COLORADO
Division of Reclamation, Mining and Safety
Department of Natural Resources
1313 Sherman Street, Room 215
Denver, CO 80203

Date: July 1, 2019

To: Jared Ebert; Division of Reclamation, Mining & Safety

From: Peter Hays; Division of Reclamation, Mining & Safety

Re: Albert Frei & Sons; Bennett Pit; File No. M-2001-038; Review of Stability Analysis (AM-01)

The Division of Reclamation, Mining and Safety (Division/DRMS) staff reviewed the geotechnical stability exhibit included with the Bennet Pit 112c permit amendment application (AM-01) submitted on June 17, 2019. The Applicant will need to address the following adequacy items identified in the review:

The following list describes the information used by the Division as presented in the permit amendment application to evaluate slope stability for the proposed site.

- The stability analysis addresses the plan to mine within 200 feet of the Copeland Trust owned structures only – fence and residence.
- The maximum mining excavation depth near the Copeland property is 55 feet below grade.
- The closest structure for which there is no damage agreement is the Copeland owned fence along the south permit boundary.
- The Copeland house is approximately 94 feet southwest of the south permit boundary.
- The setback (dig line) from the property line is 25 feet.
- The final 3H:1V slope will be mined from the dig line to the toe of permanent slope.
- The friction angle used for the alluvial sands is 42 degrees determined from previous studies.
- The unit weight for the alluvial sands is 116lb/ft^3.
- The alluvial sand is considered cohesionless for the analysis.
- No laboratory strength tests were performed on soils at the site.
- No borehole data was submitted by the Applicant.
- No groundwater will be exposed. Groundwater was modeled two (2) feet below the pit floor.

The following information is required by the Division to complete the stability analysis review.

1. On Page 4 of the Mining Plan revised on June 14, 2019, the Application states, "Along the affected lands/permit line the mining setback will be 25 feet. The exception to this is along the south permit line. In this area due to structures adjacent to the permit. In this area a working face setback of 70 feet stacked from Permit line. North of this line the working face will be worked approximately ½:1 but when mining reached this setback line mining will done on the final 3:1 grade."

   Please explain how the Applicant intends to mine from the 70 feet offset to the final 25 feet offset at the final 3H:1V slope when the toe of the permanent slope will have already been excavated.

   Based on Section B - 3H to 1V Reclaimed Slope for Fence cross-section provided in the geotechnical analysis the Division recommends the Applicant begin mining along the south boundary at a 3H:1V slope at the toe of permanent slope - 202 feet from the fence/property line.

2. On Page 1 of the geotechnical stability exhibit, the Applicant states the friction angle for alluvial sands is 42° based on previous studies. The Division typically uses a friction angle of 37° for generalized material properties for alluvial sand. Please provide the Division with the previous studies or site specific material property tests to justify the use of a 42° friction angle in the geotechnical analysis.

3. On Page 1 of the geotechnical stability exhibit, the Applicant states as mining approaches the perimeter of the mine a 25 foot mining setback will be staked from the permit line to establish the mining limit. An additional safety setback line of 25 feet will be staked from the mining setback line to establish the limit that mining with vertical face will stop. Please explain how the Applicant intends to mine the area between the 25 feet setback from the permit line and 25 feet safety setback.

4. One Pages 2 and 3 of the geotechnical stability exhibit, the Applicant states the second cross section was a calculation to confirm that the 3:1 slope would be in the guidelines and the safety factor was calculated to be FS = Tan42°/Tan17.1° = 3.93. The factor of safety listed on Sheet 2 of 2 of the exhibit is 2.93 for the same slope. Please review the safety factor value within both exhibits and explain the discrepancy.

In accordance with Table 1 - Recommended Factors of Safety for Slope Stability Analysis for Operations and Reclamation within Section 30.4 of the Policies of the Mined Land Reclamation Board effective May 16, 2018, the Division will require the Applicant to comply with the factor of safety (FOS) of 1.3 for the fence (non-critical structures) and a factor of safety of 1.5 for the

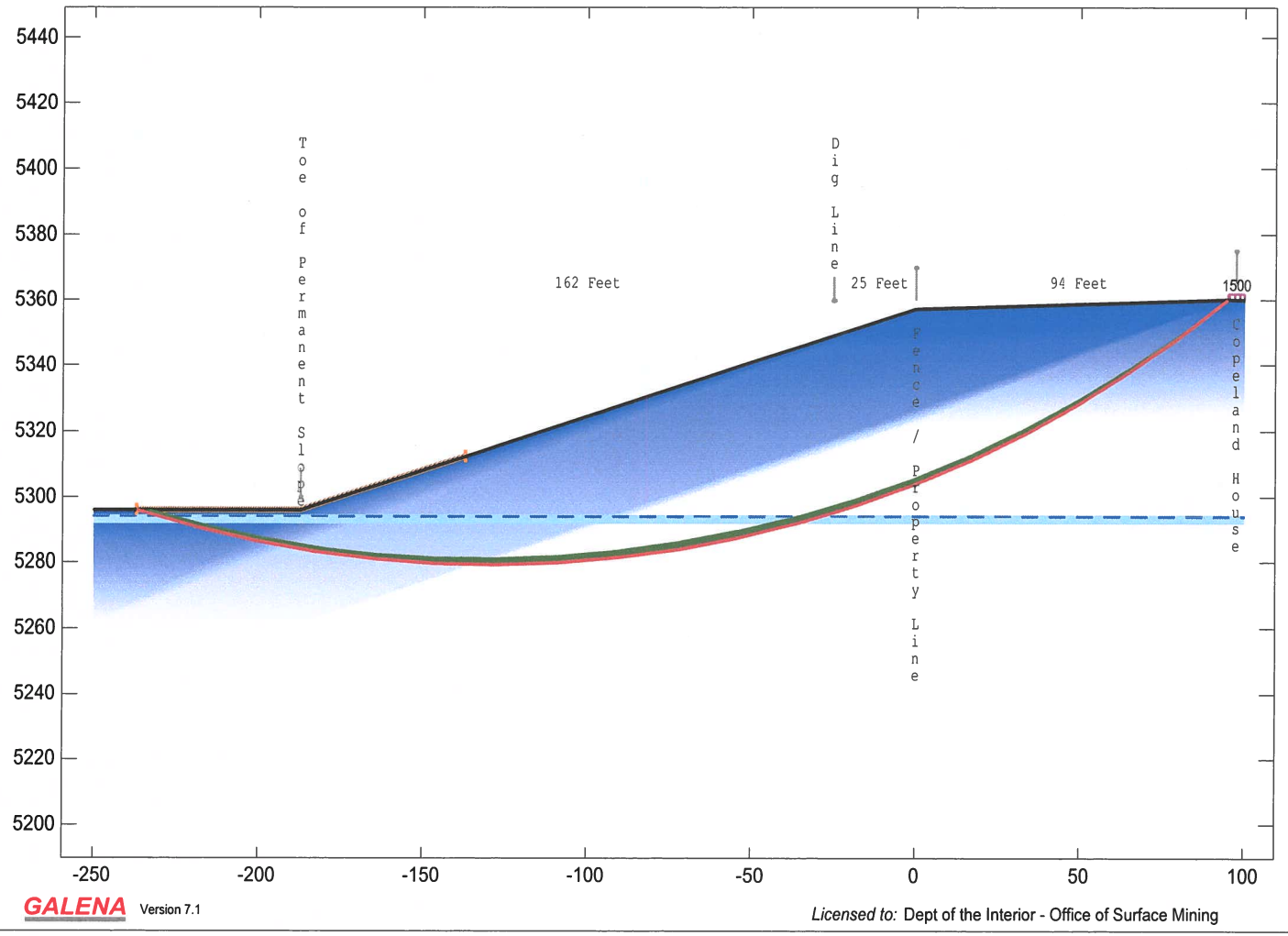
house (critical structure) since the Applicant utilized generalized strength measurements in the analysis.

The Applicant used an internal friction of 42 degrees. The Division typically uses an internal friction angle of 37 degrees for sand and gravel material when laboratory strength values are not available, Item # 2 above. The Division duplicated the Applicant's slope stability analysis using Clover Technologies Galena Slope Stability Analysis System, Version 7.10. A table of the Applicant's and the Division's analysis results for both friction angles are below:

	Applicant's FOS	DRMS FOS - 42°	DRMS FOS - 37°
Section A – 3H:1V Slope - Copeland House	3.96	3.69	3.09
Section A – 0.5H:1V Slope - Copeland House	2.08	2.30	1.92
Section B – 3H:1V Slope - Copeland Fence	2.93	2.87	2.40
Section B – 0.5H:1V Slope - Copeland Fence	1.53	1.56	1.30

The Division verified the safety factors produced by the stability analysis for the two (2) critical cross-sections meet the requirements set by the Division. However, the Applicant must address the adequacy items above prior to the Division accepting the geotechnical stability analysis for the Bennett Pit amendment application. Copies of the Division's Galena stability analysis results are attached.

If you have any questions regarding these adequacy items, please contact me at peter.hays@state.co.us or (303) 866-3567, Ext. 8124.



GALENA Version 7.1

Licensed to: Dept of the Interior - Office of Surface Mining

Material Keys

1: Dense Sand

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 3.69

Edited: 27 Jun 2019 *Processed:* 30 Jun 2019

Project Albert Frei and Sons, Inc. - Bennett Pit - AM-01 - M-2001-038
Copeland House - Final 3H:1V Grade

File: G:\My Drive\1 - My Projects Google\8 Galena - Stability Analysis Models\Frei - Bennett Pit\Copeland House.gmf

GALENA 7.1 Analysis Results Version: 7.10.2.04 Licensee: Dept of the Interior - Office of Surface Mining

Project: Albert Frei and Sons, Inc. - Bennett Pit - AM-01 - M-2001-038
File: G:\My Drive\1 - My Projects Google\8 Galena - Stability Analysis Models\Frei - Bennett Pit\Copeland House.gmf
Processed: 30 Jun 2019 13:17:53

DATA: Analysis 1 - Copeland House - Final 3H:1V Grade

Material Properties (1 material)

Material: 1 (Mohr-Coulomb Isotropic) - Dense Sand

Cohesion	Phi	UnitWeight	Ru
0.00	42.0	116.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 0.000

Material Profiles (1 profile)

Profile: 1 (2 points) Material beneath: 1 - Dense Sand

-250.00	5360.00	100.00	5360.00

Slope Surface (5 points)

-250.00	5296.00	-187.00	5296.00	0.00	5357.00	95.00	5360.00	100.00	5360.00

Phreatic Surface (3 points)

-250.00	5294.00	-190.00	5294.00	100.00	5294.00

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	-187.00	YL:	5296.00	XR:	95.00	YR: 5360.00
Centre:	XC:	-123.06	YC:	5667.54		Radius: R:	377.00

Distributed Loads (1 load)

Load	X-Left	Pressure	X-Right	Pressure
1	95.00	1500.0	100.00	1500.0

Variable Restraints

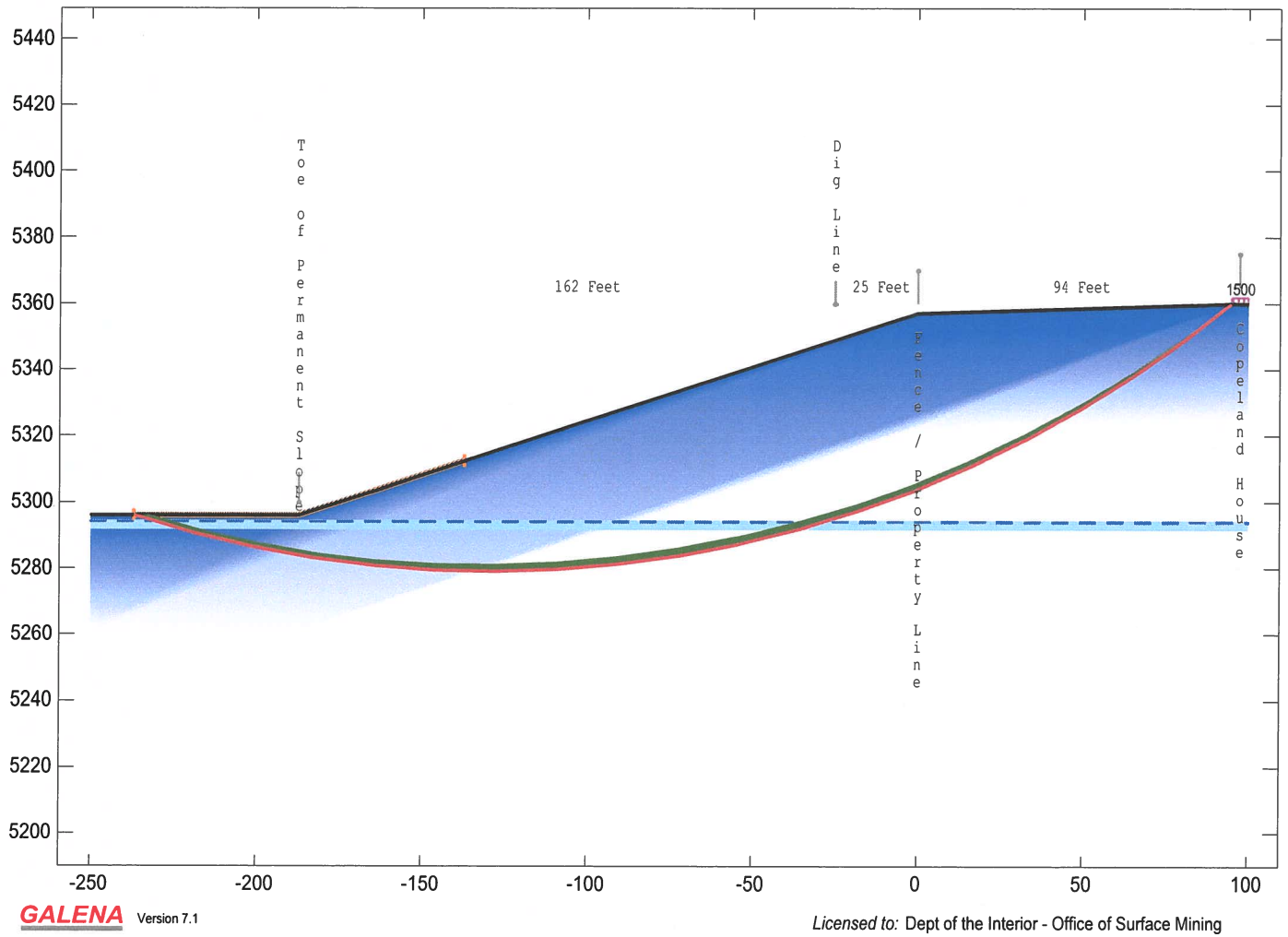
Parameter descriptor:	XL	XR	R
Range of variation:	100.00	0.00	50.00
Trial positions within range:	100	1	100

- -

RESULTS: Analysis 1 - Copeland House - Final 3H:1V Grade

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques



GALENA Version 7.1

Licensed to: Dept of the Interior - Office of Surface Mining

Material Keys

1: Dense Sand

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 3.09

Edited: 27 Jun 2019 *Processed:* 30 Jun 2019

Project Albert Frei and Sons, Inc. - Bennett Pit - AM-01 - M-2001-038
Copeland House - Final 3H:1V Grade - 37 Degree Friction Angle

File: G:\My Driv...\Copeland House - 37 Degree Friction Angle.gmf

GALENA 7.1 Analysis Results Version: 7.10.2.04 Licensee: Dept of the Interior - Office of Surface Mining

Project: Albert Frei and Sons, Inc. - Bennett Pit - AM-01 - M-2001-038
File: G:\My Drive\1 - My Projects Google\8 Galena - Stability Analysis Models...\Copeland House - 37 Degree Friction Angle.gmf
Processed: 30 Jun 2019 13:16:32

DATA: Analysis 1 - Copeland House - Final 3H:1V Grade - 37 Degree Friction Angle

Material Properties (1 material)

Material: 1 (Mohr-Coulomb Isotropic) - Dense Sand

Cohesion	Phi	UnitWeight	Ru
0.00	37.0	116.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 0.000

Material Profiles (1 profile)

Profile: 1 (2 points) Material beneath: 1 - Dense Sand

-250.00	5360.00	100.00	5360.00

Slope Surface (5 points)

-250.00	5296.00	-187.00	5296.00	0.00	5357.00	95.00	5360.00	100.00	5360.00

Phreatic Surface (3 points)

-250.00	5294.00	-190.00	5294.00	100.00	5294.00

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	-187.00	YL:	5296.00	XR:	95.00	YR: 5360.00
Centre:	XC:	-123.06	YC:	5667.54	Radius:	R:	377.00

Distributed Loads (1 load)

Load	X-Left	Pressure	X-Right	Pressure
1	95.00	1500.0	100.00	1500.0

Variable Restraints

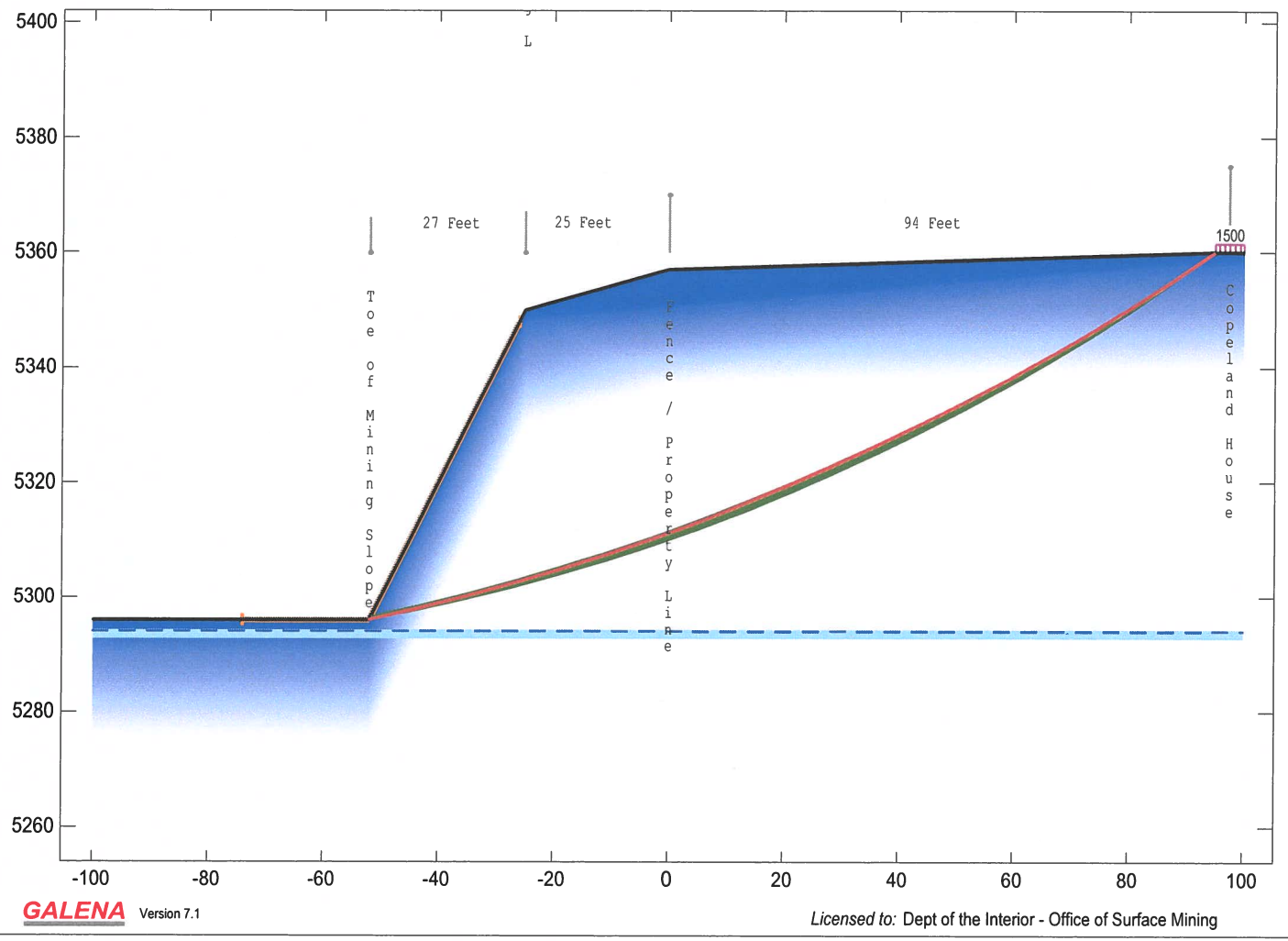
Parameter descriptor:	XL	XR	R
Range of variation:	100.00	0.00	50.00
Trial positions within range:	100	1	100

- -

RESULTS: Analysis 1 - Copeland House - Final 3H:1V Grade - 37 Degree Friction Angle

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques



GALENA Version 7.1

Licensed to: Dept of the Interior - Office of Surface Mining

Material Keys

1: Dense Sand

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 2.30

Edited: 27 Jun 2019 *Processed:* 30 Jun 2019

Project Albert Frei and Sons, Inc. - Bennett Pit - AM-01 - M-2001-038
Copeland House - Mining 0.5H:1V Slope

File: G:\My Drive\1 - My Projects Google\8 Galena - Stability Analysis Models\Frei - Bennett Pit\Copeland House Mining Slope.gmf

GALENA 7.1 Analysis Results Version: 7.10.2.04 Licensee: Dept of the Interior - Office of Surface Mining

Project: Albert Frei and Sons, Inc. - Bennett Pit - AM-01 - M-2001-038
File: G:\My Drive\1 - My Projects Google\8 Galena - Stability Analysis Models\Frei - Bennet...\Copeland House Mining Slope.gmf
Processed: 30 Jun 2019 13:17:29

DATA: Analysis 1 - Copeland House - Mining 0.5H:1V Slope

Material Properties (1 material)

Material: 1 (Mohr-Coulomb Isotropic) - Dense Sand

Cohesion	Phi	UnitWeight	Ru
0.00	42.0	116.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 0.000

Material Profiles (1 profile)

Profile: 1 (2 points) Material beneath: 1 - Dense Sand

-100.00	5360.00	100.00	5360.00

Slope Surface (6 points)

-100.00	5296.00	-52.00	5296.00	-25.00	5350.00	0.00	5357.00	95.00	5360.00
100.00	5360.00								

Phreatic Surface (2 points)

-100.00	5294.00	100.00	5294.00

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	-50.00	YL:	5300.00	XR:	95.00	YR: 5360.00
Centre:	XC:	-118.49	YC:	5670.73	Radius:	R:	377.00

Distributed Loads (1 load)

Load	X-Left	Pressure	X-Right	Pressure
1	95.00	1500.0	100.00	1500.0

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	48.00	0.00	100.00
Trial positions within range:	100	1	100

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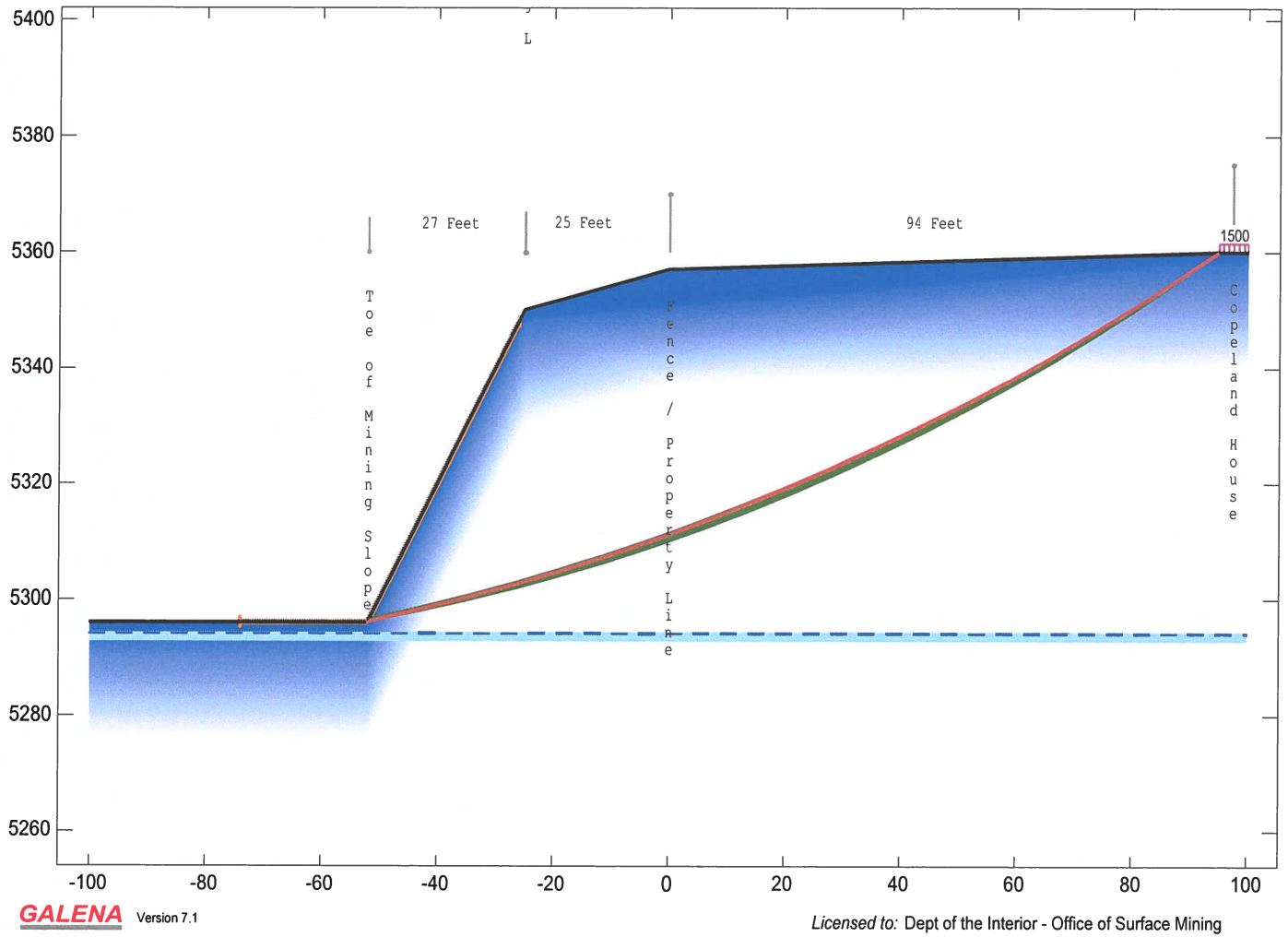
RESULTS: Analysis 1 - Copeland House - Mining 0.5H:1V Slope

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques



Licensed to: Dept of the Interior - Office of Surface Mining

Material Keys

1: Dense Sand

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 1.92

Edited: 27 Jun 2019 *Processed:* 30 Jun 2019

Project Albert Frei and Sons, Inc. - Bennett Pit - AM-01 - M-2001-038
Copeland House - Mining 0.5H:1V Slope - 37 Degree Friction Angle

File: G:\My Driv...\Copeland House Mining Slope - 37 Degree Friction Angle.gmf

GALENA 7.1 Analysis Results Version: 7.10.2.04 Licensee: Dept of the Interior - Office of Surface Mining

Project: Albert Frei and Sons, Inc. - Bennett Pit - AM-01 - M-2001-038
File: G:\My Drive\1 - My Projects Google\8 Galena - Stability An...\Copeland House Mining Slope - 37 Degree Friction Angle.gmf
Processed: 30 Jun 2019 13:17:03

DATA: Analysis 1 - Copeland House - Mining 0.5H:1V Slope - 37 Degree Friction Angle

Material Properties (1 material)

Material: 1 (Mohr-Coulomb Isotropic) - Dense Sand

Cohesion	Phi	UnitWeight	Ru
0.00	37.0	116.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 0.000

Material Profiles (1 profile)

Profile: 1 (2 points) Material beneath: 1 - Dense Sand

-100.00	5360.00	100.00	5360.00

Slope Surface (6 points)

-100.00	5296.00	-52.00	5296.00	-25.00	5350.00	0.00	5357.00	95.00	5360.00
100.00	5360.00								

Phreatic Surface (2 points)

-100.00	5294.00	100.00	5294.00

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	-50.00	YL:	5300.00	XR:	95.00	YR: 5360.00
Centre:	XC:	-118.49	YC:	5670.73	Radius:	R:	377.00

Distributed Loads (1 load)

Load	X-Left	Pressure	X-Right	Pressure
1	95.00	1500.0	100.00	1500.0

Variable Restraints

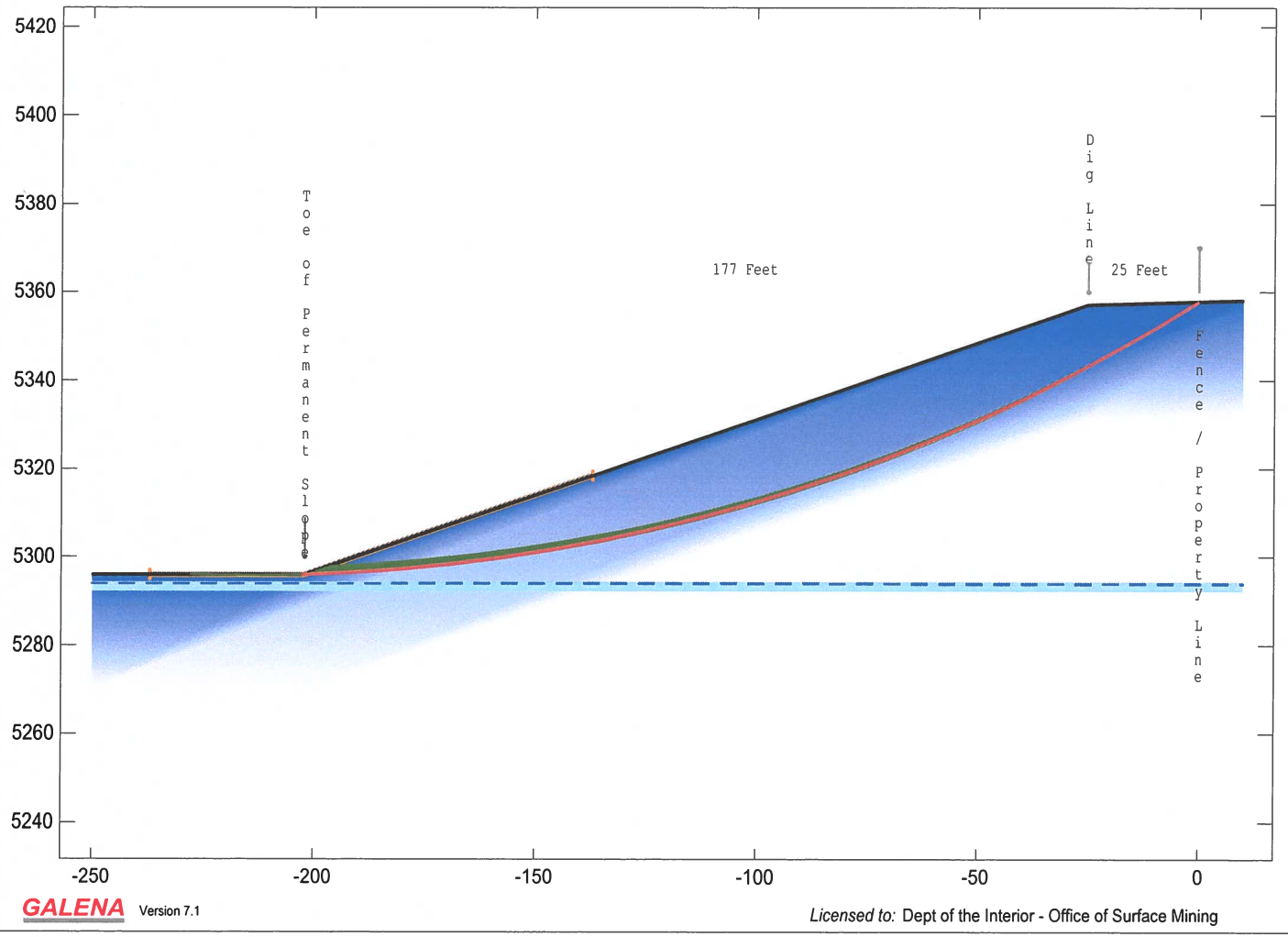
Parameter descriptor:	XL	XR	R
Range of variation:	48.00	0.00	100.00
Trial positions within range:	100	1	100

- -

RESULTS: Analysis 1 - Copeland House - Mining 0.5H:1V Slope - 37 Degree Friction Angle

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques



GALENA Version 7.1

Licensed to: Dept of the Interior - Office of Surface Mining

Material Keys

1: Dense Sand

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 2.87

Edited: 27 Jun 2019 *Processed:* 30 Jun 2019

Project Albert Frei and Sons, Inc. - Bennett Pit - AM-01 - M-2001-038
Copeland Fence - Final 3H:1V Grade

File: G:\My Drive\1 - My Projects Google\8 Galena - Stability Analysis Models\Frei - Bennett Pit\Copeland Fence.gmf

GALENA 7.1 Analysis Results Version: 7.10.2.04 Licensee: Dept of the Interior - Office of Surface Mining

Project: Albert Frei and Sons, Inc. - Bennett Pit - AM-01 - M-2001-038
File: G:\My Drive\1 - My Projects Google\8 Galena - Stability Analysis Models\Frei - Bennett Pit\Copeland Fence.gmf
Processed: 30 Jun 2019 13:16:11

DATA: Analysis 1 - Copeland Fence - Final 3H:1V Grade

Material Properties (1 material)

Material: 1 (Mohr-Coulomb Isotropic) - Dense Sand

Cohesion	Phi	UnitWeight	Ru
0.00	42.0	116.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 0.000

Material Profiles (1 profile)

Profile: 1 (2 points) Material beneath: 1 - Dense Sand

-250.00	5360.00	10.00	5360.00

Slope Surface (4 points)

-250.00	5296.00	-202.00	5296.00	-25.00	5357.00	10.00	5358.00

Phreatic Surface (3 points)

-250.00	5294.00	-190.00	5294.00	10.00	5294.00

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	-187.00	YL:	5301.17	XR:	0.00	YR: 5357.71
Centre:	XC:	-198.89	YC:	5677.98	Radius:	R:	377.00

Variable Restraints

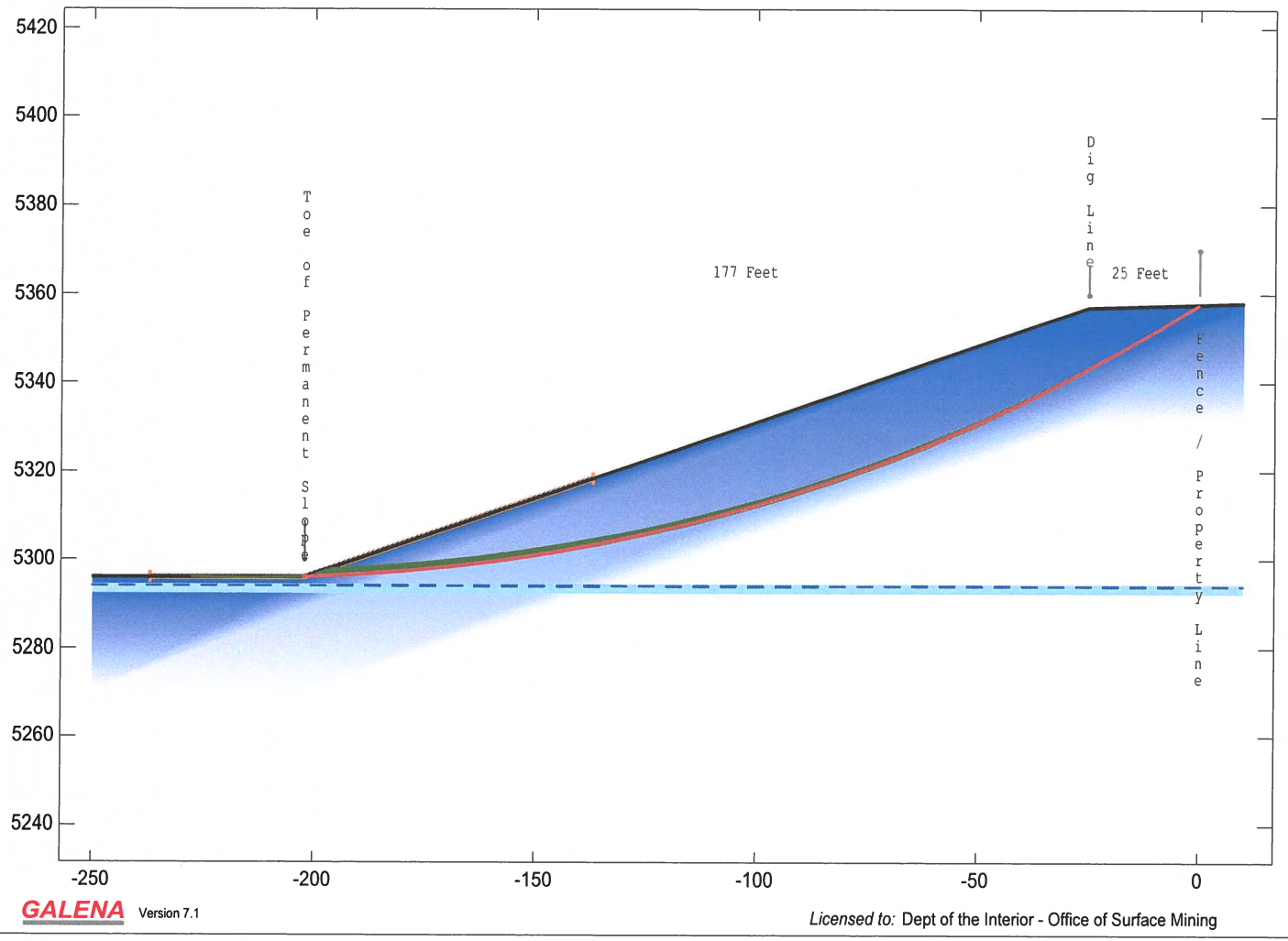
Parameter descriptor:	XL	XR	R
Range of variation:	100.00	0.00	50.00
Trial positions within range:	100	1	100

- -

RESULTS: Analysis 1 - Copeland Fence - Final 3H:1V Grade

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques



GALENA Version 7.1

Licensed to: Dept of the Interior - Office of Surface Mining

Material Keys

1: Dense Sand

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 2.40

Edited: 27 Jun 2019 *Processed:* 30 Jun 2019

Project Albert Frei and Sons, Inc. - Bennett Pit - AM-01 - M-2001-038
Copeland Fence - Final 3H:1V Grade - 37 Degree Friction Angle

File: G:\My Driv...\Copeland Fence - 37 Degree Friction Angle.gmf

GALENA 7.1 Analysis Results Version: 7.10.2.04 Licensee: Dept of the Interior - Office of Surface Mining

Project: Albert Frei and Sons, Inc. - Bennett Pit - AM-01 - M-2001-038
File: G:\My Drive\1 - My Projects Google\8 Galena - Stability Analysis Models...\Copeland Fence - 37 Degree Friction Angle.gmf
Processed: 30 Jun 2019 13:14:48

DATA: Analysis 1 - Copeland Fence - Final 3H:1V Grade - 37 Degree Friction Angle

Material Properties (1 material)

Material: 1 (Mohr-Coulomb Isotropic) - Dense Sand

Cohesion	Phi	UnitWeight	Ru
0.00	37.0	116.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 0.000

Material Profiles (1 profile)

Profile: 1 (2 points) Material beneath: 1 - Dense Sand

-250.00	5360.00	10.00	5360.00

Slope Surface (4 points)

-250.00	5296.00	-202.00	5296.00	-25.00	5357.00	10.00	5358.00

Phreatic Surface (3 points)

-250.00	5294.00	-190.00	5294.00	10.00	5294.00

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	-187.00	YL:	5301.17	XR:	0.00	YR: 5357.71
Centre:	XC:	-198.89	YC:	5677.98		Radius:	R: 377.00

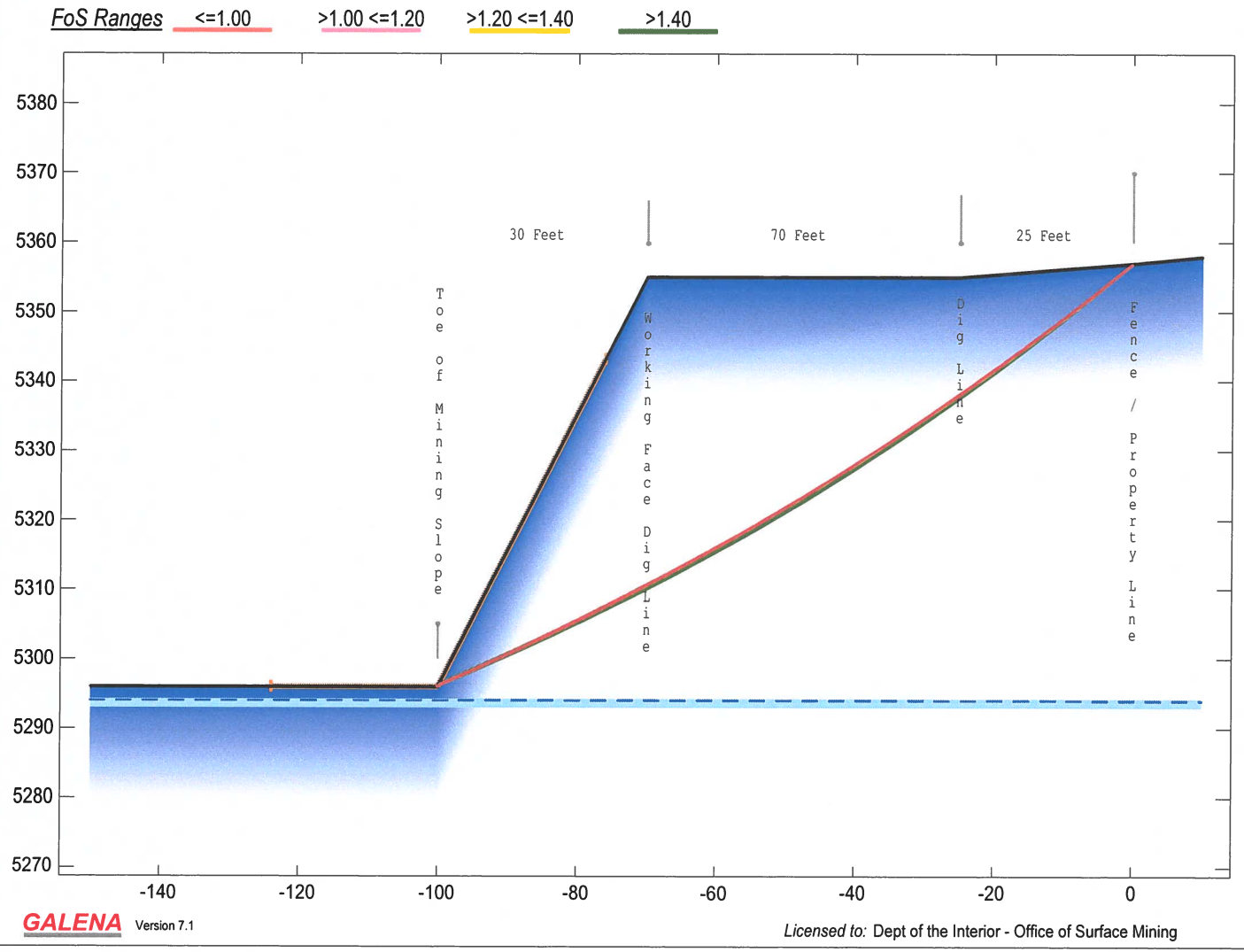
Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	100.00	0.00	50.00
Trial positions within range:	100	1	100

RESULTS: Analysis 1 - Copeland Fence - Final 3H:1V Grade - 37 Degree Friction Angle

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques



GALENA Version 7.1

Licensed to: Dept of the Interior - Office of Surface Mining

Material Keys

1: Dense Sand

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 1.56

Edited: 27 Jun 2019 *Processed:* 30 Jun 2019

Project Albert Frei and Sons, Inc. - Bennett Pit - AM-01 - M-2001-038
Copeland Fence - Mining 0.5H:1V Slope

File: G:\My Drive\1 - My Projects Google\8 Galena - Stability Analysis Models\Frei - Bennett Pit\Copeland Fence Mining Slope.gmf

GALENA 7.1 Analysis Results Version: 7.10.2.04 Licensee: Dept of the Interior - Office of Surface Mining

Project: Albert Frei and Sons, Inc. - Bennett Pit - AM-01 - M-2001-038
File: G:\My Drive\1 - My Projects Google\8 Galena - Stability Analysis Models\Frei - Bennet...\Copeland Fence Mining Slope.gmf
Processed: 30 Jun 2019 13:15:41

DATA: Analysis 1 - Copeland Fence - Mining 0.5H:1V Slope

Material Properties (1 material)

Material: 1 (Mohr-Coulomb Isotropic) - Dense Sand

Cohesion	Phi	UnitWeight	Ru
0.00	42.0	116.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 0.000

Material Profiles (1 profile)

Profile: 1 (2 points) Material beneath: 1 - Dense Sand

-150.00	5360.00	10.00	5360.00

Slope Surface (6 points)

-150.00	5296.00	-100.00	5296.00	-70.00	5355.00	-25.00	5355.00	0.00	5357.00
10.00	5358.00								

Phreatic Surface (2 points)

-150.00	5294.00	10.00	5294.00

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	-100.00	YL:	5296.00	XR:	0.00	YR: 5357.00
Centre:	XC:	-243.94	YC:	5644.44	Radius:	R:	377.00

Distributed Loads (1 load)

Load	X-Left	Pressure	X-Right	Pressure
1	95.00	1500.0	100.00	1500.0

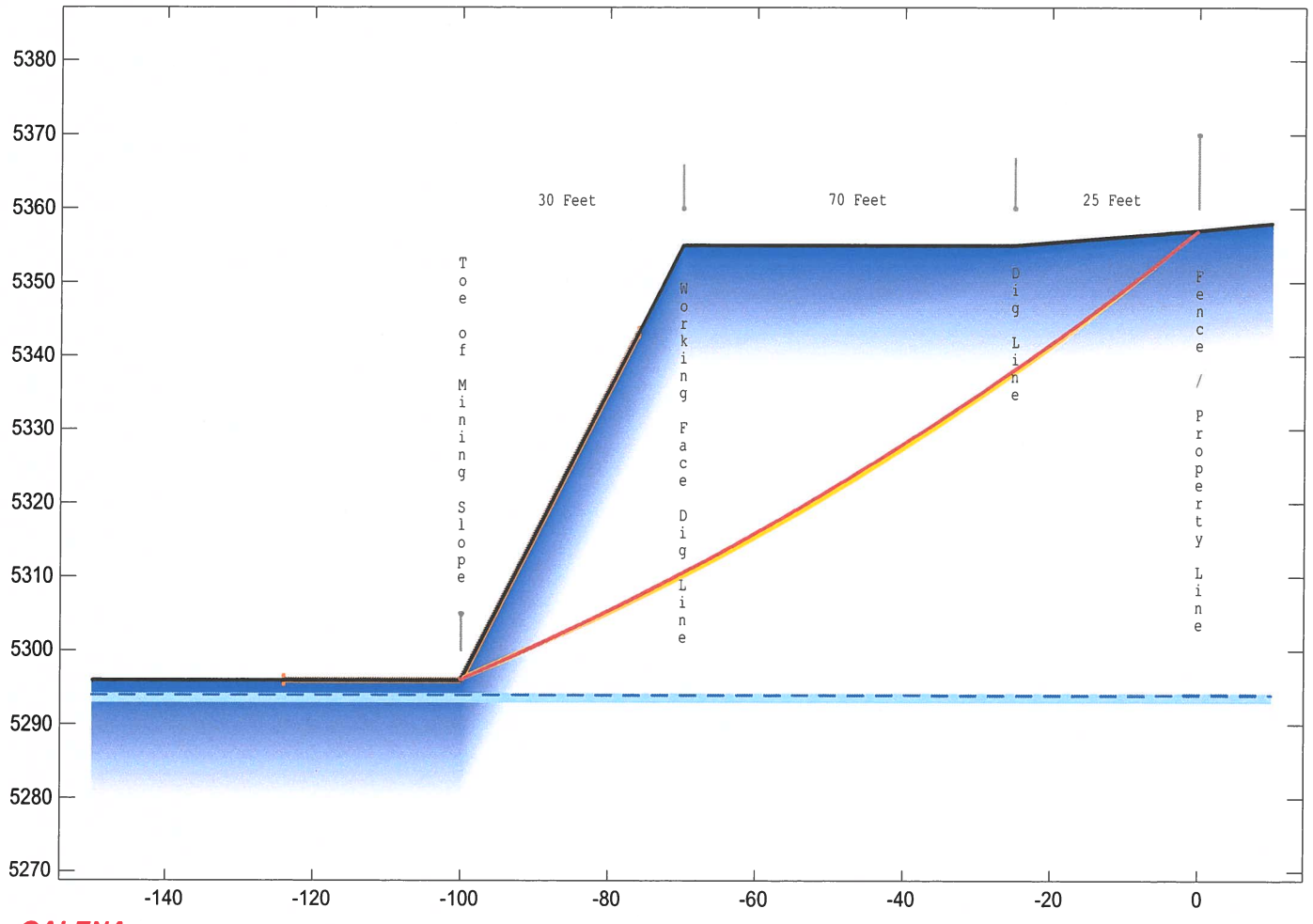
Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	48.00	0.00	100.00
Trial positions within range:	100	1	100

RESULTS: Analysis 1 - Copeland Fence - Mining 0.5H:1V Slope

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques



GALENA Version 7.1

Licensed to: Dept of the Interior - Office of Surface Mining

Material Keys

1: Dense Sand

Analysis 1

Multiple Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Critical Factor of Safety: 1.30

Edited: 27 Jun 2019 *Processed:* 30 Jun 2019

Project Albert Frei and Sons, Inc. - Bennett Pit - AM-01 - M-2001-038
Copeland Fence - Mining 0.5H:1V Slope - 37 Degree Friction Angle

File: G:\My Driv...\Copeland Fence Mining Slope - 37 Degree Friction Angle.gmf

GALENA 7.1 Analysis Results Version: 7.10.2.04 Licensee: Dept of the Interior - Office of Surface Mining

Project: Albert Frei and Sons, Inc. - Bennett Pit - AM-01 - M-2001-038
File: G:\My Drive\1 - My Projects Google\8 Galena - Stability An...\Copeland Fence Mining Slope - 37 Degree Friction Angle.gmf
Processed: 30 Jun 2019 13:15:13

DATA: Analysis 1 - Copeland Fence - Mining 0.5H:1V Slope - 37 Degree Friction Angle

Material Properties (1 material)

Material: 1 (Mohr-Coulomb Isotropic) - Dense Sand

Cohesion	Phi	UnitWeight	Ru
0.00	37.0	116.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 0.000

Material Profiles (1 profile)

Profile: 1 (2 points) Material beneath: 1 - Dense Sand

-150.00	5360.00	10.00	5360.00

Slope Surface (6 points)

-150.00	5296.00	-100.00	5296.00	-70.00	5355.00	-25.00	5355.00	0.00	5357.00
10.00	5358.00								

Phreatic Surface (2 points)

-150.00	5294.00	10.00	5294.00

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects: XL: -100.00 YL: 5296.00 XR: 0.00 YR: 5357.00
Centre: XC: -243.94 YC: 5644.44 Radius: R: 377.00

Distributed Loads (1 load)

Load	X-Left	Pressure	X-Right	Pressure
1	95.00	1500.0	100.00	1500.0

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	48.00	0.00	100.00
Trial positions within range:	100	1	100

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RESULTS: Analysis 1 - Copeland Fence - Mining 0.5H:1V Slope - 37 Degree Friction Angle

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques