IGES®
Intermountain GeoEnvironmental Services, Inc.
12429 South 300 East, Suite 100, Draper, Utah 84020 ~ T: (801) 748-4044 ~ F: (801) 748-4045

November 4, 2015

39 Summit LLC
c/o Ms. Andrea Milner
cc: Mrs. Cassandra Beresini
314 Lytton Avenue, Suite 100
Palo Alto, California 94301

IGES Project No. 02132-002

Subject: Response to Additional Review Comments - Geology
Geotechnical Investigation Report
Lot 39R of Powder Mountain Resort
8365 East Summit Pass
Weber County, Utah

Ms. Milner:

As requested, IGES has prepared the following response to additional review comments regarding the referenced geotechnical report and first review response dated September 23, 2015 for Lot 39, part of the larger Powder Mountain Resort expansion project in Weber County, Utah. The review comments to be addressed were prepared by Simon Associates LLC (SA) in a letter dated October 13, 2015; the latest comments by SA are in regard to the review response by IGES (2015c), which was prepared in response to SA's first geologic review letter (SA, 2015a) that was regarding the original geotechnical report by IGES (2015a). For convenience, the review comments will be presented first, followed by our response.

Comment No. 1

"Based on geologic conditions presented in the Western GeoLogic (2012) report, the south part of Lot 39R is underlain by mixed slope colluvium, shallow landslides, and talus, see Figures 1 and 2 (attached). Since geologic conditions should be adequately characterized for inclusion into the slope stability analysis, SA recommends Weber County request IGES clarify the geologic conditions of the property, particularly the south part of the parcel mapped as mixed slope colluvium, shallow landslides, and talus by Western GeoLogic (2012)."

Response to Comment No. 1

The Western GeoLogic (2012) report was a self-described "reconnaissance-level engineering geology and geologic review and evaluation" (Page 1), which also states: "Given the large size of the project, steep slopes, and lack of road access, not all areas were directly accessed or observed" (Page 6). As such, the report largely consisted of a desktop review and was of a wider scale and scope than the site-specific IGES investigation of the Lot 39R property. The IGES field investigation consisted of the physical traversing of the Lot 39R property and surrounding properties, which documented that the site-specific geology was more consistent with that of Sorensen and Crittenden, Jr. (1979) than with Western GeoLogic (2012). Therefore, the design-level geologic map produced by IGES for this field investigation supersedes the reconnaissance-level geologic map produced by Western GeoLogic (2012), and the geologic conditions for Lot 39R should be understood as described in the IGES September 23, 2015 response letter.

Comment No. 2a

"*SA recommends Weber County request IGES confirm their conclusion regarding faulting from a more recent publication such as the USGS Quaternary Fault and Fold Database of the United States (http://earthquake.usgs.gov/hazards/qfaults)*"

Response to Comment No. 2a

As suggested by SA, IGES confirmed our conclusion regarding faulting from the USGS Quaternary Fault and Fold Database of the United States (QFFD). The nearest published fault to the Lot 39R property is the unnamed fault identified in Sorensen and Crittenden, Jr. (1979), which is located approximately 1.5 miles southwest of the property and strikes to the northwest. This fault is not included in the QFFD. The closest fault to the subject property that is part of the QFFD is the Ogden Valley Northeastern Margin Fault. This fault is located approximately 3 miles to the southwest of the property and strikes to the northwest. The closest active fault to the subject property as found in the QFFD is the Weber section of the Wasatch Fault Zone, located approximately 10 miles west of the Lot 39R property.

Comment No. 2b

"*SA recommends Weber County request IGES provide Figure 3 of Western GeoLogic, 2012, report depicting the location of the subject site and noting "… the Holocene and Late Pleistocene landslide deposits to the west and south of the subject property*."

Response to Comment No. 2b

Figure 1 attached reproduces Figure 3 of the Western GeoLogic (2012) report, with the approximate location of Lot 39R also shown. As seen in the figure, Western GeoLogic identified six Holocene to Late Pleistocene landslides (arrows extending from the "Holocene to Late Pleistocene Landslides" label point to the individual landslide deposits) at various locations northwest to southeast of the subject property.

Comment No. 2c(i)

"*Clarify the significance of their possible late Pleistocene-age for the landslide; specifically, is IGES inferring a correlation between age of a landslide and stability of the landslide? Based on degree of erosion, it could equally be argued that the landslides are Holocene*."

Response to Comment No. 2c(i)

IGES does not maintain that there is a direct correlation between the age and stability of a landslide, as there have been a number of older landslides in Utah that have had recent recorded reactivation (Christensen and Ashland, 2006). Nevertheless, the geomorphic character of a particular landslide forms the basis for its age classification (McCalpin, 1984), and because of the more subdued geomorphic features present on the landslide south of Lot 39R, an older (Late Pleistocene) age was inferred as opposed to a younger (Holocene) age.

Comment No. 2c(ii)

"*Provide the data/evidence which forms the basis for their conclusion that the 450 foot setback of the building envelope from the landslides is an* "…acceptable setback…"

Response to Comment No. 2c(ii)

It was the intent of IGES to provide a qualitative opinion as to the potential impact of the landslide to the proposed improvements within the building envelope; the term "acceptable setback" was unfortunately misleading, as it implies a specific minimum setback value based on code, slope stability analysis, or a combination of both.

To provide a more quantitative assessment of a reasonable setback from the landslide, IGES performed a slope stability analysis. The intent of the analysis is to model a hypothetical post-failure scenario, e.g., if the mapped landslide is reactivated, what is the potential impact up-slope of the landslide?

The stability of the slope was modeled using gSTABLE7 slope stability software. Bishop's Simplified Method was used to model the slope. Calculations for stability were developed by searching for the minimum factor-of-safety for a circular-type failure. A minimum static factor-of-safety of 1.5 and seismic factor-of-safety of 1.0 was considered acceptable for this project considering the available information. Homogeneous earth materials (existing site soils, colluvium) and arcuate failure surfaces were assumed. The section analyzed is Section A-A', illustrated on Figure 1 in the first IGES review response (IGES, 2015c). For convenience, Figure 1 from the first response is included as an attachment to this letter, presented as Figure 2.

For our assessment of native site soils, IGES has reviewed soil data presented in our geotechnical report for Lot 39R (2015a). The report indicates that the subsurface in the vicinity of the property consists mostly dense, coarse gravel and cobbles in a clay matrix in the upper 10 to 15 feet, which is underlain by hard sandy lean clay. Considering the available geotechnical data and our experience in the area, appropriate engineering parameters have been selected for our model; these parameters are summarized in Table 1.

Table 1
Engineering Parameters for Subsurface Model

Soil Type	Elevation (ft. below existing grade)	Unit Weight (pcf)	Friction Angle (Degrees)	Cohesion (psf)
Clayey Gravel	0-15	130	39	100
Sandy Lean Clay	~15-20	120	26	250

Groundwater (e.g., a piezometric surface) was not identified during our geotechnical investigation; furthermore, shallow groundwater is not known to occur in this area. However, in one of the two test pits excavated during the geotechnical investigation water was observed seeping at a depth of 7 feet; this water is presumed to be a localized perched water condition, likely associated with spring run-off and therefore transient. Nonetheless, to assess the potential impact to the slope a surface saturated condition was also modeled by way of increasing the unit weight of the soil to that of the saturated condition (e.g., the clayey gravel was modeled with a unit weight of 136 pcf). A surface saturated condition is more appropriately modeled in an infinite slope stability analysis, discussed in the following section.

For the seismic (pseudo-static) assessment of slope, the seismic coefficient k_h is modeled as equal to 50% of the peak ground acceleration (PGA) resulting from a MCE seismic event (2PE50). From our referenced geotechnical report, the PGA resulting from a 2PE50 seismic event is taken as 0.326g. Therefore, we have adopted a seismic coefficient of 0.17g.

Based on our analysis, in a hypothetical post-failure condition, minimum factors-of-safety of 1.5 and 1.0 for static and seismic conditions, respectively, are maintained with respect to the proposed building envelope. Therefore, the distance between the proposed building envelope and the mapped landside is considered acceptable from a slope stability and geologic hazard standpoint. The results of the global stability analyses are attached.

Stability of Saturated Slopes

IGES assessed the potential for surficial soils becoming mobilized under saturated parallel seepage conditions. Our assessment assumes coarse colluvium, fully saturated, and a 3.7H:1V slope, which is representative for the area below the building envelope, within the property boundary. Our model assumes an effective friction angle of 39 degrees with zero cohesion, and a saturated unit weight of 136 pcf. Based on this model, a factor-of-safety of 1.64 results. It is informative to apply this analysis further down-slope, in the vicinity of the mapped landslide, south of the Lot 39R property boundary, where the prevailing natural gradient is somewhat steeper, on the order of 2.5H:1V. Using the same model except with a gradient of 2.5H:1V, a factor-of-safety of 1.10 results, suggesting marginal surficial stability. Sample calculations are attached as Figures 3 and 4.

Closure

We appreciate the opportunity to provide you with our services. If you have any questions please contact the undersigned at your convenience (801) 748-4044.

Respectfully Submitted,
IGES, Inc.

Peter E. Doumit, P.G., C.P.G.
Senior Geologist

David A. Glass, P.E.
Senior Geotechnical Engineer

Reviewed by:

C. Charles Payton, P.G.
Professional Engineering Geologist

Attachments:

References
Figure 1 – Figure 3 from the Western GeoLogic Report (2012)
Figure 2 – Geologic Cross Section A-A'
Slope Stability Analysis
Figure 3 – Infinite Slope Stability Analysis: 3.7H:1V
Figure 4 – Infinite Slope Stability Analysis: 2.5H:1V

References

Christensen, G.E., and Ashland, F.X., 2006, Assessing the Stability of Landslides – Overview of Lessons Learned from Historical Landslides in Utah: Proceedings for the 40th Symposium on Engineering Geology and Geotechnical Engineering, 17 p.

IGES, Inc., 2015a, Geotechnical Investigation Report, Lot 39R of Powder Mountain Resort, 8365 East Summit Pass, Weber County, Utah Project No. 02052-001, dated June 3, 2015.

IGES, Inc., 2015b, Design Package, Permanent Shoring System, Howery Residence, 8365 East Summit Pass (Lot 39R), Summit Eden Development, Weber County, Utah, Project No. 02132-001, dated July 6, 2015, latest revision August 27, 2015.

IGES, Inc., 2015c, Response to Review Comments – Geology, Geotechnical Investigation Report, Lot 39R of Powder Mountain Resort, 8365 East Summit Pass, Weber County, Utah, Project No. 02132-002, dated September 23, 2015.

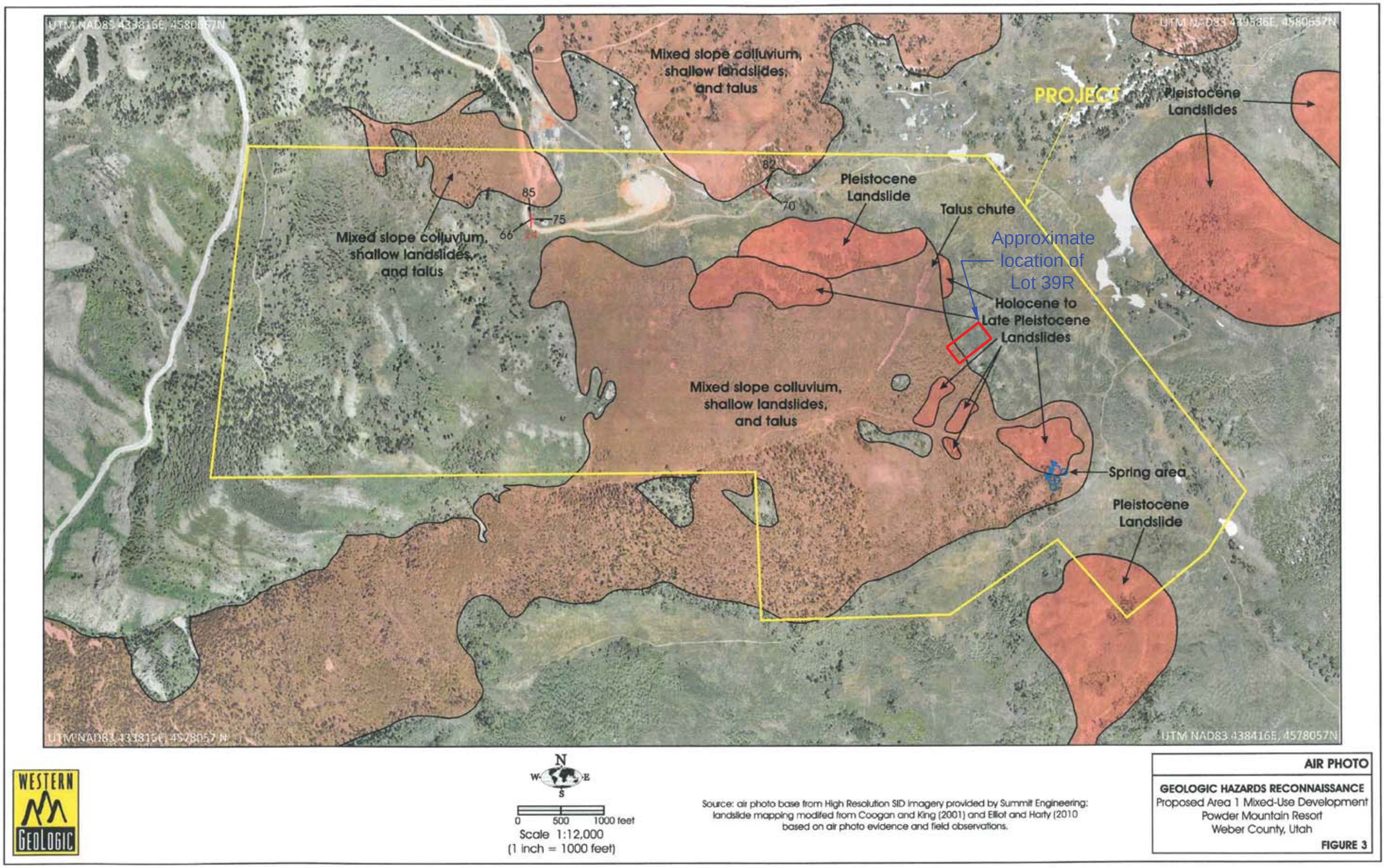
McCalpin, J.P., 1984, Preliminary age classification of landslides for inventory mapping, in Hardcastle, J.H., editor, Proceedings of the 21st Engineering Geology and Soils, Engineering Symposium: Moscow, University of Idaho, p. 99-111.

Simon Associates, LLC, 2015a, Geologic Review, Lot 39R Summit at Powder Mountain Phase I Subdivision, 8365 East Summit Pass Road, Eden, Utah, SA Project No. 15-161, dated August 17, 2015.

Simon Associates, LLC, 2015b, Geologic Review No. 2, Lot 39R Summit at Powder Mountain Phase I Subdivision, 8365 East Summit Pass Road, Eden, Utah, SA Project No. 15-161, dated October 13, 2015.

Sorensen, M.L., and Crittenden, M.D., Jr., 1979, Geologic map of the Huntsville quadrangle, Weber and Cache Counties, Utah: U.S. Geological Survey Geologic Quadrangle Series Map GQ-1503, scale 1:24,000.

Western Geologic, 2012, Report: Geologic Hazards Reconnaissance, Proposed Area 1 Mixed-Use Development, Powder Mountain Resort, Weber County, Utah, dated August 28, 2012.



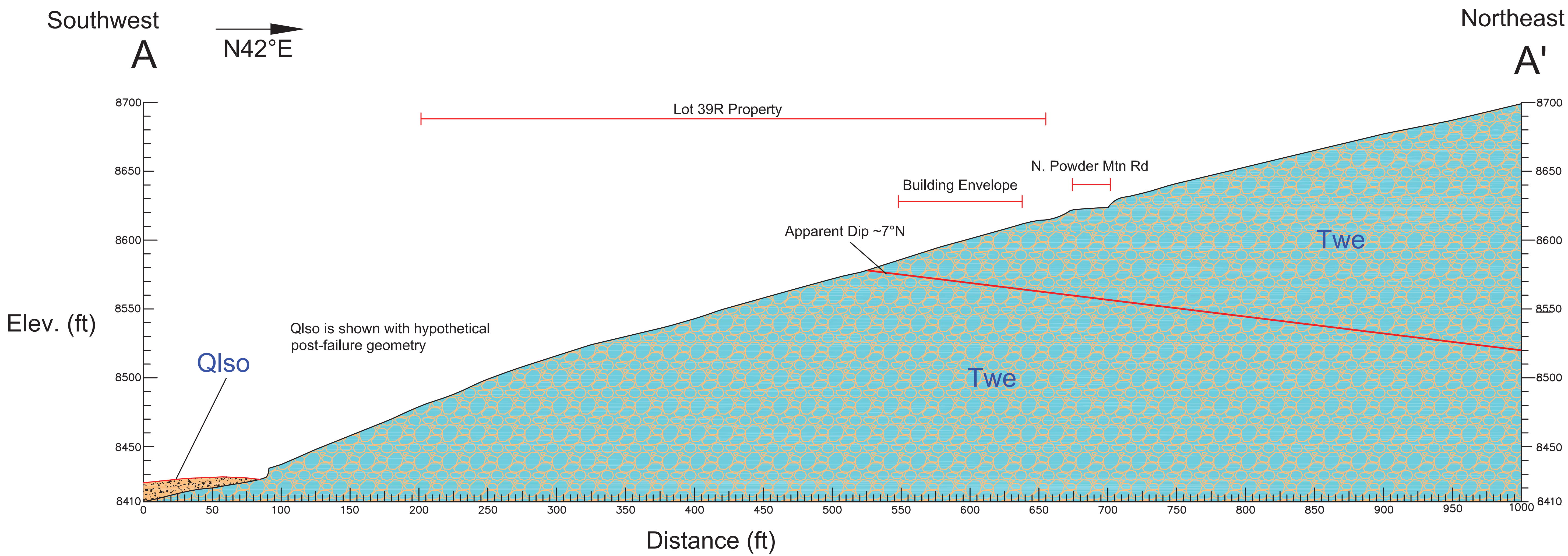
BASEMAP FROM WESTERN GEOLOGIC (2012) RECONNAISSANCE REPORT

FIGURE 1

WESTERN GEOLOGIC
FIGURE 3

DATE: 10/23/2015
FILE: 02132-002

IGES



LEGEND

Qlso: Late Pleistocene? shallow landslide deposits

Consists of irregular, hummocky topography and rounded to subrounded clasts of pink to tan to dark gray quartzite and conglomerate clasts up to 4' in diameter.

Twe: Undifferentiated Wasatch and Evanston Formations

Consists of unconsolidated Precambrian clasts of rounded to subrounded pink to tan to dark gray quartzite and conglomerate up to 6' in diameter in a reddish-brown silty matrix. Clayey interbeds with some gravel seen in test pits up to as much as 8' thick. Apparent dip calculated from generalized attitude of bedding as shown on Crittenden, Jr. (1972).

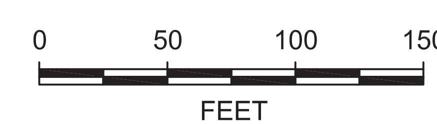


FIGURE 2

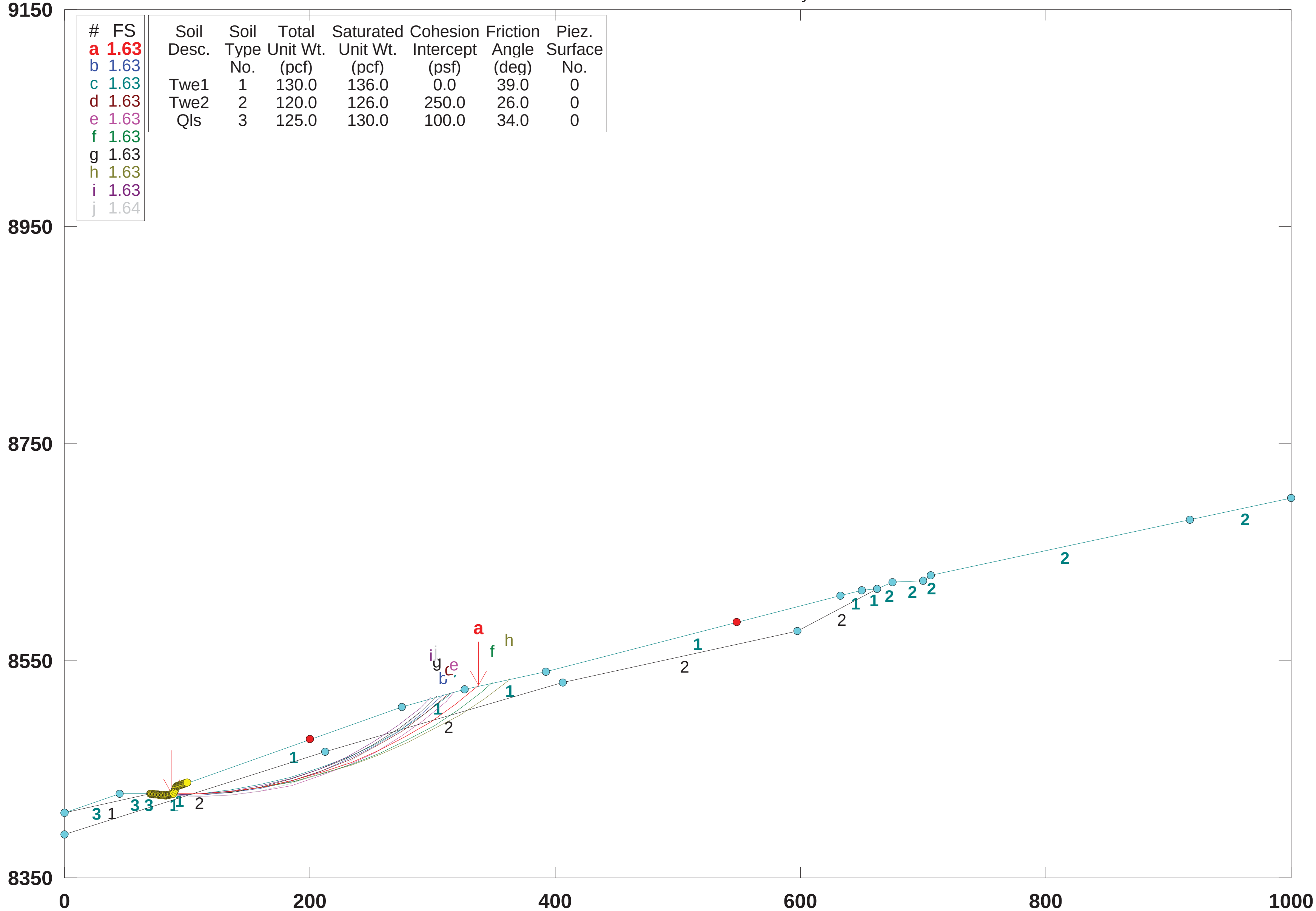
GEOLOGIC CROSS-SECTION

GEOLOGIC INVESTIGATION
LOT 39R
POWDER MTN PHASE 1 SUBDIVISION
WEBER COUNTY, UTAH

DATE: 10/30/2015
FILE: 02132-002
SCALE: 1"=75'

Lot 39; A-A'; 02132-002; Post-LS Failure; Setback; Static

C:\DOCUME~1\DAVIDG\DESKTOP\LOT39~1\A1.PL2 Run By: DAG 11/4/2015 6:01PM



Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Twe1	1	130.0	136.0	0.0	39.0	0
Twe2	2	120.0	126.0	250.0	26.0	0
Qls	3	125.0	130.0	100.0	34.0	0

GSTABL7 v.2 FSmin=1.63

Safety Factors Are Calculated By The Modified Bishop Method

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.002, December 2001 **

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback, 1
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date:	11/4/2015
Time of Run:	6:01PM
Run By:	DAG
Input Data Filename:	C:a1.
Output Filename:	C:a1.OUT
Unit System:	English
Plotted Output Filename:	C:a1.PLT

1

PROBLEM DESCRIPTION: Lot 39; A-A'; 02132-002; Post-LS Failure
; Setback; Static

BOUNDARY COORDINATES

16 Top Boundaries
21 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	8410.00	45.00	8427.00	3
2	45.00	8427.00	70.00	8427.50	3
3	70.00	8427.50	83.00	8426.00	3
4	83.00	8426.00	89.00	8427.70	1
5	89.00	8427.70	91.10	8434.30	1
6	91.10	8434.30	275.00	8508.00	1
7	275.00	8508.00	326.00	8524.30	1
8	326.00	8524.30	392.00	8540.50	1
9	392.00	8540.50	632.00	8610.00	1
10	632.00	8610.00	650.00	8614.40	1
11	650.00	8614.40	662.00	8616.10	1
12	662.00	8616.10	675.00	8622.00	2
13	675.00	8622.00	700.00	8623.60	2
14	700.00	8623.60	706.00	8629.20	2
15	706.00	8629.20	917.00	8680.00	2
16	917.00	8680.00	1000.00	8700.00	2
17	0.00	8410.00	70.00	8427.50	1
18	0.00	8390.00	212.00	8466.00	2
19	212.00	8466.00	406.00	8530.00	2
20	406.00	8530.00	597.00	8578.00	2
21	597.00	8578.00	662.00	8616.10	2

User Specified Y-Origin = 8350.00(ft)

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	136.0	0.0	39.0	0.00	0.0	0
2	120.0	126.0	250.0	26.0	0.00	0.0	0
3	125.0	130.0	100.0	34.0	0.00	0.0	0

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

2500 Trial Surfaces Have Been Generated.

50 Surface(s) Initiate(s) From Each Of 50 Points Equally Spaced
Along The Ground Surface Between X = 70.00(ft)
and X = 100.00(ft)

Each Surface Terminates Between X = 200.00(ft)
and X = 548.00(ft)

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)

25.00(ft) Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.
The Angle Has Been Restricted Between The Angles Of -30.0

And 10.0 deg.

Following Is Displayed The Most Critical Of The Trial
Failure Surfaces Evaluated.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 2500

Statistical Data On All Valid FS Values:
FS Max = 2.581 FS Min = 1.628 FS Ave = 1.990
Standard Deviation = 0.188 Coefficient of Variation = 9.43 %

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	87.76	8427.35
2	112.75	8427.71
3	137.66	8429.89
4	162.34	8433.87
5	186.66	8439.64
6	210.50	8447.17
7	233.73	8456.41
8	256.23	8467.31
9	277.87	8479.83
10	298.55	8493.88
11	318.14	8509.41
12	336.56	8526.32
13	337.26	8527.06

Circle Center At X = 95.31 ; Y = 8770.59 ; and Radius = 343.33

Factor of Safety
*** 1.628 ***

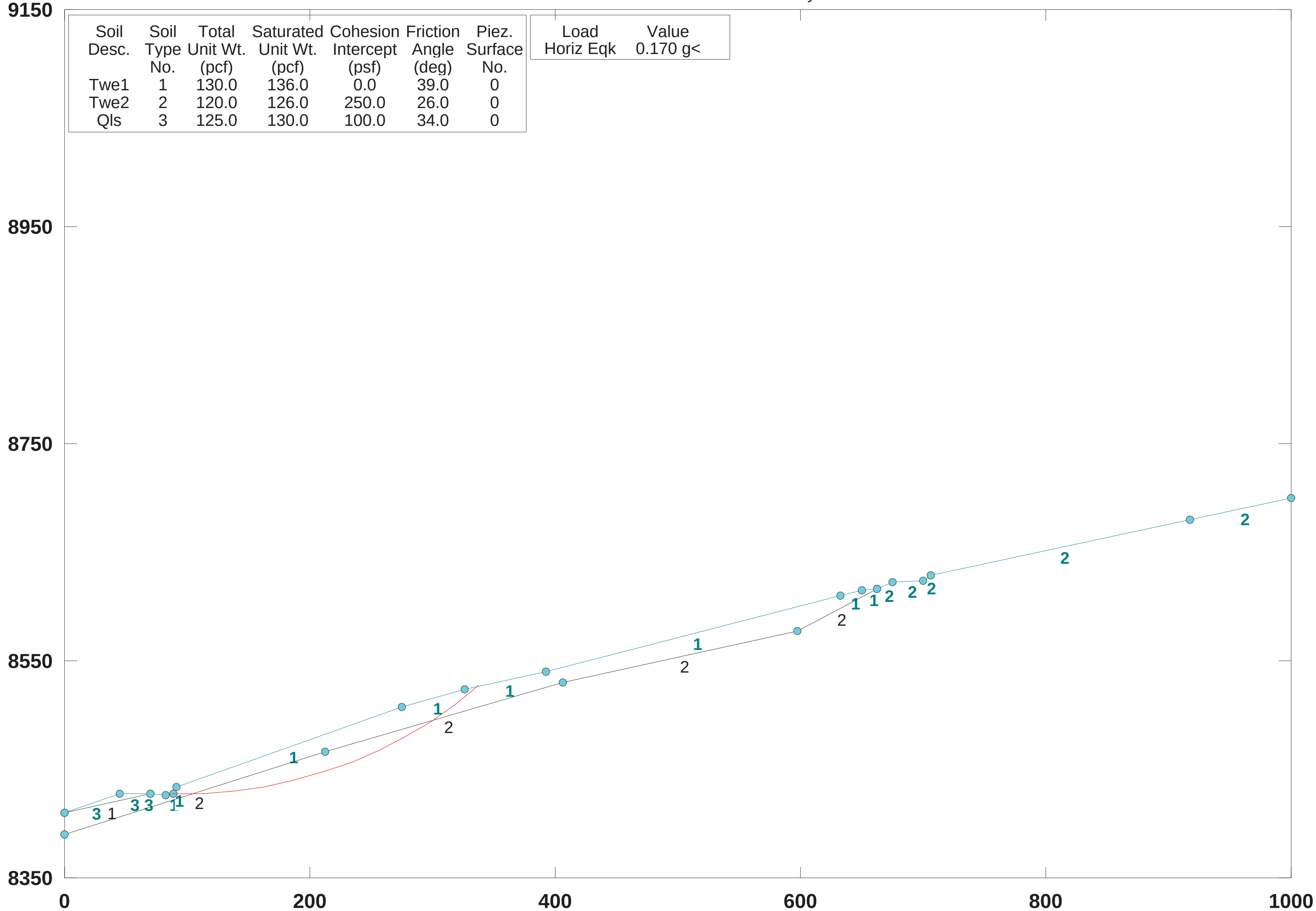
Individual data on the 19 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.2	27.0	0.0	0.0	0.	0.	0.0	0.0	0.0
2	2.1	988.0	0.0	0.0	0.	0.	0.0	0.0	0.0
3	13.8	17117.7	0.0	0.0	0.	0.	0.0	0.0	0.0
4	7.9	13982.6	0.0	0.0	0.	0.	0.0	0.0	0.0
5	24.9	60552.2	0.0	0.0	0.	0.	0.0	0.0	0.0
6	24.7	80562.8	0.0	0.0	0.	0.	0.0	0.0	0.0
7	24.3	94078.3	0.0	0.0	0.	0.	0.0	0.0	0.0
8	23.8	101041.2	0.0	0.0	0.	0.	0.0	0.0	0.0
9	1.5	6532.4	0.0	0.0	0.	0.	0.0	0.0	0.0
10	21.7	95144.5	0.0	0.0	0.	0.	0.0	0.0	0.0
11	22.5	96369.4	0.0	0.0	0.	0.	0.0	0.0	0.0
12	18.8	74804.9	0.0	0.0	0.	0.	0.0	0.0	0.0
13	2.9	10760.9	0.0	0.0	0.	0.	0.0	0.0	0.0
14	20.7	67287.9	0.0	0.0	0.	0.	0.0	0.0	0.0
15	1.4	3993.7	0.0	0.0	0.	0.	0.0	0.0	0.0
16	18.2	39338.8	0.0	0.0	0.	0.	0.0	0.0	0.0
17	7.9	10244.1	0.0	0.0	0.	0.	0.0	0.0	0.0
18	10.6	5664.5	0.0	0.0	0.	0.	0.0	0.0	0.0
19	0.7	26.4	0.0	0.0	0.	0.	0.0	0.0	0.0

**** END OF GSTABL7 OUTPUT ****

Lot 39; A-A'; 02132-002; Post-LS Failure; Setback; P-Static

C:\DOCUME~1\DAVIDG\DESKTOP\LOT39~1\A1P.PLT Run By: DAG 11/4/2015 6:02PM



GSTABL7 v.2 FSmin=1.08

Factor Of Safety Is Calculated By The Modified Bishop Method

GSTABL7

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.002,
December 2001 **

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback, 1
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 11/4/2015
Time of Run: 6:02PM
Run By: DAG
Input Data Filename: C:a1p.
Output Filename: C:a1p.OUT
Unit System: English

Plotted Output Filename: C:a1p.PLT

PROBLEM DESCRIPTION: Lot 39; A-A'; 02132-002; Post-LS Failure
; Setback; P-Static

BOUNDARY COORDINATES 1

16 Top Boundaries
21 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	8410.00	45.00	8427.00	3
2	45.00	8427.00	70.00	8427.50	3
3	70.00	8427.50	83.00	8426.00	3
4	83.00	8426.00	89.00	8427.70	1
5	89.00	8427.70	91.10	8434.30	1
6	91.10	8434.30	275.00	8508.00	1
7	275.00	8508.00	326.00	8524.30	1
8	326.00	8524.30	392.00	8540.50	1
9	392.00	8540.50	632.00	8610.00	1
10	632.00	8610.00	650.00	8614.40	1
11	650.00	8614.40	662.00	8616.10	1
12	662.00	8616.10	675.00	8622.00	2
13	675.00	8622.00	700.00	8623.60	2
14	700.00	8623.60	706.00	8629.20	2
15	706.00	8629.20	917.00	8680.00	2
16	917.00	8680.00	1000.00	8700.00	2
17	0.00	8410.00	70.00	8427.50	1
18	0.00	8390.00	212.00	8466.00	2
19	212.00	8466.00	406.00	8530.00	2
20	406.00	8530.00	597.00	8578.00	2
21	597.00	8578.00	662.00	8616.10	2

User Specified Y-Origin = 8350.00(ft)

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	130.0	136.0	0.0	39.0	0.00	0.0	0
2	120.0	126.0	250.0	26.0	0.00	0.0	0
3	125.0	130.0	100.0	34.0	0.00	0.0	0

A Horizontal Earthquake Loading Coefficient
Of0.170 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0(psf)

Trial Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	87.76	8427.35
2	112.75	8427.71
3	137.66	8429.89
4	162.34	8433.87
5	186.66	8439.64
6	210.50	8447.17
7	233.73	8456.41
8	256.23	8467.31
9	277.87	8479.83

10	298.55	8493.88
11	318.14	8509.41
12	336.56	8526.32
13	337.26	8527.06

Circle Center At X = 95.30 ; Y = 8770.61; and Radius = 343.35

* * Factor Of Safety Is Calculated By The Modified Bishop Method * *

Factor Of Safety For The Preceding Specified Surface = 1.077

Table 1 - Individual Data on the 19 Slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	1.2	26.9	0.0	0.0	0.0	0.0	4.6	0.0	0.0
2	2.1	987.8	0.0	0.0	0.0	0.0	167.9	0.0	0.0
3	13.8	17123.6	0.0	0.0	0.0	0.0	2911.0	0.0	0.0
4	7.9	13968.0	0.0	0.0	0.0	0.0	2374.6	0.0	0.0
5	24.9	60555.9	0.0	0.0	0.0	0.0	10294.5	0.0	0.0
6	24.7	80561.4	0.0	0.0	0.0	0.0	13695.4	0.0	0.0
7	24.3	94067.8	0.0	0.0	0.0	0.0	15991.5	0.0	0.0
8	23.8	101039.0	0.0	0.0	0.0	0.0	17176.6	0.0	0.0
9	1.5	6547.8	0.0	0.0	0.0	0.0	1113.1	0.0	0.0
10	21.7	95122.0	0.0	0.0	0.0	0.0	16170.7	0.0	0.0
11	22.5	96387.7	0.0	0.0	0.0	0.0	16385.9	0.0	0.0
12	18.8	74808.1	0.0	0.0	0.0	0.0	12717.4	0.0	0.0
13	2.9	10754.2	0.0	0.0	0.0	0.0	1828.2	0.0	0.0
14	20.7	67308.1	0.0	0.0	0.0	0.0	11442.4	0.0	0.0
15	1.5	4019.8	0.0	0.0	0.0	0.0	683.4	0.0	0.0
16	18.1	39301.6	0.0	0.0	0.0	0.0	6681.3	0.0	0.0
17	7.9	10244.9	0.0	0.0	0.0	0.0	1741.6	0.0	0.0
18	10.6	5660.1	0.0	0.0	0.0	0.0	962.2	0.0	0.0
19	0.7	26.0	0.0	0.0	0.0	0.0	4.4	0.0	0.0

Table 2 - Base Stress Data on the 19 Slices

Slice No. *	Alpha (deg)	X-Coord. Slice Cntr (ft)	Base Leng. (ft)	Available Shear Strength (psf)	Mobilized Shear Stress (psf)
1	0.83	88.38	1.24	17.39	2.76
2	0.83	90.05	2.10	376.79	8.24
3	0.83	97.99	13.77	995.93	18.19
4	0.83	108.81	7.88	1107.65	26.02
5	5.00	125.21	25.01	1380.93	211.22
6	9.16	150.00	25.00	1716.64	513.24
7	13.35	174.50	25.00	1929.17	868.83
8	17.53	198.58	25.00	2027.04	1217.38
9	21.69	211.25	1.61	2015.79	1501.03
10	21.69	222.86	23.39	2020.85	1503.49
11	25.85	244.98	25.00	1918.38	1680.90
12	30.05	265.61	21.69	1738.24	1727.76
13	30.05	276.43	3.32	1646.10	1625.18
14	34.19	288.21	25.00	1405.00	1513.04
15	38.41	299.28	1.85	1176.51	1348.16
16	38.41	309.07	23.14	1099.27	1055.04
17	42.55	322.07	10.67	624.37	649.62
18	42.55	331.28	14.33	256.75	267.23
19	46.75	336.91	1.02	16.74	21.53

Sum of the Resisting Forces (including Pier/Pile, Tieback, Reinforcing Soil Nail, and Applied Forces if applicable) = 414392.16 (lbs)

Average Available Shear Strength (including Tieback, Pier/Pile, Reinforcing, Soil Nail, and Applied Forces if applicable) = 1501.30(psf)

Sum of the Driving Forces = 384919.50 (lbs)

Average Mobilized Shear Stress = 1394.53(psf)

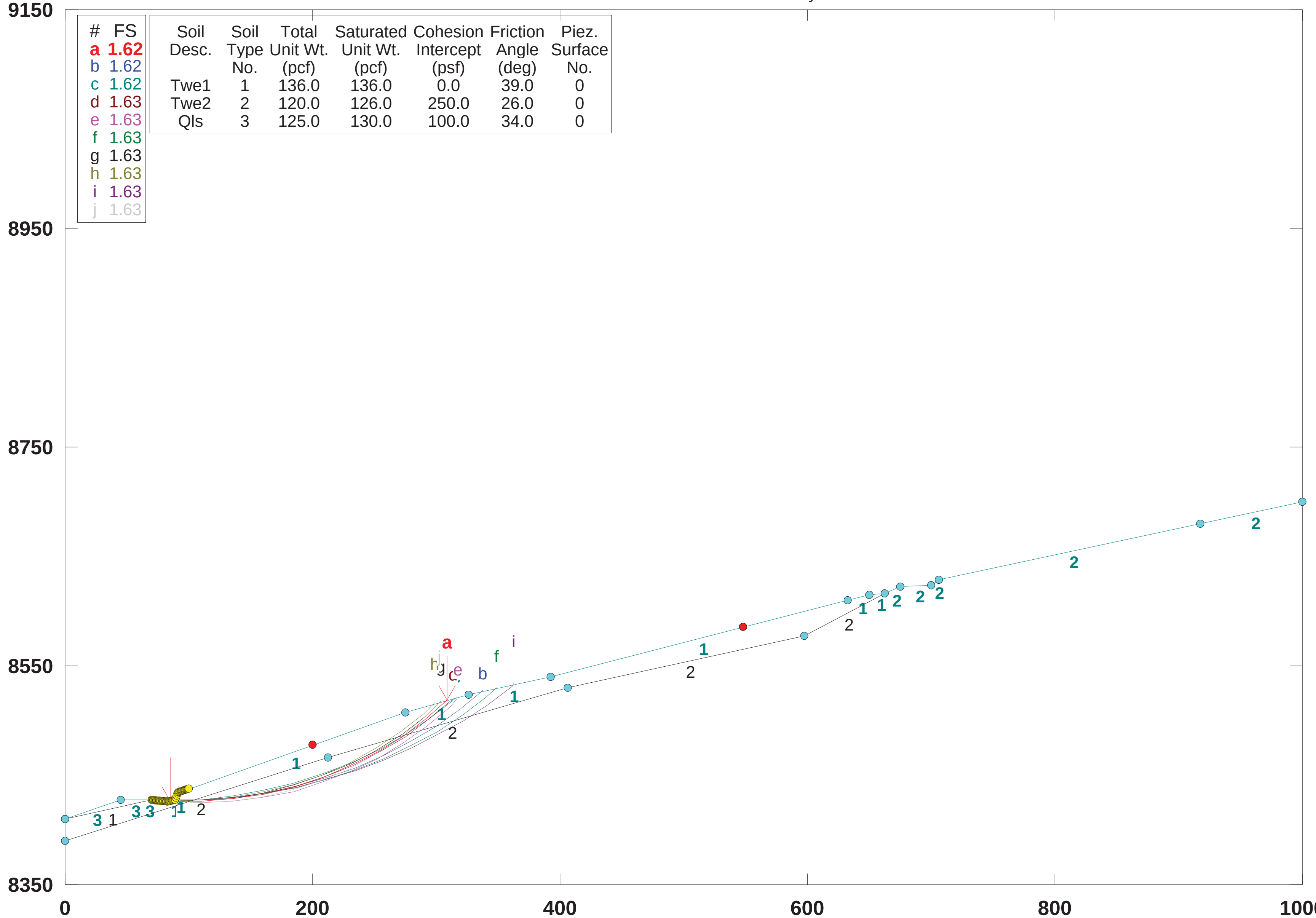
Total length of the failure surface = 276.02(ft)

CAUTION - Factor Of Safety Is Calculated By The Modified Bishop Method. This Method Is Valid Only If The Failure Surface Approximates A Circular Arc.

**** END OF GSTABL7 OUTPUT ****

Lot 39; A-A'; 02132-002; Post-LS Failure; Setback; Sat. Unit Weight; Static

C:\DOCUME~1\DAVIDG\DESKTOP\LOT39~1\A2.PL2 Run By: DAG 11/4/2015 6:03PM



GSTABL7 v.2 FSmin=1.62

Safety Factors Are Calculated By The Modified Bishop Method

*** GSTABL7 ***

** GSTABL7 by Garry H. Gregory, P.E. **

** Original Version 1.0, January 1996; Current Version 2.002, December 2001 **

****

SLOPE STABILITY ANALYSIS SYSTEM

Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback, 1
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static Earthquake, and Applied Force Options.

****

Analysis Run Date: 11/4/2015
Time of Run: 6:03PM
Run By: DAG
Input Data Filename: C:a2.
Output Filename: C:a2.OUT
Unit System: English

Plotted Output Filename: C:a2.PLT

1

PROBLEM DESCRIPTION: Lot 39; A-A'; 02132-002; Post-LS Failure ; Setback; Sat. Unit Weight; Static

BOUNDARY COORDINATES

16 Top Boundaries
21 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	8410.00	45.00	8427.00	3
2	45.00	8427.00	70.00	8427.50	3
3	70.00	8427.50	83.00	8426.00	3
4	83.00	8426.00	89.00	8427.70	1
5	89.00	8427.70	91.10	8434.30	1
6	91.10	8434.30	275.00	8508.00	1
7	275.00	8508.00	326.00	8524.30	1
8	326.00	8524.30	392.00	8540.50	1
9	392.00	8540.50	632.00	8610.00	1
10	632.00	8610.00	650.00	8614.40	1
11	650.00	8614.40	662.00	8616.10	1
12	662.00	8616.10	675.00	8622.00	2
13	675.00	8622.00	700.00	8623.60	2
14	700.00	8623.60	706.00	8629.20	2
15	706.00	8629.20	917.00	8680.00	2
16	917.00	8680.00	1000.00	8700.00	2
17	0.00	8410.00	70.00	8427.50	1
18	0.00	8390.00	212.00	8466.00	2
19	212.00	8466.00	406.00	8530.00	2
20	406.00	8530.00	597.00	8578.00	2
21	597.00	8578.00	662.00	8616.10	2

User Specified Y-Origin = 8350.00(ft)

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	136.0	136.0	0.0	39.0	0.00	0.0	0
2	120.0	126.0	250.0	26.0	0.00	0.0	0
3	125.0	130.0	100.0	34.0	0.00	0.0	0

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

2500 Trial Surfaces Have Been Generated.

50 Surface(s) Initiate(s) From Each Of 50 Points Equally Spaced Along The Ground Surface Between X = 70.00(ft) and X = 100.00(ft)

Each Surface Terminates Between X = 200.00(ft) and X = 548.00(ft)

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00(ft)

25.00(ft) Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation. The Angle Has Been Restricted Between The Angles Of -30.0

And 10.0 deg.

Following Is Displayed The Most Critical Of The Trial
Failure Surfaces Evaluated.

.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Total Number of Trial Surfaces Evaluated = 2500

Statistical Data On All Valid FS Values:
FS Max = 2.582 FS Min = 1.621 FS Ave = 1.987
Standard Deviation = 0.189 Coefficient of Variation = 9.52 %

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	85.31	8426.65
2	110.31	8426.52
3	135.22	8428.58
4	159.86	8432.82
5	184.03	8439.21
6	207.54	8447.71
7	230.22	8458.23
8	251.88	8470.71
9	272.36	8485.04
10	291.51	8501.12
11	309.16	8518.82
12	309.27	8518.95

Circle Center At X = 99.36 ; Y = 8710.44 ; and Radius = 284.13

Factor of Safety
*** 1.621 ***

Individual data on the 17 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	3.7	267.8	0.0	0.0	0.	0.	0.0	0.0	0.0
2	2.1	1248.7	0.0	0.0	0.	0.	0.0	0.0	0.0
3	10.9	14648.0	0.0	0.0	0.	0.	0.0	0.0	0.0
4	8.3	15394.9	0.0	0.0	0.	0.	0.0	0.0	0.0
5	24.9	63299.7	0.0	0.0	0.	0.	0.0	0.0	0.0
6	24.6	83044.4	0.0	0.0	0.	0.	0.0	0.0	0.0
7	24.2	94802.6	0.0	0.0	0.	0.	0.0	0.0	0.0
8	23.5	98571.2	0.0	0.0	0.	0.	0.0	0.0	0.0
9	4.5	18909.1	0.0	0.0	0.	0.	0.0	0.0	0.0
10	18.2	75893.0	0.0	0.0	0.	0.	0.0	0.0	0.0
11	21.7	84304.9	0.0	0.0	0.	0.	0.0	0.0	0.0
12	20.5	68008.9	0.0	0.0	0.	0.	0.0	0.0	0.0
13	1.7	4980.5	0.0	0.0	0.	0.	0.0	0.0	0.0
14	0.9	2653.5	0.0	0.0	0.	0.	0.0	0.0	0.0
15	16.5	36923.2	0.0	0.0	0.	0.	0.0	0.0	0.0
16	17.7	14710.2	0.0	0.0	0.	0.	0.0	0.0	0.0
17	0.1	0.7	0.0	0.0	0.	0.	0.0	0.0	0.0

**** END OF GSTABL7 OUTPUT ****

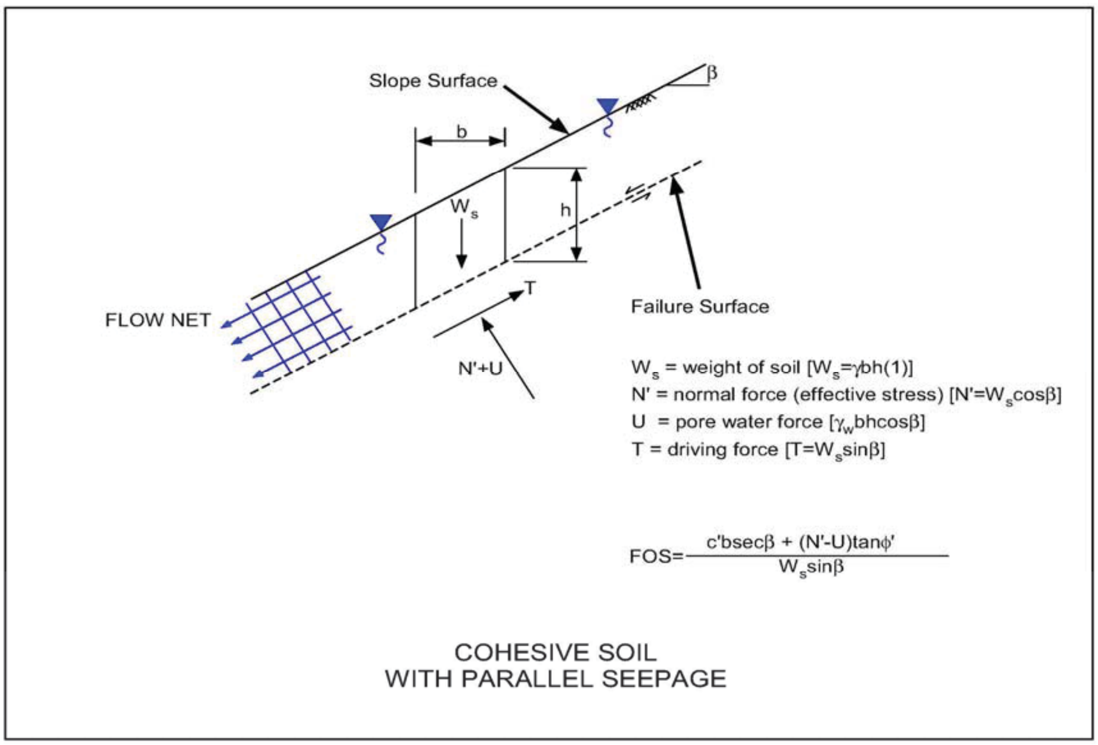
Lot 39R
02132-002
11/4/2015

c'	0	psf	Effective Cohesion
ϕ'	39	deg	Effective Friction Angle
Υ_{sat}	136	pcf	Saturated Unit Weight of Soil
Υ_w	62.4	pcf	Unit weight of water
h	7	ft	Depth to shear surface
β	15.0	deg	Slope Gradient (3.7H:1V)

FS	1.64

Input Variable
Calculated Value

This model assumes c>0 and the face of the slope is saturated to depth h



Lot 39R
02132-002
11/4/2015

c'	0	psf	Effective Cohesion
ϕ'	39	deg	Effective Friction Angle
Y_{sat}	136	pcf	Saturated Unit Weight of Soil
Y_w	62.4	pcf	Unit weight of water
h	7	ft	Depth to shear surface
β	21.8	deg	Slope Gradient (2.5H:1V)
FS	1.10		

(yellow)	Input Variable
(green)	Calculated Value

This model assumes c>0 and the face of the slope is saturated to depth h