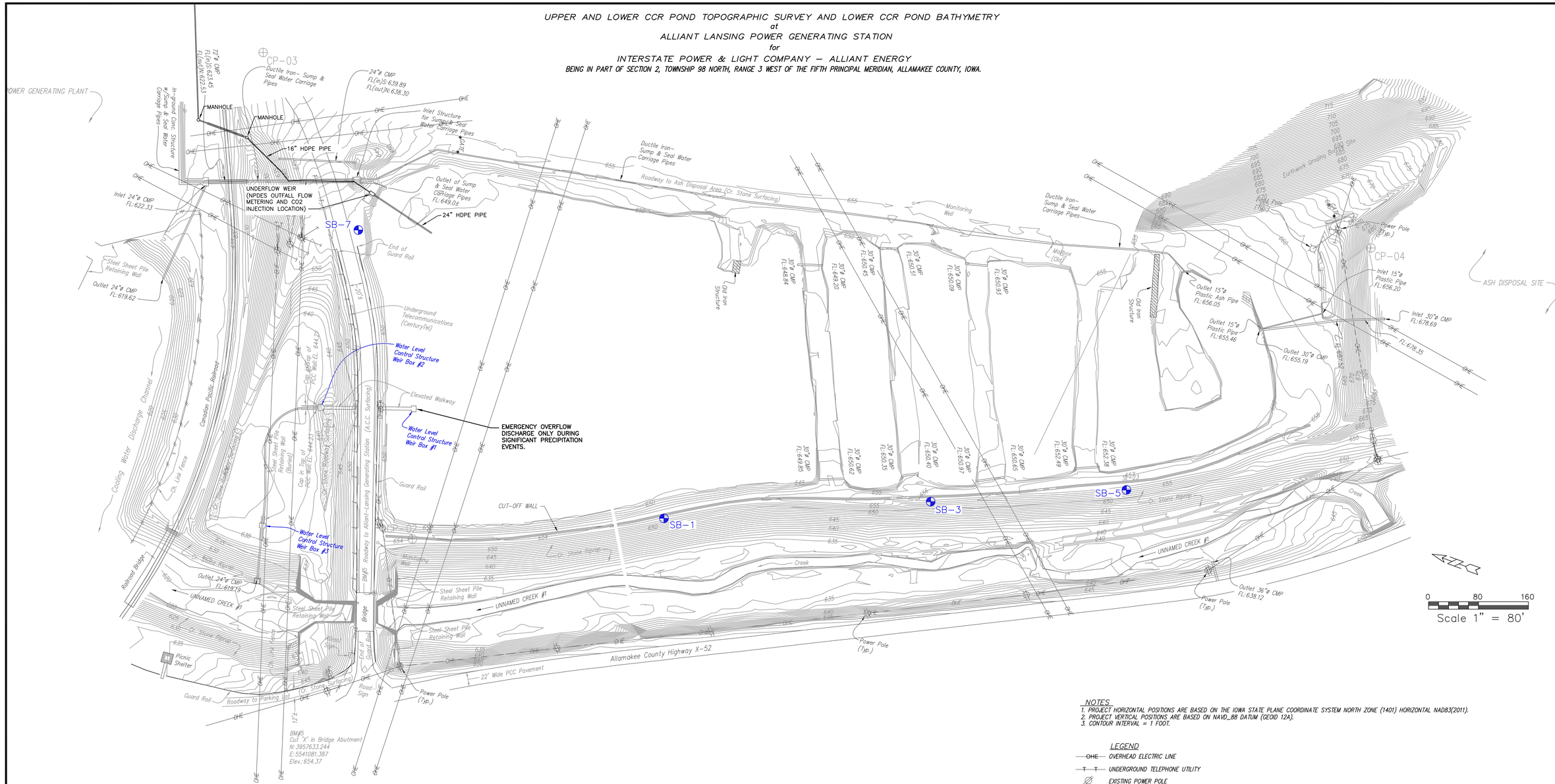
# UPPER AND LOWER CCR POND TOPOGRAPHIC SURVEY AND LOWER CCR POND BATHYMETRY
at
ALLIANT LANSING POWER GENERATING STATION
for
INTERSTATE POWER & LIGHT COMPANY – ALLIANT ENERGY
BEING IN PART OF SECTION 2, TOWNSHIP 98 NORTH, RANGE 3 WEST OF THE FIFTH PRINCIPAL MERIDIAN, ALLAMAKEE COUNTY, IOWA.




NOTES
1. PROJECT HORIZONTAL POSITIONS ARE BASED ON THE IOWA STATE PLANE COORDINATE SYSTEM NORTH ZONE (1401) HORIZONTAL NAD83(2011).
2. PROJECT VERTICAL POSITIONS ARE BASED ON NAVD_88 DATUM (GEOID 12A).
3. CONTOUR INTERVAL = 1 FOOT.

LEGEND
- OHE — OVERHEAD ELECTRIC LINE
- T T — UNDERGROUND TELEPHONE UTILITY
- EXISTING POWER POLE
- SB — SOIL BORING LOCATION
- ANALYSIS CROSS-SECTION

NOTE:
1. SURVEY INFORMATION PROVIDED ABOVE WAS COMPILED BY MOHN SURVEYING, INC. 1890 GREAT RIVER ROAD LANSING, IOWA 52151, APRIL 2015.
2. ALLIANT ENERGY REQUIRES 20 FEET OVERHEAD SEPARATION DISTANCE FOR EQUIPMENT OPERATING UNDER POWERLINES.

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| REV | DATE | BY | APP | DESCRIPTION |
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| 5 | | | | |
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| 2 | | | | |
| 1 | 4-19-21 | MWL | MWL | REVISION 1 TO PLAN |

SCALE: AS SHOWN | DATE: 4-19-21
DRAWN BY: JFD | CHECKED BY: MWL | APPROVED BY: MWL

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

CLIENT / LOCATION
INTERSTATE POWER AND LIGHT (IPL)
LANSING GENERATING STATION PROJECT
2320 POWER PLANT DR
LANSING, IA 52151

DRAWING DESCRIPTION
SOIL BORING AND
SLOPE STABILITY CROSS-SECTION LOCATION

JOB 154.018.024.004
SHT. FIGURE 2
DWG. 154.018.024.004-D2

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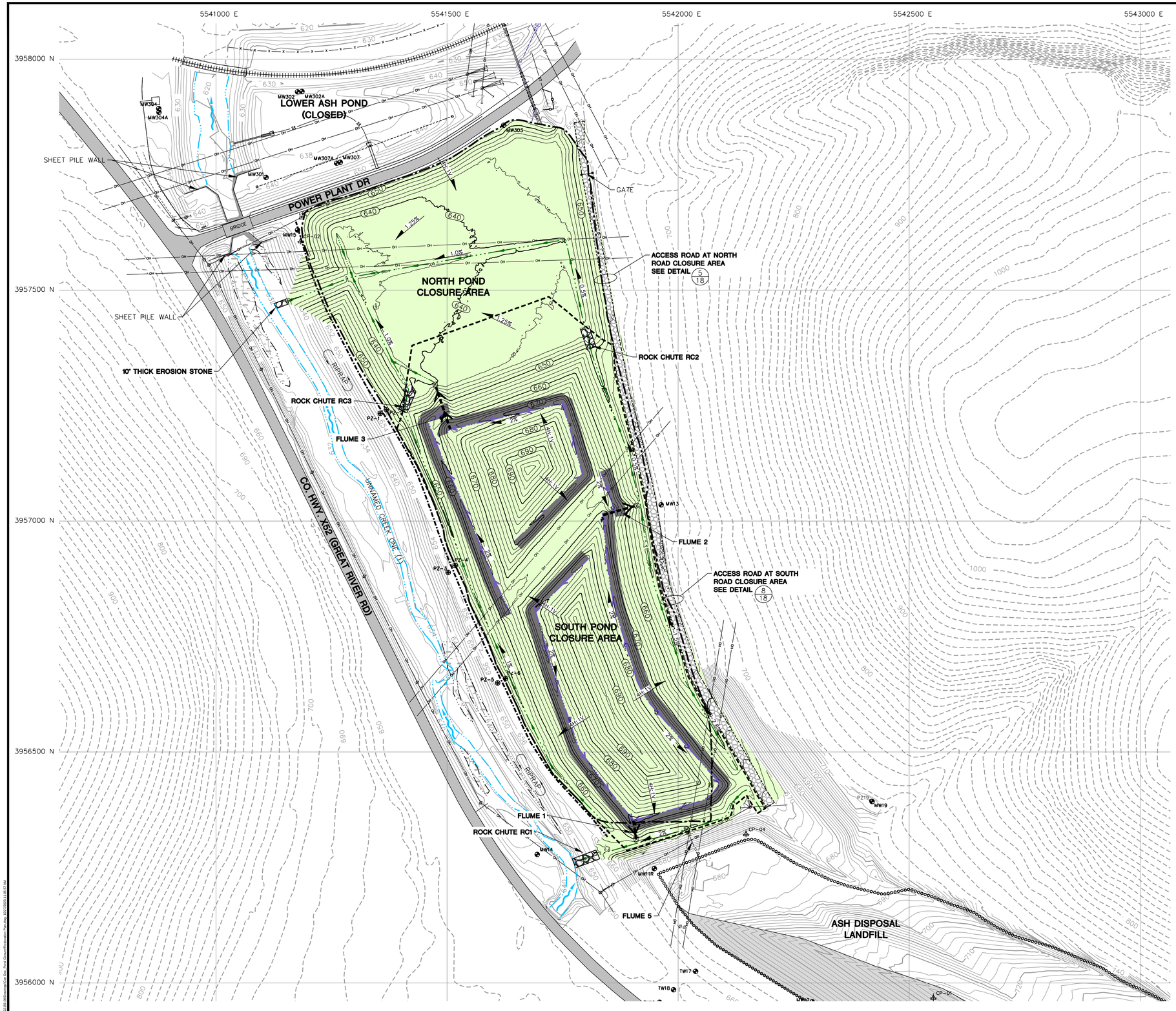



LEGEND

- 2008 EXISTING GRADE (10' CONTOUR)
- 2015/2020/2022 EXISTING GRADE (10' CONTOUR)
- 2015/2020/2022 EXISTING GRADE (2' CONTOUR)
- ASH DISPOSAL LANDFILL APPROVED LIMITS OF WASTE
- PAVED ROAD
- GRAVEL ROAD
- FENCE
- RAILROAD TRACKS
- EDGE OF WATER
- UNNAMED CREEK FLOW PATH
- OVERHEAD UTILITY
- TELEPHONE
- STORM DRAINAGE PIPE
- PROCESS WATER PIPE
- UPPER ASH POND OUTFALL REROUTE PIPING
- UTILITY POLE AND GUY WIRE
- LIGHT POLE
- CP-02 SURVEY CONTROL POINT
- MW17 MONITORING WELL
- MW17 ABANDONED MONITORING WELL
- MW12P PIEZOMETER
- MW12P ABANDONED PIEZOMETER
- PZ18 ABANDONED SHALLOW PIEZOMETER
- PZ-1 WEST EMBANKMENT SLURRY WALL PIEZOMETER (2015 BY HARD HAT SERVICES)
- SLURRY WALL (2015 BY HARD HAT SERVICES)
- APPROXIMATE LIMITS OF UPPER ASH POND
- ASH DISPOSAL LANDFILL FINAL COVER AREA
- 630 DOCUMENTED FINAL GRADE (5' CONTOUR)
- 632 DOCUMENTED FINAL GRADE (1' CONTOUR)
- FINAL COVER LIMITS
- DRAINAGE SWALE
- DIVERSION BERM
- DOWNSLOPE FLUME
- ENERGY DISSIPATOR
- ROCK CHUTE
- ACCESS ROAD RESTORATION
- VEGETATED RESTORATION

NOTES:

1. SEE SHEET 2 AND SHEET 3 FOR ADDITIONAL BASE MAP LEGEND ITEMS AND NOTES.
2. PLACED NON-CHANNEL EROSION MAT ON RESTORED SLOPES STEEPER OR EQUAL TO 4:1 OR AS NOTED.
3. PLACED CHANNEL EROSION MAT IN DRAINAGE SWALES.
4. CONTOURS WITHIN CONSTRUCTION LIMITS BASED ON SEPTEMBER 25, 2023 DRONE SURVEY PERFORMED BY AMES.

100 0 100
SCALE: 1" = 100'

N

DRAFT

DRAWN BY: BSS/KP
CHECKED BY: BSS/MRH
APPROVED BY:
PROJECT NO. 25222159.00
DRAWN: 10/05/2023
REVISED: 10/26/2023

INTERSTATE POWER AND LIGHT CO.
2320 POWER PLANT DRIVE
LANSING, IA 52151-9733
CLIENT

SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830
ENGINEER

ASH POND CLOSURE
CONSTRUCTION DOCUMENTATION
LANSING GENERATING STATION
LANSING, IOWA
SITE

CLOSURE AREA RESTORATION

SHEET
12 of 19

09/09/2026 - Classification: Internal - ECRM13805385

## APPENDIX A – Soil Borings

Alliant Energy
Interstate Power and Light Company
Lansing Generating Station
Lansing, Iowa

Safety Factor Assessment



09/09/2026 - Classification: Internal - ECRM13805385

# BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

**CLIENT:** Hard Hat

**COORDINATES:** N NOT SURVEYED, E NOT SURVEYED

**PROJECT:** Lansing, IA

**BORING NO.:** *SB1*



**LOGGED BY:** *John Noyes*
**EDITED BY:** *John Noyes*
**CHECKED BY:** *Mark Loerop*
**DATE BEGAN:** *1/22/15*
**DATE FINISHED:** *1/2213/15*
**GROUND SURFACE ELEVATION:** *NOT MEASURED*

| DEPTH TO WATER WHILE DRILLING | SAMPLE NO. AND TYPE | SAMPLE RECOVERY | SAMPLE INFROMATION BLOW COUNTS | N-VALUE | SOIL CONSISTENCY HISTOGRAM | DEPTH IN FEET | PROFILE | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| ▽ | SS1 | 18" | 4 4 5 | 9.0 | | 0 | | SILT; brown; plastic; moist; trace clay |
| | SS2 | 18" | 4 5 10 | 15.0 | | -2 | | |
| | SS3 | 18" | 3 6 9 | 15.0 | | -4 | | SAND; brown; fine grained; poorly graded; well sorted; dry to moist |
| | SS4 | 18" | 7 9 11 | 20.0 | | -6 | | 1'-5' sample collected for geotech analysis |
| | SS5 | 18" | 7 10 13 | 23.0 | | -8 | | |
| | SS6 | 18" | 7 11 18 | 29.0 | | -10 | | @ 9'2" black stained with plant matter |
| | SS7 | 18" | 8 11 14 | 25.0 | | -12 | | |
| | SS8 | 18" | 8 11 13 | 24.0 | | -14 | | SAND; gray; fine to medium grained; moist; graded; trace gravel and snail shells |
| | SS9 | 18" | 8 11 11 | 22.0 | | -16 | | |
| | SS10 | 18" | 4 7 7 | 14.0 | | -18 | | @ 15' grades wet |
| | SS11 | 18" | 2 3 6 | 8.0 | | -20 | | 15'-20' sample collected for geotech analysis |
| | SS12 | 18" | 0 0 0 | 0.0 | | -22 | | @17.5' grades brown |
| | SS13 | 18" | 0 0 0 | 0.0 | | -24 | | |
| | SS14 | 18" | 1 1 2 | 3.0 | | -26 | | @23.5' grades fine to coarse, well graded |
| | SS15 | 18" | 3 4 4 | 8.0 | | -28 | | SILT; gray; non plastic; wet; trace clay |
| | SS16 | 18" | 0 9 11 | 20.0 | | -30 | | 28'-32' sample collected for geotech analysis |
| | SS17 | 18" | 5 11 10 | 21.0 | | -32 | | @29' grades trace plant matter and snail shells |
| | SS18 | 18" | 4 5 7 | 12.0 | | -34 | | |
| | SS19 | 18" | 3 4 8 | 12.0 | | -36 | | |
| | | | | | | -38 | | GRAVEL; brown; coarse; poorly graded; wet; trace cobbles |
| | | | | | | -40 | | 40'-50' sample collected for geotech analysis |
| | | | | | | -42 | | |
| | | | | | | -44 | | |
| | | | | | | -46 | | |
| | | | | | | -48 | | SAND; light gray; coarse grained; poorly graded; wet |
| | | | | | | -50 | | |
| | | | | | | -52 | | Bottom of boring @ 50'<br>1" PVC temp well installed @ 50'.<br>10' screen, natural sand pack |
| | | | | | | -54 | | |

09/09/2026 - Classification: Internal - ECRM13805385

# BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

**CLIENT:** Hard Hat

**COORDINATES:** *N NOT SURVEYED* *E NOT SURVEYED*

**PROJECT:** Lansing, IA

**BORING NO.:** *SB3*



**LOGGED BY:** *John Noyes*
**EDITED BY:** *John Noyes*
**CHECKED BY:** *Mark Loerop*
**DATE BEGAN:** *1/22/15*
**DATE FINISHED:** *1/22/15*
**GROUND SURFACE ELEVATION:** *NOT MEASURED*

| DEPTH TO WATER WHILE DRILLING | SAMPLE NO. AND TYPE | SAMPLE RECOVERY | SAMPLE INFROMATION BLOW COUNTS | N-VALUE | SOIL CONSISTENCY HISTOGRAM | DEPTH IN FEET | PROFILE | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| ▽ | SS1 | 18" | 6 7 7 | 14.0 | | 0 | | SILT; gray to black; non plastic; moist; some bottom ash |
| | SS2 | 18" | 4 9 10 | 19.0 | | -2 | | SAND; brown; fine grained; poorly graded; moist |
| | SS3 | 18" | 5 10 19 | 29.0 | | -4 | | 2'-5' sample collected for geotech analysis |
| | SS4 | 18" | 7 13 16 | 29.0 | | -6 | | |
| | SS5 | 18" | 6 12 17 | 29.0 | | -8 | | |
| | SS6 | 18" | 6 12 16 | 28.0 | | -10 | | 13'-20' sample collected for geotech analysis |
| | SS7 | 18" | 12 21 21 | 42.0 | | -12 | | @13.5' grades wet and trace snail shells |
| | SS8 | 18" | 8 12 15 | 27.0 | | -14 | | |
| | SS9 | 18" | 8 19 21 | 40.0 | | -16 | | @16' grades fine to medium grained; graded |
| | SS10 | 18" | 8 5 6 | 11.0 | | -18 | | |
| | SS11 | 18" | 6 8 15 | 23.0 | | -20 | | |
| | SS12 | 18" | 5 5 10 | 15.0 | | -22 | | |
| | SS13 | 18" | 3 1 1 | 2.0 | | -24 | | 24'-27' sample collected for geotech analysis |
| | SS14 | 18" | 6 10 10 | 20.0 | | -26 | | SILT; gray; non plastic to low plasticity; wet; some clay; trace organic plant matter |
| | SS15 | 18" | 4 6 12 | 18.0 | | -28 | | GRAVEL; gray; coarse to cobbles; poorly graded; wet; trace to some sand |
| | SS16 | 18" | 10 9 7 | 16.0 | | -30 | | 27'-32' sample collected for geotech analysis |
| | SS17 | 18" | 6 8 10 | 18.0 | | -32 | | SILT; gray to black; non plastic; wet; trace to some clay and organic plant matter |
| | SS18 | 18" | 22 24 21 | 45.0 | | -34 | | GRAVEL; gray; coarse to cobbles; poorly graded; wet; trace to some sand |
| | SS19 | 18" | 10 10 12 | 22.0 | | -36 | | |
| | SS20 | 18" | 14 9 12 | 21.0 | | -38 | | |
| | | | | | | -40 | | |
| | | | | | | -42 | | |
| | | | | | | -44 | | |
| | | | | | | -46 | | |
| | | | | | | -48 | | |
| | | | | | | -50 | | Bottom of boring @ 50' |
| | | | | | | -52 | | 1" PVC temp well installed @ 50'. |
| | | | | | | -54 | | 10' screen, natural sand pack |

09/09/2026 - Classification: Internal - ECRM13805385

# BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

**CLIENT:** Hard Hat

**COORDINATES:** *N NOT SURVEYED* *E NOT SURVEYED*

**PROJECT:** Lansing, IA

**BORING NO.:** *SB5*



**LOGGED BY:** *John Noyes*
**EDITED BY:** *John Noyes*
**CHECKED BY:** *Mark Loerop*
**DATE BEGAN:** *1/23/15*
**DATE FINISHED:** *1/23/15*
**GROUND SURFACE ELEVATION:** *NOT MEASURED*

| DEPTH TO WATER WHILE DRILLING | SAMPLE NO. AND TYPE | SAMPLE RECOVERY | SAMPLE INFROMATION BLOW COUNTS | N-VALUE | SOIL CONSISTENCY HISTOGRAM | DEPTH IN FEET | PROFILE | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| ▽ | SS1 | 18" | 4 4 3 | 7.0 | | 0 | | SILT; black; non plastic; dry to moist |
| | SS2 | 18" | 5 7 12 | 19.0 | | -2 | | SAND; brown; fine grained; poorly graded; moist; trace to some bottom ash |
| | SS3 | 18" | 5 13 19 | 32.0 | | -4 | | 5' bottom ash grades out |
| | SS4 | 18" | 5 13 15 | 28.0 | | -6 | | |
| | SS5 | 18" | 5 11 13 | 24.0 | | -8 | | |
| | SS6 | 18" | 6 12 16 | 28.0 | | -10 | | 10'-16' sample collected for geotech analysis |
| | SS7 | 18" | 12 14 17 | 31.0 | | -12 | | @12' grades wet and trace snail shells |
| | SS8 | 18" | 3 2 2 | 4.0 | | -14 | | |
| | SS9 | 18" | 4 4 4 | 8.0 | | -16 | | @ 16' grades gray to olive |
| | SS10 | 18" | 14 9 2 | 11.0 | | -18 | | |
| | SS11 | 18" | 2 2 4 | 6.0 | | -20 | | Silty CLAY; black to dark gray; low plasticity; moist; trace fine sand and organic plant matter |
| | SS12 | 18" | 6 7 8 | 15.0 | | -22 | | 18.5'-20' sample collected for geotech analysis |
| | SS13 | 18" | 9 10 10 | 20.0 | | -24 | | SAND & GRAVEL; black; fine to coarse; well graded; wet; trace to some silt |
| | SS14 | 18" | 10 36 8 | 44.0 | | -26 | | 22'-27.5' sample collected for geotech analysis |
| | SS15 | 18" | 15 12 9 | 21.0 | | -28 | | |
| | SS16 | 18" | 20 14 14 | 28.0 | | -30 | | |
| | SS17 | 18" | 11 12 18 | 30.0 | | -32 | | |
| | SS18 | 18" | 17 14 15 | 29.0 | | -34 | | |
| | SS19 | 18" | 13 14 17 | 31.0 | | -36 | | |
| | SS20 | 18" | 18 19 24 | 43.0 | | -38 | | |
| | | | | | | -40 | | 40'-45' sample collected for geotech analysis |
| | | | | | | -42 | | |
| | | | | | | -44 | | @43.5' grades brown |
| | | | | | | -46 | | |
| | | | | | | -48 | | |
| | | | | | | -50 | | Bottom of boring @ 50' |
| | | | | | | -52 | | 1" PVC temp well installed @ 50'. |
| | | | | | | -54 | | 10' screen, natural sand pack |

09/09/2026 - Classification: Internal - ECRM13805385

# BORING LOG

CABENO Environmental Field Services, LLC
More Than Just A Probing Company

**CLIENT:** Hard Hat

**COORDINATES:** *N NOT SURVEYED* *E NOT SURVEYED*

**PROJECT:** Lansing, IA

**BORING NO.:** *SB7*



**LOGGED BY:** *John Noyes*
**EDITED BY:** *John Noyes*
**CHECKED BY:** *Mark Loerop*
**DATE BEGAN:** *1/23/15*
**DATE FINISHED:** *1/23/15*
**GROUND SURFACE ELEVATION:** *NOT MEASURED*

| DEPTH TO WATER WHILE DRILLING | SAMPLE NO. AND TYPE | SAMPLE RECOVERY | SAMPLE INFROMATION BLOW COUNTS | N-VALUE | SOIL CONSISTENCY HISTOGRAM | DEPTH IN FEET | PROFILE | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| ▽ | SS1 | 18" | 3 2 2 | 4.0 | | 0 | | Bottom ASH; black; fine grained; poorly graded |
| | SS2 | 18" | 9 11 19 | 20.0 | | -2 | | SAND; brown; fine grained; poorly graded; moist |
| | SS3 | 18" | 4 5 13 | 18.0 | | -4 | | |
| | SS4 | 18" | 7 14 18 | 32.0 | | -6 | | 4'-10' sample collected for geotech analysis |
| | SS5 | 18" | 5 11 20 | 31.0 | | -8 | | |
| | SS6 | 18" | 8 15 20 | 35.0 | | -10 | | |
| | SS7 | 18" | 7 12 14 | 26.0 | | -12 | | |
| | SS8 | 18" | 7 9 14 | 23.0 | | -14 | | |
| | SS9 | 18" | 11 13 17 | 30.0 | | -16 | | @16' grades wet |
| | SS10 | 18" | 8 12 14 | 26.0 | | -18 | | |
| | SS11 | 18" | 2 3 3 | 6.0 | | -20 | | 19'-25' sample collected for geotech analysis |
| | SS12 | 18" | 1 1 1 | 2.0 | | -22 | | @ 21' grades gray |
| | SS13 | 18" | 3 3 6 | 9.0 | | -24 | | |
| | SS14 | 18" | 2 3 4 | 7.0 | | -26 | | |
| | SS15 | 18" | 1 2 2 | 4.0 | | -28 | | |
| | SS16 | 18" | 0 0 0 | 0.0 | | -30 | | SILT; black to gray; no plasticity; moist to wet; trace clay |
| | SS17 | 18" | 2 3 4 | 7.0 | | -32 | | 29'-32.5' sample collected for geotech analysis |
| | SS18 | 18" | 3 2 2 | 4.0 | | -34 | | |
| | SS19 | 18" | 8 4 7 | 11.0 | | -36 | | 36'-40' sample collected for geotech analysis |
| | SS20 | 18" | 2 8 9 | 17.0 | | -38 | | |
| | | | | | | -40 | | |
| | | | | | | -42 | | @ 41' grading trace organic plant matter and trace intermittent 1/16" sand seams |
| | | | | | | -44 | | @ 44' is a thin, 1" gravel seam |
| | | | | | | -46 | | |
| | | | | | | -48 | | GRAVEL; brown; coarse; poorly graded; wet; trace to some silt and sand<br>46'-50' sample collected for geotech analysis<br>last spoon blocked with large gravel |
| | | | | | | -50 | | |
| | | | | | | -52 | | Bottom of boring @ 50'<br>1" PVC temp well installed @ 50'.<br>10' screen, natural sand pack |
| | | | | | | -54 | | |

09/09/2026 - Classification: Internal - ECRM13805385

## APPENDIX B – Soil Laboratory Testing

Alliant Energy
Interstate Power and Light Company
Lansing Generating Station
Lansing, Iowa

Safety Factor Assessment

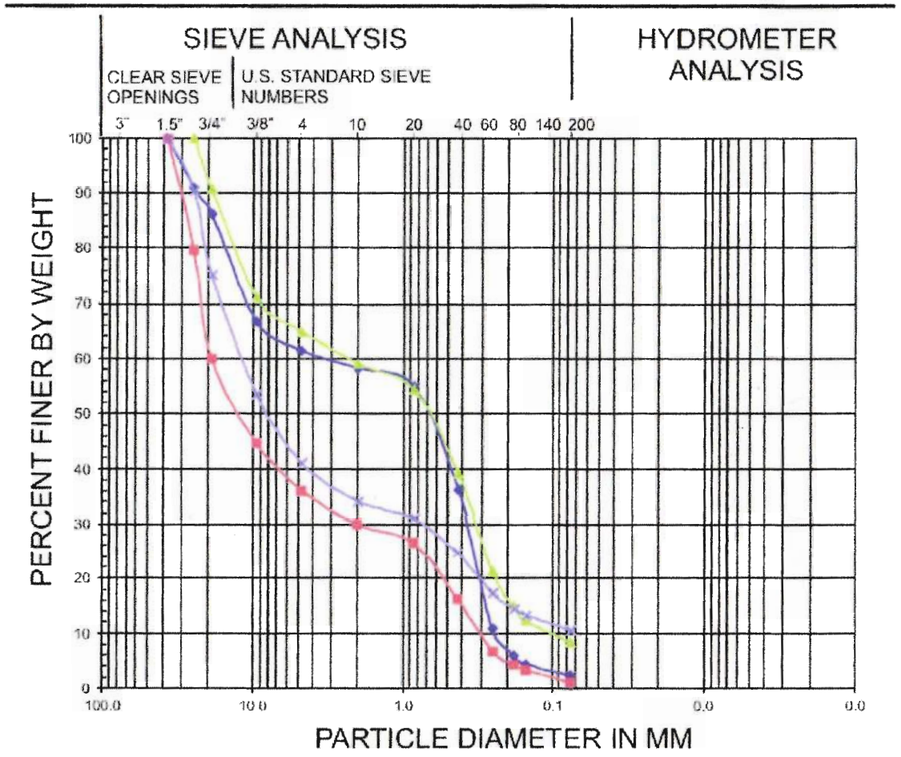


09/09/2026 - Classification: Internal - ECRM13805385

HARD HAT SERVICES
Engineering, Construction and Management Solutions

# Particle Size Distribution

Project: IPL Lansing Generating Station — Tested By: Test America — Date: 2/3/2015
Boring No.: SB-1, SB-3 & SB-5 **"SAND & GRAVEL"**



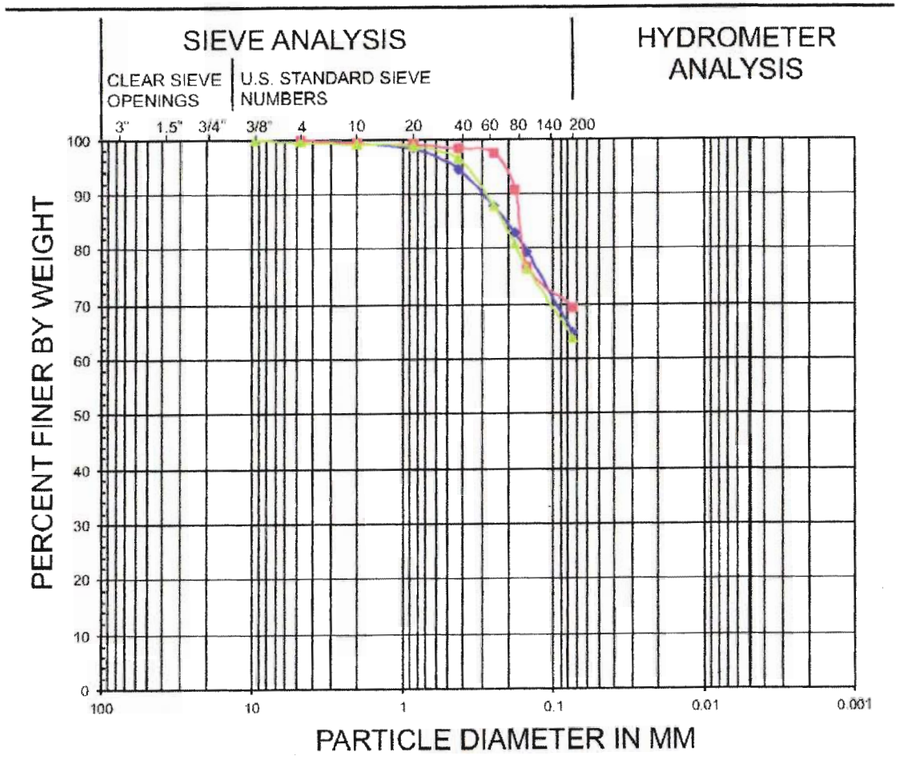

| COBBLES | GRAVEL | | SAND | | | SILT AND CLAY FRACTION |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| SYMBOL | BORING | DEPTH (FT.) | SOIL DESCRIPTION | U.S.C.S. | W % |
|---|---|---|---|---|---|
| | SB-1 | 40 - 50 | SAND & GRAVEL | SW / GW | 16.5 |
| | SB-3 | 27 - 32 | SAND & GRAVEL | SW / GW | 13.4 |
| | SB-5 | 22 - 27.5 | SAND & GRAVEL | SW / GW | 32.1 |
| | SB-5 | 44 - 45 | SAND & GRAVEL | SW / GW | 9.8 |
| | | | | | |

HARD HAT SERVICES
Engineering, Construction and Management Solutions

# Particle Size Distribution

Project: IPL – Lansing Generating Station — Tested By: Test America — Date: 2/3/2015
Boring No.: SB-1, SB-3 & SB-5 **"SANDY SILT"**




| COBBLES | GRAVEL | | SAND | | | SILT AND CLAY FRACTION |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| SYMBOL | BORING | DEPTH (FT.) | SOIL DESCRIPTION | U.S.C.S. | L.L. | P.L. | W % |
|---|---|---|---|---|---|---|---|
| | SB-1 | 28 - 32 | Sandy Silt | ML | 28 | 26 | 36.1 |
| | SB-3 | 24.5 - 27 | Sandy Silt | ML | 27 | 23 | 25.4 |
| | SB-5 | 18.5 - 20 | Sandy Silt | ML | 24 | 20 | 21.8 |
| | | | | | | | |
| | | | | | | | |

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| REV | DATE | BY | APP | DESCRIPTION |
|---|---|---|---|---|
| 5 | | | | |
| 4 | | | | |
| 3 | | | | |
| 2 | | | | |
| 1 | 6-15-15 | TJH | MWL | INCORPORATE IPL COMMENTS |

SCALE: NONE | DATE: 5-14-15
DRAWN BY: JFD | CHECKED BY: TJH | APPROVED BY: MWL

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

CLIENT / LOCATION
INTERSTATE POWER AND LIGHT (IPL)
LANSING GENERATING STATION PROJECT
2320 POWER PLANT DR
LANSING, IA 52151

DRAWING DESCRIPTION
SEEPAGE CONTROL CUT-OFF WALL
PARTICLE SIZE DISTRIBUTION
SB-1 & SB-3

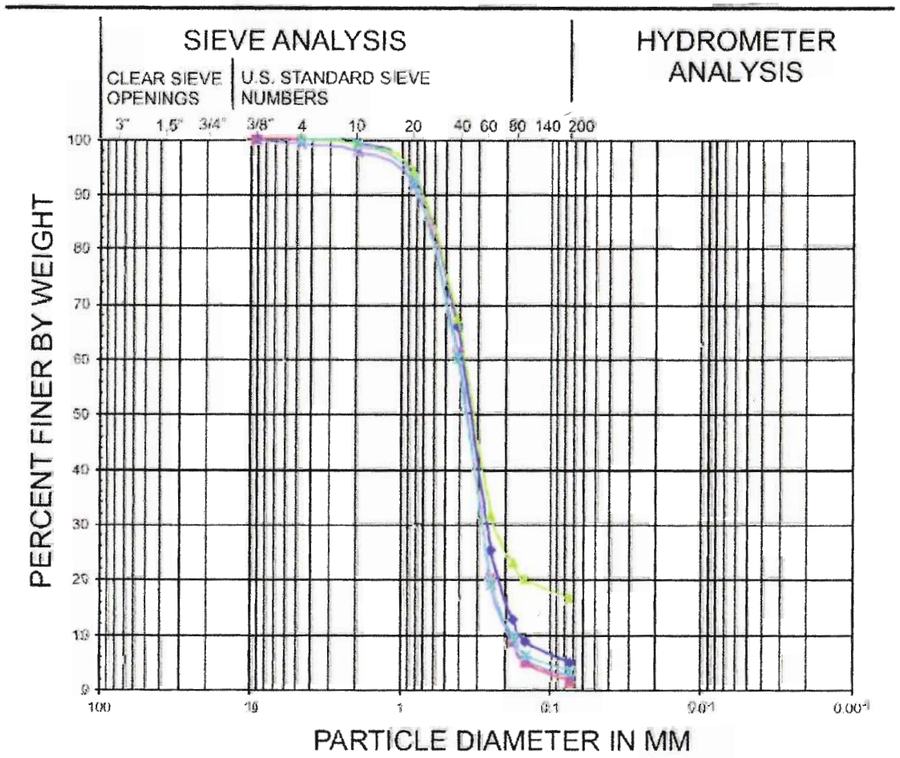
JOB 154.021.003
SHT. 8
DWG. 154021SW-08-12

09/09/2024 Classification: Internal - ECRM1380585

HARD HAT SERVICES
Engineering, Construction and Management Solutions

# Particle Size Distribution

Project: IPL Lansing Generating Station — Tested By: Test America — Date: 2/3/2015
Boring No.: SB-1, SB-3 & SB-5 "UPPER SAND"




| COBBLES | GRAVEL | | SAND | | | SILT AND CLAY FRACTION |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| SYMBOL | BORING | DEPTH (FT.) | SOIL DESCRIPTION | U.S.C.S. | W% |
|---|---|---|---|---|---|
| | SB-1 | 1 - 5 | Medium - Fine Sand | SP | 4.1 |
| | SB-1 | 15 - 20 | Medium - Fine Sand | SP | 29.1 |
| | SB-3 | 2 - 5 | Silty Medium - Fine Sand | SM | 3.1 |
| | SB-3 | 13 - 20 | Medium - Fine Sand | SP | 19.0 |
| | SB-5 | 10 - 16 | Medium - Fine Sand | SP | 13.3 |

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| REV | DATE | BY | APP | DESCRIPTION |
|---|---|---|---|---|
| 5 | | | | |
| 4 | | | | |
| 3 | | | | |
| 2 | | | | |
| 1 | 6-15-15 | TJH | MWL | INCORPORATE IPL COMMENTS |

SCALE: NONE — DATE: 5-14-15
DRAWN BY: JFD — CHECKED BY: TJH — APPRDVED BY: MWL

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

CLIENT / LOCATION
INTERSTATE PDWER AND LIGHT (IPL)
LANSING GENERATING STATION PROJECT
232D PDWER PLANT DR
LANSING, IA 52151

DRAWING DESCRIPTION
SEEPAGE CONTROL CUT-OFF WALL
PARTICLE SIZE DISTRIBUTION
SB-5

JOB 154.021.0D3
SHT. 9
DWG. 154021SW-08-12

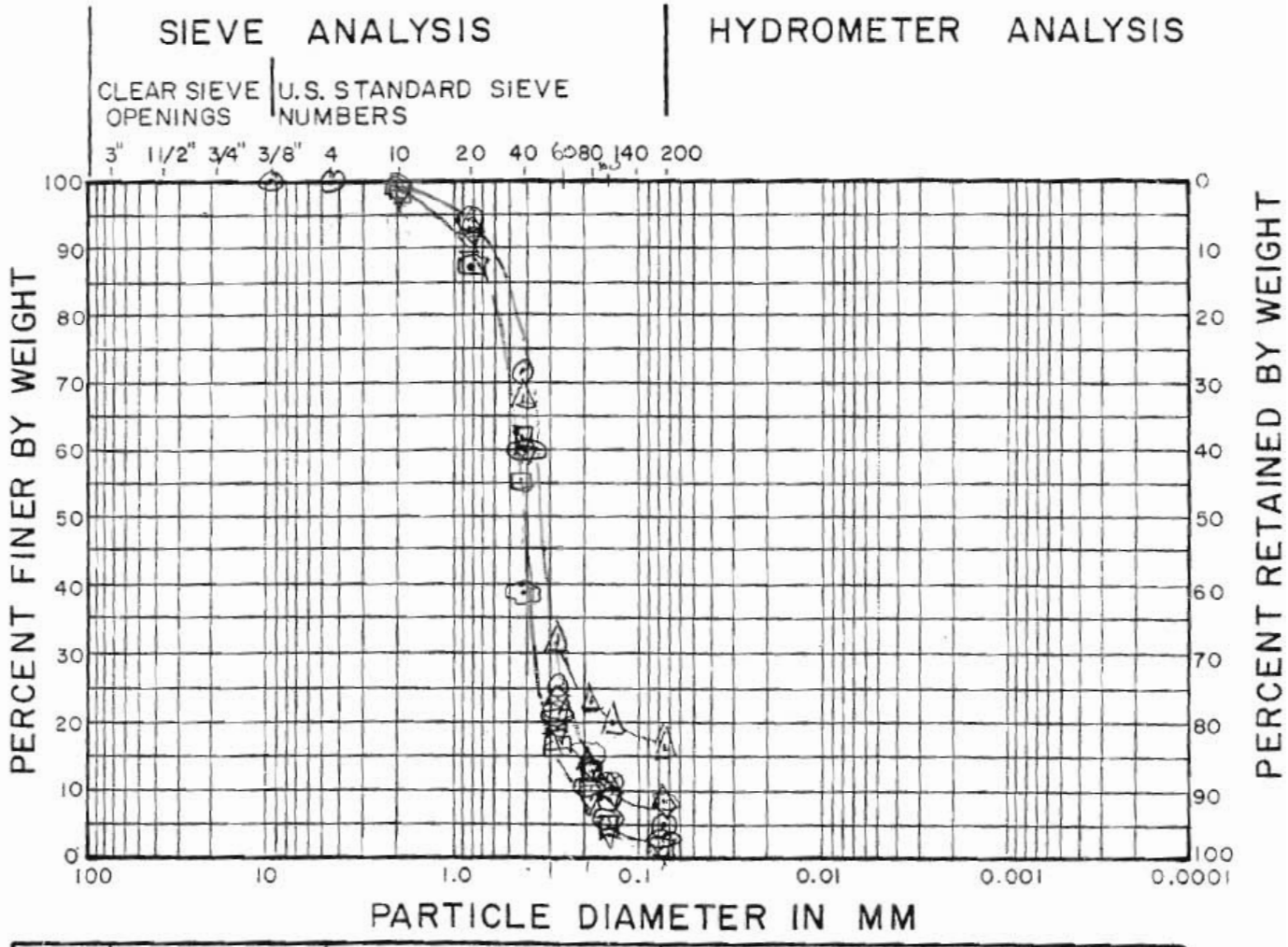
09/09/2015 Classification: Internal ECRM13865385

HEC
Harrington Engineering & Construction, Inc.

# Particle Size Distribution

" UPPER SAND "

PROJECT _____ TESTED BY _____ DATE _____
PROJECT NO. _____ CALC BY _____ DATE _____
BORING NO. _____ CHKD BY _____ DATE _____




| COBBLES | GRAVEL | | SAND | | | SILT AND CLAY FRACTION |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| SYMBOL | BORING | SAMPLE | DEPTH | SOIL DESCRIPTION | U.S.C.S. | L.L. | P.L. | W% |
|---|---|---|---|---|---|---|---|---|
| ⊙ | SB-1 | | 1-5 | MED-FINE SAND | SP | | | 4.1 |
| ⊡ | SB-1 | | 15-20 | " | SP | | | 20.1 |
| △ | SB-3 | | 2-5 | SILTY MED-FINE SAND | SM | | | 3.1 |
| ▽ | SB-3 | | 13-20 | MED-FINE SAND | SP | | | 19.0 |
| ⊙ | SB-5 | | 10-16 | " | SP | | | 13.3 |
| ◇ | SB-7 | | 4-10 | " | SP-SM | | | 3.1 |
| ▭ | SB-7 | | 19-25 | " | SP | | | 17.1 |

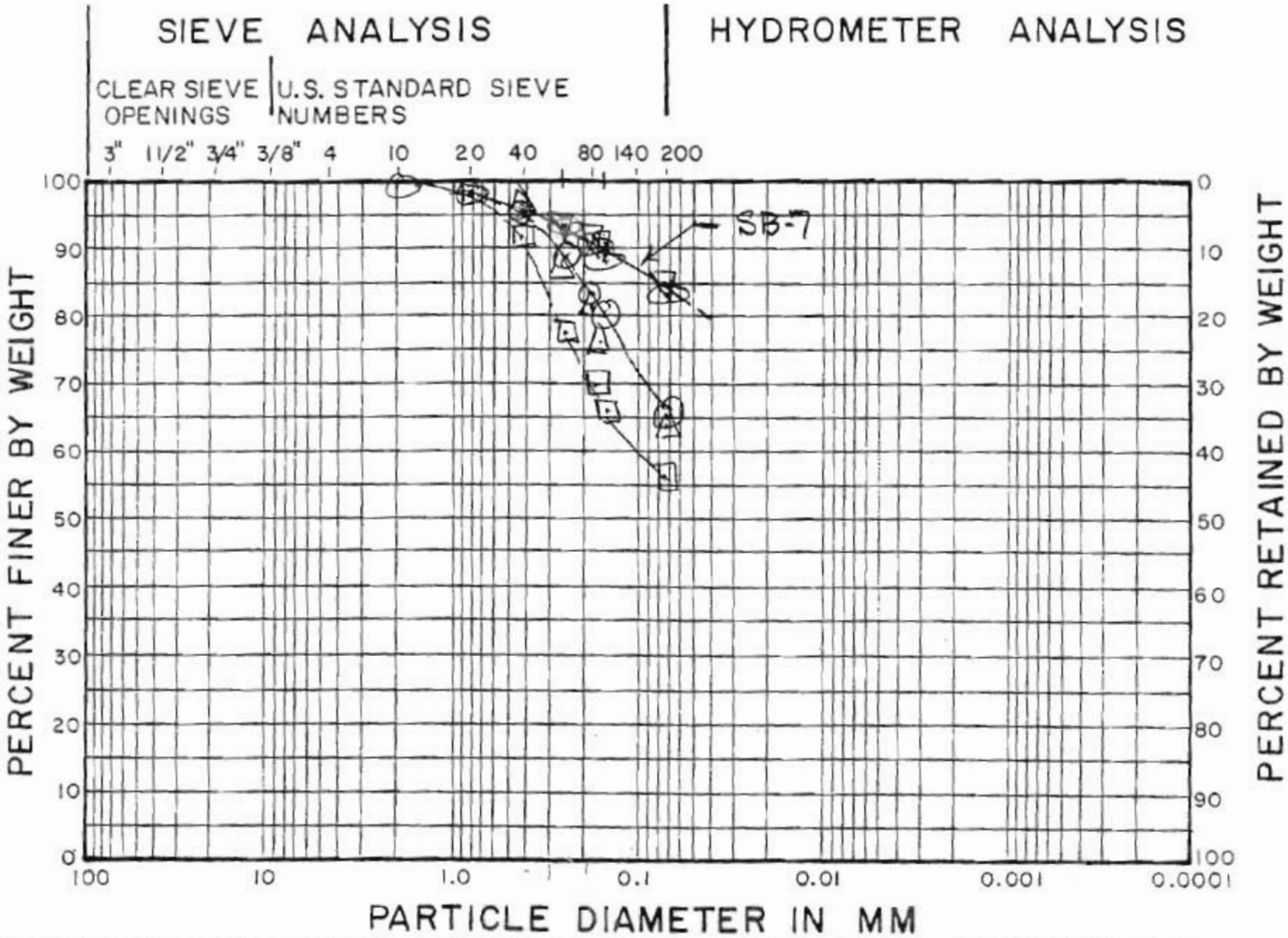
09/09/2026 - Classification: Internal - ECRM13805385

HEC
Harrington Engineering & Construction, Inc.

# Particle Size Distribution

"SANDY SILT"

PROJECT _____ TESTED BY _____ DATE _____
PROJECT NO. _____ CALC BY _____ DATE _____
BORING NO. _____ CHKD BY _____ DATE _____




| COBBLES | GRAVEL | | SAND | | | SILT AND CLAY FRACTION |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| SYMBOL | BORING | SAMPLE | DEPTH | SOIL DESCRIPTION | U.S.C.S. | L.L. | P.L. | W% |
|---|---|---|---|---|---|---|---|---|
| ○ | SB-1 | | 28-32 | SANDY SILT | ML | 28 | 26 | 36.1 |
| □ | SB-3 | | 24.5-27 | SANDY SILT | ML | 27 | 23 | 23.4 |
| △ | SB-5 | | 18.5-20 | SANDY SILT | ML | 24 | 20 | 21.8 |
| ▽ | SB-7 | | 29-32.5 | SANDY SILT | ML | 29 | 25 | 27.0 |
| ◇ | SB-7 | | 36-40 | SANDY SILT | ML | 31 | 26 | 35.7 |
| | | | | | | | | |
| | | | | | | | | |

09/09/2026 - Classification: Internal - ECRM13805385

Harrington Engineering & Construction, Inc.

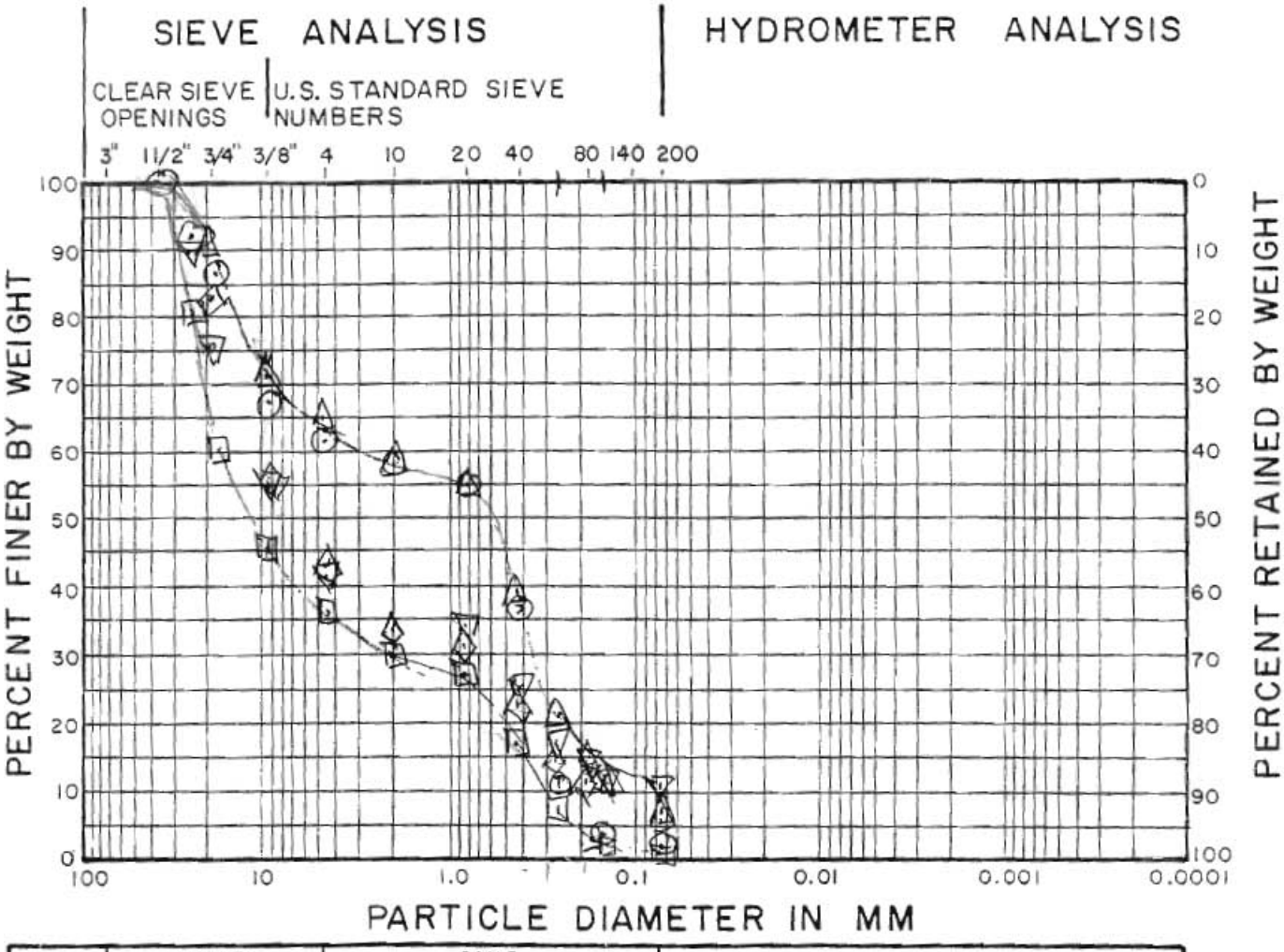
# Particle Size Distribution

" SANDY GRAVEL "

PROJECT _____ TESTED BY _____ DATE _____

PROJECT NO. _____ CALC BY _____ DATE _____

BORING NO. _____ CHKD BY _____ DATE _____




| COBBLES | GRAVEL | | SAND | | | SILT AND CLAY FRACTION |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| SYMBOL | BORING | SAMPLE | DEPTH | SOIL DESCRIPTION | U.S.C.S. | L.L. | P.L. | W% |
|---|---|---|---|---|---|---|---|---|
| ○ | SB-1 | | 40-50 | SAND & GRAVEL | SW/GW | | | 16.5 |
| □ | SB-3 | | 27-32 | " | " | | | 13.4 |
| △ | SB-5 | | 22-27.5 | " | " | | | 32.1 |
| ▽ | SB-5 | | 44-45 | " | " | | | 9.8 |
| ◇ | SB-7 | | 46-50 | " | " | | | 35.7 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

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## APPENDIX C – Earthquake and Liquefaction Analysis

Alliant Energy
Interstate Power and Light Company
Lansing Generating Station
Lansing, Iowa

Safety Factor Assessment



09/09/2026 - Classification: Internal - ECRM13805385

# USGS Design Maps Detailed Report

## ASCE 7-10 Standard (43.334°N, 91.168°W)

Site Class D – "Stiff Soil", Risk Category I/II/III

## Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain $S_S$) and 1.3 (to obtain $S_1$). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

| | |
|---|---|
| **From Figure 22-1** [1] | $S_S$ = 0.059 g |
| **From Figure 22-2** [2] | $S_1$ = 0.039 g |

## Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

| Site Class | $\bar{v}_s$ | $\bar{N}$ or $\bar{N}_{ch}$ | $\bar{s}_u$ |
|---|---|---|---|
| A. Hard Rock | >5,000 ft/s | N/A | N/A |
| B. Rock | 2,500 to 5,000 ft/s | N/A | N/A |
| C. Very dense soil and soft rock | 1,200 to 2,500 ft/s | >50 | >2,000 psf |
| D. Stiff Soil | 600 to 1,200 ft/s | 15 to 50 | 1,000 to 2,000 psf |
| E. Soft clay soil | <600 ft/s | <15 | <1,000 psf |
| | Any profile with more than 10 ft of soil having the characteristics:<br>• Plasticity index *PI* > 20,<br>• Moisture content *w* ≥ 40%, and<br>• Undrained shear strength $\bar{s}_u$ < 500 psf | | |
| F. Soils requiring site response analysis in accordance with Section 21.1 | See Section 20.3.1 | | |

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

## Section 11.4.3 — Site Coefficients and Risk–Targeted Maximum Considered Earthquake ($MCE_R$) Spectral Response Acceleration Parameters

Table 11.4–1: Site Coefficient $F_a$

| Site Class | Mapped $MCE_R$ Spectral Response Acceleration Parameter at Short Period | | | | |
|---|---|---|---|---|---|
| | $S_S \le 0.25$ | $S_S = 0.50$ | $S_S = 0.75$ | $S_S = 1.00$ | $S_S \ge 1.25$ |
| A | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| B | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| C | 1.2 | 1.2 | 1.1 | 1.0 | 1.0 |
| D | 1.6 | 1.4 | 1.2 | 1.1 | 1.0 |
| E | 2.5 | 1.7 | 1.2 | 0.9 | 0.9 |
| F | See Section 11.4.7 of ASCE 7 | | | | |

Note: Use straight–line interpolation for intermediate values of $S_S$

**For Site Class = D and $S_S$ = 0.059 g, $F_a$ = 1.600**

Table 11.4–2: Site Coefficient $F_v$

| Site Class | Mapped $MCE_R$ Spectral Response Acceleration Parameter at 1–s Period | | | | |
|---|---|---|---|---|---|
| | $S_1 \le 0.10$ | $S_1 = 0.20$ | $S_1 = 0.30$ | $S_1 = 0.40$ | $S_1 \ge 0.50$ |
| A | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| B | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| C | 1.7 | 1.6 | 1.5 | 1.4 | 1.3 |
| D | 2.4 | 2.0 | 1.8 | 1.6 | 1.5 |
| E | 3.5 | 3.2 | 2.8 | 2.4 | 2.4 |
| F | See Section 11.4.7 of ASCE 7 | | | | |

Note: Use straight–line interpolation for intermediate values of $S_1$

**For Site Class = D and $S_1$ = 0.039 g, $F_v$ = 2.400**

**Equation (11.4–1):** $S_{MS} = F_a S_S = 1.600 \times 0.059 = 0.094$ g

**Equation (11.4–2):** $S_{M1} = F_v S_1 = 2.400 \times 0.039 = 0.095$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

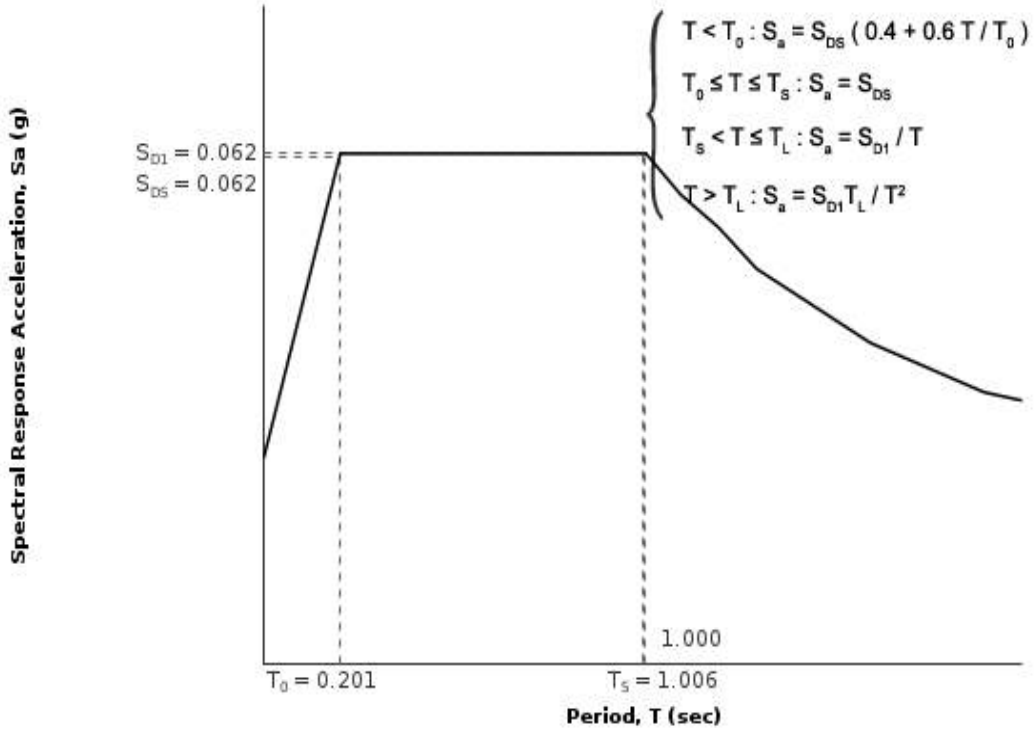
**Equation (11.4–3):** $S_{DS} = ⅔ S_{MS} = ⅔ \times 0.094 = 0.062$ g

**Equation (11.4–4):** $S_{D1} = ⅔ S_{M1} = ⅔ \times 0.095 = 0.063$ g

Section 11.4.5 — Design Response Spectrum

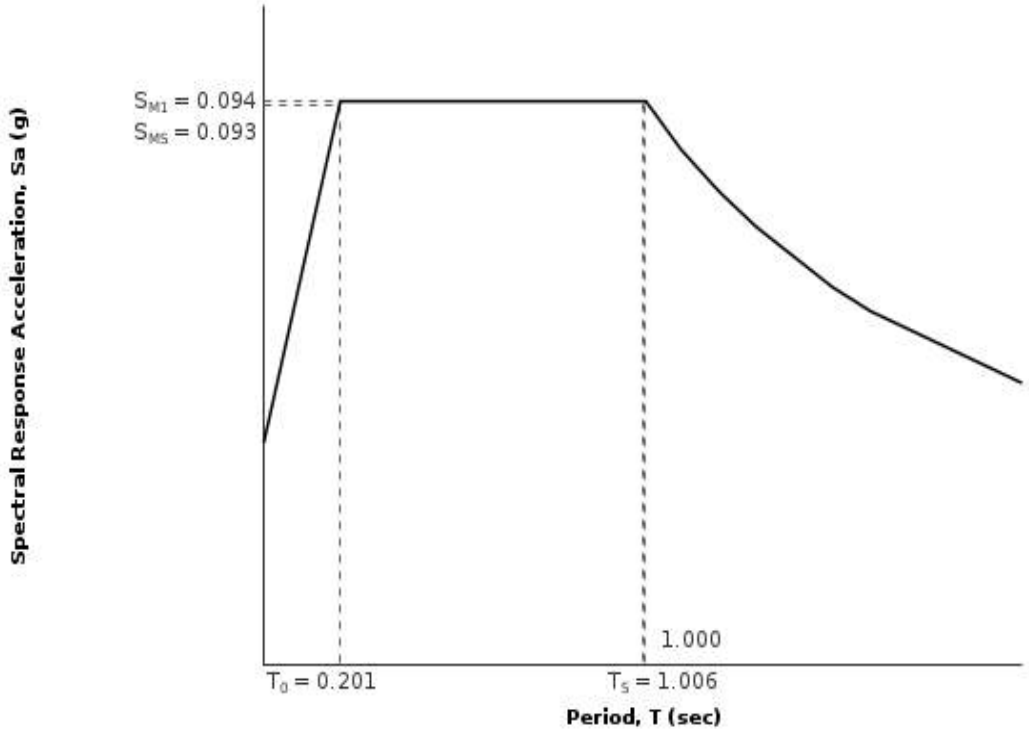
**From Figure 22-12** [3] $T_L = 12$ seconds

Figure 11.4–1: Design Response Spectrum



## Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake ($MCE_R$) Response Spectrum

The $MCE_R$ Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



## Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

**From Figure 22-7 [4]** PGA = 0.028

**Equation (11.8–1):** $PGA_M = F_{PGA}PGA = 1.600 \times 0.028 = 0.044$ g

Table 11.8–1: Site Coefficient $F_{PGA}$

| Site Class | Mapped MCE Geometric Mean Peak Ground Acceleration, PGA | | | | |
|---|---|---|---|---|---|
| | PGA ≤ 0.10 | PGA = 0.20 | PGA = 0.30 | PGA = 0.40 | PGA ≥ 0.50 |
| A | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| B | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| C | 1.2 | 1.2 | 1.1 | 1.0 | 1.0 |
| D | 1.6 | 1.4 | 1.2 | 1.1 | 1.0 |
| E | 2.5 | 1.7 | 1.2 | 0.9 | 0.9 |
| F | See Section 11.4.7 of ASCE 7 | | | | |

Note: Use straight–line interpolation for intermediate values of PGA

**For Site Class = D and PGA = 0.028 g, $F_{PGA}$ = 1.600**

## Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

**From Figure 22-17 [5]** $C_{RS}$ = 0.905

**From Figure 22-18 [6]** $C_{R1}$ = 0.862

## Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

| VALUE OF $S_{DS}$ | RISK CATEGORY | | |
|---|---|---|---|
| | I or II | III | IV |
| $S_{DS} < 0.167g$ | A | A | A |
| $0.167g \le S_{DS} < 0.33g$ | B | B | C |
| $0.33g \le S_{DS} < 0.50g$ | C | C | D |
| $0.50g \le S_{DS}$ | D | D | D |

**For Risk Category = I and $S_{DS}$ = 0.062 g, Seismic Design Category = A**

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

| VALUE OF $S_{D1}$ | RISK CATEGORY | | |
|---|---|---|---|
| | I or II | III | IV |
| $S_{D1} < 0.067g$ | A | A | A |
| $0.067g \le S_{D1} < 0.133g$ | B | B | C |
| $0.133g \le S_{D1} < 0.20g$ | C | C | D |
| $0.20g \le S_{D1}$ | D | D | D |

**For Risk Category = I and $S_{D1}$ = 0.063 g, Seismic Design Category = A**

Note: When $S_1$ is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = A

---

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

## References


1. *Figure 22-1*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf

Simplified Seed and Idriss Liquefaction Analysis
SPT Based Analysis
Lansing Generating Station
Interstate Electric Power
Equations from "Soil Liquefaqction During Earthqakes" Idriss & Boulanger
Soil Conditions at Boring SB-1 "Critical Slope Stability Cross-Section

**Input Parameters:**

| | |
|---|---|
| Peak Ground Acceleration (g) = | 0.04 |
| Earthquake Magnitude, M = | 7.7 |
| Water Table Depth (ft) = | 20 |
| Average Soil Density above water table ($lb/ft^3$) = | 115.0 |
| Average Soil Density below water table ($lb/ft^3$) = | 120.0 |
| Borehole Diameter (mm) = | 100 |

Rod Lengths assumed equal to depth plus 5.0 feet (for the above ground extension)

| SPT # | Depth (ft) | Measured N | Soil Type (USCS) | Flag "Clay" "Unsaturated" | Fines Content (%) | Energy Ratio, ER (%) | $C_e$ | $C_b$ | $C_r$ | $N_{60}$ | $\sigma_{vc}$ ($lb/ft^2$) | $\sigma_{vc}'$ ($lb/ft^2$) | $C_n$ | $(N_1)_{60}$ | ΔN for fines content | $(N_1)_{60\text{-}cs}$ | Stress Reduction Coeff, $r_d$ | CSR | MSF for sand | $k_\sigma$ for sand | CRR 7.5M & 1 atm | CRR | Factor of Safety |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 2.4 | 9 | SP | Unsaturated | 5 | 75% | 1.25 | 1 | 0.75 | 8.4 | 276 | 276 | 1.70 | 14.3 | 0.0 | 14.3 | 1.00 | 0.026 | 0.95 | 1.10 | 0.151 | n.a. | n.a. |
| 2 | 4.8 | 15 | SP | Unsaturated | 5 | 75% | 1.25 | 1 | 0.75 | 14.1 | 552 | 552 | 1.70 | 23.9 | 0.0 | 23.9 | 1.00 | 0.026 | 0.95 | 1.10 | 0.266 | n.a. | n.a. |
| 3 | 7.2 | 15 | SP | Unsaturated | 5 | 75% | 1.25 | 1 | 0.8 | 15.0 | 828 | 828 | 1.60 | 24.0 | 0.0 | 24.0 | 0.99 | 0.026 | 0.95 | 1.10 | 0.268 | n.a. | n.a. |
| 4 | 9.6 | 20 | SP | Unsaturated | 5 | 75% | 1.25 | 1 | 0.85 | 21.3 | 1104 | 1104 | 1.38 | 29.4 | 0.0 | 29.4 | 0.99 | 0.026 | 0.95 | 1.10 | 0.451 | n.a. | n.a. |
| 5 | 12 | 23 | SP | Unsaturated | 5 | 75% | 1.25 | 1 | 0.85 | 24.4 | 1380 | 1380 | 1.24 | 30.3 | 0.0 | 30.3 | 0.98 | 0.025 | 0.95 | 1.09 | 0.502 | n.a. | n.a. |
| 6 | 14.4 | 29 | SP | Unsaturated | 5 | 75% | 1.25 | 1 | 0.85 | 30.8 | 1656 | 1656 | 1.13 | 34.8 | 0.0 | 34.8 | 0.97 | 0.025 | 0.95 | 1.06 | 1.072 | n.a. | n.a. |
| 7 | 16.8 | 25 | SP | Unsaturated | 5 | 75% | 1.25 | 1 | 0.95 | 29.7 | 1932 | 1932 | 1.05 | 31.1 | 0.0 | 31.1 | 0.97 | 0.025 | 0.95 | 1.02 | 0.561 | n.a. | n.a. |
| 8 | 19.2 | 24 | SP | Unsaturated | 5 | 75% | 1.25 | 1 | 0.95 | 28.5 | 2208 | 2208 | 0.98 | 27.9 | 0.0 | 27.9 | 0.96 | 0.025 | 0.95 | 0.99 | 0.380 | n.a. | n.a. |
| 9 | 21.6 | 22 | SP | | 5 | 75% | 1.25 | 1 | 0.95 | 26.1 | 2492 | 2392 | 0.94 | 24.6 | 0.0 | 24.6 | 0.95 | 0.026 | 0.95 | 0.98 | 0.280 | 0.261 | 2.00 |
| 10 | 24 | 14 | SP | | 5 | 75% | 1.25 | 1 | 0.95 | 16.6 | 2780 | 2530 | 0.91 | 15.2 | 0.0 | 15.2 | 0.94 | 0.027 | 0.95 | 0.98 | 0.158 | 0.147 | 2.00 |
| 11 | 26.4 | 8 | SP | | 5 | 75% | 1.25 | 1 | 0.95 | 9.5 | 3068 | 2669 | 0.89 | 8.5 | 0.0 | 8.5 | 0.93 | 0.028 | 0.95 | 0.98 | 0.108 | 0.100 | 2.00 |
| 12 | 28.8 | 0 | ML | | 70 | 75% | 1.25 | 1 | 1 | 0.0 | 3356 | 2807 | 0.87 | 0.0 | 5.6 | 5.6 | 0.92 | 0.029 | 0.95 | 0.98 | 0.089 | 0.083 | 2.00 |
| 13 | 31.2 | 0 | ML | | 70 | 75% | 1.25 | 1 | 1 | 0.0 | 3644 | 2945 | 0.85 | 0.0 | 5.6 | 5.6 | 0.92 | 0.029 | 0.95 | 0.97 | 0.089 | 0.083 | 2.00 |
| 14 | 33.6 | 3 | ML | | 70 | 75% | 1.25 | 1 | 1 | 3.8 | 3932 | 3083 | 0.83 | 3.1 | 5.6 | 8.7 | 0.91 | 0.030 | 0.95 | 0.97 | 0.109 | 0.100 | 2.00 |
| 15 | 36 | 8 | GP | | 3 | 75% | 1.25 | 1 | 1 | 10.0 | 4220 | 3222 | 0.81 | 8.1 | 0.0 | 8.1 | 0.90 | 0.031 | 0.95 | 0.96 | 0.105 | 0.096 | 2.00 |
| 16 | 38.4 | 20 | GP | | 3 | 75% | 1.25 | 1 | 1 | 25.0 | 4508 | 3360 | 0.79 | 19.8 | 0.0 | 19.8 | 0.89 | 0.031 | 0.95 | 0.94 | 0.204 | 0.182 | 2.00 |
| 17 | 40.8 | 21 | GP | | 3 | 75% | 1.25 | 1 | 1 | 26.3 | 4796 | 3498 | 0.78 | 20.4 | 0.0 | 20.4 | 0.88 | 0.031 | 0.95 | 0.93 | 0.211 | 0.187 | 2.00 |
| 18 | 43.2 | 12 | GP | | 3 | 75% | 1.25 | 1 | 1 | 15.0 | 5084 | 3636 | 0.76 | 11.4 | 0.0 | 11.4 | 0.87 | 0.032 | 0.95 | 0.95 | 0.128 | 0.115 | 2.00 |
| 19 | 45.6 | 12 | SP | | 5 | 75% | 1.25 | 1 | 1 | 15.0 | 5372 | 3775 | 0.75 | 11.2 | 0.0 | 11.2 | 0.86 | 0.032 | 0.95 | 0.94 | 0.127 | 0.114 | 2.00 |

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## APPENDIX D – Slope Stability Analysis

Alliant Energy
Interstate Power and Light Company
Lansing Generating Station
Lansing, Iowa

Safety Factor Assessment



09/09/2026 - Classification: Internal - ECRM13805385

December 8, 2022
File No. 25220100.00

TECHNICAL MEMORANDUM

| | |
|---|---|
| ANALYSIS PREPARED BY: | Brandon Suchomel<br>Keith Gilkey |
| ANALYSIS REVIEWED BY: | Phil Gearing<br>Deb Nelson<br>Dave Hendron |
| SUBJECT: | Updated Geotechnical Slope Stability Analysis Summary<br>Upper Ash Pond Closure<br>Lansing Generating Station, Lansing, Iowa |

## PURPOSE

The purpose of this memorandum is to summarize the analyses performed for the Lansing Generating Station Upper Ash Pond Coal Combustion Residuals (CCR) Impoundment Closure design. Analyses were performed to evaluate slope stability of the proposed grading plan and design features. Analysis was also performed for the geotextile tube laydown and stacking arrangement. Results of the analysis were used to identify critical pore pressure elevations for geotechnical instrumentation monitoring during construction.

## CONCLUSION

The attached results confirm that the geometry and material property requirements of the design for interim and final grade conditions have calculated Factors of Safety (FS) that meet the minimum recommended FS during the construction, operation, and maintenance of the closed impoundment, including safety factor criteria of 40 CFR 257.73(e). The critical assumptions included in this conclusion are as follows:

- The slope north of the In-Situ Stabilized (ISS) wall will be at a maximum 4H:1V slope.
- The slope at the toe near the perimeter drainage swales along the east, west, and south ends will be at a maximum 3H:1V slope.
- The ISS wall material has a 4,000 psf shear strength value corresponding to an 8,000 psf unconfined compressive strength.
- Waste fill placed on and directly south of the ISS wall will consist of mixed waste material with a unit weight less than or equal to 105 pcf.



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- The geotextile tube stacking will be in a 4H:1V arrangement during filling. SCS Engineers (SCS) is relying on the contractor's past experience with the geotextile tube material and geomembrane liner system to prevent rolling and shifting of the tubes.

# APPROACH

SCS evaluated the CCR waste slope stability of the Upper Ash Pond Closure at final waste conditions at the most critical/highest waste grade cross-sections. Cross sections analyzed include 1) a section through the north slope face through the ISS wall, 2) a section through the western slope face and existing berm, and 3) a section through the eastern slope face. The waste slopes were evaluated for circular and non-circular slip surface failures.

Additionally, SCS evaluated the stability and sliding block of the geotextile tube layout for maximum 4H:1V slopes and an assumed 1 percent slope for the geomembrane scour protection layer. After the analysis, the contractor has since recommended no steeper than 0.5 percent slopes for the scour protection layer to protect against geotextile tube rolling. SCS is relying on the contractor's past experience with the geotextile tube material and geomembrane liner system to prevent rolling and shifting of tubes.

## Thixotropic Ash Shear Strength

Varied thixotropic ash material strength properties were evaluated. Based on shear strength testing of intact samples, SCS completed a review of the shear strength testing results for the borings completed in the Upper Ash Pond. Thixotropic ash shear strength values for analysis were selected based on the following:

- Estimated laboratory peak vane shear strength of 1,100 psf and average field peak vane shear strength was 900 psf (see Reference 5). The overall average shear strength from field and laboratory testing of the thixotropic ash was 1,000 psf. Analysis was completed to determine the required shear strength to meet the minimum recommended factors of safety for short-term and long-term operating conditions. Thixotropic ash shear strengths used in the analysis are summarized below.

  - The north slope and ISS wall final and waste grade evaluation included 500 psf, 650 psf, and 700 psf shear strengths for the thixotropic ash compared to the average shear strength of 1,000 psf.

  - The east and west slope final grade evaluation included 500 psf, 700 psf, and 1,000 psf shear strengths for the thixotropic ash compared to the average shear strength of 1,000 psf.

  - The geotextile tube stacking north, east, and west slope evaluation included 500 psf, 650 psf, and 700 psf shear strengths for the thixotropic ash compared to the average shear strength of 1,000 psf.

  - Analysis for the operating condition included 1,000 psf shear strengths for the thixotropic ash compared to the average shear strength of 1,000 psf.

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## North Slope and ISS Wall

The north slope and ISS wall evaluation was completed to confirm the material properties for the ISS wall and the required slope angle geometry for the north slope face. The ISS wall material was modeled as 50 ft wide, from elevation 654 ft to elevation 608 ft (extending 10 ft into native materials). Refer to the attached North Slope and ISS Wall, West Slope, and East Slope analysis section location figure and summary table. The analysis resulted in FS meeting the recommended minimums of 1.3 for short-term conditions and 1.5 for long-term conditions. Analyses were completed for:

- CCR material fully removed from the North Pond Clean Close Area of the pond closure with the exception of a 4H:1V toe buttress of remaining CCR along the north side of the wall.
- After backfilling to final grades.
- Several piezometric conditions described below.
- A seismic pseudostatic analysis for final grades using a horizontal acceleration of 0.04 g.

Piezometric conditions in the waste south of the ISS wall was evaluated at an estimated elevation of 652 ft based on planned geotextile tube dewatering operations during construction in the South Pond Closure Area. Piezometric conditions on the north side of the ISS wall were evaluated under:

- Full pond operating conditions.
- Pond water levels between a full level and the fully dewatered condition.
- Dewatered condition.
- Estimated final condition.

The piezometric condition through the ISS wall followed a linear gradient transition. The piezometric condition was assumed to conservatively be just below the outer ground surface under the dewatered pond condition.

The ISS wall material analyzed has a 4,000 psf shear strength. Note that a 4,000 psf shear strength corresponds to an unconfined compressive strength of 8,000 psf. The shear strength was confirmed by ISS mix design testing and ISS field pilot test column samples. Summary plots of the unconfined compressive strength testing bench scale and field pilot test results are provided as an attachment to this memorandum. A 10 percent mix design was selected based on these testing results for the full scale construction to meet the analyzed shear strength. Shear strength of full scale construction was confirmed by sampling drilled columns throughout construction.

Initial analysis was completed using a 90 pcf unit weight for the CCR waste material but, based on the closure approach presented by the contractor, this zone may receive conventionally excavated CCR material, coal, and/or coal impacted soil and CCR material. Additional analyses were completed on the north slope using 105 pcf unit weight material placed on and behind the ISS wall between the geotextile tube laydown area. A higher unit weight material of 105 pcf is representative of mixed waste material consisting of CCR, coal, and/or coal impacted soil placed together in a monofill.

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In March 2022, the bridge lift extension for the ISS wall construction was constructed and was relocated further north to accommodate additional water management area for interim construction sequencing. The northern relocation of the bridge lift moved the proposed north 4H:1V slope further north but the maximum waste fill height behind the ISS wall did not change. It is SCS's conclusion that the previously conducted analysis still applies.

## East Slope

The east slope face evaluation was completed to confirm the material properties and required slope angle geometry for the east slope face. Refer to the attached North Slope and ISS Wall, West Slope, and East Slope analysis section location figure and summary table. The analysis included a 3H:1V slope at the toe for the perimeter swale that results in FS meeting the recommended minimums of 1.3 for short-term conditions and 1.5 for long-term conditions. Ultimately, the geometry of the waste slope was updated to include 4H:1V slope geometry through the toe to the perimeter swales for improved slope stability.

Piezometric conditions in the waste were evaluated at elevation 652 ft based on planned geotextile tube dewatering operations. To estimate the long-term condition, lowered piezometric conditions near the estimated top of the Thixotropic Ash material were evaluated at an elevation of 639 ft.

## West Slope and Existing Berm

The west slope face evaluation was completed to confirm the material properties and required slope angle geometry for the west slope face. Refer to the attached North Slope and ISS Wall, West Slope, and East Slope analysis section location figure and summary table. Analysis was evaluated for slip surfaces through the existing berm in addition to slip surfaces isolated to the waste fill. The analysis through the existing berm results in FS meeting the recommended minimums of 1.3 for short-term conditions and 1.5 for long-term conditions. Initial analysis isolated to the waste fill included a 2H:1V slope at the toe for the perimeter swale that resulted in FS below the recommended minimum safety factor. The geometry of the waste slope was updated to include the 4H:1V slope through the toe to the perimeter swales for improved slope stability in conjunction with the analysis performed on the east slope face.

The piezometric condition outside of the existing berm was estimated at an elevation of 632.1 ft based on the 100-year flood condition. A slurry seepage cutoff wall exists in the existing berm and the piezometric condition through the slurry wall followed a linear gradient transition. Piezometric conditions in the waste were evaluated at elevation 652 ft based on planned geotextile tube dewatering operations and at lowered piezometric condition near the estimated top of the Thixotropic Ash material at elevation 639 ft to estimate the long-term condition.

## Geotextile Tube Laydown Area

The north, east, and west slope faces of the geotextile tube laydown area evaluation was completed to confirm the material properties and required slope angle geometry for the stacking arrangement with maximum slopes of 4H:1V. Refer to the attached Geotextile Tube Laydown Area analysis section location figure and summary table. The 4H:1V stacking arrangement was determined as stable in terms of slope stability based on a minimum recommended safety factor of 1.3.

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The geotextile tube stacking analysis was performed to evaluate slope stability including a sliding block analysis with assumed interface friction between the HDPE textured geomembrane scour protection layer and woven geotextile tubes. The analysis was completed using an assumed 1 percent slope for the scour protection layer and resulted in a safety factor meeting the recommended minimum value of 1.3. The contractor has since recommended no steeper than 0.5 percent slopes for the scour protection layer to protect against geotextile tube rolling. SCS is relying on the contractor's past experience with the geotextile tube material and geomembrane liner system to prevent tube rolling and shifting. The purpose of the SCS analysis is to evaluate slope stability with the thixotropic ash material below the geotextile tubes.

Piezometric conditions were assumed to follow the level of the geomembrane of the scour protection layer for the analysis.

## Operating Condition Analysis

The Upper Ash Pond will continue to operate as an active CCR impoundment during the consolidation of waste material to the south of the ISS wall. Additional analysis was performed on critical sections of the north slope and ISS wall along with the west slope where the fill geometry inside the impoundment is expected to change or impact existing impoundment embankments while still operating as a CCR impoundment and meet factors of safety required under 40 CFR 257.73(e). Analysis assumes material placement to final or final waste grades under this operating condition. Geometry of the Upper Ash Pond north embankment did not change from the previous analysis performed (see Reference 15) and was not analyzed.

- (i) The calculated static factor of safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50.
  - Maximum storage pool under normal operations is elevation 649 ft (see Reference 15 and 16). Water level in the creek assumed flowing to full bank capacity.
- (ii) The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.
  - Maximum surcharge storage pool is elevation 653 ft (see Reference 15 and 16). Water level in the creek assumed flowing to full bank capacity.
- (iii) The calculated seismic factor of safety must equal or exceed 1.00.
  - Evaluated psuedostatic analysis utilizing earthquake horizontal coefficient of 0.04g and vertical coefficient of 0.027g (see Reference 14 and 15). Water level in the creek assumed flowing to full bank capacity.
- (iv) For dikes constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.
  - Not evaluated. The embankment and foundation soils are not susceptible to liquefaction (see Reference 15).

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Refer to the attached North Slope and ISS Wall, West Slope, and East Slope analysis section location figure and the Operating Condition analysis summary table. The calculated factor of safety for the analyzed sections were above the minimum required safety factors in 40 CRF 257.73(e).

## ASSUMPTIONS

The analyses were performed with the following assumptions:

- Dredged and dewatered CCR placed into geotextile dewatering tubes and other conventionally placed CCR material and coal have the same properties and material mixed with CCR/coal impacted soils have a higher unit weight.
- Cap material consisting of low permeability soil and topsoil components will have the same properties.
- Interim conditions are appropriate for the current contractor execution plan for construction.
- Water level and piezometric conditions are appropriate for the current site condition understanding and contractor execution plan for construction. Upper Ash Pond normal operation and surcharge pool storage elevations are appropriate (see Reference 15 and 16).
- Circular and non-circular slip surface failure stability analyses are appropriate to evaluate the slope stability.
- A minimum factor of safety of 1.3 is appropriate for evaluating scenarios for short-term conditions and during construction for closure design. For operating condition under 40 CRF 257.73(e) the required factor of safety applies.
- A minimum factor of safety of 1.5 is appropriate for evaluating scenarios for long-term conditions. For operating condition under 40 CRF 257.73(e) the required factor of safety applies.
- A minimum factor of safety of 1.1 is appropriate for evaluating scenarios for seismic psuedostatic analysis. For operating condition under 40 CRF 257.73(e) the required factor of safety applies.
- Material properties shown in the attached *Material Properties and Factor of Safety Results Summary* tables are based on the indicated references and assumed values based on experience. Shear strength for CCR material and ISS mix are based on field and laboratory testing on representative site materials and SCS experience. Friction angles for soils are conservative assumed values based on soil type, published typical values, and SCS experience.

## RESULTS

The calculated safety factors for each slope section and failure type are shown in the attached *Material Properties and Factor of Safety Results Summary* tables.

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## REFERENCES

1. Geo-Slope International, Ltd., GeoStudio 2016. Version 8.16.2.14053, Slope/W slope stability software.
2. Robert M. Koerner (2005), Designing with Geosynthetics, 5th Edition.
3. SCS Engineers, Lansing Generating Station Ash Pond Closure Control Estimate Drawings, December 2021.
4. SCS Engineers, Lansing Generating Station Ash Pond Closure Issued for Construction Drawings, May 2022.
5. SCS Engineers, Lansing Generating Station Geotechnical Data Results for Coal Combustion Residual Surface Impoundment Closure, August 11, 2020.
6. SCS Engineers, B41—B42–B43 borings and associated Vibrating Wire Piezometer (VWP), Borings drilled and VWPs installed September 2021.
7. Ames Construction, LGS Execution Plan, December 17, 2021.
8. Infrastructure Alternatives, Inc., Geotextile Tube Arrangement, received via email on January 18, 2022.
9. SCS Engineers, Geotextile Tube Scour Protection Layer Grading Plan, February 3, 2022.
10. Ames Construction, Lansing Dewatering Staging Plans Rev 1, January 2022.
11. Hard Hat Services, Lansing Generating Station Project Seepage Control Cut-Off Wall, May 2015.
12. FEMA, Allamakee County, Iowa Flood Insurance Study, September 18, 2020.
13. FEMA, National Flood Insurance Flood Insurance Rate Map for Allamakee County, Iowa and Incorporated Areas, Map 19005C0300C, September 18, 2020.
14. USGS Seismic Impact Zones Map, Two-Percent probability exceedance, 2014.
15. Hard Hat Services, CCR Surface Impoundment, Safety Factor Assessment, Revision 1, August 10, 2021.
16. Hard Hat Services, CCR Surface Impoundment, Inflow Design Flood Control Plan, Revision 1, August 10, 2021.
17. USGS Coal Resource Classification System of the U.S. Geological Survey, Table 2, 2016.

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Attachments: Calculations organized as follows:

- Analysis Section Location Figure – North Slope and ISS Wall, West Slope, East Slope
- Material Properties and Factor of Safety Summary Results Table – North Slope and ISS Wall, West Slope, East Slope
- Slope/W Outputs – North Slope and ISS Wall, West Slope, East Slope
- Analysis Section Location Figure – Geotextile Tube Laydown Area
- Material Properties and Factor of Safety Summary Results Table – Geotextile Tube Laydown Area
- Slope/W Outputs – Geotextile Tube Laydown Area
- Material Properties and Factor of Safety Summary Results Table – Operating Condition
- Slope/W Outputs – North Slope and ISS Wall - Operating Condition
- Slope/W Outputs – West Slope - Operating Condition
- Bench Scale Mix Design Unconfined Strength Testing Summary
- Field Pilot Test Mix Design Unconfined Strength Testing Summary

BSS/REO/DLN/PEG/DMH/EJN

I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\221208_Tech Memo - LAN Impoundment Closure Slope Stability Analysis\221208_Tech Memo - LAN Updated Impoundment Closure Slope Stabilty Analysis_Final.docx

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# Analysis Section Location Figure - North Slope and ISS Wall, West Slope, East Slope

5541000 E | 5541500 E | 5542000 E | 5542500 E | 5543000 E

3958000 N | 3957500 N | 3957000 N | 3956500 N | 3956000 N

LOWER ASH POND (CLOSED)

NORTH POND CLOSURE AREA

SOUTH POND CLOSURE AREA

ASH DISPOSAL LANDFILL

POWER PLANT DR

BRIDGE

SHEET PILE WALL

SHEET PILE WALL

GO. HWY X52 (GREAT RIVER RD)

UNNAMED CREEK

RIPRAP

RIPRAP

UNDERFLOW WEIR

GATE

RETROFIT EXISTING WEIR BOX #1 FOR EMERGENCY SPILLWAY (TO BE DETERMINED)

North Slope and ISS Wall Analysis Section

East Slope Analysis Section

West Slope and Existing Berm Analysis Section

PLACE GENERAL FILL TO achieve PROPOSED GRADES AND RESTORE WITH 6-INCHES TOPSOIL

ROCK CHUTE C2

DOWNSLOPE FLUME (TYP) SEE DETAIL 5/20

ROCK CHUTE C1

DIVERSION BERM (TYP.) SEE DETAIL 3/20

FINAL GRADES

PERIMETER SWALE SEE DETAIL 3/14

FLAT BOTTOM PERIMETER SWALE (TYP) SEE DETAIL 4/14

ACCESS ROAD SEE DETAIL 2/14

BERM TO DIRECT FLOW TO THE WEST

ROCK CHUTE (TYP.) SEE DETAIL 5/14

ROCK CHUTE C3

ENERGY DISSIPATOR SEE DETAIL 1/16

SHORTEN 30" DIA. PIPE BACK TO ENERGY DISSIPATOR

MW302A MW302 MW303 MW304A MW301 MW15 MW13 MW14 MW1R MW19 PZ19 PZ-1 PZ-2 PZ-3 PZ-4 PZ-5 PZ-6 CP-01 CP-02 CP-04 TW17 TW18 GRIFFIN #1 GRIFFIN #2 GRIFFIN #3

## LEGEND

- 2008 EXISTING GRADE (10' CONTOUR)
- 2015/2020 EXISTING GRADE (10' CONTOUR)
- 2015/2020 EXISTING GRADE (2' CONTOUR)
- ASH DISPOSAL LANDFILL LIMITS OF WASTE
- PAVED ROAD
- GRAVEL ROAD
- FENCE
- RAILROAD TRACKS
- EDGE OF WATER
- UNNAMED CREEK FLOW PATH
- OVERHEAD UTILITY
- TELEPHONE
- STORM DRAINAGE PIPE
- PROCESS WATER PIPE
- PROPOSED UPPER ASH POND OUTFALL REROUTE PIPING (BY OTHERS)
- UTILITY POLE AND GUY WIRE
- LIGHT POLE
- SURVEY CONTROL POINT
- MONITORING WELL
- ABANDONED MONITORING WELL
- PIEZOMETER
- ABANDONED PIEZOMETER
- ABANDONED SHALLOW PIEZOMETER
- WEST EMBANKMENT SLURRY WALL PIEZOMETER (2015 BY HARD HAT SERVICES)
- SLURRY WALL (2015 BY HARD HAT SERVICES)
- APPROXIMATE LIMITS OF UPPER ASH POND
- ASH DISPOSAL LANDFILL FINAL COVER AREA
- KELLER BURIAL MOUNDS CULTURAL RESOURCE
- PROPOSED SILT FENCE
- PROPOSED GRADE (10' CONTOUR)
- PROPOSED GRADE (2' CONTOUR)
- PROPOSED FINAL COVER LIMITS
- PROPOSED DRAINAGE SWALE
- PROPOSED DIVERSION BERM
- PROPOSED DOWNSLOPE FLUME
- PROPOSED ENERGY DISSIPATOR
- PROPOSED ROCK CHUTE
- PROPOSED ACCESS ROAD

NOTES:

1. SEE SHEET 2 AND SHEET 3 FOR ADDITIONAL BASE MAP LEGEND ITEMS AND NOTES.
2. PROPOSED NORTH POND CLOSURE AREA GRADES REPRESENT PROPOSED FINAL GRADES (TOP OF TOPSOIL).
3. PROPOSED SOUTH POND CLOSURE AREA GRADES REPRESENT PROPOSED FINAL COVER GRADES (TOP OF TOPSOIL).
4. PROPOSED GRADES IN THE SOUTH POND CLOSURE AREA ARE SUBJECT TO CHANGE DEPENDENT ON VOLUME REMOVED FROM THE NORTH POND CLOSURE AREA AND ON-SITE MATERIAL BALANCING.

100 0 100

SCALE: 1" = 100'

N

**PRELIMINARY**

**NOT FOR CONSTRUCTION**

DRAWN BY: BSS
CHECKED BY: DLNNRG
APPROVED BY: EJN, 12/08/2022

PROJECT NO. 25220100.00
DRAWN: 03/25/2021
REVISED: 12/07/2021

INTERSTATE POWER AND LIGHT CO.
2320 POWER PLANT DRIVE
LANSING, IA 52151-9733

CLIENT

SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

ENGINEER

ASH POND CLOSURE
CONSTRUCTION DRAWINGS
LANSING GENERATING STATION
LANSING, IOWA

SITE

PROPOSED FINAL GRADES

SHEET 10 of 20

09/09/2026 - Classification: Internal - ECRM13805385

**Slope Stability - Lansing Impoundment Closure - North Slope and ISS Wall, West Slope, East Slope**
**Material Properties and Factors of Safety Results Summary**
**Lansing Generating Station**

| Material | Unit Weight (pcf) | Friction Angle (degrees) | Cohesion (psf) |
|---|---|---|---|
| Cap | 120 | 30 | 0 |
| Native | 125 | 30 | 0 |
| New Ash Fill/Ash Fill | 90 | 28 | 0 |
| Ash , Coal, Coal Impacted Soil Fill | 105 | 25 | 0 |
| Thixotropic Ash | 75 | 0 | 500 |
| Thixotropic Ash (650 psf) | 75 | 0 | 650 |
| Thixotropic Ash (700 psf) | 75 | 0 | 700 |
| Thixotropic Ash (1000 psf) | 75 | 0 | 1000 |
| InSitu Stabilization | 80 | 0 | 4000 |
| General Fill | 120 | 30 | 0 |
| Medium Dense Fine to Medium Sand | 120 | 30 | 0 |
| Sand and Gravel | 125 | 30 | 0 |
| Very Loose Sandy Silt | 120 | 28 | 0 |
| Slurry Wall | 110 | 25 | 0 |

**Recommended Minimum Safety Factor**

FS = 1.3 for short term conditions and during construction

FS = 1.5 for long term conditions

FS = 1.1 for seismic psuedostatic analysis.

| Scenario Analyzed | Failure Type | Calculated Safety Factor | Recommended Minimum Safety Factor | Comments |
|---|---|---|---|---|
| **North Slope and ISS Wall** | | | | |
| 3a_Seismic_Final Grades and ISS Wall | Optimized Circular | 1.387 | 1.100 | Evaluating north slope at ISS wall.<br>Approximate slope from south bridge lift limit to North peak for interim filling grade condition.<br>Piezo south of wall set at 652 ft (initial trigger level = 2 ft below top of bridge lift) piezo in front at 635 ft in North Pond filled area.<br>**Thixotropic ash cohesion = 500 psf.**<br>Psuedostatic analysis with horizontal acceleration set at 0.04g. |
| Final Waste Grades and ISS wall_Fill and Water_Thixo 650 psf | Optimized Circular | 1.573 | 1.500 | Evaluating north slope at ISS wall with higher unit weight waste material in wedge behind wall.<br>Final grade condition with cap and fill in north pond area.<br>Piezo south of wall set at 652 ft (initial trigger level = 2 ft below top of bridge lift) piezo in front at 635 ft which keeps piezo below swale in North Pond filled area. [Elevated WL behind the ISS wall]<br>**Thixotropic ash cohesion = 650 psf.** |
| Final Waste Grades and ISS wall_No Fill and No Water_Thixo 650 psf_fully drained | Optimized Circular | 1.752 | 1.300 | Evaluating north slope at ISS wall with higher unit weight waste material in wedge behind wall.<br>Peak waste grades with full excavation.<br>Piezo south of wall set at 652 ft (initial trigger level = 2 ft below top of bridge lift) piezo in front at the bottom of excavation. [fully drained]<br>**Thixotropic ash cohesion = 650 psf.** |
| Final Waste Grades and ISS wall_No Fill and Water_Thixo 650 psf | Optimized Circular | 1.420 | 1.300 | Evaluating north slope at ISS wall with higher unit weight waste material in wedge behind wall.<br>Peak waste grades with full excavation.<br>Piezo south of wall set at 652 ft (initial trigger level = 2 ft below top of bridge lift) piezo in front at top of thixo and held for water remaining in the pond.<br>**Thixotropic ash cohesion = 650 psf.** |
| Final Waste Grades and ISS wall_No Fill and Water_Thixo 650 psf_half pool | Optimized Circular | 1.513 | 1.300 | Evaluating north slope at ISS wall with higher unit weight waste material in wedge behind wall.<br>Peak waste grades with full excavation.<br>Piezo south of wall set at 652 ft (initial trigger level = 2 ft below top of bridge lift) piezo in front at 628 ft elevation for approximate half full pond.<br>**Thixotropic ash cohesion = 650 psf.** |

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**Slope Stability - Lansing Impoundment Closure - North Slope and ISS Wall, West Slope, East Slope**
**Material Properties and Factors of Safety Results Summary**
**Lansing Generating Station**

| Material | Unit Weight (pcf) | Friction Angle (degrees) | Cohesion (psf) |
|---|---|---|---|
| Cap | 120 | 30 | 0 |
| Native | 125 | 30 | 0 |
| New Ash Fill/Ash Fill | 90 | 28 | 0 |
| Ash , Coal, Coal Impacted Soil Fill | 105 | 25 | 0 |
| Thixotropic Ash | 75 | 0 | 500 |
| Thixotropic Ash (650 psf) | 75 | 0 | 650 |
| Thixotropic Ash (700 psf) | 75 | 0 | 700 |
| Thixotropic Ash (1000 psf) | 75 | 0 | 1000 |
| InSitu Stabilization | 80 | 0 | 4000 |
| General Fill | 120 | 30 | 0 |
| Medium Dense Fine to Medium Sand | 120 | 30 | 0 |
| Sand and Gravel | 125 | 30 | 0 |
| Very Loose Sandy Silt | 120 | 28 | 0 |
| Slurry Wall | 110 | 25 | 0 |

**Recommended Minimum Safety Factor**

FS = 1.3 for short term conditions and during construction

FS = 1.5 for long term conditions

FS = 1.1 for seismic psuedostatic analysis.

| Scenario Analyzed | Failure Type | Calculated Safety Factor | Recommended Minimum Safety Factor | Comments |
|---|---|---|---|---|
| **East Slope** | | | | |
| 1b_East Side 3:1_Cohesion for FS=1.3 at Elevated Piezo | Optimized Circular | 1.309 | 1.300 | Evaluating the final cover grades in South Pond closure area of the Control Estimate grading plan. Modified swale geometry to have 3H:1V slope on waste side of the swale down into swale (making swale bottom skinnier). Piezometric line set to initial planned trigger level = 652 ft ***Thixotropic ash cohesion = 700 psf.*** |
| 1b1_East Side 3:1_Cohesion for FS=1.3 at Piezo at Top of Thixo | Optimized Circular | 1.385 | 1.300 | Evaluating the final cover grades in South Pond closure area of the Control Estimate grading plan. Modified swale geometry to have 3H:1V slope on waste side of the swale down into swale (making swale bottom skinnier). Piezometric line set to just above Thixotropic Material = 639 ft ***Thixotropic ash cohesion = 700 psf.*** |
| 1c_East Side 3:1_Long Term Cohesion at Piezo at Top of Thixo | Optimized Circular | 1.760 | 1.500 | Evaluating the final cover grades in South Pond closure area of the Control Estimate grading plan. Modified swale geometry to have 3H:1V slope on waste side of the swale down into swale (making swale bottom skinnier). Piezometric line set to just above Thixotropic Material = 639 ft ***Thixotropic ash cohesion = 1,000 psf.*** |
| 2a_Seismic_East Side 3:1_Long Term Cohesion at Piezo at Top of Thixo | Optimized Circular | 1.475 | 1.100 | Evaluating the final cover grades in South Pond closure area of the Control Estimate grading plan. Modified swale geometry to have 3H:1V slope on waste side of the swale down into swale (making swale bottom skinnier). Piezometric line set to just above Thixotropic Material = 639 ft ***Thixotropic ash cohesion = 1,000 psf.*** Psuedostatic analysis with horizontal acceleration set at 0.04g. |
| **West Slope** | | | | |
| 0a_OPTIMIZED_West Swale 2:1 Slope_Though Full West Berm | Optimized Circular | 1.775 | 1.500 | Evaluating final cover grades in South Pond closure area of the Control Estimate grading plan. West swale geometry with 2H:1V slope on waste side. Forced slip surface through full west berm with piezo just above thixotropic material (639 ft). Evaluating that there are no issues with existing west berm. Water level in creek at 100-year flood condition = 632.1 **Thixotropic ash cohesion = 500 psf.** |
| 2b_OPTIMIZED_West Swale 2:1 Slope_Cohesion for FS=1.3 at Elevated Piezo | Optimized Circular | 1.348 | 1.300 | Evaluating the final cover grades in South Pond closure area of the Control Estimate grading plan. Modified swale geometry to have 3H:1V slope on waste side of the swale down into swale (making swale bottom skinnier). Piezometric line set to initial trigger level = 652 ft **Thixotropic ash cohesion = 700 psf.** |
| 2c_OPTIMIZED_West Swale 2:1 Slope_Cohesion for FS=1.3 at Piezo at Top of Thixo | Optimized Circular | 1.462 | 1.300 | Evaluating the final cover grades in South Pond closure area of the Control Estimate grading plan. Modified swale geometry to have 3H:1V slope on waste side of the swale down into swale. Piezometric line set to just above Thixotropic Material = 639 ft **Thixotropic ash cohesion = 700 psf.** |
| 2d_OPTIMIZED_West Swale 2:1 Slope_Long Term Cohesion at Piezo at Top of Thixo | Optimized Circular | 1.805 | 1.500 | Evaluating the final cover grades in South Pond closure area of the Control Estimate grading plan. Modified swale geometry to have 3H:1V slope on waste side of the swale down into swale. Piezometric line set to just above Thixotropic Material = 639 ft **Thixotropic ash cohesion = 1,000 psf.** |
| 3a_OPTIMIZED_Seismic_West Swale 2:1 Slope_Long Term Cohesion at Piezo at Top of Thixo | Optimized Circular | 1.555 | 1.100 | Evaluating the final cover grades in South Pond closure area of the Control Estimate grading plan. Modified swale geometry to have 3H:1V slope on waste side of the swale down into swale. Piezometric line set to just above Thixotropic Material = 639 ft **Thixotropic ash cohesion = 1,000 psf.** Psuedostatic analysis with horizontal acceleration set at 0.04g. |

Notes:
1. Horizontal seismic coefficient based on USGS 2014 Seismic Hazard Maps which show the site mapped in the zone of 0.04g-0.06g zone for peak acceleration

Created by: BSS, 12/24/2021
Updated by: BSS, 12/02/2022
ReChecked Updates by: PEG, 12/5/2022 and DLN, 12/08/2022



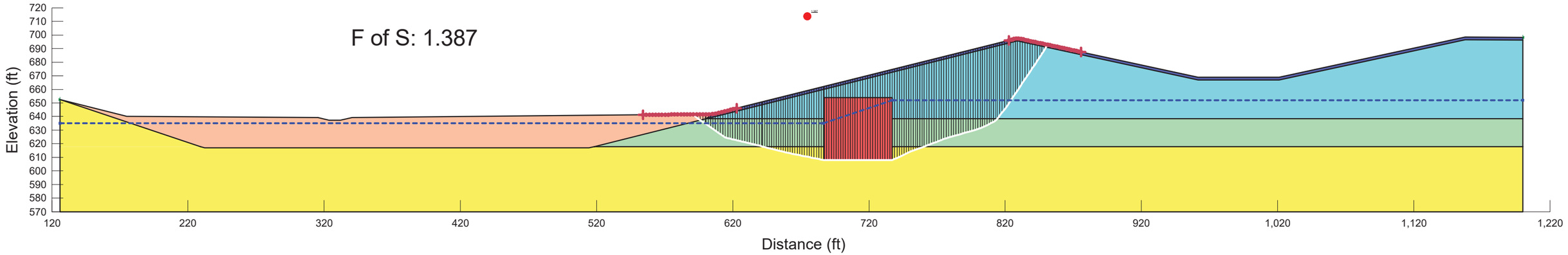
09/09/2026 - Classification: Internal - ECRM13805385

North Slope and ISS Wall

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash Fill | 90 | 0 | 25 | 1 |
| | Cap | 130 | 0 | 28 | 1 |
| | General Fill | 120 | 30 | 0 | 1 |
| | InSitu Stabilization | 80 | 4,000 | 0 | 1 |
| | Native | 125 | 0 | 30 | 1 |
| | Thixotropic Ash | 75 | 500 | 0 | 1 |

Title: Lansing Final Grades North-South Cross Section
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Final Grades\
Name: 3a_Seismic_Final Grades and ISS wall
Last Edited By: Suchomel, Brandon  Date: 12/24/2021Time: 10:19:18 AM
Horz Seismic Coef.: 0.04

F of S: 1.387



North Slope and ISS Wall

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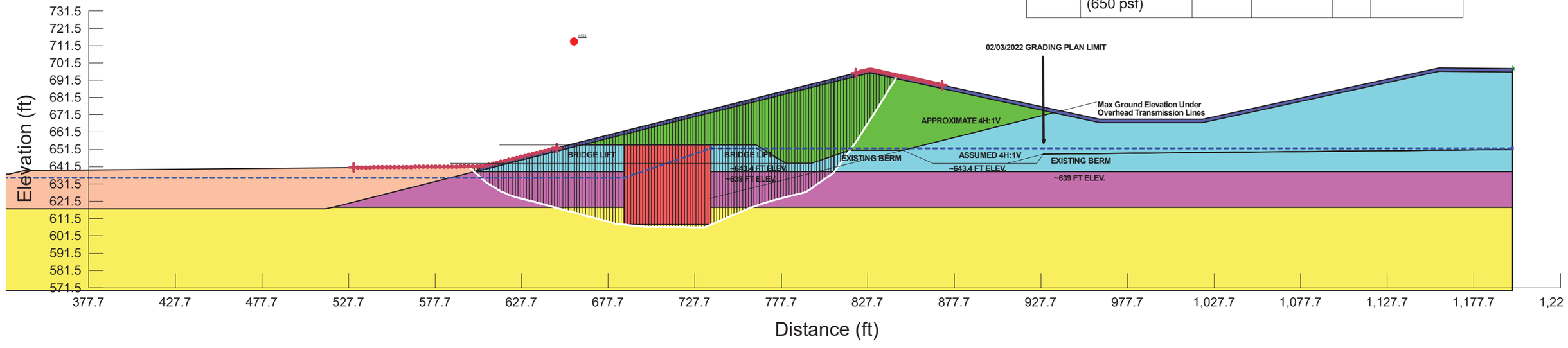
Name: Final Waste Grades and ISS wall_Fill and Water_Thixo 650 psf
Last Edited By: Suchomel, Brandon  Date: 12/1/2022Time: 1:15:40 PM
Horz Seismic Coef.: 0

F of S: 1.573

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash Fill | 90 | 0 | 25 | 1 |
| | Ash, Coal, Coal Impacted Soil Fill | 105 | 0 | 25 | 1 |
| | Cap | 130 | 0 | 28 | 1 |
| | General Fill | 120 | 30 | 0 | 1 |
| | InSitu Stabilization | 80 | 4,000 | 0 | 1 |
| | Native | 125 | 0 | 30 | 1 |
| | Thixotropic Ash (650 psf) | 75 | 650 | 0 | 1 |



North Slope and ISS Wall

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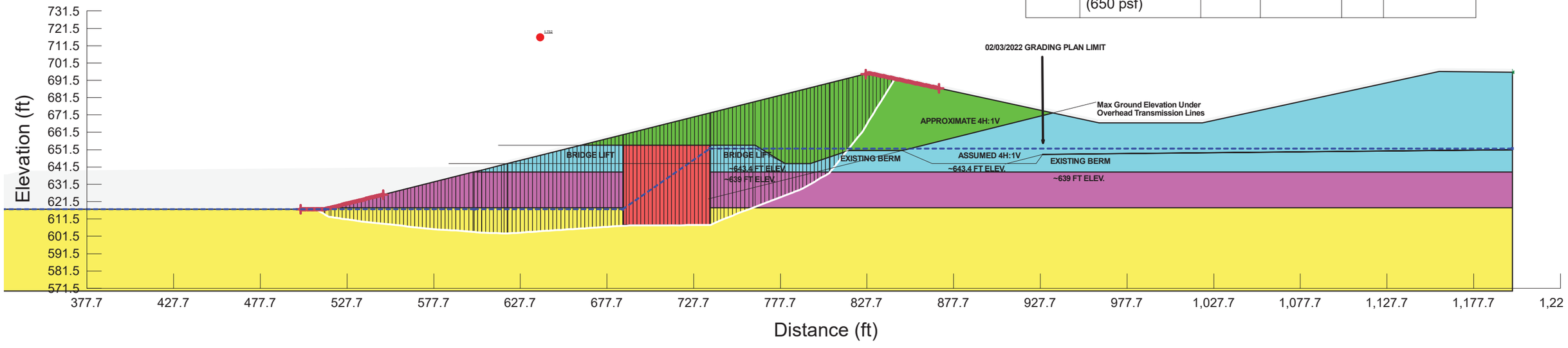
Name: Final Waste Grades and ISS wall_No Fill and No Water_Thixo 650 psf_fully drained
Last Edited By: Suchomel, Brandon  Date: 12/1/2022Time: 1:15:40 PM
Horz Seismic Coef.: 0

F of S: 1.752

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash Fill | 90 | 0 | 25 | 1 |
| | Ash, Coal, Coal Impacted Soil Fill | 105 | 0 | 25 | 1 |
| | InSitu Stabilization | 80 | 4,000 | 0 | 1 |
| | Native | 125 | 0 | 30 | 1 |
| | Thixotropic Ash (650 psf) | 75 | 650 | 0 | 1 |



North Slope and ISS Wall

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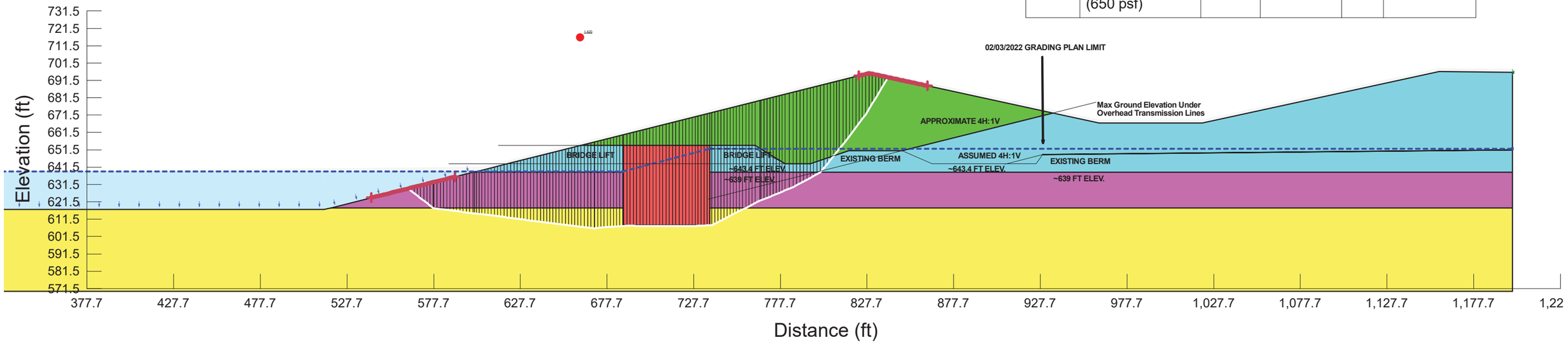
Name: Final Waste Grades and ISS wall_No Fill and Water_Thixo 650 psf
Last Edited By: Suchomel, Brandon  Date: 12/1/2022Time: 1:15:40 PM
Horz Seismic Coef.: 0

F of S: 1.420

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash Fill | 90 | 0 | 25 | 1 |
| | Ash, Coal, Coal Impacted Soil Fill | 105 | 0 | 25 | 1 |
| | InSitu Stabilization | 80 | 4,000 | 0 | 1 |
| | Native | 125 | 0 | 30 | 1 |
| | Thixotropic Ash (650 psf) | 75 | 650 | 0 | 1 |



North Slope and ISS Wall

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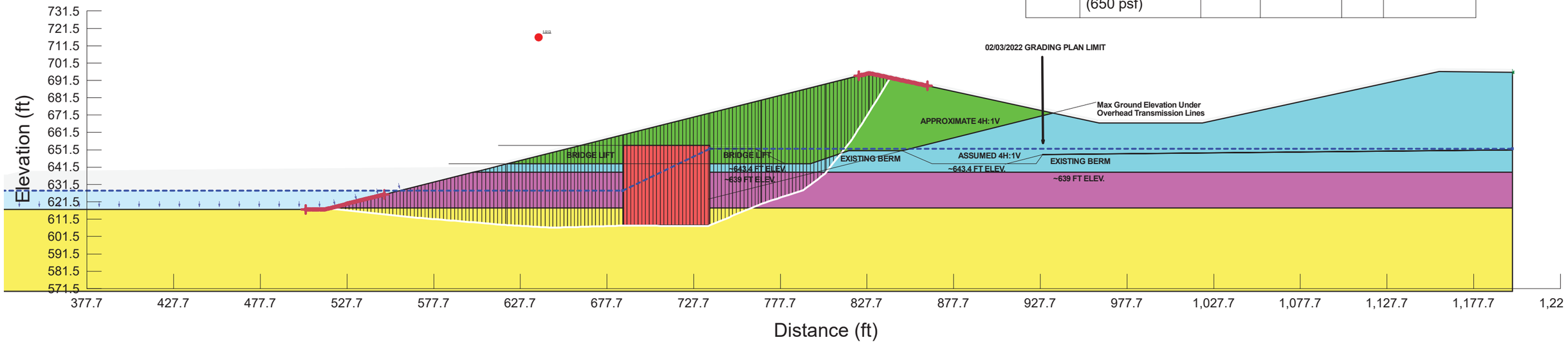
Name: Final Waste Grades and ISS wall_No Fill and Water_Thixo 650 psf_half pool
Last Edited By: Suchomel, Brandon  Date: 12/1/2022Time: 1:15:40 PM
Horz Seismic Coef.: 0

F of S: 1.513

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash Fill | 90 | 0 | 25 | 1 |
| | Ash, Coal, Coal Impacted Soil Fill | 105 | 0 | 25 | 1 |
| | InSitu Stabilization | 80 | 4,000 | 0 | 1 |
| | Native | 125 | 0 | 30 | 1 |
| | Thixotropic Ash (650 psf) | 75 | 650 | 0 | 1 |

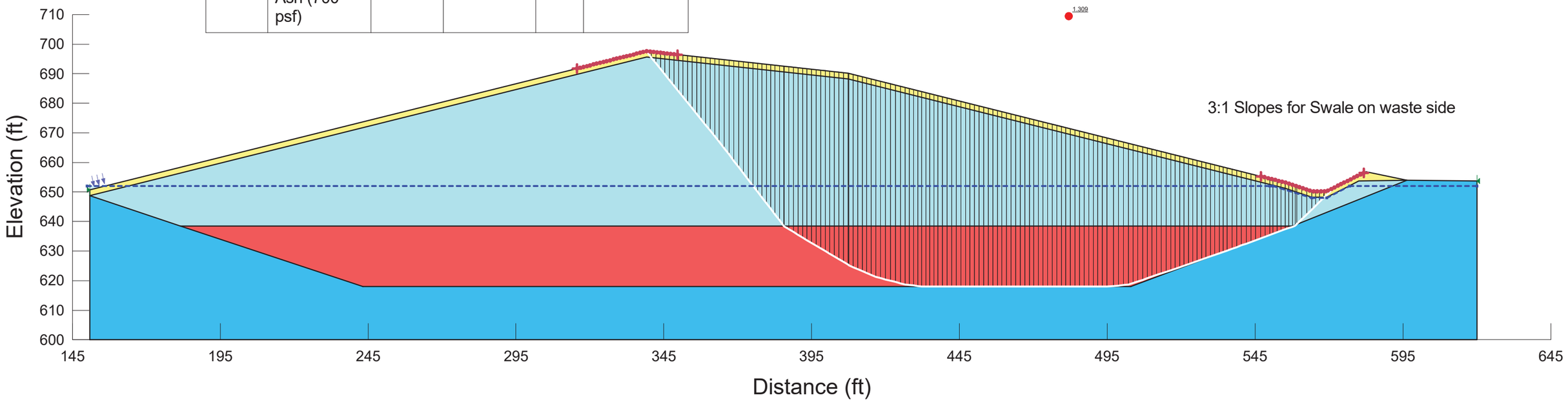


East Slope

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Cap | 120 | 0 | 30 | 1 |
| | Native | 125 | 0 | 28 | 1 |
| | New Ash Fill | 90 | 0 | 28 | 1 |
| | Thixotropic Ash (700 psf) | 75 | 700 | 0 | 1 |

File Name: East Berm 3-1.gsz
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Final Grades\
Name: 1b_East Side 3:1_Cohesion for FS=1.3 at Elevated Piezo
Last Edited By: Suchomel, Brandon
Date: 12/24/2021, Time: 7:50:15 AM

F of S: 1.309

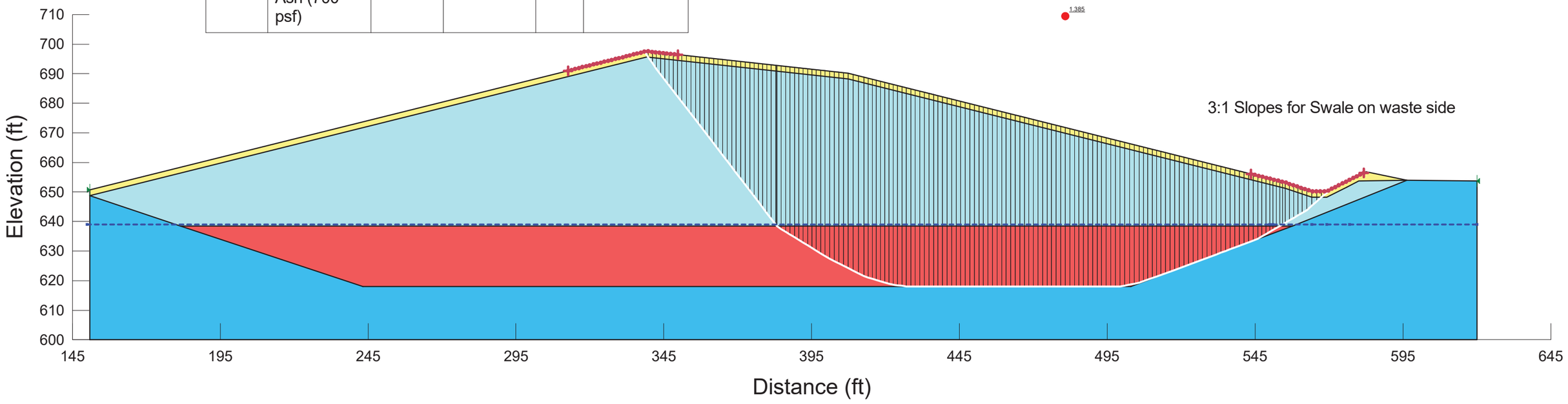


East Slope

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Cap | 120 | 0 | 30 | 1 |
| | Native | 125 | 0 | 28 | 1 |
| | New Ash Fill | 90 | 0 | 28 | 1 |
| | Thixotropic Ash (700 psf) | 75 | 700 | 0 | 1 |

File Name: East Berm 3-1.gsz
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Final Grades\
Name: 1b1_East Side 3:1_Cohesion for FS=1.3 at Piezo at Top of Thixo
Last Edited By: Suchomel, Brandon
Date: 12/24/2021, Time: 7:50:15 AM

F of S: 1.385

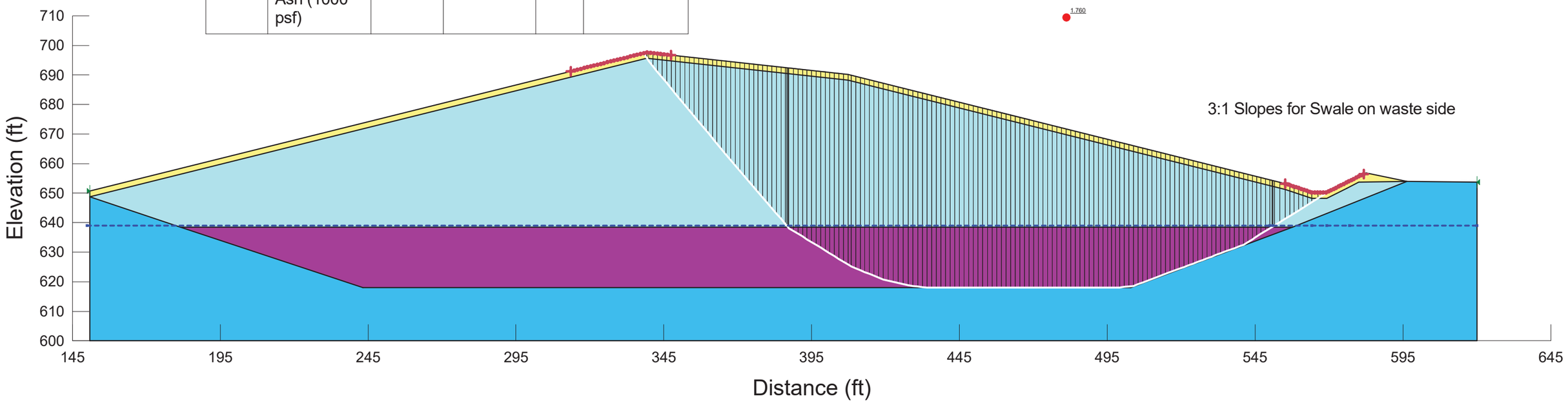


East Slope

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Cap | 120 | 0 | 30 | 1 |
| | Native | 125 | 0 | 28 | 1 |
| | New Ash Fill | 90 | 0 | 28 | 1 |
| | Thixotropic Ash (1000 psf) | 75 | 1,000 | 0 | 1 |

File Name: East Berm 3-1.gsz
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Final Grades\
Name: 1c_East Side 3:1_Long Term Cohesion at Piezo at Top of Thixo
Last Edited By: Suchomel, Brandon
Date: 12/24/2021, Time: 7:50:15 AM

F of S: 1.760

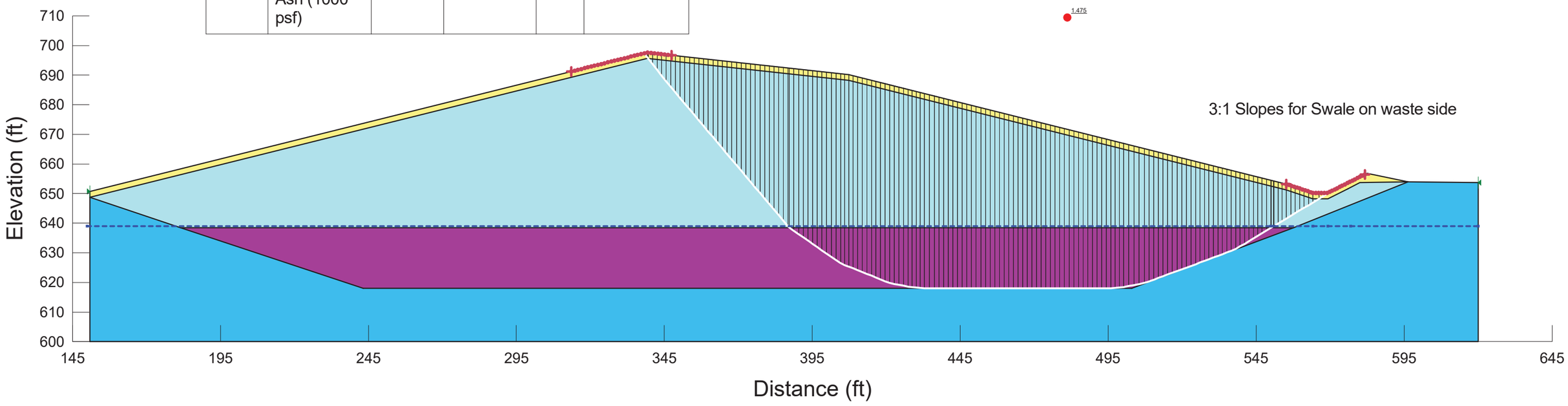


East Slope

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Cap | 120 | 0 | 30 | 1 |
| | Native | 125 | 0 | 28 | 1 |
| | New Ash Fill | 90 | 0 | 28 | 1 |
| | Thixotropic Ash (1000 psf) | 75 | 1,000 | 0 | 1 |

File Name: East Berm 3-1.gsz
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Final Grades\
Name: 2a_Seismic_East Side 3:1_Long Term Cohesion at Piezo at Top of Thixo
Last Edited By: Suchomel, Brandon
Date: 12/24/2021, Time: 9:18:45 AM

F of S: 1.475

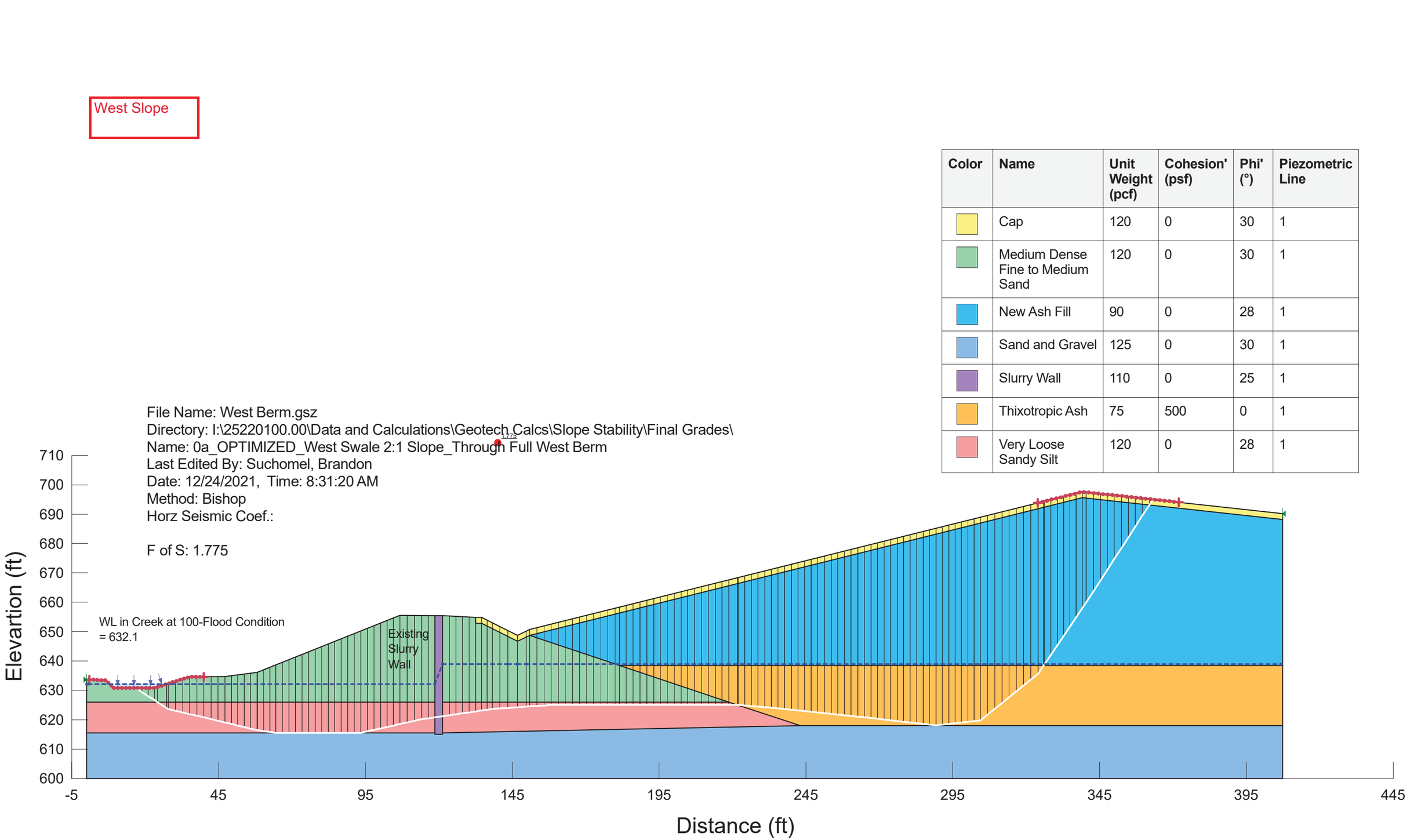


West Slope

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Cap | 120 | 0 | 30 | 1 |
| | Medium Dense Fine to Medium Sand | 120 | 0 | 30 | 1 |
| | New Ash Fill | 90 | 0 | 28 | 1 |
| | Sand and Gravel | 125 | 0 | 30 | 1 |
| | Slurry Wall | 110 | 0 | 25 | 1 |
| | Thixotropic Ash | 75 | 500 | 0 | 1 |
| | Very Loose Sandy Silt | 120 | 0 | 28 | 1 |

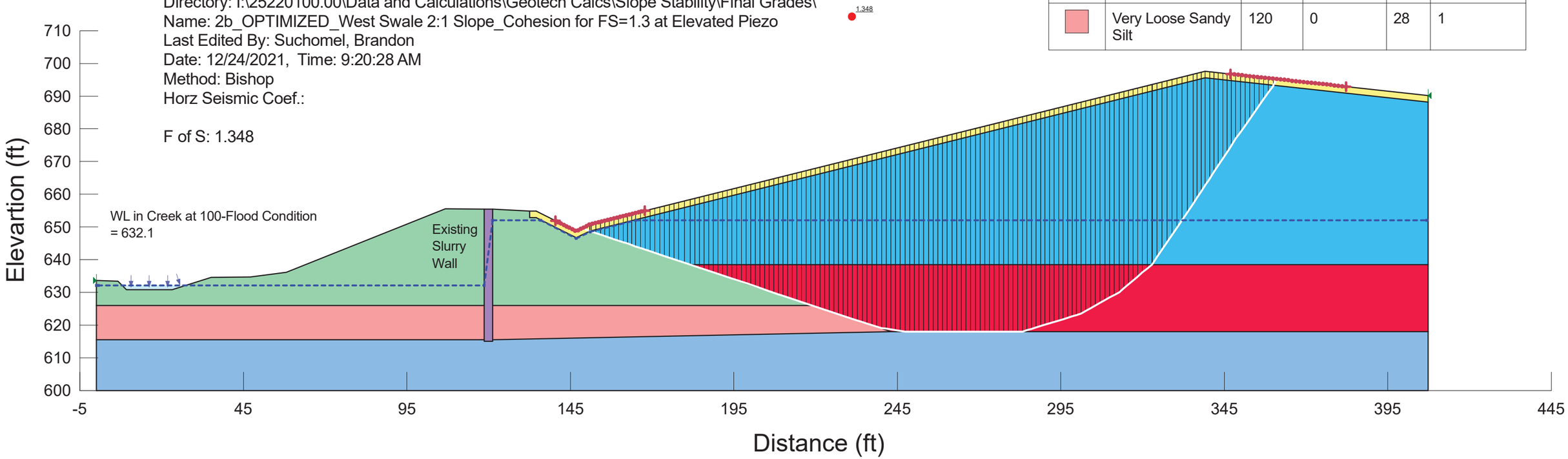
File Name: West Berm.gsz
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Final Grades\
Name: 0a_OPTIMIZED_West Swale 2:1 Slope_Through Full West Berm
Last Edited By: Suchomel, Brandon
Date: 12/24/2021, Time: 8:31:20 AM
Method: Bishop
Horz Seismic Coef.:

F of S: 1.775



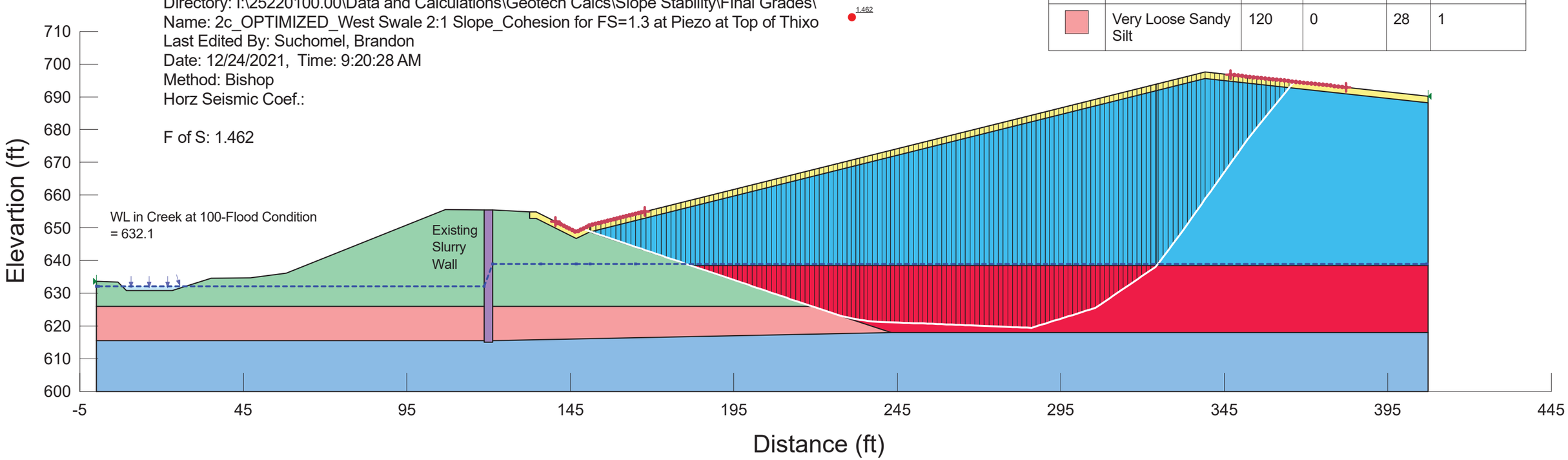
West Slope

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Cap | 120 | 0 | 30 | 1 |
| | Medium Dense Fine to Medium Sand | 120 | 0 | 30 | 1 |
| | New Ash Fill | 90 | 0 | 28 | 1 |
| | Sand and Gravel | 125 | 0 | 30 | 1 |
| | Slurry Wall | 110 | 0 | 25 | 1 |
| | Thixotropic Ash (700 psf) | 75 | 700 | 0 | 1 |
| | Very Loose Sandy Silt | 120 | 0 | 28 | 1 |



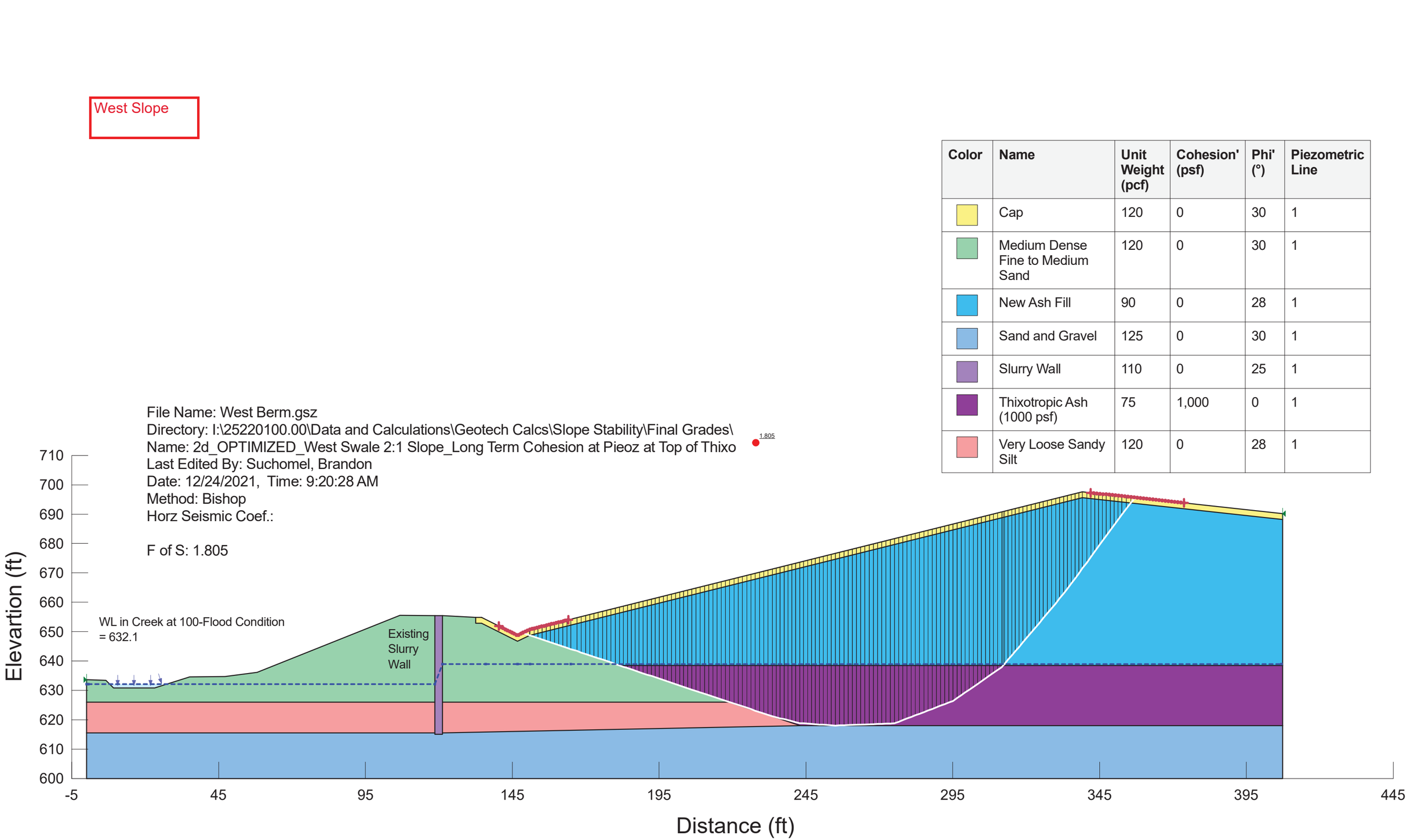
West Slope

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Cap | 120 | 0 | 30 | 1 |
| | Medium Dense Fine to Medium Sand | 120 | 0 | 30 | 1 |
| | New Ash Fill | 90 | 0 | 28 | 1 |
| | Sand and Gravel | 125 | 0 | 30 | 1 |
| | Slurry Wall | 110 | 0 | 25 | 1 |
| | Thixotropic Ash (700 psf) | 75 | 700 | 0 | 1 |
| | Very Loose Sandy Silt | 120 | 0 | 28 | 1 |



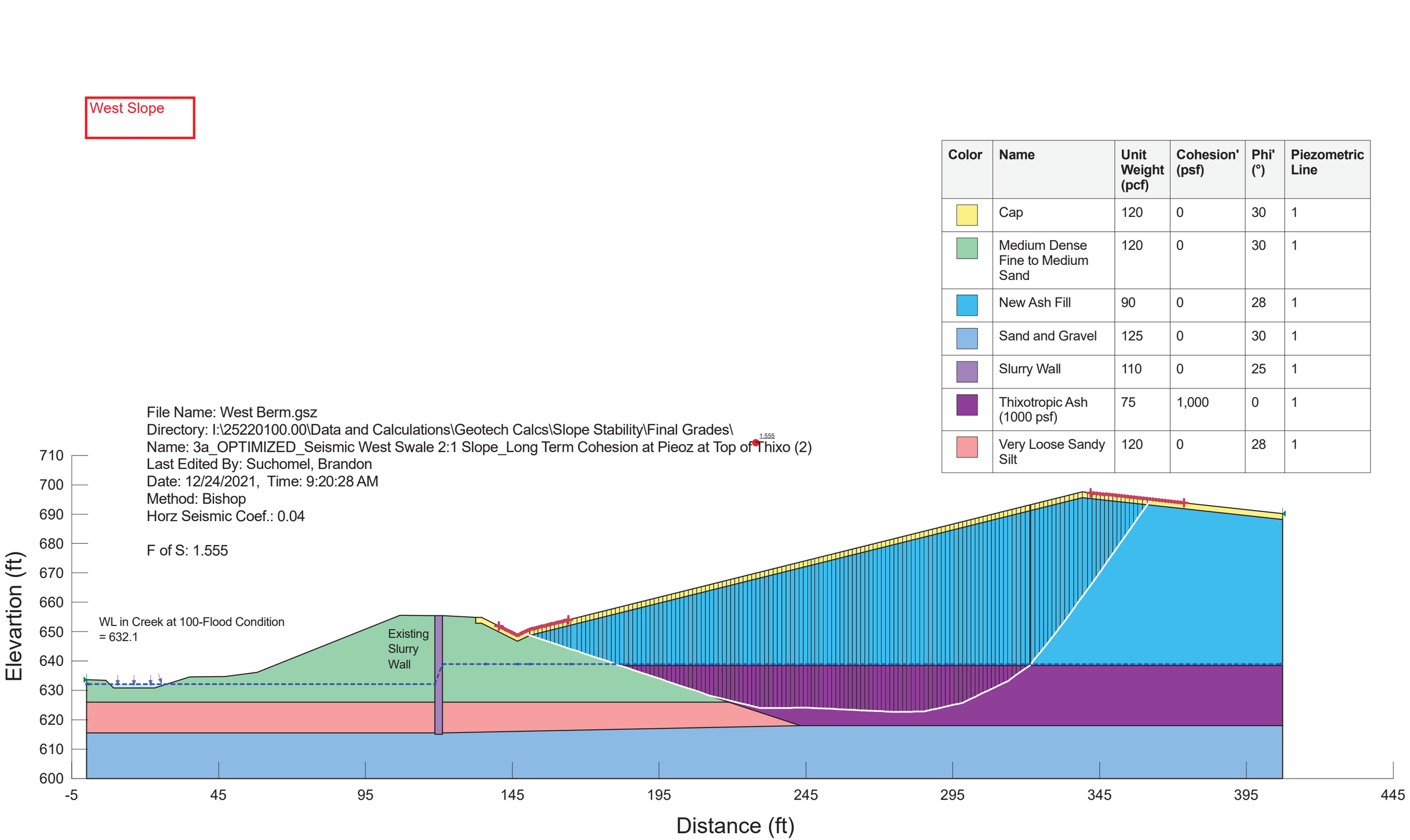
West Slope

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Cap | 120 | 0 | 30 | 1 |
| | Medium Dense Fine to Medium Sand | 120 | 0 | 30 | 1 |
| | New Ash Fill | 90 | 0 | 28 | 1 |
| | Sand and Gravel | 125 | 0 | 30 | 1 |
| | Slurry Wall | 110 | 0 | 25 | 1 |
| | Thixotropic Ash (1000 psf) | 75 | 1,000 | 0 | 1 |
| | Very Loose Sandy Silt | 120 | 0 | 28 | 1 |



West Slope

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Cap | 120 | 0 | 30 | 1 |
| | Medium Dense Fine to Medium Sand | 120 | 0 | 30 | 1 |
| | New Ash Fill | 90 | 0 | 28 | 1 |
| | Sand and Gravel | 125 | 0 | 30 | 1 |
| | Slurry Wall | 110 | 0 | 25 | 1 |
| | Thixotropic Ash (1000 psf) | 75 | 1,000 | 0 | 1 |
| | Very Loose Sandy Silt | 120 | 0 | 28 | 1 |



# Analysis Section Location Figure - Geotextile Tube Laydown Area

5541000 E | 5541500 E | 5542000 E | 5542500 E | 5543000 E

3958000 N | 3957500 N | 3957000 N | 3956500 N | 3956000 N

LOWER ASH POND (CLOSED)

NORTH POND CLOSURE AREA

SOUTH POND CLOSURE AREA

ASH DISPOSAL LANDFILL

POWER PLANT DR

BRIDGE

SHEET PILE WALL

SHEET PILE WALL

GATE

CONTRACTOR TO VERIFY CCR IMPACTED MATERIAL LIMITS WITH TEST PITS AND WORK WITH OWNER/ENGINEER TO MANAGE CCR MATERIALS

MAINTAIN PLANT ACCESS TO TO ASH DISPOSAL LANDFILL

RELOCATE IN SERVICE CERAMIC LINED FIBERGLASS PIPE (COORDINATE WITH OWNER)

ISS WALL SEE SHEETS 5 AND 6

GEOTEXTILE TUBE SCOUR PROTECTION SEE SHEET 7

GO. HWY X52 (GREAT RIVER RD)

UNNAMED CREEK

RIPRAP

Geotextile Tube Laydown Area North Slope Analysis Section

Geotextile Tube Stacking Grades Not Shown and Added to Analysis Sections Based on Information Provided by Contractor

Geotextile Tube Laydown Area East Slope Analysis Section

Geotextile Tube Laydown Area West Slope Analysis Section

## LEGEND

- 2008 EXISTING GRADE (10' CONTOUR)
- 2015/2020/2022 EXISTING GRADE (10' CONTOUR)
- 2015/2020/2022 EXISTING GRADE (2' CONTOUR)
- ASH DISPOSAL LANDFILL LIMITS OF WASTE
- PAVED ROAD
- GRAVEL ROAD
- FENCE
- RAILROAD TRACKS
- EDGE OF WATER
- UNNAMED CREEK FLOW PATH
- OVERHEAD UTILITY
- TELEPHONE
- STORM DRAINAGE PIPE
- PROCESS WATER PIPE
- UPPER ASH POND OUTFALL REROUTE PIPING
- UTILITY POLE AND GUY WIRE
- LIGHT POLE
- CP-02 SURVEY CONTROL POINT
- MW17 MONITORING WELL
- MW17 ABANDONED MONITORING WELL
- MW12P PIEZOMETER
- MW12P ABANDONED PIEZOMETER
- PZ18 ABANDONED SHALLOW PIEZOMETER
- PZ-1 WEST EMBANKMENT SLURRY WALL PIEZOMETER (2015 BY HARD HAT SERVICES)
- VWP-3 VIBRATING WIRE PIEZOMETER (VWP)
- SLURRY WALL (2015 BY HARD HAT SERVICES)
- APPROXIMATE LIMITS OF UPPER ASH POND
- ASH DISPOSAL LANDFILL FINAL COVER AREA
- KELLER BURIAL MOUNDS CULTURAL RESOURCE
- PROPOSED SILT FENCE
- 650 PROPOSED GRADE (10' CONTOUR)
- 652 PROPOSED GRADE (2' CONTOUR)
- LIMITS OF SCOUR PROTECTION GEOMEMBRANE
- APPROXIMATE GEOMEMBRANE LINED WATER MANAGEMENT SUMP
- 620 PROPOSED EXCAVATION GRADE (10' CONTOUR)
- 618 PROPOSED EXCAVATION GRADE (2' CONTOUR)
- PROPOSED DEWATERING PUMPING WELL AND SILT BARRIER
- PROPOSED VIBRATING WIRE PIEZOMETER (VWP)
- PROPOSED VIBRATING WIRE PIEZOMETER CABLE
- PROPOSED INCLINOMETER

NOTES:

1. SEE SHEET 2 AND SHEET 3 FOR ADDITIONAL BASE MAP LEGEND ITEMS AND NOTES.
2. BERM STABILIZATION TO BE COMPLETED PRIOR TO EXCAVATION/DREDGE. SEE SHEETS 5 AND 6.
3. PROPOSED GRADES REPRESENT ANTICIPATED BOTTOM OF CCR REMOVAL LIMITS. ACTUAL LIMITS WILL BE DETERMINED BY THE ENGINEER/OWNER BASED ON FIELD CONDITIONS.
4. PROPOSED EXCAVATION GRADES SLOPE NORTH OF THE BERM STABILIZATION TO BE NO STEEPER THAN 4H:1V. THE SLOPE MAY BE SHALLOWED BASED ON FIELD CONDITIONS.
5. MATERIAL REMOVED FROM THE PROPOSED EXCAVATION AREA TO BE MANAGED IN THE GEOTEXTILE TUBE SCOUR PROTECTION AREA ON ASH DISPOSAL LANDFILL.

100 0 100
SCALE: 1" = 100'

N

DRAWN BY: BSS/KP
CHECKED BY: BSS
APPROVED BY: MRH 05/18/2022

PROJECT NO. 25220100.00
DRAWN: 03/25/2021
REVISED: 05/18/2022

CLIENT
INTERSTATE POWER AND LIGHT CO.
2320 POWER PLANT DRIVE
LANSING, IA 52151-9733

ENGINEER
SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

SITE
ASH POND CLOSURE
ISSUED FOR CONSTRUCTION
LANSING GENERATING STATION
LANSING, IOWA

PROPOSED NORTH POND EXCAVATION GRADES

SHEET
8 of 22

09/09/2026 - Classification: Internal - ECRM13805385

**Slope Stability - Lansing Impoundment Closure - Geotextile Tube Laydown Area**
**Material Properties and Factors of Safety Results Summary**
**Lansing Generating Station**

| Material | Unit Weight (pcf) | Friction Angle (degrees) | Cohesion (psf) |
|---|---|---|---|
| Native | 125 | 30 | 0 |
| Ash Fill | 90 | 25 | 0 |
| Ash in Geotextile Tubes | 85 | 25 | 0 |
| Thixotropic Ash | 75 | 0 | 500 |
| Thixotropic Ash (650 psf) | 75 | 0 | 650 |
| Thixotropic Ash (700 psf) | 75 | 0 | 700 |
| InSitu Stabilization | 80 | 0 | 4000 |
| HDPE Geomembrane | 58 | 19 | 0 |

**Recommended Minimum Safety Factor**

FS = 1.3 for short term conditions and during construction

FS = 1.5 for long term conditions

FS = 1.1 for seismic psuedostatic analysis.

| Scenario Analyzed | Failure Type | Calculated Safety Factor | Recommended Minimum Safety Factor | Comments |
|---|---|---|---|---|
| **North Slope** | | | | |
| **Geotextile Tubes (4H:1V slope)** | | | | |
| 4:1 Geotubes (90 pcf) and Geomembrane - Block Failure (check full thickness) | Block | 1.770 | 1.300 | Higher unit weight ash material. Check full waste thickness failure. **Thixotropic ash cohesion = 500 psf.** |
| 4:1 Geotubes (90 pcf) and Geomembrane Circular Failure (700 psf thixo) | Optimized Circular | 1.309 | 1.300 | Higher unit weight ash material. Global failure. **Thixotropic ash cohesion = 700 psf.** |
| **East Slope** | | | | |
| **Geotextile Tubes (4H:1V slope)** | | | | |
| East 4:1 Geotubes (90 pcf) (650 psf thixo) | Optimized Circular | 1.343 | 1.300 | Higher unit weight ash material. Global failure. **Thixotropic ash cohesion = 650 psf.** |
| **West Slope** | | | | |
| **Geotextile Tubes (4H:1V slope)** | | | | |
| West 4:1 Geotubes (90 pcf) (650 psf thixo) | Optimized Circular | 1.398 | 1.300 | Higher unit weight ash material. Global failure. **Thixotropic ash cohesion = 650 psf.** |

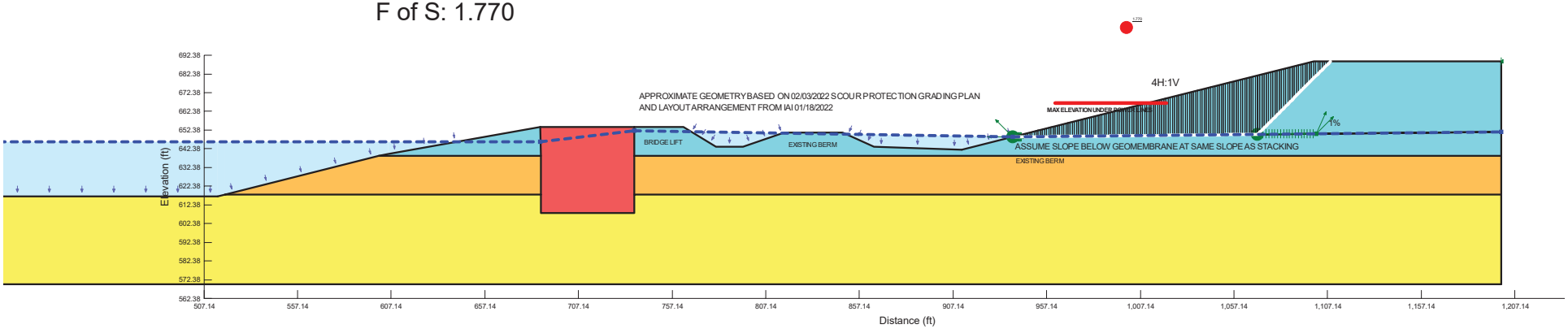
Created by: BSS, 02/02/2022
Updated by: BSS, 10/23/2022
Checked by: DLN, 10/26/2022

09/09/2026 - Classification: Internal - ECRM13805385

# Geotextile Tube Laydown Area - North Slope

Title: Lansing Excavation Grades North-South Cross Section
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Geotextile Tubes\
File Name: Geotextile tubes and geomembrane 4-1.gsz
Last Edited By: Suchomel, Brandon, Last Solved Date: 10/23/2022, Last Solved Time: 11:17:30 AM

F of S: 1.770

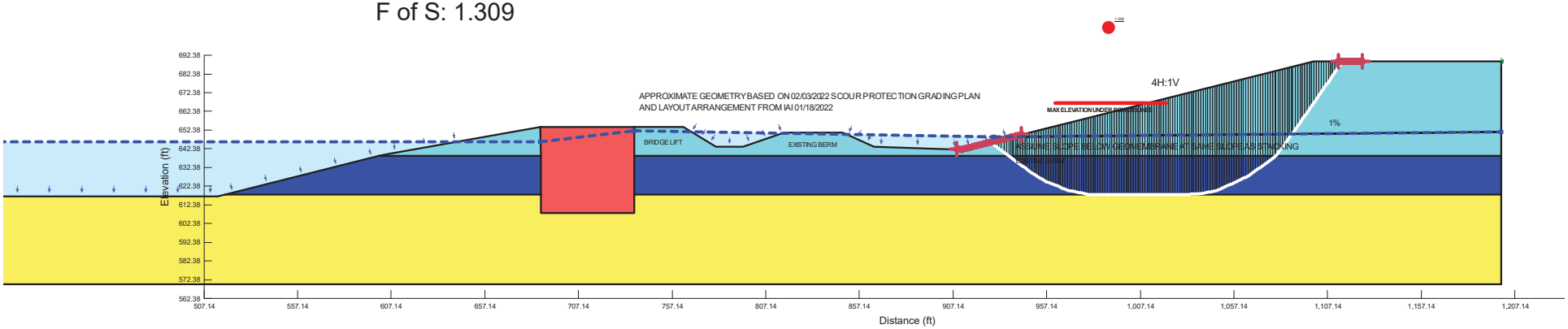



| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash Fill | 90 | 0 | 25 | 1 |
| | HDPE Geomembrane | 58 | 0 | 19 | 1 |
| | InSitu Stabilization | 80 | 4,000 | 0 | 1 |
| | Native | 125 | 0 | 30 | 1 |
| | Thixotropic Ash | 75 | 500 | 0 | 1 |

# Geotextile Tube Laydown Area - North Slope

Title: Lansing Excavation Grades North-South Cross Section
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Geotextile Tubes\
File Name: Geotextile tubes and geomembrane 4-1.gsz
Last Edited By: Suchomel, Brandon, Last Solved Date: 10/23/2022, Last Solved Time: 11:17:59 AM

F of S: 1.309



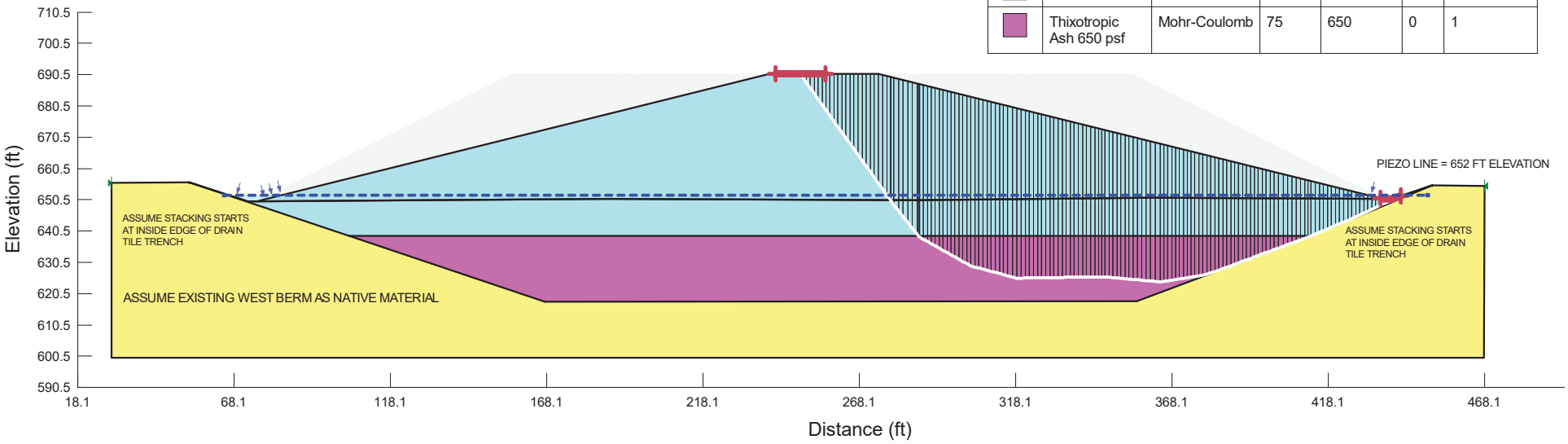

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash Fill | 90 | 0 | 25 | 1 |
| | HDPE Geomembrane | 58 | 0 | 19 | 1 |
| | InSitu Stabilization | 80 | 4,000 | 0 | 1 |
| | Native | 125 | 0 | 30 | 1 |
| | Thixotropic AsH (700 psf) | 75 | 700 | 0 | 1 |

# Geotextile Tube Laydown Area - East Slope

Title: East-West Cross Section - Geomembrane and Geotubes
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Geotextile Tubes\
Name: East 4:1 Geotubes (90 pcf) (650 psf thixo)
Method: Bishop
Last Edited By: Suchomel, Brandon, Last Solved Date: 3/8/2022, Last Solved Time: 2:03:41 PM

F of S Rank (Analysis): 1 of 28,612 slip surfaces
F of S: 1.343

| Color | Name | Model | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|---|
| | Ash Fill | Mohr-Coulomb | 90 | 0 | 25 | 1 |
| | HDPE Geomembrane | Mohr-Coulomb | 58 | 0 | 19 | 1 |
| | Native | Mohr-Coulomb | 125 | 0 | 30 | 1 |
| | Thixotropic Ash 650 psf | Mohr-Coulomb | 75 | 650 | 0 | 1 |

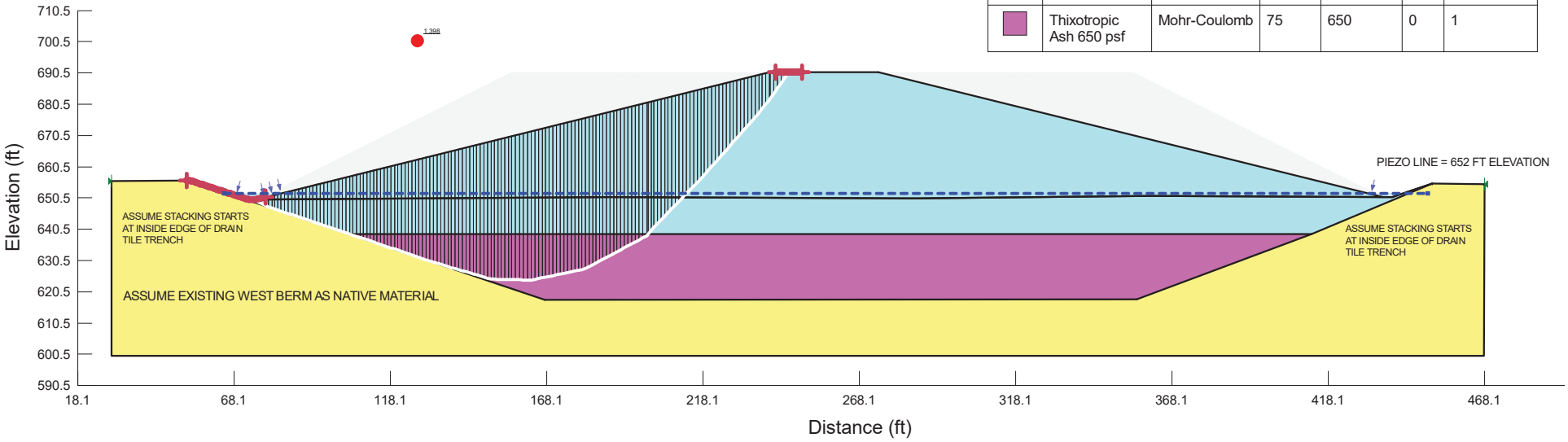


# Geotextile Tube Laydown Area - West Slope

Title: East-West Cross Section - Geomembrane and Geotubes
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Geotextile Tubes\
Name: West 4:1 Geotubes (90 pcf) (650 psf thixo)
Method: Bishop
Last Edited By: Suchomel, Brandon, Last Solved Date: 3/8/2022, Last Solved Time: 2:37:26 PM

F of S Rank (Analysis): 1 of 28,612 slip surfaces
F of S: 1.398

| Color | Name | Model | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|---|
| | Ash Fill | Mohr-Coulomb | 90 | 0 | 25 | 1 |
| | HDPE Geomembrane | Mohr-Coulomb | 58 | 0 | 19 | 1 |
| | Native | Mohr-Coulomb | 125 | 0 | 30 | 1 |
| | Thixotropic Ash 650 psf | Mohr-Coulomb | 75 | 650 | 0 | 1 |



**Slope Stability - Lansing Impoundment Closure - Operating Condition**
**Material Properties and Factors of Safety Results Summary**
**Lansing Generating Station**

| Material | Unit Weight (pcf) | Friction Angle (degrees) | Cohesion (psf) |
|---|---|---|---|
| Cap | 120 | 30 | 0 |
| Native | 125 | 30 | 0 |
| New Ash Fill/Ash Fill | 90 | 25 | 0 |
| Ash , Coal, Coal Impacted Soil Fill | 105 | 25 | 0 |
| Thixotropic Ash (1000 psf) | 75 | 0 | 1000 |
| InSitu Stabilization | 80 | 0 | 4000 |
| General Fill | 120 | 30 | 0 |
| Medium Dense Fine to Medium Sand | 120 | 30 | 0 |
| Sand and Gravel | 125 | 30 | 0 |
| Very Loose Sandy Silt | 120 | 28 | 0 |
| Slurry Wall | 110 | 25 | 0 |

**Required Minimum Safety Factor (CFR 257.73(e))**

FS = 1.5 for maximum storage pool loading condition

FS = 1.4 for maximum surcharge pool loading condition

FS = 1.0 for seismic factor of safety

| Scenario Analyzed | Failure Type | Calculated Safety Factor | Required Safety Factor | Comments |
|---|---|---|---|---|
| **North Slope and ISS Wall** | | | | |
| 1_North ISS Wall Slope_Normal Pond Water Elevation | Optimized Circular | 1.530 | 1.500 | Evaluating north slope at ISS wall. Assume full CCR removal from north of ISS wall and full waste placement behind ISS wall. Piezo WL set at normal pond water elevation of 649 ft. Thixotropic ash cohesion = 1,000 psf. |
| 2_North ISS Wall Slope_Surcharge Pond Water Elevation | Optimized Circular | 1.521 | 1.400 | Evaluating north slope at ISS wall. Assume full CCR removal from north of ISS wall and full waste placement behind ISS wall. Piezo WL set at surcharge pond water elevation of 653 ft. Thixotropic ash cohesion = 1,000 psf. |
| 3_North ISS Wall Slope_Normal Pond Water Elevation Seismic | Optimized Circular | 1.300 | 1.000 | Evaluating north slope at ISS wall. Assume full CCR removal from north of ISS wall and full waste placement behind ISS wall. Piezo WL set at normal pond water elevation of 649 ft. Thixotropic ash cohesion = 1,000 psf. Psuedostatic analysis with horizontal acceleration set at 0.04g and vertical acceleration of 0.027g. |
| **West Berm** | | | | |
| 1_West Slope_Normal Pond Water Elevation_105 pcf waste | Optimized Circular | 1.630 | 1.500 | Evaluating final cover grades in South Pond closure area of the Control Estimate grading plan. West swale geometry with 2H:1V slope on waste side. Slip surface through waste. Piezo west of existing slurry wall in unnamed creek assumed at 635 ft and east existing slurry wall at normal pond water elevation of 649 ft. Thixotropic ash cohesion = 1,000 psf. |
| 1_West Slope_Normal Pond Water Elevation_Full West Berm_105 pcf waste | Optimized Circular | 1.748 | 1.500 | Evaluating final cover grades in South Pond closure area of the Control Estimate grading plan. West swale geometry with 2H:1V slope on waste side. Slip surface through waste and west berm. Piezo west of existing slurry wall in unnamed creek assumed at 635 ft and east existing slurry wall at normal pond water elevation of 649 ft. Thixotropic ash cohesion = 1,000 psf. |
| 1_West Slope_Normal Pond Water Elevation_Full West Berm_105 pcf waste_BLOCK | Block | 1.749 | 1.500 | Evaluating final cover grades in South Pond closure area of the Control Estimate grading plan. West swale geometry with 2H:1V slope on waste side. Slip surface through waste and west berm. Piezo west of existing slurry wall in unnamed creek assumed at 635 ft and east existing slurry wall at normal pond water elevation of 649 ft. Thixotropic ash cohesion = 1,000 psf. |
| 2_West Slope_Surcharge Pond Water Elevation_105 pcf waste | Optimized Circular | 1.575 | 1.400 | Evaluating final cover grades in South Pond closure area of the Control Estimate grading plan. West swale geometry with 2H:1V slope on waste side. Slip surface through waste. Piezo west of existing slurry wall in unnamed creek assumed at 635 ft and east existing slurry wall at normal pond water elevation of 653 ft. Thixotropic ash cohesion = 1,000 psf. |
| 2_West Slope_Surcharge Pond Water Elevation_Full West Berm_105 pcf waste | Optimized Circular | 1.678 | 1.400 | Evaluating final cover grades in South Pond closure area of the Control Estimate grading plan. West swale geometry with 2H:1V slope on waste side. Slip surface through waste and west berm. Piezo west of existing slurry wall in unnamed creek assumed at 635 ft and east existing slurry wall at normal pond water elevation of 653 ft. Thixotropic ash cohesion = 1,000 psf. |
| 2_West Slope_Surcharge Pond Water Elevation_Full West Berm_105 pcf waste_BLOCK | Block | 2.119 | 1.400 | Evaluating final cover grades in South Pond closure area of the Control Estimate grading plan. West swale geometry with 2H:1V slope on waste side. Slip surface through waste and west berm. Piezo west of existing slurry wall in unnamed creek assumed at 635 ft and east existing slurry wall at normal pond water elevation of 653 ft. Thixotropic ash cohesion = 1,000 psf. |
| 3_West Slope_Normal Pond Water Elevation Seismic_105 pcf waste | Optimized Circular | 1.360 | 1.000 | Evaluating final cover grades in South Pond closure area of the Control Estimate grading plan. West swale geometry with 2H:1V slope on waste side. Slip surface through waste. Piezo west of existing slurry wall in unnamed creek assumed at 635 ft and east existing slurry wall at normal pond water elevation of 649 ft. Thixotropic ash cohesion = 1,000 psf. Psuedostatic analysis with horizontal acceleration set at 0.04g and vertical acceleration of 0.027g. |
| 3_West Slope_Normal Pond Water Elevation Seismic_Full West Berm_105 pcf waste | Optimized Circular | 1.458 | 1.000 | Evaluating final cover grades in South Pond closure area of the Control Estimate grading plan. West swale geometry with 2H:1V slope on waste side. Slip surface through waste and west berm. Piezo west of existing slurry wall in unnamed creek assumed at 635 ft and east existing slurry wall at normal pond water elevation of 649 ft. Thixotropic ash cohesion = 1,000 psf. Psuedostatic analysis with horizontal acceleration set at 0.04g and vertical acceleration of 0.027g. |

**Slope Stability - Lansing Impoundment Closure - Operating Condition**
**Material Properties and Factors of Safety Results Summary**
**Lansing Generating Station**

| Material | Unit Weight (pcf) | Friction Angle (degrees) | Cohesion (psf) |
|---|---|---|---|
| Cap | 120 | 30 | 0 |
| Native | 125 | 30 | 0 |
| New Ash Fill/Ash Fill | 90 | 25 | 0 |
| Ash , Coal, Coal Impacted Soil Fill | 105 | 25 | 0 |
| Thixotropic Ash (1000 psf) | 75 | 0 | 1000 |
| InSitu Stabilization | 80 | 0 | 4000 |
| General Fill | 120 | 30 | 0 |
| Medium Dense Fine to Medium Sand | 120 | 30 | 0 |
| Sand and Gravel | 125 | 30 | 0 |
| Very Loose Sandy Silt | 120 | 28 | 0 |
| Slurry Wall | 110 | 25 | 0 |

**Required Minimum Safety Factor (CFR 257.73(e))**

FS = 1.5 for maximum storage pool loading condition

FS = 1.4 for maximum surcharge pool loading condition

FS = 1.0 for seismic factor of safety

| Scenario Analyzed | Failure Type | Calculated Safety Factor | Required Safety Factor | Comments |
|---|---|---|---|---|
| 3_West Slope_Normal Pond Water Elevation Seismic_Full West Berm_105 pcf waste_BLOCK | Block | 1.828 | 1.000 | Evaluating final cover grades in South Pond closure area of the Control Estimate grading plan. West swale geometry with 2H:1V slope on waste side. Slip surface through waste and west berm. Piezo west of existing slurry wall in unnamed creek assumed at 635 ft and east existing slurry wall at normal pond water elevation of 649 ft. Thixotropic ash cohesion = 1,000 psf. Psuedostatic analysis with horizontal acceleration set at 0.04g and vertical acceleration of 0.027g. |

Notes:
1. Seismic coefficient based on USGS 2014 Seismic Hazard Maps which show the site mapped in the zone of 0.04g-0.06g zone for peak acceleration and August 10, 2021 CCR Surface Impoundment Safety Factor Assessment prepared by Hard Hat Services.
2. Normal Pond and Surcharge Pond water elevations obtained from August 10, 2021 CCR Surface Impoundment Safety Factor Assessment prepared by Hard Hat Services.

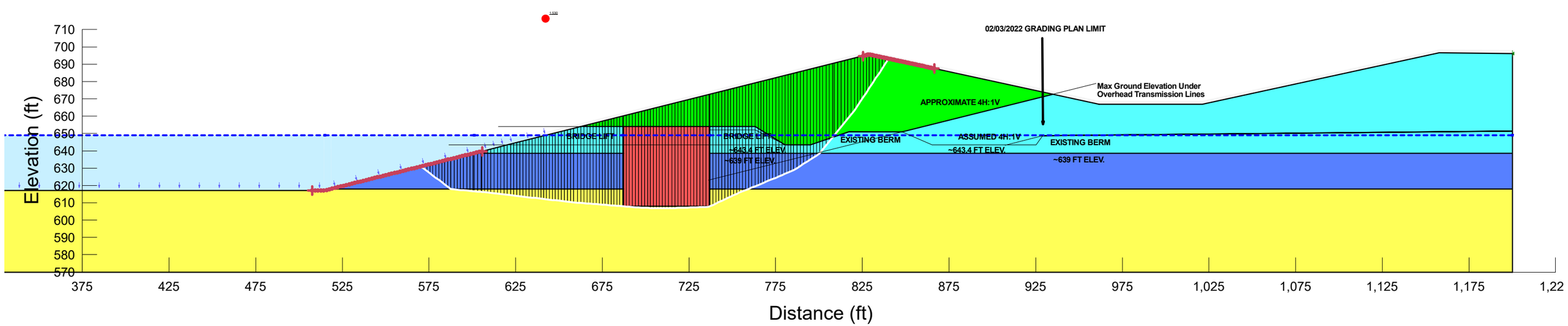
Created by: BSS, 11/29/2022
Updated by: BSS, 12/06/2022
Checked by: PEG, 12/5/22 and DLN, 12/08/2022

09/09/2026 - Classification: Internal - ECRM13805385

Title: North Slope and ISS Wall_Operating Condition
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Operating Condition Runs\
Name: 1_North ISS Wall Slope_Normal Pond Water Elevation
Last Edited By: Suchomel, Brandon  Date: 12/1/2022Time: 1:04:13 PM
Optimize Critical Slip Surface Location: Yes
Method: Bishop
Horz Seismic Coef.: 0; Vert Seismic Coef.: 0

F of S Rank (Analysis): 1 of 40,932 slip surfaces
F of S: 1.530

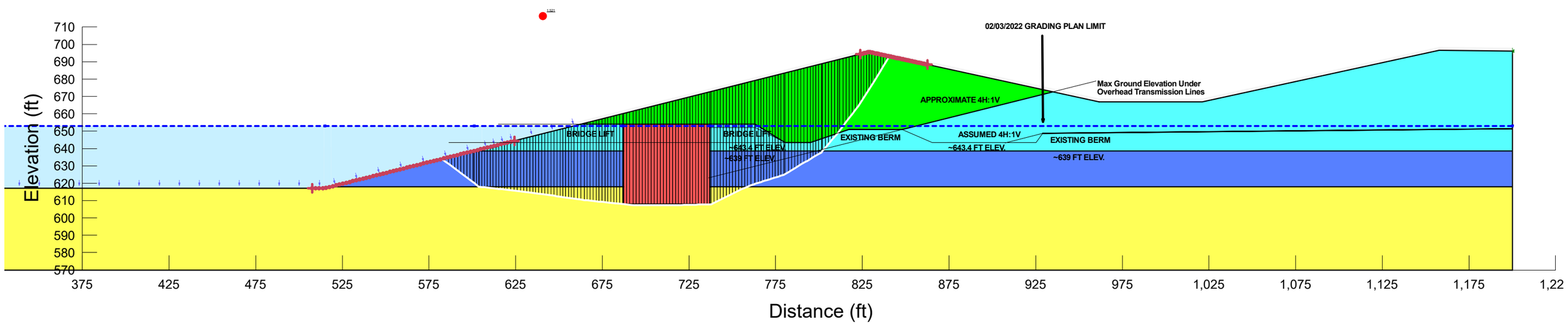
| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash Fill | 90 | 0 | 25 | 1 |
| | Ash, Coal, Coal Impacted Soil Fill | 105 | 0 | 25 | 1 |
| | InSitu Stabilization | 80 | 4,000 | 0 | 1 |
| | Native | 125 | 0 | 30 | 1 |
| | Thixotropic Ash (1000 psf) | 75 | 1,000 | 0 | 1 |



Title: North Slope and ISS Wall_Operating Condition
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Operating Condition Runs\
Name: 2_North ISS Wall Slope_Surcharge Pond Water Elevation
Last Edited By: Suchomel, Brandon  Date: 12/1/2022Time: 1:04:13 PM
Optimize Critical Slip Surface Location: Yes
Method: Bishop
Horz Seismic Coef.: 0; Vert Seismic Coef.: 0

F of S Rank (Analysis): 1 of 40,932 slip surfaces
F of S: 1.521

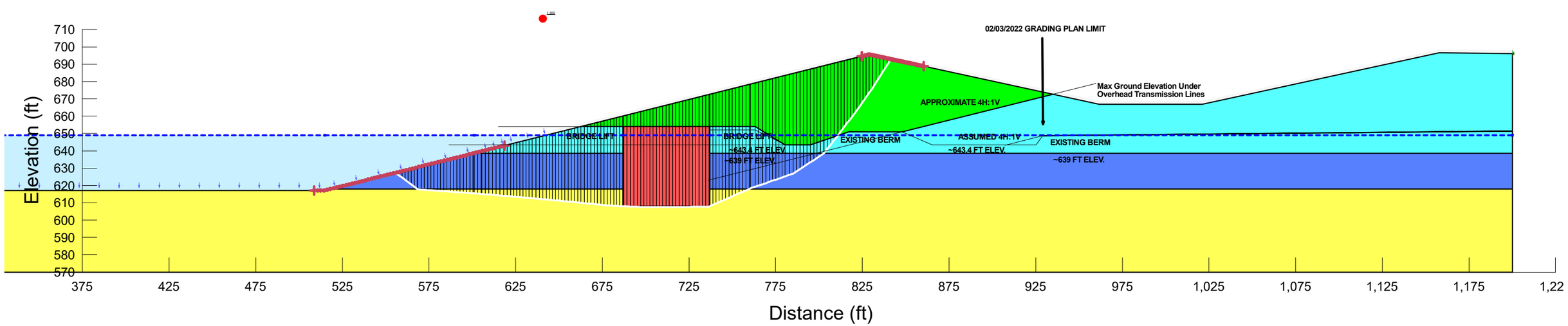
| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash Fill | 90 | 0 | 25 | 1 |
| | Ash, Coal, Coal Impacted Soil Fill | 105 | 0 | 25 | 1 |
| | InSitu Stabilization | 80 | 4,000 | 0 | 1 |
| | Native | 125 | 0 | 30 | 1 |
| | Thixotropic Ash (1000 psf) | 75 | 1,000 | 0 | 1 |



Title: North Slope and ISS Wall_Operating Condition
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Operating Condition Runs\
Name: 3_North ISS Wall Slope_Normal Pond Water Elevation Seismic
Last Edited By: Suchomel, Brandon  Date: 12/1/2022Time: 1:04:13 PM
Optimize Critical Slip Surface Location: Yes
Method: Bishop
Horz Seismic Coef.: 0.04; Vert Seismic Coef.: 0.027

F of S Rank (Analysis): 1 of 40,932 slip surfaces
F of S: 1.300

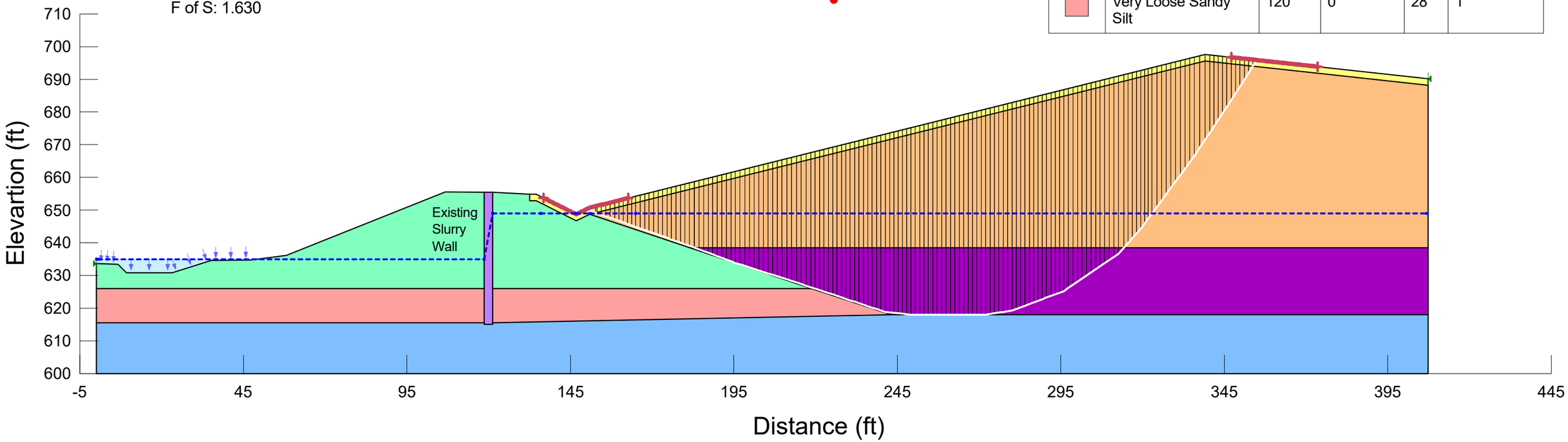
| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash Fill | 90 | 0 | 25 | 1 |
| | Ash, Coal, Coal Impacted Soil Fill | 105 | 0 | 25 | 1 |
| | InSitu Stabilization | 80 | 4,000 | 0 | 1 |
| | Native | 125 | 0 | 30 | 1 |
| | Thixotropic Ash (1000 psf) | 75 | 1,000 | 0 | 1 |



Title: West Berm_Operating Condition
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Operating Condition Runs\
Name: 1_West Slope_Normal Pond Water Elevation_105 pcf waste
Last Edited By: Suchomel, Brandon  Date: 12/6/2022Time: 8:31:05 AM
Optimize Critical Slip Surface Location: Yes
Method: Bishop
Horz Seismic Coef.: 0; Vert Seismic Coef.: 0

F of S Rank (Analysis): 1 of 40,932 slip surfaces
F of S: 1.630

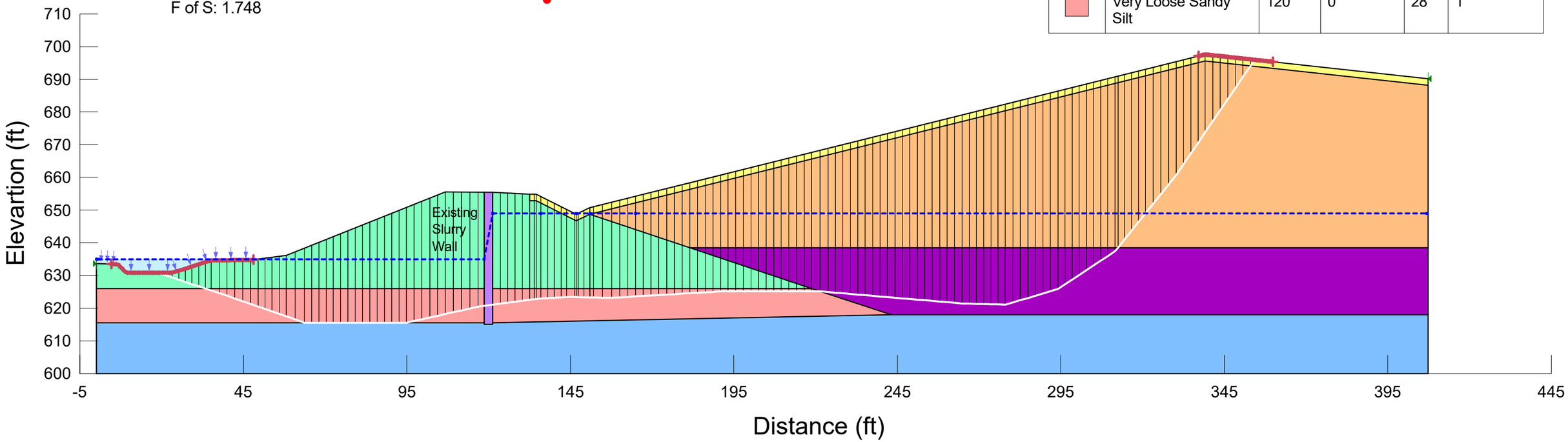
| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash, Coal, Coal Impacted Soil Fill | 105 | 0 | 28 | 1 |
| | Cap | 120 | 0 | 30 | 1 |
| | Medium Dense Fine to Medium Sand | 120 | 0 | 30 | 1 |
| | Sand and Gravel | 125 | 0 | 30 | 1 |
| | Slurry Wall | 110 | 0 | 25 | 1 |
| | Thixotropic Ash (1000 psf) | 75 | 1,000 | 0 | 1 |
| | Very Loose Sandy Silt | 120 | 0 | 28 | 1 |



Title: West Berm_Operating Condition
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Operating Condition Runs\
Name: 1_West Slope_Normal Pond Water Elevation_Full West Berm_105 pcf waste
Last Edited By: Suchomel, Brandon  Date: 12/6/2022Time: 8:31:05 AM
Optimize Critical Slip Surface Location: Yes
Method: Bishop
Horz Seismic Coef.: 0; Vert Seismic Coef.: 0

F of S Rank (Analysis): 1 of 40,932 slip surfaces
F of S: 1.748

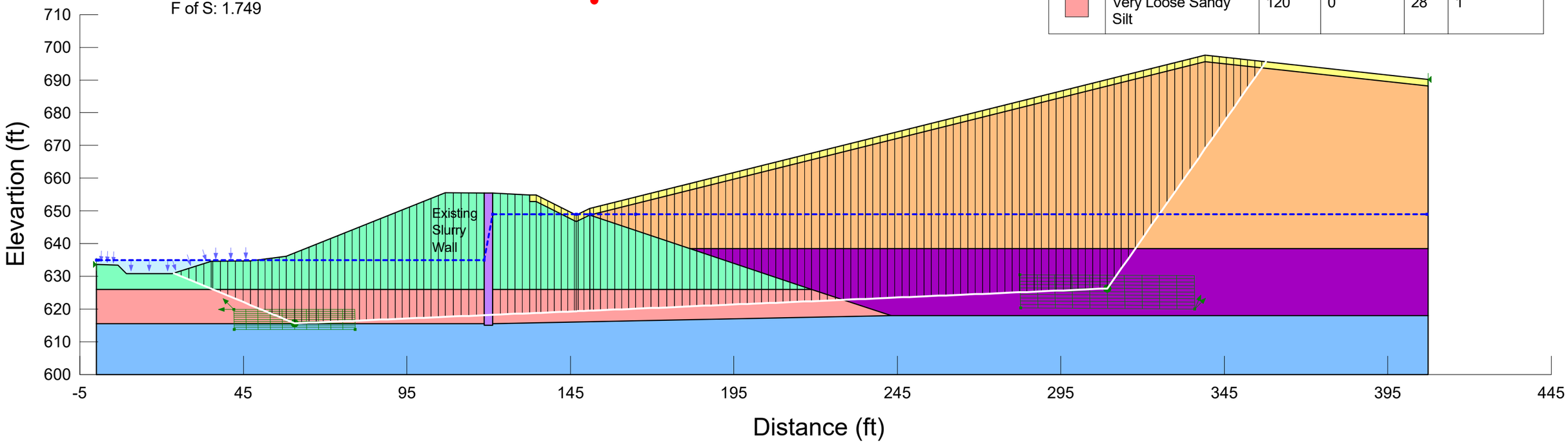
| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash, Coal, Coal Impacted Soil Fill | 105 | 0 | 28 | 1 |
| | Cap | 120 | 0 | 30 | 1 |
| | Medium Dense Fine to Medium Sand | 120 | 0 | 30 | 1 |
| | Sand and Gravel | 125 | 0 | 30 | 1 |
| | Slurry Wall | 110 | 0 | 25 | 1 |
| | Thixotropic Ash (1000 psf) | 75 | 1,000 | 0 | 1 |
| | Very Loose Sandy Silt | 120 | 0 | 28 | 1 |



Title: West Berm_Operating Condition
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Operating Condition Runs\
Name: 1_West Slope_Normal Pond Water Elevation_Full West Berm_105 pcf waste_BLOCK
Last Edited By: Suchomel, Brandon  Date: 12/6/2022Time: 8:31:05 AM
Optimize Critical Slip Surface Location: No
Method: Janbu
Horz Seismic Coef.: 0; Vert Seismic Coef.: 0

F of S Rank (Analysis): 1 of 131,769 slip surfaces
F of S: 1.749

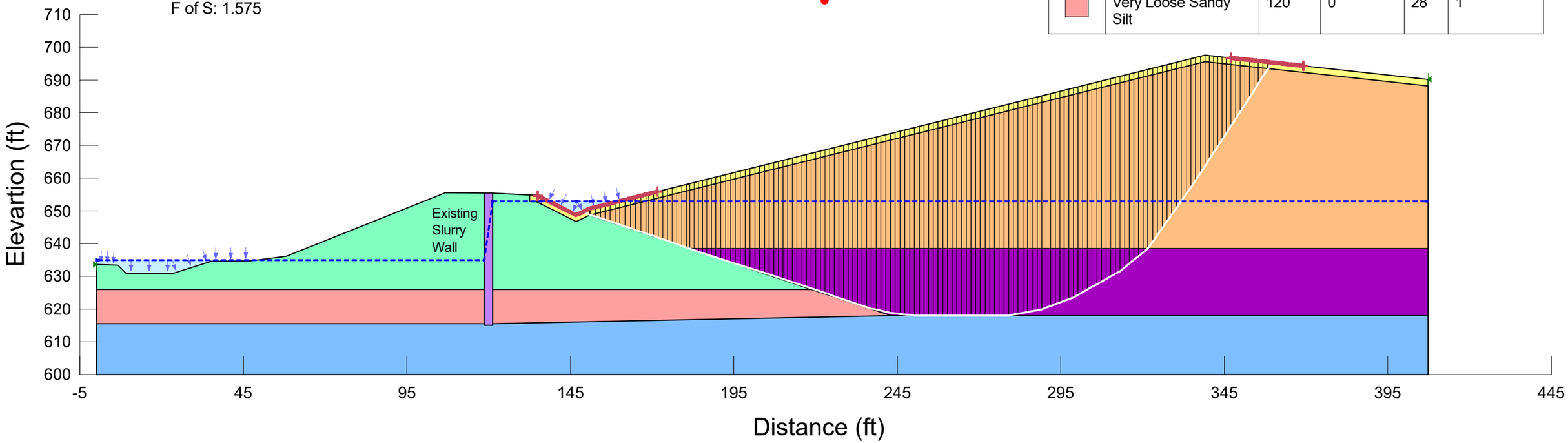
| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash, Coal, Coal Impacted Soil Fill | 105 | 0 | 28 | 1 |
| | Cap | 120 | 0 | 30 | 1 |
| | Medium Dense Fine to Medium Sand | 120 | 0 | 30 | 1 |
| | Sand and Gravel | 125 | 0 | 30 | 1 |
| | Slurry Wall | 110 | 0 | 25 | 1 |
| | Thixotropic Ash (1000 psf) | 75 | 1,000 | 0 | 1 |
| | Very Loose Sandy Silt | 120 | 0 | 28 | 1 |



Title: West Berm_Operating Condition
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Operating Condition Runs\
Name: 2_West Slope_Surcharge Pond Water Elevation_105 pcf waste
Last Edited By: Suchomel, Brandon  Date: 12/6/2022Time: 8:31:05 AM
Optimize Critical Slip Surface Location: Yes
Method: Bishop
Horz Seismic Coef.: 0; Vert Seismic Coef.: 0

F of S Rank (Analysis): 1 of 40,932 slip surfaces
F of S: 1.575

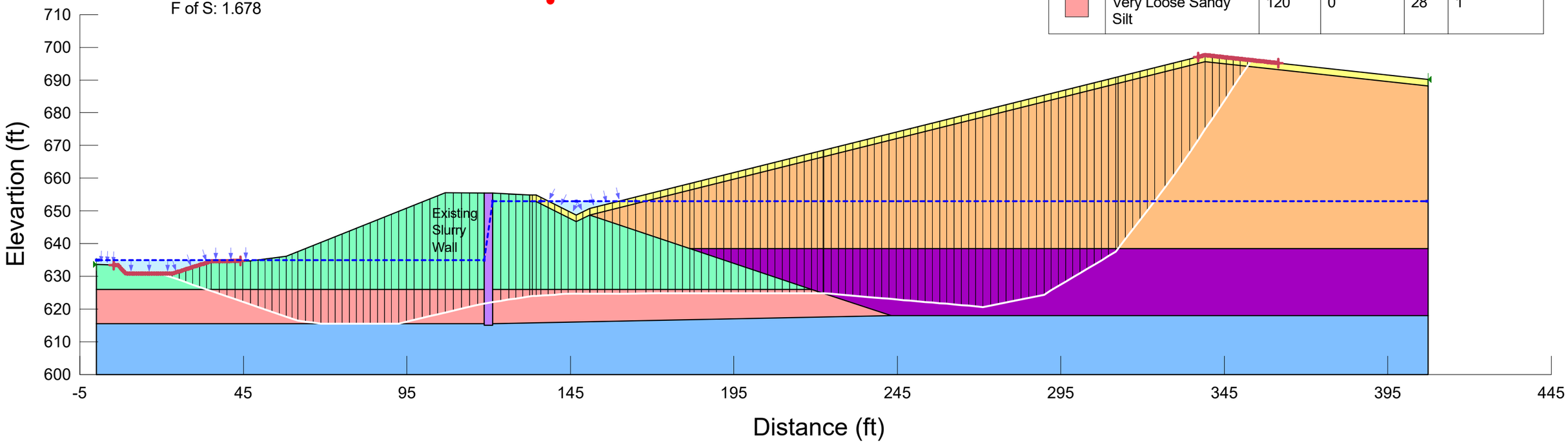
| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash, Coal, Coal Impacted Soil Fill | 105 | 0 | 28 | 1 |
| | Cap | 120 | 0 | 30 | 1 |
| | Medium Dense Fine to Medium Sand | 120 | 0 | 30 | 1 |
| | Sand and Gravel | 125 | 0 | 30 | 1 |
| | Slurry Wall | 110 | 0 | 25 | 1 |
| | Thixotropic Ash (1000 psf) | 75 | 1,000 | 0 | 1 |
| | Very Loose Sandy Silt | 120 | 0 | 28 | 1 |



Title: West Berm_Operating Condition
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Operating Condition Runs\
Name: 2_West Slope_Surcharge Pond Water Elevation_Full West Berm_105 pcf waste
Last Edited By: Suchomel, Brandon  Date: 12/6/2022Time: 8:31:05 AM
Optimize Critical Slip Surface Location: Yes
Method: Bishop
Horz Seismic Coef.: 0; Vert Seismic Coef.: 0

F of S Rank (Analysis): 1 of 40,932 slip surfaces
F of S: 1.678

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash, Coal, Coal Impacted Soil Fill | 105 | 0 | 28 | 1 |
| | Cap | 120 | 0 | 30 | 1 |
| | Medium Dense Fine to Medium Sand | 120 | 0 | 30 | 1 |
| | Sand and Gravel | 125 | 0 | 30 | 1 |
| | Slurry Wall | 110 | 0 | 25 | 1 |
| | Thixotropic Ash (1000 psf) | 75 | 1,000 | 0 | 1 |
| | Very Loose Sandy Silt | 120 | 0 | 28 | 1 |



Title: West Berm_Operating Condition
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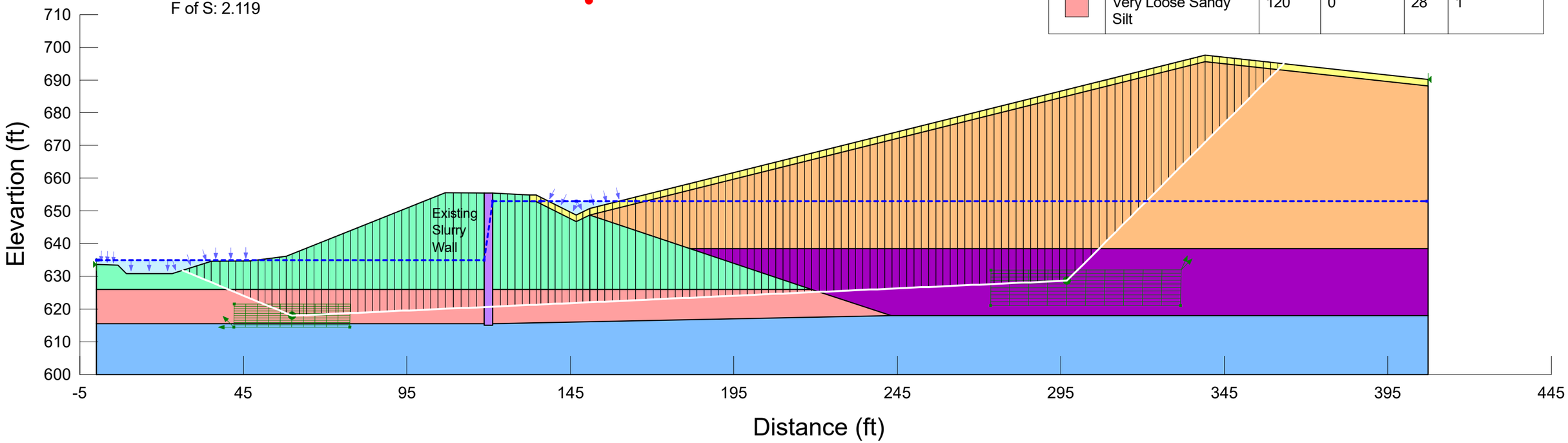
Name: 2_West Slope_Surcharge Pond Water Elevation_Full West Berm_105 pcf waste_BLOCK
Last Edited By: Suchomel, Brandon  Date: 12/6/2022Time: 8:31:05 AM
Optimize Critical Slip Surface Location: No
Method: Bishop
Horz Seismic Coef.: 0; Vert Seismic Coef.: 0

F of S Rank (Analysis): 1 of 131,769 slip surfaces
F of S: 2.119

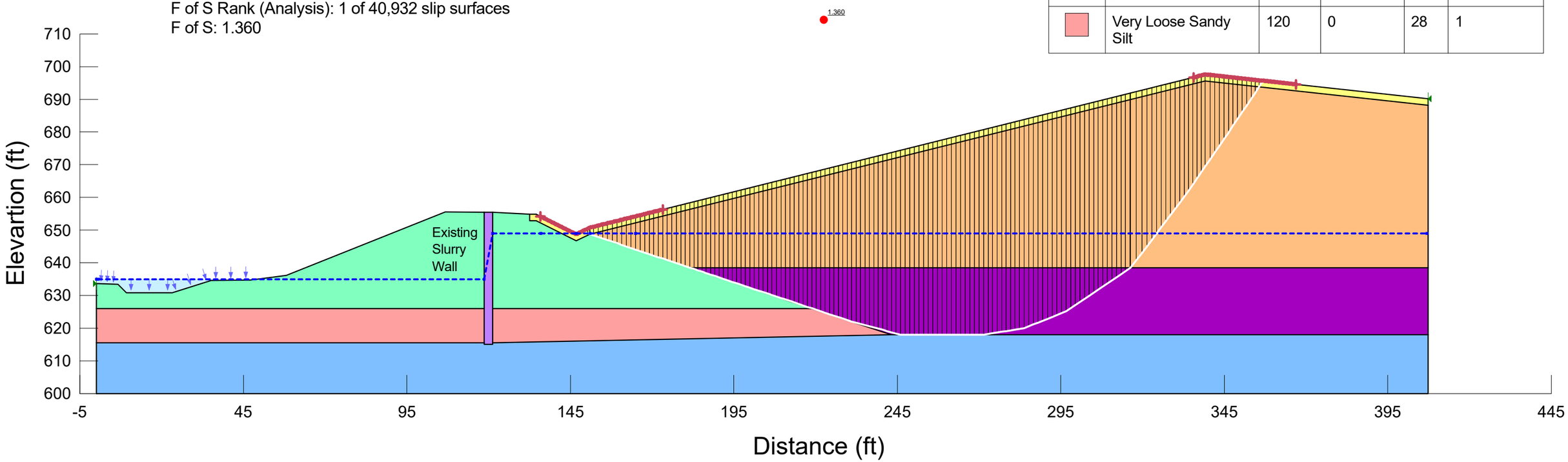
| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash, Coal, Coal Impacted Soil Fill | 105 | 0 | 28 | 1 |
| | Cap | 120 | 0 | 30 | 1 |
| | Medium Dense Fine to Medium Sand | 120 | 0 | 30 | 1 |
| | Sand and Gravel | 125 | 0 | 30 | 1 |
| | Slurry Wall | 110 | 0 | 25 | 1 |
| | Thixotropic Ash (1000 psf) | 75 | 1,000 | 0 | 1 |
| | Very Loose Sandy Silt | 120 | 0 | 28 | 1 |



Title: West Berm_Operating Condition
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Operating Condition Runs\
Name: 3_West Slope_Normal Pond Water Elevation Seismic_105 pcf waste
Last Edited By: Suchomel, Brandon  Date: 12/6/2022Time: 8:31:05 AM
Optimize Critical Slip Surface Location: Yes
Method: Bishop
Horz Seismic Coef.: 0.04; Vert Seismic Coef.: 0.027

F of S Rank (Analysis): 1 of 40,932 slip surfaces
F of S: 1.360

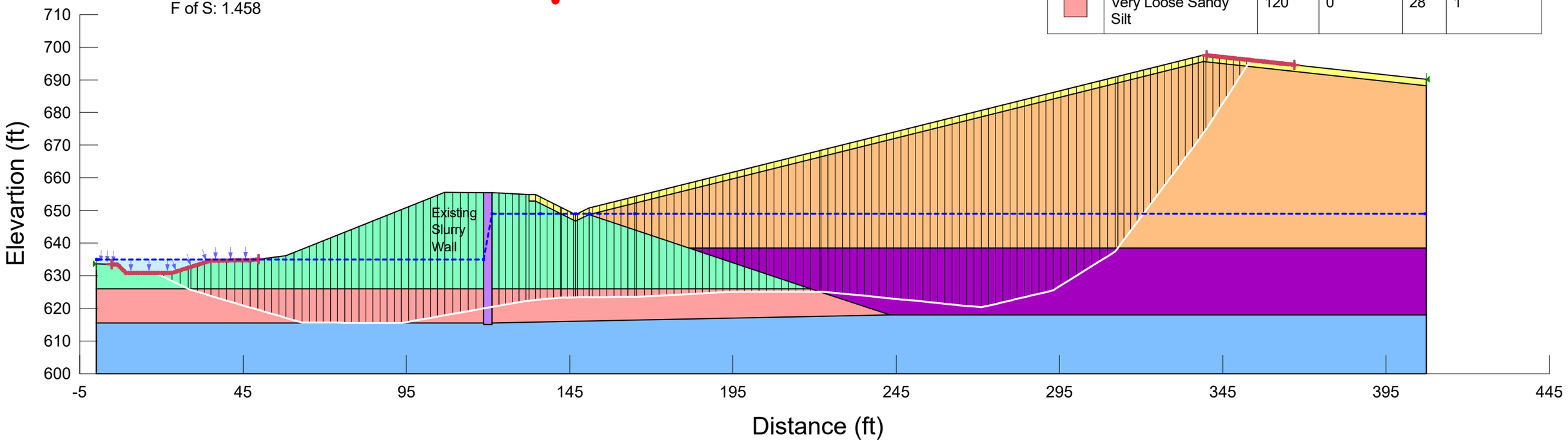
| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash, Coal, Coal Impacted Soil Fill | 105 | 0 | 28 | 1 |
| | Cap | 120 | 0 | 30 | 1 |
| | Medium Dense Fine to Medium Sand | 120 | 0 | 30 | 1 |
| | Sand and Gravel | 125 | 0 | 30 | 1 |
| | Slurry Wall | 110 | 0 | 25 | 1 |
| | Thixotropic Ash (1000 psf) | 75 | 1,000 | 0 | 1 |
| | Very Loose Sandy Silt | 120 | 0 | 28 | 1 |



Title: West Berm_Operating Condition
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Operating Condition Runs\
Name: 3_West Slope_Normal Pond Water Elevation Seismic_Full West Berm_105 pcf waste
Last Edited By: Suchomel, Brandon  Date: 12/6/2022Time: 8:31:05 AM
Optimize Critical Slip Surface Location: Yes
Method: Bishop
Horz Seismic Coef.: 0.04; Vert Seismic Coef.: 0.027

F of S Rank (Analysis): 1 of 40,932 slip surfaces
F of S: 1.458

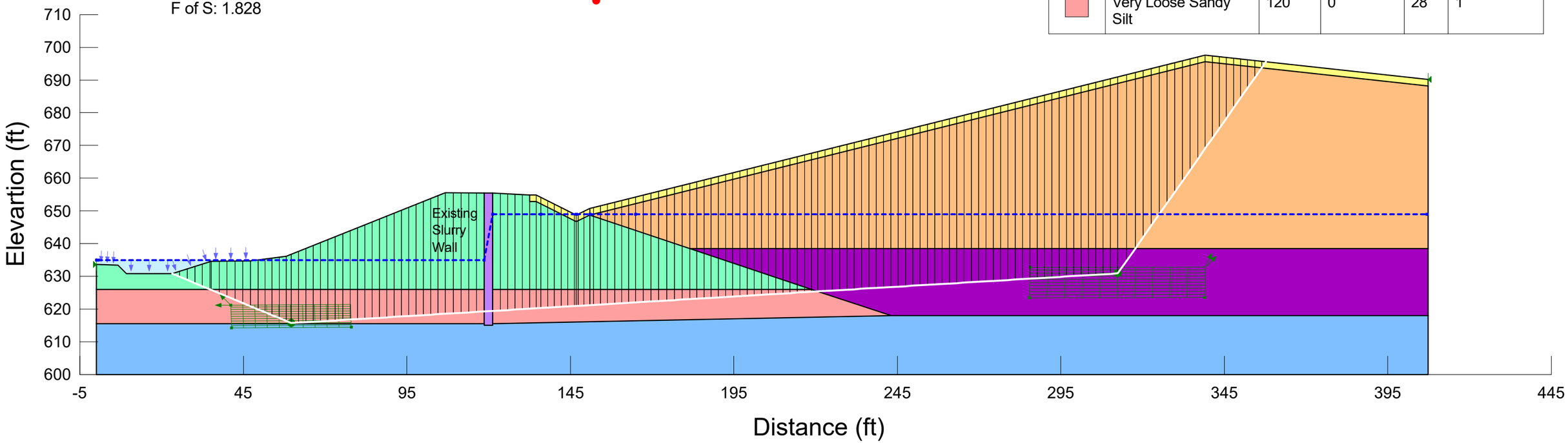
| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash, Coal, Coal Impacted Soil Fill | 105 | 0 | 28 | 1 |
| | Cap | 120 | 0 | 30 | 1 |
| | Medium Dense Fine to Medium Sand | 120 | 0 | 30 | 1 |
| | Sand and Gravel | 125 | 0 | 30 | 1 |
| | Slurry Wall | 110 | 0 | 25 | 1 |
| | Thixotropic Ash (1000 psf) | 75 | 1,000 | 0 | 1 |
| | Very Loose Sandy Silt | 120 | 0 | 28 | 1 |

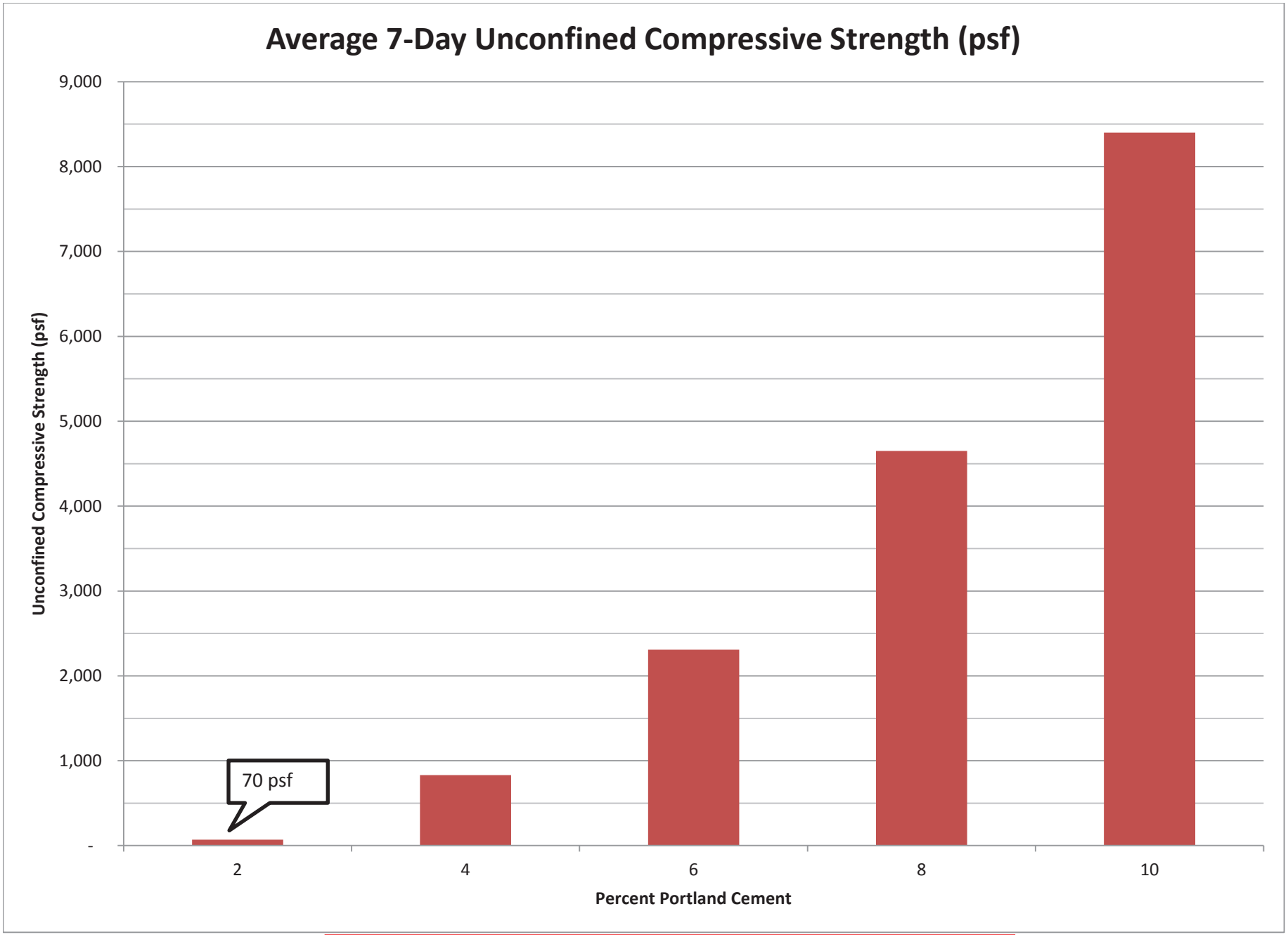


Title: West Berm_Operating Condition
Directory: I:\25220100.00\Data and Calculations\Geotech Calcs\Slope Stability\Operating Condition Runs\
Name: 3_West Slope_Normal Pond Water Elevation Seismic_Full West Berm_105 pcf waste_BLOCK
Last Edited By: Suchomel, Brandon  Date: 12/6/2022Time: 8:31:05 AM
Optimize Critical Slip Surface Location: No
Method: Bishop
Horz Seismic Coef.: 0.04; Vert Seismic Coef.: 0.027

F of S Rank (Analysis): 1 of 131,769 slip surfaces
F of S: 1.828

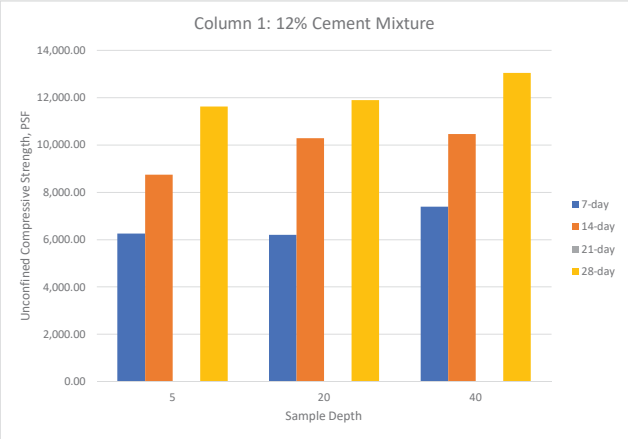
| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) | Piezometric Line |
|---|---|---|---|---|---|
| | Ash, Coal, Coal Impacted Soil Fill | 105 | 0 | 28 | 1 |
| | Cap | 120 | 0 | 30 | 1 |
| | Medium Dense Fine to Medium Sand | 120 | 0 | 30 | 1 |
| | Sand and Gravel | 125 | 0 | 30 | 1 |
| | Slurry Wall | 110 | 0 | 25 | 1 |
| | Thixotropic Ash (1000 psf) | 75 | 1,000 | 0 | 1 |
| | Very Loose Sandy Silt | 120 | 0 | 28 | 1 |

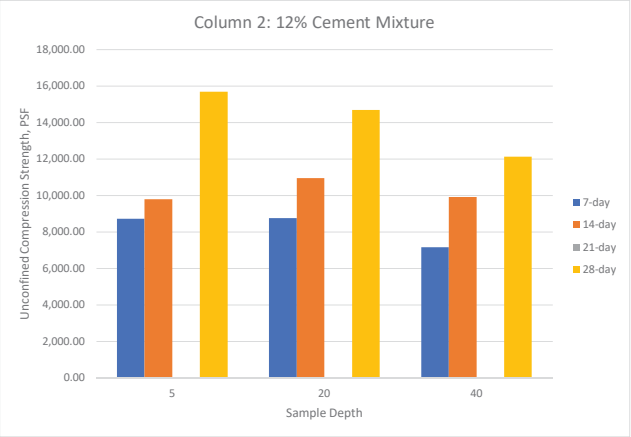


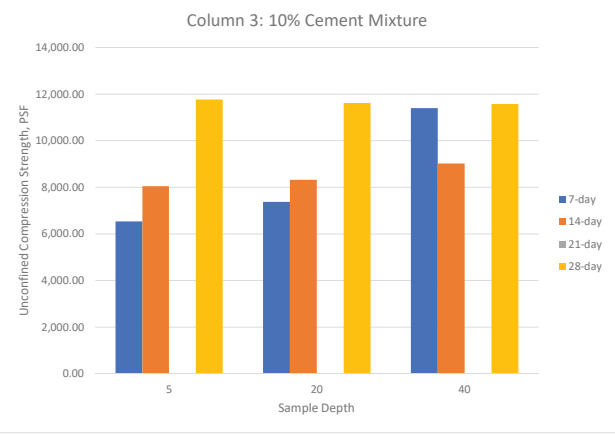


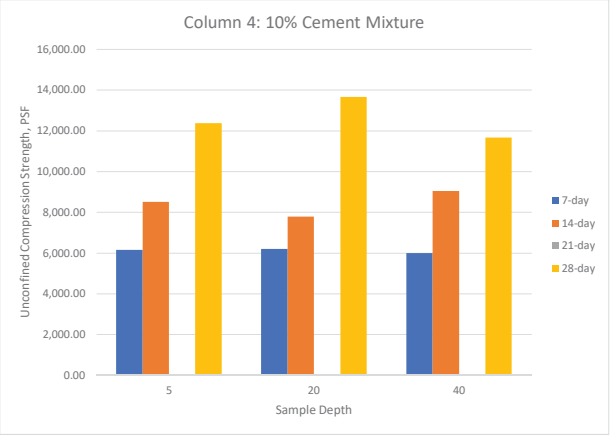

Bench scale results for fly ash/Portland cement mix design testing

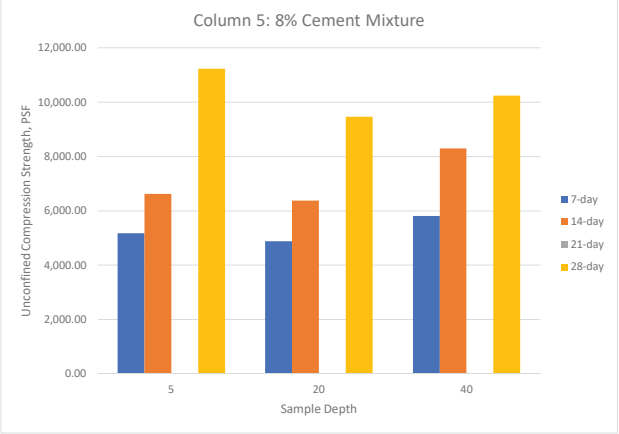
09/09/2026 - Classification: Internal - ECRM13805385

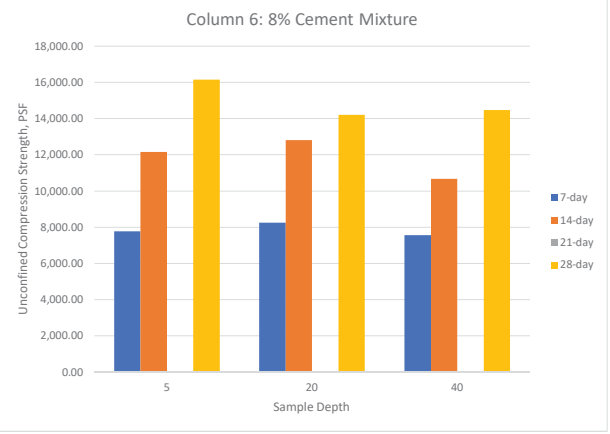



Field pilot testing results for fly ash/Portland cement mix design testing

09/09/2026 - Classification: Internal - ECRM13805385