



June 15, 2021

Mr. Vasilios Panoutsopoulos
1002 Crestview Drive
Millbrae, California 94030

Subject: ***Response to Supplemental Geotechnical Peer Review***
 APN 021-210-290 & 280
 Larkspur Drive, Millbrae, California
 Atlas Project No. 91-04373-B

References: 1) *Supplemental Geotechnical Peer Review*; letter prepared by Cotton, Shires and Associates, Inc., dated July 7, 2020.
 2) *Response to Supplemental Geotechnical Peer Review*; letter prepared by Geosphere Consultants, Inc., dated June 22, 2020.
 3) *Supplemental Geotechnical Peer Review – Panoutsopoulos Lot Split and Rezoning*; letter prepared by Cotton, Shires and Associates, Inc., dated March 9, 2020.
 4) *Geotechnical Engineering Update Study*; letter prepared by Geosphere Consultants, dated December 31, 2019.
 5) *Supplemental Geotechnical Peer Review*; letter prepared by Cotton, Shires and Associates, Inc., dated November 20, 2018.
 6) *Supplemental Geotechnical Study, Slope Stability Analyses, Proposed Parcel B- Tentative Map, APN 021-210-290 & 280, Larkspur Drive, Millbrae, California*; report prepared by Geosphere Consultants, Inc., dated October 12, 2018.

Dear Mr. Panoutsopoulos:

Atlas Technical Consultants LLC (Atlas), the Northern California Geotechnical Group which was formerly known as **Geosphere Consultants, Inc. (Geosphere)** has prepared this letter to address the comments stated by the City of Millbrae's geotechnical peer reviewer, Cotton, Shires and Associates, Inc. (CSA) in their 4th review letter to the City of Millbrae pertaining to slope stability analyses presented in our 2020 response letter for your proposed project (References 1 & 2, respectively).

Comment #1:

The Geotechnical Consultant should consider extending the slope stability cross section further upslope and re-analyzing the seismic stability to determine if more critical hypothetical failure surfaces are found which require modifications to the soil nail retaining wall loading.

Comment #1 Response:

As requested, we extended our slope stability boundary twenty feet further to the upslope direction and evaluated the potential failure surfaces, which are shown in Plates C-11 to C-14. The results of the analysis are summarized in Table 1.

Table 1: Slope Stability Analysis Results

Plate	Min FS	Description
C-11	0.82	Proposed Slope – Seismic – Circular (all slope surfaces)
C-12	-	Proposed Slope – Seismic – Circular (FS < 1.1 Only)
C-13	0.78	Proposed Slope – Seismic – Non-Circular (all slope surfaces)
C-14	-	Proposed Slope – Seismic – Non-Circular (FS < 1.1 Only)

With the expansion of our slope boundary condition, our model now includes existing 20-foot deep retaining wall piers which are 16-inch in diameter and assumed to have a spacing of 6 feet on-center. Additional deeper hypothetical potential failure surfaces under seismic loading were recorded as a result of the boundary expansion. To mitigate the deeper potential failure surfaces, we recommend all soil nails (including the upper ones on the shallower slope) to have a minimum length of at least 45 feet long.

Plates C-11 through C-14 represent the results of our analysis under seismic loading using 45 feet long soil nails. Based on our analysis, it is our opinion that all hypothetical potential failures through the proposed soil nail wall configuration itself demonstrate satisfactory stability; i.e., $FS > 1.1$ for seismic loading conditions. As previously discussed, all other shallow critical slope failures occurring on the back slope above the soil nail wall under design seismic loading which should be mitigated by (1) proper grading, vegetative planting, and surface drainage upslope of the wall being instituted to reduce the potential for oversaturating the exposed slope; and (2) construction of at least 3 feet of freeboard to the soil nail wall, and/or construction of an equivalent height engineered pier-supported debris catchment fence/wall upslope of the soil nail wall.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

The recommendations of this report are based upon the soil and groundwater conditions encountered in the borings. If variations or undesirable conditions are encountered during construction, Atlas should be contacted so that supplemental recommendations may be provided. This report is issued with the understanding that it is the responsibility of the owner or his representatives to see that the information and

recommendations contained herein are called to the attention of the other members of the design team and incorporated into the plans and specifications, and that the necessary steps are taken to see that the recommendations are implemented during construction.

This report was prepared upon your request for our services, and in accordance with currently accepted, local and current geotechnical engineering practice. No warranty based on the contents of this report is intended, and none shall be inferred from the statements or opinions expressed herein.

If you have any questions regarding the results of our analyses or these recommendations, please contact us. We greatly appreciate the opportunity to be of service to you and to be involved in the design of this project.

Sincerely,

ATLAS TECHNICAL CONSULTANTS LLC



Alex Lim, P.E., Q.S.P.
Project Engineer



Joel E. Baldwin, II, P.G., C.E.G.
Principal Engineering Geologist



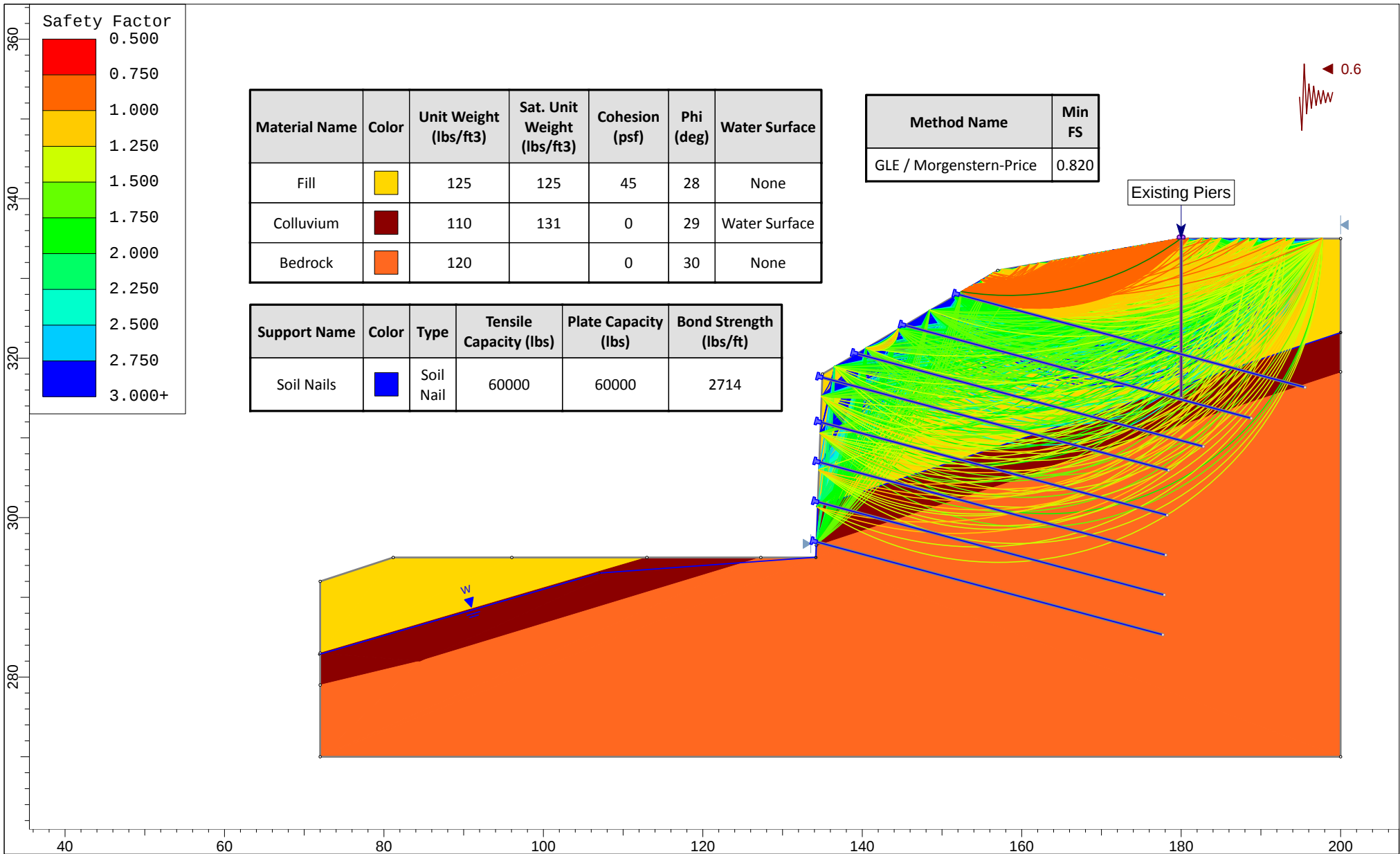
(Renewal date
02/28/2021)



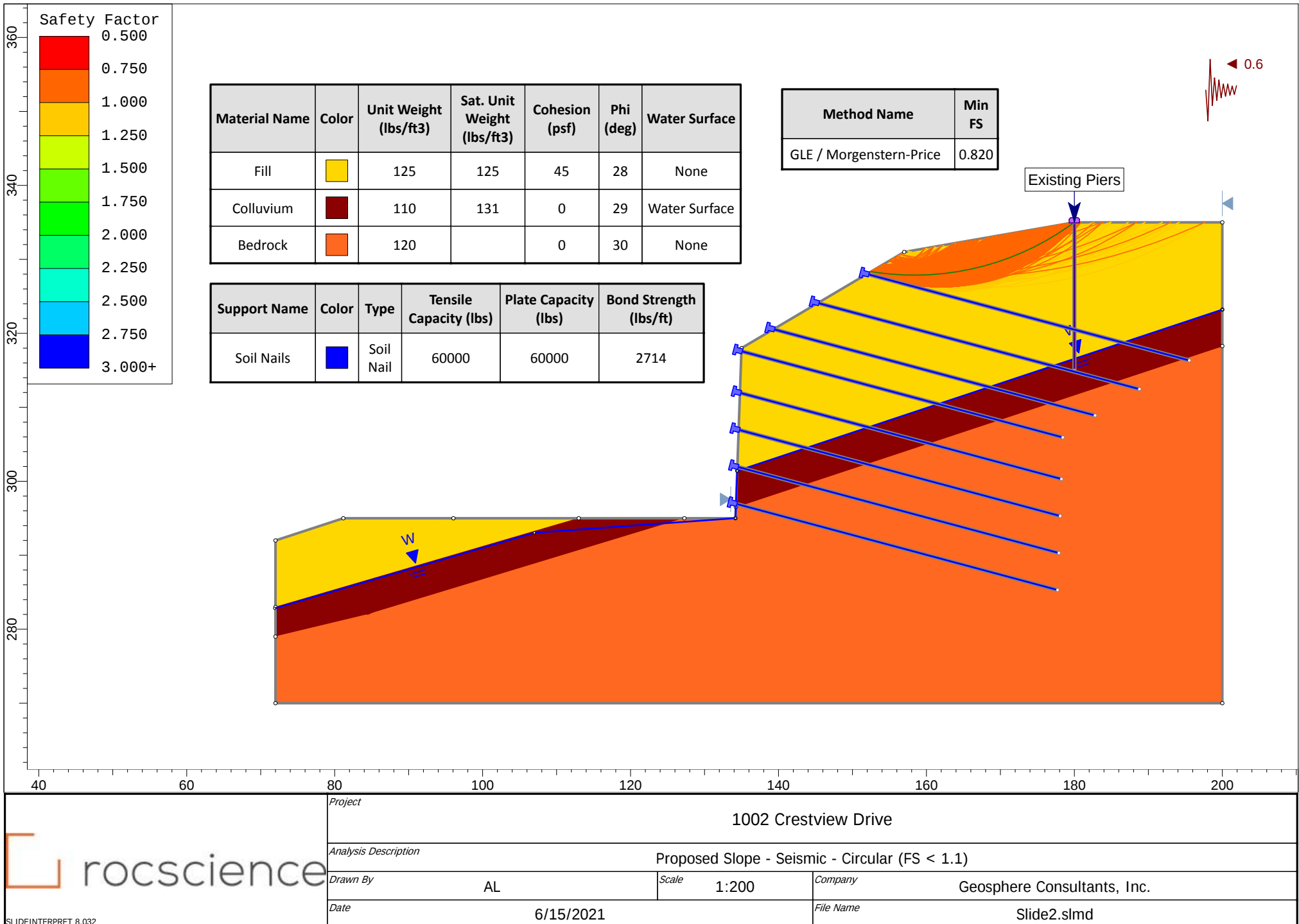
Corey T. Dare, P.E., G.E.
Principal Geotechnical Engineer

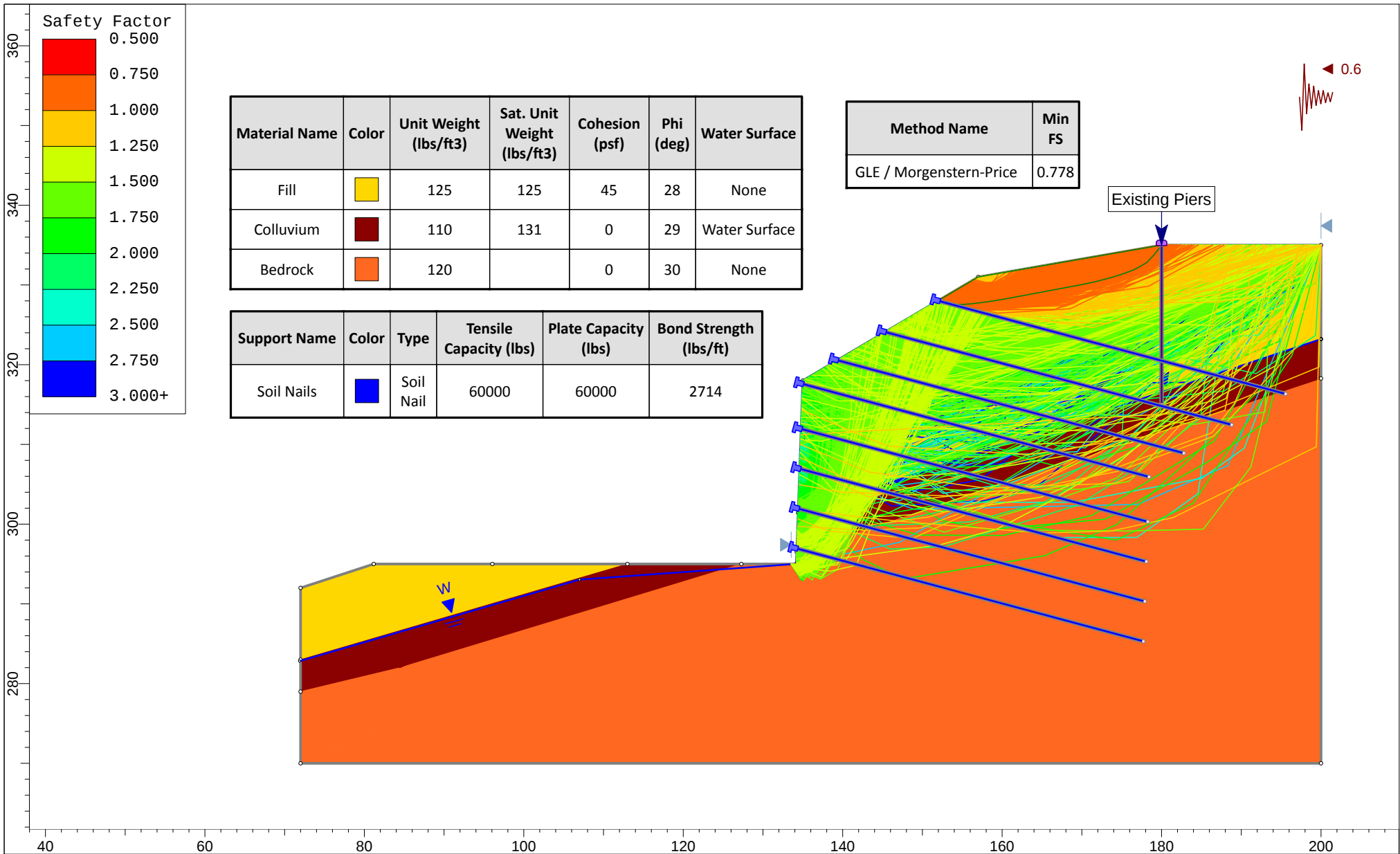


Attachments: Plates C-11 through C-14
 Info Viewer – Proposed Slope – Seismic – Circular
 Info Viewer – Proposed Slope – Seismic – Non-Circular

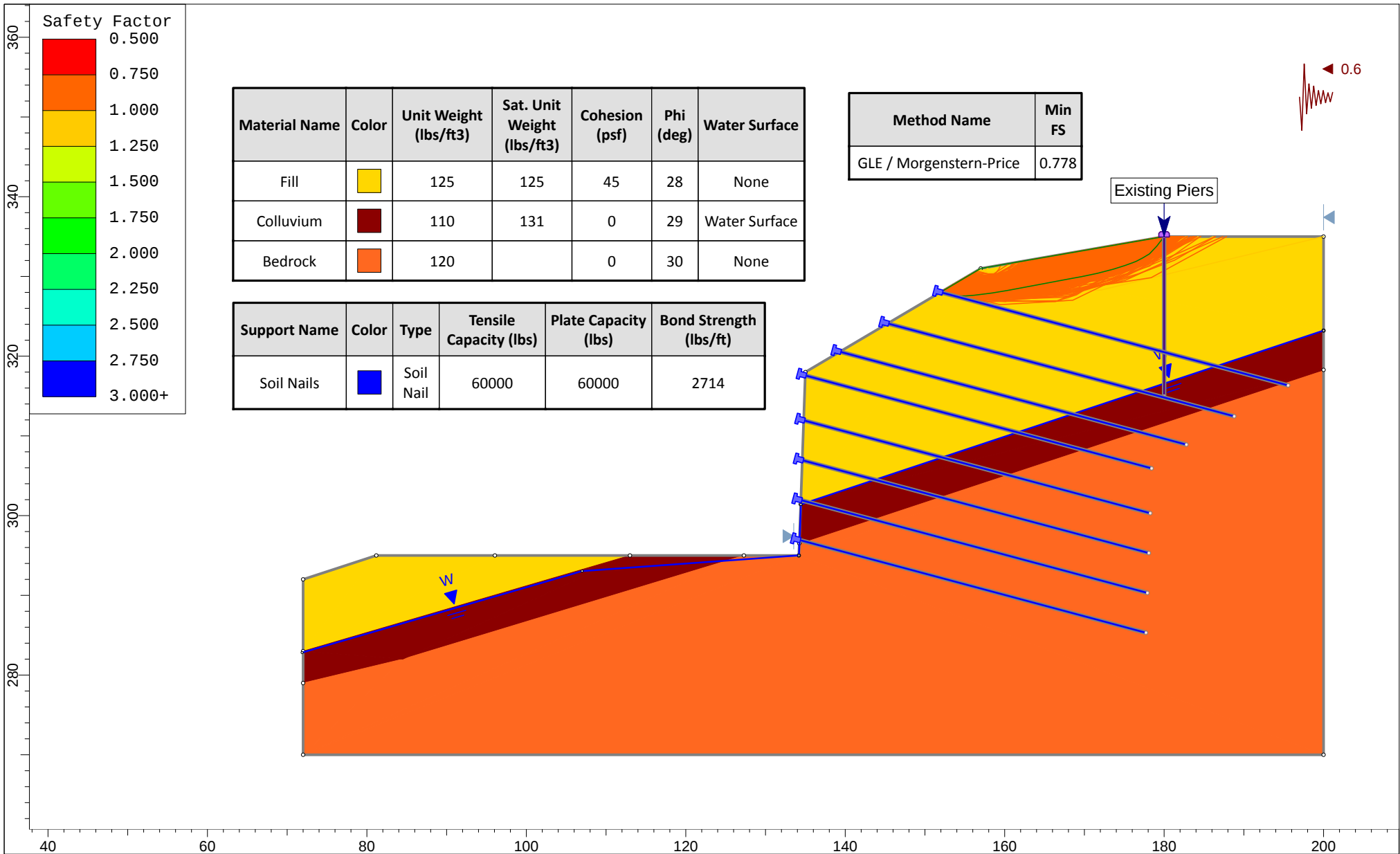


 SLIDEINTERPRET 8.032	<i>Project</i> 1002 Crestview Drive				
	<i>Analysis Description</i> Proposed Slope - Seismic - Circular				
	<i>Drawn By</i> AL		<i>Scale</i> 1:200	<i>Company</i> Geosphere Consultants, Inc.	
	<i>Date</i> 6/15/2021			<i>File Name</i> Slide2.slmd	





 SLIDEINTERPRET 8.032	Project					
	1002 Crestview Drive					
	Analysis Description					
	Proposed Slope - Seismic - Non-Circular					
	Drawn By		AL	Scale	1:200	Company
Date			6/15/2021		File Name	Slide2.slmd



 SLIDEINTERPRET 8.032	Project				
	1002 Crestview Drive				
	Analysis Description				
	Proposed Slope - Seismic - Non-Circular (FS < 1.1)				
	Drawn By	AL	Scale	1:200	Company
Date	6/15/2021			File Name	Slide2.slmd

Slide Analysis Information

Slide2

Project Summary

File Name: Slide2.slmd
Slide Modeler Version: 8.032
Compute Time: 00h:00m:06.268s
Project Title: 1002 Crestview Drive
Analysis: Proposed Slope - Seismic - Circular
Author: AL
Company: Geosphere Consultants, Inc.
Date Created: 6/15/2021

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Data Output: Standard
Failure Direction: Right to Left

Analysis Options

Analysis Methods Used

Slices Type: Vertical
GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices: 50
Tolerance: 0.005

Analysis Methods Used

Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined

Minimum Depth: Not Defined
Minimum Area: Not Defined
Minimum Weight: Not Defined

Seismic Loading

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Seismic Load Coefficient (Horizontal): 0.6

Materials

Property	Fill	Colluvium	Bedrock
Color			
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125	110	
Saturated Unit Weight [lbs/ft3]	125	131	
Cohesion [psf]	45	0	0
Friction Angle [°]	28	29	30
Water Surface	None	Water Table	None
Hu Value		1	
Ru Value	0		0

Support

Soil Nails

Support Type: Soil Nail
Force Application: Passive
Force Orientation: Parallel to Reinforcement
Out-of-Plane Spacing: 5 ft
Tensile Capacity: 60000 lb

Plate Capacity: 60000 lb
Bond Strength: 2714 lb/ft

Existing Piers

Support Type: Pile/Micro Pile
Force Application: Active
Out-of-Plane Spacing: 6 ft
Failure Mode: Ito & Matsui
Pile Diameter: 1.33 ft
Force Direction: Parallel to surface

Global Minimums

Method: gle/morgenstern-price

FS	0.820410
Center:	158.353, 364.189
Radius:	36.332
Left Slip Surface Endpoint:	152.488, 328.334
Right Slip Surface Endpoint:	179.983, 334.997
Resisting Moment:	212552 lb-ft
Driving Moment:	259080 lb-ft
Resisting Horizontal Force:	5680.32 lb
Driving Horizontal Force:	6923.76 lb
Total Slice Area:	76.107 ft ²
Surface Horizontal Width:	27.4946 ft
Surface Average Height:	2.76807 ft

Valid/Invalid Surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 8977
Number of Invalid Surfaces: 0

Slice Data

• Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.82041

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.549892	14.1106	-8.85165	Fill	45	28	82.2068	67.4433	42.2096	0	42.2096	29.4074	29.4074
2	0.549892	42.0364	-7.97499	Fill	45	28	124.208	101.902	107.017	0	107.017	89.6156	89.6156
3	0.549892	69.373	-7.10021	Fill	45	28	166.478	136.58	172.237	0	172.237	151.501	151.501
4	0.549892	96.1241	-6.22709	Fill	45	28	208.701	171.22	237.385	0	237.385	214.613	214.613
5	0.549892	122.293	-5.35541	Fill	45	28	250.463	205.482	301.824	0	301.824	278.345	278.345
6	0.549892	147.882	-4.48498	Fill	45	28	291.27	238.961	364.786	0	364.786	341.939	341.939
7	0.549892	172.893	-3.61559	Fill	45	28	330.571	271.204	425.428	0	425.428	404.54	404.54
8	0.549892	197.329	-2.74702	Fill	45	28	367.793	301.741	482.86	0	482.86	465.212	465.212
9	0.549892	216.215	-1.87909	Fill	45	28	396.011	324.891	526.399	0	526.399	513.406	513.406
10	0.549892	224.074	-1.01159	Fill	45	28	408.09	334.801	545.037	0	545.037	537.831	537.831
11	0.549892	231.029	-0.144327	Fill	45	28	416.812	341.957	558.495	0	558.495	557.445	557.445
12	0.549892	237.412	0.722907	Fill	45	28	422.457	346.588	567.205	0	567.205	572.535	572.535
13	0.549892	243.222	1.59031	Fill	45	28	424.977	348.655	571.091	0	571.091	582.889	582.889
14	0.549892	248.46	2.45807	Fill	45	28	424.417	348.196	570.229	0	570.229	588.448	588.448
15	0.549892	253.123	3.3264	Fill	45	28	420.918	345.325	564.831	0	564.831	589.295	589.295
16	0.549892	257.212	4.1955	Fill	45	28	414.698	340.222	555.232	0	555.232	585.653	585.653
17	0.549892	260.724	5.06556	Fill	45	28	406.046	333.124	541.882	0	541.882	577.875	577.875
18	0.549892	263.657	5.9368	Fill	45	28	395.304	324.311	525.308	0	525.308	566.415	566.415
19	0.549892	266.009	6.80941	Fill	45	28	382.852	314.096	506.096	0	506.096	551.812	551.812
20	0.549892	267.776	7.68362	Fill	45	28	369.09	302.805	484.86	0	484.86	534.655	534.655
21	0.549892	268.955	8.55963	Fill	45	28	354.418	290.768	462.222	0	462.222	515.567	515.567
22	0.549892	269.542	9.43766	Fill	45	28	339.223	278.302	438.778	0	438.778	495.165	495.165
23	0.549892	269.534	10.3179	Fill	45	28	323.867	265.704	415.084	0	415.084	474.045	474.045
24	0.549892	268.924	11.2007	Fill	45	28	308.671	253.237	391.636	0	391.636	452.758	452.758
25	0.549892	267.709	12.0861	Fill	45	28	293.908	241.125	368.856	0	368.856	431.79	431.79
26	0.549892	265.881	12.9745	Fill	45	28	279.798	229.549	347.086	0	347.086	411.551	411.551
27	0.549892	263.435	13.8661	Fill	45	28	266.507	218.645	326.578	0	326.578	392.365	392.365

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
28	0.549892	260.364	14.7611	Fill	45	28	254.144	208.502	307.502	0	307.502	374.465	374.465
29	0.549892	256.66	15.6598	Fill	45	28	242.763	199.165	289.942	0	289.942	357.996	357.996
30	0.549892	252.315	16.5625	Fill	45	28	232.373	190.641	273.91	0	273.91	343.018	343.018
31	0.549892	247.321	17.4694	Fill	45	28	222.935	182.898	259.348	0	259.348	329.508	329.508
32	0.549892	241.667	18.3809	Fill	45	28	214.376	175.876	246.143	0	246.143	317.377	317.377
33	0.549892	235.343	19.2972	Fill	45	28	206.593	169.491	234.133	0	234.133	306.47	306.47
34	0.549892	228.339	20.2187	Fill	45	28	199.458	163.637	223.124	0	223.124	296.584	296.584
35	0.549892	220.642	21.1457	Fill	45	28	192.827	158.197	212.893	0	212.893	287.476	287.476
36	0.549892	212.24	22.0785	Fill	45	28	186.548	153.046	203.205	0	203.205	278.873	278.873
37	0.549892	203.119	23.0175	Fill	45	28	180.46	148.051	193.811	0	193.811	270.477	270.477
38	0.549892	193.264	23.9631	Fill	45	28	174.4	143.079	184.461	0	184.461	261.974	261.974
39	0.549892	182.659	24.9157	Fill	45	28	168.206	137.998	174.903	0	174.903	253.038	253.038
40	0.549892	171.287	25.8757	Fill	45	28	161.717	132.674	164.891	0	164.891	243.332	243.332
41	0.549892	159.129	26.8436	Fill	45	28	154.776	126.98	154.182	0	154.182	232.513	232.513
42	0.549892	146.165	27.8199	Fill	45	28	147.228	120.788	142.536	0	142.536	220.226	220.226
43	0.549892	132.374	28.8049	Fill	45	28	138.92	113.972	129.716	0	129.716	206.104	206.104
44	0.549892	117.733	29.7994	Fill	45	28	129.7	106.407	115.49	0	115.49	189.768	189.768
45	0.549892	102.215	30.8039	Fill	45	28	119.415	97.9691	99.6205	0	99.6205	170.817	170.817
46	0.549892	85.7945	31.819	Fill	45	28	107.911	88.5316	81.8711	0	81.8711	148.829	148.829
47	0.549892	68.4408	32.8454	Fill	45	28	95.0322	77.9654	61.9989	0	61.9989	123.35	123.35
48	0.549892	50.1219	33.8839	Fill	45	28	80.6152	66.1375	39.7539	0	39.7539	93.8921	93.8921
49	0.549892	30.8025	34.9351	Fill	45	28	64.4918	52.9097	14.876	0	14.876	59.9248	59.9248
50	0.549892	10.444	35.9999	Fill	45	28	46.4856	38.1373	-12.907	0	-12.907	20.8667	20.8667

Interslice Data

- Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.82041

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	152.488	328.334	0	0	0

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
2	153.038	328.248	40.5015	2.03449	2.87569
3	153.588	328.171	92.0494	9.22948	5.72572
4	154.138	328.103	154.068	23.0956	8.52546
5	154.688	328.043	225.777	44.9187	11.2522
6	155.237	327.991	306.139	75.6817	13.8859
7	155.787	327.948	393.837	115.985	16.4097
8	156.337	327.913	487.258	165.972	18.8101
9	156.887	327.887	584.511	225.272	21.0768
10	157.437	327.869	682.757	292.672	23.203
11	157.987	327.859	778.747	366.189	25.1842
12	158.537	327.858	870.857	444.084	27.0188
13	159.087	327.865	957.543	524.386	28.7067
14	159.637	327.88	1037.35	604.956	30.2496
15	160.186	327.903	1108.96	683.576	31.6502
16	160.736	327.935	1171.25	758.052	32.9116
17	161.286	327.976	1223.32	826.305	34.0375
18	161.836	328.025	1264.49	886.461	35.0321
19	162.386	328.082	1294.34	936.923	35.8993
20	162.936	328.147	1312.72	976.431	36.6427
21	163.486	328.222	1319.71	1004.1	37.2657
22	164.036	328.304	1315.61	1019.42	37.7708
23	164.586	328.396	1300.93	1022.31	38.1613
24	165.135	328.496	1276.33	1013.01	38.4387
25	165.685	328.605	1242.63	992.139	38.6045
26	166.235	328.722	1200.72	960.573	38.6597
27	166.785	328.849	1151.58	919.444	38.6046
28	167.335	328.985	1096.22	870.059	38.4387
29	167.885	329.13	1035.66	813.849	38.1612
30	168.435	329.284	970.897	752.315	37.7709
31	168.985	329.447	902.912	686.976	37.2655
32	169.535	329.621	832.63	619.328	36.6427
33	170.084	329.803	760.925	550.804	35.8993

Slice Number	X	Y	Interslice	Interslice	Interslice
	coordinate [ft]	coordinate - Bottom [ft]	Normal Force [lbs]	Shear Force [lbs]	Force Angle [degrees]
34	170.634	329.996	688.616	482.751	35.0322
35	171.184	330.198	616.465	416.399	34.0376
36	171.734	330.411	545.181	352.849	32.9115
37	172.284	330.634	475.431	293.061	31.6501
38	172.834	330.868	407.842	237.843	30.2496
39	173.384	331.112	343.017	187.849	28.7068
40	173.934	331.368	281.544	143.57	27.0188
41	174.484	331.634	224.01	105.336	25.1843
42	175.034	331.913	171.014	73.3071	23.2029
43	175.583	332.203	123.181	47.4743	21.0768
44	176.133	332.505	81.1764	27.6506	18.8101
45	176.683	332.82	45.7219	13.4651	16.4097
46	177.233	333.148	17.6129	4.35414	13.8859
47	177.783	333.489	-2.26384	-0.450396	11.2522
48	178.333	333.844	-12.9089	-1.9351	8.5254
49	178.883	334.213	-13.1874	-1.32226	5.72573
50	179.433	334.597	-1.803	-0.0905688	2.87568
51	179.983	334.997	0	0	0

Entity Information

Group: Group 3 

Shared Entities

Type	Coordinates

Type	Coordinates	
External Boundary	X	Y
	72	270
	200	270
	200	318.272
	200	323.208
	200	335
	180	335
	157	331
	135	318
	134.408	301.41
	134.233	296.514
	134.177	295
	127.28	295
	112.99	295
	96.051	295
	81.167	295
	72	292
Material Boundary	72	283
	72	279
	72	279
Material Boundary	84.5	282
	127.28	295
	127.28	295
Material Boundary	134.233	296.514
	200	318.272
	200	318.272

Type	Coordinates	
Material Boundary	X	Y
	134.408	301.41
	200	323.208

Scenario-based Entities

Type	Coordinates	Master Scenario
Water Table	X	Y
	71.874	282.823
	106.999	293.042
	134.181	295.015
	134.432	301.397
	200	323.208
		Assigned to materials:
		Colluvium

Slide Analysis Information

Slide2

Project Summary

File Name:	Slide2.slmd
Slide Modeler Version:	8.032
Compute Time:	00h:00m:33.753s
Project Title:	1002 Crestview Drive
Analysis:	Proposed Slope - Seismic - Non-Circular
Author:	AL
Company:	Geosphere Consultants, Inc.
Date Created:	6/15/2021

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Analysis Methods Used

Slices Type:	Vertical
	GLE/Morgenstern-Price with interslice force function (Half Sine)
Number of slices:	50
Tolerance:	0.005

Analysis Methods Used

Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Search Method:	Cuckoo Search
Initial # of Surface Vertices:	8
Maximum Iterations:	500
Number of Nests:	50
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Convex Surfaces Only: Enabled

Seismic Loading

Advanced seismic analysis: No

Staged pseudostatic analysis: No

Seismic Load Coefficient (Horizontal): 0.6

Materials

Property	Fill	Colluvium	Bedrock
Color			
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unsaturated Unit Weight [lbs/ft3]	125	110	
Saturated Unit Weight [lbs/ft3]	125	131	
Cohesion [psf]	45	0	0
Friction Angle [°]	28	29	30
Water Surface	None	Water Table	None
Hu Value		1	
Ru Value	0		0

Support

Soil Nails

Support Type: Soil Nail
Force Application: Passive
Force Orientation: Parallel to Reinforcement
Out-of-Plane Spacing: 5 ft
Tensile Capacity: 60000 lb
Plate Capacity: 60000 lb
Bond Strength: 2714 lb/ft

Existing Piers

Support Type: Pile/Micro Pile
 Force Application: Active
 Out-of-Plane Spacing: 6 ft
 Failure Mode: Ito & Matsui
 Pile Diameter: 1.33 ft
 Force Direction: Parallel to surface

Global Minimums

Method: gle/morgenstern-price

FS	0.777853
Axis Location:	158.985, 359.545
Left Slip Surface Endpoint:	151.948, 328.015
Right Slip Surface Endpoint:	179.987, 334.998
Resisting Moment:	181796 lb-ft
Driving Moment:	234072 lb-ft
Resisting Horizontal Force:	5609.64 lb
Driving Horizontal Force:	7222.71 lb
Total Slice Area:	76.7445 ft ²
Surface Horizontal Width:	28.0389 ft
Surface Average Height:	2.73707 ft

Global Minimum Coordinates

Method: gle/morgenstern-price

X	Y
151.948	328.015
152.744	327.803
153.728	327.573
155.082	327.561
156.156	327.642

X	Y
157.268	327.777
158.377	327.911
159.735	328.133
161.087	328.372
162.121	328.566
163.23	328.774
164.339	328.983
165.365	329.175
166.39	329.368
167.513	329.579
168.639	329.79
169.83	330.014
171.021	330.243
172.034	330.493
173.046	330.754
173.924	331.009
174.803	331.263
175.656	331.577
176.508	331.905
177.333	332.331
178.157	332.828
179.072	333.803
179.53	334.4
179.987	334.998

Valid/Invalid Surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 19500

Number of Invalid Surfaces: 5556

Error Codes:

Error Code -106 reported for 139 surfaces
 Error Code -108 reported for 137 surfaces
 Error Code -109 reported for 1 surface
 Error Code -111 reported for 3487 surfaces
 Error Code -112 reported for 390 surfaces
 Error Code -114 reported for 104 surfaces
 Error Code -121 reported for 319 surfaces
 Error Code -124 reported for 34 surfaces
 Error Code -1000 reported for 945 surfaces

Error Codes

The following errors were encountered during the computation:

- 106 = Average slice width is less than $0.0001 * (\text{maximum horizontal extent of soil region})$. This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
- 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).
- 109 = Soiltype for slice base not located. This error should occur very rarely, if at all. It may occur if a very low number of slices is combined with certain soil geometries, such that the midpoint of a slice base is actually outside the soil region, even though the slip surface is wholly within the soil region.
- 111 = safety factor equation did not converge
- 112 = The coefficient $M\text{-}\alpha = \cos(\alpha)(1 + \tan(\alpha)\tan(\phi)/F) < 0.2$ 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.
- 114 = Surface with Reverse Curvature.
- 121 = Concave failure surface, only convex surfaces have been defined as being allowed.
- 124 = A slice has a width less than the minimum acceptable value.
- 1000 = No valid slip surface is generated

Slice Data

• Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.777853

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.795399	33.89	-14.9049	Fill	45	28	114.774	89.2772	83.2734	0	83.2734	52.7238	52.7238
2	0.491907	54.3956	-13.1786	Fill	45	28	185.793	144.519	187.169	0	187.169	143.665	143.665
3	0.491907	79.3509	-13.1786	Fill	45	28	248.746	193.488	279.265	0	279.265	221.02	221.02
4	1.35438	321.618	-0.519465	Fill	45	28	270.074	210.078	310.466	0	310.466	308.017	308.017

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
5	0.536961	164.057	4.35424	Fill	45	28	304.356	236.744	360.619	0	360.619	383.793	383.793
6	0.536961	182.61	4.35424	Fill	45	28	332.612	258.723	401.955	0	401.955	427.281	427.281
7	0.555932	207.746	6.8891	Fill	45	28	339.423	264.021	411.919	0	411.919	452.928	452.928
8	0.555932	224.037	6.8891	Fill	45	28	359.772	279.85	441.688	0	441.688	485.156	485.156
9	0.554804	227.787	6.8891	Fill	45	28	366.568	285.136	451.629	0	451.629	495.918	495.918
10	0.554804	229.83	6.8891	Fill	45	28	370.602	288.274	457.533	0	457.533	502.309	502.309
11	0.678724	282.703	9.30655	Fill	45	28	348.784	271.303	425.615	0	425.615	482.771	482.771
12	0.678724	283.281	9.30655	Fill	45	28	347.582	270.368	423.856	0	423.856	480.815	480.815
13	0.67606	282.384	10.0096	Fill	45	28	338.273	263.127	410.237	0	410.237	469.942	469.942
14	0.67606	282.236	10.0096	Fill	45	28	334.966	260.554	405.397	0	405.397	464.518	464.518
15	0.516974	215.534	10.6354	Fill	45	28	324.915	252.736	390.694	0	390.694	451.708	451.708
16	0.516974	215.07	10.6354	Fill	45	28	321.288	249.915	385.388	0	385.388	445.721	445.721
17	0.554476	230.157	10.6354	Fill	45	28	317.421	246.907	379.733	0	379.733	439.34	439.34
18	0.554476	229.624	10.6354	Fill	45	28	313.333	243.727	373.751	0	373.751	432.59	432.59
19	0.554476	229.091	10.6354	Fill	45	28	309.184	240.5	367.683	0	367.683	425.743	425.743
20	0.554476	228.557	10.6354	Fill	45	28	305.009	237.252	361.574	0	361.574	418.849	418.849
21	0.51289	210.941	10.6354	Fill	45	28	300.993	234.128	355.699	0	355.699	412.22	412.22
22	0.51289	210.485	10.6354	Fill	45	28	297.163	231.149	350.095	0	350.095	405.898	405.898
23	0.51289	210.029	10.6354	Fill	45	28	293.386	228.211	344.569	0	344.569	399.662	399.662
24	0.51289	209.573	10.6354	Fill	45	28	289.686	225.333	339.158	0	339.158	393.556	393.556
25	0.561358	228.854	10.6354	Fill	45	28	285.92	222.404	333.649	0	333.649	387.34	387.34
26	0.561358	228.308	10.6354	Fill	45	28	282.128	219.454	328.1	0	328.1	381.08	381.08
27	0.562898	228.386	10.6354	Fill	45	28	278.506	216.637	322.803	0	322.803	375.102	375.102
28	0.562898	227.836	10.6354	Fill	45	28	275.08	213.972	317.79	0	317.79	369.446	369.446
29	0.595593	240.471	10.6354	Fill	45	28	271.788	211.411	312.974	0	312.974	364.011	364.011
30	0.595593	239.856	10.6354	Fill	45	28	268.67	208.986	308.413	0	308.413	358.865	358.865
31	0.595593	239.136	10.8979	Fill	45	28	263.403	204.889	300.707	0	300.707	351.42	351.42
32	0.595593	238.311	10.8979	Fill	45	28	260.883	202.929	297.022	0	297.022	347.25	347.25
33	0.506151	201.002	13.872	Fill	45	28	235.361	183.076	259.682	0	259.682	317.806	317.806
34	0.506151	198.663	13.872	Fill	45	28	233.803	181.864	257.403	0	257.403	315.142	315.142
35	0.506151	196.155	14.4407	Fill	45	28	228.724	177.914	249.973	0	249.973	308.873	308.873

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
36	0.506151	193.478	14.4407	Fill	45	28	227.655	177.082	248.408	0	248.408	307.033	307.033
37	0.439321	165.369	16.175	Fill	45	28	216.826	168.659	232.568	0	232.568	295.459	295.459
38	0.439321	162.567	16.175	Fill	45	28	216.128	168.116	231.549	0	231.549	294.238	294.238
39	0.439321	159.765	16.175	Fill	45	28	215.485	167.616	230.607	0	230.607	293.109	293.109
40	0.439321	156.963	16.175	Fill	45	28	214.866	167.134	229.702	0	229.702	292.024	292.024
41	0.426239	148.726	20.2049	Fill	45	28	196.76	153.05	203.212	0	203.212	275.625	275.625
42	0.426239	144.318	20.2049	Fill	45	28	195.685	152.214	201.639	0	201.639	273.656	273.656
43	0.426239	139.719	21.0491	Fill	45	28	191.337	148.832	195.279	0	195.279	268.915	268.915
44	0.426239	134.928	21.0491	Fill	45	28	189.717	147.572	192.909	0	192.909	265.922	265.922
45	0.824635	241.836	27.3288	Fill	45	28	166.94	129.855	159.588	0	159.588	245.858	245.858
46	0.824635	209.079	31.0389	Fill	45	28	149.044	115.934	133.408	0	133.408	223.1	223.1
47	0.457484	94.2332	46.8304	Fill	45	28	106.695	82.9928	71.4542	0	71.4542	185.193	185.193
48	0.457484	70.8942	46.8304	Fill	45	28	91.8267	71.4277	49.7033	0	49.7033	147.593	147.593
49	0.457484	44.4185	52.555	Fill	45	28	65.8341	51.2092	11.6779	0	11.6779	97.6452	97.6452
50	0.457484	14.8062	52.555	Fill	45	28	42.8082	33.2985	-22.0073	0	-22.0073	33.8925	33.8925

Interslice Data

- Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.777853

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	151.948	328.015	0	0	0
2	152.744	327.803	89.1847	7.9376	5.08603
3	153.236	327.688	170.097	24.449	8.17942
4	153.728	327.573	277.813	55.0161	11.2015
5	155.082	327.561	456.831	157.118	18.9796
6	155.619	327.601	508.15	203.142	21.7899
7	156.156	327.642	561.919	255.2	24.4256
8	156.712	327.71	599.535	305.005	26.9641
9	157.268	327.777	636.764	357.441	29.3072

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
10	157.823	327.844	674.522	412.584	31.4528
11	158.377	327.911	712.913	470.261	33.4102
12	159.056	328.022	734.23	524.848	35.5582
13	159.735	328.133	754.575	577.921	37.4481
14	160.411	328.253	766.384	622.573	39.0887
15	161.087	328.372	776.608	663.343	40.5024
16	161.604	328.469	778.432	687.22	41.4389
17	162.121	328.566	779.161	707.897	42.2563
18	162.675	328.67	778.684	726.297	43.0064
19	163.23	328.774	776.867	740.596	43.6308
20	163.784	328.878	773.686	750.648	44.1341
21	164.339	328.983	769.132	756.355	44.5201
22	164.852	329.079	763.696	757.732	44.7754
23	165.365	329.175	757.096	755.367	44.9345
24	165.877	329.271	749.352	749.313	44.9985
25	166.39	329.368	740.493	739.663	44.9679
26	166.952	329.473	729.563	725.135	44.8256
27	167.513	329.579	717.404	706.678	44.5685
28	168.076	329.684	704.048	684.499	44.1934
29	168.639	329.79	689.61	658.958	43.6979
30	169.234	329.902	673.258	628.664	43.0382
31	169.83	330.014	655.916	595.454	42.2338
32	170.426	330.128	635.86	558.181	41.2778
33	171.021	330.243	615.212	519.204	40.1625
34	171.527	330.368	582.059	472.737	39.0828
35	172.034	330.493	549.8	427.639	37.8761
36	172.54	330.623	516.052	382.36	36.536
37	173.046	330.754	483.569	339.309	35.0564
38	173.485	330.881	450.592	299.99	33.6544
39	173.924	331.009	419.118	263.311	32.1391
40	174.364	331.136	389.16	229.296	30.5069
41	174.803	331.263	360.725	197.944	28.7553

Slice Number	X	Y	Interslice	Interslice	Interslice
	coordinate [ft]	coordinate - Bottom [ft]	Normal Force [lbs]	Shear Force [lbs]	Force Angle [degrees]
42	175.229	331.42	324.028	164.672	26.9398
43	175.656	331.577	289.761	135.176	25.0095
44	176.082	331.741	255.986	108.474	22.9648
45	176.508	331.905	224.779	85.422	20.8081
46	177.333	332.331	150.234	44.0282	16.334
47	178.157	332.828	82.2943	16.7551	11.5081
48	178.615	333.315	40.0377	6.13257	8.70831
49	179.072	333.803	15.5457	1.59091	5.84317
50	179.53	334.4	12.2336	0.6268	2.93304
51	179.987	334.998	0	0	0

Entity Information

Group: Group 3 

Shared Entities

[illegible]

Type	Coordinates	
External Boundary	X	Y
	72	270
	200	270
	200	318.272
	200	323.208
	200	335
	180	335
	157	331
	135	318
	134.408	301.41
	134.233	296.514
	134.178	295.015
	134.177	295
	133.974	295
	127.28	295
	112.99	295
	96.051	295
	81.167	295
	72	292
	72	283
Material Boundary	72	282.86
	72	279
Material Boundary	X	Y
	72	283
	112.99	295
Material Boundary	X	Y
	72	279
	84.5	282
	127.28	295

Type	Coordinates	
Material Boundary	X	Y
	134.233	296.514
	200	318.272
Material Boundary	X	Y
	134.408	301.41
	200	323.208

Scenario-based Entities

Type	Coordinates	Master Scenario
Water Table	X	Y
	71.874	282.823
	106.999	293.042
	134.181	295.015
	134.432	301.397
	200	323.208
Assigned to materials:		Colluvium