September 6, 2024 Project No. 24032-01

Ms. Johanna Crooker
***Meritage Homes***
5 Peters Canyon Road, Suite 310
Irvine, CA 92606

***Subject:*** ***Preliminary Geotechnical Subsurface Due Diligence Evaluation for Proposed Residential Development, Twin Oaks, West of North Twin Oaks Valley Road, San Marcos, California***

In accordance with your request, LGC Geotechnical, Inc. has performed a preliminary geotechnical subsurface due diligence evaluation for the proposed residential development, Twin Oaks, located west of North Twin Oaks Valley Road in San Marcos, California. The purpose of our study was to evaluate the site geotechnical conditions in the context of the preliminary site plans and to provide appropriate preliminary geotechnical design parameters and recommendations for the proposed development.

Should you have any questions regarding this report, please do not hesitate to contact our office. We appreciate this opportunity to be of service.

Sincerely,

***LGC Geotechnical, Inc.***

Dennis Boratynec, GE 2770
Vice President

REGISTERED PROFESSIONAL ENGINEER
DENNIS BORATYNEC
No. 2770
GEOTECHNICAL
STATE OF CALIFORNIA

Barry Graham, CEG 2749
Project Geologist

CERTIFIED ENGINEERING GEOLOGIST
BARRY GRAHAM
No. 2749
STATE OF CALIFORNIA

Branden Petersen, EIT
Senior Staff Engineer

DJB/BPG/BPP/amm

Distribution: (1) Addressee (electronic copy)

131 Calle Iglesia, Suite 200, San Clemente, CA 92672 (949) 369-6141 www.lgcgeotechnical.com

## *TABLE OF CONTENTS*

***LIST OF ILLUSTRATIONS, TABLES, & APPENDICES***

***Tables***

***TABLE OF CONTENTS (Cont'd)***

***Figures***



***Sheets***



***Appendices***

## *1.0 INTRODUCTION*

LGC Geotechnical has performed a preliminary due diligence geotechnical evaluation for the proposed residential development located west of North Twin Oaks Valley Road in the City of San Marcos, California (Figure 1). This report summarizes our findings, conclusions, and preliminary geotechnical design recommendations relative to the proposed development.

The findings and conclusions presented herein should be considered preliminary and will need to be confirmed as part of a 40-scale grading plan review report to be provided at a later date. Additional fieldwork and laboratory testing will be required. It should be noted that LGC Geotechnical does not provide environmental consulting services and did not address the environmental conditions of the subject site.

### *1.1 Project Description*

The subject site is an approximately 136-acre property located west of North Twin Oaks Valley Road in the City of San Marcos, California. The site is bound to the north and south by existing residential developments, to the east by North Twin Oaks Valley Road, and to the west by undeveloped hillside open space. The site is currently a mostly undeveloped land with 3 residential structures and livestock grazing throughout.

The site can be topographically characterized as predominately easterly draining canyons and drainages surrounded by steeper ridges and foothills underlain predominately metavolcanic to metasedimentary rocks of the Santiago Peak Volcanics. Total relief across the site is estimated to be on the order of approximately 140 feet.

Based on the conceptual site plan (Optum, 2024), proposed development is anticipated to include the construction of 257 units for residential construction, slopes, street(s) and supporting improvements.

Proposed grades are expected to include design cuts up to approximately 65 feet and design fills up to approximately 30 feet. The proposed building structures are anticipated to be light -weight at-grade structures with maximum column and wall loads of approximately 30 kips and 3 kips per linear foot, respectively. Please note no structural loads were provided to us at the time of this report.

**The preliminary recommendations given in this report are based upon the provided preliminary grading information and estimated structural loading and layout information provided above. We understand that the project plans are currently being developed at this time; LGC Geotechnical should be provided with updated project plans and the actual structural loads when they become available, in order to either confirm or modify the recommendations provided herein. This may include, but is not limited to, additional subsurface borings/test pits, seismic refraction lines, laboratory testing, and analysis to provide a design level 40-scale geotechnical evaluation report.**

## *1.2 Subsurface Evaluation*

LGC Geotechnical's limited subsurface evaluation consisted of the excavation, sampling, observation and logging of hollow-stem auger borings, exploratory test pits, Cone Penetration Tests and seismic refraction lines.

Eight exploratory hollow-stem auger borings (HS-1 through HS-4 and I-1 through I-4) were excavated using a truck mounted and limited access track-mounted drill rig equipped with 8-inch-diameter hollow-stem augers to depths ranging from approximately 5 feet to 50 feet below existing grade. An LGC Geotechnical representative observed the drilling operations, logged the borings, and collected soil samples for laboratory testing. Driven soil samples were collected by means of the Standard Penetration Test (SPT) and Modified California Drive (MCD) sampler. The SPT sampler (1.4-inch ID) and MCD sampler (2.4-inch ID, 3.0-inch OD) were driven using a 140-pound automatic hammer falling 30 inches to advance the sampler a total depth of 18 inches or until refusal. Bulk samples were also collected and logged for laboratory testing at select depths. The raw blow counts for each 6-inch increment of penetration were recorded on the boring logs. The borings were backfilled with cuttings. At the completion of infiltration testing of I-1 through I-4, the perforated pipe was removed, and the resulting void backfilled with the previously excavated soils. Some settlement of the backfilled soils may occur over time.

Eighteen exploratory geotechnical trenches (TP-1 through TP-18) were excavated utilizing a standard backhoe in order to estimate remedial grading depths and obtain samples for laboratory testing. A geologist observed the operation, logged the geotechnical trenches and collected soil samples. The exploratory trenches were subsequently backfilled with tamped native soils. Some settlement of the backfilled soils may occur over time.

Five Cone Penetration Test (CPT) soundings were performed by Kehoe Testing and Engineering under subcontract with LGC Geotechnical. The CPT probes were pushed to depths ranging from approximately 4 to 31 feet below grade in general accordance with the current ASTM standards (ASTM D5778 and ASTM D3441). The CPT soundings were pushed to practical refusal and were short of their target depths presumable due to dense/very dense subsurface layers. The CPT equipment consists of a cone penetrometer assembly mounted at the end of series of hollow sounding rods. The interior of the cone penetrometer is instrumented with strain gauges that allow the simultaneous measurement of cone tip and friction sleeve resistance during penetration. The cone penetration assembly is continuously pushed into the soil by a set of hydraulic rams at a standard rate of 0.8-inch per second while the cone tip resistance and sleeve friction resistance are recorded at approximately every 1-inch and stored in digital form. A specially designed all-wheel drive 25-ton truck provides the required reaction weight for pushing the cone assembly. The CPT soundings were backfilled with Portland cement as the probe was retracted.

Three seismic refraction lines (S-1 through S-3) were performed by Geovision in order to assess the general seismic velocity characteristics of the underlying bedrock materials with regards to rippability during grading. The seismic refraction lines were performed in proposed cut areas with dense bedrock. Line lengths ranged from approximately 350 to 450 feet which resulted in a maximum obtainable depth of approximately 100 to 150 feet below existing ground.

The approximate locations of our borings, trenches, CPTs and seismic refraction lines are provided on the Geotechnical Map (Sheet 1). Boring and geotechnical test pit logs are provided in Appendix B.

## *1.3* ***Laboratory Testing***

Representative bulk and driven (relatively undisturbed) samples were obtained for laboratory testing during our field evaluation. Laboratory testing included in-situ moisture content and in-situ dry density, fines content, Atterberg limits, expansion index, consolidation, collapse, direct shear, laboratory compaction, R-value and corrosion (sulfate, chloride, pH and minimum resistivity).

The following is a summary of the laboratory test results:

- Dry density of the samples collected ranged from approximately 91 pounds per cubic foot (pcf) to 124 pcf, with an average of 110 pcf. Field moisture contents ranged from approximately 5 to 22 percent, with an average of 13 percent.
- Seven samples were tested for fines content indicating a fines content (passing No. 200 sieve) ranging from 7 to 79 percent. According to the Unified Soils Classification System (USCS), five of the tested samples are classified as "coarse grained" soil and the other two samples are classified as "fine grained" soil.
- Four Atterberg Limit (liquid limit and plastic limit) tests were performed. Results indicated a Plasticity Index (PI) value ranging from 5 to 17. The plot is provided in Appendix C.
- Expansion potential testing indicated an expansion index value ranging from 14 to 30, corresponding to "Very Low to Low" expansion potential.
- Four direct shear tests were performed. The shear stress versus normal stress plots are provided in Appendix C.
- Two consolidation tests were performed. The deformation versus vertical stress plot is provided in Appendix C.
- One swell/collapse test was performed. The deformation versus vertical stress plot is provided in Appendix C.
- Five laboratory compaction tests of near surface samples indicated a maximum dry density ranging from 121.0 to 129.0 pcf with an optimum moisture content ranging from 9.0 to 12.0 percent.
- Corrosion testing indicated soluble sulfate contents of approximately 0.007 percent, a chloride content of 180 parts per million (ppm), pH of 6.73, and a minimum resistivity of 2,610 ohm-centimeters.

A summary of the laboratory test results is presented in Appendix C. The moisture and dry density results are presented on the boring logs in Appendix B.

## *1.4* ***Field Infiltration Testing***

Four falling head field infiltration tests (I-1 through I-4) were performed to an approximate depth ranging from approximately 7.5 to 10 feet below existing grade. Estimation of infiltration rates for the site was accomplished in general accordance with the guidelines set forth by the County of San Diego (2020). A 3-inch diameter perforated PVC pipe with filter sock was placed in the borehole, and the annulus was backfilled with gravel, including placement of approximately 2 inches of gravel at the bottom of the borehole. The infiltration wells were pre-soaked the day prior to testing. During the pre-test, if the water level drops more than 6 inches in 25 minutes for two consecutive readings, the test procedure for coarse-grained soils was followed. If the water level did not drop 6 inches in one or both pre-test readings, the procedure for fine-grained soils was followed. The procedure for coarse-grained soils requires performing the test for one hour and taking one reading every 10 minutes from a fixed reference point. The procedure for fine-grained soils requires performing the test for six hours and taking one reading every 30 minutes from a fixed reference point.

The pre-tests indicated the procedure for the fine-grained soils should be followed for 3 of the tests (I-1, I-3 and I-4) and coarse-grained soils in one of the tests (I-2). The calculated infiltration is normalized relative to the three-dimensional flow that occurs within the field test to a one-dimensional flow out of the bottom of the boring only (i.e., “Porchet Method”). The measured infiltration rates (for feasibility purposes only) are provided in Table 1. Please note that infiltration is discussed in Section 4.9 and field data is provided in Appendix D.

***TABLE 1***

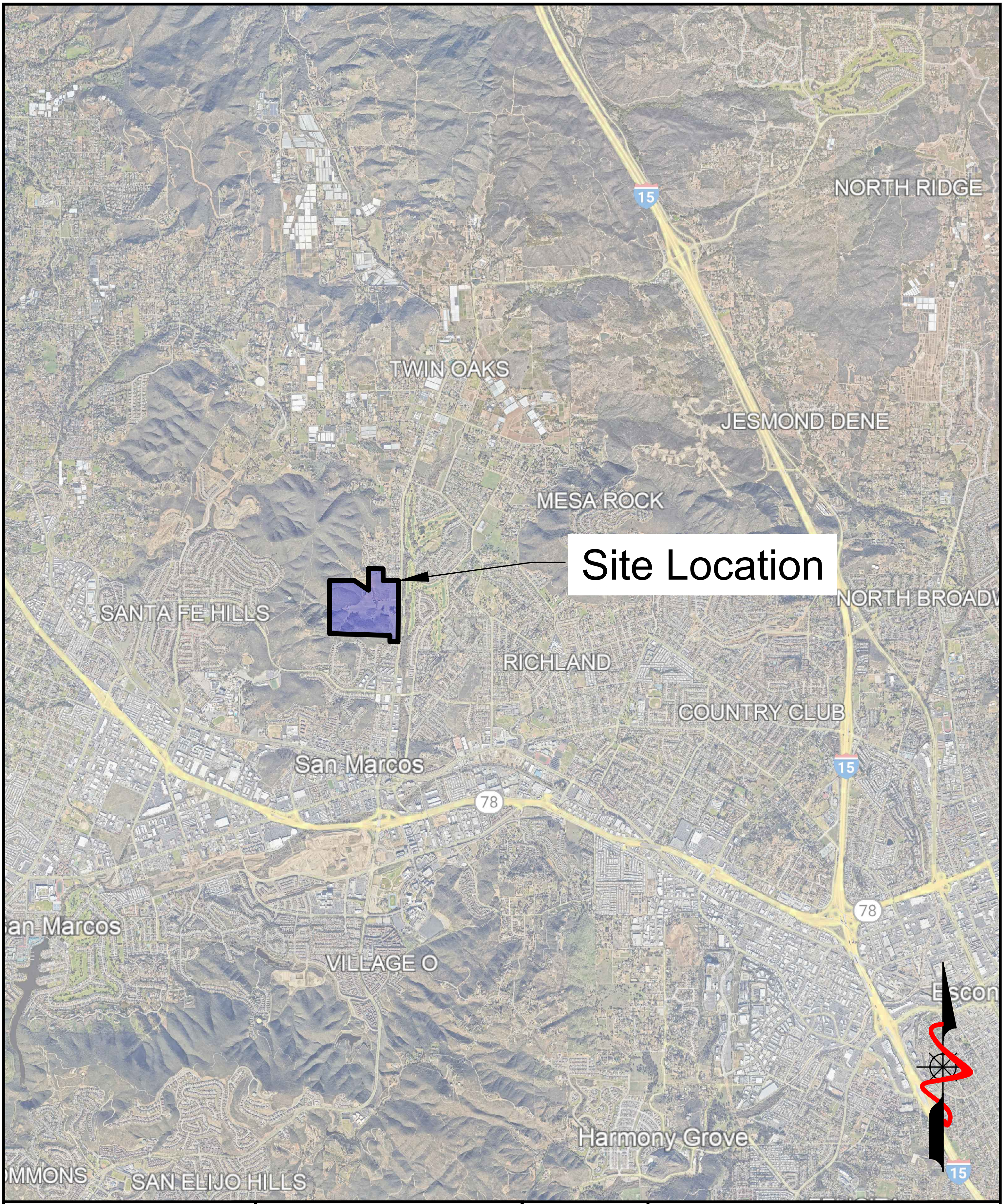
***Summary of Infiltration Testing***

| Infiltration Test Location | Infiltration Test Depth Below Existing Grade (ft) | Observed Infiltration Rate* (Inch/Hr.) |
|---|---|---|
| I-1 | 10 | 0.00 |
| I-2 | 10 | 10.50** |
| I-3 | 7.5 | 0.09 |
| I-4 | 10 | 0.02 |

*Normalized to One-Dimensional Flow, does not include any Factor of Safety

**Based on the results of our onsite testing and local experience, it is our opinion that this infiltration rate is anomalous and should be followed up with additional testing.

It should be emphasized that infiltration test results are only representative of the location and depth where they are performed. Varying subsurface conditions may exist outside of the test locations which could alter the calculated infiltration rates indicated above. Infiltration tests are performed using relatively clean water free of particulates, silt, etc. Refer to Section 4.9 for subsurface water infiltration recommendations.




LGC Geotechnical, Inc.

**FIGURE 1**
**Site Location**

| | |
|---|---|
| PROJECT NAME | Meritage - Twin Oaks, San Marcos |
| PROJECT NO. | 24032-01 |
| ENG. / GEOL. | DJB / BPG |
| SCALE | Not to Scale |
| DATE | September 2024 |

## *2.0 GEOTECHNICAL CONDITIONS*

### *2.1 Regional Geology*

Regionally the site is located generally centrally within the Peninsular Ranges Geomorphic Province, characterized by a series of rugged mountain ranges and valleys running parallel to the Pacific Coast, and a series of northwest-southeast oriented fault blocks, including the Elsinore and San Jacinto Fault zones, as well as the San Andreas Fault zone near the northeasterly margin of the province. The general topography within the province ranges from rugged landforms, developed by erosion and uplift of granitic rocks, to more subdued landforms which typify softer sedimentary formations of the coastal plains. Tertiary and Quaternary rocks are generally comprised of marine and non-marine sediments consisting of sandstone, mudstones, conglomerates, and occasional volcanic units, while older units are generally comprised of Cretaceous to Jurassic granitics and metavolcanics. Erosion and regional tectonic uplift have created the valleys and ridges of the area.

Regional geologic mapping and local topographic expressions do not indicate the presence of large-scale landslides within or adjacent to the project area.

### *2.2 Site-Specific Geology*

The site is generally underlain by surficial deposits in the lower lying flat areas and bedrock material in the hillside areas of the site. A brief description of the units encountered are described below:

#### *2.2.1 Surficial Deposits (Not Mapped)*

In general, relatively thin surficial deposits (topsoil, colluvium, and old artificial fill) are present across the site. The topsoil and colluvium are a result of the physical and chemical weathering of the underlying flood plain deposits and crystalline bedrock. These soils generally mantle the underlying materials and are on the order of approximately 1 to 2 feet thick. Older artificial fill soils associated with past grading activities are likely present underlying the existing improvements.

#### *2.2.2 Quaternary Alluvium (Map Symbol - Qal)*

Quaternary Alluvium, deposited by stream flow is generally encountered within the drainage courses of the site. In general, the alluvial materials consist of silty sand to sandy silt with many angular gravels and cobbles throughout. These soils are typically massive, poorly consolidated, and contain roots and organics. These materials are considered to be potentially compressible and should be completely removed to suitable material in areas of proposed development.

### *2.2.3 Quaternary Older Alluvium (Map Symbol - Qalo)*

Quaternary Older Alluvium can be observed in the more resistant banks along the existing main drainages running east through the site. Although not encountered in our subsurface evaluation, a review of aerial photos suggests the edges of the existing major drainage consists of more resistant alluvial material, classified currently as Older Alluvium. Older alluvial deposits typically consist of more well consolidated silty sands and sandy silts with gravel and cobbles made up of the surrounding eroded bedrock debris.

### *2.2.4 Quaternary Landslide (Map Symbol - Qls)*

Based on the regional geologic map (Kennedy et al, 2007) a queried landslide is mapped on the southern edge of the subject site. The landslide is mapped descending to the north from the southernmost ridgeline as suggested primarily by geomorphic expression. However, shallow refusal, on the order of 1 to 2 feet below the existing ground surface, was encountered within the alleged landslide, exposing very dense, slightly weathered metavolcanic to metasedimentary rock.

Seismic line SL-2 conducted within the limits of the mapped landslide resulted in seismic velocities exceeding 5,000 ft/sec as shallow as 10 feet beneath the existing ground surface and approaching velocities of nearly 10,000 ft/sec as the proposed design cut depth, indicating extremely dense materials at relatively shallow depths. (See Rippability Section 2.10)

These preliminary findings suggest the landslide mass may be shallower than expected, or it may be a more anomalous erosional feature rather than landslide. However, as the Santiago Peak Volcanics do contain interbedded tuffaceous and/or ash beds, a more block-type slide cannot be ruled out until additional subsurface studies are completed. It is recommended that an additional subsurface evaluation be conducted to properly constrain the landslide limits as it relates to the proposed approximately 50-foot cut slope that parallels the mapped landslide backscarp.

### *2.2.5 Jurassic Santiago Peak Volcanics (Map Symbol – Jsp)*

The Jurassic-aged Santiago Peak Volcanics underlies the site throughout and are generally exposed at the surface or at shallow depths in the higher relief areas. These crystalline rocks include a wide variety of low to high grade metamorphic rocks that consist mostly of volcaniclastic breccia, meta-andesitic flows, tuffs, and tuffaceous breccia (Kennedy et al, 2007). The material was found to be very dense causing shallow excavation refusal in many of our exploratory test pits. The Santiago Peak Volcanics are known to contain ash fine-grained ash and/or tuff layers, that although uncommon, may result in weak rupture planes for potential landslides.

Descriptions of the subsurface conditions are presented on the exploratory excavation logs presented in Appendix B.

### 2.3 ***Geologic Structure***

Joints set encountered within the Santiago Peak Volcanics appear to be randomly oriented and discontinuous. Foliations within the bedrock material were not encountered in our subsurface evaluation and are not indicated within regional maps. No faults have been mapped on the site nor were encountered during our field study.

### 2.4 ***Landslides***

As discussed in Section 2.2.4, a queried landslide is located within the southern portion of the site. Based on our observations and preliminary field work the mapped landslide materials are very dense, resulting in shallow refusal and limited information. Seismic lines suggest blasting will be required in very hard non-rippable material at relatively shallow depths (See Rippability Section 2.10) even within the landslide. Based on the current grading concept, the majority of the landslide mass will be removed by design cut, during grading operations. However, further subsurface evaluation will need to be completed to have a better understanding of the rear limits of the landslide, particularly as it relates to the design approximately 50-foot cut slope depicted within the landslide backscarp.

### 2.5 ***Groundwater***

Groundwater was encountered at a depth of approximately 25 and 30 feet below existing grade at HS-1 and HS-2, respectively. Groundwater is not expected to be a major constraint during construction activities.

Groundwater and/or groundwater seepage conditions may occur in the future due to changes in land use and/or following periods of heavy rain. Seasonal fluctuations of groundwater elevations should be expected over time. In general, groundwater levels fluctuate with the seasons and local zones of perched groundwater may be present within the near-surface deposits due to local landscape and vineyard irrigation or precipitation especially during rainy seasons.

### 2.6 ***Seismicity and Faulting***

Prompted by damaging earthquakes in Northern and Southern California, State legislation and policies concerning the classification and land-use criteria associated with faults have been developed. The Alquist-Priolo Earthquake Fault Zoning Act was implemented in 1972 to prevent the construction of urban developments across the trace of active faults. California Geologic Survey Special Publication 42 was created to provide guidance for following and implementing the law requirements. Special Publication 42 was most recently revised in 2018 (CGS, 2018). According to the State Geologist, an “active” fault is defined as one which has had surface displacement within Holocene time (roughly the last 11,700 years). Regulatory Earthquake Fault Zones have been delineated to encompass traces of known, Holocene-active faults to address hazards associated with surface fault rupture within California. Where developments for human occupation are proposed within these zones, the state requires detailed fault evaluations be performed so that engineering-geologists can identify the locations of active faults and recommend setbacks from locations of possible surface fault rupture.

No indication of active faulting was observed during our evaluation. The site is not located within a mapped State of California Earthquake Fault-Rupture Hazard Zone per compiled maps released by the CGS (2018), and no known active or potentially active faults cross the site. The possibility of damage due to ground rupture is considered low since no active faults are known to cross the site.

Secondary effects of seismic shaking resulting from large earthquakes on the major faults in the Southern California region, which may affect the site, include ground lurching, and shallow ground rupture, soil liquefaction, and dynamic settlement. These secondary effects of seismic shaking are a possibility throughout the Southern California region and are dependent on the distance between the site and causative fault and the onsite geology. Nearby faults that could produce these secondary effects include the Elsinore, Rose Canyon, and San Jacinto Faults, among others. A discussion of these secondary effects and their potential impact on the site is provided in the following sections.

### *2.6.1 Liquefaction and Dynamic Settlement*

Liquefaction is a seismic phenomenon in which loose, saturated, granular soils behave similarly to a fluid when subject to high-intensity ground shaking. Liquefaction occurs when three general conditions coexist: 1) shallow groundwater; 2) low density non-cohesive (granular) soils; and 3) high-intensity ground motion. Studies indicate that saturated, loose near-surface cohesionless soils exhibit the highest liquefaction potential, while dry, dense, cohesionless soils and cohesive soils exhibit low to negligible liquefaction potential. In general, cohesive soils are not considered susceptible to liquefaction, depending on their plasticity and moisture content (Bray & Sancio, 2006). Effects of liquefaction on level ground include settlement, sand boils, and bearing capacity failures below structures. Dynamic settlement of dry loose sands can occur as the sand particles tend to settle and densify as a result of a seismic event.

Liquefaction potential was evaluated using the procedures outlined by Special Publication 117A (SCEC, 1999 & CGS, 2008) and the applicable seismic criteria (e.g., 2022 CBC). Liquefaction induced settlement was estimated using the $PGA_M$ per the 2022 CBC and a moment magnitude of 6.57 (USGS, 2014).

Based on the data obtained from our field evaluation and amount of design fill being placed in the alluvial areas, liquefaction settlement in the alluvial areas is estimated to be on the order of approximately 2 inches. Differential seismic settlement may be estimated as one-half of the total seismic settlement over a horizontal span of 40 feet.

### *2.6.2 Lateral Spreading*

Lateral spreading is a type of liquefaction-induced ground failure associated with the lateral displacement of surficial blocks of sediment resulting from liquefaction in a subsurface layer. Once liquefaction transforms the subsurface layer into a fluid mass, gravity plus the earthquake inertial forces may cause the mass to move downslope towards a free face (such as a river channel or an embankment). Lateral spreading may cause large horizontal displacements and such movement typically damages pipelines, utilities, bridges, and structures.

Due to the deep nature of potentially liquefiable soils the potential for lateral spreading is considered low.

## 2.7 Seismic Design Parameters

Since the site contains soils that are susceptible to liquefaction (refer to above Section "Liquefaction and Dynamic Settlement"), ASCE 7 which has been adopted by the CBC requires that site soils be assigned Site Class "F" and a site-specific response spectrum be performed. However, in accordance with Section 20.3.1 of ASCE 7, if the fundamental periods of vibration of the planned structure are equal to or less than 0.5 second, a site-specific response spectrum is not required and ASCE 7/2022 CBC site class and seismic parameters may be used in lieu of a site-specific response spectrum. It should be noted that the seismic parameters provided herein are not applicable for any structure having a fundamental period of vibration greater than 0.5 second

The site seismic characteristics were evaluated per the guidelines set forth in Chapter 16, Section 1613 of the 2022 California Building Code (CBC) and applicable portions of ASCE 7-16 which has been adopted by the CBC. Please note that the following seismic parameters are only applicable for code-based acceleration response spectra and are not applicable for where site-specific ground motion procedures are required by ASCE 7-16. Representative site coordinates of latitude 33.163989 degrees north and longitude -117.164867 degrees west were utilized in our analyses. The maximum considered earthquake (MCE) spectral response accelerations ($S_{MS}$ and $S_{M1}$) and adjusted design spectral response acceleration parameters ($S_{DS}$ and $S_{D1}$) for Site Class C are provided in Table 2 on the following page. The structural designer should contact the geotechnical consultant if structural conditions (e.g., number of stories, seismically isolated structures, etc.) require site-specific ground motions.

***TABLE 2***

***Seismic Design Parameters***

| Selected Parameters from 2022 CBC, Section 1613 - Earthquake Loads | Seismic Design Values | Notes/Exceptions |
|---|---|---|
| Distance to applicable faults classifies the site as a "Near-Fault" site. | | Section 11.4.1 of ASCE 7 |
| Site Class | C | Chapter 20 of ASCE 7 |
| Ss (Risk-Targeted Spectral Acceleration for Short Periods) | 0.910g | From SEAOC, 2024 |
| $S_1$ (Risk-Targeted Spectral Accelerations for 1-Second Periods) | 0.334g | From SEAOC, 2024 |
| $F_a$ (per Table 1613.2.3(1)) | 1.2 | For Simplified Design Procedure of Section 12.14 of ASCE 7, $F_a$ shall be taken as 1.4 (Section 12.14.8.1) |
| $F_v$ (per Table 1613.2.3(2)) | 1.5 | - |
| $S_{MS}$ for Site Class C [Note: $S_{MS} = F_aS_S$] | 1.092g | - |
| $S_{M1}$ for Site Class C [Note: $S_{M1} = F_vS_1$] | 0.502g | - |
| $S_{DS}$ for Site Class C [Note: $S_{DS} = (^2/_3)\ S_{MS}$] | 0.728g | - |
| $S_{D1}$ for Site Class C [Note: $S_{D1} = (^2/_3)\ S_{M1}$] | 0.334g | - |
| $C_{RS}$ (Mapped Risk Coefficient at 0.2 sec) | 0.921 | ASCE 7 Chapter 22 |
| $C_{R1}$(Mapped Risk Coefficient at 1 sec) | 0.922 | ASCE 7 Chapter 22 |

A deaggregation of the PGA based on a 2,475-year average return period (MCE) indicates that an earthquake magnitude of 6.57 at a distance of approximately 18.01 km from the site would contribute the most to this ground motion. A deaggregation of the PGA based on a 475-year average return period (Design Earthquake) indicates that an earthquake magnitude of 6.62 at a distance of approximately 26.67 km from the site would contribute the most to this ground motion (USGS, 2014).

Section 1803.5.12 of the 2022 CBC (per Section 11.8.3 of ASCE 7) states that the maximum considered earthquake geometric mean ($MCE_G$) Peak Ground Acceleration (PGA) should be used for liquefaction potential. The $PGA_M$ for the site is equal to 0.472g (SEAOC, 2024). The design PGA is equal to 0.315g (2/3 of $PGA_M$).

## *2.8 <u>Preliminary Soil Shear Strength Parameters</u>*

The soil shear strength parameters presented in Table 3 on the following page were utilized in our preliminary feasibility level slope stability analysis and are based on our recent laboratory testing. Laboratory test results are provided in Appendix C.

***Table 3***

***Summary of Shear Strength Parameters for Slope Stability Analysis***

| **Soil Type** | **Static** | | **Pseudo Static** | |
|---|---|---|---|---|
| | **ϕ (Degrees)** | **Cohesion (psf)** | **ϕ (Degrees)** | **Cohesion (psf)** |
| Artificial Fill - Compacted | 31 | 200 | 31 | 350 |
| Santiago Peak Volcanics | 34 | 300 | 38 | 350 |

## *2.9* ***Preliminary Global Slope Stability Analysis***

Preliminary global slope stability analysis was performed on the tallest cut slope approximately 50 feet in height, the tallest design fill slope at 45 feet in height and tallest slope/wall combination of an approximately 30-foot-tall slope and 10-foot-tall wall.

Preliminary slope stability analysis was performed using the computer program GSTABL7 with GEOSTASE, version 4.30.31 (Gregory Geotechnical Software, 2019). Potential rotational failure modes were analyzed using Bishop's Modified Method. Slope stability analysis was performed for static and pseudo-static (seismic) loading conditions. A minimum factor of safety of 1.5 and 1.1 is typically required for static and seismic loading conditions.

Based on the conceptual site plan (Excel Engineering, 2024), preliminary slope stability analysis indicates global factors of safety greater than 1.5 and 1.1 for static and seismic loading conditions, respectively. Slope stability analysis is provided in Appendix E. Please note additional design level slope stability analysis may need to be performed during a 40-scale grading plan review level evaluation of the subject site based on results of future field work or changes to the grading plan.

## *2.10* ***Rippability***

In general, the onsite *surficial* soils (topsoil and alluvium) are anticipated to be easily rippable utilizing conventional heavy-duty earth moving equipment (Caterpillar D9 or equivalent). The excavation difficulty of the bedrock is highly dependent on the amount of physical and chemical weathering it has been subjected to over time, the amount/spacing of fractures, joints, and/or foliations present, and the equipment/techniques used by the contractor. Based on the subsurface data, bedrock is generally anticipated to range from moderately rippable to non-rippable.
Estimated seismic velocity ranges and rippability classification utilizing heavy-duty equipment (Caterpillar D-9 or equivalent) are presented in Table 2 on the following page. The rippability classifications and velocity ranges presented below are based on readily available rippability

charts (Stephens, 1978 & Caterpillar, 2019) and local experience with similar nearby projects.

***Table 4***

***Generalized Rippability Summary of Crystalline Bedrock (D9 or Equivalent)***

| Rippability Classification | Approximate Seismic Velocity (Feet per Second) |
|---|---|
| Moderate Rippability | < 4,000 |
| Difficult to Very Difficult Rippability | 4,000 to 5,500 |
| Non-Rippable (Blasting Recommended) | > 5,500 |

Based on the geologic characteristics of the onsite bedrock and local experience, we estimate that a seismic velocity of approximately 5,500 feet per second represents the boundary between a Very Difficult Rippability and Non-Rippable classification.

The depth of rippability in the bedrock varies dramatically across the site and may vary significantly over short distances. Figures 3a through 3c (rear of text) depicts the seismic data of Seismic Lines 1 through 3 with the proposed design grades and over-excavation limits overlain. The depth to Non-Rippable bedrock ranges from approximately 11 feet to 37 feet below the ground surface. Localized non-rippable zones or corestones may be present throughout and will require additional effort (very difficult ripping, breakers, etc.) and/or larger equipment for excavation. A summary of the seismic velocities encountered at the seismic line locations is presented in Table 5.

***Table 5***

***Summary of Seismic Line Velocity vs. Rippability (D-9 or Equivalent)***

| **Seismic Line** | **Approximate Depth (in feet) to Non-rippable Bedrock (Approx. Seismic Velocity 5,500 ft./sec or Greater)** |
|---|---|
| S-1 | 11-23 |
| S-2 | 12-27 |
| S-3 | 25-37 |

Performing blasting on rock classified with Moderate Rippability and Difficult to Very Difficult Rippability may be determined to be more economical or beneficial for construction scheduling than typical grading practices. This is highly dependent on anticipated production rates of the grading contractor based on the equipment used for ripping/excavation. It is recommended that the grading contractor review the provided subsurface data and independently determine the potential non-rippable/blasting depths, lateral extents, quantities, production rates, etc. based on their experience, the project schedule, and final project plans. For further details regarding rippability refer to the Seismic Refraction Survey report prepared by Geovision (2024) in Appendix F.

Please note that different earthmoving equipment (excavators, smaller dozers, backhoes, etc.) will not correlate with the velocity ranges and rippability classifications presented above. In general, a (smaller) excavator typically utilized for underground utility installation will generally encounter difficult ripping conditions in materials having a seismic velocity of approximately 4,000 to 4,500 feet per second. Therefore, any future underground utilities proposed in the area of the bedrock will require over-excavation during rough grading with the larger field equipment. Areas of proposed underground utilities in hard rock conditions are typically over-excavated a minimum depth of 2 feet below the deepest utility during rough grading operations to facilitate installation.

## *2.11 Oversized Material*

Oversized material (material larger than 8 inches in maximum dimension) is expected to be generated during site grading and/or blasting operations. Recommendations are provided for appropriate handling of oversized materials in General Earthwork & Grading Specifications, Appendix G.

## *2.12 Expansion Potential*

Based on the results of our laboratory testing, fills at the completion of grading are anticipated to have a “very low” to “low” expansion potential. Note that some soils with very high expansion potential may exist on-site based on laboratory testing from nearby sites (AGS, 2016). Final expansion potential of site soils should be determined at the completion of grading. Results of expansion testing at finish grades will be utilized to confirm final foundation design.

## *3.0 CONCLUSIONS*

Based on the results of our subsurface evaluation and geotechnical review of the proposed plan, it is our opinion that the proposed grading of the site is considered feasible from a geotechnical standpoint, provided that the recommendations provided here and in future reports are incorporated during site grading and development. A summary of our geotechnical conclusions are as follows:

- The underlying geologic bedrock unit mapped on the site is the Santiago Peak Volcanics. Unsuitable alluvial materials overlay the bedrock ranging in depth from 2 to 8 feet below existing ground. Suitable more well consolidated alluvium can be left in place.
- A mapped potential landslide is present descending into the site from the southern edge of the property. Additional subsurface studies of the landslide should be completed to further evaluate the underlying limits and how it relates to the proposed 50-foot cut slope above it.
- Groundwater was encountered at a depth of approximately 25 and 30 feet below existing grade at HS-1 and HS-2, respectively. Groundwater is not expected to be a major constraint during construction activities.
- The subject site is not located within a State of California Earthquake Fault Rupture Zone (Alquist-Priolo). The main seismic hazard that may affect the site is ground shaking from one of the active regional faults. The subject site will likely experience strong seismic ground shaking during its design life.
- Based on the data obtained from our field evaluation and amount of design fill being placed in the alluvial areas, liquefaction settlement in the alluvial areas is estimated to be on the order of approximately 2 inches. Differential seismic settlement may be estimated as one-half of the total seismic settlement over a horizontal span of 40 feet.
- Based on our preliminary evaluation, knowledge of the site and regional soil conditions, future proposed slopes and walls are anticipated to be generally stable following implementation of earthwork recommendations (current and future). Additional replacement slopes and/or buttress fills may be required based upon future subsurface exploration, laboratory testing and analysis. LGC Geotechnical may need to perform a design level slope stability evaluation once additional field work has been completed and grading plans have been finalized. Additional fieldwork and/or laboratory testing will be necessary.
- Rippability analysis suggests deeper cuts proposed within the bedrock are expected to be non-rippable and will require blasting. In general, non-rippable zones of bedrock should be anticipated at depths as shallow as 11 feet below existing grades. Locally, it may be encountered shallower. It is recommended that the grading contractor review the provided subsurface data and independently determine the potential non-rippable/blasting depths, lateral extents, quantities, production rates, etc. based on their experience, project schedule, and the project plans.
- Oversized material (material greater than 8 inches in maximum dimension) is anticipated to be generated during site grading/blasting. These materials will require special handling during grading which may include offsite disposal, crushing/breaking, and/or specialty placement in deep fills to meet project requirements.
- Based on the results of our preliminary laboratory testing, site soils are anticipated to have "Very Low" to "Low" expansion potential. Note that some soils with very high expansion potential may

exist on-site based on laboratory testing from nearby sites (AGS, 2016). Mitigation measures will be required for any planned foundations and site improvements such as concrete flatwork to minimize the impacts of expansive soils.

- Pre-soaking of the subgrade for building slabs and site flatwork may be recommended if grading operation expose additional expansive soils. The duration of this process varies greatly based on the chosen method and is also dependent on factors such as soil type and weather conditions. Time duration for presoaking should be accounted for in the construction schedule. (Typically, approximately one to three weeks depending on the finish grade expansion potential results). Additional time at the completion of presoaking may be necessary for the surface soils of the pad to dry back sufficiently to be capable of supporting trenching equipment.
- From a geotechnical perspective, the existing onsite soils are considered suitable material for use as general fill, provided that they are relatively free from oversized material (larger than 8 inches in maximum dimension), construction debris, and significant organic material. Moisture conditioning will be required to obtain the required compaction.
- The site contains soils that are not suitable for retaining wall backfill due to their fines content and expansion potential, therefore select grading and stockpiling and/or import of sandy soils may be required by the contractor for obtaining suitable backfill soil for planned site retaining walls.
- Based on the results of our evaluation and analysis provided herein, and provided our recommendations are properly implemented during construction, the proposed development of the site is not anticipated to significantly impact adjacent properties.

# ***4.0 RECOMMENDATIONS***

The following recommendations are to be considered preliminary and should be confirmed upon completion of grading and earthwork operations. In addition, they should be considered minimal from a geotechnical viewpoint, as there may be more restrictive requirements from the architect, structural engineer, building codes, governing agencies, or the owner.

It should be noted that the following geotechnical recommendations are intended to provide sufficient information to develop the site in general accordance with the 2022 CBC requirements. With regard to the potential occurrence of potentially catastrophic geotechnical hazards such as fault rupture, earthquake-induced landslides, liquefaction, etc. the following geotechnical recommendations should provide adequate protection for the proposed development to the extent required to reduce seismic risk to an "acceptable level." The "acceptable level" of risk is defined by the California Code of Regulations as "that level that provides reasonable protection of the public safety, though it does not necessarily ensure continued structural integrity and functionality of the project" [Section 3721(a)]. Therefore, repair and remedial work of the proposed improvements may be required after a significant seismic event. With regards to the potential for less significant geologic hazards to the proposed development, the recommendations contained herein are intended as a reasonable protection against the potential damaging effects of geotechnical phenomena such as expansive soils, fill settlement, groundwater seepage, etc. It should be understood, however, that although our recommendations are intended to maintain the structural integrity of the proposed development and structures given the site geotechnical conditions, they cannot preclude the potential for some cosmetic distress or nuisance issues to develop as a result of the site geotechnical conditions.

A detailed grading plan review report based on the 40-scale rough grading plans should be prepared in order to provide geotechnical recommendations for the proposed development. Additional fieldwork and laboratory testing may be required. Additional and/or modified geotechnical recommendations should be expected.

Based on our preliminary study, the following is a summary of our preliminary geotechnical recommendations.

## ***4.1 Site Earthwork***

We anticipate that earthwork at the site will consist of site preparation, removal of existing vegetation, excavation of slope stabilization fills (keyways), installation of subdrains, remedial grading, and fill placement.

We recommend that earthwork onsite be performed in accordance with the following recommendations, future grading plan review report(s), the 2022 CBC, City of San Marcos grading requirements, and the General Earthwork and Grading Specifications for Rough Grading included in Appendix G. In case of conflict, the following recommendations shall supersede all previous recommendations and those included as part of Appendix G. The following recommendations should be considered preliminary and may be revised based upon future evaluation and review of the project plans and/or based on the actual conditions encountered during site grading and construction.

#### *4.1.1 Site Preparation*

Prior to grading of areas to receive structural fill or engineered improvements, the areas should be cleared of surface obstructions, debris, and vegetation. The surface obstructions, debris, and vegetation should be removed and properly disposed of off-site. Holes resulting from the removal of buried obstructions, which extend below proposed finish grades, should be replaced with suitable compacted fill material. Any abandoned sewer or storm drain lines should be completely removed and replaced with properly placed compacted fill. We recommend the trenches associated with demolition which extend below the remedial grading depth be backfilled and properly compacted prior to the demolition contractor leaving the site.

If cesspools or septic systems are encountered, they should be removed in their entirety. The resulting excavation should be backfilled with properly compacted fill soils. As an alternative, cesspools can be backfilled with lean sand-cement slurry. Any encountered wells should be properly abandoned in accordance with regulatory requirements. At the conclusion of the clearing operations, a representative of LGC Geotechnical should observe and accept the site prior to further grading.

#### *4.1.2 Remedial Grading*

In order to provide a relatively uniform bearing condition for the planned improvements, the upper loose/compressible soils are to be temporarily removed and replaced as properly compacted fills. Existing topsoil, upper portions of alluvium, and weathered bedrock should be temporarily removed and recompacted as compacted fill. For preliminary planning purposes, estimated temporary removal and recompaction depths range from approximately 3 to 8 feet below existing grade; however, deeper removal and recompaction may be required during grading based on the conditions exposed during grading. See geotechnical map (Sheet 1) for preliminary locations and depths of the remedial grading. Updated remedial grading recommendations should be provided in the future 40-scale grading plan review report.

It should be noted that over-excavation is recommended in design cut areas (see Section 4.1.5). Additionally, local conditions may be encountered which could require additional removals beyond the estimated depths depicted on the map. The actual depth and lateral extents of removals should be determined by the geotechnical consultant, based on subsurface conditions encountered during grading. Please note that perched groundwater may be encountered at various localized areas during grading. Removal areas should be accurately staked in the field by the Project Surveyor.

#### *4.1.3 Over-excavation of Pads and Streets*

In order to provide a uniform fill blanket beneath proposed structures, it is recommended that design cut pads, and cut/fill transition pads be over-excavated a minimum of 3 feet below ultimate finish pad grade, or a minimum of 2-foot below planned footings, whichever is greater. A maximum 3:1 differential fill thickness, up to a maximum over-excavation depth of 10 feet, underneath individual lots should be maintained in order to reduce the potential for future differential settlement. Over-excavation should extend laterally a minimum of 5 feet beyond proposed building footprints. The over-excavation bottoms should be graded with a minimum 2 percent tilt towards deeper fill areas in order to reduce the potential for ponding of water.

As a minimum, streets in design cut area should be over-excavated a minimum of 2 feet below subgrade elevations. In order to avoid difficult excavation during utility installation with smaller equipment (e.g., excavators, backhoes, etc.), streets in design cut areas within the bedrock should be over-excavated to a depth equivalent to 2-feet below the lowest utility during rough grading. Extending the street over-excavation to 2-feet below the deepest utility will help mitigate potential hard rock excavation difficulties during underground utility installation.

Over-excavations/undercuts must be confirmed and mapped by the geotechnical consultant prior to subsequent fill placement. The actual depth and lateral extents of over-excavation should be determined by the geotechnical consultant, based on subsurface conditions encountered during grading. Over-excavation areas should be accurately staked in the field by the Project Surveyor. Please note that some estimated removals in the existing alluvial areas of the site may extend deeper than the recommended over-excavation in order to remove unsuitable materials (see Remedial Grading Section 4.1.2).

Updated overexcavation recommendations should be provided in the grading plan review report.

#### *4.1.4 <u>Subgrade Preparation</u>*

Removal bottoms, over-excavation bottoms and areas to receive fill should be observed and accepted by LGC Geotechnical prior to subsequent fill placement. Areas approved for fill placement should be scarified to a minimum depth of 6 to 8 inches, brought to a near-optimum moisture condition, and re-compacted in place per the project requirements.

#### *4.1.5 <u>Geologic Mapping</u>*

Removal bottoms, over-excavation bottoms, backcuts, keyway excavations and cut slopes must be geologically mapped by the geotechnical consultant during earthwork construction to confirm the anticipated conditions. If unanticipated adverse joints, fractures, and/or bedding are exposed, additional analysis and/or remediation measures may be required. The grading contractor must trim the bedrock backcuts with a slope board to remove loose material to allow for confirmation geologic mapping. Updated and/or revised geotechnical recommendations may be required based on observed conditions.

#### *4.1.6 Temporary Excavations*

Temporary excavations should be performed in accordance with project plans, specifications, and all Occupational Safety and Health Administration (OSHA) requirements. Excavations should be laid back or shored in accordance with OSHA requirements before personnel or equipment are allowed to enter. Based on our field investigation, the majority of site soils are anticipated to be OSHA Type "B" soils (refer to the attached boring logs) however some "A" and "C" soils also exist. Sandy soils are present and should be considered susceptible to caving and raveling. Soil conditions should be regularly evaluated during construction to verify conditions are as anticipated. The contractor shall be responsible for providing the "competent person" required by OSHA standards to evaluate soil conditions. Close coordination with the geotechnical consultant should be maintained to facilitate construction while providing safe excavations. Excavation safety is the sole responsibility of the contractor.

Vehicular traffic, stockpiles, and equipment storage should be set back from the perimeter of excavations a minimum distance equivalent to a 1:1 (horizontal to vertical) projection from the bottom of the excavation or 5 feet, whichever is greater, unless the cut is shored and designed for applicable surcharge load. Once an excavation has been initiated, it should be backfilled as soon as practical. Prolonged exposure of temporary excavations may result in some localized instability. Excavations should be planned so that they are not initiated without sufficient time to shore/fill them prior to weekends, holidays, or forecasted rain.

It should be noted that any excavation that extends below a 1:1 (horizontal to vertical) projection of an existing foundation will remove existing support of the structure foundation. If requested, temporary shoring parameters will be provided.

#### *4.1.7 Subdrains*

Construction of canyon style subdrains may be recommended. The locations of the recommended subdrains are generally controlled by the natural site topography. Canyon subdrains are typically placed following remedial grading and before fill placement within the "cleaned-out" canyons on the exposed bedrock removal bottoms to collect future groundwater that may accumulate/migrate in these areas along the bedrock/fill contact. At this site, canyon drains can be placed at the bottom of the canyon remedial removals within the dense alluvial materials that may remain in place. In areas where remedial grading will be deeper than available subdrain outlet elevations, fill placement should be performed until suitable subdrain flow elevations are achieved (minimum 2 percent flow towards the outlet location). In these areas, the primary purpose of the subdrains will be to reduce the potential for groundwater to rise above the subdrain elevations into the compacted fill. See Sheet 1 for Preliminary canyon subdrain locations. Final determination of locations of canyon subdrains should be provided as part of a future 40-scale grading plan review.

Installation of subdrains along backcuts of recommended stability fill keyways should also be anticipated for site grading. Recommendations for installation of subdrains along backcuts of recommended stabilization fill keyways should be provided as part of a future 40-scale grading plan review report.

If unanticipated groundwater or areas of potential future groundwater seepage and/or accumulation are encountered during grading, additional subdrains may be recommended by the geotechnical consultant.

A representative of the project civil engineer should survey the installed subdrains for alignment and grade prior to fill placement above the subdrains.

### *4.1.8 Material for Fill*

From a geotechnical perspective, the onsite soils are generally considered suitable for use as general compacted fill, provided they are relatively free of organic materials and construction debris. Any encountered oversized material (material larger than 8 inches in maximum dimension) must be appropriately handled as outlined in Appendix G.

From a geotechnical viewpoint, any required import soils for general fill (i.e., non-retaining wall backfill) should consist of clean, relatively granular soils of “Very Low” to “Low” expansion potential (expansion index 50 or less based on American Society for Testing and Materials [ASTM] D 4829), and free of organic materials, construction debris and any material greater than 3 inches in maximum dimension. Import for any required retaining wall backfill should meet the criteria outlined in the following paragraph. Source samples should be provided to the geotechnical consultant for laboratory testing a minimum of 4 working days prior to any planned importation.

Conventional (masonry) retaining wall backfill should consist of sandy soils with a maximum of 35 percent fines (passing the No. 200 sieve) per American Society for Testing and Materials (ASTM) Test Method D1140 (or ASTM D6913/D422) and a “Very Low” expansion potential (EI of 20 or less per ASTM D4829). Soils should also be screened of organic materials, construction debris, and any material greater than 3 inches in maximum dimension. Some of site soils are not suitable for retaining wall backfill due to their fines content (i.e., silt and clay content) and expansion potential. Therefore, import of select sandy soils meeting the criteria outlined above or select grading of sandy soils may be required by the contractor for obtaining suitable retaining wall backfill soil. These preliminary findings will be confirmed during grading.

Aggregate base (crushed aggregate base or crushed miscellaneous base) should conform to the latest requirements of Section 200-2 of the Standard Specifications for Public Works Construction (“Greenbook”) for untreated base materials (except processed miscellaneous base) or Caltrans Class 2 aggregate base.

### *4.1.9 General Fill Placement, Deep Fills, Rock Blankets and Rock Windrows*

General fill shall be relatively free of organics and other deleterious materials and shall have a maximum particle size less than 8 inches. General fill shall be placed following the methods described in the following section of this report. Based on the onsite geotechnical conditions, soils to be utilized as fill material will contain some irreducible rock. Thus, the need for rock disposal will be necessary during grading operations on the site. Generally, for the purpose of this report, the fill materials may be described as either:

1. Materials 8 inches or less;
2. Materials greater than 8 inches and up to 36 inches; and
3. Materials greater than 36 inches.

The placement and compaction of any fill containing particles sizes greater than 8 inches, referred to as "oversized", shall be done in accordance with either the rock blanket method or windrow method. See below for details. Please note that random placement of particles greater than 8 inches will not be allowed. Oversized materials greater than 8 inches in diameter should not be placed within 10 feet of finished grade or within 15 feet of any slope face.

The following sections outline where and how these categories of fill materials are to be placed. Consideration should be given to evaluating the total fill volume versus the volume of oversize materials.

#### *4.1.9.1 General Fill Placement and Compaction (Materials 8 inches or less)*

Soil to be placed as general fill should be brought to near optimum moisture content (generally near optimum to about 2 percent above optimum moisture content) and recompacted to at least 90 percent relative compaction (per ASTM D1557). Moisture conditioning of site soils will be required in order to achieve adequate compaction. Soils are present that will require additional moisture in order to achieve the required compaction. Drying and/or mixing the very moist soils may also be required prior to reusing the materials in compacted fills.

The optimum lift thickness to produce a uniformly compacted fill will depend on the type and size of compaction equipment used. In general, fill should be placed in uniform lifts not exceeding 8 inches in compacted thickness. Each lift should be thoroughly compacted and accepted prior to subsequent lifts. Generally, placement and compaction of fill should be performed in accordance with local grading ordinances and under the observation and testing performed by the geotechnical consultant.

Fill placed on any slopes greater than 5:1 (horizontal to vertical) should be properly keyed and benched into firm and competent soils as it is placed in lifts. During backfill of excavations, the fill should be properly benched into firm and competent soils of temporary backcut slopes as it is placed in lifts.

Fill slope faces, where applicable, should also be compacted to minimum project recommendations. This may require overbuilding of the slope face and trimming back to design grades. To improve surficial stability, vegetation specified by the landscape architect should be established on the slope face as soon as it is practical.

#### *4.1.9.2 Rock Blanket Fills (Materials Greater Than 8 inches and less than 36 inches)*

The "rock blanket fill" method for placement of oversized rock greater than 12 inches and up to 36 inches may be performed within sufficiently deep areas that are laterally extensive.

The total thickness of any single rock blanket layer shall not exceed 36 inches. Rock fill blankets may consist of a mixture of native soils (fines, sand, gravel) and rock to a maximum dimension of 36 inches. In general, rock blankets shall not exceed approximately 50 percent particles greater than 8 inches and shall contain approximately 50 percent or more material that is less than 8 inches in diameter, on a volumetric basis. This may require select grading or temporary stockpiling of materials. During placement and compaction, the rock blanket shall be heavily watered and repeatedly worked with dozers and pneumatic compaction equipment (or approved equivalent) so that the resulting fill is comprised of a mixture of the various particle sizes (not gap graded), is without significant voids, and forms a dense, compact fill matrix. A relatively large amount of water must be provided continuously during these operations.

Upon the completion of a 3-foot rock blanket, the surface should be generally level, compacted, moisture conditioned, and accepted by LGC Geotechnical prior to the placement of the next rock blanket or rock windrow.

The contractor shall periodically excavate test pits within the recently completed rock blanket at various random locations selected by the geotechnical consultant. These test pits will be used to either pass or fail the rock blanket fill.

Additional recommendations for construction of rock blankets will be provided by LGC Geotechnical based on observed field conditions. The construction of a rock blanket fill shall be continuously observed by LGC Geotechnical.

Rock blanket fills are recommended to be placed so the top of the blanket is a minimum of 10 feet below design grades. Rock blankets should be placed so the top of rock is deeper than future excavations for underground utilities or future improvements. Placing a rock banket fill is areas planned for utilities or improvements will make future excavations extremely difficult and costly.

#### *4.1.9.3 Rock Windrow (Materials Greater Than 36 Inches in Diameter)*

Disposal of oversized rock greater than 36 inches within sufficiently deep fill areas shall be performed using the windrow method. Windrowing of oversized rock shall be done in accordance with the "Oversize and Disposal Detail" in Appendix G.

Rock windrows are recommended to be placed so the top of the windrow is a minimum of 10 feet below design grades. Windrows should be placed so the top of rock is deeper than future excavations for underground utilities or future improvements. Placing a rock windrow in areas planned for utilities or improvements will make future excavations extremely difficult and costly.

#### *4.1.10 Fill Placement*

Material to be placed as fill should be brought above optimum moisture content (generally near optimum to about 2 percent above optimum moisture content) and recompacted to at least 90 percent relative compaction (per American Society for Testing and Materials [ASTM] Test Method D1557). Moisture conditioning of site soils will be required in order to achieve adequate compaction. Drying and/or mixing the very moist soils will be required prior to reusing the materials in compacted fills. Soils are also present that will require additional moisture in order to achieve the required compaction.

The optimum lift thickness to produce a uniformly compacted fill will depend on the type and size of compaction equipment used. In general, fill should be placed in uniform lifts not exceeding 8 inches in compacted thickness. Each lift should be thoroughly compacted and accepted prior to subsequent lifts. Generally, placement and compaction of fill should be performed in accordance with local grading ordinances and under the observation and testing performed by the geotechnical consultant. Any encountered oversized material as previously defined must be appropriately handled as recommended in Appendix G.

Fill placed on any slopes greater than 5:1 (horizontal to vertical) should be properly keyed and benched into firm and competent soils as it is placed in lifts. During backfill of excavations, the fill should be properly benched into firm and competent soils of temporary backcut slopes as it is placed in lifts.

Fill slope faces should also be compacted to project requirements. This may require overbuilding of the slope face and trimming back to design grades. Placement of sand or gravel lacking cohesive soil for binder on the outer slope face should be avoided in order to reduce potential for surficial instability such as erosion rills. To improve surficial stability, vegetation specified by the landscape architect should be established on the slope face as soon as it is practical.

Aggregate base material (crushed aggregate base and crushed miscellaneous base) should be compacted to a minimum of 95 percent relative compaction at or slightly above optimum moisture content per ASTM D1557. Subgrade below aggregate base should be compacted to a minimum of 90 percent relative compaction at near-optimum moisture content (generally within optimum and 2 percent above optimum moisture content) per ASTM D1557.

If gap-graded ¾-inch rock is used for backfill (around storm drain storage chambers, retaining wall backfill, etc.) it will require compaction. Rock shall be placed in thin lifts (typically not exceeding 6 inches) and mechanically compacted with observation by geotechnical consultant. Backfill rock shall meet the requirements of ASTM D2321. Gap-graded rock is required to be wrapped in filter fabric (Mirafi 140N or approved alternative) to prevent the migration of fines into the rock backfill.

### *4.1.11 Trench and Conventional Retaining Wall Backfill and Compaction*

Bedding material used within the pipe zone should conform to the requirements of the current Greenbook and the pipe manufacturer. Where applicable, sand having a sand equivalent (SE) of 20 or greater (per Caltrans Test Method [CTM] 217) may be used to bed and shade the pipes within the bedding zone. Sand backfill should be densified by jetting or flooding and then tamped to ensure adequate compaction. Sand grains should be from a natural source with a rounded shape. Manufactured sand from crushed rock or recycled material is not suitable for jetting/flooding as the grains are typically angular in shape and do not densify well enough with these methods.

The onsite soils may generally be considered suitable as trench backfill (zone defined as 12 inches above the pipe to subgrade), provided the soils are screened of rocks greater than 3 inches in maximum dimension, construction debris and organic material. Trench backfill should be compacted in uniform lifts (as outlined above in Section "Material for Fill") by mechanical means to at least 90 percent relative compaction (per ASTM D1557). If gap-graded rock is used for trench backfill, refer to Section 4.1.10.1.

Conventional retaining wall backfill should consist of sandy soils as outlined in preceding Section 4.1.9. The contractor should anticipate the select grading/stockpiling or importing of sandy soils for the required retaining wall backfill. The limits of select sandy backfill should extend a minimum ½ the height of the retaining wall or the width of the heel (if applicable), whichever is greater, refer to Figure 2. Retaining wall backfill soils should be compacted in relatively uniform thin lifts to at least 90 percent relative compaction (per ASTM D1557). Jetting or flooding of retaining wall backfill materials should not be permitted.

In backfill areas where mechanical compaction of soil backfill is impractical due to space constraints, typically sand-cement slurry may be substituted for compacted backfill. The slurry should contain about one sack of cement per yard. When set, such a mix typically has the consistency of compacted soil. Sand cement slurry placed near the surface within landscape areas should be evaluated for potential impacts on planned improvements.

A representative from LGC Geotechnical should observe, probe, and test the backfill to verify compliance with the project recommendations.

### *4.1.12 Shrinkage and Bulking*

Volumetric changes in earth quantities will occur when excavated onsite earth materials are replaced as properly compacted fill. The following is an estimate of shrinkage and bulking factors for the various geologic units found onsite, refer to Table 6 below. These estimates are based on in-place densities of the various materials and on the estimated average degree of relative compaction achieved during grading. Subsidence due to earthwork equipment is expected to be up to 0.1 feet in alluvial areas.

***TABLE 6***

***Estimated Shrink/Bulk***

| Soil Type | Allowance | Estimated Range |
|---|---|---|
| Alluvium (Qal) (Upper 5 Feet) | Shrinkage | 5% to 15% |
| Jurassic Santiago Peak Volcanics (Jsp) | Bulking | 10% to 20% |

It should be stressed that these values are only estimates and that an actual shrinkage factor is extremely difficult to predetermine. The effective shrinkage of onsite soils will depend primarily on the type of compaction equipment and method of compaction used onsite by the contractor. The above shrinkage and bulking estimates are intended as an aid for project engineers in determining preliminary earthwork quantities. However, these estimates should be used with some caution since they are not absolute values. Contingencies such as a balance pad should be made for balancing earthwork quantities based on actual shrinkage and subsidence that occurs during grading. Shrinkage and bulking are also expected to vary with variations in survey accuracy during rough grading.

## *4.2 Slopes*

Preliminary global slope stability for the site has been evaluated utilizing three critical cross sections throughout the site, refer to Appendix G. Preliminary recommendations for construction of slopes are presented below and in the Standard Earthwork and Grading Specification (Appendix G). Final determination of keyway locations and dimensions should be determined during the future 40-scale grading plan review report.

### *4.2.1 Fill Slopes*

Design fill slopes at the site are anticipated to be both grossly and surficially stable as designed provided they are constructed in accordance with the Standard Earthwork and Grading Specifications (Appendix G) and proper irrigation, landscaping and maintenance is implemented (refer to Section 4.2.4). Fill slopes should be constructed with a maximum slope ratio of 2:1 (horizontal to vertical). Slope faces should also be compacted to minimum project recommendations. This may require overbuilding of the slope face and trimming back to design grades. To improve surficial stability, vegetation specified by the landscape architect should be established on the slope face as soon as it is practical, refer to Section 4.2.4. In certain instances, a keyway may be recommended at the base of the proposed fill slope. Should the need arise, keyways should be constructed in accordance with the Standard Earthwork and Grading Specification (Appendix G).

### 4.2.2 *Cut Slopes*

The majority of the proposed cut slopes will be excavated into the Santiago Peak Volcanics bedrock. Joint and/or fracture orientations in the bedrock were observed to be discontinuous, and generally randomly oriented. Foliations were not observed.

Cut slopes should be constructed with a maximum slope ratio of 2:1 (horizontal to vertical). All cut slopes should be observed by the engineering geologist during grading. Should unfavorable conditions (e.g., seepage, out-of-slope jointing/foliations) be observed during grading, the cut slopes in question may require stabilization by means of compacted fill buttress/stabilization fills and the installation of a subdrain system.

It should be understood that graded cut slopes with bedrock at the surface may be difficult to plant and may also be prone to surficial stability issues. To reduce surficial stability issues and improve plantability and aesthetics, a replacement slope fill slope may be constructed in lieu of a cut slope if elected to do so.

Fill over cut slope conditions are anticipated, and should be constructed in accordance with the General Earthwork and Grading Specifications included in Appendix G. Preliminary recommendations for keyway design and construction are provided in Appendix G.

#### 4.2.2.1 *Toe Drains*

It is our experience that in cut slope conditions within hard rock, water can infiltrate within the cracks and joints in the rock and accumulate at the toe of the design slope or migrate deeper a few feet below the surface. This water then can encounter a relatively impermeable layer and “backup” resulting in a wet ground surface.

In these instances, installation of a subdrain system near the toe of the ascending cut slope can help reduce the potential for nuisance water to saturate the subgrade.

If a subdrain system is desired, we recommend installing what is commonly referred to as a “burrito drain” system. We recommend the burrito drain be installed within the limits of the slope, if possible, or directly adjacent to the toe of the slope. The goal of the subdrain system is to intercept subsurface water and drain it off the site before it saturates adjacent lots.

As noted above, modifications to the recommendations presented herein may be necessary based upon conditions exposed in the field at the time of grading.

#### *4.2.3 Existing Slopes*

The site is predominately surrounded by existing slopes. These slopes will be subject to "natural" phenomena such as erosion, sloughing, surficial instabilities, etc. It is impossible to predict where or when this may happen. Should erosion or slippage occur, it should be promptly repaired. Paramount in reducing the potential for either erosion or slippage is to properly maintain these slopes (refer to Section 4.2.4).

#### *4.2.4 Slope Maintenance Guidelines*

It is recommended that any graded slopes be planted with ground cover vegetation as soon as practical to protect against erosion by reducing runoff velocity. Deep-rooted vegetation that requires little water and is able to survive local climate conditions should also be established to protect against surficial slumping. Under no circumstances should slopes be allowed to be bare of vegetation. Landscape vegetation must not be "trimmed" to root structures leaving no protection of the slopes. Irrigation levels should be kept to the minimum level necessary to establish healthy plant growth. Slopes must not be overwatered. If automatic sprinklers are used, they must be adjusted during periods of rainfall. A landscape professional must be consulted for landscape recommendations.

A program for the elimination of burrowing animals in both native and graded slope areas must be established to protect slope stability by reducing the potential for surface water to penetrate into the slope. Continuous erosion control, rodent control, and maintenance are essential to the long-term stability of all slopes. Trenches excavated on a slope face for utility or irrigation lines and/or for any purpose must be properly backfilled and compacted to project recommendations (refer to Section 4.1.11) to the slope face. Observation/testing and acceptance by the geotechnical consultant during trench backfill are recommended. V-ditches should be inspected and cleared of loose soil and/or debris on a routine basis, especially prior to and during the rainy season.

### *4.3 Provisional Foundation Recommendations*

Given that the expansion index laboratory testing values correspond to "Very Low" to "Low" level of expansion (EI of 50 or less per ASTM D4829) with the possibility of soils with "Very High" expansion potential based on laboratory testing from nearby sites, the foundation system shall be designed for effects of expansive soil. Provided that the remedial grading recommendations provided herein are implemented, the site may be considered suitable for the support of the proposed structures using a post-tension foundation system. Preliminary post-tension foundation recommendations are provided in the following sections. Recommended soil bearing and estimated settlement due to structural loads are provided in Section 4.4.

Please note that the following foundation recommendations are preliminary and must be confirmed by LGC Geotechnical at the completion of project plans (i.e., foundation, grading, and site layout plans) as well as completion of grading.

### *4.3.1 Provisional Post-Tensioned Foundation Design Parameters*

These parameters have been determined in general accordance with Post-Tensioning Institute (PTI) Standard Requirements for Design of Shallow Post-Tensioned Concrete Foundations on Expansive Soils, referenced in Chapter 18 of the 2022 CBC. In utilizing these parameters, the foundation engineer should design the foundation system in accordance with the allowable deflection criteria of applicable codes and the requirements of the structural designer/architect. Other types of stiff slabs may be used in place of the CBC post-tensioned slab design provided that, in the opinion of the foundation structural designer, the alternative type of slab is at least as stiff and strong as that designed by the CBC/PTI method.

Our design parameters are based on our experience with similar projects, preliminary laboratory testing results, and the anticipated nature of the soil (with respect to expansion potential). Please note that implementation of our recommendations will not eliminate foundation movement (and related distress) should the moisture content of the subgrade fluctuate. It is the intent of these recommendations to help maintain the integrity of the proposed structures and reduce (not eliminate) movement, based upon the anticipated site soil conditions.

***TABLE 7***

***Geotechnical Parameters for Post-Tensioned Foundation Slab Design***

| **Parameter** | **PT Slab with Perimeter Footing** | **PT Mat with Thickened Edge** |
|---|---|---|
| Thornthwaite Moisture Index | -20 | -20 |
| Constant Soil Suction | PF 3.9 | PF 3.9 |
| Center Lift<br>Edge moisture variation distance, $e_m$<br>Center lift, $y_m$ | <br>9.0 feet<br>0.5 inch | <br>9.0 feet<br>0.6 inch |
| Edge Lift<br>Edge moisture variation distance, $e_m$<br>Edge lift, $y_m$ | <br>4.7 feet<br>1.1 inch | <br>4.7 feet<br>1.3 inch |
| Modulus of Subgrade Reaction, k (assuming presoaking as indicated below) | 150 pci | 150 pci |
| Minimum perimeter footing/thickened edge embedment below finish grade | 18 inches | 6 inches |
| Perimeter foundation reinforcement | N/A[1] | N/A[1] |
| Minimum slab thickness | 5 inches[1] | 8 inches[1] |
| Presoak (moisture conditioning) | 120% of Opt.<br>18 inches | 120% of Opt.<br>18 inches |

1. Recommendations for foundation reinforcement and slab thickness are ultimately the purview of the foundation engineer/structural engineer based upon geotechnical criteria and structural engineering considerations.

2. Recommendations for sand below slabs have traditionally been included with geotechnical foundation recommendations, although they are not the purview of the geotechnical consultant. The sand layer requirements are the purview of the foundation engineer/structural engineer and should be provided in accordance with ACI Publication 302 "Guide for Concrete Floor and Slab Construction".
3. Recommendations for vapor retarders below slabs are also the purview of the foundation engineer/structural engineer and should be provided in accordance with applicable code requirements.

#### *4.3.2 Foundation Subgrade Preparation and Maintenance*

Moisture conditioning (presoaking) of the subgrade soils prior to trenching the foundation may be required if the grading operation exposes soils with medium to high expansion potential. The duration of this process varies greatly based on the chosen method and is also dependent on factors such as soil type and weather conditions. Time duration for presoaking from completion of rough grading to trenching of foundations should be accounted for in the construction schedule (typically 2 to 3 weeks for medium expansion subgrade). The recommendations specific to the anticipated site soil conditions, including recommended presoak, are presented in Section 4.3.1. The subgrade moisture condition of the building pad soils should be maintained at near-optimum moisture content up to the time of concrete placement.

The geotechnical parameters provided herein assume that if the areas adjacent to the foundation are planted and irrigated, these areas will be designed with proper drainage and adequately maintained so that ponding, which causes significant moisture changes below the foundation, does not occur. Our recommendations do not account for excessive irrigation and/or incorrect landscape design. Plants should only be provided with sufficient irrigation for life and not overwatered to saturate subgrade soils. Sunken planters placed adjacent to the foundation should either be designed with an efficient drainage system or liners to prevent moisture infiltration below the foundation. Some lifting of the perimeter foundation beam should be expected even with properly constructed planters.

In addition to the factors mentioned above, the owner should be made aware of the potential negative influences of trees and/or other large vegetation. Roots that extend near the vicinity of foundations can cause distress to foundations. The owner (and the owner's landscape architect) should not plant trees/large shrubs closer to the foundations than a distance equal to half the mature height of the tree or 20 feet, whichever is more conservative unless specifically provided with root barriers to prevent root growth below the foundation.

It is the owner's responsibility to perform periodic maintenance during hot and dry periods to ensure that adequate watering has been provided to keep soils from separating or pulling back from the foundation.

#### *4.3.3 Slab Underlayment Guidelines*

The following is for informational purposes only since slab underlayment (e.g., moisture retarder, sand or gravel layers for concrete curing and/or capillary break) is unrelated to the geotechnical performance of the foundation and thereby not the purview of the geotechnical consultant. Post-construction moisture migration should be expected below the foundation. The foundation engineer/architect should determine whether the use of a capillary break (sand or gravel layer), in conjunction with the vapor retarder, is necessary or required by code. Sand layer thickness and location (above and/or below vapor retarder) should also be determined by the foundation engineer/architect.

### *4.4 Soil Bearing and Lateral Resistance*

Provided our earthwork recommendations are implemented, an allowable soil bearing pressure of 2,000 pounds per square foot (psf) may be used for the design of footings having a minimum width of 12 inches and minimum embedment of 18 inches below lowest adjacent ground surface. This value may be increased by 300 psf for each additional foot of embedment or 150 psf for each additional foot of foundation width to a maximum value of 2,500 psf. An allowable soil bearing pressure of 1,200 psf may be used for a mat slab a minimum of 6 inches below lowest adjacent grade. These allowable bearing pressures are applicable for level (ground slope equal to or flatter than 5H:1V) conditions only. Bearing values indicated above are for total dead loads and live loads. The above vertical bearing may be increased by one-third for short durations of loading which will include the effect of wind or seismic forces.

In utilizing the above-mentioned allowable bearing capacity and provided our earthwork recommendations are implemented, foundation settlement due to structural loads is anticipated to be 1-inch or less. Differential settlement may be taken as half of the total settlement (i.e., ½-inch over a horizontal span of 40 feet).

Resistance to lateral loads can be provided by friction acting at the base of foundations and by passive earth pressure. For concrete/soil frictional resistance, an allowable coefficient of friction of 0.3 may be assumed with dead-load forces. An allowable passive lateral earth pressure of 250 psf per foot of depth (or pcf) to a maximum of 2,500 psf may be used for lateral resistance. Allowable passive pressure may be increased to 340 pcf to a maximum of 3,400 psf for short duration seismic loading. These passive pressures are applicable for level (ground slope equal to or flatter than 5H:1V) conditions only. For a 2:1 (horizontal to vertical) downward sloping condition, a reduced passive lateral earth pressure of 100 pcf to a maximum of 1,000 psf may be used. This allowable passive pressure may be increased to 130 pcf to a maximum of 1,300 psf for short duration seismic loading. We recommend that the upper foot of passive resistance be neglected if finished grade will not be covered with concrete or asphalt. Frictional resistance and passive pressure may be used in combination without reduction. The provided allowable passive pressures are based on a factor of safety of 1.5 and 1.1 for static and seismic loading conditions, respectively. The structural designer should incorporate appropriate factors of safety and/or load factors in their design.

## *4.5 Foundation Setback from Top-of-Slope and Bottom-of-Slope*

Foundations should have adequate setback from top and bottom of slopes in accordance with the City of San Marcos or the 2022 CBC, whichever is more conservative. Per the 2022 CBC, the minimum top-of-slope setback is H/3, with a maximum required setback of 40 feet, where H is the total height of the slope. As an alternative to moving the building footprint, top of slope setback requirements may be accomplished by deepened footings or deep foundations. The minimum bottom-of-slope setback is H/2, with a maximum required setback of 15 feet. When determining the height of the slope, any retaining walls should be included in the total slope height. Waivers from the code can occasionally be granted for toe of slope setbacks based on the lots/building geometry. Refer to Chapter 18 of the 2022 CBC for more information. It is the purview of the project civil engineer to implement the appropriate foundation setbacks.

## *4.6 Lateral Earth Pressures for Conventional Retaining Wall Design*

The following lateral earth pressures are presented in Table 8 for approved granular soils a maximum of 35 percent fines (passing the No. 200 sieve per ASTM D1140) and Very Low expansion potential (EI of 20 or less per ASTM D4829). Retaining wall backfill should also be limited to fill material not exceeding 3 inches in greatest dimension. Please note that some of the on-site soils are not suitable for use as retaining wall backfill; therefore, select grading and stockpiling or import of select sandy soils meeting the criteria outlined above will be required by the contractor for obtaining suitable retaining wall backfill soil. The retaining wall designer should clearly indicate on the retaining wall plans the required sandy backfill.

Lateral earth pressures are provided as equivalent fluid unit weights, in psf/ft of depth or pcf. These values do not contain an appreciable factor of safety, so the retaining wall designer should apply the applicable factors of safety and/or load factors during design. A soil unit weight of 120 pcf may be assumed for calculating the actual weight of soil over the wall footing.

***TABLE 8***

***Lateral Earth Pressures – Select Sandy Import***

| Conditions | Equivalent Fluid Unit Weight (pcf) | |
|---|---|---|
| | Level Backfill | 2:1 Backfill Sloping Upwards |
| | Approved Sandy Imported Backfill | Approved Sandy Imported Backfill |
| Active | 35 | 55 |
| At-Rest | 55 | 70 |

If the wall can yield enough to mobilize the full shear strength of the soil, it can be designed for "active" pressure. If the wall cannot yield under the applied load, the earth pressure will be higher. The equivalent fluid pressure values assume free-draining conditions. Retaining wall structures should be provided with appropriate drainage and appropriately waterproofed (Refer to Figure 2). Please note that waterproofing and outlet systems are not the purview of the geotechnical consultant. If conditions other than those assumed above are anticipated, the equivalent fluid pressure values should be provided on an individual-case basis by the geotechnical consultant.

Retaining wall structures should be provided with appropriate drainage and appropriately waterproofed. To reduce, but not eliminate, saturation of near surface (upper approximate 1-foot) soils in front of the retaining walls, the perforated subdrain pipe should be located as low as possible behind the retaining wall. The outlet pipe should be sloped to drain to a suitable outlet.

Surcharge loading effects from any adjacent structures should be evaluated by the retaining wall designer. In general, structural loads within a 1:1 (horizontal to vertical) upward projection from the bottom of the proposed basement/retaining wall footing will surcharge the proposed retaining structure. In addition to the recommended earth pressure, retaining walls adjacent to streets should be designed to resist vehicular traffic if applicable. Uniform surcharges may be estimated using the applicable coefficient of lateral earth pressure using a rectangular distribution. A factor of 0.35 and 0.5 may be used for the active and at-rest conditions, respectively. The vertical traffic surcharge may be determined by the structural designer. The retaining/basement wall designer should contact the geotechnical engineer for any required geotechnical input in estimating any applicable surcharge loads.

If required, the retaining wall designer may use a seismic lateral earth pressure increment of 10 pcf for a level backfill condition and 20 pcf for a sloping condition (up to an inclination of a 2:1). This increment should be applied in addition to the provided static lateral earth pressure using a triangular distribution with the resultant acting at H/3 in relation to the base of the retaining structure (where H is the retained height). For the restrained, at-rest condition, the seismic increment may be added to the applicable active lateral earth pressure (in lieu of the at-rest lateral earth pressure) when analyzing short duration seismic loading. Per Section 1803.5.12 of the 2022 CBC, the seismic lateral earth pressure is applicable to structures assigned to Seismic Design Category D through F for retaining wall structures supporting more than 6 feet of backfill height. <u>The provided seismic lateral earth pressure should not be used for retaining walls exceeding 10 feet in height. If a retaining wall greater than 10 feet in height is proposed, the retaining wall designer should contact the geotechnical consultant for specific seismic lateral earth pressure increments based on the configuration of the planned retaining wall structures</u>.

Soil nail walls should be considered in design cut areas over 6 feet tall. Soil nail wall parameters can be provided in the design level 40-scale geotechnical evaluation report.

Soil bearing and lateral resistance (friction coefficient and passive resistance) are provided in Section 4.4. Earthwork considerations (temporary backcuts, backfill, compaction, etc.) for retaining walls are provided in Section 4.1 (Site Earthwork) and the subsequent earthwork related sub-sections.

### *4.7 Soil Corrosivity to Concrete and Metal*

Although not corrosion engineers (LGC Geotechnical is not a corrosion consultant), several governing agencies in Southern California require the geotechnical consultant to determine the corrosion potential of soils on buried concrete and metal facilities. We therefore present the results of our testing with regard to corrosion for the use of the client and other consultants, as they determine necessary.

Preliminary corrosion testing of a near-surface bulk sample indicated a soluble sulfate content less than approximately 0.007 percent, a chloride content of 180 parts per million (ppm), pH of 6.73, and a minimum resistivity of 2,610 ohm-centimeters. Based on Caltrans Corrosion Guidelines (Caltrans, 2021), soils are considered corrosive to structural elements if the pH is 5.5 or less, or the chloride concentration is 500 ppm or greater, or the sulfate concentration is 1,500 ppm (0.15 percent) or greater. Based on the preliminary test results, soils are considered corrosive using Caltrans criteria. Additionally, based on minimum resistivity the soils are considered moderately corrosive to metallic improvements. If improvements that may be susceptible to corrosion are proposed, it is recommended that further evaluation by a corrosion engineer be performed.

Based on preliminary laboratory sulfate test results, the near surface soils are designated to a class “S0” per ACI 318, Table 19.3.1.1 with respect to sulfates. Concrete in direct contact with the onsite soils can be designed according to ACI 318, Table 19.3.2.1 using the “S0” sulfate classification.

Laboratory testing may need to be performed at the completion of grading by the project corrosion engineer to further evaluate the as-graded soil corrosivity characteristics. Accordingly, revision of the corrosion potential may be needed, should future test results differ substantially from the conditions reported herein. The client and/or other members of the development team should consider this during the design and planning phase of the project and formulate an appropriate course of action.

### *4.8 Control of Surface Water and Drainage Control*

From a geotechnical perspective, we recommend that compacted finished grade soils adjacent to proposed buildings be sloped away from the proposed buildings and towards an approved drainage device or unobstructed swale. Drainage swales, wherever feasible, should not be constructed within 5 feet of buildings. Where lot and building geometry necessitates that the side yard drainage swales be routed closer than 5 feet to structural foundations, we recommend the use of area drains together with drainage swales. Drainage swales used in conjunction with area drains should be designed by the project civil engineer so that a properly constructed and maintained system will prevent ponding within 5 feet of the foundation. Code compliance of grades is not the purview of the geotechnical consultant.

Planters with open bottoms adjacent to buildings should be avoided. Planters should not be designed adjacent to buildings unless provisions for drainage, such as catch basins, liners, and/or area drains, are made. Overwatering must be avoided.

### *4.9 Subsurface Water Infiltration*

Recent regulatory changes have occurred that mandate that storm water be infiltrated below grade into subsurface soils rather than collected in a conventional storm drain system. Typically, a combination of methods are implemented to reduce surface water runoff and increase infiltration including; permeable pavements/pavers for roadways and walkways, directing surface water runoff to grass-lined swales, retention areas, and/or drywells, etc.

It should be noted that collecting and concentrating surface water for the purpose of intentionally infiltrating below grade, conflicts with the geotechnical engineering objective of directing surface water away from slopes, structures and other improvements. The geotechnical stability and integrity of a site is reliant upon appropriately handling surface water. In general, the vast majority of geotechnical distress issues are directly related to improper drainage. In general, distress in the form of movement of improvements could occur as a result of soil saturation and loss of soil support, expansion, internal soil erosion, collapse and/or settlement.

The results of our field infiltration testing indicate the observed 1-D infiltration rate for I-1 through I-4 (not including required factors of safety for design) were 0.0, 10.5, 0.09 and 0.02 inches per hour, respectively. The design infiltration rate is thereby equal to the Observed Infiltration Rate divided by the design factor of safety. The design factor of safety must be a minimum of 2.0 but may be increased at the discretion of the design engineer (County of San Diego, 2020).

It is our understanding that the originally proposed basin location where I-2 was performed has been moved approximately 150 feet west closer to a bedrock area and therefore, will likely have greatly diminished infiltration results. Additional infiltration testing should be performed in this area to confirm the infiltration rate.

Based on the results of field infiltration testing indicating very low infiltration rates at the other locations and fine-grained nature of the on-site soils, we strongly recommend against the intentional infiltration of stormwater into the subsurface soils. At this time, we do not know what type of stormwater system will be used onsite. If a bio-filtration is proposed the subdrain rock and perforated pipe should be entirely wrapped in Mirafi 140N or equivalent filter fabric.

### *4.10 Preliminary Asphalt Concrete Pavement Sections*

The following preliminary minimum asphalt concrete (AC) street sections are provided in Table 9 for Traffic Indices (TI) of 5.0, 5.5 and 6.5. These sections are based on an estimated R-value of 30. These recommendations must be confirmed with R-value testing of representative near-surface soils at the completion of grading and after underground utilities have been installed and backfilled. Final pavement sections should be confirmed by the project civil engineer or city engineer based upon the final design Traffic Index. We are not responsible for selecting a design Traffic Index. If requested, LGC Geotechnical will provide sections for alternate TI values. Should the City of San Marcos have more stringent requirements, updated pavement recommendations can be provided.

***TABLE 9***

***Preliminary Asphalt Concrete Pavement Section Options***

| | | | |
|---|---|---|---|
| **Assumed Traffic Index** | 5.0 | 5.5 | 6.5 |
| **R -Value Subgrade** | 30 | 30 | 30 |
| **AC Thickness** | 4.0 inches | 4.0 inches | 4.0 inches |
| **Aggregate Base Thickness** | 4.0 inches | 5.0 inches | 8.0 inches |

Due to anticipated heavy construction traffic prior to the completion of the project, we recommend that the total thickness (base course and capping course) of AC be placed at essentially the same time. Construction traffic loading on only the base course of the AC will increase the potential for pavement distress. It should be noted that construction traffic such as concrete trucks will likely exceed traffic loading after completion of construction.

Increasing the thickness of asphalt or adding additional base material will reduce the likelihood of the pavement experiencing distress during its service life. The above recommendations are based on the assumption that proper maintenance and irrigation of the areas adjacent to the roadway will occur through the design life of the pavement. Failure to maintain a proper maintenance and/or irrigation program may jeopardize the integrity of the pavement.

Earthwork recommendations regarding aggregate base and subgrade are provided in the previous Section 4.1 (Site Earthwork) and the related sub-sections of this report.

### *4.11 Nonstructural Concrete Flatwork*

Nonstructural concrete flatwork (such as walkways, private drives, patio slabs, etc.) has a potential for cracking due to changes in soil volume related to soil-moisture fluctuations. To reduce the potential for excessive cracking and lifting, concrete may be designed in accordance with the minimum guidelines outlined in Table 10 on the following page. These guidelines will reduce the potential for irregular cracking and promote cracking along construction joints, but will not eliminate all cracking or lifting. Thickening the concrete and/or adding additional reinforcement will further reduce cosmetic distress.

*__TABLE 10__*

*__Minimal Guidelines for Nonstructural Concrete Flatwork__*

| | **Community Sidewalks** (≤6 feet wide) | **Patios/Entryways / Walkways** (adjacent to homes or flatwork >6 feet wide) | **Vehicular Driveways** |
|---|---|---|---|
| Minimum Thickness (in.) | 4 (nominal) | 5 (full) | 5 (full) |
| Presoak | Wet down | Presoak to 12 inches | Presoak to 12 inches |
| Reinforcement | — | No. 3 at 24 inches on centers | No. 3 at 24 inches on centers |
| Thickened Edge (in.) | — | — | 8 x 8 |
| Crack Control Joints | Saw cut or deep open tool joint to a minimum of 1/3 the concrete thickness | Saw cut or deep open tool joint to a minimum of 1/3 the concrete thickness | Saw cut or deep open tool joint to a minimum of 1/3 the concrete thickness |
| Maximum Joint Spacing | 5 feet | 6 feet | 10 feet or quarter cut whichever is closer |

To reduce the potential for driveways to separate from the garage slab, the builder may elect to install dowels to tie these two elements together. Similarly, future homeowners should consider the use of dowels to connect flatwork to the foundation.

## *4.12 __Geotechnical Plan Review__*

Grading plans, retaining wall plans, foundation plans and final project drawings should be reviewed by this office prior to grading to verify that our geotechnical recommendations, provided herein, have been appropriately incorporated. Updated recommendations and/or additional fieldwork may be necessary. A more detailed 40-scale grading plan review geotechnical evaluation and report should be performed once the rough grading plans are finalized.

## *4.13 __Geotechnical Observation and Testing During Construction__*

The recommendations provided in this report are based on limited subsurface observations and geotechnical analysis. The interpolated subsurface conditions should be checked in the field during grading by a representative of LGC Geotechnical. Geotechnical observation and testing is required per Section 1705 of the 2022 California Building Code (CBC).

Geotechnical observation and/or testing should be performed by LGC Geotechnical at the following stages:

- During grading (key excavations, removal bottoms, remedial grading, fill placement, etc.);
- Subdrain construction;
- During retaining wall backfill and compaction;
- During utility trench backfill and compaction;
- After presoaking building pads and other concrete-flatwork subgrades, and prior to placement of aggregate base or concrete;
- After building and wall footing excavation and prior to placing steel reinforcement and/or concrete;
- Preparation of pavement subgrade and placement of aggregate base; and
- When any unusual soil conditions are encountered during any construction operation subsequent to issuance of this report.

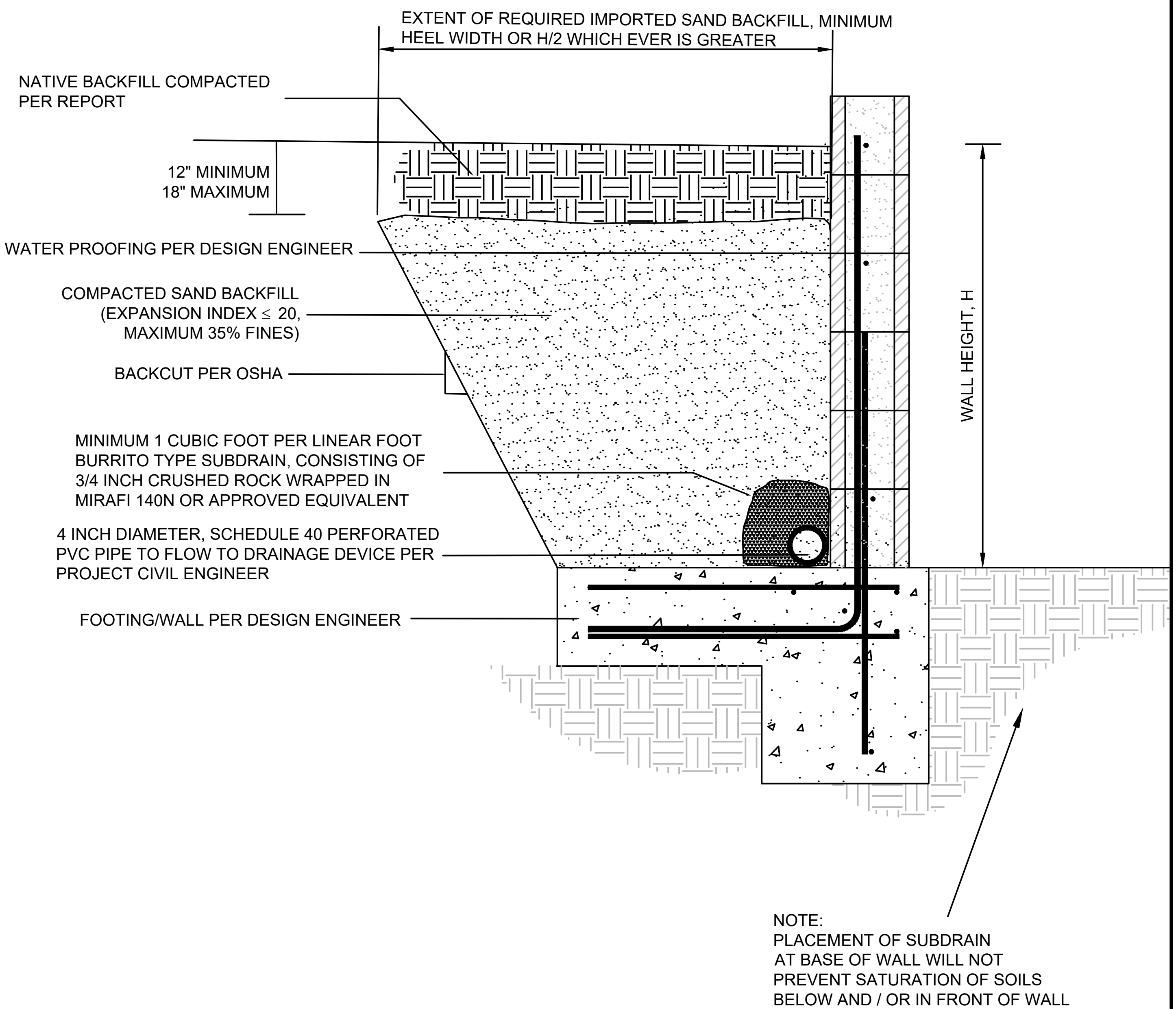
## *5.0 LIMITATIONS*

Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable engineers and geologists practicing in this or similar localities. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report. The samples taken and submitted for laboratory testing, the observations made, and the in-situ field testing performed are believed representative of the entire project; however, soil and geologic conditions revealed by excavation may be different than our preliminary findings. If this occurs, the changed conditions must be evaluated by the project soils engineer and geologist and design(s) adjusted as required or alternate design(s) recommended.

This report is issued with the understanding that it is the responsibility of the owner, or of his/her representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and/or project engineer and incorporated into the plans, and the necessary steps are taken to see that the contractor and/or subcontractor properly implements the recommendations in the field. The contractor and/or subcontractor should notify the owner if they consider any of the recommendations presented herein to be unsafe.

The findings of this report are valid as of the present date. However, changes in the conditions of a property can and do occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. Therefore, the findings, conclusions, and recommendations presented in this report can be relied upon only if LGC Geotechnical has the opportunity to observe the subsurface conditions during grading and construction of the project, in order to confirm that our preliminary findings are representative for the site.

In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and modification, and should not be relied upon after a period of 3 years.

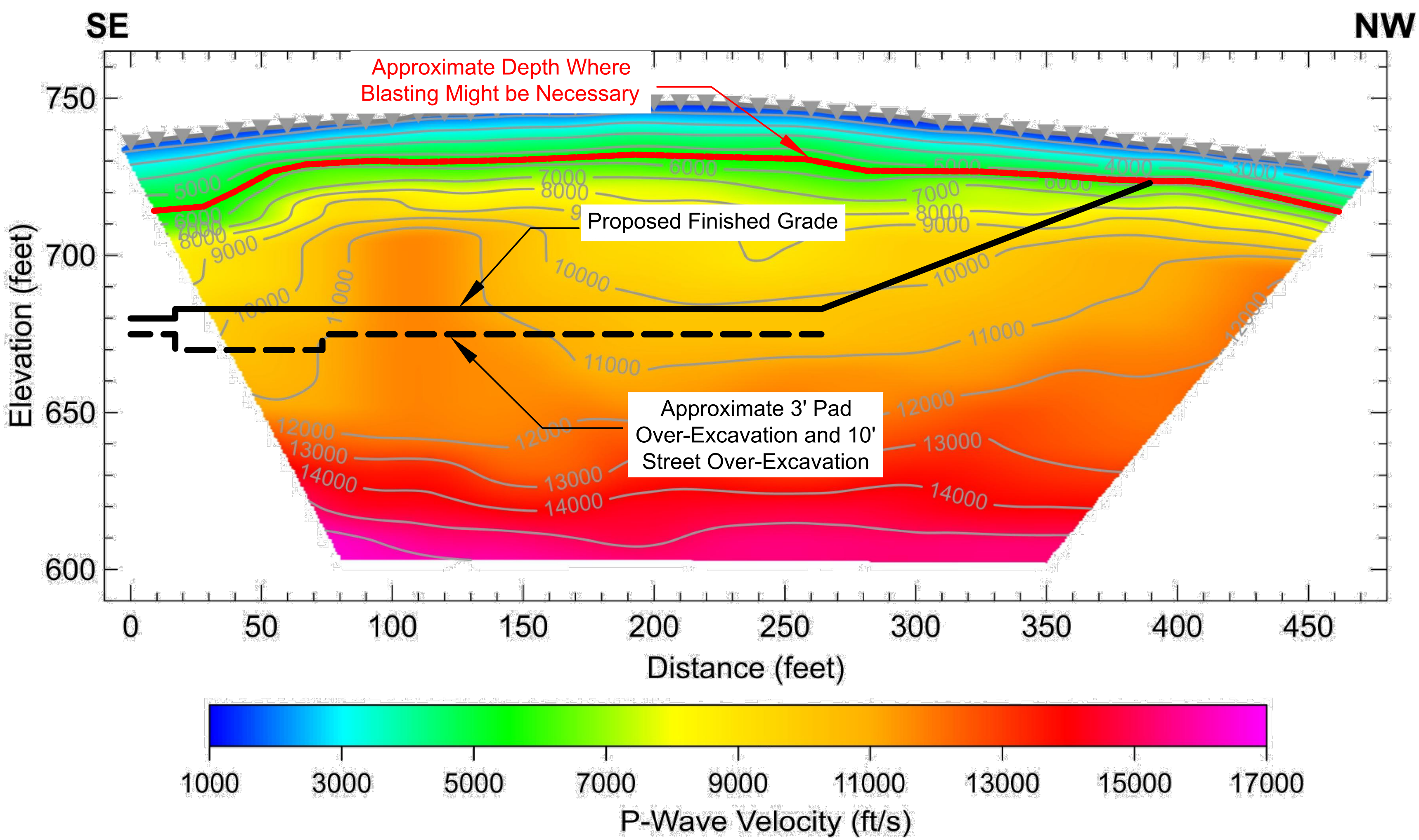



LGC Geotechnical, Inc.

**FIGURE 2**

**Retaining Wall Backfill Detail**

| | |
|---|---|
| PROJECT NAME | Meritage - Twin Oaks, San Marcos |
| PROJECT NO. | 24032-01 |
| ENG. / GEOL. | DJB / BPG |
| SCALE | Not to Scale |
| DATE | September 2024 |




SCALE: 1"=60'

60' 0 60' 120'

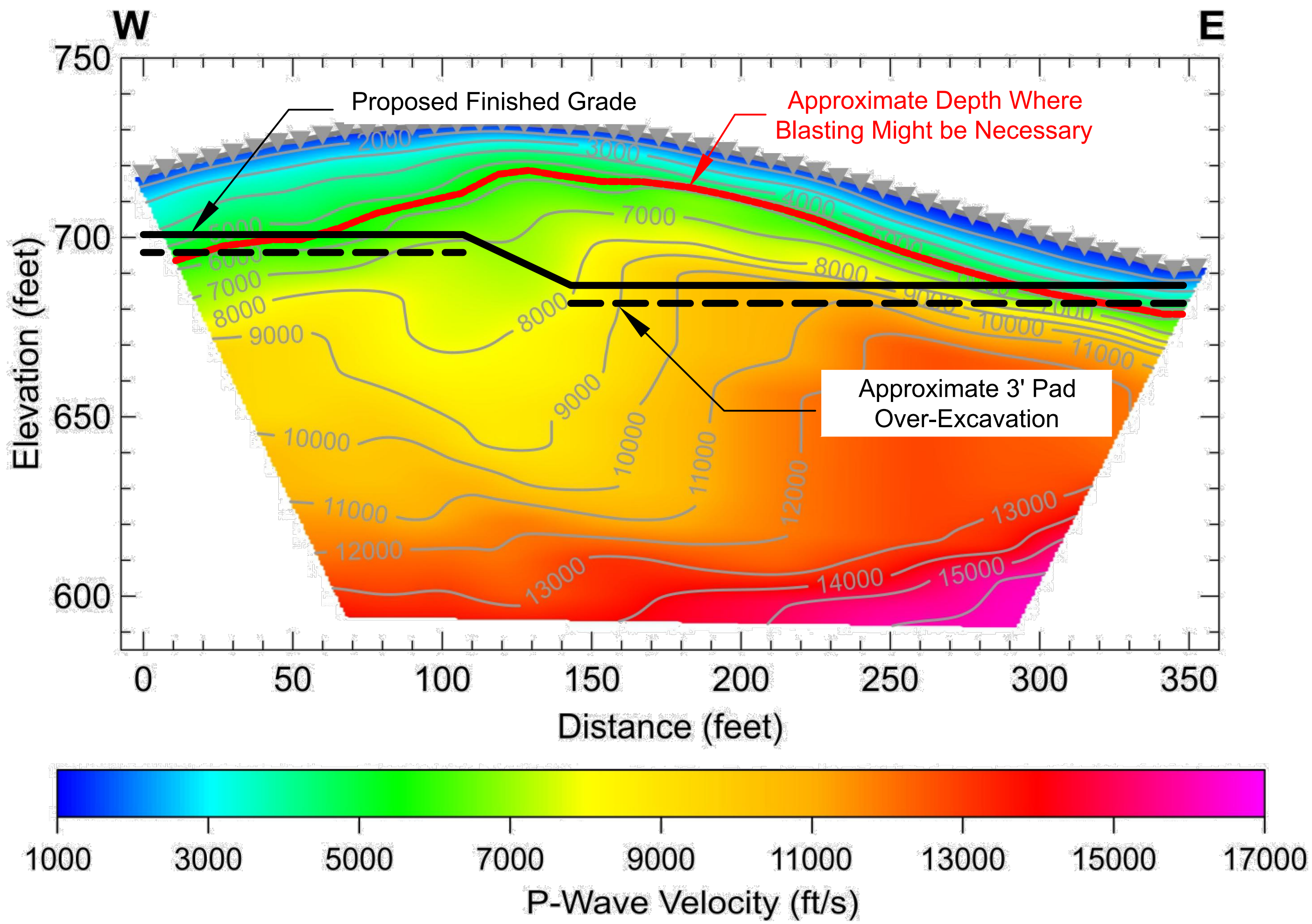
| GEOVision geophysical services | FIGURE 2<br>LINE 1 P-WAVE SEISMIC REFRACTION MODEL |
|---|---|
| Project No: 24091<br>Date: APR 3, 2024 | THE GROTH RANCH<br>SAN MARCOS, CALIFORNIA |
| Drawn By: A MARTIN<br>Approved By: | PREPARED FOR<br>LGC GEOTECHNICAL, INC. |

R:\GVProjects\2024\24091-LGC\Report\Figure 2.cdr

LGC Geotechnical, Inc.

***FIGURE 3a***
***Rippability Figure***
***Seismic Line 1***

| | |
|---|---|
| *PROJECT NAME* | *Meritage - Twin Oaks, San Marcos* |
| *PROJECT NO.* | *24032-01* |
| *ENG. / GEOL.* | *DJB / BPG* |
| *SCALE* | *1" = 60'* |
| *DATE* | *September 2024* |




SCALE: 1"=60'

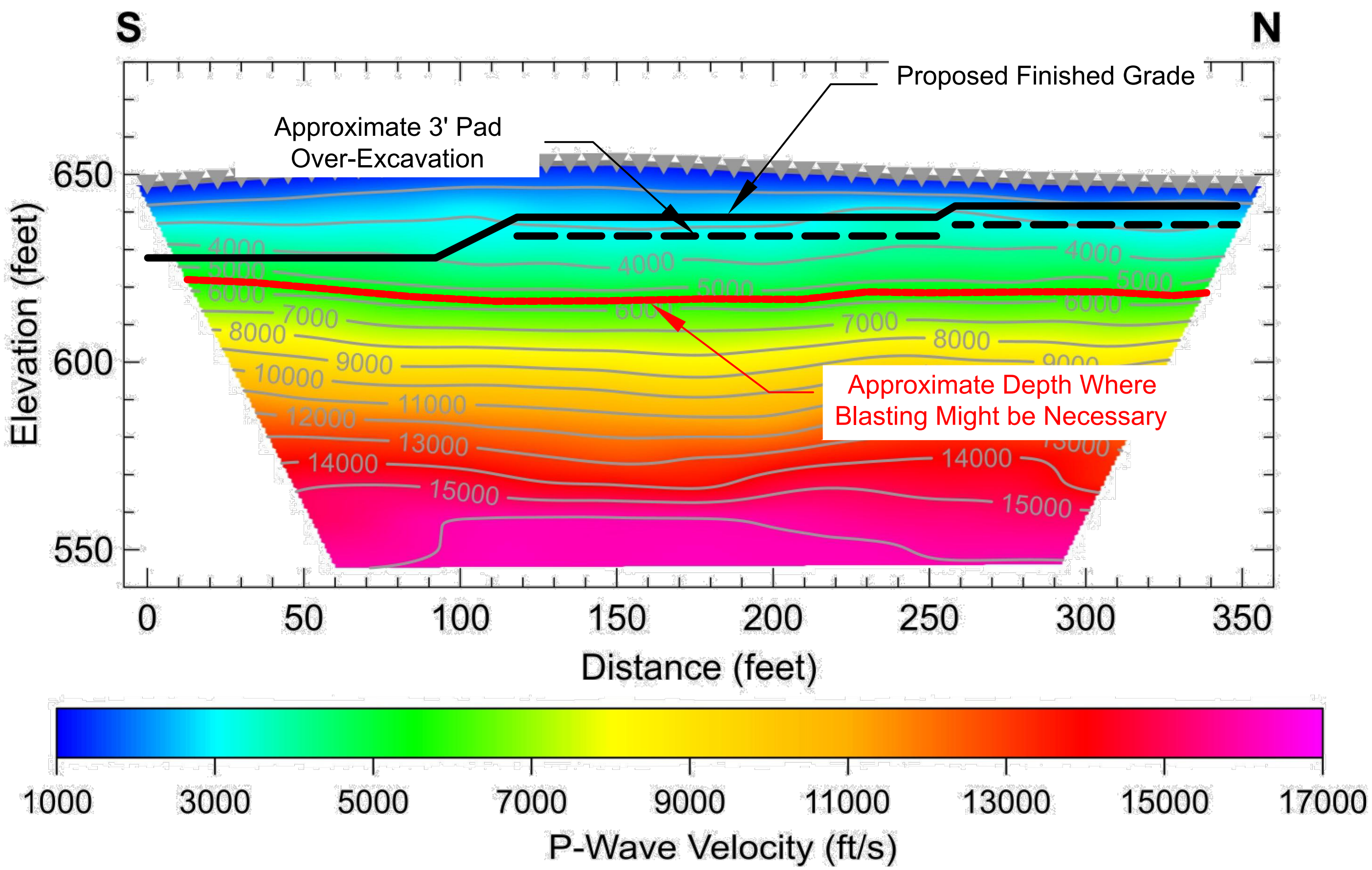
60' 0 60' 120'

| GEOVision geophysical services | FIGURE 3<br>LINE 2 P-WAVE SEISMIC REFRACTION MODEL |
|---|---|
| Project No: 24091 | THE GROTH RANCH<br>SAN MARCOS, CALIFORNIA |
| Date: APR 3, 2024 | |
| Drawn By: A MARTIN | |
| Approved By: Antony J Martin | PREPARED FOR<br>LGC GEOTECHNICAL, INC. |
| R:\GVProjects\2024\24091-LGC\Report\Figure 3.cdr | |

LGC Geotechnical, Inc.

***FIGURE 3b***
***Rippability Figure***
***Seismic Line 2***

| | |
|---|---|
| *PROJECT NAME* | *Meritage - Twin Oaks, San Marcos* |
| *PROJECT NO.* | *24032-01* |
| *ENG. / GEOL.* | *DJB / BPG* |
| *SCALE* | *1" = 60'* |
| *DATE* | *September 2024* |




SCALE: 1"=60'

60' 0 60' 120'

| GEOVision geophysical services | FIGURE 4<br>LINE 3 P-WAVE SEISMIC REFRACTION MODEL |
|---|---|
| Project No: 24091<br>Date: APR 3, 2024 | THE GROTH RANCH<br>SAN MARCOS, CALIFORNIA |
| Drawn By: A MARTIN<br>Approved By: | PREPARED FOR<br>LGC GEOTECHNICAL, INC. |

R:\GVProjects\2024\24091-LGC\Report\Figure 4.cdr

LGC Geotechnical, Inc.

***FIGURE 3c***
***Rippability Figure***
***Seismic Line 3***

| | |
|---|---|
| PROJECT NAME | Meritage - Twin Oaks, San Marcos |
| PROJECT NO. | 24032-01 |
| ENG. / GEOL. | DJB / BPG |
| SCALE | 1" = 60' |
| DATE | September 2024 |

# *Appendix A*
# *References*

## ***References***


American Concrete Institute, 2014, Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14).

American Society of Civil Engineers (ASCE), 2017, Minimum Design Loads for Buildings and Other Structures, ASCE/SEI 7-16, 2017.

_________, 2018, Standard 7-16, Minimum Design Loads for Buildings and Associated Criteria for Buildings and Other Structures, Supplement 1, effective: December 12, 2018.

Advanced Geotechnical Solutions, Inc., 2016, Preliminary Geotechnical Investigation of San Elijo – Questhaven Property, South of San Elijo Road, San Marcos Area, County of San Diego, California, dated March 11, 2016.

ASTM International, Annual Book of ASTM Standards, Volume 04.08.

Bray, J.D., and Sancio, R. B., 2006, Assessment of liquefaction susceptibility of fine-grained soils, *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE, pp. 1165-1177, dated September 2006.

California Building Standards Commission, 2022, California Building Code, California Code of Regulations Title 24, Volumes 1 and 2, dated July 2022.

California Department of Conservation (CDMG), 2005, Geologic Map of the Oceanside 30’ X 60’ Quadrangle, California, compiled by Michael P. Kennedy and Siang S. Tan, dated 2005.

California Department of Transportation (Caltrans), 2021, Corrosion Guidelines, Version 3.2, dated May 2021.

California Geological Survey (CGS), 2008, California Geological Society Special Publication 117A: Guidelines for Evaluating and Mitigating Seismic Hazards in California.

_________, 2018, Earthquake Fault Zones, Special Publication 42, Revised 2018.

Excel Engineering, 2024, IM Sheets, North Twin Oaks Valley Road, San Marcos, dated July 2, 2024.

Geocon, Inc., 2013, Update Geotechnical Investigation, San Marcos Highlands, San Marcos, California, dated February 8, 2013.

Geotechnics, Inc., 2003, Preliminary Geotechnical Investigation, 30 Acre Parcel, Encina Property, San Marcos, California, dated December 24, 2003.

GeoVision, 2024, Report, Seismic Refraction Survey, The Groth Ranch, San Marcos, California, GeoVision Project No. 24091, dated April 10, 2024.

County of San Diego, 2020, County of San Diego BMP Design Manual, dated September 15, 2020.

## ***References***

Gregory Geotechnical Software, 2019, GEOSTASE, Slope Stability Analysis Software, Version 2.7, January 2019.

Kennedy, M.P., and S.S. Tan. digital prep. by Bovard et al., 2007, Geologic Map of the Oceanside 30' x 60' Quadrangle, California: California Department of Conservation California Geological Survey. 131 / 2703141

Optum Design Group, 2024, Conceptual Site Plan (257 DU), Twin Oaks, San Marcos, dated April 29, 2024.

Lew, et al, 2010, Seismic Earth Pressures on Deep Basements, Structural Engineers Association of California (SEAOC) Convention Proceedings.

Structural Engineers Association of California (SEAOC), 2024, Seismic Design Maps, Retrieved April 5, 2024, from https://seismicmaps.org/.

United States Geological Survey (USGS), 2014, Unified Hazard Tool, Dynamic: Conterminous U.S. 2014 (update) (v4.2.0), Retrieved April 5, 2024, from: https://earthquake.usgs.gov/hazards/interactive/.

# *Appendix B*
# *Exploratory Logs*

# Geotechnical Boring Log Borehole HS-1

| | |
|---|---|
| **Date:** 3/29/2024 | **Drilling Company:** 2R Drilling |
| **Project Name:** Meritage - Twin Oaks, San Marcos | **Type of Rig:** Truck Mounted Hollow Stem Rig |
| **Project Number:** 24032-01 | **Drop:** 30" **Hole Diameter:** 8" |
| **Elevation of Top of Hole:** ~653' MSL | **Drive Weight:** 140 pounds |
| **Hole Location:** See Geotechnical Map | Page 1 of 1 |

Logged By JJV
Sampled By JJV
Checked By BPP/BPG

| Elevation (ft) | Depth (ft) | Graphic Log | Sample Number | Blow Count | Dry Density (pcf) | Moisture (%) | USCS Symbol | DESCRIPTION | Type of Test |
|---|---|---|---|---|---|---|---|---|---|
| | 0 | | R-1 | 4 3 3 | 106.9 | 16.0 | SC | **Quaternary Alluvium (Qal)**<br>@ 0.5' - Clayey SAND: dark reddish brown, very moist, loose | |
| 650 | | | R-2 | 43 50/1" | 117.7 | 9.9 | | @ 2.5' - Clayey SAND with Gravel: orangish brown, moist, very dense | |
| | 5 | | R-3 | 25 50/2" | 93.9 | 12.3 | SM | @ 5' - Silty SAND with Gravel: orangish brown, moist, very dense | |
| 645 | | | R-4 | 18 50/5" | 115.7 | 12.9 | SC | @ 7.5' - Clayey SAND with Gravel: reddish brown, moist, very dense | |
| | 10 | | R-5 | 34 50/4" | 116.1 | 12.1 | | @ 10' - Clayey SAND with Gravel: dark reddish brown, moist, very dense | |
| 640 | | | | | | | | | |
| | 15 | | SPT-1 | 13 17 24 | | 15.9 | | @ 15' - Clayey SAND: brown, very moist, very dense | |
| 635 | | | | | | | | | |
| | 20 | | R-6 | 2 29 32 | 108.7 | 13.1 | | @ 20' - Clayey SAND with Gravel: orangish brown, moist, very dense | |
| 630 | | | | | | | | | |
| | 25 | ▽ | SPT-2 | 12 12 20 | | 16.6 | | @ 25' - Clayey SAND: brown, wet, dense | |
| 625 | | | | | | | | Total Depth = 26.5'<br>Groundwater Encountered at Approximately 24.5'<br>Backfilled with Cuttings on 3/29/2024 | |
| | 30 | | | | | | | | |

LGC Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

**SAMPLE TYPES:**
B BULK SAMPLE
R RING SAMPLE (CA Modified Sampler)
G GRAB SAMPLE
SPT STANDARD PENETRATION TEST SAMPLE
▽ GROUNDWATER TABLE

**TEST TYPES:**
DS DIRECT SHEAR
MD MAXIMUM DENSITY
SA SIEVE ANALYSIS
S&H SIEVE AND HYDROMETER
EI EXPANSION INDEX
CN CONSOLIDATION
CR CORROSION
AL ATTERBERG LIMITS
CO COLLAPSE/SWELL
RV R-VALUE
-#200 % PASSING # 200 SIEVE

Last Edited: 5/3/2024

# Geotechnical Boring Log Borehole HS-2

| | |
|---|---|
| **Date:** 3/29/2024 | **Drilling Company:** 2R Drilling |
| **Project Name:** Meritage - Twin Oaks, San Marcos | **Type of Rig:** Truck Mounted Hollow Stem Rig |
| **Project Number:** 24032-01 | **Drop:** 30" **Hole Diameter:** 8" |
| **Elevation of Top of Hole:** ~641' MSL | **Drive Weight:** 140 pounds |
| **Hole Location:** See Geotechnical Map | Page 1 of 2 |

Logged By JJV
Sampled By JJV
Checked By BPP/BPG

| Elevation (ft) | Depth (ft) | Graphic Log | Sample Number | Blow Count | Dry Density (pcf) | Moisture (%) | USCS Symbol | DESCRIPTION | Type of Test |
|---|---|---|---|---|---|---|---|---|---|
| 640 | 0 | B-1 | R-1 | 7 50/5" | 113.2 | 16.5 | SC | **Quaternary Alluvium (Qal)**<br>@ 0.5' - Clayey SAND: reddish brown, very moist, very dense | MD |
| | | | R-2 | 13 50/5" | 108.7 | 17.6 | | @ 2.5' - Clayey SAND: olive brown, very moist, very dense | |
| 635 | 5 | | R-3 | 50/5" | 116.4 | 12.0 | | @ 5' - Clayey SAND with Gravel: reddish brown, moist, very dense | |
| | | | R-4 | 22 50/5" | 110.4 | 12.8 | | @ 7.5' - Clayey SAND with Gravel: brown, moist, very dense | |
| 630 | 10 | | R-5 | 25 50/4" | 105.4 | 19.6 | SM to SC | @ 10' - Silty SAND to Clayey SAND: pale brown, very moist, very dense | |
| 625 | 15 | | R-6 | 40 50/2" | 104.8 | 14.1 | SM | @ 15' - Silty SAND: brown, very moist, very dense | |
| 620 | 20 | | SPT-1 | 6 8 11 | | 22.3 | CL | @ 20' - Sandy CLAY: grayish brown, very moist, very stiff | |
| 615 | 25 | | R-7 | 4 12 27 | 106.0 | 19.9 | | @ 25' - CLAY with Sand to CLAY: brownish red, very moist, hard | -#200 AL CN |
| | 30 | | | | | | | | |

Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

**SAMPLE TYPES:**
- B BULK SAMPLE
- R RING SAMPLE (CA Modified Sampler)
- G GRAB SAMPLE
- SPT STANDARD PENETRATION TEST SAMPLE
- GROUNDWATER TABLE

**TEST TYPES:**
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- SA SIEVE ANALYSIS
- S&H SIEVE AND HYDROMETER
- EI EXPANSION INDEX
- CN CONSOLIDATION
- CR CORROSION
- AL ATTERBERG LIMITS
- CO COLLAPSE/SWELL
- RV R-VALUE
- -#200 % PASSING # 200 SIEVE

Last Edited: 5/3/2024

# Geotechnical Boring Log Borehole HS-2

| | |
|---|---|
| **Date:** 3/29/2024 | **Drilling Company:** 2R Drilling |
| **Project Name:** Meritage - Twin Oaks, San Marcos | **Type of Rig:** Truck Mounted Hollow Stem Rig |
| **Project Number:** 24032-01 | **Drop:** 30" **Hole Diameter:** 8" |
| **Elevation of Top of Hole:** ~641' MSL | **Drive Weight:** 140 pounds |
| **Hole Location:** See Geotechnical Map | Page 2 of 2 |

Logged By JJV
Sampled By JJV
Checked By BPP/BPG

| Elevation (ft) | Depth (ft) | Graphic Log | Sample Number | Blow Count | Dry Density (pcf) | Moisture (%) | USCS Symbol | DESCRIPTION | Type of Test |
|---|---|---|---|---|---|---|---|---|---|
| 610 | 30 | ▽ | SPT-2 | 9 14 19 | | 20.2 | CL | @ 30' - Sandy CLAY: reddish brown, wet, hard | |
| 605 | 35 | | R-8 | 8 14 15 | 102.3 | 21.8 | SM to CL-ML | @ 35' - Silty SAND to Silty CLAY: light brown, wet, medium dense to very stiff | -#200 AL CN |
| 600 | 40 | | SPT-3 | 8 13 11 | | 14.7 | SC | @ 40' - Clayey SAND: brown, wet, dense | -#200 |
| 595 | 45 | | R-9 | 3 4 9 | 116.2 | 14.4 | | @ 45' - Clayey SAND with Gravel: brown, wet, medium dense | -#200 AL |
| 590 | 50 | | SPT-4 | 12 12 10 | | 16.3 | | @ 50' - Clayey SAND with Gravel: brown, wet, medium dense | -#200 AL |
| 585 | 55 | | | | | | | Total Depth = 51.5'<br>Groundwater Encountered at Approximately 30.8'<br>Backfilled with Cuttings on 3/29/2024 | |
| | 60 | | | | | | | | |

Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

**SAMPLE TYPES:**
- B BULK SAMPLE
- R RING SAMPLE (CA Modified Sampler)
- G GRAB SAMPLE
- SPT STANDARD PENETRATION TEST SAMPLE
- ▽ GROUNDWATER TABLE

**TEST TYPES:**
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- SA SIEVE ANALYSIS
- S&H SIEVE AND HYDROMETER
- EI EXPANSION INDEX
- CN CONSOLIDATION
- CR CORROSION
- AL ATTERBERG LIMITS
- CO COLLAPSE/SWELL
- RV R-VALUE
- -#200 % PASSING # 200 SIEVE

# Geotechnical Boring Log Borehole HS-3

| | |
|---|---|
| **Date:** 4/18/2024 | **Drilling Company:** 2R Drilling |
| **Project Name:** Meritage - Twin Oaks, San Marcos | **Type of Rig:** Hollow Stem Limited Access Rig |
| **Project Number:** 24032-01 | **Drop:** 30" **Hole Diameter:** 8" |
| **Elevation of Top of Hole:** ~753' MSL | **Drive Weight:** 140 pounds |
| **Hole Location:** See Geotechnical Map | Page 1 of 1 |

Logged By JJV
Sampled By JJV
Checked By BPP/BPG

| Elevation (ft) | Depth (ft) | Graphic Log | Sample Number | Blow Count | Dry Density (pcf) | Moisture (%) | USCS Symbol | DESCRIPTION | Type of Test |
|---|---|---|---|---|---|---|---|---|---|
| | 0 | | R-1 | 9 11 17 | 102.1 | 12.8 | SC | **Quaternary Alluvium (Qal)**<br>@ 0.5' - Clayey SAND with Gravel: blueish gray, moist, medium dense | |
| 750 | | | R-2 | 6 19 10 | 90.7 | 10.5 | | @ 2.5' - Clayey SAND: brown, moist, medium dense | |
| | 5 | | R-3 | 2 2 3 | 105.8 | 13.4 | | @ 5' - Clayey SAND with Gravel: olive brown, moist, very loose | |
| 745 | | | R-4 | 18 17 50/5" | 112.6 | 10.2 | | @ 7.5' - Clayey SAND with Gravel: blueish gray, moist, very dense | |
| | 10 | | R-5 | 50/3" | 124.1 | 9.3 | SC to CL | **Jurassic Santiago Peak Volcanics (Jsp)**<br>@ 10' - Clayey SAND with Gravel to CLAY with Sand: reddish brown, moist, very dense to hard, refusal | DS |
| 740 | | | | | | | | Refusal @ 12'<br>Groundwater Not Encountered<br>Backfilled with Cuttings on 4/18/2024 | |
| | 15 | | | | | | | | |
| 735 | | | | | | | | | |
| | 20 | | | | | | | | |
| 730 | | | | | | | | | |
| | 25 | | | | | | | | |
| 725 | | | | | | | | | |
| | 30 | | | | | | | | |

LGC Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

**SAMPLE TYPES:**
- B BULK SAMPLE
- R RING SAMPLE (CA Modified Sampler)
- G GRAB SAMPLE
- SPT STANDARD PENETRATION TEST SAMPLE
- GROUNDWATER TABLE

**TEST TYPES:**
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- SA SIEVE ANALYSIS
- S&H SIEVE AND HYDROMETER
- EI EXPANSION INDEX
- CN CONSOLIDATION
- CR CORROSION
- AL ATTERBERG LIMITS
- CO COLLAPSE/SWELL
- RV R-VALUE
- -#200 % PASSING # 200 SIEVE

Last Edited: 5/3/2024

# Geotechnical Boring Log Borehole HS-4

| | |
|---|---|
| **Date:** 4/18/2024 | **Drilling Company:** Native Drilling |
| **Project Name:** Meritage - Twin Oaks, San Marcos | **Type of Rig:** Hollow Stem Limited Access Rig |
| **Project Number:** 24032-01 | **Drop:** 30" **Hole Diameter:** 8" |
| **Elevation of Top of Hole:** ~703' MSL | **Drive Weight:** 140 pounds |
| **Hole Location:** See Geotechnical Map | Page 1 of 1 |

Logged By JJV
Sampled By JJV
Checked By BPP/BPG

| Elevation (ft) | Depth (ft) | Graphic Log | Sample Number | Blow Count | Dry Density (pcf) | Moisture (%) | USCS Symbol | DESCRIPTION | Type of Test |
|---|---|---|---|---|---|---|---|---|---|
| | 0 | | R-1 | 1 1 2 | 101.4 | 17.7 | SC | **Quaternary Alluvium (Qal)** @ 0.5' - Clayey SAND: dark brown, very moist, very loose | |
| 700 | | | R-2 | 2 4 4 | 109.2 | 16.6 | | @ 2.5' - Clayey SAND: brown, very moist, loose | |
| | 5 | | R-3 | 4 5 6 | 111.9 | 16.8 | | @ 5' - Clayey SAND: brown, very moist, loose | |
| | | | | | | | | **Jurassic Santiago Peak Volcanics (Jsp)** | |
| 695 | | | R-4 | 50/3" | 112.2 | 5.0 | SC | @ 7.5' - Clayey SAND with Gravel: grayish brown, slightly moist, very dense | |
| | 10 | | R-5 | 50/5" | | 9.4 | SM | @ 10' - Silty SAND with Gravel: brown, moist, very dense, refusal; disturbed | |
| 690 | | | | | | | | Refusal @ 11'<br>Groundwater Not Encountered<br>Backfilled with Cuttings on 4/18/2024 | |
| | 15 | | | | | | | | |
| 685 | | | | | | | | | |
| | 20 | | | | | | | | |
| 680 | | | | | | | | | |
| | 25 | | | | | | | | |
| 675 | | | | | | | | | |
| | 30 | | | | | | | | |

LGC Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

**SAMPLE TYPES:**
B BULK SAMPLE
R RING SAMPLE (CA Modified Sampler)
G GRAB SAMPLE
SPT STANDARD PENETRATION TEST SAMPLE
GROUNDWATER TABLE

**TEST TYPES:**
DS DIRECT SHEAR
MD MAXIMUM DENSITY
SA SIEVE ANALYSIS
S&H SIEVE AND HYDROMETER
EI EXPANSION INDEX
CN CONSOLIDATION
CR CORROSION
AL ATTERBERG LIMITS
CO COLLAPSE/SWELL
RV R-VALUE
-#200 % PASSING # 200 SIEVE

Last Edited: 5/29/2024

# Geotechnical Boring Log Borehole I-1

| | |
|---|---|
| **Date:** 3/29/2024 | **Drilling Company:** 2R Drilling |
| **Project Name:** Meritage - Twin Oaks, San Marcos | **Type of Rig:** Truck Mounted Hollow Stem Rig |
| **Project Number:** 24032-01 | **Drop:** 30" **Hole Diameter:** 8" |
| **Elevation of Top of Hole:** ~651' MSL | **Drive Weight:** 140 pounds |
| **Hole Location:** See Geotechnical Map | Page 1 of 1 |

Logged By JJV
Sampled By JJV
Checked By BPP/BPG

| Elevation (ft) | Depth (ft) | Graphic Log | Sample Number | Blow Count | Dry Density (pcf) | Moisture (%) | USCS Symbol | DESCRIPTION | Type of Test |
|---|---|---|---|---|---|---|---|---|---|
| 645 | 0 | | R-1 | 8 9 16 | 120.5 | 9.8 | SC to SM | **Quaternary Alluvium (Qal)** @ 0.5' - Clayey SAND to Silty SAND: dark brown, moist, medium dense | MD |
| | | | R-2 | 13 21 33 | 119.4 | 7.3 | SM | @ 2.5' - Clayey SAND with Gravel: reddish brown, slightly moist, dense | |
| 640 | 5 | B-1 | R-3 | 40 45 40 | | 4.7 | | @ 5' - Silty SAND with Gravel: reddish brown, slightly moist, very dense; disturbed | |
| | | | R-4 | 50/5" | 111.1 | 13.7 | CL | @ 8.5' - CLAY with Sand: reddish brown, moist, hard | -#200 |
| 635 | 10 | | | | | | | Total Depth = 10'<br>Groundwater Not Encountered<br>3" of Perforated Pipe with Filter Sock Installed<br>Surrounded by Gravel and Presoaked on 3/29/2024<br>Pipe Removed and Backfilled with Cuttings on 4/19/2024 | |
| 630 | 15 | | | | | | | | |
| 625 | 20 | | | | | | | | |
| 620 | 25 | | | | | | | | |
| | 30 | | | | | | | | |

LGC Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

**SAMPLE TYPES:**
- B BULK SAMPLE
- R RING SAMPLE (CA Modified Sampler)
- G GRAB SAMPLE
- SPT STANDARD PENETRATION TEST SAMPLE
- ▽ GROUNDWATER TABLE

**TEST TYPES:**
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- SA SIEVE ANALYSIS
- S&H SIEVE AND HYDROMETER
- EI EXPANSION INDEX
- CN CONSOLIDATION
- CR CORROSION
- AL ATTERBERG LIMITS
- CO COLLAPSE/SWELL
- RV R-VALUE
- -#200 % PASSING # 200 SIEVE

Last Edited: 5/3/2024

# Geotechnical Boring Log Borehole I-2

| | |
|---|---|
| **Date:** 3/29/2024 | **Drilling Company:** 2R Drilling |
| **Project Name:** Meritage - Twin Oaks, San Marcos | **Type of Rig:** Truck Mounted Hollow Stem Rig |
| **Project Number:** 24032-01 | **Drop:** 30" **Hole Diameter:** 8" |
| **Elevation of Top of Hole:** ~630' MSL | **Drive Weight:** 140 pounds |
| **Hole Location:** See Geotechnical Map | Page 1 of 1 |

Logged By JJV
Sampled By JJV
Checked By BPP/BPG

| Elevation (ft) | Depth (ft) | Graphic Log | Sample Number | Blow Count | Dry Density (pcf) | Moisture (%) | USCS Symbol | DESCRIPTION | Type of Test |
|---|---|---|---|---|---|---|---|---|---|
| | 0 | B-1 | R-1 | 10 12 10 | 121.9 | 7.4 | SC | **Quaternary Alluvium (Qal)**<br>@ 0.5' - Clayey SAND: brown, slightly moist, medium dense | |
| | | | R-2 | 4 5 3 | 102.0 | 6.5 | SP-SM | @ 2.5' - SAND with Silt: reddish brown, moist, loose | |
| 625 | 5 | | | | | | | | |
| | | | R-3 | 7 11 16 | 114.5 | 5.7 | SP-SM to SC | @ 8.5' - SAND with Silt to Clayey SAND: yellowish brown, slightly moist, medium dense | -#200<br>CO |
| 620 | 10 | | | | | | | Total Depth = 10'<br>Groundwater Not Encountered<br>3" of Perforated Pipe with Filter Sock Installed<br>Surrounded by Gravel and Presoaked on 3/29/2024<br>Pipe Removed and Backfilled with Cuttings on 4/19/2024 | |
| 615 | 15 | | | | | | | | |
| 610 | 20 | | | | | | | | |
| 605 | 25 | | | | | | | | |
| 600 | 30 | | | | | | | | |

LGC Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

**SAMPLE TYPES:**
- B BULK SAMPLE
- R RING SAMPLE (CA Modified Sampler)
- G GRAB SAMPLE
- SPT STANDARD PENETRATION TEST SAMPLE
- GROUNDWATER TABLE

**TEST TYPES:**
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- SA SIEVE ANALYSIS
- S&H SIEVE AND HYDROMETER
- EI EXPANSION INDEX
- CN CONSOLIDATION
- CR CORROSION
- AL ATTERBERG LIMITS
- CO COLLAPSE/SWELL
- RV R-VALUE
- -#200 % PASSING # 200 SIEVE

Last Edited: 5/3/2024

# Geotechnical Boring Log Borehole I-3

| | |
|---|---|
| **Date:** 4/18/2024 | **Drilling Company:** 2R Drilling |
| **Project Name:** Meritage - Twin Oaks, San Marcos | **Type of Rig:** Truck Mounted Hollow Stem Rig |
| **Project Number:** 24032-01 | **Drop:** 30" **Hole Diameter:** 8" |
| **Elevation of Top of Hole:** ~744' MSL | **Drive Weight:** 140 pounds |
| **Hole Location:** See Geotechnical Map | Page 1 of 1 |

Logged By JJV
Sampled By JJV
Checked By BPP/BPG

| Elevation (ft) | Depth (ft) | Graphic Log | Sample Number | Blow Count | Dry Density (pcf) | Moisture (%) | USCS Symbol | DESCRIPTION | Type of Test |
|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | | | **Quaternary Alluvium (Qal)**<br>@ 0 to 7.5' - Silty SAND with Gravel/Clayey SAND: light brown, slightly moist | |
| 740 | 5 | | | | | | | | |
| 735 | 10 | | | | | | | Refusal @ 7.5'<br>Groundwater Not Encountered<br>3" of Perforated Pipe with Filter Sock Installed<br>Surrounded by Gravel and Presoaked on 3/29/2024<br>Pipe Removed and Backfilled with Cuttings on 4/19/2024 | |
| 730 | 15 | | | | | | | | |
| 725 | 20 | | | | | | | | |
| 720 | 25 | | | | | | | | |
| 715 | 30 | | | | | | | | |

LGC Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

**SAMPLE TYPES:**
- B BULK SAMPLE
- R RING SAMPLE (CA Modified Sampler)
- G GRAB SAMPLE
- SPT STANDARD PENETRATION TEST SAMPLE
- GROUNDWATER TABLE

**TEST TYPES:**
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- SA SIEVE ANALYSIS
- S&H SIEVE AND HYDROMETER
- EI EXPANSION INDEX
- CN CONSOLIDATION
- CR CORROSION
- AL ATTERBERG LIMITS
- CO COLLAPSE/SWELL
- RV R-VALUE
- -#200 % PASSING # 200 SIEVE

# Geotechnical Boring Log Borehole I-4

| | |
|---|---|
| **Date:** 4/18/2024 | **Drilling Company:** 2R Drilling |
| **Project Name:** Meritage - Twin Oaks, San Marcos | **Type of Rig:** Truck Mounted Hollow Stem Rig |
| **Project Number:** 24032-01 | **Drop:** 30" **Hole Diameter:** 8" |
| **Elevation of Top of Hole:** ~692' MSL | **Drive Weight:** 140 pounds |
| **Hole Location:** See Geotechnical Map | Page 1 of 1 |

| Elevation (ft) | Depth (ft) | Graphic Log | Sample Number | Blow Count | Dry Density (pcf) | Moisture (%) | USCS Symbol | Logged By JJV<br>Sampled By JJV<br>Checked By BPP/BPG<br><br>DESCRIPTION | Type of Test |
|---|---|---|---|---|---|---|---|---|---|
| 690 | 0 | | | | | | | **Quaternary Alluvium (Qal)**<br>@ 0 to 10' - Silty SAND with Gravel/Sandy CLAY: brown, slightly moist | |
| 685 | 5 | | | | | | | | |
| 680 | 10 | | | | | | | Total Depth = 10'<br>Groundwater Not Encountered<br>3" of Perforated Pipe with Filter Sock Installed<br>Surrounded by Gravel and Presoaked on 3/29/2024<br>Pipe Removed and Backfilled with Cuttings on<br>4/19/2024 | |
| 675 | 15 | | | | | | | | |
| 670 | 20 | | | | | | | | |
| 665 | 25 | | | | | | | | |
| | 30 | | | | | | | | |

LGC Geotechnical, Inc.

THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED. THE DESCRIPTIONS PROVIDED ARE QUALITATIVE FIELD DESCRIPTIONS AND ARE NOT BASED ON QUANTITATIVE ENGINEERING ANALYSIS.

**SAMPLE TYPES:**
- B BULK SAMPLE
- R RING SAMPLE (CA Modified Sampler)
- G GRAB SAMPLE
- SPT STANDARD PENETRATION TEST SAMPLE
- ▽ GROUNDWATER TABLE

**TEST TYPES:**
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- SA SIEVE ANALYSIS
- S&H SIEVE AND HYDROMETER
- EI EXPANSION INDEX
- CN CONSOLIDATION
- CR CORROSION
- AL ATTERBERG LIMITS
- CO COLLAPSE/SWELL
- RV R-VALUE
- -#200 % PASSING # 200 SIEVE

Last Edited: 5/3/2024

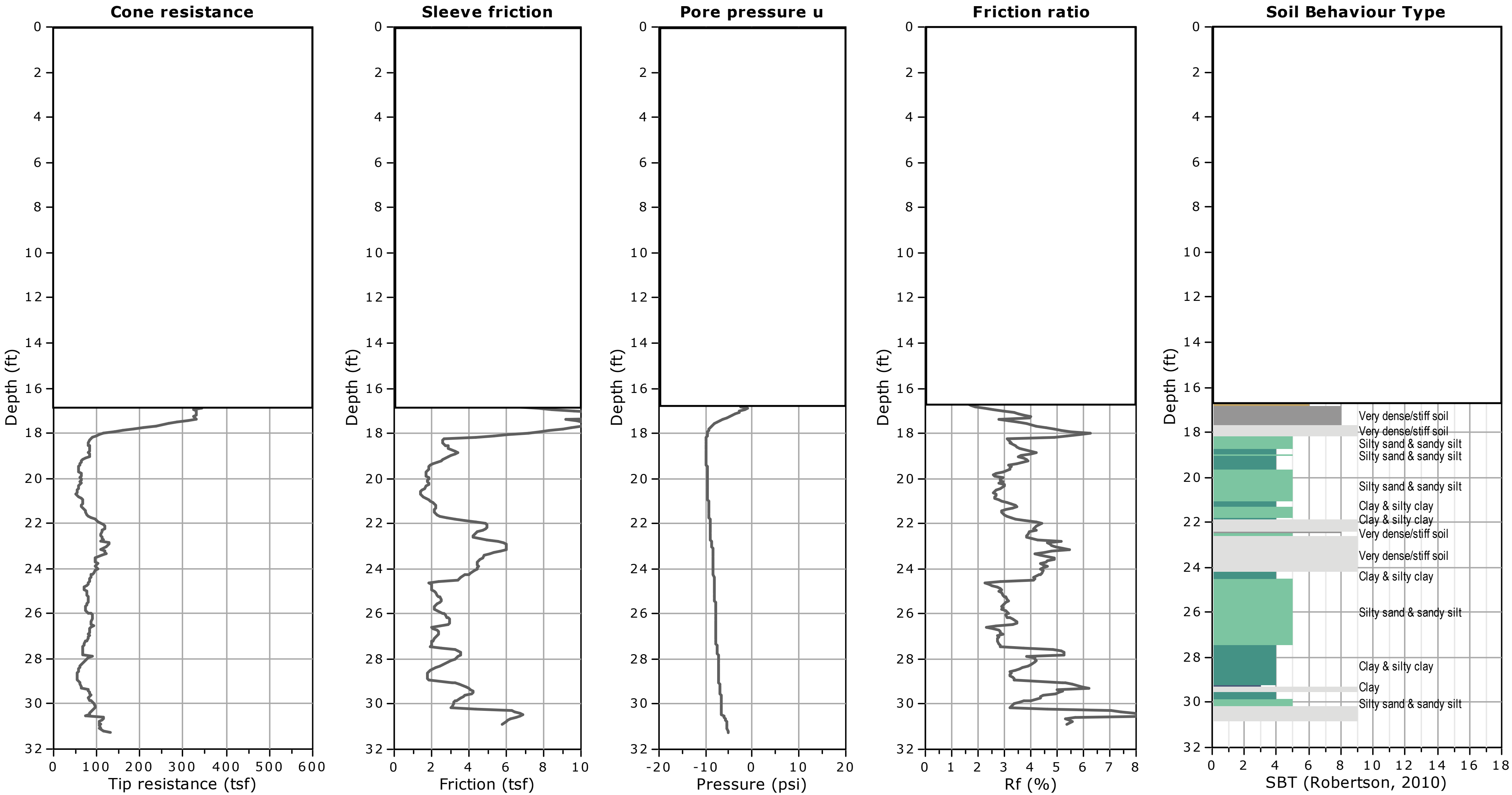
**Kehoe Testing and Engineering**
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

**Project:** LGC Geotechnical / Meritage - Twin Oaks

**Location:** 1010 N. Twin Oaks Valley Rd, San Marcos, CA

**CPT-2**

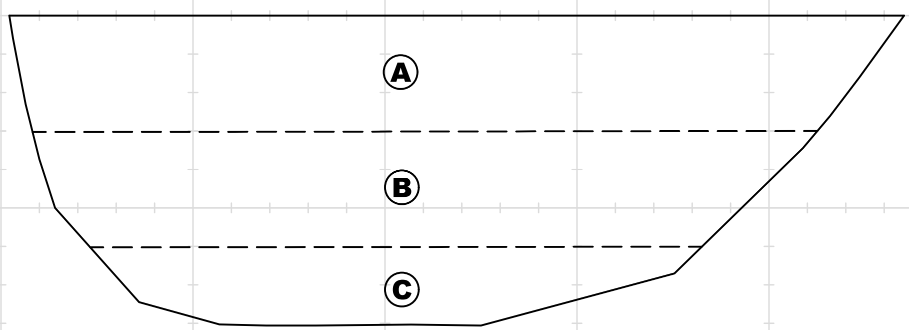
Total depth: 31.25 ft, Date: 4/25/2024



| | | | |
|---|---|---|---|
| **Project Name: Twin Oaks, San Marcos** | **Logged By: MJG** | **Trench No.: TP-1** | LGC Geotechnical, Inc. |
| **Project Number: 24032-01** | **Date: 3/20/2024** | **Engineering Properties:** | |
| **Equipment: Backhoe** | **Location: See Geotechnical Map** | | |

| Geologic Attitudes | Unit | SOIL DESCRIPTION: | GEOLOGIC UNIT | USCS | SAMPLE No | MOISTURE (%) | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | **Quaternary Alluvium (Qal)** | | | | | |
| | A | @ 0' to 3' - Clayey SILT: dark brown, slightly moist to moist, medium dense, grass at the surface | Qal | | B-1 @0'-8' | | |
| | B | @ 3' to 6' - Clayey SAND: reddish brown, slightly moist, medium dense to dense, 1" to 6" in diameter angular clasts of metamorphic bedrock | | | | | |
| | C | @ 6' to 8' - Sandy SILT with angular cobbles and rock, 1" to 6" in diameter angular metamorphic clasts, slightly moist, very dense | | | | | |
| | | Refusal @ 8' | | | | | |

**GRAPHICAL REPRESENTATION BELOW:** **Elevation: 646' MSL** **Surface Slope: 0 deg.** **Trend: N75E**




Total Depth: Refusal @ 8'
Groundwater: N/A
Backfilled: 3/20/2024

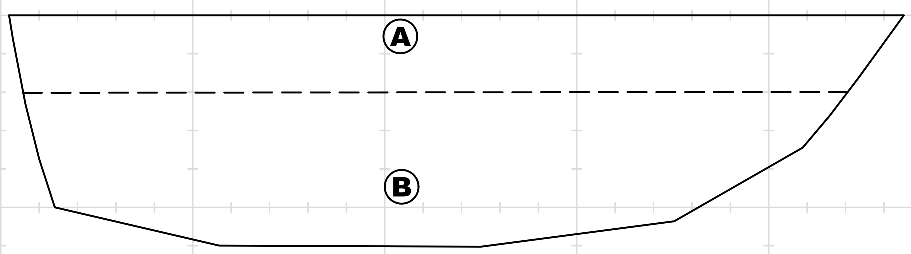
scale: 1in = 5 ft

| Project Name: Twin Oaks, San Marcos | Logged By: MJG | Trench No.: TP-2 |
|---|---|---|
| Project Number: 24032-01 | Date: 3/20/2024 | Engineering Properties: |
| Equipment: Backhoe | Location: See Geotechnical Map | |

LGC Geotechnical, Inc.

| Geologic Attitudes | Unit | SOIL DESCRIPTION: | GEOLOGIC UNIT | USCS | SAMPLE No | MOISTURE (%) | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | **Quaternary Alluvium (Qal)** | | | | | |
| | A | @ 0' to 2' - Sandy CLAY: dark brown, slightly moist, medium dense, grass & rootlets at surface | Qal | | | | |
| | B | @ 2' to 6' - Sandy SILT: light brownish gray, slightly moist, some gravel, very dense, indurated | | | | | |
| | | Refusal @ 6' | | | | | |

**GRAPHICAL REPRESENTATION BELOW:** **Elevation: 639' MSL** **Surface Slope: 0 deg.** **Trend: N65E**



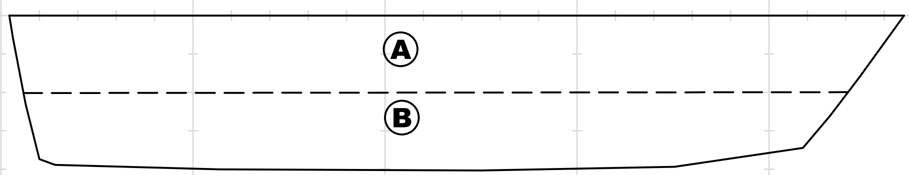

Total Depth: Refusal @ 6'
Groundwater: N/A
Backfilled: 3/20/2024

scale: 1in = 5 ft

| Project Name: Twin Oaks, San Marcos | Logged By: MJG | Trench No.: TP-3 | LGC Geotechnical, Inc. |
|---|---|---|---|
| Project Number: 24032-01 | Date: 3/20/2024 | Engineering Properties: | |
| Equipment: Backhoe | Location: See Geotechnical Map | | |

| Geologic Attitudes | Unit | SOIL DESCRIPTION: | GEOLOGIC UNIT | USCS | SAMPLE No | MOISTURE (%) | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | A | Quaternary Alluvium (Qal)<br>@ 0' to 2' - Sandy SILT to Clayey SILT: dark brown, moist, loose to medium dense, light vegetation at surface | Qal | | | | |
| | B | Jurassic Santiago Peak Volcanics (Jsp)<br>@ 2' to 4' - Fractured rock, jointed, reddish brown overall, dry to slightly moist, dense to very dense, some white mineral stains, oxidized | Jsp | | | | |
| | | Refusal @ 4' | | | | | |

**GRAPHICAL REPRESENTATION BELOW:** **Elevation: 681' MSL** **Surface Slope: 0 deg.** **Trend: N-S**



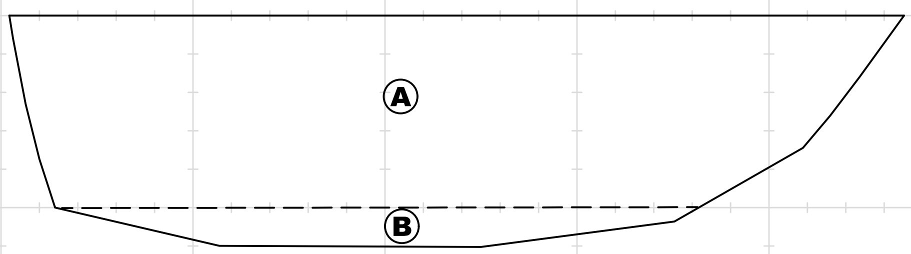

Total Depth: Refusal @ 4'
Groundwater: N/A
Backfilled: 3/20/2024

scale: 1in = 5 ft

| Project Name: Twin Oaks, San Marcos | Logged By: MJG | Trench No.: TP-4 | LGC Geotechnical, Inc. |
|---|---|---|---|
| Project Number: 24032-01 | Date: 3/20/2024 | Engineering Properties: | |
| Equipment: Backhoe | Location: See Geotechnical Map | | |

| Geologic Attitudes | Unit | SOIL DESCRIPTION: | GEOLOGIC UNIT | USCS | SAMPLE No | MOISTURE (%) | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | **Quaternary Alluvium (Qal)** | | | | | |
| | A | @ 0' to 5' - SILT: dark brown, slightly moist, loose, some $\frac{3}{4}$" gravel, angular metamorphic clasts (2-3" wide) at contact with unit B, trace clay, vegetation at surface | Qal | | | | |
| | | **Jurassic Santiago Peak Volcanics (Jsp)** | | | | | |
| | B | @ 5' to 6' - Meta-Sedimentary Bedrock, gray, slightly moist, dense to very dense, weathered rock clasts in silty matrix | Jsp | | | | |
| | | Refusal @ 6' | | | | | |

**GRAPHICAL REPRESENTATION BELOW:** Elevation: 665' MSL Surface Slope: 0 deg. Trend: N80E




Total Depth: Refusal @ 6'
Groundwater: N/A
Backfilled: 3/20/2024

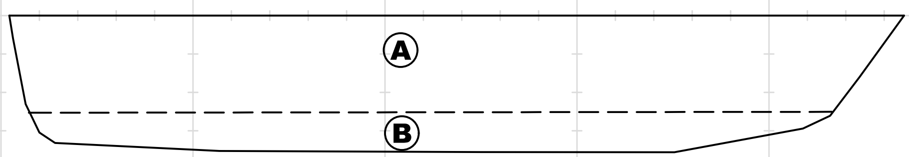
scale: 1in = 5 ft

| Project Name: Twin Oaks, San Marcos | Logged By: MJG | Trench No.: TP-5 |
|---|---|---|
| Project Number: 24032-01 | Date: 3/20/2024 | Engineering Properties: |
| Equipment: Backhoe | Location: See Geotechnical Map | |

LGC Geotechnical, Inc.

| Geologic Attitudes | Unit | SOIL DESCRIPTION: | GEOLOGIC UNIT | USCS | SAMPLE No | MOISTURE (%) | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | A | <u>Quaternary Alluvium (Qal)</u><br>@ 0' to 2.5' - CLAY with Silt: dark brown, slightly moist, loose, vegetation at surface | Qal | | | | |
| J: N25W 76SW | B | <u>Jurassic Santiago Peak Volcanics (Jsp)</u><br>@ 2.5' to 3.5' - Meta-Sedimentary Bedrock, minor weathering/fracturing, gray with some iron oxide staining, dry, very dense | Jsp | | | | |
| | | Refusal @ 3.5' | | | | | |

**GRAPHICAL REPRESENTATION BELOW:** **Elevation: 718' MSL** **Surface Slope: 0 deg.** **Trend: E-W**



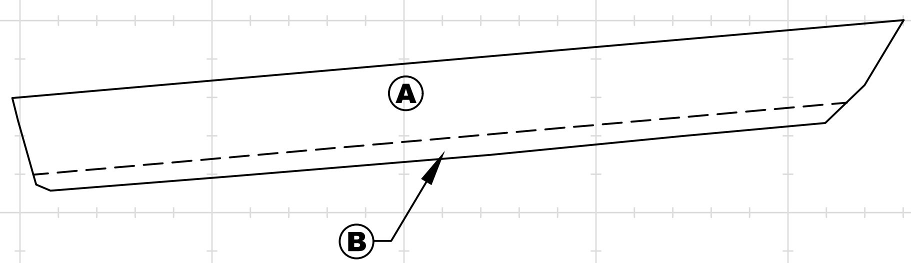

Total Depth: Refusal @ 3.5'
Groundwater: N/A
Backfilled: 3/20/2024

scale: 1in = 5 ft

| | | | |
|---|---|---|---|
| **Project Name: Twin Oaks, San Marcos** | **Logged By: MJG** | **Trench No.: TP-6** | LGC Geotechnical, Inc. |
| **Project Number: 24032-01** | **Date: 3/20/2024** | **Engineering Properties:** | |
| **Equipment: Backhoe** | **Location: See Geotechnical Map** | | |

| Geologic Attitudes | Unit | SOIL DESCRIPTION: | GEOLOGIC UNIT | USCS | SAMPLE No | MOISTURE (%) | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | A | **Quaternary Alluvium (Qal)**<br>@ 0' to 2' - Clayey SILT: dark brown, slightly moist, loose to medium dense, vegetation at surface | Qal | | B-1 @0-2' | | |
| | B | **Jurassic Santiago Peak Volcanics (Jsp)**<br>@ 2' to 2.5' - Slightly fractured Meta-Sedimentary Bedrock, gray with reddish brown iron oxide staining, dry, very dense | Jsp | | | | |
| | | Refusal @ 2.5' | | | | | |

**GRAPHICAL REPRESENTATION BELOW:** **Elevation: 764' MSL** **Surface Slope: 5 deg.** **Trend: N35W**



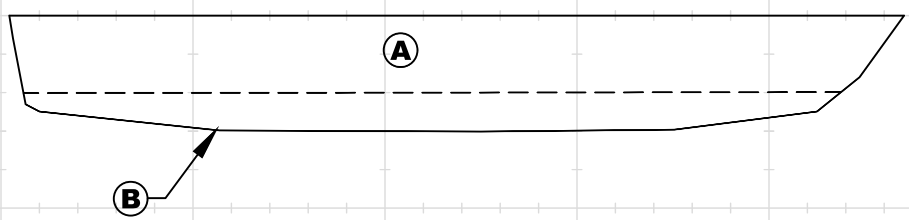

Total Depth: Refusal @ 2.5'
Groundwater: N/A
Backfilled: 3/20/2024

scale: 1in = 5 ft

| Project Name: Twin Oaks, San Marcos | Logged By: MJG | Trench No.: TP-7 |
|---|---|---|
| Project Number: 24032-01 | Date: 3/20/2024 | Engineering Properties: |
| Equipment: Backhoe | Location: See Geotechnical Map | |

| Geologic Attitudes | Unit | SOIL DESCRIPTION: | GEOLOGIC UNIT | USCS | SAMPLE No | MOISTURE (%) | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | A | Quaternary Alluvium (Qal)<br>@ 0' to 2' - Clayey SILT: dark brown, slightly moist, medium dense, 1-2" angular clasts of Meta-Sedimentary bedrock | Qal | | | | |
| | B | Jurassic Santiago Peak Volcanics (Jsp)<br>@ 2' to 3' - Fractured Meta-Sedimentary Bedrock, gray with iron oxide staining, dry, very dense | Jsp | | | | |
| | | Refusal @ 3' | | | | | |

**GRAPHICAL REPRESENTATION BELOW:** **Elevation: 753' MSL** **Surface Slope: 0 deg.** **Trend: S60E**




Total Depth: Refusal @ 3'
Groundwater: N/A
Backfilled: 3/20/2024

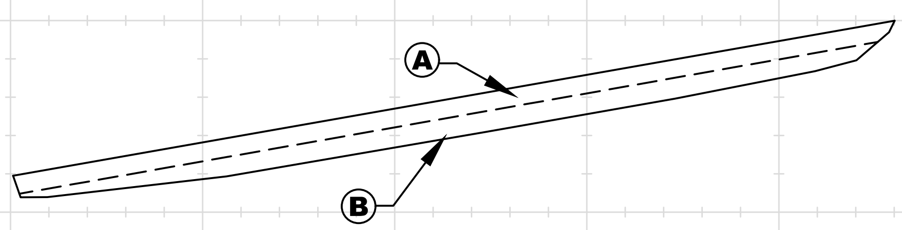
scale: 1in = 5 ft

| Project Name: Twin Oaks, San Marcos | Logged By: MJG | Trench No.: TP-8 |
|---|---|---|
| Project Number: 24032-01 | Date: 3/20/2024 | Engineering Properties: |
| Equipment: Backhoe | Location: See Geotechnical Map | |

LGC Geotechnical, Inc.

| Geologic Attitudes | Unit | SOIL DESCRIPTION: | GEOLOGIC UNIT | USCS | SAMPLE No | MOISTURE (%) | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | A | Quaternary Alluvium (Qal)<br>@ 0' to 0.5' - Clayey SILT: dark brown, slightly moist, medium dense to loose, vegetation at surface | Qal | | | | |
| | B | Jurassic Santiago Peak Volcanics (Jsp)<br>@ 0.5' to 1' - Slightly fractured Meta-Sedimentary Bedrock, gray with iron oxide staining, dry, very dense | Jsp | | | | |
| | | Refusal @ 1' | | | | | |

**GRAPHICAL REPRESENTATION BELOW:** **Elevation: 738' MSL** **Surface Slope: 10 deg.** **Trend: S20W**



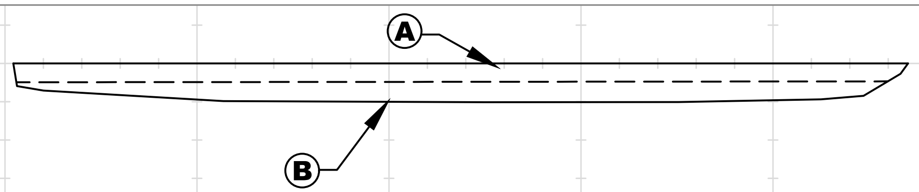

Total Depth: Refusal @ 1'
Groundwater: N/A
Backfilled: 3/20/2024

scale: 1in = 5 ft

| Project Name: Twin Oaks, San Marcos | Logged By: MJG | Trench No.: TP-9 | LGC Geotechnical, Inc. |
|---|---|---|---|
| Project Number: 24032-01 | Date: 3/20/2024 | Engineering Properties: | |
| Equipment: Backhoe | Location: See Geotechnical Map | | |

| Geologic Attitudes | Unit | SOIL DESCRIPTION: | GEOLOGIC UNIT | USCS | SAMPLE No | MOISTURE (%) | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | Quaternary Alluvium (Qal) | | | | | |
| | A | @ 0' to 1' - Clayey SILT: dark brown, slightly moist, medium dense to loose, vegetation at surface | Qal | | | | |
| | | Jurassic Santiago Peak Volcanics (Jsp) | | | | | |
| J: N39E 33NW | B | @ 1' to 1.5' - Meta-Sedimentary Bedrock, gray with iron oxide staining, dry, very dense, multiple joint sets | Jsp | | | | |
| | | Refusal @ 1.5' | | | | | |

**GRAPHICAL REPRESENTATION BELOW:** **Elevation: 723' MSL** **Surface Slope: 0 deg.** **Trend: N30W**




Total Depth: Refusal @ 1.5'
Groundwater: N/A
Backfilled: 3/20/2024

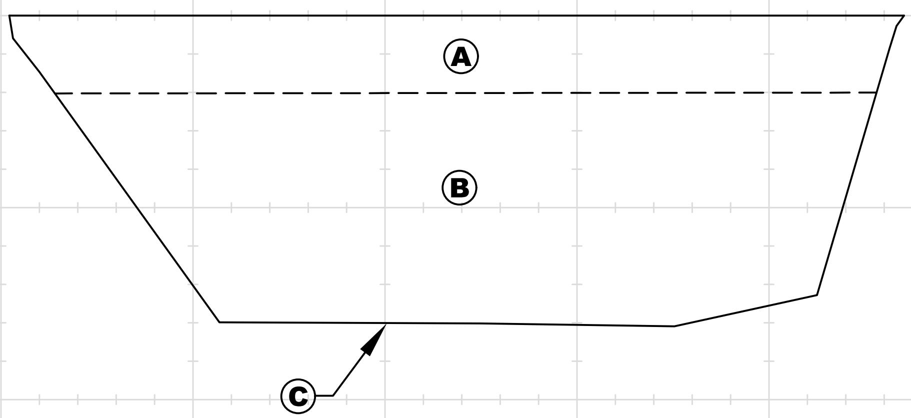
scale: 1in = 5 ft

| Project Name: Twin Oaks, San Marcos | Logged By: MJG | Trench No.: TP-10 |
|---|---|---|
| Project Number: 24032-01 | Date: 3/21/2024 | Engineering Properties: |
| Equipment: Backhoe | Location: See Geotechnical Map | |

LGC Geotechnical, Inc.

| Geologic Attitudes | Unit | SOIL DESCRIPTION: | GEOLOGIC UNIT | USCS | SAMPLE No | MOISTURE (%) | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | A | Artificial Fill, Undocumented (afu)<br>@ 0' to 2' - Clayey SILT: dark brown, slightly moist, loose, some angular fragments of Jsp, fragments of trash/debris, vegetation at surface | afu | | | | |
| | B | Quaternary Alluvium (Qal)<br>@ 2' to 8' - Sandy SILT, reddish brown, slightly moist, medium dense to dense, some 2-3" angular fractured rock clasts | Qal | | | | |
| | C | Jurassic Santiago Peak Volcanics (Jsp)<br>@ 8' - Meta-Sedimentary Bedrock, gray, dry, very dense | Jsp | | | | |
| | | Refusal @ 8' | | | | | |

GRAPHICAL REPRESENTATION BELOW: Elevation: 660' MSL Surface Slope: 0 deg. Trend: N25W



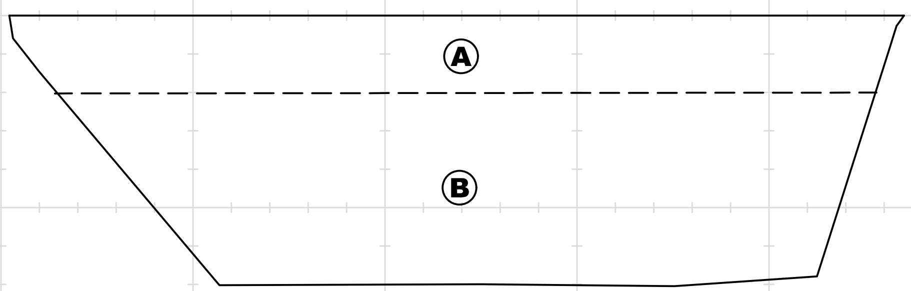

Total Depth: Refusal @ 8'
Groundwater: N/A
Backfilled: 3/21/2024

scale: 1in = 5 ft

| Project Name: Twin Oaks, San Marcos | Logged By: MJG | Trench No.: TP-11 | LGC Geotechnical, Inc. |
|---|---|---|---|
| Project Number: 24032-01 | Date: 3/21/2024 | Engineering Properties: | |
| Equipment: Backhoe | Location: See Geotechnical Map | | |

| Geologic Attitudes | Unit | SOIL DESCRIPTION: | GEOLOGIC UNIT | USCS | SAMPLE No | MOISTURE (%) | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | **Quaternary Alluvium (Qal)** | | | | | |
| | A | @ 0' to 2' - Clayey SILT: dark brown, slightly moist, soft to medium soft, vegetation/rootlets at surface | Qal | | | | |
| | B | @ 2' to 7' - Clayey SILT: dark brown, slightly moist, very stiff to hard, indurated, angular Meta-Sedimentary cobbles to 3" | | | B-1 @2-7' | | |
| | | Refusal @ 7' | | | | | |

**GRAPHICAL REPRESENTATION BELOW:** Elevation: 635' MSL Surface Slope: 0 deg. Trend: S40W



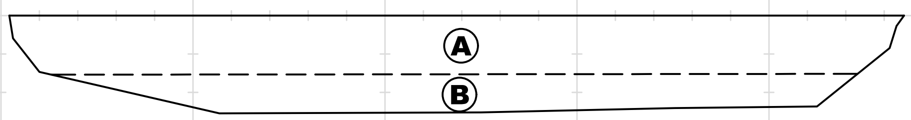

Total Depth: Refusal @ 7'
Groundwater: N/A
Backfilled: 3/21/2024

scale: 1in = 5 ft

| | | | |
|---|---|---|---|
| **Project Name: Twin Oaks, San Marcos** | **Logged By: MJG** | **Trench No.: TP-12** | LGC Geotechnical, Inc. |
| **Project Number: 24032-01** | **Date: 3/21/2024** | **Engineering Properties:** | |
| **Equipment: Backhoe** | **Location: See Geotechnical Map** | | |

| Geologic Attitudes | Unit | SOIL DESCRIPTION: | GEOLOGIC UNIT | USCS | SAMPLE No | MOISTURE (%) | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | A | **Quaternary Alluvium (Qal)**<br>@ 0' to 1.5' - Sandy SILT: dark brown, slightly moist, medium stiff, vegetation at surface | Qal | | | | |
| | B | **Jurassic Santiago Peak Volcanics (Jsp)**<br>@ 1.5' to 2.5' - Meta-Sedimentary Bedrock, gray with iron oxide stains, dry to slightly moist, very dense/hard, weathered, heavily oxidized, fractured, matrix consists of gray silty sand/sandy silt | Jsp | | | | |
| | | Refusal @ 2.5' | | | | | |

**GRAPHICAL REPRESENTATION BELOW:** **Elevation: 733' MSL** **Surface Slope: 0 deg.** **Trend: N85E**




Total Depth: Refusal @ 2.5'
Groundwater: N/A
Backfilled: 3/21/2024

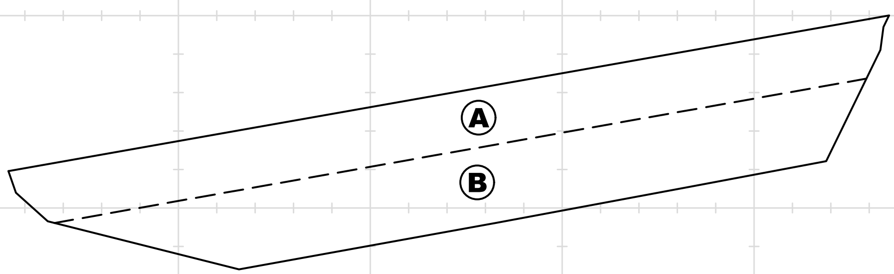
scale: 1in = 5 ft

| Project Name: Twin Oaks, San Marcos | Logged By: MJG | Trench No.: TP-13 |
|---|---|---|
| Project Number: 24032-01 | Date: 3/21/2024 | Engineering Properties: |
| Equipment: Backhoe | Location: See Geotechnical Map | |

LGC Geotechnical, Inc.

| Geologic Attitudes | Unit | SOIL DESCRIPTION: | GEOLOGIC UNIT | USCS | SAMPLE No | MOISTURE (%) | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | A | Quaternary Alluvium (Qal)<br>@ 0' to 1.5' - Clayey SILT: dark brown, slightly moist, medium stiff, vegetation at surface | Qal | | | | |
| | B | Jurassic Santiago Peak Volcanics (Jsp)<br>@ 1.5' to 3.5' - fractured Meta-Sedimentary Bedrock, gray to brownish red, slightly moist, dense to very dense, matrix is gray silt, angular clasts vary in size (1" to 6" max. diameter), oxidized | Jsp | | | | |
| | | Refusal @ 3.5' | | | | | |

**GRAPHICAL REPRESENTATION BELOW:** **Elevation: 722' MSL** **Surface Slope: 10 deg.** **Trend: S15W**



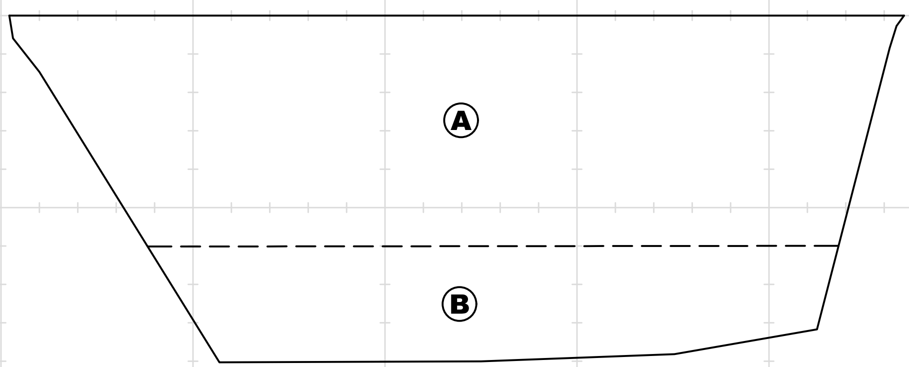

Total Depth: Refusal @ 3.5'
Groundwater: N/A
Backfilled: 3/21/2024

scale: 1in = 5 ft

| Project Name: Twin Oaks, San Marcos | Logged By: MJG | Trench No.: TP-14 | LGC Geotechnical, Inc. |
|---|---|---|---|
| Project Number: 24032-01 | Date: 3/21/2024 | Engineering Properties: | |
| Equipment: Backhoe | Location: See Geotechnical Map | | |

| Geologic Attitudes | Unit | SOIL DESCRIPTION: | GEOLOGIC UNIT | USCS | SAMPLE No | MOISTURE (%) | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | A | <u>Quaternary Alluvium (Qal)</u><br>@ 0' to 6' - Silty CLAY: dark brown, slightly moist, loose to medium dense, vegetation at surface | Qal | | | | |
| J: N70W 82N | B | <u>Jurassic Santiago Peak Volcanics (Jsp)</u><br>@ 6' to 9' - Meta-Sedimentary Bedrock, gray overall with iron oxide stains, dry to slightly moist, dense to very dense, fractured and jointed | Jsp | | B-1 @0-6' | | |
| | | Refusal @ 9' | | | | | |

**GRAPHICAL REPRESENTATION BELOW:** **Elevation: 677' MSL** **Surface Slope: 0 deg.** **Trend: N62E**



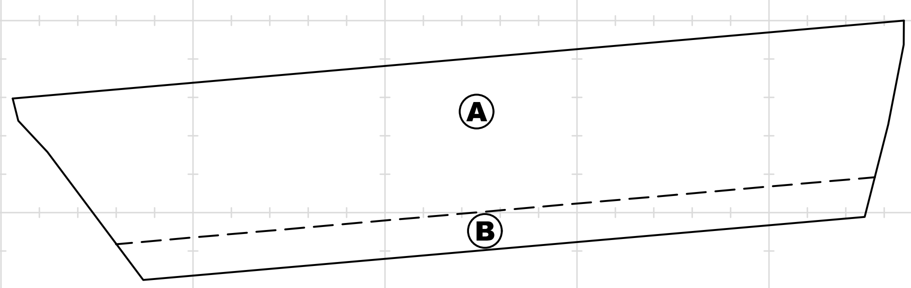

Total Depth: Refusal @ 9'
Groundwater: N/A
Backfilled: 3/21/2024

scale: 1in = 5 ft

| Project Name: Twin Oaks, San Marcos | Logged By: MJG | Trench No.: TP-15 | LGC Geotechnical, Inc. |
|---|---|---|---|
| Project Number: 24032-01 | Date: 3/21/2024 | Engineering Properties: | |
| Equipment: Backhoe | Location: See Geotechnical Map | | |

| Geologic Attitudes | Unit | SOIL DESCRIPTION: | GEOLOGIC UNIT | USCS | SAMPLE No | MOISTURE (%) | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | A | **Quaternary Alluvium (Qal)**<br>@ 0' to 4' - Clayey SILT: dark brown, slightly moist to moist, loose to medium dense | Qal | | | | |
| | B | **Jurassic Santiago Peak Volcanics (Jsp)**<br>@ 4' to 5' - Meta-Sedimentary Bedrock, light gray to olive gray, slightly moist, very dense, oxidized, weathered/fractured | Jsp | | | | |
| | | Refusal @ 5' | | | | | |

**GRAPHICAL REPRESENTATION BELOW:** **Elevation: 695' MSL** **Surface Slope: 5 deg.** **Trend: N70E**



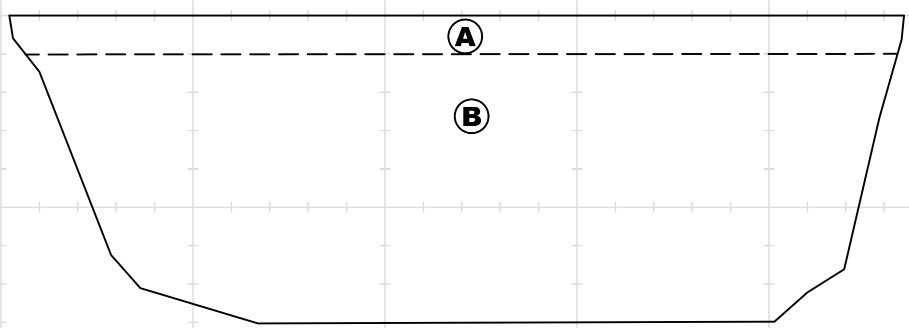

Total Depth: Refusal @ 5'
Groundwater: N/A
Backfilled: 3/21/2024

scale: 1in = 5 ft

| | | | |
|---|---|---|---|
| **Project Name: Twin Oaks, San Marcos** | **Logged By: MJG** | **Trench No.: TP-16** | LGC Geotechnical, Inc. |
| **Project Number: 24032-01** | **Date: 3/21/2024** | **Engineering Properties:** | |
| **Equipment: Backhoe** | **Location: See Geotechnical Map** | | |

| Geologic Attitudes | Unit | SOIL DESCRIPTION: | GEOLOGIC UNIT | USCS | SAMPLE No | MOISTURE (%) | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | **Quaternary Alluvium (Qal)** | | | | | |
| | A | **@ 0' to 1' - Silty Sand: mottled reddish brown, slightly moist, loose to medium dense vegetation at surface** | Qal | | | | |
| | B | **@ 1' to 8' - Sandy SILT to Silty SAND, reddish brown, oxidized, slightly moist, density increases with depth ranging from dense to very dense; angular Meta-Sedimentary cobbles are oxidized near the surface, and by 8' start to become more tightly packed (clast supported matrix) and less oxidized** | | | B-1 @0-6' | | |
| | | **Practical Refusal @ 8'** | | | | | |

**GRAPHICAL REPRESENTATION BELOW:** **Elevation: 688' MSL** **Surface Slope: 0 deg.** **Trend: N15W**



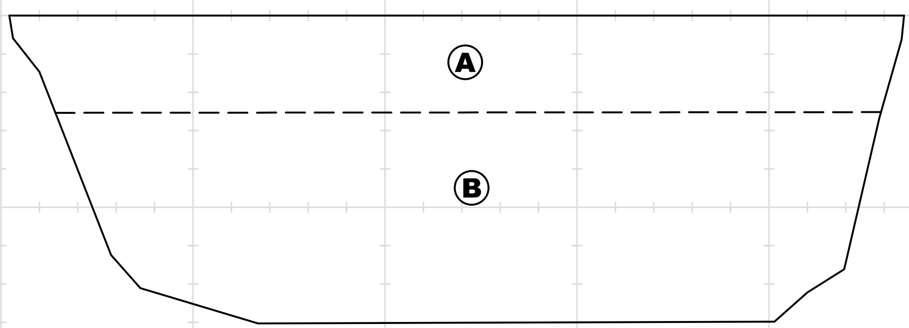

Total Depth: Refusal @ 8'
Groundwater: N/A
Backfilled: 3/21/2024

scale: 1in = 5 ft

| Project Name: Twin Oaks, San Marcos | Logged By: MJG | Trench No.: TP-17 | LGC Geotechnical, Inc. |
|---|---|---|---|
| Project Number: 24032-01 | Date: 3/21/2024 | Engineering Properties: | |
| Equipment: Backhoe | Location: See Geotechnical Map | | |

| Geologic Attitudes | Unit | SOIL DESCRIPTION: | GEOLOGIC UNIT | USCS | SAMPLE No | MOISTURE (%) | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | | <u>Artificial Fill, Undocumented (afu)</u> | | | | | |
| | A | @ 0' to 0.5' - Clayey SILT: dark brown, slightly moist, loose to medium dense, vegetation at surface, abandoned 1" pvc pipe at 6" | afu | | | | |
| | | <u>Quaternary Alluvium (Qal)</u> | | | | | |
| | B | @ 0.5' to 2.5' - Clayey SILT: dark brown, slightly moist, medium dense | Qal | | B-1 @0-8' | | |
| J: N55E 90SE J: N32W 82SW | C | <u>Jurassic Santiago Peak Volcanics (Jsp)</u><br>@ 2.5' to 8' - fractured Meta-Sedimentary Bedrock cut by multiple joint sets, gray with iron oxide staining and white mottle, slightly moist, dense | Jsp | | | | |
| | | Refusal @ 8' | | | | | |

**GRAPHICAL REPRESENTATION BELOW:** **Elevation: 720' MSL** **Surface Slope: 0 deg.** **Trend: N75W**



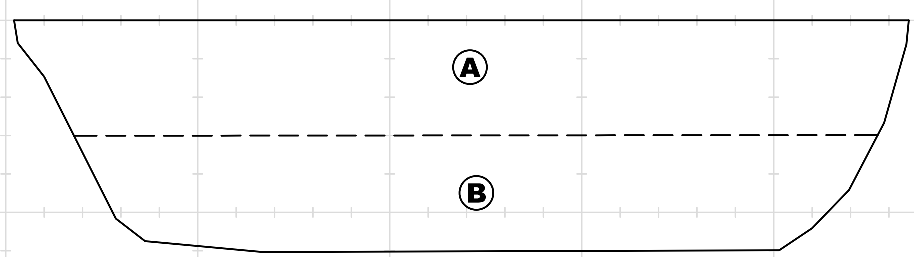

Total Depth: Refusal @ 8'
Groundwater: N/A
Backfilled: 3/21/2024

scale: 1in = 5 ft

| Project Name: Twin Oaks, San Marcos | Logged By: MJG | Trench No.: TP-18 |
|---|---|---|
| Project Number: 24032-01 | Date: 3/21/2024 | Engineering Properties: |
| Equipment: Backhoe | Location: See Geotechnical Map | |

| Geologic Attitudes | Unit | SOIL DESCRIPTION: | GEOLOGIC UNIT | USCS | SAMPLE No | MOISTURE (%) | DRY DENSITY (PCF) |
|---|---|---|---|---|---|---|---|
| | A | <u>Quaternary Alluvium (Qal)</u><br>@ 0' to 3' - Silty Clay/Clayey SILT: reddish brown, moist, medium dense, vegetation at surface, seepage at contact with bedrock below | Qal | | | | |
| | B | <u>Jurassic Santiago Peak Volcanics (Jsp)</u><br>@ 3' to 6' - fractured Meta-Sedimentary Bedrock, gray with some iron oxide stains, dense, heavily fractured/jointed with seepage at 3' | Jsp | | | | |
| | | Refusal @ 6' | | | | | |

**GRAPHICAL REPRESENTATION BELOW:** **Elevation: 718' MSL** **Surface Slope: 0 deg.** **Trend: S25W**




Total Depth: Refusal @ 6'
Groundwater: 3' (seepage)
Backfilled: 3/21/2024

scale: 1in = 5 ft

# *Appendix C*
# *Laboratory Test Results*

## *APPENDIX C*

## ***<u>Laboratory Testing Procedures and Test Results</u>***

The laboratory testing program was formulated towards providing data relating to the relevant engineering properties of the soils with respect to residential construction. Samples considered representative of site conditions were tested in general accordance with American Society for Testing and Materials (ASTM) procedure and/or California Test Methods (CTM), where applicable. The following summary is a brief outline of the test type and a table summarizing the test results.

<u>Moisture and Density Determination Tests</u>: Moisture content (ASTM D2216) and dry density determinations (ASTM D2937) were performed on relatively undisturbed samples obtained from the test borings. The results of these tests are presented in the boring logs. Where applicable, only moisture content was determined from undisturbed or disturbed samples.

<u>Grain Size Distribution/Fines Content</u>: Representative samples were dried, weighed and soaked in water until individual soil particles were separated (per ASTM D421) and then washed on a No. 200 sieve (ASTM D1140). Where applicable, the portion retained on the No. 200 sieve and dried and then sieved on a U.S. Standard brass sieve set in accordance with ASTM D6913 (sieve).

| **Sample Location** | **Description** | **% Passing # 200 Sieve** |
|---|---|---|
| HS-2 @ 25 feet | Clay with Sand | 79 |
| HS-2 @ 35 feet | Silty Sand | 43 |
| HS-2 @ 40 feet | Clayey Sand | 16 |
| HS-2 @ 45 feet | Clayey Sand with Gravel | 14 |
| HS-2 @ 50 feet | Clayey Sand with Gravel | 29 |
| I-1 @ 8.5 feet | Sandy Clay | 50 |
| I-2 @ 8.5 feet | Sand with Silt | 7 |

<u>Expansion Index</u>: The expansion potential of selected samples was evaluated by the Expansion Index Test, Standard ASTM D4829. Specimens are molded under a given compactive energy to approximately the optimum moisture content and approximately 50 percent saturation or approximately 90 percent relative compaction. The prepared 1-inch-thick by 4-inch-diameter specimens are loaded to an equivalent 144 psf surcharge and are inundated with tap water until volumetric equilibrium is reached. The results of these tests are presented in the table below.

| **Sample Location** | **Expansion Index** | **Expansion Potential*** |
|---|---|---|
| TP-1 @ 0-8 feet | 25 | Low |
| TP-6 @ 0-2 feet | 30 | Low |
| TP-14 @ 0-6 feet | 14 | Very Low |

***Laboratory Testing Procedures and Test Results***

* ASTM D4829

Atterberg Limits: The liquid and plastic limits ("Atterberg Limits") were determined per ASTM D4318 for engineering classification of fine-grained material and presented in the table below. The USCS soil classification indicated in the table below is based on the portion of sample passing the No. 40 sieve and may not necessarily be representative of the entire sample. The plots are provided in this Appendix.

| Sample Location | Liquid Limit (%) | Plastic Limit (%) | Plasticity Index (%) | USCS Soil Classification |
|---|---|---|---|---|
| HS-2 @ 25 feet | 34 | 19 | 15 | CL |
| HS-2 @ 35 feet | 28 | 23 | 5 | ML |
| HS-2 @ 45 feet | 33 | 16 | 17 | CL |
| HS-2 @ 50 feet | 30 | 14 | 16 | CL |

Maximum Density Tests: The maximum dry density and optimum moisture content of typical materials were determined in accordance with ASTM D1557. The results of these tests are presented in the table below:

| Sample Location | Sample Description | Maximum Dry Density (pcf) | Optimum Moisture Content (%) |
|---|---|---|---|
| *TP-1 @ 0-8 feet | Brown Silty Sand with Gravel | 127.0 | 10.5 |
| **TP-6 @ 0-2 feet | Reddish Brown Sandy Silt with Gravel | 121.0 | 12.0 |
| ***TP-14 @ 0-6 feet | Brown Clayey Sand with Gravel | 128.5 | 9.5 |
| ****HS-2 @ 0-5 feet | Reddish Brown Clayey Sand with Gravel | 128.5 | 9.5 |
| *****I-1 @ 0-5 feet | Brown Silty Sand with Gravel | 129.0 | 9.0 |

*Note: These max dry density results are based on a rock correction with approximately 12% retained on the No. 4 sieve.
**Note: These max dry density results are based on a rock correction with approximately 12% retained on the No. 4 sieve.
***Note: These max dry density results are based on a rock correction with approximately 7% retained on the No. 4 sieve.
****Note: These max dry density results are based on a rock correction with approximately 8% retained on the No. 4 sieve.
*****Note: These max dry density results are based on a rock correction with approximately 18% retained on the No. 4 sieve.

***Laboratory Testing Procedures and Test Results***

Collapse/Swell Potential: One collapse test was performed per ASTM D4546. A sample (2.4 inches in diameter and 1-inch in height) was placed in a consolidometer and loaded to the approximate in-situ effective stress. The curve is presented in this Appendix.

Consolidation: Two consolidation tests were performed per ASTM D2435. A sample (2.4 inches in diameter and 1 inch in height) was placed in a consolidometer and increasing loads were applied. The sample was allowed to consolidate under "double drainage" and total deformation for each loading step was recorded. The percent consolidation for each load step was recorded as the ratio of the amount of vertical compression to the original sample height. The consolidation pressure curves are provided in this Appendix.

Direct Shear: Four direct shear tests were performed on remolded samples and one on relatively undisturbed samples, which were soaked for a minimum of 24 hours prior to testing. The samples were tested under various normal loads using a motor-drive, strain-controlled, direct shear testing apparatus (ASTM D3080). The plots are provided in this Appendix.

R-value Test: R-value test was performed in general accordance with California Test Method 301. The plot is included in the Appendix.

| **Sample Location** | **R-value** |
|---|---|
| TP-17 @ 1-5 ft | 53 |

Chloride Content: Chloride content was tested in accordance with Caltrans Test Method (CTM) 422. The results are presented below.

| **Sample Location** | **Chloride Content, ppm** |
|---|---|
| TP-1 @ 0-8 feet | 180 |

***<u>Laboratory Testing Procedures and Test Results</u>***

<u>Soluble Sulfates</u>: The soluble sulfate contents of selected samples were determined by standard geochemical methods (CTM 417). The soluble sulfate content is used to determine the appropriate cement type and maximum water-cement ratios. The test results are presented in the table below.

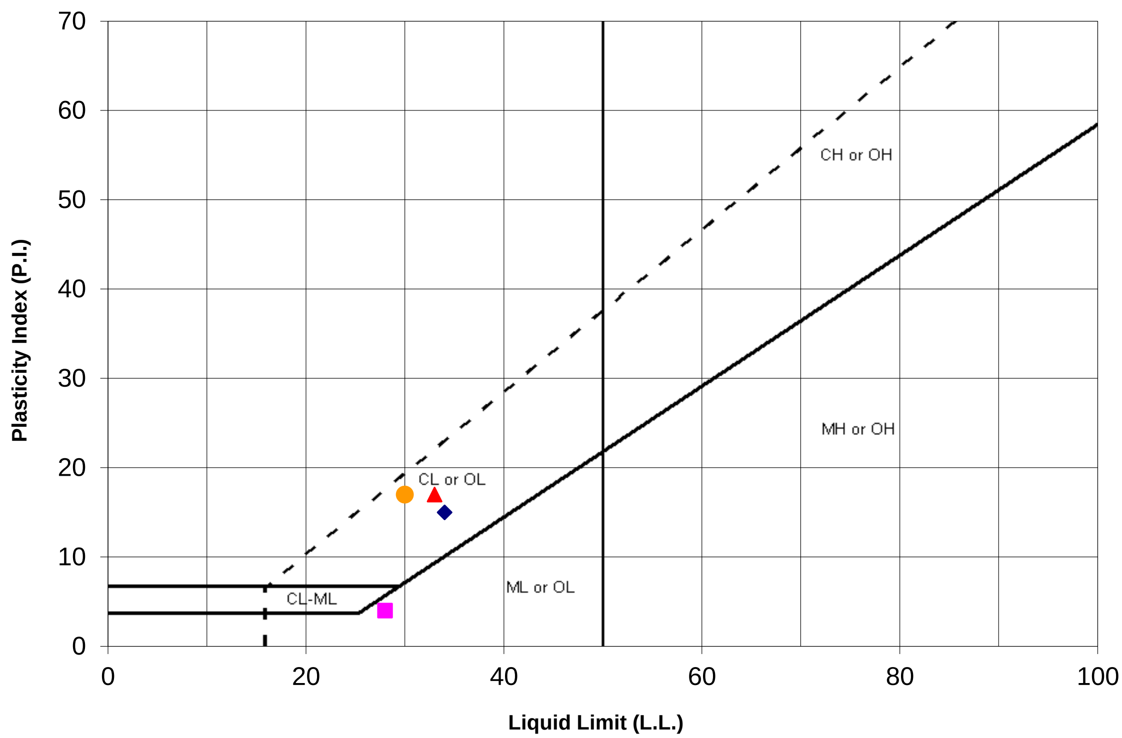
| Sample Location | Sulfate Content (ppm) | Sulfate Exposure Class * |
|---|---|---|
| TP-1 @ 0-8 feet | 70 | S0 |

*Based on ACI 318R-14, Table 19.3.1.1

<u>Minimum Resistivity and pH Tests</u>: Minimum resistivity and pH tests were performed in general accordance with CTM 643 and standard geochemical methods. The results are presented in the table below.

| Sample Location | pH | Minimum Resistivity (ohms-cm) |
|---|---|---|
| TP-1 @ 0-8 feet | 6.73 | 2,610 |

PLASTICITY CHART - CLASSIFICATION OF FINE-GRAINED SOILS




| Symbol | Location.: | Sample No.: | Depth (ft) | Passing No. 200 Sieve (%) | Liquid Limit (%) LL | Plastic Limit (%) PL | Plasticity Index (%) PI | USCS |
|---|---|---|---|---|---|---|---|---|
| ◆ | HS-2 | R-7 | 25' | 79 | 34 | 19 | 15 | CL |
| ■ | HS-2 | R-8 | 35' | 43 | 28 | 23 | 5 | ML |
| ▲ | HS-2 | R-9 | 45' | 14 | 33 | 16 | 17 | CL |
| ● | HS-2 | SPT-4 | 50' | 29 | 30 | 14 | 16 | CL |
| | | | | | | | | |

LGC Geotechnical, Inc.

**ATTERBERG LIMITS**
(ASTM D 4318)

**Project Number:** 24032-01
**Date:** May-24

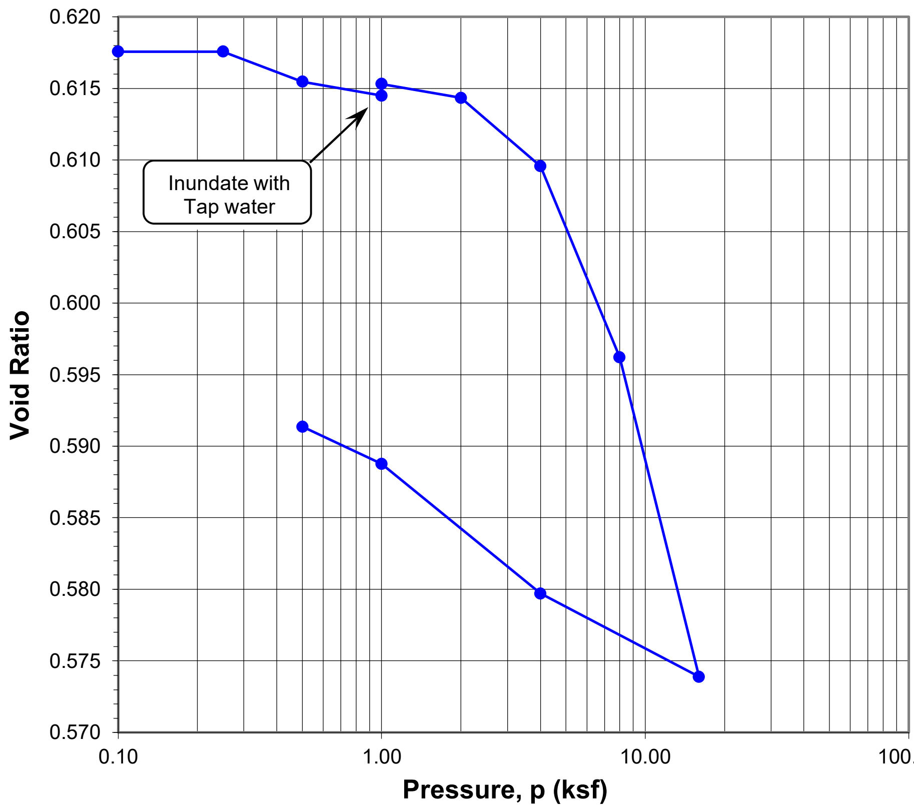
**Twin Oaks, San Marcos**

# ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

**ASTM D 2435**

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Twin Oaks, San Marcos | Tested By: | GB/JD | Date: | 05/03/24 |
| Project No.: | 24032-01 | Checked By: | J. Ward | Date: | 05/21/24 |
| Boring No.: | HS-2 | Depth (ft.): | 25.0 | | |
| Sample No.: | R-7 | Sample Type: | Ring | | |
| Soil Identification: | Strong brown lean clay (CL) | | | | |

| | |
|---|---|
| Sample Diameter (in.): | 2.415 |
| Sample Thickness (in.): | 1.000 |
| Weight of Sample + ring (g): | 195.64 |
| Weight of Ring (g): | 44.51 |
| Height after consol. (in.): | 0.9836 |
| **Before Test** | |
| Wt. of Wet Sample+Cont. (g): | 197.91 |
| Wt. of Dry Sample+Cont. (g): | 175.00 |
| Weight of Container (g): | 64.00 |
| Initial Moisture Content (%) | 20.6 |
| Initial Dry Density (pcf) | 104.2 |
| Initial Saturation (%): | 90 |
| Initial Vertical Reading (in.) | 0.1202 |
| **After Test** | |
| Wt. of Wet Sample+Cont. (g): | 255.15 |
| Wt. of Dry Sample+Cont. (g): | 228.07 |
| Weight of Container (g): | 59.15 |
| Final Moisture Content (%) | 21.77 |
| Final Dry Density (pcf): | 105.2 |
| Final Saturation (%): | 98 |
| Final Vertical Reading (in.) | 0.1450 |
| Specific Gravity (assumed): | 2.70 |
| Water Density (pcf): | 62.43 |

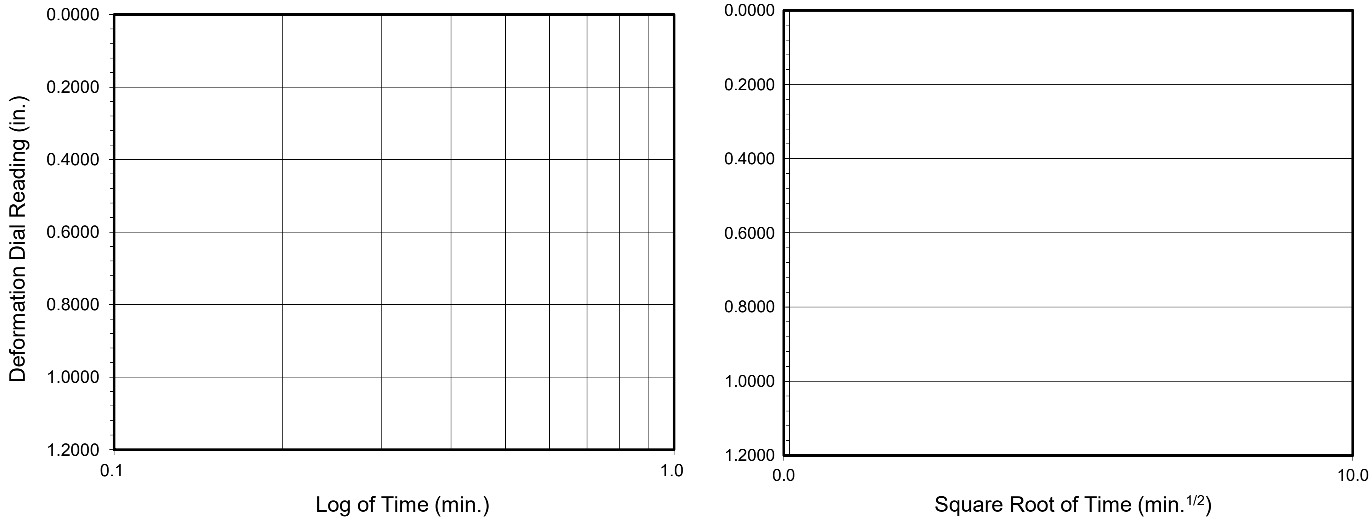


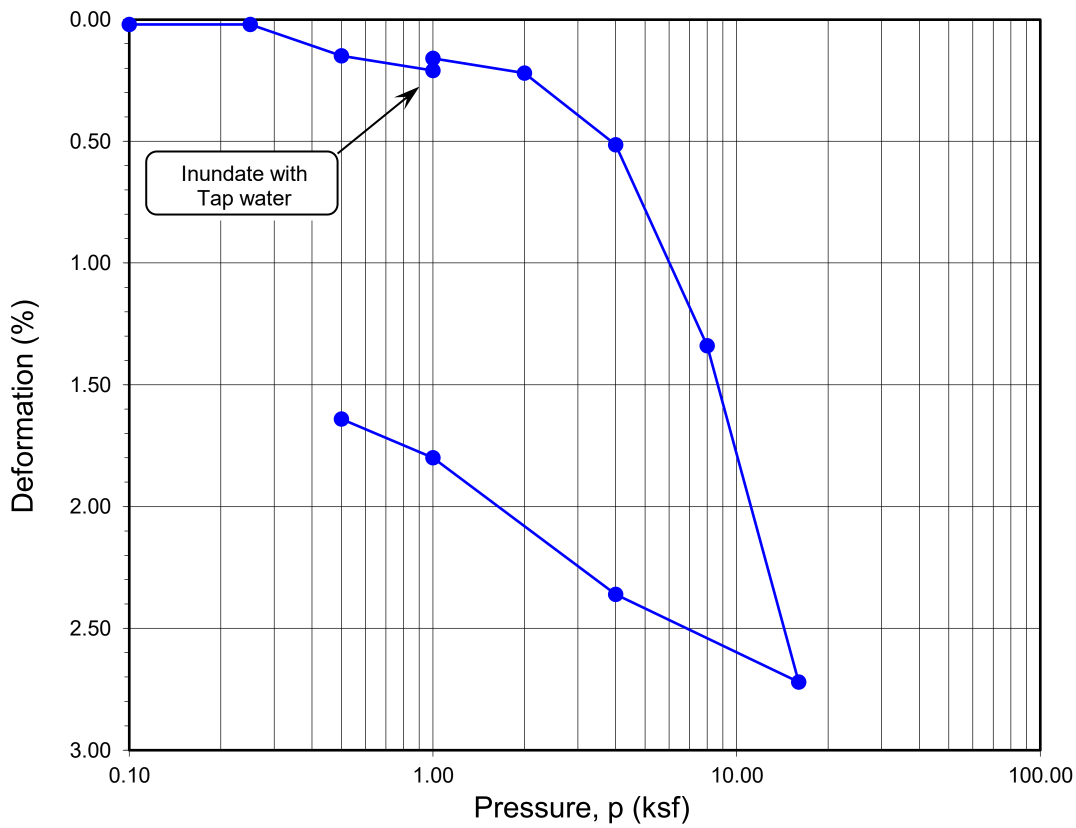

| Pressure (p) (ksf) | Final Reading (in.) | Apparent Thickness (in.) | Load Compliance (%) | Deformation % of Sample Thickness | Void Ratio | Corrected Deformation (%) |
|---|---|---|---|---|---|---|
| 0.10 | 0.1204 | 0.9998 | 0.00 | 0.02 | 0.618 | 0.02 |
| 0.25 | 0.1218 | 0.9984 | 0.14 | 0.16 | 0.618 | 0.02 |
| 0.50 | 0.1247 | 0.9955 | 0.30 | 0.45 | 0.615 | 0.15 |
| 1.00 | 0.1272 | 0.9930 | 0.49 | 0.70 | 0.614 | 0.21 |
| 1.00 | 0.1267 | 0.9935 | 0.49 | 0.65 | 0.615 | 0.16 |
| 2.00 | 0.1289 | 0.9913 | 0.65 | 0.87 | 0.614 | 0.22 |
| 4.00 | 0.1335 | 0.9868 | 0.81 | 1.33 | 0.610 | 0.51 |
| 8.00 | 0.1431 | 0.9771 | 0.95 | 2.29 | 0.596 | 1.34 |
| 16.00 | 0.1583 | 0.9619 | 1.09 | 3.81 | 0.574 | 2.72 |
| 4.00 | 0.1537 | 0.9665 | 0.99 | 3.35 | 0.580 | 2.36 |
| 1.00 | 0.1471 | 0.9731 | 0.89 | 2.69 | 0.589 | 1.80 |
| 0.50 | 0.1450 | 0.9752 | 0.84 | 2.48 | 0.591 | 1.64 |

Time Readings

| Date | Time | Elapsed Time (min) | Square Root of Time | Dial Rdgs. (in.) |
|---|---|---|---|---|

Time Readings




| Boring No. | Sample No. | Depth (ft.) | Moisture Content (%) | | Dry Density (pcf) | | Void Ratio | | Degree of Saturation (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Initial | Final | Initial | Final | Initial | Final | Initial | Final |
| **HS-2** | **R-7** | **25** | **20.6** | **21.8** | **104.2** | **105.2** | **0.618** | **0.591** | **90** | **98** |

Soil Identification: Strong brown lean clay (CL)

| | | |
|---|---|---|
| Leighton | **ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS**<br>**ASTM D 2435** | Project No.: 24032-01<br>Twin Oaks, San Marcos<br>05-24 |

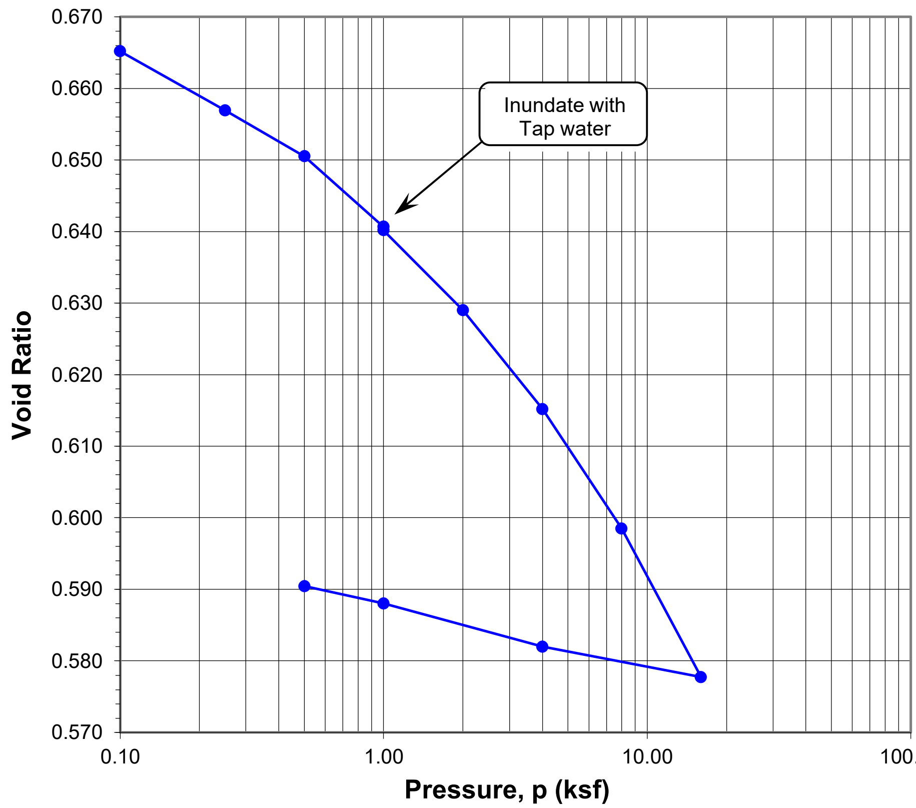
# ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

**ASTM D 2435**

Leighton

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Twin Oaks, San Marcos | Tested By: | GB/JD | Date: | 05/03/24 |
| Project No.: | 24032-01 | Checked By: | J. Ward | Date: | 05/21/24 |
| Boring No.: | HS-2 | Depth (ft.): | 35.0 | | |
| Sample No.: | R-8 | Sample Type: | Ring | | |
| Soil Identification: | Olive silty clay (CL-ML) | | | | |

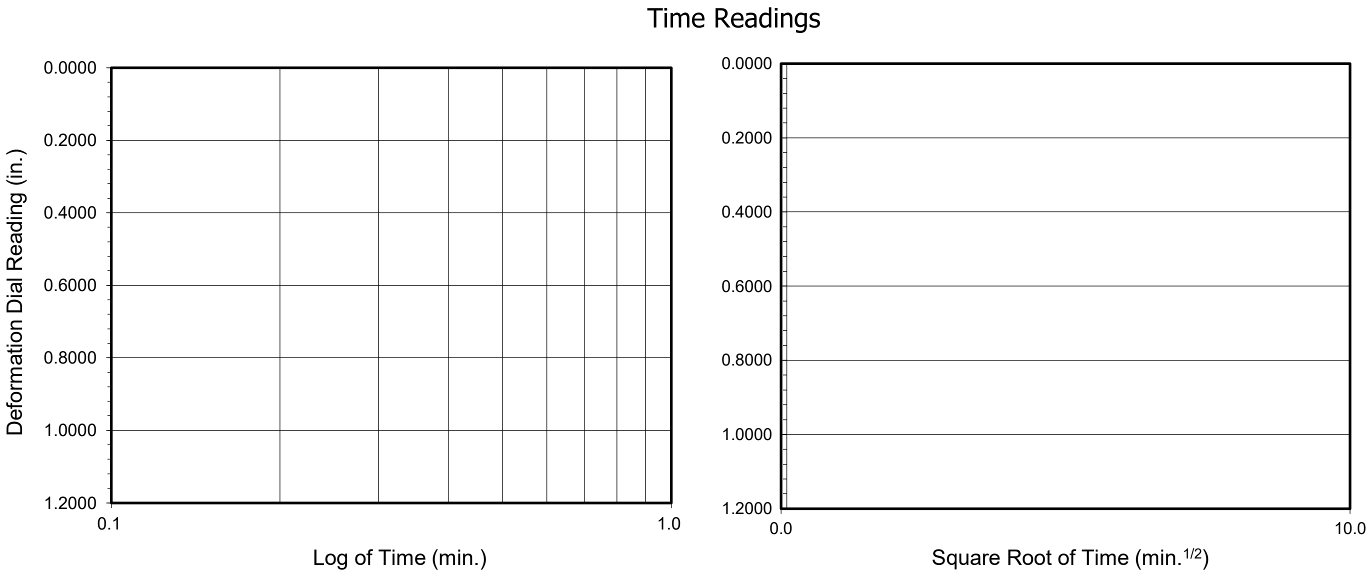
| | |
|---|---|
| Sample Diameter (in.): | 2.415 |
| Sample Thickness (in.): | 1.000 |
| Weight of Sample + ring (g): | 190.81 |
| Weight of Ring (g): | 44.54 |
| Height after consol. (in.): | 0.9543 |
| **Before Test** | |
| Wt. of Wet Sample+Cont. (g): | 175.64 |
| Wt. of Dry Sample+Cont. (g): | 155.96 |
| Weight of Container (g): | 58.92 |
| Initial Moisture Content (%) | 20.3 |
| Initial Dry Density (pcf) | 101.1 |
| Initial Saturation (%): | 82 |
| Initial Vertical Reading (in.) | 0.0775 |
| **After Test** | |
| Wt. of Wet Sample+Cont. (g): | 245.04 |
| Wt. of Dry Sample+Cont. (g): | 217.64 |
| Weight of Container (g): | 57.10 |
| Final Moisture Content (%) | 23.62 |
| Final Dry Density (pcf): | 101.1 |
| Final Saturation (%): | 96 |
| Final Vertical Reading (in.) | 0.1258 |
| Specific Gravity (assumed): | 2.70 |
| Water Density (pcf): | 62.43 |

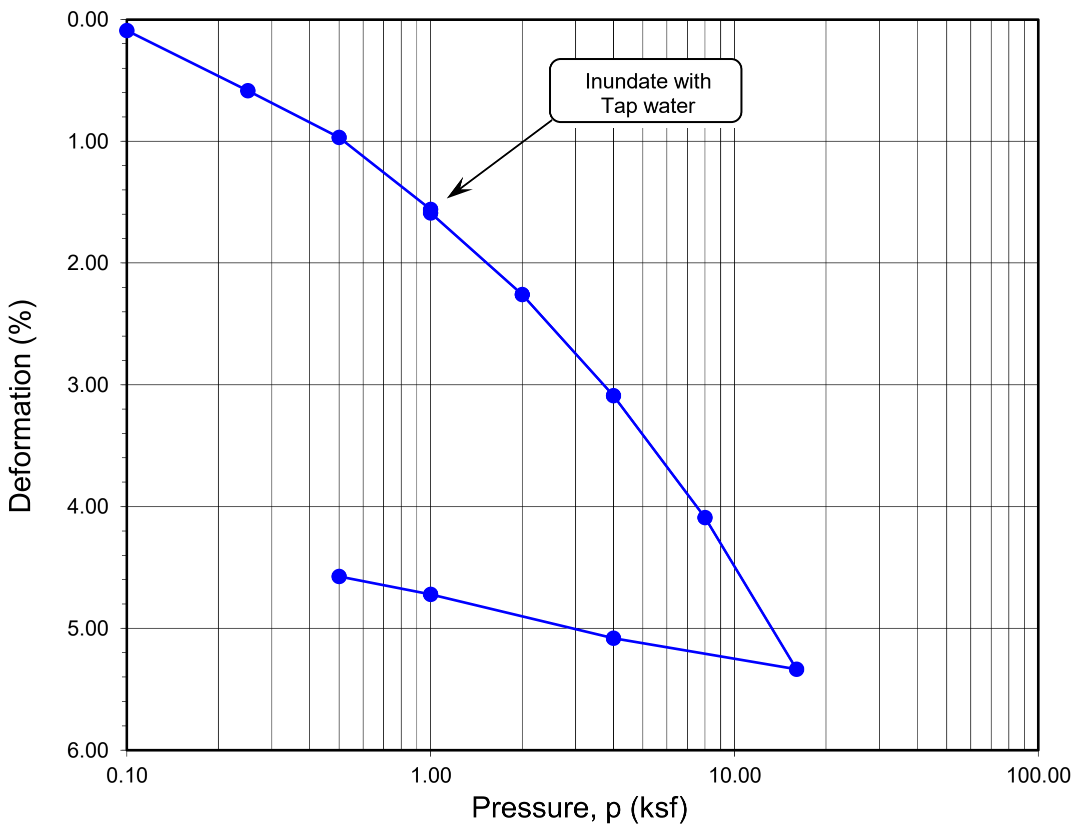



| Pressure (p) (ksf) | Final Reading (in.) | Apparent Thickness (in.) | Load Compliance (%) | Deformation % of Sample Thickness | Void Ratio | Corrected Deformation (%) |
|---|---|---|---|---|---|---|
| 0.10 | 0.0784 | 0.9991 | 0.00 | 0.09 | 0.665 | 0.09 |
| 0.25 | 0.0838 | 0.9938 | 0.04 | 0.62 | 0.657 | 0.58 |
| 0.50 | 0.0881 | 0.9894 | 0.09 | 1.06 | 0.651 | 0.97 |
| 1.00 | 0.0946 | 0.9829 | 0.15 | 1.71 | 0.641 | 1.56 |
| 1.00 | 0.0949 | 0.9826 | 0.15 | 1.74 | 0.640 | 1.59 |
| 2.00 | 0.1023 | 0.9752 | 0.22 | 2.48 | 0.629 | 2.26 |
| 4.00 | 0.1114 | 0.9661 | 0.30 | 3.39 | 0.615 | 3.09 |
| 8.00 | 0.1224 | 0.9551 | 0.40 | 4.49 | 0.599 | 4.09 |
| 16.00 | 0.1362 | 0.9414 | 0.53 | 5.87 | 0.578 | 5.34 |
| 4.00 | 0.1324 | 0.9451 | 0.41 | 5.49 | 0.582 | 5.08 |
| 1.00 | 0.1277 | 0.9498 | 0.30 | 5.02 | 0.588 | 4.72 |
| 0.50 | 0.1258 | 0.9518 | 0.25 | 4.83 | 0.590 | 4.58 |

**Time Readings**

| Date | Time | Elapsed Time (min) | Square Root of Time | Dial Rdgs. (in.) |
|---|---|---|---|---|




| Boring No. | Sample No. | Depth (ft.) | Moisture Content (%) | | Dry Density (pcf) | | Void Ratio | | Degree of Saturation (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Initial | Final | Initial | Final | Initial | Final | Initial | Final |
| **HS-2** | **R-8** | **35** | **20.3** | **23.6** | **101.1** | **101.1** | **0.667** | **0.590** | **82** | **96** |

Soil Identification: Olive silty clay (CL-ML)

Leighton

**ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS**
**ASTM D 2435**

Project No.: 24032-01

Twin Oaks, San Marcos

05-24

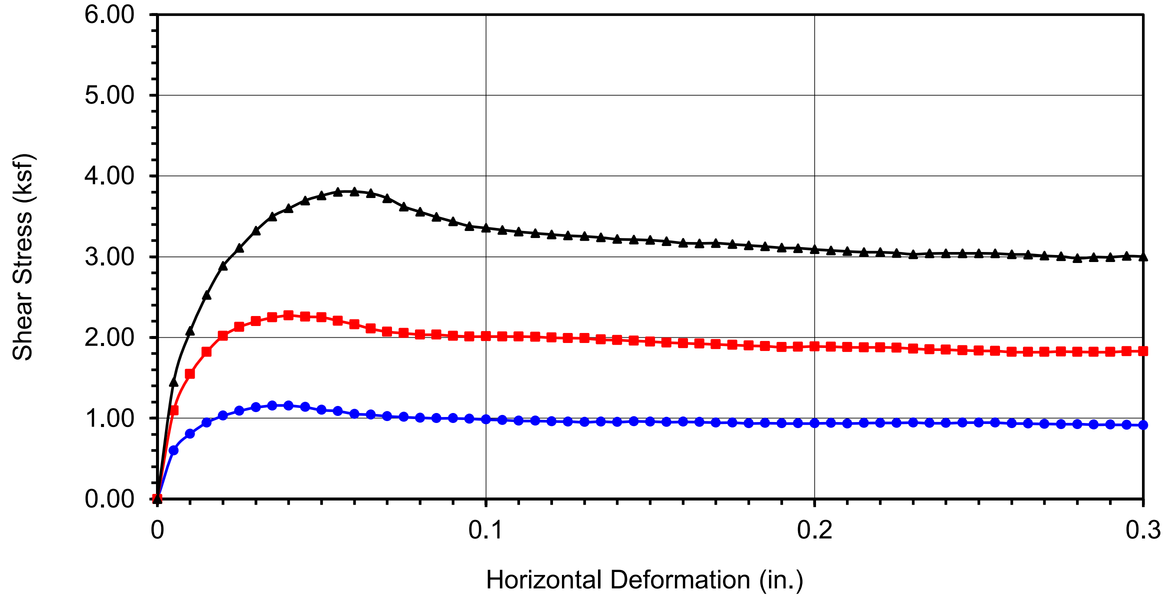
# DIRECT SHEAR TEST

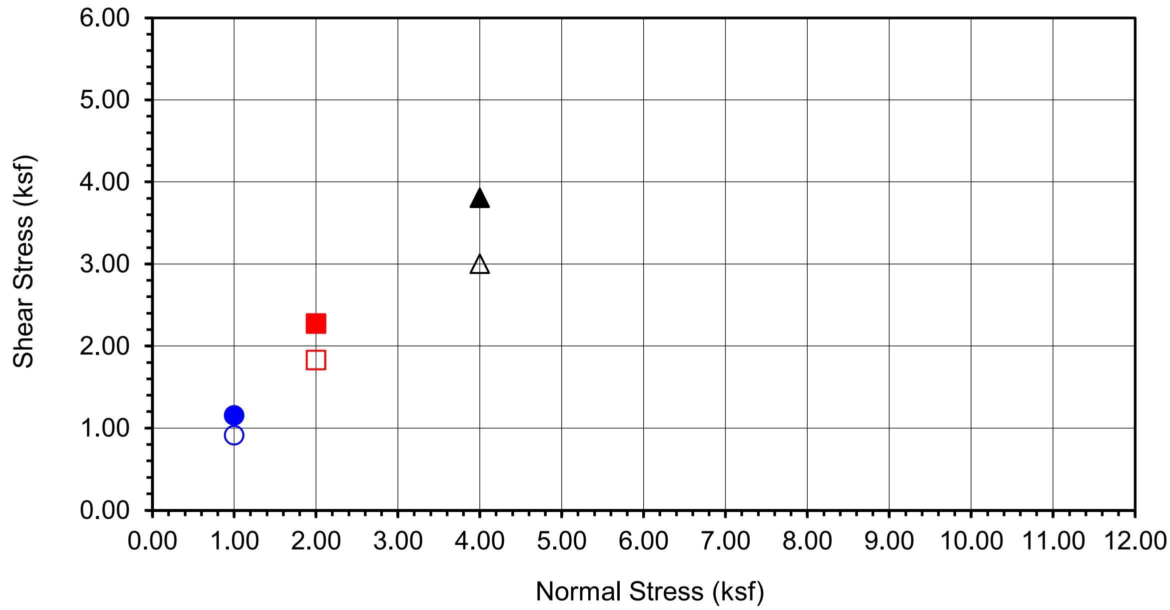
**Consolidated Drained - ASTM D 3080**

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Twin Oaks, San Marcos | Tested By: | G. Bathala | Date: | 05/06/24 |
| Project No.: | 24032-01 | Checked By: | J. Ward | Date: | 05/21/24 |
| Boring No.: | HS-3 | Sample Type: | Ring | | |
| Sample No.: | R-5 | Depth (ft.): | 10.0 | | |

Soil Identification: Grayish brown lean clay with sand (CL)s

| | | | |
|---|---|---|---|
| Sample Diameter(in): | 2.415 | 2.415 | 2.415 |
| Sample Thickness(in.): | 1.000 | 1.000 | 1.000 |
| Weight of Sample + ring(gm): | 198.86 | 201.43 | 210.30 |
| Weight of Ring(gm): | 45.54 | 44.75 | 45.38 |
| **Before Shearing** | | | |
| Weight of Wet Sample+Cont.(gm): | 218.73 | 218.73 | 218.73 |
| Weight of Dry Sample+Cont.(gm): | 206.67 | 206.67 | 206.67 |
| Weight of Container(gm): | 64.67 | 64.67 | 64.67 |
| Vertical Rdg.(in): Initial | 0.2484 | 0.0000 | 0.2379 |
| Vertical Rdg.(in): Final | 0.2534 | -0.0152 | 0.2532 |
| **After Shearing** | | | |
| Weight of Wet Sample+Cont.(gm): | 219.45 | 231.92 | 226.43 |
| Weight of Dry Sample+Cont.(gm): | 194.67 | 208.28 | 205.69 |
| Weight of Container(gm): | 57.17 | 67.11 | 55.46 |
| Specific Gravity (Assumed): | 2.70 | 2.70 | 2.70 |
| Water Density(pcf): | 62.43 | 62.43 | 62.43 |




| | |
|---|---|
| **Boring No.** | **HS-3** |
| **Sample No.** | **R-5** |
| **Depth (ft)** | **10** |
| Sample Type: Ring | |
| Soil Identification: Grayish brown lean clay with sand (CL)s | |

| | | | |
|---|---|---|---|
| Normal Stress (kip/ft²) | 1.000 | 2.000 | 4.000 |
| Peak Shear Stress (kip/ft²) | ● 1.157 | ■ 2.273 | ▲ 3.807 |
| Shear Stress @ End of Test (ksf) | ○ 0.915 | □ 1.830 | △ 3.002 |
| Deformation Rate (in./min.) | 0.0017 | 0.0017 | 0.0017 |
| Initial Sample Height (in.) | 1.000 | 1.000 | 1.000 |
| Diameter (in.) | 2.415 | 2.415 | 2.415 |
| Initial Moisture Content (%) | 8.49 | 8.49 | 8.49 |
| Dry Density (pcf) | 117.5 | 120.1 | 126.4 |
| Saturation (%) | 52.8 | 56.8 | 68.8 |
| Soil Height Before Shearing (in.) | 0.9950 | 0.9848 | 0.9847 |
| Final Moisture Content (%) | 18.0 | 16.7 | 13.8 |

Leighton

**DIRECT SHEAR TEST RESULTS**

**Consolidated Drained - ASTM D 3080**

Project No.: 24032-01

Twin Oaks, San Marcos

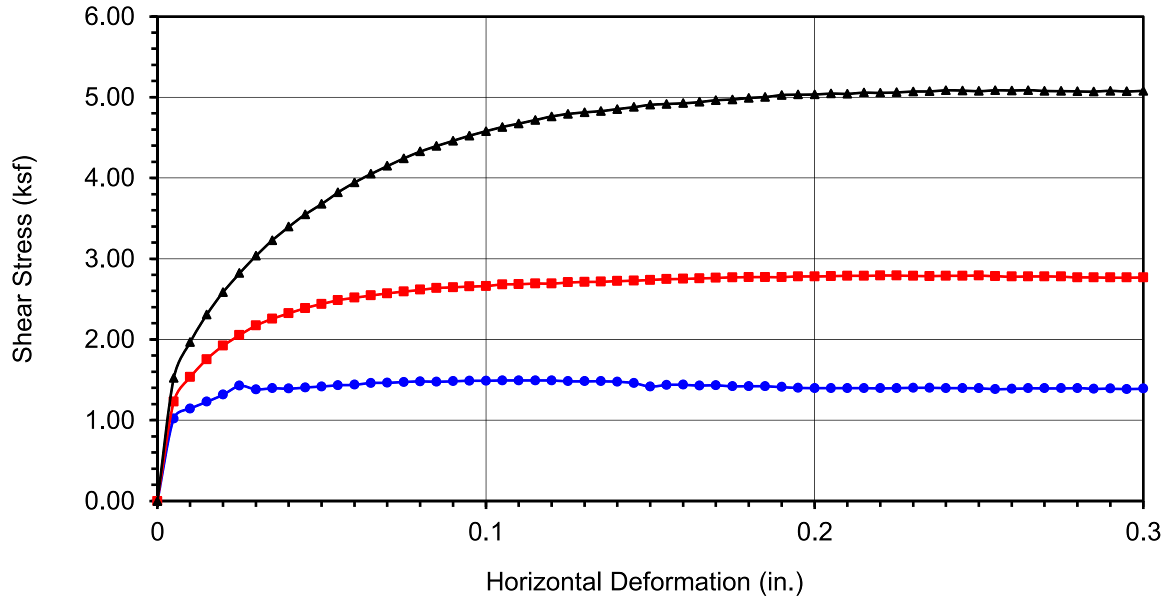
05-24

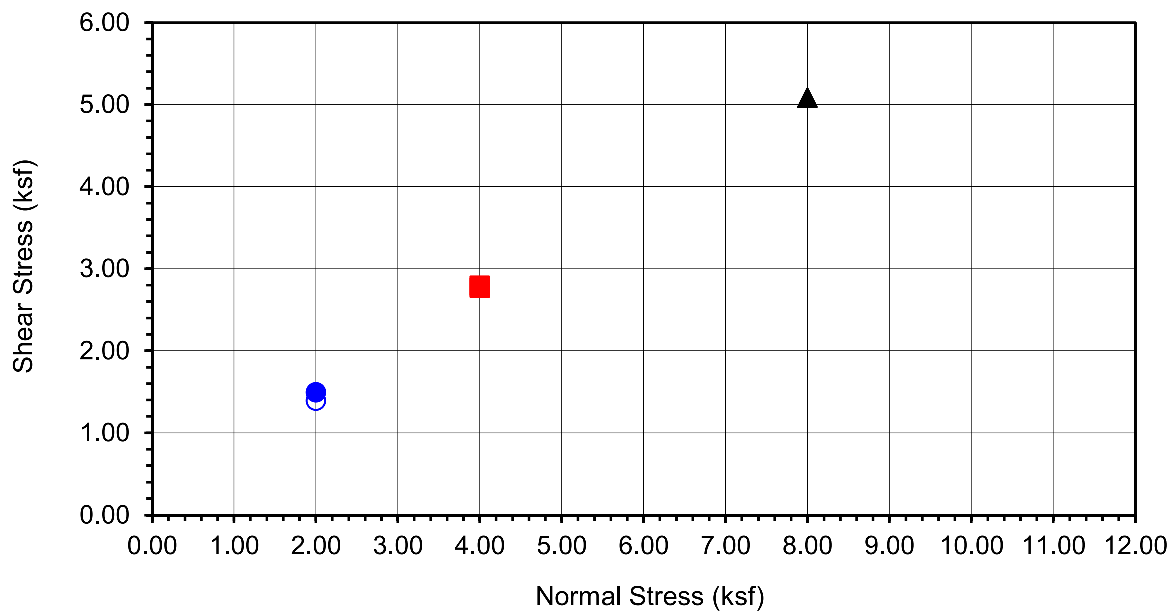
# DIRECT SHEAR TEST

**Consolidated Drained - ASTM D 3080**

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Twin Oaks, San Marcos | Tested By: | G. Bathala | Date: | 05/09/24 |
| Project No.: | 24032-01 | Checked By: | J. Ward | Date: | 05/20/24 |
| Boring No.: | TP-1 | Sample Type: | 90% Remold | | |
| Sample No.: | B-1 | Depth (ft.): | 0-8 | | |
| Soil Identification: | Brown silty sand with gravel (SM)g | | | | |

| | | | |
|---|---|---|---|
| Sample Diameter(in): | 2.415 | 2.415 | 2.415 |
| Sample Thickness(in.): | 1.000 | 1.000 | 1.000 |
| Weight of Sample + ring(gm): | 197.58 | 194.95 | 197.00 |
| Weight of Ring(gm): | 45.18 | 42.47 | 44.39 |
| **Before Shearing** | | | |
| Weight of Wet Sample+Cont.(gm): | 153.91 | 153.91 | 153.91 |
| Weight of Dry Sample+Cont.(gm): | 144.46 | 144.46 | 144.46 |
| Weight of Container(gm): | 52.56 | 52.56 | 52.56 |
| Vertical Rdg.(in): Initial | 0.2352 | 0.2418 | 0.0000 |
| Vertical Rdg.(in): Final | 0.2489 | 0.2632 | -0.0340 |
| **After Shearing** | | | |
| Weight of Wet Sample+Cont.(gm): | 193.38 | 196.54 | 217.54 |
| Weight of Dry Sample+Cont.(gm): | 171.91 | 175.44 | 197.76 |
| Weight of Container(gm): | 38.49 | 39.46 | 63.41 |
| Specific Gravity (Assumed): | 2.70 | 2.70 | 2.70 |
| Water Density(pcf): | 62.43 | 62.43 | 62.43 |




| | |
|---|---|
| **Boring No.** | **TP-1** |
| **Sample No.** | **B-1** |
| **Depth (ft)** | **0-8** |
| Sample Type:<br><br>90% Remold | |
| Soil Identification:<br>Brown silty sand with gravel (SM)g | |

| | | | |
|---|---|---|---|
| Normal Stress (kip/ft²) | 2.000 | 4.000 | 8.000 |
| Peak Shear Stress (kip/ft²) | ● 1.493 | ■ 2.792 | ▲ 5.087 |
| Shear Stress @ End of Test (ksf) | ○ 1.393 | □ 2.770 | △ 5.080 |
| Deformation Rate (in./min.) | 0.0017 | 0.0017 | 0.0017 |
| Initial Sample Height (in.) | 1.000 | 1.000 | 1.000 |
| Diameter (in.) | 2.415 | 2.415 | 2.415 |
| Initial Moisture Content (%) | 10.28 | 10.28 | 10.28 |
| Dry Density (pcf) | 114.9 | 115.0 | 115.1 |
| Saturation (%) | 59.5 | 59.6 | 59.8 |
| Soil Height Before Shearing (in.) | 0.9863 | 0.9786 | 0.9660 |
| Final Moisture Content (%) | 16.1 | 15.5 | 14.7 |

Leighton

**DIRECT SHEAR TEST RESULTS**

**Consolidated Drained - ASTM D 3080**

Project No.: 24032-01

Twin Oaks, San Marcos

05-24

# DIRECT SHEAR TEST

**Consolidated Drained - ASTM D 3080**

Project Name: Twin Oaks, San Marcos
Tested By: G. Bathala
Date: 05/08/24

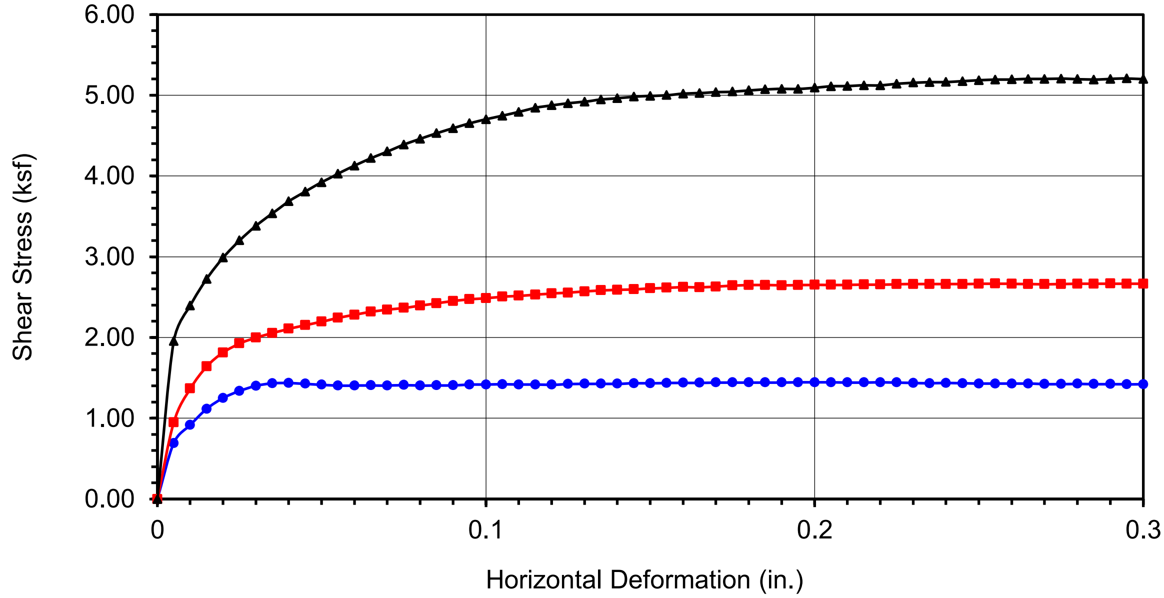
Project No.: 24032-01
Checked By: J. Ward
Date: 05/20/24

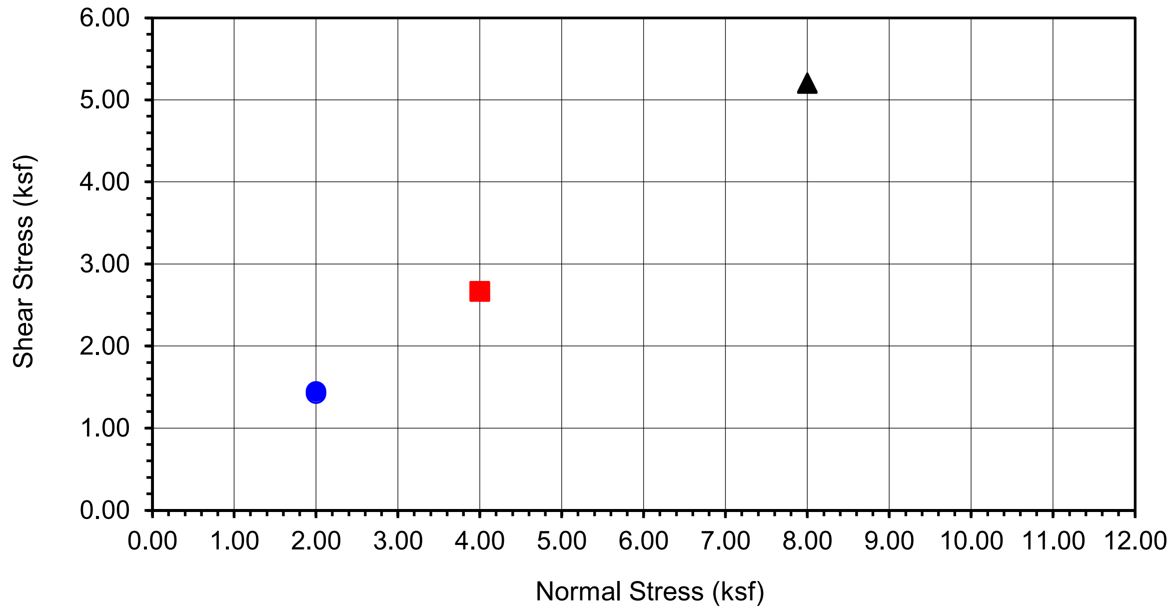
Boring No.: TP-6
Sample Type: 90% Remold

Sample No.: B-1
Depth (ft.): 0-2

Soil Identification: Reddish brown sandy silt with gravel s(ML)g

| | | | |
|---|---|---|---|
| Sample Diameter(in): | 2.415 | 2.415 | 2.415 |
| Sample Thickness(in.): | 1.000 | 1.000 | 1.000 |
| Weight of Sample + ring(gm): | 191.60 | 192.56 | 190.04 |
| Weight of Ring(gm): | 44.40 | 45.18 | 42.47 |
| **Before Shearing** | | | |
| Weight of Wet Sample+Cont.(gm): | 168.81 | 168.81 | 168.81 |
| Weight of Dry Sample+Cont.(gm): | 157.59 | 157.59 | 157.59 |
| Weight of Container(gm): | 61.73 | 61.73 | 61.73 |
| Vertical Rdg.(in): Initial | 0.0000 | 0.2666 | 0.2549 |
| Vertical Rdg.(in): Final | -0.0173 | 0.2883 | 0.2766 |
| **After Shearing** | | | |
| Weight of Wet Sample+Cont.(gm): | 210.96 | 190.30 | 208.50 |
| Weight of Dry Sample+Cont.(gm): | 186.03 | 166.43 | 185.57 |
| Weight of Container(gm): | 56.00 | 36.56 | 55.48 |
| Specific Gravity (Assumed): | 2.70 | 2.70 | 2.70 |
| Water Density(pcf): | 62.43 | 62.43 | 62.43 |




| | |
|---|---|
| **Boring No.** | **TP-6** |
| **Sample No.** | **B-1** |
| **Depth (ft)** | **0-2** |

Sample Type:

90% Remold

Soil Identification:
Reddish brown sandy silt with gravel s(ML)g

| | | | |
|---|---|---|---|
| Normal Stress (kip/ft²) | 2.000 | 4.000 | 8.000 |
| Peak Shear Stress (kip/ft²) | ● 1.446 | ■ 2.669 | ▲ 5.209 |
| Shear Stress @ End of Test (ksf) | ○ 1.421 | □ 2.666 | △ 5.200 |
| Deformation Rate (in./min.) | 0.0017 | 0.0017 | 0.0017 |
| Initial Sample Height (in.) | 1.000 | 1.000 | 1.000 |
| Diameter (in.) | 2.415 | 2.415 | 2.415 |
| Initial Moisture Content (%) | 11.70 | 11.70 | 11.70 |
| Dry Density (pcf) | 109.6 | 109.7 | 109.9 |
| Saturation (%) | 58.7 | 58.9 | 59.2 |
| Soil Height Before Shearing (in.) | 0.9827 | 0.9783 | 0.9783 |
| Final Moisture Content (%) | 19.2 | 18.4 | 17.6 |

Leighton

**DIRECT SHEAR TEST RESULTS**

**Consolidated Drained - ASTM D 3080**

Project No.: 24032-01

Twin Oaks, San Marcos

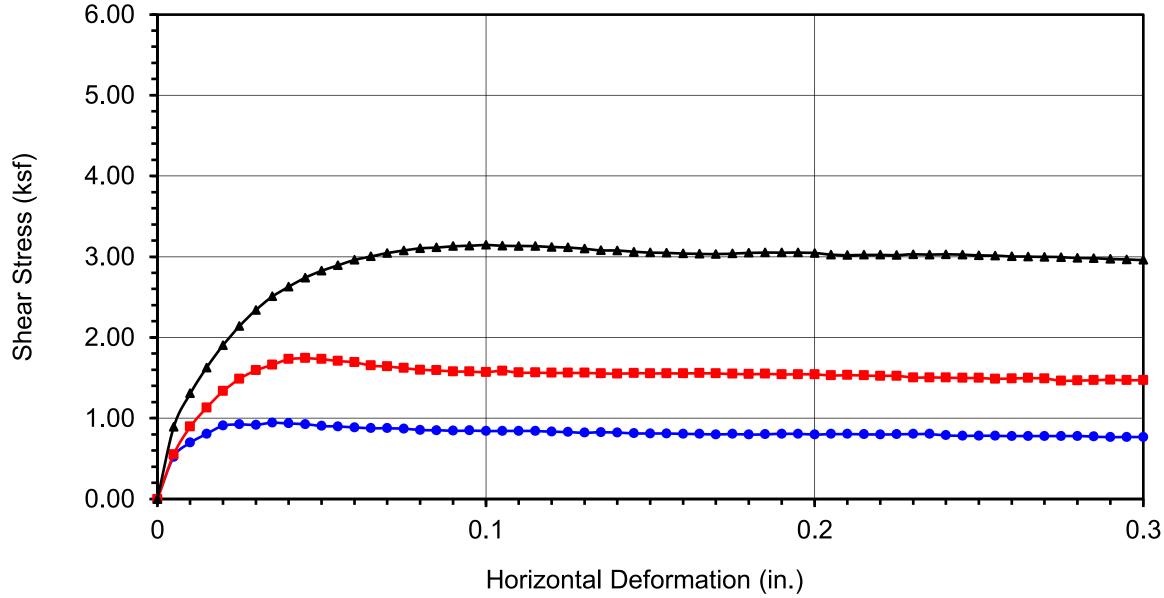
05-24

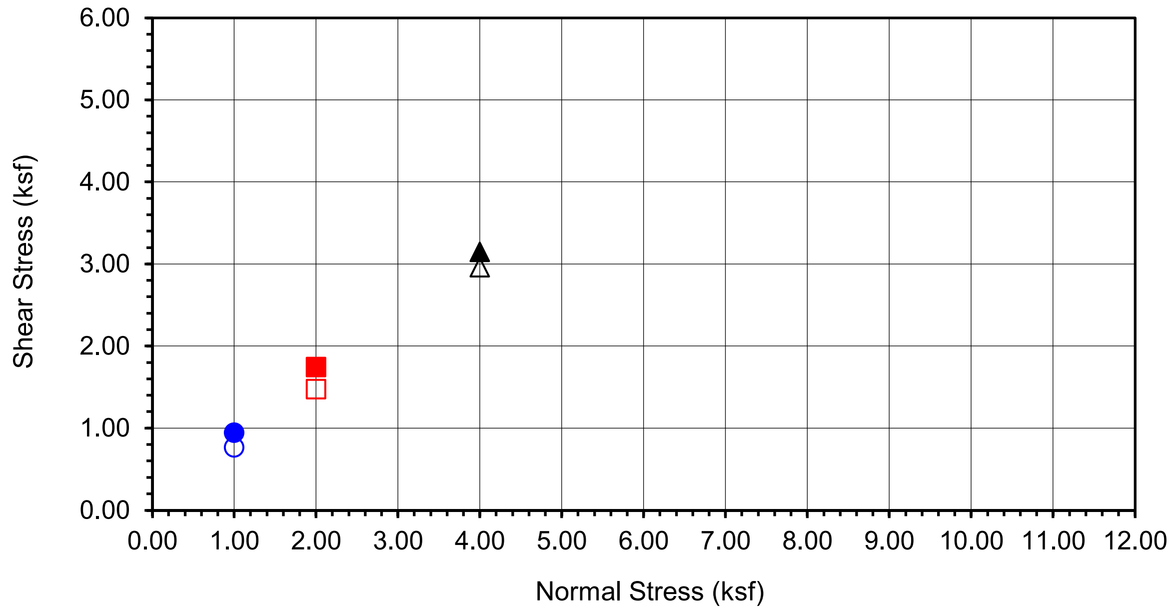
# DIRECT SHEAR TEST
**Consolidated Drained - ASTM D 3080**

| | | | | | |
|---|---|---|---|---|---|
| Project Name: | Twin Oaks, San Marcos | Tested By: | G. Bathala | Date: | 05/09/24 |
| Project No.: | 24032-01 | Checked By: | J. Ward | Date: | 05/21/24 |
| Boring No.: | TP-14 | Sample Type: | 90% Remold | | |
| Sample No.: | B-1 | Depth (ft.): | 0-6 | | |

Soil Identification: Brown clayey sand with gravel (SC)g

| | | | |
|---|---|---|---|
| Sample Diameter(in): | 2.415 | 2.415 | 2.415 |
| Sample Thickness(in.): | 1.000 | 1.000 | 1.000 |
| Weight of Sample + ring(gm): | 196.98 | 198.14 | 195.57 |
| Weight of Ring(gm): | 44.40 | 45.19 | 42.47 |
| **Before Shearing** | | | |
| Weight of Wet Sample+Cont.(gm): | 193.07 | 193.07 | 193.07 |
| Weight of Dry Sample+Cont.(gm): | 182.16 | 182.16 | 182.16 |
| Weight of Container(gm): | 64.65 | 64.65 | 64.65 |
| Vertical Rdg.(in): Initial | 0.2365 | 0.2388 | 0.0000 |
| Vertical Rdg.(in): Final | 0.2443 | 0.2524 | -0.0149 |
| **After Shearing** | | | |
| Weight of Wet Sample+Cont.(gm): | 214.19 | 218.13 | 198.62 |
| Weight of Dry Sample+Cont.(gm): | 192.18 | 196.33 | 177.52 |
| Weight of Container(gm): | 55.30 | 58.53 | 39.91 |
| Specific Gravity (Assumed): | 2.70 | 2.70 | 2.70 |
| Water Density(pcf): | 62.43 | 62.43 | 62.43 |




| | |
|---|---|
| **Boring No.** | **TP-14** |
| **Sample No.** | **B-1** |
| **Depth (ft)** | **0-6** |
| Sample Type: 90% Remold | |
| Soil Identification: Brown clayey sand with gravel (SC)g | |

| | | | |
|---|---|---|---|
| Normal Stress (kip/ft²) | 1.000 | 2.000 | 4.000 |
| Peak Shear Stress (kip/ft²) | ● 0.946 | ■ 1.745 | ▲ 3.147 |
| Shear Stress @ End of Test (ksf) | ○ 0.767 | □ 1.474 | △ 2.961 |
| Deformation Rate (in./min.) | 0.0017 | 0.0017 | 0.0017 |
| Initial Sample Height (in.) | 1.000 | 1.000 | 1.000 |
| Diameter (in.) | 2.415 | 2.415 | 2.415 |
| Initial Moisture Content (%) | 9.28 | 9.28 | 9.28 |
| Dry Density (pcf) | 116.1 | 116.4 | 116.5 |
| Saturation (%) | 55.5 | 55.9 | 56.1 |
| Soil Height Before Shearing (in.) | 0.9922 | 0.9864 | 0.9851 |
| Final Moisture Content (%) | 16.1 | 15.8 | 15.3 |

Leighton

**DIRECT SHEAR TEST RESULTS**

**Consolidated Drained - ASTM D 3080**

Project No.: 24032-01

Twin Oaks, San Marcos

05-24

# ONE-DIMENSIONAL SWELL OR SETTLEMENT POTENTIAL OF COHESIVE SOILS
## ASTM D 4546

Project Name: Twin Oaks, San Marcos
Project No.: 24032-01
Boring No.: I-2
Sample No.: R-3
Sample Description: Yellowish brown poorly-graded sand with silt (SP-SM)

Tested By: G. Bathala  Date: 05/06/24
Checked By: J. Ward  Date: 05/21/24
Sample Type: Ring
Depth (ft.) 8.5

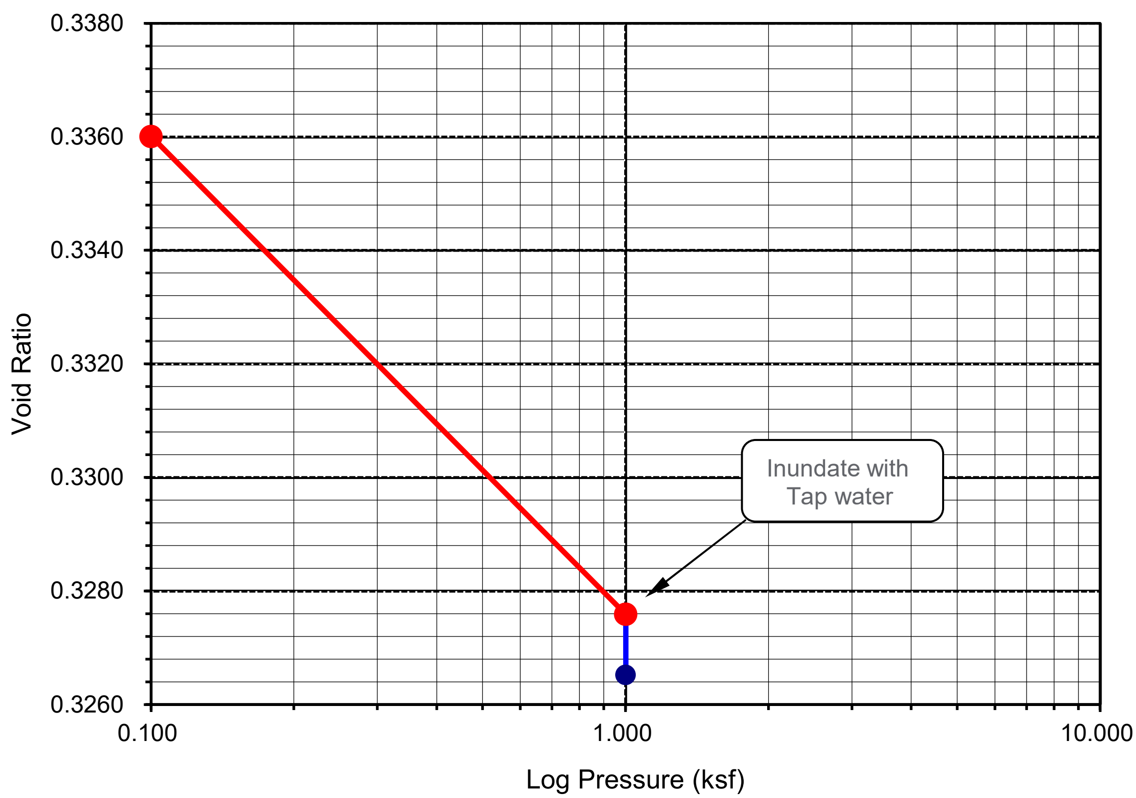
| | |
|---|---|
| Initial Dry Density (pcf): | 126.1 |
| Initial Moisture (%): | 6.88 |
| Initial Length (in.): | 1.0000 |
| Initial Dial Reading: | 0.0707 |
| Diameter(in): | 2.415 |

| | |
|---|---|
| Final Dry Density (pcf): | 127.5 |
| Final Moisture (%) : | 12.2 |
| Initial Void ratio: | 0.3364 |
| Specific Gravity(assumed): | 2.70 |
| Initial Saturation (%) | 55.2 |

| Pressure (p) (ksf) | Final Reading (in) | Apparent Thickness (in) | Load Compliance (%) | Swell (+) Settlement (-) % of Sample Thickness | Void Ratio | Corrected Deformation (%) |
|---|---|---|---|---|---|---|
| 0.100 | 0.0710 | 0.9997 | 0.00 | -0.03 | 0.3360 | -0.03 |
| 1.000 | 0.0788 | 0.9919 | 0.15 | -0.81 | 0.3276 | -0.66 |
| H2O | 0.0796 | 0.9911 | 0.15 | -0.89 | 0.3265 | -0.74 |

**Percent Swell (+) / Settlement (-) After Inundation = -0.08**

Void Ratio - Log Pressure Curve



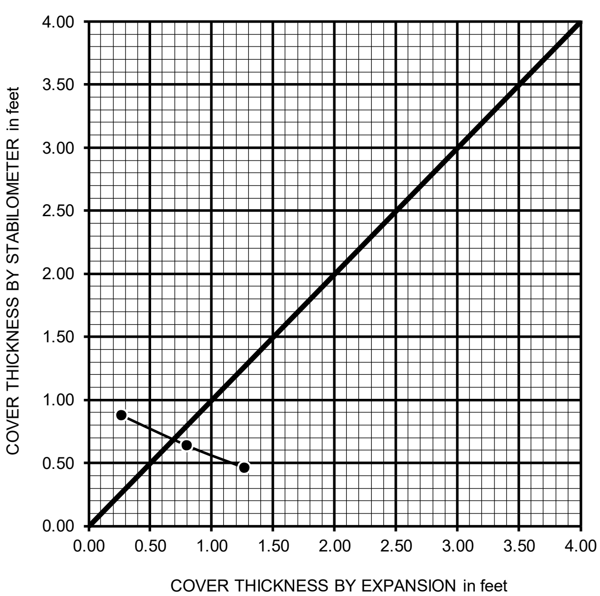
# R-VALUE TEST RESULTS
## DOT CA Test 301

| | | | |
|---|---|---|---|
| PROJECT NAME: | Twin Oaks, San Marcos | PROJECT NUMBER: | 24032-01 |
| BORING NUMBER: | TP-17 | DEPTH (FT.): | 0-8 |
| SAMPLE NUMBER: | B-1 | TECHNICIAN: | O. Figueroa |
| SAMPLE DESCRIPTION: | Light olive brown silty, clayey sand (SC-SM), w siltstones | DATE COMPLETED: | 5/9/2024 |

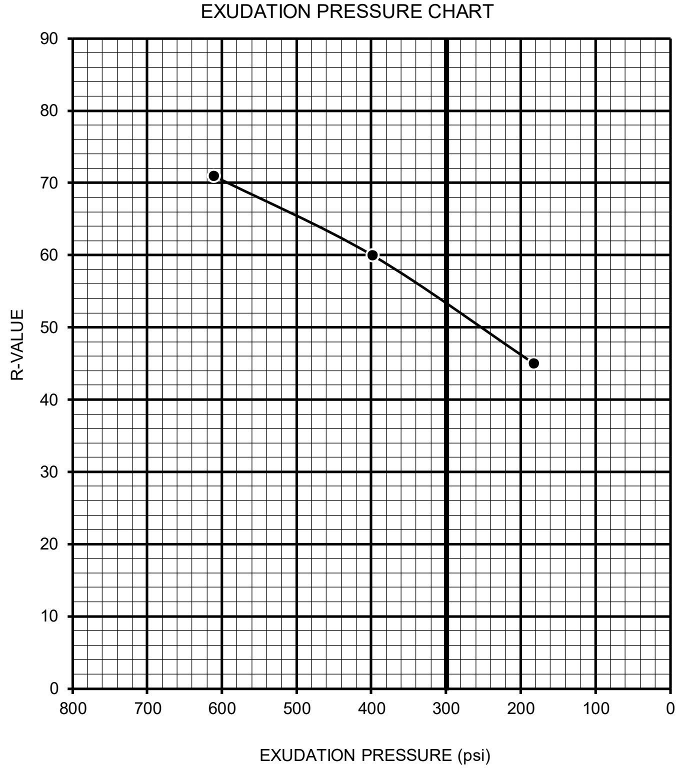
| TEST SPECIMEN | a | b | c |
|---|---|---|---|
| MOISTURE AT COMPACTION % | 10.7 | 11.4 | 12.5 |
| HEIGHT OF SAMPLE, Inches | 2.47 | 2.44 | 2.51 |
| DRY DENSITY, pcf | 127.9 | 126.4 | 124.5 |
| COMPACTOR PRESSURE, psi | 275 | 200 | 80 |
| EXUDATION PRESSURE, psi | 611 | 399 | 182 |
| EXPANSION, Inches x 10exp-4 | 38 | 24 | 8 |
| STABILITY Ph 2,000 lbs (160 psi) | 29 | 38 | 60 |
| TURNS DISPLACEMENT | 4.70 | 4.90 | 5.05 |
| R-VALUE UNCORRECTED | 71 | 62 | 45 |
| R-VALUE CORRECTED | 71 | 60 | 45 |

| DESIGN CALCULATION DATA | a | b | c |
|---|---|---|---|
| GRAVEL EQUIVALENT FACTOR | 1.0 | 1.0 | 1.0 |
| TRAFFIC INDEX | 5.0 | 5.0 | 5.0 |
| STABILOMETER THICKNESS, ft. | 0.46 | 0.64 | 0.88 |
| EXPANSION PRESSURE THICKNESS, ft. | 1.27 | 0.80 | 0.27 |

EXPANSION PRESSURE CHART




EXUDATION PRESSURE CHART




| | |
|---|---|
| R-VALUE BY EXPANSION: | 57 |
| R-VALUE BY EXUDATION: | 53 |
| EQUILIBRIUM R-VALUE: | 53 |

# *Appendix D*
# *Infiltration Test Results*

# Infiltration Test Data Sheet

**LGC Geotechnical, Inc**

**131 Calle Iglesia Suite 200, San Clemente, CA 92672 tel. (949) 369-6141**

**Project Name:** Meritage - Twin Oaks
**Project Number:** 24032-01
**Date:** 4/19/2024
**Boring Number:** I-1

| Test hole dimensions (if circular) | |
|---|---|
| Boring Depth (feet)*: | 10 |
| Boring Diameter (inches): | 8 |
| Pipe Diameter (inches): | 3 |

*measured at time of test

| Test pit dimensions (if rectangular) | |
|---|---|
| Pit Depth (feet): | |
| Pit Length (feet): | |
| Pit Breadth (feet): | |

Minimum test Head ($D_o$):

(What the sounder tape should read) Boring Depth - (5 x Boring Radius) 8.4 ft

(Shallow) The value on the sounder tape should be close to this value during testing for **DEEP** testing fill to 4 feet below top of hole

### *Pre-Test (Sandy Soil Criteria)**

| Trial No. | Start Time (24:HR) | Stop Time (24:HR) | Time Interval (min) | Initial Depth to Water (feet) | Final Depth to Water (feet) | Total Change in Water Level (feet) | Greater Than or Equal to 0.5 feet (yes/no) |
|---|---|---|---|---|---|---|---|
| 1 | 7:20 | 7:45 | 25.0 | 7.15 | 7.15 | 0.00 | No |
| 2 | 7:45 | 8:10 | 25.0 | 7.15 | 7.15 | 0.00 | No |

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight, and then obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at least 0.25 inches

### *Main Test Data*

| Trial No. | Start Time (24:HR) | Stop Time (24:HR) | Time Interval, $\Delta t$ (min) | Initial Depth to Water, $D_o$ (feet) | Final Depth to Water, $D_f$ (feet) | Change in Water Level, $\Delta D$ (feet) | Percolation Rate (in/hr) | Calculated Infiltration Rate(in/hr) |
|---|---|---|---|---|---|---|---|---|
| 1 | 8:10 | 8:40 | 30.0 | 7.15 | 7.15 | 0.00 | 0.0 | 0.00 |
| 2 | 8:40 | 9:10 | 30.0 | 7.15 | 7.15 | 0.00 | 0.0 | 0.00 |
| 3 | 9:16 | 9:46 | 30.0 | 7.15 | 7.15 | 0.00 | 0.0 | 0.00 |
| 4 | 9:50 | 10:20 | 30.0 | 7.15 | 7.15 | 0.00 | 0.0 | 0.00 |
| 5 | 10:20 | 10:50 | 30.0 | 7.15 | 7.15 | 0.00 | 0.0 | 0.00 |
| 6 | 10:50 | 11:20 | 30.0 | 7.15 | 7.15 | 0.00 | 0.0 | 0.00 |
| 7 | 11:20 | 11:50 | 30.0 | 7.15 | 7.15 | 0.00 | 0.0 | 0.00 |
| 8 | 11:55 | 12:25 | 30.0 | 7.15 | 7.15 | 0.00 | 0.0 | 0.00 |
| 9 | 12:25 | 12:55 | 30.0 | 7.15 | 7.15 | 0.00 | 0.0 | 0.00 |
| 10 | 12:55 | 13:25 | 30.0 | 7.15 | 7.15 | 0.00 | 0.0 | 0.00 |
| 11 | 13:25 | 13:55 | 30.0 | 7.15 | 7.15 | 0.00 | 0.0 | 0.00 |
| 12 | 13:55 | 14:25 | 30.0 | 7.15 | 7.15 | 0.00 | 0.0 | 0.00 |
| | | | | | | **Calculated Infiltration Rate (No factors of safety)** | | **0.00** |

***Sketch:***

***Notes:***

Based on Guidelines from: San Diego County 05/19/2011
Spreadsheet Revised on: 2/6/2017

LGC Geotechnical, Inc.

# Infiltration Test Data Sheet

**LGC Geotechnical, Inc**
131 Calle Iglesia Suite 200, San Clemente, CA 92672 tel. (949) 369-6141

**Project Name:** Meritage - Twin Oaks
**Project Number:** 24032-01
**Date:** 4/19/2024
**Boring Number:** I-2

| Test hole dimensions (if circular) | |
|---|---|
| Boring Depth (feet)*: | 10 |
| Boring Diameter (inches): | 8 |
| Pipe Diameter (inches): | 3 |

*measured at time of test

| Test pit dimensions (if rectangular) | |
|---|---|
| Pit Depth (feet): | |
| Pit Length (feet): | |
| Pit Breadth (feet): | |

Minimum test Head ($D_o$):

(What the sounder tape should read) Boring Depth - (5 x Boring Radius) 8.4 ft

(Shallow) The value on the sounder tape should be close to this value during testing for **DEEP** testing fill to 4 feet below top of hole

### *Pre-Test (Sandy Soil Criteria)**

| Trial No. | Start Time (24:HR) | Stop Time (24:HR) | Time Interval (min) | Initial Depth to Water (feet) | Final Depth to Water (feet) | Total Change in Water Level (feet) | Greater Than or Equal to 0.5 feet (yes/no) |
|---|---|---|---|---|---|---|---|
| 1 | 7:53 | 8:18 | 25.0 | 7.70 | 10 | 2.30 | Yes |
| 2 | 8:28 | 8:53 | 25.0 | 7.68 | 10 | 2.32 | Yes |

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight, and then obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at least 0.25 inches

### *Main Test Data*

| Trial No. | Start Time (24:HR) | Stop Time (24:HR) | Time Interval, $\Delta t$ (min) | Initial Depth to Water, $D_o$ (feet) | Final Depth to Water, $D_f$ (feet) | Change in Water Level, $\Delta D$ (feet) | Percolation Rate (in/hr) | Calculated Infiltration Rate(in/hr) |
|---|---|---|---|---|---|---|---|---|
| 1 | 2:56 | 3:06 | 10.0 | 7.31 | 10.00 | 2.69 | 193.7 | 21.35 |
| 2 | 3:08 | 3:13 | 5.0 | 7.09 | 8.08 | 0.99 | 142.6 | 9.20 |
| 3 | 3:13 | 3:18 | 5.0 | 6.90 | 8.30 | 1.40 | 201.6 | 13.09 |
| 4 | 3:18 | 3:23 | 5.0 | 6.50 | 8.03 | 1.53 | 220.3 | 12.65 |
| 5 | 3:23 | 3:28 | 5.0 | 6.85 | 8.09 | 1.24 | 178.6 | 11.04 |
| 6 | 3:28 | 3:33 | 5.0 | 6.24 | 7.65 | 1.41 | 203.0 | 10.50 |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |
| 12 | | | | | | | | |

**Calculated Infiltration Rate (No factors of safety)** **10.50**

***Sketch:***

***Notes:***

Based on Guidelines from: San Diego County 05/19/2011
Spreadsheet Revised on: 2/6/2017

LGC Geotechnical, Inc.

# Infiltration Test Data Sheet

**LGC Geotechnical, Inc**

131 Calle Iglesia Suite 200, San Clemente, CA 92672     tel. (949) 369-6141

**Project Name:** Meritage - Twin Oaks

**Project Number:** 24032-01

**Date:** 4/19/2024

**Boring Number:** I-3

| Test hole dimensions (if circular) | |
|---|---|
| Boring Depth (feet)*: | 7.5 |
| Boring Diameter (inches): | 8 |
| Pipe Diameter (inches): | 3 |

*measured at time of test

| Test pit dimensions (if rectangular) | |
|---|---|
| Pit Depth (feet): | |
| Pit Length (feet): | |
| Pit Breadth (feet): | |

Minimum test Head ($D_o$):

(What the sounder tape should read)     Boring Depth - (5 x Boring Radius)     5.9 ft

(Shallow) The value on the sounder tape should be close to this value during testing for **DEEP** testing fill to 4 feet below top of hole

### *Pre-Test (Sandy Soil Criteria)**

| Trial No. | Start Time (24:HR) | Stop Time (24:HR) | Time Interval (min) | Initial Depth to Water (feet) | Final Depth to Water (feet) | Total Change in Water Level (feet) | Greater Than or Equal to 0.5 feet (yes/no) |
|---|---|---|---|---|---|---|---|
| 1 | 7:15 | 7:40 | 25.0 | 3.51 | 3.56 | 0.05 | No |
| 2 | 7:40 | 8:05 | 25.0 | 3.56 | 3.62 | 0.06 | No |

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight, and then obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at least 0.25 inches

### *Main Test Data*

| Trial No. | Start Time (24:HR) | Stop Time (24:HR) | Time Interval, $\Delta t$ (min) | Initial Depth to Water, $D_o$ (feet) | Final Depth to Water, $D_f$ (feet) | Change in Water Level, $\Delta D$ (feet) | Percolation Rate (in/hr) | Calculated Infiltration Rate(in/hr) |
|---|---|---|---|---|---|---|---|---|
| 1 | 8:05 | 8:35 | 30.0 | 3.62 | 3.69 | 0.07 | 1.7 | 0.07 |
| 2 | 8:38 | 9:08 | 30.0 | 3.69 | 3.72 | 0.03 | 0.7 | 0.03 |
| 3 | 9:08 | 9:38 | 30.0 | 3.72 | 3.72 | 0.00 | 0.0 | 0.00 |
| 4 | 9:38 | 10:08 | 30.0 | 3.72 | 3.74 | 0.02 | 0.5 | 0.02 |
| 5 | 10:08 | 10:38 | 30.0 | 3.74 | 3.80 | 0.06 | 1.4 | 0.06 |
| 6 | 10:38 | 11:08 | 30.0 | 3.80 | 3.87 | 0.07 | 1.7 | 0.07 |
| 7 | 11:15 | 11:50 | 35.0 | 3.87 | 3.98 | 0.11 | 2.3 | 0.10 |
| 8 | 11:50 | 12:20 | 30.0 | 3.98 | 4.13 | 0.15 | 3.6 | 0.17 |
| 9 | 12:20 | 12:50 | 30.0 | 4.13 | 4.20 | 0.07 | 1.7 | 0.08 |
| 10 | 12:50 | 13:20 | 30.0 | 4.20 | 4.29 | 0.09 | 2.2 | 0.11 |
| 11 | 13:20 | 13:50 | 30.0 | 4.29 | 4.36 | 0.07 | 1.7 | 0.08 |
| 12 | 13:50 | 14:20 | 30.0 | 4.36 | 4.43 | 0.07 | 1.7 | 0.09 |
| | | | | | **Calculated Infiltration Rate (No factors of safety)** | | | **0.09** |

***Sketch:***

***Notes:***

Based on Guidelines from: San Diego County 05/19/2011

Spreadsheet Revised on: 2/6/2017

LGC Geotechnical, Inc.

# Infiltration Test Data Sheet

**LGC Geotechnical, Inc**
131 Calle Iglesia Suite 200, San Clemente, CA 92672 tel. (949) 369-6141

**Project Name:** Meritage - Twin Oaks
**Project Number:** 24032-01
**Date:** 4/19/2024
**Boring Number:** I-4

| Test hole dimensions (if circular) | |
|---|---|
| Boring Depth (feet)*: | 10 |
| Boring Diameter (inches): | 8 |
| Pipe Diameter (inches): | 3 |

*measured at time of test

| Test pit dimensions (if rectangular) | |
|---|---|
| Pit Depth (feet): | |
| Pit Length (feet): | |
| Pit Breadth (feet): | |

Minimum test Head ($D_o$):

(What the sounder tape should read) Boring Depth - (5 x Boring Radius) 8.4 ft

(Shallow) The value on the sounder tape should be close to this value during testing for **DEEP** testing fill to 4 feet below top of hole

### *Pre-Test (Sandy Soil Criteria)**

| Trial No. | Start Time (24:HR) | Stop Time (24:HR) | Time Interval (min) | Initial Depth to Water (feet) | Final Depth to Water (feet) | Total Change in Water Level (feet) | Greater Than or Equal to 0.5 feet (yes/no) |
|---|---|---|---|---|---|---|---|
| 1 | 7:35 | 8:00 | 25.0 | 7.92 | 8.06 | 0.14 | |
| 2 | 8:00 | 8:25 | 25.0 | 8.06 | 8.16 | 0.10 | |

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements taken every 10 minutes. Otherwise, pre-soak (fill) overnight, and then obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at least 0.25 inches

### *Main Test Data*

| Trial No. | Start Time (24:HR) | Stop Time (24:HR) | Time Interval, $\Delta t$ (min) | Initial Depth to Water, $D_o$ (feet) | Final Depth to Water, $D_f$ (feet) | Change in Water Level, $\Delta D$ (feet) | Percolation Rate (in/hr) | Calculated Infiltration Rate(in/hr) |
|---|---|---|---|---|---|---|---|---|
| 1 | 8:25 | 8:55 | 30.0 | 7.56 | 7.68 | 0.12 | 2.9 | 0.19 |
| 2 | 9:05 | 9:35 | 30.0 | 7.68 | 7.75 | 0.07 | 1.7 | 0.11 |
| 3 | 9:35 | 10:05 | 30.0 | 7.75 | 7.83 | 0.08 | 1.9 | 0.13 |
| 4 | 10:05 | 10:35 | 30.0 | 7.83 | 7.89 | 0.06 | 1.4 | 0.10 |
| 5 | 10:35 | 11:05 | 30.0 | 7.81 | 7.84 | 0.03 | 0.7 | 0.05 |
| 6 | 11:05 | 11:35 | 30.0 | 7.84 | 7.86 | 0.02 | 0.5 | 0.03 |
| 7 | 11:35 | 12:05 | 30.0 | 7.86 | 7.88 | 0.02 | 0.5 | 0.03 |
| 8 | 12:05 | 12:35 | 30.0 | 7.88 | 7.90 | 0.02 | 0.5 | 0.04 |
| 9 | 12:35 | 13:05 | 30.0 | 7.90 | 7.92 | 0.02 | 0.5 | 0.04 |
| 10 | 13:05 | 13:35 | 30.0 | 7.92 | 7.94 | 0.02 | 0.5 | 0.04 |
| 11 | 13:35 | 14:05 | 30.0 | 7.94 | 7.95 | 0.01 | 0.2 | 0.02 |
| 12 | 14:05 | 14:35 | 30.0 | 7.95 | 7.96 | 0.01 | 0.2 | 0.02 |
| | | | | | | | **Calculated Infiltration Rate (No factors of safety)** | **0.02** |

***Sketch:***

***Notes:***

Based on Guidelines from: San Diego County 05/19/2011
Spreadsheet Revised on: 2/6/2017

LGC Geotechnical, Inc.

# *Appendix E*
# *Slope Stability Analysis*

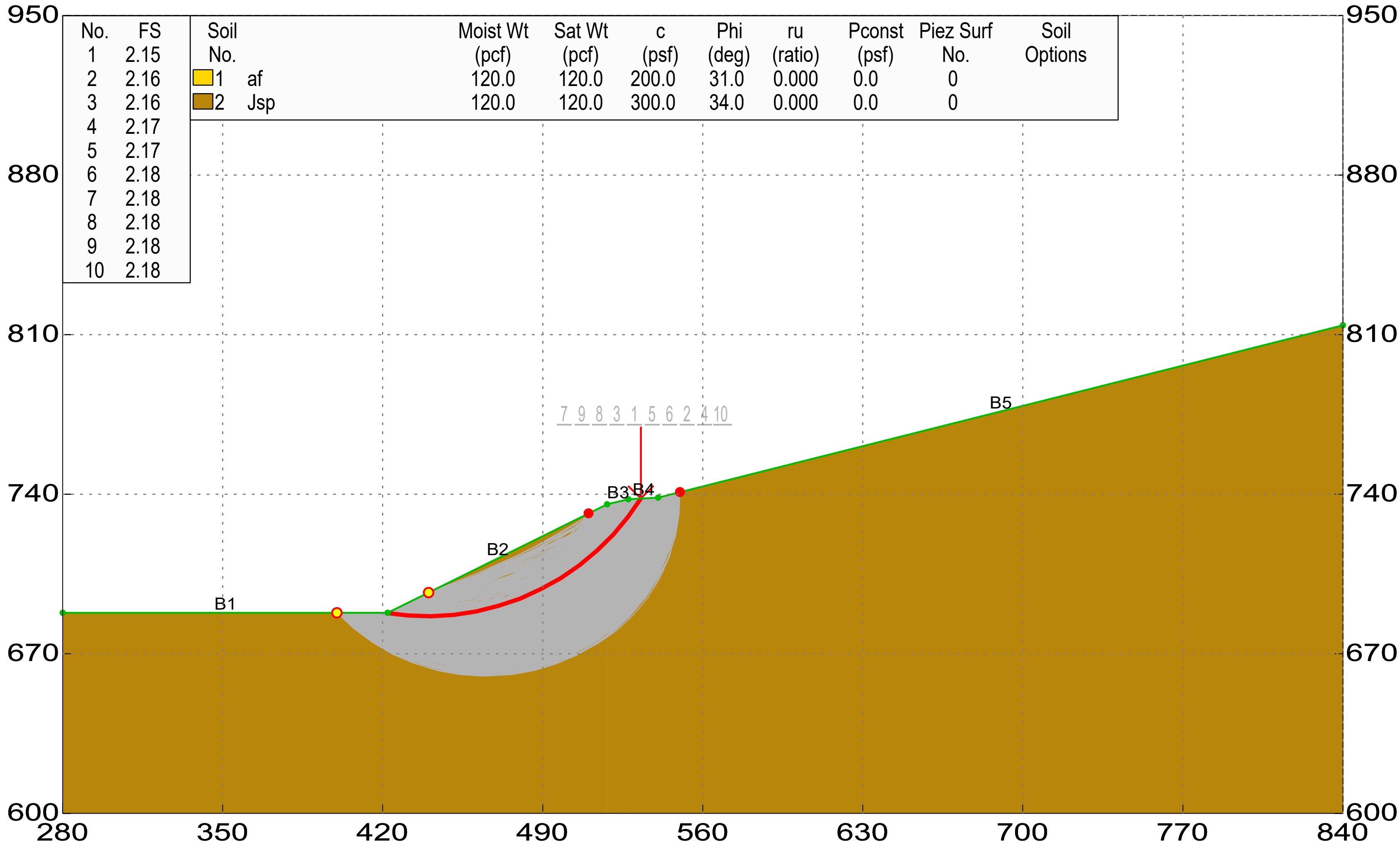
## *Summary of Slope Stability Analysis*

| Cross-Section | Factor of Safety | Description |
|---|---|---|
| 1-1' | 2.15 | Static (Rotational) |
| | 1.56 | Seismic (Rotational) |
| 7-7' | 1.93 | Static (Rotational) |
| | 1.39 | Seismic (Rotational) |
| 8-8' | 1.97 | Static (Rotational) |
| | 1.47 | Seismic (Rotational) |

# Meritage - Twin Oaks, San Marcos
# Section 1-1' (Static) - Local

LGC Geotechnical / BPP

\Section 1 - Static.gsd




| No. | FS |
|---|---|
| 1 | 2.15 |
| 2 | 2.16 |
| 3 | 2.16 |
| 4 | 2.17 |
| 5 | 2.17 |
| 6 | 2.18 |
| 7 | 2.18 |
| 8 | 2.18 |
| 9 | 2.18 |
| 10 | 2.18 |

| Soil No. | | Moist Wt (pcf) | Sat Wt (pcf) | c (psf) | Phi (deg) | ru (ratio) | Pconst (psf) | Piez Surf No. | Soil Options |
|---|---|---|---|---|---|---|---|---|---|
| 1 | af | 120.0 | 120.0 | 200.0 | 31.0 | 0.000 | 0.0 | 0 | |
| 2 | Jsp | 120.0 | 120.0 | 300.0 | 34.0 | 0.000 | 0.0 | 0 | |

GEOSTASE FS = 2.15

Simplified Bishop Method

GEOSTASE Slope Stability Analysis

GREGORY GEOTECHNICAL

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

*** GEOSTASE(R) ***

** GEOSTASE(R) (c)Copyright by Garry H. Gregory, Ph.D., P.E.,D.GE **

** Current Version 4.30.31-Double Precision, August 2019 **


*****************************************************************************
SLOPE STABILITY ANALYSIS SOFTWARE
Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
(Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
Including Pier/Pile, Planar Reinf, Nail, Tieback, Line Loads
Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
Nonlinear Undrained Shear Strength, Curved Strength Envelope,
Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
*****************************************************************************

Analysis Date: 8/ 22/ 2024
Analysis Time:
Analysis By: LGC Geotechnical / BPP
Input File Name: Z:\2024\24032-01 Meritage - Twin Oaks, San Marcos \Engineering\Slope Stability Analysis\1-1'\2024_08_05\Section 1 - Static.gsd
Output File Name: Z:\2024\24032-01 Meritage - Twin Oaks, San Marcos \Engineering\Slope Stability Analysis\1-1'\2024_08_05\Section 1 - Static.OUT
Unit System: English

PROJECT: Meritage - Twin Oaks, San Marcos

DESCRIPTION: Section 1-1' (Static) - Local

BOUNDARY DATA

5 Surface Boundaries
5 Total Boundaries

| Boundary No. | X - 1 (ft) | Y - 1 (ft) | X - 2 (ft) | Y - 2 (ft) | Soil Type Below Bnd |
|---|---|---|---|---|---|
| 1 | 280.000 | 688.000 | 422.100 | 688.000 | 2 |
| 2 | 422.100 | 688.000 | 518.200 | 735.600 | 2 |
| 3 | 518.200 | 735.600 | 527.500 | 737.800 | 2 |
| 4 | 527.500 | 737.800 | 540.500 | 738.500 | 2 |
| 5 | 540.500 | 738.500 | 840.000 | 814.100 | 2 |

User Specified X-Origin = 280.000(ft)

User Specified Y-Origin = 600.000(ft)

MOHR-COULOMB SOIL PARAMETERS

2 Type(s) of Soil Defined

| Soil Number and Description | Moist Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Pore Pressure Ratio(ru) | Pressure Constant (psf) | Water Surface No. | Water Option |
|---|---|---|---|---|---|---|---|---|
| 1 af | 120.0 | 120.0 | 200.00 | 31.00 | 0.000 | 0.0 | 0 | 0 |
| 2 Jsp | 120.0 | 120.0 | 300.00 | 34.00 | 0.000 | 0.0 | 0 | 0 |

Drained Shear Strength Reduction Factor applied after first stage = 1.0000

TRIAL FAILURE SURFACE DATA

Circular Trial Failure Surfaces Have Been Generated Using A Random Procedure.

1000 Trial Surfaces Have Been Generated.

1000 Surfaces Generated at Increments of 0.4805(in) Equally Spaced Within the Start Range

Along The Specified Surface Between X = 400.00(ft)
and X = 440.00(ft)

Each Surface Enters within a Range Between X = 510.00(ft)
and X = 550.00(ft)

Unless XCLUDE Lines Were Specified, The Minimum Elevation
To Which A Surface Extends Is Y = 600.00(ft)

Specified Maximum Radius = 10000.000(ft)

10.000(ft) Line Segments Were Used For Each Trial Failure Surface.

The Simplified Bishop Method Was Selected for FS Analysis.

Total Number of Trial Surfaces Attempted = 1000

Number of Trial Surfaces With Valid FS = 1000

Statistical Data On All Valid FS Values:
FS Max = 4.073 FS Min = 2.154 FS Ave = 2.678
Standard Deviation = 0.359 Coefficient of Variation = 13.41 %

Critical Surface is Sequence Number 526 of Those Analyzed.

*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****

BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

Circle Center At X = 439.381058(ft) ; Y = 796.973687(ft); and Radius = 110.509526(ft)

Circular Trial Failure Surface Generated With 14 Coordinate Points

| Point No. | X-Coord. (ft) | Y-Coord. (ft) |
|---|---|---|
| 1 | 421.021 | 688.000 |
| 2 | 430.947 | 686.786 |
| 3 | 440.942 | 686.475 |
| 4 | 450.925 | 687.069 |
| 5 | 460.812 | 688.562 |
| 6 | 470.525 | 690.943 |
| 7 | 479.982 | 694.193 |
| 8 | 489.107 | 698.284 |
| 9 | 497.825 | 703.183 |
| 10 | 506.064 | 708.850 |
| 11 | 513.757 | 715.239 |
| 12 | 520.841 | 722.297 |
| 13 | 527.258 | 729.966 |
| 14 | 532.890 | 738.090 |

Factor Of Safety For The Critical or Specified Surface = 2.154

***Table 1 - Geometry Data on the 28 Slices***

| Slice No. | Width (ft) | Height (ft) | X-Cntr (ft) | Y-Cntr-Base (ft) | Y-Cntr-Top (ft) | Alpha (deg) | Beta (deg) | Base Length (ft) |
|---|---|---|---|---|---|---|---|---|
| 1 | 1.08 | 0.07 | 421.56 | 687.93 | 688.00 | -6.97 | 0.00 | 1.09 |
| 2 | 4.42 | 1.50 | 424.31 | 687.60 | 689.10 | -6.97 | 26.35 | 4.46 |
| 3 | 4.42 | 4.23 | 428.74 | 687.06 | 691.29 | -6.97 | 26.35 | 4.46 |
| 4 | 5.00 | 6.91 | 433.45 | 686.71 | 693.62 | -1.78 | 26.35 | 5.00 |
| 5 | 5.00 | 9.54 | 438.44 | 686.55 | 696.10 | -1.78 | 26.35 | 5.00 |
| 6 | 4.99 | 11.95 | 443.44 | 686.62 | 698.57 | 3.40 | 26.35 | 5.00 |
| 7 | 4.99 | 14.12 | 448.43 | 686.92 | 701.04 | 3.40 | 26.35 | 5.00 |
| 8 | 4.94 | 16.06 | 453.40 | 687.44 | 703.50 | 8.59 | 26.35 | 5.00 |
| 9 | 4.94 | 17.76 | 458.34 | 688.19 | 705.95 | 8.59 | 26.35 | 5.00 |
| 10 | 4.86 | 19.22 | 463.24 | 689.16 | 708.38 | 13.78 | 26.35 | 5.00 |
| 11 | 4.86 | 20.43 | 468.10 | 690.35 | 710.78 | 13.78 | 26.35 | 5.00 |
| 12 | 4.73 | 21.40 | 472.89 | 691.76 | 713.16 | 18.96 | 26.35 | 5.00 |
| 13 | 4.73 | 22.12 | 477.62 | 693.38 | 715.50 | 18.96 | 26.35 | 5.00 |
| 14 | 4.56 | 22.58 | 482.26 | 695.22 | 717.80 | 24.15 | 26.35 | 5.00 |
| 15 | 4.56 | 22.80 | 486.83 | 697.26 | 720.06 | 24.15 | 26.35 | 5.00 |
| 16 | 4.36 | 22.76 | 491.29 | 699.51 | 722.27 | 29.34 | 26.35 | 5.00 |
| 17 | 4.36 | 22.47 | 495.65 | 701.96 | 724.43 | 29.34 | 26.35 | 5.00 |
| 18 | 4.12 | 21.93 | 499.88 | 704.60 | 726.53 | 34.52 | 26.35 | 5.00 |
| 19 | 4.12 | 21.14 | 504.00 | 707.43 | 728.57 | 34.52 | 26.35 | 5.00 |
| 20 | 3.85 | 20.09 | 507.99 | 710.45 | 730.54 | 39.71 | 26.35 | 5.00 |
| 21 | 3.85 | 18.80 | 511.83 | 713.64 | 732.45 | 39.71 | 26.35 | 5.00 |
| 22 | 4.44 | 17.05 | 515.98 | 717.45 | 734.50 | 44.89 | 26.35 | 6.27 |
| 23 | 2.64 | 14.93 | 519.52 | 720.98 | 735.91 | 44.89 | 13.31 | 3.73 |
| 24 | 3.21 | 12.39 | 522.45 | 724.21 | 736.60 | 50.08 | 13.31 | 5.00 |
| 25 | 3.21 | 9.31 | 525.65 | 728.05 | 737.36 | 50.08 | 13.31 | 5.00 |
| 26 | 0.24 | 7.63 | 527.38 | 730.14 | 737.77 | 55.27 | 13.31 | 0.42 |
| 27 | 2.70 | 5.61 | 528.85 | 732.26 | 737.87 | 55.27 | 3.08 | 4.73 |
| 28 | 2.70 | 1.87 | 531.54 | 736.15 | 738.02 | 55.27 | 3.08 | 4.73 |

***Table 2 - Force Data On The 28 Slices (Excluding Reinforcement)***

| Slice No. | Weight (lbs) | Ubeta Force Top (lbs) | Ualpha Force Bot (lbs) | Earthquake Force Hor (lbs) | Earthquake Force Ver (lbs) | Distributed Load (lbs) |
|---|---|---|---|---|---|---|
| 1 | 8.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | 795.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3 | 2245.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 | 4144.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 5 | 5722.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 6 | 7154.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 7 | 8457.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 8 | 9527.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 9 | 10537.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 10 | 11200.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11 | 11908.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12 | 12143.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13 | 12550.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 14 | 12364.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 15 | 12482.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 16 | 11905.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 17 | 11753.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 18 | 10840.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 19 | 10448.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 20 | 9275.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 21 | 8680.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 22 | 9089.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 23 | 4732.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 24 | 4770.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 25 | 3586.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 26 | 221.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 27 | 1815.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 28 | 605.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

TOTAL WEIGHT OF SLIDING MASS = 208965.72(lbs)

EFFECTIVE WEIGHT OF SLIDING MASS = 208965.72(lbs)

TOTAL AREA OF SLIDING MASS = 1741.38(ft2)

***TABLE 2A - SOIL STRENGTH & SOIL OPTIONS DATA ON THE 28 SLICES***

| Slice No. | Soil Type | Cohesion (psf) | Phi(Deg) | Options |
|---|---|---|---|---|
| 1 | 2 | 300.00 | 34.00 | |
| 2 | 2 | 300.00 | 34.00 | |
| 3 | 2 | 300.00 | 34.00 | |
| 4 | 2 | 300.00 | 34.00 | |
| 5 | 2 | 300.00 | 34.00 | |
| 6 | 2 | 300.00 | 34.00 | |
| 7 | 2 | 300.00 | 34.00 | |
| 8 | 2 | 300.00 | 34.00 | |
| 9 | 2 | 300.00 | 34.00 | |
| 10 | 2 | 300.00 | 34.00 | |
| 11 | 2 | 300.00 | 34.00 | |
| 12 | 2 | 300.00 | 34.00 | |
| 13 | 2 | 300.00 | 34.00 | |
| 14 | 2 | 300.00 | 34.00 | |
| 15 | 2 | 300.00 | 34.00 | |
| 16 | 2 | 300.00 | 34.00 | |
| 17 | 2 | 300.00 | 34.00 | |
| 18 | 2 | 300.00 | 34.00 | |
| 19 | 2 | 300.00 | 34.00 | |
| 20 | 2 | 300.00 | 34.00 | |
| 21 | 2 | 300.00 | 34.00 | |
| 22 | 2 | 300.00 | 34.00 | |
| 23 | 2 | 300.00 | 34.00 | |
| 24 | 2 | 300.00 | 34.00 | |
| 25 | 2 | 300.00 | 34.00 | |
| 26 | 2 | 300.00 | 34.00 | |
| 27 | 2 | 300.00 | 34.00 | |
| 28 | 2 | 300.00 | 34.00 | |

SOIL OPTIONS: A = ANISOTROPIC, C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C),
F = FIBER-REINFORCED SOIL (FRS), N = NONLINEAR UNDRAINED SHEAR STRENGTH,
R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
NOTE: Phi and C in Table 4 are modified values based on specified
Soil Options (if any).

***TABLE 3 - Effective and Base Shear Stress Data on the 28 Slices***

| Slice No. * | Alpha (deg) | X-Coord. Slice Cntr (ft) | Base Leng. (ft) | Effective Normal Stress (psf) | Available Shear Strength (psf) | Mobilized Shear Stress (psf) |
|---|---|---|---|---|---|---|
| 1 | -6.97 | 421.56 | 1.09 | 25.93 | 317.49 | 147.37 |
| 1 | -6.97 | 421.56 | 1.09 | 25.93 | 317.49 | 147.37 |
| 2 | -6.97 | 424.31 | 4.46 | 204.60 | 438.00 | 203.31 |
| 2 | -6.97 | 424.31 | 4.46 | 204.60 | 438.00 | 203.31 |
| 3 | -6.97 | 428.74 | 4.46 | 545.47 | 667.93 | 310.03 |
| 3 | -6.97 | 428.74 | 4.46 | 545.47 | 667.93 | 310.03 |
| 4 | -1.78 | 433.45 | 5.00 | 841.89 | 867.86 | 402.83 |
| 4 | -1.78 | 433.45 | 5.00 | 841.89 | 867.86 | 402.83 |
| 5 | -1.78 | 438.44 | 5.00 | 1160.72 | 1082.92 | 502.65 |
| 5 | -1.78 | 438.44 | 5.00 | 1160.72 | 1082.92 | 502.65 |
| 6 | 3.40 | 443.44 | 5.00 | 1399.13 | 1243.72 | 577.30 |
| 6 | 3.40 | 443.44 | 5.00 | 1399.13 | 1243.72 | 577.30 |
| 7 | 3.40 | 448.43 | 5.00 | 1655.41 | 1416.59 | 657.53 |
| 7 | 3.40 | 448.43 | 5.00 | 1655.41 | 1416.59 | 657.53 |
| 8 | 8.59 | 453.40 | 5.00 | 1820.05 | 1527.64 | 709.08 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 8 | 8.59 | 453.40 | 5.00 | 1820.05 | 1527.64 | 709.08 |
| 9 | 8.59 | 458.34 | 5.00 | 2015.07 | 1659.18 | 770.14 |
| 9 | 8.59 | 458.34 | 5.00 | 2015.07 | 1659.18 | 770.14 |
| 10 | 13.78 | 463.24 | 5.00 | 2110.27 | 1723.40 | 799.95 |
| 10 | 13.78 | 463.24 | 5.00 | 2110.27 | 1723.40 | 799.95 |
| 11 | 13.78 | 468.10 | 5.00 | 2245.65 | 1814.71 | 842.33 |
| 11 | 13.78 | 468.10 | 5.00 | 2245.65 | 1814.71 | 842.33 |
| 12 | 18.96 | 472.89 | 5.00 | 2275.47 | 1834.83 | 851.67 |
| 12 | 18.96 | 472.89 | 5.00 | 2275.47 | 1834.83 | 851.67 |
| 13 | 18.96 | 477.62 | 5.00 | 2353.21 | 1887.26 | 876.00 |
| 13 | 18.96 | 477.62 | 5.00 | 2353.21 | 1887.26 | 876.00 |
| 14 | 24.15 | 482.26 | 5.00 | 2321.76 | 1866.05 | 866.16 |
| 14 | 24.15 | 482.26 | 5.00 | 2321.76 | 1866.05 | 866.16 |
| 15 | 24.15 | 486.83 | 5.00 | 2344.31 | 1881.26 | 873.22 |
| 15 | 24.15 | 486.83 | 5.00 | 2344.31 | 1881.26 | 873.22 |
| 16 | 29.34 | 491.29 | 5.00 | 2256.04 | 1821.71 | 845.58 |
| 16 | 29.34 | 491.29 | 5.00 | 2256.04 | 1821.71 | 845.58 |
| 17 | 29.34 | 495.65 | 5.00 | 2226.39 | 1801.72 | 836.30 |
| 17 | 29.34 | 495.65 | 5.00 | 2226.39 | 1801.72 | 836.30 |
| 18 | 34.52 | 499.88 | 5.00 | 2086.28 | 1707.21 | 792.43 |
| 18 | 34.52 | 499.88 | 5.00 | 2086.28 | 1707.21 | 792.43 |
| 19 | 34.52 | 504.00 | 5.00 | 2007.97 | 1654.40 | 767.92 |
| 19 | 34.52 | 504.00 | 5.00 | 2007.97 | 1654.40 | 767.92 |
| 20 | 39.71 | 507.99 | 5.00 | 1821.90 | 1528.89 | 709.66 |
| 20 | 39.71 | 507.99 | 5.00 | 1821.90 | 1528.89 | 709.66 |
| 21 | 39.71 | 511.83 | 5.00 | 1699.13 | 1446.08 | 671.22 |
| 21 | 39.71 | 511.83 | 5.00 | 1699.13 | 1446.08 | 671.22 |
| 22 | 44.89 | 515.98 | 6.27 | 1453.51 | 1280.40 | 594.32 |
| 22 | 44.89 | 515.98 | 6.27 | 1453.51 | 1280.40 | 594.32 |
| 23 | 44.89 | 519.52 | 3.73 | 1259.94 | 1149.84 | 533.72 |
| 23 | 44.89 | 519.52 | 3.73 | 1259.94 | 1149.84 | 533.72 |
| 24 | 50.08 | 522.45 | 5.00 | 960.80 | 948.07 | 440.06 |
| 24 | 50.08 | 522.45 | 5.00 | 960.80 | 948.07 | 440.06 |
| 25 | 50.08 | 525.65 | 5.00 | 692.22 | 766.91 | 355.97 |
| 25 | 50.08 | 525.65 | 5.00 | 692.22 | 766.91 | 355.97 |
| 26 | 55.27 | 527.38 | 0.42 | 492.40 | 632.13 | 293.41 |
| 26 | 55.27 | 527.38 | 0.42 | 492.40 | 632.13 | 293.41 |
| 27 | 55.27 | 528.85 | 4.73 | 325.67 | 519.66 | 241.21 |
| 27 | 55.27 | 528.85 | 4.73 | 325.67 | 519.66 | 241.21 |
| 28 | 55.27 | 531.54 | 4.73 | 154.68 | 104.33 | 48.43 |
| 28 | 55.27 | 531.54 | 4.73 | 154.68 | 104.33 | 48.43 |

***Table 4 - Base Force Data on the 28 Slices***

| Slice No. * | Alpha (deg) | X-Coord. Slice Cntr (ft) | Base Leng. (ft) | Effective Normal Force (lbs) | Available Shear Force (lbs) | Mobilized Shear Force (lbs) |
|---|---|---|---|---|---|---|
| 1 | -6.97 | 421.56 | 1.09 | 28.19 | 345.12 | 160.19 |
| 1 | -6.97 | 421.56 | 1.09 | 28.19 | 345.12 | 160.19 |
| 2 | -6.97 | 424.31 | 4.46 | 911.80 | 1951.96 | 906.04 |
| 2 | -6.97 | 424.31 | 4.46 | 911.80 | 1951.96 | 906.04 |
| 3 | -6.97 | 428.74 | 4.46 | 2430.90 | 2976.61 | 1381.65 |
| 3 | -6.97 | 428.74 | 4.46 | 2430.90 | 2976.61 | 1381.65 |
| 4 | -1.78 | 433.45 | 5.00 | 4209.44 | 4339.30 | 2014.16 |
| 4 | -1.78 | 433.45 | 5.00 | 4209.44 | 4339.30 | 2014.16 |
| 5 | -1.78 | 438.44 | 5.00 | 5803.60 | 5414.58 | 2513.27 |
| 5 | -1.78 | 438.44 | 5.00 | 5803.60 | 5414.58 | 2513.27 |
| 6 | 3.40 | 443.44 | 5.00 | 6995.63 | 6218.61 | 2886.48 |
| 6 | 3.40 | 443.44 | 5.00 | 6995.63 | 6218.61 | 2886.48 |
| 7 | 3.40 | 448.43 | 5.00 | 8277.04 | 7082.93 | 3287.67 |
| 7 | 3.40 | 448.43 | 5.00 | 8277.04 | 7082.93 | 3287.67 |
| 8 | 8.59 | 453.40 | 5.00 | 9100.24 | 7638.19 | 3545.40 |
| 8 | 8.59 | 453.40 | 5.00 | 9100.24 | 7638.19 | 3545.40 |
| 9 | 8.59 | 458.34 | 5.00 | 10075.37 | 8295.92 | 3850.70 |
| 9 | 8.59 | 458.34 | 5.00 | 10075.37 | 8295.92 | 3850.70 |
| 10 | 13.78 | 463.24 | 5.00 | 10551.37 | 8616.99 | 3999.73 |
| 10 | 13.78 | 463.24 | 5.00 | 10551.37 | 8616.99 | 3999.73 |
| 11 | 13.78 | 468.10 | 5.00 | 11228.26 | 9073.56 | 4211.65 |
| 11 | 13.78 | 468.10 | 5.00 | 11228.26 | 9073.56 | 4211.65 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 12 | 18.96 | 472.89 | 5.00 | 11377.36 | 9174.13 | 4258.33 |
| 12 | 18.96 | 472.89 | 5.00 | 11377.36 | 9174.13 | 4258.33 |
| 13 | 18.96 | 477.62 | 5.00 | 11766.04 | 9436.29 | 4380.02 |
| 13 | 18.96 | 477.62 | 5.00 | 11766.04 | 9436.29 | 4380.02 |
| 14 | 24.15 | 482.26 | 5.00 | 11608.80 | 9330.24 | 4330.79 |
| 14 | 24.15 | 482.26 | 5.00 | 11608.80 | 9330.24 | 4330.79 |
| 15 | 24.15 | 486.83 | 5.00 | 11721.57 | 9406.30 | 4366.10 |
| 15 | 24.15 | 486.83 | 5.00 | 11721.57 | 9406.30 | 4366.10 |
| 16 | 29.34 | 491.29 | 5.00 | 11280.18 | 9108.57 | 4227.90 |
| 16 | 29.34 | 491.29 | 5.00 | 11280.18 | 9108.57 | 4227.90 |
| 17 | 29.34 | 495.65 | 5.00 | 11131.93 | 9008.58 | 4181.49 |
| 17 | 29.34 | 495.65 | 5.00 | 11131.93 | 9008.58 | 4181.49 |
| 18 | 34.52 | 499.88 | 5.00 | 10431.40 | 8536.07 | 3962.16 |
| 18 | 34.52 | 499.88 | 5.00 | 10431.40 | 8536.07 | 3962.16 |
| 19 | 34.52 | 504.00 | 5.00 | 10039.87 | 8271.98 | 3839.58 |
| 19 | 34.52 | 504.00 | 5.00 | 10039.87 | 8271.98 | 3839.58 |
| 20 | 39.71 | 507.99 | 5.00 | 9109.50 | 7644.43 | 3548.30 |
| 20 | 39.71 | 507.99 | 5.00 | 9109.50 | 7644.43 | 3548.30 |
| 21 | 39.71 | 511.83 | 5.00 | 8495.65 | 7230.39 | 3356.11 |
| 21 | 39.71 | 511.83 | 5.00 | 8495.65 | 7230.39 | 3356.11 |
| 22 | 44.89 | 515.98 | 6.27 | 9116.08 | 8030.41 | 3727.45 |
| 22 | 44.89 | 515.98 | 6.27 | 9116.08 | 8030.41 | 3727.45 |
| 23 | 44.89 | 519.52 | 3.73 | 4697.32 | 4286.84 | 1989.81 |
| 23 | 44.89 | 519.52 | 3.73 | 4697.32 | 4286.84 | 1989.81 |
| 24 | 50.08 | 522.45 | 5.00 | 4804.00 | 4740.34 | 2200.31 |
| 24 | 50.08 | 522.45 | 5.00 | 4804.00 | 4740.34 | 2200.31 |
| 25 | 50.08 | 525.65 | 5.00 | 3461.10 | 3834.54 | 1779.87 |
| 25 | 50.08 | 525.65 | 5.00 | 3461.10 | 3834.54 | 1779.87 |
| 26 | 55.27 | 527.38 | 0.42 | 209.01 | 268.32 | 124.55 |
| 26 | 55.27 | 527.38 | 0.42 | 209.01 | 268.32 | 124.55 |
| 27 | 55.27 | 528.85 | 4.73 | 1540.51 | 2458.19 | 1141.01 |
| 27 | 55.27 | 528.85 | 4.73 | 1540.51 | 2458.19 | 1141.01 |
| 28 | 55.27 | 531.54 | 4.73 | 731.69 | 493.53 | 229.08 |
| 28 | 55.27 | 531.54 | 4.73 | 731.69 | 493.53 | 229.08 |

SUM OF MOMENTS = -0.722959E-01 (ft/lbs);Imbalance (Fraction of Total Weight) = -0.3459701E-06

Sum of the Resisting Forces = 173212.92 (lbs)

Average Available Shear Strength = 1333.59(psf)

Sum of the Driving Forces = 80399.79 (lbs)

Average Mobilized Shear Stress = 619.01(psf)

Total length of the failure surface = 129.89(ft)

Factor of Safety Balance Check: FS = 2.15440

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

**** END OF GEOSTASE OUTPUT ****

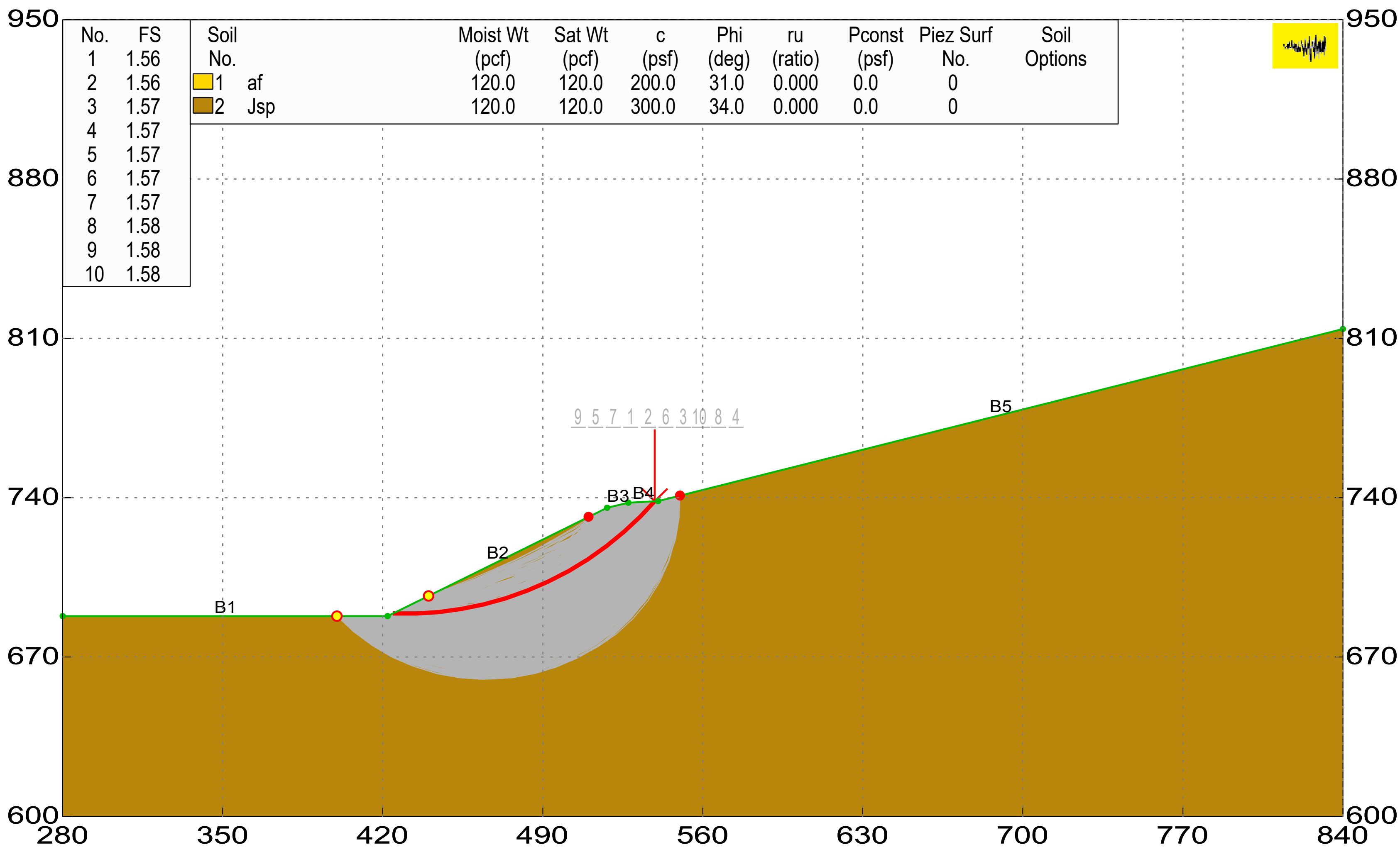
# Meritage - Twin Oaks, San Marcos
# Section 1-1' (Seismic) - Local

LGC Geotechnical / BPP

\Section 1 - Seismic.gsd

| No. | FS |
|---|---|
| 1 | 1.56 |
| 2 | 1.56 |
| 3 | 1.57 |
| 4 | 1.57 |
| 5 | 1.57 |
| 6 | 1.57 |
| 7 | 1.57 |
| 8 | 1.58 |
| 9 | 1.58 |
| 10 | 1.58 |

| Soil No. | | Moist Wt (pcf) | Sat Wt (pcf) | c (psf) | Phi (deg) | ru (ratio) | Pconst (psf) | Piez Surf No. | Soil Options |
|---|---|---|---|---|---|---|---|---|---|
| 1 | af | 120.0 | 120.0 | 200.0 | 31.0 | 0.000 | 0.0 | 0 | |
| 2 | Jsp | 120.0 | 120.0 | 300.0 | 34.0 | 0.000 | 0.0 | 0 | |




GEOSTASE FS = 1.56

Simplified Bishop Method

kh = 0.15000

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

*** GEOSTASE(R) ***



** Current Version 4.30.31-Double Precision, August 2019 **


*****************************************************************************
SLOPE STABILITY ANALYSIS SOFTWARE
Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
(Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
Including Pier/Pile, Planar Reinf, Nail, Tieback, Line Loads
Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
Nonlinear Undrained Shear Strength, Curved Strength Envelope,
Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
*****************************************************************************

Analysis Date: 8/ 22/ 2024
Analysis Time:
Analysis By: LGC Geotechnical / BPP
Input File Name: Z:\2024\24032-01 Meritage - Twin Oaks, San Marcos \Engineering\Slope Stability Analysis\1-1'\2024_08_05\Section 1 - Seismic.gsd
Output File Name: Z:\2024\24032-01 Meritage - Twin Oaks, San Marcos \Engineering\Slope Stability Analysis\1-1'\2024_08_05\Section 1 - Seismic.OUT
Unit System: English

PROJECT: Meritage - Twin Oaks, San Marcos

DESCRIPTION: Section 1-1' (Seismic) - Local

BOUNDARY DATA

5 Surface Boundaries
5 Total Boundaries

| Boundary No. | X - 1 (ft) | Y - 1 (ft) | X - 2 (ft) | Y - 2 (ft) | Soil Type Below Bnd |
|---|---|---|---|---|---|
| 1 | 280.000 | 688.000 | 422.100 | 688.000 | 2 |
| 2 | 422.100 | 688.000 | 518.200 | 735.600 | 2 |
| 3 | 518.200 | 735.600 | 527.500 | 737.800 | 2 |
| 4 | 527.500 | 737.800 | 540.500 | 738.500 | 2 |
| 5 | 540.500 | 738.500 | 840.000 | 814.100 | 2 |

User Specified X-Origin = 280.000(ft)

User Specified Y-Origin = 600.000(ft)

MOHR-COULOMB SOIL PARAMETERS

2 Type(s) of Soil Defined

| Soil Number and Description | Moist Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Pore Pressure Ratio(ru) | Pressure Constant (psf) | Water Surface No. | Water Option |
|---|---|---|---|---|---|---|---|---|
| 1 af | 120.0 | 120.0 | 200.00 | 31.00 | 0.000 | 0.0 | 0 | 0 |
| 2 Jsp | 120.0 | 120.0 | 300.00 | 34.00 | 0.000 | 0.0 | 0 | 0 |

Drained Shear Strength Reduction Factor applied after first stage = 1.0000

SEISMIC (EARTHQUAKE) DATA

Specified Peak Ground Acceleration Coefficient (PGA) = 0.000(g)
Default Velocity = 0.000(ft) per second
Specified Horizontal Earthquake Coefficient (kh) = 0.15000(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
(NOTE:Input Velocity = 0.0 will result in default Peak
Velocity = 2 times(PGA) times 2.5 fps or 0.762 mps)
Specified Seismic Pore-Pressure Factor = 0.000
Horizontal Seismic Force is Applied at Center of Gravity of Slices

TRIAL FAILURE SURFACE DATA

Circular Trial Failure Surfaces Have Been Generated Using A Random Procedure.

1000 Trial Surfaces Have Been Generated.

1000 Surfaces Generated at Increments of 0.4805(in) Equally Spaced Within the Start Range

Along The Specified Surface Between X = 400.00(ft)
and X = 440.00(ft)

Each Surface Enters within a Range Between X = 510.00(ft)
and X = 550.00(ft)

Unless XCLUDE Lines Were Specified, The Minimum Elevation
To Which A Surface Extends Is Y = 600.00(ft)

Specified Maximum Radius = 10000.000(ft)

10.000(ft) Line Segments Were Used For Each Trial Failure Surface.

The Simplified Bishop Method Was Selected for FS Analysis.

Total Number of Trial Surfaces Attempted = 1000

Number of Trial Surfaces With Valid FS = 1000

Statistical Data On All Valid FS Values:
FS Max = 3.049 FS Min = 1.556 FS Ave = 1.956
Standard Deviation = 0.270 Coefficient of Variation = 13.79 %

Critical Surface is Sequence Number 611 of Those Analyzed.

*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****

BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

Circle Center At X = 430.062464(ft) ; Y = 833.906034(ft); and Radius = 144.864462(ft)

Circular Trial Failure Surface Generated With 14 Coordinate Points

| Point No. | X-Coord. (ft) | Y-Coord. (ft) |
|---|---|---|
| 1 | 424.424 | 689.151 |
| 2 | 434.424 | 689.107 |
| 3 | 444.403 | 689.753 |
| 4 | 454.314 | 691.086 |
| 5 | 464.109 | 693.099 |
| 6 | 473.742 | 695.784 |
| 7 | 483.167 | 699.126 |

| | | |
|---|---|---|
| 8 | 492.339 | 703.111 |
| 9 | 501.214 | 707.719 |
| 10 | 509.750 | 712.928 |
| 11 | 517.906 | 718.714 |
| 12 | 525.644 | 725.049 |
| 13 | 532.926 | 731.902 |
| 14 | 538.955 | 738.417 |

Factor Of Safety For The Critical or Specified Surface = 1.556

***Table 1 - Geometry Data on the 28 Slices***

| Slice No. | Width (ft) | Height (ft) | X-Cntr (ft) | Y-Cntr-Base (ft) | Y-Cntr-Top (ft) | Alpha (deg) | Beta (deg) | Base Length (ft) |
|---|---|---|---|---|---|---|---|---|
| 1 | 5.00 | 1.25 | 426.92 | 689.14 | 690.39 | -0.25 | 26.35 | 5.00 |
| 2 | 5.00 | 3.75 | 431.92 | 689.12 | 692.87 | -0.25 | 26.35 | 5.00 |
| 3 | 4.99 | 6.07 | 436.92 | 689.27 | 695.34 | 3.70 | 26.35 | 5.00 |
| 4 | 4.99 | 8.22 | 441.91 | 689.59 | 697.81 | 3.70 | 26.35 | 5.00 |
| 5 | 4.96 | 10.19 | 446.88 | 690.09 | 700.27 | 7.66 | 26.35 | 5.00 |
| 6 | 4.96 | 11.98 | 451.84 | 690.75 | 702.73 | 7.66 | 26.35 | 5.00 |
| 7 | 4.90 | 13.58 | 456.76 | 691.59 | 705.17 | 11.62 | 26.35 | 5.00 |
| 8 | 4.90 | 15.00 | 461.66 | 692.60 | 707.60 | 11.62 | 26.35 | 5.00 |
| 9 | 4.82 | 16.23 | 466.52 | 693.77 | 710.00 | 15.57 | 26.35 | 5.00 |
| 10 | 4.82 | 17.27 | 471.33 | 695.11 | 712.39 | 15.57 | 26.35 | 5.00 |
| 11 | 4.71 | 18.13 | 476.10 | 696.62 | 714.75 | 19.53 | 26.35 | 5.00 |
| 12 | 4.71 | 18.79 | 480.81 | 698.29 | 717.08 | 19.53 | 26.35 | 5.00 |
| 13 | 4.59 | 19.26 | 485.46 | 700.12 | 719.38 | 23.48 | 26.35 | 5.00 |
| 14 | 4.59 | 19.54 | 490.05 | 702.11 | 721.65 | 23.48 | 26.35 | 5.00 |
| 15 | 4.44 | 19.63 | 494.56 | 704.26 | 723.89 | 27.44 | 26.35 | 5.00 |
| 16 | 4.44 | 19.52 | 499.00 | 706.57 | 726.09 | 27.44 | 26.35 | 5.00 |
| 17 | 4.27 | 19.22 | 503.35 | 709.02 | 728.24 | 31.39 | 26.35 | 5.00 |
| 18 | 4.27 | 18.73 | 507.62 | 711.63 | 730.36 | 31.39 | 26.35 | 5.00 |
| 19 | 4.08 | 18.05 | 511.79 | 714.37 | 732.42 | 35.35 | 26.35 | 5.00 |
| 20 | 4.08 | 17.18 | 515.87 | 717.27 | 734.44 | 35.35 | 26.35 | 5.00 |
| 21 | 0.29 | 16.69 | 518.05 | 718.83 | 735.53 | 39.31 | 26.35 | 0.38 |
| 22 | 3.72 | 15.56 | 520.06 | 720.48 | 736.04 | 39.31 | 13.31 | 4.81 |
| 23 | 3.72 | 13.40 | 523.78 | 723.53 | 736.92 | 39.31 | 13.31 | 4.81 |
| 24 | 1.86 | 11.66 | 526.57 | 725.92 | 737.58 | 43.26 | 13.31 | 2.55 |
| 25 | 2.71 | 9.80 | 528.86 | 728.07 | 737.87 | 43.26 | 3.08 | 3.73 |
| 26 | 2.71 | 7.39 | 531.57 | 730.63 | 738.02 | 43.26 | 3.08 | 3.73 |
| 27 | 3.01 | 4.64 | 534.43 | 733.53 | 738.17 | 47.22 | 3.08 | 4.44 |
| 28 | 3.01 | 1.55 | 537.45 | 736.79 | 738.34 | 47.22 | 3.08 | 4.44 |

***Table 2 - Force Data On The 28 Slices (Excluding Reinforcement)***

| Slice No. | Weight (lbs) | Ubeta Force Top (lbs) | Ualpha Force Bot (lbs) | Earthquake Force Hor (lbs) | Earthquake Force Ver (lbs) | Distributed Load (lbs) |
|---|---|---|---|---|---|---|
| 1 | 749.6 | 0.0 | 0.0 | 112.4 | 0.0 | 0.0 |
| 2 | 2248.7 | 0.0 | 0.0 | 337.3 | 0.0 | 0.0 |
| 3 | 3635.2 | 0.0 | 0.0 | 545.3 | 0.0 | 0.0 |
| 4 | 4921.6 | 0.0 | 0.0 | 738.2 | 0.0 | 0.0 |
| 5 | 6058.4 | 0.0 | 0.0 | 908.8 | 0.0 | 0.0 |
| 6 | 7121.6 | 0.0 | 0.0 | 1068.2 | 0.0 | 0.0 |
| 7 | 7981.1 | 0.0 | 0.0 | 1197.2 | 0.0 | 0.0 |
| 8 | 8815.1 | 0.0 | 0.0 | 1322.3 | 0.0 | 0.0 |
| 9 | 9380.8 | 0.0 | 0.0 | 1407.1 | 0.0 | 0.0 |
| 10 | 9984.0 | 0.0 | 0.0 | 1497.6 | 0.0 | 0.0 |
| 11 | 10250.7 | 0.0 | 0.0 | 1537.6 | 0.0 | 0.0 |
| 12 | 10625.6 | 0.0 | 0.0 | 1593.8 | 0.0 | 0.0 |
| 13 | 10599.5 | 0.0 | 0.0 | 1589.9 | 0.0 | 0.0 |
| 14 | 10753.0 | 0.0 | 0.0 | 1613.0 | 0.0 | 0.0 |
| 15 | 10451.2 | 0.0 | 0.0 | 1567.7 | 0.0 | 0.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 16 | 10394.7 | 0.0 | 0.0 | 1559.2 | 0.0 | 0.0 |
| 17 | 9844.8 | 0.0 | 0.0 | 1476.7 | 0.0 | 0.0 |
| 18 | 9593.5 | 0.0 | 0.0 | 1439.0 | 0.0 | 0.0 |
| 19 | 8833.1 | 0.0 | 0.0 | 1325.0 | 0.0 | 0.0 |
| 20 | 8405.9 | 0.0 | 0.0 | 1260.9 | 0.0 | 0.0 |
| 21 | 588.3 | 0.0 | 0.0 | 88.2 | 0.0 | 0.0 |
| 22 | 6950.6 | 0.0 | 0.0 | 1042.6 | 0.0 | 0.0 |
| 23 | 5982.9 | 0.0 | 0.0 | 897.4 | 0.0 | 0.0 |
| 24 | 2596.6 | 0.0 | 0.0 | 389.5 | 0.0 | 0.0 |
| 25 | 3190.9 | 0.0 | 0.0 | 478.6 | 0.0 | 0.0 |
| 26 | 2407.1 | 0.0 | 0.0 | 361.1 | 0.0 | 0.0 |
| 27 | 1679.2 | 0.0 | 0.0 | 251.9 | 0.0 | 0.0 |
| 28 | 559.7 | 0.0 | 0.0 | 84.0 | 0.0 | 0.0 |

TOTAL WEIGHT OF SLIDING MASS = 184603.61(lbs)

EFFECTIVE WEIGHT OF SLIDING MASS = 184603.61(lbs)

TOTAL AREA OF SLIDING MASS = 1538.36(ft2)

***TABLE 2A - SOIL STRENGTH & SOIL OPTIONS DATA ON THE 28 SLICES***

| Slice No. | Soil Type | Cohesion (psf) | Phi(Deg) | Options |
|---|---|---|---|---|
| 1 | 2 | 300.00 | 34.00 | |
| 2 | 2 | 300.00 | 34.00 | |
| 3 | 2 | 300.00 | 34.00 | |
| 4 | 2 | 300.00 | 34.00 | |
| 5 | 2 | 300.00 | 34.00 | |
| 6 | 2 | 300.00 | 34.00 | |
| 7 | 2 | 300.00 | 34.00 | |
| 8 | 2 | 300.00 | 34.00 | |
| 9 | 2 | 300.00 | 34.00 | |
| 10 | 2 | 300.00 | 34.00 | |
| 11 | 2 | 300.00 | 34.00 | |
| 12 | 2 | 300.00 | 34.00 | |
| 13 | 2 | 300.00 | 34.00 | |
| 14 | 2 | 300.00 | 34.00 | |
| 15 | 2 | 300.00 | 34.00 | |
| 16 | 2 | 300.00 | 34.00 | |
| 17 | 2 | 300.00 | 34.00 | |
| 18 | 2 | 300.00 | 34.00 | |
| 19 | 2 | 300.00 | 34.00 | |
| 20 | 2 | 300.00 | 34.00 | |
| 21 | 2 | 300.00 | 34.00 | |
| 22 | 2 | 300.00 | 34.00 | |
| 23 | 2 | 300.00 | 34.00 | |
| 24 | 2 | 300.00 | 34.00 | |
| 25 | 2 | 300.00 | 34.00 | |
| 26 | 2 | 300.00 | 34.00 | |
| 27 | 2 | 300.00 | 34.00 | |
| 28 | 2 | 300.00 | 34.00 | |

SOIL OPTIONS: A = ANISOTROPIC, C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C),
F = FIBER-REINFORCED SOIL (FRS), N = NONLINEAR UNDRAINED SHEAR STRENGTH,
R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
NOTE: Phi and C in Table 4 are modified values based on specified
Soil Options (if any).

***TABLE 3 - Effective and Base Shear Stress Data on the 28 Slices***

| Slice No. * | Alpha (deg) | X-Coord. Slice Cntr (ft) | Base Leng. (ft) | Effective Normal Stress (psf) | Available Shear Strength (psf) | Mobilized Shear Stress (psf) |
|---|---|---|---|---|---|---|
| 1 | -0.25 | 426.92 | 5.00 | 151.04 | 401.88 | 258.23 |
| 1 | -0.25 | 426.92 | 5.00 | 151.04 | 401.88 | 258.23 |
| 2 | -0.25 | 431.92 | 5.00 | 451.44 | 604.50 | 388.42 |
| 2 | -0.25 | 431.92 | 5.00 | 451.44 | 604.50 | 388.42 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | 3.70 | 436.92 | 5.00 | 696.85 | 770.03 | 494.78 |
| 3 | 3.70 | 436.92 | 5.00 | 696.85 | 770.03 | 494.78 |
| 4 | 3.70 | 441.91 | 5.00 | 947.70 | 939.23 | 603.50 |
| 4 | 3.70 | 441.91 | 5.00 | 947.70 | 939.23 | 603.50 |
| 5 | 7.66 | 446.88 | 5.00 | 1131.59 | 1063.27 | 683.19 |
| 5 | 7.66 | 446.88 | 5.00 | 1131.59 | 1063.27 | 683.19 |
| 6 | 7.66 | 451.84 | 5.00 | 1334.45 | 1200.10 | 771.11 |
| 6 | 7.66 | 451.84 | 5.00 | 1334.45 | 1200.10 | 771.11 |
| 7 | 11.62 | 456.76 | 5.00 | 1461.41 | 1285.73 | 826.14 |
| 7 | 11.62 | 456.76 | 5.00 | 1461.41 | 1285.73 | 826.14 |
| 8 | 11.62 | 461.66 | 5.00 | 1617.91 | 1391.29 | 893.97 |
| 8 | 11.62 | 461.66 | 5.00 | 1617.91 | 1391.29 | 893.97 |
| 9 | 15.57 | 466.52 | 5.00 | 1692.07 | 1441.31 | 926.11 |
| 9 | 15.57 | 466.52 | 5.00 | 1692.07 | 1441.31 | 926.11 |
| 10 | 15.57 | 471.33 | 5.00 | 1803.91 | 1516.75 | 974.58 |
| 10 | 15.57 | 471.33 | 5.00 | 1803.91 | 1516.75 | 974.58 |
| 11 | 19.53 | 476.10 | 5.00 | 1829.11 | 1533.75 | 985.50 |
| 11 | 19.53 | 476.10 | 5.00 | 1829.11 | 1533.75 | 985.50 |
| 12 | 19.53 | 480.81 | 5.00 | 1898.15 | 1580.32 | 1015.42 |
| 12 | 19.53 | 480.81 | 5.00 | 1898.15 | 1580.32 | 1015.42 |
| 13 | 23.48 | 485.46 | 5.00 | 1878.14 | 1566.82 | 1006.75 |
| 13 | 23.48 | 485.46 | 5.00 | 1878.14 | 1566.82 | 1006.75 |
| 14 | 23.48 | 490.05 | 5.00 | 1906.37 | 1585.86 | 1018.99 |
| 14 | 23.48 | 490.05 | 5.00 | 1906.37 | 1585.86 | 1018.99 |
| 15 | 27.44 | 494.56 | 5.00 | 1844.92 | 1544.41 | 992.35 |
| 15 | 27.44 | 494.56 | 5.00 | 1844.92 | 1544.41 | 992.35 |
| 16 | 27.44 | 499.00 | 5.00 | 1834.51 | 1537.40 | 987.84 |
| 16 | 27.44 | 499.00 | 5.00 | 1834.51 | 1537.40 | 987.84 |
| 17 | 31.39 | 503.35 | 5.00 | 1735.55 | 1470.64 | 944.95 |
| 17 | 31.39 | 503.35 | 5.00 | 1735.55 | 1470.64 | 944.95 |
| 18 | 31.39 | 507.62 | 5.00 | 1688.89 | 1439.17 | 924.73 |
| 18 | 31.39 | 507.62 | 5.00 | 1688.89 | 1439.17 | 924.73 |
| 19 | 35.35 | 511.79 | 5.00 | 1556.60 | 1349.94 | 867.40 |
| 19 | 35.35 | 511.79 | 5.00 | 1556.60 | 1349.94 | 867.40 |
| 20 | 35.35 | 515.87 | 5.00 | 1476.30 | 1295.78 | 832.59 |
| 20 | 35.35 | 515.87 | 5.00 | 1476.30 | 1295.78 | 832.59 |
| 21 | 39.31 | 518.05 | 0.38 | 1366.63 | 1221.80 | 785.06 |
| 21 | 39.31 | 518.05 | 0.38 | 1366.63 | 1221.80 | 785.06 |
| 22 | 39.31 | 520.06 | 4.81 | 1266.22 | 1154.07 | 741.54 |
| 22 | 39.31 | 520.06 | 4.81 | 1266.22 | 1154.07 | 741.54 |
| 23 | 39.31 | 523.78 | 4.81 | 1073.82 | 1024.30 | 658.16 |
| 23 | 39.31 | 523.78 | 4.81 | 1073.82 | 1024.30 | 658.16 |
| 24 | 43.26 | 526.57 | 2.55 | 868.50 | 885.81 | 569.17 |
| 24 | 43.26 | 526.57 | 2.55 | 868.50 | 885.81 | 569.17 |
| 25 | 43.26 | 528.86 | 3.73 | 709.73 | 778.72 | 500.36 |
| 25 | 43.26 | 528.86 | 3.73 | 709.73 | 778.72 | 500.36 |
| 26 | 43.26 | 531.57 | 3.73 | 503.98 | 639.94 | 411.19 |
| 26 | 43.26 | 531.57 | 3.73 | 503.98 | 639.94 | 411.19 |
| 27 | 47.22 | 534.43 | 4.44 | 239.65 | 461.64 | 296.63 |
| 27 | 47.22 | 534.43 | 4.44 | 239.65 | 461.64 | 296.63 |
| 28 | 47.22 | 537.45 | 4.44 | 126.86 | 85.57 | 54.98 |
| 28 | 47.22 | 537.45 | 4.44 | 126.86 | 85.57 | 54.98 |

***Table 4 - Base Force Data on the 28 Slices***

| Slice No. * | Alpha (deg) | X-Coord. Slice Cntr (ft) | Base Leng. (ft) | Effective Normal Force (lbs) | Available Shear Force (lbs) | Mobilized Shear Force (lbs) |
|---|---|---|---|---|---|---|
| 1 | -0.25 | 426.92 | 5.00 | 755.22 | 2009.40 | 1291.13 |
| 1 | -0.25 | 426.92 | 5.00 | 755.22 | 2009.40 | 1291.13 |
| 2 | -0.25 | 431.92 | 5.00 | 2257.22 | 3022.51 | 1942.10 |
| 2 | -0.25 | 431.92 | 5.00 | 2257.22 | 3022.51 | 1942.10 |
| 3 | 3.70 | 436.92 | 5.00 | 3484.27 | 3850.17 | 2473.91 |
| 3 | 3.70 | 436.92 | 5.00 | 3484.27 | 3850.17 | 2473.91 |
| 4 | 3.70 | 441.91 | 5.00 | 4738.50 | 4696.16 | 3017.49 |
| 4 | 3.70 | 441.91 | 5.00 | 4738.50 | 4696.16 | 3017.49 |
| 5 | 7.66 | 446.88 | 5.00 | 5657.94 | 5316.33 | 3415.97 |
| 5 | 7.66 | 446.88 | 5.00 | 5657.94 | 5316.33 | 3415.97 |
| 6 | 7.66 | 451.84 | 5.00 | 6672.24 | 6000.48 | 3855.57 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | 7.66 | 451.84 | 5.00 | 6672.24 | 6000.48 | 3855.57 |
| 7 | 11.62 | 456.76 | 5.00 | 7307.05 | 6428.67 | 4130.70 |
| 7 | 11.62 | 456.76 | 5.00 | 7307.05 | 6428.67 | 4130.70 |
| 8 | 11.62 | 461.66 | 5.00 | 8089.53 | 6956.45 | 4469.83 |
| 8 | 11.62 | 461.66 | 5.00 | 8089.53 | 6956.45 | 4469.83 |
| 9 | 15.57 | 466.52 | 5.00 | 8460.33 | 7206.56 | 4630.53 |
| 9 | 15.57 | 466.52 | 5.00 | 8460.33 | 7206.56 | 4630.53 |
| 10 | 15.57 | 471.33 | 5.00 | 9019.55 | 7583.76 | 4872.90 |
| 10 | 15.57 | 471.33 | 5.00 | 9019.55 | 7583.76 | 4872.90 |
| 11 | 19.53 | 476.10 | 5.00 | 9145.57 | 7668.77 | 4927.52 |
| 11 | 19.53 | 476.10 | 5.00 | 9145.57 | 7668.77 | 4927.52 |
| 12 | 19.53 | 480.81 | 5.00 | 9490.76 | 7901.60 | 5077.12 |
| 12 | 19.53 | 480.81 | 5.00 | 9490.76 | 7901.60 | 5077.12 |
| 13 | 23.48 | 485.46 | 5.00 | 9390.71 | 7834.12 | 5033.77 |
| 13 | 23.48 | 485.46 | 5.00 | 9390.71 | 7834.12 | 5033.77 |
| 14 | 23.48 | 490.05 | 5.00 | 9531.85 | 7929.31 | 5094.93 |
| 14 | 23.48 | 490.05 | 5.00 | 9531.85 | 7929.31 | 5094.93 |
| 15 | 27.44 | 494.56 | 5.00 | 9224.59 | 7722.07 | 4961.77 |
| 15 | 27.44 | 494.56 | 5.00 | 9224.59 | 7722.07 | 4961.77 |
| 16 | 27.44 | 499.00 | 5.00 | 9172.57 | 7686.98 | 4939.22 |
| 16 | 27.44 | 499.00 | 5.00 | 9172.57 | 7686.98 | 4939.22 |
| 17 | 31.39 | 503.35 | 5.00 | 8677.73 | 7353.20 | 4724.76 |
| 17 | 31.39 | 503.35 | 5.00 | 8677.73 | 7353.20 | 4724.76 |
| 18 | 31.39 | 507.62 | 5.00 | 8444.44 | 7195.85 | 4623.65 |
| 18 | 31.39 | 507.62 | 5.00 | 8444.44 | 7195.85 | 4623.65 |
| 19 | 35.35 | 511.79 | 5.00 | 7783.01 | 6749.71 | 4336.99 |
| 19 | 35.35 | 511.79 | 5.00 | 7783.01 | 6749.71 | 4336.99 |
| 20 | 35.35 | 515.87 | 5.00 | 7381.51 | 6478.89 | 4162.97 |
| 20 | 35.35 | 515.87 | 5.00 | 7381.51 | 6478.89 | 4162.97 |
| 21 | 39.31 | 518.05 | 0.38 | 518.71 | 463.74 | 297.97 |
| 21 | 39.31 | 518.05 | 0.38 | 518.71 | 463.74 | 297.97 |
| 22 | 39.31 | 520.06 | 4.81 | 6090.78 | 5551.35 | 3566.99 |
| 22 | 39.31 | 520.06 | 4.81 | 6090.78 | 5551.35 | 3566.99 |
| 23 | 39.31 | 523.78 | 4.81 | 5165.32 | 4927.12 | 3165.89 |
| 23 | 39.31 | 523.78 | 4.81 | 5165.32 | 4927.12 | 3165.89 |
| 24 | 43.26 | 526.57 | 2.55 | 2213.54 | 2257.66 | 1450.65 |
| 24 | 43.26 | 526.57 | 2.55 | 2213.54 | 2257.66 | 1450.65 |
| 25 | 43.26 | 528.86 | 3.73 | 2644.22 | 2901.24 | 1864.18 |
| 25 | 43.26 | 528.86 | 3.73 | 2644.22 | 2901.24 | 1864.18 |
| 26 | 43.26 | 531.57 | 3.73 | 1877.65 | 2384.18 | 1531.94 |
| 26 | 43.26 | 531.57 | 3.73 | 1877.65 | 2384.18 | 1531.94 |
| 27 | 47.22 | 534.43 | 4.44 | 1063.55 | 2048.77 | 1316.43 |
| 27 | 47.22 | 534.43 | 4.44 | 1063.55 | 2048.77 | 1316.43 |
| 28 | 47.22 | 537.45 | 4.44 | 563.00 | 379.75 | 244.00 |
| 28 | 47.22 | 537.45 | 4.44 | 563.00 | 379.75 | 244.00 |

SUM OF MOMENTS = -0.194310E+00 (ft/lbs);Imbalance (Fraction of Total Weight) = -0.1052579E-05

Sum of the Resisting Forces = 148504.80 (lbs)

Average Available Shear Strength = 1152.31(psf)

Sum of the Driving Forces = 95420.88 (lbs)

Average Mobilized Shear Stress = 740.41(psf)

Total length of the failure surface = 128.88(ft)

Factor of Safety Balance Check: FS = 1.55631

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

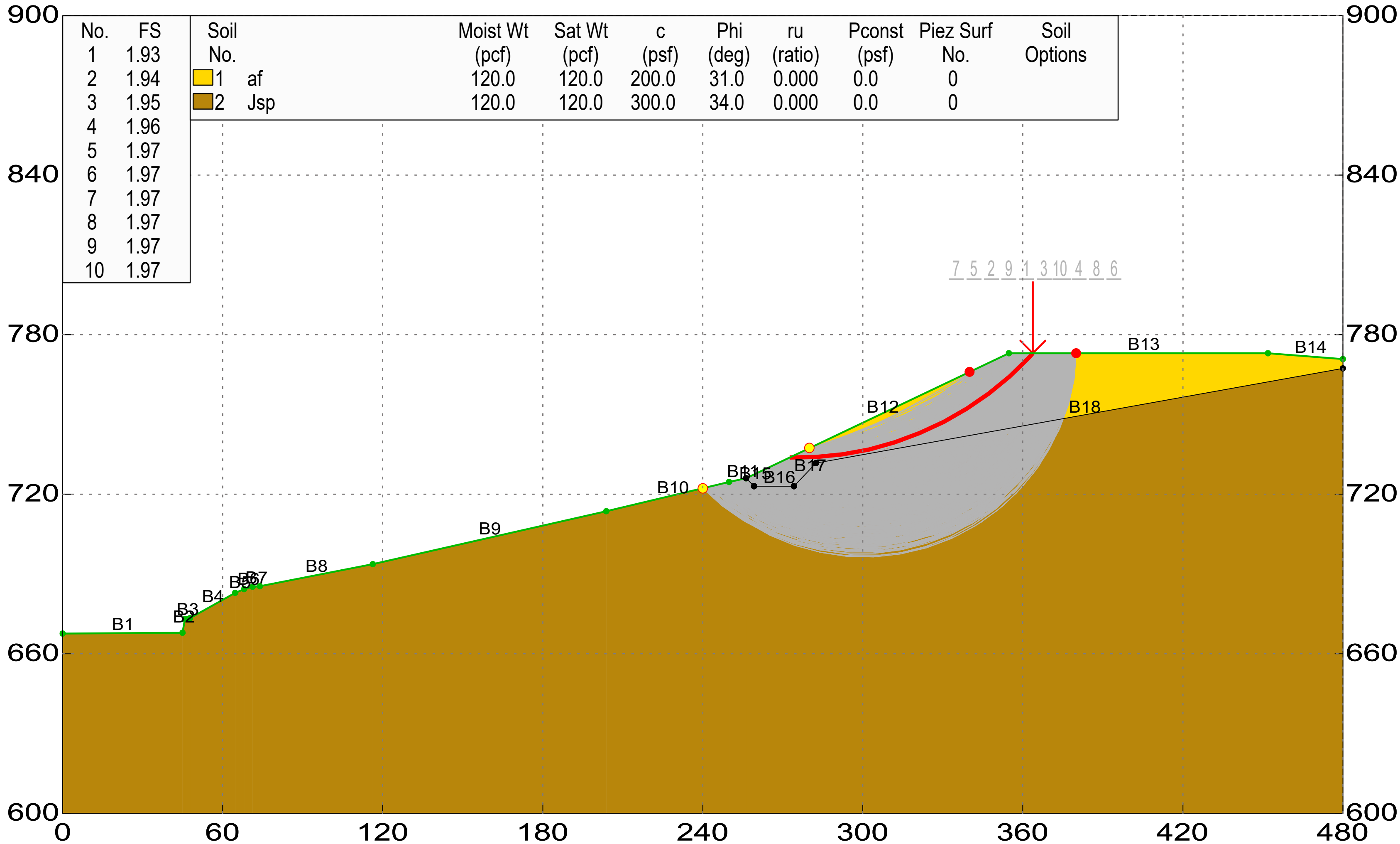
*** SEISMIC SLOPE DISPLACEMENT DATA ***
(Note: kv is set = zero for displacement calculations)
Seismic Yield Coefficient (ky) = 0.43106(g)
Calculated Newmark Seismic Displacement = 0.000(ft)

```
Average Elevation of Point of Application of kh on Sliding Mass =  713.400(ft)

Non-Symmetrical Sliding Resistance Has Been Specified
for Downhill Sliding.

              **** END OF GEOSTASE OUTPUT ****
```

# Meritage - Twin Oaks, San Marcos
# Section 7-7' (Static) - Local

LGC Geotechnical / BPP

\Section 7 - Static.gsd




GEOSTASE FS = 1.93

Simplified Bishop Method

GEOSTASE Slope Stability Analysis

GREGORY GEOTECHNICAL

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

*** GEOSTASE(R) ***

** GEOSTASE(R) (c)Copyright by Garry H. Gregory, Ph.D., P.E.,D.GE **

** Current Version 4.30.31-Double Precision, August 2019 **


*****************************************************************************
SLOPE STABILITY ANALYSIS SOFTWARE
Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
(Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
Including Pier/Pile, Planar Reinf, Nail, Tieback, Line Loads
Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
Nonlinear Undrained Shear Strength, Curved Strength Envelope,
Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
*****************************************************************************

Analysis Date: 8/ 22/ 2024
Analysis Time:
Analysis By: LGC Geotechnical / BPP
Input File Name: Z:\2024\24032-01 Meritage - Twin Oaks, San Marcos \Engineering\Slope Stability Analysis\7-7'\2024_08_05\Section 7 - Static.gsd
Output File Name: Z:\2024\24032-01 Meritage - Twin Oaks, San Marcos \Engineering\Slope Stability Analysis\7-7'\2024_08_05\Section 7 - Static.OUT
Unit System: English

PROJECT: Meritage - Twin Oaks, San Marcos

DESCRIPTION: Section 7-7' (Static) - Local

BOUNDARY DATA

14 Surface Boundaries
18 Total Boundaries

| Boundary No. | X - 1 (ft) | Y - 1 (ft) | X - 2 (ft) | Y - 2 (ft) | Soil Type Below Bnd |
|---|---|---|---|---|---|
| 1 | 0.000 | 667.600 | 44.900 | 667.900 | 2 |
| 2 | 44.900 | 667.900 | 45.800 | 673.100 | 2 |
| 3 | 45.800 | 673.100 | 47.700 | 673.400 | 2 |
| 4 | 47.700 | 673.400 | 64.700 | 682.900 | 2 |
| 5 | 64.700 | 682.900 | 68.000 | 684.300 | 2 |
| 6 | 68.000 | 684.300 | 71.200 | 685.200 | 2 |
| 7 | 71.200 | 685.200 | 73.900 | 685.400 | 2 |
| 8 | 73.900 | 685.400 | 116.300 | 693.700 | 2 |
| 9 | 116.300 | 693.700 | 203.800 | 713.600 | 2 |
| 10 | 203.800 | 713.600 | 249.900 | 724.600 | 2 |
| 11 | 249.900 | 724.600 | 256.200 | 726.000 | 2 |
| 12 | 256.200 | 726.000 | 354.800 | 773.000 | 1 |
| 13 | 354.800 | 773.000 | 451.900 | 773.000 | 1 |
| 14 | 451.900 | 773.000 | 480.000 | 770.800 | 1 |
| 15 | 256.200 | 726.000 | 259.200 | 723.000 | 2 |
| 16 | 259.200 | 723.000 | 274.200 | 723.000 | 2 |
| 17 | 274.200 | 723.000 | 282.400 | 731.700 | 2 |
| 18 | 282.400 | 731.700 | 480.000 | 767.300 | 2 |

User Specified X-Origin = 0.000(ft)

User Specified Y-Origin = 600.000(ft)

MOHR-COULOMB SOIL PARAMETERS

2 Type(s) of Soil Defined

| Soil Number and Description | Moist Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Pore Pressure Ratio(ru) | Pressure Constant (psf) | Water Surface No. | Water Option |
|---|---|---|---|---|---|---|---|---|
| 1 af | 120.0 | 120.0 | 200.00 | 31.00 | 0.000 | 0.0 | 0 | 0 |
| 2 Jsp | 120.0 | 120.0 | 300.00 | 34.00 | 0.000 | 0.0 | 0 | 0 |

Drained Shear Strength Reduction Factor applied after first stage = 1.0000

TRIAL FAILURE SURFACE DATA

Circular Trial Failure Surfaces Have Been Generated Using A Random Procedure.

1000 Trial Surfaces Have Been Generated.

1000 Surfaces Generated at Increments of 0.4805(in) Equally Spaced Within the Start Range

Along The Specified Surface Between X = 240.00(ft)
and X = 280.00(ft)

Each Surface Enters within a Range Between X = 340.00(ft)
and X = 380.00(ft)

Unless XCLUDE Lines Were Specified, The Minimum Elevation
To Which A Surface Extends Is Y = 600.00(ft)

Specified Maximum Radius = 10000.000(ft)

10.000(ft) Line Segments Were Used For Each Trial Failure Surface.

The Simplified Bishop Method Was Selected for FS Analysis.

Total Number of Trial Surfaces Attempted = 1000

Number of Trial Surfaces With Valid FS = 1000

Statistical Data On All Valid FS Values:
FS Max = 3.890 FS Min = 1.929 FS Ave = 2.673
Standard Deviation = 0.480 Coefficient of Variation = 17.97 %

Critical Surface is Sequence Number 814 of Those Analyzed.

*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****

BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

Circle Center At X = 275.427121(ft) ; Y = 852.986689(ft); and Radius = 119.226520(ft)

Circular Trial Failure Surface Generated With 12 Coordinate Points

| Point No. | X-Coord. (ft) | Y-Coord. (ft) |
|---|---|---|
| 1 | 272.553 | 733.795 |
| 2 | 282.551 | 733.973 |
| 3 | 292.499 | 734.989 |
| 4 | 302.327 | 736.834 |
| 5 | 311.966 | 739.497 |

| | | |
|---|---|---|
| 6 | 321.348 | 742.958 |
| 7 | 330.407 | 747.194 |
| 8 | 339.079 | 752.173 |
| 9 | 347.304 | 757.862 |
| 10 | 355.022 | 764.220 |
| 11 | 362.181 | 771.202 |
| 12 | 363.739 | 773.000 |

Factor Of Safety For The Critical or Specified Surface = 1.929

***Table 1 - Geometry Data on the 22 Slices***

| Slice No. | Width (ft) | Height (ft) | X-Cntr (ft) | Y-Cntr-Base (ft) | Y-Cntr-Top (ft) | Alpha (deg) | Beta (deg) | Base Length (ft) |
|---|---|---|---|---|---|---|---|---|
| 1 | 5.00 | 1.15 | 275.05 | 733.84 | 734.99 | 1.02 | 25.49 | 5.00 |
| 2 | 5.00 | 3.44 | 280.05 | 733.93 | 737.37 | 1.02 | 25.49 | 5.00 |
| 3 | 4.97 | 5.52 | 285.04 | 734.23 | 739.75 | 5.83 | 25.49 | 5.00 |
| 4 | 4.97 | 7.38 | 290.01 | 734.73 | 742.12 | 5.83 | 25.49 | 5.00 |
| 5 | 4.91 | 9.02 | 294.96 | 735.45 | 744.47 | 10.64 | 25.49 | 5.00 |
| 6 | 4.91 | 10.44 | 299.87 | 736.37 | 746.82 | 10.64 | 25.49 | 5.00 |
| 7 | 4.82 | 11.64 | 304.74 | 737.50 | 749.14 | 15.44 | 25.49 | 5.00 |
| 8 | 4.82 | 12.60 | 309.56 | 738.83 | 751.43 | 15.44 | 25.49 | 5.00 |
| 9 | 4.69 | 13.34 | 314.31 | 740.36 | 753.70 | 20.25 | 25.49 | 5.00 |
| 10 | 4.69 | 13.84 | 319.00 | 742.09 | 755.94 | 20.25 | 25.49 | 5.00 |
| 11 | 4.53 | 14.12 | 323.61 | 744.02 | 758.13 | 25.06 | 25.49 | 5.00 |
| 12 | 4.53 | 14.16 | 328.14 | 746.13 | 760.29 | 25.06 | 25.49 | 5.00 |
| 13 | 4.34 | 13.97 | 332.58 | 748.44 | 762.41 | 29.86 | 25.49 | 5.00 |
| 14 | 4.34 | 13.54 | 336.91 | 750.93 | 764.47 | 29.86 | 25.49 | 5.00 |
| 15 | 4.11 | 12.89 | 341.14 | 753.60 | 766.49 | 34.67 | 25.49 | 5.00 |
| 16 | 4.11 | 12.01 | 345.25 | 756.44 | 768.45 | 34.67 | 25.49 | 5.00 |
| 17 | 3.75 | 10.91 | 349.18 | 759.41 | 770.32 | 39.48 | 25.49 | 4.86 |
| 18 | 3.75 | 9.61 | 352.93 | 762.49 | 772.11 | 39.48 | 25.49 | 4.86 |
| 19 | 0.22 | 8.87 | 354.91 | 764.13 | 773.00 | 39.48 | 0.00 | 0.29 |
| 20 | 3.58 | 7.03 | 356.81 | 765.97 | 773.00 | 44.29 | 0.00 | 5.00 |
| 21 | 3.58 | 3.54 | 360.39 | 769.46 | 773.00 | 44.29 | 0.00 | 5.00 |
| 22 | 1.56 | 0.90 | 362.96 | 772.10 | 773.00 | 49.09 | 0.00 | 2.38 |

***Table 2 - Force Data On The 22 Slices (Excluding Reinforcement)***

| Slice No. | Weight (lbs) | Ubeta Force Top (lbs) | Ualpha Force Bot (lbs) | Earthquake Force Hor (lbs) | Earthquake Force Ver (lbs) | Distributed Load (lbs) |
|---|---|---|---|---|---|---|
| 1 | 688.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | 2064.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3 | 3294.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 | 4406.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 5 | 5321.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 6 | 6158.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 7 | 6729.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 8 | 7288.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 9 | 7508.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 10 | 7792.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11 | 7672.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12 | 7695.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13 | 7267.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 14 | 7047.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 15 | 6361.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 16 | 5924.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 17 | 4909.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 18 | 4324.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 19 | 236.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 20 | 3021.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 21 | 1522.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 22 | 168.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

TOTAL WEIGHT OF SLIDING MASS = 107402.66(lbs)

EFFECTIVE WEIGHT OF SLIDING MASS = 107402.66(lbs)

TOTAL AREA OF SLIDING MASS = 895.02(ft2)

***TABLE 2A - SOIL STRENGTH & SOIL OPTIONS DATA ON THE 22 SLICES***

| Slice No. | Soil Type | Cohesion (psf) | Phi(Deg) | Options |
|---|---|---|---|---|
| 1 | 1 | 200.00 | 31.00 | |
| 2 | 1 | 200.00 | 31.00 | |
| 3 | 1 | 200.00 | 31.00 | |
| 4 | 1 | 200.00 | 31.00 | |
| 5 | 1 | 200.00 | 31.00 | |
| 6 | 1 | 200.00 | 31.00 | |
| 7 | 1 | 200.00 | 31.00 | |
| 8 | 1 | 200.00 | 31.00 | |
| 9 | 1 | 200.00 | 31.00 | |
| 10 | 1 | 200.00 | 31.00 | |
| 11 | 1 | 200.00 | 31.00 | |
| 12 | 1 | 200.00 | 31.00 | |
| 13 | 1 | 200.00 | 31.00 | |
| 14 | 1 | 200.00 | 31.00 | |
| 15 | 1 | 200.00 | 31.00 | |
| 16 | 1 | 200.00 | 31.00 | |
| 17 | 1 | 200.00 | 31.00 | |
| 18 | 1 | 200.00 | 31.00 | |
| 19 | 1 | 200.00 | 31.00 | |
| 20 | 1 | 200.00 | 31.00 | |
| 21 | 1 | 200.00 | 31.00 | |
| 22 | 1 | 200.00 | 31.00 | |

SOIL OPTIONS: A = ANISOTROPIC, C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C),
F = FIBER-REINFORCED SOIL (FRS), N = NONLINEAR UNDRAINED SHEAR STRENGTH,
R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
NOTE: Phi and C in Table 4 are modified values based on specified
Soil Options (if any).

***TABLE 3 - Effective and Base Shear Stress Data on the 22 Slices***

| Slice No. * | Alpha (deg) | X-Coord. Slice Cntr (ft) | Base Leng. (ft) | Effective Normal Stress (psf) | Available Shear Strength (psf) | Mobilized Shear Stress (psf) |
|---|---|---|---|---|---|---|
| 1 | 1.02 | 275.05 | 5.00 | 135.03 | 281.13 | 145.72 |
| 1 | 1.02 | 275.05 | 5.00 | 135.03 | 281.13 | 145.72 |
| 2 | 1.02 | 280.05 | 5.00 | 408.76 | 445.61 | 230.98 |
| 2 | 1.02 | 280.05 | 5.00 | 408.76 | 445.61 | 230.98 |
| 3 | 5.83 | 285.04 | 5.00 | 631.63 | 579.52 | 300.39 |
| 3 | 5.83 | 285.04 | 5.00 | 631.63 | 579.52 | 300.39 |
| 4 | 5.83 | 290.01 | 5.00 | 848.33 | 709.73 | 367.88 |
| 4 | 5.83 | 290.01 | 5.00 | 848.33 | 709.73 | 367.88 |
| 5 | 10.64 | 294.96 | 5.00 | 1004.60 | 803.63 | 416.56 |
| 5 | 10.64 | 294.96 | 5.00 | 1004.60 | 803.63 | 416.56 |
| 6 | 10.64 | 299.87 | 5.00 | 1165.54 | 900.32 | 466.68 |
| 6 | 10.64 | 299.87 | 5.00 | 1165.54 | 900.32 | 466.68 |
| 7 | 15.44 | 304.74 | 5.00 | 1259.29 | 956.66 | 495.88 |
| 7 | 15.44 | 304.74 | 5.00 | 1259.29 | 956.66 | 495.88 |
| 8 | 15.44 | 309.56 | 5.00 | 1366.02 | 1020.79 | 529.12 |
| 8 | 15.44 | 309.56 | 5.00 | 1366.02 | 1020.79 | 529.12 |
| 9 | 20.25 | 314.31 | 5.00 | 1401.20 | 1041.93 | 540.08 |
| 9 | 20.25 | 314.31 | 5.00 | 1401.20 | 1041.93 | 540.08 |
| 10 | 20.25 | 319.00 | 5.00 | 1455.60 | 1074.61 | 557.02 |
| 10 | 20.25 | 319.00 | 5.00 | 1455.60 | 1074.61 | 557.02 |
| 11 | 25.06 | 323.61 | 5.00 | 1436.28 | 1063.01 | 551.01 |
| 11 | 25.06 | 323.61 | 5.00 | 1436.28 | 1063.01 | 551.01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 12 | 25.06 | 328.14 | 5.00 | 1440.63 | 1065.62 | 552.36 |
| 12 | 25.06 | 328.14 | 5.00 | 1440.63 | 1065.62 | 552.36 |
| 13 | 29.86 | 332.58 | 5.00 | 1371.21 | 1023.91 | 530.74 |
| 13 | 29.86 | 332.58 | 5.00 | 1371.21 | 1023.91 | 530.74 |
| 14 | 29.86 | 336.91 | 5.00 | 1328.17 | 998.05 | 517.33 |
| 14 | 29.86 | 336.91 | 5.00 | 1328.17 | 998.05 | 517.33 |
| 15 | 34.67 | 341.14 | 5.00 | 1213.63 | 929.22 | 481.66 |
| 15 | 34.67 | 341.14 | 5.00 | 1213.63 | 929.22 | 481.66 |
| 16 | 34.67 | 345.25 | 5.00 | 1126.34 | 876.77 | 454.47 |
| 16 | 34.67 | 345.25 | 5.00 | 1126.34 | 876.77 | 454.47 |
| 17 | 39.48 | 349.18 | 4.86 | 974.26 | 785.39 | 407.11 |
| 17 | 39.48 | 349.18 | 4.86 | 974.26 | 785.39 | 407.11 |
| 18 | 39.48 | 352.93 | 4.86 | 850.05 | 710.76 | 368.42 |
| 18 | 39.48 | 352.93 | 4.86 | 850.05 | 710.76 | 368.42 |
| 19 | 39.48 | 354.91 | 0.29 | 779.20 | 668.19 | 346.36 |
| 19 | 39.48 | 354.91 | 0.29 | 779.20 | 668.19 | 346.36 |
| 20 | 44.29 | 356.81 | 5.00 | 569.83 | 542.39 | 281.15 |
| 20 | 44.29 | 356.81 | 5.00 | 569.83 | 542.39 | 281.15 |
| 21 | 44.29 | 360.39 | 5.00 | 248.54 | 349.34 | 181.08 |
| 21 | 44.29 | 360.39 | 5.00 | 248.54 | 349.34 | 181.08 |
| 22 | 49.09 | 362.96 | 2.38 | 79.35 | 47.68 | 24.71 |
| 22 | 49.09 | 362.96 | 2.38 | 79.35 | 47.68 | 24.71 |

***Table 4 - Base Force Data on the 22 Slices***

| Slice No. * | Alpha (deg) | X-Coord. Slice Cntr (ft) | Base Leng. (ft) | Effective Normal Force (lbs) | Available Shear Force (lbs) | Mobilized Shear Force (lbs) |
|---|---|---|---|---|---|---|
| 1 | 1.02 | 275.05 | 5.00 | 675.14 | 1405.66 | 728.62 |
| 1 | 1.02 | 275.05 | 5.00 | 675.14 | 1405.66 | 728.62 |
| 2 | 1.02 | 280.05 | 5.00 | 2043.82 | 2228.05 | 1154.90 |
| 2 | 1.02 | 280.05 | 5.00 | 2043.82 | 2228.05 | 1154.90 |
| 3 | 5.83 | 285.04 | 5.00 | 3158.14 | 2897.60 | 1501.96 |
| 3 | 5.83 | 285.04 | 5.00 | 3158.14 | 2897.60 | 1501.96 |
| 4 | 5.83 | 290.01 | 5.00 | 4241.63 | 3548.63 | 1839.42 |
| 4 | 5.83 | 290.01 | 5.00 | 4241.63 | 3548.63 | 1839.42 |
| 5 | 10.64 | 294.96 | 5.00 | 5023.02 | 4018.14 | 2082.79 |
| 5 | 10.64 | 294.96 | 5.00 | 5023.02 | 4018.14 | 2082.79 |
| 6 | 10.64 | 299.87 | 5.00 | 5827.68 | 4501.62 | 2333.40 |
| 6 | 10.64 | 299.87 | 5.00 | 5827.68 | 4501.62 | 2333.40 |
| 7 | 15.44 | 304.74 | 5.00 | 6296.47 | 4783.30 | 2479.41 |
| 7 | 15.44 | 304.74 | 5.00 | 6296.47 | 4783.30 | 2479.41 |
| 8 | 15.44 | 309.56 | 5.00 | 6830.09 | 5103.93 | 2645.60 |
| 8 | 15.44 | 309.56 | 5.00 | 6830.09 | 5103.93 | 2645.60 |
| 9 | 20.25 | 314.31 | 5.00 | 7006.01 | 5209.63 | 2700.40 |
| 9 | 20.25 | 314.31 | 5.00 | 7006.01 | 5209.63 | 2700.40 |
| 10 | 20.25 | 319.00 | 5.00 | 7278.02 | 5373.07 | 2785.11 |
| 10 | 20.25 | 319.00 | 5.00 | 7278.02 | 5373.07 | 2785.11 |
| 11 | 25.06 | 323.61 | 5.00 | 7181.42 | 5315.04 | 2755.03 |
| 11 | 25.06 | 323.61 | 5.00 | 7181.42 | 5315.04 | 2755.03 |
| 12 | 25.06 | 328.14 | 5.00 | 7203.13 | 5328.08 | 2761.79 |
| 12 | 25.06 | 328.14 | 5.00 | 7203.13 | 5328.08 | 2761.79 |
| 13 | 29.86 | 332.58 | 5.00 | 6856.07 | 5119.54 | 2653.70 |
| 13 | 29.86 | 332.58 | 5.00 | 6856.07 | 5119.54 | 2653.70 |
| 14 | 29.86 | 336.91 | 5.00 | 6640.86 | 4990.23 | 2586.67 |
| 14 | 29.86 | 336.91 | 5.00 | 6640.86 | 4990.23 | 2586.67 |
| 15 | 34.67 | 341.14 | 5.00 | 6068.13 | 4646.10 | 2408.29 |
| 15 | 34.67 | 341.14 | 5.00 | 6068.13 | 4646.10 | 2408.29 |
| 16 | 34.67 | 345.25 | 5.00 | 5631.69 | 4383.86 | 2272.36 |
| 16 | 34.67 | 345.25 | 5.00 | 5631.69 | 4383.86 | 2272.36 |
| 17 | 39.48 | 349.18 | 4.86 | 4731.04 | 3813.91 | 1976.92 |
| 17 | 39.48 | 349.18 | 4.86 | 4731.04 | 3813.91 | 1976.92 |
| 18 | 39.48 | 352.93 | 4.86 | 4127.88 | 3451.49 | 1789.07 |
| 18 | 39.48 | 352.93 | 4.86 | 4127.88 | 3451.49 | 1789.07 |
| 19 | 39.48 | 354.91 | 0.29 | 224.33 | 192.37 | 99.71 |
| 19 | 39.48 | 354.91 | 0.29 | 224.33 | 192.37 | 99.71 |
| 20 | 44.29 | 356.81 | 5.00 | 2849.16 | 2711.95 | 1405.73 |
| 20 | 44.29 | 356.81 | 5.00 | 2849.16 | 2711.95 | 1405.73 |
| 21 | 44.29 | 360.39 | 5.00 | 1242.69 | 1746.69 | 905.39 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 21 | 44.29 | 360.39 | 5.00 | 1242.69 | 1746.69 | 905.39 |
| 22 | 49.09 | 362.96 | 2.38 | 188.77 | 113.43 | 58.79 |
| 22 | 49.09 | 362.96 | 2.38 | 188.77 | 113.43 | 58.79 |

SUM OF MOMENTS = -0.838821E-01 (ft/lbs);Imbalance (Fraction of Total Weight) = -0.7810061E-06

Sum of the Resisting Forces = 80882.32 (lbs)

Average Available Shear Strength = 790.03(psf)

Sum of the Driving Forces = 41925.07 (lbs)

Average Mobilized Shear Stress = 409.51(psf)

Total length of the failure surface = 102.38(ft)

Factor of Safety Balance Check: FS = 1.92921

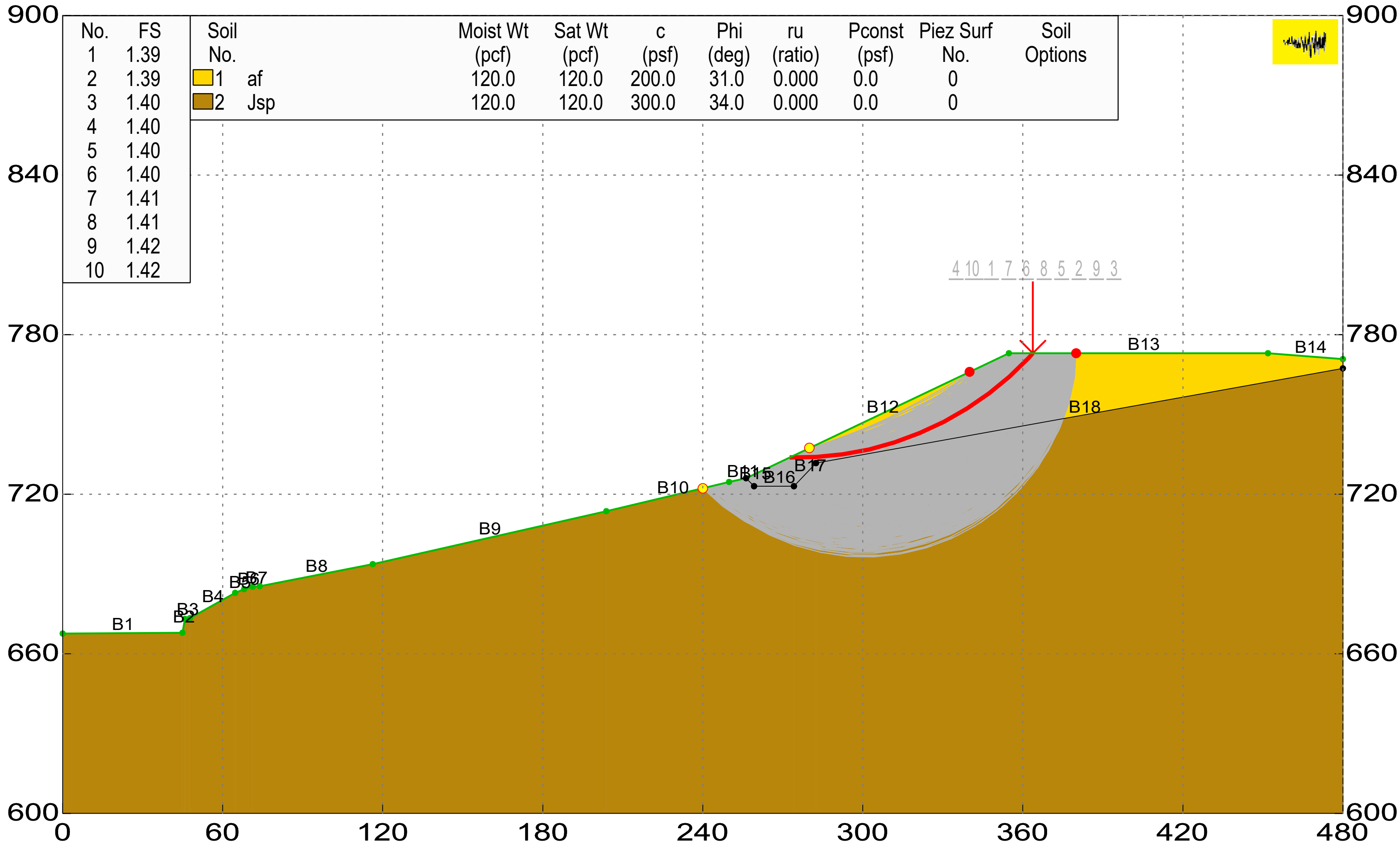
CAUTION - Factor Of Safety Is Calculated By The Simplified Bishop Method. This Method Is Valid Only If The Failure Surface Approximates A Circular Arc.

**** END OF GEOSTASE OUTPUT ****

# Meritage - Twin Oaks, San Marcos
# Section 7-7' (Seismic) - Local

LGC Geotechnical / BPP

\Section 7 - Seismic.gsd




| No. | FS |
|---|---|
| 1 | 1.39 |
| 2 | 1.39 |
| 3 | 1.40 |
| 4 | 1.40 |
| 5 | 1.40 |
| 6 | 1.40 |
| 7 | 1.41 |
| 8 | 1.41 |
| 9 | 1.42 |
| 10 | 1.42 |

| Soil No. | | Moist Wt (pcf) | Sat Wt (pcf) | c (psf) | Phi (deg) | ru (ratio) | Pconst (psf) | Piez Surf No. | Soil Options |
|---|---|---|---|---|---|---|---|---|---|
| 1 | af | 120.0 | 120.0 | 200.0 | 31.0 | 0.000 | 0.0 | 0 | |
| 2 | Jsp | 120.0 | 120.0 | 300.0 | 34.0 | 0.000 | 0.0 | 0 | |

GEOSTASE FS = 1.39

Simplified Bishop Method

kh = 0.15000

GEOSTASE Slope Stability Analysis

GREGORY GEOTECHNICAL

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

***  GEOSTASE(R)  ***



*******************************************************************************

SLOPE STABILITY ANALYSIS SOFTWARE
Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
(Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
Including Pier/Pile, Planar Reinf, Nail, Tieback, Line Loads
Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
Nonlinear Undrained Shear Strength, Curved Strength Envelope,
Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.

*******************************************************************************

Analysis Date: 8/ 22/ 2024
Analysis Time:
Analysis By: LGC Geotechnical / BPP
Input File Name: Z:\2024\24032-01 Meritage - Twin Oaks, San Marcos \Engineering\Slope Stability Analysis\7-7'\2024_08_05\Section 7 - Seismic.gsd
Output File Name: Z:\2024\24032-01 Meritage - Twin Oaks, San Marcos \Engineering\Slope Stability Analysis\7-7'\2024_08_05\Section 7 - Seismic.OUT
Unit System: English

PROJECT: Meritage - Twin Oaks, San Marcos

DESCRIPTION: Section 7-7' (Seismic) - Local

BOUNDARY DATA

14 Surface Boundaries
18 Total Boundaries

| Boundary No. | X - 1 (ft) | Y - 1 (ft) | X - 2 (ft) | Y - 2 (ft) | Soil Type Below Bnd |
|---|---|---|---|---|---|
| 1 | 0.000 | 667.600 | 44.900 | 667.900 | 2 |
| 2 | 44.900 | 667.900 | 45.800 | 673.100 | 2 |
| 3 | 45.800 | 673.100 | 47.700 | 673.400 | 2 |
| 4 | 47.700 | 673.400 | 64.700 | 682.900 | 2 |
| 5 | 64.700 | 682.900 | 68.000 | 684.300 | 2 |
| 6 | 68.000 | 684.300 | 71.200 | 685.200 | 2 |
| 7 | 71.200 | 685.200 | 73.900 | 685.400 | 2 |
| 8 | 73.900 | 685.400 | 116.300 | 693.700 | 2 |
| 9 | 116.300 | 693.700 | 203.800 | 713.600 | 2 |
| 10 | 203.800 | 713.600 | 249.900 | 724.600 | 2 |
| 11 | 249.900 | 724.600 | 256.200 | 726.000 | 2 |
| 12 | 256.200 | 726.000 | 354.800 | 773.000 | 1 |
| 13 | 354.800 | 773.000 | 451.900 | 773.000 | 1 |
| 14 | 451.900 | 773.000 | 480.000 | 770.800 | 1 |
| 15 | 256.200 | 726.000 | 259.200 | 723.000 | 2 |
| 16 | 259.200 | 723.000 | 274.200 | 723.000 | 2 |
| 17 | 274.200 | 723.000 | 282.400 | 731.700 | 2 |
| 18 | 282.400 | 731.700 | 480.000 | 767.300 | 2 |

User Specified X-Origin = 0.000(ft)

User Specified Y-Origin = 600.000(ft)

MOHR-COULOMB SOIL PARAMETERS

2 Type(s) of Soil Defined

| Soil Number and Description | Moist Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Pore Pressure Ratio(ru) | Pressure Constant (psf) | Water Surface No. | Water Option |
|---|---|---|---|---|---|---|---|---|
| 1 af | 120.0 | 120.0 | 200.00 | 31.00 | 0.000 | 0.0 | 0 | 0 |
| 2 Jsp | 120.0 | 120.0 | 300.00 | 34.00 | 0.000 | 0.0 | 0 | 0 |

Drained Shear Strength Reduction Factor applied after first stage = 1.0000

SEISMIC (EARTHQUAKE) DATA

Specified Peak Ground Acceleration Coefficient (PGA) = 0.000(g)
Default Velocity = 0.000(ft) per second
Specified Horizontal Earthquake Coefficient (kh) = 0.15000(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
(NOTE:Input Velocity = 0.0 will result in default Peak
Velocity = 2 times(PGA) times 2.5 fps or 0.762 mps)
Specified Seismic Pore-Pressure Factor = 0.000
Horizontal Seismic Force is Applied at Center of Gravity of Slices

TRIAL FAILURE SURFACE DATA

Circular Trial Failure Surfaces Have Been Generated Using A Random Procedure.

1000 Trial Surfaces Have Been Generated.

1000 Surfaces Generated at Increments of 0.4805(in) Equally Spaced Within the Start Range

Along The Specified Surface Between X = 240.00(ft)
and X = 280.00(ft)

Each Surface Enters within a Range Between X = 340.00(ft)
and X = 380.00(ft)

Unless XCLUDE Lines Were Specified, The Minimum Elevation
To Which A Surface Extends Is Y = 600.00(ft)

Specified Maximum Radius = 10000.000(ft)

10.000(ft) Line Segments Were Used For Each Trial Failure Surface.

The Simplified Bishop Method Was Selected for FS Analysis.

Total Number of Trial Surfaces Attempted = 1000

Number of Trial Surfaces With Valid FS = 1000

Statistical Data On All Valid FS Values:
FS Max = 2.798 FS Min = 1.390 FS Ave = 1.937
Standard Deviation = 0.357 Coefficient of Variation = 18.42 %

Critical Surface is Sequence Number 814 of Those Analyzed.

*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****

BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

Circle Center At X = 275.427121(ft) ; Y = 852.986689(ft); and Radius = 119.226520(ft)

Circular Trial Failure Surface Generated With 12 Coordinate Points

| Point No. | X-Coord. (ft) | Y-Coord. (ft) |
|---|---|---|
| 1 | 272.553 | 733.795 |
| 2 | 282.551 | 733.973 |
| 3 | 292.499 | 734.989 |
| 4 | 302.327 | 736.834 |
| 5 | 311.966 | 739.497 |
| 6 | 321.348 | 742.958 |
| 7 | 330.407 | 747.194 |
| 8 | 339.079 | 752.173 |
| 9 | 347.304 | 757.862 |
| 10 | 355.022 | 764.220 |
| 11 | 362.181 | 771.202 |
| 12 | 363.739 | 773.000 |

Factor Of Safety For The Critical or Specified Surface = 1.390

***Table 1 - Geometry Data on the 22 Slices***

| Slice No. | Width (ft) | Height (ft) | X-Cntr (ft) | Y-Cntr-Base (ft) | Y-Cntr-Top (ft) | Alpha (deg) | Beta (deg) | Base Length (ft) |
|---|---|---|---|---|---|---|---|---|
| 1 | 5.00 | 1.15 | 275.05 | 733.84 | 734.99 | 1.02 | 25.49 | 5.00 |
| 2 | 5.00 | 3.44 | 280.05 | 733.93 | 737.37 | 1.02 | 25.49 | 5.00 |
| 3 | 4.97 | 5.52 | 285.04 | 734.23 | 739.75 | 5.83 | 25.49 | 5.00 |
| 4 | 4.97 | 7.38 | 290.01 | 734.73 | 742.12 | 5.83 | 25.49 | 5.00 |
| 5 | 4.91 | 9.02 | 294.96 | 735.45 | 744.47 | 10.64 | 25.49 | 5.00 |
| 6 | 4.91 | 10.44 | 299.87 | 736.37 | 746.82 | 10.64 | 25.49 | 5.00 |
| 7 | 4.82 | 11.64 | 304.74 | 737.50 | 749.14 | 15.44 | 25.49 | 5.00 |
| 8 | 4.82 | 12.60 | 309.56 | 738.83 | 751.43 | 15.44 | 25.49 | 5.00 |
| 9 | 4.69 | 13.34 | 314.31 | 740.36 | 753.70 | 20.25 | 25.49 | 5.00 |
| 10 | 4.69 | 13.84 | 319.00 | 742.09 | 755.94 | 20.25 | 25.49 | 5.00 |
| 11 | 4.53 | 14.12 | 323.61 | 744.02 | 758.13 | 25.06 | 25.49 | 5.00 |
| 12 | 4.53 | 14.16 | 328.14 | 746.13 | 760.29 | 25.06 | 25.49 | 5.00 |
| 13 | 4.34 | 13.97 | 332.58 | 748.44 | 762.41 | 29.86 | 25.49 | 5.00 |
| 14 | 4.34 | 13.54 | 336.91 | 750.93 | 764.47 | 29.86 | 25.49 | 5.00 |
| 15 | 4.11 | 12.89 | 341.14 | 753.60 | 766.49 | 34.67 | 25.49 | 5.00 |
| 16 | 4.11 | 12.01 | 345.25 | 756.44 | 768.45 | 34.67 | 25.49 | 5.00 |
| 17 | 3.75 | 10.91 | 349.18 | 759.41 | 770.32 | 39.48 | 25.49 | 4.86 |
| 18 | 3.75 | 9.61 | 352.93 | 762.49 | 772.11 | 39.48 | 25.49 | 4.86 |
| 19 | 0.22 | 8.87 | 354.91 | 764.13 | 773.00 | 39.48 | 0.00 | 0.29 |
| 20 | 3.58 | 7.03 | 356.81 | 765.97 | 773.00 | 44.29 | 0.00 | 5.00 |
| 21 | 3.58 | 3.54 | 360.39 | 769.46 | 773.00 | 44.29 | 0.00 | 5.00 |
| 22 | 1.56 | 0.90 | 362.96 | 772.10 | 773.00 | 49.09 | 0.00 | 2.38 |

***Table 2 - Force Data On The 22 Slices (Excluding Reinforcement)***

| Slice No. | Weight (lbs) | Ubeta Force Top (lbs) | Ualpha Force Bot (lbs) | Earthquake Force Hor (lbs) | Earthquake Force Ver (lbs) | Distributed Load (lbs) |
|---|---|---|---|---|---|---|
| 1 | 688.0 | 0.0 | 0.0 | 103.2 | 0.0 | 0.0 |
| 2 | 2064.1 | 0.0 | 0.0 | 309.6 | 0.0 | 0.0 |
| 3 | 3294.4 | 0.0 | 0.0 | 494.2 | 0.0 | 0.0 |
| 4 | 4406.6 | 0.0 | 0.0 | 661.0 | 0.0 | 0.0 |
| 5 | 5321.3 | 0.0 | 0.0 | 798.2 | 0.0 | 0.0 |
| 6 | 6158.4 | 0.0 | 0.0 | 923.8 | 0.0 | 0.0 |
| 7 | 6729.7 | 0.0 | 0.0 | 1009.4 | 0.0 | 0.0 |
| 8 | 7288.3 | 0.0 | 0.0 | 1093.2 | 0.0 | 0.0 |
| 9 | 7508.0 | 0.0 | 0.0 | 1126.2 | 0.0 | 0.0 |
| 10 | 7792.6 | 0.0 | 0.0 | 1168.9 | 0.0 | 0.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 11 | 7672.9 | 0.0 | 0.0 | 1150.9 | 0.0 | 0.0 |
| 12 | 7695.4 | 0.0 | 0.0 | 1154.3 | 0.0 | 0.0 |
| 13 | 7267.6 | 0.0 | 0.0 | 1090.1 | 0.0 | 0.0 |
| 14 | 7047.6 | 0.0 | 0.0 | 1057.1 | 0.0 | 0.0 |
| 15 | 6361.2 | 0.0 | 0.0 | 954.2 | 0.0 | 0.0 |
| 16 | 5924.9 | 0.0 | 0.0 | 888.7 | 0.0 | 0.0 |
| 17 | 4909.2 | 0.0 | 0.0 | 736.4 | 0.0 | 0.0 |
| 18 | 4324.1 | 0.0 | 0.0 | 648.6 | 0.0 | 0.0 |
| 19 | 236.6 | 0.0 | 0.0 | 35.5 | 0.0 | 0.0 |
| 20 | 3021.6 | 0.0 | 0.0 | 453.2 | 0.0 | 0.0 |
| 21 | 1522.1 | 0.0 | 0.0 | 228.3 | 0.0 | 0.0 |
| 22 | 168.1 | 0.0 | 0.0 | 25.2 | 0.0 | 0.0 |

TOTAL WEIGHT OF SLIDING MASS = 107402.66(lbs)

EFFECTIVE WEIGHT OF SLIDING MASS = 107402.66(lbs)

TOTAL AREA OF SLIDING MASS = 895.02(ft2)

***TABLE 2A - SOIL STRENGTH & SOIL OPTIONS DATA ON THE 22 SLICES***

| Slice No. | Soil Type | Cohesion (psf) | Phi(Deg) | Options |
|---|---|---|---|---|
| 1 | 1 | 200.00 | 31.00 | |
| 2 | 1 | 200.00 | 31.00 | |
| 3 | 1 | 200.00 | 31.00 | |
| 4 | 1 | 200.00 | 31.00 | |
| 5 | 1 | 200.00 | 31.00 | |
| 6 | 1 | 200.00 | 31.00 | |
| 7 | 1 | 200.00 | 31.00 | |
| 8 | 1 | 200.00 | 31.00 | |
| 9 | 1 | 200.00 | 31.00 | |
| 10 | 1 | 200.00 | 31.00 | |
| 11 | 1 | 200.00 | 31.00 | |
| 12 | 1 | 200.00 | 31.00 | |
| 13 | 1 | 200.00 | 31.00 | |
| 14 | 1 | 200.00 | 31.00 | |
| 15 | 1 | 200.00 | 31.00 | |
| 16 | 1 | 200.00 | 31.00 | |
| 17 | 1 | 200.00 | 31.00 | |
| 18 | 1 | 200.00 | 31.00 | |
| 19 | 1 | 200.00 | 31.00 | |
| 20 | 1 | 200.00 | 31.00 | |
| 21 | 1 | 200.00 | 31.00 | |
| 22 | 1 | 200.00 | 31.00 | |

SOIL OPTIONS: A = ANISOTROPIC, C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C),
F = FIBER-REINFORCED SOIL (FRS), N = NONLINEAR UNDRAINED SHEAR STRENGTH,
R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
NOTE: Phi and C in Table 4 are modified values based on specified
Soil Options (if any).

***TABLE 3 - Effective and Base Shear Stress Data on the 22 Slices***

| Slice No. * | Alpha (deg) | X-Coord. Slice Cntr (ft) | Base Leng. (ft) | Effective Normal Stress (psf) | Available Shear Strength (psf) | Mobilized Shear Stress (psf) |
|---|---|---|---|---|---|---|
| 1 | 1.02 | 275.05 | 5.00 | 134.00 | 280.52 | 201.79 |
| 1 | 1.02 | 275.05 | 5.00 | 134.00 | 280.52 | 201.79 |
| 2 | 1.02 | 280.05 | 5.00 | 407.14 | 444.63 | 319.85 |
| 2 | 1.02 | 280.05 | 5.00 | 407.14 | 444.63 | 319.85 |
| 3 | 5.83 | 285.04 | 5.00 | 619.96 | 572.51 | 411.84 |
| 3 | 5.83 | 285.04 | 5.00 | 619.96 | 572.51 | 411.84 |
| 4 | 5.83 | 290.01 | 5.00 | 834.03 | 701.14 | 504.37 |
| 4 | 5.83 | 290.01 | 5.00 | 834.03 | 701.14 | 504.37 |
| 5 | 10.64 | 294.96 | 5.00 | 975.85 | 786.35 | 565.67 |
| 5 | 10.64 | 294.96 | 5.00 | 975.85 | 786.35 | 565.67 |
| 6 | 10.64 | 299.87 | 5.00 | 1133.33 | 880.97 | 633.73 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | 10.64 | 299.87 | 5.00 | 1133.33 | 880.97 | 633.73 |
| 7 | 15.44 | 304.74 | 5.00 | 1210.68 | 927.45 | 667.17 |
| 7 | 15.44 | 304.74 | 5.00 | 1210.68 | 927.45 | 667.17 |
| 8 | 15.44 | 309.56 | 5.00 | 1314.14 | 989.62 | 711.89 |
| 8 | 15.44 | 309.56 | 5.00 | 1314.14 | 989.62 | 711.89 |
| 9 | 20.25 | 314.31 | 5.00 | 1332.95 | 1000.92 | 720.02 |
| 9 | 20.25 | 314.31 | 5.00 | 1332.95 | 1000.92 | 720.02 |
| 10 | 20.25 | 319.00 | 5.00 | 1385.21 | 1032.32 | 742.60 |
| 10 | 20.25 | 319.00 | 5.00 | 1385.21 | 1032.32 | 742.60 |
| 11 | 25.06 | 323.61 | 5.00 | 1351.19 | 1011.88 | 727.90 |
| 11 | 25.06 | 323.61 | 5.00 | 1351.19 | 1011.88 | 727.90 |
| 12 | 25.06 | 328.14 | 5.00 | 1355.32 | 1014.36 | 729.69 |
| 12 | 25.06 | 328.14 | 5.00 | 1355.32 | 1014.36 | 729.69 |
| 13 | 29.86 | 332.58 | 5.00 | 1274.29 | 965.67 | 694.66 |
| 13 | 29.86 | 332.58 | 5.00 | 1274.29 | 965.67 | 694.66 |
| 14 | 29.86 | 336.91 | 5.00 | 1233.69 | 941.28 | 677.11 |
| 14 | 29.86 | 336.91 | 5.00 | 1233.69 | 941.28 | 677.11 |
| 15 | 34.67 | 341.14 | 5.00 | 1111.83 | 868.05 | 624.44 |
| 15 | 34.67 | 341.14 | 5.00 | 1111.83 | 868.05 | 624.44 |
| 16 | 34.67 | 345.25 | 5.00 | 1030.29 | 819.06 | 589.20 |
| 16 | 34.67 | 345.25 | 5.00 | 1030.29 | 819.06 | 589.20 |
| 17 | 39.48 | 349.18 | 4.86 | 876.13 | 726.43 | 522.56 |
| 17 | 39.48 | 349.18 | 4.86 | 876.13 | 726.43 | 522.56 |
| 18 | 39.48 | 352.93 | 4.86 | 761.24 | 657.40 | 472.91 |
| 18 | 39.48 | 352.93 | 4.86 | 761.24 | 657.40 | 472.91 |
| 19 | 39.48 | 354.91 | 0.29 | 695.72 | 618.03 | 444.58 |
| 19 | 39.48 | 354.91 | 0.29 | 695.72 | 618.03 | 444.58 |
| 20 | 44.29 | 356.81 | 5.00 | 493.31 | 496.41 | 357.10 |
| 20 | 44.29 | 356.81 | 5.00 | 493.31 | 496.41 | 357.10 |
| 21 | 44.29 | 360.39 | 5.00 | 199.25 | 319.72 | 229.99 |
| 21 | 44.29 | 360.39 | 5.00 | 199.25 | 319.72 | 229.99 |
| 22 | 49.09 | 362.96 | 2.38 | 71.80 | 43.14 | 31.03 |
| 22 | 49.09 | 362.96 | 2.38 | 71.80 | 43.14 | 31.03 |

***Table 4 - Base Force Data on the 22 Slices***

| Slice No. * | Alpha (deg) | X-Coord. Slice Cntr (ft) | Base Leng. (ft) | Effective Normal Force (lbs) | Available Shear Force (lbs) | Mobilized Shear Force (lbs) |
|---|---|---|---|---|---|---|
| 1 | 1.02 | 275.05 | 5.00 | 670.01 | 1402.58 | 1008.96 |
| 1 | 1.02 | 275.05 | 5.00 | 670.01 | 1402.58 | 1008.96 |
| 2 | 1.02 | 280.05 | 5.00 | 2035.69 | 2223.17 | 1599.25 |
| 2 | 1.02 | 280.05 | 5.00 | 2035.69 | 2223.17 | 1599.25 |
| 3 | 5.83 | 285.04 | 5.00 | 3099.78 | 2862.53 | 2059.18 |
| 3 | 5.83 | 285.04 | 5.00 | 3099.78 | 2862.53 | 2059.18 |
| 4 | 5.83 | 290.01 | 5.00 | 4170.14 | 3505.68 | 2521.83 |
| 4 | 5.83 | 290.01 | 5.00 | 4170.14 | 3505.68 | 2521.83 |
| 5 | 10.64 | 294.96 | 5.00 | 4879.27 | 3931.76 | 2828.34 |
| 5 | 10.64 | 294.96 | 5.00 | 4879.27 | 3931.76 | 2828.34 |
| 6 | 10.64 | 299.87 | 5.00 | 5666.63 | 4404.85 | 3168.66 |
| 6 | 10.64 | 299.87 | 5.00 | 5666.63 | 4404.85 | 3168.66 |
| 7 | 15.44 | 304.74 | 5.00 | 6053.39 | 4637.24 | 3335.83 |
| 7 | 15.44 | 304.74 | 5.00 | 6053.39 | 4637.24 | 3335.83 |
| 8 | 15.44 | 309.56 | 5.00 | 6570.71 | 4948.08 | 3559.44 |
| 8 | 15.44 | 309.56 | 5.00 | 6570.71 | 4948.08 | 3559.44 |
| 9 | 20.25 | 314.31 | 5.00 | 6664.74 | 5004.58 | 3600.08 |
| 9 | 20.25 | 314.31 | 5.00 | 6664.74 | 5004.58 | 3600.08 |
| 10 | 20.25 | 319.00 | 5.00 | 6926.05 | 5161.59 | 3713.02 |
| 10 | 20.25 | 319.00 | 5.00 | 6926.05 | 5161.59 | 3713.02 |
| 11 | 25.06 | 323.61 | 5.00 | 6755.94 | 5059.38 | 3639.50 |
| 11 | 25.06 | 323.61 | 5.00 | 6755.94 | 5059.38 | 3639.50 |
| 12 | 25.06 | 328.14 | 5.00 | 6776.60 | 5071.79 | 3648.43 |
| 12 | 25.06 | 328.14 | 5.00 | 6776.60 | 5071.79 | 3648.43 |
| 13 | 29.86 | 332.58 | 5.00 | 6371.43 | 4828.34 | 3473.30 |
| 13 | 29.86 | 332.58 | 5.00 | 6371.43 | 4828.34 | 3473.30 |
| 14 | 29.86 | 336.91 | 5.00 | 6168.46 | 4706.39 | 3385.57 |
| 14 | 29.86 | 336.91 | 5.00 | 6168.46 | 4706.39 | 3385.57 |
| 15 | 34.67 | 341.14 | 5.00 | 5559.14 | 4340.27 | 3122.20 |
| 15 | 34.67 | 341.14 | 5.00 | 5559.14 | 4340.27 | 3122.20 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 16 | 34.67 | 345.25 | 5.00 | 5151.43 | 4095.29 | 2945.98 |
| 16 | 34.67 | 345.25 | 5.00 | 5151.43 | 4095.29 | 2945.98 |
| 17 | 39.48 | 349.18 | 4.86 | 4254.53 | 3527.59 | 2537.59 |
| 17 | 39.48 | 349.18 | 4.86 | 4254.53 | 3527.59 | 2537.59 |
| 18 | 39.48 | 352.93 | 4.86 | 3696.64 | 3192.38 | 2296.46 |
| 18 | 39.48 | 352.93 | 4.86 | 3696.64 | 3192.38 | 2296.46 |
| 19 | 39.48 | 354.91 | 0.29 | 200.29 | 177.93 | 127.99 |
| 19 | 39.48 | 354.91 | 0.29 | 200.29 | 177.93 | 127.99 |
| 20 | 44.29 | 356.81 | 5.00 | 2466.54 | 2482.05 | 1785.48 |
| 20 | 44.29 | 356.81 | 5.00 | 2466.54 | 2482.05 | 1785.48 |
| 21 | 44.29 | 360.39 | 5.00 | 996.26 | 1598.61 | 1149.97 |
| 21 | 44.29 | 360.39 | 5.00 | 996.26 | 1598.61 | 1149.97 |
| 22 | 49.09 | 362.96 | 2.38 | 170.82 | 102.64 | 73.83 |
| 22 | 49.09 | 362.96 | 2.38 | 170.82 | 102.64 | 73.83 |

SUM OF MOMENTS = 0.581728E-01 (ft/lbs);Imbalance (Fraction of Total Weight) = 0.5416330E-06

Sum of the Resisting Forces = 77264.71 (lbs)

Average Available Shear Strength = 754.69(psf)

Sum of the Driving Forces = 55580.90 (lbs)

Average Mobilized Shear Stress = 542.89(psf)

Total length of the failure surface = 102.38(ft)

Factor of Safety Balance Check: FS = 1.39013

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

*** SEISMIC SLOPE DISPLACEMENT DATA ***

(Note: kv is set = zero for displacement calculations)
Seismic Yield Coefficient (ky) = 0.33133(g)
Calculated Newmark Seismic Displacement = 0.000(ft)

Average Elevation of Point of Application of kh on Sliding Mass = 752.973(ft)

Non-Symmetrical Sliding Resistance Has Been Specified for Downhill Sliding.

**** END OF GEOSTASE OUTPUT ****

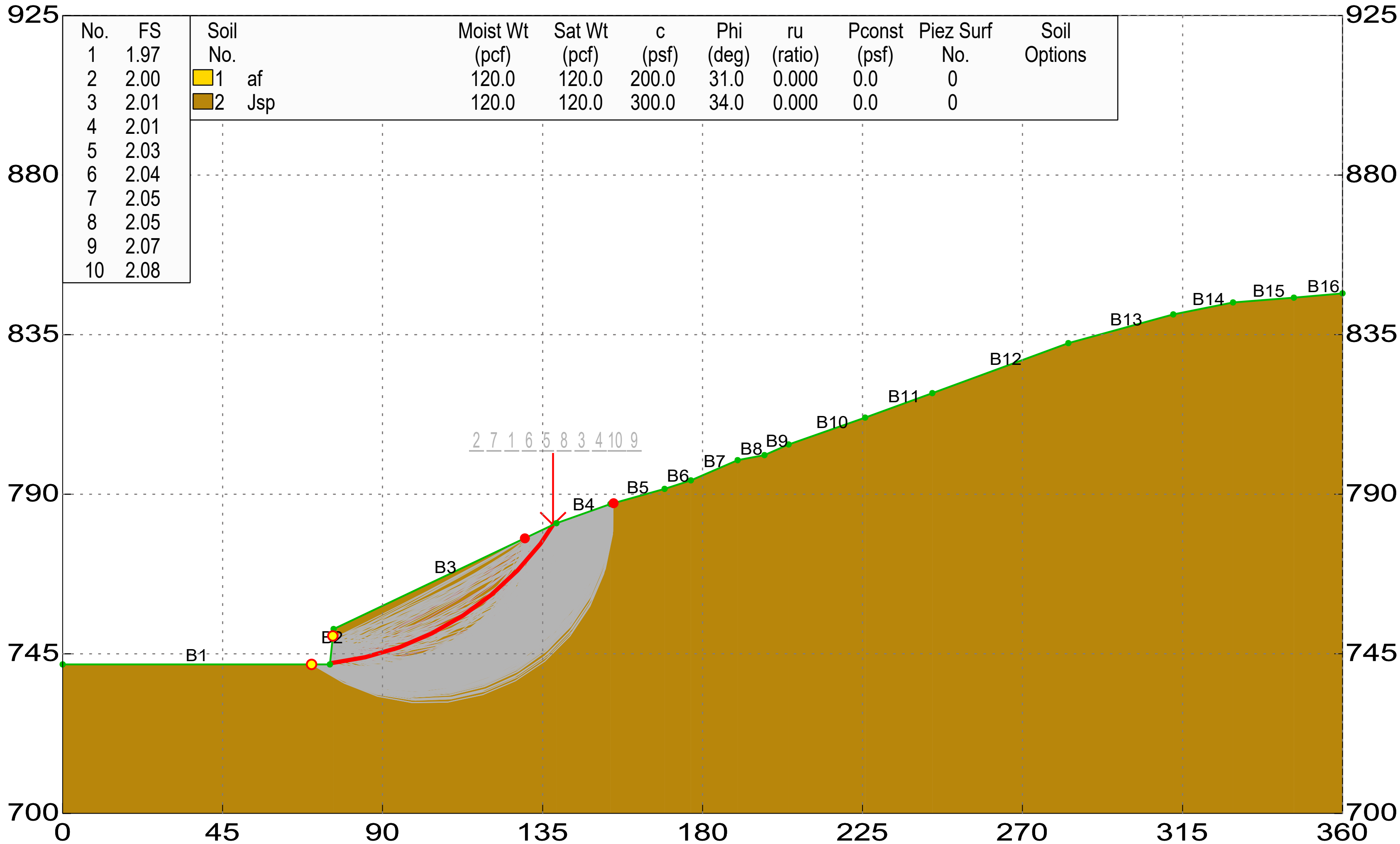
# Meritage - Twin Oaks, San Marcos
# Section 8-8' (Static) - Retaining Wall - Local

LGC Geotechnical / BPP

\Section 8 - Static.gsd

| No. | FS |
|---|---|
| 1 | 1.97 |
| 2 | 2.00 |
| 3 | 2.01 |
| 4 | 2.01 |
| 5 | 2.03 |
| 6 | 2.04 |
| 7 | 2.05 |
| 8 | 2.05 |
| 9 | 2.07 |
| 10 | 2.08 |

| Soil No. | | Moist Wt (pcf) | Sat Wt (pcf) | c (psf) | Phi (deg) | ru (ratio) | Pconst (psf) | Piez Surf No. | Soil Options |
|---|---|---|---|---|---|---|---|---|---|
| 1 | af | 120.0 | 120.0 | 200.0 | 31.0 | 0.000 | 0.0 | 0 | |
| 2 | Jsp | 120.0 | 120.0 | 300.0 | 34.0 | 0.000 | 0.0 | 0 | |




GEOSTASE FS = 1.97

Simplified Bishop Method

GEOSTASE Slope Stability Analysis

GREGORY GEOTECHNICAL

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

*** GEOSTASE(R) ***

** GEOSTASE(R) (c)Copyright by Garry H. Gregory, Ph.D., P.E.,D.GE **

** Current Version 4.30.31-Double Precision, August 2019 **


*****************************************************************************
SLOPE STABILITY ANALYSIS SOFTWARE
Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
(Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
Including Pier/Pile, Planar Reinf, Nail, Tieback, Line Loads
Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
Nonlinear Undrained Shear Strength, Curved Strength Envelope,
Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
*****************************************************************************

Analysis Date: 8/ 22/ 2024
Analysis Time:
Analysis By: LGC Geotechnical / BPP
Input File Name: Z:\2024\24032-01 Meritage - Twin Oaks, San Marcos \Engineering\Slope Stability Analysis\8-8'\Section 8 - Static.gsd
Output File Name: Z:\2024\24032-01 Meritage - Twin Oaks, San Marcos \Engineering\Slope Stability Analysis\8-8'\Section 8 - Static.OUT
Unit System: English

PROJECT: Meritage - Twin Oaks, San Marcos

DESCRIPTION: Section 8-8' (Static) - Retaining Wall - Local

BOUNDARY DATA

16 Surface Boundaries
16 Total Boundaries

| Boundary No. | X - 1 (ft) | Y - 1 (ft) | X - 2 (ft) | Y - 2 (ft) | Soil Type Below Bnd |
|---|---|---|---|---|---|
| 1 | 0.000 | 742.000 | 75.200 | 742.000 | 2 |
| 2 | 75.200 | 742.000 | 76.200 | 752.000 | 2 |
| 3 | 76.200 | 752.000 | 138.900 | 781.800 | 2 |
| 4 | 138.900 | 781.800 | 154.100 | 787.200 | 2 |
| 5 | 154.100 | 787.200 | 169.300 | 791.500 | 2 |
| 6 | 169.300 | 791.500 | 176.700 | 793.900 | 2 |
| 7 | 176.700 | 793.900 | 189.900 | 799.600 | 2 |
| 8 | 189.900 | 799.600 | 197.400 | 801.000 | 2 |
| 9 | 197.400 | 801.000 | 204.200 | 804.000 | 2 |
| 10 | 204.200 | 804.000 | 225.700 | 811.600 | 2 |
| 11 | 225.700 | 811.600 | 244.600 | 818.500 | 2 |
| 12 | 244.600 | 818.500 | 282.900 | 832.600 | 2 |
| 13 | 282.900 | 832.600 | 312.400 | 840.700 | 2 |
| 14 | 312.400 | 840.700 | 329.200 | 844.100 | 2 |
| 15 | 329.200 | 844.100 | 346.300 | 845.400 | 2 |
| 16 | 346.300 | 845.400 | 360.000 | 846.600 | 2 |

User Specified X-Origin = 0.000(ft)

User Specified Y-Origin = 700.000(ft)

MOHR-COULOMB SOIL PARAMETERS

2 Type(s) of Soil Defined

Soil Number Moist Saturated Cohesion Friction Pore Pressure Water Water

```
           and              Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
Option
       Description            (pcf)    (pcf)     (psf)     (deg)  Ratio(ru) (psf)      No.

  1 af                        120.0    120.0     200.00    31.00    0.000      0.0      0
0
  2 Jsp                       120.0    120.0     300.00    34.00    0.000      0.0      0
0
```

Drained Shear Strength Reduction Factor applied after first stage = 1.0000

TRIAL FAILURE SURFACE DATA

Circular Trial Failure Surfaces Have Been Generated Using A Random Procedure.

1000 Trial Surfaces Have Been Generated.

1000 Surfaces Generated at Increments of 0.0721(in) Equally Spaced Within the Start Range

```
Along The Specified Surface Between  X =  70.00(ft)
                                   and  X =  76.00(ft)

Each Surface Enters within a Range Between   X = 130.00(ft)
                                       and   X = 155.00(ft)

Unless XCLUDE Lines Were Specified, The Minimum Elevation
To Which A Surface Extends Is  Y =     700.00(ft)
```

Specified Maximum Radius = 10000.000(ft)

10.000(ft) Line Segments Were Used For Each Trial Failure Surface.

The Simplified Bishop Method Was Selected for FS Analysis.

Total Number of Trial Surfaces Attempted = 1000

Number of Trial Surfaces With Valid FS = 1000

```
Statistical Data On All Valid FS Values:
   FS Max =   4.303   FS Min =   1.971   FS Ave =   2.507
   Standard Deviation =    0.240   Coefficient of Variation =    9.59 %
```

Critical Surface is Sequence Number     872 of Those Analyzed.

*****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****

BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

Circle Center At X =     65.588461(ft) ; Y =    827.971348(ft); and Radius = 86.200077(ft)

Circular Trial Failure Surface Generated With  9 Coordinate Points

| Point No. | X-Coord. (ft) | Y-Coord. (ft) |
|---|---|---|
| 1 | 75.231 | 742.312 |
| 2 | 85.087 | 744.005 |
| 3 | 94.680 | 746.829 |
| 4 | 103.882 | 750.744 |
| 5 | 112.568 | 755.698 |
| 6 | 120.622 | 761.626 |
| 7 | 127.936 | 768.446 |

| | | |
|---|---|---|
| 8 | 134.410 | 776.067 |
| 9 | 137.924 | 781.336 |

Factor Of Safety For The Critical or Specified Surface = 1.971

***Table 1 - Geometry Data on the 16 Slices***

| Slice No. | Width (ft) | Height (ft) | X-Cntr (ft) | Y-Cntr-Base (ft) | Y-Cntr-Top (ft) | Alpha (deg) | Beta (deg) | Base Length (ft) |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.97 | 4.76 | 75.72 | 742.40 | 747.16 | 9.75 | 84.29 | 0.98 |
| 2 | 4.44 | 10.20 | 78.42 | 742.86 | 753.06 | 9.75 | 25.42 | 4.51 |
| 3 | 4.44 | 11.54 | 82.87 | 743.62 | 755.17 | 9.75 | 25.42 | 4.51 |
| 4 | 4.80 | 12.65 | 87.49 | 744.71 | 757.36 | 16.40 | 25.42 | 5.00 |
| 5 | 4.80 | 13.52 | 92.28 | 746.12 | 759.64 | 16.40 | 25.42 | 5.00 |
| 6 | 4.60 | 14.07 | 96.98 | 747.81 | 761.88 | 23.05 | 25.42 | 5.00 |
| 7 | 4.60 | 14.30 | 101.58 | 749.77 | 764.06 | 23.05 | 25.42 | 5.00 |
| 8 | 4.34 | 14.21 | 106.05 | 751.98 | 766.19 | 29.70 | 25.42 | 5.00 |
| 9 | 4.34 | 13.79 | 110.40 | 754.46 | 768.25 | 29.70 | 25.42 | 5.00 |
| 10 | 4.03 | 13.06 | 114.58 | 757.18 | 770.24 | 36.35 | 25.42 | 5.00 |
| 11 | 4.03 | 12.01 | 118.61 | 760.14 | 772.16 | 36.35 | 25.42 | 5.00 |
| 12 | 3.66 | 10.65 | 122.45 | 763.33 | 773.98 | 43.00 | 25.42 | 5.00 |
| 13 | 3.66 | 8.98 | 126.11 | 766.74 | 775.72 | 43.00 | 25.42 | 5.00 |
| 14 | 3.24 | 7.01 | 129.55 | 770.35 | 777.36 | 49.65 | 25.42 | 5.00 |
| 15 | 3.24 | 4.73 | 132.79 | 774.16 | 778.90 | 49.65 | 25.42 | 5.00 |
| 16 | 3.51 | 1.80 | 136.17 | 778.70 | 780.50 | 56.30 | 25.42 | 6.33 |

***Table 2 - Force Data On The 16 Slices (Excluding Reinforcement)***

| Slice No. | Weight (lbs) | Ubeta Force Top (lbs) | Ualpha Force Bot (lbs) | Earthquake Force Hor (lbs) | Earthquake Force Ver (lbs) | Distributed Load (lbs) |
|---|---|---|---|---|---|---|
| 1 | 553.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 2 | 5436.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 3 | 6155.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 | 7282.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 5 | 7782.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 6 | 7767.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 7 | 7894.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 8 | 7403.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 9 | 7188.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 10 | 6312.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11 | 5804.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 12 | 4673.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 13 | 3940.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 14 | 2722.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 15 | 1839.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 16 | 758.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

TOTAL WEIGHT OF SLIDING MASS = 83514.80(lbs)

EFFECTIVE WEIGHT OF SLIDING MASS = 83514.80(lbs)

TOTAL AREA OF SLIDING MASS = 695.96(ft2)

***TABLE 2A - SOIL STRENGTH & SOIL OPTIONS DATA ON THE 16 SLICES***

| Slice No. | Soil Type | Cohesion (psf) | Phi(Deg) | Options |
|---|---|---|---|---|
| 1 | 2 | 300.00 | 34.00 | |
| 2 | 2 | 300.00 | 34.00 | |
| 3 | 2 | 300.00 | 34.00 | |
| 4 | 2 | 300.00 | 34.00 | |

| | | | |
|---|---|---|---|
| 5 | 2 | 300.00 | 34.00 |
| 6 | 2 | 300.00 | 34.00 |
| 7 | 2 | 300.00 | 34.00 |
| 8 | 2 | 300.00 | 34.00 |
| 9 | 2 | 300.00 | 34.00 |
| 10 | 2 | 300.00 | 34.00 |
| 11 | 2 | 300.00 | 34.00 |
| 12 | 2 | 300.00 | 34.00 |
| 13 | 2 | 300.00 | 34.00 |
| 14 | 2 | 300.00 | 34.00 |
| 15 | 2 | 300.00 | 34.00 |
| 16 | 2 | 300.00 | 34.00 |

SOIL OPTIONS: A = ANISOTROPIC, C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C),
F = FIBER-REINFORCED SOIL (FRS), N = NONLINEAR UNDRAINED SHEAR STRENGTH,
R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
NOTE: Phi and C in Table 4 are modified values based on specified
Soil Options (if any).

***TABLE 3 - Effective and Base Shear Stress Data on the 16 Slices***

| Slice No. * | Alpha (deg) | X-Coord. Slice Cntr (ft) | Base Leng. (ft) | Effective Normal Stress (psf) | Available Shear Strength (psf) | Mobilized Shear Stress (psf) |
|---|---|---|---|---|---|---|
| 1 | 9.75 | 75.72 | 0.98 | 514.84 | 647.27 | 328.43 |
| 1 | 9.75 | 75.72 | 0.98 | 514.84 | 647.27 | 328.43 |
| 2 | 9.75 | 78.42 | 4.51 | 1130.80 | 1062.74 | 539.24 |
| 2 | 9.75 | 78.42 | 4.51 | 1130.80 | 1062.74 | 539.24 |
| 3 | 9.75 | 82.87 | 4.51 | 1283.64 | 1165.82 | 591.55 |
| 3 | 9.75 | 82.87 | 4.51 | 1283.64 | 1165.82 | 591.55 |
| 4 | 16.40 | 87.49 | 5.00 | 1338.62 | 1202.91 | 610.37 |
| 4 | 16.40 | 87.49 | 5.00 | 1338.62 | 1202.91 | 610.37 |
| 5 | 16.40 | 92.28 | 5.00 | 1433.26 | 1266.75 | 642.76 |
| 5 | 16.40 | 92.28 | 5.00 | 1433.26 | 1266.75 | 642.76 |
| 6 | 23.05 | 96.98 | 5.00 | 1417.10 | 1255.85 | 637.23 |
| 6 | 23.05 | 96.98 | 5.00 | 1417.10 | 1255.85 | 637.23 |
| 7 | 23.05 | 101.58 | 5.00 | 1441.10 | 1272.03 | 645.44 |
| 7 | 23.05 | 101.58 | 5.00 | 1441.10 | 1272.03 | 645.44 |
| 8 | 29.70 | 106.05 | 5.00 | 1353.60 | 1213.02 | 615.50 |
| 8 | 29.70 | 106.05 | 5.00 | 1353.60 | 1213.02 | 615.50 |
| 9 | 29.70 | 110.40 | 5.00 | 1312.13 | 1185.04 | 601.30 |
| 9 | 29.70 | 110.40 | 5.00 | 1312.13 | 1185.04 | 601.30 |
| 10 | 36.35 | 114.58 | 5.00 | 1162.50 | 1084.12 | 550.09 |
| 10 | 36.35 | 114.58 | 5.00 | 1162.50 | 1084.12 | 550.09 |
| 11 | 36.35 | 118.61 | 5.00 | 1061.89 | 1016.26 | 515.66 |
| 11 | 36.35 | 118.61 | 5.00 | 1061.89 | 1016.26 | 515.66 |
| 12 | 43.00 | 122.45 | 5.00 | 861.24 | 880.91 | 446.98 |
| 12 | 43.00 | 122.45 | 5.00 | 861.24 | 880.91 | 446.98 |
| 13 | 43.00 | 126.11 | 5.00 | 709.14 | 778.32 | 394.93 |
| 13 | 43.00 | 126.11 | 5.00 | 709.14 | 778.32 | 394.93 |
| 14 | 49.65 | 129.55 | 5.00 | 471.59 | 618.09 | 313.63 |
| 14 | 49.65 | 129.55 | 5.00 | 471.59 | 618.09 | 313.63 |
| 15 | 49.65 | 132.79 | 5.00 | 277.26 | 487.01 | 247.12 |
| 15 | 49.65 | 132.79 | 5.00 | 277.26 | 487.01 | 247.12 |
| 16 | 56.30 | 136.17 | 6.33 | 142.69 | 96.25 | 48.84 |
| 16 | 56.30 | 136.17 | 6.33 | 142.69 | 96.25 | 48.84 |

***Table 4 - Base Force Data on the 16 Slices***

| Slice No. * | Alpha (deg) | X-Coord. Slice Cntr (ft) | Base Leng. (ft) | Effective Normal Force (lbs) | Available Shear Force (lbs) | Mobilized Shear Force (lbs) |
|---|---|---|---|---|---|---|
| 1 | 9.75 | 75.72 | 0.98 | 506.07 | 636.24 | 322.83 |
| 1 | 9.75 | 75.72 | 0.98 | 506.07 | 636.24 | 322.83 |
| 2 | 9.75 | 78.42 | 4.51 | 5098.25 | 4791.37 | 2431.20 |
| 2 | 9.75 | 78.42 | 4.51 | 5098.25 | 4791.37 | 2431.20 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | 9.75 | 82.87 | 4.51 | 5787.29 | 5256.13 | 2667.02 |
| 3 | 9.75 | 82.87 | 4.51 | 5787.29 | 5256.13 | 2667.02 |
| 4 | 16.40 | 87.49 | 5.00 | 6693.10 | 6014.55 | 3051.85 |
| 4 | 16.40 | 87.49 | 5.00 | 6693.10 | 6014.55 | 3051.85 |
| 5 | 16.40 | 92.28 | 5.00 | 7166.30 | 6333.73 | 3213.81 |
| 5 | 16.40 | 92.28 | 5.00 | 7166.30 | 6333.73 | 3213.81 |
| 6 | 23.05 | 96.98 | 5.00 | 7085.51 | 6279.24 | 3186.16 |
| 6 | 23.05 | 96.98 | 5.00 | 7085.51 | 6279.24 | 3186.16 |
| 7 | 23.05 | 101.58 | 5.00 | 7205.48 | 6360.16 | 3227.22 |
| 7 | 23.05 | 101.58 | 5.00 | 7205.48 | 6360.16 | 3227.22 |
| 8 | 29.70 | 106.05 | 5.00 | 6768.01 | 6065.08 | 3077.49 |
| 8 | 29.70 | 106.05 | 5.00 | 6768.01 | 6065.08 | 3077.49 |
| 9 | 29.70 | 110.40 | 5.00 | 6560.65 | 5925.22 | 3006.52 |
| 9 | 29.70 | 110.40 | 5.00 | 6560.65 | 5925.22 | 3006.52 |
| 10 | 36.35 | 114.58 | 5.00 | 5812.52 | 5420.59 | 2750.47 |
| 10 | 36.35 | 114.58 | 5.00 | 5812.52 | 5420.59 | 2750.47 |
| 11 | 36.35 | 118.61 | 5.00 | 5309.46 | 5081.28 | 2578.30 |
| 11 | 36.35 | 118.61 | 5.00 | 5309.46 | 5081.28 | 2578.30 |
| 12 | 43.00 | 122.45 | 5.00 | 4306.18 | 4404.55 | 2234.92 |
| 12 | 43.00 | 122.45 | 5.00 | 4306.18 | 4404.55 | 2234.92 |
| 13 | 43.00 | 126.11 | 5.00 | 3545.69 | 3891.60 | 1974.64 |
| 13 | 43.00 | 126.11 | 5.00 | 3545.69 | 3891.60 | 1974.64 |
| 14 | 49.65 | 129.55 | 5.00 | 2357.97 | 3090.47 | 1568.14 |
| 14 | 49.65 | 129.55 | 5.00 | 2357.97 | 3090.47 | 1568.14 |
| 15 | 49.65 | 132.79 | 5.00 | 1386.28 | 2435.06 | 1235.58 |
| 15 | 49.65 | 132.79 | 5.00 | 1386.28 | 2435.06 | 1235.58 |
| 16 | 56.30 | 136.17 | 6.33 | 903.67 | 609.53 | 309.28 |
| 16 | 56.30 | 136.17 | 6.33 | 903.67 | 609.53 | 309.28 |

SUM OF MOMENTS = -0.948410E-01 (ft/lbs);Imbalance (Fraction of Total Weight) = -0.1135619E-05

Sum of the Resisting Forces = 72594.79 (lbs)

Average Available Shear Strength = 951.03(psf)

Sum of the Driving Forces = 36835.44 (lbs)

Average Mobilized Shear Stress = 482.56(psf)

Total length of the failure surface = 76.33(ft)

Factor of Safety Balance Check: FS = 1.97079

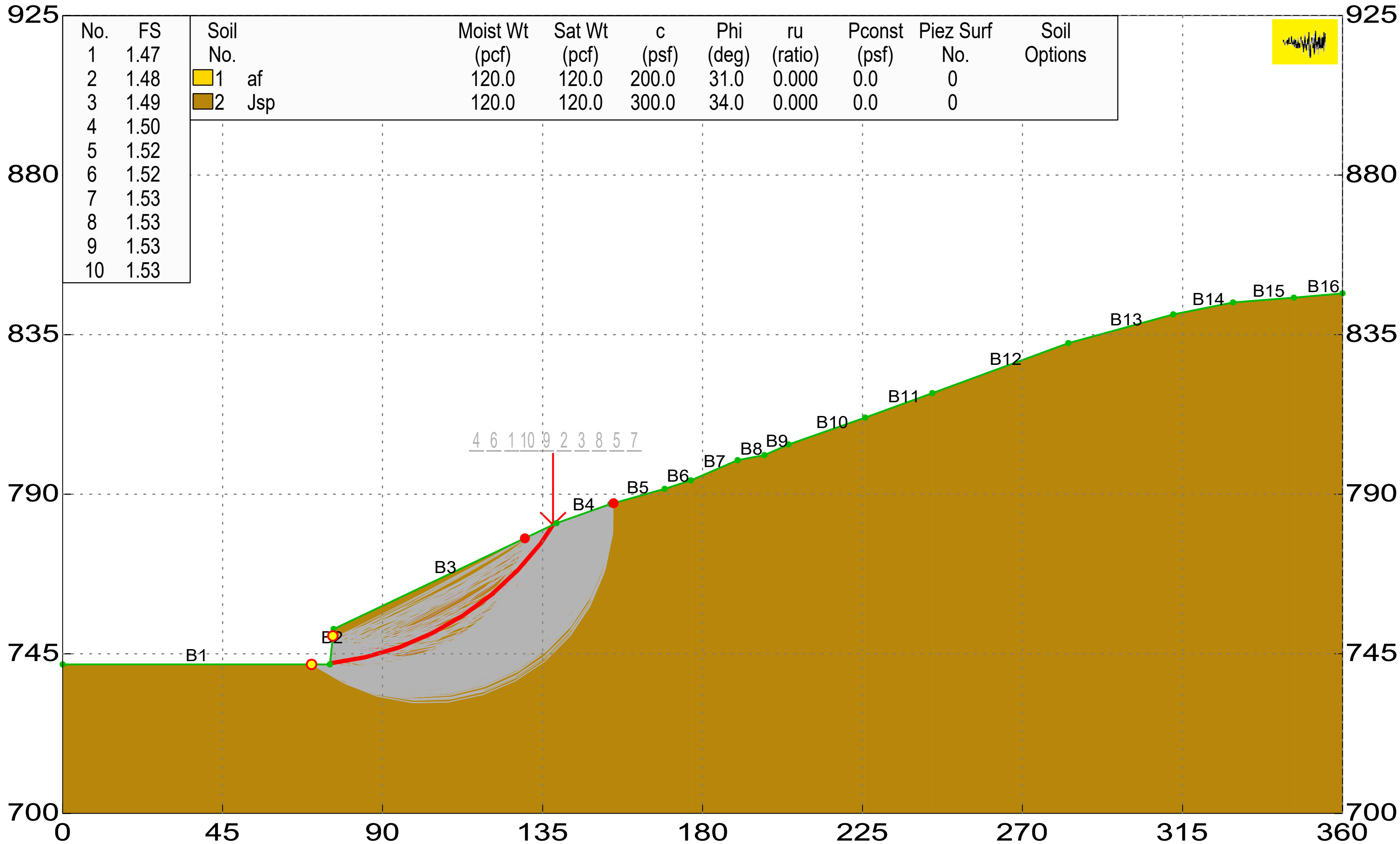
CAUTION - Factor Of Safety Is Calculated By The Simplified Bishop Method. This Method Is Valid Only If The Failure Surface Approximates A Circular Arc.

**** END OF GEOSTASE OUTPUT ****

# Meritage - Twin Oaks, San Marcos
## Section 8-8' (Seismic) - Retaining Wall - Local

LGC Geotechnical / BPP

\Section 8 - Seismic.gsd




| No. | FS |
|---|---|
| 1 | 1.47 |
| 2 | 1.48 |
| 3 | 1.49 |
| 4 | 1.50 |
| 5 | 1.52 |
| 6 | 1.52 |
| 7 | 1.53 |
| 8 | 1.53 |
| 9 | 1.53 |
| 10 | 1.53 |

| Soil No. | | Moist Wt (pcf) | Sat Wt (pcf) | c (psf) | Phi (deg) | ru (ratio) | Pconst (psf) | Piez Surf No. | Soil Options |
|---|---|---|---|---|---|---|---|---|---|
| 1 | af | 120.0 | 120.0 | 200.0 | 31.0 | 0.000 | 0.0 | 0 | |
| 2 | Jsp | 120.0 | 120.0 | 300.0 | 34.0 | 0.000 | 0.0 | 0 | |

GEOSTASE FS = 1.47

Simplified Bishop Method

kh = 0.15000

GEOSTASE Slope Stability Analysis

GREGORY GEOTECHNICAL

GEOSTASE® by GREGORY GEOTECHNICAL SOFTWARE

```
                    ***  GEOSTASE(R)  ***

     ** GEOSTASE(R) (c)Copyright by Garry H. Gregory, Ph.D., P.E.,D.GE **

        ** Current Version 4.30.31-Double Precision, August 2019 **
             (All Rights Reserved-Unauthorized Use Prohibited)
```



```
*********************************************************************************
                   SLOPE STABILITY ANALYSIS SOFTWARE
    Simplified Bishop, Simplified Janbu, or General Equilibrium (GE) Options.
       (Spencer, Morgenstern-Price, USACE, and Lowe & Karafiath)
       Including Pier/Pile, Planar Reinf,  Nail, Tieback, Line Loads
       Applied Forces, Fiber-Reinforced Soil (FRS), Distributed Loads
       Nonlinear Undrained Shear Strength, Curved Strength Envelope,
       Anisotropic Strengths, Water Surfaces, 3-Stage Rapid Drawdown
       2- or 3-Stage Pseudo-Static & Simplified Newmark Seismic Analyses.
*********************************************************************************
```

Analysis Date: 8/ 22/ 2024
Analysis Time:
Analysis By: LGC Geotechnical / BPP
Input File Name: Z:\2024\24032-01 Meritage - Twin Oaks, San Marcos \Engineering\Slope Stability Analysis\8-8'\Section 8 - Seismic.gsd
Output File Name: Z:\2024\24032-01 Meritage - Twin Oaks, San Marcos \Engineering\Slope Stability Analysis\8-8'\Section 8 - Seismic.OUT
Unit System: English

PROJECT: Meritage - Twin Oaks, San Marcos

DESCRIPTION: Section 8-8' (Seismic) - Retaining Wall - Local

BOUNDARY DATA

16 Surface Boundaries
16 Total Boundaries

| Boundary No. | X - 1 (ft) | Y - 1 (ft) | X - 2 (ft) | Y - 2 (ft) | Soil Type Below Bnd |
|---|---|---|---|---|---|
| 1 | 0.000 | 742.000 | 75.200 | 742.000 | 2 |
| 2 | 75.200 | 742.000 | 76.200 | 752.000 | 2 |
| 3 | 76.200 | 752.000 | 138.900 | 781.800 | 2 |
| 4 | 138.900 | 781.800 | 154.100 | 787.200 | 2 |
| 5 | 154.100 | 787.200 | 169.300 | 791.500 | 2 |
| 6 | 169.300 | 791.500 | 176.700 | 793.900 | 2 |
| 7 | 176.700 | 793.900 | 189.900 | 799.600 | 2 |
| 8 | 189.900 | 799.600 | 197.400 | 801.000 | 2 |
| 9 | 197.400 | 801.000 | 204.200 | 804.000 | 2 |
| 10 | 204.200 | 804.000 | 225.700 | 811.600 | 2 |
| 11 | 225.700 | 811.600 | 244.600 | 818.500 | 2 |
| 12 | 244.600 | 818.500 | 282.900 | 832.600 | 2 |
| 13 | 282.900 | 832.600 | 312.400 | 840.700 | 2 |
| 14 | 312.400 | 840.700 | 329.200 | 844.100 | 2 |
| 15 | 329.200 | 844.100 | 346.300 | 845.400 | 2 |
| 16 | 346.300 | 845.400 | 360.000 | 846.600 | 2 |

User Specified X-Origin = 0.000(ft)

User Specified Y-Origin = 700.000(ft)

MOHR-COULOMB SOIL PARAMETERS

2 Type(s) of Soil Defined

Soil Number Moist Saturated Cohesion Friction Pore Pressure Water
Water

```
           and              Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
Option
       Description           (pcf)    (pcf)     (psf)     (deg)  Ratio(ru) (psf)      No.

  1 af                       120.0    120.0     200.00    31.00    0.000      0.0      0
0
  2 Jsp                      120.0    120.0     300.00    34.00    0.000      0.0      0
0

          Drained Shear Strength Reduction Factor applied after first stage = 1.0000

         SEISMIC (EARTHQUAKE) DATA

          Specified Peak Ground Acceleration Coefficient (PGA) =   0.000(g)
          Default Velocity =   0.000(ft) per second
          Specified Horizontal Earthquake Coefficient (kh) =  0.15000(g)
          Specified Vertical Earthquake Coefficient (kv) =   0.000(g)
          (NOTE:Input Velocity = 0.0 will result in default Peak
          Velocity = 2 times(PGA) times 2.5 fps or 0.762 mps)
          Specified Seismic Pore-Pressure Factor =   0.000
          Horizontal Seismic Force is Applied at Center of Gravity of Slices


          TRIAL FAILURE SURFACE DATA

          Circular Trial Failure Surfaces Have Been Generated Using A Random Procedure.

            1000 Trial Surfaces Have Been Generated.

            1000 Surfaces Generated at Increments of 0.0721(in) Equally Spaced Within the Start
Range

          Along The Specified Surface Between  X =  70.00(ft)
                                          and  X =  76.00(ft)

          Each Surface Enters within a Range Between   X = 130.00(ft)
                                                 and   X = 155.00(ft)

          Unless XCLUDE Lines Were Specified, The Minimum Elevation
          To Which A Surface Extends Is  Y =     700.00(ft)


          Specified Maximum Radius = 10000.000(ft)

          10.000(ft) Line Segments Were Used For Each Trial Failure Surface.



          The Simplified Bishop Method Was Selected for FS Analysis.


          Total Number of Trial Surfaces Attempted = 1000

          Number of Trial Surfaces With Valid FS = 1000


          Statistical Data On All Valid FS Values:
             FS Max =   3.252   FS Min =   1.472   FS Ave =   1.874
             Standard Deviation =    0.184   Coefficient of Variation =    9.83 %


          Critical Surface is Sequence Number     872 of Those Analyzed.


          *****BEGINNING OF DETAILED GEOSTASE OUTPUT FOR CRITICAL SURFACE FROM A SEARCH*****

          BACK-CALCULATED CIRCULAR SURFACE PARAMETERS:

          Circle Center At X =     65.588461(ft) ; Y =    827.971348(ft); and Radius =
86.200077(ft)

          Circular Trial Failure Surface Generated With  9 Coordinate Points
```

| Point No. | X-Coord. (ft) | Y-Coord. (ft) |
|---|---|---|
| 1 | 75.231 | 742.312 |
| 2 | 85.087 | 744.005 |
| 3 | 94.680 | 746.829 |
| 4 | 103.882 | 750.744 |
| 5 | 112.568 | 755.698 |
| 6 | 120.622 | 761.626 |
| 7 | 127.936 | 768.446 |
| 8 | 134.410 | 776.067 |
| 9 | 137.924 | 781.336 |

Factor Of Safety For The Critical or Specified Surface = 1.472

***Table 1 - Geometry Data on the 16 Slices***

| Slice No. | Width (ft) | Height (ft) | X-Cntr (ft) | Y-Cntr-Base (ft) | Y-Cntr-Top (ft) | Alpha (deg) | Beta (deg) | Base Length (ft) |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.97 | 4.76 | 75.72 | 742.40 | 747.16 | 9.75 | 84.29 | 0.98 |
| 2 | 4.44 | 10.20 | 78.42 | 742.86 | 753.06 | 9.75 | 25.42 | 4.51 |
| 3 | 4.44 | 11.54 | 82.87 | 743.62 | 755.17 | 9.75 | 25.42 | 4.51 |
| 4 | 4.80 | 12.65 | 87.49 | 744.71 | 757.36 | 16.40 | 25.42 | 5.00 |
| 5 | 4.80 | 13.52 | 92.28 | 746.12 | 759.64 | 16.40 | 25.42 | 5.00 |
| 6 | 4.60 | 14.07 | 96.98 | 747.81 | 761.88 | 23.05 | 25.42 | 5.00 |
| 7 | 4.60 | 14.30 | 101.58 | 749.77 | 764.06 | 23.05 | 25.42 | 5.00 |
| 8 | 4.34 | 14.21 | 106.05 | 751.98 | 766.19 | 29.70 | 25.42 | 5.00 |
| 9 | 4.34 | 13.79 | 110.40 | 754.46 | 768.25 | 29.70 | 25.42 | 5.00 |
| 10 | 4.03 | 13.06 | 114.58 | 757.18 | 770.24 | 36.35 | 25.42 | 5.00 |
| 11 | 4.03 | 12.01 | 118.61 | 760.14 | 772.16 | 36.35 | 25.42 | 5.00 |
| 12 | 3.66 | 10.65 | 122.45 | 763.33 | 773.98 | 43.00 | 25.42 | 5.00 |
| 13 | 3.66 | 8.98 | 126.11 | 766.74 | 775.72 | 43.00 | 25.42 | 5.00 |
| 14 | 3.24 | 7.01 | 129.55 | 770.35 | 777.36 | 49.65 | 25.42 | 5.00 |
| 15 | 3.24 | 4.73 | 132.79 | 774.16 | 778.90 | 49.65 | 25.42 | 5.00 |
| 16 | 3.51 | 1.80 | 136.17 | 778.70 | 780.50 | 56.30 | 25.42 | 6.33 |

***Table 2 - Force Data On The 16 Slices (Excluding Reinforcement)***

| Slice No. | Weight (lbs) | Ubeta Force Top (lbs) | Ualpha Force Bot (lbs) | Earthquake Force Hor (lbs) | Earthquake Force Ver (lbs) | Distributed Load (lbs) |
|---|---|---|---|---|---|---|
| 1 | 553.4 | 0.0 | 0.0 | 83.0 | 0.0 | 0.0 |
| 2 | 5436.4 | 0.0 | 0.0 | 815.5 | 0.0 | 0.0 |
| 3 | 6155.4 | 0.0 | 0.0 | 923.3 | 0.0 | 0.0 |
| 4 | 7282.6 | 0.0 | 0.0 | 1092.4 | 0.0 | 0.0 |
| 5 | 7782.3 | 0.0 | 0.0 | 1167.3 | 0.0 | 0.0 |
| 6 | 7767.5 | 0.0 | 0.0 | 1165.1 | 0.0 | 0.0 |
| 7 | 7894.0 | 0.0 | 0.0 | 1184.1 | 0.0 | 0.0 |
| 8 | 7403.9 | 0.0 | 0.0 | 1110.6 | 0.0 | 0.0 |
| 9 | 7188.7 | 0.0 | 0.0 | 1078.3 | 0.0 | 0.0 |
| 10 | 6312.0 | 0.0 | 0.0 | 946.8 | 0.0 | 0.0 |
| 11 | 5804.8 | 0.0 | 0.0 | 870.7 | 0.0 | 0.0 |
| 12 | 4673.8 | 0.0 | 0.0 | 701.1 | 0.0 | 0.0 |
| 13 | 3940.1 | 0.0 | 0.0 | 591.0 | 0.0 | 0.0 |
| 14 | 2722.0 | 0.0 | 0.0 | 408.3 | 0.0 | 0.0 |
| 15 | 1839.4 | 0.0 | 0.0 | 275.9 | 0.0 | 0.0 |
| 16 | 758.7 | 0.0 | 0.0 | 113.8 | 0.0 | 0.0 |

TOTAL WEIGHT OF SLIDING MASS = 83514.80(lbs)

EFFECTIVE WEIGHT OF SLIDING MASS = 83514.80(lbs)

TOTAL AREA OF SLIDING MASS = 695.96(ft2)

***TABLE 2A - SOIL STRENGTH & SOIL OPTIONS DATA ON THE 16 SLICES***

| Slice No. | Soil Type | Cohesion (psf) | Phi(Deg) | Options |
|---|---|---|---|---|
| 1 | 2 | 300.00 | 34.00 | |
| 2 | 2 | 300.00 | 34.00 | |
| 3 | 2 | 300.00 | 34.00 | |
| 4 | 2 | 300.00 | 34.00 | |
| 5 | 2 | 300.00 | 34.00 | |
| 6 | 2 | 300.00 | 34.00 | |
| 7 | 2 | 300.00 | 34.00 | |
| 8 | 2 | 300.00 | 34.00 | |
| 9 | 2 | 300.00 | 34.00 | |
| 10 | 2 | 300.00 | 34.00 | |
| 11 | 2 | 300.00 | 34.00 | |
| 12 | 2 | 300.00 | 34.00 | |
| 13 | 2 | 300.00 | 34.00 | |
| 14 | 2 | 300.00 | 34.00 | |
| 15 | 2 | 300.00 | 34.00 | |
| 16 | 2 | 300.00 | 34.00 | |

SOIL OPTIONS: A = ANISOTROPIC, C = CURVED STRENGTH ENVELOPE (TANGENT PHI & C),
F = FIBER-REINFORCED SOIL (FRS), N = NONLINEAR UNDRAINED SHEAR STRENGTH,
R = RAPID DRAWDOWN OR RAPID LOADING (SEISMIC) SHEAR STRENGTH
NOTE: Phi and C in Table 4 are modified values based on specified
Soil Options (if any).

***TABLE 3 - Effective and Base Shear Stress Data on the 16 Slices***

| Slice No. * | Alpha (deg) | X-Coord. Slice Cntr (ft) | Base Leng. (ft) | Effective Normal Stress (psf) | Available Shear Strength (psf) | Mobilized Shear Stress (psf) |
|---|---|---|---|---|---|---|
| 1 | 9.75 | 75.72 | 0.98 | 497.55 | 635.60 | 431.78 |
| 1 | 9.75 | 75.72 | 0.98 | 497.55 | 635.60 | 431.78 |
| 2 | 9.75 | 78.42 | 4.51 | 1102.42 | 1043.59 | 708.93 |
| 2 | 9.75 | 78.42 | 4.51 | 1102.42 | 1043.59 | 708.93 |
| 3 | 9.75 | 82.87 | 4.51 | 1252.49 | 1144.82 | 777.70 |
| 3 | 9.75 | 82.87 | 4.51 | 1252.49 | 1144.82 | 777.70 |
| 4 | 16.40 | 87.49 | 5.00 | 1286.29 | 1167.61 | 793.18 |
| 4 | 16.40 | 87.49 | 5.00 | 1286.29 | 1167.61 | 793.18 |
| 5 | 16.40 | 92.28 | 5.00 | 1378.15 | 1229.57 | 835.28 |
| 5 | 16.40 | 92.28 | 5.00 | 1378.15 | 1229.57 | 835.28 |
| 6 | 23.05 | 96.98 | 5.00 | 1342.06 | 1205.23 | 818.74 |
| 6 | 23.05 | 96.98 | 5.00 | 1342.06 | 1205.23 | 818.74 |
| 7 | 23.05 | 101.58 | 5.00 | 1365.09 | 1220.76 | 829.29 |
| 7 | 23.05 | 101.58 | 5.00 | 1365.09 | 1220.76 | 829.29 |
| 8 | 29.70 | 106.05 | 5.00 | 1261.53 | 1150.91 | 781.84 |
| 8 | 29.70 | 106.05 | 5.00 | 1261.53 | 1150.91 | 781.84 |
| 9 | 29.70 | 110.40 | 5.00 | 1222.18 | 1124.37 | 763.81 |
| 9 | 29.70 | 110.40 | 5.00 | 1222.18 | 1124.37 | 763.81 |
| 10 | 36.35 | 114.58 | 5.00 | 1062.32 | 1016.55 | 690.56 |
| 10 | 36.35 | 114.58 | 5.00 | 1062.32 | 1016.55 | 690.56 |
| 11 | 36.35 | 118.61 | 5.00 | 967.98 | 952.91 | 647.33 |
| 11 | 36.35 | 118.61 | 5.00 | 967.98 | 952.91 | 647.33 |
| 12 | 43.00 | 122.45 | 5.00 | 764.57 | 815.71 | 554.13 |
| 12 | 43.00 | 122.45 | 5.00 | 764.57 | 815.71 | 554.13 |
| 13 | 43.00 | 126.11 | 5.00 | 623.73 | 720.71 | 489.59 |
| 13 | 43.00 | 126.11 | 5.00 | 623.73 | 720.71 | 489.59 |
| 14 | 49.65 | 129.55 | 5.00 | 392.18 | 564.53 | 383.50 |
| 14 | 49.65 | 129.55 | 5.00 | 392.18 | 564.53 | 383.50 |
| 15 | 49.65 | 132.79 | 5.00 | 214.69 | 444.81 | 302.17 |
| 15 | 49.65 | 132.79 | 5.00 | 214.69 | 444.81 | 302.17 |
| 16 | 56.30 | 136.17 | 6.33 | 128.31 | 86.55 | 58.79 |
| 16 | 56.30 | 136.17 | 6.33 | 128.31 | 86.55 | 58.79 |

***Table 4 - Base Force Data on the 16 Slices***

| Slice No. * | Alpha (deg) | X-Coord. Slice Cntr (ft) | Base Leng. (ft) | Effective Normal Force (lbs) | Available Shear Force (lbs) | Mobilized Shear Force (lbs) |
|---|---|---|---|---|---|---|
| 1 | 9.75 | 75.72 | 0.98 | 489.07 | 624.77 | 424.42 |
| 1 | 9.75 | 75.72 | 0.98 | 489.07 | 624.77 | 424.42 |
| 2 | 9.75 | 78.42 | 4.51 | 4970.26 | 4705.04 | 3196.24 |
| 2 | 9.75 | 78.42 | 4.51 | 4970.26 | 4705.04 | 3196.24 |
| 3 | 9.75 | 82.87 | 4.51 | 5646.89 | 5161.43 | 3506.27 |
| 3 | 9.75 | 82.87 | 4.51 | 5646.89 | 5161.43 | 3506.27 |
| 4 | 16.40 | 87.49 | 5.00 | 6431.43 | 5838.05 | 3965.91 |
| 4 | 16.40 | 87.49 | 5.00 | 6431.43 | 5838.05 | 3965.91 |
| 5 | 16.40 | 92.28 | 5.00 | 6890.75 | 6147.87 | 4176.38 |
| 5 | 16.40 | 92.28 | 5.00 | 6890.75 | 6147.87 | 4176.38 |
| 6 | 23.05 | 96.98 | 5.00 | 6710.30 | 6026.15 | 4093.70 |
| 6 | 23.05 | 96.98 | 5.00 | 6710.30 | 6026.15 | 4093.70 |
| 7 | 23.05 | 101.58 | 5.00 | 6825.44 | 6103.81 | 4146.45 |
| 7 | 23.05 | 101.58 | 5.00 | 6825.44 | 6103.81 | 4146.45 |
| 8 | 29.70 | 106.05 | 5.00 | 6307.63 | 5754.55 | 3909.19 |
| 8 | 29.70 | 106.05 | 5.00 | 6307.63 | 5754.55 | 3909.19 |
| 9 | 29.70 | 110.40 | 5.00 | 6110.89 | 5621.85 | 3819.04 |
| 9 | 29.70 | 110.40 | 5.00 | 6110.89 | 5621.85 | 3819.04 |
| 10 | 36.35 | 114.58 | 5.00 | 5311.61 | 5082.73 | 3452.81 |
| 10 | 36.35 | 114.58 | 5.00 | 5311.61 | 5082.73 | 3452.81 |
| 11 | 36.35 | 118.61 | 5.00 | 4839.91 | 4764.56 | 3236.67 |
| 11 | 36.35 | 118.61 | 5.00 | 4839.91 | 4764.56 | 3236.67 |
| 12 | 43.00 | 122.45 | 5.00 | 3822.84 | 4078.54 | 2770.64 |
| 12 | 43.00 | 122.45 | 5.00 | 3822.84 | 4078.54 | 2770.64 |
| 13 | 43.00 | 126.11 | 5.00 | 3118.64 | 3603.55 | 2447.97 |
| 13 | 43.00 | 126.11 | 5.00 | 3118.64 | 3603.55 | 2447.97 |
| 14 | 49.65 | 129.55 | 5.00 | 1960.92 | 2822.66 | 1917.49 |
| 14 | 49.65 | 129.55 | 5.00 | 1960.92 | 2822.66 | 1917.49 |
| 15 | 49.65 | 132.79 | 5.00 | 1073.44 | 2224.05 | 1510.84 |
| 15 | 49.65 | 132.79 | 5.00 | 1073.44 | 2224.05 | 1510.84 |
| 16 | 56.30 | 136.17 | 6.33 | 812.61 | 548.12 | 372.35 |
| 16 | 56.30 | 136.17 | 6.33 | 812.61 | 548.12 | 372.35 |

SUM OF MOMENTS = -0.114721E+00 (ft/lbs);Imbalance (Fraction of Total Weight) = -0.1373662E-05

Sum of the Resisting Forces = 69107.73 (lbs)

Average Available Shear Strength = 905.34(psf)

Sum of the Driving Forces = 46946.37 (lbs)

Average Mobilized Shear Stress = 615.02(psf)

Total length of the failure surface = 76.33(ft)

Factor of Safety Balance Check: FS = 1.47206

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

*** SEISMIC SLOPE DISPLACEMENT DATA ***
(Note: kv is set = zero for displacement calculations)
Seismic Yield Coefficient (ky) = 0.40563(g)
Calculated Newmark Seismic Displacement = 0.000(ft)

Average Elevation of Point of Application of kh on Sliding Mass = 761.124(ft)

Non-Symmetrical Sliding Resistance Has Been Specified for Downhill Sliding.

**** END OF GEOSTASE OUTPUT ****

# *Appendix F*
# *Seismic Refraction Survey Report*

# REPORT

# SEISMIC REFRACTION SURVEY

## The Groth Ranch
## San Marcos, California

**GEO***Vision* Project No. 24091

*Prepared for*

LGC Geotechnical, Inc.
131 Calle Iglesia, Suite 200
San Clemente, CA 92672
(949) 369-6141

*Prepared by*


**GEO***Vision*, Inc.
1124 Olympic Drive
Corona, CA 92881
(951) 549-1234


Report 24091-01 Rev 0

April 10, 2024

# TABLE OF CONTENTS



# LIST OF FIGURES

# 1 INTRODUCTION

A P-wave seismic refraction survey was conducted at the Groth Ranch property in San Marcos, California on March 27, 2024. The purpose of this investigation was to determine the rippability of the Mesozoic metavolcanic rock at the site. P-wave seismic refraction data was acquired along three profiles, designated as Lines 1 to 3 (Figure 1). Two other proposed seismic refraction lines were not completed because brush clearance is needed at the locations.

Depending on the degree of weathering, jointing, etc., crystalline rock may broadly be characterized as rippable using a Caterpillar D9R and D10R ripper at P-wave velocities less than 6,800 to 7,200 and 7,200 to 8,000 ft/s, respectively (Caterpillar, 2018). Crystalline rock is then expected to be marginally rippable by a D9R and D10R to a P-wave velocity of 8,000 to 9,000 ft/s and 8,500 to 9,500 ft/s, respectively, and nonrippable at higher seismic velocities (Caterpillar, 2018).

The following sections include a discussion of equipment and field procedures, methodology, data processing, and results of the geophysical survey.


Seismic Line

Notes:
Coordinate System: NAD 1983 StatePlane California VI FIPS 0406 Feet
Base map source: Nearmap (1-2024)

GEOVision geophysical services

| | |
|---|---|
| Date: | 4/5/2024 |
| GV Project: | 24091 |
| Developed by: | A Martin |
| Drawn by: | T Rodriguez |
| Approved by: | A Martin |
| File Name: | GV_24091 |

FIGURE 1
SITE MAP

THE GROTH RANCH
SAN MARCOS, CALIFORNIA

PREPARED FOR
LGC GEOTECHNICAL, INC.

# 2 METHODOLOGY

Detailed discussions of the seismic refraction method can be found in Telford et al. (1990), Dobrin and Savit (1988), and Redpath (1973).

When conducting a seismic survey, acoustic energy is input to the subsurface by an energy source such as a sledgehammer impacting a metallic plate, weight drop, vibratory source, or explosive charge. The acoustic waves propagate into the subsurface at a velocity dependent upon the elastic properties of the material through which they travel. When the waves reach an interface where the density or velocity changes significantly, a portion of the energy is reflected to the surface and the remainder is transmitted into the lower layer. Where the velocity of the lower layer is higher than that of the upper layer, a portion of the energy is also critically refracted along the interface. Critically refracted waves travel along the interface at the velocity of the lower layer and continually refract energy back to the surface. Receivers (geophones) laid out in linear array on the surface record the incoming refracted and reflected waves. The seismic refraction method involves analysis of the travel times of the first energy to arrive at the geophones. These seismic first arrivals are from either the direct wave (at geophones close to the source) or critically refracted waves (at geophones further from the source).

Analysis of seismic refraction data depends upon the complexity of the subsurface velocity structure. If the subsurface target is planar then the slope intercept method (Telford et al., 1990) can be used to model multiple horizontal or dipping planar layers. A minimum of one end shot is required to model horizontal layers and reverse end shots are required to model dipping planar layers. If the subsurface target is undulating (i.e. bedrock valley) then layer based analysis routines such as the generalized reciprocal method (Palmer, 1980 and 1981, Lankston and Lankston, 1986 and Lankston, 1990); reciprocal method (Hawkins, 1961) also referred to as the ABC method; Hales' method (Hales, 1958); delay time method (Wyrobek, 1956 and Gardner, 1967); time-term inversion (Scheidegger and Willmore, 1959); plus-minus method (Hagedoorn, 1959); and wavefront method (Rockwell, 1967) are preferred to model subsurface velocity structure. These methods generally require a minimum of 5 shot points per spread (end shots, off end shots and a center shot). If subsurface velocity structure is complex and cannot be adequately modeled using layer-based modeling techniques (e.g., complex weathering profile in bedrock, numerous lateral velocity variations), then Monte Carlo or tomographic inversion techniques (Zhang and Toksoz, 1998; Schuster and Quintus-Bosz, 1993) are required to model the seismic refraction data. These techniques require a high shot density; typically, every 3 to 6 stations/geophones.

Errors in seismic refraction models not associated with errors in first arrival data can be caused by blind zones, hidden layers, and lateral velocity variability. A blind zone is a geologic layer with a lower seismic velocity than the overlying layer and, therefore, does not give rise to a seismic refraction. This type of layer, therefore, cannot be recognized or modeled and depths to underlying layers would be overestimated. The presence of blind zones will cause errors in depth averaged seismic velocity or slowness.

A hidden layer is a layer with a velocity increase, but of sufficiently small thickness relative to the velocities of overlying and underlying layers, that refracted arrivals do not arrive at the geophones before those from the deeper, higher velocity layer. Because the seismic refraction method generally only involves the interpretation of first arrivals, a hidden layer cannot be recognized or modeled and depths to underlying layers would be underestimated. However, it can be demonstrated that the presence of hidden layers does not cause significant errors in depth averaged seismic velocity or slowness, such as the average velocity of the upper 100 ft. A subsurface velocity structure that increases as a function of depth rather than as discrete layers, will also cause depths to subsurface refractors to be underestimated, in a manner very similar to that of the hidden layer problem.

Lateral velocity variability within a layer that is not characterized by the modeling scheme utilized for analysis will also result in depth errors to underlying layers. Additionally, at sites with steeply dipping or highly irregular bedrock surfaces, out-of-plane refractions (refractions from structures to the side of the line rather than from beneath the line) may severely complicate modeling. Tomographic inversion techniques can often resolve the complex velocity structures associated with hidden layers, velocity gradients and lateral velocity variations. However, in the event of an abrupt increase in velocity at a geologic horizon, the velocity model generated using tomographic inversion routines will smooth the horizon with velocity being underestimated at the interface and possibly overestimated at depth.

# 3 EQUIPMENT AND FIELD PROCEDURES

Seismic refraction equipment used during this investigation consisted of two Geometrics Geode 24-channel signal enhancement seismographs, 10 Hz vertical geophones, seismic cables with 10-foot spaced connectors, piezo hammer switches, a 240-lb accelerated weight drop (AWD), and a 20-lb sledgehammer with an aluminum strike plate.

The locations of the seismic refraction profiles were established by SA Geotechnical, Inc. Line 1 consisted of 48 geophones spaced 10 feet apart for a line length of 470 ft and Lines 2 and 3 consisted of 48 geophones spaced 7.5 feet apart for line lengths of 352.5 ft. All geophone and shot point locations along each line were measured using a 300-foot tape measure. Elevations along each seismic refraction line were surveyed using a Trimble R10 GPS system with CenterPoint RTX real-time differential corrections.

Source locations included end shots at each end geophone, multiple off-end shot locations to a maximum offset of 105 ft as possible, and interior shot locations at a 6-geophone interval for a total of 17 to 18 source locations per line. The AWD or 20-lb sledgehammer was used as the energy source for all source locations. A hammer switch mounted on the hammer was used to trigger the seismograph upon impact with the aluminum plate. The final seismic record at each shot point was the result of stacking 10 to 20 shots to increase the signal to noise ratio. All seismic records were stored on a laptop computer. Data acquisition parameters, file names, and other observations were recorded on a field log, which is retained in project files.

# 4 DATA REDUCTION AND MODELING

The first step in data processing consisted of picking the arrival time of the first energy (first arrival) received at each geophone for each shot point. The first arrivals on each seismic record are either a direct arrival from a compressional (P) wave traveling in the uppermost layer or a refracted arrival from a subsurface interface where there is a velocity increase. First-arrival times were selected using the manual picking routines in the SeisImager™ software suite (Geometrics, Inc.). These first-arrival times were saved in an ASCII file containing shot location, geophone locations, and associated first-arrival time. Errors in the first-arrival times were variable with error generally increasing with distance from the shot point. Elevations for each geophone location were calculated from the GPS data.

Seismic refraction data were then modeled using the tomographic analysis technique available in the SeisImager™ Plotrefa software package. Refraction tomography techniques are often able to resolve complex velocity structure (e.g., velocity gradients) that can be observed in bedrock weathering profiles. Layer-based modeling techniques such as the GRM are more applicable to characterize geologic structure that exhibits layering (e.g., low velocity sediments over high velocity rock). It should be noted, however, that tomographic modeling techniques will generate a velocity model with a gradual increase in velocity with depth even though an abrupt velocity increase may be present.

Tomographic analysis was conducted as outlined in the following steps. A smooth velocity gradient initial model was developed covering the expected velocity range in weathered rock at the site. The initial model had 18 layers with the top of the bottom layer at a depth related to the effective depth of investigation of the model. Velocity ranges were also set to values outside of the starting model minimum and maximum. The velocity models were extended to permit the use of off-end shot points during the inversion, as applicable. A minimum of 10 iterations of non-linear raypath inversion were then implemented to model the seismic data. The starting model parameters were then adjusted, as necessary, and the modeling process repeated until an acceptable fit between observed and calculated first arrival data was achieved.

The final tomographic velocity models for the seismic line were exported as ASCII files and imported into the Golden Software Surfer® mapping system where the velocity model was gridded, contoured, and annotated for presentation.

# 5 DISCUSSION OF RESULTS

The P-wave seismic refraction models for Lines 1 to 3 are presented as Figures 2 to 4, respectively. A color scheme with blue-cyan, green-orange, and red-magenta representing low, intermediate, and high P-wave velocities, respectively, and velocity contours at 1,000 ft/s intervals are used to display the seismic velocity models. The depth of investigation for Lines 1, 2, and 3 is about 140, 110, and 110 feet, respectively.

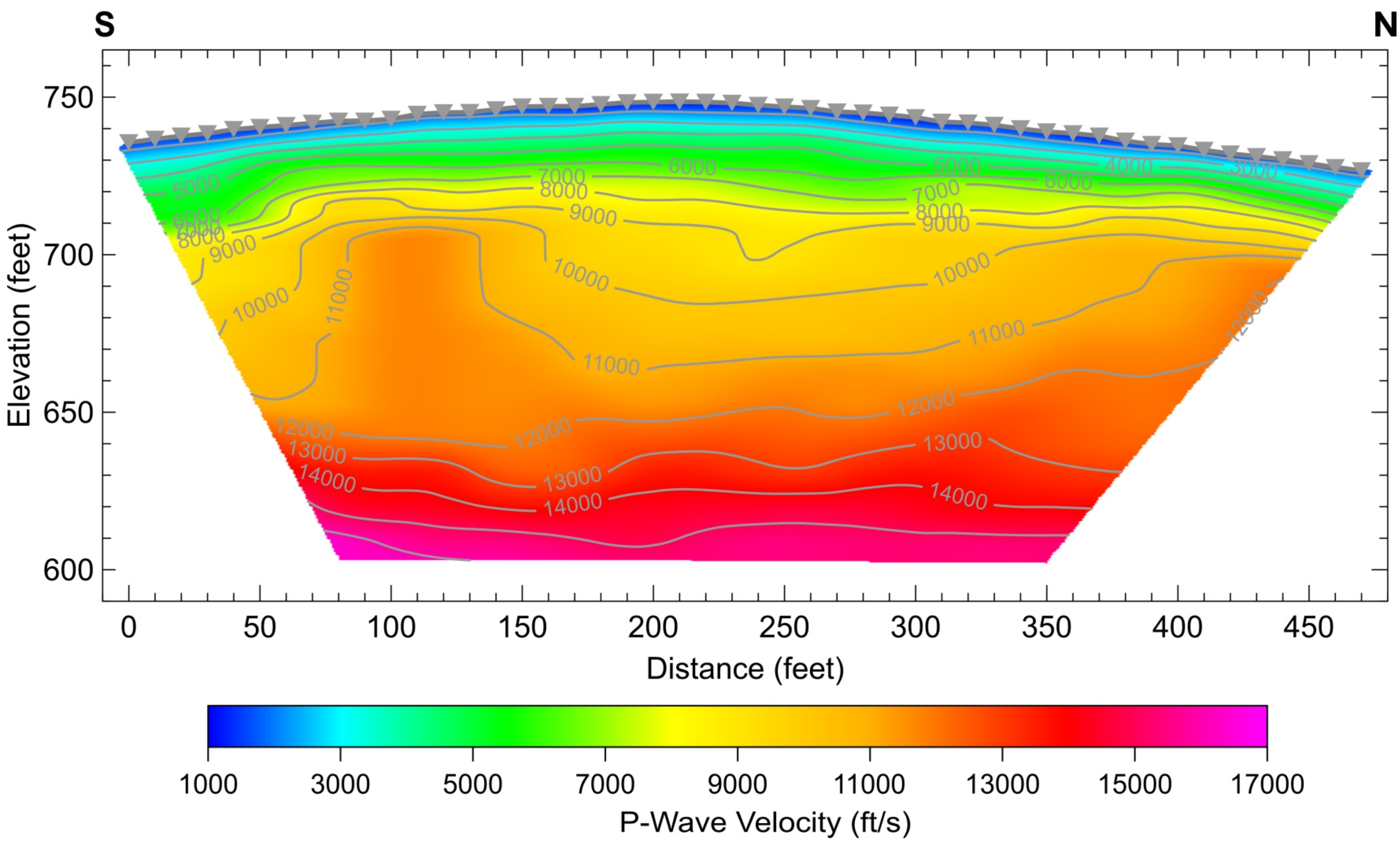
Tomographic inversion techniques will typically model a gradual increase in seismic velocity with depth even if an abrupt velocity contact is present. Velocity gradients are, however, common in weathered rock geologic environments, such as the project site.

For the purpose of discussion, we assume that a Caterpillar D9R Ripper, or equivalent, will be used on site. Crystalline rock with P-wave velocity of less than about 6,800 to 7,200 ft/s is considered rippable by a D9R assuming that the rock is sufficiently fractured and jointed. Crystalline rock with P-wave velocity between about 6,800 to 7,200 and 8,000 to 9,000 ft/s is considered marginally rippable by a D9R, although it may be more cost effective to blast rather than rip rock in this velocity range. Crystalline rock with P-wave velocity greater than about 8,000 to 9,000 ft/s is considered nonrippable by a D9R.

P-wave velocity increases with depth beneath Line 1 (Figure 2) from about 1,250 to 1,750 ft/s at the surface to over 15,000 ft/s at a depth between about 120 and 140 ft. The rock is expected to be rippable by a D9R to a depth of about 13 to 30 ft and then marginally rippable to a depth of about 19 to 40 ft.

P-wave velocity increases with depth beneath Line 2 (Figure 3) from about 1,000 to 1,500 ft/s at the surface to over 13,000 ft/s at a depth between about 75 and 130 ft. The rock is expected to be rippable by a D9R to a depth of about 16 to 40 ft and then marginally rippable to a depth of about 20 to 80 ft.

P-wave velocity increases with depth beneath Line 3 (Figure 4) from about 1,000 to 1,500 ft/s at the surface to over 15,000 ft/s at a depth of about 85 ft. The rock is expected to be rippable by a D9R to a depth of about 33 to 46 ft and then marginally rippable to a depth of about 40 to 55 ft.




GEOVision geophysical services

Project No: 24091

Date: APR 3, 2024

Drawn By: A MARTIN

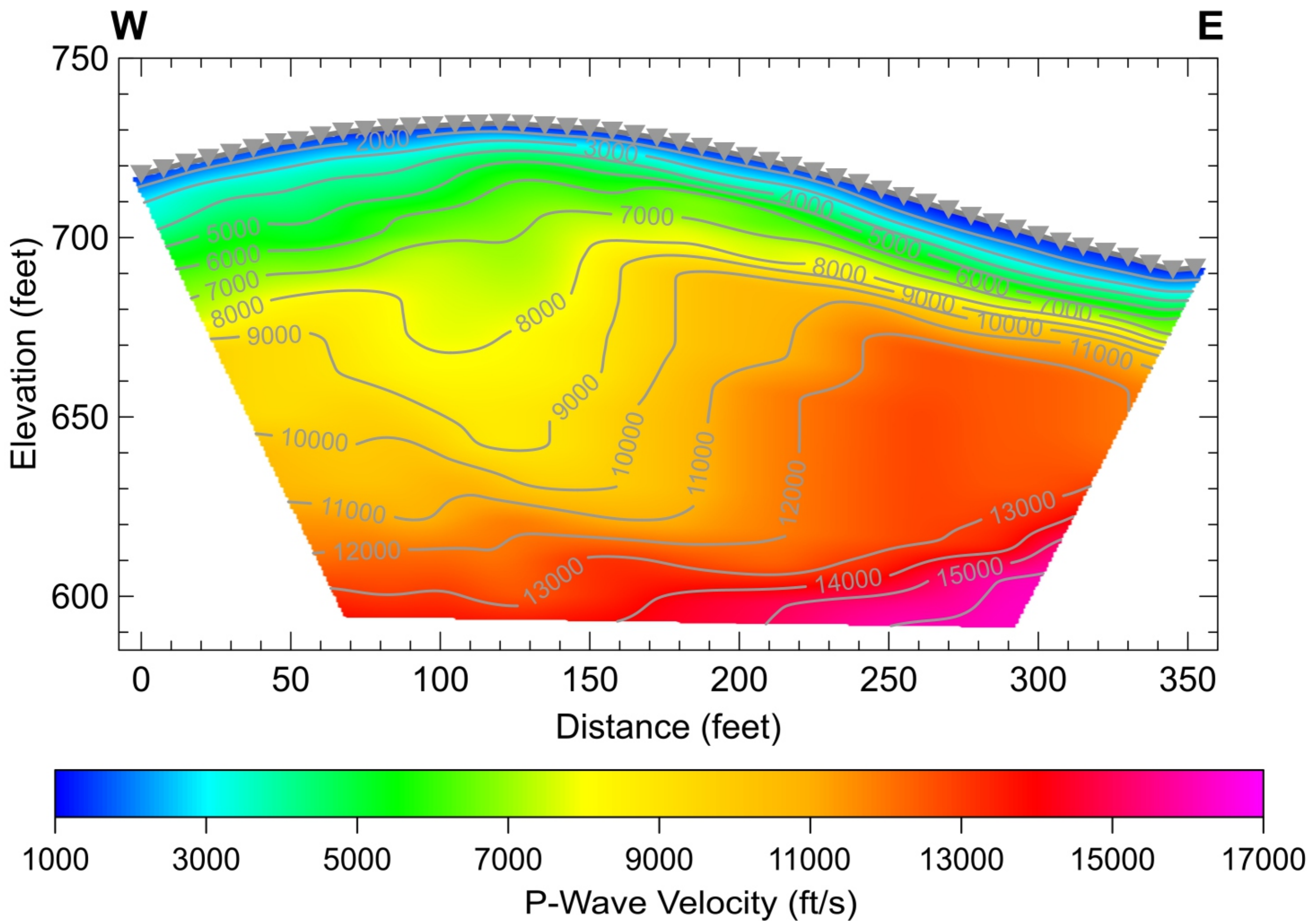
Approved By:

R:\GVProjects\2024\24091-LGC\Report\Figure 2.cdr

FIGURE 2
LINE 1 P-WAVE SEISMIC REFRACTION MODEL

THE GROTH RANCH
SAN MARCOS, CALIFORNIA

PREPARED FOR
LGC GEOTECHNICAL, INC.




GEOVision geophysical services

Project No: 24091

Date: APR 3, 2024

Drawn By: A MARTIN

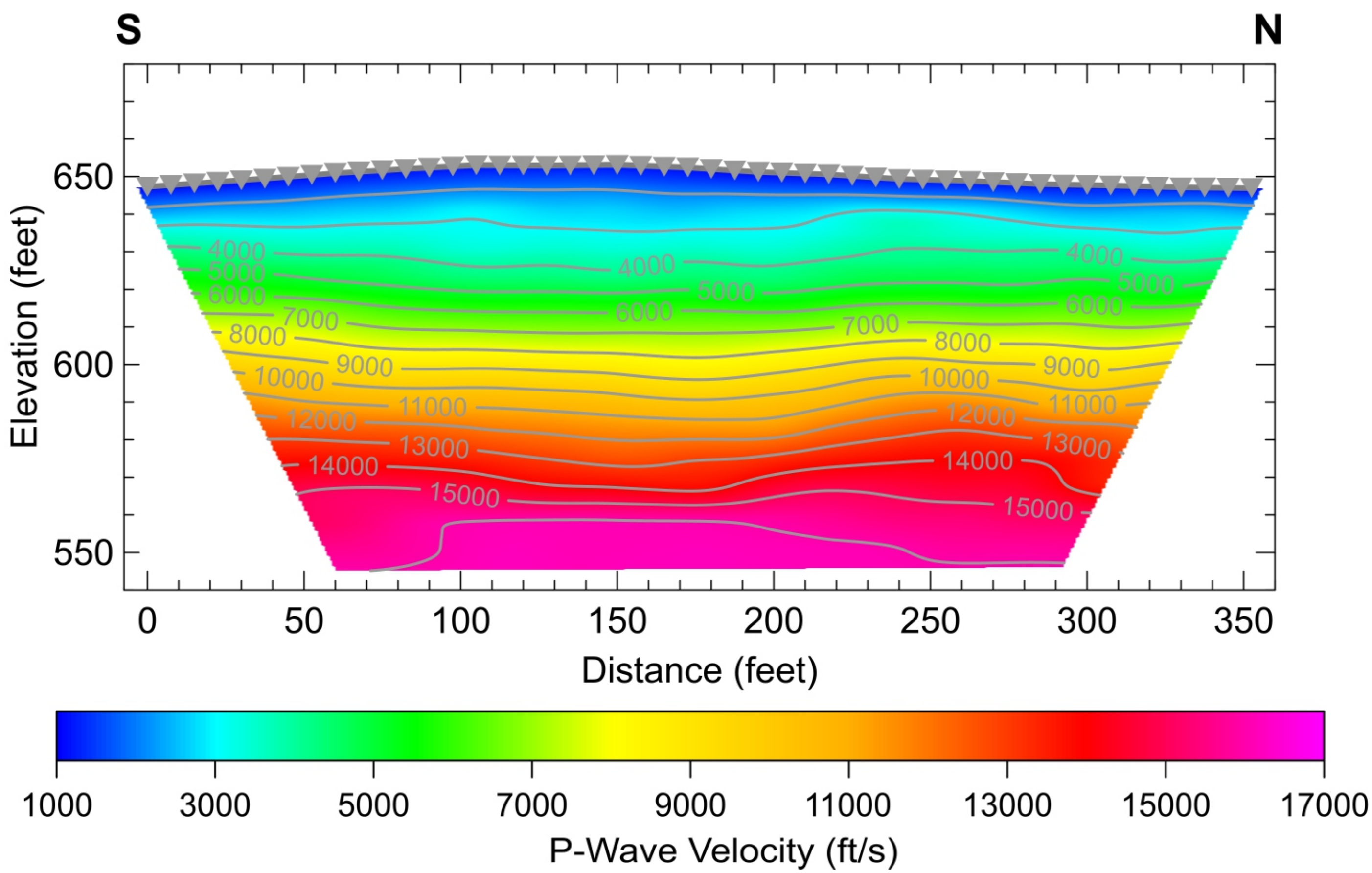
Approved By:

R:\GVProjects\2024\24091-LGC\Report\Figure 3.cdr

FIGURE 3
LINE 2 P-WAVE SEISMIC REFRACTION MODEL

THE GROTH RANCH
SAN MARCOS, CALIFORNIA

PREPARED FOR
LGC GEOTECHNICAL, INC.




GEOVision geophysical services

Project No: 24091
Date: APR 3, 2024
Drawn By: A MARTIN
Approved By:

R:\GVProjects\2024\24091-LGC\Report\Figure 4.cdr

FIGURE 4
LINE 3 P-WAVE SEISMIC REFRACTION MODEL

THE GROTH RANCH
SAN MARCOS, CALIFORNIA

PREPARED FOR
LGC GEOTECHNICAL, INC.

# 6 REFERENCES


Caterpillar Performance Handbook, 2018, 48th Edition, A publication by Caterpillar, Peoria, Illinois, U.S.A.

Dobrin, M.S., and Savit, J., 1988, Introduction to Geophysical Prospecting, McGraw-Hill Co., New York.

Gardner, L.W., 1967, Refraction seismograph profile interpretation, in Musgrave, A.W., ed., Seismic Refraction Prospecting: Society of Exploration Geophysicists, p. 338-347.

Hagedoorn, J.G., 1959, The plus-minus method of interpreting seismic refraction sections, *Geophysical Prospecting*, v. 7, p. 158-182.

Hales, F. W., 1958, An accurate graphical method for interpreting seismic refraction lines, *Geophysical Prospecting*, v. 6, p. 285-294.

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

Lankston, R. W., 1990, High-resolution refraction seismic data acquisition and interpretation, in Ward, S. H., ed., Geotechnical and Environmental Geophysics, Volume I: Review and Tutorial: Society of Exploration Geophysicists, Tulsa, Oklahoma, p. 45-74.

Lankston, R. W., and Lankston, M. M., 1986, Obtaining multilayer reciprocal times through phantoming, *Geophysics*, v. 51, p. 45-49.

Palmer, D., 1980, The generalized reciprocal method of seismic refraction interpretation, Society of Exploration Geophysics, Tulsa, Oklahoma, p. 104.

Palmer, D., 1981, An introduction to the field of seismic refraction interpretation, *Geophysics*, v. 46, p. 1508-1518.

Redpath, B. B., 1973, Seismic refraction exploration for engineering site investigations: U. S. Army Engineer Waterway Experiment Station Explosive Excavation Research Laboratory, Livermore, California, Technical Report E-73-4, 51 p.

Rockwell, D.W., 1967, General Wavefront Method, in Musgrave, A.W., ed., Seismic Refraction Prospecting: Society of Exploration Geophysicists, p. 363-415.

Scheidegger, A., and Willmore, P.L., 1957, The use of a least square method for the interpretation of data from seismic surveys, *Geophysics*, v. 22, p. 9-22.

Schuster, G. T. and Quintus-Bosz, A., 1993, Wavepath eikonal traveltime inversion: Theory: *Geophysics*, v. 58, no. 9, p. 1314-1323.

Telford, W. M., Geldart, L.P., Sheriff, R.E., 1990, Applied Geophysics, Second Edition, Cambridge University Press.

Wyrobek, S.M., 1956, Application of delay and intercept times in the interpretation of multilayer time distance curves, *Geophysical Prospecting*, v. 4, p 112-130.

Zhang, J. and Toksoz, M. N., 1998, Nonlinear refraction traveltime tomography, *Geophysic*s, v. 63, p. 1726-1737.

# 7 CERTIFICATION

All geophysical data, analysis, interpretations, conclusions, and recommendations in this document have been prepared under the supervision of and reviewed by a **GEO***Vision* California Professional Geophysicist.

Reviewed and approved by,

PROFESSIONAL GEOPHYSICIST ANTONY JEFFREY MARTIN GP 989 STATE OF CALIFORNIA

4/10/2024

Antony J. Martin Date
California Professional Geophysicist, P. Gp. 989
**GEO***Vision* Geophysical Services

* This geophysical investigation was conducted under the supervision of a California Professional Geophysicist using industry standard methods and equipment. A high degree of professionalism was maintained during all aspects of the project from the field investigation and data acquisition, through data processing, interpretation, and reporting. All original field data files, field notes, observations, and other pertinent information are maintained in the project files and are available for the client to review for a period of at least one year.

A professional geophysicist's certification of interpreted geophysical conditions comprises a declaration of his/her professional judgment. It does not constitute a warranty or guarantee, expressed or implied, nor does it relieve any other party of its responsibility to abide by contract documents, applicable codes, standards, regulations, or ordinances

# *Appendix G*
# *General Earthwork and*
# *Grading Specifications for Rough Grading*

***General Earthwork and Grading Specifications for Rough Grading***

## *1.0 General*

### *1.1 Intent*

These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

### *1.2 The Geotechnical Consultant of Record*

Prior to commencement of work, the owner shall employ a qualified Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultant shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to confirm that the attained level of compaction is being accomplished as specified. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

### *1.3 The Earthwork Contractor*

The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the project plans and specifications. The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of “equipment” of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate personnel will be available for observation and testing. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified. It is the contractor's sole responsibility to provide proper fill compaction.

## *2.0 Preparation of Areas to be Filled*

### *2.1 Clearing and Grubbing*

Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed. The contractor is responsible for all hazardous waste relating to his work. The Geotechnical Consultant does not have expertise in this area. If hazardous waste is a concern, then the Client should acquire the services of a qualified environmental assessor.

### *2.2 Processing*

Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be over-excavated as specified in the following section. Scarification shall continue until soils are broken down and free of oversize material and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

### *2.3 Over-excavation*

In addition to removals and over-excavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be over-excavated to competent ground as evaluated by the Geotechnical Consultant during grading.

### *2.4 Benching*

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. Please see the Standard Details for a graphic illustration. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise over-excavated to provide a flat subgrade for the fill.

### *2.5 Evaluation/Acceptance of Fill Areas*

All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

## *3.0 Fill Material*

### *3.1 General*

Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

### *3.2 Oversize*

Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

### 3.3 Import

If importing of fill material is required for grading, proposed import material shall meet the requirements of the geotechnical consultant. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

## 4.0 Fill Placement and Compaction

### 4.1 Fill Layers

Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

### 4.2 Fill Moisture Conditioning

Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557).

### 4.3 Compaction of Fill

After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

### 4.4 Compaction of Fill Slopes

In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557.

### 4.5 Compaction Testing

Field tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

***4.6 Frequency of Compaction Testing***

Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

***4.7 Compaction Test Locations***

The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than
5 feet apart from potential test locations shall be provided.

## ***5.0 Subdrain Installation***

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan, and the Standard Details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

## ***6.0 Excavation***

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

## ***7.0 Trench Backfills***

***7.1*** The Contractor shall follow all OHSA and Cal/OSHA requirements for safety of trench excavations.

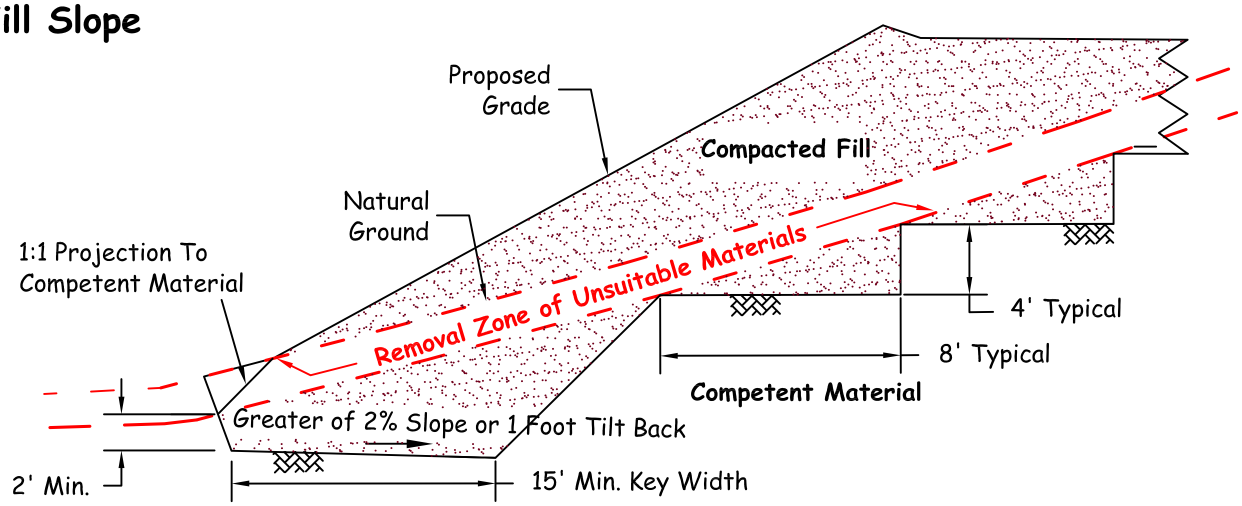
***7.2*** All bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum of 90 percent of maximum from 1 foot above the top of the conduit to the surface.

***7.3*** The jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

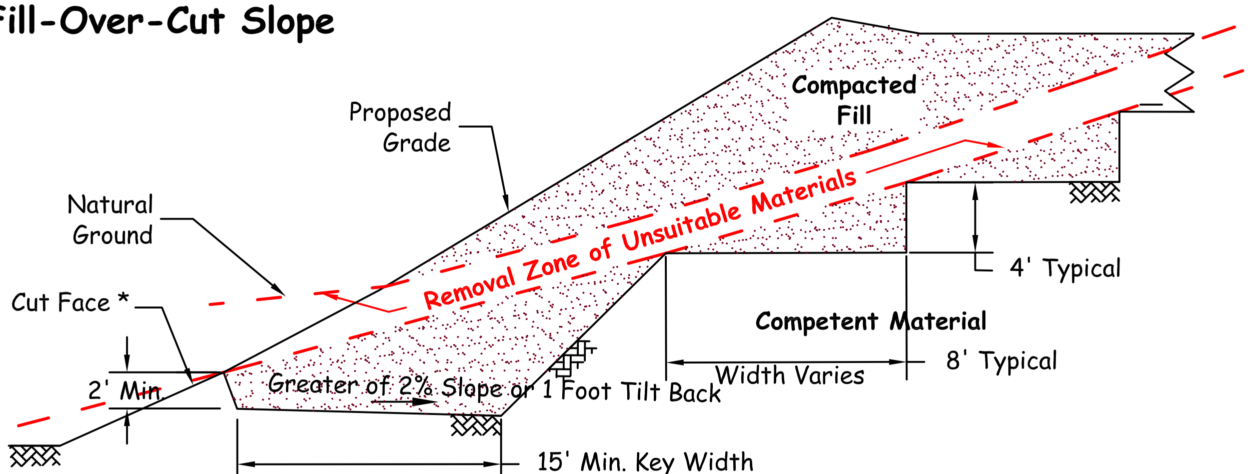
***7.4*** The Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

***7.5*** Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

## Fill Slope

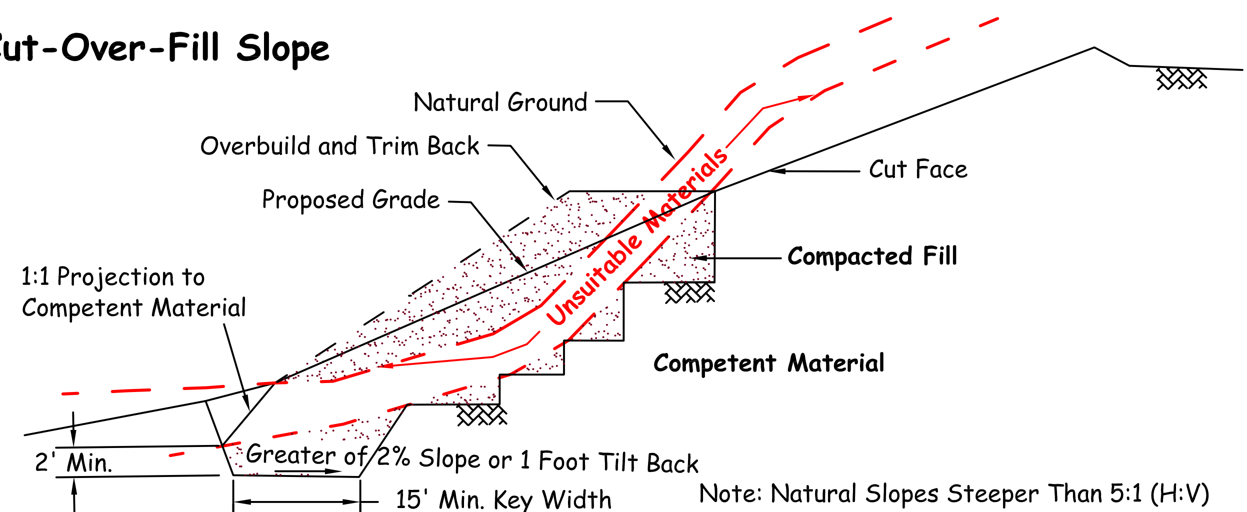



## Fill-Over-Cut Slope




* Construct Cut Slope First

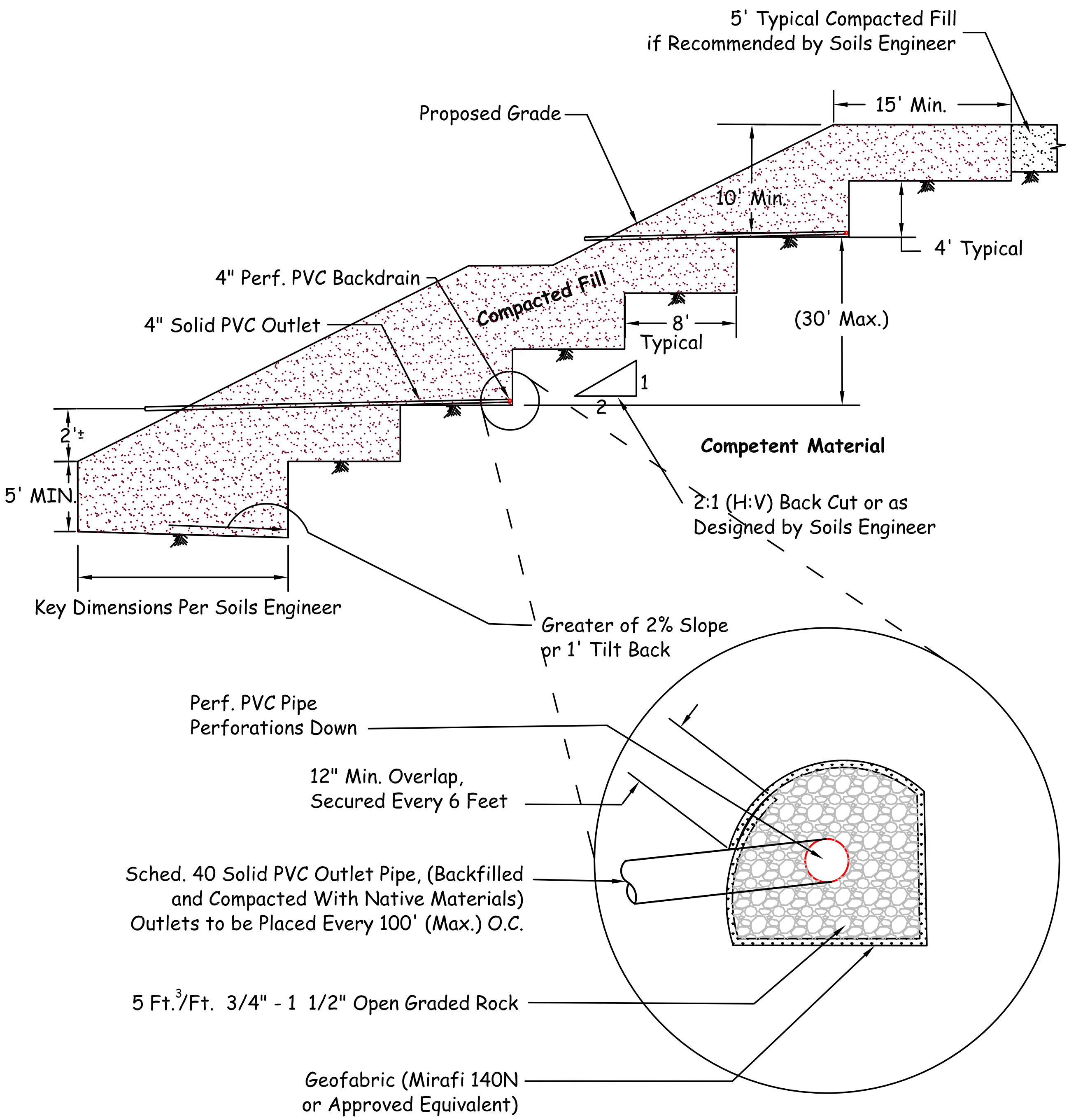
## Cut-Over-Fill Slope




Note: Natural Slopes Steeper Than 5:1 (H:V) Must Be Benched.

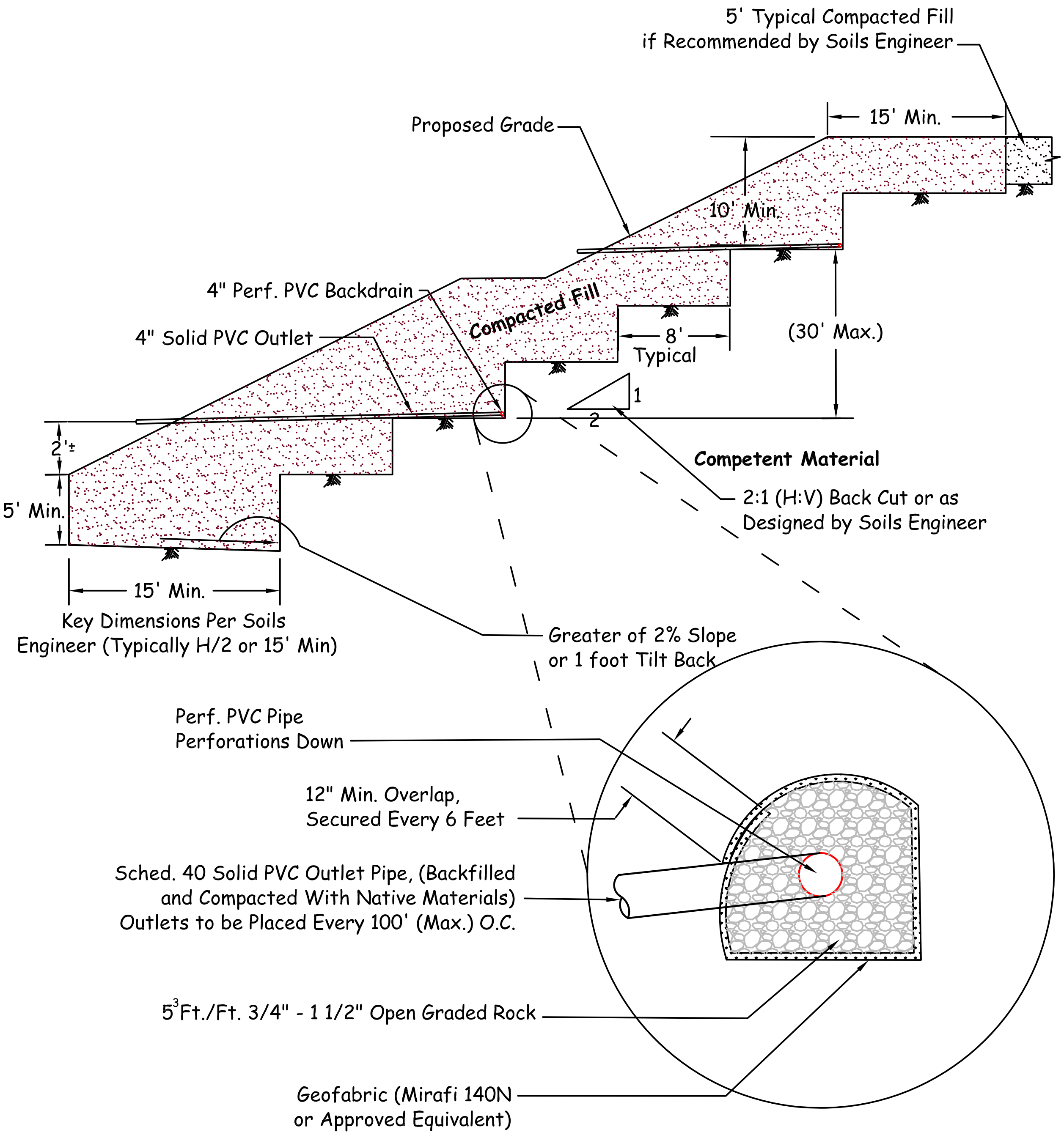
LGC Geotechnical, Inc.

# KEYING AND BENCHING




LGC Geotechnical, Inc.

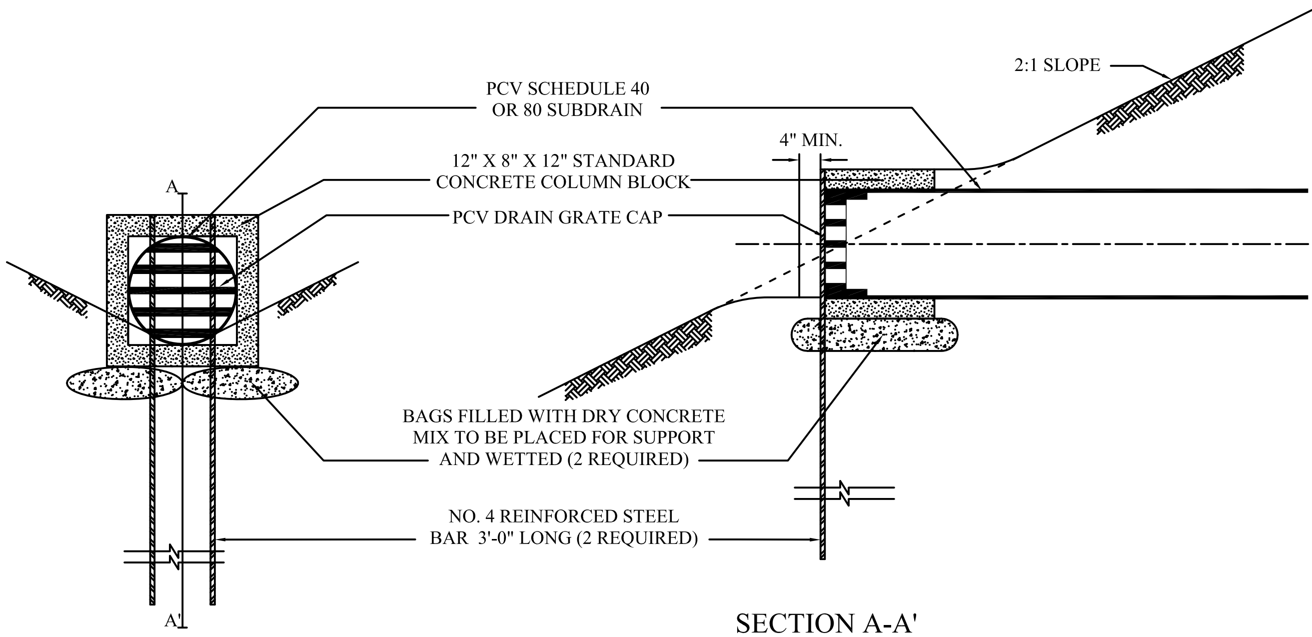
# TYPICAL BUTTRESS DETAIL




LGC Geotechnical, Inc.

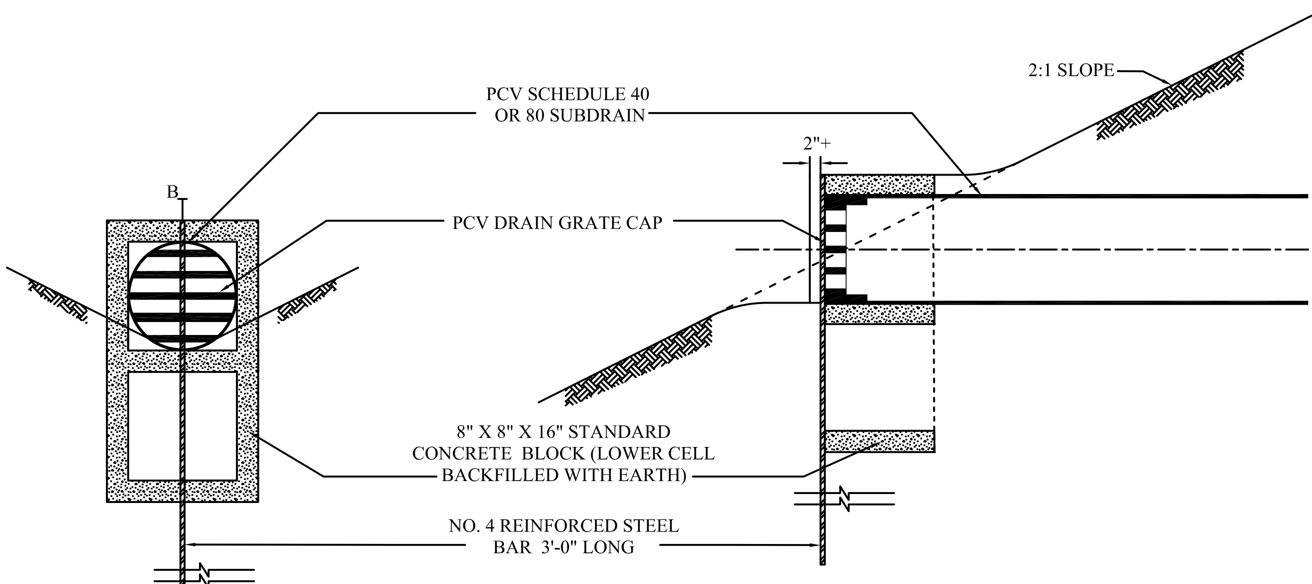
# TYPICAL STABILIZATION FILL DETAIL

# SUBDRAIN OUTLET MARKER -6" & 8" PIPE




SECTION A-A'

# SUBDRAIN OUTLET MARKER -4" PIPE




SECTION B-B'

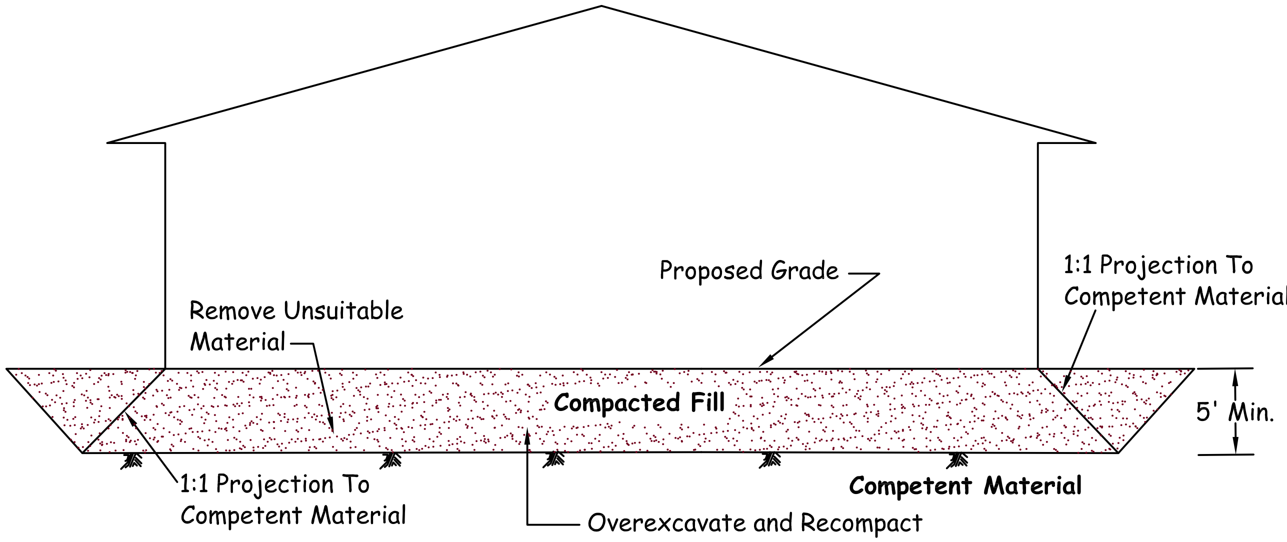
NOT TO SCALE

LGC Geotechnical, Inc.

**SUBDRAIN OUTLET MARKER DETAIL**

# Cut Lot

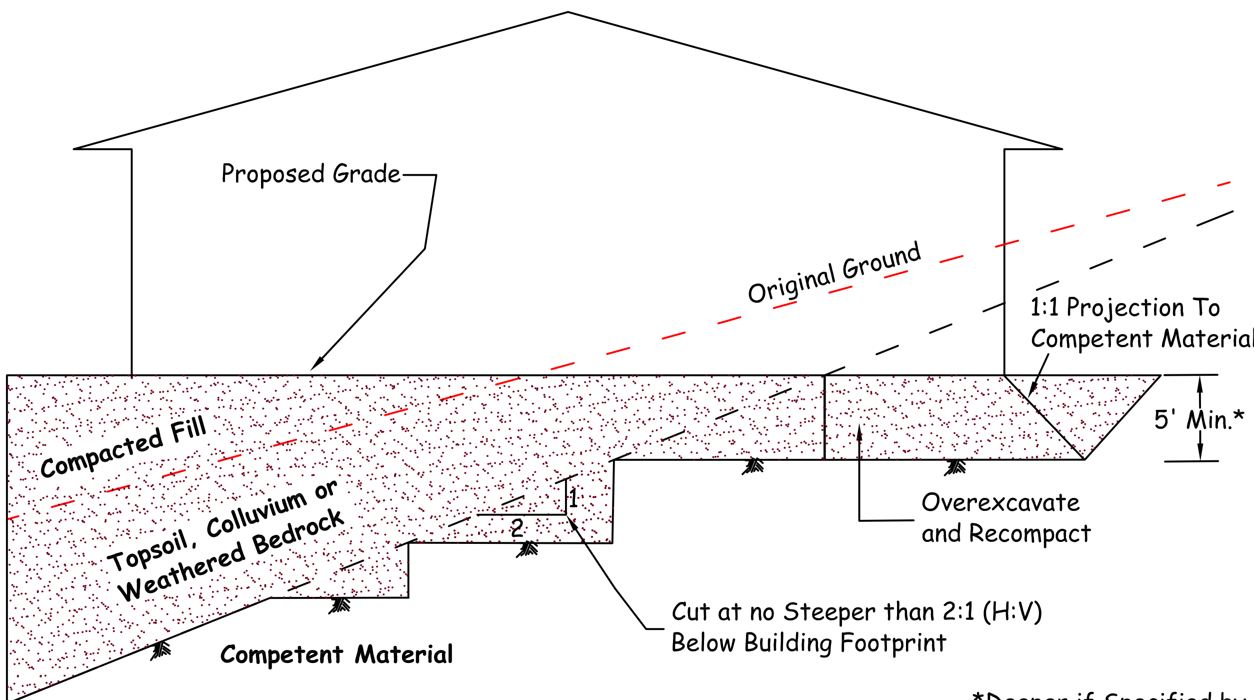
(Exposing Unsuitable Soils at Design Grade)




Note 1: Removal Bottom Should be Graded With Minimum 2% Fall Towards Street or Other Suitable Area (as Determined by Soils Engineer) to Avoid Ponding Below Building

Note 2: Where Design Cut Lots are Excavated Entirely Into Competent Material, Overexcavation May Still be Required for Hard-Rock Conditions or for Materials With Variable Expansion Characteristics.

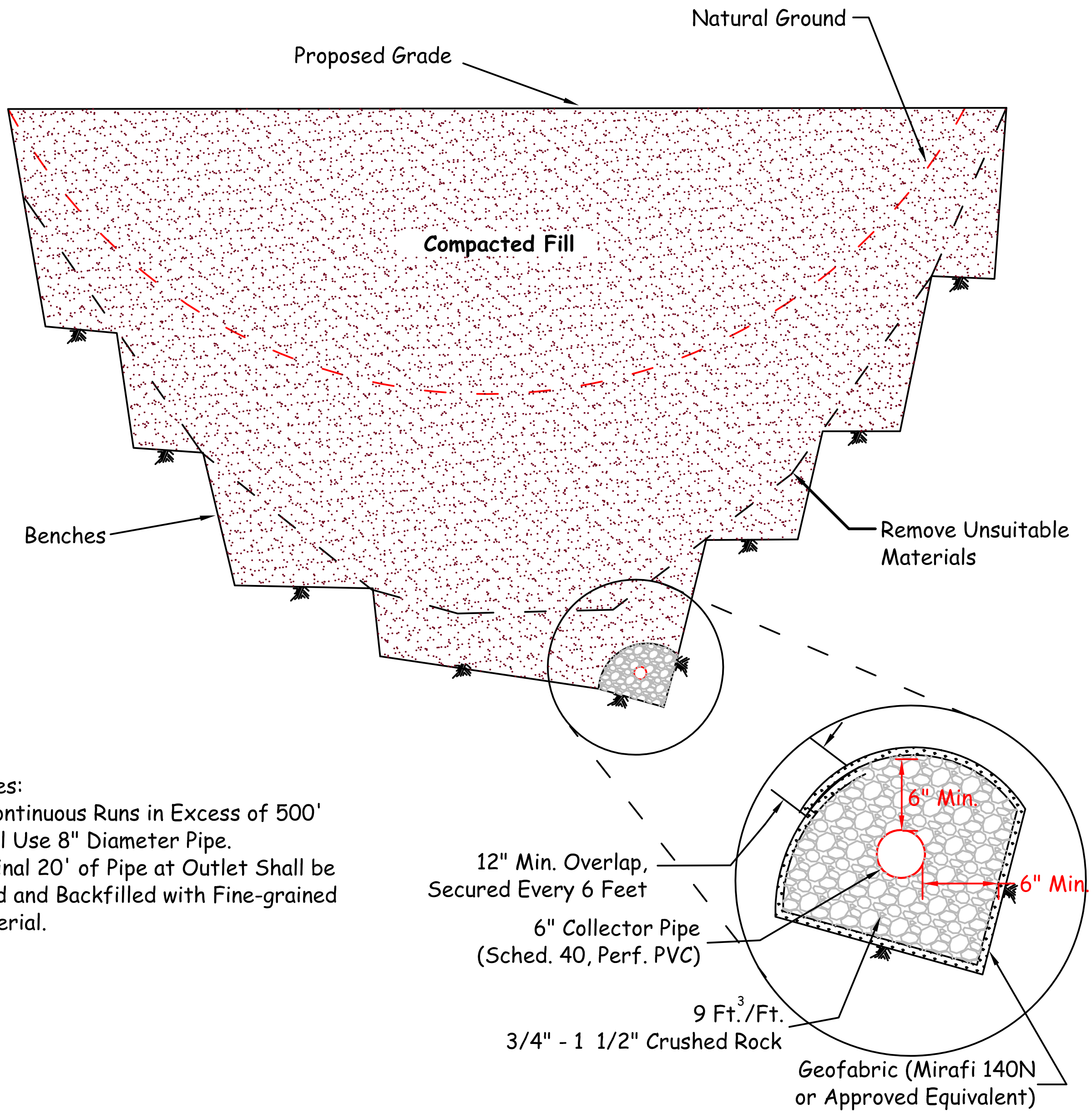
# Cut/Fill Transition Lot




*Deeper if Specified by Soils Engineer

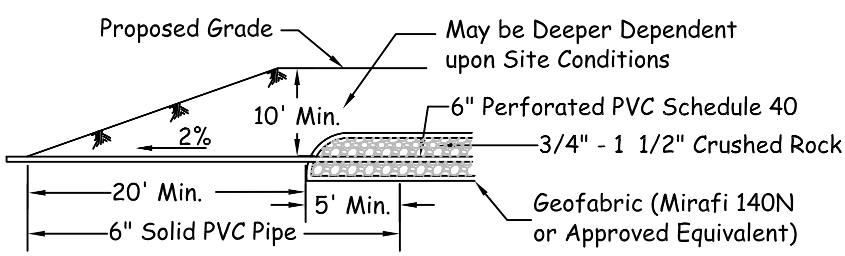
LGC Geotechnical, Inc.

# CUT AND TRANSITION LOT OVEREXCAVATION DETAIL



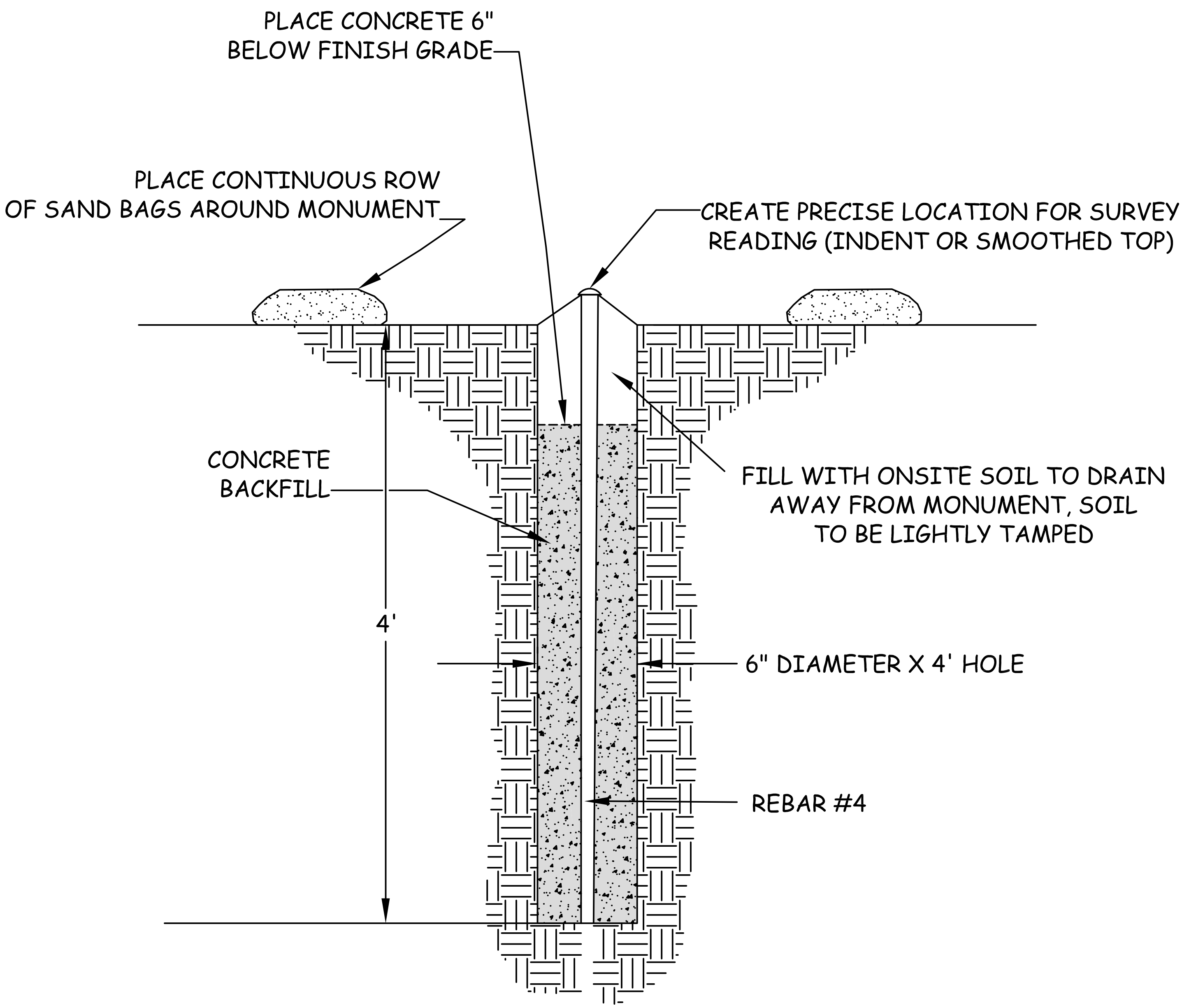

Notes:
1) Continuous Runs in Excess of 500' Shall Use 8" Diameter Pipe.
2) Final 20' of Pipe at Outlet Shall be Solid and Backfilled with Fine-grained Material.

## Proposed Outlet Detail




LGC Geotechnical, Inc.

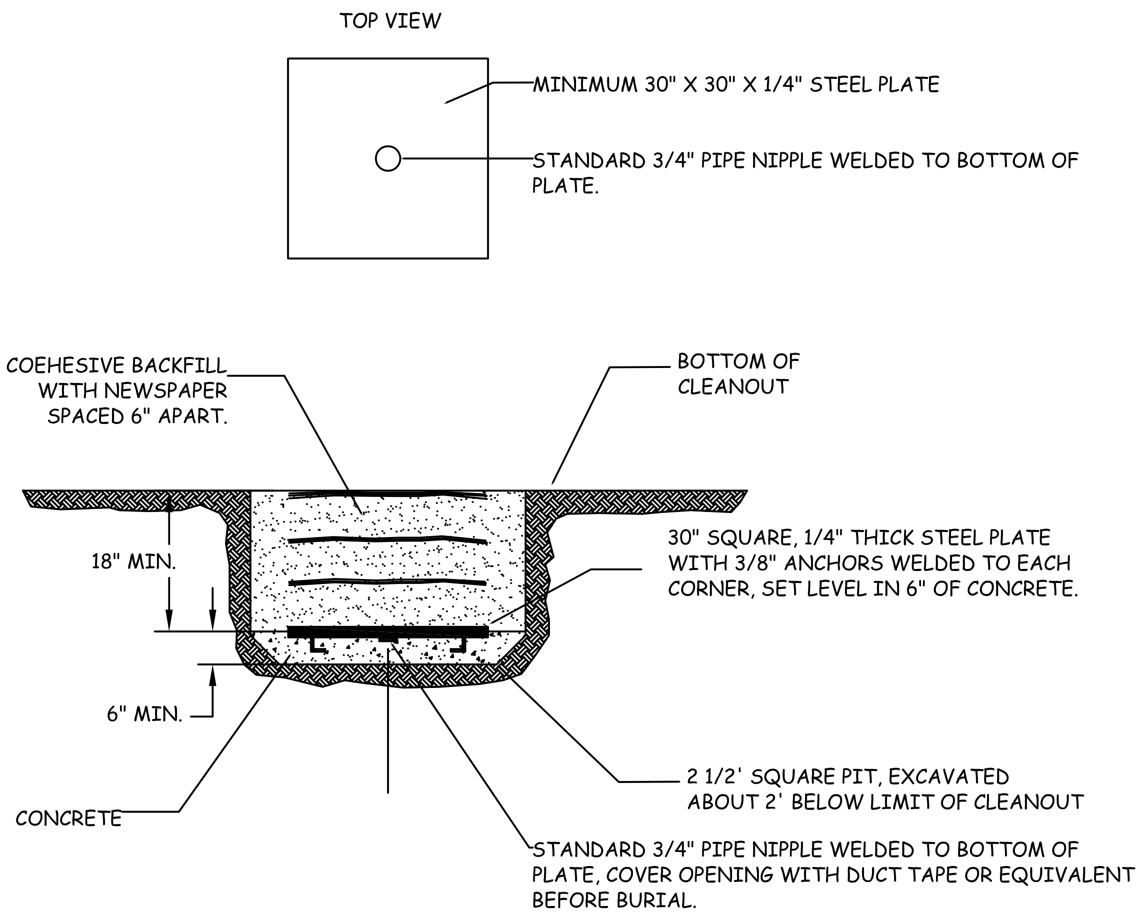
# CANYON SUBDRAINS




NO CONSTRUCTION EQUIPMENT WITHIN 25 FEET
OF ANY INSTALLED SETTLEMENT MONUMENTS

LGC Geotechnical, Inc.

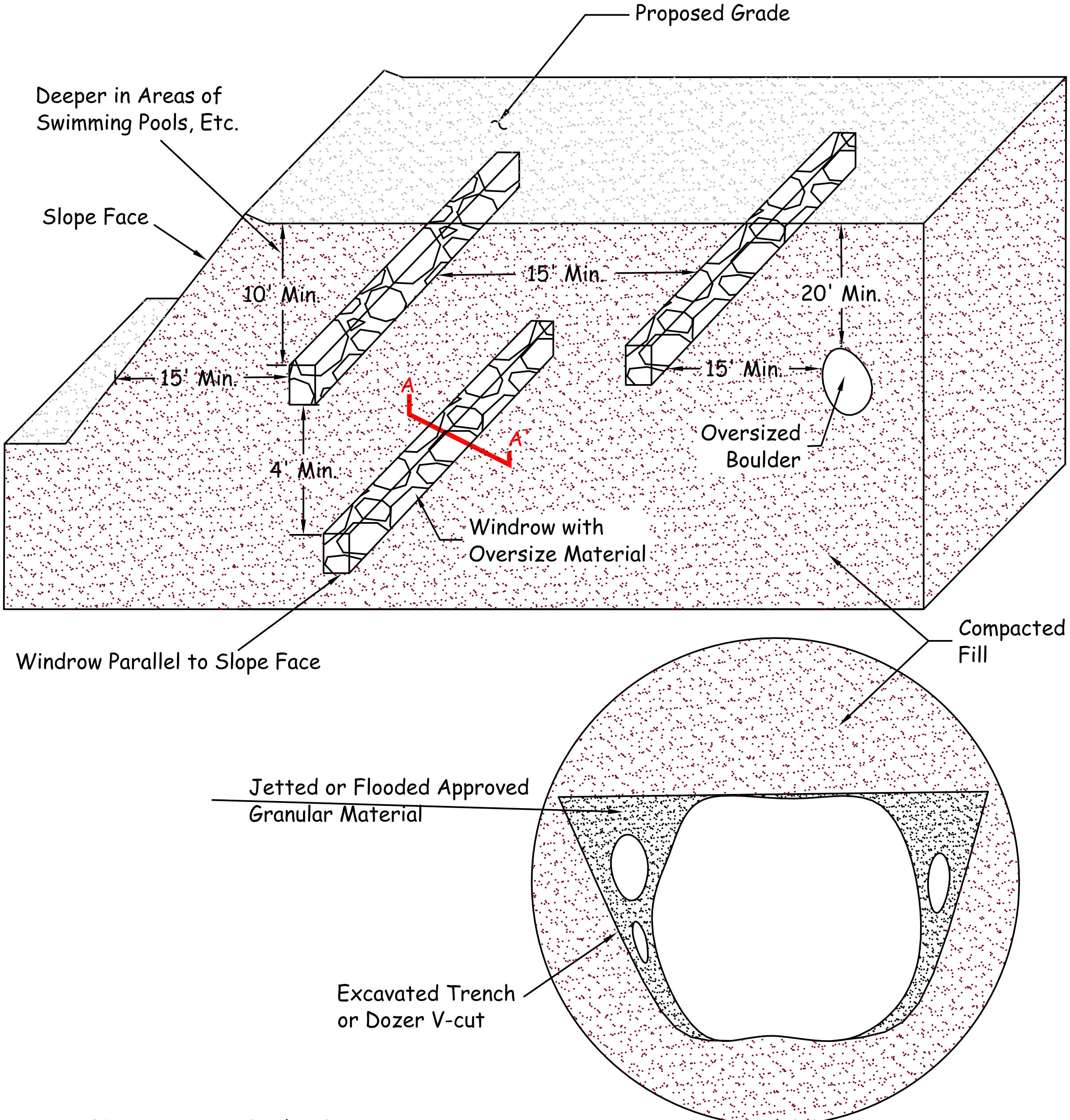
**TYPICAL SURFACE SETTLEMENT MONUMENT**




1. SURVEY FOR HORIZONTAL AND VERTICAL LOCATION TO NEAREST .01 INCH PRIOR TO BACKFILL USING KNOW LOCATIONS THAT WILL REMAIN INTACT DURING THE DURATION OF THE MONITORING PROGRAM. KNOW POINTS EXPLICITELY NOT ALLOWED ARE THOSE LOCATED ON FILL OR THAT WILL BE DESTROYED DURING GRADING.
2. IN THE EVENT OF DAMAGE TO SETTLEMENT PLATE DURING GRADING, CONTRACTOR SHALL IMMEDIATELY NOTIFY THE GEOTECHNICAL ENGINEER AND SHALL BE RESPONSIBLE FOR RESTORING THE SETTLEMENT PLATES TO WORKING ORDER.
3. DRILL TO RECOVER AND ATTACH RISER PIPE.

LGC Geotechnical, Inc.

# TYPICAL SETTLEMENT PLATE AND RISER

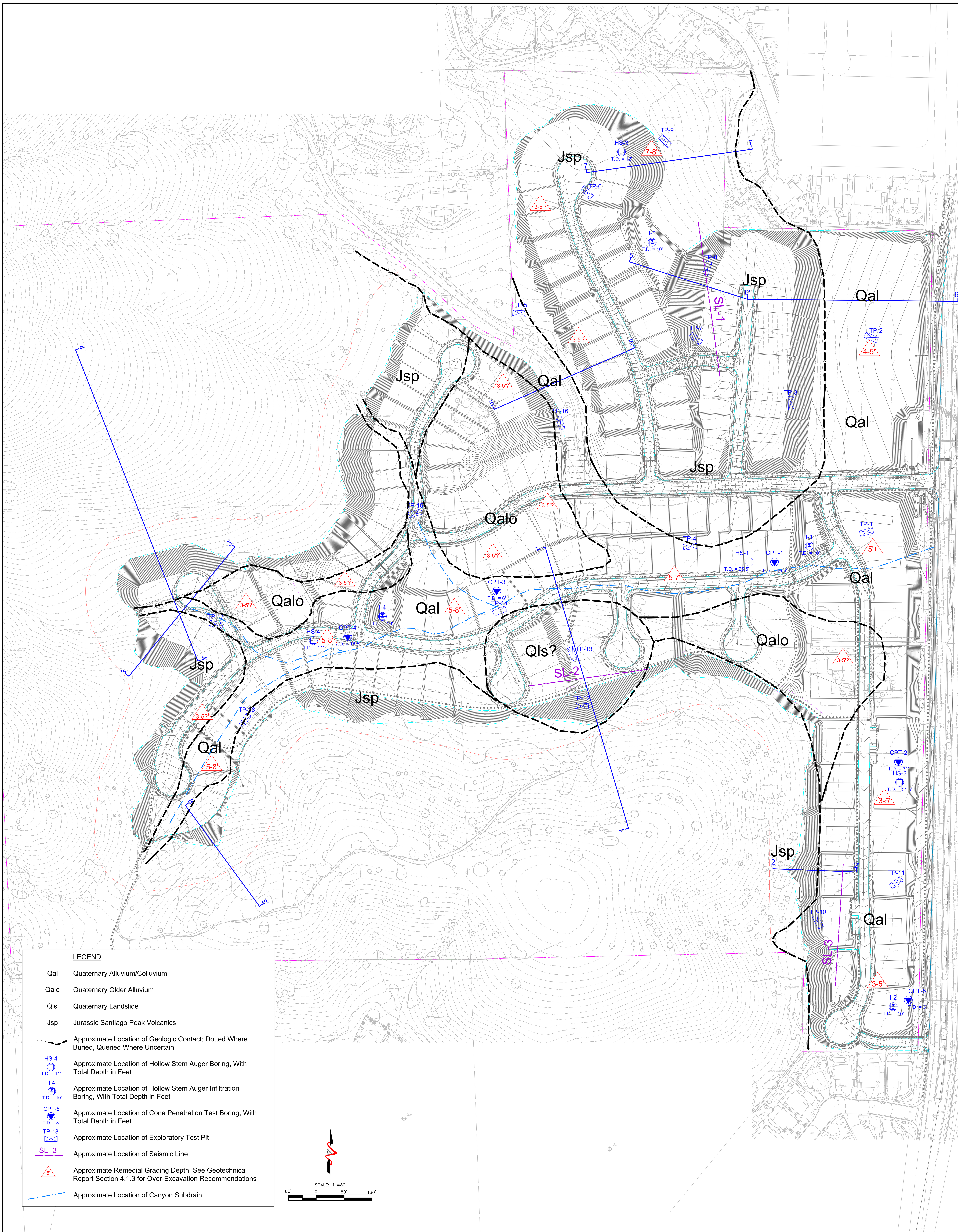



Note: Oversize Rock is Larger than 8" in Maximum Dimension.

Section A-A'

LGC Geotechnical, Inc.

**OVERSIZE ROCK DISPOSAL DETAIL**



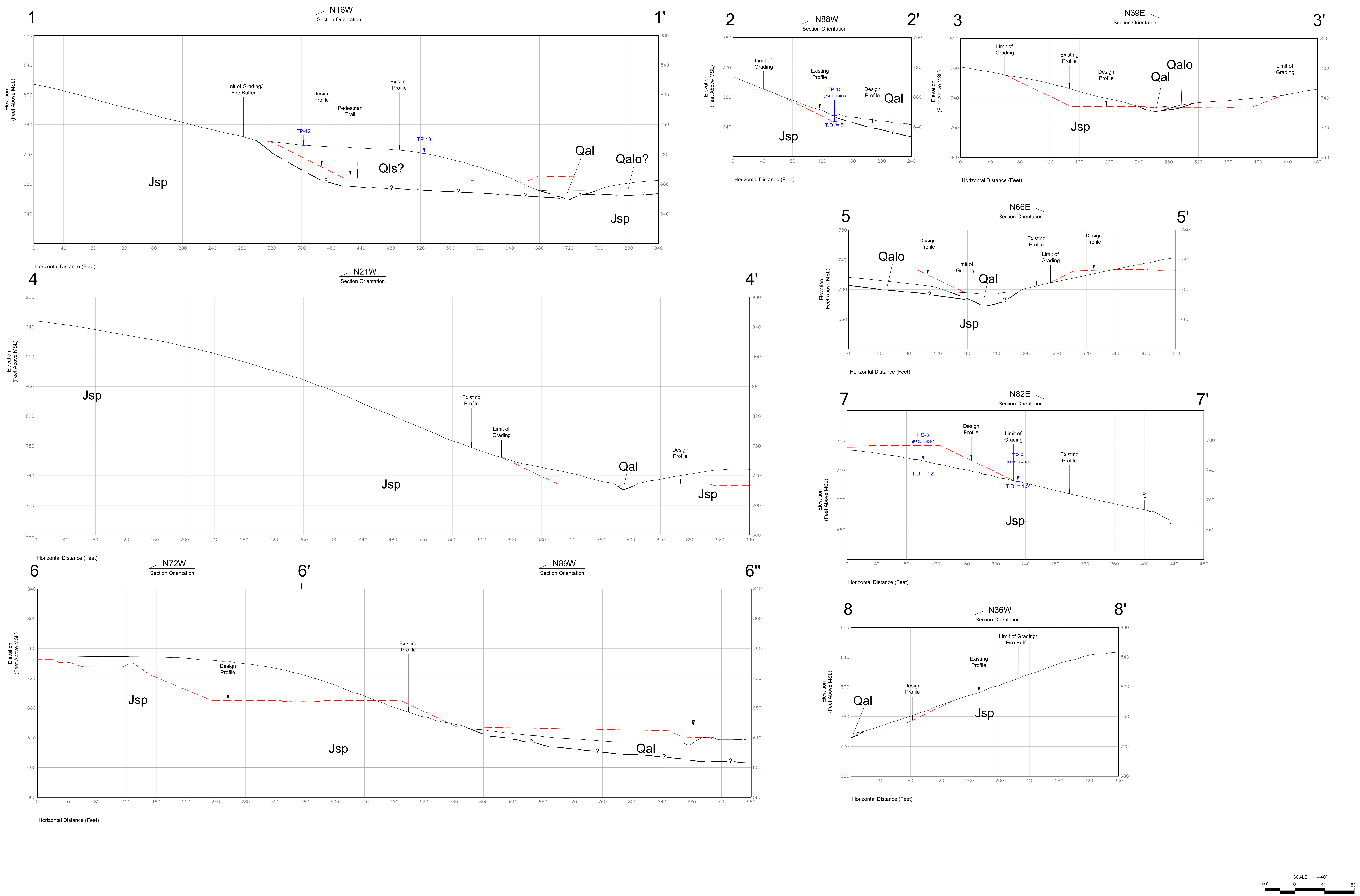

LGC Geotechnical, Inc.

LGC Geotechnical, Inc.
131 Calle Iglesia, Ste. 200
San Clemente, CA 92672
TEL (949) 369-6141 FAX (949) 369-6142

**Preliminary Geotechnical Map**

| | |
|---|---|
| PROJECT NAME | Meritage - Twin Oaks, San Marcos |
| PROJECT NO. | 24032-01 |
| ENG. / GEOL. | DJB / BPG |
| SCALE | 1" = 80' |
| DATE | September 2024 |

SHEET
1 of 2




LGC Geotechnical, Inc.

**LGC Geotechnical, Inc.**
**131 Calle Iglesia, Ste. 200**
**San Clemente, CA 92672**
**TEL (949) 369-6141 FAX (949) 369-6142**

***Geotechnical Cross Sections 1-8***

| | |
|---|---|
| PROJECT NAME | Twin Oaks, San Marcos |
| PROJECT NO. | 24032-01 |
| ENG. / GEOL. | DJB / BPG |
| SCALE | 1" = 40' |
| DATE | September 2024 |

**SHEET 1 of 1**