GEOTECHNICAL REPORT

Crystal Creek Aggregates Quarry Expansion
Shasta County, California

Submitted To:

Mr. Chris Handley
CRYSTAL CREEK AGGREGATES
10936 Iron Moutain Road
Redding, CA 96001

Prepared by:
Bajada Geosciences, Inc.

September 2, 2022
Project No. 1901.0114

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September 2, 2022
1901.0114

Mr. Chris Handley
CRYSTAL CREEK AGGREGATES
10936 Iron Mountain Road,
Redding, CA 96001

Subject: **Crystal Creek Aggregates Quarry Expansion Project**
10936 Iron Mountain Road
Shasta County, California

Dear Mr. Handley:

Bajada Geosciences, Inc., is pleased to submit this geotechnical report for the Crystal Creek Aggregates Quarry Expansion Project, located at 10936 Iron Mountain Road, in unincorporated Shasta County, California. This report is being submitted in accordance with our proposal dated March 22, 2019.

This geotechnical report discusses field mapping, laboratory testing results, conditions encountered, and geotechnical analyses associated with the study. Recommendations are provided for design and construction of the proposed quarry, where necessary.

We appreciate the opportunity to perform this study. If you have any questions pertaining to this report, or if we may be of further service, please contact us at (530) 638-5263 at your earliest convenience.

Sincerely,
BAJADA GEOSCIENCES, INC.

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EXECUTIVE SUMMARY

A proposed expansion of the Crystal Creek Quarry will result in highwalls up to 420 feet tall, with an overall slope inclination of 45 degrees. Maximum bench widths of 40 feet are proposed except for one bench that will be 60 feet wide. Bench heights of 40 are proposed for most bench faces; however, two bench faces are proposed at heights of 42 feet and one bench face at a height of 46 feet.

Geologic mapping of the proposed expansion area observed rock materials of the Copley Greenstone, Mule Mountain Stock, rhyolite, and colluvial and alluvial soils. The Copley Greenstone consists of greenstone and chloritic/epidote amphibolite. The Mule Mountain Stock consists of granodiorite and trondhjemite. Gabbro is present within the quarry and rhyolite is exposed within the expansion area. Colluvial soils, including saprolitic soils, mantle rock materials and range in thickness up to about 15 feet. A number of pre-Holocene faults were observed projecting across the quarry. Structural domains were numerous and relatively chaotic due to that faulting.

Laboratory testing of cored rock materials found the slightly weathered to fresh rock ranged from medium strong to very strong (ISRM [1981] Grade R3 to R5), with most of the rock being strong (R4). Discontinuities were moderately to very widely spaced, partially open to tight, undulating to planar, and generally rough. Few open apertures were observed but those present were filled with calcium carbonate, epidote, and quartz. Some discontinuity planes appeared to have a relatively thin coating of iron oxide, zinc oxide, calcium carbonate or other coatings. Few discontinuities were observed to be open and unfilled except where prior blasting and mining had occurred.

Kinematic evaluations of slope stability found no planar or wedge failures on an overall slope scale. On a bench scale, some failures of steeply inclined planes and wedges could occur (backbreak), which might result in periodic maintenance needs. Limit-equilibrium evaluations of slope stability found that factors of safety from those evaluations met or exceeded appropriate thresholds for static and pseudostatic conditions for the proposed quarry configuration. Limit-equilibrium evaluations of stability for colluvial and saprolitic soils found that those materials should be laid back at an inclination of 1.5:1 or flatter.

1 INTRODUCTION

BAJADA Geosciences, Inc. (BAJADA), is pleased to submit this preliminary pit slope stability study to Crystal Creek Aggregates (CCA), for the expansion of the existing quarry located in Shasta County, California. The project address is at 10936 Iron Mountain Road and includes the following parcels: APN 065-250-002, -24, -25, -026 (portion), and 065-260-010. The location is shown on Plate 1 – Site Location Map. The following report discusses our understanding of the project, observations and measurements made within the mine area, our analyses, and presents our opinion regarding slope stability at the proposed pit expansion.

1.1 PROJECT DESCRIPTION

We understand that that CCA is proposing an expansion to its reclamation plan for the existing quarry site. We understand that the existing Reclamation Plan Area covers about 110 acres. The proposed Project Reclamation Plan Area will remain the same and will have a total mining area of about 57 acres (Duane K, Miller Civil Engineer, Inc. [DKM], 2020). Total mined-out volume will exceed 12-million cubic yards of rock and overburden materials according to the proposed reclamation plan (DKM, 2020).

The materials quarried from the pit are used as aggregate for construction, decorative stone, and sand materials for various applications. The project, as we understand it, consists of the vertical and horizontal expansion of the existing quarry, as shown on Plate 2 – Proposed Mine Configuration (DKM, 2020).

The proposed Reclamation Plan, as shown on Plate 2, will create highwalls extending from elevation 1,060 down to elevation 640 feet. In general, highwall benches are proposed to be up to 40 feet tall and 40 feet wide with vertical slope faces. Interbench ramps are not proposed for the project; however, at elevation 738, just above where pit groundwater elevation is projected (post reclamation), a 60-foot-wide bench is proposed with the pit-side 16 feet of that bench inclined towards the pit at a 2:1 (horizontal:vertical) inclination. In addition, bench faces at elevations 640, 686, and 738 will be 46, 42, and 42 feet tall, respectively (DKM, 2020).

It is anticipated that the materials within the quarry will be excavated using a combination of conventional ripping and hauling methods and through blasting and hauling. It is anticipated that overburden and highly to moderately weathered rock will be rippable using single- or double-shank rippers attached to bulldozers. With depth, as materials become harder and less weathered, it is anticipated that controlled blasting will be needed to excavate rock materials. According to Cooksley Geophysical (1998), seismic velocities along two refraction surveys indicate that ripping depths might vary up to 30 feet deep or more prior to blasting being necessary. Once ripped or blasted, it is anticipated that excavators will load haul trucks with excavated materials. We understand that overburden and topsoil will be stockpiled within the quarry for later use during reclamation. It is anticipated that these soils will be placed on excavated benches to help facilitate revegetation.

The approximate center of the quarry has the following latitude and longitude:

- Latitude: 40° 36' 15.6" (40.604343°)
- Longitude: -122° 28' 6.9" (-122.468602°)

1.2 PREVIOUS WORK PERFORMED

Geophysical refraction surveys were performed at the site by Cooksley (1998). That study consisted of two seismic refraction surveys performed at locations shown on Plate 2 (DKM, 2020). For that study, 1,000- and 2,211-foot-long refraction surveys were performed. Results of that study are presented in Appendix A – Previous Geoscience Studies.

In addition, a preliminary geologic report was prepared for the site by Cooksley Geophysical (2008). That report describes the estimated geological conditions at the site based upon surficial observations. It was used as a supplement to a global stability evaluation performed by Materials Testing, Inc. (2007). That report evaluated gross stability of proposed quarry slopes using limit-equilibrium methods based upon rock strengths estimated from three unconfined compression tests.

We know of no previous geotechnical or rock slope stability evaluations that have been performed at the existing pit. Geological information has been previously published for the project region and is periodically referred to within this report. References for those data are presented in the References section (Section 12.0) of this report.

1.3 SCOPE OF SERVICES

Services performed for this study included:

- Reconnaissance of the site surface conditions;
- Acquisition of selected, existing, available geological data relevant to the subject site conditions;
- Review of pertinent, selected regional geological data;
- Observation of exposed geological conditions at the project site. Plate 3 – Geologic Map, presents the geological conditions mapped at the site;
- Collection of eight samples of surficially available on-site rock materials suitable for laboratory testing;
- Performance of laboratory testing on samples obtained from the site to estimate rock strength characteristics for use in stability analyses. Results of the laboratory testing are presented in Appendix B – Laboratory Testing.
- Performance of kinematic rock slope stability evaluations for the proposed pit slope

configurations.

- Performance of limit-equilibrium evaluations of potential planar, wedge, and toppling failures identified within the kinematic analyses. Results of the limit-equilibrium analyses are presented in Appendix C – Slope Stability Analyses;
- Performance of limit-equilibrium evaluations of the gross stability for the proposed highwall;
- Preparation of this report, which includes:
  - A description of the proposed project;
  - A summary of our field observation and laboratory testing programs;
  - A description of site surface conditions encountered during our field investigation; and
  - Our opinion regarding slope stability.

1.4 FIELD EXPLORATION

Field exploration performed by Bajada for this study consisted of reconnaissance-level geologic mapping of the study area, field measurement of discontinuity data (fractures, joints, flow bands, bedding planes, etc.) and rock mass characteristics at selected locations within the existing pit. In addition, acquisition of high-resolution overlapping (stereo) photographs of selected existing highwalls for use with software to evaluate discontinuity orientations and populations of those highwalls was performed. Field exploration occurred over the course of three working days.

Subsurface exploration was not performed as part of our services.

1.5 HISTORY OF PREVIOUS SLOPE INSTABILITIES

We understand that significant rock planar, wedge, or toppling failures have not occurred at the mine during its history. Minor sloughing, raveling, and local wedge failures are visible in existing highwalls; however, these are localized failures that appear to have occurred in areas where aggressive blasting practices have occurred. In addition, some slope failures of oversteepened colluvial and regolithic soils (overburden) have occurred and one was observed on the southern margin of the existing quarry, as shown on Plate 3.

2 PIT SLOPE DESIGN CONCEPTS

2.1 GENERAL

The design of quarry highwalls and pit slopes is the balance of economic factors with safety/social factors (Read & Stacey, 2009). Mine operators want to maximize the resource extracted from the mine and, hence, would prefer steep overall slope angles within a pit. Balanced against this is the increased likelihood that steep slopes will lead to the development of slope stability issues that could ultimately impact worker safety, productivity, and, therefore, mine profitability. The approach is to base the pit design on achieving an acceptable level of risk and incorporating this into the stability analyses as a factor of safety (FOS). Pit slopes are considered constructed overly conservative if no instability occurs during operations. Hence, some instability should be anticipated, accommodated for, and monitored during pit development.

Imprinted on pit slope design due to economic-safety/social factors are environmental and/or regulatory factors. While technical evaluations may indicate that a slope is acceptable due to the aforementioned factors, it is not unusual for regulatory and permitting processes to dictate that flatter slopes be utilized in design. Those factors are often out of the control of the geotechnical consultant and mine operator.

This section briefly introduces pit slope terminology that is used throughout this report and some of the key geotechnical and mining factors that can impact slope design. In addition, a summary of the analysis techniques utilized in this study and the adopted risk management approach are discussed.

2.2 PIT SLOPE GEOMETRIES

There are three predominant pit slope geometries that need to be recognized and addressed for any pit slope stability evaluation (Read & Stacey, 2009; Wyllie & Mah, 2010):

- Bench Geometry;
- Inter-ramp Slope; and
- Overall Slope.

Those geometries are illustrated on Plate 4 – Common Quarry Geometries and discussed below.

2.2.1 Bench Geometry

The height of benches is typically determined by the size of the shovel chosen for the mining operation or the preferred blasting and extraction methodologies of the mine operator. The bench face angle is usually selected in such a way as to reduce, to an acceptable level, the amount of material that will likely fall from the face or crest. The bench width is sized to prevent small wedges and blocks from the bench faces falling down the slope and potentially impacting men and equipment. The bench geometry that results from the bench face angle and bench width will ultimately dictate the inter-ramp slope angle. Stacked benches can be used in certain circumstances to steepen inter-ramp slopes.

2.2.2 Inter-Ramp Slope

We understand that inter-bench ramps are not proposed for the quarry. Therefore, this slope definition does not apply to the CCA quarry expansion.

2.2.3 Overall Slope

Overall slope inclination for the proposed quarry expansion is governed by bench geometry since inter-bench ramps are not proposed.

2.3 KEY FACTORS FOR PIT SLOPE DESIGN

As noted by Wyllie & Mah (2010), stability of pit slopes in rock is typically controlled by the following key geotechnical and mining factors:

- **Lithology and Alteration** – The rock types intersected by the final pit walls and level of alteration are key factors that impact eventual stability of the pit. Geological domains are created by grouping rock masses with similar geomechanical characteristics.
- **Large-Scale Structural Features –** The orientation and strength of major, continuous geological features such as faults, shear planes, weak bedding planes, structural fabric, and/or persistent planar joints will strongly influence the overall stability of the pit walls.
- **Small-Scale Structural Features –** The orientation, strength, and persistence of smaller scale structural features such as joints will control the stability of individual benches and may ultimately restrict the inter-ramp slope angles.
- **Rock Mass Quality –** Rock mass strengths are typically estimated via intact rock strength and rock mass classification schemes such as the rock mass rating (RMR) system (Hoek, 1995). Lower rock mass quality typically results in flatter overall slope angles.
- **Blasting Practice** – Production blasting can cause considerable damage to interim and final pit walls. This increased disturbance is typically accounted for with a reduction in the effective strength of the rock mass. Controlled blasting programs near the final wall can be implemented to reduce blasting induced disturbances and allow steeper slopes. Scaling of blast induced fracturing is essential.
- **Groundwater Conditions –** High groundwater pressures and water pressure in tension cracks will reduce rock mass shear strength and may adversely impact slope stability. If needed, depressurization programs can reduce water pressure behind the pit walls and allow steeper pit slopes to be developed.
- **Stress Conditions –** Mining induces stress changes due to lateral unloading within the vicinity of the pit. Stress release can lead to effective reductions in the quality of the rock mass and increases in slope displacements. Localized stress decrease can reduce confinement and result in an increased incidence of raveling type failures in the walls.

Modifying the mining arrangement and sequence can sometimes manage these stress changes to enhance the integrity of the final pit walls.

2.4 METHODOLOGY FOR PIT SLOPE STABILITY ASSESSMENT

Assessment of pit slope stability is based on the development of a geotechnical model for varying domains encountered within the projected mine area. Those domains are based upon geological, structural (geomechanical), rock mass, and hydrogeological models (Read & Stacey, 2009). Each domain has independent characteristics that affect slope stability. Once the domains have been delineated, a number of different types of stability analyses can be undertaken to estimate appropriate slope angles for a given open pit slope. Slope stability analyses undertaken for this study included the following types:

- **Kinematic Stability Analyses** – Stereographic analyses were conducted on the discontinuity orientation data and the DIPS program (Rocscience, 2019) was utilized to identify the kinematically possible failure modes. Appropriate bench face angles and/or inter-ramp slope angles are assigned in such a way as to reduce the potential for discontinuities to form unstable wedges or planes. Typically, it is not cost effective to eliminate all potentially unstable blocks and a certain percentage of bench face failures and/or multiple bench instabilities are acceptable. Most of the smaller unstable features will be removed during mining by scaling the bench faces and during periodic maintenance activities.

- **Planar and Wedge Stability Analyses** – Limit-equilibrium analyses of potential rock planar and wedge failures were performed with SLIDE 2018 program (Rocscience, 2019) and GEO5 (Fine Civil Engineering Software, 2019), respectively. These programs provide an estimate for the factor of safety against large-scale, multiple-bench failures through the rock mass. In these particular analyses, as with many pit designs, minimum static and pseudostatic (pseudo-earthquake forces) factors of safety of at least 1.3 and 1.1, respectively, were specified for these types of failure (Wyllie and Mah, 2004). Lower static factors of safety (e.g. 1.2) may sometimes be utilized for shorter periods of time, such as near the end of mine life, and where good monitoring is implemented.

- **Rock Mass Stability Analyses** – Limit-equilibrium analyses of the rock slopes were performed with SLIDE 2018 program (Rocscience, 2019). This program provides an estimate for the factor of safety against large-scale, multiple-bench failures through the rock mass. In this particular analysis, as with many pit designs, minimum static and pseudostatic factors of safety of at least 1.3 and 1.1, respectively, were specified for this type of failure (Wyllie and Mah, 2004). Lower static factors of safety (e.g. 1.2) may sometimes be utilized for shorter periods of time, such as near the end of mine life, and where good monitoring is implemented.

3 GEOLOGICAL CONDITIONS

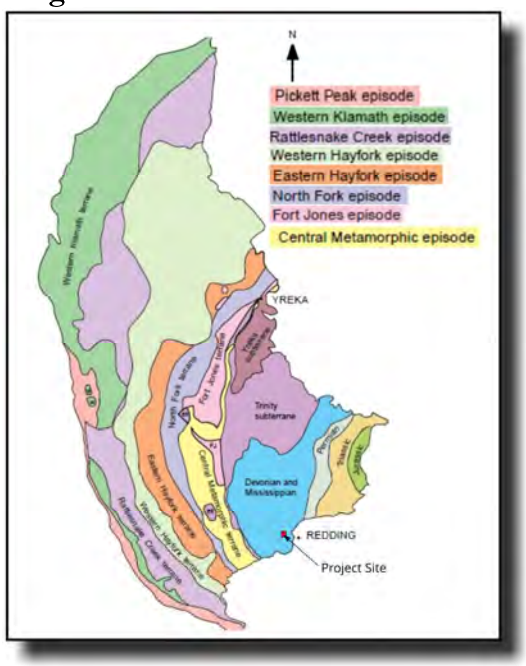
3.1 GENERAL

The project site is located in the eastern Klamath Mountains within the Klamath Mountains geomorphic Geologic Province of California. The quarry is situated near the northwestern margin of the Sacramento Valley, approximately 4 miles west of the City of Redding. This area is characterized by moderately to steeply inclined hills with moderately to steeply incised drainages.

3.2 REGIONAL GEOLOGY

The CCA quarry is in the eastern Klamath Mountains in California. The Klamath Mountains form a geologic province that extends from northern California to Southern Oregon. In California, the Klamath Mountains province extends from the Pacific Ocean to the Great Valley. The province consists of an arcuate-shaped belt of lithologic belts that are convex to the west (Snoke & Barnes, 2006).

Figure 1 – Klamath Accreted Terrane



These lithologic belts have been accreted due to tectonic processes between the North American and Pacific tectonic plates. A total of eight accretionary episodes have been identified within the Klamath Mountains (Irwin & Wooden, 1999), as shown on Figure 1. The oldest of these tectonic accretions is located on the east side of the Klamath Mountains and each accretionary terrane becomes more recent in age towards the west. Each of the accretionary episodes is separated by thrust faults, resulting in relatively older rocks resting on relatively more recent rocks. In addition, during accretion of the eight terranes, there has been clockwise rotation of the Klamath Mountains of about 110 degrees (Irwin & Wooden, 1999).

At least 10 plutons have been mapped within the Klamath Mountains. Ages of those plutons have been estimated to range from about 150- to over 400-million years old (Irwin & Wooden, 1999). Most of the plutons intruded the accreted terranes; however, some were emplaced pre-amalgamation (Silberman and Danielson, 1991).

The quarry is located within the Eastern Klamath terrane, which is about 180- to 400-million years old (Silurian-Devonian to Jurassic). The Eastern Klamath terrane is composed of three subterranes: Redding, Trinity, and Yreka subterranes. The Redding subterrane consists of Mississippian to

Devonian-age metavolcanic and metasedimentary rocks. Formations within the Redding subterrane consist of the Baird, Bragdon, and Kennett Formations, the Mule Mountain stock, Balaklala Rhyolite, and Copley Greenstone. Those formations are locally faulted into place. Superjacent rocks consist of alluvium, colluvium, local terrace, and landslide deposits.

3.3 QUARRY GEOLOGY

The existing quarry highwalls expose Mule Mountain Stock (Dmm), Copley Greenstone (Dc), and epidote and/or chloritic amphibolite, and gabbro (Da). These materials are unconformably in contact in some locations and have been juxtaposed by faulting in other locations. In areas outside of the active quarry face, Dmm and Dc are visible in outcrop, as float on the ground surface, and exposed within scoured drainages. In addition, Balaklala Ryholite (Dbc) is locally found, as shown on Plate 3.

Granitics of Dmm consist of granodiorite, albite granite, and trondhjemite that increase in hardness and competency and decrease in weathering with depth. Regolithic and saprolitic soils associated with weathering of Dmm produce overburden thicknesses ranging from a few feet to over 20 feet. Below the overburden, weathering decreases from highly weathered to fresh (International Society of Rock Mechanics [ISRM,1981] Grades IV to I) over thicknesses ranging from about 5 to 20 feet. These zones of weathering are often observed penetrating relatively fresh rocks along discontinuities. Moderately weathered to fresh Dmm ranges from weak rock to strong rock (ISRM [1981] Grades R2 to R4). Some sulfide enrichment was observed locally within Dmm.

The Dc greenstone is generally hard, dense, and locally has been sulfide enriched to exhibit pyrite mineralization. Generally, the greenstone observed within the quarry ranges from medium strong to very strong (ISRM [1981] Grade R3 to R5), with most of the rock being strong (R4).

The greenstone is generally moderately weathered grading to fresh with depth. The weathering zone is about 5 to 10 feet thick and consists of about 3 to 5 feet of colluvial soils and regolith (ISRM Grades V to VI) overlying highly fractured and weathered greenstone. Colluvial soils are present within fractures in about the upper ten feet of the greenstone profile. The fracturing, weathering, and colluvial infilling diminish with depth. Below the weathering zone, the greenstone is slightly weathered to fresh (Grade I to II). In areas where relatively closely spaced fractures are present, slight to moderate weathering (Grade II to III) can be present at depth.

Dc is massive to moderately fractured with persistent discontinuities that are moderately to very widely spaced, partially open to tight, undulating to planar, and generally rough. Few open apertures were observed but those present were filled with calcium carbonate, epidote, and quartz. Some discontinuity planes appeared to have a relatively thin coating of iron oxide, zinc oxide, calcium carbonate or other coatings. Few discontinuities were observed to be open and unfilled except where prior blasting and mining had occurred. Few discontinuities were observed to be seeping water except at Location A noted on Plate 3, where relatively persistent and moderate water seepage was observed discharging along a fault plane.

Relatively higher-grade metamorphism appears to have altered Dc into epidote and/or chloritic amphibolite. While still within green schist-phase metamorphism, these materials have generally lost the relic texture of basaltic or andesitic rocks from which they were derived. In general, Da materials are found close to the disconformable (not fault-emplaced) contact with Dmm and have an aphanitic, more crystalline texture, as compared to Dc. No exposures of Da were observed near the ground surface and Da exposed at depth was slightly weathered to fresh (ISRM [1981] Grades III to I) and medium strong to strong (ISRM [1981] Grades R3 to R4). Da was observed to be slightly to highly fractured with closed, tight, rough planes having no apparent coatings.

Dbc was not observed in highwall exposures at the site but was observed in outcrop and as surface float in the project expansion area. In the few Dbc outcrops observed, the rock materials were highly weathered (ISRM [1981] Grade IV), very weak (ISRM [1981] Grade R21), and moderately fractured.

Two cross sections through the quarry showing the final proposed quarry geometry were constructed and presented as Plates 5.1 and 5.2 – Geotechnical Sections A-A' and B-B', respectively. Locations of those cross sections are shown on Plate 2. Due to the lack of subsurface drill hole and core hole information, the projection of geologic conditions along these sections should be considered illustrative and subject to change as quarry development occurs.

3.4 FAULT CONSIDERATIONS

The State of California designates faults as Holocene-age or Pre-Holocene-age depending on the recency of movement that can be substantiated for a fault. Fault activity is rated as follows:

FAULT ACTIVITY RATINGS		
Fault Activity Rating	**Geologic Period of Last Rupture**	**Time Interval (Years)**
Holocene-Active	Holocene	Within last 11,000 Years[1]
Pre-Holocene	Quaternary & Older	>11,000 Years[1]
Age Undetermined	Unknown	Unknown

[1] – Holocene is defined as 11,700 years before present by the International Commission on Stratigraphy. The California State Mining and Geology Board, which administers the review and application of the Alquist-Priolo Earthquake Fault Zoning Act, currently recognizes the Holocene as 11,000 years before present.

The California Geologic Survey (CGS) evaluates the activity rating of a fault in fault evaluation reports (FERs). FERs compile available geologic and seismologic data and evaluate if a fault should be zoned as Holocene-active, pre-Holocene, or age undetermined. If an FER evaluates a fault as Holocene-active, then it is typically incorporated into a Special Studies Zone in accordance with the

Alquist-Priolo Earthquake Fault Zoning Act (AP). AP Special Studies Zones require site-specific evaluation of fault location for structures for human occupancy and require a habitable structure setback if the fault is found traversing a project site.

The quarry is not located within an Alquist-Priolo Earthquake Fault Zone established by the State. Because of this, the likelihood of faulting occurring across the quarry site is low.

A number of regional faults are present in the project area, as shown on Plate 6 – Fault Location Map. The closest mapped faults to the site are the pre-Holocene Hoadley and Spring Creek faults, both located within a few miles of the site. The closest mapped Holocene-active fault is the Hat Creek-McArthur fault zone, located about 39 miles east of the site.

A number of previously undocumented faults were observed within quarry highwall and excavation exposures. Those faults are shown on Plate 3 – Geologic Map and Plate 7 – Lineation Map. The faults observed at the project site juxtapose Devonian-age rock materials categorizing the faults as pre-Holocene in age. Those faults and lineations have a general east-west trend ranging from about 70 degrees east of north to 70 degrees west of north, following a similar general trend for pre-Holocene faults on the region. Mullions and slickensides along exposed fault surfaces indicate a strike-slip movement with near horizontal displacement.

3.5 PROBABILISTIC ESTIMATES OF STRING GROUND MOTION

Probabilistic evaluations of horizontal strong ground motion that could affect the site were performed using attenuation evaluation methods provided by the U.S. Geological Survey (USGS, 2019). The evaluations were performed using an estimated shear wave velocity in the upper 100 feet of the profile of 400 meters per second. Evaluations were performed for upper-bound (UBE) and design-basis (DBE) probabilistic exposures. The UBE corresponds to horizontal ground accelerations having a 10 percent probability of exceedance in a 100-year exposure period, with a statistical return period of 949 years. The DBE corresponds to horizontal ground accelerations having a 10 percent probability of exceedance in a 50-year, exposure period, with a statistical return period of 475 years. The results of these evaluations are presented in the following table:

PROBABILISTIC GROUND MOTION DATA				
Earthquake Level	**Probabilistic Estimate Exposure Period (years)**	**Probability of Exceedance (%)**	**Return Period (years)**	**Estimated Peak Horizontal Ground Acceleration (g)**
Upper-Bound Ground-Motion	100	10	949	0.20
Design-Basis Ground-Motion	50	10	475	0.14

It should be noted that although the seismic hazard models used for this study predict the probability of exceedance for various levels of acceleration in a given exposure period, the models are not able to account for the effect that the passage of time since past earthquakes has on future earthquake probability. Thus, while time may affect the incipient risk of earthquakes occurring, the UBE and DBE values are based on any 100-year and 50-year exposure period, respectively, regardless of how recently earthquakes have occurred.

3.6 GROUNDWATER CONDITIONS

Groundwater conditions at the quarry are unknown. During our site observations and mapping in April and May 2019, groundwater was observed discharging from local discontinuities and water was observed stored in local retention ponds. Based on review of historical aerial photographs, water appears to be present year-round in those retention ponds.

4 STRUCTURAL GEOLOGY & GEOTECHNICAL CONDITIONS

4.1 GENERAL

The following section discusses large- and small-scale structural geological features at the site and characterizes rock mass properties and strength used during analyses.

4.2 LARGE-SCALE STRUCTURAL FEATURES

A number of fault zones are exposed in the existing quarry and a number of lineations are visible on historical aerial photographs of the region, as discussed in Section 3.4 and shown on Plate 7. The faults and lineations are generally high angle and have general trends, as follows:

FAULT SET ORIENTATIONS		
Fault Set No.	**Strike**	**Dip**
1	N75 to 85W	80°N to Vertical
2	N60 to 70E	70 to 85°N
3	N60W	50°N

Offset magnitudes along the faults are generally indiscernible. Slickensides and mullions imply near horizontal to slightly inclined lateral movement along the fault planes. Gouge thicknesses were observed to range from about 12 inches to up to 15 feet wide. The gouge generally consisted of clay carbonate, clay, and fissile, highly sheared rock derived from the foot and/or hanging wall.

In addition to faulting, a bedding or flow band within the Copley Greenstone was observed at two locations within the quarry (Sites 1 and 3). That bedding or flow band is a dark colored unit within the lighter-colored greenstone with and orientation measured to strike about east-west and dip at about 20 degrees to the north.

4.3 SMALL-SCALE STRUCTURAL FEATURES

Measurements of discontinuity orientations were performed using two methods:

1. Manual measurement of planes at selected locations across the site; and
2. Use of software to estimate discontinuity orientations from photogrammetry (hand-held camera and photogrammetrically acquired data).

Manual measurements were taken with a Brunton compass and the orientations measured during this study are presented in Appendix A. Along with the discontinuity measurements, additional information was collected on selected discontinuity planes that would be applied to rating the overall quality of the rock mass exposed within the highwalls.

Discontinuity data estimates using software were performed by first obtaining overlapping, stereo-imagery of highwalls using a GPS-enabled camera (hand-held and via unmanned aerial systems). Those imagery were processed using photogrammetric software to develop a dense point cloud of the highwalls. The point cloud was then imported into software that computes planar features from the data based on user-defined input criteria.

The software evaluation produced millions of estimated discontinuity plane orientations. Discontinuity orientations were then plotted on an equal angle stereonet and populations were contoured to identify predominant discontinuity planes exposed within the highwall slope. Those projections are presented as Plate 8.1 through 8.5 – Site 1 through Site 5 Discontinuities, respectively. Locations of Sites 1 through 5 are shown on Plate 9 – Structural Domain Map. The primary discontinuity planes identified from this analysis have the following orientations:

PRIMARY DISCONTINUITY PLANES									
Site 1		Site 2		Site 3		Site 4		Site 5	
Dip Direction	Dip	Dip Direction	Dip	Dip Direction	Dip	Dip Direction	Dip	Dip Direction	Dip
57	66	25	53	159	73	23	77	53	48
93	57	59	70	170	78	238	45	87	44
135	54	79	83	200	76	355	29	88	83
212	61	191	83	223	82			98	83
271	86	207	68	254	63			231	87
298	59							254	88

The principal discontinuity sets are shown in a stereographic plot on Plate 10 – Stereonet Evaluations.

Data were collected on the roughness, aperture and infilling of discontinuities during surface mapping with the quarry. These data indicated that most discontinuity surfaces did not have significant infill and were of moderate roughness. Persistence was assumed to be relatively short to moderately long (up to about ten feet). The characteristics of the encountered discontinuities are utilized in combination with the intact properties of the rock to classify the rock mass as presented in Section 4.5.

Shear strength of the discontinuities was estimated from laboratory unconfined compression tests obtained through this study and reported by MTI (2007), and by backcalculating strengths along intact and existing failed wedges observed in the field. Results of the tests and evaluations are presented in Appendices B and C.

4.4 GEOTECHNICAL DOMAINS

Based on the information presented in Section 4.3, the structural geologies appear to be grossly dissimilar across the site. The orientations of predominant discontinuities measured at each site noted on Plate 9 varied significantly from one site to the next creating numerous geotechnical structural domains across the site. This is likely due to the faulting creating a relatively chaotic structural regime.

4.5 ROCK MASS QUALITY

The Rock Mass Rating (RMR) classification system (Bieniawski, 1989) was used to summarize the geomechanical characteristics of the rock masses encountered at the CCA site. It is based on five parameters describing the key rock mass characteristics, including: Unconfined Compressive Strength (UCS), Rock Quality Designation (RQD), joint spacing, joint conditions, and groundwater conditions. Ratings are assigned to each of the five parameters and the sum of these ratings defines the rock mass quality as an RMR value. RMR values range from near zero, equating to very poor rock, to 100, equating to very good rock.

RMR is used widely on geomechanical projects as is the Geological Strength Index (GSI; Marinos et al., 2005; Marinos et al., 2000). The GSI was developed as a tool for relating failure criteria to geological observations in the field (Wyllie & Mah, 2010). It provides a method for estimating the reduction in rock mass strength for different geological conditions. For this project, we set the GSI at 60 to be conservative.

The intact rock strengths were obtained from field estimates and laboratory UCS tests. The estimated UCS and deformability parameters for the site greenstone and Mule Mountain Stock are summarized in the following table:

GEOTECHNICAL ROCK MASS DESIGN PARAMETERS

Sample	Rock Type	Unconfined Compressive Strength (psi)	Rock Mass Rating (RMR)	Geologic Strength Index (GSI)
MTI 1-A	Unknown	12,380	Unknown	Unknown
MTI 1-B	Unknown	22,430	Unknown	Unknown
MTI 1-C	Unknown	12,110	Unknown	Unknown
Site 1-1	Greenstone	19,810	75	60
Site 1-2	Trondhjemite	NT[1]	71	60
Site 2-1	Greenstone	20,120	74	60
Site 2-2	Greenstone	18,550	72	60
Site 4-1	Greenstone	1,380[2]	69	60
Site 4-2	Amphibolite	15,300	71	60
Site 4-3	Trondhjemite	390[2]	65	60
Site 4-4	Trondhjemite	890[2]	66	60

[1] – Not Tested. Sufficient sample height to diameter ratio could not be obtained due to existing rock discontinuities.

[2] – Failure occurred along existing discontinuity plane and does not represent intact rock strength

As noted above, the average UCS values for the rock tested from the quarry is 19,350 pounds per square inch (psi), excluding those samples that failed along existing discontinuities. If all UCS results are utilized, than the average rock strength is 12,336 psi. Those intact rock strengths for the CCA quarry greenstone, amphibolite, and unweathered granitics are strong to very strong with an average strength of very strong (Grade R5), with typical UCS values ranging between about 12,000 and 22,000 pounds per square inch (psi). It indicates that the rock mass qualities in the CCA pit area are generally GOOD to VERY GOOD.

5 KINEMATIC STABILITY ANALYSES

5.1 GENERAL

Kinematic analyses were undertaken on the discontinuity orientation data within the geotechnical database. The purpose of this analysis was to identify the kinematically possible failure modes within each design sector using the stereographic technique. This section introduces the pit design sectors utilized throughout the stability analyses, the kinematically possible failure modes, and the results of the stereographic analyses.

5.2 PROPOSED PIT DESIGN

The proposed pit, as shown on Plate 2, has bench face orientations in all compass directions with the tallest of the proposed high walls having a dip direction ranging from 25 to 85 degrees. The overall pit slope inclination is 45 degrees. On a bench-scale, there are proposed vertical slopes up to 46 feet tall.

5.3 MODES OF FAILURE

Kinematically possible failure modes in rock slopes typically include planar, wedge, and toppling failures. These failure modes can be identified by using stereographic analysis of peak pole concentrations of the discontinuity data. These failure modes will occur if the discontinuities are continuous over the bench scale or more, if weak infilling is present along the measured discontinuities, or the geometry of the discontinuities is conducive to failure. A brief introduction on each mode of failure is provided below:

5.3.1 Planar Failure

This failure mode is kinematically possible when a discontinuity plane is inclined flatter than the slope face (it daylights) and at an angle steeper than the friction angle.

5.3.2 Wedge Failure

Wedge failures are kinematically possible when the plunge of the intersection of two planes (sliding vector) is inclined flatter than the slope face (it daylights) and at an angle greater than the combined friction angle, which is estimated from the characteristics of each plane that forms the wedge. Where kinematics are the controlling factor, the recommended pit slope angles have been adjusted to reduce the potential for large-scale, multiple bench wedge failures.

5.3.3 Toppling Failure

This failure mode is kinematically possible due to interlayer slip along discontinuity surfaces where sub-vertical jointing dips into the slope at a steep angle β. The condition for toppling to occur is when $\beta > (\varphi_j + (90-\Psi))$, where Ψ is the slope face angle and φ_j is the friction angle of the joint (Goodman, 1989).

5.4 STEREOGRAPHIC ANALYSES

Stereographic analyses have been carried out for each failure mode using the DIPS program (Rocscience, 2019). Because of the multitude of proposed pit angles noted in Section 4.2, we evaluated all slope angles to estimate the possibility of planar and wedge failures occurring.

Overall Slope Scale

Stereographic analyses of the pit wall for the proposed quarry expansion indicate that potential toppling, planar, and wedge failures should not impact the gross stability of the overall highwall. This is due to the quarry highwall having an overall inclination of 45 degrees, which is the same angle as the discontinuity angle of internal friction used in our analyses, making such failures kinematically not possible. Thus, from a gross stability due to rock-slope failures, the proposed overall slope inclination of 45 degrees for the quarry should be kinematically stable.

Bench-Level Scale

We understand that CCA is proposing vertical bench faces up to 46 feet tall as part of pit construction. Vertical bench faces can increase potential toppling, planar, and wedge failure exposure, resulting in backbreak of slopes and narrowing of benches. Backbreak is the loss of bench face due to localized bench failures, as shown on Plate 4. It is good mining practice to reduce the amount of backbreak so that a reduction in the potential amount of rock on catchment benches is minimized and to lower the potential that rock mobilized by a backbreak might mobilize downslope to the pit floor.

For vertical bench faces, stereographic analyses indicate that potential wedge and planar failures are present throughout the proposed highwall areas, as shown on Plate 10.

6 ROCK MASS STABILITY ANALYSES

6.1 GENERAL

Conventional limit-equilibrium analyses were conducted to backcalculate rock strengths along discontinuity surfaces, and to evaluate the stability of planar and wedge failures and the gross stability of the proposed highwalls. This section provides a detailed discussion of overall slope stability for the project.

6.2 ESTIMATE OF ROCK MASS STRENGTH

The rock mass strength parameters were derived using the Hoek-Brown failure criterion (Marinos et al., 2005; Marinos et al., 2000). The overall strength of a rock mass is difficult to estimate because of scale issues. Methods of estimating rock mass strength based on the strength of intact rock materials and the lithology, rock mass quality and other factors are used to downgrade the measured intact rock strength to rock mass scale values. Once these strength properties have been estimated, they can be adjusted to account for the expected level of disturbance. Rock mass disturbance is typically caused by blast damage and vertical unloading, as well as strains resulting from stress changes in the pit walls.

Following Hoek, et. al. (1995), the petrographic constant for intact rock (m_i) has been set for greenstone (basalt) encountered within the pit using a value of 25. Intact rock strength and rock mass quality at the site have been discussed in Section 4.5.

The Geological Strength Index (GSI) is based on the RMR rating system and was introduced by Hoek et al. (1995) to overcome issues with the RMR values for very poor-quality rock masses. For better quality rock masses (GSI>25), the value of GSI can be estimated from Bieniawski's RMR (1989) as GSI=RMR-5. This assumes a groundwater rating set to 15 (dry) and the adjustment for joint orientation set to 0 (very favorable). For this study, the GSI was conservatively established to be 60, which is more conservative than the typical estimation using RMR values.

Hoek et al, (2002) recommends that the utilized rock mass strengths be downgraded to disturbed values to account for rock mass disturbance associated with heavy production blasting and vertical stress relief. He indicates that a disturbance factor of 0.7 would be appropriate for a mechanical excavation where no blasting damage is expected. A value of 1.0 is assumed for conventional production blasting. A good controlled production blasting strategy is expected to be between these extremes and consistent with a disturbance factor of 0.85. For this study a disturbance factor of 1.0 was used.

The following table presents a summary of the rock mass strength parameters for the rock encountered within the pit walls.

SUMMARY OF ROCK MASS STRENGTH PARAMETERS			
Basic Parameter	**Symbol**	**Unit**	**Values**
Unit Weight	Γ	pcf	150
Intact Unconfined Compressive Strength (UCS)	σ_{ci}	psi	12,110
Basic Rock Mass Rating (1989)	RMR	-	65
Geologic Strength Index	GSI	-	60
Petrographic Constant for Intact Rock	m_i	-	25
Disturbed Rock Mass (Disturbance Factor D=1.0)			
Hoek-Brown Constant for Rock Mass	m_b	-	1.436
Hoek-Brown Constant	S	-	0.0013
Friction angle of Rock Mass	Ø'	degrees	43
Cohesion of Rock Mass	C'	psf	28,061
Compressive Strength of Rock Mass	S_{cm}	ksf	61.013
Deformation Modulus	E_m	ksf	169,644

6.3 LIMIT-EQUILIBRIUM ANALYSES

Limit-equilibrium stability analyses were performed using GEO5 – Rock Stability (Fine Civil Engineering Software, 2019) and SLIDE 2018 (Rocscience, 2019) computer programs for the pit design. GEO5 was used to evaluate limit-equilibrium conditions for potential wedge failures identified during kinematic evaluations and to backcalculate rock strengths along discontinuities for wedges observed in the field. SLIDE 2018 was used to estimate the gross stability of the overall pit slope and to perform limit-equilibrium evaluations of potential planar rock failures. Results of the limit-equilibrium analyses are presented in Appendix C. The limit-equilibrium analyses were completed to evaluate the overall stability of the jointed rock mass and to demonstrate the sensitivity of the calculated Factors of Safety (FOS) to different overall slope angles, blasting disturbance, and groundwater levels.

The evaluation of stability of rock slopes generally takes into consideration a number of rock strength parameters, geologic conditions within the slope, orientations of discontinuities (fractures, joints, flow bands, faults, etc.), hydrogeologic conditions, and surcharge and seismic loads that could affect the slope. Those parameters are typically modeled using limit-equilibrium methods (and less commonly using finite element or finite difference modeling) to estimate if the modeled scenario meets or exceeds a target minimum FOS against failure. The FOS is estimated by calculating the forces resisting slope failure divided by the forces causing slope failure. Thus, a FOS of greater than 1 implies a stable slope, a FOS of less than 1 a slope that is failing, and a FOS of 1, a slope that is on the verge of failure.

Slopes having a minimum FOS of 1.5 for static evaluations are typically considered stable for permanent engineered conditions. For open pit slopes, the FOS for static conditions is often reduced to 1.3 because the risk to structures, people, and improvements is relatively low. Pseudostatic (pseudo-earthquake forces) FOS values above 1.1 are considered stable for most engineered projects. In the case of mines, the pseudostatic stability values can be reduced and are considered acceptable provided they remain above 1.01.

6.3.1 Evaluation of Potential Wedge Failures

As noted in Section 5.4 and shown on Plate 10, it is kinematically infeasible for rock wedges to occur on an overall slope scale but possible for wedges to occur on a bench-scale. Thus, instead of posing a gross stability problem for the proposed quarry, wedges pose a potential localized maintenance and possible safety issue along benches constructed during mining. Because of the numerous and chaotic structural domains on site, it is unreasonable to perform limit-equilibrium calculations for potential wedges formed by all predominant discontinuity planes for all slope face orientations of the proposed quarry. Therefore, to evaluate the likelihood of wedge failures occurring at the site, we modeled various wedge trends and plunges. Limit-equilibrium analyses were performed using rock mass strength criterion described in Section 6.2. That criterion estimated a minimum angle of internal friction (Ø) of 51 degrees but we reduced that value to 45 degrees for discontinuity surfaces. Because cohesion along discontinuity plane sets is difficult to estimate, we backcalculated that value for wedges observed in the field and used a cohesion intercept with a marginal value of 500 psf.

In addition, the majority of discontinuities observed at the site were closed or healed. These conditions imply a low transmissive environment for groundwater and a low likelihood of high water pressures within fractures unless poor blasting practices are performed. Thus, our analyses were initially performed under dry conditions and then for critical wedge orientations, the stability was modeled where 25-, 50-, 75-, and 100-percent of the discontinuities were filled with water. Results of those analyses are presented on Plate 11 – Rock Wedge Stability Results.

As noted on Plate 11, under dry conditions, wedges should generally be stable, provided appropriate blasting methods have been utilized. Under wet conditions, the FOS for wedges decreases proportional to the amount of water filling the discontinuities forming the wedge. Thus, if good drainage control can be maintained, fewer wedge failures should occur. Regardless, wedge failures should be expected on a bench-scale during construction of the quarry, but those failures should only impact maintenance within the quarry provided good safety practices are utilized.

6.3.2 Evaluation of Planar Failures

Using the strength criterion discussed in Section 6.2, we performed limit-equilibrium evaluations for potential planar failures that were identified in the kinematic evaluations performed for this site. Results of those analyses are presented in Appendix C. Using those strength values, it was estimated that planar failures exposed within the proposed pit should have static and pseudostatic FOS values exceeding 1.3 for those planes inclined at 55 degrees or flatter. Thus, some planar failures are anticipated on a bench-scale, that will lead to annual maintenance requirements. It should be noted that few very persistent planes were observed in the areas mapped indicating that planar failures will likely be local and not extensive.

6.3.3 Evaluation of Toppling

There were no predominant discontinuity planes identified during this study that have the potential for block or flexural toppling failures. One predominant discontinuity plane was inclined at 45 degrees, which is marginal for direct toppling, but it did not meet the kinematic test for potential failure, as described in Section 5.3.3 of this report.

6.3.4 Evaluation of Gross Pit Slope Stability

Slope stability evaluations to estimate the gross stability of the overall pit slope were performed using the rock strength criteria noted above in Section 5.3. Analyses were performed on the proposed pit slope configuration shown on Plate 2. Results of those analyses are presented in Appendix C.

Stability analyses were performed using Spencer's methods for both entirely dry slopes and for a piezometric surface located at reasonable estimated depth along with a worst-case scenario with water at the ground surface. In all cases, the static and pseudostatic FOS against slope failure was greater than 1.3 and 1.01, respectively. Thus, the proposed pit configuration with an overall slope of 45 degrees should be grossly stable under the conditions evaluated.

7 OVERBURDEN STABILITY ANALYSES & EROSION

7.1 GENERAL

Colluvial soils, regolithic and saprolitic rock materials, and highly to intensely weathered rock mantle more competent rock materials across the site. These soils are typically referred to as overburden and will not remain stable if excavated at inclinations similar to the underlying competent rock materials. An illustration of this is located at the southern part of the existing quarry where a small landslide has occurred within overburden on an oversteepened slope (see Plate 3). This section evaluates the stability of overburden and recommends maximum inclinations for cut slope faces of those materials.

7.2 STRENGTH VALUES

Evaluations of overburden strengths were performed and presented in MTI (2007). Those strengths are as follows:

OVERBURDEN STRENGTH VALUES			
Soil Layer	Shear Wave Velocity (feet/second)[1]	Cohesion (psf)[2]	Angle of Internal Friction (degrees)[2]
1	1,000	100	20
2	2,000	100	24
3	3,000	250	28
[1] – per Cooksley (1998); [2] – per MTI (2007)			

Those strength values appeared relatively conservative and were utilized in limit-equilibrium stability analyses performed during this study.

7.3 LIMIT-EQUILIRIUM EVALUATIONS

Slope stability evaluations for overburden soils were performed using SLIDE 2018 (Rocscience, 2019). For overburden soils, a FOS for static conditions of 1.3 was used because the risk to structures, people, and improvements is relatively low. A pseudostatic FOS value of above 1.0 was used as a threshold for these soils.

Based on our evaluations, we recommend that permanent cut slopes exposing overburden soils be excavated no steeper than 1.5:1 (horizontal to vertical). That inclination provides a static FOS of greater than 1.3 and should be grossly stable. Localized slumps and failures can be expected; however, the bench immediately below the cut slope should have adequate area as catchment for those localized instabilities.

8 PIT WATER MANAGEMENT

Limited groundwater data is available for the site. Existing ponds are maintained at about elevation 734 feet, which is about 134 feet above the planned pit bottom, but this is largely controlled by the outlet elevation of the ponds. It is anticipated that progressive development of the pit will result in lowering the pond elevations, which could result in a lowering of the groundwater table in the vicinity of the excavation.

The groundwater table with respect to the pit floor influences the mine development in that groundwater inflows need to be pumped out of the pit. Groundwater depressurization measures are not likely to be needed; however, as the pit floor is lowered and additional geotechnical conditions exposed, depressurization may need to be implemented to enhance pit slope stability. When necessary, surface water should be diverted to reduce the amount of water handled by CCA within the pit.

As discussed earlier, slope depressurization systems are likely not to be needed. If they are, then depressurization systems could include a combination of techniques including diversion ditches, vertical pumping wells, and horizontal drains. These measures should be implemented based on regular site reconnaissance, a staged approach during pit development, and could involve the installation of depressurization systems and associated monitoring of groundwater pressures. This will enable an assessment of the pit slope drainage capability and the requirements for additional installations.

Pit inflows will occur along discontinuities extending through the granitics and greenstone. It is anticipated that most of the discontinuities are closed or open and filled/healed. Thus, inflows from good quality, low permeability rock are expected to be low. If and when needed, pit dewatering systems should be design by the project civil engineer.

9 PIT SLOPE DESIGN

9.1 GENERAL

This feasibility pit slope design has considered relevant site-specific geotechnical data, limited hydrogeological information, and the results of various stability analyses. Recommended pit slope geometries are summarized in this section, and some operational considerations related to the recommended slopes are considered.

9.2 RECOMMENDED PIT SLOPE DESIGN

9.2.1 Bench Geometries

Benches are proposed to up to be 40 feet wide and up to 40 to 46 feet tall, with vertical faces. This geometry is stable for the overall slope angle of the quarry but could expose the potential for bench-level wedge and planar failures leading to potential backbreak of the bench face, which is not unusual for this type of quarry construction. CCA can implement a number of operational and maintenance procedures that can reduce the potential of backbreak and safety issues associated with local bench-level slope failures. Those procedures include:

- Presplitting all final rock faces;
- Scaling of blasted rock faces to remove loose rocks;
- Maintenance of a 25-foot wide offset barrier from all inactive rock faces; and
- Complete daily inspection of rock faces.

We recommend that if the proposed bench faces are constructed at vertical angles, the procedures noted above be implemented and maintained by CCA and future mine owners should the mine change ownership. Furthermore, when bench-level wedge or planar failures occur, we recommend that debris from those failures be removed from the bench as routine maintenance. By implementing those procedures, impacts from backbreak should be reduced to an acceptable level.

9.2.2 Mining Buffer Area

To reduce the potential of highwall migration into adjacent parcels, we recommend that the top of the proposed highwalls be situated no closer than 40 horizontal feet from non-project related parcel boundaries.

9.2.3 Erosion Considerations

Erosion is unlikely within portions of the quarry that expose moderately weathered to fresh rock materials. Erosion could occur within overburden soils and cause some rilling of slopes exposing overburden soils near the top of highwall. The amount of erosion should be relatively limited and should be contained on benches below those slopes and within existing and proposed ponds.

To limit erosion, control of waters entering the quarry should be maintained so that they are either diverted away from quarried areas or are channeled into ponds located on site. Some erosion might occur where flow concentrations are present within overburden soils but that erosion should be contained on benches located below those soils.

If significant erosion is observed within the quarry that could extend off property, then erosion control measures should be implemented using best management practices to reduce the erosion.

9.3 OPERATIONAL CONSIDERATIONS

9.3.1 Controlled Blasting

Blasting disturbance is one of the controlling factors for rock mass strength and overall slope stability. Slope instabilities are often triggered by the progressive deterioration (raveling) of the wall face and this process is often initiated with the detachment of small rock blocks (key blocks) bounded by the rock mass discontinuities, The preservation of rock mass integrity during mining is critical to reduce the potential of these progressive failures and is required to achieve the steepest bench face angles possible.

Controlled blasting methods will facilitate steeper final pit slopes by reducing face damage from blasting. Typical controlled blasting strategies utilize small diameter blast hole detonated as a pre-shear line in harder, massive rock (pre-splitting) or as a post-shear (cushion) line in weak or heavily fractured rock. In all cases, it is important that blasthole lengths be staggered so the bottom of the hole does not intercept the crest on the bench below. Otherwise, highly fragmented bench crests will develop leading to increased and possibly unacceptable backbreak.

Interim pit slopes should incorporate some "controlled blasting" to maintain safety, but the requirements in this situation are less rigorous due to shorter operating life of these walls. The initial pit can be developed with variable slopes and blast patterns to develop optimal blasting design for final pit walls. Trial blasts are also recommended wherever there is a substantial change in rock mass characteristics, in order to evaluate and optimize blast performance.

9.3.2 Bench Scaling

It is important that benches be kept clear and that the bench faces be maintained regularly so that they remain functional during mining operations. Scaling is an important part of the bench maintenance program and should be conducted after blasting in areas where access is still available. Routine scaling may allow the bench widths to be minimized, due to a reduction in the volume of material to be controlled.

10 NATURALLY OCCURRING ASBESTOS (NOA)

10.1 INFORMATION REGARDING NATURALLY OCCURRING ASBESTOS

Ultramafic rock, such as serpentinite, amphibolite, peridotite, dunite, pyroxenite, hornblendite, etc., can contain asbestiform minerals, which are fibrous, silica-rich crystals that can cause lung cancer, mesothelioma, asbestosis, and other health-related issues, if present. Typically, six minerals within ultramafic rocks are responsible for the primary, naturally occurring asbestiform concerns for health-related issues: chrysotile, tremolite, actinolite, anthophyllite, crocidolite, and amosite. These minerals may or may not be present in ultramafic rocks; thus, the presence of ultramafic rock does not automatically indicate that there is a health hazard. The presence of asbestiform minerals can sometimes be discerned in the field based on visual examination of rock exposures but, most often, must be confirmed using laboratory testing.

Naturally occurring asbestos can be hazardous to human health if it is disturbed, becomes airborne and is inhaled. If NOA is not disturbed and fibers are not released into the air, then it is typically not considered a health hazard. Inhalation is the primary exposure route of concern, because breathing asbestos fibers may cause them to become trapped in the lungs. Ingestion is another, albeit less common, pathway of concern, because swallowing asbestos fibers may also cause the fibers to be trapped in body tissues. Asbestos is not absorbed through the skin, so merely touching it does not pose a significant risk to human health. Asbestos fibers are not water soluble and do not move through groundwater to any appreciable extent. Based on studies of other insoluble particles of similar size, the expected migration rate of an asbestos fiber through soils by the forces of groundwater is approximately 1 to 10 centimeters (0.4 to 4 inches) per 3,000 to 40,000 years (New Hampshire DES, 2010). Thus, asbestos is not considered a groundwater contaminant.

As discussed in Section 3.0, the highwall exposes amphibolite, which is a metamorphosed volcanic rock containing chlorite, amphibole, and other minerals of concern. These are considered ultramafic rock materials and, thus, may pose a risk associated with NOA.

In California, NOA is considered a concern if it exceeds a concentration of more than 0.25-percent (CGS, 2002). If NOA concentrations exceed that threshold, then mitigation measures are typically required to reduce the potential of inducing NOA to become aerosol.

10.2 SAMPLING AND TESTING

Soil and rock materials within specific areas were sampled using random multi-increment sampling. The two sample locations are shown on Plate 3. Sample materials were collected in 6-inch long and 4-inch diameter plastic sample containers, labeled appropriately, then sealed to prevent loss or introduction of contaminates. All samples were transported by BAJADA personnel to our Redding facility.

Two samples were transmitted from our Redding office to Asbestos TEM Laboratories, Inc., to perform testing for the potential presence of NOA. The Chain of Custody form used to transmit samples is included in Appendix B – Laboratory Testing. Testing was performed on each sample using a polarized light microscope with a point count of 400 in conformance with standard test method CARB 435. Results of the laboratory testing found that NOA was not present in the samples that were analyzed. Results of the testing are included in Appendix B.

11 CLOSURE

This report has been prepared in substantial accordance with the generally accepted geotechnical engineering and engineering geological practice, as it existed in the site area at the time our services were rendered. No other warranty, either express or implied, is made.

Conclusions contained in this report were based on the conditions encountered during our field observations and mapping, and are applicable only to those project features described herein (see Section 1.1). Subsurface exploration was not performed for completion of this study. Soil and rock deposits can vary in type, strength, and other geotechnical properties between points of observation and exploration. Additionally, groundwater and soil moisture conditions can also vary seasonally and for other reasons. Therefore, we do not and cannot have a complete knowledge of the subsurface conditions underlying the project site. The conclusions and recommendations presented in this report are based upon the findings at the points of observation, and interpolation and extrapolation of information between and beyond the points of observation, and are subject to confirmation based on the conditions revealed by construction. If conditions encountered during construction differ from those described in this report, or if the scope or nature of the proposed construction changes, we should be notified immediately to review and, if deemed necessary, conduct additional studies.

The scope of services provided by Bajada for this project did not include the investigation and/or evaluation of toxic substances, or soil or groundwater contamination of any type. If such conditions are encountered during site development, additional studies may be required. Further, services provided by Bajada for this project did not include the evaluation of the presence of critical environmental habitats or culturally sensitive areas.

This report may be used only by our client and their agents and only for the purposes stated herein, within a reasonable time from its issuance. Land use, site conditions, and other factors may change over time that may require additional studies. In the event significant time elapses between the issuance date of this report and full construction of the quarry, Bajada shall be notified of such occurrence to review current conditions. Depending on that review, Bajada may require that additional studies be conducted and that an updated or revised report is issued.

Any party other than our client who wishes to use all or any portion of this report shall notify Bajada of such intended use. Based on the intended use as well as other site-related factors, Bajada may require that additional studies be conducted and that an updated or revised report be issued. Failure to comply with any of the requirements outlined above by the client or any other party shall release Bajada from any liability arising from the unauthorized use of this report.

We appreciate the opportunity to assist Crystal Creek Aggregates with this project. If you have any questions, please do not hesitate to contact our office.

12 REFERENCES

Bateman, P.C., and Wahrhaftig, C., (1966), Geology of the Sierra Nevada, in Bailey, E.H., Editor, Geology of Northern California, California Division of Mines and Geology Bulletin 190, p. 107-183.

Bieniawski, Z.T. (1989), Engineering Rock Mass Classifications, Wiley, New York.

Blake, T.F., Hollingsworth, R.A., Stewart, J.P., D'Antonio, R., Earnst, J., Gharib, F., Horsman, L., Hsu, D., Kuperferman, S., Masuda, R., Pradel, D., Real, C., Redder, W., and Sathialingam, N (2002), Recommended Procedures for Implementation of DMG Special Publication 117 Guidelines for Analyzing and Mitigating Landslide Hazards in California, ASCE Los Angeles Section Geotechnical Group, June, 132 p.

California Geological Survey (2002), Guidelines for Geologic Investigations of Naturally Occurring Asbestos in California, Special Publication 124, 70 p.

Cooksley Geophysics, Inc. (1998), Refraction Seismic Investigation, Rock Classification at the Proposed Expansion of the Crystal Creek Rock Quarry, Redding, California, dated June, 3 p. with attachments.

_____ (2008), Geologic Report to Accompany Global Slope Stability Analyses for the Crystal Creek Aggregate Expansion, dated August 19, 7 p. with attachments.

Duane K. Miller Civil Engineer, Inc. (2020), Reclamation Plan Amendment 19-0001, Plan Sheets 1 of 6 through 6 of 6, dated April 6.

Fine Civil Engineering Software (2019), GEO5 – Rock Stability, version 2019.54.

Goodman, R.E., 1989, Introduction to Rock Mechanics, 2nd Edition, John Wiley.

Hart, E.W. and Bryant, W.A. (1997), Fault-Rupture Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to earthquake Fault Zone Maps, California Division of Mines and Geology Special Publication 42, with supplements 1 and 2 added in 1999, 38 p.

Hinds, N.E. (1952), Evolution of the California Landscape, California Division of Mines and Geology Bulletin 158, pp 145-152.

Hoek, E. (1995), Rock Engineering, Course Notes, Rotterdam, The Netherlands, 313 p.

Hoek, E., Carranza-Torres, C., and Corkum, B. (2002), Hoek-Brown Failure Criterion – 2—2 Edition, *Proc. NARMS-TAC Conference*, Toronto, 2002, 1, 267-273.

International Society of Rock Mechanics (1981), Rock Characterization, Testing, and Monitoring; ISRM Suggested Method, Pergamon Press, Oxford, UK.

Irwin, W.P., and Mankinen, E.A. (1998), Rotation and Accretionary Evolution of the Klamath Mountains, California and Oregon, From Devonian to Present Time, U.S. Geological Survey Open-File Report 98-114.

Irwin, W.P., and Wooden, J.P. (1999), Plutons and Accretionary Episodes of the Klamath Mountains, California and Oregon, U.S. Geological Survey Open-File Report 99-374.

Jennings, C.W. (1994), Fault Activity Map of California and Adjacent Area, with Locations and Ages of Recent Volcanic Eruptions, California Division of Mines and Geology, Geologic Data Map No. 6, Scale 1:750,000.

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

Marinos, V., Marinos, P., and Hoek, E. (2005), The Geological Strength Index: Applications and Limitations, Bulletin of Engineering Geology and Environment, vol. 64, p. 55-65.

Materials Testing, Inc. (2007), CCA Quarry Expansion, Shasta County, California, Global Slope Stability Analysis, dated October 22, 2 p. with attachments.

New Hampshire Department of Environmental Services (2010), Frequently Asked Questions webpage accessed at http://des.nh.gov/organization/divisions/waste/orcb/prs/adsp/categories/faq.htm on October 7, 2010.

Read, J., and Stacey, P. (2009), Guidelines for Open Pit Slope Design, CRC Press, Taylor & Francis Group, Leiden, The Netherlands, 496 p.

Rocscience (2007), ROCKLAB! 1.031**,** Rock Strength Analysis Using Generalized Hoek-Brown Failure Criterion, User's Guide, 24 p.

Rocscience (2019), DIPS, Version 7.015, Plotting, Analysis, and Presentation of Structural Data using Spherical Projection Techniques, March 19.

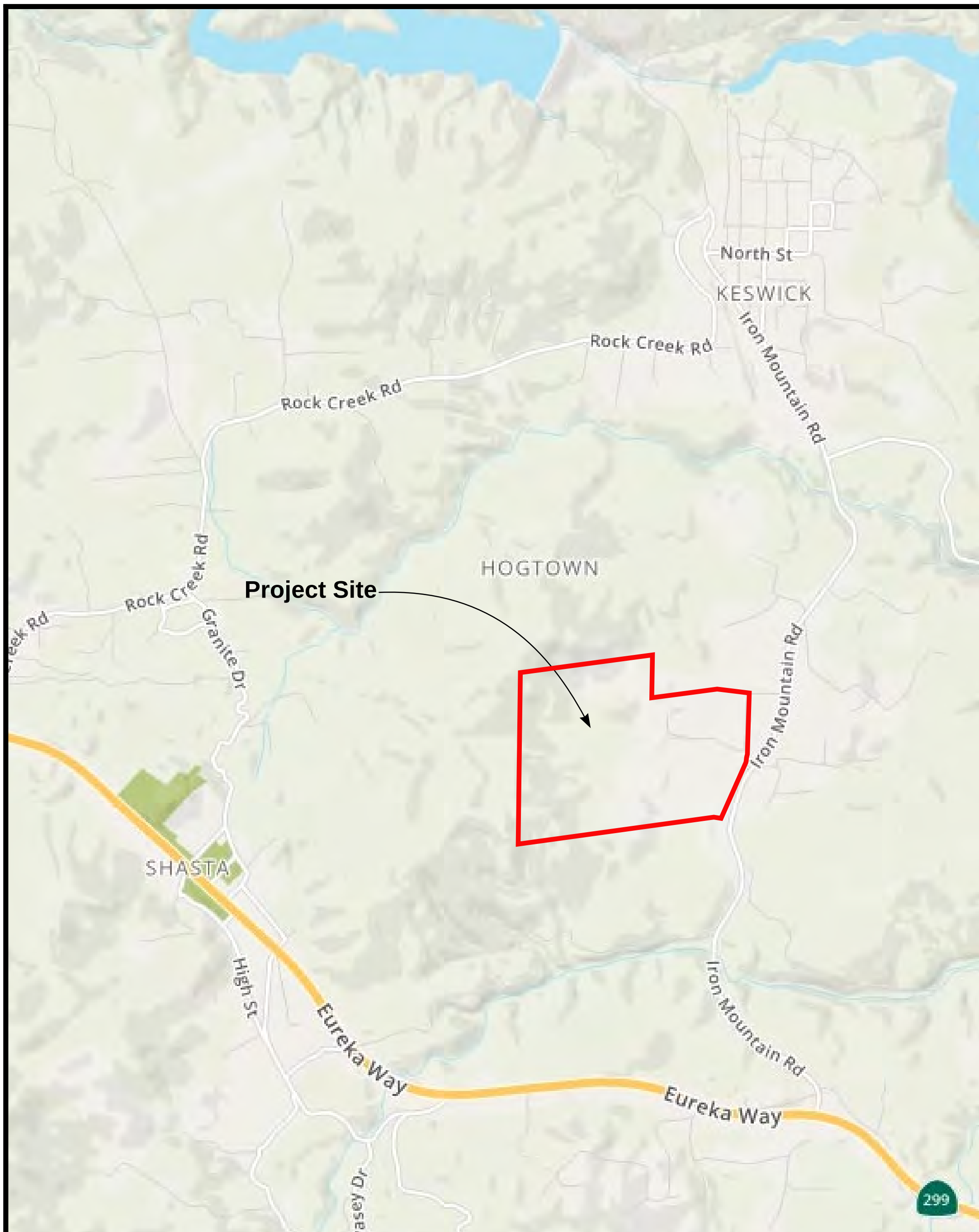
Rocscience (2019), SLIDE 2019, 2D Limit Equilibrium Slope Stability Analysis, Build 8.024, April 17.

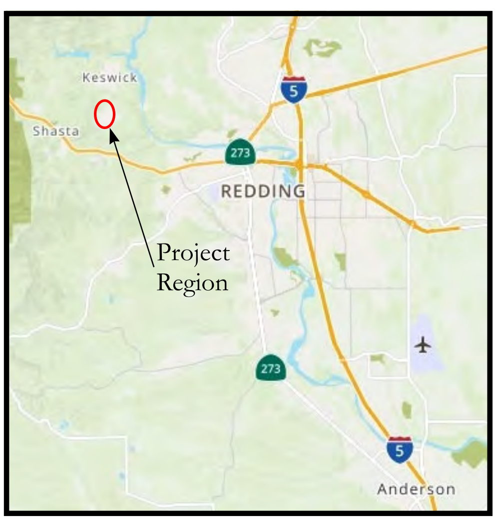
Silberman, M.L., and Danielson, J. (1991), Geologic Setting, Characteristics, and Geochemistry of Gold-Bearing Quartz Veins in the Klamath Mountains in the Redding 1x2 Degree Quadrangle, Northern California, U.S. Geological Survey Open-File Report 91-595, 29 p.

Snokes, A.W., and Barnes, C.G. (2006), The Development of Tectonic Concepts for the Klamath Mountains Province, California and Oregon, Geologic Society of America Special Paper 410, 29 p.

United States Geological Survey (2019), Unified Hazard Tool, accessed on line at: https://earthquake.usgs.gov/hazards/interactive/ .

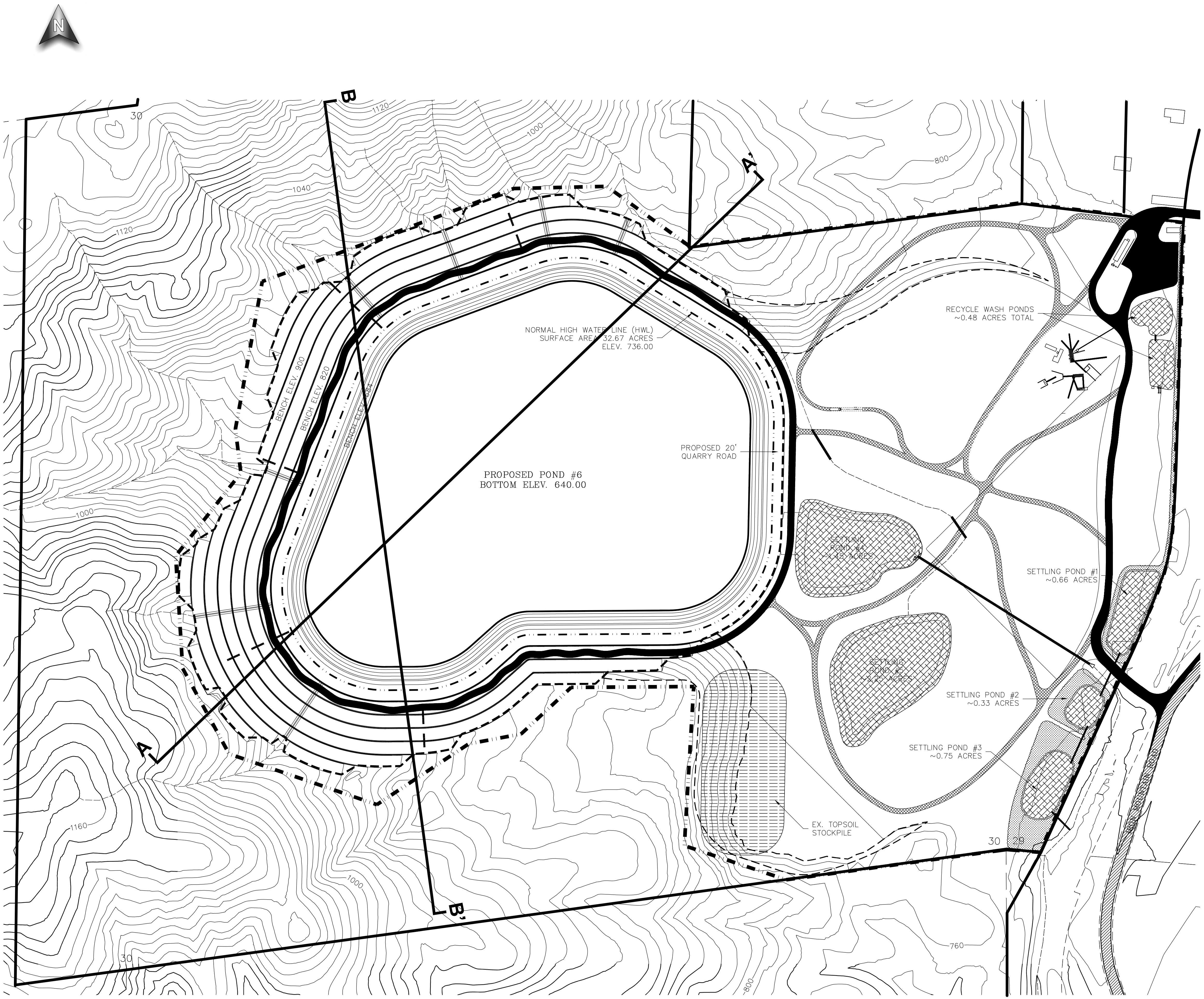
Wyllie, D.C., and Mah, C.W. (2010), Rock Slope Engineering, Civil and Mining, 4th Edition, Taylor & Francis, New York, 431 p.





Base maps from Mapquest. Scale undetermined.

SITE LOCATION MAP	
Crystal Creek Aggregates Quarry Amendment to Reclamation Plan Proposed Quarry Expansion Shasta County, California	Plate No. 1
BAJADA Geosciences, Inc.	Project no. 1901.0114



B B' Cross Sections
see Plates 5.1 & 5.2

0 150 300

Scale: 1"=300'
1:3,600

Map from Duane Miller Engineering (2020)

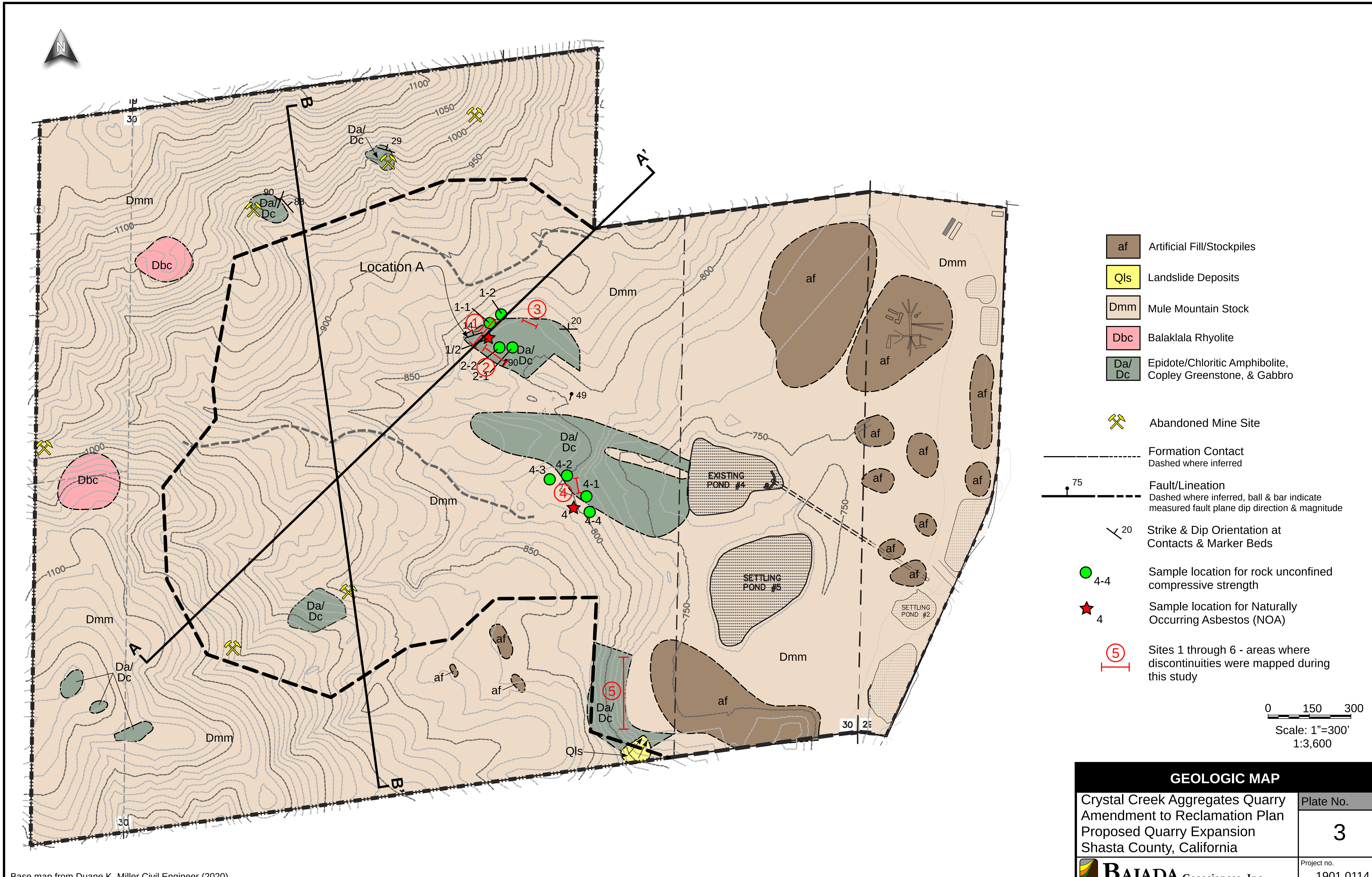
PROPOSED MINE CONFIGURATION

Crystal Creek Aggregates Quarry
Amendment to Reclamation Plan
Proposed Quarry Expansion
Shasta County, California

Plate No.
2

BAJADA Geosciences, Inc.

Project no.
1901.0114



Base map from Duane K. Miller Civil Engineer (2020)

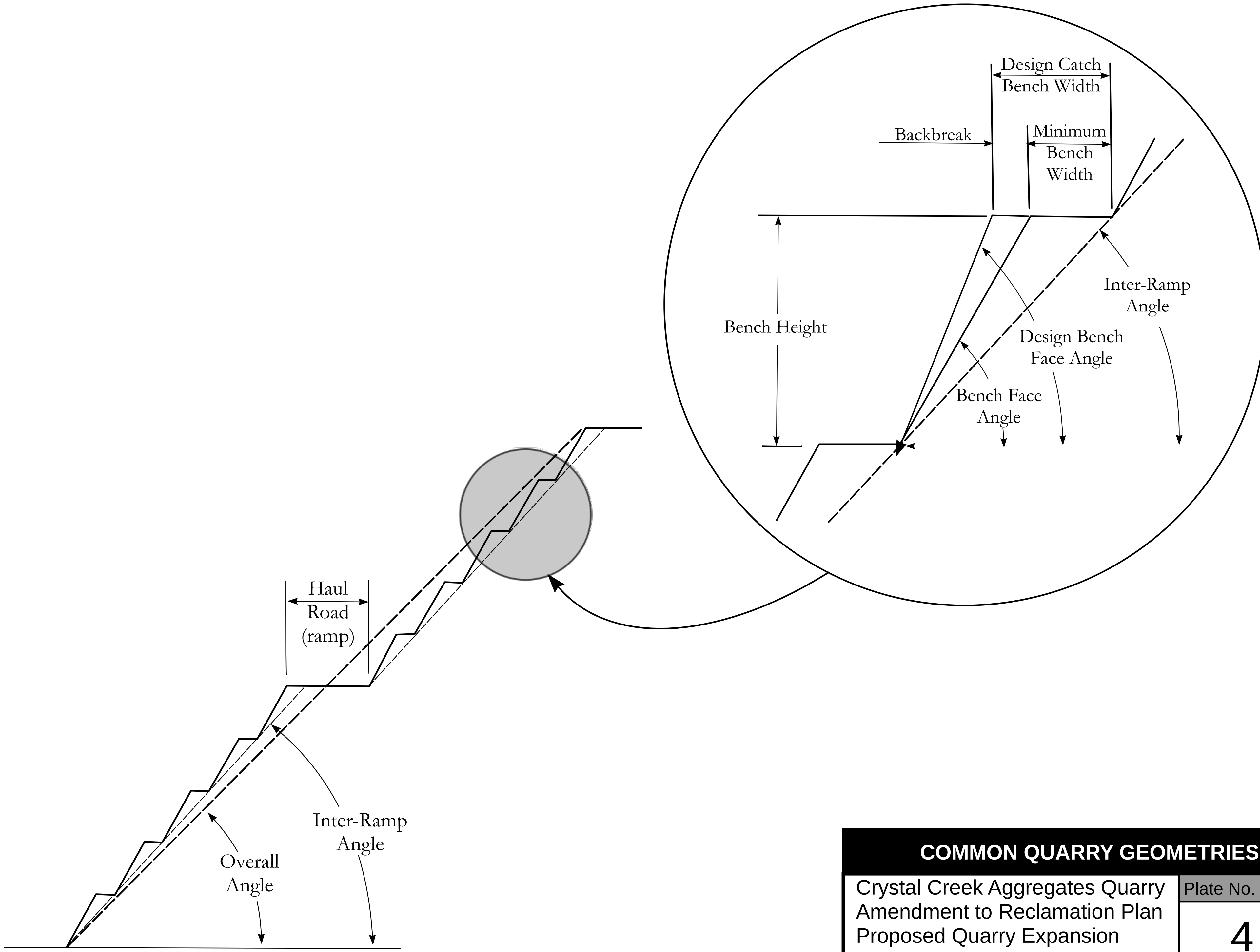
GEOLOGIC MAP

Crystal Creek Aggregates Quarry
Amendment to Reclamation Plan
Proposed Quarry Expansion
Shasta County, California

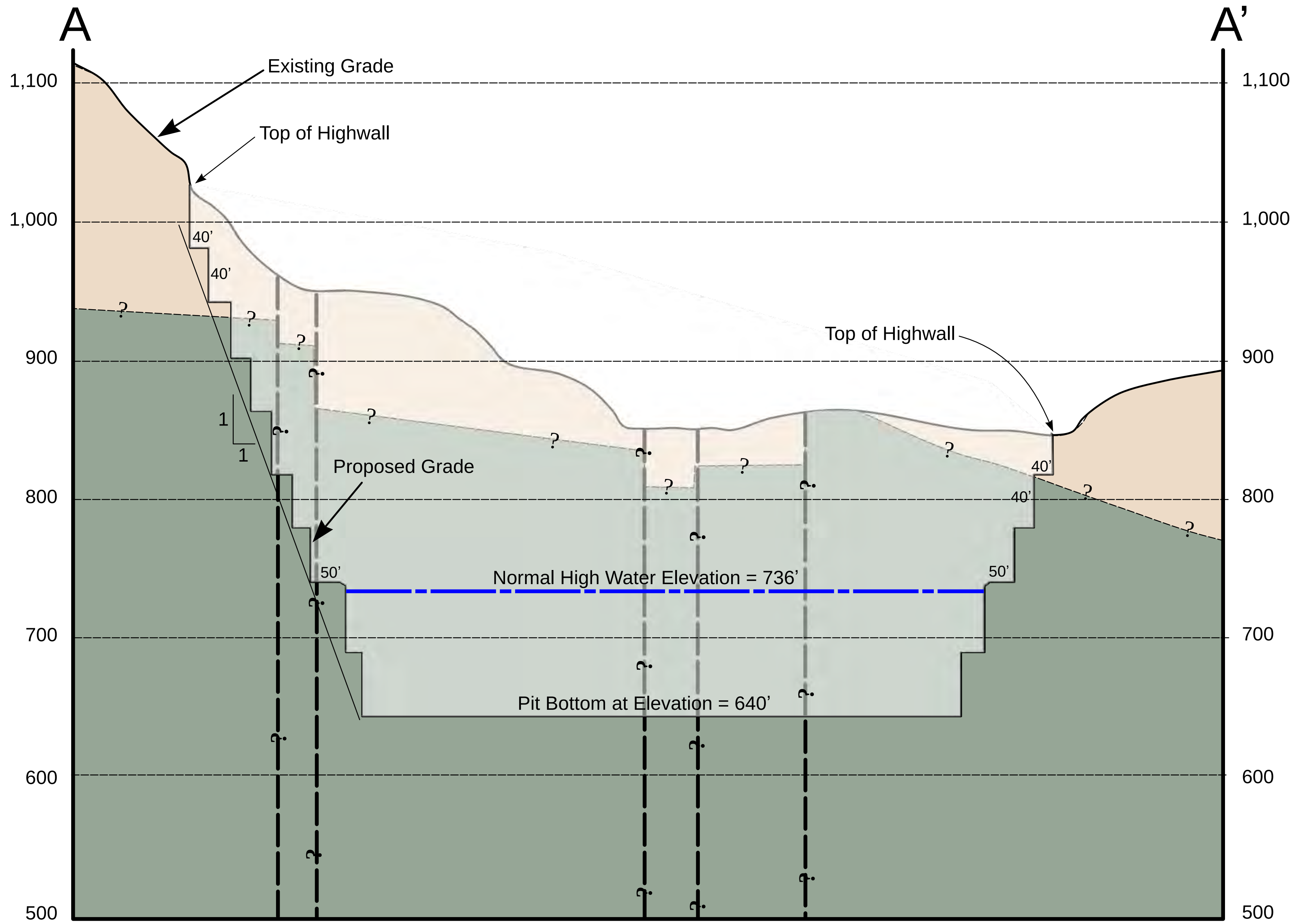
Plate No. 3

BAJADA Geosciences, Inc.

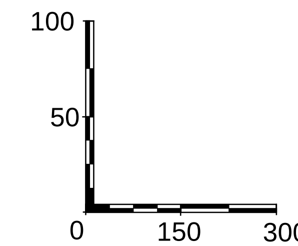
Project no. 1901.0114



COMMON QUARRY GEOMETRIES	
Crystal Creek Aggregates Quarry Amendment to Reclamation Plan Proposed Quarry Expansion Shasta County, California	Plate No. 4
BAJADA Geosciences, Inc.	Project no. 1901.0114

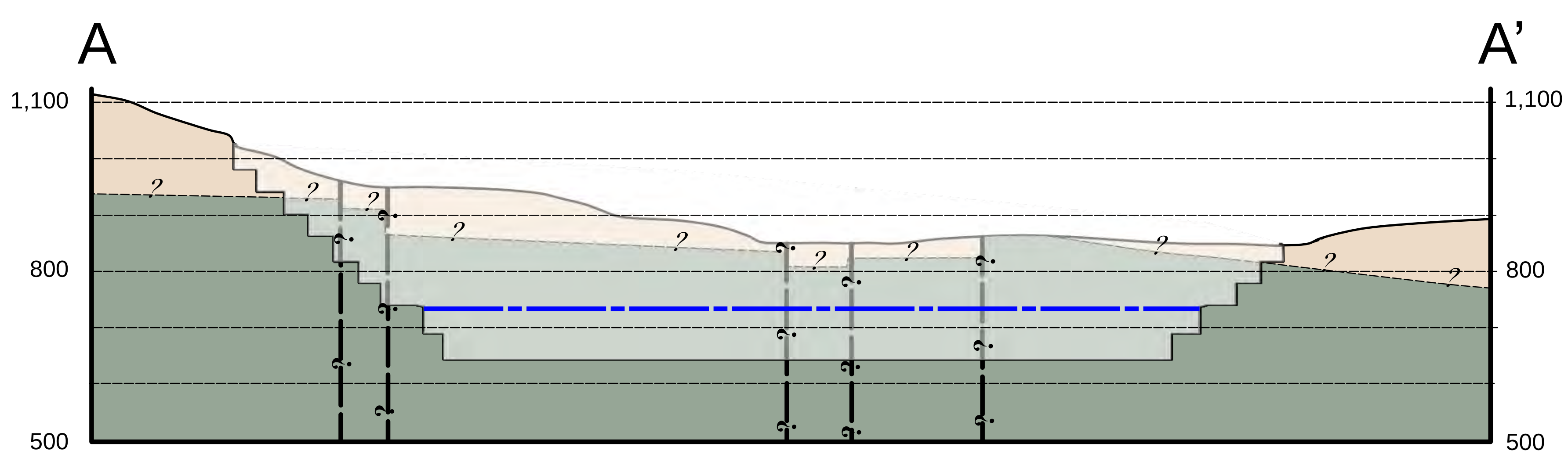


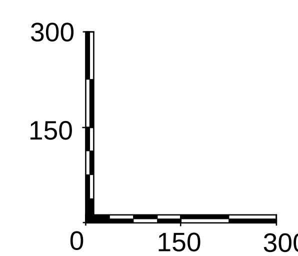
- af — Artificial Fill/Stockpiles
- Qls — Landslide Deposits
- Dmm — Mule Mountain Stock
- Dbc — Balaklala Rhyolite
- Da/Dc — Epidote/Chloritic Amphibolite, Copley Greenstone & Gabbro



Scale:
Horizontal:1"=300'
Vertical: 1"=100'
Vertical Exaggeration 3x

No subsurface information was available for this quarry. Projections of subsurface geological conditions are conjecture and subject to change as the quarry is mined and further mapping performed.





Scale:
Horizontal:1"=300'
Vertical: 1"=300'
No Vertical Exaggeration

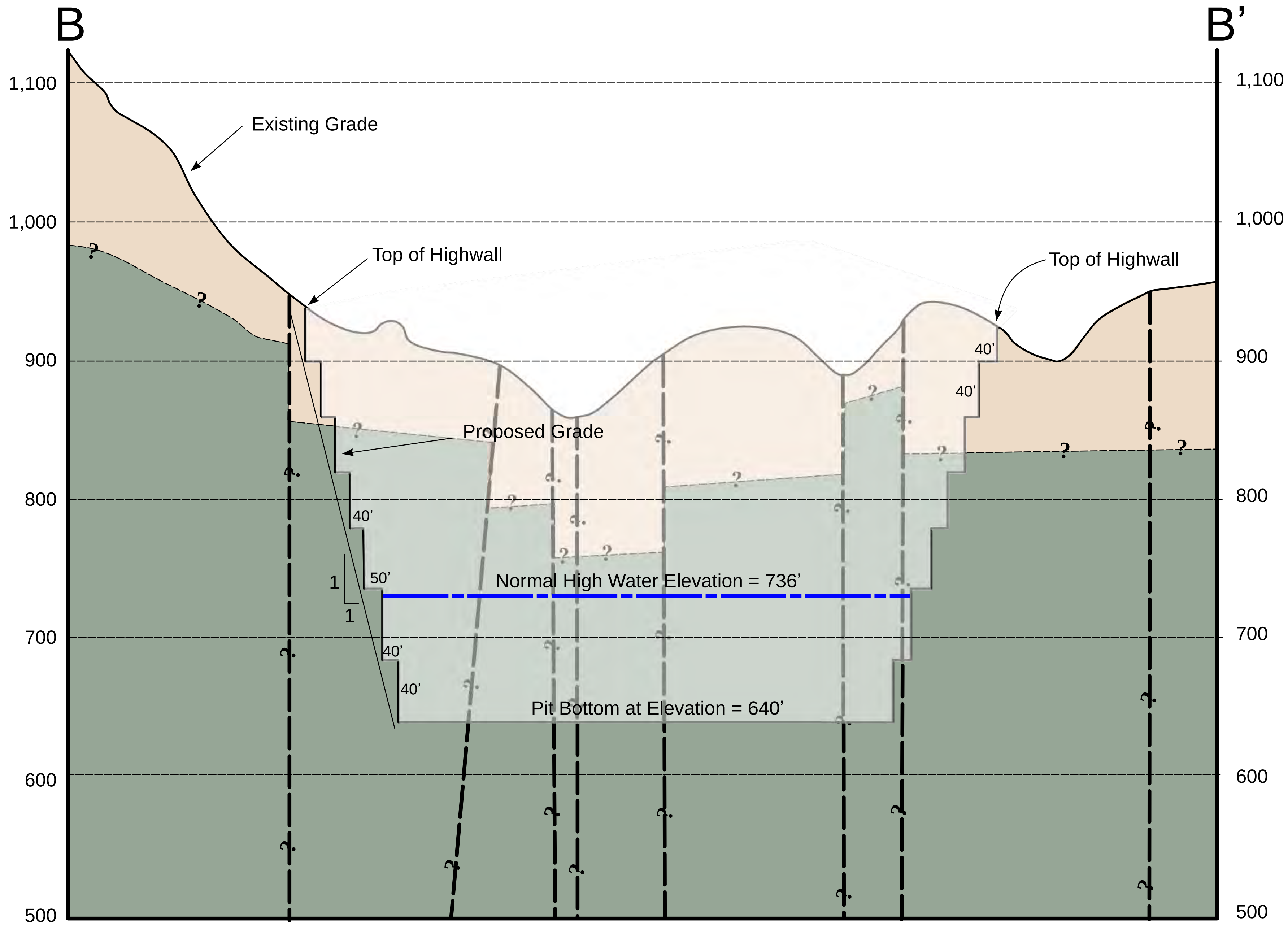
GEOTECHNICAL SECTION A-A'

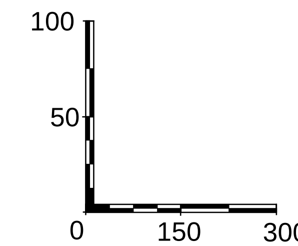
Crystal Creek Aggregates Quarry
Amendment to Reclamation Plan
Proposed Quarry Expansion
Shasta County, California

Plate No. 5.1

BAJADA Geosciences, Inc.

Project no. 1901.0114

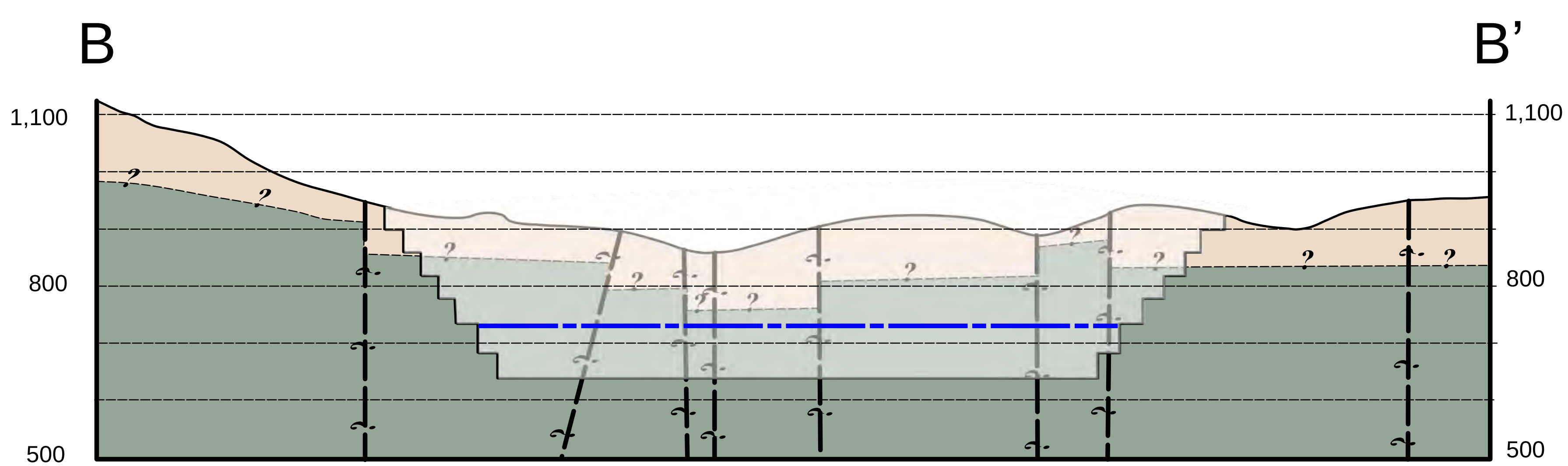


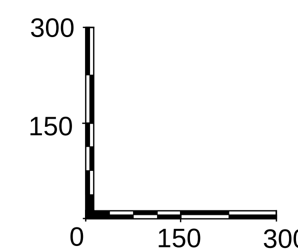


Scale:
Horizontal:1"=300'
Vertical: 1"=100'
Vertical Exaggeration 3x

af	Artificial Fill/Stockpiles
Qls	Landslide Deposits
Dmm	Mule Mountain Stock
Dbc	Balaklala Rhyolite
Da/ Dc	Epidote/Chloritic Amphibolite, Copley Greenstone & Gabbro

No subsurface information was available for this quarry. Projections of subsurface geological conditions are conjecture and subject to change as the quarry is mined and further mapping performed.





Scale:
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Vertical: 1"=300'
No Vertical Exaggeration

GEOTECHNICAL SECTION B-B'

Crystal Creek Aggregates Quarry
Amendment to Reclamation Plan
Proposed Quarry Expansion
Shasta County, California

Plate No. 5.2

BAJADA Geosciences, Inc.

Project no. 1901.0114

Scale undetermined

Active			
Historic Displacement (last 200 years)		Holocene Displacement (last 11,700 years)	
Potentially Active		**Inactive**	
Late Quaternary Displacement (last 700,000 years)		Quaternary Fault (last 1.6 million years)	

Base map from USGS Interactive Fault Map (2019)

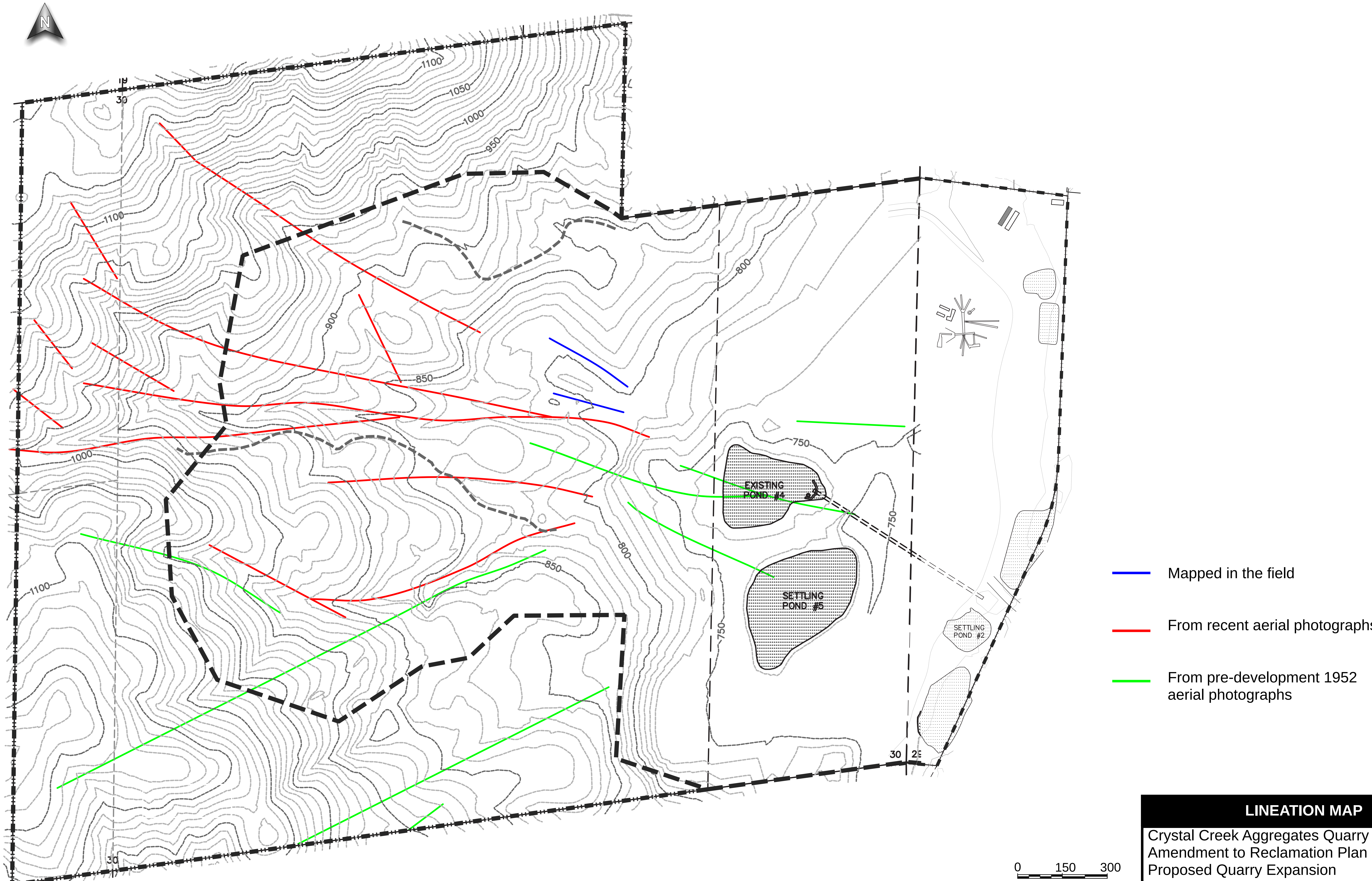
FAULT LOCATION MAP

Crystal Creek Aggregates Quarry
Amendment to Reclamation Plan
Proposed Quarry Expansion
Shasta County, California

Plate No.
6

BAJADA Geosciences, Inc.

Project no.
1901.0114



Base map from Duane K. Miller Civil Engineer (2020)

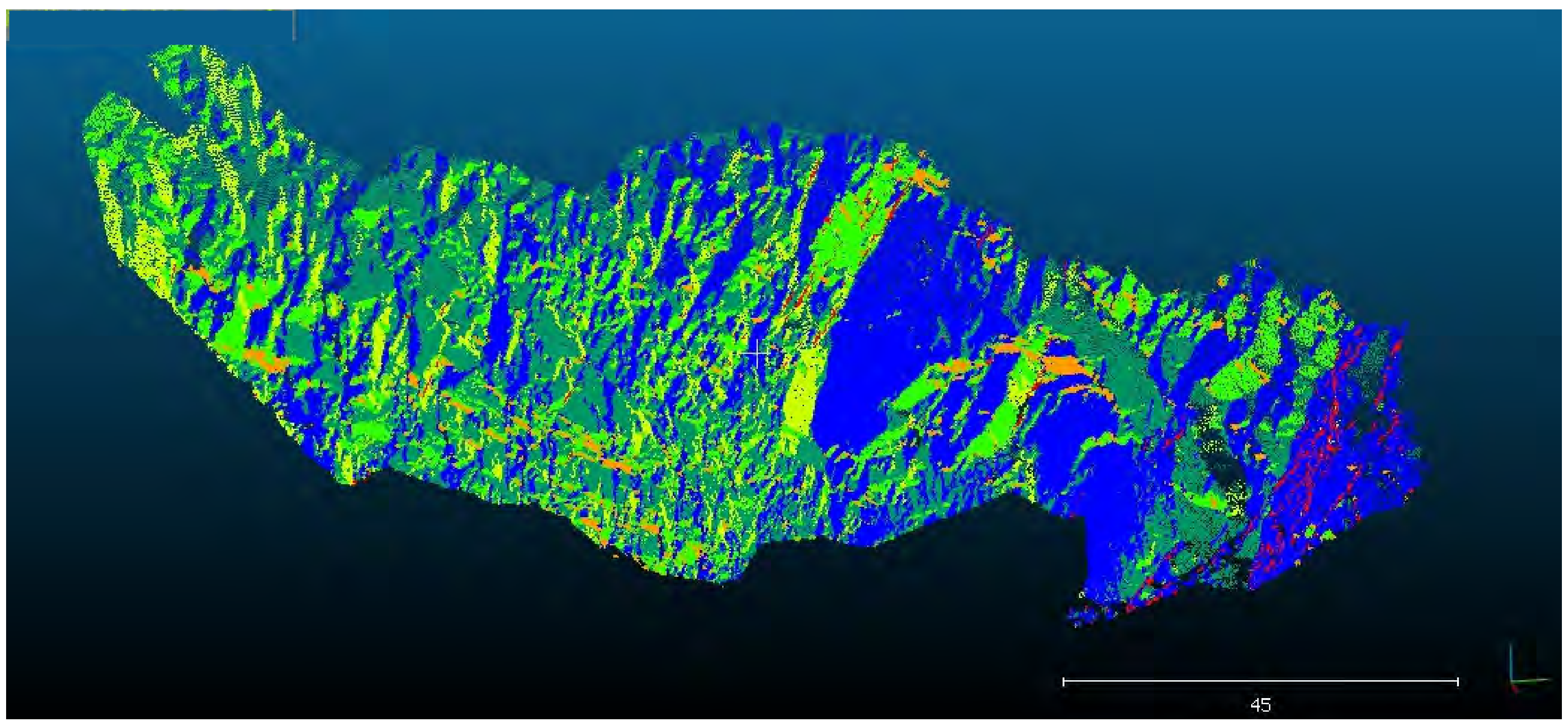
LINEATION MAP

Crystal Creek Aggregates Quarry
Amendment to Reclamation Plan
Proposed Quarry Expansion
Shasta County, California

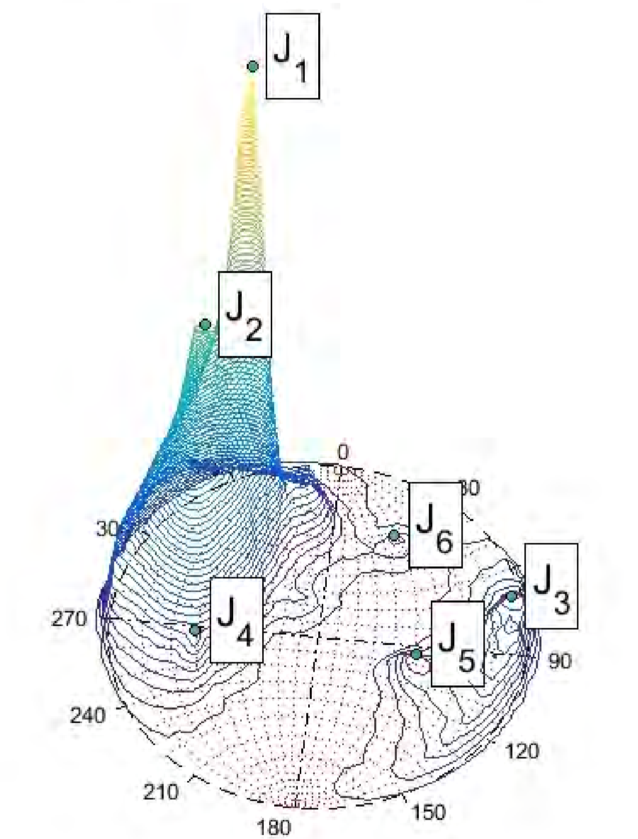
Plate No.
7

BAJADA Geosciences, Inc.

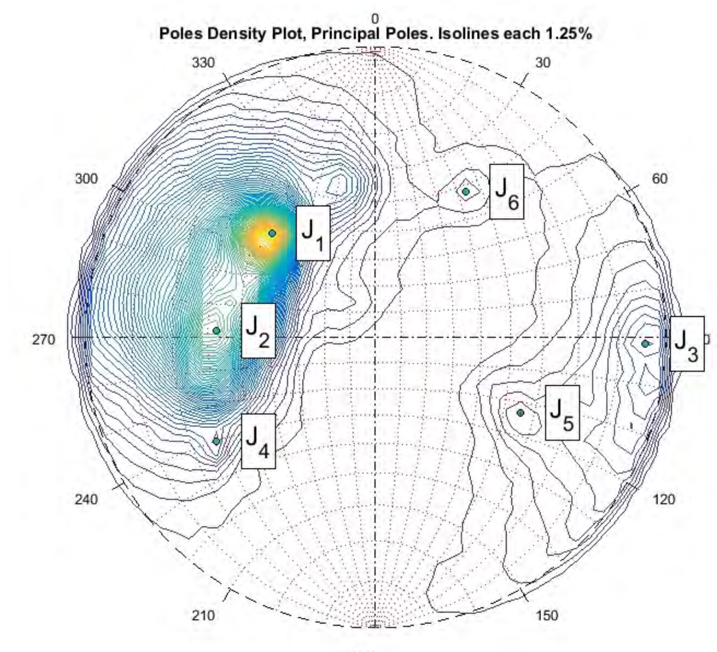
Project no.
1901.0114



Poles Density Plot, Principal Poles. Isolines each 1.25%



Poles Density Plot, Principal Poles. Isolines each 1.25%



PRIMARY DISCONTINUITIES				
Discontinuity	Color	Dip Direction	Dip	%
J1	(blue)	135	54	33
J2	(dark green)	93	57	28
J3	(bright green)	271	86	16
J4	(yellow-green)	57	66	7
J5	(orange)	298	59	5
J6	(magenta)	212	61	2

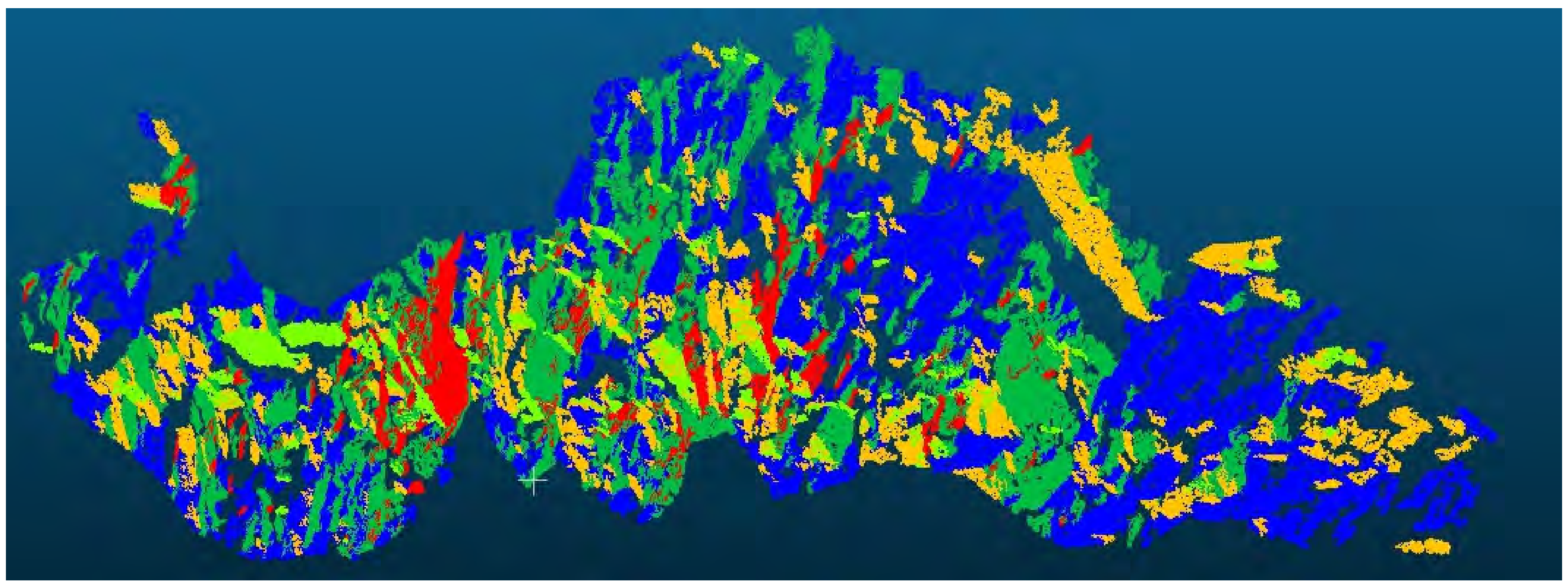
SITE 1 DISCONTINUITIES

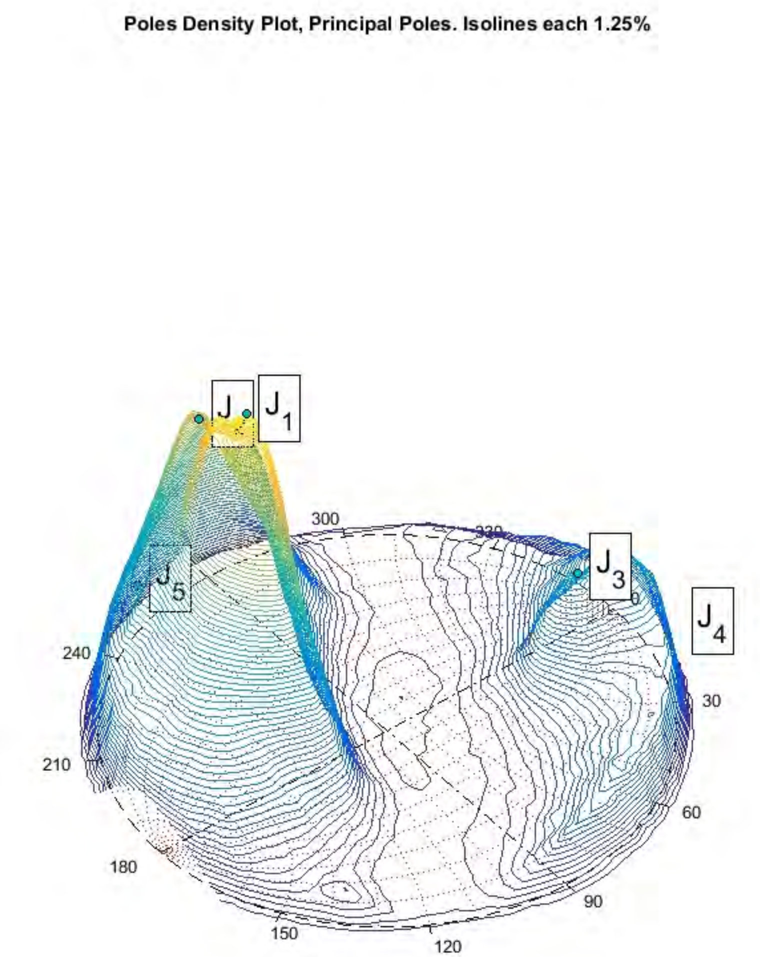
Crystal Creek Aggregates Quarry
Amendment to Reclamation Plan
Proposed Quarry Expansion
Shasta County, California

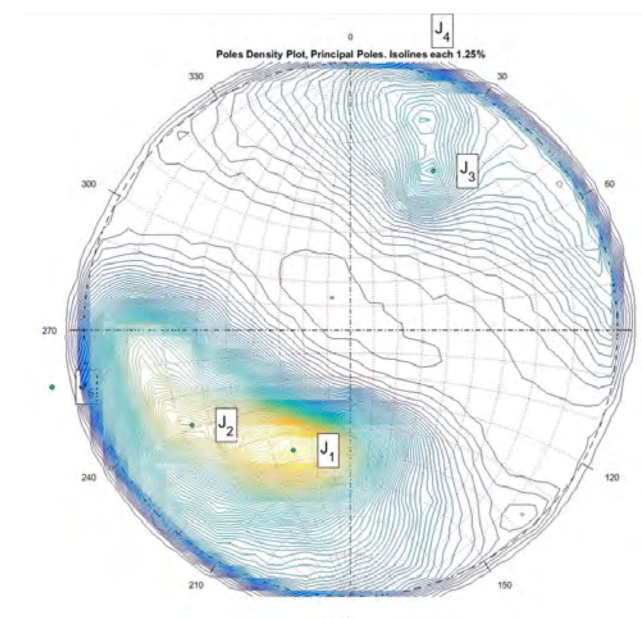
Plate No. **8.1**

BAJADA Geosciences, Inc.

Project no. 1901.0114







PRIMARY DISCONTINUITIES				
Discontinuity	Color	Dip Direction	Dip	%
J1	Blue	25	53	21
J2	Green	59	70	25
J3	Light green	207	68	11
J4	Orange	191	83	17
J5	Red	79	83	12

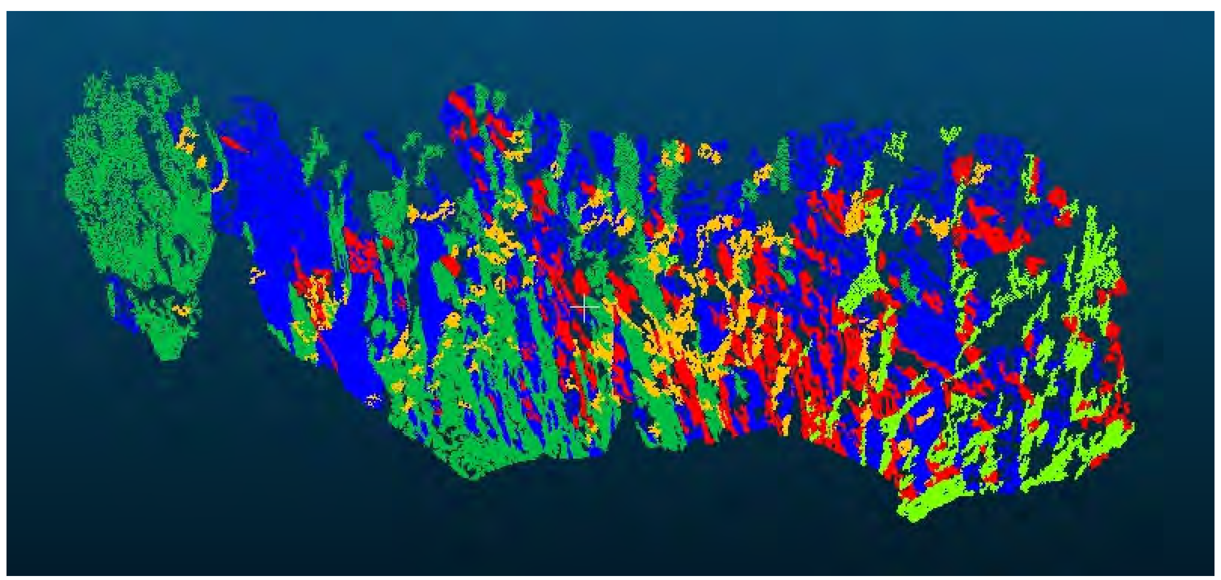
SITE 2 DISCONTINUITIES

Crystal Creek Aggregates Quarry
Amendment to Reclamation Plan
Proposed Quarry Expansion
Shasta County, California

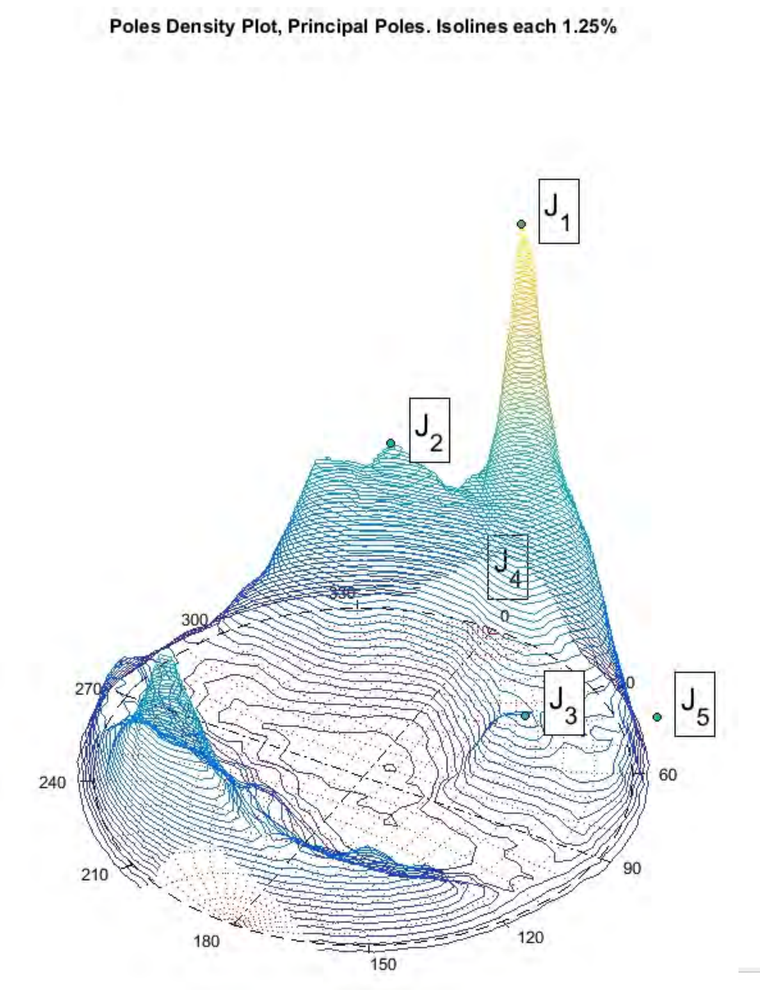
Plate No. **8.2**

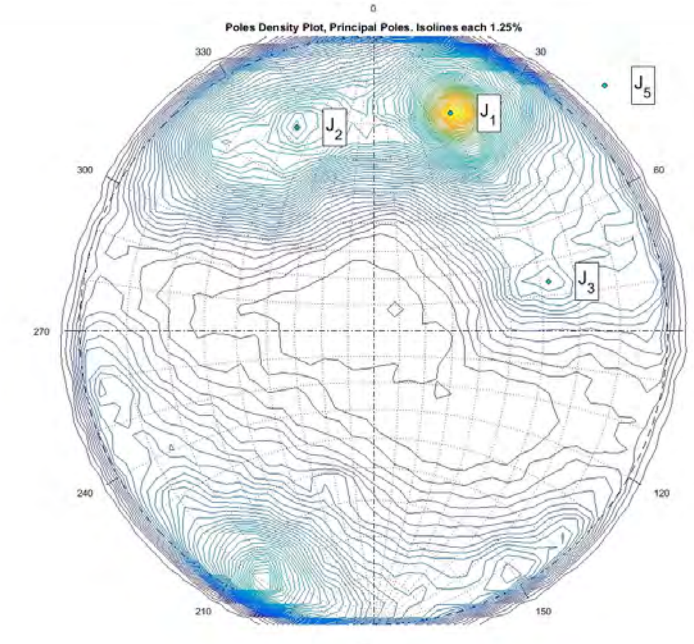
BAJADA Geosciences, Inc.

Project no. 1901.0114



PRIMARY DISCONTINUITIES				
Discontinuity	Color	Dip Direction	Dip	%
J1	Blue	200	76	27
J2	Green	159	73	23
J3	Light green	254	63	10
J4	Orange	170	78	11
J5	Red	223	82	17





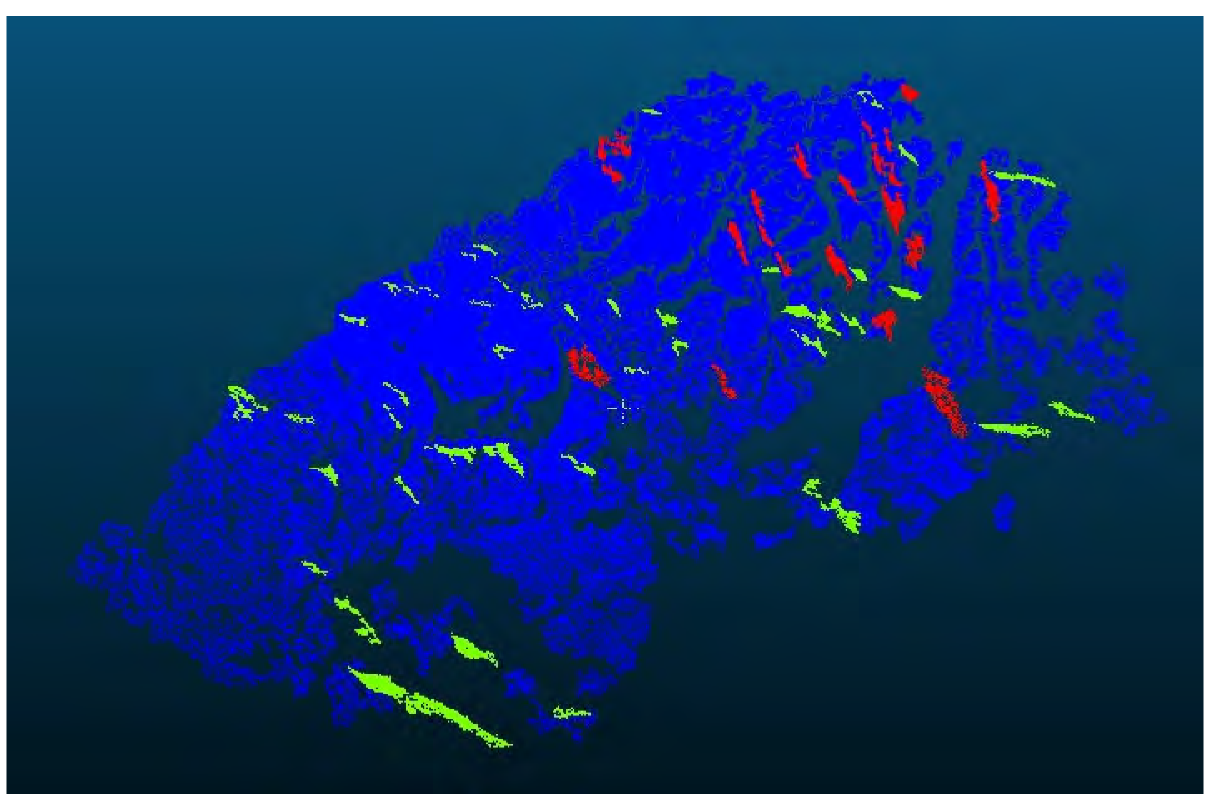
SITE 3 DISCONTINUITIES

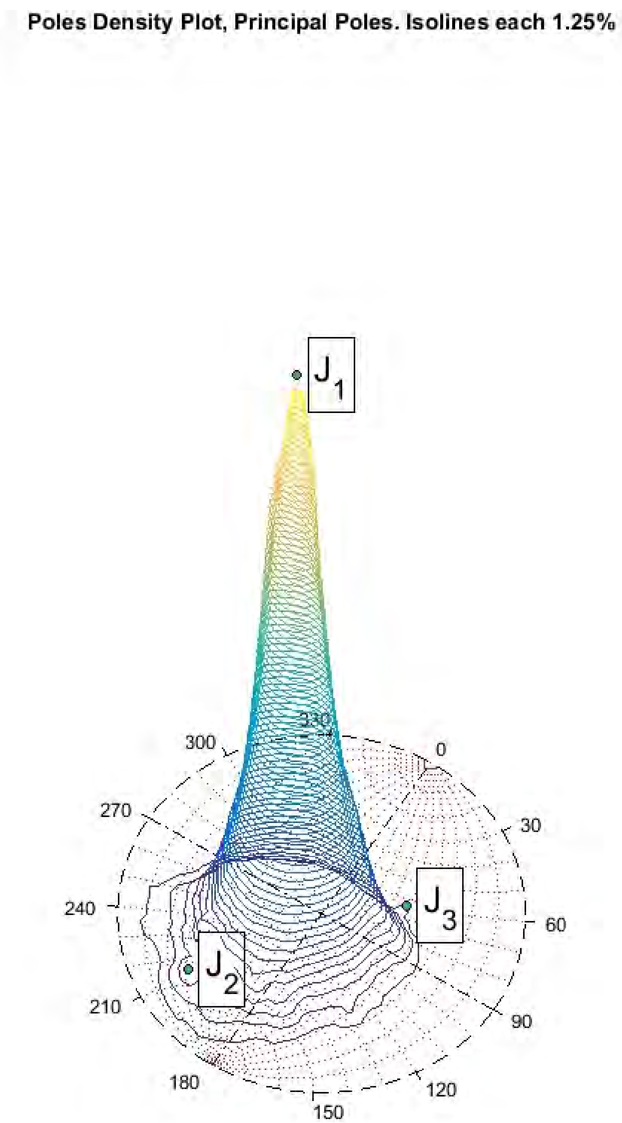
Crystal Creek Aggregates Quarry
Amendment to Reclamation Plan
Proposed Quarry Expansion
Shasta County, California

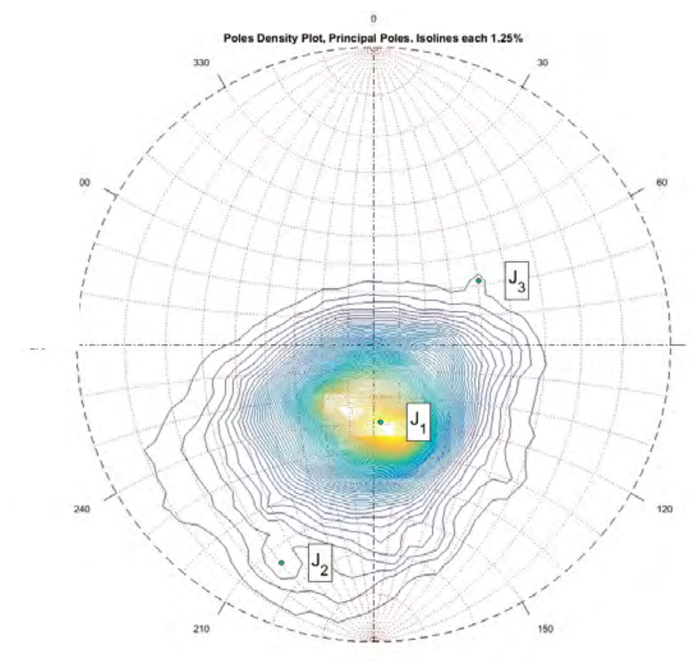
Plate No. **8.3**

BAJADA Geosciences, Inc.

Project no. 1901.0114







PRIMARY DISCONTINUITIES				
Discontinuity	Color	Dip Direction	Dip	%
J1	(blue)	355	29	68
J2	(green)	23	77	9
J3	(red)	239	45	4

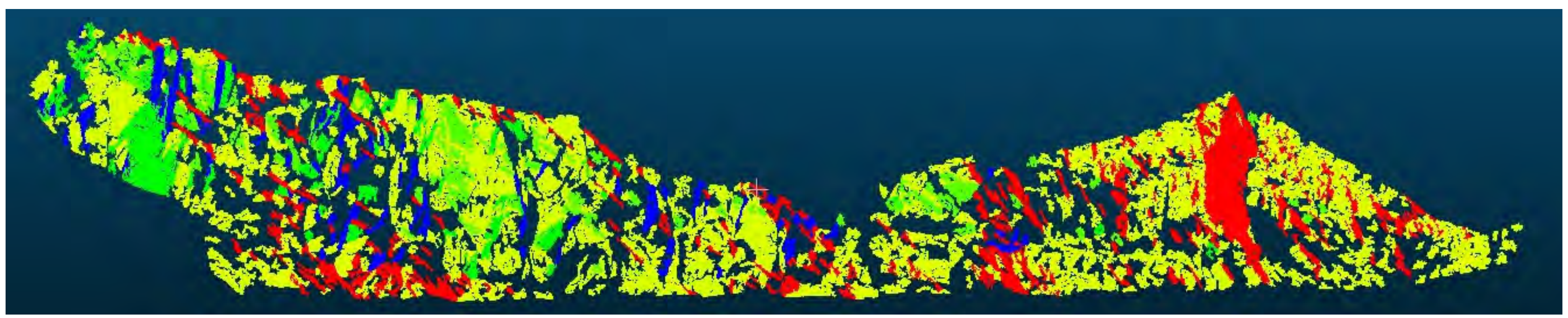
SITE 4 DISCONTINUITIES

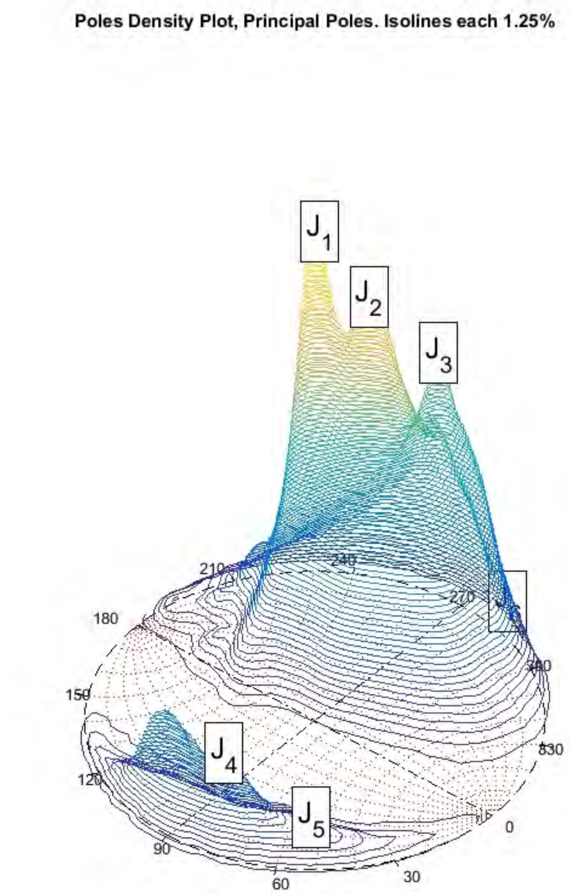
Crystal Creek Aggregates Quarry
Amendment to Reclamation Plan
Proposed Quarry Expansion
Shasta County, California

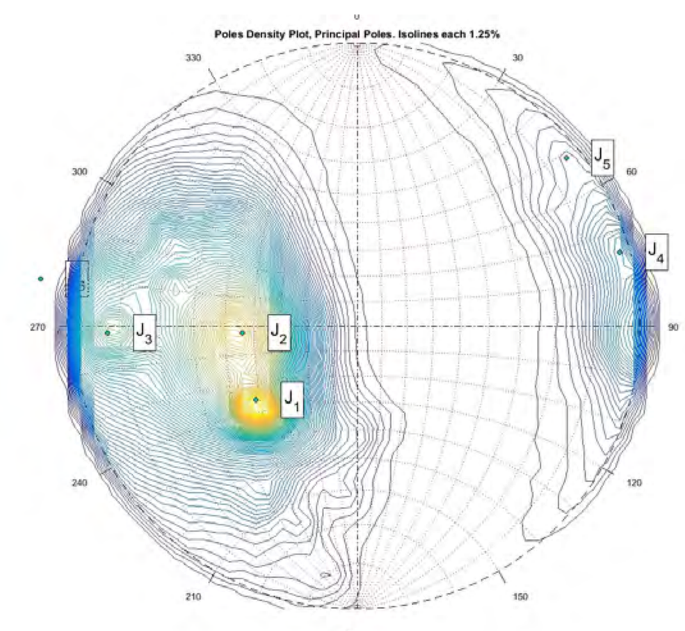
Plate No. 8.4

BAJADA Geosciences, Inc.

Project no. 1901.0114







PRIMARY DISCONTINUITIES				
Discontinuity	Color	Dip Direction	Dip	%
J1	(red)	54	48	21
J2	(yellow)	87	44	25
J3	(yellow)	88	83	19
J4	(green)	254	88	8
J5	(blue)	231	83	7
J6	(green)	98	83	7

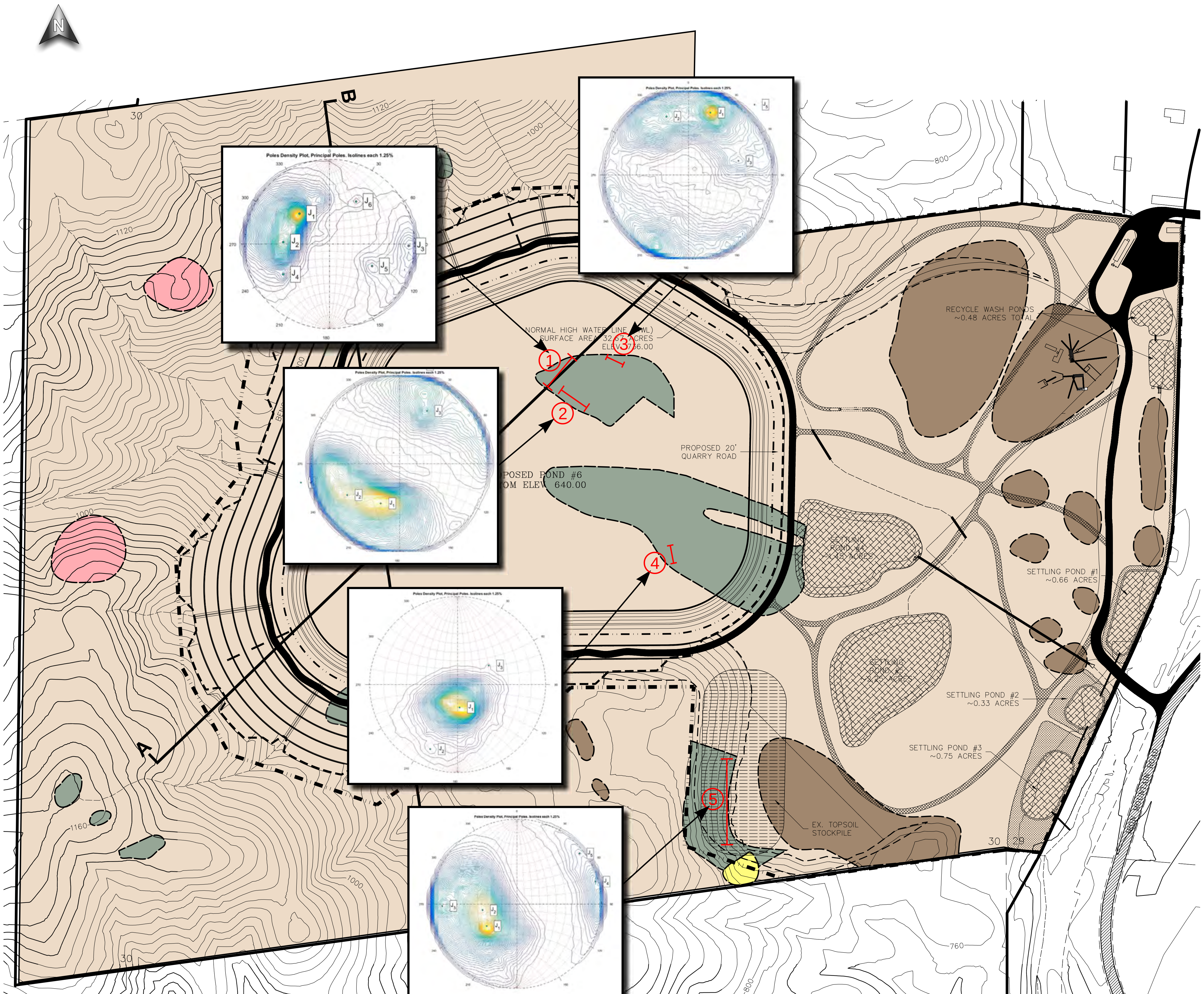
SITE 5 DISCONTINUITIES

Crystal Creek Aggregates Quarry
Amendment to Reclamation Plan
Proposed Quarry Expansion
Shasta County, California

Plate No. **8.5**

BAJADA Geosciences, Inc.

Project no. 1901.0114



Map from Duane Miller Engineering (2020)

6 Sites 1 through 6 - areas where discontinuities were mapped during this study

B B' Cross Sections see Plates 5.1 & 5.2

0 150 300

Scale: 1"=300'
1:3,600

STRUCTURAL DOMAIN MAP

Crystal Creek Aggregates Quarry
Amendment to Reclamation Plan
Proposed Quarry Expansion
Shasta County, California

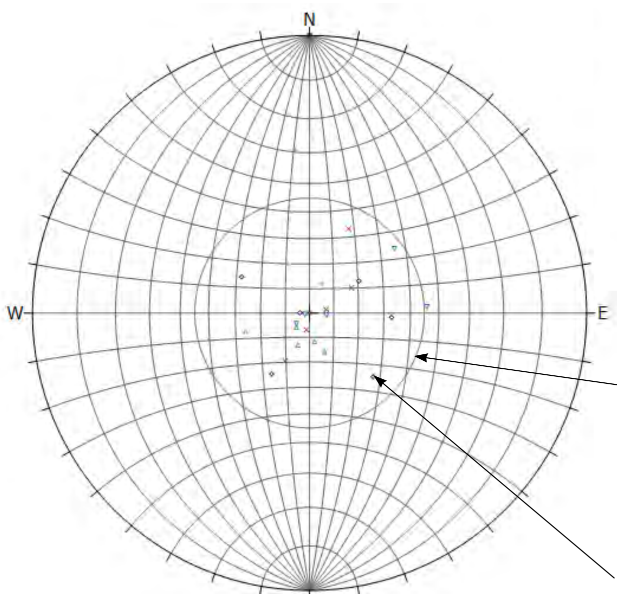
Plate No.
9

BAJADA Geosciences, Inc.

Project no.
1901.0114

KINEMATIC TEST OF POTENTIAL FAILURES AT OVERALL SLOPE-SCALE

POTENTIAL PLANAR FAILURES



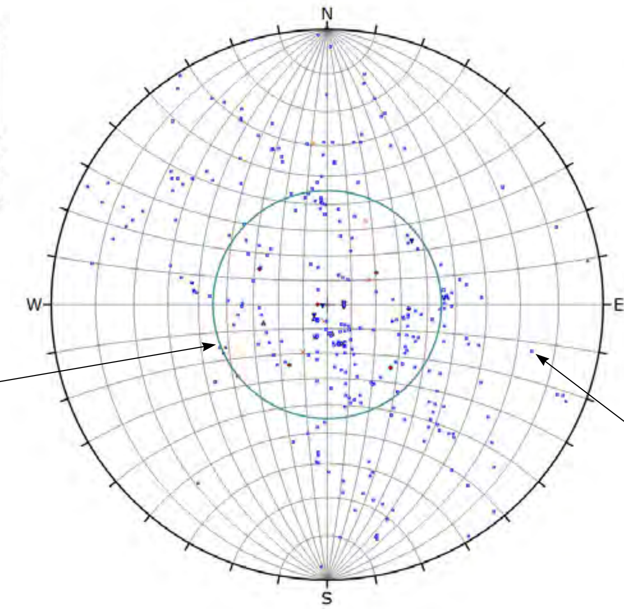
Symbol	SITE	Quantity
○	1	6
×	2	5
△	3	5
+	4	3
▽	5	6

Plot Mode	Dip Vectors
Vector Count	25 (25 Entries)
Hemisphere	Lower
Projection	Equal Angle

Angle of Internal Friction (45 degrees)

Dip Vector of Potential Planar Failure

POTENTIAL WEDGE FAILURES



Symbol	SITE	Quantity
◆	1	6
×	2	5
▲	3	5
+	4	3
▼	5	6
Symbol	**Feature**	
▪	Intersection	

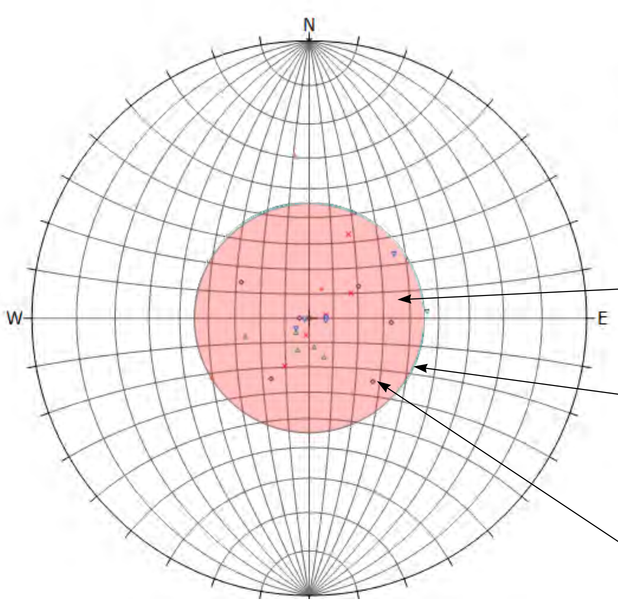
Plot Mode	Dip Vectors
Vector Count	25 (25 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	300
Hemisphere	Lower
Projection	Equal Angle

Trend & Plunge of Potential Wedge Failure

Overall slope angle at 45 degrees

KINEMATIC TEST OF POTENTIAL FAILURES AT BENCH-SCALE

POTENTIAL PLANAR FAILURES



Symbol	SITE	Quantity
○	1	6
×	2	5
△	3	5
+	4	3
▽	5	6

Plot Mode	Dip Vectors
Vector Count	25 (25 Entries)
Hemisphere	Lower
Projection	Equal Angle

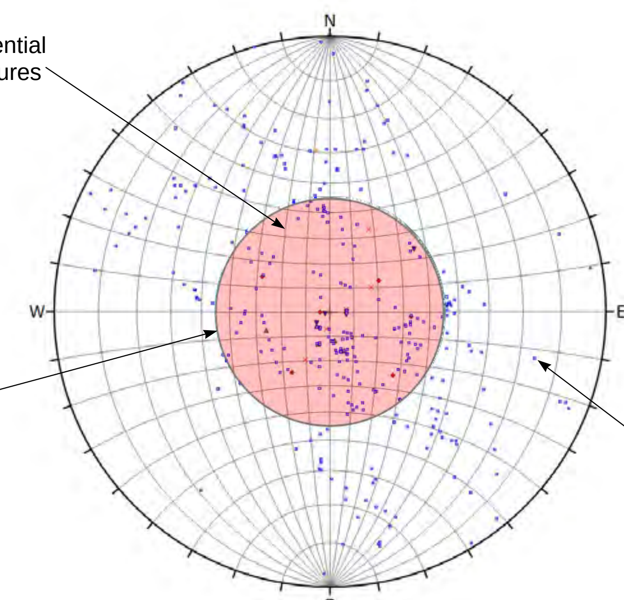
Area of Potential Planar Failures

Angle of Internal Friction (45 degrees)

Dip Vector of Potential Planar Failure

POTENTIAL WEDGE FAILURES

Area of Potential Wedge Failures



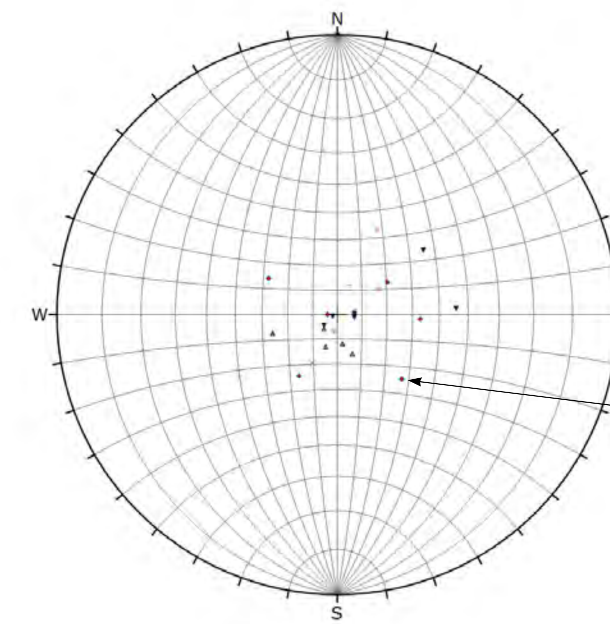
Symbol	SITE	Quantity
◆	1	6
×	2	5
▲	3	5
+	4	3
▼	5	6
Symbol	**Feature**	
▪	Intersection	

Plot Mode	Dip Vectors
Vector Count	25 (25 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	300
Hemisphere	Lower
Projection	Equal Angle

Trend & Plunge of Potential Wedge Failure

Bench face angle at 90 degrees

PREDOMINANT DISCONTINUITY PLANES

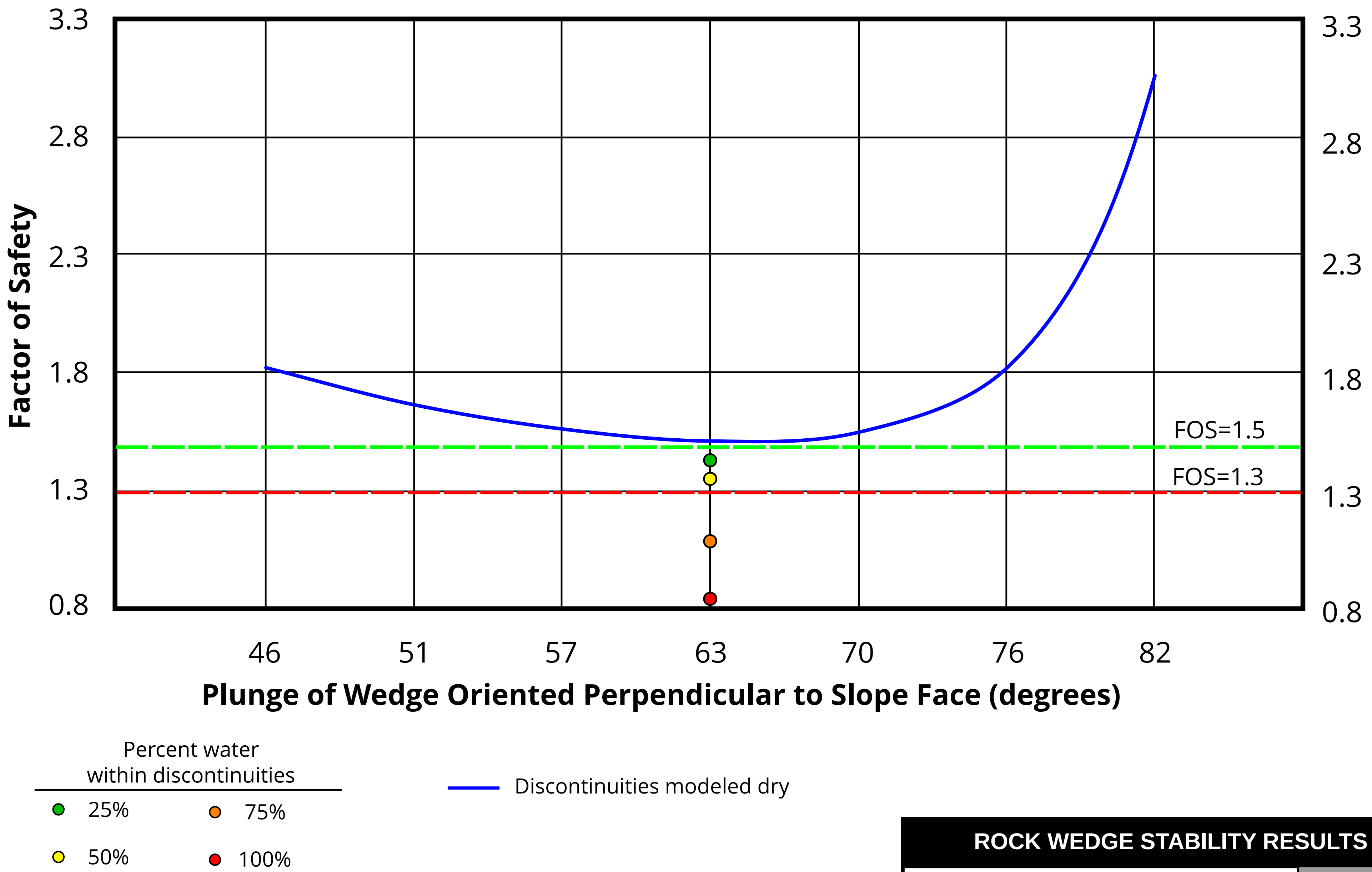


Dip Vector of Predominant Discontinuity Set

Symbol	SITE	Quantity
◆	1	6
×	2	5
▲	3	5
+	4	3
▼	5	6

Plot Mode	Dip Vectors
Vector Count	25 (25 Entries)
Hemisphere	Lower
Projection	Equal Angle

STEREONET EVALUATIONS	
Crystal Creek Aggregates Quarry Amendment to Reclamation Plan Proposed Quarry Expansion Shasta County, California	Plate No. 10
BAJADA Geosciences, Inc.	Project no. 1901.0114



ROCK WEDGE STABILITY RESULTS

Crystal Creek Aggregates Quarry Amendment to Reclamation Plan Proposed Quarry Expansion Shasta County, California	Plate No. 11
BAJADA Geosciences, Inc.	Project no. 1901.0114

APPENDIX A

Previous Geoscience Studies

APPENDIX A
PREVIOUS GEOSCIENCE STUDIES

Site specific geologic and geotechnical studies have previously been performed at the Crystal Creek Aggregate Quarry site by Cooksley Geophysics, Inc. (1998 & 2008) and Materials Testing, Inc. (2007). Those studies are included within this appendix.

GEOLOGIC REPORT TO ACCOMPANY THE GLOBAL SLOPE STABILITY ANALYSES FOR THE CRYSTAL CREEK AGGREGATE EXPANSION

OIGINALLY SUBMITTED MAY 12, 2008
REVISED AUGUST 19, 2008

CERTIFIED PROFESSIONAL IN EROSION AND SEDIMENT CONTROL
CPESC
Travis Morgan Deem
No. 3948

REGISTERED GEOLOGIST
J. W. COOKSLEY, JR.
No. EG 285
Certified Engineering Geologist
STATE OF CALIFORNIA

PURPOSE AND SCOPE OF INVESTIGATION

The Crystal Creek Aggregate (CCA) site is an existing quarry operation in Shasta County, CA. Mining for construction aggregate has been ongoing since 1990 under the same ownership. CCA has obtained approval for a 55.3 acre expansion of the quarry area with an estimated life of 65 years.

In October 2007, CCA employed Materials Testing, Inc. (MTI) to produce a slope stability analyses in response to informal technical comments from the Office of Mine Reclamation (OMR). The goal of the study was to determine the Factor of Safety of the proposed quarry benches. OMR offered further comment in their reclamation plan review letter dated April 10, 2008 which requested that additional geologic review be conducted to fully address the issue. Subsequent to initial review of this document, OMR requested clarification of certain items previously noted by their staff but not fully explained in the original report. This updated document seeks to satisfy OMR's concerns given available surface and, where available, subsurface data.

This engineering geological report assesses the potential for geologic hazards at CCA's proposed expansion site. The main objective of this investigation is to assess the strength and the resistance to slope failure of the rock units at the mine. The scope of investigation includes a refraction seismic survey directed at classifying and measuring thickness of the various soil units, weathered layers and the underlying rock units. This phase was conducted in 1998. Additional aerial photography and field reconnaissance was conducted during October 2007, spring 2008 and summer 2008 to identify rock outcrops and major geologic features.

REGIONAL GEOLOGIC SETTING

The CCA site is located in the extreme southwest corner of the Klamath Mountains. This area is underlain by metasedimentary units of Paleozoic age that have been locally intruded by trondhejemite and related intrusives of Late Jurassic age and by quartz diorite (related to the Shasta Bally batholith, also Late Jurassic in age). Alluvial cover is thin at the subject site, seldom exceeding five feet.

No active faults have been mapped in the area investigated. The lone seismic event of significant magnitude in the past fifty years was an earthquake of magnitude 5.2 (Richter scale) that occurred on Thanksgiving Day, November 26, 1998. The epicenter was reported under Keswick Reservoir, about 4 miles north of the subject site at a depth of 25.96 km. The Crystal Creek quarry area was not damaged. No secondary effects were observed.

SITE DESCRIPTION AND CONDITIONS

The site is located in Sections 19, 29 and 30, of T32N., R.5W. M.D.B.M., assessor parcel numbers 065-250-002, 065-250-023 (portion), 065-250-024, and 065-260-010. The property is 2 miles directly west of Redding, California and south of the small unincorporated community of Keswick and1 mile north of State Route 299 West. The site is approximately 550 feet west of the intersection of Iron Mountain Road and Laurie Anne Lane. The eastern portion of the property is relatively level land, while the western half contains rolling to hilly terrain. Rock Creek is 3,256 feet to the north of the property and Middle Creek is 3,700 feet south of the property.

The following rock units are present at the site:

Copley Greenstone

The oldest rock formation on this project is the Copley Greenstone. Kinkle, A.R., et al, (1956, p.10) estimate the thickness of this formation to be at least 3,700 feet in Modesty Gulch in the Whiskey Town Quadrangle. A Devonian age is assigned to this unit. The Copley is generally massive and competent in an engineering sense. It is normally jointed, the joints commonly being near vertical and of random strike. Where bedding was observed, it appeared to be of variable attitude with the dip being within 30 degrees of horizontal. In general, the lithologic and structural features within the Copley favor stability.

Intrusive Rocks

Several types of intrusives pierce the Copley Greenstone. These intrusives are mainly dikes of Late Jurassic age and range in texture from medium grained to very coarse grained, some being porphyritic. Their composition ranges from silicic to intermediate. This category includes the trondhjemite of the Mule Mountain Stock, medium grained intrusives of granitic to dioritic composition, and may include the quartz diorite of the Shasta Bally Batholith. The coarser grained intrusive (trondhjemite) tends to be less competent, deeply weathered, and more easily eroded. These dikes are known to occur in the vicinity of the quarry but within the mining boundaries there are no in situ occurrences of this material. The only surface expression of this rock within the project boundary is as isolated float which may actually have been imported for incorporation into building foundations during the gold rush.

Surficial Deposits

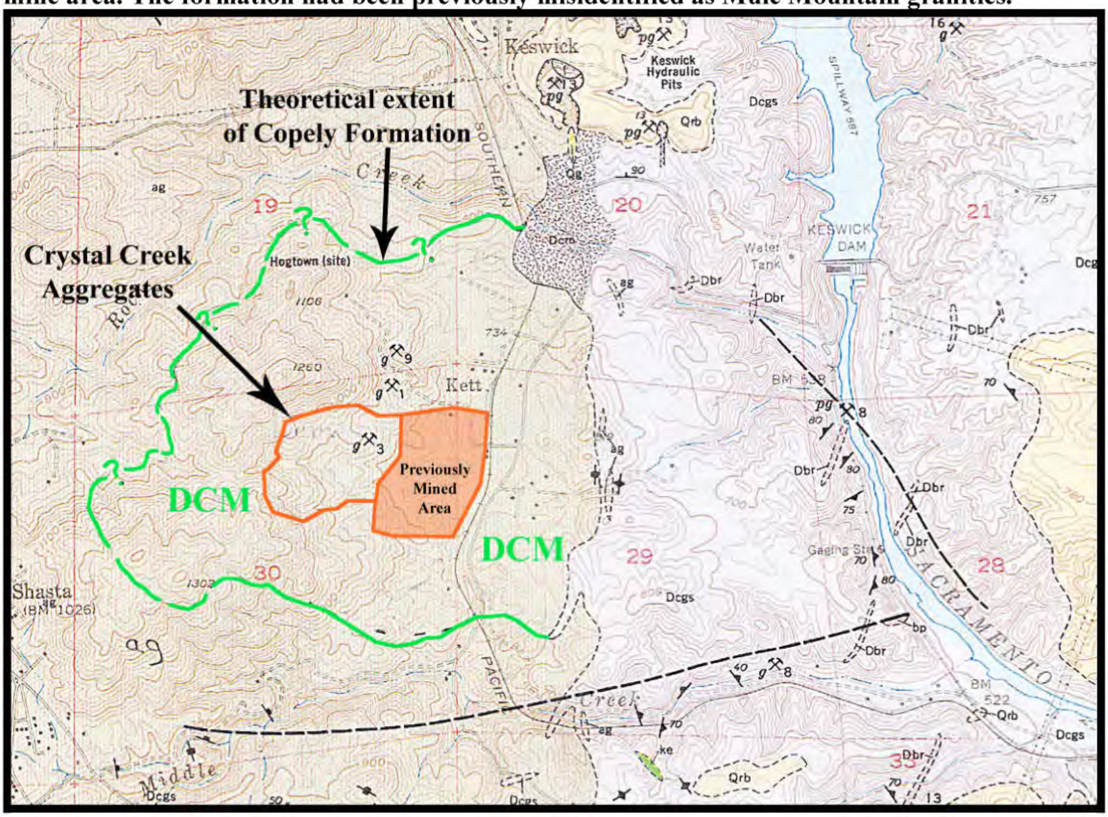
These deposits include the unconsolidated deposits at the surface and the zones of intense to intermediate weathering of the bedrock. The average thickness of the unconsolidated layer is probably less than 5 feet. The weathered layers extend another 0 to 60 feet below the unconsolidated soil, as evidenced in the refraction seismic survey performed by Cooksley Geophysics in 1998.

DESCRIPTION OF THE INVESTIGATION

Cumulative evidence derived from both the seismic and field surveys indicates that the main rock unit being quarried at the site is the Copley Greenstone. The Copley constitutes approximately 75% of the identifiable outcrops within the study area. In the sections derived from the 1998 seismic investigations, Copley Greenstone is correlative with velocities in excess of 10.0 feet per millisecond and altered intrusives, including the Mule Mountain Stock, correlates with the 5.7 – 10.0 feet per millisecond range. Velocities in the 1.0 – 4.0 feet per millisecond represent soil and weathered rock.

Investigations conducted since the beginning of 2008 consist of inspecting the majority of known outcrops, looking for indications of bedding planes or discontinuities, and photographing the few exposures of in situ rock where they occur at the surface. This procedure led to recognition of Copley Greenstone in an area previously mapped as Mule Mountain Stock (V.F. Hollister and J.R. Evans, 1965). One important observation is that small, localized areas of intrusive Mule Mountain Stock are exposed throughout the Copley. The competence of these exposures range from soft, porphyritic, trondhejemite, to hard, medium-grained intrusive to very hard migmatite. Figure 1 shows the probable extent of the Copley based on surface observations and areas of known gold mining activity which are locally associated with the Devonian volcanics.

Figure 1: Geologic map of the mine area showing theoretical boundaries of the Devonian Volcanics in the mine area. The formation had been previously misidentified as Mule Mountain granitics.



Surface observations of outcrops and float were made throughout the project area. The main objectives in this phase of the program were to map the extent of Copley Greenstone and the various intrusive rocks and to observe structural features, e.g., faults, joints and folding (tilting). Due to the amount of vegetative cover and deep weathering no signs of these underlying geologic structures were observed in the unmined areas. Within the previously mined zone the Copely manifests as a massive, largely homogenous body of rock with no adverse structural deformities or zones of weakness. Visible banding in exposed quarry faces are the result of ancient bedding / discontinuities which were later fused during metamorphic alteration.

Attention was also directed to observation of slope failure, extreme erosion, and slumps in the cut slopes of roads. Particular attention was directed to identifying any signs of slope failure in the finished benches of the existing quarry area.

During the initial stages of preparing this update it was intended that geologic cross sections would be produced in order to better characterize the rock mass. Subsequent to the completion of field work it was determined that there was not adequate information available to produce meaningful cross sections. The density of vegetation and depth of weathered material prevented observation beyond that necessary to define the general boundaries of the rock mass shown in figure 1. Where there is a good surface expression of the rock mass it generally presents itself in the same manner throughout the site but these instances are localized and of limited area. The comments from OMR explicitly requested that geologic cross sections be provided and every reasonable attempt was made to satisfy that expectation. The cross sections which accompany this report are accurate; having been derived from flown contours but are purely for the purpose of showing the general nature of the existing landforms in both the previously mined and unmined areas. The reader is also referred to the seismic sections which depict the various units in detail.

LIKELY MODES OF FAILURE

This section addresses specific modes of slope failure and the potential for occuring at the site. Particular attention was directed to finding recent scarps, failed banks along roads, arcuate scarps and arcuate shapes of vegetative cover. No evidence of these features appears on the air photos and no indicators of failure were found during field surveys.

Competence of natural outcrops of Copley
In at least one location (Photo 2 on accompanying map) the Copley can be seen to naturally exhibit stability in vertical exposures. Where the local rock is exposed in the finished quarry walls, (Photos 9, 10, 11) stability has been proven at slopes as steep as 1:1. Further evidence of the stability and resistance to erosion can be seen in Photo 9. At this location, stormwater runoff from the proposed expansion area flows over the highwall and into an existing pond. Despite the concentration of flow and velocity of water down the 52 foot slope, there is no indication of erosion or instability.

Rotational shear failures in over-steepened slopes are not present.
The competent nature of the Copley Greenstone is not compatible with the development of shear failures in the moderate terrain conditions at the quarry. Along seismic traverse "A", up to 50 feet of weathered rock with a seismic velocity of 2.0 feet per millisecond (fpms) covers fairly competent rock possessing seismic velocities generally in excess of 8.5 fpms. The shallow slope at which this unit rests precludes the formation of rotational shears. No evidence of rotational slope failure was noted in the inspection of the area.

Translational slope failures are absent in the quarry area.
Because of its competence and massive structure, the Copley Greenstone seems devoid of translational shear failures. No evidence of bedding plane or wedge failures were seen in the course of the geological recon or the seismic field work. No evidence of past slope failure is confirmable on the aerial photo and existing highwalls are stable.

There is no evidence of toppling failures.
In the course of operations of the Crystal Creek Quarry, no instances of rock toppling has been noted. The formation lacks the type of structure (e.g. vertical bedding tipping at high angle into the quarry) which would facilitate this type of failure.

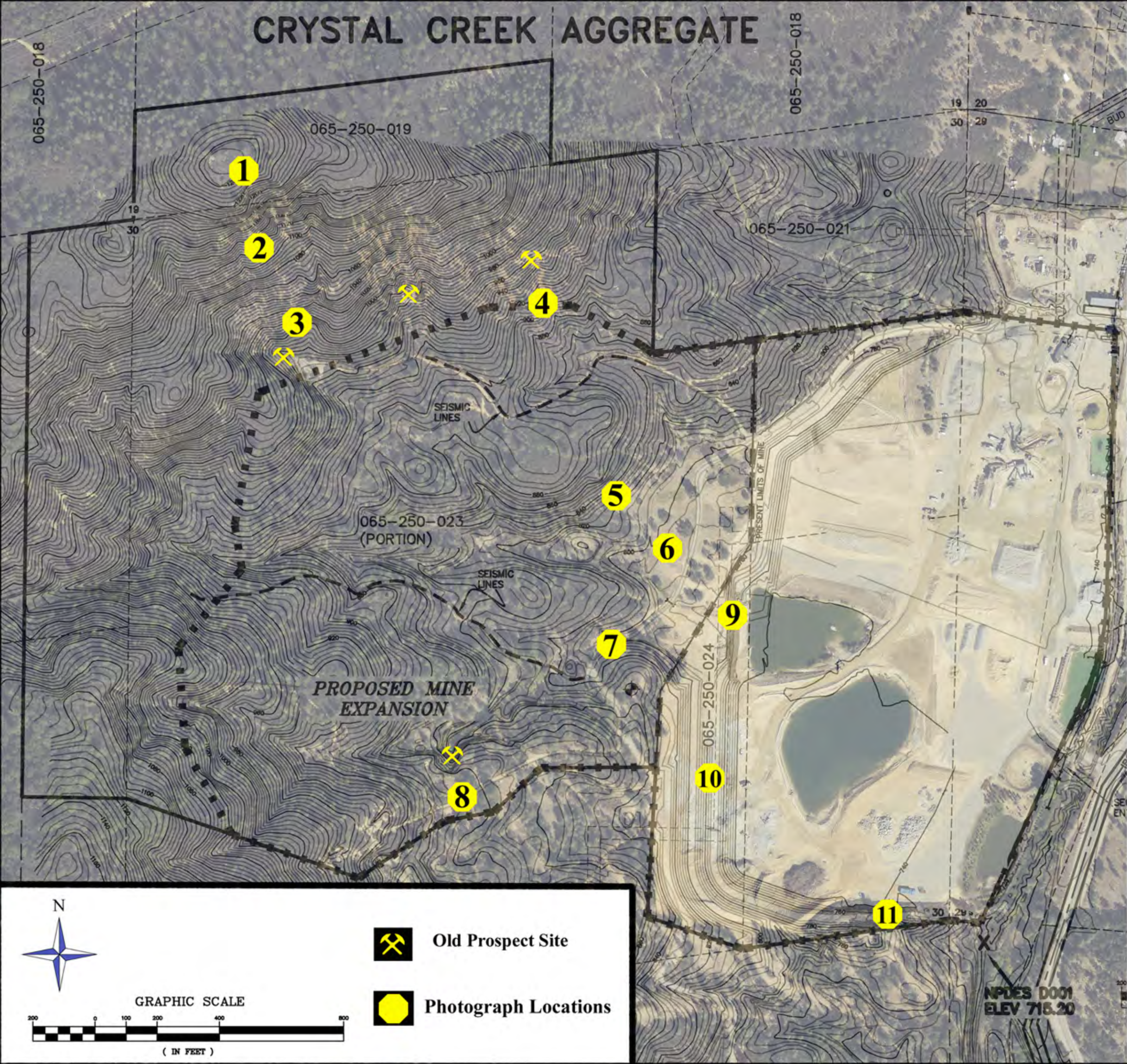
The MTI study adequately analyzed the level of safety based on likely failure modes.
Although MTI had not conducted a detailed site examination prior to producing their study, the findings of this investigation confirm that their conclusions were reasonable given site conditions. As noted above, the formation is not prone to rotational sheer failures. Indications of other failure modes being present are absent. This model serves to demonstrate the basic integrity of the material and stability of final slopes.

CONCLUSION

As a result of the surface phase of the investigation, no past, imminent or probable failures were recorded in either the Copley Greenstone or the intrusive rocks. The MTI study was adequate given the known qualities of the rock mass being mined and the final design of the cutslopes. The natural tendency of the rock mass to resist failure, combined with the proven stability of the existing highwall substantiates the findings of the MTI study; that the finished benches will be stable. In addition, provided that the operator engages in safe mining practices and avoids over-steepening or undercutting of active faces, the working face of the quarry should also remain stable. Geologic structures can be complex and can change at depth. It is recommended that the operator conduct regular inspection of all slopes for early detection of potential hazards and / or emerging failures.

ATTACHMENTS

1. Map showing site contours, aerial features, photo locations and old mine adits.
2. Site cross sections.
3. 1998 Cooksley Geophysical - Seismic Study.
4. October 2007 MTI - Global Slope Stability Analyses.



1. Steeply dipping joints in Copley Greenstone

2. Near vertical joints in massive Copley.

3. Near vertical joints of Copley surrounded by weathered migmatite.

4. Large boulders of Copely above collapsed adit entrance.

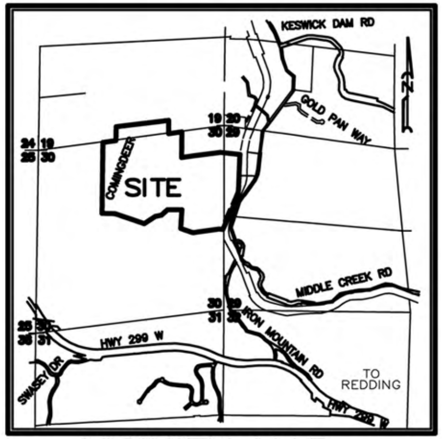
5. Massive Copley. Note joint crossing top half of photo through hat.

6. Surface expression of Copley formation.

7. Copley exposed in road cut showing beds dipping into hill at low angle.

8. Medium grained intrusive exposed near old mine workings.

9. Quarry wall in excess of 45 degrees above pond. Note rock cleaned by winter stormwater emerging from left.



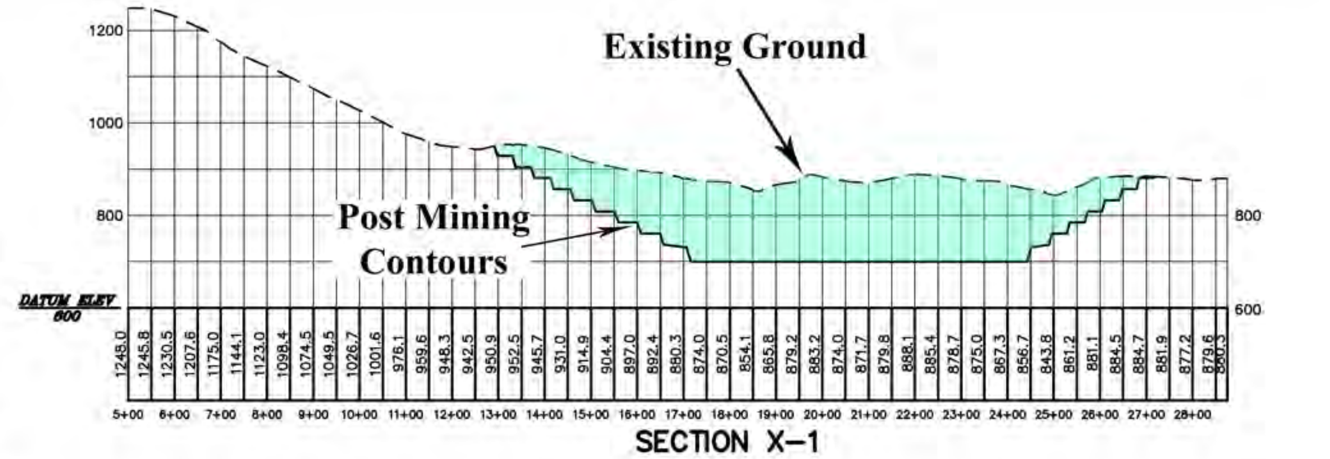
VICINITY MAP
n.t.s.

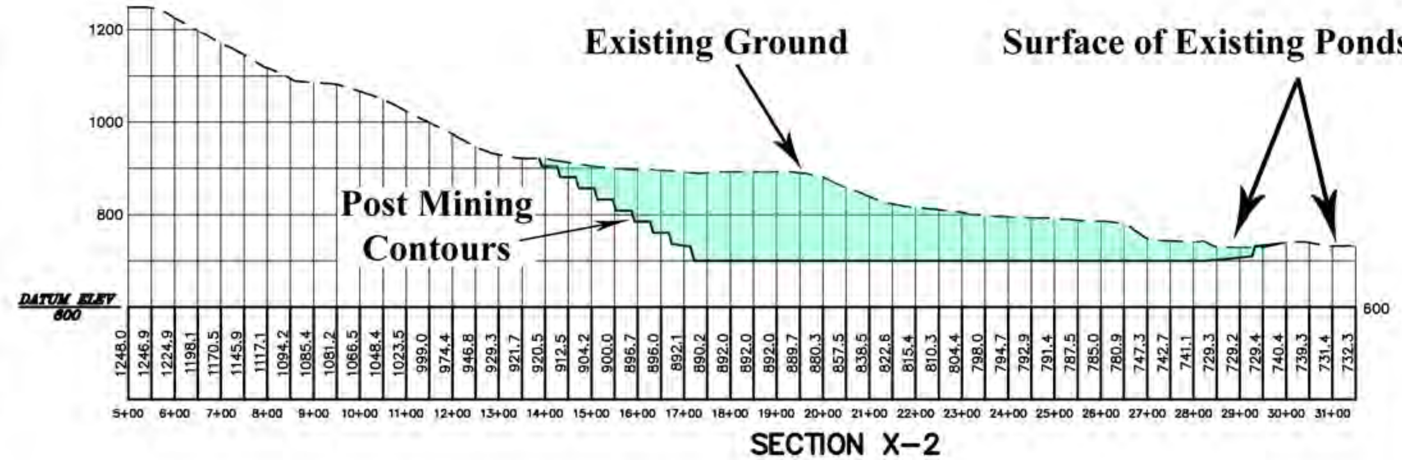
10. Southwest corner of quarry with Copley exposed in wall.

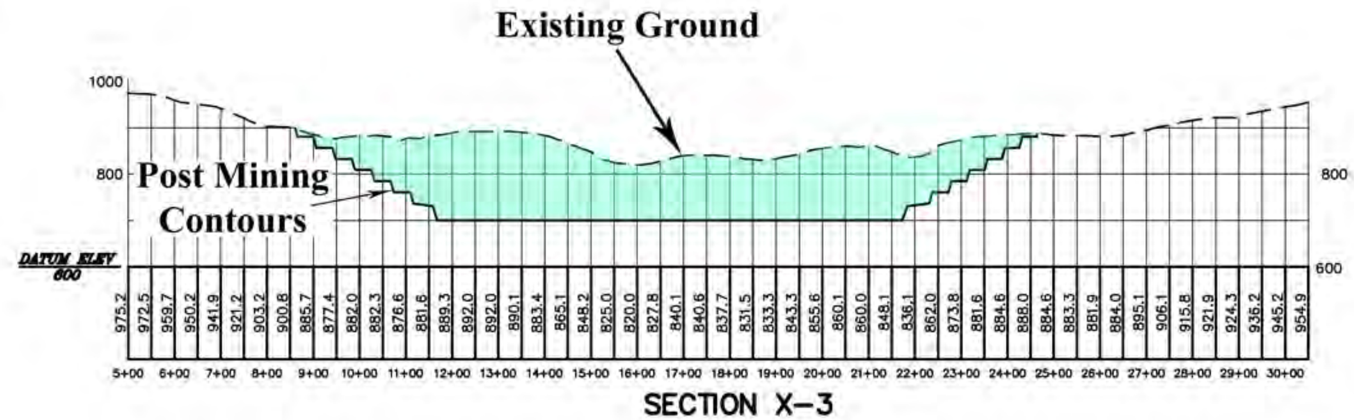
11. South quarry wall showing Copley resting on 45 degree slope.

THE LAND DESIGNERS
1975 PLACER STREET, SUITE A
REDDING, CA 96001
(530) 244-0506
LAND USE PLANNERS

ATTACHMENT 1







CRYSTAL CREEK AGGREGATES
CURRENT LANDFORMS AND POST-MINING
X-SECTIONS

ATTACHMENT 2

98-010

REFRACTION SEISMIC INVESTIGATION ROCK CLASSIFICATION AT THE PROPOSED EXPANSION OF THE CRYSTAL CREEK ROCK QUARRY, REDDING, CALIFORNIA

Prepared by:

COOKSLEY GEOPHYSICS, INC.

James W. Cooksley

June 1998

TABLE OF CONTENTS

REFRACTION SEISMIC INVESTIGATION ROCK CLASSIFICATION AT THE PROPOSED EXPANSION OF THE CRYSTAL CREEK ROCK QUARRY, REDDING, CALIFORNIA

EXECUTIVE SUMMARY

This investigation is directed to defining the depth of hard bedrock and defining areas of rock alteration and structural deformation. The study was conducted in the area west of the existing Crystal Creek Aggregates quarry, Redding, California.

Two seismic refraction lines, one thousand (1,000) feet and the other two thousand, two hundred eleven (2,211) feet in length, were executed over brushy, mildly hilly terrain. The data indicates that the depth to unweathered, non-rippable rock ranges from about ten (10) to in excess of one hundred (100) feet.

INTRODUCTION

A refraction seismic investigation program was conducted along two (2) roughly parallel, east-trending traverse lines located (see map in APPENDIX) across the proposed quarry expansion area west of the existing quarry area of Crystal Creek Aggregat, of Redding, California. The seismic program was directed toward determining the top of bedrock and assessing the excavation characteristics of the rock units underlying the site. Data were taken along the seismic lines using twenty-to thirty-three foot sensor spacings as shown on the enclosed air photo map of the site. A twenty-four channel seismic recording system was used to acquire the data.

DATA ACQUISITION

Data acquisition and recording was carried out using a Bison Series 9000, Model 9024 twenty-four channel seismograph. This unit records data on paper and in computer memory. Timing for the Bison 9024 is electronically controlled within the instrument.

Seismic vibrations were produced by striking a 20-pound hammer to a metal plate or by striking the ground with an accelerating eighty-pound mass.. The hammer blows were stacked and enhanced at each shot point. The number of blows varied according to the subsurface's capacity to propagate seismic energy. Time of shot (hammer blow) was provided by a trigger circuit attached to the hammer.

INTERPRETATIONS

In this refraction seismic investigation, the subsurface is mapped in terms of velocity units. A velocity unit is a three-dimensional unit which, due to its elastic properties and density, propagates seismic waves at a characteristic velocity or within a characteristic velocity range. Velocities denoted in this report and in the seismic refraction sections are expressed in feet per millisecond (fpms). At least one velocity is present within a geological rock unit. Each zone of weathering or zone of fracturing within a given rock unit could constitute an additional velocity unit. Conversely, when two rock units such as water saturated gravel and moderately weathered rock propagate seismic waves at the same velocity and are adjacent to each other, both units would be part of the same velocity unit.

In the interpretation of seismic data, the geologic setting is of major importance. The contact between soil and rock strata is ideally defined on a seismic profile as an abrupt change in velocities. Actually a geologic contact is often a gradational change in physical properties. Discontinuous velocities might result from variation in the degree of alteration in the form of physical and chemical weathering and should be considered in the interpretation of the data.

The seismic/geologic correlation chart below has been derived from the seismic refraction sections accompanying this report. The scope of this study did not include any reconnaissance or detailed geologic mapping, air photo interpretations or an in-depth field study of petrology and stratigraphy of the site. However, the bedrock units are discussed at some length by Kinkel, A.R., Jr., Hall, W.E., and Albers, J.P., in the Geological Survey Professional Paper 285 entitled Geology and Base-Metal Deposits of West Shasta Copper-Zinc District Shasta County, California. This information was used in interpreting the seismic sections and compiling the correlation table.

CORRELATION TABLE

Seismic Velocity in fpms	Inferred Geologic Unit	Rippability[1]
1.0 to 1.4	Unconsolidated surficial deposit.	Easily excavated
1.7 to 3.0	Intensely weathered rock.	Easily excavated or light ripping
4.0	Moderately weathered rock.	Medium ripping
5.7 to 10.0	Weaker or moderately sheared bedrock unit.	Very heavy ripping to not rippable
10.0 to 17.8 +	Masive bedrock.	Not rippable

Note [1]: Rippability based on performance of a Caterpillar D-8 tractor using a single shank ripper.

BIBLIOGRAPHY

Dobrin, M.B., 1960, Introduction to geophysical prospecting: McGraw-Hill, New York

Ewing, Maurice W., Jardetzky, Wenceslas S., and Press, Frank, 1957, Elastic waves in layered medias: McGraw-Hill, New York

Green, R., 1962, The hidden layer problem: Geoph. Prosp., 10, p. 166-177

Hagedoorn, J.G., 1959, The plus-minus method of interpreting seismic refraction section: Geoph. Prosp. 7, p. 158-182

Hawkins, L.V., 1961, The reciprocal method of routine shallow seismic refraction investigations: Geophysics 26, p. 806-819

Heiland, C.A., 1940, Geophysical exploration: Prentice Hall, New York, reprinted by Hafner Publication Co.

Jakosky, J.J., 1957, Exploration geophysics: Trija Publ. Co., Newport, CA

Kinkel, A.R., Jr., Hall, W.E., and Albers, J.P., Geological Survey Professional Paper 285, Geology and Base-Metal Deposits of West Shasta Copper-Zinc District, Shasta Co., CA

Leet, D.L., 1938, Practical seismology and seismic prospecting: D. Appleton-Century Co., New York

Levin, Franklyn K., and Ingram, John D., 1962, Headwaves from a bed of finite thickness: Geophysics 27, p. 753-765

Musgrave, albert W., editor, 1967, seismic refraction prospecting: Society of Exploration Geophysicists, Tulsa, OK

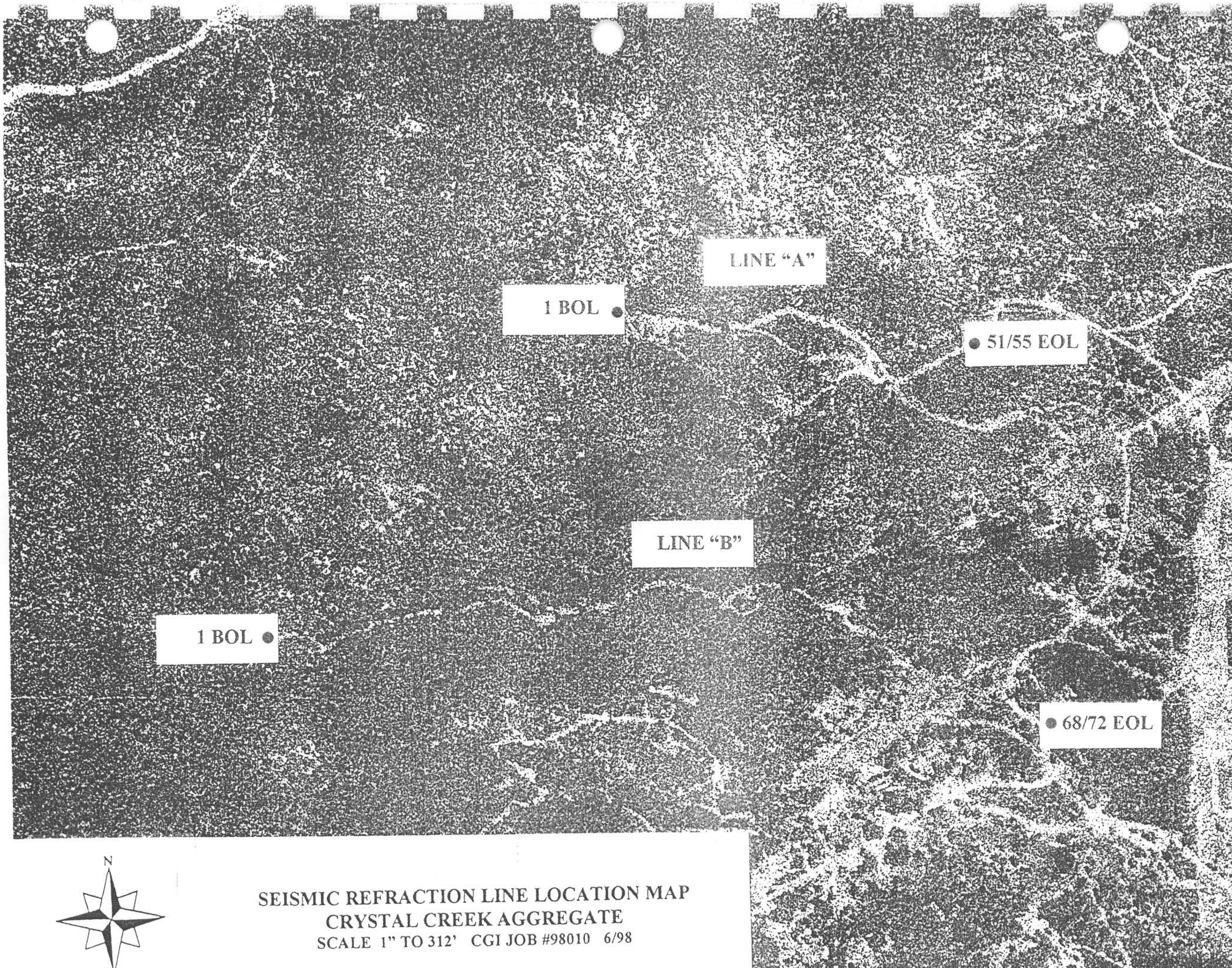
Nettleton, L.L., 1940, Geophysical exploration for oil: McGraw-Hill, New York

Redpath, B.B., 1973, Seismic refraction exploration for engineering site investigations: U.S. Army Engineer Waterways Experiment Station, Technical Report E-73-4

Soske, J.L., 1959, The blind zone problem in engineering geophysics: Geophysics 24, p. 359-365

APPENDIX

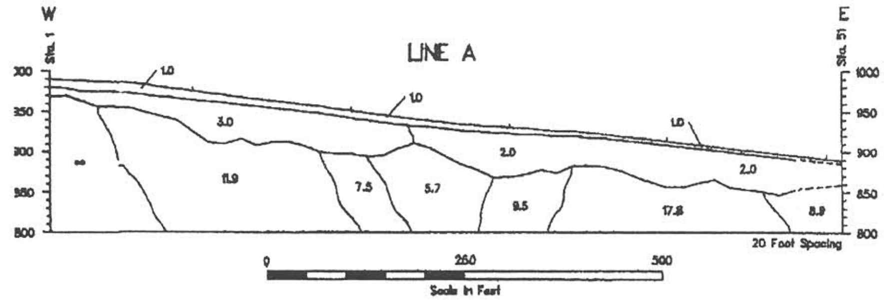
Rough Location Map (air photo)
Seismic Section A
Seismic Section B
Reproduced pages from Caterpillar Performance Handbook



SEISMIC REFRACTION LINE LOCATION MAP
CRYSTAL CREEK AGGREGATE
SCALE 1” TO 312’ CGI JOB #98010 6/98

Seismic Sections

Line A and B



CORRELATION TABLE

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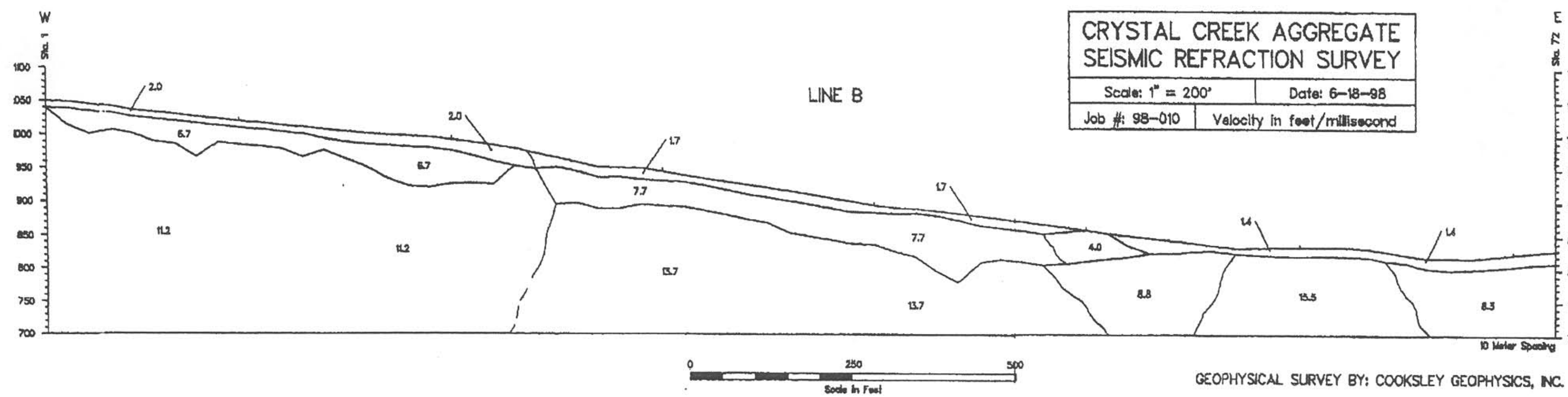
4.0	Moderately weathered rock	Medium ripping
5.7 to 10.0	Weaker or moderately sheared bedrock unit	Very heavy ripping to not rippable
10.0 to 17.8+	Massive bedrock	Not rippable

Note[1]: Rippability based on performance of a Caterpillar D-8 tractor using a single shank ripper



CRYSTAL CREEK AGGREGATE SEISMIC REFRACTION SURVEY	
Scale: 1" = 200'	Date: 6-18-98
Job #: 98-010	Velocity in feet/millisecond

GEOPHYSICAL SURVEY BY: COOKSLEY GEOPHYSICS, INC.

CATERPILLAR PERFORMANCE HANDBOOK

a CAT publication

by Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

OCTOBER 1982

Performance information in this booklet is intended for estimating purposes only. Because of the many variables peculiar to individual jobs (including material characteristics, operator efficiency, underfoot conditions, altitude, etc.), neither Caterpillar Tractor Co. nor its dealers warrant expressly or implicitly that the machines described will perform as estimated.

Materials and specifications are subject to change without notice.

CATERPILLAR

Printed in U.S.A.

Form AEKO8585

USE OF SEISMIC VELOCITY CHARTS

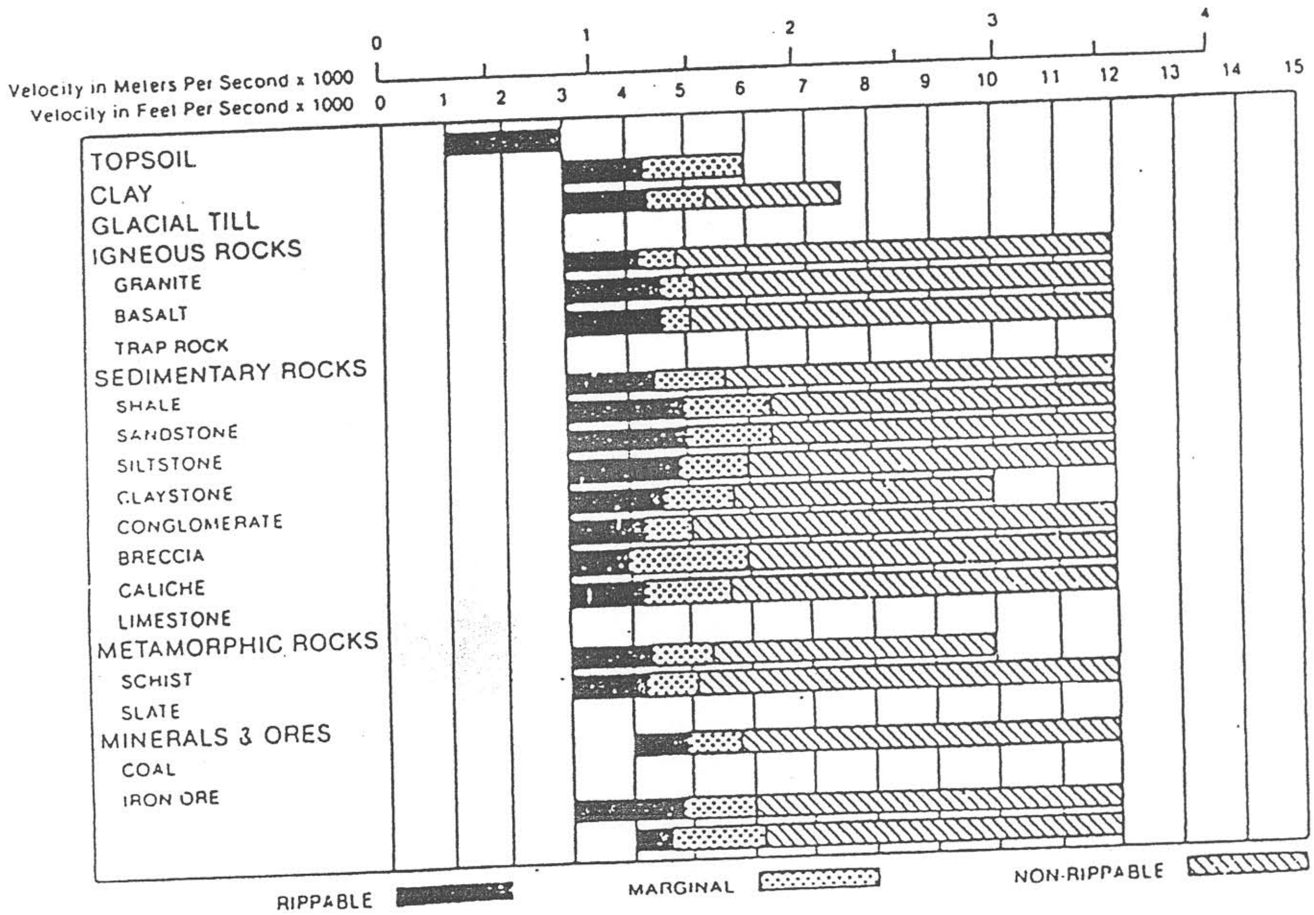
The charts of ripper performance estimated by seismic wave velocities have been developed from field tests conducted in a variety of materials. Considering the extreme variations among materials and even among rocks of a specific classification, the charts must be recognized as being at best only one indicator of rippability.

Accordingly, consider the following precautions when evaluating the feasibility of ripping a given formation:

- Tooth penetration is often the key to ripping success, regardless of seismic velocity. This is particularly true in homogeneous materials such as mudstones and claystones and the fine-grained caliches. It is also true in tightly cemented formations such as conglomerates, some glacial tills and caliches containing rock fragments.
- Low seismic velocities of sedimentaries can indicate probable rippability. However, if the fractures and bedding joints do not allow tooth penetration, the material may not be ripped effectively.
- Pre-blasting or "popping" may induce sufficient fracturing to permit tooth entry, particularly in the caliches, conglomerates and some other rocks; but the economics should be checked carefully when considering popping in the higher grades of sandstones, limestones and granites.

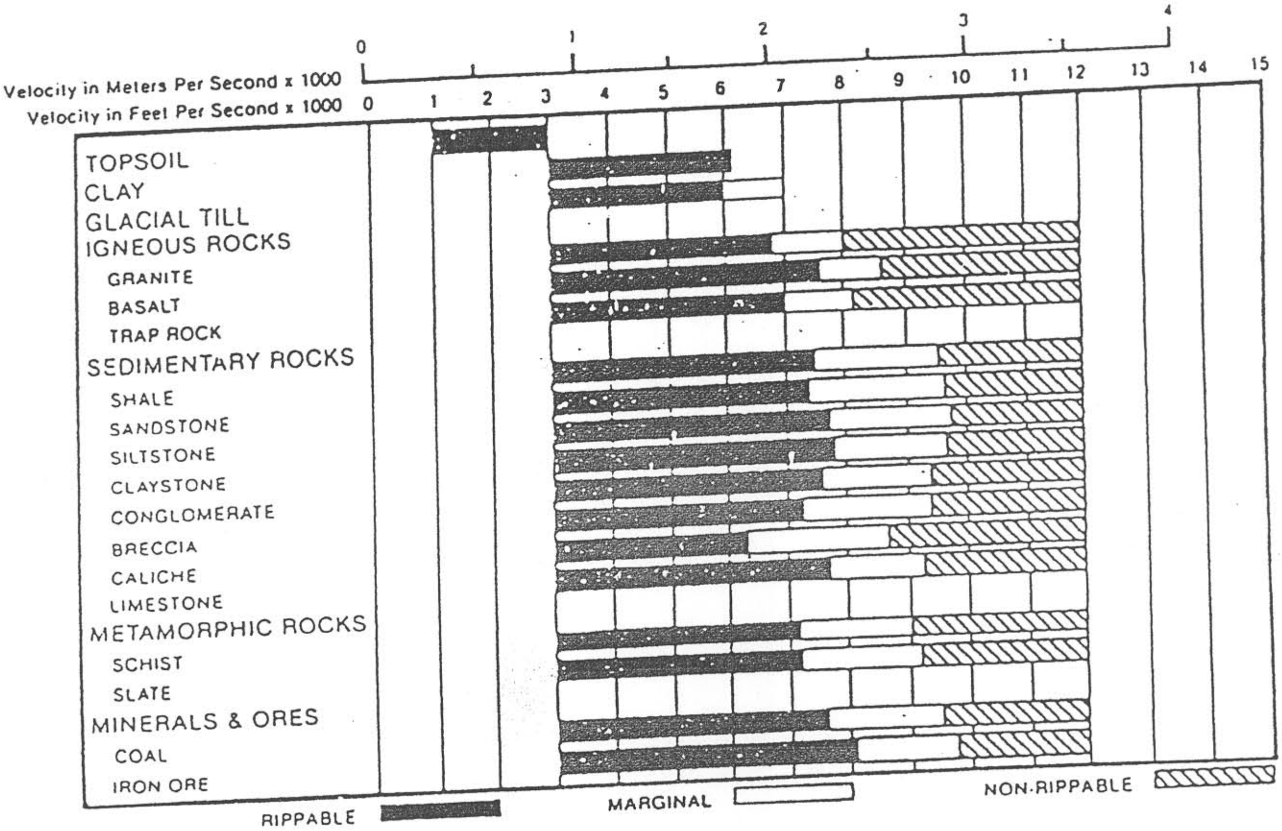
Ripping is still more art than science, and much will depend on the skill and experience of the tractor operator. Ripping for scraper loading may call for different techniques than if the same material is to be dozed away. If cross-ripping is called for, it, too, requires a change in approach. The number of shanks used, length and depth of shank and tooth angle, direction, throttle position — all must be adjusted according to field conditions encountered. Ripping success may well depend on the operator finding the proper combination for those conditions.

D7G Ripper Performance
- Estimated by Seismic Wave Velocities



D8L Ripper Performance

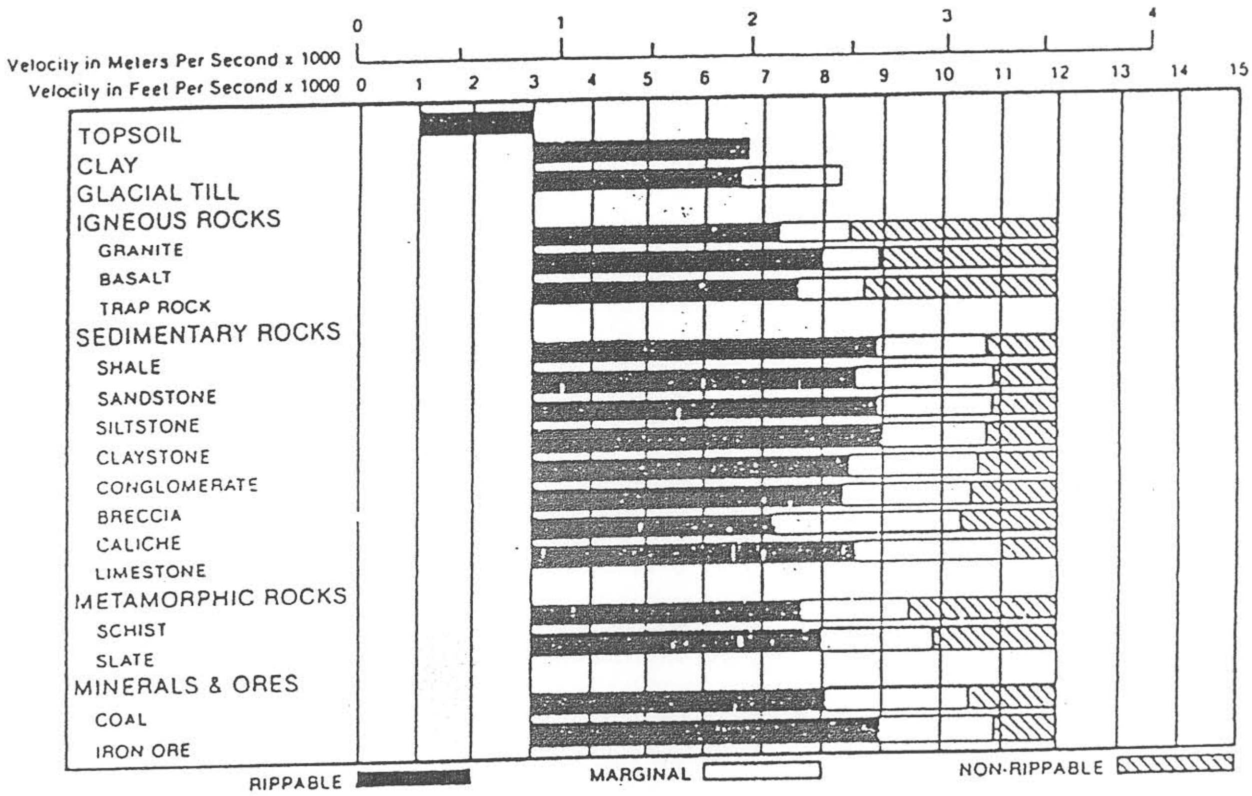
- Multi or Single Shank No. 8 Ripper
- Estimated by Seismic Wave Velocities



Rippers

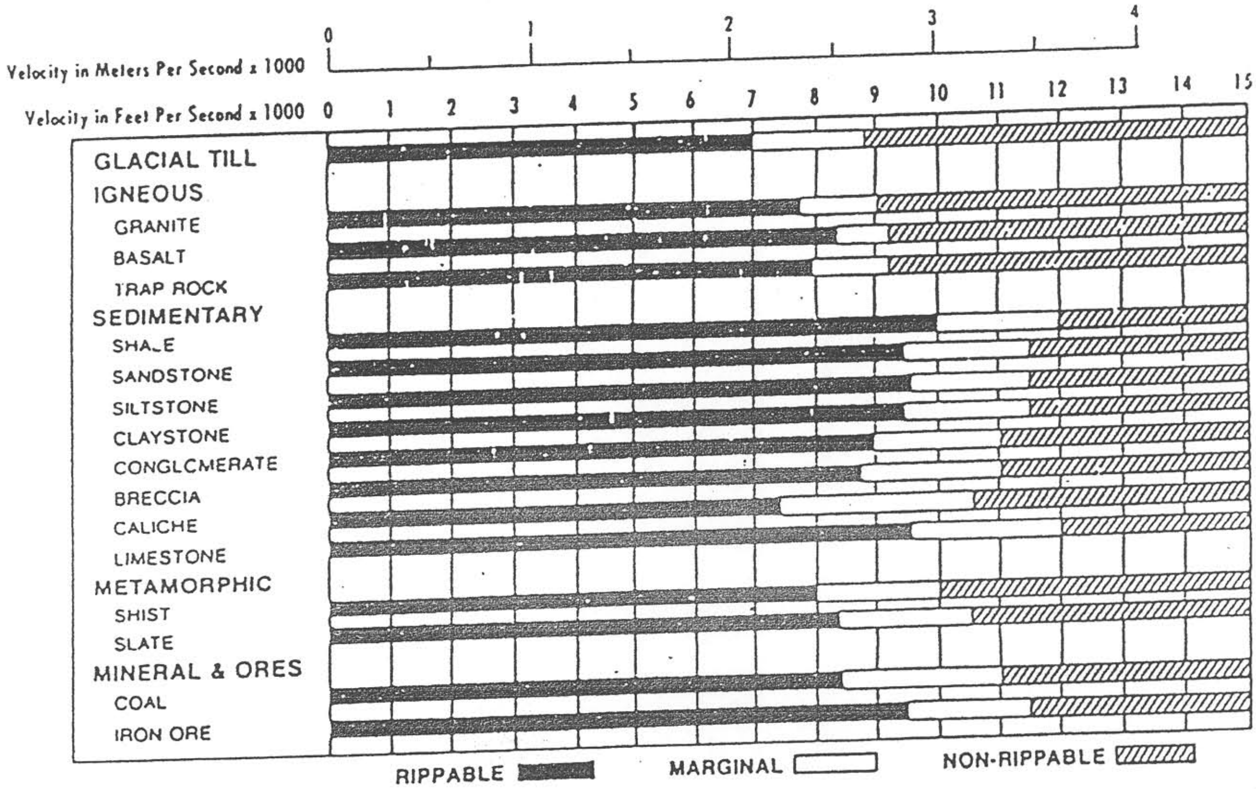
D9L Ripper Performance

- Multi or Single Shank No. 9 Ripper
- Estimated by Seismic Wave Velocities



D10 Ripper Performance

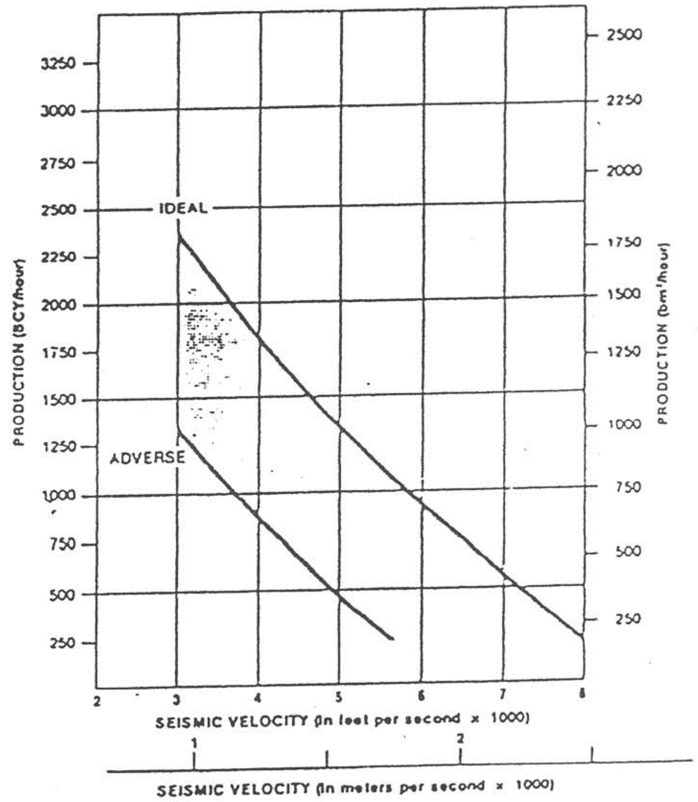
- Multi or Single Shank No. 10 Ripper
- Estimated by Seismic Wave Velocities



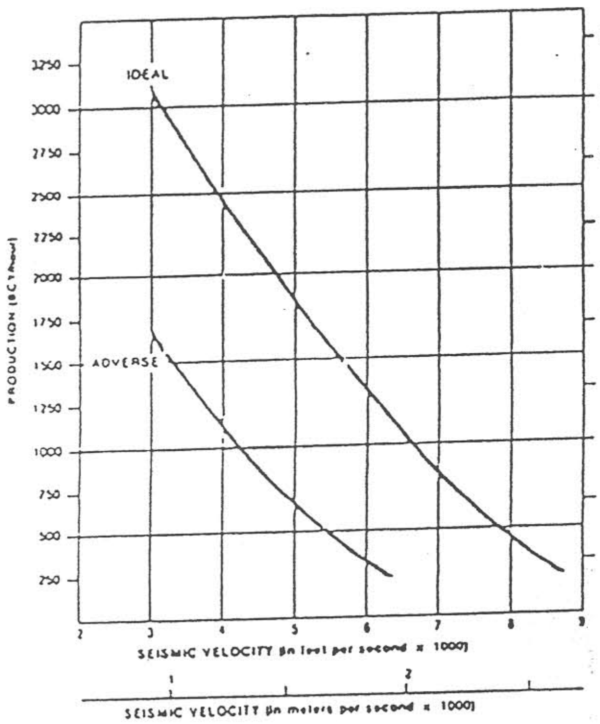
Considerations for using production estimating graphs:

- Machine rips full-time.— no dozing.
- Power shift tractors with single shank rippers.
- 100% efficiency (60 min. hour).
- Charts are for all classes of material.
- In igneous rock with seismic velocity of 8000 fps or higher for the D10, and 6000 fps or higher for the D9 and D8, the production figures shown should be reduced by 25%.
- Upper limit of charts reflect ripping under ideal conditions only. If conditions such as thick lamination, vertical lamination or any factor which would adversely affect production are present, the lower limit should be used.

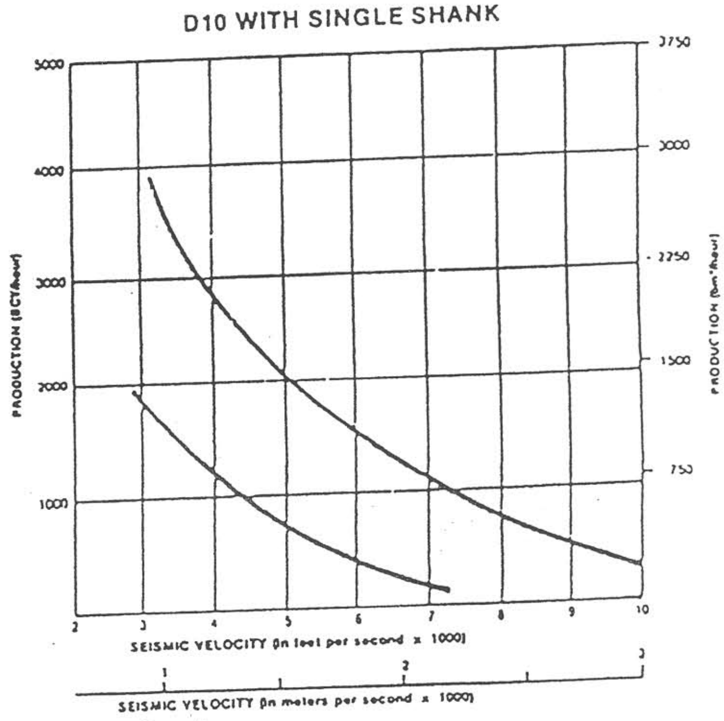
D8L WITH SINGLE SHANK



D9L WITH SINGLE SHANK



D10 WITH SINGLE SHANK



Materials Testing, Inc.

8798 Airport Road
Redding, California 96002
(530) 222-1116, fax 222-1611

865 Cotting Lane, Suite A
Vacaville, California 95688
(707) 447-4025, fax 447-4143

Client No. 380
22 October 2007

Crystal Creek Aggregate, Inc.
Mr. Jerry Comingdeer
10936 Iron Mountain Road
Redding, CA 96001

Subject: CCA Quarry Expansion
Shasta County, California
GLOBAL SLOPE STABILITY ANALYSIS

References:

1. Amendment to Reclamation Plan No. 1-90
   By: Duane K. Miller Civil Engineer, Inc.
   Dated: July 10, 2007 Sheets 1-6

2. Geological Engineering Investigation
   By: Cooksley Geoscience, LLC
   Dated: January 2007

Dear Mr. Comingdeer:

At your request, **MATERIALS TESTING, INC.** reviewed the referenced plans and performed a global slope stability analysis on the proposed cut slopes west of the existing Crystal Creek Aggregate quarry in Shasta County, California.

The expansion pit is proposed to be a maximum of three hundred and forty (340) feet in vertical height. Individual benches are proposed to have a width of thirty (30) feet with a height of twenty four (24) feet laid back at an inclination of ¼ to 1 (horizontal to vertical). This configuration of benching yields an overall cut slope of 1.5 to 1. The grade appears to drain surface water to the west away from the slope.

Our field investigation consisted of visual observations of the native topography along with obtaining representative samples of the rock and slope soil. A disturbed bulk soil sample was obtained for material classification. A relatively undisturbed rock sample was cored for compressive strength and bulk specific gravity performed in accordance with ASTM D2938 and ASTM C127, respectively. Sieve analysis testing ASTM C136 (particle size distribution) was performed on the bulk soil sample as well as Atterberg Limits Testing (ASTM D4318). The surface soils consist of moist light brown silty clayey sand with gravel. A summary of all laboratory test results is presented on the attached data sheets.

Cross sections were developed from the referenced plans and the subsurface stratigraphy was plotted by extrapolation of the seismic lines shown in Reference #2. Three slope stability analyses were performed utilizing data from the referenced reclamation plan and laboratory testing on samples taken during our field investigation. Information gathered from the field investigation coupled with the plans indicates that the rock and soils vary along the proposed cut slopes. An analysis of the slopes was performed at the tallest point of the quarry expansion and along the referenced seismic lines A and B. It was assumed that water would infiltrate the soil from the surface for a more conservative analysis.

The analysis was performed with the aid of an integrated slope stability analysis program known as XSTABL version 5 utilizing the Janbu method of slices. The attached sheets contain all the laboratory data and location of the cross sections analyzed. Based on our field and laboratory test results, the following conservative strength parameters were utilized in the analysis:

Soil Layer	Velocity (f.p.m.s.)	Unit Weight (p.c.f.)	Friction Angle (deg)	Cohesion (p.s.f.)
1	1.0	111.3	20	100
2	2.0	111.3	24	100
3	3.0	140.0	28	250
4	6.7	140.0	30	400
5	11.2	169.0	40	200
6	11.9	169.0	40	200
7	∞	169.0	40	200

Based on the conditions analyzed, the proposed cut slopes were calculated to have a factor of safety greater than 1.50. A seismic coefficient of 0.15 was then added to the analysis and a factor of safety greater than 1.15 was obtained. An acceptable factor of safety for a static condition is 1.50 and 1.15 for a dynamic condition.

Based on our analysis with the information presented above, it is the opinion of **MATERIALS TESTING, INC.**, that the cut slopes will perform adequately. However, proper positive surface drainage and erosion control measures must be maintained by the property owners at all times. Irrigation and rainfall water must be collected and directed to a suitable drainage facility and water must not be allowed to flow over the top of the slope. It is probable that surface and near surface incremental movement will occur, especially in exposed weathered bedrock. It is recommended that observation of the slopes be performed during and after construction for suitable recommendations.

Should you have any questions relating to the contents of this letter or should you require additional information, please contact our office at your convenience.

Reviewed By:

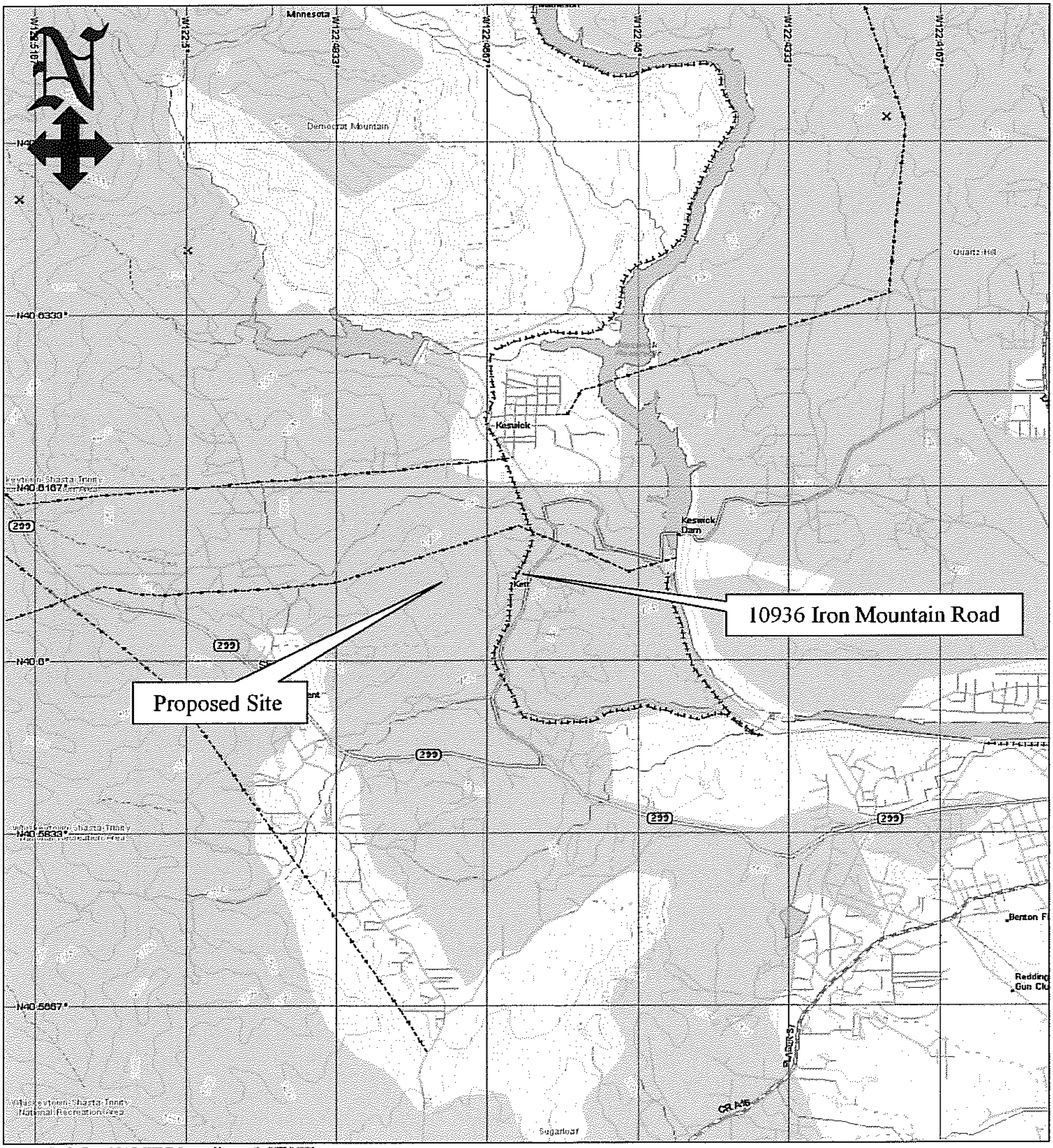
REGISTERED PROFESSIONAL ENGINEER
DOUGLAS G. KING
No. 33981
Exp. 12/31/08
CIVIL
STATE OF CALIFORNIA

Douglas G. King, P.E.
Principal Engineer

Respectfully Submitted,
KC ENGINEERING COMPANY

Andrew L. King
Staff Engineer

Copies: 2 to Client
1 to Cooksley Geoscience, LLC
1 e-copy to Duane K. Miller Civil Engineer, Inc.
1 e-copy to Bill Walker, Shasta County
1 e-copy to Keith Hamblin, Travis Deem



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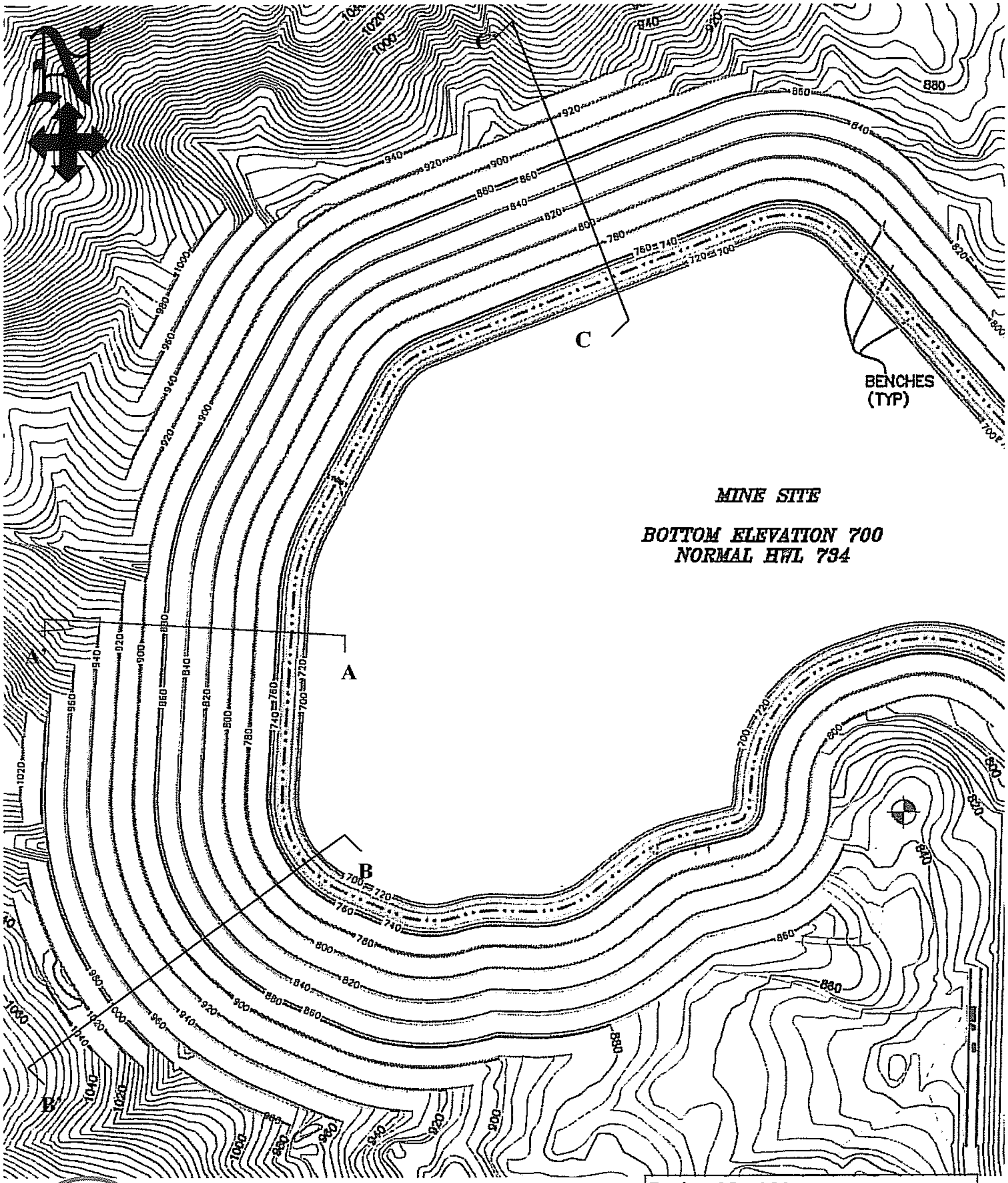
Project No. 380
Proposed CCA Quarry Expansion
Shasta County, California
Figure No. 1 - "Vicinity Map"



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Project No. 380
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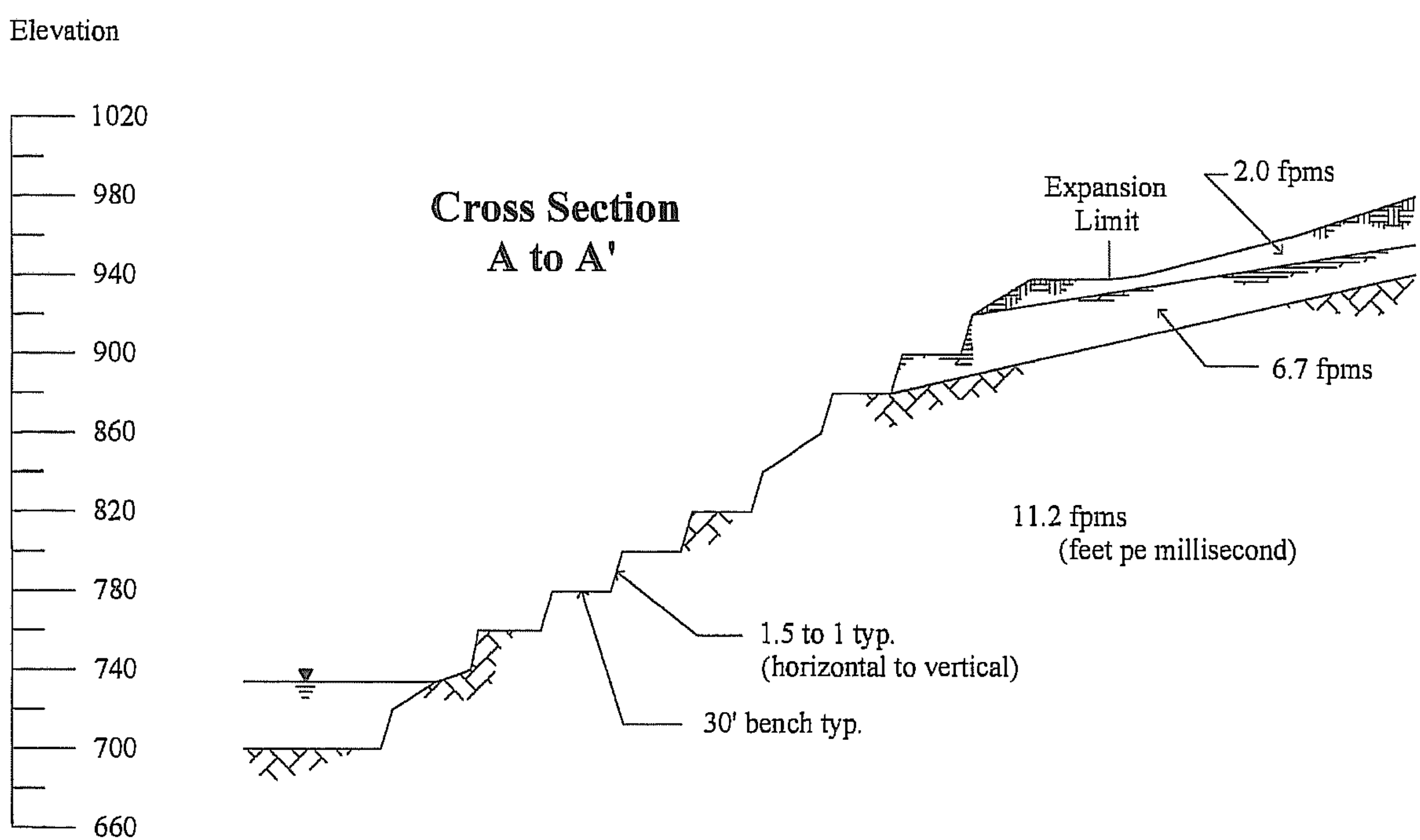
Shasta County, California
Figure No. 2 - "Site Map"



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Project No. 380
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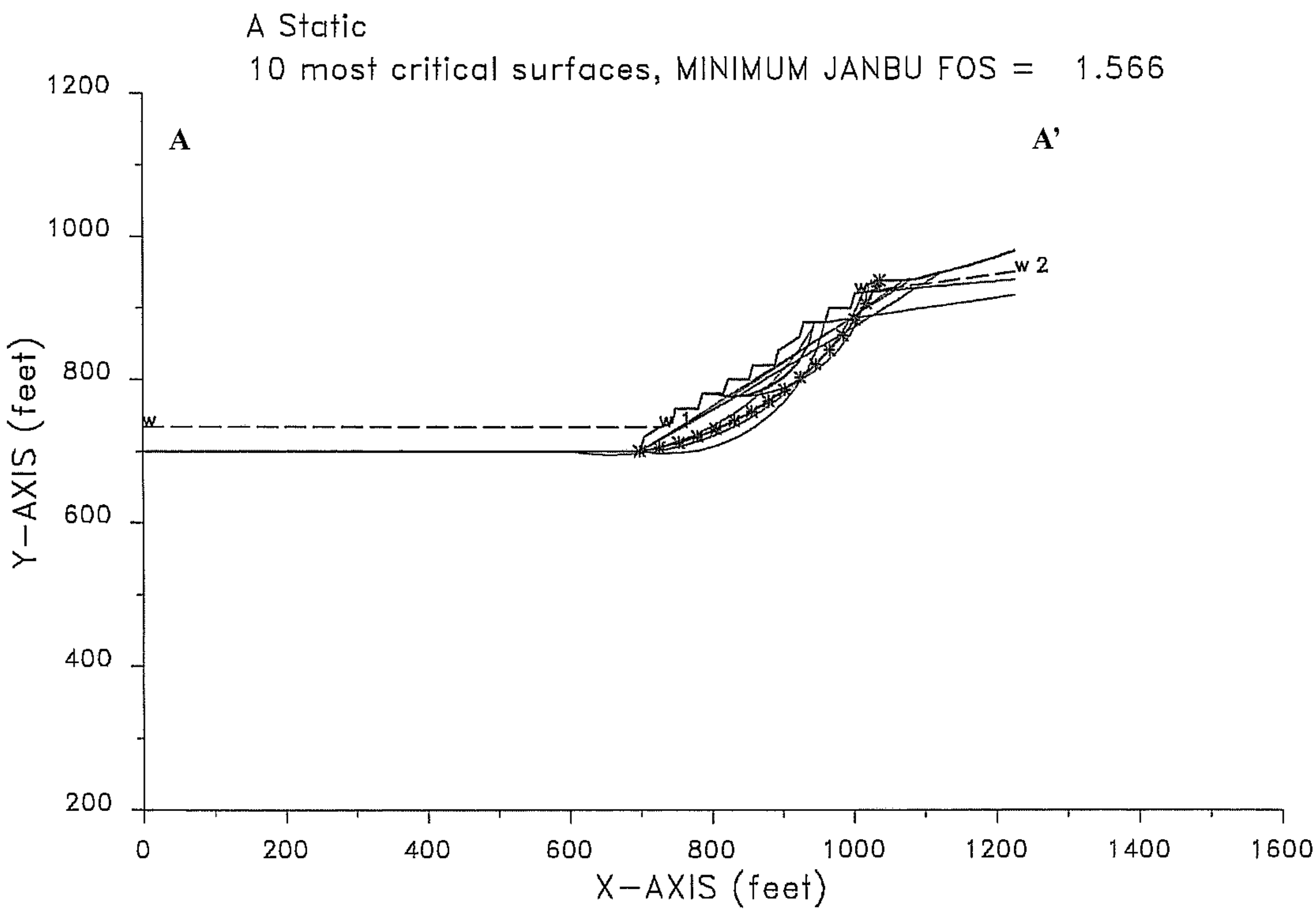
Figure No. 3 - "Cross Section- A to A' "



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Shasta County, California
Figure No. 4 - "Critical Surface- A to A' Static"

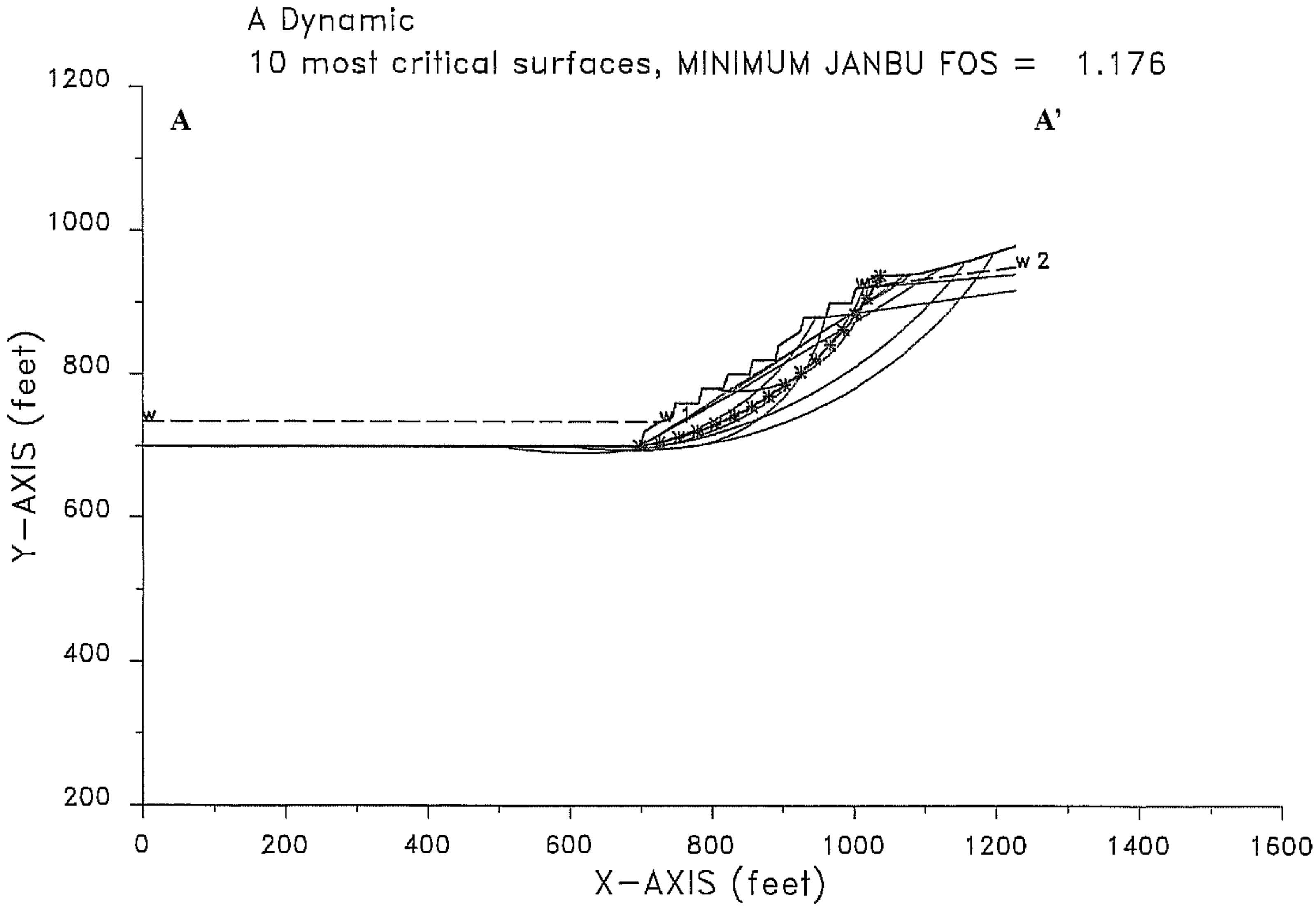

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Figure No. 5 - "Critical Surface- A to A' Dynamic"

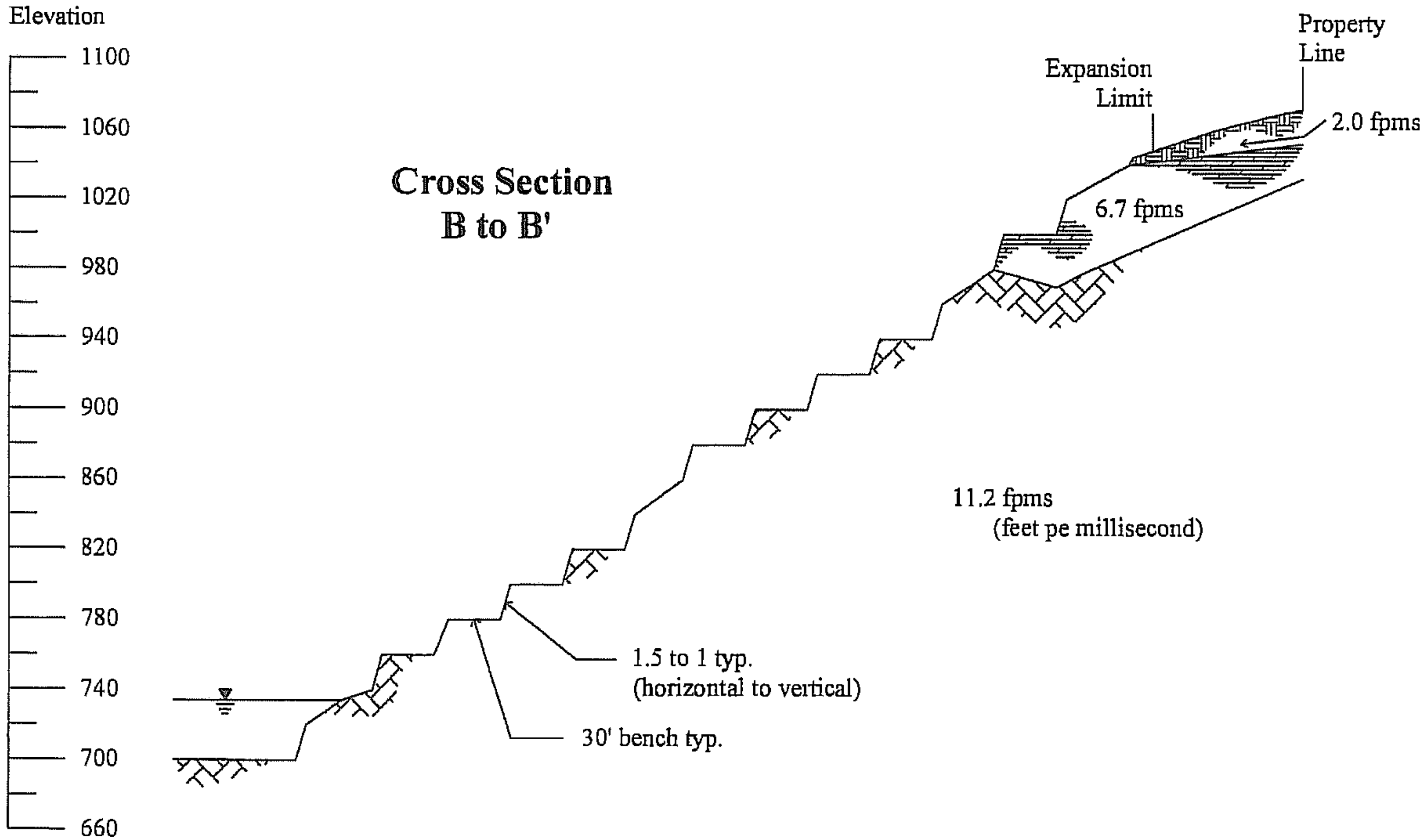

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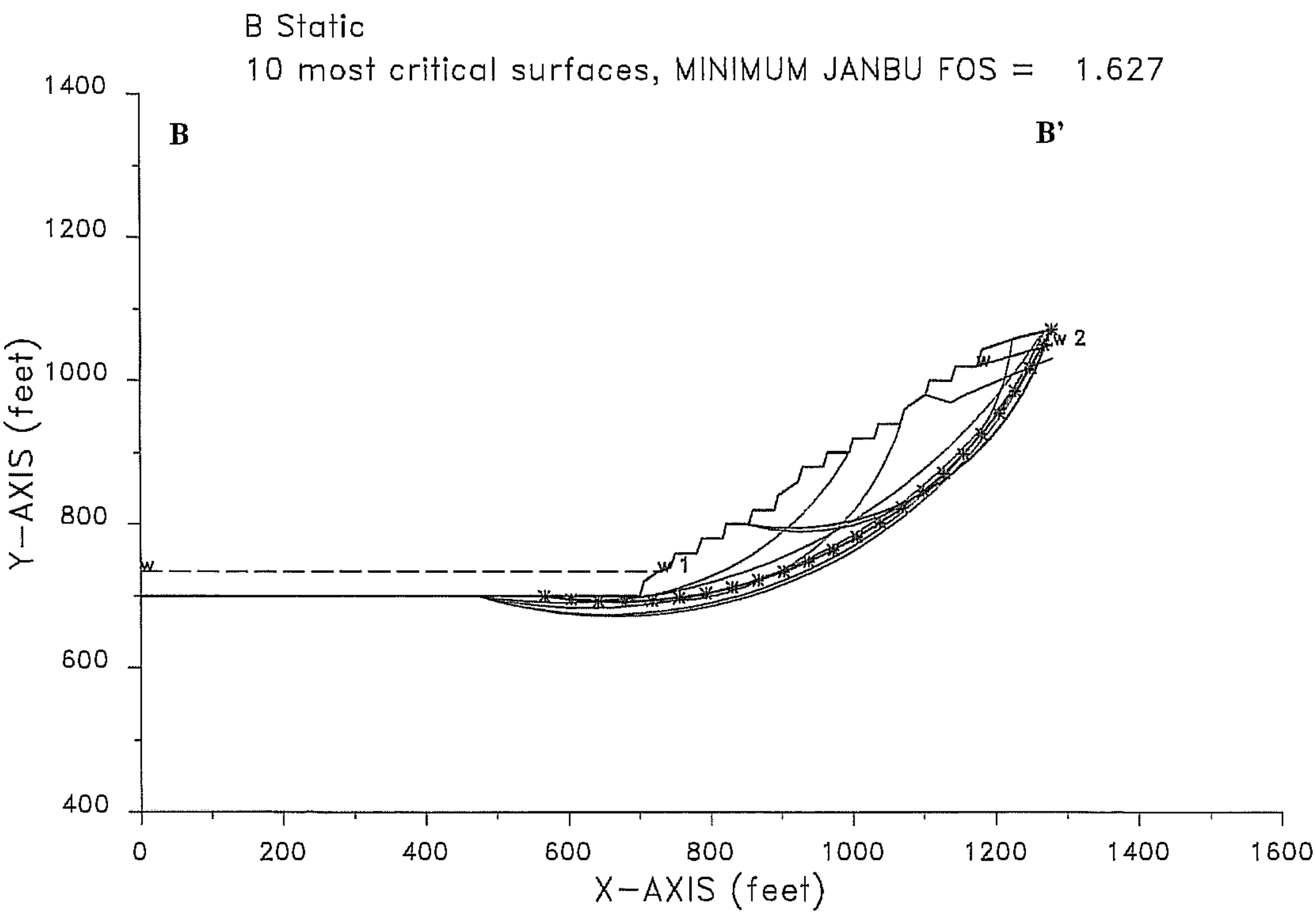
Figure No. 6 - "Cross Section- B to B' "



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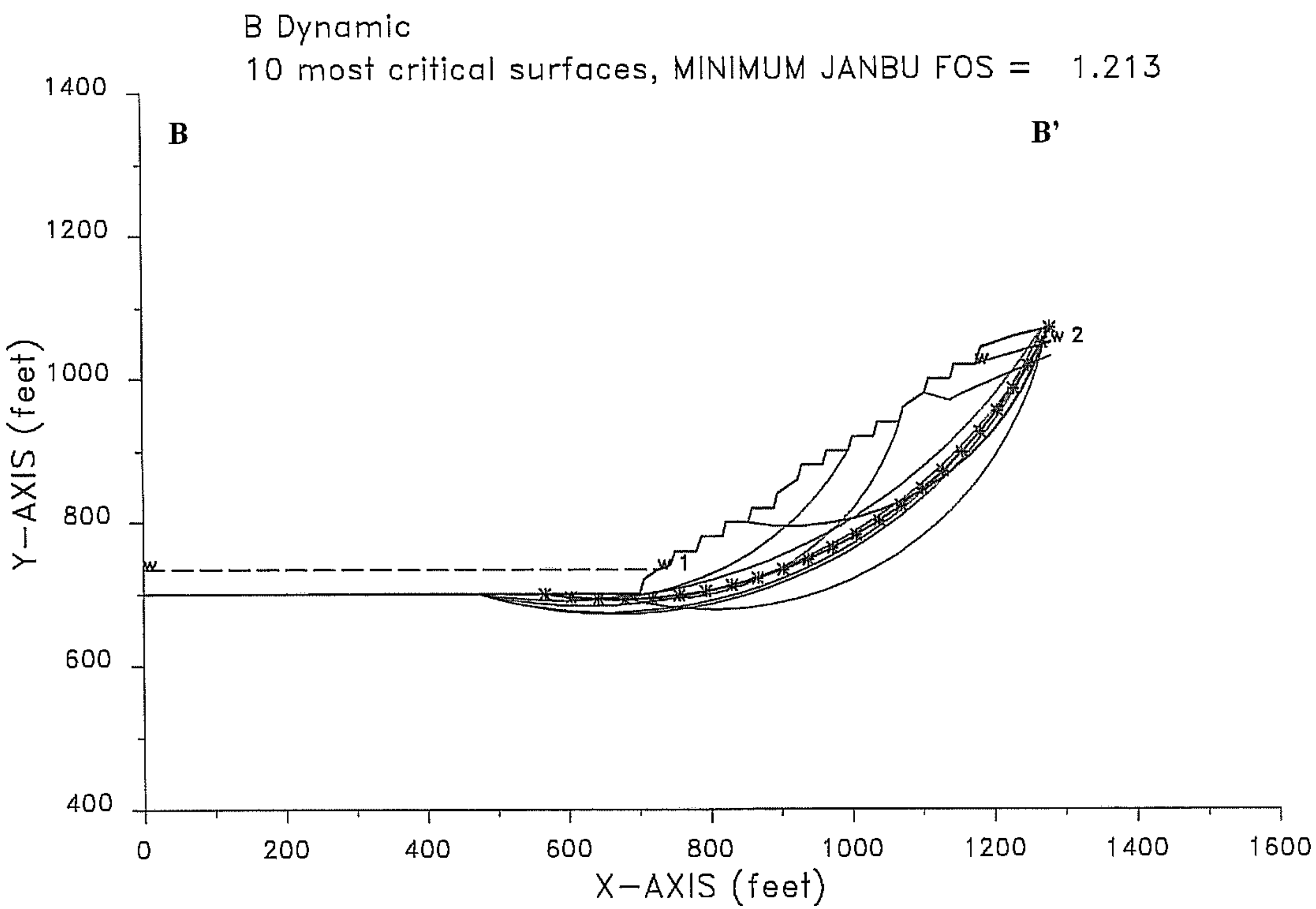
Project No. 380
Proposed CCA Quarry Expansion
Shasta County, California
Figure No. 7 - "Critical Surface- B to B' Static"



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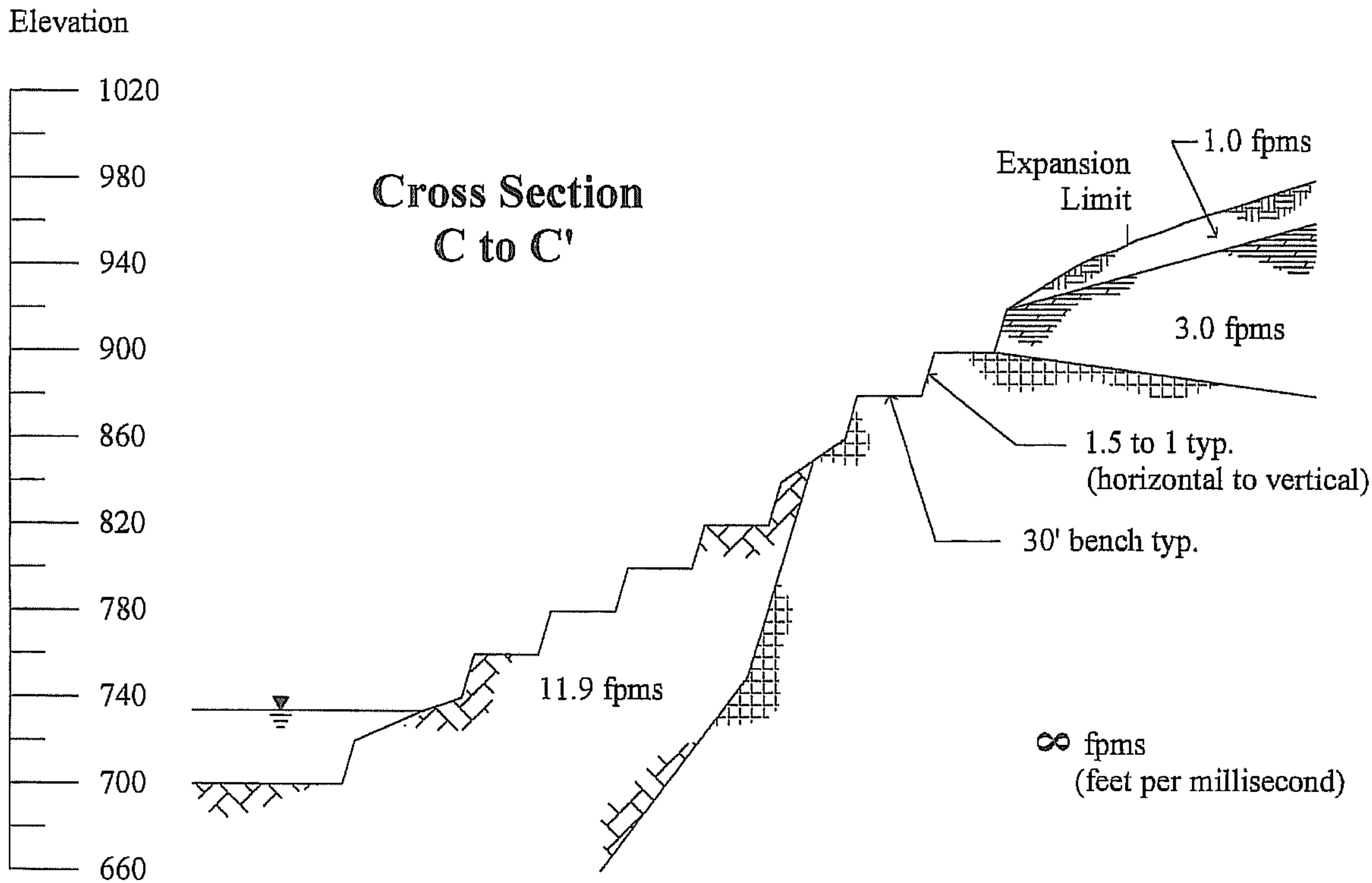
Project No. 380
Proposed CCA Quarry Expansion
Shasta County, California
Figure No. 8 - "Critical Surface- B to B' Dynamic"



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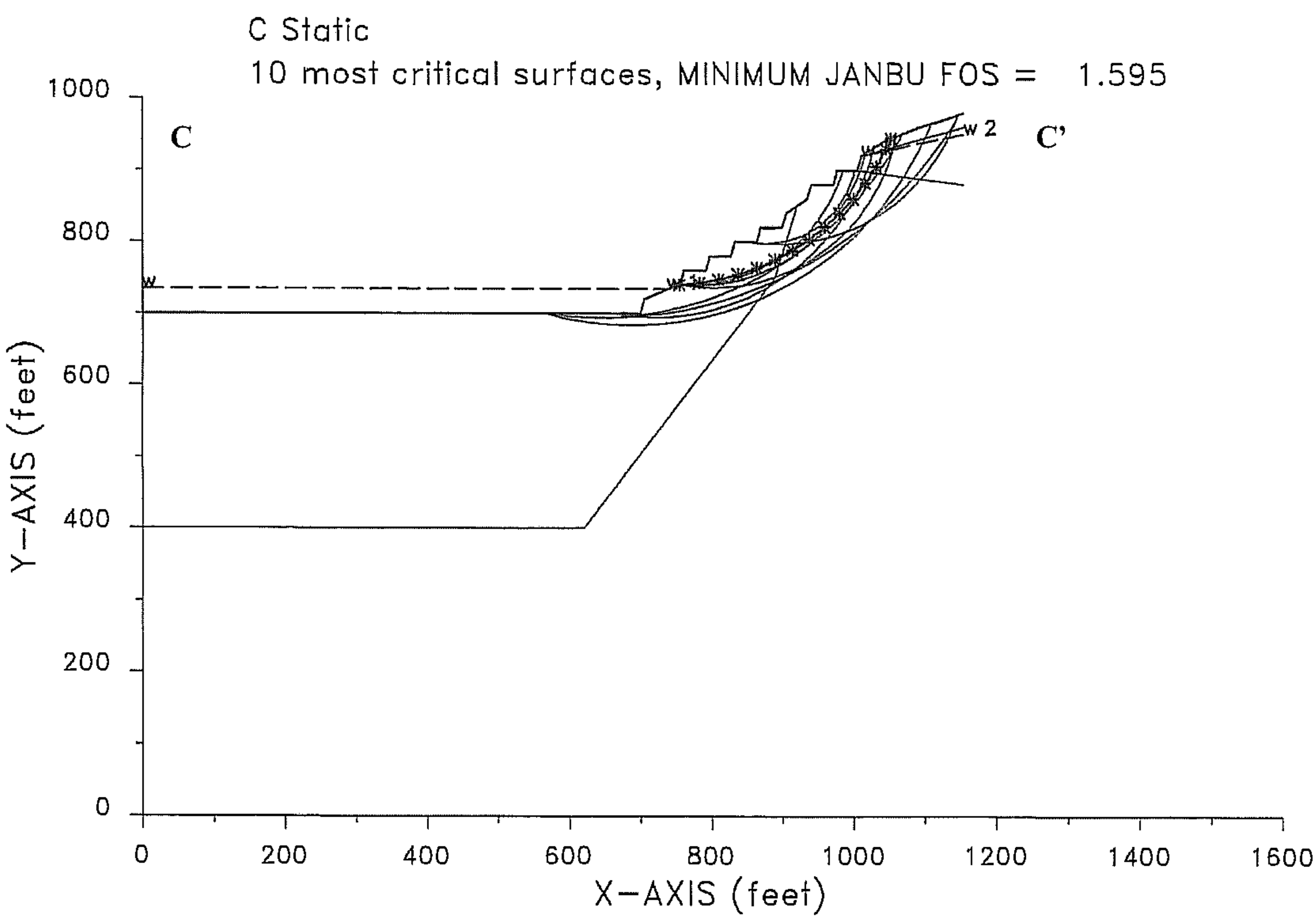
Project No. 380
Proposed CCA Quarry Expansion
Shasta County, California
Figure No. 9 - "Cross Section- C to C' "



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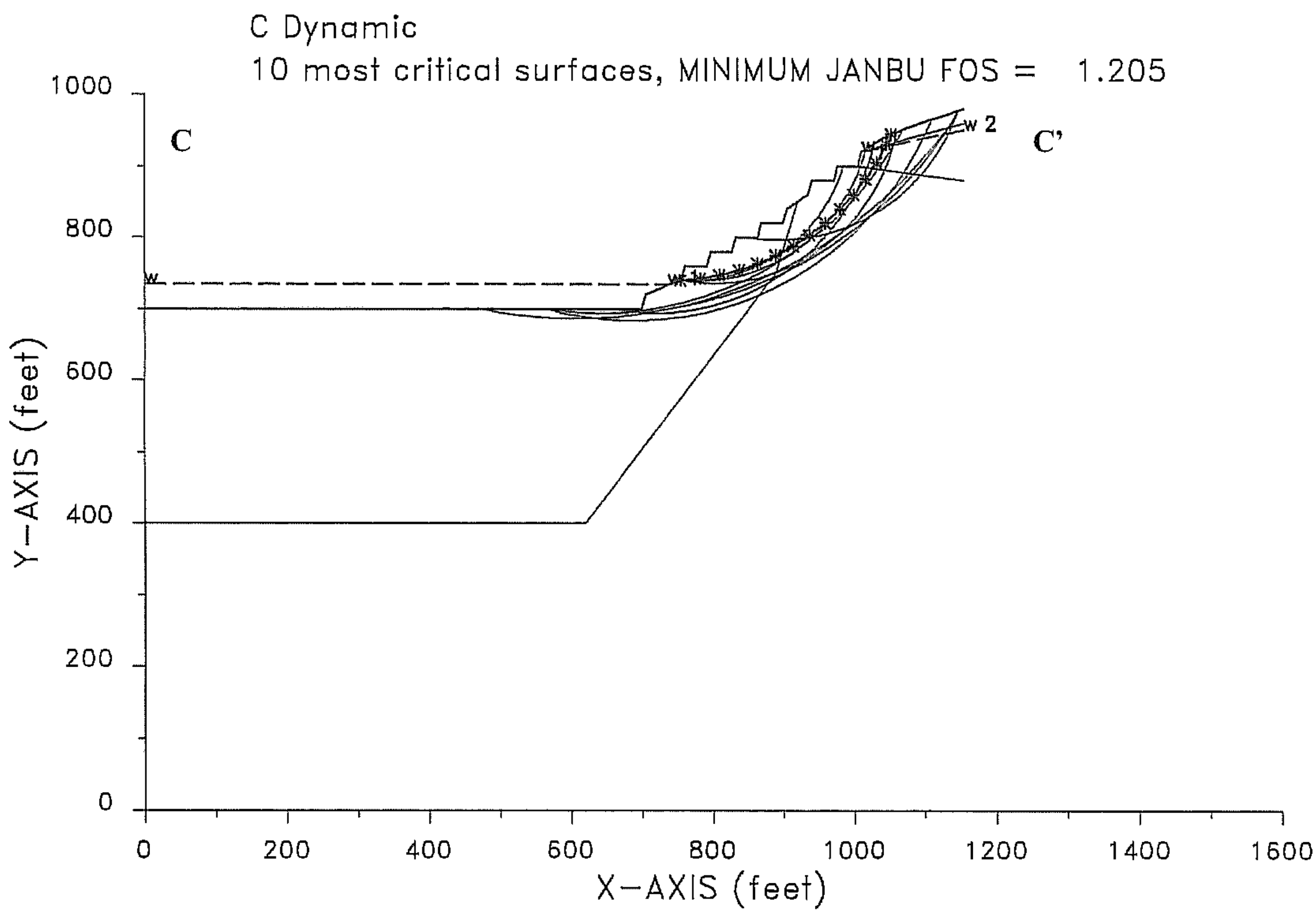
Project No. 380
Proposed CCA Quarry Expansion
Shasta County, California
Figure No. 10 - "Critical Surface- C to C' Static"



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Project No. 380
Proposed CCA Quarry Expansion
Shasta County, California
Figure No. 11 - "Critical Surface- C to C' Dynamic"

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Client:	Crystal Creek Aggregate, Inc. 10936 Iron Mountain Road Redding, CA 96001	Date: Client No: Report No:	10/09/07 0380-002 0104-010

Project: Quarry Expansion
Description: Quality Testing

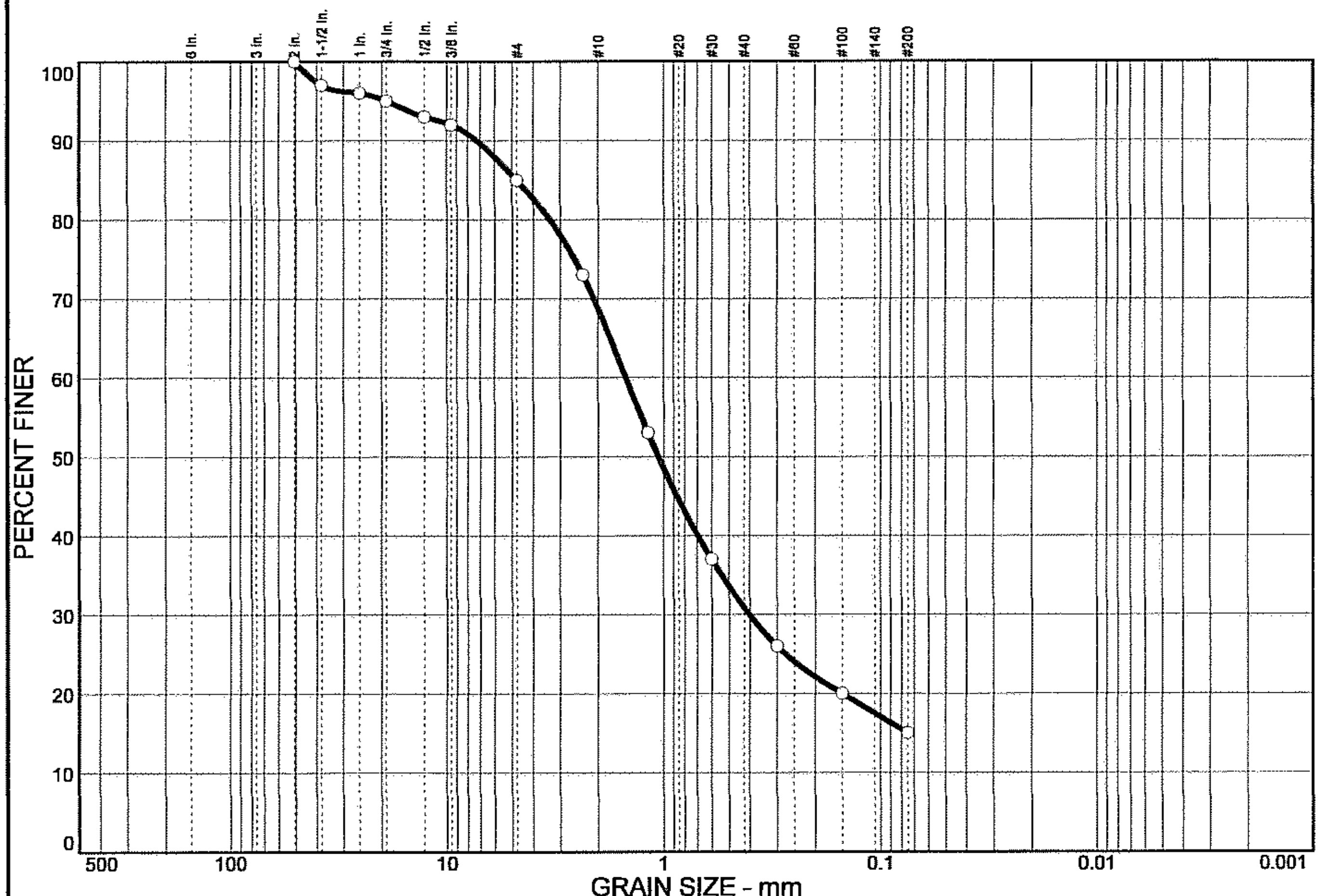
UNCONFINED COMPRESSIVE STRENGTH DATA OF ROCK CORE SPECIMENS (ASTM D-2938)

Identification	1-A	1-B	1-C	
Date Received	10/02/07	10/02/07	10/02/07	
Date Tested	10/03/07	10/03/07	10/03/07	
Diameter	2.00	2.00	2.00	
X-Sect. Area, in^2	3.14	3.14	3.14	
Trimmed Length, in.	4.00	4.00	4.00	
L/D	2.00	2.00	2.00	
Max. Load, lbs.	38,852	70,420	38,011	
Compr. Strength, psi	12,380	22,430	12,110	
Fracture Type				

Remarks:

Cored Specimens obtained and tested in accordance with ASTM D4543.
SSD Bulk Specific Gravity (ASTM C127) = 2.711

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL	% SAND	% SILT	% CLAY
0.0	15.0	70.0	15.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2 in.	100.0		
1-1/2 in.	97.0		
1 in.	96.0		
3/4 in.	95.0		
1/2 in.	93.0		
3/8 in.	92.0		
#4	85.0		
#8	73.0		
#16	53.0		
#30	37.0		
#50	26.0		
#100	20.0		
#200	15.0		

* (no specification provided)

Soil Description

Light Brown Silty Clayey Sand with Gravel

Atterberg Limits

PL= 23 LL= 29 PI= 6

Coefficients

D_{85}= 4.75 D_{60}= 1.49 D_{50}= 1.06
D_{30}= 0.403 D_{15}= 0.0750 D_{10}=
C_u= C_c=

Classification

USCS= SC/SM AASHTO= —

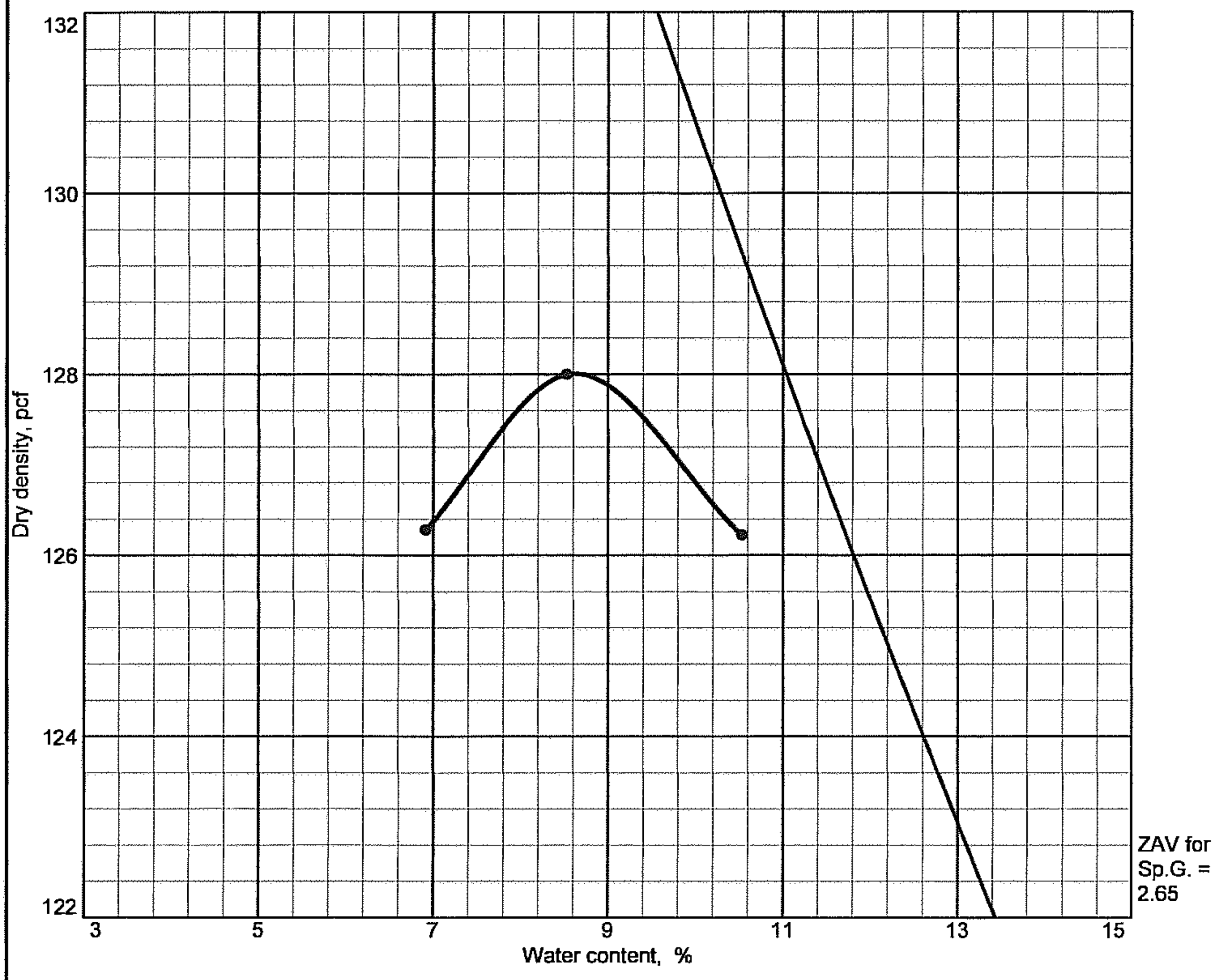
Remarks

Sample No.: 2 **Source of Sample:** Quarry Expansion (10/03/07) **Date:** 10/03/07
Location: **Elev./Depth:** —

MTI Materials Testing, Inc.

Client: Crystal Creek Aggregate
Project: Quarry Expansion
Project No: 0380-004 **Report Number:** 0400-009

COMPACTION TEST REPORT



Test specification: ASTM D 1557-02 Procedure A Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	SC/SM						15.0	15

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 128.0 pcf Optimum moisture = 8.6 %	Light Brown Silty Clayey Sand with Gravel

Project No. 0380-004 **Client:** Crystal Creek Aggregate
Project: Quarry Expansion

● **Source:** Quarry Expansion **Sample No.:** 2

MTI Materials Testing, Inc.

Remarks:
Curve #1 (10-03-07)

Report Number: 0400-011

APPENDIX B

Laboratory Testing

APPENDIX B
LABORATORY TESTING

Laboratory Analyses

Laboratory tests were performed on selected bulk soil samples to estimate engineering characteristics of the various earth materials encountered. Testing was performed under procedures described in one of the following references:

- ASTM Standards for Soil Testing, latest revision;
- Lambe, T. William, Soil Testing for Engineers, Wiley, New York, 1951;
- Laboratory Soils Testing, U.S. Army, Office of the Chief of Engineers, Engineering Manual No. 1110-2-1906, November 30, 1970.

Uniaxial Unconfined Compression Test

Uniaxial unconfined compression tests were performed on seven rock samples obtained during field evaluations in accordance with standard test method 7012. The results of the tests are attached as the plate labeled Rock Core Compressive Strength Data.

Naturally Occurring Asbestos Tests

Naturally occurring asbestos tests were performed on two composite samples in accordance with standard test method CARB 435. Results of the tests are attached to this appendix.

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Client:	BAJADA Geosciences, Inc. 28301 Inwood Road Shingletown, CA 96088	Date:	06/07/19
		Client No:	3237-026
		Report No:	0100-001
Project:	CCA Expansion Shasta County, California	Page:	1 of 2
Location:	Job # 1901.0114		

ROCK CORE COMPRESSIVE STRENGTH DATA
(ASTM D7012 Method C)

Hole #	Site 1-1	Site 1-2	Site 2-1	Site 2-2
Material	Greenstone	Trondhjemite	Greenstone	Greenstone
Date Cored	06/04/19	06/03/19	06/04/19	06/04/19
End Preparation Date:	06/04/19	---	06/04/19	06/04/19
Date Tested	06/07/19	---	06/07/19	06/07/19
Bagged Age in Days	3	---	3	3
Average Diameter, in	1.99	---	2.00	2.00
Cross Sect. Area, in^2	3.11	---	3.14	3.14
Trimmed Length, in	2.2	---	2.3	2.4
L/D Factor	1.11	---	1.15	1.20
Maximum Load, lbs.	61,610	---	63,180	58,240
Time to Failure, min.	7:36	---	7:30	5:00
Compr. Strength, psi	19,810	---	20,120	18,550
Fracture Pattern, Type	2	---	2	1

Notes: Specimens prepared in accordance with ASTM D4543.

Tested by Ricky Mathews.

Materials Testing, Inc.

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(707) 447-4025, fax 447-4143

Client: BAJADA Geosciences, Inc.
28301 Inwood Road
Shingletown, CA 96088
Project: CCA Expansion Shasta County, California
Location: Job# 1901.0114

Date: 06/07/19
Client No: 3237-026
Report No: 0100-001

ROCK CORE COMPRESSIVE STRENGTH DATA
(ASTM D7012 Method C)

Hole #	Site 4-1	Site 4-2	Site 4-3	Site 4-4
Material	Greenstone	Amphibolite	Trondhjemite	Trondhjemite
Date Cored	06/03/19	06/0319	06/03/19	06/03/19
End Preparation Date:	06/04/19	06/04/19	06/04/19	06/04/19
Date Tested	06/07/19	06/07/19	06/07/19	06/07/19
Bagged Age in Days	3	3	3	3
Average Diameter, in	1.99	1.99	1.99	2.00
Cross Sect. Area, in^2	3.11	3.11	3.11	3.14
Trimmed Length, in	2.2	2.2	2.2	2.3
L/D Factor	1.11	1.11	1.11	1.15
Maximum Load, lbs.	4,300	47,590	1,220	2,790
Time to Failure, min.	0:05	4:27	0:40	0:50
Compr. Strength, psi	1,380	15,300	390	890
Fracture Pattern, Type	2	3	3	4

Notes: Specimens prepared in accordance with ASTM D4543.

Respectfully Submitted,
MATERIALS TESTING, INC.

Andrew L. King
Project Engineer

Tested by Ricky Mathews.

ASBESTOS TEM LABORATORIES, INC.

CARB Method 435
Polarized Light Microscopy
Analytical Report

<u>Laboratory Job # 96-02884</u>

630 Bancroft Way
Berkeley, CA 94710
(510) 704-8930
FAX (510) 704-8429

Jun/07/2019

Jim Bianchin
Bajada Geosciences, Inc.
28301 Inwood Road
Shingletown, CA 96088

RE: LABORATORY JOB # 96-02884
Polarized light microscopy analytical results for 2 bulk sample(s).
Job Site: 1901.0114
Job No.: Crystal Creek Aggregate

Enclosed please find the bulk material analytical results for one or more samples submitted for asbestos analysis. The analyses were performed in accordance with the California Air Resources Board (ARB) Method 435 for the determination of asbestos in serpentine aggregate samples.

Prior to analysis, samples are logged-in and all data pertinent to the sample recorded. The samples are checked for damage or disruption of any chain-of-custody seals. A unique laboratory ID number is assigned to each sample. A hard copy log-in sheet containing all pertinent information concerning the sample is generated. This and all other relevant paper work are kept with the sample throughout the analytical procedures to assure proper analysis.

Sample preparation follows a standard CARB 435 prep method. The entire sample is dried at 135-150 C and then crushed to ~3/8" gravel size using a Bico Chipmunk crusher. If the submitted sample is >1 pint, the sample was split using a 1/2" riffle splitter following ASTM Method C-702-98 to obtain a 1 pint aliquot. The entire 1 pint aliquot, or entire original sample, is then pulverized in a Bico Braun disc pulverizer calibrated to produce a nominal 200 mesh final product. If necessary, additional homogenization steps are undertaken using a 3/8" riffle splitter. Small aliquots are collected from throughout the pulverized material to create three separate microsope slide mounts containing the appropriate refractive index oil. The prepared slides are placed under a polarizing light microscope where standard mineralogical techniques are used to analyze the various materials present, including asbestos. If asbestos is identified and of less than 10% concentration by visual area estimate then an additional five sample mounts are prepared. Quantification of asbestos concentration is obtained using the standard CAL ARB Method 435 point count protocol. For samples observed to contain visible asbestos of less than 10% concentration, a point counting techinique is used with 50 points counted on each of eight sample mounts for a total of 400 points. The data is then compiled into standard report format and subjected to a thorough quality assurance check before the information is released to the client.

While the CARB 435 method has much to commend it, there are a number of situations where it fails to provide sufficient accuracy to make a definitive determination of the presence/absence of asbestos and/or an accurate count of the asbestos concentration present in a given sample. These problems include, but are not limited to, 1) statistical uncertainty with samples containing <1% asbestos when too few particles are counted, 2) definitive identification and discrimination between various fibrous amphibole minerals such as tremolite/actinolite/hornblende and the "Libby amphiboles" such as tremolite/winchite/richterite/arfvedsonite, and C) small asbestiform fibers which are near or below the resolution limit of the PLM microscope such as those found in various California coast range serpentine bodies. In these cases, further analysis by transmission electron microscopy is recommended to obtain a more accurate result.

Sincerely Yours,

Lab Manager
ASBESTOS TEM LABORATORIES, INC.

--- These results relate only to the samples tested and must not be reproduced, except in full, without the approval of the laboratory. ---

POLARIZED LIGHT MICROSCOPY
CARB 435 ANALYTICAL REPORT

Contact: Jim Bianchin

Address: Bajada Geosciences, Inc.
28301 Inwood Road
Shingletown, CA 96088

Samples Submittec 2

Samples Analyzed: 2

Job Site / No. Crystal Creek Aggregate
1901.0114

Report No. **364128**

Date Submitted: May-24-19

Date Reported: Jun-07-19

SAMPLE ID	POINTS COUNTED	ASBESTOS %	ASBESTOS TYPE	LOCATION / DESCRIPTION
Site 1/2 Lab ID # 96-02884-001	**400** - Total Points	**<0.25%**	**None Detected**	Trondhjemite No Asbestos Detected
Site 4 Lab ID # 96-02884-002	**400** - Total Points	**<0.25%**	**None Detected**	Amphibolite/Greenstone No Asbestos Detected
Lab ID #	- Total Points			
Lab ID #	- Total Points			
Lab ID #	- Total Points			
Lab ID #	- Total Points			
Lab ID #	- Total Points			
Lab ID #	- Total Points			
Lab ID #	- Total Points			
Lab ID #	- Total Points			

QC Reviewer ____________________

Analys ____________________

ASBESTOS TEM LABORATORIES CHAIN OF CUSTODY

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NEVADA: 1350 Freeport Blvd. #104, Sparks, NV 89431 Phone (775) 359-3377 Fax (775) 359-2798
You may also email this chain of custody to coc@asbestostemlabs.com
** denotes required field*

Company: Bajada Geosciences, Inc.	Contact:* Jim Bianchin	Phone:* (530) 638-5263	Email:* jim.bianchin@bajadageo.com
Address:* 28301 Inwood Road	City:* Shingletown	State:* CA Zip: 96088	Email:
Job Site:* Crystal Creek Aggregate	Job #: 1901.0114	PO #:	Email:

Reporting*	■ Email ☐ Phone ☐ Fax ■ Mail ☐ FTP ☐ Pickup — Billing: ☐ Fax ☐ Email ☐ Mail ☐ Pre-Paid ■ On Receipt: via CC ☐ 3rd Party
Results Due:*	☐ 2 HR ☐ 4 HR ☐ 6 HR ☐ 8 HR ☐ 24 HR ☐ 48 HR ☐ 3 DAY ☐ 4 DAY ■ 5 DAY X 10 DAY ☐ Hold Samples ☐ *After Hours: *** ______ see below
Asbestos Air	☐ PCM (NIOSH 7400A ☐ TEM AHERA ☐ TEM CARB Mod. AHERA ☐ TEM EPA Yamate Level II ☐ TEM NIOSH 7402 ☐ ISO 10312 ☐ ISO 13794
Asbestos Bulk	☐ PLM Standard (EPA 600/R-93-1) ☐ PLM 400 PC ☐ PLM 1000 PC ☐ PLM 400 PC Grav. Red. ☐ PLM 1000 PC Grav. Red. ☐ TEM EPA Qualitative ☐ TEM EPA Quantitatve ☐ TEM Chatfield (Semi-Quant) ☐ PREP ONLY ☐ Custom Analysis: **
Asbestos Soils	☐ CARB 435 Prep Only ■ CARB 435 PLM 400 PC ☐ CARB 435 PLM 1000 PC ☐ EPA Soil Screening Qualitative ☐ TEM EPA/CARB Quantitative
Asbestos Dust	☐ ASTM D-5755 Fiber Count ☐ ASTM D-5756 Wt. % ☐ ASTM D-5756 Mass ☐ ASTM D-6480-99 Dust Wipe ☐ Total Particulates (Grav.)
Asbestos Water	☐ 100.2 Potable Drinking Water ☐ 100.1 Non Potable Water ☐ REPORT TO STATE: EDT # ______
Lead/Silica	☐ Lead Paint Chips ☐ Lead Dust Wipe ☐ Lead Air Cassette ☐ Lead Soil ☐ Silica Dust Airborne by NIOSH 7500 ☐ Crystalline Silica (Single Species) ☐ Silica Dust Bulk by NIOSH 7500 ☐ Crystalline Silica in Bulk (Single Species)
Sample Storage	☐ No Test, Hold Until: ______ ☐ Test AND Hold Until: ______ *All samples will be held for 3 months from the date of receipt at ATEM. Additional sample storage time may be obtained through ATEM Customer Service.*
Custom Order	☐ Sensitivity: ______ ☐ Composite 8 Hour TWA ☐ **Special Instructions:**
REANALYSIS	Original Login/Lot # ______/______ New Analysis Type: ______ TAT: ______ Special Instructions: ______

Sample #*	Sample Type	Date Collected	Time On	Time Off	Total Time (min)	Flow Rate (lpm) On	Flow Rate (lpm) Off	Flow Rate (lpm) Average	Volume or Area Sampled	Hold Sample	Description*
Site 1/2	Composite bulk	5/20/19								☐	Trondhjemite
Site 4	Composite bulk	5/20/19								☐	Amphibolite/Greenstone
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	
										☐	

Submitted By*: JB	Received By: MD
Date/Time Submitted*: 5/23/19 / 1354	Date/Time Received
Submitted By	Received By
Date/Time Submitted	Date/Time Received

*** Any special instructions, RUSH results or Custom Analysis, you must clarify these specifications AND, of more importance, contact us here at ATEM ahead of time to manage scheduling to meet your requests. Drop off and processing of samples after hours cannot be accommodated without proper notification from you, and confirmation by ATEM staff.*

APPENDIX C
Slope Stability Analyses

APPENDIX C
SLOPE STABILITY ANALYSES

METHODS OF ANALYSIS

Computer-aided slope stability analyses were performed using the computer program SLIDE 2018. SLIDE 2018 was developed by Rocscience, Inc. (2019) and offers a wide variety of limit-equilibrium procedures. Those include the Modified Bishop, the Simplified and Corrected Janbu, Corps of Engineers #1 and #2, GLE/Morgenstern-Price, Lowe-Karafiath, and the Spencer methods. Those limit-equilibrium procedures are all "method of slices", but they differ from the Ordinary Method of Slices (Fellenius method – also included within SLIDE 2018) in:

1. The simplifying assumptions that have been made achieve static determinacy; and
2. The particular conditions of equilibrium that are satisfied.

SLIDE 2018 allows the use of any or all of the methods listed above because they better satisfy limit equilibrium conditions. A summary of the equilibrium conditions satisfied by each of these procedures and the type of failure surface for which each is useful is presented in the following table.

EQUILIBRIUM CONDITIONS SATISFIED BY PROCEDURES

Procedure of Analysis	Overall			Individual Slices			
	Moment	Vertical Force	Horizontal Force	Moment	Vertical Force	Horizontal Force	Slip Surface
Ordinary Method of Slices (Fellenius)	Yes	No	No	No	No	No	Circular Arc
Modified Bishop	Yes	(Yes)[1]	No	No	Yes	No	General Shape[2]
Simplified Janbu	No	(Yes)[1]	(Yes)[1]	No	Yes	Yes	General Shape
Spencer	Yes	(Yes)[1]	(Yes)[1]	Yes	Yes	Yes	General Shape

Per Wright (1969); (Yes)[1] - Parentheses indicate that this condition of equilibrium is implicitly satisfied as a result of the direct consideration of other equilibrium conditions; [2] – The original presentation of this procedure was for circular surfaces only.

Ordinary Method of Slices. From the above table, it is apparent that for circular failures, the Ordinary Method of Slices (Fellenius method) satisfies overall moment equilibrium, but does not satisfy individual slice moment equilibrium, or horizontal or vertical force equilibrium. Sherard et al. (1963), have suggested that the Fellenius method of slices might also be applied to non-circular surfaces; however, for noncircular surfaces that method would not, in general, satisfy any of the equilibrium conditions (Wright, 1969).

The Ordinary Method of Slices has been widely used by practicing engineers for many years because of its simplicity, but it has long been known to grossly underestimate (and in some cases overestimate) the factor of safety. Lambe and Whitman (1969) report that in some cases the Ordinary Method of Slices may underestimate the factor of safety by about 10 to 15 percent, but in other problems (particularly for noncircular slip surfaces) the error may be as much as 60 percent. With the development of high-speed computers, this approximate method has largely been replaced by more accurate methods that better satisfy equilibrium conditions. The Ordinary Method of Slices remains an acceptable method for performing hand-calculated estimates of slope stability for conditions where accurate solutions are not required.

Modified Bishop Method. The Modified Bishop Method assumes that the normal and weight forces act through a point on the center of the base of each slice and that there are no interslice shear forces. The resulting equation can be demonstrated to satisfy vertical force equilibrium as well as overall moment equilibrium for circular shear surfaces. The Modified Bishop Method is relatively simple to perform on a calculator, although the necessary iterations make it more suitable for use on a computer system. In spite of the necessary iterations, the Modified Bishop Method typically converges rapidly, therefore, it requires little computer time to perform.

Fredlund and Krahn (1977) have shown that the Modified Bishop Method typically estimates factors of safety that are typically within a few percent of those obtained from more rigorous methods that satisfy complete moment and force equilibrium.

Simplified Janbu Method. Although the simplifying assumption made in the Simplified Janbu Method is the same as that made for the Modified Bishop Method, the conditions of equilibrium that are satisfied are not the same. The Simplified Janbu Method satisfies vertical and horizontal force equilibrium for individual slices and for the overall shear surface while assuming that there are no interslice shear forces. An advantage of the Simplified Janbu Method is its suitability for the analysis of noncircular failure surfaces. While retaining a rapid computational speed, the Simplified Janbu Method yields factors of safety that are closer to those obtained by more rigorous methods (such as the Spencer Method) than those obtained from the Ordinary Method of Slices.

Spencer Method. The Spencer Method assumes that the normal forces are located at the center of the base of each slice and that all side forces are parallel. The result is an equation that satisfies complete moment and force equilibrium. Although the Spencer Method was directly applicable to a circular shear surface, the procedure may be readily extended to slip surfaces of a general shape (Wright, 1969).

Because of the complexity of the procedure, the Spencer Method is suitable only for computer-aided slope stability analyses. Although the Spencer Method typically yields a relatively accurate estimate of the factor of safety for a slope, its solution requires several iterations. Consequently, considerable time is needed to perform the analyses on a personal computer. Therefore, the Spencer Method is commonly used to refine the factor of safety for a critical failure plane that has been located by a search, which has used a more time-efficient method of analysis such as the Modified Bishop Method or Simplified Janbu procedure.

ANALYSES PERFORMED

Introduction. Analyses were performed to calculate the stability of the earth materials exposed in the slope. It is necessary to know the: 1) surface and subsurface geometry, 2) soil properties (unit weight and shear strength of the soil materials present), and 3) phreatic water level (groundwater) conditions.

Surface and Subsurface Geometry. Data for the surface geometry of the project area was obtained using topographic data from DKM (2019).

Engineering Properties. A summary and discussion of soil and rock mass strength values is presented in the text of the report.

Piezometric Water Level. The elevations of groundwater beneath the site are discussed in the text of the report.

Results of Analyses. The following table presents the conditions evaluated and results of the stability evaluations:

RESULTS OF STABILITY ANALYSES		
Slope Condition Evaluated	**Factor of Safety**	**File Name**
Overall slope, static conditions, reasonable water table, backcalculated strength.	1.36	A-A'BCStatic.slim
Overall Slope, pseudostatic conditions, reasonable water table, backcalculated strength.	1.06	A-A'BCPS.slim
Overall slope, static, reasonable water table, strength from Hoek & Brown criterion.	2.39	A-A'StaticLowH2O.slim
Overall slope, pseudostatic, reasonable water table, strength from Hoek & Brown criterion.	1.92	A-A'LowH2OPS.slim
Overall slope, static, worst case water table, strength from Hoek & Brown criterion.	1.65	A-A'StaticHighH2O.slim
Overall slope, pseudostatic, worst case water table, strength from Hoek & Brown criterion.	1.30	A-A'StaticHighH2OPS.slim
Maximum overburden inclination, static, dry.	1.30	OverburdenStatic.slim
Planar failure, discontinuity dipping at 55 degrees, static, strength from Hoek & Brown criterion.	2.15	55deg.slmd
Planar failure, discontinuity dipping at 65 degrees, static, strength from Hoek & Brown criterion.	2.05	65deg.slmd
Planar failure, discontinuity dipping at 75 degrees, static, strength from Hoek & Brown criterion.	2.26	75deg.slmd
Planar failure, discontinuity dipping at 75 degrees, static, backcalculation of discontinuity strength	1.52	75PlanarBackCalculate.slmd

REFERENCES

Fellenius, W. (1936), Calculation of the Stability of Earth Dams, Transactions of the Second Congress on Large Dams, vol. 4, pp. 445-463.

Frelund, D.G., and Krahn, J. (1977), Comparison of Slope Stability Methods of Analysis, Canadian Geotechnical Journal, vol. 14, pp. 429-439.

Janbu, N., Bjerrum, L., and Kjaernsli, B. (1956), Veiledning ved losning av fundamenterings-oppgaver-2. Stabilitetsberegning for fyllinger, skjaeringer og naturlige skraninger. (Soil Mechanics Applies to Some Engineering Problems – Chapter 2. Stability Calculations for Embankments, Cuts, and Natural Slopes), Publication 16, Norwegian Geotechnical Institute, Oslo, pp. 17-26.

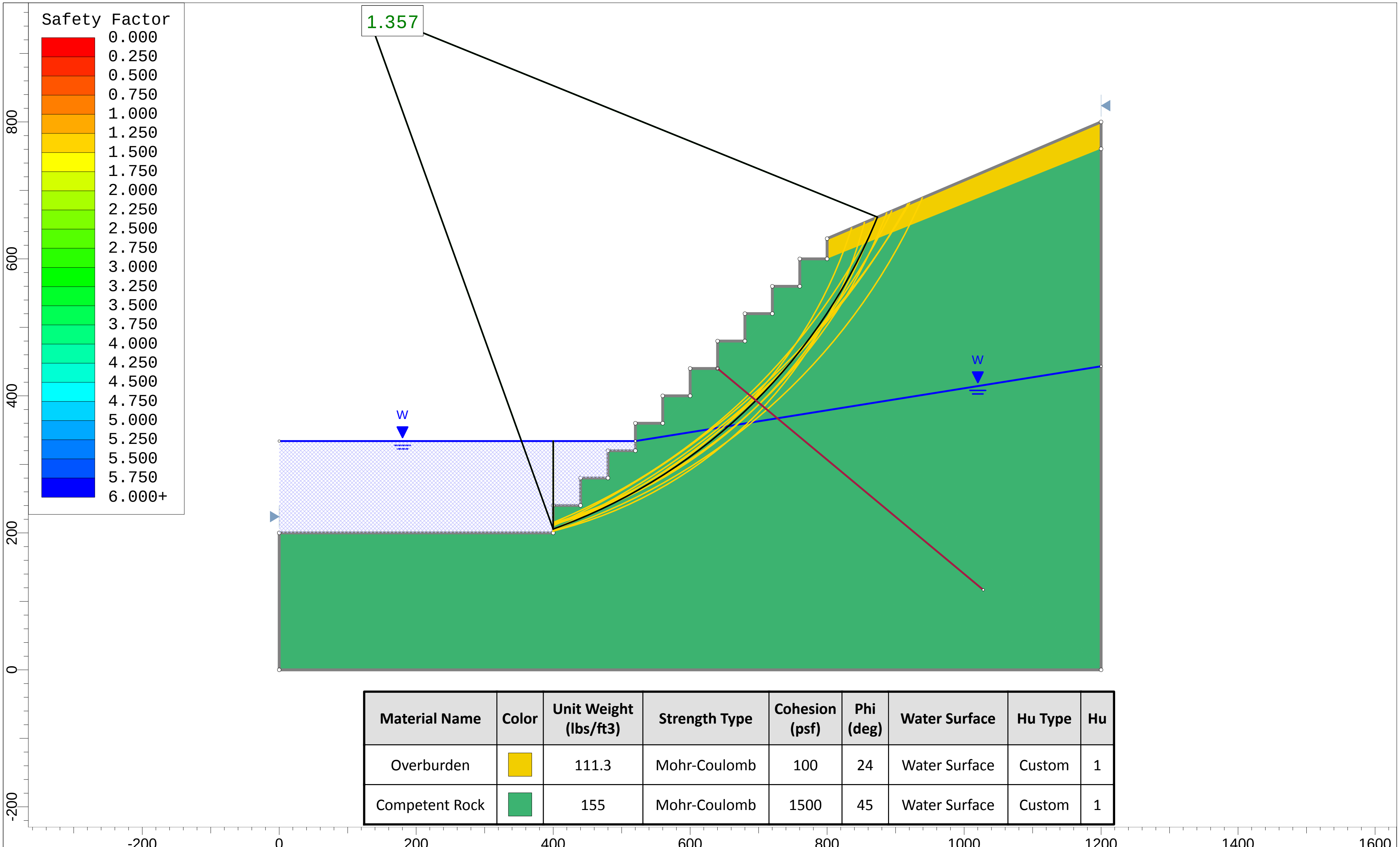
Lambe, T.W., and Whitman, R.V., (1969), Soil Mechanics, John Wiley & Sons, New York, 553 pp.

Rocscience (2019), SLIDE 2019, 2D Limit Equilibrium Slope Stability Analysis, Build 8.024, April 17.

Sherard, J.L., Woodward, R.J., Gizienski, S.F., and Clevenger, W.A. (1963), Stability Analyses, Earth and Earth-Rock Dams, 1st Edition, John Wiley & Sons, New York, 345 pp.

Spencer, E. (1967), A Method of Analyses of the Stability of Embankments Assuming Parallel Inter-Slice Forces, Geotechnique, vol. 17, no. 1, pp. 11-26.

Wright, S. (1969), A Study of Slope Stability and the Undrained Shear Strength of Clay Shales, Ph.D. Thesis, University of California, Berkley.



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Overburden		111.3	Mohr-Coulomb	100	24	Water Surface	Custom	1
Competent Rock		155	Mohr-Coulomb	1500	45	Water Surface	Custom	1

Bajada Geosciences, Inc.

SLIDEINTERPRET 8.023

Project
Crystal Creek Aggregate Quarry Expansion

Analysis Description
Gross Stability, Static, Backcalculate Minimum Shar Strength

Drawn By	*Scale*	*Company*
J.Bianchin	1:2326	Bajada Geosciences, Inc.

Date 5/17/2019, 9:14:14 AM

File Name A-A'BCStatic.slim

Slide Analysis Information

Crystal Creek Aggregate Quarry Expansion

Project Summary

Slide Modeler Version:	8.023
Compute Time:	00h:00m:00.674s

General Settings

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

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

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

Random Numbers

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

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle [°]:	Not Defined
Lower Angle [°]:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Property	Overburden	Competent Rock
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	111.3	155
Cohesion [psf]	100	1500
Friction Angle [°]	24	45
Water Surface	Water Table	Water Table
Hu Value	1	1

Global Minimums

Method: spencer

FS	1.357450
Center:	126.532, 963.759
Radius:	806.056
Left Slip Surface Endpoint:	400.000, 205.510
Right Slip Surface Endpoint:	873.534, 660.916
Left Slope Intercept:	400.000 334.000
Right Slope Intercept:	873.534 660.916
Resisting Moment:	4.1603e+09 lb-ft
Driving Moment:	3.06478e+09 lb-ft
Resisting Horizontal Force:	3.79917e+06 lb
Driving Horizontal Force:	2.79874e+06 lb
Total Slice Area:	47695.2 ft2
Surface Horizontal Width:	473.534 ft
Surface Average Height:	100.722 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	886
Number of Invalid Surfaces:	4114

Error Codes:

Error Code -103 reported for 1118 surfaces

Error Code -108 reported for 3 surfaces
Error Code -111 reported for 331 surfaces
Error Code -114 reported for 2458 surfaces
Error Code -118 reported for 204 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-114 = Surface with Reverse Curvature.
-118 = Surface does not pass through the search focus

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.35745

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	9.47412	103662	20.191	Competent Rock	1500	45	13465.2	18278.4	24687.4	7909.08	16778.3	29639.3	21730.2
2	9.47412	98445.9	20.9102	Competent Rock	1500	45	1895.32	2572.8	8760.23	7687.44	1072.79	9484.37	1796.93
3	9.47412	93029.3	21.6329	Competent Rock	1500	45	1624.9	2205.71	8162.99	7457.27	705.715	8807.41	1350.14
4	9.47412	87409	22.3592	Competent Rock	1500	45	1358.9	1844.64	7563.1	7218.46	344.639	8122.07	903.607
5	9.47412	108883	23.0894	Competent Rock	1500	45	11181.3	15178	20648.8	6970.85	13678	25415.6	18444.7
6	9.47412	110637	23.8235	Competent Rock	1500	45	3244.93	4404.83	9619.15	6714.32	2904.83	11051.9	4337.6
7	9.47412	104386	24.5618	Competent Rock	1500	45	2949.29	4003.52	8952.23	6448.71	2503.52	10300.1	3851.43
8	9.47412	97918.2	25.3045	Competent Rock	1500	45	2659.31	3609.88	8283.74	6173.86	2109.88	9541.04	3367.18
9	9.47412	110738	26.0517	Competent Rock	1500	45	7160.27	9719.71	14109.3	5889.6	8219.73	17609.6	11720
10	9.47412	119406	26.8038	Competent Rock	1500	45	4330.15	5877.96	9973.72	5595.76	4377.96	12161.4	6565.64
11	9.47412	112261	27.5609	Competent Rock	1500	45	4016.66	5452.41	9244.56	5292.15	3952.41	11340.9	6048.78
12	9.47412	104881	28.3232	Competent Rock	1500	45	3709.85	5035.94	8514.5	4978.56	3535.94	10514	5535.43
13	9.47412	114111	29.0911	Competent Rock	1500	45	4660.88	6326.91	9481.7	4654.78	4826.92	12075	7420.17
14	9.47412	139859	29.8647	Competent Rock	1500	45	6036.05	8193.64	11093.4	4399.76	6693.61	14559.3	10159.5
15	9.47412	131744	30.6443	Competent Rock	1500	45	5622.46	7632.21	10282.1	4149.86	6132.23	13613.1	9463.22
16	9.47412	123371	31.4303	Competent Rock	1500	45	5218.14	7083.37	9472.46	3889.05	5583.41	12661.4	8772.37
17	9.47412	121308	32.223	Competent Rock	1500	45	5189.66	7044.71	9161.71	3617.04	5544.67	12432.7	8815.69
18	9.47412	164569	33.0226	Competent Rock	1500	45	7650.03	10384.5	12218.1	3333.56	8884.52	17190.4	13856.8
19	9.47412	155386	33.8295	Competent Rock	1500	45	7211.74	9789.58	11327.8	3038.28	8289.54	16161	13122.8
20	9.47412	145917	34.6442	Competent Rock	1500	45	6783.78	9208.64	10439.5	2730.87	7708.6	15127	12396.1
21	9.47412	136154	35.4669	Competent	1500	45	6366.22	8641.83	9552.79	2410.99	7141.8	14088.2	11677.2

				Rock									
22	9.47412	178359	36.2981	Competent Rock	1500	45	8598.92	11672.6	12250.9	2078.23	10172.6	18567	16488.7
23	9.47412	174451	37.1383	Competent Rock	1500	45	8469.19	11496.5	11728.7	1732.2	9996.49	18142.8	16410.6
24	9.47412	163750	37.9879	Competent Rock	1500	45	8023.99	10892.2	10764.6	1372.44	9392.19	17030.9	15658.5
25	9.47412	152715	38.8475	Competent Rock	1500	45	7590.19	10303.3	9801.77	998.483	8803.29	15914.8	14916.3
26	9.47412	180561	39.7176	Competent Rock	1500	45	8990.17	12203.7	11313.5	609.808	10703.7	18781.9	18172.1
27	9.47412	188332	40.5988	Competent Rock	1500	45	9427.46	12797.3	11503.2	205.856	11297.3	19583.1	19377.3
28	9.57935	178104	41.4969	Competent Rock	1500	45	8824.71	11979.1	10479.2	0	10479.2	18285.8	18285.8
29	9.57935	165316	42.4126	Competent Rock	1500	45	8088	10979.1	9479.03	0	9479.03	16867.6	16867.6
30	9.57935	180251	43.3418	Competent Rock	1500	45	8541.31	11594.4	10094.4	0	10094.4	18155.1	18155.1
31	9.57935	197852	44.2856	Competent Rock	1500	45	9074.96	12318.8	10818.9	0	10818.9	19670.3	19670.3
32	9.57935	183743	45.2447	Competent Rock	1500	45	8304.81	11273.4	9773.34	0	9773.34	18149.4	18149.4
33	9.57935	169149	46.2204	Competent Rock	1500	45	7543.36	10239.7	8739.75	0	8739.75	16611.5	16611.5
34	9.57935	171755	47.2136	Competent Rock	1500	45	7465.28	10133.7	8633.73	0	8633.73	16699.3	16699.3
35	9.57935	197791	48.2259	Competent Rock	1500	45	8250.9	11200.2	9700.2	0	9700.2	18936.7	18936.7
36	9.57935	181574	49.2586	Competent Rock	1500	45	7458.73	10124.9	8624.84	0	8624.84	17283.8	17283.8
37	9.57935	164747	50.3135	Competent Rock	1500	45	6676.19	9062.59	7562.57	0	7562.57	15607.9	15607.9
38	9.57935	154550	51.3922	Competent Rock	1500	45	6152.12	8351.2	6851.22	0	6851.22	14555.7	14555.7
39	9.57935	188490	52.4971	Competent Rock	1500	45	7109.61	9650.94	8150.94	0	8150.94	17415.4	17415.4
40	9.57935	169566	53.6305	Competent Rock	1500	45	6298.5	8549.9	7049.89	0	7049.89	15602.5	15602.5
41	9.57935	149829	54.7952	Competent Rock	1500	45	5498.24	7463.59	5963.59	0	5963.59	13756.5	13756.5
42	9.57935	129208	55.9945	Competent Rock	1500	45	4709.4	6392.77	4892.77	0	4892.77	11873.3	11873.3
43	9.57935	140162	57.2323	Competent Rock	1500	45	4877.54	6621.01	5121.01	0	5121.01	12698.8	12698.8
44	9.57935	125131	58.5132	Competent Rock	1500	45	4292.45	5826.78	4326.78	0	4326.78	11335.1	11335.1
45	9.57935	107242	59.8428	Competent Rock	1500	45	3659.28	4967.29	3467.29	0	3467.29	9765.38	9765.38
46	9.57935	88013.7	61.2279	Competent Rock	1500	45	3027.13	4109.18	2609.18	0	2609.18	8121.87	8121.87
47	9.57935	67260.1	62.677	Competent Rock	1500	45	2396.96	3253.75	1753.75	0	1753.75	6393.19	6393.19
48	9.57935	44745.7	64.201	Competent Rock	1500	45	1770.05	2402.75	902.751	0	902.751	4564.44	4564.44
49	8.28332	21718.9	65.6987	Overburden	100	24	439.05	595.989	1114.01	0	1114.01	2086.34	2086.34
50	8.28332	7444.75	67.1729	Overburden	100	24	146.241	198.515	221.269	0	221.269	568.703	568.703

Query 1 (spencer) - Safety Factor: 1.35745

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	9.47412	103662	20.191	Competent Rock	1500	45	13465.2	18278.4	24687.4	7909.08	16778.3	29639.3	21730.2
2	9.47412	98445.9	20.9102	Competent	1500	45	1895.32	2572.8	8760.23	7687.44	1072.79	9484.37	1796.93

				Rock										
3	9.47412	93029.3	21.6329	Competent Rock	1500	45	1624.9	2205.71	8162.99	7457.27	705.715	8807.41	1350.14
4	9.47412	87409	22.3592	Competent Rock	1500	45	1358.9	1844.64	7563.1	7218.46	344.639	8122.07	903.607
5	9.47412	108883	23.0894	Competent Rock	1500	45	11181.3	15178	20648.8	6970.85	13678	25415.6	18444.7
6	9.47412	110637	23.8235	Competent Rock	1500	45	3244.93	4404.83	9619.15	6714.32	2904.83	11051.9	4337.6
7	9.47412	104386	24.5618	Competent Rock	1500	45	2949.29	4003.52	8952.23	6448.71	2503.52	10300.1	3851.43
8	9.47412	97918.2	25.3045	Competent Rock	1500	45	2659.31	3609.88	8283.74	6173.86	2109.88	9541.04	3367.18
9	9.47412	110738	26.0517	Competent Rock	1500	45	7160.27	9719.71	14109.3	5889.6	8219.73	17609.6	11720
10	9.47412	119406	26.8038	Competent Rock	1500	45	4330.15	5877.96	9973.72	5595.76	4377.96	12161.4	6565.64
11	9.47412	112261	27.5609	Competent Rock	1500	45	4016.66	5452.41	9244.56	5292.15	3952.41	11340.9	6048.78
12	9.47412	104881	28.3232	Competent Rock	1500	45	3709.85	5035.94	8514.5	4978.56	3535.94	10514	5535.43
13	9.47412	114111	29.0911	Competent Rock	1500	45	4660.88	6326.91	9481.7	4654.78	4826.92	12075	7420.17
14	9.47412	139859	29.8647	Competent Rock	1500	45	6036.05	8193.64	11093.4	4399.76	6693.61	14559.3	10159.5
15	9.47412	131744	30.6443	Competent Rock	1500	45	5622.46	7632.21	10282.1	4149.86	6132.23	13613.1	9463.22
16	9.47412	123371	31.4303	Competent Rock	1500	45	5218.14	7083.37	9472.46	3889.05	5583.41	12661.4	8772.37
17	9.47412	121308	32.223	Competent Rock	1500	45	5189.66	7044.71	9161.71	3617.04	5544.67	12432.7	8815.69
18	9.47412	164569	33.0226	Competent Rock	1500	45	7650.03	10384.5	12218.1	3333.56	8884.52	17190.4	13856.8
19	9.47412	155386	33.8295	Competent Rock	1500	45	7211.74	9789.58	11327.8	3038.28	8289.54	16161	13122.8
20	9.47412	145917	34.6442	Competent Rock	1500	45	6783.78	9208.64	10439.5	2730.87	7708.6	15127	12396.1
21	9.47412	136154	35.4669	Competent Rock	1500	45	6366.22	8641.83	9552.79	2410.99	7141.8	14088.2	11677.2
22	9.47412	178359	36.2981	Competent Rock	1500	45	8598.92	11672.6	12250.9	2078.23	10172.6	18567	16488.7
23	9.47412	174451	37.1383	Competent Rock	1500	45	8469.19	11496.5	11728.7	1732.2	9996.49	18142.8	16410.6
24	9.47412	163750	37.9879	Competent Rock	1500	45	8023.99	10892.2	10764.6	1372.44	9392.19	17030.9	15658.5
25	9.47412	152715	38.8475	Competent Rock	1500	45	7590.19	10303.3	9801.77	998.483	8803.29	15914.8	14916.3
26	9.47412	180561	39.7176	Competent Rock	1500	45	8990.17	12203.7	11313.5	609.808	10703.7	18781.9	18172.1
27	9.47412	188332	40.5988	Competent Rock	1500	45	9427.46	12797.3	11503.2	205.856	11297.3	19583.1	19377.3
28	9.57935	178104	41.4969	Competent Rock	1500	45	8824.71	11979.1	10479.2	0	10479.2	18285.8	18285.8
29	9.57935	165316	42.4126	Competent Rock	1500	45	8088	10979.1	9479.03	0	9479.03	16867.6	16867.6
30	9.57935	180251	43.3418	Competent Rock	1500	45	8541.31	11594.4	10094.4	0	10094.4	18155.1	18155.1
31	9.57935	197852	44.2856	Competent Rock	1500	45	9074.96	12318.8	10818.9	0	10818.9	19670.3	19670.3
32	9.57935	183743	45.2447	Competent Rock	1500	45	8304.81	11273.4	9773.34	0	9773.34	18149.4	18149.4
33	9.57935	169149	46.2204	Competent Rock	1500	45	7543.36	10239.7	8739.75	0	8739.75	16611.5	16611.5
34	9.57935	171755	47.2136	Competent Rock	1500	45	7465.28	10133.7	8633.73	0	8633.73	16699.3	16699.3
35	9.57935	197791	48.2259	Competent Rock	1500	45	8250.9	11200.2	9700.2	0	9700.2	18936.7	18936.7

36	9.57935	181574	49.2586	Competent Rock	1500	45	7458.73	10124.9	8624.84	0	8624.84	17283.8	17283.8
37	9.57935	164747	50.3135	Competent Rock	1500	45	6676.19	9062.59	7562.57	0	7562.57	15607.9	15607.9
38	9.57935	154550	51.3922	Competent Rock	1500	45	6152.12	8351.2	6851.22	0	6851.22	14555.7	14555.7
39	9.57935	188490	52.4971	Competent Rock	1500	45	7109.61	9650.94	8150.94	0	8150.94	17415.4	17415.4
40	9.57935	169566	53.6305	Competent Rock	1500	45	6298.5	8549.9	7049.89	0	7049.89	15602.5	15602.5
41	9.57935	149829	54.7952	Competent Rock	1500	45	5498.24	7463.59	5963.59	0	5963.59	13756.5	13756.5
42	9.57935	129208	55.9945	Competent Rock	1500	45	4709.4	6392.77	4892.77	0	4892.77	11873.3	11873.3
43	9.57935	140162	57.2323	Competent Rock	1500	45	4877.54	6621.01	5121.01	0	5121.01	12698.8	12698.8
44	9.57935	125131	58.5132	Competent Rock	1500	45	4292.45	5826.78	4326.78	0	4326.78	11335.1	11335.1
45	9.57935	107242	59.8428	Competent Rock	1500	45	3659.28	4967.29	3467.29	0	3467.29	9765.38	9765.38
46	9.57935	88013.7	61.2279	Competent Rock	1500	45	3027.13	4109.18	2609.18	0	2609.18	8121.87	8121.87
47	9.57935	67260.1	62.677	Competent Rock	1500	45	2396.96	3253.75	1753.75	0	1753.75	6393.19	6393.19
48	9.57935	44745.7	64.201	Competent Rock	1500	45	1770.05	2402.75	902.751	0	902.751	4564.44	4564.44
49	8.28332	21718.9	65.6987	Overburden	100	24	439.05	595.989	1114.01	0	1114.01	2086.34	2086.34
50	8.28332	7444.75	67.1729	Overburden	100	24	146.241	198.515	221.269	0	221.269	568.703	568.703

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.35745

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	400	205.51	515105	0	0
2	409.474	208.994	280913	182285	32.9796
3	418.948	212.614	267150	173354	32.9796
4	428.422	216.371	251865	163436	32.9797
5	437.896	220.268	235259	152660	32.9796
6	447.371	224.307	442441	287101	32.9796
7	456.845	228.49	432929	280928	32.9796
8	466.319	232.82	422094	273897	32.9796
9	475.793	237.299	410170	266160	32.9796
10	485.267	241.931	497490	322822	32.9796
11	494.741	246.717	490753	318451	32.9797
12	504.215	251.662	483076	313469	32.9796
13	513.689	256.768	474729	308052	32.9796
14	523.164	262.04	474998	308227	32.9796
15	532.638	267.48	471806	306156	32.9796
16	542.112	273.093	467334	303254	32.9796
17	551.586	278.883	461901	299729	32.9797
18	561.06	284.854	456334	296116	32.9796
19	570.534	291.012	453537	294301	32.9796
20	580.008	297.361	449901	291941	32.9796
21	589.482	303.908	445795	289277	32.9796
22	598.957	310.657	441601	286556	32.9796
23	608.431	317.616	437773	284072	32.9796
24	617.905	324.792	433814	281503	32.9796
25	627.379	332.19	430150	279125	32.9796
26	636.853	339.821	427233	277232	32.9796
27	646.327	347.691	423320	274693	32.9796
28	655.801	355.811	419185	272010	32.9796
29	665.381	364.285	414875	269213	32.9796
30	674.96	373.036	409361	265635	32.9796
31	684.539	382.077	399883	259485	32.9796
32	694.119	391.42	385686	250272	32.9796
33	703.698	401.082	370774	240596	32.9796
34	713.277	411.078	355631	230770	32.9797
35	722.857	421.428	337750	219167	32.9797
36	732.436	432.151	312726	202928	32.9796
37	742.015	443.272	288224	187029	32.9796
38	751.595	454.816	264843	171857	32.9796
39	761.174	466.812	241555	156745	32.9795
40	770.753	479.295	207879	134893	32.9796
41	780.333	492.303	176481	114519	32.9796
42	789.912	505.88	148155	96138.2	32.9797
43	799.491	520.079	123772	80316	32.9797
44	809.071	534.962	94257.3	61163.7	32.9796
45	818.65	550.602	67683.2	43919.8	32.9796
46	828.229	567.089	45552.5	29559.1	32.9796
47	837.809	584.534	29018.6	18830.2	32.9796
48	847.388	603.075	19451.2	12621.9	32.9796
49	856.968	622.892	18508.7	12010.3	32.9795
50	865.251	641.237	1707.76	1108.17	32.9796
51	873.534	660.916	0	0	0

Query 1 (spencer) - Safety Factor: 1.35745

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	400	205.51	515105	0	0
2	409.474	208.994	280913	182285	32.9796
3	418.948	212.614	267150	173354	32.9796
4	428.422	216.371	251865	163436	32.9797
5	437.896	220.268	235259	152660	32.9796
6	447.371	224.307	442441	287101	32.9796
7	456.845	228.49	432929	280928	32.9796
8	466.319	232.82	422094	273897	32.9796
9	475.793	237.299	410170	266160	32.9796
10	485.267	241.931	497490	322822	32.9796
11	494.741	246.717	490753	318451	32.9797
12	504.215	251.662	483076	313469	32.9796
13	513.689	256.768	474729	308052	32.9796
14	523.164	262.04	474998	308227	32.9796
15	532.638	267.48	471806	306156	32.9796
16	542.112	273.093	467334	303254	32.9796
17	551.586	278.883	461901	299729	32.9797
18	561.06	284.854	456334	296116	32.9796
19	570.534	291.012	453537	294301	32.9796
20	580.008	297.361	449901	291941	32.9796
21	589.482	303.908	445795	289277	32.9796
22	598.957	310.657	441601	286556	32.9796
23	608.431	317.616	437773	284072	32.9796
24	617.905	324.792	433814	281503	32.9796
25	627.379	332.19	430150	279125	32.9796
26	636.853	339.821	427233	277232	32.9796
27	646.327	347.691	423320	274693	32.9796
28	655.801	355.811	419185	272010	32.9796
29	665.381	364.285	414875	269213	32.9796
30	674.96	373.036	409361	265635	32.9796
31	684.539	382.077	399883	259485	32.9796
32	694.119	391.42	385686	250272	32.9796
33	703.698	401.082	370774	240596	32.9796
34	713.277	411.078	355631	230770	32.9797
35	722.857	421.428	337750	219167	32.9797
36	732.436	432.151	312726	202928	32.9796
37	742.015	443.272	288224	187029	32.9796
38	751.595	454.816	264843	171857	32.9796
39	761.174	466.812	241555	156745	32.9795
40	770.753	479.295	207879	134893	32.9796
41	780.333	492.303	176481	114519	32.9796
42	789.912	505.88	148155	96138.2	32.9797
43	799.491	520.079	123772	80316	32.9797
44	809.071	534.962	94257.3	61163.7	32.9796
45	818.65	550.602	67683.2	43919.8	32.9796
46	828.229	567.089	45552.5	29559.1	32.9796
47	837.809	584.534	29018.6	18830.2	32.9796
48	847.388	603.075	19451.2	12621.9	32.9796
49	856.968	622.892	18508.7	12010.3	32.9795
50	865.251	641.237	1707.76	1108.17	32.9796
51	873.534	660.916	0	0	0

Entity Information

Water Table

X	Y
0	334
520	334
1200	443.215

Focus Search Line

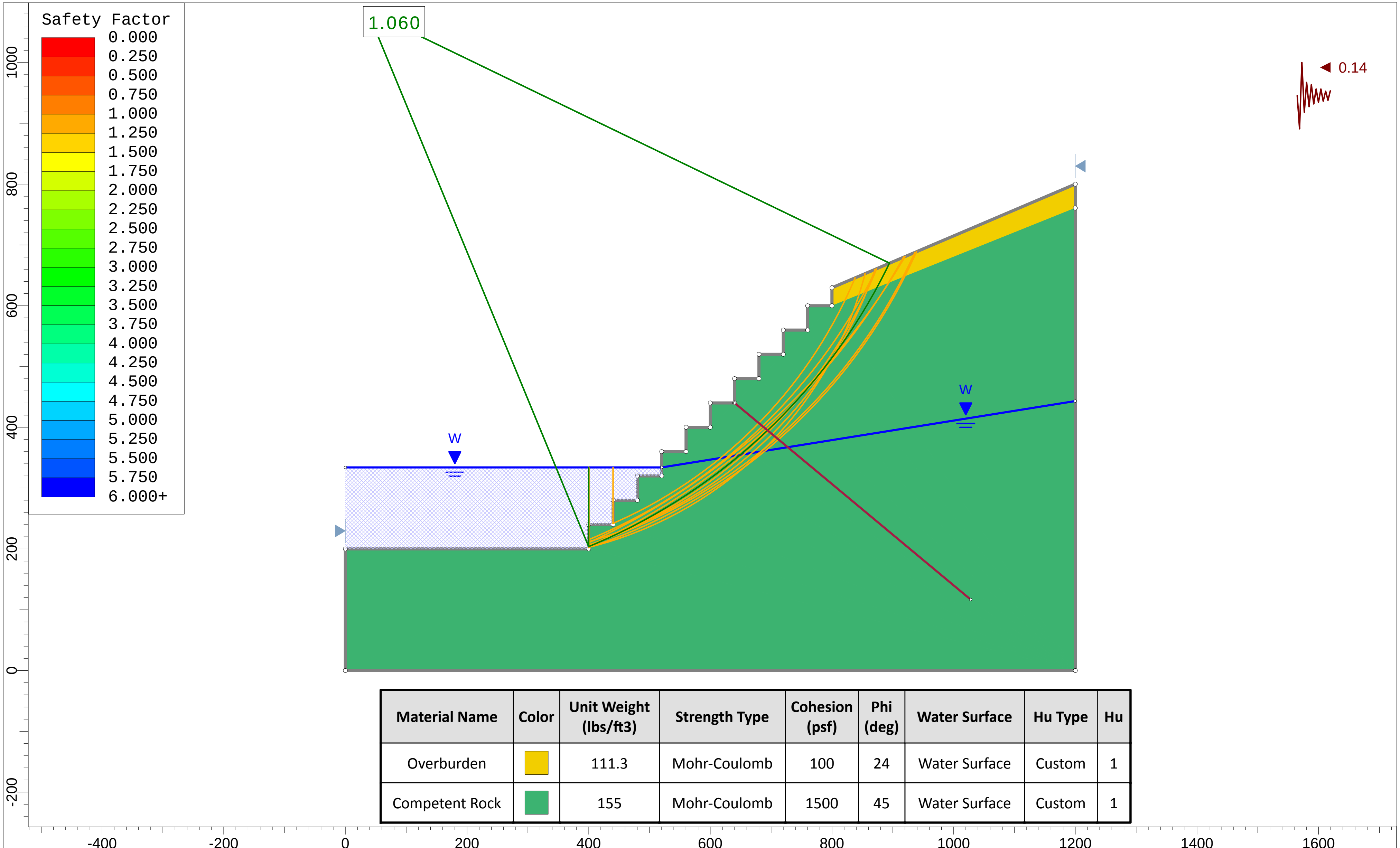
X	Y
640	440
1028.05	116.815

External Boundary

X	Y
0	0
1200	0
1200	760.738
1200	800
800	629.588
800	600
760	600
760	560
720	560
720	520
680	520
680	480
640	480
640	440
600	440
600	400
560	400
560	360
520	360
520	320
480	320
480	280
440	280
440	240
400	240
400	200
0	200

Material Boundary

X	Y
800	600
1200	760.738



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Overburden		111.3	Mohr-Coulomb	100	24	Water Surface	Custom	1
Competent Rock		155	Mohr-Coulomb	1500	45	Water Surface	Custom	1

BAJADA Geosciences, Inc.

SLIDEINTERPRET 8.023

Project	Crystal Creek Aggregate Quarry Expansion		
Analysis Description	Gross Stability, Pseudostatic, Backcalculate Minimum Shar Strength		
Drawn By J.Bianchin	*Scale* 1:2619	*Company*	Bajada Geosciences, Inc.
Date	5/17/2019, 9:14:14 AM	*File Name*	A-A'BCPS.slim

Slide Analysis Information

Crystal Creek Aggregate Quarry Expansion

Project Summary

Slide Modeler Version:	8.023
Compute Time:	00h:00m:00.765s

General Settings

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

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

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

Random Numbers

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

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle [°]:	Not Defined
Lower Angle [°]:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Seismic Load Coefficient (Horizontal): 0.14

Materials

Property	Overburden	Competent Rock
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	111.3	155
Cohesion [psf]	100	1500
Friction Angle [°]	24	45
Water Surface	Water Table	Water Table
Hu Value	1	1

Global Minimums

Method: spencer

FS	1.059520
Center:	36.341, 1085.181
Radius:	953.585
Left Slip Surface Endpoint:	400.000, 203.662
Right Slip Surface Endpoint:	894.783, 669.968
Left Slope Intercept:	400.000 334.000
Right Slope Intercept:	894.783 669.968
Resisting Moment:	4.55263e+09 lb-ft
Driving Moment:	4.29688e+09 lb-ft
Resisting Horizontal Force:	3.56619e+06 lb
Driving Horizontal Force:	3.36585e+06 lb
Total Slice Area:	48515.4 ft2
Surface Horizontal Width:	494.783 ft
Surface Average Height:	98.054 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 679
Number of Invalid Surfaces: 4321

Error Codes:

Error Code -103 reported for 1118 surfaces
Error Code -108 reported for 7 surfaces
Error Code -111 reported for 534 surfaces
Error Code -114 reported for 2458 surfaces
Error Code -118 reported for 204 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-114 = Surface with Reverse Curvature.
-118 = Surface does not pass through the search focus

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.05952

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	9.97605	111472	22.7429	Competent Rock	1500	45	28323.5	30009.3	36511.9	8002.62	28509.3	48384.8	40382.2
2	9.97605	104902	23.3945	Competent Rock	1500	45	1026.56	1087.66	7325.15	7737.49	-412.342	7769.26	31.7707
3	9.97605	98122.9	24.0492	Competent Rock	1500	45	712.82	755.247	6719.18	7463.93	-744.753	7037.28	-426.652
4	9.97605	91132.2	24.7073	Competent Rock	1500	45	416.84	441.65	6123.48	7181.83	-1058.35	6315.27	-866.562
5	9.97605	120523	25.3689	Competent Rock	1500	45	20451.5	21668.8	27059.9	6891.03	20168.9	36757.4	29866.4
6	9.97605	113453	26.0341	Competent Rock	1500	45	2539.07	2690.2	7781.61	6591.41	1190.2	9021.87	2430.46
7	9.97605	105806	26.7032	Competent Rock	1500	45	2220.45	2352.61	7135.42	6282.8	852.615	8252.34	1969.54
8	9.97605	97931.9	27.3762	Competent Rock	1500	45	1919.88	2034.16	6499.22	5965.06	534.161	7493.38	1528.32
9	9.97605	126069	28.0533	Competent Rock	1500	45	11326	12000.1	16138.1	5638.02	10500.1	22173.8	16535.7
10	9.97605	118440	28.7347	Competent Rock	1500	45	3759.19	3982.94	7784.44	5301.5	2482.94	9845.5	4544
11	9.97605	109862	29.4205	Competent Rock	1500	45	3446.46	3651.59	7106.92	4955.32	2151.6	9050.52	4095.2
12	9.97605	101039	30.1111	Competent Rock	1500	45	3151.77	3339.36	6438.65	4599.29	1839.36	8266.48	3667.19
13	9.97605	143573	30.8065	Competent Rock	1500	45	6654.2	7050.26	9830.57	4280.3	5550.27	13798.3	9517.99
14	9.97605	135777	31.5069	Competent Rock	1500	45	5810.06	6155.87	8659.73	4003.9	4655.83	12221.1	8217.2
15	9.97605	126189	32.2127	Competent Rock	1500	45	5362.28	5681.44	7898.43	3716.99	4181.44	11276.9	7559.9
16	9.97605	116335	32.924	Competent Rock	1500	45	4936.91	5230.76	7150.09	3419.33	3730.76	10346.9	6927.53
17	9.97605	165685	33.641	Competent Rock	1500	45	8120.43	8603.76	10214.4	3110.65	7103.75	15618	12507.3
18	9.97605	157654	34.3641	Competent Rock	1500	45	7785.41	8248.8	9539.49	2790.68	6748.81	14863.1	12072.4
19	9.97605	146960	35.0935	Competent Rock	1500	45	7330.47	7766.78	8725.89	2459.13	6266.76	13876.6	11417.5
20	9.97605	135972	35.8294	Competent	1500	45	6898.37	7308.96	7924.64	2115.68	5808.96	12905.3	10789.6

				Rock								
21	9.97605	183563	36.5723	Competent Rock	1500	45	9687.45	10264	10524	1760.02	8764.03	17711.3	15951.3
22	9.97605	174930	37.3223	Competent Rock	1500	45	9373.94	9931.88	9823.63	1391.77	8431.86	16970.4	15578.7
23	9.97605	163006	38.0799	Competent Rock	1500	45	8922.67	9453.75	8964.29	1010.57	7953.72	15955.5	14944.9
24	9.97605	150751	38.8455	Competent Rock	1500	45	8494.57	9000.17	8116.18	616.015	7500.16	14957.1	14341.1
25	9.97605	196443	39.6194	Competent Rock	1500	45	10938.3	11589.4	10297	207.666	10089.4	19352.3	19144.6
26	9.77251	183373	40.394	Competent Rock	1500	45	10439.9	11061.2	9561.2	0	9561.2	18444.3	18444.3
27	9.77251	170603	41.1695	Competent Rock	1500	45	9581.88	10152.2	8652.19	0	8652.19	17031.5	17031.5
28	9.77251	157477	41.9543	Competent Rock	1500	45	8743.76	9264.19	7764.16	0	7764.16	15624.4	15624.4
29	9.77251	196628	42.7489	Competent Rock	1500	45	10286.2	10898.5	9398.44	0	9398.44	18906.6	18906.6
30	9.77251	190693	43.5538	Competent Rock	1500	45	9769.84	10351.3	8851.35	0	8851.35	18140	18140
31	9.77251	176416	44.3696	Competent Rock	1500	45	8917.19	9447.94	7947.94	0	7947.94	16671	16671
32	9.77251	161723	45.1969	Competent Rock	1500	45	8084.24	8565.41	7065.41	0	7065.41	15205.4	15205.4
33	9.77251	193601	46.0365	Competent Rock	1500	45	9156.51	9701.51	8201.53	0	8201.53	17695.5	17695.5
34	9.77251	191605	46.889	Competent Rock	1500	45	8837.95	9363.99	7863.95	0	7863.95	17304.8	17304.8
35	9.77251	175549	47.7553	Competent Rock	1500	45	7994.39	8470.22	6970.23	0	6970.23	15773	15773
36	9.77251	158994	48.6363	Competent Rock	1500	45	7170.75	7597.55	6097.55	0	6097.55	14241.5	14241.5
37	9.77251	183275	49.5329	Competent Rock	1500	45	7839.55	8306.16	6806.16	0	6806.16	15995.8	15995.8
38	9.77251	184864	50.4463	Competent Rock	1500	45	7673.22	8129.93	6629.96	0	6629.96	15920.6	15920.6
39	9.77251	166638	51.3777	Competent Rock	1500	45	6842.95	7250.24	5750.24	0	5750.24	14315.4	14315.4
40	9.77251	147788	52.3285	Competent Rock	1500	45	6033.38	6392.49	4892.48	0	4892.48	12706.8	12706.8
41	9.77251	148324	53.3001	Competent Rock	1500	45	5870.55	6219.97	4719.97	0	4719.97	12596	12596
42	9.77251	146987	54.2945	Competent Rock	1500	45	5650.44	5986.75	4486.76	0	4486.76	12348.6	12348.6
43	9.77251	132201	55.3134	Competent Rock	1500	45	5042.75	5342.89	3842.89	0	3842.89	11129.2	11129.2
44	9.77251	116589	56.3593	Competent Rock	1500	45	4443.92	4708.42	3208.42	0	3208.42	9886.76	9886.76
45	9.77251	100083	57.4347	Competent Rock	1500	45	3854.59	4084.01	2584.02	0	2584.02	8619.31	8619.31
46	9.77251	82601.4	58.5427	Competent Rock	1500	45	3275.48	3470.44	1970.44	0	1970.44	7324.5	7324.5
47	9.77251	64049.2	59.687	Competent Rock	1500	45	2707.45	2868.6	1368.6	0	1368.6	5999.45	5999.45
48	9.77251	44313	60.8719	Competent Rock	1500	45	2151.49	2279.54	779.544	0	779.544	4640.54	4640.54
49	10.3068	27335	62.1376	Overburden	100	24	494.253	523.671	951.579	0	951.579	1886.54	1886.54
50	10.3068	9335.31	63.494	Overburden	100	24	171.14	181.326	182.661	0	182.661	525.824	525.824

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.05952

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	400	203.662	530027	0	0
2	409.976	207.844	376330	375041	44.9017
3	419.952	212.16	348445	347252	44.9017
4	429.928	216.611	320087	318990	44.9016
5	439.904	221.201	291565	290566	44.9017
6	449.88	225.932	539820	537971	44.9017
7	459.856	230.805	516011	514243	44.9017
8	469.832	235.823	492213	490526	44.9016
9	479.808	240.989	468756	467150	44.9017
10	489.784	246.305	564264	562330	44.9016
11	499.761	251.775	543764	541901	44.9017
12	509.737	257.401	523946	522151	44.9017
13	519.713	263.186	505160	503429	44.9017
14	529.689	269.134	499006	497296	44.9017
15	539.665	275.249	484908	483247	44.9017
16	549.641	281.535	471003	469389	44.9017
17	559.617	287.995	457697	456129	44.9017
18	569.593	294.633	447570	446036	44.9016
19	579.569	301.454	437963	436462	44.9016
20	589.545	308.464	429231	427761	44.9017
21	599.521	315.667	421820	420375	44.9017
22	609.497	323.068	414711	413290	44.9017
23	619.473	330.674	408863	407463	44.9017
24	629.449	338.491	404838	403451	44.9017
25	639.425	346.525	403129	401747	44.9016
26	649.401	354.783	399528	398159	44.9017
27	659.174	363.099	396206	394848	44.9016
28	668.946	371.645	391863	390521	44.9017
29	678.719	380.43	386914	385589	44.9017
30	688.491	389.463	374843	373559	44.9017
31	698.264	398.754	361224	359986	44.9016
32	708.036	408.314	347544	346353	44.9017
33	717.809	418.154	334252	333107	44.9017
34	727.581	428.286	313379	312305	44.9017
35	737.354	438.726	290686	289690	44.9017
36	747.126	449.486	269101	268179	44.9017
37	756.899	460.585	249126	248272	44.9016
38	766.671	472.041	221985	221224	44.9016
39	776.444	483.873	192518	191858	44.9016
40	786.217	496.105	165613	165046	44.9018
41	795.989	508.762	141862	141376	44.9017
42	805.762	521.873	116488	116089	44.9017
43	815.534	535.47	90030.3	89721.8	44.9017
44	825.307	549.591	66457.7	66230	44.9017
45	835.079	564.277	46372.1	46213.2	44.9017
46	844.852	579.578	30428.3	30324.1	44.9017
47	854.624	595.552	19344.9	19278.6	44.9016
48	864.397	612.267	13916.6	13868.9	44.9016
49	874.169	629.804	15032.1	14980.6	44.9017
50	884.476	649.302	-2262.09	-2254.34	44.9017
51	894.783	669.968	0	0	0

Entity Information

Water Table

X	Y
0	334
520	334
1200	443.215

Focus Search Line

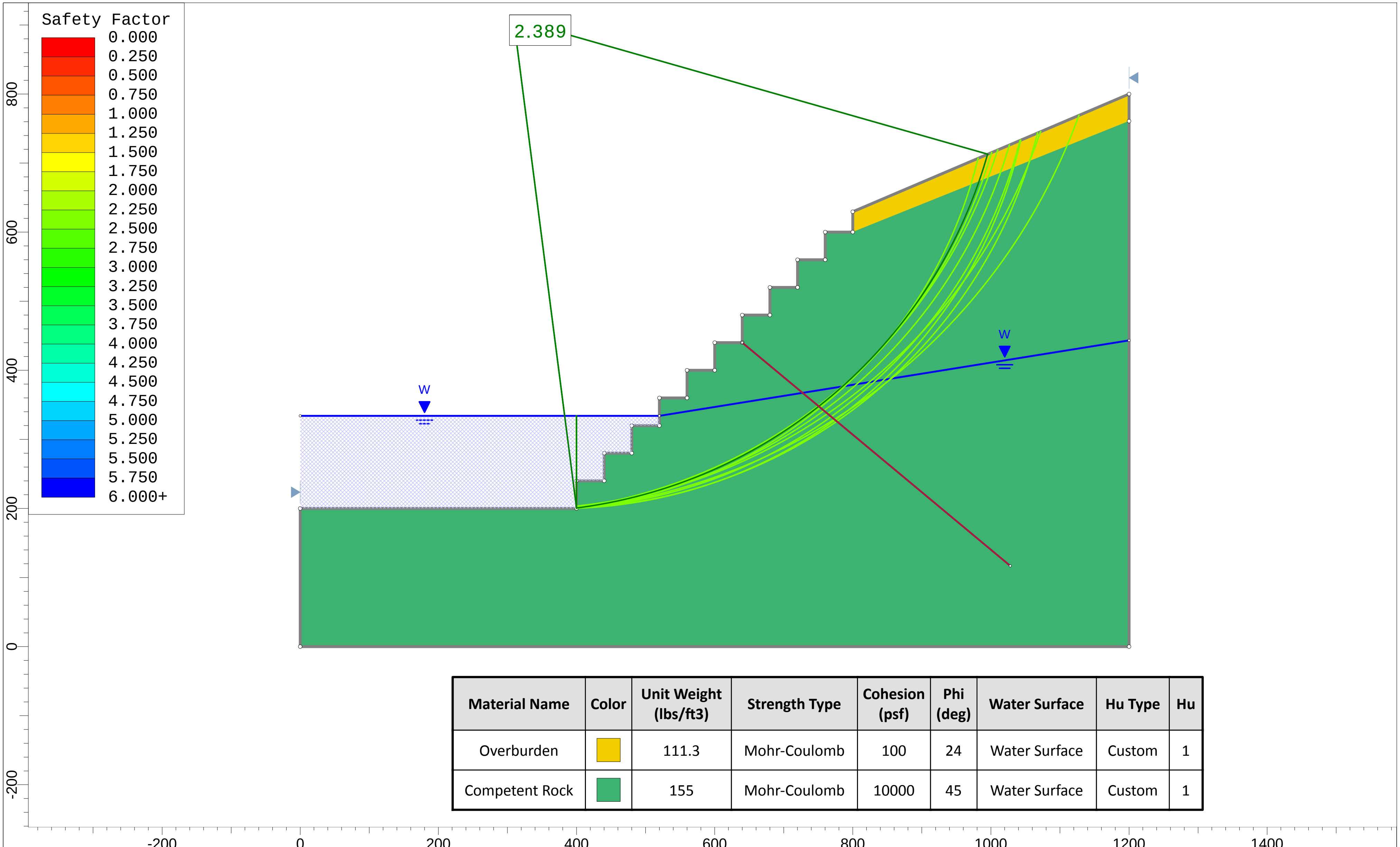
X	Y
640	440
1028.05	116.815

External Boundary

X	Y
0	0
1200	0
1200	760.738
1200	800
800	629.588
800	600
760	600
760	560
720	560
720	520
680	520
680	480
640	480
640	440
600	440
600	400
560	400
560	360
520	360
520	320
480	320
480	280
440	280
440	240
400	240
400	200
0	200

Material Boundary

X	Y
800	600
1200	760.738



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Overburden		111.3	Mohr-Coulomb	100	24	Water Surface	Custom	1
Competent Rock		155	Mohr-Coulomb	10000	45	Water Surface	Custom	1

BAJADA Geosciences, Inc.

SLIDEINTERPRET 8.023

Project	Crystal Creek Aggregate Quarry Expansion		
Analysis Description	Gross Stability, Static, Low Piezometric Surface		
Drawn By J.Bianchin	*Scale* 1:2306	*Company*	Bajada Geosciences, Inc.
Date	5/17/2019, 9:14:14 AM	*File Name*	A-A'StaticLowH20.slim

Slide Analysis Information

Crystal Creek Aggregate Quarry Expansion

Project Summary

Slide Modeler Version:	8.023
Compute Time:	00h:00m:01.64s

General Settings

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

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

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

Random Numbers

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

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle [°]:	Not Defined
Lower Angle [°]:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Property	Overburden	Competent Rock
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	111.3	155
Cohesion [psf]	100	10000
Friction Angle [°]	24	45
Water Surface	Water Table	Water Table
Hu Value	1	1

Global Minimums

Method: spencer

FS	2.389330
Center:	308.862, 908.387
Radius:	713.929
Left Slip Surface Endpoint:	400.000, 200.298
Right Slip Surface Endpoint:	995.499, 712.877
Left Slope Intercept:	400.000 334.000
Right Slope Intercept:	995.499 712.877
Resisting Moment:	1.26482e+10 lb-ft
Driving Moment:	5.29361e+09 lb-ft
Resisting Horizontal Force:	1.36306e+07 lb
Driving Horizontal Force:	5.70478e+06 lb
Total Slice Area:	96575.8 ft2
Surface Horizontal Width:	595.499 ft
Surface Average Height:	162.176 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	734
Number of Invalid Surfaces:	4266

Error Codes:

Error Code -103 reported for 1118 surfaces

Error Code -108 reported for 6 surfaces
Error Code -111 reported for 450 surfaces
Error Code -112 reported for 30 surfaces
Error Code -114 reported for 2458 surfaces
Error Code -118 reported for 204 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
-114 = Surface with Reverse Curvature.
-118 = Surface does not pass through the search focus

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.38933

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	12.0373	143138	7.82178	Competent Rock	10000	45	11341.4	27098.4	25389.8	8291.39	17098.4	26947.8	18656.4
2	12.0373	139857	8.79812	Competent Rock	10000	45	6065.02	14491.3	12673	8181.67	4491.37	13611.8	5430.08
3	12.0373	136184	9.77704	Competent Rock	10000	45	5896.7	14089.2	12148	8058.83	4089.19	13164.1	5105.3
4	12.0373	162299	10.7589	Competent Rock	10000	45	10011.8	23921.6	21844.4	7922.75	13921.6	23746.8	15824
5	12.0373	172233	11.7439	Competent Rock	10000	45	7127.81	17030.7	14804	7773.31	7030.73	16285.8	8512.52
6	12.0373	167361	12.7324	Competent Rock	10000	45	6926.79	16550.4	14160.8	7610.38	6550.38	15725.9	8115.53
7	12.0373	177863	13.7249	Competent Rock	10000	45	8670.84	20717.5	18151.2	7433.79	10717.4	20268.9	12835.1
8	12.0373	200974	14.7215	Competent Rock	10000	45	8020.7	19164.1	16407.5	7243.39	9164.12	18514.9	11271.5
9	12.0373	194863	15.7227	Competent Rock	10000	45	7791.66	18616.8	15655.8	7038.98	8616.81	17849.3	10810.3
10	12.0373	190311	16.7289	Competent Rock	10000	45	7723.6	18454.2	15274.6	6820.38	8454.23	17596.1	10775.7
11	12.0373	245474	17.7404	Competent Rock	10000	45	9358.02	22359.4	19010.8	6651.4	12359.4	22004.6	15353.2
12	12.0373	238068	18.7577	Competent Rock	10000	45	9041.53	21603.2	18127.5	6524.35	11603.1	21198	14673.7
13	12.0373	230216	19.7811	Competent Rock	10000	45	8726.3	20850	17232.4	6382.37	10850	20370.8	13988.4
14	12.0373	274743	20.8112	Competent Rock	10000	45	10024.1	23950.9	20176.2	6225.19	13951	23986.2	17761
15	12.0373	287769	21.8483	Competent Rock	10000	45	10339.3	24704.1	20756.6	6052.51	14704.1	24902.2	18849.7
16	12.0373	278525	22.893	Competent Rock	10000	45	9991.67	23873.4	19737.4	5863.97	13873.4	23956.6	18092.6
17	12.0373	297523	23.9459	Competent Rock	10000	45	10479.8	25039.8	20699	5659.23	15039.8	25353.1	19693.8
18	12.0373	333202	25.0074	Competent Rock	10000	45	11432.5	27316	22753.9	5437.9	17316	28086.8	22648.9
19	12.0373	322468	26.0782	Competent Rock	10000	45	11055.6	26415.4	21614.9	5199.54	16415.4	27025.8	21826.2

20	12.0373	315831	27.1588	Competent Rock	10000	45	10808.7	25825.6	20769.3	4943.7	15825.6	26314.4	21370.7
21	12.0373	374047	28.25	Competent Rock	10000	45	12332.7	29466.9	24136.8	4669.87	19467	30763.5	26093.6
22	12.0373	361698	29.3526	Competent Rock	10000	45	11928.9	28502.1	22879.7	4377.5	18502.2	29588.2	25210.7
23	12.0373	348777	30.4671	Competent Rock	10000	45	11528.3	27544.9	21610.9	4066	17544.9	28392.7	24326.7
24	12.0373	390408	31.5946	Competent Rock	10000	45	12547.9	29981	23715.7	3734.71	19981	31433.6	27698.9
25	12.0373	395769	32.7359	Competent Rock	10000	45	12619.7	30152.7	23535.5	3382.91	20152.6	31648.4	28265.5
26	12.0373	381007	33.8921	Competent Rock	10000	45	12194.3	29136.3	22146.1	3009.81	19136.3	30337.9	27328.1
27	12.0373	396618	35.0641	Competent Rock	10000	45	12526.6	29930.2	22544.8	2614.56	19930.3	31336.9	28722.4
28	12.0373	424096	36.2532	Competent Rock	10000	45	13132.8	31378.6	23574.8	2196.2	21378.6	33205.3	31009.1
29	12.0373	407257	37.4607	Competent Rock	10000	45	12683.6	30305.4	22059	1753.66	20305.4	31777.7	30024.1
30	12.0373	396590	38.6881	Competent Rock	10000	45	12396.9	29620.4	20906.1	1285.77	19620.4	30833.7	29548
31	12.0373	445897	39.9369	Competent Rock	10000	45	13469.8	32183.9	22975.2	791.227	22184	34252.5	33461.2
32	12.0373	426661	41.2089	Competent Rock	10000	45	12997	31054.1	21322.7	268.553	21054.1	32704.2	32435.7
33	11.6398	393447	42.4843	Competent Rock	10000	45	12434.4	29709.8	19709.8	0	19709.8	31097.5	31097.5
34	11.6398	404005	43.7644	Competent Rock	10000	45	12435.6	29712.8	19712.8	0	19712.8	31623.3	31623.3
35	11.6398	402331	45.0726	Competent Rock	10000	45	12163.6	29062.9	19062.9	0	19062.9	31257.4	31257.4
36	11.6398	389578	46.4114	Competent Rock	10000	45	11659.7	27858.9	17858.8	0	17858.8	30107.6	30107.6
37	11.6398	375777	47.784	Competent Rock	10000	45	11142.9	26624.1	16624.1	0	16624.1	28906.1	28906.1
38	11.6398	360845	49.1939	Competent Rock	10000	45	10612.8	25357.4	15357.4	0	15357.4	27649.7	27649.7
39	11.6398	344684	50.6452	Competent Rock	10000	45	10068.7	24057.5	14057.5	0	14057.5	26335	26335
40	11.6398	327175	52.1429	Competent Rock	10000	45	9510.03	22722.6	12722.6	0	12722.6	24957.7	24957.7
41	11.6398	308179	53.6928	Competent Rock	10000	45	8935.94	21350.9	11350.9	0	11350.9	23512.5	23512.5
42	11.6398	287527	55.3022	Competent Rock	10000	45	8345.4	19939.9	9939.9	0	9939.9	21993.2	21993.2
43	11.6398	265009	56.9799	Competent Rock	10000	45	7737.09	18486.5	8486.44	0	8486.44	20391.4	20391.4
44	11.6398	240362	58.737	Competent Rock	10000	45	7109.35	16986.6	6986.58	0	6986.58	18696.4	18696.4
45	11.6398	213245	60.5882	Competent Rock	10000	45	6459.97	15435	5434.98	0	5434.98	16894.1	16894.1
46	11.6398	183208	62.5527	Competent Rock	10000	45	5785.91	13824.5	3824.45	0	3824.45	14964.1	14964.1
47	11.6398	149625	64.6574	Competent Rock	10000	45	5082.84	12144.6	2144.59	0	2144.59	12876.8	12876.8
48	11.6398	111592	66.9412	Competent Rock	10000	45	4344.2	10379.7	379.721	0	379.721	10584.9	10584.9
49	11.6398	67697.5	69.4655	Competent Rock	10000	45	3559.27	8504.28	-1495.72	0	-1495.72	8006.52	8006.52
50	12.4313	23531.9	72.4518	Overburden	100	24	206.518	493.44	883.683	0	883.683	1536.76	1536.76

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.38933

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	400	200.298	557737	0	0
2	412.037	201.952	376491	183626	25.9999
3	424.075	203.815	425833	207691	25.9998
4	436.112	205.889	471564	229996	25.9999
5	448.149	208.176	726732	354449	25.9999
6	460.186	210.679	775424	378197	25.9998
7	472.224	213.399	820227	400049	25.9999
8	484.261	216.338	956026	466282	25.9999
9	496.298	219.501	1.00061e+06	488027	25.9999
10	508.335	222.89	1.04128e+06	507863	25.9999
11	520.373	226.508	1.08504e+06	529204	25.9998
12	532.41	230.359	1.12439e+06	548398	25.9998
13	544.447	234.447	1.15904e+06	565299	25.9999
14	556.484	238.776	1.1894e+06	580107	25.9999
15	568.522	243.351	1.21767e+06	593893	25.9998
16	580.559	248.177	1.24186e+06	605691	25.9998
17	592.596	253.26	1.26172e+06	615377	25.9998
18	604.633	258.606	1.27712e+06	622891	25.9999
19	616.671	264.221	1.28688e+06	627648	25.9998
20	628.708	270.112	1.29252e+06	630400	25.9999
21	640.745	276.288	1.29427e+06	631256	25.9999
22	652.782	282.756	1.28651e+06	627467	25.9998
23	664.82	289.525	1.27511e+06	621908	25.9998
24	676.857	296.606	1.26075e+06	614903	25.9998
25	688.894	304.01	1.23609e+06	602878	25.9999
26	700.931	311.749	1.20576e+06	588085	25.9999
27	712.969	319.835	1.17336e+06	572282	25.9998
28	725.006	328.284	1.13356e+06	552872	25.9999
29	737.043	337.111	1.08343e+06	528423	26
30	749.081	346.334	1.03254e+06	503600	25.9998
31	761.118	355.974	980131	478039	25.9999
32	773.155	366.052	910612	444132	25.9998
33	785.192	376.593	842182	410757	25.9999
34	796.832	387.253	776703	378821	25.9999
35	808.472	398.401	701583	342182	25.9998
36	820.112	410.07	620611	302690	25.9998
37	831.751	422.298	537853	262327	25.9999
38	843.391	435.128	454179	221516	25.9998
39	855.031	448.61	370573	180739	25.9998
40	866.671	462.803	288164	140546	25.9998
41	878.31	477.778	208256	101573	25.9999
42	889.95	493.619	132378	64564.7	25.9999
43	901.59	510.431	62343.1	30406.6	25.9999
44	913.23	528.341	344.296	167.923	25.9998
45	924.869	547.513	-50910.9	-24830.8	25.9999
46	936.509	568.16	-87991	-42915.8	25.9999
47	948.149	590.57	-106400	-51894.2	25.9998
48	959.789	615.147	-99986.6	-48766.4	25.9999
49	971.428	642.49	-59840.7	-29186.1	25.9999
50	983.068	673.565	28037.7	13674.8	25.9998
51	995.499	712.877	0	0	0

Entity Information

Water Table

X	Y
0	334
520	334
1200	443.215

Focus Search Line

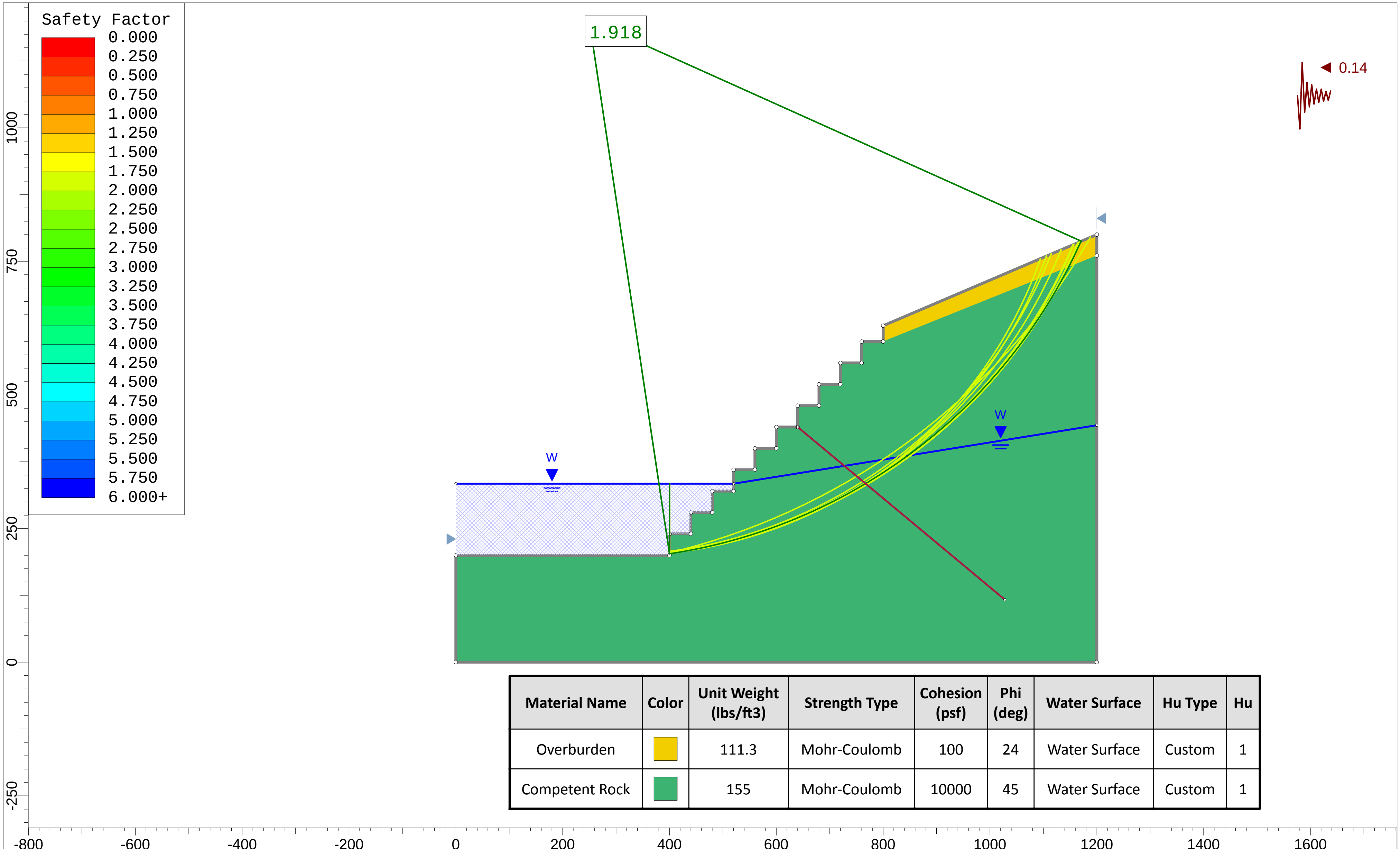
X	Y
640	440
1028.05	116.815

External Boundary

X	Y
0	0
1200	0
1200	760.738
1200	800
800	629.588
800	600
760	600
760	560
720	560
720	520
680	520
680	480
640	480
640	440
600	440
600	400
560	400
560	360
520	360
520	320
480	320
480	280
440	280
440	240
400	240
400	200
0	200

Material Boundary

X	Y
800	600
1200	760.738



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Overburden		111.3	Mohr-Coulomb	100	24	Water Surface	Custom	1
Competent Rock		155	Mohr-Coulomb	10000	45	Water Surface	Custom	1

BAJADA Geosciences, Inc.

SLIDEINTERPRET 8.023

Project	Crystal Creek Aggregate Quarry Expansion
Analysis Description	Gross Stability, Pseudostatic, Low Piezometric Surface
Drawn By	J.Bianchin
Scale	1:2983
Company	Bajada Geosciences, Inc.
Date	5/17/2019, 9:14:14 AM
File Name	A-A'LowH20PS.slim

Slide Analysis Information

Crystal Creek Aggregate Quarry Expansion

Project Summary

Slide Modeler Version:	8.023
Compute Time:	00h:00m:02.252s

General Settings

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

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

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

Random Numbers

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

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle [°]:	Not Defined
Lower Angle [°]:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Seismic Load Coefficient (Horizontal): 0.14

Materials

Property	Overburden	Competent Rock
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	111.3	155
Cohesion [psf]	100	10000
Friction Angle [°]	24	45
Water Surface	Water Table	Water Table
Hu Value	1	1

Global Minimums

Method: spencer

FS	1.918000
Center:	249.636, 1201.423
Radius:	1010.057
Left Slip Surface Endpoint:	400.000, 202.621
Right Slip Surface Endpoint:	1171.062, 787.671
Left Slope Intercept:	400.000 334.000
Right Slope Intercept:	1171.062 787.671
Resisting Moment:	2.3476e+10 lb-ft
Driving Moment:	1.22398e+10 lb-ft
Resisting Horizontal Force:	1.88607e+07 lb
Driving Horizontal Force:	9.83349e+06 lb
Total Slice Area:	136299 ft2
Surface Horizontal Width:	771.062 ft
Surface Average Height:	176.768 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 211
Number of Invalid Surfaces: 4789

Error Codes:

Error Code -103 reported for 1118 surfaces
Error Code -108 reported for 7 surfaces
Error Code -111 reported for 1001 surfaces
Error Code -112 reported for 1 surface
Error Code -114 reported for 2458 surfaces
Error Code -118 reported for 204 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
-114 = Surface with Reverse Curvature.
-118 = Surface does not pass through the search focus

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.918

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	15.3881	176507	9.00314	Competent Rock	10000	45	20189.4	38723.2	36845.2	8121.98	28723.2	40044	31922
2	15.3881	170401	9.88806	Competent Rock	10000	45	8748.87	16780.3	14742.5	7962.22	6780.33	16267.6	8305.37
3	15.3881	186542	10.7754	Competent Rock	10000	45	16670.9	31974.7	29761.9	7787.16	21974.7	32934.6	25147.4
4	15.3881	213425	11.6653	Competent Rock	10000	45	9960.6	19104.4	16701.1	7596.66	9104.46	18757.6	11160.9
5	15.3881	205549	12.5581	Competent Rock	10000	45	9588.61	18391	15781.6	7390.59	8390.98	17917.5	10526.9
6	15.3881	242735	13.454	Competent Rock	10000	45	13872.1	26606.7	23775.5	7168.79	16606.7	27094.1	19925.3
7	15.3881	244982	14.3533	Competent Rock	10000	45	10592.4	20316.3	17247.4	6931.08	10316.4	19957.9	13026.8
8	15.3881	251816	15.2562	Competent Rock	10000	45	10953.8	21009.3	17686.6	6677.28	11009.3	20674.2	13996.9
9	15.3881	306919	16.163	Competent Rock	10000	45	12288.7	23569.7	20085.2	6515.4	13569.8	23646.8	17131.4
10	15.3881	295964	17.074	Competent Rock	10000	45	11746	22528.9	18912	6383.02	12528.9	22519.7	16136.7
11	15.3881	341834	17.9895	Competent Rock	10000	45	12950.2	24838.5	21072.3	6233.88	14838.4	25277.5	19043.6
12	15.3881	367529	18.9097	Competent Rock	10000	45	13506.4	25905.2	21972.9	6067.73	15905.2	26599.7	20532
13	15.3881	354901	19.835	Competent Rock	10000	45	12948.4	24835.1	20719.4	5884.3	14835.1	25390.1	19505.8
14	15.3881	436451	20.7658	Competent Rock	10000	45	15038.3	28843.4	24526.7	5683.29	18843.4	30228.9	24545.6
15	15.3881	422189	21.7023	Competent Rock	10000	45	14439.9	27695.8	23160.2	5464.39	17695.8	28907.2	23442.9
16	15.3881	445725	22.645	Competent Rock	10000	45	14873	28526.4	23753.7	5227.23	18526.5	29958.4	24731.2
17	15.3881	486964	23.5941	Competent Rock	10000	45	15743.1	30195.3	25166.8	4971.47	20195.3	32042.8	27071.4
18	15.3881	470566	24.5502	Competent	10000	45	15142	29042.3	23738.9	4696.69	19042.2	30655.6	25958.9

				Rock									
19	15.3881	530138	25.5137	Competent Rock	10000	45	16419.1	31491.9	25894.4	4402.46	21491.9	33730.7	29328.2
20	15.3881	530928	26.4849	Competent Rock	10000	45	16252.5	31172.3	25260.7	4088.33	21172.4	33358.5	29270.2
21	15.3881	531772	27.4644	Competent Rock	10000	45	16104.3	30888.1	24641.9	3753.79	20888.1	33012.6	29258.8
22	15.3881	588169	28.4527	Competent Rock	10000	45	17213	33014.5	26412.8	3398.29	23014.5	35740.3	32342
23	15.3881	567863	29.4504	Competent Rock	10000	45	16605.5	31849.3	24870.6	3021.27	21849.3	34246.5	31225.2
24	15.3881	604453	30.4579	Competent Rock	10000	45	17243.1	33072.3	25694.4	2622.08	23072.3	35834.3	33212.2
25	15.3881	620089	31.476	Competent Rock	10000	45	17425.5	33422.2	25622.2	2200.03	23422.2	36290.5	34090.5
26	15.3881	597455	32.5052	Competent Rock	10000	45	16840.7	32300.4	24054.8	1754.4	22300.4	34785.7	33031.3
27	15.3881	631756	33.5465	Competent Rock	10000	45	17409.4	33391.3	24675.6	1284.36	23391.3	36219	34934.6
28	15.3881	622315	34.6004	Competent Rock	10000	45	17127.4	32850.4	23639.4	789.033	22850.4	35455	34665.9
29	15.3881	611870	35.6678	Competent Rock	10000	45	16853	32324	22591.5	267.462	22324	34687.2	34419.7
30	15.0909	588904	36.7392	Competent Rock	10000	45	16434.5	31521.3	21521.4	0	21521.4	33788.7	33788.7
31	15.0909	576830	37.8151	Competent Rock	10000	45	15870.1	30438.8	20438.7	0	20438.7	32755.5	32755.5
32	15.0909	563685	38.9069	Competent Rock	10000	45	15305.5	29355.9	19355.9	0	19355.9	31709	31709
33	15.0909	549420	40.0159	Competent Rock	10000	45	14740.6	28272.5	18272.5	0	18272.5	30648.3	30648.3
34	15.0909	533980	41.1431	Competent Rock	10000	45	14175.1	27187.9	17187.9	0	17187.9	29572.4	29572.4
35	15.0909	517303	42.2901	Competent Rock	10000	45	13608.6	26101.2	16101.2	0	16101.2	28479.7	28479.7
36	15.0909	499323	43.4584	Competent Rock	10000	45	13040.4	25011.5	15011.5	0	15011.5	27368.4	27368.4
37	15.0909	479961	44.6497	Competent Rock	10000	45	12470	23917.4	13917.4	0	13917.4	26235.8	26235.8
38	15.0909	459133	45.866	Competent Rock	10000	45	11896.3	22817.1	12817.2	0	12817.2	25078.6	25078.6
39	15.0909	436740	47.1096	Competent Rock	10000	45	11318.4	21708.6	11708.6	0	11708.6	23892.6	23892.6
40	15.0909	412671	48.3829	Competent Rock	10000	45	10734.6	20588.9	10588.9	0	10588.9	22672.3	22672.3
41	15.0909	386798	49.689	Competent Rock	10000	45	10143.2	19454.6	9454.63	0	9454.63	21410.4	21410.4
42	15.0909	358973	51.0313	Competent Rock	10000	45	9541.91	18301.4	8301.38	0	8301.38	20097.8	20097.8
43	15.0909	329022	52.4136	Competent Rock	10000	45	8927.82	17123.6	7123.57	0	7123.57	18722.3	18722.3
44	15.0909	296739	53.8408	Competent Rock	10000	45	8297.19	15914	5914.02	0	5914.02	17267.6	17267.6
45	15.0909	261880	55.3184	Competent Rock	10000	45	7645.25	14663.6	4663.59	0	4663.59	15712.3	15712.3
46	15.0909	224145	56.8535	Competent Rock	10000	45	6965.77	13360.3	3360.34	0	3360.34	14026.9	14026.9
47	15.0909	183167	58.4544	Competent Rock	10000	45	6250.56	11988.6	1988.58	0	1988.58	12170.4	12170.4
48	15.0909	138482	60.132	Competent Rock	10000	45	5488.68	10527.3	527.286	0	527.286	10084.8	10084.8
49	15.0909	89491.4	61.9003	Competent Rock	10000	45	4665.17	8947.79	-1052.21	0	-1052.21	7684.99	7684.99
50	22.991	48626.8	64.3137	Overburden	100	24	649.239	1245.24	2572.25	0	2572.25	3922.1	3922.1

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.918

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	400	202.621	538527	0	0
2	415.388	205.059	471962	475788	45.2313
3	430.776	207.741	555978	560485	45.2313
4	446.164	210.67	894710	901963	45.2313
5	461.552	213.847	972478	980360	45.2313
6	476.94	217.275	1.04458e+06	1.05305e+06	45.2314
7	492.328	220.956	1.22459e+06	1.23452e+06	45.2314
8	507.716	224.894	1.28745e+06	1.29788e+06	45.2311
9	523.104	229.091	1.35432e+06	1.3653e+06	45.2313
10	538.493	233.551	1.41109e+06	1.42253e+06	45.2313
11	553.881	238.277	1.46122e+06	1.47307e+06	45.2314
12	569.269	243.274	1.50758e+06	1.5198e+06	45.2313
13	584.657	248.545	1.54836e+06	1.56092e+06	45.2314
14	600.045	254.096	1.58315e+06	1.59598e+06	45.2312
15	615.433	259.931	1.61061e+06	1.62366e+06	45.2312
16	630.821	266.055	1.63211e+06	1.64534e+06	45.2313
17	646.209	272.475	1.64635e+06	1.65969e+06	45.2312
18	661.597	279.196	1.65155e+06	1.66494e+06	45.2313
19	676.985	286.225	1.65208e+06	1.66547e+06	45.2313
20	692.373	293.569	1.64063e+06	1.65393e+06	45.2313
21	707.761	301.236	1.623e+06	1.63616e+06	45.2314
22	723.149	309.234	1.59955e+06	1.61252e+06	45.2314
23	738.537	317.573	1.56213e+06	1.5748e+06	45.2314
24	753.925	326.262	1.52236e+06	1.5347e+06	45.2313
25	769.313	335.311	1.47086e+06	1.48279e+06	45.2314
26	784.702	344.732	1.41111e+06	1.42255e+06	45.2313
27	800.09	354.537	1.35104e+06	1.36199e+06	45.2312
28	815.478	364.74	1.27903e+06	1.2894e+06	45.2313
29	830.866	375.356	1.20481e+06	1.21458e+06	45.2314
30	846.254	386.4	1.12927e+06	1.13842e+06	45.2312
31	861.345	397.664	1.05269e+06	1.06122e+06	45.2312
32	876.435	409.376	972314	980195	45.2313
33	891.526	421.556	888880	896085	45.2313
34	906.617	434.226	803151	809661	45.2313
35	921.708	447.411	715934	721737	45.2313
36	936.799	461.137	628089	633180	45.2313
37	951.89	475.437	540534	544916	45.2313
38	966.981	490.345	454262	457944	45.2313
39	982.071	505.899	370352	373354	45.2313
40	997.162	522.144	289997	292348	45.2313
41	1012.25	539.131	214526	216265	45.2313
42	1027.34	556.919	145440	146619	45.2313
43	1042.43	575.575	84467.7	85152.4	45.2313
44	1057.53	595.181	33624.2	33896.7	45.2312
45	1072.62	615.83	-4689.94	-4727.96	45.2313
46	1087.71	637.639	-27557.6	-27780.9	45.2312
47	1102.8	660.748	-31351.6	-31605.8	45.2313
48	1117.89	685.33	-11445.8	-11538.5	45.2311
49	1132.98	711.607	38233.2	38543.1	45.2313
50	1148.07	739.871	125924	126944	45.2311
51	1171.06	787.671	0	0	0

Entity Information

Water Table

X	Y
0	334
520	334
1200	443.215

Focus Search Line

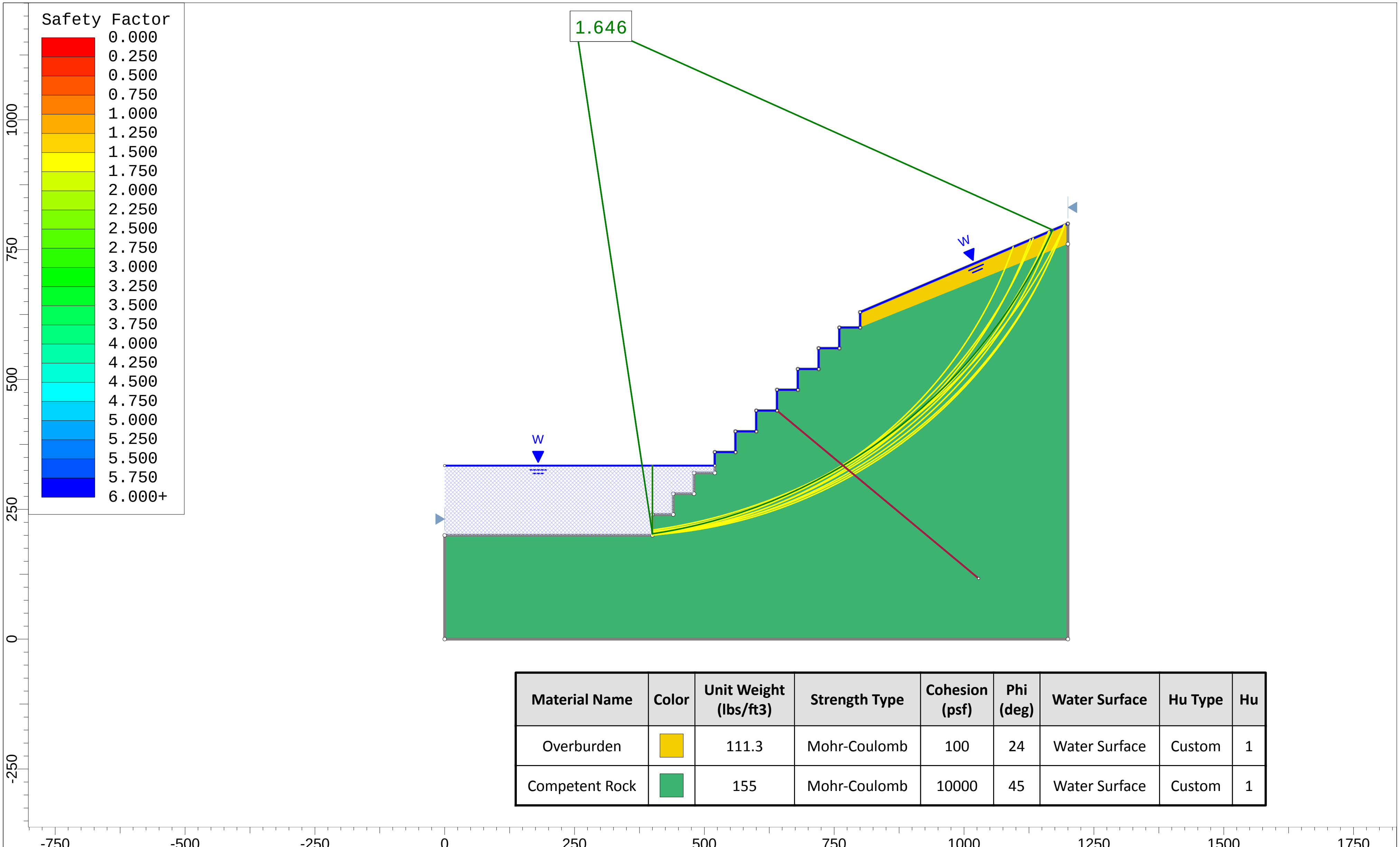
X	Y
640	440
1028.05	116.815

External Boundary

X	Y
0	0
1200	0
1200	760.738
1200	800
800	629.588
800	600
760	600
760	560
720	560
720	520
680	520
680	480
640	480
640	440
600	440
600	400
560	400
560	360
520	360
520	320
480	320
480	280
440	280
440	240
400	240
400	200
0	200

Material Boundary

X	Y
800	600
1200	760.738



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Overburden		111.3	Mohr-Coulomb	100	24	Water Surface	Custom	1
Competent Rock		155	Mohr-Coulomb	10000	45	Water Surface	Custom	1

BAJADA Geosciences, Inc.

Project	Crystal Creek Aggregate Quarry Expansion
Analysis Description	Gross Stability, Static
Drawn By	J.Bianchin
Scale	1:3067
Company	Bajada Geosciences, Inc.
Date	5/17/2019, 9:14:14 AM
File Name	A-A'StaticHighH20.slim

SLIDEINTERPRET 8.023

Slide Analysis Information

Crystal Creek Aggregate Quarry Expansion

Project Summary

Slide Modeler Version:	8.023
Compute Time:	00h:00m:01.421s

General Settings

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

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

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

Random Numbers

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

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle [°]:	Not Defined
Lower Angle [°]:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Property	Overburden	Competent Rock
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	111.3	155
Cohesion [psf]	100	10000
Friction Angle [°]	24	45
Water Surface	Water Table	Water Table
Hu Value	1	1

Global Minimums

Method: spencer

FS	1.646190
Center:	249.636, 1201.423
Radius:	1010.057
Left Slip Surface Endpoint:	400.000, 202.621
Right Slip Surface Endpoint:	1171.062, 787.671
Left Slope Intercept:	400.000 334.000
Right Slope Intercept:	1171.062 787.671
Resisting Moment:	1.68796e+10 lb-ft
Driving Moment:	1.02537e+10 lb-ft
Resisting Horizontal Force:	1.38698e+07 lb
Driving Horizontal Force:	8.4254e+06 lb
Total Slice Area:	136298 ft2
Surface Horizontal Width:	771.062 ft
Surface Average Height:	176.767 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	555
Number of Invalid Surfaces:	4445

Error Codes:

Error Code -103 reported for 1118 surfaces

Error Code -108 reported for 6 surfaces
Error Code -111 reported for 658 surfaces
Error Code -112 reported for 1 surface
Error Code -114 reported for 2458 surfaces
Error Code -118 reported for 204 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
-114 = Surface with Reverse Curvature.
-118 = Surface does not pass through the search focus

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.64619

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	15.2668	175140	8.99965	Competent Rock	10000	45	16142	26572.8	24695.4	8122.61	16572.8	27252	19129.3
2	15.2668	169134	9.87758	Competent Rock	10000	45	9285.67	15286	13250.2	7964.23	5285.96	14867	6902.82
3	15.2668	184041	10.7579	Competent Rock	10000	45	14345.2	23615	21405.8	7790.79	13615	24131.3	16340.6
4	15.2668	211951	11.6407	Competent Rock	10000	45	11098.3	18269.9	15872	7602.16	8269.88	18158.4	10556.2
5	15.2668	204217	12.5264	Competent Rock	10000	45	10712.7	17635.2	15033.4	7398.2	7635.16	17413.5	10015.3
6	15.2668	238864	13.4151	Competent Rock	10000	45	14079.4	23177.4	20356.2	7178.77	13177.4	23714.3	16535.5
7	15.2668	243528	14.3071	Competent Rock	10000	45	12286.9	20226.6	17170.3	6943.68	10226.6	20303.8	13360.1
8	15.2668	245380	15.2027	Competent Rock	10000	45	12456.5	20505.8	17198.6	6692.77	10505.8	20583.5	13890.8
9	15.2668	305207	16.1021	Competent Rock	10000	45	13533.4	22278.6	20326.8	8048.23	12278.6	24233.6	16185.4
10	15.2668	294468	17.0056	Competent Rock	10000	45	13062.5	21503.4	19268.5	7765.05	11503.4	23263.5	15498.4
11	15.2668	332297	17.9135	Competent Rock	10000	45	12762.6	21009.7	20971.1	9961.4	11009.7	25096.6	15135.2
12	15.2668	365761	18.8261	Competent Rock	10000	45	13991.9	23033.4	22678.4	9645.03	13033.4	27448.8	17803.7
13	15.2668	353120	19.7436	Competent Rock	10000	45	13484.5	22198.1	21509.8	9311.68	12198.1	26349.5	17037.9
14	15.2668	424977	20.6664	Competent Rock	10000	45	14398.5	23702.6	25159.7	11457.1	13702.6	30590.7	19133.6
15	15.2668	420514	21.5949	Competent Rock	10000	45	14198.2	23373	24461.9	11088.8	13373.1	30081.9	18993.1
16	15.2668	432333	22.5294	Competent Rock	10000	45	14582	24004.7	24707.5	10702.7	14004.8	30756.3	20053.6
17	15.2668	485189	23.4703	Competent Rock	10000	45	14748.8	24279.3	27073.7	12794.3	14279.4	33477.5	20683.2
18	15.2668	469145	24.4179	Competent Rock	10000	45	14180.5	23343.8	25715	12371.2	13343.8	32152.9	19781.7
19	15.2668	514802	25.3727	Competent Rock	10000	45	14089.3	23193.7	27618.8	14425.1	13193.7	34300.7	19875.6

20	15.2668	529525	26.3351	Competent Rock	10000	45	14550.2	23952.4	27915.9	13963.4	13952.5	35118.1	21154.7
21	15.2668	514989	27.3055	Competent Rock	10000	45	14080.3	23178.9	26660.7	13481.7	13179	33929.8	20448.1
22	15.2668	586867	28.2846	Competent Rock	10000	45	14779.5	24329.8	29805.4	15475.5	14329.9	37758.2	22282.7
23	15.2668	567022	29.2727	Competent Rock	10000	45	14167.7	23322.7	28274.9	14952.2	13322.7	36216.6	21264.4
24	15.2668	586046	30.2704	Competent Rock	10000	45	14743.4	24270.5	28677.7	14407.2	14270.5	37282.8	22875.6
25	15.2668	619492	31.2785	Competent Rock	10000	45	14242.8	23446.3	29782.2	16335.8	13446.4	38434.6	22098.8
26	15.2668	597100	32.2974	Competent Rock	10000	45	13619.9	22420.9	28166.3	15745.4	12420.9	36775.6	21030.2
27	15.2668	618826	33.3279	Competent Rock	10000	45	13118.8	21596.1	28694.9	17098.8	11596.1	37321.5	20222.7
28	15.2668	619525	34.3707	Competent Rock	10000	45	12950.1	21318.3	28184	16865.7	11318.3	37041.4	20175.7
29	15.2668	609465	35.4267	Competent Rock	10000	45	12507.3	20589.4	27196.4	16606.9	10589.5	36093.6	19486.7
30	15.2668	598396	36.4968	Competent Rock	10000	45	12063.6	19859	26180.5	16321.5	9859.04	35106.1	18784.6
31	15.2668	586274	37.5818	Competent Rock	10000	45	11619.4	19127.8	25136.1	16008.4	9127.75	34078.4	18070
32	15.2668	573055	38.6829	Competent Rock	10000	45	11175.1	18396.3	24062.6	15666.3	8396.28	33010	17343.7
33	15.2668	558687	39.8013	Competent Rock	10000	45	10731.1	17665.4	22959.3	15293.9	7665.39	31900.5	16606.6
34	15.2668	543113	40.9381	Competent Rock	10000	45	10287.9	16935.8	21825.5	14889.7	6935.79	30749.1	15859.4
35	15.2668	526271	42.0948	Competent Rock	10000	45	9845.96	16208.3	20660.4	14452.1	6208.31	29555.3	15103.2
36	15.2668	508092	43.2731	Competent Rock	10000	45	9405.85	15483.8	19463	13979.2	5483.8	28318.3	14339.1
37	15.2668	488495	44.4747	Competent Rock	10000	45	8968.13	14763.2	18232.2	13468.9	4763.29	27037.4	13568.5
38	15.2668	467394	45.7015	Competent Rock	10000	45	8533.39	14047.6	16966.5	12919	4047.55	25711.5	12792.5
39	15.2668	444687	46.9559	Competent Rock	10000	45	8102.31	13337.9	15664.6	12326.7	3337.94	24339.9	12013.2
40	15.2668	420260	48.2405	Competent Rock	10000	45	7675.61	12635.5	14324.6	11689.1	2635.47	22921.5	11232.4
41	15.2668	393980	49.5582	Competent Rock	10000	45	7254.11	11941.6	12944.2	11002.6	1941.63	21455.2	10452.6
42	15.2668	365695	50.9125	Competent Rock	10000	45	6838.69	11257.8	11521	10263.2	1257.78	19939.7	9676.54
43	15.2668	335226	52.3075	Competent Rock	10000	45	6430.33	10585.5	10051.7	9466.22	585.53	18373.9	8907.65
44	15.2668	302360	53.748	Competent Rock	10000	45	6030.15	9926.77	8532.81	8606.05	-73.2397	16756.3	8150.23
45	15.2668	266843	55.2397	Competent Rock	10000	45	5639.41	9283.53	6959.52	7675.98	-716.462	15085.6	7409.59
46	15.2668	228367	56.7898	Competent Rock	10000	45	5259.53	8658.18	5326.03	6667.86	-1341.83	13360.3	6692.45
47	15.2668	186549	58.407	Competent Rock	10000	45	4892.14	8053.39	3625.03	5571.64	-1946.61	11579.3	6007.61
48	15.2668	140909	60.1022	Competent Rock	10000	45	4539.12	7472.26	1846.87	4374.61	-2527.74	9741.36	5366.75
49	15.2668	90822.5	61.89	Competent Rock	10000	45	4202.63	6918.32	-21.3425	3060.34	-3081.68	7846.18	4785.84
50	22.991	48626.8	64.3137	Overburden	100	24	122.85	202.234	1415.4	1185.78	229.619	1670.82	485.038

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.64619

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	400	202.621	538527	0	0
2	415.267	205.039	449605	250285	29.1037
3	430.534	207.697	556164	309604	29.1037
4	445.8	210.598	897815	499793	29.1037
5	461.067	213.743	1.01736e+06	566339	29.1036
6	476.334	217.135	1.12994e+06	629010	29.1036
7	491.601	220.776	1.35566e+06	754663	29.1036
8	506.867	224.67	1.47641e+06	821885	29.1037
9	522.134	228.818	1.60138e+06	891449	29.1036
10	537.401	233.225	1.71843e+06	956613	29.1037
11	552.668	237.895	1.82792e+06	1.01756e+06	29.1037
12	567.934	242.83	1.9193e+06	1.06843e+06	29.1037
13	583.201	248.035	2.0149e+06	1.12165e+06	29.1037
14	598.468	253.514	2.10294e+06	1.17066e+06	29.1037
15	613.735	259.273	2.1779e+06	1.21239e+06	29.1037
16	629.001	265.316	2.24687e+06	1.25078e+06	29.1037
17	644.268	271.648	2.31306e+06	1.28763e+06	29.1037
18	659.535	278.277	2.35879e+06	1.31309e+06	29.1038
19	674.802	285.208	2.39708e+06	1.3344e+06	29.1037
20	690.068	292.448	2.41225e+06	1.34284e+06	29.1036
21	705.335	300.005	2.42345e+06	1.34908e+06	29.1037
22	720.602	307.887	2.42832e+06	1.35179e+06	29.1037
23	735.869	316.102	2.40914e+06	1.34111e+06	29.1036
24	751.135	324.66	2.38349e+06	1.32684e+06	29.1038
25	766.402	333.57	2.35307e+06	1.3099e+06	29.1037
26	781.669	342.845	2.29433e+06	1.2772e+06	29.1037
27	796.936	352.495	2.23048e+06	1.24166e+06	29.1037
28	812.202	362.534	2.14273e+06	1.19281e+06	29.1037
29	827.469	372.976	2.04617e+06	1.13905e+06	29.1036
30	842.736	383.836	1.94178e+06	1.08095e+06	29.1038
31	858.003	395.132	1.83026e+06	1.01886e+06	29.1036
32	873.269	406.881	1.71235e+06	953225	29.1037
33	888.536	419.105	1.58885e+06	884477	29.1037
34	903.803	431.825	1.46065e+06	813113	29.1038
35	919.07	445.067	1.32872e+06	739669	29.1037
36	934.336	458.859	1.19411e+06	664733	29.1037
37	949.603	473.232	1.05798e+06	588955	29.1038
38	964.87	488.222	921629	513050	29.1037
39	980.137	503.867	786480	437815	29.1037
40	995.403	520.213	654134	364142	29.1037
41	1010.67	537.312	526394	293031	29.1036
42	1025.94	555.224	405302	225622	29.1036
43	1041.2	574.018	293195	163215	29.1037
44	1056.47	593.777	192775	107314	29.1038
45	1071.74	614.596	107199	59675.5	29.1038
46	1087	636.595	40208.9	22383.4	29.1037
47	1102.27	659.916	-3691.87	-2055.18	29.1037
48	1117.54	684.738	-18976.2	-10563.6	29.1036
49	1132.8	711.29	1293.53	720.078	29.1037
50	1148.07	739.871	66073.4	36781.6	29.1037
51	1171.06	787.671	0	0	0

Entity Information

Water Table

X	Y
0	334
520	334
520	360
560	360
560	400
600	400
600	440
640	440
640	480
680	480
680	520
720	520
720	560
760	560
760	600
800	600
800	629.588
1200	800

Focus Search Line

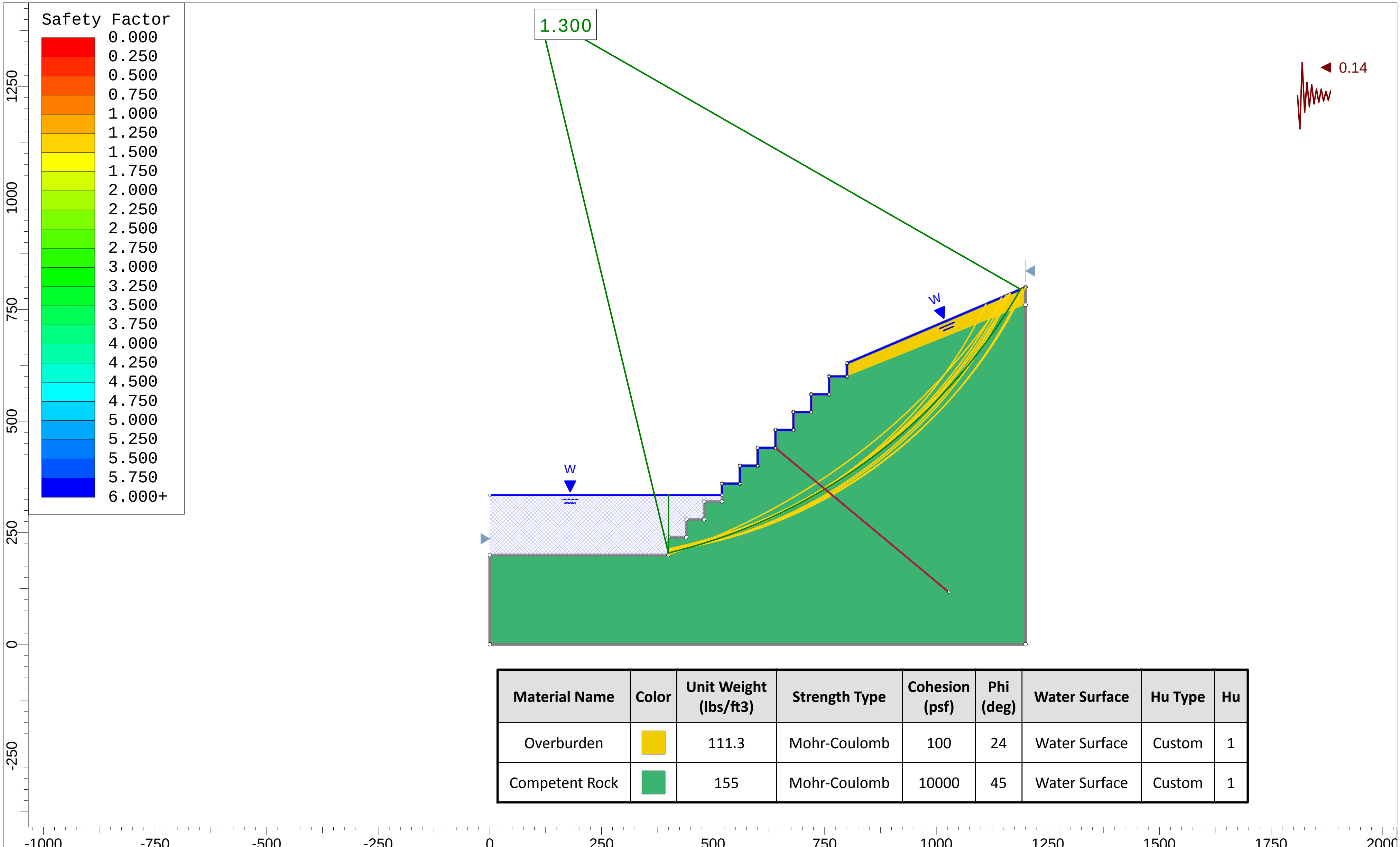
X	Y
640	440
1028.05	116.815

External Boundary

X	Y
0	0
1200	0
1200	760.738
1200	800
800	629.588
800	600
760	600
760	560
720	560
720	520
680	520
680	480
640	480
640	440
600	440
600	400
560	400
560	360
520	360
520	320
480	320
480	280
440	280
440	240
400	240
400	200
0	200

Material Boundary

X	Y
800	600
1200	760.738



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Overburden		111.3	Mohr-Coulomb	100	24	Water Surface	Custom	1
Competent Rock		155	Mohr-Coulomb	10000	45	Water Surface	Custom	1

BAJADA Geosciences, Inc.

SLIDEINTERPRET 8.023

Project Crystal Creek Aggregate Quarry Expansion

Analysis Description Gross Stability, High Piezometric Surface, Pseudostatic

Drawn By J.Bianchin | *Scale* 1:3569 | *Company* Bajada Geosciences, Inc.

Date 5/17/2019, 9:14:14 AM | *File Name* A-A'StaticHighH20PS.slim

Slide Analysis Information

Crystal Creek Aggregate Quarry Expansion

Project Summary

Slide Modeler Version:	8.023
Compute Time:	00h:00m:01.488s

General Settings

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

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

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

Random Numbers

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

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle [°]:	Not Defined
Lower Angle [°]:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Seismic Load Coefficient (Horizontal): 0.14

Materials

Property	Overburden	Competent Rock
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	111.3	155
Cohesion [psf]	100	10000
Friction Angle [°]	24	45
Water Surface	Water Table	Water Table
Hu Value	1	1

Global Minimums

Method: spencer

FS	1.299620
Center:	110.136, 1413.477
Radius:	1243.342
Left Slip Surface Endpoint:	400.000, 204.396
Right Slip Surface Endpoint:	1188.894, 795.268
Left Slope Intercept:	400.000 334.000
Right Slope Intercept:	1188.894 795.268
Resisting Moment:	1.82462e+10 lb-ft
Driving Moment:	1.40397e+10 lb-ft
Resisting Horizontal Force:	1.22737e+07 lb
Driving Horizontal Force:	9.44412e+06 lb
Total Slice Area:	124679 ft2
Surface Horizontal Width:	788.894 ft
Surface Average Height:	158.043 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 298
Number of Invalid Surfaces: 4702

Error Codes:

Error Code -103 reported for 1118 surfaces
Error Code -108 reported for 14 surfaces
Error Code -111 reported for 908 surfaces
Error Code -114 reported for 2458 surfaces
Error Code -118 reported for 204 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-114 = Surface with Reverse Curvature.
-118 = Surface does not pass through the search focus

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.29962

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	15.7849	174936	13.8562	Competent Rock	10000	45	25158.8	32696.9	30662.8	7965.82	22697	36868.5	28902.7
2	15.7849	165141	14.6066	Competent Rock	10000	45	12245.4	15914.3	13630.4	7715.99	5914.37	16821.6	9105.57
3	15.7849	182046	15.3597	Competent Rock	10000	45	21705.3	28208.7	25661.1	7452.37	18208.7	31623.3	24171
4	15.7849	202388	16.1154	Competent Rock	10000	45	13920.6	18091.5	15266.3	7174.79	8091.47	19288.3	12113.5
5	15.7849	190952	16.8741	Competent Rock	10000	45	13336.6	17332.6	14215.7	6883.11	7332.57	18261.1	11378
6	15.7849	233439	17.6358	Competent Rock	10000	45	18898.8	24561.2	21138.4	6577.16	14561.2	27146.4	20569.2
7	15.7849	224860	18.4007	Competent Rock	10000	45	14776	19203.2	15459.9	6256.76	9203.19	20375.5	14118.7
8	15.7849	245169	19.1691	Competent Rock	10000	45	15958.6	20740.1	16661.8	5921.72	10740	22209.5	16287.8
9	15.7849	282081	19.941	Competent Rock	10000	45	15664.7	20358.1	17552.3	7194.24	10358.1	23235.6	16041.3
10	15.7849	267773	20.7168	Competent Rock	10000	45	15048.4	19557.2	16386.5	6829.3	9557.18	22077.8	15248.5
11	15.7849	337395	21.4965	Competent Rock	10000	45	15590	20261.1	19206.1	8945.08	10261.1	25346.1	16401
12	15.7849	335214	22.2804	Competent Rock	10000	45	15524.7	20176.2	18725.5	8549.33	10176.2	25086.4	16537.1
13	15.7849	351341	23.0688	Competent Rock	10000	45	16230.4	21093.4	19231.1	8137.79	11093.4	26143.6	18005.8
14	15.7849	400178	23.8618	Competent Rock	10000	45	15832.9	20576.7	20782.9	10206.2	10576.7	27786.4	17580.2
15	15.7849	382771	24.6597	Competent Rock	10000	45	15197.1	19750.5	19512.7	9762.25	9750.48	26489.7	16727.4
16	15.7849	442574	25.4627	Competent Rock	10000	45	15226.1	19788.1	21585.7	11797.6	9788.12	28836	17038.4
17	15.7849	443851	26.2712	Competent Rock	10000	45	15341.1	19937.6	21257.6	11320	9937.56	28830	17510
18	15.7849	450039	27.0853	Competent Rock	10000	45	15646.4	20334.4	21159.5	10825.1	10334.4	29161.1	18336
19	15.7849	502209	27.9053	Competent Rock	10000	45	15352.4	19952.3	22760.8	12808.4	9952.35	30891.3	18082.9
20	15.7849	481396	28.7317	Competent	10000	45	14716	19125.2	21402.7	12277.6	9125.14	29470.1	17192.5

				Rock									
21	15.7849	531051	29.5646	Competent Rock	10000	45	14338	18634	22858.2	14224.2	8634.02	30991.6	16767.4
22	15.7849	535438	30.4044	Competent Rock	10000	45	14600.8	18975.5	22631.4	13655.9	8975.49	31199.2	17543.3
23	15.7849	531316	31.2516	Competent Rock	10000	45	14593.2	18965.6	22033.6	13068	8965.64	30889.6	17821.6
24	15.7849	586420	32.1064	Competent Rock	10000	45	14378.8	18687	23643.1	14956.1	8687.05	32665.2	17709.1
25	15.7849	561778	32.9693	Competent Rock	10000	45	13755.3	17876.7	22204.3	14327.7	7876.64	31126.6	16798.9
26	15.7849	574099	33.8407	Competent Rock	10000	45	12725.7	16538.6	22129.8	15591.2	6538.55	30662	15070.8
27	15.7849	580729	34.721	Competent Rock	10000	45	12769.3	16595.2	21934.6	15339.3	6595.27	30783.4	15444.1
28	15.7849	569708	35.6109	Competent Rock	10000	45	12315.2	16005	21070	15064.9	6005.08	29890.3	14825.4
29	15.7849	557773	36.5108	Competent Rock	10000	45	11869.2	15425.4	20192.7	14767.3	5425.38	28978.9	14211.6
30	15.7849	544894	37.4213	Competent Rock	10000	45	11431.6	14856.7	19302.2	14445.5	4856.71	28049	13603.5
31	15.7849	531035	38.3429	Competent Rock	10000	45	11002.7	14299.4	18398.2	14098.8	4299.37	27101	13002.2
32	15.7849	516159	39.2765	Competent Rock	10000	45	10583.1	13754	17480	13726.1	3753.95	26134.9	12408.8
33	15.7849	500226	40.2227	Competent Rock	10000	45	10173	13221	16547.4	13326.4	3221.02	25151.2	11824.8
34	15.7849	483190	41.1823	Competent Rock	10000	45	9772.95	12701.1	15599.8	12898.7	2701.12	24150.1	11251.4
35	15.7849	465004	42.1562	Competent Rock	10000	45	9383.55	12195	14636.6	12441.6	2195.03	23132	10690.4
36	15.7849	445612	43.1453	Competent Rock	10000	45	9005.38	11703.6	13657.3	11953.7	1703.61	22097.7	10144
37	15.7849	424958	44.1506	Competent Rock	10000	45	8639.13	11227.6	12661.2	11433.7	1227.52	21047.9	9614.24
38	15.7849	402975	45.1735	Competent Rock	10000	45	8285.58	10768.1	11647.8	10879.7	768.133	19983.7	9104.03
39	15.7849	379590	46.215	Competent Rock	10000	45	7945.61	10326.3	10616.3	10290	326.31	18906.3	8616.26
40	15.7849	354724	47.2767	Competent Rock	10000	45	7620.21	9903.38	9565.91	9662.56	-96.6468	17817.1	8154.56
41	15.7849	328286	48.3602	Competent Rock	10000	45	7310.51	9500.89	8495.87	8994.99	-499.122	16718.4	7723.38
42	15.7849	300174	49.4672	Competent Rock	10000	45	7017.81	9120.49	7405.22	8284.73	-879.515	15612.5	7327.76
43	15.7849	270272	50.5998	Competent Rock	10000	45	6743.59	8764.1	6292.92	7528.84	-1235.92	14502.6	6973.81
44	15.7849	238450	51.7605	Competent Rock	10000	45	6489.56	8433.96	5157.92	6723.95	-1566.03	13393	6669.04
45	15.7849	204555	52.9518	Competent Rock	10000	45	6257.71	8132.65	3998.88	5866.21	-1867.33	12288.6	6422.41
46	15.7849	168413	54.1769	Competent Rock	10000	45	6050.4	7863.22	2814.38	4951.16	-2136.78	11196.3	6245.17
47	15.7849	129819	55.4394	Competent Rock	10000	45	5870.39	7629.27	1602.83	3973.56	-2370.73	10125	6151.42
48	15.7849	88530.4	56.7438	Competent Rock	10000	45	5720.98	7435.1	362.345	2927.24	-2564.89	9086.24	6159
49	15.6091	50435.2	58.0874	Overburden	100	24	282.077	366.593	2410.3	1811.52	598.779	2863.25	1051.73
50	15.6091	17219.6	59.4759	Overburden	100	24	0	0	-78.6404	618.484	-697.124	-78.6404	-697.124

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.29962

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	400	204.396	524075	0	0
2	415.785	208.289	513104	406365	38.3783
3	431.57	212.403	639438	506419	38.3783
4	447.355	216.739	1.0391e+06	822944	38.3784
5	463.14	221.3	1.1675e+06	924628	38.3783
6	478.925	226.088	1.28987e+06	1.02154e+06	38.3782
7	494.709	231.106	1.53547e+06	1.21605e+06	38.3783
8	510.494	236.357	1.65709e+06	1.31237e+06	38.3783
9	526.279	241.844	1.78957e+06	1.41729e+06	38.3783
10	542.064	247.571	1.89589e+06	1.50149e+06	38.3782
11	557.849	253.541	1.99721e+06	1.58174e+06	38.3783
12	573.634	259.758	2.07574e+06	1.64393e+06	38.3783
13	589.419	266.225	2.15183e+06	1.70419e+06	38.3783
14	605.204	272.948	2.22858e+06	1.76498e+06	38.3783
15	620.989	279.93	2.27642e+06	1.80286e+06	38.3782
16	636.774	287.177	2.3204e+06	1.8377e+06	38.3784
17	652.558	294.693	2.33563e+06	1.84976e+06	38.3783
18	668.343	302.485	2.3491e+06	1.86043e+06	38.3784
19	684.128	310.557	2.36133e+06	1.87011e+06	38.3783
20	699.913	318.917	2.34217e+06	1.85494e+06	38.3783
21	715.698	327.57	2.32099e+06	1.83816e+06	38.3783
22	731.483	336.524	2.26743e+06	1.79575e+06	38.3784
23	747.268	345.787	2.21245e+06	1.7522e+06	38.3783
24	763.053	355.366	2.15648e+06	1.70788e+06	38.3784
25	778.838	365.27	2.06632e+06	1.63647e+06	38.3783
26	794.623	375.509	1.97663e+06	1.56544e+06	38.3783
27	810.408	386.092	1.86217e+06	1.47479e+06	38.3783
28	826.192	397.031	1.74173e+06	1.37941e+06	38.3784
29	841.977	408.336	1.61743e+06	1.28096e+06	38.3783
30	857.762	420.021	1.49004e+06	1.18007e+06	38.3782
31	873.547	432.099	1.36039e+06	1.07739e+06	38.3782
32	889.332	444.584	1.22936e+06	973619	38.3782
33	905.117	457.493	1.09787e+06	869481	38.3782
34	920.902	470.843	966898	765758	38.3783
35	936.687	484.653	837499	663278	38.3783
36	952.472	498.944	710787	562925	38.3783
37	968.257	513.739	587958	465648	38.3783
38	984.042	529.063	470299	372465	38.3783
39	999.826	544.943	359199	284476	38.3783
40	1015.61	561.412	256163	202875	38.3784
41	1031.4	578.504	162830	128958	38.3785
42	1047.18	596.259	80993.3	64144.6	38.3783
43	1062.97	614.719	12622.8	9996.94	38.3783
44	1078.75	633.936	-40100.7	-31758.7	38.3783
45	1094.54	653.966	-74749.8	-59200	38.3784
46	1110.32	674.877	-88602.4	-70170.8	38.3783
47	1126.11	696.745	-78580.4	-62233.6	38.3783
48	1141.89	719.66	-41171.2	-32606.6	38.3784
49	1157.68	743.73	27676.5	21919	38.3782
50	1173.28	768.795	-35411.7	-28045.2	38.3784
51	1188.89	795.268	0	0	0

Entity Information

Water Table

X	Y
0	334
520	334
520	360
560	360
560	400
600	400
600	440
640	440
640	480
680	480
680	520
720	520
720	560
760	560
760	600
800	600
800	629.588
1200	800

Focus Search Line

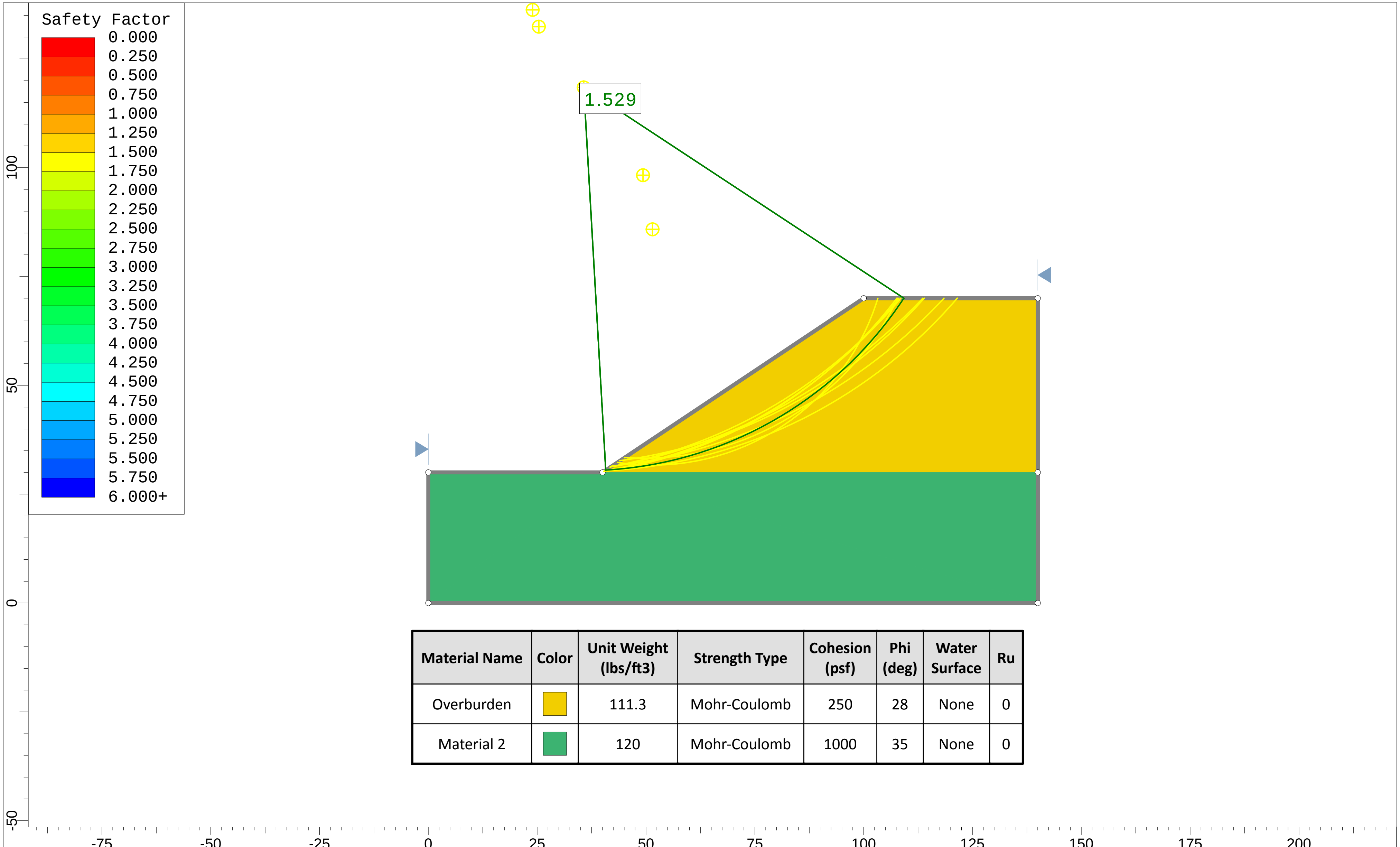
X	Y
640	440
1028.05	116.815

External Boundary

X	Y
0	0
1200	0
1200	760.738
1200	800
800	629.588
800	600
760	600
760	560
720	560
720	520
680	520
680	480
640	480
640	440
600	440
600	400
560	400
560	360
520	360
520	320
480	320
480	280
440	280
440	240
400	240
400	200
0	200

Material Boundary

X	Y
800	600
1200	760.738



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Overburden		111.3	Mohr-Coulomb	250	28	None	0
Material 2		120	Mohr-Coulomb	1000	35	None	0

BAJADA Geosciences, Inc.

Project	Crystal Creek Aggregate Quarry Expansion		
Analysis Description	Overburden Cut Inclination - 1.5:1 Slope		
Drawn By J. Bianchin	*Scale* 1:366	*Company*	Bajada Geosciences, Inc.
Date	5/17/2019, 10:48:54 AM	*File Name*	OverburdenStatic1.5-1.slim

SLIDEINTERPRET 8.026

Slide Analysis Information

Crystal Creek Aggregate Quarry Expansion

Project Summary

Slide Modeler Version:	8.026
Compute Time:	00h:00m:03.135s

General Settings

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

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

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

Random Numbers

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

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle [°]:	Not Defined
Lower Angle [°]:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Property	Overburden	Material 2
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	111.3	120
Cohesion [psf]	250	1000
Friction Angle [°]	28	35
Water Surface	None	None
Ru Value	0	0

Global Minimums

Method: spencer

FS	1.528980
Center:	35.689, 118.443
Radius:	88.096
Left Slip Surface Endpoint:	40.738, 30.492
Right Slip Surface Endpoint:	109.270, 70.000
Resisting Moment:	4.98879e+06 lb-ft
Driving Moment:	3.26283e+06 lb-ft
Resisting Horizontal Force:	48292.3 lb
Driving Horizontal Force:	31584.7 lb
Total Slice Area:	682.965 ft2
Surface Horizontal Width:	68.5319 ft
Surface Average Height:	9.96565 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	2899
Number of Invalid Surfaces:	2101

Error Codes:

Error Code -105 reported for 1 surface
Error Code -106 reported for 22 surfaces
Error Code -108 reported for 44 surfaces

Error Code -111 reported for 555 surfaces
Error Code -112 reported for 11 surfaces
Error Code -114 reported for 1468 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.
-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
-114 = Surface with Reverse Curvature.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.52898

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.37064	62.878	3.73229	Overburden	250	28	207.943	317.941	127.778	0	127.778	141.343	141.343
2	1.37064	186.994	4.62613	Overburden	250	28	241.351	369.021	223.846	0	223.846	243.376	243.376
3	1.37064	307.825	5.52111	Overburden	250	28	272.897	417.254	314.558	0	314.558	340.937	340.937
4	1.37064	425.356	6.41744	Overburden	250	28	302.642	462.734	400.095	0	400.095	434.135	434.135
5	1.37064	539.572	7.31535	Overburden	250	28	330.647	505.553	480.625	0	480.625	523.072	523.072
6	1.37064	650.453	8.21507	Overburden	250	28	356.965	545.793	556.306	0	556.306	607.841	607.841
7	1.37064	757.978	9.11684	Overburden	250	28	381.649	583.534	627.286	0	627.286	688.531	688.531
8	1.37064	862.123	10.0209	Overburden	250	28	404.746	618.848	693.702	0	693.702	765.222	765.222
9	1.37064	962.861	10.9275	Overburden	250	28	426.3	651.804	755.686	0	755.686	837.99	837.99
10	1.37064	1060.16	11.8368	Overburden	250	28	446.354	682.466	813.35	0	813.35	906.898	906.898
11	1.37064	1153.99	12.7492	Overburden	250	28	464.947	710.894	866.813	0	866.813	972.013	972.013
12	1.37064	1244.31	13.6649	Overburden	250	28	482.116	737.145	916.185	0	916.185	1033.4	1033.4
13	1.37064	1331.09	14.5842	Overburden	250	28	497.895	761.271	961.559	0	961.559	1091.1	1091.1
14	1.37064	1414.28	15.5073	Overburden	250	28	512.316	783.321	1003.03	0	1003.03	1145.18	1145.18
15	1.37064	1493.83	16.4346	Overburden	250	28	525.41	803.342	1040.68	0	1040.68	1195.66	1195.66
16	1.37064	1569.69	17.3663	Overburden	250	28	537.205	821.376	1074.6	0	1074.6	1242.61	1242.61
17	1.37064	1641.81	18.3028	Overburden	250	28	547.727	837.463	1104.85	0	1104.85	1286.03	1286.03
18	1.37064	1710.12	19.2443	Overburden	250	28	556.999	851.641	1131.52	0	1131.52	1325.97	1325.97
19	1.37064	1774.57	20.1914	Overburden	250	28	565.046	863.944	1154.66	0	1154.66	1362.46	1362.46
20	1.37064	1835.09	21.1442	Overburden	250	28	571.888	874.406	1174.34	0	1174.34	1395.52	1395.52
21	1.37064	1891.59	22.1031	Overburden	250	28	577.545	883.055	1190.6	0	1190.6	1425.16	1425.16
22	1.37064	1944	23.0687	Overburden	250	28	582.035	889.92	1203.52	0	1203.52	1451.4	1451.4
23	1.37064	1992.24	24.0412	Overburden	250	28	585.375	895.026	1213.11	0	1213.11	1474.24	1474.24
24	1.37064	2036.2	25.0211	Overburden	250	28	587.579	898.396	1219.46	0	1219.46	1493.71	1493.71
25	1.37064	2075.78	26.009	Overburden	250	28	588.662	900.053	1222.57	0	1222.57	1509.79	1509.79
26	1.37064	2110.89	27.0052	Overburden	250	28	588.638	900.015	1222.5	0	1222.5	1522.49	1522.49
27	1.37064	2141.39	28.0103	Overburden	250	28	587.516	898.3	1219.28	0	1219.28	1531.8	1531.8
28	1.37064	2167.16	29.0249	Overburden	250	28	585.307	894.923	1212.92	0	1212.92	1537.7	1537.7
29	1.37064	2188.07	30.0496	Overburden	250	28	582.02	889.897	1203.47	0	1203.47	1540.17	1540.17
30	1.37064	2203.95	31.085	Overburden	250	28	577.664	883.236	1190.94	0	1190.94	1539.21	1539.21
31	1.37064	2214.65	32.1318	Overburden	250	28	572.242	874.947	1175.35	0	1175.35	1534.76	1534.76
32	1.37064	2220	33.1908	Overburden	250	28	565.763	865.04	1156.72	0	1156.72	1526.82	1526.82
33	1.37064	2219.79	34.2627	Overburden	250	28	558.228	853.519	1135.06	0	1135.06	1515.32	1515.32
34	1.37064	2213.81	35.3485	Overburden	250	28	549.641	840.39	1110.36	0	1110.36	1500.23	1500.23
35	1.37064	2201.83	36.4491	Overburden	250	28	540.002	825.652	1082.64	0	1082.64	1481.48	1481.48
36	1.37064	2183.6	37.5655	Overburden	250	28	529.312	809.307	1051.9	0	1051.9	1459.02	1459.02
37	1.37064	2158.83	38.6989	Overburden	250	28	517.568	791.351	1018.13	0	1018.13	1432.77	1432.77
38	1.37064	2127.21	39.8506	Overburden	250	28	504.767	771.778	981.324	0	981.324	1402.64	1402.64
39	1.37064	2088.39	41.022	Overburden	250	28	490.903	750.581	941.455	0	941.455	1368.52	1368.52
40	1.37064	2041.99	42.2146	Overburden	250	28	475.97	727.749	898.515	0	898.515	1330.32	1330.32
41	1.37064	1987.57	43.4302	Overburden	250	28	459.958	703.267	852.473	0	852.473	1287.89	1287.89
42	1.37064	1924.64	44.6707	Overburden	250	28	442.855	677.117	803.292	0	803.292	1241.09	1241.09
43	1.37064	1852.66	45.9384	Overburden	250	28	424.646	649.276	750.929	0	750.929	1189.72	1189.72
44	1.37064	1730.38	47.2358	Overburden	250	28	399.277	610.487	677.978	0	677.978	1109.7	1109.7
45	1.37064	1502.8	48.5658	Overburden	250	28	359.217	549.235	562.779	0	562.779	969.74	969.74
46	1.37064	1260.07	49.9318	Overburden	250	28	318.312	486.692	445.153	0	445.153	823.586	823.586
47	1.37064	1005.1	51.3377	Overburden	250	28	277.139	423.74	326.758	0	326.758	673.151	673.151
48	1.37064	736.752	52.7882	Overburden	250	28	235.692	360.368	207.572	0	207.572	517.952	517.952
49	1.37064	453.643	54.2889	Overburden	250	28	193.96	296.56	87.5672	0	87.5672	357.38	357.38
50	1.37064	154.105	55.8465	Overburden	250	28	152.907	233.792	-30.4836	0	-30.4836	194.905	194.905

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.52898

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	40.738	30.492	0	0	0
2	42.1087	30.5814	273.073	132.256	25.8421
3	43.4793	30.6923	578.451	280.159	25.8421
4	44.85	30.8248	910.14	440.805	25.8421
5	46.2206	30.979	1262.52	611.472	25.8421
6	47.5912	31.155	1630.33	789.611	25.8421
7	48.9619	31.3528	2008.63	972.832	25.8421
8	50.3325	31.5728	2392.81	1158.9	25.8421
9	51.7031	31.815	2778.55	1345.73	25.8422
10	53.0738	32.0796	3161.82	1531.35	25.8421
11	54.4444	32.3669	3538.85	1713.96	25.8422
12	55.8151	32.677	3906.15	1891.85	25.8421
13	57.1857	33.0102	4260.45	2063.45	25.8421
14	58.5563	33.3669	4598.73	2227.29	25.8422
15	59.927	33.7472	4918.21	2382.02	25.8421
16	61.2976	34.1515	5216.3	2526.39	25.8421
17	62.6683	34.5801	5490.65	2659.27	25.8422
18	64.0389	35.0335	5739.12	2779.61	25.8422
19	65.4095	35.512	5959.75	2886.46	25.8421
20	66.7802	36.016	6150.8	2978.99	25.8421
21	68.1508	36.5461	6310.71	3056.44	25.8421
22	69.5215	37.1028	6438.13	3118.16	25.8422
23	70.8921	37.6865	6531.91	3163.58	25.8422
24	72.2627	38.2979	6591.05	3192.22	25.8421
25	73.6334	38.9377	6614.79	3203.72	25.8422
26	75.004	39.6065	6602.55	3197.79	25.8421
27	76.3746	40.305	6553.94	3174.25	25.8422
28	77.7453	41.0341	6468.78	3133	25.8421
29	79.1159	41.7946	6347.1	3074.07	25.8421
30	80.4866	42.5876	6189.13	2997.56	25.8421
31	81.8572	43.4139	5995.35	2903.71	25.8422
32	83.2278	44.2747	5766.44	2792.84	25.8421
33	84.5985	45.1714	5503.37	2665.43	25.8422
34	85.9691	46.105	5207.33	2522.05	25.8422
35	87.3398	47.0772	4879.82	2363.43	25.8422
36	88.7104	48.0896	4522.63	2190.43	25.8421
37	90.081	49.1438	4137.87	2004.08	25.8421
38	91.4517	50.2418	3728.03	1805.58	25.8421
39	92.8223	51.3859	3295.96	1596.32	25.8421
40	94.193	52.5783	2845	1377.91	25.8422
41	95.5636	53.8217	2378.94	1152.18	25.8421
42	96.9342	55.1192	1902.13	921.253	25.8422
43	98.3049	56.4742	1419.59	687.544	25.8421
44	99.6755	57.8905	937.037	453.832	25.8421
45	101.046	59.3725	478.539	231.769	25.8421
46	102.417	60.9253	96.1098	46.5485	25.8421
47	103.787	62.5549	-193.778	-93.852	25.8422
48	105.158	64.268	-374.394	-181.329	25.8421
49	106.529	66.073	-426.595	-206.611	25.8421
50	107.899	67.9796	-328.191	-158.952	25.8422
51	109.27	70	0	0	0

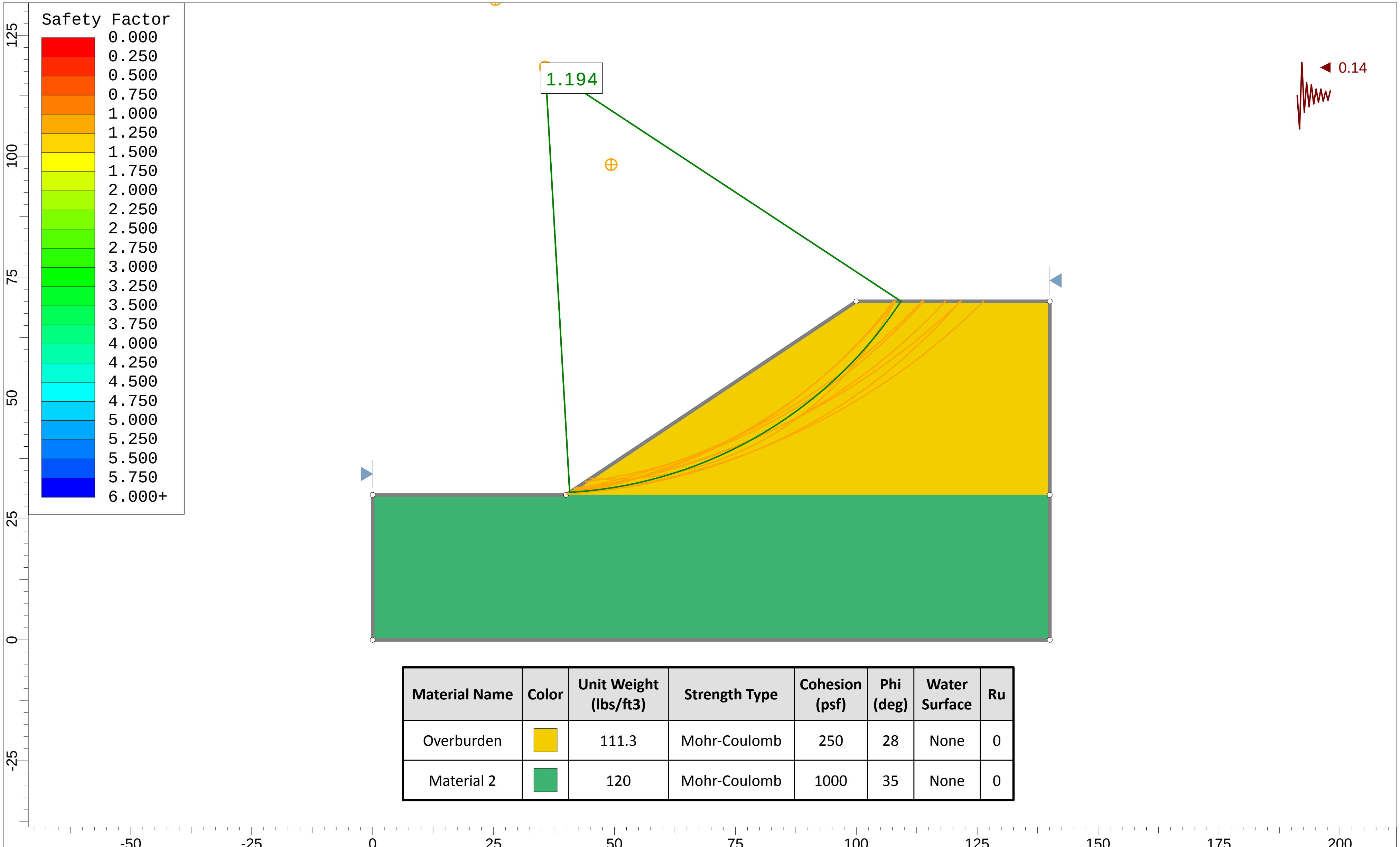
Entity Information

External Boundary

X	Y
0	0
140	0
140	30
140	70
100	70
40	30
0	30

Material Boundary

X	Y
40	30
140	30



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Overburden		111.3	Mohr-Coulomb	250	28	None	0
Material 2		120	Mohr-Coulomb	1000	35	None	0

BAJADA Geosciences, Inc.

SLIDEINTERPRET 8.026

Project	Crystal Creek Aggregate Quarry Expansion
Analysis Description	Overburden Cut Inclination - 1.5:1 Slope, Pseudostatic
Drawn By	J. Bianchin
Scale	1:329
Company	Bajada Geosciences, Inc.
Date	5/17/2019, 10:48:54 AM
File Name	OverburdenStatic1.5-1PS.slim

Slide Analysis Information

Crystal Creek Aggregate Quarry Expansion

Project Summary

Slide Modeler Version:	8.026
Compute Time:	00h:00m:02.947s

General Settings

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

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

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

Random Numbers

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

Surface Options

Surface Type:	Circular
Search Method:	Slope Search
Number of Surfaces:	5000
Upper Angle [°]:	Not Defined
Lower Angle [°]:	Not Defined
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Seismic Load Coefficient (Horizontal): 0.14

Materials

Property	Overburden	Material 2
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	111.3	120
Cohesion [psf]	250	1000
Friction Angle [°]	28	35
Water Surface	None	None
Ru Value	0	0

Global Minimums

Method: spencer

FS	1.193830
Center:	35.689, 118.443
Radius:	88.096
Left Slip Surface Endpoint:	40.738, 30.492
Right Slip Surface Endpoint:	109.270, 70.000
Resisting Moment:	4.76964e+06 lb-ft
Driving Moment:	3.99523e+06 lb-ft
Resisting Horizontal Force:	46431.4 lb
Driving Horizontal Force:	38892.7 lb
Total Slice Area:	682.965 ft2
Surface Horizontal Width:	68.5319 ft
Surface Average Height:	9.96565 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 2533
Number of Invalid Surfaces: 2467

Error Codes:

Error Code -105 reported for 1 surface

Error Code -106 reported for 22 surfaces
Error Code -108 reported for 12 surfaces
Error Code -111 reported for 959 surfaces
Error Code -112 reported for 5 surfaces
Error Code -114 reported for 1468 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.
-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.
-114 = Surface with Reverse Curvature.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.19383

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.37064	62.878	3.73229	Overburden	250	28	304.21	363.175	212.851	0	212.851	232.696	232.696
2	1.37064	186.994	4.62613	Overburden	250	28	346.815	414.038	308.51	0	308.51	336.573	336.573
3	1.37064	307.825	5.52111	Overburden	250	28	386.416	461.315	397.426	0	397.426	434.778	434.778
4	1.37064	425.356	6.41744	Overburden	250	28	423.162	505.184	479.931	0	479.931	527.527	527.527
5	1.37064	539.572	7.31535	Overburden	250	28	457.19	545.807	556.331	0	556.331	615.023	615.023
6	1.37064	650.453	8.21507	Overburden	250	28	488.625	583.335	626.912	0	626.912	697.455	697.455
7	1.37064	757.978	9.11684	Overburden	250	28	517.587	617.911	691.939	0	691.939	774.999	774.999
8	1.37064	862.123	10.0209	Overburden	250	28	544.186	649.665	751.664	0	751.664	847.823	847.823
9	1.37064	962.861	10.9275	Overburden	250	28	568.525	678.722	806.311	0	806.311	916.074	916.074
10	1.37064	1060.16	11.8368	Overburden	250	28	590.701	705.196	856.102	0	856.102	979.902	979.902
11	1.37064	1153.99	12.7492	Overburden	250	28	610.802	729.194	901.233	0	901.233	1039.43	1039.43
12	1.37064	1244.31	13.6649	Overburden	250	28	628.915	750.817	941.898	0	941.898	1094.8	1094.8
13	1.37064	1331.09	14.5842	Overburden	250	28	645.116	770.159	978.279	0	978.279	1146.13	1146.13
14	1.37064	1414.28	15.5073	Overburden	250	28	659.481	787.308	1010.53	0	1010.53	1193.51	1193.51
15	1.37064	1493.83	16.4346	Overburden	250	28	672.078	802.347	1038.81	0	1038.81	1237.06	1237.06
16	1.37064	1569.69	17.3663	Overburden	250	28	682.972	815.352	1063.27	0	1063.27	1276.86	1276.86
17	1.37064	1641.81	18.3028	Overburden	250	28	692.224	826.398	1084.05	0	1084.05	1313.02	1313.02
18	1.37064	1710.12	19.2443	Overburden	250	28	699.892	835.552	1101.26	0	1101.26	1345.6	1345.6
19	1.37064	1774.57	20.1914	Overburden	250	28	706.029	842.879	1115.04	0	1115.04	1374.69	1374.69
20	1.37064	1835.09	21.1442	Overburden	250	28	710.686	848.438	1125.5	0	1125.5	1400.36	1400.36
21	1.37064	1891.59	22.1031	Overburden	250	28	713.91	852.287	1132.73	0	1132.73	1422.67	1422.67
22	1.37064	1944	23.0687	Overburden	250	28	715.745	854.478	1136.86	0	1136.86	1441.68	1441.68
23	1.37064	1992.24	24.0412	Overburden	250	28	716.233	855.061	1137.96	0	1137.96	1457.46	1457.46
24	1.37064	2036.2	25.0211	Overburden	250	28	715.414	854.083	1136.12	0	1136.12	1470.04	1470.04
25	1.37064	2075.78	26.009	Overburden	250	28	713.324	851.588	1131.42	0	1131.42	1479.47	1479.47
26	1.37064	2110.89	27.0052	Overburden	250	28	709.999	847.618	1123.95	0	1123.95	1485.8	1485.8
27	1.37064	2141.39	28.0103	Overburden	250	28	705.468	842.209	1113.78	0	1113.78	1489.05	1489.05
28	1.37064	2167.16	29.0249	Overburden	250	28	699.764	835.399	1100.97	0	1100.97	1489.26	1489.26
29	1.37064	2188.07	30.0496	Overburden	250	28	692.913	827.22	1085.59	0	1085.59	1486.44	1486.44
30	1.37064	2203.95	31.085	Overburden	250	28	684.941	817.703	1067.69	0	1067.69	1480.63	1480.63
31	1.37064	2214.65	32.1318	Overburden	250	28	675.873	806.877	1047.33	0	1047.33	1471.83	1471.83
32	1.37064	2220	33.1908	Overburden	250	28	665.728	794.766	1024.56	0	1024.56	1460.04	1460.04
33	1.37064	2219.79	34.2627	Overburden	250	28	654.529	781.396	999.412	0	999.412	1445.28	1445.28
34	1.37064	2213.81	35.3485	Overburden	250	28	642.291	766.786	971.931	0	971.931	1427.51	1427.51
35	1.37064	2201.83	36.4491	Overburden	250	28	629.029	750.954	942.16	0	942.16	1406.75	1406.75
36	1.37064	2183.6	37.5655	Overburden	250	28	614.758	733.916	910.113	0	910.113	1382.95	1382.95
37	1.37064	2158.83	38.6989	Overburden	250	28	599.487	715.685	875.829	0	875.829	1356.09	1356.09
38	1.37064	2127.21	39.8506	Overburden	250	28	583.224	696.27	839.312	0	839.312	1326.11	1326.11
39	1.37064	2088.39	41.022	Overburden	250	28	565.973	675.675	800.58	0	800.58	1292.95	1292.95
40	1.37064	2041.99	42.2146	Overburden	250	28	547.736	653.904	759.633	0	759.633	1256.54	1256.54
41	1.37064	1987.57	43.4302	Overburden	250	28	528.511	630.952	716.47	0	716.47	1216.78	1216.78
42	1.37064	1924.64	44.6707	Overburden	250	28	508.29	606.812	671.068	0	671.068	1173.55	1173.55
43	1.37064	1852.66	45.9384	Overburden	250	28	487.06	581.467	623.4	0	623.4	1126.68	1126.68
44	1.37064	1730.38	47.2358	Overburden	250	28	458.393	547.243	559.033	0	559.033	1054.67	1054.67
45	1.37064	1502.8	48.5658	Overburden	250	28	414.346	494.659	460.137	0	460.137	929.555	929.555
46	1.37064	1260.07	49.9318	Overburden	250	28	369.625	441.269	359.725	0	359.725	799.163	799.163
47	1.37064	1005.1	51.3377	Overburden	250	28	324.787	387.741	259.053	0	259.053	665.001	665.001
48	1.37064	736.752	52.7882	Overburden	250	28	279.761	333.986	157.956	0	157.956	526.369	526.369
49	1.37064	453.643	54.2889	Overburden	250	28	234.451	279.894	56.2232	0	56.2232	382.363	382.363
50	1.37064	154.105	55.8465	Overburden	250	28	188.534	225.077	-46.8729	0	-46.8729	231.031	231.031

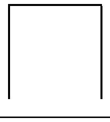
Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.19383

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	40.738	30.492	0	0	0
2	42.1087	30.5814	390.246	267.056	34.3849
3	43.4793	30.6923	806.483	551.898	34.3849
4	44.85	30.8248	1241.79	849.791	34.3849
5	46.2206	30.979	1689.81	1156.38	34.3848
6	47.5912	31.155	2144.7	1467.68	34.385
7	48.9619	31.3528	2601.11	1780.01	34.3849
8	50.3325	31.5728	3054.13	2090.02	34.3848
9	51.7031	31.815	3499.26	2394.64	34.3849
10	53.0738	32.0796	3932.43	2691.06	34.3848
11	54.4444	32.3669	4349.89	2976.75	34.3849
12	55.8151	32.677	4748.27	3249.37	34.3849
13	57.1857	33.0102	5124.52	3506.84	34.3848
14	58.5563	33.3669	5475.89	3747.29	34.3848
15	59.927	33.7472	5799.92	3969.04	34.3849
16	61.2976	34.1515	6094.44	4170.59	34.3849
17	62.6683	34.5801	6357.53	4350.63	34.3849
18	64.0389	35.0335	6587.54	4508.03	34.3849
19	65.4095	35.512	6783.04	4641.82	34.3849
20	66.7802	36.016	6942.86	4751.18	34.3849
21	68.1508	36.5461	7066.03	4835.47	34.3849
22	69.5215	37.1028	7151.81	4894.17	34.3849
23	70.8921	37.6865	7199.67	4926.93	34.3849
24	72.2627	38.2979	7209.31	4933.53	34.3849
25	73.6334	38.9377	7180.62	4913.89	34.3849
26	75.004	39.6065	7113.68	4868.08	34.3849
27	76.3746	40.305	7008.8	4796.31	34.3849
28	77.7453	41.0341	6866.48	4698.91	34.3848
29	79.1159	41.7946	6687.44	4576.39	34.3849
30	80.4866	42.5876	6472.6	4429.37	34.3849
31	81.8572	43.4139	6223.1	4258.63	34.3849
32	83.2278	44.2747	5940.31	4065.11	34.3849
33	84.5985	45.1714	5625.8	3849.89	34.3849
34	85.9691	46.105	5281.43	3614.23	34.3849
35	87.3398	47.0772	4909.29	3359.56	34.3849
36	88.7104	48.0896	4511.74	3087.5	34.3848
37	90.081	49.1438	4091.45	2799.89	34.3849
38	91.4517	50.2418	3651.4	2498.75	34.3849
39	92.8223	51.3859	3194.93	2186.37	34.3848
40	94.193	52.5783	2725.76	1865.31	34.3849
41	95.5636	53.8217	2248.08	1538.42	34.3849
42	96.9342	55.1192	1766.53	1208.88	34.3848
43	98.3049	56.4742	1286.36	880.287	34.3848
44	99.6755	57.8905	813.445	556.662	34.3849
45	101.046	59.3725	372.675	255.031	34.3848
46	102.417	60.9253	17.2179	11.7827	34.3849
47	103.787	62.5549	-237.39	-162.452	34.3848
48	105.158	64.268	-375.539	-256.991	34.3848
49	106.529	66.073	-379.312	-259.573	34.3848
50	107.899	67.9796	-227.812	-155.898	34.3849
51	109.27	70	0	0	0

Entity Information

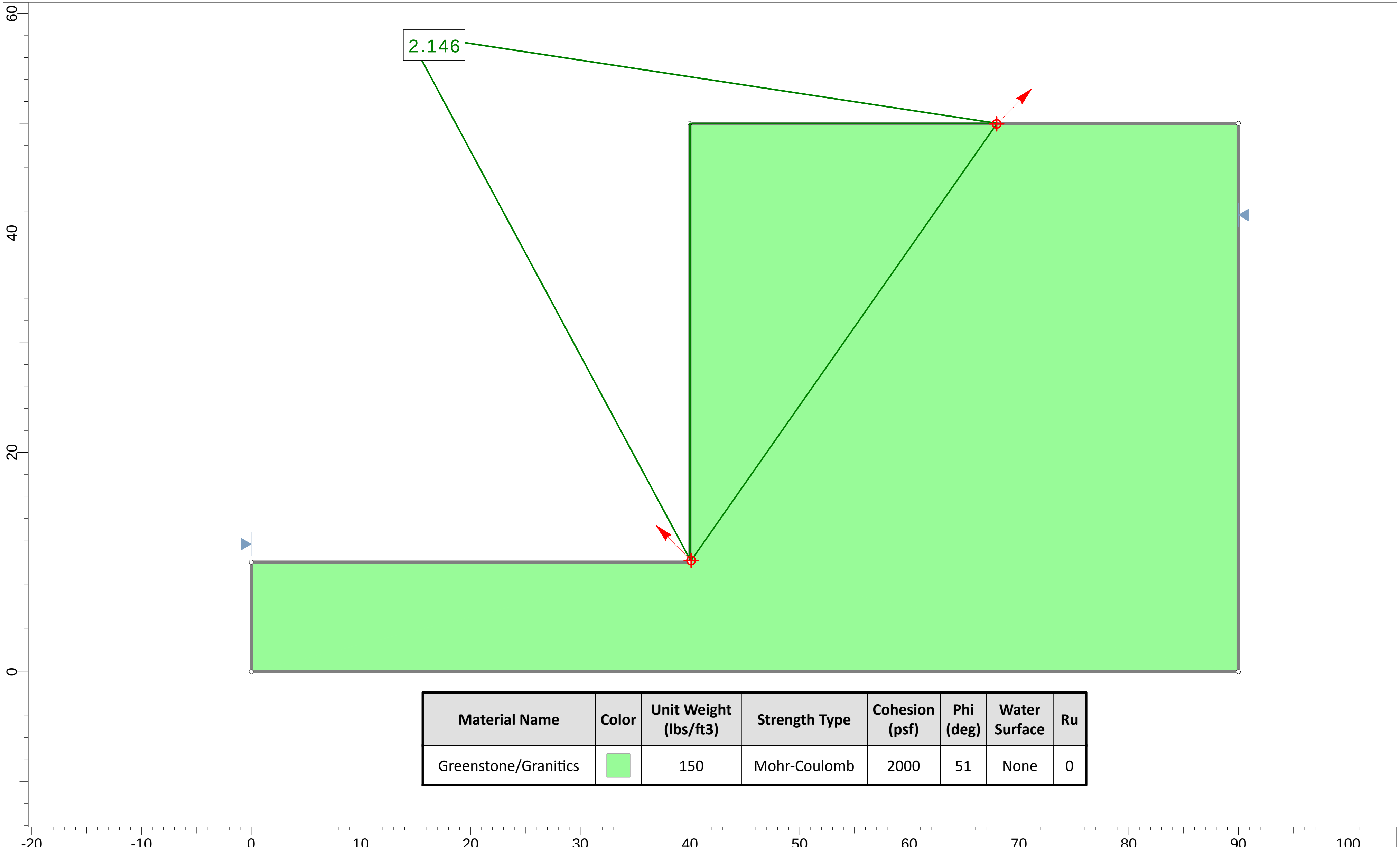
External Boundary



X	Y
0	0
140	0
140	30
140	70
100	70
40	30
0	30

Material Boundary

X	Y
40	30
140	30



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Greenstone/Granitics		150	Mohr-Coulomb	2000	51	None	0

BAJADA Geosciences, Inc.

SLIDEINTERPRET 8.023

Project	Crystal Creek Quarry Expansion		
Analysis Description	Planar Failure - Discontinuity at 55 degrees		
Drawn By J.Bianchin	*Scale* 1:145	*Company*	Bajada Geosciences, inc.
Date	5-16-19	*File Name*	55deg.slmd

Slide Analysis Information

55deg

Project Summary

File Name:	55deg.slmd
Slide Modeler Version:	8.023
Compute Time:	00h:00m:02.646s
Project Title:	Crystal Creek Quarry Expansion
Analysis:	Planar Failure - Discontinuity at 55 degrees
Author:	J.Bianchin
Company:	Bajada Geosciences, inc.
Date Created:	5-16-19

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	Janbu simplified
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

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

Random Numbers

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

Surface Options

Surface Type:	Non-Circular Block Search
Number of Surfaces:	5000
Multiple Groups:	Disabled
Pseudo-Random Surfaces:	Enabled
Convex Surfaces Only:	Disabled
Left Projection Angle (Start Angle) [°]:	135
Left Projection Angle (End Angle) [°]:	135
Right Projection Angle (Start Angle) [°]:	45
Right Projection Angle (End Angle) [°]:	45
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Property	Greenstone/Granitics
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	150
Cohesion [psf]	2000
Friction Angle [°]	51
Water Surface	None
Ru Value	0

Global Minimums

Method: bishop simplified

FS	**2.146330**
Axis Location:	14.268, 58.147
Left Slip Surface Endpoint:	40.000, 10.259
Right Slip Surface Endpoint:	68.017, 50.000
Left Slope Intercept:	40.000 50.000
Right Slope Intercept:	68.017 50.000
Resisting Moment:	7.45506e+06 lb-ft
Driving Moment:	3.4734e+06 lb-ft
Total Slice Area:	559.987 ft2
Surface Horizontal Width:	28.017 ft
Surface Average Height:	19.9874 ft

Method: janbu simplified

FS	2.371420
Axis Location:	14.268, 58.147
Left Slip Surface Endpoint:	40.000, 10.259
Right Slip Surface Endpoint:	68.017, 50.000
Left Slope Intercept:	40.000 50.000
Right Slope Intercept:	68.017 50.000
Resisting Horizontal Force:	93161.9 lb
Driving Horizontal Force:	39285.3 lb
Total Slice Area:	559.987 ft2
Surface Horizontal Width:	28.017 ft
Surface Average Height:	19.9874 ft

Method: spencer

FS	2.993140
Axis Location:	14.268, 58.147
Left Slip Surface Endpoint:	40.000, 10.259
Right Slip Surface Endpoint:	68.017, 50.000
Left Slope Intercept:	40.000 50.000
Right Slope Intercept:	68.017 50.000
Resisting Moment:	8.41628e+06 lb-ft
Driving Moment:	2.81185e+06 lb-ft
Resisting Horizontal Force:	108502 lb
Driving Horizontal Force:	36250.1 lb
Total Slice Area:	559.987 ft2
Surface Horizontal Width:	28.017 ft
Surface Average Height:	19.9874 ft

Global Minimum Coordinates

Method: bishop simplified

X	Y
40	10.259
40.1067	10.1524
67.9603	49.9433
68.017	50

Method: janbu simplified

X	Y
40	10.259
40.1067	10.1524
67.9603	49.9433
68.017	50

Method: spencer

X	Y
40	10.259
40.1067	10.1524
67.9603	49.9433
68.017	50

Valid/Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 5000
Number of Invalid Surfaces: 0

Method: janbu simplified

Number of Valid Surfaces: 5000
Number of Invalid Surfaces: 0

Method: spencer

Number of Valid Surfaces: 5000
Number of Invalid Surfaces: 0

Slice Data

- **Global Minimum Query (bishop simplified) - Safety Factor: 2.14633**

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.106667	636.708	-45	Greenstone/Granitics	2000	51	10261	22023.4	16214.7	0	16214.7	5953.7	5953.7
2	0.580284	3432.36	55.008	Greenstone/Granitics	2000	51	2380.97	5110.35	2518.71	0	2518.71	5920.1	5920.1
3	0.580284	3360.21	55.008	Greenstone/Granitics	2000	51	2341.68	5026.01	2450.41	0	2450.41	5795.66	5795.66
4	0.580284	3288.05	55.008	Greenstone/Granitics	2000	51	2302.38	4941.67	2382.11	0	2382.11	5671.23	5671.23
5	0.580284	3215.89	55.008	Greenstone/Granitics	2000	51	2263.09	4857.33	2313.83	0	2313.83	5546.81	5546.81
6	0.580284	3143.74	55.008	Greenstone/Granitics	2000	51	2223.79	4772.99	2245.53	0	2245.53	5422.37	5422.37
7	0.580284	3071.58	55.008	Greenstone/Granitics	2000	51	2184.5	4688.65	2177.23	0	2177.23	5297.94	5297.94
8	0.580284	2999.42	55.008	Greenstone/Granitics	2000	51	2145.2	4604.31	2108.93	0	2108.93	5173.51	5173.51
9	0.580284	2927.27	55.008	Greenstone/Granitics	2000	51	2105.91	4519.98	2040.64	0	2040.64	5049.08	5049.08
10	0.580284	2855.11	55.008	Greenstone/Granitics	2000	51	2066.62	4435.64	1972.34	0	1972.34	4924.65	4924.65
11	0.580284	2782.96	55.008	Greenstone/Granitics	2000	51	2027.32	4351.3	1904.04	0	1904.04	4800.21	4800.21
12	0.580284	2710.8	55.008	Greenstone/Granitics	2000	51	1988.03	4266.96	1835.74	0	1835.74	4675.78	4675.78
13	0.580284	2638.64	55.008	Greenstone/Granitics	2000	51	1948.73	4182.62	1767.45	0	1767.45	4551.36	4551.36
14	0.580284	2566.49	55.008	Greenstone/Granitics	2000	51	1909.44	4098.28	1699.16	0	1699.16	4426.92	4426.92
15	0.580284	2494.33	55.008	Greenstone/Granitics	2000	51	1870.14	4013.94	1630.86	0	1630.86	4302.49	4302.49
16	0.580284	2422.17	55.008	Greenstone/Granitics	2000	51	1830.85	3929.6	1562.56	0	1562.56	4178.06	4178.06
17	0.580284	2350.02	55.008	Greenstone/Granitics	2000	51	1791.55	3845.26	1494.26	0	1494.26	4053.62	4053.62
18	0.580284	2277.86	55.008	Greenstone/Granitics	2000	51	1752.26	3760.93	1425.97	0	1425.97	3929.2	3929.2
19	0.580284	2205.7	55.008	Greenstone/Granitics	2000	51	1712.97	3676.59	1357.67	0	1357.67	3804.76	3804.76
20	0.580284	2133.55	55.008	Greenstone/Granitics	2000	51	1673.67	3592.25	1289.38	0	1289.38	3680.34	3680.34
21	0.580284	2061.39	55.008	Greenstone/Granitics	2000	51	1634.38	3507.91	1221.08	0	1221.08	3555.91	3555.91
22	0.580284	1989.24	55.008	Greenstone/Granitics	2000	51	1595.08	3423.57	1152.79	0	1152.79	3431.47	3431.47
23	0.580284	1917.08	55.008	Greenstone/Granitics	2000	51	1555.79	3339.23	1084.49	0	1084.49	3307.04	3307.04
24	0.580284	1844.92	55.008	Greenstone/Granitics	2000	51	1516.49	3254.89	1016.19	0	1016.19	3182.61	3182.61
25	0.580284	1772.77	55.008	Greenstone/Granitics	2000	51	1477.2	3170.55	947.896	0	947.896	3058.18	3058.18
26	0.580284	1700.61	55.008	Greenstone/Granitics	2000	51	1437.9	3086.21	879.599	0	879.599	2933.74	2933.74
27	0.580284	1628.45	55.008	Greenstone/Granitics	2000	51	1398.61	3001.88	811.303	0	811.303	2809.32	2809.32
28	0.580284	1556.3	55.008	Greenstone/Granitics	2000	51	1359.31	2917.54	743.007	0	743.007	2684.88	2684.88
29	0.580284	1484.14	55.008	Greenstone/Granitics	2000	51	1320.02	2833.2	674.711	0	674.711	2560.45	2560.45
30	0.580284	1411.98	55.008	Greenstone/Granitics	2000	51	1280.73	2748.86	606.414	0	606.414	2436.02	2436.02
31	0.580284	1339.83	55.008	Greenstone/Granitics	2000	51	1241.43	2664.52	538.118	0	538.118	2311.59	2311.59
32	0.580284	1267.67	55.008	Greenstone/Granitics	2000	51	1202.14	2580.18	469.822	0	469.822	2187.16	2187.16
33	0.580284	1195.52	55.008	Greenstone/Granitics	2000	51	1162.84	2495.84	401.526	0	401.526	2062.73	2062.73
34	0.580284	1123.36	55.008	Greenstone/Granitics	2000	51	1123.55	2411.5	333.229	0	333.229	1938.3	1938.3
35	0.580284	1051.2	55.008	Greenstone/Granitics	2000	51	1084.25	2327.16	264.933	0	264.933	1813.87	1813.87
36	0.580284	979.047	55.008	Greenstone/Granitics	2000	51	1044.96	2242.83	196.637	0	196.637	1689.43	1689.43
37	0.580284	906.89	55.008	Greenstone/Granitics	2000	51	1005.66	2158.49	128.34	0	128.34	1565	1565
38	0.580284	834.734	55.008	Greenstone/Granitics	2000	51	966.37	2074.15	60.0442	0	60.0442	1440.57	1440.57
39	0.580284	762.578	55.008	Greenstone/Granitics	2000	51	927.075	1989.81	-8.25202	0	-8.25202	1316.14	1316.14
40	0.580284	690.421	55.008	Greenstone/Granitics	2000	51	887.781	1905.47	-76.5483	0	-76.5483	1191.71	1191.71
41	0.580284	618.265	55.008	Greenstone/Granitics	2000	51	848.486	1821.13	-144.845	0	-144.845	1067.28	1067.28
42	0.580284	546.109	55.008	Greenstone/Granitics	2000	51	809.192	1736.79	-213.141	0	-213.141	942.848	942.848
43	0.580284	473.952	55.008	Greenstone/Granitics	2000	51	769.897	1652.45	-281.437	0	-281.437	818.416	818.416
44	0.580284	401.796	55.008	Greenstone/Granitics	2000	51	730.603	1568.12	-349.734	0	-349.734	693.985	693.985
45	0.580284	329.64	55.008	Greenstone/Granitics	2000	51	691.308	1483.78	-418.029	0	-418.029	569.554	569.554
46	0.580284	257.483	55.008	Greenstone/Granitics	2000	51	652.014	1399.44	-486.326	0	-486.326	445.123	445.123
47	0.580284	185.327	55.008	Greenstone/Granitics	2000	51	612.72	1315.1	-554.622	0	-554.622	320.692	320.692
48	0.580284	113.17	55.008	Greenstone/Granitics	2000	51	573.425	1230.76	-622.919	0	-622.919	196.26	196.26
49	0.580284	41.0141	55.008	Greenstone/Granitics	2000	51	534.131	1146.42	-691.214	0	-691.214	71.8296	71.8296
50	0.0567069	0.241176	45	Greenstone/Granitics	2000	51	593.381	1273.59	-588.234	0	-588.234	5.1476	5.1476

- **Global Minimum Query (janbu simplified) - Safety Factor: 2.37142**

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.106667	636.708	-45	Greenstone/Granitics	2000	51	8238.65	19537.3	14201.5	0	14201.5	5962.8	5962.8
2	0.580284	3432.36	55.008	Greenstone/Granitics	2000	51	2250.59	5337.09	2702.32	0	2702.32	5917.45	5917.45
3	0.580284	3360.21	55.008	Greenstone/Granitics	2000	51	2213.45	5249.01	2630.99	0	2630.99	5793.06	5793.06
4	0.580284	3288.05	55.008	Greenstone/Granitics	2000	51	2176.3	5160.93	2559.67	0	2559.67	5668.68	5668.68
5	0.580284	3215.89	55.008	Greenstone/Granitics	2000	51	2139.16	5072.85	2488.34	0	2488.34	5544.28	5544.28
6	0.580284	3143.74	55.008	Greenstone/Granitics	2000	51	2102.02	4984.77	2417.02	0	2417.02	5419.9	5419.9
7	0.580284	3071.58	55.008	Greenstone/Granitics	2000	51	2064.88	4896.69	2345.69	0	2345.69	5295.51	5295.51
8	0.580284	2999.42	55.008	Greenstone/Granitics	2000	51	2027.73	4808.61	2274.36	0	2274.36	5171.13	5171.13
9	0.580284	2927.27	55.008	Greenstone/Granitics	2000	51	1990.59	4720.52	2203.03	0	2203.03	5046.73	5046.73
10	0.580284	2855.11	55.008	Greenstone/Granitics	2000	51	1953.45	4632.44	2131.71	0	2131.71	4922.35	4922.35
11	0.580284	2782.96	55.008	Greenstone/Granitics	2000	51	1916.3	4544.36	2060.38	0	2060.38	4797.96	4797.96
12	0.580284	2710.8	55.008	Greenstone/Granitics	2000	51	1879.16	4456.28	1989.06	0	1989.06	4673.57	4673.57
13	0.580284	2638.64	55.008	Greenstone/Granitics	2000	51	1842.02	4368.2	1917.73	0	1917.73	4549.18	4549.18
14	0.580284	2566.49	55.008	Greenstone/Granitics	2000	51	1804.88	4280.12	1846.41	0	1846.41	4424.8	4424.8
15	0.580284	2494.33	55.008	Greenstone/Granitics	2000	51	1767.73	4192.04	1775.07	0	1775.07	4300.41	4300.41
16	0.580284	2422.17	55.008	Greenstone/Granitics	2000	51	1730.59	4103.96	1703.75	0	1703.75	4176.03	4176.03
17	0.580284	2350.02	55.008	Greenstone/Granitics	2000	51	1693.45	4015.88	1632.42	0	1632.42	4051.63	4051.63
18	0.580284	2277.86	55.008	Greenstone/Granitics	2000	51	1656.31	3927.8	1561.1	0	1561.1	3927.25	3927.25
19	0.580284	2205.7	55.008	Greenstone/Granitics	2000	51	1619.16	3839.72	1489.77	0	1489.77	3802.86	3802.86
20	0.580284	2133.55	55.008	Greenstone/Granitics	2000	51	1582.02	3751.63	1418.45	0	1418.45	3678.47	3678.47
21	0.580284	2061.39	55.008	Greenstone/Granitics	2000	51	1544.88	3663.55	1347.11	0	1347.11	3554.08	3554.08
22	0.580284	1989.24	55.008	Greenstone/Granitics	2000	51	1507.73	3575.47	1275.79	0	1275.79	3429.7	3429.7
23	0.580284	1917.08	55.008	Greenstone/Granitics	2000	51	1470.59	3487.39	1204.46	0	1204.46	3305.31	3305.31
24	0.580284	1844.92	55.008	Greenstone/Granitics	2000	51	1433.45	3399.31	1133.14	0	1133.14	3180.92	3180.92
25	0.580284	1772.77	55.008	Greenstone/Granitics	2000	51	1396.31	3311.23	1061.81	0	1061.81	3056.53	3056.53
26	0.580284	1700.61	55.008	Greenstone/Granitics	2000	51	1359.16	3223.15	990.487	0	990.487	2932.15	2932.15
27	0.580284	1628.45	55.008	Greenstone/Granitics	2000	51	1322.02	3135.07	919.16	0	919.16	2807.76	2807.76
28	0.580284	1556.3	55.008	Greenstone/Granitics	2000	51	1284.88	3046.99	847.833	0	847.833	2683.38	2683.38
29	0.580284	1484.14	55.008	Greenstone/Granitics	2000	51	1247.74	2958.91	776.507	0	776.507	2558.99	2558.99
30	0.580284	1411.98	55.008	Greenstone/Granitics	2000	51	1210.59	2870.82	705.18	0	705.18	2434.6	2434.6
31	0.580284	1339.83	55.008	Greenstone/Granitics	2000	51	1173.45	2782.74	633.854	0	633.854	2310.21	2310.21
32	0.580284	1267.67	55.008	Greenstone/Granitics	2000	51	1136.31	2694.66	562.527	0	562.527	2185.82	2185.82
33	0.580284	1195.52	55.008	Greenstone/Granitics	2000	51	1099.17	2606.58	491.201	0	491.201	2061.44	2061.44
34	0.580284	1123.36	55.008	Greenstone/Granitics	2000	51	1062.02	2518.5	419.874	0	419.874	1937.05	1937.05
35	0.580284	1051.2	55.008	Greenstone/Granitics	2000	51	1024.88	2430.42	348.548	0	348.548	1812.66	1812.66
36	0.580284	979.047	55.008	Greenstone/Granitics	2000	51	987.737	2342.34	277.221	0	277.221	1688.27	1688.27
37	0.580284	906.89	55.008	Greenstone/Granitics	2000	51	950.594	2254.26	205.895	0	205.895	1563.89	1563.89
38	0.580284	834.734	55.008	Greenstone/Granitics	2000	51	913.451	2166.18	134.568	0	134.568	1439.5	1439.5
39	0.580284	762.578	55.008	Greenstone/Granitics	2000	51	876.309	2078.1	63.2413	0	63.2413	1315.11	1315.11
40	0.580284	690.421	55.008	Greenstone/Granitics	2000	51	839.166	1990.02	-8.0852	0	-8.0852	1190.72	1190.72
41	0.580284	618.265	55.008	Greenstone/Granitics	2000	51	802.024	1901.93	-79.4117	0	-79.4117	1066.34	1066.34
42	0.580284	546.109	55.008	Greenstone/Granitics	2000	51	764.881	1813.85	-150.738	0	-150.738	941.949	941.949
43	0.580284	473.952	55.008	Greenstone/Granitics	2000	51	727.738	1725.77	-222.064	0	-222.064	817.562	817.562
44	0.580284	401.796	55.008	Greenstone/Granitics	2000	51	690.596	1637.69	-293.391	0	-293.391	693.174	693.174
45	0.580284	329.64	55.008	Greenstone/Granitics	2000	51	653.453	1549.61	-364.718	0	-364.718	568.786	568.786
46	0.580284	257.483	55.008	Greenstone/Granitics	2000	51	616.31	1461.53	-436.045	0	-436.045	444.398	444.398
47	0.580284	185.327	55.008	Greenstone/Granitics	2000	51	579.167	1373.45	-507.371	0	-507.371	320.01	320.01
48	0.580284	113.17	55.008	Greenstone/Granitics	2000	51	542.025	1285.37	-578.698	0	-578.698	195.623	195.623
49	0.580284	41.0141	55.008	Greenstone/Granitics	2000	51	504.882	1197.29	-650.024	0	-650.024	71.2354	71.2354
50	0.0567069	0.241176	45	Greenstone/Granitics	2000	51	556.186	1318.95	-551.503	0	-551.503	4.68225	4.68225

- **Global Minimum Query (spencer) - Safety Factor: 2.99314**

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.106667	636.708	-45	Greenstone/Granitics	2000	51	39613.2	118568	94394.8	0	94394.8	54781.6	54781.6
2	0.580284	3432.36	55.008	Greenstone/Granitics	2000	51	1763.5	5278.4	2654.79	0	2654.79	5174.07	5174.07
3	0.580284	3360.21	55.008	Greenstone/Granitics	2000	51	1737.33	5200.08	2591.37	0	2591.37	5073.28	5073.28
4	0.580284	3288.05	55.008	Greenstone/Granitics	2000	51	1711.17	5121.76	2527.95	0	2527.95	4972.47	4972.47
5	0.580284	3215.89	55.008	Greenstone/Granitics	2000	51	1685	5043.44	2464.53	0	2464.53	4871.67	4871.67
6	0.580284	3143.74	55.008	Greenstone/Granitics	2000	51	1658.84	4965.13	2401.12	0	2401.12	4770.88	4770.88
7	0.580284	3071.58	55.008	Greenstone/Granitics	2000	51	1632.67	4886.81	2337.69	0	2337.69	4670.08	4670.08
8	0.580284	2999.42	55.008	Greenstone/Granitics	2000	51	1606.5	4808.49	2274.28	0	2274.28	4569.28	4569.28
9	0.580284	2927.27	55.008	Greenstone/Granitics	2000	51	1580.34	4730.18	2210.85	0	2210.85	4468.48	4468.48
10	0.580284	2855.11	55.008	Greenstone/Granitics	2000	51	1554.17	4651.86	2147.43	0	2147.43	4367.68	4367.68
11	0.580284	2782.96	55.008	Greenstone/Granitics	2000	51	1528.01	4573.54	2084.01	0	2084.01	4266.88	4266.88
12	0.580284	2710.8	55.008	Greenstone/Granitics	2000	51	1501.84	4495.22	2020.59	0	2020.59	4166.08	4166.08
13	0.580284	2638.64	55.008	Greenstone/Granitics	2000	51	1475.68	4416.91	1957.17	0	1957.17	4065.28	4065.28
14	0.580284	2566.49	55.008	Greenstone/Granitics	2000	51	1449.51	4338.59	1893.75	0	1893.75	3964.48	3964.48
15	0.580284	2494.33	55.008	Greenstone/Granitics	2000	51	1423.34	4260.27	1830.34	0	1830.34	3863.69	3863.69
16	0.580284	2422.17	55.008	Greenstone/Granitics	2000	51	1397.18	4181.96	1766.91	0	1766.91	3762.88	3762.88
17	0.580284	2350.02	55.008	Greenstone/Granitics	2000	51	1371.02	4103.64	1703.5	0	1703.5	3662.09	3662.09
18	0.580284	2277.86	55.008	Greenstone/Granitics	2000	51	1344.85	4025.32	1640.07	0	1640.07	3561.28	3561.28
19	0.580284	2205.7	55.008	Greenstone/Granitics	2000	51	1318.68	3947	1576.65	0	1576.65	3460.49	3460.49
20	0.580284	2133.55	55.008	Greenstone/Granitics	2000	51	1292.52	3868.69	1513.23	0	1513.23	3359.68	3359.68
21	0.580284	2061.39	55.008	Greenstone/Granitics	2000	51	1266.35	3790.37	1449.81	0	1449.81	3258.89	3258.89
22	0.580284	1989.24	55.008	Greenstone/Granitics	2000	51	1240.19	3712.05	1386.39	0	1386.39	3158.08	3158.08
23	0.580284	1917.08	55.008	Greenstone/Granitics	2000	51	1214.02	3633.73	1322.97	0	1322.97	3057.29	3057.29
24	0.580284	1844.92	55.008	Greenstone/Granitics	2000	51	1187.86	3555.42	1259.56	0	1259.56	2956.49	2956.49
25	0.580284	1772.77	55.008	Greenstone/Granitics	2000	51	1161.69	3477.1	1196.13	0	1196.13	2855.69	2855.69
26	0.580284	1700.61	55.008	Greenstone/Granitics	2000	51	1135.52	3398.78	1132.72	0	1132.72	2754.89	2754.89
27	0.580284	1628.45	55.008	Greenstone/Granitics	2000	51	1109.36	3320.47	1069.29	0	1069.29	2654.09	2654.09
28	0.580284	1556.3	55.008	Greenstone/Granitics	2000	51	1083.19	3242.15	1005.87	0	1005.87	2553.29	2553.29
29	0.580284	1484.14	55.008	Greenstone/Granitics	2000	51	1057.03	3163.83	942.453	0	942.453	2452.49	2452.49
30	0.580284	1411.98	55.008	Greenstone/Granitics	2000	51	1030.86	3085.51	879.032	0	879.032	2351.69	2351.69
31	0.580284	1339.83	55.008	Greenstone/Granitics	2000	51	1004.7	3007.2	815.613	0	815.613	2250.89	2250.89
32	0.580284	1267.67	55.008	Greenstone/Granitics	2000	51	978.531	2928.88	752.192	0	752.192	2150.09	2150.09
33	0.580284	1195.52	55.008	Greenstone/Granitics	2000	51	952.365	2850.56	688.773	0	688.773	2049.29	2049.29
34	0.580284	1123.36	55.008	Greenstone/Granitics	2000	51	926.2	2772.25	625.353	0	625.353	1948.5	1948.5
35	0.580284	1051.2	55.008	Greenstone/Granitics	2000	51	900.034	2693.93	561.932	0	561.932	1847.7	1847.7
36	0.580284	979.047	55.008	Greenstone/Granitics	2000	51	873.869	2615.61	498.513	0	498.513	1746.9	1746.9
37	0.580284	906.89	55.008	Greenstone/Granitics	2000	51	847.703	2537.3	435.092	0	435.092	1646.1	1646.1
38	0.580284	834.734	55.008	Greenstone/Granitics	2000	51	821.538	2458.98	371.673	0	371.673	1545.3	1545.3
39	0.580284	762.578	55.008	Greenstone/Granitics	2000	51	795.372	2380.66	308.253	0	308.253	1444.5	1444.5
40	0.580284	690.421	55.008	Greenstone/Granitics	2000	51	769.207	2302.34	244.833	0	244.833	1343.7	1343.7
41	0.580284	618.265	55.008	Greenstone/Granitics	2000	51	743.041	2224.03	181.413	0	181.413	1242.9	1242.9
42	0.580284	546.109	55.008	Greenstone/Granitics	2000	51	716.876	2145.71	117.992	0	117.992	1142.1	1142.1
43	0.580284	473.952	55.008	Greenstone/Granitics	2000	51	690.71	2067.39	54.5726	0	54.5726	1041.3	1041.3
44	0.580284	401.796	55.008	Greenstone/Granitics	2000	51	664.544	1989.07	-8.84734	0	-8.84734	940.502	940.502
45	0.580284	329.64	55.008	Greenstone/Granitics	2000	51	638.379	1910.76	-72.2673	0	-72.2673	839.702	839.702
46	0.580284	257.483	55.008	Greenstone/Granitics	2000	51	612.213	1832.44	-135.687	0	-135.687	738.903	738.903
47	0.580284	185.327	55.008	Greenstone/Granitics	2000	51	586.048	1754.12	-199.107	0	-199.107	638.104	638.104
48	0.580284	113.17	55.008	Greenstone/Granitics	2000	51	559.882	1675.81	-262.527	0	-262.527	537.305	537.305
49	0.580284	41.0141	55.008	Greenstone/Granitics	2000	51	533.717	1597.49	-325.948	0	-325.948	436.505	436.505
50	0.0567069	0.241176	45	Greenstone/Granitics	2000	51	562.379	1683.28	-256.476	0	-256.476	305.903	305.903

Interslice Data

- **Global Minimum Query (bishop simplified) - Safety Factor: 2.14633**

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	40	10.259	0	0	0
2	40.1067	10.1524	2822.41	0	0
3	40.687	10.9814	2114.02	0	0
4	41.2672	11.8103	1439.47	0	0
5	41.8475	12.6393	798.77	0	0
6	42.4278	13.4683	191.919	0	0
7	43.0081	14.2973	-381.084	0	0
8	43.5884	15.1262	-920.238	0	0
9	44.1687	15.9552	-1425.54	0	0
10	44.7489	16.7842	-1897	0	0
11	45.3292	17.6132	-2334.61	0	0
12	45.9095	18.4422	-2738.37	0	0
13	46.4898	19.2711	-3108.28	0	0
14	47.0701	20.1001	-3444.34	0	0
15	47.6504	20.9291	-3746.56	0	0
16	48.2306	21.7581	-4014.93	0	0
17	48.8109	22.587	-4249.44	0	0
18	49.3912	23.416	-4450.11	0	0
19	49.9715	24.245	-4616.93	0	0
20	50.5518	25.074	-4749.91	0	0
21	51.1321	25.903	-4849.03	0	0
22	51.7123	26.7319	-4914.31	0	0
23	52.2926	27.5609	-4945.73	0	0
24	52.8729	28.3899	-4943.31	0	0
25	53.4532	29.2189	-4907.04	0	0
26	54.0335	30.0478	-4836.92	0	0
27	54.6138	30.8768	-4732.96	0	0
28	55.1941	31.7058	-4595.14	0	0
29	55.7743	32.5348	-4423.48	0	0
30	56.3546	33.3637	-4217.96	0	0
31	56.9349	34.1927	-3978.6	0	0
32	57.5152	35.0217	-3705.39	0	0
33	58.0955	35.8507	-3398.34	0	0
34	58.6758	36.6797	-3057.43	0	0
35	59.256	37.5086	-2682.67	0	0
36	59.8363	38.3376	-2274.07	0	0
37	60.4166	39.1666	-1831.62	0	0
38	60.9969	39.9956	-1355.32	0	0
39	61.5772	40.8245	-845.171	0	0
40	62.1575	41.6535	-301.174	0	0
41	62.7377	42.4825	276.672	0	0
42	63.318	43.3115	888.366	0	0
43	63.8983	44.1405	1533.91	0	0
44	64.4786	44.9694	2213.3	0	0
45	65.0589	45.7984	2926.54	0	0
46	65.6392	46.6274	3673.63	0	0
47	66.2195	47.4564	4454.56	0	0
48	66.7997	48.2853	5269.35	0	0
49	67.38	49.1143	6117.98	0	0
50	67.9603	49.9433	7000.46	0	0
51	68.017	50	0	0	0

- **Global Minimum Query (janbu simplified) - Safety Factor: 2.37142**

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	40	10.259	0	0	0
2	40.1067	10.1524	2392.93	0	0
3	40.687	10.9814	1457.74	0	0
4	41.2672	11.8103	560.14	0	0
5	41.8475	12.6393	-299.868	0	0
6	42.4278	13.4683	-1122.29	0	0
7	43.0081	14.2973	-1907.11	0	0
8	43.5884	15.1262	-2654.35	0	0
9	44.1687	15.9552	-3363.99	0	0
10	44.7489	16.7842	-4036.04	0	0
11	45.3292	17.6132	-4670.5	0	0
12	45.9095	18.4422	-5267.37	0	0
13	46.4898	19.2711	-5826.65	0	0
14	47.0701	20.1001	-6348.33	0	0
15	47.6504	20.9291	-6832.43	0	0
16	48.2306	21.7581	-7278.93	0	0
17	48.8109	22.587	-7687.84	0	0
18	49.3912	23.416	-8059.16	0	0
19	49.9715	24.245	-8392.89	0	0
20	50.5518	25.074	-8689.03	0	0
21	51.1321	25.903	-8947.58	0	0
22	51.7123	26.7319	-9168.53	0	0
23	52.2926	27.5609	-9351.9	0	0
24	52.8729	28.3899	-9497.67	0	0
25	53.4532	29.2189	-9605.85	0	0
26	54.0335	30.0478	-9676.44	0	0
27	54.6138	30.8768	-9709.44	0	0
28	55.1941	31.7058	-9704.84	0	0
29	55.7743	32.5348	-9662.66	0	0
30	56.3546	33.3637	-9582.88	0	0
31	56.9349	34.1927	-9465.51	0	0
32	57.5152	35.0217	-9310.55	0	0
33	58.0955	35.8507	-9118	0	0
34	58.6758	36.6797	-8887.86	0	0
35	59.256	37.5086	-8620.13	0	0
36	59.8363	38.3376	-8314.8	0	0
37	60.4166	39.1666	-7971.89	0	0
38	60.9969	39.9956	-7591.38	0	0
39	61.5772	40.8245	-7173.28	0	0
40	62.1575	41.6535	-6717.59	0	0
41	62.7377	42.4825	-6224.31	0	0
42	63.318	43.3115	-5693.44	0	0
43	63.8983	44.1405	-5124.97	0	0
44	64.4786	44.9694	-4518.92	0	0
45	65.0589	45.7984	-3875.27	0	0
46	65.6392	46.6274	-3194.03	0	0
47	66.2195	47.4564	-2475.2	0	0
48	66.7997	48.2853	-1718.78	0	0
49	67.38	49.1143	-924.768	0	0
50	67.9603	49.9433	-93.1638	0	0
51	68.017	50	0	0	0

- **Global Minimum Query (spencer) - Safety Factor: 2.99314**

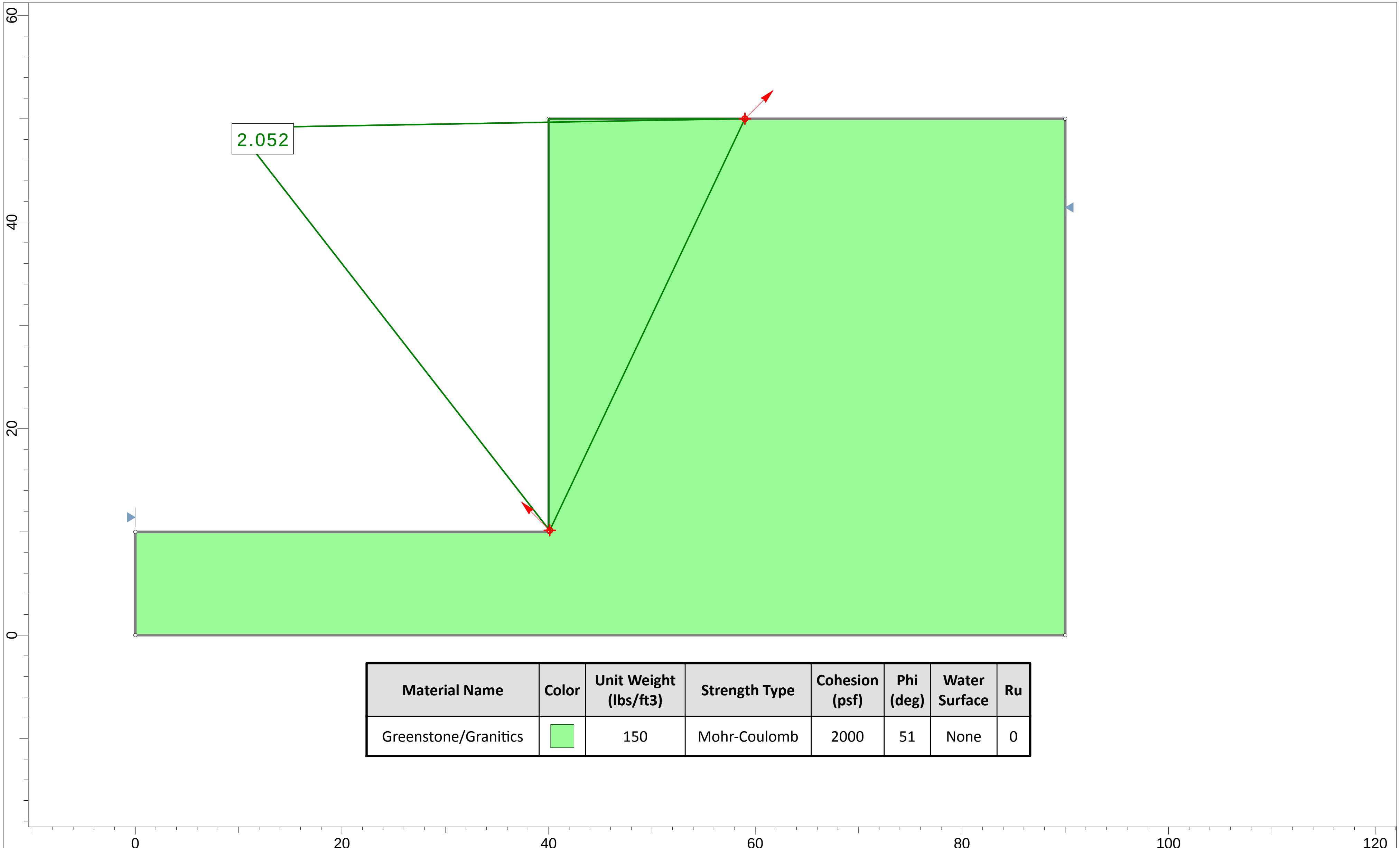
Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	40	10.259	0	0	0
2	40.1067	10.1524	14294.1	5227.53	20.0881
3	40.687	10.9814	13116.7	4796.93	20.0881
4	41.2672	11.8103	11976.7	4380	20.088
5	41.8475	12.6393	10874	3976.74	20.088
6	42.4278	13.4683	9808.73	3587.16	20.088
7	43.0081	14.2973	8780.85	3211.26	20.0881
8	43.5884	15.1262	7790.36	2849.02	20.088
9	44.1687	15.9552	6837.27	2500.47	20.0881
10	44.7489	16.7842	5921.56	2165.58	20.088
11	45.3292	17.6132	5043.25	1844.37	20.088
12	45.9095	18.4422	4202.32	1536.84	20.0881
13	46.4898	19.2711	3398.78	1242.97	20.088
14	47.0701	20.1001	2632.64	962.786	20.088
15	47.6504	20.9291	1903.89	696.273	20.088
16	48.2306	21.7581	1212.52	443.433	20.0881
17	48.8109	22.587	558.548	204.267	20.088
18	49.3912	23.416	-58.0351	-21.2241	20.088
19	49.9715	24.245	-637.228	-233.042	20.0881
20	50.5518	25.074	-1179.03	-431.185	20.0881
21	51.1321	25.903	-1683.44	-615.654	20.0881
22	51.7123	26.7319	-2150.46	-786.449	20.0881
23	52.2926	27.5609	-2580.1	-943.57	20.088
24	52.8729	28.3899	-2972.34	-1087.02	20.0881
25	53.4532	29.2189	-3327.19	-1216.79	20.088
26	54.0335	30.0478	-3644.65	-1332.89	20.088
27	54.6138	30.8768	-3924.72	-1435.31	20.088
28	55.1941	31.7058	-4167.4	-1524.06	20.088
29	55.7743	32.5348	-4372.69	-1599.14	20.088
30	56.3546	33.3637	-4540.59	-1660.54	20.088
31	56.9349	34.1927	-4671.09	-1708.27	20.088
32	57.5152	35.0217	-4764.21	-1742.33	20.0881
33	58.0955	35.8507	-4819.94	-1762.71	20.0881
34	58.6758	36.6797	-4838.28	-1769.41	20.088
35	59.256	37.5086	-4819.22	-1762.45	20.0881
36	59.8363	38.3376	-4762.78	-1741.8	20.088
37	60.4166	39.1666	-4668.95	-1707.49	20.0881
38	60.9969	39.9956	-4537.72	-1659.5	20.0881
39	61.5772	40.8245	-4369.11	-1597.83	20.088
40	62.1575	41.6535	-4163.1	-1522.49	20.088
41	62.7377	42.4825	-3919.71	-1433.48	20.088
42	63.318	43.3115	-3638.92	-1330.8	20.0881
43	63.8983	44.1405	-3320.75	-1214.44	20.0881
44	64.4786	44.9694	-2965.18	-1084.4	20.088
45	65.0589	45.7984	-2572.23	-940.692	20.088
46	65.6392	46.6274	-2141.88	-783.309	20.088
47	66.2195	47.4564	-1674.14	-612.252	20.088
48	66.7997	48.2853	-1169.01	-427.521	20.0881
49	67.38	49.1143	-626.495	-229.116	20.088
50	67.9603	49.9433	-46.5867	-17.0373	20.0881
51	68.017	50	0	0	0

Entity Information

Group: Group 1

Shared Entities

Type	Coordinates	
	X	Y
External Boundary	0	0
	90	0
	90	50
	40	50
	40	10
	0	10



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Greenstone/Granitics		150	Mohr-Coulomb	2000	51	None	0

BAJADA Geosciences, Inc.

Project	Crystal Creek Quarry Expansion		
Analysis Description	Planar Failure - Discontinuity at 65 degree		
Drawn By J.Bianchin	*Scale* 1:154	*Company*	Bajada Geosciences, Inc.
Date	5-16-19	*File Name*	65deg.slmd

SLIDEINTERPRET 8.023

Slide Analysis Information

65deg

Project Summary

File Name:	65deg.slmd
Slide Modeler Version:	8.023
Compute Time:	00h:00m:00.286s
Project Title:	Crystal Creek Quarry Expansion
Analysis:	Planar Failure - Discontinuity at 65 degree
Author:	J.Bianchin
Company:	Bajada Geosciences, Inc.
Date Created:	5-16-19

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	Janbu simplified
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

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

Random Numbers

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

Surface Options

Surface Type:	Non-Circular Block Search
Number of Surfaces:	5000
Multiple Groups:	Disabled
Pseudo-Random Surfaces:	Enabled
Convex Surfaces Only:	Disabled
Left Projection Angle (Start Angle) [°]:	135
Left Projection Angle (End Angle) [°]:	135
Right Projection Angle (Start Angle) [°]:	45
Right Projection Angle (End Angle) [°]:	45
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Property	Greenstone/Granitics
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	150
Cohesion [psf]	2000
Friction Angle [°]	51
Water Surface	None
Ru Value	0

Global Minimums

Method: bishop simplified

FS	2.051790
Axis Location:	9.759, 49.130
Left Slip Surface Endpoint:	40.000, 10.259
Right Slip Surface Endpoint:	59.000, 50.000
Left Slope Intercept:	40.000 50.000
Right Slope Intercept:	59.000 50.000
Resisting Moment:	4.90376e+06 lb-ft
Driving Moment:	2.38999e+06 lb-ft
Total Slice Area:	380.672 ft2
Surface Horizontal Width:	19 ft
Surface Average Height:	20.0354 ft

Method: janbu simplified

Resisting Horizontal Force:	-0 lb
Driving Horizontal Force:	0 lb
Total Slice Area:	0 ft2
Surface Horizontal Width:	0 ft
Surface Average Height:	0 ft

Method: spencer

Resisting Moment:	-0 lb-ft
Driving Moment:	0 lb-ft
Resisting Horizontal Force:	-0 lb
Driving Horizontal Force:	0 lb
Total Slice Area:	0 ft2
Surface Horizontal Width:	0 ft
Surface Average Height:	0 ft

Global Minimum Coordinates

Method: bishop simplified

X	Y
40	10.259
40.1067	10.1524
59	50

Valid/Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces:	5000
Number of Invalid Surfaces:	0

Method: janbu simplified

Number of Valid Surfaces:	0
Number of Invalid Surfaces:	5000

Error Codes:

Error Code -111 reported for 5000 surfaces

Method: spencer

Number of Valid Surfaces:	0
Number of Invalid Surfaces:	5000

Error Codes:

Error Code -111 reported for 5000 surfaces

Error Codes

The following errors were encountered during the computation:

-111 = safety factor equation did not converge

Slice Data

- **Global Minimum Query (bishop simplified) - Safety Factor: 2.05179**

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.106667	636.708	-45	Greenstone/Granitics	2000	51	11451.4	23495.9	17407	0	17407	5955.62	5955.62
2	0.385578	2281.14	64.6325	Greenstone/Granitics	2000	51	1999.87	4103.32	1703.23	0	1703.23	5921.13	5921.13
3	0.385578	2234.11	64.6325	Greenstone/Granitics	2000	51	1967.5	4036.9	1649.44	0	1649.44	5799.07	5799.07
4	0.385578	2187.07	64.6325	Greenstone/Granitics	2000	51	1935.12	3970.47	1595.66	0	1595.66	5677	5677
5	0.385578	2140.04	64.6325	Greenstone/Granitics	2000	51	1902.75	3904.05	1541.87	0	1541.87	5554.94	5554.94
6	0.385578	2093	64.6325	Greenstone/Granitics	2000	51	1870.38	3837.63	1488.09	0	1488.09	5432.88	5432.88
7	0.385578	2045.97	64.6325	Greenstone/Granitics	2000	51	1838.01	3771.21	1434.3	0	1434.3	5310.81	5310.81
8	0.385578	1998.94	64.6325	Greenstone/Granitics	2000	51	1805.64	3704.79	1380.51	0	1380.51	5188.75	5188.75
9	0.385578	1951.9	64.6325	Greenstone/Granitics	2000	51	1773.27	3638.37	1326.73	0	1326.73	5066.7	5066.7
10	0.385578	1904.87	64.6325	Greenstone/Granitics	2000	51	1740.89	3571.95	1272.94	0	1272.94	4944.63	4944.63
11	0.385578	1857.84	64.6325	Greenstone/Granitics	2000	51	1708.52	3505.52	1219.15	0	1219.15	4822.56	4822.56
12	0.385578	1810.8	64.6325	Greenstone/Granitics	2000	51	1676.15	3439.1	1165.36	0	1165.36	4700.49	4700.49
13	0.385578	1763.77	64.6325	Greenstone/Granitics	2000	51	1643.77	3372.68	1111.57	0	1111.57	4578.43	4578.43
14	0.385578	1716.73	64.6325	Greenstone/Granitics	2000	51	1611.4	3306.26	1057.79	0	1057.79	4456.37	4456.37
15	0.385578	1669.7	64.6325	Greenstone/Granitics	2000	51	1579.03	3239.84	1004	0	1004	4334.31	4334.31
16	0.385578	1622.67	64.6325	Greenstone/Granitics	2000	51	1546.66	3173.42	950.215	0	950.215	4212.25	4212.25
17	0.385578	1575.63	64.6325	Greenstone/Granitics	2000	51	1514.29	3107	896.428	0	896.428	4090.19	4090.19
18	0.385578	1528.6	64.6325	Greenstone/Granitics	2000	51	1481.91	3040.57	842.641	0	842.641	3968.11	3968.11
19	0.385578	1481.56	64.6325	Greenstone/Granitics	2000	51	1449.54	2974.15	788.854	0	788.854	3846.06	3846.06
20	0.385578	1434.53	64.6325	Greenstone/Granitics	2000	51	1417.17	2907.73	735.067	0	735.067	3723.99	3723.99
21	0.385578	1387.5	64.6325	Greenstone/Granitics	2000	51	1384.8	2841.31	681.28	0	681.28	3601.93	3601.93
22	0.385578	1340.46	64.6325	Greenstone/Granitics	2000	51	1352.42	2774.89	627.493	0	627.493	3479.87	3479.87
23	0.385578	1293.43	64.6325	Greenstone/Granitics	2000	51	1320.05	2708.47	573.706	0	573.706	3357.8	3357.8
24	0.385578	1246.4	64.6325	Greenstone/Granitics	2000	51	1287.68	2642.05	519.919	0	519.919	3235.74	3235.74
25	0.385578	1199.36	64.6325	Greenstone/Granitics	2000	51	1255.31	2575.63	466.132	0	466.132	3113.68	3113.68
26	0.385578	1152.33	64.6325	Greenstone/Granitics	2000	51	1222.93	2509.2	412.345	0	412.345	2991.62	2991.62
27	0.385578	1105.29	64.6325	Greenstone/Granitics	2000	51	1190.56	2442.78	358.558	0	358.558	2869.55	2869.55
28	0.385578	1058.26	64.6325	Greenstone/Granitics	2000	51	1158.19	2376.36	304.772	0	304.772	2747.49	2747.49
29	0.385578	1011.23	64.6325	Greenstone/Granitics	2000	51	1125.82	2309.94	250.983	0	250.983	2625.42	2625.42
30	0.385578	964.193	64.6325	Greenstone/Granitics	2000	51	1093.44	2243.52	197.197	0	197.197	2503.36	2503.36
31	0.385578	917.159	64.6325	Greenstone/Granitics	2000	51	1061.07	2177.1	143.41	0	143.41	2381.3	2381.3
32	0.385578	870.125	64.6325	Greenstone/Granitics	2000	51	1028.7	2110.68	89.6231	0	89.6231	2259.24	2259.24
33	0.385578	823.091	64.6325	Greenstone/Granitics	2000	51	996.327	2044.25	35.8362	0	35.8362	2137.17	2137.17
34	0.385578	776.058	64.6325	Greenstone/Granitics	2000	51	963.955	1977.83	-17.9509	0	-17.9509	2015.11	2015.11
35	0.385578	729.024	64.6325	Greenstone/Granitics	2000	51	931.582	1911.41	-71.7378	0	-71.7378	1893.05	1893.05
36	0.385578	681.99	64.6325	Greenstone/Granitics	2000	51	899.21	1844.99	-125.525	0	-125.525	1770.98	1770.98
37	0.385578	634.956	64.6325	Greenstone/Granitics	2000	51	866.837	1778.57	-179.312	0	-179.312	1648.92	1648.92
38	0.385578	587.922	64.6325	Greenstone/Granitics	2000	51	834.465	1712.15	-233.099	0	-233.099	1526.86	1526.86
39	0.385578	540.889	64.6325	Greenstone/Granitics	2000	51	802.093	1645.73	-286.886	0	-286.886	1404.79	1404.79
40	0.385578	493.855	64.6325	Greenstone/Granitics	2000	51	769.72	1579.3	-340.673	0	-340.673	1282.73	1282.73
41	0.385578	446.821	64.6325	Greenstone/Granitics	2000	51	737.348	1512.88	-394.46	0	-394.46	1160.67	1160.67
42	0.385578	399.787	64.6325	Greenstone/Granitics	2000	51	704.976	1446.46	-448.247	0	-448.247	1038.61	1038.61
43	0.385578	352.753	64.6325	Greenstone/Granitics	2000	51	672.603	1380.04	-502.034	0	-502.034	916.542	916.542
44	0.385578	305.72	64.6325	Greenstone/Granitics	2000	51	640.231	1313.62	-555.821	0	-555.821	794.48	794.48
45	0.385578	258.686	64.6325	Greenstone/Granitics	2000	51	607.859	1247.2	-609.607	0	-609.607	672.417	672.417
46	0.385578	211.652	64.6325	Greenstone/Granitics	2000	51	575.486	1180.78	-663.394	0	-663.394	550.353	550.353
47	0.385578	164.618	64.6325	Greenstone/Granitics	2000	51	543.114	1114.36	-717.181	0	-717.181	428.291	428.291
48	0.385578	117.584	64.6325	Greenstone/Granitics	2000	51	510.741	1047.93	-770.968	0	-770.968	306.227	306.227
49	0.385578	70.5507	64.6325	Greenstone/Granitics	2000	51	478.368	981.51	-824.755	0	-824.755	184.162	184.162
50	0.385578	23.5169	64.6325	Greenstone/Granitics	2000	51	445.996	915.09	-878.542	0	-878.542	62.1006	62.1006

Interslice Data

- **Global Minimum Query (bishop simplified) - Safety Factor: 2.05179**

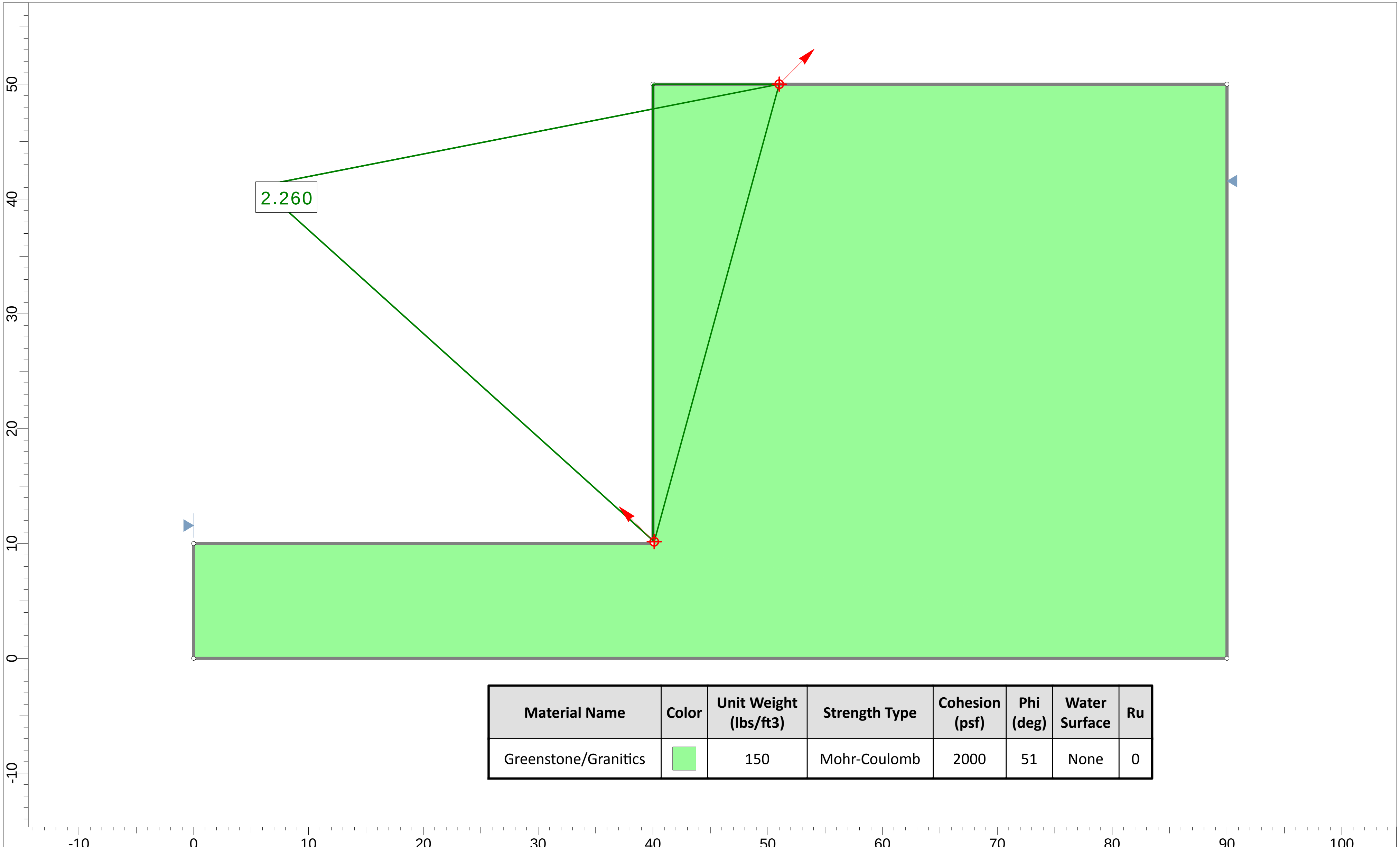
Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	40	10.259	0	0	0
2	40.1067	10.1524	3076.8	0	0
3	40.4922	10.9656	2461.9	0	0
4	40.8778	11.7788	1878.27	0	0
5	41.2634	12.592	1325.92	0	0
6	41.649	13.4052	804.836	0	0
7	42.0346	14.2185	315.029	0	0
8	42.4201	15.0317	-143.506	0	0
9	42.8057	15.8449	-570.767	0	0
10	43.1913	16.6581	-966.755	0	0
11	43.5769	17.4713	-1331.47	0	0
12	43.9624	18.2845	-1664.91	0	0
13	44.348	19.0978	-1967.08	0	0
14	44.7336	19.911	-2237.98	0	0
15	45.1192	20.7242	-2477.6	0	0
16	45.5048	21.5374	-2685.95	0	0
17	45.8903	22.3506	-2863.02	0	0
18	46.2759	23.1638	-3008.83	0	0
19	46.6615	23.9771	-3123.36	0	0
20	47.0471	24.7903	-3206.61	0	0
21	47.4327	25.6035	-3258.6	0	0
22	47.8182	26.4167	-3279.31	0	0
23	48.2038	27.2299	-3268.75	0	0
24	48.5894	28.0431	-3226.91	0	0
25	48.975	28.8564	-3153.8	0	0
26	49.3605	29.6696	-3049.42	0	0
27	49.7461	30.4828	-2913.77	0	0
28	50.1317	31.296	-2746.84	0	0
29	50.5173	32.1092	-2548.64	0	0
30	50.9029	32.9224	-2319.17	0	0
31	51.2884	33.7357	-2058.42	0	0
32	51.674	34.5489	-1766.4	0	0
33	52.0596	35.3621	-1443.11	0	0
34	52.4452	36.1753	-1088.54	0	0
35	52.8307	36.9885	-702.7	0	0
36	53.2163	37.8017	-285.587	0	0
37	53.6019	38.615	162.798	0	0
38	53.9875	39.4282	642.457	0	0
39	54.3731	40.2414	1153.39	0	0
40	54.7586	41.0546	1695.59	0	0
41	55.1442	41.8678	2269.07	0	0
42	55.5298	42.681	2873.82	0	0
43	55.9154	43.4943	3509.85	0	0
44	56.301	44.3075	4177.14	0	0
45	56.6865	45.1207	4875.71	0	0
46	57.0721	45.9339	5605.56	0	0
47	57.4577	46.7471	6366.67	0	0
48	57.8433	47.5603	7159.06	0	0
49	58.2288	48.3736	7982.73	0	0
50	58.6144	49.1868	8837.66	0	0
51	59	50	0	0	0

Entity Information

Group: Group 1

Shared Entities

Type	Coordinates	
	X	Y
External Boundary	0	0
	90	0
	90	50
	40	50
	40	10
	0	10



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Greenstone/Granitics		150	Mohr-Coulomb	2000	51	None	0

BAJADA Geosciences, Inc.	*Project* Crystal Creek Quarry Expansion		
	Analysis Description Planar Failure - Discontinuity at 75 degree		
	Drawn By J.Bianchin	*Scale* 1:139	*Company* Bajada Geosciences, Inc.
SLIDEINTERPRET 8.023	*Date* 5-16-19		*File Name* 75deg.slmd

Slide Analysis Information

75deg

Project Summary

File Name:	75deg.slmd
Slide Modeler Version:	8.023
Compute Time:	00h:00m:00.288s
Project Title:	Crystal Creek Quarry Expansion
Analysis:	Planar Failure - Discontinuity at 75 degree
Author:	J.Bianchin
Company:	Bajada Geosciences, Inc.
Date Created:	5-16-19

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	Janbu simplified
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

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

Random Numbers

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

Surface Options

Surface Type:	Non-Circular Block Search
Number of Surfaces:	5000
Multiple Groups:	Disabled
Pseudo-Random Surfaces:	Enabled
Convex Surfaces Only:	Disabled
Left Projection Angle (Start Angle) [°]:	135
Left Projection Angle (End Angle) [°]:	135
Right Projection Angle (Start Angle) [°]:	45
Right Projection Angle (End Angle) [°]:	45
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Property	Greenstone/Granitics
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	150
Cohesion [psf]	2000
Friction Angle [°]	51
Water Surface	None
Ru Value	0

Global Minimums

Method: bishop simplified

FS	2.259910
Axis Location:	5.759, 41.130
Left Slip Surface Endpoint:	40.000, 10.259
Right Slip Surface Endpoint:	51.000, 50.000
Left Slope Intercept:	40.000 50.000
Right Slope Intercept:	51.000 50.000
Resisting Moment:	3.24504e+06 lb-ft
Driving Moment:	1.43591e+06 lb-ft
Total Slice Area:	221.281 ft2
Surface Horizontal Width:	11 ft
Surface Average Height:	20.1165 ft

Method: janbu simplified

Resisting Horizontal Force:	-0 lb
Driving Horizontal Force:	0 lb
Total Slice Area:	0 ft2
Surface Horizontal Width:	0 ft
Surface Average Height:	0 ft

Method: spencer

Resisting Moment:	-0 lb-ft
Driving Moment:	0 lb-ft
Resisting Horizontal Force:	-0 lb
Driving Horizontal Force:	0 lb
Total Slice Area:	0 ft2
Surface Horizontal Width:	0 ft
Surface Average Height:	0 ft

Global Minimum Coordinates

Method: bishop simplified

X	Y
40	10.259
40.1067	10.1524
51	50

Valid/Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces:	5000
Number of Invalid Surfaces:	0

Method: janbu simplified

Number of Valid Surfaces:	0
Number of Invalid Surfaces:	5000

Error Codes:

Error Code -111 reported for 5000 surfaces

Method: spencer

Number of Valid Surfaces:	0
Number of Invalid Surfaces:	5000

Error Codes:

Error Code -111 reported for 5000 surfaces

Error Codes

The following errors were encountered during the computation:

-111 = safety factor equation did not converge

Slice Data

- **Global Minimum Query (bishop simplified) - Safety Factor: 2.25991**

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.106667	636.708	-45	Greenstone/Granitics	2000	51	9142	20660.1	15110.6	0	15110.6	5968.64	5968.64
2	0.222313	1315.24	74.7104	Greenstone/Granitics	2000	51	1373.17	3103.24	893.387	0	893.387	5916.42	5916.42
3	0.222313	1288.12	74.7104	Greenstone/Granitics	2000	51	1350.94	3053.01	852.71	0	852.71	5794.44	5794.44
4	0.222313	1261	74.7104	Greenstone/Granitics	2000	51	1328.72	3002.78	812.032	0	812.032	5672.45	5672.45
5	0.222313	1233.88	74.7104	Greenstone/Granitics	2000	51	1306.49	2952.54	771.354	0	771.354	5550.46	5550.46
6	0.222313	1206.76	74.7104	Greenstone/Granitics	2000	51	1284.26	2902.31	730.676	0	730.676	5428.47	5428.47
7	0.222313	1179.65	74.7104	Greenstone/Granitics	2000	51	1262.03	2852.08	689.999	0	689.999	5306.49	5306.49
8	0.222313	1152.53	74.7104	Greenstone/Granitics	2000	51	1239.8	2801.84	649.321	0	649.321	5184.5	5184.5
9	0.222313	1125.41	74.7104	Greenstone/Granitics	2000	51	1217.58	2751.61	608.642	0	608.642	5062.51	5062.51
10	0.222313	1098.29	74.7104	Greenstone/Granitics	2000	51	1195.35	2701.38	567.965	0	567.965	4940.53	4940.53
11	0.222313	1071.17	74.7104	Greenstone/Granitics	2000	51	1173.12	2651.14	527.287	0	527.287	4818.54	4818.54
12	0.222313	1044.05	74.7104	Greenstone/Granitics	2000	51	1150.89	2600.91	486.609	0	486.609	4696.55	4696.55
13	0.222313	1016.94	74.7104	Greenstone/Granitics	2000	51	1128.66	2550.68	445.932	0	445.932	4574.57	4574.57
14	0.222313	989.818	74.7104	Greenstone/Granitics	2000	51	1106.44	2500.45	405.254	0	405.254	4452.58	4452.58
15	0.222313	962.699	74.7104	Greenstone/Granitics	2000	51	1084.21	2450.21	364.576	0	364.576	4330.59	4330.59
16	0.222313	935.581	74.7104	Greenstone/Granitics	2000	51	1061.98	2399.98	323.898	0	323.898	4208.6	4208.6
17	0.222313	908.463	74.7104	Greenstone/Granitics	2000	51	1039.75	2349.75	283.221	0	283.221	4086.62	4086.62
18	0.222313	881.344	74.7104	Greenstone/Granitics	2000	51	1017.53	2299.51	242.542	0	242.542	3964.63	3964.63
19	0.222313	854.226	74.7104	Greenstone/Granitics	2000	51	995.297	2249.28	201.864	0	201.864	3842.64	3842.64
20	0.222313	827.108	74.7104	Greenstone/Granitics	2000	51	973.069	2199.05	161.187	0	161.187	3720.66	3720.66
21	0.222313	799.99	74.7104	Greenstone/Granitics	2000	51	950.841	2148.82	120.509	0	120.509	3598.67	3598.67
22	0.222313	772.871	74.7104	Greenstone/Granitics	2000	51	928.614	2098.58	79.8312	0	79.8312	3476.68	3476.68
23	0.222313	745.753	74.7104	Greenstone/Granitics	2000	51	906.386	2048.35	39.1534	0	39.1534	3354.7	3354.7
24	0.222313	718.635	74.7104	Greenstone/Granitics	2000	51	884.158	1998.12	-1.52445	0	-1.52445	3232.71	3232.71
25	0.222313	691.516	74.7104	Greenstone/Granitics	2000	51	861.93	1947.88	-42.2023	0	-42.2023	3110.72	3110.72
26	0.222313	664.398	74.7104	Greenstone/Granitics	2000	51	839.702	1897.65	-82.8801	0	-82.8801	2988.74	2988.74
27	0.222313	637.28	74.7104	Greenstone/Granitics	2000	51	817.475	1847.42	-123.558	0	-123.558	2866.75	2866.75
28	0.222313	610.161	74.7104	Greenstone/Granitics	2000	51	795.247	1797.19	-164.236	0	-164.236	2744.76	2744.76
29	0.222313	583.043	74.7104	Greenstone/Granitics	2000	51	773.019	1746.95	-204.914	0	-204.914	2622.78	2622.78
30	0.222313	555.925	74.7104	Greenstone/Granitics	2000	51	750.791	1696.72	-245.591	0	-245.591	2500.79	2500.79
31	0.222313	528.807	74.7104	Greenstone/Granitics	2000	51	728.563	1646.49	-286.269	0	-286.269	2378.8	2378.8
32	0.222313	501.688	74.7104	Greenstone/Granitics	2000	51	706.335	1596.25	-326.947	0	-326.947	2256.81	2256.81
33	0.222313	474.57	74.7104	Greenstone/Granitics	2000	51	684.107	1546.02	-367.625	0	-367.625	2134.83	2134.83
34	0.222313	447.452	74.7104	Greenstone/Granitics	2000	51	661.879	1495.79	-408.302	0	-408.302	2012.84	2012.84
35	0.222313	420.333	74.7104	Greenstone/Granitics	2000	51	639.652	1445.55	-448.981	0	-448.981	1890.85	1890.85
36	0.222313	393.215	74.7104	Greenstone/Granitics	2000	51	617.424	1395.32	-489.659	0	-489.659	1768.87	1768.87
37	0.222313	366.097	74.7104	Greenstone/Granitics	2000	51	595.196	1345.09	-530.336	0	-530.336	1646.88	1646.88
38	0.222313	338.979	74.7104	Greenstone/Granitics	2000	51	572.968	1294.86	-571.014	0	-571.014	1524.89	1524.89
39	0.222313	311.86	74.7104	Greenstone/Granitics	2000	51	550.741	1244.62	-611.692	0	-611.692	1402.91	1402.91
40	0.222313	284.742	74.7104	Greenstone/Granitics	2000	51	528.513	1194.39	-652.369	0	-652.369	1280.92	1280.92
41	0.222313	257.624	74.7104	Greenstone/Granitics	2000	51	506.285	1144.16	-693.047	0	-693.047	1158.93	1158.93
42	0.222313	230.505	74.7104	Greenstone/Granitics	2000	51	484.057	1093.92	-733.725	0	-733.725	1036.95	1036.95
43	0.222313	203.387	74.7104	Greenstone/Granitics	2000	51	461.829	1043.69	-774.404	0	-774.404	914.959	914.959
44	0.222313	176.269	74.7104	Greenstone/Granitics	2000	51	439.602	993.46	-815.08	0	-815.08	792.974	792.974
45	0.222313	149.151	74.7104	Greenstone/Granitics	2000	51	417.375	943.23	-855.759	0	-855.759	670.992	670.992
46	0.222313	122.032	74.7104	Greenstone/Granitics	2000	51	395.144	892.99	-896.437	0	-896.437	548.993	548.993
47	0.222313	94.914	74.7104	Greenstone/Granitics	2000	51	372.918	842.76	-937.114	0	-937.114	427.012	427.012
48	0.222313	67.7957	74.7104	Greenstone/Granitics	2000	51	350.691	792.53	-977.792	0	-977.792	305.029	305.029
49	0.222313	40.6774	74.7104	Greenstone/Granitics	2000	51	328.46	742.29	-1018.47	0	-1018.47	183.031	183.031
50	0.222313	13.5591	74.7104	Greenstone/Granitics	2000	51	306.233	692.06	-1059.15	0	-1059.15	61.0493	61.0493

Interslice Data

- **Global Minimum Query (bishop simplified) - Safety Factor: 2.25991**

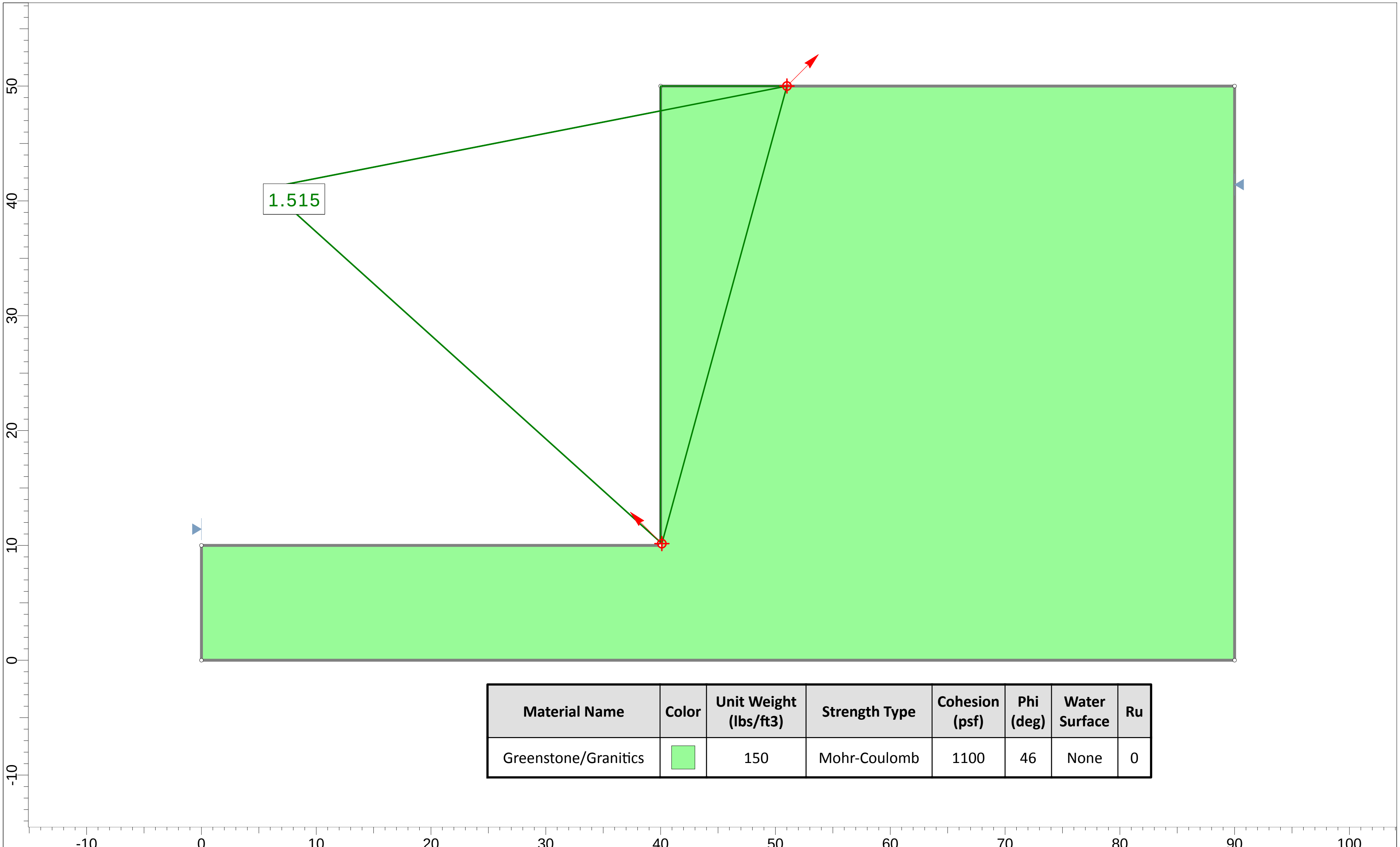
Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	40	10.259	0	0	0
2	40.1067	10.1524	2586.9	0	0
3	40.329	10.9656	2165.64	0	0
4	40.5513	11.7788	1772.51	0	0
5	40.7736	12.592	1407.53	0	0
6	40.9959	13.4052	1070.69	0	0
7	41.2182	14.2185	761.981	0	0
8	41.4405	15.0317	481.413	0	0
9	41.6629	15.8449	228.984	0	0
10	41.8852	16.6581	4.69415	0	0
11	42.1075	17.4713	-191.457	0	0
12	42.3298	18.2845	-359.47	0	0
13	42.5521	19.0978	-499.345	0	0
14	42.7744	19.911	-611.081	0	0
15	42.9967	20.7242	-694.678	0	0
16	43.219	21.5374	-750.136	0	0
17	43.4414	22.3506	-777.456	0	0
18	43.6637	23.1638	-776.638	0	0
19	43.886	23.9771	-747.68	0	0
20	44.1083	24.7903	-690.584	0	0
21	44.3306	25.6035	-605.35	0	0
22	44.5529	26.4167	-491.977	0	0
23	44.7752	27.2299	-350.465	0	0
24	44.9976	28.0431	-180.815	0	0
25	45.2199	28.8564	16.9742	0	0
26	45.4422	29.6696	242.902	0	0
27	45.6645	30.4828	496.968	0	0
28	45.8868	31.296	779.173	0	0
29	46.1091	32.1092	1089.52	0	0
30	46.3314	32.9224	1428	0	0
31	46.5537	33.7357	1794.62	0	0
32	46.7761	34.5489	2189.38	0	0
33	46.9984	35.3621	2612.28	0	0
34	47.2207	36.1753	3063.31	0	0
35	47.443	36.9885	3542.49	0	0
36	47.6653	37.8017	4049.8	0	0
37	47.8876	38.615	4585.25	0	0
38	48.1099	39.4282	5148.84	0	0
39	48.3322	40.2414	5740.57	0	0
40	48.5546	41.0546	6360.44	0	0
41	48.7769	41.8678	7008.45	0	0
42	48.9992	42.681	7684.59	0	0
43	49.2215	43.4943	8388.88	0	0
44	49.4438	44.3075	9121.3	0	0
45	49.6661	45.1207	9881.86	0	0
46	49.8884	45.9339	10670.6	0	0
47	50.1107	46.7471	11487.4	0	0
48	50.3331	47.5603	12332.4	0	0
49	50.5554	48.3736	13205.5	0	0
50	50.7777	49.1868	14106.7	0	0
51	51	50	0	0	0

Entity Information

Group: Group 1

Shared Entities

Type	Coordinates	
	X	Y
External Boundary	0	0
	90	0
	90	50
	40	50
	40	10
	0	10



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Greenstone/Granitics		150	Mohr-Coulomb	1100	46	None	0

Bajada Geosciences, Inc.

Project	Crystal Creek Quarry Expansion		
Analysis Description	Planar Failure - Discontinuity at 75 degree - Backcalculate Strength		
Drawn By J.Bianchin	*Scale* 1:139	*Company*	Bajada Geosciences, Inc.
Date	5-16-19	*File Name*	75PlanarBackCalculate.slmd

SLIDEINTERPRET 8.023

Slide Analysis Information

75PlanarBackCalculate

Project Summary

File Name:	75PlanarBackCalculate.slmd
Slide Modeler Version:	8.023
Compute Time:	00h:00m:00.312s
Project Title:	Crystal Creek Quarry Expansion
Analysis:	Planar Failure - Discontinuity at 75 degree - Backcalculate Strength
Author:	J.Bianchin
Company:	Bajada Geosciences, Inc.
Date Created:	5-16-19

General Settings

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

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	Janbu simplified
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

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

Random Numbers

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

Surface Options

Surface Type:	Non-Circular Block Search
Number of Surfaces:	5000
Multiple Groups:	Disabled
Pseudo-Random Surfaces:	Enabled
Convex Surfaces Only:	Disabled
Left Projection Angle (Start Angle) [°]:	135
Left Projection Angle (End Angle) [°]:	135
Right Projection Angle (Start Angle) [°]:	45
Right Projection Angle (End Angle) [°]:	45
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Property	Greenstone/Granitics
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	150
Cohesion [psf]	1100
Friction Angle [°]	46
Water Surface	None
Ru Value	0

Global Minimums

Method: bishop simplified

FS	1.514740
Axis Location:	5.759, 41.130
Left Slip Surface Endpoint:	40.000, 10.259
Right Slip Surface Endpoint:	51.000, 50.000
Left Slope Intercept:	40.000 50.000
Right Slope Intercept:	51.000 50.000
Resisting Moment:	2.05036e+06 lb-ft
Driving Moment:	1.35361e+06 lb-ft
Total Slice Area:	221.281 ft2
Surface Horizontal Width:	11 ft
Surface Average Height:	20.1165 ft

Method: janbu simplified

Resisting Horizontal Force:	-0 lb
Driving Horizontal Force:	0 lb
Total Slice Area:	0 ft2
Surface Horizontal Width:	0 ft
Surface Average Height:	0 ft

Method: spencer

Resisting Moment:	-0 lb-ft
Driving Moment:	0 lb-ft
Resisting Horizontal Force:	-0 lb
Driving Horizontal Force:	0 lb
Total Slice Area:	0 ft2
Surface Horizontal Width:	0 ft
Surface Average Height:	0 ft

Global Minimum Coordinates

Method: bishop simplified

X	Y
40	10.259
40.1067	10.1524
51	50

Valid/Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces:	5000
Number of Invalid Surfaces:	0

Method: janbu simplified

Number of Valid Surfaces:	0
Number of Invalid Surfaces:	5000

Error Codes:

Error Code -111 reported for 5000 surfaces

Method: spencer

Number of Valid Surfaces:	0
Number of Invalid Surfaces:	5000

Error Codes:

Error Code -111 reported for 5000 surfaces

Error Codes

The following errors were encountered during the computation:

-111 = safety factor equation did not converge

Slice Data

- **Global Minimum Query (bishop simplified) - Safety Factor: 1.51474**

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.106667	636.708	-45	Greenstone/Granitics	1100	46	15246.1	23093.9	21239.3	0	21239.3	5993.16	5993.16
2	0.222313	1315.24	74.7104	Greenstone/Granitics	1100	46	1361.24	2061.92	928.919	0	928.919	5908.31	5908.31
3	0.222313	1288.12	74.7104	Greenstone/Granitics	1100	46	1337.44	2025.88	894.113	0	894.113	5786.46	5786.46
4	0.222313	1261	74.7104	Greenstone/Granitics	1100	46	1313.65	1989.84	859.308	0	859.308	5664.62	5664.62
5	0.222313	1233.88	74.7104	Greenstone/Granitics	1100	46	1289.86	1953.8	824.502	0	824.502	5542.77	5542.77
6	0.222313	1206.76	74.7104	Greenstone/Granitics	1100	46	1266.06	1917.75	789.695	0	789.695	5420.93	5420.93
7	0.222313	1179.65	74.7104	Greenstone/Granitics	1100	46	1242.27	1881.71	754.89	0	754.89	5299.08	5299.08
8	0.222313	1152.53	74.7104	Greenstone/Granitics	1100	46	1218.47	1845.67	720.084	0	720.084	5177.24	5177.24
9	0.222313	1125.41	74.7104	Greenstone/Granitics	1100	46	1194.68	1809.63	685.279	0	685.279	5055.39	5055.39
10	0.222313	1098.29	74.7104	Greenstone/Granitics	1100	46	1170.88	1773.58	650.474	0	650.474	4933.54	4933.54
11	0.222313	1071.17	74.7104	Greenstone/Granitics	1100	46	1147.09	1737.54	615.667	0	615.667	4811.7	4811.7
12	0.222313	1044.05	74.7104	Greenstone/Granitics	1100	46	1123.3	1701.5	580.861	0	580.861	4689.85	4689.85
13	0.222313	1016.94	74.7104	Greenstone/Granitics	1100	46	1099.5	1665.46	546.056	0	546.056	4568.01	4568.01
14	0.222313	989.818	74.7104	Greenstone/Granitics	1100	46	1075.71	1629.41	511.25	0	511.25	4446.16	4446.16
15	0.222313	962.699	74.7104	Greenstone/Granitics	1100	46	1051.91	1593.37	476.444	0	476.444	4324.32	4324.32
16	0.222313	935.581	74.7104	Greenstone/Granitics	1100	46	1028.12	1557.33	441.638	0	441.638	4202.47	4202.47
17	0.222313	908.463	74.7104	Greenstone/Granitics	1100	46	1004.32	1521.29	406.833	0	406.833	4080.63	4080.63
18	0.222313	881.344	74.7104	Greenstone/Granitics	1100	46	980.528	1485.24	372.027	0	372.027	3958.78	3958.78
19	0.222313	854.226	74.7104	Greenstone/Granitics	1100	46	956.734	1449.2	337.222	0	337.222	3836.94	3836.94
20	0.222313	827.108	74.7104	Greenstone/Granitics	1100	46	932.939	1413.16	302.415	0	302.415	3715.09	3715.09
21	0.222313	799.99	74.7104	Greenstone/Granitics	1100	46	909.145	1377.12	267.61	0	267.61	3593.25	3593.25
22	0.222313	772.871	74.7104	Greenstone/Granitics	1100	46	885.351	1341.08	232.804	0	232.804	3471.4	3471.4
23	0.222313	745.753	74.7104	Greenstone/Granitics	1100	46	861.556	1305.03	197.999	0	197.999	3349.55	3349.55
24	0.222313	718.635	74.7104	Greenstone/Granitics	1100	46	837.762	1268.99	163.193	0	163.193	3227.71	3227.71
25	0.222313	691.516	74.7104	Greenstone/Granitics	1100	46	813.967	1232.95	128.386	0	128.386	3105.86	3105.86
26	0.222313	664.398	74.7104	Greenstone/Granitics	1100	46	790.173	1196.91	93.5811	0	93.5811	2984.02	2984.02
27	0.222313	637.28	74.7104	Greenstone/Granitics	1100	46	766.378	1160.86	58.7754	0	58.7754	2862.17	2862.17
28	0.222313	610.161	74.7104	Greenstone/Granitics	1100	46	742.584	1124.82	23.9696	0	23.9696	2740.33	2740.33
29	0.222313	583.043	74.7104	Greenstone/Granitics	1100	46	718.789	1088.78	-10.8361	0	-10.8361	2618.48	2618.48
30	0.222313	555.925	74.7104	Greenstone/Granitics	1100	46	694.995	1052.74	-45.6419	0	-45.6419	2496.64	2496.64
31	0.222313	528.807	74.7104	Greenstone/Granitics	1100	46	671.2	1016.69	-80.4476	0	-80.4476	2374.79	2374.79
32	0.222313	501.688	74.7104	Greenstone/Granitics	1100	46	647.406	980.652	-115.253	0	-115.253	2252.95	2252.95
33	0.222313	474.57	74.7104	Greenstone/Granitics	1100	46	623.611	944.609	-150.059	0	-150.059	2131.1	2131.1
34	0.222313	447.452	74.7104	Greenstone/Granitics	1100	46	599.817	908.567	-184.865	0	-184.865	2009.25	2009.25
35	0.222313	420.333	74.7104	Greenstone/Granitics	1100	46	576.022	872.524	-219.671	0	-219.671	1887.41	1887.41
36	0.222313	393.215	74.7104	Greenstone/Granitics	1100	46	552.228	836.482	-254.476	0	-254.476	1765.56	1765.56
37	0.222313	366.097	74.7104	Greenstone/Granitics	1100	46	528.434	800.44	-289.282	0	-289.282	1643.72	1643.72
38	0.222313	338.979	74.7104	Greenstone/Granitics	1100	46	504.639	764.397	-324.087	0	-324.087	1521.87	1521.87
39	0.222313	311.86	74.7104	Greenstone/Granitics	1100	46	480.845	728.355	-358.894	0	-358.894	1400.03	1400.03
40	0.222313	284.742	74.7104	Greenstone/Granitics	1100	46	457.05	692.312	-393.7	0	-393.7	1278.18	1278.18
41	0.222313	257.624	74.7104	Greenstone/Granitics	1100	46	433.256	656.27	-428.505	0	-428.505	1156.34	1156.34
42	0.222313	230.505	74.7104	Greenstone/Granitics	1100	46	409.462	620.228	-463.311	0	-463.311	1034.49	1034.49
43	0.222313	203.387	74.7104	Greenstone/Granitics	1100	46	385.667	584.185	-498.116	0	-498.116	912.646	912.646
44	0.222313	176.269	74.7104	Greenstone/Granitics	1100	46	361.873	548.143	-532.923	0	-532.923	790.801	790.801
45	0.222313	149.151	74.7104	Greenstone/Granitics	1100	46	338.078	512.1	-567.728	0	-567.728	668.954	668.954
46	0.222313	122.032	74.7104	Greenstone/Granitics	1100	46	314.284	476.058	-602.534	0	-602.534	547.11	547.11
47	0.222313	94.914	74.7104	Greenstone/Granitics	1100	46	290.489	440.016	-637.339	0	-637.339	425.266	425.266
48	0.222313	67.7957	74.7104	Greenstone/Granitics	1100	46	266.695	403.973	-672.145	0	-672.145	303.419	303.419
49	0.222313	40.6774	74.7104	Greenstone/Granitics	1100	46	242.9	367.931	-706.951	0	-706.951	181.574	181.574
50	0.222313	13.5591	74.7104	Greenstone/Granitics	1100	46	219.106	331.888	-741.757	0	-741.757	59.7275	59.7275

Interslice Data

- **Global Minimum Query (bishop simplified) - Safety Factor: 1.51474**

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	40	10.259	0	0	0
2	40.1067	10.1524	3894.34	0	0
3	40.329	10.9656	3442.02	0	0
4	40.5513	11.7788	3012.72	0	0
5	40.7736	12.592	2606.41	0	0
6	40.9959	13.4052	2223.12	0	0
7	41.2182	14.2185	1862.83	0	0
8	41.4405	15.0317	1525.55	0	0
9	41.6629	15.8449	1211.27	0	0
10	41.8852	16.6581	920.003	0	0
11	42.1075	17.4713	651.74	0	0
12	42.3298	18.2845	406.484	0	0
13	42.5521	19.0978	184.234	0	0
14	42.7744	19.911	-15.0095	0	0
15	42.9967	20.7242	-191.246	0	0
16	43.219	21.5374	-344.477	0	0
17	43.4414	22.3506	-474.701	0	0
18	43.6637	23.1638	-581.919	0	0
19	43.886	23.9771	-666.13	0	0
20	44.1083	24.7903	-727.334	0	0
21	44.3306	25.6035	-765.533	0	0
22	44.5529	26.4167	-780.724	0	0
23	44.7752	27.2299	-772.91	0	0
24	44.9976	28.0431	-742.089	0	0
25	45.2199	28.8564	-688.261	0	0
26	45.4422	29.6696	-611.427	0	0
27	45.6645	30.4828	-511.586	0	0
28	45.8868	31.296	-388.739	0	0
29	46.1091	32.1092	-242.886	0	0
30	46.3314	32.9224	-74.0257	0	0
31	46.5537	33.7357	117.841	0	0
32	46.7761	34.5489	332.714	0	0
33	46.9984	35.3621	570.593	0	0
34	47.2207	36.1753	831.479	0	0
35	47.443	36.9885	1115.37	0	0
36	47.6653	37.8017	1422.27	0	0
37	47.8876	38.615	1752.18	0	0
38	48.1099	39.4282	2105.09	0	0
39	48.3322	40.2414	2481.01	0	0
40	48.5546	41.0546	2879.93	0	0
41	48.7769	41.8678	3301.86	0	0
42	48.9992	42.681	3746.8	0	0
43	49.2215	43.4943	4214.74	0	0
44	49.4438	44.3075	4705.69	0	0
45	49.6661	45.1207	5219.65	0	0
46	49.8884	45.9339	5756.61	0	0
47	50.1107	46.7471	6316.58	0	0
48	50.3331	47.5603	6899.56	0	0
49	50.5554	48.3736	7505.54	0	0
50	50.7777	49.1868	8134.53	0	0
51	51	50	0	0	0

Entity Information

Group: Group 1

Shared Entities

Type	Coordinates	
	X	Y
External Boundary	0	0
	90	0
	90	50
	40	50
	40	10
	0	10