phelps dodge Tyrone Inc. P. O. Drawer 571, Tyrone, New Mexico 88065 • (505) 538-5331

July 28, 2006

Certified Mail #70051820000773756415
Return Receipt Requested

Mr. Keith Ehlert
Groundwater Quality Bureau
New Mexico Environment Department
1190 St. Francis Dr. P.O. Box 26110
Santa Fe, New Mexico 87502

Certified Mail #70051820000773756422
Return Receipt Requested

Mr. David Ohori
Mining Act Reclamation Program
Mining and Minerals Division
1220 South St. Francis Dr.
Santa Fe, New Mexico 87505

Dear Messrs Ehlert and Ohori,

Re: Submittal of Slope Stability Analysis, Tyrone Mine
Stockpiles 1A and 1B. DP- 1341,Condition 78, and GR010RE, Condition 9L.2

Please find enclosed three hardcopies and an electronic copy of the above referenced study for each agency prepared by Golder Associates on behalf of Phelps Dodge Tyrone Inc. (PDTI).

The attached Stability Analysis Reports are in partial fulfillment with the above cited Permits and Conditions. As previously discussed and agreed to by the Agencies and PDTI, the Slope Stability Analysis reports will be submitted by stockpile units in an order which reflects the anticipated reclamation sequence.

If you have any questions or comments regarding this submittal please contact Mr. Greg Schoen at (505) 574-6359

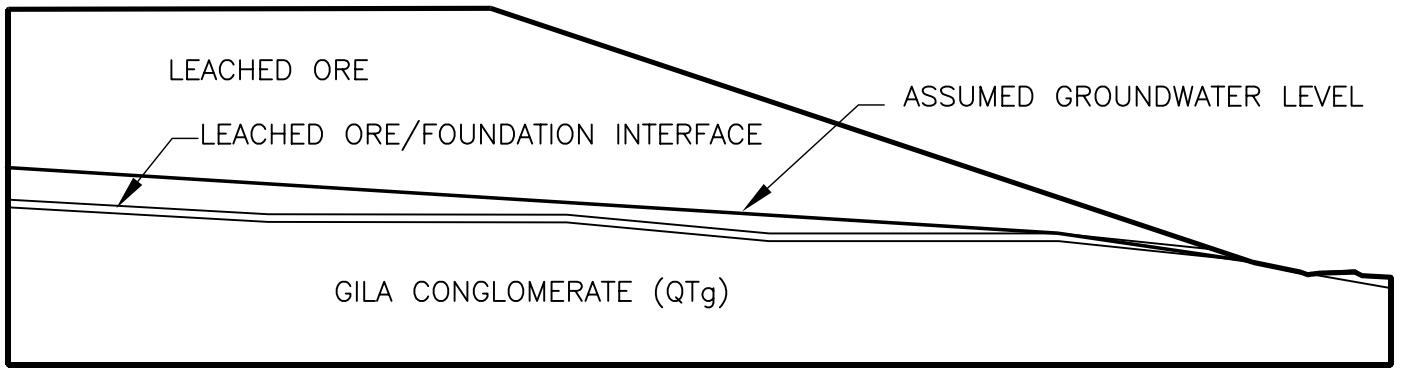
Very truly yours,

M Jaworski for Tom Shelley

Thomas L. Shelley, Manager
Environment, Land & Water

TLS:gs
Attachment
20060724-101

c: Clint Marshall, NMED
Tom Whythes, Golder



B **CROSS-SECTION B**

PROJECT
phelps dodge Tyrone Inc.

SUPPLEMENTAL STABILITY ANALYSIS
TYRONE MINE, NEW MEXICO

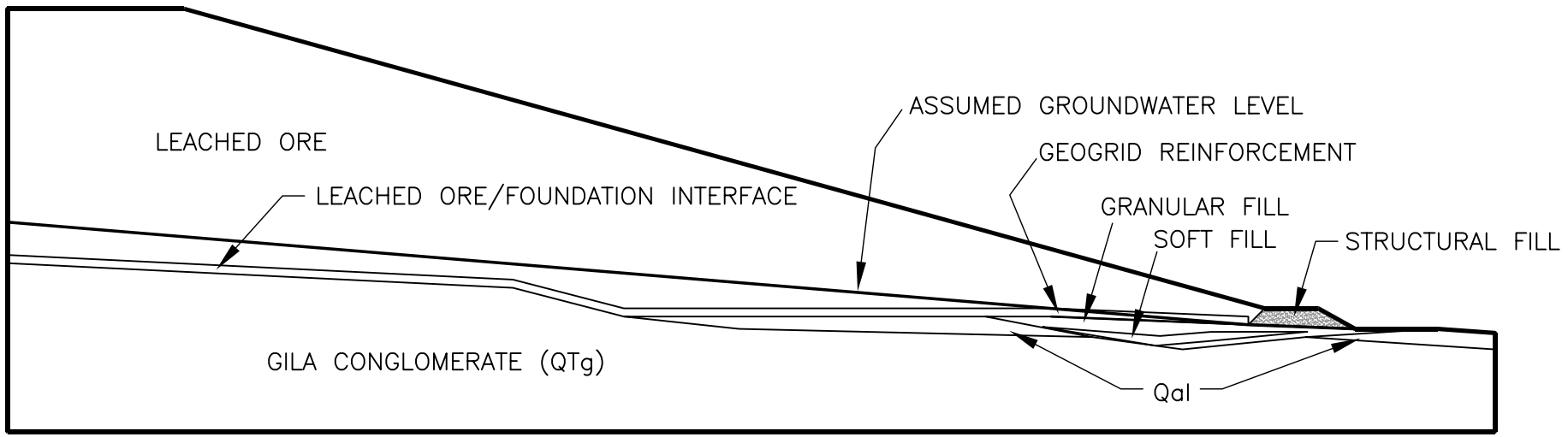
TITLE

CROSS-SECTION B, No. 1A STOCKPILE MATERIAL IDENTIFICATION

Golder Associates
Tucson, Arizona

PROJECT No.		053–2550	FILE No.	0532550C003
DESIGN	GM	05/31/06	SCALE AS SHOWN	REV. A
CADD	ANV	06/05/06		
CHECK	GM	06/05/06		
REVIEW	DAK	07/13/06		

FIGURE 3.1



A CROSS-SECTION A

PROJECT

phelps dodge Tyrone Inc.

SUPPLEMENTAL STABILITY ANALYSIS
TYRONE MINE, NEW MEXICO

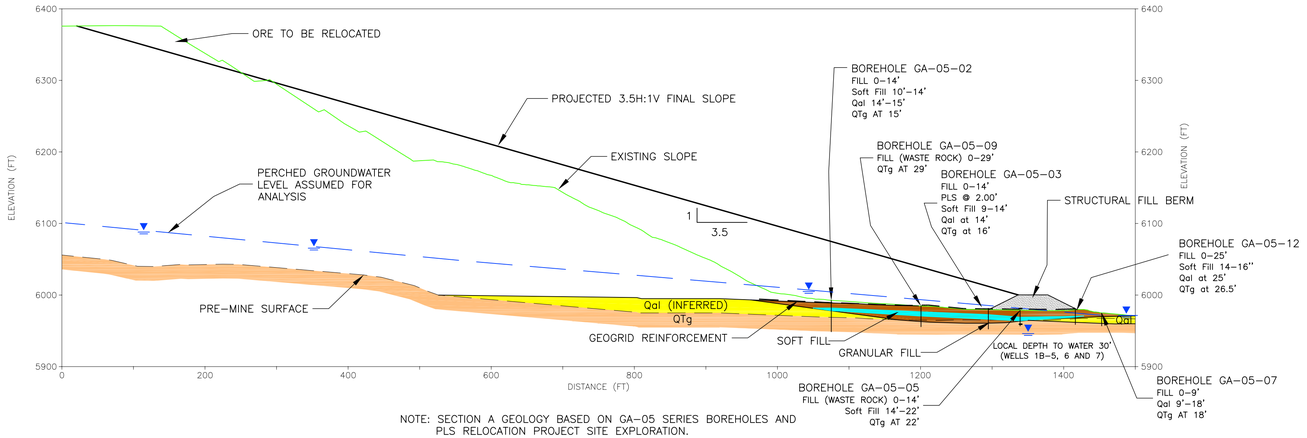
TITLE

CROSS-SECTION A, No. 1B STOCKPILE MATERIAL IDENTIFICATION

Golder Associates
Tucson, Arizona

PROJECT No.		053–2550	FILE No.	0532550C003
DESIGN	GM	05/31/06	SCALE AS SHOWN	REV. A
CADD	ANV	06/05/06		
CHECK	GM	06/05/06		
REVIEW	DAK	07/13/06		

FIGURE 2.1



NOTE: SECTION A GEOLOGY BASED ON GA-05 SERIES BOREHOLES AND PLS RELOCATION PROJECT SITE EXPLORATION.

A/2 **CROSS-SECTION A**

100 0 100 200
SCALE FEET

LEGEND

- PRE-MINE SURFACE
- EXISTING STOCKPILE SURFACE
- PROJECTED FINAL 3.5H:1V SLOPE SURFACE

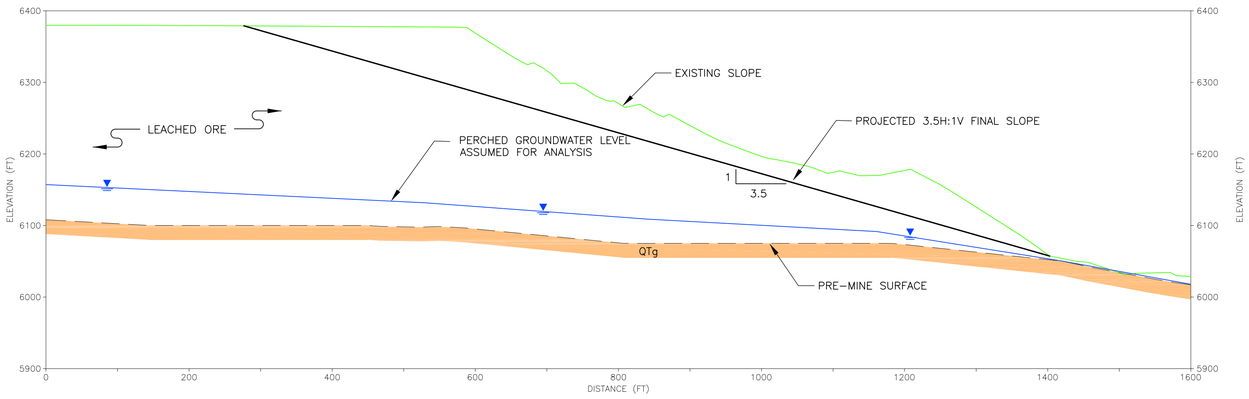
DRAWING REFERENCES

SECTION A TOE AREA STABILIZATION MEASURES AND GEOTECHNICAL INFORMATION IN "UNDRAINED LOADING EVALUATION, No. 1B STOCKPILE PLS COLLECTION SYSTEM RELOCATION DESIGN PROJECT, TYRONE, NEW MEXICO" GOLDER, MARCH 7 2006, DRAFT LETTER TO MR. ELMO GOMEZ, PHELPS DODGE TYRONE Inc., GOLDER PROJECT No. 053-2275.

WATER LEVELS AND GEOLOGIC CONTACTS FROM PDTI MONITORING WELL AND DRILLING RECORDS.

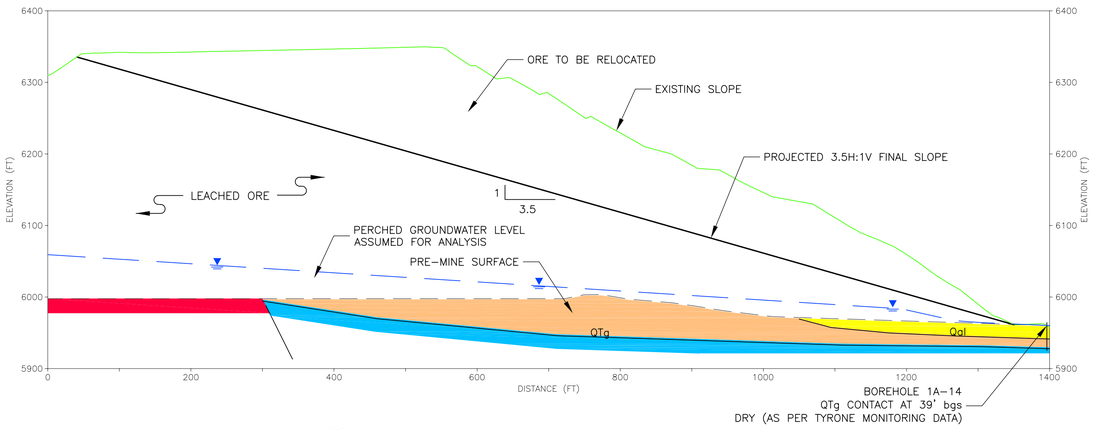
GEOLOGIC LEGEND

Andesite\K volcanics	
Basal volcanics (K?)	Cretaceous
Colorado Shale \ Beartooth Quartzite	
Diabase	
Granitoid Rocks	Precambrian
Igneous Breccia	
Granodiorite-Tonalite-Dacite	
Diorite/Biotite Diorite	Tertiary
Granodiorite-Quartz Diorite	
Mine Dumps	
Alluvium (QAL)	Quaternary
Colluvium	
Upper Mangas Conglomerate	Upper Tertiary/
Lower Mangas Conglomerate	Quaternary (QTg)
Latite & Basaltic Andesite-Tml	
Wind Mountain Ash-flow Tuff - Twt	
Volcanics and Volcaniclastics (Tws,Twb,Tipa,Tipb)	Tertiary
Volcanic Rocks (undiff.)	
Tonalite-Dacite	



B/2 **CROSS-SECTION B**

100 0 100 200
SCALE FEET



C/2 **CROSS-SECTION C**

100 0 100 200
SCALE FEET

PROJECT
phelps dodge TYRONE Inc.

SUPPLEMENTAL STABILITY ANALYSIS
TYRONE MINE, NEW MEXICO

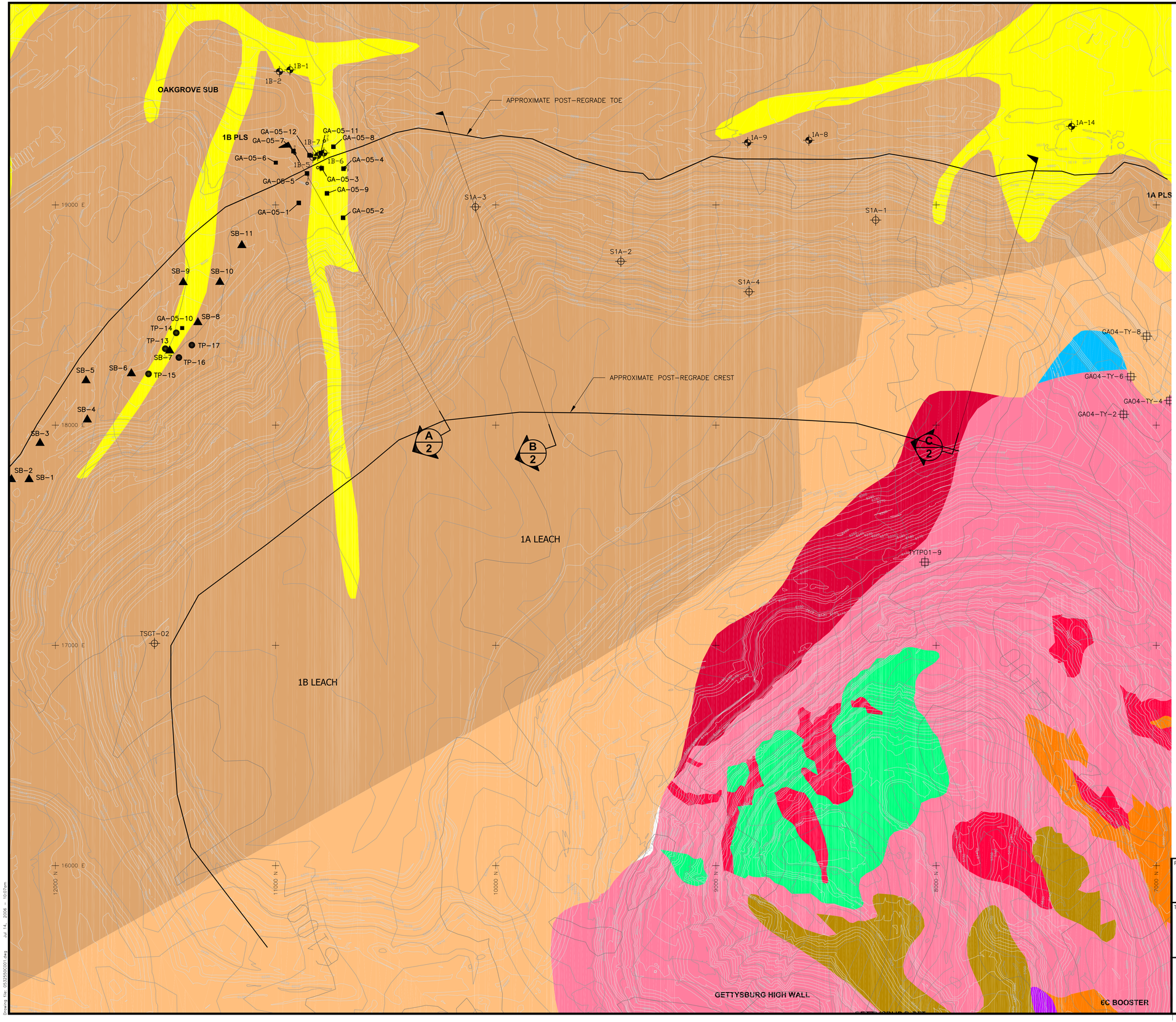
TITLE

No. 1A AND 1B STOCKPILES STABILITY CROSS-SECTIONS

Golder Associates
Tucson, Arizona

PROJECT No.		053-2550	FILE No.		0532550C002
DESIGN	GM	05/09/06	SCALE	AS SHOWN	REV. A
CADD	NIL	05/17/06	DRAWING		
CHECK	GM	05/11/06		2	
REVIEW	DAK	07/13/06			

Drawing file: 0532550C002.dwg Jul 14, 2006 - 10:05am



LEGEND

- ROTOSONIC BOREHOLE LOCATION
- STOCKPILE TEST PIT LOCATION
- GA-05-3 — SEPTEMBER 2005 BOREHOLE LOCATION (BY GOLDER)
- TP-13 — TEST PIT LOCATION
- SB-1 — DRILLHOLE LOCATION

Andesite\K volcanics		
Basal volcanics (K?)		Cretaceous
Colorado Shale	Beartooth Quartzite	
Diabase		Precambrian
Granitoid Rocks		
Igneous Breccia		
Granodiorite–Tonalite–Dacite		
Diorite/Biotite Diorite		Tertiary
Granodiorite–Quartz Diorite		
Mine Dumps		
Alluvium		Quaternary
Colluvium		
Upper Mangas Conglomerate		Upper Tertiary/
Lower Mangas Conglomerate		Quaternary
Latite & Basaltic Andesite–Tml		
Wind Mountain Ash–flow Tuff – Twt		
Volcanics and Volcaniclastics (Tws,Twb,Tipa,Tipb)		Tertiary
Volcanic Rocks (undiff.)		
Tonalite–Dacite		

REFERENCES

1.) GEOLOGY FROM PDTI PROJECT GEOLOGY MAP.

2.) SELECTED MONITORING WELLS FROM PDTI RECORDS.

3.) GA–05 AND SB SERIES DRILLHOLES REPORTED IN "UNDRAINED LOADING EVALUATION, No. 1B STOCKPILE PLS COLLECTION SYSTEM RELOCATION DESIGN PROJECT, TYRONE, NEW MEXICO", GOLDER ASSOCIATES DRAFT LETTER TO MR. ELMO GOMEZ, PDTI, MARCH 7, 2006.

4.) STOCKPILE GEOTECHNICAL INVESTIGATION REPORTED IN "SUPPLEMENTAL STABILITY STUDY OF WASTE ROCK PILES AND LEACH ORE STOCKPILES, INTERIM REPORT FOR DP1341, CONDITION 78, TYRONE MINE", GOLDER ASSOCIATES, JANUARY 2003.

200 0 200 400
SCALE FEET

PROJECT
phelps dodge TYRONE Inc.

SUPPLEMENTAL STABILITY ANALYSIS
TYRONE MINE, NEW MEXICO

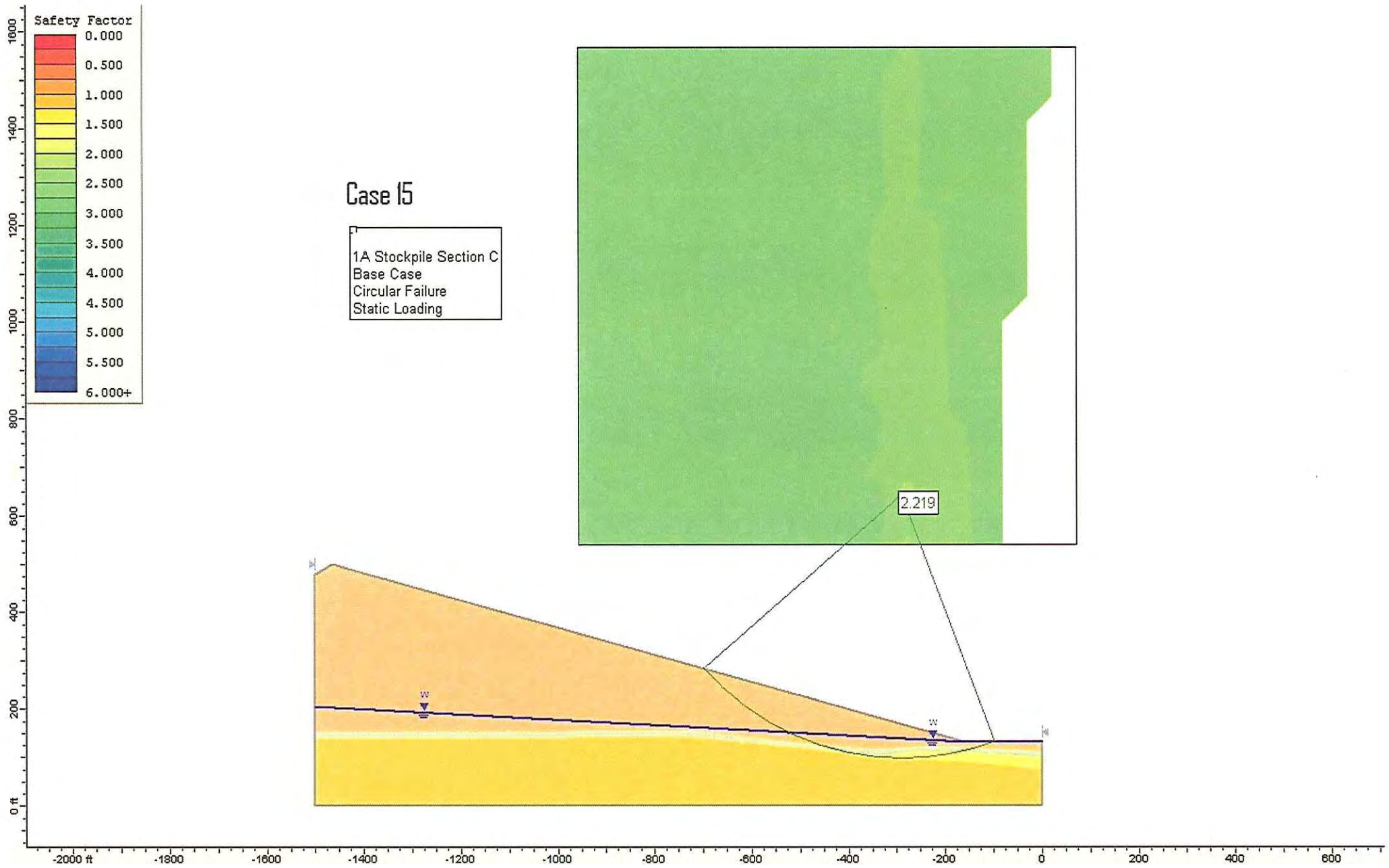
TITLE

No. 1A AND 1B STOCKPILES STABILITY SECTION LOCATIONS

Golder Associates
Tucson, Arizona

PROJECT No.		053–2550	FILE No.		0532550C001
DESIGN	GM	05/09/06	SCALE	AS SHOWN	REV. A
CADD	ANV	05/11/06	DRAWING		
CHECK	GM	05/11/06		1	
REVIEW	DAK	07/13/06			

Drawing file: 0532550C001.dwg Jul 14, 2006 - 10:07am


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 15
1A Stockpile Section C
Base Case
Circular Failure
Static Loading
2.219
1600
1400
1200
1000
800
600
400
200
0 ft
-2000 ft
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
600

Case 15
Slide Analysis Information
1A Stockpile Section C
Base Case, Static, Circular Failure

Document Name

File Name: Section C 1A.sli

Project Settings

Project Title: 1A Stockpile Section C
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Leached Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table

Custom Hu value: 1

Material: Interface Zone
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Qal
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gila Conglomerate
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: bishop simplified
FS: 2.218770
Center: -289.006, 641.869
Radius: 546.045
Left Slip Surface Endpoint: -700.866, 283.349
Right Slip Surface Endpoint: -98.862, 130.000
Resisting Moment=1.27888e+009 lb-ft
Driving Moment=5.76393e+008 lb-ft

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4130
Number of Invalid Surfaces: 721
Error Codes:
Error Code -103 reported for 168 surfaces
Error Code -108 reported for 124 surfaces
Error Code -1000 reported for 429 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections,

but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

List of All Coordinates

Search Grid

-956.671	539.152
70.505	539.152
70.505	1566.328
-956.671	1566.328

Material Boundary

-1500.000	140.000
-1200.000	140.000
-740.000	145.000
-455.000	115.000
-335.000	95.000
-265.000	95.000
-160.000	90.000
0.000	75.000

Material Boundary

-740.000	145.000
-335.000	105.000
-265.000	110.000
-160.000	110.000
0.000	100.000

Material Boundary

-1500.000	150.000
-1200.000	150.000
-740.000	155.000
-455.000	125.000
-335.000	115.000
-265.000	120.000
-160.000	120.000
0.000	110.000

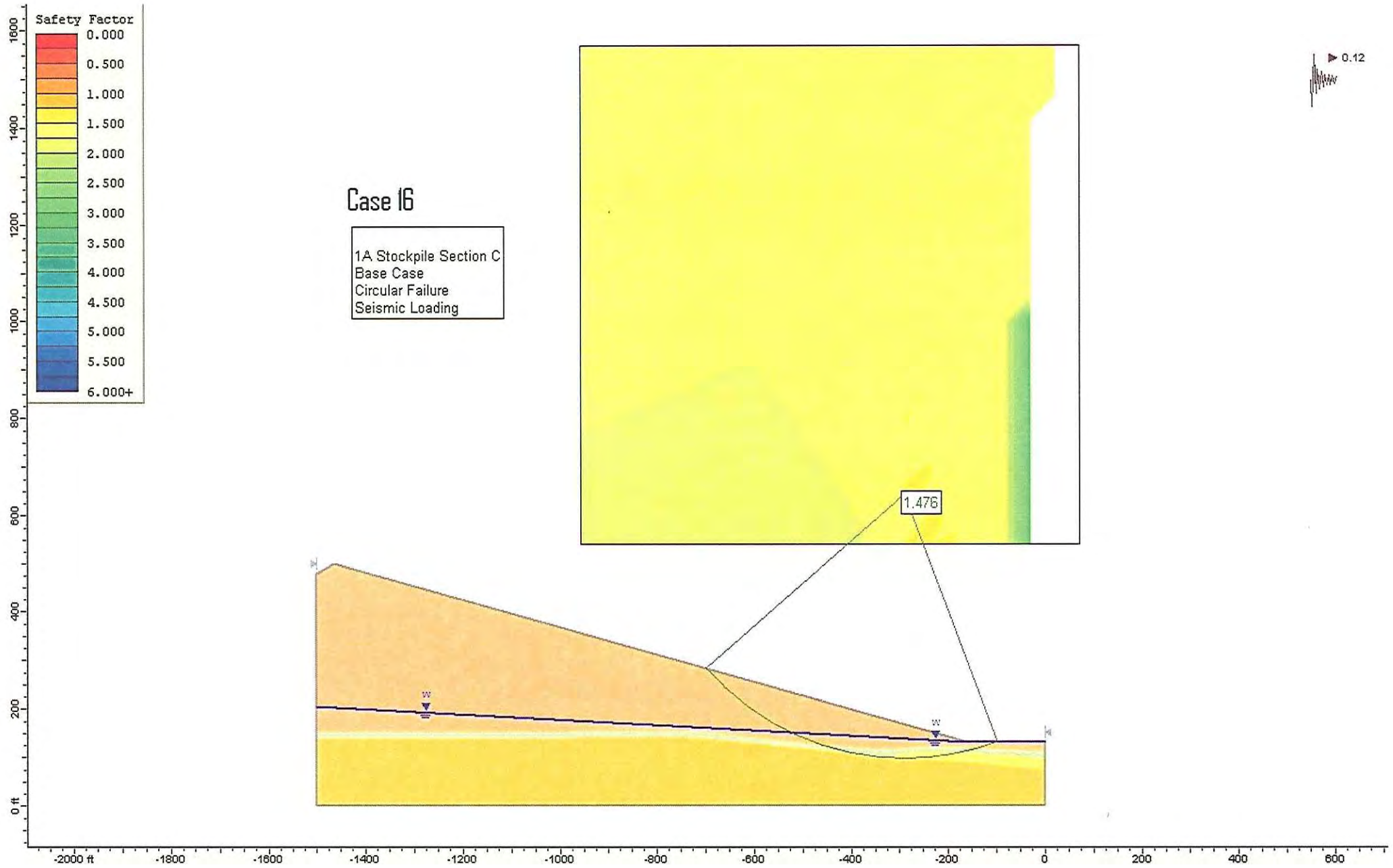
External Boundary

0.000	0.000
0.000	75.000
0.000	100.000
0.000	110.000

0.000	130.000
-160.000	130.000
-1465.000	500.000
-1500.000	480.000
-1500.000	205.000
-1500.000	150.000
-1500.000	140.000
-1500.000	0.000

Water Table

-1501.098	203.988
-160.000	130.000
0.000	130.000


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 16
1A Stockpile Section C
Base Case
Circular Failure
Seismic Loading
1.476
0.12
1600
1400
1200
1000
800
600
400
200
0 ft
-2000 ft
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
600

Case 16
Slide Analysis Information
1A Stockpile Section C
Base Case, Seismic Loading, Circular Failure

Document Name

File Name: Section C 1A.sli

Project Settings

Project Title: 1A Stockpile Section C
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Leached Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3

Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Interface Zone
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Qal
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gila Conglomerate
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: bishop simplified
FS: 1.475650
Center: -289.006, 641.869
Radius: 546.045
Left Slip Surface Endpoint: -700.866, 283.349
Right Slip Surface Endpoint: -98.862, 130.000
Resisting Moment=1.22428e+009 lb-ft
Driving Moment=8.29654e+008 lb-ft

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4254
Number of Invalid Surfaces: 597
Error Codes:
Error Code -103 reported for 168 surfaces
Error Code -1000 reported for 429 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections,
but one or more surface / nonslope external polygon
intersections lie between them. This usually occurs
when the slip surface extends past the bottom of the
soil region, but may also occur on a benched
slope model with two sets of Slope Limits.

-1000 = No valid slip surfaces are generated
at a grid center. Unable to draw a surface.

List of All Coordinates

Search Grid

-956.671	539.152
70.505	539.152
70.505	1566.328
-956.671	1566.328

Material Boundary

-1500.000	140.000
-1200.000	140.000
-740.000	145.000
-455.000	115.000
-335.000	95.000
-265.000	95.000
-160.000	90.000
0.000	75.000

Material Boundary

-740.000	145.000
-335.000	105.000
-265.000	110.000
-160.000	110.000
0.000	100.000

Material Boundary

-1500.000	150.000
-1200.000	150.000
-740.000	155.000
-455.000	125.000
-335.000	115.000
-265.000	120.000
-160.000	120.000
0.000	110.000

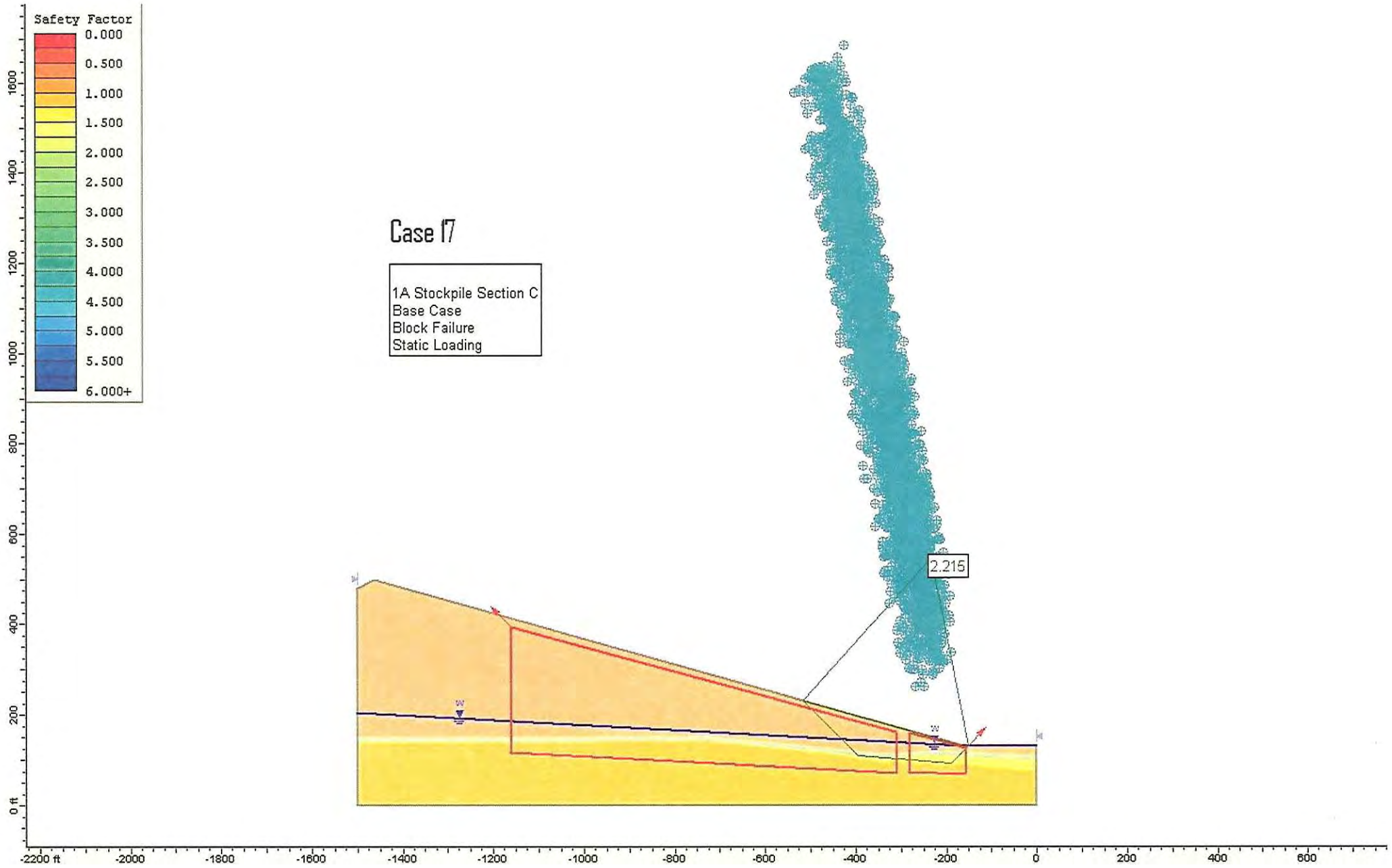
External Boundary

0.000	0.000
0.000	75.000
0.000	100.000
0.000	110.000
0.000	130.000
-160.000	130.000
-1465.000	500.000

-1500.000	480.000
-1500.000	205.000
-1500.000	150.000
-1500.000	140.000
-1500.000	0.000

Water Table

-1501.098	203.988
-160.000	130.000
0.000	130.000


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 17
1A Stockpile Section C
Base Case
Block Failure
Static Loading
2.215
1600
1400
1200
1000
800
600
400
200
0 ft
-2200 ft
-2000
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
600

Case 17
Slide Analysis Information
1A Stockpile Section C
Base Case, Block Failure, Static

Document Name

File Name: Section C 1A.sli

Project Settings

Project Title: 1A Stockpile Section C
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 135
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Leached Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3

Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Interface Zone
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Qal
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gila Conglomerate
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: bishop simplified
FS: 2.215290
Axis Location: -233.214, 546.396
Left Slip Surface Endpoint: -517.414, 231.336
Right Slip Surface Endpoint: -151.686, 130.000
Resisting Moment=5.23047e+008 lb-ft
Driving Moment=2.36108e+008 lb-ft

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4999
Number of Invalid Surfaces: 1
Error Codes:
Error Code -108 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment

or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

List of All Coordinates

Material Boundary

-1500.000	140.000
-1200.000	140.000
-740.000	145.000
-455.000	115.000
-335.000	95.000
-265.000	95.000
-160.000	90.000
0.000	75.000

Material Boundary

-740.000	145.000
-335.000	105.000
-265.000	110.000
-160.000	110.000
0.000	100.000

Material Boundary

-1500.000	150.000
-1200.000	150.000
-740.000	155.000
-455.000	125.000
-335.000	115.000
-265.000	120.000
-160.000	120.000
0.000	110.000

External Boundary

0.000	0.000
0.000	75.000
0.000	100.000
0.000	110.000
0.000	130.000
-160.000	130.000
-1465.000	500.000
-1500.000	480.000
-1500.000	205.000
-1500.000	150.000
-1500.000	140.000
-1500.000	0.000

Water Table

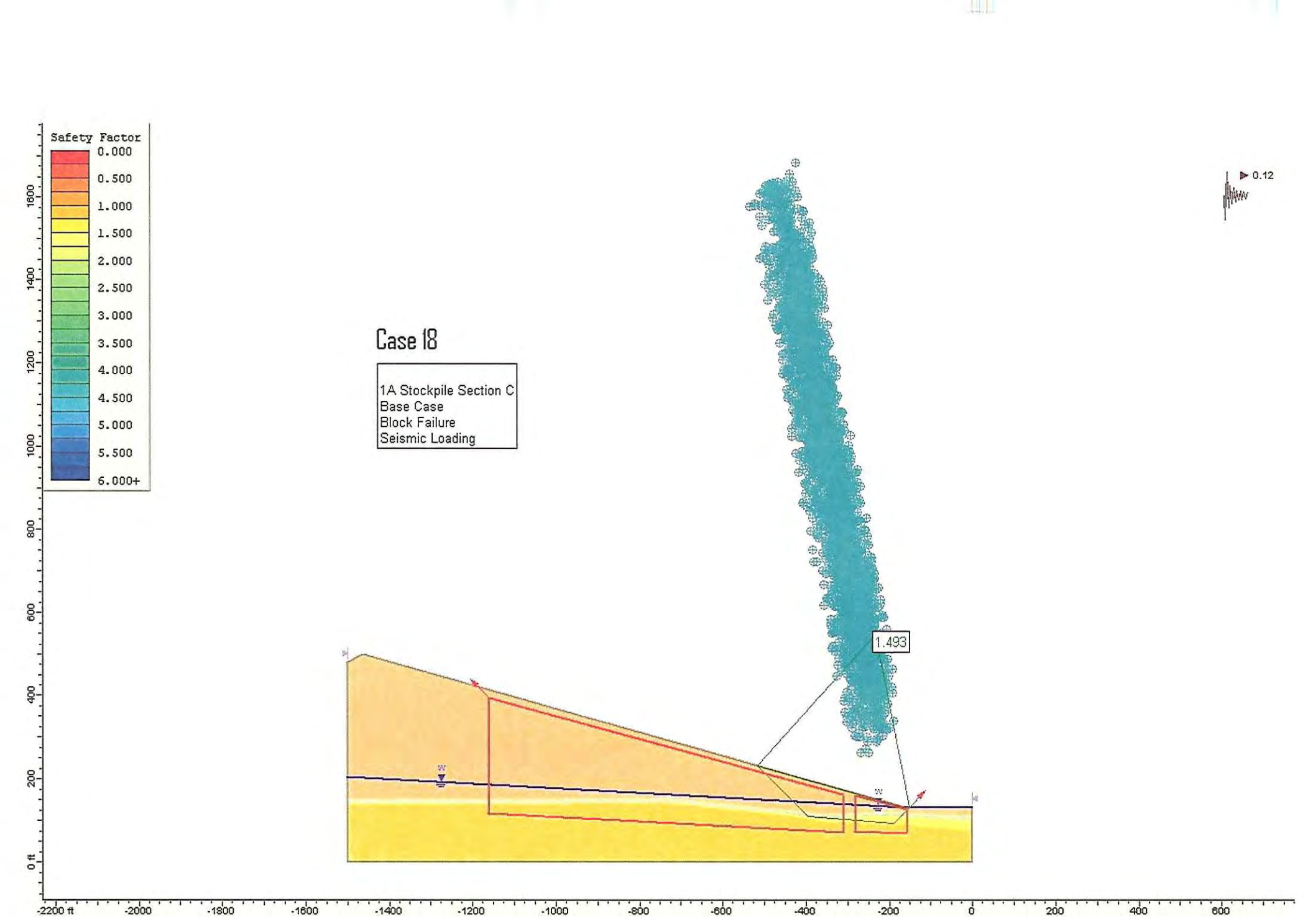
-1501.098	203.988
-160.000	130.000
0.000	130.000

Focus/Block Search Window

-156.089	125.999

-279.859 160.380
-282.151 72.519
-159.145 69.463

Focus/Block Search Window
-1160.146 393.824
-1162.118 117.739
-309.560 71.125
-310.998 163.133


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 18
1A Stockpile Section C
Base Case
Block Failure
Seismic Loading
0.12
1.493
1800
1400
1200
1000
800
600
400
200
0 ft
-2200 ft
-2000
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
600

Case 18
Slide Analysis Information
Base Case, Block Failure Mode
Seismic Loading

Document Name

File Name: Section C 1A.sli

Project Settings

Project Title: 1A Stockpile Section C
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 135
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Leached Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Interface Zone
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Qal
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gila Conglomerate
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: bishop simplified
FS: 1.493080
Axis Location: -233.214, 546.396
Left Slip Surface Endpoint: -517.414, 231.336
Right Slip Surface Endpoint: -151.686, 130.000
Resisting Moment=5.05092e+008 lb-ft
Driving Moment=3.38288e+008 lb-ft

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4999
Number of Invalid Surfaces: 1
Error Codes:
Error Code -108 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment
or total driving force < 0.1. This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

List of All Coordinates

Material Boundary

-1500.000	140.000
-1200.000	140.000
-740.000	145.000
-455.000	115.000
-335.000	95.000
-265.000	95.000
-160.000	90.000
0.000	75.000

Material Boundary

-740.000	145.000
-335.000	105.000
-265.000	110.000
-160.000	110.000
0.000	100.000

Material Boundary

-1500.000	150.000
-1200.000	150.000
-740.000	155.000
-455.000	125.000
-335.000	115.000
-265.000	120.000
-160.000	120.000
0.000	110.000

External Boundary

0.000	0.000
0.000	75.000
0.000	100.000
0.000	110.000
0.000	130.000
-160.000	130.000
-1465.000	500.000
-1500.000	480.000
-1500.000	205.000
-1500.000	150.000
-1500.000	140.000
-1500.000	0.000

Water Table

-1501.098	203.988
-160.000	130.000

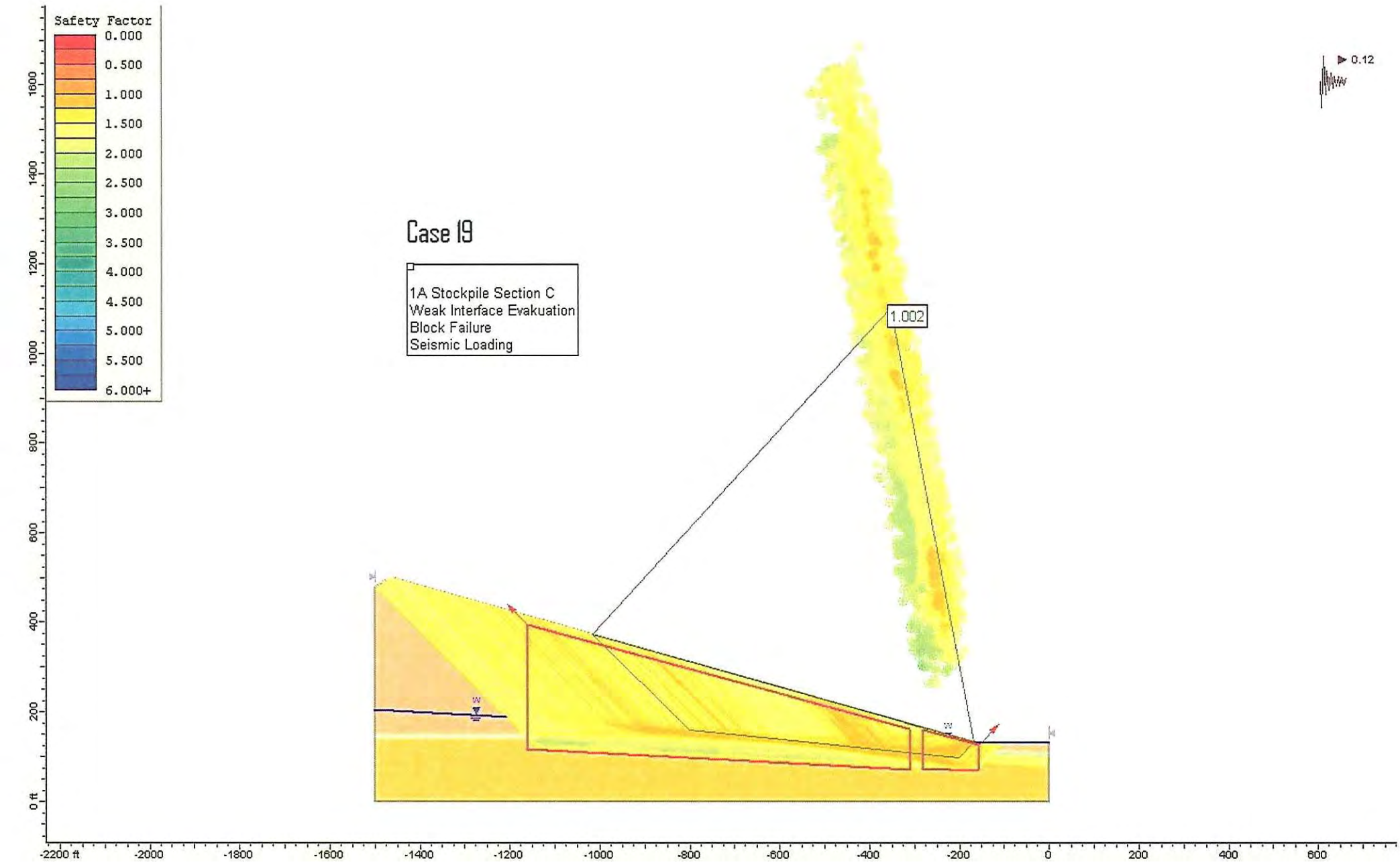
0.000	130.000

Focus/Block Search Window

-156.089	125.999
-279.859	160.380
-282.151	72.519
-159.145	69.463

Focus/Block Search Window

-1160.146	393.824
-1162.118	117.739
-309.560	71.125
-310.998	163.133


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 19
1A Stockpile Section C
Weak Interface Evakuation
Block Failure
Seismic Loading
1.002
0.12
1600
1400
1200
1000
800
600
400
200
0 ft
-2200 ft
-2000
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
600

Case 19
Slide Analysis Information
1A Stockpile Section C
Weak Interface Evaluation
Block Failure, Seismic Loading

Document Name

File Name: Section C 1A.sli

Project Settings

Project Title: 1A Stockpile Section C
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 135
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Leached Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Interface Zone
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 12 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Qal
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gila Conglomerate
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: bishop simplified
FS: 1.001720
Axis Location: -351.497, 1100.196
Left Slip Surface Endpoint: -1015.734, 372.622
Right Slip Surface Endpoint: -167.980, 132.262
Resisting Moment=3.00364e+009 lb-ft
Driving Moment=2.99848e+009 lb-ft

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4975
Number of Invalid Surfaces: 25
Error Codes:
Error Code -108 reported for 1 surface

Error Code -112 reported for 24 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment
or total driving force < 0.1. This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F)
< 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

List of All Coordinates

Material Boundary

-1500.000	140.000
-1200.000	140.000
-740.000	145.000
-455.000	115.000
-335.000	95.000
-265.000	95.000
-160.000	90.000
0.000	75.000

Material Boundary

-740.000	145.000
-335.000	105.000
-265.000	110.000
-160.000	110.000
0.000	100.000

Material Boundary

-1500.000	150.000
-1200.000	150.000
-740.000	155.000
-455.000	125.000
-335.000	115.000
-265.000	120.000
-160.000	120.000
0.000	110.000

External Boundary

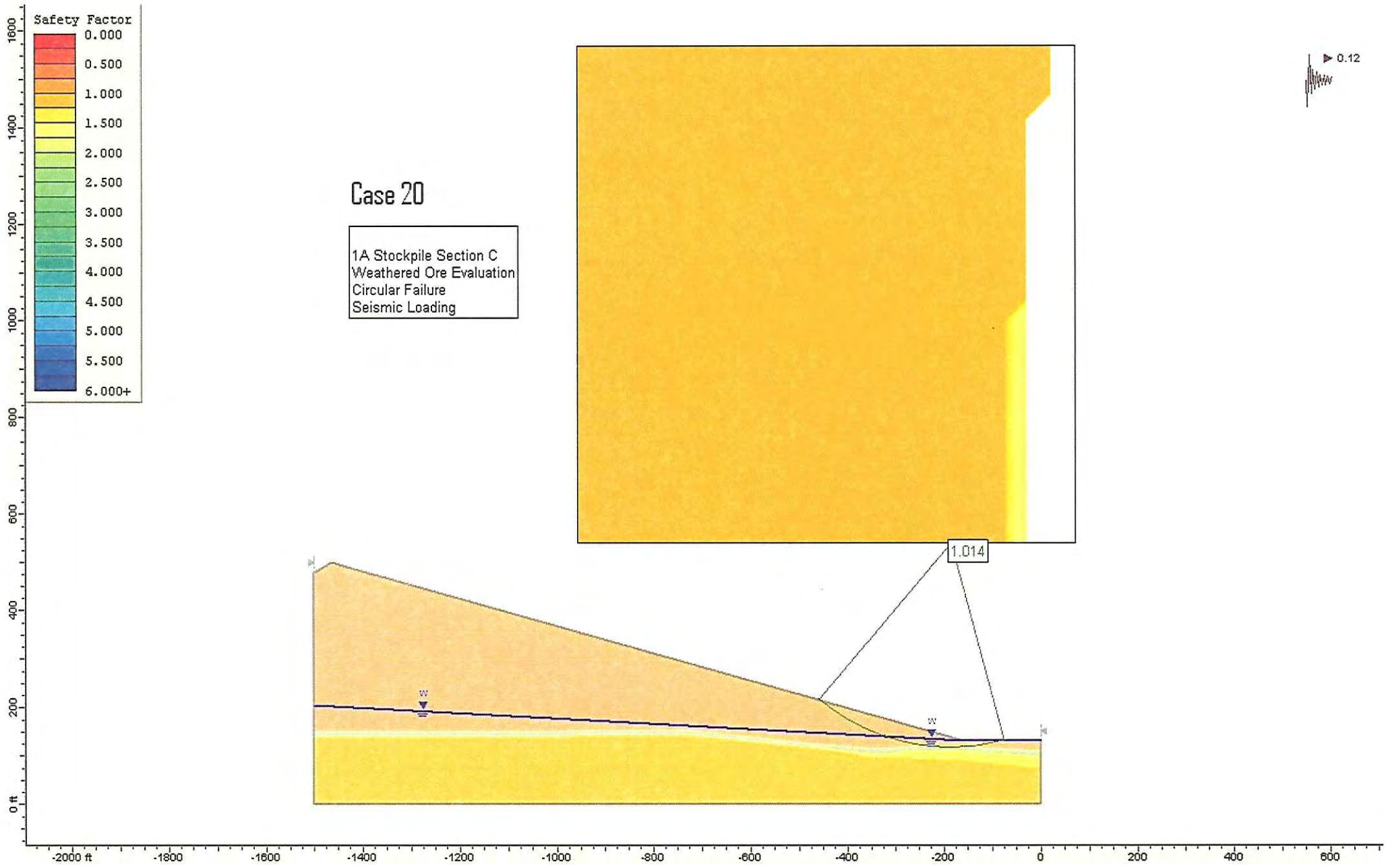
0.000	0.000
0.000	75.000
0.000	100.000
0.000	110.000
0.000	130.000
-160.000	130.000

-1465.000 500.000
-1500.000 480.000
-1500.000 205.000
-1500.000 150.000
-1500.000 140.000
-1500.000 0.000

Water Table
-1501.098 203.988
-160.000 130.000
0.000 130.000

Focus/Block Search Window
-156.089 125.999
-279.859 160.380
-282.151 72.519
-159.145 69.463

Focus/Block Search Window
-1160.146 393.824
-1162.118 117.739
-309.560 71.125
-310.998 163.133


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 20
1A Stockpile Section C
Weathered Ore Evaluation
Circular Failure
Seismic Loading
0.12
1.014
1600
1400
1200
1000
800
600
400
200
0 ft
-2000 ft
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
600

Case 20
Slide Analysis Information
Weathered Ore Evaluation
Seismic Loading, Circular Failure

Document Name

File Name: Section C 1A.sli

Project Settings

Project Title: 1A Stockpile Section C
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Leached Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3

Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 23.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Interface Zone
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 23.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Qal
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gila Conglomerate
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: bishop simplified
FS: 1.014350
Center: -186.289, 539.152
Radius: 423.694
Left Slip Surface Endpoint: -458.790, 214.714
Right Slip Surface Endpoint: -76.236, 130.000
Resisting Moment=1.65539e+008 lb-ft
Driving Moment=1.63198e+008 lb-ft

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4254
Number of Invalid Surfaces: 597
Error Codes:
Error Code -103 reported for 168 surfaces
Error Code -1000 reported for 429 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections,
but one or more surface / nonslope external polygon
intersections lie between them. This usually occurs
when the slip surface extends past the bottom of the
soil region, but may also occur on a benched
slope model with two sets of Slope Limits.

-1000 = No valid slip surfaces are generated
at a grid center. Unable to draw a surface.

List of All Coordinates

Search Grid

-956.671	539.152
70.505	539.152
70.505	1566.328
-956.671	1566.328

Material Boundary

-1500.000	140.000
-1200.000	140.000
-740.000	145.000
-455.000	115.000
-335.000	95.000
-265.000	95.000
-160.000	90.000
0.000	75.000

Material Boundary

-740.000	145.000
-335.000	105.000
-265.000	110.000
-160.000	110.000
0.000	100.000

Material Boundary

-1500.000	150.000
-1200.000	150.000
-740.000	155.000
-455.000	125.000
-335.000	115.000
-265.000	120.000
-160.000	120.000
0.000	110.000

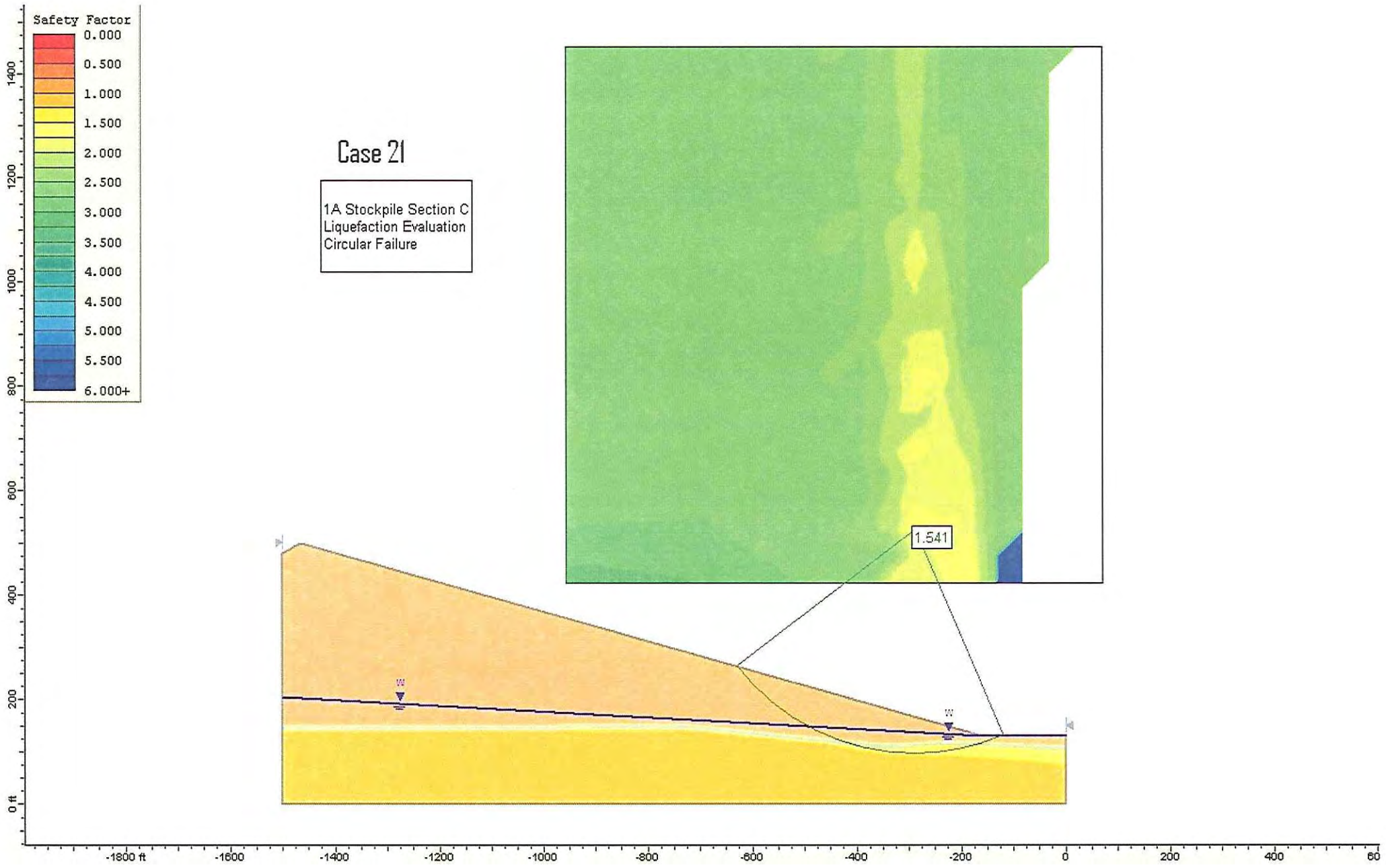
External Boundary

0.000	0.000
0.000	75.000
0.000	100.000
0.000	110.000
0.000	130.000
-160.000	130.000
-1465.000	500.000

-1500.000	480.000
-1500.000	205.000
-1500.000	150.000
-1500.000	140.000
-1500.000	0.000

Water Table

-1501.098	203.988
-160.000	130.000
0.000	130.000


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 21
1A Stockpile Section C
Liquefaction Evaluation
Circular Failure
1.541
W
W
1400
1200
1000
800
600
400
200
0 ft
-1800 ft
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
60

Case 21
Slide Analysis Information
1A Stockpile Section C
Liquefaction Evaluation
Circular Failure

Document Name

File Name: Section C 1A.sli

Project Settings

Project Title: 1A Stockpile Section C
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Leached Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf

Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Interface Zone
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Qal
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 8 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gila Conglomerate
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: bishop simplified
FS: 1.540580
Center: -289.006, 525.519
Radius: 430.601
Left Slip Surface Endpoint: -630.673, 263.447
Right Slip Surface Endpoint: -118.765, 130.000
Resisting Moment=5.70387e+008 lb-ft
Driving Moment=3.70243e+008 lb-ft

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 3944
Number of Invalid Surfaces: 907
Error Codes:
Error Code -103 reported for 283 surfaces
Error Code -108 reported for 173 surfaces
Error Code -1000 reported for 451 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

List of All Coordinates

Search Grid

-956.671	422.801
70.505	422.801
70.505	1449.978
-956.671	1449.978

Material Boundary

-1500.000	140.000
-1200.000	140.000
-740.000	145.000
-455.000	115.000
-335.000	95.000
-265.000	95.000
-160.000	90.000
0.000	75.000

Material Boundary

-740.000	145.000
-335.000	105.000
-265.000	110.000
-160.000	110.000
0.000	100.000

Material Boundary

-1500.000	150.000
-1200.000	150.000
-740.000	155.000
-455.000	125.000
-335.000	115.000
-265.000	120.000
-160.000	120.000
0.000	110.000

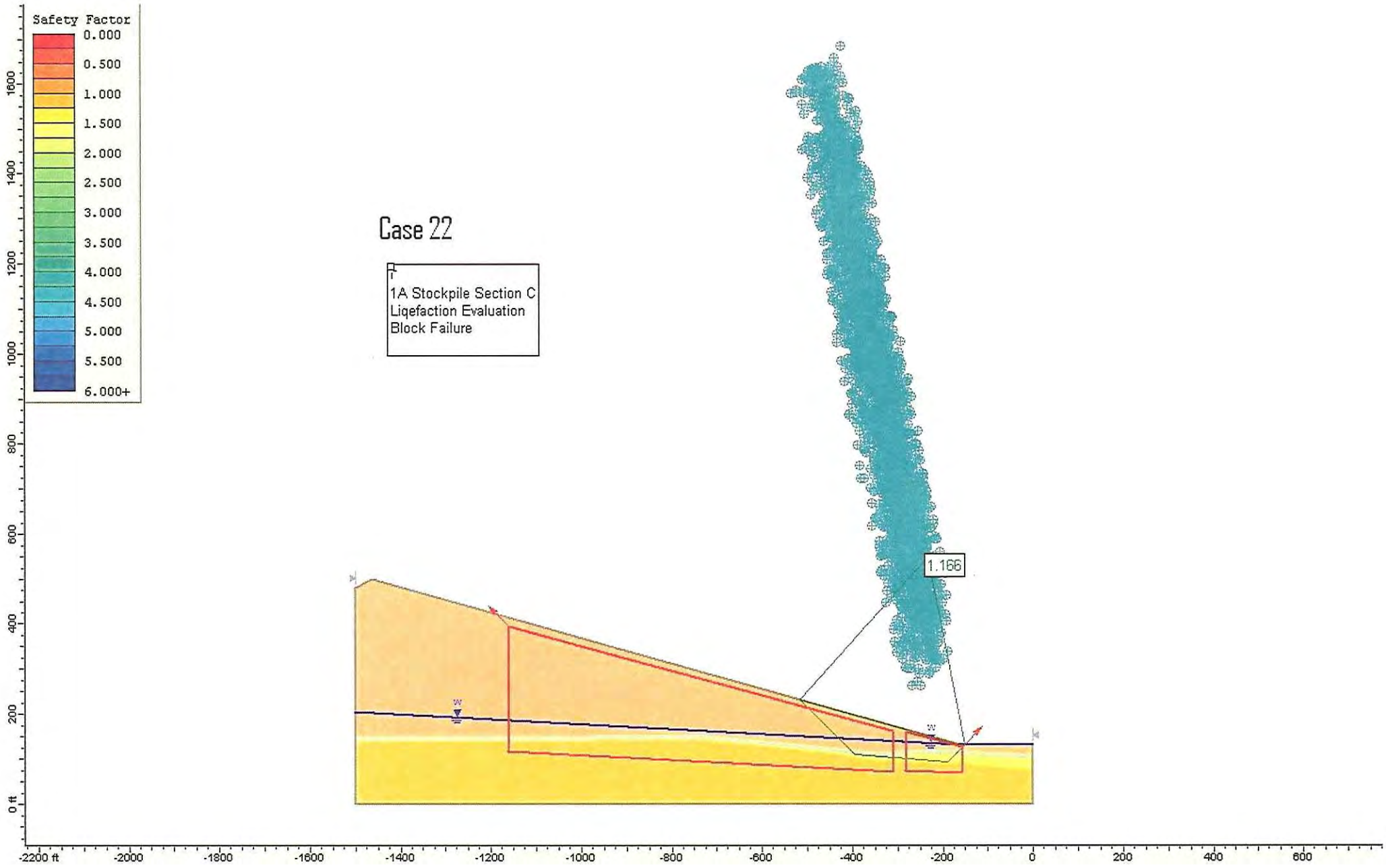
External Boundary

0.000	0.000
0.000	75.000

0.000	100.000
0.000	110.000
0.000	130.000
-160.000	130.000
-1465.000	500.000
-1500.000	480.000
-1500.000	205.000
-1500.000	150.000
-1500.000	140.000
-1500.000	0.000

Water Table

-1501.098	203.988
-160.000	130.000
0.000	130.000


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 22
1A Stockpile Section C
Liqefaction Evaluation
Block Failure
1.166
1600
1400
1200
1000
800
600
400
200
0 ft
-2200 ft
-2000
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
600

Case 22
Slide Analysis Information
1A Stockpile Section C
Liquefaction Evaluation
Block Failure

Document Name

File Name: Section C 1A.sli

Project Settings

Project Title: 1A Stockpile Section C
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 135
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Leached Ore
Strength Type: Mohr-Coulomb

Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Interface Zone
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Qal
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 8 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gila Conglomerate
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Custom Hu value: 1

Global Minimums

Method: bishop simplified
FS: 1.166230
Axis Location: -233.214, 546.396
Left Slip Surface Endpoint: -517.414, 231.336
Right Slip Surface Endpoint: -151.686, 130.000
Resisting Moment=2.53991e+008 lb-ft
Driving Moment=2.17789e+008 lb-ft

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4999
Number of Invalid Surfaces: 1
Error Codes:
Error Code -108 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment
or total driving force < 0.1. This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

List of All Coordinates

Material Boundary

-1500.000	140.000
-1200.000	140.000
-740.000	145.000
-455.000	115.000
-335.000	95.000
-265.000	95.000
-160.000	90.000
0.000	75.000

Material Boundary

-740.000	145.000
-335.000	105.000
-265.000	110.000
-160.000	110.000
0.000	100.000

Material Boundary

-1500.000	150.000
-1200.000	150.000
-740.000	155.000
-455.000	125.000
-335.000	115.000
-265.000	120.000
-160.000	120.000
0.000	110.000

External Boundary

0.000	0.000
0.000	75.000
0.000	100.000
0.000	110.000
0.000	130.000
-160.000	130.000
-1465.000	500.000
-1500.000	480.000
-1500.000	205.000
-1500.000	150.000
-1500.000	140.000
-1500.000	0.000

Water Table

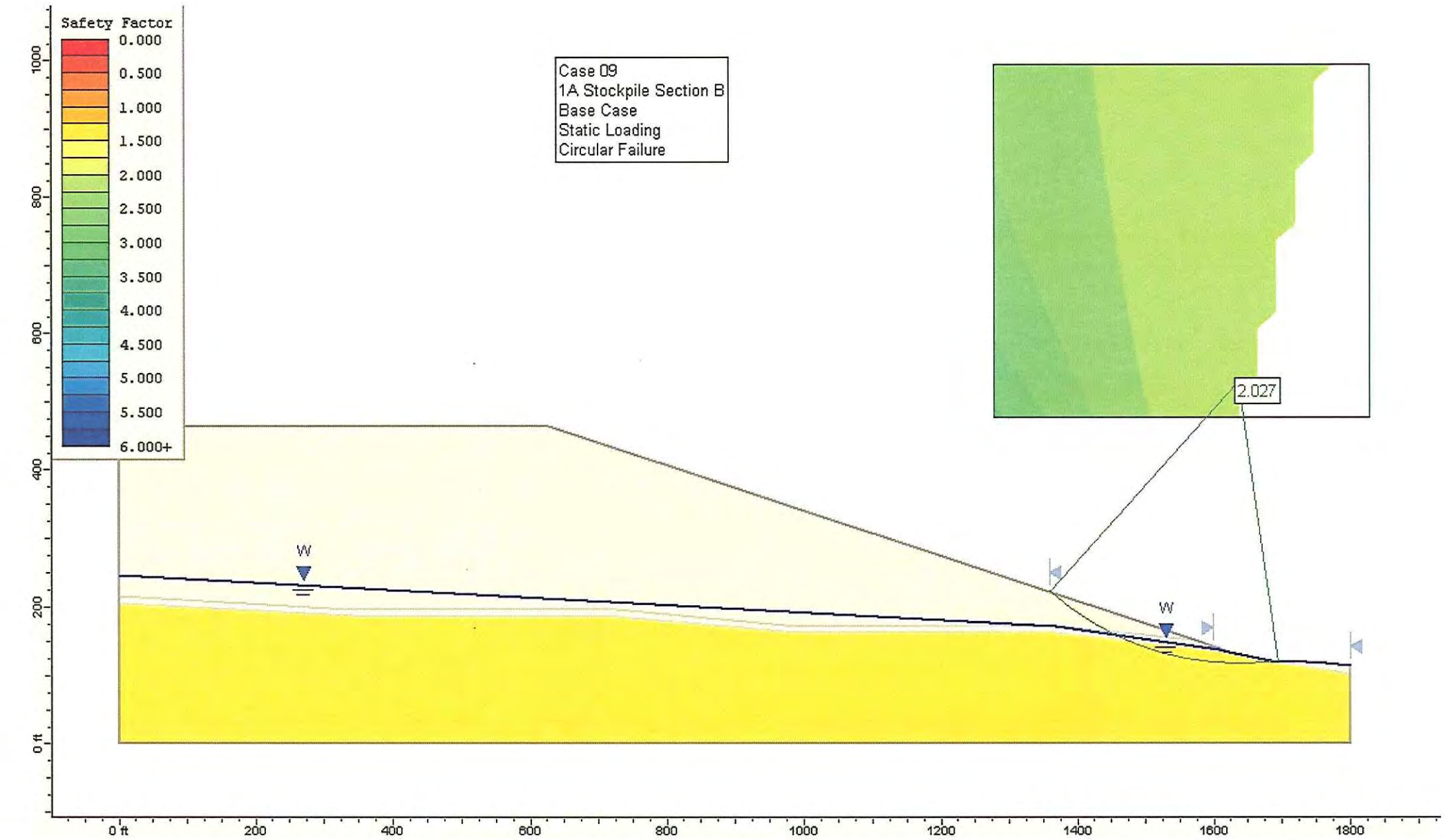
-1501.098	203.988
-160.000	130.000
0.000	130.000

Focus/Block Search Window

-156.089	125.999
-279.859	160.380
-282.151	72.519
-159.145	69.463

Focus/Block Search Window

-1160.146	393.824
-1162.118	117.739
-309.560	71.125
-310.998	163.133


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 09
1A Stockpile Section B
Base Case
Static Loading
Circular Failure
2.027
W
W
1000
800
600
400
200
0 ft
0 ft
200
400
600
800
1000
1200
1400
1600
1800

Case 9
Slide Analysis Information
1A Stockpile Section B
Base Case, Circular Failure, Static

Document Name

File Name: Case 09.Section B.1A-base case-static-circ.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: leached ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Hu value: automatically calculated

Material: Gila Conglomerate
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Hu value: automatically calculated

List of All Coordinates

Material Boundary

1696.449	118.162
1800.000	100.038

Material Boundary

0.234	205.221
338.078	186.290
726.717	185.549
990.151	161.290
1367.408	161.290
1607.438	136.290
1620.762	133.538

Material Boundary

0.234	215.237
338.368	196.290
727.186	195.549
990.610	171.290
1367.928	171.290
1570.940	150.146

Material Boundary

0.000	205.233
0.234	205.221

Material Boundary

0.000	215.255
0.234	215.237

External Boundary

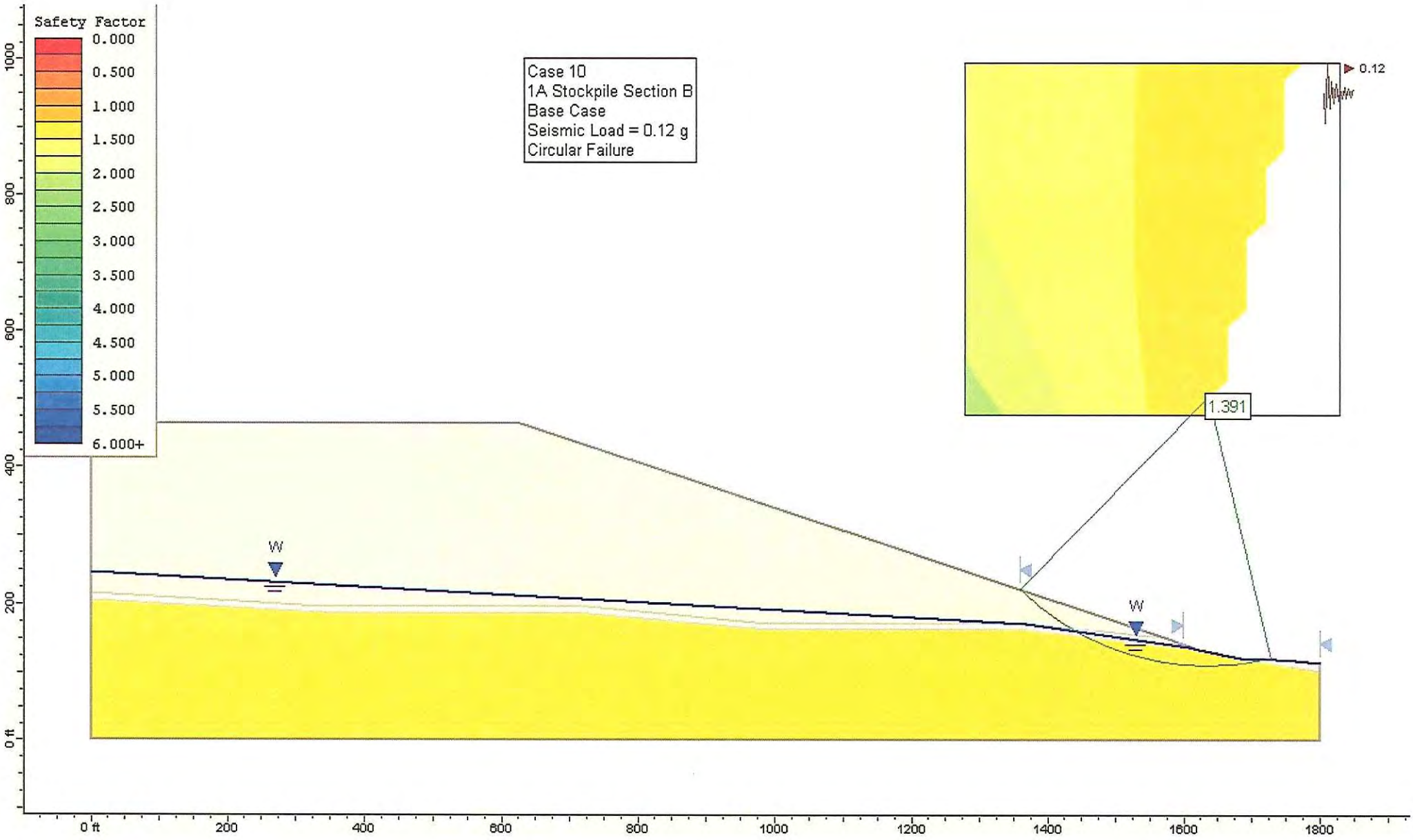
1620.762	133.538
1570.940	150.146
628.045	464.444
0.000	463.183
0.000	215.255
0.000	205.233
0.000	0.000
1800.000	0.000
1800.000	100.038
1800.000	114.036
1762.612	116.290
1708.220	119.625
1696.449	118.162
1682.558	120.776

Water Table

0.000	245.727
1367.928	171.290
1607.438	136.290
1620.762	133.538
1682.558	120.776
1696.449	118.162
1708.220	119.625
1762.612	116.290
1800.000	114.036

Search Grid

1277.264	476.618
1828.274	476.618
1828.274	992.694
1277.264	992.694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0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 10
1A Stockpile Section B
Base Case
Seismic Load = 0.12 g
Circular Failure
0.12
1.391
W
W
1000
800
600
400
200
0 ft
0 ft
200
400
600
800
1000
1200
1400
1600
1800

Case 10
Slide Analysis Information
1A Stockpile Section B
Base Case, Circular Failure, Seismic

Document Name

File Name: Case 10.Section B.1A-base case-ps.static-circ.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: leached ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3

Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Hu value: automatically calculated

Material: Gila Conglomerate
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Hu value: automatically calculated

List of All Coordinates

Material Boundary

1696.449	118.162
1800.000	100.038

Material Boundary

0.234	205.221
338.078	186.290
726.717	185.549
990.151	161.290
1367.408	161.290
1607.438	136.290
1620.762	133.538

Material Boundary

0.234	215.237
338.368	196.290
727.186	195.549
990.610	171.290
1367.928	171.290
1570.940	150.146

Material Boundary

0.000	205.233
0.234	205.221

Material Boundary

0.000	215.255
0.234	215.237

External Boundary

1620.762	133.538
1570.940	150.146
628.045	464.444
0.000	463.183
0.000	215.255
0.000	205.233
0.000	0.000
1800.000	0.000
1800.000	100.038

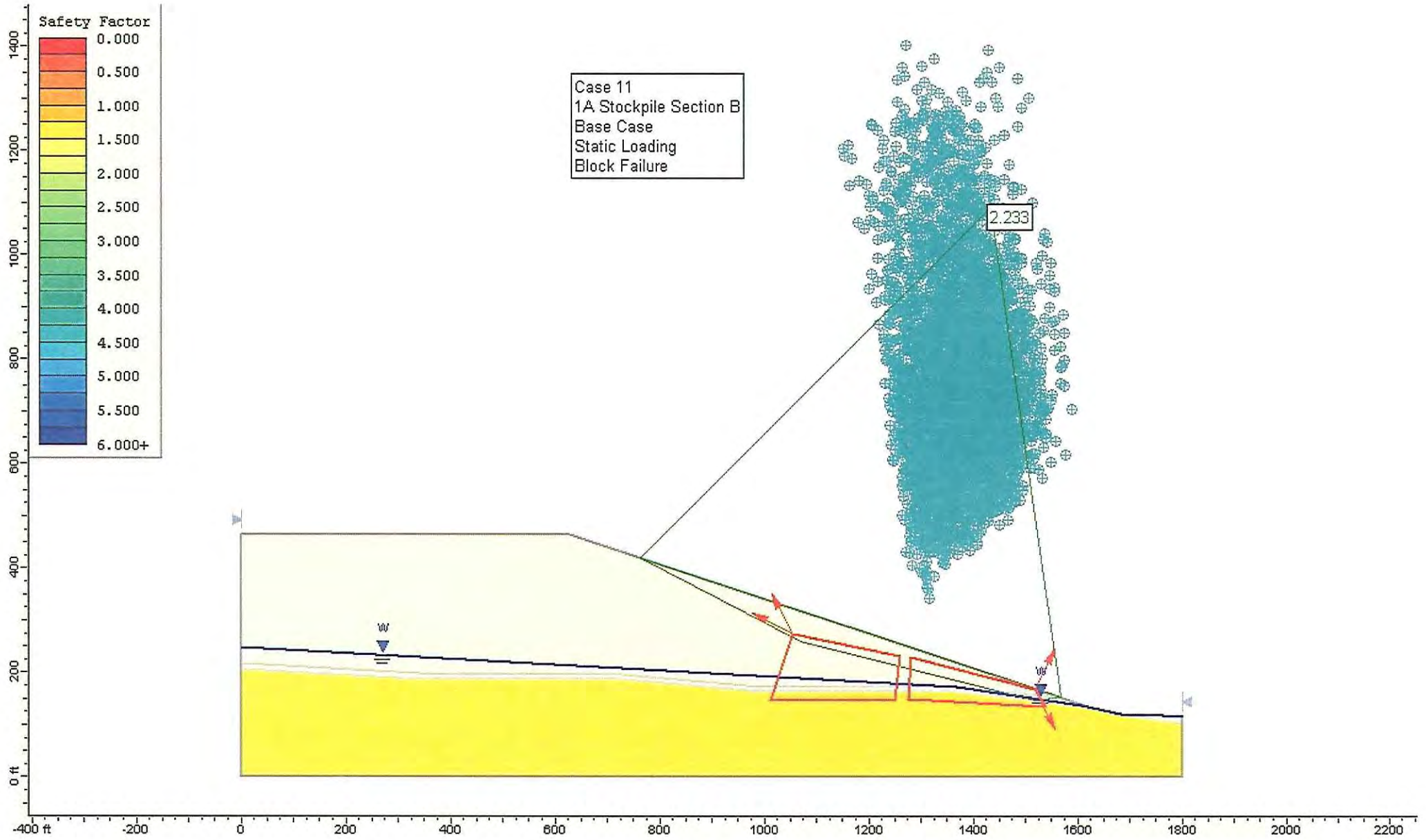
1800.000	114.036
1762.612	116.290
1708.220	119.625
1696.449	118.162
1682.558	120.776

Water Table

0.000	245.727
1367.928	171.290
1607.438	136.290
1620.762	133.538
1682.558	120.776
1696.449	118.162
1708.220	119.625
1762.612	116.290
1800.000	114.036

Search Grid

1277.264	476.618
1828.274	476.618
1828.274	992.694
1277.264	992.694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0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 11
1A Stockpile Section B
Base Case
Static Loading
Block Failure
2.233
W
W
1400
1200
1000
800
600
400
200
0 ft
-400 ft
-200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200

Case 11
Slide Analysis Information
1A Stockpile Section B
Base Case, Block Failure, Static

Document Name

File Name: Case 11.Section B.1A-base case-static-block.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 152.75
Left Projection Angle (End Angle): 117.25
Right Projection Angle (Start Angle): 62.75
Right Projection Angle (End Angle): -62.75
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: leached ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf

Friction Angle: 35.5 degrees
Water Surface: Water Table
Hu value: automatically calculated

Material: Gila Conglomerate
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Hu value: automatically calculated

List of All Coordinates

Material Boundary

1696.449	118.162
1800.000	100.038

Material Boundary

0.234	205.221
338.078	186.290
726.717	185.549
990.151	161.290
1367.408	161.290
1607.438	136.290
1620.762	133.538

Material Boundary

0.234	215.237
338.368	196.290
727.186	195.549
990.610	171.290
1367.928	171.290
1570.940	150.146

Material Boundary

0.000	205.233
0.234	205.221

Material Boundary

0.000	215.255
0.234	215.237

External Boundary

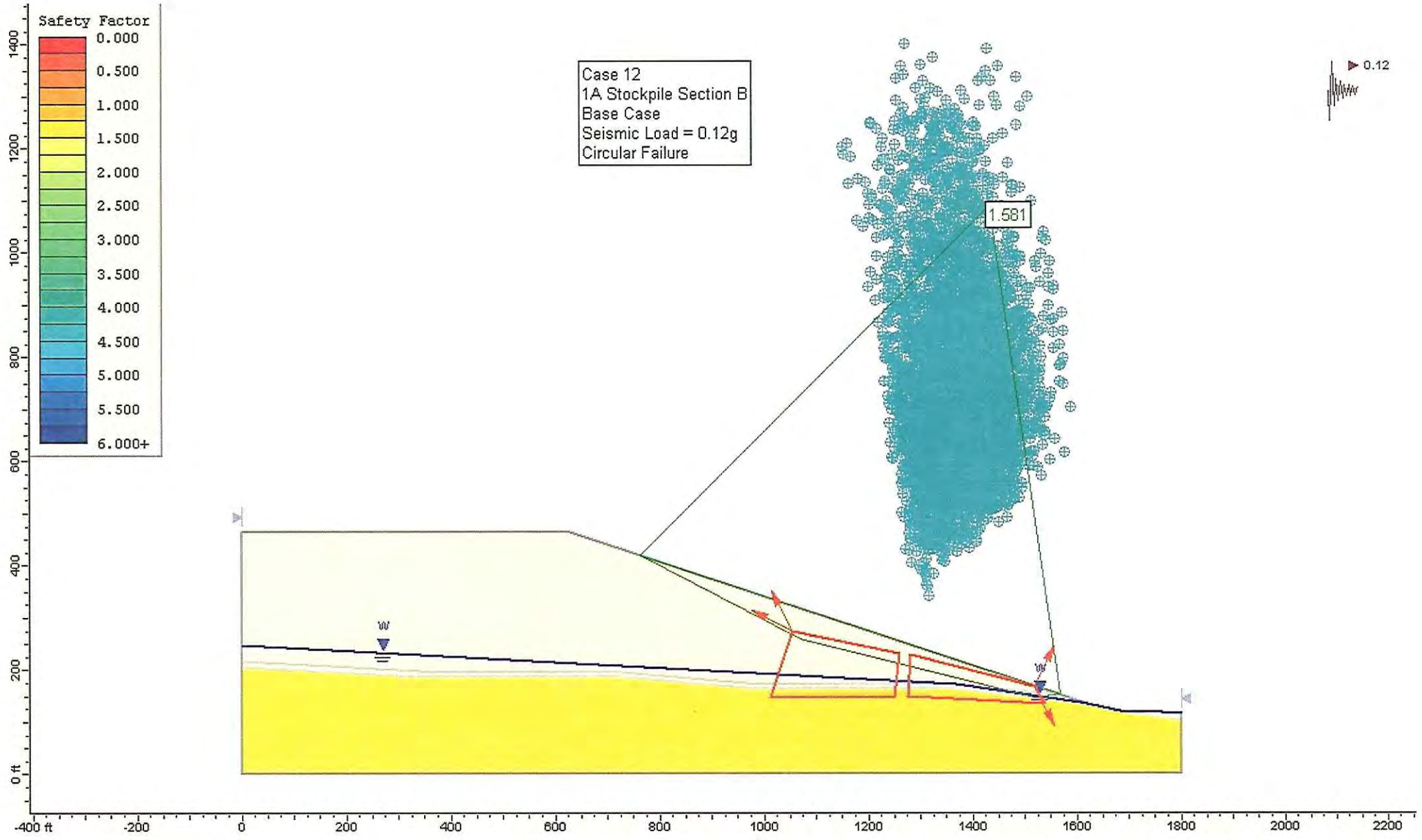
1620.762	133.538
1570.940	150.146
628.045	464.444
0.000	463.183
0.000	215.255
0.000	205.233
0.000	0.000
1800.000	0.000
1800.000	100.038
1800.000	114.036
1762.612	116.290

1708.220 119.625
1696.449 118.162
1682.558 120.776

Water Table
0.000 245.727
1367.928 171.290
1607.438 136.290
1620.762 133.538
1682.558 120.776
1696.449 118.162
1708.220 119.625
1762.612 116.290
1800.000 114.036

Focus/Block Search Window
1055.360 273.333
1011.730 145.981
1250.159 145.368
1259.211 231.013

Focus/Block Search Window
1281.492 227.531
1276.618 146.761
1539.889 133.461
1519.024 167.451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0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 12
1A Stockpile Section B
Base Case
Seismic Load = 0.12g
Circular Failure
1.581
0.12
1400
1200
1000
800
600
400
200
0 ft
-400 ft
-200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200

Case 12
Slide Analysis Information
1A Stockpile Section B
Base Case, Block Failure, Seismic

Document Name

File Name: Case 12.Section B.1A-base case-ps.static-block.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 152.75
Left Projection Angle (End Angle): 117.25
Right Projection Angle (Start Angle): 62.75
Right Projection Angle (End Angle): -62.75
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: leached ore

Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Hu value: automatically calculated

Material: Gila Conglomerate
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Hu value: automatically calculated

List of All Coordinates

Material Boundary

1696.449	118.162
1800.000	100.038

Material Boundary

0.234	205.221
338.078	186.290
726.717	185.549
990.151	161.290
1367.408	161.290
1607.438	136.290
1620.762	133.538

Material Boundary

0.234	215.237
338.368	196.290
727.186	195.549
990.610	171.290
1367.928	171.290
1570.940	150.146

Material Boundary

0.000	205.233
0.234	205.221

Material Boundary

0.000	215.255
0.234	215.237

External Boundary

1620.762	133.538
1570.940	150.146
628.045	464.444
0.000	463.183
0.000	215.255
0.000	205.233
0.000	0.000

1800.000	0.000
1800.000	100.038
1800.000	114.036
1762.612	116.290
1708.220	119.625
1696.449	118.162
1682.558	120.776

Water Table

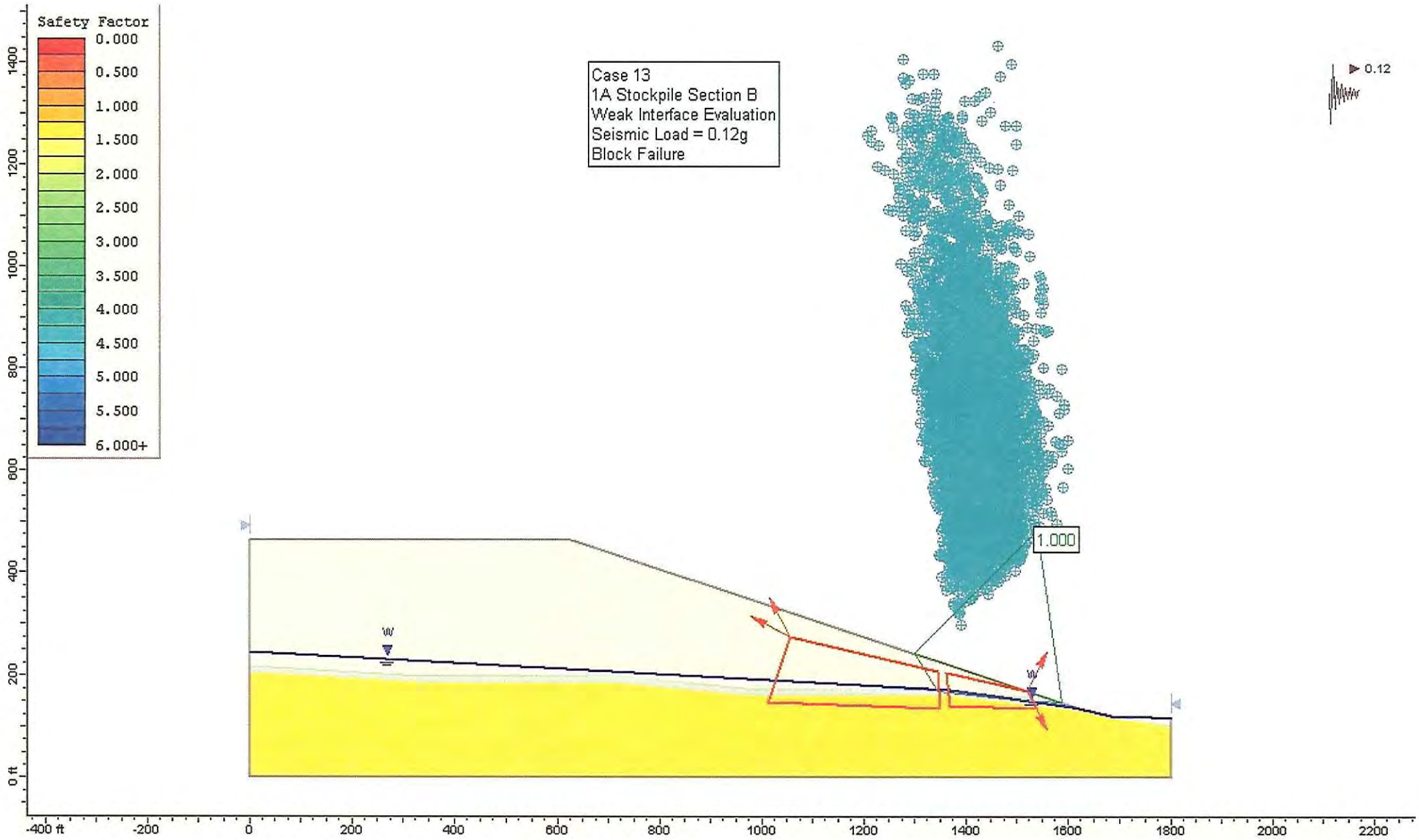
0.000	245.727
1367.928	171.290
1607.438	136.290
1620.762	133.538
1682.558	120.776
1696.449	118.162
1708.220	119.625
1762.612	116.290
1800.000	114.036

Focus/Block Search Window

1055.360	273.333
1011.730	145.981
1250.159	145.368
1259.211	231.013

Focus/Block Search Window

1281.492	227.531
1276.618	146.761
1539.889	133.461
1519.024	167.451


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 13
1A Stockpile Section B
Weak Interface Evaluation
Seismic Load = 0.12g
Block Failure
0.12
1.000
0 ft
200
400
600
800
1000
1200
1400
-400 ft
-200
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200

Case 13
Slide Analysis Information
1A Stockpile Section B
Weak Interface Evaluation,
Block Failure, Static

Document Name

File Name: Case 13.Section B.1A- wk int case-ps.static-block.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 152.75
Left Projection Angle (End Angle): 117.25
Right Projection Angle (Start Angle): 62.75
Right Projection Angle (End Angle): -62.75
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: leached ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Hu value: automatically calculated

Material: Interface Zone
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 18.1 degrees
Water Surface: Water Table
Hu value: automatically calculated

Material: Gila Conglomerate
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Hu value: automatically calculated

List of All Coordinates

Material Boundary

1696.449	118.162
1800.000	100.038

Material Boundary

0.234	205.221
338.078	186.290
726.717	185.549
990.151	161.290
1367.408	161.290
1607.438	136.290
1620.762	133.538

Material Boundary

0.234	215.237
338.368	196.290
727.186	195.549
990.610	171.290
1367.928	171.290
1570.940	150.146

Material Boundary

0.000	205.233
0.234	205.221

Material Boundary

0.000	215.255
0.234	215.237

External Boundary

1620.762	133.538
1570.940	150.146
628.045	464.444
0.000	463.183
0.000	215.255
0.000	205.233
0.000	0.000
1800.000	0.000
1800.000	100.038
1800.000	114.036
1762.612	116.290
1708.220	119.625
1696.449	118.162
1682.558	120.776

Water Table

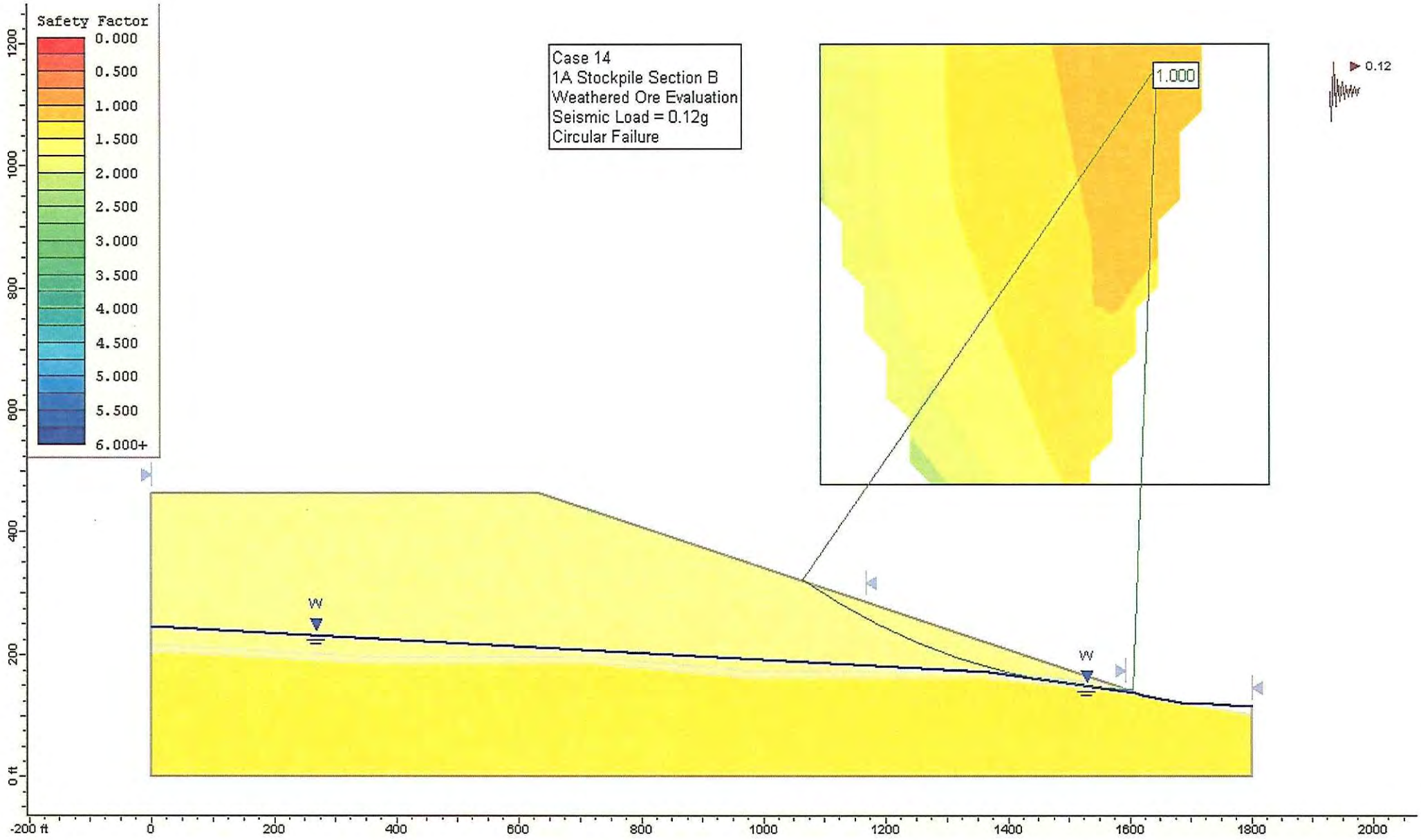
0.000	245.727
1367.928	171.290
1607.438	136.290
1620.762	133.538
1682.558	120.776
1696.449	118.162
1708.220	119.625
1762.612	116.290
1800.000	114.036

Focus/Block Search Window

1055.360	273.333
1011.730	145.981
1348.931	135.181
1344.132	205.791

Focus/Block Search Window

1361.271	203.049
1368.811	139.294
1539.889	133.461
1519.024	167.451


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 14
1A Stockpile Section B
Weathered Ore Evaluation
Seismic Load = 0.12g
Circular Failure
1.000
0.12
W
W
1200
1000
800
600
400
200
0 ft
-200 ft
0
200
400
600
800
1000
1200
1400
1600
1800
2000

Case 14
Slide Analysis Information
1A Stockpile Section B
Weathered Ore Evaluation
Circular Failure, Seismic

Document Name

File Name: Case 14.Section B.1A-weath ore case-ps.static-circ.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: leached ore
Strength Type: Mohr-Coulomb

Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Hu value: automatically calculated

Material: Gila Conglomerate
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Hu value: automatically calculated

Material: Weathered ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 24.78 degrees
Water Surface: Water Table
Hu value: automatically calculated

List of All Coordinates

Material Boundary

1696.449	118.162
1800.000	100.038

Material Boundary

0.234	205.221
338.078	186.290
726.717	185.549
990.151	161.290
1367.408	161.290
1607.438	136.290
1620.762	133.538

Material Boundary

0.234	215.237
338.368	196.290
727.186	195.549
990.610	171.290
1367.928	171.290
1570.940	150.146

Material Boundary

0.000	205.233
0.234	205.221

Material Boundary

0.000	215.255
0.234	215.237

External Boundary

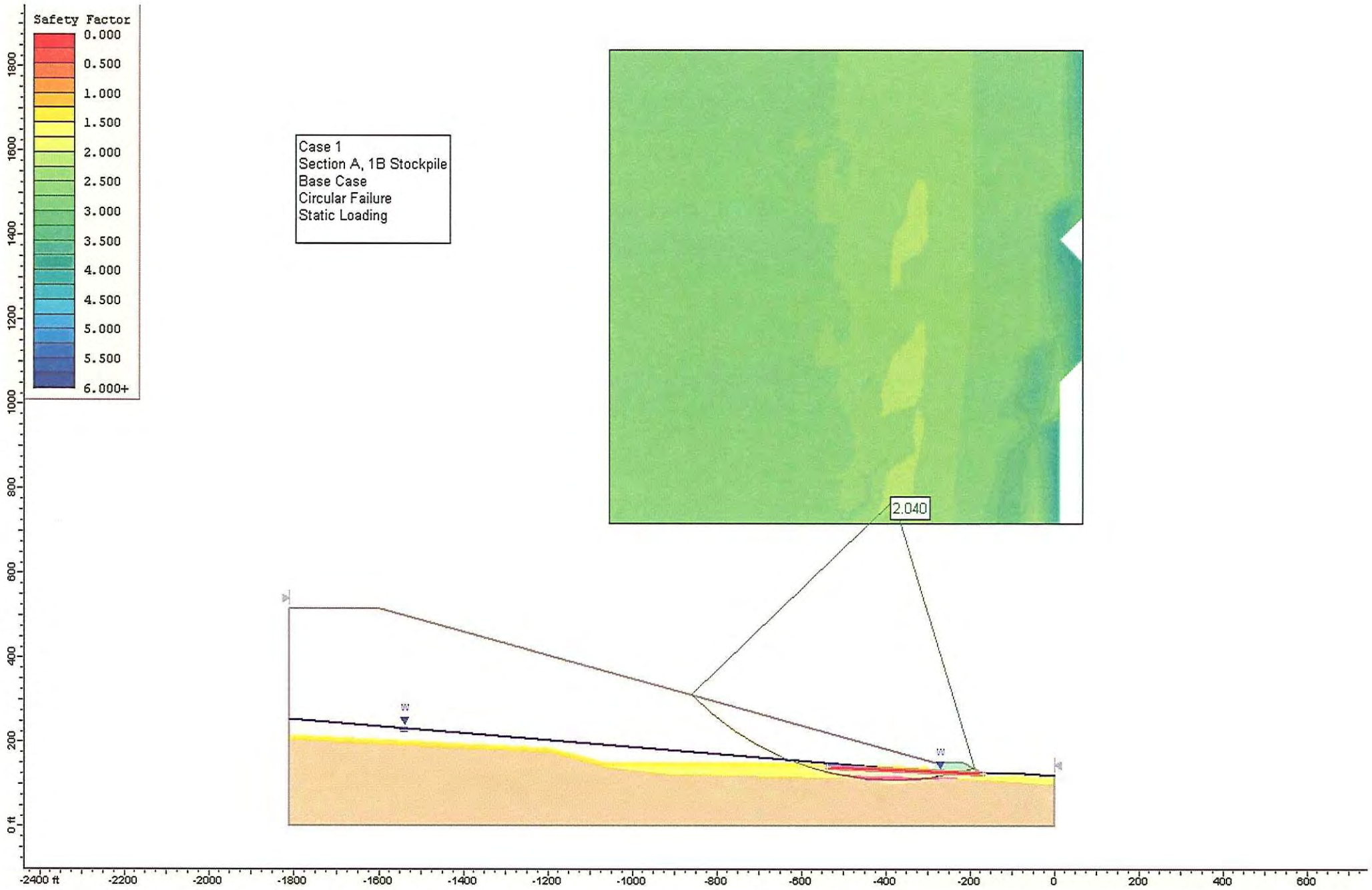
1620.762	133.538
1570.940	150.146
628.045	464.444
0.000	463.183
0.000	215.255
0.000	205.233
0.000	0.000
1800.000	0.000
1800.000	100.038
1800.000	114.036
1762.612	116.290
1708.220	119.625
1696.449	118.162
1682.558	120.776

Water Table

0.000	245.727
1367.928	171.290
1607.438	136.290
1620.762	133.538
1682.558	120.776
1696.449	118.162
1708.220	119.625
1762.612	116.290
1800.000	114.036

Search Grid

1092.111	476.618
1828.274	476.618
1828.274	1197.147
1092.111	1197.147


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 1
Section A, 1B Stockpile
Base Case
Circular Failure
Static Loading
2.040
1800
1600
1400
1200
1000
800
600
400
200
0 ft
-2400 ft
-2200
-2000
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
600

Case 1
Slide Analysis Information
1B Stockpile Section A
Base case, static loading

Document Name

File Name: section a1b.sli

Project Settings

Project Title: 1B Stockpile Section A
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Leached Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees

Water Surface: Water Table
Custom Hu value: 1

Material: Qal
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Granualt Fill
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Structural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gila Fm
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Interface Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Soft Clayey Fill
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 15 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: BX 1500 Geogrid
BX 1500 Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Parallel to Reinforcement
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 1650 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: bishop simplified
FS: 2.039940
Center: -382.440, 773.180
Radius: 664.992
Left Slip Surface Endpoint: -860.759, 311.199
Right Slip Surface Endpoint: -190.619, 136.455
Resisting Moment=1.64866e+009 lb-ft
Driving Moment=8.08193e+008 lb-ft

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4505
Number of Invalid Surfaces: 346
Error Codes:
Error Code -103 reported for 224 surfaces
Error Code -106 reported for 56 surfaces
Error Code -1000 reported for 66 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections,
but one or more surface / nonslope external polygon
intersections lie between them. This usually occurs
when the slip surface extends past the bottom of the
soil region, but may also occur on a benched
slope model with two sets of Slope Limits.

-106 = Average slice width is less than
0.0001 * (maximum horizontal extent of soil region).
This limitation is imposed to avoid numerical errors
which may result from too many slices, or too
small a slip region.

-1000 = No valid slip surfaces are generated
at a grid center. Unable to draw a surface.

List of All Coordinates

Search Grid

-1054.800	717.150
65.799	717.150
65.799	1837.748
-1054.800	1837.748

Material Boundary

-280.000	150.000
-300.000	130.000
-170.000	125.000

Material Boundary

-1810.000	205.000
-1195.000	175.000
-1060.000	140.000
-620.000	140.000
-540.000	140.000
-300.000	130.000

Material Boundary

-620.000	140.000
-490.000	115.000
-380.000	100.000
-230.000	115.000
-229.891	115.007
-70.000	125.000

Material Boundary

-230.000	115.000
0.000	100.000

Material Boundary

-1060.000	140.000
-920.000	125.000
-490.000	115.000

Material Boundary

-1810.000	215.000
-1195.000	185.000
-1060.000	150.000
-620.000	150.000
-540.000	150.000
-300.000	140.000
-300.000	130.000

Material Boundary

-558.792	129.097
-434.529	116.904
-358.903	116.904
-230.761	115.007
-229.891	115.007
-229.880	115.007

Material Boundary

-558.792	129.097
-434.625	107.962
-358.891	107.962
-230.761	115.007

External Boundary

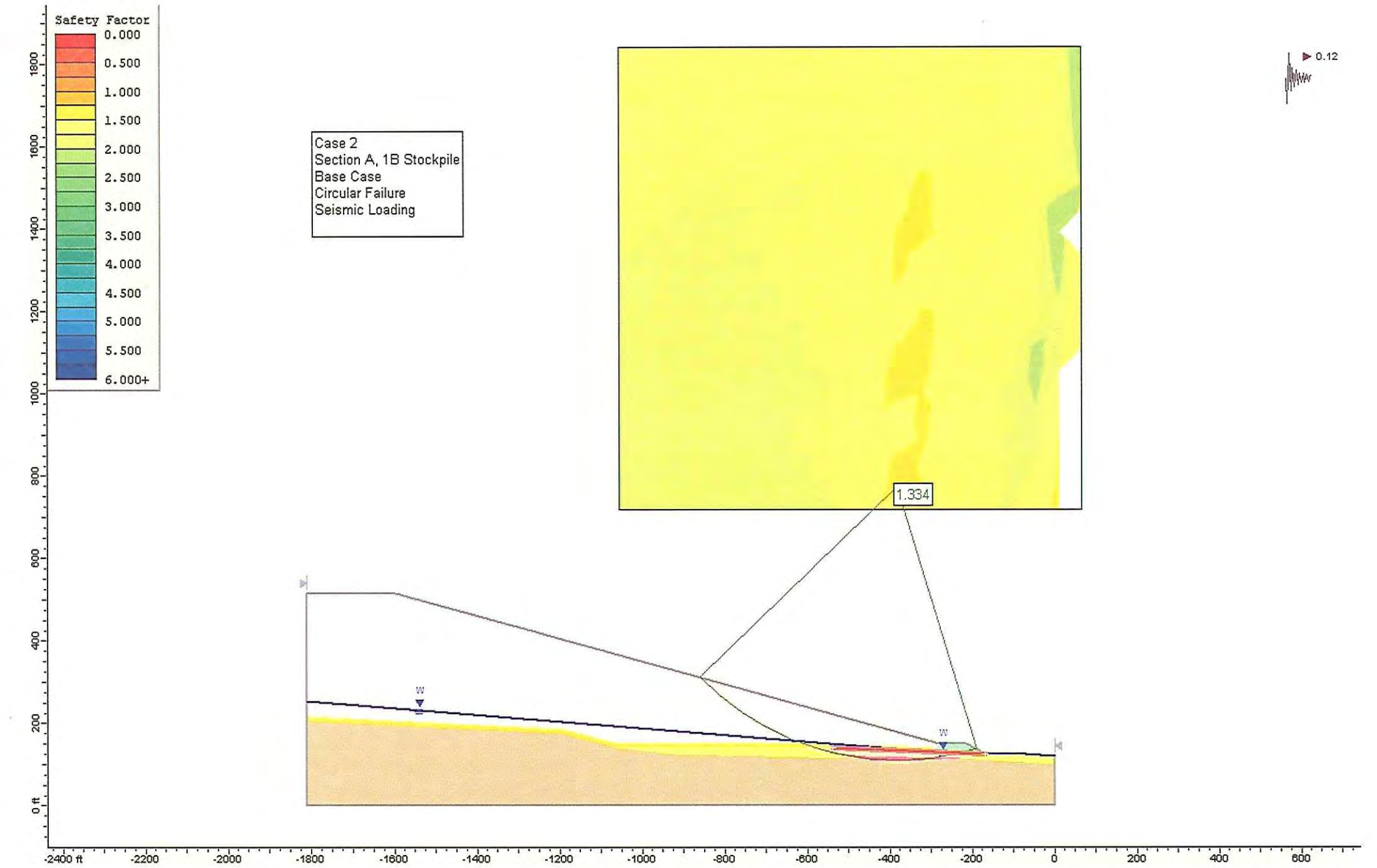
0.000	100.000
0.000	120.000
-70.000	125.000
-170.000	125.000
-215.000	150.000
-280.000	150.000
-1595.000	515.000
-1810.000	515.000
-1810.000	255.000
-1810.000	215.000
-1810.000	205.000
-1810.000	195.000
-1810.000	0.000
0.000	0.000

Water Table

-1810.000	255.000
-300.000	130.000
-170.000	125.000
-70.000	125.000
0.000	120.000

Support

-170.000	125.000
-540.000	140.000


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 2
Section A, 1B Stockpile
Base Case
Circular Failure
Seismic Loading
0.12
1.334
W
W
1800
1600
1400
1200
1000
800
600
400
200
0 ft
-2400 ft
-2200
-2000
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
600

Slide Analysis Information
Section A, 1B Stcockpile, Case 2
Circular Failure

Document Name

File Name: section a1b.sli

Project Settings

Project Title: 1B Stockpile Section A
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Leached Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf

Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Qal
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Granualt Fill
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Structural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gila Fm
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Interface Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Soft Clayey Fill
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 15 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: BX 1500 Geogrid
BX 1500 Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Parallel to Reinforcement
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 1650 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: bishop simplified
FS: 1.333620
Center: -382.440, 773.180
Radius: 664.992
Left Slip Surface Endpoint: -860.759, 311.199
Right Slip Surface Endpoint: -190.619, 136.455
Resisting Moment=1.56909e+009 lb-ft
Driving Moment=1.17657e+009 lb-ft

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4505
Number of Invalid Surfaces: 346
Error Codes:
Error Code -103 reported for 224 surfaces
Error Code -106 reported for 56 surfaces
Error Code -1000 reported for 66 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections,
but one or more surface / nonslope external polygon
intersections lie between them. This usually occurs
when the slip surface extends past the bottom of the
soil region, but may also occur on a benched
slope model with two sets of Slope Limits.

-106 = Average slice width is less than
0.0001 * (maximum horizontal extent of soil region).
This limitation is imposed to avoid numerical errors
which may result from too many slices, or too
small a slip region.

-1000 = No valid slip surfaces are generated
at a grid center. Unable to draw a surface.

List of All Coordinates

Search Grid

-1054.800	717.150
65.799	717.150
65.799	1837.748
-1054.800	1837.748

Material Boundary

-280.000	150.000
-300.000	130.000
-170.000	125.000

Material Boundary

-1810.000	205.000
-1195.000	175.000
-1060.000	140.000
-620.000	140.000
-540.000	140.000
-300.000	130.000

Material Boundary

-620.000	140.000
-490.000	115.000
-380.000	100.000
-230.000	115.000
-229.891	115.007
-70.000	125.000

Material Boundary

-230.000	115.000
0.000	100.000

Material Boundary

-1060.000	140.000
-920.000	125.000
-490.000	115.000

Material Boundary

-1810.000	215.000
-1195.000	185.000
-1060.000	150.000
-620.000	150.000
-540.000	150.000
-300.000	140.000
-300.000	130.000

Material Boundary

-558.792	129.097
-434.529	116.904
-358.903	116.904
-230.761	115.007
-229.891	115.007
-229.880	115.007

Material Boundary

-558.792	129.097
-434.625	107.962
-358.891	107.962
-230.761	115.007

External Boundary

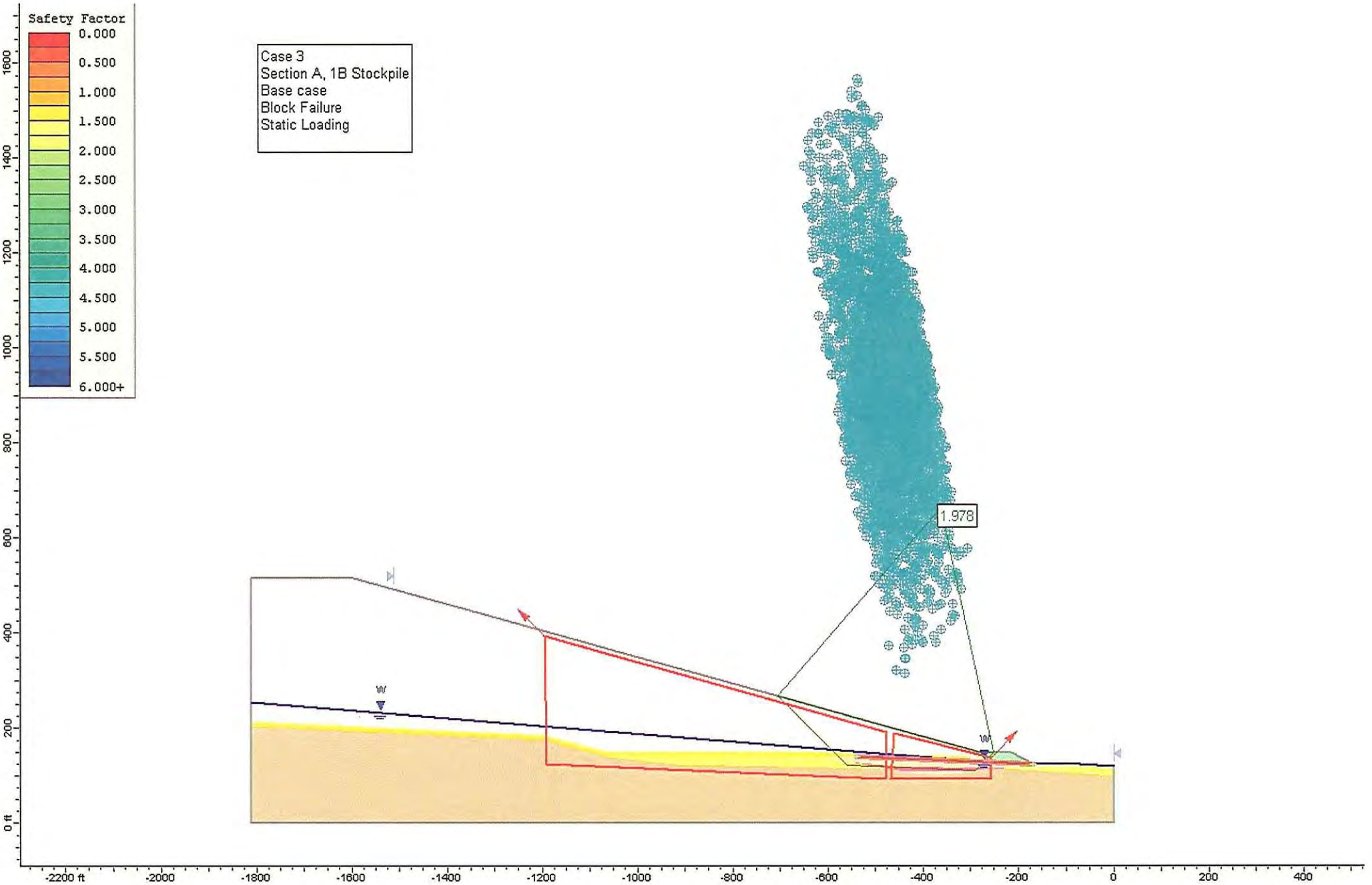
0.000	100.000
0.000	120.000
-70.000	125.000
-170.000	125.000
-215.000	150.000
-280.000	150.000
-1595.000	515.000
-1810.000	515.000
-1810.000	255.000
-1810.000	215.000
-1810.000	205.000
-1810.000	195.000
-1810.000	0.000
0.000	0.000

Water Table

-1810.000	255.000
-300.000	130.000
-170.000	125.000
-70.000	125.000
0.000	120.000

Support

-170.000	125.000
-540.000	140.000


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 3
Section A, 1B Stockpile
Base case
Block Failure
Static Loading
1.978
1600
1400
1200
1000
800
600
400
200
0 ft
-2200 ft
-2000
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400

Case 3
Slide Analysis Information
Section A, 1B Stockpile
Block Failure, Static, Base Case

Document Name

File Name: section a1b.sli

Project Settings

Project Title: 1B Stockpile Section A
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 135
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Material: Leached Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3

Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Qal
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Granualt Fill
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Structural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gila Fm
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Interface Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Soft Clayey Fill
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 15 degrees
Water Surface: Water Table

Custom Hu value: 1

Support Properties

Support: BX 1500 Geogrid
BX 1500 Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Parallel to Reinforcement
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 1650 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: bishop simplified
FS: 1.977610
Axis Location: -361.455, 662.792
Left Slip Surface Endpoint: -706.674, 268.431
Right Slip Surface Endpoint: -253.097, 150.000
Resisting Moment=7.77491e+008 lb-ft
Driving Moment=3.93147e+008 lb-ft

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4998
Number of Invalid Surfaces: 2
Error Codes:
Error Code -111 reported for 2 surfaces

Error Codes

The following errors were encountered during the computation:

-111 = safety factor equation did not converge

List of All Coordinates

Material Boundary

-280.000	150.000
-300.000	130.000
-170.000	125.000

Material Boundary

-1810.000	205.000
-1195.000	175.000
-1060.000	140.000
-620.000	140.000
-540.000	140.000
-300.000	130.000

Material Boundary

-620.000	140.000
-490.000	115.000
-380.000	100.000
-230.000	115.000
-229.891	115.007
-70.000	125.000

Material Boundary

-230.000	115.000
0.000	100.000

Material Boundary

-1060.000	140.000
-920.000	125.000
-490.000	115.000

Material Boundary

-1810.000	215.000
-1195.000	185.000
-1060.000	150.000
-620.000	150.000
-540.000	150.000
-300.000	140.000
-300.000	130.000

Material Boundary

-558.792	129.097
-434.529	116.904
-358.903	116.904
-230.761	115.007
-229.891	115.007
-229.880	115.007

Material Boundary

-558.792	129.097
-434.625	107.962
-358.891	107.962
-230.761	115.007

External Boundary

0.000	100.000
0.000	120.000
-70.000	125.000
-170.000	125.000
-215.000	150.000
-280.000	150.000
-1595.000	515.000
-1810.000	515.000
-1810.000	255.000
-1810.000	215.000
-1810.000	205.000
-1810.000	195.000
-1810.000	0.000
0.000	0.000

Water Table

-1810.000	255.000
-300.000	130.000
-170.000	125.000
-70.000	125.000
0.000	120.000

Focus/Block Search Window

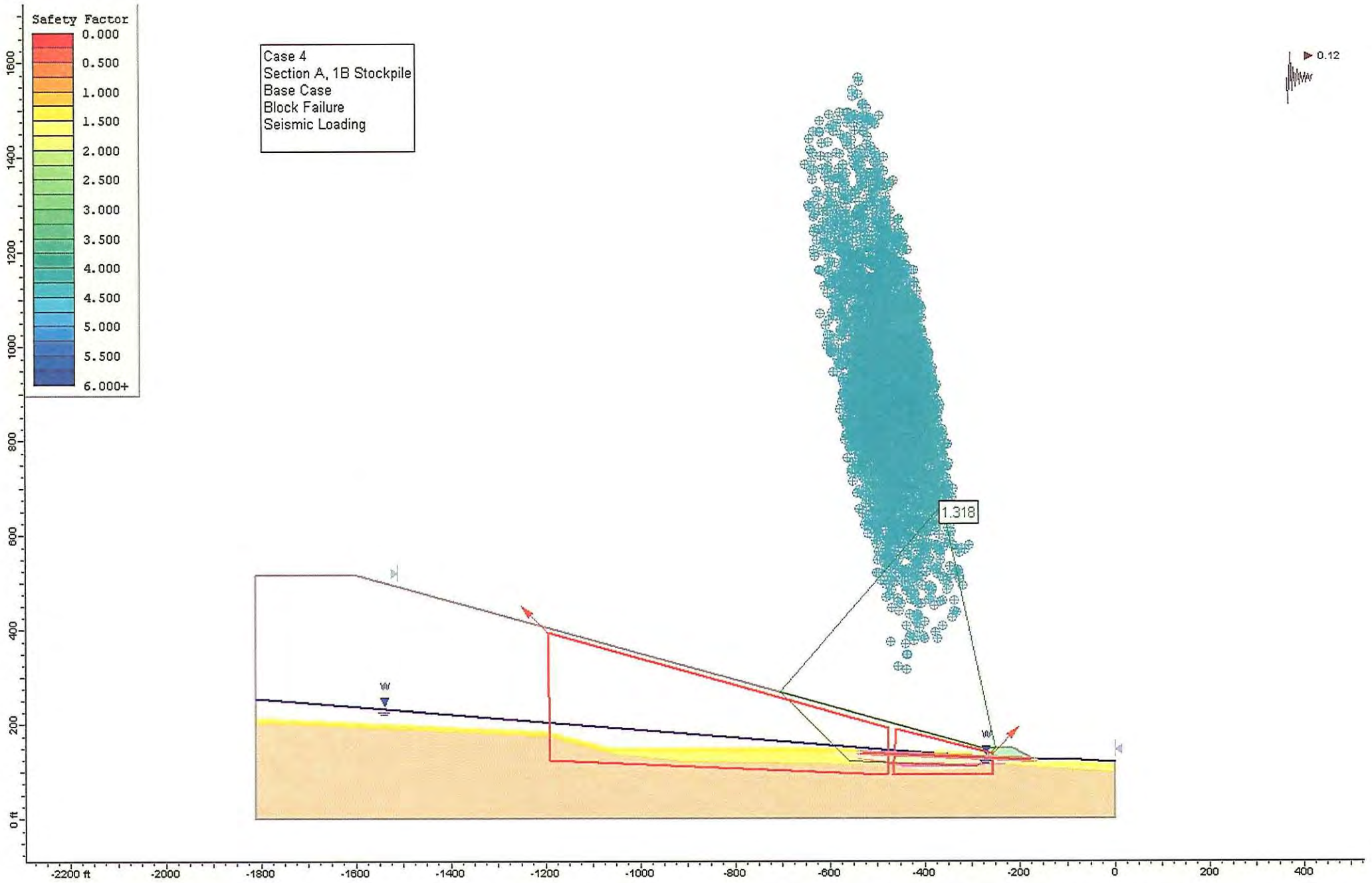
-462.048	189.207
-467.227	92.108
-256.310	91.892
-257.909	138.244

Focus/Block Search Window

-477.584	191.796
-1196.133	393.978
-1189.740	123.859
-480.174	92.108

Support

-170.000	125.000
-540.000	140.000


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 4
Section A, 1B Stockpile
Base Case
Block Failure
Seismic Loading
0.12
1.318
1600
1400
1200
1000
800
600
400
200
0 ft
-2200 ft
-2000
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400

Case 4
Slide Analysis Information
Section A, 1B Stockpile
Block Failure, Seismic Loading

Document Name

File Name: section a1b.sli

Project Settings

Project Title: 1B Stockpile Section A
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 135
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Leached Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Qal
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Granualt Fill
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Structural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gila Fm
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Interface Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Soft Clayey Fill
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3

Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 15 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: BX 1500 Geogrid
BX 1500 Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Parallel to Reinforcement
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 1650 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: bishop simplified
FS: 1.318450
Axis Location: -361.455, 662.792
Left Slip Surface Endpoint: -706.674, 268.431
Right Slip Surface Endpoint: -253.097, 150.000
Resisting Moment=7.48553e+008 lb-ft
Driving Moment=5.67751e+008 lb-ft

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4998
Number of Invalid Surfaces: 2
Error Codes:
Error Code -108 reported for 2 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment
or total driving force < 0.1. This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

List of All Coordinates

Material Boundary

-280.000	150.000
-300.000	130.000
-170.000	125.000

Material Boundary

-1810.000	205.000
-1195.000	175.000
-1060.000	140.000
-620.000	140.000
-540.000	140.000
-300.000	130.000

Material Boundary

-620.000	140.000
-490.000	115.000
-380.000	100.000
-230.000	115.000
-229.891	115.007
-70.000	125.000

Material Boundary

-230.000	115.000
0.000	100.000

Material Boundary

-1060.000	140.000
-920.000	125.000
-490.000	115.000

Material Boundary

-1810.000	215.000
-1195.000	185.000
-1060.000	150.000
-620.000	150.000
-540.000	150.000
-300.000	140.000
-300.000	130.000

Material Boundary

-558.792	129.097
-434.529	116.904
-358.903	116.904
-230.761	115.007
-229.891	115.007
-229.880	115.007

Material Boundary

-558.792	129.097
-434.625	107.962
-358.891	107.962
-230.761	115.007

External Boundary

0.000	100.000
0.000	120.000
-70.000	125.000
-170.000	125.000
-215.000	150.000
-280.000	150.000

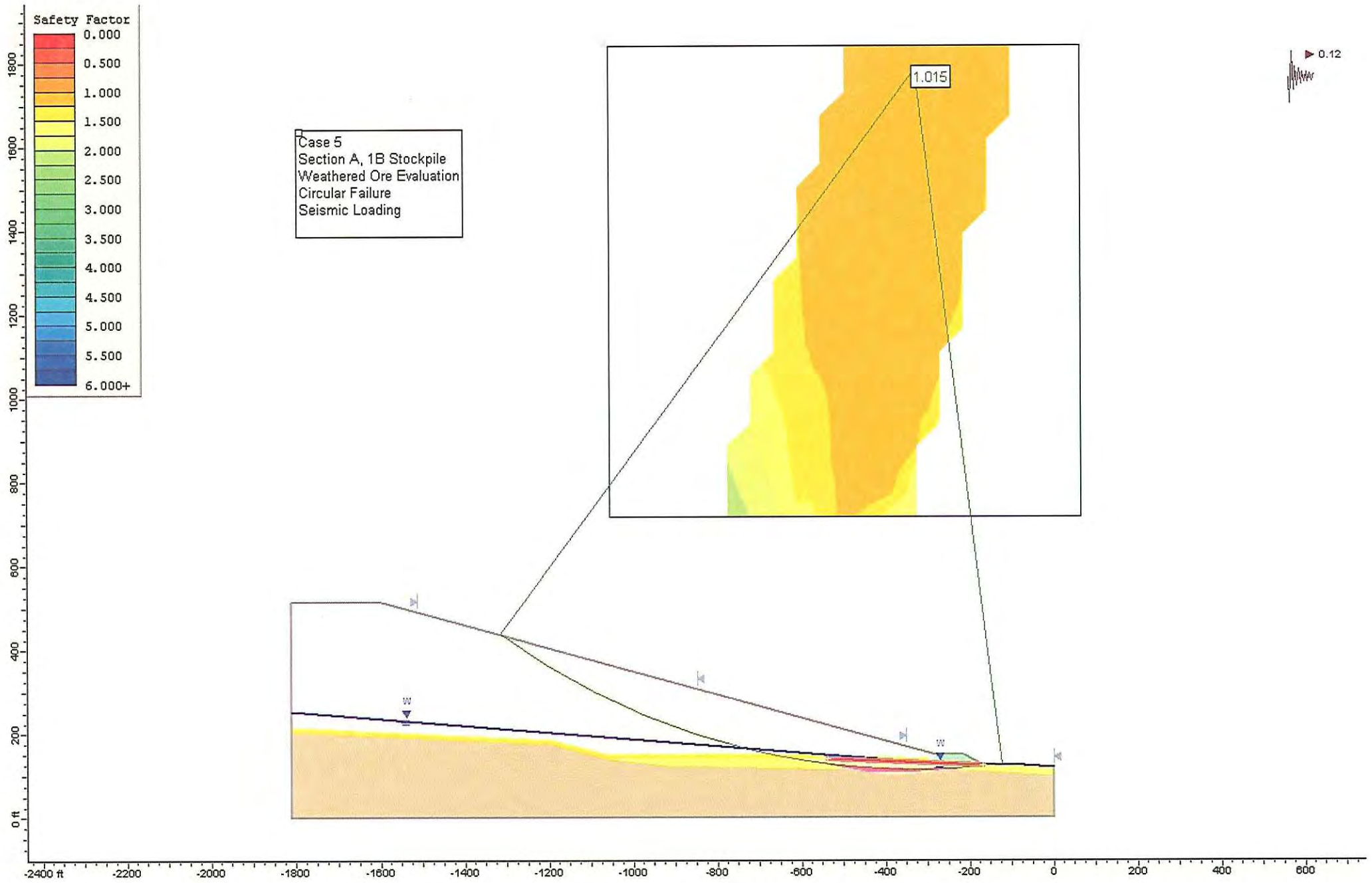
-1595.000 515.000
-1810.000 515.000
-1810.000 255.000
-1810.000 215.000
-1810.000 205.000
-1810.000 195.000
-1810.000 0.000
0.000 0.000

Water Table
-1810.000 255.000
-300.000 130.000
-170.000 125.000
-70.000 125.000
0.000 120.000

Focus/Block Search Window
-462.048 189.207
-467.227 92.108
-256.310 91.892
-257.909 138.244

Focus/Block Search Window
-477.584 191.796
-1196.133 393.978
-1189.740 123.859
-480.174 92.108

Support
-170.000 125.000
-540.000 140.000


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 5
Section A, 1B Stockpile
Weathered Ore Evaluation
Circular Failure
Seismic Loading
1.015
0.12
W
W
1800
1600
1400
1200
1000
800
600
400
200
0 ft
-2400 ft
-2200
-2000
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
600

Case 5 Slide Analysis Information
Section A 1B Stockpile
Weathered Ore Evaluation
Seismic Loading

Document Name

File Name: section a1b.sli

Project Settings

Project Title: 1B Stockpile Section A
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Leached Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3

Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 22.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Qal
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Granualt Fill
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Structural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gila Fm
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Interface Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Soft Clayey Fill
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 15 degrees

Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: BX 1500 Geogrid
BX 1500 Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Parallel to Reinforcement
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 1650 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: bishop simplified
FS: 1.014560
Center: -326.411, 1781.719
Radius: 1669.086
Left Slip Surface Endpoint: -1315.833, 437.513
Right Slip Surface Endpoint: -123.604, 125.000
Resisting Moment=6.54424e+009 lb-ft
Driving Moment=6.45034e+009 lb-ft

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 1839
Number of Invalid Surfaces: 3012
Error Codes:
Error Code -101 reported for 31 surfaces
Error Code -103 reported for 121 surfaces
Error Code -1000 reported for 2860 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero)
surface / slope intersections.

-103 = Two surface / slope intersections,
but one or more surface / nonslope external polygon
intersections lie between them. This usually occurs
when the slip surface extends past the bottom of the
soil region, but may also occur on a benched
slope model with two sets of Slope Limits.

-1000 = No valid slip surfaces are generated
at a grid center. Unable to draw a surface.

List of All Coordinates

Search Grid

-1054.800	717.150
65.799	717.150
65.799	1837.748
-1054.800	1837.748

Material Boundary

-280.000	150.000
-300.000	130.000
-170.000	125.000

Material Boundary

-1810.000	205.000
-1195.000	175.000
-1060.000	140.000
-620.000	140.000
-540.000	140.000
-300.000	130.000

Material Boundary

-620.000	140.000
-490.000	115.000
-380.000	100.000
-230.000	115.000
-229.891	115.007
-70.000	125.000

Material Boundary

-230.000	115.000
0.000	100.000

Material Boundary

-1060.000	140.000
-920.000	125.000
-490.000	115.000

Material Boundary

-1810.000	215.000
-1195.000	185.000
-1060.000	150.000
-620.000	150.000
-540.000	150.000
-300.000	140.000
-300.000	130.000

Material Boundary

-558.792	129.097
-434.529	116.904
-358.903	116.904
-230.761	115.007
-229.891	115.007
-229.880	115.007

Material Boundary

-558.792	129.097
-434.625	107.962
-358.891	107.962
-230.761	115.007

External Boundary

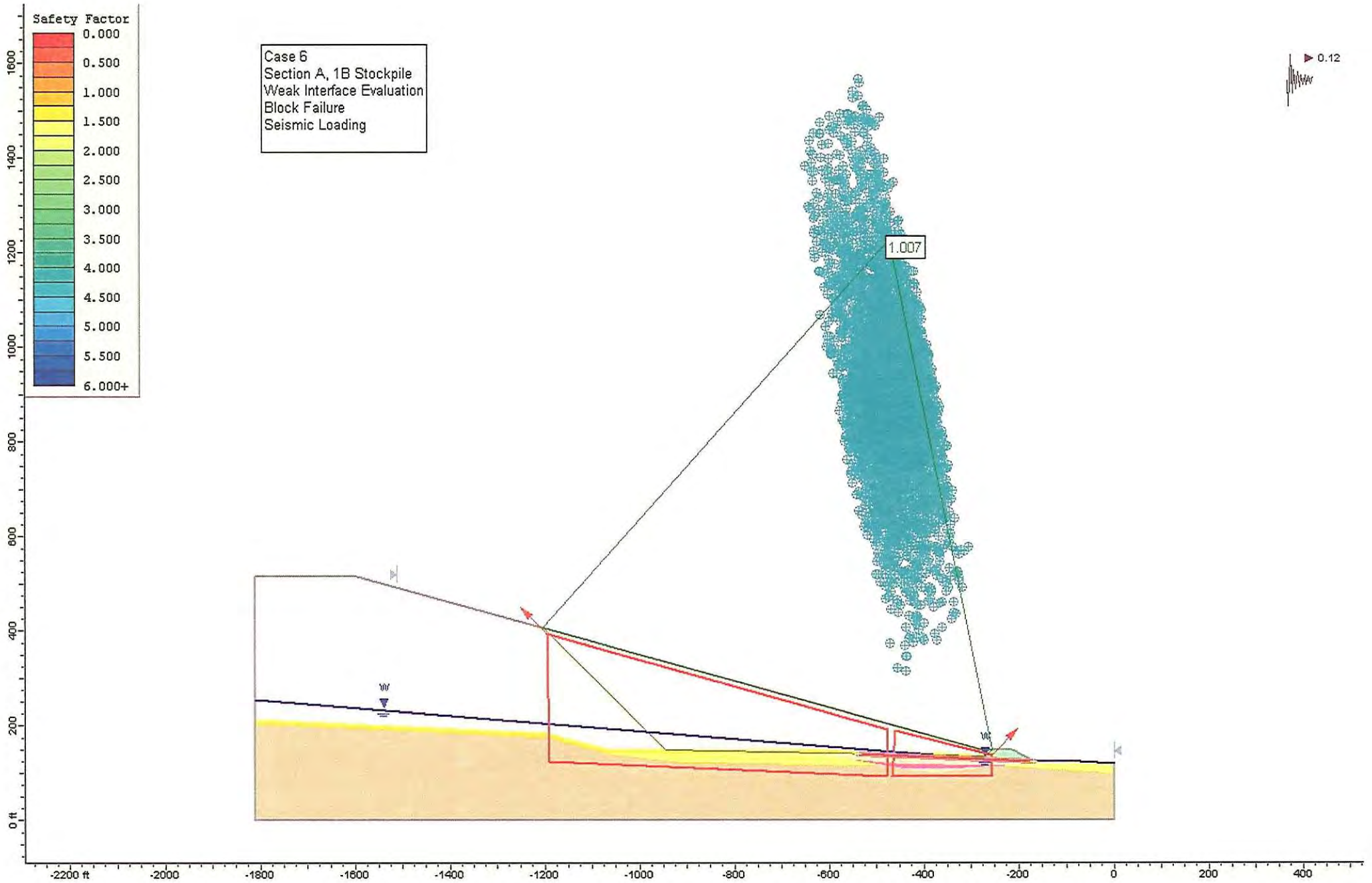
0.000	100.000
0.000	120.000
-70.000	125.000
-170.000	125.000
-215.000	150.000
-280.000	150.000
-1595.000	515.000
-1810.000	515.000
-1810.000	255.000
-1810.000	215.000
-1810.000	205.000
-1810.000	195.000
-1810.000	0.000
0.000	0.000

Water Table

-1810.000	255.000
-300.000	130.000
-170.000	125.000
-70.000	125.000
0.000	120.000

Support

-170.000	125.000
-540.000	140.000


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 6
Section A, 1B Stockpile
Weak Interface Evaluation
Block Failure
Seismic Loading
1.007
0.12
1600
1400
1200
1000
800
600
400
200
0 ft
-2200 ft
-2000
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400

Case 6
Slide Analysis Information
Section A, 1B Stockpile
Weak Interface Evaluation
Block failure, Seismic Loading

Document Name

File Name: section a1b.sli

Project Settings

Project Title: 1B Stockpile Section A
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 135
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Leached Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Qal
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Granualt Fill
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Structural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gila Fm
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Interface Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 13.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Soft Clayey Fill

Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 15 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: BX 1500 Geogrid
BX 1500 Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Parallel to Reinforcement
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 1650 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: bishop simplified
FS: 1.007150
Axis Location: -473.538, 1226.113
Left Slip Surface Endpoint: -1203.935, 406.453
Right Slip Surface Endpoint: -256.049, 150.000
Resisting Moment=3.85373e+009 lb-ft
Driving Moment=3.82637e+009 lb-ft

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4998
Number of Invalid Surfaces: 2
Error Codes:
Error Code -108 reported for 2 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment
or total driving force < 0.1. This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

List of All Coordinates

Material Boundary
-280.000 150.000

-300.000 130.000
-170.000 125.000

Material Boundary
-1810.000 205.000
-1195.000 175.000
-1060.000 140.000
-620.000 140.000
-540.000 140.000
-300.000 130.000

Material Boundary
-620.000 140.000
-490.000 115.000
-380.000 100.000
-230.000 115.000
-229.891 115.007
-70.000 125.000

Material Boundary
-230.000 115.000
0.000 100.000

Material Boundary
-1060.000 140.000
-920.000 125.000
-490.000 115.000

Material Boundary
-1810.000 215.000
-1195.000 185.000
-1060.000 150.000
-620.000 150.000
-540.000 150.000
-300.000 140.000
-300.000 130.000

Material Boundary
-558.792 129.097
-434.529 116.904
-358.903 116.904
-230.761 115.007
-229.891 115.007
-229.880 115.007

Material Boundary
-558.792 129.097
-434.625 107.962
-358.891 107.962
-230.761 115.007

External Boundary
0.000 100.000
0.000 120.000
-70.000 125.000
-170.000 125.000

-215.000	150.000
-280.000	150.000
-1595.000	515.000
-1810.000	515.000
-1810.000	255.000
-1810.000	215.000
-1810.000	205.000
-1810.000	195.000
-1810.000	0.000
0.000	0.000

Water Table

-1810.000	255.000
-300.000	130.000
-170.000	125.000
-70.000	125.000
0.000	120.000

Focus/Block Search Window

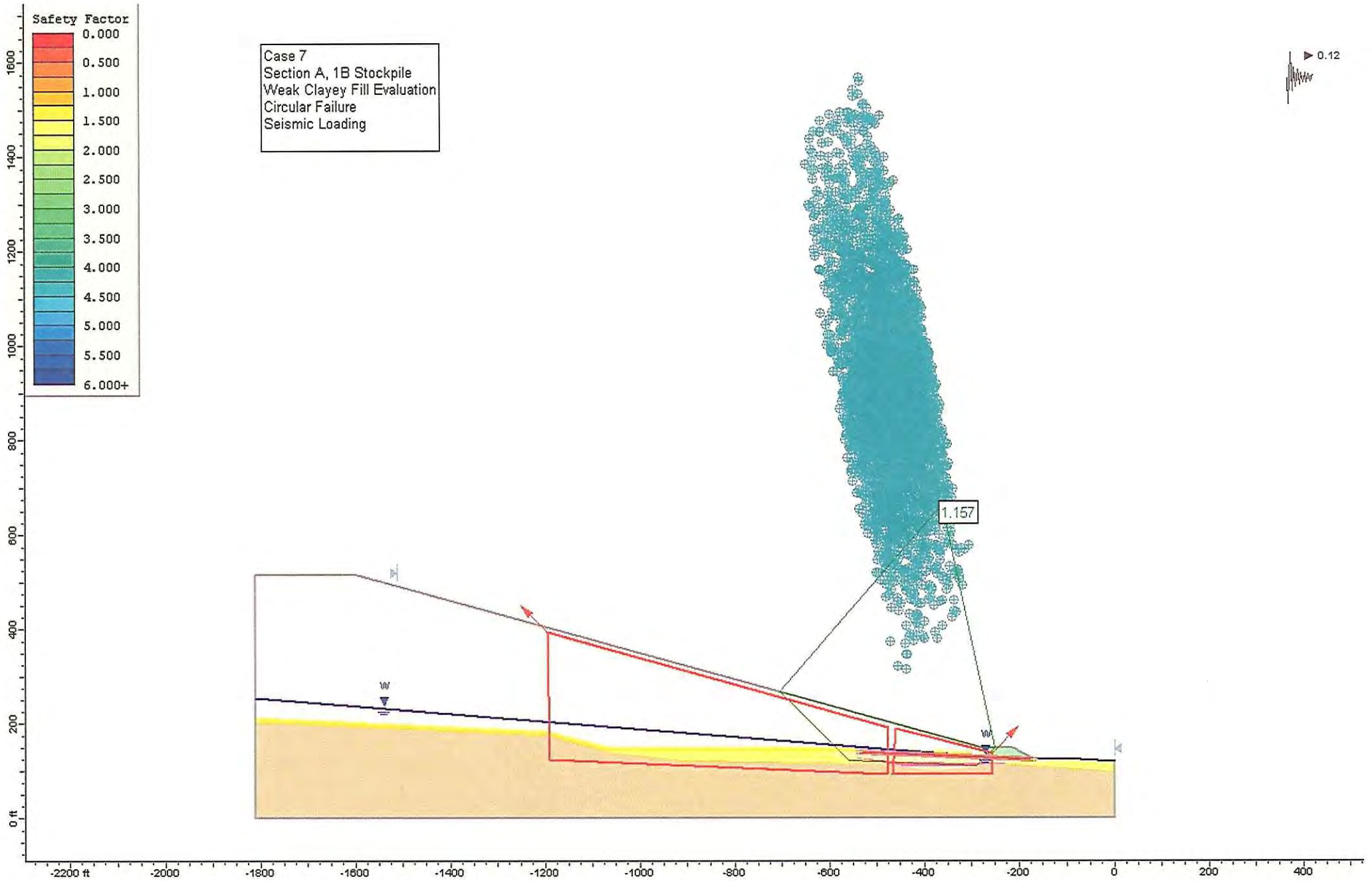
-462.048	189.207
-467.227	92.108
-256.310	91.892
-257.909	138.244

Focus/Block Search Window

-477.584	191.796
-1196.133	393.978
-1189.740	123.859
-480.174	92.108

Support

-170.000	125.000
-540.000	140.000


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 7
Section A, 1B Stockpile
Weak Clayey Fill Evaluation
Circular Failure
Seismic Loading
0.12
1.157
W
W
1600
1400
1200
1000
800
600
400
200
0 ft
-2200 ft
-2000
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400

Case 7
Slide Analysis Information
Section A 1B Stockpile
Weak Clayey Fill Evaluation
Block Failure, Seismic Loading

Document Name

File Name: section a1b.sli

Project Settings

Project Title: 1B Stockpile Section A
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Non-Circular Block Search
Number of Surfaces: 5000
Pseudo-Random Surfaces: Enabled
Convex Surfaces Only: Disabled
Left Projection Angle (Start Angle): 135
Left Projection Angle (End Angle): 135
Right Projection Angle (Start Angle): 45
Right Projection Angle (End Angle): 45
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Leached Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Qal
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Granualt Fill
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Structural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gila Fm
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Interface Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Soft Clayey Fill
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 8 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: BX 1500 Geogrid
BX 1500 Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Parallel to Reinforcement
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 1650 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: bishop simplified
FS: 1.156760
Axis Location: -361.455, 662.792
Left Slip Surface Endpoint: -706.674, 268.431
Right Slip Surface Endpoint: -253.097, 150.000
Resisting Moment=6.41097e+008 lb-ft
Driving Moment=5.54217e+008 lb-ft

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 4998
Number of Invalid Surfaces: 2
Error Codes:
Error Code -108 reported for 2 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment
or total driving force < 0.1. This is to
limit the calculation of extremely high safety
factors if the driving force is very small
(0.1 is an arbitrary number).

List of All Coordinates

Material Boundary

-280.000	150.000
-300.000	130.000
-170.000	125.000

Material Boundary

-1810.000	205.000
-1195.000	175.000
-1060.000	140.000
-620.000	140.000
-540.000	140.000
-300.000	130.000

Material Boundary

-620.000	140.000
-490.000	115.000
-380.000	100.000
-230.000	115.000
-229.891	115.007
-70.000	125.000

Material Boundary

-230.000	115.000
0.000	100.000

Material Boundary

-1060.000	140.000
-920.000	125.000
-490.000	115.000

Material Boundary

-1810.000	215.000
-1195.000	185.000
-1060.000	150.000
-620.000	150.000
-540.000	150.000
-300.000	140.000
-300.000	130.000

Material Boundary

-558.792	129.097
-434.529	116.904
-358.903	116.904
-230.761	115.007
-229.891	115.007
-229.880	115.007

Material Boundary

-558.792	129.097
-434.625	107.962
-358.891	107.962
-230.761	115.007

External Boundary

0.000	100.000
0.000	120.000

-70.000	125.000
-170.000	125.000
-215.000	150.000
-280.000	150.000
-1595.000	515.000
-1810.000	515.000
-1810.000	255.000
-1810.000	215.000
-1810.000	205.000
-1810.000	195.000
-1810.000	0.000
0.000	0.000

Water Table

-1810.000	255.000
-300.000	130.000
-170.000	125.000
-70.000	125.000
0.000	120.000

Focus/Block Search Window

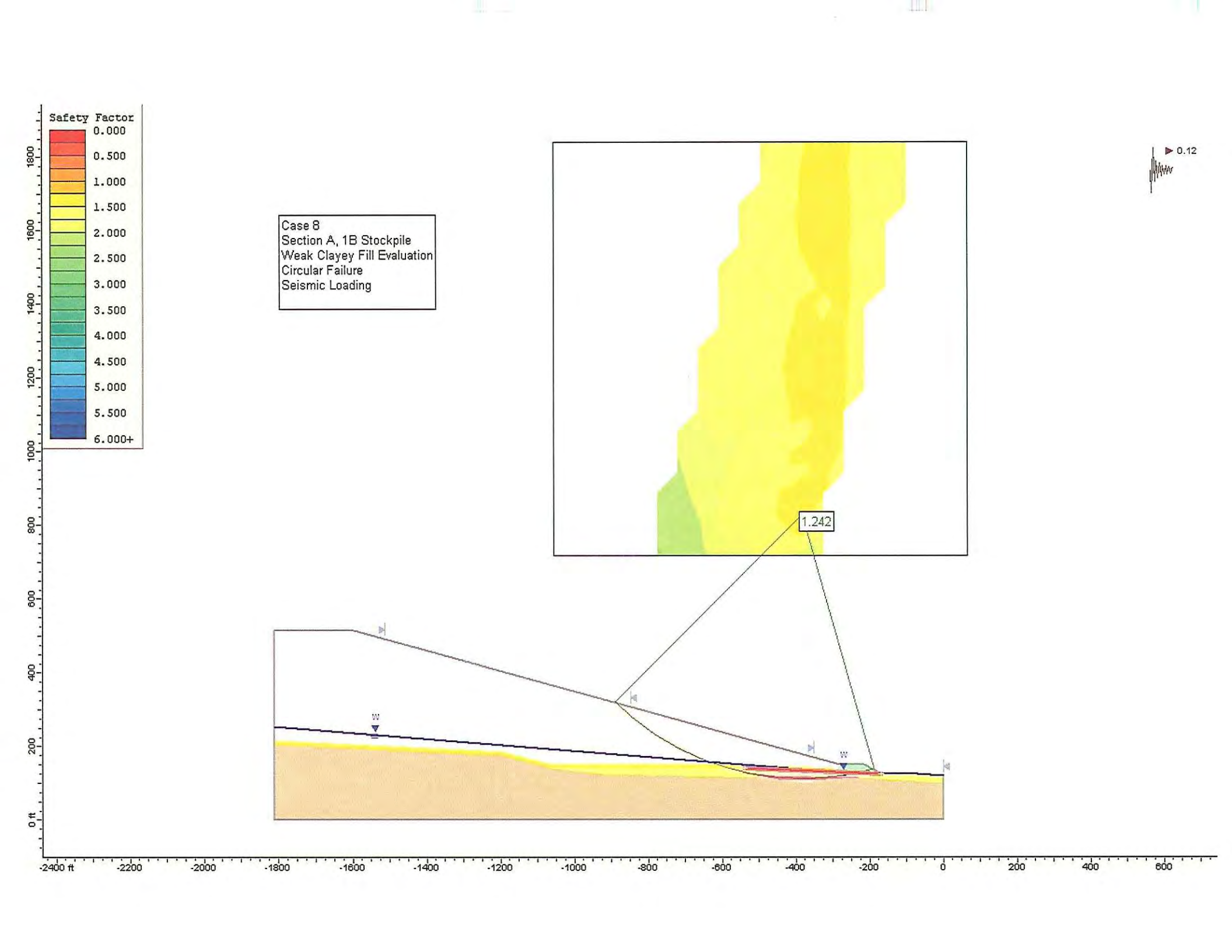
-462.048	189.207
-467.227	92.108
-256.310	91.892
-257.909	138.244

Focus/Block Search Window

-477.584	191.796
-1196.133	393.978
-1189.740	123.859
-480.174	92.108

Support

-170.000	125.000
-540.000	140.000


Safety Factor
0.000
0.500
1.000
1.500
2.000
2.500
3.000
3.500
4.000
4.500
5.000
5.500
6.000+
Case 8
Section A, 1B Stockpile
Weak Clayey Fill Evaluation
Circular Failure
Seismic Loading
0.12
1.242
W
W
1800
1600
1400
1200
1000
800
600
400
200
0 ft
-2400 ft
-2200
-2000
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
600

Case 8
Slide Analysis Information
Section A, 1B Stockpile
Weak Clayey Fill Evaluation
Circular Failure, Seismic Loading

Document Name

File Name: section a1b.sli

Project Settings

Project Title: 1B Stockpile Section A
Failure Direction: Left to Right
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Bishop simplified

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.12

Material Properties

Material: Leached Ore

Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Qal
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 29 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Granualt Fill
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Structural Fill
Strength Type: Mohr-Coulomb
Unit Weight: 120 lb/ft3
Cohesion: 0 psf
Friction Angle: 34 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Gila Fm
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Interface Ore
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3
Cohesion: 0 psf
Friction Angle: 35.5 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Soft Clayey Fill
Strength Type: Mohr-Coulomb
Unsaturated Unit Weight: 120 lb/ft3
Saturated Unit Weight: 130 lb/ft3

Cohesion: 0 psf
Friction Angle: 8 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: BX 1500 Geogrid
BX 1500 Geogrid
Support Type: GeoTextile
Force Application: Passive
Force Orientation: Parallel to Reinforcement
Anchorage: Slope Face
Shear Strength Model: Linear
Strip Coverage: 100 percent
Tensile Strength: 1650 lb/ft
Pullout Strength Adhesion: 0 lb/ft2
Pullout Strength Friction Angle: 25 degrees

Global Minimums

Method: bishop simplified
FS: 1.241850
Center: -382.440, 829.210
Radius: 720.328
Left Slip Surface Endpoint: -891.721, 319.793
Right Slip Surface Endpoint: -188.744, 135.413
Resisting Moment=1.69667e+009 lb-ft
Driving Moment=1.36625e+009 lb-ft

Valid / Invalid Surfaces

Method: bishop simplified
Number of Valid Surfaces: 1839
Number of Invalid Surfaces: 3012
Error Codes:
Error Code -101 reported for 31 surfaces
Error Code -103 reported for 121 surfaces
Error Code -1000 reported for 2860 surfaces

Error Codes

The following errors were encountered during the computation:

-101 = Only one (or zero)
surface / slope intersections.

-103 = Two surface / slope intersections,
but one or more surface / nonslope external polygon
intersections lie between them. This usually occurs
when the slip surface extends past the bottom of the
soil region, but may also occur on a benched
slope model with two sets of Slope Limits.

-1000 = No valid slip surfaces are generated

at a grid center. Unable to draw a surface.

List of All Coordinates

Search Grid

-1054.800	717.150
65.799	717.150
65.799	1837.748
-1054.800	1837.748

Material Boundary

-280.000	150.000
-300.000	130.000
-170.000	125.000

Material Boundary

-1810.000	205.000
-1195.000	175.000
-1060.000	140.000
-620.000	140.000
-540.000	140.000
-300.000	130.000

Material Boundary

-620.000	140.000
-490.000	115.000
-380.000	100.000
-230.000	115.000
-229.891	115.007
-70.000	125.000

Material Boundary

-230.000	115.000
0.000	100.000

Material Boundary

-1060.000	140.000
-920.000	125.000
-490.000	115.000

Material Boundary

-1810.000	215.000
-1195.000	185.000
-1060.000	150.000
-620.000	150.000
-540.000	150.000
-300.000	140.000
-300.000	130.000

Material Boundary

-558.792	129.097
-434.529	116.904
-358.903	116.904
-230.761	115.007
-229.891	115.007

-229.880	115.007

Material Boundary

-558.792	129.097
-434.625	107.962
-358.891	107.962
-230.761	115.007

External Boundary

0.000	100.000
0.000	120.000
-70.000	125.000
-170.000	125.000
-215.000	150.000
-280.000	150.000
-1595.000	515.000
-1810.000	515.000
-1810.000	255.000
-1810.000	215.000
-1810.000	205.000
-1810.000	195.000
-1810.000	0.000
0.000	0.000

Water Table

-1810.000	255.000
-300.000	130.000
-170.000	125.000
-70.000	125.000
0.000	120.000

Support

-170.000	125.000
-540.000	140.000

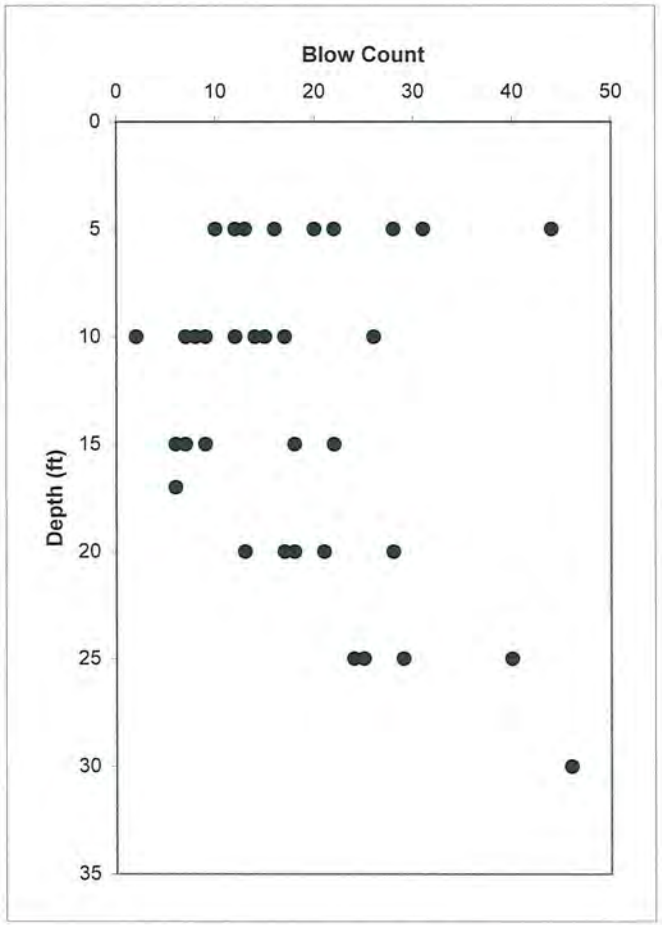
TABLE 1-1
GROUNDWATER AT EXISTING SURFACE

All Qal SPT Data, Number 1A-1B Stockpile
Corrected N Value (As per Youd et al., 1996 and 1998 NCEER Workshops)

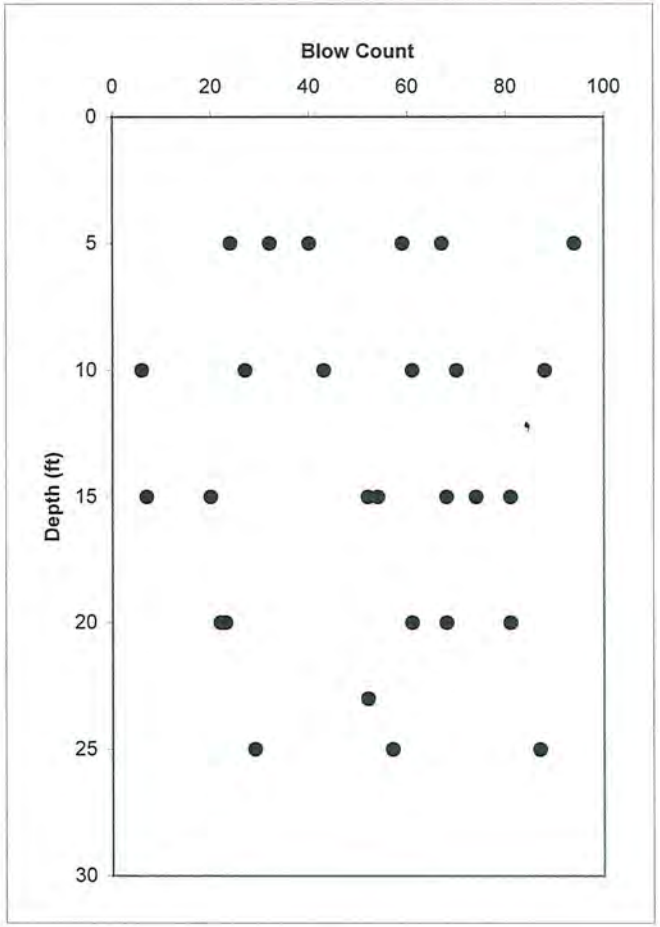
Qal moist unit weight	120 PCF	
Qal sat unit weight	130 PCF	
Borehole dia correction	1.05 (Cb)	Youd et al
Rod length corr	0.8 (Cr)	Youd et al
Energy Ratio	1 (Ce)	Youd et al
Sampling Method Corr	1 (Cs)	Youd et al
Correction Product	0.84 (Less Ovb corr, Column J)	
Max surface Accel	0.18 g	URS Seismicity Study
	No. 1A-1B	
Percent Fines	10 %	
Max Quake Magnitude	6.7	URS Seismicity Study
Mag Scale Factor	1.31	Table 3, Idriss, Column 3 (after Youd and Noble 1997)
Regrade Burial Depth	0 Feet	
Surcharge Pressure	0 PSF at surface	

Hole	Depth to Water (bgs)	Sample Depth	Material	Blows/ft (uncorr)	Depth below gws	u (pcf)	Total Stress	Effective Stress	Cn (ovb) Correction (Youd eqn 9)	N1(60) BPF (Youd eqn 8)	CSR (Youd eqn 1)	CRR (LIQFAC Lookup)	FS (Youd eqn 23)
SB-1	0	10	Qal	61	10	624	1300	676	1.70	87.11	0.220	2.6200	NL
SB-2	0	6	Qal	94	6	374.4	780	405.6	1.70	134.23	0.222	2.6200	NL
SB-2	0	10	Qal	88	10	624	1300	676	1.70	125.66	0.220	2.6200	NL
SB-2	0	15	Qal	68	15	936	1950	1014	1.40	80.22	0.217	2.6200	NL
SB-3	0	5	Qal	67	5	312	650	338	1.70	95.68	0.222	2.6200	NL
SB-6	0	5	Qal	59	5	312	650	338	1.70	84.25	0.222	2.6200	NL
SB-7	0	15	Qal	81	15	936	1950	1014	1.40	95.56	0.217	2.6200	NL
SB-7	0	20	Qal	68	20	1248	2600	1352	1.22	69.47	0.215	2.6200	NL
SB-8	0	20	Qal	81	20	1248	2600	1352	1.22	82.75	0.215	2.6200	NL
SB-9	0	5	Qal	24	5	312	650	338	1.70	34.27	0.222	2.6200	NL
SB-9	0	10	Qal	27	10	624	1300	676	1.70	38.56	0.220	2.6200	NL
SB-9	0	15	Qal	52	15	936	1950	1014	1.40	61.34	0.217	2.6200	NL
SB-10	0	20	Qal	22	20	1248	2600	1352	1.22	22.48	0.215	0.4467	2.7
SB-11	0	10	Qal	16	10	624	1300	676	1.70	22.85	0.220	0.4467	2.7
GA-05-01	0	25	Qal	29	25	1560	3250	1690	1.09	26.50	0.212	1.0480	6.5
GA-05-02	0	15	Qal	74	15	936	1950	1014	1.40	87.30	0.217	2.6200	NL
GA-05-03	0	20	Qal	20	20	1248	2600	1352	1.22	20.43	0.215	0.3825	2.3
GA-05-03	0	25	Qal	23	25	1560	3250	1690	1.09	21.02	0.212	0.4140	2.6
GA-05-03	0	23	Qal	87	23	1435.2	2990	1554.8	1.13	82.89	0.213	2.6200	NL
GA-05-05	0	5	Qal	52	5	312	650	338	1.70	74.26	0.222	2.6200	NL
GA-05-06	0	5	Qal	32	5	312	650	338	1.70	45.70	0.222	2.6200	NL
GA-05-06	0	10	Qal	43	10	624	1300	676	1.70	61.40	0.220	2.6200	NL
GA-05-07	0	10	Qal	6	10	624	1300	676	1.70	8.57	0.220	0.1729	1.0
GA-05-07	0	15	Qal	7	15	936	1950	1014	1.40	8.26	0.217	0.1729	1.0
GA-05-10	0	15	Qal	54	15	936	1950	1014	1.40	63.70	0.217	2.6200	NL
GA-05-10	0	20	Qal	61	20	1248	2600	1352	1.22	62.32	0.215	2.6200	NL
GA-05-12	0	25	Qal	57	25	1560	3250	1690	1.09	52.09	0.212	2.6200	NL

FILL SOILS



ALLUVIAL SOILS



Golder Associates Denver, Colorado

TITLE

MEASURED BLOWCOUNTS IN FILL AND ALLUVIUAL SOILS

CLIENT/PROJECT

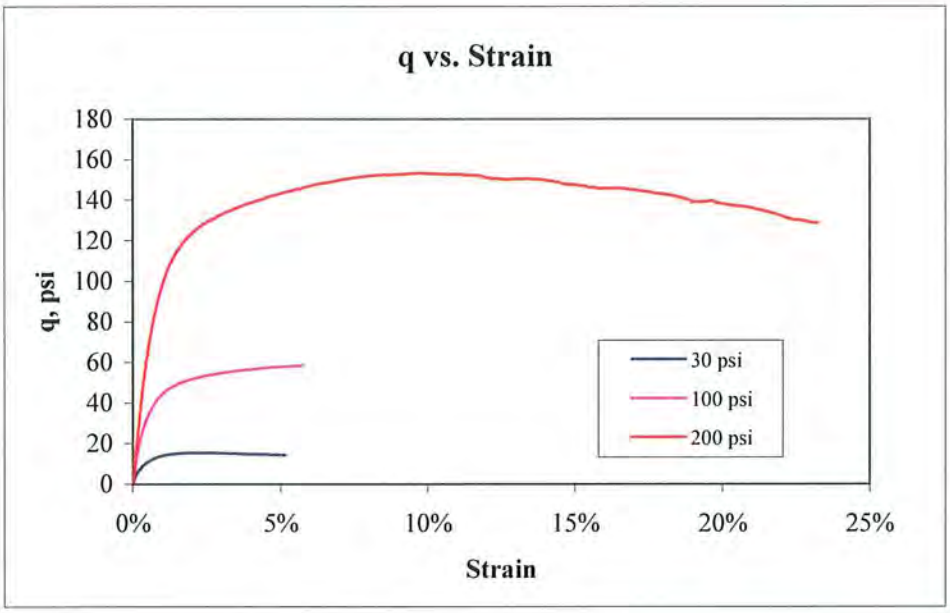
PHELPS DODGE TYRONE INC.
NO. 1 B STOCKPILE PLS RELOCATION DESIGN PROJECT

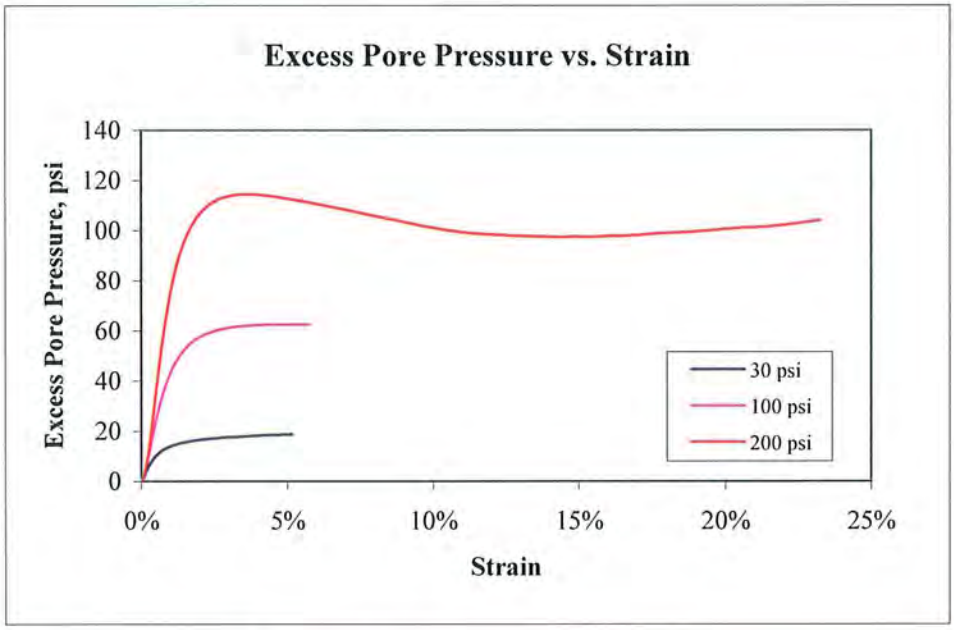
DRAWN	KFM	DATE	2-Mar-06	JOB NO.	053-2275
CHECKED	BRB	SCALE	N.T.S.	DWG. NO.	N/A
REVIEWED	TLS	FILE NO.	Blowcount-Summary.xls	FIGURE NO.	2

Sample # =	TSTG-04		Sample # =	TSTG-04		Sample # =	TSTG-04	
Point # =	1		Point # =	2		Point # =	3	
	Initial			**Initial**			**Initial**	
Length =	14.67	cm	Length =	14.67	cm	Length =	14.67	cm
Diameter =	7.27	cm	Diameter =	7.27	cm	Diameter =	7.27	cm
Wet Weight =	1235.20	g	Wet Weight =	1235.20	g	Wet Weight =	1235.20	g
Area =	41.5	cm^2	Area =	41.5	cm^2	Area =	41.5	cm^2
Sample Area =	6.43	in^2	Sample Area =	6.43	in^2	Sample Area =	6.43	in^2
Volume =	608.9	cm^3	Volume =	608.9	cm^3	Volume =	608.9	cm^3
Moisture Content =	11.0%		Moisture Content =	11.0%		Moisture Content =	11.0%	
Specific Gravity =	-		Specific Gravity =	-		Specific Gravity =	-	
Dry Weight of Solids =	1112.79	g	Dry Weight of Solids =	1112.79	g	Dry Weight of Solids =	1112.79	g
Wet Unit Weight =	2.03	g/cm^3	Wet Unit Weight =	2.03	g/cm^3	Wet Unit Weight =	2.03	g/cm^3
Dry Unit Weight =	1.83	g/cm^3	Dry Unit Weight =	1.83	g/cm^3	Dry Unit Weight =	1.83	g/cm^3
Wet Unit Weight =	126.6	pcf	Wet Unit Weight =	126.6	pcf	Wet Unit Weight =	126.6	pcf
Dry Unit Weight =	114.0	pcf	Dry Unit Weight =	114.0	pcf	Dry Unit Weight =	114.0	pcf
Cell Pressure =	80	psi	Cell Pressure =	150	psi	Cell Pressure =	250	psi
Back Pressure =	50	psi	Back Pressure =	50	psi	Back Pressure =	50	psi
Confining Pressure =	30	psi	Confining Pressure =	100	psi	Confining Pressure =	200	psi

Notes: Material visually described as sand, reddish-brown, with clay and fine gravel.
Specimen remolded with a light to moderate tamp at visually estimated optimum moisture content.
Failure defined as maximum principal stress ratio.
The strain rate was 0.1mm/min, and t_{50} was 0.1 minutes.
Test was a staged trixial test.

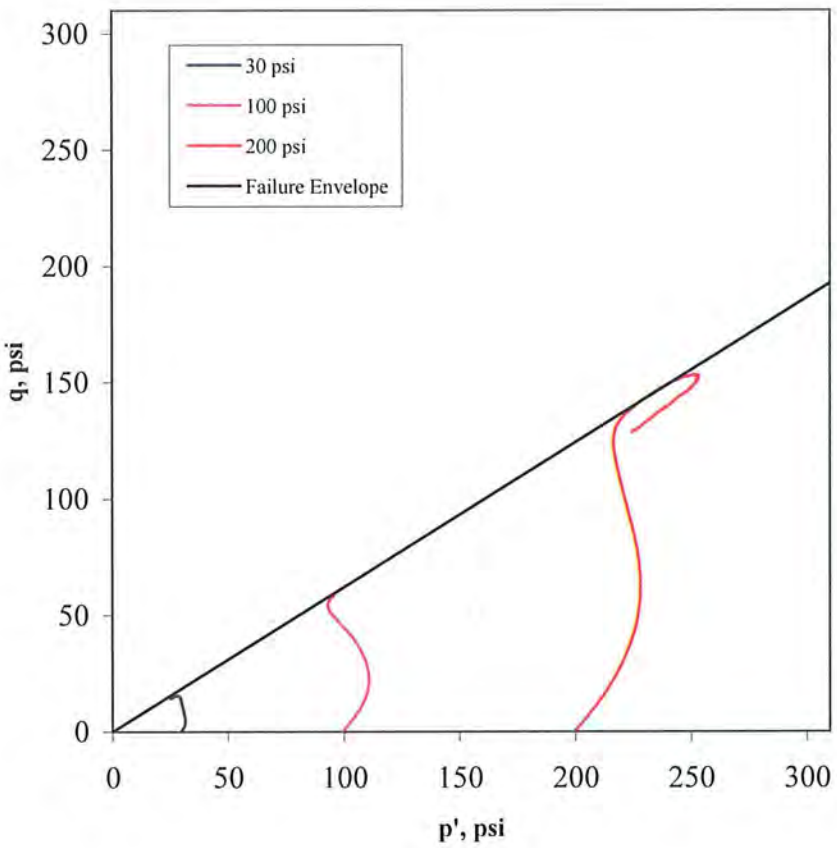
Golder Associates, Inc. **Denver, Colorado**	**Title:** **TRIAXIAL SHEAR TEST REPORT** **SAMPLE DATA AND CALCULATIONS**			
Job Short Title: PD Tyrone/Stockpile Geotech				
Sample Number: **TSTG-04 @ 265-268**	**Reviewed:** **JEO**	**Date:** **6/7/2006**	**Job Number:** **053-2550**	**Figure:** **1**





Golder Associates, Inc. Denver, Colorado	Title: C-U TRIAXIAL SHEAR DATA q AND EXCESS PORE PRESSURE PLOTS			
Job Short Title: PD Tyrone/Stockpile Geotech				
Sample Number: TSTG-04 @ 265-268	Reviewed: JEO	Date: 06/07/06	Job Number: 053-2550	Figure: 2

Stress Path (p'-q) Plot

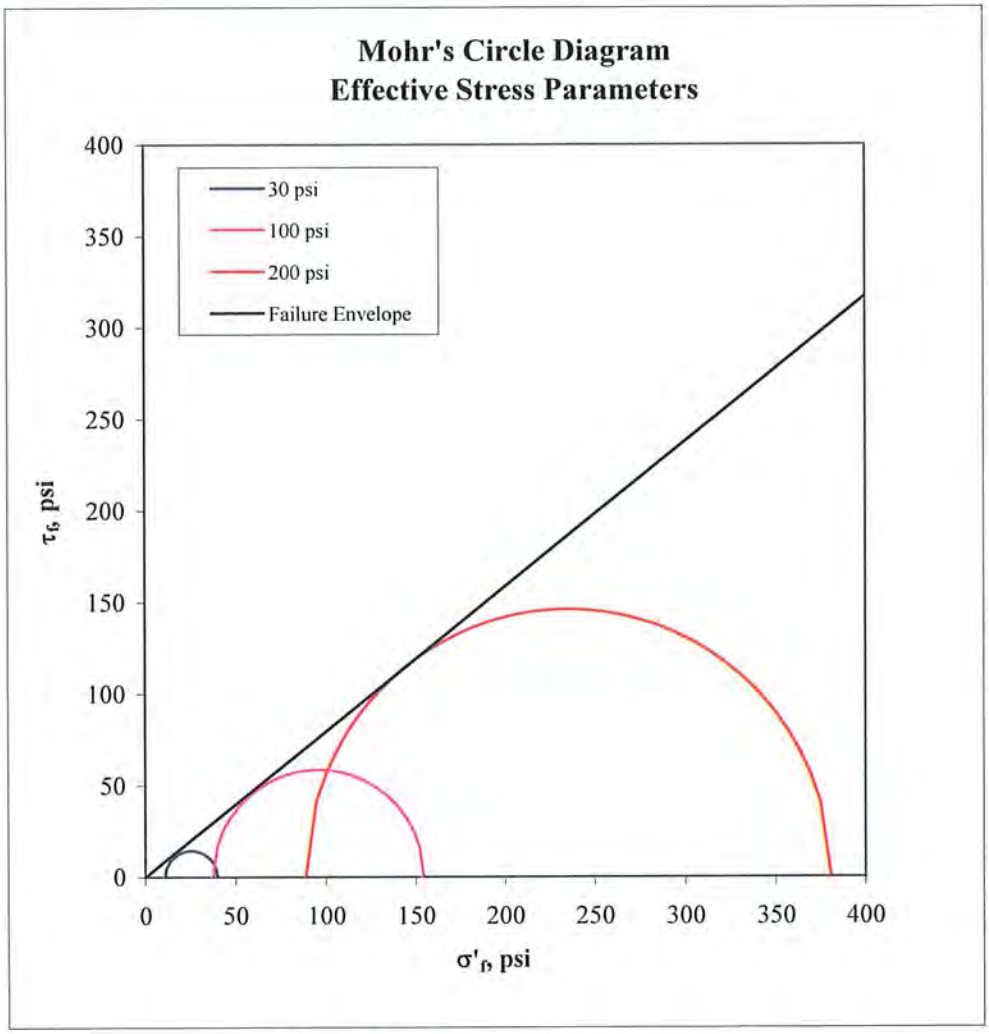


Stress Path Parameters

ψ' = **31.8 degrees**

a' = 0.0 psi

Golder Associates, Inc. Denver, Colorado		**Title:** C-U TRIAXIAL SHEAR DATA STRESS PATH PLOT		
Job Short Title: PD Tyrone/Stockpile Geotech				
Sample Number: TSTG-04 @ 265-268	**Reviewed:** JEO	**Date:** 6/7/2006	**Job Number:** 053-2550	**Figure:** 3



Effective Stress Shear Strength Parameters

ϕ' = 38.4 degrees

c' = 0.0 psi

Golder Associates, Inc. **Denver, Colorado**	Title: **C-U TRIAXIAL SHEAR DATA** **MOHR'S CIRCLE DIAGRAM**			
Job Short Title: PD Tyrone/Stockpile Geotech				
Sample Number: **TSTG-04 @ 265-268**	Reviewed: **JEO**	Date: **6/7/2006**	Job Number: **053-2550**	Figure: **4**

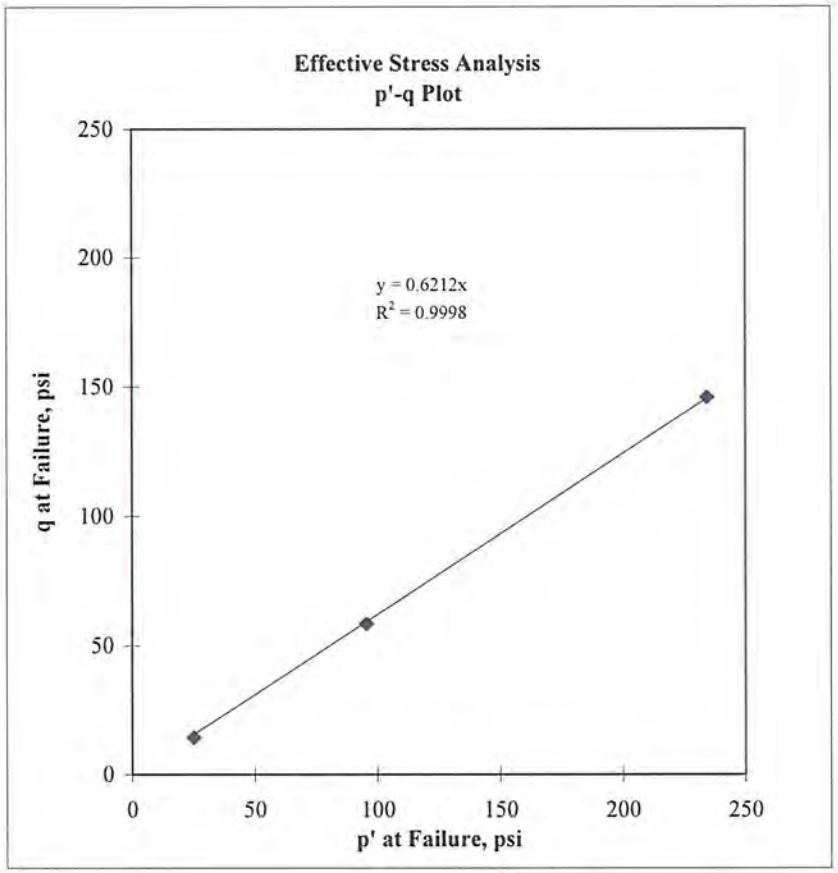
Consolidated-Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES, INC.
Project: **PD Tyrone/Stockpile Geotech**
Project Number: **053-2550**

Sample Number	TSTG-04 @ 265-268
Effective Stress Analysis	

Point Number	p' (psi)	q (psi)
1	25.1	14.4
2	95.5	58.5
3	234.4	146.0

tan(ψ') = 0.6212
a' = 0.0 psi

ϕ' = 38.4 degrees
c' = 0.0 psi



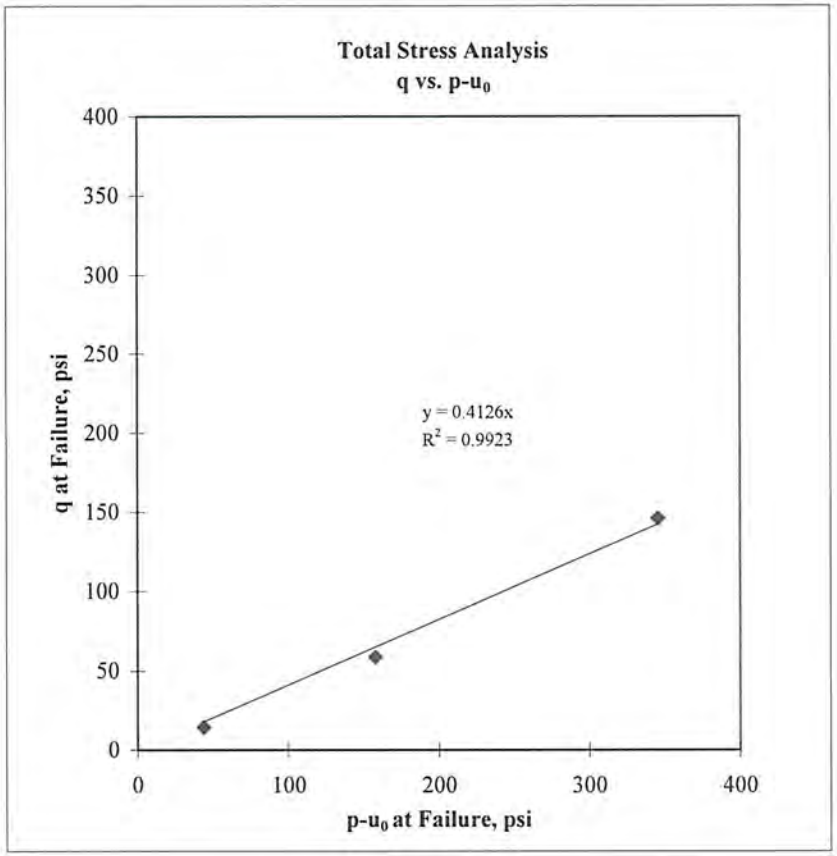
Consolidated-Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES, INC.
Project: **PD Tyrone/Stockpile Geotech**
Project Number: **053-2550**

Sample Number	TSTG-04 @ 265-268
Total Stress Analysis	

Point Number	$p-u_o$ (psi)	q (psi)
1	43.8	14.4
2	157.8	58.5
3	345.5	146.0

$\tan(\psi)$ = 0.4126
a = 0.0 psi

ϕ = 24.4 degrees
c = 0.0 psi



Consolidated-Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES, INC.
Project: **PD Tyrone/Stockpile Geotech**
Project Number: **053-2550**

Mohr-Coulomb Failure Criteria:

$$\tau_{ff} = c' + \sigma'_{ff} \tan(\phi')$$
$$\tau_{ff} = c + \sigma_{ff} \tan(\phi)$$

Where:
c', c = effective and total stress cohesion intercepts

ϕ', ϕ = effective and total stress friction angles

τ_{ff} = shear strength on the failure surface at failure

σ'_{ff}, σ_{ff} = effective and total normal stresses on the failure surface at failure

Stress Path Space:

$$q = \frac{\sigma_1 - \sigma_3}{2} \qquad p' = \frac{\sigma'_1 + \sigma'_3}{2} \qquad p = \frac{\sigma_1 + \sigma_3}{2}$$

Where:
q = maximum shear stress

p', p = mean effective and total stresses
σ'_1, σ_1 = effective and total axial stresses

σ'_3, σ_3 = effective and total confining stresses

Stress Path Failure Criteria:

$$q = a' + p' \tan(\psi')$$
$$q = a + (p - u_0) \tan(\psi)$$

Where:
a', a = intercepts of the q-axis in effective stress and total stress spaces

ψ', ψ = angles of the failure envelopes in effective stress and total stress spaces

q = maximum shear stress at failure

p' = mean effective stress at failure

$p\text{-}u_0$ = mean total stress at failure minus the initial pore pressure

The relationships between ψ and ϕ and a and c are as follows:

$$\tan(\psi) = \sin(\phi)$$
$$a = c \cos(\phi)$$

The relationships between ψ' and ϕ' and a' and c' are as follows:

$$\tan(\psi') = \sin(\phi')$$
$$a' = c' \cos(\phi')$$


PD TYRONE/STOCKPILE GEOTEC
053-2550
TSTG=4 @265-268
STAGED TRIAXIAL SHEAR TEST
Golder Associates, Inc.
Denver, Colorado

TECHNICAL MEMORANDUM

Golder Associates Inc.
4730 North Oracle Road, Suite 210
Tucson, Arizona, USA 85705

Telephone: 520-888-8818
Fax Access: 520-888-8817

TO:	Greg Schoen – Phelps Dodge Tyrone, Inc.	**DATE:**	July 14, 2006
FROM:	Tom Wythes, P.E., R.G. and Eugene Muller, P.E. - Golder Associates Inc.	**OUR REF.:**	053-2550
RE:	**TYRONE RECLAMATION NO. 1A AND 1B STOCKPILES STABILITY ANALYSIS**		

1.0 INTRODUCTION

Golder Associates Inc. (Golder) is performing slope stability studies of waste rock and leached ore stockpiles at Phelps Dodge Tyrone, Inc.'s (PDTI) Tyrone Mine to address the supplemental stability analysis requirements of Condition 78 of the New Mexico Environment Department's Discharge Permit (DP)-1341. PDTI is currently conducting reclamation activities at the No. 1A and 1B Stockpiles. Activities include regrading, relocation of PLS collection systems, and preparation of the stockpiles for reclamation cover placement.

At the No. 1A Stockpile, the toe of the leached ore will remain in its current location and regrading will involve removal of leached ore to create a final slope. At the No. 1B Stockpile, the toe of the ore will be advanced outward. Overall slopes of 3.5 horizontal to 1 vertical (3.5H:1V) are planned during final grading, and the surfaces will be reclaimed with ridge and valley erosion control features and a cover system. This technical memorandum presents an analysis of the post-reclamation configuration of the No. 1A and 1B Stockpiles.

2.0 OBJECTIVE

The purpose of this technical memorandum is to document foundation conditions and evaluate the stability of the reclaimed configuration of the No. 1A and 1B Stockpiles. These stability analyses focus on the stockpile outslopes where PDTI's current reclamation activities are occurring. Internal waste rock and leached ore stockpile slopes near the open pits and the external slopes along the east, west, and north sides of the Tyrone property have not been evaluated yet. These areas will be addressed at a later date when a long-term plan for reclamation of these sites has been developed.

3.0 METHOD

3.1 Overall Approach

Golder performed stability evaluations through a two-dimensional, limit equilibrium analysis with the computer program SLIDE (Rocscience, 2000) and application of Bishop's Method of Slices (Bishop, 1955) using effective stress parameters.

The following conditions were considered in the analyses:

- base-case (expected) conditions;
- the potential impact of long-term weathering and decrepitation of the leached ore, and the resulting reduction of strength;
- the potential impact of weathering and decrepitation of the interface beneath leached ore stockpiles and foundation, and the resulting reduction of shear strength;
- the potential for liquefaction of Quaternary alluvium (Qal) that occurs locally in the toe area; and
- the potential impact of weak fill material identified in the area of the No. 1B Stockpile PLS Pond.

Base-case stability analyses represent the predicted stability of the leached ore stockpiles based on measured strength properties. To address future and/or unknown conditions, Golder conducted sensitivity studies to determine the range in material strength required to maintain stable conditions. Sensitivity studies involve back calculation of minimum material strengths required to produce a minimally acceptable factor of safety of 1.0 with respect to slope stability.

3.2 Evaluation of Weathering and Decrepitation

The long-term effects of weathering and decrepitation on the strength of waste rock and leached ore at Tyrone have been investigated by EnviroGroup (2005a and 2005b) as a part of the supplemental materials characterization requirements of Condition 80 of DP-1341. The EnviroGroup studies supplement previous material characterization studies by Greystone and Daniel B. Stephens & Associates, Inc., which are referenced in EnviroGroup (2005a and 2005b). The results of the material characterization studies indicate that sulfide oxidation is occurring in the stockpiles, but at generally low rates due to the low sulfide concentrations.

There is a weak correlation between the age of the stockpile materials and the sulfide concentration suggesting that sulfide is being consumed over time. There is no clear relationship between grain size, mineralogy, or clay content (or other factors that may influence shear strength) with the age of the stockpile. The variability of these factors is overwhelmingly attributed to variability in the lithology and hydrothermal alteration of the ore and overburden, and the mechanical segregation of the materials as they were originally placed in the stockpile rather than post-placement weathering.

Currently, the geochemical characterization studies do not provide a direct means to assess the potential long-term strength reductions for the stockpile materials that may be attributable to weathering and chemical decrepitation. However, Condition 78 states that the stability analyses should account for changes in the chemical and physical properties of the stockpile materials from the time of deposition to present day and to a specified time during post-closure. To address this requirement, we have performed back-analyses to determine the minimum leached ore shear strength that results in a minimally acceptable factor of safety of 1.0 under pseudostatic loading.

To assess the potential that a weak layer at the stockpile-foundation interface will impact the stockpile stability, Golder completed a back-analyses of the required shear strength reduction to result in a computed factor of safety of 1.0 under pseudostatic loading using a block failure analysis.

3.3 Evaluation of Liquefaction

Golder performed an analysis of the seismically induced liquefaction potential of Qal near the No. 1B Stockpile. The analysis was based on Standard Penetration Test (SPT) blow counts for borehole intervals identified as Qal by Golder (2006c) during the No. 1B Stockpile PLS collection system redesign project. The measured SPT results in blows per foot for the Qal intervals in GA-05 and SB series boreholes were corrected by methods presented in Youd et al. (2001). The cyclic resistance and cyclic stress ratios ($CRR_{7.5}$ and CSR) were calculated for each interval. Local Qal test pit samples subjected to gradation tests indicate granular soils with a fines (minus 200 standard sieve) fraction of 10 to 20 percent in the No. 1B Stockpile Area. Therefore, calculation of the $CRR_{7.5}$ was based on the 15 percent fines content curve (Youd et al., 2001, Figure 2). In all calculations, the groundwater level was assumed to be at the pre-regraded ground surface level. Additional post-regrade surcharge loads that would increase confining pressure and enhance liquefaction resistance in the long term were not considered in the calculations.

The tabulated SPT data and the liquefaction potential calculations are contained in Attachment 1. In most instances, the corrected blow counts exceed 30, and the intervals are

considered non-liquefiable. In seven tests, the corrected blow counts were below 30. In five of the seven tests with corrected blow counts less than 30, the calculated factor of safety against liquefaction exceeded 2.0. In two tests, the calculated factor of safety was 1.0. Because these latter tests are located outside the proposed regrade area, the liquefaction potential in Qal beneath the regraded No. 1B Stockpile is considered low, and a stability analysis incorporating a residual strength representing a liquefied soil zone at Section A was not performed.

There is considerably less subsurface data available for the No. 1A Stockpile Area because relocation of the facility toe and PLS collection system is not proposed. The PDTI geologic map shows an area mapped as recent alluvium (Qal) beneath the No. 1A Stockpile at the location of Section C. The Qal in this area was buried by up to approximately 180 feet of stockpile material prior to regrading activities; therefore, the alluvium has been pre-consolidated, reducing its potential for liquefaction. Qal is also locally present in the foundation at the toe of the No. 1A Stockpile. At the toe, the Qal is not significantly pre-consolidated. No drillhole information is available in the area. PDTI monitoring records for nearby Well 1A-14 indicate the QTg contact at 39 feet below ground surface (ft bgs) and a dry well. Given unsaturated conditions in the alluvium, the potential for liquefaction in this area is considered low. Available information suggests a low potential for liquefaction at Section C. Because we do not have site-specific SPT blow count information for the alluvium in this area we have performed a stability analysis applying a residual shear strength consistent with a loose, clean sand to simulate liquefied alluvium. The results are reported in Section 6.3.

3.4 Evaluation of Weak Foundation Fill

During the geotechnical investigation for the PLS collection system area (Golder, 2006c), a zone of weak fill materials and sediment was identified within the ultimate footprint of the No. 1B Stockpile. Based on consolidation testing of a clayey fill sample, the potential for short-term, undrained loading conditions during construction was identified. Recommendations (Golder, 2006c) for mitigating undrained loading include placement of geogrid reinforcement, preliminary controlled placement of a limited quantity of fill, and construction of a structural fill berm at the final stockpile toe. Following controlled fill placement, the weak foundation fill will be allowed to consolidate for 10 weeks before regrading and final fill placement is resumed.

Proposed undrained loading mitigation measures are incorporated in the analysis of the long-term, post-reclamation stability of the No. 1B Stockpile. The impact of the weak fill zone on the stability of the No. 1B Stockpile was evaluated by applying a minimum shear strength of 8 degrees to the weak fill zone.

4.0 DEVELOPMENT OF THE STABILITY MODEL

4.1 Geometry, Geology, Groundwater, and Modeling Assumptions

Stability section locations and foundation geology are shown on Figure 1 with local boreholes, selected wells, and test pits. Stability cross-sections (Figure 2) show pre-mine, pre-regrade, and projected post-regrade surfaces. Groundwater depths from selected local wells as well as water table conditions applied in the stability evaluation are shown on the cross-sections. Geological contacts determined from geotechnical boreholes and well drilling records have been located on the sections.

The geological base map (Figure 1) is based on PDTI's mine area geology map. Section geology locally differs from that shown on the geologic base map because the sections have been updated to reflect recent geotechnical investigation results and post-geological mapping disturbances.

The compositional models included in the material characterization studies (EnviroGroup, 2005a and 2005b) provide additional information regarding the character of the materials. In general, the stockpile materials consist of clayey gravel with sand and contain 10 to 50 percent cobbles and boulders. The materials are dominantly porphyry leach cap with minor oxide copper and sulfides.

Groundwater considered in the stability analyses is limited to local perched water in basal zones where such conditions can reasonably be expected to occur either regularly or intermittently. Information regarding moisture conditions in the stockpiles is available from downhole geophysical logging in two sonic drillholes completed in the No. 3A Leach Stockpile and the No. 5A Waste Stockpile, and moisture testing in the No. 1A Stockpile. The No. 1 Stockpile has been under leach recently, and measured moisture contents are expected to be higher than those that can be anticipated during closure conditions. Testing of Rotosonic drillhole samples collected in October 2005 (Golder, 2006a) from the No. 1A Stockpile indicated gravimetric moisture contents ranging from 4.3 to 22.5 percent, and averaging 10.1 percent. Geophysical data (EnviroGroup, 2005a) from actively leached stockpiles indicate volumetric moisture contents in the range of 3 to 19 percent, with typical volumetric moisture contents in the range of 10 to 15 percent. This represents gravimetric moisture content averaging approximately 5 to 7.5 percent. Applying a dry unit weight of 120 pounds per cubic foot (pcf) and specific gravity of soil solids of 2.765 (the average from available laboratory testing), saturated conditions would occur at a gravimetric moisture content of 16 percent. Stockpile material properties are expected to vary; however, we believe that unsaturated conditions are indicated within the leached ore stockpiles.

These data are consistent with EnviroGroup (2005a and 2005b) findings, which indicate that the stockpiles are drained and that moisture content correlates with the grain size of the materials, with sands and gravels having low moisture content and zones with higher clay content having higher retained moisture. The stockpiles are considered to be, on the whole, unsaturated. We have applied a water table condition in the stability analyses that is perched on top of the pre-mine surface and daylights at the toe of the stockpile. The water table is assumed to rise under the stockpile with a gradient of approximately 8 percent to form a subdued reflection of the foundation topography as shown on Figure 2.

Elevated groundwater levels and local groundwater mounds in the stockpiles are not expected because of the drainage capacity of the waste rock and leached ore piles. In particular, the ore stockpiles have previously been leached at rates that exceed 100-year storm rainfall amounts on a daily basis. Under these conditions, saturation and instability did not occur. With the cessation of leaching operations, cover placement, and implementation of surface water management, the potential for elevated groundwater levels will be further reduced. The available information indicates that the stockpiles are currently drained and will remain drained in the long term.

4.2 No. 1B Stockpile

4.2.1 Geometry

Section A on Figure 2 illustrates geological, geotechnical, and hydrogeological conditions at the No. 1B Stockpile near the No. 1B PLS Pond. This section was selected for evaluation due to the presence of weak foundation fill.

Because the No. 1B Stockpile toe will be moved outward during stockpile regrading, the existing PLS collection system will be modified and relocated to accommodate the post-regrade configuration. Leached ore removed from the No. 1A Stockpile outslope will then be placed on the No. 1B Stockpile outslope to create the final 3.5H:1V surface.

The height of the ore stockpile at Section A is approximately 350 feet, and the location represents the maximum stockpile thickness. The foundation outslope is relatively flat based on pre-mine topography. The existing overall stockpile slope is approximately 3H:1V. Regrading will move the toe outward and produce a more gently sloping reclaimed surface.

4.2.2 Geology

In 2005 and 2006, Golder conducted a detailed geotechnical investigation of the new No. 1B PLS collection system area. Test Pits TP-1 through TP-12 and the SB series boreholes were

completed in August 2005. Boreholes GA-05-1 through -12 were completed in September 2005 and Test Pits TP-13 through TP-17 were completed in February 2006. Geotechnical exploration sites are shown on Figure 1. Geotechnical test results are reported by Golder (2006c).

At Section A, the interior of the stockpile overlies the Mangus Conglomerate, the local equivalent of the Gila Conglomerate (QTg). Alluvium, which is likely to be composed of weathered QTg, has been identified in local boreholes completed within the expanded footprint area. The expansion area also contains a former collection pond. As a result, the existing surface of the expansion area is covered with fill materials that include soft clayey fill (sediment) and granular fill derived from waste rock and alluvium. Contacts for the various foundation and fill units identified during drilling are shown on Section A.

Proposed foundation fill reinforcement and the structural fill berm at the toe of the regraded stockpile are incorporated in the stability model of Section A. A buried zone of Qal is inferred based on its occurrence in Borehole GA-05-02.

The stability section incorporates a basal ore zone that can be modeled as a weak stockpile-foundation interface.

Material properties for all foundation and fill units incorporated in Section A are discussed in Section 4.4 and summarized in Table 1.

4.2.3 Groundwater Conditions

Local Wells 1B-5, -6, and -7 are monitored by PDTI. The reported water depth is approximately 30 ft bgs within the QTg. A perched water zone is incorporated in the model. This zone is assumed to intersect the ground surface at the stockpile toe and continue under the stockpile with a surface gradient of approximately 8 percent.

4.3 No. 1A Stockpile

4.3.1 Geometry

Sections B and C illustrate conditions in the No. 1A Stockpile. Section B represents the location of the steepest foundation outslope (approximately 12 percent). The existing stockpile surface slope is approximately 2H:1V. The slope will be flattened to approximately 3.5H:1V by placing a buttress. The maximum thickness of the leached ore will be approximately 300 feet.

Section C was selected for analysis because the stockpile toe overlies Qal. The toe at Section C will remain fixed, and the existing slope will be reduced to 3.5H:1V by mining leached ore. The maximum slope height will be approximately 350 feet.

4.3.2 Geology

Conditions in the No. 1A Stockpile are illustrated on Sections B and C. At Section B, the stockpile is founded entirely on Gila Conglomerate. A basal leached ore zone was defined in the stability model to enable variation of stockpile-foundation interface strength for sensitivity analyses.

At Section C, the stockpile overlies Qal, QTg, and granitic bedrock. The stability analysis includes no differentiation between QTg and bedrock, and both materials are assigned the strength of the QTg. This is considered a conservative approach because granitic bedrock would be assigned a greater strength than the QTg, and its incorporation in the model would result in at least as high a computed factor of safety.

4.3.3 Groundwater

At Section C, PDTI monitoring data suggest that the groundwater is at a depth of at least 39 feet at the toe of the reclaimed stockpile. Monitoring data were not available for Section B.

A zone of perched water is assumed for stability analysis at Sections B and C as shown on Figure 2. The perched water level is assumed to intercept the ground surface at the stockpile toe, and the basal zone of the ore stockpile lies below the perched water table.

4.4 Material Properties

Materials considered in the stability analysis include leached ore, fill material, Qal, and QTg. Strength data have been determined through a number of geotechnical investigations and test programs, and the application of conservative assumptions. Analyses have been performed using effective stress strength parameters, and the effect of pore pressures was modeled by defining a static water table condition.

4.4.1 Leached Ore

Golder conducted strength tests on four leached ore samples collected from drillholes and test pits completed in the Tyrone Mine leached ore stockpiles. Results of triaxial and direct shear tests are reported in the *Tyrone Supplemental Stability Evaluation Interim Report*

(Golder, 2006a). The average angle of internal friction (ϕ) measured in the leached ore samples was 35.6 degrees, and cohesion averaged 0.95 pounds per square inch. Leached ore cohesion has been ignored in these stability analyses, and an internal friction angle of 35.5 degrees was assumed for leached ore in all base-case analyses.

To evaluate the potential impact of a decrease in leached ore strength due to long-term weathering and decrepitation, the internal friction of the ore was varied in the stability analyses to yield a factor of safety of 1.0 under seismic loading. The back-analyzed strengths that yield a factor of safety of 1.0 under seismic loading are reported for each stability section.

Geophysical data (EnviroGroup, 2005a) indicate leached ore density from 100 to 150 pcf. The leached ore is assumed to have a moist unit weight of 120 pcf and a saturated unit weight of 130 pcf. These unit weights represent typical values for gravelly soils.

4.4.2 Foundation Fill Zone

The fill zone identified during the PLS collection system design project (Golder, 2006c) is shown on Section A. Materials identified within this zone include waste rock, alluvial soil, and soft fill (sediment). The soft fill includes clayey soil identified on the basis of blow counts ranging from 2 to 9 blows per foot. A summary of SPT blow counts from the PLS relocation project is contained in Attachment 1. A sample of the clayey fill from Borehole GA-05-05 had a fines content of 68 percent and a plasticity index of 27. This material was classified as a low plasticity clay (CL).

In the undrained loading evaluation (Golder, 2006c), the strength of the soft fill zone was evaluated by various empirical correlations. Correlation to SPT blow counts indicates an internal friction angle between 10 and 37 degrees. Correlation to plasticity index suggests an internal friction angle of 12 degrees. For the base-case condition, the zone of weak, clayey fill is assumed to have a post–consolidation (long-term loading condition) internal friction angle of 15 degrees as proposed in the undrained loading evaluation (Golder, 2006c). We consider the application of an undrained shear strength to the evaluation of long-term stability to be very conservative.

An internal friction angle of 8 degrees was applied to the soft fill zone to evaluate potential uncertainty regarding the strength of the weak fill. This represents what is considered to be a minimum strength based on empirical correlation to SPT blow counts and index properties.

Consolidated, undrained (CU) triaxial tests conducted on two granular fill samples yielded effective internal friction angles of 40.2 and 40.5 degrees (Golder, 2006c). Gradation

analyses of the granular fill indicate that the material can be classified as clayey sand (SC). Granular fill in the No. 1B Stockpile toe area has been assigned a conservative shear strength of 30 degrees.

4.4.3 Quaternary Alluvium

Golder (2006c) tested a sample of alluvium recovered from the No. 1B PLS collection area and measured an effective internal friction angle of 39.1 degrees in a CU triaxial test. A detailed analysis of Qal samples in the Brick Kiln Gulch Area (Golder, 2006b) indicated an internal friction angle of 29 degrees based on empirical correlation to SPT results. An internal friction angle of 29 degrees was applied to Qal for all base-case analyses.

As discussed above, Qal within the regraded footprint of the No. 1B Stockpile has a low potential for liquefaction. For analysis of the liquefaction potential of Qal at the No. 1A Stockpile, the Qal was assigned a residual shear strength of 8 degrees. The resulting value is within the range of residual strength values for clean sand (5 to 11 degrees) reported by Vaid and Thomas (1994).

4.4.4 Gila Conglomerate

Call and Nicolas Inc. (1982) report a peak shear strength of 40.89 degrees from large-scale, direct shear testing of disturbed samples of Gila Conglomerate. We have applied an internal friction angle of 39 degrees for these stability analyses.

4.4.5 Basal Interface

A triaxial test was recently completed on basal interface material from Borehole TSGT-04 (265 to 269 feet) beneath the No. 2A Leach Stockpile. Laboratory data are contained in Attachment 1. This material exhibited an effective internal friction angle of 38 degrees. The defined stockpile-foundation interface zone in each stability section was assigned the strength of the leached ore (35.5 degrees) for base-case stability analyses. To evaluate the potential risk posed by a weak interface, Golder back-calculated the shear strength required to maintain a minimally acceptable safety factor of 1.0 under seismic loading conditions.

4.4.6 Summary of Material Properties

Material strength parameters applied in the stability models are summarized in Table 1. The leached ore, fill, alluvium, and Gila Conglomerate are assumed to have moist and saturated unit weights of 120 and 130 pcf, respectively.

TABLE 1
MATERIAL STRENGTH MATRIX, NO. 1A AND 1B STOCKPILES

Material	Base Case (ϕ Degrees)	Weak Interface (ϕ Degrees)	Weathered Ore (ϕ Degrees)	Effect of Weak Clay Fill (ϕ Degrees)	Liquefaction (Section C) (ϕ Degrees)
Leached Ore	35.5	35.5	Solve for FOS=1.0	35.5	35.5
Qal	29	29	29	29	8
Foundation Fill (Granular Fill, No. 1B Stockpile Only)	30	30	30	30	NA
Soft Fill (Clayey Fill, No. 1B Stockpile Only)	15	15	15	8	NA
Structural Fill (No. 1B Stockpile Only)	34	34	34	34	NA
Foundation Interface	35.5	Solve for FOS=1.0	35.5	35.5	35.5
Gila Conglomerate	39	39	39	39	39

Note:
FOS = factor of safety

4.5 Seismic Loading

Based on the seismic hazard analysis prepared by URS Corporation (2005), the peak ground acceleration for a 2,500-year return period at bedrock sites is between 0.08 and 0.09g. For sites underlain by local soils and Gila Conglomerate, magnification of bedrock acceleration was predicted to result in a peak acceleration of 0.18g at the ground surface. Hynes and Franklin (1984) discuss the selection of pseudostatic coefficients for use in dam design and recommend the use of one-half of the peak acceleration with a 20-percent reduction of the shear strength and a target factor of safety of 1.0. Bray et al. (1993) provide recommendations for seismic design of landfills and note that "the normalized fundamental periods of many solid waste landfills are greater than two, and that for these cases, the maximum horizontal equivalent acceleration value used to represent the seismic loading will be less than one-half of the bedrock maximum horizontal acceleration." Jansen (1985) states that an acceleration of 0.4 to 0.7 times peak ground acceleration is typically suitable for computing the sustained effect of an earthquake on embankment stability.

The No. 1A and 1B Stockpiles lie primarily on a foundation of Gila Conglomerate. A seismic acceleration equal to 0.66 times the amplified peak ground acceleration (i.e., 0.12g) for an event with a 2,500-year return period was used in pseudostatic analyses of these facilities. Golder believes this approach to be conservative and consistent with standard industry practice.

5.0 CALCULATIONS

Circular and block failure searches for critical failure surfaces were completed using SLIDE. Stability analyses were performed for existing base-case conditions under static and pseudostatic loading. In the block failure analyses, failure surface searches were configured to incorporate all foundation layers. In circular failure analyses, failure surface search limits were set to eliminate minor local failure.

Base-case analyses incorporate shear strengths measured or estimated based on current conditions and available test results. The results reflect conditions that we believe exist at present.

Analyses were performed to evaluate the potential impacts of strength loss in the stockpiles and the stockpile-foundation interface due to decrepitation and weathering. Decrepitated stockpile analyses were evaluated using a circular failure mode, while block failure searches were used to investigate the effects of a weakened stockpile-foundation interface. To evaluate a weak interface, the basal 10-foot thick zone of the leached ore was assigned a lower shear strength as discussed above.

The reported factors of safety are based on Bishop's (1955) Method of Slices. We consider factors of safety of 1.3 for static conditions and 1.0 for pseudostatic conditions as representing adequate safety factors for stockpiles and consistent with common industry practice. Where liquefaction analyses indicate low factors of safety, we have considered the consequence of failure. Where the consequence is low we consider a factor of safety of 1.0 as suitable.

6.0 RESULTS

6.1 No. 1B Stockpile Section A

Results of the stability analyses for the No. 1B Stockpile are presented in Table 2. SLIDE computer output is provided in Attachment 2. Circular and block failure surface searches indicate factors of safety of approximately 2.0 under static conditions for circular and block failure modes. Under seismic loading conditions, the predicted factor of safety is 1.3.

The friction angle of the waste rock was varied to determine the shear strength required to yield a factor of safety of 1.0 for pseudostatic loading. The resulting friction angle was 22.5 degrees. This analysis considered a circular failure mode with the failure surface constrained within the leached ore.

To determine the extent of foundation interface weathering that would be required to induce instability, the stockpile-foundation interface internal friction angle was varied until a factor of safety of 1.0 was predicted. A foundation interface friction angle of 13.5 degrees produced this condition in block failure mode under seismic loading.

The base-case analysis incorporates granular and clayey foundation fill strengths of 30 and 15 degrees, respectively. To evaluate the effect of weak clayey fill, circular and block failure analyses were conducted with the clayey fill assigned a minimum shear strength of 8 degrees. At minimum strength, the factor of safety under seismic loading was reduced from 1.3 to 1.2. Therefore we do not believe the existence of weak clayey fill poses a significant risk to the overall stockpile stability provided that design mitigation measures (Golder, 2006c) are applied.

The liquefaction potential of the alluvium near the toe of the No. 1B Stockpile was evaluated based on SPT blow count information as discussed in Section 3.3. The results indicate that there is a low potential for liquefaction to occur beneath the toe of the No. 1B Stockpile.

TABLE 2
STABILITY ANALYSIS SUMMARY NO. 1B STOCKPILE SECTION A

Condition	Cross-section	Static Factor of Safety	Pseudostatic Factor of Safety (0.12g)	Failure Analysis	Comment
Post-regrade	A	2.0[1]	1.3[2]	Circular	Base Case
	A	2.0[3]	1.3[4]	Block	Base Case
	A	NA	1.0[5]	Circular	Weathered Ore Evaluation, Back-Analyzed ϕ = 22.5º
	A	NA	1.0[6]	Block	Weak Interface Evaluation, Back-Analyzed ϕ = 13.5º
	A	NA	1.2[7]	Block	Weak Clayey Fill Evaluation ϕ = 8º
	A	NA	1.2[8]	Circular	Weak Clayey Fill Evaluation, ϕ = 8º

Note:
Numbers in parentheses indicate the numbered stability analysis output provided in Attachment 2.

6.2 No. 1A Stockpile, Section B

Stability analysis results for the No. 1A Stockpile Section B are contained in Attachment 3 and summarized in Table 3. For expected base-case conditions, the static safety factors are 2.0 and 2.2, respectively, in circular and block failure modes. Under pseudostatic loading, the factors of safety are 1.4 to 1.6.

Back calculations indicate that a minimum internal friction angle of 18.1 degrees is required for the stockpile-foundation interface in block failure mode under seismic loading at Section B. Evaluation of leached ore weathering and decrepitation indicates a minimum ore angle of internal friction of 24.8 degrees is required to maintain pseudostatic stability at Section B.

TABLE 3
STABILITY ANALYSIS SUMMARY NO. 1A STOCKPILE SECTION B

Condition	Cross-section	Static Factor of Safety	Pseudostatic Factor of Safety (0.12g)	Failure Analysis	Comment
Post-regrade	B	2.0[9]	1.4[10]	Circular	Base Case
	B	2.2[11]	1.6[12]	Block	Base Case
	B	NA	1.0[13]	Block	Weak Interface, Back Analyzed ϕ = 18.1º
	B	NA	1.0[14]	Circular	Weathered Ore Back-Analyzed ϕ = 24.8º

Note:
Numbers in parentheses indicate the numbered stability analysis output provided in Attachment 3.

6.3 No. 1A Stockpile, Section C

Stability model output for No. 1A Stockpile Section C is contained in Attachment 4 and summarized in Table 4. Base-case stability analyses indicate a static factor of safety of 2.2 for circular and block failure mode, with a factor of safety of 1.5 under seismic loading conditions.

Back calculation of weathered waste rock strength returned a minimum waste rock internal friction angle of 23.5 degrees for a safety factor of 1.0 at Section C. In evaluation of a weak stockpile-foundation interface, the strength required to maintain a factor of safety of 1.0 against block failure under seismic loading in Section C is 12 degrees.

In evaluating the effects of liquefaction, the Qal was assigned a residual shear strength of 8 degrees. The computed factors of safety for circular and block failure modes are 1.5 and 1.2, respectively.

TABLE 4
STABILITY ANALYSIS SUMMARY NO. 1A STOCKPILE SECTION C

Condition	Cross-section	Static Factor of Safety	Pseudostatic Factor of Safety (0.12g)	Failure Analysis	Comment
Post Regrade 7A East	C	2.2[15]	1.5[16]	Circular	Base Case
	C	2.2[17]	1.5 [18]	Block	Base Case
	C	NA	1.0[19]	Block	Weak Interface, Back-Analyzed ϕ = 12º
	C	NA	1.0 [20]	Circular	Weathered Ore Back-Analyzed ϕ = 23.5º
	C	1.5[21]	NA	Circular	Liquefaction Analysis, Qal ϕ = 8º
	C	1.2[22]	NA	Block	Liquefaction Analysis, Qal ϕ = 8º

Note:
Numbers in parentheses indicate the numbered stability analysis output provided in Attachment 4

7.0 CONCLUSIONS

The base-case strength properties used in these stability analyses are based primarily on recent and previously completed geotechnical testing. Base-case properties represent the material strengths that we expect to exist under current conditions. Stability evaluations incorporating base-case strength properties indicate that the No. 1A and 1B Stockpiles will be stable under their post-reclamation configurations.

The effects of weathering and decrepitation on the grain-size distribution and strength of waste rock and leached ore have not been unequivocally determined on the basis of the material characterization studies completed for Tyrone. General conclusions suggest that little loss of strength should be anticipated given the lithology of the ore, its current state of alteration, and the ambient conditions to which it is exposed. The effect of the reduction of leached ore and stockpile-foundation interface strength was evaluated indirectly through back analyses. Shear strengths were varied to determine minimum strengths required to maintain a pseudostatic factor of safety of 1.0. These analyses were performed to enable estimation of the extent of strength loss that can be tolerated before instability could occur and to assess the potential risk that weathering and decrepitation may have on the long-term stockpile stability.

PDTI is currently regrading waste rock and leached ore slopes to approximately 3.5H:1V. At this slope angle, a minimum internal friction angle of 23 to 25 degrees will be required to produce a pseudostatic factor of safety of 1.0. The average measured internal friction angle of the sampled stockpile materials from laboratory shear strength testing is 35.6 degrees (Golder, 2006a). A considerable change in the physical condition of the ore will be required

to enable a slope failure; however, material characterization studies do not predict significant changes in material properties over time.

To evaluate tolerable strength reduction along a stockpile-foundation interface due to decrepitation, the internal friction angle in a 10-foot thick basal layer of the stockpile was varied until a safety factor of 1.0 was predicted under seismic loading conditions. The internal friction angle required for this condition is the minimum tolerable foundation interface strength for the group of assumptions and conditions considered in the stability models. Interface friction angles of 10 to 18 degrees are required to resist basal sliding failure under the design seismic event. The highest required strength (18 degrees) is at Section B, which models a steep interface slope near the toe of the stockpile.

Based on the back-calculation of the strength reduction of the stockpile material resulting from weathering and decrepitation, a considerable loss of strength will be required to induce instability in the long term. For leached ore, a strength reduction in excess of 32 percent of laboratory-measured values will be required to induce a circular failure under seismic loading conditions. The laboratory-measured values are from the soil matrix component of the stockpiles, and we consider that this represents the fully weathered (or decrepitated) condition of the stockpiles. The stockpile/foundation interface shear strength that results in a factor of safety of 1.0 for sliding failure at the stockpile-foundation interface at most locations is approximately 40 percent of the average stockpile strength. At Section B, a 50-percent strength reduction is required for instability under seismic loading conditions. Therefore, a long-term reduction in stability due to basal interface weathering is also not expected.

Regrading of the No. 1B Stockpile will result in outward movement of the toe over Qal. SPT test results indicate relatively high density in drillhole intervals identified as Qal near the No. 1B Stockpile PLS collection facilities. Therefore, Golder did not perform an analysis of liquefaction potential at Section A. At Section C in the No. 1A Stockpile, assumption of residual shear strength in the Qal indicated a minimum factor of safety of 1.2.

The stability analyses completed for the No. 1A and 1B Stockpiles indicate that the stockpiles will be stable in their post-reclamation configurations. Evaluations of the potential impacts of long-term weathering indicate that a very significant reduction in the shear strength, compared to laboratory-measured values of the stockpile material, would be required to lead to slope instability. The material characterization studies that have been completed do not support this expectation.

8.0 REFERENCES

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Attachments:

Figures 1 and 2

Attachment 1- Blow Count Summary 1B PLS Collection Relocation Project
Liquefaction Potential Calculations
Triaxial Test Results, Basal Interface Material

Attachment 2 - Stability Output, No. 1B Stockpile Section A,

Attachment 3 - Stability Output, No. 1A Stockpile Section B

Attachment 4 - Stability Output, No. 1A Stockpile Section C

FIGURES

ATTACHMENT 1

BLOW COUNT SUMMARY
NO. 1B PLS COLLECTION RELOCATION PROJECT
TRIAXIAL TEST RESULTS, BASAL INTERFACE MATERIAL

ATTACHMENT 2

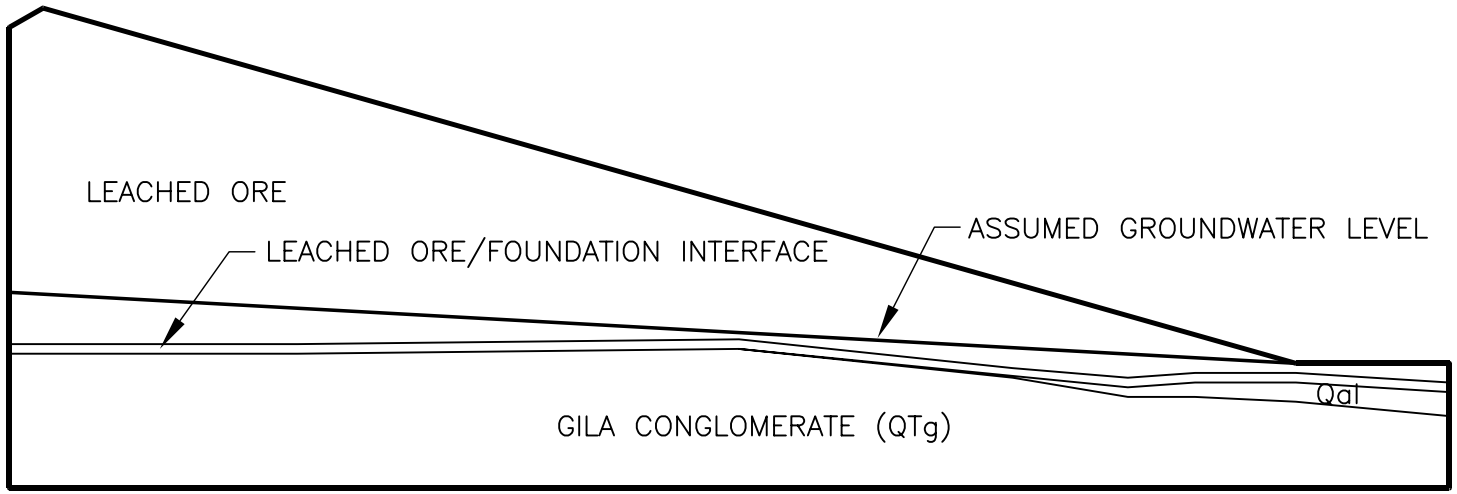
STABILITY OUTPUT – SECTION A, NO. 1B STOCKPILE

ATTACHMENT 3

STABILITY OUTPUT – SECTION B, NO. 1A STOCKPILE

ATTACHMENT 4

STABILITY OUTPUT – SECTION C NO. 1A STOCKPILE



C **CROSS-SECTION C**

PROJECT
phelps dodge Tyrone Inc.

SUPPLEMENTAL STABILITY ANALYSIS
TYRONE MINE, NEW MEXICO

TITLE

CROSS-SECTION C, No. 1A STOCKPILE MATERIAL IDENTIFICATION

Golder Associates
Tucson, Arizona

PROJECT No.		053–2550	FILE No.	0532550C003
DESIGN	GM	05/31/06	SCALE AS SHOWN	REV. A
CADD	ANV	06/05/06		
CHECK	GM	06/05/06		
REVIEW	DAK	07/13/06		

FIGURE 4.1