# Appendix G

Residential Site Preliminary Geotechnical Investigation



April 26, 2023 J.N.: 3138.00

Mr. Michael Johnson Overton Moore Properties 19700 South Vermont Avenue Suite 101 Torrance, CA 90502

# Subject: Preliminary Geotechnical Investigation, Proposed Residential Development, North of Sierra Madre Avenue and Vernon Avenue (Azusa Greens Country Club), Azusa, California

Dear Mr. Johnson,

Pursuant to your request, *Albus & Associates, Inc.* is pleased to present to you our preliminary geotechnical investigation report for the proposed development at the subject site. This report presents the results of our aerial photo and literature review, subsurface exploration, laboratory testing, and engineering analyses. Conclusions relevant to the feasibility of the proposed site development and recommendations for design are also presented herein based on the findings of our work.

We appreciate this opportunity to be of service to you. If you have any questions regarding the contents of this report, please do not hesitate to call.

Sincerely,

ALBUS & ASSOCIATES, INC.

Principal Engineer

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# ALBUS & ASSOCIATES, INC.

# **1.0 INTRODUCTION**

#### 2.1 PURPOSE AND SCOPE

The purposes of our preliminary geotechnical investigation were to evaluate geotechnical conditions within the project area and to provide conclusions and recommendations relevant to the design and construction of the proposed development at the subject site. The scope of this investigation included the following:

- Review of the historical aerial photographs,
- Review of previous geotechnical reports for the area as well as published geologic and seismic data for the surrounding area,
- Exploratory drilling and soil sampling,
- Laboratory testing of selected soil samples,
- Engineering analyses of data obtained from our review, exploration, and laboratory testing,
- Evaluation of site seismicity, liquefaction potential, and settlement potential,
- Preparation of this report.

#### 2.2 SITE LOCATION AND DESCRIPTION

The site is located at 919 Sierra Madre Avenue within the city of Azusa, California. The property is bordered by Sierra Madre Avenue to the South, residential units to the south, west, and east, as well as a water basin to the North. The location of the site and its relationship to the surrounding areas is shown on Figure 1, Site Location Map.

The site consists of an irregularly-shaped property occupying approximately 21 acres of land. The site is relatively flat with elevations ranging from 650 to 665 feet above mean sea level (based on Google Earth). The topography generally descends to the south. A water basin is located directly north of the property. The slope of the basin descends about 40 feet in height based on topographic data we obtained for the site. The gradient of the slope is about 2.75:1 (H:V) but includes some terrace benches that result in an overall gradient of about 3.75:1 (H:V). Water in the basin appears to pond to typical depths of about 10 to 15 feet.

The site is currently a portion of a golf course and appears to not have been used for some time. The perimeters of the site are primarily bounded by chain-link fencing. Some block walls are present along portions of the site adjacent residential units.

Vegetation within the site consists of large trees dividing the different fairways. The vast majority of the site is covered by grass with additional limited vegetation. A few structures are present onsite with a club house and associated parking lot located at the south end of the site.

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# FIGURE 1-SITE LOCATION MAP

Proposed Residential Development 919 Sierra Madre Avenue Azusa, California

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#### 2.3 PROPOSED DEVELOPMENT

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Based on our understanding and review of the site plan by Architecture Design Relationships, site development is anticipated to consist of (38) one-story, single-family residences and (2) three-story multi-family residences. Associated interior driveways, decorative hardscape, parking areas, common areas and underground utilities are also anticipated.

We anticipate demolition of existing site improvements and some minor cut and filling of the site will be required to achieve future surface configuration and we expect future foundation loads will be light. All structures are anticipated to be at grade.

# 2.0 INVESTIGATION

# 2.1 RESEARCH

We have reviewed the referenced geologic publications and maps (see references). Data from these sources were utilized to develop some of the findings and conclusions presented herein.

We have also reviewed available historical aerial photographs. The aerial photos indicate that grading for the golf course began around 1964 and continued into 1965. By 1972 the golf course has already been completed and the residential properties surrounding the golf course are under construction. Sometime between 1972-1977, the water basin to the north was constructed. The site and surrounding areas appear to have remained relatively unchanged since the 1970s.

# **2.2 PREVIOUS GEOTECHNICAL REPORTS**

A geotechnical investigation was conducted by Geotechnical Professionals, Inc (GPI, 2008) for the existing Target store at the southwest corner of north Azusa Avenue and East 9<sup>th</sup> street nearly 1 mile southeast of the subject site. The investigation by Geotechnical Professionals Inc. included exploration with four hollow-stem auger borings and six CPT soundings. Refusal was met at a depth of 9 feet or shallower in all 10 exploration points. GPI also performed a microtremor refraction survey. During the microtremor refraction survey, an array of geophones was placed across the site and connected to a seismograph to measure propagating Rayleigh waves from both active and passive sources. The survey indicated a shear wave velocity of 700 ft/sec and increasing with depth to a peak value of 2,200 ft/sec occurring at a depth of 20 to 30 feet. Thereafter, the velocity diminished to a value of 1,650 ft/sec. indicating the occurrence of groundwater below a depth of 30 feet. The results of the microtremor refraction survey from Geotechnical Professionals, Inc. can be found in Appendix C.

Another nearby investigation was performed by Diaz Yorman (DYA 2014) for a site located at northeast corner of E. Foothill Blvd and N. Alameda Ave. also located about 1 mile southeast of the subject site. Their investigation consisted of 7 hollow-stem auger borings and one Becker hammer boring. The hollow-stem auger borings were advanced to a maximum depth of 20 feet and resulted in blow counts exceeding 50 blows at depths of 10 to 20 feet. The Becker hammer boring was advanced to a depth of 50 feet and demonstrated Becker blow counts of 20 to over 100 for the depths of 10 to 50 feet. The equivalent SPT blows range from 36 to over 180. The log of the Becker hammer boring is provided in Appendix C.

The locations of these prior investigations relative to the subject site are depicted on Figure 2.

# **2.3 SUBSURFACE EXPLORATION**

Subsurface exploration for this investigation was conducted on February 28 and March 9, 2023, and consisted of drilling six (6) soil borings and excavating ten (10) test pits to depths ranging from approximately 5 to 8 feet below the existing ground surface (bgs). The borings were drilled using a truck-mounted, high-torque, continuous flight, hollow-stem-auger drill rig and the test pits were excavated utilizing a backhoe with a 4-foot-wide bucket attachment. A representative of Albus & Associates, Inc. logged the exploratory excavations.



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# FIGURE 2- PREVIOUS EXPLORATION LOCATION MAP

Visual and tactile identifications were made of the materials encountered and their descriptions are presented in the Exploration Logs in Appendix A. The approximate locations of the exploratory excavations completed by this firm are shown on the enclosed Geotechnical Map, Plate 1.

Bulk samples were obtained at selected depths within the exploratory borings and test pits for subsequent laboratory testing. Samples were placed in plastic bags and transported to our laboratory for analyses. As part of our sampling, two test pits were selected for large-scale gradation testing (TP-3 and TP-8). A tarp was placed on the ground adjacent to each of these test pits and a large sample of material was removed and placed on the tarps. The total weights of these samples were 1,848 lbs. and 4,317 lbs. for TP-3 and TP-8, respectively. The testing of each sample is discussed further in Section 2.4. The exploratory excavations were backfilled with cuttings upon completion of sampling.

Upon completion of drilling, well materials were installed within each boring for subsequent percolation testing. Details and results of percolation tests are reported under a separate cover.

# 2.4 LABORATORY TESTING

Selected samples obtained from our subsurface exploration were tested in our soil laboratory. Tests consisted of in-situ moisture content and dry density, and grain-size distribution analysis. A description of laboratory test criteria and test results are presented in Appendix B.

As discussed in Section 2.3, two large samples of materials were obtained from TP-3 and TP-8. These samples were tested for gradation using a combination of field measurements and laboratory testing. Particles that were larger than 3 inches in the median dimension were individually weighed and measured for dimension in three principal axes. This information was recorded for further processing. The remaining portions of these samples were bagged and returned to our laboratory.

# **3.0 SUBSURFACE CONDITIONS**

# 3.1 SOIL CONDITIONS

Descriptions of the earth materials encountered during our investigation are summarized below and are presented in detail on the Exploration Logs presented in Appendix A.

Review of the Dibblee Map for the Mt. Wilson and Azusa Quadrangles (Dibble 1998) indicates the site is south of the San Gabriel Mountains and is underlain by quaternary alluvial fan deposits (Qg). The materials are described by Dibble as consisting of gravel and sand of stream channels and alluvial fan outwash from major canyons. The site is located just easterly of the San Gabriel River where it flows out of the San Gabriel Mountains and falls within the overbank areas of the river.

Based on our site-specific investigation, a thin mantle of top soil is present throughout the golf course, but was observed to be generally only 0.5 feet in thickness. The topsoil generally consists of silty sand (SM) that is fine to medium grained and often contains roots and rootlets.

Underlying the topsoil or exposed at the surface in some areas are quaternary alluvial deposits (Qg). The alluvial soils were encountered to the maximum depth explored, i.e., 8 feet, but extend to more than 50 feet in depth. The materials were generally consistent with the description above by Dibblee (1998) although the site deposits tend to also contain abundant cobbles and some boulders up to about 3.5 feet in median diameter. The larger cobbles and boulders are typically oblong in shape with the maximum dimension reaching about 4 to 5 feet across. Gradationally the materials tend to become coarser grained with depth but boulders were encountered within 1.5 to 2 feet of the ground surface in some areas.

A more detailed description of the interpreted soil profile at each of the exploration locations, based upon the soil cuttings and soil samples, are presented in Appendix A. The stratigraphic descriptions in the logs represent the predominant materials encountered during investigation. Relatively thin, often discontinuous layers of different material may occur within the major divisions.

# **3.2 GROUNDWATER**

Groundwater was not encountered during this firm's subsurface exploration to a depth of 8 feet. The CDMG Special Report 021 suggests that historic high groundwater for the subject site is about 10-30 feet below the ground surface. Review of the California Department of Water Resources groundwater well data for well 4275A indicates groundwater has fluctuated between 20-60 feet below ground surface between 2011-2022.

Review of the Los Angeles County Public Works groundwater level data for the nearby wells 4285B and 4285H indicate that groundwater for the area has generally been below 30 feet from 1944 to 2009 with a few short-lived spikes to a depth of 10 feet. The locations of these three wells are depicted on Figure 2. The recorded depths to groundwater from these wells are plotted on Figure 3.

Depths as measured between Well 4285H and Well 4285B indicate the depth to ground water drops off sharply to the south indicating the influence of the infiltration ponds located north of the subject site.



# FIGURE 3 - Groundwater Well Location Map

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FIGURE 4 - Ground Water Data

# 3.3 FAULTING

Based on our review of the referenced publications and seismic data, no active faults are known to project through or immediately adjacent to the subject site and the site do not lie within an "Earthquake Fault Zone" as defined by the State of California in Earthquake Fault Zoning Act. Table 3.1 presents a summary of known seismically active faults within 10 miles of the sites based on the 2008 USGS National Seismic Hazard Maps for the 10 closest faults.

| TABL    | E 3.1     |
|---------|-----------|
| Summary | of Faults |

| Name                   | Dist.<br>(miles) | Slip Rate<br>(mm/yr.) | Preferred<br>Dip<br>(degrees) | Slip Sense  | Rupture<br>Top<br>(km) | Fault<br>Length<br>(km) |
|------------------------|------------------|-----------------------|-------------------------------|-------------|------------------------|-------------------------|
| Sierra Madre Connected | 0.39             | 2                     | 51                            | reverse     | 0                      | 76                      |
| Sierra Madre           | 0.39             | 2                     | 53                            | reverse     | 0                      | 57                      |
| Raymond                | 4.34             | 1.5                   | 79                            | strike slip | 0                      | 22                      |
| Clamshell-Sawpit       | 4.57             | 0.5                   | 50                            | reverse     | 0                      | 16                      |
| San Jose               | 7.28             | 0.5                   | 74                            | strike slip | 0                      | 20                      |

# 4.0 ANALYSES

# 4.1 SEISMICITY

2022 CBC requires seismic parameters in accordance with ASCE 7-16 and supplement 1, 2, and 3. Unless noted otherwise, all section numbers cited in the following refer to the sections in ASCE 7-16.

Per Section 20.3 the project site was designated as Site Class D. We used the OSHPD seismic hazard tool to obtain the basic mapped acceleration parameters, including short periods ( $S_S$ ) and 1-second period ( $S_1$ ) MCE<sub>R</sub> Spectral Response Accelerations.

Section 11.4.8 and supplement 3 require site-specific ground hazard analysis for structures on Site Class D with S<sub>1</sub> greater than or equal to 0.2. Based on the mapped values of Ss and S<sub>1</sub> the project site falls within this category, requiring site-specific hazard analysis in accordance with Section 21.2. However, "A ground motion hazard analysis is not required for structures where the value of the parameter S<sub>M1</sub> determined by Eq. (11.4-2) is increase by 50% for all applications of S<sub>M1</sub> in the Standard. The resulting value of the parameter S<sub>D1</sub> determined by Eq. (11.4-4) shall be used for all applications of S<sub>D1</sub> in this Standard." Assuming this exception is met for this project, a ground motion hazard analysis is required to determine the Design response spectra for the proposed structures at this site. Both mapped and site-specific seismic design parameters are provided in this report, as presented in Section 6.2. Details of a ground motion hazard analysis are explained below.

According to Section 21.2.3 (Supplement 1), the site-specific Risk Targeted Maximum Considered Earthquake (MCE<sub>R</sub>) spectral response acceleration at any period is the lesser of the probabilistic and the deterministic response accelerations, subject to the exception specified in the same section. The probabilistic response spectrum was developed using the computer program OpenSHA (Field et al., 2013), which implements Method 1 as described in Section 21.2.1.1. Fault Models 3.1 and 3.2 from the Third Uniform California Earthquake Rupture Forecast (UCERF3) were used as the earthquake rupture forecast models for the PSHA. In addition to known fault sources, background seismicity was also included in the PSHA. The ground motion Prediction Equations (GMPEs) selected for use in this analysis are those developed for the Pacific Earthquake Engineering Research Center (PEER) Next Generation Attenuation (NGA) West 2 project. Four GMPEs - Abrahamson et al. (2014), Boore et al. (2014), Campbell and Bozorgnia (2014), and Chiou and Youngs (2014) were used to perform the analysis.

In accordance with Section 21.2.2 (Supplement 1), the deterministic spectral response acceleration at each period was calculated as the 84th percentile, 5% damped response acceleration, using NGA-West2 GMPE Worksheet. For this, the information from at least three causative faults with the greatest contribution per deaggregation analysis were used and the larger acceleration spectrum among these was selected as the deterministic response spectrum. The deterministic spectrum was adjusted per requirements in Section 21.2.2 (Supplement 1) where applicable. Both probabilistic and deterministic spectra were subjected to the maximum direction scale factors specified in Section 21.2 to produce the maximum acceleration spectra.

Design response spectrum was developed by subjecting the site-specific  $MCE_R$  response spectrum to the provisions outlined in Section 21.3. This process included comparison with 80% code-based

design spectrum determined in accordance with Section 11.4.6. The short period and long period site coefficients (Fa and Fv, respectively) were determined per Section 21.3 in conjunction with Table 11.4-1. Site-specific design acceleration parameters (S<sub>MS</sub>, S<sub>M1</sub>, S<sub>DS</sub>, and S<sub>D1</sub>) were calculated according to Section 21.4.

Per Section 11.2 (definitions on Page 79 of ASCE7-16) for evaluation of liquefaction, lateral spreading, seismic settlements, and other soil-related issues, Maximum Considered Earthquake Geometric Mean (MCE<sub>G</sub>) peak ground acceleration PGA<sub>M</sub> shall be used. The site-specific PGA<sub>M</sub> is calculated per Section 21.5.3, as the lesser of the probabilistic PGA<sub>M</sub> (Section 21.5.1) and deterministic PGA<sub>M</sub> (Section 21.5.2), but no less than 80% site modified peak ground acceleration, PGA<sub>M</sub>, obtained from OSHPD seismic hazard tool. From our analyses, we obtain a PGA<sub>M</sub> of 0.787g.

# 4.2 LIQUEFACTION

Engineering research of soil liquefaction potential (Youd et al., 2001) indicates that generally three basic factors must exist concurrently in order for liquefaction to occur. These factors include:

- A source of ground shaking, such as an earthquake, capable of generating soil mass distortions.
- A relatively loose silty and/or sandy soil.
- A relative shallow groundwater table (within approximately 50 feet below ground surface) or completely saturated soil conditions that will allow positive pore pressure generation.

The site is located within a State-designated zone of potentially liquefiable soils. The liquefaction susceptibility of the onsite soils was evaluated by analyzing the potential concurrent occurrence of the above-mentioned three basic factors. The liquefaction evaluation for the site was completed under the guidance of Special Publication 117A: Guidelines for Evaluating and Mitigating Seismic Hazards in California (CDMG, 2008).

The site is located in an area subject to strong ground shaking and groundwater is commonly present at depths that are shallower than 50 feet. As discussed in Section 3.2, groundwater is generally below a depth of 20 to 30 feet within the site boundaries. For relatively short periods, groundwater can rise to within about 10 feet of the surface. The potential for the concurrent occurrence of strong ground shaking and groundwater shallower than 20 feet is very low.

The geologic conditions of the subject site are similar to those at the two sites investigated by GPI (2008) and DAY (2014). As such, data regarding the density of the underlying alluvial fan deposits can be used to assess the subject site. The shear wave measurements provided in the GPI report indicate a velocity of 1,200 ft/sec starting at a depth of only 6 feet. A velocity of 1,200 ft/sec suggests the material has a SPT blow count of about 50. Based on our observations in our borings and test pits at the subject site, similar velocities would be expected by a depth of 6 feet. According to the GPI data, the shear wave velocity continues to increase to 2,200 ft/sec until a depth of 30 feet when ground water is encountered. Because of the groundwater, velocity measurements below a depth of 30 feet do not reflect the properties of the soil deposit but can be reasonably assumed to remain near or above 2,200 ft/sec to a depth of 50 feet. Based on this data, soils at the subject site conservatively exhibit an SPT blow count greater than 50 at a depth of 10 feet and greater.

The Becker hammer data obtained by DYA indicates a Becker blow count of about 25 (45 blows equivalent SPT) or greater for nearly all materials located below a depth of 2 feet. The lowest recorded Becker blow count recorded was 15 (27 blows equivalent SPT) at a depth of 47 feet. Based on this data, soils at the subject site conservatively exhibit an SPT blow count greater than 50 at a depth of 10 feet and greater.

Based on Youd et al. (2001), soils with an SPT blow count of 30 and greater are very unlikely to be prone to liquefaction. Since this condition is in present below a depth of 10 feet and because historical groundwater has remained below 10 feet, the site is considered not prone to liquefaction.

# 4.3 SLOPE STABILITY

Engineering analyses were performed to evaluate the stability of the water basin slope that supports the northern side of the site. A typical profile of the slope was prepared using Google Earth. Groundwater was assumed to create a level phreatic surface at a depth of about 25 feet below the upper grade. The shear strength of the alluvial fan deposits was estimated from blow counts obtained from the nearby Becker hammer boring performed by DYA (2014). The equivalent SPT N<sub>60</sub> was estimated by applying a factor of 1.8 times the Becker hammer blow counts. From this, the alluvial fan deposits exhibited a SPT blow count generally greater than 50 which indicates the friction angle of the soils can conservatively be estimated as 45 degrees. For the pseudo-static analysis, the seismic coefficient, k<sub>eq</sub> of 0.23g was calculated based on the recommendations presented in the CGS Special Publication 117A (2008) and FHWA-NHI-11-032. Details of the derivation of K<sub>eq</sub> is provided in Appendix D. From our analyses, the estimated factors of safety for static and pseudostatic conditions are 2.55 and 1.45, respectively. Printouts of the analyses are provided in Appendix D.

# 5.0 CONCLUSIONS

# 5.1 FEASIBILITY OF PROPOSED DEVELOPMENT

From a geotechnical point of view, the proposed site development is considered feasible provided the recommendations presented in this report are incorporated into the design and construction of the project. Furthermore, it is also our opinion that the proposed development will not adversely impact the stability of adjoining properties. Key geotechnical issues that could have significant impacts on the proposed site development are discussed in the following sections of this report.

# 5.2 GEOLOGIC HAZARDS

# 5.2.1 Ground Rupture

No known active faults are known to project through the subject sites nor does the sites lie within the boundaries of an "Earthquake Fault Zone" as defined by the State of California in the Alquist-Priolo Earthquake Fault Zoning Act. The closest known active fault is the Sierra Madre fault located approximately 0.39 miles away. Therefore, potential for ground rupture due to an earthquake beneath the sites is considered low.

# 5.2.2 Ground Shaking

The site is situated in a seismically active area that has historically been affected by generally moderate to occasionally high levels of ground motion. The site lies in relatively close proximity to several seismically active faults; therefore, during the life of the proposed improvements, the property will probably experience similar moderate to occasionally high ground shaking from these fault zones, as well as some background shaking from other seismically active areas of the Southern California region. Design and construction in accordance with the current California Building Code (CBC) requirements is anticipated to address the issues related to potential ground shaking.

# 5.2.3 Landsliding

There are no known historical geologic hazards associated with landsliding at or in proximity to the site. The site is directly adjacent to a descending cut slope along the northern boundary. Based on the results of our analyses discussed in Section 4.3, the factors of safety against failure under static and pseudostatic conditions exceed 1.5 and 1.1, respectively and is therefore considered adequately stable without mitigation.

# 5.2.4 Liquefaction

As discussed in Section 4.2, the site is located within a State-designated zone of potentially liquefiable soils. However, as further detailed in Section 4.2, the soils underlying the site are very dense and as such, the potential for liquefaction at the subject site is very low. No mitigating measures are deemed necessary with regard to the effects of liquefaction.

# 5.3 STATIC SETTLEMENT

Provided site grading is performed in accordance with the recommendations provided herein and based on the anticipated relatively light foundation loads, total and differential static settlement is not anticipated to exceed 1 inch and ½-inch over 30 feet, respectively, for the proposed commercial structure. The estimated magnitudes of static settlements are considered within tolerable limits for the proposed structure.

# 5.4 EXCAVATION AND MATERIAL CHARACTERISTICS

Based on anticipated grading to be completed at the site, oversized materials (>8 inches in median dimension) are expected to be generated. Our exploration indicates that material with particles having a maximum dimension of about 4 to 5 feet are present. We estimate that particles greater than 8 inches in median dimension range from about 8% to 25% by weight of site materials within the upper 10 feet depending on location within the site. We estimate the upper 10 feet across the site on average will contain about 14% by weight greater than 8 inches in median dimension. Each cubic yard of soil excavated from the upper 10 feet is estimated to require on average about 0.22 cubic yards of space to dispose of the over-sized particles contained in that cubic yard of excavation. As an example, 10,000 cubic yards of excavation will need about 2,200 cubic yards of space to bury the oversized material created by that excavation. The burial would include the over-sized material as well as finer material to fill in the voids. An estimated breakdown of typical site materials is summarized in Table 5.1.

| Median Dimension    | Typical Portion of Material<br>(by weight) | Description       |  |  |  |
|---------------------|--|-------------------|--|--|--|
| No. 200 to 3 in.    | 55% to 75%                                 | Sands and Gravels |  |  |  |
| 3 in. to 12 in.     | 20% to 30%                                 | Cobbles           |  |  |  |
| 12 in. to 24 in.    | 3% to 7%                                   | Fine Boulders     |  |  |  |
| 24 in to 36 in.     | 2% to 6%                                   | Medium Boulders   |  |  |  |
| Greater than 36 in. | 0% to 2%                                   | Large Boulders    |  |  |  |

# TABLE 5.1Typical Gradation of Site Materials

Rocks larger than 8 inches in median dimension will require disposal offsite or special handling for onsite disposal. Specific recommendations regarding placement of over-sized rock are provided in Section 6.1.6. We also anticipate that particles over 8 inches in median dimension will result in difficulty and increased costs for trenching of foundations and utilities. Consideration can be given to selectively removing materials over about 8 inches in size from areas of the site that will require trenching.

Depending on the time of year, most of site materials are likely to be below optimum moisture content and will require the addition of water to achieve proper compaction.

Off-site improvements exist near the property lines. Excavations greater than about 2 feet will be subject to caving and raveling. Therefore, excavations of greater depth will require special considerations. Specific recommendations regarding temporary excavations are provided in Section 6.1.7.

# 5.5 SOIL EXPANSION

Based on the USCS visual manual classification, the near-surface soils are generally anticipated to possess a **Very Low** expansion potential. Additional testing for soil expansion will be required prior to the construction of foundations and other concrete work to confirm these conditions.

# 6.0 **RECOMMENDATIONS**

# 6.1 EARTHWORK

# 6.1.1 General Earthwork and Grading Specifications

All earthwork and grading should be performed in accordance with applicable requirements of Cal/OSHA, applicable specifications of the Grading Codes of the City of Azusa, California in addition to the recommendations presented herein.

# 6.1.2 Pre-Grade Meeting and Geotechnical Observation

Prior to commencement of grading, we recommend a meeting be held between the developer, City Inspector, grading contractor, civil engineer, and geotechnical consultant to discuss the proposed grading and construction logistics. We also recommend a geotechnical consultant be retained to provide soil engineering and engineering geologic services during site grading and foundation construction. This is to observe compliance with the design specifications and recommendations and to allow for design changes in the event that subsurface conditions differ from those anticipated. If conditions are encountered that appear to be different than those indicated in this report, the project geotechnical consultant should be notified immediately. Design and construction revisions may be required.

# 6.1.3 Site Clearing

Areas to be graded should be cleared of vegetation, existing asphalt, underground improvements to be abandoned and deleterious materials. Asphaltic concrete and Portland Cement concrete can be incorporated into the fill as recommended in Sections 6.1.5 and 6.1.6.

Existing underground utility lines within the project area that will be protected in place and that fall within a 1 to 1 (H:V) plane projected down from the edges of footings may be subject to surcharge loads if they are within about 3 feet horizontally of footings. Under such conditions, this office should be made aware of these conditions for evaluation of potential surcharging. Supplemental recommendations may be required to protect such improvements in place.

The project geotechnical consultant should be notified at the appropriate times to provide observation services during clearing operations to verify compliance with the above recommendations. Voids created by clearing and excavation should be left open for observation by the geotechnical consultant. Should any unusual soil conditions or subsurface structures be encountered during site clearing or grading that are not described or anticipated herein, these conditions should be brought to the immediate attention of the project geotechnical consultant for corrective recommendations as needed.

Temporary construction equipment (office trailers, power poles, etc.) should be positioned to allow adequate room for clearing and recommended ground preparation to be performed for proposed structures, pavements, and hardscapes.

# 6.1.4 Ground Preparation

In general, any existing artificial fill and topsoil is considered unsuitable for support of the proposed development. Artificial fill and topsoil is estimated to be typically 1 feet thick but was encountered up to 2.5 feet in depth. These materials likely are locally deeper particularly where berms are present. These materials should be removed from within the limits of the proposed building, pavement, screening/retaining walls, and any other "structural" areas. Where removals are limited due to property line constraints, special techniques, such as shoring may be required to prevent sloughing of the alluvial materials.

The removals should extend a minimum horizontal distance of 5 feet beyond the limits of the foundations of the new building or a 1:1 (H:V) projection laterally down and away from the bottom of the footings, whichever is greater. The actual depth of removal should be determined by the geotechnical consultant during grading. All removal excavations should be evaluated by the geotechnical consultant during grading to confirm the exposed conditions are as anticipated and to provide supplemental recommendations if required.

The presence of over-sized materials will likely make excavation during utility work and foundation trenching difficult and likely result in localized refusal for backhoes. To mitigate this potential issue, consideration should be given to over-excavating building pads and roadways to a depth that extends below the proposed utilities. The fill then placed in the over-excavated areas can be limited to contain only material with a median dimension of 8 inches or less. The over-sized material screened out of the cut materials can then be place in accordance with Section 6.1.6.

The grading contractor should take appropriate measures when excavating adjacent any existing improvements to remain in-place to avoid disturbing or compromising support of existing structures.

Following removals, the exposed grade should first be brought to at least 110 percent of the optimum moisture content, and then compacted to at least 90 percent of the laboratory standard (ASTM D 1557). Preparation of bottoms may require the selective removal of over-sized rock if the surface varies in elevation by more than about 8 inches over a horizontal distance of about 5 feet. Where this condition occurs, individual oversized particles should be removed from the surface and handled as over-sized material as further recommended in Section 6.1.6.

# 6.1.5 Fill Placement

Materials excavated from the site may be reused as fill provided they are free of deleterious materials and particles greater than 8 inches in maximum dimension (oversized materials). The fills *should contain sufficient finer granular materials* to eliminate nesting of rock fragments as recommended by the geotechnical consultant during grading. Asphaltic and concrete debris generated during site demolition or encountered within the existing fill can be incorporated within new fill soils during earthwork operations provided they are reduced to no more than 8 inches in maximum dimension. Such materials should be mixed thoroughly with fill soils to prevent nesting. All fill should be placed in lifts no greater than 8 inches in loose thickness, moisture conditioned to at least the optimum moisture content, then compacted in place to at least 90 percent of the laboratory standard. The laboratory standard for maximum dry density and optimum moisture content for each change in soil type should be determined in accordance with ASTM D 1557. Each lift should be treated in a similar manner. Subsequent lifts should not be placed until the project geotechnical consultant has approved the preceding lift.

Material having particles that are greater than 8 inches in diameter should be handled as discussed in Section 6.1.6.

# 6.1.6 Over-sized Materials

Particles greater than 8 inches in median dimension but less than 3 feet in median dimension may be placed within engineered fills as rock blankets at least 10 feet below proposed grades as well as at least 18 inches below deepest utilities within streets, as presented in Appendix E. Such placement will require the use of material less than 8 inches in median dimension to be blended into the over-sized materials to limit nesting. The process will primarily require the placement of oversized particles in a blanket or windrow followed by placing a lift of finer fill over the top of the rock blanket or windrow. The area should then be flooded to wash the finer material in and around the oversized rocks followed by track walking with a dozer. Afterwards, a new lift of finer material should be placed, washed, and track walked. The process should be repeated until the over-sized rock blanket or windrow will not

accept any additional finer material and the area can be finished to a relatively smooth grade. Thereafter, the process may be repeated by placement of a new rock blanket or windrow.

Particles greater than 3 feet in median dimension should be reduced in size to less than 3 feet in diameter or be removed from the site.

Due to the significant amount of over-sized particles (estimated to be about 14% by weight of all materials in the upper 10 feet), the grading contactor should be prepared to use "skeleton" buckets on loaders to shift out over-sized particles from cut and fill areas and rock trucks for hauling over-sized materials across the site for special burial. We recommend that specific areas of the site be selected in advance for use in disposal of over-sized particles. This will likey require mining below finish grades to form "disposal pits" that can be primarily filled with over-sized particles. The space required for disposal can be estimated using the information discuss in Section 5.4.

# 6.1.7 Temporary Excavations

Temporary excavations may be cut vertical up to a height of 3 feet. Temporary cuts that are greater than 3 feet in height should be laid back at a maximum gradient of 1.5:1 (H:V) with no portions that are vertical. Excavations should not be left open for prolonged periods of time. Where insufficient room is present for an open temporary cut, shoring should be used.

The project geotechnical consultant should observe all temporary cuts to confirm anticipated conditions and to provide alternate recommendations if conditions dictate. All excavations should conform to the requirements of CAL OSHA.

# 6.1.8 Import Materials

If import materials are required to achieve the proposed finish grades, the proposed import soils should have an Expansion Index (EI, ASTM D 4829) less than 21, possess negligible soluble sulfate concentrations, and not contain deleterious materials. Import sources should be indicated to the geotechnical consultant prior to hauling the materials to the site so that appropriate testing and evaluation of the fill materials can be performed in advance.

# 6.2 SEISMIC DESIGN PARAMETERS

# 6.2.1 Mapped Seismic Design Parameters

For the design of the project in accordance with Chapter 16 of the 2022 CBC, the mapped seismic parameters may be taken as presented in the Table 6.1 below.

According to Section 11.4.8 in ASCE 7-16 and supplement 3, "a ground motion hazard analysis shall be performed in accordance with Section 21.2 for the following structures on Site Class D site with  $S_1$  greater than or equal to 0.2." However, "A ground motion hazard analysis is not required for structures where the value of the parameter  $S_{M1}$  determined by Eq. (11.4-2) is increase by 50% for all applications of  $S_{M1}$  in the Standard. The resulting value of the parameter  $S_{D1}$  determined by Eq. (11.4-4) shall be used for all applications of  $S_{D1}$  in this Standard." Should this exception not be met, the site-specific seismic design parameters provided in the next section should be used.

| Parameter   | Value |
|---|-------|
| Site Class  | D     |
| Mapped MCE <sub>R</sub> Spectral Response Acceleration, short periods, Ss                     | 1.714 |
| Mapped MCE <sub>R</sub> Spectral Response Acceleration, at 1-second period, S <sub>1</sub>    | 0.653 |
| Site Coefficient, F <sub>a</sub>  | 1.0   |
| Site Coefficient, Fv  | 1.7   |
| Adjusted MCE <sub>R</sub> Spectral Response Acceleration, short periods, S <sub>MS</sub>      | 1.714 |
| Adjusted MCE <sub>R</sub> Spectral Response Acceleration, at 1-second period, S <sub>M1</sub> | 1.665 |
| Design Spectral Response Acceleration, short periods, S <sub>DS</sub>                         | 1.143 |
| Design Spectral Response Acceleration, at 1-second period, SD1                                | 1.110 |
| Long-Period Transition Period, TL (sec.)  | 8     |
| Seismic Design Category for Risk Categories I-IV  | II    |

TABLE 6.12022 CBC Mapped Seismic Design Parameters

MCE<sub>R</sub> = Risk-Targeted Maximum Considered Earthquake

# 6.2.2 Site-Specific Seismic Design Parameters

In addition to the Code Spectra parameters presented in Table 6.1, we have performed a site-specific ground motion hazard analysis in accordance with Chapter 21 of ASCE 7-16 to obtain site-specific seismic design acceleration parameters, the risk-targeted maximum considered earthquake response spectrum, and the design earthquake response spectrum. The site-specific seismic design parameters are presented below.

TABLE 6.22022 CBC Site Specific Seismic Design Parameters

| Parameter  | Value |
|--|-------|
| Site Class   | D     |
| Site Coefficient, F <sub>a</sub>   | 1.0   |
| Site Coefficient, F <sub>v</sub>   | 2.5   |
| Adjusted MCE Spectral Response Acceleration, short periods, S <sub>MS</sub>      | 1.371 |
| Adjusted MCE Spectral Response Acceleration, at 1-second period, S <sub>M1</sub> | 1.306 |
| Design Spectral Response Acceleration, short periods, SDS                        | 0.914 |
| Design Spectral Response Acceleration, at 1-second period, S <sub>D1</sub>       | 0.871 |

MCE = Maximum Considered Earthquake

# 6.3 CONVENTIONAL FOUNDATION DESIGN

# 6.3.1 General

The following design parameters are provided to assist the project structural engineer to design foundations for structures at the site. These design parameters are based on typical site materials encountered during subsurface exploration and are provided for preliminary design and estimating purposes. The project geotechnical consultant should provide final design parameters following observation and testing of site materials during grading. Depending on actual materials encountered during site grading, the design parameters presented herein may require modification.

# 6.3.2 Soil Expansion

The recommendations presented herein are based on soils with a **Very Low** expansion potential. Following site grading, additional testing of site soils should be performed by the project geotechnical consultant to confirm the basis of these recommendations. If site soils with higher expansion potentials are encountered or imported to the site, the recommendations contained herein may require modification.

# 6.3.3 Static and Seismic Settlement

Based on anticipated foundation loads and provided that the recommendations for ground preparation in this report are followed, total and differential static settlements are anticipated to be less than 1 inch and  $\frac{1}{2}$  inch over 30 feet, respectively. These values are considered within tolerable limits of the proposed structure and site improvements. Design of the structure should consider these maximum anticipated settlements.

# 6.3.4 Allowable Bearing Value

Foundations may utilize a bearing value of 2,500 pounds per square foot (psf) for continuous and pad footings with a minimum width of 12 inches and founded at a minimum depth of 12 inches below the lowest adjacent grade. This value may be increased by 500 psf and 1500 psf for each additional foot in width and depth, respectively, up to a maximum value of 4,000 psf. Recommended allowable bearing values include both dead and live loads and may be increased by one-third for wind and seismic forces.

# 6.3.5 Lateral Resistance

A passive earth pressure of 240 pounds per square foot per foot of depth (psf/ft) up to a maximum value of 1,500 pounds per square foot (psf) may be used to determine lateral bearing for footings. This value may be increased by one-third when designing for wind and seismic forces. A coefficient of friction of 0.45 times the dead load forces may also be used between concrete and the supporting soils to determine lateral sliding resistance. No increase in the coefficient of friction should be used when designing for wind and seismic forces.

The above values are based on footings placed directly against compacted fill or competent native soils. In the case where footing sides are formed, all backfill against the footings should be compacted to at least 90 percent of the laboratory standard.

# 6.3.6 Footing Dimensions and Reinforcement

Exterior and interior building footings should be founded at a minimum depth of 12 inches and 12 inches, respectively, below the lowest adjacent grade. All continuous footings should be reinforced with a minimum of two No. 4 bars, one top and one bottom. The structural engineer may require different reinforcement and should dictate if greater than the recommendations provided herein.

Interior isolated pad footings should be a minimum of 24 inches square and founded at minimum depths of 12 inches below the lowest adjacent final grade. Exterior isolated pad footings intended for support of patio covers or similar construction should be a minimum of 24 inches square and founded at a minimum depth of 12 inches below the lowest adjacent final grade.

Interior concrete slabs constructed on grade should be a minimum 4 inches thick and should be reinforced with No. 3 bars spaced 30 inches on center, each way. Care should be taken to ensure the placement of reinforcement at mid-slab height. The structural engineer may recommend a greater slab thickness and reinforcement based on proposed use and loading conditions and such recommendations should govern if greater than the recommendations presented herein.

Concrete floor slabs in areas to receive carpet, tile, or other moisture sensitive coverings should be underlain with a minimum of 15-mil moisture vapor retarder conforming to ASTM E 1745-11, Class A. The membrane should be properly lapped, sealed, and underlain with at least 2 inches of sand having a SE no less than 30. One additional inch of sand may be placed over the membrane to aid in the curing of the concrete. This vapor retarder system is anticipated to be suitable for most flooring finishes that can accommodate some vapor emissions. However, this system may emit more than 4 pounds of water per 1000 sq. ft. and therefore, may not be suitable for all flooring finishes. Additional steps should be taken if such vapor emission levels are too high for anticipated flooring finishes.

Special consideration should be given to slabs in areas to receive ceramic tile or other rigid, cracksensitive floor coverings. Design and construction of such areas should mitigate hairline cracking as recommended by the structural engineer.

Block-outs should be provided around interior columns to permit relative movement and mitigate distress to the floor slabs due to differential settlement that will occur between column footings and adjacent floor subgrade soils as loads are applied.

# 6.3.7 Foundation Observations

Foundation excavation should be observed by the project geotechnical consultant to verify that they have been excavated into competent bearing soils and to the minimum embedment recommended above. These observations should be performed prior to placement of forms or reinforcement. The excavations should be trimmed neat, level and square. Loose, sloughed or moisture-softened materials and debris should be removed prior to placing concrete.

# 6.4 RETAINING AND SCREENING WALLS

# 6.4.1 General

The following preliminary design and construction recommendations are provided for general retaining and screen walls supported by engineered compacted fill or competent native soils. Final wall designs specific to the site development should be provided for review once completed. The structural engineer and architect should provide appropriate recommendations for sealing of all joints and applying moisture-proofing material on the back of the walls.

# 6.4.2 Allowable Bearing Value and Lateral Resistance

Design of retaining and screen walls may utilize the bearing and lateral resistance values provided in Section 6.3.4 and 6.3.5.

# 6.4.3 Active Earth Pressures

Static and seismic earth pressures for level and 2:1 (H:V) backfill conditions are provided in Table 6.3. Seismic earth pressures provided herein are based on the method provided by Seed & Whitman (1970) using a peak ground acceleration (PGA) of 0.427 g for 10% probability of exceedance in 50 years. As indicated in Section 1803.5.12 of the 2022 CBC, retaining walls supporting 6 feet of backfill or less are not required to be designed for seismic earth pressures. The values provided in Table 6.3 do not consider hydrostatic pressure. Retaining walls should also be designed to support adjacent surcharge loads imposed by other nearby footings or traffic loads in addition to the earth pressure.

# TABLE 6.3



#### **Pressure Values**

| Valuo  | Backfill Condition |             |  |  |  |  |  |
|--------|--------------------|-------------|--|--|--|--|--|
| v aluc | Level              | 2H:1V Slope |  |  |  |  |  |
| Α      | 30H                | 44H         |  |  |  |  |  |
| В      | 13H                | 13H         |  |  |  |  |  |
| С      | 21.5H              | 28.5H       |  |  |  |  |  |

Note:

H is in feet and resulting pressure is in psf. Design may utilize either the sum of the static component and the seismic component force diagrams or the total force diagram above. SEAOSC has suggested using a load factor of 1.7 for the static component and 1.0 for the seismic component. The actual load factors should be determined by the structural engineer.

# 6.4.4 Drainage and Moisture-Proofing

Retaining walls should be constructed with a perforated pipe and gravel subdrain to prevent entrapment of water in the backfill. The perforated pipe should consist of 4-inch-diameter, ABS SDR-35 or PVC Schedule 40 with the perforations laid down. The pipe should be embedded in <sup>3</sup>/<sub>4</sub>- to 1<sup>1</sup>/<sub>2</sub>-inch open-graded gravel wrapped in filter fabric. The gravel should be at least one foot wide and extend at least one foot up the wall above the footing and drainage outlet. Drainage gravel and piping should not be placed below outlets and weepholes. Filter fabric should consist of Mirafi 140N, or equal. Outlet pipes should be directed to positive drainage devices.

The use of weepholes may be considered in locations where aesthetic issues from potential nuisance water are not a concern. Weepholes should be 2 inches in diameter and provided at least every 6 feet on center. Where weepholes are used, perforated pipe may be omitted from the gravel subdrain.

Retaining walls supporting backfill should also be coated with a moisture-proofing compound or covered with such material to inhibit infiltration of moisture through the walls. Moisture-proofing material should cover any portion of the back of wall that will be in contact with soil and should lap over and onto the top of footing. The project structural engineer should provide specific recommendations for moisture-proofing, water stops, and joint details.

# 6.4.5 Footing Reinforcement and Wall Jointing

All continuous footings should be reinforced with a minimum of two No. 4 bars, one top and one bottom. Walls should be provided with cold joints spaced no more than 40 feet apart. Wall finishes and capping materials should not extend across the cold joint. The structural engineer may require different reinforcement or jointing and should dictate if greater than the recommendations provided herein. Where recommended removals are limited due to space restrictions, greater reinforcement and closer jointing may be recommended. Specific recommendations should be provided by the geotechnical consultant during grading based on as-built conditions exposed in the field.

# 6.4.6 Foundation Observations

Footing excavations should be observed by the project geotechnical consultant to verify that they have been excavated into competent bearing soils and to the minimum embedment recommended herein. These observations should be performed prior to placement of forms or reinforcement. The excavations should be trimmed neat, level and square. Loose, sloughed or moisture-softened materials and debris should be removed prior to placing concrete.

# 6.5 EXTERIOR FLATWORK

Exterior flatwork should be a nominal 4 inches thick. Cold joints or saw cuts should be provided at least every 15 feet in each direction. Special jointing detail should be provided in areas of block-outs, notches, or other irregularities to avoid cracking at points of high stress. Subgrade soils below flatwork should be thoroughly moistened to at least 110 percent of the optimum moisture content to a depth of 12 inches. Moistening should be accomplished by lightly spraying the area over a period of a few days just prior to pouring concrete. The geotechnical consultant should observe and verify the density and moisture content of subgrade soils prior to pouring concrete to ensure that the required compaction and pre-moistening recommendations have been met.

Drainage from flatwork areas should be directed to local area drains and/or other appropriate collection devices designed to carry runoff water to the street or other approved drainage structures. The concrete flatwork should also be sloped at a minimum gradient of 0.5 percent away from building foundations and retaining walls.

# 6.6 CONCRETE MIX DESIGN

We recommend following the procedures provided in ACI 318, Section 19.3, Table 19.3.1.1 for **S0** sulfate exposure. Upon completion of rough grading, an evaluation of as-graded conditions and further laboratory testing should be completed for the site to confirm or modify the recommendations provided in this section.

# 6.7 CORROSION

The site is considered Non-Corrosive to metals that are in contact or close proximity to onsite soils. As such, no special considerations will be required if construction will include metals that will be near or in direct contact with site soils.

# 6.8 PRELIMINARY PAVEMENT DESIGN

# 6.8.1 Preliminary Pavement Structural Sections

Based on the soil conditions present at the site and an estimated traffic index, preliminary pavement sections are provided in Table 6.4. An estimated "R-value" of 50 was used for the near-surface soil in this preliminary pavement design based on laboratory results. The sections provided below are for planning purposes only and should be re-evaluated subsequent to site grading. Final pavement sections should be based on actual R-value testing of in-place soils and analysis of anticipated traffic.

| Location                                | Traffic<br>Index | AC<br>(inches) | Concrete<br>Pavers<br>(mm) | PCC<br>(inches) | AB<br>(inches) |
|---|------------------|----------------|----------------------------|-----------------|----------------|
|   |                  | 3.0            |                            |                 | 6.0            |
| Entry Way and Main<br>Drives            | 6.5              |                |                            | 5.0             |                |
| Dirves                                  |                  |                | 80.0                       |                 | 6.0            |
|   |                  | 3.0            |                            |                 | 4.0            |
| Cottage Driveways and<br>Parking Stalls | 4.5              |                |                            | 4.0             |                |
| i arking Stans                          |                  |                | 80.0                       |                 | 4.0            |

TABLE 6.4PRELIMINARY PAVEMENT STRUCTURAL SECTIONS

#### 6.8.2 Subgrade Preparation

Prior to placement of paving elements, subgrade soils should be scarified 6 inches, moistureconditioned to above the optimum moisture content then compacted to at least 90 percent of the maximum dry density determined in accordance with ASTM D1557. Areas observed to pump or yield under vehicle traffic should be removed and replaced with firm and unyielding engineered compacted soil or aggregate base materials.

# 6.8.3 Aggregate Base

Aggregate base materials should be Crushed Aggregate Base or Crushed Miscellaneous Base conforming to Section 200-2 of the Standard Specification for Public Works Construction (Greenbook) or Class 2 Aggregate Base conforming to the Caltrans' Standard Specifications. The materials should be moisture conditioned to slightly over the optimum moisture content then compacted to at least 95 percent of ASTM D 1557.

# 6.8.4 Asphaltic Concrete

Paving asphalt should be PG 64-10 conforming to the requirements of Section 203-1 of the Greenbook. Asphalt concrete materials should conform to Section 203-6 and construction should conform to Section 302 of the Greenbook.

#### 6.8.5 Concrete Paver

Concrete pavers should conform to the requirements of ASTM C 936. Construction of the pavers, including bedding sand, should follow manufacturer's specifications. Typical thickness of bedding sand is about 1 inch. The gradation of bedding sand should meet the requirement in Table 6.5.

| Oradation for Sand Dedding |                 |  |  |  |  |  |  |
|----------------------------|-----------------|--|--|--|--|--|--|
| Sieve Size                 | Percent Passing |  |  |  |  |  |  |
| 3/8"                       | 100             |  |  |  |  |  |  |
| No. 4                      | 95 - 100        |  |  |  |  |  |  |
| No. 8                      | 80 - 100        |  |  |  |  |  |  |
| No. 16                     | 50 - 85         |  |  |  |  |  |  |
| No. 30                     | 25 - 60         |  |  |  |  |  |  |
| No. 50                     | 5 - 30          |  |  |  |  |  |  |
| No. 100                    | 0 - 10          |  |  |  |  |  |  |
| No. 200                    | 0 - 1           |  |  |  |  |  |  |

TABLE 6.5Gradation for Sand Bedding

# 6.8.6 Portland Cement Concrete

Portland cement concrete used to construct concrete paving should conform to Section 201 of the Greenbook and should have a minimum compressive strength of 3,250 pounds per square inch (psi) at 28 days. Reinforcement and jointing of concrete pavement sections should be designed according to the minimum recommendations provided by the Portland Cement Association (PCA). For rigid pavement, transverse and longitudinal contraction joints should be provided at spacing no greater than 15 feet. Score joints may be constructed by saw cutting to a depth of <sup>1</sup>/<sub>4</sub> of the slab thickness. Expansion/cold joints may be used in lieu of score joints. Such joints should be properly sealed. Where traffic will traverse over cold joints without keyways or dowels or edges of concrete paving, the edges should be thickneed by 20% of the design thickness toward the edge over a horizontal distance of 5 feet.

# 6.9 POST GRADING CONSIDERATIONS

# 6.9.1 Site Drainage and Irrigation

The ground immediately adjacent to foundations should be provided with positive drainage away from the structures in accordance with 2022 CBC, Section 1804.4. However, the ground slope may be limited to 2% for soils and climatic reasons. No rain or excess water should be allowed to pond against structures such as walls, foundations, flatwork, etc.

Excessive irrigation water can be detrimental to the performance of the proposed site development. Water applied in excess of the needs of vegetation will tend to percolate into the ground. Such percolation can lead to nuisance seepage and shallow perched groundwater. Seepage can form on slope faces, on the faces of retaining walls, in streets, or other low-lying areas. These conditions could lead to adverse effects such as the formation of stagnant water that breeds insects, distress or damage of trees, surface erosion, slope instability, discoloration and salt buildup on wall faces, and premature failure of pavement. Excessive watering can also lead to elevated vapor emissions within buildings that can damage flooring finishes or lead to mold growth inside the home.

Key factors that can help mitigate the potential for adverse effects of overwatering include the judicious use of water for irrigation, use of irrigation systems that are appropriate for the type of vegetation and geometric configuration of the planted area, the use of soil amendments to enhance moisture retention, use of low-water demand vegetation, regular use of appropriate fertilizers, and seasonal adjustments of irrigation systems to match the water requirements of vegetation. Specific recommendations should be provided by a landscape architect or other knowledgeable professional.

# 6.9.2 Utility Trenches

Trench excavations should be constructed in accordance with the recommendations contained in Section 6.1.7 of this report. Trench excavations must also conform to the requirements of Cal/OSHA.

Trench backfill materials and compaction criteria should conform to the requirements of the local municipalities. As a minimum, utility trench backfill should be compacted to at least 90 percent of the laboratory standard. Materials placed within the pipe zone (6 inches below and 12 inches above the pipe) should consist of particles no greater than <sup>3</sup>/<sub>4</sub> inches and have a SE of at least 30. The materials within the pipe zone should be moisture-conditioned and compacted by hand-operated compaction equipment. Above the pipe zone (>1 foot above pipe), the backfill may consist of general fill materials with no particles greater than 8 inches in median dimension. Trench backfill should be moisture-conditioned to slightly over the optimum moisture content, placed in lifts no greater than 12 inches in thickness, and then mechanically compacted with appropriate equipment to at least 90 percent of the laboratory standard. For trenches with sloped walls, backfill material should be placed in lifts no greater than 8 inches in loose thickness, and then compacted by rolling with a sheepsfoot roller or similar equipment. The project geotechnical consultant should perform density testing along with probing to verify that adequate compaction has been achieved.

Within shallow trenches (less than 18 inches deep) where pipes may be damaged by heavy compaction equipment, imported clean sand having a SE of 30 or greater may be utilized. The sand should be placed in the trench, thoroughly watered, and then compacted with a vibratory compactor. For utility trenches located below a 1:1 (H:V) plane projecting downward from the outside edge of the adjacent footing base or crossing footing trenches, concrete or slurry should be used as trench backfill.

# 6.10 PLAN REVIEW AND CONSTRUCTION SERVICES

We recommend *Albus & Associates, Inc.* be engaged to review any future development plans, including civil plans (grading plans), foundation plans, and proposed structural loads, prior to construction. This is to verify that the assumptions of this report are valid and that the preliminary conclusions and recommendations contained in this report have been properly interpreted and are incorporated into the project plans and specifications. If we are not provided the opportunity to review these documents, we take no responsibility for misinterpretation of our preliminary conclusions and recommendations.

We recommend that a geotechnical consultant be retained to provide soil engineering services during construction of the project. These services are to observe compliance with the design, specifications or recommendations, and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

If the project plans change significantly from the assumed development described herein, the project geotechnical consultant should review our preliminary design recommendations and their applicability to the revised construction. If conditions are encountered during construction that appears to be different than those indicated in this report or subsequent design reports, the project geotechnical consultant should be notified immediately. Design and construction revisions may be required.

# 7.0 LIMITATIONS

This report is based on the proposed development and geotechnical data as described herein. The materials encountered on the project site and utilized in our laboratory testing for this investigation are believed representative of the total project area, and the conclusions and recommendations contained in this report are presented on that basis. However, soil and bedrock materials can vary in characteristics between points of exploration, both laterally and vertically, and those variations could affect the conclusions and recommendations contained herein. As such, observation and testing by a geotechnical consultant during the grading and construction phases of the project are essential to confirming the basis of this report.

This report has been prepared consistent with that level of care being provided by other professionals providing similar services at the same locale and time period. The contents of this report are professional opinions and as such, are not to be considered a guaranty or warranty.

This report should be reviewed and updated after a period of one year or if the site ownership or project concept changes from that described herein.

This report has been prepared for the exclusive use of **Overton Moore Properties** and its project consultants in the planning and design of the proposed development. This report has not been prepared for use by parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes.

This report is subject to review by the controlling governmental agency.

April 26, 2023 J.N.: 3138.00 Page 25

Respectfully submitted,

# ALBUS & ASSOCIATES, INC.

Daniel D. Albus

Project Engineer

David E. Albus Principal Engineer GE 2455



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# **APPENDIX** A

# **EXPLORATION LOGS**

# **Field Identification Sheet**



Albus & Associates, Inc.

# EXPLORATION LOG

| Project         | Project:       |   |  |                      |      |      | Location:                  |                         |                    |          |  |  |
|-----------------|----------------|---|--|----------------------|------|------|----------------------------|-------------------------|--------------------|----------|--|--|
| Addres          | ss:            |   |  |                      |      |      |                            | Elevation:              |                    |          |  |  |
| Job Nu          | mber:          |   | Client:  |                      |      |      | Date:                      |                         |                    |          |  |  |
| Drill Method:   |                |   | Driving Weight:  |                      |      | ]    | Log                        | gged By:                |                    |          |  |  |
|                 |                |   |  |                      | Sam  | ples | 5                          | La                      | boratory Te        | sts      |  |  |
| Depth<br>(feet) | Lith-<br>ology | Mate  | Water  | Blows<br>Per<br>Foot | Core | Bulk | Moisture<br>Content<br>(%) | Dry<br>Density<br>(pcf) | Other<br>Lab Tests |          |  |  |
|                 |                | <b>EXPLANATION</b>  |  |                      |      |      |                            |                         |                    |          |  |  |
|                 |                |   |  |                      |      |      |                            |                         |                    |          |  |  |
|                 |                | Solid lines separate geolo  | gic units and/or material types.   | -                    |      |      |                            |                         |                    |          |  |  |
| _ 5 _           |                | Dashed lines indicate unk<br>material type change.  | nown depth of geologic unit change or  |                      |      |      |                            |                         |                    |          |  |  |
|                 |                | <b>Solid black rectangle</b> in Split Spoon sampler (2.5i   | Core column represents California<br>n ID, 3in OD).  |                      |      |      |                            |                         |                    |          |  |  |
|                 |                | <b>Double triangle</b> in core c  | column represents SPT sampler.   |                      |      | X    |                            |                         |                    |          |  |  |
| 10              | -              | Vertical Lines in core co   | lumn represents Shelby sampler.  |                      |      |      |                            |                         |                    |          |  |  |
|                 |                | Solid black rectangle in sample.  | Bulk column respresents large bag  |                      |      |      |                            |                         |                    |          |  |  |
| 15<br>20        |                | Other Laboratory Tests<br>Max = Maximum Dry De<br>EI = Expansion Index<br>SO4 = Soluble Sulfate Co<br>DSR = Direct Shear, Rem<br>DS = Direct Shear, Undis<br>SA = Sieve Analysis (1" of<br>Hydro = Particle Size Am<br>200 = Percent Passing #2<br>Consol = Consolidation<br>SE = Sand Equivalent<br>Rval = R-Value<br>ATT = Atterberg Limits | <u>:</u><br>nsity/Optimum Moisture Content<br>ontent<br>holded<br>turbed<br>through #200 sieve)<br>alysis (SA with Hydrometer)<br>00 Sieve |                      |      |      |                            |                         |                    |          |  |  |
| Albus           | & As           | sociates, Inc.  |  |                      |      |      |                            |                         | P                  | late A-1 |  |  |



|   |  | EXP  | LORAT                                   | ION LOG P-1                   |                                |            |            |                       |                      |                    |      |
|---|--|--|---|-------------------------------|--------------------------------|------------|------------|-----------------------|----------------------|--------------------|------|
| JOB NO.<br>3138.00  | CLIENT/PROJE<br>Overton Mo   | CT<br>Ore Properties   |   |                               | DAY<br>TuesdayDATE<br>2023-02- |            |            |                       |                      |                    | 2-28 |
| LOCATION<br>919 Sierra N  | Madre Avenu  | e, Azusa   |   | LATITUDE<br>34.14300          | LC<br>-1                       | DNG<br>17. | іті<br>.91 | <sup>JDE</sup><br>952 | ELI<br>64            | evation<br>9.5     |      |
| LOGGED BY<br>ddalbus  |  | DRILLER<br>2R Drilling   |   | DRILL METHOD<br>Hollow-Stem A | uge                            | er         |            | drivi<br>140 l        | ng wei<br>bs / 30    | GHT<br>I <b>in</b> |      |
| DEPTH LITHO   | DESCRIPTION  |  |   |                               | H2O                            | COR        | BAG        | BLOW<br>COUNT         | MC<br>(%)            | DD<br>(pcf)        | LAB  |
| ddalbus $DEPTH$ LITHO   - 1   - 2   - 2   - 3   - 2   - 3   - 2   - 3   - 2   - 3   - 4   - 5   - 6   - 7   - 8   - 9   - 10   - 11   - 12   - 13   - 14   - 15   - 16   - 19   - 20   - 21 | DESCRIPTION<br>Topsoil<br>Silty Sand<br>grained<br>Alluvium<br>Sandy Gra<br>damp to m<br>Total Dept<br>No Ground | (SM): brown, mc<br>(Qg)<br>vel with Cobbles<br>oist, fine to coars<br>h 5 feet<br>lwater | oist, fine to<br>and Bould<br>e grained | medium /                      |                                |            | BAG        | BLOW<br>COUNT         | bs / 30<br>мс<br>(%) | DD<br>(pcf)        | LAB  |
| - 22 -  |  |  |   |                               |                                |            |            |                       |                      |                    |      |
| - 23 -  |  |  |   |                               |                                |            |            |                       |                      |                    |      |
| — 24 —  |  |  |   |                               |                                |            |            |                       |                      |                    |      |

1011 North Armando Street, Anaheim CA 92806 (714) 630-1626


|                                 |               |   | ]   | EXPLORAT  | TION LOG P-2                  |          |            |             |                |                    |                |      |
|---------------------------------|---------------|---|---|---|-------------------------------|----------|------------|-------------|----------------|--------------------|----------------|------|
| јов no.<br>3138.0               | )0            | CLIENT/PROJEC<br>Overton Mo   | ore Prope   | rties   |                               |          |            | D<br>T      | AY<br>uesday   | 7                  | DATE<br>2023-0 | 2-28 |
| locati<br>919 Si                | ion<br>erra M | ladre Avenu   | e, Azusa  |   | LATITUDE<br>34.14491          | L(<br>-] | onc<br>117 | ытц<br>7.91 | 1995           | ELE<br>65.         | vation<br>3.1  |      |
| LOGGEI<br>ddalb                 | D BY<br>US    |   | DRILLER<br>2R Drillin   | ıg  | DRILL METHOD<br>Hollow-Stem A | uge      | er         |             | drivi<br>140 I | ng weic<br>bs / 30 | нт<br>in       |      |
| DEPTH                           | LITHO         | DESCRIPTION   |   |   |                               | H2O      | COR        | BAG         | BLOW<br>COUNT  | MC<br>(%)          | DD<br>(pcf)    | LAB  |
| - 1<br>- 2<br>- 3<br>- 4<br>- 5 |               | Topsoil<br>Silty Sand (<br>Medium gra<br>Alluvium (<br>Sandy Grav<br>damp to mo | (SM): brow<br>ained<br><b>Og)</b><br>vel with Co<br>bist, fine to | n, damp to mo<br>bbles and Boul<br>coarse grained | ist, fine to                  | -        |            |             |                |                    |                |      |
| - 6 -                           |               | No Ground   | water   |   |                               |          |            |             | -              |                    |                |      |
| - 7 -                           |               |   |   |   |                               |          |            |             | -              |                    |                |      |
| - 8 -                           |               |   |   |   |                               |          |            |             | -              |                    |                |      |
| - 9 -                           |               |   |   |   |                               |          | -          |             | -              |                    |                |      |
| - 10 -                          |               |   |   |   |                               |          | -          |             | -              |                    |                |      |
| - 11 -                          |               |   |   |   |                               |          |            |             | -              |                    |                |      |
| - 12 -                          |               |   |   |   |                               |          | -          |             | -              |                    |                |      |
| - 13 -                          |               |   |   |   |                               |          |            |             | -              |                    |                |      |
| - 14 -                          |               |   |   |   |                               |          |            |             |                |                    |                |      |
| - 15 -                          |               |   |   |   |                               |          |            |             |                |                    |                |      |
| — 16 —                          |               |   |   |   |                               |          |            |             | -              |                    |                |      |
| — 17 —                          |               |   |   |   |                               |          |            |             | -              |                    |                |      |
| — 18 —                          |               |   |   |   |                               |          |            |             | -              |                    |                |      |
| - 19 -                          |               |   |   |   |                               |          |            |             | -              |                    |                |      |
| — 20 —                          |               |   |   |   |                               |          |            |             |                |                    |                |      |
| - 21 -                          |               |   |   |   |                               |          |            |             |                |                    |                |      |
| - 22 -                          |               |   |   |   |                               |          |            |             |                |                    |                |      |
| - 23 -                          |               |   |   |   |                               |          |            |             |                |                    |                |      |
| - 24 -                          |               |   |   |   |                               |          |            |             |                |                    |                |      |





|  |              |  | E  | CXPLORAT      | TION LOG P-4                  |          |            |             |                        |                      |                   |      |
|--|--------------|--|--|---------------|-------------------------------|----------|------------|-------------|------------------------|----------------------|-------------------|------|
| јов no.<br>3138.0(   | 0            | CLIENT/PROJECT<br>Overton Moo  | re Proper  | ties          |                               |          |            | D<br>T      | AY<br>uesday           | y                    | DATE<br>2023-0    | 2-28 |
| LOCATIC<br>919 Sie   | on<br>erra M | ladre Avenue   | , Azusa  |               | LATITUDE<br>34.14647          | L(<br>_] | onc<br>117 | ыті<br>1.92 | <sup>JDE</sup><br>2143 | ELI<br>66            | evation<br>5.4    |      |
| LOGGED<br>ddalbu   | ) BY<br>IS   | ļ  | ORILLER<br>2R Drilling   | g             | DRILL METHOD<br>Hollow-Stem A | uge      | er         |             | DRIVI<br>140 l         | ng weic<br>bs / 30   | GHT<br>in         |      |
| DEPTH I  | LITHO        | DESCRIPTION  |  |               |                               | H2O      | COR        | BAG         | BLOW<br>COUNT          | MC<br>(%)            | DD<br>(pcf)       | LAB  |
| ddaibu $DEPTH$ $  -$ |              | DESCRIPTION Topsoil Silty Sand (S Medium grain Alluvium (C Sandy Grave damp to moin Total Depth No Groundv | SM): brown<br>ined<br><b>2g)</b><br>el with Cot<br>ist, fine to o<br>5 feet<br>vater | n, damp to mo | Honow-Stem A                  |          |            | BAG         |                        | BS 7 30<br>MC<br>(%) | IN<br>DD<br>(pcf) | LAB  |
| - 22   |              |  |  |               |                               |          |            |             |                        |                      |                   |      |
| - 23 -   |              |  |  |               |                               |          |            |             |                        |                      |                   |      |
| - 24 -   |              |  |  |               |                               |          |            |             | 1                      |                      |                   |      |



|   |  | <b>EXPLORA</b>   | TION LOG P-5                  |          |            |           |                |                      |                   |      |
|---|--|--|-------------------------------|----------|------------|-----------|----------------|----------------------|-------------------|------|
| JOB NO.<br>3138.00  | CLIENT/PROJECT<br>Overton Moore P  | roperties  |                               |          |            | P<br>T    | AY<br>uesday   | 7                    | DATE<br>2023-0    | 2-28 |
| LOCATION<br>919 Sierra I  | Madre Avenue, Az   | usa  | LATITUDE<br>34.14696          | LC<br>-1 | DNG<br>17. | іті<br>92 | 119            | ELE<br>665           | vation<br>5.2     |      |
| LOGGED BY<br>ddalbus  | 2 DRILL<br>2 ZR I  | Ler<br>Drilling  | DRILL METHOD<br>Hollow-Stem A | uge      | er         |           | DRIVI<br>140 I | ng weic<br>bs / 30   | нт<br>in          |      |
| DEPTH LITHO   | DESCRIPTION  |  |                               | H2O      | COR        | BAG       | BLOW<br>COUNT  | MC<br>(%)            | DD<br>(pcf)       | LAB  |
| ddalbus         DEPTH       LITHO $-1$ $ 2$ $ 3$ $ 3$ $ -3$ $ -4$ $ -5$ $ -6$ $ -7$ $ -8$ $ -9$ $ -10$ $ -11$ $ -12$ $ -13$ $ -14$ $ -15$ $ -16$ $ -17$ $ -18$ $ -19$ $ -20$ $ -21$ $-$ | 2 2RI<br>DESCRIPTION<br>Topsoil<br>Silty Sand (SM)<br>medium grained<br>Alluvium (Qg)<br>Sandy Gravel wi<br>damp to moist, f | brilling<br>brown, damp to me<br>th Cobbles and Bou<br>ine to coarse grained | Hollow-Stem A                 |          |            | BAG       |                | bs / 30<br>MC<br>(%) | in<br>DD<br>(pcf) | LAB  |
| 27  |  |  |                               |          |            |           |                |                      |                   |      |
|   |  |  |                               |          |            |           |                |                      |                   |      |
| - 23 -  |  |  |                               |          |            |           | 1              |                      |                   |      |
| - 24  |  |  |                               |          |            |           |                |                      |                   |      |



| EXPLORATION LOG P-6                                  |  |                  |                               |          |            |           |                |                   |                |      |  |  |
|--|--|------------------|-------------------------------|----------|------------|-----------|----------------|-------------------|----------------|------|--|--|
| JOB NO.<br>3138.00                                   | CLIENT/PROJECT<br>Overton Moore Pro  | perties          |                               |          |            | D<br>T    | AY<br>uesday   | y                 | DATE<br>2023-0 | 2-28 |  |  |
| LOCATION<br>919 Sierra I                             | ladre Avenue, Azusa  | l                | LATITUDE<br>34.14709          | L(<br>-] | one<br>117 | ыті<br>92 | 10E<br>2304    | EL<br>66          | evation<br>2.8 |      |  |  |
| LOGGED BY<br>ddalbus                                 | DRILLER<br>2R Dri  | lling            | DRILL METHOD<br>Hollow-Stem A | uge      | er         |           | DRIVI<br>140 l | ng wei<br>bs / 30 | GHT<br>) in    |      |  |  |
| DEPTH LITHO  | DESCRIPTION  |                  |                               | H2O      | COR        | BAG       | BLOW<br>COUNT  | MC<br>(%)         | DD<br>(pcf)    | LAB  |  |  |
| DEPTH LITHO<br>-1 $-1$ $-1$ $-1$ $-1$ $-1$ $-1$ $-1$ | DESCRIPTION         Topsoil         Silty Sand (SM): br         medium grained         Alluvium (Qg)         Sandy Gravel with         damp to moist, fine         Total Depth 5 feet         No Groundwater | own, damp to moi | st, fine to                   |          |            | BAG       |                |                   | DD<br>(pcf)    | LAB  |  |  |
| - 24 -   |  |                  |                               |          |            |           | 1              |                   |                |      |  |  |



| EXPLORATION LOG TP-1   |   |   |         |             |            |               |           |                 |       |  |  |  |
|--|---|---|---------|-------------|------------|---------------|-----------|-----------------|-------|--|--|--|
| JOB NO.<br>3138.00   | CLIENT/PROJECT<br>Overton Moore Properties  |   |         |             | P          | AY<br>hursda  | ay        | DATE<br>2023-   | 03-09 |  |  |  |
| LOCATION<br>919 Sierra N   | Madre Avenue, Azusa   | LATITUDE<br>34.14362                                    | Lg<br>- | ong<br>117. | іті<br>.91 | ude<br>1975   | E E       | LEVATIO<br>50.7 | N     |  |  |  |
| LOGGED BY<br>dloya   | DRILLER<br>other  | DRILL METHOD<br>Backhoe                                 |         |             |            | DRIVI<br>othe | NG WE     | EIGHT           |       |  |  |  |
| DEPTH LITHO  | DESCRIPTION   | ·   | H2O     | COR         | BAG        | BLOW<br>COUNT | MC<br>(%) | DD<br>(pcf)     | LAB   |  |  |  |
| $ \begin{array}{c} -1 \\ -2 \\ -3 \\ -3 \\ -4 \\ -6 \\ -6 \\ -6 \\ -6 \\ -6 \\ -6 \\ -6 \\ -6$ | Topsoil         Silty Sand (SM): dark brown, dam         medium-grained, abundant rootlet:         3/4-inch thick         Alluvium (Og)         Sandy Gravel with Cobbles and Be         brown, damp to moist, fine to coar         abundant cobbles and boulders up         diameter, clasts are subrounded         Total depth 7 feet         No groundwater         Minor sidewall caving         Backfilled with spoils on 3/9/2023 | oulders (GP): grey<br>rse-grained sand,<br>to 2 feet in |         |             |            |               |           |                 |       |  |  |  |



| EXPLORATION LOG TP-2     |  |   |                           |            |            |                |             |              |       |  |  |  |
|--------------------------|--|---|---------------------------|------------|------------|----------------|-------------|--------------|-------|--|--|--|
| JOB NO.<br>3138.00       | CLIENT/PROJECT<br>Overton Moore Properties   |   | DAY<br>Thursday 2023-03-0 |            |            |                |             |              | )3-09 |  |  |  |
| LOCATION<br>919 Sierra N | ladre Avenue, Azusa  | LATITUDE<br>34.14428                        | Lj<br>-                   | ong<br>117 | нті<br>.92 | UDE<br>2037    | EL<br>65    | EVATION<br>2 | N     |  |  |  |
| LOGGED BY<br>dloya       | DRILLER<br>other   | DRILL METHOD<br>Backhoe                     |                           |            |            | DRIVI<br>other | NG WEI<br>r | GHT          |       |  |  |  |
| DEPTH LITHO              | DESCRIPTION  |   | H2O                       | COR        | BAG        | BLOW<br>COUNT  | MC<br>(%)   | DD<br>(pcf)  | LAB   |  |  |  |
|                          | Topsoil<br>Silty Sand (SM): dark brown, mo   | pist, fine to                               | ,                         |            |            | -              |             |              |       |  |  |  |
| - 2 -                    | Alluvium (Qg)<br>Sand with Gravel (SP): grey brow<br>fine to coarse-grained, gravel up         | vn, damp to moist,<br>to 3 inches           |                           |            |            | -              |             |              |       |  |  |  |
| - 3                      | Gravelly Sand with Cobbles (SP)<br>fine to coarse-grained, cobbles up                          | e grey brown, damp,<br>o to 8 inches        | -                         |            |            | -              |             |              |       |  |  |  |
| - 4                      |  |   |                           |            |            | -              |             |              |       |  |  |  |
| - 6 - ····               | • Gravelly Sand with Cobbles and<br>brown, damp, fine to coarse-grain<br>18 inches in diameter | Boulders (SP): grey<br>ned , boulders up to |                           |            |            | -              | 3.1         |              |       |  |  |  |
| - 7 -                    | Total depth 7 feet   |   | -                         |            |            | -              |             |              |       |  |  |  |
| - 8 -                    | Minor sidewall caving<br>Backfilled with spoils on 3/9/202                                     | 3   |                           |            |            | _              |             |              |       |  |  |  |
| _ 9 _                    |  |   |                           |            |            | -              |             |              |       |  |  |  |
|                          |  |   |                           |            |            |                |             |              |       |  |  |  |
| - 12 -                   |  |   |                           |            |            | -              |             |              |       |  |  |  |
| - 13 -                   |  |   |                           |            |            | -              |             |              |       |  |  |  |
| - 14                     |  |   |                           |            |            | -              |             |              |       |  |  |  |



| EXPLORATION LOG TP-3  |  |  |        |            |            |                |           |                |       |  |  |  |
|---|--|--|--------|------------|------------|----------------|-----------|----------------|-------|--|--|--|
| JOB NO.<br>3138.00  | CLIENT/PROJECT<br>Overton Moore Properties   |  |        |            | P          | AY<br>hursda   | ay        | DATE<br>2023-0 | )3-09 |  |  |  |
| LOCATION<br>919 Sierra N  | ladre Avenue, Azusa  | LATITUDE<br>34.14516   | L<br>- | ong<br>117 | іті<br>.92 | UDE<br>2034    | EI<br>65  | LEVATION       | 1     |  |  |  |
| LOGGED BY<br>dloya  | DRILLER<br>other   | DRILL METHOD<br>Backhoe  |        |            |            | DRIVI<br>other | NG WE     | IGHT           |       |  |  |  |
| DEPTH LITHO   | DESCRIPTION  |  | H20    | COR        | BAG        | BLOW<br>COUNT  | MC<br>(%) | DD<br>(pcf)    | LAB   |  |  |  |
| $ \begin{array}{c} -1 \\ -2 \\ -3 \\ -3 \\ -4 \\ -6 \\ -6 \\ -6 \\ -7 \\ -8 \\ -9 \\ -10 \\ -11 \\ -12 \\ -13 \\ -14$ | Topsoil         Silty Sand (SM): dark brown, mo         medium-grained, rootlets, some r         thick, some gravel         Alluvium (Og)         Gravelly Sand with Silt and Cobb         damp to moist, fine to coarse-grain 10 inches in diameter         @ 1.5 ft, grey-brown, damp, som         feet in diameter         @ 1.5 ft, grey-brown, damp, som         feet in diameter         Minor sidewall caving         Backfilled with spoils on 3/9/202 | oist, fine to<br>oots up to 1/2-inch<br>oles (SP): brown,<br>ined, cobbles up to<br>e boulders up to 2 |        |            |            |                |           |                | sa    |  |  |  |



| EXPLORATION LOG TP-4                    |   |  |   |  |          |            |             |                        |               |                    |      |  |
|---|---|--|---|--|----------|------------|-------------|------------------------|---------------|--------------------|------|--|
| JOB NO.<br>3138.00                      | CLIENT/PROJECOVERTON MC   | CT<br>CT Properties  | s   |  |          |            | D<br>T      | AY<br>hursda           | ay            | DATE<br>2023-0     | 3-09 |  |
| LOCATION<br>919 Sierra N                | Aadre Avenu   | ie, Azusa  |   | latitude<br>34.14555   | L(<br>_] | one<br>117 | аті<br>1.92 | <sup>JDE</sup><br>2105 | ELI<br>65     | EVATION<br>4.7     |      |  |
| LOGGED BY<br>dloya                      |   | DRILLER<br>other   |   | DRILL METHOD<br>Backhoe  |          |            |             | DRIVI<br>other         | NG WEI        | GHT                |      |  |
| DEPTH LITHO                             | DESCRIPTION   |  |   |  | H2O      | COR        | BAG         | BLOW<br>COUNT          | MC<br>(%)     | DD<br>(pcf)        | LAB  |  |
| LOGGED BY<br>dloya<br>DEPTH LITHO<br>-1 | DESCRIPTION         Topsoil         Silty Sand         medium-gr         Alluvium (Gravelly Sigrey-brown some bould large as 2 ft the ground)         Total depth         No ground:         Backfilled | (SM): dark bro<br>rained, rootlets,<br>(Qg)<br>and with Cobbl<br>n, damp to mois<br>ders up to 4 feet<br>feet in diameter<br>surface | wn , moist, f<br>trace gravel<br>les and Bould<br>st, fine to coa<br>t in diameter<br>encountered | DRILL METHOD         Backhoe         ine to         ders (SP):         arse-grained,         boulders as         l very close to | H20      |            | BAG         | DRIVI<br>other         | мс (%)<br>2.9 | SHT<br>DD<br>(pcf) | LAB  |  |
|   |   |  |   |  |          |            |             |                        |               |                    |      |  |
| - 14 -                                  |   |  |   |  |          |            |             |                        |               |                    |      |  |



| EXPLORATION LOG TP-5                                     |   |                         |                           |            |     |               |            |                |       |  |  |  |
|--|---|-------------------------|---------------------------|------------|-----|---------------|------------|----------------|-------|--|--|--|
| JOB NO.<br>3138.00                                       | client/project<br>Overton Moore Properties  |                         | DAY<br>Thursday 2023-03-0 |            |     |               |            |                | 03-09 |  |  |  |
| LOCATION<br>919 Sierra N                                 | ladre Avenue, Azusa   | LATITUDE<br>34.14616    | L<br>=                    | one<br>117 | .92 | JDE<br>2040   | EI<br>6    | LEVATION<br>63 | Ň     |  |  |  |
| LOGGED BY<br>dloya                                       | DRILLER<br>other  | DRILL METHOD<br>Backhoe |                           |            |     | DRIVI<br>othe | NG WE<br>r | IGHT           |       |  |  |  |
| DEPTH LITHO  | DESCRIPTION   |                         | H2O                       | COR        | BAG | BLOW<br>COUNT | MC<br>(%)  | DD<br>(pcf)    | LAB   |  |  |  |
|  | <b>Topsoil</b><br>Silty Sand (SM): dark brown, moi                                    | st, fine to             |                           |            |     |               |            |                |       |  |  |  |
|  | with roots up to 1.5 inches thick   |                         | ,                         |            |     | -             |            |                |       |  |  |  |
| - 2 -  | Alluvium (Qg)<br>Gravelly Sand with Cobbles and E<br>grav brown damp to moist fing to | Boulders (SP):          |                           |            |     | -             |            |                |       |  |  |  |
| - 3 - ····   | boulders up to 2.5 feet in diameter   | encountered very        |                           |            |     | -             |            |                |       |  |  |  |
| • • • • • • • • • • • • • • • • • • •                    |   |                         |                           |            |     |               |            |                |       |  |  |  |
| - 4 - <sup>1</sup> · · · · · · · · · · · · · · · · · · · |   |                         |                           |            |     |               |            |                |       |  |  |  |
| - 5 - •  |   |                         |                           |            |     | -             |            |                |       |  |  |  |
| - 6 - · · · · ·  | -<br>-<br>-<br>-  |                         |                           |            |     |               |            |                |       |  |  |  |
|  | Total depth 6 feet<br>No groundwater  |                         |                           |            |     |               |            |                |       |  |  |  |
| - 7 -  | Backfilled with spoils on 3/9/2023  | 3                       |                           |            |     |               |            |                |       |  |  |  |
| - 8 -  |   |                         |                           |            |     | -             |            |                |       |  |  |  |
| _ 9 _  |   |                         |                           |            |     | -             |            |                |       |  |  |  |
| 10   |   |                         |                           |            |     |               |            |                |       |  |  |  |
| - 10   |   |                         |                           |            |     |               |            |                |       |  |  |  |
| - 11 -   |   |                         |                           |            |     | -             |            |                |       |  |  |  |
| - 12   |   |                         |                           |            |     | -             |            |                |       |  |  |  |
| - 13 -   |   |                         |                           |            |     |               |            |                |       |  |  |  |
| 15   |   |                         |                           |            |     |               |            |                |       |  |  |  |
| - 14   |   |                         |                           |            |     | _             |            |                |       |  |  |  |
|  |   |                         |                           |            |     |               |            |                |       |  |  |  |



| EXPLORATION LOG TP-6     |  |  |                                   |     |            |               |               |                |               |     |  |  |
|--------------------------|--|--|-----------------------------------|-----|------------|---------------|---------------|----------------|---------------|-----|--|--|
| JOB NO.<br>3138.00       | CLIENT/PROJECT<br>Overton Moore Proper   |  |                                   |     | D<br>T     | AY<br>Thursda | ay            | DATE<br>2023-0 | )3-09         |     |  |  |
| LOCATION<br>919 Sierra N | Iadre Avenue, Azusa  | LATITU<br>34.14  | DE<br>686                         | L.  | one<br>117 | ыті<br>1.91   | ude<br>1964   | EI<br>60       | EVATION<br>55 | 1   |  |  |
| LOGGED BY<br>dloya       | DRILLER<br>other   | DRILL<br>Back  | METHOD<br>10e                     |     |            |               | DRIVI<br>othe | NG WEI<br>r    | IGHT          |     |  |  |
| DEPTH LITHO              | DESCRIPTION  |  |                                   | H2O | COR        | BAG           | BLOW<br>COUNT | MC<br>(%)      | DD<br>(pcf)   | LAB |  |  |
| DEPTH LITHO<br>-1 - 1    | <b>Topsoil</b> Silty Sand (SM): dark         'roots up to 1-inch thick <b>Alluvium (Og)</b> Gravelly Sand with Cogrey-brown, moist, find         1.5 to 2 feet in diamete         ground surface         Total depth 7 feet         No groundwater         Minor sidewall caving         Backfilled with spoils of | brown , moist, fine-gra<br>bbles and Boulders (S<br>e to coarse-grained, bo<br>r encountered very clo<br>on 3/9/2023 | nined,<br>P):<br>ulders<br>ose to |     |            | BAG           |               | MC (%)         | DD<br>(pcf)   | LAB |  |  |



| EXPLORATION LOG TP-7  |  |   |   |   |          |             |            |                        |            |             |     |  |
|---|--|---|---|---|----------|-------------|------------|------------------------|------------|-------------|-----|--|
| јов no.<br>3138.00  | CLIENT/PROJEC<br>Overton Mo  |   |   |   | P        | AY<br>hursd | ay         | DATE<br>2023-0         | 3-09       |             |     |  |
| LOCATION<br>919 Sierra N  | ladre Avenue   | e, Azusa  |   | latitude<br>34.14698                                      | L(<br>-] | ong<br>117  | аті<br>.92 | <sup>.DE</sup><br>2131 | EI<br>6    | EVATION     | I   |  |
| LOGGED BY<br>dloya  |  | driller<br>other  | -   | drill method<br>Backhoe                                   |          |             |            | DRIVI<br>othe          | NG WE<br>r | IGHT        |     |  |
| DEPTH LITHO   | DESCRIPTION  |   |   |   | H20      | COR         | BAG        | BLOW<br>COUNT          | MC<br>(%)  | DD<br>(pcf) | LAB |  |
| $ \begin{array}{c}         -1 - \\         -2 - \\         -2 - \\         -3 - \\         -3 - \\         -4 - $ | Topsoil<br>Silty Sand (<br>'rootlets<br>Alluvium (<br>Gravelly Sa<br>grey-brown<br>some bould<br>very close to<br>Total depth<br>No groundy<br>Minor sidev<br>Backfilled v | SM): dark brown<br><b>Qg)</b><br>Ind with Cobbles<br>, damp to moist,<br>ers up to 2.5 feet<br>o ground surface<br>7 feet<br>vater<br>vall caving<br>with spoils on 3/9 | n, moist, fir<br>and Bould<br>fine to coa<br>in diamete | ne-grained,<br>ers (SP):<br>rse-grained,<br>r encountered |          |             |            |                        |            |             |     |  |



| JOB NO.<br>3138.00       CLIENT/PROJECT<br>Overton Moore Properties         LOCATION<br>919 Sierra Madre Avenue, Azusa       34.14649         JOGGED BY<br>dloya       DRILLER<br>other       DRILL METHOD<br>Backhoe         DEPTH       LITHO       DESCRIPTION         Image: Solution of the state in the   | DAY<br>Thursday     DATE<br>2023-03-09       GITUDE<br>7.92224     ELEVATION<br>662.8       DRIVING WEIGHT<br>other       ∑     BLOW<br>COUNT       ∑     BLOW<br>COUNT       (%)     DD<br>(pcf)       Sa |
|--|--|
| LOCATION<br>919 Sierra Madre Avenue, Azusa       LATITUDE<br>34.14649       LON<br>-11         LOGGED BY<br>dloya       DRILLER<br>other       DRILL METHOD<br>Backhoe         DEPTH       LITHO       DESCRIPTION       E         - 1       -       -       Filty Sand (SM): brown, moist, fine to<br>medium-grained, mulch and vegetation debris at<br>'surface, rootlets, roots up to 1/2-inch thick       -         - 2       -       -       -       -         - 3       -       -       -       -         - 4       -       -       -       -  | GITUDE<br>7.92224 ELEVATION<br>662.8 DRIVING WEIGHT<br>Other<br>BLOW MC DD LAB<br>COUNT (%) (pcf) Sa   |
| LOGGED BY<br>dloya       DRILLER<br>other       DRILL METHOD<br>Backhoe         DEPTH       LITHO       DESCRIPTION       E       02         - 1       •       Silty Sand (SM): brown, moist, fine to<br>medium-grained, mulch and vegetation debris at<br>'surface, rootlets, roots up to 1/2-inch thick       •       •         - 2       •       •       Gravelly Sand with Cobbles trace Boulders (SP):<br>grey-brown, damp, fine to coarse-grained, less<br>cobbles within the upper 2 feet       •       •         - 3       •       @ 2 ft, boulders up to 2 foot in diameter       •       •   | BLOW other       BLOW COUNT     MC DD (pef)       Count     (%)       Count     (%)  |
| DEPTH       LITHO       DESCRIPTION       E       O         - 1       •       •       Silty Sand (SM): brown, moist, fine to<br>medium-grained, mulch and vegetation debris at<br>'surface, rootlets, roots up to 1/2-inch thick       •         - 2       •       •       •       •         •       •       •       •       •         •       •       •       •       •         •       •       •       •       •         •       •       •       •       •         •       •       •       •       •         •       •       •       •       •         •       •       •       •       •         •       •       •       •       •         •       •       •       •       •         •       •       •       •       •         •       •       •       •       •         •       •       •       •       •       •         •       •       •       •       •       •         •       •       •       •       •       •         •       •       •   | BLOW     MC     DD     LAB       COUNT     (%)     (pcf)     sa  |
| <ul> <li>Topsoil</li> <li>Silty Sand (SM): brown, moist, fine to<br/>medium-grained, mulch and vegetation debris at<br/>'surface, rootlets, roots up to 1/2-inch thick</li> <li>Alluvium (Qg)</li> <li>Gravelly Sand with Cobbles trace Boulders (SP):<br/>grey-brown, damp, fine to coarse-grained, less<br/>cobbles within the upper 2 feet</li> <li>3 - (a) 2 ft, boulders up to 2 foot in diameter</li> </ul>  | sa   |
| $ \begin{array}{c} \mathbf{-5} \\ \mathbf{-6} \\ \mathbf{-7} \\ \mathbf{-6} \\ \mathbf{-7} $ |  |



| 3938.00       Observe of More Properties       Thursday       2023-03-09         000000000000000000000000000000000000  | EXPLORATION LOG TP-9  |  |                               |  |     |          |                 |           |             |     |  |
|--|---|--|-------------------------------|--|-----|----------|-----------------|-----------|-------------|-----|--|
| Spectra Madre Avenue, Azusa       34.1132/6       LOCCUP avenue, Azusa       Constraints         OCCED BY       DBULER       DBULER       DRIVEN WEIGHT         DEFTH       LTHO       DESCRIPTION       ED (D) (D) (D) (D) (D) (D) (D) (D) (D) (D   | JOB NO.<br>3138.00  |  | DAY<br>Thursday DATE<br>2023- |  |     |          | DATE<br>2023-0  | )3-09     |             |     |  |
| Alluvium (Q2)     Alluvium (Q2)     Alluvium (Q2)     Alluvium (Q2)       - 1     -     -     -       - 3     -     -     -       - 4     -     -     -       - 5     -     -     -       - 6     -     -     -       - 7     -     -     -       - 8     -     -     -       - 10     -     -     -       - 11     -     -     -  | LOCATION<br>919 Sierra N  | Aadre Avenue, Azusa  | LATITUDE<br>34.14676          | LONGITUDE<br>-117.92348 ELEVATION<br>660.8 |     |          |                 | N         |             |     |  |
| DEPTH       LITBO       DESCRIPTION       E  | LOGGED BY<br>dloya  | DRILLER<br>other   | DRILL METHOD<br>Backhoe       |  |     | D<br>O   | orivin<br>other | IG WEI    | IGHT        |     |  |
| Image: state of the state | DEPTH LITHO   | DESCRIPTION  |                               | H20  | COR | BL<br>CC | LOW<br>DUNT     | MC<br>(%) | DD<br>(pcf) | LAB |  |
|  | $ \begin{array}{c} -1 \\ -2 \\ -3 \\ -3 \\ -4 \\ -5 \\ -6 \\ -7 \\ -8 \\ -9 \\ -10 \\ -11 \\ -12 \\ -13 \\ -13 \\ -11 \\ -12 \\ -13 \\ -11 \\ -11 \\ -12 \\ -13 \\ -11 \\ -1$ | Alluvium (Qa)         Silty Sand (SM): grey-brown, m         medium-grained, rootlets, roots         trace mica         Alluvium (Qg)         Gravelly Sand with Cobbles and         grey-brown, damp to moist, fine         boulders up to 2 feet in diameter         Total depth 8 feet         No groundwater         Minor sidewall caving         Backfilled with spoils on 3/9/201 | 23                            |  |     |          | DUNT            | (%)       | (pcf)       |     |  |



| EXPLORATION LOG TP-10   |   |  |   |   |     |            |     |                                |               |             |     |
|---|---|--|---|---|-----|------------|-----|--------------------------------|---------------|-------------|-----|
| JOB NO.<br>3138.00 CLIENT/PROJECT<br>Overton Moore Properties   |   |  |   |   |     |            |     | DAY<br>Thursday DATE<br>2023-( |               |             |     |
| LOCATION<br>919 Sierra I  | Madre Avenu   | e, Azusa   |   | LATITUDE<br>34.14723                                    | L(  | one<br>117 | .92 | лре<br>2 <b>39</b> 4           | -<br>EL<br>66 | EVATION 1.2 | I   |
| LOGGED BY<br>dloya  |   | driller<br>other   |   | DRILL METHOD<br>Backhoe                                 |     |            |     | DRIVI<br>other                 | NG WEI        | GHT         |     |
| DEPTH LITHO   | DESCRIPTION   | •  |   |   | H2O | COR        | BAG | BLOW<br>COUNT                  | MC<br>(%)     | DD<br>(pcf) | LAB |
| $ \begin{array}{c} -1 \\ -2 \\ -3 \\ -3 \\ -4 \\ -5 \\ -6 \\ -7 \\ -8 \\ -9 \\ -10 \\ -11 \\ -12 \\ -13 \\ -14 \\ -14 \\ -14 \\ -14 \\ -14 \\ -14 \\ -14 \\ -11 \\ -14 \\ -14 \\ -11 \\ -14 \\ -11 \\ -14 \\ -11 \\ -1$ | Topsoil         Silty Sand         medium-gr         'rootlets, roo         Alluvium         Gravelly S         grey-brown         boulders up         boulders and         Total depth         No ground         Minor side         Backfilled | (SM): brown, m<br>rained, vegetatio<br>ots up to 3/4-inc<br>(Qg)<br>and with Cobble<br>n, damp to mois<br>p to 2.5 feet in d<br>re within 2 feet f<br>n 6.5 feet<br>water<br>wall caving<br>with spoils on 3 | anoist, fine to<br>on debris at s<br>ch thick<br>es and Bould<br>t, fine to coa-<br>liameter, son<br>from the gro | ders (SP):<br>arse-grained,<br>me large<br>bund surface |     |            |     |                                | 2.5           |             |     |

# **APPENDIX B**

# LABORATORY TEST RESULTS

#### LABORATORY TESTING PROGRAM

#### Soil Classification

Soils encountered within the exploratory borings were initially classified in the field in general accordance with the visual-manual procedures of the Unified Soil Classification System (ASTM D 2488). The samples were re-examined in the laboratory and classifications reviewed and then revised where appropriate. The assigned group symbols are presented on the Exploration Logs provided in Appendix A.

#### **In-Situ Moisture Content and Dry Density**

Moisture content and dry density of in-place soil materials were determined in representative strata. Test data are summarized on the Exploration Logs, Appendix A.

#### Particle Size Analyses

Particle size analyses were performed on representative samples of site materials in accordance with ASTM D 422. The results are presented graphically on the attached Plates B-1 through B-2.

#### **GRAIN SIZE DISTRIBUTION**



#### **GRAIN SIZE DISTRIBUTION**



# **APPENDIX C**

### MICROTREMOR REFRACTION SURVEY BY GEOTECHNICAL PROFESSIONALS, INC. (2008)

# **SHEAR-WAVE SURVEY LINE S-1**



Shear-Wave Velocity, ft/s

08/13/14 ISSUED FOR BIDDING



| BORING LOCATION: See Figure 2   |  | ELEVATION AND DATUM (feet): MSL   |        |  |                               |  |
|---|--|---|--------|--|-------------------------------|--|
| LATITUDE:   |  | LONGITUDE:  |        |  |                               |  |
| DRILLING EQUIPMENT: Beck  | ker Hammer   | DRILLING METHOD: Open end   |        |  |                               |  |
| BORING DIAMETER (inches):   | 6  | BORING DEPTH (feet): 50.5   |        |  |                               |  |
| DATE STARTED: 5/19/   | /11  | DATE COMPLETED: 5/19/11   |        |  |                               |  |
| DRILLING COMPANY: Layn  | e Christensen  | SPT/DRIVE HAMMER DROP: 30 inches  | /T: 14 | 40 lbs   |                               |  |
| LOGGED BY: KMV  | ENTERED BY: SS   | DRIVE SAMPLER DIAMETER (inches) ID: 2.4   | O      | 0:3  |                               |  |
| Elevation<br>(feet)<br>Depth<br>(feet)<br>Sampler<br>Symbol<br>Blows per<br>6 Inches<br>SPT N<br>Blows per Foot | (isd) eunsseud<br>DESCF  | DESCRIPTION   |        | Becker Harnmer<br>Blows per foot   | Penetration<br>(Minutes/foot) |  |
|   | ASPHALT CONCRETE (AC):<br>SILTY SAND (SM): brown, mo<br>SILTY SAND (SM): brown, mo<br>POORLY GRADED SAND with<br>to coarse-grained sand, fine<br>POORLY GRADED SAND with<br>to coarse-grained sand, fine<br>POORLY GRADED GRAVEL<br>few cobbles and possibly bo<br>cobbles stuck in the shoe that<br>24 feet<br>cobbles cleared out from the s<br>18<br>19<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10<br>10 | -10 inches<br>bist, very dense, fine-grained sand, FILL<br>h GRAVEL (SP): olive gray, moist, very dense, fine-<br>to coarse gravel, angular gravel<br>(GP): gray, moist, very dense, fine to coarse gravel,<br>ulders?<br>may have caused high blow counts from 20 feet to<br>hoe |        | 18           44           40           24           34           45           27           17           17           17           40           24           34           45           27           17           17           40           62           54           70           145           80           32           121           175           285           525           775           400           25           17           35           51 |                               |  |
|   | 20   |   | -      | 51<br>56   |                               |  |

### LOG OF BORING DYB11-1

Page 1 of 2 Foothill Transit Azuza Park & Ride Project No. 2011-019

Template: DYLG1-2006 BECKER; Prj ID: 2011-019<sup>4</sup>GPJ

.

| Elevation<br>(feet) | Depth<br>(feet) | Sampler | Symbol | Blows per<br>6 Inches | SPT N<br>Blows per Foot | Pressure (psi)   | DESCRIPTION   | Depth<br>(feet) | Becker Hammer<br>Blows per foot   | Penetration<br>(Minutes/foot) |
|---------------------|-----------------|---------|--------|-----------------------|-------------------------|--|---|-----------------|---|-------------------------------|
|                     |                 | ×       |        | 38<br>50/3"<br>50/6"  | 100                     | 20<br>22<br>25<br>18<br>20<br>18<br>20<br>22<br>21<br>21<br>18<br>20<br>15<br>18<br>19<br>15<br>18<br>18 | wet POORLY GRADED SAND with SILT and GRAVEL (SP-SM): dark yellowish brown, wet, very dense, medium- to coarse-grained sand, fine to coarse gravel, few cobbles CLAYEY SAND with GRAVEL (SC): strong brown, wet, very dense, fine- to coarse-grained sand, fine to coarse gravel, slightly micaceous Bottom of penetration at 50.5 feet. Groundwater measured at 38 teet at the end of penetration. Hole backflued with benchate chips. Surface patched with rapid set concrete. |                 | 112<br>144<br>431<br>70<br>115<br>27<br>31<br>110<br>73<br>49<br>27<br>79<br>30<br>21<br>50<br>15<br>22<br>17 |                               |

## LOG OF BORING DYB11-1

Page 2 of 2 Foothill Transit Azuza Park & Ride Project No. 2011-019

Template: DYLG1-2006 BECKEH; Prj ID: 2011-019.GPJ





DATE:05/04/1

-

# **APPENDIX D**

# STABILITY ANALYSES

#### **Computer Program**

Stability analyses were performed using the computer program Slide by Rocscience. The program analyzes slope stability problems by a two-dimensional limit equilibrium methods including Bishop's, Janbu, Morgenstern & Price, and general limit equilibrium (GLE). The particular method used for each analysis is indicated on the output plots.

Soil strength can be modeled in a variety of ways including standard Mohr-Coulomb, bilinear Mohr-Coulomb, and general shear strength relationships. Where materials strengths have anisotropic properties, the program allows the strength to be modeled by introducing a strength function depending upon the angle of inclination of the slice base. With this function, anisotropic conditions typically found in bedrock materials can be modeled.

Potential failure surfaces are determined by a variety of search methods including circular surfaces, block-specified surfaces, fully-specified surfaces, and random-generated search algorithms. The program calculates the factor of safety for all possible combinations of surfaces defined by search method. The program can also model other factors such as groundwater, earthquake loads, and external loads.

#### Shear Strengths

The shear strengths used in our analyses were based on correlations with blow counts and previous experience. The strength values used are summarized In Table D-1 below:

| Material                          | Unit Weight | Cohesion | Friction Angle |
|-----------------------------------|-------------|----------|----------------|
|                                   | (pcf)       | (psf)    | (degrees)      |
| Quaternary alluvial deposits (Qg) | 125         | 0        | 45             |

# TABLE D-1Summary of Shear Strengths

#### **Summary of Results**

Results of the analyses are summarized in Table D-2 below. Plots and output of the results are attached.

# TABLE D-2Summary of Stability Analyses

| Section | Search<br>Type | Analysis Method     | Minimum Static<br>Factor of Safety | Minimum Seismic<br>Factor of Safety |
|---------|----------------|---------------------|------------------------------------|-------------------------------------|
| A-A'    | Circular       | Bishop's simplified | 2.55                               | 1.45                                |







# Slide Analysis Information 3138.00 Cross Section A (Static)

### **Project Summary**

| File Name:             | 3138.00 Cross Section A-Static with water |
|------------------------|---|
| Slide Modeler Version: | 7.017                                     |
| Project Title:         | 3138.00 Cross Section A (Static)          |
| Analysis:              | Bishop                                    |

#### **General Settings**

| Units of Measurement:        | Imperial Units |
|------------------------------|----------------|
| Time Units:                  | days           |
| Permeability Units:          | feet/second    |
| Failure Direction:           | Left to Right  |
| Data Output:                 | Standard       |
| Maximum Material Properties: | 20             |
| Maximum Support Properties:  | 20             |

#### **Analysis Options**

| Slices Type:  | Vertical                              |
|---|---------------------------------------|
| Analysis Methods Used   |                                       |
|   | Bishop simplified<br>Janbu simplified |
| 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:      | Grid Search      |
| Radius Increment:   | 10               |
| Composite Surfaces: | Disabled         |
| Reverse Curvature:  | Invalid Surfaces |
| Minimum Elevation:  | Not Defined      |
| Minimum Depth:      | Not Defined      |
| Minimum Area:       | Not Defined      |
| Minimum Weight:     | Not Defined      |

#### Seismic

Advanced seismic analysis: No Staged pseudostatic analysis: No

#### **Material Properties**

| Property              | Qg           |
|-----------------------|--------------|
| Color                 |              |
| Strength Type         | Mohr-Coulomb |
| Unit Weight [lbs/ft3] | 125          |
| Cohesion [psf]        | 0            |
| Friction Angle [deg]  | 45           |
| Water Surface         | Water Table  |
| Hu Value              | 1            |

#### **Global Minimums**

#### Method: bishop simplified

| FS                           | 2.551780         |
|------------------------------|------------------|
| Center:                      | 420.531, 831.106 |
| Radius:                      | 205.408          |
| Left Slip Surface Endpoint:  | 341.884, 641.351 |
| Right Slip Surface Endpoint: | 349.878, 638.232 |
| Left Slope Intercept:        | 341.884 641.351  |
| Right Slope Intercept:       | 349.878 638.500  |
| Resisting Moment:            | 14616.9 lb-ft    |
| Driving Moment:              | 5728.1 lb-ft     |
| Total Slice Area:            | 0.704107 ft2     |
| Surface Horizontal Width:    | 7.99351 ft       |
| Surface Average Height:      | 0.0880848 ft     |



#### Method: janbu simplified

| FS                           | 2.551130         |
|------------------------------|------------------|
| Center:                      | 382.936, 735.077 |
| Radius:                      | 102.334          |
| Left Slip Surface Endpoint:  | 341.732, 641.405 |
| Right Slip Surface Endpoint: | 349.907, 638.221 |
| Left Slope Intercept:        | 341.732 641.405  |
| Right Slope Intercept:       | 349.907 638.500  |
| Resisting Horizontal Force:  | 100.116 lb       |
| Driving Horizontal Force:    | 39.244 lb        |
| Total Slice Area:            | 1.02865 ft2      |
| Surface Horizontal Width:    | 8.1744 ft        |
| Surface Average Height:      | 0.125838 ft      |

#### Valid / Invalid Surfaces

#### Method: bishop simplified

Number of Valid Surfaces: 6918 Number of Invalid Surfaces: 3653

#### Error Codes:

Error Code -102 reported for 9 surfaces Error Code -103 reported for 2772 surfaces Error Code -106 reported for 91 surfaces Error Code -1000 reported for 781 surfaces

#### Method: janbu simplified

Number of Valid Surfaces: 6833 Number of Invalid Surfaces: 3738

#### Error Codes:

Error Code -102 reported for 9 surfaces Error Code -103 reported for 2772 surfaces Error Code -106 reported for 91 surfaces Error Code -108 reported for 85 surfaces Error Code -1000 reported for 781 surfaces

#### **Error Codes**

The following errors were encountered during the computation:

-102 = Two surface / slope intersections, but resulting arc is actually outside soil region.

-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.

-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).

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.



### Slice Data



| Slice<br>Number | Width<br>[ft] | Weight<br>[lbs] | Angle<br>of Slice<br>Base<br>[degrees] | Base<br>Material | Base<br>Cohesion<br>[psf] | Base<br>Friction<br>Angle<br>[degrees] | Shear<br>Stress<br>[psf] | Shear<br>Strength<br>[psf] | Base<br>Normal<br>Stress<br>[psf] | Pore<br>Pressure<br>[psf] | Effective<br>Normal<br>Stress<br>[psf] |
|-----------------|---------------|-----------------|--|------------------|---------------------------|--|--------------------------|----------------------------|-----------------------------------|---------------------------|--|
| 1               | 0.161491      | 0.0947005       | -22.488                                | Qg               | 0                         | 45                                     | 0.197729                 | 0.504562                   | 0.504562                          | 0                         | 0.504562                               |
| 2               | 0.161491      | 0.282478        | -22.4393                               | Qg               | 0                         | 45                                     | 0.589996                 | 1.50554                    | 1.50554                           | 0                         | 1.50554                                |
| 3               | 0.161491      | 0.467009        | -22.3905                               | Qg               | 0                         | 45                                     | 0.975746                 | 2.48989                    | 2.48989                           | 0                         | 2.48989                                |
| 4               | 0.161491      | 0.648298        | -22.3418                               | Qg               | 0                         | 45                                     | 1.35498                  | 3.4576                     | 3.4576                            | 0                         | 3.4576                                 |
| 5               | 0.161491      | 0.826349        | -22.2931                               | Qg               | 0                         | 45                                     | 1.72769                  | 4.40868                    | 4.40868                           | 0                         | 4.40868                                |
| 6               | 0.161491      | 1.00116         | -22.2444                               | Qg               | 0                         | 45                                     | 2.09388                  | 5.34313                    | 5.34313                           | 0                         | 5.34313                                |
| 7               | 0.161491      | 1.17275         | -22.1958                               | Qg               | 0                         | 45                                     | 2.45356                  | 6.26095                    | 6.26097                           | 0                         | 6.26097                                |
| 8               | 0.161491      | 1.3411          | -22.1471                               | Qg               | 0                         | 45                                     | 2.80672                  | 7.16213                    | 7.16211                           | 0                         | 7.16211                                |
| 9               | 0.161491      | 1.50623         | -22.0985                               | Qg               | 0                         | 45                                     | 3.15336                  | 8.04669                    | 8.0467                            | 0                         | 8.0467                                 |
| 10              | 0.161491      | 1.66813         | -22.0499                               | Qg               | 0                         | 45                                     | 3.49349                  | 8.91461                    | 8.91463                           | 0                         | 8.91463                                |
| 11              | 0.161491      | 1.82682         | -22.0013                               | Qg               | 0                         | 45                                     | 3.8271                   | 9.76591                    | 9.76591                           | 0                         | 9.76591                                |
| 12              | 0.161491      | 1.98229         | -21.9527                               | Qg               | 0                         | 45                                     | 4.1542                   | 10.6006                    | 10.6005                           | 0                         | 10.6005                                |
| 13              | 0.161491      | 2.13455         | -21.9042                               | Qg               | 0                         | 45                                     | 4.47476                  | 11.4186                    | 11.4186                           | 0                         | 11.4186                                |
| 14              | 0.161491      | 2.2836          | -21.8556                               | Qg               | 0                         | 45                                     | 4.78881                  | 12.22                      | 12.22                             | 0                         | 12.22                                  |
| 15              | 0.161491      | 2.42945         | -21.8071                               | Qg               | 0                         | 45                                     | 5.09636                  | 13.0048                    | 13.0047                           | 0                         | 13.0047                                |
| 16              | 0.161491      | 2.57209         | -21.7586                               | Qg               | 0                         | 45                                     | 5.39737                  | 13.7729                    | 13.7729                           | 0                         | 13.7729                                |
| 17              | 0.161491      | 2.66361         | -21.7101                               | Qg               | 0                         | 45                                     | 5.59131                  | 14.2678                    | 14.2678                           | 0                         | 14.2678                                |
| 18              | 0.161491      | 2.63816         | -21.6616                               | Qg               | 0                         | 45                                     | 5.5397                   | 14.1361                    | 14.1361                           | 0                         | 14.1361                                |
| 19              | 0.161491      | 2.60465         | -21.6132                               | Qg               | 0                         | 45                                     | 5.47116                  | 13.9612                    | 13.9612                           | 0                         | 13.9612                                |
| 20              | 0.161491      | 2.56795         | -21.5647                               | Qg               | 0                         | 45                                     | 5.39584                  | 13.769                     | 13.769                            | 0                         | 13.769                                 |
| 21              | 0.161491      | 2.52807         | -21.5163                               | Qg               | 0                         | 45                                     | 5.31382                  | 13.5597                    | 13.5597                           | 0                         | 13.5597                                |
| 22              | 0.161491      | 2.485           | -21.4679                               | Qg               | 0                         | 45                                     | 5.22502                  | 13.3331                    | 13.3331                           | 0                         | 13.3331                                |
| 23              | 0.161491      | 2.43876         | -21.4195                               | Qg               | 0                         | 45                                     | 5.12948                  | 13.0893                    | 13.0893                           | 0                         | 13.0893                                |
| 24              | 0.161491      | 2.38933         | -21.3711                               | Qg               | 0                         | 45                                     | 5.0272                   | 12.8283                    | 12.8283                           | 0                         | 12.8283                                |
| 25              | 0.161491      | 2.33674         | -21.3228                               | Qg               | 0                         | 45                                     | 4.91817                  | 12.5501                    | 12.5501                           | 0                         | 12.5501                                |
| 26              | 0.161491      | 2.28097         | -21.2744                               | Qg               | 0                         | 45                                     | 4.80237                  | 12.2546                    | 12.2546                           | 0                         | 12.2546                                |
| 27              | 0.161491      | 2.22203         | -21.2261                               | Qg               | 0                         | 45                                     | 4.67983                  | 11.9419                    | 11.9419                           | 0                         | 11.9419                                |
| 28              | 0.161491      | 2.15994         | -21.1778                               | Qg               | 0                         | 45                                     | 4.55055                  | 11.612                     | 11.612                            | 0                         | 11.612                                 |
| 29              | 0.161491      | 2.09468         | -21.1295                               | Qg               | 0                         | 45                                     | 4.41453                  | 11.2649                    | 11.2649                           | 0                         | 11.2649                                |
| 30              | 0.161491      | 2.02626         | -21.0812                               | Qg               | 0                         | 45                                     | 4.27172                  | 10.9005                    | 10.9005                           | 0                         | 10.9005                                |
| 31              | 0.161491      | 1.95469         | -21.0329                               | Qg               | 0                         | 45                                     | 4.12222                  | 10.519                     | 10.5189                           | 0                         | 10.5189                                |
| 32              | 0.161491      | 1.87996         | -20.9847                               | Qg               | 0                         | 45                                     | 3.96594                  | 10.1202                    | 10.1202                           | 0                         | 10.1202                                |
| 33              | 0.161491      | 1.80209         | -20.9364                               | Qg               | 0                         | 45                                     | 3.80289                  | 9.70415                    | 9.70414                           | 0                         | 9.70414                                |
| 34              | 0.161491      | 1.72107         | -20.8882                               | Qg               | 0                         | 45                                     | 3.63311                  | 9.27091                    | 9.27093                           | 0                         | 9.27093                                |
| 35              | 0.161491      | 1.63691         | -20.84                                 | Qg               | 0                         | 45                                     | 3.45659                  | 8.82045                    | 8.82048                           | 0                         | 8.82048                                |
| 36              | 0.161491      | 1.5496          | -20.7918                               | Qg               | 0                         | 45                                     | 3.27331                  | 8.35277                    | 8.35276                           | 0                         | 8.35276                                |
| 37              | 0.161491      | 1.45917         | -20.7436                               | Qg               | 0                         | 45                                     | 3.08328                  | 7.86786                    | 7.86784                           | 0                         | 7.86784                                |
| 38              | 0.161491      | 1.36559         | -20.6955                               | Qg               | 0                         | 45                                     | 2.88651                  | 7.36574                    | 7.36573                           | 0                         | 7.36573                                |
| 39              | 0.161491      | 1.26889         | -20.6473                               | Qg               | 0                         | 45                                     | 2.68298                  | 6.84638                    | 6.84639                           | 0                         | 6.84639                                |
| 40              | 0.161491      | 1.16906         | -20.5992                               | Qg               | 0                         | 45                                     | 2.47271                  | 6.30981                    | 6.30983                           | 0                         | 6.30983                                |
| 41              | 0.161491      | 1.06611         | -20.5511                               | Qg               | 0                         | 45                                     | 2.25568                  | 5.75601                    | 5.75601                           | 0                         | 5.75601                                |
| 42              | 0.161491      | 0.960028        | -20.503                                | Qg               | 0                         | 45                                     | 2.03191                  | 5.18498                    | 5.18498                           | 0                         | 5.18498                                |
| 43              | 0.161491      | 0.850832        | -20.4549                               | Qg               | 0                         | 45                                     | 1.80138                  | 4.59673                    | 4.59673                           | 0                         | 4.59673                                |
| 44              | 0.161491      | 0.73852         | -20.4068                               | Qg               | 0                         | 45                                     | 1.5641                   | 3.99125                    | 3.99125                           | 0                         | 3.99125                                |
| 45              | 0.161491      | 0.623094        | -20.3588                               | Qg               | 0                         | 45                                     | 1.32008                  | 3.36855                    | 3.36855                           | 0                         | 3.36855                                |
| 46              | 0.145284      | 0.533822        | -20.3131                               | Qg               | 0                         | 45                                     | 0.683249                 | 1.7435                     | 3.42143                           | 1.67793                   | 1.7435                                 |
| 47              | 0.145284      | 0.911657        | -20.2699                               | Qg               | 0                         | 45                                     | 0.426244                 | 1.08768                    | 6.1176                            | 5.02991                   | 1.08769                                |
| 48              | 0.145284      | 1.34721         | -20.2267                               | Qg               | 0                         | 45                                     | 0.307786                 | 0.785403                   | 9.15955                           | 8.37413                   | 0.785417                               |
| 49              | 0.145284      | 1.7805          | -20.1835                               | Qg               | 0                         | 45                                     | 0.186591                 | 0.47614                    | 12.1867                           | 11.7106                   | 0.476123                               |
| 50              | 0.145284      | 2.21153         | -20.1404                               | Qg               | 0                         | 45                                     | 0.0626594                | 0.159893                   | 15.1992                           | 15.0393                   | 0.159852                               |

Global Minimum Query (janbu simplified) - Safety Factor: 2.55113



| Slice  | Width    | Weight   | Angle<br>of Slice | Base     | Base              | Base<br>Friction | Shear           | Shear             | Base<br>Normal | Pore              | Effective<br>Normal |
|--------|----------|----------|-------------------|----------|-------------------|------------------|-----------------|-------------------|----------------|-------------------|---------------------|
| Number | [ft]     | [lbs]    | Base              | Material | Cohesion<br>[psf] | Angle            | Stress<br>[psf] | Strength<br>[psf] | Stress         | Pressure<br>[psf] | Stress              |
| 1      | 0 162696 | 0 120022 | 22 6025           | 04       | 0                 | [uegrees]        | 0 202002        | 0 724246          | [psi]          | 0                 | [psi]               |
| 1      | 0.103000 | 0.130955 | -23.0955          | Ug<br>Og | 0                 | 45               | 0.205092        | 2 15607           | 2 15607        | 0                 | 0.724247            |
| 2      | 0.103080 | 0.413314 | -23.3353          | Qg<br>Qg | 0                 | 45               | 1 20202         | 2.13007           | 2.13007        | 0                 | 2.13007             |
| 5      | 0.103000 | 0.060754 | -25.4955          | Ug<br>Or | 0                 | 45               | 1.59295         | 3.33333           | 3.55555        | 0                 | 3.55555             |
| 4      | 0.103080 | 0.941209 | -23.3930          | Ug<br>Or | 0                 | 45               | 1.92720         | 4.91009           | 4.91669        | 0                 | 4.91669             |
| 5      | 0.163686 | 1.19475  | -23.2938          | Ug<br>Or | 0                 | 45               | 2.44813         | 0.24549           | 6.24551        | 0                 | 5.24551             |
| 6      | 0.163686 | 1.44139  | -23.194           | Qg       | 0                 | 45               | 2.95553         | 7.53995           | 7.53995        | 0                 | 7.53995             |
| /      | 0.163686 | 1.68112  | -23.0944          | Qg       | 0                 | 45               | 3.44949         | 8.80009           | 8.80009        | 0                 | 8.80009             |
| 8      | 0.163686 | 1.91397  | -22.9948          | Qg       | 0                 | 45               | 3.92998         | 10.0259           | 10.0259        | 0                 | 10.0259             |
| 9      | 0.163686 | 2.13996  | -22.8953          | Qg       | 0                 | 45               | 4.39703         | 11.21/4           | 11.21/4        | 0                 | 11.2174             |
| 10     | 0.163686 | 2.35909  | -22.7958          | Qg       | 0                 | 45               | 4.8506          | 12.3745           | 12.3745        | 0                 | 12.3745             |
| 11     | 0.163686 | 2.5/138  | -22.6964          | Qg       | 0                 | 45               | 5.29075         | 13.4974           | 13.4974        | 0                 | 13.4974             |
| 12     | 0.163686 | 2.77685  | -22.59/1          | Qg       | 0                 | 45               | 5./1/43         | 14.5859           | 14.5859        | 0                 | 14.5859             |
| 13     | 0.163686 | 2.97552  | -22.49/9          | Qg       | 0                 | 45               | 6.13066         | 15.6401           | 15.6401        | 0                 | 15.6401             |
| 14     | 0.163686 | 3.16739  | -22.3987          | Qg       | 0                 | 45               | 6.53044         | 16.66             | 16.66          | 0                 | 16.66               |
| 15     | 0.163686 | 3.35248  | -22.2996          | Qg       | 0                 | 45               | 6.916/8         | 17.6456           | 17.6456        | 0                 | 17.6456             |
| 16     | 0.163686 | 3.53081  | -22.2006          | Qg       | 0                 | 45               | 7.28967         | 18.5969           | 18.5969        | 0                 | 18.5969             |
| 17     | 0.163686 | 3.70218  | -22.1017          | Qg       | 0                 | 45               | 7.64869         | 19.5128           | 19.5128        | 0                 | 19.5128             |
| 18     | 0.163686 | 3.77329  | -22.0028          | Qg       | 0                 | 45               | 7.8009          | 19.9011           | 19.9011        | 0                 | 19.9011             |
| 19     | 0.163686 | 3.76029  | -21.904           | Qg       | 0                 | 45               | /.//93          | 19.846            | 19.846         | 0                 | 19.846              |
| 20     | 0.163686 | 3.74058  | -21.8052          | Qg       | 0                 | 45               | 7.74378         | 19.7554           | 19.7554        | 0                 | 19.7554             |
| 21     | 0.163686 | 3.71418  | -21.7066          | Qg       | 0                 | 45               | 7.69432         | 19.6292           | 19.6292        | 0                 | 19.6292             |
| 22     | 0.163686 | 3.6811   | -21.608           | Qg       | 0                 | 45               | 7.63093         | 19.4675           | 19.4675        | 0                 | 19.4675             |
| 23     | 0.163686 | 3.64135  | -21.5094          | Qg       | 0                 | 45               | 7.55363         | 19.2703           | 19.2703        | 0                 | 19.2703             |
| 24     | 0.163686 | 3.59496  | -21.4109          | Qg       | 0                 | 45               | 7.46242         | 19.0376           | 19.0376        | 0                 | 19.0376             |
| 25     | 0.163686 | 3.54192  | -21.3125          | Qg       | 0                 | 45               | 7.35725         | 18.7693           | 18.7693        | 0                 | 18.7693             |
| 26     | 0.163686 | 3.48225  | -21.2142          | Qg       | 0                 | 45               | 7.2382          | 18.4656           | 18.4656        | 0                 | 18.4656             |
| 27     | 0.163686 | 3.41598  | -21.1159          | Qg       | 0                 | 45               | 7.1052          | 18.1263           | 18.1263        | 0                 | 18.1263             |
| 28     | 0.163686 | 3.3431   | -21.0177          | Qg       | 0                 | 45               | 6.95829         | 17.7515           | 17.7515        | 0                 | 17.7515             |
| 29     | 0.163686 | 3.26364  | -20.9196          | Qg       | 0                 | 45               | 6.79746         | 17.3412           | 17.3411        | 0                 | 17.3411             |
| 30     | 0.163686 | 3.17761  | -20.8215          | Qg       | 0                 | 45               | 6.62267         | 16.8953           | 16.8953        | 0                 | 16.8953             |
| 31     | 0.163686 | 3.08501  | -20.7235          | Qg       | 0                 | 45               | 6.43397         | 16.4139           | 16.4139        | 0                 | 16.4139             |
| 32     | 0.163686 | 2.98587  | -20.6255          | Qg       | 0                 | 45               | 6.23136         | 15.897            | 15.897         | 0                 | 15.897              |
| 33     | 0.163686 | 2.88019  | -20.5276          | Qg       | 0                 | 45               | 6.01482         | 15.3446           | 15.3446        | 0                 | 15.3446             |
| 34     | 0.163686 | 2.76799  | -20.4298          | Qg       | 0                 | 45               | 5.78438         | 14.7567           | 14.7567        | 0                 | 14.7567             |
| 35     | 0.163686 | 2.64928  | -20.332           | Qg       | 0                 | 45               | 5.53998         | 14.1332           | 14.1332        | 0                 | 14.1332             |
| 36     | 0.163686 | 2.52408  | -20.2343          | Qg       | 0                 | 45               | 5.28166         | 13.4742           | 13.4742        | 0                 | 13.4742             |
| 37     | 0.163686 | 2.39239  | -20.1367          | Qg       | 0                 | 45               | 5.00939         | 12.7796           | 12.7797        | 0                 | 12.7797             |
| 38     | 0.163686 | 2.25422  | -20.0391          | Qg       | 0                 | 45               | 4.72324         | 12.0496           | 12.0495        | 0                 | 12.0495             |
| 39     | 0.163686 | 2.1096   | -19.9416          | Qg       | 0                 | 45               | 4.4231          | 11.2839           | 11.284         | 0                 | 11.284              |
| 40     | 0.163686 | 1.95852  | -19.8441          | Qg       | 0                 | 45               | 4.10908         | 10.4828           | 10.4828        | 0                 | 10.4828             |
| 41     | 0.163686 | 1.80101  | -19.7467          | Qg       | 0                 | 45               | 3.7811          | 9.64608           | 9.64607        | 0                 | 9.64607             |
| 42     | 0.163686 | 1.63707  | -19.6494          | Qg       | 0                 | 45               | 3.43919         | 8.77382           | 8.77384        | 0                 | 8.77384             |
| 43     | 0.163686 | 1.46672  | -19.5521          | Qg       | 0                 | 45               | 3.08334         | 7.866             | 7.86598        | 0                 | 7.86598             |
| 44     | 0.163686 | 1.28997  | -19.4548          | Qg       | 0                 | 45               | 2.71355         | 6.92263           | 6.92265        | 0                 | 6.92265             |
| 45     | 0.163686 | 1.10682  | -19.3577          | Qg       | 0                 | 45               | 2.32983         | 5.94369           | 5.9437         | 0                 | 5.9437              |
| 46     | 0.161703 | 0.927642 | -19.2612          | Qg       | 0                 | 45               | 1.37007         | 3.49523           | 5.25817        | 1.76294           | 3.49523             |
| 47     | 0.161703 | 1.21239  | -19.1653          | Qg       | 0                 | 45               | 0./65316        | 1.95242           | 7.23175        | 5.27935           | 1.9524              |
| 48     | 0.161703 | 1.67918  | -19.0695          | Qg       | 0                 | 45               | 0.554942        | 1.41573           | 10.1926        | 8.77685           | 1.41575             |
| 49     | 0.161703 | 2.13984  | -18.9737          | Qg       | 0                 | 45               | 0.337754        | 0.861655          | 13.1171        | 12.2555           | 0.861624            |
| 50     | 0.161703 | 2.5944   | -18.878           | Qg       | 0                 | 45               | 0.113746        | 0.290181          | 16.0054        | 15.7152           | 0.290207            |

#### Interslice Data



#### Global Minimum Query (bishop simplified) - Safety Factor: 2.55178

| Slice<br>Number | X<br>coordinate | Y<br>coordinate - Bottom | Interslice<br>Normal Force | Interslice<br>Shear Force | Interslice<br>Force Angle |
|-----------------|-----------------|--------------------------|----------------------------|---------------------------|---------------------------|
|                 | [ft]            | [ft]                     | [lbs]                      | [lbs]                     | [degrees]                 |
| 1               | 341.884         | 641.351                  | 0                          | 0                         | 0                         |
| 2               | 342.046         | 641.285                  | 0.00180043                 | 0                         | 0                         |
| 3               | 342.207         | 641.218                  | 0.00693046                 | 0                         | 0                         |
| 4               | 342.369         | 641.151                  | 0.0150144                  | 0                         | 0                         |
| 5               | 342.53          | 641.085                  | 0.0256852                  | 0                         | 0                         |
| 6               | 342.692         | 641.019                  | 0.0385842                  | 0                         | 0                         |
| 7               | 342.853         | 640.953                  | 0.0533612                  | 0                         | 0                         |
| 8               | 343.015         | 640.887                  | 0.0696746                  | 0                         | 0                         |
| 9               | 343.176         | 640.821                  | 0.08/1911                  | 0                         | 0                         |
| 10              | 343.338         | 640.755                  | 0.105586                   | 0                         | 0                         |
| 11              | 343.499         | 640.69                   | 0.124542                   | 0                         | 0                         |
| 12              | 343.661         | 640.625                  | 0.143753                   | 0                         | 0                         |
| 13              | 343.822         | 640.56                   | 0.162917                   | 0                         | 0                         |
| 14              | 343.984         | 640.495                  | 0.181745                   | 0                         | 0                         |
| 15              | 344.145         | 640.43                   | 0.199952                   | 0                         | 0                         |
| 16              | 344.307         | 640.365                  | 0.217264                   | 0                         | 0                         |
| 17              | 344.468         | 640.301                  | 0.233415                   | 0                         | 0                         |
| 18              | 344.629         | 640.237                  | 0.247887                   | 0                         | 0                         |
| 19              | 344.791         | 640.173                  | 0.259987                   | 0                         | 0                         |
| 20              | 344.952         | 640.109                  | 0.269731                   | 0                         | 0                         |
| 21              | 345.114         | 640.045                  | 0.277167                   | 0                         | 0                         |
| 22              | 345.275         | 639.981                  | 0.28235                    | 0                         | 0                         |
| 23              | 345.437         | 639.918                  | 0.285346                   | 0                         | 0                         |
| 24              | 345.598         | 639.854                  | 0.286225                   | 0                         | 0                         |
| 25              | 345.76          | 639.791                  | 0.285069                   | 0                         | 0                         |
| 26              | 345.921         | 639.728                  | 0.281967                   | 0                         | 0                         |
| 27              | 346.083         | 639.665                  | 0.277013                   | 0                         | 0                         |
| 28              | 346.244         | 639.602                  | 0.270313                   | 0                         | 0                         |
| 29              | 346.406         | 639.54                   | 0.261979                   | 0                         | 0                         |
| 30              | 346.567         | 639.477                  | 0.252131                   | 0                         | 0                         |
| 31              | 346.729         | 639.415                  | 0.240897                   | 0                         | 0                         |
| 32              | 346.89          | 639.353                  | 0.228412                   | 0                         | 0                         |
| 33              | 347.052         | 639.291                  | 0.214822                   | 0                         | 0                         |
| 34              | 347.213         | 639.229                  | 0.200278                   | 0                         | 0                         |
| 35              | 347.375         | 639.168                  | 0.184938                   | 0                         | 0                         |
| 36              | 347.536         | 639.106                  | 0.168972                   | 0                         | 0                         |
| 37              | 347.698         | 639.045                  | 0.152553                   | 0                         | 0                         |
| 38              | 347.859         | 638.984                  | 0.135866                   | 0                         | 0                         |
| 39              | 348.021         | 638.923                  | 0.119101                   | 0                         | 0                         |
| 40              | 348.182         | 638.862                  | 0.102456                   | 0                         | 0                         |
| 41              | 348.344         | 638.801                  | 0.0861393                  | 0                         | 0                         |
| 42              | 348.505         | 638.741                  | 0.0703637                  | 0                         | 0                         |
| 43              | 348.667         | 638.68                   | 0.0553516                  | 0                         | 0                         |
| 44              | 348.828         | 638.62                   | 0.0205440                  | 0                         | 0                         |
| 45              | 348.99          | 638.56                   | 0.0285448                  | 0                         | 0                         |
| 46              | 349.151         | 038.5                    | 0.01/2326                  | 0                         | U                         |
| 4/              | 349.297         | 638.446                  | 0.0716904                  | 0                         | U                         |
| 48              | 349.442         | 638.393                  | 0.113995                   | 0                         | 0                         |
| 49              | 349.58/         | 038.339                  | 0.0200100                  | 0                         | 0                         |
| 50              | 349./32         | 038.280                  | 0.0809109                  | 0                         | 0                         |
| 51              | 349.878         | 638.232                  | 2.23515                    | 0                         | 0                         |


#### Global Minimum Query (janbu simplified) - Safety Factor: 2.55113

| Slice  | X                  | Y                           | Interslice            | Interslice           | Interslice               |
|--------|--------------------|-----------------------------|-----------------------|----------------------|--------------------------|
| Number | coordinate<br>[ft] | coordinate - Bottom<br>[ft] | Normal Force<br>[lbs] | Shear Force<br>[lbs] | Force Angle<br>[degrees] |
| 1      | 341.732            | 641.405                     | 0                     | 0                    | 0                        |
| 2      | 341.896            | 641.334                     | 0.00557442            | 0                    | 0                        |
| 3      | 342.06             | 641.262                     | 0.0214351             | 0                    | 0                        |
| 4      | 342.223            | 641.191                     | 0.0463684             | 0                    | 0                        |
| 5      | 342.387            | 641.12                      | 0.0791992             | 0                    | 0                        |
| 6      | 342.551            | 641.05                      | 0.11879               | 0                    | 0                        |
| 7      | 342.714            | 640.98                      | 0.164042              | 0                    | 0                        |
| 8      | 342.878            | 640.91                      | 0.213893              | 0                    | 0                        |
| 9      | 343.042            | 640.84                      | 0.26732               | 0                    | 0                        |
| 10     | 343.206            | 640.771                     | 0.323334              | 0                    | 0                        |
| 11     | 343.369            | 640.702                     | 0.380987              | 0                    | 0                        |
| 12     | 343.533            | 640.634                     | 0.439367              | 0                    | 0                        |
| 13     | 343.697            | 640.566                     | 0.497596              | 0                    | 0                        |
| 14     | 343.86             | 640.498                     | 0.554835              | 0                    | 0                        |
| 15     | 344 024            | 640.43                      | 0 610282              | 0                    | 0                        |
| 16     | 344 188            | 640 363                     | 0.663169              | 0                    | 0                        |
| 10     | 344.100            | 640.297                     | 0.003105              | 0                    | 0                        |
| 10     | 244.551            | 640.237                     | 0.712700              | 0                    | 0                        |
| 10     | 244.515            | 640.25                      | 0.758570              | 0                    | 0                        |
| 19     | 244.079            | 640.104                     | 0.796549              | 0                    | 0                        |
| 20     | 344.042            | 640.098                     | 0.851099              | 0                    | 0                        |
| 21     | 345.000            | 640.033                     | 0.858427              | 0                    | 0                        |
| 22     | 345.17             | 639.967                     | 0.87857               | 0                    | 0                        |
| 23     | 345.333            | 639.903                     | 0.892197              | 0                    | 0                        |
| 24     | 345.497            | 639.838                     | 0.899415              | 0                    | 0                        |
| 25     | 345.661            | 639.774                     | 0.900363              | 0                    | 0                        |
| 26     | 345.825            | 639./1                      | 0.895213              | 0                    | 0                        |
| 27     | 345.988            | 639.647                     | 0.884173              | 0                    | 0                        |
| 28     | 346.152            | 639.583                     | 0.867484              | 0                    | 0                        |
| 29     | 346.316            | 639.52                      | 0.84542               | 0                    | 0                        |
| 30     | 346.479            | 639.458                     | 0.818289              | 0                    | 0                        |
| 31     | 346.643            | 639.396                     | 0.786434              | 0                    | 0                        |
| 32     | 346.807            | 639.334                     | 0.750229              | 0                    | 0                        |
| 33     | 346.97             | 639.272                     | 0.710082              | 0                    | 0                        |
| 34     | 347.134            | 639.211                     | 0.666434              | 0                    | 0                        |
| 35     | 347.298            | 639.15                      | 0.619759              | 0                    | 0                        |
| 36     | 347.461            | 639.089                     | 0.570563              | 0                    | 0                        |
| 37     | 347.625            | 639.029                     | 0.519387              | 0                    | 0                        |
| 38     | 347.789            | 638.969                     | 0.466801              | 0                    | 0                        |
| 39     | 347.952            | 638.909                     | 0.413412              | 0                    | 0                        |
| 40     | 348.116            | 638.85                      | 0.359855              | 0                    | 0                        |
| 41     | 348.28             | 638.791                     | 0.306799              | 0                    | 0                        |
| 42     | 348.443            | 638.732                     | 0.254946              | 0                    | 0                        |
| 43     | 348.607            | 638.673                     | 0.20503               | 0                    | 0                        |
| 44     | 348.771            | 638.615                     | 0.157815              | 0                    | 0                        |
| 45     | 348.935            | 638.558                     | 0.114098              | 0                    | 0                        |
| 46     | 349.098            | 638.5                       | 0.0747087             | 0                    | 0                        |
| 47     | 349.26             | 638.443                     | 0.142117              | 0                    | 0                        |
| 48     | 349.422            | 638.387                     | 0.222945              | 0                    | 0                        |
| 49     | 349.583            | 638.331                     | 0.230863              | 0                    | 0                        |
| 50     | 349.745            | 638.276                     | 0.163168              | 0                    | 0                        |
| 51     | 349.907            | 638.221                     | 2.43724               | 0                    | 0                        |



# List Of Coordinates

#### Water Table

| Х   | Y     |
|-----|-------|
| 0   | 638.5 |
| 485 | 638.5 |

### **External Boundary**

-

| Х       | Y       |  |  |
|---------|---------|--|--|
| 5.276   | 663.553 |  |  |
| 0       | 663.458 |  |  |
| 0       | 600.14  |  |  |
| 485     | 600.14  |  |  |
| 485     | 630.057 |  |  |
| 432.69  | 631.984 |  |  |
| 385.343 | 634.21  |  |  |
| 373.357 | 635.401 |  |  |
| 361     | 636.906 |  |  |
| 352.592 | 637.709 |  |  |
| 350.08  | 638.15  |  |  |
| 344.507 | 640.418 |  |  |
| 331.786 | 644.945 |  |  |
| 325.53  | 646.745 |  |  |
| 321.064 | 647.155 |  |  |
| 316.753 | 647.155 |  |  |
| 312.656 | 647.923 |  |  |
| 304.204 | 650.441 |  |  |
| 294.344 | 653.813 |  |  |
| 284.271 | 657.697 |  |  |
| 277.265 | 660.503 |  |  |
| 273.1   | 662.054 |  |  |
| 269.65  | 662.054 |  |  |
| 261.321 | 662.054 |  |  |
| 258.156 | 662.626 |  |  |
| 254.122 | 664.206 |  |  |
| 250.778 | 664.83  |  |  |
| 248.922 | 664.585 |  |  |
| 238.949 | 664.585 |  |  |
| 235.547 | 665.129 |  |  |
| 233.052 | 665.832 |  |  |
| 230.08  | 667.125 |  |  |
| 225.974 | 669.008 |  |  |
| 223.242 | 670.028 |  |  |
| 221.322 | 670.549 |  |  |
| 220.266 | 670.549 |  |  |
| 218.143 | 670.149 |  |  |
| 215.482 | 669.532 |  |  |
| 211.337 | 668.496 |  |  |
| 205.933 | 667.376 |  |  |
| 198.51  | 665.98  |  |  |
| 194.639 | 665.622 |  |  |
| 189.336 | 665.28  |  |  |



| 665.12  |
|---------|
| 664.935 |
| 664.735 |
| 664.735 |
| 664.535 |
| 664.281 |
| 664.182 |
| 664.337 |
| 664.049 |
| 664.217 |
| 664.217 |
| 664.081 |
| 663.725 |
| 663.725 |
| 663.571 |
| 663.387 |
| 663.387 |
| 663.553 |
| 663.553 |
|         |

### Worksheet to Determine Seismic Coefficient

REFERENCE: Guidelines for Evaluating and Mitigating Seismic Hazards in Calfiornia SP 117A (CGS, 2008)

Recommended Procedures for Implementation of DMG Special Publication 117 (2002)

\*grey cells = required input

| Project Number = | 3138.00                          |
|------------------|----------------------------------|
| Project Name =   | Residential Development at Azusa |
| Date =           | 4/26/2023                        |
| By =             | EJJ                              |

Step 1) Determine modal magnitude (M) and distance (r) pair based on de-aggregation of peak ground acceleration with 475-year return period, using USGS website: <u>https://earthquake.usgs.gov/hazards/interactive/</u>

Step 2) Input values below:

Mode Magnitude = 7.71Mode Distance = 9.14 km unweighted PGA = 0.4273 g (475-year return period PGA) Slope Height H = 40 ft  $F_v = 0.8$  Site Class B  $S_1 = 0.653$ 

- Step 3) Calculate MHA (kav) based on FHWA-NHI-11-032 & NCHRP 611
  - $\beta$  = 1.223  $\alpha$  = 0.845 MHA = 0.361
- Step 3) Calculate the median value of the duration of strong shaking,  $D_{5-95,med}$  based on equations 10.1a and 10.1b:

D<sub>5-95,med</sub> = 26.38 seconds

Step 4) Calculate the Non-Linear Response Factor, *NRF* based on equation 11.3:

NRF = 1.031 (for 0.1<PGA/g<0.8)

Step 5) Calculate the f<sub>eq</sub> factor based on equation 11.2 using a typical displacement of either 5 cm (maximum probable event) or 15 cm (maximum credible event):

u = <u>5</u> cm (either 5 or 15 cm)  $f_{eq} = 0.641$ 

Step 6) Calculate the seismic coefficient for analysis,  $k_{eq}$  based on equation 11.1:





| 650 700 750 800 850 | Safety Facto<br>0.000<br>0.250<br>0.750<br>0.750<br>1.000<br>1.250<br>1.500<br>1.250<br>2.250<br>2.250<br>2.250<br>2.500<br>3.000<br>3.250<br>3.500<br>3.750<br>4.000<br>4.250<br>4.500<br>5.500<br>5.750<br>6.000 | r<br>+        | - • • •     |                    |               |          | W     |               |                | 1.445  |
|---------------------|--|---------------|-------------|--------------------|---------------|----------|-------|---------------|----------------|--|
| 600                 |  | Material Name | Color       | Unit Weight        | Strength Type | Cohesion | Phi   | Water Surface | Hu Type        | Hu   |
| -                   | -  | 09            |             | (lbs/ft3)          | Mohr-Coulomb  | (psf)    | (deg) | Water Surface | Custom         | 1  |
| 550                 |  | <u>مە</u>     | · · · · · · |                    |               |          |       |               |                |  |
|                     | 0  | 50            | 10          | 00<br>Project      | 150 2         | 200      | 25    | 3138 00 Cr    | U<br>NSS Sarti | <u>350 400 450 500 550</u>                                     |
|                     |  | -             |             | Analysis Descripti | on            |          |       | 5150.00 Cl    | Bick           |  |
|                     |  | 3115          |             | Drawn By           |               |          |       | Scale 1:69    | 5              | Company Albus & Associates, Inc.                               |
| SLID                | PASS<br>EINTERPRET 7.017   | OCIATES       |             | Date               |               |          |       | I             |                | File Name 3138.00 Cross Section A-Pseudostatic with water.slim |



# Slide Analysis Information 3138.00 Cross Section A (Pseudostatic)

# **Project Summary**

| File Name:             | 3138.00 Cross Section A-Pseudostatic with water |
|------------------------|---|
| Slide Modeler Version: | 7.017   |
| Project Title:         | 3138.00 Cross Section A (Pseudostatic)          |
| Analysis:              | Bishop  |

## **General Settings**

| Units of Measurement:        | Imperial Units |
|------------------------------|----------------|
| Time Units:                  | days           |
| Permeability Units:          | feet/second    |
| Failure Direction:           | Left to Right  |
| Data Output:                 | Standard       |
| Maximum Material Properties: | 20             |
| Maximum Support Properties:  | 20             |

## **Analysis Options**

| Slices Type:  | Vertical                              |
|---|---------------------------------------|
| Analysis Methods Used   |                                       |
|   | Bishop simplified<br>Janbu simplified |
| 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:      | Grid Search      |
| Radius Increment:   | 10               |
| Composite Surfaces: | Disabled         |
| Reverse Curvature:  | Invalid Surfaces |
| Minimum Elevation:  | Not Defined      |
| Minimum Depth:      | Not Defined      |
| Minimum Area:       | Not Defined      |
| Minimum Weight:     | Not Defined      |

## Seismic

Advanced seismic analysis: No Staged pseudostatic analysis: No

# Loading

Seismic Load Coefficient (Horizontal): 0.23

### **Material Properties**

| Property              | Qg           |
|-----------------------|--------------|
| Color                 |              |
| Strength Type         | Mohr-Coulomb |
| Unit Weight [lbs/ft3] | 125          |
| Cohesion [psf]        | 0            |
| Friction Angle [deg]  | 45           |
| Water Surface         | Water Table  |
| Hu Value              | 1            |

## **Global Minimums**

#### Method: bishop simplified



| FS                           | 1.444520         |
|------------------------------|------------------|
| Center:                      | 428.459, 846.614 |
| Radius:                      | 222.687          |
| Left Slip Surface Endpoint:  | 343.400, 640.812 |
| Right Slip Surface Endpoint: | 349.152, 638.528 |
| Resisting Moment:            | 5168.62 lb-ft    |
| Driving Moment:              | 3578.09 lb-ft    |
| Total Slice Area:            | 0.220021 ft2     |
| Surface Horizontal Width:    | 5.7516 ft        |
| Surface Average Height:      | 0.0382538 ft     |
|                              |                  |

#### Method: janbu simplified

| FS                           | 1.443990         |
|------------------------------|------------------|
| Center:                      | 428.459, 846.614 |
| Radius:                      | 222.687          |
| Left Slip Surface Endpoint:  | 343.400, 640.812 |
| Right Slip Surface Endpoint: | 349.152, 638.528 |
| Resisting Horizontal Force:  | 21.5547 lb       |
| Driving Horizontal Force:    | 14.9272 lb       |
| Total Slice Area:            | 0.220021 ft2     |
| Surface Horizontal Width:    | 5.7516 ft        |
| Surface Average Height:      | 0.0382538 ft     |

### Valid / Invalid Surfaces

#### Method: bishop simplified

Number of Valid Surfaces: 2780 Number of Invalid Surfaces: 2071

#### Error Codes:

Error Code -102 reported for 12 surfaces Error Code -103 reported for 1031 surfaces Error Code -106 reported for 62 surfaces Error Code -112 reported for 1 surface Error Code -114 reported for 8 surfaces Error Code -1000 reported for 957 surfaces

#### Method: janbu simplified

Number of Valid Surfaces: 2768 Number of Invalid Surfaces: 2083

#### Error Codes:

Error Code -102 reported for 12 surfaces Error Code -103 reported for 1031 surfaces Error Code -106 reported for 62 surfaces Error Code -112 reported for 13 surfaces Error Code -114 reported for 8 surfaces Error Code -1000 reported for 957 surfaces

#### **Error Codes**



The following errors were encountered during the computation:

-102 = Two surface / slope intersections, but resulting arc is actually outside soil region.

-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.

-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.

-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.

-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

### Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.44452



| Slice<br>Number | Width<br>[ft] | Weight<br>[Ibs] | Angle<br>of Slice<br>Base<br>[degrees] | Base<br>Material | Base<br>Cohesion<br>[psf] | Base<br>Friction<br>Angle<br>[degrees] | Shear<br>Stress<br>[psf] | Shear<br>Strength<br>[psf] | Base<br>Normal<br>Stress<br>[psf] | Pore<br>Pressure<br>[psf] | Effective<br>Normal<br>Stress<br>[psf] |
|-----------------|---------------|-----------------|--|------------------|---------------------------|--|--------------------------|----------------------------|-----------------------------------|---------------------------|--|
| 1               | 0.115032      | 0.0472309       | -22.4395                               | Qg               | 0                         | 45                                     | 0.221121                 | 0.319414                   | 0.319414                          | 0                         | 0.319414                               |
| 2               | 0.115032      | 0.141152        | -22.4075                               | Qg               | 0                         | 45                                     | 0.661064                 | 0.95492                    | 0.954924                          | 0                         | 0.954924                               |
| 3               | 0.115032      | 0.233991        | -22.3755                               | Qg               | 0                         | 45                                     | 1.09625                  | 1.58356                    | 1.58355                           | 0                         | 1.58355                                |
| 4               | 0.115032      | 0.32575         | -22.3435                               | Qg               | 0                         | 45                                     | 1.52668                  | 2.20532                    | 2.20532                           | 0                         | 2.20532                                |
| 5               | 0.115032      | 0.41643         | -22.3115                               | Qg               | 0                         | 45                                     | 1.95234                  | 2.8202                     | 2.8202                            | 0                         | 2.8202                                 |
| 6               | 0.115032      | 0.50603         | -22.2795                               | Qg               | 0                         | 45                                     | 2.37325                  | 3.42821                    | 3.42821                           | 0                         | 3.42821                                |
| 7               | 0.115032      | 0.594552        | -22.2475                               | Qg               | 0                         | 45                                     | 2.78939                  | 4.02933                    | 4.02933                           | 0                         | 4.02933                                |
| 8               | 0.115032      | 0.681996        | -22.2156                               | Qg               | 0                         | 45                                     | 3.20077                  | 4.62357                    | 4.62357                           | 0                         | 4.62357                                |
| 9               | 0.115032      | 0.768363        | -22.1836                               | Qg               | 0                         | 45                                     | 3.60737                  | 5.21092                    | 5.21092                           | 0                         | 5.21092                                |
| 10              | 0.115032      | 0.847682        | -22.1516                               | Qg               | 0                         | 45                                     | 3.98116                  | 5.75087                    | 5.75087                           | 0                         | 5.75087                                |
| 11              | 0.115032      | 0.863841        | -22.1197                               | Qg               | 0                         | 45                                     | 4.05848                  | 5.86255                    | 5.86256                           | 0                         | 5.86256                                |
| 12              | 0.115032      | 0.862471        | -22.0877                               | Qg               | 0                         | 45                                     | 4.05346                  | 5.85531                    | 5.85531                           | 0                         | 5.85531                                |
| 13              | 0.115032      | 0.860026        | -22.0558                               | Qg               | 0                         | 45                                     | 4.04339                  | 5.84076                    | 5.84076                           | 0                         | 5.84076                                |
| 14              | 0.115032      | 0.856509        | -22.0239                               | Qg               | 0                         | 45                                     | 4.02826                  | 5.8189                     | 5.81891                           | 0                         | 5.81891                                |
| 15              | 0.115032      | 0.851918        | -21.992                                | Qg               | 0                         | 45                                     | 4.00808                  | 5.78975                    | 5.78975                           | 0                         | 5.78975                                |
| 16              | 0.115032      | 0.846256        | -21.96                                 | Qg               | 0                         | 45                                     | 3.98283                  | 5.75328                    | 5.75328                           | 0                         | 5.75328                                |
| 17              | 0.115032      | 0.839523        | -21.9281                               | Qg               | 0                         | 45                                     | 3.95252                  | 5.7095                     | 5.7095                            | 0                         | 5.7095                                 |
| 18              | 0.115032      | 0.83172         | -21.8962                               | Qg               | 0                         | 45                                     | 3.91716                  | 5.65841                    | 5.65842                           | 0                         | 5.65842                                |
| 19              | 0.115032      | 0.822847        | -21.8643                               | Qg               | 0                         | 45                                     | 3.87673                  | 5.60001                    | 5.60001                           | 0                         | 5.60001                                |
| 20              | 0.115032      | 0.812905        | -21.8324                               | Qg               | 0                         | 45                                     | 3.83122                  | 5.53428                    | 5.53428                           | 0                         | 5.53428                                |
| 21              | 0.115032      | 0.801895        | -21.8006                               | Qg               | 0                         | 45                                     | 3.78065                  | 5.46123                    | 5.46123                           | 0                         | 5.46123                                |
| 22              | 0.115032      | 0.789818        | -21.7687                               | Qg               | 0                         | 45                                     | 3.72502                  | 5.38086                    | 5.38086                           | 0                         | 5.38086                                |
| 23              | 0.115032      | 0.776674        | -21.7368                               | Qg               | 0                         | 45                                     | 3.6643                   | 5.29316                    | 5.29316                           | 0                         | 5.29316                                |
| 24              | 0.115032      | 0.762464        | -21.705                                | Qg               | 0                         | 45                                     | 3.59852                  | 5.19813                    | 5.19813                           | 0                         | 5.19813                                |
| 25              | 0.115032      | 0.747188        | -21.6731                               | Qg               | 0                         | 45                                     | 3.52766                  | 5.09577                    | 5.09577                           | 0                         | 5.09577                                |
| 26              | 0.115032      | 0.730848        | -21.6413                               | Qg               | 0                         | 45                                     | 3.45171                  | 4.98607                    | 4.98607                           | 0                         | 4.98607                                |
| 27              | 0.115032      | 0.713444        | -21.6094                               | Qg               | 0                         | 45                                     | 3.37069                  | 4.86903                    | 4.86903                           | 0                         | 4.86903                                |
| 28              | 0.115032      | 0.694977        | -21.5776                               | Qg               | 0                         | 45                                     | 3.28459                  | 4.74465                    | 4.74465                           | 0                         | 4.74465                                |
| 29              | 0.115032      | 0.675447        | -21.5458                               | Qg               | 0                         | 45                                     | 3.1934                   | 4.61293                    | 4.61293                           | 0                         | 4.61293                                |
| 30              | 0.115032      | 0.654855        | -21.514                                | Qg               | 0                         | 45                                     | 3.09713                  | 4.47386                    | 4.47386                           | 0                         | 4.47386                                |
| 31              | 0.115032      | 0.633202        | -21.4822                               | Qg               | 0                         | 45                                     | 2.99576                  | 4.32744                    | 4.32743                           | 0                         | 4.32743                                |
| 32              | 0.115032      | 0.610489        | -21.4504                               | Qg               | 0                         | 45                                     | 2.88931                  | 4.17367                    | 4.17366                           | 0                         | 4.17366                                |
| 33              | 0.115032      | 0.586716        | -21.4186                               | Qg               | 0                         | 45                                     | 2.77777                  | 4.01254                    | 4.01254                           | 0                         | 4.01254                                |
| 34              | 0.115032      | 0.561884        | -21.3868                               | Qg               | 0                         | 45                                     | 2.66113                  | 3.84405                    | 3.84405                           | 0                         | 3.84405                                |
| 35              | 0.115032      | 0.535994        | -21.355                                | Qg               | 0                         | 45                                     | 2.53939                  | 3.6682                     | 3.6682                            | 0                         | 3.6682                                 |
| 36              | 0.115032      | 0.509046        | -21.3232                               | Qg               | 0                         | 45                                     | 2.41256                  | 3.48499                    | 3.48499                           | 0                         | 3.48499                                |
| 37              | 0.115032      | 0.481041        | -21.2914                               | Qg               | 0                         | 45                                     | 2.28063                  | 3.29441                    | 3.29441                           | 0                         | 3.29441                                |
| 38              | 0.115032      | 0.45198         | -21.2597                               | Qg               | 0                         | 45                                     | 2.14359                  | 3.09646                    | 3.09646                           | 0                         | 3.09646                                |
| 39              | 0.115032      | 0.421864        | -21.2279                               | Qg               | 0                         | 45                                     | 2.00145                  | 2.89114                    | 2.89114                           | 0                         | 2.89114                                |
| 40              | 0.115032      | 0.390692        | -21.1962                               | Qg               | 0                         | 45                                     | 1.85421                  | 2.67844                    | 2.67844                           | 0                         | 2.67844                                |
| 41              | 0.115032      | 0.358466        | -21.1644                               | Qg               | 0                         | 45                                     | 1.70186                  | 2.45837                    | 2.45836                           | 0                         | 2.45836                                |
| 42              | 0.115032      | 0.325187        | -21.1327                               | Qg               | 0                         | 45                                     | 1.5444                   | 2.23091                    | 2.23091                           | 0                         | 2.23091                                |
| 43              | 0.115032      | 0.290854        | -21.101                                | Qg               | 0                         | 45                                     | 1.38182                  | 1.99607                    | 1.99607                           | 0                         | 1.99607                                |
| 44              | 0.115032      | 0.25547         | -21.0693                               | Qg               | 0                         | 45                                     | 1.21413                  | 1.75384                    | 1.75384                           | 0                         | 1.75384                                |
| 45              | 0.115032      | 0.219034        | -21.0375                               | Qg               | 0                         | 45                                     | 1.04133                  | 1.50422                    | 1.50422                           | 0                         | 1.50422                                |
| 46              | 0.115032      | 0.181547        | -21.0058                               | Qg               | 0                         | 45                                     | 0.863408                 | 1.24721                    | 1.24722                           | 0                         | 1.24722                                |
| 47              | 0.115032      | 0.14301         | -20.9741                               | Qg               | 0                         | 45                                     | 0.680369                 | 0.982807                   | 0.982811                          | 0                         | 0.982811                               |
| 48              | 0.115032      | 0.103423        | -20.9424                               | Qg               | 0                         | 45                                     | 0.492206                 | 0.711002                   | 0.711002                          | 0                         | 0.711002                               |
| 49              | 0.115032      | 0.0627875       | -20.9107                               | Qg               | 0                         | 45                                     | 0.298919                 | 0.431795                   | 0.431794                          | 0                         | 0.431794                               |
| 50              | 0.115032      | 0.0211038       | -20.8791                               | Qg               | 0                         | 45                                     | 0.100506                 | 0.145183                   | 0.145183                          | 0                         | 0.145183                               |

Global Minimum Query (janbu simplified) - Safety Factor: 1.44399



| Slice<br>Number | Width<br>[ft] | Weight<br>[lbs] | Angle<br>of Slice<br>Base<br>[degrees] | Base<br>Material | Base<br>Cohesion<br>[psf] | Base<br>Friction<br>Angle<br>[degrees] | Shear<br>Stress<br>[psf] | Shear<br>Strength<br>[psf] | Base<br>Normal<br>Stress<br>[psf] | Pore<br>Pressure<br>[psf] | Effective<br>Normal<br>Stress<br>[psf] |
|-----------------|---------------|-----------------|--|------------------|---------------------------|--|--------------------------|----------------------------|-----------------------------------|---------------------------|--|
| 1               | 0.115032      | 0.0472309       | -22.4395                               | Qg               | 0                         | 45                                     | 0.221182                 | 0.319384                   | 0.319383                          | 0                         | 0.319383                               |
| 2               | 0.115032      | 0.141152        | -22.4075                               | Qg               | 0                         | 45                                     | 0.661243                 | 0.954829                   | 0.954827                          | 0                         | 0.954827                               |
| 3               | 0.115032      | 0.233991        | -22.3755                               | Qg               | 0                         | 45                                     | 1.09654                  | 1.5834                     | 1.58341                           | 0                         | 1.58341                                |
| 4               | 0.115032      | 0.32575         | -22.3435                               | Qg               | 0                         | 45                                     | 1.5271                   | 2.20511                    | 2.20511                           | 0                         | 2.20511                                |
| 5               | 0.115032      | 0.41643         | -22.3115                               | Qg               | 0                         | 45                                     | 1.95287                  | 2.81993                    | 2.81993                           | 0                         | 2.81993                                |
| 6               | 0.115032      | 0.50603         | -22.2795                               | Qg               | 0                         | 45                                     | 2.37389                  | 3.42788                    | 3.42788                           | 0                         | 3.42788                                |
| 7               | 0.115032      | 0.594552        | -22.2475                               | Qg               | 0                         | 45                                     | 2.79015                  | 4.02895                    | 4.02895                           | 0                         | 4.02895                                |
| 8               | 0.115032      | 0.681996        | -22.2156                               | Qg               | 0                         | 45                                     | 3.20164                  | 4.62313                    | 4.62313                           | 0                         | 4.62313                                |
| 9               | 0.115032      | 0.768363        | -22.1836                               | Qg               | 0                         | 45                                     | 3.60836                  | 5.21043                    | 5.21043                           | 0                         | 5.21043                                |
| 10              | 0.115032      | 0.847682        | -22.1516                               | Qg               | 0                         | 45                                     | 3.98225                  | 5.75033                    | 5.75032                           | 0                         | 5.75032                                |
| 11              | 0.115032      | 0.863841        | -22.1197                               | Qg               | 0                         | 45                                     | 4.05958                  | 5.862                      | 5.862                             | 0                         | 5.862                                  |
| 12              | 0.115032      | 0.862471        | -22.0877                               | Qg               | 0                         | 45                                     | 4.05456                  | 5.85475                    | 5.85476                           | 0                         | 5.85476                                |
| 13              | 0.115032      | 0.860026        | -22.0558                               | Qg               | 0                         | 45                                     | 4.04449                  | 5.84021                    | 5.84021                           | 0                         | 5.84021                                |
| 14              | 0.115032      | 0.856509        | -22.0239                               | Qg               | 0                         | 45                                     | 4.02936                  | 5.81836                    | 5.81836                           | 0                         | 5.81836                                |
| 15              | 0.115032      | 0.851918        | -21.992                                | Qg               | 0                         | 45                                     | 4.00917                  | 5.7892                     | 5.78921                           | 0                         | 5.78921                                |
| 16              | 0.115032      | 0.846256        | -21.96                                 | Qg               | 0                         | 45                                     | 3.98392                  | 5.75274                    | 5.75274                           | 0                         | 5.75274                                |
| 17              | 0.115032      | 0.839523        | -21.9281                               | Qg               | 0                         | 45                                     | 3.95361                  | 5.70897                    | 5.70897                           | 0                         | 5.70897                                |
| 18              | 0.115032      | 0.83172         | -21.8962                               | Qg               | 0                         | 45                                     | 3.91823                  | 5.65789                    | 5.65788                           | 0                         | 5.65788                                |
| 19              | 0.115032      | 0.822847        | -21.8643                               | Qg               | 0                         | 45                                     | 3.87779                  | 5.59949                    | 5.59949                           | 0                         | 5.59949                                |
| 20              | 0.115032      | 0.812905        | -21.8324                               | Qg               | 0                         | 45                                     | 3.83228                  | 5.53377                    | 5.53377                           | 0                         | 5.53377                                |
| 21              | 0.115032      | 0.801895        | -21.8006                               | Qg               | 0                         | 45                                     | 3.7817                   | 5.46073                    | 5.46072                           | 0                         | 5.46072                                |
| 22              | 0.115032      | 0.789818        | -21.7687                               | Qg               | 0                         | 45                                     | 3.72604                  | 5.38036                    | 5.38036                           | 0                         | 5.38036                                |
| 23              | 0.115032      | 0.776674        | -21.7368                               | Qg               | 0                         | 45                                     | 3.66531                  | 5.29267                    | 5.29267                           | 0                         | 5.29267                                |
| 24              | 0.115032      | 0.762464        | -21.705                                | Qg               | 0                         | 45                                     | 3.59951                  | 5.19765                    | 5.19765                           | 0                         | 5.19765                                |
| 25              | 0.115032      | 0.747188        | -21.6731                               | Qg               | 0                         | 45                                     | 3.52863                  | 5.0953                     | 5.0953                            | 0                         | 5.0953                                 |
| 26              | 0.115032      | 0.730848        | -21.6413                               | Qg               | 0                         | 45                                     | 3.45266                  | 4.98561                    | 4.98561                           | 0                         | 4.98561                                |
| 27              | 0.115032      | 0.713444        | -21.6094                               | Qg               | 0                         | 45                                     | 3.37162                  | 4.86858                    | 4.86859                           | 0                         | 4.86859                                |
| 28              | 0.115032      | 0.694977        | -21.5776                               | Qg               | 0                         | 45                                     | 3.28549                  | 4.74421                    | 4.74422                           | 0                         | 4.74422                                |
| 29              | 0.115032      | 0.675447        | -21.5458                               | Qg               | 0                         | 45                                     | 3.19427                  | 4.6125                     | 4.61251                           | 0                         | 4.61251                                |
| 30              | 0.115032      | 0.654855        | -21.514                                | Qg               | 0                         | 45                                     | 3.09798                  | 4.47345                    | 4.47345                           | 0                         | 4.47345                                |
| 31              | 0.115032      | 0.633202        | -21.4822                               | Qg               | 0                         | 45                                     | 2.99659                  | 4.32704                    | 4.32704                           | 0                         | 4.32704                                |
| 32              | 0.115032      | 0.610489        | -21.4504                               | Qg               | 0                         | 45                                     | 2.8901                   | 4.17328                    | 4.17328                           | 0                         | 4.17328                                |
| 33              | 0.115032      | 0.586716        | -21.4186                               | Qg               | 0                         | 45                                     | 2.77853                  | 4.01217                    | 4.01217                           | 0                         | 4.01217                                |
| 34              | 0.115032      | 0.561884        | -21.3868                               | Qg               | 0                         | 45                                     | 2.66186                  | 3.8437                     | 3.8437                            | 0                         | 3.8437                                 |
| 35              | 0.115032      | 0.535994        | -21.355                                | Qg               | 0                         | 45                                     | 2.54009                  | 3.66787                    | 3.66787                           | 0                         | 3.66787                                |
| 36              | 0.115032      | 0.509046        | -21.3232                               | Qg               | 0                         | 45                                     | 2.41322                  | 3.48467                    | 3.48467                           | 0                         | 3.48467                                |
| 37              | 0.115032      | 0.481041        | -21.2914                               | Qg               | 0                         | 45                                     | 2.28126                  | 3.29411                    | 3.29411                           | 0                         | 3.29411                                |
| 38              | 0.115032      | 0.45198         | -21.2597                               | Qg               | 0                         | 45                                     | 2.14418                  | 3.09618                    | 3.09618                           | 0                         | 3.09618                                |
| 39              | 0.115032      | 0.421864        | -21.2279                               | Qg               | 0                         | 45                                     | 2.00201                  | 2.89088                    | 2.89088                           | 0                         | 2.89088                                |
| 40              | 0.115032      | 0.390692        | -21.1962                               | Qg               | 0                         | 45                                     | 1.85472                  | 2.6782                     | 2.6782                            | 0                         | 2.6782                                 |
| 41              | 0.115032      | 0.358466        | -21.1644                               | Qg               | 0                         | 45                                     | 1.70233                  | 2.45815                    | 2.45815                           | 0                         | 2.45815                                |
| 42              | 0.115032      | 0.325187        | -21.1327                               | Qg               | 0                         | 45                                     | 1.54482                  | 2.23071                    | 2.23071                           | 0                         | 2.23071                                |
| 43              | 0.115032      | 0.290854        | -21.101                                | Qg               | 0                         | 45                                     | 1.3822                   | 1.99589                    | 1.99589                           | 0                         | 1.99589                                |
| 44              | 0.115032      | 0.25547         | -21.0693                               | Qg               | 0                         | 45                                     | 1.21447                  | 1.75368                    | 1.75368                           | 0                         | 1.75368                                |
| 45              | 0.115032      | 0.219034        | -21.0375                               | Qg               | 0                         | 45                                     | 1.04162                  | 1.50409                    | 1.50409                           | 0                         | 1.50409                                |
| 46              | 0.115032      | 0.181547        | -21.0058                               | Qg               | 0                         | 45                                     | 0.863649                 | 1.2471                     | 1.2471                            | 0                         | 1.2471                                 |
| 47              | 0.115032      | 0.14301         | -20.9741                               | Qg               | 0                         | 45                                     | 0.680558                 | 0.982719                   | 0.982722                          | 0                         | 0.982722                               |
| 48              | 0.115032      | 0.103423        | -20.9424                               | Qg               | 0                         | 45                                     | 0.492343                 | 0.710938                   | 0.710937                          | 0                         | 0.710937                               |
| 49              | 0.115032      | 0.0627875       | -20.9107                               | Qg               | 0                         | 45                                     | 0.299002                 | 0.431756                   | 0.431756                          | 0                         | 0.431756                               |
| 50              | 0.115032      | 0.0211038       | -20.8791                               | Qg               | 0                         | 45                                     | 0.100534                 | 0.14517                    | 0.14517                           | 0                         | 0.14517                                |



# Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.44452



| Slice<br>Number | X<br>coordinate<br>[ft] | Y<br>coordinate - Bottom<br>[ft] | Interslice<br>Normal Force<br>[lbs] | Interslice<br>Shear Force<br>[lbs] | Interslice<br>Force Angle<br>[degrees] |
|-----------------|-------------------------|----------------------------------|-------------------------------------|------------------------------------|--|
| 1               | 343.4                   | 640.812                          | 0                                   | 0                                  | 0                                      |
| 2               | 343.515                 | 640.764                          | 0.000640905                         | 0                                  | 0                                      |
| 3               | 343.63                  | 640.717                          | 0.0024737                           | 0                                  | 0                                      |
| 4               | 343.745                 | 640.67                           | 0.00537507                          | 0                                  | 0                                      |
| 5               | 343.86                  | 640.622                          | 0.00922362                          | 0                                  | 0                                      |
| 6               | 343.975                 | 640.575                          | 0.0138998                           | 0                                  | 0                                      |
| 7               | 344.09                  | 640.528                          | 0.0192861                           | 0                                  | 0                                      |
| 8               | 344.205                 | 640.481                          | 0.0252668                           | 0                                  | 0                                      |
| 9               | 344.32                  | 640.434                          | 0.031728                            | 0                                  | 0                                      |
| 10              | 344.435                 | 640.387                          | 0.0385579                           | 0                                  | 0                                      |
| 11              | 344.55                  | 640.34                           | 0.0455969                           | 0                                  | 0                                      |
| 12              | 344.665                 | 640.294                          | 0.0522645                           | 0                                  | 0                                      |
| 13              | 344.78                  | 640.247                          | 0.0584169                           | 0                                  | 0                                      |
| 14              | 344.895                 | 640.2                            | 0.0640486                           | 0                                  | 0                                      |
| 15              | 345.01                  | 640.154                          | 0.069156                            | 0                                  | 0                                      |
| 16              | 345.125                 | 640.107                          | 0.0737375                           | 0                                  | 0                                      |
| 17              | 345.24                  | 640.061                          | 0.0777933                           | 0                                  | 0                                      |
| 18              | 345.355                 | 640.015                          | 0.0813256                           | 0                                  | 0                                      |
| 19              | 345.471                 | 639.968                          | 0.0843382                           | 0                                  | 0                                      |
| 20              | 345.586                 | 639.922                          | 0.0868371                           | 0                                  | 0                                      |
| 21              | 345.701                 | 639.876                          | 0.0888301                           | 0                                  | 0                                      |
| 22              | 345.816                 | 639.83                           | 0.0903267                           | 0                                  | 0                                      |
| 23              | 345.931                 | 639.784                          | 0.0913385                           | 0                                  | 0                                      |
| 24              | 346.046                 | 639.738                          | 0.0918788                           | 0                                  | 0                                      |
| 25              | 346.161                 | 639.692                          | 0.0919629                           | 0                                  | 0                                      |
| 26              | 346.276                 | 639.647                          | 0.091608                            | 0                                  | 0                                      |
| 27              | 346.391                 | 639.601                          | 0.090833                            | 0                                  | 0                                      |
| 28              | 346.506                 | 639.556                          | 0.0896587                           | 0                                  | 0                                      |
| 29              | 346.621                 | 639.51                           | 0.088108                            | 0                                  | 0                                      |
| 30              | 346.736                 | 639.465                          | 0.0862055                           | 0                                  | 0                                      |
| 31              | 346.851                 | 639.419                          | 0.0839775                           | 0                                  | 0                                      |
| 32              | 346.966                 | 639.374                          | 0.0814524                           | 0                                  | 0                                      |
| 33              | 347.081                 | 639.329                          | 0.0786605                           | 0                                  | 0                                      |
| 34              | 347.196                 | 639.284                          | 0.0756337                           | 0                                  | 0                                      |
| 35              | 347.311                 | 639.239                          | 0.072406                            | 0                                  | 0                                      |
| 36              | 347.426                 | 639.194                          | 0.0690131                           | 0                                  | 0                                      |
| 37              | 347.541                 | 639.149                          | 0.0654927                           | 0                                  | 0                                      |
| 38              | 347.656                 | 639.104                          | 0.0618843                           | 0                                  | 0                                      |
| 39              | 347.771                 | 639.059                          | 0.0582291                           | 0                                  | 0                                      |
| 40              | 347.886                 | 639.015                          | 0.0545704                           | 0                                  | 0                                      |
| 41              | 348.001                 | 638.97                           | 0.0509532                           | 0                                  | 0                                      |
| 42              | 348.116                 | 638.925                          | 0.0474244                           | 0                                  | 0                                      |
| 43              | 348.231                 | 638.881                          | 0.0440326                           | 0                                  | 0                                      |
| 44              | 348.346                 | 638.837                          | 0.0408286                           | 0                                  | 0                                      |
| 45              | 348.461                 | 638.792                          | 0.0378647                           | 0                                  | 0                                      |
| 40              | 348.576                 | 638.748                          | 0.0351952                           | 0                                  | U                                      |
| 4/              | 348.691                 | 638.704                          | 0.0328762                           | 0                                  | U                                      |
| 48              | 348.800<br>210 021      | 038.00<br>630.616                | 0.030905/                           | 0                                  | 0                                      |
| 49<br>E0        | 240.921<br>210 026      | 620.010<br>620 570               | 0.0295234                           | 0                                  | 0                                      |
| 51              | 349,152                 | 638.528                          | 0.020011                            | 0                                  | 0                                      |

Global Minimum Query (janbu simplified) - Safety Factor: 1.44399

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| Slice<br>Number | X<br>coordinate<br>[ft] | Y<br>coordinate - Bottom<br>[ft] | Interslice<br>Normal Force<br>[lbs] | Interslice<br>Shear Force<br>[lbs] | Interslice<br>Force Angle<br>[degrees] |
|-----------------|-------------------------|----------------------------------|-------------------------------------|------------------------------------|--|
| 1               | 343.4                   | 640.812                          | 0                                   | 0                                  | 0                                      |
| 2               | 343.515                 | 640.764                          | 0.000630975                         | 0                                  | 0                                      |
| 3               | 343.63                  | 640.717                          | 0.00243408                          | 0                                  | 0                                      |
| 4               | 343,745                 | 640.67                           | 0.00528624                          | 0                                  | 0                                      |
| 5               | 343.86                  | 640.622                          | 0.00906625                          | 0                                  | 0                                      |
| 6               | 343.975                 | 640.575                          | 0.0136548                           | 0                                  | 0                                      |
| 7               | 344.09                  | 640.528                          | 0.0189346                           | 0                                  | 0                                      |
| 8               | 344.205                 | 640.481                          | 0.0247901                           | 0                                  | 0                                      |
| 9               | 344.32                  | 640.434                          | 0.0311077                           | 0                                  | 0                                      |
| 10              | 344.435                 | 640.387                          | 0.0377757                           | 0                                  | 0                                      |
| 11              | 344.55                  | 640.34                           | 0.044636                            | 0                                  | 0                                      |
| 12              | 344.665                 | 640,294                          | 0.0511216                           | 0                                  | 0                                      |
| 13              | 344.78                  | 640.247                          | 0.0570922                           | 0                                  | 0                                      |
| 14              | 344.895                 | 640.2                            | 0.0625425                           | 0                                  | 0                                      |
| 15              | 345.01                  | 640.154                          | 0.0674693                           | 0                                  | 0                                      |
| 16              | 345.125                 | 640.107                          | 0.0718711                           | 0                                  | 0                                      |
| 17              | 345.24                  | 640.061                          | 0.0757483                           | 0                                  | 0                                      |
| 18              | 345.355                 | 640.015                          | 0.0791033                           | 0                                  | 0                                      |
| 19              | 345.471                 | 639.968                          | 0.0819404                           | 0                                  | 0                                      |
| 20              | 345.586                 | 639.922                          | 0.0842655                           | 0                                  | 0                                      |
| 21              | 345.701                 | 639.876                          | 0.0860867                           | 0                                  | 0                                      |
| 22              | 345.816                 | 639.83                           | 0.0874139                           | 0                                  | 0                                      |
| 23              | 345.931                 | 639.784                          | 0.0882588                           | 0                                  | 0                                      |
| 24              | 346.046                 | 639.738                          | 0.0886349                           | 0                                  | 0                                      |
| 25              | 346.161                 | 639.692                          | 0.0885578                           | 0                                  | 0                                      |
| 26              | 346.276                 | 639.647                          | 0.0880448                           | 0                                  | 0                                      |
| 27              | 346.391                 | 639.601                          | 0.0871152                           | 0                                  | 0                                      |
| 28              | 346.506                 | 639.556                          | 0.08579                             | 0                                  | 0                                      |
| 29              | 346.621                 | 639.51                           | 0.0840922                           | 0                                  | 0                                      |
| 30              | 346.736                 | 639.465                          | 0.0820466                           | 0                                  | 0                                      |
| 31              | 346.851                 | 639.419                          | 0.0796799                           | 0                                  | 0                                      |
| 32              | 346.966                 | 639.374                          | 0.0770207                           | 0                                  | 0                                      |
| 33              | 347.081                 | 639.329                          | 0.0740994                           | 0                                  | 0                                      |
| 34              | 347.196                 | 639.284                          | 0.0709483                           | 0                                  | 0                                      |
| 35              | 347.311                 | 639.239                          | 0.0676015                           | 0                                  | 0                                      |
| 36              | 347.426                 | 639.194                          | 0.064095                            | 0                                  | 0                                      |
| 37              | 347.541                 | 639.149                          | 0.0604666                           | 0                                  | 0                                      |
| 38              | 347.656                 | 639.104                          | 0.0567561                           | 0                                  | 0                                      |
| 39              | 347.771                 | 639.059                          | 0.053005                            | 0                                  | 0                                      |
| 40              | 347.886                 | 639.015                          | 0.0492567                           | 0                                  | 0                                      |
| 41              | 348.001                 | 638.97                           | 0.0455565                           | 0                                  | 0                                      |
| 42              | 348.116                 | 638.925                          | 0.0419516                           | 0                                  | 0                                      |
| 43              | 348.231                 | 638.881                          | 0.0384908                           | 0                                  | 0                                      |
| 44              | 348.346                 | 638.837                          | 0.0352249                           | 0                                  | 0                                      |
| 45              | 348.461                 | 638.792                          | 0.0322067                           | 0                                  | 0                                      |
| 46              | 348.576                 | 638.748                          | 0.0294906                           | 0                                  | 0                                      |
| 47              | 348.691                 | 638.704                          | 0.027133                            | 0                                  | 0                                      |
| 48              | 348.806                 | 638.66                           | 0.0251921                           | 0                                  | 0                                      |
| 49              | 348.921                 | 638.616                          | 0.0237278                           | 0                                  | 0                                      |
| 50              | 349.036                 | 638.572                          | 0.022802                            | 0                                  | 0                                      |
| 51              | 349.152                 | 638.528                          | 0                                   | 0                                  | 0                                      |



# List Of Coordinates

#### Water Table

| х   | Y     |
|-----|-------|
| 0   | 638.5 |
| 485 | 638.5 |

#### **External Boundary**

| Х       | Y       |
|---------|---------|
| 5.276   | 663.553 |
| 0       | 663.458 |
| 0       | 600.14  |
| 485     | 600.14  |
| 485     | 630.057 |
| 432.69  | 631.984 |
| 385.343 | 634.21  |
| 373.357 | 635.401 |
| 361     | 636.906 |
| 352.592 | 637.709 |
| 350.08  | 638.15  |
| 344.507 | 640.418 |
| 331.786 | 644.945 |
| 325.53  | 646.745 |
| 321.064 | 647.155 |
| 316.753 | 647.155 |
| 312.656 | 647.923 |
| 304.204 | 650.441 |
| 294.344 | 653.813 |
| 284.271 | 657.697 |
| 277.265 | 660.503 |
| 273.1   | 662.054 |
| 269.65  | 662.054 |
| 261.321 | 662.054 |
| 258.156 | 662.626 |
| 254.122 | 664.206 |
| 250.778 | 664.83  |
| 248.922 | 664.585 |
| 238.949 | 664.585 |
| 235.547 | 665.129 |
| 233.052 | 665.832 |
| 230.08  | 667.125 |
| 225.974 | 669.008 |
| 223.242 | 670.028 |
| 221.322 | 670.549 |
| 220.266 | 670.549 |
| 218.143 | 670.149 |
| 215.482 | 669.532 |
| 211.337 | 668.496 |
| 205.933 | 667.376 |
| 198.51  | 665.98  |
| 194.639 | 665.622 |
|         |         |



| 180.898 | 665.12  |
|---------|---------|
| 174.544 | 664.935 |
| 163.816 | 664.735 |
| 151.141 | 664.735 |
| 146.681 | 664.535 |
| 140.446 | 664.281 |
| 125.012 | 664.182 |
| 121.783 | 664.337 |
| 112.772 | 664.049 |
| 99.454  | 664.217 |
| 94.114  | 664.217 |
| 85.265  | 664.081 |
| 70.446  | 663.725 |
| 43.663  | 663.725 |
| 41.273  | 663.571 |
| 37.475  | 663.387 |
| 27.223  | 663.387 |
| 20.749  | 663.553 |
| 9.632   | 663.553 |

# **APPENDIX E**

# STANDARD GRADING DETAILS



ALBUS & ASSOCIATES, INC.



- B. Rock Blankets should be constructed by creating 4-foot-deep "basins" within General Fill materials that are then filled with oversized rock. General Fill consists of general site material having a maximum particl size of 8 inches and approved by the Soil Engineer. The basins can be created by constructing false fills away from the basin area and then trimming the false fill face back to a compacted core. Once the basin is created, the area may be filled with a blanket of Oversized Rock.
- C. The maximum thickness of an Oversized Rock blanket should not exceed 4 feet.
- D. After placement of the Oversized Rock, the material should be track walked with a dozer, or other equipment and proceedure approved by the Soils Engineer.

E. A 12-inch thick layer of select material, having a maximum particle size of 3 inches and having an SE of 30 or greater, should be placed over the track walked rock and flooded to wash the material between the voids between rocks. The area should then be track walked with a dozer. Additional layers of select material should be placed, flooded, and track walked in a similar manner until no additional select material can be washed into the Oversized Rock. A final track walk with a dozer should be performed before fill placement continues.

F. A minimum of 12 inches of General Fill should be placed over a blanket of Oversized Rockprior to placing more over-sized material.



Not To Scale See attached soils report for specific recommendations

