COLORADO
Division of Reclamation, Mining and Safety
Department of Natural Resources

1313 Sherman Street, Room 215
Denver, CO 80203

September 16, 2016

Jim Helmericks
Glacier Gravel Products
995 Hwy 3
Durango, CO 81301

Re: J & J Pit, Permit No. M-1985-001 Technical Revision Application TR-1, Adequacy Response

Mr. Helmericks:

On August 29, 2016, the Division of Reclamation, Mining and Safety received your Technical Revision application **TR-1** for the J & J Pit Permit No. **M-1985-001**. The revision requested addresses the following items:

- *Revise/replace Exhibits C, D and L, Supplement Exhibit E, add Geotechnical Stability Exhibit and clarify the original application*

During the technical review of the submitted revision the following items were noted to require clarification and or need to be addressed:

1. *Attachment 2, item 5:* Please note that the storage of these materials is allowed within the permitted area, other state, federal and local permits may be required. Approving the storage of these items within the permitted area does not grant an exemption from other permits that may or may not be required for such activities.
2. *Attachment 3 item 6:* The existing storm water and surface water management plans are vague and outdated. Please update the existing, or create new surface and storm water management plans. These plans should outline measures taken to prevent erosion during both the mining and reclamation of the site including the type and locations of any and all storm water control devices such as storm water ditches, or catchment basins that will be utilized on site.
3. *Attachment 3, item 7 and Attachment 6:* The geotechnical stability exhibit has been reviewed by the Divisions slope stability personnel and determined that based on the information provided 1H: 1V slopes do not meet the adequate factor of safety requirement (see the attached Memorandum dated September 8, 2016). Please revisit you analysis and provide the additional information required to demonstrate an adequate

factor of safety. If such demonstration cannot be made, the operator shall commit to buttressing or using engineered retaining walls on all reclaimed slopes. In either case, please provide detailed plans outlining the method and materials required for buttressing or engineered retaining walls that will be utilized to stabilize the reclaimed slopes. Please note that if retaining walls are chosen, engineered designs will be required.

4. *Attachment 3, Item 7:* While the Division does for allow the importation of offsite fill material to be used in the backfilling process, the operator must submit an affidavit in compliance with Section 3.1.5 (9) of the Rules for the Extraction of Construction Materials. The affidavit must also certify that the material is clean, inert and free from all protruding metal (rebar). Please review Rule 3.1.5 (9) and submit the required information to allow for the importation of offsite fill materials.
5. *Enclosure 1 to Exhibit D:* Please identify the method of seed bed preparation and clarify the seeding method and mulching plan. In the enclosure a seed bed preparation method was not identified, tasks such as pocking or surface roughening are recommended by the Division. Steep slopes also require alternate seeding and mulching methods to ensure proper seed to soil contact and increase reclamation success. Broadcast seeding and straw spreading, in this scenario, are deemed inadequate. Please identify an alternate seeding and mulching plan, the Division recommends hyrdro seeding and mulching with a tackifier, or a similar method.
6. *Enclosure 2 to Attachment 3:* The seed mix included in the revision lacks diversity and is recommended to be revised. Smooth brome and Intermediate wheatgrass are both cool season species, as a general guideline the Division likes to see at least two cool season and two warm season species in a seed mix. Please revise the seed mix to include at least two warm season species such as Galleta or Sand dropseed. Additionally the revision calls for planting 120 total "transplant" shrubs and small trees. While this practice is encouraged, the financial warranty cannot be updated without clarification. Please clarify what exact plants will be transplanted as well as the number of each species to be transplanted.
7. *Attachment 3 and Attachment 4 sheet 6:* Please clarify in the narrative, as well as include on sheet 6 of the Maps, the areas to be seeded as well as the areas to be left graveled for landowner use including the acreages of each section in both the narrative and on the map.

Please submit the requested information within **30 days** of the date of this letter. All clarifications and supporting documentation must be received by the Division no later than **Thursday October 14, 2016**. If these items are not received your Technical Revision application may be denied and need to be re-submitted. Please feel free to contact me if you have any further questions at the Division's Grand Junction Field Office at (970)-243-6368 or by email at lucas.west@state.co.us.

Sincerely,

Lucas J. West
Environmental Protection Specialist
Division of Reclamation, Mining and Safety
1313 Sherman Street, Room 215

Denver, CO 80203
Phone: (970)-243-6368

Enclosure: MEMORANDUM, J & J pit, Permit # M-1985-001, TR-1 Geotechnical Exhibit

Cc: Russ Means, Senior Environmental Protection Specialist

Ec w/enclosure: Nathan Barton, Wasteline Inc.

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Denver, CO 80203

MEMORANDUM

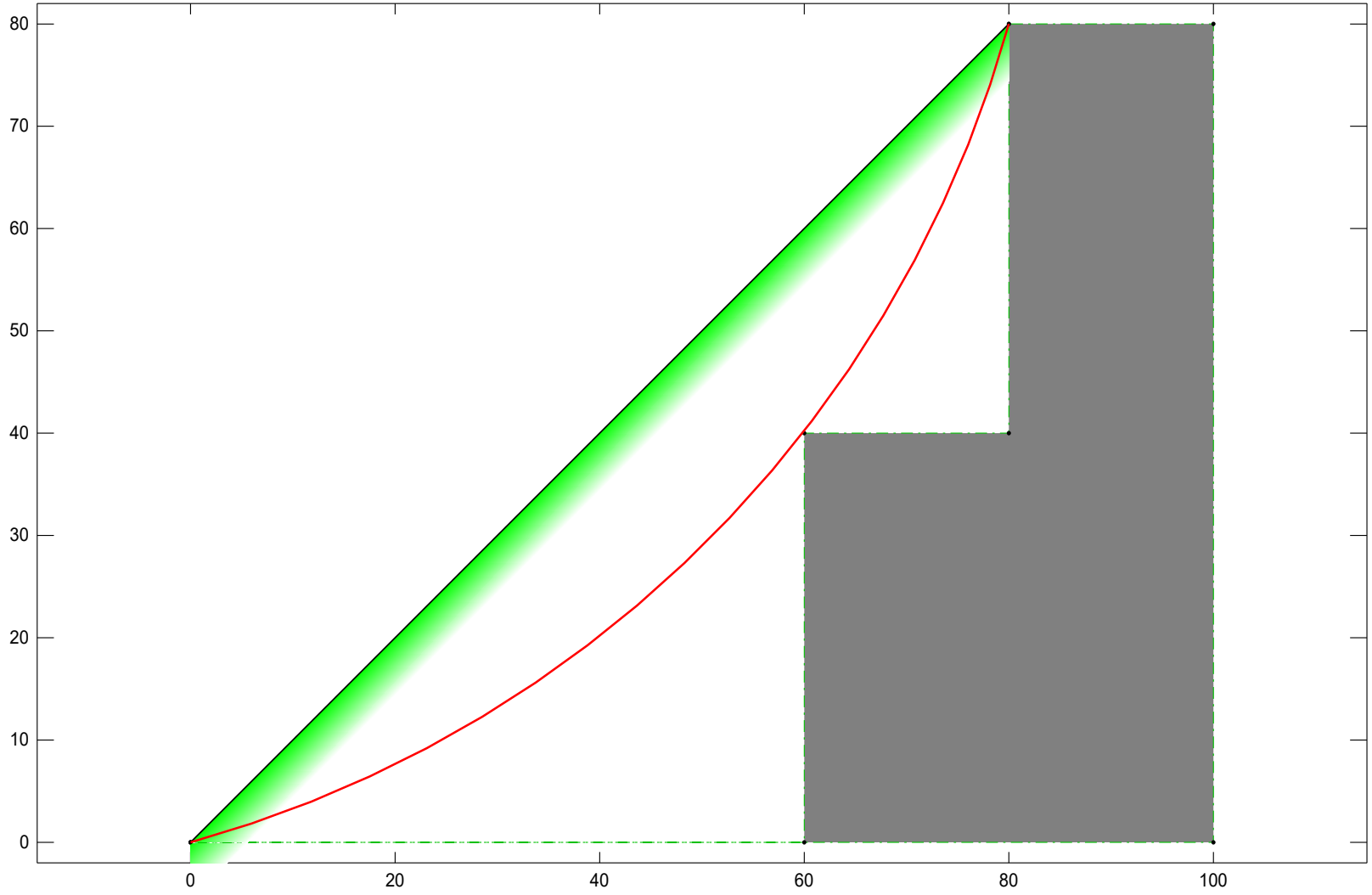
To: Lucas West

From: Dustin Czapla, DRMS

Date: September 8, 2016

RE: J & J Pit, Permit # M-1985-001, TR-1 Geotechnical Exhibit

I have reviewed the geotechnical information included with TR-1 for the J & J Pit. TR-1 proposes the site be mined in phases resulting in a benched highwall. The estimated final height of the highwall is unclear because of conflicting information in TR-1, but it is my understanding that the highwall will be 80-100 feet in total height at the end of mining. The vertical faces of the highwall will be no more than 40 feet high, separated by benches at least 20 feet wide. TR-1 proposes that the highwall would be backfilled to a 1H:1V slope with on-site shale or imported materials. The TR-1 Geotechnical Stability Exhibit attempts to show that a final slope of 1H:1V would be stable, with a Factor of Safety ranging from 3.6 to 9.0. These values are quite high and not likely realistic. I have run models with Galena software using several different highwall scenarios and found that the 1H:1V slope, as proposed, does not provide an adequate safety factor to be considered stable for final reclamation. I recommend the requirement to backfill the slopes to 2H:1V during final reclamation remain in place in order to ensure adequate Factor of Safety for the long term stability of the reclaimed slope.



Project M-1981-185 1H:1V

Analysis 1

GALENA Version 6.10

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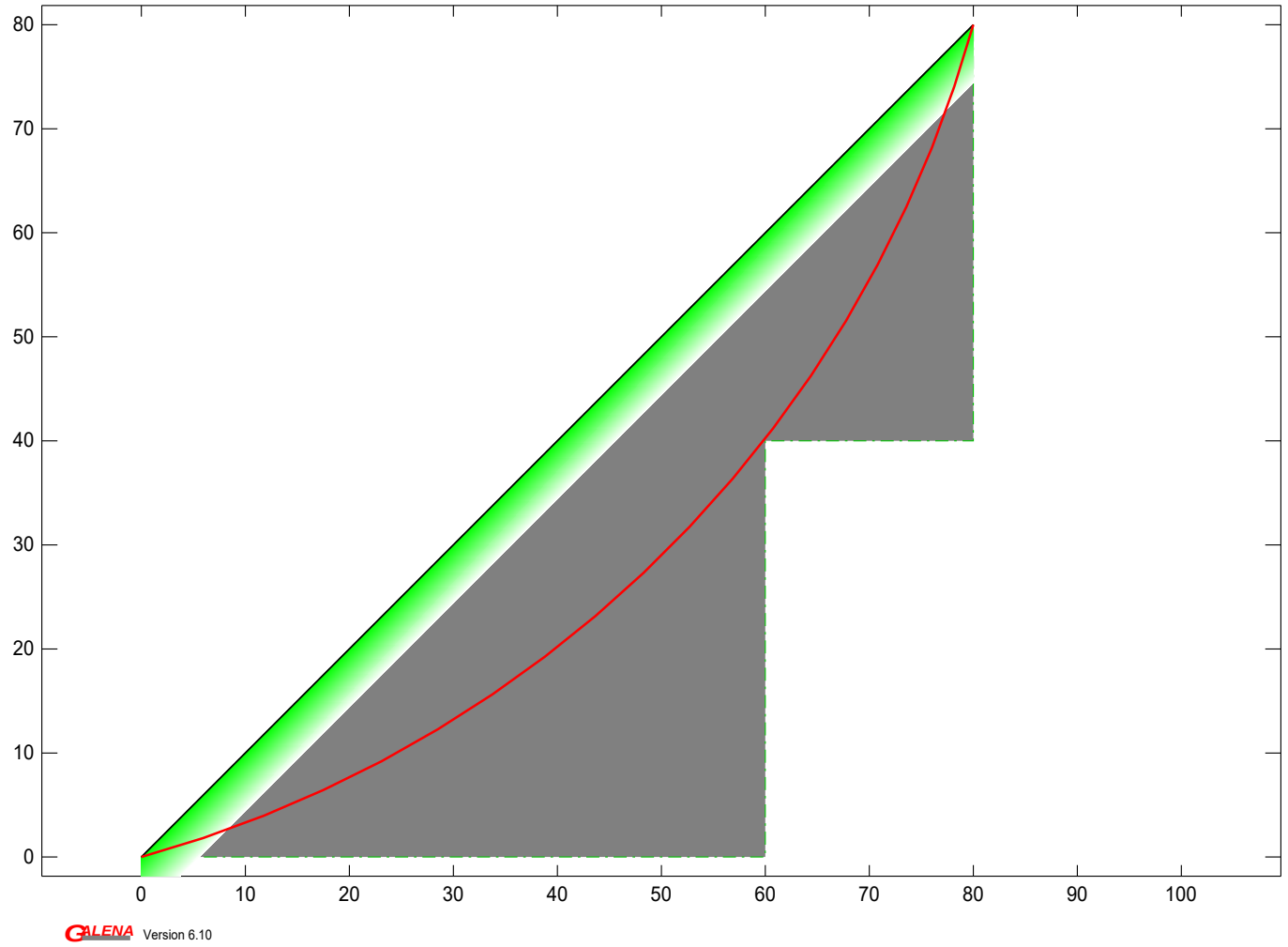

Material Keys

Glacial Till

Fill

Analysis 1

Single Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Factor of Safety: 1.20

Edited: 9 Sep 2016 *Processed:* 9 Sep 2016

Project M-1981-185 1H:1V

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Project: M-1981-185 1H:1V
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DATA: Analysis 1

Material Properties (2 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Glacial Till

Cohesion	Phi	UnitWeight	Ru
0.00	31.0	20.00	0.00

Material: 2 (Mohr-Coulomb Isotropic) - Fill

Cohesion	Phi	UnitWeight	Ru
50.00	33.0	18.50	0.00

Material Profiles (2 profiles)

Profile: 1 (8 points) Material within: 1 - Glacial Till

0.00	0.00	60.00	0.00	60.00	40.00	80.00	40.00
80.00	80.00	100.00	0.00	0.00	0.00		

Profile: 2 (2 points) Material beneath: 2 - Fill

0.00	0.00	80.00	80.00

Slope Surface (2 points)

0.00	0.00	80.00	80.00

Failure Surface

Circular surface defined by: XL,XR,R
Intersects: XL: 0.00 YL: 0.00 XR: 80.00 YR: 80.00
Centre: XC: -30.80 YC: 110.80 Radius: R: 115.00

RESULTS: Analysis 1

Bishop Simplified Method of Analysis - Circular Failure Surface

Factor of Safety: 1.20

Negative normal stresses exist on the base of one or more slices - examine slice data and consult the GALENA Help utility

Slice Geometry and Properties (40 slices)

Slice	X-S	Base							PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	0.00	1.36	17.1	1.98	2.07	2	50.00	33.0	25.20	0.00	-0.08	0.90
2	1.98	4.09	17.1	1.98	2.07	2	50.00	33.0	75.61	0.00	21.71	0.90
3	3.97	6.81	17.1	1.98	2.07	2	50.00	33.0	126.00	0.00	43.50	0.90
4	5.95	9.22	20.2	1.95	2.07	2	50.00	33.0	170.66	0.00	60.33	0.89
5	7.90	11.62	20.2	1.95	2.07	2	50.00	33.0	215.02	0.00	79.33	0.89
6	9.84	14.02	20.2	1.95	2.07	2	50.00	33.0	259.39	0.00	98.34	0.89
7	11.79	15.93	23.3	1.91	2.07	2	50.00	33.0	294.69	0.00	110.89	0.88
8	13.70	18.00	23.3	1.91	2.07	2	50.00	33.0	332.96	0.00	127.18	0.88
9	15.60	20.07	23.3	1.91	2.07	2	50.00	33.0	371.24	0.00	143.47	0.88
10	17.51	21.45	26.4	1.86	2.07	2	50.00	33.0	396.81	0.00	152.04	0.88
11	19.37	23.19	26.4	1.86	2.07	2	50.00	33.0	429.01	0.00	165.70	0.88
12	21.23	24.93	26.4	1.86	2.07	2	50.00	33.0	461.19	0.00	179.35	0.88
13	23.09	25.78	29.5	1.81	2.07	2	50.00	33.0	476.90	0.00	184.18	0.88
14	24.89	27.20	29.5	1.81	2.07	2	50.00	33.0	503.11	0.00	195.29	0.88
15	26.70	28.61	29.5	1.81	2.07	2	50.00	33.0	529.32	0.00	206.41	0.88
16	28.50	43.81	32.6	2.62	3.11	2	50.00	33.0	810.49	0.00	209.90	0.88
17	31.13	46.29	32.6	2.62	3.11	2	50.00	33.0	856.36	0.00	222.90	0.88
18	33.75	46.72	35.7	2.53	3.11	2	50.00	33.0	864.23	0.00	224.70	0.89
19	36.28	48.51	35.7	2.53	3.11	2	50.00	33.0	897.51	0.00	234.19	0.89
20	38.80	48.00	38.8	2.43	3.11	2	50.00	33.0	887.94	0.00	231.81	0.89
21	41.23	49.15	38.8	2.43	3.11	2	50.00	33.0	909.29	0.00	237.95	0.89
22	43.65	47.77	41.9	2.32	3.11	2	50.00	33.0	883.70	0.00	231.70	0.90
23	45.97	48.32	41.9	2.32	3.11	2	50.00	33.0	893.90	0.00	234.66	0.90
24	48.29	46.16	45.0	2.20	3.11	2	50.00	33.0	854.04	0.00	224.85	0.92
25	50.49	46.16	45.0	2.20	3.11	2	50.00	33.0	854.05	0.00	224.85	0.92
26	52.69	43.35	48.1	2.08	3.11	2	50.00	33.0	801.99	0.00	211.80	0.93
27	54.77	42.86	48.1	2.08	3.11	2	50.00	33.0	792.85	0.00	209.05	0.93
28	56.85	39.51	51.2	1.95	3.11	2	50.00	33.0	730.99	0.00	193.15	0.95
29	58.80	38.59	51.2	1.95	3.11	2	50.00	33.0	713.84	0.00	187.89	0.95
30	60.75	34.85	54.3	1.82	3.11	2	50.00	33.0	644.80	0.00	169.52	0.98
31	62.56	33.56	54.3	1.82	3.11	2	50.00	33.0	620.89	0.00	162.01	0.98
32	64.38	29.60	57.4	1.68	3.11	2	50.00	33.0	547.52	0.00	141.65	1.01
33	66.05	28.01	57.4	1.68	3.11	2	50.00	33.0	518.20	0.00	132.18	1.01
34	67.73	23.97	60.5	1.53	3.11	2	50.00	33.0	443.50	0.00	110.34	1.04
35	69.26	22.17	60.5	1.53	3.11	2	50.00	33.0	410.13	0.00	99.21	1.04
36	70.80	18.23	63.6	1.38	3.11	2	50.00	33.0	337.27	0.00	76.51	1.08
37	72.18	16.29	63.6	1.38	3.11	2	50.00	33.0	301.33	0.00	64.08	1.08
38	73.56	23.24	66.7	2.46	6.22	2	50.00	33.0	429.95	0.00	34.56	1.12
39	76.02	12.82	69.8	2.15	6.22	2	50.00	33.0	237.16	0.00	-1.15	1.17
40	78.17	3.77	72.9	1.83	6.22	2	50.00	33.0	69.71	0.00	-35.28	1.23

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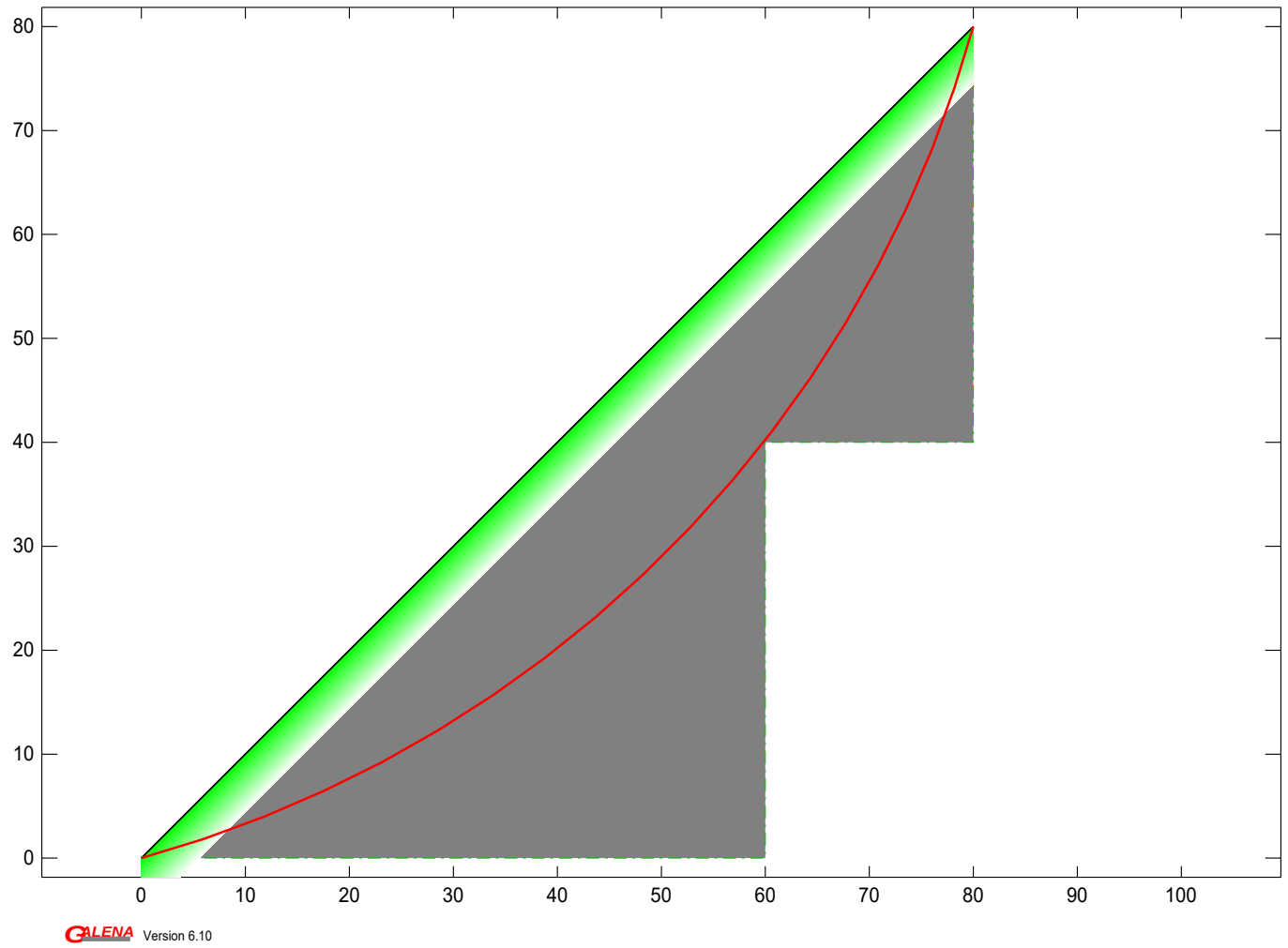

Material Keys

Glacial Till

Fill

Analysis 1

Single Stability Analysis

Method: Spencer-Wright

Surface: Circular

Results

Factor of Safety: 1.20

Interslice Force (Final) Angle: 35.8 °

Edited: 9 Sep 2016 *Processed:* 9 Sep 2016

Project M-1981-185 1H:1V

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Project: M-1981-185 1H:1V
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DATA: Analysis 1

Material Properties (2 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Glacial Till

Cohesion	Phi	UnitWeight	Ru
0.00	31.0	20.00	0.00

Material: 2 (Mohr-Coulomb Isotropic) - Fill

Cohesion	Phi	UnitWeight	Ru
50.00	33.0	18.50	0.00

Material Profiles (2 profiles)

Profile: 1 (8 points) Material within: 1 - Glacial Till

0.00	0.00	60.00	0.00	60.00	40.00	80.00	40.00
80.00	80.00	100.00	0.00	0.00	0.00		

Profile: 2 (2 points) Material beneath: 2 - Fill

0.00	0.00	80.00	80.00

Slope Surface (2 points)

0.00	0.00	80.00	80.00

Failure Surface

Circular surface defined by: XL,XR,R
Intersects: XL: 0.00 YL: 0.00 XR: 80.00 YR: 80.00
Centre: XC: -30.80 YC: 110.80 Radius: R: 115.00

RESULTS: Analysis 1

Spencer-Wright Method of Analysis - Circular Failure Surface

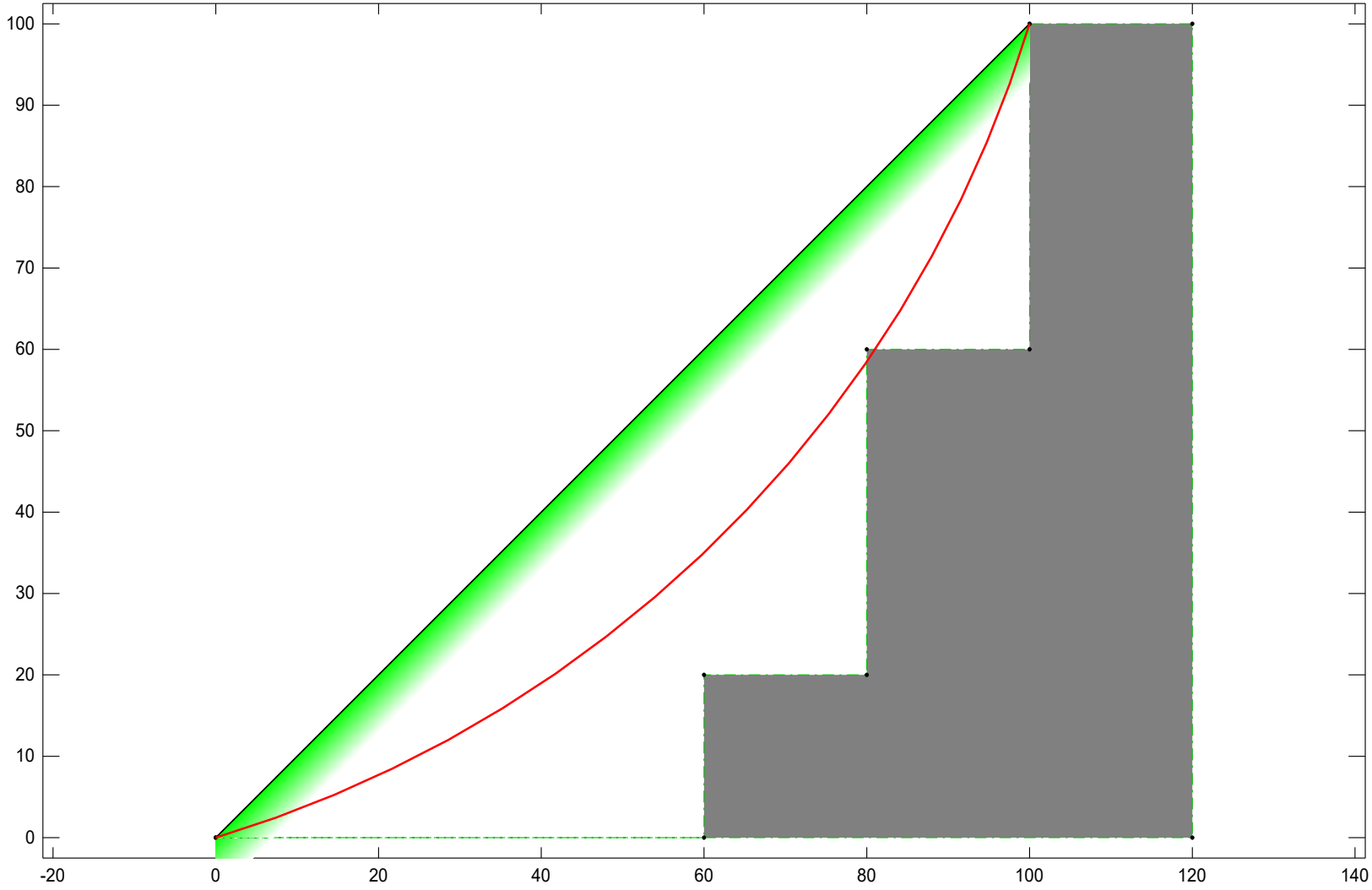
Factor of Safety: 1.20

Final Angle of Interslice Forces: 35.8 degrees
Negative interslice forces exist on one or more slices - examine slice data and consult the GALENA Help utility
Effective stress line of thrust is not within one or more slices - examine slice data and consult the GALENA Help utility

Slice Geometry and Properties (40 slices)

Slice	X-S	Base							PoreWater	Left Hand Side		
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Side Force	l/h	l'/h
1	0.00	1.36	17.1	1.98	2.07	2	50.00	33.0	25.20	0.00	0.00	0.00	0.00
2	1.98	4.09	17.1	1.98	2.07	2	50.00	33.0	75.61	0.00	119.41	0.30	0.30
3	3.97	6.81	17.1	1.98	2.07	2	50.00	33.0	126.00	0.00	253.46	0.29	0.29
4	5.95	9.22	20.2	1.95	2.07	2	50.00	33.0	170.66	0.00	402.15	0.28	0.28
5	7.90	11.62	20.2	1.95	2.07	2	50.00	33.0	215.02	0.00	542.42	0.27	0.27
6	9.84	14.02	20.2	1.95	2.07	2	50.00	33.0	259.39	0.00	691.58	0.27	0.27
7	11.79	15.93	23.3	1.91	2.07	2	50.00	33.0	294.69	0.00	849.65	0.26	0.26
8	13.70	18.00	23.3	1.91	2.07	2	50.00	33.0	332.96	0.00	985.79	0.26	0.26
9	15.60	20.07	23.3	1.91	2.07	2	50.00	33.0	371.24	0.00	1126.51	0.25	0.25
10	17.51	21.45	26.4	1.86	2.07	2	50.00	33.0	396.81	0.00	1271.81	0.25	0.25
11	19.37	23.19	26.4	1.86	2.07	2	50.00	33.0	429.01	0.00	1386.54	0.24	0.24
12	21.23	24.93	26.4	1.86	2.07	2	50.00	33.0	461.19	0.00	1502.74	0.24	0.24
13	23.09	25.78	29.5	1.81	2.07	2	50.00	33.0	476.90	0.00	1620.42	0.24	0.24
14	24.89	27.20	29.5	1.81	2.07	2	50.00	33.0	503.11	0.00	1702.76	0.23	0.23
15	26.70	28.61	29.5	1.81	2.07	2	50.00	33.0	529.32	0.00	1784.54	0.23	0.23
16	28.50	43.81	32.6	2.62	3.11	2	50.00	33.0	810.49	0.00	1865.74	0.22	0.22
17	31.13	46.29	32.6	2.62	3.11	2	50.00	33.0	856.36	0.00	1931.43	0.22	0.22
18	33.75	46.72	35.7	2.53	3.11	2	50.00	33.0	864.23	0.00	1993.25	0.21	0.21
19	36.28	48.51	35.7	2.53	3.11	2	50.00	33.0	897.51	0.00	1999.49	0.20	0.20
20	38.80	48.00	38.8	2.43	3.11	2	50.00	33.0	887.94	0.00	2000.96	0.20	0.20
21	41.23	49.15	38.8	2.43	3.11	2	50.00	33.0	909.29	0.00	1951.10	0.19	0.19
22	43.65	47.77	41.9	2.32	3.11	2	50.00	33.0	883.70	0.00	1897.01	0.18	0.18
23	45.97	48.32	41.9	2.32	3.11	2	50.00	33.0	893.90	0.00	1798.53	0.16	0.16
24	48.29	46.16	45.0	2.20	3.11	2	50.00	33.0	854.04	0.00	1697.49	0.15	0.15
25	50.49	46.16	45.0	2.20	3.11	2	50.00	33.0	854.05	0.00	1561.01	0.14	0.14
26	52.69	43.35	48.1	2.08	3.11	2	50.00	33.0	801.99	0.00	1424.53	0.12	0.12
27	54.77	42.86	48.1	2.08	3.11	2	50.00	33.0	792.85	0.00	1262.85	0.09	0.09
28	56.85	39.51	51.2	1.95	3.11	2	50.00	33.0	730.99	0.00	1104.37	0.06	0.06
29	58.80	38.59	51.2	1.95	3.11	2	50.00	33.0	713.84	0.00	931.57	0.02	0.02
30	60.75	34.85	54.3	1.82	3.11	2	50.00	33.0	644.80	0.00	765.59	-0.03	-0.03
31	62.56	33.56	54.3	1.82	3.11	2	50.00	33.0	620.89	0.00	596.22	-0.11	-0.11
32	64.38	29.60	57.4	1.68	3.11	2	50.00	33.0	547.52	0.00	437.43	-0.24	-0.24
33	66.05	28.01	57.4	1.68	3.11	2	50.00	33.0	518.20	0.00	285.61	-0.49	-0.49
34	67.73	23.97	60.5	1.53	3.11	2	50.00	33.0	443.50	0.00	148.09	-1.13	-1.13
35	69.26	22.17	60.5	1.53	3.11	2	50.00	33.0	410.13	0.00	26.76	-7.11	-7.11
36	70.80	18.23	63.6	1.38	3.11	2	50.00	33.0	337.27	0.00	-76.84	2.65	2.65
37	72.18	16.29	63.6	1.38	3.11	2	50.00	33.0	301.33	0.00	-156.76	1.34	1.34

38	73.56	23.24	66.7	2.46	6.22	2	50.00	33.0	429.95	0.00	-216.00	0.95	0.95
39	76.02	12.82	69.8	2.15	6.22	2	50.00	33.0	237.16	0.00	-253.74	0.68	0.68
40	78.17	3.77	72.9	1.83	6.22	2	50.00	33.0	69.71	0.00	-181.64	0.56	0.56
RHS	80.00										0.03	0.00	0.00
X-S Area:		1133.99	Path Length:		118.27			X-S Weight:	20978.72				



Project M-1981-185 1H:1V

Analysis 1

GALENA Version 6.10

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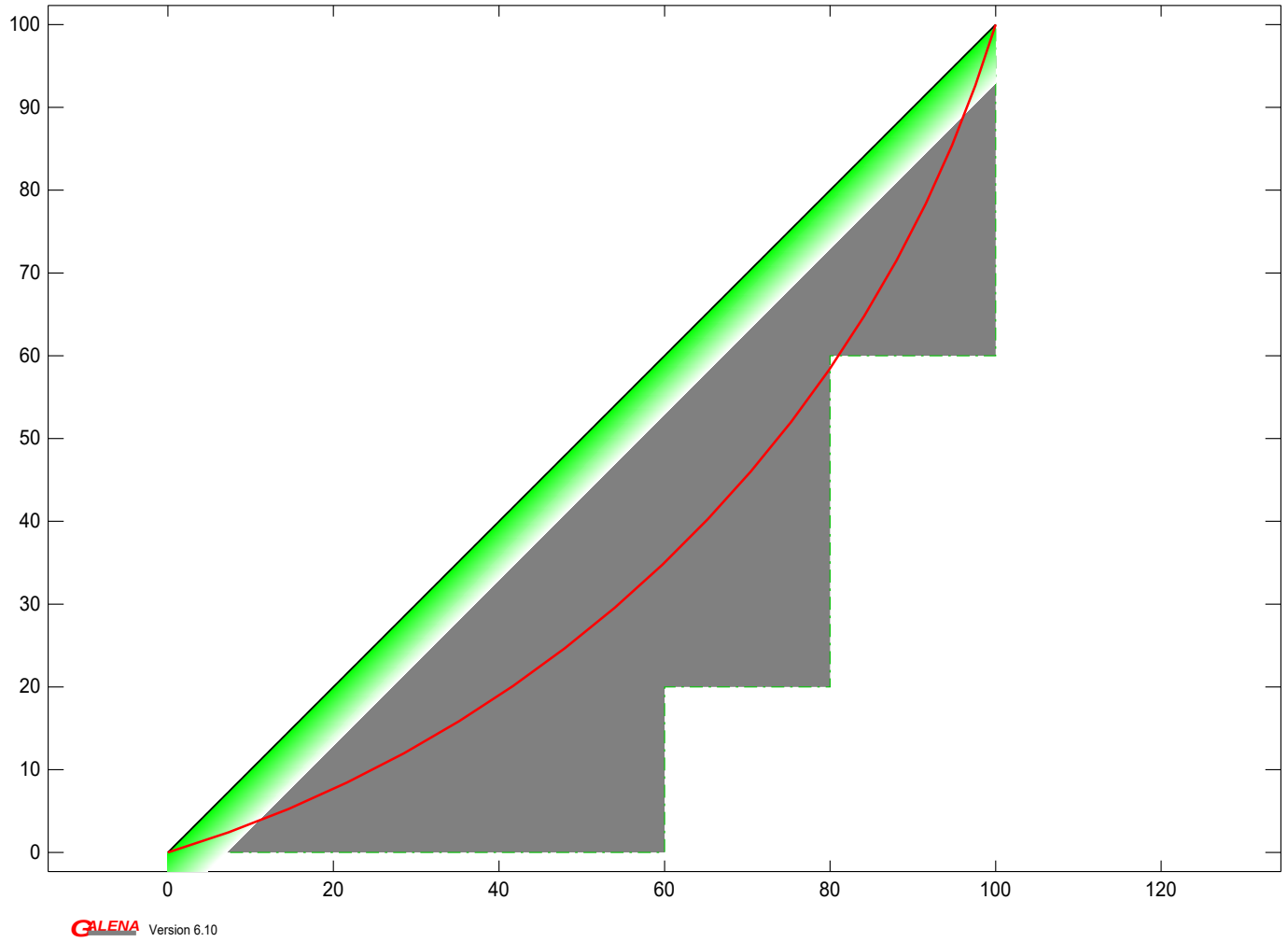

Material Keys

Glacial Till

Fill

Analysis 1

Single Stability Analysis

Method: Bishop Simplified

Surface: Circular

Results

Factor of Safety: 1.12

Project M-1981-185 1H:1V

Edited: 9 Sep 2016 *Processed:* 9 Sep 2016

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DATA: Analysis 1

Material Properties (2 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Glacial Till

Cohesion	Phi	UnitWeight	Ru
0.00	31.0	20.00	0.00

Material: 2 (Mohr-Coulomb Isotropic) - Fill

Cohesion	Phi	UnitWeight	Ru
50.00	33.0	18.50	0.00

Material Profiles (2 profiles)

Profile: 1 (10 points) Material within: 1 - Glacial Till

0.00	0.00	60.00	0.00	60.00	20.00	80.00	20.00	80.00	60.00
100.00	60.00	100.00	100.00	120.00	100.00	120.00	0.00	0.00	0.00

Profile: 2 (2 points) Material beneath: 2 - Fill

0.00	0.00	100.00	100.00

Slope Surface (2 points)

0.00	0.00	100.00	100.00

Failure Surface

Circular surface defined by: XL,XR,R
Intersects: XL: 0.00 YL: 0.00 XR: 100.00 YR: 100.00
Centre: XC: -43.54 YC: 143.54 Radius: R: 150.00

RESULTS: Analysis 1

Bishop Simplified Method of Analysis - Circular Failure Surface

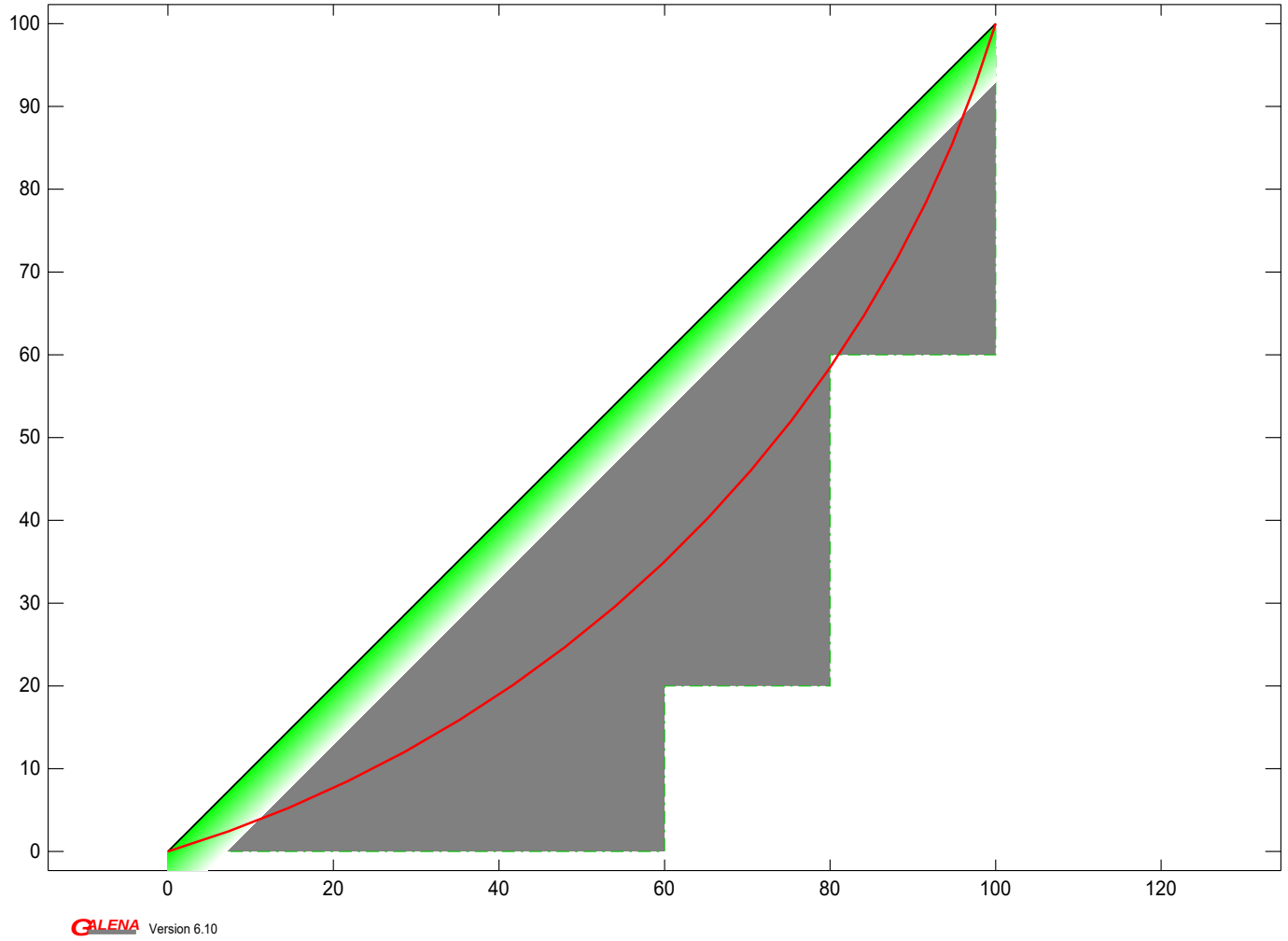
Factor of Safety: 1.12

Negative normal stresses exist on the base of one or more slices - examine slice data and consult the GALENA Help utility

Slice Geometry and Properties (40 slices)

Slice	X-S	Base							PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	0.00	2.01	18.4	2.45	2.58	2	50.00	33.0	37.16	0.00	0.23	0.88
2	2.45	6.03	18.4	2.45	2.58	2	50.00	33.0	111.48	0.00	25.64	0.88
3	4.90	10.04	18.4	2.45	2.58	2	50.00	33.0	185.80	0.00	51.04	0.88
4	7.36	13.59	21.3	2.41	2.58	2	50.00	33.0	251.50	0.00	70.90	0.87
5	9.76	17.13	21.3	2.41	2.58	2	50.00	33.0	316.84	0.00	93.03	0.87
6	12.17	20.66	21.3	2.41	2.58	2	50.00	33.0	382.17	0.00	115.15	0.87
7	14.58	23.46	24.3	2.35	2.58	2	50.00	33.0	434.10	0.00	129.98	0.87
8	16.93	26.51	24.3	2.35	2.58	2	50.00	33.0	490.42	0.00	148.92	0.87
9	19.29	29.55	24.3	2.35	2.58	2	50.00	33.0	546.74	0.00	167.87	0.87
10	21.64	31.59	27.2	2.30	2.58	2	50.00	33.0	584.42	0.00	178.01	0.87
11	23.94	34.15	27.2	2.30	2.58	2	50.00	33.0	631.76	0.00	193.87	0.87
12	26.23	36.71	27.2	2.30	2.58	2	50.00	33.0	679.13	0.00	209.73	0.87
13	28.53	37.97	30.2	2.23	2.58	2	50.00	33.0	702.47	0.00	215.50	0.86
14	30.76	40.06	30.2	2.23	2.58	2	50.00	33.0	741.04	0.00	228.40	0.86
15	33.00	42.14	30.2	2.23	2.58	2	50.00	33.0	779.59	0.00	241.30	0.86
16	35.23	64.56	33.2	3.24	3.87	2	50.00	33.0	1194.43	0.00	245.51	0.87
17	38.47	68.21	33.2	3.24	3.87	2	50.00	33.0	1261.92	0.00	260.58	0.87
18	41.72	68.90	36.1	3.13	3.87	2	50.00	33.0	1274.71	0.00	262.83	0.87
19	44.85	71.55	36.1	3.13	3.87	2	50.00	33.0	1323.70	0.00	273.82	0.87
20	47.98	70.88	39.1	3.01	3.87	2	50.00	33.0	1311.30	0.00	271.25	0.87
21	50.99	72.58	39.1	3.01	3.87	2	50.00	33.0	1342.76	0.00	278.35	0.87
22	53.99	70.66	42.0	2.88	3.87	2	50.00	33.0	1307.24	0.00	271.34	0.88
23	56.87	71.48	42.0	2.88	3.87	2	50.00	33.0	1322.31	0.00	274.78	0.88
24	59.75	68.44	45.0	2.74	3.87	2	50.00	33.0	1266.15	0.00	263.70	0.89
25	62.49	68.44	45.0	2.74	3.87	2	50.00	33.0	1266.14	0.00	263.70	0.89
26	65.23	64.45	48.0	2.59	3.87	2	50.00	33.0	1192.28	0.00	248.97	0.91
27	67.82	63.71	48.0	2.59	3.87	2	50.00	33.0	1178.69	0.00	245.78	0.91
28	70.42	58.94	50.9	2.44	3.87	2	50.00	33.0	1090.42	0.00	227.82	0.92
29	72.86	57.56	50.9	2.44	3.87	2	50.00	33.0	1064.88	0.00	221.73	0.92
30	75.30	52.21	53.9	2.28	3.87	2	50.00	33.0	965.90	0.00	201.02	0.94
31	77.59	50.28	53.9	2.28	3.87	2	50.00	33.0	930.16	0.00	192.32	0.94
32	79.87	23.88	56.8	1.12	2.05	1	0.00	31.0	443.26	0.00	216.57	1.00
33	80.99	62.86	56.8	3.12	5.70	2	50.00	33.0	1162.97	0.00	160.98	0.97
34	84.11	36.33	59.8	1.95	3.87	2	50.00	33.0	672.10	0.00	133.86	0.99
35	86.06	33.60	59.8	1.95	3.87	2	50.00	33.0	621.62	0.00	120.91	0.99
36	88.01	27.85	62.8	1.77	3.87	2	50.00	33.0	515.22	0.00	95.45	1.03
37	89.78	24.89	62.8	1.77	3.87	2	50.00	33.0	460.37	0.00	80.93	1.03
38	91.56	35.87	65.7	3.19	7.75	2	50.00	33.0	663.53	0.00	47.50	1.06
39	94.74	20.05	68.7	2.82	7.75	2	50.00	33.0	370.88	0.00	6.72	1.10
40	97.56	6.00	71.6	2.44	7.75	2	50.00	33.0	110.95	0.00	-32.55	1.15

X-S Area:	1685.79	Path Length:	147.25	X-S Weight:	31188.54



Material Keys

Glacial Till

Fill

Analysis 1

Single Stability Analysis

Method: Spencer-Wright

Surface: Circular

Results

Factor of Safety: 1.11

Interslice Force (Final) Angle: 37.2 °

Edited: 9 Sep 2016 *Processed:* 9 Sep 2016

Project M-1981-185 1H:1V

File: C:\Users\dmc\Documents\Galena\M1985001 J&J - 1-1 -100.gmf

US Dept of Interior - Office of Surface Mining

Project: M-1981-185 1H:1V
File: C:\Users\dmc\Documents\Galena\M1985001 J&J - 1-1 -100.gmf Processed: 09 Sep 2016 10:22:28

DATA: Analysis 1

Material Properties (2 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Glacial Till

Cohesion	Phi	UnitWeight	Ru
0.00	31.0	20.00	0.00

Material: 2 (Mohr-Coulomb Isotropic) - Fill

Cohesion	Phi	UnitWeight	Ru
50.00	33.0	18.50	0.00

Material Profiles (2 profiles)

Profile: 1 (10 points) Material within: 1 - Glacial Till

0.00	0.00	60.00	0.00	60.00	20.00	80.00	20.00	80.00	60.00
100.00	60.00	100.00	100.00	120.00	100.00	120.00	0.00	0.00	0.00

Profile: 2 (2 points) Material beneath: 2 - Fill

0.00	0.00	100.00	100.00

Slope Surface (2 points)

0.00	0.00	100.00	100.00

Failure Surface

Circular surface defined by: XL,XR,R
Intersects: XL: 0.00 YL: 0.00 XR: 100.00 YR: 100.00
Centre: XC: -43.54 YC: 143.54 Radius: R: 150.00

RESULTS: Analysis 1

Spencer-Wright Method of Analysis - Circular Failure Surface

Factor of Safety: 1.11

Final Angle of Interslice Forces: 37.2 degrees
Negative interslice forces exist on one or more slices - examine slice data and consult the GALENA Help utility
Effective stress line of thrust is not within one or more slices - examine slice data and consult the GALENA Help utility

Slice Geometry and Properties (40 slices)

Slice	X-S	Base							PoreWater	Left Hand Side		
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Side Force	l/h	l'/h
1	0.00	2.01	18.4	2.45	2.58	2	50.00	33.0	37.16	0.00	0.00	0.00	0.00
2	2.45	6.03	18.4	2.45	2.58	2	50.00	33.0	111.48	0.00	165.21	0.32	0.32
3	4.90	10.04	18.4	2.45	2.58	2	50.00	33.0	185.80	0.00	353.94	0.31	0.31
4	7.36	13.59	21.3	2.41	2.58	2	50.00	33.0	251.50	0.00	566.17	0.30	0.30
5	9.76	17.13	21.3	2.41	2.58	2	50.00	33.0	316.84	0.00	767.84	0.29	0.29
6	12.17	20.66	21.3	2.41	2.58	2	50.00	33.0	382.17	0.00	984.25	0.29	0.29
7	14.58	23.46	24.3	2.35	2.58	2	50.00	33.0	434.10	0.00	1215.38	0.28	0.28
8	16.93	26.51	24.3	2.35	2.58	2	50.00	33.0	490.42	0.00	1415.56	0.28	0.28
9	19.29	29.55	24.3	2.35	2.58	2	50.00	33.0	546.74	0.00	1623.85	0.27	0.27
10	21.64	31.59	27.2	2.30	2.58	2	50.00	33.0	584.42	0.00	1840.23	0.27	0.27
11	23.94	34.15	27.2	2.30	2.58	2	50.00	33.0	631.76	0.00	2012.55	0.26	0.26
12	26.23	36.71	27.2	2.30	2.58	2	50.00	33.0	679.13	0.00	2188.18	0.26	0.26
13	28.53	37.97	30.2	2.23	2.58	2	50.00	33.0	702.47	0.00	2367.12	0.26	0.26
14	30.76	40.06	30.2	2.23	2.58	2	50.00	33.0	741.04	0.00	2494.71	0.25	0.25
15	33.00	42.14	30.2	2.23	2.58	2	50.00	33.0	779.59	0.00	2622.37	0.25	0.25
16	35.23	64.56	33.2	3.24	3.87	2	50.00	33.0	1194.43	0.00	2750.10	0.25	0.25
17	38.47	68.21	33.2	3.24	3.87	2	50.00	33.0	1261.92	0.00	2859.99	0.24	0.24
18	41.72	68.90	36.1	3.13	3.87	2	50.00	33.0	1274.71	0.00	2965.77	0.24	0.24
19	44.85	71.55	36.1	3.13	3.87	2	50.00	33.0	1323.70	0.00	2990.39	0.23	0.23
20	47.98	70.88	39.1	3.01	3.87	2	50.00	33.0	1311.30	0.00	3009.17	0.22	0.22
21	50.99	72.58	39.1	3.01	3.87	2	50.00	33.0	1342.76	0.00	2952.40	0.22	0.22
22	53.99	70.66	42.0	2.88	3.87	2	50.00	33.0	1307.24	0.00	2890.16	0.21	0.21
23	56.87	71.48	42.0	2.88	3.87	2	50.00	33.0	1322.31	0.00	2761.93	0.20	0.20
24	59.75	68.44	45.0	2.74	3.87	2	50.00	33.0	1266.15	0.00	2630.29	0.19	0.19
25	62.49	68.44	45.0	2.74	3.87	2	50.00	33.0	1266.14	0.00	2445.09	0.18	0.18
26	65.23	64.45	48.0	2.59	3.87	2	50.00	33.0	1192.28	0.00	2259.89	0.16	0.16
27	67.82	63.71	48.0	2.59	3.87	2	50.00	33.0	1178.69	0.00	2035.47	0.15	0.15
28	70.42	58.94	50.9	2.44	3.87	2	50.00	33.0	1090.42	0.00	1815.42	0.13	0.13
29	72.86	57.56	50.9	2.44	3.87	2	50.00	33.0	1064.88	0.00	1571.48	0.10	0.10
30	75.30	52.21	53.9	2.28	3.87	2	50.00	33.0	965.90	0.00	1336.93	0.06	0.06
31	77.59	50.28	53.9	2.28	3.87	2	50.00	33.0	930.16	0.00	1093.95	0.01	0.01
32	79.87	23.88	56.8	1.12	2.05	1	0.00	31.0	443.26	0.00	865.70	-0.06	-0.06
33	80.99	62.86	56.8	3.12	5.70	2	50.00	33.0	1162.97	0.00	651.99	-0.13	-0.13
34	84.11	36.33	59.8	1.95	3.87	2	50.00	33.0	672.10	0.00	348.14	-0.44	-0.44
35	86.06	33.60	59.8	1.95	3.87	2	50.00	33.0	621.62	0.00	165.85	-1.16	-1.16
36	88.01	27.85	62.8	1.77	3.87	2	50.00	33.0	515.22	0.00	8.66	-25.28	-25.28
37	89.78	24.89	62.8	1.77	3.87	2	50.00	33.0	460.37	0.00	-117.94	2.00	2.00

38	91.56	35.87	65.7	3.19	7.75	2	50.00	33.0	663.53	0.00	-214.99	1.11	1.11
39	94.74	20.05	68.7	2.82	7.75	2	50.00	33.0	370.88	0.00	-298.78	0.71	0.71
40	97.56	6.00	71.6	2.44	7.75	2	50.00	33.0	110.95	0.00	-228.18	0.56	0.56
RHS	100.00	--------			-------				----------		0.04	0.00	0.00
	X-S Area:	1685.79	Path Length:		147.25			X-S Weight:	31188.54				