Appendix E1

Geotechnical Investigation

GEOCON

UPDATE GEOTECHNICAL INVESTIGATION

OLIVE PARK APARTMENTS
OLIVE DRIVE
OCEANSIDE, CALIFORNIA

MARCH 12, 2024
REVISED DECEMBER 17, 2024
PROJECT NO. G3035-52-01

PREPARED FOR:

CAPSTONE EQUITIES

GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. G3035-52-01
March 12, 2024
Revised December 17, 2024

Capstone Equities
5600 W Jefferson Boulevard
Los Angeles, California 90016

Attention: Mr. Brian Mikail

Subject: UPDATE GEOTECHNICAL INVESTIGATION
OLIVE PARK APARTMENTS
OLIVE DRIVE
OCEANSIDE, CALIFORNIA

Dear Mr. Mikail:

In accordance with your request and authorization of our original Proposal No. LG-22452 dated September 22, 2022 and subsequent change orders, we herein submit the results of our update geotechnical investigation for the subject project. We performed our investigation to evaluate the underlying soil and geologic conditions and potential geologic hazards, and to assist in the design of the proposed building and associated improvements.

The accompanying report contains the results of our study and conclusions and recommendations pertaining to geotechnical aspects of the proposed project. The site is suitable for the proposed buildings and improvements provided the recommendations of this report are incorporated into the design and construction of the planned project.

Should you have questions regarding this report, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

GEOCON INCORPORATED

Nikolas Garcia, EIT
Senior Staff Engineer

Matt Love
GE 3238

REGISTERED PROFESSIONAL ENGINEER MATTHEW R. LOVE C84154 CIVIL STATE OF CALIFORNIA

Rupert S. Adams
CEG 2561

PROFESSIONAL GEOLOGIST RUPERT S. ADAMS NO. 2561 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

Shawn Foy Weedon
GE 2714

REGISTERED PROFESSIONAL ENGINEER SHAWN WEEDON No. 2714 GEOTECHNICAL STATE OF CALIFORNIA

NG:ML:RSA:SFW:kv

(e-mail) Addressee

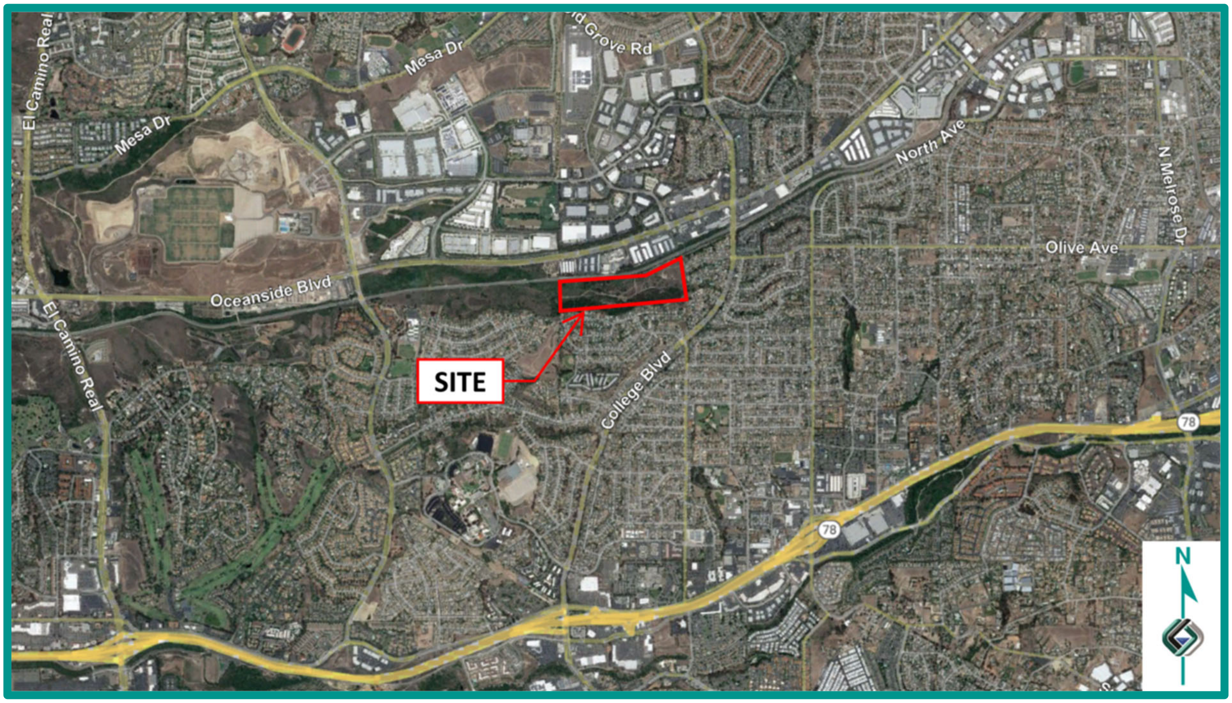
TABLE OF CONTENTS

TABLE OF CONTENTS (CONCLUDED)

UPDATE GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report contains the results of our update geotechnical investigation for the proposed affordable housing project located west of Olive Drive and north of Wooster Drive in the City of Oceanside, California (see Vicinity Map).



Vicinity Map

The purpose of this update geotechnical investigation is to evaluate the surface and subsurface soil conditions and general site geology, and to identify geotechnical constraints that may affect development of the property including faulting, liquefaction and seismic shaking based on the 2022 CBC seismic design criteria. In addition, we provided recommendations for remedial grading, shallow foundations, concrete slab-on-grade, concrete flatwork, pavement and retaining walls. We also reviewed the following plans and reports during preparation of this report:

1. *Site Plan, Olive Drive, Oceanside, California,* prepared by Hunsaker & Associates, dated March 7, 2024.
2. *Soil and Geologic Investigation for: Westwind, Oceanside, California,* prepared by Geocon Incorporated, dated July 1, 1985 (File No. D-3453-M02).

3. *Geotechnical Investigation, Oceanside Vista, Oceanside, California,* prepared by Geocon Incorporated, dated October 12, 2005 (Project No. 07227-52-02).

4. *Preliminary Geotechnical Evaluation for: Oceanside Vista Residential Development, Oceanside, California,* prepared by GeoTek, Inc., dated March 21, 2007 (Project No. 3129SD3)

The scope of this update investigation included reviewing readily available published and unpublished geologic literature (see List of References), performing engineering analyses and preparing this report. We also drilled 3 large diameter borings to a maximum depth of 100 feet and excavated 5 exploratory trenches to a maximum depth of approximately 8 feet. Appendix A presents the exploratory boring and trench logs and details of the field investigation. The details of the laboratory tests and a summary of the test results are shown in Appendix B and on the boring logs in Appendix A. Appendix C presents previous exploratory excavations and laboratory data. Appendix D presents our slope stability analysis.

2. SITE AND PROJECT DESCRIPTION

The site is an approximately 43-acre, east-west oriented, semi-rectangular-shaped property. The site is south of Oceanside Boulevard and the North County Transit District (NCTD) Sprinter line, east of an undeveloped property, and north and west of existing residential subdivisions. The Existing Site Plan shows the current site conditions.

Existing Site Plan

Topographically, the site is located on slopes that descend northwest to Loma Alta Creek located along the north margin of the site. The Geologic Map, Figure 1, depicts the topography of the site with ascending natural slopes to the south with a maximum height of approximately 200 feet. The site is steeper on the south and becomes flatter to the north. The gentle-gradient creek has a general west-flowing meandering orientation and has locally incised vertical embankments up to 10 feet high at the stream margins. A fill berm related to railroad improvements has been constructed along the northeast margin of the site. Elevations on site vary from a low of approximately 185 feet above Mean Sea Level (MSL) at Loma Alta Creek in the northwest corner of the site to 460 feet MSL at the top of the southeast slope.

We understand the project will consist of constructing a new affordable housing complex that includes two 4-story buildings, surface parking with accommodating flatwork, utilities and landscaping. Storm water BMPs are planned on the west side of the property within the proposed parking lot.

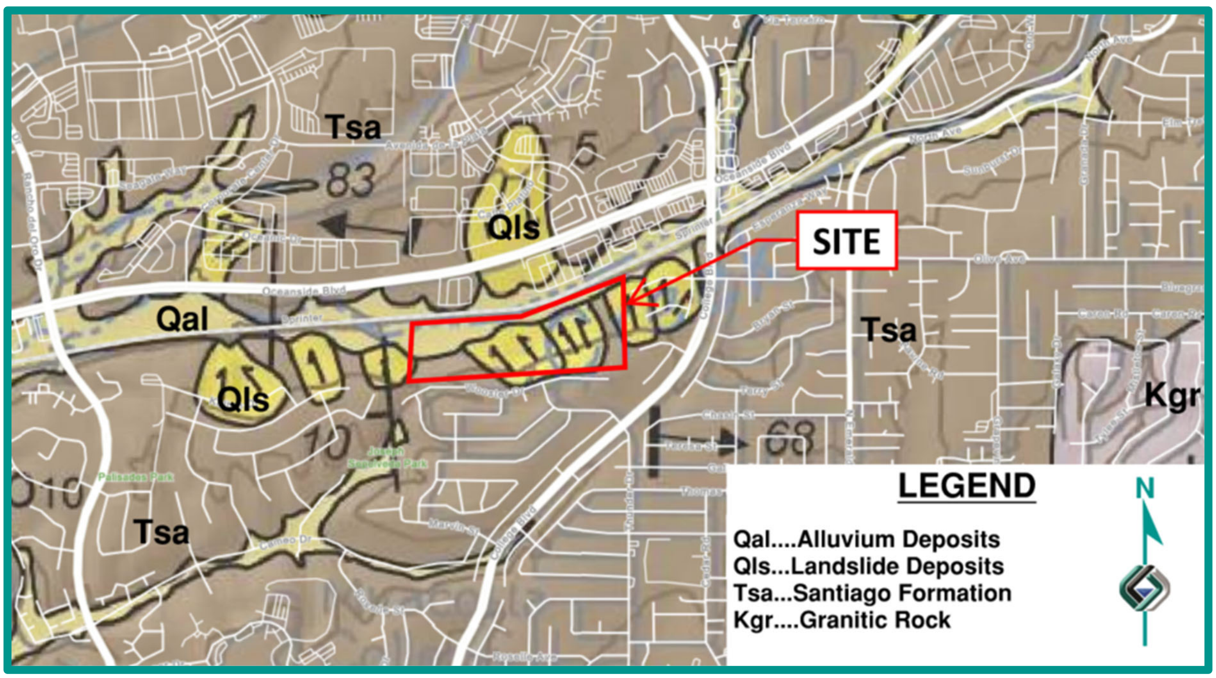
The locations, site descriptions, and proposed development are based on our site reconnaissance, review of published geologic literature, field investigations, and discussions with project personnel. If development plans differ from those described herein, Geocon Incorporated should be contacted for review of the plans and possible revisions to this report.

3. GEOLOGIC SETTING

Regionally, the site is in the Peninsular Ranges geomorphic province. The province is bounded by the Transverse Ranges to the north, the San Jacinto Fault Zone on the east, the Pacific Ocean coastline on the west, and the Baja California on the south. The province is characterized by elongated northwest-trending mountain ridges separated by straight-sided sediment-filled valleys. The northwest trend is further reflected in the direction of the dominant geologic structural features of the province that are northwest to west-northwest trending folds and faults, such as the nearby Rose Canyon fault zone.

Locally, the site is within the coastal plain of San Diego County. The coastal plain is underlain by a thick sequence of relatively undisturbed and non-conformable sedimentary bedrock units that thicken to the west and range in age from Upper Cretaceous age through the Pleistocene age which have been deposited on Cretaceous to Jurassic age igneous and volcanic bedrock. Geomorphically, the coastal plain is characterized by a series of 21, stair-stepped marine terraces (younger to the west) that have been dissected by west flowing rivers. The coastal plain is a relatively stable block that is dissected by relatively few faults consisting of the potentially active La Nacion Fault Zone and the active Rose Canyon Fault Zone.

The site is located on the western portion of the coastal plain. Marine sedimentary units make up the geologic sequence encountered on the site overlain by surficial deposits. Geomorphically, the site is located within the southern limits of an east-west flowing drainage channel. The Eocene-age Santiago Formation is mapped within the upper slopes in the southern portion of the site and underlies the landslide deposits in the central portion of the site and the alluvium in the northern portion the site. Cretaceous-age granitic rock is exposed in limited areas along the northern property boundary and is documented as underlying the Santiago Formation in some large diameter borings. The Regional Geologic Map shows the geologic units in the area of the site.



Regional Geologic Map

4. SOIL AND GEOLOGIC CONDITIONS

We encountered six surficial soil units (consisting of undocumented fill, previously placed fill, topsoil, alluvium, colluvium and landslide debris) and two formational units (consisting of the Santiago Formation and granitic rock) at the site. The occurrence, distribution, and description of each unit encountered is shown on the Geologic Map, Figure 1 and on the boring and trench logs in Appendix A.

The Geologic Cross-Sections, Figure 2, show the approximate subsurface relationship between the geologic units. We prepared the geologic cross-sections using interpolation between exploratory excavations and observations; therefore, actual geotechnical conditions may vary from those illustrated and should be considered approximate. The surficial soil and geologic units are described herein in order of increasing age.

4.1 Undocumented Fill (Qudf)

Undocumented fill underlies the northern and western portions of the site. The northern fill areas are associated with a berm that was apparently graded to control water flow in Loma Alta Creek and support the existing rail line. The western undocumented fill area is associated with waterline backfill that traverses the site in a north-south direction. The fill material generally consists of soft, fine to medium, sandy clay with silt and has an estimated maximum thickness of 10 feet. The fill is not considered suitable for support of site development in its present condition and will require remedial grading.

4.2 Previously Placed Fill (Qpf)

Previously placed fill is present on the south and northeast portions of the property. The southern fill underlies residential building pads that bound the southern margin of the property along Wooster Drive. The southern fill likely consists of loose, silty, fine- to medium-grained sand, and is estimated to have a maximum thickness of about 25 feet at the top of slope. Improvements are not planned in the vicinity of the southern fill areas. Previously placed fill also underlies the residential development along Olive Drive adjacent to the northeastern corner of the site (as observed in Trench T-14). The fill consists of loose, moist, clayey sand and is underlain by relatively thick topsoil. The fill is not considered suitable for support of the proposed fill and structural loads.

4.3 Topsoil (Unmapped)

Topsoil typically blankets the site and consists of brown, sandy clay to sandy silt. Topsoil is generally on the order of 1 to 4 feet thick, but localized areas with greater thicknesses may exist. The topsoil is unsuitable for support of site development in its present condition and will require remedial grading.

4.4 Colluvium (Qcol)

Colluvium, coincident with thinner topsoil deposits, consisting of brown to reddish brown, clayey sand and sandy clay, is mapped along toe of slope areas capping landslide deposits, weathered Santiago

Formation or alluvium. Colluvium up to 10 feet thick was also logged by several authors in some large diameter borings, where it was interpreted as post-landslide graben infill. Colluvium is unsuitable for support of site development in its present condition and will require remedial grading.

4.5 Alluvium (Qal)

Alluvium is mapped on the northern portion of the site in the Loma Alta Creek drainage. The alluvial soil consists of soft, sandy to silty clay and loose silty to clayey sand. The alluvium is locally underlain by and interfingered with landslide deposits and colluvium. We encountered alluvial materials up to approximately 15½ feet deep and likely extend deeper toward the north. A shallow groundwater table is likely to exist approximately 3 to 5 feet below existing grade in the area of the streambed at the northern portion of the site. The alluvium is compressible, possesses a “very low” to “high” expansion potential (expansion index of 130 or less), possibly subject to liquefaction, and may have low to high permeability. The alluvium is not considered suitable for support of site development in its present condition and will require remedial grading. We expect some alluvium will remain in place on the western portion of the property due to grading limitations.

4.6 Landslide Deposits (Qls)

We encountered and observed landslide deposits in the exploratory borings and trenches performed for this update report. Landslide deposits are mapped underlying most of the central and eastern portions of the site, including the areas of proposed development. Based on our review of previous boring logs by Geocon (1985, 2005) and by Geotek (2007), and logging of new large diameter borings (B-11 through B-13) and exploratory trenches (T-15A-F through T-19), landslide deposits generally consist of disturbed to relatively intact blocks of sandstone, siltstone, and claystone. Due to weathering, this stratigraphy is less apparent in test pits excavated around the perimeter of mapped landslides or in low lying areas where landslide deposits are capped by colluvium or alluvium.

Landslide deposits are typically unstable within cut slopes and may be susceptible to significant settlement. Therefore, the highly compressible portions of the landslide debris within the proposed development areas should be removed and recompacted during the remedial grading of the site. In general, landslide debris is suitable for reuse as compacted fill provided potentially expansive clay is properly mixed with sandy material where located within about 5 feet of proposed grade.

4.7 Santiago Formation (Tsa)

We encountered the middle Eocene-age Santiago Formation underlying surficial soil in the majority of the exploratory excavations performed at the site. The Santiago Formation underlies the majority of the steep slope areas located to the south of the proposed development. The Santiago Formation is generally composed of light colored, massive to poorly bedded, fine- to medium-grained sandstone interbedded with weak siltstone and claystone layers. Claystone beds within the Santiago Formation contain bedding plane shears and internal shearing, some of which displayed out-of-slope bedding orientations. Bedding plane shears can be a contributing factor to slope instability. Cut slopes exposing out-of-slope bedding plane shears will require slope stabilization measures.

The Santiago Formation is considered suitable for foundation and/or fill support. However, the claystone and siltstone units may be susceptible to landsliding and slope instability. Additionally, some sandstone units of the Santiago Formation are poorly cemented and susceptible to erosion. Materials generated from excavations within the silty and sandy portions of the Santiago Formation are suitable for reuse as compacted fill. Claystone that is potentially expansive should be mixed with sandy material, as discussed herein.

4.8 Granitic Rock (Kgr)

Cretaceous-age granitic rock is mapped in the general vicinity of the site by Tan and Kennedy (1996) as the Green Valley Tonalite. We encountered granitic rock in Borings B-1 and B-2 (Geocon, 1985), Boring B-1 (Geocon, 2005) and in Trenches T-6, T-7, T-11 through T-13, and T-15 through T-19. Granitic rock was also encountered (but incorrectly identified on the boring logs) in borings GTB-1, GTB-2, GTB-7, and GTB-8 (Geotek, 2007). Based on drill rig performance, it is likely that refusal occurred on granitic rock in Borings B-11 and B-13 (Geocon, 2024) even though it was not logged or identified in cuttings.

The granitic rock consists of yellowish brown to gray, moderately weak to moderately strong, highly to moderately weathered, and displayed a fine-to coarse-grained crystalline texture. Granitic rock is considered suitable for the support of structures and/or compacted fill.

5. GROUNDWATER

We encountered groundwater during the previous field investigation in several of our borings at depths ranging from 9 to 45 feet below existing grade (elevation 183 to 199 feet MSL) as shown in the following table.

RECORDED GROUNDWATER ELEVATION

Boring No.	Date Recorded	Approximate Depth of Groundwater Below Existing Grade (feet)	Approximate Elevation of Groundwater (feet, MSL)
B-6	5/23/2005	24	199
B-7	5/20/2005	44	197
B-8	5/24/2005	45	189
B-9	5/25/2005	13	189
B-10	5/25/2005	15	183
T-3	5/09/2005	10	194
T-4	5/09/2005	9	198

However, we did not encounter groundwater within the proposed development area of the subject site but expect possible groundwater on the north side of the proposed west parking lot near Trench T-4. The use of dewatering techniques may be necessary during the installation of deep utilities, if heavy seepage or excavations below the groundwater elevation occur. It is not uncommon for ground-water or seepage conditions to develop where none previously existed. Groundwater and seepage is dependent on seasonal precipitation, irrigation, land use, among other factors, and varies as a result. Proper surface drainage will be important to future performance of the project.

Groundwater could have potentially changed over the past 20 years. However, the proposed development is situated within the higher elevation side of the site and groundwater was not encountered within the proposed development during the current and previous field studies. Additionally, within the proposed buildings the landslide debris is going to be removed and replaced with properly compacted fill.

6. GEOLOGIC STRUCTURE

Mapping by Tan and Kennedy (1996) indicates that on a regional basis, the Santiago Formation in the vicinity of the site is inclined down to the west and northwest between 5 to 10 degrees. This orientation is unfavorable for north-facing slopes. Review of available structural data collected in new and historical borings generally confirms mapping by Tan and Kennedy (1996); however, for reasons discussed herein, use of some of the previous structural data recorded at the site has resulted in mis-interpretation of site geology.

6.1 Landslide Stratigraphy

The primary mechanism for landsliding at the site is deep-seated block failure along weakened planes (i.e., bedding plane shears [BPSs]) that are present within claystone beds. Utilizing the new, 100-foot-deep boring B-12 as a ‘type section’, three, relatively continuous, moderately fissured claystone beds with associated BPSs, varying between approximately 2 and 5 feet thick, can be correlated with older borings across the site to help define subsurface landslide geometry. Our current geologic model identifies the claystone bed occurring at a depth of 34 feet (elevation 277 feet MSL) as containing the basal rupture surface of the large landslide mass underlying the proposed building areas. Some older boring logs identify a claystone bed logged in B-12 (Geocon, 2024) at 22 feet (elevation 285 feet MSL) as the bottom of the landslide, as there is evidence of shearing and movement along remolded clay seam at the higher elevation. The lowest claystone bed at 78 feet (elevation 231 feet MSL) does not correlate with other borings drilled in the main landslide area. However, the claystone bed at 78 feet does correlate with the basal rupture surface of the smaller landslide underlying the parking area, identified in borings B-3 and B-4 (Geocon, 2005) and GTB-3 (Geotek, 2007).

Geologic interpretation previously presented by Geocon (1985) suggested that shearing at the bottom of the landslide also occurred in some areas along the contact between the Santiago Formation and the underlying granitic rock. This was not observed in recent large diameter borings; however, landslide deposits overlie granitic rock in some areas along the northern property boundary. The shape of the angular unconformity between the granitic rock and the Santiago Formation is not clearly defined, but field evidence indicates that the shape and inclination of the unconformity may have partially controlled landsliding in the eastern portion of the site.

6.2 Landslide Geometry

Previous efforts to model site geologic structure and landslide geometry have utilized apparent dips derived from bed-specific measurements taken in large diameter borings to draw geologic cross-sections. This method is better suited for use in well-bedded geologic formations dipping more than 10 degrees where accurate structural attitudes can be collected. Bedding attitudes recorded on undulatory beds that are close to horizontal are usually incorrect, as the dip or the dip direction cannot be properly identified in a 30-inch diameter hole. The preferred method for defining landslide geometry (and geologic structure below the landslide) in massive to poorly bedded formations with dips less than 10 degrees, is to create structure contours from multiple piercing points through the basal slide surface. Utilizing the structure contouring technique, the local geologic structure under the site generally dips northwards (plus or minus 20 degrees from north) at inclinations between 4 and 8 degrees. This interpretation is supported by calculating the mean apparent dip along Geologic Cross-Sections 1-1’ through 3-3’, using only structural measurements taken below the basal slide plane.

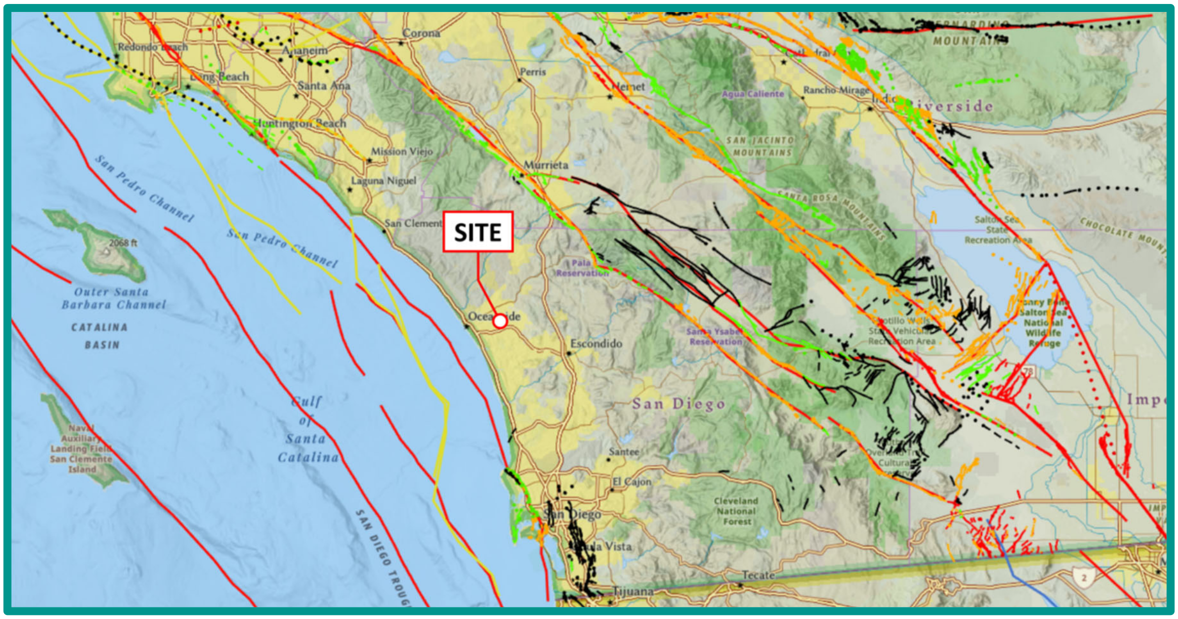
We prepared Geologic Cross-Sections 1-1’ through 4-4’ to help show correlations between the claystone beds identified in Boring B-12 (Geocon 2024) and the bottom of landslides underlying the proposed development area using the structural geology principals discussed herein. Some historical borings were terminated at elevations too shallow to pierce the bottom of the landslide including Borings B-5 and B-6 (Geocon, 1985).

7. GEOLOGIC HAZARDS

7.1 Regional Faulting and Seismicity

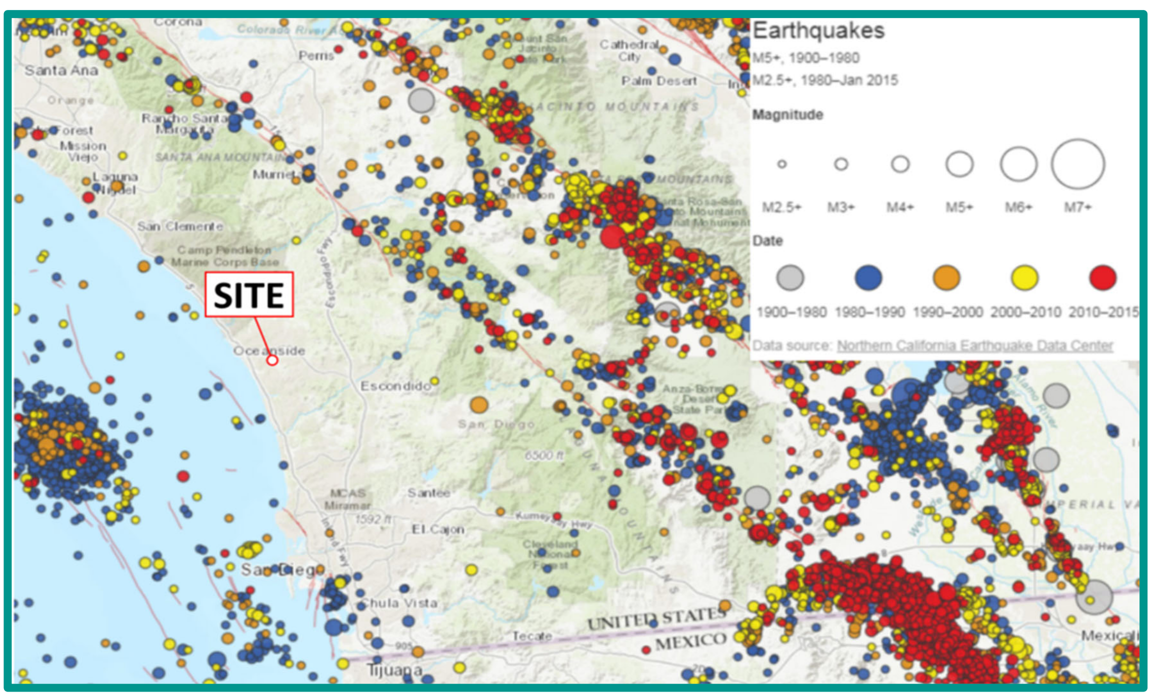
A review of the referenced geologic materials and our knowledge of the general area indicate that the site is not underlain by active, potentially active, or inactive faults. An active fault is defined by the California Geological Survey (CGS) as a fault showing evidence for activity within the last 11,700 years. The site is not located within a State of California Earthquake Fault Zone.

The USGS has developed a program to evaluate the approximate location of faulting in the area of properties. The following figure shows the location of the existing faulting in the San Diego County and Southern California region. The fault traces are shown as solid, dashed and dotted that represent well-constrained, moderately constrained and inferred, respectively. The fault line colors represent faults with ages less than 150 years (red), 15,000 years (orange), 130,000 years (green), 750,000 years (blue) and 1.6 million years (black).



Faults in Southern California

The San Diego County and Southern California region is seismically active. The following figure presents the occurrence of earthquakes with a magnitude greater than 2.5 from the period of 1900 through 2015 according to the Bay Area Earthquake Alliance website.



Earthquakes in Southern California

Considerations important in seismic design include the frequency and duration of motion and the soil conditions underlying the site. Seismic design of structures should be evaluated in accordance with the California Building Code (CBC) guidelines currently adopted by the local agency.

7.2 Liquefaction

Liquefaction typically occurs when a site is located in a zone with seismic activity, onsite soils are cohesionless, groundwater is encountered within 50 feet of the surface, and soil relative densities are less than about 70 percent. If all four previous criteria are met, a seismic event could result in a rapid pore water pressure increase from the earthquake-generated ground accelerations. The groundwater table was not encountered underlying the portions of the property where development is planned; therefore, the potential for liquefaction occurring at the site within the proposed improvement areas is considered to be very low.

7.3 Storm Surge, Tsunamis, and Seiches

Storm surges are large ocean waves that sweep across coastal areas when storms make landfall. Storm surges can cause inundation, severe erosion and backwater flooding along the water front. The site is located over 5 miles from the Pacific Ocean and is at an elevation of about 185 feet or greater above Mean Sea Level (MSL). Therefore, the potential of storm surges affecting the site is considered low.

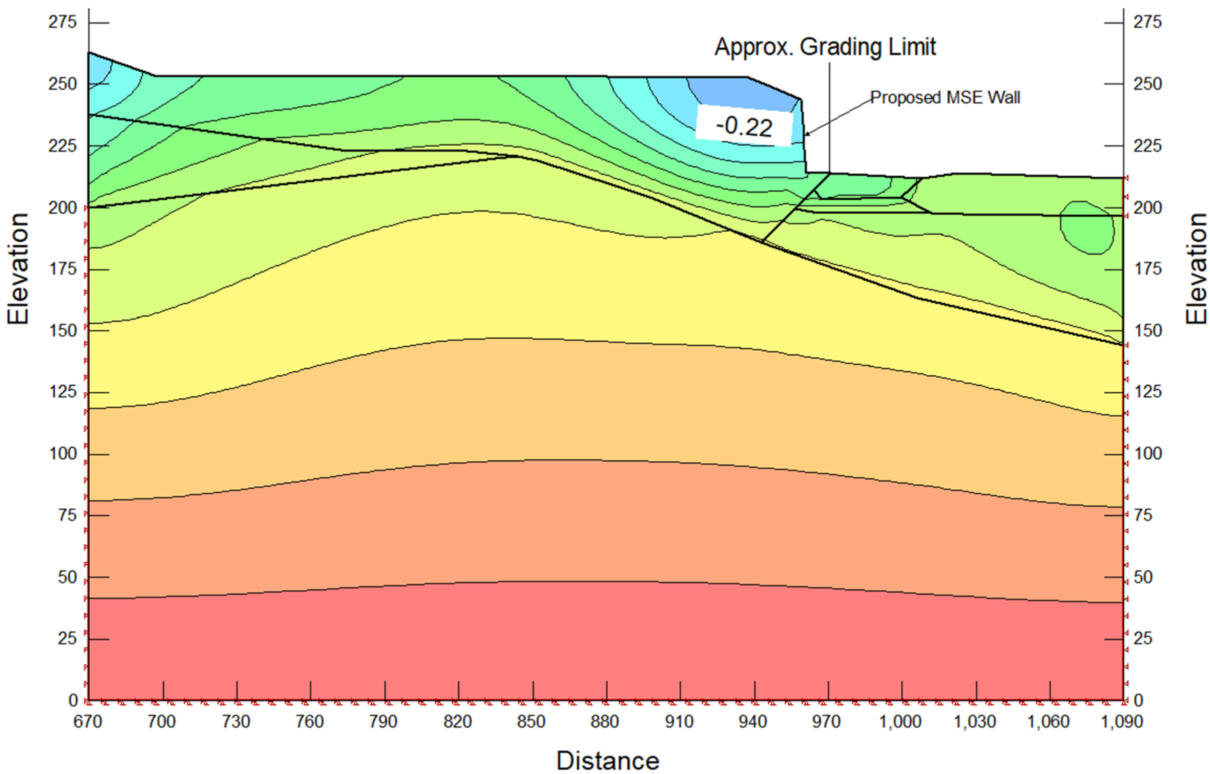
A tsunami is a series of long period waves generated in the ocean by a sudden displacement of large volumes of water. Causes of tsunamis include underwater earthquakes, volcanic eruptions, or offshore slope failures. The potential for the site to be affected by a tsunami is negligible due to the distance from the Pacific Ocean and the site elevation.

A seiche is a run-up of water within a lake or embayment triggered by fault- or landslide-induced ground displacement. The site is not located in the vicinity of or downstream from such bodies of water. Therefore, the risk of seiches affecting the site is negligible.

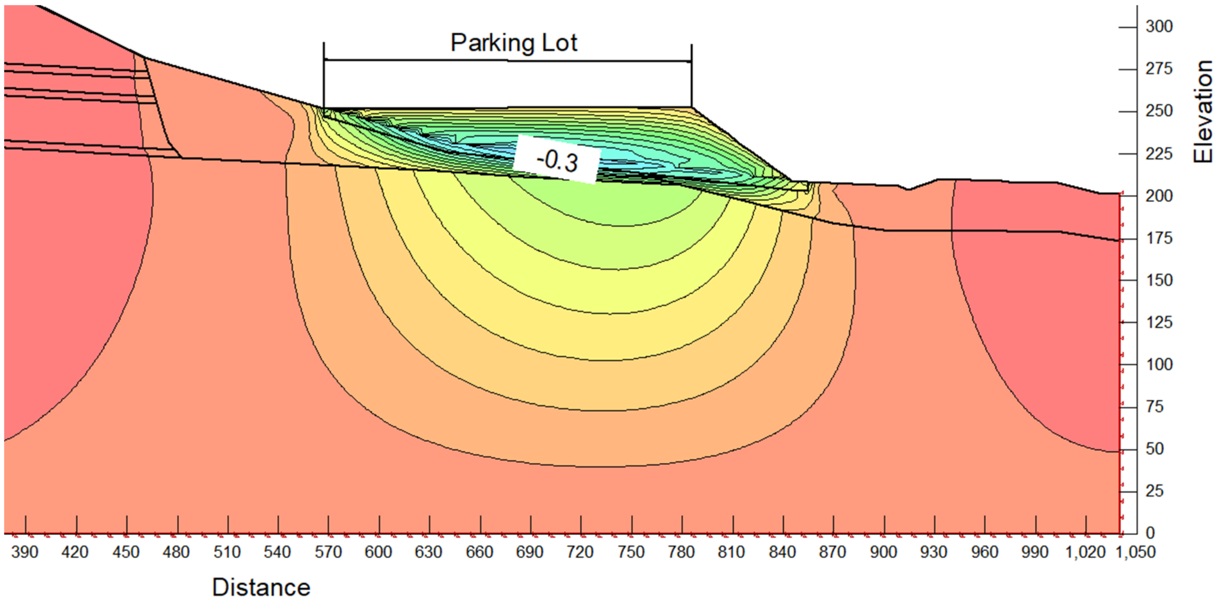
7.4 Settlement Due to Fill Loads

We understand new fill will be placed to achieve proposed grades with depths ranging from 10 to 60 feet. The increased weight due to the anticipated fill load is expected to cause settlement due to the underlying compressible landslide debris and alluvial soils, where left in place. We expect the compressible materials underneath the proposed building’s footprint will be removed and replaced with properly compacted fill, as discussed herein. However, we expect approximately 20 feet of compressible material will be left in place underneath the proposed western parking lot and in the western portion of the north retaining wall due to grading and/or temporary slope limitations.

The amount of settlement that could occur is a function of how thick the fill layer is, how compressible the existing layer is, and the magnitude of the new vertical load (weight of new fill or future building loads). We performed a settlement evaluation using Geostudio2018 (SigmaW). Based on laboratory test results and engineering analyses, we estimate theoretical maximum settlements of up to 3 inches (0.22 feet) and 3.6 (0.3 feet) inches for the retaining wall and western parking lot, respectively. The following figures present the computer output of our static condition settlement analyses for the retaining wall and parking lot (with settlements indicated in feet).



Vertical Settlement Analysis – Western Portion of Retaining Wall



Vertical Settlement Analysis – Western Parking Lot

Deep foundations are the most effective means of reducing the ultimate settlement potential of proposed structures to a negligible amount. Recommendations for deep foundations can be provided upon request. The settlement due to the weight of the fill should be considered in the design of improvements and adjacent flatwork. Additionally, the total and differential settlement should be incorporated into the design for pavement areas and retaining walls (where applicable). Placing the fill during construction and waiting for the settlement to occur would also help reduce the potential for distress. Settlement monitors can be installed to determine when the consolidation has stabilized and should be installed as discussed herein. We can provide additional mitigation options (including wick drains, surcharging, etc.) if being considered by the design team and once design plans are available.

7.5 Mitigation of Compressible Soils

Based on our analysis discussed herein, we estimate a potential for up to approximately 5.5 inches of settlement due to fill loads in the western parking lot subsequent to remedial grading. We expect mitigation of soil will be necessary for settlement-sensitive structures. The effects of differential settlement of utilities and improvements, including pavement and flatwork, can be mitigated by designing to accommodate for the differential movement using the settlement values presented herein. Several alternatives are generally available for mitigation including deep foundations, ground improvements and structural mitigation.

Based on the grading plans, we expect fills ranging from 0 to 40 feet will be placed in the area of the western parking lot. Therefore, we expect the total and differential settlements due to fill loads will be about 5.5 inches. The utilities should be designed with flexible connections to incorporate these settlements.

Ground improvement techniques mitigate compressible soils by densifying existing soil using aggregate piers, deep dynamic compaction, compaction grouting, soil mixing or other densification method. We do not recommend that deep dynamic compaction be used for densification due to the proximity of adjacent residential homes and the limited influence depth of the method in fine grained materials. In addition, compaction grouting may not be economical due to the expected depth and the area of the required improvements.

Soil-cement mixing is a soil improvement technique of mechanically blending a cementitious binder into existing unsuitable soils to create load bearing columns. As the soil mixing tool is advanced into the ground, cement-based slurry is pumped through the hollow stem of the shaft and injected into the soil through jets located on the backside of the leading rotating mixing blades. The mixing blades on the tool mix the soil with the slurry. Injection and mixing will continue to design depth. When design depth is reached, the mixing tool is withdrawn, leaving behind stabilized soil mix columns. Soil mix piles are typically designed and installed by a specialty geotechnical contractor. Soil mix piles should derive support in the competent Santiago Formation or Granitic Rock.

Rammed aggregate pier systems are a ground improvement technique that provides a densified column of aggregate surrounded by a stiffened soil matrix. The aggregate piers are constructed by applying direct vertical ramming energy to densely compact aggregate to form a high stiffness engineered soil column within the foundation zone and increased lateral strength to the surrounding soil. Aggregate pier systems are typically designed and installed by a specialty geotechnical contractor.

The remedial grading can be reduced to the upper 3 to 4 feet of the existing soil if ground improvements (cement-mixing or rammed aggregate piers) are selected. Additional grading may be required after the ground improvements process to reestablish the building pad.

The mitigation could be limited to the foundation areas of the storm drain vault as determined by the specialty contractor. We can provide additional recommendations for the ground improvement techniques when the improvement has been selected.

7.6 Slope Stability

Slope stability analyses for deep seated failure are discussed in the Recommendations section of this report and the computer output analyses is presented in Appendix D. The southern slope consists of a backscarp of a landslide and landslide debris is located on the site. The Santiago Formation possesses weak claystone/siltstone beds that generally create slope instability. We performed a slope stability evaluation for the existing and proposed slope configurations as discussed in this report. Shear pins and buttresses will be required to stabilize the southern slope in the areas of the proposed building as discussed herein.

Slope stability analyses for the proposed buttress fill slopes with inclinations as steep as 2:1 (horizontal: vertical) indicate a calculated factor of safety of at least 1.5 under static conditions for surficial failure. The following table presents the surficial slope stability analysis for the existing siltstone in the Santiago Formation and proposed fill slope sloping conditions.

SURFICIAL SLOPE STABILITY EVALUATION

Parameter	Value	
	Existing	Proposed
Slope Height, H	∞	∞
Vertical Depth of Saturation, Z	5 Feet	5 Feet
Slope Inclination, I (Horizontal to Vertical)	2.3:1 (23.5 Degrees)	2:1 (26.6 Degrees)
Total Soil Unit Weight, γ	125 pcf	125 pcf
Water Unit Weight, γ_W	62.4 pcf	62.4 pcf
Friction Angle, f	28 Degrees	28 Degrees
Cohesion, C	200 psf	300 psf
Factor of Safety = $(C+(\gamma+\gamma_W)Z\cos^2 I \tan f)/(\gamma Z \sin I \cos I)$	1.50	1.73

Slopes should be landscaped with drought-tolerant vegetation having variable root depths and requiring minimal landscape irrigation. In addition, slopes should be drained and properly maintained to reduce erosion.

7.7 Landslides

Referenced information and the results of our subsurface investigation indicate that the majority of the northern half of the site is underlain by landslides. Landslide deposits are described herein and the approximate extent of landslide deposits is presented on the Geologic Map and in the Geologic Cross

Sections, Figures 1 and 2. We encountered landslides deposits to a depth of approximately 56 feet during our field investigation and generally thin toward the northern portion of the site.

Topographically, the site shows lobate features, topographic benches, deflected and depressed drainages, and local low areas, which are features indicative of landsliding. These topographic features indicate most of the intermediate slopes are affected by landslides. Topographic expression and our geologic mapping suggests the upper portions of the steep slopes along the south margin of the property are composed of Santiago Formation and likely represent a “backscarp” to deeper landslides that underlie the intermediate slopes. The backscarp areas are clearly evident on the 1953 aerial photographs as steep slopes with a prominent break in slope denoting the “heads” of the landslide debris. To aid in our interpretation of landslide morphology, we reviewed a color anaglyph created from AXN-8M-66 and -67, which are part of the 1953 aerial photograph flight series covering San Diego County. Given that the site has never been developed, historical topographic maps with wider contour intervals are less useful for interpretation of landslide morphology when compared to the site topography provided by the project civil engineer.

The backscarp areas have been subject to subsequent erosion which has likely removed the previously existing landslide debris along the lower portions of these steep slopes. The “toes” of the larger landslides extend into the active creek drainage and are typically overlain by alluvium. Smaller and more recent landslides have developed within the larger-scale landslide debris. The on-site landslides have occurred within the weak claystone and/or siltstone beds of the Santiago Formation. The lower portions of the landslide debris in the western portion of the site were observed to be saturated and prone to significant caving and seepage. The landslide debris should be removed and recompacted or stabilized by remedial grading measures, as described herein.

Based on our review of predevelopment aerial photographs and site topographic maps, we estimated the southern limit of landslide debris and is therefore queried on the Geologic Cross-Sections, Figure 2. Additionally, the presence of thick colluvial deposits in Borings B-12 (Geocon, 1985), B-3 (Geocon, 2005), and B-5 (Geocon, 1985) above landslide deposits is interpreted as graben infill which would indicate the southerly limit of the landslide headscarp area.

Figure 3 depicts an overlay of landslide limits taken from the following reports: Geocon (1985), Geocon (2005), Geotek (2007), and Geocon (03/2024 and 08/2024). The published landslide boundary interpretations shown in Figure 3 are congruent with the accepted geomorphic principal that the headscarp of an ancient landslide is generally coincident with a break-in-slope separating hummocky or convrex-rounded terrain from steeper slopes behind the headscarp. Three of the four southern landslide limit interpretations shown on Figure 3 partially overlap. The fourth interpretation (Geocon; 2005 and 03/2024) is between 30 and 50 feet of the next closest limit line. The southern landslide limit matches our mapped field conditions and closely matches previous interpretations.

7.8 Debris Flows

Debris flows are rapid downslope movements of surficial soil resulting from the failure of unconsolidated sediments along steep slopes. Debris flows generally occur within colluvial deposits and may be triggered by over-saturation during periods of heavy rainfall or due to seismic shaking. Slopes that are at particular risk include those with relatively thick colluvial deposits and relatively thin or denuded vegetative cover on slopes composed of low permeability formational material (Turner and Schuster, 1996). The steep slope portions of the site were observed during our geologic reconnaissance to contain relatively thin deposits of colluvium and relatively thick, native vegetation overlying slopes composed of relatively permeable sandstone formational material. We encountered colluvium within the landslide debris along the shallower intermediate slopes in the central portion of the site. Due to lack of high-risk factors, the relatively large distance from the steep slopes to the proposed areas of development, and the results of our analysis of shallow slope stability, we opine the slopes along the southern portion of the site do not pose a significant debris flow hazard to the proposed development.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 General

8.1.1 We did not encounter soil or geologic conditions during our exploration that would preclude the proposed development, provided the recommendations presented herein are followed and implemented during design and construction. We will provide supplemental recommendations if we observe variable or undesirable conditions during construction, or if the proposed construction will differ from that anticipated herein. The following table summarizes our conclusions and recommendations for the proposed project.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Attribute	Conclusion/Recommendations
Existing Geologic Hazards	Strong Seismic Shaking
	Settlement
	Slope Stability
Existing Geologic Units	Undocumented Fill (Requiring Remedial Grading)
	Landslide Debris (Requiring Remedial Grading)
	Alluvium/Topsoil/Colluvium (Requiring Remedial Grading)
	Santiago Formation (Suitable for Support)
	Granitic Rock (Suitable for Support)
Groundwater	Not Encountered Within the Proposed Development
	May Be Encountered During Deep Utility Excavations
Seepage	May Be Encountered During Landslide Removals
Excavations	Surficial Soil – Moderate to Difficult
	Rock – Difficult to Non-Rippable
Expansion Index	130 or Less
Water-Soluble Sulfate Content	“S0”
Drainage	Maintain Drainage As Discussed Herein

8.1.2 Potential geologic hazards exist at the site including unstable slopes and seismic shaking. Existing landslides have been mapped at the site by the State of California and were observed during our subsurface investigation. Proposed cut slopes and building pads are susceptible to hazards associated with future landslides, slope instability and settlement, if not properly stabilized, as discussed herein.

8.1.3 The undocumented fill, landslide debris, and alluvium are potentially compressible and unsuitable in their present condition for the support of compacted fill or settlement-sensitive improvements. Remedial grading of these materials should be performed as discussed herein. Weak claystone/siltstone beds, bedding plane shears and unfavorable bedding orientations are common within the Santiago Formation. Slopes with calculated factors of safety less than 1.5 should be stabilized as recommended herein. Formational materials of the Santiago Formation and granitic rock are considered suitable for the support of proposed fill and structural loads.

8.1.4 We encountered groundwater at a depth of approximately 7 to 13 feet below the existing ground surface (approximate elevation of 1 to 5 feet above MSL) on the western portion of the property (not in the proposed development area). Groundwater will likely have a significant influence on construction of deep utilities and subterranean structures (if proposed in the alluvium areas). Dewatering ~~will likely be required~~ techniques may be necessary during the installation of utilities for excavations below the fluctuating groundwater elevation and preliminary recommendations are provided herein. However, we do not expect we will encounter groundwater during the construction of the proposed building. We may encounter groundwater during the installation of improvements that extend to the west of the proposed development area where alluvium is present.

8.1.5 We expect the surficial soils to be rippable with moderate effort to proposed finish grades using conventional grading equipment. The rippability of the granitic rock is variable and ranges between moderate to difficult. We do not expect a rock blasting program will be required for the proposed grading operations due to the limited cut areas within the rock areas. However, the grading contractor should be prepared to handle localized strong rock areas and rock corestones, if encountered.

8.1.6 The majority of the existing slopes and proposed cut slopes will be subject to potential slope instability and will require extensive remedial grading measures. Appendix D presents the results of our slope stability analyses.

8.1.7 Proper drainage should be maintained in order to preserve the engineering properties of the fill in both the building pads and slope areas. Recommendations for site drainage are provided herein.

8.1.8 We will prepare a storm water management investigation under a separate report to help evaluate the potential for infiltration on the property. The project civil engineer should use that report to help design the storm water management devices.

8.1.9 Based on our review of the project plans, we opine the planned development can be constructed in accordance with our recommendations provided herein. We do not expect the planned development will destabilize or result in settlement of adjacent properties if properly constructed.

8.1.10 Canyon subdrains will not be required on this project. However, surface settlement monuments may be used to utilized to determine when the fill and consolidation settlement has stabilized as discussed herein.

8.2 Excavation and Soil Characteristics

8.2.1 Excavation of the in-situ soil should be possible with moderate to heavy effort using conventional heavy-duty equipment. Excavation of the formational materials will require heavy to very heavy effort and may generate oversized material using conventional heavy-duty equipment during the grading operations. Oversized rock (rocks greater than 12 inches in dimension) may be generated with the granitic rock materials that can be incorporated into landscape use or deep compacted fill areas, if available. The grading and improvement contractors should review this report and evaluate the proper equipment to use for the planned excavations. Based on the proposed grading plans, deep excavations into the granitic material are not expected; therefore, a seismic study for excavation characteristics are not necessary.

8.2.2 The soil encountered in the field investigation is “expansive” (expansion index [EI] greater than 20) as defined by 2022 California Building Code (CBC) Section 1803.5.3. We expect most of the soil encountered possess a “very low” to “high” expansion potential (EI of 130 or less) in accordance with ASTM D 4829. The following presents soil classifications based on the expansion index.

EXPANSION CLASSIFICATION BASED ON EXPANSION INDEX

Expansion Index (EI)	ASTM D 4829 Expansion Classification	2022 CBC Expansion Classification
0 – 20	Very Low	Non-Expansive
21 – 50	Low	Expansive
51 – 90	Medium	
91 – 130	High	
Greater Than 130	Very High	

8.2.3 We performed laboratory tests on samples of the site materials to evaluate the percentage of water-soluble sulfate content. Appendix B presents results of the laboratory water-soluble sulfate content tests. The test results indicate the on-site materials at the locations tested possess "S0" sulfate exposure to concrete structures as defined by 2022 CBC Section 1904 and ACI 318-19 Chapter 19.

8.2.4 Geocon Incorporated does not practice in the field of corrosion engineering. Therefore, further evaluation by a corrosion engineer may be performed if improvements susceptible to corrosion are planned.

8.3 Slope Stability Analyses

8.3.1 We performed slope stability analyses using the two-dimensional computer program *GeoStudio* created by Geo-Slope International Ltd. We calculated the factor of safety for the planned slopes for rotational-mode and block-mode analyses using the Spencer's method. Output of the computer program including the calculated factor of safety and the failure surface is presented in Appendix C.

8.3.2 We used average drained direct shear, fully softened, residual strength parameters and Stark Correlations (2023) based on laboratory tests and our experience with similar soil types in nearby areas for the slope stability analyses. Our calculations indicate the proposed slopes, constructed of on-site materials, should have calculated factors of safety (FOS) of at least 1.5 and 1.1 under static and seismic conditions, respectively for deep-seated failure and a FOS of at least 1.5 for shallow sloughing conditions when the recommendations of this report are followed.

8.3.3 We selected Cross-Sections 1-1’, 2-2’, and 3-3’ to perform the slope stability analyses. Appendix D presents the results of the slope stability analyses. Based on our analyses, the existing southern slopes possess a factor of safety of less than 1.5 and stabilization techniques will be required. A factor of safety of at least 1.5 is currently required by the City of Oceanside for all slopes that could affect proposed and existing structures.

8.3.4 Shear pins for the proposed southern slope will be required to provide an adequate factor of safety due to the presence of weak claystone/siltstone layers and landslide debris. The approximate location of the shear pins are shown on the Geologic Map, Figure 1, and Geologic Cross Sections, Figures 2 and 3. The shear pins should be designed by a structural engineer familiar with the design process. A more detailed discussion of the shear pins in provided in the following section.

8.3.5 In addition, slope buttresses will be required north of the planned shear pins to increase the local stability of the proposed slopes. Buttress widths ranging from 20 to 50 feet should be constructed along the southern edge of the plan development as shown on the Geologic Map, Figure 1. Based on our analyses, the slope will possess a factor of safety of at least 1.5 and 1.1 subsequent to the construction of the shear pins and buttresses for static and seismic conditions, respectively.

8.3.6 Planned buttress keyways and proposed subdrains should be surveyed during construction with their approximate locations depicted on the Geologic Map. We based the buttress widths and depths on the results of the slope stability analyses. The buttresses will require drains located at the heel of the buttress and will be as-built and surveyed by the project civil engineer.

8.3.7 Excavations including buttresses, shear keys, and stability fills should be observed during grading by an engineering geologist with Geocon to evaluate whether soil and geologic conditions do not differ significantly from those expected or identified in this report.

8.3.8 We performed the slope stability analyses based on the interpretation of geologic conditions encountered during our field investigation. We should evaluate the geologic conditions during the grading operations to check if the conditions observed during grading are consistent with our interpretations. Additional slope stability analyses and modifications to the proposed buttresses may be required during the grading operations.

8.3.9 The buttress excavations are not planned adjacent to existing improvements or residences. If excavation failures were to occur, we expect the failures would be limited to within the property limits and outside improvements/structures would not be affected. In addition, the grading contractor would be required to remove the volume of soil that failed and evaluate the additional excavation procedures.

8.3.10 We selected Cross Sections 1-1’ and 2-2’ to perform the slope stability analyses for temporary conditions as described in the following table. A minimum factor of safety of 1.25 is currently required by the City of Oceanside for temporary slope stability conditions. A temporary backcut ranging from of 1.3:1 to 1.5:1 (horizontal to vertical) with slot cutting would be required in the area of Geologic Cross Sections 1-1’ and 2-2’ to achieve an adequate factor of safety.

SUMMARY OF SLOPE STABILITY ANALYSES FOR TEMPORARY EXCAVATIONS

Cross-Section	File Name	Condition of Slope Stability Analyses	Slot Cut Elevation Feet (MSL)	Calculated Factor of Safety
1-1’	Case 10 1-1'-Temp Slot Cut	Temporary backcut for 50-foot-buttress, below shear pin (100 kips/foot), 1.5:1 slope, block-mode analysis along BPS, static condition	280	1.26
2-2’	Case 10_2-2'-Temp Slot Cut	Temporary backcut for 20-foot-buttress, 1.3:1 slope, below shear pin (115 kips/foot), block-mode analysis along BPS, static condition	261	1.25

8.3.11 Slopes should be landscaped with drought-tolerant vegetation having variable root depths and requiring minimal landscape irrigation. In addition, slopes should be drained and properly maintained to reduce erosion.

8.4 Slope Stabilization – Shear Pins

8.4.1 Based on our slope stability analyses for Cross-Sections 1-1’ and 2-2’ shear pins will be required to increase the factor of safety to at least 1.5 for the southern slope. A buttress will also be required north and below the shear pins to help stabilize the landslide debris and weak clay/siltstone layers.

8.4.2 We expect the shear pins will need to be installed on the southern slope prior to the grading operations for the building pads due to the potential slope instability.

8.4.3 We applied a shear load at the location of the bedding plane shear (BPS) within the cross-sections to calculate the load required to possess a factor of safety of at least 1.5. Based on our analyses, the resistive shear load ranges from at least 100 kips per linear foot (kpf) to 115 kpf and will be required for calculated Geologic Cross-Sections 1-1' and 2-2' (see Appendix D).

8.4.4 After we calculated the load required, we adjusted the pin location including the length above and below the shear plane, to calculate a factor of safety of at least 1.5 above and below the pin. The following table presents the calculated shear pin characteristics.

SHEAR PIN CHARACTERISTICS

Cross-Section	Calculated Minimum Shear Resistance (Kips/Foot)	Top of Pin Elevation (Feet, MSL)	Base of Pin Elevation (Feet)	Total Length of Pin (Feet)	Estimated Elevation of BPS (Feet)
1-1'	100	320	254	66	264
2-2'	115	307	250	57	265

*Based on the planned layout of the property (see Geologic Map, Figure 1).

8.4.5 The portion of the drilled excavation above the pin (elevations higher than the top of pin listed in the previous table) may be backfilled with lean concrete slurry.

8.4.6 A licensed structural engineer should be retained to design the required structural elements of the pins as discussed herein.

8.4.7 Geocon Incorporated should observe the drilling operations and perform down-hole observations to confirm that the pins are placed in the proper location and the geologic conditions are similar to those expected. Adjustments in the depth of the pins may be necessary based on the conditions encountered. The client should consider performing large diameter drilling in the locations of the proposed shear pins to confirm design assumption prior to contractor arriving on site.

8.5 Grading

8.5.1 Grading should be performed in accordance with the recommendations provided in this report, the Recommended Grading Specifications contained in Appendix E and the local grading ordinance. Geocon Incorporated should observe the grading operations on a full-time basis and provide testing during the fill placement.

8.5.2 Prior to commencing grading, a preconstruction conference should be held at the site with the agency inspector, owner or developer, grading contractor, civil engineer, and geotechnical engineer in attendance. Special soil handling and/or the grading plans can be discussed at that time.

8.5.3 The sequencing of the grading and slope stabilization operations should be evaluated by the grading contractor and design team due to the potential instability of the temporary slopes. We expect the shear pins will need to be installed on the southern slope prior to the grading operations for the building pads.

8.5.4 Site preparation should begin with the removal of deleterious material, debris, and vegetation. The depth of vegetation removal should be such that material exposed in cut areas or soil to be used as fill is relatively free of organic matter. Material generated during stripping and/or site demolition should be exported from the site. Asphalt and concrete should not be mixed with the fill soil unless approved by the Geotechnical Engineer.

8.5.5 Abandoned foundations, buried utilities (if encountered) and our previous exploratory excavations should be removed and the resultant depressions and/or trenches should be backfilled with properly compacted material as part of the remedial grading.

8.5.6 **Proposed Buildings:** Undocumented fill, landslide debris, colluvium and alluvium within the proposed building pads should be excavated to expose firm/competent formational materials. We expect the surficial soil can be removed in the areas of the proposed buildings and the structures can be supported on a shallow foundation system. In addition, the buildings pads should be undercut where formational materials are located near the surface at least 3 feet below proposed grade and 2 feet below proposed foundations and replaced with properly compacted fill, whichever results in a deeper excavation. Prior to fill soil being placed, the existing ground surface should be scarified, moisture conditioned as necessary, and compacted to a depth of at least 12 inches. Deeper excavations may be required if saturated or loose fill soil is encountered. The base of the excavations should extend laterally equal to the depth of the excavation below proposed grade such that the surficial materials are removed below a 1:1 plane that extends down from the proposed building envelopes. A representative of Geocon should be on-site during excavations to evaluate the limits of the remedial grading.

8.5.7 **North Retaining Wall:** We anticipate up to 30 feet of alluvium and landslide debris below the western portion of the proposed northern retaining wall. We understand the proposed grading is limited to 10 feet outside (north) of the proposed wall. Therefore, full removal of the existing surficial soil may be infeasible due to the property line constraints or possible groundwater within the western portion of the retaining wall area. The excavations can be limited to the underlying formational materials. The Geologic Cross-Sections, Figure 2, show the expected grading limits with the excavations beginning 10 feet outside of the proposed retaining walls. We expect some of the surficial soil will remain in place due to the limited excavations and the walls will be designed as discussed herein. The resulting excavations should be backfilled with properly compacted fill to proposed grades.

8.5.8 **Western Parking and Improvement Areas:** The existing soil in the upper 5 feet of the proposed improvement areas should be excavated and properly compacted fill should be placed. The excavations can be limited to competent formational materials, where encountered.

8.5.9 **Storm Drain Vault Option 1 – Remedial Grading:** Undocumented fill, landslide debris. Colluvium and alluvium within the storm drain vault area should be excavated to expose firm/competent formational materials. The base of the excavations should extend laterally equal to the depth of the excavation below proposed grade such that the surficial materials are removed below a 1:1 plane that extends down from the proposed vault envelope. The limits of the removal are presented on the Geologic Map, Figure 1. A representative of Geocon should be on-site during excavations to evaluate the limits of the remedial grading. This option increases the potential for backcut failures due to the existing landslide debris.

8.5.10 **Storm Drain Vault Option 2 – Ground Improvements:** To help reduce the potential for backcut failures, the storm drain vault can be supported on ground improvements. If the storm drain vault will be supported on shallow or mat foundation system over improved ground (i.e. deep soil mixing, rammed aggregate piers), the upper 5 feet of existing materials and 3 feet below the proposed grade (whichever results in a deeper excavation) should be excavated and properly compacted fill should be placed. The excavations should extend at least 10 feet laterally outside of the proposed foundation zones. Deeper excavations may be required in areas where loose or saturated materials are encountered. The remedial grading should be performed after completion of ground improvement operations for aggregate piers and prior to construction of soil mix columns.

SUMMARY OF REMEDIAL GRADING RECOMMENDATIONS

Area	Remedial Grading Excavation Recommendations
Building Pads	Excavate Landslide Debris to Formational Materials
	Undercut at Least 3 Feet Below Proposed Pad Grade or 2 Feet Below Footings, Whichever is Greater
Retaining Wall	Begin Excavation 10 Feet Outside of Wall and Excavate to Formational Materials Where Feasible
Storm Drain Vault	Option 1: Excavate Landslide Debris to Formational Materials
	Option 2: Excavate Upper 5 Feet or 3 Feet Below Proposed Grade Prior to Installing Ground Improvements
Site Development	Process Upper 5 Feet of Existing Materials
Lateral Grading Limits	Excavate Laterally Equal to the Depth of the Excavation Below Proposed Grade Such that the Surficial Materials Are Removed Below a 1:1 Plane that Extends Down from the Proposed Building Envelopes
	Storm Drain Vault: Excavate Outside A 1:1 Plane Outside The Area Or At Least 5 Feet Outside Area If Ground Improvements Are Used
	Minimum 10 Feet Outside of Buildings
	Minimum 2 Feet Outside of Improvement Areas
Exposed Excavation Bottoms	Scarify Upper 12 Inches and Recompact
	Slope 1% to Adjacent Street or Deeper Fill

8.5.11 The site should then be brought to final subgrade elevations with fill compacted in layers as recommended in the following table. In general, the existing soil is suitable for use from a geotechnical engineering standpoint as fill if relatively free from vegetation, debris and other deleterious material. Layers of fill should be about 6 to 8 inches in loose thickness and no thicker than will allow for adequate bonding and compaction. Fill materials placed below optimum moisture content may require additional moisture conditioning prior to placing additional fill.

SUMMARY OF COMPACTED FILL RECOMMENDATIONS

Fill Location	Relative Compaction*	Relative Moisture Content*
Upper 40 Feet of Grading Utility/Retaining Wall Backfill Sidewalk and Curb/Gutter Subgrade	90% of Laboratory Maximum Dry Density	Near to Slightly Above Optimum
Deeper Than 40 Feet of Grading	92% of Laboratory Maximum Dry Density	Near to Slightly Above Optimum
Pavement and Cross-Gutter Subgrade Base Materials	95% of Laboratory Maximum Dry Density	Near to Slightly Above Optimum

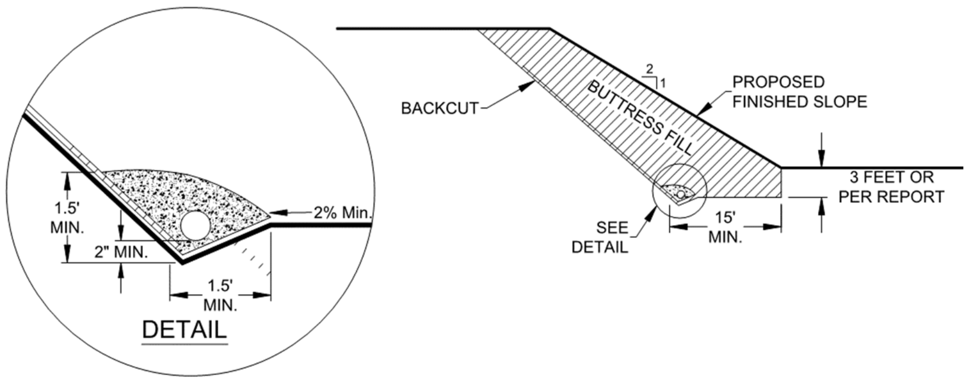
*In accordance with ASTM D 1557.

8.5.12 The upper 3 feet of all building pads should be composed of properly compacted fill with a "very low" to "medium" expansion potential (EI of 90 or less), where possible. Fill with an expansion index greater than 90 should be placed at least 3 feet below finish grade at the maximum extent practical. In addition, formational materials with an expansion index greater than 90 should be undercut at least 3 feet below finish-pad grade and replaced with soil with soil possessing a "very low" to "medium" expansion potential. Cobbles or concretions greater than 1 foot in maximum dimension should not be placed within 10 feet of finish grade or 3 feet of the deepest utility. Cobbles and concretions greater than 6 inches in maximum dimension should not be placed within 3 feet of finish grade.

8.5.13 Slope stability analyses utilizing drained direct shear strength parameters based on our experience with similar soil types in nearby areas and laboratory test results indicates the proposed southern slope will require shear pins and buttressing to obtain a factor of safety of at least 1.5. The slope is shown on the Geologic Map, Figure 1, should be graded with a buttress varying from approximately 20 to 50 feet wide at the base. The minimum design buttress widths are shown on the Geologic Cross-Sections, Figure 2.

8.5.14 The Typical Buttress/Stability Fill Detail should be used for design and construction of slopes. The backcut for the buttress should commence at least 10 feet from the top of the proposed finish-graded slope and should extend at least 5 feet below adjacent pad grade or below the bedding plane shear/claystone layer, to a maximum depth of 15 feet below finish-pad grade. The base of the key should be slopes at least 5 percent to the drain, into slope. Elevations of the base of the buttress are shown on the Geologic Map and Cross-Sections, Figures 1 and 2.

Buttress and stability fill excavations must be approved by our certified engineering geologist, and surveyed by the project civil engineer prior to fill placement.



Typical Buttress/Stability Fill Detail

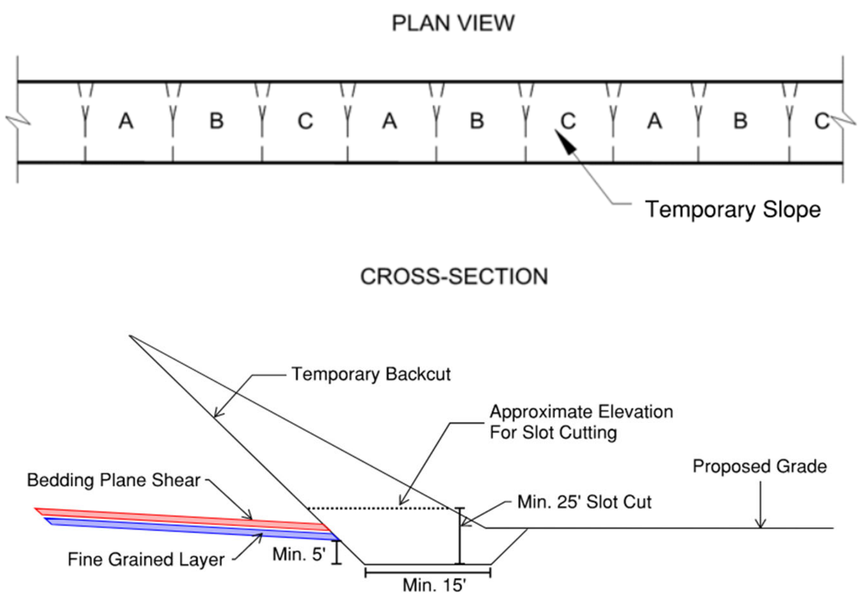
8.5.15 The slope backcut should be in accordance with OSHA requirements. Based on our analyses, we expect a slope of 2:1 or flatter will be required for stability purposes. Chimney drains should be installed along the backcut that are 4 feet wide, 20-foot on center and provide dual-sided drainage. Closer spacing may be required where seepage is encountered. The collector pipe at the base of the backcut should consists of a minimum 6-inch diameter, perforated, Schedule 40 PVC pipe drained at a minimum of 1%. The pipe should be surrounded by ¾-inch gravel wrapped in an approved filter fabric (Mirafi 140N or equivalent).

8.5.16 Cut slope excavations including buttresses and shear keys should be observed during grading operations to check that soil and geologic conditions do not differ significantly from those expected. During the construction of buttresses, there is a risk that the temporary backcut slopes will become unstable. This risk can be reduced by grading the buttress fill in short segments and/or flattening the inclination of the temporary slope. Temporary backcut slopes should be excavated and fill placed as soon as possible to help prevent slope backcut failures.

8.5.17 Slot cutting of the buttress excavations will likely be necessary to provide an adequate temporary factor of safety during grading. The top of the slot cut should be at an elevation of 25 feet above the design base of the buttress as shown on Cross-sections 1-1’ and 2-2’, Figure 2. The slot cut should then extend a minimum of 5 feet into the sandy portion of the formational materials. Each slot should be no wider than 50 feet (or as determined by the grading contractor) and the excavation should extend to the base of the keyway which should be graded as shown in the typical buttress/stability fill detail herein. This may require reduced slot cut lengths if loose or otherwise unstable soil is encountered. The contractor should be aware that there is an inherent risk to slot-cutting as movement of near vertical excavations can cause stress relief features and vertical ground settlement outside of the excavation. The grading contractor should be prepared to take necessary steps to provide lateral stability/temporary buttressing if slot cut sidewalls experience instability. The slot-cutting should be perform using the A-B-C Method (excavate the soil and place compacted fill in the A Areas, then the B areas, then the C areas). The following table presents the summary of the slot cutting elevations.

SUMMARY OF SLOT CUTTING ELEVATIONS

Cross-Section	Approximate Top Elevation of Slot Cut (Feet , MSL)	Approximate Bottom Elevation of Slot Cut (Feet , MSL)
1-1′	280	255
2-2′	261	240



Slot-Cutting Overexcavation Detail

8.5.18 The outer 15 feet (or a distance equal to the height of the slope, whichever is less) of slopes should be composed of properly compacted granular "soil" fill to reduce the potential for surficial sloughing. In general, soil with an expansion index of 90 or less or at least 35 percent sand-size particles should be acceptable as "soil" fill. Soil of questionable strength to satisfy surficial stability should be tested in the laboratory for acceptable drained shear strength. The use of cohesionless soil in the outer portion of fill slopes should be avoided. Fill slopes should be overbuilt 2 feet and cut back or be compacted by backrolling with a loaded sheepsfoot roller at vertical intervals not to exceed 4 feet and should be track-walked at the completion of each slope such that the fill is compacted to a dry density of at least 90 percent of the laboratory maximum dry density near to slightly above optimum moisture content to the face of the finished sloped.

8.5.19 Import fill (if necessary) should consist of the characteristics presented in the following table. Geocon Incorporated should be notified of the import soil source and should perform laboratory testing of import soil prior to its arrival at the site to determine its suitability as fill material.

SUMMARY OF IMPORT FILL RECOMMENDATIONS

Soil Characteristic	Values
Expansion Potential	"Very Low" to "Medium" (Expansion Index of 90 or Less)
Particle Size	Maximum Dimension Less Than 3 Inches
	Generally Free of Debris

8.6 Earthwork Grading Factors

8.6.1 Estimates of shrink-swell factors are based on comparing laboratory compaction tests with the density of the material in its natural state and experience with similar soil types. Variations in natural soil density and compacted fill render shrinkage value estimates very approximate. As an example, the contractor can compact fill to a density of 90 percent or higher of the laboratory maximum dry density. Thus, the contractor has at least a 10 percent range of control over the fill volume. Based on the work performed to date and considering the discussion herein, the earthwork factors in the following table may be used as a basis for estimating how much the on-site soils may shrink or swell when removed from their natural state and placed as compacted fill.

SHRINKAGE AND BULK FACTORS

Soil Unit	Shrink/Bulk Factor
Surficial Soil (Fill/Topsoil/Colluvium/Qal/Qls)	10-15% Shrink
Santiago Formation (Tsa)	3-5% Bulk

8.7 Temporary Excavations

8.7.1 The recommendations included herein are provided for stable excavations. It is the responsibility of the contractor and their competent person to ensure all excavations, temporary slopes and trenches are properly constructed and maintained in accordance with applicable OSHA guidelines in order to maintain safety and the stability of the excavations and adjacent improvements. These excavations should not be allowed to become saturated or to dry out. Surcharge loads should not be permitted to a distance equal to the height of the excavation from the top of the excavation. The top of the excavation should be a minimum of 15 feet from the edge of existing improvements. Excavations steeper than those recommended or closer than 15 feet from an existing surface improvement should be shored in accordance with applicable OSHA codes and regulations.

8.7.2 The stability of the excavations is dependent on the design and construction of the shoring system and site conditions. Therefore, Geocon Incorporated cannot be responsible for site safety and the stability of the proposed excavations.

8.7.3 The property possesses landslide debris that typically has a tendency to possess stability issues. The underground contractors should be ready to provide shoring or flatten temporary excavation inclinations if localized instability is encountered.

8.8 Seismic Design Criteria – 2022 California Building Code

8.8.1 The following table summarizes site-specific design criteria obtained from the 2022 California Building Code (CBC; Based on the 2021 International Building Code [IBC] and ASCE 7-16), Chapter 16 Structural Design, Section 1613 Earthquake Loads. We used the computer program *U.S. Seismic Design Maps*, provided by the Structural Engineers Association (SEA) to calculate the seismic design parameters. The short spectral response uses a period of 0.2 second. We evaluated the Site Class based on the discussion in Section 1613.2.2 of the 2022 CBC and Table 20.3-1 of ASCE 7-16. The values presented herein are for the risk-targeted maximum considered earthquake (MCE_R). Sites designated as Site Class D, E and F may require additional analyses if requested by the project structural engineer and client.

2022 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	2022 CBC Reference
Site Class	D	Section 1613.2.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	0.928g	Figure 1613.2.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.343g	Figure 1613.2.1(3)
Site Coefficient, F_A	1.129	Table 1613.2.3(1)
Site Coefficient, F_V	1.957*	Table 1613.2.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	1.047g	Section 1613.2.3 (Eqn 16-20)
Site Class Modified MCE_R Spectral Response Acceleration – (1 sec), S_{M1}	0..671g*	Section 1613.2.3 (Eqn 16-21)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	0.698g	Section 1613.2.4 (Eqn 16-22)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.447g*	Section 1613.2.4 (Eqn 16-23)

*See following paragraph.

8.8.2 Using the code-based values presented in the previous table, in lieu of a performing a ground motion hazard analysis, requires the exceptions outlined in ASCE 7-16 Section 11.4.8 be followed by the project structural engineer. Per Section 11.4.8 of ASCE/SEI 7-16, a ground motion hazard analysis should be performed for projects for Site Class “D” sites with S1 greater than 0.2g. Section 11.4.8 also provides exceptions which indicates that the ground motion hazard analysis may be waived provided the exceptions are followed. Supplement 3 of ASCE 7-16 provides an exception stating that that the GMHA may be waived provided that the parameter S_{M1} is increased by 50% for all applications of S_{M1}. The values for parameters S_{M1} and S_{D1} presented herein above have **not** been increased in accordance with Supplement 3 of ASCE 7-16.

8.8.3 The following table presents the mapped maximum considered geometric mean (MCE_G) seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-16.

ASCE 7-16 PEAK GROUND ACCELERATION

Parameter	Value	ASCE 7-16 Reference
Mapped MCE_G Peak Ground Acceleration, PGA	0.402g	Figure 22-9
Site Coefficient, F_{PGA}	1.198	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.482g	Section 11.8.3 (Eqn 11.8-1)

8.8.4 Conformance to the criteria in this section for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur in the event of a large earthquake. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

8.8.5 The project structural engineer and architect should evaluate the appropriate Risk Category and Seismic Design Category for the planned structures. The values presented herein assume a Risk Category of II and resulting in a Seismic Design Category D. The following table summarizes of the risk categories in accordance with ASCE 7-16.

ASCE 7-16 RISK CATEGORIES

Risk Category	Building Use	Examples
I	Low risk to Human Life at Failure	Barn, Storage Shelter
II	Nominal Risk to Human Life at Failure (Buildings Not Designated as I, III or IV)	Residential, Commercial and Industrial Buildings
III	Substantial Risk to Human Life at Failure	Theaters, Lecture Halls, Dining Halls, Schools, Prisons, Small Healthcare Facilities, Infrastructure Plants, Storage for Explosives/Toxins
IV	Essential Facilities	Hazardous Material Facilities, Hospitals, Fire and Rescue, Emergency Shelters, Police Stations, Power Stations, Aviation Control Facilities, National Defense, Water Storage

8.9 Fill Settlement

8.9.1 Fill soil, even if properly compacted, will experience settlement over the lifetime of the improvements that it supports. The ultimate settlement potential of the fill is a function of the soil classification, placement relative compaction, and subsequent increases in the soil moisture content.

8.9.2 Building 1 and 2 will be underlain by a maximum fill thickness of about 50 and 25 feet, respectively. The settlement of compacted fill is expected to continue over a relatively extended time period resulting from both gravity loading and hydrocompression upon wetting from rainfall and/or landscape irrigation.

8.9.3 Due to the variable fill thickness, a potential for differential settlement across the proposed buildings exist and special foundation design may be consideration. Based on measured settlement of similar fill depths on other sites and the time period since the fill was placed, we estimate that maximum settlement of the compacted fill will be approximately 0.4 percent for the proposed compacted fills.

8.9.4 The following table presents the estimated total and differential fill thickness and settlements of the building pads for the proposed pad grades provided on the referenced plans. These settlement magnitudes should be considered in design of the foundation system and adjacent flatwork that connects to the proposed buildings.

EXPECTED DIFFERENTIAL SETTLEMENT OF FILL SOIL

Building	Maximum Depth of Fill Beneath Structure (Feet)	Maximum Fill Differential (Feet)	Estimated Maximum Settlement (Inches)	Estimated Differential Settlement (Inches)	Length of Differential Settlement (Feet)	Estimated Maximum Angular Distortion
Building 1	50	45	2.4	2.2	380	1/700
Building 2	25	20	1.2	1.0	180	1/950

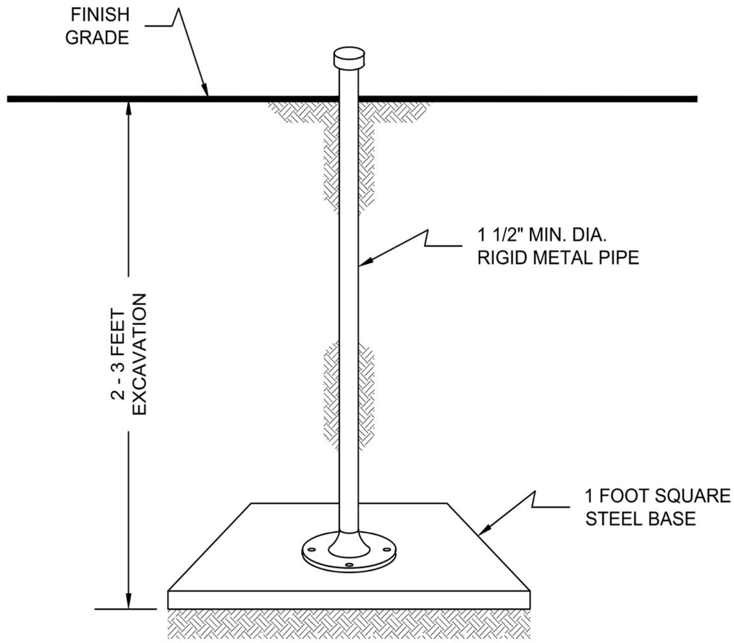
8.9.5 Deep foundations such as driven piles or drilled piers are the most effective means of reducing the ultimate settlement potential of the proposed structures to a negligible amount. Alternatively, ground improvements and/or highly reinforced shallow foundation systems and slabs-on-grade may be used for support of the buildings; however, the shallow foundation systems would not eliminate the potential for cosmetic distress related to differential settlement of the underlying fill. Some cosmetic distress cannot be avoided and should be expected over the life of the structure as a result of long-term differential settlement. The owner, tenants, and future owners should be made aware that cosmetic distress, including separation of caulking at wall joints, small non-structural wall panel cracks, and separation of concrete flatwork is likely to occur. This discussion in no way describes latent defects to the building's structure nor foundation, nor allows them to be common place. We understand the settlements and angular rotation values are within normal design ranges and are within "standard practice" values. We can provide additional recommendations when a structural engineer begins their design and if they require additional design parameters or recommendations to support the planned structure.

8.10 Settlement Monuments

8.10.1 We expect fill settlement and settlement due to fill loads over compressible materials will occur after remedial grading operations for the proposed development. Based on our recommendations, surficial soil will be left in place on the western portion of the site below the proposed parking area. We recommended a settlement program for this area for the proposed improvements and can occur for 6 months.

8.10.2 Therefore, settlement monitoring using plate and surface settlement monuments will be required as discussed herein to evaluate when the settlement has stabilized, and further improvements may proceed. The Geologic Map, Figure 1, presents the approximate locations of the proposed settlement monuments. However, we will evaluate the number, locations, and type of settlement monuments during grading operations based on the final limits or removals performed.

8.10.3 Surface settlement monuments should be installed at finished grade after the placement of fill in areas where compressible surficial materials will be left in place to monitor settlement movement of the underlying fill and surficial materials thereafter. A typical surface settlement monument detail is presented herein.



Surface Settlement Monument Detail

8.10.4 The project surveyor should record the movements of the surface settlement monuments every two weeks until data indicates that the rate of primary fill and left in place surficial material soil compression is essentially non-detrimental (settlement monument data with a relatively level plateau) to proposed improvements. When we receive two to three data points of settlement values that show a relatively level settlement slope on the graphs, the construction of the building and surrounding improvements can begin.

8.10.5 The City of Oceanside requires at least 6 months of monitoring unless documented evidence of the completion of primary settlement is provided. The settlement timeframe can be reduced, as necessary, during the settlement evaluation process. The settlement due to primary consolidation will be considered to have ceased when survey readings show a relatively level plateau of settlement data over 4 consecutive weekly readings. At that time, Geocon can prepare a report recommending for submittal for city approval. Improvements that are sensitive to the estimated settlements may be installed after the monitoring program shows the primary consolidation is relatively complete. Based on our experience, we expect the monuments will require monitoring for roughly 150 days. At that time, we expect development can begin for settlement-sensitive underground utilities with less than one percent gradient along with construction of the building and improvements. Underground utilities with a gradient of one percent or greater will not have a waiting period and can start construction after finish grade is achieved. Underground wet utilities should not be installed until finish grade is achieved, as excessive settlements will occur with the placement of compacted fills. We will evaluate the location of the settlement monuments subsequent to the grading operations. There will be no monitoring or waiting time for improvements that are not underlain by compressible materials or have less than 20 feet within the eastern end of the site.

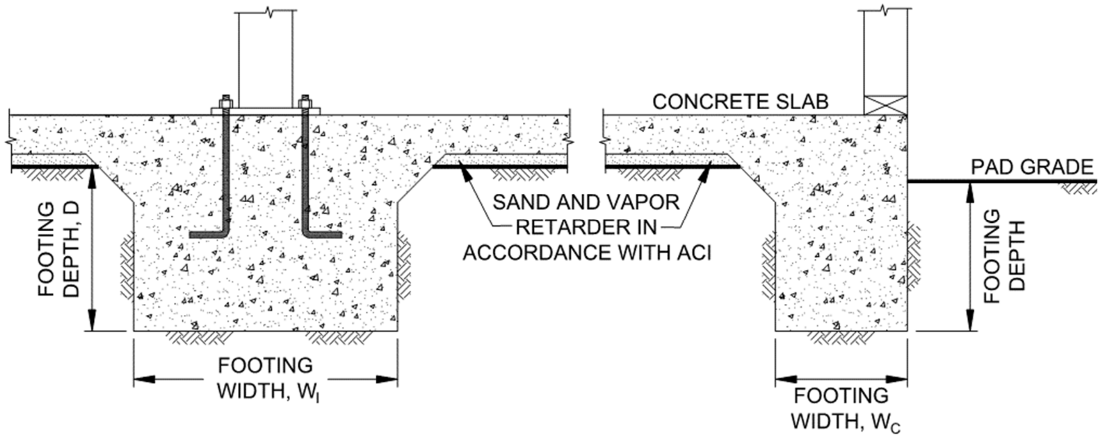
8.11 Shallow Foundations

8.11.1 The proposed structure can be supported on a shallow foundation system founded in the compacted fill. Foundations for the structure should consist of continuous strip footings and/or isolated spread footings and should be designed using the parameters in the following table.

SUMMARY OF FOUNDATION RECOMMENDATIONS

Parameter	Value
Minimum Continuous Foundation Width, W_C	12 Inches
Minimum Isolated Foundation Width, W_I	24 Inches
Minimum Foundation Depth, D	24 Inches Below Lowest Adjacent Grade
Minimum Steel Reinforcement	4 No. 5 Bars, 2 Top and 2 Bottom
Allowable Bearing Capacity	2,500 psf
Bearing Capacity Increase	500 psf per Foot of Depth
	300 psf per Foot of Width
Maximum Allowable Bearing Capacity	4,000 psf
Estimated Total Settlement	1 Inch
Estimated Differential Settlement	½ Inch in 40 Feet
Footing Size Used for Settlement	8-Foot Square
Design Expansion Index	50 or Less

8.11.2 The foundations should be embedded in accordance with the recommendations herein and the Wall/Column Footing Dimension Detail. The embedment depths should be measured from the lowest adjacent pad grade for both interior and exterior footings. Footings should be deepened such that the bottom outside edge of the footing is at least 7 feet horizontally from the face of the slope (unless designed with a post-tensioned foundation system as discussed herein).



Wall/Column Footing Dimension Detail

8.11.3 The bearing capacity values presented herein are for dead plus live loads and may be increased by one-third when considering transient loads due to wind or seismic forces.

8.11.4 Where buildings or other improvements are planned near the top of a slope steeper than 3:1 (horizontal: vertical), special foundations and/or design considerations are recommended due to the tendency for lateral soil movement to occur.

- For fill slopes less than 20 feet high, building footings should be deepened such that the bottom outside edge of the footing is at least 7 feet horizontally from the face of the slope.
- When located next to a descending 3:1 (horizontal: vertical) fill slope or steeper, the foundations should be extended to a depth where the minimum horizontal distance is equal to H/3 (where H equals the vertical distance from the top of the fill slope to the base of the fill soil) with a minimum of 7 feet but need not exceed 40 feet. The horizontal distance is measured from the outer, deepest edge of the footing to the face of the slope. An acceptable alternative to deepening the footings would be the use of a post-tensioned slab and foundation system or increased footing and slab reinforcement. Specific design parameters or recommendations for either of these alternatives can be provided once the building location and fill slope geometry have been determined.
- If swimming pools are planned, Geocon Incorporated should be contacted for a review of specific site conditions.
- Although other improvements, which are relatively rigid or brittle, such as concrete flatwork or masonry walls, may experience some distress if located near the top of a slope, it is generally not economical to mitigate this potential. It may be possible,

however, to incorporate design measures that would permit some lateral soil movement without causing extensive distress. Geocon Incorporated should be consulted for specific recommendations.

8.11.5 We should observe the foundation excavations prior to the placement of reinforcing steel and concrete to check that the exposed soil conditions are similar to those expected and that they have been extended to the appropriate bearing strata. Foundation modifications may be required if unexpected soil conditions are encountered.

8.11.6 Geocon Incorporated should be consulted to provide additional design parameters as required by the structural engineer.

8.12 Concrete Slabs-On-Grade

8.12.1 Concrete slabs-on-grade for the structures should be constructed using the parameters presented in the following table.

MINIMUM CONCRETE SLAB-ON-GRADE RECOMMENDATIONS

Parameter	Value
Minimum Concrete Slab Thickness	5 Inches
Minimum Steel Reinforcement	No. 3 Bars 24 Inches on Center, Both Directions
Typical Slab Underlayment	3 to 4 Inches of Sand/Gravel/Base
Design Expansion Index	90 or Less

8.12.2 Slabs that may receive moisture-sensitive floor coverings or may be used to store moisture-sensitive materials should be underlain by a vapor retarder. The vapor retarder design should be consistent with the guidelines presented in the American Concrete Institute's (ACI) *Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials* (ACI 302.2R-06). In addition, the membrane should be installed in accordance with manufacturer's recommendations and ASTM requirements and installed in a manner that prevents puncture. The vapor retarder used should be specified by the project architect or developer based on the type of floor covering that will be installed and if the structure will possess a humidity controlled environment.

8.12.3 The bedding sand thickness should be determined by the project foundation engineer, architect, and/or developer. It is common to have 3 to 4 inches of sand for 5-inch and 4-inch thick slabs, respectively, in the southern California region. However, we should be contacted to provide recommendations if the bedding sand is thicker than 6 inches. The foundation design engineer should provide appropriate concrete mix design criteria and curing measures to assure proper curing of the slab by reducing the potential for rapid moisture loss and subsequent cracking and/or slab curl. We suggest that the foundation design engineer present the concrete mix design and proper curing methods on the foundation plans. It is critical that the foundation contractor understands and follows the recommendations presented on the foundation plans.

8.12.4 Some projects remove the sand layer below the slab in parking structure areas. This is acceptable from a geotechnical engineering standpoint; however, relatively minor cracks could form due to differential curing. Therefore, the structural engineer and/or the concrete contractor should provide recommendations for proper curing techniques to help prevent cracking.

8.12.5 Concrete slabs should be provided with adequate crack-control joints, construction joints and/or expansion joints to reduce unsightly shrinkage cracking. The design of joints should consider criteria of the American Concrete Institute (ACI) when establishing crack-control spacing. Crack-control joints should be spaced at intervals no greater than 12 feet. Additional steel reinforcing, concrete admixtures and/or closer crack control joint spacing should be considered where concrete-exposed finished floors are planned.

8.12.6 Special subgrade presaturation is not deemed necessary prior to placing concrete; however, the exposed foundation and slab subgrade soil should be moisturized to maintain a moist condition as would be expected in any such concrete placement.

8.12.7 The concrete slab-on-grade recommendations are based on soil support characteristics only. The project structural engineer should evaluate the structural requirements of the concrete slabs for supporting expected loads.

8.12.8 The recommendations of this report are intended to reduce the potential for cracking of slabs due to expansive soil (if present), differential settlement of existing soil or soil with varying thicknesses. However, even with the incorporation of the recommendations presented herein, foundations, stucco walls, and slabs-on-grade placed on such conditions may still exhibit some cracking due to soil movement and/or shrinkage. The occurrence of concrete shrinkage cracks is independent of the supporting soil characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, proper concrete placement and curing, and by the placement of crack control joints at periodic intervals, in particular, where re-entrant slab corners occur.

8.13 Exterior Concrete Flatwork

8.13.1 Exterior concrete flatwork not subject to vehicular traffic should be constructed in accordance with the recommendations presented in the following table. The recommended steel reinforcement would help reduce the potential for cracking.

MINIMUM CONCRETE FLATWORK RECOMMENDATIONS

Expansion Index, EI	Minimum Steel Reinforcement* Options	Minimum Thickness
EI $\leq$ 90	No. 3 Bars 18 inches on center, Both Directions	4 Inches
EI $\leq$ 130	No. 4 Bars 12 inches on center, Both Directions	4 Inches

*In excess of 8 feet square.

8.13.2 The subgrade soil should be properly moisturized and compacted prior to the placement of steel and concrete. The subgrade soil should be compacted to a dry density of at least 90 percent of the laboratory maximum dry density near to slightly above optimum moisture content in accordance with ASTM D 1557.

8.13.3 Even with the incorporation of the recommendations of this report, the exterior concrete flatwork has a potential to experience some uplift due to expansive soil beneath grade. The steel reinforcement should overlap continuously in flatwork to reduce the potential for vertical offsets within flatwork. Additionally, flatwork should be structurally connected to the curbs, where possible, to reduce the potential for offsets between the curbs and the flatwork.

8.13.4 Concrete flatwork should be provided with crack control joints to reduce and/or control shrinkage cracking. Crack control spacing should be determined by the project structural engineer based upon the slab thickness and intended usage. Criteria of the American Concrete Institute (ACI) should be taken into consideration when establishing crack control spacing. Subgrade soil for exterior slabs not subjected to vehicle loads should be compacted in accordance with criteria presented in the grading section prior to concrete placement. Subgrade soil should be properly compacted and the moisture content of subgrade soil should be verified prior to placing concrete. Base materials will not be required below concrete improvements.

8.13.5 Where exterior flatwork abuts the structure at entrant or exit points, the exterior slab should be dowelled into the structure's foundation stemwall. This recommendation is intended to reduce the potential for differential elevations that could result from differential settlement or minor heave of the flatwork. Dowelling details should be designed by the project structural engineer.

8.13.6 The recommendations presented herein are intended to reduce the potential for cracking of exterior slabs as a result of differential movement. However, even with the incorporation of the recommendations presented herein, slabs-on-grade will still crack. The occurrence of concrete shrinkage cracks is independent of the soil supporting characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, the use of crack control joints and proper concrete placement and curing. Crack control joints should be spaced at intervals no greater than 12 feet. Literature provided by the Portland Concrete Association (PCA) and American Concrete Institute (ACI) present recommendations for proper concrete mix, construction, and curing practices, and should be incorporated into project construction.

8.14 Conventional Retaining Walls

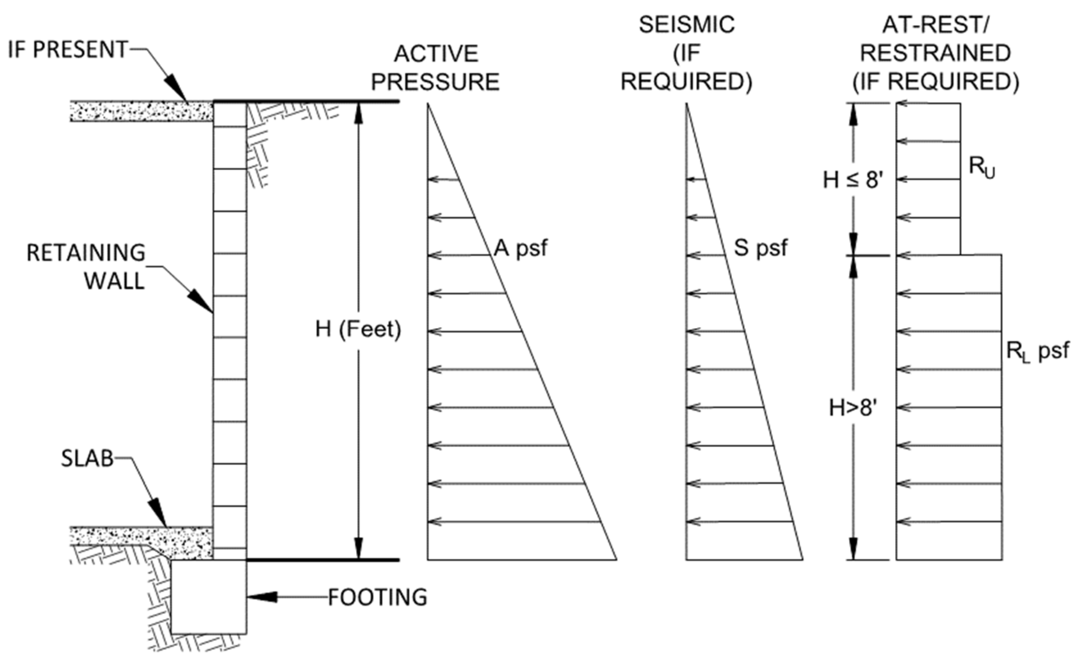
8.14.1 We understand that conventional and a subterranean garage walls may be planned for the site with a maximum height of about 10 feet. Retaining walls should be designed using the values presented in the following table. Soil with an expansion index (EI) of greater than 50 should not be used as backfill material behind retaining walls.

RETAINING WALL DESIGN RECOMMENDATIONS

Parameter	Value
Active Soil Pressure, A (Fluid Density, Level Backfill)	40 pcf
Active Soil Pressure, A (Fluid Density, 2:1 Sloping Backfill)	55 pcf
Seismic Pressure, S	15H psf
At-Rest/Restrained Walls Additional Uniform Pressure, R_U (0 to 8 Feet High)	7H psf
At-Rest/Restrained Walls Additional Uniform Pressure, R_L (8+ Feet High)	13H psf
Expected Expansion Index for the Subject Property	EI$\leq$ 90

H equals the height of the retaining portion of the wall

8.14.2 The project retaining walls should be designed as shown in the Retaining Wall Loading Diagram.



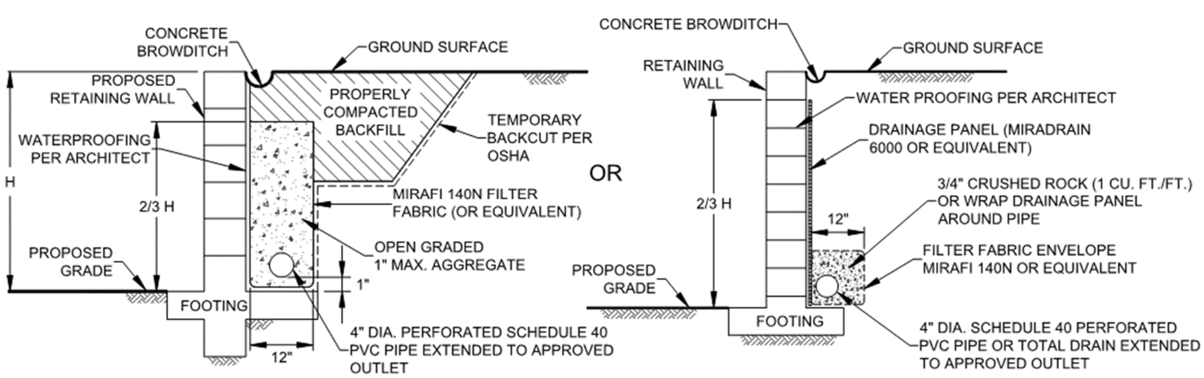
Retaining Wall Loading Diagram

8.14.3 Unrestrained walls are those that are allowed to rotate more than 0.001H (where H equals the height of the retaining portion of the wall) at the top of the wall. Where walls are restrained from movement at the top (at-rest condition), an additional uniform pressure should be applied to the wall. For retaining walls subject to vehicular loads within a horizontal distance equal to two-thirds the wall height, a surcharge equivalent to 2 feet of fill soil should be added to the upper 10 feet of the retaining wall.

8.14.4 The structural engineer should determine the Seismic Design Category for the project in accordance with Section 1613 of the 2022 CBC or Section 11.6 of ASCE 7-16. For structures assigned to Seismic Design Category of D, E, or F, retaining walls that support more than 6 feet of backfill should be designed with seismic lateral pressure in accordance with Section 1803.5.12 of the 2022 CBC. The seismic load is dependent on the retained height where H is the height of the wall, in feet, and the calculated loads result in pounds per square foot (psf) exerted at the base of the wall and zero at the top of the wall.

8.14.5 Retaining walls should be designed to ensure stability against overturning sliding, and excessive foundation pressure. Where a keyway is extended below the wall base with the intent to engage passive pressure and enhance sliding stability, it is not necessary to consider active pressure on the keyway.

8.14.6 Drainage openings through the base of the wall (weep holes) should not be used where the seepage could be a nuisance or otherwise adversely affect the property adjacent to the base of the wall. The recommendations herein assume a properly compacted granular (EI of 90 or less) free-draining backfill material with no hydrostatic forces or imposed surcharge load. The retaining wall should be properly drained as shown in the Typical Retaining Wall Drainage Detail. If conditions different than those described are expected, or if specific drainage details are desired, Geocon Incorporated should be contacted for additional recommendations.



Typical Retaining Wall Drainage Detail

8.14.7 The retaining walls may be designed using either the active and restrained (at-rest) loading condition or the active and seismic loading condition as suggested by the structural engineer. Typically, it appears the design of the restrained condition for retaining wall loading may be adequate for the seismic design of the retaining walls. However, the active earth pressure combined with the seismic design load should be reviewed and also considered in the design of the retaining walls.

8.14.8 In general, wall foundations should be designed using the parameters presented in the following table. The proximity of the foundation to the top of a slope steeper than 3:1 could impact the allowable soil bearing pressure. Therefore, retaining wall foundations should be deepened such that the bottom outside edge of the footing is at least 7 feet horizontally from the face of the slope.

SUMMARY OF RETAINING WALL FOUNDATION RECOMMENDATIONS

Parameter	Value
Minimum Retaining Wall Foundation Width	12 Inches
Minimum Retaining Wall Foundation Depth	12 Inches
Minimum Steel Reinforcement	Per Structural Engineer
Allowable Bearing Capacity	2,000 psf
Estimated Total Settlement	1 Inch
Estimated Differential Settlement	½ Inch in 40 Feet

8.14.9 The recommendations presented herein are generally applicable to the design of rigid concrete or masonry retaining walls. In the event that other types of walls (such as mechanically stabilized earth [MSE] walls, soil nail walls, or soldier pile walls) are planned, Geocon Incorporated should be consulted for additional recommendations.

8.14.10 It is common to see retaining walls constructed in the areas of the elevator pits. The retaining walls should be properly drained and designed in accordance with the recommendations presented herein. If the elevator pit walls are not drained, the walls should be designed with an increased active pressure with an equivalent fluid density of 90 pcf. It is also common to see seepage and water collection within the elevator pit. The pit should be designed and properly waterproofed to prevent seepage and water migration into the elevator pit.

8.14.11 Unrestrained walls will move laterally when backfilled and loading is applied. The amount of lateral deflection is dependent on the wall height, the type of soil used for backfill, and loads acting on the wall. The retaining walls and improvements above the retaining walls should be designed to incorporate an appropriate amount of lateral deflection as determined by the structural engineer.

8.14.12 Soil contemplated for use as retaining wall backfill, including import materials, should be identified in the field prior to backfill. At that time, Geocon Incorporated should obtain samples for laboratory testing to evaluate its suitability. Modified lateral earth pressures may be necessary if the backfill soil does not meet the required expansion index or shear strength. City or regional standard wall designs, if used, are based on a specific active lateral earth pressure and/or soil friction angle. In this regard, on-site soil to be used as backfill may or may not meet the values for standard wall designs. Geocon Incorporated should be consulted to assess the suitability of the on-site soil for use as wall backfill if standard wall designs will be used.

8.15 Mechanically Stabilized Earth (MSE) Retaining Walls

8.15.1 We understand a Mechanized stabilized earth (MSE) retaining wall will be used on the northern edge of the property. MSE retaining walls are alternative walls that consist of modular block facing units with geogrid reinforced earth behind the block. The reinforcement grid attaches to the block units and is typically placed at specified vertical intervals and embedment lengths. The grid length and spacing will be determined by the wall designer. The designer should also check that sufficient horizontal distance exists to install the grids without having to excavate into the slope as the slope face consists of very strong rock material or rock fill.

8.15.2 We expect the MSE wall footing will be embedded in properly compacted fill over formational materials from Sta 3+85-9+48. From Sta 0+00-3+85 the wall footing will be embedded into properly compacted fill with a potential of 15 to 20 feet of landslide debris being left in place at Sta 0+00 and thinning out to a full removal at Sta 3+85. The settlement and stability analyses are presented herein.

8.15.3 The geotechnical parameters listed in the following table can be used for preliminary design of the MSE walls. We understand that a combination of onsite soil and import soil will be used as backfill material behind the walls. Once the import source has been determined, laboratory testing should be performed to check that the shear strength parameters used in the design of the MSE walls meet the required strength within the reinforced zone.

GEOTECHNICAL PARAMETERS FOR MSE WALLS

Parameter	Soil Source	Reinforced Zone	Retained Zone	Foundation Zone
Angle of Internal Friction	On-Site	26 Degrees	26 Degrees	26 Degrees
	Select Sand Grading	30 Degrees	30 Degrees	30 Degrees
Cohesion	On-Site and Select Grading	200 psf	200 psf	200 psf
Wet Unit Density	On-Site and Select Grading	125 pcf	125 pcf	125 pcf

8.15.4 The soil parameters presented in the previous table are based on our experience and direct shear-strength tests performed during the geotechnical investigation and represent some of the on-site materials. The wet unit density values can be used for design but actual in-place densities may range from approximately 90 to 135 pounds per cubic foot. Geocon has no way of knowing which materials will actually be used as backfill behind the wall during construction. It is up to the wall designers to use their judgment in selection of the design parameters. As such, once backfill materials have been selected and/or stockpiled, sufficient shear tests should be conducted on samples of the proposed backfill materials to check that they conform to actual design values. Results should be provided to the designer to re-evaluate stability of the walls. Dependent upon test results, the designer may require modifications to the original wall design (e.g., longer reinforcement embedment lengths and/or steel reinforcement).

8.15.5 The foundation zone is the area where the footing is embedded, the reinforced zone is the area of the backfill that possesses the reinforcing fabric, and the retained zone is the area behind the reinforced zone.

8.15.6 The MSE wall foundations should be designed using the values in the following table. The walls should be deepened such that the bottom outside edge of the footing is at least 7 feet horizontally from the face of the slope.

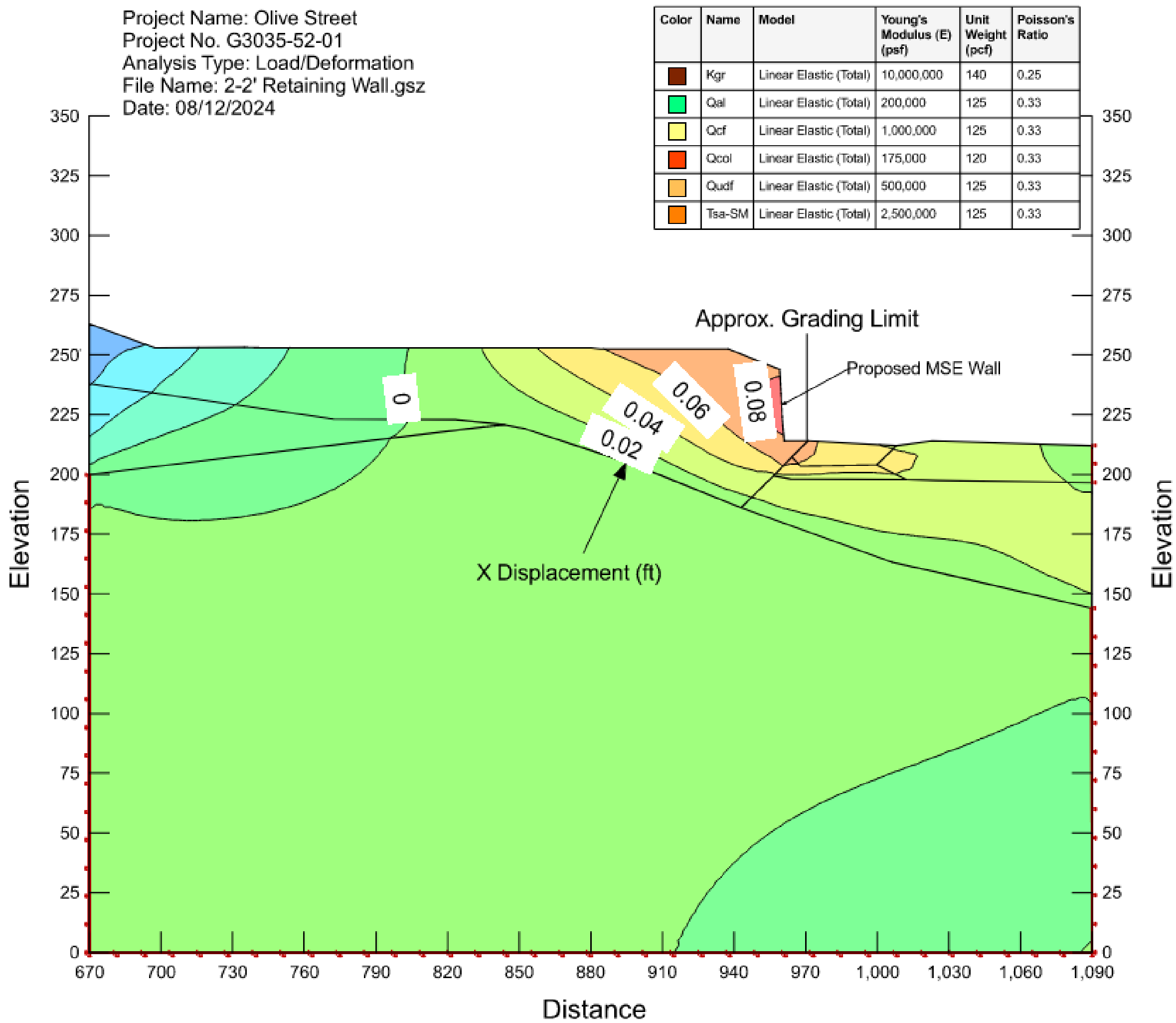
SUMMARY OF MSE RETAINING WALL FOUNDATION RECOMMENDATIONS

Parameter	Value
Minimum Retaining Wall Foundation Width	12 Inches
Minimum Retaining Wall Foundation Depth	12 Inches
Bearing Capacity	2,000 psf
Bearing Capacity Increase	500 psf per Foot of Depth
	300 psf per Foot of Width
Maximum Bearing Capacity	3,500 psf
Estimated Total and Differential Settlement	1 Inch (Stations 3+80 to 9+40)
	3 Inches (Stations 0+00 to 3+80)

*Settlement associated with 35-foot fill height

8.15.7 MSE retaining walls can be designed for a differential settlement of up to 1 percent in accordance with Section 12.3.4 of the *Design Manual for Segmental Retaining Walls, 3rd Edition*. The settlement values presented herein show the proposed MSE retaining walls should be designed using a differential settlement of 1 inches in 40 feet (about 0.2 percent) for the wall from Stations 3+80 to 9+40 and 3 inches in 40 feet (about 0.6 percent) for the wall from Stations 0+00 to 3+80. Therefore, we opine the MSE walls will be able to tolerate the proposed settlements based on the calculated estimates from SigmaW. We can provide additional recommendations if the MSE retaining wall designer requests additional support for the proposed walls.

8.15.8 We performed a lateral deflection analysis using SigmaW that resulted in a calculated maximum lateral movement of about 1 inch (0.08 feet) for the wall as shown in the following lateral Deflection Analysis.



Lateral Deflection Analysis

8.15.9 We will perform testing and observation services during grading operations and retaining wall backfill operations. Backfill materials within the reinforced zone should be compacted to a dry density of at least 90 percent of the laboratory maximum dry density near to slightly above optimum moisture content in accordance with ASTM D 1557. This is applicable to the entire embedment width of the reinforcement. Typically, wall designers specify no heavy compaction equipment within 3 feet of the face of the wall. However, smaller equipment (e.g., walk-behind, self-driven compactors or hand whackers) can be used to compact the materials without causing deformation of the wall. If the designer specifies no compactive effort for this zone, the materials are essentially not properly compacted and the reinforcement grid within the uncompacted zone should not be relied upon for reinforcement, and overall embedment lengths will have to be increased to account for the difference.

8.15.10 Select backfill materials may be required to be in accordance with the MSE retaining wall system. Materials as outlined in the specifications of the retaining wall plans may be generated and stockpiled during grading, if encountered, or may require import. Geocon should perform laboratory tests during the backfill materials to check that soil properties are in accordance with the retaining wall plans and specifications.

8.15.11 The wall should be provided with a drainage system sufficient to prevent excessive seepage through the wall and the base of the wall, thus preventing hydrostatic pressures behind the wall.

8.15.12 Geosynthetic reinforcement must elongate to develop full tensile resistance. This elongation generally results in movement at the top of the wall. The amount of movement is dependent on the height of the wall (e.g., higher walls rotate more) and the type of reinforcing grid used. In addition, over time the reinforcement grid has been known to exhibit creep (sometimes as much as 5 percent) and can undergo additional movement. Given this condition, the owner should be aware that structures and pavement placed within the reinforced and retained zones of the wall may undergo movement.

8.15.13 The MSE wall contractor should provide the estimated deformation of wall and adjacent ground in associated with wall construction. The calculated horizontal and vertical deformations should be determined by the wall designer. The estimated movements should be provided to the project structural engineer to determine if the planned improvements can tolerate the expected movements.

8.15.14 The MSE wall designer/contractor should review this report, including the slope stability requirements, and incorporate our recommendations as presented herein. We should be provided the plans for the MSE walls to check if they are in conformance with our recommendations prior to issuance of a permit and construction.

8.16 Lateral Loading

8.16.1 The values in the following table should be used to help design the proposed structures and improvements to resist lateral loads for the design of footings or shear keys. The allowable passive pressure assumes a horizontal surface extending at least 5 feet, or three times the surface generating the passive pressure, whichever is greater. The upper 12 inches of material in areas not protected by floor slabs or pavement should not be included in design for passive resistance.

SUMMARY OF LATERAL LOAD DESIGN RECOMMENDATIONS

Parameter	Value
Passive Pressure Fluid Density	300 pcf
Coefficient of Friction (Concrete and Soil)	0.35
Coefficient of Friction (Along Vapor Barrier)	0.2 to 0.25*

*Per manufacturer's recommendations.

8.16.2 The passive and frictional resistant loads can be combined for design purposes. The lateral passive pressures may be increased by one-third when considering transient loads due to wind or seismic forces.

8.17 Preliminary Pavement Recommendations

8.17.1 We calculated the flexible pavement sections in general conformance with the *Caltrans Method of Flexible Pavement Design* (Highway Design Manual, Section 608.4) using an estimated Traffic Index (TI) of 5.0, 5.5, 6.0, and 7.0 for parking stalls, driveways, medium truck traffic areas, and heavy truck traffic areas, respectively. The project civil engineer and owner should review the pavement designations to determine appropriate locations for pavement thickness. The final pavement sections for the parking lot should be based on the R-Value of the subgrade soil encountered at final subgrade elevation. We have assumed an R-Value of 15 (based on previous testing) and 78 for the subgrade soil and base materials, respectively, for the purposes of this preliminary analysis. The following table presents the preliminary flexible pavement sections.

PRELIMINARY FLEXIBLE PAVEMENT SECTION

Location	Assumed Traffic Index	Assumed Subgrade R-Value	Asphalt Concrete Thickness (Inches)		
			3	3 ½	4
			Class 2 Aggregate Base (Inches)		
Parking Stalls for Automobiles and Light-Duty Vehicles	5.0	15	8	7	6
Driveways for Automobiles and Light-Duty Vehicles	5.5	15	10	9	8
Medium Truck Traffic Areas	6.0	15	---	11	10
Driveways for Heavy Truck Traffic	7.0	15	---	---	13

8.17.2 Prior to placing base materials, the upper 12 inches of the subgrade soil should be scarified, moisture conditioned as necessary, and recompacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content as determined by ASTM D 1557. Similarly, the base material should be compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content. Asphalt concrete should be compacted to a density of at least 95 percent of the laboratory Hveem density in accordance with ASTM D 2726.

8.17.3 Base materials should conform to Section 26-1.02B of the *Standard Specifications for The State of California Department of Transportation (Caltrans)* with a ¾-inch maximum size aggregate. Asphalt concrete should conform to Section 203-6 of the *Standard Specifications for Public Works Construction (Greenbook)*.

8.17.4 The base thickness can be reduced if the subgrade can be compacted to 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content and a reinforcement geogrid is used during the installation of the pavement. In areas where reinforcement geogrid is placed due to pumping subgrade or not being able to achieve 95 percent of the laboratory maximum dry density then the base cannot be reduced and the full section should be installed. Geocon should be contact for additional recommendations if alternate design parameters are requested. In are

8.17.5 A rigid Portland cement concrete (PCC) pavement section should be placed in roadway aprons and cross gutters. We calculated the rigid pavement section in general conformance with the procedure recommended by the American Concrete Institute report ACI 330-21 *Commercial Concrete Parking Lots and Site Paving Design and Construction – Guide.* We used the following traffic categories and design parameters used for the calculations for 20-year design life.

TRAFFIC CATEGORIES

Traffic Category	Description	Reliability (%)	Slabs Cracked at End of Design Life (%)
A	Car Parking Areas and Access Lanes	60	15
B	Entrance and Truck Service Lanes	60	15
E	Garbage or Fire Truck Lane	75	15

8.17.6 We used the parameters presented in the following table to calculate the pavement design sections. We should be contacted to provide updated design sections, if necessary.

RIGID PAVEMENT DESIGN PARAMETERS

Design Parameter	Design Value
Modulus of Subgrade Reaction, k	100 pci
Modulus of Rupture for Concrete, M_R	500 psi
Concrete Compressive Strength	3,000 psi
Concrete Modulus of Elasticity, E	3,150,000 psi

8.17.7 Based on the criteria presented herein, the PCC pavement sections should have the following minimum thicknesses for the applicable traffic category.

RIGID VEHICULAR PAVEMENT RECOMMENDATIONS

Traffic Category	Trucks Per Day	Portland Cement Concrete, T (Inches)
A = Car Parking Areas and Access Lanes	10	6
B = Entrance and Truck Service Lanes	10	6
E = Garbage or Fire Truck Lanes	5	6½

8.17.8 The PCC vehicular pavement should be placed over a minimum of 6 inches of aggregate base, per City of Oceanside, over subgrade soil both compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content. The garbage truck pad should be large enough such that all wheels are on the concrete pad during the loading operations.

8.17.9 Adequate joint spacing should be incorporated into the design and construction of the rigid pavement in accordance with the following table.

MAXIMUM JOINT SPACING

Pavement Thickness, T (Inches)	Maximum Joint Spacing (Feet)
4<T<5	10
5≤T<6	12.5
6≤T	15

8.17.10 The rigid pavement should also be designed and constructed incorporating the following parameters.

ADDITIONAL RIGID PAVEMENT RECOMMENDATIONS

Subject	Value
Thickened Edge	1.2 Times Slab Thickness Adjacent to Structures
	1.5 Times Slab Thickness Adjacent to Soil
	Minimum Increase of 2 Inches
	4 Feet Wide
Crack Control Joint Depth	Early Entry Sawn = T/6 to T/5, 1.25 Inch Minimum
	Conventional (Tooled or Conventional Sawing) = T/4 to T/3
Crack Control Joint Width	¼-Inch for Sealed Joints and Per Sealer Manufacturer's Recommendations
	$^{1}/_{16}$- to $^{1}/_{4}$-Inch is Common for Unsealed Joints

8.17.11 Reinforcing steel will not be necessary within the concrete for geotechnical purposes with the possible exception of dowels at construction joints as discussed herein.

8.17.12 To control the location and spread of concrete shrinkage cracks, crack-control joints (weakened plane joints) should be included in the design of the concrete pavement slab. Crack-control joints should be sealed with an appropriate sealant to prevent the migration of water through the control joint to the subgrade materials. The depth of the crack-control joints should be in accordance with the referenced ACI guide.

8.17.13 To provide load transfer between adjacent pavement slab sections, a butt-type construction joint should be constructed. The butt-type joint should be thickened by at least 20 percent at the edge and taper back at least 4 feet from the face of the slab.

8.17.14 Concrete curb/gutter should be placed on soil subgrade compacted to a dry density of at least 90 percent of the laboratory maximum dry density near to slightly above optimum moisture content. Cross-gutters that receive vehicular traffic should be placed on a minimum of 6 inches of Class II Base, unless the subgrade soils have an expansion index of 20 or less, per City of Oceanside, over subgrade soil both compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content. Where flatwork is located directly adjacent to the curb/gutter, the concrete flatwork should be structurally connected to the curbs to help reduce the potential for offsets between the curbs and the flatwork.

8.18 Site Drainage and Moisture Protection

8.18.1 Adequate site drainage is critical to reduce the potential for differential soil movement, erosion and subsurface seepage. Under no circumstances should water be allowed to pond adjacent to footings. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2022 CBC 1804.4 or other applicable standards. In addition, surface drainage should be directed away from the top of slopes into swales or other controlled drainage devices. Roof and pavement drainage should be directed into conduits that carry runoff away from the proposed structure.

8.18.2 We understand a storm drain vault will be constructed underneath the western parking lot. We expect that up to 20 feet of compressible material may be left in place underneath the storm drain vault if remedial grading measures or ground improvements are not performed. The amount of settlement that could occur is a function of how thick the layer is, how compressible the layer is and the magnitude of the new vertical load (weight of new fill or vault loads). Based on laboratory test results and engineering analyses, we estimate theoretical maximum settlements of up to 1½ inches and 3½ inches and the following table presents the settlement values of the vault. As previously discussed, these settlements can be mitigated with remedial grading (excavating the landslide debris to expose the underlying formational materials and placing compacted fill) or ground improvements (soil mixing or rammed aggregate piers).

STORM VAULT SETTLEMENTS

Vault Location	Settlement (Inches)
Northeast & Northwest Corners	3½
Southeast Corner	2
Southwest Corner	1½

8.18.3 In the case of basement walls or building walls retaining landscaping areas, a water-proofing system should be used on the wall and joints, and a Miradrain drainage panel (or similar) should be placed over the waterproofing. The project architect or civil engineer should provide detailed specifications on the plans for all waterproofing and drainage.

8.18.4 Underground utilities should be leak free. Utility and irrigation lines should be checked periodically for leaks and detected leaks should be repaired promptly. Detrimental soil movement could occur if water is allowed to infiltrate the soil for prolonged periods of time.

8.18.5 Landscaping planters adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement's subgrade and base course. Area drains to collect excess irrigation water and transmit it to drainage structures or impervious above-grade planter boxes can be used. In addition, where landscaping is planned adjacent to the pavement, construction of a cutoff wall along the edge of the pavement that extends at least 6 inches below the bottom of the base material should be considered.

8.18.6 We should prepare a storm water infiltration feasibility report of storm water management devices are planned.

8.19 Grading and Foundation Plan Review

8.19.1 Geocon Incorporated should review the grading and building foundation plans for the project prior to final design submittal to evaluate if additional analyses and/or recommendations are required.

8.20 Testing and Observation Services During Construction

8.20.1 Geocon Incorporated should provide geotechnical testing and observation services during the grading operations, foundation construction, utility installation, retaining wall backfill and pavement installation. The following table presents the typical geotechnical observations we would expect for the proposed improvements.

EXPECTED GEOTECHNICAL TESTING AND OBSERVATION SERVICES

Construction Phase	Observations	Expected Time Frame
Ground Modification	Installation	Full Time (Including Confirmation Logging of Select Drilled Shafts)
Grading	Base of Removal	Part Time During Removals
	Geologic Logging	Part Time to Full Time
	Fill Placement and Soil Compaction	Full Time
Foundations	Foundation Excavation Observations	Full Time
Shear Pins	Drilling Operations for Pins	Full Time
Utility Backfill	Fill Placement and Soil Compaction	Part Time to Full Time
Retaining Wall Backfill	Fill Placement and Soil Compaction	Part Time to Full Time
Subgrade for Sidewalks, Curb/Gutter and Pavement	Soil Compaction	Part Time
Pavement Construction	Base Placement and Compaction	Part Time
	Asphalt Concrete Placement and Compaction	Full Time

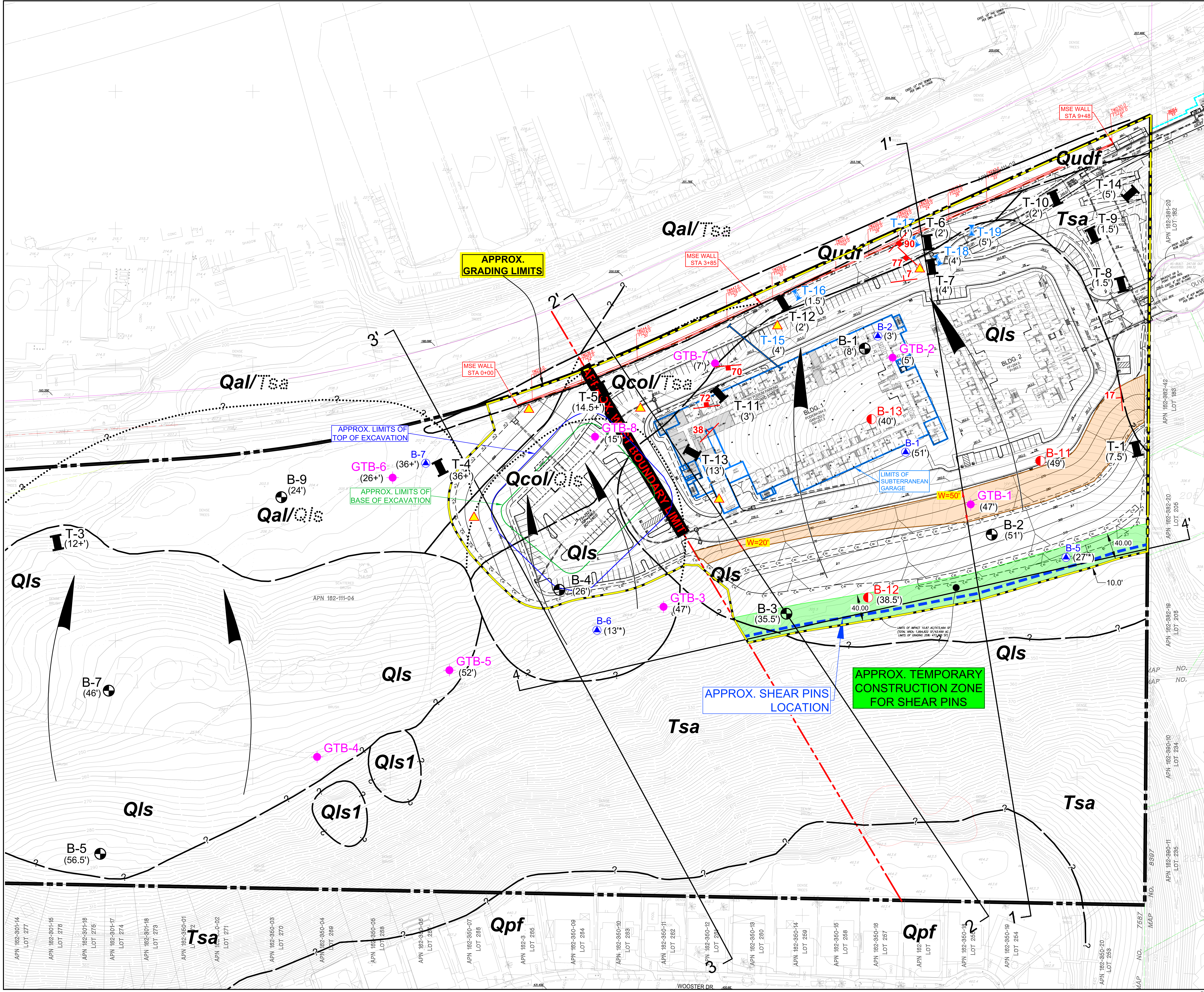
LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

2. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon Incorporated should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon Incorporated.

3. This report is issued with the understanding that it is the responsibility of the owner or his representative to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

4. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. 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 should not be relied upon after a period of three years.



B-1	
@5'	S:N59W/14NE
@13'	C:N38W/8SW
@22'	B:N16E/5SE

B-2	
@19'	S:N29E/6NW
@21'	B:N42W/5NE
@32'	B:N16W/6NE
@48'	S:N56W/12SW
@63'	C:N22E/7SE
@69.5'	S:N41W/11SW
@70.5'	S:N13W/15SW

B-3	
@19'	C:N64W/3NE
@20'	B:N7E/4NW
@32'	C:N75E/6NW
@34'	F:N54W/32SW
@35.5'	C:N29W/5NE
@35.5'	S:N68W/3NE
@56'	B:N10E/8SE
@70.5'	C:N18W/8SW

B-4	
@7'	B:N70E/22NW
@13'	S:N51E/36NW
@15.5'	C:N29E/16NW
@24'	S:N59W/14NE
@41.5'	C:N44W/6SW

B-5	
@47.5'	B:N81W/44SW
@55'	B:N81W/17SW
@56'	S:N11W/4NE
@65'	B:N17E/4NW

B-6	
@9.5'	C:N14W/46NE
@19'	B:N28E/38SE

B-7	
@ 7'	B:N56W/40SW
@17.5'	B:N85E/27NW
@21.5'	C:N83E/21SE
@45'	S:N46W/4NE

B-8	
@35'	B:N4E/53NW

GEOCON LEGEND

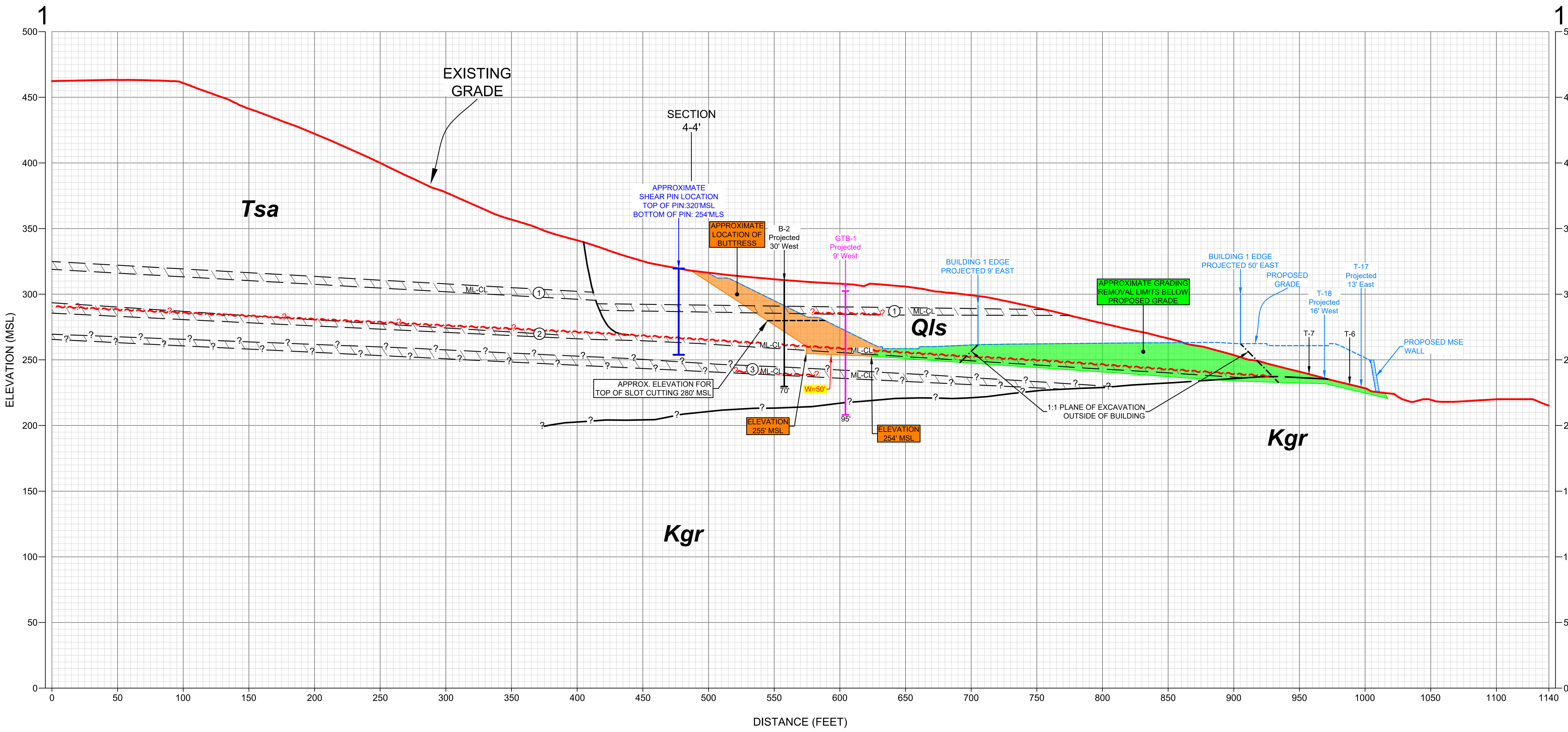
- Qudf ........UNDOCUMENTED FILL
- Qpf ....PREVIOUSLY PLACED FILL
- Qal ....ALLUVIUM
- Qls ....LANDSLIDE DEBRIS (Dotted Where Buried; Queried Where Uncertain)
- Tsa ....SANTIAGO FORMATION (Dotted Where Buried)
- Kgr ....GRANITIC ROCK (Dotted Where Buried)
- B-7 ....APPROX. LOCATION OF BORING (Geocon, 1985)
- GTB-8 ....APPROX. LOCATION OF BORING (GeoTek, 2007)
- B-10 ....APPROX. LOCATION OF EXPLORATORY BORINGS (Geocon, 2005)
- B-13 ....APPROX. LOCATION OF BORINGS (Geocon, 2024)
- T-15 ....APPROX. LOCATION OF TRENCHES (Geocon, 2024)
- T-14 ....APPROX. LOCATION OF EXPLORATORY TRENCHES (Geocon, 2005)
- (56.5) ....APPROX. DEPTH TO FORMATIONAL MATERIAL (In Feet)
- (28.5*) ....APPROX. DEPTH TO FORMATION MAY BE INACCURATE (In Feet)
- 77 ....APPROX. ORIENTATION OF GEOLOGIC STRUCTURE
- 38 ....APPROX. ORIENTATION OF CONTACT BETWEEN GEOLOGIC UNITS
- ....APPROX. LOCATION OF PROPOSED SETTLEMENT MONUMENTS
- ....APPROX. LOCATION OF PROPOSED SHEAR PINS
- 4 4' ....APPROX. LOCATION OF GEOLOGIC CROSS SECTION
- W=35' ....APPROX. WIDTH OF BUTTRESS KEY (In Feet)
- ? ....APPROX. LOCATION OF GEOLOGIC CONTACT (Dotted Where Buried; Queried Where Uncertain)
- ....APPROX. LOCATION OF BUTTRESS KEY WIDTH

GEOLOGIC MAP

OLIVE PARK APARTMENTS
OCEANSIDE, CALIFORNIA

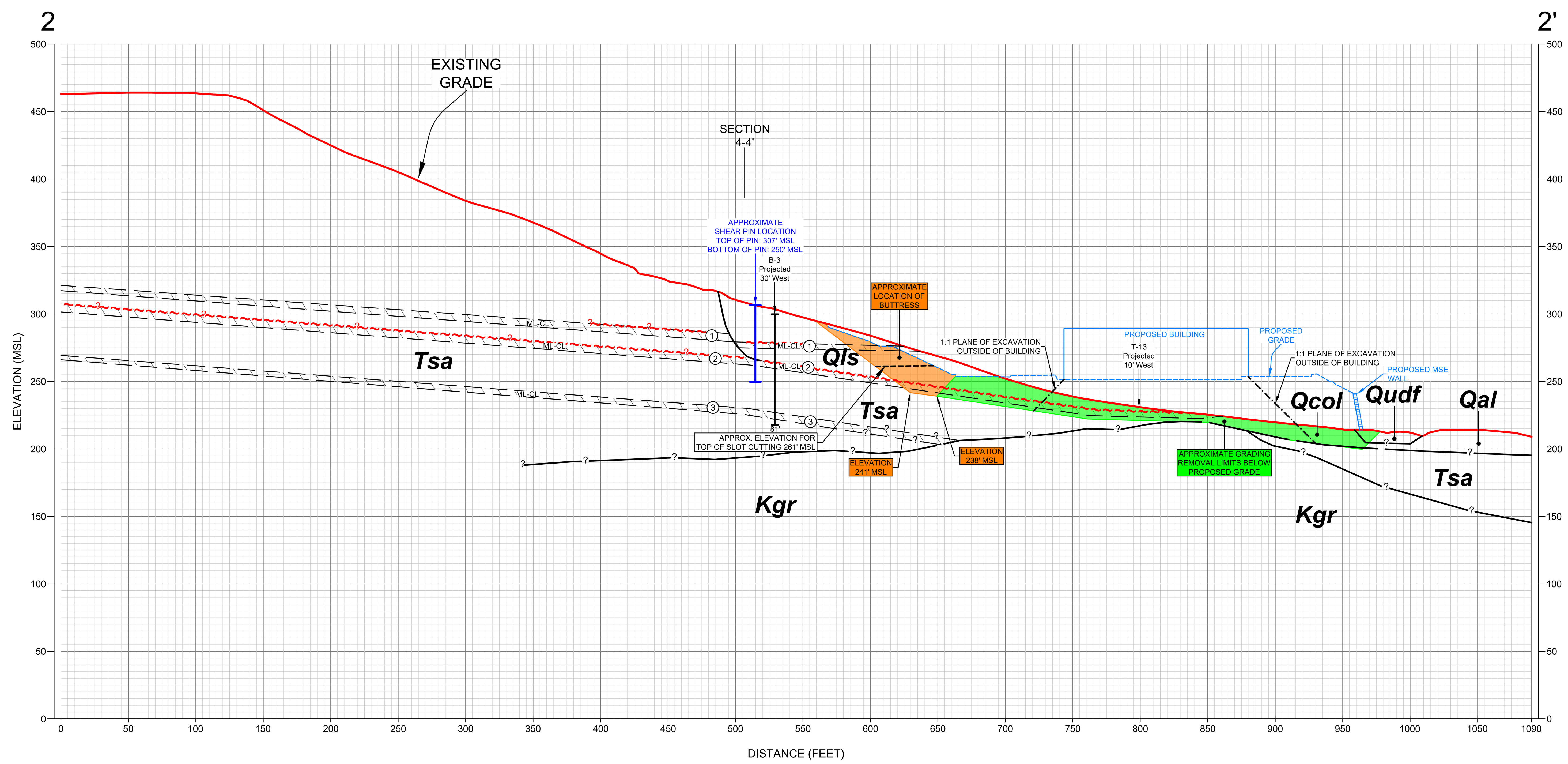
GEOCON INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

SCALE	1" = 50'	DATE	08 - 13 - 2024
PROJECT NO.	G3035 - 52 - 01	FIGURE	1
SHEET	1 OF 1		



GEOLOGIC CROSS-SECTION 1-1'

SCALE: 1" = 50' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION 2-2'

SCALE: 1" = 50' (Vert. = Horiz.)

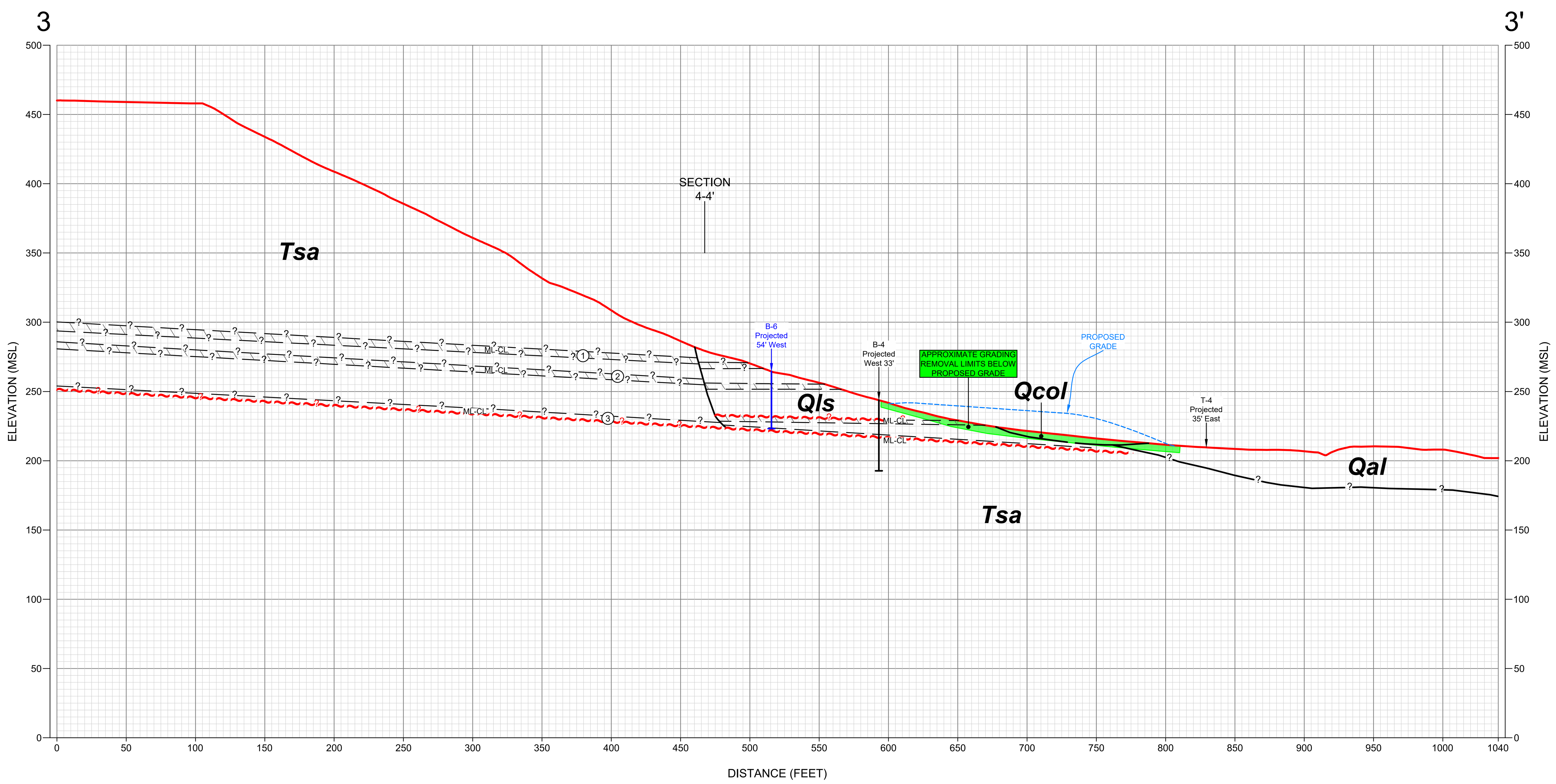
GEOCON LEGEND

- **Qudf** ........UNDOCUMENTED FILL
- **Qal** ....ALLUVIUM
- **Qls** ....LANDSLIDE DEBRIS
- **Qcol** ....COLLUVIUM
- **Tsa** ....SANTIAGO FORMATION
- **Kgr** ....GRANITIC ROCK
- ....APPROX. LOCATION OF GEOLOGIC CONTACT (Queried Where Uncertain)
- ....APPROX. LOCATION OF SILTSTONE/CLAYSTONE (Queried Where Uncertain)
- ....APPROX. LOCATION OF BEDDING PLANE SHEAR (BPS) (Queried Where Uncertain)
- B-5 ....APPROX. LOCATION OF BORING (Geocon, 1985)
- GTB-8 ....APPROX. LOCATION OF BORING (GeoTek, 2007)
- B-4 ....APPROX. LOCATION OF EXPLORATORY BORINGS (Geocon, 2005)
- B-12 ....APPROX. LOCATION OF BORINGS (Geocon, 2024)

GEOLOGIC CROSS - SECTIONS

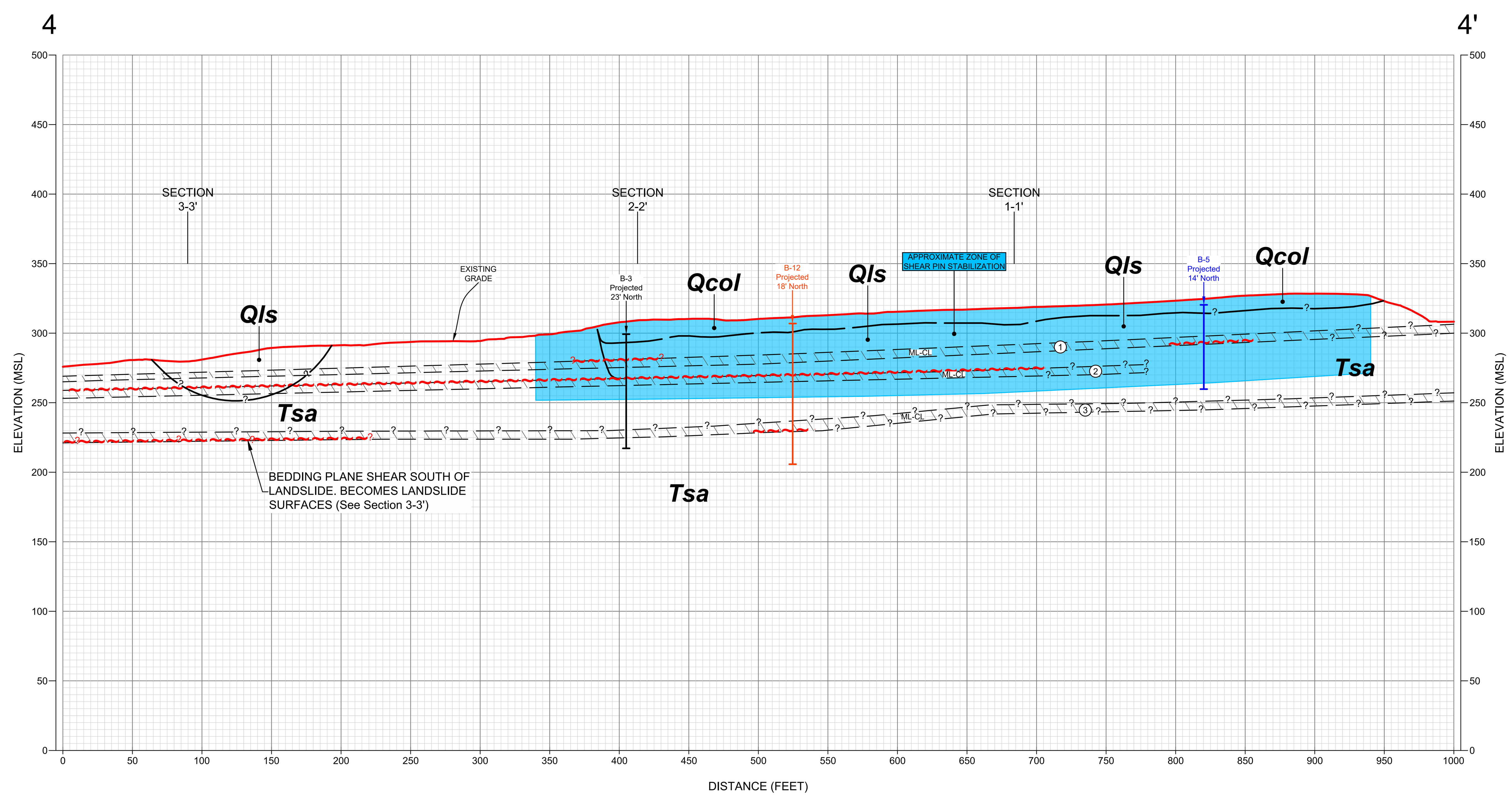
OLIVE PARK APARTMENTS
OCEANSIDE, CALIFORNIA

GEOCON INCORPORATED	SCALE 1" = 50'	DATE 08 - 13 - 2024
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS	PROJECT NO. G3035 - 52 - 01	FIGURE 2
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974 PHONE 858 558-6900 - FAX 858 558-6159	SHEET 1 OF 2	



GEOLOGIC CROSS-SECTION 3-3'

SCALE: 1" = 50' (Vert. = Horiz.)



GEOLOGIC CROSS-SECTION 4-4'

SCALE: 1" = 50' (Vert. = Horiz.)

GEOCON LEGEND

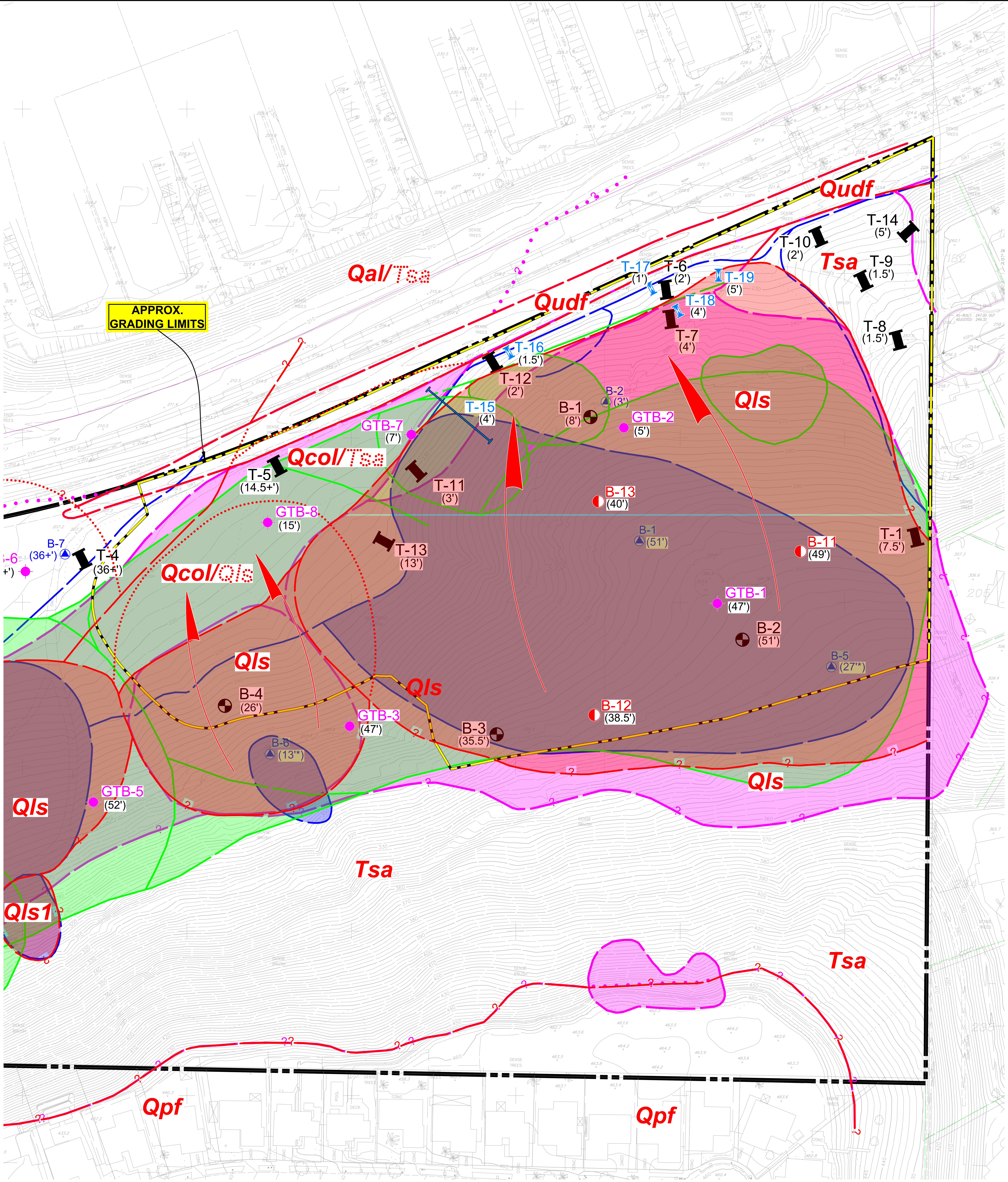
- **Qudf** ........UNDOCUMENTED FILL
- **Qal** ....ALLUVIUM
- **Qls** ....LANDSLIDE DEBRIS
- **Qcol** ....COLLUVIUM
- **Tsa** ....SANTIAGO FORMATION
- **Kgr** ....GRANITIC ROCK
- ....APPROX. LOCATION OF GEOLOGIC CONTACT (Queried Where Uncertain)
- ....APPROX. LOCATION OF SILTSTONE/CLAYSTONE (Queried Where Uncertain)
- ....APPROX. LOCATION OF BEDDING PLANE SHEAR (BPS) (Queried Where Uncertain)
- B-5 ....APPROX. LOCATION OF BORING (Geocon, 1985)
- GTB-8 ....APPROX. LOCATION OF BORING (GeoTek, 2007)
- B-4 ....APPROX. LOCATION OF EXPLORATORY BORINGS (Geocon, 2005)
- B-12 ....APPROX. LOCATION OF BORINGS (Geocon, 2024)

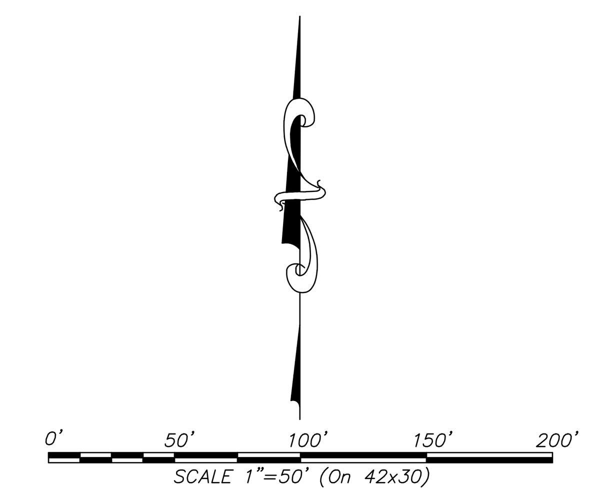
GEOLOGIC CROSS - SECTION

OLIVE PARK APARTMENTS\
OCEANSIDE, CALIFORNIA

GEOCON
INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

SCALE 1" = 50'	DATE 08 - 13 - 2024
PROJECT NO. G3035 - 52 - 01	FIGURE 3
SHEET 2 OF 2	





GEOCON LEGEND

Qudf	........UNDOCUMENTED FILL
Qpf	........PREVIOUSLY PLACED FILL
Qal	........ALLUVIUM
Qls	........LANDSLIDE DEBRIS (Dotted Where Buried; Queried Where Uncertain)
Tsa	........SANTIAGO FORMATION (Dotted Where Buried)
Kgr	........GRANITIC ROCK (Dotted Where Buried)
B-7	........APPROX. LOCATION OF BORING (Geocon, 1985)
GTB-8	........APPROX. LOCATION OF BORING (GeoTek, 2007)
B-10	........APPROX. LOCATION OF EXPLORATORY BORINGS (Geocon, 2005)
B-13	........APPROX. LOCATION OF BORINGS (Geocon, 2024)
T-15	........APPROX. LOCATION OF TRENCHES (Geocon, 2024)
T-14	........APPROX. LOCATION OF EXPLORATORY TRENCHES (Geocon, 2005)
(56.5)	........APPROX. DEPTH TO FORMATIONAL MATERIAL (In Feet)
(28.5*)	........APPROX. DEPTH TO FORMATION MAY BE INACCURATE (In Feet)
77	........APPROX. ORIENTATION OF GEOLOGIC STRUCTURE
38	........APPROX. ORIENTATION OF CONTACT BETWEEN GEOLOGIC UNITS
	........APPROX. LOCATION OF PROPOSED SETTLEMENT MONUMENTS
	........APPROX. LOCATION OF PROPOSED SHEAR PINS
4 4'	........APPROX. LOCATION OF GEOLOGIC CROSS SECTION
W=35'	........APPROX. WIDTH OF BUTTRESS KEY (In Feet)
?	........APPROX. LOCATION OF GEOLOGIC CONTACT (Dotted Where Buried; Queried Where Uncertain)
	........APPROX. LOCATION OF BUTTRESS KEY WIDTH
	........LANDSLIDE INFO FROM 1985 - Geocon
	........LANDSLIDE INFO FROM 2005/03-2024 - Geocon
	........LANDSLIDE INFO FROM 2007 - Geotek
	........LANDSLIDE INFO FROM 08-2024 - Geocon

GEOLOGIC MAP

OLIVE PARK APARTMENTS
OCEANSIDE, CALIFORNIA

GEOCON INCORPORATED
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

SCALE 1" = 50'	DATE 08 - 13 - 2024	FIGURE 4
PROJECT NO. G3035 - 52 - 01		
SHEET 1 OF 1		

Plotted:10/21/2024 12:46PM | By:ALVIN LADRILLONO | File Location:Y:\PROJECTS\G3035-52-01 Oceanside Trolley Place\SHEETS\G3035-52-01 GeoMap-LandslideLimitsExhibit.dwg

APPENDIX A

APPENDIX A
FIELD INVESTIGATION

Geocon has performed several historical field investigations at the site. Our investigations were performed in June, 1985, and included excavation of 6 large diameter borings and 2 small diameter borings, Between May 9 and May 25, 2005, and included 10 exploratory borings and 14 exploratory trenches and July 11 through July 13, 2024 that consisted of the excavation of 3 exploratory borings and 5 exploratory trenches. Borings B-1 through B-8 and B-11 through B-13 were excavated to a maximum depth of approximately 100 feet with an EZ-Bore drill rig with a 30-inch-diameter bucket auger. Borings B-9 and B-10 were excavated to a maximum depth of approximately 58 feet below existing grade using a CME-75 drill rig equipped with 8-inch diameter hollow stem augers. The exploratory trenches were excavated to a maximum depth of approximately 18 feet using a JD 555 track-mounted backhoe equipped with a 24-inch wide bucket. The Geologic Map, figure 1, shows the approximate locations of the current exploratory excavations for this study. We located the borings and trenches in the field using a measuring tape and existing reference points; therefore, actual boring locations may deviate slightly. The exploratory logs are presented herein.

We obtained soil samples during our subsurface exploration in the borings using either a California sampler or a Standard Penetration Test (SPT) sampler. Both samplers are composed of steel and are driven to obtain ring samples. The California sampler has an inside diameter of 2.5 inches and an outside diameter of 3 inches. Up to 18 rings are placed inside the sampler that is 2.4 inches in diameter and 1 inch in height. The SPT sampler has an inside diameter of 1.5 inches and an outside diameter of 2 inches. We obtained ring samples at appropriate intervals, placed them in moisture-tight containers, and transported them to the laboratory for testing. We also obtained bulk samples for laboratory testing. The type of sample is noted on the exploratory boring logs.

For the small diameter borings, the sampler was driven 18 inches into the bottom of the excavations with the use of an automatic hammer and the use of A rods. The sampler is connected to the A rods and driven into the bottom of the excavation using a 140-pound hammer with a 30-inch drop. Blow counts are recorded for every 6 inches the sampler is driven. The penetration resistances shown on the boring logs are shown in terms of blows per foot. The values indicated on the boring logs are the sum of the last 12 inches of the sampler if driven 18 inches. If the sampler was not driven for 18 inches, an approximate value is calculated in term of blows per foot or the final 6-inch interval is reported. These values are not to be taken as N-values, adjustments have not been applied.

For the large diameter borings, the samplers were driven 12 inches into the bottom of the excavations with the use of a telescoping Kelly bar. The weight of the Kelly bar (3,500 lbs. maximum) drives the sampler and varies with depth. The height of drop is usually 12 inches. Blow counts are recorded for every 12 inches the sampler is driven. The penetration resistance values shown on the boring logs are shown in terms of blows per foot. These values are not to be taken as N-values; adjustments have not been applied. Elevations shown on the boring logs were determined either from a topographic map or by using a benchmark. Each excavation was backfilled unless otherwise noted.

We visually examined, classified, and logged the soil encountered in the borings in general accordance with American Society for Testing and Materials (ASTM) practice for Description and Identification of Soils (Visual-Manual Procedure D 2488). The logs depict the soil and geologic conditions observed and the depth at which samples were obtained.

BORING B 1

ELEV. (MSL.) **259'** DATE COMPLETED **05-10-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 5				SC+CL	**LANDSLIDE DEBRIS** Loose and stiff, moist, grayish brown to brownish gray, Clayey and Silty SAND and Sandy CLAY; jumbled texture; thin roots and rock fragments; pockets of clay material in sandy matrix; layer of fat sheared clay at 5 feet approximately 1/2" to 1" thick (S: N59W/14NE)			
5 – 8	B1-1 B1-6			CL	Stiff, moist, olive gray, Silty to fine Sandy CLAY; highly fractured and sheared with internal polished surfaces and iron oxide mineralization	1/12"	99.9	24.7
8 – 13	B1-2			ML	**SANTIAGO FORMATION** Hard, damp, light olive gray, Sandy to Clayey SILTSTONE; moderately to strongly indurated; few joints; overall intact and undisturbed -B: N38W/8SW	6/12"	116.4	11.6
13 – 25.5	B1-3			SM	Dense, damp, light gray, Silty, fine- to medium-grained SANDSTONE; moderately cemented; micaceous; massive bedding; intact	8/9"	129.4	7.5
					-Very dense; drilling using down-crowds			
	B1-4					8/6"	122.2	5.7
					-Strongly cemented; some cross bedding; B:N16E/5SE			
					-Very dense and very strongly cemented along basal contact -Contact irregular to dipping approximately 18º NW			
25.5 – 30					**GRANITIC ROCK** Moderately hard, damp, grayish brown to light gray, GRANITIC ROCK; fine- to coarse-grained crystalline texture; moderately weathered; high-angle jointing			

Figure A-1,
Log of Boring B 1, Page 1 of 2

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 1 ELEV. (MSL.) 259' DATE COMPLETED 05-10-2005 EQUIPMENT 30-INCH DIAMETER BUCKET AUGER	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
30	B1-5					15/6"	124.0	6.4
32								
					BORING TERMINATED AT 33 FEET No groundwater encountered Backfilled with 45 cu. ft. of bentonite and soil cuttings in alternating layers			

Figure A-1,
Log of Boring B 1, Page 2 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

BORING B 2

ELEV. (MSL.) **311'** DATE COMPLETED **05-10-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				CL	**LANDSLIDE DEBRIS** Stiff, moist, dark brown, fine, Sandy CLAY; porous; moderate topsoil development; thin roots			
4	B2-1			SC	Medium dense, moist, mottled olive, reddish and grayish brown, Clayey, fine SAND; jumbled texture; thin roots; no distinguishable bedding; scattered carbonate pods; abundant fractures, generally healed with manganese and iron oxide mineralization	2/12"	115.9	14.5
10	B2-2			SM	Medium dense, moist, gray with mottled yellowish brown, Silty, fine to medium SAND; structureless; few coarse grains and pieces of charcoal	3/12"	115.9	11.2
	B2-3				-Loose; mixed with pods of olive clay; decomposed pods of organic material; sand becomes fine to coarse grained; jumbled mixture of disturbed sand and silt beds displaying offset along randomly oriented fractures	2/12"	112.9	14.5
19	B2-4				-Encountered layers of (weathered) sheared fat, gray-green clay; undulates with scour approximately 1/2 inch thick; undulating with general orientation of S: N29E/6NW; common slickensides; probably main slip surface (potential shear surface if undercut)	3/12"	111.5	14.3
	B2-15 B2-5			CL	**SANTIAGO FORMATION** Very stiff, most, olive to greenish gray, fat CLAYSTONE; highly fractured with abundant polished and slickensided shear surfaces; manganese oxide mineralization and sheared clay between claystone fragments B: N42W/5NE			
25.5	B2-6			ML	Hard, moist, olive gray, Clayey, SILTSTONE; moderately indurated; some fractures; overall intact and undisturbed	7/12"	109.8	19.3
					-Marked increase in degree of induration; few fractures			

Figure A-2,
Log of Boring B 2, Page 1 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

BORING B 2

ELEV. (MSL.) **311'** DATE COMPLETED **05-10-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B2-7			14/12"	105.5	13.9
32		SM	Grades to dense, damp, gray to olive gray, Silty, fine-grained SANDSTONE; moderately cemented. B:N16W/6NE			
34			-Becomes white; massive at 34 feet			
35	B2-8			15/9"	126.0	7.2
40	B2-9			15/9"		
41			-Few pods of olive green, subrounded claystone with sandstone matrix			
45			-Becomes strongly cemented; common claystone pods; probably rip-up clasts			
48		CL	Abrupt contact between SANDSTONE and CLAYSTONE, C: N56W/12SW slightly undulating; sandstone is reddish brown in a layer approximately 1/2 inch thick; polished, slickensided shear surface along base of sandstone unit continuous around hole (bedding plane shear); sandstone very moist and weakly cemented within 1 foot of contact. Hard, damp, olive gray, fine-grained Sandy CLAYSTONE at 50 feet			
50	B2-10			11/12"	120.5	13.9
51		ML	Grades to hard, damp, olive gray, fine-grained Sandy SILTSTONE; moderately to strongly indurated			
53		SM	Very dense, damp, light gray to white, Silty, fine- to coarse-grained SANDSTONE; moderately to strongly cemented; massive			
55	B2-11			15/7"	123.9	8.7

Figure A-2,
Log of Boring B 2, Page 2 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 2

ELEV. (MSL.) 311' DATE COMPLETED 05-10-2005

EQUIPMENT 30-INCH DIAMETER BUCKET AUGER

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60–63				SM	-Abrupt contact between SANDSTONE and Clayey SILTSTONE at 63 feet; sandstone yellowish to reddish within 3 inches of contact C: N22E/7SE.			
63–66	B2-12			ML	Hard, damp, olive gray, Clayey SILTSTONE; strongly indurated	30/11"	122.7	11.2
66–68				CH	Hard, damp, dark reddish gray, fat CLAYSTONE; strongly indurated; polished internal surfaces			
68–70.5	B2-13			CL	Hard, damp, reddish gray, CLAYSTONE; highly fragmented and fractured; yellow clay film along polished surfaces; shearing generally high-angle and discontinuous.	30/10"	132.9	8.4
70.5–72	B2-14				-CLAYSTONE shattered to crushed within a 9-inch thick zone; becomes soft and sheared with remolded clays and polished slickensided surfaces; layer continuous around hole; S: N14W/11SW; (bedding plane shear) abundant yellowish to reddish brown iron oxide mineralization			
72–80				ML	Basal contact with very hard, damp, mottled gray and yellowish to reddish brown, Clayey SILTSTONE; strongly indurated, laminated locally; no evidence of shearing or displacement			

BORING TERMINATED AT 80 FEET
No groundwater encountered
Backfilled with 69 cu. ft. of bentonite and soil cuttings in alternating layers

Figure A-2,
Log of Boring B 2, Page 3 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 3

ELEV. (MSL.) **300'** DATE COMPLETED **05-11-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				CL	**LANDSLIDE DEBRIS** Soft to stiff, most, dark brown, fine Sandy CLAY; porous with thin roots; moderately well developed topsoil in upper foot; probably within graben zone of upper slide			
	B3-1				-Grades to clayey sand; common carbonate pods and stringers	1	116.8	13.4
8				SM	Loose, moist, light grayish brown, Clayey and Silty, fine to medium SAND with pods of olive clay; jumbled texture; chaotic and discontinuous bedding; displaced beds of silt and clay			
10	B3-2					1/12"	115.1	9.9
	B3-3				-Scattered pieces of organic material and carbon			
					-Discontinuous beds of fat claystone and siltstone displaced and dipping 28º NW			
					-Approximately 2- to 4-inch thick, partially remolded sandy clay B: N60E/50NW; scattered fragments of charcoal			
15	B3-4			SM	Loose to medium dense, light gray, Silty, fine to coarse SAND with pods of olive clay	2/12"	116.5	13.1
					-Becomes very moist and fractured; undulating contact C: N63W/3NE			
					-Basal contact of upper slide; some sheared clays and yellow-green mineralization 2 inch thick band around hole			
19	B3-5			ML	Medium dense, moist, olive gray, fine Sandy SILTSTONE; some fracturing	3/12"	117.1	14.7
22				CL	Moderately hard, moist, olive gray, Silty CLAYSTONE; internal fracturing and shearing with polished surfaces and slickensides			
25	B3-6			ML	Very stiff, moist, olive gray, Clayey SILTSTONE; fractured	3/12"	113.9	15.4
					-Discordant, undulating basal contact			
29				SM	Medium dense, light gray, fine SAND; red and yellow banding; some			

Figure A-3,
Log of Boring B 3, Page 1 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

BORING B 3

ELEV. (MSL.) 300' DATE COMPLETED 05-11-2005

EQUIPMENT 30-INCH DIAMETER BUCKET AUGER

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B3-7			SM	manganese oxide and carbonate mineralization -Medium dense to dense, moist, light gray, Silty, fine to coarse SAND; through going thin clay-filled fractures; pods of greenish clay -At 32 feet: continuous 2 to 4 inch bed of sandy siltstone B: N79E/6NW -At 33 feet: discontinuous bed of fractured gray CLAYSTONE within sandstone beds -Along contact: yellow to red mineralization; beds displaced approximately 4 inches on fracture F: N54W/32S; C: N29W/5NE; 3 inch thick layer of crushed, remolded clay with shears and slickensides S: N68W/3NE	11/12"	119.6	10.5
35.5	B3-8			CL	**SANTIAGO FORMATION** Hard, moist, olive green, fat CLAYSTONE, internally sheared with polished surfaces and manganese oxide mineralization	7/12"	106.3	20.3
39				ML	Dense, damp, olive gray, Clayey SILTSTONE; strongly indurated; intact			
40.5	B3-9			SM	Dense, damp, light olive gray, Silty, fine-grained SANDSTONE; massive and undisturbed; moderately cemented -Becomes fine- to coarse-grained	15/10"	119.0	13.0
45.5	B3-10				-Fine- to medium-grained, very light gray	15/16"	131.0	6.4
50.5	B3-11			SM	-Light gray, silty sandstone	15/9"	129.6	6.5
52					-Becomes hard and strongly cemented; difficult drilling using down-crowds			
56					-Beds with common claystone fragments B: N10E/8SE			
58								

Figure A-3, Log of Boring B 3, Page 2 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

BORING B 3

ELEV. (MSL.) **300'** DATE COMPLETED **05-11-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60	B3-12			SM	Very dense, damp, light gray, Silty, fine- to coarse-grained SANDSTONE; pods of olive claystone; overall massive and intact; moderately cemented	30/8"	112.7	6.8
62								
64								
66					-Cross bedded; fine- to medium-grained			
68					-Pods of iron oxide mineralization			
70					-Abrupt basal contact between silty sandstone and siltstone C: N18W/8SW			
	B3-13			ML	Hard, damp, olive gray, Clayey SILTSTONE; strongly indurated	28/12"	113.9	16.2
72								
74				CL	Hard, damp, dark gray with mottled dark reddish brown, Silty CLAYSTONE; moderately to strongly indurated; local, randomly oriented, polished internal surfaces with some manganese oxide mineralization; no evidence of remolding or displacement			
76								
78				ML	Hard, damp, greenish gray, Clayey SILTSTONE; strongly indurated			
80	B3-14					28/12"	114.6	15.4

BORING TERMINATED AT 80 FEET
No groundwater encountered
Backfilled with 69 cu. ft. of bentonite and soil cuttings in alternating layers

Figure A-3,
Log of Boring B 3, Page 3 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 4

ELEV. (MSL.) **243'** DATE COMPLETED **05-20-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0			**LANDSLIDE DEBRIS**			
0–7	B4-1	CL	Stiff, damp to moist, dark grayish brown, fine to medium Sandy CLAY; pods of carbonate; porous with thin roots; graben zone backfilled with colluvial material; krotovina; some small pieces of charcoal	1/12"	115.9	9.5
7–13.5	B4-2	SM	-B: N70E/22NW -Becomes jumbled mixture of sand, silt, and clay; common krotovina Loose, moist, light yellowish to olive brown, Silty, fine to medium SAND with pockets of clay and shattered claystone, fragments of sandstone; generally structureless -Common small charcoal fragments; iron oxide mineralization at 12 feet	2/12"	114.0	10.2
13.5–15.5	B4-3	SP	-Thick layer of remolded and sheared clay; some slickensides; S: N51E/36NW; basal slip surface of upper recent slide Displaced bed of fine- to medium-grained SANDSTONE approximately 2 feet thick on south side of hole and completely sheared away on north side; microfaulting and crossbedding common within sandstone bed; undulating basal contact C: N29E/16NW			
15.5–19		CL-ML	Fractured to shattered beds of very stiff, olive gray, Clayey SILTSTONE and Silty CLAYSTONE	3/12"	112.0	17.1
19–20		CH	Very stiff, moist, olive gray, fat CLAYSTONE, internally sheared with polished surfaces and slickensides			
20–24	B4-4	CL-ML	Stiff, moist, olive gray, Clayey SILTSTONE and CLAYSTONE beds; internally sheared with evidence of displacement	3/12"	110.0	18.3
24–24.5		SC				
24.5–26	B4-9 B4-5	CH	Approximately 6 to 12 inch thick bed of white SANDSTONE displaced approximately 6 inches along approximately 2 inch thick sheared and remolded clay seam S: N59W/14NE; undulating contact with iron oxide staining at base of sandstone -Base of slide debris at 26 feet within sheared and remolded fat CLAY	2/12"	108.9	17.0
26–30		ML	**SANTIAGO FORMATION** Hard, moist, olive gray, Clayey SILTSTONE; strongly indurated; weakly jointed to relatively intact; no displacement			

Figure A-4,
Log of Boring B 4, Page 1 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 4

ELEV. (MSL.) **243'** DATE COMPLETED **05-20-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B4-6			CL+ML	Hard, damp, olive gray, Silty CLAYSTONE and Clayey SILTSTONE, mottled with reddish brown; strongly indurated; few joints; gradational contact	8/12"	119.6	14.0
34				SM	Dense, moist, light olive gray, Silty, fine-grained SANDSTONE; moderately cemented; massive			
36					-Grades to fine- to coarse-grained, very light gray sandstone at 36 feet			
40	B4-7					10/10"	123.3	10.2
41					-Slightly undulating contact; iron oxide mineralization along contact C: N44W/6SW			
42				CL+ML	Hard, moist, olive gray, Clayey SILTSTONE and Silty CLAYSTONE interbeds; strongly indurated; weakly jointed with some polishing and manganese oxide along joint surfaces			
45				SM	Very dense, damp, light gray to gray, Silty, fine-grained SANDSTONE; massive and moderately to strongly cemented			
50	B4-8					10/10"	121.7	12.2

BORING TERMINATED AT 51 FEET
No groundwater encountered
Backfilled with soil cuttings and 55 cu. ft. of bentonite in alternating layers

Figure A-4,
Log of Boring B 4, Page 2 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 5

ELEV. (MSL.) **287'** DATE COMPLETED **05-24-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**LANDSLIDE DEBRIS**			
					Loose, moist, dark brown, Clayey, fine to medium SAND; thin roots; carbonate pods and stringers			
2				SC				
4					Loose, moist, light brown to light olive brown, Silty, fine to medium SAND; porous; common krotovina; generally structureless; few gravel and charcoal			
6	B5-1					2/12"	108.5	6.4
8					-Common thin, clay-filled fractures			
10	B5-2					1/12"		
12								
14								
16	B5-3			SM		1/12"	93.4	9.1
18					-Relict structure in disturbed sand beds B: N86E/23SE; some sandstone and claystone fragments in matrix of silty fine sand			
20	B5-4					1/12"	97.8	8.0
22								
24								
26	B5-5					1/12"	99.1	9.0
28					-Minor caving; hole belled to 48-inch diameter; increase in sandstone and claystone fragments			

Figure A-5,
Log of Boring B 5, Page 1 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 5

ELEV. (MSL.) 287' DATE COMPLETED 05-24-2005

EQUIPMENT 30-INCH DIAMETER BUCKET AUGER

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B5-6					3/12"	101.4	7.7
32					-Mottled yellowish brown to light gray; abundant thin fractures backfilled with carbonate and clay; highly disturbed bedding with random and discontinuous orientations; some relatively intact blocks of sandstone and claystone generally less than 6-inch diameter			
34								
36	B5-7					3/12"	99.0	9.1
38								
40	B5-8					4/12"	108.8	10.8
42								
44				SM	-Displaced sheared and elongated beds of siltstone and claystone off set along abundant thin fractures; dip approximately 65º S; overall chaotic structure			
46	B5-9					6/12"	116.1	13.6
48					-Displaced bed of sandstone B: N81W/44SW			
					-Becomes increasingly moist; medium dense; and light gray to grayish brown			
50	B5-10				-Twisted and rotated block of light gray sandstone in matrix of yellowish brown sand; block approximately 2 foot diameter and containing stratification oriented nearly vertical	6/12"	108.9	14.0
52								
54								
	B5-11				-Sheared and elongated bed of yellowish brown sandy silt; very moist; B: N81W/17SW; bed thinned from 6 inches to 1 inch from north to south at 55 feet	12/12"	112.1	17.7
56	B5-16			CH				
				CL	BASAL SLIP SURFACE; approximately 3 inch thick layer of remolded and sheared fat gray CLAY with abundant polished slickensided surfaces; very well defined; S: N11W/4NE			
58				ML	**SANTIAGO FORMATION** Hard, moist, dark olive gray, Silty CLAYSTONE; strongly indurated; some sheared and polished internal surfaces; randomly oriented			

Figure A-5,
Log of Boring B 5, Page 2 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 5

ELEV. (MSL.) 287' DATE COMPLETED 05-24-2005

EQUIPMENT 30-INCH DIAMETER BUCKET AUGER

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60	B5-12			ML	Hard, damp, olive gray, Clayey to Sandy SILTSTONE; strongly indurated; intact and well-bedded; no indications of shearing or offset	12/10"	113.1	16.8
62				SM	Dense, moist, light olive gray, Silty, fine-grained SANDSTONE; moderately cemented			
64	B5-13			ML	Hard, moist, olive gray, Clayey SILTSTONE; strongly indurated B: N17E/4NW	7/12"	113.9	15.7
66								
68				SM+ML	Becomes interbedded Sandy SILTSTONE and Silty SANDSTONE; moderately cemented; generally well-bedded and intact; beds 1 to 2 feet thick; few interbeds of strongly indurated claystone			
70	B5-14					15/10"	125.3	11.5
72								
74								
76								
78								
80	B5-15			CL	Hard, moist, dark olive gray, Silty CLAYSTONE; strongly indurated; no evidence of shearing	25/10"	112.7	15.5

BORING TERMINATED AT 81 FEET
No groundwater encountered
Backfilled with alternating layers of soil cuttings and 69 cu. ft. of bentonite

Figure A-5,
Log of Boring B 5, Page 3 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

PROJECT NO. 07227-52-02

BORING B 6

ELEV. (MSL.) **223'** DATE COMPLETED **05-23-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 4			SC	**LANDSLIDE DEBRIS** Loose, moist, dark brown, Clayey, fine to medium SAND; thin roots and pods to stringers of carbonate; porous; moderate topsoil development			
4 – 6.5	B6-1		SM-ML	Loose, moist, grayish brown, Silty, fine SAND to Sandy SILT; abundant carbonate-filled fractures; porous; few pieces of charcoal	2/12"	115.9	9.8
6.5 – 9.5			SM	Loose, moist, light gray, Silty, fine to coarse SAND and SANDSTONE fragments; some elongated and sheared beds of claystone; high-angle dip			
9.5 – 22	B6-2		CL-ML	Displaced contact between SAND unit and SILT/CLAY units; displaced along series of stepped fractures; approximately 4 feet of vertical displacement; C: N14W/46NE; fractures high-angle to near vertical; thin bed of sheared, elongated claystone underlying contact	3/12"	106.4	5.4
				-Becomes displaced beds of olive gray sandy to clayey siltstone with abundant fractures			
	B6-3			-Siltstone fragments in a matrix of sheared and crushed clay and silt	4/12"	119.7	13.2
				-Chaotic mixture of crushed siltstone, sandstone, and claystone fragments; generally structureless at 18 feet -Beds of claystone and sandstone displaced along high-angle fractures; vertical offset approximately 2 1/2 feet B: N28E/38SE; material crushed and rubbly on downthrown blocks			
	B6-4				2/12"	112.1	14.7
22 – 30		▼ (24 ft)	SM	Becomes loose, moist, light gray to white, Silty, fine to coarse SAND; some claystone fragments; disturbed sandstone beds offset by significant fractures; groundwater at 24 feet; hole belled and caving Loose, moist to wet, olive gray, Silty, fine to medium SAND			
	B6-5				2/12"	114.9	13.4
				-Unable to proceed down-hole logging deeper than 24 feet due to groundwater table and caving			

Figure A-6,
Log of Boring B 6, Page 1 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 6

ELEV. (MSL.) **223'** DATE COMPLETED **05-23-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B6-6			SM		7/12"	117.9	14.8
32					BORING TERMINATED AT 32 FEET Groundwater encountered at 24 feet Backfilled with alternating layers of soil cuttings and 45 cu. ft. of bentonite			

Figure A-6,
Log of Boring B 6, Page 2 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

BORING B 7

ELEV. (MSL.) **241'** DATE COMPLETED **05-20-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0		SM-ML	**LANDSLIDE DEBRIS** Loose, damp, dark brown, Clayey, fine to medium SAND; weakly developed topsoil in upper 9 inches; porous with thin roots -Loose, damp, light gray, silty, fine to medium SAND to Sandy SILT; common carbonate stringers and krotovina; some fragments of sandstone and claystone			
6	B7-1		-Common blocks of shattered claystone and sandstone in a matrix of sand and silt; few void spaces at 6 feet -Highly displaced and tilted bed of shattered claystone B: N56W/40SW; internal stratification	2/12"	109.6	13.4
8		SM	Loose, damp, light gray, Silty, fine SAND; generally structureless; common thin, high-angle fractures; scattered fragments of claystone			
10	B7-2			2/12"	102.8	9.4
12			-Tilted and displaced block of silty sandstone with beds generally dipping toward the north at relatively high angles; common fractures			
15	B7-3		-Broken block of cemented sandstone; fragments displaced approximately 2 feet -No sample recovery in layer of strongly cemented sandstone fragments at 15 feet -Elongated and highly disturbed bed of sheared claystone B: N85E/27NW at 17.5 feet -Loose, moist, light gray, fine to coarse SAND with fragments of claystone and sandstone; generally disturbed and structureless	5/12"		
20	B7-4		-Block of white sandstone displaced approximately 1.5 feet to the south along fractures at 20 feet -Undulating contact C: N83E/21SE at 21.5 feet	3/12"	103.3	3.7
22		SC+CL	Fractured and sheared beds of Silty CLAYSTONE in a matrix of sand and clay -Chaotic mixture of sheared and displaced sandstone and claystone beds; common iron oxide mineralization infilling fractures and between blocks			
25	B7-5			2/12"	111.5	16.8
27			Becomes more intact; disturbed beds of Clayey SILTSTONE and Silty CLAYSTONE			

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28

Column headings also include: LITHOLOGY, GROUNDWATER

Figure A-7,
Log of Boring B 7, Page 1 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 7

ELEV. (MSL.) **241'** DATE COMPLETED **05-20-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B7-6			ML+CL	-Approximately 6 inch thick bed of loose sand and sandstone fragments; undulating and irregular contact	3/12"	107.5	19.8
32				CL	Disturbed and sheared beds of Silty CLAYSTONE; polished surfaces and slickensides; manganese and iron oxide mineralization			
35	B7-7					3/12"	109.4	17.2
40	B7-8				-Stiff, moist, olive gray, silty claystone beds; disturbed and sheared -Becomes wet and shattered to crushed; pods of carbonate; abundant remolded and polished surfaces; dark gray and fat	3/12"	100.9	22.9
44			▼		-Water seeping from abundant fractures			
45	B7-9 B7-12					6/12"	109.3	19.6
45.5				CH	Abrupt and very well defined slip surface S: N46W/4NE; slightly undulating approximately 3 inch thick seam in highly remolded, polished and slickensided fat CLAY; base of slide debris at approximately 46 feet; slip surface within beds of fat claystone			
46				SM-ML	**SANTIAGO FORMATION** Dense, damp, light olive gray, Silty, fine-grained SANDSTONE to fine-grained Sandy SILTSTONE; moderately cemented; some minor water seeping from thin fractures			
50	B7-10					10/10"	121.3	12.4
52				SM	Dense, moist to wet, light gray, Silty, fine- to medium-grained SANDSTONE; massive; moderately cemented; relatively intact and undisturbed			
57					-Grades fine- to coarse-grained			

Figure A-7,
Log of Boring B 7, Page 2 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

BORING B 7

ELEV. (MSL.) **241'** DATE COMPLETED **05-20-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60	B7-11					20/6"	119.0	9.1
					BORING TERMINATED AT 60.5 FEET Seepage encountered at 44 feet Backfilled with alternating layers of soil cuttings and 60 cu. ft. of bentonite			

Figure A-7,
Log of Boring B 7, Page 3 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 8

ELEV. (MSL.) **234'** DATE COMPLETED **05-24-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B8-1				**LANDSLIDE DEBRIS** Loose, moist, dark brown, Clayey, fine to medium SAND; porous with thin roots			
2								
4								
6				SC	-Abundant carbonate pods and stringers; medium dense; probably colluvium-infilled graben zone of slide			
8								
10					-Common roots; loose and porous			
12					Loose, moist, light grayish brown, Silty, fine to medium SAND; mottled with dark gray; common krotovina; porous			
14								
16					-Scattered fragments of sandstone and claystone; few pieces of charcoal			
18								
20				SM+CL				
22								
24					-Jumbled texture; thin clay-filled fractured; scattered blocks of sandstone and claystone generally less than 6-inch diameter, continued pieces of charcoal; yellowish brown to light olive gray			
26								
28								

Figure A-8,
Log of Boring B 8, Page 1 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 8

ELEV. (MSL.) **234'** DATE COMPLETED **05-24-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30 – 39				SM	-Displaced sandstone beds; highly fractured to shattered; elongated layer of carbon-rich material along bedding surface B: N4E/53NW -Becomes light gray			
39 – 49			▼ (45)	SM+SC	Becomes jumbled mixture of Sandstone and Claystone fragments in a matrix of Silty SAND; carbonate pods; pieces of charcoal; few shattered sandstone blocks; structureless; wet -Hole completely caved to 44 feet; abundant seepage; unable to continue down-hole logging			
49 – 54				CL+SM	Mixture of olive gray clay and Claystone fragments in a matrix of SAND and SANDSTONE fragments; sheared and remolded clay seams			

BORING TERMINATED AT 54 FEET
Seepage encountered at 45 feet
Caving 44 to 54 feet
Backfilled with 54 cu. ft. of bentonite and soil cuttings in alternating layers

Figure A-8,
Log of Boring B 8, Page 2 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 9

ELEV. (MSL.) 202' DATE COMPLETED 05-25-2005

EQUIPMENT CME 75 WITH 8" HOLLOW STEM AUGER BY: N. ASH

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ALLUVIUM** Very stiff, moist, dark brown, fine, Sandy CLAY; porous with thin roots and scattered pieces of organic material; interlayers of medium dense, moist, gray, clayey, fine sand			
3	B9-2			CL+SC				
5	B9-1					19	102.5	22.3
9					Medium dense, moist, brownish gray, Clayey, fine to medium SAND; porous, scattered pockets of clay			
10	B9-3			SC		10		
13			▼		-Encountered groundwater table at 13 feet			
13					**LANDSLIDE DEBRIS** Loose, saturated, olive gray, Silty, fine to coarse SAND; jumbled texture			
15	B9-4			SM		11	106.5	19.6
20	B9-5					7		
24					**SANTIAGO FORMATION** Dense, wet, light gray, Silty, fine- to coarse-grained SANDSTONE; weakly cemented			
25	B9-6			SM		30		

Figure A-9,
Log of Boring B 9, Page 1 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 9

ELEV. (MSL.) **202'** DATE COMPLETED **05-25-2005**

EQUIPMENT **CME 75 WITH 8" HOLLOW STEM AUGER** BY: **N. ASH**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B9-7			ML	Hard, moist, light gray to olive gray, fine-grained Sandy to Clayey SILTSTONE; scattered iron oxide staining	59	98.9	23.4
34				SM+SC	Medium dense to dense, wet, light olive gray, Clayey and Silty, fine to coarse SAND			
	B9-8					43	107.6	20.6
38				ML	Hard, moist, olive to olive gray, fine-grained Sandy SILTSTONE; weakly indurated			
40	B9-9					31		
44				CL-SC	Dense to hard, moist, olive to greenish gray, fine-grained Sandy CLAYSTONE to Clayey SANDSTONE; weakly indurated and cemented			
	B9-10					42	100.5	23.9
50	B9-11					28		
52				ML	Hard, moist, olive gray, Clayey SILTSTONE; strongly indurated			
	B9-12					50/5"	111.3	16.6
					GRANITIC ROCK Hard, moist, gray, GRANITIC ROCK; moderately weathered; fine- to coarse-grained crystalline texture			
58	B9-13				-No recovery at 58 feet -Refusal at 58.5 feet	50/1"		

Figure A-9,
Log of Boring B 9, Page 2 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**BORING B 9** ELEV. (MSL.) **202'** DATE COMPLETED **05-25-2005** EQUIPMENT **CME 75 WITH 8" HOLLOW STEM AUGER** BY: **N. ASH**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
					BORING TERMINATED AT 58.5 FEET Groundwater encountered at 13 feet Backfilled with 20.5 cu. ft. of bentonite slurry			

Figure A-9,
Log of Boring B 9, Page 3 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

BORING B 10

ELEV. (MSL.) 198' DATE COMPLETED 05-25-2005

EQUIPMENT CME 75 WITH 8" HOLLOW STEM AUGER BY: N. ASH

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B10-1			SM+SC	**ALLUVIUM** Loose, moist, dark brown, Clayey and Silty, fine to medium SAND; porous with thin roots			
5	B10-2				-Wet	10	100.6	21.9
8				SC	Medium dense, moist, dark brown to mottled grayish brown, Clayey, fine to medium SAND; some carbonate pods; porous			
10	B10-3					18	104.0	20.3
15	B10-4		▼		-Encountered groundwater at 15 feet			
15.5				SM	**LANDSLIDE DEBRIS** Loose to medium dense, wet, olive gray, Silty, fine to medium SAND; pods of carbonate	15	104.5	21.9
19.5					-Loose to medium dense, saturated, fine- to coarse-grained			
20	B10-5					32		
21.5				SM	Dense, moist, light gray, Silty, fine- to medium-grained SANDSTONE; carbonate-filled fractures			
23				SM-ML	**SANTIAGO FORMATION** Dense, moist, light olive gray, Silty, fine-grained SANDSTONE to fine-grained Sandy SILTSTONE; moderately cemented			
25	B10-6					74/11"	114.2	15.3

Figure A-10,
Log of Boring B 10, Page 1 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	▼ ... WATER TABLE OR ▽ ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 10

ELEV. (MSL.) **198'** DATE COMPLETED **05-25-2005**

EQUIPMENT **CME 75 WITH 8" HOLLOW STEM AUGER** BY: **N. ASH**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B10-7				Dense, moist, light gray, Silty, fine- to coarse-grained SANDSTONE; weakly cemented; slightly micaceous	74		
32								
34								
	B10-8			SM	-Moderately cemented	50/6"	117.4	13.4
36								
38								
40	B10-9					50/5"	111.5	15.4
					Hard, moist, olive gray, Clayey to fine-grained Sandy SILTSTONE; strongly indurated; some iron oxide mineralization			
42								
	B10-10			ML		80/10"		
44					-Refusal to penetration at 43.5 feet			

BORING TERMINATED AT 44 FEET
Groundwater encountered at 15 feet
Backfilled with 15 cu. ft. of bentonite slurry

Figure A-10,
Log of Boring B 10, Page 2 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR ... SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

SOIL BORING NUMBER: B - 1 1

GEOCON

PROJECT Olive Park Apartments
PROJECT NUMBER G3035-52-01
DATE STARTED 07/12/2024 **COMPLETED** 07/12/2024
CONTRACTOR Dave's Drilling
METHOD HSA
RIG TYPE EZ Bore **BORING DIAMETER** 30 in
HAMMER TYPE Auto

LOGGED BY R. Adams
LATITUDE / LONGITUDE 33.20297, -117.2887
DEPTH 57' **SURFACE ELEVATION** ~307'

Depth (ft)	Elevation (ft)	Water Levels	Graphic Log	USCS	Material Description
	307				
	305			SC	**LANDSLIDE DEBRIS** (Qls) Hard, dry, brown to reddish brown, **Clayey SAND** (SC); few rock fragments
5				SM	Dense, damp, pale yellowish brown, **Silty SANDSTONE** (SM), fine to coarse grained; abundant chunks of claystone up to 8" in width, some clay-infilled fractures (near vertical)
	300			SC	Dense, damp, yellowish brown, **Clayey SANDSTONE** (SC), fine to coarse grained; few roots on fracture surfaces
10	295			CL	Firm, moist, grayish brown, **Sandy CLAYSTONE** (CL); no remolding
15				CL-ML	Soft to Firm, damp, greenish gray to greenish brown, **CLAYSTONE** (CL-ML); highly fractured and brecciated, weakly fissured with few polished, striated parting surfaces; no remolded clay seams observed -Claystone becomes less brecciated
	290			ML	Hard, damp, olive brown, **Sandy SILTSTONE** (ML), fine grained; massive, contact with overlying claystone is undulatory (subhorizontal)
20	285			SC	Very dense, damp to moist, pale yellowish brown to whitish brown, **Clayey SANDSTONE** (SC), fine to coarse grained; massive, few infilled fractures
25	280			SP	Very dense, damp to moist, whitish brown, **SANDSTONE** (SP), medium to coarse grained; moderately cross-bedded, trace silt and clay

GEOCON

SOIL BORING: B-11

Depth (ft)	Elevation (ft)	Water Levels	Graphic Log	USCS	Material Description
	275			SP	
35	270				-Becomes very coarse grained. Several 4-6" diameter claystone rip up clasts. Imbricated with cross-bedding direction
				SC	Very dense, damp to moist, grayish white, **Clayey SANDSTONE** (SC), fine to coarse grained; massive
40	265			ML	Hard, damp, olive brown, **Clayey SILTSTONE** (ML); massive, contact of overlying sandstone is erosional (uncomformable) with an approximate orientation of N20°E/25°W, few gypsum filled fractures throughout
45					-High angle fracture N6°E/58°W
	260			CL-ML	Firm to hard, damp, dark greenish brown, **CLAYSTONE** (CL-ML); contact with overlying siltstone is transitional -BASAL RUPTURE SURFACE; 1/4 to 3/4" thick, gray, plastic, poorly to moderately remolded clay gouge. Polished and striated on bounding surfaces. Gouge zone is poorly developed but can be traced around the hole. Clay gouge surface is undulatory with a dip of less than 2° -At 47.8'; Claystone becomes moderately fissured and fractured with heavy orangish brown oxidation staining
50	255			SC	**SANTIAGO FORMATION** (Tsa) Very dense, damp to moist, whitish brown, **Clayey SANDSTONE** (SC), medium to coarse grained; massive, contact with overlying claystone is undulatory sub-horizontal
55	250				

REFUSAL AT 57'
No groundwater encountered
Backfilled 07/12/2024

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN APPLIES ONLY TO THE SPECIFIC BORING OR TRENCH LOCATION AT THE DATE INDICATED AND MIGHT NOT REPRESENT SUBSURFACE CONDITIONS AT OTHER LOCATIONS OR TIMES. THE STRATIGRAPHY PRESENTED REPRESENTS THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; THESE TRANSITIONS COULD BE GRADUAL.

GEOCON

SOIL BORING NUMBER: B - 1 2

PROJECT Olive Park Apartments
PROJECT NUMBER G3035-52-01
DATE STARTED 07/11/2024 **COMPLETED** 07/11/2024
CONTRACTOR Dave's Drilling
METHOD HSA
RIG TYPE EZ Bore **BORING DIAMETER** 30 in
HAMMER TYPE -

LOGGED BY R. Adams
LATITUDE / LONGITUDE 33.20242, -117.28951
DEPTH 100' **SURFACE ELEVATION** ~307'

Depth (ft)	Elevation (ft)	Water Levels	Graphic Log	USCS	Material Description
	307				
0–9	305, 300			SC	**COLLUVIUM** (Qcol) Dense, moist, brown, **Clayey SAND** (SC), fine grained; few claystone fragments, few krotovina, minor carbonate development. Probable graben infill.
9–14	295			SM	**LANDSLIDE DEBRIS** (Qls) Dense to very dense, damp to moist, gray to pale yellowish brown, **Silty SANDSTONE** (SM), fine to coarse grained; some claystone fragments up to 5" in width, few thin, sub-vertical clay filled fractures
14–15					Dense, damp, olive gray, **Silty SANDSTONE** (SM), fine grained; minor offset along sub-vertical, clay filled fractures
15–22	290, 285			SP	Very dense, damp to moist, pale yellowish brown, **SANDSTONE** (SP); few very coarse cross-beds
22–30	280			CL-ML	Stiff to hard, damp, olive gray, **CLAYSTONE** (CL-ML); moderately fissured and fractured with pockets of soft clay throughout, few rootlets along clay-filled fractures, fractures are closed contact with overlying sandstone is undulatory N80°E/8°S

Depth scale: 5, 10, 15, 20, 25

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN APPLIES ONLY TO THE SPECIFIC BORING OR TRENCH LOCATION AT THE DATE INDICATED AND MIGHT NOT REPRESENT SUBSURFACE CONDITIONS AT OTHER LOCATIONS OR TIMES. THE STRATIGRAPHY PRESENTED REPRESENTS THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; THESE TRANSITIONS COULD BE GRADUAL.

GEOCON

SOIL BORING: B-12

Depth (ft)	Elevation (ft)	Water Levels	Graphic Log	USCS	Material Description
				SP	Dense, damp, whitish brown, **SANDSTONE** (SP), coarse grained; sub-horizontal approximate bedding N10°W/5°W
	275			SM	Dense to very dense, moist, light olive brown, **Silty SANDSTONE** (SM), fine to coarse grained
35	270			CL-ML	Hard, moist, olive gray, **CLAYSTONE** (CL-ML); moderately to highly fissured and fractured with some plastic clay films on fracture surfaces BASAL RUPTURE SURFACE; 1/8 to 1/4" thick, slightly to moderately developed, approximate angle of basal rupture surface N5°E/4-6°W
40 45 50 55	265 260 255 250			SM	**SANTIAGO FORMATION** (Tsa) Very dense, moist, olive gray, **Silty SANDSTONE** (SM), fine grained; interbedded with hard Sandy SILTSTONE, few gypsum filled fractures -Slow drilling (concretionary) -Some claystone rip-up clasts
				CL	Hard, damp to moist, olive gray, **Silty CLAYSTONE** (CL); very minor fissuring, upper contact:

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN APPLIES ONLY TO THE SPECIFIC BORING OR TRENCH LOCATION AT THE DATE INDICATED AND MIGHT NOT REPRESENT SUBSURFACE CONDITIONS AT OTHER LOCATIONS OR TIMES. THE STRATIGRAPHY PRESENTED REPRESENTS THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; THESE TRANSITIONS COULD BE GRADUAL.

GEOCON

SOIL BORING: B-12

Depth (ft)	Elevation (ft)	Water Levels	Graphic Log	USCS	Material Description
				CL	Hard, damp to moist, olive gray, **Silty CLAYSTONE** (CL); very minor fissuring, upper contact: N25°W/8°W, some oxidation staining
	245			SC-SM	Very dense, moist, olive gray, **Silty to Clayey SANDSTONE** (SC-SM), fine to medium grained, with gravel; few gypsum filled fractures, massive
65	240				
70	235			ML	Hard, moist, olive gray, **Sandy SILTSTONE** (ML); upper contact is horizontal, waxy texture
75	230				-Becomes moderately fissured with few pockets of soft clay
				CL-ML	Hard, moist, olive gray, **Silty CLAYSTONE** (CL-ML); highly fissured and brecciated -BEDDING PLANE SHEAR; 1/8" to 1/4" thick, moderately remolded plastic clay gouge, BPS is bifurcated/offset along fracture. Polished on bounding surfaces approximate attitude N45°E/4°N
80	225				
85				ML	Hard, moist, olive gray (ML); 1.4' thick SILTSTONE bed; horizontal
	220			CL-ML	Hard, moist, olive gray, **Silty CLAYSTONE** (CL-ML) -High angle fracture with clay infill; fracture orientation N65°E/40°S

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN APPLIES ONLY TO THE SPECIFIC BORING OR TRENCH LOCATION AT THE DATE INDICATED AND MIGHT NOT REPRESENT SUBSURFACE CONDITIONS AT OTHER LOCATIONS OR TIMES. THE STRATIGRAPHY PRESENTED REPRESENTS THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; THESE TRANSITIONS COULD BE GRADUAL.

GEOCON

SOIL BORING: B-12

Depth (ft)	Elevation (ft)	Water Levels	Graphic Log	USCS	Material Description
	215			CL-ML	
95	210				
100	205				TOTAL DEPTH 100 FEET Logged to 97 feet No groundwater encountered Backfilled 07/11/2024
105	200				
110	195				
115	190				

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN APPLIES ONLY TO THE SPECIFIC BORING OR TRENCH LOCATION AT THE DATE INDICATED AND MIGHT NOT REPRESENT SUBSURFACE CONDITIONS AT OTHER LOCATIONS OR TIMES. THE STRATIGRAPHY PRESENTED REPRESENTS THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; THESE TRANSITIONS COULD BE GRADUAL.

GEOCON

SOIL BORING NUMBER: B - 1 3

PROJECT Olive Park Apartments

PROJECT NUMBER G3035-52-01

DATE STARTED 07/12/2024 **COMPLETED** 07/12/2024

CONTRACTOR Dave's Drilling

METHOD HSA

RIG TYPE EZ Bore **BORING DIAMETER** 30 in

HAMMER TYPE -

LOGGED BY R. Adams

LATITUDE / LONGITUDE 33.20313, -117.28951

DEPTH 48' **SURFACE ELEVATION** ~286'

Depth (ft)	Elevation (ft)	Water Levels	Graphic Log	USCS	Material Description
	286				
	285			CL	**COLLUVIUM** (Qcol) Stiff, dry to damp, brown, **Sandy CLAY** (CL)
5	280			SM	**LANDSLIDE DEBRIS** (Qls) Loose to medium dense, damp to moist, grayish white, **Silty SANDSTONE** (SM), fine to coarse grained; multiple near vertical clay-filled fractures, some embedded fragments of colluvium
					-Few claystone fragments, some oxidation staining
10	275				-1/2 to 2" thick, offset, back-rotated clay bed bedding: N30°E/10°S, fracture offset: N70°E/74°S
15	270			CL	Firm, moist, grayish brown to olive brown, **Sandy CLAYSTONE** (CL); no remolding, weakly fissured with few polished and striated parting surfaces
					Stiff to hard, damp, greenish gray, **CLAYSTONE** (CL); weakly to moderately fissured, no remolding, slightly brecciated
20	265			SM	Very dense, damp to moist, grayish white, **Silty SANDSTONE** (SM), fine to coarse grained; trace clay, massive with some cross-bedding, contact with overlying claystone is horizontal
25	260				Dense, damp, dark brown to dark reddish-brown, **Silty SANDSTONE** (SM), fine to coarse grained; convoluted cross-bedding

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN APPLIES ONLY TO THE SPECIFIC BORING OR TRENCH LOCATION AT THE DATE INDICATED AND MIGHT NOT REPRESENT SUBSURFACE CONDITIONS AT OTHER LOCATIONS OR TIMES. THE STRATIGRAPHY PRESENTED REPRESENTS THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; THESE TRANSITIONS COULD BE GRADUAL.

GEOCON

SOIL BORING: B-13

Depth (ft)	Elevation (ft)	Water Levels	Graphic Log	USCS	Material Description
	255			SM	-Becomes coarse grained
35	250				-Few claystone rip-up clasts
				CL-ML	Hard, damp, greenish gray to greenish black, **CLAYSTONE** (CL-ML); moderately to highly fissured and fractured, numerous polished and striated parting surfaces throughout. Contact with overlying sandstone is horizontal -BASAL RUPTURE SURFACE; 1 to 3" thick zone of pulverized claystone containing a 1/4 to 3/4" thick, moderately remolded clay seam. Remolded clay seam is moderately developed/semi-continuous around the boring. Bounding surfaces are polished and striated. Heavy oxidation mottling below the remolded clay seam
40	245			SM	**SANTIAGO FORMATION** (Tsa) Very dense, damp, grayish brown to whitish brown, **Silty SANDSTONE** (SM), fine to coarse grained; massive, contact with overlying claystone is undulatory/sub-horizontal
45	240				
					REFUSAL AT 48 FEET No groundwater encountered Backfilled 07/12/2024
50	235				
55	230				

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN APPLIES ONLY TO THE SPECIFIC BORING OR TRENCH LOCATION AT THE DATE INDICATED AND MIGHT NOT REPRESENT SUBSURFACE CONDITIONS AT OTHER LOCATIONS OR TIMES. THE STRATIGRAPHY PRESENTED REPRESENTS THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; THESE TRANSITIONS COULD BE GRADUAL.

PROJECT NO. 07227-52-02

TRENCH T 1

ELEV. (MSL.) **300'** DATE COMPLETED **05-09-2005**

EQUIPMENT **JD 450 TRACK-MOUNTED BACKHOE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 3				CL	**LANDSLIDE DEBRIS** Soft, moist, dark brown to grayish brown, fine Sandy CLAY; moderate topsoil development; common thin roots			
3 – 7.5				CH	Stiff, moist, brownish to olive gray, fine Sandy fat CLAY; abundant slickensided sheared surfaces; carbonate mineralization; scattered roots; overall jumbled texture; fractured claystone blocks S: N5W/17SW			
7.5 – 11				SM+SC	**SANTIAGO FORMATION** Dense, moist, light olive gray, fine- to medium-grained Silty to locally Clayey SANDSTONE; moderately cemented; weakly jointed; generally massive and undisturbed			

TRENCH TERMINATED AT 11 FEET
No groundwater encountered

Figure A-11,
Log of Trench T 1, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

TRENCH T 2

ELEV. (MSL.) **195'** DATE COMPLETED **05-09-2005**

EQUIPMENT **JD 450 TRACK-MOUNTED BACKHOE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 3				CL	**LANDSLIDE DEBRIS** Soft, moist, brown to grayish brown, fine Sandy CLAY; moderate topsoil development; abundant thin roots			
3 – 9				CH+SC	Medium dense and stiff, moist, light gray to olive gray, fat CLAY and Clayey to Silty SAND; jumbled texture; chaotic structure; some fragments of sandstone and claystone; clayey areas sheared and slickensided; back-rotated beds generally dipping at low to moderate angles into hillside			

TRENCH TERMINATED AT 9 FEET
No groundwater encountered

Figure A-12,
Log of Trench T 2, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**TRENCH T 3** ELEV. (MSL.) **204'** DATE COMPLETED **05-09-2005** EQUIPMENT **JD 450 TRACK-MOUNTED BACKHOE**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0 – 3				CL	**LANDSLIDE DEBRIS** Soft, moist, dark brown, fine Sandy CLAY; abundant roots and porosity			
3 – 12			▼ (10)	SM+SC	Loose, moist to wet, yellowish brown to light olive gray, Silty to Clayey SAND; highly disturbed, chaotic texture, some fragments of sandstone; few roots -Very loose and saturated; walls of trench highly prone to caving; abundant seepage			
12					TRENCH TERMINATED AT 12 FEET Seepage at 10 feet			

Figure A-13,
Log of Trench T 3, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	⊠ ... DISTURBED OR BAG SAMPLE	◣ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

TRENCH T 4

ELEV. (MSL.) **207'** DATE COMPLETED **05-09-2005**

EQUIPMENT **JD 450 TRACK-MOUNTED BACKHOE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 5				SC	**ALLUVIUM** Loose, moist, dark brown, Clayey, fine SAND; porous; common roots			
5 – 14			▼ (9 ft)	SM+SC	**LANDSLIDE DEBRIS** Loose, wet, olive gray to grayish brown, Clayey to Silty, fine SAND and Sandy CLAY; porous; jumbled texture and chaotic structure -Saturated; abundant seepage; caving of trench walls			

TRENCH TERMINATED AT 14 FEET
Seepage at 9 feet

Figure A-14,
Log of Trench T 4, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	⊠ ... DISTURBED OR BAG SAMPLE	◣ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 5 ELEV. (MSL.) 212' DATE COMPLETED 05-09-2005 EQUIPMENT JD 450 TRACK-MOUNTED BACKHOE	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0–5				SC	**LANDSLIDE DEBRIS** Loose, moist, dark gray, Clayey, fine SAND; porous; thin roots; weakly developed topsoil in upper 2 feet			
5–14.5				SM+SC	Loose, moist to wet, olive gray, Clayey to Silty, fine to coarse SAND; jumbled texture; chaotic structure; some clayey sandstone fragments in sandy matrix			
					TRENCH TERMINATED AT 14.5 FEET No groundwater encountered			

Figure A-15,
Log of Trench T 5, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

TRENCH T 6

ELEV. (MSL.) **226'** DATE COMPLETED **05-10-2005**

EQUIPMENT **JD 450 TRACK-MOUNTED BACKHOE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 2				SC	**TOPSOIL** Loose to medium dense, dry to damp, Clayey SAND			
2 – 9.5	T6-1				**GRANITIC ROCK** Moderately hard, moist, tan to gray, GRANITIC ROCK; highly weathered; moderately fractured; damp to dry; light green clay on fracture surfaces -At 5 feet J: N37E/vertical -At 7 feet J:N53W/77SW			
					TRENCH TERMINATED AT 9.5 FEET No groundwater encountered No caving			

Figure A-16,
Log of Trench T 6, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

TRENCH T 7

ELEV. (MSL.) **240'** DATE COMPLETED **05-10-2005**

EQUIPMENT **JD 450 TRACK-MOUNTED BACKHOE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 4				SC	**LANDSLIDE DEBRIS** Loose to medium dense, dry to damp, dark gray, Clayey SAND; moderate topsoil development Medium dense, moist, light gray brown; scattered flecks of black organics; base subparallel to slope; grades to very light gray with medium gray brown laminations			
4 – 8				SM	**SANTIAGO FORMATION** Dense, damp, very light gray, fine- to medium-grained Silty SANDSTONE; massive to thickly slightly weathered -Becomes dark brown at 7.5 feet -C: 80E/5-10N (at top)			
8 – 9					**GRANITIC ROCK** Moderately hard, damp to moist, greenish gray with abundant orange staining, GRANITIC ROCK; highly weathered			

TRENCH TERMINATED AT 9 FEET
No groundwater encountered
No caving

Figure A-17,
Log of Trench T 7, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

PROJECT NO. 07227-52-02

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 8 ELEV. (MSL.) 254' DATE COMPLETED 05-10-2005 EQUIPMENT JD 450 TRACK-MOUNTED BACKHOE	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SC	**TOPSOIL** Medium dense, dry to damp, dark gray, Clayey SAND			
2 4	T8-1			SM	**SANTIAGO FORMATION** Dense, damp, very light gray, Silty SANDSTONE; fine- to medium-grained; moderately weathered; massive; moderately cemented -Slightly weathered at 4 feet			
					TRENCH TERMINATED AT 5 FEET No groundwater encountered			

Figure A-18,
Log of Trench T 8, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 9 ELEV. (MSL.) 241' DATE COMPLETED 05-10-2005 EQUIPMENT JD 450 TRACK-MOUNTED BACKHOE	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Medium dense, dry to damp, dark gray-brown, Silty SAND			
2 4				SM	**SANTIAGO FORMATION** Dense, damp, very light gray with some orange staining, Silty SANDSTONE; fine- to medium-grained; moderately weathered, slightly fractured; moderately cemented; massive -Slightly weathered; fine roots; dark brown staining at 4 feet -At 3 feet; J: N70W/65NE			
					TRENCH TERMINATED AT 5 FEET No groundwater encountered			

Figure A-19,
Log of Trench T 9, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

TRENCH T 10

ELEV. (MSL.) **228'** DATE COMPLETED **05-10-2005**

EQUIPMENT **JD 450 TRACK-MOUNTED BACKHOE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 2				SM	**TOPSOIL** Medium dense, dry to damp, dark gray, Silty SAND			
2 – 11				SP	**SANTIAGO FORMATION** Medium dense, moist, very light pale brown, SANDSTONE; massive; moderately hard; weakly cemented; moderately weathered -Very light gray; slightly weathered; slightly moist at 4 feet -Moderate seepage at 11 feet			
11 – 13	T10-1		▼	SM	Dense, damp, greenish medium gray, Silty, fine to medium SANDSTONE; trace clay -Refusal at 13 feet			

TRENCH TERMINATED AT 13 FEET
Seepage at 11 feet

Figure A-20,
Log of Trench T 10, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 11 ELEV. (MSL.) 226' DATE COMPLETED 05-10-2005 EQUIPMENT JD 450 TRACK-MOUNTED BACKHOE	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0 2				SC	**TOPSOIL** Medium dense, damp, dark gray, Clayey SAND			
4 6					**GRANITIC ROCK** Moderately hard, slightly moist, light gray brown with orange staining, GRANITIC ROCK; highly weathered, highly fractured -At 6 feet J: N70E/72NW; J: N72E/70SE			
					TRENCH TERMINATED AT 7.5 FEET No groundwater encountered			

Figure A-21,
Log of Trench T 11, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 12 ELEV. (MSL.) 220' DATE COMPLETED 05-10-2005 EQUIPMENT JD 450 TRACK-MOUNTED BACKHOE	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0 2				SC	**TOPSOIL** Medium dense, slightly moist, dark gray, Clayey SAND			
2 4 6					**GRANITIC ROCK** Moderately hard, damp, light gray brown with orange staining, GRANITIC ROCK; highly weathered; scattered hard rounded nodules (some nodules, moderately weathered); fine- to coarse-grained crystalline texture			
					TRENCH TERMINATED AT 7 FEET No groundwater encountered			

Figure A-22,
Log of Trench T 12, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

TRENCH T 13

ELEV. (MSL.) **228'** DATE COMPLETED **05-10-2005**

EQUIPMENT **JD 450 TRACK-MOUNTED BACKHOE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 3				CL	**LANDSLIDE DEBRIS** Stiff, moist, dark brown, Sandy CLAY; porous with roots and krotovina; moderate topsoil development			
3 – 5.5				SM	Loose, moist, light olive gray, Silty, fine to medium SAND; common clay-filled; high-angle fractures			
5.5 – 13	T13-1			CH	Stiff, moist, dark olive gray; Sandy, fat CLAY; pockets of silty sand and granitic rock fragments; highly fractured and sheared; chaotic bedding orientations B: N35E/38NW -Carbonate and iron oxide mineralization between sand and clay beds -At 13 feet, contact roughly horizontal, undulatory			
13 – 14					**GRANITIC ROCK** Moderately hard to hard, damp, light to medium brown, GRANITIC ROCK; moderately weathered			

TRENCH TERMINATED AT 14 FEET
No groundwater encountered
No caving

Figure A-23,
Log of Trench T 13, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

TRENCH T 14

ELEV. (MSL.) **238'** DATE COMPLETED **05-10-2005**

EQUIPMENT **JD 450 TRACK-MOUNTED BACKHOE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 2				SC	**PREVIOUSLY PLACED FILL** Loose, moist, grayish brown, Clayey, fine to medium SAND; few gravels			
2 – 5				CL	**TOPSOIL** Stiff, moist, dark brown, fine Sandy CLAY; few gravels; common roots; porous			
5 – 8				CH	**SANTIAGO FORMATION** Very stiff, moist, dark olive gray, fine Sandy, fat CLAY; highly weathered and some shearing			
8 – 18				SM-SC	Medium dense, moist, light olive gray, Clayey and Silty, SANDSTONE; fine- to medium-grained; very weakly cemented; massive bedding -Becomes dense; fine-grained and clayey			

TRENCH TERMINATED AT 18 FEET
No groundwater encountered
No caving

Figure A-24,
Log of Trench T 14, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

TRENCH NUMBER: T-15

PROJECT NAME	Olive Park Apartments	**PROJECT NUMBER**	G3035-52-01
DATE STARTED	07/13/2024 **COMPLETED** 07/13/2024	**LATITUDE / LONGITUDE**	33.20341, -117.29006
CONTRACTOR	Dave's Drilling	**RIG TYPE**	CAT 430F
METHOD	Backhoe	**LOCATION**	-
LOGGED BY	R. Adams	**DEPTH**	8' **SURFACE ELEVATION** ~227'

Depth (ft)	Elevation (ft)	Water Levels	Graphic Log	USCS	Material Description
0	227			CL	**LANDSLIDE DEBRIS** (Qls) Firm to stiff, moist, grayish brown to light brown, **Sandy CLAY** (CL); roots, some carbonate development, few infilled fractures with oxidation staining on fracture surfaces
2	225				
4					**GRANITIC ROCK** (Kgr) Moderately Weak, weathered, pale reddish brown to grayish brown, **Granitic Rock**; isolated weathered core stones <18" diameter; excavates as a coarse SAND
6					
7	220				
8					PRACTICAL REFUSAL AT 8 FEET No groundwater encountered Backfilled 07/13/2024
10					

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN APPLIES ONLY TO THE SPECIFIC BORING OR TRENCH LOCATION AT THE DATE INDICATED AND MIGHT NOT REPRESENT SUBSURFACE CONDITIONS AT OTHER LOCATIONS OR TIMES. THE STRATIGRAPHY PRESENTED REPRESENTS THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; THESE TRANSITIONS COULD BE GRADUAL.

TRENCH NUMBER: T-16

PROJECT NAME	Olive Park Apartments	**PROJECT NUMBER**	G3035-52-01
DATE STARTED	07/13/2024 **COMPLETED** 07/13/2024	**LATITUDE / LONGITUDE**	33.20363, -117.28987
CONTRACTOR	Dave's Drilling	**RIG TYPE**	CAT 430F
METHOD	Backhoe	**LOCATION**	-
LOGGED BY	R. Adams	**DEPTH**	7' **SURFACE ELEVATION** ~223'

Depth (ft)	Elevation (ft)	Water Levels	Graphic Log	USCS	Material Description
	223				
0–1.5				CL	**COLLUVIUM** (Qcol) Stiff to hard, dry to moist, dark brown to black, **Sandy CLAY** (CL)
1.5–7	220				**GRANITIC ROCK** (Kgr) Weak to moderately weak, completely to highly weathered, greenish gray to reddish brown, **Granitic Rock**; excavates as a Silty, coarse SAND
7	215				TRENCH TERMINATED AT 7 FEET No groundwater encountered Backfilled 07/13/2024

Depth scale: 2, 4, 6, 8, 10

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN APPLIES ONLY TO THE SPECIFIC BORING OR TRENCH LOCATION AT THE DATE INDICATED AND MIGHT NOT REPRESENT SUBSURFACE CONDITIONS AT OTHER LOCATIONS OR TIMES. THE STRATIGRAPHY PRESENTED REPRESENTS THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; THESE TRANSITIONS COULD BE GRADUAL.

GEOCON

TRENCH NUMBER: T-17

PROJECT NAME	Olive Park Apartments	**PROJECT NUMBER**	G3035-52-01
DATE STARTED	07/13/2024 **COMPLETED** 07/13/2024	**LATITUDE / LONGITUDE**	33.20385, -117.28931
CONTRACTOR	Dave's Drolling	**RIG TYPE**	CAT 430F
METHOD	Backhoe	**LOCATION**	-
LOGGED BY	R. Adams	**DEPTH**	3' **SURFACE ELEVATION** ~228'

Depth (ft)	Elevation (ft)	Water Levels	Graphic Log	USCS	Material Description
	228				
				CL	**COLLUVIUM** (Qcol) Hard, dry, dark grayish brown, **Sandy CLAY** (CL)
2	225				**GRANITIC ROCK** Weak, highly weathered, orangish brown, **Granitic Rock**; excavates as a coarse SAND
4					TRENCH TERMINATED AT 3 FEET No groundwater encountered Backfilled 07/13/2024
6					
8	220				
10					

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN APPLIES ONLY TO THE SPECIFIC BORING OR TRENCH LOCATION AT THE DATE INDICATED AND MIGHT NOT REPRESENT SUBSURFACE CONDITIONS AT OTHER LOCATIONS OR TIMES. THE STRATIGRAPHY PRESENTED REPRESENTS THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; THESE TRANSITIONS COULD BE GRADUAL.

GEOCON

TRENCH NUMBER: T-18

PROJECT NAME Olive Park Apartments

PROJECT NUMBER G3035-52-01

DATE STARTED 07/13/2024 **COMPLETED** 07/13/2024

LATITUDE / LONGITUDE 33.20377, -117.2892

CONTRACTOR Dave's Drilling

RIG TYPE CAT 430F

METHOD Backhoe

LOCATION -

LOGGED BY R. Adams

DEPTH 6' **SURFACE ELEVATION** ~238'

Depth (ft)	Elevation (ft)	Water Levels	Graphic Log	USCS	Material Description
0	238			CL	**LANDSLIDE DEBRIS** (Qls) Stiff, dry to moist, dark brown, **Sandy CLAY** (CL)
2	235			SM	Medium dense, damp, grayish white, **Silty SAND** (SM), fine to coarse grained; highly irregular contact with inclusions of colluvium along contact with granitic rock, fractures terminate at contact
4					**GRANITIC ROCK** (Kgr) Weak, completely to highly weathered, **Granitic Rock**; excavates to a Silty, medium to coarse SAND
6					TRENCH TERMINATED AT 6 FEET No groundwater encountered Backfilled 07/13/2024
8	230				
10					

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN APPLIES ONLY TO THE SPECIFIC BORING OR TRENCH LOCATION AT THE DATE INDICATED AND MIGHT NOT REPRESENT SUBSURFACE CONDITIONS AT OTHER LOCATIONS OR TIMES. THE STRATIGRAPHY PRESENTED REPRESENTS THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; THESE TRANSITIONS COULD BE GRADUAL.

GEOCON

TRENCH NUMBER: T-19

PROJECT NAME Olive Park Apartments
PROJECT NUMBER G3035-52-01
DATE STARTED 07/13/2024 **COMPLETED** 07/13/2024
LATITUDE / LONGITUDE 33.20389, -117.28904
CONTRACTOR Dave's Drilling
RIG TYPE CAT 430F
METHOD Backhoe
LOCATION -
LOGGED BY R. Adams
DEPTH 8' **SURFACE ELEVATION** ~227'

Depth (ft)	Elevation (ft)	Water Levels	Graphic Log	USCS	Material Description
0	227			CL	**LANDSLIDE DEBRIS** (Qls) Stiff, dry to damp, brown, **Sandy CLAY** (CL)
1				SC	Medium dense, damp, white gray, **Clayey SAND** (SC), medium to coarse grained; numerous clay filled, subvertical fractures
2	225				
3					-Sand becomes mixed with overlying sandy clay
4					
5					**GRANITIC ROCK** (Kgr) Weak, completely to highly weathered, greenish gray to grayish brown, **Granitic Rock**; excavates as a coarse sand
6					
7	220				
8					TRENCH TERMINATED AT 8 FEET No groundwater encountered Backfilled 07/13/2024
10					

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN APPLIES ONLY TO THE SPECIFIC BORING OR TRENCH LOCATION AT THE DATE INDICATED AND MIGHT NOT REPRESENT SUBSURFACE CONDITIONS AT OTHER LOCATIONS OR TIMES. THE STRATIGRAPHY PRESENTED REPRESENTS THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; THESE TRANSITIONS COULD BE GRADUAL.

APPENDIX B

APPENDIX B
LABORATORY TESTING

We performed laboratory tests in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. We tested selected soil samples for in-place dry density/moisture content, maximum density/optimum moisture content, expansion index, water-soluble sulfate, Atterberg limits, R-Value, unconfined compressive strength, consolidation, gradation and direct shear strength. The results of our current laboratory tests are presented herein. The in-place dry density and moisture content of the samples tested are presented on the boring logs in Appendix A.

SUMMARY OF LABORATORY MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT TEST RESULTS ASTM D 1557

Sample No.	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (% dry wt.)
B3-3	Olive brown, Silty, fine SAND	124.0	10.1
T13-1	Dark olive gray, Sandy, CLAY	117.8	14.9

SUMMARY OF LABORATORY DIRECT SHEAR TEST RESULTS ASTM D 3080

Sample No.	Dry Density (pcf)	Moisture Content (%)		Unit Cohesion (psf)	Angle of Shear Resistance (degrees)
		Initial	Final		
B1-1	99.9	24.7	30.8	275	20
B1-3	129.4	7.5	11.1	1300	29
B1-5	124.0	6.4	13.1	1000	51
B1-6*	--	--	--	250	13
B2-6	109.8	19.3	23.9	200	30
B3-8	106.3	20.3	26.9	475	22
B4-7	119.0	8.8	13.8	800	35
B5-2	102.7	8.8	20.7	0	35
B7-9**	109.3	19.6	27.7	250	13
B7-10	119.9	11.1	18.8	900	31
B7-12*	--	--	--	50	15

*Samples were remolded into a paste to obtain fully softened values.
**Residual Shear

SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS
ASTM D 4829

Sample No.	Moisture Content (%)		Dry Density (pcf)	Expansion Index	2022 CBC Expansion Classification	ASTM Soil Expansion Classification
	Before Test	After Test				
B3-3	11.4	20.3	105.8	28	Expansive	Low
T10-1	11.8	22.4	105.5	35	Expansive	Low
T13-1	14.3	26.9	95.1	25	Expansive	Low

SUMMARY OF LABORATORY WATER-SOLUBLE SULFATE TEST RESULTS
CALIFORNIA TEST NO. 417

Sample No.	Depth (feet)	Geologic Unit	Water-Soluble Sulfate (%)	ACI 318 Sulfate Exposure
T10-1	11-13	Tsa	0.011	S0
T13-1	10-12	Qls	0.005	S0

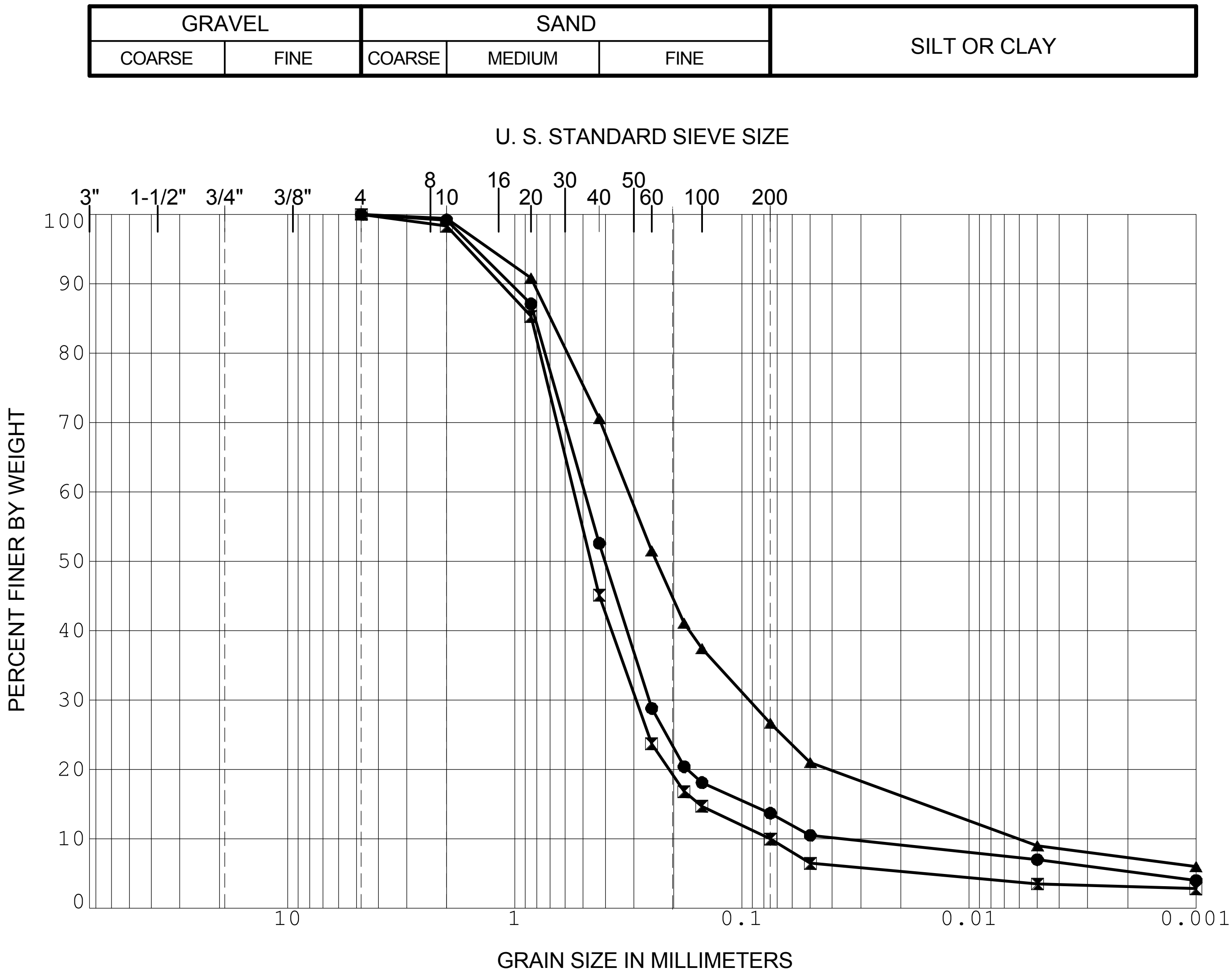
SUMMARY OF LABORATORY RESISTANCE VALUE (R-VALUE) TEST RESULTS
ASTM D 2844

Sample No.	Depth (Feet)	Description (Geologic Unit)	R-Value
B3-3	10-15	Olive brown, Silty, fine SAND (Qls)	18
T10-1	11-13	Olive gray, Silty, fine to medium SAND (Tsa)	15
T13-1	10-12	Dark olive gray, Sandy, CLAY (Qls)	23

SUMMARY OF LABORATORY PLASTICITY INDEX TEST RESULTS
ASTM D 4318

Sample No.	Depth (Feet)	Geologic Unit	Liquid Limit	Plastic Limit	Plasticity Index	Soil Classification
B1-6	6	Qls	63	22	41	CH
B7-12	45	Qls	55	32	23	MH

PROJECT NO. 07227-52-02



SAMPLE	DEPTH (ft)	CLASSIFICATION	NAT WC	LL	PL	PI
● B9-4	16.0	Silty SAND (SM)				
⧗ B9-5	21.0	SAND with Silt (SP-SM)				
▲ B9-6	26.0	Silty SAND (SM)				

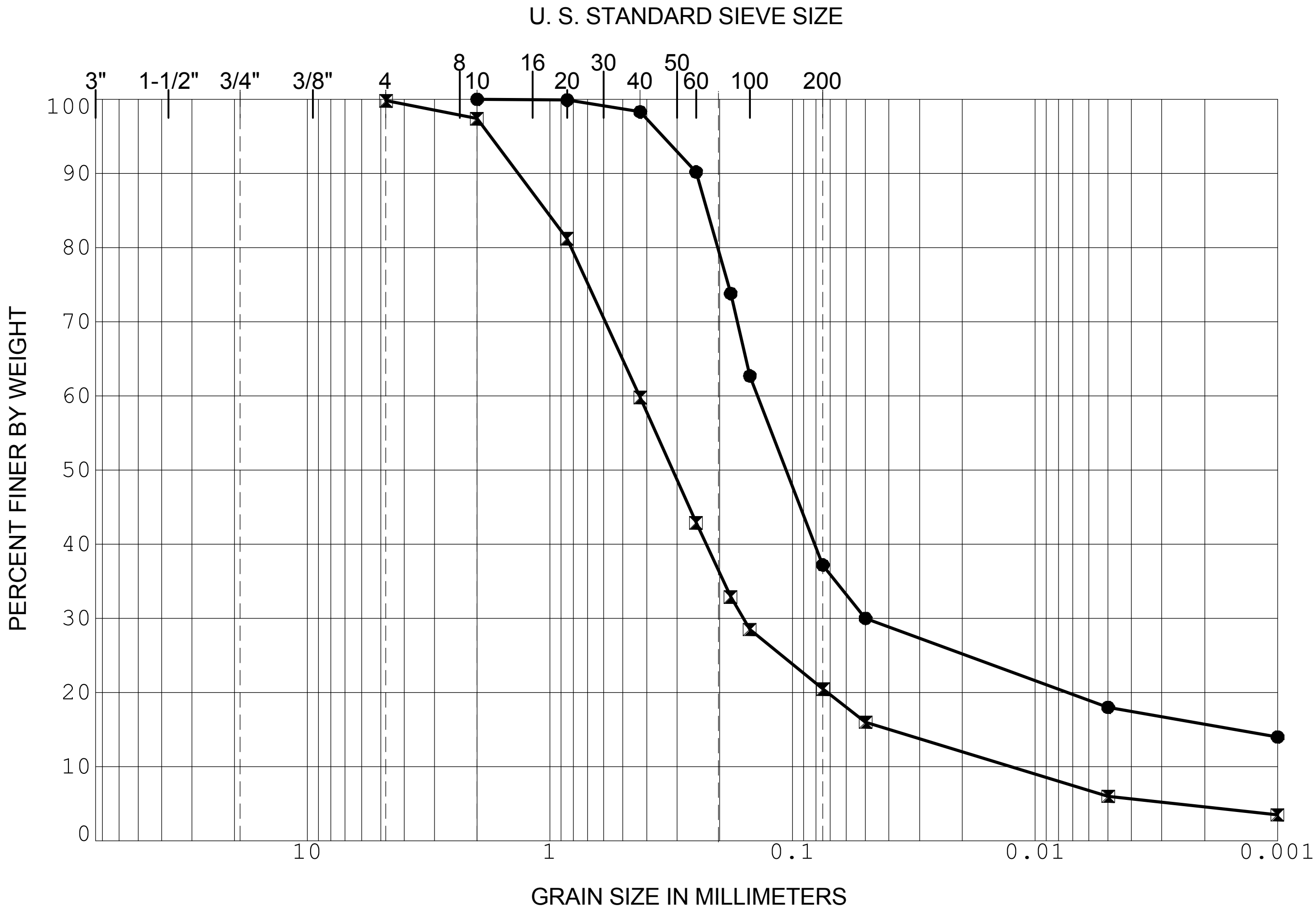
GRADATION CURVE

OCEANSIDE VISTA

OCEANSIDE, CALIFORNIA

07227-52-02.GPJ

GRAVEL		SAND			SILT OR CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



	SAMPLE	DEPTH (ft)	CLASSIFICATION	NAT WC	LL	PL	PI
●	B10-4	16.0	Silty Clayey SAND (SC-SM)				
⧗	B10-5	21.0	Silty SAND (SM)				

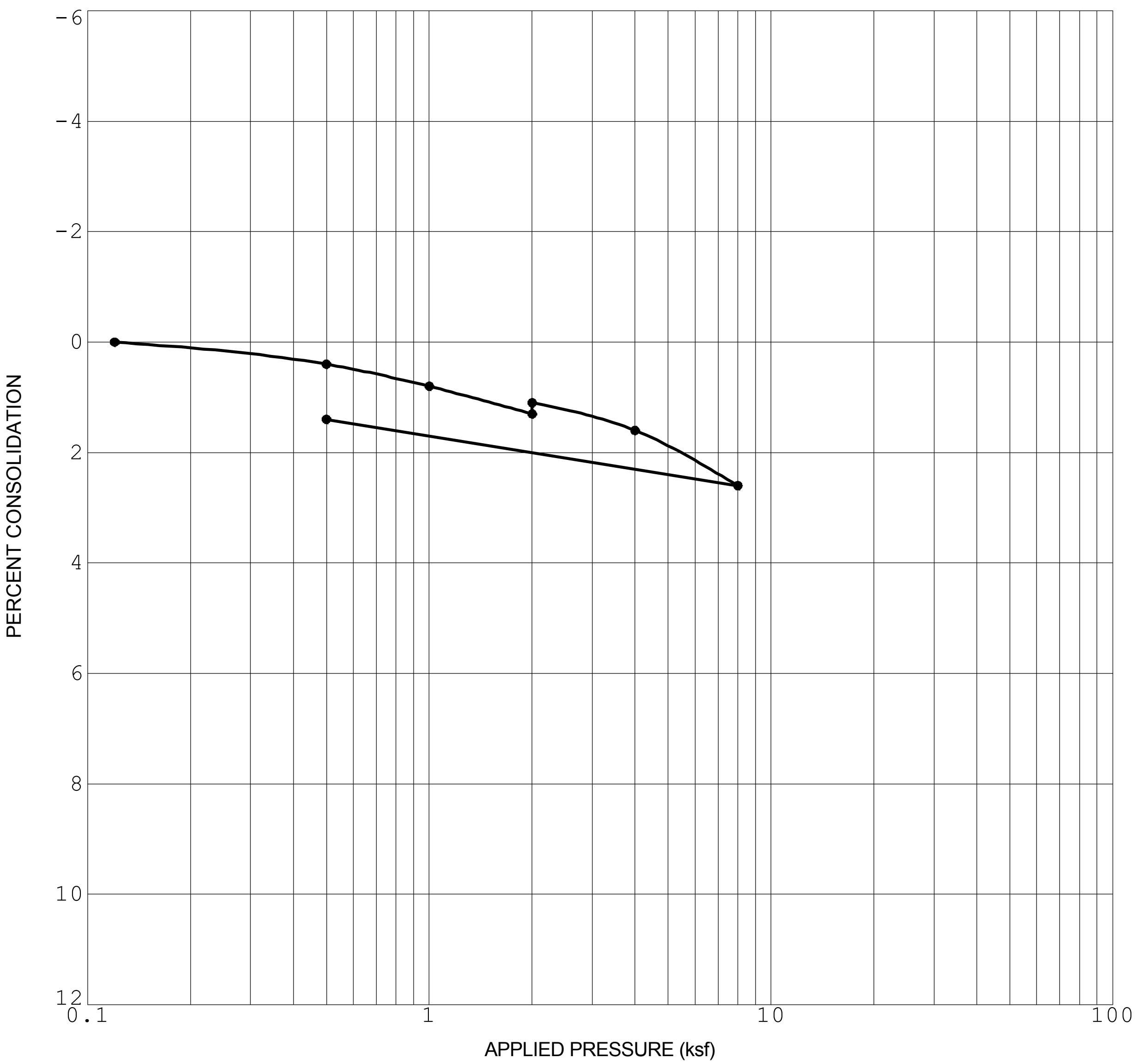
GRADATION CURVE

OCEANSIDE VISTA

OCEANSIDE, CALIFORNIA

PROJECT NO. 07227-52-02

SAMPLE NO. B2-3



Initial Dry Density (pcf)	108.6		**Initial Saturation (%)**	80.7
Initial Water Content (%)	16.0		**Sample Saturated at (ksf)**	2.0

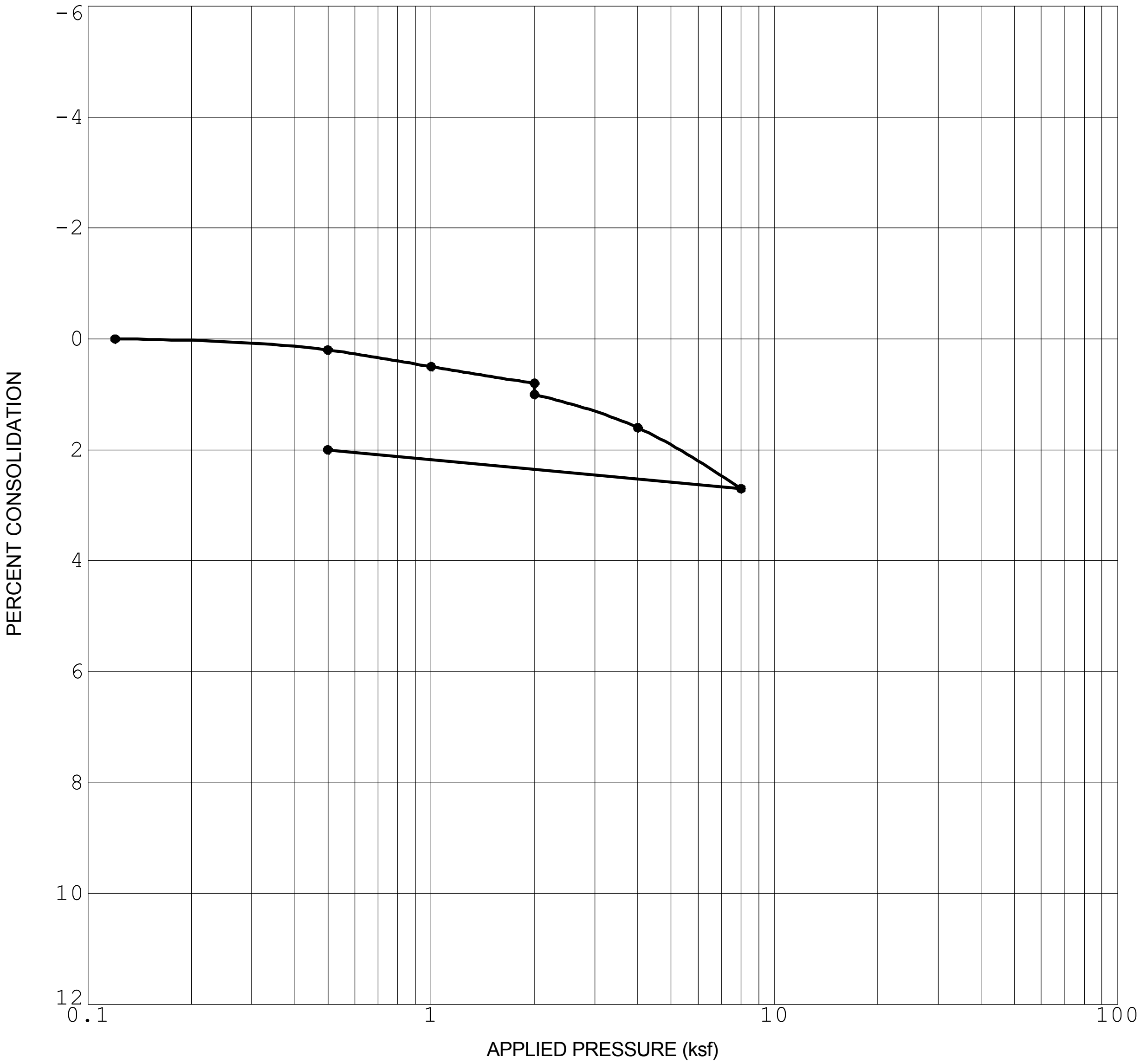
CONSOLIDATION CURVE

OCEANSIDE VISTA

OCEANSIDE, CALIFORNIA

PROJECT NO. 07227-52-02

SAMPLE NO. B3-7



Initial Dry Density (pcf)	115.9		**Initial Saturation (%)**	54.0	
Initial Water Content (%)	8.8		**Sample Saturated at (ksf)**	2.0	

CONSOLIDATION CURVE

OCEANSIDE VISTA

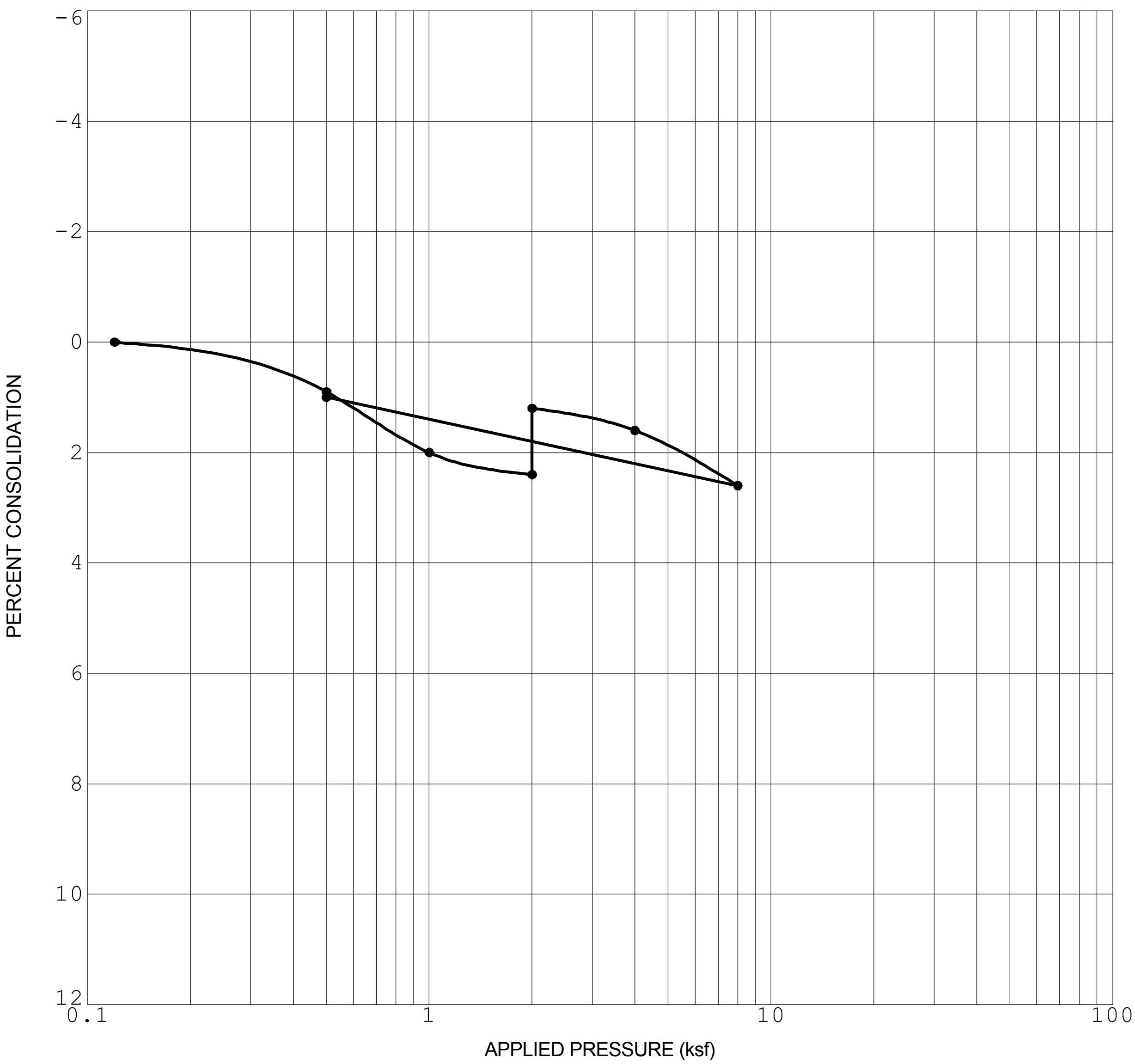
OCEANSIDE, CALIFORNIA

07227-52-02.GPJ

Figure B-4

PROJECT NO. 07227-52-02

SAMPLE NO. B4-4



Initial Dry Density (pcf)	108.7
Initial Water Content (%)	17.7

Initial Saturation (%)	100
Sample Saturated at (ksf)	2.0

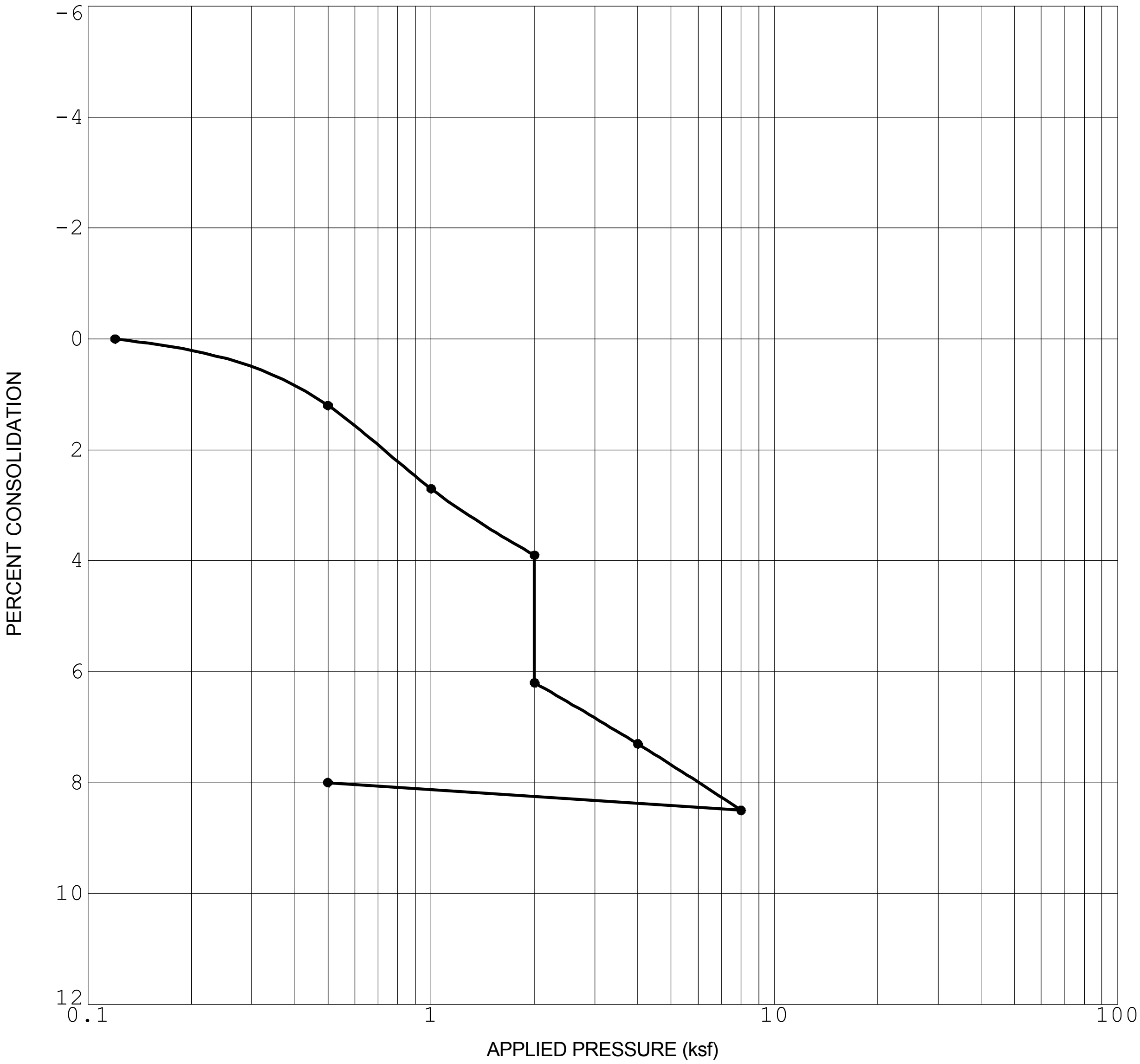
CONSOLIDATION CURVE

OCEANSIDE VISTA

OCEANSIDE, CALIFORNIA

PROJECT NO. 07227-52-02

SAMPLE NO. B7-4



Initial Dry Density (pcf)	96.9	**Initial Saturation (%)**	32.8
Initial Water Content (%)	8.8	**Sample Saturated at (ksf)**	2.0

CONSOLIDATION CURVE

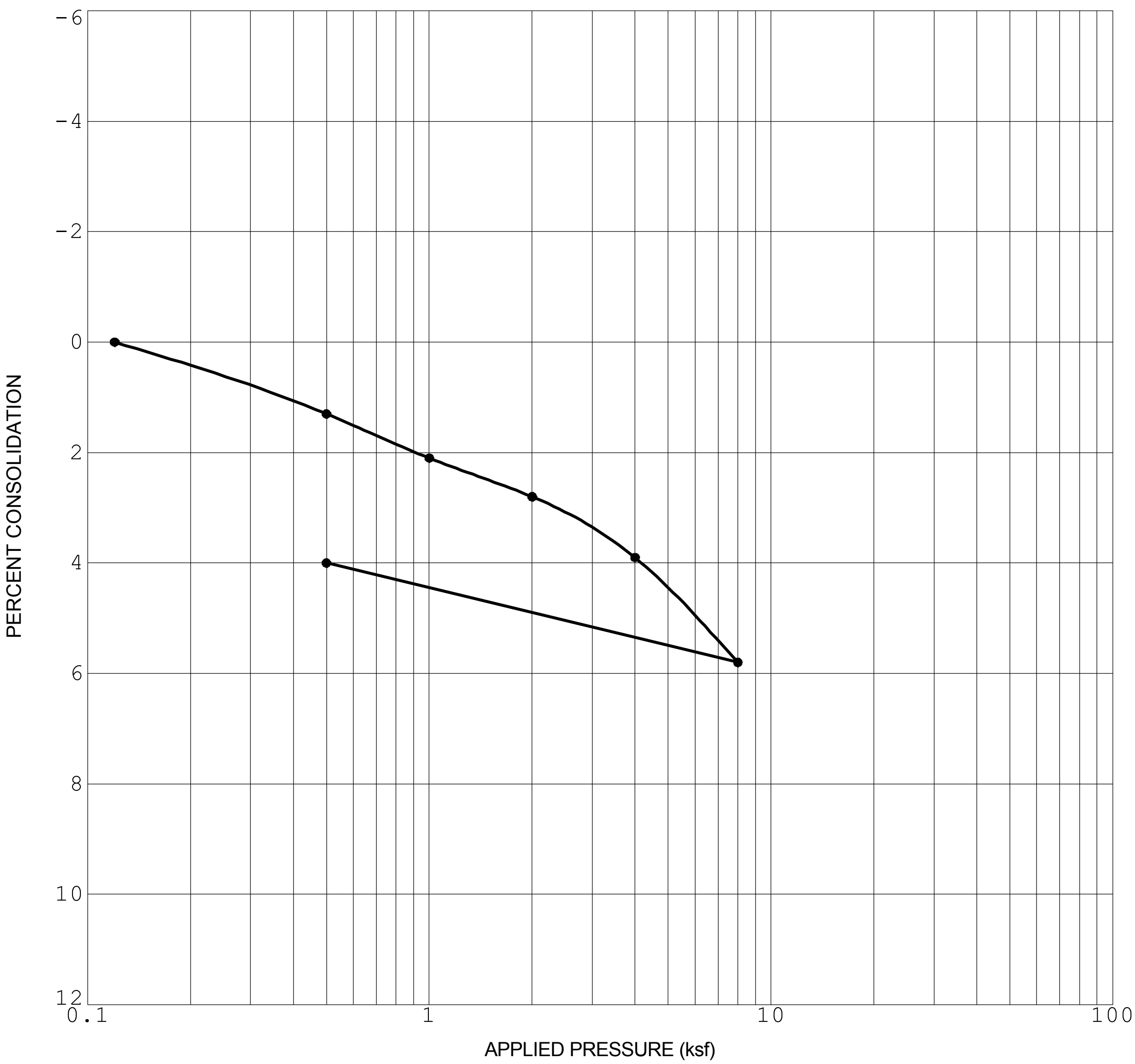
OCEANSIDE VISTA

OCEANSIDE, CALIFORNIA

07227-52-02.GPJ

Figure B-6

SAMPLE NO. B7-6



Initial Dry Density (pcf)	104.9
Initial Water Content (%)	14.3

Initial Saturation (%)	72.2
Sample Saturated at (ksf)	2.0

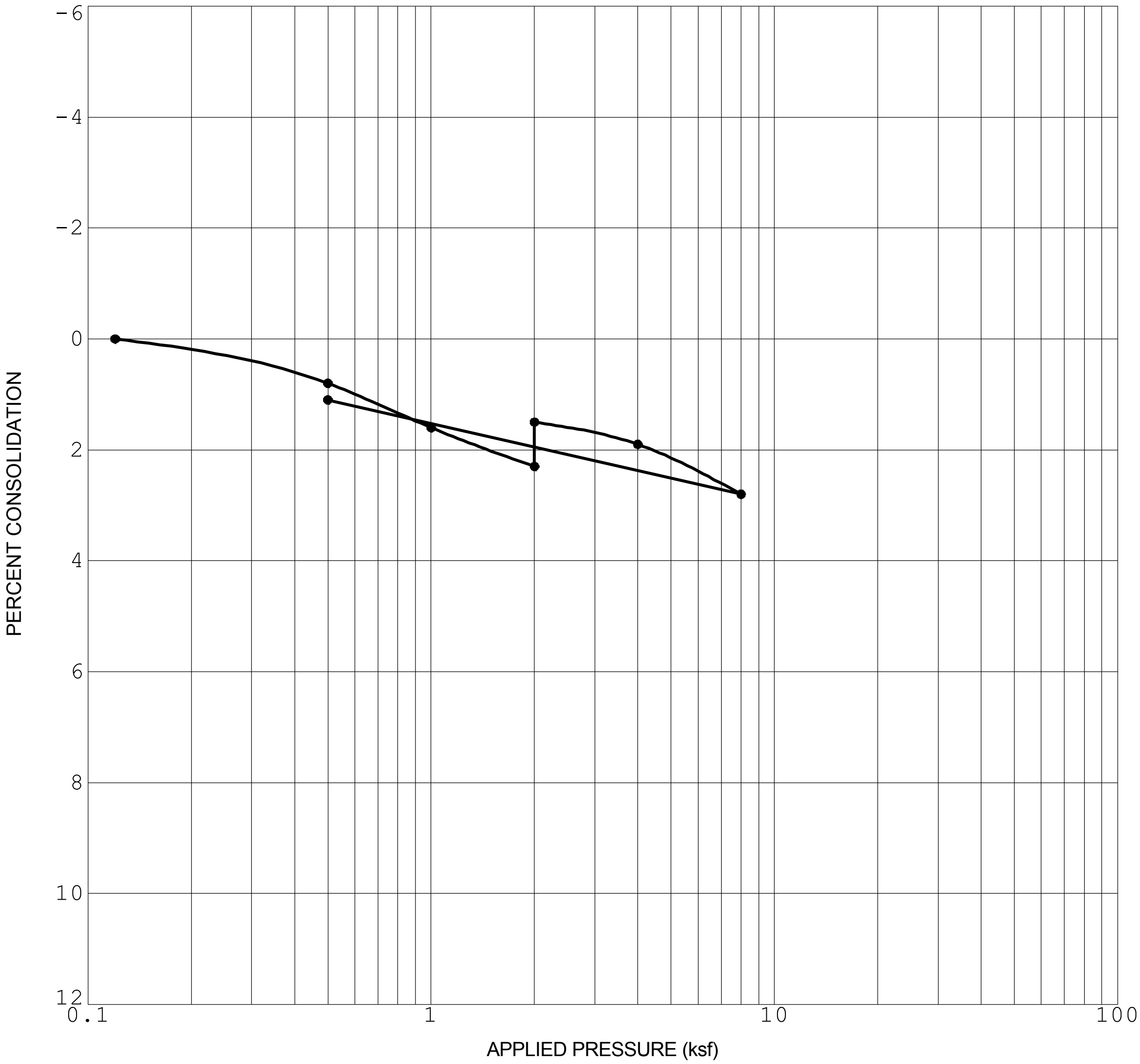
CONSOLIDATION CURVE

OCEANSIDE VISTA

OCEANSIDE, CALIFORNIA

PROJECT NO. 07227-52-02

SAMPLE NO. B7-8



Initial Dry Density (pcf)	103.6
Initial Water Content (%)	19.7

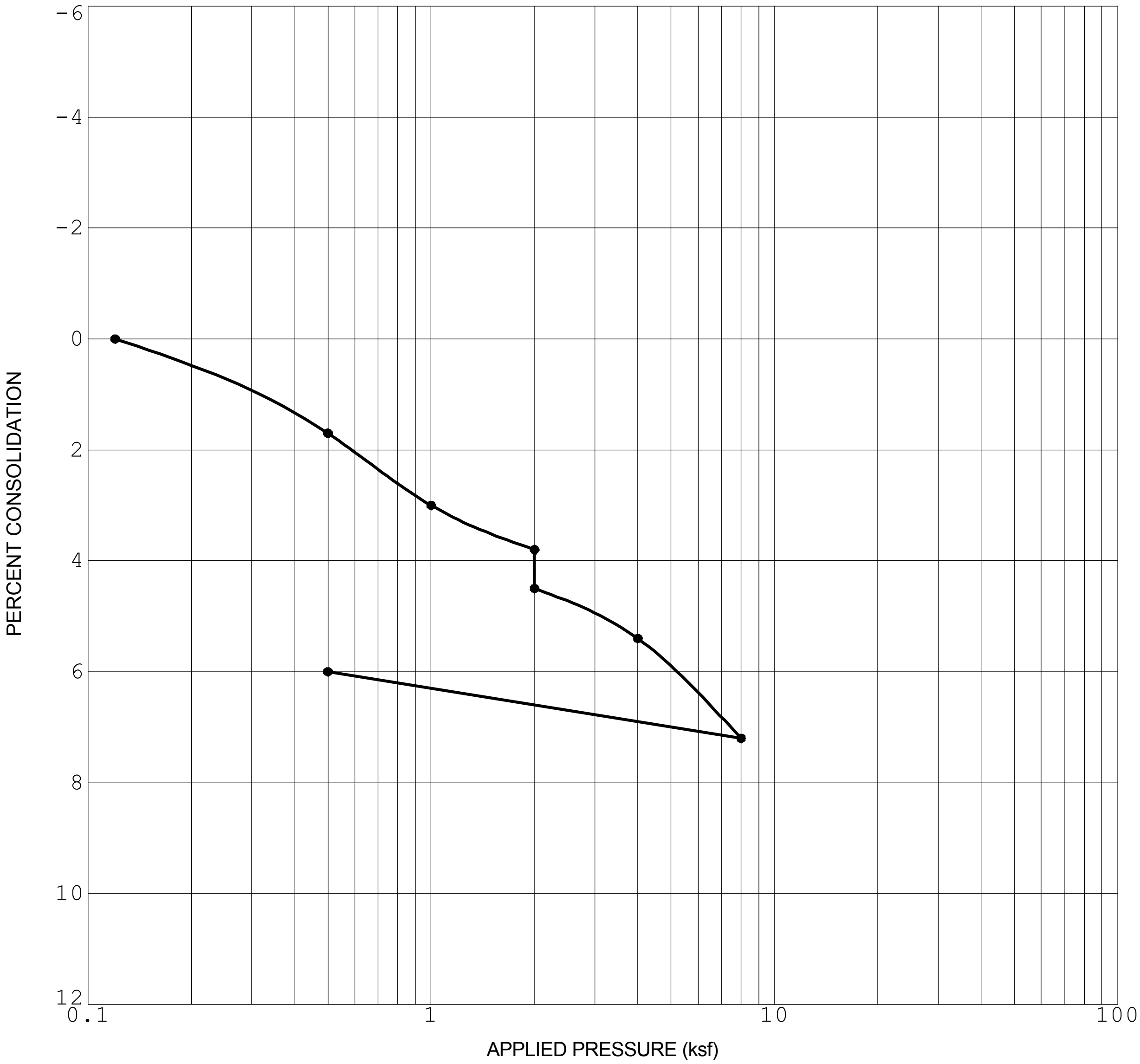
Initial Saturation (%)	87.1
Sample Saturated at (ksf)	2.0

CONSOLIDATION CURVE

OCEANSIDE VISTA

OCEANSIDE, CALIFORNIA

SAMPLE NO. B10-3



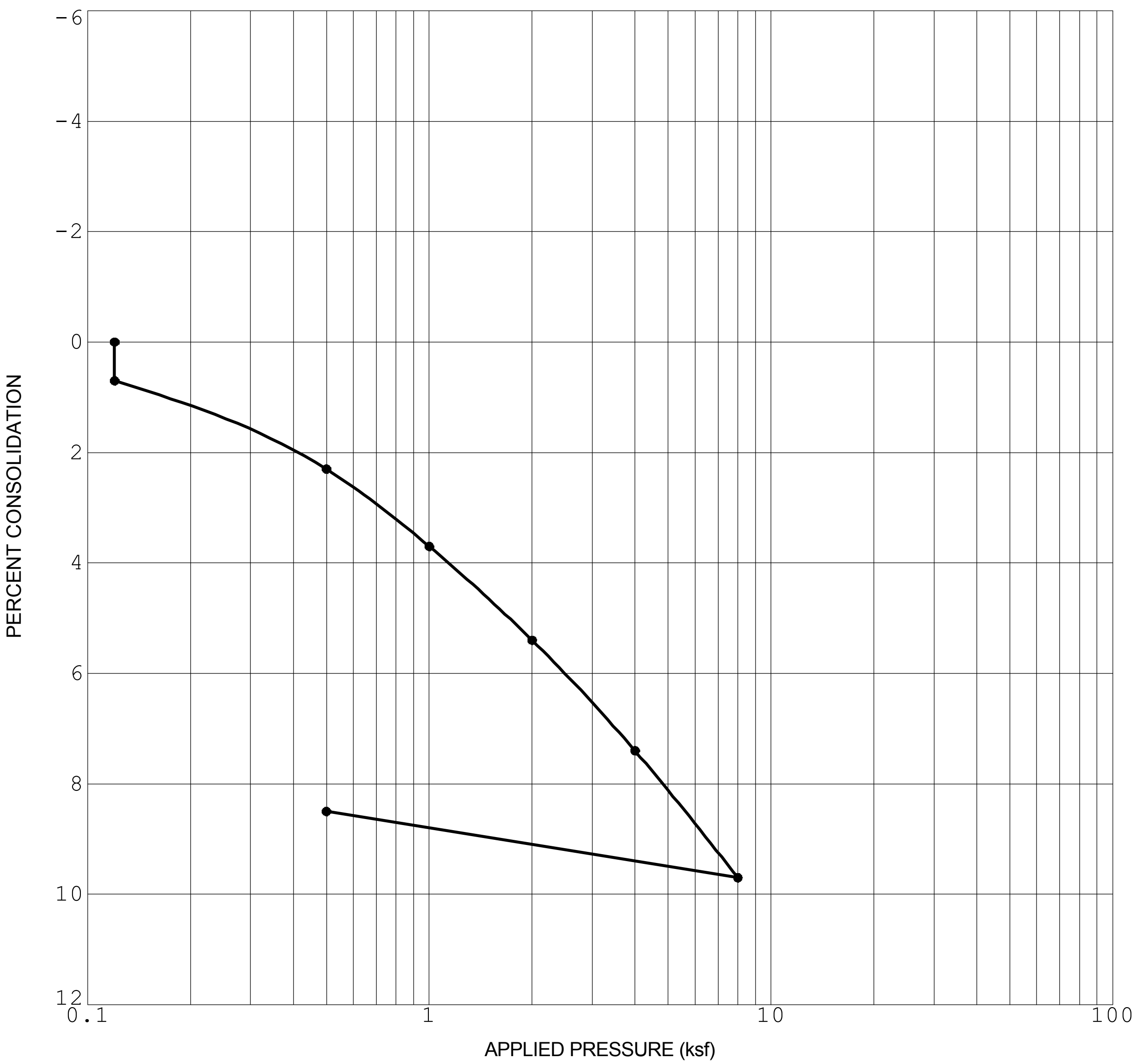
Initial Dry Density (pcf)	105.5		**Initial Saturation (%)**	89.1
Initial Water Content (%)	19.2		**Sample Saturated at (ksf)**	2.0

CONSOLIDATION CURVE

OCEANSIDE VISTA

OCEANSIDE, CALIFORNIA

SAMPLE NO. B10-4



Initial Dry Density (pcf)	101.5		**Initial Saturation (%)**	92.1
Initial Water Content (%)	22.0		**Sample Saturated at (ksf)**	0.125

CONSOLIDATION CURVE

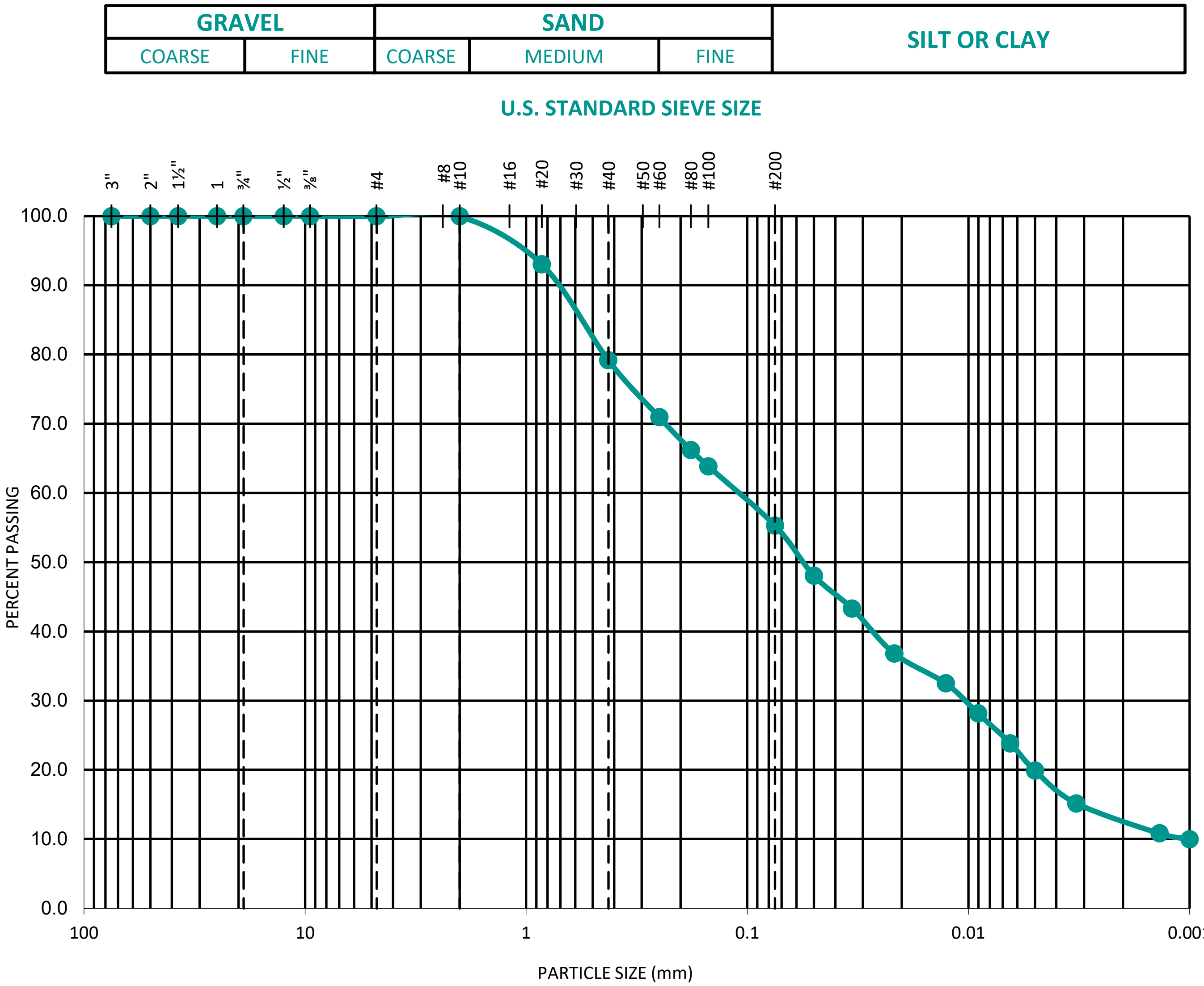
OCEANSIDE VISTA

OCEANSIDE, CALIFORNIA

SAMPLE NO.: **B11-1**

SAMPLE DEPTH (FT.): **39**

GEOLOGIC UNIT: **Qls**



TEST DATA					
D_{10} (mm)	D_{30} (mm)	D_{60} (mm)	C_c	C_u	SOIL DESCRIPTION
0.00101	0.01058	0.11618	1.0	115.4	Sandy SILT

GEOCON INCORPORATED

GEOTECHNICAL CONSULTANTS

6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974

PHONE 858 558-6900 - FAX 858 558-6159

SIEVE ANALYSES - ASTM D 135 & D 422

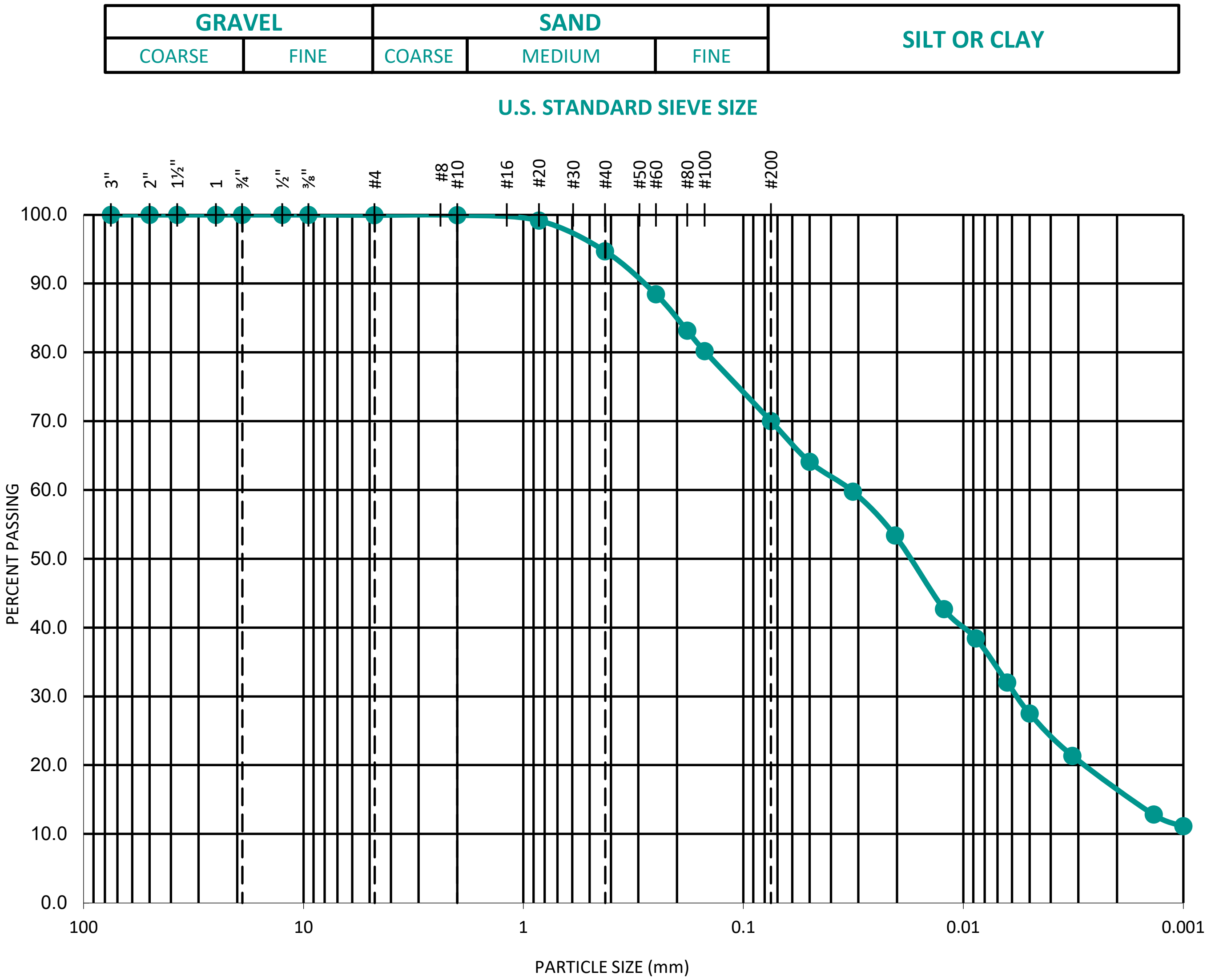
OLIVE PARK APARTMENTS

PROJECT NO.: G3035-52-01

SAMPLE NO.: **B-12**

SAMPLE DEPTH (FT.): **78**

GEOLOGIC UNIT: **Qls**



TEST DATA					
D_{10} (mm)	D_{30} (mm)	D_{60} (mm)	C_c	C_u	SOIL DESCRIPTION
--	0.00573	0.03271	--	--	SILT with sand

GEOCON INCORPORATED

GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

SIEVE ANALYSES - ASTM D 135 & D 422

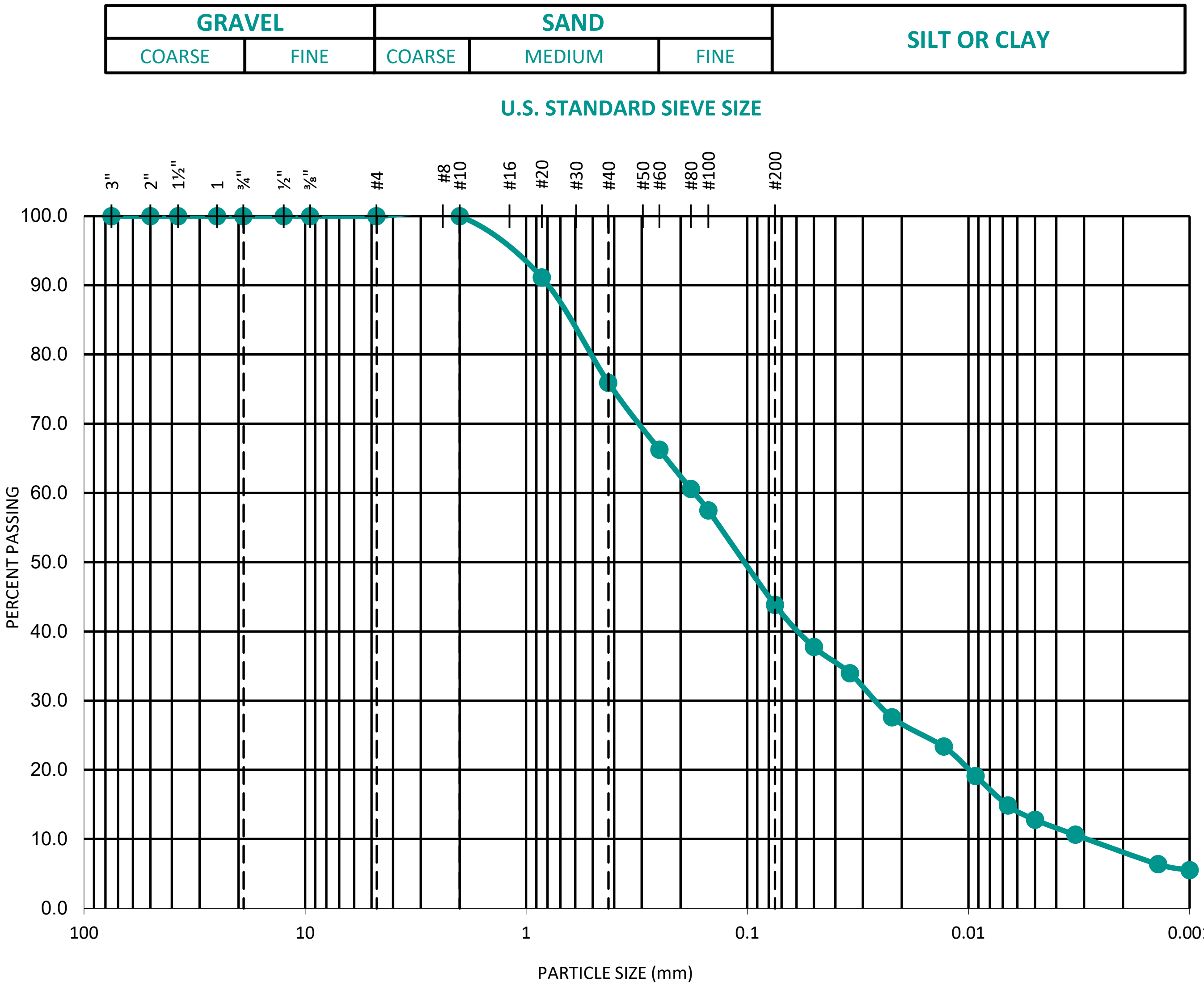
OLIVE PARK APARTMENTS

PROJECT NO.: G3035-52-01

SAMPLE NO.: **B13-1**

SAMPLE DEPTH (FT.): **39'**

GEOLOGIC UNIT: **Qls**



TEST DATA					
D_{10} (mm)	D_{30} (mm)	D_{60} (mm)	C_c	C_u	SOIL DESCRIPTION
0.00301	0.02675	0.17441	1.4	58.0	Silty SAND

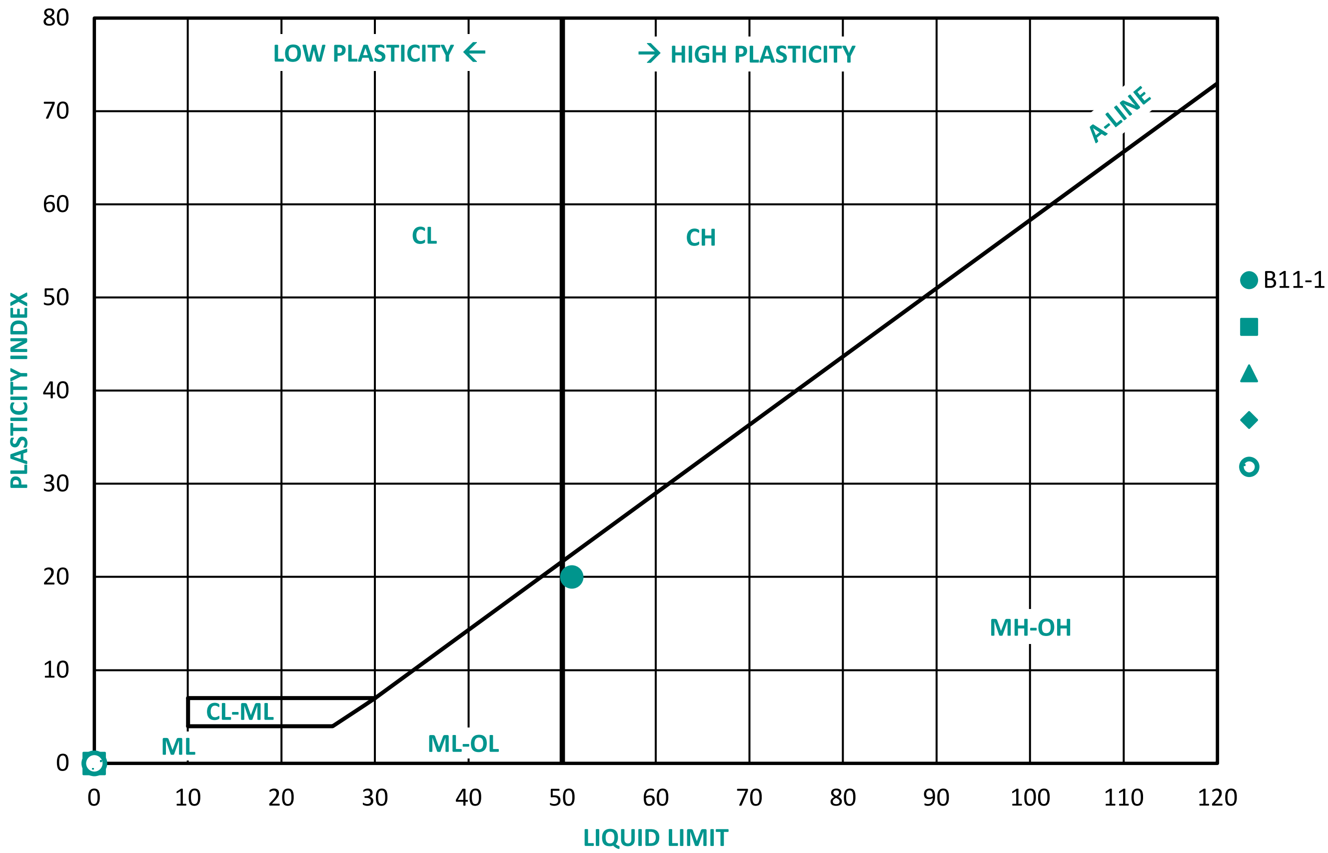
GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121-2974
PHONE 858 558-6900 - FAX 858 558-6159

SIEVE ANALYSES - ASTM D 135 & D 422

OLIVE PARK APARTMENTS

PROJECT NO.: G3035-52-01

TEST RESULTS					
SAMPLE NO.	GEOLOGIC UNIT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SOIL TYPE
B11-1	Qls	51	31	20	MH-OH



SOIL TYPE DESCRIPTION	
CH	High-Plasticity Clay
CL	Low-Plasticity Clay
ML	Low-Plasticity Silt
CL-ML	Low-Plasticity Clay to Low-Plasticity Silt
MH-OH	High-Plasticity Silt to High-Plasticity, Organic Silt
ML-OL	Low-Plasticity Silt to Low-Plasticity, Organic Silt

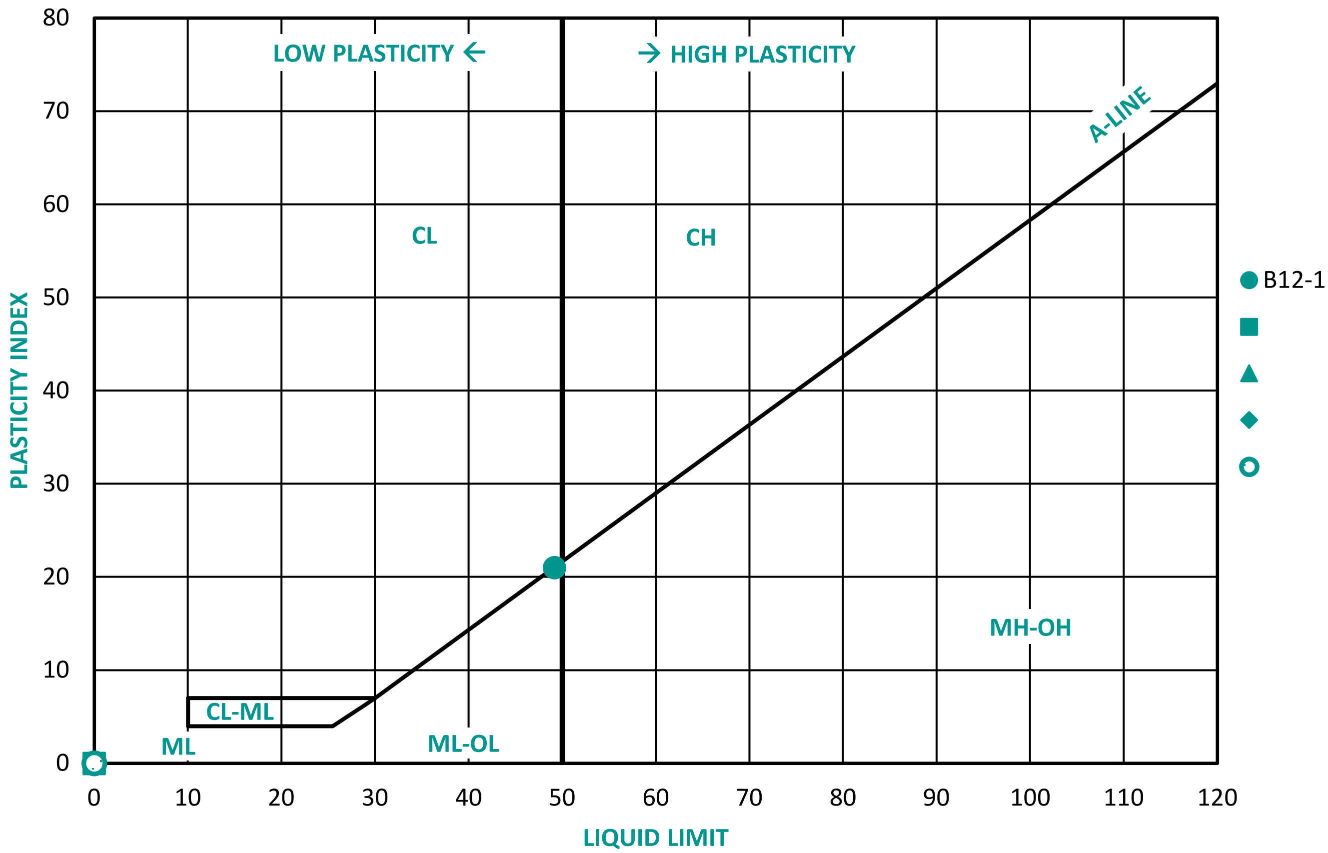
GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

PLASTICITY INDEX - ASTM D 4318

OLIVE PARK APARTMENTS

PROJECT NO.: G3035-52-01

TEST RESULTS					
SAMPLE NO.	GEOLOGIC UNIT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SOIL TYPE
B12-1	Qls	49	28	21	ML-OL



SOIL TYPE DESCRIPTION	
CH	High-Plasticity Clay
CL	Low-Plasticity Clay
ML	Low-Plasticity Silt
CL-ML	Low-Plasticity Clay to Low-Plasticity Silt
MH-OH	High-Plasticity Silt to High-Plasticity, Organic Silt
ML-OL	Low-Plasticity Silt to Low-Plasticity, Organic Silt

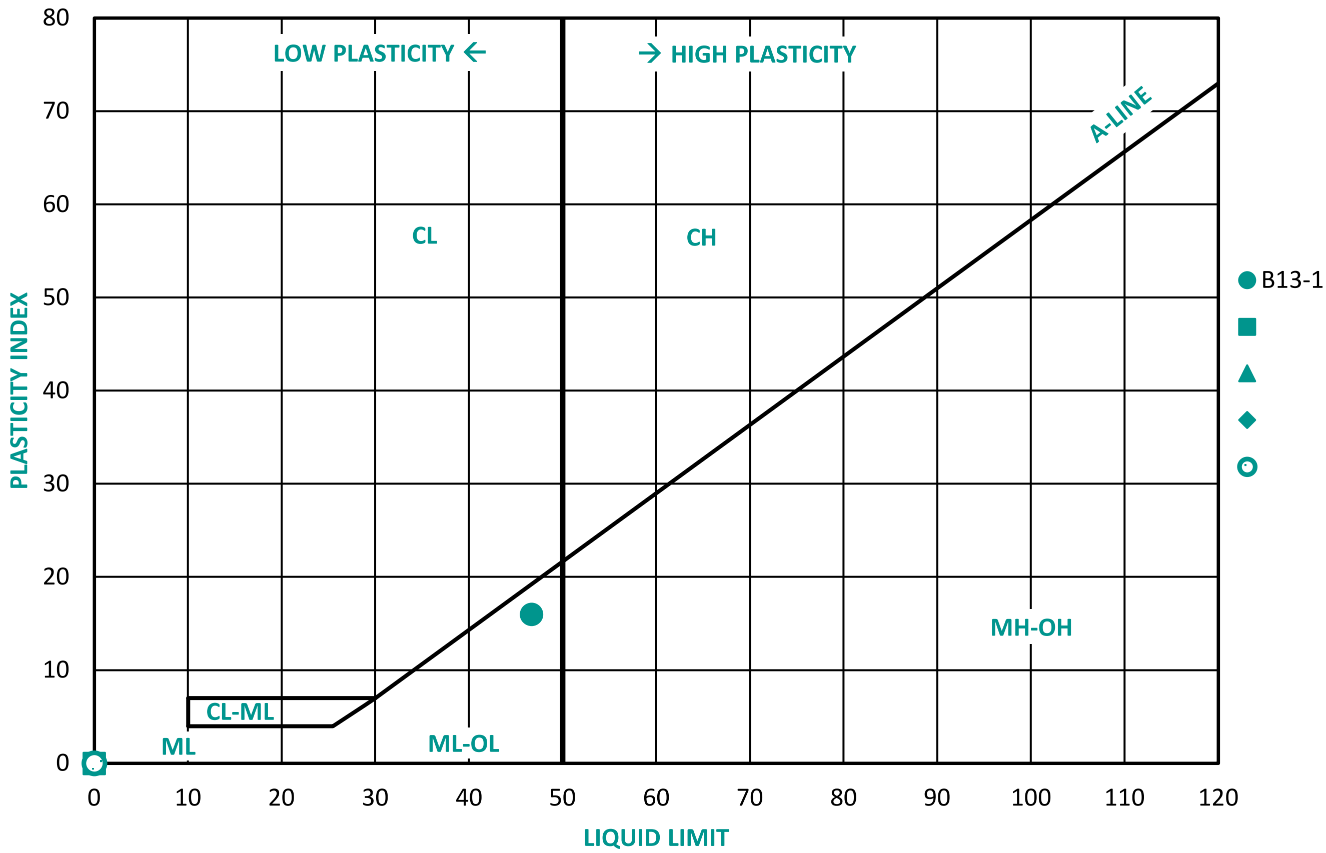
GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

PLASTICITY INDEX - ASTM D 4318

OLIVE PARK APARTMENTS

PROJECT NO.: G3035-52-01

TEST RESULTS					
SAMPLE NO.	GEOLOGIC UNIT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SOIL TYPE
B13-1	Qls	47	31	16	ML-OL



SOIL TYPE DESCRIPTION	
CH	High-Plasticity Clay
CL	Low-Plasticity Clay
ML	Low-Plasticity Silt
CL-ML	Low-Plasticity Clay to Low-Plasticity Silt
MH-OH	High-Plasticity Silt to High-Plasticity, Organic Silt
ML-OL	Low-Plasticity Silt to Low-Plasticity, Organic Silt

GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121-2974
PHONE 858 558-6900 - FAX 858 558-6159

PLASTICITY INDEX - ASTM D 4318

OLIVE PARK APARTMENTS

PROJECT NO.: G3035-52-01

APPENDIX C

APPENDIX C

PREVIOUS BORING LOGS, TRENCHES AND RESULTS OF LABORATORY TESTING (GEOCON, 1985 AND GEOTEK, 2007)

FOR

OLIVE PARK APARTMENTS
OLIVE DRIVE
OCEANSIDE, CALIFORNIA

PROJECT NO. G3035-52-01

File No. D-3453-MO2
July 1, 1985

BORING 1

ELEVATION 292' DATE DRILLED 6/5/85

EQUIPMENT Bucket Rig

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (U.S.C.S.)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE BLOWS/FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT, %
0					COLLUVIUM Medium dense, humid, light brown, Clayey SAND			
2								
4					LANDSLIDE DEBRIS Dense, humid, olive Silty SAND			
6					grades into very dense, moist, olive gray, highly fractured SANDSTONE			
8								
10					Dense, humid, cohesionless, whitich gray, medium-grained SAND			
12					Medium stiff to soft, humid, olive-gray, highly fractured CLAYSTONE with numerous randomly oriented minor shear planes			
14								
16					grades into hard, fractured Sandy SILTSTONE			
18								
20								
22					Very dense, humid, whitish-gray, fractured SANDSTONE			
24								
26					becomes massive, light gray, weakly cemented, medium- to coarse-grained SANDSTONE			
28								
30								

Figure A-1, Log of Test Boring 1

Continued next page

SAMPLE SYMBOLS
- ☐ — SAMPLING UNSUCCESSFUL
- ☒ — DISTURBED OR BAG SAMPLE
- STANDARD PENETRATION TEST
- CHUNK SAMPLE
- ■ — DRIVE SAMPLE (UNDISTURBED)
- WATER TABLE OR SEEPAGE

File No. D-3453-M02
July 1, 1985

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (U.S.C.S.)	BORING 1 CONTINUED ELEVATION ____ DATE DRILLED ____ EQUIPMENT ____ MATERIAL DESCRIPTION	PENETRATION RESISTANCE BLOWS/FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT, %
30								
32					Highly fractured, humid, olive-gray CLAYSTONE, contact sheared, dips steeply NW			
34								
36					dense, humid, whitish-gray cohesionless SAND			
38					grades into highly fractured, dark gray, fine Silty SANDSTONE			
40								
42					becomes light gray, medium to coarse SANDSTONE			
44					highly cemented zone			
46								
48					grades into medium-grained to fine SANDSTONE			
50								
52					becomes well cemented			
					Shear zone, thickness 1", attitude N10°W/6°W			
54								
56					PALEOSOL Hard, well cemented, humid, mottled rust btown-olive gray, Sandy SILTSTONE/SANDSTONE			
58								
60								

Figure A-2, Log of Test Boring 1 Continued

Continued next page

SAMPLE SYMBOLS
- ☐ — SAMPLING UNSUCCESSFUL
- ☒ — DISTURBED OR BAG SAMPLE
- STANDARD PENETRATION TEST
- CHUNK SAMPLE
- DRIVE SAMPLE (UNDISTURBED)
- WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

File No. D-3453-M02
July 1, 1985

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (U.S.C.S.)	BORING 1 CONTINUED ELEVATION ______ DATE DRILLED ______ EQUIPMENT ______	PENETRATION RESISTANCE BLOWS/FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT, %
					MATERIAL DESCRIPTION			
60								
62					Break in log			
74					DECOMPOSED GRANITICS			
76					Contact attitude N70°E/10°N, contact sheared, thickness of shear zone 1"-10", apparently discontinuous, very stiff, fractured, dark olive CLAYSTONE			
78					grades into very dense, moist, olive gray, Clayey, very coarse SANDSTONE			
80								
82					BORING TERMINATED AT 82.0 FEET			

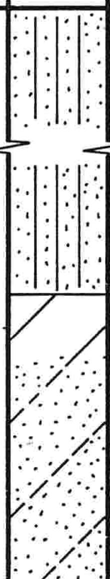


Figure A-3, Log of Test Boring 1 Continued

SAMPLE SYMBOLS

- ☐ --- SAMPLING UNSUCCESSFUL
- ☒ --- DISTURBED OR BAG SAMPLE
- --- STANDARD PENETRATION TEST
- --- CHUNK SAMPLE
- --- DRIVE SAMPLE (UNDISTURBED)
- --- WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

File No. D-3453-M02
July 1, 1985

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (U.S.C.S.)	BORING 2 ELEVATION 259' DATE DRILLED 6/6/85 EQUIPMENT Bucket Rig	PENETRATION RESISTANCE BLOWS/FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT, %
					MATERIAL DESCRIPTION			
0					TOPSOIL/COLLUVIUM Medium stiff, humid, blackish-gray, Sandy CLAY			
2								
4					SANTIAGO FORMATION Very dense, humid, gray, fractured Sandy SILTSTONE			
6					grades into weakly cemented coarse SANDSTONE			
8					Stiff, humid, fractured, gray SILTSTONE, bedding attitude N50°W/6°SW			
10					grades into very dense, humid, light gray, slightly fractured, very fine SANDSTONE			
12								
14					minor shear plane, thickness approximately 1/16", dips south 11°			
16								
18					Very dense, humid, massive, whitish-gray, weakly cemented, medium-grained SANDSTONE			
20								
22								
24								
26								
28					Very hard, highly cemented, whitish-gray, coarse SANDSTONE			
30								

Figure A-4, Log of Test Boring 2

Continued next page

SAMPLE SYMBOLS
☐ --- SAMPLING UNSUCCESSFUL
▯ --- STANDARD PENETRATION TEST
■ --- DRIVE SAMPLE (UNDISTURBED)
☒ --- DISTURBED OR BAG SAMPLE
◪ --- CHUNK SAMPLE
▽ --- WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

File No. D-3453-MO2
July 1, 1985

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (U.S.C.S.)	BORING 2 CONTINUED ELEVATION ______ DATE DRILLED 6/6/85 EQUIPMENT ______	PENETRATION RESISTANCE BLOWS/FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT, %
					MATERIAL DESCRIPTION			
30					DECOMPOSED GRANITICS Very dense, humid, olive, weathered, coarse SAND in Clayey matrix, attitude of contact N60°E/30°SE, some highly cemented paleosol remnants along the contact			
32								
34								
					grades into very hard, very dense DECOMPOSED GRANITIC ROCKS			
36								
38								
40								
42								
44								
46								
					Shear zone, minor fault, attitude N-S/45°W			
48								
50								
52								
54								
					BORING TERMINATED AT 55.0 FEET			
56								

Figure A-5, Log of Test Boring 2 Continued

SAMPLE SYMBOLS
- ☐ --- SAMPLING UNSUCCESSFUL
- ☒ --- DISTURBED OR BAG SAMPLE
- STANDARD PENETRATION TEST
- CHUNK SAMPLE
- DRIVE SAMPLE (UNDISTURBED)
- WATER TABLE OR SEEPAGE

File No. D-3453-M02
July 1, 1985

BORING 3

ELEVATION 232' DATE DRILLED 6/6/85

EQUIPMENT Bucket Rig

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (U.S.C.S.)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE BLOWS/FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT, %
0					LANDSLIDE DEBRIS Loose to medium dense, humid, olive-light gray, highly fractured, very fine Silty SANDSTONE			
5					Dense, dry, whitish-gray, highly fractured, very weakly cemented to cohesionless, medium- to coarse-grained SANDSTONE			
10	3-1					1/ 4"	112.9	8.8
11					occasional rip-up clasts			
15					grades into dense, fractured, light gray, Silty, very fine SANDSTONE/SILTSTONE			
20	3-2				grades into highly fractured, humid, dark gray SILTSTONE	3	104.6	18.0
26					highly fractured, very fine SANDSTONE			
30								

Figure A-6, Log of Test Boring 3

Continued next page

SAMPLE SYMBOLS
- SAMPLING UNSUCCESSFUL
- DISTURBED OR BAG SAMPLE
- STANDARD PENETRATION TEST
- CHUNK SAMPLE
- DRIVE SAMPLE (UNDISTURBED)
- WATER TABLE OR SEEPAGE

File No. D-3453-M02
July 1, 1985

BORING 3 CONTINUED

ELEVATION ____________ DATE DRILLED ____________

EQUIPMENT ____________

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (U.S.C.S.)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE BLOWS/FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT, %
30	3-3				minor shear zone, attitude approximately E-W/vertical	4	104.0	21.8
32					loose, moist, tan fine Silty SAND			
34					minor shear zone, attitude N45°W/60°NE			
36					Medium stiff to soft, moist, blackish-gray, Silty CLAY			
38					major shear zone, thickness 3"-4", attitude N60°W/4°SW			
40	3-4				SANTIAGO FORMATION Stiff, fractured, humid, light brown CLAYSTONE with shiny parting surfaces and randomly oriented minor shear planes	20	115.1	16.1
42								
44					grades into very dense, massive, humid, light gray Silty fine SANDSTONE			
46								
48					Very dense, massive, moist, whitish-gray, weakly cemented coarse SANDSTONE			
50					very hard, highly cemented SANDSTONE bed, attitude horizontal			
52					light general seepage			
54					Unconformity, hard, wet, dark olive, fractured SILTSTONE, contact dips approximately 25°W			
56								
58								
62					BORING TERMINATED AT 62.0 FEET			

Figure A-7, Log of Test Boring 3 Continued

SAMPLE SYMBOLS
- ☐ --- SAMPLING UNSUCCESSFUL
- ☒ --- DISTURBED OR BAG SAMPLE
- STANDARD PENETRATION TEST
- CHUNK SAMPLE
- DRIVE SAMPLE (UNDISTURBED)
- WATER TABLE OR SEEPAGE

File No. D-3453-M02
July 1, 1985

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (U.S.C.S.)	BORING 4 ELEVATION 282 DATE DRILLED 6/7/85 EQUIPMENT Bucket Rig MATERIAL DESCRIPTION	PENETRATION RESISTANCE BLOWS/FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT, %
0 – 5					TOPSOIL/COLLUVIUM Medium stiff to stiff, humid, blackish-brown, Silty CLAY			
5 – 10					LANDSLIDE DEBRIS Loose, humid to dry, light brown-tan, very fine Silty SAND			
10					grades into medium dense, humid, light brown-tan, cohesionless to very weakly cemented, very fine, poorly graded, Silty SAND with occasional angular sandstone fragments			
15	4-1					2	104.6	9.1
17	4-2						BULK SAMPLE	
21					Break in log			
53					Basal Shear Zone, soft, sheared, dark olive, Silty CLAY, thickness 2"-4", attitude near horizontal			
57 – 60					SANTIAGO FORMATION Very stiff, fractured, dark olive CLAYSTONE with shiny parging surfaces			

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 52, 54, 56, 58, 60

Figure A-8, Log of Test Boring 4

Continued next page

SAMPLE SYMBOLS
- ☐ --- SAMPLING UNSUCCESSFUL
- ☒ --- DISTURBED OR BAG SAMPLE
- STANDARD PENETRATION TEST
- CHUNK SAMPLE
- DRIVE SAMPLE (UNDISTURBED)
- WATER TABLE OR SEEPAGE

File No. D-3453-M02
July 1, 1985

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (U.S.C.S.)	BORING 4 CONTINUED ELEVATION______ DATE DRILLED______ EQUIPMENT ______	PENETRATION RESISTANCE BLOWS/FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT, %
					MATERIAL DESCRIPTION			
60					---grades into hard, olive, Clayey massive SILTSTONE			
62								
64					--- grades into very dense, massive, humid, olive-gray, medium cemented, very fine SANDSTONE			
66								
					BORING TERMINATED AT 65.0 FEET			

Figure A-9, Log of Test Boring 4 Continued

SAMPLE SYMBOLS

- ☐ --- SAMPLING UNSUCCESSFUL
- ☒ --- DISTURBED OR BAG SAMPLE
- --- STANDARD PENETRATION TEST
- --- CHUNK SAMPLE
- --- DRIVE SAMPLE (UNDISTURBED)
- --- WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

File No. D-3453-M02
July 1, 1985

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (U.S.C.S.)	BORING 5 ELEVATION 320' DATE DRILLED 6/7/85 EQUIPMENT Bucket Rig	PENETRATION RESISTANCE BLOWS/FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT, %
					MATERIAL DESCRIPTION			
0–6					TOPSOIL/COLLUVIUM Medium stiff, black, dry, Sandy CLAY grades into medium dense, moist, mottled Silty SAND			
6–26					LANDSLIDE DEBRIS Medium dense to dense, moist, mottled, light brown-tan, highly disturbed, fine Silty SAND with angular sandstone fragments soft, moist, gray, Silty CLAY/SILT Medium dense, humid, whitish-gray, cohesionless SAND with numerous soft SILTSTONE and CLAYSTONE fragments minor shear zone, thickness 1", attitude N50°W/35°SW Highly fractured, sheared, olive CLAYSTONE major shear zone, thickness 4"-6", attitude N20°W/16°W			
26–30					SANTIAGO FORMATION Highly fractured, humid, dark olive CLAYSTONE with shiny parting surfaces and randomly oriented minor shear planes			

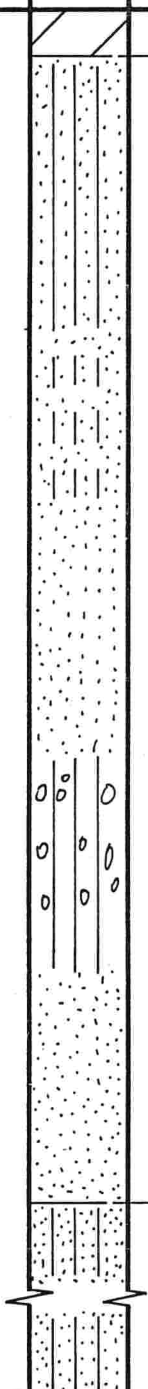
Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30

Figure A-10, Log of Test Boring 5

Continued next page

SAMPLE SYMBOLS			
	☐ — SAMPLING UNSUCCESSFUL	◧ — STANDARD PENETRATION TEST	■ — DRIVE SAMPLE (UNDISTURBED)
	☒ — DISTURBED OR BAG SAMPLE	◩ — CHUNK SAMPLE	▽ — WATER TABLE OR SEEPAGE

File No. D-3453-M02
July 1, 1985

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (U.S.C.S.)	BORING 5 CONTINUED ELEVATION ______ DATE DRILLED ______ EQUIPMENT ______	PENETRATION RESISTANCE BLOWS/FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT, %
					MATERIAL DESCRIPTION			
30								
32					grades into very dense, moist, olive-gray, Sandy SILTSTONE/very fine SANDSTONE			
34								
36								
38					grades into very dense, massive, humid, whitish-gray, Silty fine SANDSTONE			
40					grades into very dense, humid, whitish-tan, weakly cemented, well graded SANDSTONE			
42								
44								
46					numerous pebbles and siltstone, rip-up clasts			
48								
50					approximately 3" thick SILTSTONE bed, attitude N10°W/2°W			
52								
54					Unconformity, attitude of contact N80°W/30°S contact highly irregular			
56					hard, humid, dark gray, Sandy SILTSTONE/SANDSTONE			
					Break in log			
60								
62					BORING TERMINATED AT 61.0 FEET			

Figute A-11, Log of Test Boring 5

SAMPLE SYMBOLS
- SAMPLING UNSUCCESSFUL
- DISTURBED OR BAG SAMPLE
- STANDARD PENETRATION TEST
- CHUNK SAMPLE
- DRIVE SAMPLE (UNDISTURBED)
- WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

File No. D-3453-M02
July 1, 1985

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (U.S.C.S.)	BORING 6 ELEVATION 264' DATE DRILLED 6/7/85 EQUIPMENT Bucket Rig	PENETRATION RESISTANCE BLOWS/FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT, %
					MATERIAL DESCRIPTION			
0					TOPSOIL/COLLUVIUM Stiff, dry, grayish-brown, calichefied, Sandy CLAY			
5					LANDSLIDE DEBRIS Loose, dry, grayish-tan, cohesionless SAND			
11					Highly fractured, humid, dark olive, Silty CLAYSTONE, attitude N20°E/9°W			
14					SANTIAGO FORMATION Very dense, humid, massive, olive gray SANDSTONE			
17					grades into light olive gray SANDSTONE			
19					Very dense, humid, whitish gray-tan, weakly cemented, well graded SANDSTONE			
22.5					very coarse with numerous pebbles and rip-up clasts			
29					SILTSTONE bed			
30								

Figure A-12, Log of Test Boring 6

Continued next page

SAMPLE SYMBOLS
- ☐ — SAMPLING UNSUCCESSFUL
- ☒ — DISTURBED OR BAG SAMPLE
- STANDARD PENETRATION TEST
- CHUNK SAMPLE
- DRIVE SAMPLE (UNDISTURBED)
- WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

File No. D-3453-M02
July 1, 1985

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (U.S.C.S.)	BORING 6 CONTINUED ELEVATION ______ DATE DRILLED ______ EQUIPMENT ______	PENETRATION RESISTANCE BLOWS/FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT, %
					MATERIAL DESCRIPTION			
30					very light seepage			
32					Unconformity, attitude of contact N65°E/6°NE, hard, highly fractured, moist, dark olive-gray CLAYSTONE with shiny paring surfaces and randomly oriented minor shear zones, contact with the overlying sandstone sheared			
34								
36								
38					grades into hard, massive, humid, gray SILTSTONE			
40								
42					BORING TERMINATED AT 42.0 FEET			

Figure A-13, Log of Test Boring 6 Continued

SAMPLE SYMBOLS
- ☐ — SAMPLING UNSUCCESSFUL
- ☒ — DISTURBED OR BAG SAMPLE
- STANDARD PENETRATION TEST
- CHUNK SAMPLE
- DRIVE SAMPLE (UNDISTURBED)
- WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

File No. D-3453-M02
July 1, 1985

BORING 7

ELEVATION 204 DATE DRILLED 6/12/85

EQUIPMENT Mobile B-50

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (U.S.C.S.)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE BLOWS/FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT, %
0					TOPSOIL Soft, dry to humid, blackish-gray, Sandy CLAY			
4					ALLUVIUM Loose to medium dense, moist to wet, dark grayish-brown, Clayey SAND			
6	7-1					28	114.7	
8					grades into medium dense, wet, brownish-gray, Silty fine SAND			
10	7-2		▽			23	100.9	
14					Very dense, saturated, dark gray, Silty SAND with soft, blackish-gray CLAY interbeds			
16	7-3					40	112.3	
					Break in log			
26					LANDSLIDE DEBRIS? OR WEATHERED SANTIAGO FM. Medium stiff, saturated, mottled olive green-purple, Sandy CLAY/SAND			
36					BORING TERMINATED AT 35.0 FEET			

Figure A-14, Log of Test Boring 7

SAMPLE SYMBOLS
- ☐ --- SAMPLING UNSUCCESSFUL
- ☒ --- DISTURBED OR BAG SAMPLE
- STANDARD PENETRATION TEST
- CHUNK SAMPLE
- DRIVE SAMPLE (UNDISTURBED)
- ▽ --- WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

File No. D-3453-M02
July 1, 1985

BORING 8

ELEVATION 185 DATE DRILLED 6/12/85

EQUIPMENT Mobile B-50

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (U.S.C.S.)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE BLOWS/FT.	DRY DENSITY P.C.F.	MOISTURE CONTENT, %
0					ALLUVIUM Very loose, dry, whitish-gray, poorly graded fine SAND			
2								
4					grades into loose, moist, mottled light gray-black SAND/CLAY			
6	8-1					19	102.0	
8					grades into moist to wet, olive gray, pooly graded fine Silty SAND			
10	8-2		▽			21	103.0	
12								
14					grades into loose to medium dense, interbedded fine SAND and Sandy CLAY			
16	8-3					20	95.9	
					Break in log			
34					Soft, saturated, black Silty CLAY			
36					SANTIAGO FORMATION Very dense, saturated, light olive, massive, very fine Silty SANDSTONE			
38								
40								
42								
44								
46					BORING TERMINATED AT 45.0 FEET			

Figure A-15, Log of Test Boring 8

SAMPLE SYMBOLS

☐ — SAMPLING UNSUCCESSFUL
☒ — DISTURBED OR BAG SAMPLE
◧ — STANDARD PENETRATION TEST
◩ — CHUNK SAMPLE
■ — DRIVE SAMPLE (UNDISTURBED)
▽ — WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

File No. D-3453-M02
July 1, 1985

TABLE I

Summary of In-Place Moisture-Density and Direct Shear Test Results

Sample No.	Depth ft.	Dry Density pcf	Moisture Content %	Unit Cohesion psf	Angle of Shear Resistance Degrees
3-1	10	112.9	8.8		
3-2	20	104.6	18.0	1110	19
3-3	30	104.0	21.8		
3-4	40	115.1	16.1		
4-1	15	104.6	9.1		
*4-2	16-19	104.8	13.7	310	26

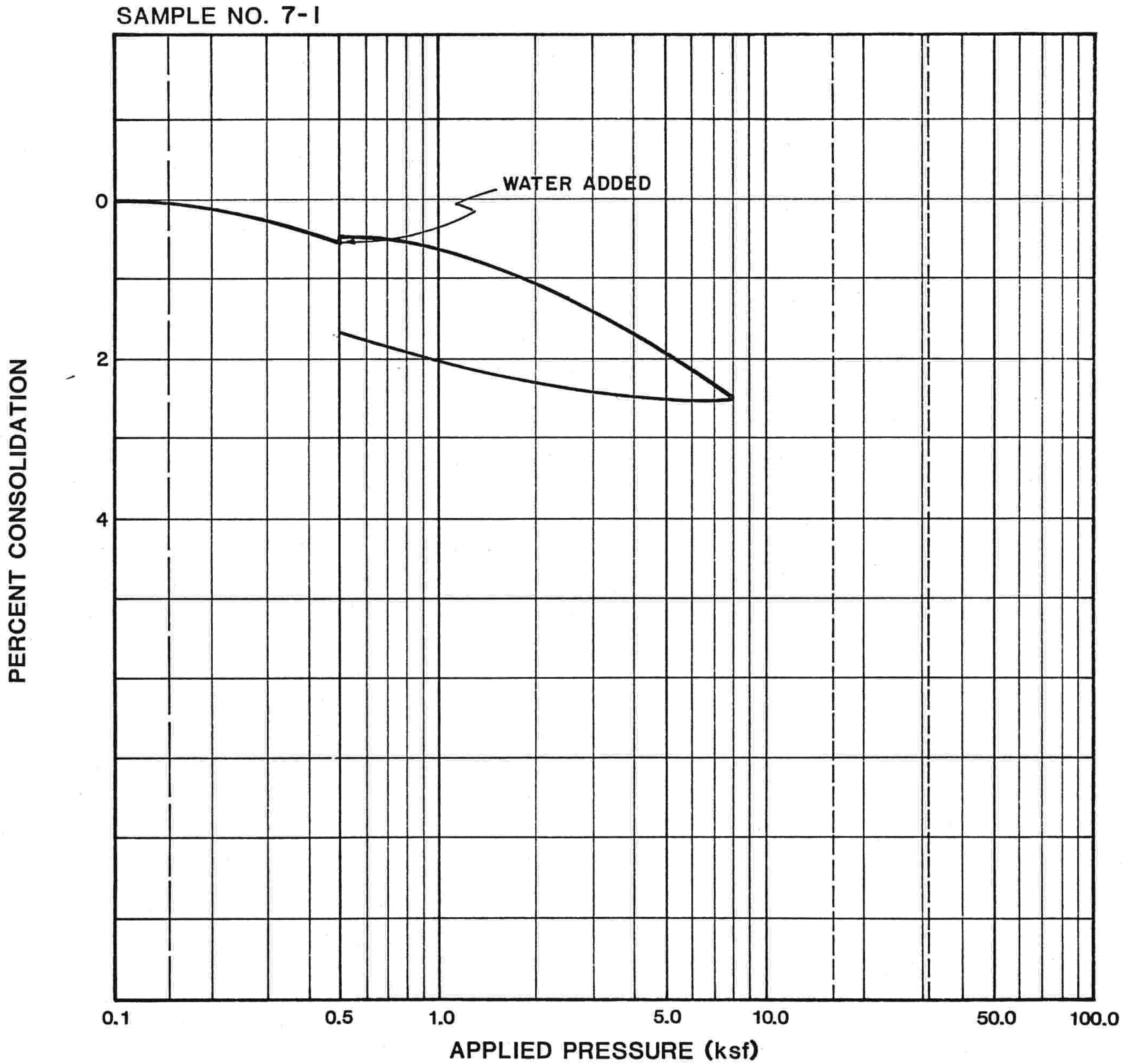
TABLE II

Summary of Laboratory Compaction Test Results

ASTM D1557-70

Sample No.	Description	Maximum Dry Density pcf	Optimum Moisture % Dry Wt.
4-2	Light brown, fine SAND	116.6	13.3

*Sample remolded to approximately 90 percent of maximum dry density at near optimum moisture content.



INITIAL DRY DENSITY	114.7 (pcf)	INITIAL SATURATION	15.9 (%)
INITIAL WATER CONTENT	13.7 (%)	SAMPLE SATURATED AT	500 (ksf)

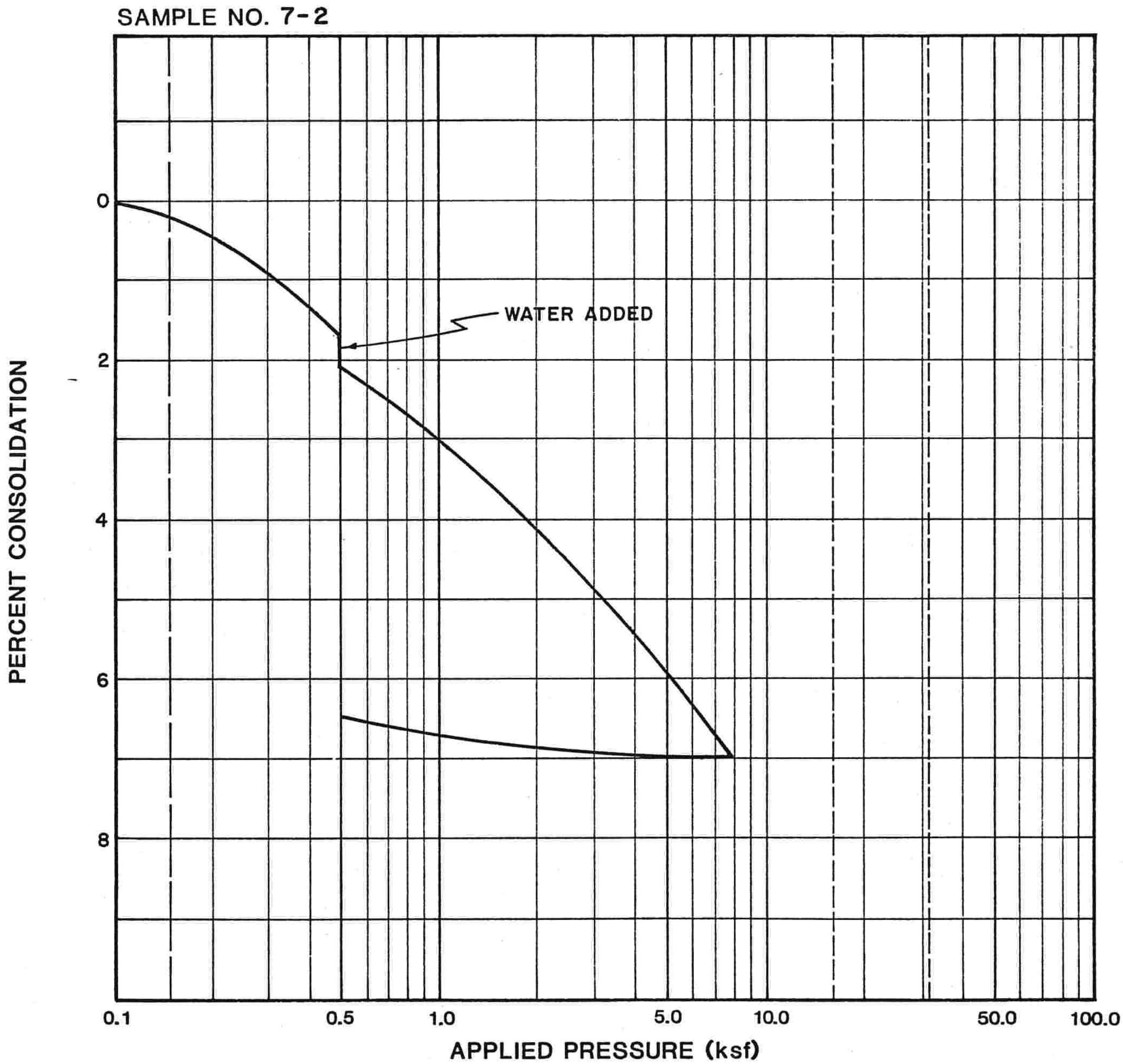
CONSOLIDATION CURVE

WESTWIND

OCEANSIDE, CALIFORNIA

Figure B-1

File No. D-3453-M02
July 1, 1985



INITIAL DRY DENSITY	100.9 (pcf)	INITIAL SATURATION	20.3 (%)
INITIAL WATER CONTENT	21.6 (%)	SAMPLE SATURATED AT	100.9 (ksf)

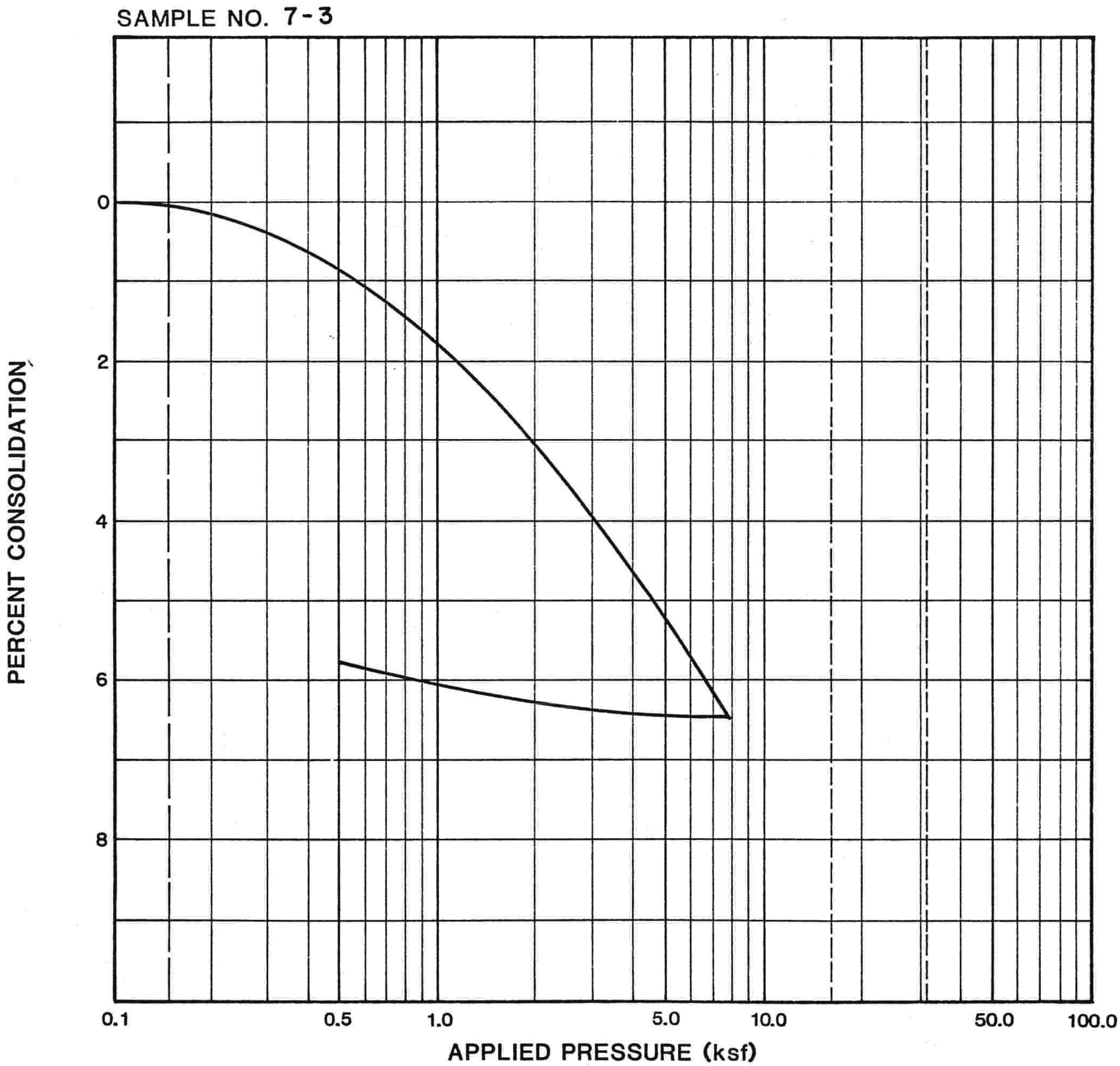
CONSOLIDATION CURVE

WESTWIND

OCEANSIDE, CALIFORNIA

Figure B-2

File No. D-3453-M02
July 1, 1985



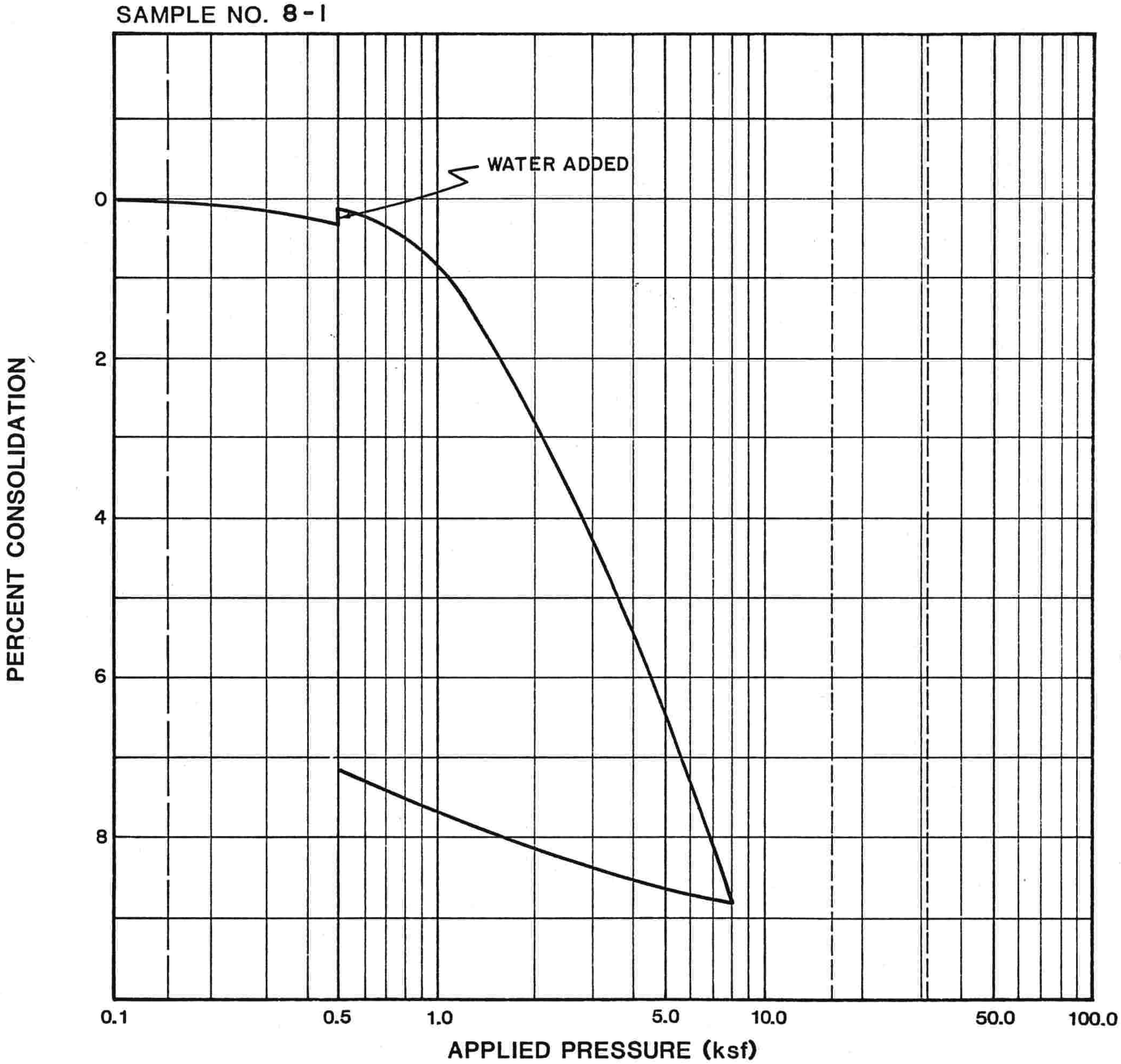
INITIAL DRY DENSITY	112.3 (pcf)	INITIAL SATURATION	16.2 (%)
INITIAL WATER CONTENT	16.6 (%)	SAMPLE SATURATED AT	125 (ksf)

CONSOLIDATION CURVE

WESTWIND

OCEANSIDE, CALIFORNIA

Figure B-3



INITIAL DRY DENSITY	102 (pcf)	INITIAL SATURATION	19.4 (%)
INITIAL WATER CONTENT	8.7 (%)	SAMPLE SATURATED AT	500 (ksf)

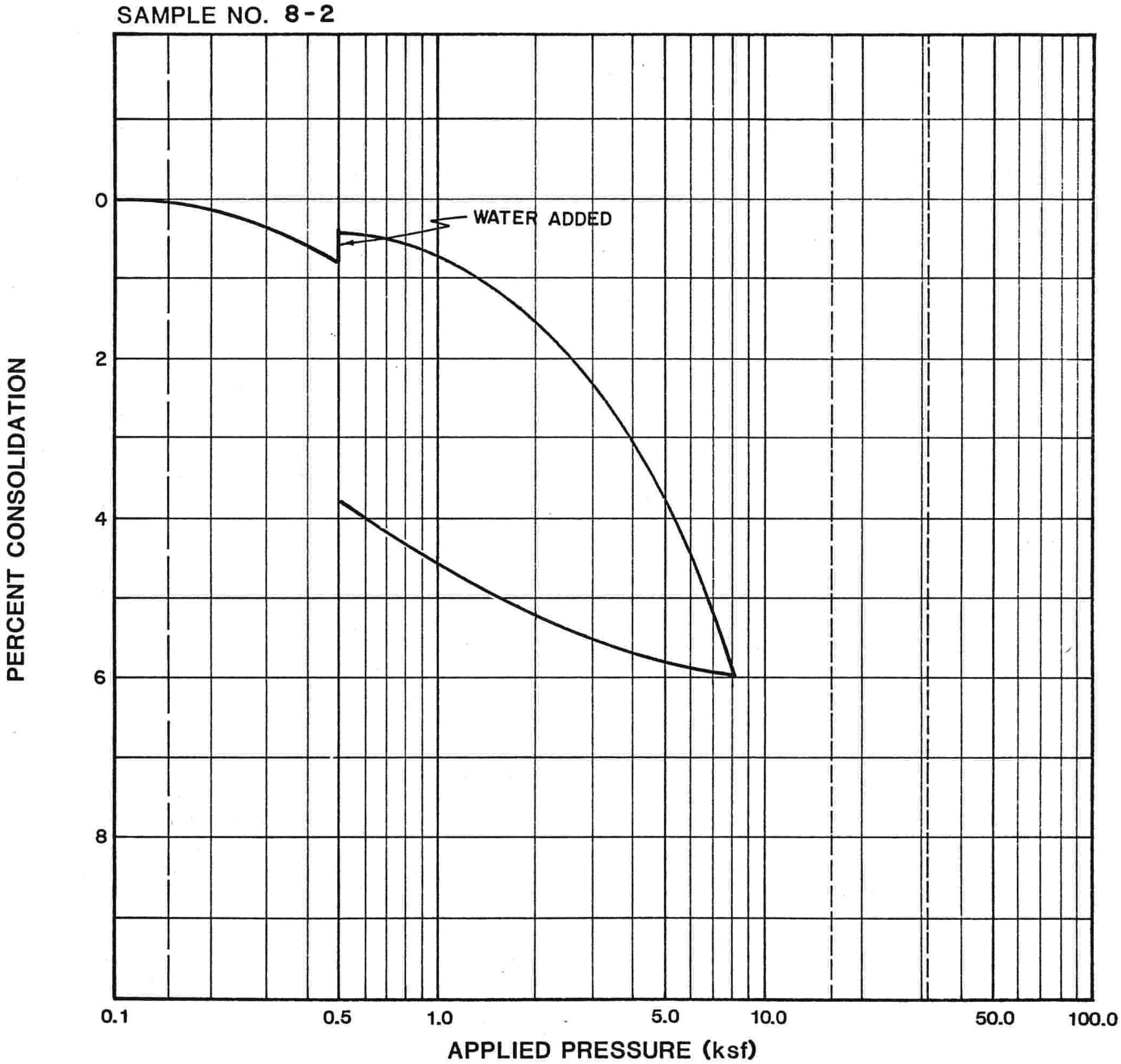
CONSOLIDATION CURVE

WESTWIND

OCEANSIDE, CALIFORNIA

Figure B-4

File No. D-3453-M02
July 1, 1985



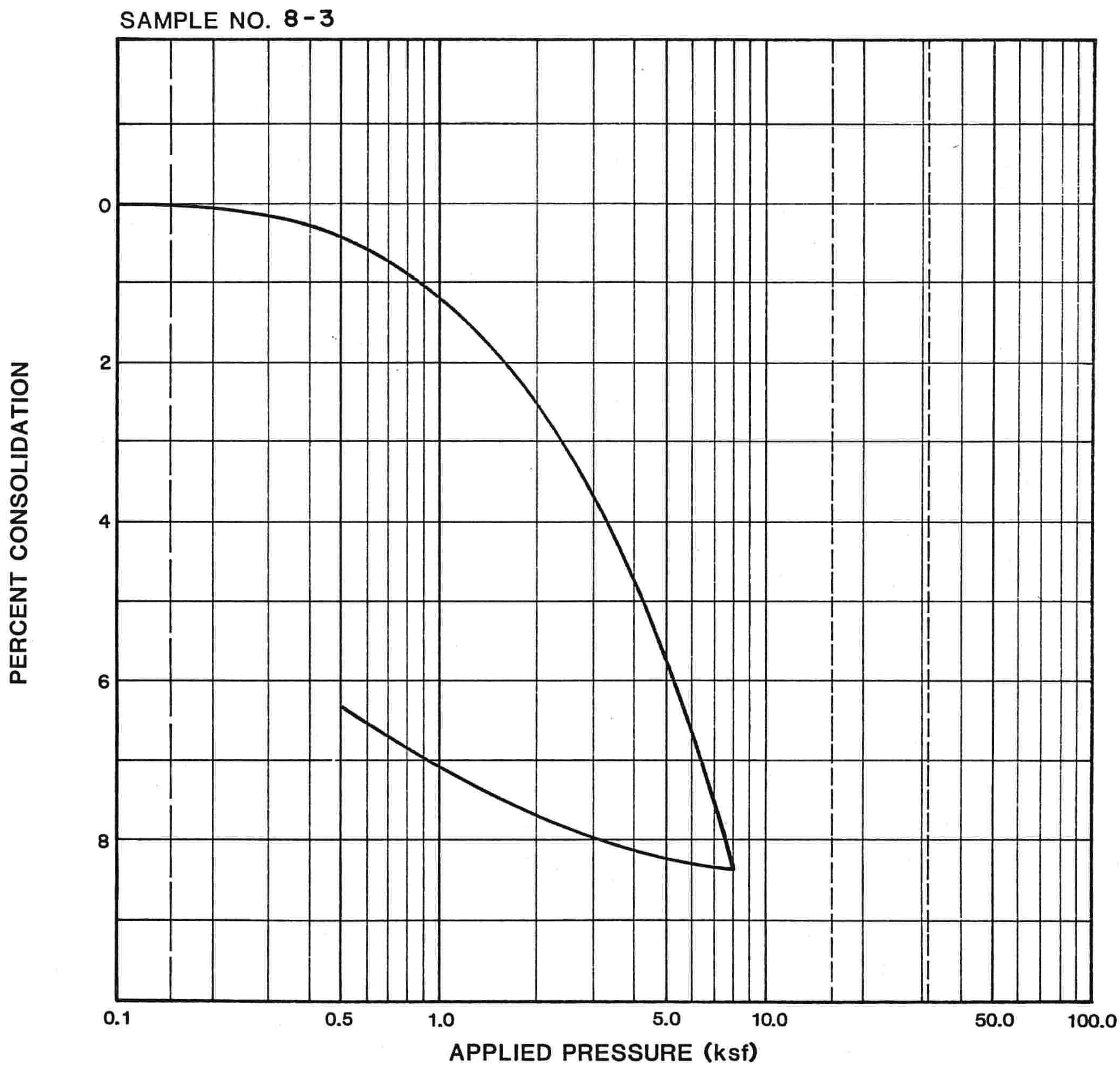
INITIAL DRY DENSITY	103.0 (pcf)	INITIAL SATURATION	22.4 (%)
INITIAL WATER CONTENT	23.3 (%)	SAMPLE SATURATED AT	500 (ksf)

CONSOLIDATION CURVE

WESTWIND

OCEANSIDE, CALIFORNIA

Figure B-5



INITIAL DRY DENSITY	95.9 (pcf)	INITIAL SATURATION	25.2 (%)
INITIAL WATER CONTENT	28.1 (%)	SAMPLE SATURATED AT	500 (ksf)

CONSOLIDATION CURVE

WESTWIND

OCEANSIDE, CALIFORNIA

Figure B-6

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	Urban Structures LLC	**DRILLER:**	Larive	**LOGGED BY:**	BO/JB
PROJECT NAME:	Oceanside Vista Residential Dvlp	**DRILL METHOD:**	30" Bucket	**OPERATOR:**	Richard/Adam
PROJECT NO.:	3129SD3	**HAMMER:**	Kelly Bar	**RIG TYPE:**	Earthdrill 45L
LOCATION:	See Site Plan	**ELEVATION:**	304 feet above MSL	**DATE:**	11/28/2006

BORING NO.: *GTB-1*

Depth (ft)	SAMPLES: Sample Type	Blows/ 12 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
				SM	**Landslide Deposits** Tan to light gray, moist, loose, silty, fine to medium SAND, friable 1 inch fragments of silty claystone, iron oxide stain, rootlets.			Kelly Bar 3500 Lbs.
5	Ring	1	B1-1			10.7	96	SH
	Small Bulk		B1-2					SR, SA
10					@ 11': several sub-parallel clay lined fractures (1/2"), infilled, dipping steeply to the SE @ 40-60 degrees, continuous to contact @ 13.5 feet.			C: N50W 35NE
				CL	Light olive gray silty CLAYSTONE, moist, loose, steep undulating contact, fractured/jumbled appearance, interbeds with tan sandstone.			
15	Ring	Push	B1-3		@ 16.5': remolded olive gray clay seam (1/4"), soft, continuous around bore hole, slightly undulating, random orientated, polished surfaces and clay and Manganesse oxide staining, healed fractures	21.5	117	SH CS: N70E 11NE
					@ 19': becoming more massive, less fractured			
20					@ 21': random orientated slicks			
					@ 23': grades to well indurated massive silty claystone, some scattered orange-brown rip up casts.			
25								Kelly Bar 2400 Lbs. C: N40W 8NE
				SM	Tan to light gray, moist, very dense, silty fine to medium SAND massive			
30					**(continued)**			

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:
AL = Atterberg Limits | EI = Expansion Index | SA = Sieve Analysis | RV = R-Value Test
SR = Sulfate/Resisitivity Test | SH = Shear Test | CO = Consolidation test | MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	Urban Structures LLC	**DRILLER:**	Larive	**LOGGED BY:**	BO/JB
PROJECT NAME:	Oceanside Vista Residential Dvlp	**DRILL METHOD:**	30" Bucket	**OPERATOR:**	Richard/Adam
PROJECT NO.:	3129SD3	**HAMMER:**	Kelly Bar	**RIG TYPE:**	Earthdrill 45L
LOCATION:	See Site Plan	**ELEVATION:**	304 feet above MSL	**DATE:**	11/28/2006

BORING NO.: *GTB-1*

Depth (ft)	Sample Type	Blows/ 12 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Water Content (%)	Dry Density (pcf)	Others
30	Ring	15/8"	B1-4	SM	**Landslide Deposits (continued)** Tan to light gray, moist, very dense, silty fine to medium SAND			
					@ 32': pockets of silty claystone within massive silty sandstone friable, massive.			
35					@ 36':increasing in grain size; becoming coarse grained sand			
40					@ 41': scattered 1" to 3" rip up casts of silty claystone			
					@ 44': sharply defined iron oxide stained 3" layer of coarse grained sandstone, undulating near horizontal attitude.			
45	Ring / Small Bulk	10	B1-5		@ 44.4 to 44.9': Basalrupture Surface: 5 inch thick zone of remolded clay, sheared and highly polished surfaces, iron oxide at base, rootlets in fractures			RS: N50W 2-4NE SH Driller utilized down crowds
				CL	**Santiago Formation** Olive gray, moist, hard silty CLAYSTONE very dense,silty fine SANDSTONE, well indurated, massive, no fractures.			
50								C: N30E 8 SE
				SM	@ 51': grades to light gray, damp, fine to medium silty SANDSTONE			
					@ 54': cemented zone in sandstone			
55					@ 55' becoming moist			Kelly 1300 Lbs.
	Small Bulk		B1-6					
60					**(contined)**			

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; CO = Consolidation test; MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	Urban Structures LLC	**DRILLER:**	Larive	**LOGGED BY:**	BO/JB
PROJECT NAME:	Oceanside Vista Residential Dvlp	**DRILL METHOD:**	30" Bucket	**OPERATOR:**	Richard/Adam
PROJECT NO.:	3129SD3	**HAMMER:**	Kelly Bar	**RIG TYPE:**	Earthdrill 45L
LOCATION:	See Site Plan	**ELEVATION:**	304 feet above MSL	**DATE:**	11/28/2006

BORING NO.: *GTB-1*

Depth (ft)	SAMPLES: Sample Type	Blows/ 12 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
60	Ring	25/9"	B1-7	SM	**Santiago Formation (continued)** @ 60': sharp flat contact 1" thick iron oxide layer: Tan silty SANDSTONE to pink to orange, mottled, damp, very dense, silty SANDSTONE, massive no bedding.	9.2	132	
65								
					@ 67'- 68': well cemented zone			
70								
	Ring	25/6"	B1-8					
75					@ 75'- 81': gray to orange mottled			
80	Ring	25/ 10"	B1-9					
	Ring		B1-10		@ 84': dark grayish green rip up casts w/ the appearance of weathered granitic rock.			
85				SC	Grayish green, moist, very dense, well indurated granitic detritus with 4" to 8" of cobbles of granitic rock, flat contact, very difficult drilling.			Kelly 1800 Lbs. 30" auger and down crowds
90								
					(continued)			

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits EI = Expansion Index SA = Sieve Analysis RV = R-Value Test
SR = Sulfate/Resisitivity Test SH = Shear Test CO = Consolidation test MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	Urban Structures LLC	**DRILLER:**	Larive	**LOGGED BY:**	BO/JB
PROJECT NAME:	Oceanside Vista Residential Dvlp	**DRILL METHOD:**	30" Bucket	**OPERATOR:**	Richard/Adam
PROJECT NO.:	3129SD3	**HAMMER:**	Kelly Bar	**RIG TYPE:**	Earthdrill 45L
LOCATION:	See Site Plan	**ELEVATION:**	304 feet above MSL	**DATE:**	11/28/2006

BORING NO.: *GTB-1*

Depth (ft)	SAMPLES: Sample Type	Blows/ 12 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
90				SC	**Santiago Formation (continued)** Greenish Gray, moist, very dense, well indurated granitic detritus with 4" to 8" granitic rock cobbles.			
95					-HOLE TERMINATED AT 95 FEET- Practical refusal at 95 feet No groundwater encountered Hole backfilled with 80 cft bentonite and cuttings			
100								
105								
110								
115								
120								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; CO = Consolidation test; MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	Urban Structures LLC	**DRILLER:**	Larive	**LOGGED BY:**	BO/JB
PROJECT NAME:	Oceanside Vista Residential Dvlp	**DRILL METHOD:**	30" Bucket	**OPERATOR:**	Richard/Adam
PROJECT NO.:	3129SD3	**HAMMER:**	Kelly Bar	**RIG TYPE:**	Earthdrill 45L
LOCATION:	See Site Plan	**ELEVATION:**	259 feet above MSL	**DATE:**	

BORING NO.: *GTB-2*

Depth (ft)	SAMPLES: Sample Type	Blows/ 12 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
				SM	**Landslide Deposits** Dark Brown, damp, loose, silty fine SANDS			Kelly Bar 3500 Lbs.
	Ring	push/ 16"	B2-1					
	Small Bulk		B2-2	CL	Light greenish gray, v.moist, soft, silty CLAY mixed with tan fine to medium sands @ 3.5': clay seam 1/4 inch @ 4.7': Basalrupture surface, remolded clay seam greenish gray, highly plastic, saturated, undulatory surface			CS: N40E 16NW RS: N40E 15SE
5	Large Bulk		B2-3	CL	**Santiago Formation** Gray moist, medium dense, silty CLAYSTONE with some sand closed fractures, no apparent bedding.			SR, EI, MD, SH
10	Ring	5	B2-3			14.9	115	
				SM	@ 13.5' grades to light gray, damp,dense,silty fine to medium SANDSTONE massive			@14': down crowds
15								
20					@21': becomes red-brown, damp, v. dense, silty fine to coarse SANDSTONE: numerous redish-orange to greenish rock fragments			@21': down crowds and auger
	Large Bulk		B2-4					
25					@ 25': becomes tannish-brown well indurated granitic detritus with fragments of decomposed granitic rock.			Kelly Bar 2400 Lbs.
30					-HOLE TERMINATED AT 30 FEET- No groundwater encountered Practical refusal at 30 feet Hole backfilled with 45 cft bentonite and cuttings.			

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:
AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test
SR = Sulfate/Resisitivity Test; SH = Shear Test; CO = Consolidation test; MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	Urban Structures LLC	**DRILLER:**	Larive	**LOGGED BY:**	BO/JB
PROJECT NAME:	Oceanside Vista Residential Dvlp	**DRILL METHOD:**	30" Bucket	**OPERATOR:**	Richard/Adam
PROJECT NO.:	3129SD3	**HAMMER:**	Kelly Bar	**RIG TYPE:**	Earthdrill 45L
LOCATION:	See Site Plan	**ELEVATION:**	265 feet above MSL	**DATE:**	11/30/06 & 12/1/06

BORING NO.: *GTB-3*

Depth (ft)	SAMPLES: Sample Type	Blows/ 12 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
				SM	**Landslide Deposits** Tan moist, loose, silty fine SAND with small fragments of siltstone, CaCO3 stringers.			Kelly Bar 3500 Lbs.
5				CL	Olive gray silty CLAYSTONE @ 5.5': clay seam, broken and tumbled, FeOx stain on fractures some clay healing @ 6': fractures tighten @ 8': grades to fine sandy claystone			S: N20W 20 NW
				SM	Light gray, moist, very dense silty fine SANDSTONE massive no discernable bedding.			@ 9': down crowds
10	Ring	8/10"	B3-1			12.7	124	
					@ 12': becomes fine to coarse sandstone. From 12' to 14.7 feet closed near vertical fracture, FeOx staining on fracture face.			
15								
	Ring	8/11"	B3-2			14.8	118	
				SC	Olive gray, moist, dense, silty, clayey fine SANDSTONE massive			C: N40E 5SE
20					@ 20.6': becomes silty fine to coarse sandstone			
	Large Bulk		B3-3					
25								Kelly Bar 2400 Lbs.
	Ring	7	B3-4		@ 28.5: scattered rip up casts of claystone	14.6	118	MD, EI
30	Large Bulk		B3-5	CL	Olive green, moist, dense, silty CLAYSTONE fractured, polished surfaces, random oriented slicks. **(continued)**			C: N80E 4 NW

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; CO = Consolidation test; MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	Urban Structures LLC	**DRILLER:**	Larive	**LOGGED BY:**	BO/JB
PROJECT NAME:	Oceanside Vista Residential Dvlp	**DRILL METHOD:**	30" Bucket	**OPERATOR:**	Richard/Adam
PROJECT NO.:	3129SD3	**HAMMER:**	Kelly Bar	**RIG TYPE:**	Earthdrill 45L
LOCATION:	See Site Plan	**ELEVATION:**	265 feet above MSL	**DATE:**	11/30/06 & 12/1/06

BORING NO.: *GTB-3*

Depth (ft)	SAMPLES: Sample Type	Blows/ 12 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
30					**Landslide Deposits (continued)**			
				CL	@ 31'-32' polished surfaces, random oriented slicks, poorly developed shear plane, approximately 1/4" remolded clay discontinuous around bore hole.			S: N40E 13-20NW
35				SM	Light olive gray, moist, dense, fine to medium silty SANDSTONE			
40					@ 40': grades to damp, dense, coarse sandstone			
					@ 42': FeOx stain at base of coarse sandstone.			
				CL	Dark olive gray silty claystone @ 43': basalrupture surface, well developed shear zone, undulatory surface, polished @ 43.4 remolded clay layer 3/4" to 2" thick materials above and below do not appear disturbed.			RS: N5-10W 5-8 SW
45								
				ML-SC	**Santiago Formation** Dark gray, moist, very dense clayey SILTSTONE and fine silty SANDSTONE.			
50					@ 50'-51.5' sheared zone dicontinuous around hole, polished surfaces, tight discontinuous fractures; no basal plane/clay seams observed			
					@ 53': random polished surfaces; CaCO3 stringers in fractures dipping 25-30 south.			
55								@ 55': down crowds utilized Kelly 1300 Lbs.
60					-HOLE TERMINATED 60 FEET- No groundwater encountered Hole backfilled w/ 60 cft bentonite and cuttings.			

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:
AL = Atterberg Limits
SR = Sulfate/Resisitivity Test
EI = Expansion Index
SH = Shear Test
SA = Sieve Analysis
CO = Consolidation test
RV = R-Value Test
MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	Urban Structures LLC	**DRILLER:**	Larive	**LOGGED BY:**	BO/JB
PROJECT NAME:	Oceanside Vista Residential Dvlp	**DRILL METHOD:**	30" Bucket	**OPERATOR:**	Richard/Adam
PROJECT NO.:	3129SD3	**HAMMER:**	Kelly Bar	**RIG TYPE:**	Earthdrill 45L
LOCATION:	See Site Plan	**ELEVATION:**	262 feet above MSL	**DATE:**	12/4/2006

BORING NO.: *GTB-4*

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 12 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				SM	**Landslide Deposits (graben material)** Dark brown, moist, loose, silty fine SAND; carbonate stringers and nodules.			Kelly Bar 3500 Lbs.
5	Large Bulk		B4-1		@ 5': becoming clayey silty fine sands			EI, MD, SH
	Ring	Push/ 10"	B4-2		@ 7': rootlets, porous, pockets of dark brown to black organic material	10.9	112	
10								
15								
				SM	**Landslide Deposit** Light tan, moist, loose, silty fine SAND, Steeply dipping iron oxide filled fractures			
20	Ring / Large Bulk	1	B4-3			8.9	102	
					@ 22': fragments of heavely iron oxide stained decomposed granite.			
25					@ 25': steeply dipping (40 N) iron oxide stained fractures.			Kelly Bar 2400 Lbs.
					@ 28': fragments of greenish gray silty claystone.			
30								

(continued)

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:

AL = Atterberg Limits	EI = Expansion Index	SA = Sieve Analysis	RV = R-Value Test
SR = Sulfate/Resisitivity Test	SH = Shear Test	CO = Consolidation test	MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	Urban Structures LLC	**DRILLER:**	Larive	**LOGGED BY:**	BO/JB
PROJECT NAME:	Oceanside Vista Residential Dvlp	**DRILL METHOD:**	30" Bucket	**OPERATOR:**	Richard/Adam
PROJECT NO.:	3129SD3	**HAMMER:**	Kelly Bar	**RIG TYPE:**	Earthdrill 45L
LOCATION:	See Site Plan	**ELEVATION:**	262 feet above MSL	**DATE:**	12/4/2006

BORING NO.: *GTB-4*

Depth (ft)	SAMPLES: Sample Type	Blows/ 12 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
30	Ring	2	B4-4	SM	**Landslide Deposits (continued)** Light tan, moist, loose, silty fine SAND	11.6	97	
					@ 34': claystone fragments			
35					@ 36': diagonal shears on SW wall.			
40	Ring	6	B4-5	CL	Steep undulating contact to olive gray silty claystone, iron oxide staining on fracture surfaces.	17.6	112	C: N65E 50NW
					@ 43' - 45': shear zone, polished surfaces, highly fractured, 1/4" remolded clay along near vertical fracture			F: N80E 70 NE/ N10W 5 NE
45								
50	Ring	7	B4-6		Possible basalrupture surface/slide plane at 51 feet	15.5	117	RS: N30E 20NW
				CL	**Santiago Formation (?)** Olive gray silty CLAYSTONE, very moist, dense.	▽		@ 51': Ground Water
55								Kelly 1300 Lbs.
60	Ring	12	B4-7		-same	19.3	109	
					-HOLE TERMINATED 61 FEET- Groundwater and caving encountered at 51 feet Hole backfilled w/ 93 cft of bentonite and cuttings			

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; CO = Consolidation test; MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	Urban Structures LLC	**DRILLER:**	Larive	**LOGGED BY:**	BO/JB
PROJECT NAME:	Oceanside Vista Residential Dvlp	**DRILL METHOD:**	30" Bucket	**OPERATOR:**	Richard/Adam
PROJECT NO.:	3129SD3	**HAMMER:**	Kelly Bar	**RIG TYPE:**	Earthdrill 45L
LOCATION:	See Site Plan	**ELEVATION:**	256 feet above MSL	**DATE:**	12/4/06 & 12/5/06

BORING NO.: *GTB-5*

Depth (ft)	SAMPLES: Sample Type	Blows/ 12 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
				SM	**Landslide Deposits (graben material)** Dark brown, damp to moist, loose, silty fine SAND, carbonate stringers.			Kelly Bar 3500 Lbs.
5	Large Bulk	1	B5-1	SM	**Landslide Deposits** Tan, moist, loose silty fine SAND, porous, rootlets, carbonate nodules.	8.4	106	MD
10				CL	Well defined contact with olive gray silty CLAYSTONE, rip up casts of claystone in tan silty sand @ 9.5': highly fractured, open structure, carbonate stringers.			C: N5E 7NW
15				SM	Undulating contact, no apparent strike, iron oxide staining along contact. Light olive green, moist, medium dense, silty fine SANDSTONE with some clay. @ 17': jumbled claystone and sandstone, large (1 foot) rip up casts of claystone in sandstone matrix.			
20	Ring	8	B5-2		@ 21': root approx 1/2 " thick	12.2	124	
25								Kelly Bar 2400 Lbs.
30	Ring	7	B5-3	CL	Olive green, moist, medium dense, silty CLAYSTONE, fractured 4" to 6" spacing, rootlets in open fractures. **(continued)**	19	114	

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:

AL = Atterberg Limits	EI = Expansion Index	SA = Sieve Analysis	RV = R-Value Test
SR = Sulfate/Resisitivity Test	SH = Shear Test	CO = Consolidation test	MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Urban Structures LLC	**DRILLER:**	Larive	**LOGGED BY:**	BO/JB
PROJECT NAME:	Oceanside Vista Residential Dvlp	**DRILL METHOD:**	30" Bucket	**OPERATOR:**	Richard/Adam
PROJECT NO.:	3129SD3	**HAMMER:**	Kelly Bar	**RIG TYPE:**	Earthdrill 45L
LOCATION:	See Site Plan	**ELEVATION:**	256 feet above MSL	**DATE:**	12/4/06 & 12/5/06

BORING NO.: *GTB-5*

Depth (ft)	SAMPLES: Sample Type	Blows/ 12 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
30				CL	**Landslide Deposits (continued)** Olive green, moist, medium dense, silty claystone			
35					@ 35': shear zone polished surfaces, no apparent strike or dip.			
				SM	Light olive gray, moist, loose, silty fine SAND @ 35'-37' shear zone			
40	Ring	3	B5-4		@ 41': very coarse grained iron oxide stained zone	12	108	
				CL	Olive gray, moist, hard claystone			@ 42': down crowds
45						Water Table		12/4/2006 groundwater @ 46' overnight 12/5/2006
				SM	Light olive green silty sandstone jumbled with dark greenish gray silty claystone.			
50	Small Bulk	14	B5-5		@ 49.5': basalrupture surface, 2 " thick remolded clay, undulatory surface, free water seepage from slide plane, fracture zone above slide plane with 4" to 6" fracture fragments.			RS: N20E 4-6 NW
				SM	**Santiago Formation** Massive, very dense, silty fine to coarse silty SANDSTONE, unbroken, unsheared	12.2	125	SH
55								Kelly 1300 Lbs. @ 55': down crowds
60	Ring	25/9"	B5-6		-same	10.5	128	SH
					-HOLE TERMINATED AT 61 FEET- Groundwater and caving encountered at 45 feet Hole Backfilled with 65 cft bentonite and cuttings.			

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:
AL = Atterberg Limits
EI = Expansion Index
SA = Sieve Analysis
RV = R-Value Test
SR = Sulfate/Resisitivity Test
SH = Shear Test
CO = Consolidation test
MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	Urban Structures LLC	**DRILLER:**	Larive	**LOGGED BY:**	BO
PROJECT NAME:	Oceanside Vista Residential Dvlp	**DRILL METHOD:**	30" Bucket	**OPERATOR:**	Richard/Adam
PROJECT NO.:	3129SD3	**HAMMER:**	Kelly Bar	**RIG TYPE:**	Earthdrill 45L
LOCATION:	See Site Plan	**ELEVATION:**	206 feet above MSL	**DATE:**	12/5/2006

BORING NO.: *GTB-6*

Depth (ft)	Sample Type	Blows/ 12 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Water Content (%)	Dry Density (pcf)	Others
				SC	**Alluvium** Dark brown, moist, loose, clayey fine SAND			Kelly Bar 3500 Lbs.
5								
					@ 6': becoming very moist.			
10	Ring	Push	B6-1		-same	19.7	107	
						⊽		@ 12': groundwater
				SM-SC	**Landslide Deposits** Dark grayish brown, very moist to wet, loose, clayey to silty fine SAND			
15								
					@ 17': light gray saturated clayey silty fine sands, iron oxide staining			
20	Ring	Push	B6-2		-same	19.1	112	
					@ 23': bore hole squeezing			
					@ 24': grayish green silty fine sands with fragments of olive green silty claystone fragments.			
25	Ring	Push	B6-3					Kelly Bar 2400 Lbs.
					-HOLE TERMINATED AT 26.5 FEET- Groundwater at 12 feet Hole backfilled with 45 cft bentonite and cuttings			
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ⊽ ---Water Table

Lab testing:
AL = Atterberg Limits EI = Expansion Index SA = Sieve Analysis RV = R-Value Test
SR = Sulfate/Resisitivity Test SH = Shear Test CO = Consolidation test MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Urban Structures LLC	**DRILLER:**	Larive	**LOGGED BY:**	BO/JB
PROJECT NAME:	Oceanside Vista Residential Dvlp	**DRILL METHOD:**	30" Bucket	**OPERATOR:**	Richard/Adam
PROJECT NO.:	3129SD3	**HAMMER:**	Kelly Bar	**RIG TYPE:**	Earthdrill 45L
LOCATION:	See Site Plan	**ELEVATION:**	216 feet above MSL	**DATE:**	12/6/2006

BORING NO.: *GTB-7*

Depth (ft)	SAMPLES: Sample Type	Blows/ 12 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
				CL	**Landslide Deposits** Dark gray, damp, medium stiff, clayey coarse SAND, desiccated			Kelly Bar 3500 Lbs.
5	Ring	6	B7-1		@ 5': remolded clay seam (1/4"), associated with surficial landslide mapped above drill location.	5.4	128	S: N50E 22NW
				SC	**Santiago Formation** Light brown well indurated granitic detritus with 4" to 6" cobbles of rounded granite cobbles. Very difficult drilling.			@ 6': down crowds and auger
10								
15					@ 15': large rock in sidewall			
					-HOLE TERMINATED AT 18 FEET- No groundwater encountered Hole backfilled with cuttings Practical refusal at 18 feet Hole backfilled with 40 cft bentonite and cuttings			
20								
25								Kelly Bar 2400 Lbs.
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits EI = Expansion Index SA = Sieve Analysis RV = R-Value Test SR = Sulfate/Resisitivity Test SH = Shear Test CO = Consolidation test MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	Urban Structures LLC	**DRILLER:**	Larive	**LOGGED BY:**	BO/JB
PROJECT NAME:	Oceanside Vista Residential Dvlp	**DRILL METHOD:**	30" Bucket	**OPERATOR:**	Richard/Adam
PROJECT NO.:	3129SD3	**HAMMER:**	Kelly Bar	**RIG TYPE:**	Earthdrill 45L
LOCATION:	See Site Plan	**ELEVATION:**	216 feet above MSL	**DATE:**	12/6/2006

BORING NO.: *GTB-8*

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 12 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
				CL	**Landslide Deposit** Dark gray, damp, soft, sandy CLAY, desiccated			Kelly Bar 3500 Lbs.
					@ 3': fragments of granitic rock			
5					@ 6': carbonate stringers and nodules.			
10	Ring	1	B8-1	SC	Light grayish green, moist, loose, silty fine to medium SAND with some clay; jumbled appearance with claystone fragments	9.8	117	SH
					Abrupt contact, 1.5" remolded clay shear zone,			
15	Small Bulk	Push/ 8" 1/5"	B8-2	CL	**Santiago formation** Grayish green, very moist, loose, silty CLAYSTONE	26.2	99	S: N10E 6-9NW
20					@ 20': bedding plane shear < 1/4" thick clay seam			S: N10W 25NW
					@ 21': becoming more hard			
								@ 22': down crowds utilized
					@ 24": fragments of heavily iron oxide stained granitic fragments			
25								Kelly Bar 2400 Lbs.
				SC	Light green, well indurated, granitic detritus, very dense.			
30					-HOLE TERMINATED AT 30 FEET- No groundwater encountered, Boring terminated due to practical refusal hole backfilled with 47 cft of bentonite and cuttings.			

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing: AL = Atterberg Limits, EI = Expansion Index, SA = Sieve Analysis, RV = R-Value Test, SR = Sulfate/Resisitivity Test, SH = Shear Test, CO = Consolidation test, MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	Urban Structures LLC	**DRILLER:**	Pacific Drilling	**LOGGED BY:**	LG
PROJECT NAME:	Oceanside Vista Residential Dvlp	**DRILL METHOD:**	6" Hollow Stem Auger	**OPERATOR:**	Toby
PROJECT NO.:	3129SD3	**HAMMER:**	140lbs/ 30in	**RIG TYPE:**	Mole Rig - Limited Access Rig
LOCATION:	See Site Plan	**ELEVATION:**	± 203.5 feet	**DATE:**	11/30/2006

BORING NO.: *GTB-9*

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
	Small Bulk		B9-1	SC	**Lanslide Deposits** Light gray-dry, loose, clayey fine SAND; rootlets			
	Ring	14 24 27	B9-2	SM	light gray, damp to moist, medium dense, silty fine SAND	9.5	122	
5	SPT	3 2 4	B9-3		@5': Light yellow, moist, loose, silty fine SAND with clay; iron oxide	11.8		
	Large Bulk		B9-4					
	Ring	16 14 20	B9-5		Yellow, moist, medium dense, silty fine to medium SAND	12.1	115	
10	SPT	5 4 5	B9-6		@10': becomes yellow, very moist, loose, silty fine to medium SAND; with clay	14		
15	Ring	7 8 9	B9-7	ML/CL	Green, wet, silty CLAY to clayey SILT	18.1		**Contact: QLS / Form** ∇
					Santiago Formation White, moist, medium dense, silty fine SAND -difficulty drilling			
20	SPT	18 36 50/5"	B9-8		@20': becomes dense			
25	SPT	33 50/5"	B9-9		@24.5': becomes very dense			
30					-HOLE TERMINATED AT 24.5 FEET Groundwater at 17 feet Hole backfilled with bentonite Practical refusal at 25.5 feet on dense material			

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ∇ ---Water Table

Lab testing:

AL = Atterberg Limits	EI = Expansion Index	SA = Sieve Analysis	RV = R-Value Test
SR = Sulfate/Resisitivity Test	SH = Shear Test	CO = Consolidation test	MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY BORING

CLIENT:	Urban Structures LLC	**DRILLER:**	Pacific Drilling	**LOGGED BY:**	LG
PROJECT NAME:	Oceanside Vista Residential Dvlp	**DRILL METHOD:**	6" Hollow Stem Auger	**OPERATOR:**	Toby
PROJECT NO.:	3129SD3	**HAMMER:**	140lbs/ 30in	**RIG TYPE:**	Mole Rig - Limited Access Rig
LOCATION:	See Site Plan	**ELEVATION:**	± 202 feet	**DATE:**	11/30/2006

BORING NO.: *GTB-10*

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Others
	Small Bulk		B10-1	SM	**Alluvium** Light gray, damp, loose, silty fine SAND; rootlets			
	Ring	18 16 21	B10-2		@2.5': Light brown, moist, medium dense, silty fine SAND; rootlests; chunks of white SS in rings	4.3	109	
5	SPT	10 8 6	B10-3	SM	Dark gray black, moist, medium dense, silty fine SAND ; calcium carbonate; roots	7.2		
	Ring	16 8 12	B10-4	SC	Dark gray-black, very moist, medium dense, clayey fine to medium SAND; calcium carbonate; roots; micaceous	19.6	109	
10	SPT	3 5 6	B10-5	SC	Gray-black, moist, medium dense, clayey fine SAND	19.5		Water Table
				SC/CL	Gray, wet to saturated clayey fine SAND to sandy CLAY; roots			
	Small Bulk		B10-6					
15	SPT	3 3 3	B10-7		@15': Gray, wet to saturated, loose, clayey fine SAND to sandy CLAY; roots	23.9		
20	SPT	2 2 3	B10-8		-same			
25	SPT	2 4 5	B10-9		-same			
				SM	**Santiago Formation** Light yellow, moist, medium dense, silty fine to medium SAND			
30	SPT	4 6 8	B10-10	ML/CL	Green, moist to wet, medium dense, clayey SILT to hard silty CLAY			
					-HOLE TERMINATED AT 31.5 FEET- Groundwater encountered at 10 feet Hole backfilled with bentonite			

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

Lab testing:

AL = Atterberg Limits	EI = Expansion Index	SA = Sieve Analysis	RV = R-Value Test
SR = Sulfate/Resisitivity Test	SH = Shear Test	CO = Consolidation test	MD = Maximum Density

APPENDIX A-2

LOGS OF EXPLORATORY BORINGS / TRENCHES

Borings B1 through B10 (Geocon Inc., previous studies)

Trenches T-1 through T-14 (Geocon Inc., previous studies)

PROJECT NO. 07227-52-02

BORING B 1

ELEV. (MSL.) 259' DATE COMPLETED 05-10-2005

EQUIPMENT 30-INCH DIAMETER BUCKET AUGER

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0–5				SC+CL	**LANDSLIDE DEBRIS** Loose and stiff, moist, grayish brown to brownish gray, Clayey and Silty SAND and Sandy CLAY; jumbled texture; thin roots and rock fragments; pockets of clay material in sandy matrix; layer of fat sheared clay at 5 feet approximately 1/2" to 1" thick (S: N59W/14NE)			
5–8	B1-1 B1-6			CL	Stiff, moist, olive gray, Silty to fine Sandy CLAY; highly fractured and sheared with internal polished surfaces and iron oxide mineralization	1/12"	99.9	24.7
8–13	B1-2			ML	**SANTIAGO FORMATION** Hard, damp, light olive gray, Sandy to Clayey SILTSTONE; moderately to strongly indurated; few joints; overall intact and undisturbed -B: N38W/8SW	6/12"	116.4	11.6
13–25.5	B1-3			SM	Dense, damp, light gray, Silty, fine- to medium-grained SANDSTONE; moderately cemented; micaceous; massive bedding; intact	8/9"	129.4	7.5
					-Very dense; drilling using down-crowds			
	B1-4					8/6"	122.2	5.7
					-Strongly cemented; some cross bedding; B:N16E/5SE			
					-Very dense and very strongly cemented along basal contact -Contact irregular to dipping approximately 18° NW			
25.5–30					**GRANITIC ROCK** Moderately hard, damp, grayish brown to light gray, GRANITIC ROCK; fine- to coarse-grained crystalline texture; moderately weathered; high-angle jointing			

Figure A-1,
Log of Boring B 1, Page 1 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS ... SAMPLING UNSUCCESSFUL ... STANDARD PENETRATION TEST ... DRIVE SAMPLE (UNDISTURBED) ... DISTURBED OR BAG SAMPLE ... CHUNK SAMPLE ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 1 ELEV. (MSL.) 259' DATE COMPLETED 05-10-2005 EQUIPMENT 30-INCH DIAMETER BUCKET AUGER	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
30	B1-5	+ +				15/6"	124.0	6.4
32								
					BORING TERMINATED AT 33 FEET No groundwater encountered Backfilled with 45 cu. ft. of bentonite and soil cuttings in alternating layers			

Figure A-1,
Log of Boring B 1, Page 2 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 2

ELEV. (MSL.) 311' DATE COMPLETED 05-10-2005

EQUIPMENT 30-INCH DIAMETER BUCKET AUGER

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0–4				CL	**LANDSLIDE DEBRIS** Stiff, moist, dark brown, fine, Sandy CLAY; porous; moderate topsoil development; thin roots			
4–10	B2-1			SC	Medium dense, moist, mottled olive, reddish and grayish brown, Clayey, fine SAND; jumbled texture; thin roots; no distinguishable bedding; scattered carbonate pods; abundant fractures, generally healed with manganese and iron oxide mineralization	2/12"	115.9	14.5
10–19	B2-2			SM	Medium dense, moist, gray with mottled yellowish brown, Silty, fine to medium SAND; structureless; few coarse grains and pieces of charcoal	3/12"	115.9	11.2
	B2-3				-Loose; mixed with pods of olive clay; decomposed pods of organic material; sand becomes fine to coarse grained; jumbled mixture of disturbed sand and silt beds displaying offset along randomly oriented fractures	2/12"	112.9	14.5
19–21	B2-4 B2-15 B2-5				-Encountered layers of (weathered) sheared fat, gray-green clay; undulates with scour approximately 1/2 inch thick; undulating with general orientation of S: N29E/6NW; common slickensides; probably main slip surface (potential shear surface if undercut)	3/12"	111.5	14.3
21–26				CL	**SANTIAGO FORMATION** Very stiff, most, olive to greenish gray, fat CLAYSTONE; highly fractured with abundant polished and slickensided shear surfaces; manganese oxide mineralization and sheared clay between claystone fragments B: N42W/5NE			
26–30	B2-6			ML	Hard, moist, olive gray, Clayey, SILTSTONE; moderately indurated; some fractures; overall intact and undisturbed	7/12"	109.8	19.3
					-Marked increase in degree of induration; few fractures			

07227-52-02.GPJ

Figure A-2,
Log of Boring B 2, Page 1 of 3

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 2 ELEV. (MSL.) 311' DATE COMPLETED 05-10-2005 EQUIPMENT 30-INCH DIAMETER BUCKET AUGER MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B2-7					14/12"	105.5	13.9
32				SM	Grades to dense, damp, gray to olive gray, Silty, fine-grained SANDSTONE; moderately cemented. B:N16W/6NE			
34					-Becomes white; massive at 34 feet			
36	B2-8					15/9"	126.0	7.2
38								
40	B2-9					15/9"		
42					-Few pods of olive green, subrounded claystone with sandstone matrix			
44								
46					-Becomes strongly cemented; common claystone pods; probably rip-up clasts			
48				CL	Abrupt contact between SANDSTONE and CLAYSTONE, C: N56W/12SW slightly undulating; sandstone is reddish brown in a layer approximately 1/2 inch thick; polished, slickensided shear surface along base of sandstone unit continuous around hole (bedding plane shear); sandstone very moist and weakly cemented within 1 foot of contact. Hard, damp, olive gray, fine-grained Sandy CLAYSTONE at 50 feet			
50	B2-10					11/12"	120.5	13.9
52				ML	Grades to hard, damp, olive gray, fine-grained Sandy SILTSTONE; moderately to strongly indurated			
53				SM	Very dense, damp, light gray to white, Silty, fine- to coarse-grained SANDSTONE; moderately to strongly cemented; massive			
54								
56	B2-11					15/7"	123.9	8.7
58								

Figure A-2,
Log of Boring B 2, Page 2 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 2

ELEV. (MSL.) **311'** DATE COMPLETED **05-10-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60–63				SM	-Abrupt contact between SANDSTONE and Clayey SILTSTONE at 63 feet; sandstone yellowish to reddish within 3 inches of contact C: N22E/7SE.			
63–66	B2-12			ML	Hard, damp, olive gray, Clayey SILTSTONE; strongly indurated	30/11"	122.7	11.2
66–68				CH	Hard, damp, dark reddish gray, fat CLAYSTONE; strongly indurated; polished internal surfaces			
68–72	B2-13 B2-14			CL	Hard, damp, reddish gray, CLAYSTONE; highly fragmented and fractured; yellow clay film along polished surfaces; shearing generally high-angle and discontinuous. -CLAYSTONE shattered to crushed within a 9-inch thick zone; becomes soft and sheared with remolded clays and polished slickensided surfaces; layer continuous around hole; S: N14W/11SW; (bedding plane shear) abundant yellowish to reddish brown iron oxide mineralization	30/10"	132.9	8.4
72–80				ML	Basal contact with very hard, damp, mottled gray and yellowish to reddish brown, Clayey SILTSTONE; strongly indurated, laminated locally; no evidence of shearing or displacement			

BORING TERMINATED AT 80 FEET
No groundwater encountered
Backfilled with 69 cu. ft. of bentonite and soil cuttings in alternating layers

Figure A-2,
Log of Boring B 2, Page 3 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 3

ELEV. (MSL.) 300' DATE COMPLETED 05-11-2005

EQUIPMENT 30-INCH DIAMETER BUCKET AUGER

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**LANDSLIDE DEBRIS** Soft to stiff, most, dark brown, fine Sandy CLAY; porous with thin roots; moderately well developed topsoil in upper foot; probably within graben zone of upper slide			
4				CL	-Grades to clayey sand; common carbonate pods and stringers			
6	B3-1					1	116.8	13.4
8					Loose, moist, light grayish brown, Clayey and Silty, fine to medium SAND with pods of olive clay; jumbled texture; chaotic and discontinuous bedding; displaced beds of silt and clay			
10	B3-2					1/12"	115.1	9.9
	B3-3			SM				
12					-Scattered pieces of organic material and carbon			
					-Discontinuous beds of fat claystone and siltstone displaced and dipping 28° NW			
14					-Approximately 2- to 4-inch thick, partially remolded sandy clay B: N60E/50NW; scattered fragments of charcoal			
16	B3-4				Loose to medium dense, light gray, Silty, fine to coarse SAND with pods of olive clay	2/12"	116.5	13.1
				SM	-Becomes very moist and fractured; undulating contact C: N63W/3NE			
18					-Basal contact of upper slide; some sheared clays and yellow-green mineralization 2 inch thick band around hole			
20	B3-5			ML	Medium dense, moist, olive gray, fine Sandy SILTSTONE; some fracturing	3/12"	117.1	14.7
22				CL	Moderately hard, moist, olive gray, Silty CLAYSTONE; internal fracturing and shearing with polished surfaces and slickensides			
24								
26	B3-6			ML	Very stiff, moist, olive gray, Clayey SILTSTONE; fractured	3/12"	113.9	15.4
28					-Discordant, undulating basal contact			
				SM	Medium dense, light gray, fine SAND; red and yellow banding; some			

Figure A-3,
Log of Boring B 3, Page 1 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 3

ELEV. (MSL.) 300' DATE COMPLETED 05-11-2005

EQUIPMENT 30-INCH DIAMETER BUCKET AUGER

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B3-7			SM	manganese oxide and carbonate mineralization -Medium dense to dense, moist, light gray, Silty, fine to coarse SAND; through going thin clay-filled fractures; pods of greenish clay -At 32 feet: continuous 2 to 4 inch bed of sandy siltstone B: N79E/6NW -At 33 feet: discontinuous bed of fractured gray CLAYSTONE within sandstone beds -Along contact: yellow to red mineralization; beds displaced approximately 4 inches on fracture F: N54W/32S; C: N29W/5NE; 3 inch thick layer of crushed, remolded clay with shears and slickensides S: N68W/3NE	11/12"	119.6	10.5
32								
34								
36	B3-8			CL	**SANTIAGO FORMATION** Hard, moist, olive green, fat CLAYSTONE, internally sheared with polished surfaces and manganese oxide mineralization	7/12"	106.3	20.3
38								
40				ML	Dense, damp, olive gray, Clayey SILTSTONE; strongly indurated; intact			
	B3-9			SM	Dense, damp, light olive gray, Silty, fine-grained SANDSTONE; massive and undisturbed; moderately cemented	15/10"	119.0	13.0
42					-Becomes fine- to coarse-grained			
44								
46	B3-10				-Fine- to medium-grained, very light gray	15/16"	131.0	6.4
48								
50	B3-11			SM	-Light gray, silty sandstone	15/9"	129.6	6.5
52					-Becomes hard and strongly cemented; difficult drilling using down-crowds			
54								
56					-Beds with common claystone fragments B: N10E/8SE			
58								

07227-52-02.GPJ

Figure A-3,
Log of Boring B 3, Page 2 of 3

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 3

ELEV. (MSL.) 300' DATE COMPLETED 05-11-2005

EQUIPMENT 30-INCH DIAMETER BUCKET AUGER

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60	B3-12			SM	Very dense, damp, light gray, Silty, fine- to coarse-grained SANDSTONE; pods of olive claystone; overall massive and intact; moderately cemented	30/8"	112.7	6.8
62								
64								
66					-Cross bedded; fine- to medium-grained			
68					-Pods of iron oxide mineralization			
70					-Abrupt basal contact between silty sandstone and siltstone C: N18W/8SW			
	B3-13			ML	Hard, damp, olive gray, Clayey SILTSTONE; strongly indurated	28/12"	113.9	16.2
72								
74				CL	Hard, damp, dark gray with mottled dark reddish brown, Silty CLAYSTONE; moderately to strongly indurated; local, randomly oriented, polished internal surfaces with some manganese oxide mineralization; no evidence of remolding or displacement			
76								
78				ML	Hard, damp, greenish gray, Clayey SILTSTONE; strongly indurated			
80	B3-14					28/12"	114.6	15.4

BORING TERMINATED AT 80 FEET
No groundwater encountered
Backfilled with 69 cu. ft. of bentonite and soil cuttings in alternating layers

07227-52-02.GPJ

**Figure A-3,
Log of Boring B 3, Page 3 of 3**

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

BORING B 4

ELEV. (MSL.) **243'** DATE COMPLETED **05-20-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0–7	B4-1 (at ~5.5)			CL	**LANDSLIDE DEBRIS** Stiff, damp to moist, dark grayish brown, fine to medium Sandy CLAY; pods of carbonate; porous with thin roots; graben zone backfilled with colluvial material; krotovina; some small pieces of charcoal	1/12"	115.9	9.5
7–14	B4-2 (at ~10.5)			SM	-B: N70E/22NW -Becomes jumbled mixture of sand, silt, and clay; common krotovina Loose, moist, light yellowish to olive brown, Silty, fine to medium SAND with pockets of clay and shattered claystone, fragments of sandstone; generally structureless -Common small charcoal fragments; iron oxide mineralization at 12 feet	2/12"	114.0	10.2
14–16	B4-3 (at ~15.5)			SP	-Thick layer of remolded and sheared clay; some slickensides; S: N51E/36NW; basal slip surface of upper recent slide Displaced bed of fine- to medium-grained SANDSTONE approximately 2 feet thick on south side of hole and completely sheared away on north side; microfaulting and crossbedding common within sandstone bed; undulating basal contact C: N29E/16NW	3/12"	112.0	17.1
16–19				CL-ML	Fractured to shattered beds of very stiff, olive gray, Clayey SILTSTONE and Silty CLAYSTONE			
19–20				CH	Very stiff, moist, olive gray, fat CLAYSTONE, internally sheared with polished surfaces and slickensides			
20–24	B4-4 (at ~20.5)			CL-ML	Stiff, moist, olive gray, Clayey SILTSTONE and CLAYSTONE beds; internally sheared with evidence of displacement	3/12"	110.0	18.3
24–24.5				SC	Approximately 6 to 12 inch thick bed of white SANDSTONE displaced approximately 6 inches along approximately 2 inch thick sheared and remolded clay seam S: N59W/14NE; undulating contact with iron oxide staining at base of sandstone			
24.5–26	B4-9 B4-5			CH	-Base of slide debris at 26 feet within sheared and remolded fat CLAY	2/12"	108.9	17.0
26–30				ML	**SANTIAGO FORMATION** Hard, moist, olive gray, Clayey SILTSTONE; strongly indurated; weakly jointed to relatively intact; no displacement			

Figure A-4, Log of Boring B 4, Page 1 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	⊠ ... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

BORING B 4

ELEV. (MSL.) 243' DATE COMPLETED 05-20-2005

EQUIPMENT 30-INCH DIAMETER BUCKET AUGER

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B4-6			CL+ML	Hard, damp, olive gray, Silty CLAYSTONE and Clayey SILTSTONE, mottled with reddish brown; strongly indurated; few joints; gradational contact	8/12"	119.6	14.0
34				SM	Dense, moist, light olive gray, Silty, fine-grained SANDSTONE; moderately cemented; massive -Grades to fine- to coarse-grained, very light gray sandstone at 36 feet			
40	B4-7					10/10"	123.3	10.2
41					-Slightly undulating contact; iron oxide mineralization along contact C: N44W/6SW			
42				CL+ML	Hard, moist, olive gray, Clayey SILTSTONE and Silty CLAYSTONE interbeds; strongly indurated; weakly jointed with some polishing and manganese oxide along joint surfaces			
45				SM	Very dense, damp, light gray to gray, Silty, fine-grained SANDSTONE; massive and moderately to strongly cemented			
50	B4-8					10/10"	121.7	12.2

BORING TERMINATED AT 51 FEET
No groundwater encountered
Backfilled with soil cuttings and 55 cu. ft. of bentonite in alternating layers

Figure A-4,
Log of Boring B 4, Page 2 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 5

ELEV. (MSL.) 287' DATE COMPLETED 05-24-2005

EQUIPMENT 30-INCH DIAMETER BUCKET AUGER

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**LANDSLIDE DEBRIS** Loose, moist, dark brown, Clayey, fine to medium SAND; thin roots; carbonate pods and stringers			
4				SM	Loose, moist, light brown to light olive brown, Silty, fine to medium SAND; porous; common krotovina; generally structureless; few gravel and charcoal			
6	B5-1					2/12"	108.5	6.4
8					-Common thin, clay-filled fractures			
10	B5-2					1/12"		
16	B5-3					1/12"	93.4	9.1
18					-Relict structure in disturbed sand beds B: N86E/23SE; some sandstone and claystone fragments in matrix of silty fine sand			
20	B5-4					1/12"	97.8	8.0
25	B5-5					1/12"	99.1	9.0
27					-Minor caving; hole belled to 48-inch diameter; increase in sandstone and claystone fragments			

Figure A-5,
Log of Boring B 5, Page 1 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

BORING B 5

ELEV. (MSL.) **287'** DATE COMPLETED **05-24-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B5-6					3/12"	101.4	7.7
32					-Mottled yellowish brown to light gray; abundant thin fractures backfilled with carbonate and clay; highly disturbed bedding with random and discontinuous orientations; some relatively intact blocks of sandstone and claystone generally less than 6-inch diameter			
34								
36	B5-7					3/12"	99.0	9.1
38								
40	B5-8					4/12"	108.8	10.8
42								
44				SM	-Displaced sheared and elongated beds of siltstone and claystone off set along abundant thin fractures; dip approximately 65° S; overall chaotic structure			
46	B5-9					6/12"	116.1	13.6
48					-Displaced bed of sandstone B: N81W/44SW -Becomes increasingly moist; medium dense; and light gray to grayish brown			
50	B5-10				-Twisted and rotated block of light gray sandstone in matrix of yellowish brown sand; block approximately 2 foot diameter and containing stratification oriented nearly vertical	6/12"	108.9	14.0
52								
54								
56	B5-11				-Sheared and elongated bed of yellowish brown sandy silt; very moist; B: N81W/17SW; bed thinned from 6 inches to 1 inch from north to south at 55 feet	12/12"	112.1	17.7
	B5-16			CH	BASAL SLIP SURFACE; approximately 3 inch thick layer of remolded and sheared fat gray CLAY with abundant polished slickensided surfaces; very well defined; S: N11W/4NE			
58				CL				
				ML	**SANTIAGO FORMATION** Hard, moist, dark olive gray, Silty CLAYSTONE; strongly indurated; some sheared and polished internal surfaces; randomly oriented			

Figure A-5,
Log of Boring B 5, Page 2 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	⊠ ... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 5

ELEV. (MSL.) 287' DATE COMPLETED 05-24-2005

EQUIPMENT 30-INCH DIAMETER BUCKET AUGER

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
60–62	B5-12			ML	Hard, damp, olive gray, Clayey to Sandy SILTSTONE; strongly indurated; intact and well-bedded; no indications of shearing or offset	12/10"	113.1	16.8
62–64				SM	Dense, moist, light olive gray, Silty, fine-grained SANDSTONE; moderately cemented			
64–67	B5-13			ML	Hard, moist, olive gray, Clayey SILTSTONE; strongly indurated B: N17E/4NW	7/12"	113.9	15.7
67–79	B5-14			SM+ML	Becomes interbedded Sandy SILTSTONE and Silty SANDSTONE; moderately cemented; generally well-bedded and intact; beds 1 to 2 feet thick; few interbeds of strongly indurated claystone	15/10"	125.3	11.5
79–81	B5-15			CL	Hard, moist, dark olive gray, Silty CLAYSTONE; strongly indurated; no evidence of shearing	25/10"	112.7	15.5

BORING TERMINATED AT 81 FEET
No groundwater encountered
Backfilled with alternating layers of soil cuttings and 69 cu. ft. of bentonite

Figure A-5,
Log of Boring B 5, Page 3 of 3

07227-52-02.GPJ

SAMPLE SYMBOLS: ... SAMPLING UNSUCCESSFUL; ... STANDARD PENETRATION TEST; ... DRIVE SAMPLE (UNDISTURBED); ... DISTURBED OR BAG SAMPLE; ... CHUNK SAMPLE; ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 6

ELEV. (MSL.) 223' DATE COMPLETED 05-23-2005

EQUIPMENT 30-INCH DIAMETER BUCKET AUGER

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0–4				SC	**LANDSLIDE DEBRIS** Loose, moist, dark brown, Clayey, fine to medium SAND; thin roots and pods to stringers of carbonate; porous; moderate topsoil development			
4–6.5	B6-1			SM-ML	Loose, moist, grayish brown, Silty, fine SAND to Sandy SILT; abundant carbonate-filled fractures; porous; few pieces of charcoal	2/12"	115.9	9.8
6.5–9.5				SM	Loose, moist, light gray, Silty, fine to coarse SAND and SANDSTONE fragments; some elongated and sheared beds of claystone; high-angle dip			
9.5–22	B6-2			CL-ML	Displaced contact between SAND unit and SILT/CLAY units; displaced along series of stepped fractures; approximately 4 feet of vertical displacement; C: N14W/46NE; fractures high-angle to near vertical; thin bed of sheared, elongated claystone underlying contact	3/12"	106.4	5.4
					-Becomes displaced beds of olive gray sandy to clayey siltstone with abundant fractures			
	B6-3				-Siltstone fragments in a matrix of sheared and crushed clay and silt	4/12"	119.7	13.2
					-Chaotic mixture of crushed siltstone, sandstone, and claystone fragments; generally structureless at 18 feet			
	B6-4				-Beds of claystone and sandstone displaced along high-angle fractures; vertical offset approximately 2 1/2 feet B: N28E/38SE; material crushed and rubbly on downthrown blocks	2/12"	112.1	14.7
22–30				SM	Becomes loose, moist, light gray to white, Silty, fine to coarse SAND; some claystone fragments; disturbed sandstone beds offset by significant fractures; groundwater at 24 feet; hole belled and caving			
24			▼		Loose, moist to wet, olive gray, Silty, fine to medium SAND			
	B6-5					2/12"	114.9	13.4
					-Unable to proceed down-hole logging deeper than 24 feet due to groundwater table and caving			

Figure A-6, Log of Boring B 6, Page 1 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 6

ELEV. (MSL.) **223'** DATE COMPLETED **05-23-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B6-6			SM		7/12"	117.9	14.8
32					BORING TERMINATED AT 32 FEET Groundwater encountered at 24 feet Backfilled with alternating layers of soil cuttings and 45 cu. ft. of bentonite			

Figure A-6,
Log of Boring B 6, Page 2 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 7

ELEV. (MSL.) **241'** DATE COMPLETED **05-20-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**LANDSLIDE DEBRIS**			
2					Loose, damp, dark brown, Clayey, fine to medium SAND; weakly developed topsoil in upper 9 inches; porous with thin roots -Loose, damp, light gray, silty, fine to medium SAND to Sandy SILT; common carbonate stringers and krotovina; some fragments of sandstone and claystone			
4				SM-ML				
6	B7-1					2/12"	109.6	13.4
8					-Common blocks of shattered claystone and sandstone in a matrix of sand and silt; few void spaces at 6 feet -Highly displaced and tilted bed of shattered claystone B: N56W/40SW; internal stratification			
10	B7-2				Loose, damp, light gray, Silty, fine SAND; generally structureless; common thin, high-angle fractures; scattered fragments of claystone	2/12"	102.8	9.4
12					-Tilted and displaced block of silty sandstone with beds generally dipping toward the north at relatively high angles; common fractures			
14								
16	B7-3			SM	-Broken block of cemented sandstone; fragments displaced approximately 2 feet -No sample recovery in layer of strongly cemented sandstone fragments at 15 feet	5/12"		
18					-Elongated and highly disturbed bed of sheared claystone B: N85E/27NW at 17.5 feet -Loose, moist, light gray, fine to coarse SAND with fragments of claystone and sandstone; generally disturbed and structureless			
20	B7-4				-Block of white sandstone displaced approximately 1.5 feet to the south along fractures at 20 feet -Undulating contact C: N83E/21SE at 21.5 feet	3/12"	103.3	3.7
22					Fractured and sheared beds of Silty CLAYSTONE in a matrix of sand and clay			
24					-Chaotic mixture of sheared and displaced sandstone and claystone beds; common iron oxide mineralization infilling fractures and between blocks			
26	B7-5			SC+CL		2/12"	111.5	16.8
28					Becomes more intact; disturbed beds of Clayey SILTSTONE and Silty CLAYSTONE			
30	B7-6			ML+CL	-Approximately 6 inch thick bed of loose sand and sandstone fragments; undulating and irregular contact	3/12"	107.5	19.8

Figure A-7,
Log of Boring B 7, Page 1 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 7

ELEV. (MSL.) **241'** DATE COMPLETED **05-20-2005**

EQUIPMENT **30-INCH DIAMETER BUCKET AUGER**

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
32		CL	Disturbed and sheared beds of Silty CLAYSTONE; polished surfaces and slickensides; manganese and iron oxide mineralization			
35	B7-7			3/12"	109.4	17.2
40	B7-8		-Stiff, moist, olive gray, silty claystone beds; disturbed and sheared -Becomes wet and shattered to crushed; pods of carbonate; abundant remolded and polished surfaces; dark gray and fat	3/12"	100.9	22.9
44			-Water seeping from abundant fractures			
45	B7-9			6/12"	109.3	19.6
46	B7-12	CH	Abrupt and very well defined slip surface S: N46W/4NE; slightly undulating approximately 3 inch thick seam in highly remolded, polished and slickensided fat CLAY; base of slide debris at approximately 46 feet; slip surface within beds of fat claystone			
48		SM-ML	**SANTIAGO FORMATION** Dense, damp, light olive gray, Silty, fine-grained SANDSTONE to fine-grained Sandy SILTSTONE; moderately cemented; some minor water seeping from thin fractures			
50	B7-10			10/10"	121.3	12.4
52		SM	Dense, moist to wet, light gray, Silty, fine- to medium-grained SANDSTONE; massive; moderately cemented; relatively intact and undisturbed			
56			-Grades fine- to coarse-grained			
60	B7-11			20/6"	119.0	9.1

BORING TERMINATED AT 60.5 FEET
Seepage encountered at 44 feet
Backfilled with alternating layers of soil cuttings and 60 cu. ft. of bentonite

07227-52-02.GPJ

Figure A-7,
Log of Boring B 7, Page 2 of 2

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

BORING B 8

ELEV. (MSL.) 234' DATE COMPLETED 05-24-2005

EQUIPMENT 30-INCH DIAMETER BUCKET AUGER

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B8-1				**LANDSLIDE DEBRIS** Loose, moist, dark brown, Clayey, fine to medium SAND; porous with thin roots			
5				SC	-Abundant carbonate pods and stringers; medium dense; probably colluvium-infilled graben zone of slide			
10					-Common roots; loose and porous			
11.5					Loose, moist, light grayish brown, Silty, fine to medium SAND; mottled with dark gray; common krotovina; porous			
16					-Scattered fragments of sandstone and claystone; few pieces of charcoal			
20				SM+CL				
23					-Jumbled texture; thin clay-filled fractured; scattered blocks of sandstone and claystone generally less than 6-inch diameter, continued pieces of charcoal; yellowish brown to light olive gray			

07227-52-02.GPJ

Figure A-8,
Log of Boring B 8, Page 1 of 2

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING B 8 ELEV. (MSL.) 234' DATE COMPLETED 05-24-2005 EQUIPMENT 30-INCH DIAMETER BUCKET AUGER	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
30 – 39				SM	-Displaced sandstone beds; highly fractured to shattered; elongated layer of carbon-rich material along bedding surface B: N4E/53NW -Becomes light gray			
39 – 49			▼ (45)	SM+SC	Becomes jumbled mixture of Sandstone and Claystone fragments in a matrix of Silty SAND; carbonate pods; pieces of charcoal; few shattered sandstone blocks; structureless; wet -Hole completely caved to 44 feet; abundant seepage; unable to continue down-hole logging			
49 – 54				CL+SM	Mixture of olive gray clay and Claystone fragments in a matrix of SAND and SANDSTONE fragments; sheared and remolded clay seams			
54					BORING TERMINATED AT 54 FEET Seepage encountered at 45 feet Caving 44 to 54 feet Backfilled with 54 cu. ft. of bentonite and soil cuttings in alternating layers			

Figure A-8,
Log of Boring B 8, Page 2 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	⊠ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

BORING B 9

ELEV. (MSL.) **202'** DATE COMPLETED **05-25-2205**

EQUIPMENT **CME 75 WITH 8" HOLLOW STEM AUGER**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ALLUVIUM** Very stiff, moist, dark brown, fine, Sandy CLAY; porous with thin roots and scattered pieces of organic material; interlayers of medium dense, moist, gray, clayey, fine sand			
2								
4	B9-2			CL+SC				
6	B9-1					19	102.5	22.3
8								
10	B9-3			SC	Medium dense, moist, brownish gray, Clayey, fine to medium SAND; porous, scattered pockets of clay	10		
12			▼		-Encountered groundwater table at 13 feet			
14					**LANDSLIDE DEBRIS** Loose, saturated, olive gray, Silty, fine to coarse SAND; jumbled texture			
16	B9-4					11	106.5	19.6
18				SM				
20	B9-5					7		
22								
24					**SANTIAGO FORMATION** Dense, wet, light gray, Silty, fine- to coarse-grained SANDSTONE; weakly cemented			
26	B9-6					30		
28				SM				
30	B9-7			ML	Hard, moist, light gray to olive gray, fine-grained Sandy to Clayey SILTSTONE; scattered iron oxide staining	59	98.9	23.4

Figure A-9, Log of Boring B 9, Page 1 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 9

ELEV. (MSL.) 202' DATE COMPLETED 05-25-2205

EQUIPMENT CME 75 WITH 8" HOLLOW STEM AUGER

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
32								
34 – 38	B9-8			SM+SC	Medium dense to dense, wet, light olive gray, Clayey and Silty, fine to coarse SAND	43	107.6	20.6
38 – 44	B9-9			ML	Hard, moist, olive to olive gray, fine-grained Sandy SILTSTONE; weakly indurated	31		
44 – 52	B9-10			CL-SC	Dense to hard, moist, olive to greenish gray, fine-grained Sandy CLAYSTONE to Clayey SANDSTONE; weakly indurated and cemented	42	100.5	23.9
	B9-11					28		
52 – 56	B9-12			ML	Hard, moist, olive gray, Clayey SILTSTONE; strongly indurated	50/5"	111.3	16.6
56 – 58.5	B9-13				**GRANITIC ROCK** Hard, moist, gray, GRANITIC ROCK; moderately weathered; fine- to coarse-grained crystalline texture -No recovery at 58 feet -Refusal at 58.5 feet	50/1"		

BORING TERMINATED AT 58.5 FEET
Groundwater encountered at 13 feet
Backfilled with 20.5 cu. ft. of bentonite slurry

07227-52-02.GPJ

Figure A-9,
Log of Boring B 9, Page 2 of 2

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

BORING B 10

ELEV. (MSL.) 198' DATE COMPLETED 05-25-2205

EQUIPMENT CME 75 WITH 8" HOLLOW STEM AUGER

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B10-1			SM+SC	**ALLUVIUM** Loose, moist, dark brown, Clayey and Silty, fine to medium SAND; porous with thin roots			
	B10-2				-Wet	10	100.6	21.9
8				SC	Medium dense, moist, dark brown to mottled grayish brown, Clayey, fine to medium SAND; some carbonate pods; porous			
10	B10-3					18	104.0	20.3
14			▼		-Encountered groundwater at 15 feet			
16	B10-4			SM	**LANDSLIDE DEBRIS** Loose to medium dense, wet, olive gray, Silty, fine to medium SAND; pods of carbonate	15	104.5	21.9
18					-Loose to medium dense, saturated, fine- to coarse-grained			
20	B10-5					32		
22				SM	Dense, moist, light gray, Silty, fine- to medium-grained SANDSTONE; carbonate-filled fractures			
24				SM-ML	**SANTIAGO FORMATION** Dense, moist, light olive gray, Silty, fine-grained SANDSTONE to fine-grained Sandy SILTSTONE; moderately cemented			
26	B10-6					74/11"	114.2	15.3
28								

Figure A-10,
Log of Boring B 10, Page 1 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

BORING B 10

ELEV. (MSL.) **198'** DATE COMPLETED **05-25-2205**

EQUIPMENT **CME 75 WITH 8" HOLLOW STEM AUGER**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B10-7				Dense, moist, light gray, Silty, fine- to coarse-grained SANDSTONE; weakly cemented; slightly micaceous	74		
32								
34								
36	B10-8			SM	-Moderately cemented	50/6"	117.4	13.4
38								
40	B10-9					50/5"	111.5	15.4
42				ML	Hard, moist, olive gray, Clayey to fine-grained Sandy SILTSTONE; strongly indurated; some iron oxide mineralization			
44	B10-10				-Refusal to penetration at 43.5 feet	80/10"		

BORING TERMINATED AT 44 FEET
Groundwater encountered at 15 feet
Backfilled with 15 cu. ft. of bentonite slurry

Figure A-10,
Log of Boring B 10, Page 2 of 2

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

TRENCH T 1

ELEV. (MSL.) **300'** DATE COMPLETED **05-09-2005**

EQUIPMENT **JD 450 TRACK-MOUNTED BACKHOE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 2				CL	**LANDSLIDE DEBRIS** Soft, moist, dark brown to grayish brown, fine Sandy CLAY; moderate topsoil development; common thin roots			
4 – 6				CH	Stiff, moist, brownish to olive gray, fine Sandy fat CLAY; abundant slickensided sheared surfaces; carbonate mineralization; scattered roots; overall jumbled texture; fractured claystone blocks S: N5W/17SW			
8 – 10				SM+SC	**SANTIAGO FORMATION** Dense, moist, light olive gray, fine- to medium-grained Silty to locally Clayey SANDSTONE; moderately cemented; weakly jointed; generally massive and undisturbed			
					TRENCH TERMINATED AT 11 FEET No groundwater encountered			

Figure A-11,
Log of Trench T 1, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 2 ELEV. (MSL.) 195' DATE COMPLETED 05-09-2005 EQUIPMENT JD 450 TRACK-MOUNTED BACKHOE	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0 2				CL	**LANDSLIDE DEBRIS** Soft, moist, brown to grayish brown, fine Sandy CLAY; moderate topsoil development; abundant thin roots			
4 6 8				CH+SC	Medium dense and stiff, moist, light gray to olive gray, fat CLAY and Clayey to Silty SAND; jumbled texture; chaotic structure; some fragments of sandstone and claystone; clayey areas sheared and slickensided; back-rotated beds generally dipping at low to moderate angles into hillside			
					TRENCH TERMINATED AT 9 FEET No groundwater encountered			

Figure A-12,
Log of Trench T 2, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

TRENCH T 3

ELEV. (MSL.) 204' DATE COMPLETED 05-09-2005

EQUIPMENT JD 450 TRACK-MOUNTED BACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 3				CL	**LANDSLIDE DEBRIS** Soft, moist, dark brown, fine Sandy CLAY; abundant roots and porosity			
3 – 12			▼ (10)	SM+SC	Loose, moist to wet, yellowish brown to light olive gray, Silty to Clayey SAND; highly disturbed, chaotic texture, some fragments of sandstone; few roots -Very loose and saturated; walls of trench highly prone to caving; abundant seepage			
12					TRENCH TERMINATED AT 12 FEET Seepage at 10 feet			

07227-52-02.GPJ

Figure A-13,
Log of Trench T 3, Page 1 of 1

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	◧ ... STANDARD PENETRATION TEST	■ ... DRIVE SAMPLE (UNDISTURBED)
	⊠ ... DISTURBED OR BAG SAMPLE	◪ ... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

TRENCH T 4

ELEV. (MSL.) **207'** DATE COMPLETED **05-09-2005**

EQUIPMENT **JD 450 TRACK-MOUNTED BACKHOE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 5				SC	**ALLUVIUM** Loose, moist, dark brown, Clayey, fine SAND; porous; common roots			
5 – 14			▼ (9 ft)	SM+SC	**LANDSLIDE DEBRIS** Loose, wet, olive gray to grayish brown, Clayey to Silty, fine SAND and Sandy CLAY; porous; jumbled texture and chaotic structure -Saturated; abundant seepage; caving of trench walls			

TRENCH TERMINATED AT 14 FEET
Seepage at 9 feet

Figure A-14,
Log of Trench T 4, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ☒ ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

TRENCH T 5

ELEV. (MSL.) **212'** DATE COMPLETED **05-09-2005**

EQUIPMENT **JD 450 TRACK-MOUNTED BACKHOE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 2 – 4				SC	**LANDSLIDE DEBRIS** Loose, moist, dark gray, Clayey, fine SAND; porous; thin roots; weakly developed topsoil in upper 2 feet			
6 – 8 – 10 – 12 – 14				SM+SC	Loose, moist to wet, olive gray, Clayey to Silty, fine to coarse SAND; jumbled texture; chaotic structure; some clayey sandstone fragments in sandy matrix			
					TRENCH TERMINATED AT 14.5 FEET No groundwater encountered			

Figure A-15,
Log of Trench T 5, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 6 ELEV. (MSL.) 226' DATE COMPLETED 05-10-2005 EQUIPMENT JD 450 TRACK-MOUNTED BACKHOE	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SC	**TOPSOIL** Loose to medium dense, dry to damp, Clayey SAND			
2					**GRANITIC ROCK** Moderately hard, moist, tan to gray, GRANITIC ROCK; highly weathered; moderately fractured; damp to dry; light green clay on fracture surfaces			
4	T6-1							
6					-At 5 feet J: N37E/vertical			
8					-At 7 feet J:N53W/77SW			
					TRENCH TERMINATED AT 9.5 FEET No groundwater encountered No caving			

Figure A-16,
Log of Trench T 6, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

TRENCH T 7

ELEV. (MSL.) **240'** DATE COMPLETED **05-10-2005**

EQUIPMENT **JD 450 TRACK-MOUNTED BACKHOE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 4				SC	**LANDSLIDE DEBRIS** Loose to medium dense, dry to damp, dark gray, Clayey SAND; moderate topsoil development. Medium dense, moist, light gray brown; scattered flecks of black organics; base subparallel to slope; grades to very light gray with medium gray brown laminations			
4 – 8				SM	**SANTIAGO FORMATION** Dense, damp, very light gray, fine- to medium-grained Silty SANDSTONE; massive to thickly slightly weathered. -Becomes dark brown at 7.5 feet. -C: 80E/5-10N (at top)			
8 – 9					**GRANITIC ROCK** Moderately hard, damp to moist, greenish gray with abundant orange staining, GRANITIC ROCK; highly weathered			

TRENCH TERMINATED AT 9 FEET
No groundwater encountered
No caving

07227-52-02.GPJ

Figure A-17,
Log of Trench T 7, Page 1 of 1

SAMPLE SYMBOLS: ... SAMPLING UNSUCCESSFUL; ... DISTURBED OR BAG SAMPLE; ... STANDARD PENETRATION TEST; ... CHUNK SAMPLE; ... DRIVE SAMPLE (UNDISTURBED); ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 8 ELEV. (MSL.) 254' DATE COMPLETED 05-10-2005 EQUIPMENT JD 450 TRACK-MOUNTED BACKHOE	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SC	**TOPSOIL** Medium dense, dry to damp, dark gray, Clayey SAND			
2 4	T8-1			SM	**SANTIAGO FORMATION** Dense, damp, very light gray, Silty SANDSTONE; fine- to medium-grained; moderately weathered; massive; moderately cemented -Slightly weathered at 4 feet			
					TRENCH TERMINATED AT 5 FEET No groundwater encountered			

07227-52-02.GPJ

Figure A-18,
Log of Trench T 8, Page 1 of 1

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

TRENCH T 9

ELEV. (MSL.) 241' DATE COMPLETED 05-10-2005

EQUIPMENT JD 450 TRACK-MOUNTED BACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Medium dense, dry to damp, dark gray-brown, Silty SAND			
2 4				SM	**SANTIAGO FORMATION** Dense, damp, very light gray with some orange staining, Silty SANDSTONE; fine- to medium-grained; moderately weathered, slightly fractured; moderately cemented; massive -Slightly weathered; fine roots; dark brown staining at 4 feet -At 3 feet; J: N70W/65NE			

TRENCH TERMINATED AT 5 FEET
No groundwater encountered

Figure A-19,
Log of Trench T 9, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07227-52-02

TRENCH T 10

ELEV. (MSL.) 228' DATE COMPLETED 05-10-2005

EQUIPMENT JD 450 TRACK-MOUNTED BACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 2				SM	**TOPSOIL** Medium dense, dry to damp, dark gray, Silty SAND			
2 – 11				SP	**SANTIAGO FORMATION** Medium dense, moist, very light pale brown, SANDSTONE; massive; moderately hard; weakly cemented; moderately weathered -Very light gray; slightly weathered; slightly moist at 4 feet -Moderate seepage at 11 feet			
11 – 13	T10-1		▼	SM	Dense, damp, greenish medium gray, Silty, fine to medium SANDSTONE; trace clay -Refusal at 13 feet			

TRENCH TERMINATED AT 13 FEET
Seepage at 11 feet

07227-52-02.GPJ

Figure A-20,
Log of Trench T 10, Page 1 of 1

SAMPLE SYMBOLS			
	☐ ... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	⊠ ... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 11 ELEV. (MSL.) 226' DATE COMPLETED 05-10-2005 EQUIPMENT JD 450 TRACK-MOUNTED BACKHOE	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0 2				SC	**TOPSOIL** Medium dense, damp, dark gray, Clayey SAND			
4 6					**GRANITIC ROCK** Moderately hard, slightly moist, light gray brown with orange staining, GRANITIC ROCK; highly weathered, highly fractured -At 6 feet J: N70E/72NW; J: N72E/70SE			
					TRENCH TERMINATED AT 7.5 FEET No groundwater encountered			

Figure A-21,
Log of Trench T 11, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

TRENCH T 12

ELEV. (MSL.) **220'** DATE COMPLETED **05-10-2005**

EQUIPMENT **JD 450 TRACK-MOUNTED BACKHOE**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**TOPSOIL** Medium dense, slightly moist, dark gray, Clayey SAND			
2 4 6					**GRANITIC ROCK** Moderately hard, damp, light gray brown with orange staining, GRANITIC ROCK; highly weathered; scattered hard rounded nodules (some nodules, moderately weathered); fine- to coarse-grained crystalline texture			
					TRENCH TERMINATED AT 7 FEET No groundwater encountered			

Figure A-22,
Log of Trench T 12, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

TRENCH T 13

ELEV. (MSL.) 228' DATE COMPLETED 05-10-2005

EQUIPMENT JD 450 TRACK-MOUNTED BACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 3				CL	**LANDSLIDE DEBRIS** Stiff, moist, dark brown, Sandy CLAY; porous with roots and krotovina; moderate topsoil development			
3 – 5.5				SM	Loose, moist, light olive gray, Silty, fine to medium SAND; common clay-filled; high-angle fractures			
5.5 – 13	T13-1 (10–12)			CH	Stiff, moist, dark olive gray; Sandy, fat CLAY; pockets of silty sand and granitic rock fragments; highly fractured and sheared; chaotic bedding orientations B: N35E/38NW -Carbonate and iron oxide mineralization between sand and clay beds -At 13 feet, contact roughly horizontal, undulatory			
13 – 14					**GRANITIC ROCK** Moderately hard to hard, damp, light to medium brown, GRANITIC ROCK; moderately weathered			

TRENCH TERMINATED AT 14 FEET
No groundwater encountered
No caving

07227-52-02.GPJ

Figure A-23,
Log of Trench T 13, Page 1 of 1

SAMPLE SYMBOLS: ... SAMPLING UNSUCCESSFUL; ... DISTURBED OR BAG SAMPLE; ... STANDARD PENETRATION TEST; ... CHUNK SAMPLE; ... DRIVE SAMPLE (UNDISTURBED); ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

TRENCH T 14

ELEV. (MSL.) 238' DATE COMPLETED 05-10-2005

EQUIPMENT JD 450 TRACK-MOUNTED BACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0–2				SC	**PREVIOUSLY PLACED FILL** Loose, moist, grayish brown, Clayey, fine to medium SAND; few gravels			
2–5				CL	**TOPSOIL** Stiff, moist, dark brown, fine Sandy CLAY; few gravels; common roots; porous			
5–8				CH	**SANTIAGO FORMATION** Very stiff, moist, dark olive gray, fine Sandy, fat CLAY; highly weathered and some shearing			
8–18				SM-SC	Medium dense, moist, light olive gray, Clayey and Silty, SANDSTONE; fine- to medium-grained; very weakly cemented; massive bedding -Becomes dense; fine-grained and clayey			

TRENCH TERMINATED AT 18 FEET
No groundwater encountered
No caving

Figure A-24,
Log of Trench T 14, Page 1 of 1

07227-52-02.GPJ

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

SUMMARY OF LABORATORY TESTING

Classification

Soils were classified visually according to the Unified Soil Classification System (ASTM Test Method D2487). The soil classifications are shown on the logs of exploratory borings/trenches in Appendix A.

Liquid limit, plastic limit and plasticity index were determined in accordance with ASTM Test Method D4318. Results are shown below:

RESULTS OF LABORATORY ATTERBERG LIMITS

Boring No.	Sample Depth (Ft)	Liquid Limit (%)	Plasticity Index (%)	Unified Soil Classification Symbol
Geocon B1-6	6	63	41	CL
Geocon B7-12	46	55	23	CH

(Geocon, 2005)

Expansion Index

Expansion Index testing was performed on representative soil samples at locations listed. Testing was performed in general accordance with ASTM Test Method D4829. The Expansion Index (EI) test results are presented below:

RESULTS OF LABORATORY EXPANSION INDEX

Test Location	Expansion Index	Potential Expansion
GeoTek B-4 @ 5 feet	27	Low
GeoTek B-3 @ 29 feet	76	Medium
GeoTek B-2 @ 5 feet	164	High

GEOTEK

EXPANSION INDEX TEST

(ASTM D4829)

Project Name: Oceanside Residential Development
Project Number: 3129-SD3

Tested/ Checked By: TM Lab No 2507
Date Tested: 12/18/2006
Sample Source: GTB2 @ 5
Sample Description: Gray Silty Clay

Ring Id 12 Ring Dia. " 4" Ring 1"
Loading weight: 5516. grams

DENSITY DETERMINATION

A	Weight of compacted sample & ring	**760.4**
B	Weight of ring	370
C	Net weight of sample	390.4
D	Wet Density, lb / ft3 (C*0.3016)	117.7
E	Dry Density, lb / ft3 (D/1.F)	**105.1**

SATURATION DETERMINATION

F	Moisture Content, %	**12.0**
G	(E*F)	1261.5
H	(E/167.232)	0.63
I	(1.-H)	0.37
J	(62.4*I)	23.2
K	(G/J)= **L** % Saturation	**54.4**

READINGS

DATE	TIME	READING	
12/18/2006	11:20	0.024	Initial
12/18/2006	11:30	0.024	10 min/Dry
12/18/2006	11:31	0.032	1 min/Wet
12/18/2006	11:36	0.040	5 min/Wet
12/18/2006	1:10	0.052	Random
12/19/2006	8:00	0.182	Final

FINAL MOISTURE

Weight of wet sample & tare	Weight of dry sample & tare	Tare	% Moisture
138	110.3	12.5	**28.3%**

EXPANSION INDEX = 164
(@50% SATURATION)

GEOTEK

EXPANSION INDEX TEST

(ASTM D4829)

Project Name: Oceanside Residential Development

Project Number: 3129-SD3

Tested/ Checked By: TM Lab No 2507

Date Tested: 12/18/2006

Sample Source: GTB3 @ 29

Sample Description: Light Olive Gray Silty Clay

Ring Id 12 Ring Dia. " 4" Ring 1"

Loading weight: 5516. grams

DENSITY DETERMINATION

A	Weight of compacted sample & ring	**742.4**
B	Weight of ring	370
C	Net weight of sample	372.4
D	Wet Density, lb / ft3 (C*0.3016)	112.3
E	Dry Density, lb / ft3 (D/1.F)	**98.7**

SATURATION DETERMINATION

F	Moisture Content, %	**13.8**
G	(E*F)	1362.0
H	(E/167.232)	0.59
I	(1.-H)	0.41
J	(62.4*I)	25.6
K	(G/J)= L % Saturation	**53.3**

READINGS			
DATE	TIME	READING	
12/18/2006	11:20	0.035	Initial
12/18/2006	11:30	0.035	10 min/Dry
12/18/2006	11:31	0.067	1 min/Wet
12/18/2006	11:36	0.089	5 min/Wet
12/18/2006	1:10	0.092	Random
12/19/2006	8:00	0.108	Final

FINAL MOISTURE

Weight of wet sample & tare	Weight of dry sample & tare	Tare	% Moisture
135	110.1	12.2	**25.4%**

EXPANSION INDEX = 76

(@50% SATURATION)

GEOTEK

EXPANSION INDEX TEST

(ASTM D4829)

Project Name: Oceanside Residential Development

Project Number: 3129-SD3

Tested/ Checked By: TM Lab No 2507

Date Tested: 12/18/2006

Sample Source: GTB4 @ 5

Sample Description: Gray Brown Clayey Silty Sand

Ring Id 12 Ring Dia. " 4" Ring 1"

Loading weight: 5516. grams

DENSITY DETERMINATION

A	Weight of compacted sample & ring	**764.1**
B	Weight of ring	370
C	Net weight of sample	394.1
D	Wet Density, lb / ft3 (C*0.3016)	118.9
E	Dry Density, lb / ft3 (D/1.F)	**105.6**

SATURATION DETERMINATION

F	Moisture Content, %	**12.6**
G	(E*F)	1330.1
H	(E/167.232)	0.63
I	(1.-H)	0.37
J	(62.4*I)	23.0
K	(G/J)= **L** % Saturation	**57.8**

READINGS

DATE	TIME	READING	
12/18/2006	11:20	0.013	Initial
12/18/2006	11:30	0.012	10 min/Dry
12/18/2006	11:31	0.015	1 min/Wet
12/18/2006	11:36	0.020	5 min/Wet
12/18/2006	1:10	0.024	Random
12/19/2006	8:00	0.036	Final

FINAL MOISTURE

Weight of wet sample & tare	Weight of dry sample & tare	Tare	% Moisture
111.5	92.8	12.5	**23.3%**

EXPANSION INDEX = 27

(@50% SATURATION)

Moisture-Density Relations

Laboratory testing was performed on representative samples collected during the subsurface exploration. The laboratory maximum dry density and optimum moisture content for representative soil types were determined in general accordance with test method ASTM D1557.

RESULTS OF LABORATORY TEST OF MAXIMUM DRY DENSITY

Test Location	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
GeoTek B-5 @ 5 feet	117.5	13.5
GeoTek B-4 @ 5 feet	115.0	13.0
Geotek B-3 @ 29 feet	111.5	16.5
GeoTek B-2 @ 5 feet	115.5	14.0

Direct Shear

Shear testing was performed in a direct shear machine of the strain-control type in general accordance with ASTM Test Method D3080. The rate of deformation is 0.03 inches per minute. The sample was sheared under varying confining loads in order to determine the coulomb shear strength parameters, angle of internal friction and cohesion. The shear test results are included in the report.

RESULTS OF LABORATORY SHEAR TESTING

Soil Description/Source	Shear Strength		Dry Unit Weight (pcf)
	Friction (Degrees)	Cohesion (psf)	
GeoTek B-1 at 5'	41.0	116	112.2
GeoTek B-1 at 16'	38.0	114	114.3
GeoTek B-1 at 45'	43.8	260	118.7
GeoTek B-2 at 5'	35.4	560	103.9
GeoTek B-4 at 5'	33.0	360	103.9
GeoTek B-5 at 50'	42.9	940	123.5
GeoTek B-5 at 60'	41.7	150	117.9
GeoTek B-8 at 10'	36.5	280	116.4

MAXIMUM DENSITY CURVE

Curve No.: GTB2 @ 5'

Project No.: 3129-SD3 **Date:** 12/18/06

Project: Oceanside Residential Development

Location:

Elev./Depth:

Remarks:

MATERIAL DESCRIPTION

Description: Light Olive Gray Silty Clay

Classifications - **USCS:** **AASHTO:**

Nat. Moist. = **Sp.G. =**

Liquid Limit = **Plasticity Index =**

% > No.4 = % **% < No.200 =**

TEST RESULTS
Maximum dry density = 115.5 pcf
Optimum moisture = 14 %

Test specification:
ASTM D 1557-00 Method A Modified

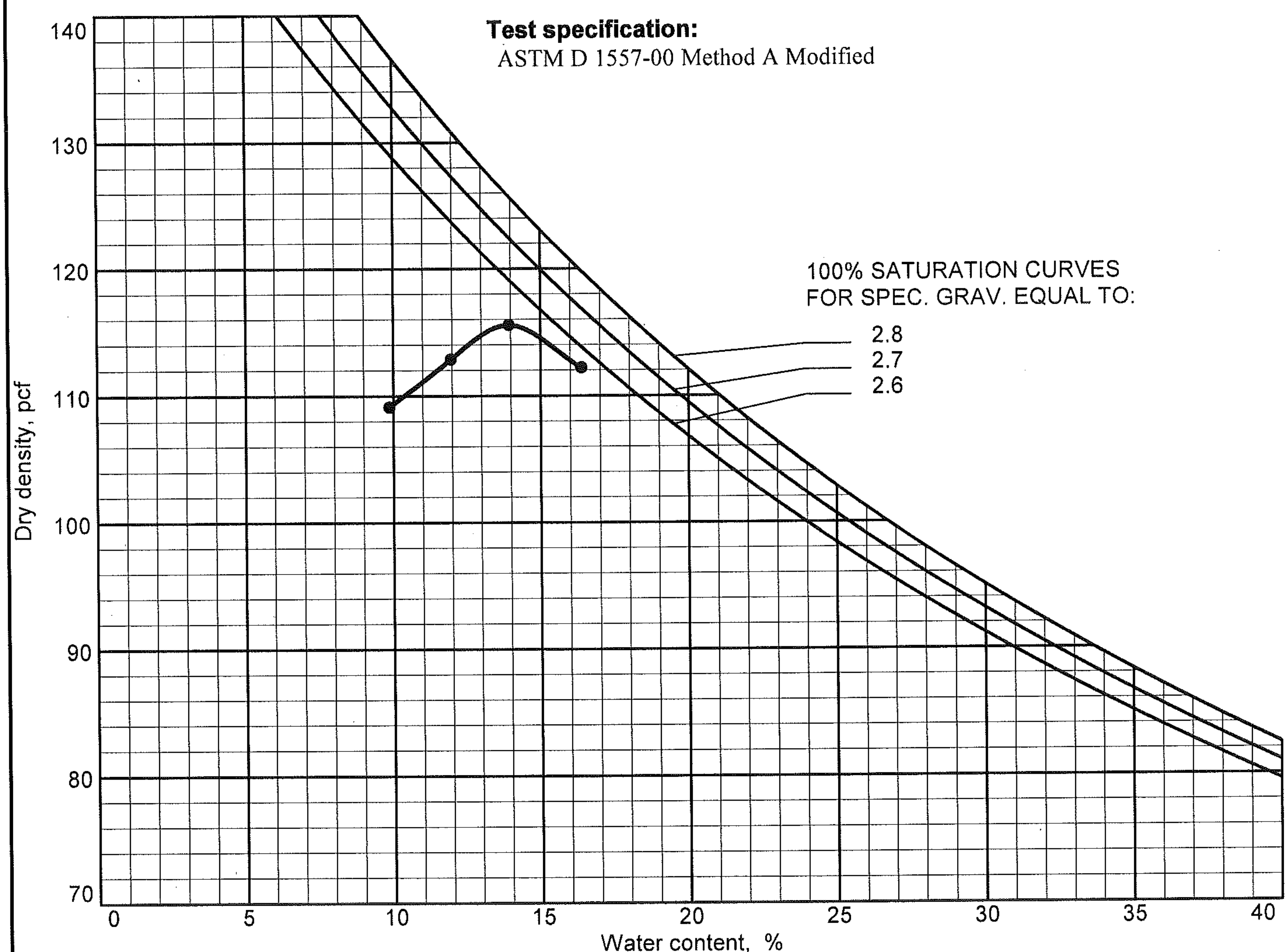


Plate 1

MAXIMUM DENSITY CURVE

Curve No.: GTB3 @ 29'

Project No.: 3129-SD3 **Date:** 12/18/06

Project: Oceanside Residential Development

Location:

Elev./Depth:

Remarks:

MATERIAL DESCRIPTION

Description: Light Olive Gray Silty Clay

Classifications - **USCS:** **AASHTO:**

Nat. Moist. = **Sp.G. =**

Liquid Limit = **Plasticity Index =**

% > No.4 = % **% < No.200 =**

TEST RESULTS
Maximum dry density = 111.5 pcf
Optimum moisture = 16.5 %

Test specification:
ASTM D 1557-00 Method A Modified

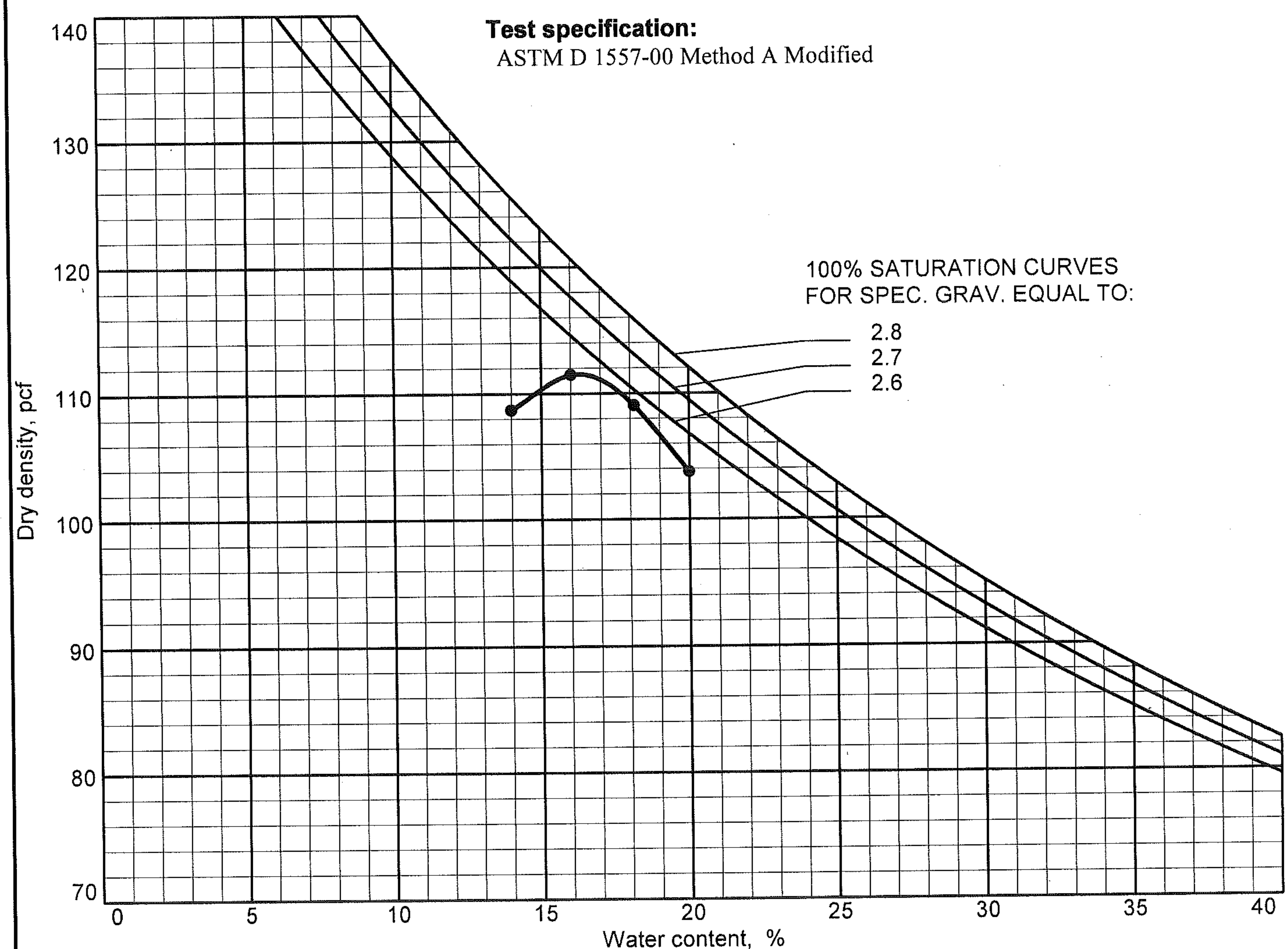


Plate 2

MAXIMUM DENSITY CURVE

Curve No.: GTB4 @ 5'

Project No.: 3129-SD3 **Date:** 12/19/06

Project: Oceanside Residential Development

Location:

Elev./Depth:

Remarks:

MATERIAL DESCRIPTION

Description: GRAY BROWN CLAYEY SILTY SAND

Classifications - **USCS:** **AASHTO:**

Nat. Moist. = **Sp.G. =**

Liquid Limit = **Plasticity Index =**

% > No.4 = % **% < No.200 =**

TEST RESULTS
Maximum dry density = 115 pcf
Optimum moisture = 13 %

Test specification:
ASTM D 1557-00 Method A Modified

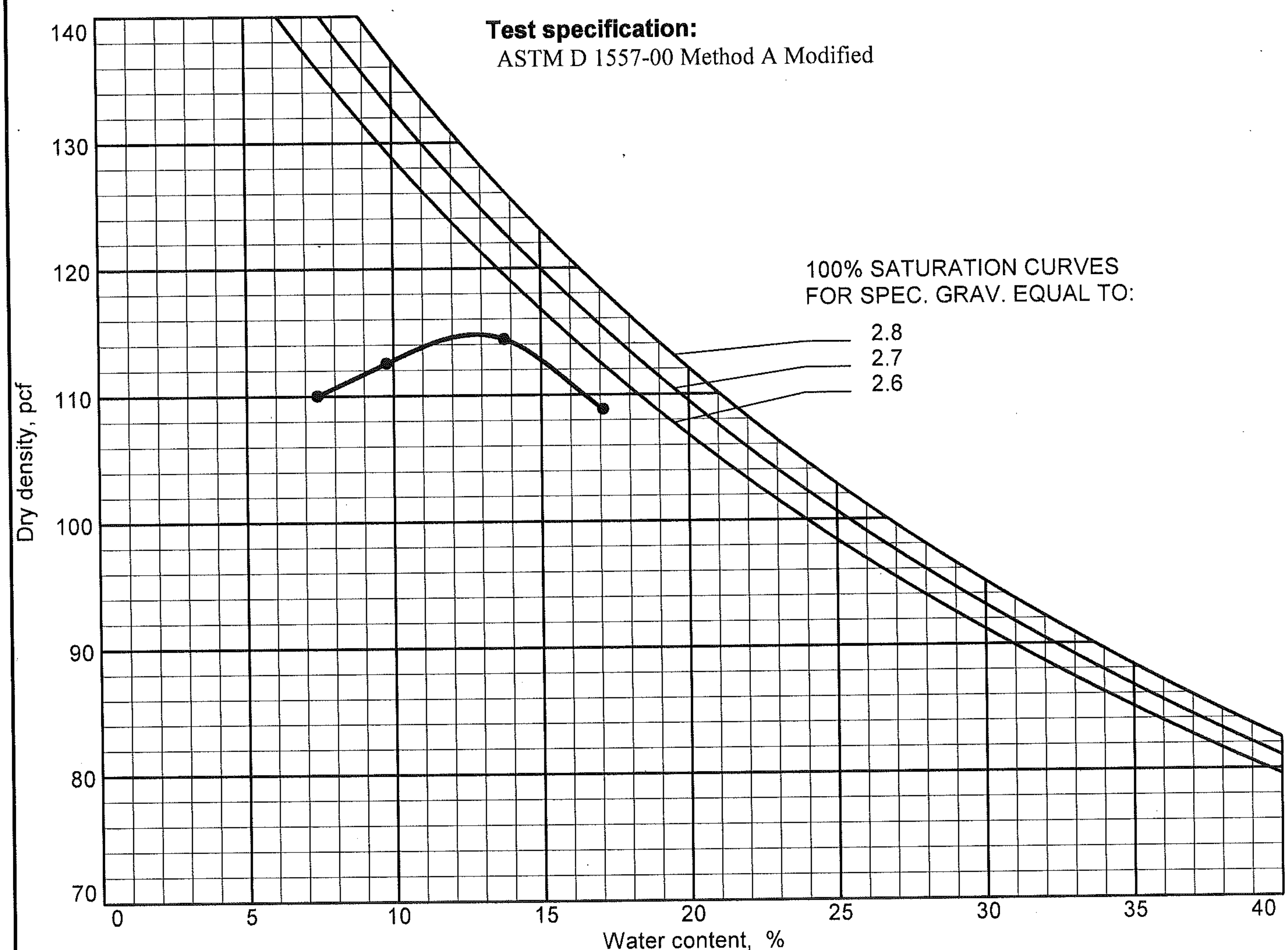


Plate 3

MAXIMUM DENSITY CURVE

Curve No.: GTB5 @ 5'

Project No.: 3129-SD3 **Date:** 12/19/06

Project: Oceanside Residential Development

Location:

Elev./Depth:

Remarks:

MATERIAL DESCRIPTION

Description: Olive Gray Silty Fine Sand

Classifications - **USCS:** **AASHTO:**

Nat. Moist. = **Sp.G. =**

Liquid Limit = **Plasticity Index =**

% > No.4 = % **% < No.200 =**

TEST RESULTS
Maximum dry density = 117.5 pcf
Optimum moisture = 13.5 %

Test specification:
ASTM D 1557-00 Method A Modified

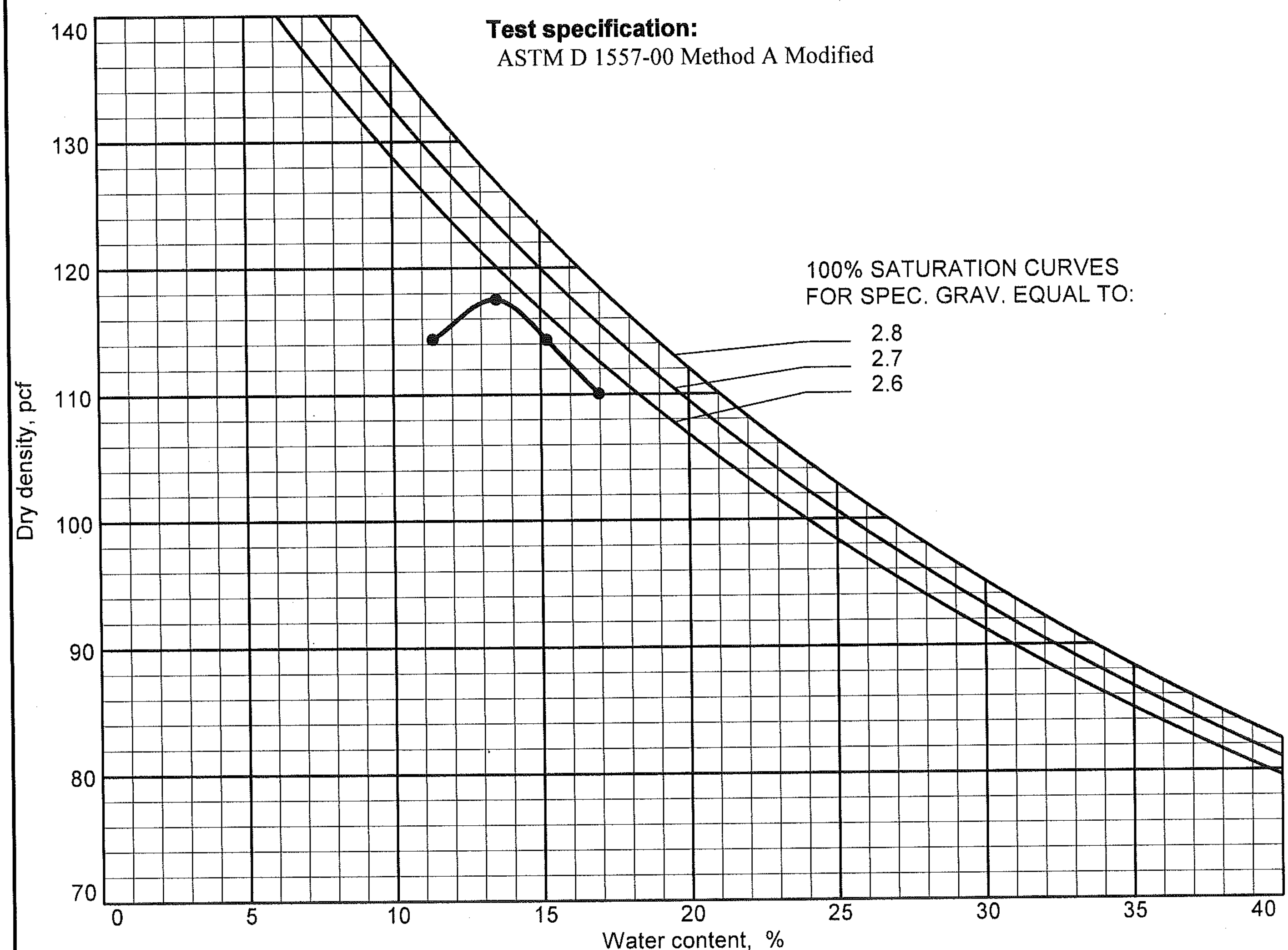


Plate 4

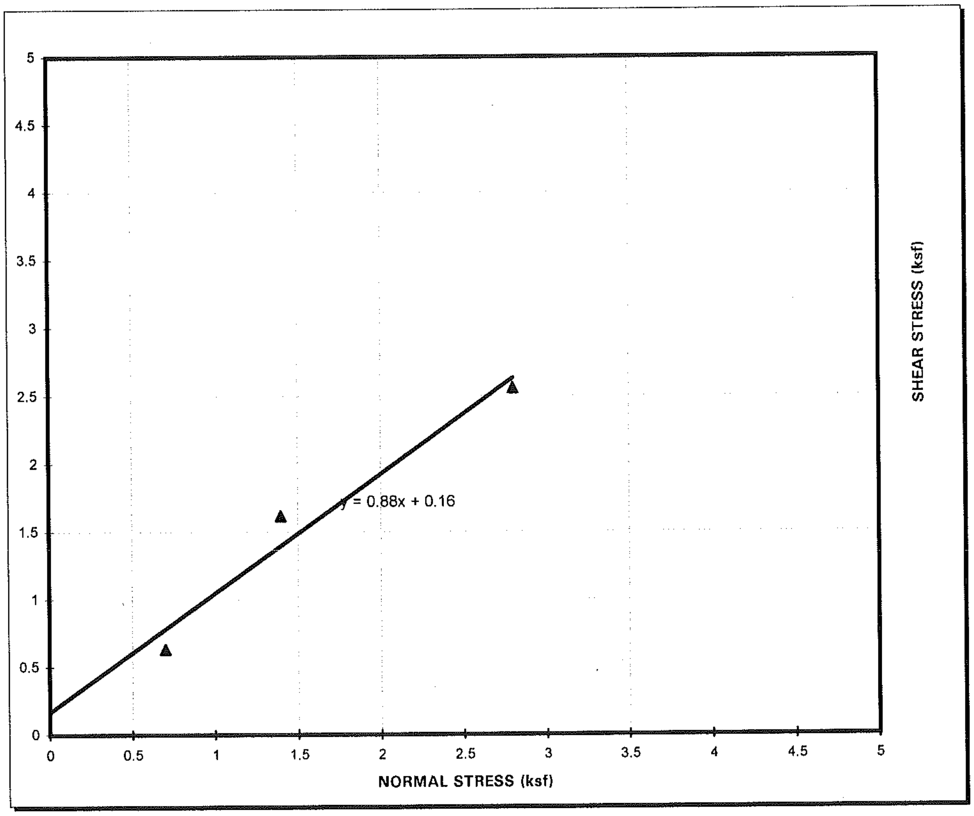
GEOTEK

DIRECT SHEAR TEST

Project Name: Lundstrom/Oceanside
Project Number: 3129 SD3

Sample Source: GTB1 @ 5'
Date Tested: 12/13/06

Soil Description: Brown Silty SAND



Shear Strength: $\Phi = 41.0^{o}$, **C =** 0.16 **ksf**

Test No.	Load (ksf)	Water Content (%)	Dry Density (pcf)
1	0.7	10.7	111.7
2	1.4	10.7	113.1
3	2.8	10.7	111.8

Note: Saturated in shear box

Notes:
1 - The soil specimen used in the shear box were "ring" samples collected during the field investigation.
2 - Shear strength calculated at peak load.
3 - The tests were ran at a shear rate of 0.03 in/min.

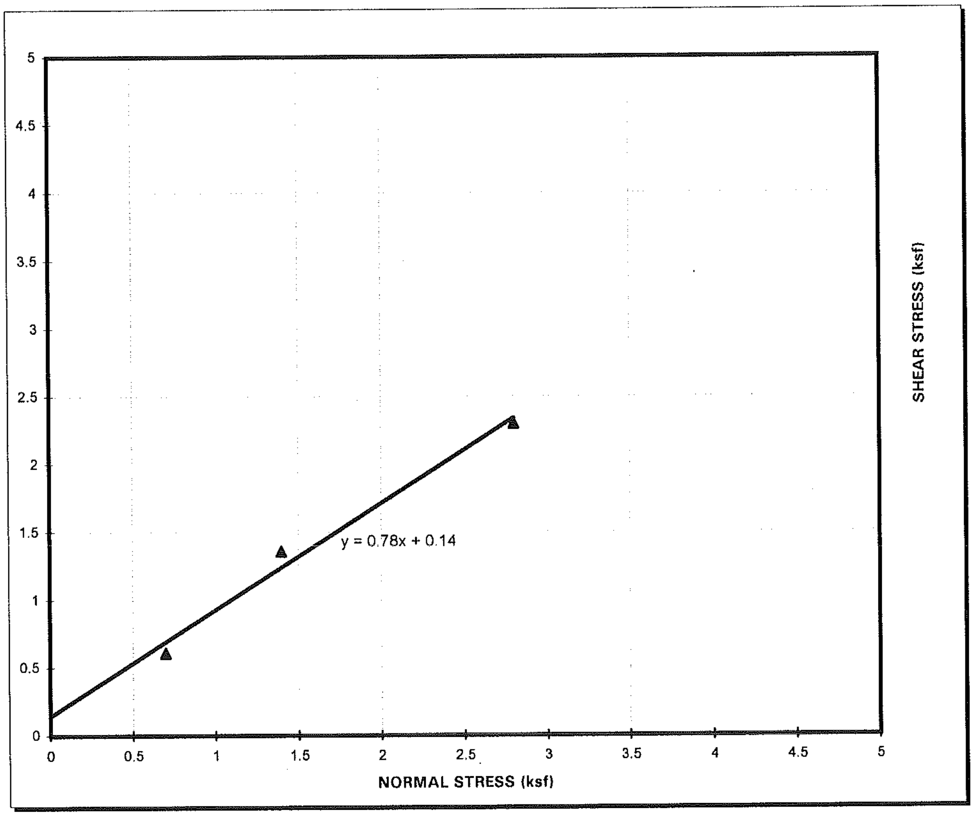
GEOTEK

DIRECT SHEAR TEST

Project Name: Oceanside Residential Development
Project Number: 3129 SD3

Sample Source: GTB1 @ 16'
Date Tested: 12/14/06

Soil Description: Olive Gray Silty Clay



Shear Strength: $\Phi = 38.0^{O}$, **C =** 0.14 **ksf**

Test No.	Load (ksf)	Water Content (%)	Dry Density (pcf)
1	0.7	21.5	114.8
2	1.4	21.5	114.2
3	2.8	21.5	113.8

Note: Saturated in shear box

Notes:
1 - The soil specimen used in the shear box were "ring" samples collected during the field investigation.
2 - Shear strength calculated at peak load.
3 - The tests were ran at a shear rate of 0.03 in/min.

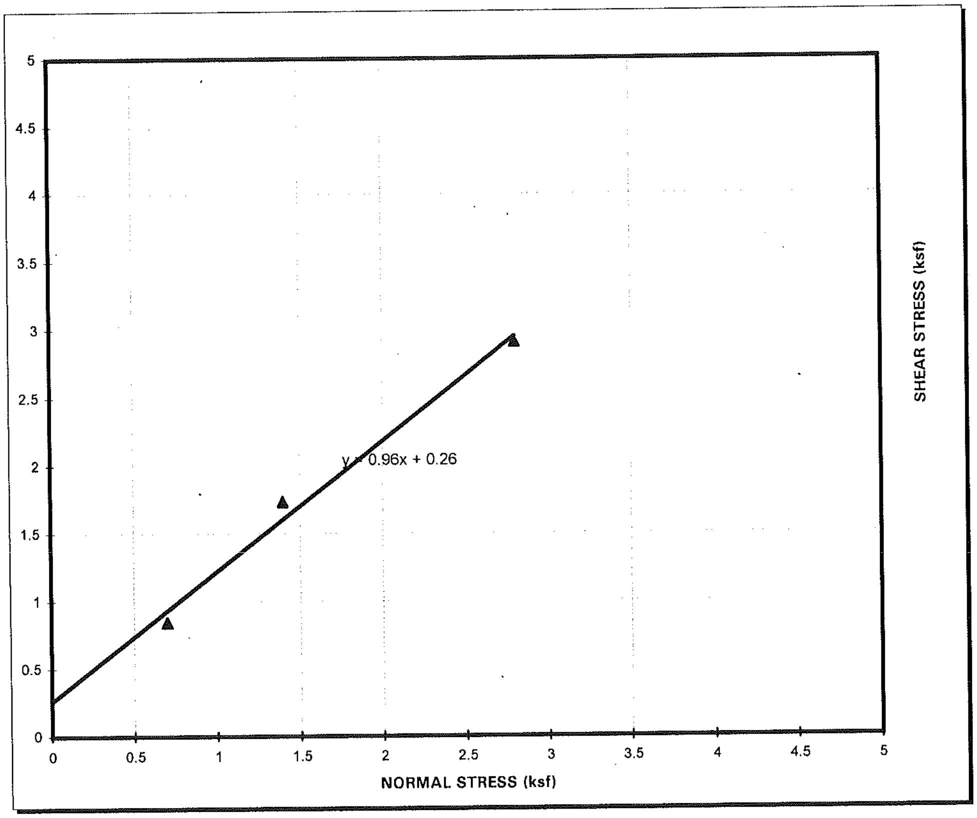
GEOTEK

DIRECT SHEAR TEST

Project Name: Oceanside Residential Development
Project Number: 3129 SD3

Sample Source: GTB1 @ 45'
Date Tested: 12/20/06

Soil Description: Olive Gray Brown Fine Sandy Silt



Shear Strength: $\Phi = 43.8^{o}$, **C =** 0.26 **ksf**

Test No.	Load (ksf)	Water Content (%)	Dry Density (pcf)
1	0.7	11.2	119.1
2	1.4	11.2	118.6
3	2.8	11.2	118.3

Note: Saturated in shear box

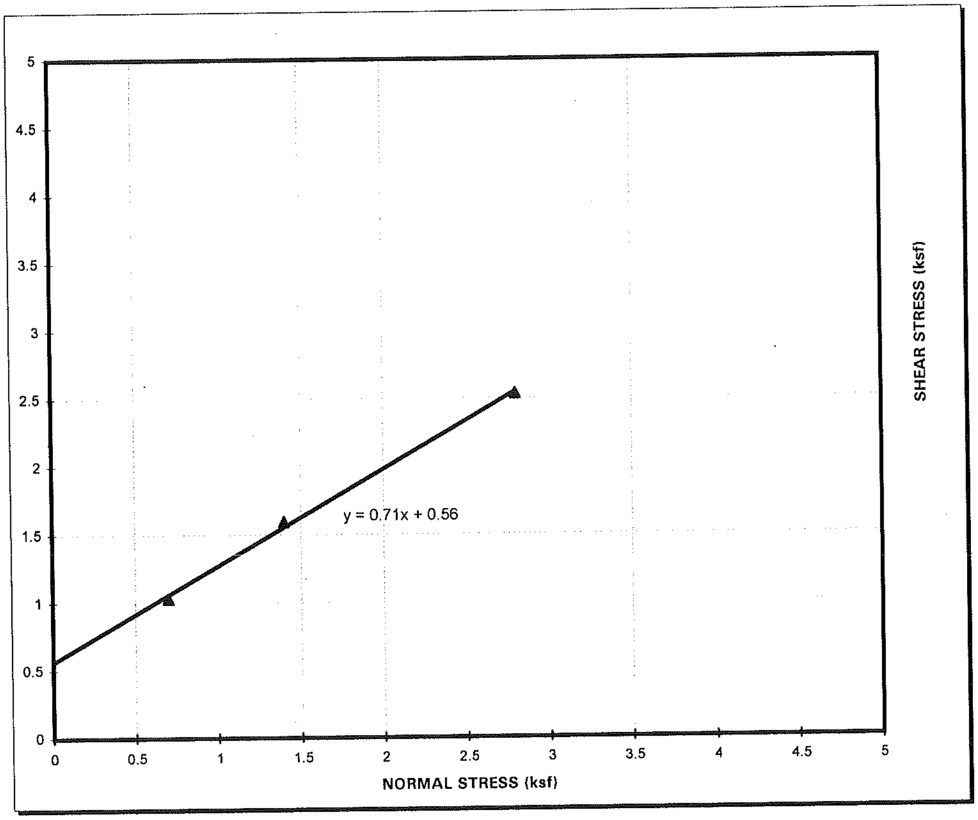
Notes:
1 - The soil specimen used in the shear box were "ring" samples collected during the field investigation.
2 - Shear strength calculated at peak load.
3 - The tests were ran at a shear rate of 0.03 in/min.

DIRECT SHEAR TEST

Project Name: Oceanside Residential Development
Project Number: 3129 SD3

Sample Source: GTB2 @ 5'
Date Tested: 12/20/06

Soil Description: Light Olive Gray Silty Clay



Shear Strength: $\Phi = 35.4^{o}$, **C =** 0.56 **ksf**

Test No.	Load (ksf)	Water Content (%)	Dry Density (pcf)
1	0.7	14	104.1
2	1.4	14	103.9
3	2.8	14	103.8

Note: Saturated in shear box

Notes:
1 - The soil specimen used in the shear box were remolded "ring" samples.
2 - Shear strength calculated at peak load.
3 - The tests were ran at a shear rate of 0.03 in/min.

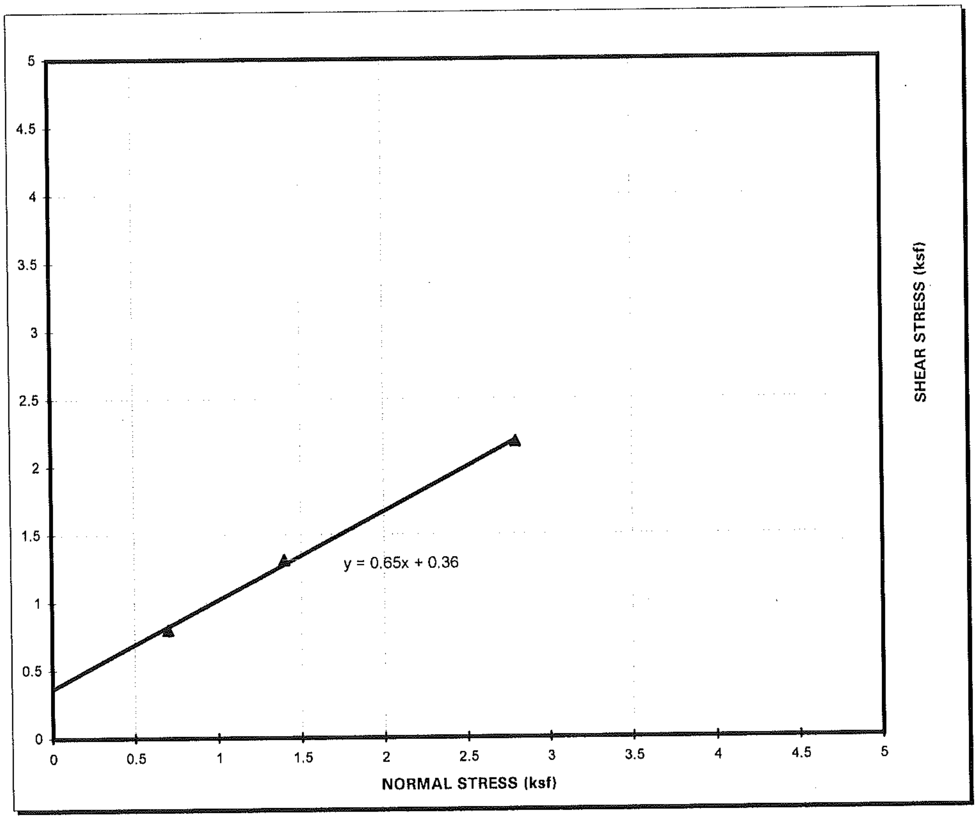
GEOTEK

DIRECT SHEAR TEST

Project Name: Oceanside Residential Development
Project Number: 3129 SD3

Sample Source: GTB4 @ 5'
Date Tested: 12/20/06

Soil Description: Dark Brown Silty Fine Sand



Shear Strength: $\Phi = 33.0^{O}$, **C =** 0.36 **ksf**

Test No.	Load (ksf)	Water Content (%)	Dry Density (pcf)
1	0.7	13	103.9
2	1.4	13	103.7
3	2.8	13	104.1

Note: Saturated in shear box

Notes:
1 - The soil specimen used in the shear box were remolded "ring" samples.
2 - Shear strength calculated at peak load.
3 - The tests were ran at a shear rate of 0.03 in/min.

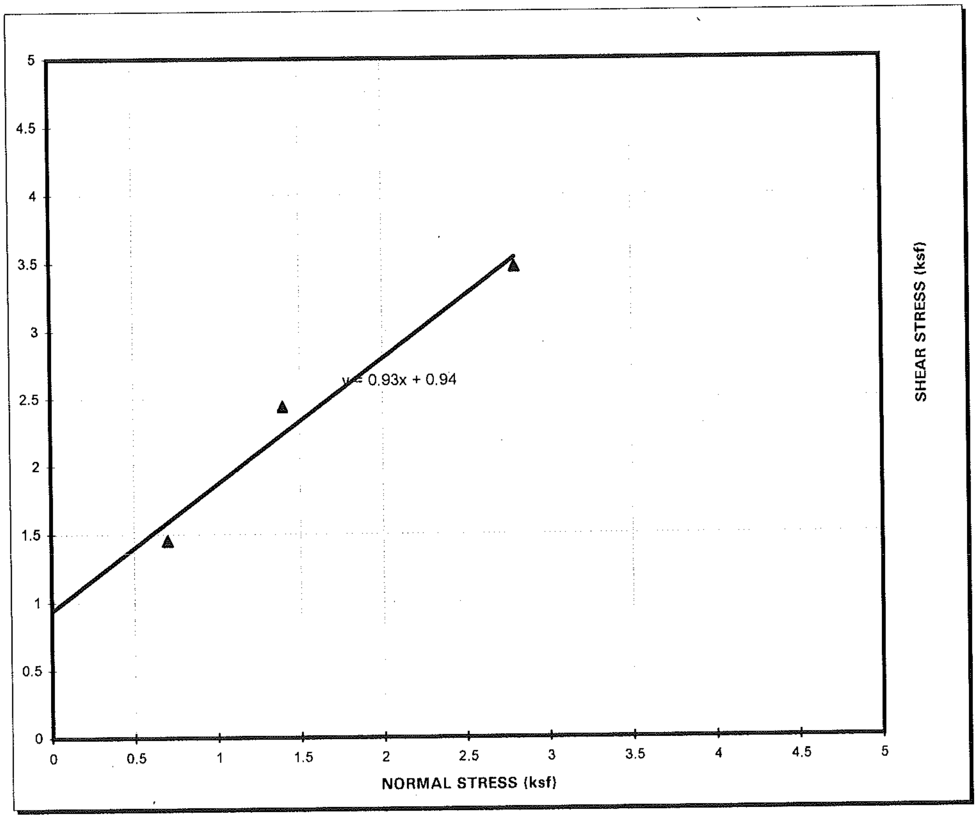
GEOTEK

DIRECT SHEAR TEST

Project Name: Oceanside Residential Development
Project Number: 3129 SD3

Sample Source: GTB5 @ 50'
Date Tested: 12/19/06

Soil Description: Olive Gray Silty Fine Sand



Shear Strength: $\Phi = 42.9^{O}$, **C =** 0.94 **ksf**

Test No.	Load (ksf)	Water Content (%)	Dry Density (pcf)
1	0.7	11.5	124.1
2	1.4	11.5	123.8
3	2.8	11.5	122.5

Note: Saturated in shear box

Notes:
1 - The soil specimen used in the shear box were "ring" samples collected during the field investigation.
2 - Shear strength calculated at residual load.
3 - The tests were ran at a shear rate of 0.03 in/min.

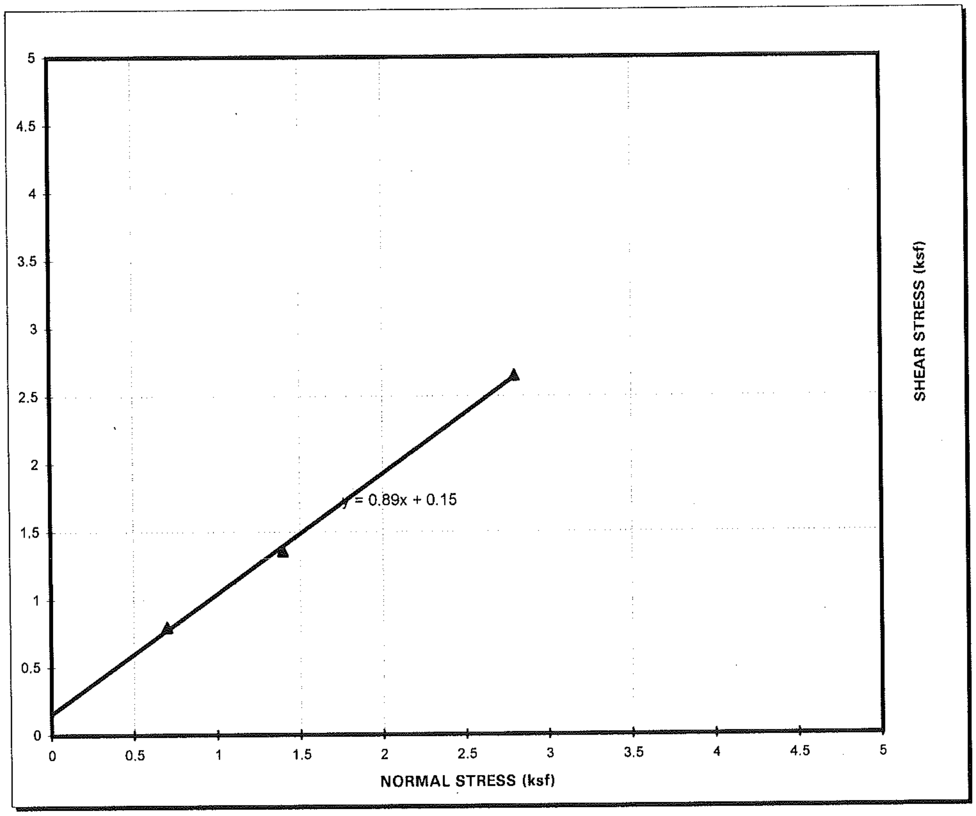
GEOTEK

DIRECT SHEAR TEST

Project Name: Oceanside Residential Development
Project Number: 3129 SD3

Sample Source: GTB5 @ 60'
Date Tested: 12/15/06

Soil Description: Brown Silty Sand



Shear Strength: $\Phi = 41.7^{o}$, **C =** 0.15 **ksf**

Test No.	Load (ksf)	Water Content (%)	Dry Density (pcf)
1	0.7	10.4	118.4
2	1.4	10.4	117.5
3	2.8	10.4	117.8

Note: Saturated in shear box

Notes:
1 - The soil specimen used in the shear box were "ring" samples collected during the field investigation.
2 - Shear strength calculated at residual load.
3 - The tests were ran at a shear rate of 0.03 in/min.

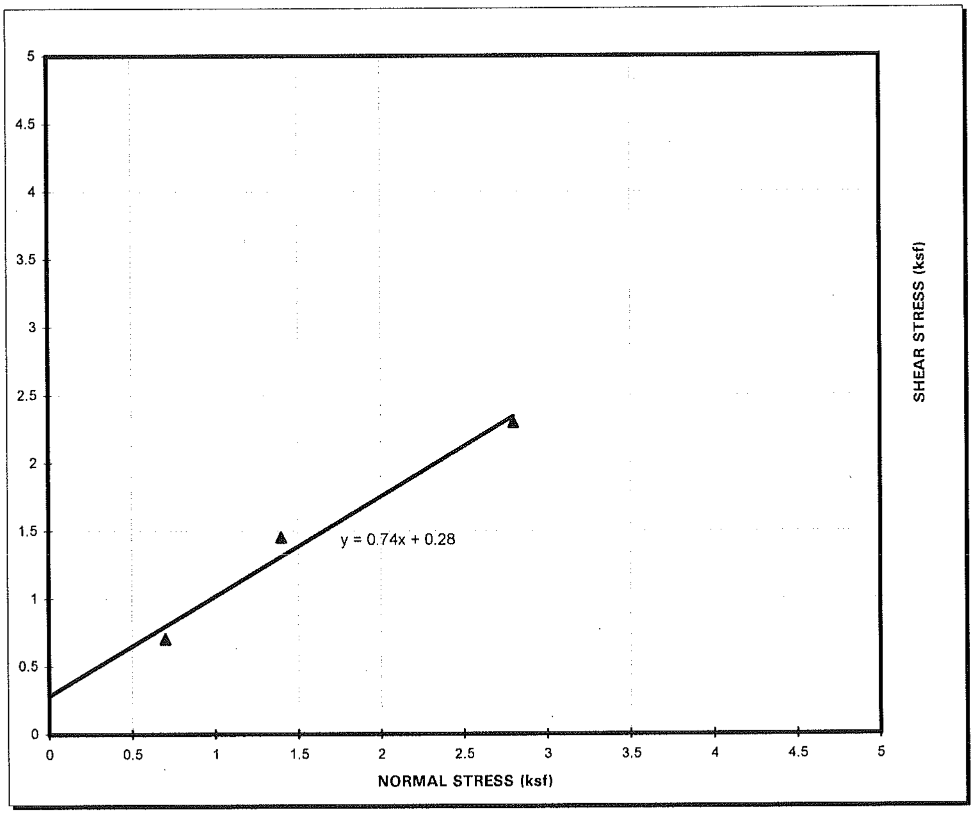
GEOTEK

DIRECT SHEAR TEST

Project Name: Oceanside Residential Development
Project Number: 3129 SD3

Sample Source: GTB8 @ 10'
Date Tested: 12/19/06

Soil Description: Grayish Brown Silty Fine Sand



Shear Strength: Φ = 36.5°, **C =** 0.28 **ksf**

Test No.	Load (ksf)	Water Content (%)	Dry Density (pcf)
1	0.7	9.7	117.1
2	1.4	9.7	116.4
3	2.8	9.7	115.8

Note: Saturated in shear box

Notes:
1 - The soil specimen used in the shear box were "ring" samples collected during the field investigation.
2 - Shear strength calculated at residual load.
3 - The tests were ran at a shear rate of 0.03 in/min.

GEOTEK

1384 Poinsettia Ave., Suite A, Vista, CA 92083
(760) 599-0509 FAX (760) 599-0593

SOIL RESISTIVITY

(California Test 643)

Project Name:	Oceanside Residential Development	**Tested/ Checked By:**	DC Lab No 2507
Project Number:	3129 SD3	**Date Tested:**	12/17/2006
		Sample Source:	GTB1 @ 6'
		Sample Description:	Brown Silty Sand

A Determing the soil's pH 8.6

	Water Added (mL)	Measured Res from Nil. 400 (ohms-cm)
B	100	1450
C	50	1150
D	20	1025
E	20	975
F	20	995
G		
H		
I		
J		

Minimum Resistivity = 975

24.7 years to perforation for a 18 gauge metal culvert.
32.1 years to perforation for a 16 gauge metal culvert.
39.5 years to perforation for a 14 gauge metal culvert.
54.4 years to perforation for a 12 gauge metal culvert.
69.2 years to perforation for a 10 gauge metal culvert.
84.0 years to perforation for a 8 gauge metal culvert.

GEOTEK
1384 Poinsettia Ave., Suite A, Vista, CA 92083
(760) 599-0509 FAX (760) 599-0593

SOIL RESISTIVITY
(California Test 643)

Project Name:	Oceanside Residential Development	***Tested/ Checked By:***	DC Lab No 2507
Project Number:	3129 SD3	***Date Tested:***	12/17/2006
		Sample Source:	GTB2 @ 5'
		Sample Description:	Light Olive Gray Silty Clay

A Determing the soil's pH 8.3

	Water Added (mL)	Measured Res from Nil. 400 (ohms-cm)
B	100	750
C	50	425
D	20	300
E	20	260
F	20	275
G		
H		
I		
J		

Minimum Resistivity = 260

14.4 years to perforation for a 18 gauge metal culvert.
18.7 years to perforation for a 16 gauge metal culvert.
23.0 years to perforation for a 14 gauge metal culvert.
31.6 years to perforation for a 12 gauge metal culvert.
40.2 years to perforation for a 10 gauge metal culvert.
48.9 years to perforation for a 8 gauge metal culvert.

LABORATORY REPORT

Telephone (619) 425-1993 Fax 425-7917 Established 1928

CLARKSON LABORATORY AND SUPPLY INC.
350 Trousdale Dr. Chula Vista, Ca. 91910 www.clarksonlab.com
ANALYTICAL AND CONSULTING CHEMISTS

Date: December 21, 2006
Purchase Order Number: 640
Sales Order Number: 86732
Account Number: GEOT

To:
--
GeoTek, Inc.
1384 Poinsetta Avenue, Suite A
Vista, CA 92083
Attention: David Cliff

Laboratory Number: SO1979 Customers Phone: 760-599-0509
Fax: 760-599-0593

Sample Designation:
--
Two soil samples received on 12/20/06 taken from
Lundstrom 3129-SD3 Job# 2507 marked as follows:

ANALYSIS: Water Soluble Sulfate California Test 417

Sample	SO_4%
GTB1@6'	<0.001
GTB2@5'	0.017

Laura Torres

Laura Torres
LT/arr

APPENDIX D

APPENDIX D
SLOPE STABILITY ANALYSES

We performed the slope stability analyses using the two-dimensional computer software *GeoStudio2018* developed by Geo-Slope International Ltd. We analyzed the critical modes of potential slip surfaces using rotational-mode based on Spencer's method. The soil parameters used, case conditions, and the calculated factors of safety are presented herein. Plots of the calculation results, including the soil stratigraphy, potential failure surfaces, and calculated factors of safety, are attached within this appendix.

We used the average direct shear, fully softened, and residual strength parameters based on laboratory tests and our experience with similar soil types in nearby areas for the slope stability analyses. We performed direct shear tests on samples of the landslide debris, the sandstone and claystone portions of the Santiago Formation and the granitic rock. Fully softened and residual shear tests were performed on samples of the shear plane materials and the claystone encountered in the Santiago Formation. We performed the laboratory shear tests in accordance with AASHTO T-236 with strain rates of 0.001 in/min and strain distance of 0.25 to 0.3 inches. Additionally, we incorporated Stark Correlations to help evaluate the residual and fully softened strength parameters to perform our slope stability analyses.

We used the 2023 Stark correlation website to help evaluate the results of the laboratory data of the fully softened and residual shear strengths for the bedding plane shear. Based on the correlation spreadsheet (only using Plasticity Index, which is normally a more conservative evaluation, because we do not have the clay fraction information), we obtained a cohesion of 100 psf and a friction angle of 11 degrees. However, we did not include this result in our referenced report because the sample description did not match the other bedding plane shear descriptions and the sample is not taken from the same elevation of the basal slide plane that is controlling the slope stability analyses. A comparison of borings B-1 (Geocon, 2005), B-2 (Geocon, 1985), and GTB-2 (Geotek, 2007), which are located in the same general area and have the same approximate top-of-boring elevation, shows several discrepancies in landslide geometry interpretations. Given the discrepancy in basal shear plane elevations, and the fact that the aforementioned boring logs are inconsistent with our updated geologic model, we opine the shear strength values used herein are applicable for project design.

For the seismic analyses, we used a higher shear strength (as discussed in SP 117) and the lower-than-average value of the test results as shown in the figure titled *Landslide Debris – Fully Softened and Stark Correlations (Seismic Case)* presented herein. The Stark correlations used in this figure are based on the "fully-softened" equations/graphs.

We used average-to-lower bound shear values from our shear strength tests (see graphical representations herein). For the static analyses, we used the lower bound value of the test results for the bedding plane shear strengths (including residual shear tests and stark correlations) as shown in the figure titled *Landslide Debris – Residual and Stark Correlations*. The Stark correlations used in this figure are based on the "residual" equations/graphs. The following table presents the values used for the input into the Stark Correlation Spreadsheet.

SUMMARY OF SOIL PROPERTIES USED FOR STARK CORRELATION ANALYSES

Sample No. (Year)	Depth (Feet)	Plasticity Index	Liquid Limit	CF (% Clay <0.002mm)	Liquid Limit (Not Ball Milled Correction)	CF (Not Balled Milled Correction)
B7-12 (2005)	45	23	55	--	--	--
B1-6 (2006)	6	41	63	--	--	--
B11-1 (2024)	48	21	51	13	71	24
B12-1 (2024)	78	20	49	16	67	28
B13-1 (2024)	39	16	17	10	64	10

Peak shear values were assigned to the sandstone portion of the Santiago Formation and the granitic rock, an average of the ultimate-inflection point and the ultimate-end-of-test values were assigned to the alluvium, landslide debris, and the claystone portion of the Santiago Formation, and fully softened and residual values were assigned to the landslide shear plane and the along bedding (anisotropic) of the claystone/siltstone portion of the Santiago Formation. Our calculations indicate were the proposed buildings are planned the existing and proposed southern slopes have calculated factors of safety (FOS) of at least 1.5 and 1.1 under static and seismic permanent conditions, respectively for both deep-seated failure and shallow sloughing conditions with the construction of shear pins and buttresses. The following table presents a summary of the soil properties used for the slope stability analyses.

SUMMARY OF SOIL PROPERTIES USED FOR SLOPE STABILITY ANALYSES

Geologic Unit/Material	Density (pcf)	Cohesion (psf)	Friction Angle (degrees)
Compacted Fill (Qcf)	130	300	28
Alluvium (Qal)	130	150	26
Landslide Debris (Qls)	130	150	26
Landslide Shear Plane (Qlsp)	130	50	14
Santiago Formation – Sandstone (Tsa)	130	800	34
Santiago Formation – Siltstone/Claystone (Tsa)	130	200	28
Santiago Formation – Siltstone/Claystone Along Bedding (Tsa)	130	50	14
Granitic Rock (Kgr)	130	1000	51

We selected Cross-Sections 1-1’, 2-2’, and 3-3’ to perform the slope stability analyses for the existing conditions. Appendix D presents the results of the slope stability analyses.

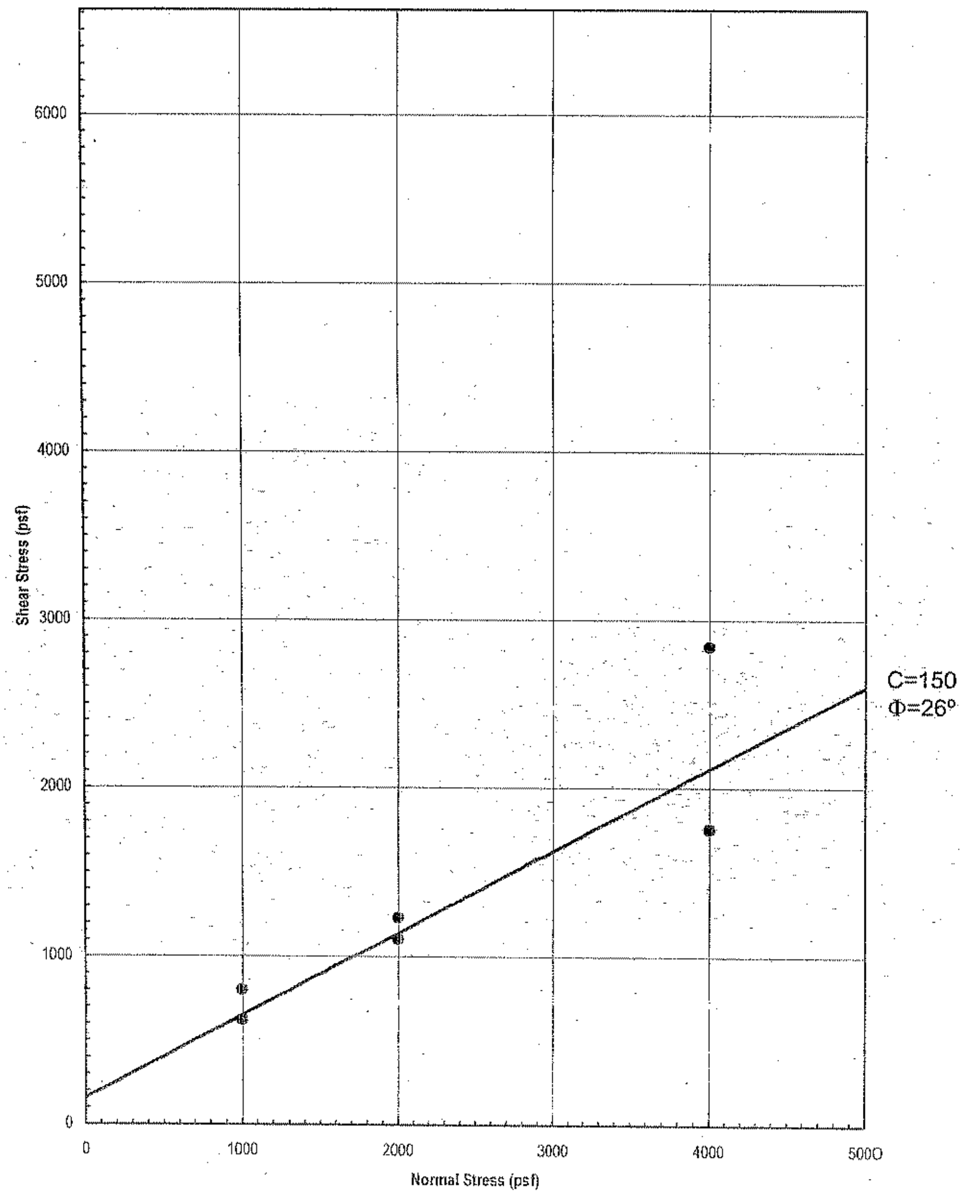
The presence of weak claystone/siltstone layers and landslide debris will require the installation of shear pins and the use of slope buttresses or stabilization fills on the southern slope. Surficial slope stability calculations were performed for a 2:1 (horizontal: vertical) fill slope. The calculated factor of safety is greater than the required minimum factor of safety of 1.5.

Excavations should be observed during grading by an engineering geologist with Geocon to evaluate whether soil and geologic conditions do not differ significantly from those expected or identified in this report.

We performed the slope stability analyses based on the interpretation of geologic conditions encountered during our field investigation. We should evaluate the geologic conditions during the grading operations to check if the conditions observed during grading are consistent with our interpretations. Additional slope stability analyses may be required during the grading operations.

OCEANSIDE VISTA
OCEANSIDE, CALIFORNIA

Landslide Debris - Average of Ultimate-Inflection and Ultimate End-of-Test

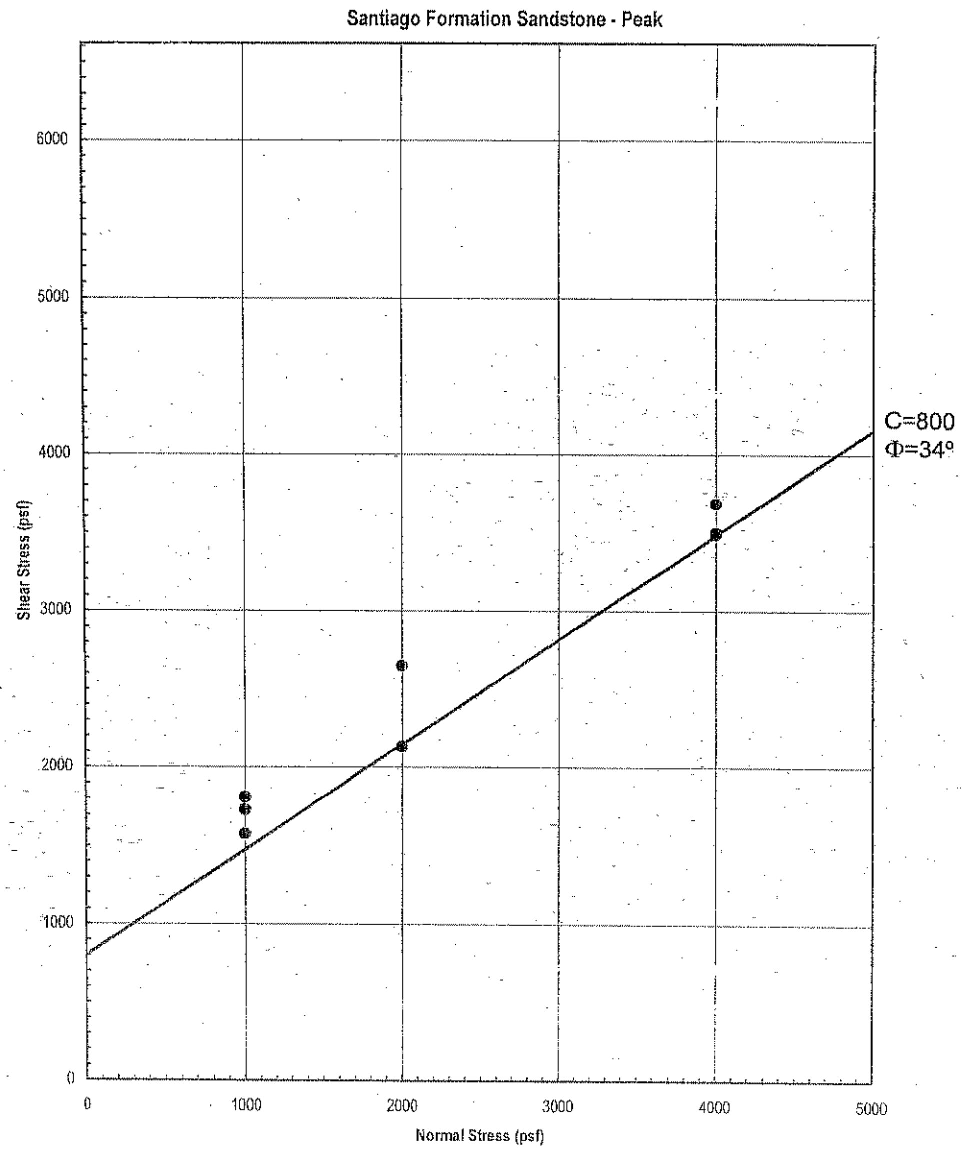


GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

PROJECT NO. 07227 - 52 - 02

FIGURE C-1

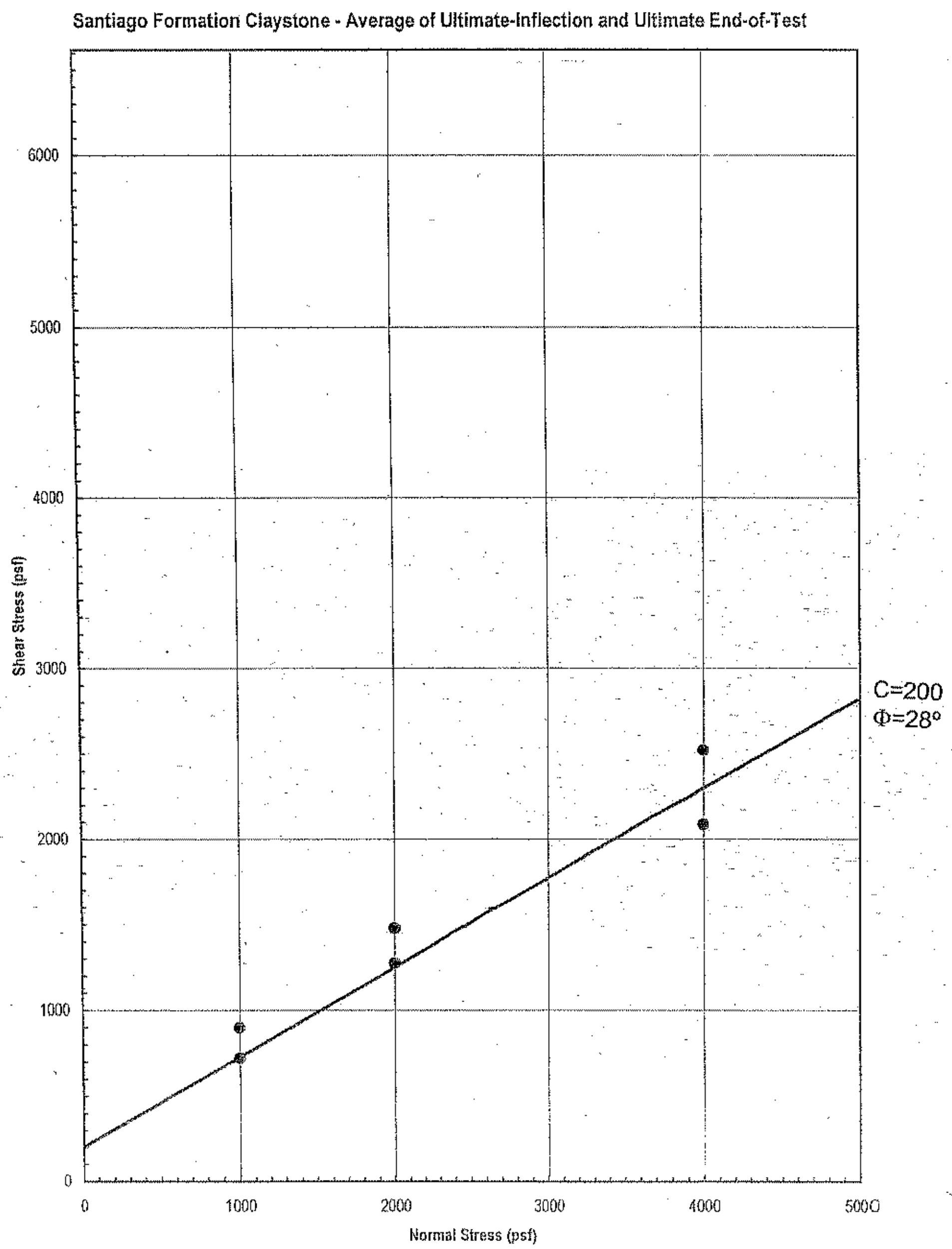
OCEANSIDE VISTA
OCEANSIDE, CALIFORNIA



GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

PROJECT NO. 07227 - 52 - 02
FIGURE C-2

OCEANSIDE VISTA
OCEANSIDE, CALIFORNIA



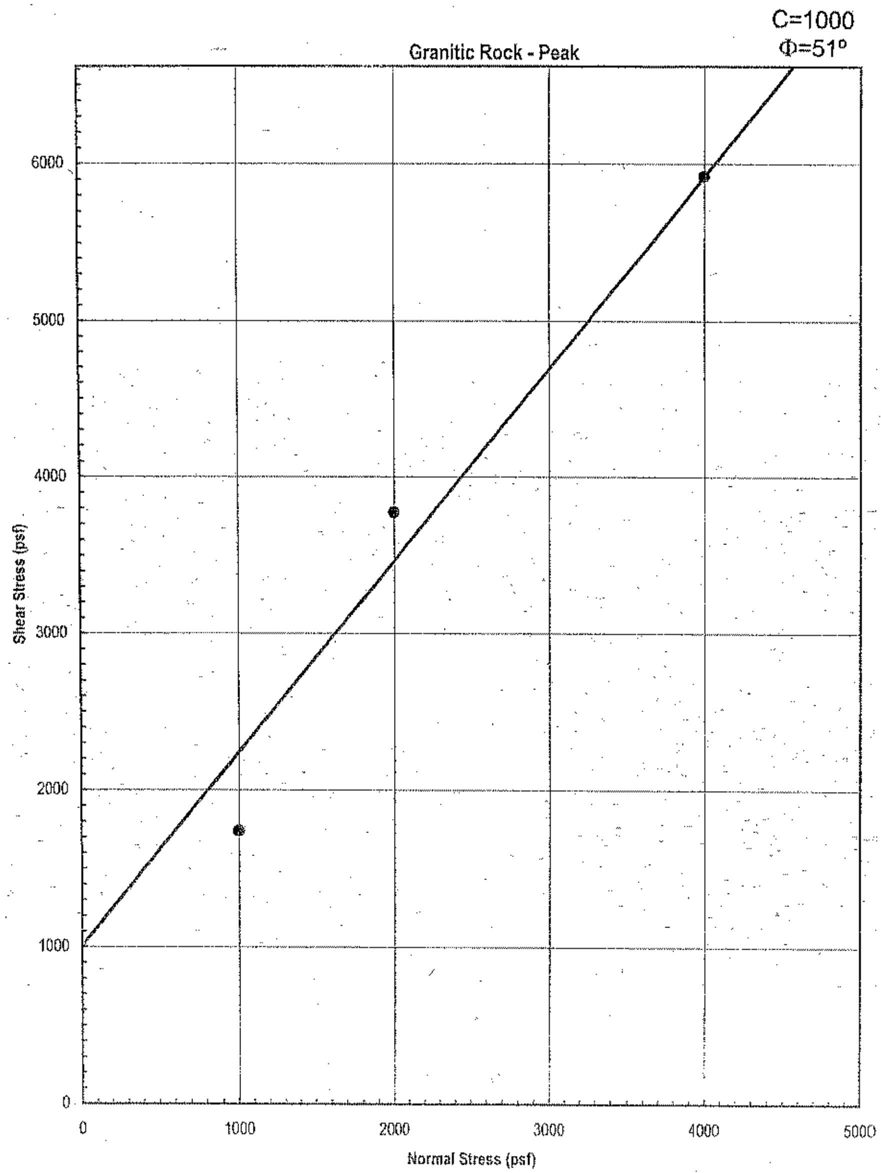
GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

PROJECT NO. 07227 - 52 - 02

FIGURE C-3

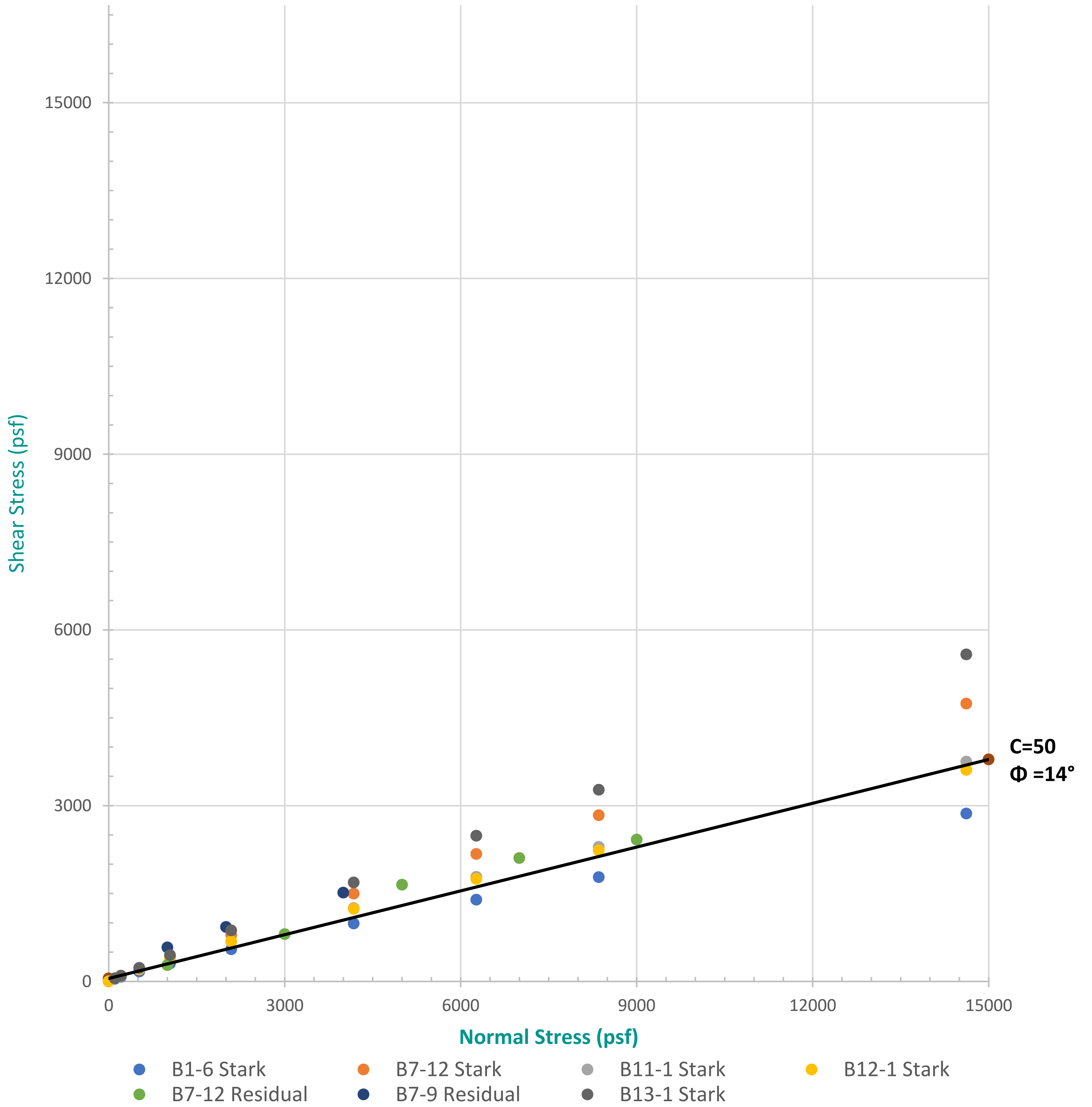
X:/R14TEMP/1_GEOTECH/1_GEOTECH_TEMPLATES

OCEANSIDE VISTA
OCEANSIDE, CALIFORNIA



GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159
PROJECT NO. 07227 - 52 - 02
FIGURE C-5

Landslide Debris-Residual and Stark Correlations

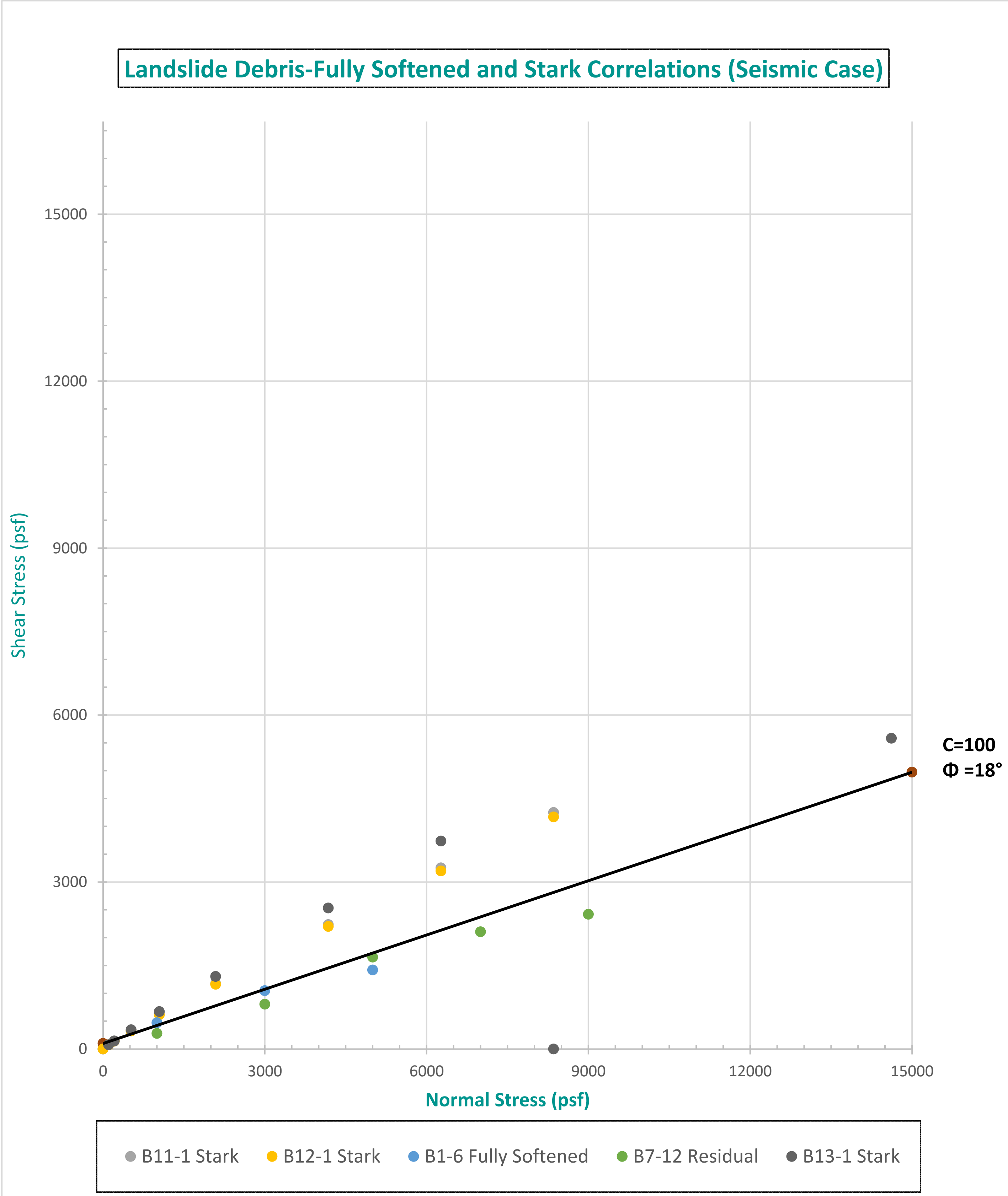


GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121-2974
PHONE 858 558-6900 - FAX 858 558-6159

DIRECT SHEAR - AASHTO T-236 & STARK CORRELATIONS (2023)

OLIVE PARK APARTMENTS

PROJECT NO.: G3035-52-01



GEOCON INCORPORATED

GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121-2974
PHONE 858 558-6900 - FAX 858 558-6159

DIRECT SHEAR - AASHTO T-236 & STARK CORRELATIONS (2023)

OLIVE PARK APARTMENTS

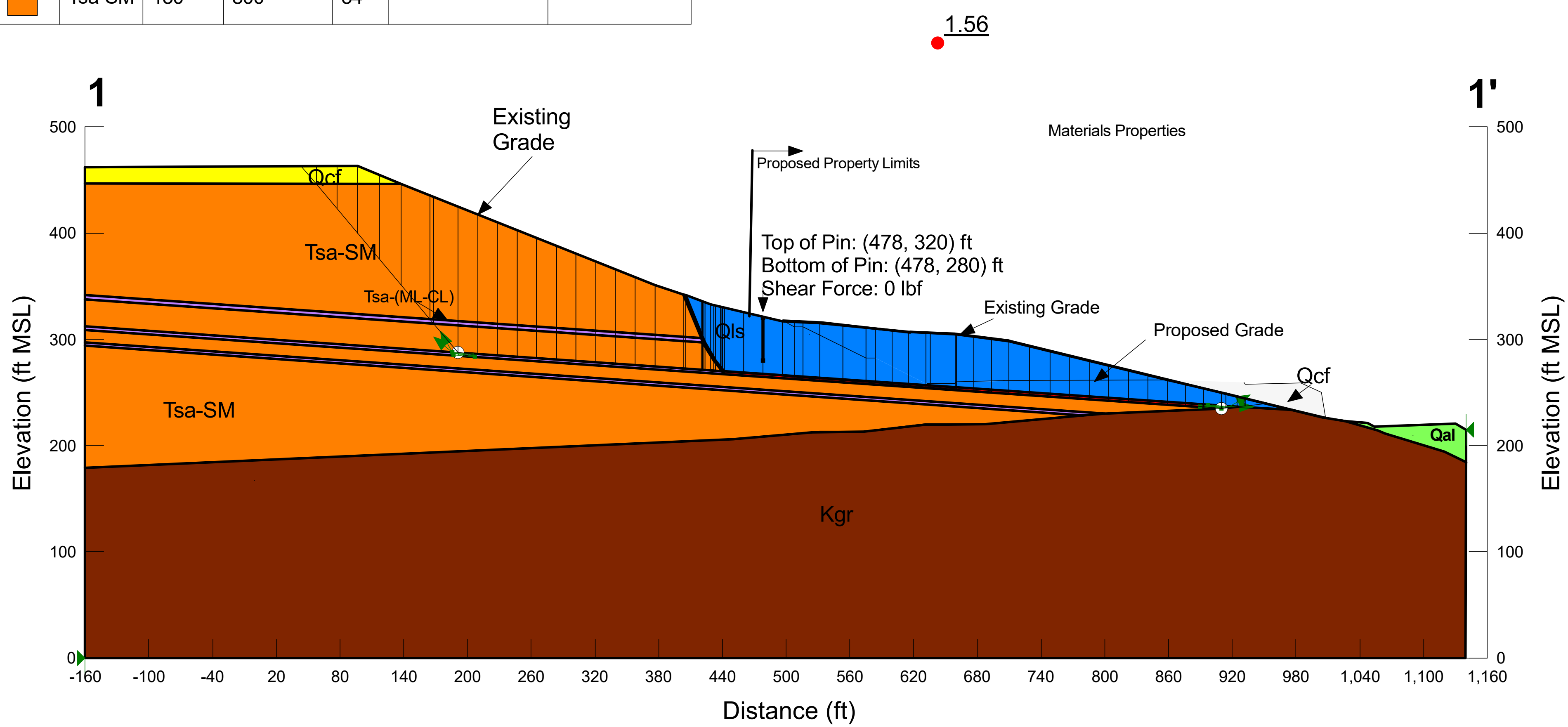
PROJECT NO.: G3035-52-01

Materials Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-SM	130	800	34		

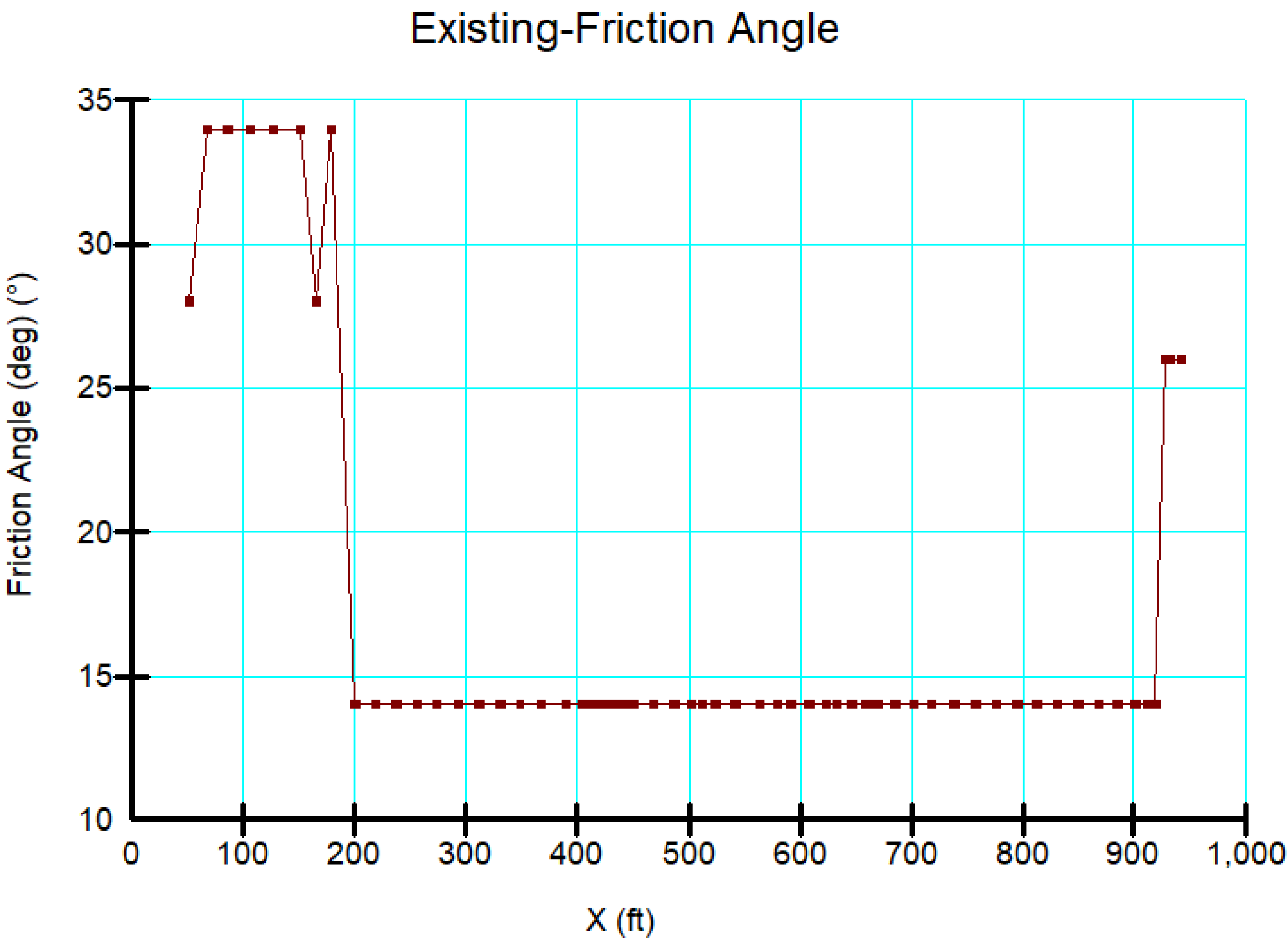
Existing Grade
Static Condition

Olive Street
Project No. G3035-52-01
Name: 1-1'-Existing.gsz

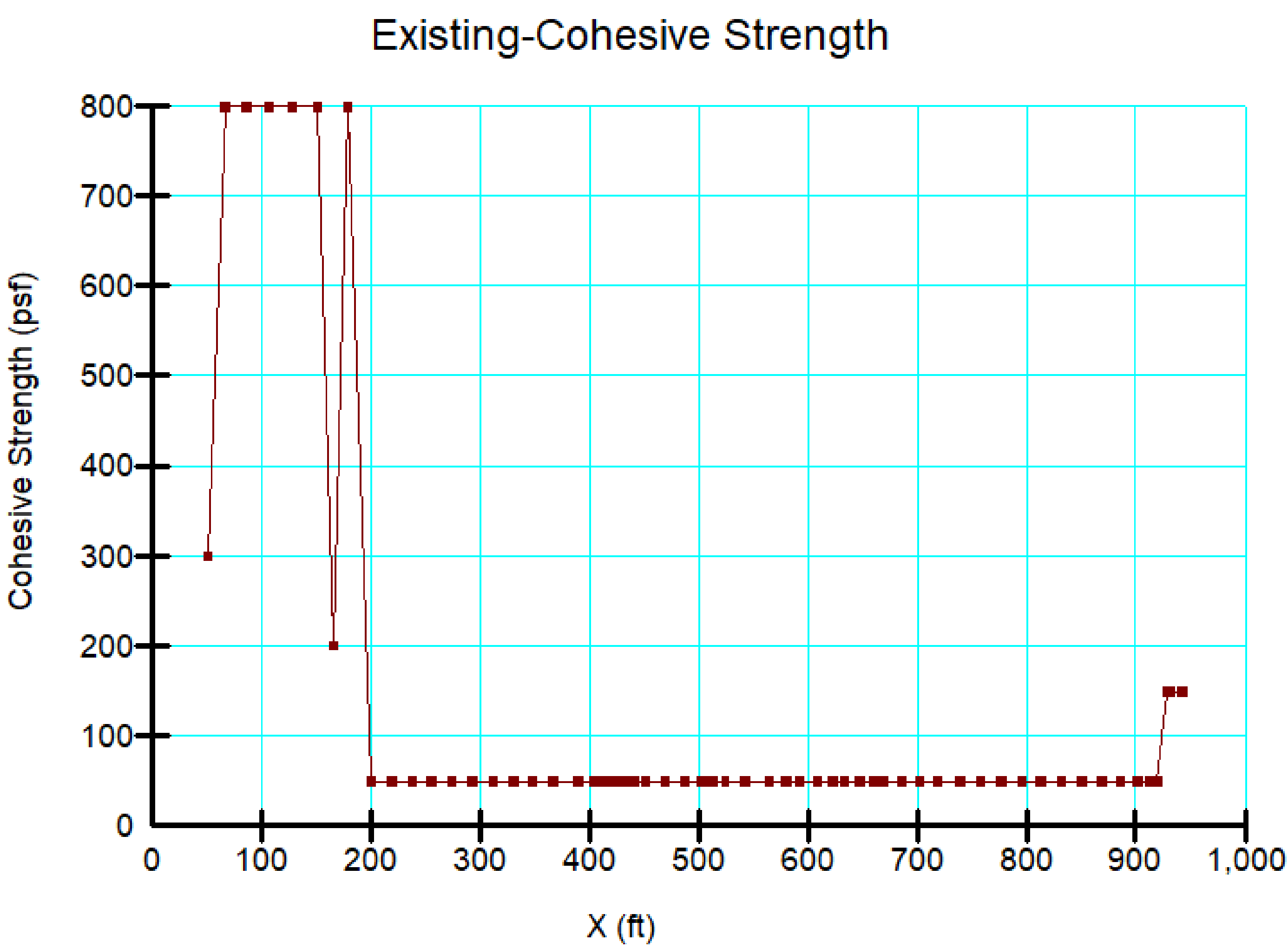


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\1-1' Geo Studio\File Name: 1-1'-Existing.gszDTime: 02:23:25 PMate: 07/25/2024

1-1'



Existing-Friction Angle
Friction Angle (deg) (°)
35
30
25
20
15
10
0
100
200
300
400
500
600
700
800
900
1,000
X (ft)



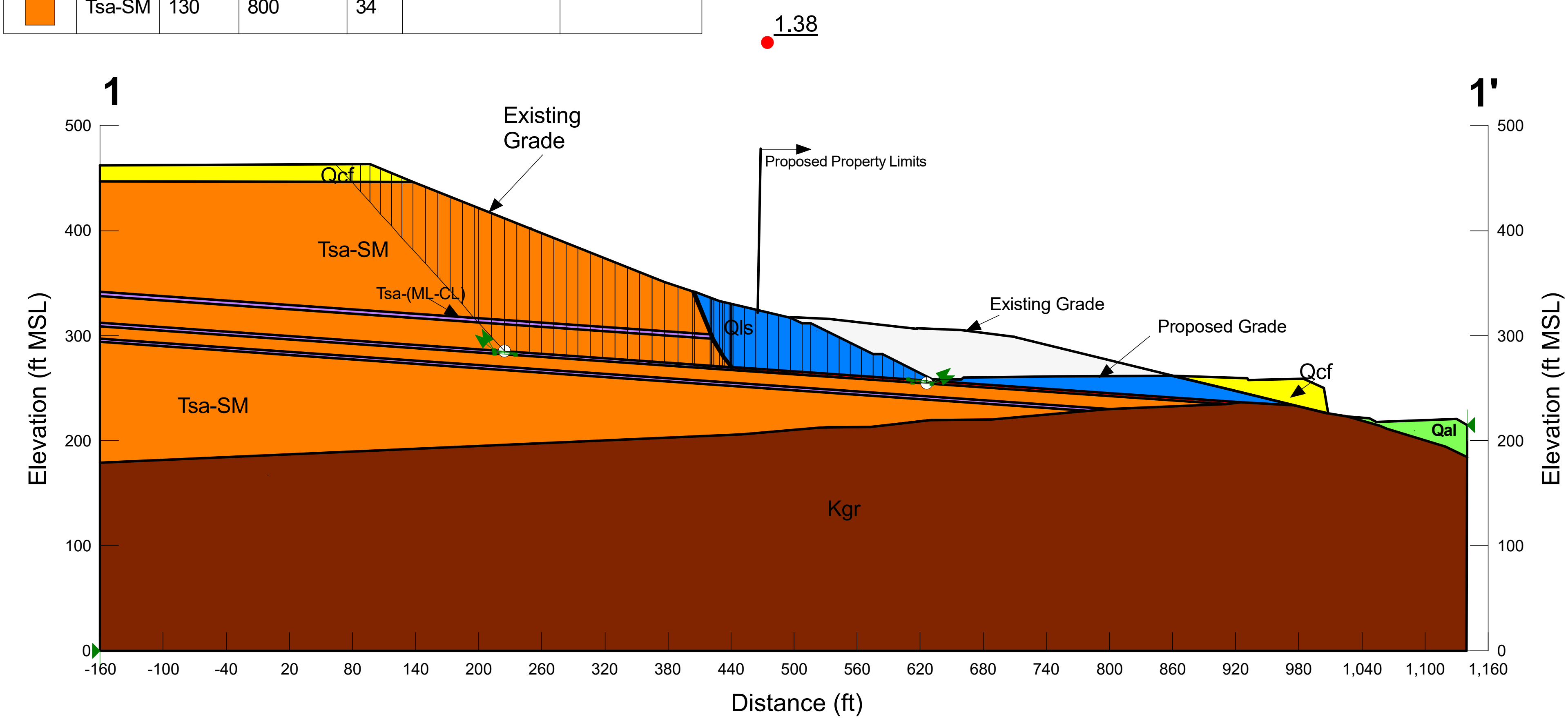
Existing-Cohesive Strength
Cohesive Strength (psf)
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
800
900
1,000
X (ft)

Materials Properties:

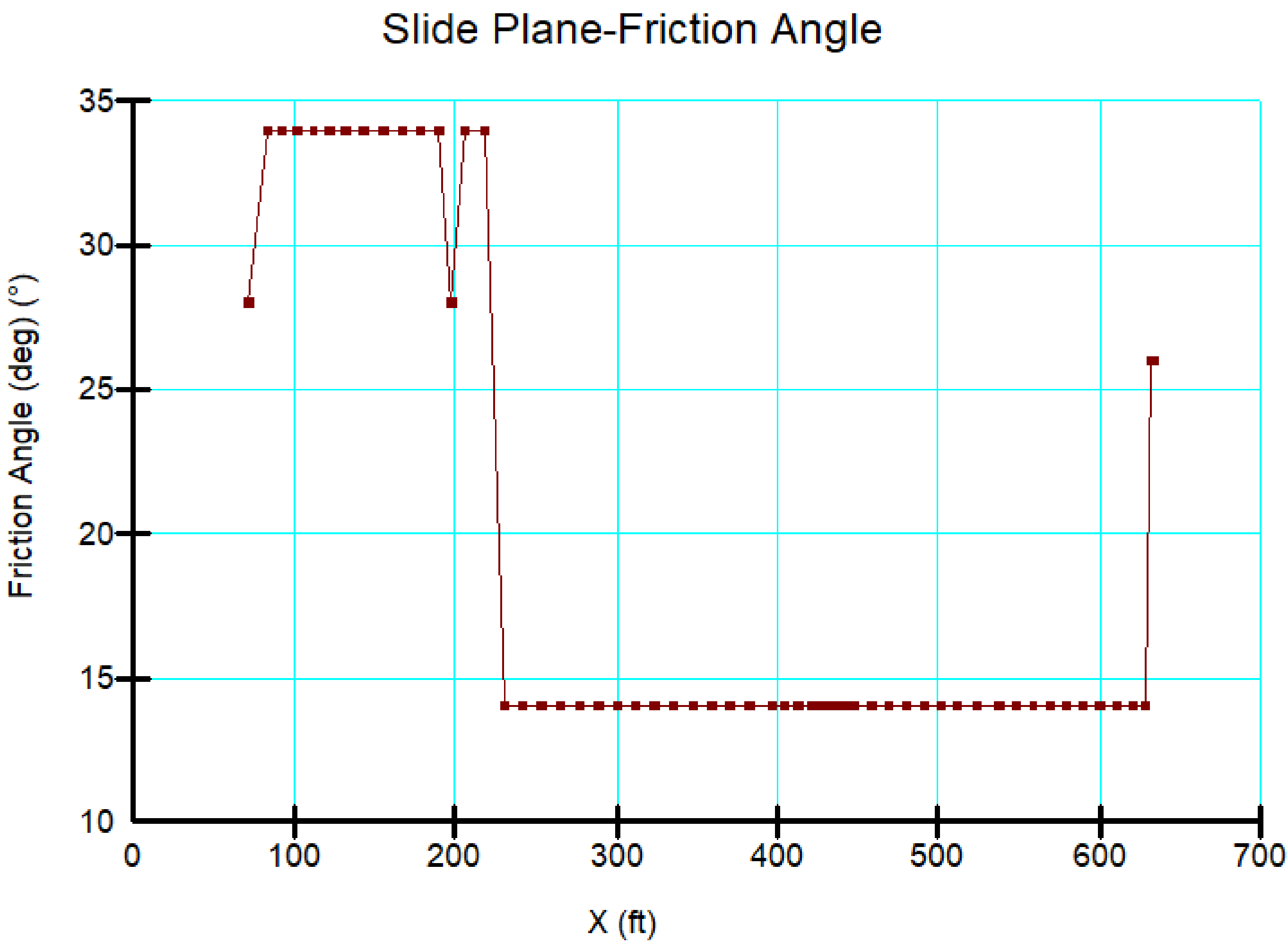
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-SM	130	800	34		

Proposed Grade
Static Condition

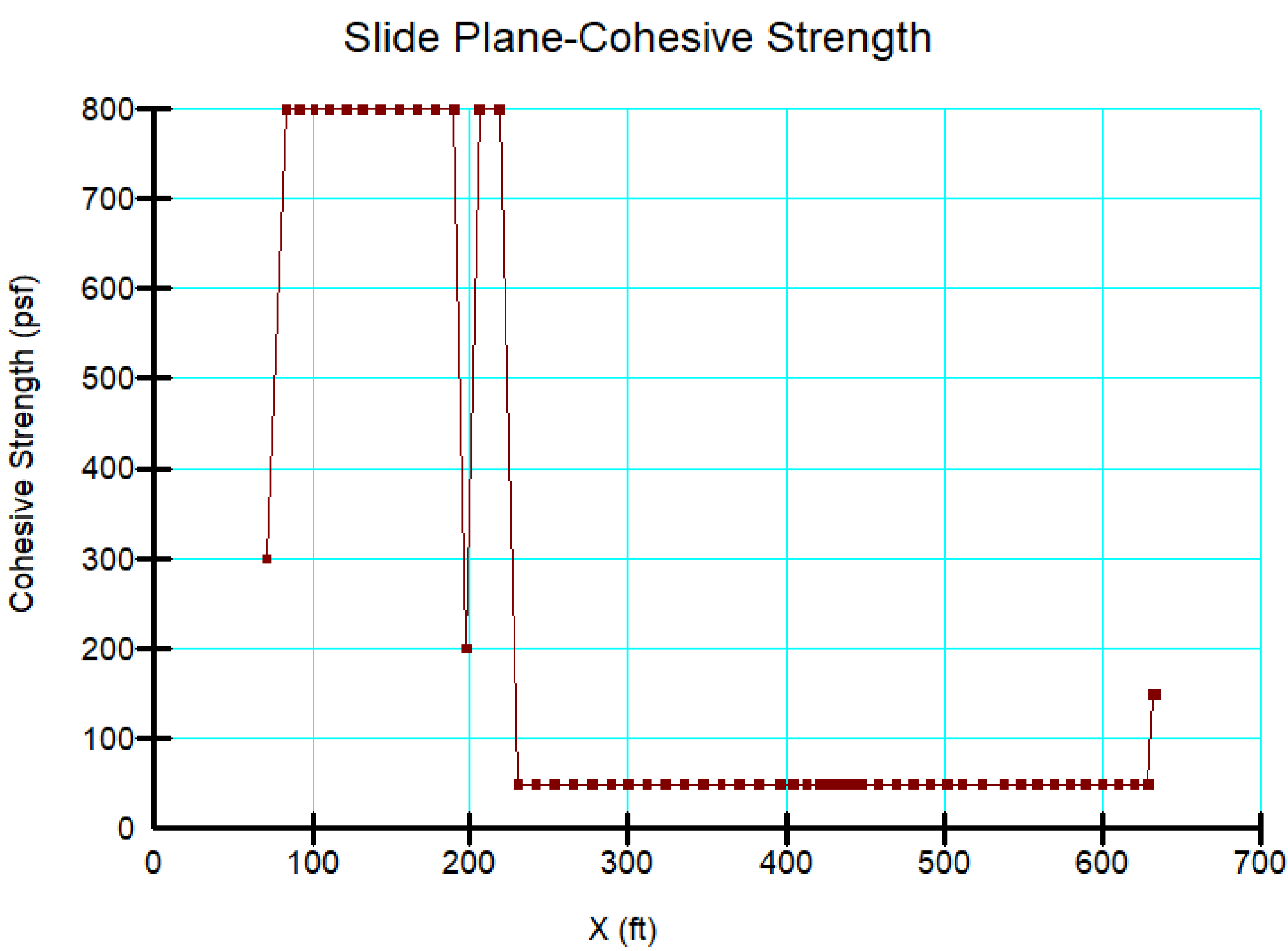
Olive Street
Project No. G3035-52-01
Name: Case 1_1-1'_Slide Plane.gsz



1-1'



Slide Plane-Friction Angle
Friction Angle (deg) (°)
35
30
25
20
15
10
0
100
200
300
400
500
600
700
X (ft)



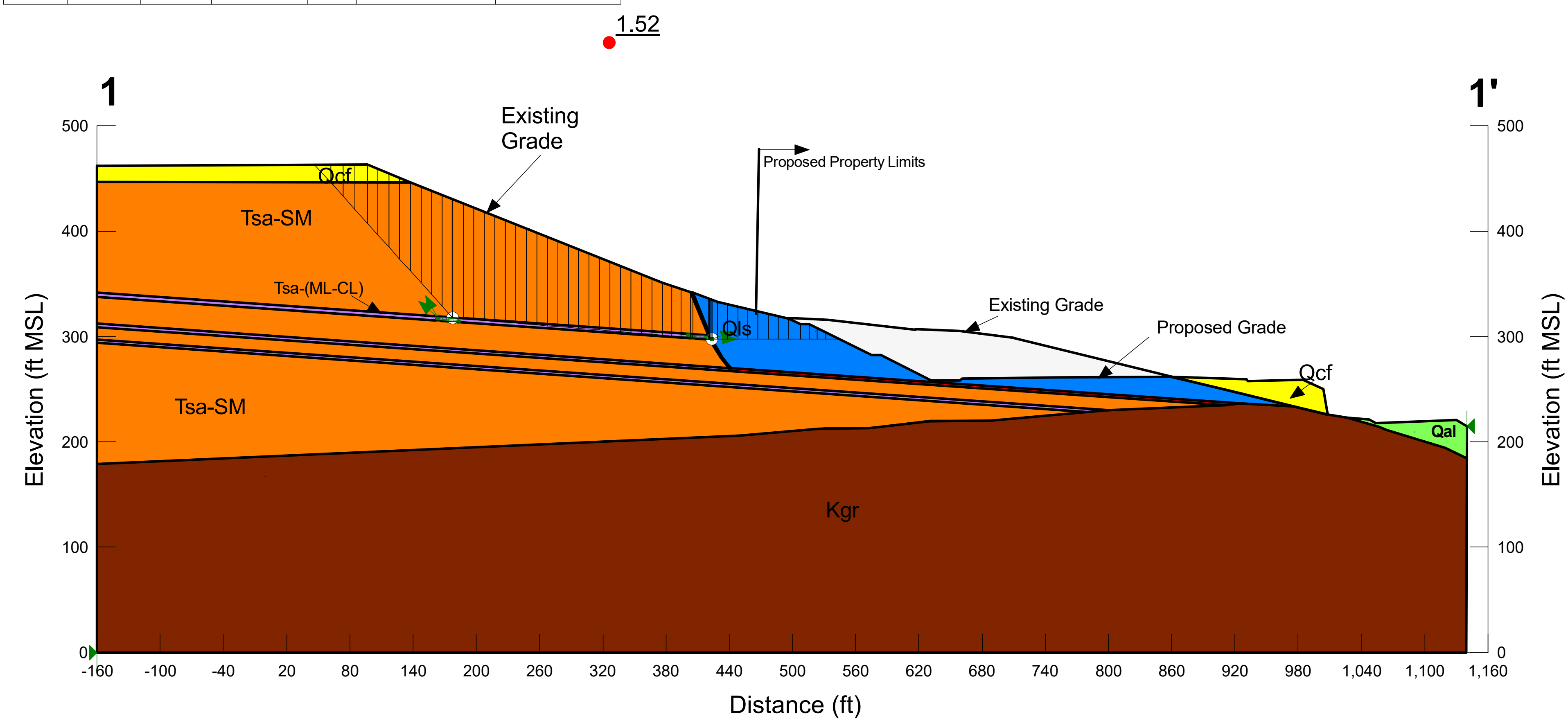
Slide Plane-Cohesive Strength
Cohesive Strength (psf)
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
X (ft)

Materials Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-SM	130	800	34		

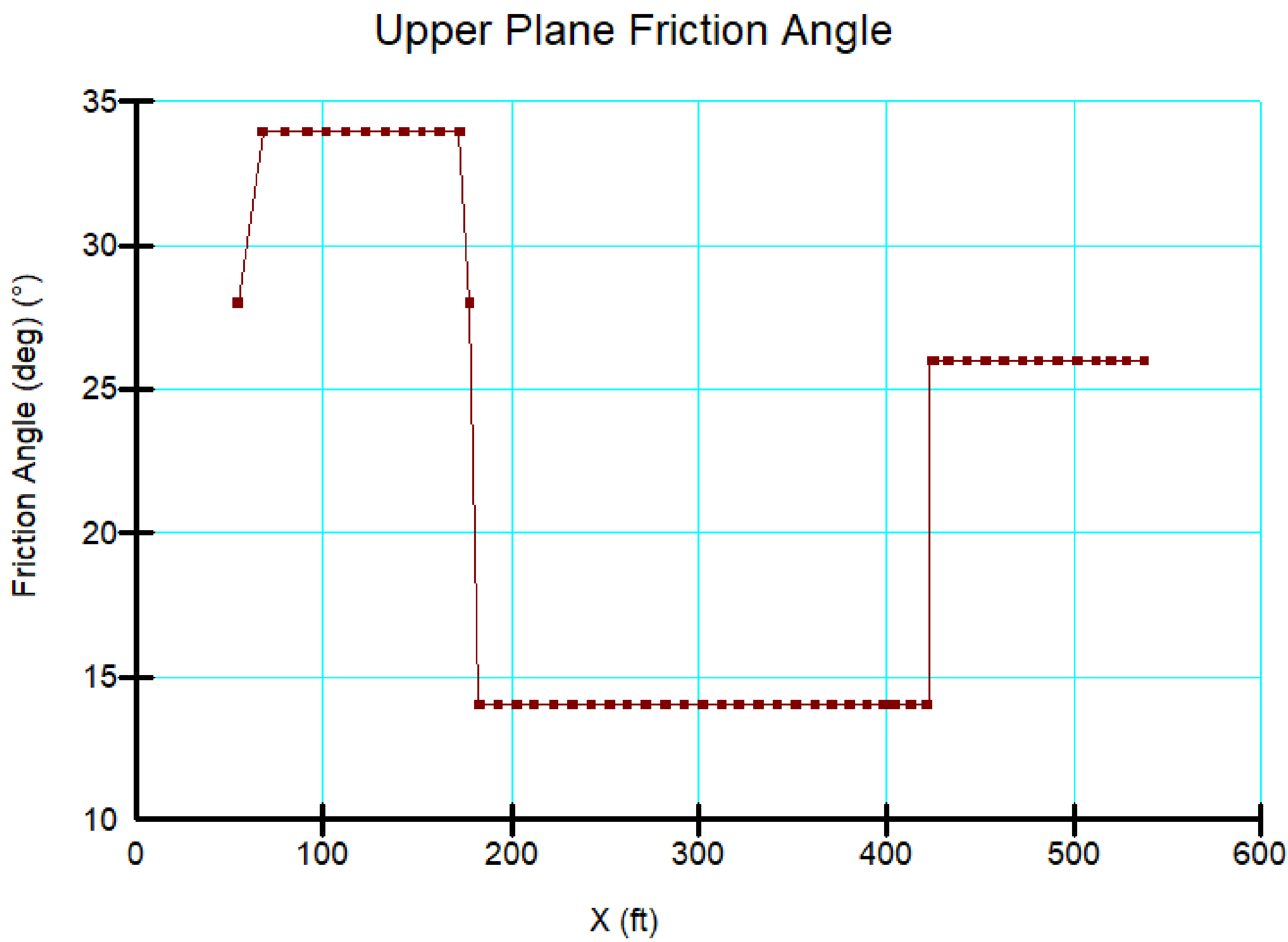
Proposed Grade
Static Condition

Olive Street
Project No. G3035-52-01
Name: Case 2_1-1'_Upper Plane.gsz

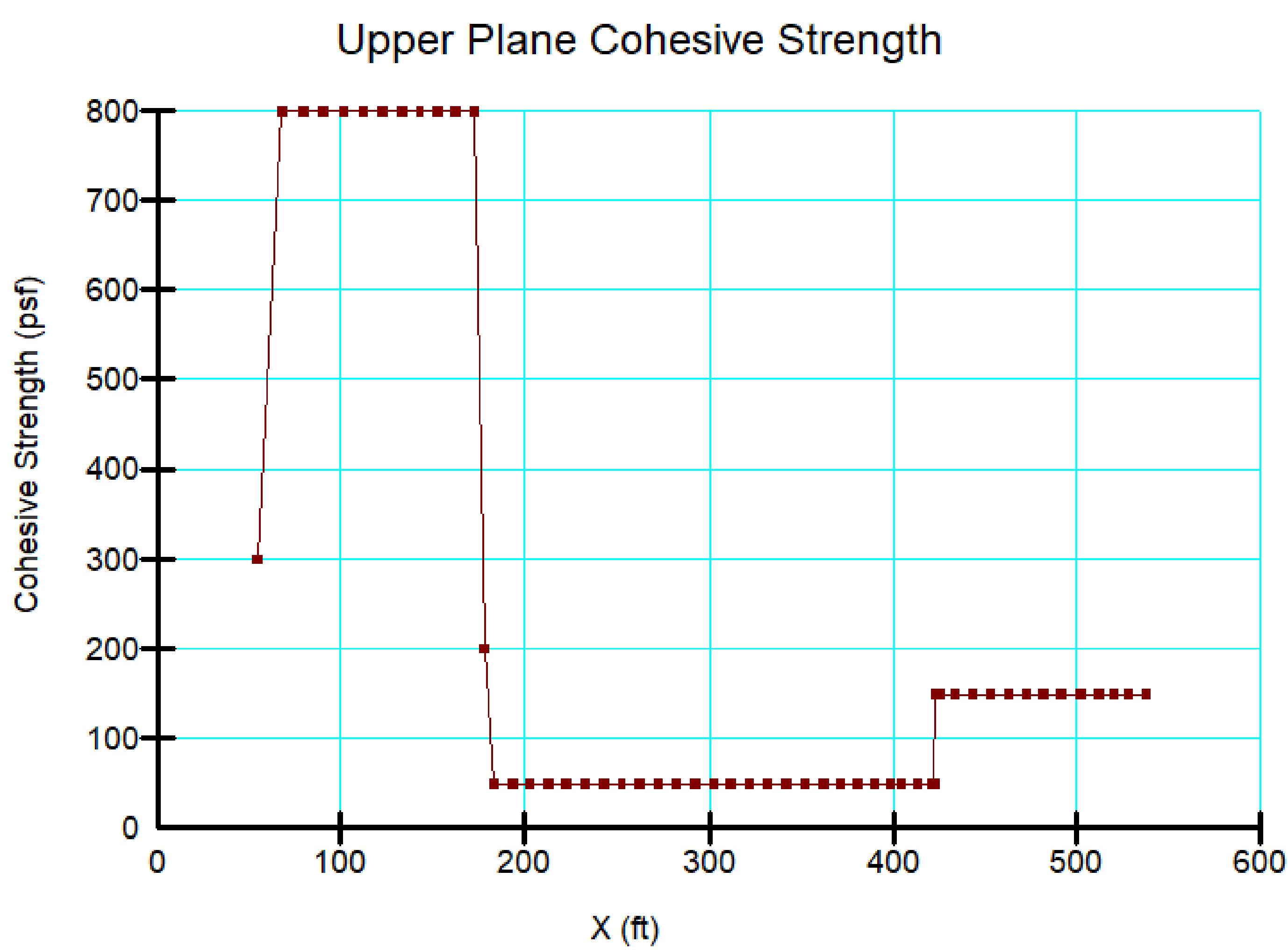


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\1-1' Geo Studio\File Name: Case 2_1-1'_Upper Plane.gszDTime: 02:39:33 PMate: 07/25/2024

1-1'



Upper Plane Friction Angle
Friction Angle (deg) (°)
35
30
25
20
15
10
0
100
200
300
400
500
600
X (ft)



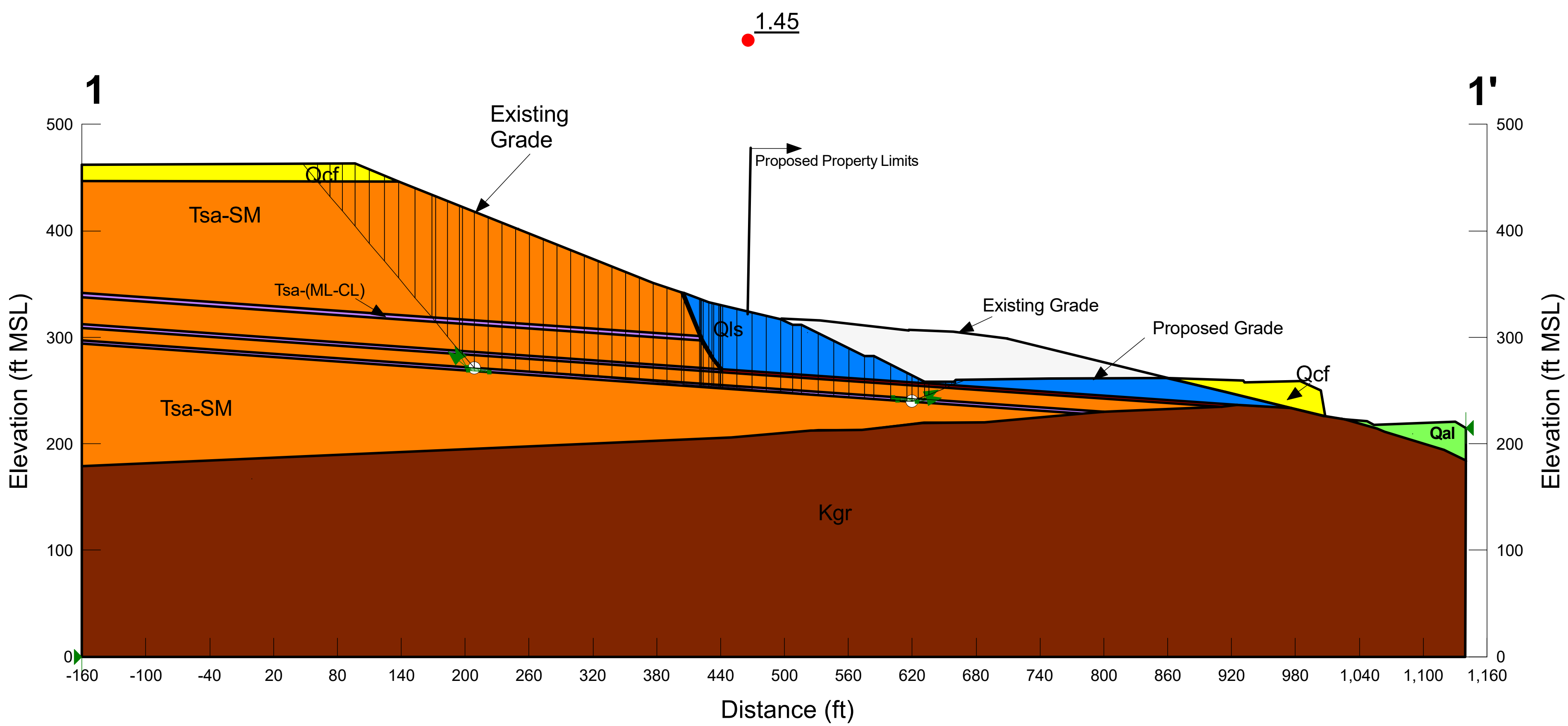
Upper Plane Cohesive Strength
Cohesive Strength (psf)
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
X (ft)

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-SM	130	800	34		

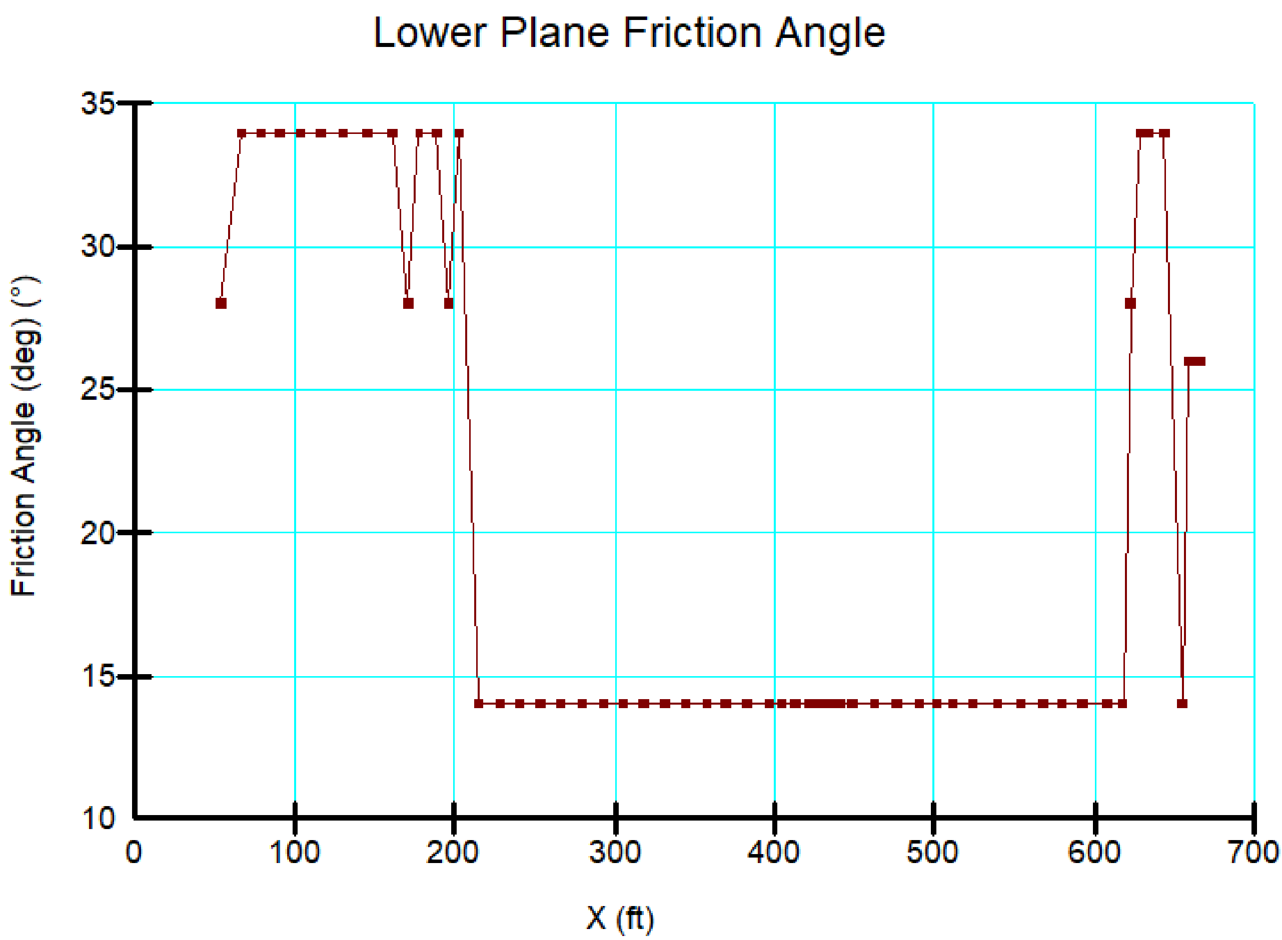
Proposed Grade
Static Condition

Olive Street
Project No. G3035-52-01
Name: Case 3_1-1'_Lower Plane.gsz

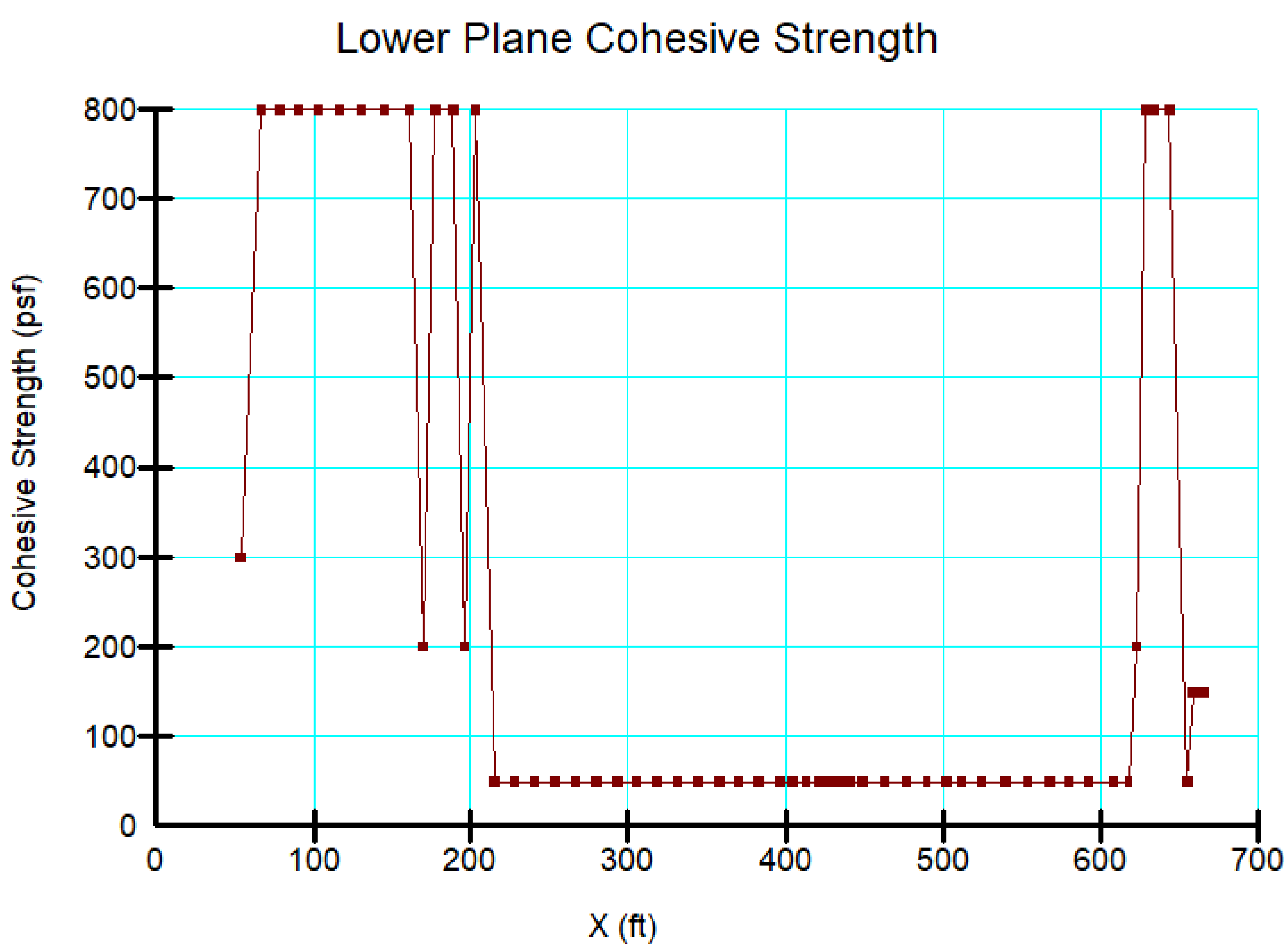


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\1-1' Geo Studio\File Name: Case 3_1-1'_Lower Plane.gszDTime: 01:55:28 PMate: 07/26/2024

1-1'



Lower Plane Friction Angle
Friction Angle (deg) (°)
35
30
25
20
15
10
0
100
200
300
400
500
600
700
X (ft)



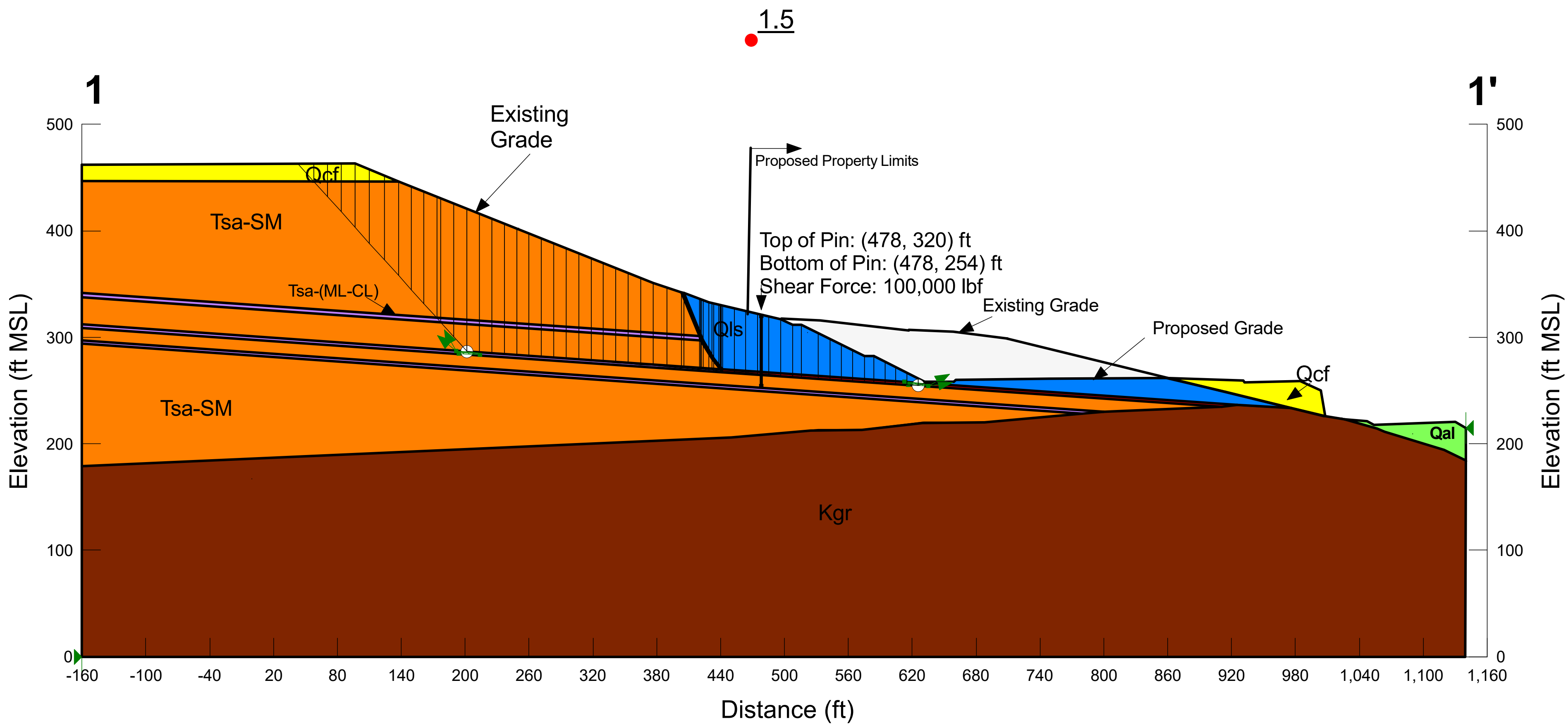
Lower Plane Cohesive Strength
Cohesive Strength (psf)
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
X (ft)

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-SM	130	800	34		

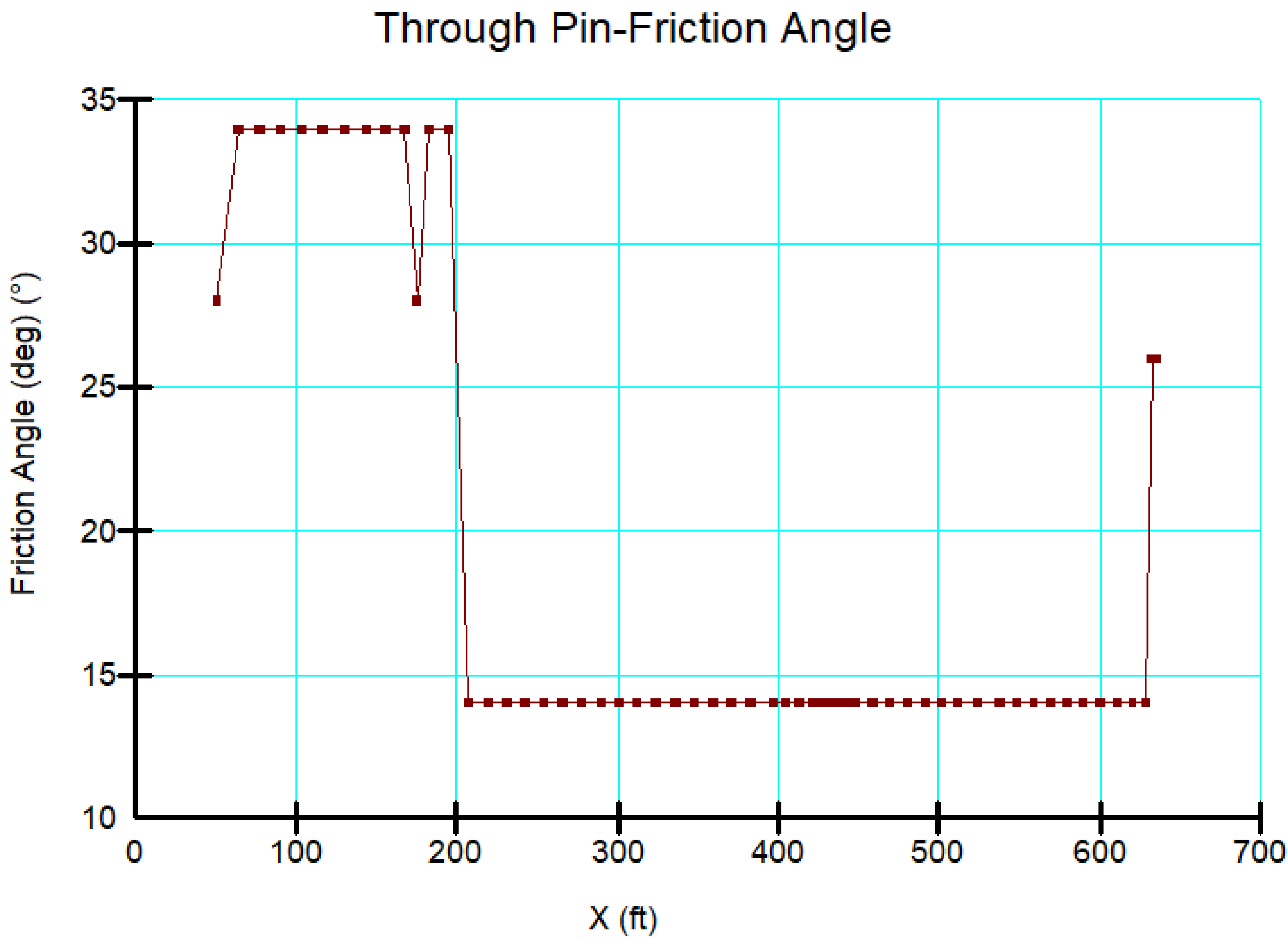
Proposed Grade
Static Condition

Olive Street
Project No. G3035-52-01
Name: Case 4_1-1'_Through Pin.gsz

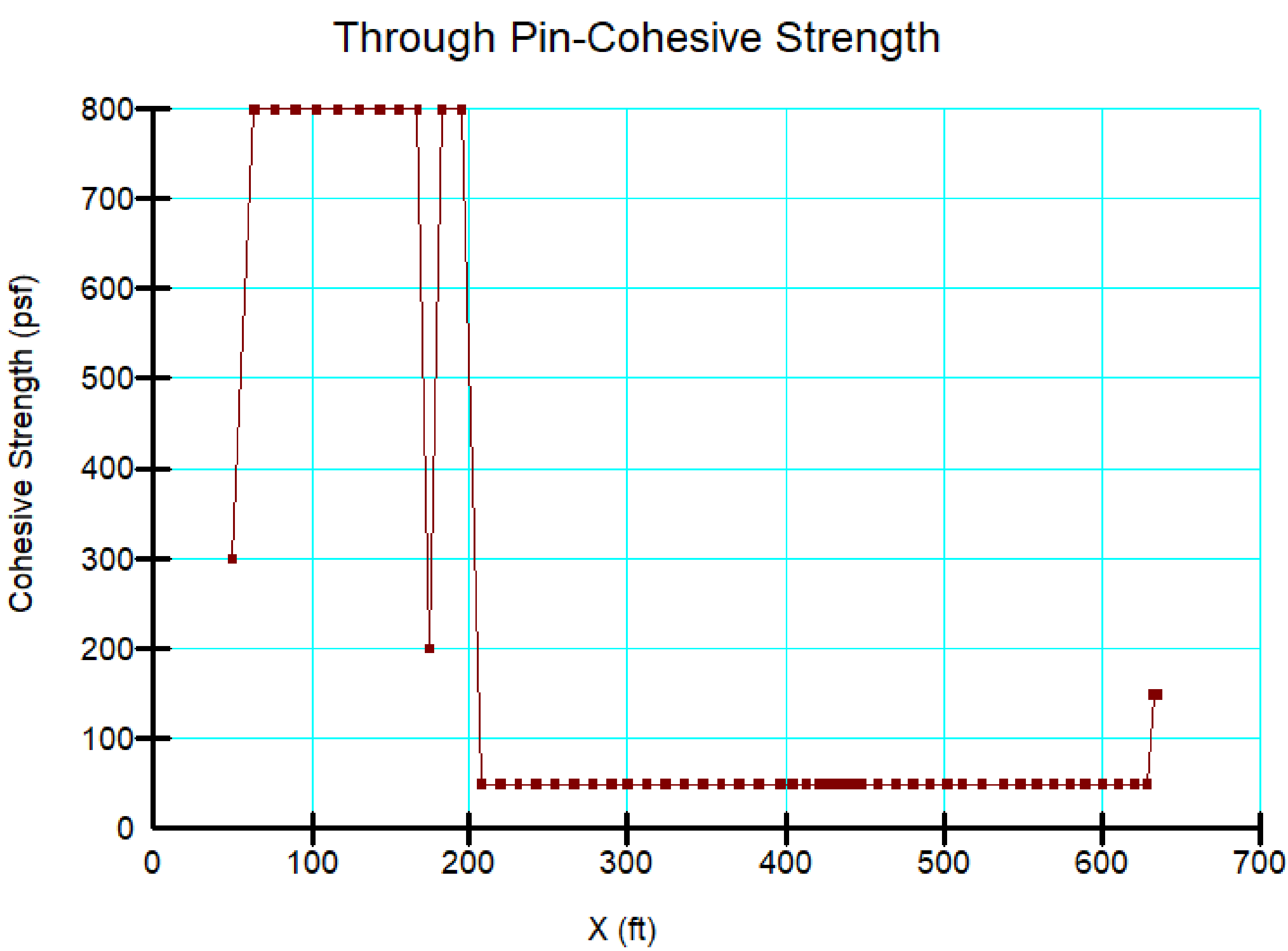


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\1-1' Geo Studio\File Name: Case 4_1-1'_Through Pin.gszDTime: 02:03:22 PMate: 07/26/2024

1-1'



Through Pin-Friction Angle
Friction Angle (deg) (°)
35
30
25
20
15
10
0
100
200
300
400
500
600
700
X (ft)



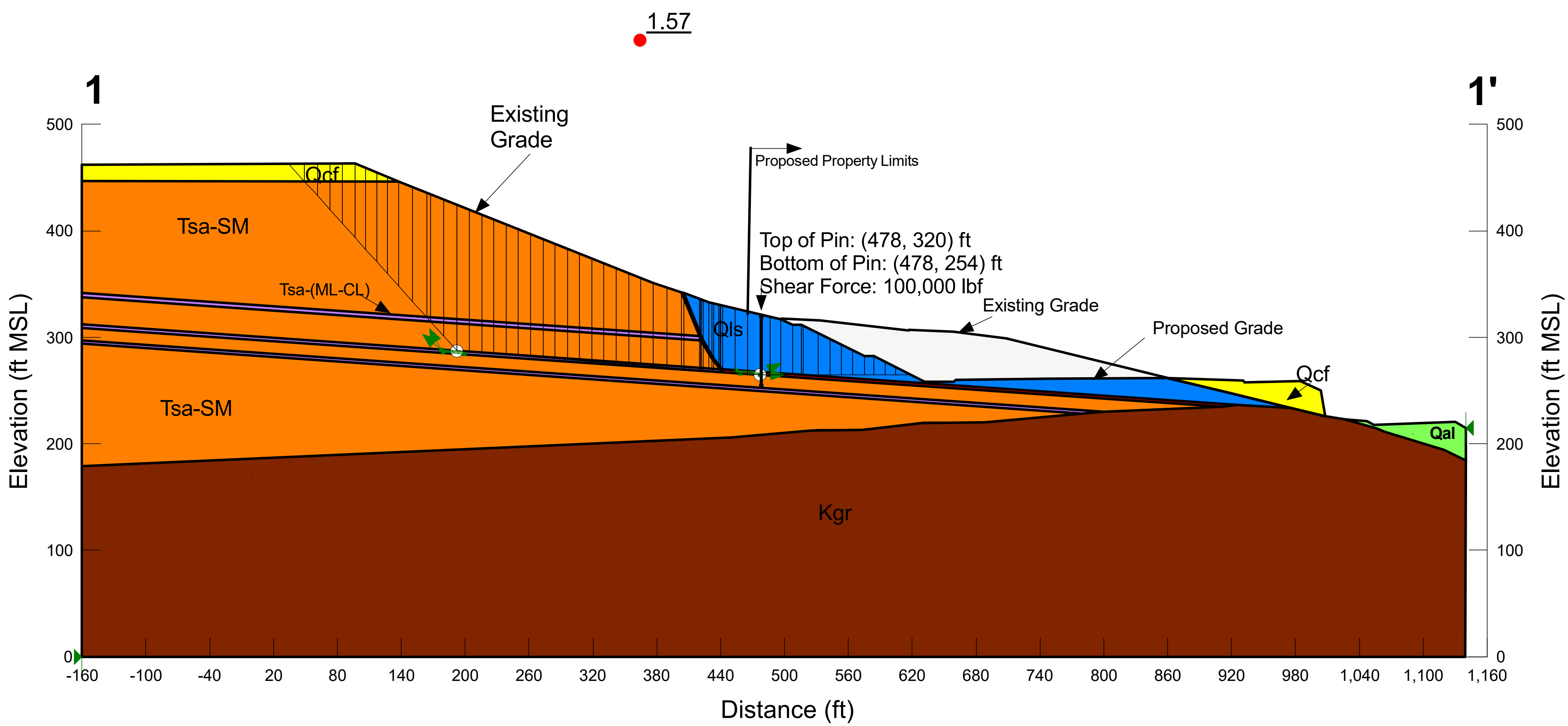
Through Pin-Cohesive Strength
Cohesive Strength (psf)
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
X (ft)

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-SM	130	800	34		

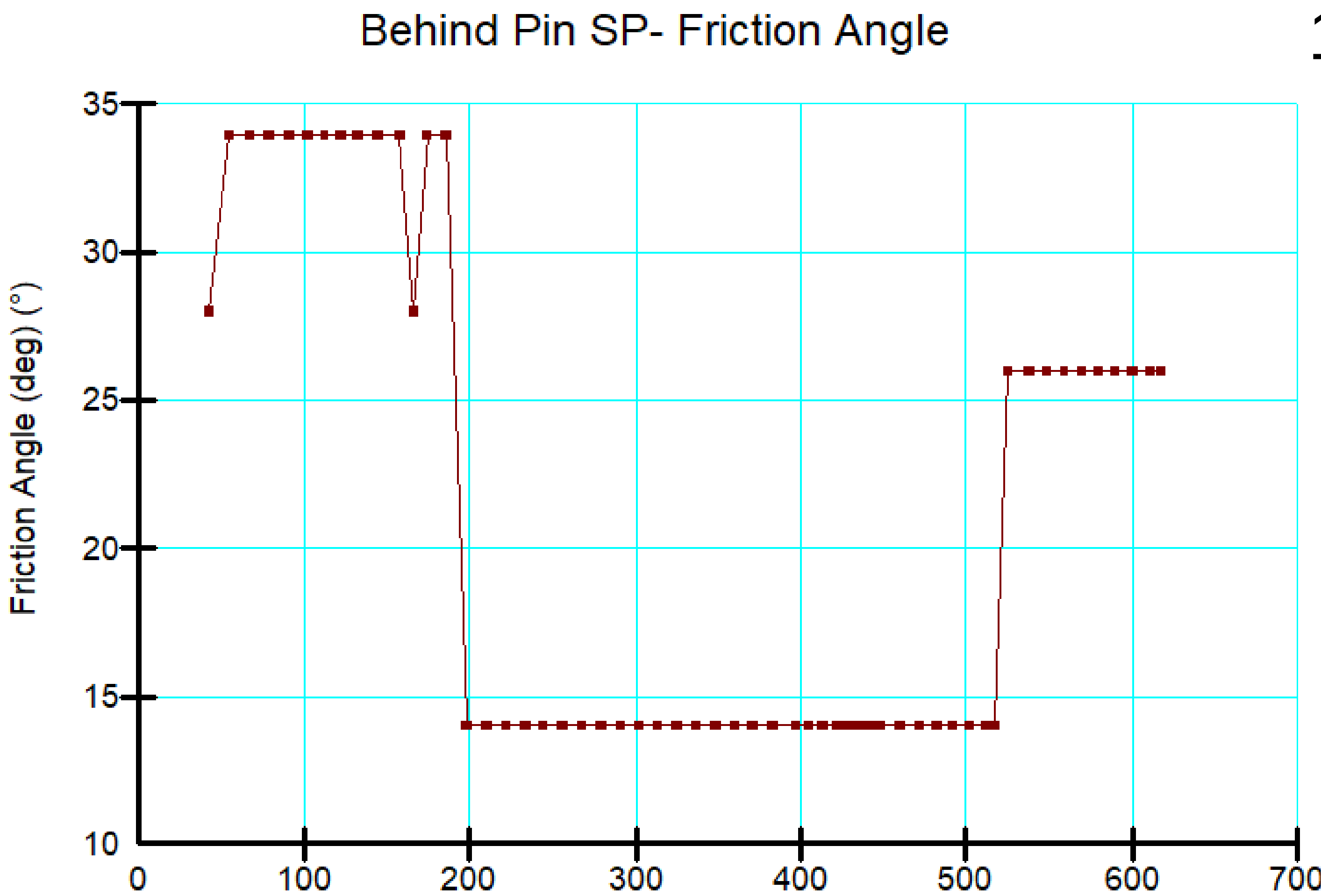
Proposed Grade
Static Condition

Olive Street
Project No. G3035-52-01
Name: Case 5_1-1'_Behind Pin-Slide Plane.gsz

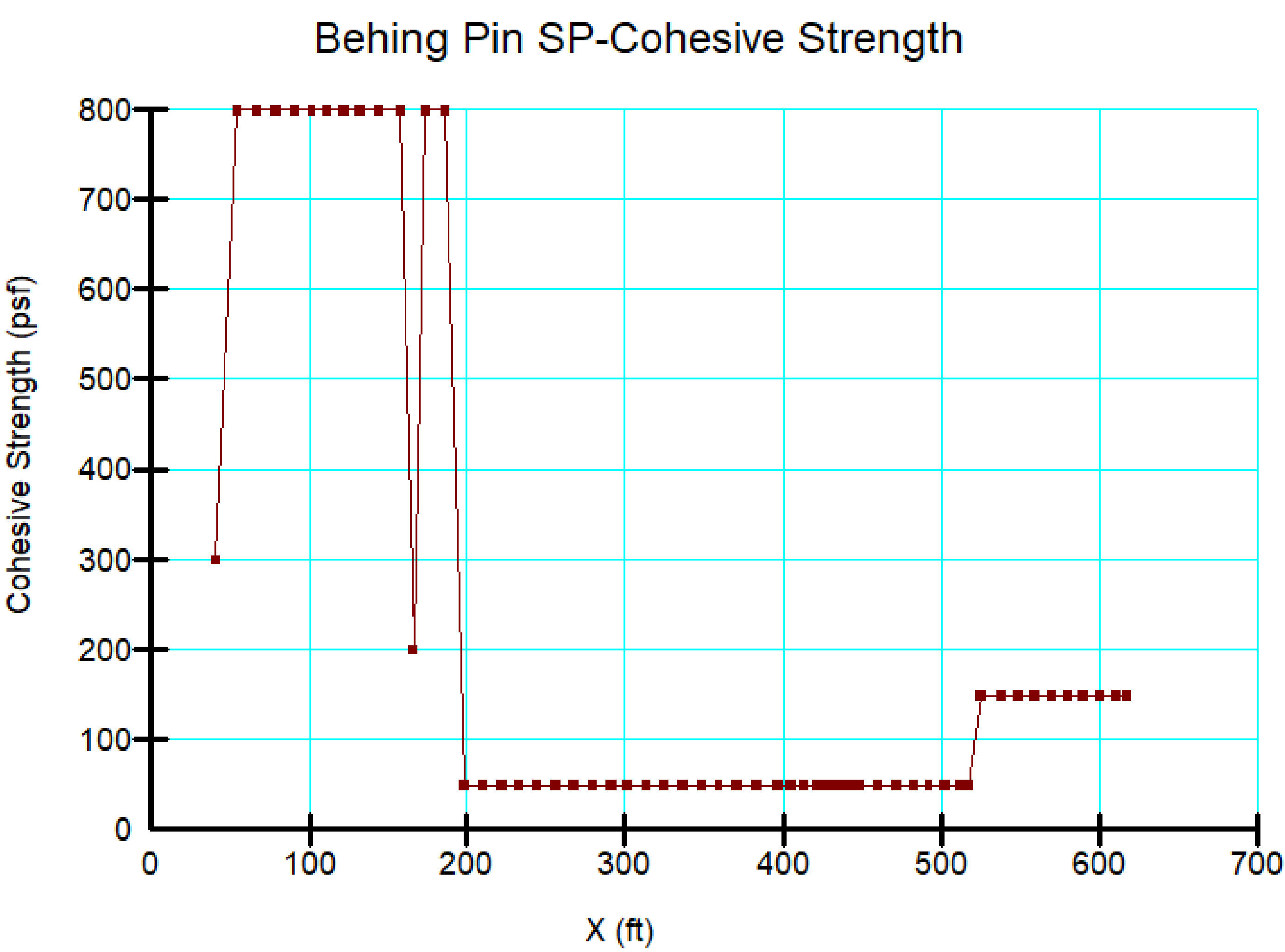


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\1-1' Geo Studio\File Name: Case 5_1-1'_Behind Pin-Slide Plane.gszDTime: 10:59:42 AMate: 07/28/2024

1-1'



Behind Pin SP- Friction Angle
Friction Angle (deg) (°)
35
30
25
20
15
10
0
100
200
300
400
500
600
700



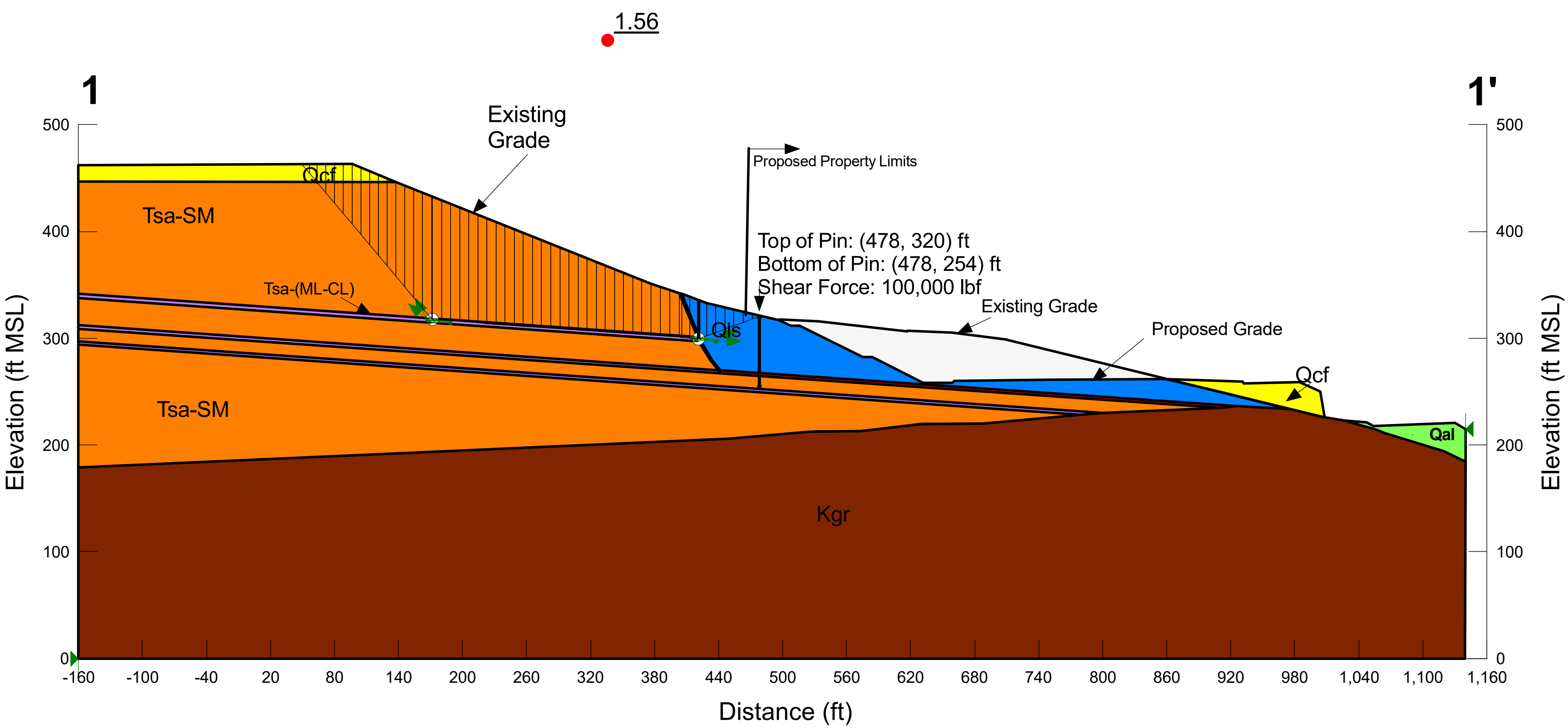
Behing Pin SP-Cohesive Strength
Cohesive Strength (psf)
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
X (ft)

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-SM	130	800	34		

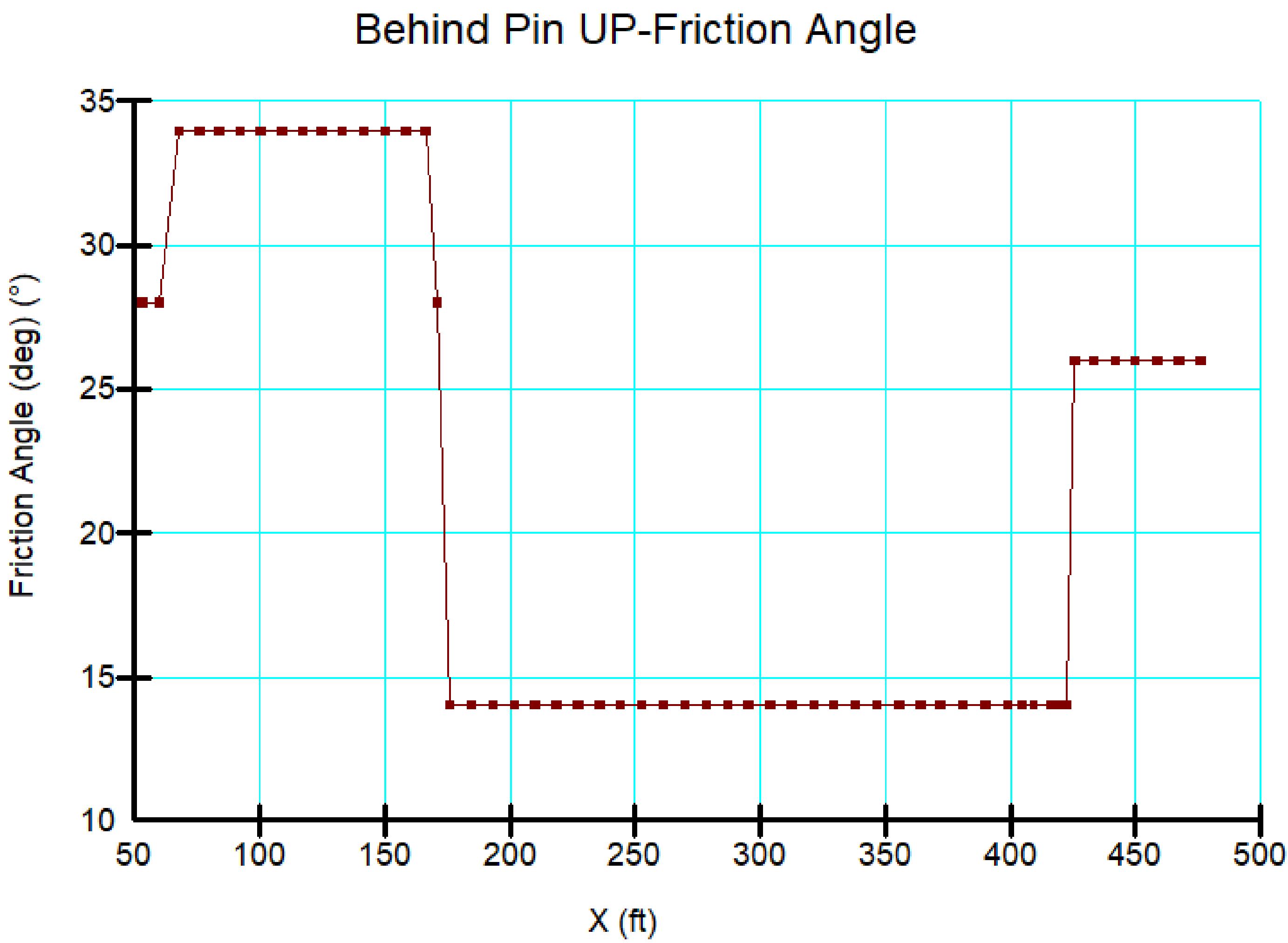
Proposed Grade
Static Condition

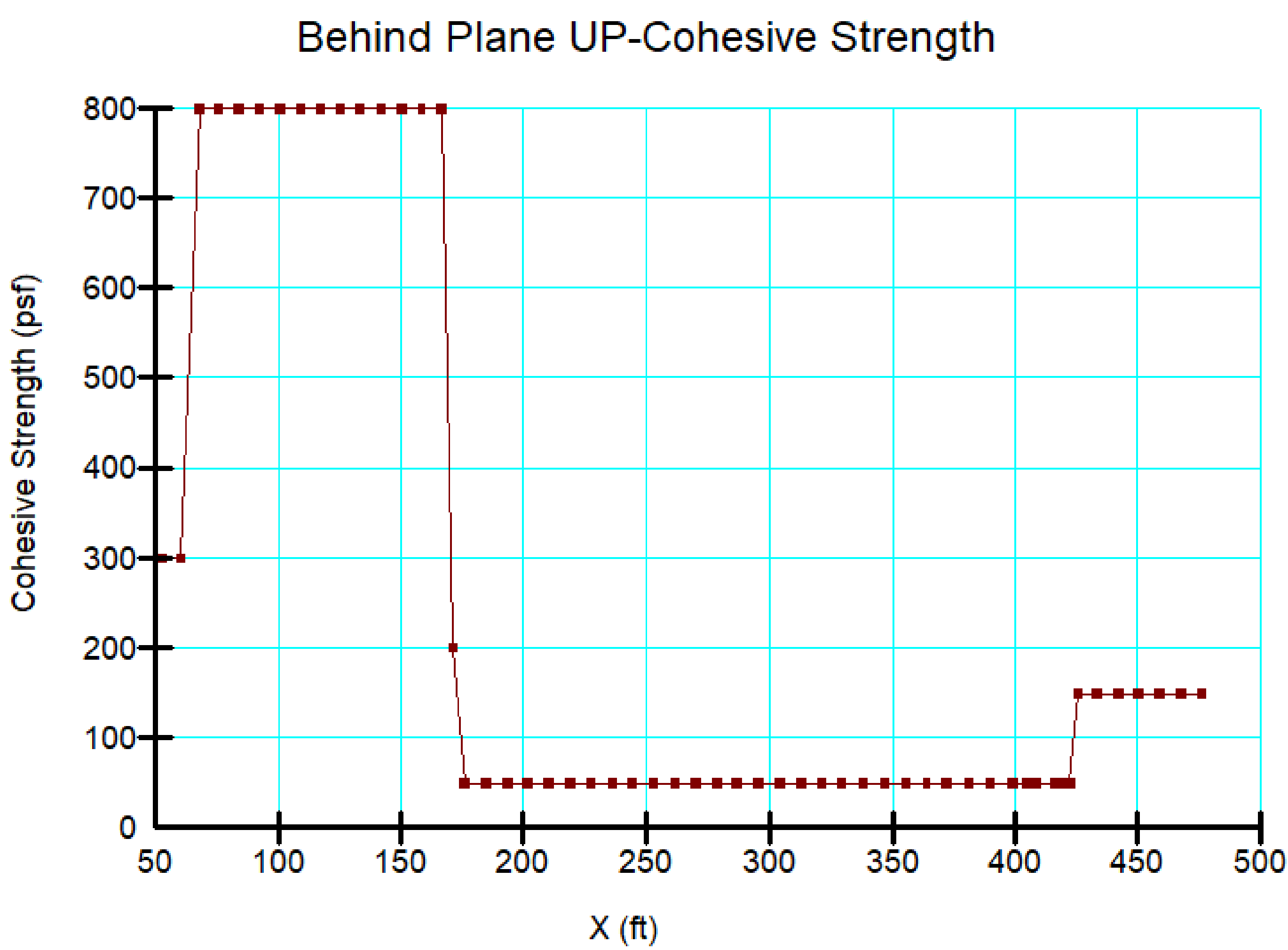
Olive Street
Project No. G3035-52-01
Name: Case 6_1-1'_Behind Pin-Upper.gsz



Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\1-1' Geo Studio\File Name: Case 6_1-1'_Behind Pin-Upper.gszDTime: 11:09:01 AMate: 07/28/2024

1-1'


Behind Pin UP-Friction Angle
Friction Angle (deg) (°)
35
30
25
20
15
10
50
100
150
200
250
300
350
400
450
500
X (ft)

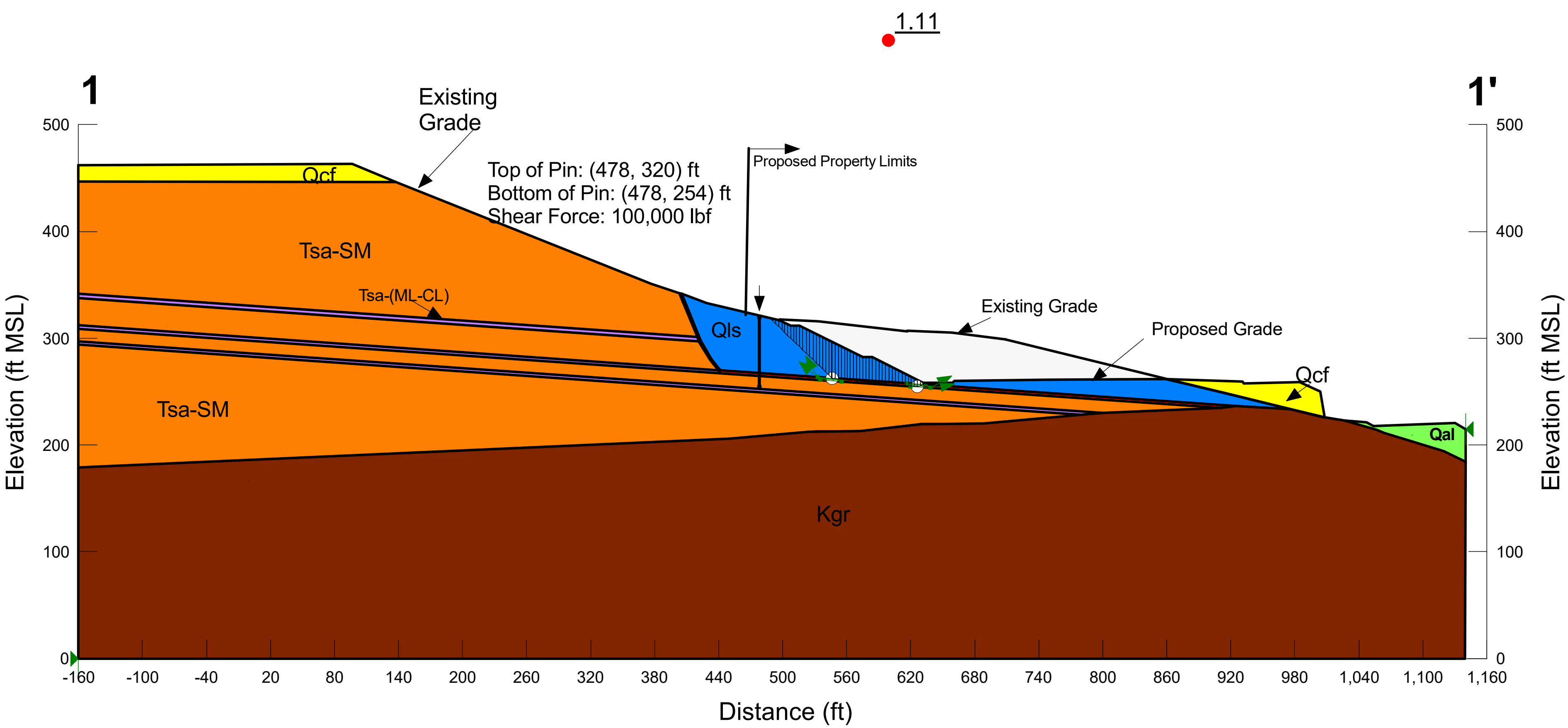

Behind Plane UP-Cohesive Strength
Cohesive Strength (psf)
800
700
600
500
400
300
200
100
0
50
100
150
200
250
300
350
400
450
500
X (ft)

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-SM	130	800	34		

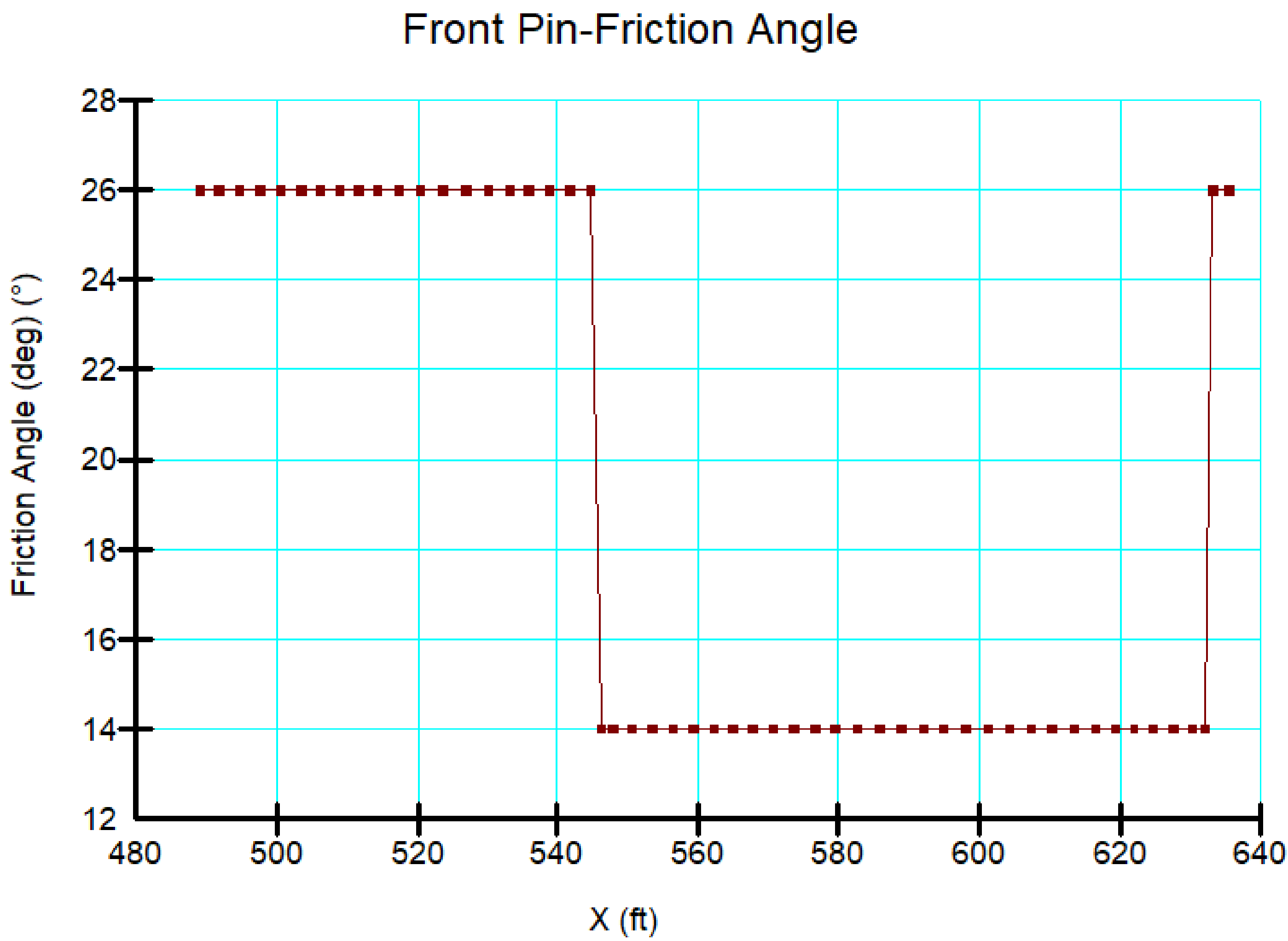
Proposed Grade
Static Condition

Olive Street
Project No. G3035-52-01
Name: Case 7_1-1'_Front Pin.gsz

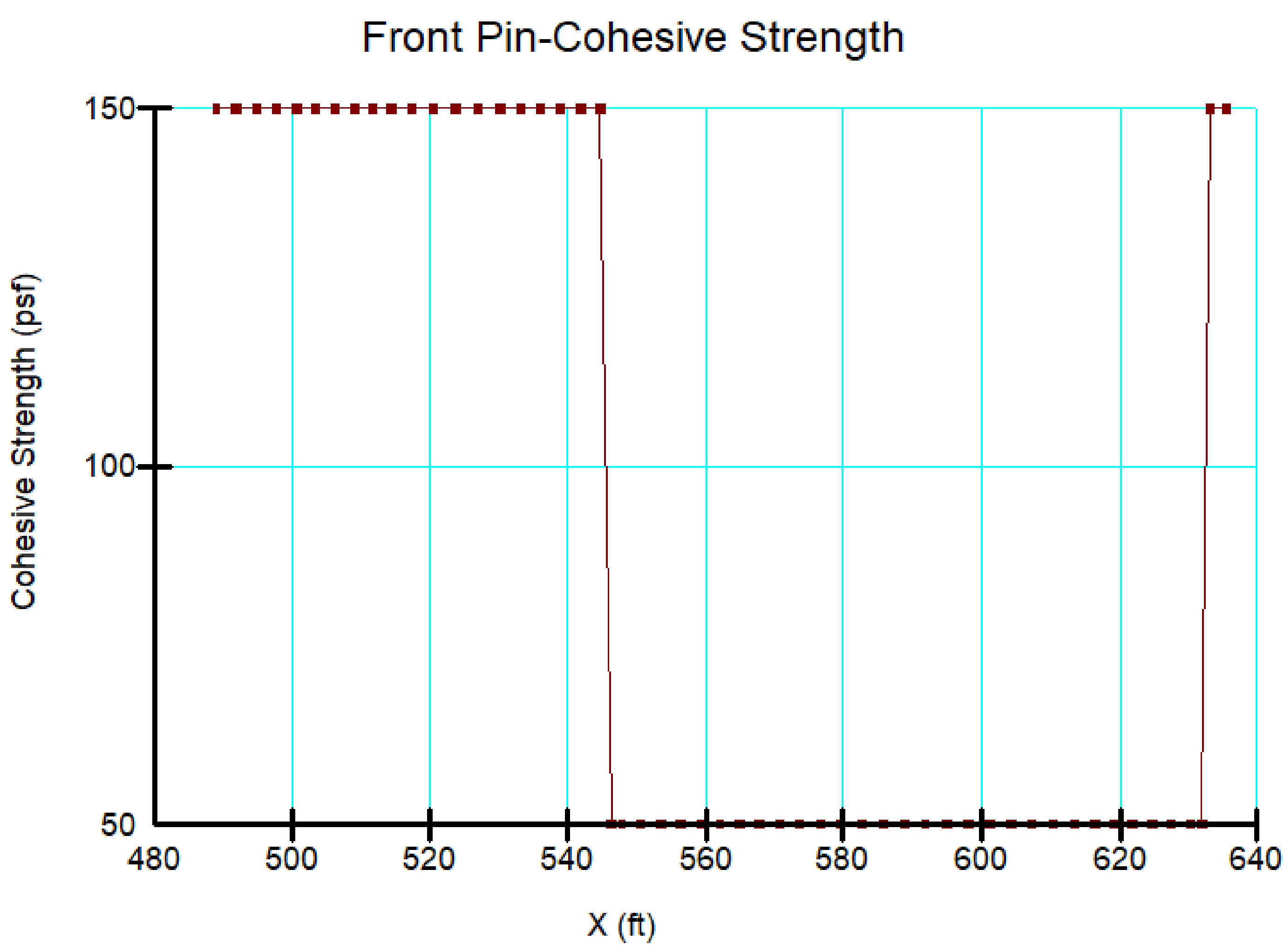


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\1-1' Geo Studio\File Name: Case 7_1-1'_Front Pin.gszDTime: 11:42:01 AMate: 07/28/2024

1-1'



Front Pin-Friction Angle
Friction Angle (deg) (°)
28
26
24
22
20
18
16
14
12
480
500
520
540
560
580
600
620
640
X (ft)



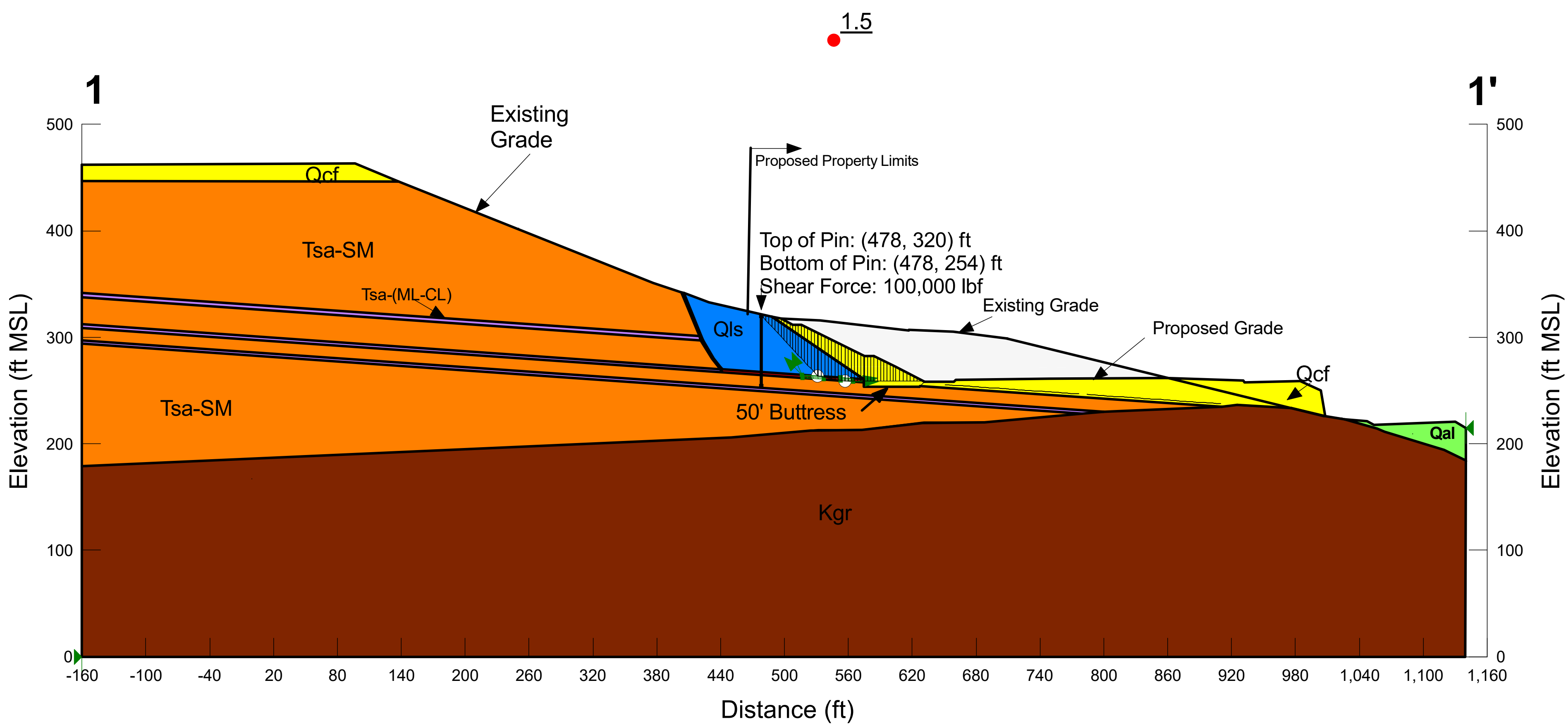
Front Pin-Cohesive Strength
Cohesive Strength (psf)
150
100
50
480
500
520
540
560
580
600
620
640
X (ft)

Proposed Grade
Static Condition

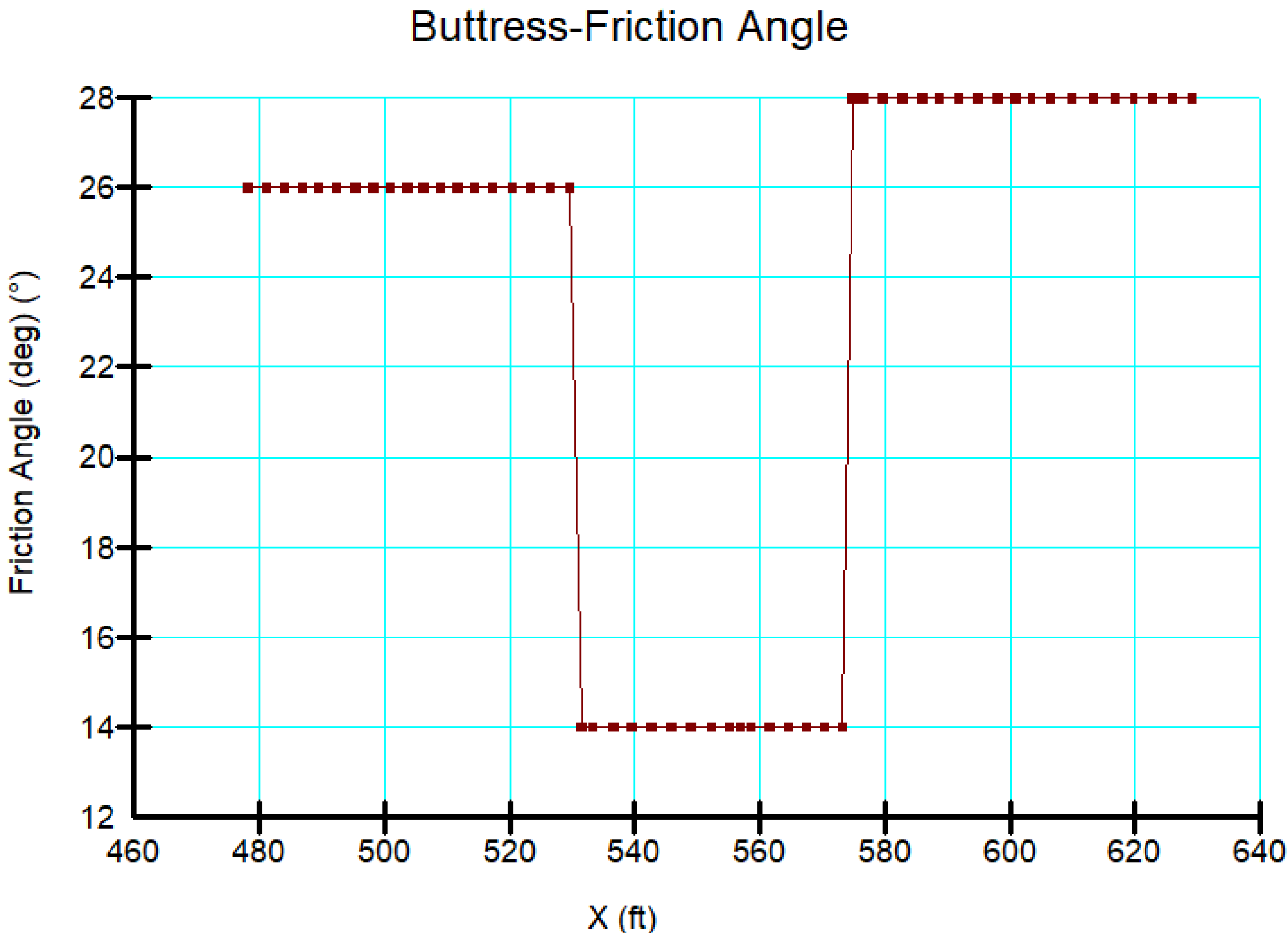
Olive Street
Project No. G3035-52-01
Name: Case 8_1-1'_Buttress.gsz

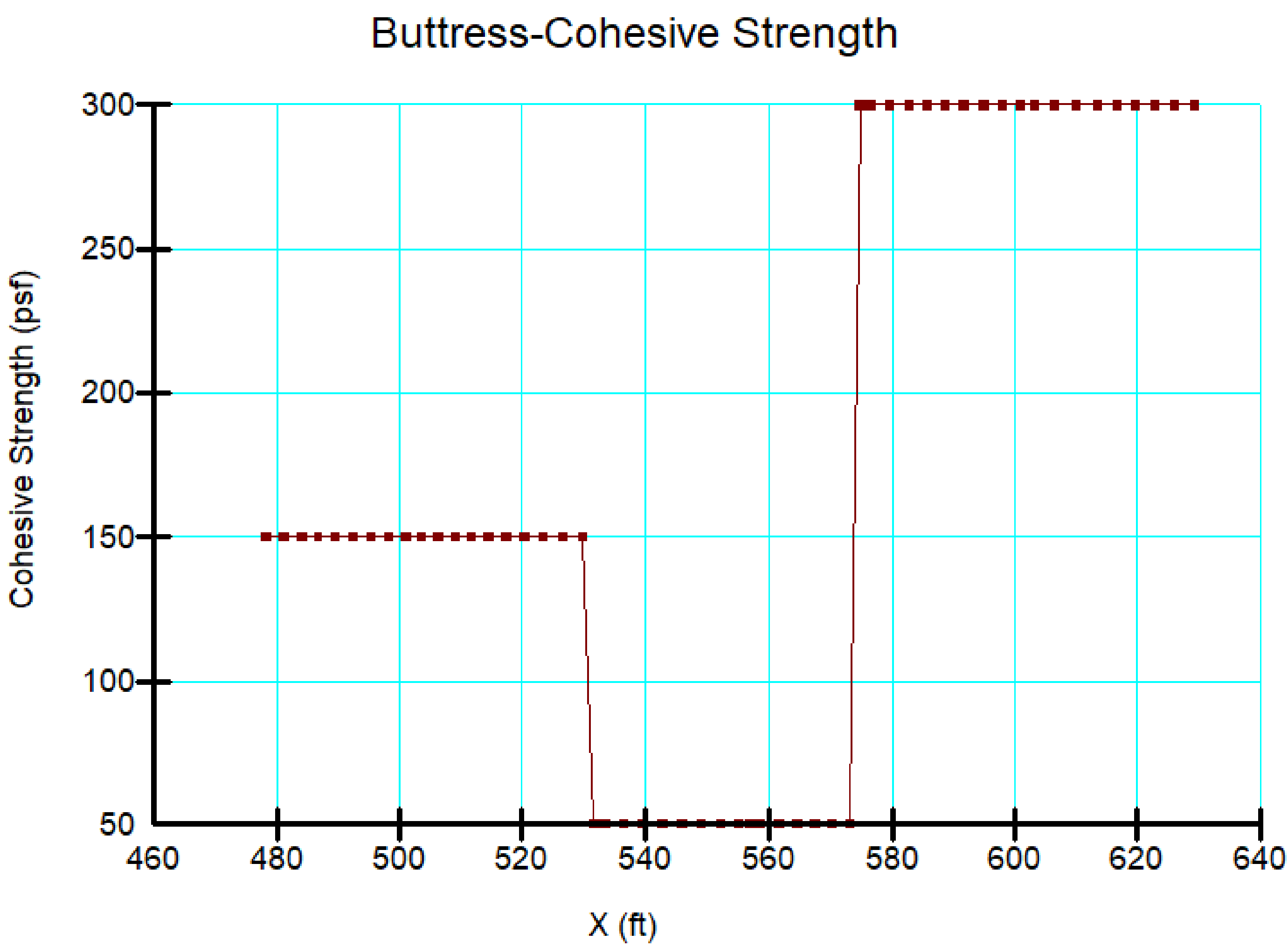
Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-SM	130	800	34		



1-1'


Buttress-Friction Angle
Friction Angle (deg) (°)
28
26
24
22
20
18
16
14
12
460
480
500
520
540
560
580
600
620
640
X (ft)

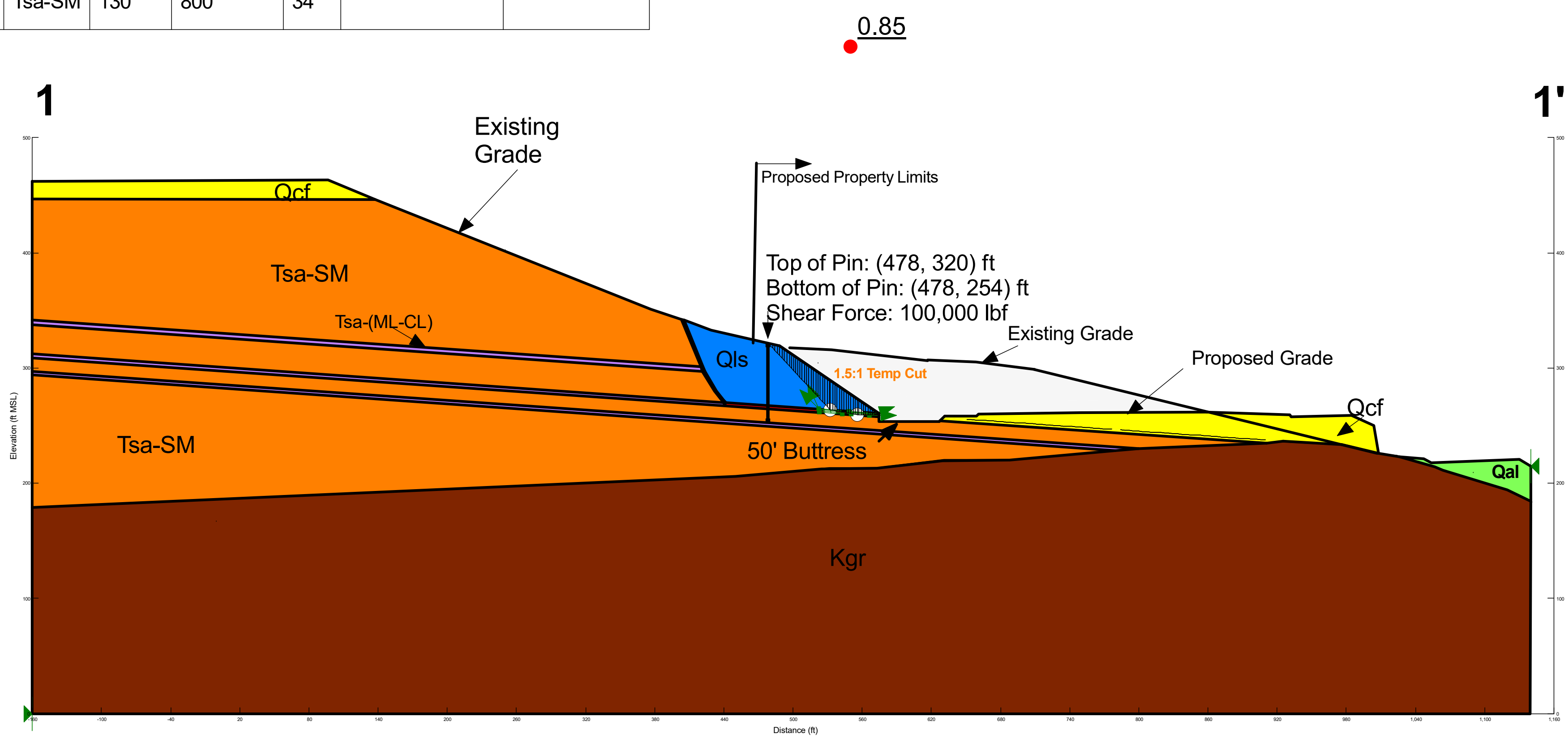

Buttress-Cohesive Strength
Cohesive Strength (psf)
300
250
200
150
100
50
460
480
500
520
540
560
580
600
620
640
X (ft)

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-SM	130	800	34		

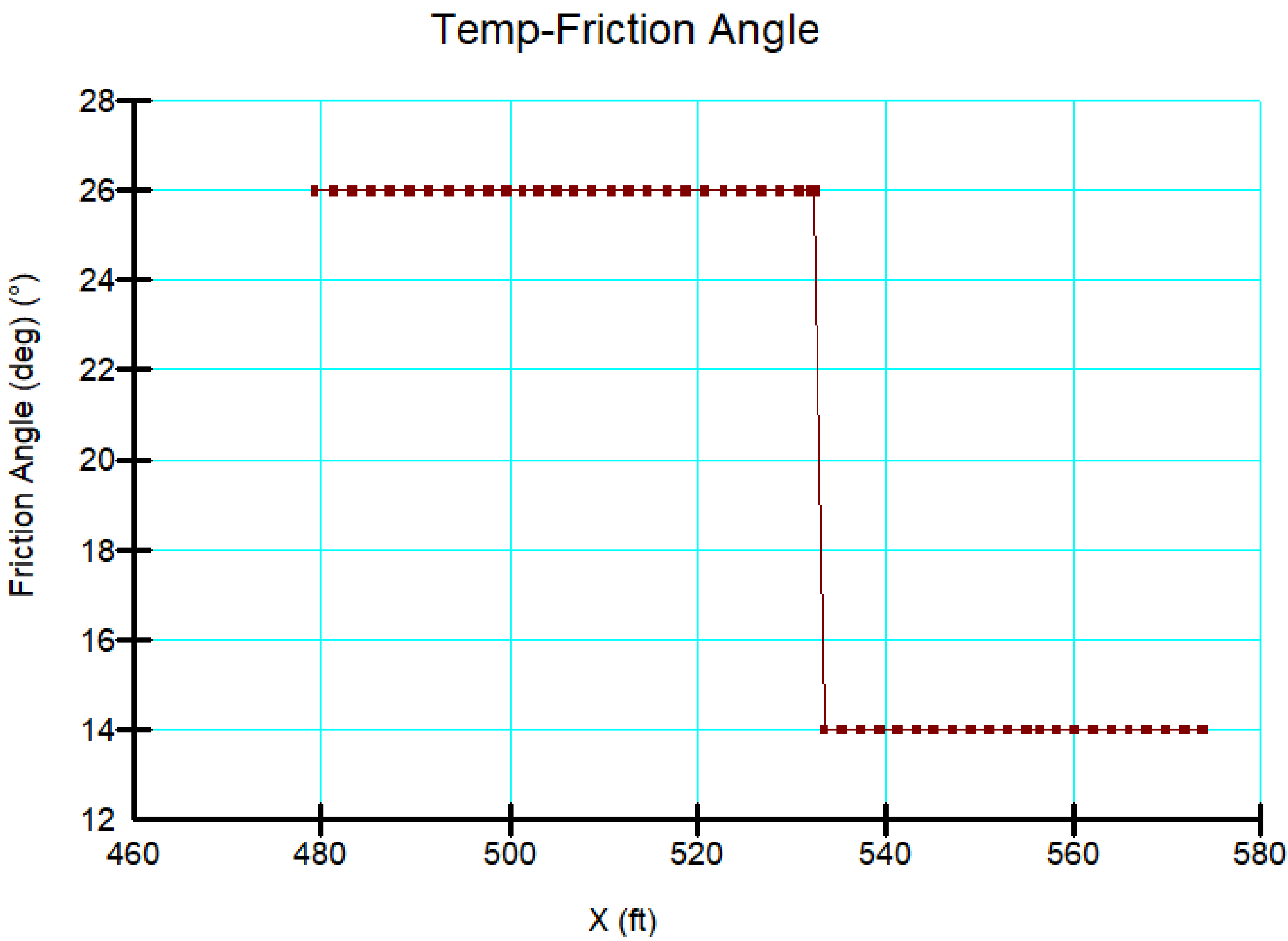
Proposed Grade
Static Condition

Olive Street
Project No. G3035-52-01
Name: Case 9_1-1'_Temp-block.gsz

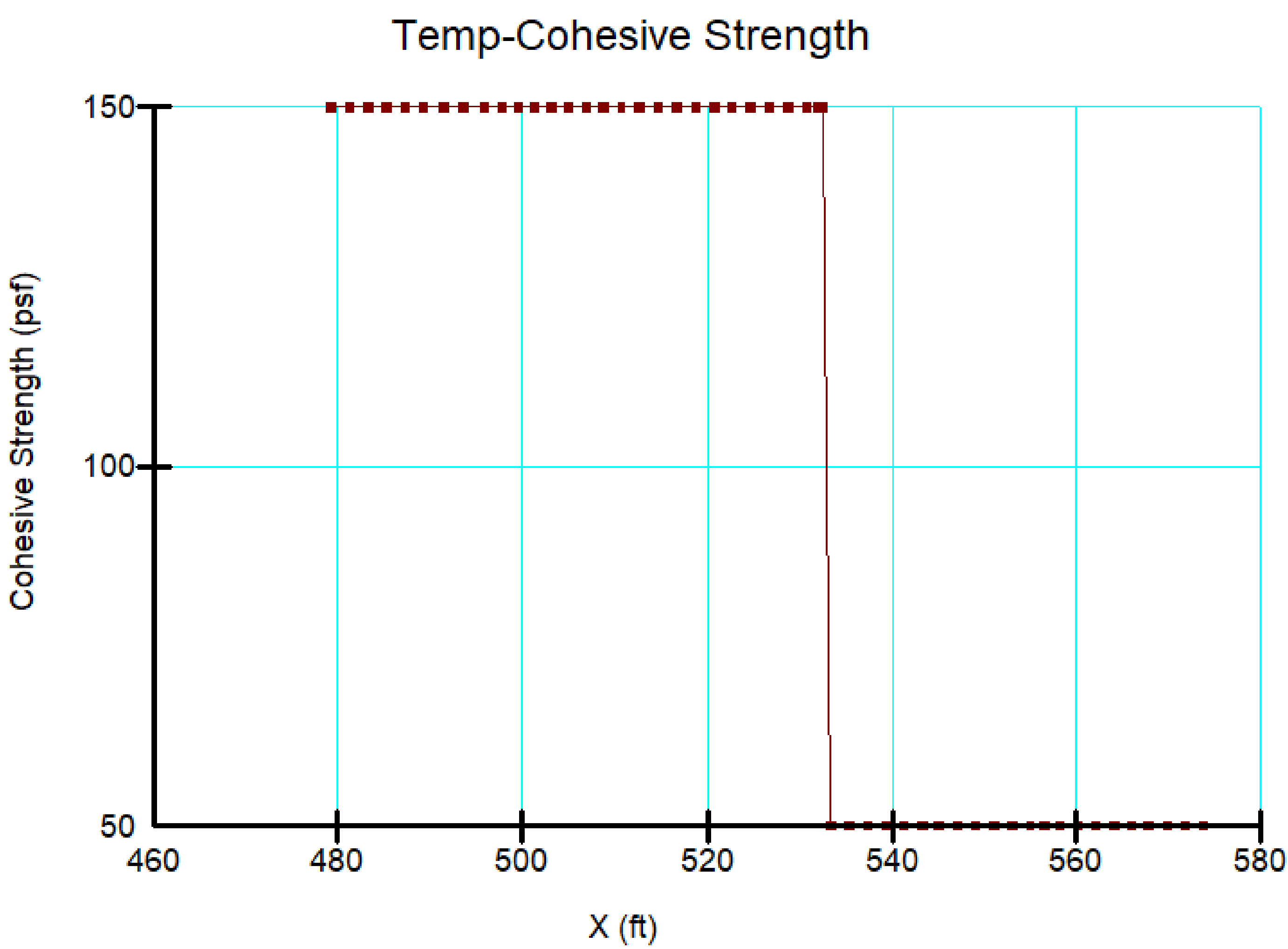


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\1-1' Geo Studio\File Name: Case 9_1-1'_Temp-block.gszDTime: 12:07:31 PMate: 07/28/2024

1-1'



Temp-Friction Angle
Friction Angle (deg) (°)
28
26
24
22
20
18
16
14
12
460
480
500
520
540
560
580
X (ft)



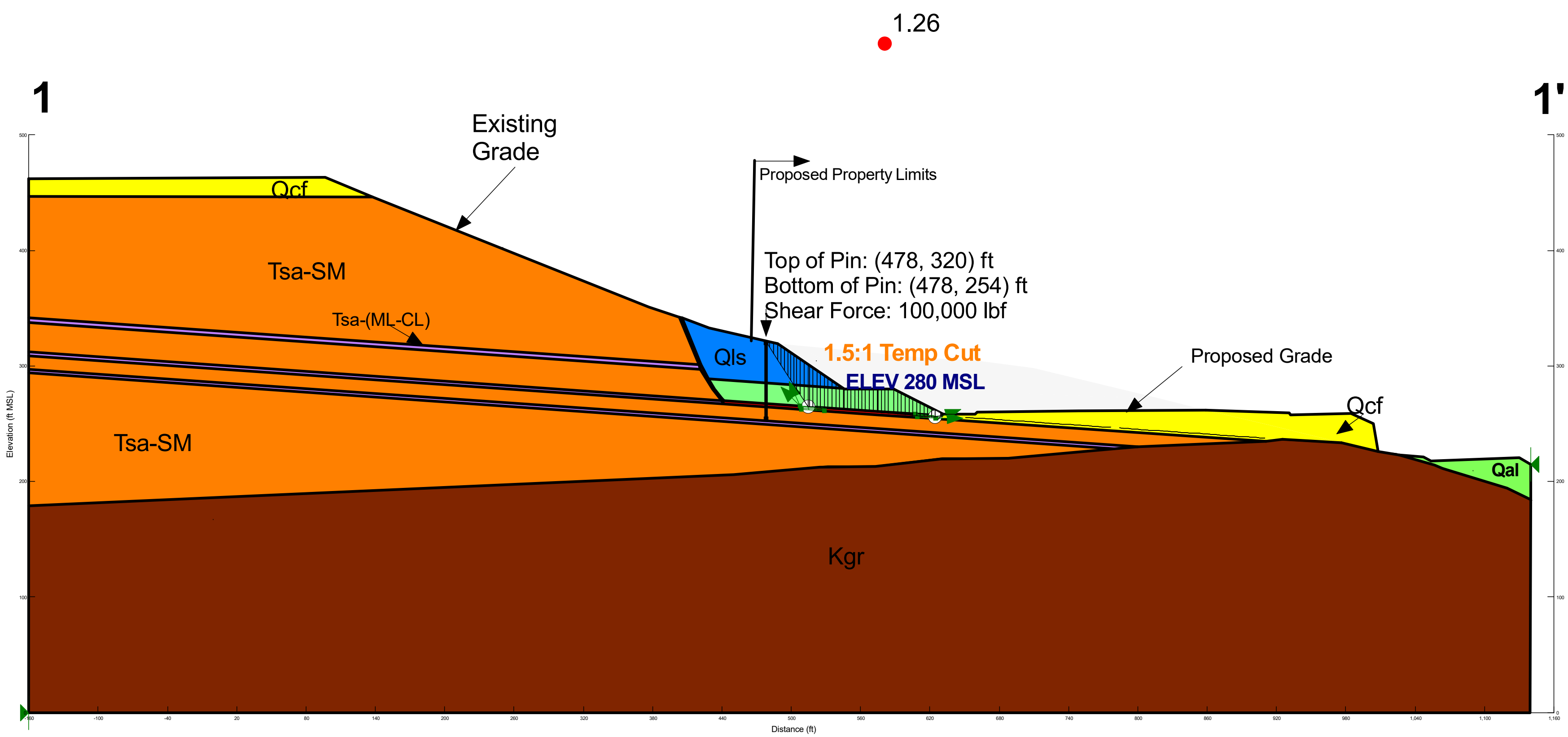
Temp-Cohesive Strength
Cohesive Strength (psf)
150
100
50
460
480
500
520
540
560
580
X (ft)

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Qls-SM	130	300	30		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-SM	130	800	34		

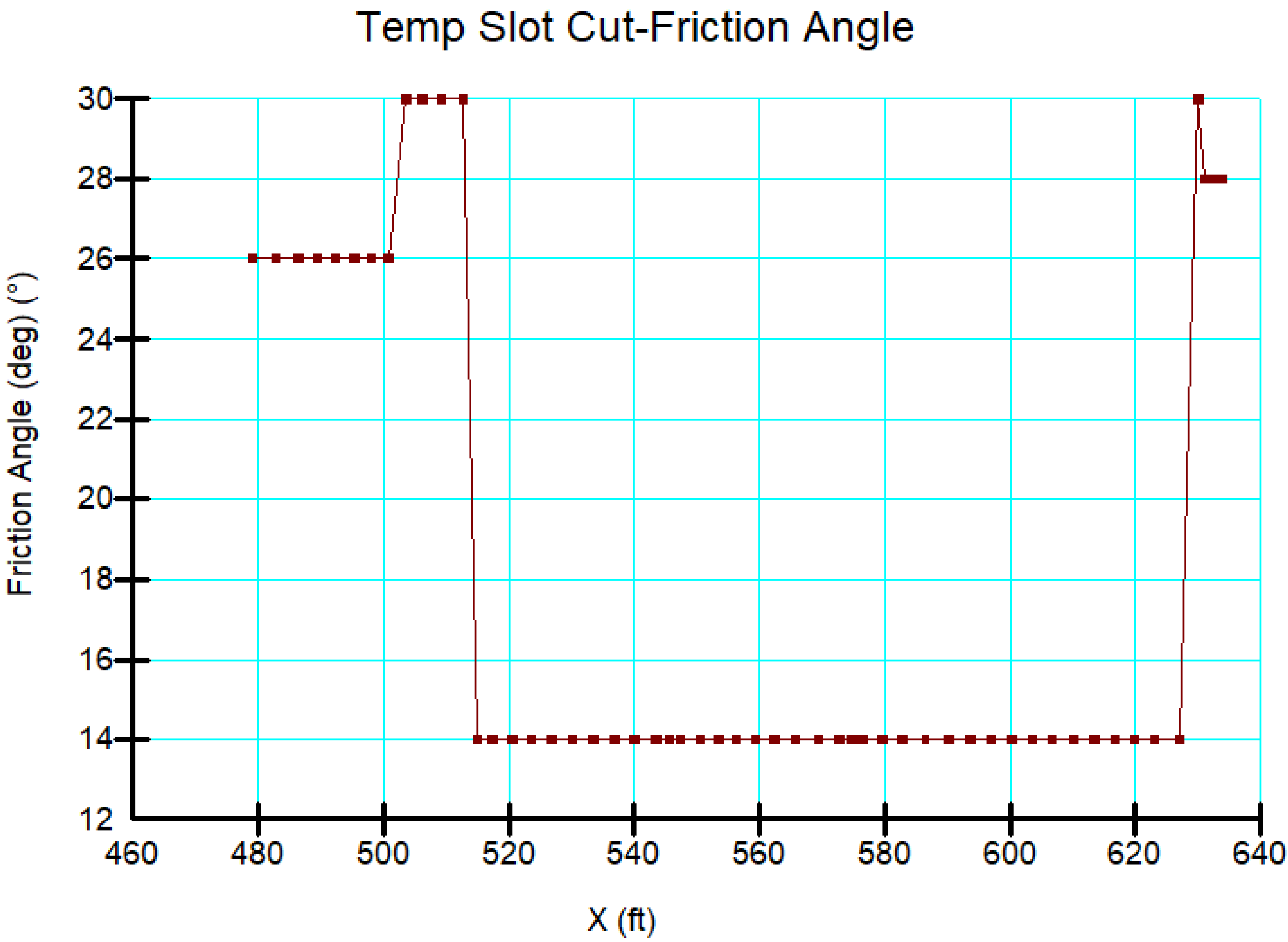
Proposed Grade
Static Condition

Olive Street
Project No. G3035-52-01
Name: Case 10_1-1'_Temp-block-Slot Cut.gsz

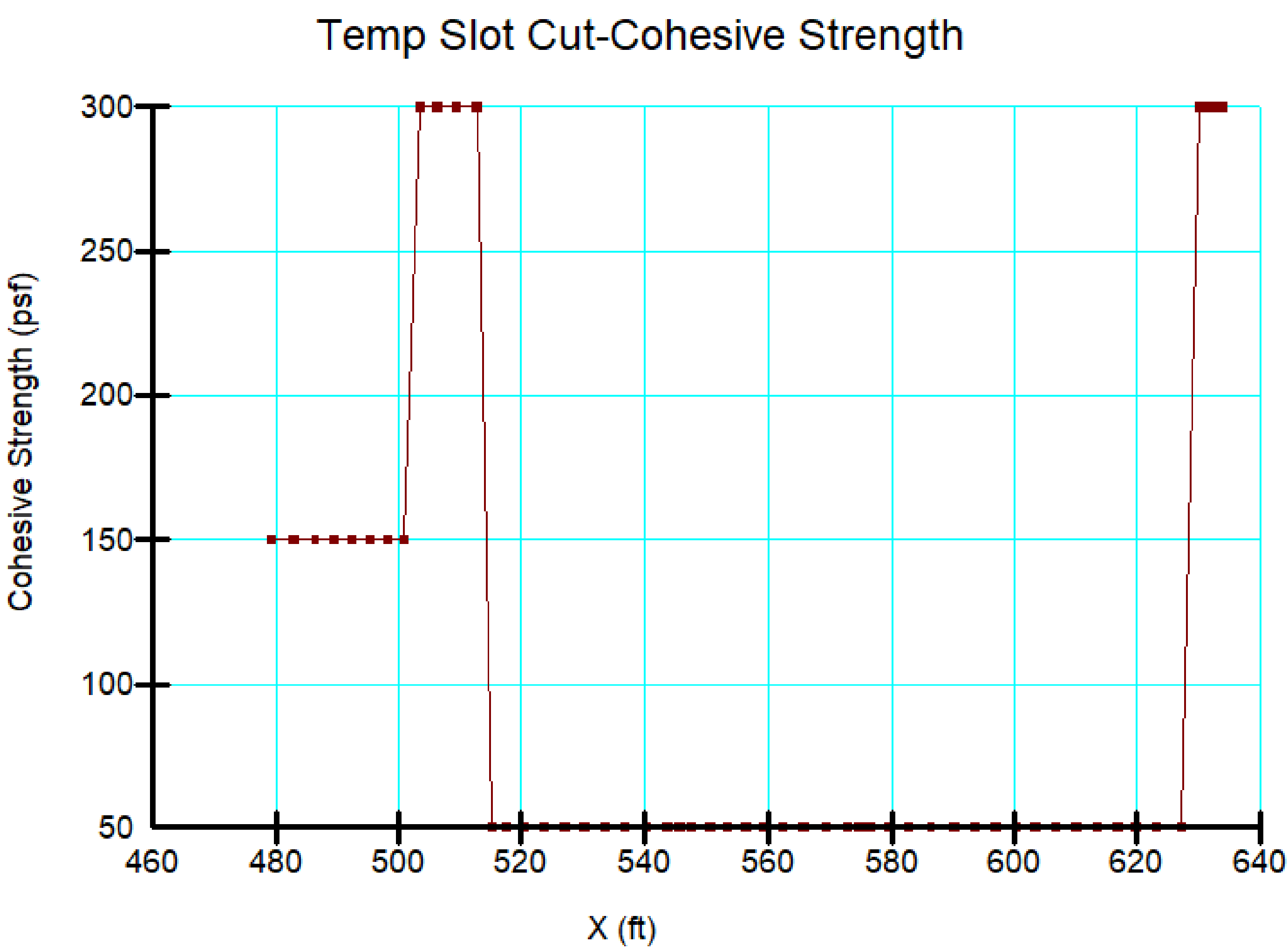


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\1-1' Geo Studio\File Name: Case 10_1-1'_Temp-block-Slot Cut.gszDTime: 11:31:45 AMate: 08/08/2024

1-1'



Temp Slot Cut-Friction Angle
Friction Angle (deg) (°)
X (ft)



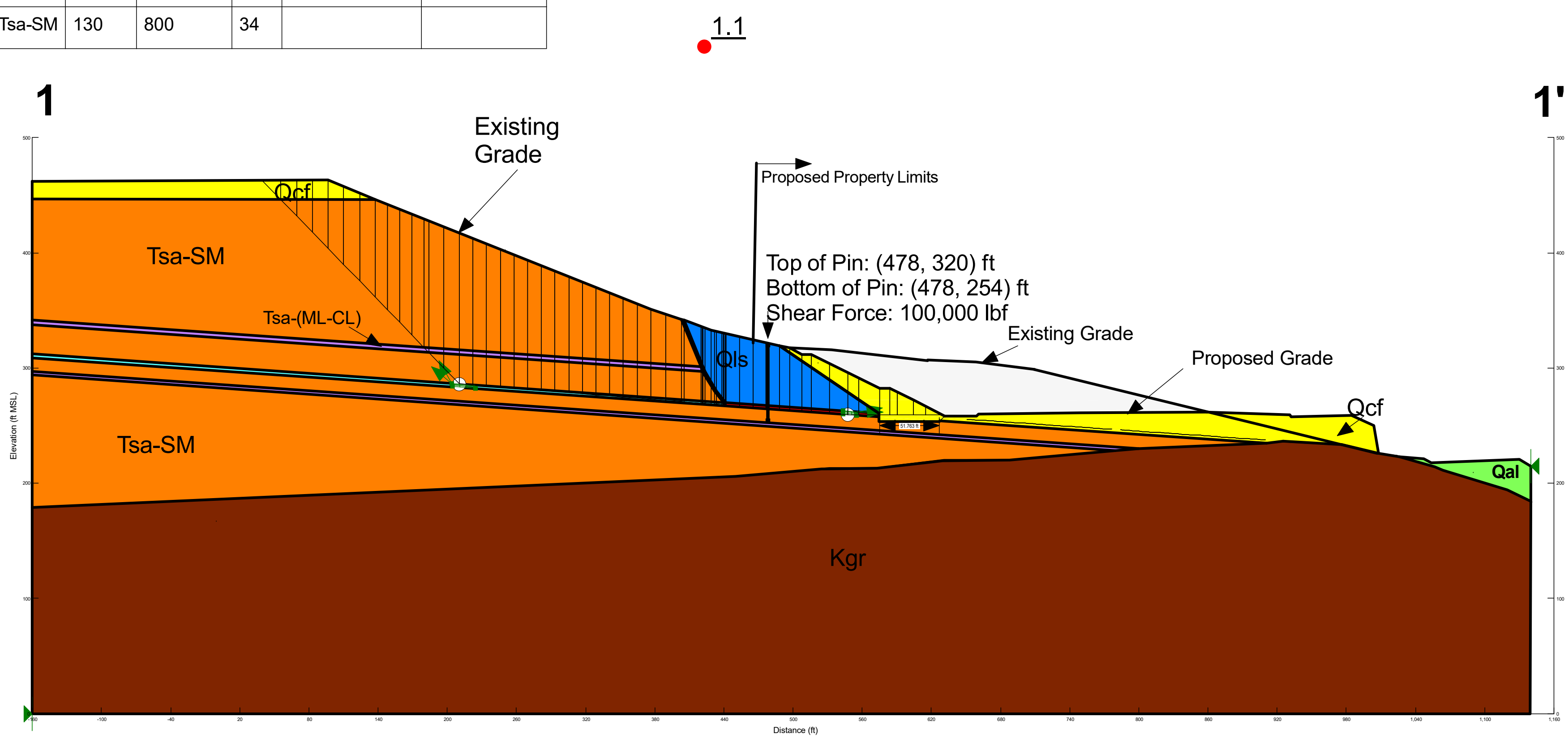
Temp Slot Cut-Cohesive Strength
Cohesive Strength (psf)
X (ft)

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-ML FS	130	200	28	Phi-18°	Cohesion-FS 100 (psf)
	Tsa-SM	130	800	34		

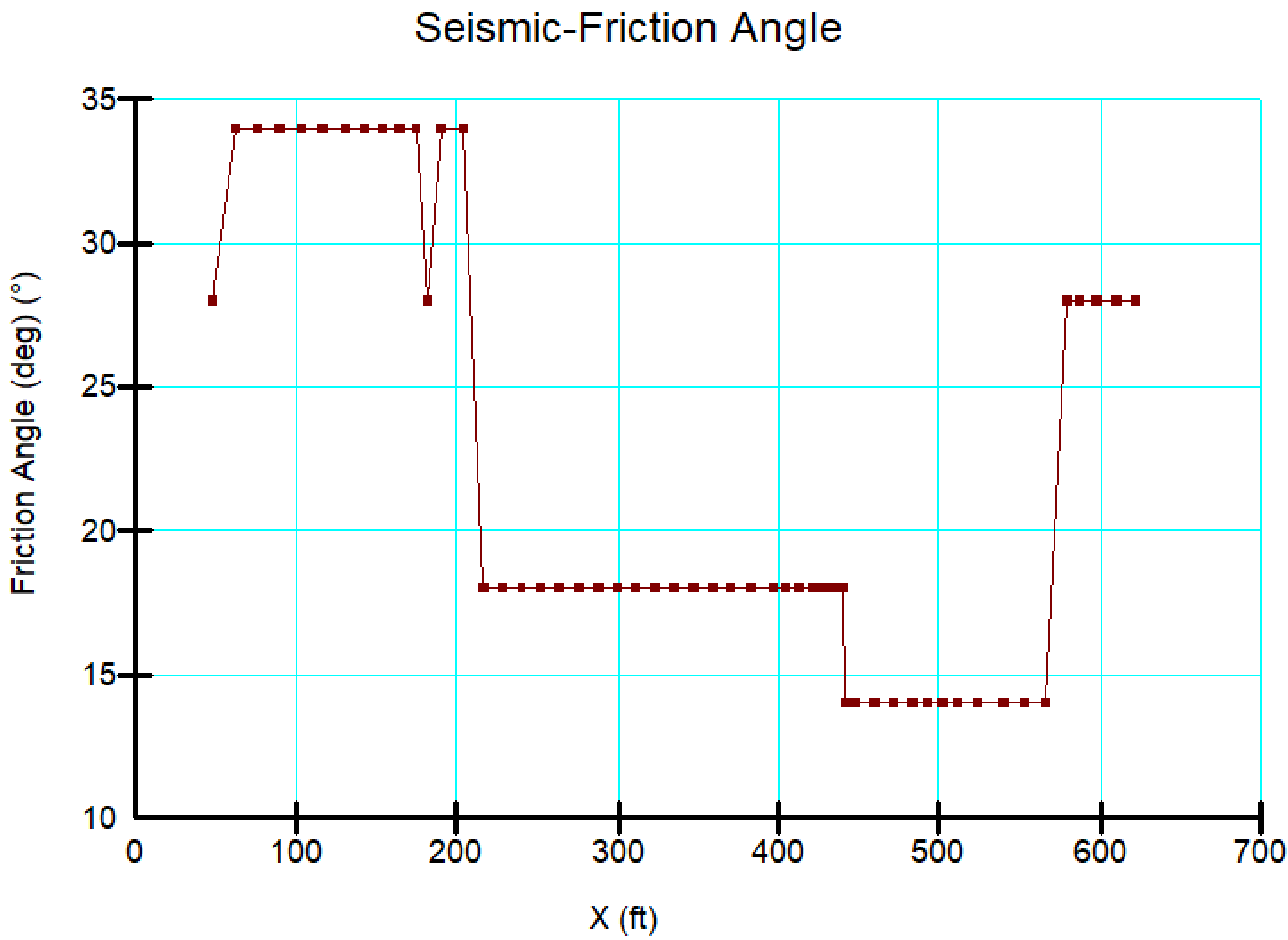
Proposed Grade
Static Condition

Olive Street
Project No. G3035-52-01
Name: Case 11_1-1'_Buttress-Seismic.gsz
Horz Seismic Coef.: 0.15

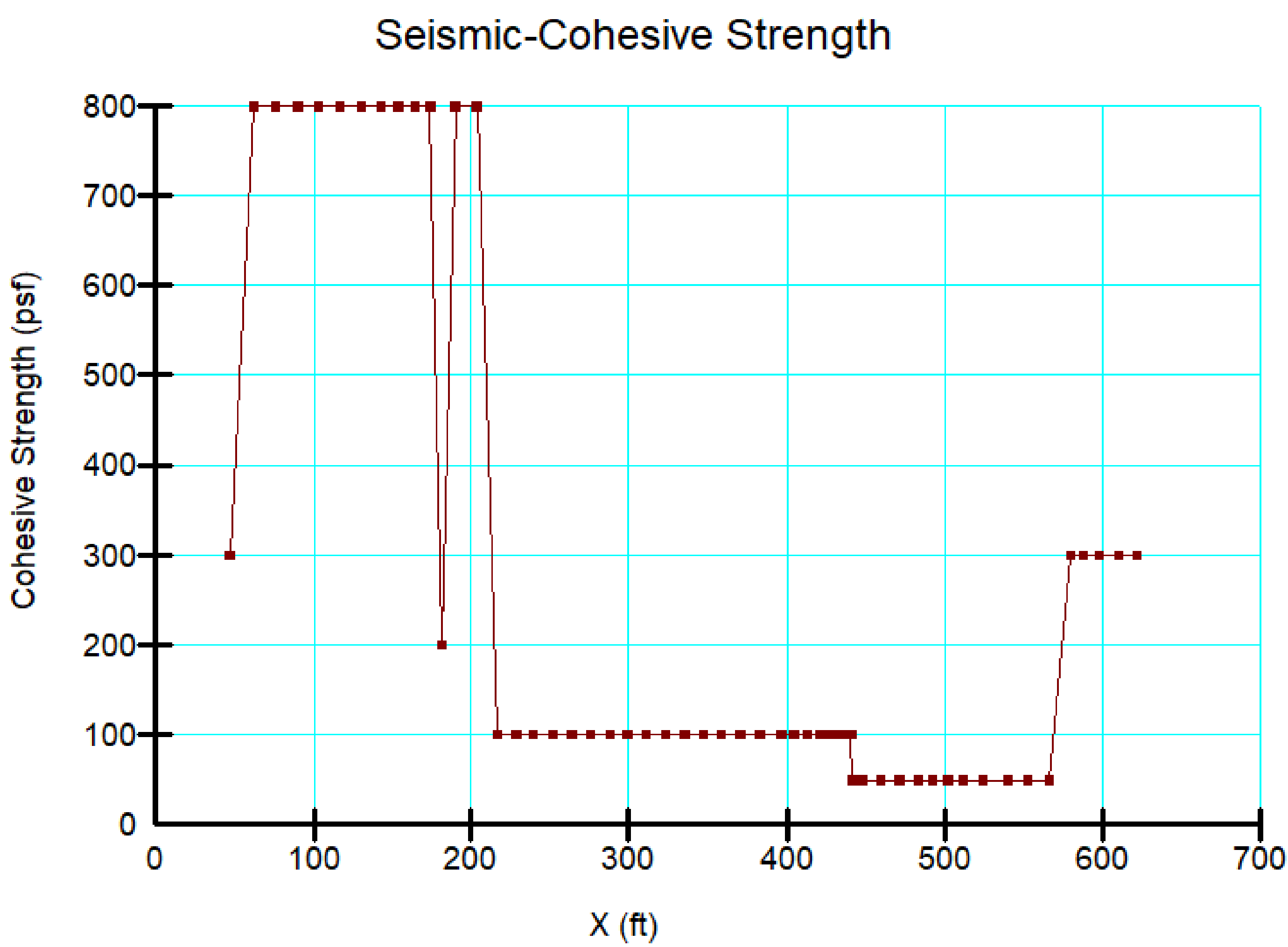


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\1-1' Geo Studio\File Name: Case 11_1-1'_Buttress-Seismic.gszDTime: 09:44:42 PMate: 07/28/2024

1-1'



Seismic-Friction Angle
Friction Angle (deg) (°)
35
30
25
20
15
10
0
100
200
300
400
500
600
700
X (ft)



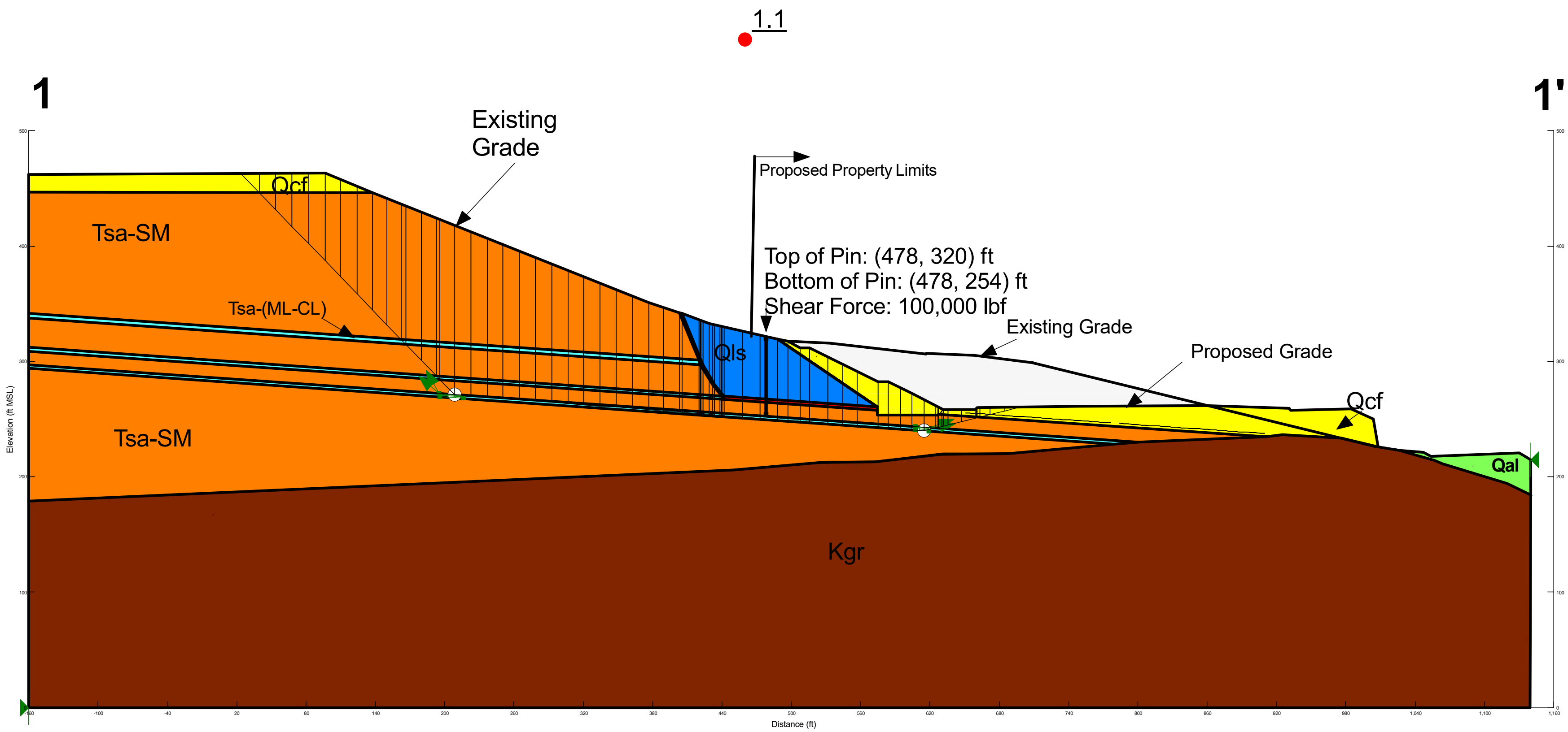
Seismic-Cohesive Strength
Cohesive Strength (psf)
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
X (ft)

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Tsa-ML FS	130	200	28	Phi-18°	Cohesion-FS 100 (psf)
	Tsa-SM	130	800	34		

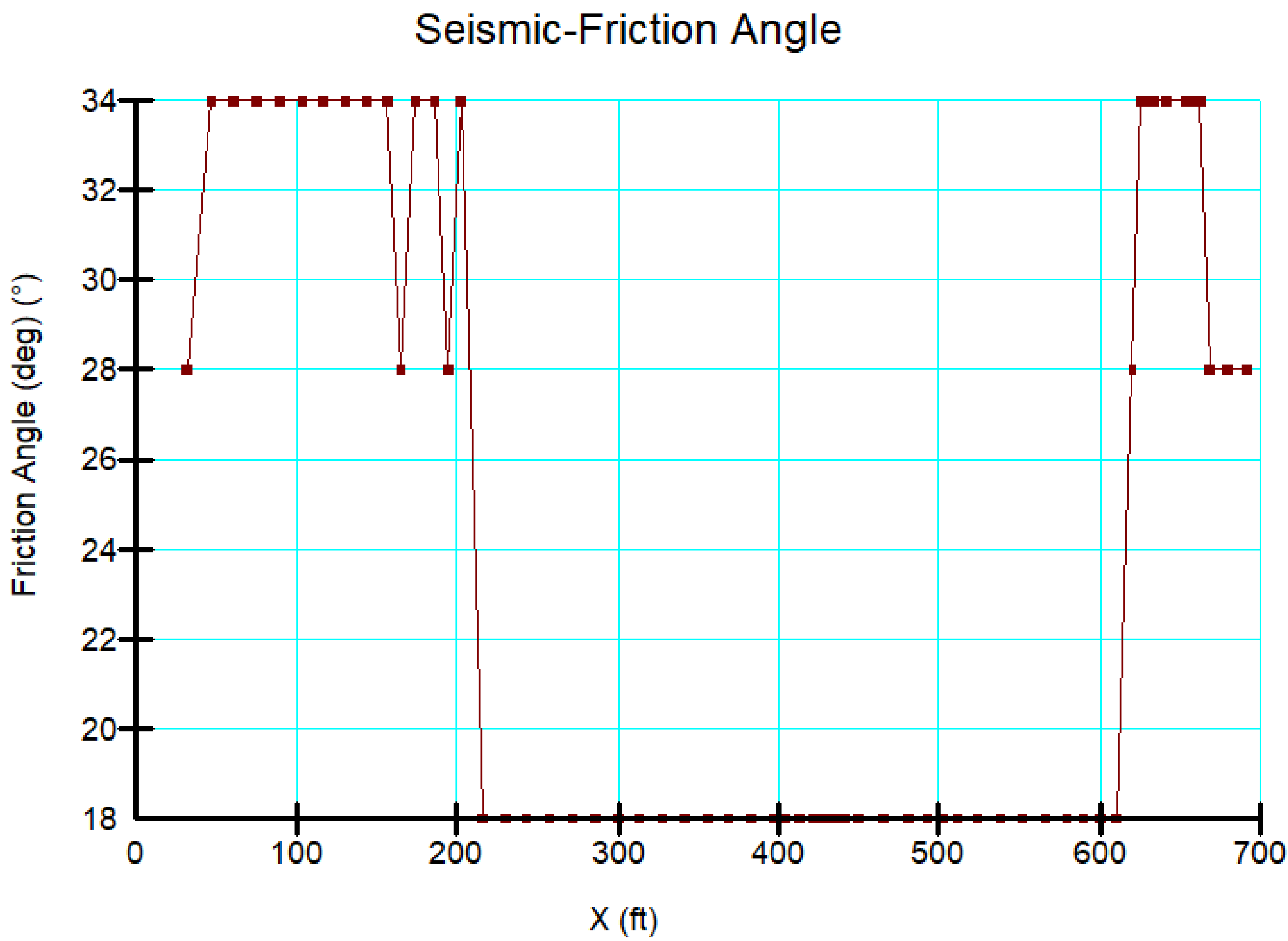
Proposed Grade
Static Condition

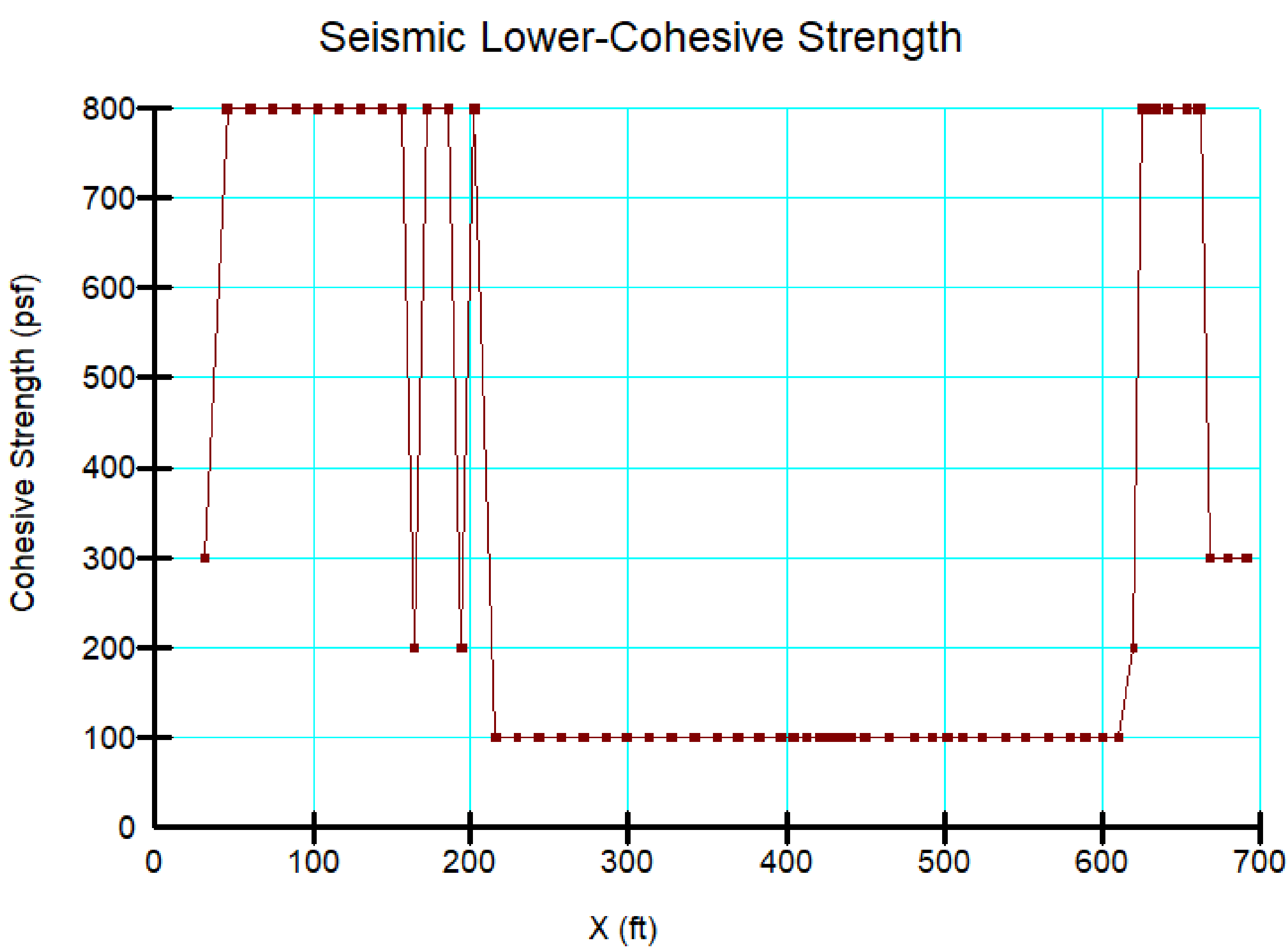
Olive Street
Project No. G3035-52-01
Name: Case 12_1-1'_Seismic-Lower Plane.gsz
Horz Seismic Coef.: 0.15



Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\1-1' Geo Studio\File Name: Case 12_1-1'_Seismic-Lower Plane.gszDTime: 10:00:11 PMate: 07/28/2024

1-1'


Seismic-Friction Angle
Friction Angle (deg) (°)
34
32
30
28
26
24
22
20
18
0
100
200
300
400
500
600
700
X (ft)

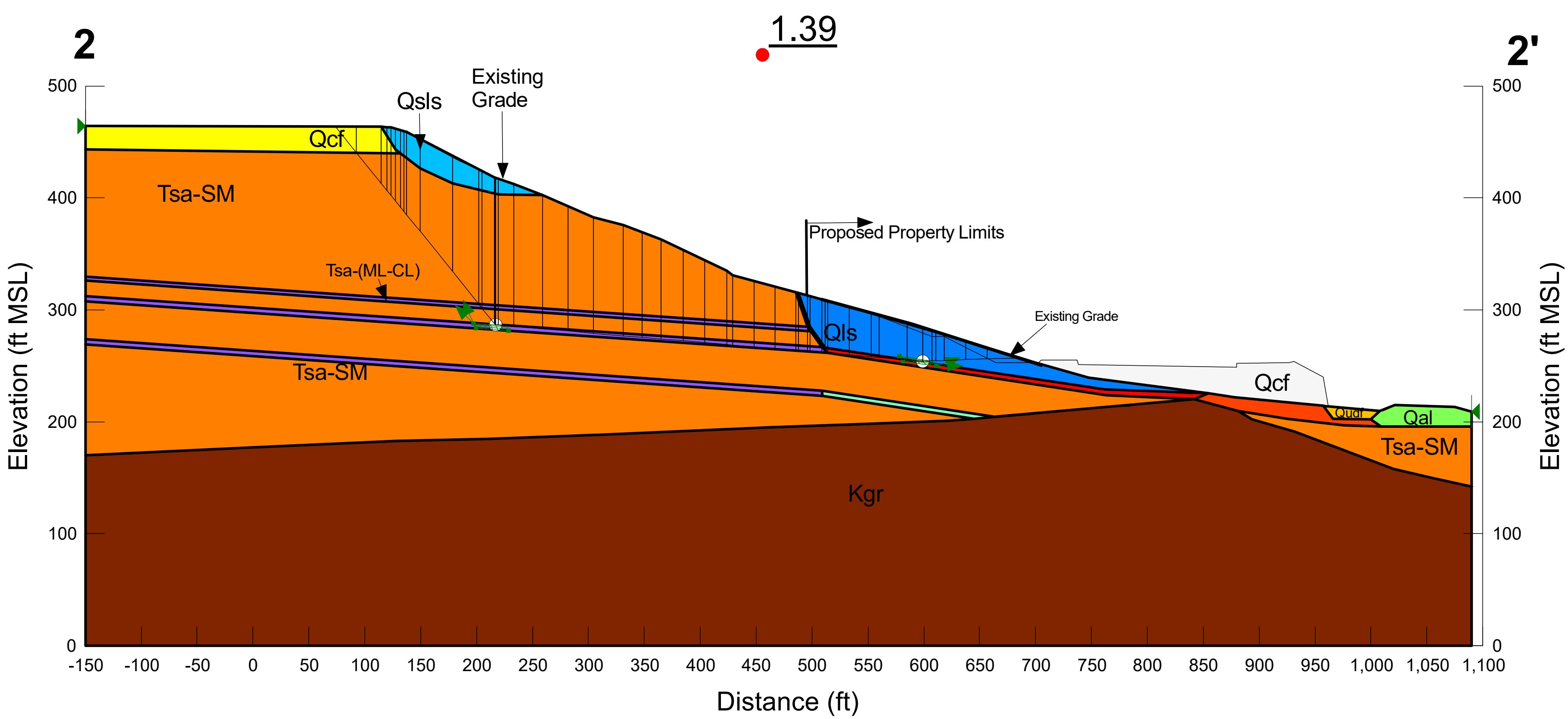

Seismic Lower-Cohesive Strength
Cohesive Strength (psf)
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
X (ft)

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qcol	130	150	26		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Qsls	130	150	26		
	Qudf	130	300	28		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-ML 8 Deg	130	200	28	Phi-14, angle 8	Cohesion-50, angle 8
	Tsa-SM	130	800	34		

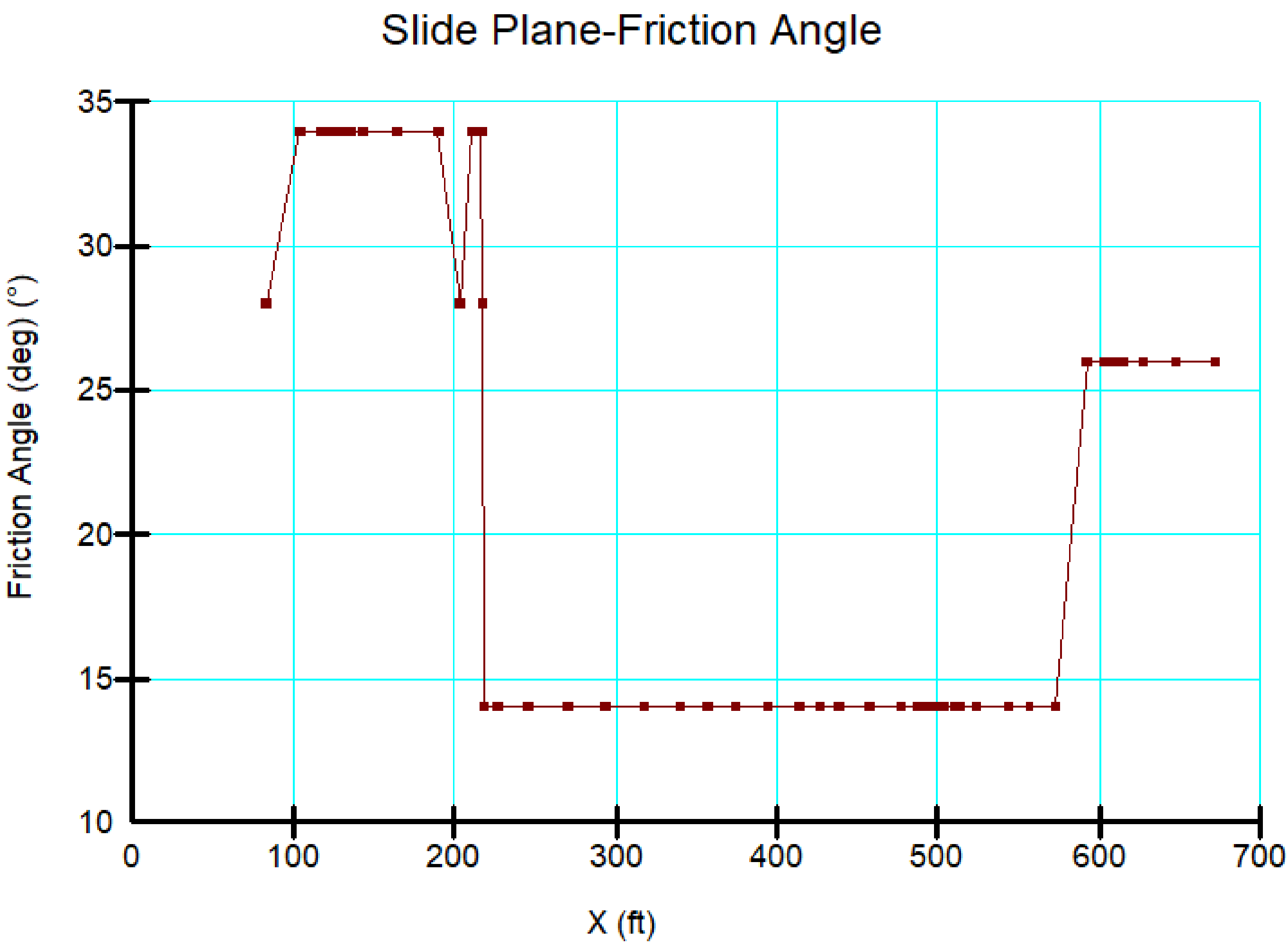
Existing Grade
Static Condition

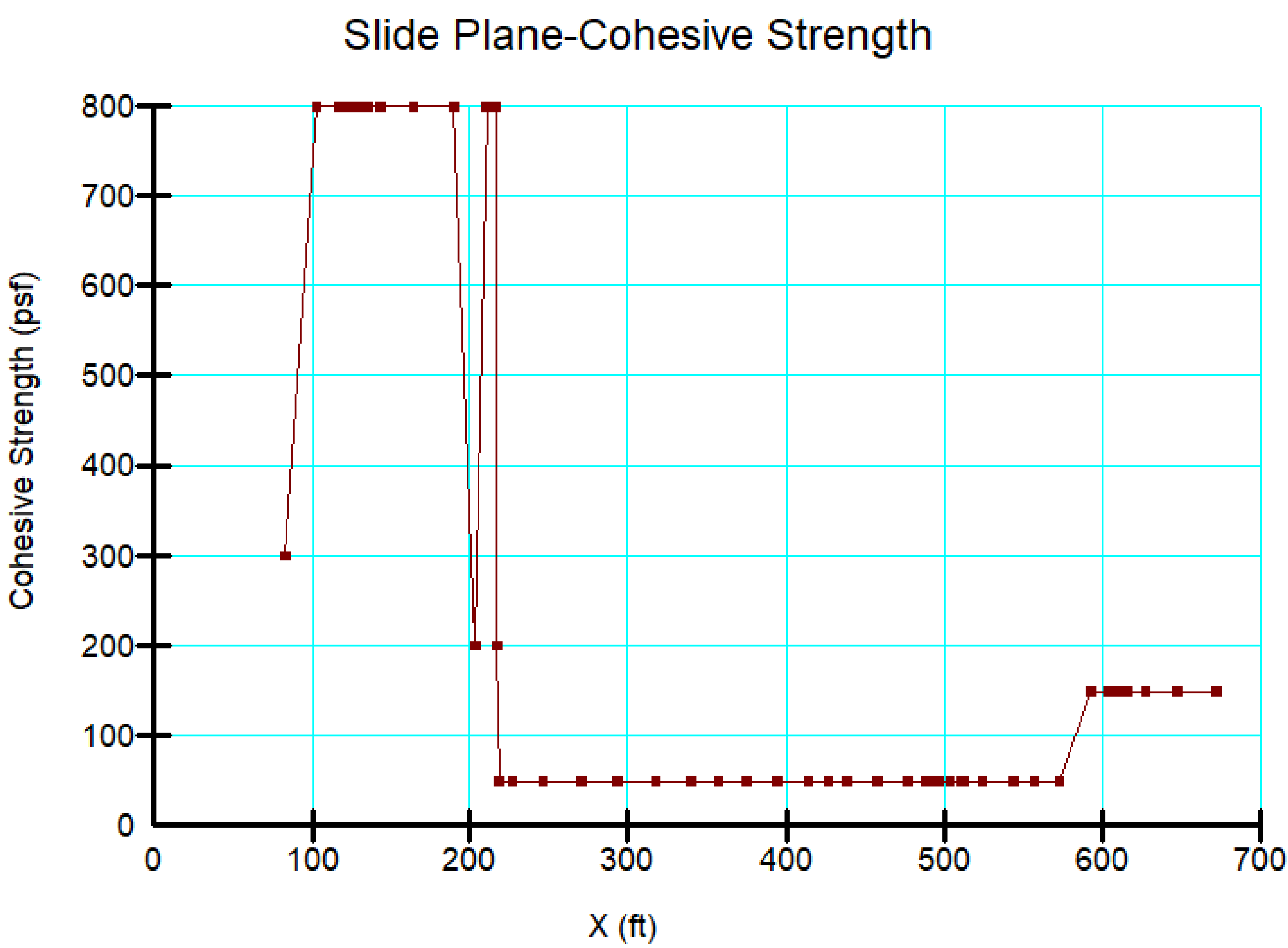
Olive Street
Project No. G3035-52-01
Name: 2-2'_Existing.gsz



Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\2-2' Geo Studio\File Name: 2-2'_Existing.gszDTime: 09:06:55 PMate: 08/12/2024

2-2'


Slide Plane-Friction Angle
Friction Angle (deg) (°)
35
30
25
20
15
10
0
100
200
300
400
500
600
700
X (ft)

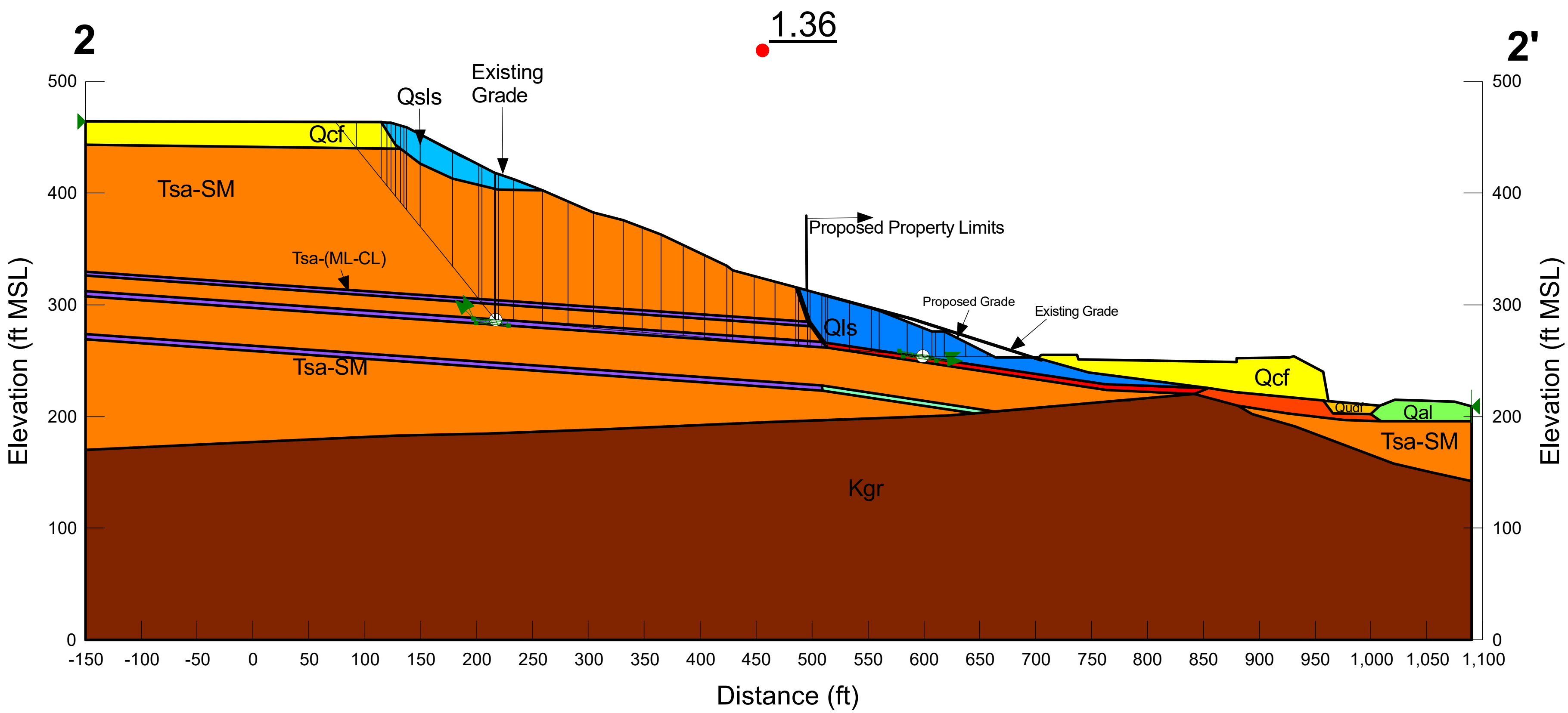

Slide Plane-Cohesive Strength
Cohesive Strength (psf)
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
X (ft)

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qcol	130	150	26		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Qsls	130	150	26		
	Qudf	130	300	28		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-ML 8 Deg	130	200	28	Phi-14, angle 8	Cohesion-50, angle 8
	Tsa-SM	130	800	34		

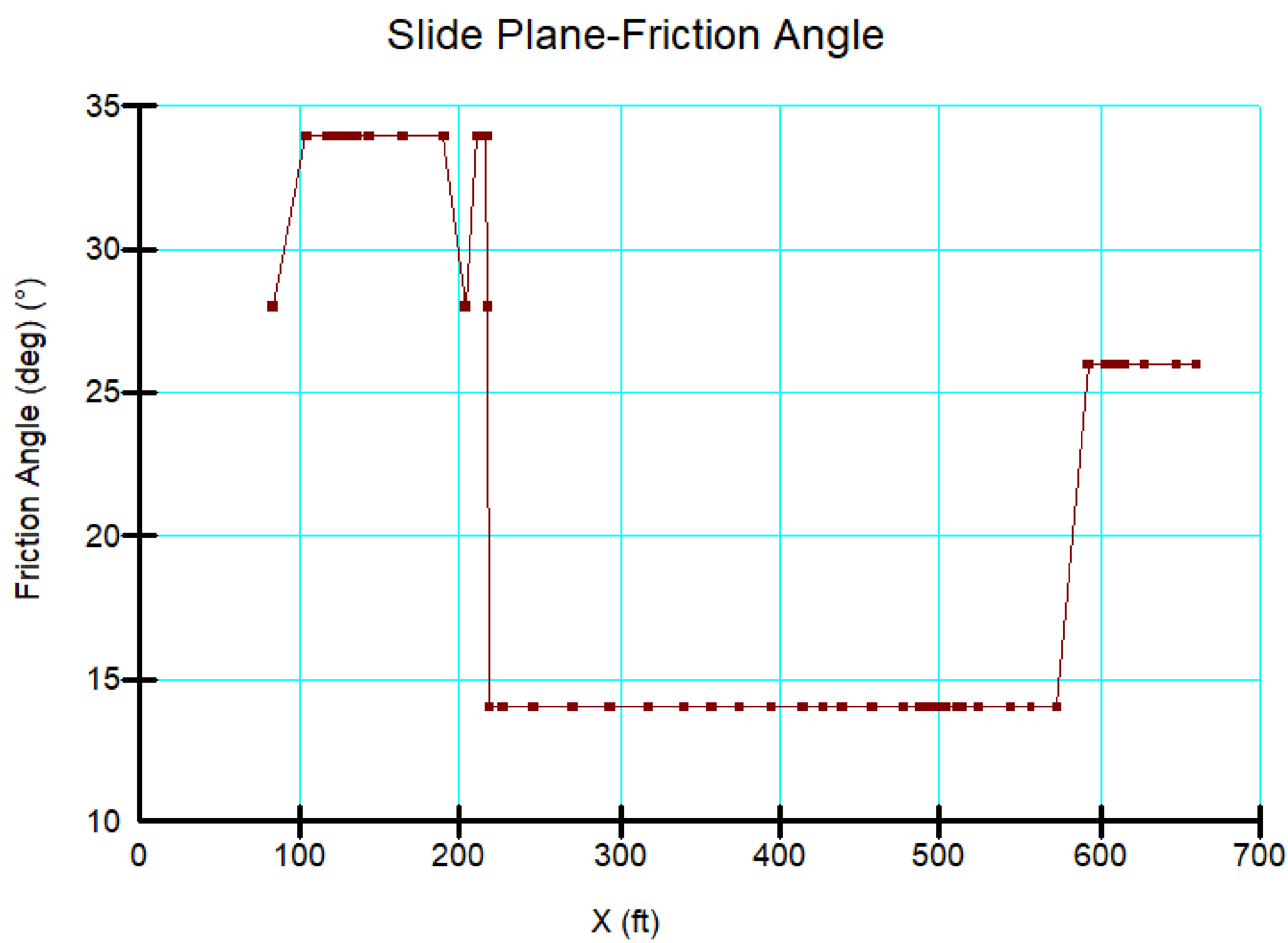
Proposed Grade
Static Condition

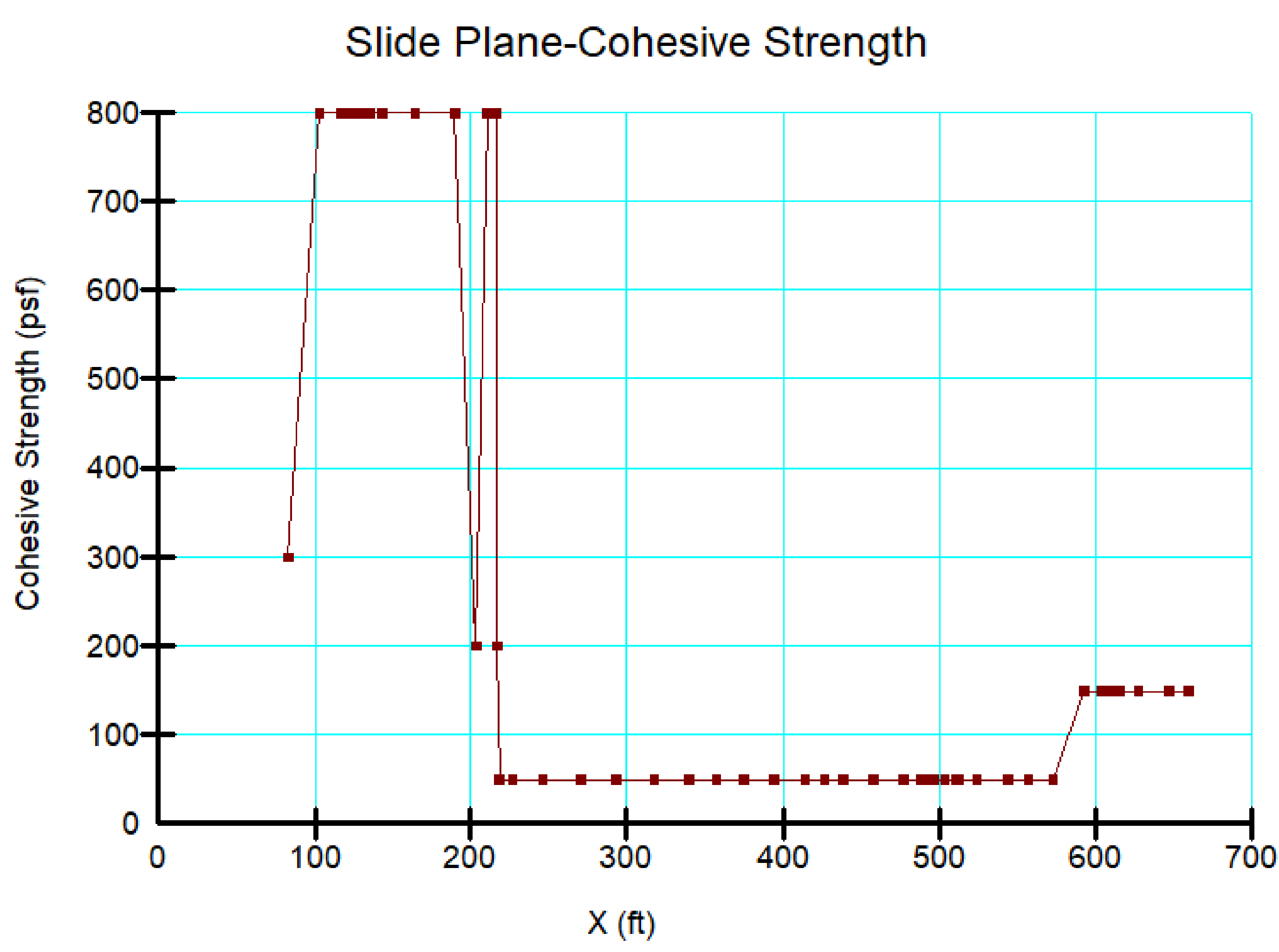
Olive Street
Project No. G3035-52-01
Name: Case 1_2-2'_Slide Plane.gsz



Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\2-2' Geo Studio\File Name: Case 1_2-2'_Slide Plane.gszDTime: 08:16:17 AMate: 07/29/2024

2-2'


Slide Plane-Friction Angle
Friction Angle (deg) (°)
35
30
25
20
15
10
0
100
200
300
400
500
600
700
X (ft)

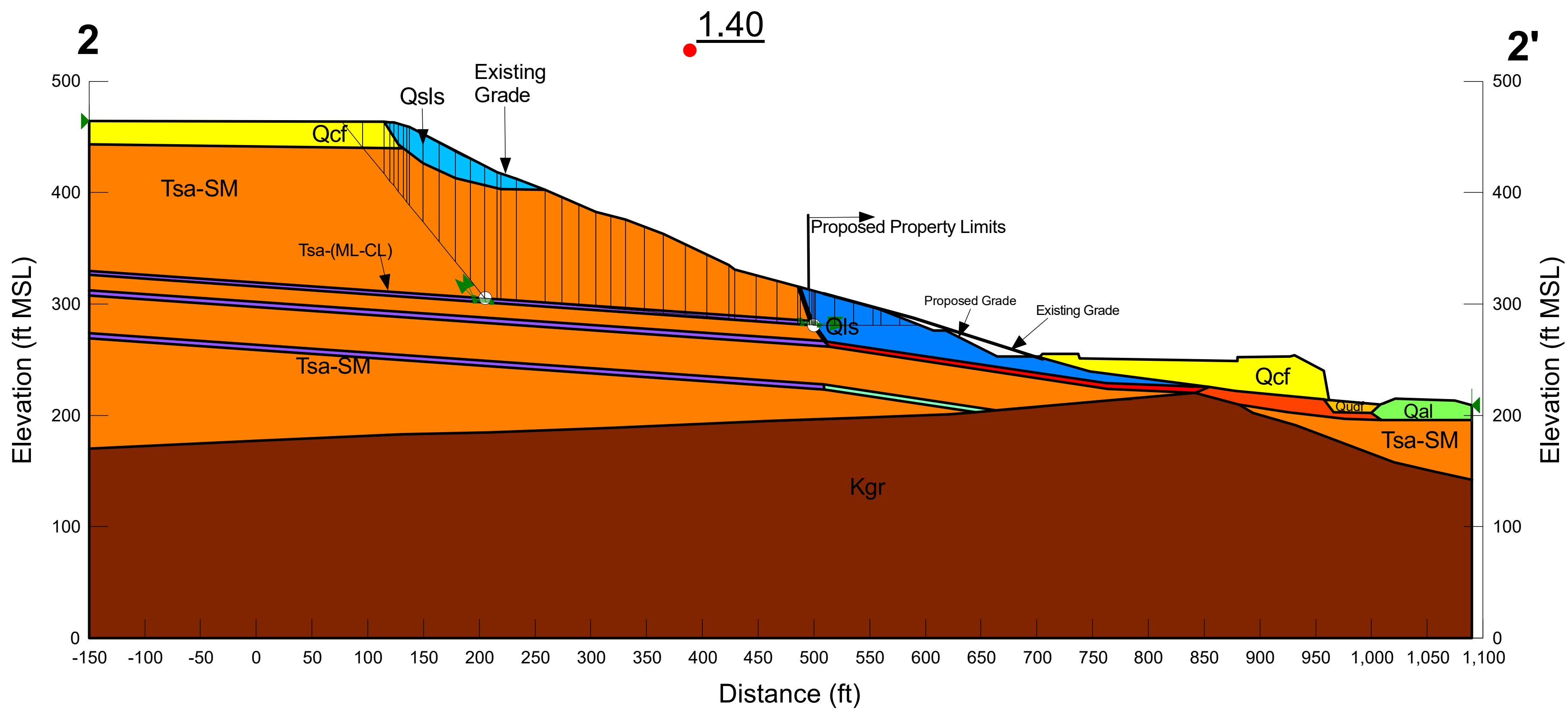

Slide Plane-Cohesive Strength
Cohesive Strength (psf)
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
X (ft)

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qcol	130	150	26		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Qsls	130	150	26		
	Qudf	130	300	28		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-ML 8 Deg	130	200	28	Phi-14, angle 8	Cohesion-50, angle 8
	Tsa-SM	130	800	34		

Proposed Grade
Static Condition

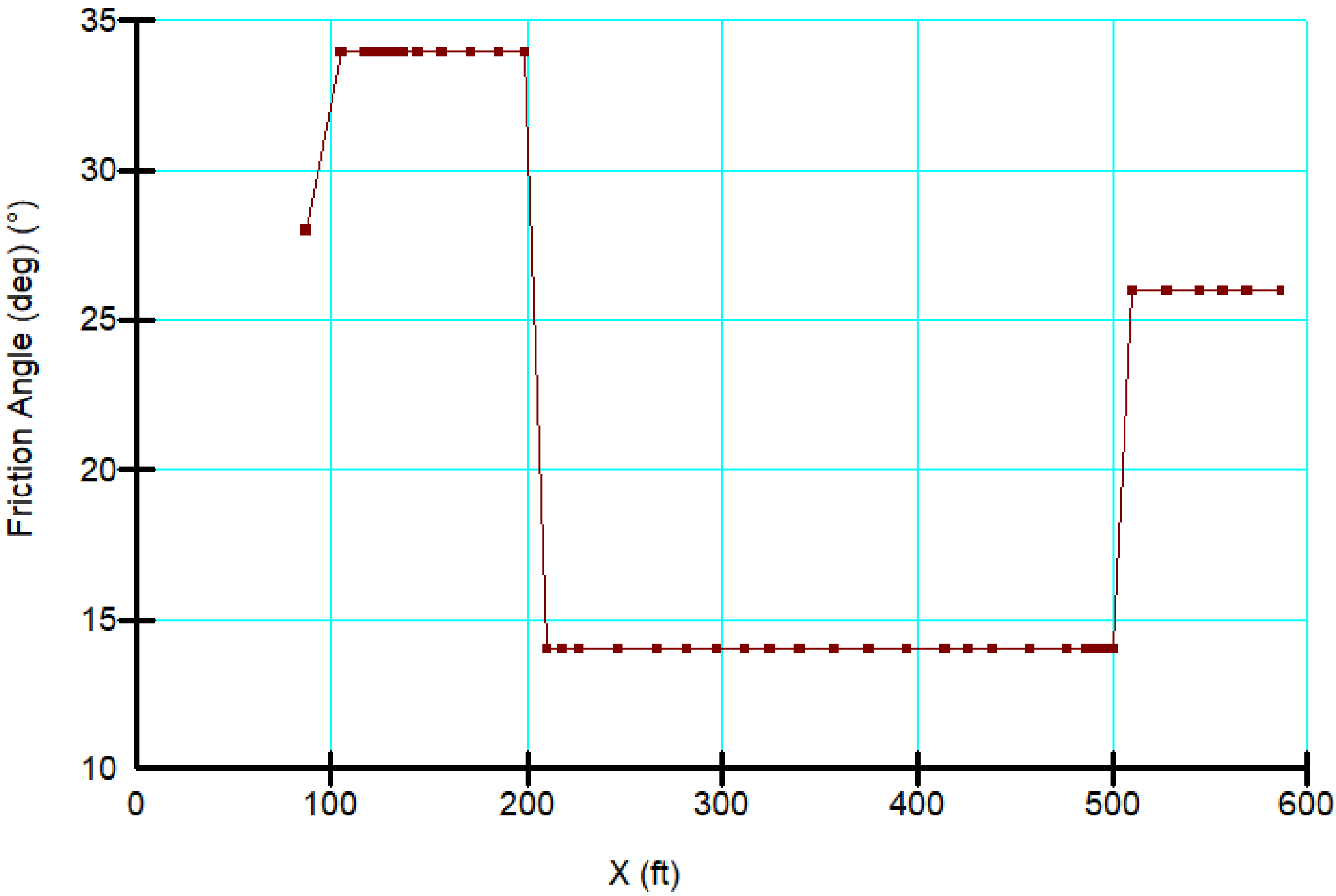
Olive Street
Project No. G3035-52-01
Name: Case 2_2-2'_Upper Plane.gsz



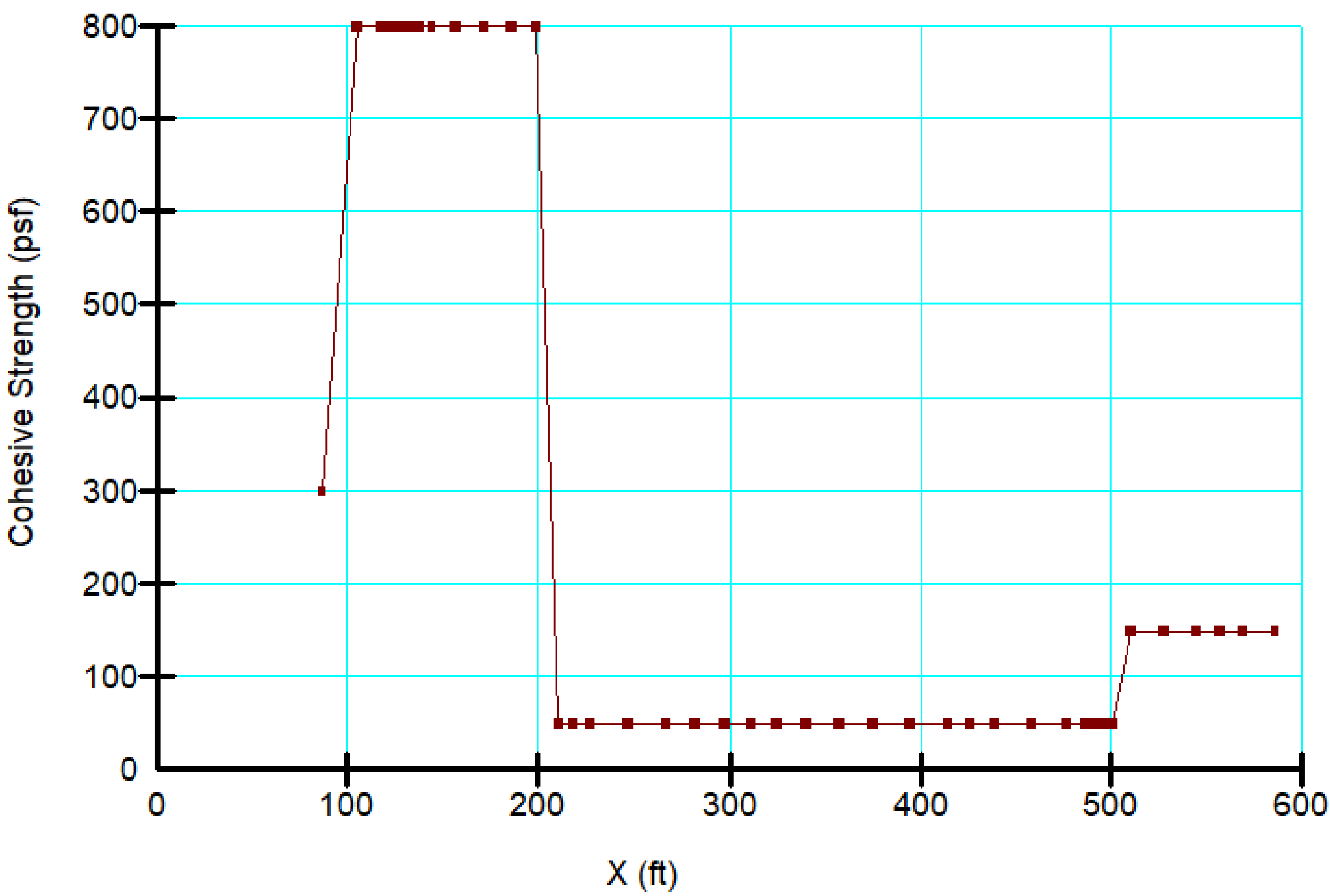
Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\2-2' Geo Studio\File Name: Case 2_2-2'_Upper Plane.gszDTime: 08:31:32 AMate: 07/29/2024

2-2'

Upper Plane-Friction Angle



Upper Plane-Cohesive Strength

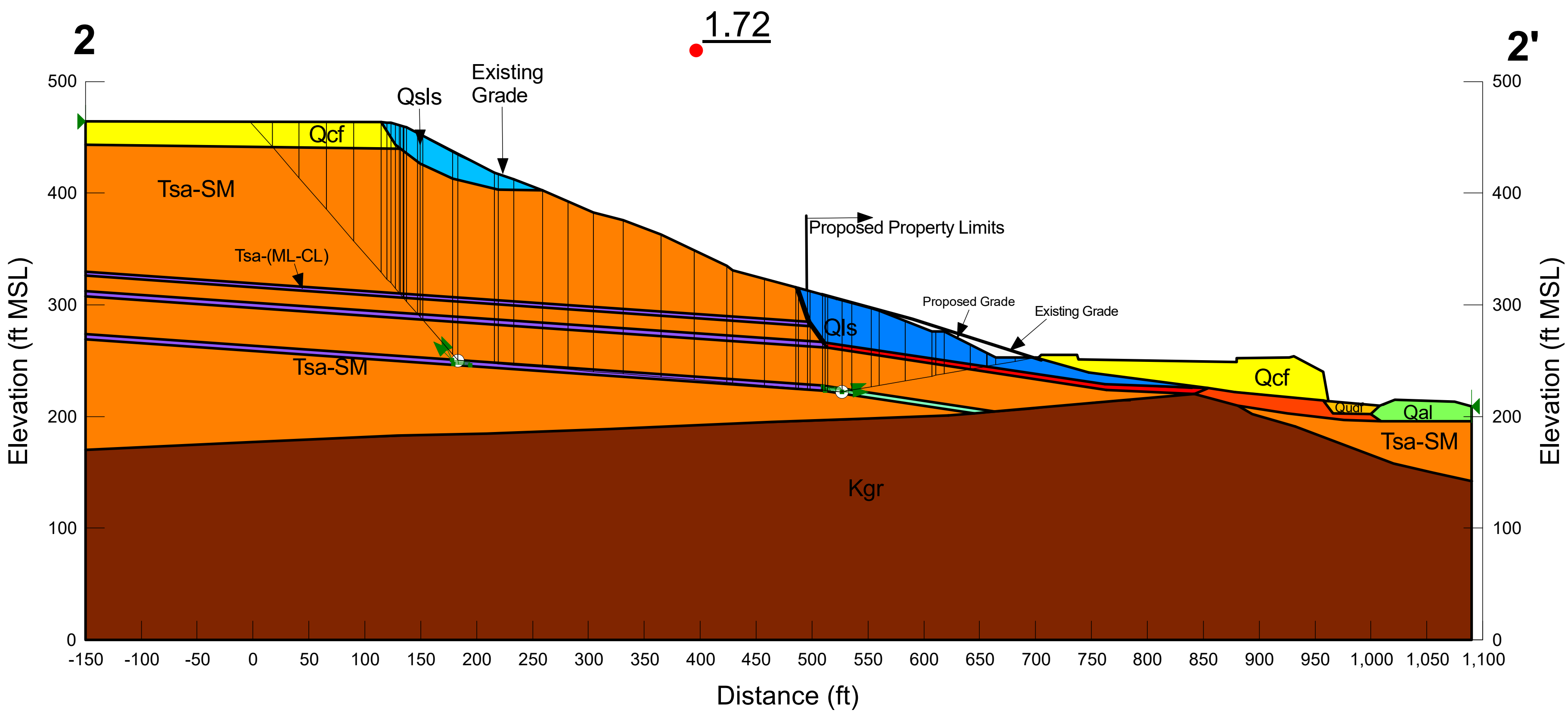


Material Properties:

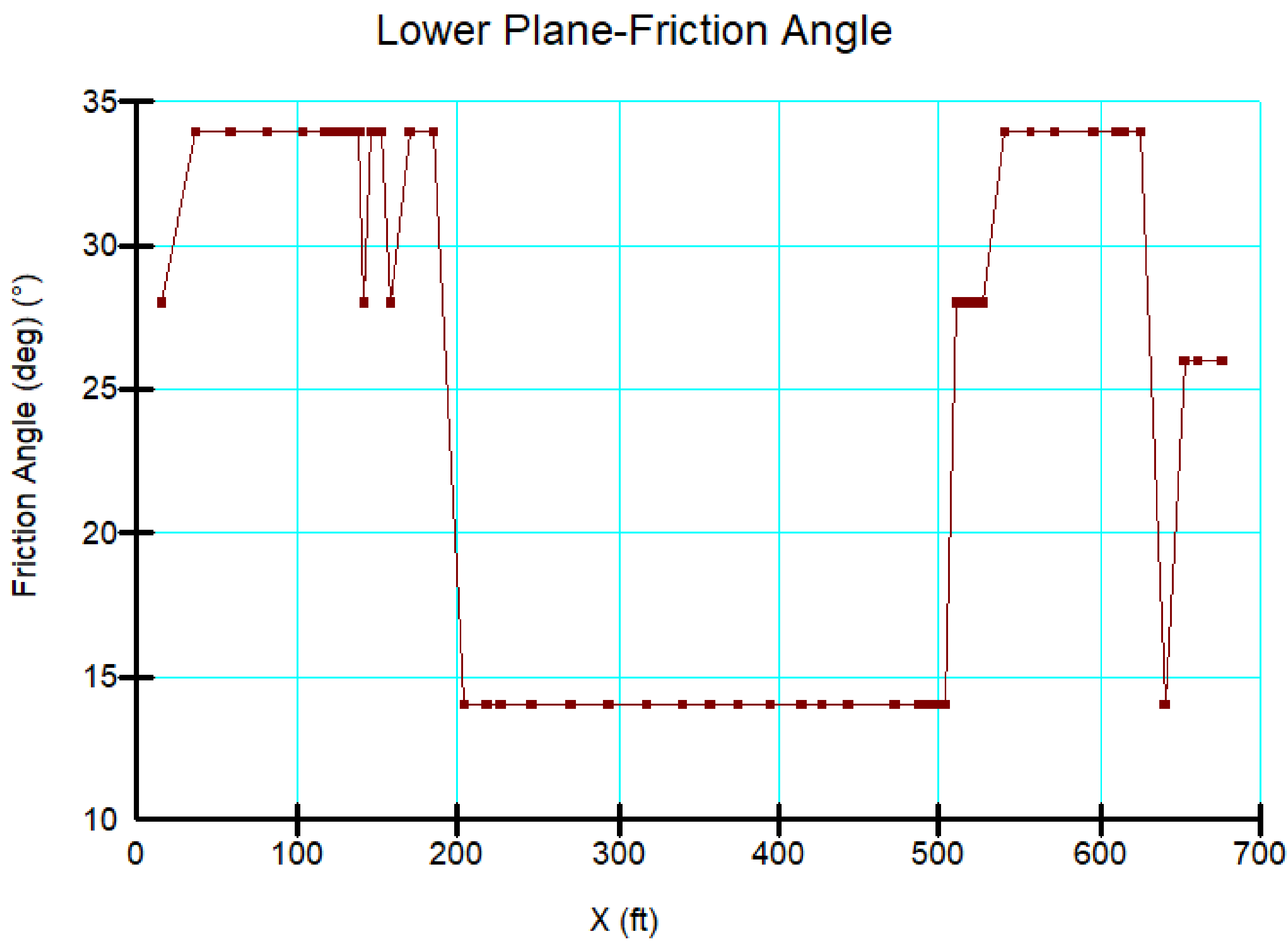
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qcol	130	150	26		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Qsls	130	150	26		
	Qudf	130	300	28		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-ML 8 Deg	130	200	28	Phi-14, angle 8	Cohesion-50, angle 8
	Tsa-SM	130	800	34		

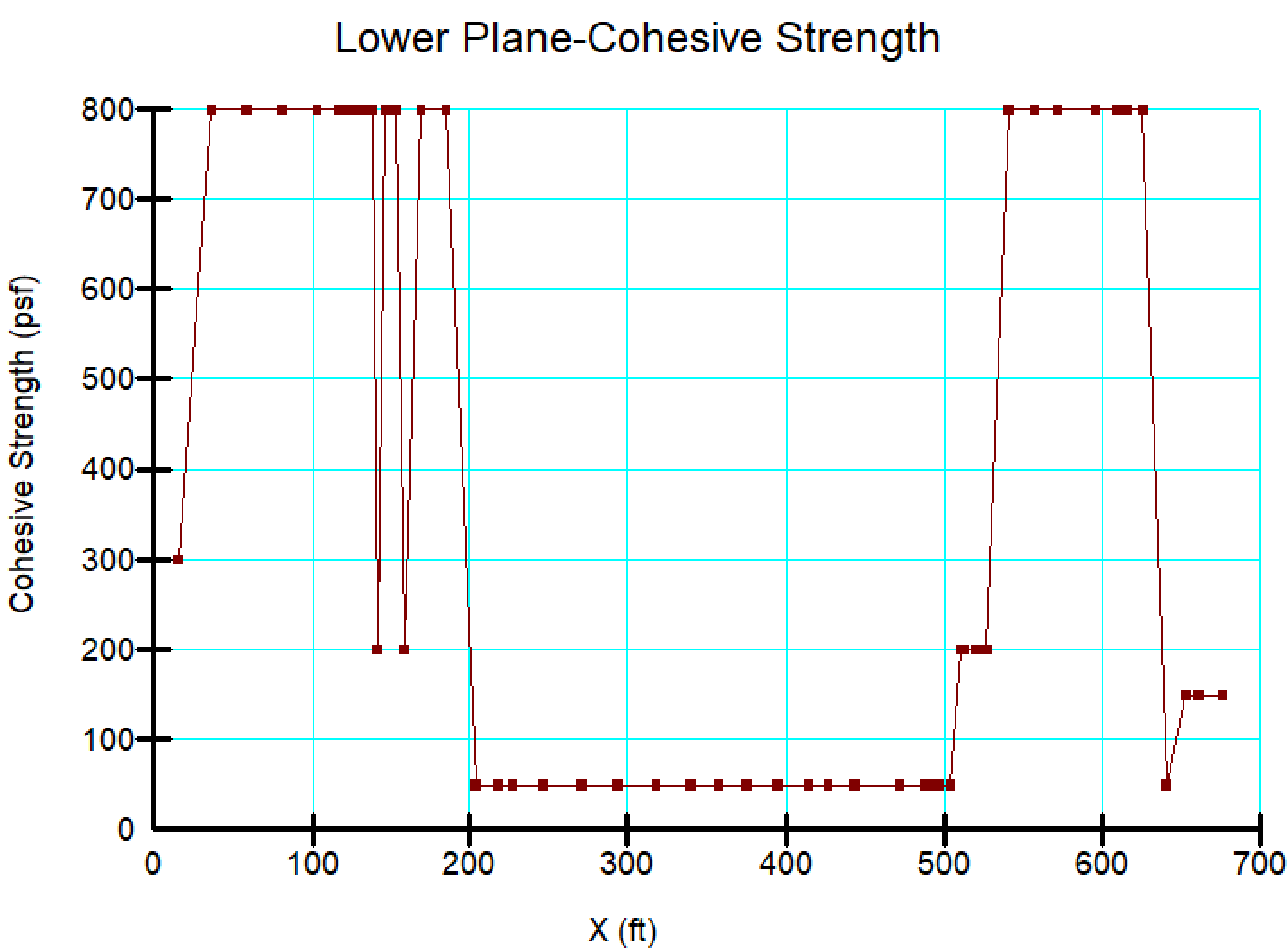
Proposed Grade
Static Condition

Olive Street
Project No. G3035-52-01
Name: Case 3_2-2'_Lower Plane.gsz



2-2'


Lower Plane-Friction Angle
Friction Angle (deg) (°)
35
30
25
20
15
10
0
100
200
300
400
500
600
700
X (ft)

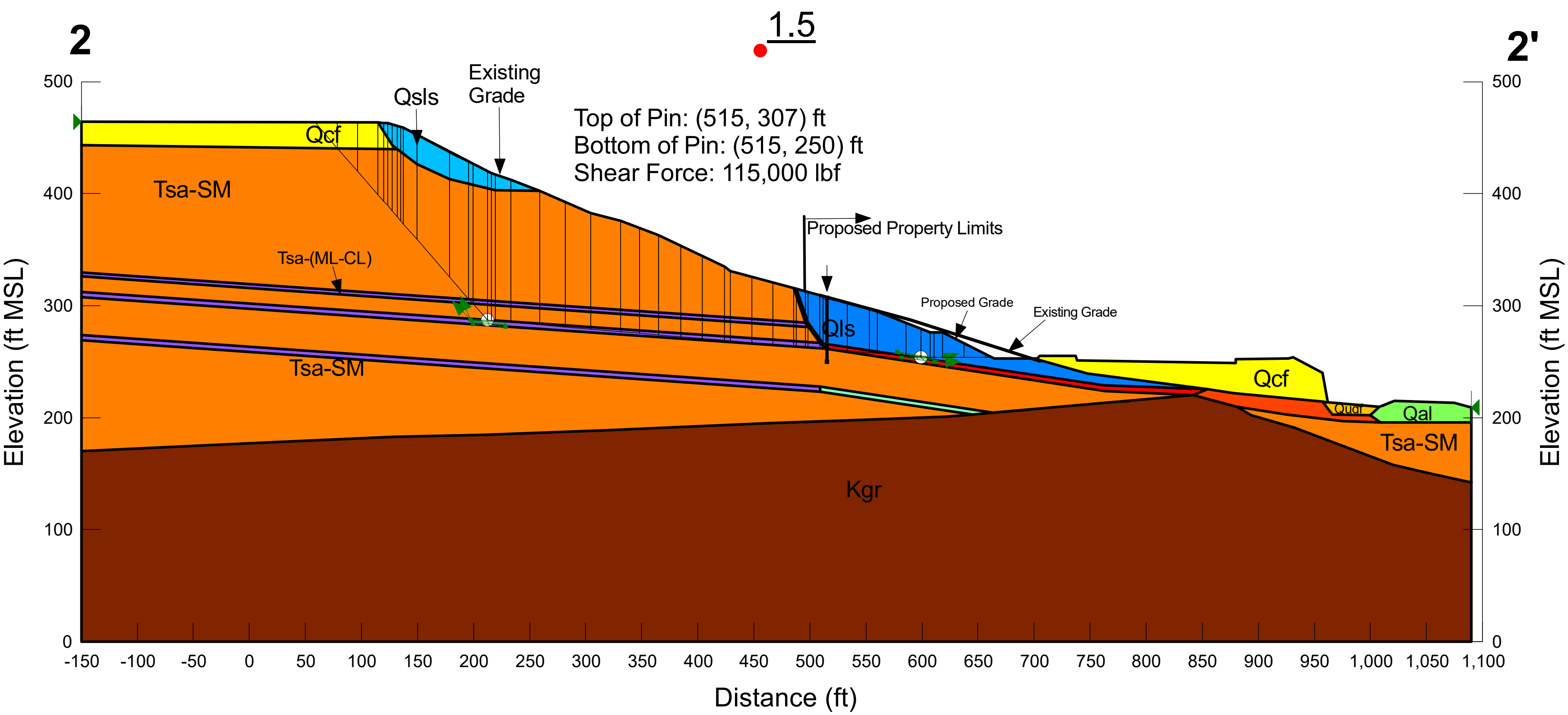

Lower Plane-Cohesive Strength
Cohesive Strength (psf)
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
X (ft)

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qcol	130	150	26		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Qsls	130	150	26		
	Qudf	130	300	28		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-ML 8 Deg	130	200	28	Phi-14, angle 8	Cohesion-50, angle 8
	Tsa-SM	130	800	34		

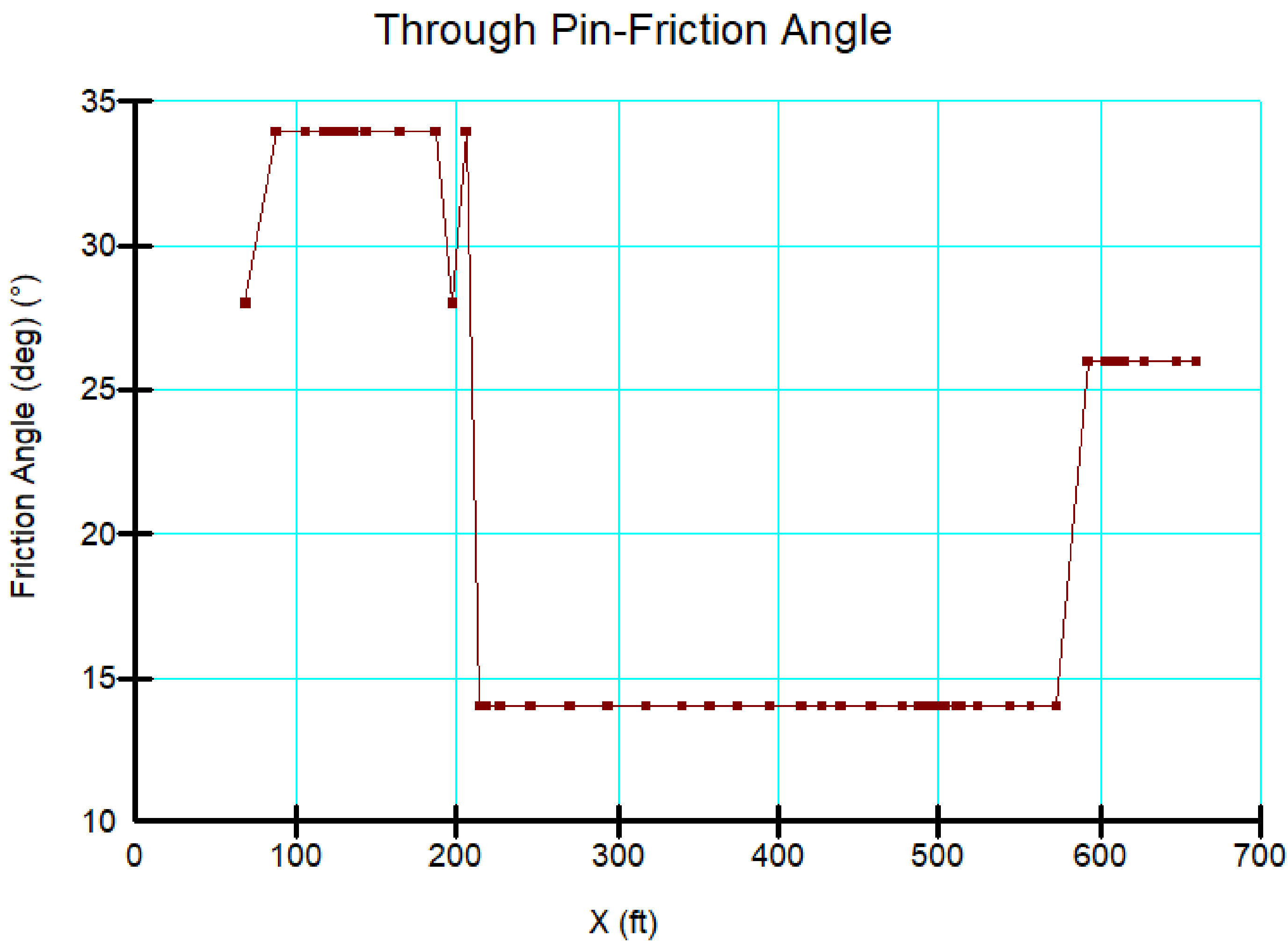
Proposed Grade
Static Condition

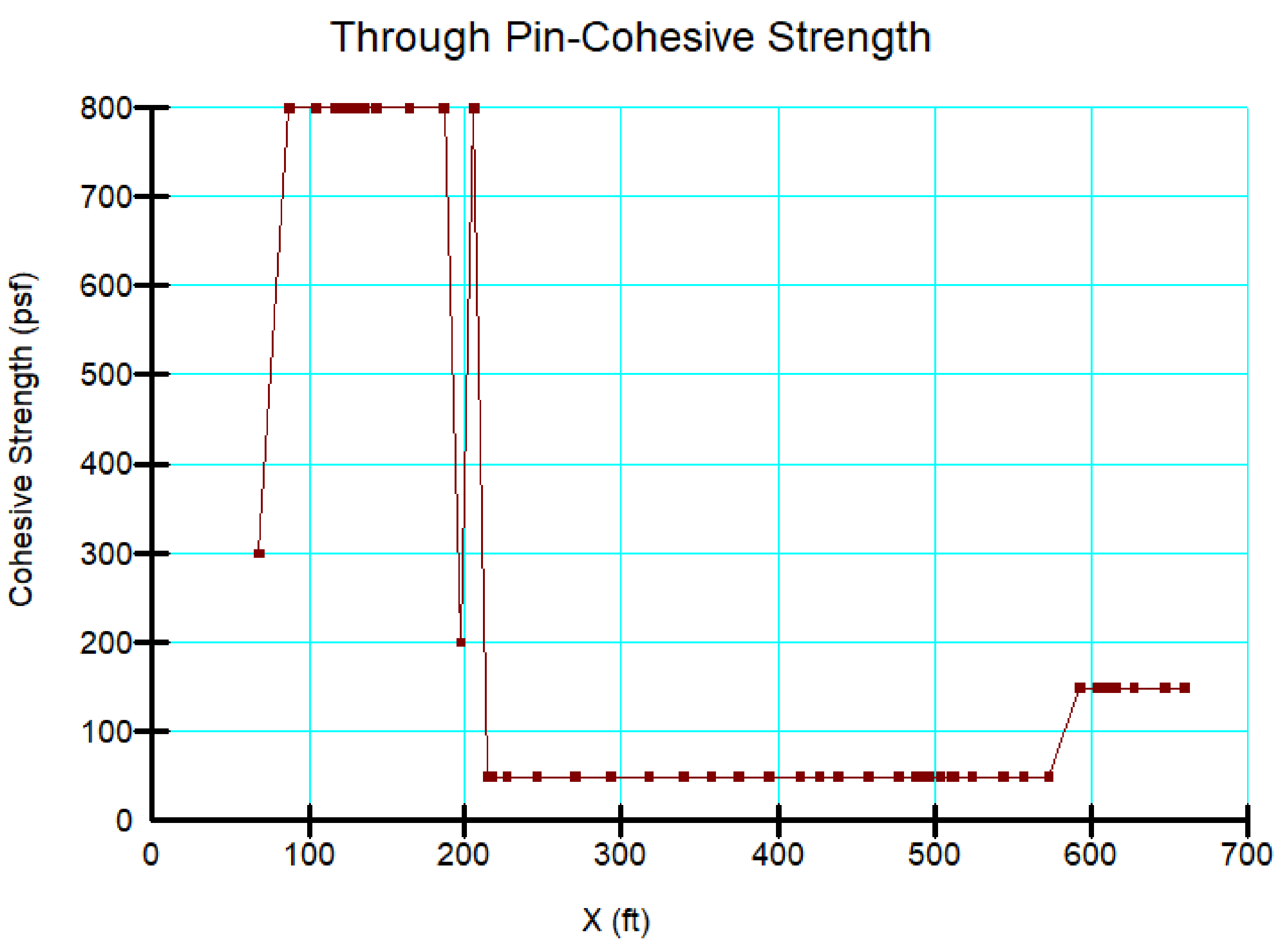
Olive Street
Project No. G3035-52-01
Name: Case 4_2-2'_Through Pin.gsz



Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\2-2' Geo Studio\File Name: Case 4_2-2'_Through Pin.gszDTime: 08:32:25 AMate: 08/09/2024

2-2'


Through Pin-Friction Angle
Friction Angle (deg) (°)
35
30
25
20
15
10
0
100
200
300
400
500
600
700
X (ft)

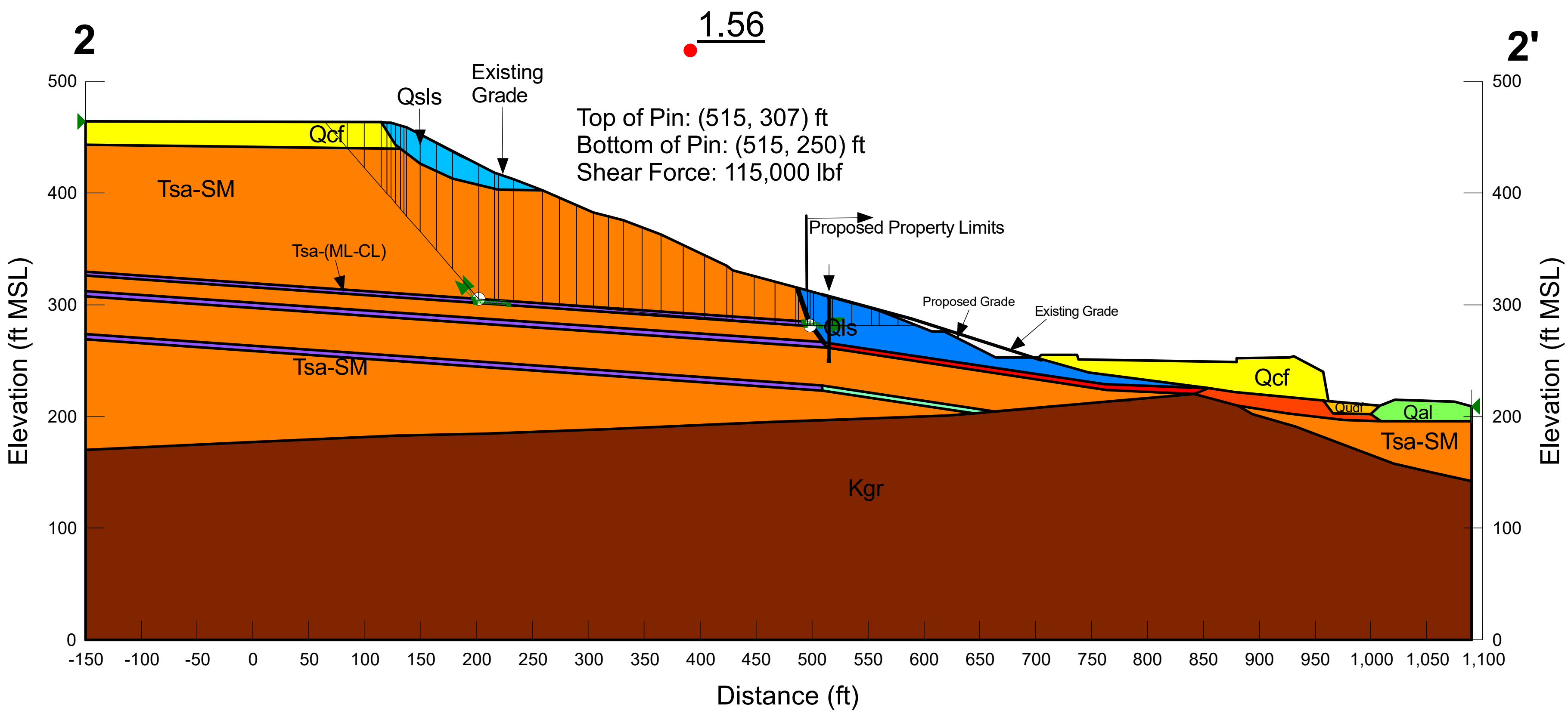

Through Pin-Cohesive Strength
Cohesive Strength (psf)
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
X (ft)

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qcol	130	150	26		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Qsls	130	150	26		
	Qudf	130	300	28		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-ML 8 Deg	130	200	28	Phi-14, angle 8	Cohesion-50, angle 8
	Tsa-SM	130	800	34		

Proposed Grade
Static Condition

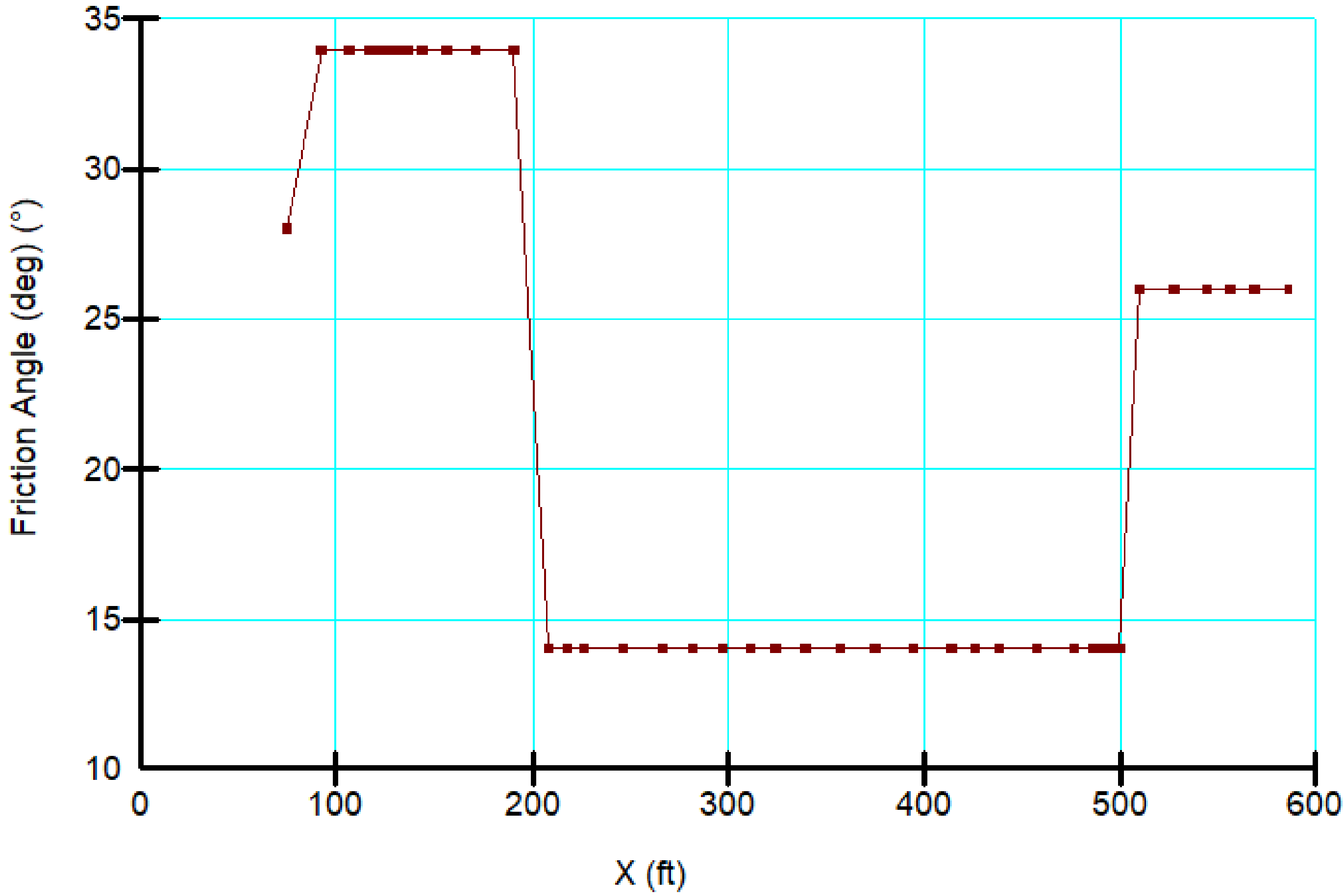
Olive Street
Project No. G3035-52-01
Name: Case 5_2-2'_Behind Pin-Upper.gsz



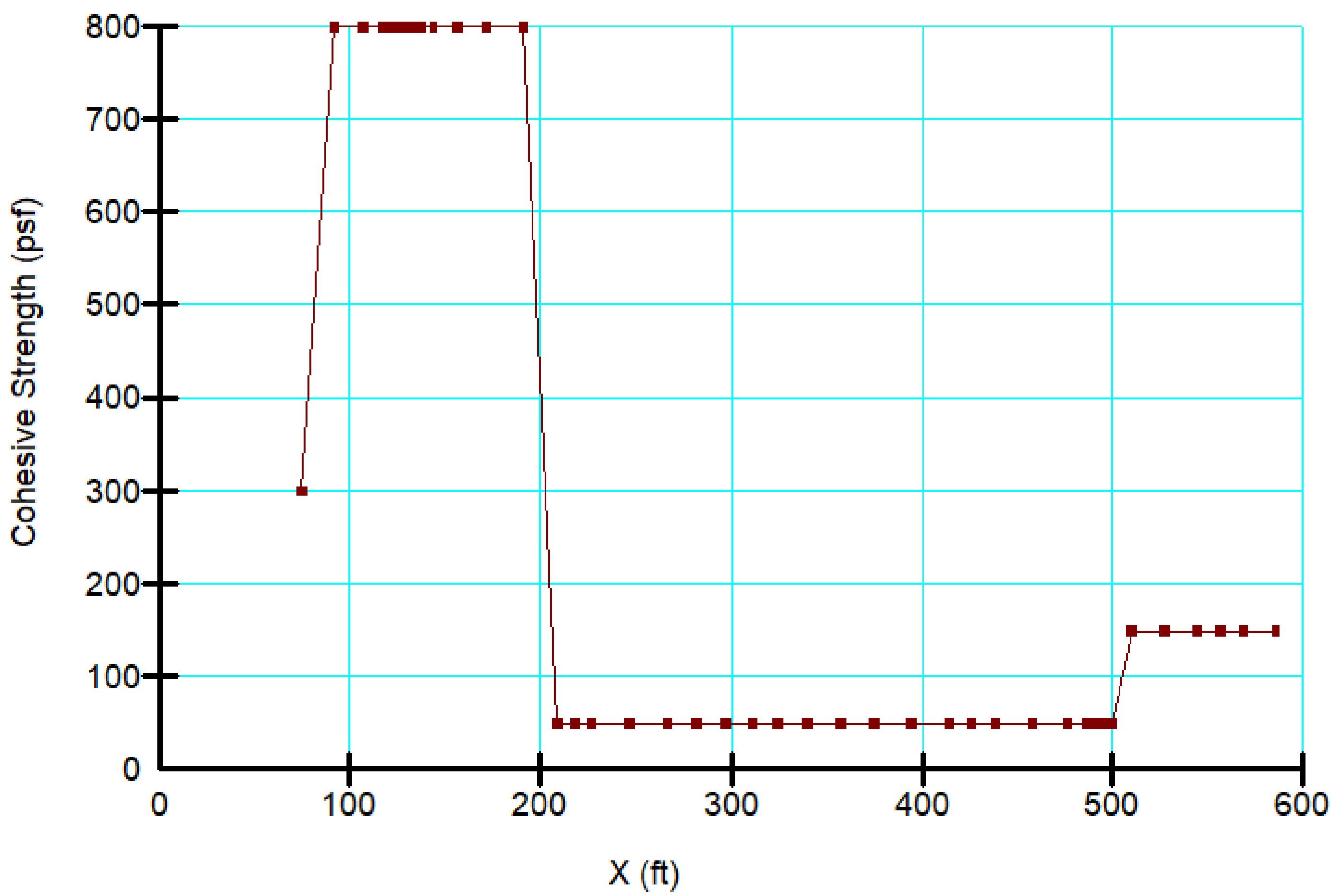
Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\2-2' Geo Studio\File Name: Case 5_2-2'_Behind Pin-Upper.gszDTime: 08:35:04 AMate: 08/09/2024

2-2'

Behind Pin UP-Friction Angle



Behind Pin UP-Cohesive Strength

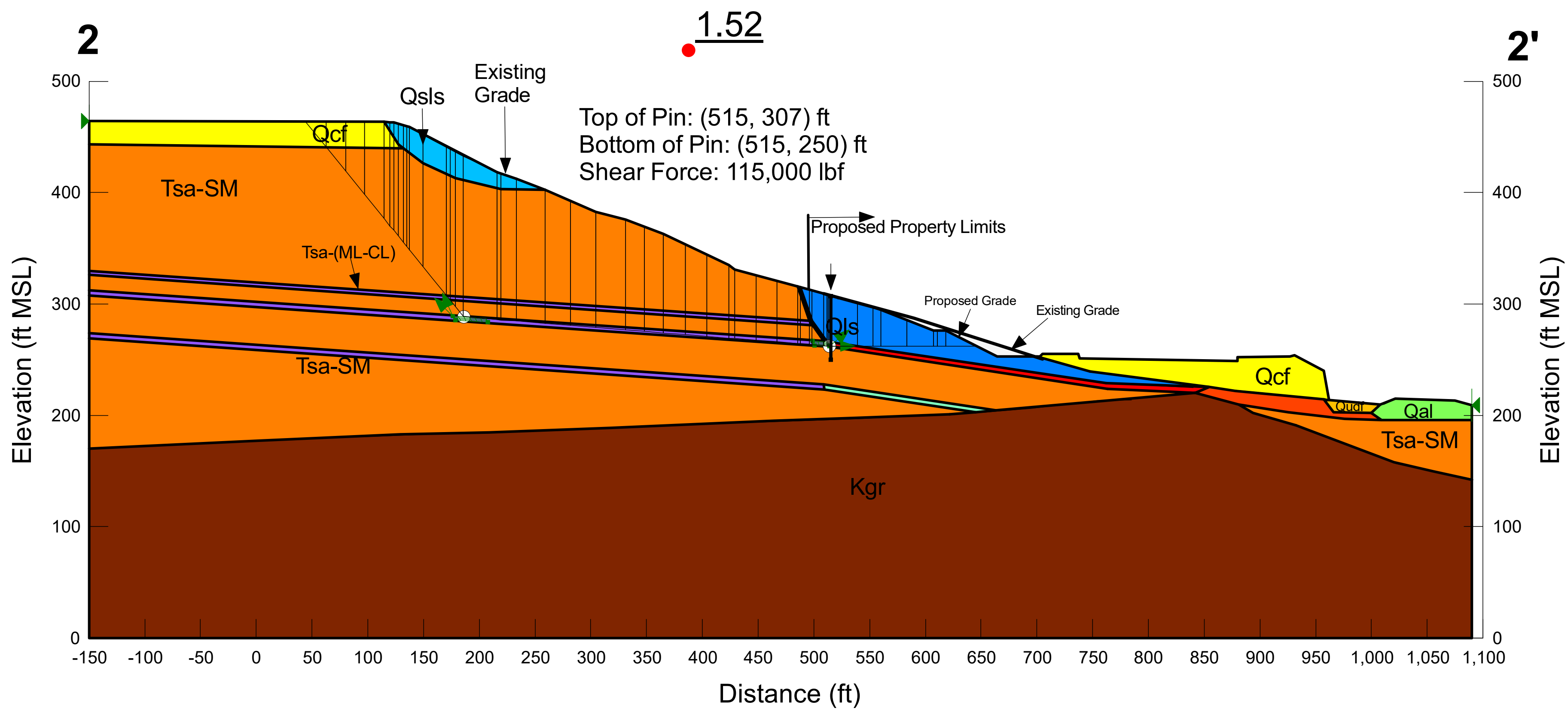


Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qcol	130	150	26		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Qsls	130	150	26		
	Qudf	130	300	28		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-ML 8 Deg	130	200	28	Phi-14, angle 8	Cohesion-50, angle 8
	Tsa-SM	130	800	34		

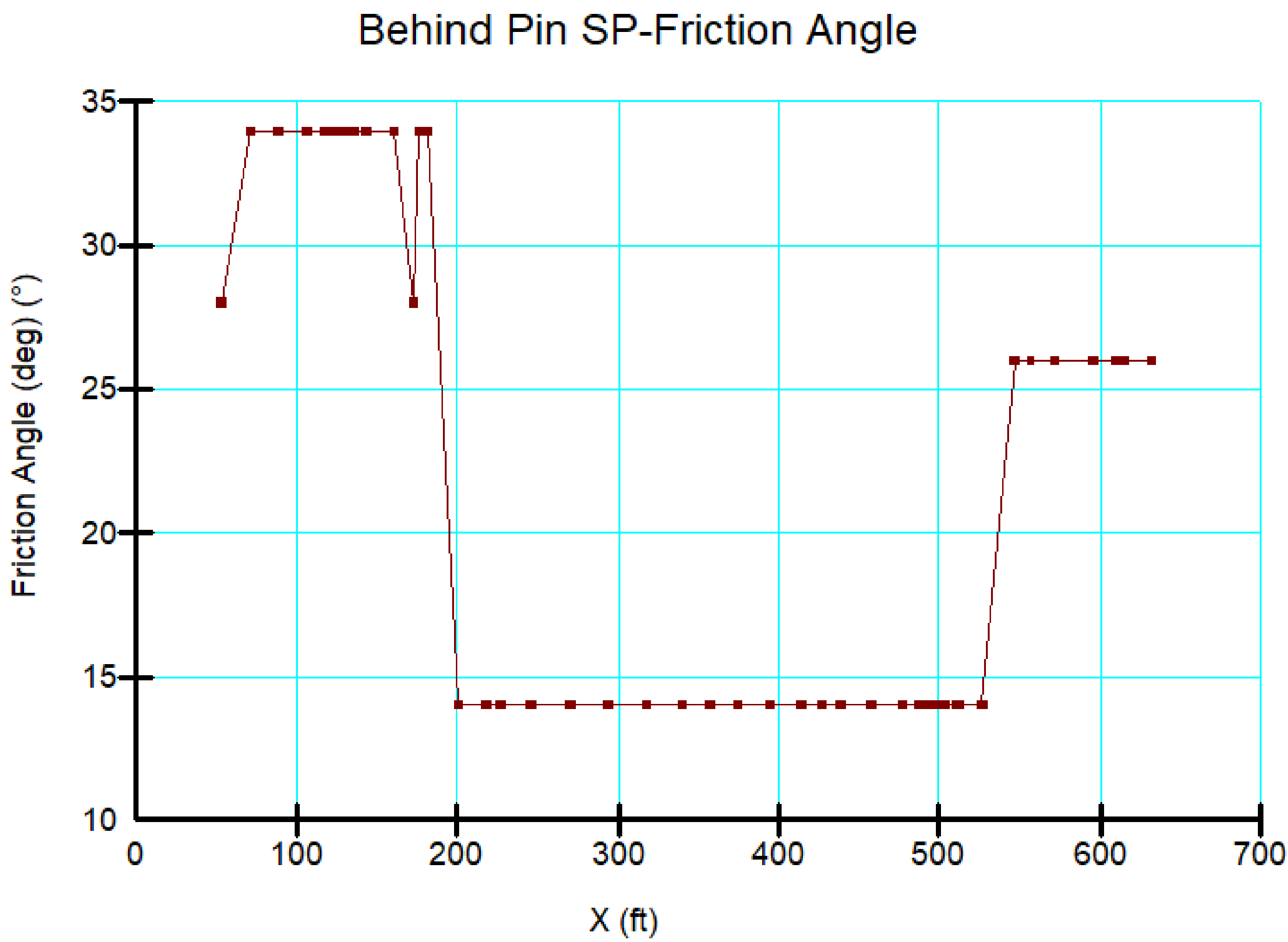
Proposed Grade
Static Condition

Olive Street
Project No. G3035-52-01
Name: Case 6_2-2'_Behind Pin-Slide Plane.gsz

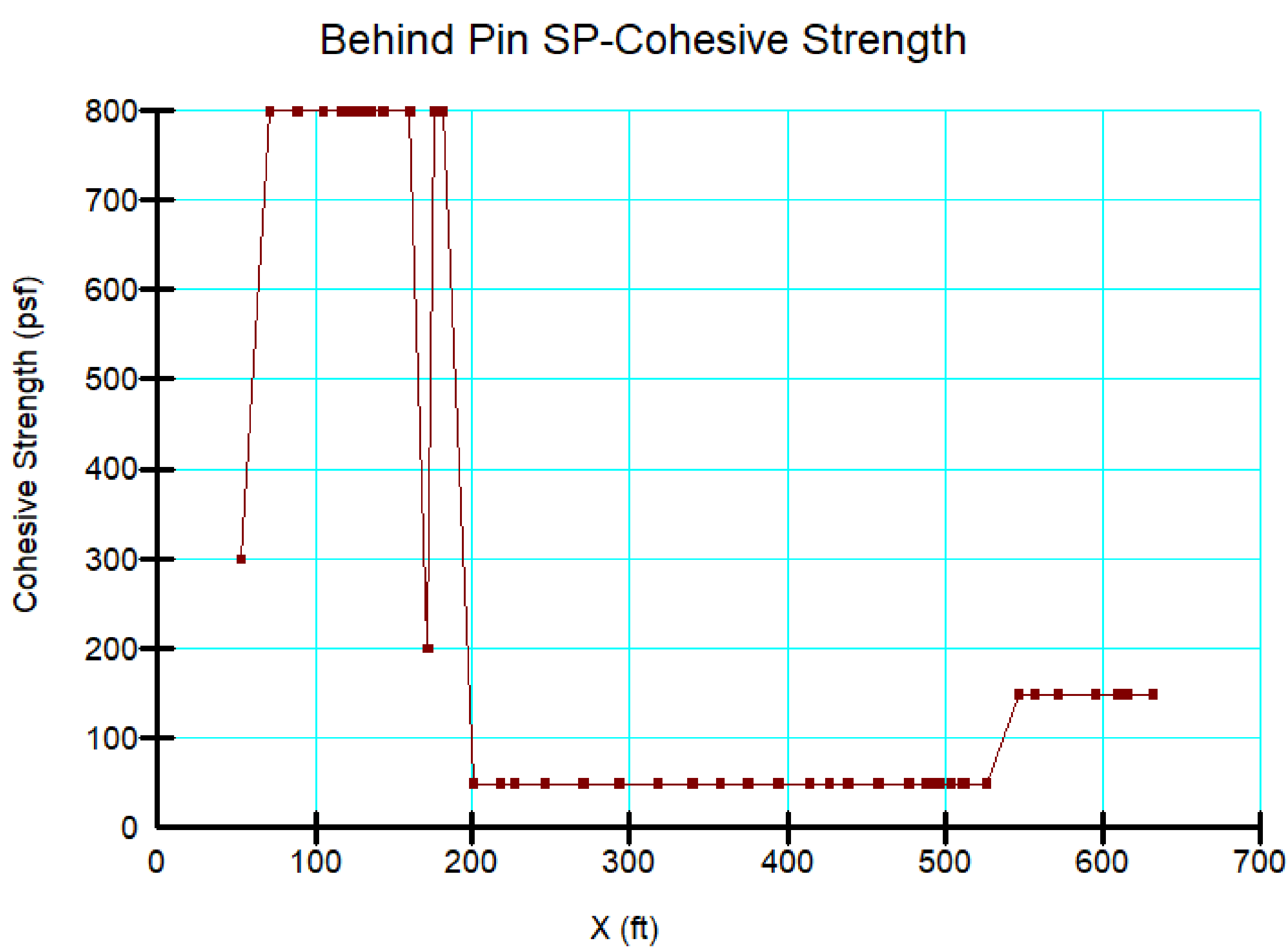


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\2-2' Geo Studio\File Name: Case 6_2-2'_Behind Pin-Slide Plane.gszDTime: 08:37:10 AMate: 08/09/2024

2-2'



Behind Pin SP-Friction Angle
Friction Angle (deg) (°)
35
30
25
20
15
10
0
100
200
300
400
500
600
700
X (ft)



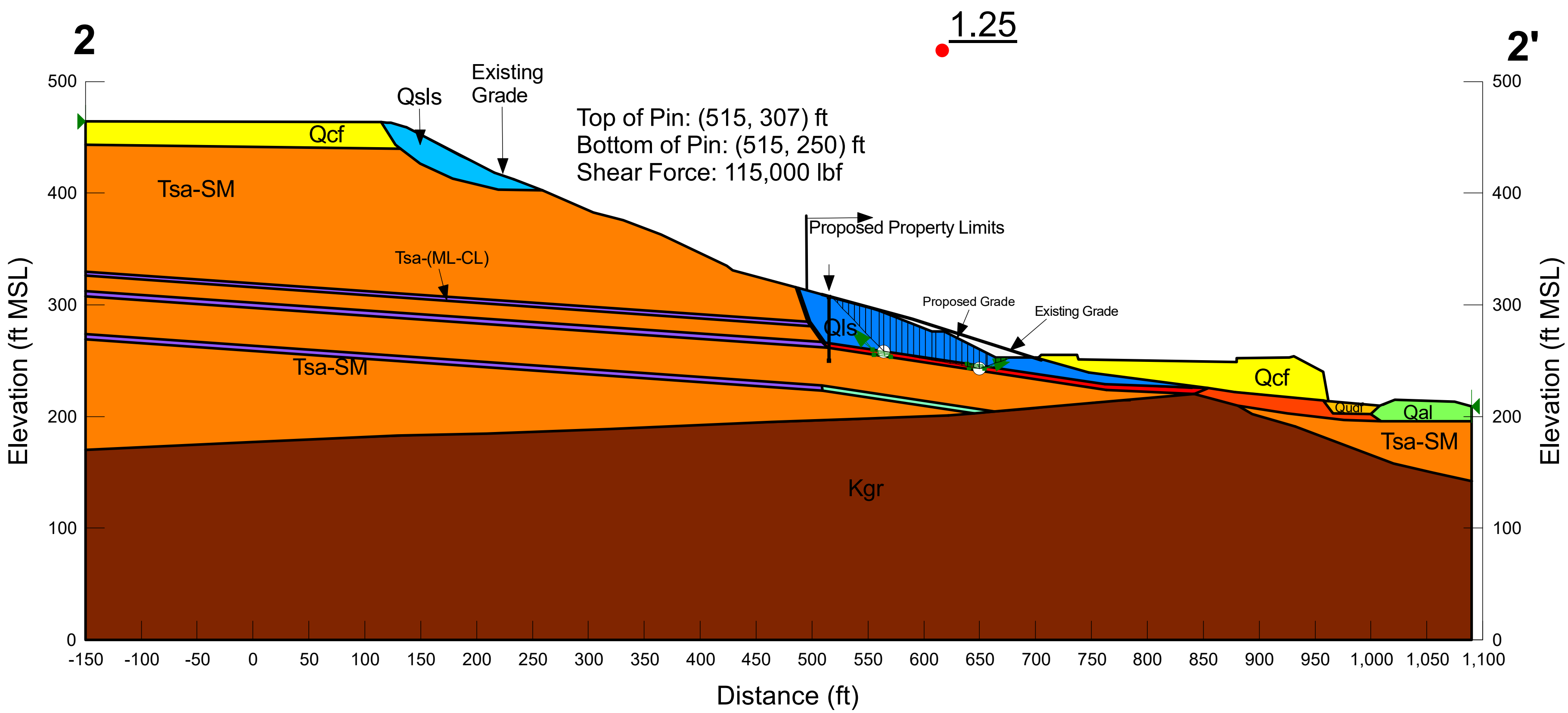
Behind Pin SP-Cohesive Strength
Cohesive Strength (psf)
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
X (ft)

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qcol	130	150	26		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Qsls	130	150	26		
	Qudf	130	300	28		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-ML 8 Deg	130	200	28	Phi-14, angle 8	Cohesion-50, angle 8
	Tsa-SM	130	800	34		

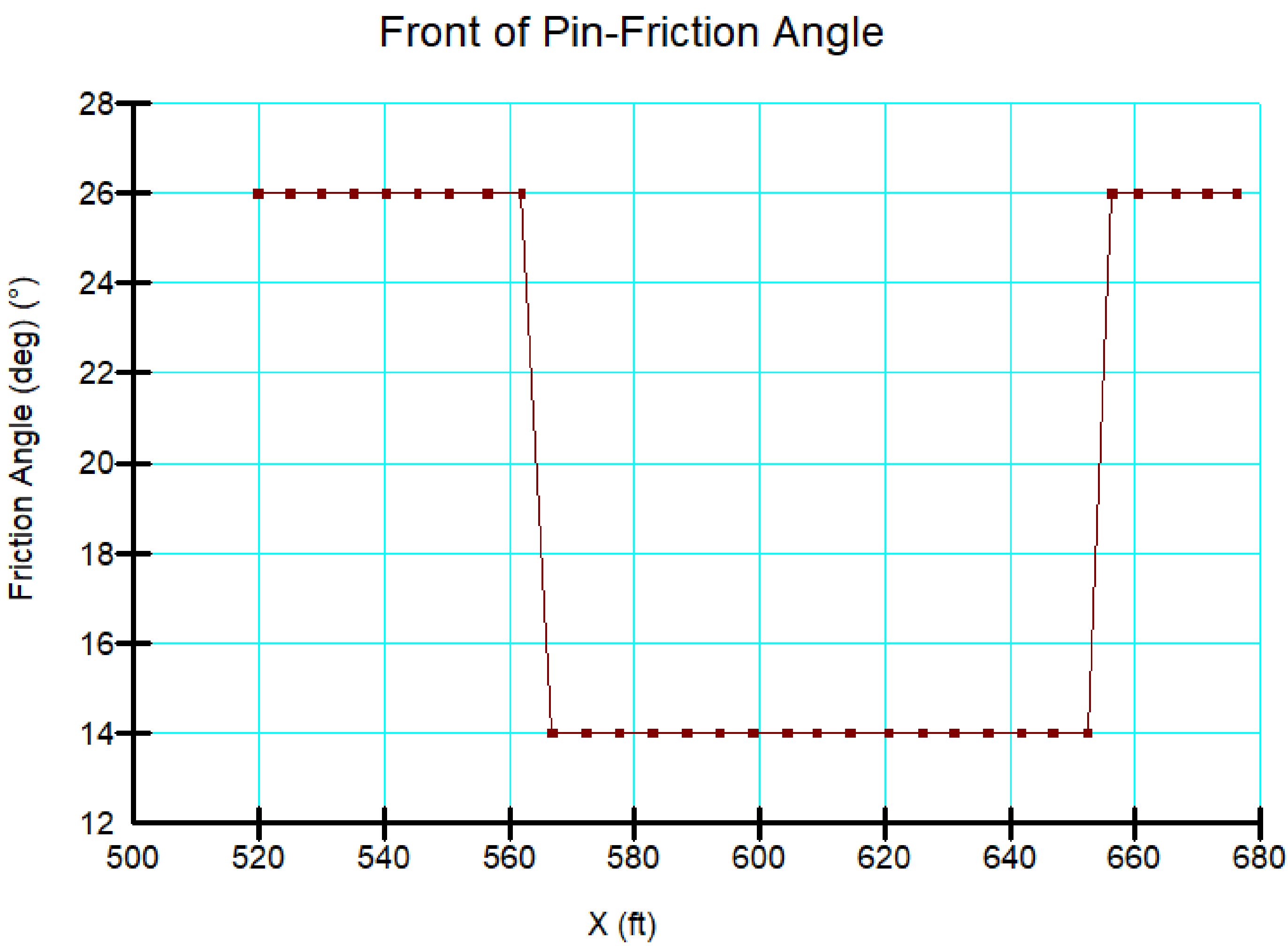
Proposed Grade
Static Condition

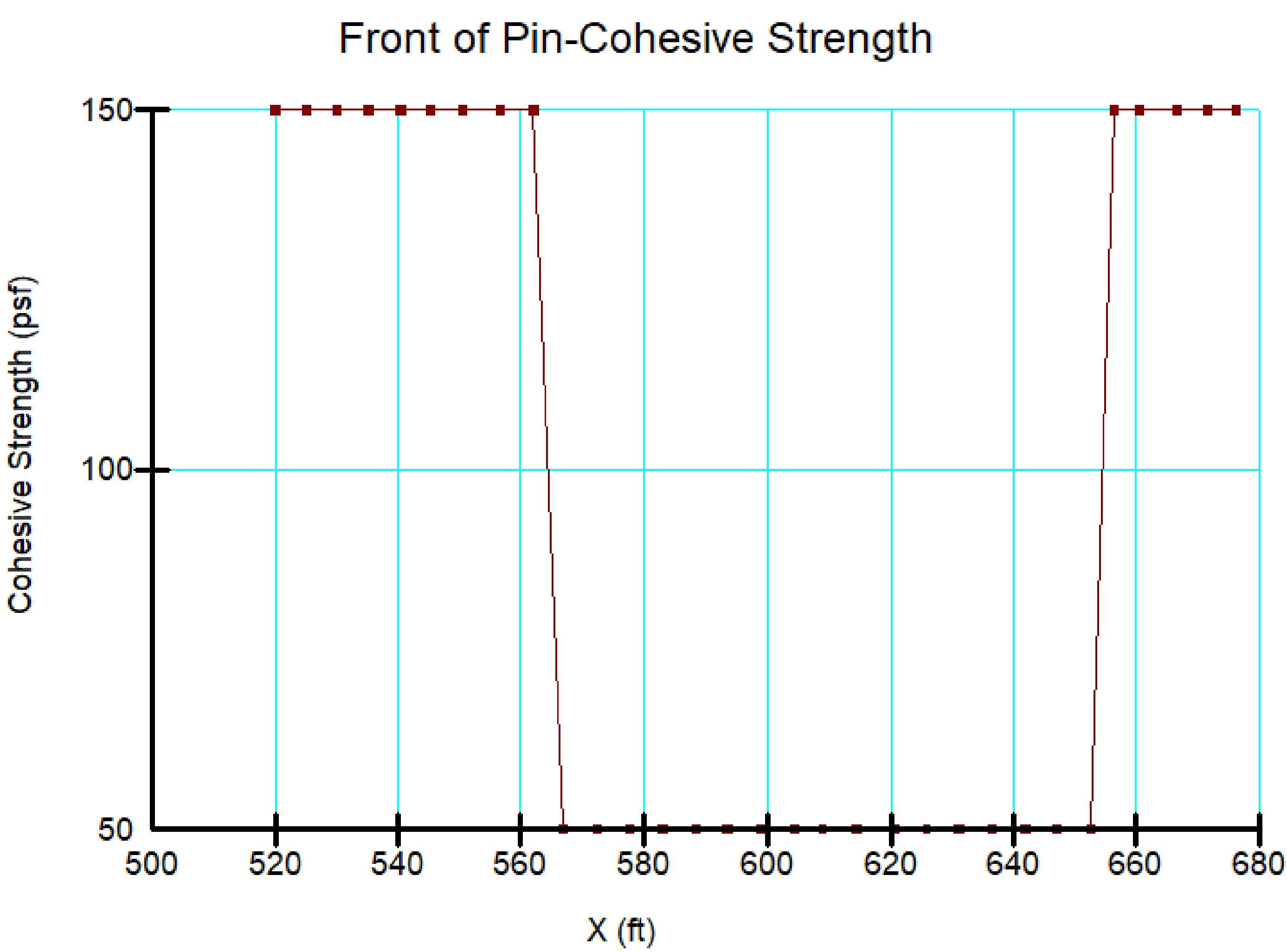
Olive Street
Project No. G3035-52-01
Name: Case 7_2-2'-Front of Pin.gsz



Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\2-2' Geo Studio\File Name: Case 7_2-2'-Front of Pin.gszDTime: 08:42:42 AMate: 08/09/2024

2'


Front of Pin-Friction Angle
Friction Angle (deg) (°)
28
26
24
22
20
18
16
14
12
500
520
540
560
580
600
620
640
660
680
X (ft)

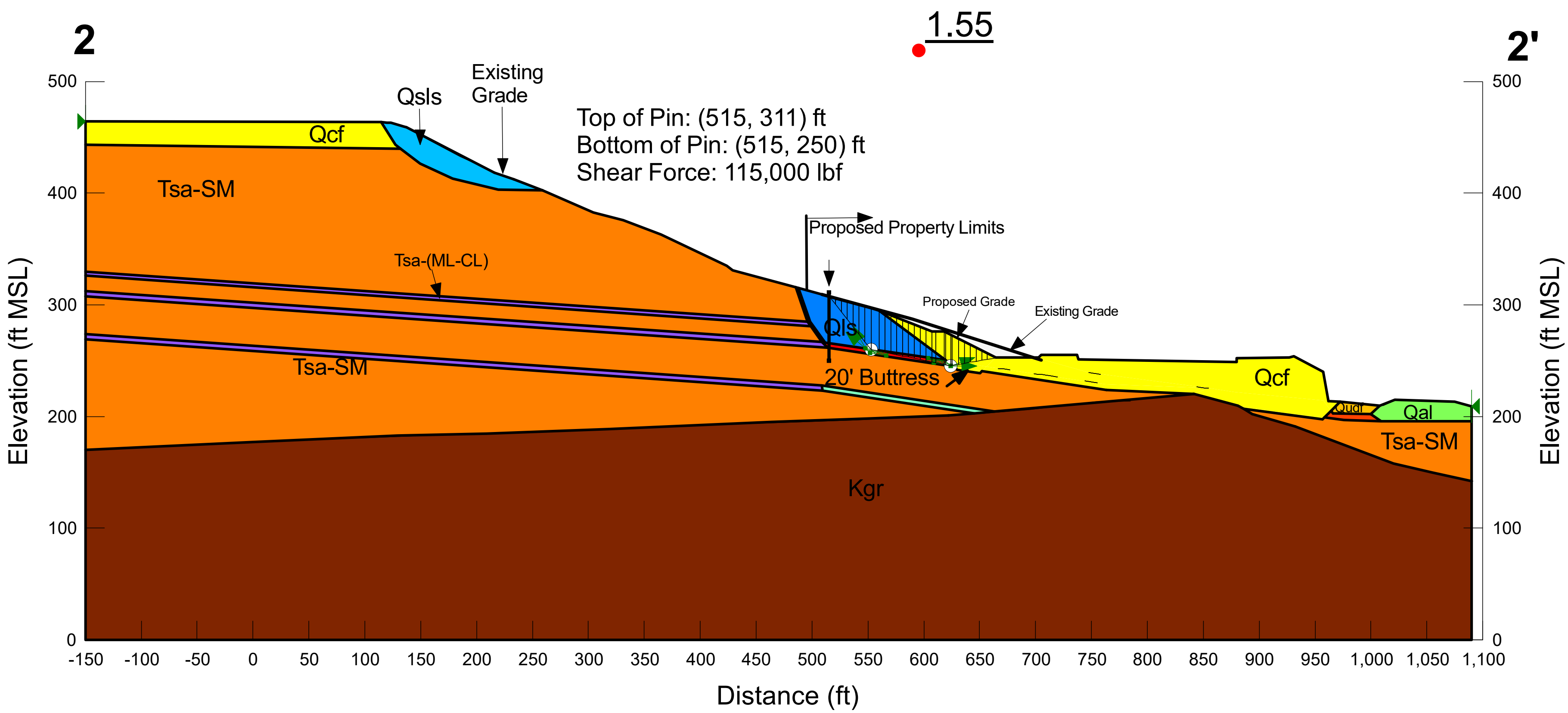

Front of Pin-Cohesive Strength
Cohesive Strength (psf)
150
100
50
500
520
540
560
580
600
620
640
660
680
X (ft)

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qcol	130	150	26		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Qsls	130	150	26		
	Qudf	130	300	28		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-ML 8 Deg	130	200	28	Phi-14, angle 8	Cohesion-50, angle 8
	Tsa-SM	130	800	34		

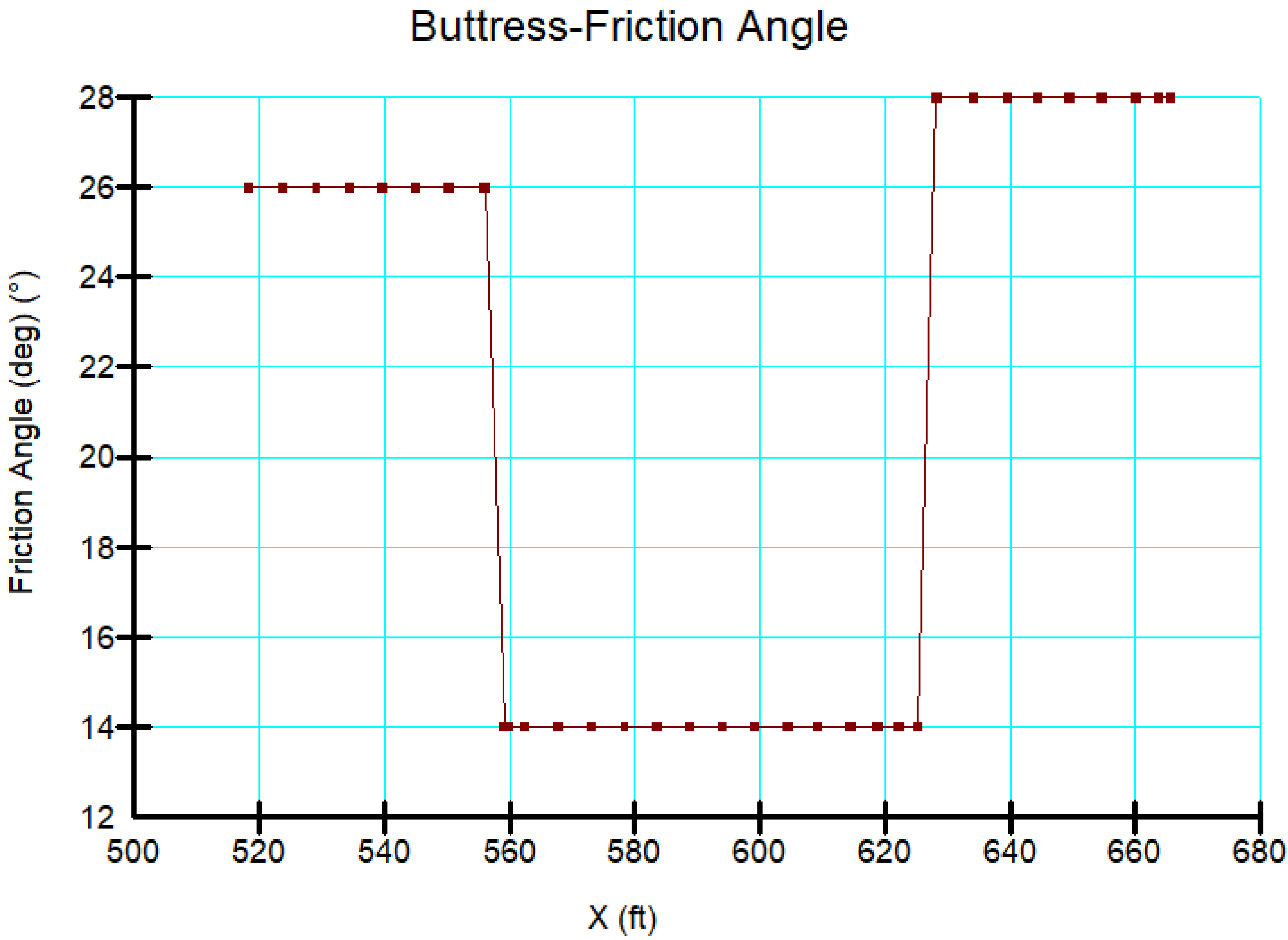
Proposed Grade
Static Condition

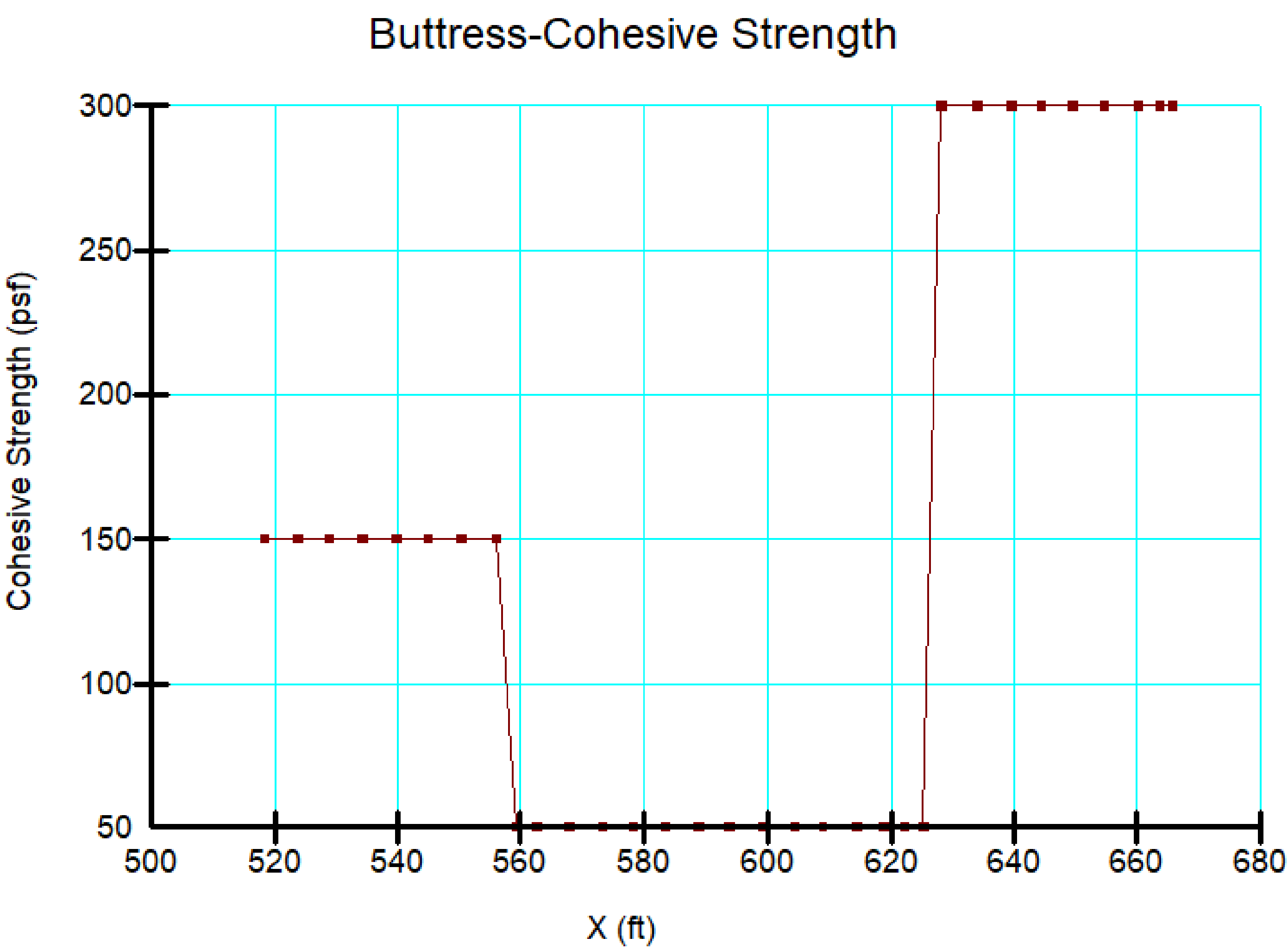
Olive Street
Project No. G3035-52-01
Name: Case 8_2-2'-Buttress.gsz



Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\2-2' Geo Studio\File Name: Case 8_2-2'-Buttress.gszDTime: 08:48:10 AMate: 08/09/2024

2-2'


Buttress-Friction Angle
Friction Angle (deg) (°)
28
26
24
22
20
18
16
14
12
500
520
540
560
580
600
620
640
660
680
X (ft)

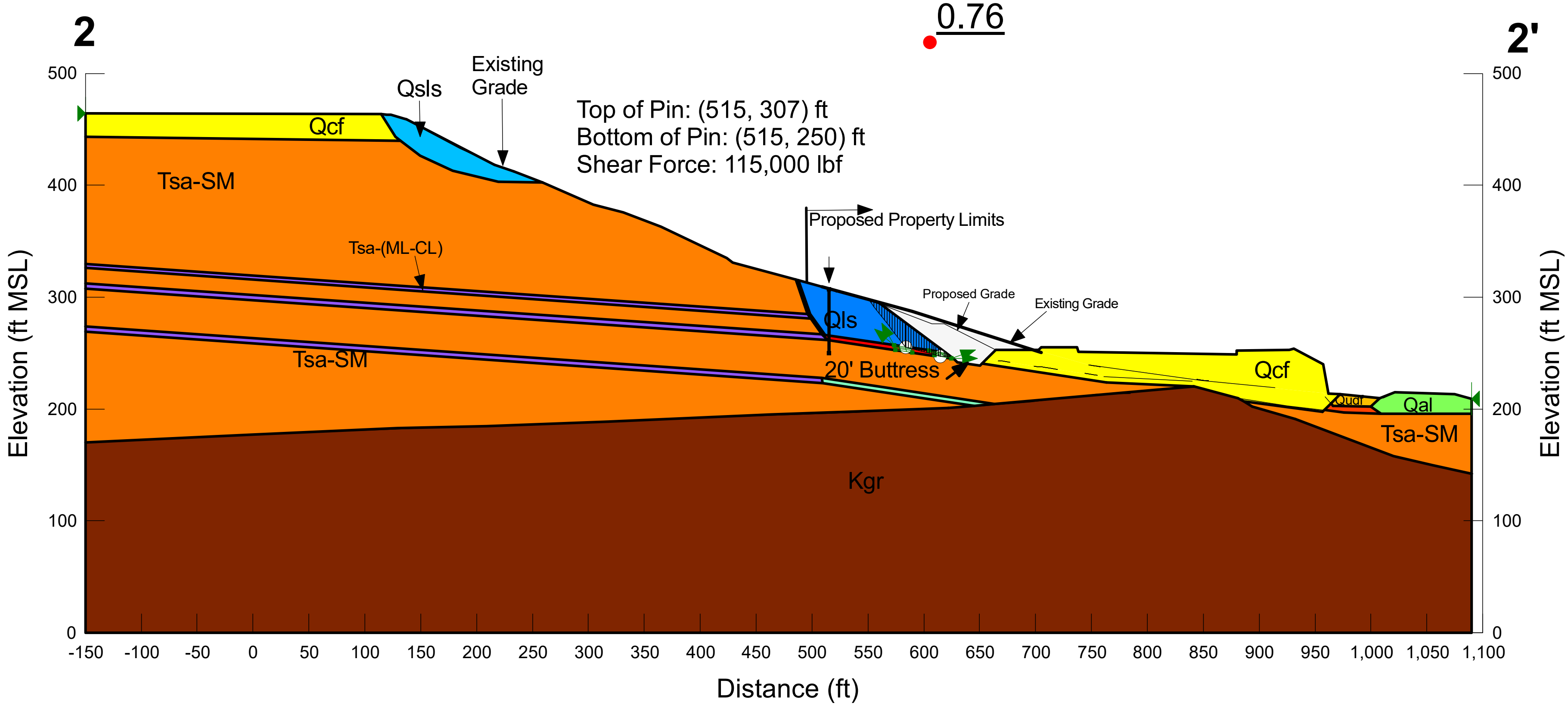

Buttress-Cohesive Strength
Cohesive Strength (psf)
300
250
200
150
100
50
500
520
540
560
580
600
620
640
660
680
X (ft)

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qcol	130	150	26		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Qsls	130	150	26		
	Qudf	130	300	28		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-ML 8 Deg	130	200	28	Phi-14, angle 8	Cohesion-50, angle 8
	Tsa-SM	130	800	34		

Proposed Grade
Static Condition

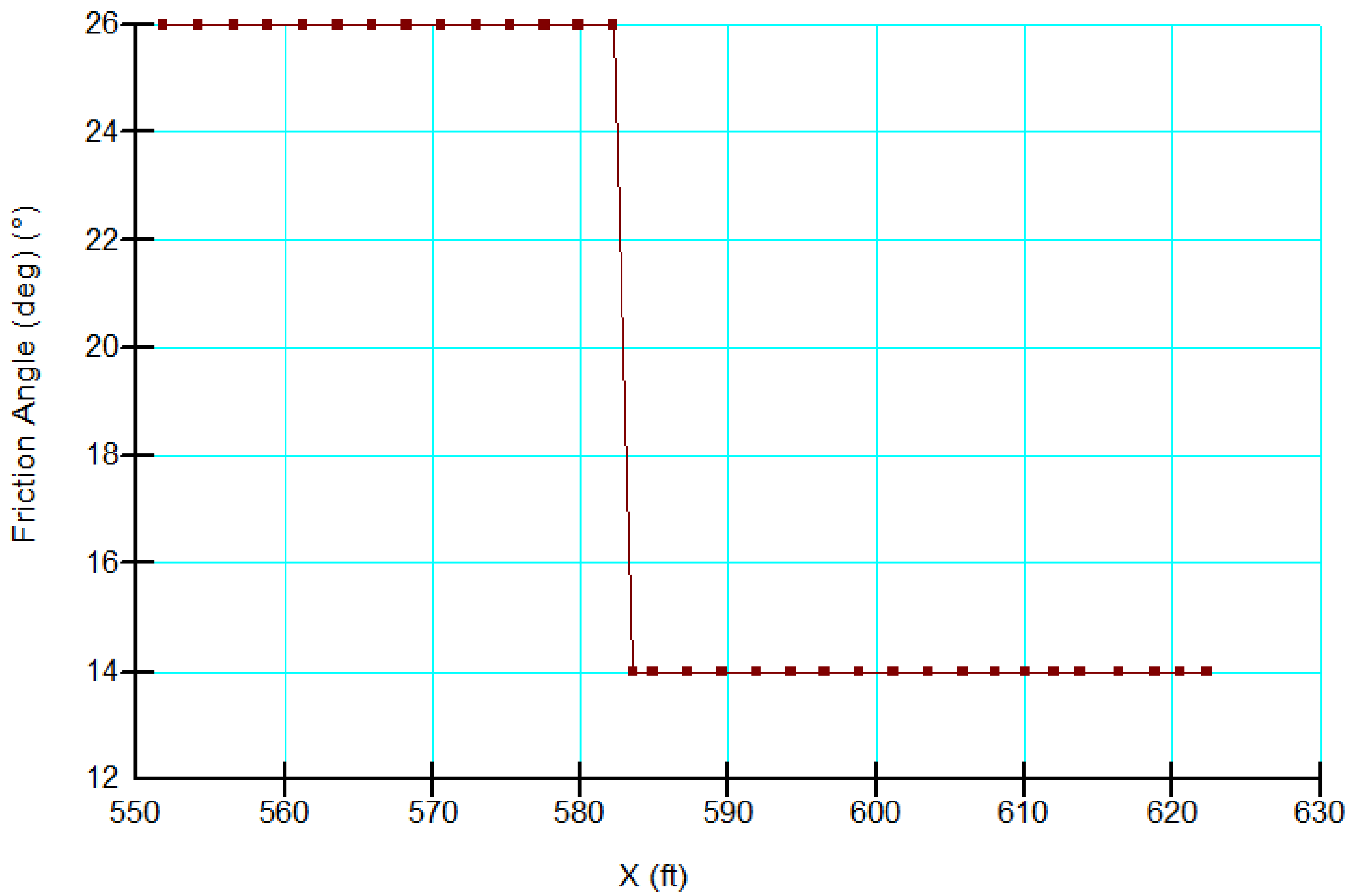
Olive Street
Project No. G3035-52-01
Name: Case 9_2-2'-Temp.gsz



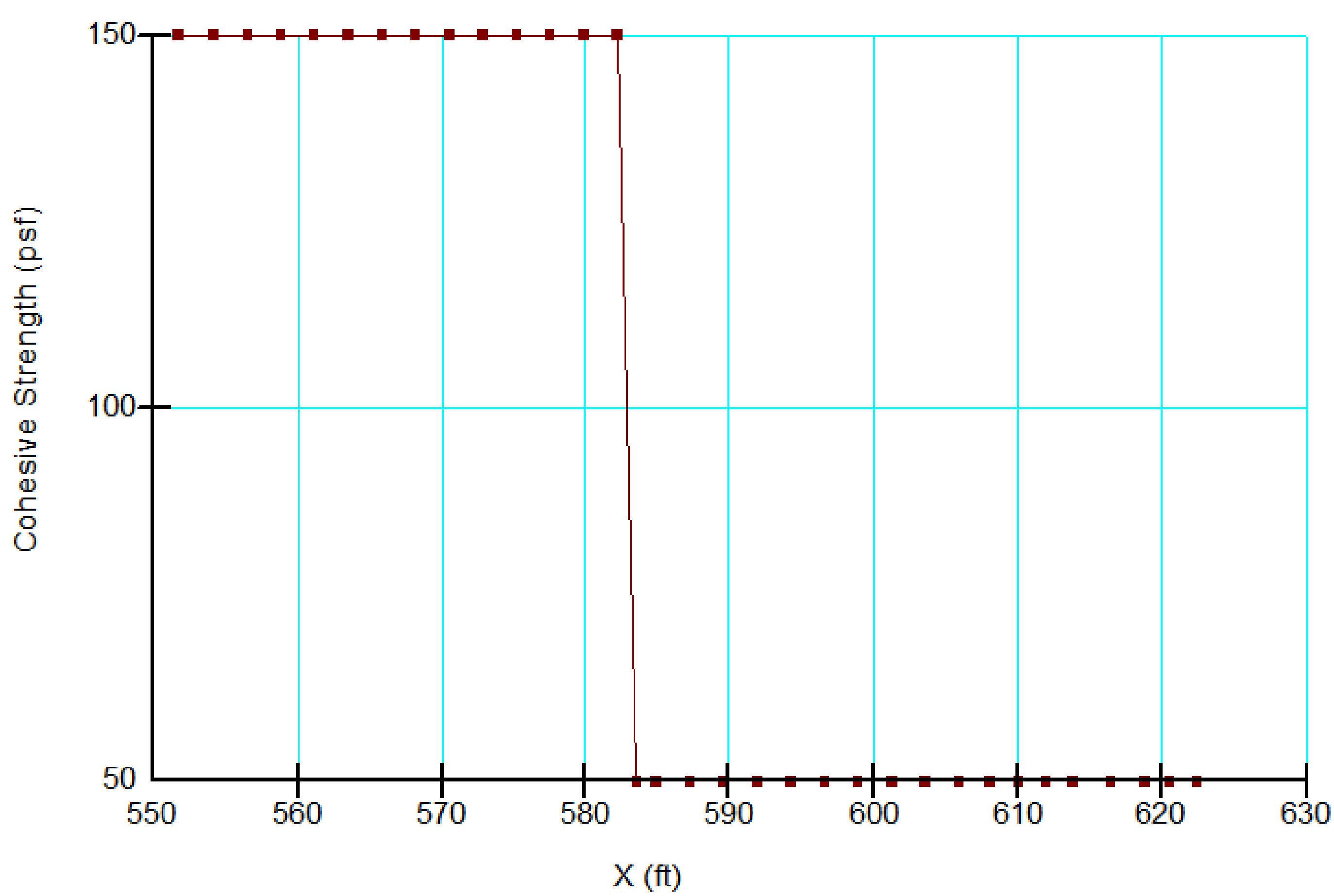
Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\2-2' Geo Studio\File Name: Case 9_2-2'-Temp.gszDTime: 08:50:42 AMate: 08/09/2024

2-2'

Temp-Friction Angle



Temp-Cohesive Strength

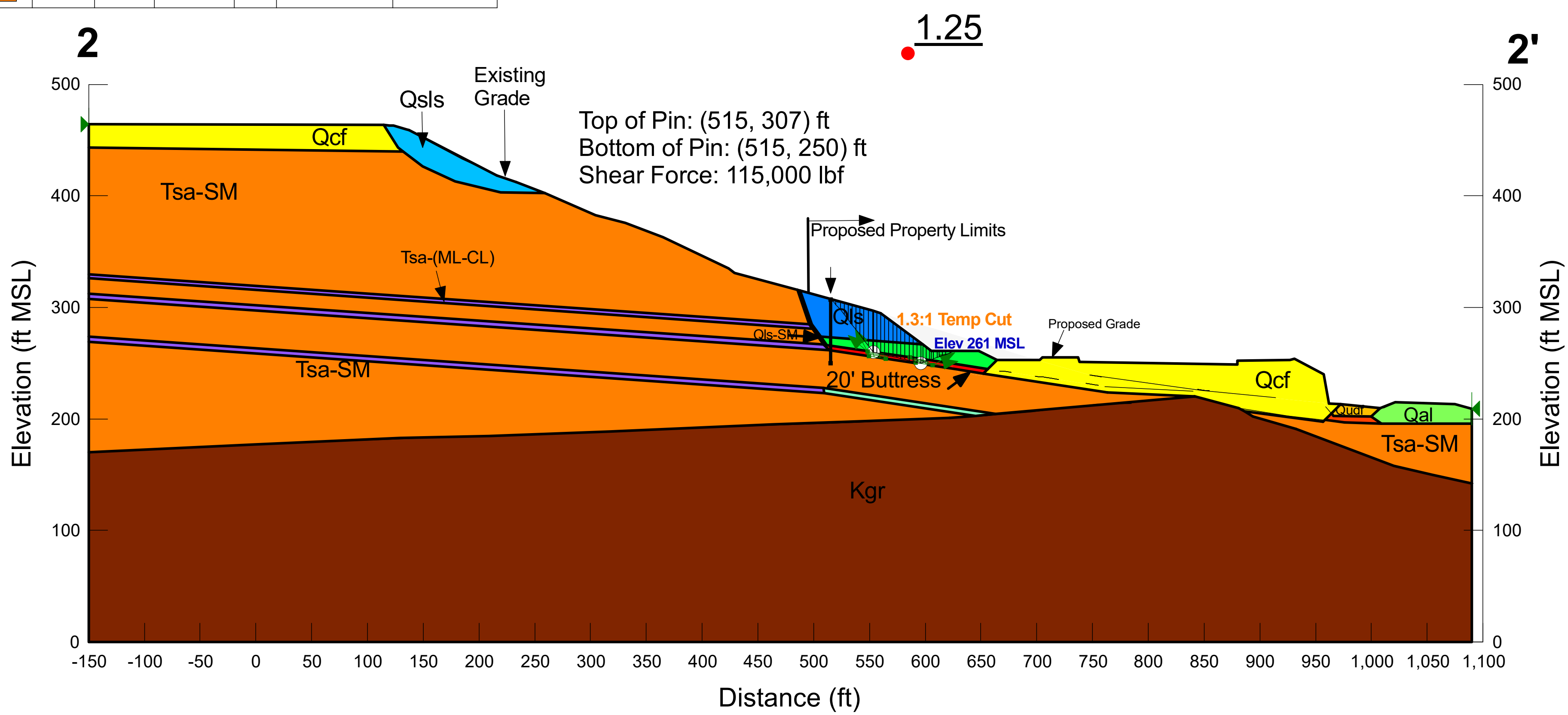


Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qcol	130	150	26		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Qls-SM	130	300	30		
	Qsls	130	150	26		
	Qudf	130	300	28		
	Tsa-ML	130	200	28	Phi-14°	Cohesion-50 (psf)
	Tsa-ML 8 Deg	130	200	28	Phi-14, angle 8	Cohesion-50, angle 8
	Tsa-SM	130	800	34		

Proposed Grade
Static Condition

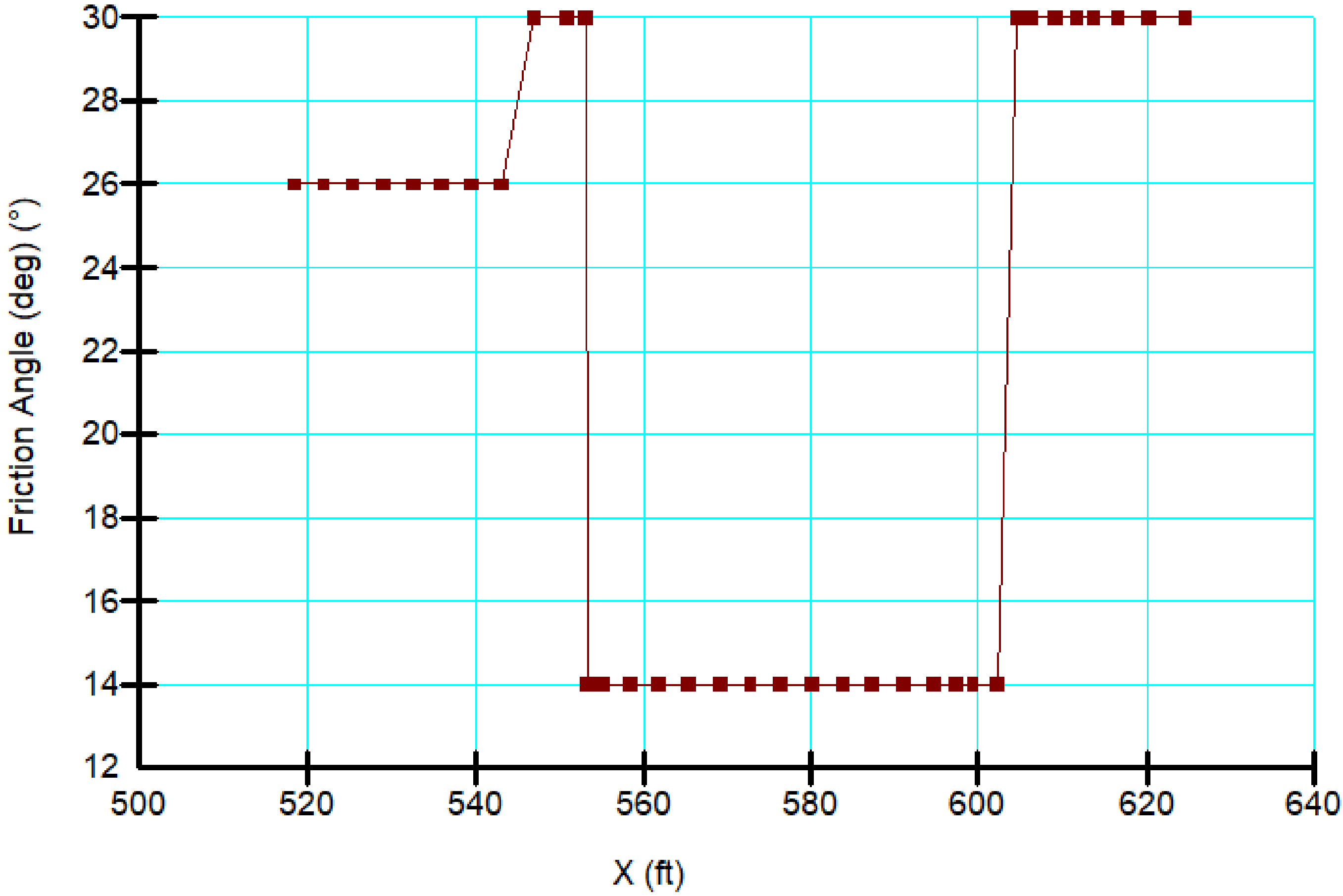
Olive Street
Project No. G3035-52-01
Name: Case 10_2-2'-Temp Slot Cut.gsz



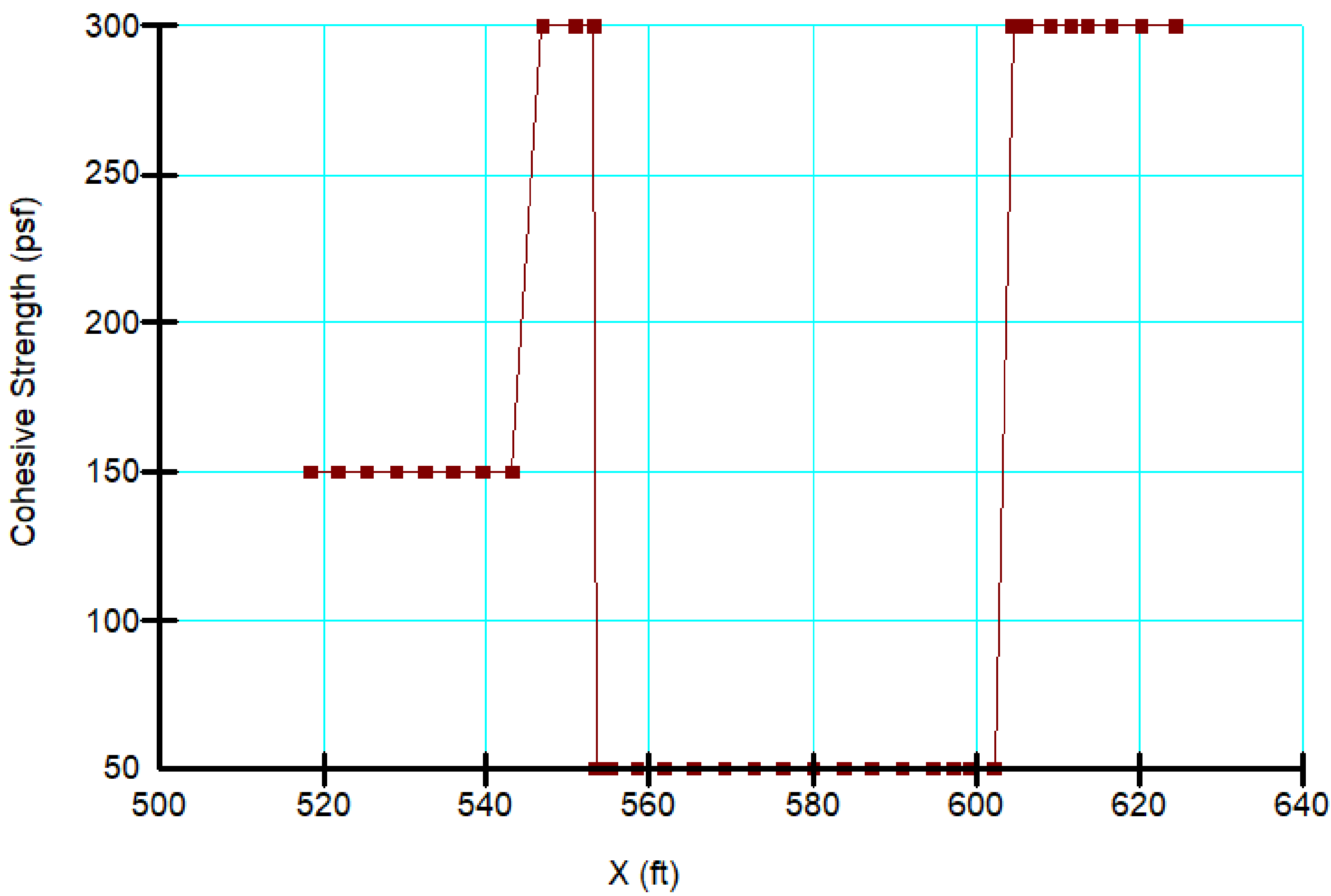
Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\2-2' Geo Studio\File Name: Case 10_2-2'-Temp Slot Cut.gszDTime: 08:52:22 AMate: 08/09/2024

·2'

Temp Slot Cut-Friction Angle



Temp Clot Cut-Cohesive Strength

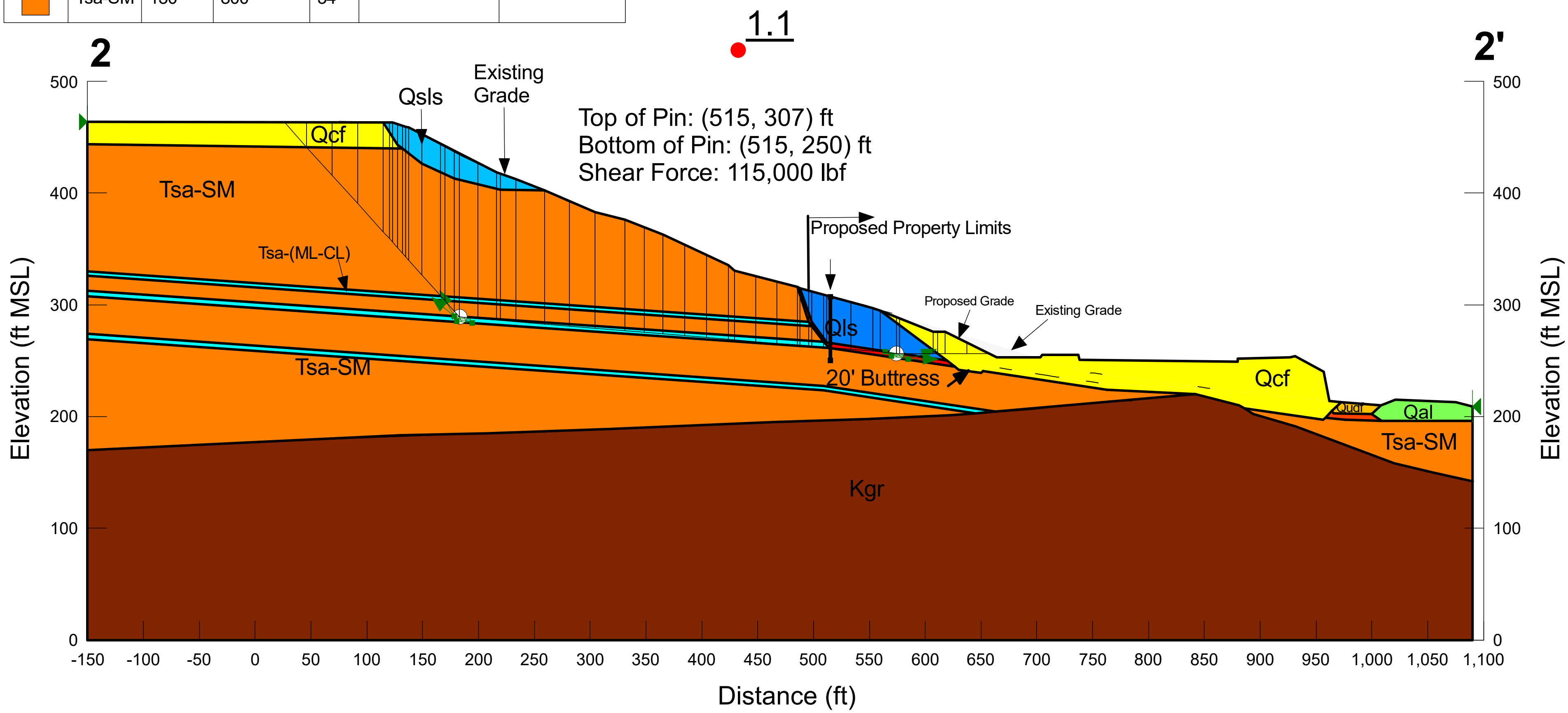


Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Kgr	130	1,000	51		
	Qal	130	150	26		
	Qcf	130	300	28		
	Qcol	130	150	26		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Qsls	130	150	26		
	Qudf	130	300	28		
	Tsa-ML FS	130	200	28	Phi-FS 18°	Cohesion-FS 100 (psf)
	Tsa-SM	130	800	34		

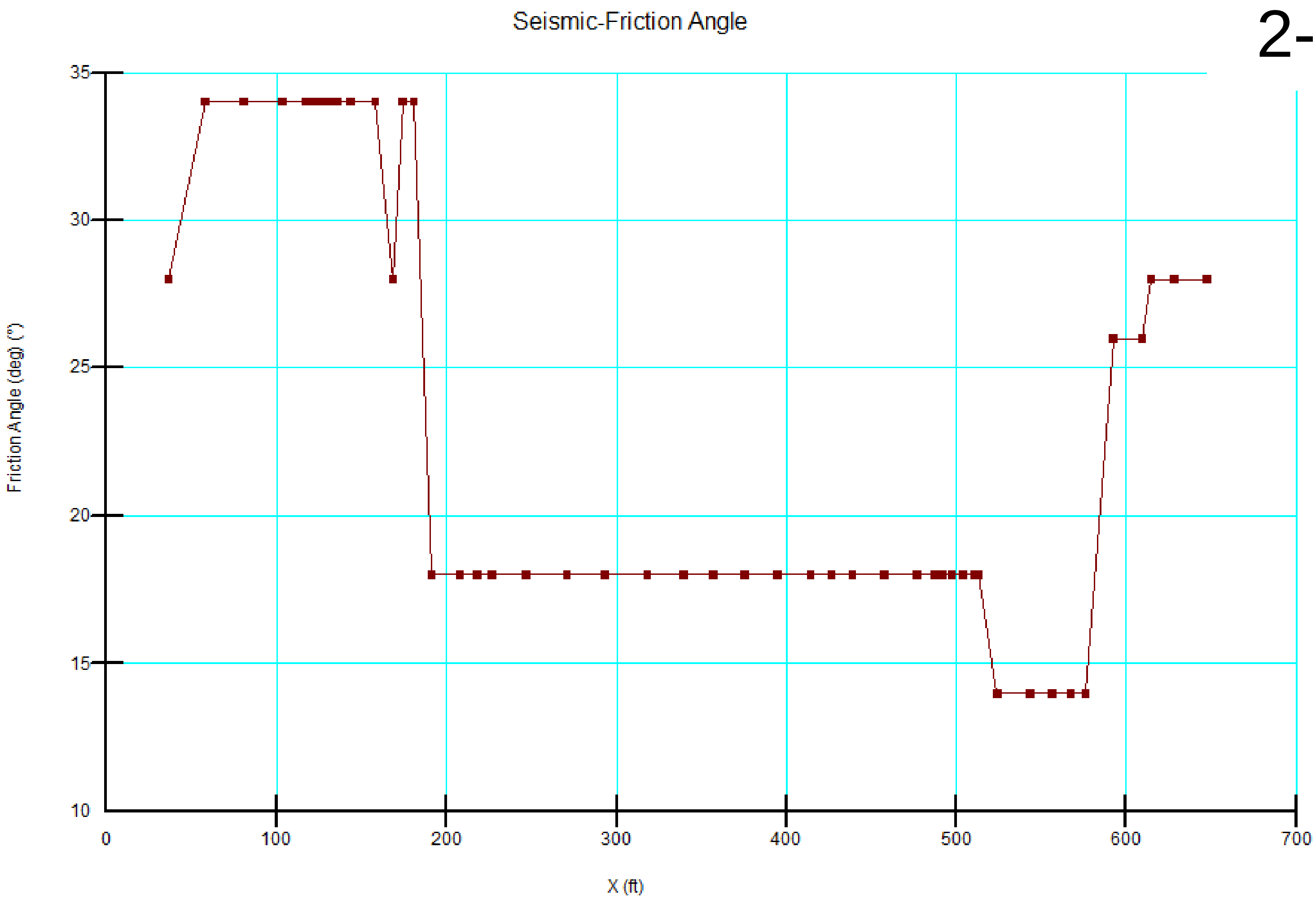
Proposed Grade
Static Condition

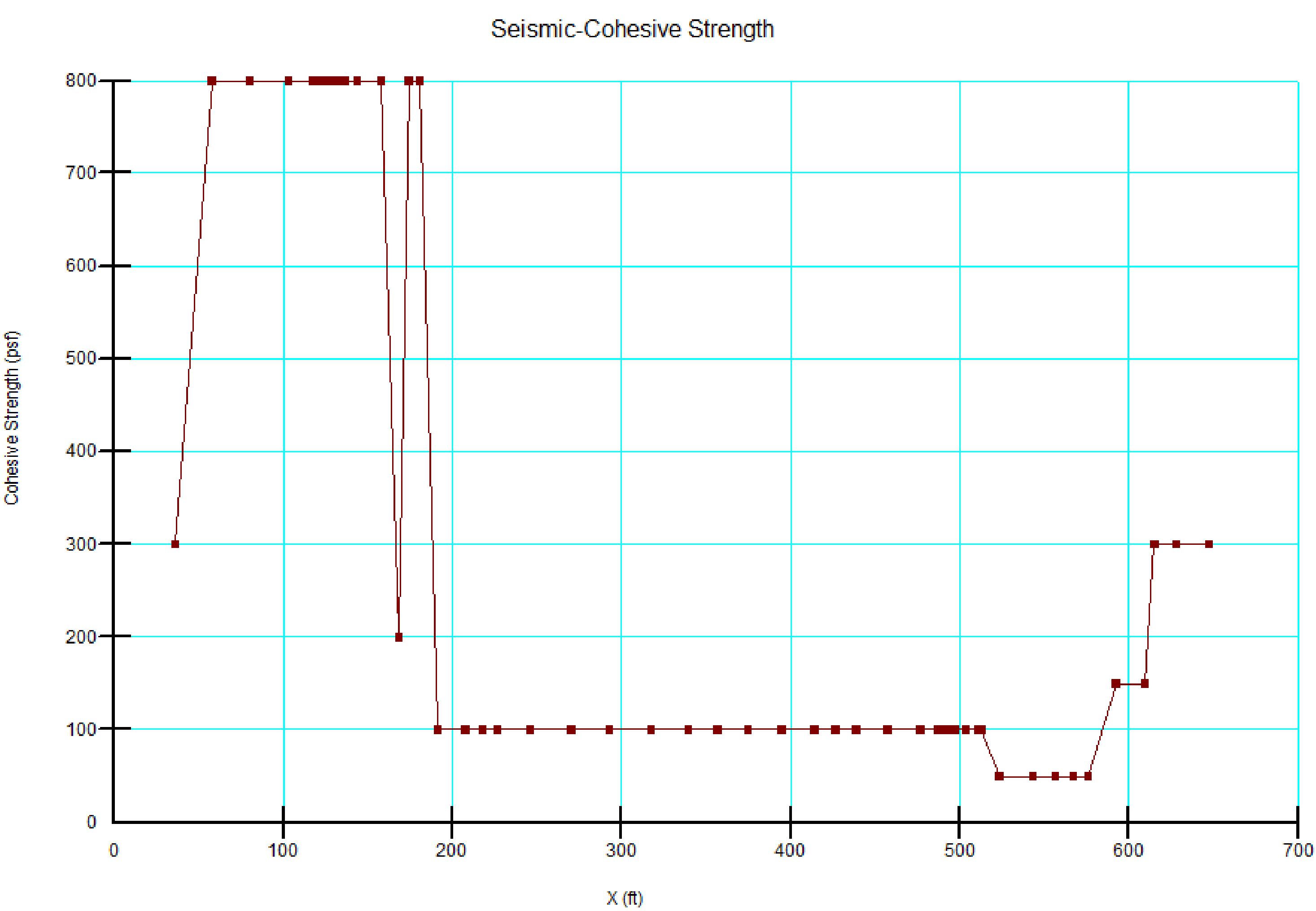
Olive Street
Project No. G3035-52-01
Name: Case 11_2-2'-Seismic.gsz



Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\2-2' Geo Studio\File Name: Case 11_2-2'-Seismic.gszDTime: 08:54:31 AMate: 08/09/2024

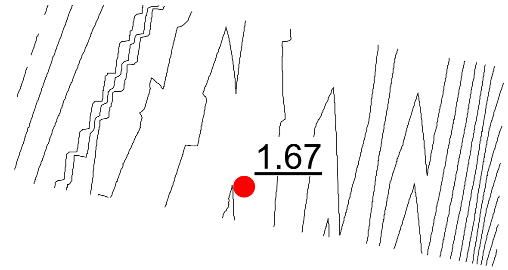
2-2'


Seismic-Friction Angle
Friction Angle (deg) (°)
35
30
25
20
15
10
0
100
200
300
400
500
600
700
X (ft)


Seismic-Cohesive Strength
Cohesive Strength (psf)
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
X (ft)

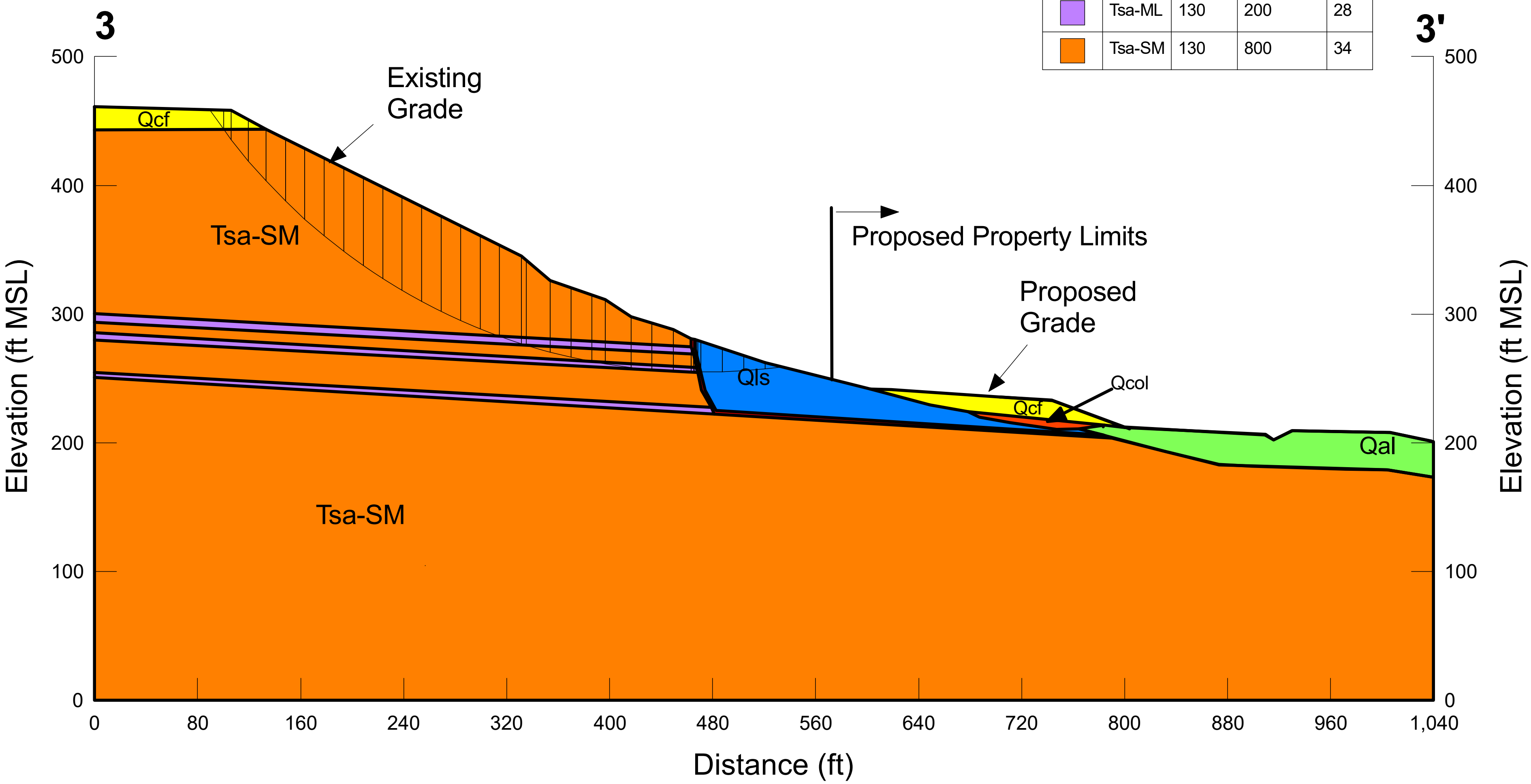
Olive Street
Project No. G3035-52-01
Name: 3-3'-Cir.gsz

Existing Grade
Static Condition



Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Qal	130	150	26
	Qcf	130	300	28
	Qcol	125	150	26
	Qls	130	150	26
	Qlsp	130	50	14
	Tsa-ML	130	200	28
	Tsa-SM	130	800	34



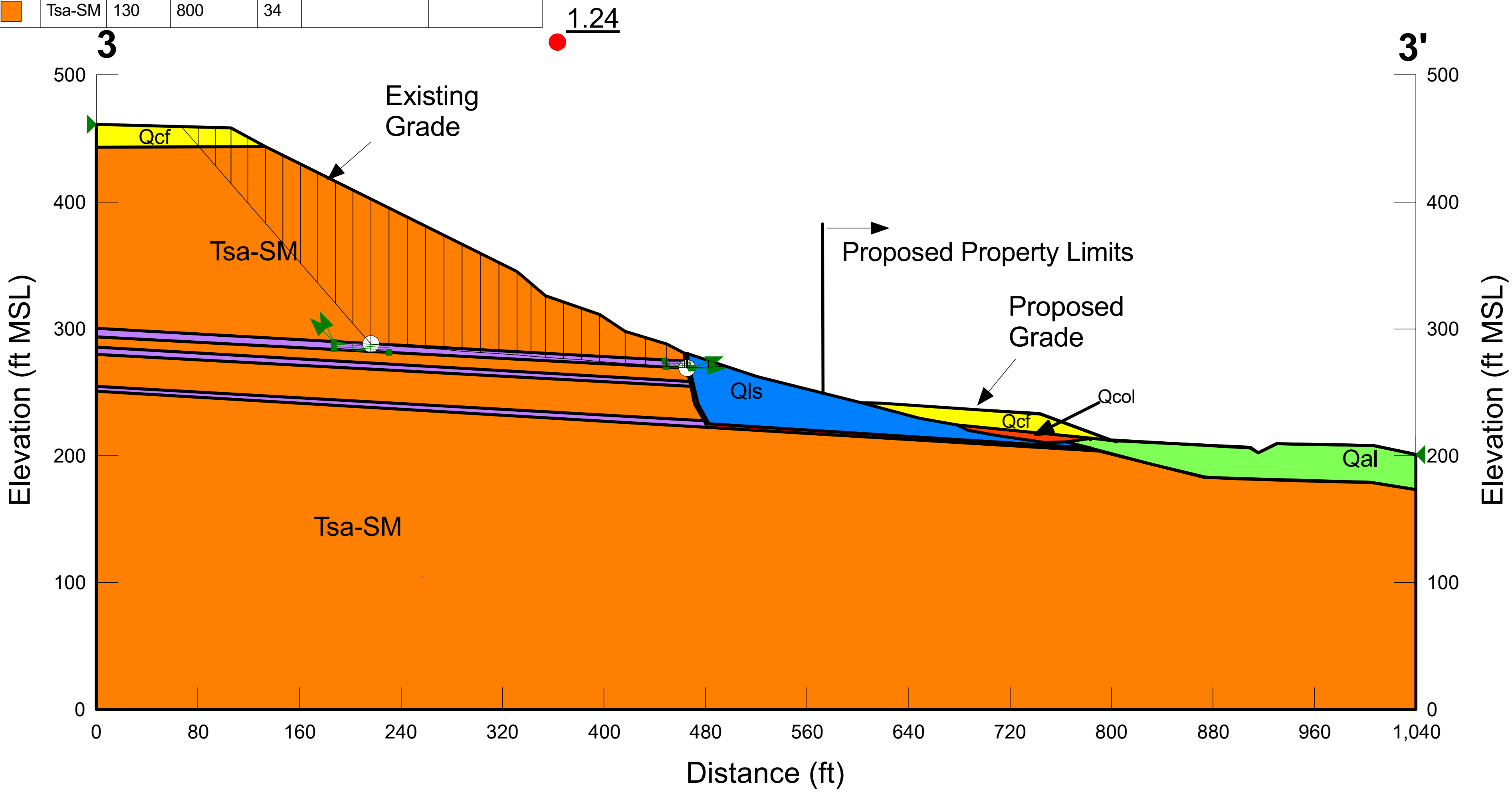
Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\3-3' Geo Studio\File Name: 3-3'-Cir.gszDTime: 02:46:40 PMate: 08/08/2024

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Qal	130	150	26		
	Qcf	130	300	28		
	Qcol	125	150	26		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Tsa-ML	130	200	28	Phi-14 °	Cohesion-50 (psf)
	Tsa-SM	130	800	34		

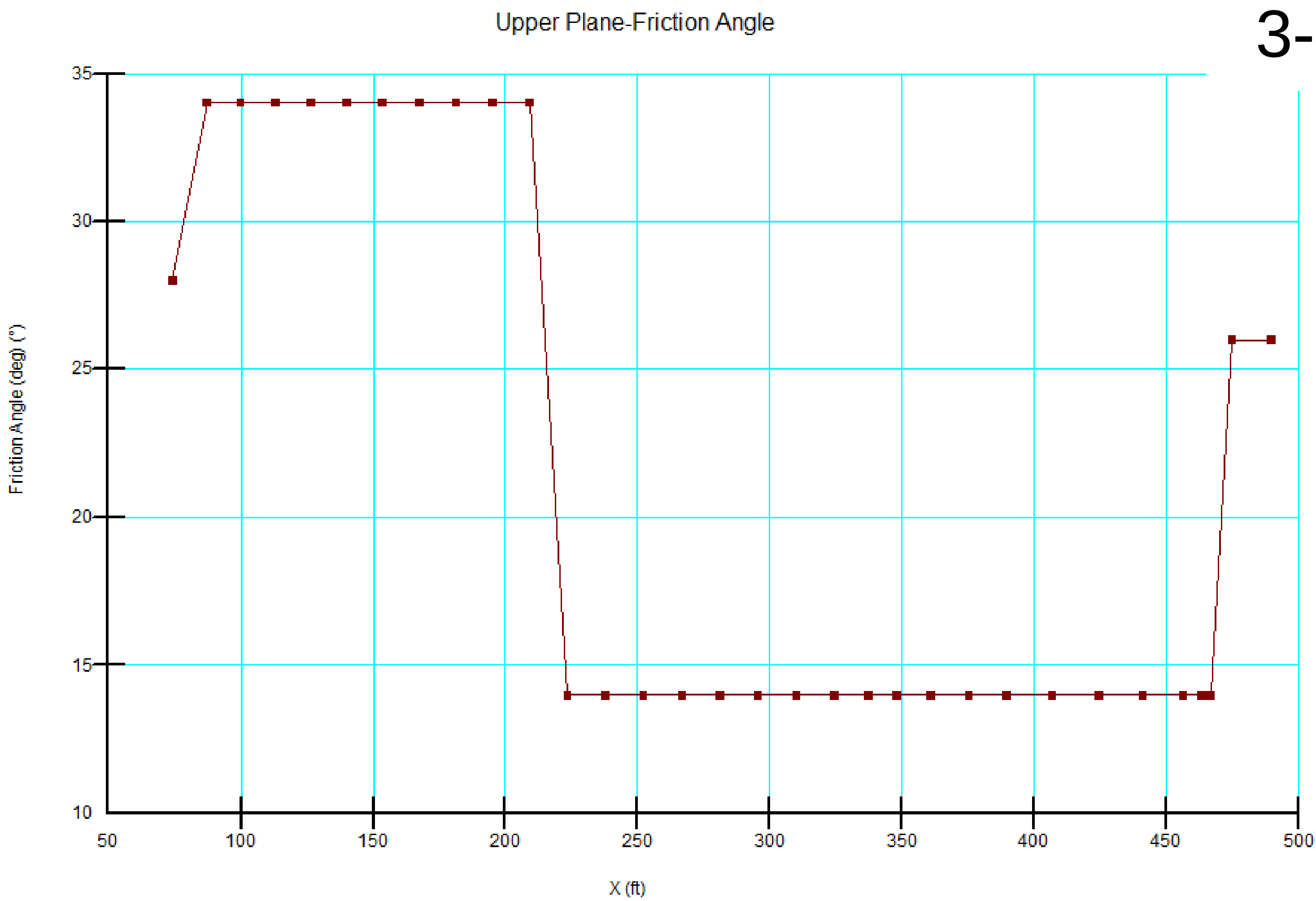
Proposed Grade
Static Condition

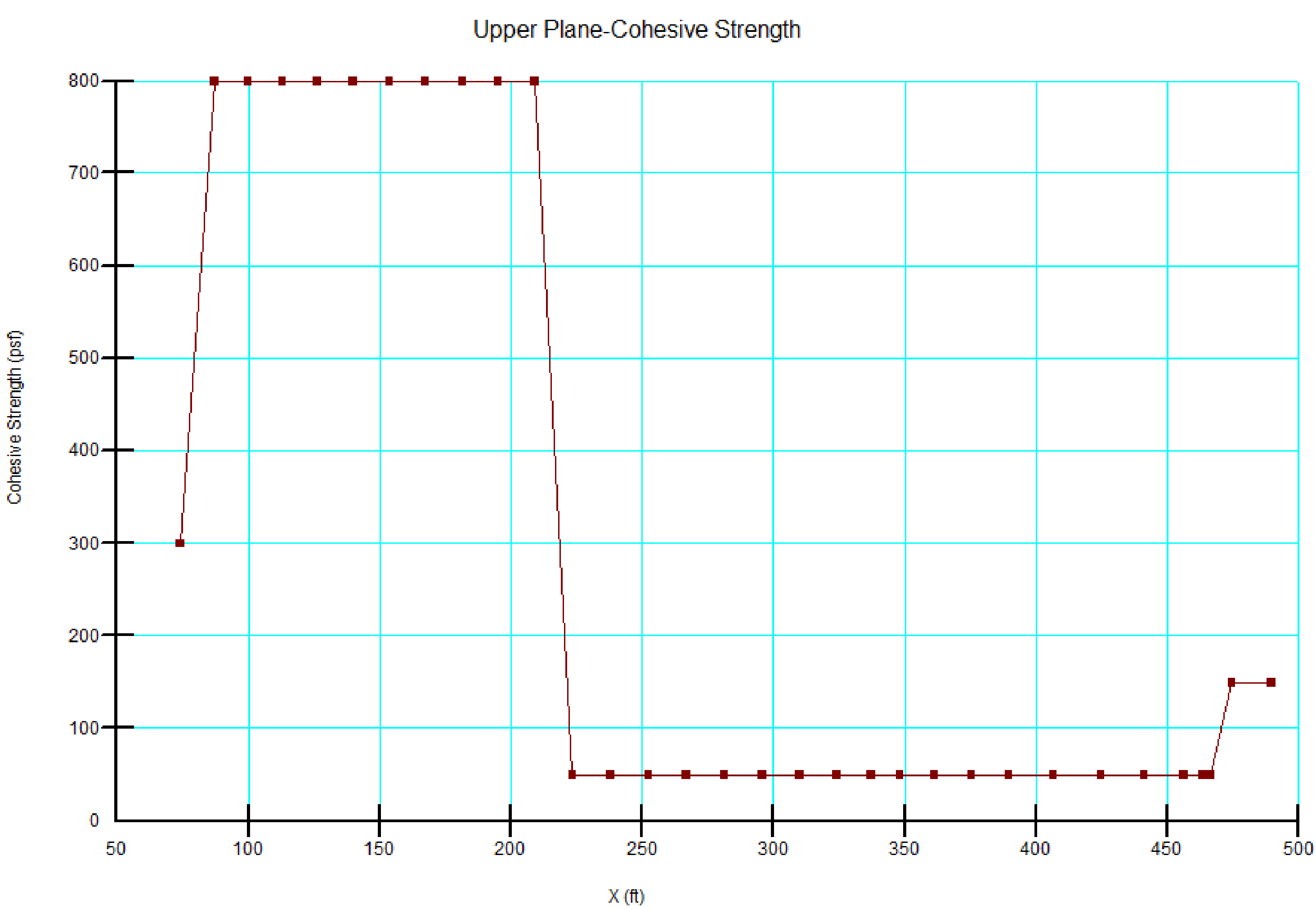
Olive Street
Project No. G3035-52-01
Name: Case 2_3-3'-Upper Plane.gsz



Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\3-3' Geo Studio\File Name: Case 2_3-3'-Upper Plane.gszDTime: 02:59:40 PMate: 08/08/2024

3-3'


Upper Plane-Friction Angle
Friction Angle (deg) (°)
35
30
25
20
15
10
50
100
150
200
250
300
350
400
450
500
X (ft)

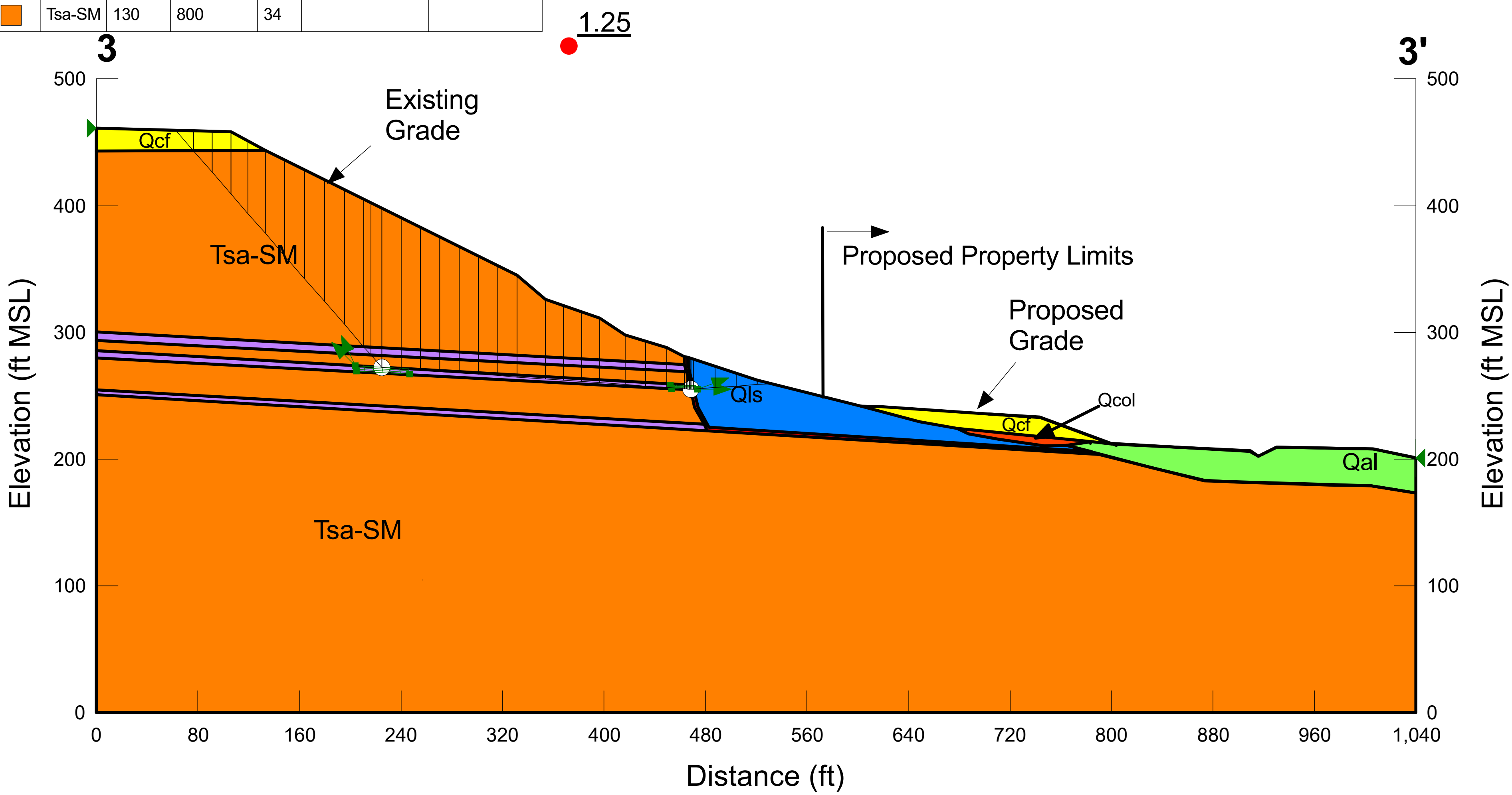

Upper Plane-Cohesive Strength
Cohesive Strength (psf)
800
700
600
500
400
300
200
100
0
50
100
150
200
250
300
350
400
450
500
X (ft)

Proposed Grade
Static Condition

Olive Street
Project No. G3035-52-01
Name: Case 3_3-3'-Mid Plane.gsz

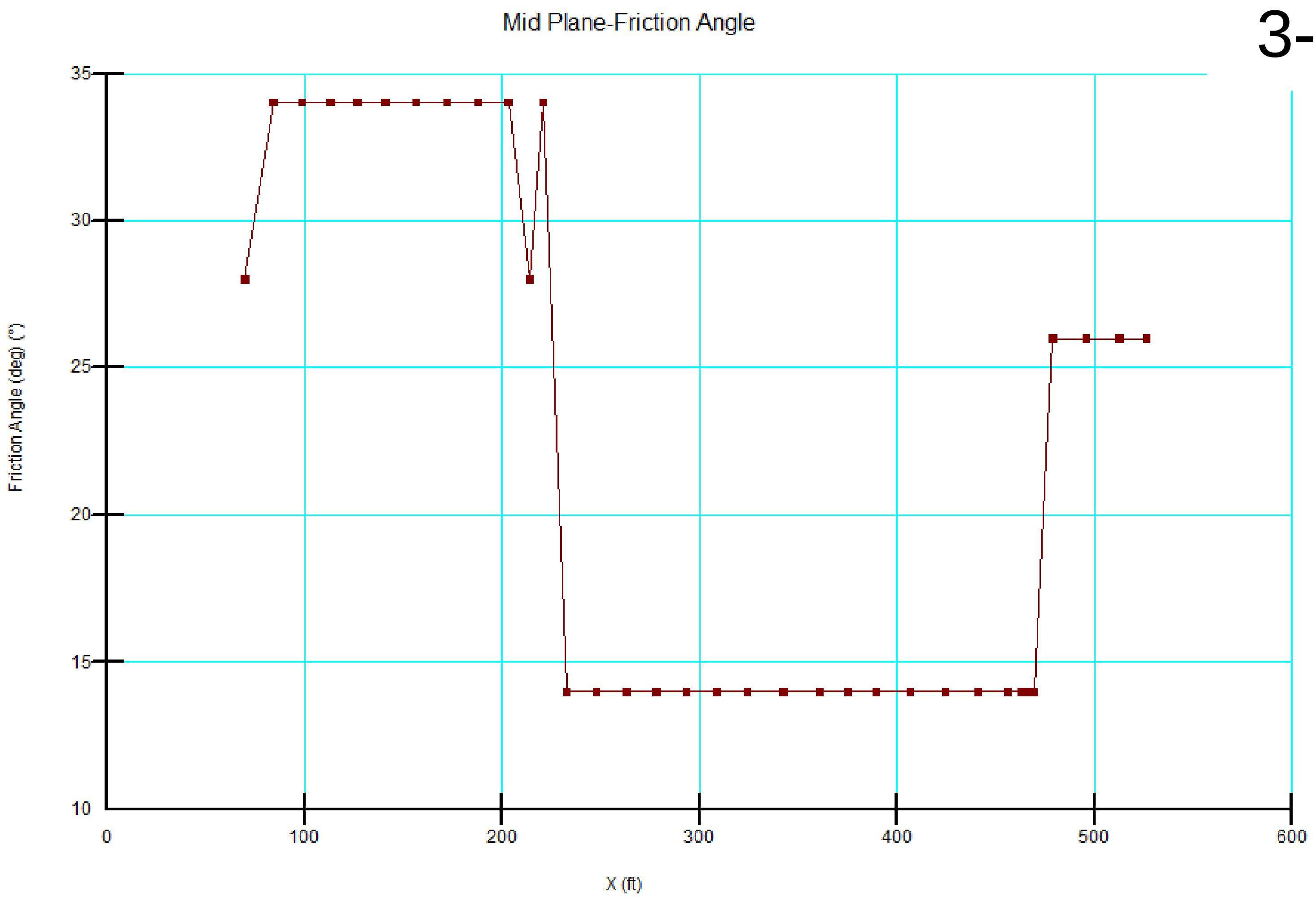
Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Qal	130	150	26		
	Qcf	130	300	28		
	Qcol	125	150	26		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Tsa-ML	130	200	28	Phi-14 °	Cohesion-50 (psf)
	Tsa-SM	130	800	34		

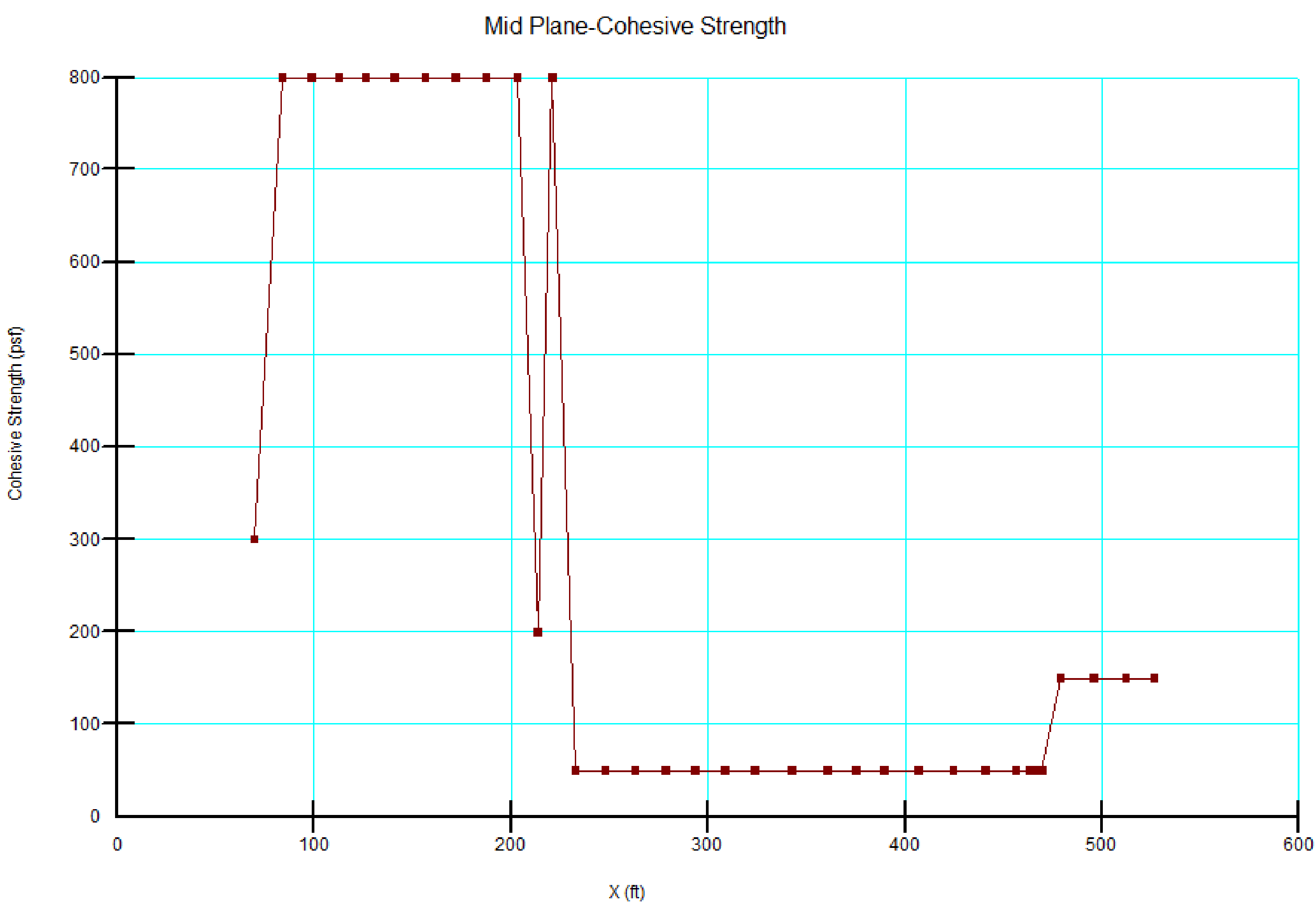


Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-07-16 Addtional Drilling\3-3' Geo Studio\File Name: Case 3_3-3'-Mid Plane.gszDTime: 03:03:08 PMate: 08/08/2024

3-3'



Mid Plane-Friction Angle
Friction Angle (deg) (°)
35
30
25
20
15
10
0
100
200
300
400
500
600
X (ft)



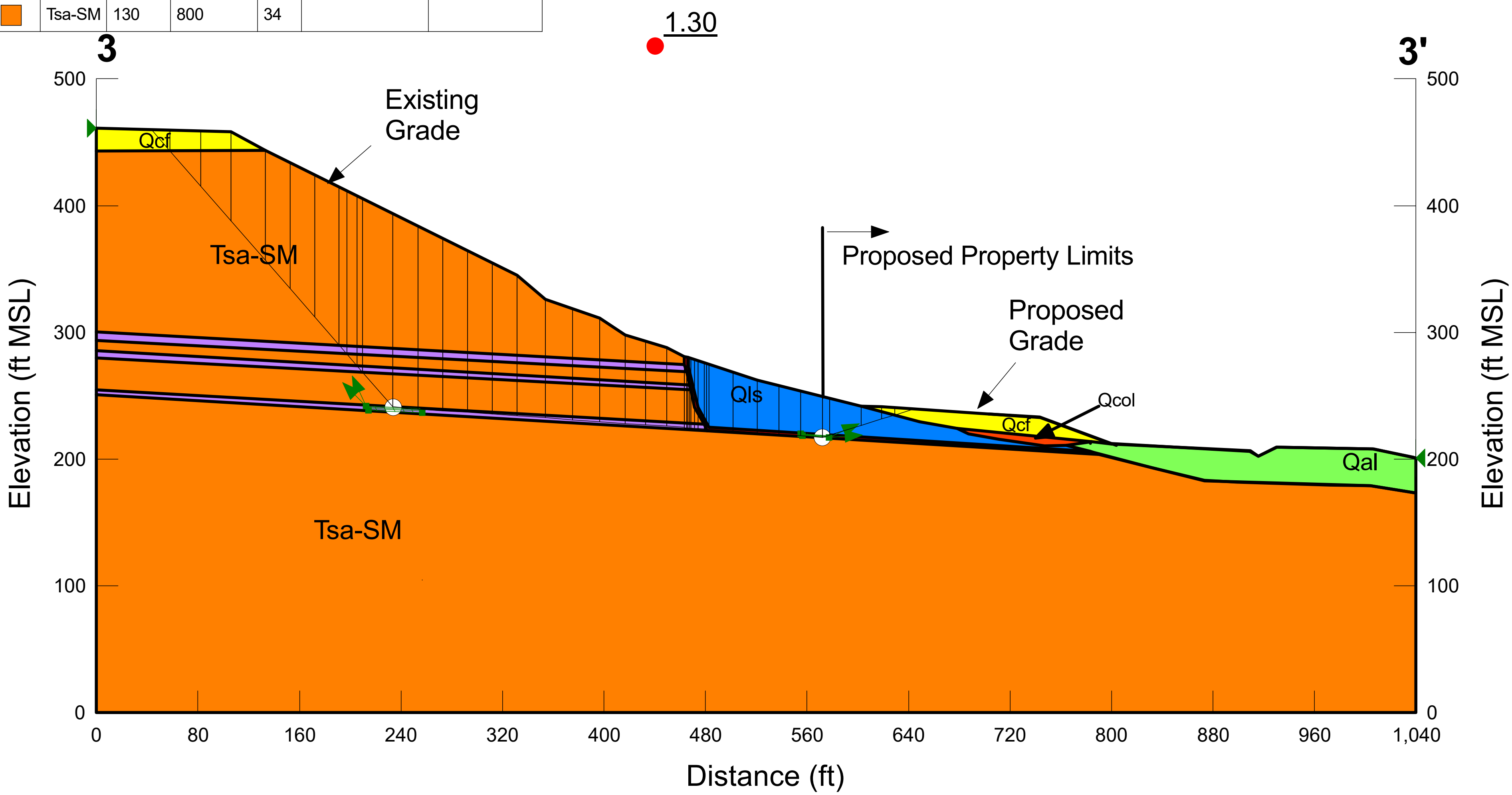
Mid Plane-Cohesive Strength
Cohesive Strength (psf)
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
X (ft)

Material Properties:

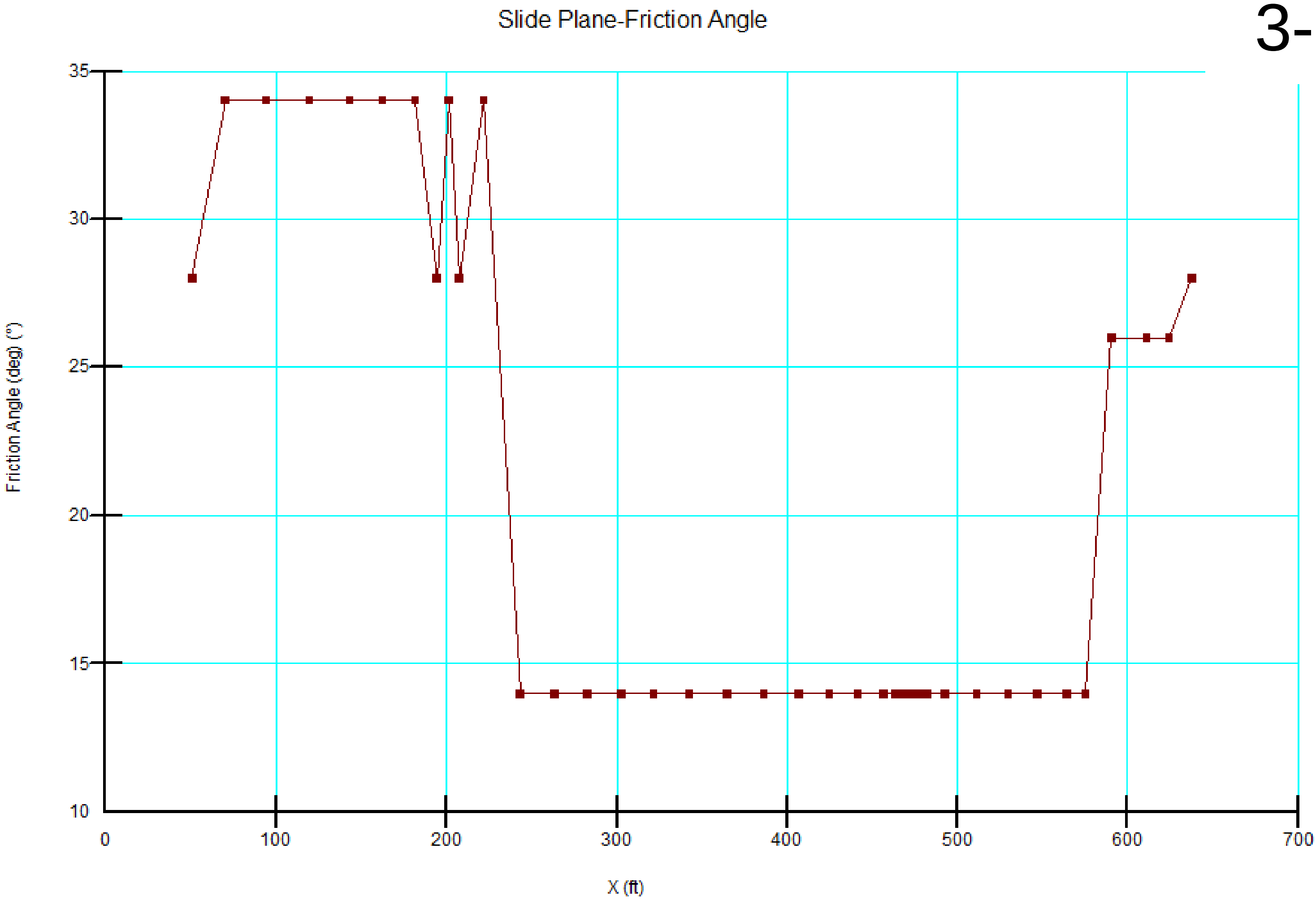
Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-Anisotropic Strength Fn.	C-Anisotropic Strength Fn.
	Qal	130	150	26		
	Qcf	130	300	28		
	Qcol	125	150	26		
	Qls	130	150	26		
	Qlsp	130	50	14		
	Tsa-ML	130	200	28	Phi-14 °	Cohesion-50 (psf)
	Tsa-SM	130	800	34		

Proposed Grade
Static Condition

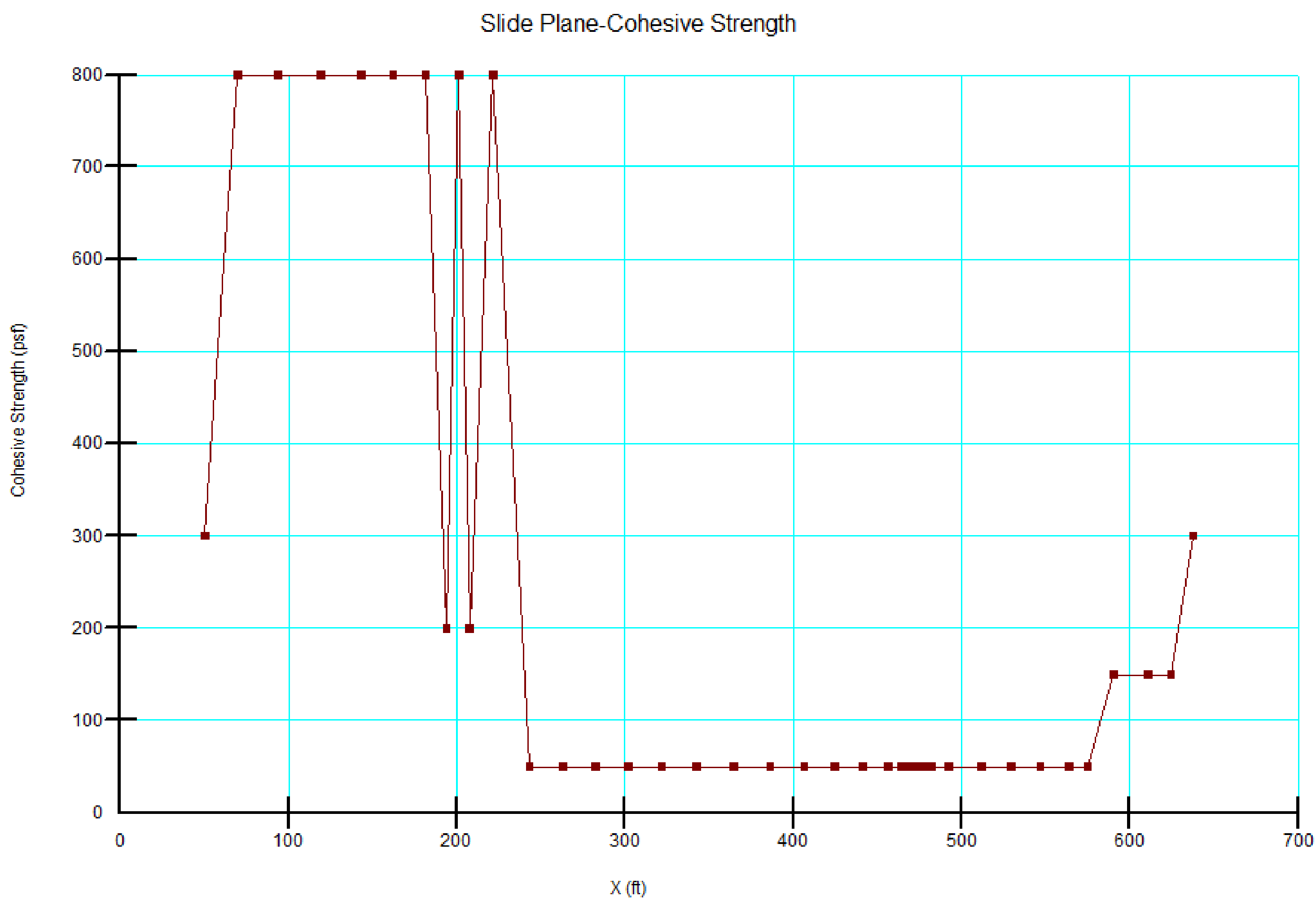
Olive Street
Project No. G3035-52-01
Name: Case 4_3-3'-Slide Plane.gsz



3-3'



Slide Plane-Friction Angle
Friction Angle (deg) (°)
35
30
25
20
15
10
0
100
200
300
400
500
600
700
X (ft)



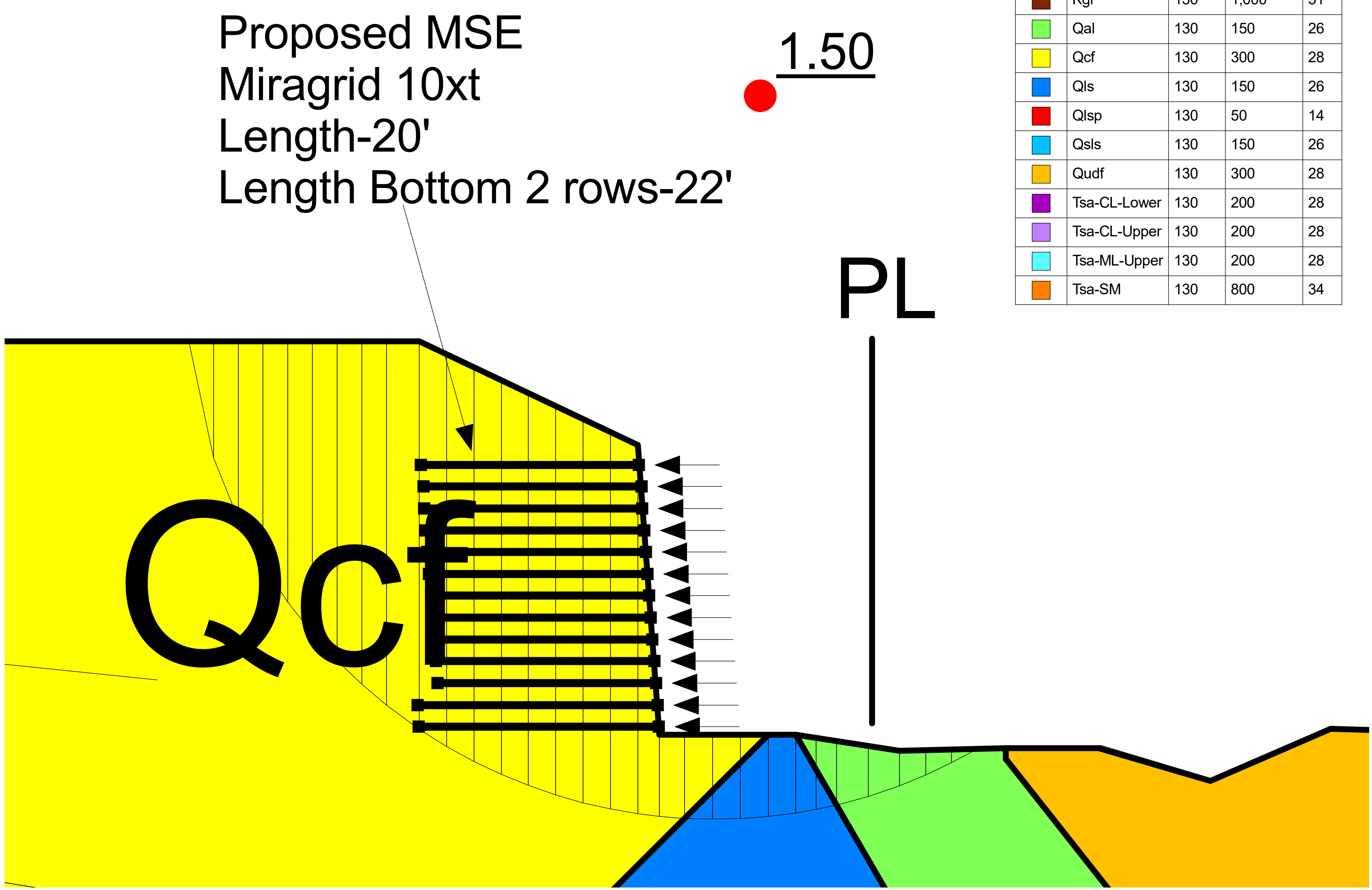
Slide Plane-Cohesive Strength
Cohesive Strength (psf)
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
X (ft)

Olive Street
Project No. G3035-52-01
Name: 2-2'-RW.gsz

Proposed MSE Wall
Static Condition
Cross-section 2-2'
Approx Sta 2+50

Material Properties:

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)
	Kgr	130	1,000	51
	Qal	130	150	26
	Qcf	130	300	28
	Qls	130	150	26
	Qlsp	130	50	14
	Qsls	130	150	26
	Qudf	130	300	28
	Tsa-CL-Lower	130	200	28
	Tsa-CL-Upper	130	200	28
	Tsa-ML-Upper	130	200	28
	Tsa-SM	130	800	34



Directory: S:\Engineering and Geology\ENGINEER PROGRAMS, GUIDES, ETC\EngrgPrg\GEO-SLOPE2018\G3035-52-01 Olive Street\2024-02-21 Updated Plans\24-01-30 Slot Cutting\File Name: 2-2'-RW.gszDTime: 11:05:53 AMate: 03/01/2024

APPENDIX E

APPENDIX E

RECOMMENDED GRADING SPECIFICATIONS

FOR

OLIVE PARK APARTMENTS
OLIVE DRIVE
OCEANSIDE, CALIFORNIA

PROJECT NO. G3035-52-01

RECOMMENDED GRADING SPECIFICATIONS

1. GENERAL

1.1 These Recommended Grading Specifications shall be used in conjunction with the Geotechnical Report for the project prepared by Geocon. The recommendations contained in the text of the Geotechnical Report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict.

1.2 Prior to the commencement of grading, a geotechnical consultant (Consultant) shall be employed for the purpose of observing earthwork procedures and testing the fills for substantial conformance with the recommendations of the Geotechnical Report and these specifications. The Consultant should provide adequate testing and observation services so that they may assess whether, in their opinion, the work was performed in substantial conformance with these specifications. It shall be the responsibility of the Contractor to assist the Consultant and keep them apprised of work schedules and changes so that personnel may be scheduled accordingly.

1.3 It shall be the sole responsibility of the Contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and the approved grading plans. If, in the opinion of the Consultant, unsatisfactory conditions such as questionable soil materials, poor moisture condition, inadequate compaction, and/or adverse weather result in a quality of work not in conformance with these specifications, the Consultant will be empowered to reject the work and recommend to the Owner that grading be stopped until the unacceptable conditions are corrected.

2. DEFINITIONS

2.1 **Owner** shall refer to the owner of the property or the entity on whose behalf the grading work is being performed and who has contracted with the Contractor to have grading performed.

2.2 **Contractor** shall refer to the Contractor performing the site grading work.

2.3 **Civil Engineer** or **Engineer of Work** shall refer to the California licensed Civil Engineer or consulting firm responsible for preparation of the grading plans, surveying and verifying as-graded topography.

2.4 **Consultant** shall refer to the soil engineering and engineering geology consulting firm retained to provide geotechnical services for the project.

2.5 **Soil Engineer** shall refer to a California licensed Civil Engineer retained by the Owner, who is experienced in the practice of geotechnical engineering. The Soil Engineer shall be responsible for having qualified representatives on-site to observe and test the Contractor's work for conformance with these specifications.

2.6 **Engineering Geologist** shall refer to a California licensed Engineering Geologist retained by the Owner to provide geologic observations and recommendations during the site grading.

2.7 **Geotechnical Report** shall refer to a soil report (including all addenda) which may include a geologic reconnaissance or geologic investigation that was prepared specifically for the development of the project for which these Recommended Grading Specifications are intended to apply.

3. MATERIALS

3.1 Materials for compacted fill shall consist of any soil excavated from the cut areas or imported to the site that, in the opinion of the Consultant, is suitable for use in construction of fills. In general, fill materials can be classified as *soil* fills, *soil-rock* fills or *rock* fills, as defined below.

3.1.1 **Soil fills** are defined as fills containing no rocks or hard lumps greater than 12 inches in maximum dimension and containing at least 40 percent by weight of material smaller than ¾ inch in size.

3.1.2 **Soil-rock fills** are defined as fills containing no rocks or hard lumps larger than 4 feet in maximum dimension and containing a sufficient matrix of soil fill to allow for proper compaction of soil fill around the rock fragments or hard lumps as specified in Paragraph 6.2. **Oversize rock** is defined as material greater than 12 inches.

3.1.3 **Rock fills** are defined as fills containing no rocks or hard lumps larger than 3 feet in maximum dimension and containing little or no fines. Fines are defined as material smaller than ¾ inch in maximum dimension. The quantity of fines shall be less than approximately 20 percent of the rock fill quantity.

3.2 Material of a perishable, spongy, or otherwise unsuitable nature as determined by the Consultant shall not be used in fills.

3.3 Materials used for fill, either imported or on-site, shall not contain hazardous materials as defined by the California Code of Regulations, Title 22, Division 4, Chapter 30, Articles 9 and 10; 40CFR; and any other applicable local, state or federal laws. The Consultant shall not be responsible for the identification or analysis of the potential presence of hazardous materials. However, if observations, odors or soil discoloration cause Consultant to suspect the presence of hazardous materials, the Consultant may request from the Owner the termination of grading operations within the affected area. Prior to resuming grading operations, the Owner shall provide a written report to the Consultant indicating that the suspected materials are not hazardous as defined by applicable laws and regulations.

3.4 The outer 15 feet of *soil-rock* fill slopes, measured horizontally, should be composed of properly compacted *soil* fill materials approved by the Consultant. *Rock* fill may extend to the slope face, provided that the slope is not steeper than 2:1 (horizontal:vertical) and a soil layer no thicker than 12 inches is track-walked onto the face for landscaping purposes. This procedure may be utilized provided it is acceptable to the governing agency, Owner and Consultant.

3.5 Samples of soil materials to be used for fill should be tested in the laboratory by the Consultant to determine the maximum density, optimum moisture content, and, where appropriate, shear strength, expansion, and gradation characteristics of the soil.

3.6 During grading, soil or groundwater conditions other than those identified in the Geotechnical Report may be encountered by the Contractor. The Consultant shall be notified immediately to evaluate the significance of the unanticipated condition.

4. CLEARING AND PREPARING AREAS TO BE FILLED

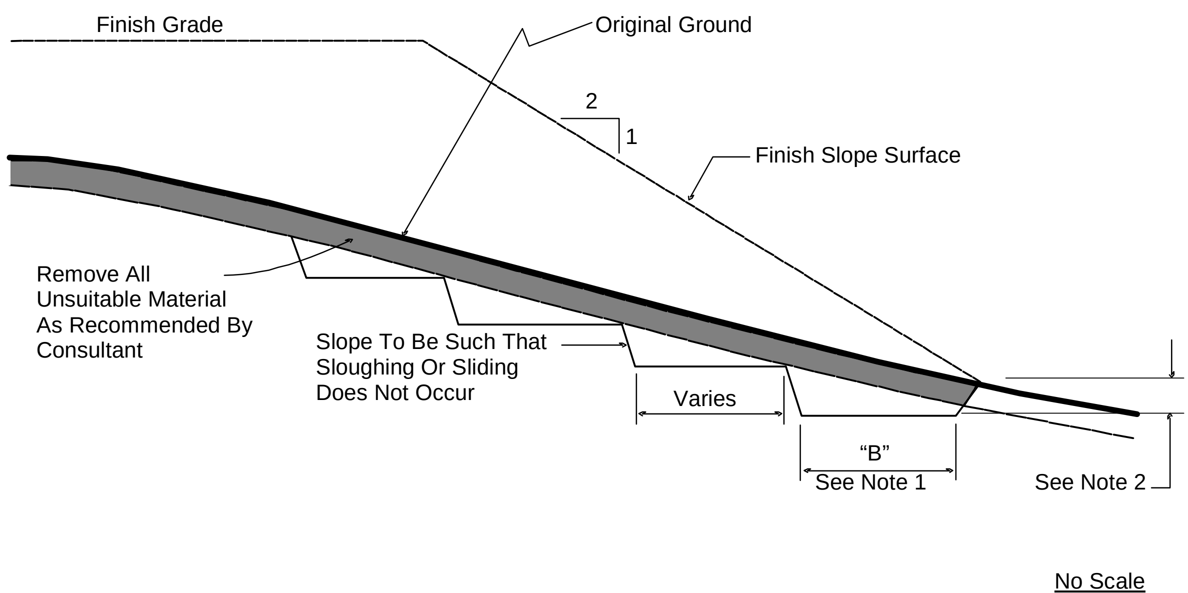
4.1 Areas to be excavated and filled shall be cleared and grubbed. Clearing shall consist of complete removal above the ground surface of trees, stumps, brush, vegetation, man-made structures, and similar debris. Grubbing shall consist of removal of stumps, roots, buried logs and other unsuitable material and shall be performed in areas to be graded. Roots and other projections exceeding 1½ inches in diameter shall be removed to a depth of 3 feet below the surface of the ground. Borrow areas shall be grubbed to the extent necessary to provide suitable fill materials.

4.2 Asphalt pavement material removed during clearing operations should be properly disposed at an approved off-site facility or in an acceptable area of the project evaluated by Geocon and the property owner. Concrete fragments that are free of reinforcing steel may be placed in fills, provided they are placed in accordance with Section 6.2 or 6.3 of this document.

4.3 After clearing and grubbing of organic matter and other unsuitable material, loose or porous soils shall be removed to the depth recommended in the Geotechnical Report. The depth of removal and compaction should be observed and approved by a representative of the Consultant. The exposed surface shall then be plowed or scarified to a minimum depth of 6 inches and until the surface is free from uneven features that would tend to prevent uniform compaction by the equipment to be used.

4.4 Where the slope ratio of the original ground is steeper than 5:1 (horizontal:vertical), or where recommended by the Consultant, the original ground should be benched in accordance with the following illustration.

TYPICAL BENCHING DETAIL



DETAIL NOTES:

(1) Key width "B" should be a minimum of 10 feet, or sufficiently wide to permit complete coverage with the compaction equipment used. The base of the key should be graded horizontal, or inclined slightly into the natural slope.

(2) The outside of the key should be below the topsoil or unsuitable surficial material and at least 2 feet into dense formational material. Where hard rock is exposed in the bottom of the key, the depth and configuration of the key may be modified as approved by the Consultant.

4.5 After areas to receive fill have been cleared and scarified, the surface should be moisture conditioned to achieve the proper moisture content, and compacted as recommended in Section 6 of these specifications.

5. COMPACTION EQUIPMENT

5.1 Compaction of *soil* or *soil-rock* fill shall be accomplished by sheepsfoot or segmented-steel wheeled rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers, or other types of acceptable compaction equipment. Equipment shall be of such a design that it will be capable of compacting the *soil* or *soil-rock* fill to the specified relative compaction at the specified moisture content.

5.2 Compaction of *rock* fills shall be performed in accordance with Section 6.3.

6. PLACING, SPREADING AND COMPACTION OF FILL MATERIAL

6.1 *Soil* fill, as defined in Paragraph 3.1.1, shall be placed by the Contractor in accordance with the following recommendations:

6.1.1 *Soil* fill shall be placed by the Contractor in layers that, when compacted, should generally not exceed 8 inches. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to obtain uniformity of material and moisture in each layer. The entire fill shall be constructed as a unit in nearly level lifts. Rock materials greater than 12 inches in maximum dimension shall be placed in accordance with Section 6.2 or 6.3 of these specifications.

6.1.2 In general, the *soil* fill shall be compacted at a moisture content at or above the optimum moisture content as determined by ASTM D 1557.

6.1.3 When the moisture content of *soil* fill is below that specified by the Consultant, water shall be added by the Contractor until the moisture content is in the range specified.

6.1.4 When the moisture content of the *soil* fill is above the range specified by the Consultant or too wet to achieve proper compaction, the *soil* fill shall be aerated by the Contractor by blading/mixing, or other satisfactory methods until the moisture content is within the range specified.

6.1.5 After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted by the Contractor to a relative compaction of at least 90 percent. Relative compaction is defined as the ratio (expressed in percent) of the in-place dry density of the compacted fill to the maximum laboratory dry density as determined in accordance with ASTM D 1557. Compaction shall be continuous over the entire area, and compaction equipment shall make sufficient passes so that the specified minimum relative compaction has been achieved throughout the entire fill.

6.1.6 Where practical, soils having an Expansion Index greater than 50 should be placed at least 3 feet below finish pad grade and should be compacted at a moisture content generally 2 to 4 percent greater than the optimum moisture content for the material.

6.1.7 Properly compacted *soil* fill shall extend to the design surface of fill slopes. To achieve proper compaction, it is recommended that fill slopes be over-built by at least 3 feet and then cut to the design grade. This procedure is considered preferable to track-walking of slopes, as described in the following paragraph.

6.1.8 As an alternative to over-building of slopes, slope faces may be back-rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Upon completion, slopes should then be track-walked with a D-8 dozer or similar equipment, such that a dozer track covers all slope surfaces at least twice.

6.2 *Soil-rock* fill, as defined in Paragraph 3.1.2, shall be placed by the Contractor in accordance with the following recommendations:

6.2.1 Rocks larger than 12 inches but less than 4 feet in maximum dimension may be incorporated into the compacted *soil* fill, but shall be limited to the area measured 15 feet minimum horizontally from the slope face and 5 feet below finish grade or 3 feet below the deepest utility, whichever is deeper.

6.2.2 Rocks or rock fragments up to 4 feet in maximum dimension may either be individually placed or placed in windrows. Under certain conditions, rocks or rock fragments up to 10 feet in maximum dimension may be placed using similar methods. The acceptability of placing rock materials greater than 4 feet in maximum dimension shall be evaluated during grading as specific cases arise and shall be approved by the Consultant prior to placement.

6.2.3 For individual placement, sufficient space shall be provided between rocks to allow for passage of compaction equipment.

6.2.4 For windrow placement, the rocks should be placed in trenches excavated in properly compacted *soil* fill. Trenches should be approximately 5 feet wide and 4 feet deep in maximum dimension. The voids around and beneath rocks should be filled with approved granular soil having a Sand Equivalent of 30 or greater and should be compacted by flooding. Windrows may also be placed utilizing an "open-face" method in lieu of the trench procedure, however, this method should first be approved by the Consultant.

6.2.5 Windrows should generally be parallel to each other and may be placed either parallel to or perpendicular to the face of the slope depending on the site geometry. The minimum horizontal spacing for windrows shall be 12 feet center-to-center with a 5-foot stagger or offset from lower courses to next overlying course. The minimum vertical spacing between windrow courses shall be 2 feet from the top of a lower windrow to the bottom of the next higher windrow.

6.2.6 Rock placement, fill placement and flooding of approved granular soil in the windrows should be continuously observed by the Consultant.

6.3 *Rock* fills, as defined in Section 3.1.3, shall be placed by the Contractor in accordance with the following recommendations:

6.3.1 The base of the *rock* fill shall be placed on a sloping surface (minimum slope of 2 percent). The surface shall slope toward suitable subdrainage outlet facilities. The *rock* fills shall be provided with subdrains during construction so that a hydrostatic pressure buildup does not develop. The subdrains shall be permanently connected to controlled drainage facilities to control post-construction infiltration of water.

6.3.2 *Rock* fills shall be placed in lifts not exceeding 3 feet. Placement shall be by rock trucks traversing previously placed lifts and dumping at the edge of the currently placed lift. Spreading of the *rock* fill shall be by dozer to facilitate *seating* of the rock. The *rock* fill shall be watered heavily during placement. Watering shall consist of water trucks traversing in front of the current rock lift face and spraying water continuously during rock placement. Compaction equipment with compactive energy comparable to or greater than that of a 20-ton steel vibratory roller or other compaction equipment providing suitable energy to achieve the required compaction or deflection as recommended in Paragraph 6.3.3 shall be utilized. The number of passes to be made should be determined as described in Paragraph 6.3.3. Once a *rock* fill lift has been covered with *soil* fill, no additional *rock* fill lifts will be permitted over the *soil* fill.

6.3.3 Plate bearing tests, in accordance with ASTM D 1196, may be performed in both the compacted *soil* fill and in the *rock* fill to aid in determining the required minimum number of passes of the compaction equipment. If performed, a minimum of three plate bearing tests should be performed in the properly compacted *soil* fill (minimum relative compaction of 90 percent). Plate bearing tests shall then be performed on areas of *rock* fill having two passes, four passes and six passes of the compaction equipment, respectively. The number of passes required for the *rock* fill shall be determined by comparing the results of the plate bearing tests for the *soil* fill and the *rock* fill and by evaluating the deflection variation with number of passes. The required number of passes of the compaction equipment will be performed as necessary until the plate bearing deflections are equal to or less than that determined for the properly compacted *soil* fill. In no case will the required number of passes be less than two.

6.3.4 A representative of the Consultant should be present during *rock* fill operations to observe that the minimum number of "passes" have been obtained, that water is being properly applied and that specified procedures are being followed. The actual number of plate bearing tests will be determined by the Consultant during grading.

6.3.5 Test pits shall be excavated by the Contractor so that the Consultant can state that, in their opinion, sufficient water is present and that voids between large rocks are properly filled with smaller rock material. In-place density testing will not be required in the *rock* fills.

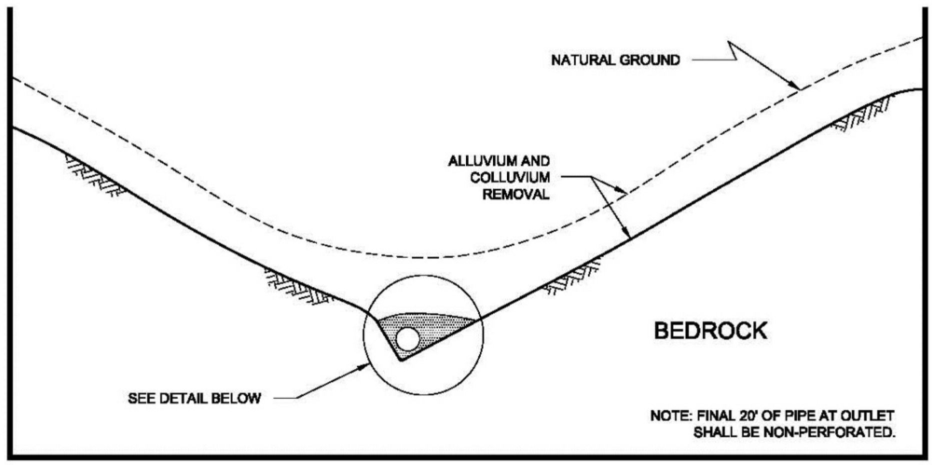
6.3.6 To reduce the potential for "piping" of fines into the *rock* fill from overlying *soil* fill material, a 2-foot layer of graded filter material shall be placed above the uppermost lift of *rock* fill. The need to place graded filter material below the *rock* should be determined by the Consultant prior to commencing grading. The gradation of the graded filter material will be determined at the time the *rock* fill is being excavated. Materials typical of the *rock* fill should be submitted to the Consultant in a timely manner, to allow design of the graded filter prior to the commencement of *rock* fill placement.

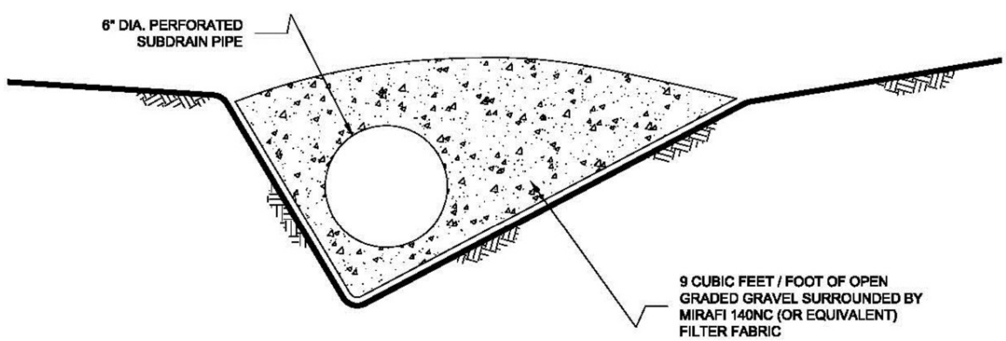
6.3.7 *Rock* fill placement should be continuously observed during placement by the Consultant.

7. SUBDRAINS

7.1 The geologic units on the site may have permeability characteristics and/or fracture systems that could be susceptible under certain conditions to seepage. The use of canyon subdrains may be necessary to mitigate the potential for adverse impacts associated with seepage conditions. Canyon subdrains with lengths in excess of 500 feet or extensions of existing offsite subdrains should use 8-inch-diameter pipes. Canyon subdrains less than 500 feet in length should use 6-inch-diameter pipes.

TYPICAL CANYON DRAIN DETAIL





NOTES:

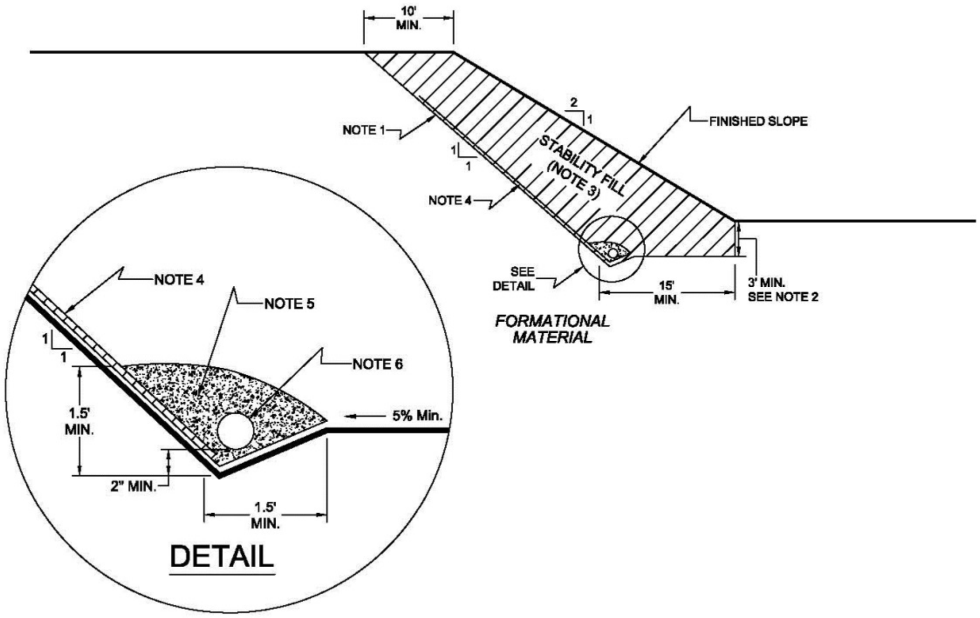
1......6-INCH DIAMETER, SCHEDULE 80 PVC PERFORATED PIPE FOR FILLS IN EXCESS OF 100-FEET IN DEPTH OR A PIPE LENGTH OF LONGER THAN 500 FEET.

2......6-INCH DIAMETER, SCHEDULE 40 PVC PERFORATED PIPE FOR FILLS LESS THAN 100-FEET IN DEPTH OR A PIPE LENGTH SHORTER THAN 500 FEET.

NO SCALE

7.2 Slope drains within stability fill keyways should use 4-inch-diameter (or lager) pipes.

TYPICAL STABILITY FILL DETAIL



NOTES:

1.....EXCAVATE BACKCUT AT 1:1 INCLINATION (UNLESS OTHERWISE NOTED).

2.....BASE OF STABILITY FILL TO BE 3 FEET INTO FORMATIONAL MATERIAL, SLOPING A MINIMUM 5% INTO SLOPE.

3.....STABILITY FILL TO BE COMPOSED OF PROPERLY COMPACTED GRANULAR SOIL.

4.....CHIMNEY DRAINS TO BE APPROVED PREFABRICATED CHIMNEY DRAIN PANELS (MIRADRAIN G200N OR EQUIVALENT) SPACED APPROXIMATELY 20 FEET CENTER TO CENTER AND 4 FEET WIDE. CLOSER SPACING MAY BE REQUIRED IF SEEPAGE IS ENCOUNTERED.

5.....FILTER MATERIAL TO BE 3/4-INCH, OPEN-GRADED CRUSHED ROCK ENCLOSED IN APPROVED FILTER FABRIC (MIRAFI 140NC).

6.....COLLECTOR PIPE TO BE 4-INCH MINIMUM DIAMETER, PERFORATED, THICK-WALLED PVC SCHEDULE 40 OR EQUIVALENT, AND SLOPED TO DRAIN AT 1 PERCENT MINIMUM TO APPROVED OUTLET.

NO SCALE

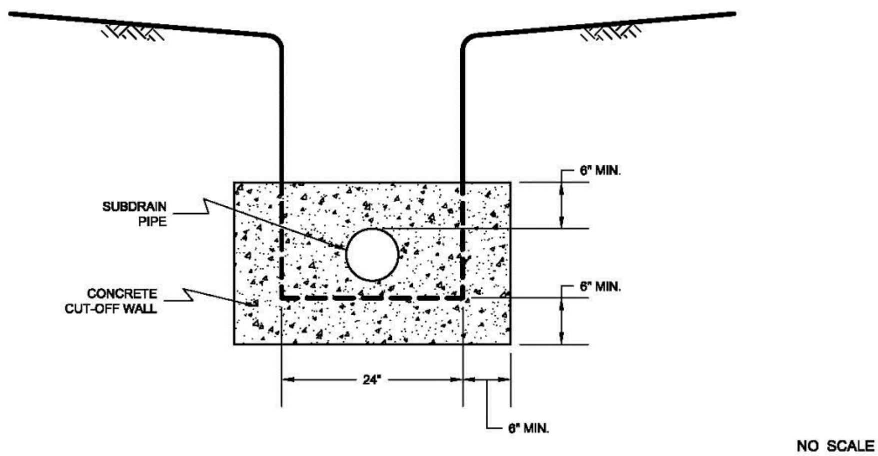
7.3 The actual subdrain locations will be evaluated in the field during the remedial grading operations. Additional drains may be necessary depending on the conditions observed and the requirements of the local regulatory agencies. Appropriate subdrain outlets should be evaluated prior to finalizing 40-scale grading plans.

7.4 *Rock* fill or *soil-rock* fill areas may require subdrains along their down-slope perimeters to mitigate the potential for buildup of water from construction or landscape irrigation. The subdrains should be at least 6-inch-diameter pipes encapsulated in gravel and filter fabric. *Rock* fill drains should be constructed using the same requirements as canyon subdrains.

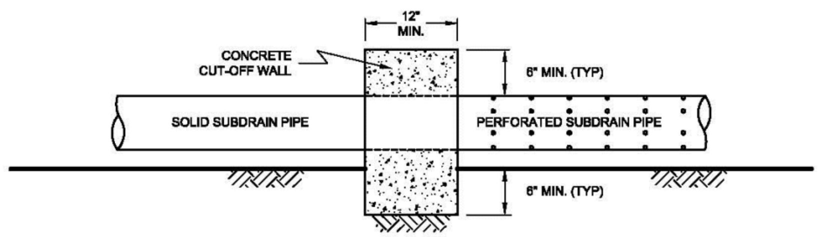
7.5 Prior to outletting, the final 20-foot segment of a subdrain that will not be extended during future development should consist of non-perforated drainpipe. At the non-perforated/ perforated interface, a seepage cutoff wall should be constructed on the downslope side of the pipe.

TYPICAL CUT OFF WALL DETAIL

FRONT VIEW

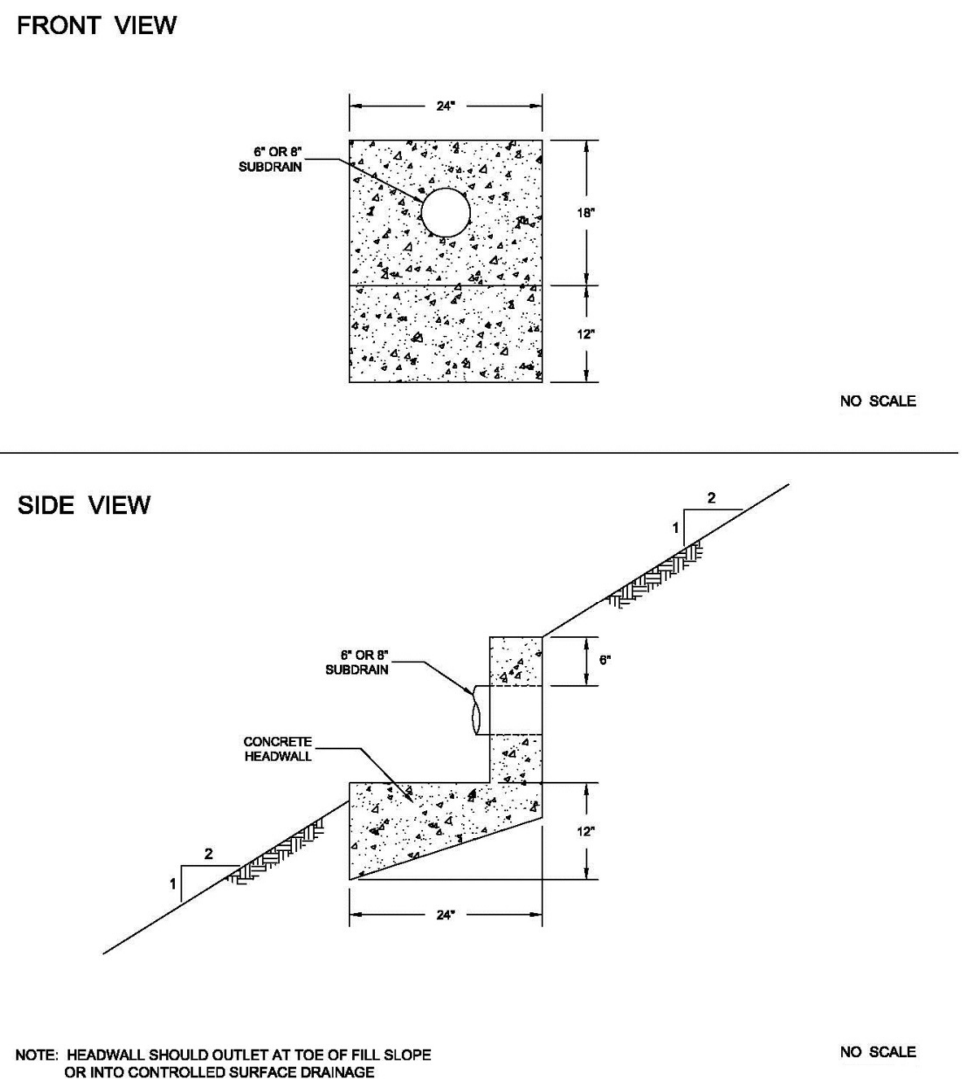


SIDE VIEW



7.6 Subdrains that discharge into a natural drainage course or open space area should be provided with a permanent headwall structure.

TYPICAL HEADWALL DETAIL



7.7 The final grading plans should show the location of the proposed subdrains. After completion of remedial excavations and subdrain installation, the project civil engineer should survey the drain locations and prepare an “as-built” map showing the drain locations. The final outlet and connection locations should be determined during grading operations. Subdrains that will be extended on adjacent projects after grading can be placed on formational material and a vertical riser should be placed at the end of the subdrain. The grading contractor should consider videoing the subdrains shortly after burial to check proper installation and functionality. The contractor is responsible for the performance of the drains.

8. OBSERVATION AND TESTING

8.1 The Consultant shall be the Owner's representative to observe and perform tests during clearing, grubbing, filling, and compaction operations. In general, no more than 2 feet in vertical elevation of *soil* or *soil-rock* fill should be placed without at least one field density test being performed within that interval. In addition, a minimum of one field density test should be performed for every 2,000 cubic yards of *soil* or *soil-rock* fill placed and compacted.

8.2 The Consultant should perform a sufficient distribution of field density tests of the compacted *soil* or *soil-rock* fill to provide a basis for expressing an opinion whether the fill material is compacted as specified. Density tests shall be performed in the compacted materials below any disturbed surface. When these tests indicate that the density of any layer of fill or portion thereof is below that specified, the particular layer or areas represented by the test shall be reworked until the specified density has been achieved.

8.3 During placement of *rock* fill, the Consultant should observe that the minimum number of passes have been obtained per the criteria discussed in Section 6.3.3. The Consultant should request the excavation of observation pits and may perform plate bearing tests on the placed *rock* fills. The observation pits will be excavated to provide a basis for expressing an opinion as to whether the *rock* fill is properly seated and sufficient moisture has been applied to the material. When observations indicate that a layer of *rock* fill or any portion thereof is below that specified, the affected layer or area shall be reworked until the *rock* fill has been adequately seated and sufficient moisture applied.

8.4 A settlement monitoring program designed by the Consultant may be conducted in areas of *rock* fill placement. The specific design of the monitoring program shall be as recommended in the Conclusions and Recommendations section of the project Geotechnical Report or in the final report of testing and observation services performed during grading.

8.5 We should observe the placement of subdrains, to check that the drainage devices have been placed and constructed in substantial conformance with project specifications.

8.6 Testing procedures shall conform to the following Standards as appropriate:

8.6.1 Soil and Soil-Rock Fills:

8.6.1.1 Field Density Test, ASTM D 1556, *Density of Soil In-Place By the Sand-Cone Method.*

8.6.1.2 Field Density Test, Nuclear Method, ASTM D 6938, *Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).*

8.6.1.3 Laboratory Compaction Test, ASTM D 1557, *Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Pound Hammer and 18-Inch Drop*.

8.6.1.4. Expansion Index Test, ASTM D 4829, *Expansion Index Test*.

9. PROTECTION OF WORK

9.1 During construction, the Contractor shall properly grade all excavated surfaces to provide positive drainage and prevent ponding of water. Drainage of surface water shall be controlled to avoid damage to adjoining properties or to finished work on the site. The Contractor shall take remedial measures to prevent erosion of freshly graded areas until such time as permanent drainage and erosion control features have been installed. Areas subjected to erosion or sedimentation shall be properly prepared in accordance with the Specifications prior to placing additional fill or structures.

9.2 After completion of grading as observed and tested by the Consultant, no further excavation or filling shall be conducted except in conjunction with the services of the Consultant.

10. CERTIFICATIONS AND FINAL REPORTS

10.1 Upon completion of the work, Contractor shall furnish Owner a certification by the Civil Engineer stating that the lots and/or building pads are graded to within 0.1 foot vertically of elevations shown on the grading plan and that all tops and toes of slopes are within 0.5 foot horizontally of the positions shown on the grading plans. After installation of a section of subdrain, the project Civil Engineer should survey its location and prepare an *as-built* plan of the subdrain location. The project Civil Engineer should verify the proper outlet for the subdrains and the Contractor should ensure that the drain system is free of obstructions.

10.2 The Owner is responsible for furnishing a final as-graded soil and geologic report satisfactory to the appropriate governing or accepting agencies. The as-graded report should be prepared and signed by a California licensed Civil Engineer experienced in geotechnical engineering and by a California Certified Engineering Geologist, indicating that the geotechnical aspects of the grading were performed in substantial conformance with the Specifications or approved changes to the Specifications.

LIST OF REFERENCES

1. *2022 California Building Code, California Code of Regulations, Title 24, Part 2, based on the 2018 International Building Code*, prepared by California Building Standards Commission, dated July 2022.

2. *ACI 302.2R-06, Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials*, prepared by the American Concrete Institute, dated August 2006.

3. *ACI 318-19, Commentary on Building Code Requirements for Structural Concrete,* prepared by the American Concrete Institute, dated May 2019.

4. *ACI 330-21, Commercial Concrete Parking Lots and Site Paving Design and Construction - Guide,* prepared by the American Concrete Institute, dated 2021.

5. American Society of Civil Engineers (ASCE), *ASCE 7-16, Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, 2017.

6. Bay Area Earthquake Alliance, *How Close To a Fault Do You Live?*: Website, https://bayquakealliance.org/howclose/

7. California Geological Survey (2008), *Special Publication 117A, Guidelines For Evaluating and Mitigating Seismic Hazards in California*, Revised and Re-adopted September 11, 2008.

8. California Geologic Survey (CGS), *EQ Zapp: California Earthquake Hazards Zone Application*, online map that queries California Geological Survey mapped earthquake hazard zones, https://www.conservation.ca.gov/cgs/geohazards/eq-zapp

9. County of San Diego, *San Diego County Multi Jurisdiction Hazard Mitigation Plan, San Diego, California – Final Draft,* dated 2017.

10. *Drained Residual and Fully softened Strengths and Standard Deviation – September 1, 2023, http://tstark.net/geotechnical-software*

11. Geotechnical *Investigation, Oceanside Vista, Oceanside, California,* prepared by Geocon Incorporated, dated October 12, 2005 (Project No. 07227-52-02).

12. Historical Aerial Photos. *http://www.historicaerials.com*

13. Kennedy, M. P., and S. S. Tan, 2007, *Geologic Map of the Oceanside 30'x60' Quadrangle, California*, USGS Regional Map Series Map No. 2, Scale 1:100,000.

14. *Preliminary Geotechnical Evaluation for: Oceanside Vista Residential Development, Oceanside, California,* prepared by GeoTek, Inc., dated March 21, 2007 (Project No. 3129SD3)

15. SEAOC, *OSHPD Seismic Design Maps:* Structural Engineers Association of California website, http://seismicmaps.org/

16. Unpublished reports, aerial photographs, and maps on file with Geocon Incorporated.

17. USGS, *Quaternary Fault and Fold Database of the United States*: U.S. Geological Survey website, https://www.usgs.gov/natural-hazards/earthquake-hazards/faults.

18. USGS, *Uniform Hazard Tool*, U.S. Geological Survey website, https://earthquake.usgs.gov/hazards/interactive/.