Appendix P:

Updated Slope Stability Report

PETRA

UPDATED SLOPE STABILITY EVALUATION, 3M MOODY FLATS QUARRY, SHASTA COUNTY, CALIFORNIA

BENCHMARK RESOURCES

AUGUST 21, 2012
J.N. 293-11

Riverside County / Environmental

40880-R County Center Drive
Temecula, CA 92591
T: 951.600.9271 F: 951.719.1499

PETRA

past + present + future
it's in our science

Engineers, Geologists
Environmental Scientists

August 21, 2012
J.N. 293-11

Mr. Andrew White
BENCHMARK RESOURCES
4990 Hillside Circle, Suite 400
El Dorado Hills, California 95762

Subject: Updated Slope Stability Evaluation, 3M Moody Flats Quarry, Shasta County, California

Dear Mr. White:

Petra Geotechnical, Inc. (Petra) has prepared the following updated slope stability evaluation of the proposed 3M Moody Flats Quarry, located in southwest Shasta County, California. The purpose of this evaluation is to determine the impacts of potential adverse slope stability of the proposed quarry and stockpile slopes identified in the Reclamation Plan. This report supersedes the previous evaluation report that was prepared in December of 2009 (Petra, 2009). It has been updated to address review comments by the California Department of Conservation, Office of Mine Reclamation (OMR), as well as peer-review comments by CGI Technical Services, Inc. In addition, minor alterations of the proposed quarry slopes, primarily in the northwest portion of the site where proposed grading was removed from the watershed of Shasta Lake, have been addressed in this report.

The following services were completed to prepare this updated report:

- Additional geologic mapping
- Review of stereographic aerial photographs
- Laboratory testing of existing core samples
- Geologic analysis, included revising geologic maps and cross sections
- Geotechnical analysis, included slope stability calculations

The updated report includes the entirety of our available data, analysis, conclusions and recommendations and is intended to be a "stand alone" document to be used for project design, without the necessity of referring to the previous report. The comment sheet by OMR and a synopsis of our responses are included for reference in Appendix A.

TABLE OF CONTENTS

Page

SITE DESCRIPTION **3**

PROJECT UNDERSTANDING **3**

BACKGROUND **4**

FINDINGS **5**

REGIONAL GEOLOGY 5
LOCAL GEOLOGY 5
GEOLOGIC STRUCTURE (COPLEY GREENSTONE) 6
GROUNDWATER 7
LANDSLIDES AND SLOPE INSTABILITY 7
SEISMIC SETTING 7
KINEMATIC ANALYSIS 8
LABORATORY TESTING 8
GEOLOGIC STRENGTH INDEX - ROCK MASS STRENGTH ESTIMATION 8
SLOPE STABILITY ANALYSIS 9

GENERAL SLOPE STABILITY DISCUSSION **11**

CONCLUSIONS AND RECOMMENDATIONS **11**

NORTH PIT 12
SOUTH PIT 12
OVERBURDEN STORAGE AREA 13

REFERENCES

ATTACHMENTS:

Figures: Figure 1 – Site Location Map
Figure 2 – Site Geologic Map
Figure 3 – Cross Sections A-A' and B-B'
Figure 4 – Cross Sections C-C' and D-D'
Figure 5 – Cross Sections E-E' and F-F'
Figure 6 – Cross Sections G-G' and H-H'

Plates: Plate 1 – Geologic Map – Pit Areas

Appendices: Appendix A – OMR Comments and Responses
Appendix B – Core Hole Logs, Boring Logs
Appendix C – Kinematic Analysis
Appendix D – Laboratory Test Results
Appendix E – GSI Analysis
Appendix F – Slope Stability Analysis

SITE DESCRIPTION

The proposed hard-rock quarry is situated in the southwestern portion of Shasta County. The approximately 1,900 acre site is located west of Interstate 5, near the Wonderland Boulevard off ramp, and just north of the City of Shasta Lake (see Figure 1). The City of Redding is located approximately 4 miles south of the site.

Terrain of the site is mountainous, with elevations generally rising to the northwest. Slopes are steeper in the western part of the site with relatively flat gradients at the eastern edge of the site. Elevation ranges from approximately 2,035 feet above sea level on a peak in the northwest part of the site, to approximately 860 feet, where Moody Creek leaves the eastern boundary. Most of the site is densely vegetated. A line of the Southern Pacific Railroad traverses through the eastern portion of the site. Access to the site is from a driveway from Wonderland Boulevard near the eastern boundary of the site. Digger Bay Road traverses through the western part of the site (see Figure 2).

PROJECT UNDERSTANDING

Based upon the draft mine and reclamation plans prepared by Benchmark Resources, two pits are proposed; a north pit and a south pit. An overburden stockpile area is proposed to be located east of the pits (see Plate 1). The north pit is the larger of the two pits and is approximately 4050 feet long (north to south) and 3350 feet wide (west to east). The smaller south pit is approximately 2280 feet long and 1530 feet wide. The overburden storage area is approximately 1480 feet wide (north to south) and 2300 feet long (west to east).

The proposed elevation of the floor of the north pit is 1,200 feet above mean sea level (msl). The highest slope will be along the northwestern area of the pit, at a height of approximately 800 feet (see Cross Section F-F', Figure 5). The proposed elevation of the floor of the south pit is 950 feet msl. The highest slope will be along the southeastern area of the pit, at a height of approximately 360 feet (see Cross Section E-E', Figure 5). The general design of the pit slopes consists of 50-foot high slopes at an approximate inclination of 68° from horizontal (0.4:1 {horizontal:vertical [h:v]}), separated by an approximately 50-foot wide horizontal bench. The overall gradient of these slopes is approximately 35°, a slope ratio of 1.4:1 (h:v).

As shown on Plate 1, overburden material will be stockpiled to the immediate east of the north pit. The stockpiled material is proposed to have individual fill slopes of 50 feet in height separated by 45- to 50-foot wide horizontal benches for a maximum height of approximately 250 feet (see Cross Section G-G, Figure 6). The gradient of the individual 50-foot high fill slopes is currently 2:1 (h:v) with an overall slope gradient with the benches of 2.5 (h:v).

BACKGROUND

In 1980, 3M drilled core holes in the area of the proposed south pit and two core holes in the southern area of the north pit as a part of a qualitative evaluation of the rock. Portions of the core samples from these cores were made available to Petra for review as part of this stability assessment. Logs of the core holes were presented in a subsequent hydrology study by Brown and Caldwell (Brown and Caldwell, 2009) and are included in Appendix B. Copies of the field logs that were not included in the Brown and Caldwell 2009 report are also included in Appendix B. Based upon the logs of the core holes and visual observation of available core specimens, the south pit will encounter a relatively thick, but variable, section of weathered bedrock. Below the weathered section of core, hard coherent bedrock extended to the total depth of the borings with minor intervals of weak broken rock. Fractures/joints of various orientations were present, but the non-oriented character of the core precluded obtaining attitudes of these structures.

Subsequent to 3M's initial subsurface field work, CH_2MHill performed a preliminary geotechnical exploration of the proposed plant site (CH_2MHill 1981). Four of their exploratory excavations were situated near the toe area of the now proposed overburden stockpile and "depth to very dense to hard material" was reported to range from 7 to 20 feet below existing grade. Groundwater was reported to be on the order of 20 feet below ground surface.

As previously noted, a hydrology report for the quarry was produced by Brown and Caldwell in mid-2009 (Brown and Caldwell, 2009). Their report has summarized the background regional geology and, as mentioned above, includes copies of the 3M core logs from several of the borings. As a part of that study, Brown and Caldwell drilled four borings in which monitoring wells were installed. The locations of these are shown on Plate 1. The forth boring was designated as Monitoring Well MW-1 and is shown as such on Plate 1. The logs of the borings and monitoring well are included in Appendix B. At first, only two of

their borings encountered groundwater. However, after a few days groundwater was found near the bottom of all four of their borings at depths ranging from 50 to 100 feet below ground surface. Brown and Caldwell completed an amended report in 2010 (Brown and Caldwell, 2010), which presented additional groundwater sampling results as well as additional geologic mapping. In 2011 Brown and Caldwell installed and tested two potential production wells on the property (Brown and Caldwell, 2011).

FINDINGS

Regional Geology

The proposed Moody Flats Quarry is located at southern edge the Klamath Mountains geologic province. This part of province contains a widely varying assemblage of plutonic, metamorphic and sedimentary rocks of Ordovician to Jurassic age. The northern edge of the Sacramento Valley is located southeast of the site.

Local Geology

The geology of the site is dominated by Paleozoic metavolcanic and metasedimentary rock. Limited areas of Quaternary alluvial deposits are also present. The Site Geologic Map (Figure 2) shows approximate distribution of the geologic units on the entire property. A more detailed geologic map of the pit and overburden storage areas is presented on Plate 1 (in pocket). The geologic units are discussed further below.

The oldest and dominating rock unit in the area of the Moody Flats Quarry is the Copley Greenstone of probable middle Devonian age. This formation is comprised of volcanic basalt flows, pyroclastic flows, tuffs and pillow lavas that have been metamorphosed. The predominant lithology of the Copley Formation is a metavolcanic greenstone that is characterized by its greenish gray color. Based core hole logs in the south pit area, massive greenstone is interbedded with greenstone breccias. Outcrops, especially in the south pit area, display weathered reddish to orange-brown patina. Based on our field observations, the weathering is more prominent in the area of the south pit than the north pit, where relatively unweathered outcrops are exposed. Joints observed in the Copley Greenstone are discussed below.

The Kennett Formation is exposed east of the Copley Greenstone (see Figure 2). The Kennett Formation on the site consists of thin-bedded siliceous mudstone. Hypabyssal intrusions, that are locally brecciated, were observed in several areas, mainly along steep cuts along the railroad track at the eastern part of the site.

The Bass Mountain Diabase is exposed in the northeastern part of the site. Our observations of the formation at a small outcrop along a drainage in the relatively flat eastern part of the site, the formation consists of dark greenish gray diabase. This Bass Mountain Diabase is outside of the proposed pit areas.

Alluvial deposits are present along the drainages and flatter portions of the eastern part of the site, including Moody Flats. This material generally consists of silty sand with gravel. Rounded greenstone cobbles are common in the prominent drainages of the site.

Geologic Structure (Copley Greenstone)

Copley Greenstone outcrops are common in the proposed pit areas of the site, especially along the peaks and ridges (see Plate 1). Joint attitudes were measured in the field and are shown on Plate 1. The orientations of the joints are roughly orthogonal with common orientations striking north-south with near vertical dips and striking east-west with steep to moderate dips to the north and moderate to the south. Joint data were plotted on stereonets (see Appendix C), both as great circles and density contours of poles. The later particularly show the common orientations. Geologic cross-sections (Figures 3 to 5) show the proposed quarry slopes and geologic structure (apparent attitudes). Joint spacing and conditions vary on the site. In the south pit area, where there is more weathering, spacing is locally less than one foot apart. Bolder outcrops in the North pit area generally have joint spacing of a few feet to over 10 feet apart. Joints are generally rough to smooth planar.

Based on the core logs by 3M, occasional zones of broken and fractured core were described (see Appendix B). Cross section D-D' through the south pit shows the approximate location of these zones as described in the logs of CH-2 and CH 7. It is not known if these zones are continuous. However, if they do represent continuous zones, they dip towards the west and do not appear to present an adverse condition of the quarry slope.

Groundwater

Based on information from Brown and Caldwell (2009), groundwater was approximately 50 to 100 feet below the surface in the south pit area in mid-2009. This groundwater represents a fractured bedrock aquifer and, as such, can be highly variable. Brown and Caldwell (2011), recently installed two potential water production wells on the property (see Figure 2). Near the eastern edge of the site, PW-1 was placed in an area of shallow alluvium over Bass Mountain Diabase. In the western part of the property, PW-2 was placed within the Copley Greenstone in a prominent drainage. Both wells were drilled to approximately 400 feet. Water production was poor in both wells and primarily came from the upper 20 feet where the rock was more weathered and fractured. PW-2 was abandoned because of the lack of groundwater production. An aquifer test in PW-1 indicated that water production from that well would be approximately 2 gallons per minute.

Landslides and Slope Instability

No landslides or other evidence of slope instability were observed during our geologic mapping and review of stereographic aerial photographs of the site.

Seismic Setting

No active faults are known to traverse on or near the site. The closest potentially active fault is the Battle Creek fault located approximately 23 miles to the south (Jennings and Bryant, 2010). Several potentially active faults are located in the Lassen area east of the, the closest being the Hatchet Mountain fault, approximately 32 miles to the east. The most seismically active area to the site is the Mendocino triple junction (where the North American, Pacific, and Gorda tectonic plates meet). This area is located approximately 100 miles west of the site.

For the purposes of this report, an "active" fault is defined as a fault that has had displacement within the Holocene epoch or last 11,000 years. A "potentially active" fault is a fault that does not have evidence of movement within the last 11,000 years, but has moved within the last 1.6 million years.

Because of the absence of local fault, the site has a low potential for strong seismic ground shaking compared to many places in California. Based on probabilistic analysis from the California Geological

Survey web site, the peak ground acceleration at the site is estimated to be approximate 0.16g for firm rock conditions, based on a probability of 10 percent in 50 years.

Kinematic Analysis

Kinematic analyses of the structural attitudes were performed to evaluate stability of the conditions anticipated for each overall slope configuration indicated in the two pits of the proposed Reclamation Plan. The results of our analyses indicate the potential for small-scale (bench scale) planar toppling and wedge failures along portions of the proposed slopes. These small-scale failures are common in hard rock quarries, but do not represent a significant slope instability impact. These wedge-failure analyses indicate that such failures are likely to happen. Results of these analyses are included in Appendix C.

Laboratory Testing

Select specimens of the cores obtained by 3M from their initial investigation in 1980 were tested for unconfined compressive strength. A total of 27 test specimens were cut from Cores H-4, H-5, H-8, H-15, H-16 and H-29 and tested in general accordance with ASTM D2938-02. Test results are presented in Appendix D. The unconfined compressive strength values, expressed in units of mega pascals (MPa), were utilized in the Geologic Strength Index analysis in the determination of intact rock strength.

Geologic Strength Index - Rock Mass Strength Estimation

Strength parameters for highly weathered bedrock and topsoil were drawn from experience with similar materials and environments. The strength parameters for the rock mass comprising the quarry slopes were estimated using the Geologic Strength Index (GSI) approach (Marino and Hoek, 2000). The rock strength estimation utilizes the surface conditions of the rock observed, such as structure, weathering and conditions of jointing, to graphically estimate the GSI (see Appendix E). Additional factors used include depth of failure, a constant for intact rock (m_i), uniaxial compressive strength (σ_{ci}) and unit weight. These inputs are empirically analyzed in a spread sheet to derive the phi (friction angle) and cohesion values that are then used in the limit equilibrium slope stability analysis. The GSI analysis is presented in Appendix E.

Slope Stability Analysis

Limit equilibrium slope stability analyses were performed for proposed quarry slopes of the north and south pits, as well as the proposed overburden stockpile, as depicted on the Reclamation Plan. Geologic cross sections were prepared for representation of the various slope conditions, forming the geometric configurations for the individual analyses, as well as providing the spatial limits for the assignment of the various soil/bedrock strength and density parameters. Limit equilibrium stability analyses were run on nine cross-sections (Figures 3 through 6): three representing the north, west and southwest walls of the north pit; two sections representing the west, and southeast, east and northeast walls of the south pit; and, one section through the proposed overburden stockpile fill slope. Groundwater levels were approximated from approximately 50 to 200 feet below existing grades with a drawdown profile conservatively coincidental with the toes of the bench faces. Slope angles and bench configurations were taken from the Reclamation Plan in preparation by Benchmark Resources. The analyses were performed using the computer program GSTABL7, Version 2.004, prepared by Garry H. Gregory, PE. The analytical method used in the analyses included the Bishop and Spencer's slip circle and Janbu block slide methods. The detailed results of the analyses are presented in Appendix F.

The various soil and rock unit weight and strength parameters, as well as the seismic coefficient, which were utilized in the slope stability analyses, are summarized in the following table:

Slope Stability Analysis Parameters

Material	Unit Weight (pcf)	Angle of Internal Friction (φ)	Cohesion (psf)	Seismic Coefficient
Copley Greenstone – unweathered (Dcg)	165	52	3000*	0.10
Copley Greenstone – Weathered	130	32**	400**	0.10
Stockpile materials	125	31**	50**	0.10
Shale bedrock below stockpile	135	35**	400**	0.10
Topsoil overlying shale bedrock	125	15**	300**	0.10

* Derived by GSI
** Based on engineering judgment from experience with similar materials

The results of the slope stability analyses, expressed as factors of safety, are summarized in the following table:

Summary of Stability Analysis Results

Cross Section	Description	Factors of Safety	
		Static	Seismic
Section A-A' North Pit Central Slope	Height = 770' Unweathered bedrock for full height	1.69	1.37
Section B-B' North Pit South-Central Slope	Height = 550' Unweathered bedrock for full height	1.75	1.41
Section C-C' North Pit South Slope	Height = 175' Weathered bedrock in upper 60 feet Unweathered bedrock for full height	2.72	2.21
Section D-D' South Pit West Slope	Height = 295' Weathered bedrock in upper 60 feet Unweathered bedrock below 60 feet	2.20	1.84
Section E-E' South Pit South Slope	Height = 400' Weathered bedrock in upper 60 feet Unweathered bedrock below 60 feet	2.05	1.61
Section F-F' North Pit North Slope	Height = 845' Unweathered bedrock for full height	1.62	1.31
Section G-G' Fill Stockpile South Facing Slope	Height = 250' Fill keyway at toe extending through topsoil and alluvium and excavated into bedrock. Bottom width of keyway = 50 feet No Groundwater	1.53	1.17
Section H-H' Fill Stockpile East Facing Slope	Height = 170' Fill keyway at toe extending through topsoil and excavated into bedrock. Bottom width of keyway = 50 feet No Groundwater	1.62	1.27

The minimum factor of safety determined for the final configuration of the north pit was computed at 1.62 for static conditions and 1.31 for pseudo-static (seismic) for Section F-F', the northern slope. In the south pit the minimum factor of safety was computed at 2.05 for static conditions and 1.61 for seismic in Section E-E', the south slope. The stockpile fill slope produced a minimum factor of safety of 1.53 for static and 1.17 for seismic for Section G-G', the south-facing slope. The seismic analyses were

performed on each section using a seismic coefficient of 0.10 to evaluate the stability of the pit slopes during a seismic event. These factors of safety indicate that the overall quarry and stockpile slopes are grossly stable and they exceed the minimum values to be stable for undeveloped, open space lands.

GENERAL SLOPE STABILITY DISCUSSION

Slope instability can impact a development in a number of ways. Pertaining to this site, the following represent those most applicable:

- Hazard to human occupancy;
- Impact to adjacent property due to unstable land
- Encroachment onto adjacent watersheds, stream capture etc.; and,
- Increased erosion and resultant off-site sediment transport.

In addition to the above items, the Surface Mining and Reclamation Act (SMARA) was implemented to reclaim mining activities. In keeping with SMARA requirements, stability analyses are required for proposed slopes to demonstrate a factor of safety against slope failure suitable for the proposed end use.

The Moody Flats Quarry is presently undeveloped open space and it is understood that the end use will be the same, undeveloped open space. Thus, slope stability does not present a hazard to human occupancy. The indicated offset distances between pit wall and nearest adjacent property line, and/or drainage channel imply the potential for impacts to adjacent property or drainage are highly unlikely. Furthermore, the Reclamation Plans show essentially no alteration of adjacent watersheds. The two pits comprising the quarry reflect an enclosed drainage pattern; therefore, erosion from the finished slopes will be contained/retained within the quarry eliminating the potential of off-site sediment transport. The above discussion demonstrates that the primary slope stability issue is in compliance with SMARA.

CONCLUSIONS AND RECOMMENDATIONS

Petra's slope stability evaluation, based on the data presented herein, indicates that if the following recommendations are implemented, then the proposed Reclamation Plan generally results in grossly stable slopes that will mitigate potential large-scale slope failures and complies with SMARA. The following presents our area-specific conclusions and recommendations:

North Pit

- Gross stability of the overall proposed quarry slopes is satisfactory per limit equilibrium stability analyses.

- Individual slopes are anticipated to be stable at a gradient of 0.4:1 (horizontal:vertical [h:v]), as proposed. Individual slopes may possibly be steepened to gradients of 0.25:1 (h:v) with localized steepening to vertical to accommodate the local geologic structure.

- During mining operations, each quarry slope should be inspected by a California-registered Certified Engineering Geologist prior to the final trim blast. The geologist can provide direction as to the final slope face configuration in view of the geologic structure.

- If significant seepage areas are encountered during mining operations, hydraugers (drilled horizontal drains) could be installed to provide local dewatering.

- Localized layback of the individual slopes may be needed to accommodate unfavorable fracture planes as encountered during quarry activities.

- The results of our kinematic analyses indicate that potential for small-scale (bench scale) planar, toppling and wedge failures along portions of the proposed slopes exist due to inherent fracturing of the bedrock. These small-scale failures are common in many hard-rock quarries and do not represent a significant slope instability impact.

- Due to the long term potential for localized failures, i.e., rock-fall, of the individual quarry slope faces, the quarry should be restricted from public access. Rock-fall poses an omnipresent danger to all personnel in the quarry area and access to the quarry slopes should be limited to qualified personnel.

- Drainage from the North Pit should be directed away from the South Pit.

South Pit

- The area of the South Pit is capped with a variable thickness of highly weathered bedrock with anticipated depths of up to 60 feet below the ground surface. The highly weathered bedrock appears to be more prominent in the eastern portion of the South Pit and will be exposed in the northwest-, west-, and southwest-facing quarry slopes.

- The uppermost portions of the northwest-, west-, and southwest-facing quarry slopes, where highly weathered bedrock is encountered, should be laid back to 1.5:1 (h:v). The vertical extent of the layback is anticipated to be on the order of 60 vertical feet, but is subject to field evaluation by the California-certified Engineering Geologist during construction.

- Gross stability of the overall proposed quarry slopes is satisfactory per limit equilibrium stability analyses.

- If significant seepage areas are encountered during mining operations, hydraugers could be installed to provide local dewatering.

- Individual slopes are anticipated to be stable at a gradient of 0.4:1 (horizontal:vertical [h:v]), as proposed. Individual slopes may possibly be steepened to gradients of 0.25:1 (h:v) with localized steepening to vertical to accommodate the local geologic structure.

- During mining operations, each quarry slope should be inspected by a California-registered Certified Engineering Geologist prior to the final trim blast. The geologist can provide direction as to the final slope face configuration in view of the geologic structure.

- Localized layback of the individual slopes may be needed to accommodate unfavorable fracture planes as encountered during quarry activities.

- The results of our kinematic analyses indicate that potential for small-scale (bench scale) planar, toppling and wedge failures along portions of the proposed slopes exist due to inherent fracturing of the bedrock. These small-scale failures are common in many hard-rock quarries and do not represent a significant slope instability impact.

- Due to the long term potential for localized failures, i.e., rock-fall, of the individual quarry slope faces, the quarry should be restricted from public access. Rock-fall poses an omnipresent danger to all personnel in the quarry area and access to the quarry slopes should be limited to qualified personnel.

Overburden Storage Area

- The area is underlain by weathered shale capped with clay topsoil.

- Fill materials are anticipated to be granular and therefore relatively permeable.

- The topsoil is not suitable to support stockpiled fill on sloping ground. Consequently, all topsoil should be stripped prior to placement of stockpile materials.

- Gross stability of the overall proposed stockpile slopes is satisfactory per limit equilibrium stability analyses.

- The stability factor of safety is satisfactory where the topsoil is removed and the stockpile is placed directly on bedrock.

- Individual slopes are not expected to be stable at 2:1 (h:v) unless constructed in an engineered fashion (i.e., compacted). Therefore, when constructed at a gradient of 2:1 (h:v), fill slopes should be properly keyed into the underlying bedrock. The outer 20 feet of the fill slopes must be uniformly compacted to 90 percent or more relative compaction with reference to ASTM D1557, extending to the slope face. The compaction requirement may be waived where the individual slopes are constructed no steeper than 2.5:1 (h:v).

- The fill slope key must be constructed with a backdrain at the heel of the key to prevent the buildup of hydrostatic pressures behind the compacted fill slope.

- Erosion protection should be provided for the toe of slope where exposed in or adjacent to drainages.

This opportunity to be of continued service is appreciated. Should you have questions, please contact this office.

Respectfully submitted,

PETRA GEOTECHNICAL, INC.

Daniel C. Schneidereit, CEG
Associate Geologist
CEG 1621

PROFESSIONAL GEOLOGIST
DANIEL C. SCHNEIDEREIT
NO. 1621
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

Grayson R. Walker, GE
Principal Engineer
GE 871

REGISTERED PROFESSIONAL ENGINEER
GRAYSON R. WALKER
GE 871
GEOTECHNICAL
STATE OF CALIFORNIA

DCS/GRW/kms

Distribution: (3) Addressee
(3) 3M Industrial Mineral Products Division, Attention: Mr. John Beck

REFERENCES

Albers, J.P., 1985, *A Special Issue Devoted to Massive Sulfide Deposits, West Shasta District*, California: Economic Geology, Vol. 80, No. 8, December, 1985

Beale, G., 2009, *Hydrogeologic Model,* in Read, J. and Stacey, P., eds, *Guidelines for Open Pit Slope Design*: CSIRO Publishing/CRC Press.

Bieniawski, Z.T., 1988, *The Rock Mass Rating (RMR) System (Geomechanics Classification) in Engineering Practices,* Rock Classification Systems for Engineering Purposes, 17-34, Philadelphia, Pennsylvania: American Society for Testing and Materials

Brown and Caldwell, 2009, *Field Investigation Report, Hydrology Analysis, 3M Redding Hard-Rock Aggregate Quarry, Shasta County, California*: Project No. 137108-003, June 30, 2009

Brown and Caldwell, 2010, *Addendum Field Investigation Report, Hydrology Analysis, 3M Redding Hard-Rock Aggregate Quarry, Shasta County, California*: Prepared for Resource Design Technology, Inc., May 24, 2011.

Brown and Caldwell, 2010, *Addendum 2 Field Investigation Report, Hydrology Analysis, 3M Redding Hard-Rock Aggregate Quarry, Shasta County, California*: Prepared for Resource Design Technology, Inc., January 21, 2010.

Brown and Caldwell, 2011, *Technical Memorandum, Installation and Aquifer Test of Test Wells*: Prepared for Benchmark Resources, October 11, 2011.

CGI Technical Services Inc., 2012, *Geotechnical Peer Review of Slope Stability Evaluation & Site Development, Moody Flats Quarry Project, Shasta County, California (DRAFT)*: prepared for De Novo Planning Group., dated January 26, 2012.

CH_2MHill,1981, *Preliminary Geotechnical Exploration, 3M Plantsite Development, Mountain Gate, California*, R14202.A5, March, 1981

Diller, J.S., 1906, *Description of the Redding Quadrangle,* In: U.S. Geological Survey Geologic Atlas of the United States: Redding Folio, California, Department of the Interior

Fraticelli, L.A., Albers, J.P., Irwin, W.P., and Blake, Jr., M.C., 1987, *Geologic Map of the Redding 1x2 Degree Quadrangle, Shasta, Tehama, Humbolt, and Trinity Counties, California*: U.S. Geological Survey Open-File Report 87-257, 1987.

Hack, R.D., Price, D., and Rengers, N., 2002, *A New Approach to Rock Slope Stability – A Probability Classification (SPPC)*: Bulletin of Engineering Geology and the Environment, Springer Verlag, Vol. 62, Article DOI 10.1007/s10064-002-0155-4, 2002.

Jennings, C.W. and Bryant, W.A., compilers, 2010, *Fault Activity Map of California*: California Geological Survey Geologic Data Map No. 6, scale 1:750,000.

Karzulovic, A. and Read, J., 2009, *Rock Mass Model,* in Read, J. and Stacey, P., eds, *Guidelines for Open Pit Slope Design*: CSIRO Publishing/CRC Press.

Marinos, P. and Hoek, E., 2000, *GSI: A Geologically Friendly Tool for Rock Mass Strength Estimation*: Proc. GeoEng2000 Conference, P. 1422-1442.

Petra Geotechnical, Inc., 2009, *Slope Stability Evaluation, 3M Moody Flats Quarry, Shasta County, California*: prepared for Resourced Design Technology, Inc., J.N. 247-09, dated December 7, 2009.

Read, J., Jakubec, J., and Beale, G., 2009, *Field Data Collection,* in Read, J. and Stacey, P., eds, *Guidelines for Open Pit Slope Design*: CSIRO Publishing/CRC Press.

Resource Design Technology, Inc., 2009, *3M Reclamation Plan, Moody Flats Quarry*

Röller, K. and Trepmann, C.A., 2010, *Stereo32*: computer program for stereographic analysis, Ruhr University Bochum (RUB)

Strand, R.G., compiler, 1962, *Geologic Map of California, Olaf P. Jenkins Edition, Redding Sheet*, California Division of Mines and Geology, Scale 1:250,000

Aerial Photographs Reviewed

Flight I.D.	Date	Frame(s)
CH2M-1988-CAN-11-RDD88	7-18-1988	8-18 and 8-19
CH2M-1985-CAN-14-RDD85	8-20-1938	5-19 and 5-20
CH2M-1981-CAN-13-RDD81	6-17-1981	5-17, 5-18, and 5-19
CH2M-1978-CAN-17-Greater Redding	8-17-1978	3-19, 3-20, 4-18, and 4-19

APPENDIX A

OMR COMMENTS AND RESPONSES

Geotechnical Requirements
(Refer to CCR sections 3502, 3704)

CCR sections 3502 and 3704 require reclamation plans to include a final slope design that is based on site-specific information and that will be stable with a minimum slope stability factor of safety that is suitable for the proposed end use. The reclamation plan indicates that the quarry face cut slopes will be final graded to an inclination of about 1H:1V (i.e., horizontal to vertical), and the final fill slopes will be 2H:1V or possibly 2.5H:1V. The slope design in the reclamation plan is supported by a study by Petra Geotechnical, Inc. (Petra), dated December 7, 2009, and is included as Appendix E. The results of the Petra study conclude that the proposed slopes will be stable with factors of safety suitable for the proposed end use; however, the following aspects of the study need clarification and/or additional information:

- A map showing the strike and dip of discontinuities is presented in the Petra report; however, no map illustrating the distribution of geologic units on the mine site is included. Petra indicates that more than one geologic unit occurs within the proposed mine site. The maps should be revised to show the areal distribution of geologic units.
- Petra describes the results of shallow geotechnical borings and somewhat deeper boreholes drilled in the area of the South Pit; however, these data do not appear in any of Petra's cross sections and appear to be only qualitatively incorporated in the slope stability study. Petra does not present any of the borehole data in their report; however, they note that "...minor intervals of weak broken rock intervals..." in the rock core. It is unclear how or if these intervals are considered in the stability analyses. The locations of boreholes referred to in the slope stability study should be depicted on the map and cross sections and should be incorporated into the analyses.
- OMR's review of the borehole information in the original documents cited by Petra indicates that they may be of limited usefulness for evaluating cut slope stability. For example, deeper boreholes were drilled in the area of the much smaller South Pit, and no boreholes penetrating bedrock apparently were drilled in the area of the much larger North Pit that has significantly higher final slopes. Data necessary for evaluating cut slope stability (e.g. engineering geologic rock descriptions such as fracturing, strength, hardness, weathering, etc., discontinuity data, ROD, etc.) are not reported or are incompletely reported. Collection of subsurface data is recommended for the North Pit area, and a more thorough analysis of subsurface data is recommended for the South Pit.
- Petra apparently gathered discontinuity data from surface mapping for use in the kinematic analysis; however, the data are not presented in a tabular format that would facilitate OMR's independent review.
- No laboratory testing of the bedrock samples apparently were conducted by Petra or during previous studies. The strength and unit weight values in the stability analysis were assumed based on engineering judgment and using the "Slope Stability Probability Classification (SSPC)." The assumed values were presented in tabular form; however, the discussion provides very little justification for the values that were chosen. OMR recommends that justification be provided and laboratory testing completed to corroborate unit weight and strength values utilized in the stability analyses.
- Some of the recommendations for the final slope design in the Petra study do not appear to be adequately reflected in the reclamation plan. For example, there is a recommendation to lay back the upper portions of the South Pit quarry slopes to 2H:1V based on field evaluations by a registered professional; however, this recommendation does not appear to be reflected in the final

slope design described in the reclamation plan. All recommendations for a stable final slope design should be appropriately incorporated in the reclamation plan.

- Petra indicates that fill slopes inclined 2H:1V will not be stable unless they are properly designed. They conclude that overburden fill slopes should not exceed and inclination of 2.5H:1V unless the fill is properly compacted. The reclamation plan appears to confuse the recommendations of Petra and indicates that final fill slopes will be 2H:1V but may be modified to 2.5H:1V if they are properly engineered. OMR recommends that reclamation plan be revised to specify that the final fill slopes shall not exceed 2.5H:1V unless the fill materials are properly compacted.
- OMR recommends that the reclamation plan be revised to include a requirement for a registered professional engineer or geologist to periodically inspect the slopes during the development and operation of the mine. A subsequent slope stability study may be necessary in order to recommend any necessary changes to the final slope design. The results of the inspection should be documented in a report. If changes to the final slope design are warranted based on the inspections, the reclamation plan must be amended prior to implementing the changes.
- OMR may make additional comments on the slope stability analyses once the reclamation plan is submitted for official review.

CCR section 3704(b) states that where backfilling is required for resource conservation purposes, fill material shall be backfilled to the standards required for the resource conservation use involved. The reclamation plan should be revised to describe the placement and compaction *effort* of the backfill materials.

Response Synopsis to OMR Review Comments

Comment 1

A map showing the strike and dip of discontinuities is presented in the Petra report; however, no map illustrating the distribution of geologic units on the mine site is included. Petra indicates that more than one geologic unite occurs within the proposed mine site. The maps should be revised to show the areal distribution of the geologic units.

Response to Comment 1

See Figure 2 and Plate 1

Comment 2

Petra describes the results of shallow geotechnical borings and somewhat deeper boreholes drilled in the area of the South Pit; however, these data do not appear in any of Petra's cross sections and appear to be only qualitatively incorporated in the slope stability study. Petra does not present any of the borehole data in their report; however, they note that "...minor intervals of weak broken rock intervals..."in the rock core. It is unclear how or if these intervals are considered in the stability analyses. The locations of the boreholes referred to in the slope stability study should be depicted on the map and cross sections and should be incorporated into the analyses.

Response to Comment 2

Available core and boring logs are presented in Appendix B and the locations are shown on Plate 1.

Comment 3

OMR's review of the borehole information in the original documents cited by Petra indicates that they may be of limited usefulness for evaluating cut slope stability. For example, deeper boreholes were drilled in the area of the much smaller South Pit, and no boreholes penetrating bedrock apparently were drilled in the area of the much larger North Pit that has significantly higher final slopes. Data necessary for evaluating cut slope stability (e.g. engineering geologic rock descriptions such as fracturing, strength, hardness, weathering, etc., discontinuity data, RQD, etc.) are not reported or are incompletely reported. Collection of subsurface data is recommended for the North Pit area, and more thorough analysis of subsurface data is recommended for the South Pit.

Response to Comment 3

An evaluation of the available is presented in the various sections of the report. Recommendation for the acquisition of additional data in both the North Pit and South Pit areas is noted in the Additional Work section of this report.

Comment 4

Petra apparently gathered discontinuity data from surface mapping for use in the kinematic analysis: however, the data are not presented in a tabular format that would facilitate OMR's independent review.

Response to Comment 4

A revised kinematic analysis is presented in Appendix C. The presentation includes the data in a tabular format. If desired, the data can also be obtained as an Excel spreadsheet by requesting Petra's geologist at dschneidereit@petra-inc.com.

Comment 5

No laboratory testing of the bedrock samples apparently were conducted by Petra or during previous studies. The strength and unit weight values in the stability analysis were assumed based on engineering judgment and using the "Slope Stability Probability Classification (SSPC)." The assumed values were presented in tabular form; however, the discussion provides very little justification for the values that were chosen. OMR recommends that justification be provided and laboratory testing completed to corroborate unit weight and strength values utilized in the stability analyses.

Response to Comment 5

Petra conducted laboratory strength testing on the limited core samples in our possession (see Appendix D). A summary of the GSI estimate is also included in Appendix E.

Comment 6

Some of the recommendations for the final slope design in the Petra study do not appear to be adequately reflected in the reclamation plan. For example, there is a recommendation to lay back the upper portion of the South Pit quarry slopes to 2H:1V based on field evaluations by a registered professional; however, this recommendation does not appear to be reflected in the final slope design described in the reclamation plan. All recommendations for a stable final slope design should be appropriately incorporated in the reclamation plan.

Response to Comment 6

Acknowledged.

Comment 7

Petra indicates that fill slopes inclined 2H:1V will not be stable unless they are properly designed. They conclude that overburden fill slopes should not exceed an inclination of 2.5H:1V unless the fill is properly compacted. The reclamation plan appears to confuse the recommendations of Petra and indicates that

the final fill slopes will be 2H:1V but may be modified to 2.5H:1V if they are properly engineered. OMR recommends that reclamation plan be revised to specify that the final fill slopes shall not exceed 2.5H:1V unless the fill materials are properly compacted.

Response to Comment 7

Acknowledged.

Comment 8

OMR recommends that the reclamation plan be revised to include a requirement for a registered professional engineer or geologist to periodically inspect the slopes during the development and operation of the mine. A subsequent slope stability study may be necessary in order to recommend any necessary changes to the final slope design. The results of the inspection should be documented in a report. If changes to the final slope design area warranted based on the inspections, the reclamation plan must be amended prior to implementing the changes.

Response to Comment 8

Acknowledged.

Comment 9

OMR may make additional comments on the slope stability analyses one the reclamation plan is submitted for official review.

Response to Comment 9

Acknowledged.

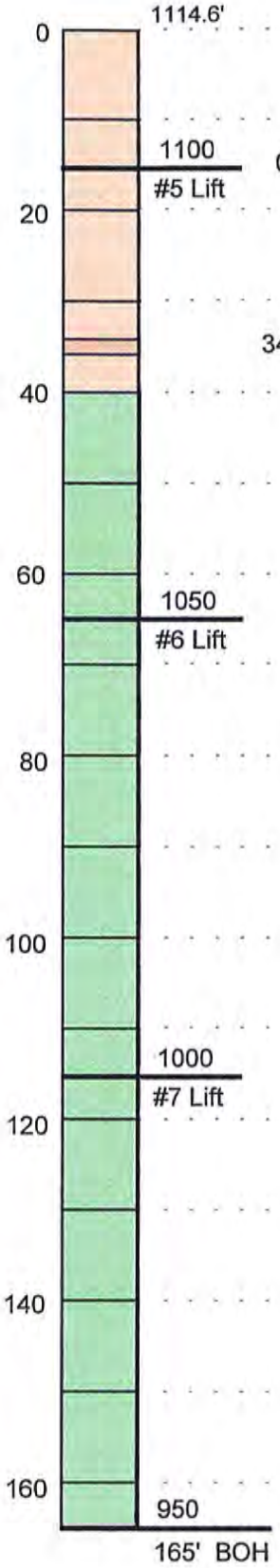
APPENDIX B

CORE HOLE LOGS

BORING LOGS

3M Geology

DESCRIPTION



0' - 40' - Overburden - Weathered residual soil, clay and rock rubble

34' - 36' - Wea GS Boulder

40' - First Core

GS Breccia - Spheroidal, Irregular Qtz and Hornblend Fillled Vesicles in GS Breccia. Strong Qtz Veining

Smaller Rounded Clasts Minor to Mod Pyrite

Ovuloids of Qtz ~2-10mm in Coarse Volc Breccia

Strong Pyr. in Gray Clasts ~85Ft.

Massive, Brecciated GS with minor spotty Pyrite

Very Broken Core of Brecciated GS at 110Ft.

Broken Core GS breccia

GS breccia - minor qtz veining in competent core fm 138'-158'

4" qtz vein in broken GS breccia core @ 158'

City	Shasta Lake
State	CA
Hole No.	R-1-80
Loc. N	498750
Loc. E	1896750
Collar El	1114.6
Core Size	BX
Logged By	BWK
Date	2/80
Drilled By	Boyles
Drill Date	2/12/80

Vertical Scale
1 in. = 20 ft.

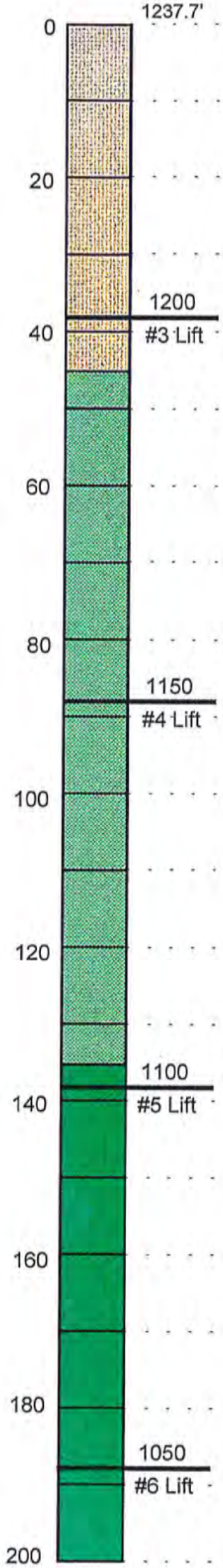
Rock Type-Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Weathered

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology



DESCRIPTION

0' - 45' - Overburden - Weathered residual soil, clay and rock rubble

45' - First Core - 45' - 47' Very Fractured

GS Breccia -
51' - 52' - Spheroidal, Irregular Qtz Inclusions in GS
57' - 59' - Irregular Qtz Inclusions in GS Breccia

88' - 97' - GS Breccia, moderate alteration, dense, very fine xtln, minor qtz veining

GS Breccia, moderate alteration, dense, very fine xtln, minor qtz veining

130' - 6" vein of white qtz in GS Breccia
132'-135' - Broken Core of Brecciated GS
135'-138' - Change to gry-grn, dense GS, minor pyrite

Pyrite noted at 158'

2" qtz vein in broken GS breccia core @ 161'
Broken and Fractured Core at intervals
175'-183' and 194'-199'

City	Shasta Lake
State	CA
Hole No.	R-2-80
Loc. N	498250
Loc. E	1896750
Collar El	1237.7
Core Size	BX
Logged By	CEN
Date	2/80
Drilled By	Boyles
Drill Date	2/20/80

Vertical Scale
1 in. = 20 ft.

Rock Type-Discription Legend:

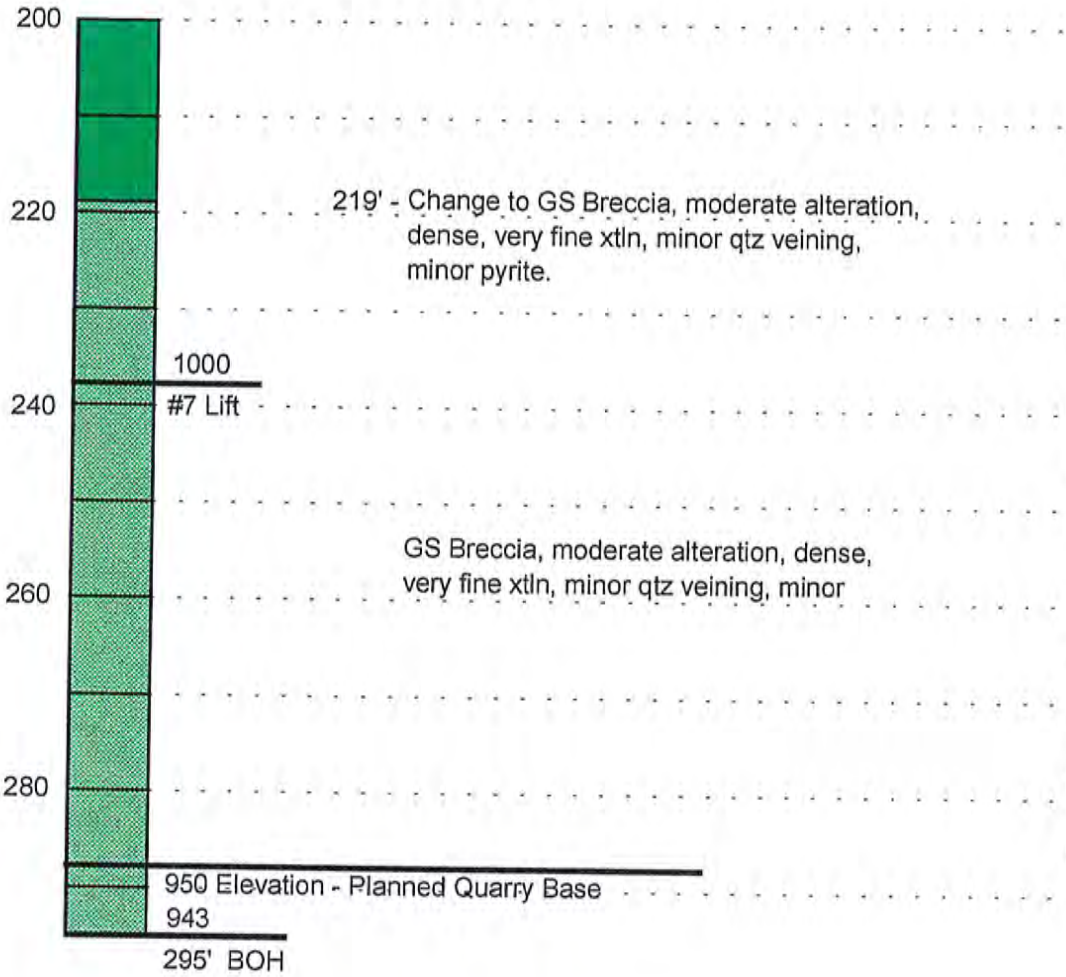
- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

DESCRIPTION

3M Geology



City	Shasta Lake
State	CA
Hole No.	R-2-80
Loc. N	498250
Loc. E	1896750
Collar El	1237.7
Core Size	BX
Logged By	CEN
Date	2/80
Drilled By	Boyles
Drill Date	2/20/80

Vertical Scale
1 in. = 20 ft.

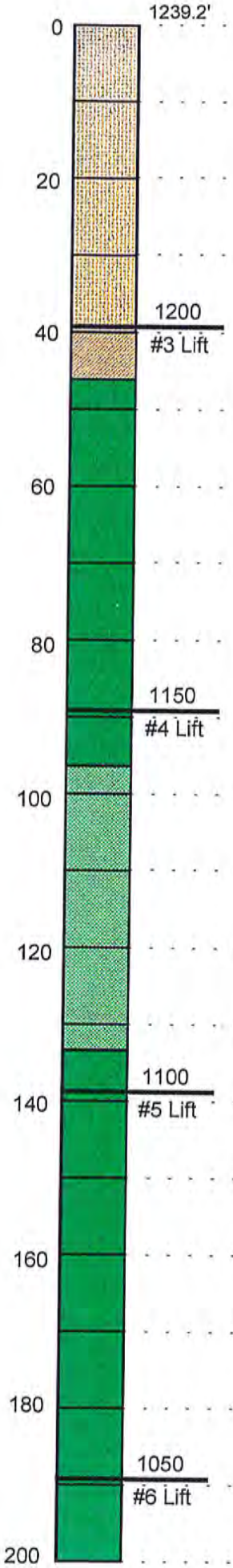
Rock Type-
Discription Legend:

- Risiduum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology



DESCRIPTION

0' - 40' - Overburden - Weathered, residual soil, clay and rock rubble

40' - 46' - First Core - 40' - 46' Fractured Wea Core

Dense, very fine xtln, gry-grn GS: Moderate Pyrite grading to minor level at 85'. Minor to moderate qtz veining.

96' - GS Breccia, moderate alteration, dense, very fine xtln, minor qtz veining, minor pyrite

133' - Change to Gry-grn Greenstone with occasional narrow veins <1/2" of white qtz.

GS, gry-grn, dense, minor pyrite, minor qtz veining.

Occasional variable sized breccia 0.5-2" inclusions in GS.

Broken and Fractured Core at intervals 174'-184' and 189'-202'

City	Shasta Lake
State	CA
Hole No.	R-3-80
Loc. N	497750
Loc. E	1896750
Collar El	1239.2
Core Size	BX
Logged By	CEN
Date	2/80
Drilled By	Boyles
Drill Date	2/24/80

Vertical Scale
1 in. = 20 ft.

Rock Type-Discription Legend:

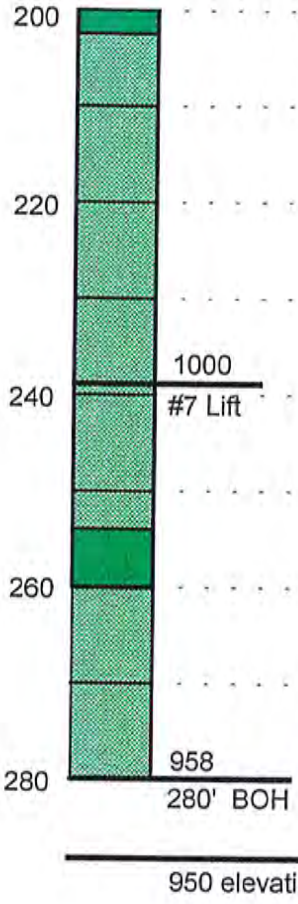
- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology

DESCRIPTION



202' - Change to Cse GS Breccia, dense, very fine xtln, slight trace of pyrite

Cse GS Breccia, dense, very fine xtln, slight trace of pyrite

254' - Change to gry-grn GS, dense, minor pyrite, qtz veining.

260' - Dark grn-blk GS Breccia, Blk qtz veining, minor pyrite

City	Shasta Lake
State	CA
Hole No.	R-3-80
Loc. N	497750
Loc. E	1896750
Collar El	1239.2
Core Size	BX
Logged By	CEN
Date	2/80
Drilled By	Boyles
Drill Date	2/24/80

Vertical Scale
1 in. = 20 ft.

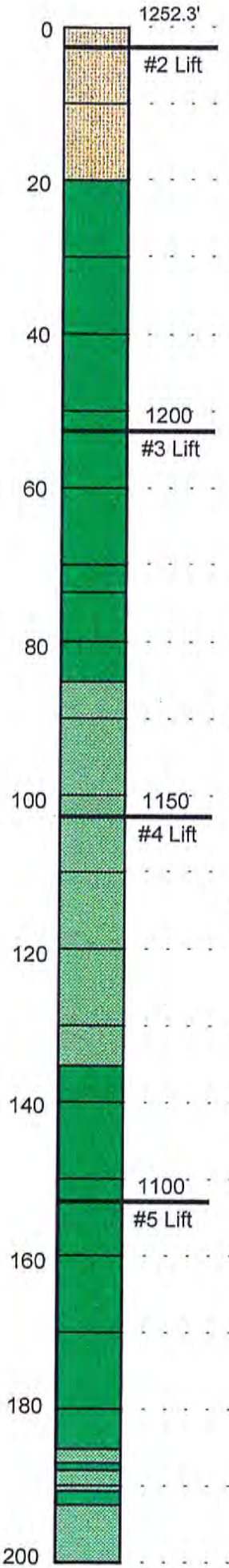
Rock Type-Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology



DESCRIPTION

0' - 20' - Overburden - Weathered, residual soil, clay and rock rubble

20' - 73' - Homogeneous, Dense, very fine xtln, gry-grn GS. Minor, inter-xtln Pyrite. Little to no qtz or calcite.

73'-85' - Distinct lithologic change to gray-blk-grn, GS. Core is fractured 73'-77'. Ubiquitous pyrite- some heavy.

85'-135' - Gry GS Breccia, moderate to heavy pyrite

135' - Change to Gry-gry-blk GS with Epidote & Chlorite veining. Mod pyrite, minor qtz.

Heavy pyrite in gry, chloritic GS, minor calc, minor qtz.

Occasional variable sized breccia 0.5-2" inclusions in GS

Broken and Fractured, brecciated GS Core at 185'-193'. Grading to GS Breccia

City	Shasta Lake
State	CA
Hole No.	R-4-80
Loc. N	497250
Loc. E	1896750
Collar El	1252.3
Core Size	NX-BX
Logged By	BWK
Date	2/80
Drilled By	Boyles
Drill Date	3/5/80

Vertical Scale
1 in. = 20 ft.

Rock Type-Discription Legend:

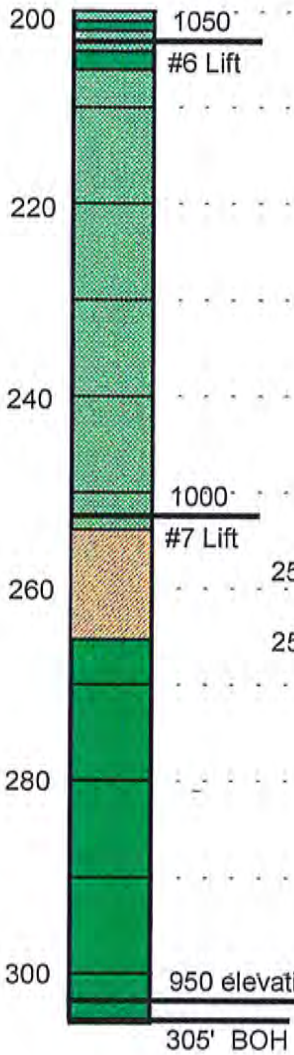
- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology

DESCRIPTION



Cse GS Breccia, dense, very fine xtln, slight trace of pyrite

Gry-grn GS Breccia, heavy pyrite.

Gry-grn GS Breccia, mod to heavy pyrite

Gry, Pyritic, Calcitic, GS Breccia,

257'-265' - Broken, very fractured core at contact

257'-265' - Distinct Lithologic Change to Grn, Homogeneous, fine xtln, GS with minor pyrite and calcite. No Breccia.

950 elevation - Planned Quarry Base

City	Shasta Lake
State	CA
Hole No.	R-4-80
Loc. N	497250
Loc. E	1896750
Collar El	1252.3
Core Size	NX-BX
Logged By	BWK
Date	2/80
Drilled By	Boyles
Drill Date	3/5/80

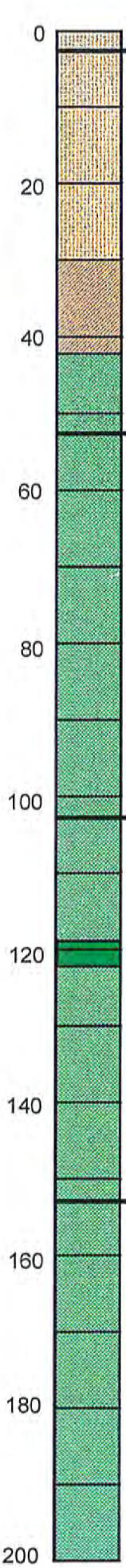
Vertical Scale
1 in. = 20 ft.

Rock Type-Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz



DESCRIPTION

0' - 30' - Overburden - Weathered, residual soil, clay and rock rubble

30' - 42' - Brkn, Wea, GS Breccia, soft.

42'-119' - Gry GS Breccia, moderate to heavy pyrite

119'-122' - Gry-grn, very fine xtln, dense GS with slight pyrite.

Broken and Fractured, brecciated GS Core from 198'-244' with trace of visible pyrite

3M Geology

City	Shasta Lake
State	CA
Hole No.	R-5-80
Loc. N	497250
Loc. E	1896250
Collar El	1252.0
Core Size	NX-BX
Logged By	BWK-CEN
Date	2/80
Drilled By	Boyles
Drill Date	2/14/80

Vertical Scale
1 in. = 20 ft.

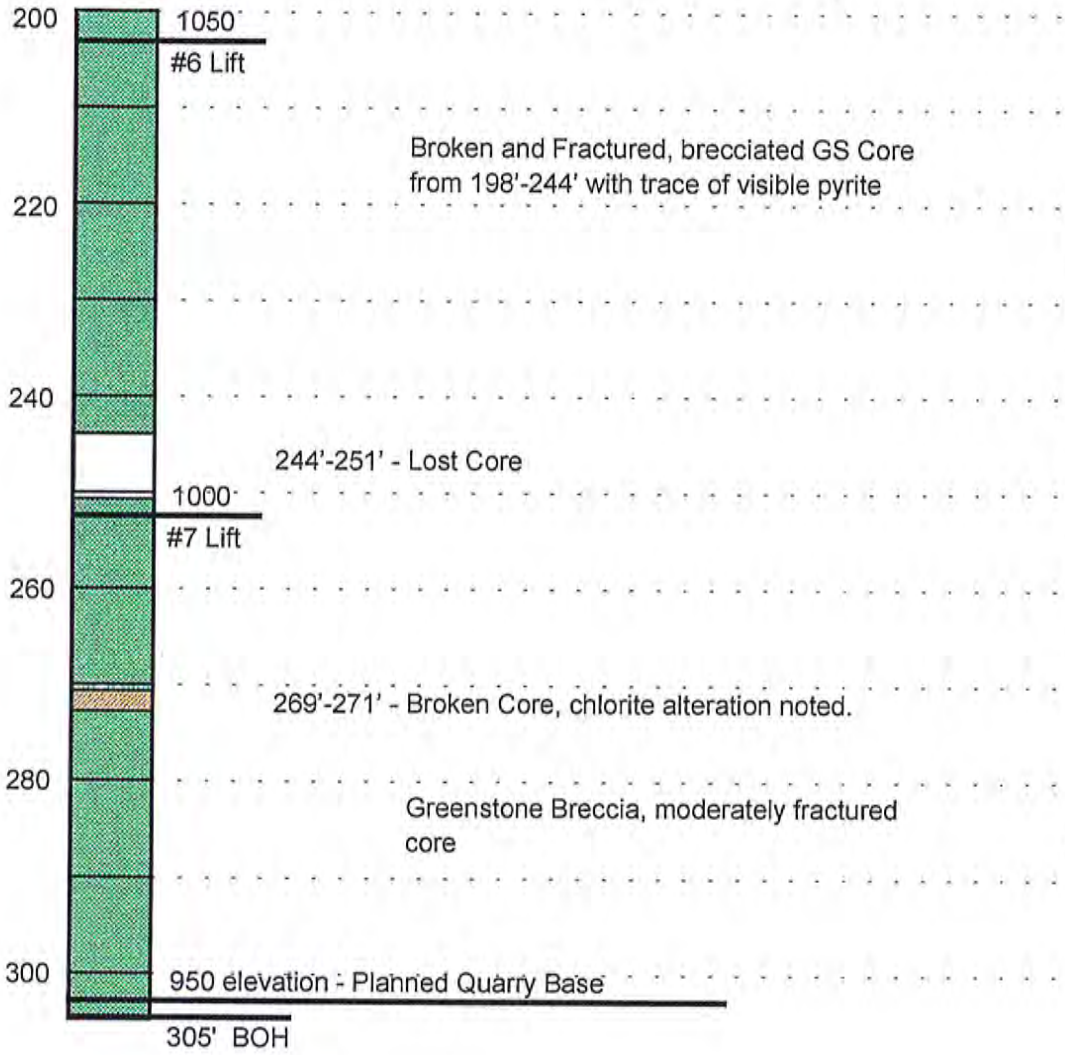
Rock Type-Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

DESCRIPTION



3M Geology

City	Shasta Lake
State	CA
Hole No.	R-5-80
Loc. N	497250
Loc. E	1896250
Collar El	1252.0
Core Size	BX
Logged By	BWK-CEN
Date	2/80
Drilled By	Boyles
Drill Date	2/14/80

Vertical Scale
1 in. = 20 ft.

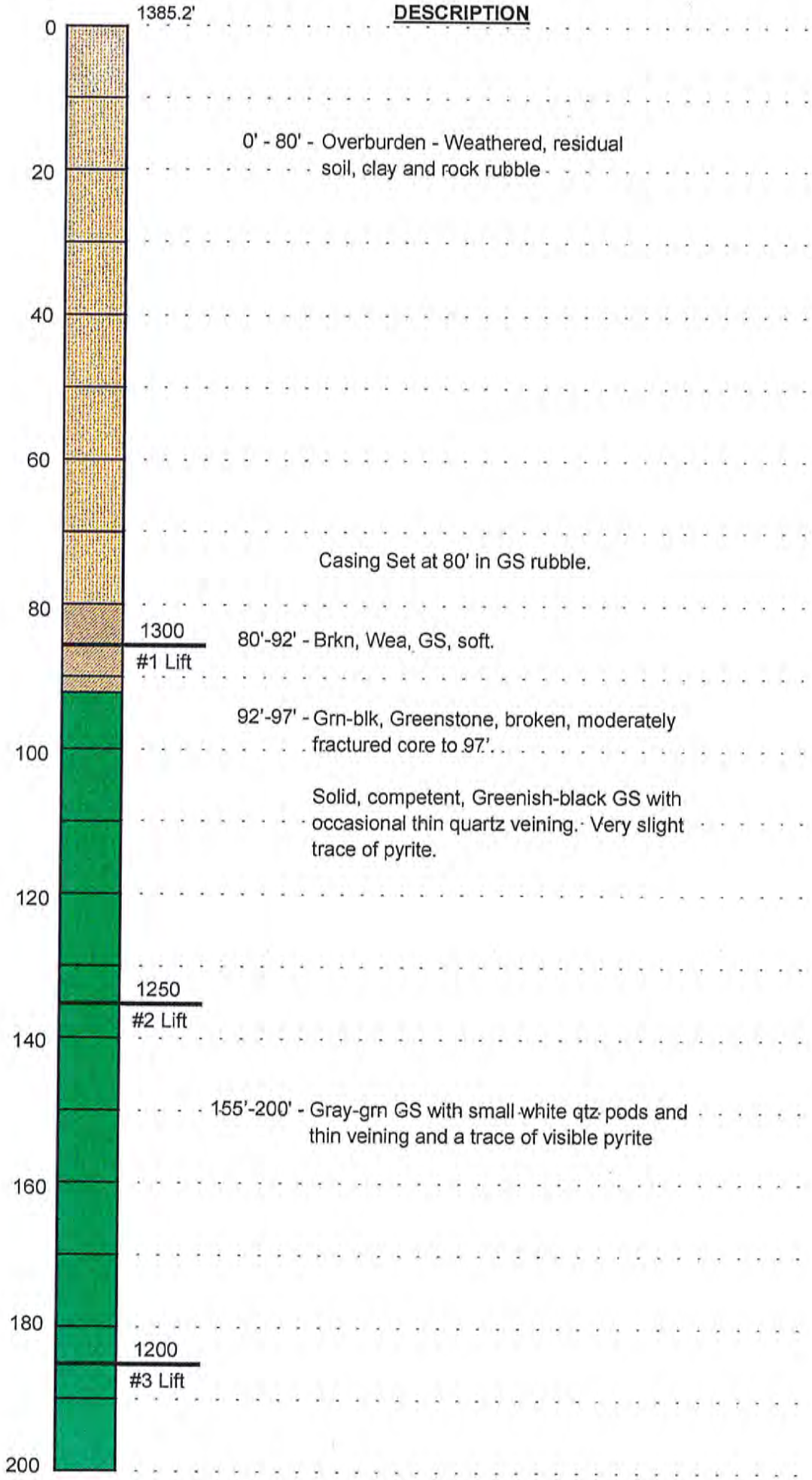
Rock Type-Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M
Geology



City	Shasta Lake
State	CA
Hole No.	R-6-80
Loc. N	497673
Loc. E	1896338
Collar El	1385.2
Core Size	BX
Logged By	CEN
Date	2/80
Drilled By	Boyles
Drill Date	1/25/80

Vertical Scale
1 in. = 20 ft.

Rock Type-Discription Legend:

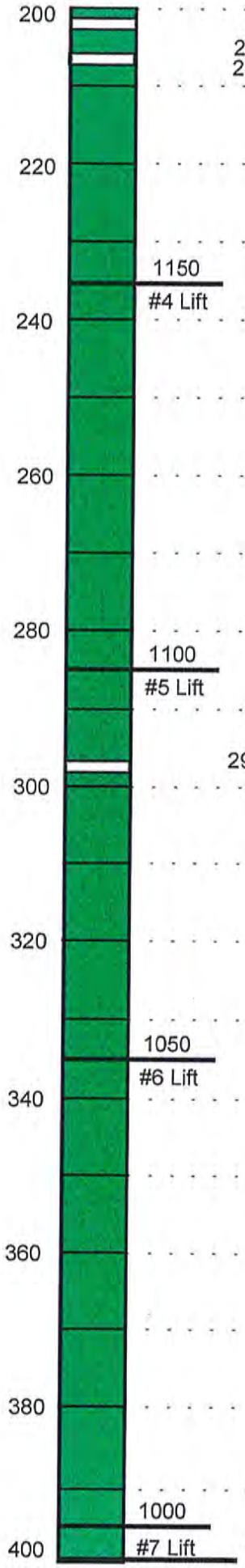
- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology

DESCRIPTION



202'-203' - 12" thick white qtz veining
207'-208' -

Dense, gry-grn GS Core with secondary qtz as pods and void fillings. Slight trace of visible pyrite on fractures.

297'-298' - 12" thick whte qtz in homogenous, gry-grn GS

400' BOH

City	Shasta Lake
State	CA
Hole No.	R-6-80
Loc. N	497673
Loc. E	1896338
Collar El	1385.2
Core Size	BX
Logged By	CEN
Date	2/80
Drilled By	Boyles
Drill Date	1/25/80

Vertical Scale
1 in. = 20 ft.

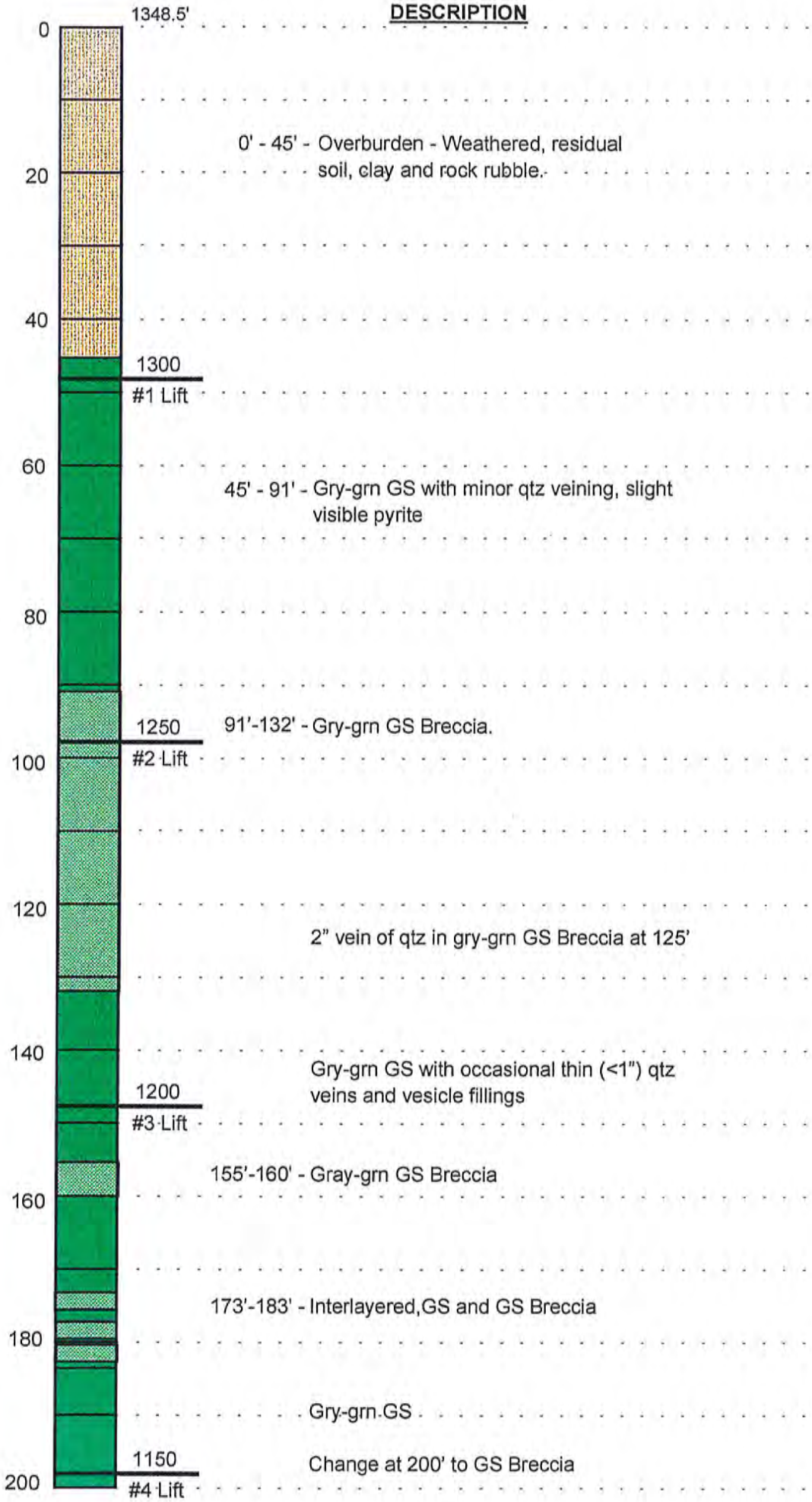
Rock Type-Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology



City	Shasta Lake
State	CA
Hole No.	R-7-80
Loc. N	498250
Loc. E	1896250
Collar El	1348.5
Core Size	NX-BX
Logged By	CEN-BWK
Date	2/80
Drilled By	Boyles
Drill Date	1/28/80-2/6/80

Vertical Scale
1 in. = 20 ft.

Rock Type-Discription Legend:

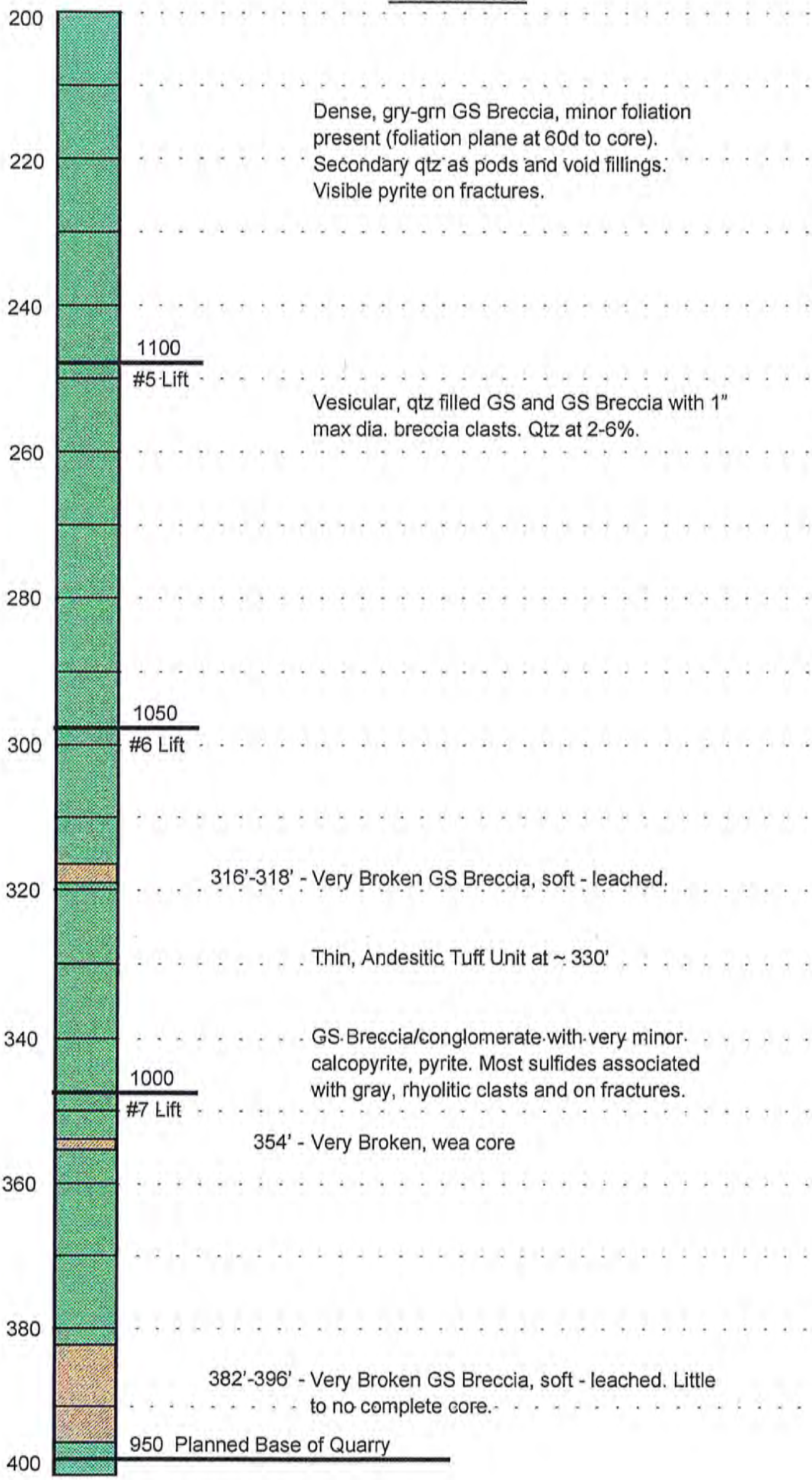
- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology

DESCRIPTION



Dense, gry-grn GS Breccia, minor foliation present (foliation plane at 60d to core). Secondary qtz as pods and void fillings. Visible pyrite on fractures.

Vesicular, qtz filled GS and GS Breccia with 1" max dia. breccia clasts. Qtz at 2-6%.

316'-318' - Very Broken GS Breccia, soft - leached.

Thin, Andesitic Tuff Unit at ~ 330'

GS Breccia/conglomerate with very minor calcopyrite, pyrite. Most sulfides associated with gray, rhyolitic clasts and on fractures.

354' - Very Broken, wea core

382'-396' - Very Broken GS Breccia, soft - leached. Little to no complete core.

City	Shasta Lake
State	CA
Hole No.	R-7-80
Loc. N	498250
Loc. E	1896250
Collar El	1348.5
Core Size	NX-BX
Logged By	CEN-BWK
Date	2/80
Drilled By	Boyles
Drill Date	1/28/80-2/6/80

Vertical Scale
1 in. = 20 ft.

Rock Type-Discription Legend:

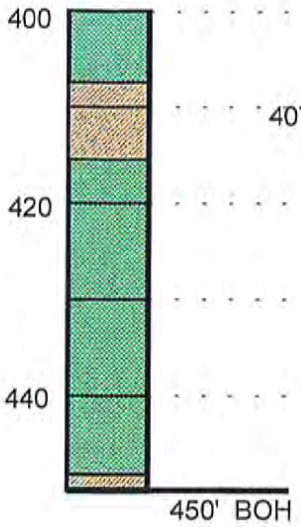
- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology

DESCRIPTION



407'-415' - Soft, Brkn, Leached GS Breccia

Hard, GS Breccia, some fractured core.

Soft, Brkn, Leached zone at BOH

City	Shasta Lake
State	CA
Hole No.	R-7-80
Loc. N	498250
Loc. E	1896250
Collar El	1348.5
Core Size	NX-BX
Logged By	CEN-BWK
Date	2/80
Drilled By	Boyles
Drill Date	1/28/80-2/6/80

Vertical Scale
1 in. = 20 ft.

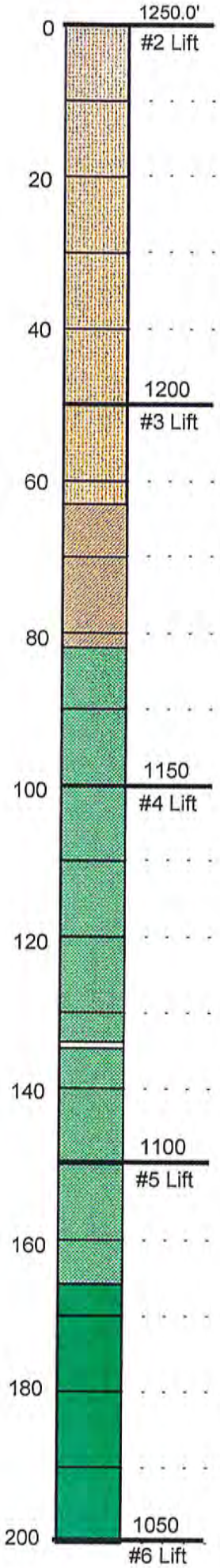
Rock Type-
Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Wea/Brkn

Log Abbreviation
Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology



DESCRIPTION

0' - 63' - Overburden - Weathered, residual soil, clay and rock rubble

63'-82' - Very broken, weathered core - Fractures are all oxidized; vesicles are weathered out with some qtz remaining.

Soft gray moderately leached GS Breccia to 90'.

Minor oxidation on fractures in generally hard, competent GS Breccia. Periodic zones of visible pyrite

6" vein of white qtz @ 135'.

166' - Chg to hard massive homogeneous, dk grn, andesitic tuff (GS). Moderate to heavy intergranular pyrite.

City	Shasta Lake
State	CA
Hole No.	R-8-80
Loc. N	498750
Loc. E	1896250
Collar El	1250.0
Core Size	BX
Logged By	BWK
Date	2/80
Drilled By	Boyles
Drill Date	2/9/80

Vertical Scale
1 in. = 20 ft.

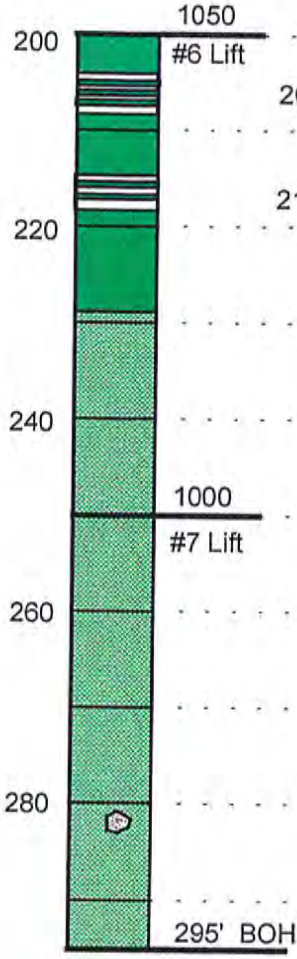
Rock Type-Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology



950 Elevation - Planned Quarry Base

DESCRIPTION

204'-208' - Qtz veining, vertical flow banding, very broken, pyritic GS.

215'-219' - Qtz veining, vertical flow banding, very broken, pyritic GS.

229' - Chg in lithology to lt grn GS Breccia. Minor to moderate pyrite and calcopyrite.

281' - Large(~6" dia.) gry (rhyolitic) breccia block full of pyrite.

City	Shasta Lake
State	CA
Hole No.	R-8-80
Loc. N	498750
Loc. E	1896250
Collar El	1250.0
Core Size	BX
Logged By	BWK
Date	2/80
Drilled By	Boyles
Drill Date	2/9/80

Vertical Scale
1 in. = 20 ft.

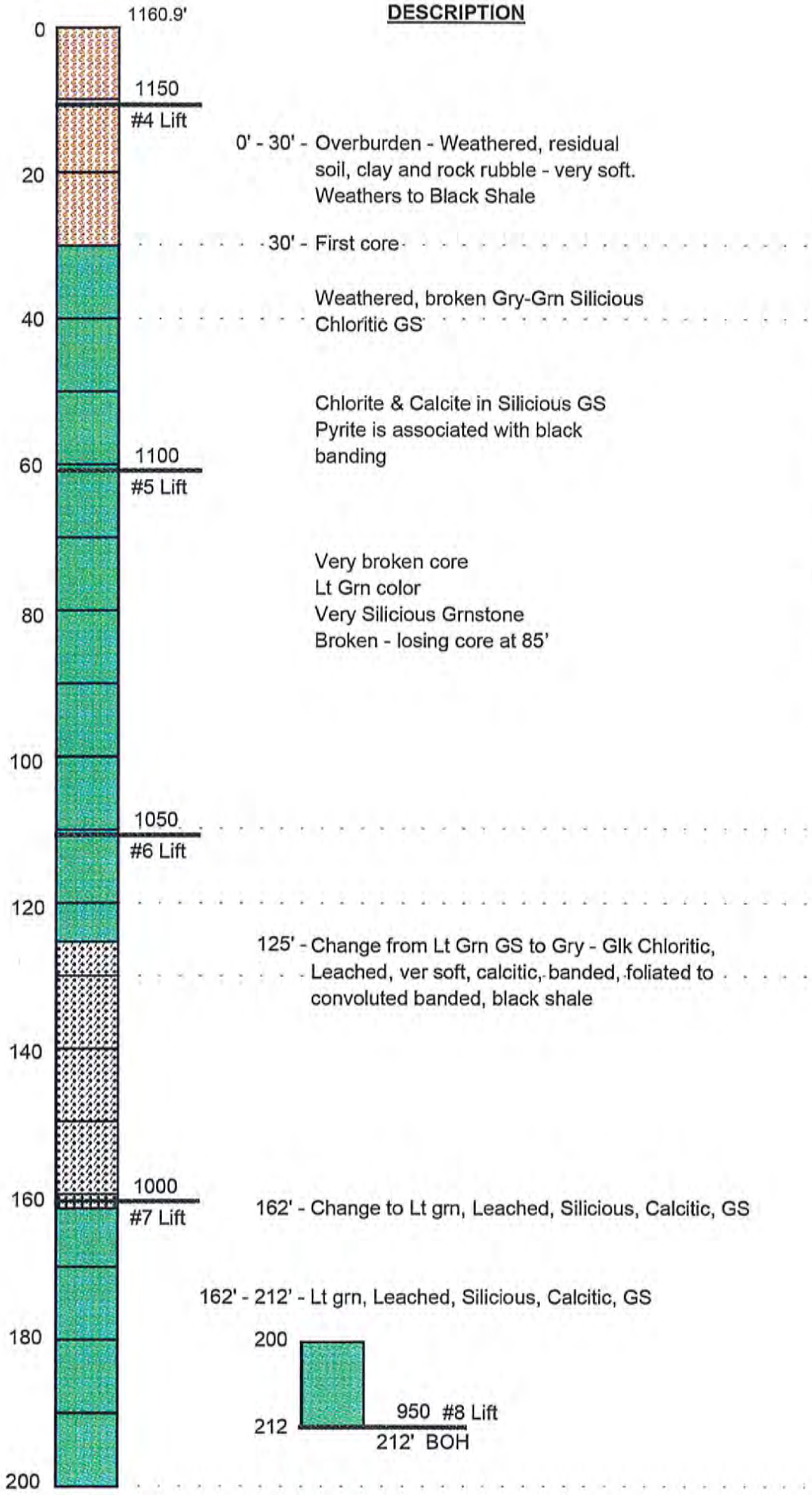
Rock Type-Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology



DESCRIPTION

0' - 30' - Overburden - Weathered, residual soil, clay and rock rubble - very soft. Weathers to Black Shale

30' - First core

Weathered, broken Gry-Grn Silicious Chloritic GS

Chlorite & Calcite in Silicious GS
Pyrite is associated with black banding

Very broken core
Lt Grn color
Very Silicious Grnstone
Broken - losing core at 85'

125' - Change from Lt Grn GS to Gry - Glk Chloritic, Leached, ver soft, calcitic, banded, foliated to convoluted banded, black shale

162' - Change to Lt grn, Leached, Silicious, Calcitic, GS

162' - 212' - Lt grn, Leached, Silicious, Calcitic, GS

City	Shasta Lake
State	CA
Hole No.	R-9-80
Loc. N	499250
Loc. E	1896250
Collar El	1160.9
Core Size	NX to 50'
Logged By	BWK
Date	3/12/80
Drilled By	Boyles
Drill Date	03/12/80

Vertical Scale
1 in. = 20 ft.

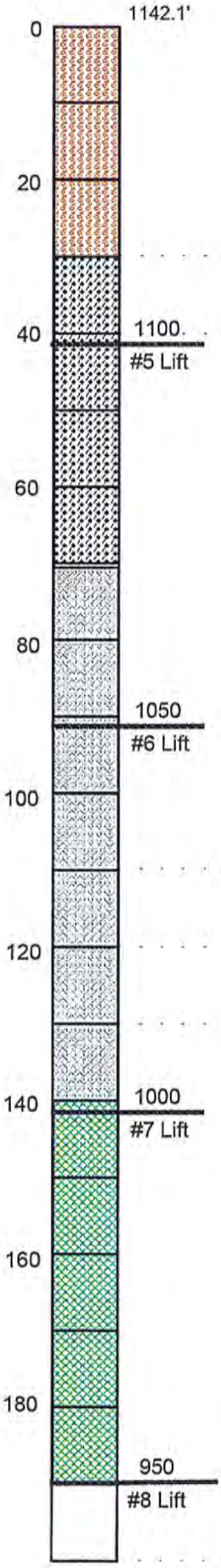
Rock Type-Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Blk Shale
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology



DESCRIPTION

0' - 30' - Overburden - residual soil, clay and shale rubble - soft.

30' - First core

Leached, soft grn -blk, fine to medium bedded; clayey shale with marble cake appearance

56' - Gry - grn leached soft shaley core

70.5' - Distinct Lithologic chg to hard, gray, broken, calcitic, intermediate volcano clastic; Disseminated fine pyr throughout

Brittle, gry - dk gry, granular, intermediate, volcanic clastic; Very alkaline - highly calcitic with dissmenated pryite >= 50% calcite

140' - Lithologic Change from Gry - Dk Gry Volcano clastic to calcitic, coarse, Drk Grn, GS Breccia

Leached, soft, altered, Dk Grn, GS Breccia

190' BOH

City	Shasta Lake
State	CA
Hole No.	R-10-80
Loc. N	499000
Loc. E	1897000
Collar El	1142.1
Core Size	NX
Logged By	BWK
Date	04/13/80
Drilled By	Boyles
Drill Date	04/13/80

Vertical Scale
1 in. = 20 ft.

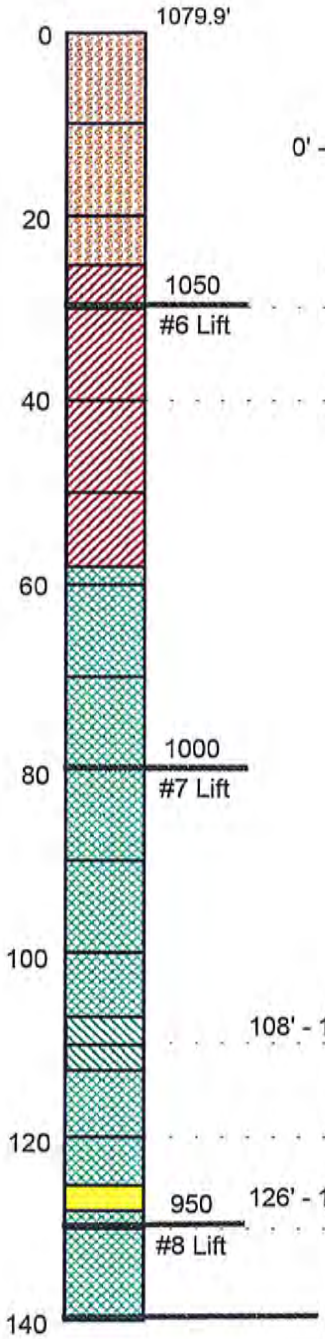
Rock Type-Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Blk Shale
- Volc Clastic

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology



DESCRIPTION

0' - 25' - Overburden - residual soil, clay and rock rubble - soft.

25' - First core
Weathered, broken, gry breccia
Leached, grn clay
Dk Chloritic GS, very brkn

Fine Disseminated pyr in Wea, chloritic GS Breccia

Competent,Gry-dk grn, GS Breccia some broken zones

GS Breccia, minor calc & pyr & qtz

GS Breccia, minor calc & pyr & qtz

108' - 112' - Very broken GS Breccia Core zone

126' - 128' - Calcite Vein in Calcitic GS Breccia

City	Shasta Lake
State	CA
Hole No.	R-11-80
Loc. N	498250
Loc. E	1897250
Collar El	1079.9
Core Size	NX - BX
Logged By	BWK
Date	03/10/80
Drilled By	Boyles
Drill Date	03/10/80

Vertical Scale
1 in. = 20 ft.

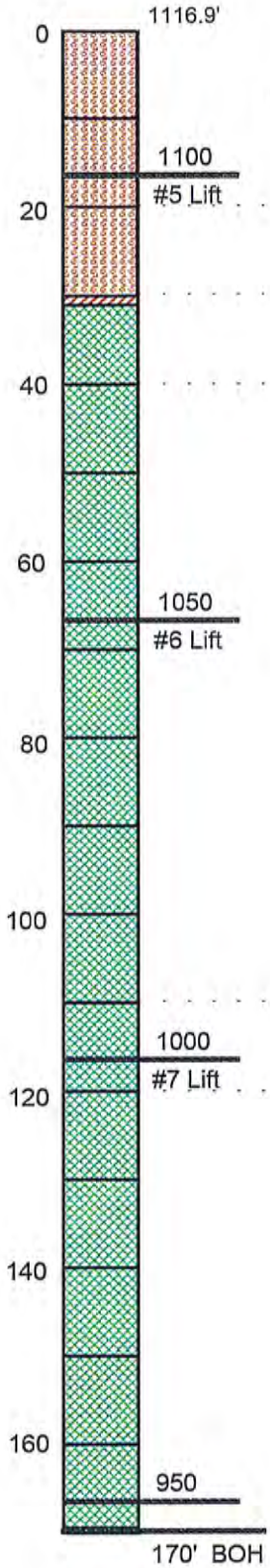
Rock Type-Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Blk Shale
- Weathered

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology



DESCRIPTION

0' - 30' - Overburden - Weathered residual soil, clay and rock rubble

30' - First Core - Wea rock rubble
31' - Unweathered Brkn GS Breccia

GS Breccia - Generally hard
Copetent core, little to no sulfides
Minor qtz & calc on frac's and as stringers

68' - More Calcitic core Calc vein @ 70.5' (4")

Very calcitic, broken core
Gry - Grn GS Breccia

Leached, porous core; Fine disseminated pyr & Calc in GS Breccia

Gry - Grn GS Breccia
Brkn Core

City	Shasta Lake
State	CA
Hole No.	R-12-80
Loc. N	497750
Loc. E	1897250
Collar El	1116.9
Core Size	NX
Logged By	BWK
Date	04/15/80
Drilled By	Boyles
Drill Date	4/15/80

Vertical Scale
1 in. = 20 ft.

Rock Type-Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Weathered

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
0	
10	13' GS BRECCIA
20	BROKEN WEATHERED FRAC. SOME RUBBLE - MINOR SPOTTY PYR.
30	
40	38' WEA. CORE ENDS
50	LT GRN GS BRECCIA
60	MINOR - MODERATE SPOTTY PYR. QTZ VEINING MORE EVIDENT
70	
80	GS BRECCIA Good CORE MINOR PYR MINOR QTZ
90	
100	GS BRECCIA TYPE I
110	LITTLE TO NO QTZ STRINGERS MINOR ALMOST NO PYRITE GOOD LOOKING BASEROCK
120	
130	
140	LIGHTER [illegible] MORE QTZ - CAL STRINGERS FLOW [illegible] OF POLIATION
150	152 LITHO CHG FM GS BRECCIA
160	TO LITE GN GS - POSSIBLE BREC A LARGE BOULDER IN BRECCIA
170	2' CALCITE VEIN (168-170)
	HEAVY PYRITE IN GS BRECCIA
180	GS BRECCIA W/ HOMOG. GS TUFF BOULDERS MOD. - MINOR PYR
190	DK GRN GS BRECCIA
200	GS BRECCIA
210	GS BRECCIA W/ CALCITE STRINGERS
220	GS BRECCIA W/ CALCITE 20% CAL
230	GS BRECCIA W/ CAL STRINGERS MINOR PYRITE
240	LESS CALCITE
250	GS BRECCIA

CORE LOG

Date 3/5/80 Hole No. R-13-80

City CEDAR VALLEY State Co

Location 497250 N

1897250 E

Drilled By: BOYLES

Logged By: BWK

Core Size NX - BX Elevation ~~1290~~ 1316.1

Remarks NX TO 50'

LEGEND

= Overburden

= Acceptable Base Rock Type

= Questionable Rock Type

= Unacceptable Rock Type

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
260 0	264' GS BRECCIA MINOR CAL-PYR
270 10	DISTINCT LITHO. CHG
	CHG TO DK GRN GS TUFF
280 20	FINE DISSEM. PYR.
	CALCITE STRINGERS
290 30	DK GRN CHLORITIC GS
	BROKEN - SOME BRECCIATION
300 40	DK GRN CHLO. GS PYRITE
310 50	DISSEM THROUGHOUT
	HARD COMP. CORE
320 60	
330 70	DISTINCT LITHO CHG TO GS BRECCIA CALCITE
340 80	BROKEN at 330-331
	EOH
90	
100	
110	
120	
130	
140	
150	
160	
170	
180	
190	
200	
210	
220	
230	
240	
250	

CORE LOG Continued

Date 3/9 Hole No. R-13-80

City Central Valley, State Ca

Location 497250 N

1897250 E

Drilled By: Boyle

Logged By: BWK

Core Size BX Elevation 1316.1

Remarks NX to 50'

LEGEND

= Overburden

= Acceptable Base Rock Type

= Questionable Rock Type

= Unacceptable Rock Type

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
0	
10	CLAY + RUBBLE NO CORE
20	1ST CORE HIGHLY WEA. BROKEN GS BRECCIA
30	LESS WEA. TYPE I GS BRECCIA
40	WEA. - CLAY - BROKEN
	WEA. BROK GS BRECCIA
50	LESS WEATHERING LESS BROKEN
	GS BRECCIA SOME WEA. CORE
60	END OF WEATHERING
70	CALCITE STRINGERS IN TYPE I GS BRECCIA W/ MODER. PYR
80	TYPE I GS BRECCIA
90	PYR. ASSOC W/ GRY CLASTS CALCITE ON FRACS.
100	EXCELLENT COMPETENT CORE
110	
120	
130	SOME LEACHING MORE GRAY
140	MATERIAL BROKEN BROKEN GRY-GRN BRECCIA CALCITE VEINING
150	COARSE GS BRECCIA
160	GRY - GRN COARSE BRECCIA
170	HIGHLY MIXED VARIED GRY GRN BRECCIA
180	CALCITE VEIN 173'-176 FINE DISSEM PYR. COARSE GS BRECCIA
190	
200	
210	
211	DISTINCT LITHO CHG TO GRN GS GRANULAR TEXTURE
220	
230	GS SOME VERTICAL [illegible]
240	GRN GRAN. GS CALC. VEINING
250	

CORE LOG

Date 3/10/80 Hole No. R-14-80

City CENTRAL VALLEY, State CA

Location 497000 N

1897000E

Drilled By: BOYLES

Logged By: BWK

Core Size NX-BX Elevation ~~1330~~ 1352.7'

Remarks

LEGEND

= Overburden

= Acceptable Base Rock Type

= Questionable Rock Type

= Unacceptable Rock Type

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet		Description
250	0	
260	10	HOMOGENEOUS GS; 257–261 ± GS BRECCIA
270	20	GRAN. MED-GRAN HOMOG. GS
280	30	
290	40	
300	50	
310	60	CALCITE VEIN LITHO CHG; GS BRECCIA TYPE I
320	70	
330	80	GS BRECCIA; BROKEN MORE GRY HAT
340	90	
350	100	GS BRECCIA
360	110	
369	120	EOH
	130	
	140	
	150	
	160	
	170	
	180	
	190	
	200	
	210	
	220	
	230	
	240	
	250	

CORE LOG Continued

Date 3/12/90 Hole No. R-14-80

City _____, State _____

Location _____

Drilled By: BOYES

Logged By: BWK

Core Size _____ Elevation 1352.7'

Remarks _____

LEGEND

= Overburden

= Acceptable Base Rock Type _____

= Questionable Rock Type _____

= Unacceptable Rock Type _____

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
0	CLAY, RUBBLE, BROKEN ROCK
10	
20	1st CORE
	23' BASE OF WEATHERING
30	
40	GS BRECCIA COMPETENT CALCITIC
50	
60	COARSE GS BRECCIA
70	72'-74' BROKEN LEACHED
80	77'-84' BROKEN
90	SOLID COMP. GS BRECCIA 84'-92'
100	BROKEN - LEACHED
	CALC. QTZ VEINING STRONG
110	GEN. BROKEN GS BRECCIA
120	
130	GS BRECCIA
140	
150	
160	
170	DISSEM MOD. PYR IN GS BRECCIA
	STG ASSOC. W/ RHYO. CLASTS
180	INTERMITANT CALC. STRINGERS
190	AND VEINLETS TO ~ 2"
200	200'-204' GS BRECCIA ALTERED CALCITIC
210	BROKEN, ALTERED, LEACHED FLOW BANDING GRY-GRN BRECCIA W/ INTER LAYERS OF BELOW
220	222' LITHO. CHG
230	HARD, GRN, GRANULAR, PYRITIC GS
240	236 236'-235' HIGHLY BROKEN LITHO. CHG
250	GS BRECCIA ALTERED NEAR CONTACT
	EOH

CORE LOG

Date 4/17/80 Hole No. R-15-80

City CENTRAL VALLEY, State CA.

Location 497750 N
1895750 E

Drilled By: BOYLES

Logged By: RWK

Core Size NX Elevation 1197.3'

Remarks

LEGEND

= Overburden

= Acceptable Base Rock Type

= Questionable Rock Type

= Unacceptable Rock Type

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
0	
10	CLAY - SOIL - RUBBLE
20	
30	1st CORE @ 30'
32'	GOOD UNWEA. CORE GS BRECCIA (T1) VERY CALCITIC MINOR DESSEN. PYR.
40	
50	
60	
70	GS BRECCIA COMP. CORE CALCITE VEINLETS AND STRINGERS
80	
90	
100	GS BRECCIA (T1) W/ CALCITE
110	
120	
130	
140	GS BRECCIA (TYPE 1) W/ CALCITE
150	
160	
170	GS BRECCIA (T1) W/ CALCITE
180	
190	
192	GEN. LESS CALCITE
200	GS BRECCIA EXCELLENT CORE - CALCITIC BUT VERY FEIN VEINS OR STRINGERS
210	
220	
230	
240	GS BRECCIA TYPE 1 GOOD CORE
248	BROKEN MORE CALCITE
250	

CORE LOG

Date 4/13/80 Hole No. R-16-80

City [illegible], State Cal

Location 498750 N

1895750 E

Drilled By: BOYLES

Logged By: BWK

Core Size NX Elevation 1227.2'

Remarks

LEGEND

= Overburden

= Acceptable Base Rock Type

= Questionable Rock Type

= Unacceptable Rock Type

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet		Description
250	0	
260	10	GS BRECCIA W/ CALC.
270	20	262 267 — 265 - 6" VEIN OF CAL-QTZ ZONE OF ABUND. CAL 262'-267'
280	30	EOH
	40	
	50	
	60	
	70	
	80	
	90	
	100	
	110	
	120	
	130	
	140	
	150	
	160	
	170	
	180	
	190	
	200	
	210	
	220	
	230	
	240	
	250	

CORE LOG CONTINUED

Date 4/16/80 Hole No. R-16-80

City Central Valley, State Cal

Location 498250N

1895750 E

Drilled By: Boyle

Logged By: RWK

Core Size NX Elevation 1227.2'

Remarks

LEGEND

= Overburden

= Acceptable Base Rock Type

= Questionable Rock Type

= Unacceptable Rock Type

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
0	
10	SOIL RUBBLE
20	CORE
30	BROKEN WEA. GS HARD USABLE
40	35' BASE OF WEA. — CLASTIC GS LITTLE BRECCIA GRADING TO THIS GS BRECCIA
50	44 1" QTZ VEIN GS BRECCIA MINOR WEA. ON FRAC'S BROKEN
60	61 2" QTZ VEIN
70	— BROKEN CORE
80	
90	COARSE (T1) GS BRECCIA
100	
110	
120	COARSE BRECCIA PYR IN GRY CLASTS
130	
140	134 QTZ-CAL VEINING LEACHED CORE
150	HIGHLY LEACHED GS BRECCIA VERY GRAY 25%-50% CAL QTZ VEINING SOFT-CLAYEY
160	
170	
180	LESS VEINING HIGHLY LEACHED GS BRECCIA
190	
200	
210	[illegible] SOFT CORE UNUSABLE
220	DISASTROPHENIC - PROBABLE THRUST OR LOW ANGLE FAULT GOUGE ?
230	
240	
250	

CORE LOG

Date 4/12/80 Hole No. R-17-80

City Central Valley, State Cal

Location 498930 N
1895750 E

Drilled By: BOYLES

Logged By: BWK

Core Size NX Elevation 1285.4'

Remarks BELOW 130' THIS HOLE IS TOTALLY UNACCEPTABLE

LEGEND

= Overburden

= Acceptable Base Rock Type

= Questionable Rock Type

= Unacceptable Rock Type

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
250 0	
260 10	BRECCIATED, LEACHED, ALTERED, SOFT, POROUS, CALCITIC, QTZITIC GS
270 20	
280 30	SLIGHTLY LESS ALTERED HARDER MORE COMPETENT CORE (GS BRECCIA) BUT STILL 25% CAL - QTZ - CLAY
290 40	
300 50	
310 60	
320 70	
324	EOH
80	
90	
100	
110	
120	
130	
140	
150	
160	
170	
180	
190	
200	
210	
220	
230	
240	
250	

CORE LOG continued

Date 4/13/80 Hole No. R-17-80

City Central Valley, State Cal

Location 498930 N

1895750 E

Drilled By: Boyles

Logged By: BWK

Core Size NK Elevation 1285.4

Remarks Poor - unacceptable from 139' → EOH

LEGEND

= Overburden

= Acceptable Base Rock Type

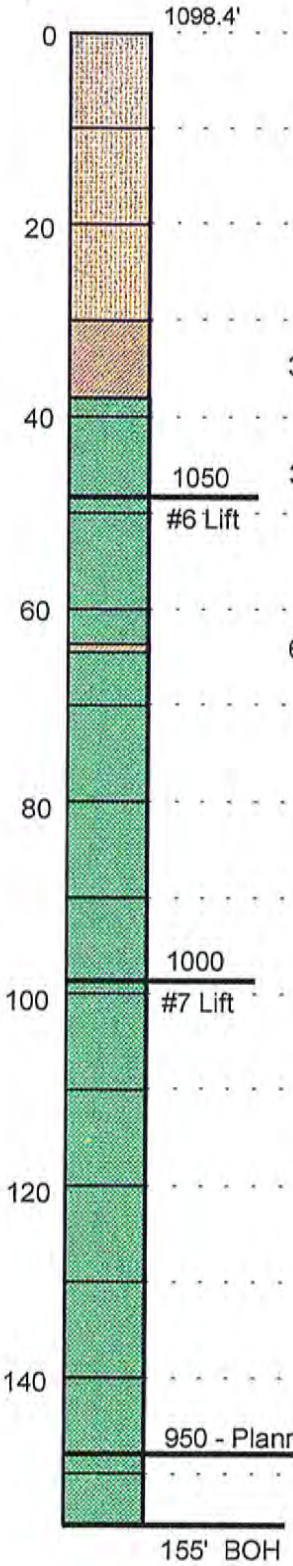
= Questionable Rock Type

= Unacceptable Rock Type

LC = Lost Core

3M Geology

DESCRIPTION



0' - 30' - Overburden - Weathered residual soil, clay and rock rubble

30' - First Core.- set casing

30' - 38' - Heavy Weathering with clay, brkn- incomplete core 50% rec

38' - 64' - Moderate weathering on fractures in GS Breccia -

63' - 64' - Very brkn, weathered seam at base of wea. zone

2" qtz vein @ 82'
Competent, hard GS Breccia, minor qtz as thin veins and pods. No visible pyrite.

Competent, hard GS Breccia, minor qtz and calcite as thin veins and pods (~2-5%). No visible pyrite.

950 - Planned Base of Quarry

City	Shasta Lake
State	CA
Hole No.	R-21-80
Loc. N	498500
Loc. E	1897000
Collar El	1098.4
Core Size	NX
Logged By	BWK
Date	2/80
Drilled By	Boyles
Drill Date	4/12/80

Vertical Scale
1 in. = 20 ft.

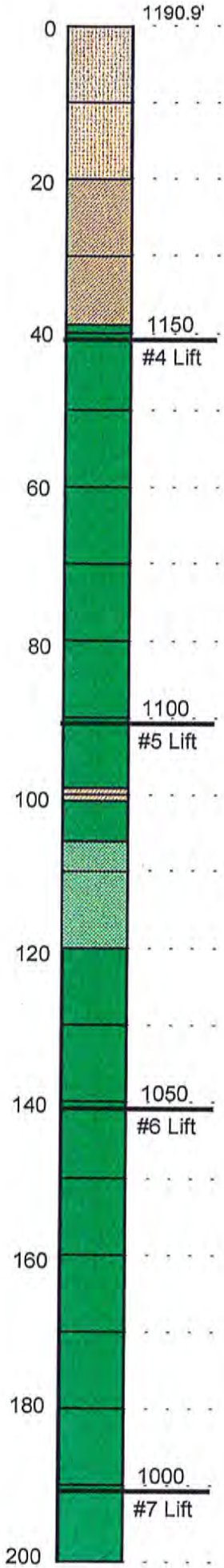
Rock Type-Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Weathered

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology



DESCRIPTION

0' - 20' - Overburden - Weathered, residual soil, clay and rock rubble

20' - 39' - Highly Weathered GS - Fully Oxidized Core Cross Section

Mod pyrite noted at 43'

53' - Base of Weathering
Homogeneous, fine xtln, sugar textured, grn, GS: Some brecciation noted.

NX Core to 70' then chg to BX

99'-101' - Brkn, Wea., GS

106'-120' - Change to Gry-grn GS Breccia

120' - Lithologic change to Dk grn, massive, porphyritic GS.

Dk grn, massive, porphyritic GS. Minor thin epidote, calcite & qtz veining.

177.5' - 2" qtz vein in very homogeneous dk grn GS.

Gradually increasing amounts of silica and calcite

City	Shasta Lake
State	CA
Hole No.	R-22-80
Loc. N	498000
Loc. E	1897000
Collar El	1190.9
Core Size	NX-BX
Logged By	BWK
Date	2/80
Drilled By	Boyles
Drill Date	4/1/80

Vertical Scale
1 in. = 20 ft.

Rock Type-Discription Legend:

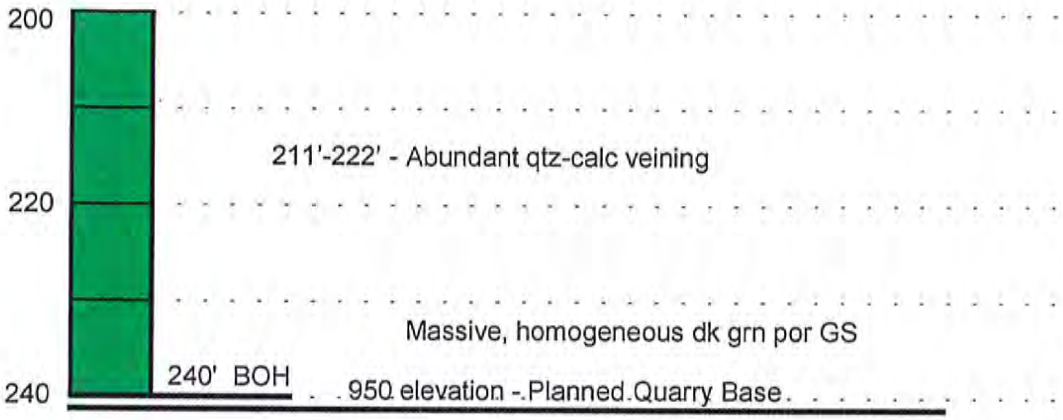
- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology

DESCRIPTION



City	Shasta Lake
State	CA
Hole No.	R-22-80
Loc. N	498000
Loc. E	1897000
Collar El	1190.9
Core Size	NX-BX
Logged By	BWK
Date	2/80
Drilled By	Boyles
Drill Date	4/1/80

Vertical Scale
1 in. = 20 ft.

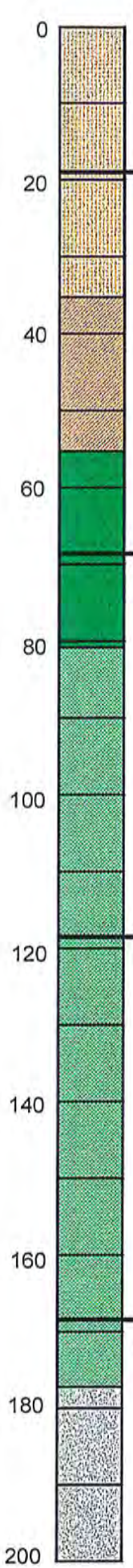
Rock Type-
Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Conglomerate
- Wea/Brkn

Log Abbreviation
Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology



DESCRIPTION

0' - 35' - Overburden - Weathered, residual soil, clay and rock rubble

Casing Set at 35' in GS rubble.

35' - 55' - Soft, decomposed GS, highly wea and oxidized.

NX to 7.1' Remainder BX core.

Gry-grn GS. Occasional minor brecciation.

81'-177' - Gry-grn GS Breccia, no visible sulfides

Occasional minor sulfides in breccia clasts and very minor qtz veining

177'-268' - Dk gry, very fine xtln, Rhyolite welded tuff, Ignimbritic flow banding evident.

City	Shasta Lake
State	CA
Hole No.	R-23-80
Loc. N	497500
Loc. E	1896500
Collar El	1318.6
Core Size	NX-BX
Logged By	MCG-CEN
Date	2/80
Drilled By	Boyles
Drill Date	3/27/80

Vertical Scale
1 in. = 20 ft.

Rock Type-Discription Legend:

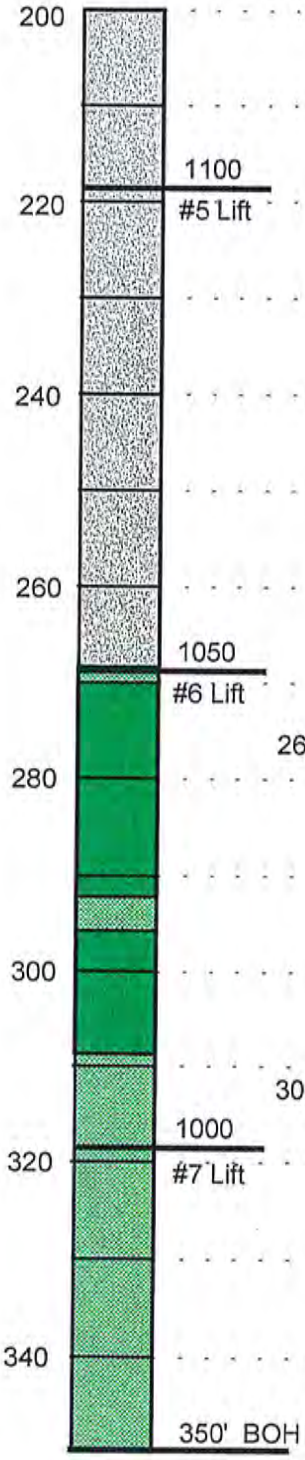
- Residuum/Soil
- Greenstone
- GS Breccia
- Rhyolite
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology

DESCRIPTION



Dk gry, very fine xtln, Rhyolite welded tuff, Ignimbritic flow banding evident. Secondary alteration of epidote and chlorite along banding.

268'-308' - Alternating layers of GS Breccia and Gry-grn GS: Minor sulfides and qtz.

308'-350' - Gry-grn GS Breccia with slight visible pyrite in hard, competent core.

950 Elevation - Planned Base of Quarry

City	Shasta Lake
State	CA
Hole No.	R-23-80
Loc. N	497500
Loc. E	1896500
Collar El	1318.6
Core Size	NX-BX
Logged By	MCG-CEN
Date	2/80
Drilled By	Boyles
Drill Date	3/27/80

Vertical Scale
1 in. = 20 ft.

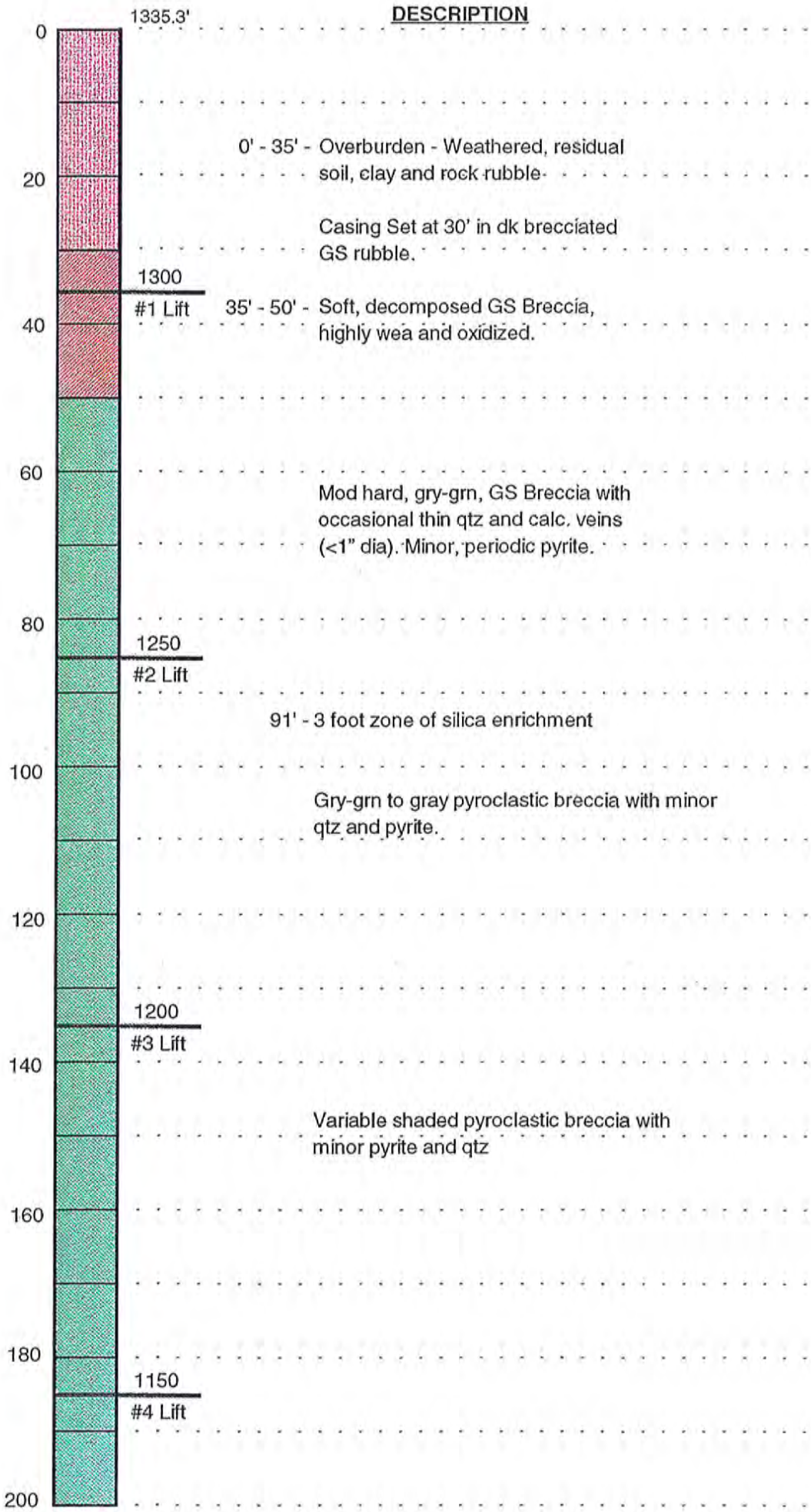
Rock Type-Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Rhyolite
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology



DESCRIPTION

0' - 35' - Overburden - Weathered, residual soil, clay and rock rubble

Casing Set at 30' in dk brecciated GS rubble.

35' - 50' - Soft, decomposed GS Breccia, highly wea and oxidized.

Mod hard, gry-grn, GS Breccia with occasional thin qtz and calc. veins (<1" dia). Minor, periodic pyrite.

91' - 3 foot zone of silica enrichment

Gry-grn to gray pyroclastic breccia with minor qtz and pyrite.

Variable shaded pyroclastic breccia with minor pyrite and qtz

City	Shasta Lake
State	CA
Hole No.	R-24-80
Loc. N	498000
Loc. E	1896500
Collar El	1335.3
Core Size	NX
Logged By	MCG
Date	2/80
Drilled By	Boyles
Drill Date	3/22/80

Vertical Scale
1 in. = 20 ft.

Rock Type-Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Rhyolite
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology

DESCRIPTION

200

Lt gry to gry grn, pyroclastic breccia. Qtz and calcite fracture fillings and patches. Variable xtln texture with variable color.

220

1100
#5 Lift

240

260

Med gry-grn, GS Breccia. Minor sulfides and qtz.

280

1050
#6 Lift

300

320

1000
#7 Lift

340

350' - 370' - Gry-grn GS Breccia with slight visible pyrite in mottled; broken core.

360

370' BOH

950 Elevation - Planned Base of Quarry

City	Shasta Lake
State	CA
Hole No.	R-24-80
Loc. N	498000
Loc. E	1896500
Collar El	1335.3
Core Size	NX
Logged By	MCG
Date	2/80
Drilled By	Boyles
Drill Date	3/22/80

Vertical Scale
1 in. = 20 ft.

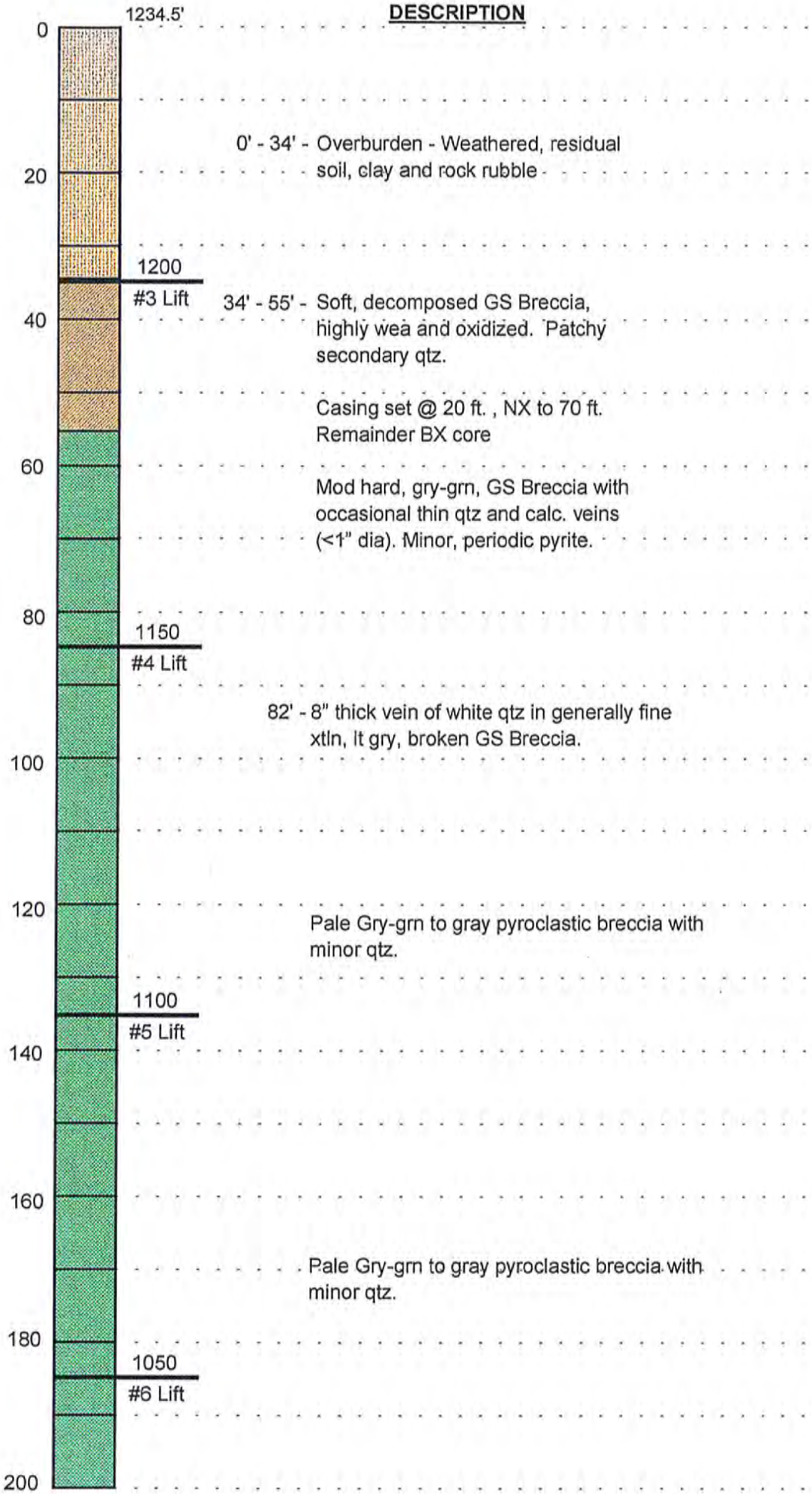
Rock Type-Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Rhyolite
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology



DESCRIPTION

0' - 34' - Overburden - Weathered, residual soil, clay and rock rubble

34' - 55' - Soft, decomposed GS Breccia, highly wea and oxidized. Patchy secondary qtz.

Casing set @ 20 ft. , NX to 70 ft. Remainder BX core

Mod hard, gry-grn, GS Breccia with occasional thin qtz and calc. veins (<1" dia). Minor, periodic pyrite.

82' - 8" thick vein of white qtz in generally fine xtln, lt gry, broken GS Breccia.

Pale Gry-grn to gray pyroclastic breccia with minor qtz.

Pale Gry-grn to gray pyroclastic breccia with minor qtz.

City	Shasta Lake
State	CA
Hole No.	R-25-80
Loc. N	498500
Loc. E	1896500
Collar El	1234.5
Core Size	NX-BX
Logged By	MCG
Date	2/80
Drilled By	Boyles
Drill Date	3/22/80

Vertical Scale
1 in. = 20 ft.

Rock Type-Discription Legend:

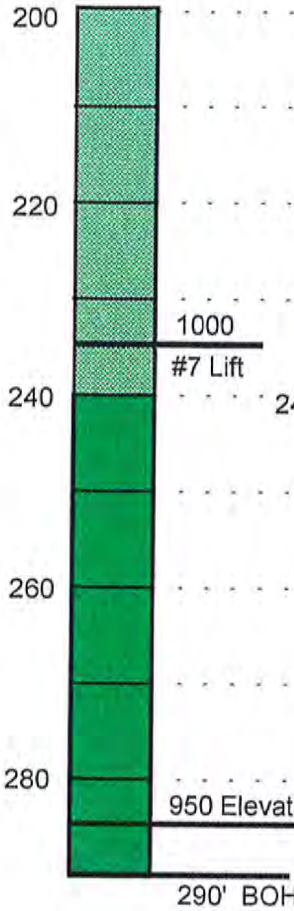
- Residuum/Soil
- Greenstone
- GS Breccia
- Rhyolite
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Grn-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

3M Geology

DESCRIPTION



Lt gry to gry grn, pyroclastic breccia. Qtz and calcite fracture fillings and patches. Variable xtln texture with variable color.

240'-290' - Gry, mottled pyroclastic GS. Very shattered core grading to welded GS in more competent core.

City	Shasta Lake
State	CA
Hole No.	R-25-80
Loc. N	498500
Loc. E	1896500
Collar El	1234.5
Core Size	NX
Logged By	MCG
Date	2/80
Drilled By	Boyles
Drill Date	3/22/80

Vertical Scale
1 in. = 20 ft.

Rock Type-Discription Legend:

- Residuum/Soil
- Greenstone
- GS Breccia
- Rhyolite
- Wea/Brkn

Log Abbreviation Legend:

Alt-	Altered
Brkn-	Broken
Brn-	Brown
Cse-	Coarse
Dk-	Dark
Fn-	Fine
Gry-	Gray
Lt-	Light
Med-	Medium
Gm-	Green
Cgl-	Conglomerate
Por-	Porphyritic
Wea-	Weathered
GS-	Greenstone
Xtln-	Crystalline
Qtz	Quartz

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
0	
10	NO CORE
20	
30	LT GRAY GREEN GS BRECCIA, FRACTURED. QTZ & CAL VEINLETS TO 3/4". SILICIOUS.
40	
50	CAL VEINLETS [illegible] QTZ [illegible] AS ABOVE
60	VERY BROKEN 46-65' HARD
70	LT GRAY GREEN GS 68-77 FRACTURED, [illegible]
80	2" QTZ VEIN @ 82'
90	GS BRECCIA, QTZ [illegible] & [illegible], 1"-2" QTZ VEINS [illegible]
100	
110	LT GRAY BRECCIA, [illegible] VEINLETS & [illegible] HARD, GOOD CORE RED,
120	
130	
140	MOTTLED GRAY GREEN GS [illegible], QTZ AS ABOVE
150	
160	
170	LT GRAY HARD BRECCIA
180	FINE TO 1.5" QTZ/CALC VEINS
190	BOTTOM 190'
200	
210	
220	
230	
240	
250	

CORE LOG

Date [illegible] Hole No. R-26-[illegible]

City [illegible], State CA

Location N 499000, E 1896500

Drilled By: [illegible]

Logged By: [illegible]

Core Size [illegible] Elevation 1/36.0'

Remarks

LEGEND

= Overburden

= Acceptable Base Rock Type

= Questionable Rock Type

= Unacceptable Rock Type

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
0	
10	SOIL, SHALLOW BROKEN DECOMPOSED GS
20	
30	MED GREY GREEN FINE TO COARSE GRAINED DGS, BUCKSHOT QTZ.
NX / BX 40	BROKEN, AS ABOVE, SOME FINE PYRITE
50	
60	AS ABOVE
70	
80	MEDIUM GREY GREEN PYROCLASTIC [illegible] QTZ/CALC. [illegible]
90	FRACTURED GS BRECCIA.
100	QUARTZ/CALC VERNALIZED [illegible] PYRITE
110	[illegible]
120	[illegible]
130	
140	
150	
160	
170	
180	
190	[illegible]
200	
210	
220	
230	[illegible]
240	
250	

CORE LOG

Date 3/26/80 Hole No. R-27-80

City Project City, State CA

Location N 498500 E 1896000

Drilled By: Boyles Bros

Logged By: MCG

Core Size NX-BX Elevation 1275.5'

Remarks

LEGEND

= Overburden

= Acceptable Base Rock Type

= Questionable Rock Type

= Unacceptable Rock Type

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
250	
10	
20	
30	
40	
350	Est.
60	
70	
80	
90	
100	
110	
120	
130	
140	
150	
160	
170	
180	
190	
200	
210	
220	
230	
240	
250	

CORE LOG

Date 3/26/80 Hole No. 27

City _____, State _____

Location _____

Drilled By: Boyles Bros

Logged By: MCL - CEN

Core Size NX-BX Elevation 1275.5

Remarks _____

LEGEND

= Overburden

= Acceptable Base Rock Type _____

= Questionable Rock Type _____

= Unacceptable Rock Type _____

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
0	
10	
20	
30	32
NX 40	
50	47
BX 60	
70	
80	
90	
100	
110	
120	
130	
140	
150	
160	
170	
180	
190	
200	
210	
220	
230	
240	
250	

CORE LOG

Date 3/31/80 Hole No. R-28-80

City Potrero Valley, State Ca.

Location 478000 N, 1896000 E

Drilled By: Barlee Bros

Logged By: C.E.N.

Core Size NX 50' Elevation 1251.9'

Remarks

LEGEND

= Overburden

= Acceptable Base Rock Type

= Questionable Rock Type

= Unacceptable Rock Type

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
200	
210	
220	
230	
240	
350	
360	
70	
80	
90	
100	
110	
120	
130	
140	
150	
160	
170	
180	
190	
200	
210	
220	
230	
240	
250	

CORE LOG

Date 4/1/80 Hole No. R-28-80

City _____, State _____

Location _____

Drilled By: _____

Logged By: _____

Core Size _____ Elevation 1251.9'

Remarks _____

LEGEND

= Overburden

= Acceptable Base Rock Type _____

= Questionable Rock Type _____

= Unacceptable Rock Type _____

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
0	
Core	04 [illegible]
10	
NX	
20	HIGHLY BROKEN CLAY RUBBLE TO 25'
BX	
30	MOD WEATHER
40	36' BASE OF WEA. GS BRECCIA TYPE I GS BRECCIA
50	
60	BROKEN - BUT GOOD CORE LITTLE TO NO QTZ, CAL, PYR
70	QTZ. CAL STRINGERS
80	
90	GS BRECCIA
100	99' QTZ VEINLETS LEACHED CORE
110	BROKEN - GRY CLAY
120	GRY - GRY-GRN BRECCIA
130	
140	GS BRECCIA MINOR QTZ CAL
150	
160	BROKEN BUT GOOD CORE
170	REC GS BRECCIA (T1)
180	
190	
200	GS BRECCIA - MINOR CAL QTZ PYR
210	
220	
230	
240	
250	

CORE LOG

Date 4/1/80 Hole No. R-29-80

City Central Valley State Ca.

Location 497500 N, 1896000 E

Drilled By: Boyles Bros.

Logged By: CEN - BWK

Core Size NX-0'-20' ~~BX-20'~~ Elevation 1271.7'

Remarks

1st Core @ 4'

LEGEND

= Overburden

= Acceptable Base Rock Type

= Questionable Rock Type

= Unacceptable Rock Type

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet		Description
250	0	
260	10	CONSISTANT (TYPE I) GS BRECCIA MINOR QTZ - PYR. GRN. GOOD CORE + RECOV.
270	20	
280	30	
290	40	
300	50	CONSISTANT (T I) GS BRECCIA
310	60	
320	70	
330	80	EOH
	90	
	100	
	110	
	120	
	130	
	140	
	150	
	160	
	170	
	180	
	190	
	200	
	210	
	220	
	230	
	240	
	250	

CORE LOG continued

Date 4/10/80 Hole No. R-29-80

City Central Valley, State Cal

Location 497500N

1896000E

Drilled By: Bogles

Logged By: BWK

Core Size _____ Elevation 1271.7'

Remarks _____

LEGEND

= Overburden

= Acceptable Base Rock Type _____

= Questionable Rock Type _____

= Unacceptable Rock Type _____

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
0	
10	
20	
30	26' 25' 1st CORE BROKEN & WEA. TO 26' BASE OF WEA
40	GRANULAR DIABASIC GS MINOR CALC VEINING. GOOD LOOKING STONE
50	
60	
70	
80	
90	
100	102 LITHO CHG TO GRANU. GRY BRECCIA BROKEN & WEA. @ CONTACT
110	
120	GRY - GRY-GRN COARSE BRECCIA
130	
140	- BROKEN LEACHED @ 141 - 142.5
150	
160	GS BRECCIA - BROKEN - HARD
170	
180	GS BRECCIA
190	LEACHED, SOFT, BROKEN CORE
200	
210	
220	VERTICAL CALCITE BANDING 217 - 3" CALC. VEIN
230	
240	BROKEN GS BRECCIA
250	

CORE LOG

Date 4/17/80 Hole No. R-30-80

City CENTRAL VALLEY, State CAL

Location ~ 499 ~~300~~ 130 N

~ 1895 1~~35~~ 70 E

Drilled By: BOYLES

Logged By: RWK

Core Size NX. Elevation ~1350

Remarks

LEGEND

= Overburden

= Acceptable Base Rock Type

= Questionable Rock Type

= Unacceptable Rock Type

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
0	
10	VERY [illegible] LESSER GS [illegible] [illegible] CALC.
20	HARDER - MORE COMPETENT CORE GS [illegible]
30	
40	[illegible] CORE GS [illegible] CALC. VEINS [illegible]
50	STRONG PVR IN CALC. VEINS
60	
70	
80	
90	
100	EOH
110	
120	
130	
140	
150	
160	
170	
180	
190	
200	
210	
220	
230	
240	
250	

CORE LOG

Continued

Date 4/23/80 Hole No. R-30-80

City Gold Valley, State Ga

Location 409 130 W

18951 70 S

Drilled By: BOYLES

Logged By: BWK

Core Size NX Elevation ~1350

Remarks

LEGEND

= Overburden

= Acceptable Base Rock Type

= Questionable Rock Type

= Unacceptable Rock Type

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
0	
10	BROKEN ROCK - SOIL
20	21' ← 1ST CORE @ 20' EAST OF OXIDIZED ZONE
30	
40	
50	TYPE I DARK SOLID GS BRECCIA MINOR CALCITE QTZ
60	
70	
80	
90	← 59' SLIGHT LITHO CHG TO MORE GRY COARSE GS BRECCIA MORE CALCITE
100	
110	
120	
130	
140	
150	COARSE GS BRECCIA GEN GOOD CORE SOME CALC. VEINING
160	
170	
180	
190	GRN-GRY COARSE BRECCIA MINOR CAL - QTZ - PYR
200	
210	
220	
230	
240	
250	

CORE LOG

Date 4/23/80 Hole No. R-31-80

City Central Valley, State Ca

Location ~ 499 890 ~ 000N

~ 1895090 E

Drilled By: B

Logged By: BWK

Core Size NX Elevation ~1450

Remarks

LEGEND

= Overburden

= Acceptable Base Rock Type

= Questionable Rock Type

= Unacceptable Rock Type

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
250 0	
260 10	CONTACT ZONE
270 20	LITHO CHG TO SANDED BLACK VOLCANO CLASTIC
280 30	'MARBLE CAKE' BLACK CARBITIC 'SHALE'
290 40	
300 50	(VERY POOR GRANULE BASEROCK)
310 60	MIXED BRECCIA AND BLACK VOLCANIC SHALE
320 70	
330 80	
340 90	
350 100	
360 110	
370 120	
380 130	
390 140	
400 150	
410 160	
420 170	
430 180	
440 190	
450 200	
210	
220	
230	
240	
250	

CORE LOG

Date 4/25/80 Hole No. R-31-80

City CENTRAL VALLEY, State CAL

Location ~ ~~500,000~~ 499,890 N

1895 ~~0~~ 9 E

Drilled By: BOYLES

Logged By: BWK

Core Size NX Elevation ~1450

Remarks

LEGEND

= Overburden

= Acceptable Base Rock Type

= Questionable Rock Type

= Unacceptable Rock Type

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
0	
10	
20	
30	
40	
50	
60	
70	
80	
90	
100	
110	
120	
130	
140	
150	
160	
170	
180	
190	
200	
210	
220	
230	
240	
250	

CORE LOG

Date 5/16/80 Hole No. R-32-80

City [illegible], State [illegible]

Location ~~500125~~ 499930 N, 18958~~15~~ 90 E.

Drilled By: BOYLES

Logged By: CEN

Core Size NX Elevation 1260 EST

Remarks Poor throught.

LEGEND

= Overburden

= Acceptable Base Rock Type

= Questionable Rock Type

= Unacceptable Rock Type

LC = Lost Core

MINNESOTA MINING & MFG. CO.
ENVIRONMENTAL ENGINEERING

Feet	Description
0	
10	
20	
30	EOH 277'
40	
50	
60	
70	
80	
90	
100	
110	
120	
130	
140	
150	
160	
170	
180	
190	
200	
210	
220	
230	
240	
250	

CORE LOG

Date 5/16/80 Hole No. R-32-80

City Central Valley, State Co.

Location ~~500135~~ 499930 N, 18958 ~~X~~ 90 E

Drilled By: Boyles

Logged By: CEN

Core Size NX Elevation ~1260

Remarks

LEGEND

= Overburden

= Acceptable Base Rock Type

= Questionable Rock Type

= Unacceptable Rock Type

LC = Lost Core

BROWN AND CALDWELL

BORING LOG

Project Name: Moody Creek | Project Number: 137108

Soil Boring [x] Hand Auger Boring [ ] Monitoring Well [x] Boring/Well Number: B-1 Sheet 1 of 1

Boring Location: Redding/Mountain Gade		Elevation and Datum: Approx: 1115 feet msl	
Drilling Contractor: WDC	Driller: Joe Zimmer	Date Started: 5/1/2009	Date Finished: 5/1/2009
Drilling Equipment: Arch	Borehole Diameter: 10"	Completed Depth: (feet) 50.0	Water Depth (Feet): Static/First Encountered 17.95/30.0
Sampling Method: Grab		WELL CONSTRUCTION	
Drilling Method: Air Rotary	Drilling Fluid: Air	Type and Diameter of Well Casing: 6" Steel and 2" PCV	
Backfill Material: Bentonite chips		Slot Size: 0.02	Filter Material: Bentonite chips
Logged By: Tim Godwin	Checked By: Tim Godwin	Development Method: N/A	

Depth (feet)	USCS Soil Type	Description (group name, gradation [%gravel, %sands, %fines] munsell color, color, soil characteristics)	Blow Counts	Sample No.	Graphic Log: Sample	Graphic Log: Lithology	Graphic Log: Boring/Well Completion	PID Readings PPM	Remarks
5	CL	Soils - silty clay, moist, very dark red, fill from road cut, highly weathered							10" borehole from 0 to 20 feet bgs with 6" steel conductor casing, annulus sealed with hydrated bentonite chip according to Shasta County specifications.
10		Weathered bedrock - light reddish brown, sandy clayey soils and rock fragments							
15		More competent							
20		Basaltic rock							Static water level = 17.95 feet bgs 6" borehole from 20 to 50 feet bgs. with 2" PVC casing from 0 to 50 feet bgs no filter pack, free standing in open borehole. PCV 0.020" slot screen from 30 to 50 feet bgs.
25		More competent, fine grain, dark black/green with minor phenocrysts (plagioclase), some weathering.							
30									First encountered groundwater = 29 feet bgs Minor water, cuttings wet, no runoff during drilling.
35									Low water production, 1 gpm.
40		Greenstone/andesite - light green with moderate quartz phenocrysts, and trace pyrite							
45									
50		Total depth of boring = 50 feet bgs							

BROWN AND CALDWELL

BORING LOG

Project Name: Moody Creek Project Number: 137108

Soil Boring [x] Hand Auger Boring [ ] Monitoring Well [x] Boring/Well Number: B-2 Sheet 1 of 1

Boring Location: Redding/Mountain Gade		Elevation and Datum: Approx: 1150 feet msl	
Drilling Contractor: WDC	Driller: Joe Zimmer	Date Started: 4/28/2009	Date Finished: 4/29/2009
Drilling Equipment: Arch	Borehole Diameter: 8"	Completed Depth: (feet) 50.0	Water Depth (Feet): Static/First Encountered NA/NA
Sampling Method: Grab		WELL CONSTRUCTION	
Drilling Method: Air Rotary	Drilling Fluid: Air	Type and Diameter of Well Casing: 6" Steel and 2" PCV	
Backfill Material: Granular bentonite		Slot Size: 0.02	Filter Material: Granular bentonite
Logged By: Tim Godwin	Checked By: Tim Godwin	Development Method: NA	

Depth (feet)	USCS Soil Type	Description (group name, gradation [%gravel, %sands, %fines] munsell color, color, soil characteristics)	Blow Counts	Sample No.	Graphic Log: Sample	Graphic Log: Lithology	Graphic Log: Boring/Well Completion	PID Readings PPM	Remarks
	ML	Silt, red							8" borehole from 0 to 20 feet bgs with 6" steel conductor casing, annulus sealed with hydrated bentonite chip according to Shasta County specifications.
5		Weathered Bedrock - Green andesite with minor euhedral quartz, some surfaces weathered with red oxidation stains.							
10									
15									
20									6" borehole from 20 to 50 feet bgs. with 2" PVC casing from 0 to 50 feet bgs no filter pack, free standing in open borehole. PCV 0.020" slot screen from 30 to 50 feet bgs.
25		Andesite - fine grained with phenocrysts of quartz and plagioclase, minor reddish oxidation on fracture surfaces; trace pyrite or chalcopyrite (very fine grained).							
30									
35		-Color change to darker green; pyrite not observed.							
40		-Quartz veins, massive.							
45		-No quartz veins, phenocrysts.							
50		Total depth of boring = 50 feet bgs							

BROWN AND CALDWELL

BORING LOG

Project Name: Moody Creek | Project Number: 137108

Soil Boring [X] Hand Auger Boring [ ] Monitoring Well [X] Boring/Well Number: B-3 Sheet 1 of 1

Boring Location: Redding/Mountain Gade		Elevation and Datum: Approx: 1200 feet msl	
Drilling Contractor: WDC	Driller: Joe Zimmer	Date Started: 4/30/2009	Date Finished: 5/1/2009
Drilling Equipment: Arch	Borehole Diameter: 10"	Completed Depth: (feet) 50.0	Water Depth (Feet): Static/First Encountered NA/NA
Sampling Method: Grab		WELL CONSTRUCTION	
Drilling Method: Air Rotary	Drilling Fluid: Air	Type and Diameter of Well Casing: 6" Steel and 2" PCV	
Backfill Material: Bentonite chips		Slot Size: 0.02	Filter Material: Bentonite chips
Logged By: Tim Godwin	Checked By: Tim Godwin	Development Method: NA	

Depth (feet)	USCS Soil Type	Description (group name, gradation [%gravel, %sands, %fines] munsell color, color, soil characteristics)	Blow Counts	Sample No.	Graphic Log: Sample	Graphic Log: Lithology	Graphic Log: Boring/Well Completion	PID Readings PPM	Remarks
		Soil/weathered rock, strongly oxidized and weathered, rock is possibly andesite and/or basalt.							10" borehole from 0 to 20 feet bgs with 6" steel conductor casing, annulus sealed with hydrated bentonite chip according to Shasta County specifications.
5		Weathered Basalt - weathered, reddish oxidation staining, blocky fracturing, minor quartz veining.							
10									
15		Andesitic Basalt - Light green andesitic basalt composition, much more competent, still lightly weathered.							
20		Andesitic Basalt - competent, fine grained, minor/trace phenocrysts of quartz; weathered surfaces are dark red to black.							6" borehole from 20 to 50 feet bgs. with 2" PVC casing from 0 to 50 feet bgs no filter pack, free standing in open borehole. PCV 0.020" slot screen from 30 to 50 feet bgs.
		Andesite, light green, fine grained with moderate phenocrysts composed of quartz, plagioclase, mafics (hornblende).							
25									
30		-Quartz veining present.							
35									
40									
45		-Trace quartz veining.							
50		Total depth of boring = 50 feet bgs							

BROWN AND CALDWELL

BORING LOG

Project Name: Moody Creek | Project Number: 137108

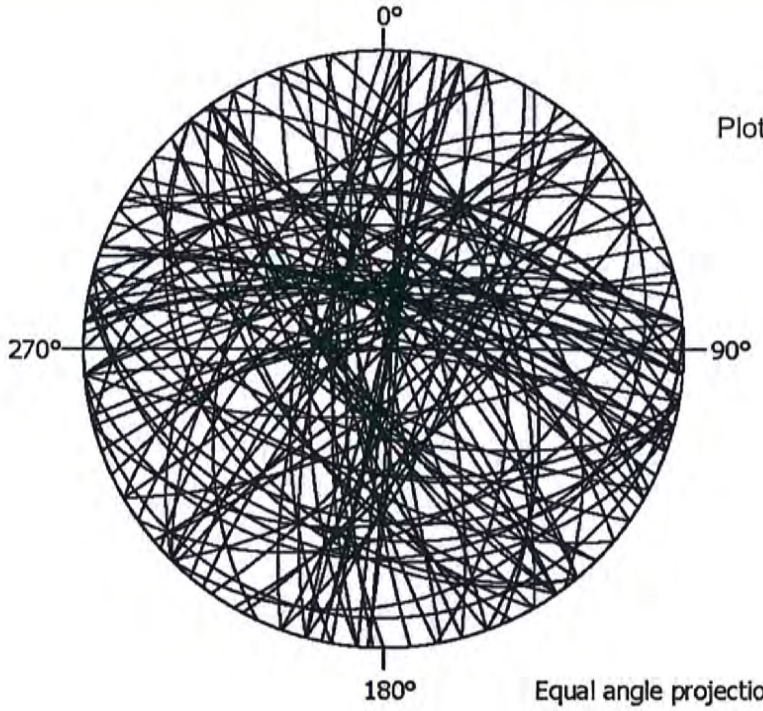
Soil Boring [X] Hand Auger Boring [ ] Monitoring Well [X] Boring/Well Number: MW-1 Sheet 1 of 1

Boring Location: Redding/Mountain Gade		Elevation and Datum: Approx: 1200 feet msl	
Drilling Contractor: WDC	Driller: Joe Zimmer	Date Started: 4/29/2009	Date Finished: 4/30/2009
Drilling Equipment: Arch	Borehole Diameter: 10"	Completed Depth: (feet) 100.0	Water Depth (Feet): Static/First Encountered 22.86/NA
Sampling Method: Grab		WELL CONSTRUCTION	
Drilling Method: Air Rotary	Drilling Fluid: Air	Type and Diameter of Well Casing: 6" Steel and 2" PCV	
Backfill Material: Bentonite chips		Slot Size: 0.02	Filter Material: Bentonite Chips
Logged By: Tim Godwin	Checked By: Tim Godwin	Development Method: N/A	

Depth (feet)	USCS Soil Type	Description (group name, gradation [%gravel, %sands, %fines] munsell color, color, soil characteristics)	Blow Counts	Sample No.	Graphic Log: Sample	Graphic Log: Lithology	Graphic Log: Boring/Well Completion	PID Readings PPM	Remarks
	ML	Soils and fill from road cut, silty sands, highly weathered rock, very red oxidized soils, clasts are andesite.							10" borehole from 0 to 20 feet bgs with 6" steel conductor casing, annulus sealed with hydrated bentonite chip according to Shasta County specifications.
5		Weathered Andesite - fine grained, blocky fracture, weathered reddish oxidation staining.							
10									
15		- More competent bedrock							
20		- More competent bedrock							
		Andesite - fine grained, light green in color, moderate phenocrysts to 3 mm, quartz, plagioclase							6" borehole from 20 to 50 feet bgs. with 2" PVC casing from 0 to 50 feet bgs no filter pack, free standing in open borehole. PCV 0.020" slot screen from 30 to 50 feet bgs. Static Water = 22.86 feet below ground surface.
25									
30									
35									
40									
45		-Color change to darker green, finer grained less phenocrysts.							
50									
55		-Approximately 40% quartz.							
60		-Fine quartz veins, approximately 10% to 15% and 0.5 cm wide.							
65		-Very dark green, trace quartz vein fragments, andesite is very fine grained, approximately 10% non-distinguishable phenocrysts (possibly plagioclase).							
70		-Dark mafic minerals 1 to 2 mm and are subhedral to euhedral.							
75									
80									
85									
90									
95									
100		Dark green in color. Total depth of boring = 100 feet bgs							
105									

APPENDIX C

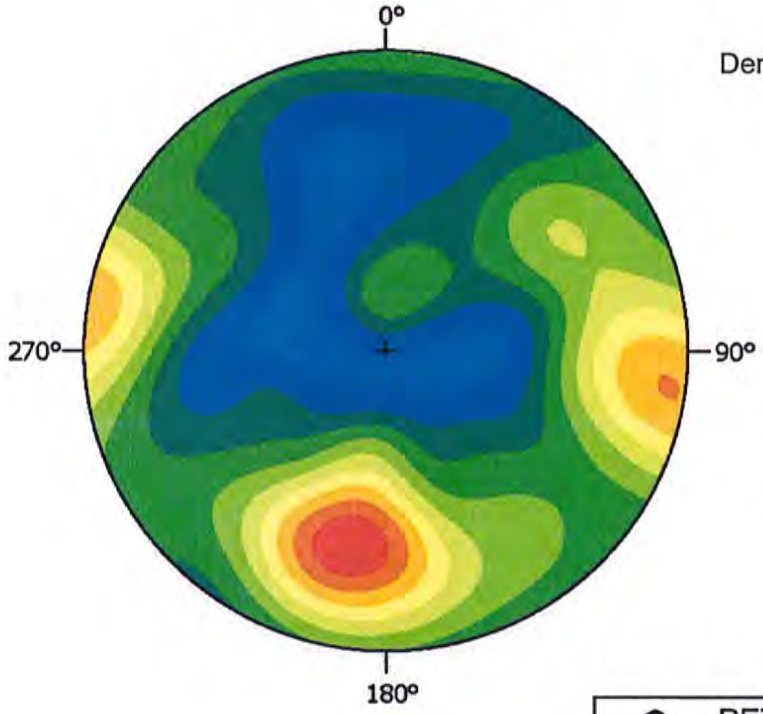
KINEMATIC ANALYSIS



Plot of great circles of joints

N total = 118
n=118 (planar)

Equal angle projection, lower hemisphere



Density contours of joint poles

N = 118
Maximum density = 14.3
Minimum density = 1.55
Mean density = 5.62
Density calculation: Cosine sums
Cosine exponent = 20
Contour intervals = 10
From minimum to maximum

Northern Pit
all structure

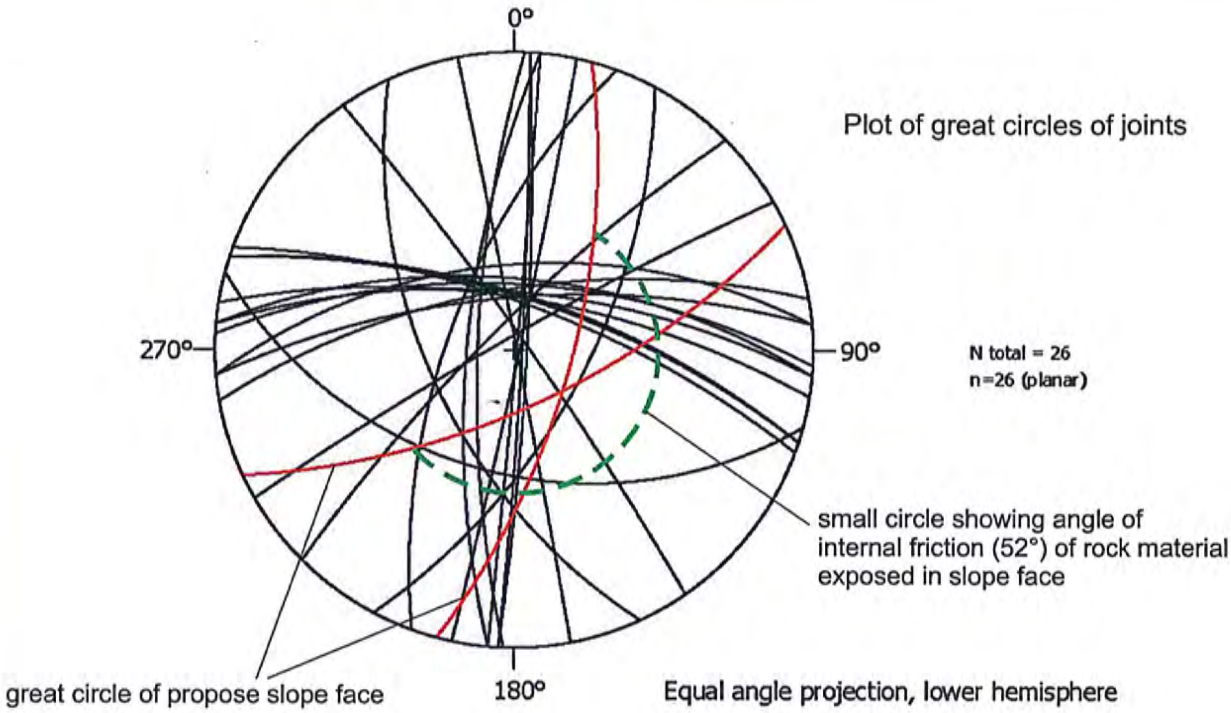
Analysis using *Stereo32*, Röller and Trepmann, 2010

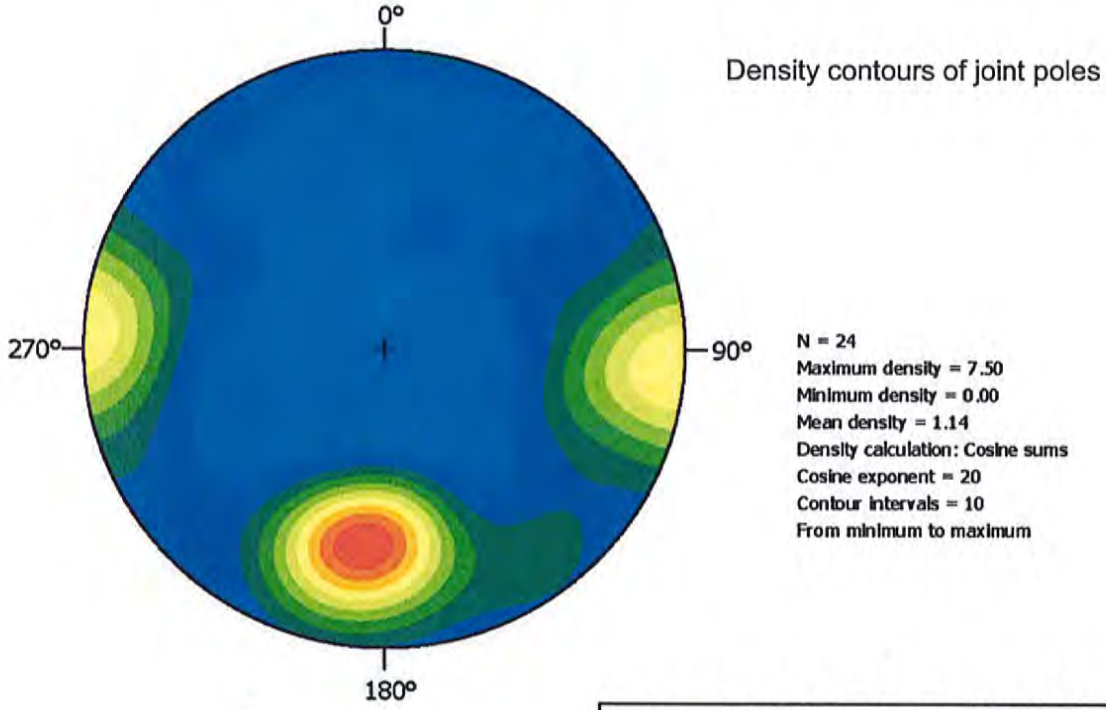
PETRA GEOTECHNICAL, INC.
40880 COUNTY CENTER DRIVE, SUITE R,
TEMECULA, CALIFORNIA 92591
PHONE: (951) 600-9271
COSTA MESA MURRIETA PALM DESERT SANTA CLARITA

KINEMATIC ANALYSIS

3M MOODY FLATS QUARRY
SHASTA COUNTY, CALIFORNIA

DATE: August 2012	J.N.: 293-11	**Figure C-1**
DWG BY: DCS	SCALE: na	





Northern Pit
northern portion

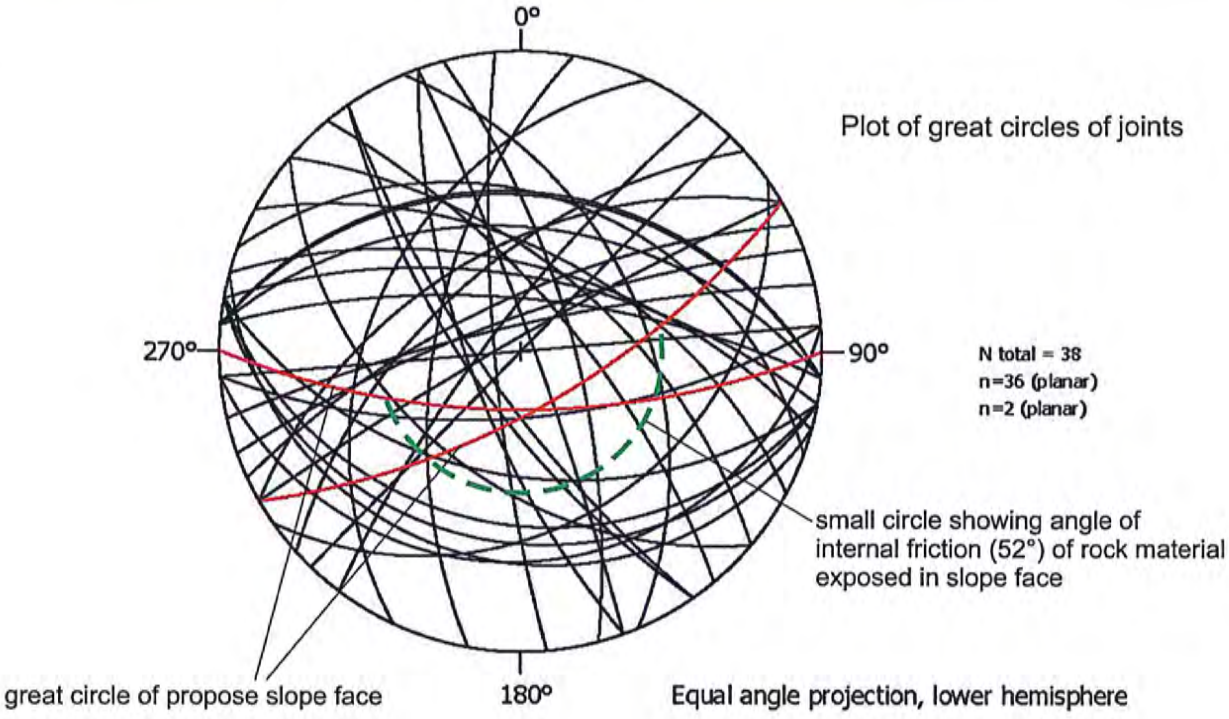
Analysis using *Stereo32*, Röller and Trepmann, 2010

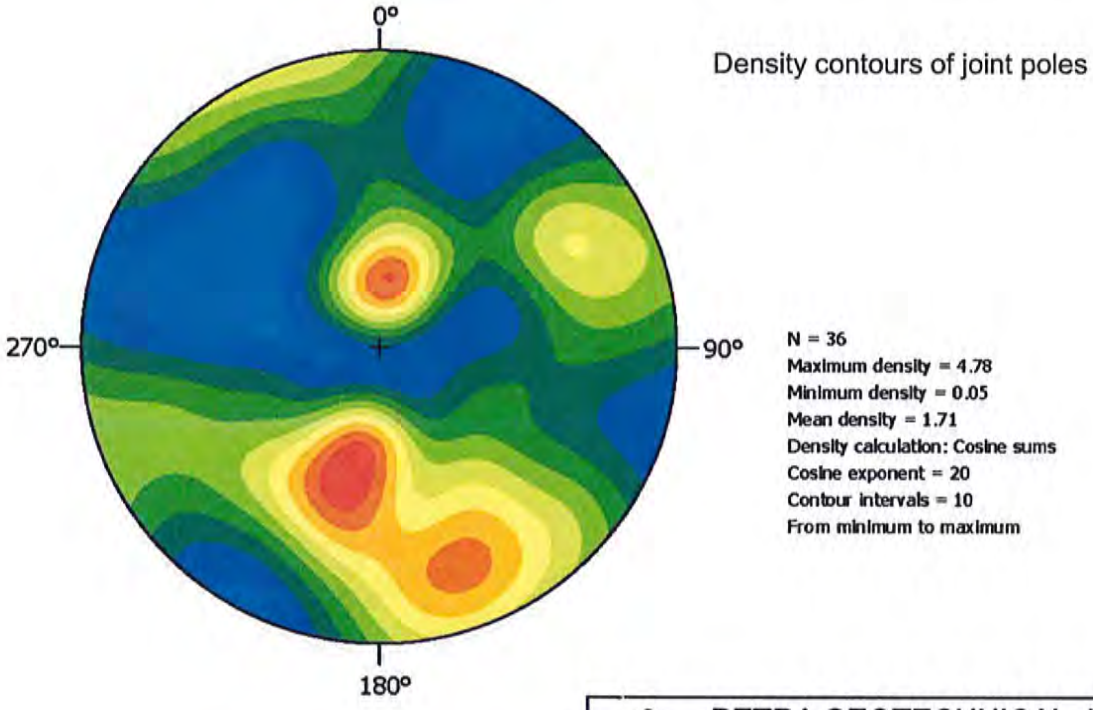
PETRA GEOTECHNICAL, INC.
40880 COUNTY CENTER DRIVE, SUITE R,
TEMECULA, CALIFORNIA 92591
PHONE: (951) 600-9271
COSTA MESA MURRIETA PALM DESERT SANTA CLARITA

KINEMATIC ANALYSIS

3M MOODY FLATS QUARRY
SHASTA COUNTY, CALIFORNIA

DATE: August 2012	J.N.: 293-11	**Figure C-2**
DWG BY: DCS	SCALE: na	





Northern Pit
northwestern portion

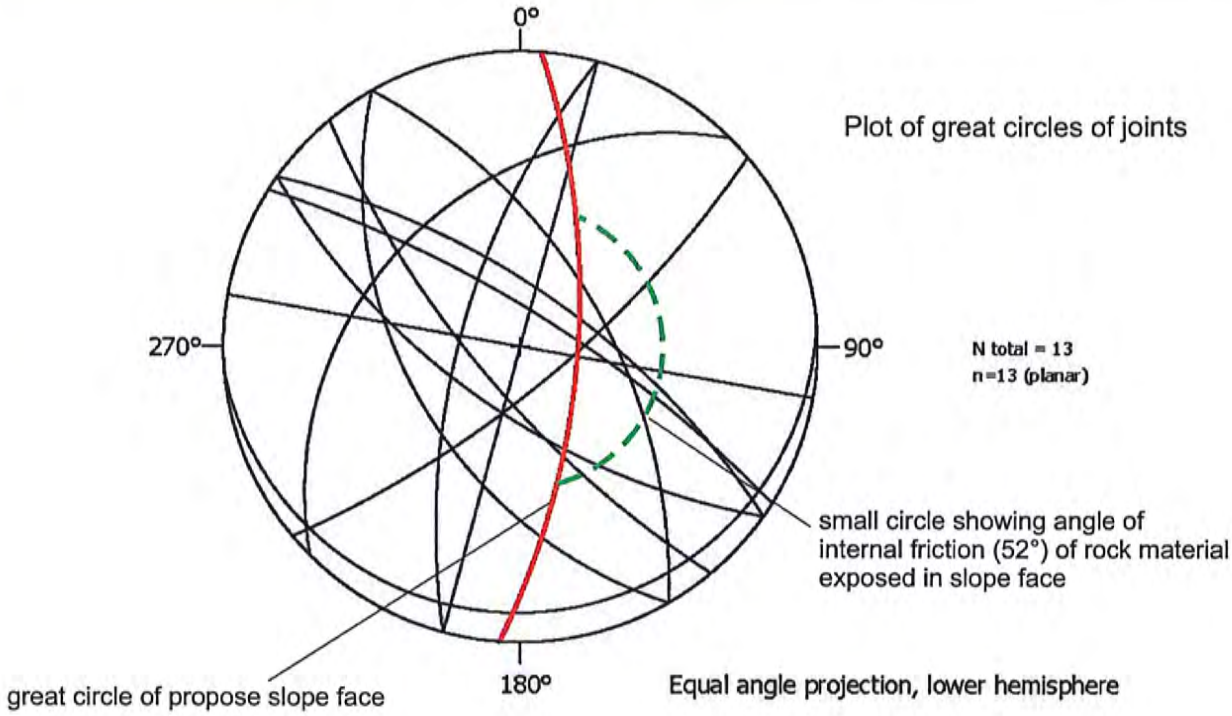
Analysis using *Stereo32*, Röller and Trepmann, 2010

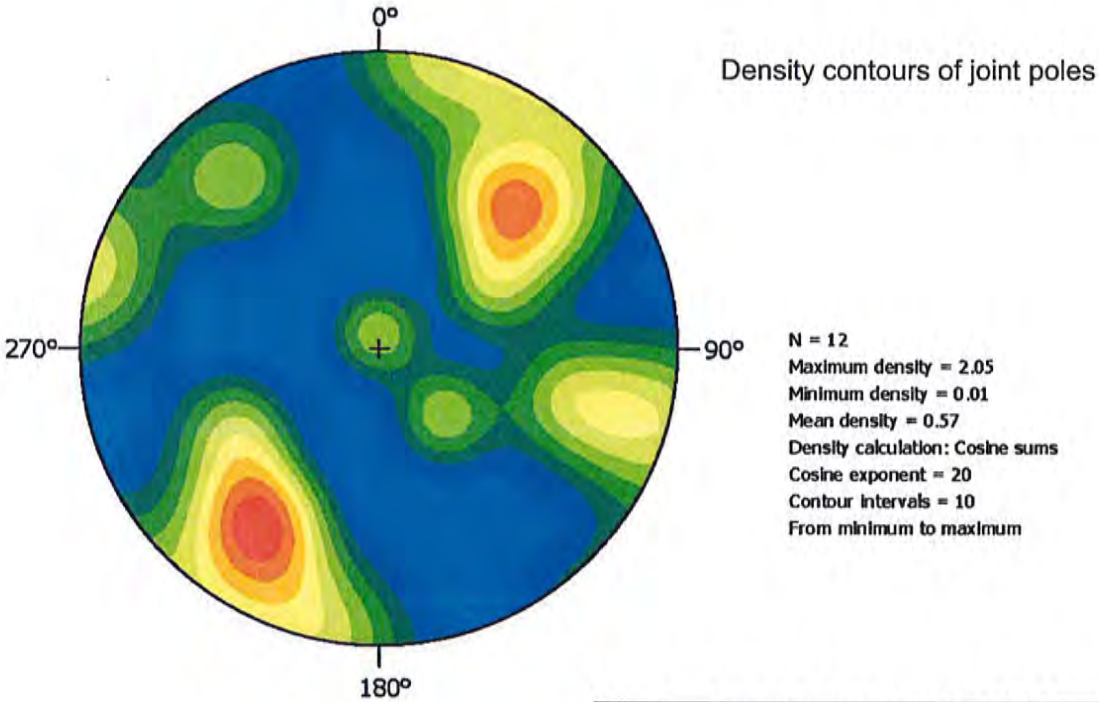
PETRA GEOTECHNICAL, INC.
40880 COUNTY CENTER DRIVE, SUITE R,
TEMECULA, CALIFORNIA 92591
PHONE: (951) 600-9271
COSTA MESA MURRIETA PALM DESERT SANTA CLARITA

KINEMATIC ANALYSIS

3M MOODY FLATS QUARRY
SHASTA COUNTY, CALIFORNIA

DATE: August 2012	J.N.: 293-11	**Figure C-3**
DWG BY: DCS	SCALE: na	





Northern Pit
western portion

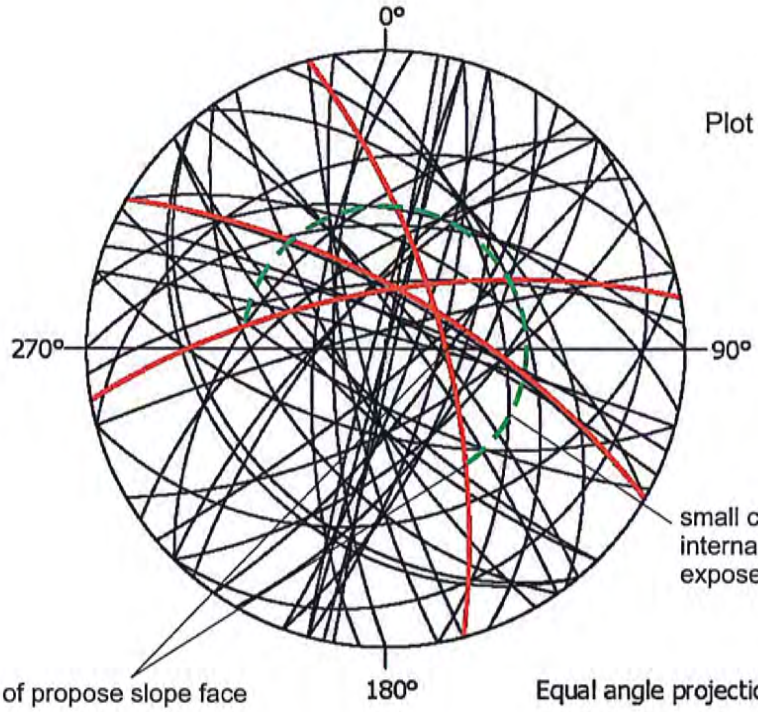
Analysis using *Stereo32*, Röller and Trepmann, 2010

PETRA GEOTECHNICAL, INC.
40880 COUNTY CENTER DRIVE, SUITE R,
TEMECULA, CALIFORNIA 92591
PHONE: (951) 600-9271
COSTA MESA MURRIETA PALM DESERT SANTA CLARITA

KINEMATIC ANALYSIS

3M MOODY FLATS QUARRY
SHASTA COUNTY, CALIFORNIA

DATE: August 2012	J.N.: 293-11	**Figure C-4**
DWG BY: DCS	SCALE: na	

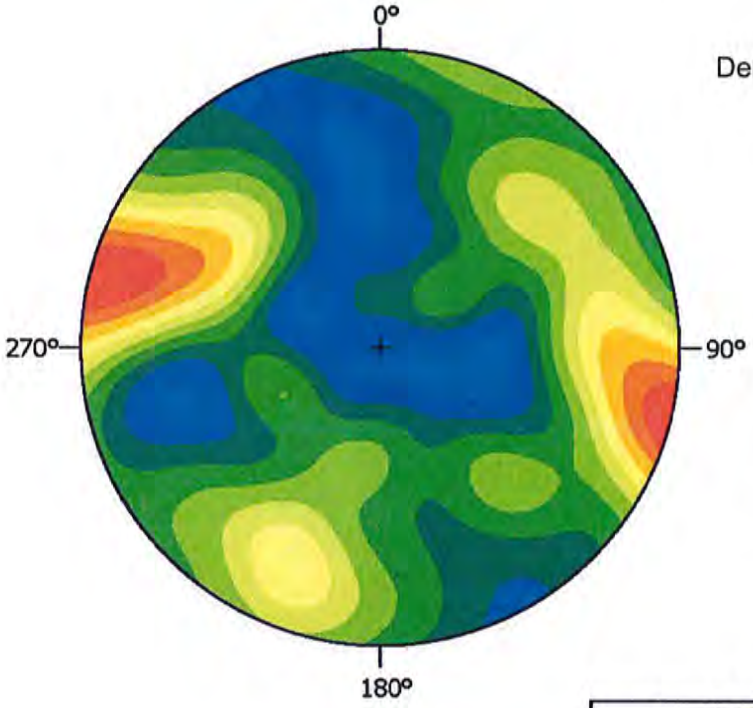


Plot of great circles of joints

N total = 49
n=46 (planar)
n=3 (planar)

small circle showing angle of internal friction (52°) of rock material exposed in slope face

Equal angle projection, lower hemisphere



Density contours of joint poles

N = 46
Maximum density = 5.43
Minimum density = 0.57
Mean density = 2.19
Density calculation: Cosine sums
Cosine exponent = 20
Contour intervals = 10
From minimum to maximum

Northern Pit
southwestern portion

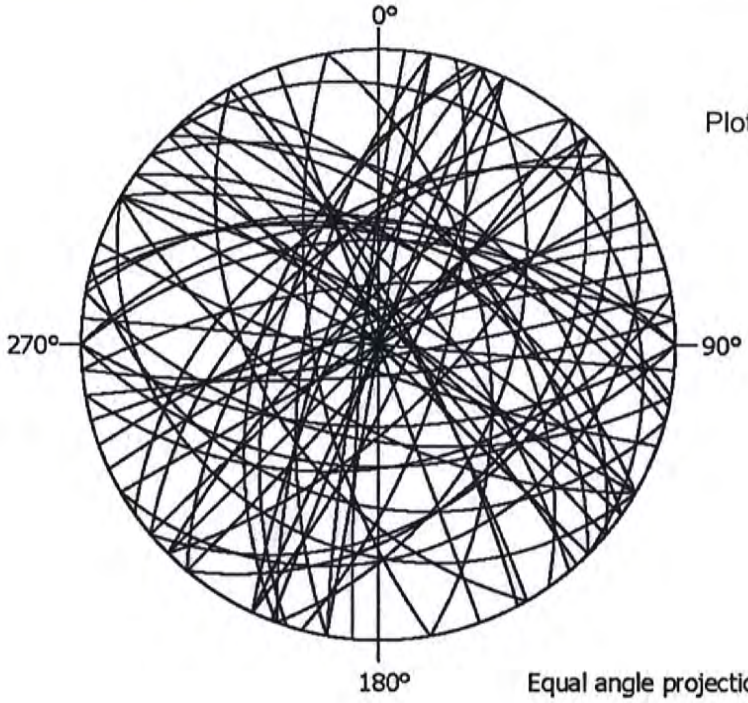
Analysis using *Stereo32*, Röller and Trepmann, 2010

PETRA GEOTECHNICAL, INC.
40880 COUNTY CENTER DRIVE, SUITE R,
TEMECULA, CALIFORNIA 92591
PHONE: (951) 600-9271
COSTA MESA MURRIETA PALM DESERT SANTA CLARITA

KINEMATIC ANALYSIS

3M MOODY FLATS QUARRY
SHASTA COUNTY, CALIFORNIA

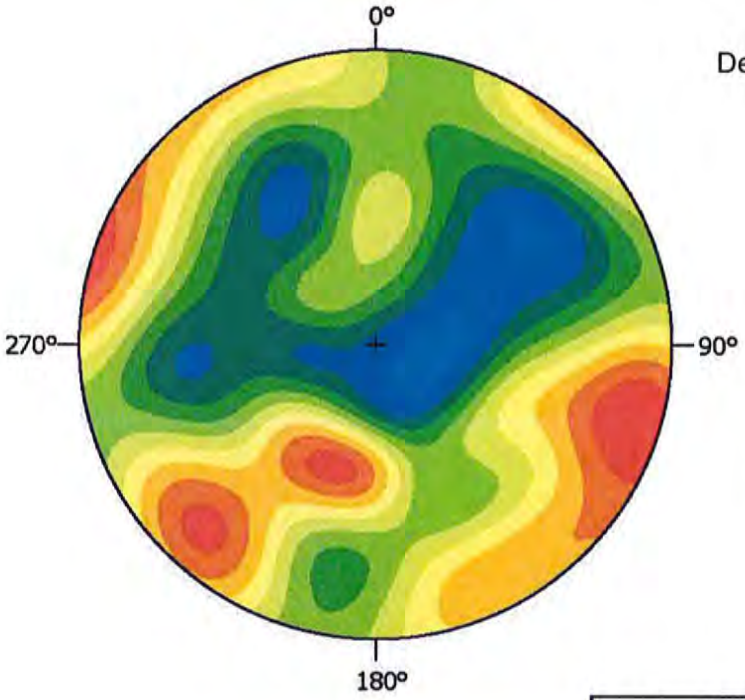
DATE: August 2012	J.N.: 293-11	**Figure C-5**
DWG BY: DCS	SCALE: na	



Plot of great circles of joints

N total = 65
n=65 (planar)

Equal angle projection, lower hemisphere



Density contours of joint poles

N = 65
Maximum density = 6.38
Minimum density = 0.52
Mean density = 3.10
Density calculation: Cosine sums
Cosine exponent = 20
Contour intervals = 10
From minimum to maximum

Southern Pit
all structure

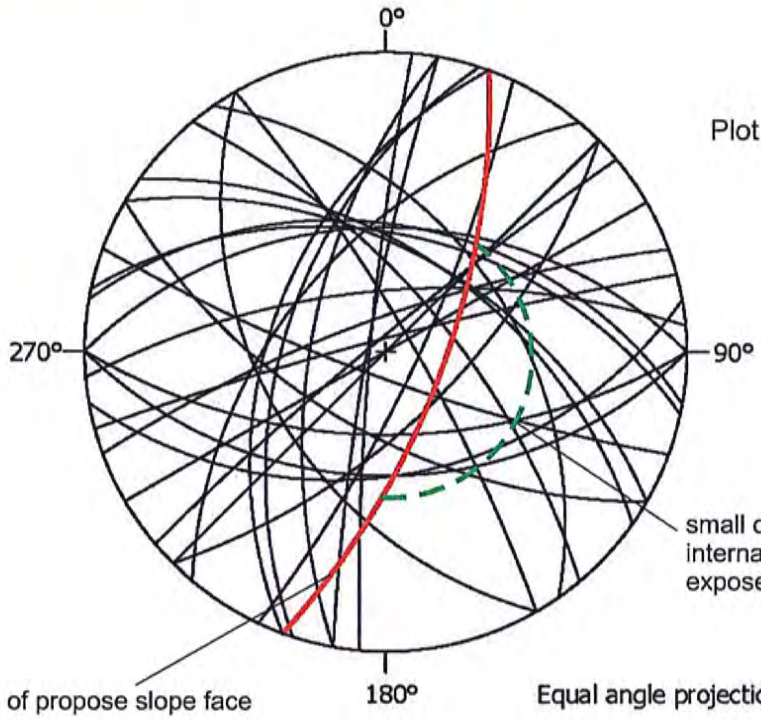
Analysis using *Stereo32*, Röller and Trepmann, 2010

PETRA GEOTECHNICAL, INC.
40880 COUNTY CENTER DRIVE, SUITE R,
TEMECULA, CALIFORNIA 92591
PHONE: (951) 600-9271
COSTA MESA MURRIETA PALM DESERT SANTA CLARITA

KINEMATIC ANALYSIS

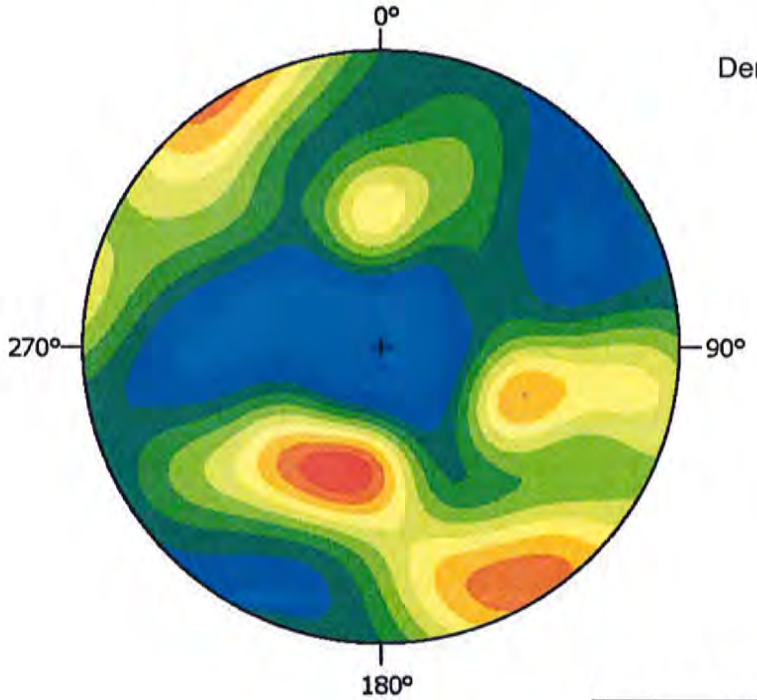
3M MOODY FLATS QUARRY
SHASTA COUNTY, CALIFORNIA

DATE: August 2012	J.N.: 293-11	**Figure C-6**
DWG BY: DCS	SCALE: na	



Plot of great circles of joints

Equal angle projection, lower hemisphere



Density contours of joint poles

N = 28
Maximum density = 3.84
Minimum density = 0.01
Mean density = 1.33
Density calculation: Cosine sums
Cosine exponent = 20
Contour intervals = 10
From minimum to maximum

Southern Pit
northwestern portion

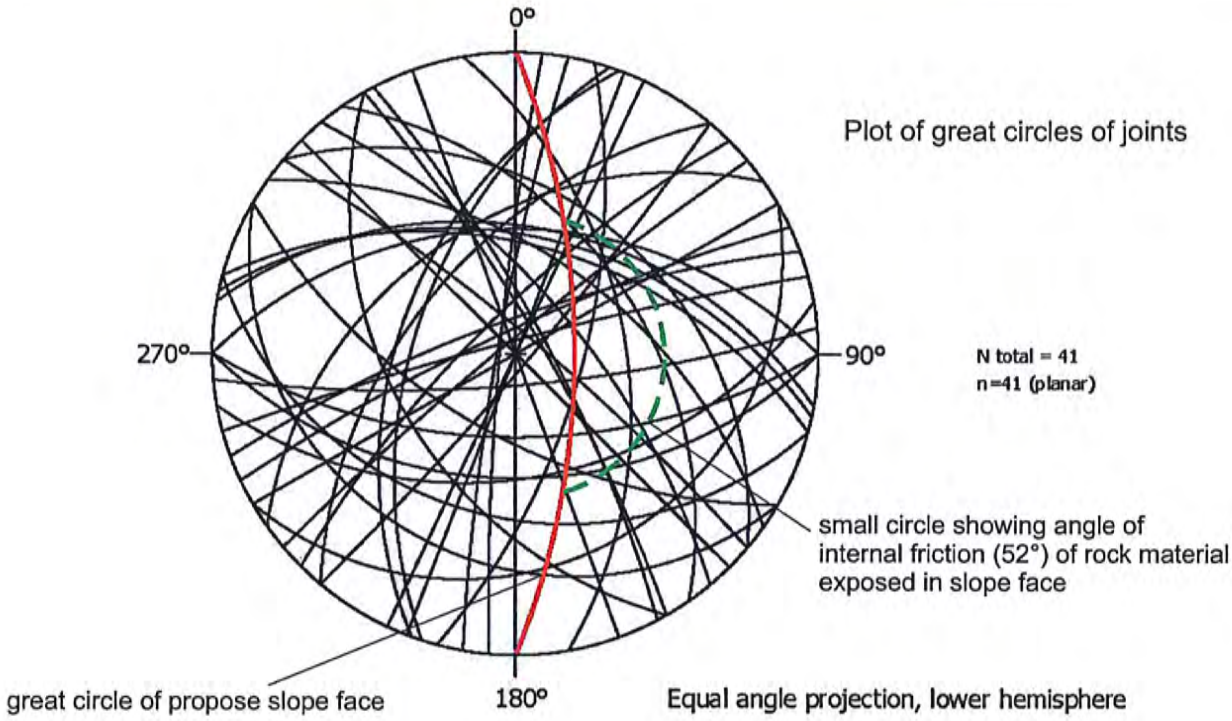
Analysis using *Stereo32*, Röller and Trepmann, 2010

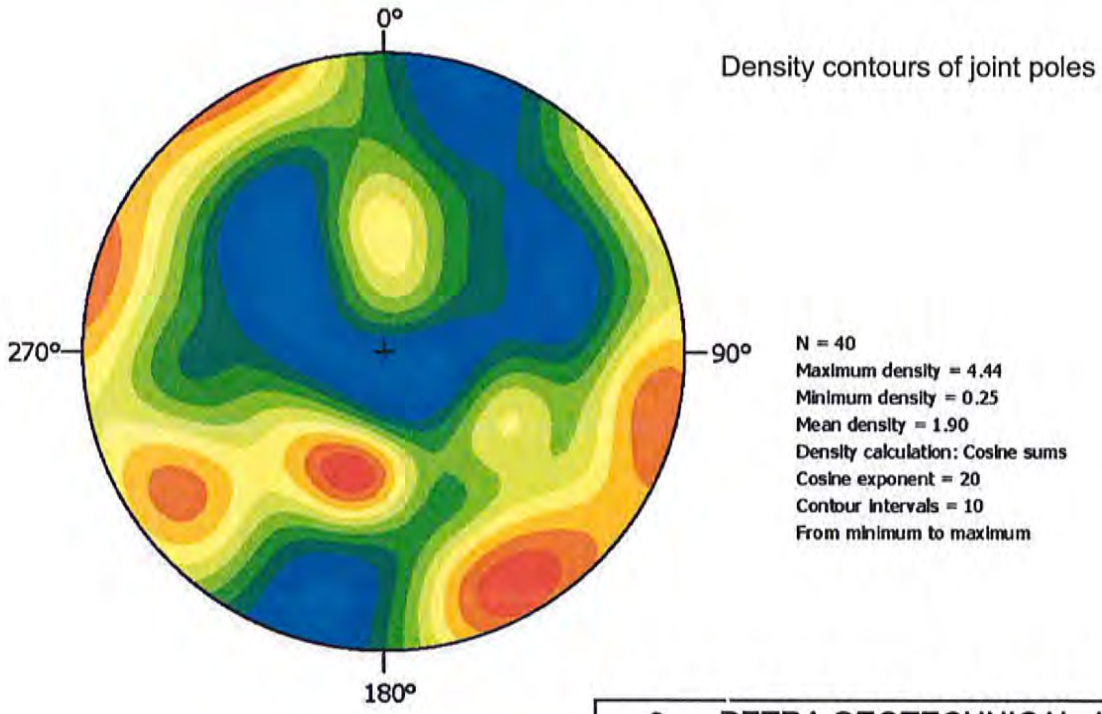
PETRA GEOTECHNICAL, INC.
40880 COUNTY CENTER DRIVE, SUITE R,
TEMECULA, CALIFORNIA 92591
PHONE: (951) 600-9271
COSTA MESA MURRIETA PALM DESERT SANTA CLARITA

KINEMATIC ANALYSIS

3M MOODY FLATS QUARRY
SHASTA COUNTY, CALIFORNIA

DATE: August 2012	J.N.: 293-11	**Figure C-7**
DWG BY: DCS	SCALE: na	





Southern Pit
western portion

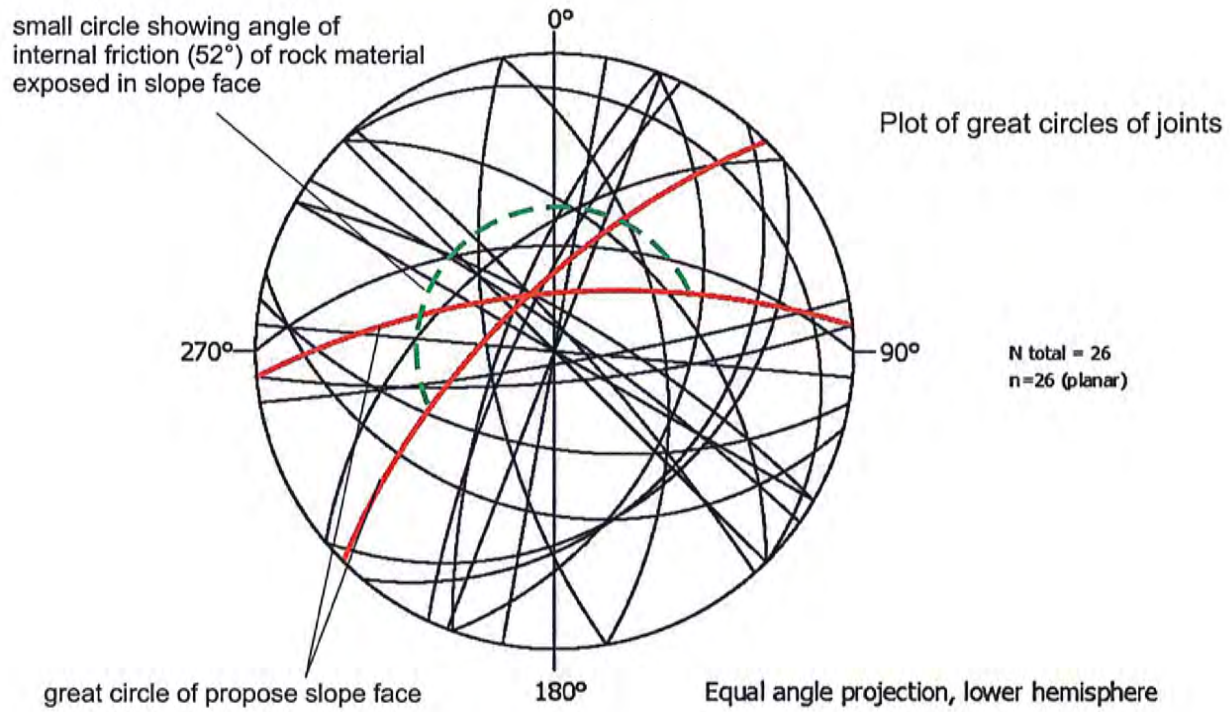
Analysis using *Stereo32*, Röller and Trepmann, 2010

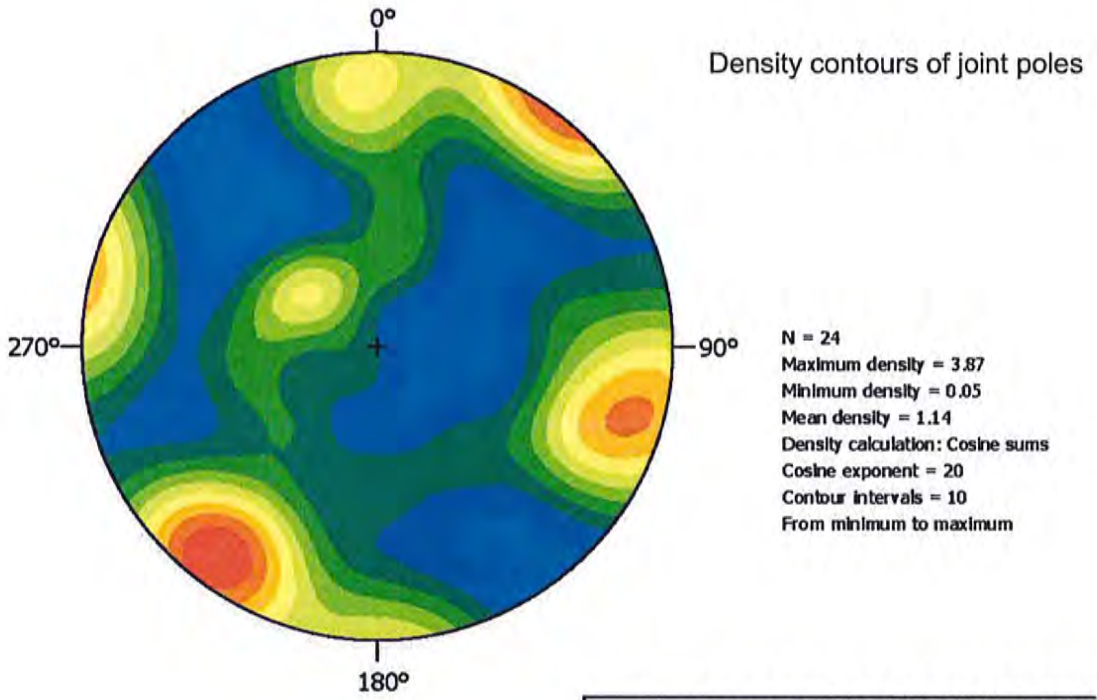
PETRA GEOTECHNICAL, INC.
40880 COUNTY CENTER DRIVE, SUITE R,
TEMECULA, CALIFORNIA 92591
PHONE: (951) 600-9271
COSTA MESA MURRIETA PALM DESERT SANTA CLARITA

KINEMATIC ANALYSIS

3M MOODY FLATS QUARRY
SHASTA COUNTY, CALIFORNIA

DATE: August 2012	J.N.: 293-11	**Figure C-8**
DWG BY: DCS	SCALE: na	





Southern Pit
southeastern portion

Analysis using *Stereo32*, Röller and Trepmann, 2010

PETRA GEOTECHNICAL, INC.
40880 COUNTY CENTER DRIVE, SUITE R,
TEMECULA, CALIFORNIA 92591
PHONE: (951) 600-9271
COSTA MESA MURRIETA PALM DESERT SANTA CLARITA

KINEMATIC ANALYSIS

3M MOODY FLATS QUARRY
SHASTA COUNTY, CALIFORNIA

DATE: August 2012	J.N.: 293-11	**Figure C-9**
DWG BY: DCS	SCALE: na	

DISCONTINUITY DATA

North Pit N

Azimuth of Dip Direction	Dip	Feature
330	85	Joint
275	72	Joint
350	67	Joint
272	76	Joint
9	70	Joint
355	58	Joint
245	58	Joint
118	63	Joint
315	80	Joint
79	89	Joint
5	63	Joint
3	65	Joint
18	70	Joint
18	69	Joint
95	89	Joint
20	72	Joint
93	87	Joint
355	70	Joint
5	68	Joint
93	85	Joint
195	45	Joint
102	88	Joint
55	85	Joint
290	65	Joint
105	68	Proposed Slope Face
155	68	Proposed Slope Face

North Pit NW

Azimuth of Dip Direction	Dip	Feature
330	85	Joint
5	35	Joint
175	20	Joint
50	70	Joint
10	62	Joint
295	37	Joint
280	58	Joint
175	65	Joint
67	45	Joint
347	80	Joint
340	77	Joint
250	70	Joint
190	30	Joint
330	52	Joint
5	34	Joint
40	58	Joint
175	90	Joint
195	20	Joint
20	35	Joint
235	75	Joint
134	90	Joint
190	25	Joint
307	78	Joint
5	70	Joint
15	58	Joint
75	70	Joint
220	45	Joint
28	53	Joint
190	45	Joint
70	85	Joint
265	80	Joint
235	70	Joint
5	45	Joint
335	70	Joint
318	58	Joint
145	30	Joint
150	68	Proposed Slope Face
180	68	Proposed Slope Face

DISCONTINUITY DATA

North Pit W

Azimuth of Dip Direction	Dip	Feature
140	74	Joint
10	90	Joint
175	6	Joint
240	48	Joint
315	35	Joint
105	90	Joint
230	73	Joint
35	68	Joint
32	76	Joint
215	65	Joint
285	67	Joint
60	58	Joint
94	68	Proposed Slope Face

North Pit SW

Azimuth of Dip Direction	Dip	Feature
230	30	Joint
315	70	Joint
50	75	Joint
12	40	Joint
105	70	Joint
100	90	Joint
20	77	Joint
105	90	Joint
125	70	Joint
315	45	Joint
110	80	Joint
55	80	Joint
345	83	Joint
135	55	Joint
325	57	Joint
195	58	Joint
165	30	Joint
355	65	Joint
270	70	Joint
70	40	Joint
310	70	Joint
25	78	Joint
102	87	Joint
53	35	Joint
208	70	Joint
120	58	Joint
235	47	Joint
0	45	Joint
255	80	Joint
225	73	Joint
285	85	Joint
80	47	Joint
230	27	Joint
150	62	Joint
240	73	Joint
275	63	Joint
140	80	Joint
135	12	Joint
260	74	Joint
30	70	Joint
225	67	Joint
30	52	Joint
345	25	Joint
15	85	Joint
110	62	Joint
0	90	Joint
30	68	Proposed Slope Face
75	68	Proposed Slope Face
350	68	Proposed Slope Face

DISCONTINUITY DATA

South Pit NW

Azimuth of Dip Direction	Dip	Feature
355	67	Joint
135	64	Joint
115	78	Joint
135	90	Joint
30	53	Joint
200	80	Joint
280	62	Joint
55	45	Joint
150	90	Joint
180	59	Joint
60	80	Joint
240	45	Joint
275	84	Joint
310	53	Joint
170	45	Joint
12	47	Joint
288	53	Joint
0	45	Joint
345	85	Joint
10	44	Joint
320	85	Joint
280	83	Joint
210	60	Joint
35	53	Joint
180	45	Joint
340	77	Joint
290	48	Joint
50	67	Joint
110	68	Proposed Slope Face

South Pit W

Azimuth of Dip Direction	Dip	Feature
55	45	Joint
150	90	Joint
180	59	Joint
60	80	Joint
240	45	Joint
275	84	Joint
310	53	Joint
170	45	Joint
12	47	Joint
288	53	Joint
0	45	Joint
345	85	Joint
10	44	Joint
320	85	Joint
280	83	Joint
210	60	Joint
35	53	Joint
180	45	Joint
340	77	Joint
290	48	Joint
50	67	Joint
325	43	Joint
115	90	Joint
40	35	Joint
62	78	Joint
335	81	Joint
210	21	Joint
70	90	Joint
105	65	Joint
40	82	Joint
130	85	Joint
315	75	Joint
150	20	Joint
15	50	Joint
45	90	Joint
111	90	Joint
195	33	Joint
175	78	Joint
90	90	Joint
80	50	Joint
90	68	Proposed Slope Face

DISCONTINUITY DATA

South Pit SE

Azimuth of Dip Direction	Dip	Feature
45	90	Joint
111	90	Joint
195	33	Joint
175	78	Joint
90	90	Joint
80	50	Joint
110	42	Joint
35	82	Joint
260	65	Joint
30	75	Joint
45	10	Joint
190	54	Joint
140	30	Joint
48	82	Joint
45	45	Joint
0	51	Joint
170	85	Joint
320	50	Joint
295	75	Joint
290	70	Joint
30	90	Joint
5	90	Joint
130	32	Joint
100	90	Joint
315	68	Proposed Slope Face
355	68	Proposed Slope Face

APPENDIX D

LABORATORY TESTING RESULTS

Compressive Strength of Rock Cores

Select specimens of the cores obtained by 3M from their initial investigation in 1980 were tested for unconfined compressive strength. A total of 27 test specimens were cut from Cores H-4, H-5, H-8, H-15, H-16 and H-29 and tested in general accordance with ASTM D2938-02. Test results are presented in the following table.

Unconfined Compressive Strength Test Results (ASTM D2938-02)

Core Specimen	Length (in)	Diameter (in)	Comp. Strength (psi)	Comp. Strength (MPa)
H-4 at 21 ft	3.6	1.853	12,980	89.5
H-4 at 24 ft	3.7	1.862	11,380	78.5
H-4 at 26 ft	3.5	1.863	17,440	120.3
H-4 at 31 ft	2.6	1.412	8,930	61.6
H-4 at 38 ft	2.5	1.413	14,660	101.1
H-4 at 45 ft	2.7	1.412	10,530	72.6
H-5 at 44 ft	2.7	1.416	13,340	92.0
H-8 at 95 ft	2.6	1.418	2,530*	17.4
H-15 at 26 ft	3.5	1.864	24,550	169.3
H-15 at 31 ft	3.5	1.869	14,210	98.0
H-15 at 35 ft	3.2	1.871	18,550	127.9
H-15 at 38 ft	3.4	1.869	9,400	64.8
H-15 at 44 ft	3.4	1.868	1,090*	7.5
H-15 at 48 ft	3.5	1.863	6,960	48.0
H-15 at 51 ft	3.7	1.865	3,110*	21.4
H-15 at 53 ft	3.5	1.866	3,660*	25.2
H-16 at 33 ft	3.5	1.867	11,680	80.6
H-16 at 36 ft	3.5	1.865	13,900	95.9
H-16 at 41 ft	3.4	1.865	10,980	75.7
H-16 at 48 ft	3.5	1.866	9,320	64.3
H-29 at 39 ft	2.6	1.418	18,040	124.4
H-29 at 40 ft	2.6	1.417	8,560	59.0
H-29 at 42 ft	2.6	1.416	9,520	65.7
H-29 at 47 ft	2.7	1.416	9,520	65.7
H-29 at 49 ft	2.6	1.419	14,860	102.5
H-29 at 56 ft	2.5	1.418	8,230	56.8
H-29 at 64 ft	2.6	1.424	9,420	65.0

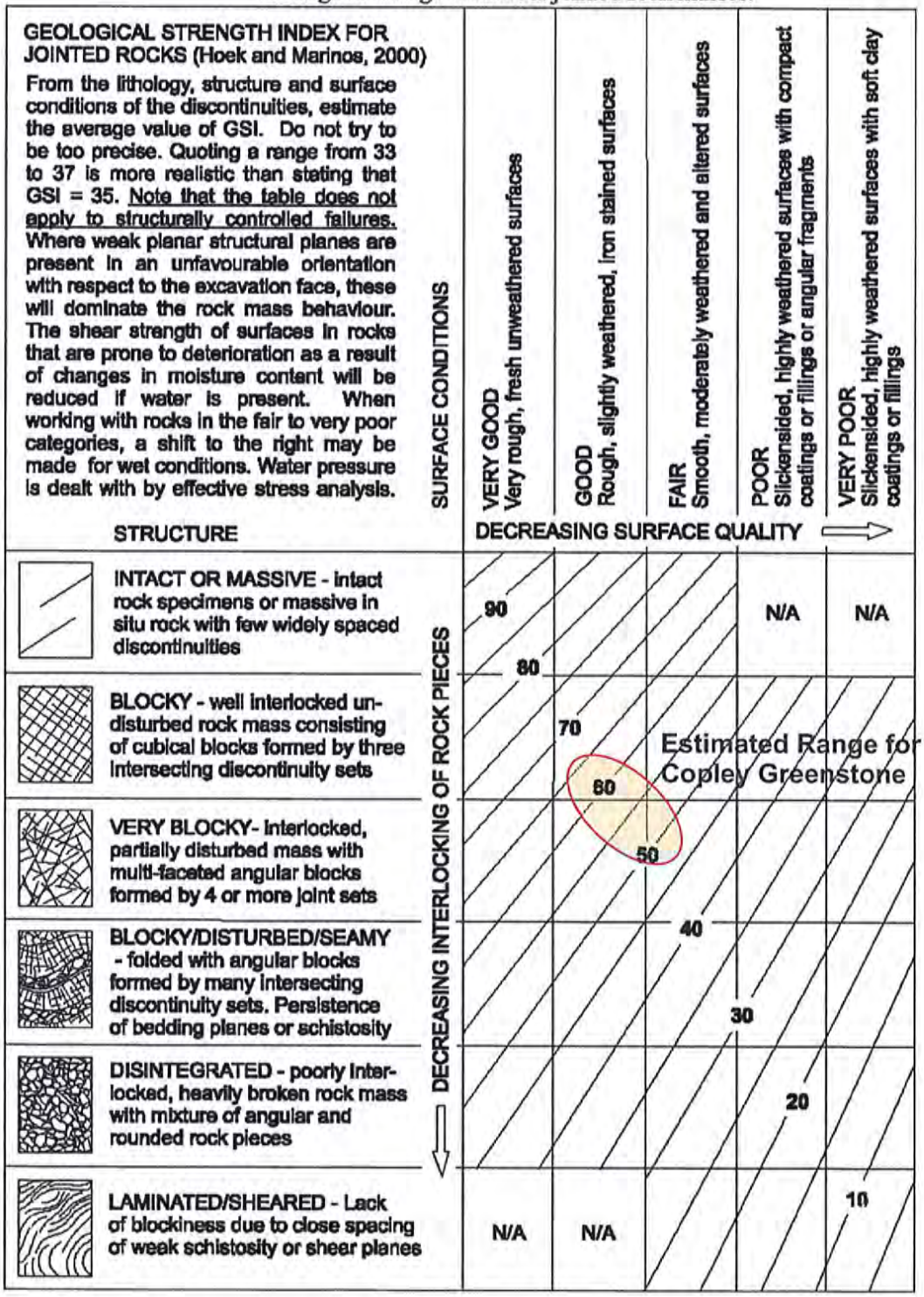
* Failure along weathered joints

APPENDIX E

GSI ANALYSIS

GSI Rock Mass Properties Estimation

Geological strength index for jointed rock masses.



Source: Marinos and Hoek, 2000

GSI Rock Mass Properties Estimation

Values of the constant m_i for intact rock, by rock group[4]. Note that values in parenthesis are estimates. The range of values quoted for each material depends upon the granularity and interlocking of the crystal structure – the higher values being associated with tightly interlocked and more frictional characteristics.

	Rock type	Class	Group	Texture: Coarse	Texture: Medium	Texture: Fine	Texture: Very fine
SEDIMENTARY		Clastic		Conglomerates * Breccias *	Sandstones 17 ± 4	Siltstones 7 ± 2 Greywackes (18 ± 3)	Claystones 4 ± 2 Shales (6 ± 2) Marls (7 ± 2)
		Non-Clastic	Carbonates	Crystalline Limestone (12 ± 3)	Sparitic Limestones (10 ± 2)	Micritic Limestones (9 ± 2)	Dolomites (9 ± 3)
			Evaporites		Gypsum 8 ± 2	Anhydrite 12 ± 2	
			Organic				Chalk 7 ± 2
METAMORPHIC		Non Foliated		Marble 9 ± 3	Hornfels (19 ± 4) Metasandstone (19 ± 3)	Quartzites 20 ± 3	
		Slightly foliated		Migmatite (29 ± 3)	Amphibolites 26 ± 6	Gneiss 28 ± 5	
		Foliated**			Schists 12 ± 3	Phyllites (7 ± 3)	Slates 7 ± 4
IGNEOUS		Plutonic	Light	Granite 32 ± 3	Diorite 25 ± 5 Granodiorite (29 ± 3)		
			Dark	Gabbro 27 ± 3 Norite 20 ± 5	Dolerite (16 ± 5)		
		Hypabyssal		Porphyries (20 ± 5)		Diabase (15 ± 5)	Peridotite (25 ± 5)
		Volcanic	Lava		Rhyolite (25 ± 5) Andesite 25 ± 5	Dacite (25 ± 3) Basalt (25 ± 5)	
			Pyroclastic	Agglomerate (19 ± 3)	Breccia (19 ± 5)	Tuff (13 ± 5)	

* Conglomerates and breccias may present a wide range of m_i values depending on the nature of the cementing material and the degree of cementation, so they may range from values similar to sandstone, to values used for fine grained sediments (even under 10).

** These values are for intact rock specimens tested normal to bedding or foliation. The value of mi will be significantly different if failure occurs along a weakness plane.

[4] Note that this table contains several changes from previously published versions, These changes have been made to reflect data that has been accumulated from laboratory tests and the experience gained from discussions with geologists and engineering geologists.

Source: Marinos and Hoek, 2000

GSI Rock Mass Properties Calculations for Copley Greenstone

293-11

Input:

sigci =	10	Mpa	mi =	15	GSI =	50
Depth of failure surface or tunnel below slope =	10	m	Unit wt. =	0.0259	MN/m3	

Output:

stress =	0.26	Mpa	mb =	2.52	s =	0.0039
a =	0.5		sigtm =	-0.0154 Mpa	A =	0.6716
B =	0.7255		k =	8.39	phi =	52 degrees
coh =	0.145	Mpa	sigcm =	0.84 Mpa	E =	3162.28 Mpa
	3,000	psf				

Calculation:

									Sums
sig3	1E-10	0.04	0.07	0.11	0.15	0.19	0.22	0.26	1.03
sig1	0.62	1.20	1.56	1.89	2.18	2.43	2.66	2.89	15.42
ds1ds3	21.23	11.85	9.46	8.06	7.20	6.60	6.15	5.79	76.34
sign	0.03	0.13	0.21	0.31	0.40	0.48	0.56	0.65	2.76
tau	0.13	0.31	0.44	0.56	0.66	0.76	0.85	0.93	4.63
x	-2.36	-1.84	-1.64	-1.49	-1.39	-1.30	-1.24	-1.18	-12.44
y	-1.89	-1.51	-1.36	-1.25	-1.18	-1.12	-1.07	-1.03	-10.41
xy	4.47	2.78	2.23	1.87	1.63	1.46	1.33	1.22	16.98
xsq	5.58	3.39	2.68	2.22	1.92	1.70	1.53	1.39	20.44
sig3sig1	0.00	0.05	0.11	0.21	0.32	0.45	0.59	0.75	2
sig3sq	1E-20	0.00	0.01	0.01	0.02	0.03	0.05	0.07	0
taucalc	0.13	0.31	0.44	0.56	0.66	0.76	0.85	0.94	
sig1sig3fit	0.84	1.16	1.45	1.77	2.08	2.40	2.70	3.02	
signtaufit	0.18	0.31	0.42	0.54	0.65	0.76	0.86	0.97	

Cell Formulas

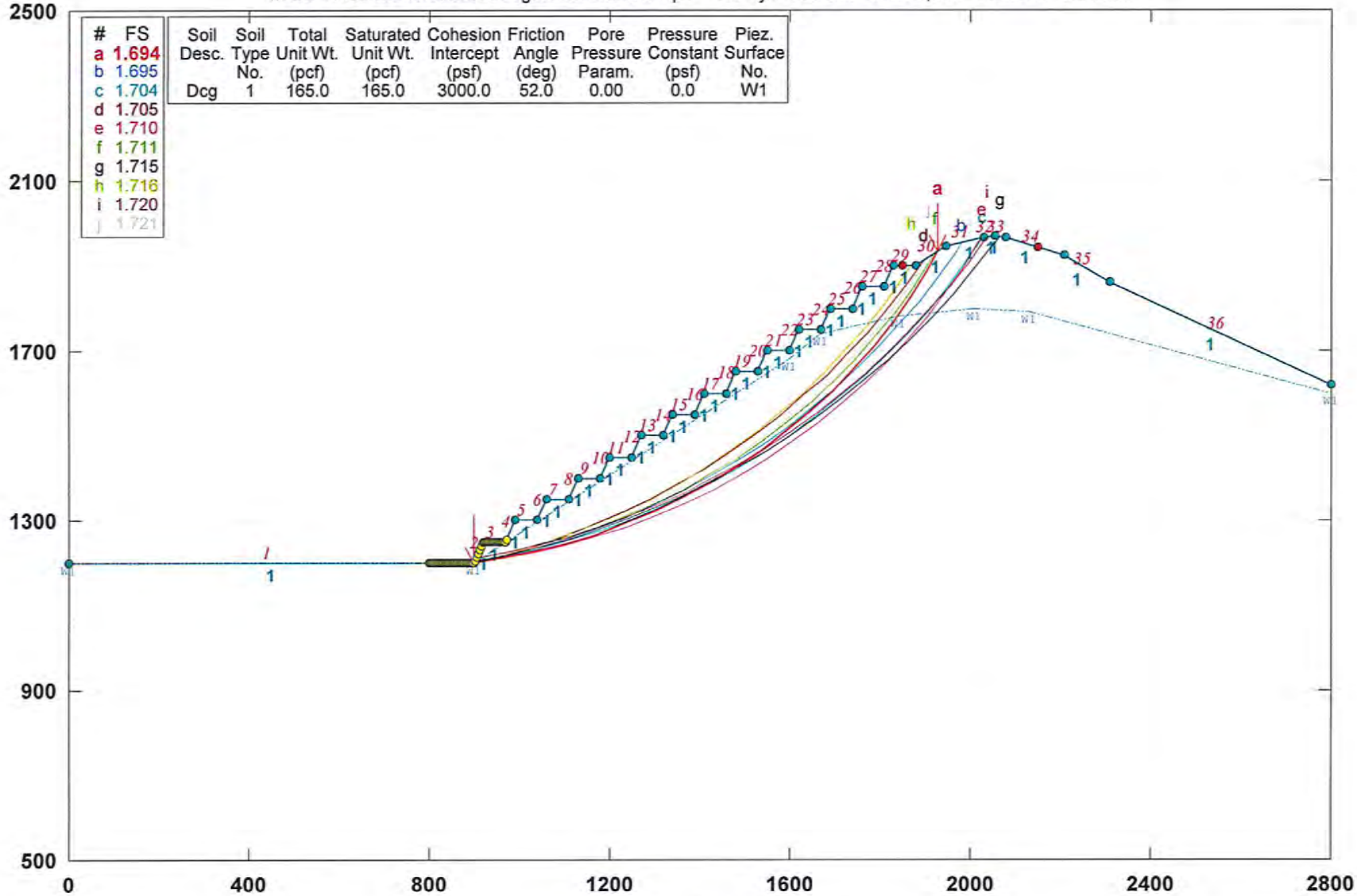
```
stress = IF(depth>90, sigci*0.25,depth*unitwt)
    mb = mi*EXP((GSI-100)/28)
     s = IF(GSI>25,EXP((GSI-100)/9),0)
     a = IF(GSI>25,0.5,0.65-GSI/200)
 sigtm = 0.5*sigci*(mb-SQRT(mb^2+4s))
  sig3 = Start at 1E-10 (to avoid zero errors) and increment in 7 steps to stress
  sig1 = sig3+sigci(((mb*sig3)/sigci)+s)^a
 ds1ds3 = IF(GSI>25,(1+(mb*sigci)/(2*(sig1-sig3))),1+(a*mb^a)*(sig3/sigci)^(a-1))
  sign = sig3+(sig1-sig3)/(1+ds1ds3)
   tau = (sign-sig3)*SQRT(ds1ds3)
     x = LOG((sign-sigtm)/sigci)
     y = LOG(tau/sigci)
    xy = x*y
   xsq = x^2
     A = acalc =      10^(sumy/8-bcalc*sumx/8)
     B = bcalc =      (sumxy-(sumx*sumy)/8)/(sumxsq-(sumx^2)/8)
     k = (sumsig3sig1-(sumsig3*sumsig1)/8)/(sumsig3sq-(sumsig3^2)/8)
   phi = ASIN((k-1)/(k+1))*180/PI()
   coh = sigmc/(2*SQRT(k))
 sigcm = sumsig1/8-k*sumsig3/8
     E = IF(sigci>100,1000*10^((GSI-10)/40),SQRT(sigci/100)*1000*10^((GSI-10)/40))
  phit = (ATAN(acalc*bcalc*((signt-sigtm)/sigci)^bcalc-1)))*180/PI()
  coht = acalc*sigci*((signt-sigtm)/sigci^(bcalc-signt*TAN(phit*PI()/180)
sig3sig1 = sig3*sig1
 sig3sq = sig3^2
taucalc = acalc*sigci*((sign-sigtm)/sigci)^bcalc
 s3sifit = sigcm+k*sig3
signtaufit = coh+sign*TAN(phi*PI()/180)
```

APPENDIX F

SLOPE STABILITY ANALYSIS

3M Moody Flats - Section A-A' Spencer Method With GW - Static

f:\293-11 revised calculations august 2012\aa\a-a-1.pl2 Run By: Petra Geotechnical, Inc. 8/6/2012 03:12PM



GSTABL7 v.2 FSmin=1.694

Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2)

GSTABL7

```
                    *** GSTABL7 ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
              (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                    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,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************
Analysis Run Date:        8/6/2012
Time of Run:              03:12PM
Run By:                   Petra Geotechnical, Inc.
Input Data Filename:      f:\293-11 Revised Calculations August 2012\AA\a-a-1.
Output Filename:          f:\293-11 Revised Calculations August 2012\AA\a-a-1.OUT
Unit System:              English
Plotted Output Filename:  f:\293-11 Revised Calculations August 2012\AA\a-a-1.PLT
PROBLEM DESCRIPTION:  3M Moody Flats - Section A-A'
                      Spencer Method With GW  - Static
BOUNDARY COORDINATES
   36 Top   Boundaries
   36 Total Boundaries
```

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	1200.00	900.00	1200.00	1
2	900.00	1200.00	920.00	1250.00	1
3	920.00	1250.00	970.00	1250.00	1
4	970.00	1250.00	990.00	1300.00	1
5	990.00	1300.00	1040.00	1300.00	1
6	1040.00	1300.00	1060.00	1350.00	1
7	1060.00	1350.00	1110.00	1350.00	1
8	1110.00	1350.00	1130.00	1400.00	1
9	1130.00	1400.00	1180.00	1400.00	1
10	1180.00	1400.00	1200.00	1450.00	1
11	1200.00	1450.00	1250.00	1450.00	1
12	1250.00	1450.00	1270.00	1500.00	1
13	1270.00	1500.00	1320.00	1500.00	1
14	1320.00	1500.00	1340.00	1550.00	1
15	1340.00	1550.00	1390.00	1550.00	1
16	1390.00	1550.00	1410.00	1600.00	1
17	1410.00	1600.00	1460.00	1600.00	1
18	1460.00	1600.00	1480.00	1650.00	1
19	1480.00	1650.00	1530.00	1650.00	1
20	1530.00	1650.00	1550.00	1700.00	1
21	1550.00	1700.00	1600.00	1700.00	1
22	1600.00	1700.00	1620.00	1750.00	1
23	1620.00	1750.00	1670.00	1750.00	1
24	1670.00	1750.00	1690.00	1800.00	1
25	1690.00	1800.00	1740.00	1800.00	1
26	1740.00	1800.00	1760.00	1850.00	1
27	1760.00	1850.00	1810.00	1850.00	1
28	1810.00	1850.00	1830.00	1900.00	1
29	1830.00	1900.00	1880.00	1900.00	1
30	1880.00	1900.00	1945.00	1945.00	1
31	1945.00	1945.00	2030.00	1965.00	1
32	2030.00	1965.00	2055.00	1970.00	1
33	2055.00	1970.00	2080.00	1965.00	1
34	2080.00	1965.00	2210.00	1925.00	1
35	2210.00	1925.00	2310.00	1860.00	1
36	2310.00	1860.00	2800.00	1620.00	1

```
User Specified Y-Origin =        500.00(ft)
User Specified X-Plus Value = *******(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
```

1 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	165.0	165.0	3000.0	52.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.00 (pcf)
Piezometric Surface No. 1 Specified by 8 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	1200.00
2	900.00	1200.00
3	1600.00	1680.00
4	1670.00	1740.00
5	1840.00	1780.00
6	2010.00	1800.00
7	2130.00	1790.00
8	2800.00	1600.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
5000 Trial Surfaces Have Been Generated.
10 Surface(s) Initiate(s) From Each Of 500 Points Equally Spaced
Along The Ground Surface Between X = 800.00(ft)
and X = 975.00(ft)
Each Surface Terminates Between X =1850.00(ft)
and X =2150.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
70.00(ft) Line Segments Define Each Trial Failure Surface.
Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
18.00	2.927	2.834	0.325
27.00	2.890	2.835	0.510
44.60	3.426	2.835	0.986
24.59	2.903	2.834	0.458
14.39	2.935	2.834	0.257
57.29	3.063	2.836	1.557
0.00	2.954	2.834	0.000
0.00	2.954	2.834	0.000
0.00	2.950	2.833	0.000
0.00	2.950	2.833	0.000
0.00	2.950	2.833	0.000
0.00	2.950	2.833	0.000
0.00	2.950	2.833	0.000
0.00	2.950	2.833	0.000
0.00	2.950	2.833	0.000
0.00	2.950	2.833	0.000
0.00	2.950	2.833	0.000
0.00	2.950	2.833	0.000
0.00	2.950	2.833	0.000

The Trial Failure Surface In Question Is Defined
By The Following 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	901.71	1204.26
2	960.35	1242.49
3	1018.91	1280.83
4	1077.40	1319.30
5	1135.81	1357.88
6	1194.13	1396.58
7	1252.39	1435.39
8	1310.56	1474.33

9	1368.65	1513.38
10	1426.67	1552.55
11	1484.60	1591.84
12	1542.46	1631.25
13	1600.23	1670.77
14	1657.93	1710.41
15	1715.54	1750.16
16	1773.07	1790.04
17	1830.53	1830.03
18	1887.90	1870.13
19	1945.19	1910.35
20	2002.40	1950.69
21	2018.93	1962.39

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
18.00	2.988	2.906	0.325
27.00	2.954	2.906	0.510
44.31	3.455	2.906	0.976
24.76	2.966	2.906	0.461
15.04	2.994	2.905	0.269
55.65	3.116	2.907	1.463
0.00	3.013	2.905	0.000
0.00	3.013	2.905	0.000
39.67	2.097	2.906	0.829
6.20	3.007	2.905	0.109
0.00	3.013	2.905	0.000
89.94	3.027	2.912	*****
0.00	3.013	2.905	0.000
0.00	3.013	2.905	0.000
0.00	3.013	2.902	0.000
0.00	3.013	2.902	0.000
0.00	3.013	2.902	0.000
0.00	3.013	2.902	0.000
0.00	3.013	2.902	0.000
0.00	3.013	2.902	0.000

The Trial Failure Surface In Question Is Defined
By The Following 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	970.44	1251.11
2	1028.84	1289.71
3	1087.18	1328.39
4	1145.47	1367.15
5	1203.71	1405.98
6	1261.90	1444.90
7	1320.03	1483.89
8	1378.12	1522.96
9	1436.15	1562.10
10	1494.13	1601.32
11	1552.06	1640.62
12	1609.93	1680.00
13	1667.75	1719.46
14	1725.52	1758.99
15	1783.24	1798.60
16	1840.90	1838.28
17	1898.51	1878.05
18	1956.07	1917.88
19	2013.57	1957.80
20	2020.80	1962.84

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda

18.00	2.585	2.504	0.325
27.00	2.544	2.504	0.510
38.38	2.648	2.505	0.792
21.17	2.575	2.504	0.387
0.00	2.613	2.503	0.000
80.05	2.675	2.512	5.698
0.00	2.613	2.503	0.000
0.00	2.613	2.503	0.000
41.53	3.661	2.505	0.886
0.00	2.613	2.503	0.000
0.00	2.613	2.503	0.000
41.27	4.052	2.505	0.878
0.00	2.613	2.503	0.000
0.00	2.613	2.503	0.000
0.00	2.609	2.503	0.000
0.00	2.609	2.503	0.000
0.00	2.609	2.503	0.000
0.00	2.609	2.503	0.000
0.00	2.609	2.503	0.000
0.00	2.609	2.503	0.000

The Trial Failure Surface In Question Is Defined
By The Following 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	973.95	1259.88
2	1034.01	1295.83
3	1093.98	1331.94
4	1153.86	1368.20
5	1213.64	1404.61
6	1273.34	1441.17
7	1332.94	1477.88
8	1392.44	1514.75
9	1451.86	1551.76
10	1511.18	1588.92
11	1570.40	1626.24
12	1629.53	1663.70
13	1688.57	1701.31
14	1747.51	1739.08
15	1806.35	1776.99
16	1865.10	1815.05
17	1923.75	1853.26
18	1982.31	1891.62
19	2040.77	1930.12
20	2089.16	1962.18

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2) * *
Selected ki function = Bi-linear
Selected Lambda Coefficient = 1.00
Forces from Reinforcement, Piers/Piles, Soil Nails, and Applied Forces
(if applicable) have been applied to the slice base(s)
on which they intersect.
Specified Tension Crack Water Force Factor = 0.000
Total Number of Trial Surfaces Attempted = 5000
WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 20 Iterations.
Number of Trial Surfaces with Non-Converged FS = 3
Number of Trial Surfaces With Valid FS = 4997
Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Attempted = 0.1 %
Statistical Data On All Valid FS Values:
FS Max = 2.845 FS Min = 1.694 FS Ave = 2.237
Standard Deviation = 0.233 Coefficient of Variation = 10.40 %
((Modified Bishop FS for Critical Surface = 1.681))
Failure Surface Specified By 20 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	900.302	1200.756
2	969.350	1212.263
3	1037.720	1227.281
4	1105.234	1245.771
5	1171.716	1267.684
6	1236.992	1292.963
7	1300.892	1321.542
8	1363.249	1353.348
9	1423.901	1388.295
10	1482.689	1426.295
11	1539.460	1467.246
12	1594.066	1511.044
13	1646.364	1557.572
14	1696.218	1606.710
15	1743.498	1658.330
16	1788.080	1712.297
17	1829.849	1768.470
18	1868.694	1826.703
19	1904.515	1886.843
20	1929.619	1934.352

Circle Center At X = 710.130 ; Y = 2556.511 ; and Radius = 1369.027

*** FOS = 1.694 Theta (ki=1.0) = 30.47 ***

Lambda = 0.588

Individual data on the 49 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	1.1	215.2	0.0	0.0	0.	0.	0.0	0.0	0.0
2	18.6	74473.7	0.0	4761.6	0.	0.	0.0	0.0	0.0
3	49.4	340766.5	0.0	58588.7	0.	0.	0.0	0.0	0.0
4	0.6	4038.2	0.0	1228.1	0.	0.	0.0	0.0	0.0
5	20.0	199311.2	0.0	42933.3	0.	0.	0.0	0.0	0.0
6	47.7	613842.9	0.0	*******	0.	0.	0.0	0.0	0.0
7	2.3	27236.8	0.0	8325.7	0.	0.	0.0	0.0	0.0
8	20.0	311374.2	0.0	77994.9	0.	0.	0.0	0.0	0.0
9	45.2	824158.2	0.0	*******	0.	0.	0.0	0.0	0.0
10	4.8	81345.0	0.0	25041.8	0.	0.	0.0	0.0	0.0
11	20.0	410395.6	0.0	*******	0.	0.	0.0	0.0	0.0
12	41.7	958069.0	0.0	*******	0.	0.	0.0	0.0	0.0
13	8.3	178669.1	0.0	55466.1	0.	0.	0.0	0.0	0.0
14	20.0	495777.1	0.0	*******	0.	0.	0.0	0.0	0.0
15	37.0	1002219.1	0.0	*******	0.	0.	0.0	0.0	0.0
16	13.0	330812.9	0.0	*******	0.	0.	0.0	0.0	0.0
17	20.0	566763.8	0.0	*******	0.	0.	0.0	0.0	0.0
18	30.9	944838.4	0.0	*******	0.	0.	0.0	0.0	0.0
19	19.1	547285.4	0.0	*******	0.	0.	0.0	0.0	0.0
20	20.0	622416.6	0.0	*******	0.	0.	0.0	0.0	0.0
21	23.2	777124.9	0.0	*******	0.	0.	0.0	0.0	0.0
22	26.8	833985.1	0.0	*******	0.	0.	0.0	0.0	0.0
23	20.0	661572.2	0.0	*******	0.	0.	0.0	0.0	0.0
24	13.9	494765.6	0.0	*******	0.	0.	0.0	0.0	0.0
25	36.1	1191492.4	0.0	*******	0.	0.	0.0	0.0	0.0
26	20.0	682793.9	0.0	*******	0.	0.	0.0	0.0	0.0
27	2.7	99648.0	0.0	28888.4	0.	0.	0.0	0.0	0.0
28	47.3	1613101.4	0.0	*******	0.	0.	0.0	0.0	0.0
29	9.5	309055.0	0.0	*******	0.	0.	0.0	0.0	0.0
30	10.5	374507.6	0.0	*******	0.	0.	0.0	0.0	0.0
31	44.1	1502376.2	0.0	*******	0.	0.	0.0	0.0	0.0
32	5.9	182419.5	0.0	67960.1	0.	0.	0.0	0.0	0.0
33	20.0	659275.3	0.0	*******	0.	0.	0.0	0.0	0.0
34	26.4	888102.6	0.0	*******	0.	0.	0.0	0.0	0.0
35	23.6	705019.0	0.0	*******	0.	0.	0.0	0.0	0.0
36	20.0	608108.0	0.0	*******	0.	0.	0.0	0.0	0.0
37	6.2	201465.9	0.0	74743.6	0.	0.	0.0	0.0	0.0
38	43.8	1223662.5	0.0	*******	0.	0.	0.0	0.0	0.0

39	3.5	85397.5	0.0	31413.1	0.	0.	0.0	0.0	0.0
40	16.5	438519.4	0.0	*******	0.	0.	0.0	0.0	0.0
41	28.1	716759.2	0.0	*******	0.	0.	0.0	0.0	0.0
42	21.9	444723.6	0.0	96089.2	0.	0.	0.0	0.0	0.0
43	19.8	391981.9	0.0	40473.6	0.	0.	0.0	0.0	0.0
44	0.2	3274.8	0.0	148.8	0.	0.	0.0	0.0	0.0
45	7.1	147226.6	0.0	3447.8	0.	0.	0.0	0.0	0.0
46	31.6	505912.3	0.0	0.0	0.	0.	0.0	0.0	0.0
47	11.3	119027.9	0.0	0.0	0.	0.	0.0	0.0	0.0
48	24.5	170791.8	0.0	0.0	0.	0.	0.0	0.0	0.0
49	25.1	62399.1	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	901.004	1202.510
2	969.380	1217.501
3	1037.055	1235.391
4	1103.907	1256.148
5	1169.814	1279.734
6	1234.656	1306.106
7	1298.315	1335.217
8	1360.677	1367.013
9	1421.628	1401.438
10	1481.056	1438.427
11	1538.855	1477.915
12	1594.920	1519.829
13	1649.147	1564.094
14	1701.440	1610.628
15	1751.703	1659.348
16	1799.845	1710.165
17	1845.778	1762.987
18	1889.419	1817.718
19	1930.689	1874.258
20	1969.513	1932.505
21	1982.438	1953.809

Circle Center At X = 583.464 ; Y = 2814.297 ; and Radius = 1642.769
*** FOS = 1.695 Theta (ki=1.0) = 30.39 ***
Lambda = 0.586

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	901.355	1203.386
2	970.086	1216.652
3	1038.193	1232.820
4	1105.554	1251.862
5	1172.046	1273.742
6	1237.551	1298.423
7	1301.950	1325.859
8	1365.128	1356.001
9	1426.971	1388.795
10	1487.368	1424.182
11	1546.210	1462.098
12	1603.391	1502.476
13	1658.808	1545.241
14	1712.363	1590.318
15	1763.957	1637.625
16	1813.500	1687.078
17	1860.900	1738.587
18	1906.074	1792.060
19	1948.940	1847.400
20	1989.421	1904.508
21	2027.444	1963.281
22	2028.207	1964.578

Circle Center At X = 623.090 ; Y = 2830.004 ; and Radius = 1650.247
*** FOS = 1.704 Theta (ki=1.0) = 29.86 ***
Lambda = 0.574

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	900.302	1200.756
2	967.988	1218.609
3	1034.848	1239.338
4	1100.762	1262.904
5	1165.608	1289.266
6	1229.269	1318.375
7	1291.628	1350.177
8	1352.571	1384.615
9	1411.986	1421.626
10	1469.766	1461.141
11	1525.805	1503.090
12	1580.000	1547.395
13	1632.252	1593.975
14	1682.466	1642.745
15	1730.550	1693.617
16	1776.416	1746.497
17	1819.981	1801.288
18	1861.165	1857.891
19	1896.905	1911.703

Circle Center At X = 516.542 ; Y = 2792.945 ; and Radius = 1637.784
*** FOS = 1.705 Theta (ki=1.0) = 31.16 ***
Lambda = 0.605

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	901.004	1202.510
2	970.257	1212.708
3	1038.956	1226.141
4	1106.950	1242.777
5	1174.090	1262.581
6	1240.229	1285.510
7	1305.220	1311.512
8	1368.922	1340.531
9	1431.194	1372.503
10	1491.899	1407.357
11	1550.905	1445.018
12	1608.081	1485.402
13	1663.302	1528.421
14	1716.447	1573.980
15	1767.399	1621.979
16	1816.046	1672.313
17	1862.280	1724.871
18	1906.002	1779.538
19	1947.114	1836.193
20	1985.526	1894.713
21	2021.153	1954.967
22	2025.964	1964.050

Circle Center At X = 718.429 ; Y = 2683.888 ; and Radius = 1492.587
*** FOS = 1.710 Theta (ki=1.0) = 29.70 ***
Lambda = 0.570

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	904.511	1211.277
2	973.222	1224.648
3	1041.205	1241.331
4	1108.301	1261.286
5	1174.351	1284.468
6	1239.201	1310.821
7	1302.698	1340.283
8	1364.695	1372.787
9	1425.044	1408.254
10	1483.605	1446.603
11	1540.240	1487.743
12	1594.816	1531.577

13	1647.205	1578.003
14	1697.284	1626.912
15	1744.936	1678.189
16	1790.049	1731.713
17	1832.516	1787.359
18	1872.239	1844.997
19	1909.124	1904.491
20	1923.241	1929.936

Circle Center At X = 663.740 ; Y = 2633.958 ; and Radius = 1442.911
*** FOS = 1.711 Theta (ki=1.0) = 30.46 ***
Lambda = 0.588
Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	900.653	1201.633
2	969.058	1216.491
3	1036.850	1233.936
4	1103.930	1253.942
5	1170.201	1276.482
6	1235.569	1301.523
7	1299.939	1329.028
8	1363.218	1358.958
9	1425.315	1391.269
10	1486.139	1425.915
11	1545.604	1462.847
12	1603.624	1502.010
13	1660.114	1543.348
14	1714.993	1586.802
15	1768.183	1632.308
16	1819.606	1679.802
17	1869.188	1729.215
18	1916.858	1780.475
19	1962.547	1833.508
20	2006.189	1888.238
21	2047.721	1944.586
22	2063.804	1968.239

Circle Center At X = 544.588 ; Y = 3007.594 ; and Radius = 1840.728
*** FOS = 1.715 Theta (ki=1.0) = 29.84 ***
Lambda = 0.574
Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	901.705	1204.263
2	969.583	1221.368
3	1036.610	1241.554
4	1102.645	1264.778
5	1167.551	1290.993
6	1231.193	1320.143
7	1293.437	1352.168
8	1354.155	1387.001
9	1413.219	1424.570
10	1470.507	1464.795
11	1525.899	1507.594
12	1579.279	1552.877
13	1630.536	1600.550
14	1679.564	1650.513
15	1726.260	1702.661
16	1770.527	1756.888
17	1812.272	1813.078
18	1851.408	1871.115
19	1869.023	1900.000

Circle Center At X = 561.144 ; Y = 2698.965 ; and Radius = 1533.009
*** FOS = 1.716 Theta (ki=1.0) = 31.18 ***
Lambda = 0.605
Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	904.160	1210.401
2	972.752	1224.372
3	1040.717	1241.128
4	1107.943	1260.640
5	1174.317	1282.875
6	1239.730	1307.797
7	1304.074	1335.364
8	1367.240	1365.530
9	1429.124	1398.246
10	1489.624	1433.457
11	1548.638	1471.104
12	1606.069	1511.125
13	1661.821	1553.454
14	1715.802	1598.020
15	1767.921	1644.748
16	1818.093	1693.562
17	1866.234	1744.380
18	1912.263	1797.118
19	1956.105	1851.688
20	1997.686	1908.000
21	2036.938	1965.959
22	2037.241	1966.448

Circle Center At X = 595.808 ; Y = 2899.617 ; and Radius = 1717.130
*** FOS = 1.720 Theta (ki=1.0) = 29.71 ***
Lambda = 0.571

Failure Surface Specified By 20 Coordinate Points

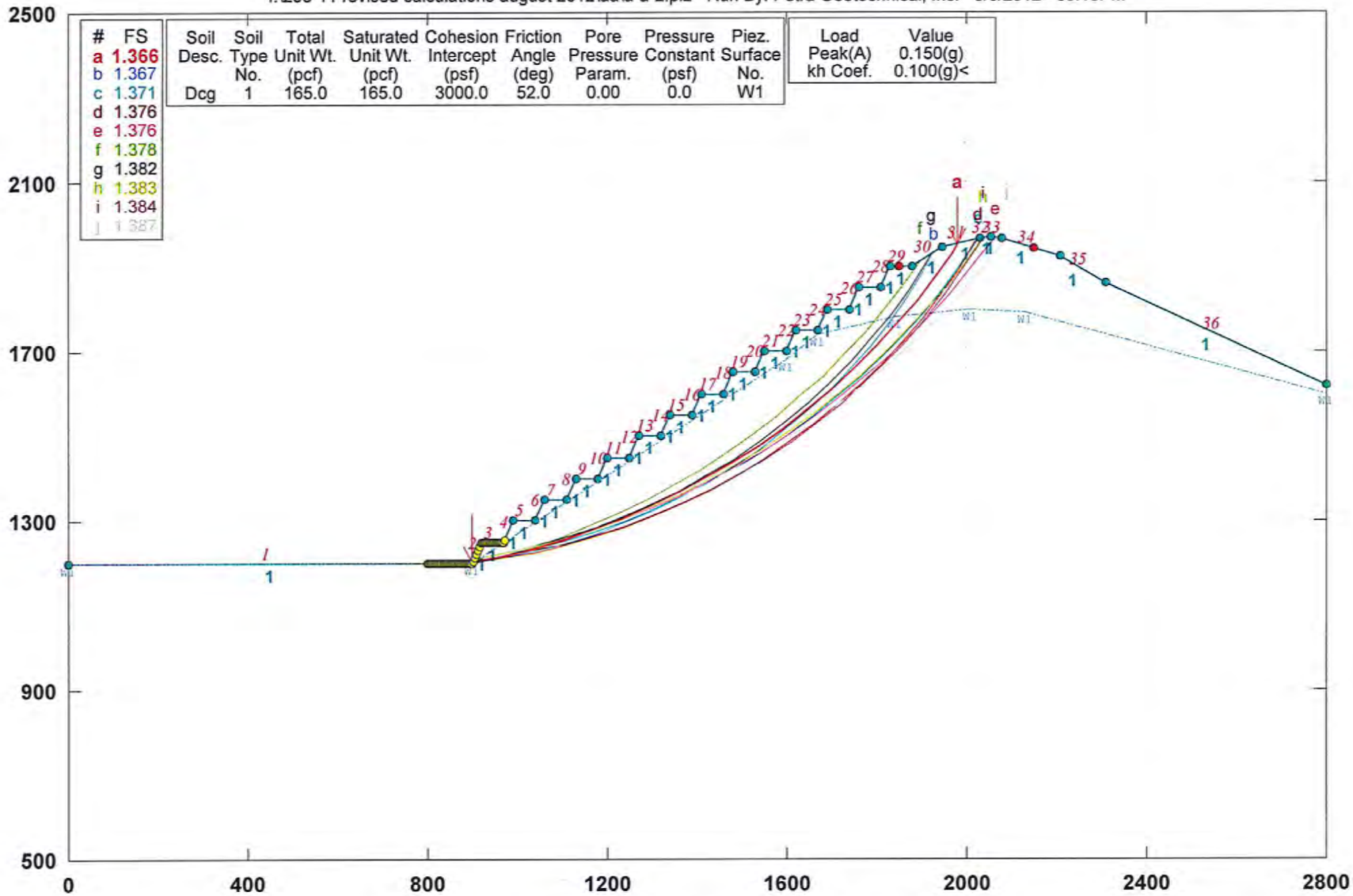
Point No.	X-Surf (ft)	Y-Surf (ft)
1	906.265	1215.661
2	974.978	1229.018
3	1042.950	1245.745
4	1110.016	1265.802
5	1176.011	1289.140
6	1240.775	1315.702
7	1304.152	1345.423
8	1365.987	1378.232
9	1426.130	1414.048
10	1484.435	1452.786
11	1540.760	1494.349
12	1594.967	1538.638
13	1646.927	1585.545
14	1696.511	1634.956
15	1743.599	1686.750
16	1788.078	1740.802
17	1829.839	1796.981
18	1868.781	1855.149
19	1904.808	1915.166
20	1906.515	1918.357

Circle Center At X = 669.941 ; Y = 2615.307 ; and Radius = 1419.456
*** FOS = 1.721 Theta (ki=1.0) = 30.60 ***
Lambda = 0.591

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

3M Moody Flats - Section A-A' Spencer Method With GW - Earthquake

f:\293-11 revised calculations august 2012\aa\a-a-2.pl2 Run By: Petra Geotechnical, Inc. 8/6/2012 03:15PM



GSTABL7 v.2 FSmin=1.366

Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2)

GSTABL7

```
                    *** GSTABL7 ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
          (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                  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,
      Nonlinear Undrained Shear Strength, Curved Phi Envelope,
      Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
      Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************
Analysis Run Date:        8/6/2012
Time of Run:              03:15PM
Run By:                   Petra Geotechnical, Inc.
Input Data Filename:      f:\293-11 Revised Calculations August 2012\AA\A-A-2.
Output Filename:          f:\293-11 Revised Calculations August 2012\AA\A-A-2.OUT
Unit System:              English
Plotted Output Filename:  f:\293-11 Revised Calculations August 2012\AA\A-A-2.PLT
PROBLEM DESCRIPTION:  3M Moody Flats - Section A-A'
                      Spencer Method With GW  - Earthquake
BOUNDARY COORDINATES
   36 Top   Boundaries
   36 Total Boundaries
```

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	1200.00	900.00	1200.00	1
2	900.00	1200.00	920.00	1250.00	1
3	920.00	1250.00	970.00	1250.00	1
4	970.00	1250.00	990.00	1300.00	1
5	990.00	1300.00	1040.00	1300.00	1
6	1040.00	1300.00	1060.00	1350.00	1
7	1060.00	1350.00	1110.00	1350.00	1
8	1110.00	1350.00	1130.00	1400.00	1
9	1130.00	1400.00	1180.00	1400.00	1
10	1180.00	1400.00	1200.00	1450.00	1
11	1200.00	1450.00	1250.00	1450.00	1
12	1250.00	1450.00	1270.00	1500.00	1
13	1270.00	1500.00	1320.00	1500.00	1
14	1320.00	1500.00	1340.00	1550.00	1
15	1340.00	1550.00	1390.00	1550.00	1
16	1390.00	1550.00	1410.00	1600.00	1
17	1410.00	1600.00	1460.00	1600.00	1
18	1460.00	1600.00	1480.00	1650.00	1
19	1480.00	1650.00	1530.00	1650.00	1
20	1530.00	1650.00	1550.00	1700.00	1
21	1550.00	1700.00	1600.00	1700.00	1
22	1600.00	1700.00	1620.00	1750.00	1
23	1620.00	1750.00	1670.00	1750.00	1
24	1670.00	1750.00	1690.00	1800.00	1
25	1690.00	1800.00	1740.00	1800.00	1
26	1740.00	1800.00	1760.00	1850.00	1
27	1760.00	1850.00	1810.00	1850.00	1
28	1810.00	1850.00	1830.00	1900.00	1
29	1830.00	1900.00	1880.00	1900.00	1
30	1880.00	1900.00	1945.00	1945.00	1
31	1945.00	1945.00	2030.00	1965.00	1
32	2030.00	1965.00	2055.00	1970.00	1
33	2055.00	1970.00	2080.00	1965.00	1
34	2080.00	1965.00	2210.00	1925.00	1
35	2210.00	1925.00	2310.00	1860.00	1
36	2310.00	1860.00	2800.00	1620.00	1

```
User Specified Y-Origin =        500.00(ft)
User Specified X-Plus Value = *******(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
  1 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	165.0	165.0	3000.0	52.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 8 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	1200.00
2	900.00	1200.00
3	1600.00	1680.00
4	1670.00	1740.00
5	1840.00	1780.00
6	2010.00	1800.00
7	2130.00	1790.00
8	2800.00	1600.00

Specified Peak Ground Acceleration Coefficient (A) = 0.150(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.100(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
5000 Trial Surfaces Have Been Generated.
10 Surface(s) Initiate(s) From Each Of 500 Points Equally Spaced
Along The Ground Surface Between X = 800.00(ft)
and X = 975.00(ft)
Each Surface Terminates Between X =1850.00(ft)
and X =2150.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
70.00(ft) Line Segments Define Each Trial Failure Surface.
Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
18.00	2.438	2.359	0.325
27.00	2.407	2.360	0.510
45.13	2.776	2.360	1.004
23.90	2.421	2.359	0.443
11.89	2.448	2.359	0.211
63.58	2.531	2.362	2.013
0.00	2.460	2.359	0.000
0.00	2.460	2.359	0.000
0.00	2.457	2.359	0.000
0.00	2.457	2.359	0.000
0.00	2.457	2.359	0.000
0.00	2.457	2.359	0.000
0.00	2.457	2.359	0.000
0.00	2.457	2.359	0.000
0.00	2.457	2.359	0.000
0.00	2.457	2.359	0.000
0.00	2.457	2.359	0.000
0.00	2.457	2.359	0.000
0.00	2.457	2.359	0.000
0.00	2.457	2.359	0.000

The Trial Failure Surface In Question Is Defined
By The Following 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	901.71	1204.26
2	960.35	1242.49
3	1018.91	1280.83
4	1077.40	1319.30
5	1135.81	1357.88

6	1194.13	1396.58
7	1252.39	1435.39
8	1310.56	1474.33
9	1368.65	1513.38
10	1426.67	1552.55
11	1484.60	1591.84
12	1542.46	1631.25
13	1600.23	1670.77
14	1657.93	1710.41
15	1715.54	1750.16
16	1773.07	1790.04
17	1830.53	1830.03
18	1887.90	1870.13
19	1945.19	1910.35
20	2002.40	1950.69
21	2018.93	1962.39

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
18.00	2.491	2.421	0.325
27.00	2.462	2.421	0.510
44.52	2.836	2.421	0.983
24.40	2.474	2.421	0.454
13.77	2.498	2.420	0.245
58.72	2.586	2.422	1.646
0.00	2.511	2.420	0.000
0.00	2.511	2.420	0.000
42.11	1.985	2.421	0.904
9.71	2.503	2.420	0.171
5.78	2.507	2.420	0.101
89.94	2.530	2.430	*****
0.00	2.511	2.420	0.000
0.00	2.511	2.420	0.000
0.00	2.511	2.417	0.000
0.00	2.511	2.417	0.000
0.00	2.511	2.417	0.000
0.00	2.511	2.417	0.000
0.00	2.511	2.417	0.000
0.00	2.511	2.417	0.000

The Trial Failure Surface In Question Is Defined
By The Following 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	970.44	1251.11
2	1028.84	1289.71
3	1087.18	1328.39
4	1145.47	1367.15
5	1203.71	1405.98
6	1261.90	1444.90
7	1320.03	1483.89
8	1378.12	1522.96
9	1436.15	1562.10
10	1494.13	1601.32
11	1552.06	1640.62
12	1609.93	1680.00
13	1667.75	1719.46
14	1725.52	1758.99
15	1783.24	1798.60
16	1840.90	1838.28
17	1898.51	1878.05
18	1956.07	1917.88
19	2013.57	1957.80
20	2020.80	1962.84

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
18.00	2.303	2.235	0.325
27.00	2.273	2.235	0.510
42.68	2.877	2.235	0.922
25.66	2.280	2.235	0.480
18.27	2.302	2.235	0.330
48.04	2.476	2.235	1.112
2.72	2.322	2.234	0.048
0.00	2.324	2.234	0.000
89.94	2.352	2.252	*****
0.00	2.323	2.234	0.000
0.00	2.323	2.234	0.000
40.63	2.530	2.235	0.858
0.00	2.324	2.234	0.000
0.00	2.324	2.234	0.000
0.00	2.321	2.234	0.000
0.00	2.321	2.234	0.000
0.00	2.321	2.234	0.000
0.00	2.321	2.234	0.000
0.00	2.321	2.234	0.000
0.00	2.321	2.234	0.000

The Trial Failure Surface In Question Is Defined
By The Following 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	971.15	1252.86
2	1030.05	1290.68
3	1088.91	1328.58
4	1147.71	1366.55
5	1206.46	1404.61
6	1265.16	1442.75
7	1323.81	1480.96
8	1382.41	1519.25
9	1440.95	1557.63
10	1499.44	1596.08
11	1557.88	1634.61
12	1616.27	1673.22
13	1674.61	1711.91
14	1732.89	1750.68
15	1791.13	1789.52
16	1849.31	1828.45
17	1907.43	1867.45
18	1965.51	1906.53
19	2023.53	1945.69
20	2058.42	1969.32

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
18.00	2.172	2.106	0.325
27.00	2.141	2.106	0.510
40.71	5.641	2.107	0.861
26.82	2.142	2.106	0.506
21.99	2.162	2.106	0.404
40.10	1.707	2.107	0.842
24.95	2.151	2.106	0.465
21.96	2.162	2.106	0.403
42.68	2.591	2.107	0.922
18.35	2.171	2.106	0.332
5.21	2.188	2.106	0.091
87.20	2.244	2.124	*****
0.00	2.192	2.106	0.000
0.00	2.192	2.106	0.000
0.00	2.192	2.105	0.000

```
  0.00        2.192       2.105      0.000
  0.00        2.192       2.105      0.000
  0.00        2.192       2.105      0.000
  0.00        2.192       2.105      0.000
  0.00        2.192       2.105      0.000
The Trial Failure Surface In Question Is Defined
By The Following 20 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1         972.20      1255.49
    2        1031.68      1292.39
    3        1091.11      1329.39
    4        1150.48      1366.47
    5        1209.80      1403.64
    6        1269.05      1440.90
    7        1328.26      1478.25
    8        1387.40      1515.70
    9        1446.49      1553.23
   10        1505.52      1590.85
   11        1564.49      1628.56
   12        1623.41      1666.36
   13        1682.26      1704.26
   14        1741.06      1742.24
   15        1799.80      1780.31
   16        1858.49      1818.47
   17        1917.11      1856.72
   18        1975.68      1895.06
   19        2034.19      1933.49
   20        2081.37      1964.58
Following Are Displayed The Ten Most Critical Of The Trial
      Failure Surfaces Evaluated. They Are
      Ordered - Most Critical First.
      * * Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2) * *
      Selected ki function = Bi-linear
      Selected Lambda Coefficient =  1.00
      Forces from Reinforcement, Piers/Piles, Soil Nails, and Applied Forces
      (if applicable) have been applied to the slice base(s)
      on which they intersect.
      Specified Tension Crack Water Force Factor =   0.000
      Total Number of Trial Surfaces Attempted =  5000
      WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
      Did Not Converge in 20 Iterations.
      Number of Trial Surfaces with Non-Converged FS =    4
      Number of Trial Surfaces With Valid FS = 4996
      Percentage of Trial Surfaces With Non-Valid FS Solutions
      of the Total Attempted =   0.1 %
      Statistical Data On All Valid FS Values:
         FS Max =   2.381   FS Min =   1.366   FS Ave =   1.796
         Standard Deviation =    0.178   Coefficient of Variation =    9.90 %
                 ((Modified Bishop FS for Critical Surface =  1.371))
      Failure Surface Specified By 21 Coordinate Points
        Point       X-Surf       Y-Surf
         No.         (ft)         (ft)
          1        901.004     1202.510
          2        969.380     1217.501
          3       1037.055     1235.391
          4       1103.907     1256.148
          5       1169.814     1279.734
          6       1234.656     1306.106
          7       1298.315     1335.217
          8       1360.677     1367.013
          9       1421.628     1401.438
         10       1481.056     1438.427
         11       1538.855     1477.915
         12       1594.920     1519.829
         13       1649.147     1564.094
         14       1701.440     1610.628
```

15	1751.703	1659.348
16	1799.845	1710.165
17	1845.778	1762.987
18	1889.419	1817.718
19	1930.689	1874.258
20	1969.513	1932.505
21	1982.438	1953.809

Circle Center At X = 583.464 ; Y = 2814.297 ; and Radius = 1642.769

*** FOS = 1.366 Theta (ki=1.0) = 29.78 ***

Lambda = 0.572

Individual data on the 52 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	3.9	2868.6	0.0	0.0	0.	0.	286.9	0.0	0.0
2	15.1	65030.0	0.0	2850.8	0.	0.	6503.0	0.0	0.0
3	49.4	308898.8	0.0	49176.8	0.	0.	30889.9	0.0	0.0
4	0.6	3316.9	0.0	1015.6	0.	0.	331.7	0.0	0.0
5	20.0	180483.2	0.0	37466.6	0.	0.	18048.3	0.0	0.0
6	47.1	549922.6	0.0	*******	0.	0.	54992.3	0.0	0.0
7	2.9	31171.2	0.0	9559.9	0.	0.	3117.1	0.0	0.0
8	20.0	282446.9	0.0	69652.7	0.	0.	28244.7	0.0	0.0
9	43.9	729307.7	0.0	*******	0.	0.	72930.8	0.0	0.0
10	6.1	93260.0	0.0	28725.3	0.	0.	9326.0	0.0	0.0
11	20.0	373207.0	0.0	99050.1	0.	0.	37320.7	0.0	0.0
12	39.8	836857.7	0.0	*******	0.	0.	83685.8	0.0	0.0
13	10.2	198656.5	0.0	61509.9	0.	0.	19865.6	0.0	0.0
14	20.0	452284.9	0.0	*******	0.	0.	45228.5	0.0	0.0
15	34.7	863109.5	0.0	*******	0.	0.	86311.0	0.0	0.0
16	15.3	355430.4	0.0	*******	0.	0.	35543.0	0.0	0.0
17	20.0	519103.5	0.0	*******	0.	0.	51910.3	0.0	0.0
18	28.3	800117.5	0.0	*******	0.	0.	80011.8	0.0	0.0
19	21.7	569809.4	0.0	*******	0.	0.	56980.9	0.0	0.0
20	20.0	572972.2	0.0	*******	0.	0.	57297.2	0.0	0.0
21	20.7	642284.0	0.0	*******	0.	0.	64228.4	0.0	0.0
22	29.3	845275.2	0.0	*******	0.	0.	84527.5	0.0	0.0
23	20.0	613065.6	0.0	*******	0.	0.	61306.6	0.0	0.0
24	11.6	387255.2	0.0	*******	0.	0.	38725.5	0.0	0.0
25	38.4	1181575.6	0.0	*******	0.	0.	*******	0.0	0.0
26	20.0	638400.1	0.0	*******	0.	0.	63840.0	0.0	0.0
27	1.1	36935.6	0.0	10435.2	0.	0.	3693.6	0.0	0.0
28	48.9	1573581.4	0.0	*******	0.	0.	*******	0.0	0.0
29	8.9	272032.8	0.0	90034.7	0.	0.	27203.3	0.0	0.0
30	11.1	375107.9	0.0	*******	0.	0.	37510.8	0.0	0.0
31	44.9	1459833.6	0.0	*******	0.	0.	*******	0.0	0.0
32	5.1	149290.8	0.0	53751.5	0.	0.	14929.1	0.0	0.0
33	20.0	636442.8	0.0	*******	0.	0.	63644.3	0.0	0.0
34	29.1	951298.2	0.0	*******	0.	0.	95129.8	0.0	0.0
35	20.9	607719.5	0.0	*******	0.	0.	60771.9	0.0	0.0
36	20.0	605389.2	0.0	*******	0.	0.	60538.9	0.0	0.0
37	11.4	367076.6	0.0	*******	0.	0.	36707.7	0.0	0.0
38	38.6	1085950.1	0.0	*******	0.	0.	*******	0.0	0.0
39	11.7	310805.8	0.0	*******	0.	0.	31080.6	0.0	0.0
40	8.3	240803.7	0.0	70718.6	0.	0.	24080.4	0.0	0.0
41	39.8	1057590.9	0.0	*******	0.	0.	*******	0.0	0.0
42	10.2	224521.0	0.0	52417.9	0.	0.	22452.1	0.0	0.0
43	20.0	467469.2	0.0	77694.3	0.	0.	46746.9	0.0	0.0
44	10.0	246522.7	0.0	26142.2	0.	0.	24652.3	0.0	0.0
45	5.8	133796.2	0.0	11283.0	0.	0.	13379.6	0.0	0.0
46	15.6	326881.9	0.0	13690.6	0.	0.	32688.2	0.0	0.0
47	18.7	325606.4	0.0	0.0	0.	0.	32560.6	0.0	0.0
48	9.4	142131.5	0.0	0.0	0.	0.	14213.2	0.0	0.0
49	41.3	509486.2	0.0	0.0	0.	0.	50948.6	0.0	0.0
50	14.3	129995.0	0.0	0.0	0.	0.	12999.5	0.0	0.0
51	24.5	136580.6	0.0	0.0	0.	0.	13658.1	0.0	0.0
52	12.9	19473.2	0.0	0.0	0.	0.	1947.3	0.0	0.0

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	900.302	1200.756
2	969.350	1212.263
3	1037.720	1227.281
4	1105.234	1245.771
5	1171.716	1267.684
6	1236.992	1292.963
7	1300.892	1321.542
8	1363.249	1353.348
9	1423.901	1388.295
10	1482.689	1426.295
11	1539.460	1467.246
12	1594.066	1511.044
13	1646.364	1557.572
14	1696.218	1606.710
15	1743.498	1658.330
16	1788.080	1712.297
17	1829.849	1768.470
18	1868.694	1826.703
19	1904.515	1886.843
20	1929.619	1934.352

Circle Center At X = 710.130 ; Y = 2556.511 ; and Radius = 1369.027
*** FOS = 1.367 Theta (ki=1.0) = 29.91 ***
Lambda = 0.575

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	901.355	1203.386
2	970.086	1216.652
3	1038.193	1232.820
4	1105.554	1251.862
5	1172.046	1273.742
6	1237.551	1298.423
7	1301.950	1325.859
8	1365.128	1356.001
9	1426.971	1388.795
10	1487.368	1424.182
11	1546.210	1462.098
12	1603.391	1502.476
13	1658.808	1545.241
14	1712.363	1590.318
15	1763.957	1637.625
16	1813.500	1687.078
17	1860.900	1738.587
18	1906.074	1792.060
19	1948.940	1847.400
20	1989.421	1904.508
21	2027.444	1963.281
22	2028.207	1964.578

Circle Center At X = 623.090 ; Y = 2830.004 ; and Radius = 1650.247
*** FOS = 1.371 Theta (ki=1.0) = 29.29 ***
Lambda = 0.561

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	901.004	1202.510
2	970.257	1212.708
3	1038.956	1226.141
4	1106.950	1242.777
5	1174.090	1262.581
6	1240.229	1285.510
7	1305.220	1311.512
8	1368.922	1340.531
9	1431.194	1372.503
10	1491.899	1407.357

11	1550.905	1445.018
12	1608.081	1485.402
13	1663.302	1528.421
14	1716.447	1573.980
15	1767.399	1621.979
16	1816.046	1672.313
17	1862.280	1724.871
18	1906.002	1779.538
19	1947.114	1836.193
20	1985.526	1894.713
21	2021.153	1954.967
22	2025.964	1964.050

Circle Center At X = 718.429 ; Y = 2683.888 ; and Radius = 1492.587
*** FOS = 1.376 Theta (ki=1.0) = 29.09 ***
Lambda = 0.556
Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	900.653	1201.633
2	969.058	1216.491
3	1036.850	1233.936
4	1103.930	1253.942
5	1170.201	1276.482
6	1235.569	1301.523
7	1299.939	1329.028
8	1363.218	1358.958
9	1425.315	1391.269
10	1486.139	1425.915
11	1545.604	1462.847
12	1603.624	1502.010
13	1660.114	1543.348
14	1714.993	1586.802
15	1768.183	1632.308
16	1819.606	1679.802
17	1869.188	1729.215
18	1916.858	1780.475
19	1962.547	1833.508
20	2006.189	1888.238
21	2047.721	1944.586
22	2063.804	1968.239

Circle Center At X = 544.588 ; Y = 3007.594 ; and Radius = 1840.728
*** FOS = 1.376 Theta (ki=1.0) = 28.95 ***
Lambda = 0.553
Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	900.302	1200.756
2	967.988	1218.609
3	1034.848	1239.338
4	1100.762	1262.904
5	1165.608	1289.266
6	1229.269	1318.375
7	1291.628	1350.177
8	1352.571	1384.615
9	1411.986	1421.626
10	1469.766	1461.141
11	1525.805	1503.090
12	1580.000	1547.395
13	1632.252	1593.975
14	1682.466	1642.745
15	1730.550	1693.617
16	1776.416	1746.497
17	1819.981	1801.288
18	1861.165	1857.891
19	1896.905	1911.703

Circle Center At X = 516.542 ; Y = 2792.945 ; and Radius = 1637.784
*** FOS = 1.378 Theta (ki=1.0) = 30.53 ***

Lambda = 0.590

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	904.511	1211.277
2	973.222	1224.648
3	1041.205	1241.331
4	1108.301	1261.286
5	1174.351	1284.468
6	1239.201	1310.821
7	1302.698	1340.283
8	1364.695	1372.787
9	1425.044	1408.254
10	1483.605	1446.603
11	1540.240	1487.743
12	1594.816	1531.577
13	1647.205	1578.003
14	1697.284	1626.912
15	1744.936	1678.189
16	1790.049	1731.713
17	1832.516	1787.359
18	1872.239	1844.997
19	1909.124	1904.491
20	1923.241	1929.936

Circle Center At X = 663.740 ; Y = 2633.958 ; and Radius = 1442.911

*** FOS = 1.382 Theta (ki=1.0) = 29.90 ***

Lambda = 0.575

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	904.160	1210.401
2	972.752	1224.372
3	1040.717	1241.128
4	1107.943	1260.640
5	1174.317	1282.875
6	1239.730	1307.797
7	1304.074	1335.364
8	1367.240	1365.530
9	1429.124	1398.246
10	1489.624	1433.457
11	1548.638	1471.104
12	1606.069	1511.125
13	1661.821	1553.454
14	1715.802	1598.020
15	1767.921	1644.748
16	1818.093	1693.562
17	1866.234	1744.380
18	1912.263	1797.118
19	1956.105	1851.688
20	1997.686	1908.000
21	2036.938	1965.959
22	2037.241	1966.448

Circle Center At X = 595.808 ; Y = 2899.617 ; and Radius = 1717.130

*** FOS = 1.383 Theta (ki=1.0) = 29.11 ***

Lambda = 0.557

Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	903.108	1207.770
2	972.411	1217.627
3	1041.178	1230.706
4	1109.261	1246.977
5	1176.510	1266.405
6	1242.781	1288.948
7	1307.928	1314.558
8	1371.810	1343.178
9	1434.288	1374.745

10	1495.226	1409.193
11	1554.491	1446.444
12	1611.954	1486.419
13	1667.490	1529.030
14	1720.979	1574.184
15	1772.304	1621.784
16	1821.353	1671.726
17	1868.020	1723.901
18	1912.203	1778.195
19	1953.806	1834.491
20	1992.738	1892.666
21	2028.915	1952.593
22	2036.321	1966.264

Circle Center At X = 726.960 ; Y = 2696.715 ; and Radius = 1499.328
*** FOS = 1.384 Theta (ki=1.0) = 28.86 ***
Lambda = 0.551

Failure Surface Specified By 22 Coordinate Points

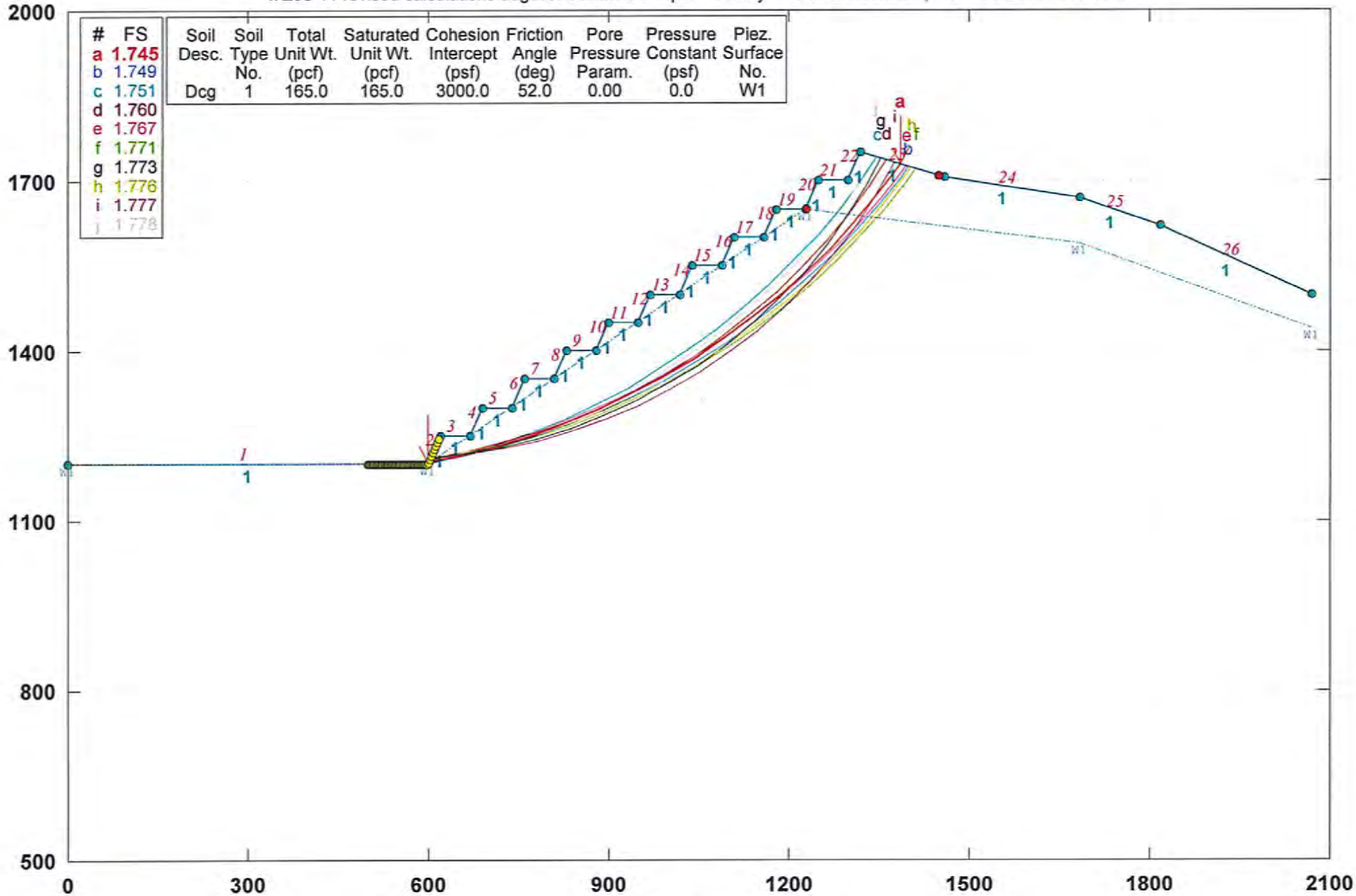
Point No.	X-Surf (ft)	Y-Surf (ft)
1	901.004	1202.510
2	969.401	1217.404
3	1037.215	1234.760
4	1104.358	1254.555
5	1170.742	1276.763
6	1236.280	1301.354
7	1300.887	1328.298
8	1364.478	1357.559
9	1426.970	1389.098
10	1488.282	1422.875
11	1548.333	1458.844
12	1607.046	1496.961
13	1664.343	1537.173
14	1720.149	1579.430
15	1774.393	1623.675
16	1827.002	1669.851
17	1877.908	1717.899
18	1927.046	1767.754
19	1974.350	1819.352
20	2019.758	1872.625
21	2063.212	1927.504
22	2088.774	1962.300

Circle Center At X = 523.908 ; Y = 3100.328 ; and Radius = 1934.920
*** FOS = 1.387 Theta (ki=1.0) = 28.66 ***
Lambda = 0.547

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

3M Moody Flats Section B-B' Spencer Method - GW - Static

f:\293-11 revised calculations august 2012\bb\b-b-1.pl2 Run By: Petra Geotechnical, Inc. 8/6/2012 03:19PM



GSTABL7 v.2 FSmin=1.745

Safety Factors Are Calculated By GLE (Spencer`s) Method (1-2)

GSTABL7

```
                    *** GSTABL7 ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
          (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                  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,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************
Analysis Run Date:        8/6/2012
Time of Run:              03:19PM
Run By:                   Petra Geotechnical, Inc.
Input Data Filename:      f:\293-11 Revised Calculations August 2012\BB\B-B-1.
Output Filename:          f:\293-11 Revised Calculations August 2012\BB\B-B-1.OUT
Unit System:              English
Plotted Output Filename:  f:\293-11 Revised Calculations August 2012\BB\B-B-1.PLT
PROBLEM DESCRIPTION:  3M Moody Flats Section B-B'
                      Spencer Method - GW - Static
BOUNDARY COORDINATES
   26 Top   Boundaries
   26 Total Boundaries
Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
   No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
    1         0.00    1200.00     600.00    1200.00        1
    2       600.00    1200.00     620.00    1250.00        1
    3       620.00    1250.00     670.00    1250.00        1
    4       670.00    1250.00     690.00    1300.00        1
    5       690.00    1300.00     740.00    1300.00        1
    6       740.00    1300.00     760.00    1350.00        1
    7       760.00    1350.00     810.00    1350.00        1
    8       810.00    1350.00     830.00    1400.00        1
    9       830.00    1400.00     880.00    1400.00        1
   10       880.00    1400.00     900.00    1450.00        1
   11       900.00    1450.00     950.00    1450.00        1
   12       950.00    1450.00     970.00    1500.00        1
   13       970.00    1500.00    1020.00    1500.00        1
   14      1020.00    1500.00    1040.00    1550.00        1
   15      1040.00    1550.00    1090.00    1550.00        1
   16      1090.00    1550.00    1110.00    1600.00        1
   17      1110.00    1600.00    1160.00    1600.00        1
   18      1160.00    1600.00    1180.00    1650.00        1
   19      1180.00    1650.00    1230.00    1650.00        1
   20      1230.00    1650.00    1250.00    1700.00        1
   21      1250.00    1700.00    1300.00    1700.00        1
   22      1300.00    1700.00    1320.00    1750.00        1
   23      1320.00    1750.00    1460.00    1705.00        1
   24      1460.00    1705.00    1685.00    1670.00        1
   25      1685.00    1670.00    1820.00    1620.00        1
   26      1820.00    1620.00    2070.00    1500.00        1
User Specified Y-Origin =        500.00(ft)
User Specified X-Plus Value = -400.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
 1 Type(s) of Soil
Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
 No.  (pcf)    (pcf)     (psf)     (deg)    Param.   (psf)     No.
  1   165.0    165.0    3000.0     52.0     0.00      0.0      1
1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water =  62.40 (pcf)
Piezometric Surface No.  1 Specified by  5 Coordinate Points
Pore Pressure Inclination Factor =  0.50
  Point      X-Water     Y-Water
```

No.	(ft)	(ft)
1	0.00	1200.00
2	600.00	1200.00
3	1230.00	1650.00
4	1685.00	1590.00
5	2070.00	1440.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
5000 Trial Surfaces Have Been Generated.
10 Surface(s) Initiate(s) From Each Of 500 Points Equally Spaced
Along The Ground Surface Between X = 500.00(ft)
and X = 620.00(ft)
Each Surface Terminates Between X =1230.00(ft)
and X =1450.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
60.00(ft) Line Segments Define Each Trial Failure Surface.
Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
18.00	2.462	2.349	0.325
27.00	2.417	2.351	0.510
43.69	3.109	2.355	0.955
24.88	2.432	2.351	0.464
15.56	2.469	2.349	0.279
54.31	2.654	2.358	1.392
0.00	2.493	2.347	0.000
0.00	2.493	2.347	0.000
41.36	12.283	2.354	0.880
0.00	2.493	2.347	0.000
0.00	2.493	2.347	0.000
0.00	2.493	2.347	0.000
0.00	2.493	2.347	0.000
0.00	2.493	2.347	0.000
0.00	2.493	2.347	0.000
0.00	2.493	2.347	0.000
0.00	2.493	2.347	0.000
0.00	2.493	2.347	0.000
0.00	2.493	2.347	0.000
0.00	2.493	2.347	0.000

The Trial Failure Surface In Question Is Defined
By The Following 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	600.76	1201.90
2	652.46	1232.34
3	703.92	1263.20
4	755.14	1294.46
5	806.10	1326.13
6	856.80	1358.20
7	907.25	1390.68
8	957.44	1423.56
9	1007.37	1456.84
10	1057.03	1490.51
11	1106.42	1524.58
12	1155.53	1559.04
13	1204.37	1593.90
14	1252.93	1629.14
15	1301.21	1664.76
16	1349.20	1700.77
17	1385.95	1728.80

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg)	FOS (Moment)	FOS (Force)

(ki=1.0)	(Equil.)	(Equil.)	Lambda
18.00	2.485	2.368	0.325
27.00	2.438	2.370	0.510
43.89	3.201	2.374	0.962
24.97	2.454	2.369	0.466
15.81	2.492	2.368	0.283
53.89	2.695	2.377	1.371
0.00	2.517	2.365	0.000
0.00	2.517	2.365	0.000
41.36	12.283	2.373	0.880
0.00	2.517	2.365	0.000
0.00	2.517	2.365	0.000
0.00	2.517	2.365	0.000
0.00	2.517	2.365	0.000
0.00	2.517	2.365	0.000
0.00	2.517	2.365	0.000
0.00	2.517	2.365	0.000
0.00	2.517	2.365	0.000
0.00	2.517	2.365	0.000
0.00	2.517	2.365	0.000
0.00	2.517	2.365	0.000

The Trial Failure Surface In Question Is Defined
By The Following 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	601.24	1203.10
2	652.99	1233.46
3	704.49	1264.26
4	755.72	1295.48
5	806.69	1327.14
6	857.39	1359.22
7	907.82	1391.73
8	957.98	1424.66
9	1007.85	1458.02
10	1057.45	1491.79
11	1106.75	1525.98
12	1155.77	1560.58
13	1204.49	1595.59
14	1252.92	1631.02
15	1301.05	1666.84
16	1348.88	1703.08
17	1383.34	1729.64

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
18.00	2.717	2.598	0.325
27.00	2.674	2.599	0.510
47.04	3.122	2.603	1.074
22.52	2.700	2.598	0.415
6.37	2.740	2.596	0.112
79.24	2.844	2.624	5.264
0.00	2.748	2.595	0.000
0.00	2.748	2.595	0.000
42.06	5.796	2.602	0.902
0.00	2.748	2.595	0.000
0.00	2.748	2.595	0.000
0.00	2.748	2.595	0.000
0.00	2.748	2.595	0.000
0.00	2.748	2.595	0.000
0.00	2.748	2.595	0.000
0.00	2.748	2.595	0.000
0.00	2.748	2.595	0.000
0.00	2.748	2.595	0.000
0.00	2.748	2.595	0.000
0.00	2.748	2.595	0.000

The Trial Failure Surface In Question Is Defined
By The Following 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	601.96	1204.91
2	653.21	1236.12
3	704.21	1267.72
4	754.96	1299.72
5	805.47	1332.10
6	855.74	1364.87
7	905.74	1398.03
8	955.50	1431.56
9	1004.99	1465.48
10	1054.22	1499.77
11	1103.19	1534.44
12	1151.89	1569.49
13	1200.32	1604.91
14	1248.48	1640.70
15	1296.36	1676.85
16	1343.97	1713.38
17	1370.24	1733.85

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
18.00	2.639	2.512	0.325
27.00	2.587	2.514	0.510
43.14	2.555	2.519	0.937
63.76	2.847	2.531	2.029
39.63	1.862	2.518	0.828
53.30	2.948	2.524	1.342
46.14	3.429	2.521	1.041
64.07	2.846	2.532	2.057
76.71	2.821	2.550	4.234
89.94	2.856	2.647	*****
89.94	2.856	2.647	*****
12.18	2.656	2.510	0.216
0.00	2.677	2.508	0.000
89.94	2.856	2.647	*****
0.00	2.677	2.508	0.000
0.00	2.677	2.508	0.000
0.00	2.677	2.508	0.000
0.00	2.677	2.508	0.000
0.00	2.677	2.508	0.000
0.00	2.677	2.508	0.000

The Trial Failure Surface In Question Is Defined
By The Following 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	603.65	1209.12
2	655.57	1239.18
3	707.18	1269.78
4	758.46	1300.94
5	809.40	1332.63
6	860.01	1364.86
7	910.28	1397.62
8	960.19	1430.92
9	1009.75	1464.74
10	1058.95	1499.09
11	1107.78	1533.95
12	1156.24	1569.33
13	1204.32	1605.22
14	1252.02	1641.61
15	1299.33	1678.51
16	1346.25	1715.91
17	1368.83	1734.30

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By GLE (Spencer`s) Method (1-2) * *
Selected ki function = Bi-linear
Selected Lambda Coefficient = 1.00
Forces from Reinforcement, Piers/Piles,Soil Nails, and Applied Forces
(if applicable) have been distributed over the entire
failure surface based upon slice width.
Specified Tension Crack Water Force Factor = 0.000
Total Number of Trial Surfaces Attempted = 5000
WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 20 Iterations.
Number of Trial Surfaces with Non-Converged FS = 4
Number of Trial Surfaces With Valid FS = 4996
Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Attempted = 0.1 %
Statistical Data On All Valid FS Values:
FS Max = 2.788 FS Min = 1.745 FS Ave = 2.243
Standard Deviation = 0.223 Coefficient of Variation = 9.94 %
((Modified Bishop FS for Critical Surface = 1.737))
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	601.241	1203.104
2	659.754	1216.379
3	717.556	1232.472
4	774.510	1251.345
5	830.484	1272.953
6	885.346	1297.247
7	938.967	1324.169
8	991.222	1353.655
9	1041.987	1385.638
10	1091.144	1420.041
11	1138.578	1456.784
12	1184.177	1495.781
13	1227.834	1536.940
14	1269.447	1580.164
15	1308.918	1625.353
16	1346.154	1672.401
17	1381.069	1721.196
18	1385.969	1728.796

Circle Center At X = 356.982 ; Y = 2416.269 ; and Radius = 1237.510
*** FOS = 1.745 Theta (ki=1.0) = 30.29 ***
Lambda = 0.584
Individual data on the 40 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	4.5	3879.5	0.0	0.0	0.	0.	0.0	0.0	0.0
2	14.2	62110.3	0.0	2617.0	0.	0.	0.0	0.0	0.0
3	39.8	250118.8	0.0	35124.0	0.	0.	0.0	0.0	0.0
4	10.2	54426.0	0.0	15738.6	0.	0.	0.0	0.0	0.0
5	20.0	174848.8	0.0	37819.4	0.	0.	0.0	0.0	0.0
6	27.6	324475.6	0.0	67481.8	0.	0.	0.0	0.0	0.0
7	22.4	236303.6	0.0	68412.9	0.	0.	0.0	0.0	0.0
8	20.0	269865.6	0.0	69842.5	0.	0.	0.0	0.0	0.0
9	14.5	241960.1	0.0	55910.4	0.	0.	0.0	0.0	0.0
10	35.5	537589.1	0.0	*******	0.	0.	0.0	0.0	0.0
11	20.0	350111.0	0.0	98101.5	0.	0.	0.0	0.0	0.0
12	0.5	10160.0	0.0	2466.1	0.	0.	0.0	0.0	0.0
13	49.5	948413.4	0.0	*******	0.	0.	0.0	0.0	0.0
14	5.3	97578.7	0.0	32094.0	0.	0.	0.0	0.0	0.0
15	14.7	316156.0	0.0	91945.1	0.	0.	0.0	0.0	0.0
16	39.0	871939.6	0.0	*******	0.	0.	0.0	0.0	0.0
17	11.0	223397.5	0.0	78032.7	0.	0.	0.0	0.0	0.0

18	20.0	458577.1	0.0	*******	0.	0.	0.0	0.0	0.0
19	21.2	533406.3	0.0	*******	0.	0.	0.0	0.0	0.0
20	28.8	651857.9	0.0	*******	0.	0.	0.0	0.0	0.0
21	20.0	484817.2	0.0	*******	0.	0.	0.0	0.0	0.0
22	2.0	54097.2	0.0	15832.1	0.	0.	0.0	0.0	0.0
23	48.0	1168996.5	0.0	*******	0.	0.	0.0	0.0	0.0
24	1.1	24885.6	0.0	9472.8	0.	0.	0.0	0.0	0.0
25	18.9	463835.1	0.0	*******	0.	0.	0.0	0.0	0.0
26	28.6	727513.1	0.0	*******	0.	0.	0.0	0.0	0.0
27	21.4	473835.7	0.0	*******	0.	0.	0.0	0.0	0.0
28	20.0	466434.8	0.0	*******	0.	0.	0.0	0.0	0.0
29	4.2	107519.9	0.0	34711.8	0.	0.	0.0	0.0	0.0
30	43.7	962661.9	0.0	*******	0.	0.	0.0	0.0	0.0
31	2.2	40004.9	0.0	18004.0	0.	0.	0.0	0.0	0.0
32	20.0	413896.2	0.0	*******	0.	0.	0.0	0.0	0.0
33	19.4	416927.3	0.0	*******	0.	0.	0.0	0.0	0.0
34	30.6	515955.4	0.0	*******	0.	0.	0.0	0.0	0.0
35	8.9	133750.7	0.0	16716.8	0.	0.	0.0	0.0	0.0
36	10.2	173863.7	0.0	7243.4	0.	0.	0.0	0.0	0.0
37	0.9	15929.3	0.0	0.0	0.	0.	0.0	0.0	0.0
38	26.2	388038.1	0.0	0.0	0.	0.	0.0	0.0	0.0
39	34.9	225734.3	0.0	0.0	0.	0.	0.0	0.0	0.0
40	4.9	3708.7	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	600.520	1201.300
2	659.171	1213.951
3	717.152	1229.385
4	774.332	1247.565
5	830.579	1268.451
6	885.767	1291.995
7	939.769	1318.144
8	992.463	1346.838
9	1043.729	1378.012
10	1093.450	1411.594
11	1141.513	1447.510
12	1187.810	1485.676
13	1232.234	1526.006
14	1274.684	1568.408
15	1315.064	1612.787
16	1353.282	1659.040
17	1389.252	1707.063
18	1400.750	1724.045

Circle Center At X = 365.459 ; Y = 2435.015 ; and Radius = 1255.909

*** FOS = 1.749 Theta (ki=1.0) = 29.80 ***

Lambda = 0.573

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	600.280	1200.699
2	658.322	1215.899
3	715.535	1233.974
4	771.775	1254.881
5	826.902	1278.567
6	880.779	1304.972
7	933.272	1334.032
8	984.250	1365.674
9	1033.587	1399.820
10	1081.159	1436.383
11	1126.848	1475.273
12	1170.541	1516.394
13	1212.129	1559.643
14	1251.508	1604.913
15	1288.580	1652.090
16	1323.252	1701.057
17	1348.534	1740.828

Circle Center At X = 324.737 ; Y = 2371.328 ; and Radius = 1202.620
*** FOS = 1.751 Theta (ki=1.0) = 31.08 ***
Lambda = 0.603
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	604.127	1210.318
2	663.011	1221.837
3	721.166	1236.604
4	778.411	1254.574
5	834.572	1275.692
6	889.475	1299.892
7	942.951	1327.100
8	994.836	1357.233
9	1044.969	1390.198
10	1093.197	1425.892
11	1139.370	1464.207
12	1183.348	1505.023
13	1224.993	1548.217
14	1264.179	1593.653
15	1300.784	1641.194
16	1334.695	1690.691
17	1362.400	1736.372

Circle Center At X = 426.066 ; Y = 2276.843 ; and Radius = 1081.287
*** FOS = 1.760 Theta (ki=1.0) = 30.55 ***
Lambda = 0.590
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	603.165	1207.913
2	661.600	1221.529
3	719.346	1237.820
4	776.281	1256.753
5	832.283	1278.287
6	887.234	1302.377
7	941.019	1328.972
8	993.521	1358.015
9	1044.631	1389.444
10	1094.239	1423.194
11	1142.241	1459.191
12	1188.534	1497.361
13	1233.021	1537.622
14	1275.607	1579.888
15	1316.201	1624.070
16	1354.719	1670.075
17	1391.077	1717.804
18	1396.366	1725.454

Circle Center At X = 337.338 ; Y = 2481.943 ; and Radius = 1301.467
*** FOS = 1.767 Theta (ki=1.0) = 29.85 ***
Lambda = 0.574
Failure Surface Specified By 18 Coordinate Points

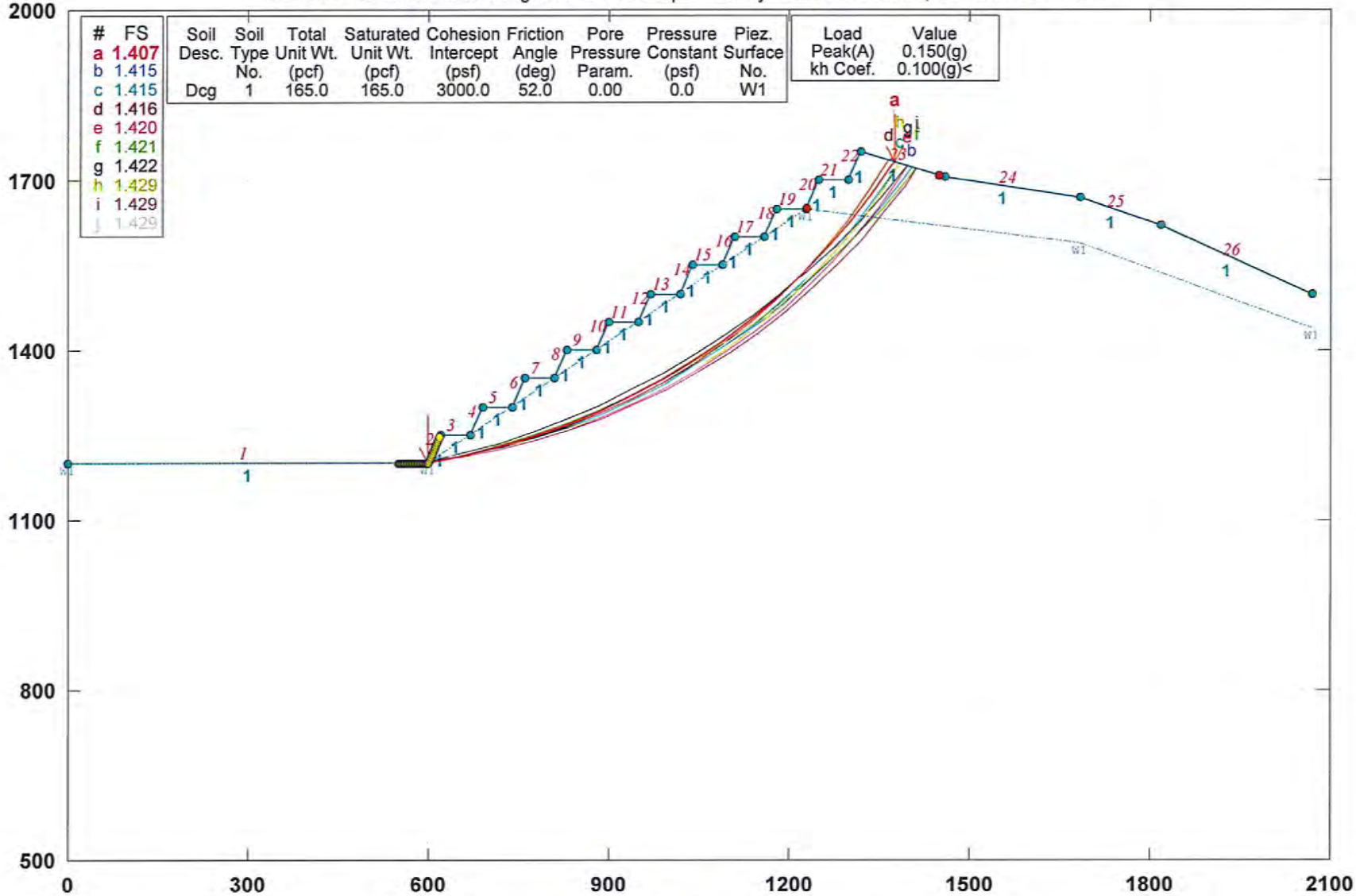
Point No.	X-Surf (ft)	Y-Surf (ft)
1	601.963	1204.907
2	660.931	1215.986
3	719.284	1229.949
4	776.880	1246.764
5	833.579	1266.389
6	889.246	1288.777
7	943.745	1313.874
8	996.945	1341.619
9	1048.716	1371.946
10	1098.935	1404.780
11	1147.479	1440.043
12	1194.231	1477.649
13	1239.078	1517.508
14	1281.912	1559.522

```
   15        1322.630      1603.592
   16        1361.132      1649.609
   17        1397.326      1697.463
   18        1412.806      1720.169
Circle Center At X =   406.967 ; Y =  2407.386 ; and Radius =  1218.187
***  FOS =     1.771   Theta (ki=1.0) =    29.18  ***
                     Lambda =   0.558
Failure Surface Specified By 17 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        604.608      1211.520
    2        664.141      1218.989
    3        723.061      1230.326
    4        781.115      1245.483
    5        838.056      1264.395
    6        893.642      1286.983
    7        947.636      1313.149
    8        999.808      1342.781
    9       1049.935      1375.755
   10       1097.804      1411.929
   11       1143.211      1451.149
   12       1185.962      1493.249
   13       1225.875      1538.047
   14       1262.781      1585.355
   15       1296.521      1634.969
   16       1326.952      1686.679
   17       1353.435      1739.253
Circle Center At X =   520.026 ; Y =  2126.742 ; and Radius =   919.121
***  FOS =     1.773   Theta (ki=1.0) =    30.23  ***
                     Lambda =   0.583
Failure Surface Specified By 18 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        604.127      1210.318
    2        663.140      1221.158
    3        721.526      1234.978
    4        779.137      1251.743
    5        835.822      1271.409
    6        891.437      1293.925
    7        945.838      1319.234
    8        998.885      1347.270
    9       1050.441      1377.962
   10       1100.374      1411.230
   11       1148.554      1446.988
   12       1194.858      1485.144
   13       1239.167      1525.601
   14       1281.366      1568.253
   15       1321.347      1612.992
   16       1359.007      1659.701
   17       1394.249      1708.260
   18       1403.870      1723.042
Circle Center At X =   420.766 ; Y =  2376.402 ; and Radius =  1180.412
***  FOS =     1.776   Theta (ki=1.0) =    29.36  ***
                     Lambda =   0.563
Failure Surface Specified By 18 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        603.887      1209.717
    2        663.561      1215.958
    3        722.714      1226.006
    4        781.102      1239.822
    5        838.485      1257.347
    6        894.629      1278.510
    7        949.303      1303.224
    8       1002.282      1331.388
    9       1053.349      1362.886
   10       1102.295      1397.589
```

```
   11        1148.919      1435.355
   12        1193.029      1476.028
   13        1234.444      1519.441
   14        1272.996      1565.418
   15        1308.524      1613.768
   16        1340.884      1664.293
   17        1369.943      1716.787
   18        1376.984      1731.684
Circle Center At X =   536.818 ; Y =  2142.563 ; and Radius =   935.255
***  FOS =      1.777   Theta (ki=1.0) =    29.72  ***
                     Lambda =   0.571
Failure Surface Specified By 17 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        605.330      1213.324
    2        664.138      1225.224
    3        722.170      1240.463
    4        779.238      1258.990
    5        835.155      1280.744
    6        889.739      1305.656
    7        942.812      1333.644
    8        994.200      1364.616
    9       1043.736      1398.472
   10       1091.258      1435.100
   11       1136.611      1474.382
   12       1179.647      1516.190
   13       1220.227      1560.386
   14       1258.217      1606.827
   15       1293.493      1655.361
   16       1325.941      1705.830
   17       1346.147      1741.596
Circle Center At X =   426.471 ; Y =  2248.456 ; and Radius =  1050.471
***  FOS =      1.778   Theta (ki=1.0) =    30.52  ***
                     Lambda =   0.590
          **** END OF GSTABL7 OUTPUT ****
```

3M Moody Flats Section B-B' Spencer Method - GW - Earthquake

f:\293-11 revised calculations august 2012\bb\b-b-2.pl2 Run By: Petra Geotechnical, Inc. 8/6/2012 03:21PM



GSTABL7 v.2 FSmin=1.407

Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2)

GSTABL7

```
                    *** GSTABL7 ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
          (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                  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,
      Nonlinear Undrained Shear Strength, Curved Phi Envelope,
      Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
      Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************
Analysis Run Date:          8/6/2012
Time of Run:                03:21PM
Run By:                     Petra Geotechnical, Inc.
Input Data Filename:        f:\293-11 Revised Calculations August 2012\BB\b-b-2.
Output Filename:            f:\293-11 Revised Calculations August 2012\BB\b-b-2.OUT
Unit System:                English
Plotted Output Filename:    f:\293-11 Revised Calculations August 2012\BB\b-b-2.PLT
PROBLEM DESCRIPTION:  3M Moody Flats Section B-B'
                      Spencer Method - GW - Earthquake
BOUNDARY COORDINATES
   26 Top   Boundaries
   26 Total Boundaries
Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
   No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
    1         0.00    1200.00     600.00    1200.00        1
    2       600.00    1200.00     620.00    1250.00        1
    3       620.00    1250.00     670.00    1250.00        1
    4       670.00    1250.00     690.00    1300.00        1
    5       690.00    1300.00     740.00    1300.00        1
    6       740.00    1300.00     760.00    1350.00        1
    7       760.00    1350.00     810.00    1350.00        1
    8       810.00    1350.00     830.00    1400.00        1
    9       830.00    1400.00     880.00    1400.00        1
   10       880.00    1400.00     900.00    1450.00        1
   11       900.00    1450.00     950.00    1450.00        1
   12       950.00    1450.00     970.00    1500.00        1
   13       970.00    1500.00    1020.00    1500.00        1
   14      1020.00    1500.00    1040.00    1550.00        1
   15      1040.00    1550.00    1090.00    1550.00        1
   16      1090.00    1550.00    1110.00    1600.00        1
   17      1110.00    1600.00    1160.00    1600.00        1
   18      1160.00    1600.00    1180.00    1650.00        1
   19      1180.00    1650.00    1230.00    1650.00        1
   20      1230.00    1650.00    1250.00    1700.00        1
   21      1250.00    1700.00    1300.00    1700.00        1
   22      1300.00    1700.00    1320.00    1750.00        1
   23      1320.00    1750.00    1460.00    1705.00        1
   24      1460.00    1705.00    1685.00    1670.00        1
   25      1685.00    1670.00    1820.00    1620.00        1
   26      1820.00    1620.00    2070.00    1500.00        1
User Specified Y-Origin =        500.00(ft)
User Specified X-Plus Value = -400.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
  1 Type(s) of Soil
Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
 No.  (pcf)    (pcf)     (psf)     (deg)    Param.   (psf)     No.
  1   165.0    165.0    3000.0     52.0    0.00       0.0      1
1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water =  62.40 (pcf)
Piezometric Surface No.  1 Specified by  5 Coordinate Points
Pore Pressure Inclination Factor =  0.50
  Point       X-Water     Y-Water
```

No.	(ft)	(ft)
1	0.00	1200.00
2	600.00	1200.00
3	1230.00	1650.00
4	1685.00	1590.00
5	2070.00	1440.00

Specified Peak Ground Acceleration Coefficient (A) = 0.150(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.100(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
5000 Trial Surfaces Have Been Generated.
10 Surface(s) Initiate(s) From Each Of 500 Points Equally Spaced
Along The Ground Surface Between X = 550.00(ft)
and X = 620.00(ft)
Each Surface Terminates Between X =1230.00(ft)
and X =1450.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
60.00(ft) Line Segments Define Each Trial Failure Surface.
Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
18.00	2.188	2.085	0.325
27.00	2.150	2.086	0.510
47.33	2.351	2.087	1.085
18.25	2.188	2.085	0.330
0.00	2.212	2.085	0.000
89.94	2.261	2.134	*****
40.40	2.904	2.086	0.851
89.94	2.261	2.134	*****
89.94	2.261	2.134	*****
10.68	2.201	2.085	0.189
0.00	2.212	2.085	0.000
89.94	2.261	2.134	*****
0.00	2.216	2.085	0.000
89.94	0.002	1.904	*****
7.73	2.205	2.085	0.136
0.00	2.212	2.085	0.000
89.94	2.261	2.134	*****
0.00	2.216	2.085	0.000
89.94	0.002	1.855	*****
7.94	2.205	2.085	0.139

The Trial Failure Surface In Question Is Defined
By The Following 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	600.07	1200.18
2	650.64	1232.47
3	701.15	1264.85
4	751.60	1297.34
5	801.98	1329.92
6	852.31	1362.59
7	902.57	1395.36
8	952.76	1428.23
9	1002.89	1461.20
10	1052.96	1494.26
11	1102.97	1527.42
12	1152.91	1560.67
13	1202.79	1594.02
14	1252.60	1627.47
15	1302.35	1661.01
16	1352.03	1694.65
17	1397.03	1725.24

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
18.00	2.813	2.737	0.325
27.00	2.790	2.738	0.510
53.76	2.915	2.739	1.364
11.92	2.821	2.737	0.211
0.00	2.830	2.737	0.000
89.94	2.851	2.749	*****
0.00	2.830	2.737	0.000
0.00	2.830	2.737	0.000
40.26	3.523	2.738	0.847
0.00	2.830	2.737	0.000
0.00	2.830	2.737	0.000
40.16	1.976	2.738	0.844
5.86	2.826	2.737	0.103
0.00	2.830	2.737	0.000
89.94	2.851	2.749	*****
0.00	2.830	2.737	0.000
0.00	2.830	2.737	0.000
0.00	2.830	2.731	0.000
89.94	2.851	2.749	*****
0.00	2.830	2.737	0.000

The Trial Failure Surface In Question Is Defined
By The Following 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	601.33	1203.34
2	651.16	1236.76
3	700.88	1270.34
4	750.50	1304.08
5	800.02	1337.96
6	849.43	1372.00
7	898.73	1406.20
8	947.93	1440.54
9	997.02	1475.04
10	1046.00	1509.69
11	1094.88	1544.49
12	1143.65	1579.44
13	1192.31	1614.55
14	1240.86	1649.80
15	1289.30	1685.20
16	1337.63	1720.76
17	1359.83	1737.20

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
18.00	2.315	2.213	0.325
27.00	2.279	2.214	0.510
48.39	2.544	2.217	1.126
19.87	2.310	2.213	0.361
0.00	2.340	2.211	0.000
89.94	2.432	2.291	*****
0.00	2.340	2.211	0.000
0.00	2.340	2.211	0.000
39.15	3.523	2.215	0.814
0.00	2.340	2.211	0.000
0.00	2.340	2.211	0.000
40.16	1.976	2.216	0.844
18.74	2.313	2.213	0.339
20.03	2.310	2.213	0.365
65.18	2.425	2.221	2.162
0.00	2.340	2.211	0.000

0.00	2.340	2.211	0.000
0.00	2.340	2.211	0.000
89.94	0.796	1.473	*****
19.21	2.312	2.213	0.348

The Trial Failure Surface In Question Is Defined
By The Following 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	601.47	1203.69
2	652.30	1235.57
3	702.95	1267.73
4	753.43	1300.17
5	803.72	1332.89
6	853.84	1365.88
7	903.77	1399.15
8	953.52	1432.69
9	1003.09	1466.50
10	1052.47	1500.58
11	1101.66	1534.94
12	1150.66	1569.56
13	1199.47	1604.45
14	1248.09	1639.61
15	1296.52	1675.04
16	1344.75	1710.73
17	1374.02	1732.64

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
18.00	2.315	2.187	0.325
27.00	2.270	2.188	0.510
49.00	2.527	2.190	1.150
17.50	2.316	2.187	0.315
0.00	2.344	2.186	0.000
89.94	2.418	2.254	*****
0.00	2.344	2.186	0.000
0.00	2.344	2.186	0.000
40.53	11.114	2.189	0.855
0.00	2.344	2.186	0.000
0.00	2.344	2.186	0.000
40.16	1.976	2.189	0.844
22.86	2.296	2.188	0.422
24.91	2.285	2.188	0.464
48.51	2.536	2.190	1.131
12.54	2.328	2.187	0.222
0.00	2.344	2.186	0.000
89.94	2.418	2.254	*****
0.00	2.344	2.186	0.000
0.00	2.344	2.186	0.000

The Trial Failure Surface In Question Is Defined
By The Following 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	602.04	1205.09
2	652.79	1237.10
3	703.42	1269.29
4	753.94	1301.66
5	804.34	1334.22
6	854.62	1366.95
7	904.78	1399.87
8	954.83	1432.97
9	1004.75	1466.25
10	1054.56	1499.70
11	1104.24	1533.34
12	1153.81	1567.16
13	1203.25	1601.15

14	1252.57	1635.32
15	1301.76	1669.67
16	1350.83	1704.20
17	1385.66	1728.90

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
18.00	2.534	2.456	0.325
27.00	2.504	2.457	0.510
45.06	3.116	2.460	1.002
25.15	2.513	2.457	0.469
16.04	2.538	2.456	0.288
54.06	2.697	2.462	1.379
0.00	2.556	2.454	0.000
0.00	2.556	2.454	0.000
40.27	1.902	2.459	0.847
8.31	2.549	2.455	0.146
3.80	2.553	2.455	0.066
89.94	2.645	2.514	*****
0.00	2.556	2.454	0.000
0.00	2.556	2.454	0.000
56.82	2.676	2.462	1.529
0.00	2.556	2.454	0.000
0.00	2.556	2.454	0.000
89.94	2.645	2.514	*****
0.00	2.556	2.454	0.000
0.00	2.556	2.454	0.000

The Trial Failure Surface In Question Is Defined
By The Following 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	602.88	1207.19
2	653.75	1239.00
3	704.39	1271.19
4	754.78	1303.75
5	804.93	1336.70
6	854.82	1370.02
7	904.47	1403.72
8	953.86	1437.79
9	1002.99	1472.23
10	1051.86	1507.04
11	1100.47	1542.21
12	1148.81	1577.75
13	1196.88	1613.66
14	1244.68	1649.92
15	1292.21	1686.54
16	1339.46	1723.52
17	1357.57	1737.92

The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	605.82	1214.56
2	658.74	1242.83
3	711.41	1271.58
4	763.81	1300.80
5	815.95	1330.49
6	867.82	1360.65
7	919.42	1391.27
8	970.73	1422.36
9	1021.77	1453.91
10	1072.52	1485.92
11	1122.98	1518.38
12	1173.14	1551.30

13	1223.01	1584.66
14	1272.57	1618.48
15	1321.83	1652.74
16	1370.78	1687.44
17	1415.07	1719.44

Factor Of Safety For The Preceding Specified Surface = 1.994
Theta (ki = 1.0) = 88.59 Deg Lambda =
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	605.82	1214.56
2	665.75	1217.57
3	725.27	1225.09
4	784.06	1237.08
5	841.78	1253.46
6	898.11	1274.15
7	952.71	1299.02
8	1005.28	1327.93
9	1055.53	1360.73
10	1103.16	1397.22
11	1147.90	1437.19
12	1189.50	1480.42
13	1227.73	1526.67
14	1262.37	1575.66
15	1293.21	1627.13
16	1320.09	1680.77
17	1342.85	1736.29
18	1344.72	1742.06

Factor Of Safety For The Preceding Specified Surface = 2.329
Theta (ki = 1.0) = 88.15 Deg Lambda =
Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
18.00	2.027	1.398	0.325
27.00	2.061	1.438	0.510
89.94	6.378	0.001	*****
17.92	44.713	1.398	0.323
89.94	-0.631	0.848	*****
86.77	0.804	0.882	*****
85.48	0.680	0.892	*****
88.21	2.166	0.889	*****
86.00	1.341	0.909	*****
83.75	-2.260	0.783	9.133
85.62	-0.154	0.900	*****
86.95	0.646	0.961	*****
87.70	0.709	0.983	*****
89.94	1.185	1.086	*****
89.15	1.005	1.045	*****
89.19	0.780	1.047	*****
88.43	2.535	2.611	*****
87.76	3.458	1.690	*****
88.39	2.531	2.607	*****
88.36	2.528	2.603	*****

The Trial Failure Surface In Question Is Defined
By The Following 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	605.96	1214.91
2	665.48	1222.53
3	724.44	1233.61
4	782.67	1248.11
5	839.94	1265.98
6	896.08	1287.16

7	950.89	1311.57
8	1004.18	1339.14
9	1055.78	1369.77
10	1105.50	1403.35
11	1153.17	1439.78
12	1198.65	1478.92
13	1241.76	1520.65
14	1282.37	1564.82
15	1320.34	1611.28
16	1355.53	1659.88
17	1387.83	1710.44
18	1396.25	1725.49

Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2) * *
Selected ki function = Bi-linear
Selected Lambda Coefficient = 1.00
Forces from Reinforcement, Piers/Piles, Soil Nails, and Applied Forces
(if applicable) have been applied to the slice base(s)
on which they intersect.
Specified Tension Crack Water Force Factor = 0.000
Total Number of Trial Surfaces Attempted = 5000
WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 20 Iterations.
Number of Trial Surfaces with Non-Converged FS = 6
Number of Trial Surfaces with Misleading FS = 2
Number of Trial Surfaces With Valid FS = 4992
Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Attempted = 0.2 %
Statistical Data On All Valid FS Values:
FS Max = 2.437 FS Min = 1.407 FS Ave = 1.808
Standard Deviation = 0.174 Coefficient of Variation = 9.60 %
((Modified Bishop FS for Critical Surface = 1.411))
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	600.633	1201.583
2	659.402	1213.678
3	717.454	1228.842
4	774.630	1247.034
5	830.771	1268.204
6	885.723	1292.292
7	939.334	1319.234
8	991.457	1348.953
9	1041.946	1381.369
10	1090.664	1416.392
11	1137.475	1453.925
12	1182.251	1493.864
13	1224.867	1536.100
14	1265.206	1580.516
15	1303.157	1626.988
16	1338.615	1675.390
17	1371.482	1725.587
18	1375.339	1732.213

Circle Center At X = 400.259 ; Y = 2324.965 ; and Radius = 1141.112
*** FOS = 1.407 Theta (ki=1.0) = 29.99 ***
Lambda = 0.577
Individual data on the 40 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	2.2	936.5	0.0	0.0	0.	0.	93.7	0.0	0.0
2	17.1	70052.8	0.0	3955.6	0.	0.	7005.3	0.0	0.0
3	39.4	262499.3	0.0	39083.0	0.	0.	26249.9	0.0	0.0
4	10.6	61095.8	0.0	17696.6	0.	0.	6109.6	0.0	0.0

5	20.0	184606.6	0.0	40826.0	0.	0.	18460.7	0.0	0.0
6	27.5	338580.5	0.0	71860.4	0.	0.	33858.0	0.0	0.0
7	22.5	251371.3	0.0	73028.7	0.	0.	25137.1	0.0	0.0
8	20.0	283148.2	0.0	73953.2	0.	0.	28314.8	0.0	0.0
9	14.6	254165.5	0.0	59555.8	0.	0.	25416.6	0.0	0.0
10	35.4	562002.2	0.0	*******	0.	0.	56200.2	0.0	0.0
11	20.0	365830.7	0.0	*******	0.	0.	36583.1	0.0	0.0
12	0.8	16783.6	0.0	4123.4	0.	0.	1678.4	0.0	0.0
13	49.2	982910.8	0.0	*******	0.	0.	98291.1	0.0	0.0
14	5.7	109649.4	0.0	35972.6	0.	0.	10964.9	0.0	0.0
15	14.3	321020.4	0.0	93889.2	0.	0.	32102.0	0.0	0.0
16	39.3	912840.7	0.0	*******	0.	0.	91284.1	0.0	0.0
17	10.7	224775.8	0.0	78898.9	0.	0.	22477.6	0.0	0.0
18	20.0	475144.4	0.0	*******	0.	0.	47514.4	0.0	0.0
19	21.5	556417.3	0.0	*******	0.	0.	55641.7	0.0	0.0
20	28.5	668222.8	0.0	*******	0.	0.	66822.3	0.0	0.0
21	20.0	499293.0	0.0	*******	0.	0.	49929.3	0.0	0.0
22	1.9	54357.8	0.0	16102.1	0.	0.	5435.8	0.0	0.0
23	48.1	1200096.9	0.0	*******	0.	0.	*******	0.0	0.0
24	0.7	14756.6	0.0	5686.9	0.	0.	1475.7	0.0	0.0
25	19.3	483945.6	0.0	*******	0.	0.	48394.6	0.0	0.0
26	27.5	712154.0	0.0	*******	0.	0.	71215.4	0.0	0.0
27	22.5	505565.4	0.0	*******	0.	0.	50556.5	0.0	0.0
28	20.0	468809.1	0.0	*******	0.	0.	46880.9	0.0	0.0
29	2.3	58353.9	0.0	19116.8	0.	0.	5835.4	0.0	0.0
30	42.6	949399.6	0.0	*******	0.	0.	94940.0	0.0	0.0
31	5.1	94079.1	0.0	43254.7	0.	0.	9407.9	0.0	0.0
32	20.0	403383.5	0.0	*******	0.	0.	40338.4	0.0	0.0
33	15.2	320787.0	0.0	*******	0.	0.	32078.7	0.0	0.0
34	34.8	563657.9	0.0	*******	0.	0.	56365.8	0.0	0.0
35	3.2	41092.6	0.0	4787.8	0.	0.	4109.3	0.0	0.0
36	8.9	126645.9	0.0	6245.7	0.	0.	12664.6	0.0	0.0
37	7.9	124758.2	0.0	0.0	0.	0.	12475.8	0.0	0.0
38	18.6	258994.9	0.0	0.0	0.	0.	25899.5	0.0	0.0
39	32.9	207409.2	0.0	0.0	0.	0.	20740.9	0.0	0.0
40	3.9	2502.6	0.0	0.0	0.	0.	250.3	0.0	0.0

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	600.493	1201.233
2	659.290	1213.189
3	717.438	1227.982
4	774.800	1245.576
5	831.242	1265.931
6	886.631	1288.997
7	940.837	1314.722
8	993.731	1343.044
9	1045.191	1373.897
10	1095.094	1407.209
11	1143.324	1442.901
12	1189.767	1480.888
13	1234.313	1521.083
14	1276.859	1563.390
15	1317.304	1607.709
16	1355.552	1653.937
17	1391.515	1701.965
18	1405.420	1722.544

Circle Center At X = 384.213 ; Y = 2417.255 ; and Radius = 1235.106

*** FOS = 1.415 Theta (ki=1.0) = 29.11 ***

Lambda = 0.557

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	601.615	1204.038
2	660.728	1214.318
3	719.186	1227.835
4	776.811	1244.548

```
    5        833.430     1264.405
    6        888.870     1287.348
    7        942.965     1313.305
    8        995.549     1342.200
    9       1046.464     1373.944
   10       1095.555     1408.441
   11       1142.674     1445.586
   12       1187.679     1485.267
   13       1230.432     1527.365
   14       1270.804     1571.750
   15       1308.673     1618.290
   16       1343.924     1666.843
   17       1376.451     1717.261
   18       1383.479     1729.596
Circle Center At X =   445.001 ; Y =  2281.392 ; and Radius =  1088.678
***  FOS =     1.415   Theta (ki=1.0) =    29.53  ***
                     Lambda =   0.566
Failure Surface Specified By 18 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        601.755     1204.389
    2        660.921     1214.361
    3        719.404     1227.766
    4        777.006     1244.559
    5        833.531     1264.682
    6        888.787     1288.067
    7        942.584     1314.634
    8        994.741     1344.293
    9       1045.080     1376.943
   10       1093.430     1412.472
   11       1139.625     1450.760
   12       1183.509     1491.677
   13       1224.933     1535.083
   14       1263.755     1580.831
   15       1299.843     1628.764
   16       1333.075     1678.720
   17       1363.338     1730.530
   18       1365.759     1735.292
Circle Center At X =   460.704 ; Y =  2222.546 ; and Radius =  1027.881
***  FOS =     1.416   Theta (ki=1.0) =    29.89  ***
                     Lambda =   0.575
Failure Surface Specified By 18 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        601.054     1202.635
    2        660.330     1211.930
    3        719.005     1224.467
    4        776.903     1240.210
    5        833.849     1259.111
    6        889.669     1281.112
    7        944.196     1306.148
    8        997.265     1334.142
    9       1048.716     1365.011
   10       1098.392     1398.660
   11       1146.144     1434.988
   12       1191.828     1473.885
   13       1235.305     1515.234
   14       1276.445     1558.909
   15       1315.122     1604.780
   16       1351.219     1652.706
   17       1384.629     1702.544
   18       1397.927     1724.952
Circle Center At X =   462.378 ; Y =  2283.241 ; and Radius =  1089.467
***  FOS =     1.420   Theta (ki=1.0) =    29.00  ***
                     Lambda =   0.554
Failure Surface Specified By 18 Coordinate Points
  Point      X-Surf      Y-Surf
```

No.	(ft)	(ft)
1	600.774	1201.934
2	659.251	1215.366
3	717.074	1231.383
4	774.127	1249.953
5	830.300	1271.041
6	885.479	1294.604
7	939.557	1320.596
8	992.427	1348.965
9	1043.983	1379.656
10	1094.125	1412.607
11	1142.754	1447.754
12	1189.772	1485.027
13	1235.087	1524.352
14	1278.611	1565.653
15	1320.255	1608.847
16	1359.940	1653.848
17	1397.585	1700.569
18	1412.146	1720.382

Circle Center At X = 328.806 ; Y = 2521.689 ; and Radius = 1347.486
*** FOS = 1.421 Theta (ki=1.0) = 28.97 ***
Lambda = 0.554
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	601.475	1203.688
2	659.628	1218.460
3	717.080	1235.760
4	773.721	1255.552
5	829.444	1277.800
6	884.142	1302.462
7	937.710	1329.489
8	990.046	1358.831
9	1041.050	1390.431
10	1090.625	1424.229
11	1138.676	1460.160
12	1185.112	1498.157
13	1229.843	1538.146
14	1272.785	1580.051
15	1313.854	1623.792
16	1352.974	1669.285
17	1390.069	1716.444
18	1396.508	1725.408

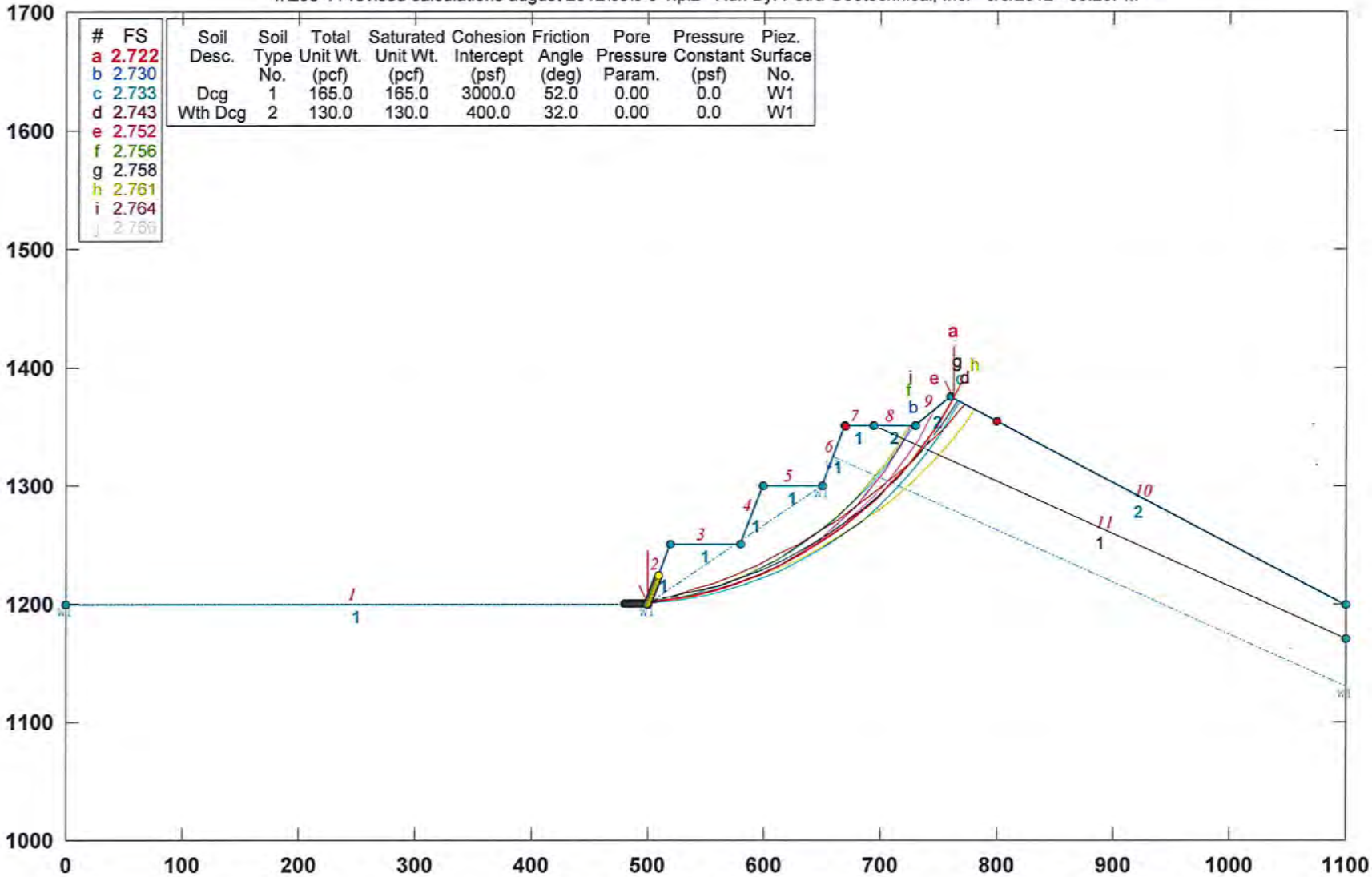
Circle Center At X = 293.183 ; Y = 2540.104 ; and Radius = 1371.515
*** FOS = 1.422 Theta (ki=1.0) = 29.57 ***
Lambda = 0.567
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	603.298	1208.246
2	662.703	1216.678
3	721.510	1228.584
4	779.516	1243.923
5	836.522	1262.641
6	892.330	1284.673
7	946.748	1309.945
8	999.589	1338.368
9	1050.670	1369.844
10	1099.814	1404.266
11	1146.852	1441.513
12	1191.623	1481.459
13	1233.970	1523.964
14	1273.749	1568.882
15	1310.822	1616.058
16	1345.060	1665.330
17	1376.347	1716.527
18	1383.339	1729.641

```
Circle Center At X =   490.014 ; Y =  2221.919 ; and Radius =  1019.984
***  FOS =     1.429   Theta (ki=1.0) =    29.24  ***
                   Lambda =   0.560
Failure Surface Specified By 18 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        601.194      1202.986
    2        660.513      1212.002
    3        719.264      1224.180
    4        777.280      1239.484
    5        834.393      1257.870
    6        890.441      1279.287
    7        945.262      1303.673
    8        998.699      1330.957
    9       1050.600      1361.062
   10       1100.815      1393.901
   11       1149.202      1429.381
   12       1195.620      1467.399
   13       1239.937      1507.846
   14       1282.026      1550.607
   15       1321.766      1595.559
   16       1359.044      1642.574
   17       1393.752      1691.516
   18       1412.011      1720.425
Circle Center At X =   463.166 ; Y =  2313.260 ; and Radius =  1118.821
***  FOS =     1.429   Theta (ki=1.0) =    28.54  ***
                   Lambda =   0.544
Failure Surface Specified By 18 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        603.158      1207.895
    2        662.623      1215.889
    3        721.489      1227.502
    4        779.535      1242.690
    5        836.544      1261.396
    6        892.304      1283.552
    7        946.605      1309.073
    8        999.246      1337.864
    9       1050.029      1369.819
   10       1098.765      1404.817
   11       1145.270      1442.727
   12       1189.373      1483.409
   13       1230.907      1526.709
   14       1269.717      1572.467
   15       1305.659      1620.510
   16       1338.598      1670.660
   17       1368.411      1722.729
   18       1373.403      1732.835
Circle Center At X =   502.598 ; Y =  2183.008 ; and Radius =   980.285
***  FOS =     1.429   Theta (ki=1.0) =    29.45  ***
                   Lambda =   0.565
          **** END OF GSTABL7 OUTPUT ****
```

3M Moody Flats Section C-C' Spencer Method - GW - Static

f:\293-11 revised calculations august 2012\cc\c-c-1.pl2 Run By: Petra Geotechnical, Inc. 8/6/2012 03:23PM



GSTABL7 v.2 FSmin=2.722

Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2)

GSTABL7

```
                    *** GSTABL7 ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
          (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                 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,
      Nonlinear Undrained Shear Strength, Curved Phi Envelope,
      Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
      Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************
Analysis Run Date:        8/6/2012
Time of Run:              03:23PM
Run By:                   Petra Geotechnical, Inc.
Input Data Filename:      f:\293-11 Revised Calculations August 2012\CC\c-c-1.
Output Filename:          f:\293-11 Revised Calculations August 2012\CC\c-c-1.OUT
Unit System:              English
Plotted Output Filename:  f:\293-11 Revised Calculations August 2012\CC\c-c-1.PLT
PROBLEM DESCRIPTION:  3M Moody Flats  Section C-C'
                      Spencer Method - GW - Static
BOUNDARY COORDINATES
   10 Top   Boundaries
   11 Total Boundaries
Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
   No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
    1         0.00    1200.00     500.00    1200.00        1
    2       500.00    1200.00     520.00    1250.00        1
    3       520.00    1250.00     580.00    1250.00        1
    4       580.00    1250.00     600.00    1300.00        1
    5       600.00    1300.00     650.00    1300.00        1
    6       650.00    1300.00     670.00    1350.00        1
    7       670.00    1350.00     695.00    1350.00        1
    8       695.00    1350.00     730.00    1350.00        2
    9       730.00    1350.00     760.00    1375.00        2
   10       760.00    1375.00    1100.00    1200.00        2
   11       695.00    1350.00    1100.00    1170.00        1
User Specified Y-Origin =      1000.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
  2 Type(s) of Soil
Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
 No.  (pcf)    (pcf)     (psf)     (deg)    Param.   (psf)     No.
  1   165.0    165.0    3000.0     52.0    0.00      0.0       1
  2   130.0    130.0     400.0     32.0    0.00      0.0       1
1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water =  62.40 (pcf)
Piezometric Surface No.  1 Specified by  5 Coordinate Points
Pore Pressure Inclination Factor =  0.50
  Point      X-Water     Y-Water
   No.        (ft)        (ft)
    1         0.00     1200.00
    2       500.00     1200.00
    3       650.00     1300.00
    4       660.00     1325.00
    5      1100.00     1130.00
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
5000 Trial Surfaces Have Been Generated.
  10 Surface(s) Initiate(s) From Each Of   500 Points Equally Spaced
Along The Ground Surface Between  X = 480.00(ft)
                              and  X = 510.00(ft)
Each Surface Terminates Between   X = 670.00(ft)
                              and  X = 800.00(ft)
```

Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
20.00(ft) Line Segments Define Each Trial Failure Surface.
Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	3.508	3.286	0.315
26.25	3.440	3.291	0.493
49.85	3.706	3.308	1.185
7.53	3.537	3.280	0.132
0.00	3.549	3.275	0.000
89.94	3.591	3.398	*****
89.94	3.591	3.398	*****
0.00	3.549	3.275	0.000
89.94	3.591	3.398	*****
89.94	3.591	3.398	*****
0.00	3.549	3.275	0.000
89.94	3.591	3.398	*****
89.94	3.591	3.398	*****
0.00	3.549	3.275	0.000
89.94	3.591	3.398	*****
89.94	3.591	3.398	*****
0.00	3.549	3.275	0.000
89.94	3.591	3.398	*****
89.94	3.591	3.398	*****
0.00	3.549	3.275	0.000

The Trial Failure Surface In Question Is Defined
By The Following 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.08	1200.20
2	517.49	1210.05
3	534.87	1219.94
4	552.23	1229.87
5	569.56	1239.85
6	586.87	1249.87
7	604.16	1259.92
8	621.42	1270.02
9	638.66	1280.17
10	655.87	1290.35
11	673.06	1300.57
12	690.23	1310.84
13	707.37	1321.15
14	724.48	1331.49
15	741.57	1341.88
16	758.64	1352.31
17	775.68	1362.79
18	779.34	1365.05

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	3.374	3.157	0.315
26.25	3.303	3.164	0.493
46.89	3.770	3.183	1.068
17.71	3.373	3.157	0.319
0.00	3.423	3.143	0.000
89.94	3.542	3.326	*****
89.94	3.542	3.326	*****
0.00	3.423	3.137	0.000
89.94	3.542	3.326	*****
89.94	3.542	3.326	*****
0.00	3.423	3.143	0.000
89.94	3.542	3.326	*****

89.94	3.542	3.326	*****
0.00	3.423	3.137	0.000
89.94	3.542	3.326	*****
89.94	3.542	3.326	*****
0.00	3.423	3.143	0.000
89.94	3.542	3.326	*****
89.94	3.542	3.326	*****
0.00	3.423	3.137	0.000

The Trial Failure Surface In Question Is Defined
By The Following 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.08	1200.20
2	517.81	1209.45
3	535.46	1218.86
4	553.04	1228.40
5	570.53	1238.09
6	587.95	1247.93
7	605.28	1257.91
8	622.53	1268.03
9	639.70	1278.29
10	656.78	1288.70
11	673.77	1299.24
12	690.68	1309.93
13	707.49	1320.75
14	724.22	1331.72
15	740.86	1342.82
16	757.40	1354.06
17	773.85	1365.43
18	775.85	1366.84

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	3.698	3.575	0.315
26.25	3.660	3.577	0.493
50.39	3.950	3.585	1.208
16.79	3.700	3.575	0.302
0.00	3.727	3.570	0.000
89.94	3.791	3.635	*****
40.36	2.940	3.581	0.850
77.01	3.806	3.603	4.334
65.24	3.829	3.592	2.169
89.94	3.791	3.635	*****
89.94	3.791	3.635	*****
89.94	3.791	3.635	*****
89.94	3.791	3.635	*****
0.00	3.727	3.570	0.000
89.94	3.791	3.635	*****
89.94	3.791	3.635	*****
0.00	3.727	3.570	0.000
89.94	3.791	3.635	*****
89.94	3.791	3.635	*****
0.00	3.727	3.570	0.000

The Trial Failure Surface In Question Is Defined
By The Following 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.26	1200.65
2	517.69	1210.47
3	534.98	1220.51
4	552.14	1230.78
5	569.17	1241.28
6	586.05	1251.99
7	602.80	1262.93
8	619.40	1274.08

9	635.85	1285.45
10	652.16	1297.04
11	668.31	1308.83
12	684.30	1320.84
13	700.14	1333.06
14	715.81	1345.48
15	721.37	1350.00

Factor Of Safety Calculation By GLE (Spencer's) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	3.514	3.377	0.315
26.25	3.465	3.382	0.493
44.13	3.709	3.395	0.970
17.71	3.513	3.377	0.319
0.00	3.554	3.366	0.000
84.94	3.746	3.492	*****
0.00	3.554	3.366	0.000
0.00	3.554	3.366	0.000
89.94	3.758	3.548	*****
0.00	3.554	3.366	0.000
0.00	3.554	3.366	0.000
89.94	3.758	3.548	*****
0.00	3.554	3.366	0.000
0.00	3.554	3.366	0.000
89.94	3.758	3.548	*****
0.00	3.554	3.366	0.000
0.00	3.554	3.366	0.000
89.94	3.758	3.548	*****
0.00	3.554	3.366	0.000
0.00	3.554	3.366	0.000

The Trial Failure Surface In Question Is Defined
By The Following 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.26	1200.65
2	518.16	1209.57
3	535.84	1218.92
4	553.29	1228.70
5	570.48	1238.91
6	587.43	1249.54
7	604.10	1260.58
8	620.50	1272.02
9	636.62	1283.87
10	652.44	1296.11
11	667.95	1308.73
12	683.15	1321.73
13	698.03	1335.09
14	712.57	1348.82
15	713.76	1350.00

Factor Of Safety Calculation By GLE (Spencer's) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	3.843	3.755	0.315
26.25	3.817	3.757	0.493
50.87	4.070	3.764	1.229
18.26	3.842	3.755	0.330
0.00	3.865	3.751	0.000
89.94	3.917	3.804	*****
41.04	3.330	3.761	0.871
76.43	3.930	3.779	4.142
64.20	3.954	3.770	2.069
89.94	3.917	3.804	*****
89.94	3.917	3.804	*****

89.94	3.917	3.804	*****
0.00	3.865	3.751	0.000
0.00	3.865	3.751	0.000
89.94	3.917	3.804	*****
0.00	3.865	3.751	0.000
0.00	3.865	3.751	0.000
89.94	3.917	3.804	*****
0.00	3.865	3.751	0.000
0.00	3.865	3.751	0.000

The Trial Failure Surface In Question Is Defined
By The Following 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.56	1201.40
2	518.02	1211.16
3	535.31	1221.22
4	552.41	1231.58
5	569.33	1242.25
6	586.05	1253.21
7	602.58	1264.47
8	618.91	1276.03
9	635.03	1287.86
10	650.94	1299.98
11	666.63	1312.39
12	682.10	1325.06
13	697.34	1338.01
14	710.95	1350.00

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	3.483	3.233	0.315
26.25	3.394	3.240	0.493
45.13	3.834	3.257	1.004
17.09	3.485	3.233	0.307
0.00	3.536	3.220	0.000
89.94	3.618	3.389	*****
89.94	3.618	3.389	*****
12.25	3.506	3.229	0.217
89.94	3.618	3.389	*****
89.94	3.618	3.389	*****
89.94	3.618	3.389	*****
89.94	3.618	3.389	*****
0.00	3.536	3.220	0.000
89.94	3.618	3.389	*****
89.94	3.618	3.389	*****
0.00	3.536	3.220	0.000
89.94	3.618	3.389	*****
89.94	3.618	3.389	*****
0.00	3.536	3.220	0.000
89.94	3.618	3.389	*****

The Trial Failure Surface In Question Is Defined
By The Following 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.68	1201.70
2	518.36	1211.06
3	535.99	1220.49
4	553.58	1230.02
5	571.12	1239.62
6	588.62	1249.31
7	606.07	1259.08
8	623.47	1268.93
9	640.83	1278.87
10	658.14	1288.89
11	675.40	1298.99

12	692.62	1309.17
13	709.78	1319.44
14	726.90	1329.79
15	743.96	1340.21
16	760.98	1350.72
17	777.95	1361.31
18	781.83	1363.76

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	3.611	3.439	0.315
26.25	3.553	3.442	0.493
47.30	4.028	3.453	1.084
19.56	3.602	3.440	0.355
0.00	3.652	3.432	0.000
89.94	3.773	3.548	*****
0.00	3.652	3.432	0.000
0.00	3.652	3.432	0.000
89.94	3.773	3.548	*****
0.00	3.652	3.432	0.000
0.00	3.652	3.432	0.000
89.94	3.773	3.548	*****
0.00	3.652	3.432	0.000
0.00	3.652	3.432	0.000
89.94	3.773	3.548	*****
0.00	3.652	3.432	0.000
0.00	3.652	3.432	0.000

The Trial Failure Surface In Question Is Defined
By The Following 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.68	1201.70
2	518.36	1211.06
3	535.90	1220.67
4	553.30	1230.53
5	570.55	1240.64
6	587.66	1251.00
7	604.62	1261.60
8	621.43	1272.44
9	638.08	1283.52
10	654.57	1294.84
11	670.89	1306.40
12	687.05	1318.19
13	703.03	1330.21
14	718.84	1342.45
15	728.30	1350.00

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	3.531	3.274	0.315
26.25	3.403	3.280	0.493
37.05	4.013	3.288	0.755
23.29	3.472	3.278	0.431
12.01	3.557	3.270	0.213
58.34	3.682	3.309	1.622
0.00	3.586	3.262	0.000
0.00	3.586	3.262	0.000
41.95	3.797	3.292	0.899
0.00	3.586	3.262	0.000
0.00	3.586	3.262	0.000

89.94	3.630	3.416	*****
89.94	3.630	3.416	*****
0.00	3.586	3.262	0.000
89.94	3.630	3.416	*****
89.94	3.630	3.416	*****
0.00	3.586	3.262	0.000
89.94	3.630	3.416	*****
89.94	3.630	3.416	*****
0.00	3.586	3.262	0.000

The Trial Failure Surface In Question Is Defined
By The Following 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.86	1202.15
2	518.62	1211.36
3	536.36	1220.59
4	554.09	1229.84
5	571.82	1239.10
6	589.54	1248.38
7	607.24	1257.68
8	624.94	1266.99
9	642.63	1276.33
10	660.31	1285.68
11	677.98	1295.05
12	695.64	1304.43
13	713.29	1313.84
14	730.93	1323.26
15	748.56	1332.70
16	766.19	1342.16
17	783.80	1351.63
18	794.35	1357.32

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	3.443	3.195	0.315
26.25	3.365	3.203	0.493
48.37	3.777	3.226	1.125
13.91	3.459	3.192	0.248
0.00	3.492	3.179	0.000
89.94	3.658	3.403	*****
89.94	3.658	3.403	*****
12.25	3.464	3.190	0.217
89.94	3.225	3.238	*****
85.37	3.637	3.344	*****
89.69	3.656	3.399	*****
89.94	3.658	3.403	*****
89.94	3.658	3.403	*****
0.00	3.492	3.179	0.000
89.94	3.658	3.403	*****
89.94	3.658	3.403	*****
0.00	3.492	3.179	0.000
89.94	3.658	3.403	*****
89.94	3.658	3.403	*****
0.00	3.492	3.179	0.000

The Trial Failure Surface In Question Is Defined
By The Following 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.86	1202.15
2	518.74	1211.12
3	536.52	1220.28
4	554.19	1229.64
5	571.76	1239.19
6	589.23	1248.94
7	606.58	1258.88

8	623.83	1269.01
9	640.96	1279.33
10	657.98	1289.84
11	674.88	1300.54
12	691.66	1311.42
13	708.31	1322.48
14	724.85	1333.73
15	741.26	1345.17
16	757.54	1356.78
17	773.20	1368.21

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	3.826	3.571	0.315
26.25	3.766	3.575	0.493
61.06	3.924	3.599	1.809
0.00	3.859	3.561	0.000
0.00	3.859	3.561	0.000
38.12	4.353	3.582	0.785
0.00	3.859	3.561	0.000
0.00	3.859	3.561	0.000
37.95	4.389	3.582	0.780
0.00	3.859	3.561	0.000
0.00	3.859	3.561	0.000
41.70	4.072	3.584	0.891
0.00	3.859	3.561	0.000
0.00	3.859	3.561	0.000
89.94	3.880	3.658	*****
89.94	3.880	3.658	*****
0.00	3.859	3.561	0.000
89.94	3.880	3.658	*****
89.94	3.880	3.658	*****
0.00	3.859	3.561	0.000

The Trial Failure Surface In Question Is Defined
By The Following 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	501.28	1203.21
2	518.51	1213.36
3	535.74	1223.53
4	552.95	1233.71
5	570.15	1243.92
6	587.34	1254.14
7	604.52	1264.38
8	621.69	1274.64
9	638.85	1284.91
10	656.00	1295.20
11	673.13	1305.51
12	690.26	1315.84
13	707.38	1326.18
14	724.49	1336.54
15	741.58	1346.92
16	758.67	1357.32
17	775.00	1367.28

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	3.793	3.531	0.315
26.25	3.706	3.536	0.493
47.44	4.081	3.551	1.089
13.00	3.814	3.528	0.231
0.00	3.847	3.519	0.000
89.94	3.898	3.640	*****

```
 89.94       3.898      3.640     *****
  8.92       3.827      3.525     0.157
 89.94       3.898      3.640     *****
 89.94       3.898      3.640     *****
  9.84       3.825      3.526     0.173
 89.94       3.898      3.640     *****
 89.94       3.898      3.640     *****
  0.00       3.847      3.520     0.000
 89.94       3.898      3.640     *****
 89.94       3.898      3.640     *****
  0.00       3.847      3.520     0.000
 89.94       3.898      3.640     *****
 89.94       3.898      3.640     *****
  0.00       3.847      3.520     0.000
The Trial Failure Surface In Question Is Defined
By The Following 18 Coordinate Points
  ################### SOME LINES SKIPPED ####################
      Following Are Displayed The Ten Most Critical Of The Trial
      Failure Surfaces Evaluated. They Are
      Ordered - Most Critical First.
      * * Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2) * *
      Selected ki function = Bi-linear
      Selected Lambda Coefficient =  1.00
      Forces from Reinforcement, Piers/Piles, Soil Nails, and Applied Forces
      (if applicable) have been applied to the slice base(s)
      on which they intersect.
      Specified Tension Crack Water Force Factor =   0.000
      Total Number of Trial Surfaces Attempted =  5000
      WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
      Did Not Converge in 20 Iterations.
      Number of Trial Surfaces with Non-Converged FS =   30
      Number of Trial Surfaces With Valid FS = 4970
      Percentage of Trial Surfaces With Non-Valid FS Solutions
      of the Total Attempted =   0.6 %
      Statistical Data On All Valid FS Values:
         FS Max =   4.948   FS Min =   2.722   FS Ave =   3.557
         Standard Deviation =    0.439   Coefficient of Variation =   12.35 %
                  ((Modified Bishop FS for Critical Surface =  2.718))
      Failure Surface Specified By 18 Coordinate Points
        Point      X-Surf      Y-Surf
         No.        (ft)        (ft)
          1        500.200     1200.500
          2        520.037     1203.051
          3        539.688     1206.768
          4        559.086     1211.639
          5        578.163     1217.646
          6        596.851     1224.769
          7        615.087     1232.983
          8        632.806     1242.259
          9        649.946     1252.565
         10        666.448     1263.865
         11        682.254     1276.119
         12        697.309     1289.285
         13        711.561     1303.316
         14        724.960     1318.165
         15        737.459     1333.778
         16        749.014     1350.102
         17        759.585     1367.080
         18        763.040     1373.436
      Circle Center At X =   467.146 ; Y =  1536.948 ; and Radius =   338.067
      ***  FOS =     2.722   Theta (ki=1.0) =    27.71  ***
                          Lambda =   0.525
           Individual data on the    29  slices
                      Water  Water     Tie     Tie     Earthquake
                      Force  Force    Force   Force       Force   Surcharge
Slice  Width   Weight   Top    Bot     Norm     Tan     Hor     Ver    Load
 No.    (ft)    (lbs)   (lbs)  (lbs)    (lbs)   (lbs)   (lbs)   (lbs)   (lbs)
```

1	0.7	91.0	0.0	0.0	0.	0.	0.0	0.0	0.0
2	19.1	76607.2	0.0	5234.6	0.	0.	0.0	0.0	0.0
3	0.0	285.6	0.0	20.2	0.	0.	0.0	0.0	0.0
4	19.7	146205.3	0.0	15838.6	0.	0.	0.0	0.0	0.0
5	19.4	130574.6	0.0	25049.7	0.	0.	0.0	0.0	0.0
6	19.1	111291.3	0.0	32849.0	0.	0.	0.0	0.0	0.0
7	1.8	9701.9	0.0	3604.9	0.	0.	0.0	0.0	0.0
8	16.9	137650.0	0.0	35604.5	0.	0.	0.0	0.0	0.0
9	3.1	36672.3	0.0	7318.9	0.	0.	0.0	0.0	0.0
10	15.1	175283.7	0.0	36789.8	0.	0.	0.0	0.0	0.0
11	17.7	182370.5	0.0	47529.9	0.	0.	0.0	0.0	0.0
12	17.1	148726.2	0.0	49461.1	0.	0.	0.0	0.0	0.0
13	0.1	423.6	0.0	164.2	0.	0.	0.0	0.0	0.0
14	10.0	93182.3	0.0	24300.3	0.	0.	0.0	0.0	0.0
15	6.4	75966.2	0.0	27713.4	0.	0.	0.0	0.0	0.0
16	3.6	47073.8	0.0	14445.7	0.	0.	0.0	0.0	0.0
17	12.3	158987.2	0.0	41283.6	0.	0.	0.0	0.0	0.0
18	12.7	143656.1	0.0	29697.3	0.	0.	0.0	0.0	0.0
19	2.3	23479.4	0.0	3637.9	0.	0.	0.0	0.0	0.0
20	13.4	118038.9	0.0	10355.9	0.	0.	0.0	0.0	0.0
21	0.8	6146.4	0.0	0.0	0.	0.	0.0	0.0	0.0
22	13.4	81945.8	0.0	0.0	0.	0.	0.0	0.0	0.0
23	5.0	21310.3	0.0	0.0	0.	0.	0.0	0.0	0.0
24	5.9	19661.6	0.0	0.0	0.	0.	0.0	0.0	0.0
25	1.6	4627.8	0.0	0.0	0.	0.	0.0	0.0	0.0
26	11.6	28676.6	0.0	0.0	0.	0.	0.0	0.0	0.0
27	10.6	16022.1	0.0	0.0	0.	0.	0.0	0.0	0.0
28	0.4	397.1	0.0	0.0	0.	0.	0.0	0.0	0.0
29	3.0	1414.0	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.020	1200.050
2	519.746	1203.349
3	539.223	1207.891
4	558.374	1213.656
5	577.123	1220.620
6	595.392	1228.757
7	613.111	1238.034
8	630.207	1248.413
9	646.612	1259.854
10	662.260	1272.309
11	677.089	1285.729
12	691.039	1300.061
13	704.054	1315.246
14	716.083	1331.225
15	727.076	1347.932
16	728.256	1350.000

Circle Center At X = 457.899 ; Y = 1512.833 ; and Radius = 315.606

*** FOS = 2.730 Theta (ki=1.0) = 28.05 ***

Lambda = 0.533

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.200	1200.500
2	520.134	1202.121
3	539.930	1204.976
4	559.509	1209.056
5	578.797	1214.344
6	597.720	1220.820
7	616.204	1228.459
8	634.177	1237.231
9	651.571	1247.103
10	668.318	1258.036
11	684.354	1269.988
12	699.616	1282.914
13	714.046	1296.762

```
   14        727.587     1311.480
   15        740.189     1327.011
   16        751.801     1343.295
   17        762.379     1360.268
   18        768.087     1370.838
Circle Center At X =   484.276 ; Y =  1521.365 ; and Radius =   321.259
***  FOS =     2.733   Theta (ki=1.0) =    27.29  ***
                     Lambda =   0.516
Failure Surface Specified By 18 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        500.260     1200.651
    2        519.656     1205.532
    3        538.839     1211.187
    4        557.781     1217.608
    5        576.449     1224.783
    6        594.815     1232.701
    7        612.848     1241.350
    8        630.520     1250.715
    9        647.802     1260.782
   10        664.666     1271.534
   11        681.085     1282.954
   12        697.033     1295.023
   13        712.483     1307.723
   14        727.412     1321.032
   15        741.795     1334.929
   16        755.608     1349.393
   17        768.831     1364.398
   18        772.300     1368.669
Circle Center At X =   388.625 ; Y =  1685.639 ; and Radius =   497.670
***  FOS =     2.743   Theta (ki=1.0) =    29.20  ***
                     Lambda =   0.559
Failure Surface Specified By 17 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        500.381     1200.951
    2        520.267     1203.083
    3        539.969     1206.522
    4        559.401     1211.254
    5        578.479     1217.258
    6        597.119     1224.507
    7        615.240     1232.970
    8        632.763     1242.610
    9        649.612     1253.385
   10        665.714     1265.249
   11        680.997     1278.149
   12        695.396     1292.030
   13        708.848     1306.830
   14        721.294     1322.485
   15        732.680     1338.928
   16        742.957     1356.086
   17        747.172     1364.310
Circle Center At X =   478.048 ; Y =  1503.092 ; and Radius =   302.965
***  FOS =     2.752   Theta (ki=1.0) =    26.82  ***
                     Lambda =   0.506
Failure Surface Specified By 15 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        500.561     1201.402
    2        520.342     1204.355
    3        539.879     1208.630
    4        559.086     1214.209
    5        577.874     1221.066
    6        596.158     1229.169
    7        613.857     1238.484
    8        630.890     1248.966
    9        647.180     1260.569
```

```
   10        662.653     1273.241
   11        677.240     1286.924
   12        690.875     1301.556
   13        703.495     1317.071
   14        715.045     1333.400
   15        725.185     1350.000
Circle Center At X =   466.560 ; Y =  1496.908 ; and Radius =   297.455
***  FOS =     2.756   Theta (ki=1.0) =    27.95  ***
                     Lambda =   0.531
Failure Surface Specified By 18 Coordinate Points
  Point       X-Surf      Y-Surf
   No.         (ft)        (ft)
    1        501.102     1202.755
    2        520.885     1205.694
    3        540.476     1209.717
    4        559.817     1214.811
    5        578.847     1220.961
    6        597.511     1228.149
    7        615.751     1236.353
    8        633.512     1245.548
    9        650.740     1255.706
   10        667.384     1266.796
   11        683.392     1278.785
   12        698.717     1291.636
   13        713.311     1305.312
   14        727.131     1319.769
   15        740.135     1334.964
   16        752.283     1350.852
   17        763.539     1367.384
   18        766.206     1371.806
Circle Center At X =   457.790 ; Y =  1563.069 ; and Radius =   362.907
***  FOS =     2.758   Theta (ki=1.0) =    27.98  ***
                     Lambda =   0.531
Failure Surface Specified By 18 Coordinate Points
  Point       X-Surf      Y-Surf
   No.         (ft)        (ft)
    1        500.441     1201.102
    2        520.269     1203.716
    3        539.942     1207.320
    4        559.409     1211.907
    5        578.621     1217.464
    6        597.531     1223.977
    7        616.090     1231.429
    8        634.253     1239.803
    9        651.973     1249.077
   10        669.205     1259.228
   11        685.907     1270.230
   12        702.037     1282.056
   13        717.553     1294.675
   14        732.417     1308.056
   15        746.592     1322.166
   16        760.041     1336.968
   17        772.731     1352.427
   18        781.319     1364.027
Circle Center At X =   458.422 ; Y =  1597.115 ; and Radius =   398.237
***  FOS =     2.761   Theta (ki=1.0) =    27.09  ***
                     Lambda =   0.511
Failure Surface Specified By 16 Coordinate Points
  Point       X-Surf      Y-Surf
   No.         (ft)        (ft)
    1        500.621     1201.553
    2        520.563     1203.076
    3        540.329     1206.127
    4        559.801     1210.690
    5        578.866     1216.735
    6        597.409     1224.228
    7        615.321     1233.125
```

```
    8        632.497      1243.372
    9        648.834      1254.909
   10        664.235      1267.668
   11        678.610      1281.574
   12        691.874      1296.543
   13        703.948      1312.487
   14        714.760      1329.313
   15        724.247      1346.919
   16        725.612      1350.000
Circle Center At X =   490.923 ; Y =  1460.977 ; and Radius =   259.606
***  FOS =     2.764   Theta (ki=1.0) =    26.95  ***
                    Lambda =   0.508
Failure Surface Specified By 18 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        501.162      1202.905
    2        521.043      1205.080
    3        540.757      1208.453
    4        560.231      1213.011
    5        579.394      1218.737
    6        598.175      1225.611
    7        616.507      1233.607
    8        634.323      1242.696
    9        651.556      1252.845
   10        668.145      1264.017
   11        684.028      1276.171
   12        699.148      1289.263
   13        713.449      1303.244
   14        726.879      1318.064
   15        739.389      1333.669
   16        750.933      1350.001
   17        761.469      1367.001
   18        764.525      1372.671
Circle Center At X =   475.317 ; Y =  1532.165 ; and Radius =   330.273
***  FOS =     2.766   Theta (ki=1.0) =    27.43  ***
                    Lambda =   0.519
          **** END OF GSTABL7 OUTPUT ****
```

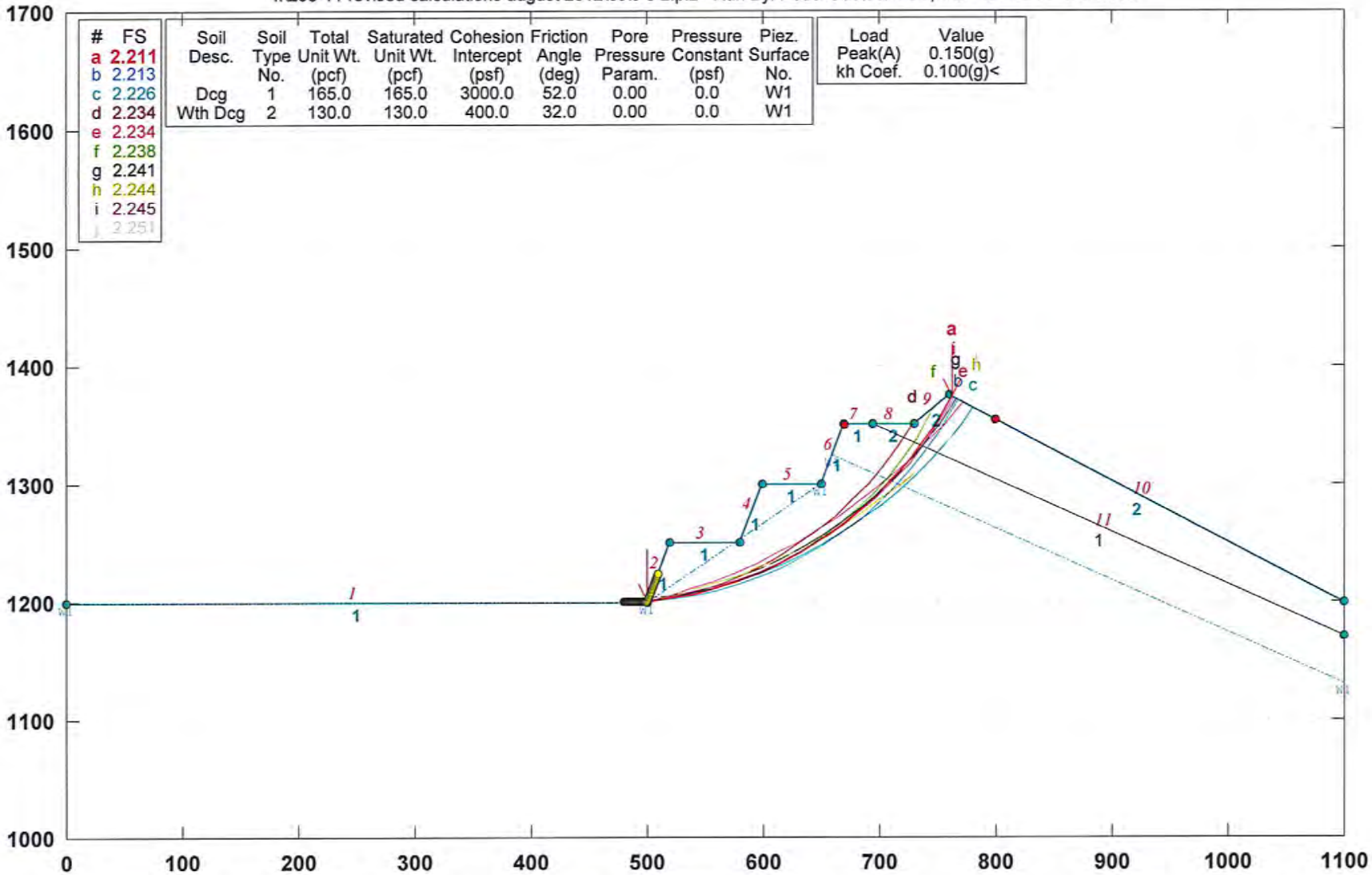
3M Moody Flats Section C-C' Spencer Method - GW - Earthquake

f:\293-11 revised calculations august 2012\cc\c-c-2.pl2 Run By: Petra Geotechnical, Inc. 8/6/2012 03:25PM

#	FS
a	2.211
b	2.213
c	2.226
d	2.234
e	2.234
f	2.238
g	2.241
h	2.244
i	2.245
j	2.251

Soil Desc.	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.
Dcg	1	165.0	165.0	3000.0	52.0	0.00	0.0	W1
Wth Dcg	2	130.0	130.0	400.0	32.0	0.00	0.0	W1

Load	Value
Peak(A)	0.150(g)
kh Coef.	0.100(g)<



GSTABL7 v.2 FSmin=2.211

Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2)

GSTABL7

```
                    *** GSTABL7 ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
          (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                  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,
      Nonlinear Undrained Shear Strength, Curved Phi Envelope,
      Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
      Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************
Analysis Run Date:        8/6/2012
Time of Run:              03:25PM
Run By:                   Petra Geotechnical, Inc.
Input Data Filename:      f:\293-11 Revised Calculations August 2012\CC\c-c-2.
Output Filename:          f:\293-11 Revised Calculations August 2012\CC\c-c-2.OUT
Unit System:              English
Plotted Output Filename:  f:\293-11 Revised Calculations August 2012\CC\c-c-2.PLT
PROBLEM DESCRIPTION:  3M Moody Flats  Section C-C'
                      Spencer Method - GW - Earthquake
BOUNDARY COORDINATES
   10 Top   Boundaries
   11 Total Boundaries
Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
   No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
    1         0.00    1200.00     500.00    1200.00        1
    2       500.00    1200.00     520.00    1250.00        1
    3       520.00    1250.00     580.00    1250.00        1
    4       580.00    1250.00     600.00    1300.00        1
    5       600.00    1300.00     650.00    1300.00        1
    6       650.00    1300.00     670.00    1350.00        1
    7       670.00    1350.00     695.00    1350.00        1
    8       695.00    1350.00     730.00    1350.00        2
    9       730.00    1350.00     760.00    1375.00        2
   10       760.00    1375.00    1100.00    1200.00        2
   11       695.00    1350.00    1100.00    1170.00        1
User Specified Y-Origin =      1000.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
  2 Type(s) of Soil
Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
 No.  (pcf)    (pcf)     (psf)     (deg)    Param.   (psf)     No.
  1   165.0    165.0    3000.0     52.0    0.00      0.0       1
  2   130.0    130.0     400.0     32.0    0.00      0.0       1
1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water =  62.40 (pcf)
Piezometric Surface No.  1 Specified by  5 Coordinate Points
Pore Pressure Inclination Factor =  0.50
  Point      X-Water     Y-Water
   No.        (ft)        (ft)
    1         0.00     1200.00
    2       500.00     1200.00
    3       650.00     1300.00
    4       660.00     1325.00
    5      1100.00     1130.00
Specified Peak Ground Acceleration Coefficient (A) =   0.150(g)
Specified Horizontal Earthquake Coefficient (kh) =   0.100(g)
Specified Vertical Earthquake Coefficient (kv) =   0.000(g)
Specified Seismic Pore-Pressure Factor =   0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
5000 Trial Surfaces Have Been Generated.
  10 Surface(s) Initiate(s) From Each Of   500 Points Equally Spaced
```

Along The Ground Surface Between X = 480.00(ft)
and X = 510.00(ft)
Each Surface Terminates Between X = 670.00(ft)
and X = 800.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
20.00(ft) Line Segments Define Each Trial Failure Surface.
Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	2.891	2.704	0.306
25.50	2.843	2.709	0.477
54.15	3.021	2.730	1.384
0.00	2.922	2.694	0.000
0.00	2.922	2.694	0.000
29.76	2.776	2.711	0.572
45.41	3.096	2.722	1.014
25.41	2.844	2.709	0.475
3.68	2.917	2.696	0.064
77.78	2.978	2.767	4.617
89.94	1.216	1.048	*****
89.94	0.000	1.038	*****
0.00	2.922	2.694	0.000
0.00	2.922	2.694	0.000
0.00	2.922	2.694	0.000
0.00	2.922	2.694	0.000
0.00	2.922	2.694	0.000
0.00	2.922	2.694	0.000
0.00	2.922	2.694	0.000
0.00	2.922	2.694	0.000

The Trial Failure Surface In Question Is Defined
By The Following 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.08	1200.20
2	517.49	1210.05
3	534.87	1219.94
4	552.23	1229.87
5	569.56	1239.85
6	586.87	1249.87
7	604.16	1259.92
8	621.42	1270.02
9	638.66	1280.17
10	655.87	1290.35
11	673.06	1300.57
12	690.23	1310.84
13	707.37	1321.15
14	724.48	1331.49
15	741.57	1341.88
16	758.64	1352.31
17	775.68	1362.79
18	779.34	1365.05

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	2.776	2.600	0.306
25.50	2.727	2.606	0.477
50.20	3.007	2.627	1.200
10.12	2.795	2.595	0.178
0.00	2.811	2.588	0.000
89.94	2.946	2.802	*****
89.94	2.946	2.802	*****
5.35	2.804	2.592	0.094

89.94	2.946	2.802	*****
89.94	2.946	2.802	*****
89.94	0.000	-0.004	*****
89.94	0.589	0.835	*****
0.00	2.811	2.588	0.000
27.07	2.710	2.607	0.511
57.98	2.946	2.636	1.599
6.50	2.802	2.592	0.114
0.00	2.811	2.588	0.000
89.94	2.946	2.802	*****
89.94	2.946	2.802	*****
0.00	2.811	2.588	0.000

The Trial Failure Surface In Question Is Defined
By The Following 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.08	1200.20
2	517.81	1209.45
3	535.46	1218.86
4	553.04	1228.40
5	570.53	1238.09
6	587.95	1247.93
7	605.28	1257.91
8	622.53	1268.03
9	639.70	1278.29
10	656.78	1288.70
11	673.77	1299.24
12	690.68	1309.93
13	707.49	1320.75
14	724.22	1331.72
15	740.86	1342.82
16	757.40	1354.06
17	773.85	1365.43
18	775.85	1366.84

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	3.088	2.999	0.306
25.50	3.063	3.000	0.477
51.84	3.248	3.007	1.273
13.17	3.095	2.998	0.234
0.00	3.108	2.995	0.000
89.94	3.166	3.057	*****
89.94	2.596	2.388	*****
0.00	3.108	2.995	0.000
0.00	3.108	2.995	0.000
36.56	2.902	3.003	0.742
13.57	3.094	2.998	0.241
20.87	3.079	2.999	0.381
68.53	3.178	3.015	2.542
0.00	3.108	2.995	0.000
0.00	3.108	2.995	0.000
15.52	3.091	2.998	0.278
89.94	3.166	3.057	*****
0.00	3.108	2.995	0.000
89.94	2.946	2.802	*****
0.00	3.108	2.995	0.000

The Trial Failure Surface In Question Is Defined
By The Following 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.26	1200.65
2	517.69	1210.47
3	534.98	1220.51
4	552.14	1230.78

5	569.17	1241.28
6	586.05	1251.99
7	602.80	1262.93
8	619.40	1274.08
9	635.85	1285.45
10	652.16	1297.04
11	668.31	1308.83
12	684.30	1320.84
13	700.14	1333.06
14	715.81	1345.48
15	721.37	1350.00

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	2.927	2.833	0.306
25.50	2.895	2.837	0.477
44.01	3.385	2.847	0.966
22.51	2.909	2.835	0.414
10.81	2.940	2.830	0.191
58.26	3.174	2.859	1.617
0.00	2.954	2.826	0.000
0.00	2.954	2.825	0.000
0.00	2.954	2.826	0.000
36.56	2.755	2.842	0.742
16.78	2.927	2.833	0.302
23.88	2.903	2.836	0.443
46.97	4.881	2.849	1.071
22.83	2.907	2.835	0.421
13.61	2.934	2.831	0.242
54.48	3.240	2.855	1.401
0.00	2.954	2.826	0.000
0.00	2.954	2.825	0.000
89.94	2.946	2.802	*****
0.00	2.954	2.826	0.000

The Trial Failure Surface In Question Is Defined
By The Following 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.26	1200.65
2	518.16	1209.57
3	535.84	1218.92
4	553.29	1228.70
5	570.48	1238.91
6	587.43	1249.54
7	604.10	1260.58
8	620.50	1272.02
9	636.62	1283.87
10	652.44	1296.11
11	667.95	1308.73
12	683.15	1321.73
13	698.03	1335.09
14	712.57	1348.82
15	713.76	1350.00

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	2.752	2.552	0.306
25.50	2.653	2.558	0.477
35.74	3.307	2.566	0.720
23.49	2.693	2.556	0.435
15.71	2.758	2.551	0.281
45.92	2.940	2.576	1.032
0.00	2.797	2.539	0.000

0.00	2.797	2.539	0.000
41.32	2.995	2.571	0.879
0.00	2.797	2.539	0.000
0.00	2.797	2.539	0.000
36.07	3.258	2.566	0.728
0.00	2.797	2.539	0.000
0.00	2.797	2.539	0.000
29.26	2.455	2.561	0.560
17.89	2.747	2.552	0.323
23.93	2.686	2.557	0.444
39.71	3.033	2.570	0.831
15.80	2.758	2.551	0.283
0.00	2.797	2.539	0.000

The Trial Failure Surface In Question Is Defined
By The Following 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.44	1201.10
2	518.50	1209.69
3	536.53	1218.36
4	554.52	1227.10
5	572.47	1235.91
6	590.38	1244.81
7	608.26	1253.77
8	626.10	1262.82
9	643.90	1271.94
10	661.66	1281.13
11	679.38	1290.40
12	697.07	1299.74
13	714.71	1309.16
14	732.32	1318.65
15	749.88	1328.21
16	767.40	1337.85
17	784.89	1347.56
18	798.48	1355.19

Factor Of Safety Calculation By GLE (Spencer's) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	3.221	3.169	0.306
25.50	3.205	3.170	0.477
48.18	3.429	3.174	1.117
20.69	3.215	3.169	0.378
3.37	3.233	3.166	0.059
79.75	3.277	3.188	5.531
0.00	3.235	3.166	0.000
0.00	3.235	3.166	0.000
40.99	2.847	3.173	0.869
9.55	3.229	3.167	0.168
5.70	3.231	3.167	0.100
89.94	3.274	3.207	*****
0.00	3.235	3.166	0.000
0.00	3.235	3.166	0.000
29.26	3.192	3.170	0.560
46.67	3.510	3.174	1.060
27.70	3.198	3.170	0.525
19.11	3.218	3.169	0.346
45.31	3.699	3.173	1.011
15.50	3.223	3.168	0.277

The Trial Failure Surface In Question Is Defined
By The Following 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.56	1201.40
2	518.02	1211.16
3	535.31	1221.22

4	552.41	1231.58
5	569.33	1242.25
6	586.05	1253.21
7	602.58	1264.47
8	618.91	1276.03
9	635.03	1287.86
10	650.94	1299.98
11	666.63	1312.39
12	682.10	1325.06
13	697.34	1338.01
14	710.95	1350.00

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	2.853	2.650	0.306
25.50	2.790	2.656	0.477
47.19	3.092	2.674	1.080
11.91	2.871	2.646	0.211
0.00	2.893	2.638	0.000
89.94	2.989	2.831	*****
89.94	2.989	2.831	*****
11.16	2.873	2.646	0.197
89.94	2.989	2.831	*****
89.94	2.989	2.831	*****
10.44	2.875	2.645	0.184
89.94	2.989	2.831	*****
89.94	2.989	2.831	*****
0.00	2.893	2.638	0.000
89.94	2.989	2.831	*****
89.94	2.989	2.831	*****
7.47	2.881	2.643	0.131
89.94	2.989	2.831	*****
89.94	2.989	2.831	*****
0.00	2.893	2.638	0.000

The Trial Failure Surface In Question Is Defined
By The Following 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.68	1201.70
2	518.36	1211.06
3	535.99	1220.49
4	553.58	1230.02
5	571.12	1239.62
6	588.62	1249.31
7	606.07	1259.08
8	623.47	1268.93
9	640.83	1278.87
10	658.14	1288.89
11	675.40	1298.99
12	692.62	1309.17
13	709.78	1319.44
14	726.90	1329.79
15	743.96	1340.21
16	760.98	1350.72
17	777.95	1361.31
18	781.83	1363.76

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	2.998	2.868	0.306
25.50	2.959	2.871	0.477
49.17	3.252	2.880	1.157
15.69	3.002	2.867	0.281

0.00	3.027	2.863	0.000
89.94	3.146	2.988	*****
89.94	2.442	2.421	*****
6.67	3.019	2.865	0.117
89.94	2.889	2.834	*****
89.94	3.146	2.988	*****
10.44	3.013	2.866	0.184
0.00	3.027	2.863	0.000
89.94	3.146	2.988	*****
89.94	2.893	2.638	*****
89.94	3.146	2.988	*****
89.94	3.146	2.988	*****
7.47	3.018	2.865	0.131
0.00	3.027	2.863	0.000
89.94	3.146	2.988	*****
89.94	0.003	0.792	*****

The Trial Failure Surface In Question Is Defined
By The Following 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.68	1201.70
2	518.36	1211.06
3	535.90	1220.67
4	553.30	1230.53
5	570.55	1240.64
6	587.66	1251.00
7	604.62	1261.60
8	621.43	1272.44
9	638.08	1283.52
10	654.57	1294.84
11	670.89	1306.40
12	687.05	1318.19
13	703.03	1330.21
14	718.84	1342.45
15	728.30	1350.00

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	2.878	2.650	0.306
25.50	2.803	2.656	0.477
46.14	3.019	2.672	1.041
5.22	2.907	2.643	0.091
0.00	2.913	2.639	0.000
89.94	2.958	2.816	*****
89.94	2.958	2.816	*****
7.17	2.904	2.644	0.126
89.94	2.958	2.816	*****
89.94	2.958	2.816	*****
11.26	2.896	2.646	0.199
89.94	2.958	2.816	*****
89.94	2.958	2.816	*****
89.94	2.893	2.638	*****
89.94	2.958	2.816	*****
89.94	2.958	2.816	*****
7.47	2.903	2.644	0.131
89.94	2.958	2.816	*****
89.94	2.958	2.816	*****
89.94	0.003	0.792	*****

The Trial Failure Surface In Question Is Defined
By The Following 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.86	1202.15
2	518.62	1211.36
3	536.36	1220.59

4	554.09	1229.84
5	571.82	1239.10
6	589.54	1248.38
7	607.24	1257.68
8	624.94	1266.99
9	642.63	1276.33
10	660.31	1285.68
11	677.98	1295.05
12	695.64	1304.43
13	713.29	1313.84
14	730.93	1323.26
15	748.56	1332.70
16	766.19	1342.16
17	783.80	1351.63
18	794.35	1357.32

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	31.479	2.608	0.306
25.50	33.203	2.790	0.477
0.00	58.745	-0.004	0.000
70.49	-9.943	-0.007	2.823
56.90	967.491	-0.001	1.534
70.31	-2.694	-0.004	2.794
70.26	-0.768	-0.004	2.787
17.94	30.029	2.626	0.324
68.37	23.328	0.000	2.521
89.94	-0.364	-0.541	*****
89.94	-0.364	-0.541	*****
89.94	3.383	3.403	*****
89.94	2.958	3.550	*****
89.94	2.893	0.159	*****
89.94	15.434	3.551	*****
89.94	2.958	3.551	*****
7.47	26.732	2.453	0.131
87.33	26.732	0.055	*****
0.00	21.951	-0.004	0.000
0.00	21.951	-0.004	0.000

The Trial Failure Surface In Question Is Defined
By The Following 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.86	1202.15
2	520.08	1196.61
3	539.71	1192.78
4	559.60	1190.69
5	579.60	1190.35
6	599.55	1191.77
7	619.29	1194.94
8	638.69	1199.83
9	657.58	1206.40
10	675.82	1214.61
11	693.26	1224.38
12	709.79	1235.65
13	725.25	1248.33
14	739.55	1262.32
15	752.56	1277.51
16	764.19	1293.78
17	774.34	1311.01
18	782.95	1329.06
19	789.93	1347.81
20	792.77	1358.13

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta	FOS	FOS

```
 (deg)       (Moment)    (Force)
(ki=1.0)     (Equil.)    (Equil.)    Lambda
 17.00        2.833       2.634      0.306
 25.50        2.781       2.641      0.477
 52.26        3.036       2.667      1.292
  3.69        2.863       2.623      0.065
  0.00        2.868       2.620      0.000
 89.94        3.051       2.886      *****
 89.94        3.051       2.886      *****
 11.40        2.849       2.629      0.202
 89.94       23.328       0.000      *****
 10.40        2.852       2.629      0.184
  0.00        2.868       2.620      0.000
 89.94        3.051       2.886      *****
 89.94        3.051       2.886      *****
 89.94        2.893       0.159      *****
 89.94        3.051       2.886      *****
 #################### SOME LINES SKIPPED ####################
     Following Are Displayed The Ten Most Critical Of The Trial
     Failure Surfaces Evaluated. They Are
     Ordered - Most Critical First.
     * * Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2) * *
     Selected ki function = Bi-linear
     Selected Lambda Coefficient =  1.00
     Forces from Reinforcement, Piers/Piles, Soil Nails, and Applied Forces
     (if applicable) have been applied to the slice base(s)
     on which they intersect.
     Specified Tension Crack Water Force Factor =   0.000
     Total Number of Trial Surfaces Attempted =  5000
     WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
     Did Not Converge in 20 Iterations.
     Number of Trial Surfaces with Non-Converged FS =   77
     Number of Trial Surfaces with Misleading FS =    9
     Number of Trial Surfaces With Valid FS = 4914
     Percentage of Trial Surfaces With Non-Valid FS Solutions
     of the Total Attempted =   1.7 %
     Statistical Data On All Valid FS Values:
        FS Max =   3.666   FS Min =   2.211   FS Ave =   2.779
        Standard Deviation =    0.285   Coefficient of Variation =   10.26 %
                 ((Modified Bishop FS for Critical Surface =  2.244))
     Failure Surface Specified By 18 Coordinate Points
       Point       X-Surf       Y-Surf
       No.          (ft)         (ft)
        1         500.200      1200.500
        2         520.037      1203.051
        3         539.688      1206.768
        4         559.086      1211.639
        5         578.163      1217.646
        6         596.851      1224.769
        7         615.087      1232.983
        8         632.806      1242.259
        9         649.946      1252.565
       10         666.448      1263.865
       11         682.254      1276.119
       12         697.309      1289.285
       13         711.561      1303.316
       14         724.960      1318.165
       15         737.459      1333.778
       16         749.014      1350.102
       17         759.585      1367.080
       18         763.040      1373.436
     Circle Center At X =   467.146 ; Y =  1536.948 ; and Radius =   338.067
     ***  FOS =     2.211   Theta (ki=1.0) =    27.13  ***
                          Lambda =   0.512
         Individual data on the    29  slices
                   Water  Water     Tie     Tie     Earthquake
                   Force  Force    Force   Force       Force   Surcharge
```

Slice No.	Width (ft)	Weight (lbs)	Top (lbs)	Bot (lbs)	Norm (lbs)	Tan (lbs)	Hor (lbs)	Ver (lbs)	Load (lbs)
1	0.7	91.0	0.0	0.0	0.	0.	9.1	0.0	0.0
2	19.1	76607.2	0.0	5234.6	0.	0.	7660.7	0.0	0.0
3	0.0	285.6	0.0	20.2	0.	0.	28.6	0.0	0.0
4	19.7	146205.3	0.0	15838.6	0.	0.	14620.5	0.0	0.0
5	19.4	130574.6	0.0	25049.7	0.	0.	13057.5	0.0	0.0
6	19.1	111291.3	0.0	32849.0	0.	0.	11129.1	0.0	0.0
7	1.8	9701.9	0.0	3604.9	0.	0.	970.2	0.0	0.0
8	16.9	137650.0	0.0	35604.5	0.	0.	13765.0	0.0	0.0
9	3.1	36672.3	0.0	7318.9	0.	0.	3667.2	0.0	0.0
10	15.1	175283.7	0.0	36789.8	0.	0.	17528.4	0.0	0.0
11	17.7	182370.5	0.0	47529.9	0.	0.	18237.1	0.0	0.0
12	17.1	148726.2	0.0	49461.1	0.	0.	14872.6	0.0	0.0
13	0.1	423.6	0.0	164.2	0.	0.	42.4	0.0	0.0
14	10.0	93182.3	0.0	24300.3	0.	0.	9318.2	0.0	0.0
15	6.4	75966.2	0.0	27713.4	0.	0.	7596.6	0.0	0.0
16	3.6	47073.8	0.0	14445.7	0.	0.	4707.4	0.0	0.0
17	12.3	158987.2	0.0	41283.6	0.	0.	15898.7	0.0	0.0
18	12.7	143656.1	0.0	29697.3	0.	0.	14365.6	0.0	0.0
19	2.3	23479.4	0.0	3637.9	0.	0.	2347.9	0.0	0.0
20	13.4	118038.9	0.0	10355.9	0.	0.	11803.9	0.0	0.0
21	0.8	6146.4	0.0	0.0	0.	0.	614.6	0.0	0.0
22	13.4	81945.8	0.0	0.0	0.	0.	8194.6	0.0	0.0
23	5.0	21310.3	0.0	0.0	0.	0.	2131.0	0.0	0.0
24	5.9	19661.6	0.0	0.0	0.	0.	1966.2	0.0	0.0
25	1.6	4627.8	0.0	0.0	0.	0.	462.8	0.0	0.0
26	11.6	28676.6	0.0	0.0	0.	0.	2867.7	0.0	0.0
27	10.6	16022.1	0.0	0.0	0.	0.	1602.2	0.0	0.0
28	0.4	397.1	0.0	0.0	0.	0.	39.7	0.0	0.0
29	3.0	1414.0	0.0	0.0	0.	0.	141.4	0.0	0.0

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.200	1200.500
2	520.134	1202.121
3	539.930	1204.976
4	559.509	1209.056
5	578.797	1214.344
6	597.720	1220.820
7	616.204	1228.459
8	634.177	1237.231
9	651.571	1247.103
10	668.318	1258.036
11	684.354	1269.988
12	699.616	1282.914
13	714.046	1296.762
14	727.587	1311.480
15	740.189	1327.011
16	751.801	1343.295
17	762.379	1360.268
18	768.087	1370.838

Circle Center At X = 484.276 ; Y = 1521.365 ; and Radius = 321.259

*** FOS = 2.213 Theta (ki=1.0) = 26.69 ***

Lambda = 0.503

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.441	1201.102
2	520.269	1203.716
3	539.942	1207.320
4	559.409	1211.907
5	578.621	1217.464
6	597.531	1223.977
7	616.090	1231.429
8	634.253	1239.803
9	651.973	1249.077

10	669.205	1259.228
11	685.907	1270.230
12	702.037	1282.056
13	717.553	1294.675
14	732.417	1308.056
15	746.592	1322.166
16	760.041	1336.968
17	772.731	1352.427
18	781.319	1364.027

Circle Center At X = 458.422 ; Y = 1597.115 ; and Radius = 398.237
*** FOS = 2.226 Theta (ki=1.0) = 26.63 ***
Lambda = 0.501
Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.020	1200.050
2	519.746	1203.349
3	539.223	1207.891
4	558.374	1213.656
5	577.123	1220.620
6	595.392	1228.757
7	613.111	1238.034
8	630.207	1248.413
9	646.612	1259.854
10	662.260	1272.309
11	677.089	1285.729
12	691.039	1300.061
13	704.054	1315.246
14	716.083	1331.225
15	727.076	1347.932
16	728.256	1350.000

Circle Center At X = 457.899 ; Y = 1512.833 ; and Radius = 315.606
*** FOS = 2.234 Theta (ki=1.0) = 27.41 ***
Lambda = 0.518
Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.260	1200.651
2	519.656	1205.532
3	538.839	1211.187
4	557.781	1217.608
5	576.449	1224.783
6	594.815	1232.701
7	612.848	1241.350
8	630.520	1250.715
9	647.802	1260.782
10	664.666	1271.534
11	681.085	1282.954
12	697.033	1295.023
13	712.483	1307.723
14	727.412	1321.032
15	741.795	1334.929
16	755.608	1349.393
17	768.831	1364.398
18	772.300	1368.669

Circle Center At X = 388.625 ; Y = 1685.639 ; and Radius = 497.670
*** FOS = 2.234 Theta (ki=1.0) = 28.89 ***
Lambda = 0.552
Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.381	1200.951
2	520.267	1203.083
3	539.969	1206.522
4	559.401	1211.254
5	578.479	1217.258
6	597.119	1224.507

```
    7        615.240     1232.970
    8        632.763     1242.610
    9        649.612     1253.385
   10        665.714     1265.249
   11        680.997     1278.149
   12        695.396     1292.030
   13        708.848     1306.830
   14        721.294     1322.485
   15        732.680     1338.928
   16        742.957     1356.086
   17        747.172     1364.310
Circle Center At X =   478.048 ; Y =  1503.092 ; and Radius =   302.965
***  FOS =     2.238   Theta (ki=1.0) =    26.15  ***
                    Lambda =   0.491
Failure Surface Specified By 18 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        501.102     1202.755
    2        520.885     1205.694
    3        540.476     1209.717
    4        559.817     1214.811
    5        578.847     1220.961
    6        597.511     1228.149
    7        615.751     1236.353
    8        633.512     1245.548
    9        650.740     1255.706
   10        667.384     1266.796
   11        683.392     1278.785
   12        698.717     1291.636
   13        713.311     1305.312
   14        727.131     1319.769
   15        740.135     1334.964
   16        752.283     1350.852
   17        763.539     1367.384
   18        766.206     1371.806
Circle Center At X =   457.790 ; Y =  1563.069 ; and Radius =   362.907
***  FOS =     2.241   Theta (ki=1.0) =    27.44  ***
                    Lambda =   0.519
Failure Surface Specified By 18 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        500.561     1201.402
    2        520.166     1205.358
    3        539.594     1210.104
    4        558.815     1215.634
    5        577.795     1221.938
    6        596.505     1229.006
    7        614.912     1236.827
    8        632.988     1245.387
    9        650.701     1254.673
   10        668.024     1264.669
   11        684.928     1275.358
   12        701.384     1286.724
   13        717.367     1298.747
   14        732.849     1311.409
   15        747.805     1324.687
   16        762.211     1338.560
   17        776.043     1353.006
   18        784.380     1362.451
Circle Center At X =   413.074 ; Y =  1686.196 ; and Radius =   492.624
***  FOS =     2.244   Theta (ki=1.0) =    27.21  ***
                    Lambda =   0.514
Failure Surface Specified By 18 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        501.162     1202.905
    2        521.043     1205.080
```

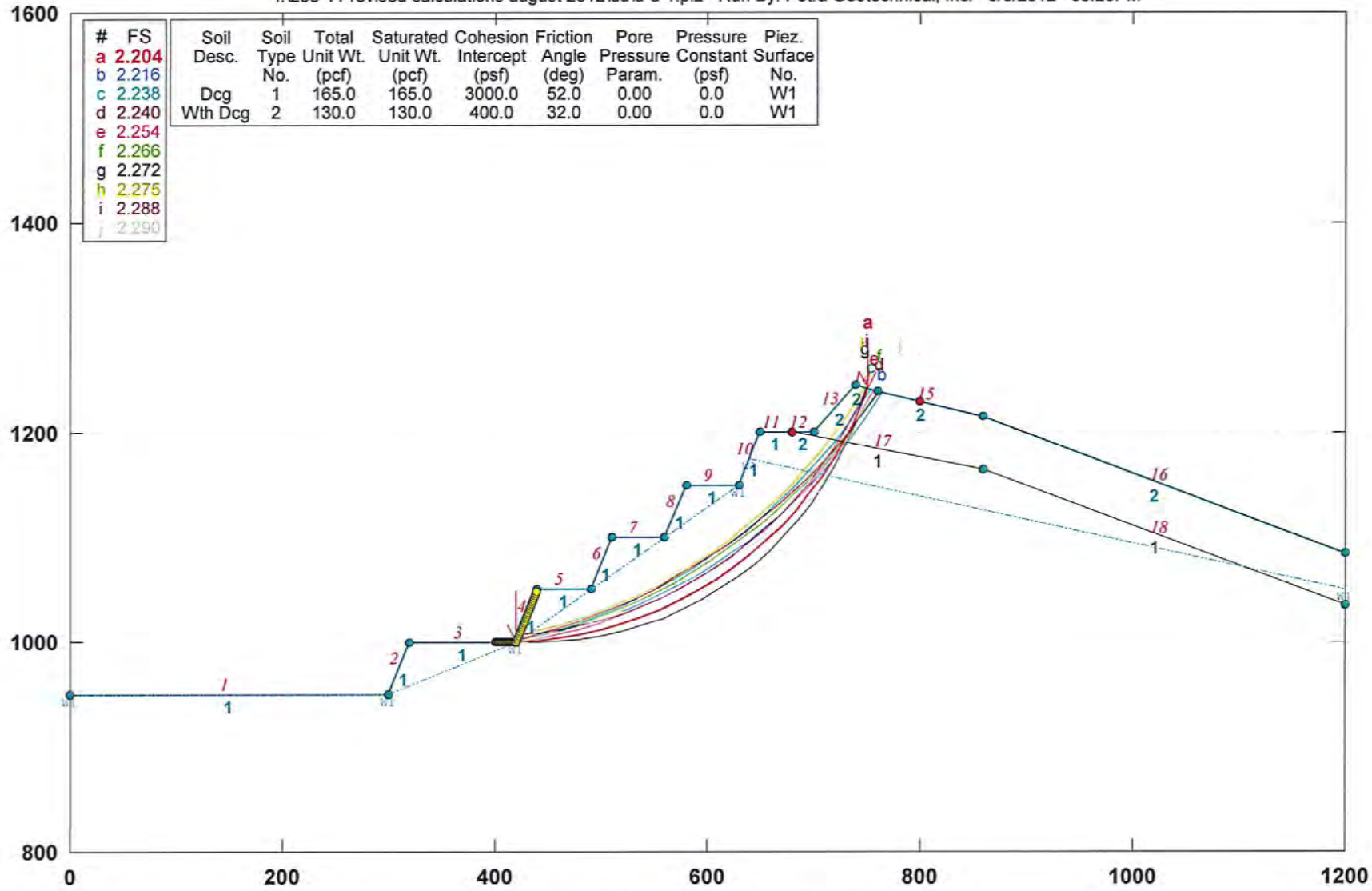
```
    3        540.757     1208.453
    4        560.231     1213.011
    5        579.394     1218.737
    6        598.175     1225.611
    7        616.507     1233.607
    8        634.323     1242.696
    9        651.556     1252.845
   10        668.145     1264.017
   11        684.028     1276.171
   12        699.148     1289.263
   13        713.449     1303.244
   14        726.879     1318.064
   15        739.389     1333.669
   16        750.933     1350.001
   17        761.469     1367.001
   18        764.525     1372.671
Circle Center At X =   475.317 ; Y =  1532.165 ; and Radius =   330.273
***  FOS =     2.245   Theta (ki=1.0) =    26.87  ***
                     Lambda =   0.507
Failure Surface Specified By 18 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        500.922     1202.304
    2        520.636     1205.671
    3        540.182     1209.909
    4        559.521     1215.010
    5        578.614     1220.964
    6        597.424     1227.760
    7        615.914     1235.383
    8        634.047     1243.820
    9        651.789     1253.053
   10        669.103     1263.064
   11        685.956     1273.833
   12        702.314     1285.340
   13        718.146     1297.561
   14        733.420     1310.472
   15        748.106     1324.049
   16        762.175     1338.264
   17        775.599     1353.089
   18        783.657     1362.824
Circle Center At X =   435.186 ; Y =  1647.350 ; and Radius =   449.875
***  FOS =     2.251   Theta (ki=1.0) =    26.80  ***
                     Lambda =   0.505
          **** END OF GSTABL7 OUTPUT ****
```

3M Moody Flats Section D-D' West Side - Spencer Method - Static - GW

f:\293-11 revised calculations august 2012\dd\d-d-1.pl2 Run By: Petra Geotechnical, Inc. 8/6/2012 03:28PM

#	FS
a	2.204
b	2.216
c	2.238
d	2.240
e	2.254
f	2.266
g	2.272
h	2.275
i	2.288
j	2.290

Soil Desc.	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.
Dcg	1	165.0	165.0	3000.0	52.0	0.00	0.0	W1
Wth Dcg	2	130.0	130.0	400.0	32.0	0.00	0.0	W1



GSTABL7 v.2 FSmin=2.204

Safety Factors Are Calculated By GLE (Spencer`s) Method (0-1)

GSTABL7

```
                    *** GSTABL7 ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
            (All Rights Reserved-Unauthorized Use Prohibited)
*****************************************************************************
                  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,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*****************************************************************************
Analysis Run Date:        8/6/2012
Time of Run:              03:28PM
Run By:                   Petra Geotechnical, Inc.
Input Data Filename:      f:\293-11 Revised Calculations August 2012\DD\d-d-1.
Output Filename:          f:\293-11 Revised Calculations August 2012\DD\d-d-1.OUT
Unit System:              English
Plotted Output Filename:  f:\293-11 Revised Calculations August 2012\DD\d-d-1.PLT
PROBLEM DESCRIPTION:  3M Moody Flats  Section D-D'
                      West Side - Spencer Method - Static - GW
BOUNDARY COORDINATES
   16 Top   Boundaries
   18 Total Boundaries
Boundary     X-Left     Y-Left     X-Right    Y-Right    Soil Type
  No.         (ft)       (ft)       (ft)       (ft)     Below Bnd
   1          0.00     950.00     300.00     950.00        1
   2        300.00     950.00     320.00    1000.00        1
   3        320.00    1000.00     420.00    1000.00        1
   4        420.00    1000.00     440.00    1050.00        1
   5        440.00    1050.00     490.00    1050.00        1
   6        490.00    1050.00     510.00    1100.00        1
   7        510.00    1100.00     560.00    1100.00        1
   8        560.00    1100.00     580.00    1150.00        1
   9        580.00    1150.00     630.00    1150.00        1
  10        630.00    1150.00     650.00    1200.00        1
  11        650.00    1200.00     680.00    1200.00        1
  12        680.00    1200.00     700.00    1200.00        2
  13        700.00    1200.00     740.00    1245.00        2
  14        740.00    1245.00     760.00    1240.00        2
  15        760.00    1240.00     860.00    1215.00        2
  16        860.00    1215.00    1200.00    1085.00        2
  17        680.00    1200.00     860.00    1165.00        1
  18        860.00    1165.00    1200.00    1035.00        1
User Specified Y-Origin =        800.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
 2 Type(s) of Soil
Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
 No.  (pcf)    (pcf)     (psf)     (deg)    Param.   (psf)     No.
  1   165.0    165.0    3000.0     52.0    0.00       0.0      1
  2   130.0    130.0     400.0     32.0    0.00       0.0      1
1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water =  62.40 (pcf)
Piezometric Surface No.  1 Specified by  6 Coordinate Points
Pore Pressure Inclination Factor =  0.50
  Point      X-Water     Y-Water
   No.        (ft)        (ft)
    1         0.00      950.00
    2       300.00      950.00
    3       420.00     1000.00
    4       630.00     1150.00
    5       640.00     1175.00
    6      1200.00     1050.00
```

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
5000 Trial Surfaces Have Been Generated.
10 Surface(s) Initiate(s) From Each Of 500 Points Equally Spaced
Along The Ground Surface Between X = 400.00(ft)
and X = 440.00(ft)
Each Surface Terminates Between X = 680.00(ft)
and X = 800.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
20.00(ft) Line Segments Define Each Trial Failure Surface.
Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	2.705	2.458	0.315
26.25	2.638	2.470	0.493
51.04	2.877	2.512	1.236
0.00	2.726	2.435	0.000
0.00	2.726	2.435	0.000
40.24	2.992	2.491	0.846
0.00	2.726	2.435	0.000
0.00	2.726	2.435	0.000
40.16	2.994	2.491	0.844
0.00	2.726	2.435	0.000
0.00	2.726	2.435	0.000
0.00	2.726	2.433	0.000
0.00	2.726	2.433	0.000
0.00	2.726	2.433	0.000
0.00	2.726	2.433	0.000
0.00	2.726	2.433	0.000
0.00	2.726	2.433	0.000
0.00	2.726	2.433	0.000
0.00	2.726	2.433	0.000
0.00	2.726	2.433	0.000

The Trial Failure Surface In Question Is Defined
By The Following 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.04	1000.11
2	438.32	1008.23
3	456.49	1016.58
4	474.56	1025.16
5	492.52	1033.95
6	510.38	1042.96
7	528.12	1052.19
8	545.75	1061.63
9	563.26	1071.29
10	580.66	1081.17
11	597.93	1091.25
12	615.07	1101.55
13	632.09	1112.06
14	648.98	1122.77
15	665.74	1133.69
16	682.36	1144.81
17	698.84	1156.14
18	715.19	1167.66
19	731.39	1179.39
20	747.45	1191.31
21	763.36	1203.43
22	779.12	1215.74
23	794.73	1228.25
24	797.59	1230.60

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta	FOS	FOS

(deg) (ki=1.0)	(Moment) (Equil.)	(Force) (Equil.)	Lambda
17.50	3.048	2.792	0.315
26.25	3.030	2.801	0.493
89.94	3.170	2.969	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****

The Trial Failure Surface In Question Is Defined
By The Following 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.04	1000.11
2	437.31	1010.20
3	454.50	1020.42
4	471.62	1030.76
5	488.67	1041.22
6	505.64	1051.80
7	522.54	1062.50
8	539.36	1073.32
9	556.10	1084.26
10	572.76	1095.32
11	589.35	1106.50
12	605.85	1117.79
13	622.28	1129.20
14	638.62	1140.73
15	654.88	1152.38
16	671.06	1164.14
17	687.15	1176.01
18	703.16	1188.00
19	719.08	1200.10
20	734.92	1212.32
21	750.67	1224.64
22	766.33	1237.08
23	767.60	1238.10

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	2.701	2.444	0.315
26.25	2.653	2.458	0.493
62.16	2.898	2.543	1.893
0.00	2.720	2.415	0.000
0.00	2.720	2.415	0.000
89.94	0.000	0.001	*****
89.60	0.000	0.001	*****
89.49	0.000	0.001	*****
89.45	0.000	0.001	*****
89.44	0.000	0.001	*****
89.44	0.000	0.001	*****
89.44	0.000	0.001	*****
89.43	0.000	0.001	*****

89.43	0.000	0.001	*****
89.43	0.000	0.001	*****
89.43	0.000	0.001	*****
89.43	0.000	0.001	*****
89.43	0.000	0.001	*****
89.43	0.000	0.001	*****
89.43	0.000	0.001	*****

The Trial Failure Surface In Question Is Defined
By The Following 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.04	1000.11
2	438.21	1008.46
3	456.25	1017.11
4	474.14	1026.04
5	491.90	1035.25
6	509.50	1044.74
7	526.95	1054.51
8	544.24	1064.56
9	561.38	1074.88
10	578.34	1085.47
11	595.14	1096.33
12	611.76	1107.45
13	628.20	1118.84
14	644.46	1130.49
15	660.53	1142.39
16	676.41	1154.55
17	692.10	1166.95
18	707.59	1179.61
19	722.87	1192.51
20	737.95	1205.65
21	752.82	1219.02
22	767.47	1232.64
23	772.01	1237.00

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	1.517	2.372	0.315
26.25	-1.585	2.464	0.493
14.38	1.572	2.343	0.256
6.70	1.677	2.277	0.117
0.00	1.746	2.223	0.000
0.00	1.746	2.223	0.000
89.94	0.001	1.136	*****
0.00	1.746	2.223	0.000
0.00	1.746	2.223	0.000
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****

The Trial Failure Surface In Question Is Defined
By The Following 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.04	1000.11
2	440.03	999.32
3	460.03	999.57
4	479.98	1000.87

5	499.85	1003.20
6	519.56	1006.57
7	539.07	1010.96
8	558.33	1016.36
9	577.28	1022.75
10	595.87	1030.13
11	614.05	1038.46
12	631.77	1047.73
13	648.99	1057.92
14	665.65	1068.98
15	681.71	1080.90
16	697.13	1093.64
17	711.86	1107.17
18	725.87	1121.44
19	739.11	1136.43
20	751.56	1152.08
21	763.17	1168.37
22	773.92	1185.23
23	783.77	1202.64
24	792.71	1220.53
25	797.14	1230.71

The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.04	1000.11
2	439.45	995.28
3	459.16	991.86
4	479.06	989.88
5	499.05	989.34
6	519.03	990.25
7	538.89	992.61
8	558.53	996.39
9	577.85	1001.58
10	596.73	1008.15
11	615.10	1016.07
12	632.84	1025.30
13	649.87	1035.79
14	666.10	1047.48
15	681.44	1060.31
16	695.81	1074.22
17	709.14	1089.13
18	721.36	1104.97
19	732.40	1121.64
20	742.20	1139.07
21	750.72	1157.17
22	757.91	1175.83
23	763.73	1194.97
24	768.16	1214.47
25	771.16	1234.24
26	771.39	1237.15

Factor Of Safety For The Preceding Specified Surface = 0.512
Theta (ki = 1.0) = 46.43 Deg Lambda =
Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	1.405	2.251	0.315
26.25	-1.531	2.339	0.493
14.24	1.446	2.221	0.254
6.22	1.526	2.154	0.109
0.00	1.575	2.105	0.000
0.00	1.575	2.105	0.000
0.00	1.575	2.105	0.000
0.00	1.575	2.105	0.000

0.00	1.575	2.105	0.000
89.94	-0.053	0.933	*****
0.00	3.192	2.105	0.000
32.88	-7.039	2.420	0.647
4.52	1.541	2.141	0.079
0.00	1.575	2.105	0.000
0.00	1.575	2.105	0.000
69.90	0.613	0.631	2.732
73.17	0.612	0.627	3.305
89.94	-0.644	-4.028	*****
73.26	0.607	0.540	3.325
67.25	0.637	0.654	2.385

The Trial Failure Surface In Question Is Defined
By The Following 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.12	1000.31
2	440.12	1000.17
3	460.10	1001.16
4	479.99	1003.27
5	499.72	1006.51
6	519.24	1010.85
7	538.49	1016.29
8	557.40	1022.81
9	575.91	1030.39
10	593.96	1038.99
11	611.50	1048.61
12	628.47	1059.20
13	644.81	1070.73
14	660.47	1083.16
15	675.41	1096.46
16	689.57	1110.58
17	702.92	1125.48
18	715.40	1141.11
19	726.98	1157.42
20	737.61	1174.35
21	747.28	1191.86
22	755.94	1209.89
23	763.57	1228.37
24	767.01	1238.25

The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.12	1000.31
2	439.34	1005.85
3	458.37	1012.00
4	477.20	1018.75
5	495.79	1026.11
6	514.15	1034.05
7	532.24	1042.57
8	550.05	1051.67
9	567.56	1061.34
10	584.76	1071.55
11	601.61	1082.31
12	618.12	1093.61
13	634.26	1105.42
14	650.01	1117.75
15	665.36	1130.57
16	680.29	1143.87
17	694.79	1157.65
18	708.84	1171.88
19	722.44	1186.55
20	735.55	1201.65
21	748.18	1217.16
22	760.30	1233.07

```
   23          764.45      1238.89
Factor Of Safety For The Preceding Specified Surface =  0.562
Theta (ki = 1.0) =  68.53 Deg    Lambda =
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 19 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1         420.12      1000.31
    2         438.76      1007.56
    3         457.16      1015.39
    4         475.32      1023.79
    5         493.20      1032.74
    6         510.80      1042.25
    7         528.09      1052.30
    8         545.06      1062.88
    9         561.70      1073.98
   10         577.98      1085.59
   11         593.89      1097.70
   12         609.43      1110.31
   13         624.56      1123.38
   14         639.28      1136.92
   15         653.57      1150.91
   16         667.42      1165.34
   17         680.82      1180.19
   18         693.75      1195.45
   19         697.37      1200.00
Factor Of Safety For The Preceding Specified Surface =  0.647
Theta (ki = 1.0) =  70.76 Deg    Lambda =
Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations
 Theta         FOS         FOS
 (deg)       (Moment)    (Force)
(ki=1.0)     (Equil.)    (Equil.)   Lambda
 17.50        3.587       3.372     0.315
 26.25        3.591       3.377     0.493
 89.94        3.600       3.455     *****
 89.94        3.600       3.455     *****
  9.55        3.585       3.366     0.168
 89.94        3.600       3.455     *****
 89.94        3.600       3.455     *****
  0.00        3.583       3.360     0.000
 89.94        3.600       3.455     *****
 89.94        3.600       3.455     *****
  0.00        3.583       3.360     0.000
 89.94        3.600       3.455     *****
 89.94        3.600       3.455     *****
  0.00        3.583       3.360     0.000
 89.94        3.600       3.455     *****
 89.94        3.600       3.455     *****
 89.94        3.279       3.273     *****
 64.08      229.759       1.990     2.057
 89.94        3.600       3.455     *****
 89.96        3.600       3.455     *****
The Trial Failure Surface In Question Is Defined
By The Following 22 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1         420.12      1000.31
    2         436.65      1011.57
    3         453.16      1022.86
    4         469.65      1034.17
    5         486.13      1045.50
    6         502.60      1056.86
    7         519.04      1068.24
    8         535.47      1079.64
    9         551.89      1091.07
```

10	568.28	1102.52
11	584.66	1114.00
12	601.03	1125.49
13	617.38	1137.01
14	633.71	1148.56
15	650.03	1160.12
16	666.33	1171.71
17	682.61	1183.33
18	698.88	1194.96
19	715.13	1206.62
20	731.36	1218.30
21	747.58	1230.01
22	761.02	1239.74

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	2.550	2.295	0.315
26.25	2.478	2.316	0.493
46.32	3.172	2.378	1.047
19.43	2.540	2.299	0.353
0.00	2.580	2.253	0.000
89.94	3.600	3.455	*****
89.94	3.600	3.455	*****
0.00	2.580	2.253	0.000
89.94	3.600	3.455	*****
89.94	3.600	3.455	*****
0.00	2.580	2.253	0.000
89.94	3.600	3.455	*****
89.94	3.600	3.455	*****
0.00	2.580	2.253	0.000
89.94	3.600	3.455	*****
89.94	3.600	3.455	*****
89.94	3.279	3.273	*****
64.08	0.721	0.649	2.057
89.94	3.600	3.455	*****
29.98	3.600	2.216	0.577

The Trial Failure Surface In Question Is Defined
By The Following 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.12	1000.31
2	438.97	1007.01
3	457.64	1014.17
4	476.13	1021.78
5	494.44	1029.85
6	512.54	1038.36
7	530.42	1047.31
8	548.08	1056.69
9	565.51	1066.51
10	582.69	1076.75
11	599.62	1087.40
12	616.28	1098.47
13	632.66	1109.94
14	648.76	1121.80
15	664.56	1134.06
16	680.06	1146.70
17	695.25	1159.72
18	710.11	1173.10
19	724.64	1186.84
20	738.83	1200.94
21	752.67	1215.37
22	766.15	1230.15
23	772.09	1236.98

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	3.287	2.304	0.315
26.25	3.422	2.390	0.493
0.00	3.080	2.163	0.000
0.00	3.080	2.163	0.000
45.69	3.528	2.685	1.024
89.94	-0.070	0.000	*****
85.42	0.180	0.000	*****
88.25	0.178	0.000	*****
89.94	0.184	0.000	*****
23.20	0.252	-0.001	0.429
89.94	0.185	0.000	*****
89.94	0.185	0.000	*****
89.94	3.600	3.455	*****
0.00	3.080	2.163	0.000
89.94	3.600	3.455	*****
89.94	3.600	3.455	*****
89.94	3.279	3.273	*****
64.08	0.637	0.652	2.057
79.96	2.373	2.405	5.651

```
 ################### SOME LINES SKIPPED ###################
     Following Are Displayed The Ten Most Critical Of The Trial
     Failure Surfaces Evaluated. They Are
     Ordered - Most Critical First.
     * * Safety Factors Are Calculated By GLE (Spencer`s) Method (0-1) * *
     Selected ki function = Constant (1.0)
     Selected Lambda Coefficient =  1.00
     Forces from Reinforcement, Piers/Piles, Soil Nails, and Applied Forces
     (if applicable) have been applied to the slice base(s)
     on which they intersect.
     Specified Tension Crack Water Force Factor =   0.000
     Total Number of Trial Surfaces Attempted =  5000
     WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
     Did Not Converge in 20 Iterations.
     Number of Trial Surfaces with Non-Converged FS =  415
     Number of Trial Surfaces with Misleading FS =   34
     Number of Trial Surfaces With Valid FS = 4551
     Percentage of Trial Surfaces With Non-Valid FS Solutions
     of the Total Attempted =   9.0 %
     Statistical Data On All Valid FS Values:
        FS Max =   3.779   FS Min =   2.204   FS Ave =   2.845
        Standard Deviation =    0.264   Coefficient of Variation =    9.29 %
                 ((Modified Bishop FS for Critical Surface =  2.243))
     Failure Surface Specified By 23 Coordinate Points
```

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.203	1000.507
2	440.166	1001.714
3	460.034	1004.014
4	479.745	1007.399
5	499.241	1011.860
6	518.464	1017.382
7	537.355	1023.950
8	555.857	1031.543
9	573.916	1040.139
10	591.476	1049.712
11	608.485	1060.233
12	624.892	1071.670
13	640.647	1083.990
14	655.703	1097.154
15	670.016	1111.124
16	683.541	1125.858
17	696.238	1141.311
18	708.069	1157.436
19	718.998	1174.185

20	728.993	1191.509
21	738.023	1209.354
22	746.062	1227.667
23	751.485	1242.129

Circle Center At X = 408.173 ; Y = 1365.064 ; and Radius = 364.756

*** FOS = 2.204 Theta (ki=1.0) = 17.72 ***

Lambda = 0.320

Individual data on the 36 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	0.6	61.7	0.0	0.0	0.	0.	0.0	0.0	0.0
2	19.2	78818.7	0.0	6289.4	0.	0.	0.0	0.0	0.0
3	0.2	1325.0	0.0	109.2	0.	0.	0.0	0.0	0.0
4	19.9	154516.6	0.0	19328.9	0.	0.	0.0	0.0	0.0
5	19.7	144059.2	0.0	31041.7	0.	0.	0.0	0.0	0.0
6	10.3	70098.3	0.0	20603.1	0.	0.	0.0	0.0	0.0
7	9.2	77382.9	0.0	20893.3	0.	0.	0.0	0.0	0.0
8	10.8	129848.5	0.0	27306.1	0.	0.	0.0	0.0	0.0
9	8.5	117075.1	0.0	23355.5	0.	0.	0.0	0.0	0.0
10	18.9	247283.5	0.0	58509.9	0.	0.	0.0	0.0	0.0
11	18.5	220583.4	0.0	65017.5	0.	0.	0.0	0.0	0.0
12	4.1	46121.3	0.0	15702.4	0.	0.	0.0	0.0	0.0
13	13.9	184988.2	0.0	54462.4	0.	0.	0.0	0.0	0.0
14	6.1	100991.9	0.0	25269.4	0.	0.	0.0	0.0	0.0
15	11.5	195818.2	0.0	48667.2	0.	0.	0.0	0.0	0.0
16	17.0	266694.6	0.0	76321.5	0.	0.	0.0	0.0	0.0
17	16.4	227530.0	0.0	77312.0	0.	0.	0.0	0.0	0.0
18	5.1	64338.0	0.0	25055.8	0.	0.	0.0	0.0	0.0
19	10.0	136827.3	0.0	37373.4	0.	0.	0.0	0.0	0.0
20	0.6	9829.6	0.0	4562.8	0.	0.	0.0	0.0	0.0
21	9.4	154678.9	0.0	64887.6	0.	0.	0.0	0.0	0.0
22	5.7	99130.9	0.0	35754.9	0.	0.	0.0	0.0	0.0
23	14.3	226376.0	0.0	80118.5	0.	0.	0.0	0.0	0.0
24	10.0	137456.6	0.0	45532.3	0.	0.	0.0	0.0	0.0
25	3.5	44397.5	0.0	13315.2	0.	0.	0.0	0.0	0.0
26	12.7	138287.8	0.0	36892.5	0.	0.	0.0	0.0	0.0
27	3.8	34377.9	0.0	7033.3	0.	0.	0.0	0.0	0.0
28	8.1	67428.9	0.0	7286.8	0.	0.	0.0	0.0	0.0
29	1.3	10712.8	0.0	178.3	0.	0.	0.0	0.0	0.0
30	9.6	70080.9	0.0	0.0	0.	0.	0.0	0.0	0.0
31	9.5	57499.1	0.0	0.0	0.	0.	0.0	0.0	0.0
32	0.5	2881.8	0.0	0.0	0.	0.	0.0	0.0	0.0
33	9.0	43747.6	0.0	0.0	0.	0.	0.0	0.0	0.0
34	2.0	8294.9	0.0	0.0	0.	0.	0.0	0.0	0.0
35	6.1	18504.2	0.0	0.0	0.	0.	0.0	0.0	0.0
36	5.4	5575.7	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.604	1001.509
2	440.253	1005.235
3	459.737	1009.750
4	479.023	1015.048
5	498.079	1021.119
6	516.875	1027.953
7	535.380	1035.541
8	553.564	1043.868
9	571.397	1052.922
10	588.851	1062.688
11	605.896	1073.150
12	622.506	1084.291
13	638.653	1096.092
14	654.311	1108.536
15	669.454	1121.600
16	684.057	1135.265

17	698.098	1149.508
18	711.553	1164.305
19	724.401	1179.633
20	736.619	1195.467
21	748.189	1211.781
22	759.092	1228.548
23	765.135	1238.716

Circle Center At X = 338.086 ; Y = 1490.375 ; and Radius = 495.781
*** FOS = 2.216 Theta (ki=1.0) = 20.87 ***
Lambda = 0.381
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.684	1001.709
2	440.105	1006.488
3	459.331	1011.998
4	478.334	1018.232
5	497.088	1025.181
6	515.566	1032.834
7	533.741	1041.182
8	551.586	1050.212
9	569.077	1059.910
10	586.188	1070.264
11	602.896	1081.258
12	619.175	1092.877
13	635.002	1105.104
14	650.356	1117.920
15	665.213	1131.309
16	679.552	1145.251
17	693.354	1159.726
18	706.598	1174.712
19	719.265	1190.189
20	731.338	1206.135
21	742.797	1222.526
22	753.629	1239.339
23	754.791	1241.302

Circle Center At X = 304.206 ; Y = 1516.969 ; and Radius = 528.261
*** FOS = 2.238 Theta (ki=1.0) = 18.44 ***
Lambda = 0.334
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.684	1001.709
2	440.016	1006.833
3	459.162	1012.617
4	478.098	1019.054
5	496.801	1026.137
6	515.251	1033.857
7	533.425	1042.206
8	551.302	1051.173
9	568.861	1060.748
10	586.082	1070.920
11	602.943	1081.676
12	619.425	1093.005
13	635.509	1104.892
14	651.176	1117.324
15	666.407	1130.286
16	681.184	1143.763
17	695.491	1157.739
18	709.309	1172.197
19	722.624	1187.121
20	735.419	1202.493
21	747.679	1218.295
22	759.389	1234.507
23	762.635	1239.341

Circle Center At X = 281.027 ; Y = 1567.696 ; and Radius = 582.962
*** FOS = 2.240 Theta (ki=1.0) = 18.61 ***

Lambda = 0.337
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.042	1000.106
2	439.804	1003.185
3	459.406	1007.156
4	478.807	1012.011
5	497.969	1017.741
6	516.851	1024.334
7	535.415	1031.776
8	553.623	1040.051
9	571.437	1049.144
10	588.820	1059.034
11	605.737	1069.703
12	622.153	1081.127
13	638.034	1093.283
14	653.348	1106.147
15	668.064	1119.692
16	682.150	1133.890
17	695.578	1148.712
18	708.320	1164.127
19	720.351	1180.104
20	731.645	1196.610
21	742.179	1213.611
22	751.932	1231.072
23	756.801	1240.800

Circle Center At X = 362.041 ; Y = 1437.392 ; and Radius = 441.116
*** FOS = 2.254 Theta (ki=1.0) = 30.12 ***

Lambda = 0.580
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.363	1000.908
2	439.845	1005.432
3	459.143	1010.684
4	478.230	1016.656
5	497.081	1023.340
6	515.667	1030.725
7	533.963	1038.802
8	551.944	1047.560
9	569.584	1056.985
10	586.857	1067.066
11	603.741	1077.787
12	620.211	1089.134
13	636.244	1101.090
14	651.817	1113.639
15	666.909	1126.763
16	681.498	1140.443
17	695.563	1154.661
18	709.086	1169.397
19	722.047	1184.629
20	734.427	1200.337
21	746.210	1216.497
22	757.379	1233.088
23	761.440	1239.640

Circle Center At X = 309.477 ; Y = 1522.545 ; and Radius = 533.292
*** FOS = 2.266 Theta (ki=1.0) = 30.93 ***

Lambda = 0.599
Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.203	1000.507
2	440.194	999.915
3	460.183	1000.579
4	480.091	1002.498
5	499.839	1005.663

6	519.349	1010.062
7	538.544	1015.678
8	557.349	1022.489
9	575.688	1030.468
10	593.491	1039.582
11	610.686	1049.797
12	627.205	1061.071
13	642.983	1073.361
14	657.959	1086.618
15	672.072	1100.789
16	685.267	1115.818
17	697.492	1131.647
18	708.699	1148.212
19	718.843	1165.448
20	727.885	1183.288
21	735.788	1201.660
22	742.522	1220.493
23	748.060	1239.711
24	748.746	1242.814

Circle Center At X = 439.673 ; Y = 1317.995 ; and Radius = 318.085
*** FOS = 2.272 Theta (ki=1.0) = 18.93 ***
Lambda = 0.343
Failure Surface Specified By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	422.608	1006.520
2	442.093	1011.030
3	461.379	1016.325
4	480.435	1022.398
5	499.229	1029.238
6	517.730	1036.833
7	535.909	1045.172
8	553.735	1054.240
9	571.179	1064.023
10	588.213	1074.504
11	604.808	1085.667
12	620.937	1097.493
13	636.574	1109.962
14	651.692	1123.055
15	666.268	1136.750
16	680.278	1151.023
17	693.697	1165.853
18	706.505	1181.214
19	718.680	1197.081
20	730.203	1213.428
21	741.053	1230.229
22	748.511	1242.872

Circle Center At X = 321.240 ; Y = 1489.162 ; and Radius = 493.173
*** FOS = 2.275 Theta (ki=1.0) = 7.98 ***
Lambda = 0.140
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	422.528	1006.319
2	442.423	1008.367
3	462.185	1011.442
4	481.761	1015.535
5	501.100	1020.636
6	520.149	1026.730
7	538.857	1033.802
8	557.174	1041.832
9	575.051	1050.799
10	592.440	1060.680
11	609.295	1071.446
12	625.570	1083.071
13	641.221	1095.522
14	656.208	1108.766

15	670.489	1122.767
16	684.027	1137.489
17	696.784	1152.892
18	708.728	1168.934
19	719.826	1185.573
20	730.048	1202.763
21	739.366	1220.459
22	747.757	1238.614
23	749.377	1242.656

Circle Center At X = 392.918 ; Y = 1391.594 ; and Radius = 386.411
*** FOS = 2.288 Theta (ki=1.0) = 22.82 ***
Lambda = 0.421

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.684	1001.709
2	440.337	1005.420
3	459.841	1009.847
4	479.170	1014.983
5	498.298	1020.822
6	517.201	1027.357
7	535.852	1034.577
8	554.227	1042.475
9	572.300	1051.039
10	590.049	1060.257
11	607.449	1070.118
12	624.477	1080.608
13	641.111	1091.714
14	657.327	1103.420
15	673.105	1115.710
16	688.423	1128.569
17	703.261	1141.980
18	717.599	1155.923
19	731.418	1170.381
20	744.699	1185.335
21	757.425	1200.764
22	769.578	1216.647
23	781.143	1232.965
24	782.128	1234.468

Circle Center At X = 329.068 ; Y = 1540.995 ; and Radius = 547.012
*** FOS = 2.290 Theta (ki=1.0) = 29.11 ***
Lambda = 0.557

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

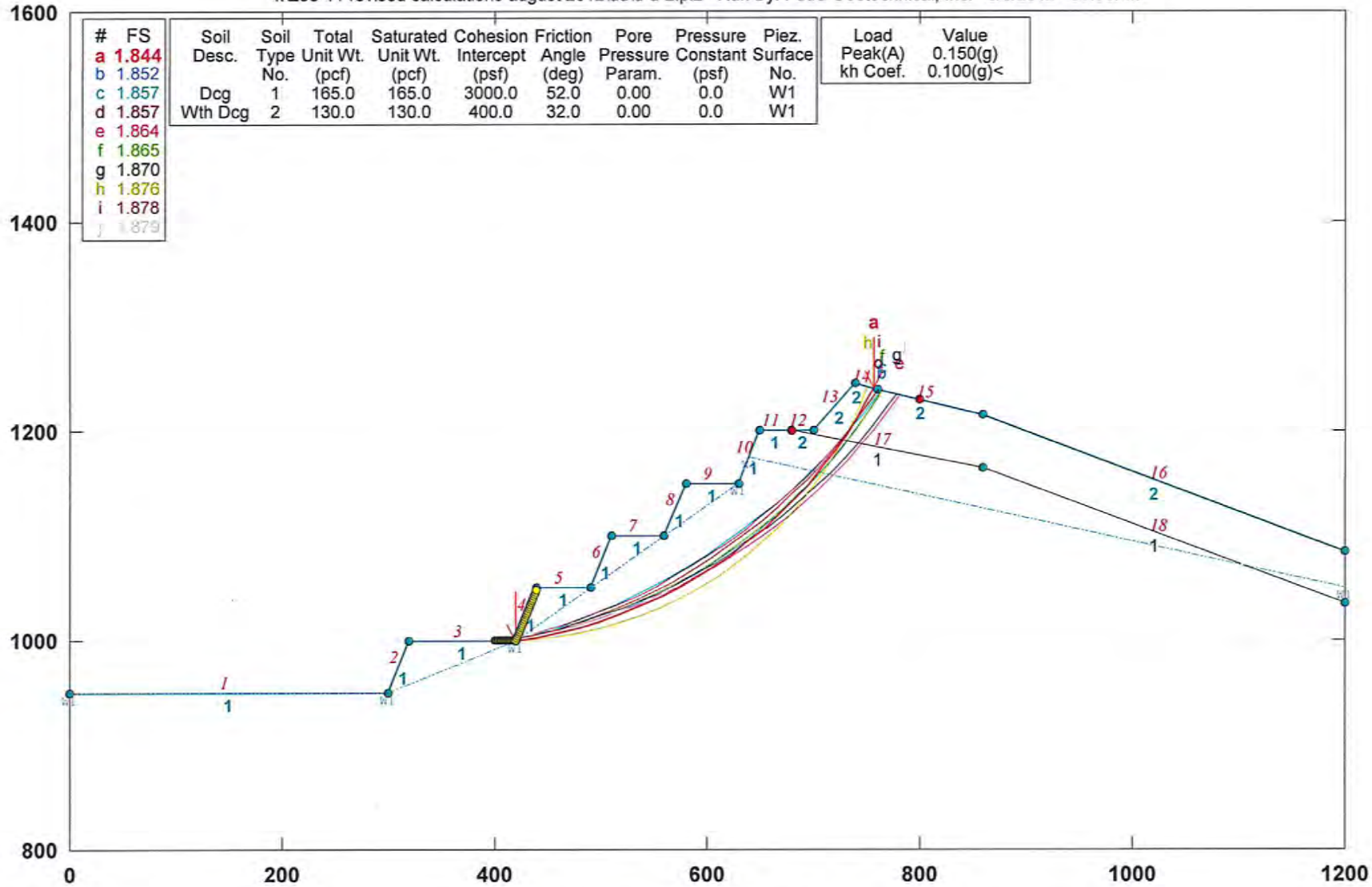
3M Moody Flats Section D-D' West Side - Spencer Method - Equake - GW

f:\293-11 revised calculations august 2012\dd\d-d-2.pl2 Run By: Petra Geotechnical, Inc. 8/6/2012 03:30PM

#	FS
a	1.844
b	1.852
c	1.857
d	1.857
e	1.864
f	1.865
g	1.870
h	1.876
i	1.878
j	1.879

Soil Desc.	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.
Dcg	1	165.0	165.0	3000.0	52.0	0.00	0.0	W1
Wth Dcg	2	130.0	130.0	400.0	32.0	0.00	0.0	W1

Load	Value
Peak(A)	0.150(g)
kh Coef.	0.100(g)<



GSTABL7 v.2 FSmin=1.844

Safety Factors Are Calculated By GLE (Spencer`s) Method (0-1)

GSTABL7

```
                    ***  GSTABL7  ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
          (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                  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,
      Nonlinear Undrained Shear Strength, Curved Phi Envelope,
      Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
      Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************
Analysis Run Date:        8/6/2012
Time of Run:              03:30PM
Run By:                   Petra Geotechnical, Inc.
Input Data Filename:      f:\293-11 Revised Calculations August 2012\DD\d-d-2.
Output Filename:          f:\293-11 Revised Calculations August 2012\DD\d-d-2.OUT
Unit System:              English
Plotted Output Filename:  f:\293-11 Revised Calculations August 2012\DD\d-d-2.PLT
PROBLEM DESCRIPTION:  3M Moody Flats  Section D-D'
                      West Side - Spencer Method - Equake - GW
BOUNDARY COORDINATES
   16 Top   Boundaries
   18 Total Boundaries
Boundary     X-Left     Y-Left     X-Right    Y-Right    Soil Type
   No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
    1         0.00     950.00     300.00     950.00        1
    2       300.00     950.00     320.00    1000.00        1
    3       320.00    1000.00     420.00    1000.00        1
    4       420.00    1000.00     440.00    1050.00        1
    5       440.00    1050.00     490.00    1050.00        1
    6       490.00    1050.00     510.00    1100.00        1
    7       510.00    1100.00     560.00    1100.00        1
    8       560.00    1100.00     580.00    1150.00        1
    9       580.00    1150.00     630.00    1150.00        1
   10       630.00    1150.00     650.00    1200.00        1
   11       650.00    1200.00     680.00    1200.00        1
   12       680.00    1200.00     700.00    1200.00        2
   13       700.00    1200.00     740.00    1245.00        2
   14       740.00    1245.00     760.00    1240.00        2
   15       760.00    1240.00     860.00    1215.00        2
   16       860.00    1215.00    1200.00    1085.00        2
   17       680.00    1200.00     860.00    1165.00        1
   18       860.00    1165.00    1200.00    1035.00        1
User Specified Y-Origin =        800.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
  2 Type(s) of Soil
Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
 No.  (pcf)    (pcf)     (psf)     (deg)    Param.   (psf)     No.
  1   165.0    165.0    3000.0     52.0    0.00      0.0       1
  2   130.0    130.0     400.0     32.0    0.00      0.0       1
1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water =  62.40 (pcf)
Piezometric Surface No.  1 Specified by  6 Coordinate Points
Pore Pressure Inclination Factor =  0.50
  Point      X-Water     Y-Water
   No.        (ft)        (ft)
    1         0.00      950.00
    2       300.00      950.00
    3       420.00     1000.00
    4       630.00     1150.00
    5       640.00     1175.00
    6      1200.00     1050.00
```

Specified Peak Ground Acceleration Coefficient (A) = 0.150(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.100(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
5000 Trial Surfaces Have Been Generated.
10 Surface(s) Initiate(s) From Each Of 500 Points Equally Spaced
Along The Ground Surface Between X = 400.00(ft)
and X = 440.00(ft)
Each Surface Terminates Between X = 680.00(ft)
and X = 800.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
20.00(ft) Line Segments Define Each Trial Failure Surface.
Factor Of Safety Calculation By GLE (Spencer's) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	2.195	2.008	0.315
26.25	2.142	2.018	0.493
49.30	2.339	2.053	1.162
2.60	2.212	1.991	0.045
0.00	2.212	1.988	0.000
89.94	2.260	2.159	*****
89.94	2.295	2.307	*****
9.49	2.208	1.999	0.167
84.38	30.887	0.001	*****
8.81	2.209	1.998	0.155
0.00	2.212	1.988	0.000
89.94	0.000	0.000	*****
89.91	0.000	0.000	*****
89.90	0.000	0.000	*****
89.90	0.000	0.000	*****
89.90	0.000	0.000	*****
89.90	0.000	0.000	*****
89.90	0.000	0.000	*****
89.90	0.000	0.000	*****
89.90	0.000	0.000	*****

The Trial Failure Surface In Question Is Defined
By The Following 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.04	1000.11
2	438.32	1008.23
3	456.49	1016.58
4	474.56	1025.16
5	492.52	1033.95
6	510.38	1042.96
7	528.12	1052.19
8	545.75	1061.63
9	563.26	1071.29
10	580.66	1081.17
11	597.93	1091.25
12	615.07	1101.55
13	632.09	1112.06
14	648.98	1122.77
15	665.74	1133.69
16	682.36	1144.81
17	698.84	1156.14
18	715.19	1167.66
19	731.39	1179.39
20	747.45	1191.31
21	763.36	1203.43
22	779.12	1215.74
23	794.73	1228.25

24	797.59	1230.60

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	2.534	2.327	0.315
26.25	2.519	2.335	0.493
89.94	2.669	2.531	*****
89.94	-0.001	1.949	*****
2.49	2.538	2.312	0.044
0.00	2.538	2.310	0.000
89.94	2.669	2.531	*****
89.94	2.669	2.531	*****
84.38	2.625	2.461	*****
89.94	2.669	2.531	*****
89.94	2.669	2.531	*****
89.94	2.035	2.033	*****
89.91	0.000	0.000	*****
89.90	0.000	-0.004	*****
89.90	0.000	-0.011	*****
89.90	0.000	-0.013	*****
89.90	0.000	-0.014	*****
89.90	0.000	-0.014	*****
89.90	0.000	-0.014	*****
89.90	0.000	-0.014	*****

The Trial Failure Surface In Question Is Defined
By The Following 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.04	1000.11
2	437.31	1010.20
3	454.50	1020.42
4	471.62	1030.76
5	488.67	1041.22
6	505.64	1051.80
7	522.54	1062.50
8	539.36	1073.32
9	556.10	1084.26
10	572.76	1095.32
11	589.35	1106.50
12	605.85	1117.79
13	622.28	1129.20
14	638.62	1140.73
15	654.88	1152.38
16	671.06	1164.14
17	687.15	1176.01
18	703.16	1188.00
19	719.08	1200.10
20	734.92	1212.32
21	750.67	1224.64
22	766.33	1237.08
23	767.60	1238.10

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	2.216	2.018	0.315
26.25	2.178	2.030	0.493
60.65	2.378	2.104	1.778
0.00	2.230	1.993	0.000
0.00	2.230	1.994	0.000
15.41	2.220	2.015	0.276
89.94	2.153	2.336	*****
43.00	2.500	2.058	0.933
71.56	2.404	2.161	2.999

89.94	2.085	2.344	*****
83.44	2.545	2.366	8.697
84.81	2.586	2.426	*****
89.94	28.890	2.947	*****
84.77	2.584	2.424	*****
83.00	2.534	2.351	8.150
89.94	0.000	-0.013	*****
89.94	0.003	0.003	*****
89.94	0.003	0.003	*****
89.94	0.003	0.003	*****
89.94	0.003	0.003	*****

The Trial Failure Surface In Question Is Defined
By The Following 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.04	1000.11
2	438.21	1008.46
3	456.25	1017.11
4	474.14	1026.04
5	491.90	1035.25
6	509.50	1044.74
7	526.95	1054.51
8	544.24	1064.56
9	561.38	1074.88
10	578.34	1085.47
11	595.14	1096.33
12	611.76	1107.45
13	628.20	1118.84
14	644.46	1130.49
15	660.53	1142.39
16	676.41	1154.55
17	692.10	1166.95
18	707.59	1179.61
19	722.87	1192.51
20	737.95	1205.65
21	752.82	1219.02
22	767.47	1232.64
23	772.01	1237.00

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	2.237	2.103	0.315
26.25	2.193	2.114	0.493
43.09	3.591	2.142	0.935
24.96	2.203	2.113	0.465
17.31	2.237	2.103	0.312
48.75	2.680	2.156	1.140
2.92	2.256	2.088	0.051
0.00	2.257	2.085	0.000
89.94	2.108	2.309	*****
55.21	2.564	2.176	1.440
74.13	2.605	2.323	3.517
89.94	2.669	1.534	*****
67.17	2.552	2.241	2.375
48.12	2.705	2.154	1.115
89.94	0.000	0.001	*****
89.91	0.000	-0.013	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****
89.94	0.000	0.001	*****

The Trial Failure Surface In Question Is Defined
By The Following 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	420.12	1000.31
2	438.76	1007.56
3	457.16	1015.39
4	475.32	1023.79
5	493.20	1032.74
6	510.80	1042.25
7	528.09	1052.30
8	545.06	1062.88
9	561.70	1073.98
10	577.98	1085.59
11	593.89	1097.70
12	609.43	1110.31
13	624.56	1123.38
14	639.28	1136.92
15	653.57	1150.91
16	667.42	1165.34
17	680.82	1180.19
18	693.75	1195.45
19	697.37	1200.00

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	3.021	2.842	0.315
26.25	3.021	2.848	0.493
89.94	3.039	2.929	*****
89.94	3.039	2.929	*****
8.67	3.020	2.837	0.152
89.94	3.039	2.929	*****
89.94	3.039	2.929	*****
0.00	3.019	2.831	0.000
89.94	3.039	2.929	*****
89.94	3.039	2.929	*****
74.13	3.031	2.890	3.517
89.94	3.039	2.929	*****
89.94	3.039	2.929	*****
48.12	3.027	2.862	1.115
89.94	3.039	2.929	*****
89.94	3.039	2.929	*****
89.94	2.763	2.772	*****
89.94	2.763	2.772	*****
89.94	2.763	2.772	*****
89.94	2.763	2.772	*****

The Trial Failure Surface In Question Is Defined
By The Following 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.12	1000.31
2	436.65	1011.57
3	453.16	1022.86
4	469.65	1034.17
5	486.13	1045.50
6	502.60	1056.86
7	519.04	1068.24
8	535.47	1079.64
9	551.89	1091.07
10	568.28	1102.52
11	584.66	1114.00
12	601.03	1125.49
13	617.38	1137.01
14	633.71	1148.56
15	650.03	1160.12
16	666.33	1171.71
17	682.61	1183.33
18	698.88	1194.96
19	715.13	1206.62

20	731.36	1218.30
21	747.58	1230.01
22	761.02	1239.74

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	2.080	1.885	0.315
26.25	2.027	1.903	0.493
46.69	2.519	1.959	1.061
18.50	2.076	1.887	0.335
0.00	2.101	1.851	0.000
89.94	1.872	1.894	*****
80.26	3.039	235.309	5.827
89.94	0.001	0.000	*****
89.94	0.001	0.000	*****
89.94	0.001	0.000	*****
89.94	0.001	0.000	*****
89.94	0.001	0.000	*****
89.94	0.001	0.000	*****
89.94	0.001	0.000	*****
89.94	0.001	0.000	*****
89.94	0.001	0.000	*****
89.94	0.001	0.000	*****
89.94	0.001	0.000	*****
89.94	0.001	0.000	*****
89.94	0.001	0.000	*****

The Trial Failure Surface In Question Is Defined
By The Following 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.12	1000.31
2	438.97	1007.01
3	457.64	1014.17
4	476.13	1021.78
5	494.44	1029.85
6	512.54	1038.36
7	530.42	1047.31
8	548.08	1056.69
9	565.51	1066.51
10	582.69	1076.75
11	599.62	1087.40
12	616.28	1098.47
13	632.66	1109.94
14	648.76	1121.80
15	664.56	1134.06
16	680.06	1146.70
17	695.25	1159.72
18	710.11	1173.10
19	724.64	1186.84
20	738.83	1200.94
21	752.67	1215.37
22	766.15	1230.15
23	772.09	1236.98

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	2.096	1.955	0.315
26.25	2.056	1.972	0.493
43.48	8.787	2.015	0.948
25.96	2.058	1.971	0.487
19.82	2.089	1.959	0.360
44.53	3.938	2.018	0.984
17.43	2.096	1.955	0.314

5.52	2.112	1.934	0.097
82.90	2.037	0.707	8.032
0.00	2.113	1.925	0.000
0.00	2.113	1.925	0.000
89.94	1.518	2.338	*****
22.45	2.079	1.964	0.413
10.98	2.107	1.943	0.194
61.64	2.471	2.105	1.852
0.00	2.113	1.924	0.000
0.00	2.113	1.924	0.000
89.94	0.000	2.285	*****
9.16	2.109	1.940	0.161
0.00	2.113	1.925	0.000

The Trial Failure Surface In Question Is Defined
By The Following 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.12	1000.31
2	439.01	1006.90
3	457.68	1014.07
4	476.12	1021.81
5	494.31	1030.12
6	512.23	1039.00
7	529.87	1048.42
8	547.21	1058.39
9	564.24	1068.88
10	580.93	1079.90
11	597.27	1091.43
12	613.24	1103.47
13	628.84	1115.99
14	644.04	1128.99
15	658.83	1142.45
16	673.20	1156.36
17	687.12	1170.72
18	700.60	1185.49
19	713.61	1200.68
20	726.15	1216.26
21	738.20	1232.23
22	746.14	1243.46

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	2.174	1.994	0.315
26.25	2.108	2.005	0.493
41.94	2.422	2.029	0.899
18.83	2.169	1.996	0.341
0.00	2.197	1.974	0.000
89.94	2.111	2.125	*****
83.03	2.115	2.073	8.181
87.66	1.941	2.012	*****
85.31	2.037	0.707	*****
87.50	1.971	1.940	*****
87.57	2.113	1.925	*****
87.49	1.518	2.338	*****
87.55	1.150	1.945	*****
89.94	0.011	0.000	*****
89.90	0.006	0.000	*****
0.00	2.197	1.974	0.000
89.94	-0.001	0.000	*****
89.34	-0.001	0.000	*****
0.00	2.197	1.974	0.000
88.73	-0.001	0.000	*****

The Trial Failure Surface In Question Is Defined
By The Following 24 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	420.28	1000.71
2	438.70	1008.50
3	457.01	1016.55
4	475.21	1024.84
5	493.30	1033.38
6	511.27	1042.16
7	529.11	1051.19
8	546.83	1060.46
9	564.43	1069.97
10	581.89	1079.72
11	599.22	1089.70
12	616.41	1099.92
13	633.47	1110.37
14	650.37	1121.05
15	667.13	1131.97
16	683.75	1143.10
17	700.20	1154.47
18	716.51	1166.05
19	732.65	1177.86
20	748.63	1189.89
21	764.45	1202.13
22	780.10	1214.58
23	795.57	1227.25
24	799.11	1230.22

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.50	2.073	1.899	0.315
26.25	1.993	1.915	0.493
35.70	2.024	1.937	0.719
0.00	2.105	1.868	0.000
75.54	2.197	1.974	3.878
89.94	3.558	0.748	*****
73.88	2.526	2.250	3.461
66.19	2.425	2.098	2.266
89.94	2.739	0.000	*****
61.89	2.402	2.053	1.872
47.09	2.464	1.971	1.076
89.94	2.362	2.360	*****
89.94	2.469	2.343	*****
89.59	0.000	-12.634	*****
89.94	2.599	2.343	*****
89.95	2.470	2.486	*****
89.94	0.000	2.468	*****
89.33	-0.001	-3.200	*****
89.59	-0.001	-0.081	*****
89.60	-0.001	0.000	*****

The Trial Failure Surface In Question Is Defined
By The Following 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.36	1000.91
2	439.38	1007.11
3	458.25	1013.74
4	476.96	1020.79
5	495.52	1028.25
6	513.91	1036.12
7	532.11	1044.40
8	550.13	1053.08
9	567.95	1062.16
10	585.56	1071.63
11	602.96	1081.49
12	620.14	1091.74
13	637.08	1102.37

```
   14        653.78     1113.37
   15        670.24     1124.74
   16        686.43     1136.47
   17        702.36     1148.56
   18        718.02     1161.01
   19        733.40     1173.79
   20        748.49     1186.92
   21        763.28     1200.38
   22        777.78     1214.17
   23        791.96     1228.27
   24        794.86     1231.29
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 24 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        420.36     1000.91
    2        439.04     1008.07
    3        457.59     1015.54
    4        476.01     1023.33
    5        494.30     1031.42
    6        512.45     1039.83
    7        530.45     1048.54
    8        548.31     1057.55
    9        566.00     1066.86
   10        583.54     1076.47
   11        600.92     1086.38
   12        618.12     1096.58
   13        635.15     1107.06
  ##################### SOME LINES SKIPPED #####################
      Following Are Displayed The Ten Most Critical Of The Trial
      Failure Surfaces Evaluated. They Are
      Ordered - Most Critical First.
      * * Safety Factors Are Calculated By GLE (Spencer`s) Method (0-1) * *
      Selected ki function = Constant (1.0)
      Selected Lambda Coefficient =  1.00
      Forces from Reinforcement, Piers/Piles, Soil Nails, and Applied Forces
      (if applicable) have been applied to the slice base(s)
      on which they intersect.
      Specified Tension Crack Water Force Factor =   0.000
      Total Number of Trial Surfaces Attempted =  5000
      WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
      Did Not Converge in 20 Iterations.
      Number of Trial Surfaces with Non-Converged FS =  539
      Number of Trial Surfaces with Misleading FS =   57
      Number of Trial Surfaces With Valid FS = 4404
      Percentage of Trial Surfaces With Non-Valid FS Solutions
      of the Total Attempted =  11.9 %
      Statistical Data On All Valid FS Values:
         FS Max =  29.080   FS Min =   1.844   FS Ave =   2.283
         Standard Deviation =    0.445   Coefficient of Variation =   19.47 %
                  ((Modified Bishop FS for Critical Surface =  1.860))
      Failure Surface Specified By 23 Coordinate Points
        Point       X-Surf       Y-Surf
         No.         (ft)         (ft)
          1        420.042     1000.106
          2        439.804     1003.185
          3        459.406     1007.156
          4        478.807     1012.011
          5        497.969     1017.741
          6        516.851     1024.334
          7        535.415     1031.776
          8        553.623     1040.051
          9        571.437     1049.144
         10        588.820     1059.034
         11        605.737     1069.703
         12        622.153     1081.127
```

13	638.034	1093.283
14	653.348	1106.147
15	668.064	1119.692
16	682.150	1133.890
17	695.578	1148.712
18	708.320	1164.127
19	720.351	1180.104
20	731.645	1196.610
21	742.179	1213.611
22	751.932	1231.072
23	756.801	1240.800

Circle Center At X = 362.041 ; Y = 1437.392 ; and Radius = 441.116

*** FOS = 1.844 Theta (ki=1.0) = 29.61 ***

Lambda = 0.568

Individual data on the 36 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	0.1	3.6	0.0	0.0	0.	0.	0.4	0.0	0.0
2	19.6	75522.8	0.0	5645.3	0.	0.	7552.3	0.0	0.0
3	0.2	1504.9	0.0	114.2	0.	0.	150.5	0.0	0.0
4	19.4	143479.9	0.0	16456.2	0.	0.	14348.0	0.0	0.0
5	19.4	129384.0	0.0	26440.7	0.	0.	12938.4	0.0	0.0
6	11.2	67065.7	0.0	19579.3	0.	0.	6706.6	0.0	0.0
7	8.0	57082.2	0.0	15656.7	0.	0.	5708.2	0.0	0.0
8	12.0	129269.2	0.0	26531.4	0.	0.	12926.9	0.0	0.0
9	6.9	86890.1	0.0	16406.4	0.	0.	8689.0	0.0	0.0
10	18.6	220371.6	0.0	49530.5	0.	0.	22037.2	0.0	0.0
11	18.2	192531.0	0.0	55000.7	0.	0.	19253.1	0.0	0.0
12	6.4	61367.6	0.0	20809.3	0.	0.	6136.8	0.0	0.0
13	11.4	128450.9	0.0	38527.5	0.	0.	12845.1	0.0	0.0
14	8.6	123940.0	0.0	30476.7	0.	0.	12394.0	0.0	0.0
15	8.8	136030.1	0.0	32053.5	0.	0.	13603.0	0.0	0.0
16	16.9	239024.3	0.0	64574.1	0.	0.	23902.4	0.0	0.0
17	16.4	202026.2	0.0	65464.7	0.	0.	20202.6	0.0	0.0
18	7.8	85285.8	0.0	32320.6	0.	0.	8528.6	0.0	0.0
19	8.0	92577.6	0.0	25086.1	0.	0.	9257.8	0.0	0.0
20	2.0	25438.5	0.0	7148.6	0.	0.	2543.9	0.0	0.0
21	10.0	145803.0	0.0	59470.5	0.	0.	14580.3	0.0	0.0
22	3.3	52630.1	0.0	18023.0	0.	0.	5263.0	0.0	0.0
23	14.7	211431.9	0.0	70006.4	0.	0.	21143.2	0.0	0.0
24	11.9	146318.8	0.0	43048.6	0.	0.	14631.9	0.0	0.0
25	2.1	23818.7	0.0	6140.9	0.	0.	2381.9	0.0	0.0
26	13.4	129246.1	0.0	27769.5	0.	0.	12924.6	0.0	0.0
27	4.4	34935.5	0.0	4530.3	0.	0.	3493.5	0.0	0.0
28	5.3	38363.2	0.0	1899.6	0.	0.	3836.3	0.0	0.0
29	3.1	21488.6	0.0	0.0	0.	0.	2148.9	0.0	0.0
30	12.0	77764.3	0.0	0.0	0.	0.	7776.4	0.0	0.0
31	7.3	40856.9	0.0	0.0	0.	0.	4085.7	0.0	0.0
32	4.0	20714.8	0.0	0.0	0.	0.	2071.5	0.0	0.0
33	8.4	40131.5	0.0	0.0	0.	0.	4013.2	0.0	0.0
34	2.2	9313.7	0.0	0.0	0.	0.	931.4	0.0	0.0
35	9.8	26491.9	0.0	0.0	0.	0.	2649.2	0.0	0.0
36	4.9	3464.0	0.0	0.0	0.	0.	346.4	0.0	0.0

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.604	1001.509
2	440.253	1005.235
3	459.737	1009.750
4	479.023	1015.048
5	498.079	1021.119
6	516.875	1027.953
7	535.380	1035.541
8	553.564	1043.868
9	571.397	1052.922

10	588.851	1062.688
11	605.896	1073.150
12	622.506	1084.291
13	638.653	1096.092
14	654.311	1108.536
15	669.454	1121.600
16	684.057	1135.265
17	698.098	1149.508
18	711.553	1164.305
19	724.401	1179.633
20	736.619	1195.467
21	748.189	1211.781
22	759.092	1228.548
23	765.135	1238.716

Circle Center At X = 338.086 ; Y = 1490.375 ; and Radius = 495.781
*** FOS = 1.852 Theta (ki=1.0) = 29.73 ***
Lambda = 0.571
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.123	1000.306
2	439.340	1005.846
3	458.371	1011.997
4	477.195	1018.752
5	495.795	1026.105
6	514.150	1034.049
7	532.242	1042.574
8	550.052	1051.673
9	567.563	1061.336
10	584.756	1071.553
11	601.615	1082.314
12	618.121	1093.608
13	634.258	1105.423
14	650.009	1117.747
15	665.359	1130.568
16	680.291	1143.873
17	694.792	1157.648
18	708.844	1171.879
19	722.435	1186.551
20	735.551	1201.650
21	748.178	1217.161
22	760.303	1233.066
23	764.453	1238.887

Circle Center At X = 256.297 ; Y = 1604.708 ; and Radius = 626.211
*** FOS = 1.857 Theta (ki=1.0) = 26.23 ***
Lambda = 0.493
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.363	1000.908
2	439.845	1005.432
3	459.143	1010.684
4	478.230	1016.656
5	497.081	1023.340
6	515.667	1030.725
7	533.963	1038.802
8	551.944	1047.560
9	569.584	1056.985
10	586.857	1067.066
11	603.741	1077.787
12	620.211	1089.134
13	636.244	1101.090
14	651.817	1113.639
15	666.909	1126.763
16	681.498	1140.443
17	695.563	1154.661
18	709.086	1169.397

```
   19        722.047     1184.629
   20        734.427     1200.337
   21        746.210     1216.497
   22        757.379     1233.088
   23        761.440     1239.640
Circle Center At X =   309.477 ; Y =  1522.545 ; and Radius =   533.292
***  FOS =     1.857   Theta (ki=1.0) =    30.50  ***
                     Lambda =   0.589
Failure Surface Specified By 24 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        420.684     1001.709
    2        440.337     1005.420
    3        459.841     1009.847
    4        479.170     1014.983
    5        498.298     1020.822
    6        517.201     1027.357
    7        535.852     1034.577
    8        554.227     1042.475
    9        572.300     1051.039
   10        590.049     1060.257
   11        607.449     1070.118
   12        624.477     1080.608
   13        641.111     1091.714
   14        657.327     1103.420
   15        673.105     1115.710
   16        688.423     1128.569
   17        703.261     1141.980
   18        717.599     1155.923
   19        731.418     1170.381
   20        744.699     1185.335
   21        757.425     1200.764
   22        769.578     1216.647
   23        781.143     1232.965
   24        782.128     1234.468
Circle Center At X =   329.068 ; Y =  1540.995 ; and Radius =   547.012
***  FOS =     1.864   Theta (ki=1.0) =    28.70  ***
                     Lambda =   0.548
Failure Surface Specified By 23 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        421.085     1002.712
    2        440.707     1006.581
    3        460.161     1011.223
    4        479.416     1016.631
    5        498.442     1022.795
    6        517.209     1029.707
    7        535.689     1037.356
    8        553.852     1045.729
    9        571.670     1054.814
   10        589.114     1064.596
   11        606.158     1075.060
   12        622.775     1086.190
   13        638.939     1097.969
   14        654.625     1110.376
   15        669.808     1123.395
   16        684.464     1137.003
   17        698.571     1151.181
   18        712.106     1165.905
   19        725.049     1181.152
   20        737.378     1196.900
   21        749.076     1213.122
   22        760.123     1229.795
   23        765.486     1238.629
Circle Center At X =   333.065 ; Y =  1500.761 ; and Radius =   505.767
***  FOS =     1.865   Theta (ki=1.0) =    29.84  ***
                     Lambda =   0.574
```

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	421.085	1002.712
2	440.684	1006.694
3	460.127	1011.381
4	479.388	1016.767
5	498.443	1022.845
6	517.265	1029.606
7	535.831	1037.042
8	554.116	1045.144
9	572.098	1053.901
10	589.751	1063.301
11	607.054	1073.332
12	623.983	1083.981
13	640.517	1095.234
14	656.634	1107.077
15	672.312	1119.493
16	687.533	1132.468
17	702.275	1145.983
18	716.520	1160.022
19	730.249	1174.566
20	743.443	1189.596
21	756.087	1205.092
22	768.163	1221.035
23	778.272	1235.432

Circle Center At X = 320.595 ; Y = 1547.509 ; and Radius = 553.988
*** FOS = 1.870 Theta (ki=1.0) = 29.12 ***
Lambda = 0.557

Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.203	1000.507
2	440.166	1001.714
3	460.034	1004.014
4	479.745	1007.399
5	499.241	1011.860
6	518.464	1017.382
7	537.355	1023.950
8	555.857	1031.543
9	573.916	1040.139
10	591.476	1049.712
11	608.485	1060.233
12	624.892	1071.670
13	640.647	1083.990
14	655.703	1097.154
15	670.016	1111.124
16	683.541	1125.858
17	696.238	1141.311
18	708.069	1157.436
19	718.998	1174.185
20	728.993	1191.509
21	738.023	1209.354
22	746.062	1227.667
23	751.485	1242.129

Circle Center At X = 408.173 ; Y = 1365.064 ; and Radius = 364.756
*** FOS = 1.876 Theta (ki=1.0) = 28.29 ***
Lambda = 0.538

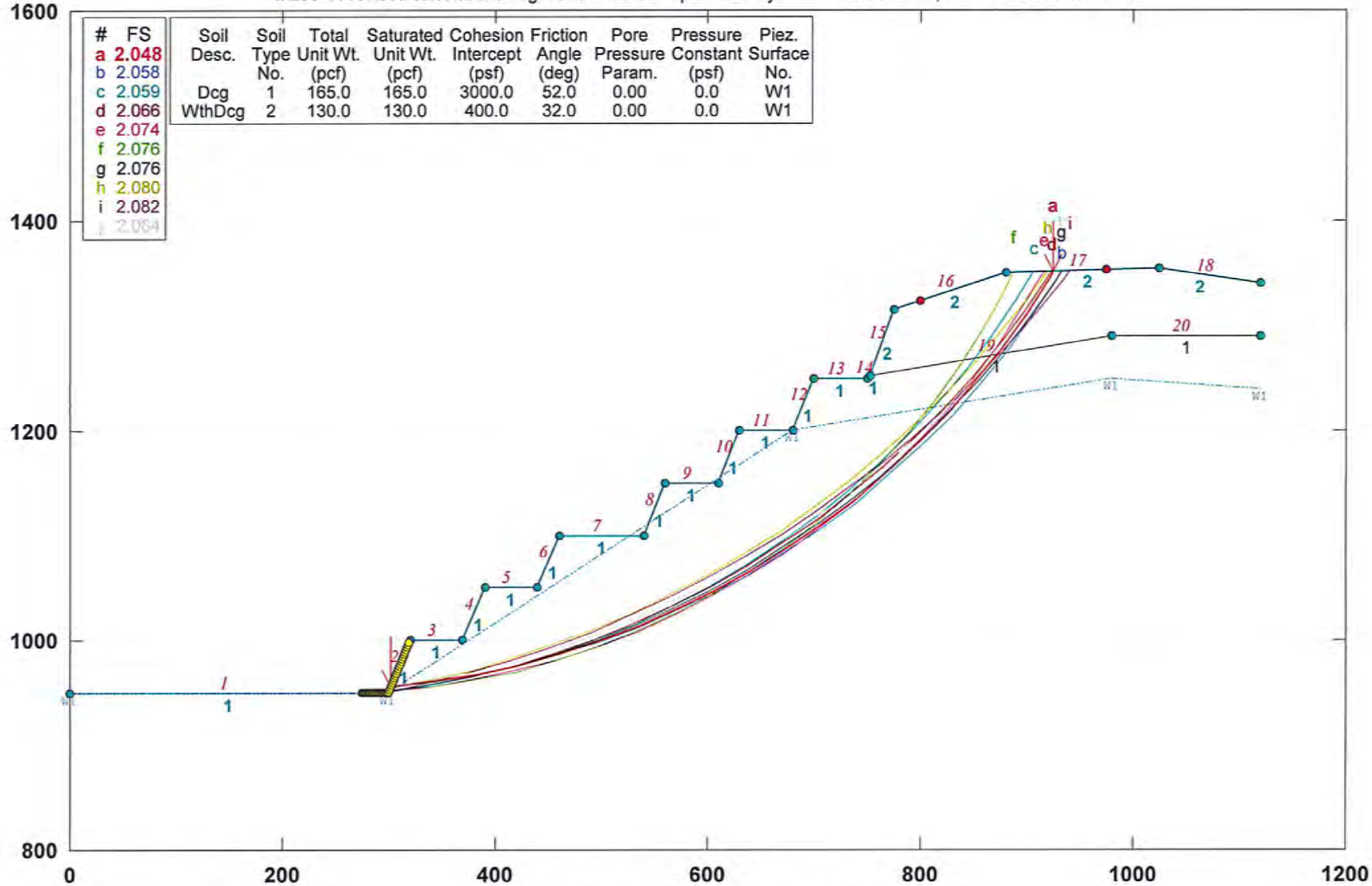
Failure Surface Specified By 23 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	420.684	1001.709
2	440.016	1006.833
3	459.162	1012.617
4	478.098	1019.054
5	496.801	1026.137
6	515.251	1033.857

```
    7        533.425     1042.206
    8        551.302     1051.173
    9        568.861     1060.748
   10        586.082     1070.920
   11        602.943     1081.676
   12        619.425     1093.005
   13        635.509     1104.892
   14        651.176     1117.324
   15        666.407     1130.286
   16        681.184     1143.763
   17        695.491     1157.739
   18        709.309     1172.197
   19        722.624     1187.121
   20        735.419     1202.493
   21        747.679     1218.295
   22        759.389     1234.507
   23        762.635     1239.341
Circle Center At X =   281.027 ; Y =  1567.696 ; and Radius =   582.962
***  FOS =     1.878   Theta (ki=1.0) =    30.81  ***
                     Lambda =   0.596
Failure Surface Specified By 24 Coordinate Points
  Point       X-Surf      Y-Surf
   No.         (ft)        (ft)
    1        421.165     1002.912
    2        440.834     1006.533
    3        460.360     1010.864
    4        479.716     1015.898
    5        498.877     1021.630
    6        517.818     1028.051
    7        536.514     1035.154
    8        554.941     1042.928
    9        573.075     1051.365
   10        590.891     1060.452
   11        608.367     1070.178
   12        625.479     1080.531
   13        642.206     1091.495
   14        658.524     1103.058
   15        674.414     1115.204
   16        689.853     1127.918
   17        704.822     1141.181
   18        719.301     1154.978
   19        733.272     1169.290
   20        746.715     1184.098
   21        759.614     1199.383
   22        771.951     1215.125
   23        783.710     1231.302
   24        785.305     1233.674
Circle Center At X =   331.085 ; Y =  1547.744 ; and Radius =   552.228
***  FOS =     1.879   Theta (ki=1.0) =    28.38  ***
                     Lambda =   0.540
          **** END OF GSTABL7 OUTPUT ****
```

3M Moody Flats Section E-E' Spencer Method With GW - Static

f:\293-11 revised calculations august 2012\ee\e-e-1.pl2 Run By: Petra Geotechnical, Inc. 8/6/2012 03:35PM



GSTABL7 v.2 FSmin=2.048

Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2)

GSTABL7

```
                    *** GSTABL7 ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
          (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                  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,
      Nonlinear Undrained Shear Strength, Curved Phi Envelope,
      Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
      Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************
Analysis Run Date:        8/6/2012
Time of Run:              03:35PM
Run By:                   Petra Geotechnical, Inc.
Input Data Filename:      f:\293-11 Revised Calculations August 2012\EE\e-e-1.
Output Filename:          f:\293-11 Revised Calculations August 2012\EE\e-e-1.OUT
Unit System:              English
Plotted Output Filename:  f:\293-11 Revised Calculations August 2012\EE\e-e-1.PLT
PROBLEM DESCRIPTION:  3M Moody Flats  Section E-E'
                      Spencer Method With GW - Static
BOUNDARY COORDINATES
   18 Top   Boundaries
   20 Total Boundaries
Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
   No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
    1         0.00     950.00     300.00     950.00        1
    2       300.00     950.00     320.00    1000.00        1
    3       320.00    1000.00     370.00    1000.00        1
    4       370.00    1000.00     390.00    1050.00        1
    5       390.00    1050.00     440.00    1050.00        1
    6       440.00    1050.00     460.00    1100.00        1
    7       460.00    1100.00     540.00    1100.00        1
    8       540.00    1100.00     560.00    1150.00        1
    9       560.00    1150.00     610.00    1150.00        1
   10       610.00    1150.00     630.00    1200.00        1
   11       630.00    1200.00     680.00    1200.00        1
   12       680.00    1200.00     700.00    1250.00        1
   13       700.00    1250.00     750.00    1250.00        1
   14       750.00    1250.00     753.00    1252.00        1
   15       753.00    1252.00     775.00    1315.00        2
   16       775.00    1315.00     880.00    1350.00        2
   17       880.00    1350.00    1025.00    1355.00        2
   18      1025.00    1355.00    1120.00    1340.00        2
   19       753.00    1252.00     980.00    1290.00        1
   20       980.00    1290.00    1120.00    1290.00        1
User Specified Y-Origin =        800.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
 2 Type(s) of Soil
Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
 No.  (pcf)    (pcf)     (psf)     (deg)    Param.   (psf)     No.
  1   165.0    165.0    3000.0     52.0    0.00       0.0      1
  2   130.0    130.0     400.0     32.0    0.00       0.0      1
1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water =  62.40 (pcf)
Piezometric Surface No.  1 Specified by  5 Coordinate Points
Pore Pressure Inclination Factor =  0.50
  Point      X-Water     Y-Water
   No.        (ft)        (ft)
    1         0.00      950.00
    2       300.00      950.00
    3       680.00     1200.00
    4       980.00     1250.00
```

```
    5        1120.00      1240.00
Specified Peak Ground Acceleration Coefficient (A) =    0.150(g)
Specified Horizontal Earthquake Coefficient (kh) =   0.100(g)
Specified Vertical Earthquake Coefficient (kv) =   0.000(g)
Specified Seismic Pore-Pressure Factor =   0.000
EARTHQUAKE DATA HAS BEEN SUPPRESSED
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
5000 Trial Surfaces Have Been Generated.
   5 Surface(s) Initiate(s) From Each Of  1000 Points Equally Spaced
Along The Ground Surface Between  X = 275.00(ft)
                              and  X = 320.00(ft)
Each Surface Terminates Between   X = 800.00(ft)
                              and  X = 975.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is  Y =       0.00(ft)
40.00(ft) Line Segments Define Each Trial Failure Surface.
Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations
```

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	2.446	2.244	0.306
25.50	2.373	2.255	0.477
41.36	2.599	2.280	0.880
13.03	2.465	2.239	0.231
0.00	2.499	2.223	0.000
89.94	2.117	2.112	*****
89.94	0.000	2.058	*****
0.00	2.499	2.223	0.000
0.00	2.499	2.223	0.000
0.00	2.499	2.222	0.000
0.00	2.499	2.222	0.000
0.00	2.499	2.222	0.000
0.00	2.499	2.222	0.000
0.00	2.499	2.222	0.000
0.00	2.499	2.222	0.000
0.00	2.499	2.222	0.000
0.00	2.499	2.222	0.000
0.00	2.499	2.222	0.000
0.00	2.499	2.222	0.000
0.00	2.499	2.222	0.000

The Trial Failure Surface In Question Is Defined
By The Following 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.09	950.22
2	337.15	965.28
3	373.95	980.95
4	410.50	997.21
5	446.77	1014.07
6	482.76	1031.52
7	518.46	1049.56
8	553.86	1068.18
9	588.96	1087.38
10	623.73	1107.15
11	658.17	1127.49
12	692.28	1148.39
13	726.04	1169.84
14	759.44	1191.84
15	792.48	1214.39
16	825.15	1237.48
17	857.43	1261.10
18	889.32	1285.24
19	920.81	1309.90
20	951.90	1335.08
21	973.57	1353.23

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	2.410	2.191	0.306
25.50	2.356	2.213	0.477
46.98	2.864	2.282	1.072
16.15	2.414	2.189	0.290
0.00	2.458	2.151	0.000
80.06	3.089	2.700	5.706
0.00	2.458	2.151	0.000
0.00	2.458	2.151	0.000
42.38	1.764	2.264	0.913
21.52	2.386	2.202	0.394
22.03	2.382	2.204	0.405
48.40	2.810	2.288	1.126
3.73	2.451	2.160	0.065
0.00	2.458	2.151	0.000
89.94	-0.172	0.510	*****
37.27	2.140	2.246	0.761
6.77	2.445	2.167	0.119
26.03	2.351	2.214	0.488
51.09	2.499	2.300	1.239
0.00	2.458	2.151	0.000

The Trial Failure Surface In Question Is Defined
By The Following 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.22	950.56
2	337.86	964.10
3	375.02	978.91
4	411.66	994.96
5	447.73	1012.24
6	483.20	1030.73
7	518.03	1050.41
8	552.16	1071.26
9	585.58	1093.25
10	618.23	1116.35
11	650.08	1140.55
12	681.10	1165.81
13	711.25	1192.10
14	740.49	1219.40
15	768.78	1247.66
16	796.11	1276.87
17	822.44	1306.99
18	847.73	1337.98
19	849.02	1339.67

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	2.689	2.437	0.306
25.50	2.618	2.448	0.477
49.02	3.133	2.484	1.151
14.36	2.701	2.433	0.256
0.00	2.741	2.414	0.000
89.94	2.960	2.771	*****
89.94	2.960	2.771	*****
12.46	2.709	2.431	0.221
89.94	0.000	0.936	*****
36.10	2.087	2.463	0.729
0.00	2.741	2.414	0.000
10.35	2.716	2.428	0.183
89.94	2.960	2.771	*****
89.94	2.458	2.151	*****

66.53	2.924	2.528	2.303
89.94	2.140	0.834	*****
52.96	3.033	2.492	1.325
5.78	2.729	2.422	0.101
0.00	2.741	2.414	0.000
89.94	2.960	2.771	*****

The Trial Failure Surface In Question Is Defined
By The Following 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.36	950.90
2	335.90	969.26
3	371.28	987.91
4	406.52	1006.83
5	441.61	1026.03
6	476.55	1045.51
7	511.33	1065.27
8	545.96	1085.30
9	580.42	1105.60
10	614.72	1126.18
11	648.86	1147.02
12	682.83	1168.14
13	716.64	1189.52
14	750.27	1211.17
15	783.74	1233.09
16	817.02	1255.27
17	850.13	1277.71
18	883.07	1300.41
19	915.82	1323.38
20	948.39	1346.60
21	956.73	1352.65

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	2.729	2.439	0.306
25.50	2.662	2.452	0.477
55.15	3.018	2.507	1.436
0.00	2.778	2.413	0.000
0.00	2.778	2.413	0.000
55.85	3.011	2.509	1.474
0.00	2.778	2.413	0.000
0.00	2.778	2.413	0.000
89.94	0.000	0.936	*****
33.60	2.422	2.464	0.664
11.28	2.752	2.431	0.200
30.15	2.574	2.459	0.581
44.18	3.460	2.483	0.972
27.66	2.629	2.455	0.524
17.36	2.727	2.440	0.313
52.19	3.058	2.500	1.289
0.00	2.778	2.413	0.000
0.00	2.778	2.413	0.000
0.00	2.778	2.413	0.000
89.94	3.001	2.794	*****

The Trial Failure Surface In Question Is Defined
By The Following 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.40	951.01
2	335.90	969.45
3	371.23	988.21
4	406.38	1007.29
5	441.36	1026.70
6	476.15	1046.44
7	510.76	1066.49

8	545.19	1086.86
9	579.42	1107.55
10	613.46	1128.56
11	647.30	1149.88
12	680.95	1171.51
13	714.39	1193.45
14	747.64	1215.70
15	780.67	1238.26
16	813.49	1261.12
17	846.10	1284.28
18	878.50	1307.75
19	910.67	1331.51
20	937.88	1352.00

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	3.077	2.699	0.306
25.50	3.000	2.712	0.477
61.73	3.289	2.786	1.859
0.00	3.130	2.671	0.000
0.00	3.130	2.672	0.000
37.83	2.107	2.733	0.777
21.32	3.047	2.706	0.390
23.58	3.025	2.709	0.437
60.48	3.295	2.782	1.766
0.00	3.130	2.672	0.000
0.00	3.130	2.672	0.000
39.70	5.208	2.736	0.830
0.00	3.130	2.672	0.000
0.00	3.130	2.672	0.000
32.09	2.798	2.723	0.627
40.46	4.400	2.738	0.853
31.57	2.829	2.722	0.614
27.79	2.959	2.716	0.527
36.77	2.571	2.731	0.747
32.01	2.803	2.723	0.625

The Trial Failure Surface In Question Is Defined
By The Following 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.54	951.35
2	334.95	971.74
3	369.30	992.23
4	403.59	1012.83
5	437.82	1033.53
6	471.99	1054.33
7	506.09	1075.24
8	540.13	1096.24
9	574.11	1117.35
10	608.02	1138.56
11	641.87	1159.87
12	675.66	1181.28
13	709.38	1202.80
14	743.04	1224.41
15	776.63	1246.13
16	810.16	1267.94
17	843.62	1289.86
18	877.01	1311.88
19	910.34	1333.99
20	937.27	1351.97

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda

17.00	3.229	2.809	0.306
25.50	3.146	2.823	0.477
63.55	3.434	2.903	2.010
0.00	3.285	2.781	0.000
0.00	3.285	2.781	0.000
37.83	34.938	2.844	0.777
0.00	3.285	2.781	0.000
0.00	3.285	2.781	0.000
68.34	3.418	2.920	2.518
89.94	3.130	2.672	*****
89.94	3.130	2.672	*****
9.72	3.261	2.797	0.171
89.94	3.122	2.951	*****
89.94	3.373	3.074	*****
2.11	3.281	2.784	0.037
89.94	3.373	3.074	*****
89.94	3.373	3.074	*****
11.30	3.255	2.800	0.200
89.94	3.373	3.074	*****
89.94	3.373	3.074	*****

The Trial Failure Surface In Question Is Defined
By The Following 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.54	951.35
2	334.59	972.34
3	368.62	993.36
4	402.63	1014.42
5	436.62	1035.51
6	470.58	1056.63
7	504.53	1077.79
8	538.45	1098.99
9	572.36	1120.21
10	606.24	1141.47
11	640.10	1162.77
12	673.94	1184.10
13	707.75	1205.46
14	741.55	1226.86
15	775.32	1248.29
16	809.08	1269.76
17	842.81	1291.26
18	876.52	1312.79
19	910.20	1334.36
20	937.68	1351.99

The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.72	951.80
2	338.02	966.24
3	374.95	981.61
4	411.49	997.89
5	447.61	1015.08
6	483.28	1033.17
7	518.50	1052.14
8	553.23	1071.98
9	587.45	1092.69
10	621.15	1114.24
11	654.30	1136.63
12	686.88	1159.84
13	718.87	1183.85
14	750.25	1208.66
15	781.00	1234.24
16	811.10	1260.58
17	840.54	1287.66
18	869.29	1315.47

19	897.33	1343.99
20	903.72	1350.82

Factor Of Safety For The Preceding Specified Surface = 2.211
Theta (ki = 1.0) = 33.03 Deg Lambda =
Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	2.937	2.596	0.306
25.50	2.862	2.609	0.477
58.17	3.167	2.670	1.611
0.00	2.988	2.570	0.000
0.00	2.988	2.570	0.000
64.01	3.140	2.687	2.052
0.00	2.988	2.570	0.000
0.00	2.988	2.570	0.000
43.61	3.505	2.638	0.953
0.00	2.988	2.570	0.000
0.00	2.988	2.570	0.000
49.93	3.253	2.651	1.189
0.00	2.988	2.570	0.000
0.00	2.988	2.570	0.000
45.86	3.366	2.643	1.030
0.00	2.988	2.570	0.000
0.00	2.988	2.570	0.000
45.69	3.374	2.642	1.024
0.00	2.988	2.570	0.000
0.00	2.988	2.570	0.000

The Trial Failure Surface In Question Is Defined
By The Following 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.77	951.91
2	335.60	971.57
3	370.35	991.39
4	404.99	1011.38
5	439.54	1031.54
6	474.00	1051.86
7	508.35	1072.35
8	542.60	1093.00
9	576.76	1113.82
10	610.81	1134.81
11	644.76	1155.96
12	678.61	1177.27
13	712.36	1198.75
14	746.00	1220.39
15	779.54	1242.19
16	812.97	1264.15
17	846.29	1286.27
18	879.51	1308.56
19	912.62	1331.00
20	943.55	1352.19

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	2.623	2.353	0.306
25.50	2.557	2.368	0.477
52.13	3.219	2.427	1.286
14.37	2.635	2.349	0.256
0.00	2.676	2.323	0.000
89.94	2.790	2.783	*****
89.94	3.089	2.904	*****
0.00	2.676	2.323	0.000
89.94	3.505	2.638	*****

0.00	2.676	2.323	0.000
0.00	2.676	2.323	0.000
49.93	3.379	2.421	1.189
0.00	2.676	2.323	0.000
0.00	2.676	2.323	0.000
45.86	4.794	2.410	1.030
0.00	2.676	2.323	0.000
0.00	2.676	2.323	0.000
45.69	5.039	2.410	1.024
0.00	2.676	2.323	0.000
0.00	2.676	2.323	0.000

The Trial Failure Surface In Question Is Defined
By The Following 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.86	952.14
2	336.99	969.30
3	372.85	987.02
4	408.43	1005.30
5	443.72	1024.13
6	478.71	1043.50
7	513.40	1063.42
8	547.77	1083.88
9	581.82	1104.87
10	615.54	1126.39
11	648.92	1148.43
12	681.95	1170.99
13	714.63	1194.05
14	746.95	1217.63
15	778.89	1241.70
16	810.45	1266.28
17	841.63	1291.33
18	872.42	1316.87
19	902.80	1342.89
20	912.09	1351.11

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	2.710	2.453	0.306
25.50	2.636	2.464	0.477
48.45	3.189	2.500	1.128
15.29	2.719	2.450	0.273
0.00	2.765	2.430	0.000
89.94	2.988	2.790	*****
89.94	2.988	2.790	*****
0.00	2.765	2.430	0.000
89.94	2.988	2.790	*****
89.94	2.988	2.790	*****
0.00	2.765	2.430	0.000
89.94	2.988	2.790	*****
89.94	2.988	2.790	*****
0.00	2.765	2.430	0.000
89.94	2.988	2.790	*****
89.94	2.988	2.790	*****
0.00	2.765	2.430	0.000
89.94	2.988	2.790	*****
89.94	2.988	2.790	*****
0.00	2.765	2.430	0.000

The Trial Failure Surface In Question Is Defined
By The Following 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.86	952.14
2	336.41	970.45
3	371.83	989.05

4	407.10	1007.92
5	442.22	1027.07
6	477.18	1046.50
7	512.00	1066.19
8	546.65	1086.16
9	581.16	1106.41
10	615.50	1126.92
11	649.67	1147.70
12	683.69	1168.75
13	717.54	1190.06
14	751.21	1211.64
15	784.72	1233.49
16	818.06	1255.59
17	851.22	1277.96
18	884.21	1300.59
19	917.01	1323.47
20	949.64	1346.61
21	958.07	1352.69

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations
##################### SOME LINES SKIPPED #####################
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2) * *
Selected ki function = Bi-linear
Selected Lambda Coefficient = 1.00
Forces from Reinforcement, Piers/Piles, Soil Nails, and Applied Forces
(if applicable) have been applied to the slice base(s)
on which they intersect.
Specified Tension Crack Water Force Factor = 0.000
Total Number of Trial Surfaces Attempted = 5000
WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
Did Not Converge in 20 Iterations.
Number of Trial Surfaces with Non-Converged FS = 175
Number of Trial Surfaces with Misleading FS = 27
Number of Trial Surfaces With Valid FS = 4798
Percentage of Trial Surfaces With Non-Valid FS Solutions
of the Total Attempted = 4.0 %
Statistical Data On All Valid FS Values:
FS Max = 3.298 FS Min = 2.048 FS Ave = 2.519
Standard Deviation = 0.230 Coefficient of Variation = 9.14 %
((Modified Bishop FS for Critical Surface = 2.047))
Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	302.252	955.629
2	341.971	960.356
3	381.410	967.033
4	420.472	975.644
5	459.064	986.166
6	497.090	998.575
7	534.459	1012.842
8	571.081	1028.930
9	606.867	1046.802
10	641.729	1066.413
11	675.584	1087.717
12	708.349	1110.661
13	739.946	1135.190
14	770.296	1161.245
15	799.327	1188.763
16	826.968	1217.676
17	853.153	1247.914
18	877.817	1279.405
19	900.901	1312.072
20	922.350	1345.835
21	925.610	1351.573

Circle Center At X = 226.130 ; Y = 1764.417 ; and Radius = 812.363
*** FOS = 2.048 Theta (ki=1.0) = 20.98 ***
Lambda = 0.383
Individual data on the 38 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	7.7	11637.0	0.0	0.0	0.	0.	0.0	0.0	0.0
2	10.1	50239.9	0.0	1452.3	0.	0.	0.0	0.0	0.0
3	22.0	148458.1	0.0	13287.8	0.	0.	0.0	0.0	0.0
4	28.0	172368.5	0.0	36299.0	0.	0.	0.0	0.0	0.0
5	11.4	90735.0	0.0	20683.4	0.	0.	0.0	0.0	0.0
6	8.6	101031.4	0.0	17895.7	0.	0.	0.0	0.0	0.0
7	30.5	390745.8	0.0	77608.4	0.	0.	0.0	0.0	0.0
8	19.5	231002.7	0.0	61521.0	0.	0.	0.0	0.0	0.0
9	19.1	283918.9	0.0	67839.8	0.	0.	0.0	0.0	0.0
10	0.9	17384.7	0.0	3581.7	0.	0.	0.0	0.0	0.0
11	37.1	657738.6	0.0	*******	0.	0.	0.0	0.0	0.0
12	37.4	581398.0	0.0	*******	0.	0.	0.0	0.0	0.0
13	5.5	78567.3	0.0	29498.4	0.	0.	0.0	0.0	0.0
14	20.0	347593.3	0.0	*******	0.	0.	0.0	0.0	0.0
15	11.1	225818.0	0.0	62965.7	0.	0.	0.0	0.0	0.0
16	35.8	662110.4	0.0	*******	0.	0.	0.0	0.0	0.0
17	3.1	52893.4	0.0	20040.0	0.	0.	0.0	0.0	0.0
18	20.0	398675.2	0.0	*******	0.	0.	0.0	0.0	0.0
19	11.7	264923.6	0.0	76890.0	0.	0.	0.0	0.0	0.0
20	33.9	686722.9	0.0	*******	0.	0.	0.0	0.0	0.0
21	4.4	80682.4	0.0	31209.0	0.	0.	0.0	0.0	0.0
22	20.0	419722.4	0.0	*******	0.	0.	0.0	0.0	0.0
23	8.3	195990.2	0.0	60418.8	0.	0.	0.0	0.0	0.0
24	31.6	662483.8	0.0	*******	0.	0.	0.0	0.0	0.0
25	10.1	183307.7	0.0	58178.0	0.	0.	0.0	0.0	0.0
26	3.0	52415.8	0.0	16259.8	0.	0.	0.0	0.0	0.0
27	17.3	336743.6	0.0	83892.1	0.	0.	0.0	0.0	0.0
28	4.7	103660.5	0.0	20733.6	0.	0.	0.0	0.0	0.0
29	24.3	517038.0	0.0	83825.9	0.	0.	0.0	0.0	0.0
30	27.6	504296.3	0.0	46714.7	0.	0.	0.0	0.0	0.0
31	6.9	110767.0	0.0	2212.6	0.	0.	0.0	0.0	0.0
32	19.3	273838.1	0.0	0.0	0.	0.	0.0	0.0	0.0
33	18.8	212770.2	0.0	0.0	0.	0.	0.0	0.0	0.0
34	5.9	55414.5	0.0	0.0	0.	0.	0.0	0.0	0.0
35	2.2	19491.4	0.0	0.0	0.	0.	0.0	0.0	0.0
36	20.9	144222.2	0.0	0.0	0.	0.	0.0	0.0	0.0
37	21.4	61724.9	0.0	0.0	0.	0.	0.0	0.0	0.0
38	3.3	1192.1	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	302.252	955.629
2	341.981	960.273
3	381.440	966.832
4	420.535	975.291
5	459.175	985.631
6	497.271	997.827
7	534.732	1011.850
8	571.471	1027.668
9	607.403	1045.245
10	642.443	1064.537
11	676.509	1085.502
12	709.522	1108.089
13	741.404	1132.245
14	772.080	1157.915
15	801.480	1185.038
16	829.534	1213.551
17	856.177	1243.386
18	881.346	1274.475

```
   19        904.982      1306.745
   20        927.031      1340.119
   21        933.997      1351.862
Circle Center At X =   226.126 ; Y =  1779.194 ; and Radius =   827.076
***  FOS =     2.058   Theta (ki=1.0) =    20.89  ***
                    Lambda =   0.382
Failure Surface Specified By 20 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        300.495       951.237
    2        340.066       957.077
    3        379.304       964.848
    4        418.114       974.532
    5        456.404       986.104
    6        494.080       999.538
    7        531.054      1014.801
    8        567.235      1031.857
    9        602.538      1050.664
   10        636.878      1071.178
   11        670.171      1093.349
   12        702.339      1117.124
   13        733.303      1142.445
   14        762.991      1169.253
   15        791.329      1197.483
   16        818.251      1227.067
   17        843.692      1257.933
   18        867.591      1290.009
   19        889.890      1323.217
   20        906.582      1350.917
Circle Center At X =   201.353 ; Y =  1760.965 ; and Radius =   815.775
***  FOS =     2.059   Theta (ki=1.0) =    29.97  ***
                    Lambda =   0.577
Failure Surface Specified By 21 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        300.495       951.237
    2        339.989       957.577
    3        379.155       965.701
    4        417.913       975.594
    5        456.181       987.235
    6        493.883      1000.600
    7        530.939      1015.662
    8        567.273      1032.389
    9        602.812      1050.746
   10        637.481      1070.697
   11        671.210      1092.201
   12        703.928      1115.212
   13        735.569      1139.683
   14        766.067      1165.565
   15        795.360      1192.803
   16        823.387      1221.343
   17        850.090      1251.124
   18        875.415      1282.086
   19        899.310      1314.165
   20        921.724      1347.295
   21        924.317      1351.528
Circle Center At X =   180.559 ; Y =  1824.599 ; and Radius =   881.558
***  FOS =     2.066   Theta (ki=1.0) =    29.37  ***
                    Lambda =   0.563
Failure Surface Specified By 21 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        300.630       951.575
    2        340.399       955.865
    3        379.894       962.202
    4        419.009       970.570
    5        457.640       980.947
```

6	495.683	993.304
7	533.038	1007.609
8	569.604	1023.824
9	605.284	1041.905
10	639.983	1061.804
11	673.608	1083.469
12	706.070	1106.841
13	737.281	1131.857
14	767.160	1158.452
15	795.625	1186.554
16	822.601	1216.088
17	848.017	1246.976
18	871.803	1279.135
19	893.898	1312.479
20	914.241	1346.920
21	916.510	1351.259

Circle Center At X = 237.492 ; Y = 1723.433 ; and Radius = 774.437
*** FOS = 2.074 Theta (ki=1.0) = 29.21 ***
Lambda = 0.559
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.855	952.138
2	340.684	955.840
3	380.235	961.814
4	419.380	970.039
5	457.991	980.490
6	495.941	993.131
7	533.106	1007.921
8	569.365	1024.812
9	604.598	1043.749
10	638.691	1064.669
11	671.532	1087.505
12	703.014	1112.181
13	733.033	1138.617
14	761.491	1166.726
15	788.295	1196.417
16	813.358	1227.591
17	836.598	1260.148
18	857.937	1293.980
19	877.307	1328.977
20	887.544	1350.260

Circle Center At X = 256.393 ; Y = 1649.004 ; and Radius = 698.283
*** FOS = 2.076 Theta (ki=1.0) = 29.73 ***
Lambda = 0.571
Failure Surface Specified By 21 Coordinate Points

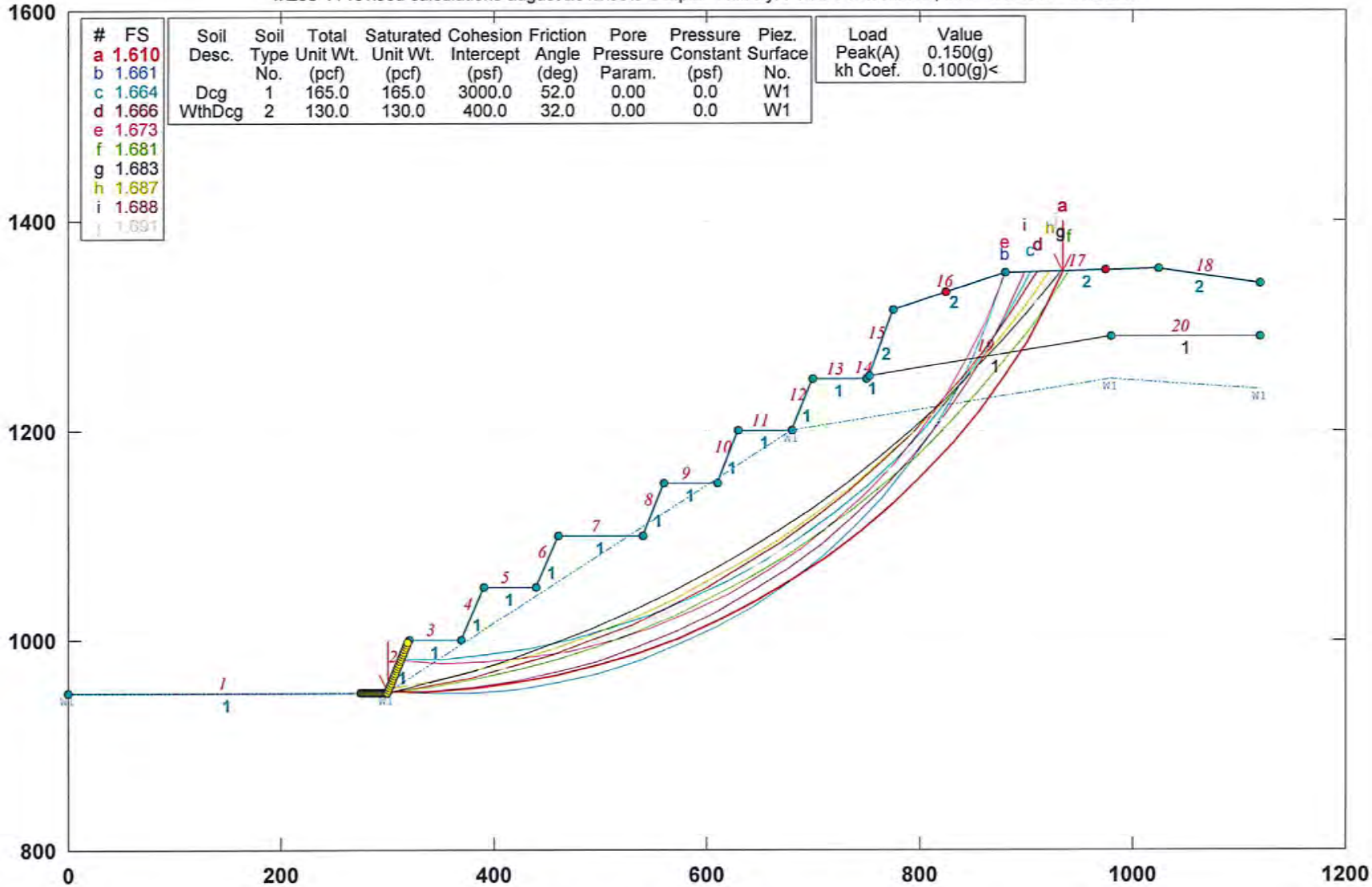
Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.585	951.462
2	340.124	957.520
3	379.350	965.350
4	418.184	974.938
5	456.547	986.263
6	494.362	999.303
7	531.552	1014.031
8	568.041	1030.418
9	603.756	1048.430
10	638.625	1068.031
11	672.576	1089.181
12	705.541	1111.837
13	737.453	1135.953
14	768.248	1161.481
15	797.864	1188.368
16	826.239	1216.561
17	853.317	1246.002
18	879.043	1276.632
19	903.364	1308.388

```
   20        926.232     1341.207
   21        932.943     1351.826
Circle Center At X =   185.796 ; Y =  1832.771 ; and Radius =   888.753
***  FOS =     2.076   Theta (ki=1.0) =    29.27  ***
                    Lambda =   0.560
Failure Surface Specified By 20 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        301.441      953.602
    2        340.606      961.730
    3        379.405      971.460
    4        417.771      982.776
    5        455.639      995.659
    6        492.947     1010.086
    7        529.630     1026.035
    8        565.627     1043.477
    9        600.877     1062.383
   10        635.320     1082.722
   11        668.898     1104.458
   12        701.556     1127.556
   13        733.236     1151.977
   14        763.887     1177.678
   15        793.455     1204.616
   16        821.892     1232.747
   17        849.149     1262.023
   18        875.180     1292.394
   19        899.942     1323.808
   20        919.890     1351.375
Circle Center At X =   123.531 ; Y =  1909.874 ; and Radius =   972.681
***  FOS =     2.080   Theta (ki=1.0) =    30.23  ***
                    Lambda =   0.583
Failure Surface Specified By 21 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        300.135      950.336
    2        339.197      958.944
    3        377.911      969.006
    4        416.222      980.508
    5        454.076      993.434
    6        491.420     1007.766
    7        528.203     1023.484
    8        564.372     1040.565
    9        599.878     1058.986
   10        634.670     1078.722
   11        668.700     1099.744
   12        701.921     1122.024
   13        734.286     1145.529
   14        765.750     1170.228
   15        796.269     1196.086
   16        825.799     1223.066
   17        854.301     1251.131
   18        881.734     1280.242
   19        908.059     1310.358
   20        933.241     1341.437
   21        941.249     1352.112
Circle Center At X =    89.443 ; Y =  1999.382 ; and Radius =  1069.994
***  FOS =     2.082   Theta (ki=1.0) =    29.80  ***
                    Lambda =   0.573
Failure Surface Specified By 21 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        301.351      953.377
    2        340.737      960.357
    3        379.789      969.013
    4        418.436      979.330
    5        456.607      991.287
    6        494.232     1004.864
```

```
    7        531.243     1020.036
    8        567.573     1036.774
    9        603.154     1055.049
   10        637.922     1074.828
   11        671.814     1096.073
   12        704.767     1118.746
   13        736.722     1142.806
   14        767.620     1168.208
   15        797.405     1194.908
   16        826.023     1222.855
   17        853.420     1251.999
   18        879.548     1282.286
   19        904.359     1313.662
   20        927.806     1346.069
   21        931.577     1351.778
Circle Center At X =   157.687 ; Y =  1878.594 ; and Radius =   936.305
***  FOS =     2.084   Theta (ki=1.0) =    29.60  ***
                     Lambda =   0.568
          **** END OF GSTABL7 OUTPUT ****
```

3M Moody Flats Section E-E' Spencer Method With GW - Earthquake

f:\293-11 revised calculations august 2012\ee\e-e-2.pl2 Run By: Petra Geotechnical, Inc. 8/6/2012 03:38PM



GSTABL7 v.2 FSmin=1.610

Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2)

GSTABL7

```
                    *** GSTABL7 ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
          (All Rights Reserved-Unauthorized Use Prohibited)
*****************************************************************************
                 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,
      Nonlinear Undrained Shear Strength, Curved Phi Envelope,
      Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
      Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*****************************************************************************
Analysis Run Date:          8/6/2012
Time of Run:                03:38PM
Run By:                     Petra Geotechnical, Inc.
Input Data Filename:        f:\293-11 Revised Calculations August 2012\EE\e-e-2.
Output Filename:            f:\293-11 Revised Calculations August 2012\EE\e-e-2.OUT
Unit System:                English
Plotted Output Filename:    f:\293-11 Revised Calculations August 2012\EE\e-e-2.PLT
PROBLEM DESCRIPTION:  3M Moody Flats  Section E-E'
                      Spencer Method With GW - Earthquake
BOUNDARY COORDINATES
   18 Top   Boundaries
   20 Total Boundaries
Boundary     X-Left     Y-Left     X-Right    Y-Right    Soil Type
   No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
    1         0.00     950.00     300.00     950.00        1
    2       300.00     950.00     320.00    1000.00        1
    3       320.00    1000.00     370.00    1000.00        1
    4       370.00    1000.00     390.00    1050.00        1
    5       390.00    1050.00     440.00    1050.00        1
    6       440.00    1050.00     460.00    1100.00        1
    7       460.00    1100.00     540.00    1100.00        1
    8       540.00    1100.00     560.00    1150.00        1
    9       560.00    1150.00     610.00    1150.00        1
   10       610.00    1150.00     630.00    1200.00        1
   11       630.00    1200.00     680.00    1200.00        1
   12       680.00    1200.00     700.00    1250.00        1
   13       700.00    1250.00     750.00    1250.00        1
   14       750.00    1250.00     753.00    1252.00        1
   15       753.00    1252.00     775.00    1315.00        2
   16       775.00    1315.00     880.00    1350.00        2
   17       880.00    1350.00    1025.00    1355.00        2
   18      1025.00    1355.00    1120.00    1340.00        2
   19       753.00    1252.00     980.00    1290.00        1
   20       980.00    1290.00    1120.00    1290.00        1
User Specified Y-Origin =        800.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
  2 Type(s) of Soil
Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
 No.  (pcf)    (pcf)     (psf)     (deg)    Param.   (psf)     No.
  1   165.0    165.0    3000.0     52.0     0.00      0.0      1
  2   130.0    130.0     400.0     32.0     0.00      0.0      1
1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water =  62.40 (pcf)
Piezometric Surface No.  1 Specified by  5 Coordinate Points
Pore Pressure Inclination Factor =  0.50
  Point      X-Water     Y-Water
   No.        (ft)        (ft)
    1         0.00      950.00
    2       300.00      950.00
    3       680.00     1200.00
    4       980.00     1250.00
```

```
    5        1120.00      1240.00
Specified Peak Ground Acceleration Coefficient (A) =   0.150(g)
Specified Horizontal Earthquake Coefficient (kh) =   0.100(g)
Specified Vertical Earthquake Coefficient (kv) =   0.000(g)
Specified Seismic Pore-Pressure Factor =   0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
5000 Trial Surfaces Have Been Generated.
   5 Surface(s) Initiate(s) From Each Of  1000 Points Equally Spaced
Along The Ground Surface Between  X = 275.00(ft)
                                and  X = 320.00(ft)
Each Surface Terminates Between   X = 825.00(ft)
                                and  X = 975.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is  Y =       0.00(ft)
40.00(ft) Line Segments Define Each Trial Failure Surface.
Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations
 Theta        FOS        FOS
 (deg)      (Moment)   (Force)
(ki=1.0)    (Equil.)   (Equil.)   Lambda
 17.00       2.185      1.988     0.306
 25.50       2.132      1.998     0.477
 50.25       2.433      2.032     1.203
  8.79       2.207      1.979     0.155
  0.00       2.221      1.970     0.000
 89.94       1.093      1.988     *****
 26.27       2.124      1.998     0.494
 15.51       2.190      1.987     0.278
 53.06       2.402      2.037     1.330
  0.00       2.221      1.970     0.000
  0.00       2.221      1.970     0.000
  0.00       2.221      1.970     0.000
  0.00       2.221      1.970     0.000
  0.00       2.221      1.970     0.000
  0.00       2.221      1.970     0.000
  0.00       2.221      1.970     0.000
  0.00       2.221      1.970     0.000
  0.00       2.221      1.970     0.000
  0.00       2.221      1.970     0.000
  0.00       2.221      1.970     0.000
The Trial Failure Surface In Question Is Defined
By The Following 21 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        300.04      950.11
    2        335.58      968.48
    3        370.98      987.10
    4        406.24     1005.98
    5        441.38     1025.10
    6        476.37     1044.48
    7        511.22     1064.10
    8        545.94     1083.98
    9        580.51     1104.10
   10        614.94     1124.47
   11        649.22     1145.08
   12        683.35     1165.94
   13        717.33     1187.04
   14        751.16     1208.38
   15        784.84     1229.96
   16        818.36     1251.78
   17        851.73     1273.84
   18        884.93     1296.14
   19        917.98     1318.68
   20        950.87     1341.45
   21        967.31     1353.01
Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
```

Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	1.984	1.829	0.306
25.50	1.931	1.838	0.477
42.05	4.506	1.861	0.902
24.70	1.938	1.837	0.460
18.00	1.980	1.830	0.325
45.17	2.613	1.867	1.006
8.88	2.007	1.821	0.156
0.00	2.021	1.812	0.000
89.94	1.770	1.804	*****
73.36	2.254	2.003	3.346
87.32	0.001	2.284	*****
75.20	2.269	2.033	3.785
72.67	2.249	1.994	3.206
89.94	2.391	2.372	*****
89.94	2.478	2.400	*****
0.00	2.021	1.812	0.000
89.94	2.684	0.000	*****
0.00	2.021	1.812	0.000
0.00	2.021	1.812	0.000
0.00	2.019	1.809	0.000

The Trial Failure Surface In Question Is Defined
By The Following 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.09	950.22
2	337.06	965.50
3	373.78	981.36
4	410.25	997.78
5	446.46	1014.78
6	482.40	1032.35
7	518.05	1050.47
8	553.42	1069.16
9	588.49	1088.39
10	623.26	1108.18
11	657.71	1128.50
12	691.84	1149.37
13	725.63	1170.76
14	759.09	1192.69
15	792.20	1215.13
16	824.95	1238.10
17	857.34	1261.57
18	889.35	1285.55
19	920.99	1310.03
20	952.24	1335.00
21	974.36	1353.25

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	2.469	2.190	0.306
25.50	2.415	2.204	0.477
60.84	2.673	2.280	1.792
0.00	2.510	2.162	0.000
0.00	2.510	2.162	0.000
31.85	2.305	2.215	0.621
46.77	2.917	2.243	1.064
28.76	2.374	2.210	0.549
15.00	2.477	2.187	0.268
57.38	2.695	2.269	1.562
0.00	2.510	2.162	0.000
0.00	2.510	2.162	0.000
89.94	2.041	1.956	*****

89.94	1.870	1.924	*****
89.94	2.652	2.508	*****
0.00	2.510	2.162	0.000
89.94	2.652	2.508	*****
89.94	2.652	2.508	*****
0.00	2.510	2.162	0.000
89.94	2.652	2.508	*****

The Trial Failure Surface In Question Is Defined
By The Following 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.13	950.34
2	334.79	970.31
3	369.33	990.48
4	403.75	1010.87
5	438.04	1031.46
6	472.20	1052.27
7	506.24	1073.27
8	540.15	1094.49
9	573.94	1115.90
10	607.59	1137.52
11	641.11	1159.35
12	674.50	1181.38
13	707.76	1203.60
14	740.88	1226.03
15	773.86	1248.66
16	806.71	1271.49
17	839.41	1294.52
18	871.98	1317.74
19	904.41	1341.16
20	918.30	1351.32

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	2.122	1.939	0.306
25.50	2.072	1.948	0.477
49.39	2.377	1.979	1.166
11.09	2.138	1.933	0.196
0.00	2.155	1.922	0.000
89.94	1.937	2.025	*****
57.15	2.310	1.995	1.549
80.42	2.321	2.129	5.926
89.94	2.477	2.553	*****
86.34	2.695	0.000	*****
89.81	2.347	1.920	*****
89.94	2.075	0.001	*****
89.77	2.250	2.285	*****
89.71	2.290	1.033	*****
89.94	2.258	0.905	*****
85.62	20.902	0.774	*****
89.94	0.000	0.877	*****
89.70	1.623	0.880	*****
89.77	1.622	0.884	*****
89.94	0.001	0.852	*****

The Trial Failure Surface In Question Is Defined
By The Following 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.13	950.34
2	336.10	967.85
3	371.90	985.69
4	407.53	1003.86
5	443.00	1022.36
6	478.29	1041.18
7	513.41	1060.33

8	548.36	1079.80
9	583.12	1099.58
10	617.70	1119.69
11	652.09	1140.11
12	686.30	1160.85
13	720.31	1181.90
14	754.13	1203.26
15	787.75	1224.93
16	821.17	1246.91
17	854.39	1269.20
18	887.40	1291.79
19	920.20	1314.68
20	952.79	1337.87
21	973.98	1353.24

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	1.916	1.746	0.306
25.50	1.869	1.762	0.477
44.80	2.345	1.811	0.993
19.03	1.908	1.750	0.345
0.00	1.955	1.717	0.000
75.49	2.213	2.014	3.863
89.94	3.419	0.726	*****
73.95	2.389	2.080	3.477
65.85	2.365	1.935	2.231
89.94	2.301	0.726	*****
53.81	2.737	1.847	1.367
0.00	1.955	1.717	0.000
0.00	1.955	1.717	0.000
89.94	2.077	2.063	*****
89.94	1.930	2.212	*****
85.55	2.565	1.214	*****
88.93	1.862	0.570	*****
89.94	-0.093	0.577	*****
89.48	0.000	0.542	*****
86.74	0.407	0.489	*****

The Trial Failure Surface In Question Is Defined
By The Following 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.18	950.45
2	337.73	964.22
3	374.89	979.03
4	411.62	994.87
5	447.90	1011.72
6	483.70	1029.57
7	518.98	1048.41
8	553.73	1068.23
9	587.91	1089.00
10	621.50	1110.72
11	654.48	1133.36
12	686.81	1156.91
13	718.48	1181.34
14	749.45	1206.65
15	779.71	1232.81
16	809.23	1259.81
17	837.99	1287.61
18	865.96	1316.20
19	893.13	1345.56
20	897.55	1350.61

The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 21 Coordinate Points

Point	X-Surf	Y-Surf

No.	(ft)	(ft)
1	300.22	950.56
2	339.58	957.70
3	378.59	966.55
4	417.18	977.08
5	455.28	989.28
6	492.81	1003.12
7	529.70	1018.57
8	565.89	1035.61
9	601.30	1054.21
10	635.87	1074.33
11	669.54	1095.93
12	702.24	1118.97
13	733.91	1143.40
14	764.48	1169.19
15	793.91	1196.29
16	822.13	1224.63
17	849.10	1254.18
18	874.76	1284.86
19	899.06	1316.64
20	921.96	1349.43
21	923.26	1351.49

Factor Of Safety For The Preceding Specified Surface = 2.435
Theta (ki = 1.0) = 87.96 Deg Lambda =
Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	3.487	1.694	0.306
25.50	4.685	1.712	0.477
0.00	2.836	1.665	0.000
0.00	2.836	1.665	0.000
10.92	3.154	1.683	0.193
0.00	2.836	1.665	0.000
0.00	2.836	1.665	0.000
89.94	2.079	2.054	*****
89.94	1.984	1.989	*****
55.83	-0.214	1.286	1.473
89.94	1.984	1.989	*****
89.94	1.984	1.989	*****
89.94	22.302	0.559	*****
87.89	2.459	2.472	*****
87.21	2.218	2.228	*****
83.59	1.412	1.475	8.897
89.31	2.245	2.251	*****
89.94	2.480	2.492	*****
88.42	1.878	1.879	*****
87.62	1.700	1.698	*****

The Trial Failure Surface In Question Is Defined
By The Following 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.22	950.56
2	338.97	960.49
3	377.39	971.62
4	415.46	983.92
5	453.12	997.38
6	490.35	1012.00
7	527.12	1027.76
8	563.38	1044.65
9	599.10	1062.64
10	634.26	1081.73
11	668.80	1101.89
12	702.71	1123.11
13	735.96	1145.35
14	768.49	1168.62

15	800.30	1192.87
16	831.35	1218.09
17	861.60	1244.26
18	891.04	1271.35
19	919.62	1299.33
20	947.33	1328.18
21	969.83	1353.10

Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations

Theta (deg) (ki=1.0)	FOS (Moment) (Equil.)	FOS (Force) (Equil.)	Lambda
17.00	2.280	2.061	0.306
25.50	2.237	2.076	0.477
57.96	2.562	2.148	1.598
0.00	2.314	2.032	0.000
0.00	2.314	2.032	0.000
0.00	2.314	2.032	0.000
0.00	2.314	2.032	0.000
89.94	22.302	2.201	*****
0.00	2.314	2.032	0.000
0.00	2.314	2.032	0.000
89.94	2.146	2.493	*****
53.77	2.635	2.135	1.365
70.18	2.494	2.198	2.774
89.94	2.456	2.467	*****
89.04	2.639	2.540	*****
89.83	2.389	2.303	*****
89.94	72.157	0.700	*****
89.83	2.480	2.492	*****
89.79	1.878	1.879	*****
87.66	1.700	1.698	*****

The Trial Failure Surface In Question Is Defined
By The Following 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.31	950.79
2	335.98	968.90
3	371.36	987.56
4	406.46	1006.74
5	441.26	1026.46
6	475.77	1046.70
7	509.96	1067.45
8	543.83	1088.73
9	577.38	1110.51
10	610.60	1132.79
11	643.48	1155.58
12	676.00	1178.86
13	708.18	1202.62
14	739.99	1226.88
15	771.43	1251.61
16	802.49	1276.81
17	833.17	1302.47
18	863.45	1328.60
19	887.81	1350.27

The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 22 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.31	950.79
2	340.28	949.01
3	380.27	949.61
4	420.16	952.61
5	459.80	957.99
6	499.04	965.72
7	537.75	975.79

8	575.80	988.15
9	613.03	1002.76
10	649.33	1019.56
11	684.56	1038.51
12	718.59	1059.53
13	751.31	1082.54
14	782.59	1107.47
15	812.33	1134.22
16	840.42	1162.70
17	866.75	1192.81
18	891.24	1224.44
19	913.80	1257.47
20	934.34	1291.79
21	952.79	1327.28
22	964.23	1352.90

Factor Of Safety For The Preceding Specified Surface = 2.661
Theta (ki = 1.0) = 89.83 Deg Lambda =
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.31	950.79
2	338.16	963.75
3	375.53	978.00
4	412.39	993.54
5	448.69	1010.33
6	484.40	1028.37
7	519.46	1047.62
8	553.84	1068.07
9	587.49	1089.69
10	620.38	1112.46
11	652.46	1136.35
12	683.71	1161.32
13	714.07	1187.36
14	743.52	1214.43
15	772.03	1242.49
16	799.54	1271.52
17	826.05	1301.48
18	851.50	1332.34
19	859.94	1343.31

Factor Of Safety For The Preceding Specified Surface = 2.661
Theta (ki = 1.0) = 79.17 Deg Lambda =
The Factor Of Safety For The Trial Failure Surface Defined
By The Coordinates Listed Below Is Misleading.
Failure Surface Defined By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.36	950.90
2	336.02	969.01
3	371.51	987.47
4	406.81	1006.28
5	441.93	1025.43
6	476.86	1044.91
7	511.60	1064.74
8	546.15	1084.90
9	580.50	1105.40
10	614.65	1126.23
11	648.59	1147.39
12	682.33	1168.88
13	715.85	1190.70
14	749.17	1212.84
15	782.26	1235.31
16	815.14	1258.09
17	847.79	1281.20
18	880.22	1304.62
19	912.41	1328.35

```
   20        944.13     1352.21
Factor Of Safety For The Preceding Specified Surface =  1.902
Theta (ki = 1.0) =  89.92 Deg    Lambda =
Factor Of Safety Calculation By GLE (Spencer`s) Method of Slices
Has Gone Through 20 Iterations
 Theta        FOS        FOS
 (deg)      (Moment)   (Force)
(ki=1.0)    (Equil.)   (Equil.)   Lambda
  ################### SOME LINES SKIPPED ####################
      Following Are Displayed The Ten Most Critical Of The Trial
      Failure Surfaces Evaluated. They Are
      Ordered - Most Critical First.
      * * Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2) * *
      Selected ki function = Bi-linear
      Selected Lambda Coefficient =  1.00
      Forces from Reinforcement, Piers/Piles, Soil Nails, and Applied Forces
      (if applicable) have been applied to the slice base(s)
      on which they intersect.
      Specified Tension Crack Water Force Factor =   0.000
      Total Number of Trial Surfaces Attempted =  5000
      WARNING! The Factor of Safety Calculation for one or More Trial Surfaces
      Did Not Converge in 20 Iterations.
      Number of Trial Surfaces with Non-Converged FS =  379
      Number of Trial Surfaces with Misleading FS =   73
      Number of Trial Surfaces With Valid FS = 4548
      Percentage of Trial Surfaces With Non-Valid FS Solutions
      of the Total Attempted =   9.0 %
      Statistical Data On All Valid FS Values:
         FS Max =   2.853   FS Min =   1.610   FS Ave =   2.019
         Standard Deviation =    0.172   Coefficient of Variation =    8.54 %
                  ((Modified Bishop FS for Critical Surface =  1.671))
      Failure Surface Specified By 21 Coordinate Points
        Point       X-Surf       Y-Surf
         No.         (ft)         (ft)
          1         300.540      951.350
          2         340.539      951.576
          3         380.456      954.159
          4         420.151      959.090
          5         459.486      966.352
          6         498.325      975.919
          7         536.532      987.759
          8         573.976     1001.830
          9         610.525     1018.083
         10         646.052     1036.463
         11         680.435     1056.904
         12         713.553     1079.335
         13         745.291     1103.680
         14         775.540     1129.853
         15         804.193     1157.763
         16         831.152     1187.314
         17         856.322     1218.402
         18         879.617     1250.919
         19         900.954     1284.753
         20         920.260     1319.785
         21         935.573     1351.916
      Circle Center At X =   316.709 ; Y =  1629.565 ; and Radius =   678.408
      ***  FOS =     1.610   Theta (ki=1.0) =     8.17  ***
                          Lambda =   0.144
           Individual data on the    38  slices
                        Water  Water     Tie     Tie     Earthquake
                        Force  Force    Force   Force       Force   Surcharge
Slice  Width   Weight    Top    Bot     Norm    Tan     Hor     Ver    Load
 No.    (ft)    (lbs)   (lbs)  (lbs)    (lbs)   (lbs)   (lbs)   (lbs)   (lbs)
  1      1.5     478.5     0.0     0.0       0.      0.    47.8     0.0      0.0
  2     17.9   77451.0     0.0  5557.5       0.      0.  7745.1     0.0      0.0
  3     20.5  164305.4     0.0 20017.0       0.      0. 16430.5     0.0      0.0
  4     29.5  230757.8     0.0 52912.7       0.      0. 23075.8     0.0      0.0
```

5	10.5	102217.3	0.0	25350.3	0.	0.	10221.7	0.0	0.0
6	9.5	131209.4	0.0	26146.9	0.	0.	13120.9	0.0	0.0
7	30.2	461583.0	0.0	99647.5	0.	0.	46158.3	0.0	0.0
8	19.8	291742.9	0.0	79826.7	0.	0.	29174.3	0.0	0.0
9	19.5	353042.6	0.0	88136.7	0.	0.	35304.3	0.0	0.0
10	0.5	11275.0	0.0	2486.9	0.	0.	1127.5	0.0	0.0
11	38.3	814490.4	0.0	*******	0.	0.	81449.0	0.0	0.0
12	38.2	744916.4	0.0	*******	0.	0.	74491.6	0.0	0.0
13	3.5	63845.1	0.0	23223.3	0.	0.	6384.5	0.0	0.0
14	20.0	436194.4	0.0	*******	0.	0.	43619.4	0.0	0.0
15	14.0	347737.6	0.0	*******	0.	0.	34773.8	0.0	0.0
16	36.0	833109.6	0.0	*******	0.	0.	83311.0	0.0	0.0
17	0.5	11489.4	0.0	4142.5	0.	0.	1148.9	0.0	0.0
18	19.5	490158.4	0.0	*******	0.	0.	49015.8	0.0	0.0
19	16.1	444147.8	0.0	*******	0.	0.	44414.8	0.0	0.0
20	33.9	859509.3	0.0	*******	0.	0.	85950.9	0.0	0.0
21	0.4	10316.1	0.0	4461.6	0.	0.	1031.6	0.0	0.0
22	19.6	523020.7	0.0	*******	0.	0.	52302.1	0.0	0.0
23	13.6	391911.4	0.0	*******	0.	0.	39191.1	0.0	0.0
24	31.7	829999.2	0.0	*******	0.	0.	82999.9	0.0	0.0
25	4.7	112095.0	0.0	40458.2	0.	0.	11209.5	0.0	0.0
26	3.0	70264.1	0.0	25119.9	0.	0.	7026.4	0.0	0.0
27	22.0	571146.9	0.0	*******	0.	0.	57114.7	0.0	0.0
28	0.5	15402.8	0.0	3791.5	0.	0.	1540.3	0.0	0.0
29	28.7	770830.6	0.0	*******	0.	0.	77083.1	0.0	0.0
30	27.0	634317.8	0.0	*******	0.	0.	63431.8	0.0	0.0
31	25.2	498591.1	0.0	60157.5	0.	0.	49859.1	0.0	0.0
32	8.9	152399.8	0.0	5188.6	0.	0.	15240.0	0.0	0.0
33	14.4	214563.0	0.0	0.0	0.	0.	21456.3	0.0	0.0
34	0.4	5213.2	0.0	0.0	0.	0.	521.3	0.0	0.0
35	15.3	178321.8	0.0	0.0	0.	0.	17832.2	0.0	0.0
36	5.6	51481.0	0.0	0.0	0.	0.	5148.1	0.0	0.0
37	19.3	122445.4	0.0	0.0	0.	0.	12244.5	0.0	0.0
38	15.3	31454.8	0.0	0.0	0.	0.	3145.5	0.0	0.0

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.675	951.688
2	340.599	949.217
3	380.596	949.679
4	420.452	953.070
5	459.952	959.372
6	498.885	968.552
7	537.040	980.560
8	574.212	995.332
9	610.203	1012.788
10	644.817	1032.834
11	677.869	1055.362
12	709.182	1080.252
13	738.587	1107.370
14	765.926	1136.569
15	791.051	1167.693
16	813.829	1200.574
17	834.135	1235.036
18	851.862	1270.894
19	866.914	1307.954
20	879.210	1346.017
21	880.182	1350.006

Circle Center At X = 354.307 ; Y = 1494.562 ; and Radius = 545.517

*** FOS = 1.661 Theta (ki=1.0) = 15.41 ***

Lambda = 0.276

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	312.612	981.529
2	352.599	982.536
3	392.450	985.986

4	432.015	991.866
5	471.148	1000.153
6	509.700	1010.818
7	547.528	1023.819
8	584.491	1039.108
9	620.450	1056.628
10	655.270	1076.314
11	688.822	1098.092
12	720.980	1121.880
13	751.623	1147.589
14	780.638	1175.124
15	807.915	1204.381
16	833.352	1235.250
17	856.855	1267.618
18	878.335	1301.361
19	897.712	1336.354
20	904.616	1350.849

Circle Center At X = 316.403 ; Y = 1634.591 ; and Radius = 653.073
*** FOS = 1.664 Theta (ki=1.0) = 7.07 ***
Lambda = 0.124
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.044	950.111
2	339.560	956.317
3	378.738	964.387
4	417.489	974.302
5	455.728	986.042
6	493.367	999.579
7	530.324	1014.884
8	566.514	1031.921
9	601.857	1050.652
10	636.273	1071.036
11	669.686	1093.027
12	702.020	1116.576
13	733.202	1141.629
14	763.163	1168.130
15	791.836	1196.021
16	819.156	1225.237
17	845.062	1255.715
18	869.495	1287.385
19	892.402	1320.177
20	911.891	1351.100

Circle Center At X = 188.946 ; Y = 1786.917 ; and Radius = 844.149
*** FOS = 1.666 Theta (ki=1.0) = 29.39 ***
Lambda = 0.563
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	312.071	980.178
2	352.020	978.162
3	392.010	979.050
4	431.831	982.837
5	471.271	989.504
6	510.124	999.015
7	548.184	1011.321
8	585.251	1026.356
9	621.129	1044.040
10	655.630	1064.282
11	688.570	1086.974
12	719.777	1111.996
13	749.087	1139.217
14	776.343	1168.493
15	801.404	1199.669
16	824.136	1232.582
17	844.420	1267.057
18	862.149	1302.914

```
   19         877.229      1339.962
   20         880.494      1350.017
Circle Center At X =   359.960 ; Y =  1528.312 ; and Radius =   550.222
***  FOS =     1.673   Theta (ki=1.0) =     9.29  ***
                    Lambda =   0.163
Failure Surface Specified By 21 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1         300.044       950.111
    2         339.747       954.976
    3         379.177       961.708
    4         418.245       970.291
    5         456.865       980.708
    6         494.951       992.934
    7         532.417      1006.943
    8         569.182      1022.703
    9         605.162      1040.179
   10         640.278      1059.333
   11         674.452      1080.121
   12         707.608      1102.498
   13         739.671      1126.413
   14         770.571      1151.814
   15         800.238      1178.644
   16         828.607      1206.843
   17         855.615      1236.348
   18         881.202      1267.094
   19         905.310      1299.013
   20         927.886      1332.033
   21         940.245      1352.077
Circle Center At X =   216.794 ; Y =  1793.982 ; and Radius =   847.967
***  FOS =     1.681   Theta (ki=1.0) =    28.14  ***
                    Lambda =   0.535
Failure Surface Specified By 21 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1         300.135       950.336
    2         339.075       959.481
    3         377.651       970.059
    4         415.810       982.056
    5         453.499       995.455
    6         490.666      1010.239
    7         527.262      1026.386
    8         563.236      1043.876
    9         598.539      1062.683
   10         633.122      1082.783
   11         666.939      1104.148
   12         699.942      1126.748
   13         732.088      1150.553
   14         763.331      1175.530
   15         793.630      1201.645
   16         822.942      1228.862
   17         851.228      1257.144
   18         878.449      1286.453
   19         904.569      1316.748
   20         929.550      1347.988
   21         932.378      1351.806
Circle Center At X =    72.337 ; Y =  2007.855 ; and Radius =  1081.775
***  FOS =     1.683   Theta (ki=1.0) =    30.00  ***
                    Lambda =   0.577
Failure Surface Specified By 20 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1         301.846       954.615
    2         341.248       961.506
    3         380.308       970.126
    4         418.950       980.460
    5         457.099       992.488
```

6	494.681	1006.185
7	531.623	1021.525
8	567.852	1038.479
9	603.299	1057.013
10	637.894	1077.091
11	671.571	1098.676
12	704.264	1121.723
13	735.909	1146.189
14	766.445	1172.026
15	795.812	1199.185
16	823.954	1227.611
17	850.815	1257.250
18	876.343	1288.044
19	900.490	1319.934
20	922.241	1351.457

Circle Center At X = 165.372 ; Y = 1851.332 ; and Radius = 907.042
*** FOS = 1.687 Theta (ki=1.0) = 29.32 ***
Lambda = 0.562
Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	300.405	951.012
2	340.398	951.754
3	380.265	955.006
4	419.850	960.755
5	458.996	968.978
6	497.548	979.642
7	535.354	992.707
8	572.266	1008.119
9	608.137	1025.818
10	642.826	1045.735
11	676.196	1067.791
12	708.115	1091.898
13	738.458	1117.962
14	767.104	1145.879
15	793.941	1175.541
16	818.862	1206.828
17	841.770	1239.619
18	862.574	1273.784
19	881.191	1309.187
20	897.549	1345.689
21	899.415	1350.669

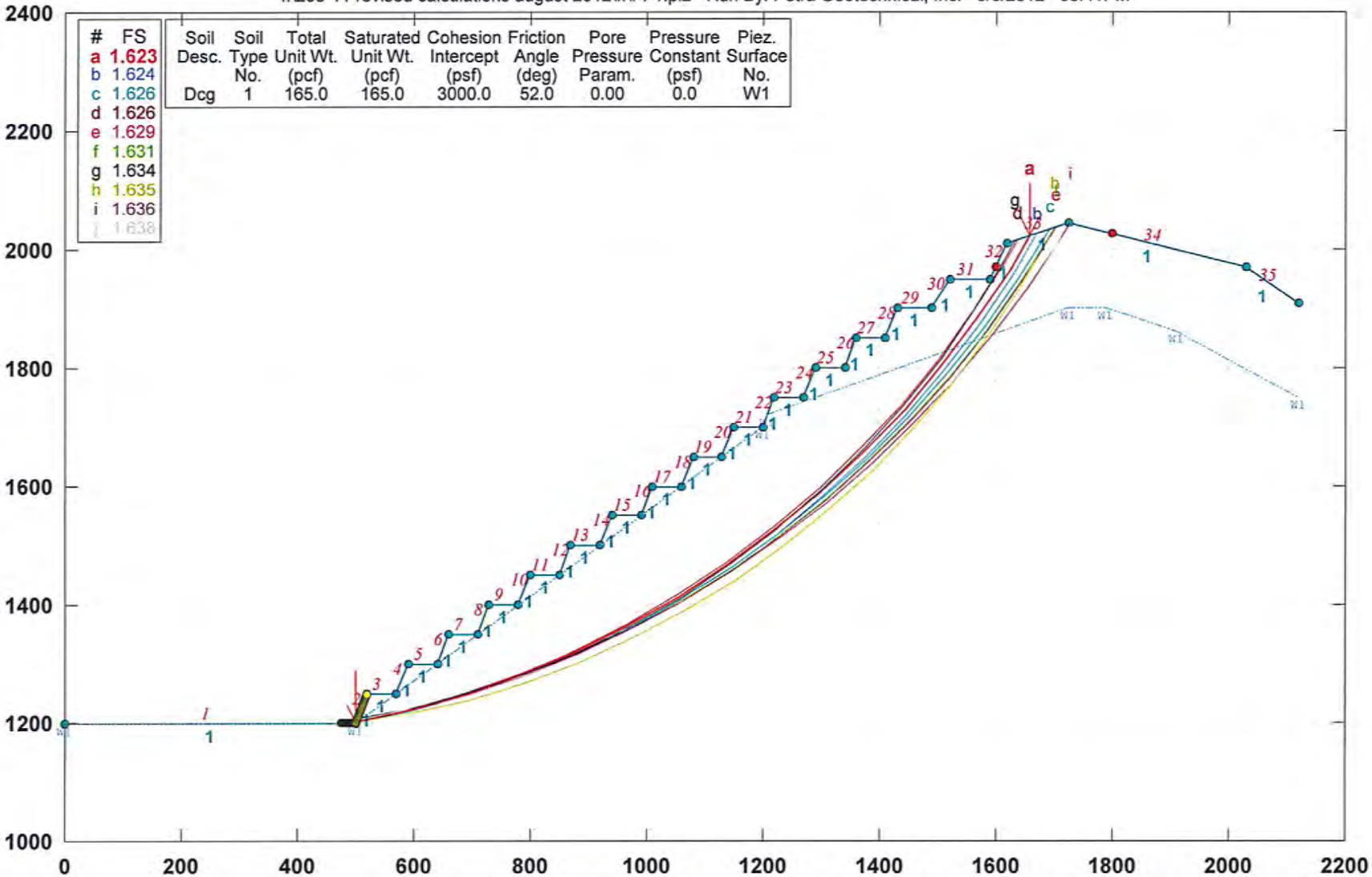
Circle Center At X = 308.591 ; Y = 1587.702 ; and Radius = 636.743
*** FOS = 1.688 Theta (ki=1.0) = 24.86 ***
Lambda = 0.463
Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	301.891	954.728
2	341.570	959.786
3	380.960	966.745
4	419.970	975.589
5	458.510	986.297
6	496.491	998.846
7	533.825	1013.205
8	570.425	1029.342
9	606.208	1047.219
10	641.090	1066.796
11	674.991	1088.026
12	707.832	1110.861
13	739.538	1135.248
14	770.036	1161.131
15	799.254	1188.450
16	827.125	1217.141
17	853.585	1247.138
18	878.573	1278.373
19	902.031	1310.772

```
   20        923.905     1344.262
   21        928.247     1351.664
Circle Center At X =   216.555 ; Y =  1782.382 ; and Radius =   832.042
***  FOS =     1.691   Theta (ki=1.0) =    28.46  ***
                    Lambda =   0.542
          **** END OF GSTABL7 OUTPUT ****
```

3M Moody Flats - Section F-F' Spencer Method With GW - Static

f:\293-11 revised calculations august 2012\ff\f-f-1.pl2 Run By: Petra Geotechnical, Inc. 8/6/2012 03:41PM



GSTABL7 v.2 FSmin=1.623

Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2)

GSTABL7

```
                    ***  GSTABL7  ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
              (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                    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,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************
Analysis Run Date:        8/6/2012
Time of Run:              03:41PM
Run By:                   Petra Geotechnical, Inc.
Input Data Filename:      f:\293-11 Revised Calculations August 2012\FF\f-f-1.
Output Filename:          f:\293-11 Revised Calculations August 2012\FF\f-f-1.OUT
Unit System:              English
Plotted Output Filename:  f:\293-11 Revised Calculations August 2012\FF\f-f-1.PLT
PROBLEM DESCRIPTION:  3M Moody Flats - Section F-F'
                      Spencer Method With GW - Static
BOUNDARY COORDINATES
   35 Top   Boundaries
   35 Total Boundaries
```

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	1200.00	500.00	1200.00	1
2	500.00	1200.00	520.00	1250.00	1
3	520.00	1250.00	570.00	1250.00	1
4	570.00	1250.00	590.00	1300.00	1
5	590.00	1300.00	640.00	1300.00	1
6	640.00	1300.00	660.00	1350.00	1
7	660.00	1350.00	710.00	1350.00	1
8	710.00	1350.00	730.00	1400.00	1
9	730.00	1400.00	780.00	1400.00	1
10	780.00	1400.00	800.00	1450.00	1
11	800.00	1450.00	850.00	1450.00	1
12	850.00	1450.00	870.00	1500.00	1
13	870.00	1500.00	920.00	1500.00	1
14	920.00	1500.00	940.00	1550.00	1
15	940.00	1550.00	990.00	1550.00	1
16	990.00	1550.00	1010.00	1600.00	1
17	1010.00	1600.00	1060.00	1600.00	1
18	1060.00	1600.00	1080.00	1650.00	1
19	1080.00	1650.00	1130.00	1650.00	1
20	1130.00	1650.00	1150.00	1700.00	1
21	1150.00	1700.00	1200.00	1700.00	1
22	1200.00	1700.00	1220.00	1750.00	1
23	1220.00	1750.00	1270.00	1750.00	1
24	1270.00	1750.00	1290.00	1800.00	1
25	1290.00	1800.00	1340.00	1800.00	1
26	1340.00	1800.00	1360.00	1850.00	1
27	1360.00	1850.00	1410.00	1850.00	1
28	1410.00	1850.00	1430.00	1900.00	1
29	1430.00	1900.00	1490.00	1900.00	1
30	1490.00	1900.00	1520.00	1950.00	1
31	1520.00	1950.00	1590.00	1950.00	1
32	1590.00	1950.00	1620.00	2010.00	1
33	1620.00	2010.00	1725.00	2045.00	1
34	1725.00	2045.00	2030.00	1970.00	1
35	2030.00	1970.00	2120.00	1910.00	1

```
User Specified Y-Origin =      1000.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
  1 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	165.0	165.0	3000.0	52.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 8 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	1200.00
2	500.00	1200.00
3	1200.00	1700.00
4	1208.00	1720.00
5	1725.00	1900.00
6	1790.00	1900.00
7	1910.00	1860.00
8	2120.00	1750.00

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
5000 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 250 Points Equally Spaced
Along The Ground Surface Between X = 475.00(ft)
and X = 520.00(ft)
Each Surface Terminates Between X =1600.00(ft)
and X =1800.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
100.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2) * *
Selected ki function = Bi-linear
Selected Lambda Coefficient = 1.00
Forces from Reinforcement, Piers/Piles, Soil Nails, and Applied Forces
(if applicable) have been applied to the slice base(s)
on which they intersect.
Specified Tension Crack Water Force Factor = 0.000
Total Number of Trial Surfaces Attempted = 5000
Number of Trial Surfaces With Valid FS = 5000
Statistical Data On All Valid FS Values:
FS Max = 2.902 FS Min = 1.623 FS Ave = 2.046
Standard Deviation = 0.199 Coefficient of Variation = 9.72 %
((Modified Bishop FS for Critical Surface = 1.613))
Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.121	1200.302
2	597.660	1222.348
3	693.764	1249.991
4	788.110	1283.140
5	880.383	1321.684
6	970.276	1365.493
7	1057.488	1414.422
8	1141.729	1468.306
9	1222.716	1526.967
10	1300.179	1590.209
11	1373.859	1657.819
12	1443.511	1729.573
13	1508.902	1805.230
14	1569.813	1884.539
15	1626.042	1967.233
16	1659.525	2023.175

Circle Center At X = 168.962 ; Y = 2895.115 ; and Radius = 1726.863
*** FOS = 1.623 Theta (ki=1.0) = 29.87 ***
Lambda = 0.574

Individual data on the 49 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	0.4	36.6	0.0	0.0	0.	0.	0.0	0.0	0.0
2	19.4	74100.9	0.0	4904.0	0.	0.	0.0	0.0	0.0
3	50.0	326324.2	0.0	57679.7	0.	0.	0.0	0.0	0.0
4	20.0	186924.1	0.0	41243.7	0.	0.	0.0	0.0	0.0
5	7.7	99243.9	0.0	18547.5	0.	0.	0.0	0.0	0.0
6	42.3	499939.8	0.0	*******	0.	0.	0.0	0.0	0.0
7	20.0	289069.8	0.0	75266.2	0.	0.	0.0	0.0	0.0
8	33.8	584200.8	0.0	*******	0.	0.	0.0	0.0	0.0
9	16.2	260281.0	0.0	81533.7	0.	0.	0.0	0.0	0.0
10	20.0	382107.9	0.0	*******	0.	0.	0.0	0.0	0.0
11	50.0	1060066.6	0.0	*******	0.	0.	0.0	0.0	0.0
12	8.1	171839.0	0.0	54018.0	0.	0.	0.0	0.0	0.0
13	11.9	293332.1	0.0	83142.1	0.	0.	0.0	0.0	0.0
14	50.0	1249465.1	0.0	*******	0.	0.	0.0	0.0	0.0
15	20.0	534040.9	0.0	*******	0.	0.	0.0	0.0	0.0
16	10.4	309211.3	0.0	86645.5	0.	0.	0.0	0.0	0.0
17	39.6	1102511.1	0.0	*******	0.	0.	0.0	0.0	0.0
18	20.0	591147.9	0.0	*******	0.	0.	0.0	0.0	0.0
19	30.3	958573.9	0.0	*******	0.	0.	0.0	0.0	0.0
20	19.7	582459.5	0.0	*******	0.	0.	0.0	0.0	0.0
21	20.0	636342.9	0.0	*******	0.	0.	0.0	0.0	0.0
22	47.5	1558496.5	0.0	*******	0.	0.	0.0	0.0	0.0
23	2.5	76573.4	0.0	28430.8	0.	0.	0.0	0.0	0.0
24	20.0	668498.6	0.0	*******	0.	0.	0.0	0.0	0.0
25	50.0	1692795.9	0.0	*******	0.	0.	0.0	0.0	0.0
26	11.7	387249.2	0.0	*******	0.	0.	0.0	0.0	0.0
27	8.3	298010.5	0.0	*******	0.	0.	0.0	0.0	0.0
28	50.0	1712652.5	0.0	*******	0.	0.	0.0	0.0	0.0
29	8.0	259497.1	0.0	68945.2	0.	0.	0.0	0.0	0.0
30	12.0	424404.0	0.0	*******	0.	0.	0.0	0.0	0.0
31	2.7	100374.9	0.0	39320.8	0.	0.	0.0	0.0	0.0
32	47.3	1589494.6	0.0	*******	0.	0.	0.0	0.0	0.0
33	20.0	664175.4	0.0	*******	0.	0.	0.0	0.0	0.0
34	10.2	359320.1	0.0	*******	0.	0.	0.0	0.0	0.0
35	39.8	1258390.4	0.0	*******	0.	0.	0.0	0.0	0.0
36	20.0	623945.8	0.0	*******	0.	0.	0.0	0.0	0.0
37	13.9	454015.3	0.0	*******	0.	0.	0.0	0.0	0.0
38	36.1	1035007.2	0.0	*******	0.	0.	0.0	0.0	0.0
39	20.0	559837.8	0.0	*******	0.	0.	0.0	0.0	0.0
40	13.5	395457.3	0.0	88201.4	0.	0.	0.0	0.0	0.0
41	46.5	1100993.5	0.0	*******	0.	0.	0.0	0.0	0.0
42	18.9	378803.9	0.0	46370.7	0.	0.	0.0	0.0	0.0
43	11.1	234930.8	0.0	15314.2	0.	0.	0.0	0.0	0.0
44	9.4	192233.4	0.0	4066.0	0.	0.	0.0	0.0	0.0
45	40.4	612349.2	0.0	0.0	0.	0.	0.0	0.0	0.0
46	20.2	168595.5	0.0	0.0	0.	0.	0.0	0.0	0.0
47	30.0	216378.2	0.0	0.0	0.	0.	0.0	0.0	0.0
48	6.0	48065.7	0.0	0.0	0.	0.	0.0	0.0	0.0
49	33.5	123703.5	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.121	1200.302
2	597.910	1221.212
3	694.312	1247.795
4	788.997	1279.962
5	881.643	1317.603
6	971.933	1360.588
7	1059.558	1408.773
8	1144.221	1461.991
9	1225.632	1520.062
10	1303.514	1582.787

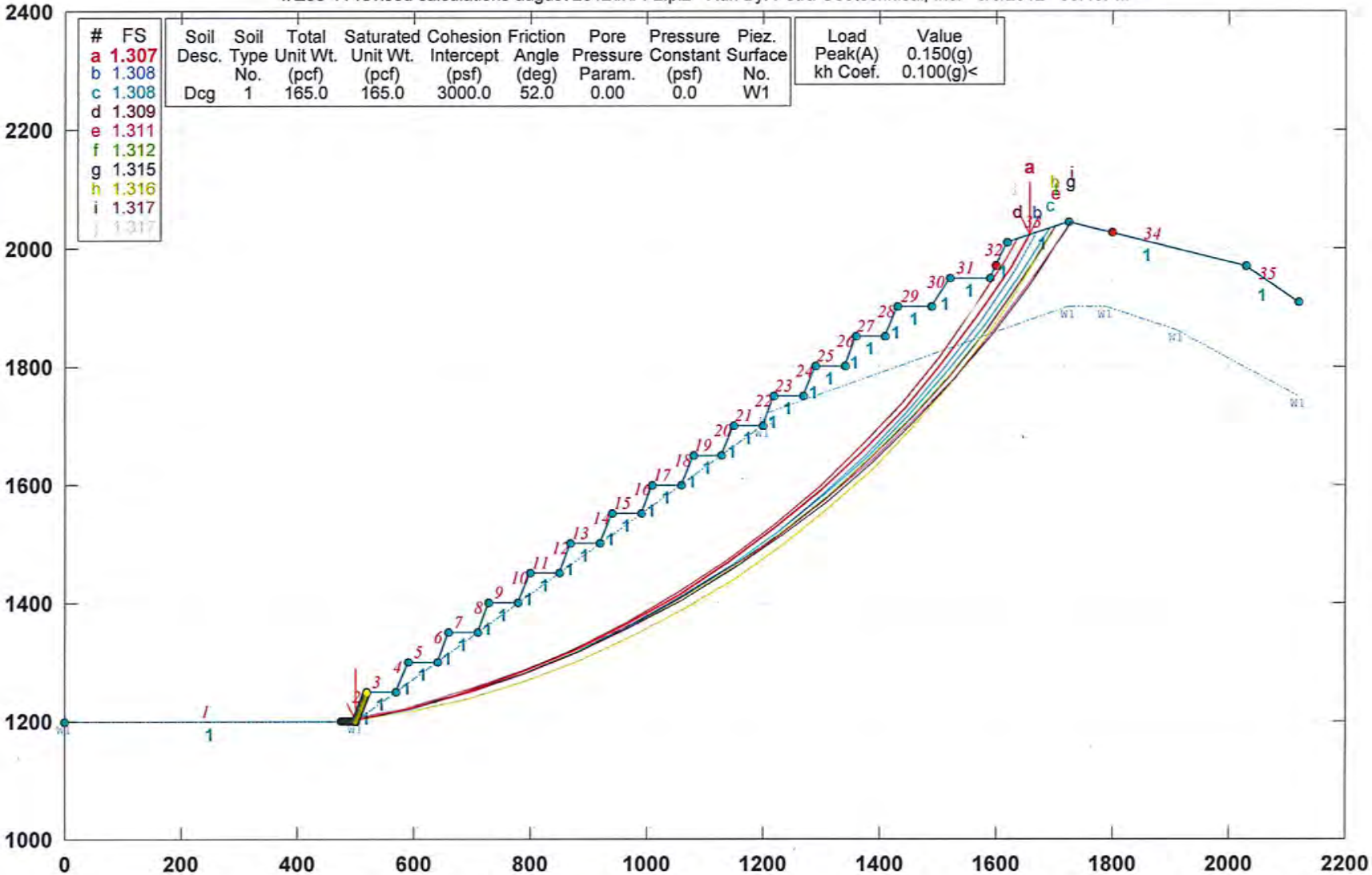
```
   11        1377.600      1649.953
   12        1447.639      1721.329
   13        1513.390      1796.674
   14        1574.630      1875.729
   15        1631.149      1958.224
   16        1672.984      2027.661
Circle Center At X =   192.098 ; Y =  2881.959 ; and Radius =  1709.635
***  FOS =      1.624   Theta (ki=1.0) =    29.88  ***
                     Lambda =   0.575
Failure Surface Specified By 17 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        500.121      1200.302
    2        597.740      1221.991
    3        693.996      1249.101
    4        788.586      1281.546
    5        881.216      1319.225
    6        971.596      1362.021
    7       1059.443      1409.799
    8       1144.484      1462.412
    9       1226.453      1519.693
   10       1305.093      1581.465
   11       1380.159      1647.533
   12       1451.416      1717.693
   13       1518.642      1791.724
   14       1581.627      1869.396
   15       1640.174      1950.466
   16       1694.100      2034.680
   17       1694.115      2034.705
Circle Center At X =   161.036 ; Y =  2956.998 ; and Radius =  1789.122
***  FOS =      1.626   Theta (ki=1.0) =    29.90  ***
                     Lambda =   0.575
Failure Surface Specified By 16 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        500.482      1201.206
    2        598.002      1223.338
    3        694.038      1251.214
    4        788.253      1284.734
    5        880.315      1323.781
    6        969.899      1368.218
    7       1056.691      1417.887
    8       1140.386      1472.615
    9       1220.689      1532.209
   10       1297.318      1596.459
   11       1370.002      1665.139
   12       1438.487      1738.008
   13       1502.531      1814.809
   14       1561.909      1895.272
   15       1616.412      1979.113
   16       1637.248      2015.749
Circle Center At X =   177.818 ; Y =  2852.011 ; and Radius =  1682.043
***  FOS =      1.626   Theta (ki=1.0) =    29.74  ***
                     Lambda =   0.571
Failure Surface Specified By 17 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        500.482      1201.206
    2        598.405      1221.481
    3        695.011      1247.314
    4        789.984      1278.621
    5        883.015      1315.299
    6        973.799      1357.229
    7       1062.042      1404.274
    8       1147.454      1456.281
    9       1229.758      1513.079
   10       1308.685      1574.485
```

```
   11        1383.977      1640.296
   12        1455.388      1710.299
   13        1522.686      1784.265
   14        1585.651      1861.953
   15        1644.078      1943.109
   16        1697.775      2027.469
   17        1703.585      2037.862
Circle Center At X =   194.628 ; Y =  2925.000 ; and Radius =  1750.718
***  FOS =      1.629   Theta (ki=1.0) =    29.84  ***
                     Lambda =   0.574
Failure Surface Specified By 17 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        501.024      1202.561
    2        598.865      1223.228
    3        695.380      1249.398
    4        790.260      1280.987
    5        883.200      1317.893
    6        973.904      1359.999
    7       1062.079      1407.170
    8       1147.445      1459.253
    9       1229.727      1516.084
   10       1308.662      1577.478
   11       1383.996      1643.241
   12       1455.489      1713.160
   13       1522.912      1787.013
   14       1586.048      1864.562
   15       1644.695      1945.559
   16       1698.665      2029.745
   17       1703.163      2037.721
Circle Center At X =   184.962 ; Y =  2940.770 ; and Radius =  1766.710
***  FOS =      1.631   Theta (ki=1.0) =    29.81  ***
                     Lambda =   0.573
Failure Surface Specified By 16 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        502.289      1205.724
    2        600.324      1225.451
    3        696.922      1251.314
    4        791.699      1283.211
    5        884.278      1321.013
    6        974.293      1364.572
    7       1061.385      1413.713
    8       1145.210      1468.243
    9       1225.433      1527.944
   10       1301.736      1592.580
   11       1373.817      1661.893
   12       1441.389      1735.609
   13       1504.184      1813.435
   14       1561.952      1895.061
   15       1614.464      1980.164
   16       1632.614      2014.205
Circle Center At X =   239.807 ; Y =  2767.081 ; and Radius =  1583.267
***  FOS =      1.634   Theta (ki=1.0) =    29.61  ***
                     Lambda =   0.568
Failure Surface Specified By 17 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        500.121      1200.302
    2        598.733      1216.905
    3        696.124      1239.600
    4        791.917      1268.300
    5        885.742      1302.893
    6        977.239      1343.247
    7       1066.052      1389.205
    8       1151.840      1440.591
    9       1234.271      1497.205
```

```
   10        1313.027      1558.829
   11        1387.803      1625.225
   12        1458.312      1696.137
   13        1524.281      1771.291
   14        1585.454      1850.397
   15        1641.597      1933.150
   16        1692.492      2019.229
   17        1701.675      2037.225
Circle Center At X =   282.350 ; Y =  2794.900 ; and Radius =  1609.400
***  FOS =      1.635   Theta (ki=1.0) =    29.76  ***
                     Lambda =   0.572
Failure Surface Specified By 17 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        501.386      1203.465
    2        599.213      1224.197
    3        695.758      1250.255
    4        790.733      1281.558
    5        883.851      1318.013
    6        974.834      1359.512
    7       1063.408      1405.929
    8       1149.309      1457.125
    9       1232.278      1512.947
   10       1312.067      1573.228
   11       1388.437      1637.785
   12       1461.157      1706.427
   13       1530.011      1778.947
   14       1594.792      1855.128
   15       1655.305      1934.740
   16       1711.369      2017.546
   17       1727.475      2044.391
Circle Center At X =   171.858 ; Y =  2999.498 ; and Radius =  1826.013
***  FOS =      1.636   Theta (ki=1.0) =    29.73  ***
                     Lambda =   0.571
Failure Surface Specified By 17 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        501.928      1204.820
    2        599.538      1226.554
    3        695.854      1253.447
    4        790.603      1285.424
    5        883.519      1322.393
    6        974.337      1364.250
    7       1062.801      1410.878
    8       1148.661      1462.143
    9       1231.673      1517.901
   10       1311.604      1577.993
   11       1388.225      1642.251
   12       1461.322      1710.493
   13       1530.687      1782.524
   14       1596.124      1858.142
   15       1657.447      1937.132
   16       1714.484      2019.271
   17       1729.680      2043.849
Circle Center At X =   142.273 ; Y =  3050.128 ; and Radius =  1880.030
***  FOS =      1.638   Theta (ki=1.0) =    29.71  ***
                     Lambda =   0.571
          **** END OF GSTABL7 OUTPUT ****
```

3M Moody Flats - Section F-F' Spencer Method With GW - Earthquake

f:\293-11 revised calculations august 2012\ff\f-f-2.pl2 Run By: Petra Geotechnical, Inc. 8/6/2012 03:43PM



GSTABL7 v.2 FSmin=1.307

Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2)

GSTABL7

*** GSTABL7 ***

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

** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **

(All Rights Reserved-Unauthorized Use Prohibited)

****

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,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 8/6/2012
Time of Run: 03:43PM
Run By: Petra Geotechnical, Inc.
Input Data Filename: f:\293-11 Revised Calculations August 2012\FF\f-f-2.
Output Filename: f:\293-11 Revised Calculations August 2012\FF\f-f-2.OUT
Unit System: English
Plotted Output Filename: f:\293-11 Revised Calculations August 2012\FF\f-f-2.PLT
PROBLEM DESCRIPTION: 3M Moody Flats - Section F-F'
Spencer Method With GW - Earthquake

BOUNDARY COORDINATES
35 Top Boundaries
35 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	1200.00	500.00	1200.00	1
2	500.00	1200.00	520.00	1250.00	1
3	520.00	1250.00	570.00	1250.00	1
4	570.00	1250.00	590.00	1300.00	1
5	590.00	1300.00	640.00	1300.00	1
6	640.00	1300.00	660.00	1350.00	1
7	660.00	1350.00	710.00	1350.00	1
8	710.00	1350.00	730.00	1400.00	1
9	730.00	1400.00	780.00	1400.00	1
10	780.00	1400.00	800.00	1450.00	1
11	800.00	1450.00	850.00	1450.00	1
12	850.00	1450.00	870.00	1500.00	1
13	870.00	1500.00	920.00	1500.00	1
14	920.00	1500.00	940.00	1550.00	1
15	940.00	1550.00	990.00	1550.00	1
16	990.00	1550.00	1010.00	1600.00	1
17	1010.00	1600.00	1060.00	1600.00	1
18	1060.00	1600.00	1080.00	1650.00	1
19	1080.00	1650.00	1130.00	1650.00	1
20	1130.00	1650.00	1150.00	1700.00	1
21	1150.00	1700.00	1200.00	1700.00	1
22	1200.00	1700.00	1220.00	1750.00	1
23	1220.00	1750.00	1270.00	1750.00	1
24	1270.00	1750.00	1290.00	1800.00	1
25	1290.00	1800.00	1340.00	1800.00	1
26	1340.00	1800.00	1360.00	1850.00	1
27	1360.00	1850.00	1410.00	1850.00	1
28	1410.00	1850.00	1430.00	1900.00	1
29	1430.00	1900.00	1490.00	1900.00	1
30	1490.00	1900.00	1520.00	1950.00	1
31	1520.00	1950.00	1590.00	1950.00	1
32	1590.00	1950.00	1620.00	2010.00	1
33	1620.00	2010.00	1725.00	2045.00	1
34	1725.00	2045.00	2030.00	1970.00	1
35	2030.00	1970.00	2120.00	1910.00	1

User Specified Y-Origin = 1000.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
1 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	165.0	165.0	3000.0	52.0	0.00	0.0	1

1 PIEZOMETRIC SURFACE(S) SPECIFIED
Unit Weight of Water = 62.40 (pcf)
Piezometric Surface No. 1 Specified by 8 Coordinate Points
Pore Pressure Inclination Factor = 0.50

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	1200.00
2	500.00	1200.00
3	1200.00	1700.00
4	1208.00	1720.00
5	1725.00	1900.00
6	1790.00	1900.00
7	1910.00	1860.00
8	2120.00	1750.00

Specified Peak Ground Acceleration Coefficient (A) = 0.150(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.100(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
5000 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 250 Points Equally Spaced
Along The Ground Surface Between X = 475.00(ft)
and X = 520.00(ft)
Each Surface Terminates Between X =1600.00(ft)
and X =1800.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
100.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By GLE (Spencer`s) Method (0-2) * *
Selected ki function = Bi-linear
Selected Lambda Coefficient = 1.00
Forces from Reinforcement, Piers/Piles, Soil Nails, and Applied Forces
(if applicable) have been applied to the slice base(s)
on which they intersect.
Specified Tension Crack Water Force Factor = 0.000
Total Number of Trial Surfaces Attempted = 5000
Number of Trial Surfaces With Valid FS = 5000
Statistical Data On All Valid FS Values:
FS Max = 2.422 FS Min = 1.307 FS Ave = 1.655
Standard Deviation = 0.161 Coefficient of Variation = 9.75 %
((Modified Bishop FS for Critical Surface = 1.310))
Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.121	1200.302
2	597.660	1222.348
3	693.764	1249.991
4	788.110	1283.140
5	880.383	1321.684
6	970.276	1365.493
7	1057.488	1414.422
8	1141.729	1468.306
9	1222.716	1526.967
10	1300.179	1590.209
11	1373.859	1657.819
12	1443.511	1729.573
13	1508.902	1805.230
14	1569.813	1884.539
15	1626.042	1967.233

16 1659.525 2023.175
Circle Center At X = 168.962 ; Y = 2895.115 ; and Radius = 1726.863
*** FOS = 1.307 Theta (ki=1.0) = 29.27 ***
Lambda = 0.560
Individual data on the 49 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	0.4	36.6	0.0	0.0	0.	0.	3.7	0.0	0.0
2	19.4	74100.9	0.0	4904.0	0.	0.	7410.1	0.0	0.0
3	50.0	326324.2	0.0	57679.7	0.	0.	32632.4	0.0	0.0
4	20.0	186924.1	0.0	41243.7	0.	0.	18692.4	0.0	0.0
5	7.7	99243.9	0.0	18547.5	0.	0.	9924.4	0.0	0.0
6	42.3	499939.8	0.0	*******	0.	0.	49994.0	0.0	0.0
7	20.0	289069.8	0.0	75266.2	0.	0.	28907.0	0.0	0.0
8	33.8	584200.8	0.0	*******	0.	0.	58420.1	0.0	0.0
9	16.2	260281.0	0.0	81533.7	0.	0.	26028.1	0.0	0.0
10	20.0	382107.9	0.0	*******	0.	0.	38210.8	0.0	0.0
11	50.0	1060066.6	0.0	*******	0.	0.	*******	0.0	0.0
12	8.1	171839.0	0.0	54018.0	0.	0.	17183.9	0.0	0.0
13	11.9	293332.1	0.0	83142.1	0.	0.	29333.2	0.0	0.0
14	50.0	1249465.1	0.0	*******	0.	0.	*******	0.0	0.0
15	20.0	534040.9	0.0	*******	0.	0.	53404.1	0.0	0.0
16	10.4	309211.3	0.0	86645.5	0.	0.	30921.1	0.0	0.0
17	39.6	1102511.1	0.0	*******	0.	0.	*******	0.0	0.0
18	20.0	591147.9	0.0	*******	0.	0.	59114.8	0.0	0.0
19	30.3	958573.9	0.0	*******	0.	0.	95857.4	0.0	0.0
20	19.7	582459.5	0.0	*******	0.	0.	58245.9	0.0	0.0
21	20.0	636342.9	0.0	*******	0.	0.	63634.3	0.0	0.0
22	47.5	1558496.5	0.0	*******	0.	0.	*******	0.0	0.0
23	2.5	76573.4	0.0	28430.8	0.	0.	7657.3	0.0	0.0
24	20.0	668498.6	0.0	*******	0.	0.	66849.9	0.0	0.0
25	50.0	1692795.9	0.0	*******	0.	0.	*******	0.0	0.0
26	11.7	387249.2	0.0	*******	0.	0.	38724.9	0.0	0.0
27	8.3	298010.5	0.0	*******	0.	0.	29801.1	0.0	0.0
28	50.0	1712652.5	0.0	*******	0.	0.	*******	0.0	0.0
29	8.0	259497.1	0.0	68945.2	0.	0.	25949.7	0.0	0.0
30	12.0	424404.0	0.0	*******	0.	0.	42440.4	0.0	0.0
31	2.7	100374.9	0.0	39320.8	0.	0.	10037.5	0.0	0.0
32	47.3	1589494.6	0.0	*******	0.	0.	*******	0.0	0.0
33	20.0	664175.4	0.0	*******	0.	0.	66417.5	0.0	0.0
34	10.2	359320.1	0.0	*******	0.	0.	35932.0	0.0	0.0
35	39.8	1258390.4	0.0	*******	0.	0.	*******	0.0	0.0
36	20.0	623945.8	0.0	*******	0.	0.	62394.6	0.0	0.0
37	13.9	454015.3	0.0	*******	0.	0.	45401.5	0.0	0.0
38	36.1	1035007.2	0.0	*******	0.	0.	*******	0.0	0.0
39	20.0	559837.8	0.0	*******	0.	0.	55983.8	0.0	0.0
40	13.5	395457.3	0.0	88201.4	0.	0.	39545.7	0.0	0.0
41	46.5	1100993.5	0.0	*******	0.	0.	*******	0.0	0.0
42	18.9	378803.9	0.0	46370.7	0.	0.	37880.4	0.0	0.0
43	11.1	234930.8	0.0	15314.2	0.	0.	23493.1	0.0	0.0
44	9.4	192233.4	0.0	4066.0	0.	0.	19223.3	0.0	0.0
45	40.4	612349.2	0.0	0.0	0.	0.	61234.9	0.0	0.0
46	20.2	168595.5	0.0	0.0	0.	0.	16859.6	0.0	0.0
47	30.0	216378.2	0.0	0.0	0.	0.	21637.8	0.0	0.0
48	6.0	48065.7	0.0	0.0	0.	0.	4806.6	0.0	0.0
49	33.5	123703.5	0.0	0.0	0.	0.	12370.4	0.0	0.0

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	500.121	1200.302
2	597.910	1221.212
3	694.312	1247.795
4	788.997	1279.962
5	881.643	1317.603
6	971.933	1360.588

```
    7        1059.558      1408.773
    8        1144.221      1461.991
    9        1225.632      1520.062
   10        1303.514      1582.787
   11        1377.600      1649.953
   12        1447.639      1721.329
   13        1513.390      1796.674
   14        1574.630      1875.729
   15        1631.149      1958.224
   16        1672.984      2027.661
Circle Center At X =   192.098 ; Y =  2881.959 ; and Radius =  1709.635
***  FOS =      1.308   Theta (ki=1.0) =    29.27  ***
                     Lambda =   0.560
Failure Surface Specified By 17 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        500.121      1200.302
    2        597.740      1221.991
    3        693.996      1249.101
    4        788.586      1281.546
    5        881.216      1319.225
    6        971.596      1362.021
    7       1059.443      1409.799
    8       1144.484      1462.412
    9       1226.453      1519.693
   10       1305.093      1581.465
   11       1380.159      1647.533
   12       1451.416      1717.693
   13       1518.642      1791.724
   14       1581.627      1869.396
   15       1640.174      1950.466
   16       1694.100      2034.680
   17       1694.115      2034.705
Circle Center At X =   161.036 ; Y =  2956.998 ; and Radius =  1789.122
***  FOS =      1.308   Theta (ki=1.0) =    29.27  ***
                     Lambda =   0.561
Failure Surface Specified By 16 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        500.482      1201.206
    2        598.002      1223.338
    3        694.038      1251.214
    4        788.253      1284.734
    5        880.315      1323.781
    6        969.899      1368.218
    7       1056.691      1417.887
    8       1140.386      1472.615
    9       1220.689      1532.209
   10       1297.318      1596.459
   11       1370.002      1665.139
   12       1438.487      1738.008
   13       1502.531      1814.809
   14       1561.909      1895.272
   15       1616.412      1979.113
   16       1637.248      2015.749
Circle Center At X =   177.818 ; Y =  2852.011 ; and Radius =  1682.043
***  FOS =      1.309   Theta (ki=1.0) =    29.14  ***
                     Lambda =   0.557
Failure Surface Specified By 17 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        500.482      1201.206
    2        598.405      1221.481
    3        695.011      1247.314
    4        789.984      1278.621
    5        883.015      1315.299
    6        973.799      1357.229
```

```
    7        1062.042      1404.274
    8        1147.454      1456.281
    9        1229.758      1513.079
   10        1308.685      1574.485
   11        1383.977      1640.296
   12        1455.388      1710.299
   13        1522.686      1784.265
   14        1585.651      1861.953
   15        1644.078      1943.109
   16        1697.775      2027.469
   17        1703.585      2037.862
Circle Center At X =   194.628 ; Y =  2925.000 ; and Radius =  1750.718
***  FOS =      1.311   Theta (ki=1.0) =    29.22  ***
                     Lambda =   0.559
Failure Surface Specified By 17 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        501.024      1202.561
    2        598.865      1223.228
    3        695.380      1249.398
    4        790.260      1280.987
    5        883.200      1317.893
    6        973.904      1359.999
    7       1062.079      1407.170
    8       1147.445      1459.253
    9       1229.727      1516.084
   10       1308.662      1577.478
   11       1383.996      1643.241
   12       1455.489      1713.160
   13       1522.912      1787.013
   14       1586.048      1864.562
   15       1644.695      1945.559
   16       1698.665      2029.745
   17       1703.163      2037.721
Circle Center At X =   184.962 ; Y =  2940.770 ; and Radius =  1766.710
***  FOS =      1.312   Theta (ki=1.0) =    29.21  ***
                     Lambda =   0.559
Failure Surface Specified By 17 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        501.386      1203.465
    2        599.213      1224.197
    3        695.758      1250.255
    4        790.733      1281.558
    5        883.851      1318.013
    6        974.834      1359.512
    7       1063.408      1405.929
    8       1149.309      1457.125
    9       1232.278      1512.947
   10       1312.067      1573.228
   11       1388.437      1637.785
   12       1461.157      1706.427
   13       1530.011      1778.947
   14       1594.792      1855.128
   15       1655.305      1934.740
   16       1711.369      2017.546
   17       1727.475      2044.391
Circle Center At X =   171.858 ; Y =  2999.498 ; and Radius =  1826.013
***  FOS =      1.315   Theta (ki=1.0) =    29.12  ***
                     Lambda =   0.557
Failure Surface Specified By 17 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        500.121      1200.302
    2        598.733      1216.905
    3        696.124      1239.600
    4        791.917      1268.300
```

5	885.742	1302.893
6	977.239	1343.247
7	1066.052	1389.205
8	1151.840	1440.591
9	1234.271	1497.205
10	1313.027	1558.829
11	1387.803	1625.225
12	1458.312	1696.137
13	1524.281	1771.291
14	1585.454	1850.397
15	1641.597	1933.150
16	1692.492	2019.229
17	1701.675	2037.225

Circle Center At X = 282.350 ; Y = 2794.900 ; and Radius = 1609.400
*** FOS = 1.316 Theta (ki=1.0) = 29.12 ***
Lambda = 0.557

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	501.928	1204.820
2	599.538	1226.554
3	695.854	1253.447
4	790.603	1285.424
5	883.519	1322.393
6	974.337	1364.250
7	1062.801	1410.878
8	1148.661	1462.143
9	1231.673	1517.901
10	1311.604	1577.993
11	1388.225	1642.251
12	1461.322	1710.493
13	1530.687	1782.524
14	1596.124	1858.142
15	1657.447	1937.132
16	1714.484	2019.271
17	1729.680	2043.849

Circle Center At X = 142.273 ; Y = 3050.128 ; and Radius = 1880.030
*** FOS = 1.317 Theta (ki=1.0) = 29.08 ***
Lambda = 0.556

Failure Surface Specified By 16 Coordinate Points

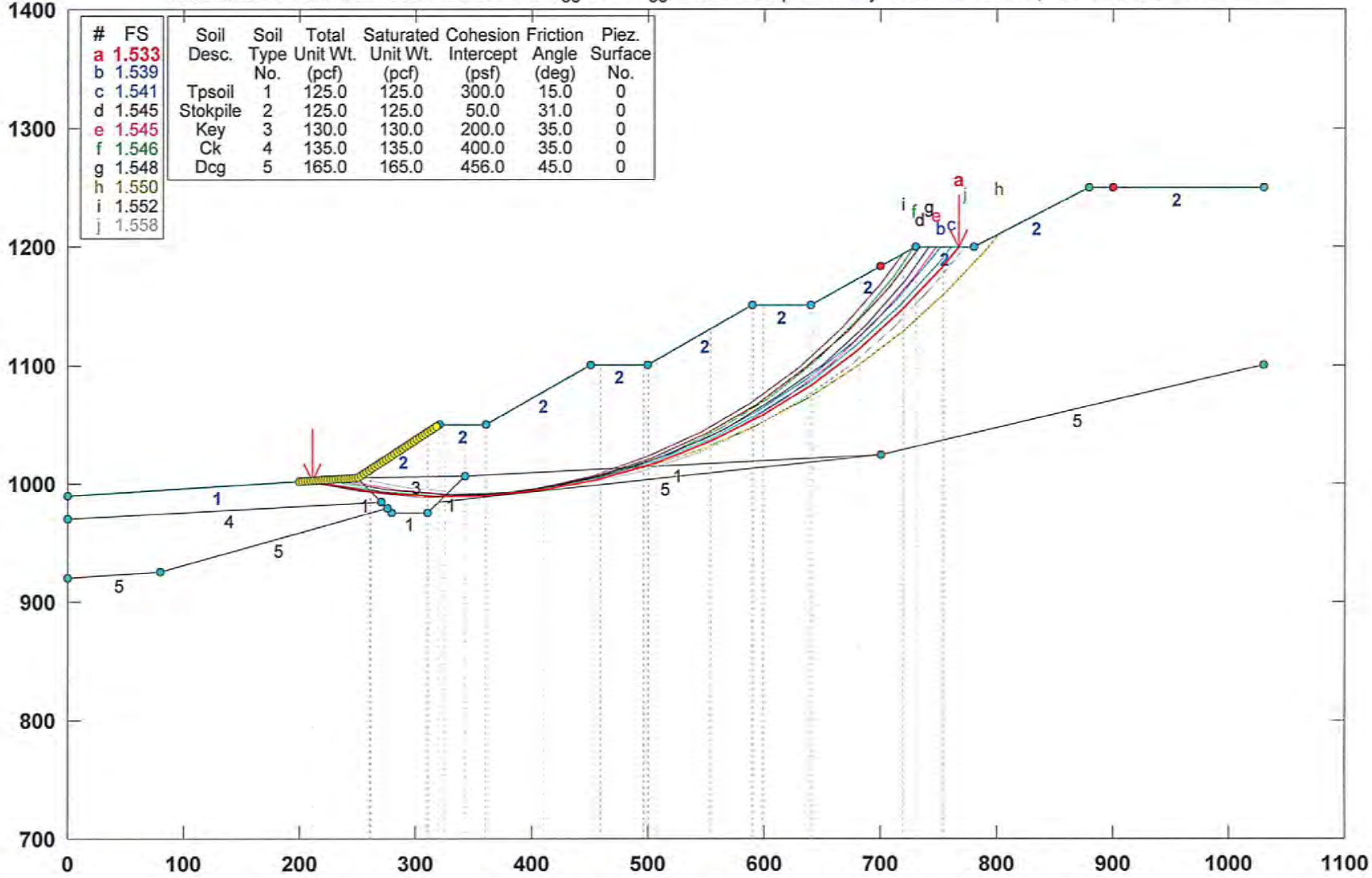
Point No.	X-Surf (ft)	Y-Surf (ft)
1	502.289	1205.724
2	600.324	1225.451
3	696.922	1251.314
4	791.699	1283.211
5	884.278	1321.013
6	974.293	1364.572
7	1061.385	1413.713
8	1145.210	1468.243
9	1225.433	1527.944
10	1301.736	1592.580
11	1373.817	1661.893
12	1441.389	1735.609
13	1504.184	1813.435
14	1561.952	1895.061
15	1614.464	1980.164
16	1632.614	2014.205

Circle Center At X = 239.807 ; Y = 2767.081 ; and Radius = 1583.267
*** FOS = 1.317 Theta (ki=1.0) = 29.00 ***
Lambda = 0.554

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

293-11 3M Moody Flats G-G' - Static

c:\stedwin\293-11 3m shasta\sect d to h\sect d to h\gg'\293-11 gg' - static 2.1.1.pl2 Run By: Petra Geotechnical, Inc. 8/10/2012 08:12AM



GSTABL7 v.2 FSmin=1.533

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

```
                    ***  GSTABL7  ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
          (All Rights Reserved-Unauthorized Use Prohibited)
*******************************************************************************
                  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,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*******************************************************************************
 Analysis Run Date:        8/10/2012
 Time of Run:              08:12AM
 Run By:                   Petra Geotechnical, Inc.
 Input Data Filename:      C:\STEDWIN\293-11 3M Shasta\Sect D to H\Sect D to H\GG'\293-
11 gg' -  static 2.1.1.in
 Output Filename:          C:\STEDWIN\293-11 3M Shasta\Sect D to H\Sect D to H\GG'\293-
11 gg' -  static 2.1.1.OUT
 Unit System:              English
 Plotted Output Filename:  C:\STEDWIN\293-11 3M Shasta\Sect D to H\Sect D to H\GG'\293-
11 gg' -  static 2.1.1.PLT
 PROBLEM DESCRIPTION:  293-11 3M Moody Flats
                       G-G' - Static
 BOUNDARY COORDINATES
    11 Top   Boundaries
    21 Total Boundaries
 Boundary     X-Left     Y-Left     X-Right    Y-Right    Soil Type
    No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
     1         0.00     990.00     250.00    1005.00        1
     2       250.00    1005.00     320.00    1050.00        2
     3       320.00    1050.00     360.00    1050.00        2
     4       360.00    1050.00     450.00    1100.00        2
     5       450.00    1100.00     500.00    1100.00        2
     6       500.00    1100.00     590.00    1150.00        2
     7       590.00    1150.00     640.00    1150.00        2
     8       640.00    1150.00     730.00    1200.00        2
     9       730.00    1200.00     780.00    1200.00        2
    10       780.00    1200.00     880.00    1250.00        2
    11       880.00    1250.00    1030.00    1250.00        2
    12       250.00    1005.00     342.00    1007.00        3
    13       342.00    1007.00     700.00    1025.00        1
    14       700.00    1025.00    1030.00    1100.00        5
    15       250.00    1005.00     280.00     975.00        1
    16       280.00     975.00     310.00     975.00        1
    17       310.00     975.00     342.00    1007.00        1
    18         0.00     970.00     270.00     985.00        4
    19       320.00     985.00     700.00    1025.00        5
    20         0.00     920.00      80.00     925.00        5
    21        80.00     925.00     275.00     980.00        5
 User Specified Y-Origin =        700.00(ft)
 Default X-Plus Value = 0.00(ft)
 Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
  5 Type(s) of Soil
 Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
 Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
  No.  (pcf)    (pcf)     (psf)     (deg)    Param.   (psf)     No.
   1   125.0    125.0     300.0     15.0     0.00      0.0       0
   2   125.0    125.0      50.0     31.0     0.00      0.0       0
   3   130.0    130.0     200.0     35.0     0.00      0.0       0
   4   135.0    135.0     400.0     35.0     0.00      0.0       0
   5   165.0    165.0     456.0     45.0     0.00      0.0       0
 A Critical Failure Surface Searching Method, Using A Random
 Technique For Generating Circular Surfaces, Has Been Specified.
 5000 Trial Surfaces Have Been Generated.
```

10 Surface(s) Initiate(s) From Each Of 500 Points Equally Spaced
Along The Ground Surface Between X = 200.00(ft)
and X = 320.00(ft)
Each Surface Terminates Between X = 700.00(ft)
and X = 900.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
50.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 5000
Number of Trial Surfaces With Valid FS = 5000
Statistical Data On All Valid FS Values:
FS Max = 5.672 FS Min = 1.533 FS Ave = 3.609
Standard Deviation = 1.305 Coefficient of Variation = 36.17 %
Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	210.822	1002.649
2	260.073	994.030
3	309.899	989.862
4	359.898	990.177
5	409.667	994.975
6	458.806	1004.216
7	506.918	1017.825
8	553.616	1035.693
9	598.524	1057.677
10	641.280	1083.598
11	681.540	1113.249
12	718.979	1146.390
13	753.296	1182.754
14	766.865	1200.000

Circle Center At X = 331.477 ; Y = 1544.710 ; and Radius = 555.327
Factor of Safety
*** 1.533 ***
Individual data on the 25 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	39.2	22545.1	0.0	0.0	0.	0.	0.0	0.0	0.0
2	10.1	17038.7	0.0	0.0	0.	0.	0.0	0.0	0.0
3	1.0	2230.8	0.0	0.0	0.	0.	0.0	0.0	0.0
4	48.8	222593.0	0.0	0.0	0.	0.	0.0	0.0	0.0
5	10.1	72627.1	0.0	0.0	0.	0.	0.0	0.0	0.0
6	5.0	37623.4	0.0	0.0	0.	0.	0.0	0.0	0.0
7	17.0	128513.6	0.0	0.0	0.	0.	0.0	0.0	0.0
8	17.9	133964.4	0.0	0.0	0.	0.	0.0	0.0	0.0
9	0.1	763.1	0.0	0.0	0.	0.	0.0	0.0	0.0
10	49.7	442135.0	0.0	0.0	0.	0.	0.0	0.0	0.0
11	40.3	453891.0	0.0	0.0	0.	0.	0.0	0.0	0.0
12	8.8	106345.8	0.0	0.0	0.	0.	0.0	0.0	0.0
13	37.2	421170.7	0.0	0.0	0.	0.	0.0	0.0	0.0
14	4.0	42047.4	0.0	0.0	0.	0.	0.0	0.0	0.0
15	6.9	73571.2	0.0	0.0	0.	0.	0.0	0.0	0.0
16	46.7	525682.3	0.0	0.0	0.	0.	0.0	0.0	0.0
17	36.4	433396.6	0.0	0.0	0.	0.	0.0	0.0	0.0
18	8.5	100598.5	0.0	0.0	0.	0.	0.0	0.0	0.0
19	41.5	413463.5	0.0	0.0	0.	0.	0.0	0.0	0.0
20	1.3	10747.2	0.0	0.0	0.	0.	0.0	0.0	0.0
21	40.3	319415.9	0.0	0.0	0.	0.	0.0	0.0	0.0
22	37.4	251113.6	0.0	0.0	0.	0.	0.0	0.0	0.0
23	11.0	61592.9	0.0	0.0	0.	0.	0.0	0.0	0.0
24	23.3	86161.1	0.0	0.0	0.	0.	0.0	0.0	0.0
25	13.6	14626.0	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	208.898	1002.534
2	258.152	993.931
3	307.993	989.940
4	357.988	990.596
5	407.707	995.893
6	456.719	1005.785
7	504.600	1020.186
8	550.936	1038.973
9	595.327	1061.982
10	637.389	1089.015
11	676.759	1119.838
12	713.095	1154.184
13	746.084	1191.757
14	752.062	1200.000

Circle Center At X = 326.018 ; Y = 1526.141 ; and Radius = 536.546

Factor of Safety

*** 1.539 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	210.341	1002.620
2	259.632	994.231
3	309.479	990.325
4	359.475	990.934
5	409.212	996.054
6	458.284	1005.642
7	506.291	1019.621
8	552.839	1037.875
9	597.550	1060.257
10	640.058	1086.583
11	680.017	1116.639
12	717.099	1150.178
13	751.003	1186.928
14	761.038	1200.000

Circle Center At X = 327.836 ; Y = 1541.729 ; and Radius = 551.763

Factor of Safety

*** 1.541 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	208.898	1002.534
2	258.076	993.507
3	307.908	989.407
4	357.900	990.275
5	407.560	996.101
6	456.395	1006.830
7	503.924	1022.354
8	549.677	1042.520
9	593.202	1067.129
10	634.068	1095.937
11	671.872	1128.661
12	706.241	1164.976
13	733.335	1200.000

Circle Center At X = 324.185 ; Y = 1492.133 ; and Radius = 502.989

Factor of Safety

*** 1.545 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	235.110	1004.107
2	284.285	995.063
3	334.127	991.094
4	384.114	992.242
5	433.722	998.493

6	482.431	1009.784
7	529.730	1025.994
8	575.124	1046.955
9	618.138	1072.447
10	658.320	1102.202
11	695.250	1135.910
12	728.540	1173.216
13	747.912	1200.000

Circle Center At X = 347.927 ; Y = 1479.352 ; and Radius = 488.453

Factor of Safety

*** 1.545 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	221.643	1003.299
2	270.741	993.842
3	320.561	989.611
4	370.551	990.652
5	420.152	996.955
6	468.813	1008.447
7	515.993	1025.003
8	561.165	1046.437
9	603.829	1072.511
10	643.508	1102.934
11	679.760	1137.369
12	712.183	1175.431
13	728.375	1199.097

Circle Center At X = 335.699 ; Y = 1463.296 ; and Radius = 473.927

Factor of Safety

*** 1.546 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	225.731	1003.544
2	274.948	994.728
3	324.802	990.908
4	374.787	992.121
5	424.397	998.355
6	473.128	1009.547
7	520.487	1025.584
8	565.992	1046.303
9	609.183	1071.493
10	649.621	1100.900
11	686.896	1134.225
12	720.631	1171.130
13	742.117	1200.000

Circle Center At X = 337.765 ; Y = 1487.235 ; and Radius = 496.496

Factor of Safety

*** 1.548 ***

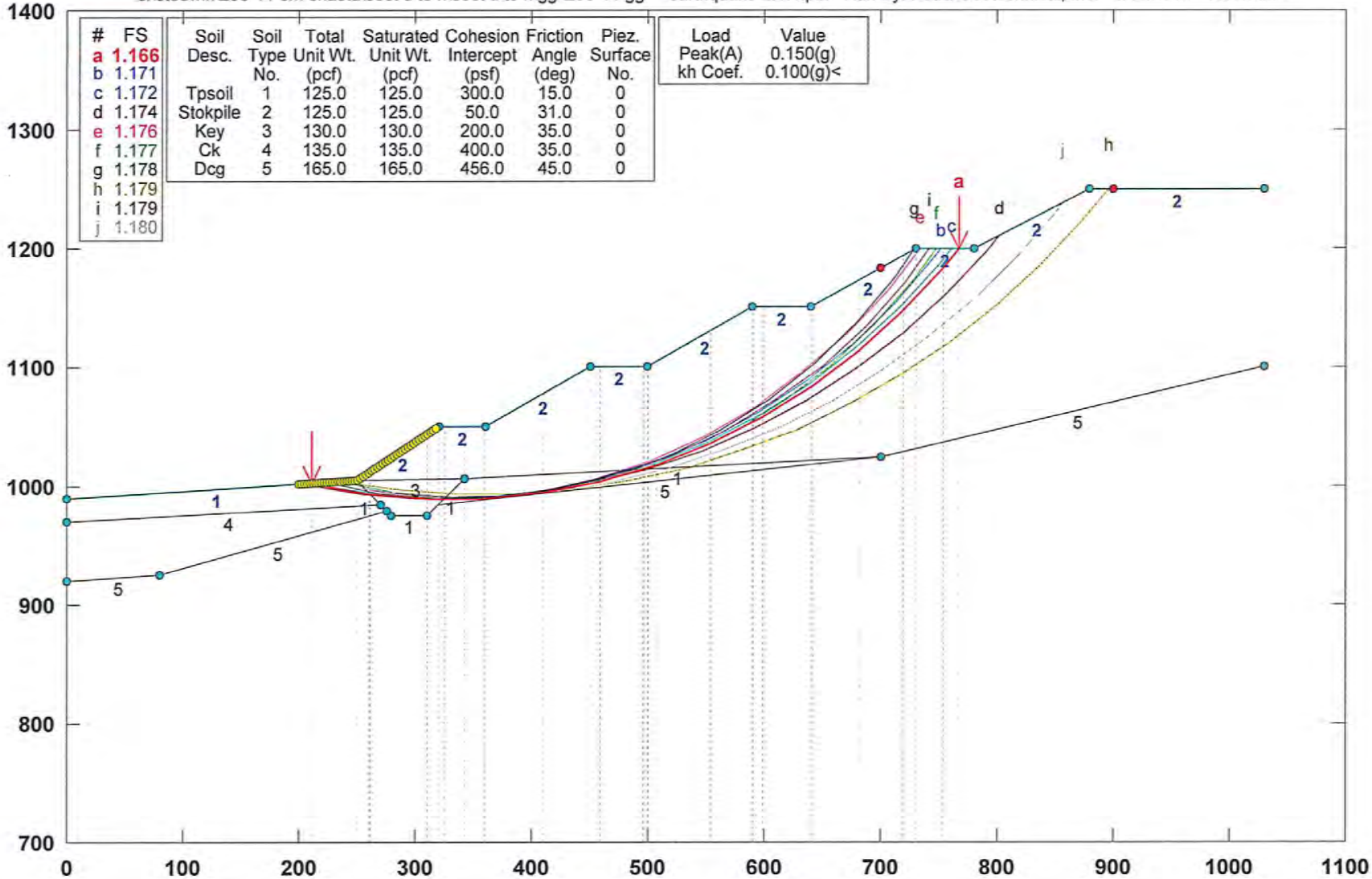
Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	202.405	1002.144
2	251.764	994.168
3	301.605	990.177
4	351.605	990.196
5	401.442	994.225
6	450.796	1002.239
7	499.348	1014.186
8	546.785	1029.988
9	592.802	1049.544
10	637.102	1072.729
11	679.399	1099.392
12	719.422	1129.361
13	756.912	1162.445
14	791.627	1198.428
15	801.904	1210.952

```
Circle Center At X =   326.368 ; Y =  1612.553 ; and Radius =   622.869
       Factor of Safety
      ***    1.550   ***
Failure Surface Specified By 13 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        205.050     1002.303
    2        254.189      993.065
    3        304.013      988.869
    4        354.005      989.757
    5        403.648      995.722
    6        452.428     1006.700
    7        499.839     1022.579
    8        545.392     1043.194
    9        588.614     1068.331
   10        629.057     1097.731
   11        666.303     1131.088
   12        699.967     1168.058
   13        719.123     1193.957
Circle Center At X =   320.287 ; Y =  1479.973 ; and Radius =   491.374
       Factor of Safety
      ***    1.552   ***
Failure Surface Specified By 13 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        247.374     1004.842
    2        296.640      996.304
    3        346.501      992.585
    4        396.488      993.722
    5        446.129      999.703
    6        494.956     1010.473
    7        542.507     1025.929
    8        588.334     1045.926
    9        632.005     1070.275
   10        673.107     1098.745
   11        711.253     1131.070
   12        746.083     1166.943
   13        772.459     1200.000
Circle Center At X =   359.806 ; Y =  1507.142 ; and Radius =   514.728
       Factor of Safety
      ***    1.558   ***
          **** END OF GSTABL7 OUTPUT ****
```

293-11 3M Moody Flats G-G' - Earthquake

c:\stedwin\293-11 3m shasta\sect d to h\sect d to h\gg'\293-11 gg' - earthquake 2.1.1.pl2 Run By: Petra Geotechnical, Inc. 8/10/2012 08:09AM



GSTABL7 v.2 FSmin=1.166

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

***** GSTABL7 *****

** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
(All Rights Reserved-Unauthorized Use Prohibited)

****

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,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 8/10/2012
Time of Run: 08:09AM
Run By: Petra Geotechnical, Inc.
Input Data Filename: C:\STEDWIN\293-11 3M Shasta\Sect D to H\Sect D to H\GG'\293-11 gg' - earthquake 2.1.1.in
Output Filename: C:\STEDWIN\293-11 3M Shasta\Sect D to H\Sect D to H\GG'\293-11 gg' - earthquake 2.1.1.OUT
Unit System: English
Plotted Output Filename: C:\STEDWIN\293-11 3M Shasta\Sect D to H\Sect D to H\GG'\293-11 gg' - earthquake 2.1.1.PLT
PROBLEM DESCRIPTION: 293-11 3M Moody Flats
G-G' - Earthquake

BOUNDARY COORDINATES
11 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	990.00	250.00	1005.00	1
2	250.00	1005.00	320.00	1050.00	2
3	320.00	1050.00	360.00	1050.00	2
4	360.00	1050.00	450.00	1100.00	2
5	450.00	1100.00	500.00	1100.00	2
6	500.00	1100.00	590.00	1150.00	2
7	590.00	1150.00	640.00	1150.00	2
8	640.00	1150.00	730.00	1200.00	2
9	730.00	1200.00	780.00	1200.00	2
10	780.00	1200.00	880.00	1250.00	2
11	880.00	1250.00	1030.00	1250.00	2
12	250.00	1005.00	342.00	1007.00	3
13	342.00	1007.00	700.00	1025.00	1
14	700.00	1025.00	1030.00	1100.00	5
15	250.00	1005.00	280.00	975.00	1
16	280.00	975.00	310.00	975.00	1
17	310.00	975.00	342.00	1007.00	1
18	0.00	970.00	270.00	985.00	4
19	320.00	985.00	700.00	1025.00	5
20	0.00	920.00	80.00	925.00	5
21	80.00	925.00	275.00	980.00	5

User Specified Y-Origin = 700.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
5 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	125.0	125.0	300.0	15.0	0.00	0.0	0
2	125.0	125.0	50.0	31.0	0.00	0.0	0
3	130.0	130.0	200.0	35.0	0.00	0.0	0
4	135.0	135.0	400.0	35.0	0.00	0.0	0
5	165.0	165.0	456.0	45.0	0.00	0.0	0

Specified Peak Ground Acceleration Coefficient (A) = 0.150(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.100(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)

Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
5000 Trial Surfaces Have Been Generated.
10 Surface(s) Initiate(s) From Each Of 500 Points Equally Spaced
Along The Ground Surface Between X = 200.00(ft)
and X = 320.00(ft)
Each Surface Terminates Between X = 700.00(ft)
and X = 900.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
50.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 5000
Number of Trial Surfaces With Valid FS = 5000
Statistical Data On All Valid FS Values:
FS Max = 4.285 FS Min = 1.166 FS Ave = 2.745
Standard Deviation = 0.989 Coefficient of Variation = 36.02 %
Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	210.822	1002.649
2	260.073	994.030
3	309.899	989.862
4	359.898	990.177
5	409.667	994.975
6	458.806	1004.216
7	506.918	1017.825
8	553.616	1035.693
9	598.524	1057.677
10	641.280	1083.598
11	681.540	1113.249
12	718.979	1146.390
13	753.296	1182.754
14	766.865	1200.000

Circle Center At X = 331.477 ; Y = 1544.710 ; and Radius = 555.327
Factor of Safety
*** 1.166 ***
Individual data on the 25 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	39.2	22545.1	0.0	0.0	0.	0.	2254.5	0.0	0.0
2	10.1	17038.7	0.0	0.0	0.	0.	1703.9	0.0	0.0
3	1.0	2230.8	0.0	0.0	0.	0.	223.1	0.0	0.0
4	48.8	222593.0	0.0	0.0	0.	0.	22259.3	0.0	0.0
5	10.1	72627.1	0.0	0.0	0.	0.	7262.7	0.0	0.0
6	5.0	37623.4	0.0	0.0	0.	0.	3762.3	0.0	0.0
7	17.0	128513.6	0.0	0.0	0.	0.	12851.4	0.0	0.0
8	17.9	133964.4	0.0	0.0	0.	0.	13396.4	0.0	0.0
9	0.1	763.1	0.0	0.0	0.	0.	76.3	0.0	0.0
10	49.7	442135.0	0.0	0.0	0.	0.	44213.5	0.0	0.0
11	40.3	453891.0	0.0	0.0	0.	0.	45389.1	0.0	0.0
12	8.8	106345.8	0.0	0.0	0.	0.	10634.6	0.0	0.0
13	37.2	421170.7	0.0	0.0	0.	0.	42117.1	0.0	0.0
14	4.0	42047.4	0.0	0.0	0.	0.	4204.7	0.0	0.0
15	6.9	73571.2	0.0	0.0	0.	0.	7357.1	0.0	0.0
16	46.7	525682.3	0.0	0.0	0.	0.	52568.2	0.0	0.0
17	36.4	433396.6	0.0	0.0	0.	0.	43339.7	0.0	0.0
18	8.5	100598.5	0.0	0.0	0.	0.	10059.9	0.0	0.0
19	41.5	413463.5	0.0	0.0	0.	0.	41346.4	0.0	0.0
20	1.3	10747.2	0.0	0.0	0.	0.	1074.7	0.0	0.0
21	40.3	319415.9	0.0	0.0	0.	0.	31941.6	0.0	0.0

22	37.4	251113.6	0.0	0.0	0.	0.	25111.4	0.0	0.0
23	11.0	61592.9	0.0	0.0	0.	0.	6159.3	0.0	0.0
24	23.3	86161.1	0.0	0.0	0.	0.	8616.1	0.0	0.0
25	13.6	14626.0	0.0	0.0	0.	0.	1462.6	0.0	0.0

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	208.898	1002.534
2	258.152	993.931
3	307.993	989.940
4	357.988	990.596
5	407.707	995.893
6	456.719	1005.785
7	504.600	1020.186
8	550.936	1038.973
9	595.327	1061.982
10	637.389	1089.015
11	676.759	1119.838
12	713.095	1154.184
13	746.084	1191.757
14	752.062	1200.000

Circle Center At X = 326.018 ; Y = 1526.141 ; and Radius = 536.546

Factor of Safety

*** 1.171 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	210.341	1002.620
2	259.632	994.231
3	309.479	990.325
4	359.475	990.934
5	409.212	996.054
6	458.284	1005.642
7	506.291	1019.621
8	552.839	1037.875
9	597.550	1060.257
10	640.058	1086.583
11	680.017	1116.639
12	717.099	1150.178
13	751.003	1186.928
14	761.038	1200.000

Circle Center At X = 327.836 ; Y = 1541.729 ; and Radius = 551.763

Factor of Safety

*** 1.172 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	202.405	1002.144
2	251.764	994.168
3	301.605	990.177
4	351.605	990.196
5	401.442	994.225
6	450.796	1002.239
7	499.348	1014.186
8	546.785	1029.988
9	592.802	1049.544
10	637.102	1072.729
11	679.399	1099.392
12	719.422	1129.361
13	756.912	1162.445
14	791.627	1198.428
15	801.904	1210.952

Circle Center At X = 326.368 ; Y = 1612.553 ; and Radius = 622.869

Factor of Safety

*** 1.174 ***

Failure Surface Specified By 13 Coordinate Points

Point	X-Surf	Y-Surf

```
   No.          (ft)          (ft)
    1         208.898      1002.534
    2         258.076       993.507
    3         307.908       989.407
    4         357.900       990.275
    5         407.560       996.101
    6         456.395      1006.830
    7         503.924      1022.354
    8         549.677      1042.520
    9         593.202      1067.129
   10         634.068      1095.937
   11         671.872      1128.661
   12         706.241      1164.976
   13         733.335      1200.000
Circle Center At X =   324.185 ; Y =  1492.133 ; and Radius =   502.989
       Factor of Safety
      ***    1.176   ***
Failure Surface Specified By 13 Coordinate Points
  Point       X-Surf       Y-Surf
   No.          (ft)          (ft)
    1         235.110      1004.107
    2         284.285       995.063
    3         334.127       991.094
    4         384.114       992.242
    5         433.722       998.493
    6         482.431      1009.784
    7         529.730      1025.994
    8         575.124      1046.955
    9         618.138      1072.447
   10         658.320      1102.202
   11         695.250      1135.910
   12         728.540      1173.216
   13         747.912      1200.000
Circle Center At X =   347.927 ; Y =  1479.352 ; and Radius =   488.453
       Factor of Safety
      ***    1.177   ***
Failure Surface Specified By 13 Coordinate Points
  Point       X-Surf       Y-Surf
   No.          (ft)          (ft)
    1         221.643      1003.299
    2         270.741       993.842
    3         320.561       989.611
    4         370.551       990.652
    5         420.152       996.955
    6         468.813      1008.447
    7         515.993      1025.003
    8         561.165      1046.437
    9         603.829      1072.511
   10         643.508      1102.934
   11         679.760      1137.369
   12         712.183      1175.431
   13         728.375      1199.097
Circle Center At X =   335.699 ; Y =  1463.296 ; and Radius =   473.927
       Factor of Safety
      ***    1.178   ***
Failure Surface Specified By 16 Coordinate Points
  Point       X-Surf       Y-Surf
   No.          (ft)          (ft)
    1         237.034      1004.222
    2         286.529       997.138
    3         336.408       993.658
    4         386.408       993.799
    5         436.266       997.561
    6         485.721      1004.924
    7         534.513      1015.848
    8         582.386      1030.278
    9         629.087      1048.137
```

10	674.373	1069.332
11	718.005	1093.750
12	759.754	1121.264
13	799.401	1151.729
14	836.737	1184.986
15	871.567	1220.859
16	896.020	1250.000

Circle Center At X = 359.551 ; Y = 1682.061 ; and Radius = 688.822

Factor of Safety

*** 1.179 ***

Failure Surface Specified By 13 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	225.731	1003.544
2	274.948	994.728
3	324.802	990.908
4	374.787	992.121
5	424.397	998.355
6	473.128	1009.547
7	520.487	1025.584
8	565.992	1046.303
9	609.183	1071.493
10	649.621	1100.900
11	686.896	1134.225
12	720.631	1171.130
13	742.117	1200.000

Circle Center At X = 337.765 ; Y = 1487.235 ; and Radius = 496.496

Factor of Safety

*** 1.179 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	221.884	1003.313
2	271.319	995.821
3	321.182	992.119
4	371.182	992.228
5	421.028	996.148
6	470.430	1003.855
7	519.102	1015.305
8	566.759	1030.431
9	613.124	1049.145
10	657.929	1071.339
11	700.912	1096.883
12	741.822	1125.628
13	780.423	1157.408
14	816.490	1192.037
15	849.813	1229.315
16	856.742	1238.371

Circle Center At X = 344.847 ; Y = 1646.067 ; and Radius = 654.410

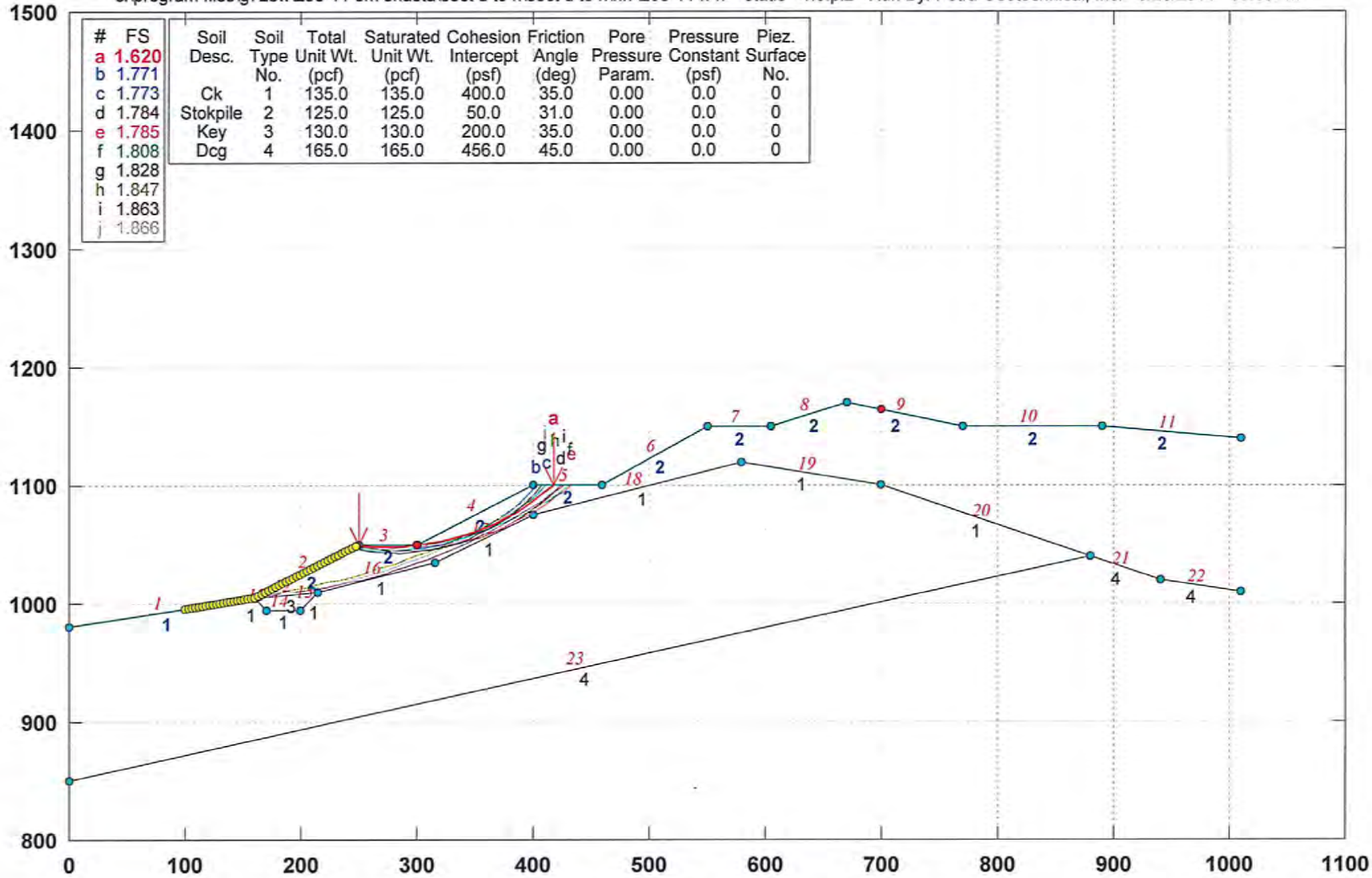
Factor of Safety

*** 1.180 ***

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

293-11 3M Moody Flats H-H' Static

c:\program files\g72sw\293-11 3m shasta\sect d to h\sect d to h\hh'\293-11 h-h' - static - 1.0.pl2 Run By: Petra Geotechnical, Inc. 9/28/2011 05:05PM



#	FS
a	1.620
b	1.771
c	1.773
d	1.784
e	1.785
f	1.808
g	1.828
h	1.847
i	1.863
j	1.866

Soil Desc.	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.
Ck	1	135.0	135.0	400.0	35.0	0.00	0.0	0
Stokpile	2	125.0	125.0	50.0	31.0	0.00	0.0	0
Key	3	130.0	130.0	200.0	35.0	0.00	0.0	0
Dcg	4	165.0	165.0	456.0	45.0	0.00	0.0	0

GSTABL7 v.2 FSmin=1.620

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

```
                    *** GSTABL7 ***
              ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
              (All Rights Reserved-Unauthorized Use Prohibited)
*****************************************************************************
                    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,
        Nonlinear Undrained Shear Strength, Curved Phi Envelope,
        Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
        Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*****************************************************************************
Analysis Run Date:        9/28/2011
Time of Run:              05:05PM
Run By:                   Petra Geotechnical, Inc.
Input Data Filename:      C:\program files\g72sw\293-11 3M Shasta\Sect D to H\Sect D t
o H\HH'\293-11 h-h' - static - 1.0.in
Output Filename:          C:\program files\g72sw\293-11 3M Shasta\Sect D to H\Sect D t
o H\HH'\293-11 h-h' - static - 1.0.OUT
Unit System:              English
Plotted Output Filename:  C:\program files\g72sw\293-11 3M Shasta\Sect D to H\Sect D t
o H\HH'\293-11 h-h' - static - 1.0.PLT
PROBLEM DESCRIPTION:  293-11 3M Moody Flats
                      H-H' Static
BOUNDARY COORDINATES
   11 Top   Boundaries
   23 Total Boundaries
```

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	980.00	160.00	1005.00	1
2	160.00	1005.00	250.00	1050.00	2
3	250.00	1050.00	300.00	1050.00	2
4	300.00	1050.00	400.00	1100.00	2
5	400.00	1100.00	460.00	1100.00	2
6	460.00	1100.00	550.00	1150.00	2
7	550.00	1150.00	605.00	1150.00	2
8	605.00	1150.00	670.00	1170.00	2
9	670.00	1170.00	770.00	1150.00	2
10	770.00	1150.00	890.00	1150.00	2
11	890.00	1150.00	1010.00	1140.00	2
12	160.00	1005.00	215.00	1010.00	3
13	160.00	1005.00	170.00	995.00	1
14	170.00	995.00	200.00	995.00	1
15	200.00	995.00	215.00	1010.00	1
16	215.00	1010.00	315.00	1035.00	1
17	315.00	1035.00	400.00	1075.00	1
18	400.00	1075.00	580.00	1120.00	1
19	580.00	1120.00	700.00	1100.00	1
20	700.00	1100.00	880.00	1040.00	1
21	880.00	1040.00	940.00	1020.00	4
22	940.00	1020.00	1010.00	1010.00	4
23	0.00	850.00	880.00	1040.00	4

```
User Specified Y-Origin =       800.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
  4 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	135.0	135.0	400.0	35.0	0.00	0.0	0
2	125.0	125.0	50.0	31.0	0.00	0.0	0
3	130.0	130.0	200.0	35.0	0.00	0.0	0
4	165.0	165.0	456.0	45.0	0.00	0.0	0

```
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
5000 Trial Surfaces Have Been Generated.
```

10 Surface(s) Initiate(s) From Each Of 500 Points Equally Spaced
Along The Ground Surface Between X = 100.00(ft)
and X = 250.00(ft)
Each Surface Terminates Between X = 300.00(ft)
and X = 700.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 5000
Number of Trial Surfaces With Valid FS = 5000
Statistical Data On All Valid FS Values:
FS Max = 236.553 FS Min = 1.620 FS Ave = 3.905
Standard Deviation = 5.781 Coefficient of Variation = 148.06 %
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	249.698	1049.849
2	259.649	1048.860
3	269.635	1048.327
4	279.634	1048.251
5	289.627	1048.634
6	299.592	1049.472
7	309.508	1050.766
8	319.354	1052.512
9	329.110	1054.707
10	338.756	1057.346
11	348.271	1060.423
12	357.635	1063.932
13	366.828	1067.866
14	375.833	1072.216
15	384.628	1076.974
16	393.197	1082.129
17	401.521	1087.671
18	409.583	1093.588
19	417.366	1099.867
20	417.516	1100.000

Circle Center At X = 276.285 ; Y = 1266.737 ; and Radius = 218.512
Factor of Safety
*** 1.620 ***
Individual data on the 22 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	0.3	3.4	0.0	0.0	0.	0.	0.0	0.0	0.0
2	9.6	797.0	0.0	0.0	0.	0.	0.0	0.0	0.0
3	10.0	1755.8	0.0	0.0	0.	0.	0.0	0.0	0.0
4	10.0	2138.5	0.0	0.0	0.	0.	0.0	0.0	0.0
5	10.0	1945.4	0.0	0.0	0.	0.	0.0	0.0	0.0
6	10.0	1179.6	0.0	0.0	0.	0.	0.0	0.0	0.0
7	0.4	25.6	0.0	0.0	0.	0.	0.0	0.0	0.0
8	9.5	2651.4	0.0	0.0	0.	0.	0.0	0.0	0.0
9	9.8	6863.1	0.0	0.0	0.	0.	0.0	0.0	0.0
10	9.8	10373.8	0.0	0.0	0.	0.	0.0	0.0	0.0
11	9.6	13190.6	0.0	0.0	0.	0.	0.0	0.0	0.0
12	9.5	15309.8	0.0	0.0	0.	0.	0.0	0.0	0.0
13	9.4	16736.9	0.0	0.0	0.	0.	0.0	0.0	0.0
14	9.2	17487.2	0.0	0.0	0.	0.	0.0	0.0	0.0
15	9.0	17585.1	0.0	0.0	0.	0.	0.0	0.0	0.0
16	8.8	17063.7	0.0	0.0	0.	0.	0.0	0.0	0.0
17	8.6	15964.4	0.0	0.0	0.	0.	0.0	0.0	0.0
18	6.8	11824.8	0.0	0.0	0.	0.	0.0	0.0	0.0
19	1.5	2440.5	0.0	0.0	0.	0.	0.0	0.0	0.0

20	8.1	9443.0	0.0	0.0	0.	0.	0.0	0.0	0.0
21	7.8	3183.7	0.0	0.0	0.	0.	0.0	0.0	0.0
22	0.2	1.2	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	247.293	1048.646
2	257.134	1046.868
3	267.065	1045.695
4	277.049	1045.132
5	287.049	1045.181
6	297.027	1045.842
7	306.946	1047.113
8	316.769	1048.987
9	326.458	1051.460
10	335.978	1054.520
11	345.293	1058.158
12	354.368	1062.358
13	363.169	1067.106
14	371.663	1072.384
15	379.818	1078.171
16	387.604	1084.447
17	394.991	1091.188
18	401.951	1098.367
19	403.351	1100.000

Circle Center At X = 281.248 ; Y = 1208.424 ; and Radius = 163.346

Factor of Safety

*** 1.771 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	244.588	1047.294
2	254.495	1045.934
3	264.459	1045.085
4	274.453	1044.748
5	284.451	1044.924
6	294.428	1045.614
7	304.355	1046.815
8	314.208	1048.523
9	323.960	1050.736
10	333.586	1053.446
11	343.060	1056.646
12	352.358	1060.329
13	361.454	1064.484
14	370.324	1069.100
15	378.946	1074.165
16	387.297	1079.667
17	395.354	1085.590
18	403.097	1091.918
19	410.504	1098.636
20	411.861	1100.000

Circle Center At X = 276.027 ; Y = 1239.306 ; and Radius = 194.569

Factor of Safety

*** 1.773 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	247.594	1048.797
2	257.423	1046.958
3	267.334	1045.627
4	277.300	1044.806
5	287.296	1044.498
6	297.294	1044.703
7	307.268	1045.422
8	317.192	1046.652
9	327.040	1048.390
10	336.785	1050.631

11	346.403	1053.370
12	355.867	1056.599
13	365.153	1060.309
14	374.237	1064.492
15	383.093	1069.135
16	391.700	1074.227
17	400.033	1079.755
18	408.072	1085.702
19	415.795	1092.055
20	423.181	1098.796
21	424.372	1100.000

Circle Center At X = 288.293 ; Y = 1239.184 ; and Radius = 194.689
Factor of Safety
*** 1.784 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	248.796	1049.398
2	258.715	1048.124
3	268.678	1047.272
4	278.669	1046.842
5	288.669	1046.837
6	298.660	1047.255
7	308.625	1048.096
8	318.545	1049.359
9	328.402	1051.041
10	338.180	1053.139
11	347.859	1055.650
12	357.424	1058.568
13	366.856	1061.890
14	376.139	1065.608
15	385.256	1069.716
16	394.191	1074.207
17	402.928	1079.073
18	411.450	1084.304
19	419.743	1089.892
20	427.792	1095.827
21	432.977	1100.000

Circle Center At X = 283.802 ; Y = 1282.696 ; and Radius = 235.909
Factor of Safety
*** 1.785 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	245.189	1047.594
2	255.170	1046.978
3	265.166	1046.716
4	275.166	1046.809
5	285.156	1047.258
6	295.124	1048.061
7	305.056	1049.218
8	314.942	1050.727
9	324.768	1052.586
10	334.521	1054.793
11	344.190	1057.345
12	353.762	1060.239
13	363.225	1063.471
14	372.568	1067.038
15	381.777	1070.934
16	390.843	1075.155
17	399.753	1079.695
18	408.496	1084.548
19	417.061	1089.710
20	425.438	1095.172
21	432.296	1100.000

Circle Center At X = 267.536 ; Y = 1328.158 ; and Radius = 281.452
Factor of Safety

```
      ***    1.808    ***
Failure Surface Specified By 19 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        245.189      1047.594
    2        254.976      1045.542
    3        264.870      1044.091
    4        274.834      1043.246
    5        284.832      1043.012
    6        294.825      1043.388
    7        304.776      1044.374
    8        314.648      1045.965
    9        324.405      1048.157
   10        334.010      1050.940
   11        343.427      1054.304
   12        352.621      1058.237
   13        361.558      1062.724
   14        370.204      1067.749
   15        378.528      1073.292
   16        386.497      1079.333
   17        394.082      1085.849
   18        401.256      1092.816
   19        407.801      1100.000
Circle Center At X =   283.670 ; Y =  1206.709 ; and Radius =   163.702
       Factor of Safety
      ***    1.828    ***
Failure Surface Specified By 29 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        164.629      1007.314
    2        174.535      1008.676
    3        184.419      1010.197
    4        194.277      1011.878
    5        204.106      1013.717
    6        213.905      1015.715
    7        223.670      1017.871
    8        233.398      1020.183
    9        243.089      1022.653
   10        252.738      1025.278
   11        262.344      1028.059
   12        271.903      1030.994
   13        281.414      1034.083
   14        290.874      1037.325
   15        300.280      1040.719
   16        309.631      1044.264
   17        318.923      1047.960
   18        328.154      1051.805
   19        337.322      1055.799
   20        346.424      1059.940
   21        355.459      1064.227
   22        364.423      1068.660
   23        373.314      1073.236
   24        382.130      1077.955
   25        390.869      1082.816
   26        399.529      1087.817
   27        408.107      1092.958
   28        416.600      1098.235
   29        419.341      1100.000
Circle Center At X =    85.162 ; Y =  1622.149 ; and Radius =   619.949
       Factor of Safety
      ***    1.847    ***
Failure Surface Specified By 30 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1        163.126      1006.563
    2        173.100      1007.282
    3        183.058      1008.198
```

4	192.996	1009.309
5	202.910	1010.616
6	212.797	1012.117
7	222.652	1013.812
8	232.472	1015.701
9	242.253	1017.782
10	251.991	1020.056
11	261.683	1022.520
12	271.324	1025.175
13	280.911	1028.018
14	290.440	1031.050
15	299.908	1034.269
16	309.311	1037.673
17	318.645	1041.261
18	327.907	1045.032
19	337.093	1048.984
20	346.199	1053.117
21	355.222	1057.428
22	364.159	1061.915
23	373.005	1066.577
24	381.759	1071.412
25	390.415	1076.419
26	398.972	1081.594
27	407.424	1086.938
28	415.771	1092.446
29	424.007	1098.117
30	426.630	1100.000

Circle Center At X = 131.581 ; Y = 1513.799 ; and Radius = 508.216

Factor of Safety

*** 1.863 ***

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	163.727	1006.863
2	173.691	1007.710
3	183.635	1008.769
4	193.554	1010.040
5	203.443	1011.524
6	213.298	1013.219
7	223.115	1015.124
8	232.889	1017.239
9	242.615	1019.562
10	252.290	1022.093
11	261.908	1024.831
12	271.465	1027.773
13	280.957	1030.920
14	290.379	1034.269
15	299.728	1037.818
16	308.999	1041.567
17	318.187	1045.514
18	327.289	1049.656
19	336.300	1053.992
20	345.217	1058.519
21	354.034	1063.237
22	362.748	1068.142
23	371.356	1073.232
24	379.853	1078.505
25	388.234	1083.959
26	396.498	1089.591
27	404.638	1095.399
28	410.805	1100.000

Circle Center At X = 129.216 ; Y = 1472.718 ; and Radius = 467.131

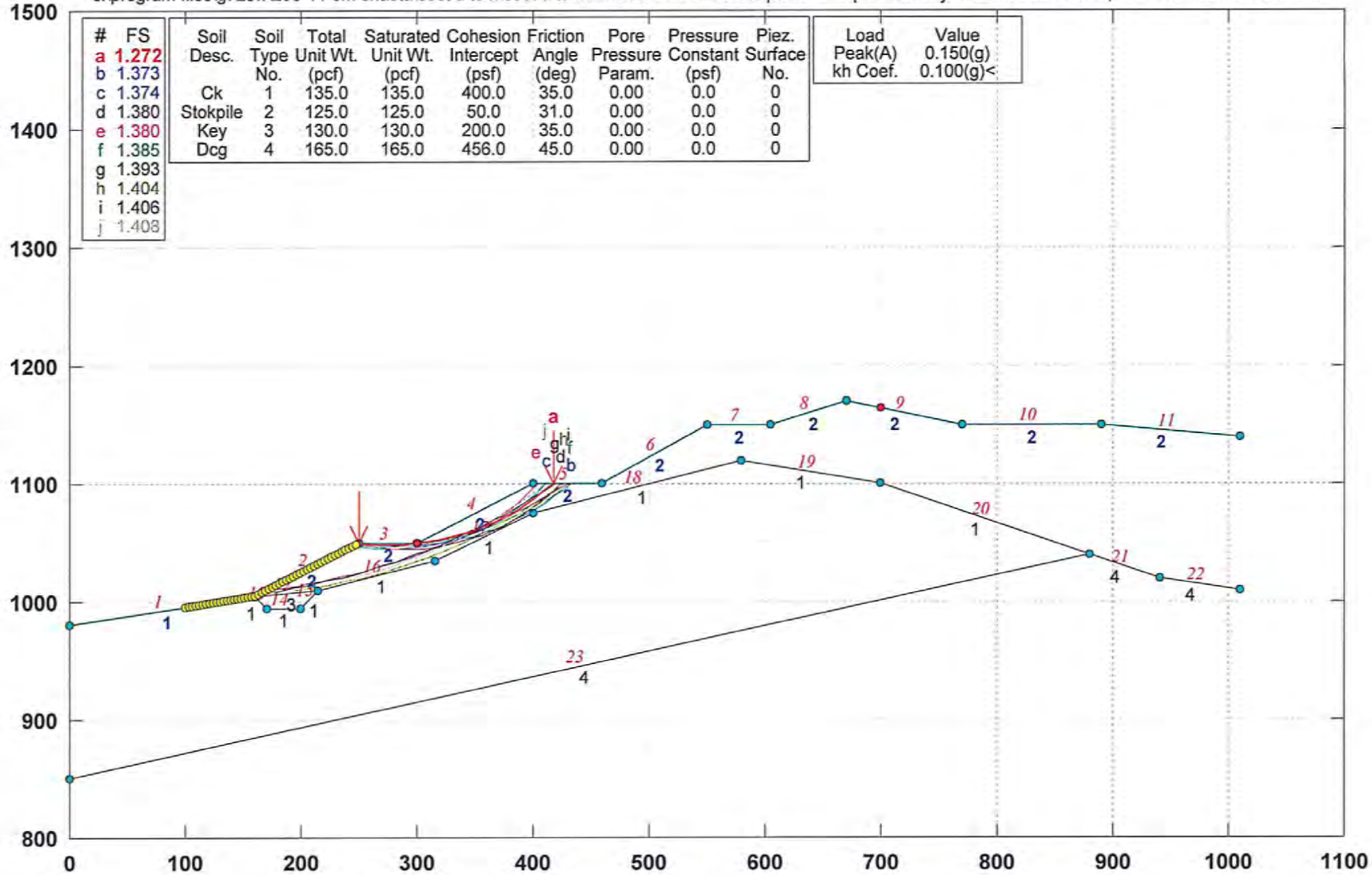
Factor of Safety

*** 1.866 ***

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

293-11 3M Moody Flats H-H' Earthquake

c:\program files\g72sw\293-11 3m shasta\sect d to h\sect d to h\hh'\293-11 h-h' - earthquake - 1.0.pl2 Run By: Petra Geotechnical, Inc. 9/28/2011 05:07PM



#	FS
a	1.272
b	1.373
c	1.374
d	1.380
e	1.380
f	1.385
g	1.393
h	1.404
i	1.406
j	1.408

Soil Desc.	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.
Ck	1	135.0	135.0	400.0	35.0	0.00	0.0	0
Stokpile	2	125.0	125.0	50.0	31.0	0.00	0.0	0
Key	3	130.0	130.0	200.0	35.0	0.00	0.0	0
Dcg	4	165.0	165.0	456.0	45.0	0.00	0.0	0

Load	Value
Peak(A)	0.150(g)
kh Coef.	0.100(g)<

GSTABL7 v.2 FSmin=1.272

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

***** GSTABL7 *****

** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
(All Rights Reserved-Unauthorized Use Prohibited)

****

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,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 9/28/2011
Time of Run: 05:07PM
Run By: Petra Geotechnical, Inc.
Input Data Filename: C:\program files\g72sw\293-11 3M Shasta\Sect D to H\Sect D to H\HH'\293-11 h-h' - earthquake - 1.0.in
Output Filename: C:\program files\g72sw\293-11 3M Shasta\Sect D to H\Sect D to H\HH'\293-11 h-h' - earthquake - 1.0.OUT
Unit System: English
Plotted Output Filename: C:\program files\g72sw\293-11 3M Shasta\Sect D to H\Sect D to H\HH'\293-11 h-h' - earthquake - 1.0.PLT
PROBLEM DESCRIPTION: 293-11 3M Moody Flats
H-H' Earthquake

BOUNDARY COORDINATES
11 Top Boundaries
23 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	980.00	160.00	1005.00	1
2	160.00	1005.00	250.00	1050.00	2
3	250.00	1050.00	300.00	1050.00	2
4	300.00	1050.00	400.00	1100.00	2
5	400.00	1100.00	460.00	1100.00	2
6	460.00	1100.00	550.00	1150.00	2
7	550.00	1150.00	605.00	1150.00	2
8	605.00	1150.00	670.00	1170.00	2
9	670.00	1170.00	770.00	1150.00	2
10	770.00	1150.00	890.00	1150.00	2
11	890.00	1150.00	1010.00	1140.00	2
12	160.00	1005.00	215.00	1010.00	3
13	160.00	1005.00	170.00	995.00	1
14	170.00	995.00	200.00	995.00	1
15	200.00	995.00	215.00	1010.00	1
16	215.00	1010.00	315.00	1035.00	1
17	315.00	1035.00	400.00	1075.00	1
18	400.00	1075.00	580.00	1120.00	1
19	580.00	1120.00	700.00	1100.00	1
20	700.00	1100.00	880.00	1040.00	1
21	880.00	1040.00	940.00	1020.00	4
22	940.00	1020.00	1010.00	1010.00	4
23	0.00	850.00	880.00	1040.00	4

User Specified Y-Origin = 800.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
4 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	135.0	135.0	400.0	35.0	0.00	0.0	0
2	125.0	125.0	50.0	31.0	0.00	0.0	0
3	130.0	130.0	200.0	35.0	0.00	0.0	0
4	165.0	165.0	456.0	45.0	0.00	0.0	0

Specified Peak Ground Acceleration Coefficient (A) = 0.150(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.100(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)

Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
5000 Trial Surfaces Have Been Generated.
10 Surface(s) Initiate(s) From Each Of 500 Points Equally Spaced
Along The Ground Surface Between X = 100.00(ft)
and X = 250.00(ft)
Each Surface Terminates Between X = 300.00(ft)
and X = 700.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 5000
Number of Trial Surfaces With Valid FS = 5000
Statistical Data On All Valid FS Values:
FS Max = 9.070 FS Min = 1.272 FS Ave = 2.606
Standard Deviation = 0.780 Coefficient of Variation = 29.91 %
Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	249.698	1049.849
2	259.649	1048.860
3	269.635	1048.327
4	279.634	1048.251
5	289.627	1048.634
6	299.592	1049.472
7	309.508	1050.766
8	319.354	1052.512
9	329.110	1054.707
10	338.756	1057.346
11	348.271	1060.423
12	357.635	1063.932
13	366.828	1067.866
14	375.833	1072.216
15	384.628	1076.974
16	393.197	1082.129
17	401.521	1087.671
18	409.583	1093.588
19	417.366	1099.867
20	417.516	1100.000

Circle Center At X = 276.285 ; Y = 1266.737 ; and Radius = 218.512
Factor of Safety
*** 1.272 ***
Individual data on the 22 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	0.3	3.4	0.0	0.0	0.	0.	0.3	0.0	0.0
2	9.6	797.0	0.0	0.0	0.	0.	79.7	0.0	0.0
3	10.0	1755.8	0.0	0.0	0.	0.	175.6	0.0	0.0
4	10.0	2138.5	0.0	0.0	0.	0.	213.8	0.0	0.0
5	10.0	1945.4	0.0	0.0	0.	0.	194.5	0.0	0.0
6	10.0	1179.6	0.0	0.0	0.	0.	118.0	0.0	0.0
7	0.4	25.6	0.0	0.0	0.	0.	2.6	0.0	0.0
8	9.5	2651.4	0.0	0.0	0.	0.	265.1	0.0	0.0
9	9.8	6863.1	0.0	0.0	0.	0.	686.3	0.0	0.0
10	9.8	10373.8	0.0	0.0	0.	0.	1037.4	0.0	0.0
11	9.6	13190.6	0.0	0.0	0.	0.	1319.1	0.0	0.0
12	9.5	15309.8	0.0	0.0	0.	0.	1531.0	0.0	0.0
13	9.4	16736.9	0.0	0.0	0.	0.	1673.7	0.0	0.0
14	9.2	17487.2	0.0	0.0	0.	0.	1748.7	0.0	0.0
15	9.0	17585.1	0.0	0.0	0.	0.	1758.5	0.0	0.0

16	8.8	17063.7	0.0	0.0	0.	0.	1706.4	0.0	0.0
17	8.6	15964.4	0.0	0.0	0.	0.	1596.4	0.0	0.0
18	6.8	11824.8	0.0	0.0	0.	0.	1182.5	0.0	0.0
19	1.5	2440.5	0.0	0.0	0.	0.	244.0	0.0	0.0
20	8.1	9443.0	0.0	0.0	0.	0.	944.3	0.0	0.0
21	7.8	3183.7	0.0	0.0	0.	0.	318.4	0.0	0.0
22	0.2	1.2	0.0	0.0	0.	0.	0.1	0.0	0.0

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	248.796	1049.398
2	258.715	1048.124
3	268.678	1047.272
4	278.669	1046.842
5	288.669	1046.837
6	298.660	1047.255
7	308.625	1048.096
8	318.545	1049.359
9	328.402	1051.041
10	338.180	1053.139
11	347.859	1055.650
12	357.424	1058.568
13	366.856	1061.890
14	376.139	1065.608
15	385.256	1069.716
16	394.191	1074.207
17	402.928	1079.073
18	411.450	1084.304
19	419.743	1089.892
20	427.792	1095.827
21	432.977	1100.000

Circle Center At X = 283.802 ; Y = 1282.696 ; and Radius = 235.909

Factor of Safety

*** 1.373 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	244.588	1047.294
2	254.495	1045.934
3	264.459	1045.085
4	274.453	1044.748
5	284.451	1044.924
6	294.428	1045.614
7	304.355	1046.815
8	314.208	1048.523
9	323.960	1050.736
10	333.586	1053.446
11	343.060	1056.646
12	352.358	1060.329
13	361.454	1064.484
14	370.324	1069.100
15	378.946	1074.165
16	387.297	1079.667
17	395.354	1085.590
18	403.097	1091.918
19	410.504	1098.636
20	411.861	1100.000

Circle Center At X = 276.027 ; Y = 1239.306 ; and Radius = 194.569

Factor of Safety

*** 1.374 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	247.594	1048.797
2	257.423	1046.958
3	267.334	1045.627
4	277.300	1044.806

5	287.296	1044.498
6	297.294	1044.703
7	307.268	1045.422
8	317.192	1046.652
9	327.040	1048.390
10	336.785	1050.631
11	346.403	1053.370
12	355.867	1056.599
13	365.153	1060.309
14	374.237	1064.492
15	383.093	1069.135
16	391.700	1074.227
17	400.033	1079.755
18	408.072	1085.702
19	415.795	1092.055
20	423.181	1098.796
21	424.372	1100.000

Circle Center At X = 288.293 ; Y = 1239.184 ; and Radius = 194.689
Factor of Safety
*** 1.380 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	247.293	1048.646
2	257.134	1046.868
3	267.065	1045.695
4	277.049	1045.132
5	287.049	1045.181
6	297.027	1045.842
7	306.946	1047.113
8	316.769	1048.987
9	326.458	1051.460
10	335.978	1054.520
11	345.293	1058.158
12	354.368	1062.358
13	363.169	1067.106
14	371.663	1072.384
15	379.818	1078.171
16	387.604	1084.447
17	394.991	1091.188
18	401.951	1098.367
19	403.351	1100.000

Circle Center At X = 281.248 ; Y = 1208.424 ; and Radius = 163.346
Factor of Safety
*** 1.380 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	245.189	1047.594
2	255.170	1046.978
3	265.166	1046.716
4	275.166	1046.809
5	285.156	1047.258
6	295.124	1048.061
7	305.056	1049.218
8	314.942	1050.727
9	324.768	1052.586
10	334.521	1054.793
11	344.190	1057.345
12	353.762	1060.239
13	363.225	1063.471
14	372.568	1067.038
15	381.777	1070.934
16	390.843	1075.155
17	399.753	1079.695
18	408.496	1084.548
19	417.061	1089.710

20	425.438	1095.172
21	432.296	1100.000

Circle Center At X = 267.536 ; Y = 1328.158 ; and Radius = 281.452

Factor of Safety

*** 1.385 ***

Failure Surface Specified By 29 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	164.629	1007.314
2	174.535	1008.676
3	184.419	1010.197
4	194.277	1011.878
5	204.106	1013.717
6	213.905	1015.715
7	223.670	1017.871
8	233.398	1020.183
9	243.089	1022.653
10	252.738	1025.278
11	262.344	1028.059
12	271.903	1030.994
13	281.414	1034.083
14	290.874	1037.325
15	300.280	1040.719
16	309.631	1044.264
17	318.923	1047.960
18	328.154	1051.805
19	337.322	1055.799
20	346.424	1059.940
21	355.459	1064.227
22	364.423	1068.660
23	373.314	1073.236
24	382.130	1077.955
25	390.869	1082.816
26	399.529	1087.817
27	408.107	1092.958
28	416.600	1098.235
29	419.341	1100.000

Circle Center At X = 85.162 ; Y = 1622.149 ; and Radius = 619.949

Factor of Safety

*** 1.393 ***

Failure Surface Specified By 30 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	163.126	1006.563
2	173.100	1007.282
3	183.058	1008.198
4	192.996	1009.309
5	202.910	1010.616
6	212.797	1012.117
7	222.652	1013.812
8	232.472	1015.701
9	242.253	1017.782
10	251.991	1020.056
11	261.683	1022.520
12	271.324	1025.175
13	280.911	1028.018
14	290.440	1031.050
15	299.908	1034.269
16	309.311	1037.673
17	318.645	1041.261
18	327.907	1045.032
19	337.093	1048.984
20	346.199	1053.117
21	355.222	1057.428
22	364.159	1061.915
23	373.005	1066.577
24	381.759	1071.412

25	390.415	1076.419
26	398.972	1081.594
27	407.424	1086.938
28	415.771	1092.446
29	424.007	1098.117
30	426.630	1100.000

Circle Center At X = 131.581 ; Y = 1513.799 ; and Radius = 508.216

Factor of Safety

*** 1.404 ***

Failure Surface Specified By 29 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	167.935	1008.968
2	177.839	1010.349
3	187.723	1011.872
4	197.583	1013.539
5	207.418	1015.348
6	217.226	1017.298
7	227.005	1019.390
8	236.752	1021.623
9	246.466	1023.996
10	256.145	1026.510
11	265.787	1029.163
12	275.389	1031.955
13	284.950	1034.885
14	294.468	1037.954
15	303.940	1041.159
16	313.365	1044.501
17	322.741	1047.978
18	332.066	1051.591
19	341.337	1055.338
20	350.554	1059.218
21	359.713	1063.231
22	368.814	1067.376
23	377.854	1071.652
24	386.831	1076.058
25	395.743	1080.593
26	404.589	1085.256
27	413.367	1090.047
28	422.075	1094.964
29	430.699	1100.000

Circle Center At X = 77.267 ; Y = 1695.432 ; and Radius = 692.426

Factor of Safety

*** 1.406 ***

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	163.727	1006.863
2	173.691	1007.710
3	183.635	1008.769
4	193.554	1010.040
5	203.443	1011.524
6	213.298	1013.219
7	223.115	1015.124
8	232.889	1017.239
9	242.615	1019.562
10	252.290	1022.093
11	261.908	1024.831
12	271.465	1027.773
13	280.957	1030.920
14	290.379	1034.269
15	299.728	1037.818
16	308.999	1041.567
17	318.187	1045.514
18	327.289	1049.656
19	336.300	1053.992
20	345.217	1058.519

```
  21        354.034     1063.237
  22        362.748     1068.142
  23        371.356     1073.232
  24        379.853     1078.505
  25        388.234     1083.959
  26        396.498     1089.591
  27        404.638     1095.399
  28        410.805     1100.000
Circle Center At X =   129.216 ; Y =  1472.718 ; and Radius =   467.131
      Factor of Safety
     ***    1.408   ***
         **** END OF GSTABL7 OUTPUT ****
```