

Changed Pages
Part III, Appendix III-D.5-2
Slope Stability Analyses

APPENDIX III-D.5-2
SLOPE STABILITY ANALYSES



8-15-2017

Michael W. Oden

This document is released for the purpose of permitting only under the authority of Michael W. Oden, P.E. #67165. It has been Updated in August 2017 to match the current landfill configuration. It is not to be used for bidding or construction. Texas Registered Engineering Firm F-5650.

Updates August 2017


Appendix III-D.5-2, Slope Stability Analyses

- Updated calculations to match new landfill geometry



J. Varsho 3-2-15

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	Client Name: Rancho Viejo Waste Management, LLC	
	Project Name: Pescadito Environmental Resource Center	Project No.: 148866
	Modified by: O. Covert	Date Modified: 8/2/2017
	Reviewed by: P. Thomas	Date Reviewed: 8/7/17
TITLE: SLOPE STABILITY ANALYSES		

Problem Statement

Determine the factor of safety against slope failure during the construction, operation and closure periods of the landfill under static loading conditions. A factor of safety of 1.5 for static conditions is deemed acceptable (note the site is not located within a seismic hazard zone).

References

The referenced literature cited below is provided in the attached pages. Referenced site specific information is provided within the Application as stated below, and referenced documents specific to this analysis are provided in the attached pages.

1. Computer model SLIDE - 2D Limit Equilibrium Slope Stability Analysis, version 6.0, developed by Rocscience, Inc. was used for the stability analyses (attached pages)
2. Figure No. 1 presents the locations of the critical cross section selected (attached pages).
3. Landfill design specifications for layer types and thicknesses provided in the Summary of Geotechnical Design Parameters (contained in **Appendix III-D.5-1**).
4. Details of landfill systems provided in the Design Drawing Set contained in this Application.
5. SLIDE output plot files (attached pages).

Assumptions

Critical Cross Section


Cross Section A-A' as shown on **Figure No. 1** (see attached pages, **Reference No. 2**) was determined to be the most critical cross section for the global mass stability of the proposed landfill design. Cross Section A-A' is an idealized cross section, is orientated from south to north (left to right), and is characterized by the following features:

- o Peak final landform elevation of approximately 704 ft MSL;
- o Final cover sideslopes are 4H:1V with a 6% slope across the plateau;
- o Cell excavation slope of 3H:1V; and
- o Maximum waste column thickness of 241 ft.

Note, that both the north and south edges of Section A-A' were evaluated for stability, but results for only the most critical edge (i.e., that which yielded the lowest safety factors) — the north edge for global stability is presented. The interim stability stages and the cell excavation/development stages were analyzed on the north edge because it will be developed and have waste placed there first.

Landfill Stages Analyzed and Modes of Failure

Stability of the landfill was analyzed for essentially three different landfill stages: complete landfill build-out / final landform, landfill cell excavation / development, and operational at interim waste fill heights. The three landfill stages were analyzed using two modes of failure within the SLIDE model — translational (non-circular / block) failure and rotational (circular) failure. The translational failure mode was used to analyze the stability of the liner system along critical (weak) interfaces; and the rotational failure mode was used to analyze the stability of the waste mass and the foundation.

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Stability of Liner System by Translational Failure Mode. The stability of the liner system was evaluated by constraining the failure surfaces (generated by the SLIDE model) to occur within the liner system at the most critical interface. The SLIDE model was used to perform a block search for translational failure surfaces (i.e., non-circular failure surfaces that follow along a weak plane or interface). A constraining boundary was applied through the liner system along the base liner and sideslope liner at approximately mid-height within the SLIDE model. Failure surfaces were then generated through the liner layer, and the most critical failure surface was determined (i.e., lowest factor of safety).

Stability of Waste Mass and Foundation by Rotational Failure Mode. The stability of the waste mass and foundation was evaluated within the SLIDE model using a grid search to find the most critical circular failure surfaces within the waste mass and foundation. The grid search was performed in an iterative manner by the SLIDE model user. Each time the user adjusted / fine-tuned the grid to the point where the model generated the absolute lowest factor of safety.

Failure Conditions

The stability analyses were performed for both short-term and long-term shear strength / static conditions. Long-term shear strength conditions will most likely occur following the complete build-out of the landfill.

Material Properties

The geotechnical parameters used in the slope stability analyses have been discussed in detail in the Summary of the Geotechnical Design Parameters (**Appendix III-D.5-1**). A summary of the material properties and shear strength parameters used in the stability analyses are presented on the following page on **Table 1**.

Water Table

The water table was conservatively assumed to be at ground surface for the stability calculations and was assumed as follows for the different stability scenarios:

- *Cell Excavation / Development Scenarios* - the water surface is at the bottom of the compacted low permeable soil liner layer along the base liner and sideslope liner; and
- *Complete Build-Out / Final Landform and Interim Waste Scenarios* - the water surface is at the top of the leachate collection system drainage geocomposite, or approximately 1 inch above the compacted low permeable soil liner layer along sideslopes and base.



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Table 1 Summary of Material Unit Weights and Shear Strength						
Layer Description	Moist Unit Weight γ_{moist}	Saturated Unit Weight γ_{sat}	Short-Term Shear Strength		Long-Term Shear Strength	
			Cohesion c	Friction Angle ϕ	Cohesion c'	Friction Angle ϕ'
Soil Stratum I:						
Beneath Landfill Liner Sideslopes, and outside of Landfill footprint	125 pcf	126 pcf	1,000 psf	0°	250 psf	10°
Soil Stratum II-III- IV:						
Beneath Landfill Base Liner, Sideslope Liner, and areas outside Landfill footprint	129 pcf	132 pcf	2,500 psf	5°	720 psf	13.5°
Landfill Layers:						
Final Cover	129 pcf	132 pcf	720 psf	13.5°	720 psf	13.5°
Waste	65 pcf	65 pcf	0 psf	30°	0 psf	30°
Protective Soil Cover Layer (2-ft) on Base Liner and Sideslope Liner	129 pcf	132 pcf	720 psf	13.5°	720 psf	13.5°
Compacted Low Permeable Soil Liner (3-ft)	129 pcf	132 pcf	720 psf	13.5°	720 psf	13.5°
Critical Geosynthetic Interface along Sideslope Liner	129 pcf	132 pcf	0 psf	8°	0 psf	8°
Critical Geosynthetic Interface along Base Liner	129 pcf	132 pcf	0 psf	14°	0 psf	14°



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Analyses

The stability analyses were performed for the following modeled scenarios:

- Global Stability of Complete Build-Out / Final Landform
 - *Stability of Liner System* - evaluated stability of the liner system under short-term and long-term shear strength / static conditions. (Note that because the liner shear strength parameters are the same for both short- and long-term conditions, the resulting critical failure surface and safety factor are identical for both short- and long-term analyses. The SLIDE output plot file is therefore only presented for the short-term analysis in the attached pages.)
 - *Stability of Waste and Foundation* - evaluated stability of the waste mass and foundation under short-term and long-term shear strength / static conditions.
- Stability at Interim Waste Fill Height
 - *Stability of Liner System* -- evaluated the stability of the liner system under short-term shear strength / static conditions. Landfill filling is intended to progress from North to South (Cell NE-1 through NE-3). Therefore the stability of the interim waste was modeled from the maximum waste thickness with 100-foot benches every 60 vertical feet with 3H:1V sideslopes with complete buildout in cell NE-1 and partial buildout in cells NE-2 and NE-3 . (Note that because the liner shear strength parameters are the same for both short- and long-term conditions, the resulting critical failure surface and safety factor for the long-term conditions would be identical to that of the short-term conditions analysis.)
 - *Stability of Waste and Foundation* -- evaluated the stability of the waste mass and foundation for short-term shear strength / static conditions.
- Stability of Cell Excavation / Development
 - *Stability of Liner System* -- evaluated the stability of the liner system under short-term shear strength / static conditions. Landfill cell development is intended to progress from North to South (Cell NE-1 through NE-3). Therefore the stability of the initial cell excavation/development was modeled in cell NE-1 along section A-A' from North to South. (Note that because the liner shear strength parameters are the same for both short- and long-term conditions, the resulting critical failure surface and safety factor for the long-term conditions would be identical to that of the short-term conditions analysis.)
 - *Stability of Foundation* -- evaluated the stability of the foundation under short-term shear strength / static conditions.

Limit Equilibrium Analysis Methods

The limit equilibrium analysis methods used in the SLIDE model analyses included the following three methods:

- Bishop Simplified - the Bishop Simplified method uses the method of slices to determine the stability of the slide mass. It satisfies vertical force equilibrium for each slice as well as overall horizontal force equilibrium for the entire slide mass (i.e., all slices). It assumes zero interslice shear forces.
- Janbu Corrected - the Janbu Corrected method uses the method of slices to determine the stability of the slide mass, satisfying vertical force equilibrium for each slice and horizontal force equilibrium for the entire slide mass (i.e., all slices). It also accounts for interslice shear forces in the analysis.
- GLE / Morgenstern-Price - the GLE (Generalized Limit Equilibrium) / Morgenstern-Price method uses the method of slices to determine the stability of the slide mass. It satisfies vertical force equilibrium for each



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slice as well as overall horizontal force equilibrium for the entire slide mass (i.e., all slices). It also accounts for interslice shear forces in the analysis.

The lowest factor of safety from the three methods used (i.e., Bishop, Janbu, GLE / Morgenstern-Price) is reported on the SLIDE plot for each modeled scenario (attached pages) and on the summary table on the following page. All of the modeled scenarios are graphically presented on the SLIDE plots provided in the attached pages.

Results

Results of the stability analyses are summarized on **Table 2** below. The following results demonstrate that the proposed landfill development meets and/or exceeds the recommended safety factor of 1.5, and complies with the regulatory requirements of Title 30 Texas Administrative Code (TAC) §330.337. SLIDE output plot files are provided in the attached pages.

Table 2 Slope Stability Summary Stability Section A-A'		
Scenario	Safety Factor	
	Short-Term Conditions	Long-Term Conditions
Complete Build- Out / Final Landform:		
Global Stability of Liner System - Block (<i>orientation South to North / left to right</i>)	2.005 (<i>Bishop</i>)	2.005 (<i>Bishop</i>)
Global Stability of Waste & Foundation - Circular (<i>orientation South to North / left to right</i>)	2.453 (<i>GLE/M-P</i>)	2.091 (<i>GLE/M-P</i>)
Excavated / Partially Lined Cell w/ 100-ft Length of Sideslope Liner Installed, Complete Base Liner Installed, and 35-ft High Lift of Waste Fill Placed at 3H:1V Slope:		
Stability of Liner System - Block (<i>orientation South to North / left to right</i>)	1.711 (<i>Bishop</i>)	<i>same</i>
Stability of Waste & Foundation - Circular (<i>orientation South to North / left to right</i>)	1.518 (<i>Janbu</i>)	<i>n/a</i>
Excavated / Developed Cell w/ Complete Liner System Installed, & 100-ft High Waste Fill Lift Placed (at 3H:1V Slope with 100-ft Wide Benching):		
Stability of Liner System - Block (<i>orientation South to North / left to right</i>)	1.551 (<i>Bishop</i>)	<i>same</i>
Stability of Waste & Foundation - Circular (<i>orientation South to North / left to right</i>)	1.733 (<i>Bishop</i>)	<i>n/a</i>
Interim Waste Fill Height with 3H:1V Waste Slope and 100-ft Wide Benching (Maximum Elevation - 704 ft MSL):		
Stability of Liner System - Block (<i>orientation South to North / left to right</i>)	1.512 (<i>Bishop</i>)	<i>same</i>
Stability of Waste & Foundation - Circular (<i>orientation South to North / left to right</i>)	1.688 (<i>Janbu</i>)	<i>n/a</i>

Reference No. 1

SLIDE - 2D Limit Equilibrium
Slope Stability Program

Slide 6.0

Slope Stability & Groundwater Software

Slide 6.0 is a comprehensive 2D limit equilibrium slope stability analysis program for all types of soil and rock slopes, embankments, earth dams and retaining walls. Slide includes probabilistic analysis, support design and finite element groundwater seepage analysis.

Slope Stability

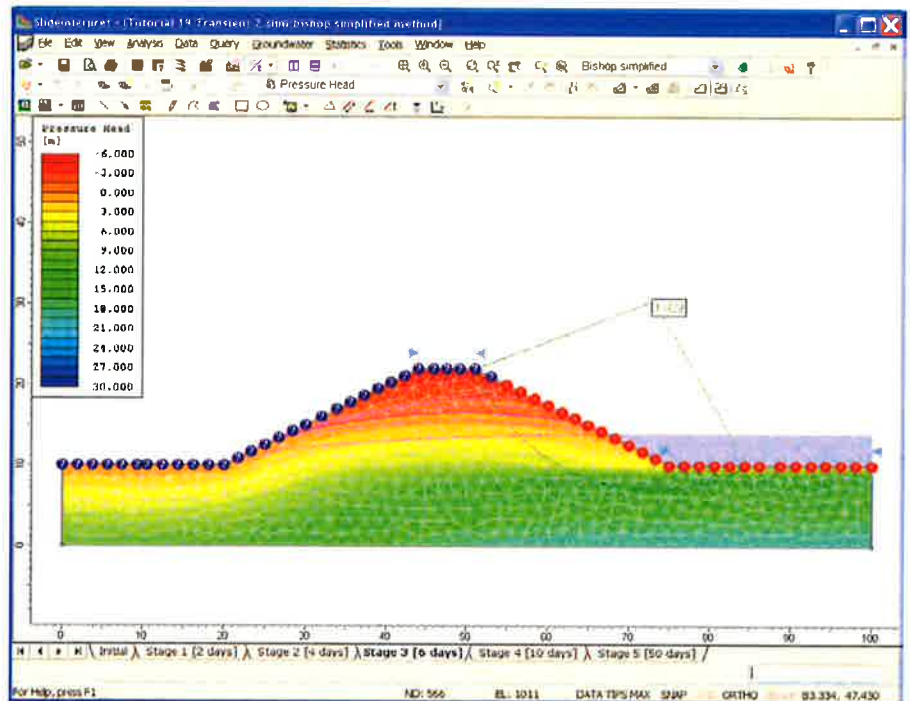
Slide offers no less than 17 different material strength models for rock and soil including Mohr-Coulomb, Anisotropic and Generalized Hoek-Brown. Support types include tieback, end anchored, soil nail, micro pile and geotextile. State of the art modeling capabilities allow you to create and edit complex slope models very easily. Advanced search algorithms simplify the task of finding the critical slip surface with the lowest safety factor.

FE Groundwater

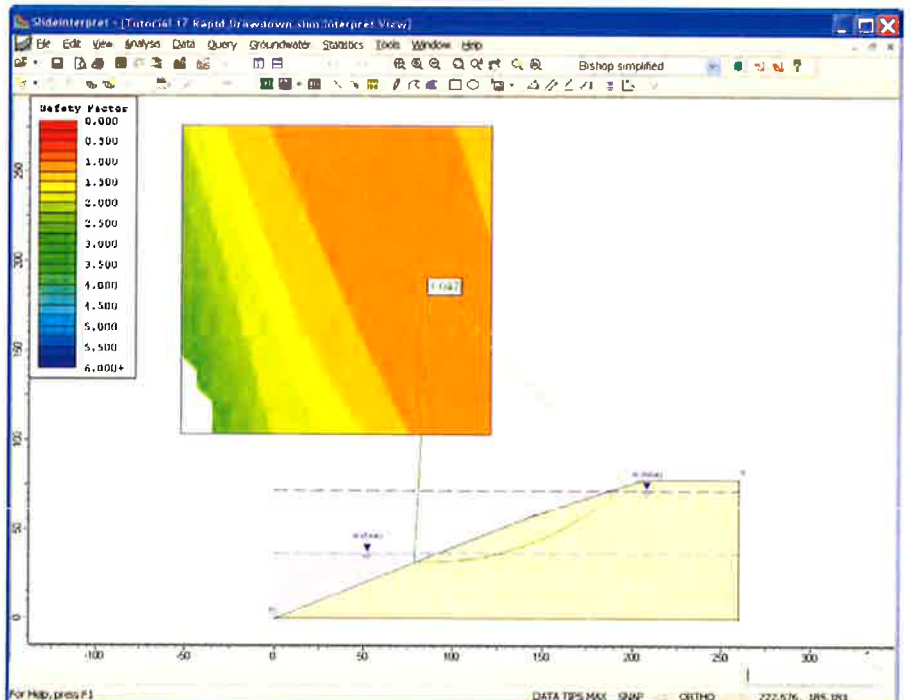
Groundwater pore pressure can be determined using steady state or transient finite element seepage analysis – flows, pressures and gradients are calculated based on user defined hydraulic boundary conditions. Seepage analysis is fully integrated with the slope stability analysis or can be used as a standalone module. For transient groundwater analysis, the safety factor can be calculated at each time stage.

Probabilistic Analysis

In *Slide* 6.0 probabilistic analysis, you may assign statistical distributions to almost any input parameters, including material properties, support properties, loads, and water table location. The probability of failure/reliability index is calculated, and provides an objective measure of the risk of failure associated with a slope design. Sensitivity analysis allows you to determine the effect of individual variables on the safety factor of the slope.



Multi-stage time dependent transient groundwater seepage analysis of earth dam under drawdown conditions. Minimum safety factor slip surface at intermediate drawdown level.



Rapid drawdown analysis of embankment dam using the Duncan, Wright, Wong 3-stage method (1990), showing critical slip circle for drawdown state.

Modeling

- interactive geometry entry
- grid/vertex/object snapping
- interactive zoom and pan
- view vertex coordinates
- DXF import / export
- multiple materials
- unlimited undo/redo
- right-click editing shortcuts
- one-click material assignment

Surface Types

- circular surfaces
- non-circular surfaces
- composite surfaces
- tension cracks

Search Methods

- grid search
- slope search
- auto-refine search
- block search
- path search
- simulated annealing
- non-circular surface optimization

Analysis Methods

- Bishop simplified
- Corps of Engineers #1
- Corps of Engineers #2
- GLE/Morgenstern-Price
- Janbu simplified
- Janbu corrected
- Lowe-Karafiath
- Ordinary/Fellenius
- Spencer
- Eurocode 7 design standard

Strength Models

- Mohr-Coulomb
- Undrained
- Anisotropic Strength
- Shear/normal function
- Hoek-Brown
- Generalized Hoek-Brown
- Vertical Stress Ratio
- Barton-Bandis
- Power Curve
- Hyperbolic
- Discrete Function

- Drained-Undrained
- Generalized Anisotropic
- Unsaturated shear strength

Pore Pressure Definition

- finite element groundwater seepage analysis
- phreatic surfaces
- piezometric surfaces
- Ru coefficients
- pore pressure grids - total head, pressure head, pore pressure
- choose grid interpolation method
- calculate excess pore pressure using B-bar method
- rapid drawdown analysis

Finite Element Groundwater Seepage Analysis

- multi-stage transient groundwater seepage
- steady state seepage
- saturated/unsaturated
- constant or time dependent boundary conditions
- one-click automatic meshing
- mapped meshing
- show mesh quality
- discharge sections
- view groundwater and slope stability results simultaneously

Rapid Drawdown Methods

- Duncan, Wright, Wong 3 stage
- Army Corps Engineering 2 stage
- Lowe and Karafiath
- Effective stress using B-bar

Probabilistic Analysis

- Monte Carlo or Latin Hypercube simulation
- use any input parameters as random variables
- distributions - Normal, Uniform, Triangular, Beta, Exponential, Lognormal, Gamma
- probability of failure
- reliability index
- critical probabilistic surface
- histogram, cumulative and scatter plots
- sensitivity analysis

Loading

- line loads
- distributed loads
- seismic load

Support

- end-anchored bolts
- grouted tiebacks
- soil nails
- geotextiles
- piles and micropiles
- user-defined support model
- active vs. passive anchors
- easily define/edit patterns
- back analysis - compute required support force for safety factor

Data Interpretation

- plot slip surface data
- plot slice data
- plot results directly on slip surface
- filter slip surfaces
- plot safety factor vs. time for transient analysis
- contour groundwater results (total head, pressure head, pore pressure)
- plot factor of safety along slope
- support force diagrams
- interactive data tips
- annotation and dimensioning tool kit
- save display options, drawings, annotations
- print models at scale
- export to Excel
- export image files

Price & Licensing

Slide 6.0 is sold as single licenses, which are purchased outright, for \$2495 US (\$2495 CDN).

Flexible Licenses are also available; they are sold as a yearly subscription, with price based on the number of concurrent users. Please contact:

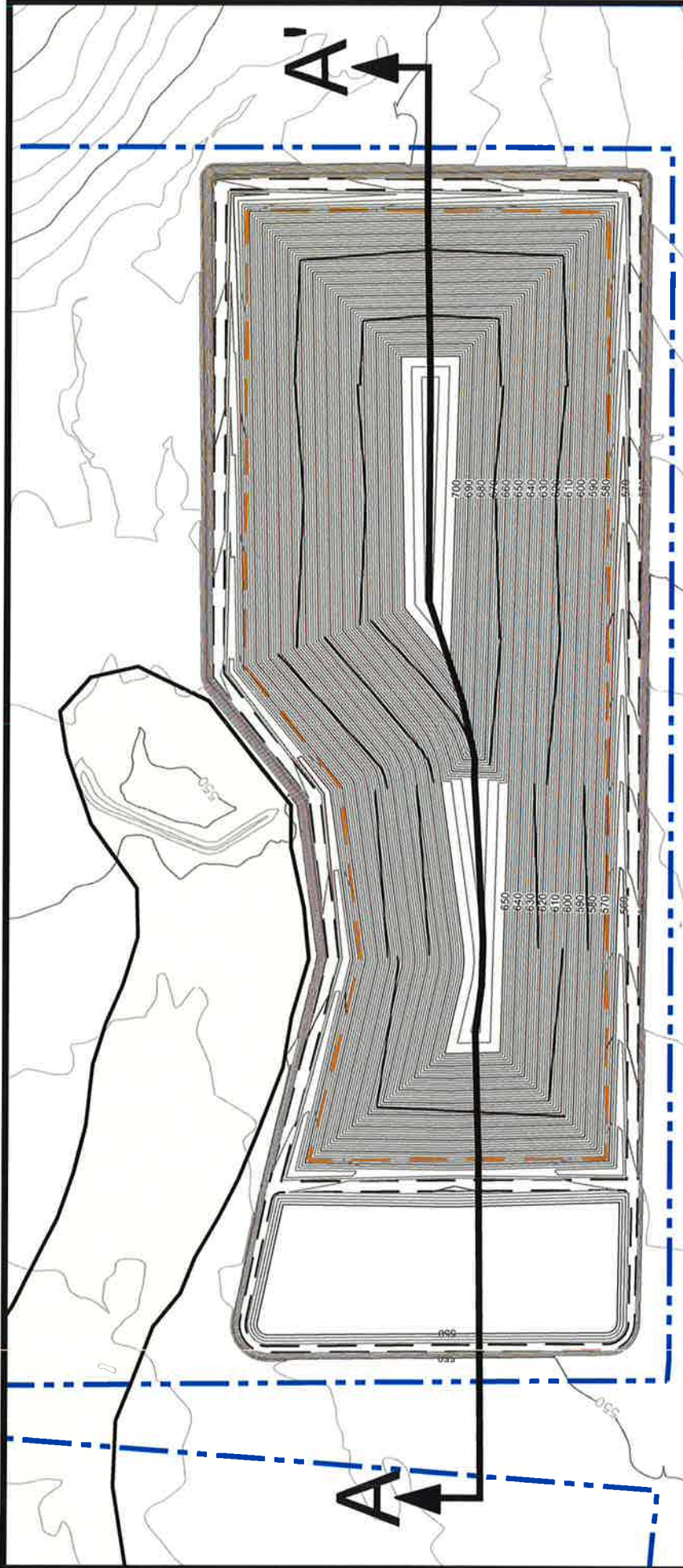
software@rocscience.com

for more information.

www.rocscience.com

Reference No. 2

Figure 1 - Stability Section Location



8-15-2017

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**PESCADITO ENVIRONMENTAL RESEARCH CENTER
 WEBB COUNTY, TEXAS (MSW 2374)**

**APPENDIX III-D.5-2, FIGURE 1
 SLOPE STABILITY CROSS SECTION
 SHOWN ON TOP OF MASS EXCAVATION GRADES**

DRAWN BY: ORC **APPROVED BY:** MWO **PROJ. NO.:** 155145 **DATE:** AUGUST 2017

**APTIM Environmental
 & Infrastructure, Inc.**



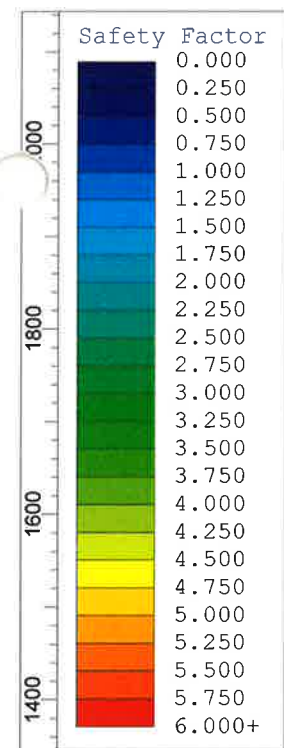
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Reference No. 5
SLIDE Output Plots

**SLOPE STABILITY
NORTH SLOPE - SECTION A-A'**

GLOBAL STABILITY ANALYSIS

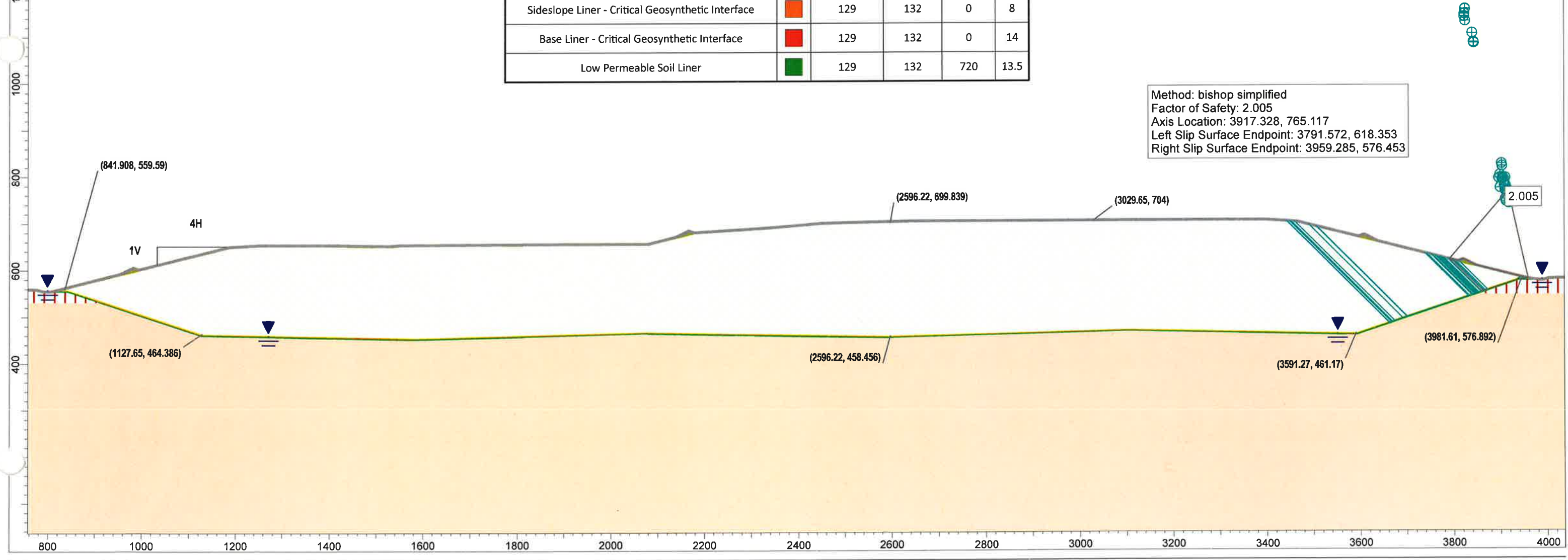
**COMPLETE BUILD-OUT / FINAL LANDFORM
BLOCK ANALYSIS OF LINER SYSTEM
(TRANSLATIONAL SLOPE FAILURE)**



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Stratum I		125	126	1000	0
Stratum II, III, IV		129	132	2500	5
Final Cover		129	132	720	13.5
Waste		65	65	0	30
Protective Soil Cover (2-ft)		129	132	720	13.5
Sideslope Liner - Critical Geosynthetic Interface		129	132	0	8
Base Liner - Critical Geosynthetic Interface		129	132	0	14
Low Permeable Soil Liner		129	132	720	13.5

Pescadito Landfill: Section A-A'
Complete Build-out / Final Landform
Global Stability of Liner System
Block Analysis - Short Term Conditions

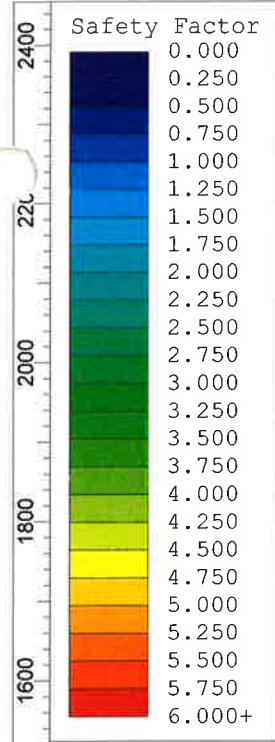
Method: bishop simplified
 Factor of Safety: 2.005
 Axis Location: 3917.328, 765.117
 Left Slip Surface Endpoint: 3791.572, 618.353
 Right Slip Surface Endpoint: 3959.285, 576.453



**SLOPE STABILITY
NORTH SLOPE - SECTION A-A'**

GLOBAL STABILITY ANALYSIS

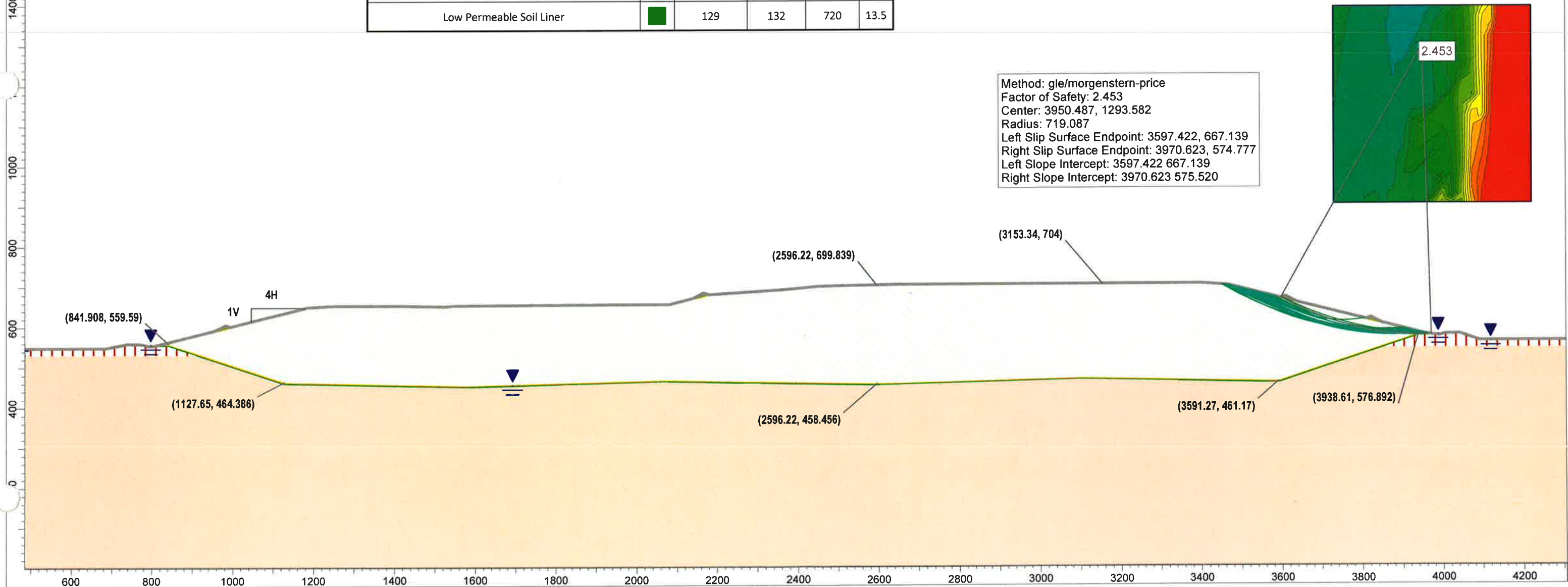
**COMPLETE BUILD-OUT / FINAL LANDFORM
CIRCULAR ANALYSIS OF WASTE AND FOUNDATION
(ROTATIONAL SLOPE FAILURE)**

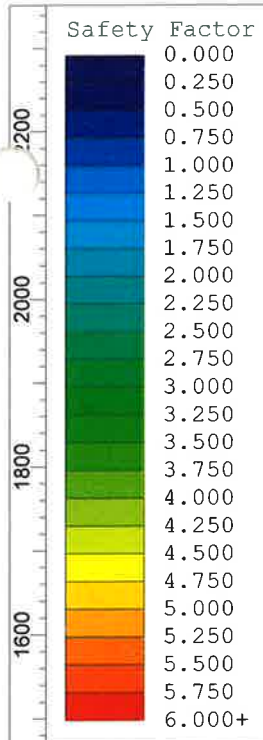


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Stratum I		125	126	1000	0
Stratum II, III, IV		129	132	2500	5
Final Cover		129	132	720	13.5
Waste		65	65	0	30
Protective Soil Cover (2-ft)		129	132	720	13.5
Sideslope Liner - Critical Geosynthetic Interface		129	132	0	8
Base Liner - Critical Geosynthetic Interface		129	132	0	14
Low Permeable Soil Liner		129	132	720	13.5

Pescadito Landfill: Section A-A'
Complete Build-Out / Final Landform
Global Stability of Waste and Foundation
Circular Analysis - Short Term Conditions

Method: gle/morgenstern-price
 Factor of Safety: 2.453
 Center: 3950.487, 1293.582
 Radius: 719.087
 Left Slip Surface Endpoint: 3597.422, 667.139
 Right Slip Surface Endpoint: 3970.623, 574.777
 Left Slope Intercept: 3597.422 667.139
 Right Slope Intercept: 3970.623 575.520

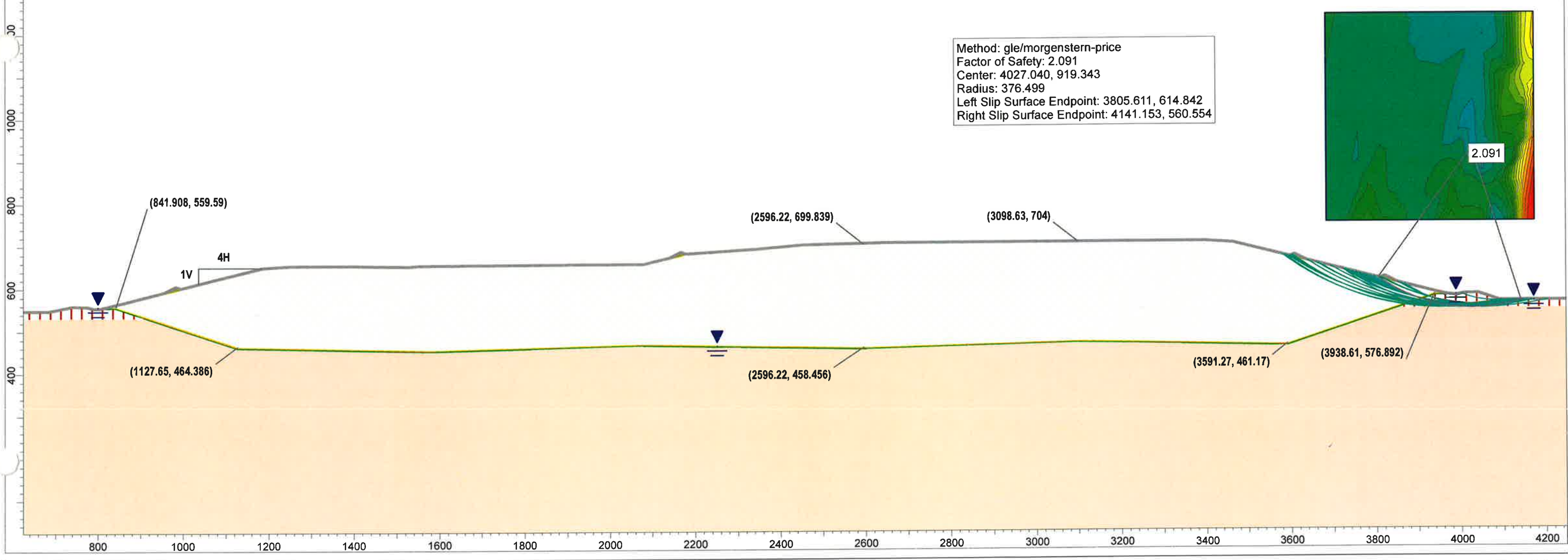




Material Name	Color	Unit Weight (lbs/ft ³)	Sat. Unit Weight (lbs/ft ³)	Cohesion (psf)	Phi (deg)
Stratum I		125	126	250	10
Stratum II, III, IV		129	132	720	13.5
Final Cover		129	132	720	13.5
Waste		65	65	0	30
Protective Soil Cover (2-ft)		129	132	720	13.5
Sideslope Liner - Critical Geosynthetic Interface		129	132	0	8
Base Liner - Critical Geosynthetic Interface		129	132	0	14
Low Permeable Soil Liner		129	132	720	13.5

Pescadito Landfill: Section A-A'
Complete Build-Out / Final Landform
Global Stability of Waste and Foundation
Circular Analysis - Long Term Conditions

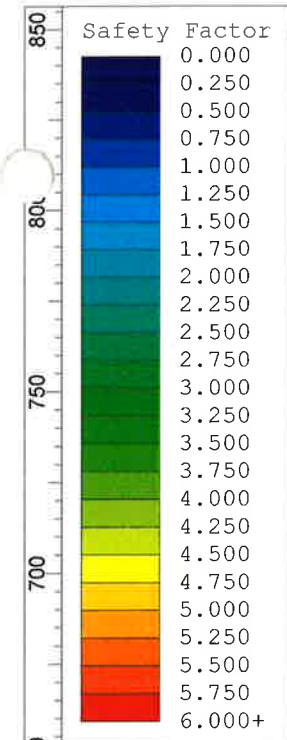
Method: gle/morgenstern-price
 Factor of Safety: 2.091
 Center: 4027.040, 919.343
 Radius: 376.499
 Left Slip Surface Endpoint: 3805.611, 614.842
 Right Slip Surface Endpoint: 4141.153, 560.554



**SLOPE STABILITY
NORTH SLOPE - SECTION A-A'**

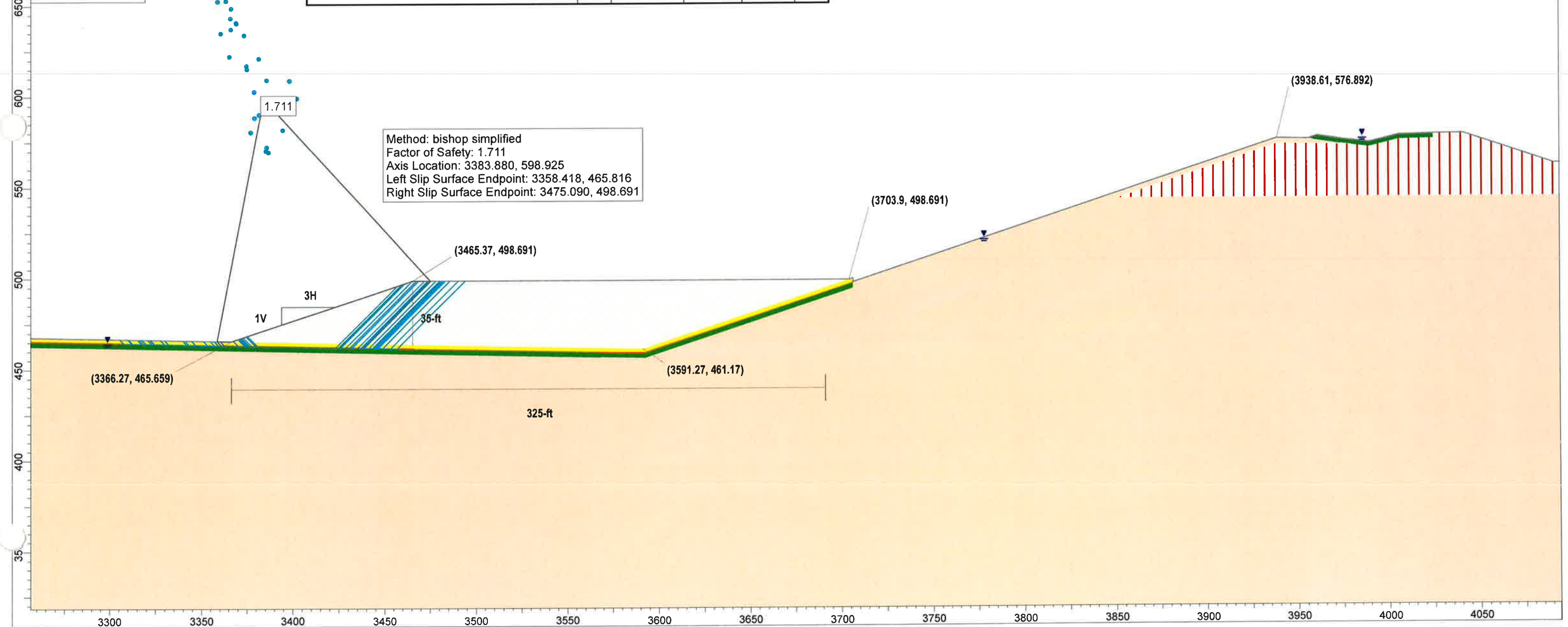
**STABILITY OF EXCAVATED / PARTIALLY LINED CELL
w/ 100-FT LENGTH OF SIDESLOPE LINER INSTALLED
& 35-FT HIGH WASTE FILL LIFT PLACED (AT 3H:1V SLOPE)**

**BLOCK ANALYSIS OF LINER SYSTEM
(TRANSLATIONAL SLOPE FAILURE)**



Material Name	Color	Unit Weight (lbs/ft ³)	Sat. Unit Weight (lbs/ft ³)	Cohesion (psf)	Phi (deg)
Stratum I		125	126	1000	0
Stratum II, III, IV		129	132	2500	5
Waste		65	65	0	30
Protective Soil Cover (2-ft)		129	132	720	13.5
Sideslope Liner - Critical Geosynthetic Interface		129	132	0	8
Base Liner - Critical Geosynthetic Interface		129	132	0	14
Low Permeable Soil Liner		129	132	720	13.5

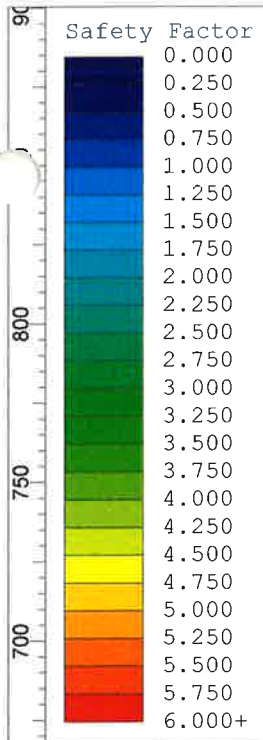
Pescadito Landfill: Section A-A'
Excavated / Partially Lined Cell
100-ft Length / Increment of Sideslope Liner Installed
(Waste Fill Height 35 ft w/ 3H:1V Slope)
Stability of Liner System
Block Analysis - Short Term Conditions



**SLOPE STABILITY
NORTH SLOPE - SECTION A-A'**

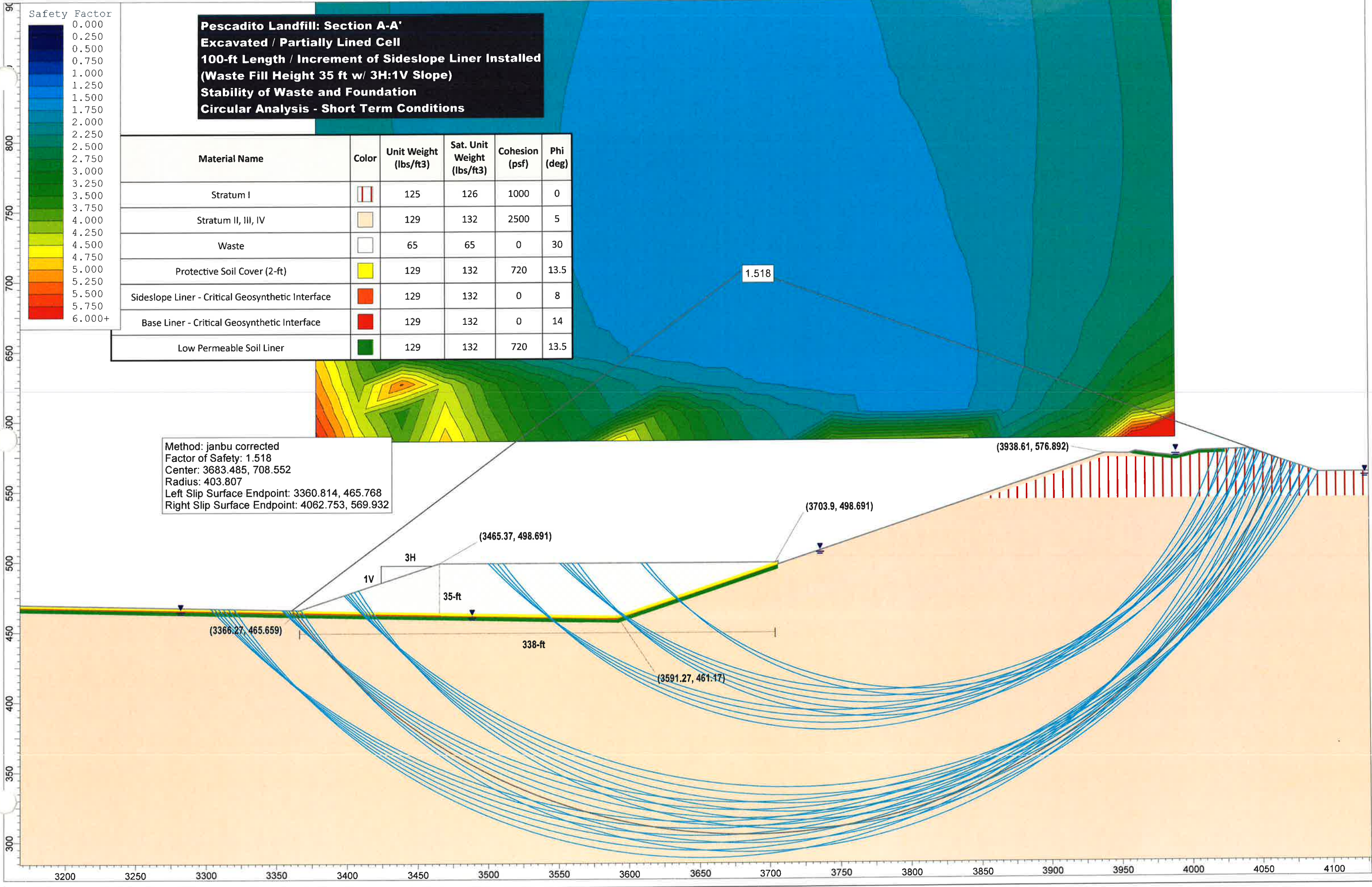
**STABILITY OF EXCAVATED / PARTIALLY LINED CELL
w/ 100-FT LENGTH OF SIDESLOPE LINER INSTALLED
& 35-FT HIGH WASTE FILL LIFT PLACED (AT 3H:1V SLOPE)**

**CIRCULAR ANALYSIS OF FOUNDATION
(ROTATIONAL SLOPE FAILURE)**



Pescadito Landfill: Section A-A'
Excavated / Partially Lined Cell
100-ft Length / Increment of Sideslope Liner Installed
(Waste Fill Height 35 ft w/ 3H:1V Slope)
Stability of Waste and Foundation
Circular Analysis - Short Term Conditions

Material Name	Color	Unit Weight (lbs/ft ³)	Sat. Unit Weight (lbs/ft ³)	Cohesion (psf)	Phi (deg)
Stratum I		125	126	1000	0
Stratum II, III, IV		129	132	2500	5
Waste		65	65	0	30
Protective Soil Cover (2-ft)		129	132	720	13.5
Sideslope Liner - Critical Geosynthetic Interface		129	132	0	8
Base Liner - Critical Geosynthetic Interface		129	132	0	14
Low Permeable Soil Liner		129	132	720	13.5



Method: janbu corrected
 Factor of Safety: 1.518
 Center: 3683.485, 708.552
 Radius: 403.807
 Left Slip Surface Endpoint: 3360.814, 465.768
 Right Slip Surface Endpoint: 4062.753, 569.932

1.518

(3938.61, 576.892)

(3703.9, 498.691)

(3465.37, 498.691)

(3591.27, 461.17)

(3366.27, 465.659)

3H
1V

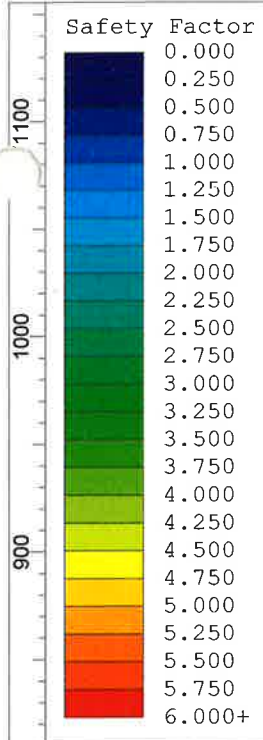
35-ft

338-ft

**SLOPE STABILITY
NORTH SLOPE - SECTION A-A'**

**STABILITY OF EXCAVATED / DEVELOPED CELL
w/ COMPLETE LINER SYSTEM INSTALLED
& 100-FT HIGH WASTE FILL LIFT PLACED (AT 3H:1V SLOPE)**

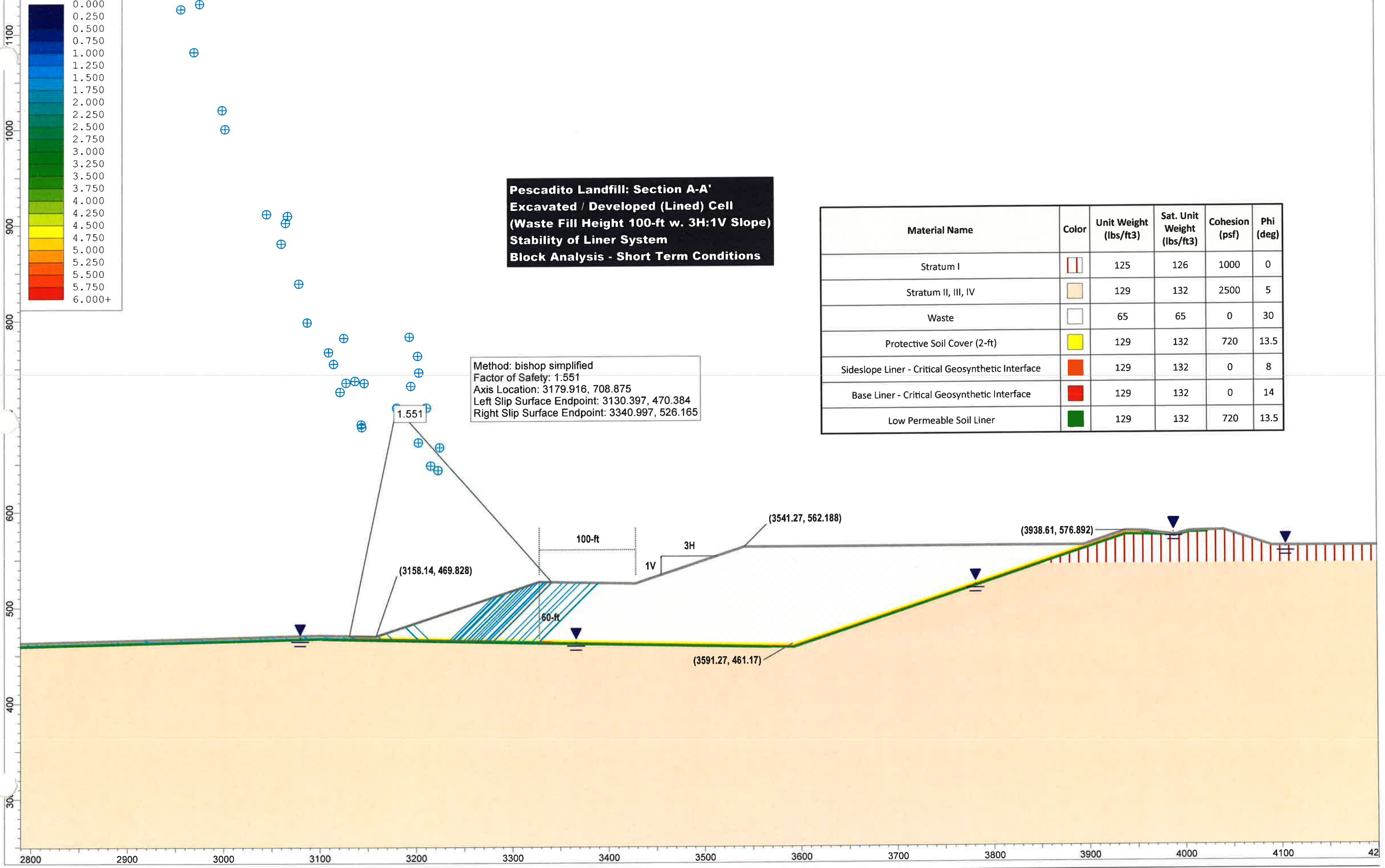
**BLOCK ANALYSIS OF LINER SYSTEM
(TRANSLATIONAL SLOPE FAILURE)**



Pescadito Landfill: Section A-A'
Excavated / Developed (Lined) Cell
(Waste Fill Height 100-ft w. 3H:1V Slope)
Stability of Liner System
Block Analysis - Short Term Conditions

Material Name	Color	Unit Weight (lbs/ft ³)	Sat. Unit Weight (lbs/ft ³)	Cohesion (psf)	Phi (deg)
Stratum I	[Red/White Hatched]	125	126	1000	0
Stratum II, III, IV	[Orange]	129	132	2500	5
Waste	[White]	65	65	0	30
Protective Soil Cover (2-ft)	[Yellow]	129	132	720	13.5
Sideslope Liner - Critical Geosynthetic Interface	[Orange]	129	132	0	8
Base Liner - Critical Geosynthetic Interface	[Red]	129	132	0	14
Low Permeable Soil Liner	[Green]	129	132	720	13.5

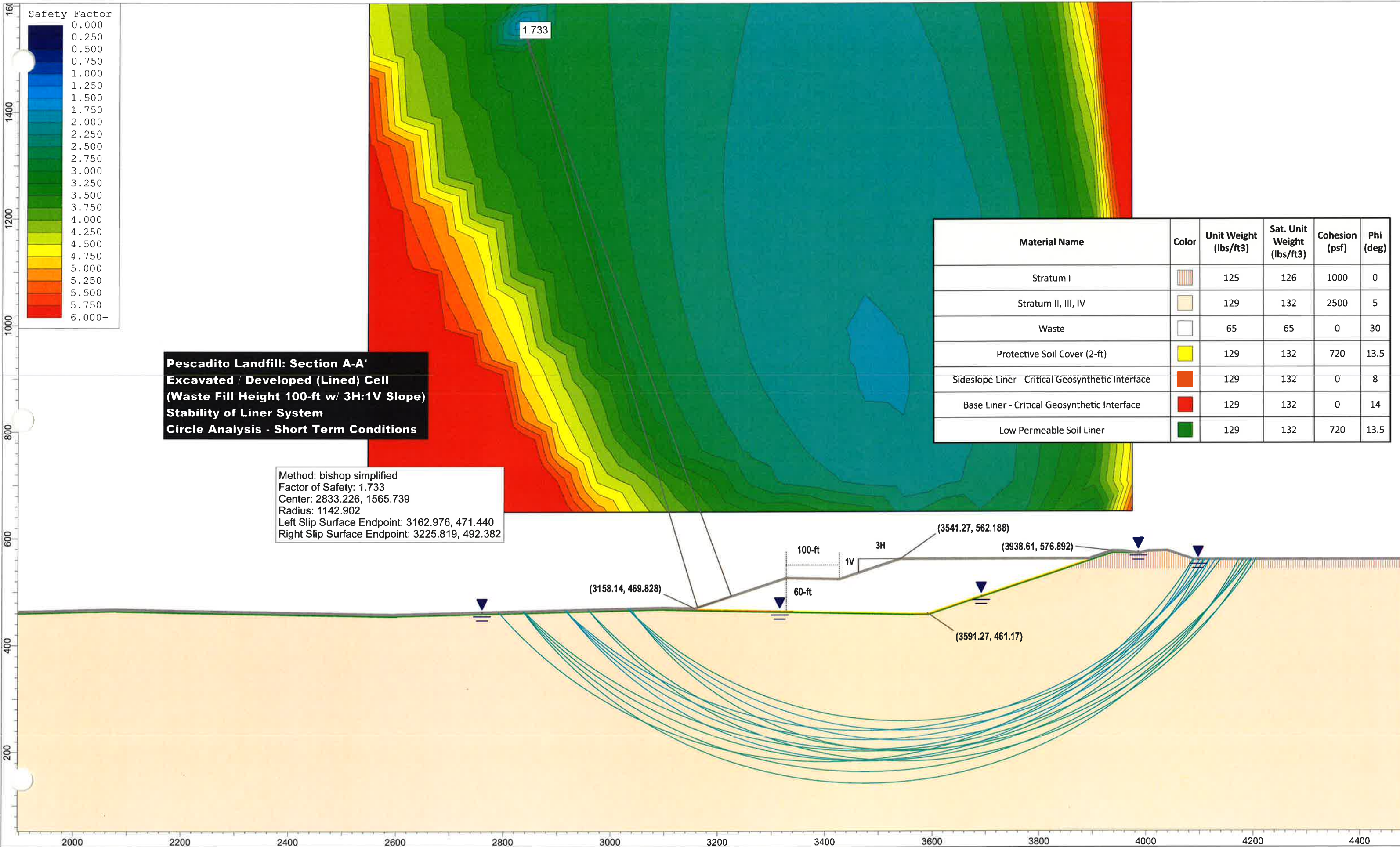
Method: bishop simplified
 Factor of Safety: 1.551
 Axis Location: 3179.916, 708.875
 Left Slip Surface Endpoint: 3130.397, 470.384
 Right Slip Surface Endpoint: 3340.997, 526.165



**SLOPE STABILITY
NORTH SLOPE - SECTION A-A'**

**STABILITY OF EXCAVATED / DEVELOPED CELL
w/ COMPLETE LINER SYSTEM INSTALLED
& 100-FT HIGH WASTE FILL LIFT PLACED (AT 3H:1V SLOPE)**

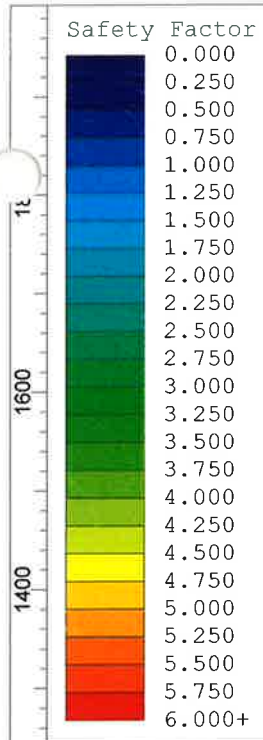
**CIRCULAR ANALYSIS OF FOUNDATION SYSTEM
(ROTATIONAL SLOPE FAILURE)**



**SLOPE STABILITY
NORTH SLOPE - SECTION A-A'**

**INTERIM WASTE STABILITY
CELLS DEVELOPED / FILLED**

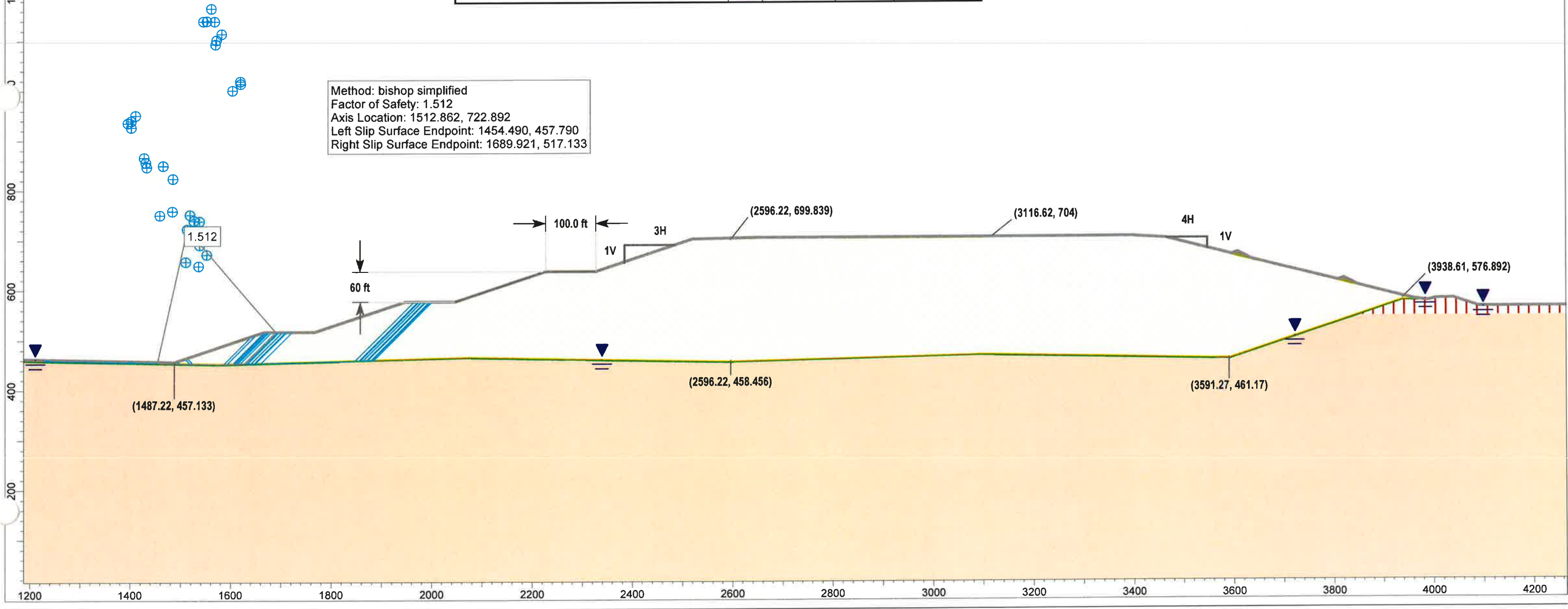
**BLOCK ANALYSIS OF LINER SYSTEM
(TRANSLATIONAL SLOPE FAILURE)**



Material Name	Color	Unit Weight (lbs/ft ³)	Sat. Unit Weight (lbs/ft ³)	Cohesion (psf)	Phi (deg)
Stratum I		125	126	1000	0
Stratum II, III, IV		129	132	2500	5
Final Cover		129	132	720	13.5
Waste		65	65	0	30
Protective Soil Cover (2-ft)		129	132	720	13.5
Sideslope Liner - Critical Geosynthetic Interface		129	132	0	8
Base Liner - Critical Geosynthetic Interface		129	132	0	14
Low Permeable Soil Liner		129	132	720	13.5

Pescadito Landfill: Section A-A'
Interim Waste Fill Height
Stability of Liner System
Block Analysis - Short Term Conditions

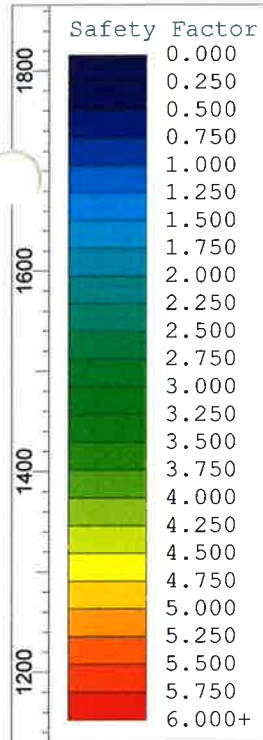
Method: bishop simplified
 Factor of Safety: 1.512
 Axis Location: 1512.862, 722.892
 Left Slip Surface Endpoint: 1454.490, 457.790
 Right Slip Surface Endpoint: 1689.921, 517.133



**SLOPE STABILITY
NORTH SLOPE - SECTION A-A'**

**INTERIM WASTE STABILITY
CELLS DEVELOPED / FILLED**

**CIRCULAR ANALYSIS OF FOUNDATION SYSTEM
(ROTATIONAL SLOPE FAILURE)**



Material Name	Color	Unit Weight (lbs/ft ³)	Sat. Unit Weight (lbs/ft ³)	Cohesion (psf)	Phi (deg)
Stratum I		125	126	1000	0
Stratum II, III, IV		129	132	2500	5
Final Cover		129	132	720	13.5
Waste		65	65	0	30
Protective Soil Cover (2-ft)		129	132	720	13.5
Sideslope Liner - Critical Geosynthetic Interface		129	132	0	8
Base Liner - Critical Geosynthetic Interface		129	132	0	14
Low Permeable Soil Liner		129	132	720	13.5

Method: janbu corrected
 Factor of Safety: 1.688
 Center: 1985.505, 978.163
 Radius: 773.932
 Left Slip Surface Endpoint: 1411.854, 458.649
 Right Slip Surface Endpoint: 2709.248, 704.000

Pescadito Landfill: Section A-A'
Interim Waste Fill Height
Stability of Waste and Foundation
Circular Analysis - Short Term Conditions

