
APPENDIX K

**GEOTECHNICAL ENGINEERING STUDY
FOR
SHRINERS PROPERTY**
East Covell Boulevard
Davis, California

Project No. E24278.000
November 2024



YOUNGDAHL

ESTABLISHED 1984

Davis Eastside LLC
2251 Fair Oaks Boulevard, Suite 200
Sacramento, California 95825

Project No. E24278.000
11 November 2024

Attention: Mr. Gary Perry

Subject: **SHRINERS PROPERTY**
East Covell Boulevard, Davis, California 95618
GEOTECHNICAL ENGINEERING STUDY

References: See Page ii

Dear Mr. Perry:

In accordance with your authorization, Youngdahl Consulting Group, Inc. has prepared this geotechnical engineering study update for the project site located north of East Covell Boulevard in Davis, California. The purpose of this study was to prepare a site-specific geotechnical report that can be incorporated into design of the proposed site. To complete this task, our firm completed a subsurface exploration, laboratory testing, reviewed the referenced documents, and prepared this report in accordance with the Reference 5 contract.

Based upon our observations, the geotechnical aspects of the site appear to be suitable for support of the proposed structure provided the recommendations presented in this report are incorporated into the design and construction. Geotechnical conditions associated with site development are anticipated to include processing existing grades for preparation to receive engineered fills, the placement of engineered fills, mitigation of expansive soils, improvement for drainage controls, and the construction of foundations.

Due to the non-uniform nature of soils, other geotechnical issues may become more apparent during grading operations which are not listed above. The descriptions, findings, conclusions, and recommendations provided in this report are formulated as a whole; specific conclusions or recommendations should not be derived or used out of context. Please review the limitations and uniformity of conditions section of this report.

This report has been prepared for the exclusive use of the addressee of this report and their consultants, for specific application to this project, in accordance with generally accepted geotechnical engineering practice. Should you have any questions or require additional information, please contact our office at your convenience.

Very truly yours,
Youngdahl Consulting Group, Inc.

Reviewed by:


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Staff Engineer


Matthew J. Gross, P.E., G.E.
Senior Geotechnical Engineer/VP 11-11-24



Distribution: PDF to Client
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- References:
1. Conceptual Lotting Study for Shriners Property, prepared by Black Oak Design, dated August 2023.
 2. Site Plan for Shriners Property, prepared by CBG Civil Engineers, dated 29 May 2024.
 3. Proposal and Executed Contract for Shriners Property, prepared by Youngdahl Consulting Group, Inc., dated 23 July 2024 (Project No. E24278.000).
 4. Executed Change Order No. 1 for Shriners Property, prepared by Youngdahl Consulting Group, Inc., dated 8 October 2024 (Project No. E24278.000).
 5. Results of Infiltration Testing for Shriners Property, prepared by Youngdahl Consulting Group, Inc., dated 23 October 2024 (Project No. E24278.000).

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GEOTECHNICAL ENGINEERING STUDY FOR SHRINERS PROPERTY

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering study performed for the proposed improvements planned to be constructed at north of East Covell Boulevard in Davis, California. The vicinity map provided on Figure A-1, Appendix A shows the approximate project location.

Project Understanding

We understand that planned development will consist of the construction of single-family residences, multi-family residences, a park, and connecting roadways located north of East Covell Drive in Davis, California. The Reference 1 conceptual lotting plan indicates the development may include 714 single-family residences and 486 dwelling units within multi-family apartments. Based on discussions with the client's representative, we anticipate that the single-family residence will be one to two-stories and the apartments will be two to three-stories, of wood-frame construction, and supported by conventional shallow foundations, slab-on-grade floors, and/or mat foundations. Appurtenant construction is anticipated to include new roadways, basins, underground utilities, concrete hardscaping, and landscaping. We are unaware of any planned lift stations or other utility infrastructure and have not included those items as part of this study.

Background

Based on a limited review of historical aerial imagery, the site appears to have been agricultural land since at least 1957. In the 1957 image, a channel is visible in the northern area of the property. Rice fields appear to be located to the north of the channel, and a possible east-west oriented drainage appears to be located to the south of the channel. Between 1957 and 1968, the possible channel appears to have been graded into an unimproved access road. A residential subdivision and golf course were constructed to the west of the property between 1984 and 2003. Between June 2007 and March 2008, a pedestrian underpass below East Covell Boulevard appears to have been constructed in the southwest corner of the site. The site appears to have remained relatively unchanged since.

If studies or plans pertaining to the site exist and are not cited as a reference in this report, we should be afforded the opportunity to review and modify our conclusions and recommendations as necessary.

Purpose and Scope

Youngdahl Consulting Group, Inc. has prepared this report to provide geotechnical engineering recommendations and considerations for incorporation into the design and development of the site. The following scope of services were developed and performed for preparation of this report:

- A review of geotechnical and geologic data available to us at the time of our study;
- Performance of a field study consisting of a site reconnaissance and subsurface explorations to observe and characterize the subsurface conditions;
- Laboratory testing on representative samples collected during our field study;
- Evaluation of the data and information obtained from our field study, laboratory testing, and literature review for geotechnical conditions;
- Development of the following geotechnical recommendations and considerations regarding earthwork construction including, site preparation and grading, engineered fill criteria, seasonal moisture conditions, compaction equipment, excavation characteristics, slope configuration and grading, and drainage;

- Development of geotechnical design criteria for code-based seismicity, post-tensioned slabs, foundations, slabs on grade, and retaining walls;
- Preparation of this report summarizing our findings, conclusions, and recommendations regarding the above-described information.

2.0 SITE CONDITIONS

The following section describes our findings regarding the site conditions that we observed during our site reconnaissance and subsequent subsurface explorations.

Surface Observations

The project site is an agricultural property located north of East Covell Boulevard in Davis, California. The site is bounded by East Covell Boulevard to the south, agricultural properties to the north and east, and a residential subdivision, a golf course and rural residence to the west. The property consists of four fields which are separated by approximately east-west oriented boundaries. A meandering agricultural canal is located between the northern two fields, and unimproved access roads are located along the site perimeter and between the fields. Topography at the site is relatively flat within the southern half of the site, then gently slopes down to the north from an access road into a relatively flat field to the canal. The canal slopes were steeper than 2H:1V (Horizontal:Vertical). The field north of the canal is relatively flat. At the time of our site visit on 11 September 2024, the southern two fields were tilled and the northern two fields were plowed and furrowed. Vegetation at the site consisted of trees along the southern and western perimeter and grasses and shrubs within the canal. No standing water was observed.

Subsurface Conditions

Our field study included a site reconnaissance by a representative of our firm and a subsurface exploration program. The exploration program included the excavation of 10 test pits and the advancement of 15 exploratory borings, 9 infiltration borings, and 16 cone penetration tests (CPTs) to evaluate the subsurface soils conditions. The approximate locations of the borings and test pits are presented on Figure A-2, Appendix A. The logs from our test pit, boring, and CPT exploration program are provided in Appendix B. The results from the infiltration testing are presented in the Reference 5 report.

The subsurface soils at the project site were observed to consist of surface soils comprised of low-plasticity clays and sandy clays which were underlain by high-plasticity clays. The tilled depth was approximately 12 inches within the recent test pits. The low-plasticity clays and clayey sands were encountered in medium stiff to stiff/medium dense conditions. The high-plasticity clays were encountered approximately 2½ to 7 feet below the existing ground surface (bgs) in a stiff to very stiff condition and extended to the maximum depth explored of approximately 50 feet bgs. Thin lenses of clayey sands were encountered between approximately 35 to 45 feet bgs and were in a dense condition.

Groundwater Conditions

Groundwater table was encountered at the project site at a depth of approximately 40 feet bgs within our boring and CPTs. No impact to the development of the site for shallow facilities is expected for this condition but groundwater elevations can change. According to California Department of Water Resources Water Data Library Station Map, a groundwater well located within the southeast corner of the site was measured to have groundwater at approximate depths of 7½ feet, 14 feet, and 28 feet bgs in 1983, 2006, and 2015, respectively, which could impact deeper facilities (i.e., pipelines, manholes, that encroach this depth or wet wells) and basin construction.

Perched water conditions may also be encountered at the site; typically, during the winter and spring seasons. Clays typically have poor drainage conditions and the results of the Reference 5 infiltration testing along the eastern and northern areas of the site indicated very low infiltration rates. The presence of perched water can vary because of many factors such as the proximity to the poorly-draining clays, topographic elevations, and the presence of utility trenches.

3.0 GEOTECHNICAL SOIL CHARACTERISTICS

The geotechnical soil characteristics presented in this section of the report are based on laboratory testing from recent and previous studies and observation of samples collected from subsurface soils.

Laboratory Testing

Laboratory testing of the collected samples was directed towards evaluating the physical and engineering properties of the soil underlying the site. A description of the tests performed for this project and the associated test results are presented in Appendix B. In summary, the following tests were performed for the preparation of this report:

Table 1: Laboratory Tests

Laboratory Test	Test Standard	Summary of Results	
Direct Shear	ASTM D3080	TP-8 @ 1-2' B-6 @ 0-5'	$\Phi = 33.6^\circ$, $c = 40$ psf (90% RC) $\Phi = 29.8^\circ$, $c = 98$ psf (90% RC)
Maximum Dry Density	ASTM D1557	TP-8 @ 1-2' B-6 @ 0-5'	DD = 114.9 pcf, MC = 14.4 % DD = 116.9 pcf, MC = 13.7 %
R-Value	CTM 301	TP-10 @ 1-2' B-6 @ 0-5'	R = 20 R < 5
Expansion Index	ASTM D4829	TP-3 @ 3-4' TP-3 @ 5-6' TP-8 @ 1-2' TP-8 @ 8'	EI = 88 (Medium) EI = 118 (High) EI = 51 (Medium) EI = 114 (High)
Atterberg Limits	ASTM D4318	TP-10 @ 1-2' B-2 @ 6-6.5'	LL = 39; PL = 19; PI = 20 (CL) LL = 68; PL = 21; PI = 57 (CH)
Unconfined Compressive Strength	ASTM D2166	B-1 @ 11-11.5' B-1 @ 26-26.5' B-4 @ 3.5-4' B-12 @ 6-6.5'	UCS = 5,700 psf, Su = 2,850 psf UCS = 2,400 psf, Su = 1,220 psf UCS = 11,180 psf, Su = 5,590 psf UCS = 1,240 psf, Su = 620 psf
Sieve Analysis	ASTM D6913	B-1 @ 46-46.5'	0% > No. 4, 49.0% < No. 200
Sieve Analysis with Hydrometer	ASTM D6913 and S7928	B-2 @ 3.5-4'	0% > No. 4; 97.5% < No. 200; 27.1% < 1 μ m
Amount Finer than No. 200	ASTM D1140	B-2 @ 6-6.5' B-5 @ 3.5-4' B-6 @ 3.5-4' B-15 @ 3.5-4' TP-8 @ 1-2'	98.0% < No. 200 86.6% < No. 200 88.0% < No. 200 35.4% < No. 200 87.5% < No. 200
Corrosivity Suite	CA DOT Tests 417, 422 and 643	See Soil Corrosivity Section	

Soil Expansion Potential

We observed expansive soils in all of our borings and test pits. The clay samples were tested to have medium to high (EI = 51, 88, 114, and 118) expansion potentials. The findings to date suggest that the expansion potential is stratified with the near surface materials. Clays with higher expansion were encountered below the surficial moderately expansive clays. Due to the presence

of plastic materials observed, special design considerations for expansive soils should be planned.

Soil Corrosivity

A corrosivity testing suite consisting of soil pH, resistivity, sulfate, and chloride content tests were performed on selected soil samples collected during our recent site exploration. We are not corrosion specialists and recommend that the results be evaluated by a qualified corrosion expert. The laboratory test results (provided by Sunland Analytical, Inc.) are provided in Appendix B.

Table 2: Corrosivity Summary

Location	Depth (in)	Soil pH	Minimum Resistivity ohm-cm (x1000)	Chloride (ppm)	Sulfate (ppm)	Caltrans Environment	ACI Environment
TP-4	1-2	7.49	1.13	4.8	14.0	Potentially Corrosive	S0 (Not a Concern)
TP-10	1-2	7.00	1.50	7.0	17.3	Potentially Corrosive	S0 (Not a Concern)
B-4	3-3.4	7.01	0.80	61.4	74.3	Potentially Corrosive	S0 (Not a Concern)
B-11	6-6.5	7.65	1.15	19.5	61.8	Potentially Corrosive	S0 (Not a Concern)

According to Caltrans Corrosion Guidelines Version 3.2, May 2021, the test results appear to indicate a potentially corrosive environment due to low resistivity. According to the 2022 California Building Code Section 1904.1 and ACI 318-19 Table 19.3.1.1, the test results indicate the onsite soils have a negligible potential for sulfide attack of concrete. Accordingly, Type I/II Portland cement is appropriate for use in concrete construction. A certified corrosion engineer should be consulted to review the tests and site conditions in order to develop specific mitigation recommendations if metallic pipes or structural elements are designed to be in contact with or buried in soil.

4.0 GEOLOGY AND SEISMICITY

The geologic portion of this report includes a review of geologic data pertinent to the site based on an interpretation of our observations of the surface exposures and our observations in our exploratory test pits, borings, and CPTs.

Geologic Conditions

The site is located within the Great Valley geomorphic province of California. This province is underlain by Cretaceous, Tertiary and Quaternary age sediments which may exceed 16,000 feet in thickness in the Davis Area (Harwood & Helley, 1987). The Cretaceous age rocks consist of indurated marine sandstones and shales. The consolidated Tertiary sediments consist of interbedded stream and lake deposits. The Quaternary age sediments consist of poorly consolidated stream and lake deposits composed of alluvial gravels, sands, silts, and clays. Based upon a review of the Preliminary Geologic Map of the Sacramento 30' x 60' Quadrangle (Gutierrez, C.I., 2011), the site is primarily mapped as Holocene alluvial fan deposits (map unit Qhf) with a portion of the northeast and vicinity to the north mapped as Holocene basin deposits.

Seismicity

Our evaluation of seismicity for the project site included reviewing existing fault maps and obtaining seismic design parameters from the USGS online calculators and databases. For the

purpose of this study, we used a latitude and longitude of 38.567519, 121.708358 to identify the project site.

Alquist-Priolo Regulatory Faults

Based upon the records currently available from the California Department of Conservation, the project site is not located within an Alquist-Priolo Regulatory Review Zone and there are no known faults located at the subject site. We do not anticipate special design or construction requirements for faulting at this project site.

Code Based Seismic Criteria

Based upon the subsurface conditions encountered during our study and our experience in the area, the site should be classified as Site Class D. The structural engineer should review the conditions of the exception and the final choice of design parameters remains the purview of the project structural engineer.

Table 3: Seismic Design Parameters*

	Reference	Seismic Parameter	Recommended Value
ASCE 7-16	Table 20.3-1	Site Class	D
	Figure 22-7	Maximum Considered Earthquake Geometric Mean (MCEC) PGA	0.332g
	Table 11.8-1	Site Coefficient F_{PGA}	1.268
	Equation 11.8-1	$PGA_M = F_{PGA} PGA$	0.421g
2022 CBC	Figure 1613.2.1(1)	Short-Period MCE at 0.2s, S_S	0.789g
	Figure 1613.2.1(2)	1.0s Period MCE, S_1	0.309g
	Table 1613.2.3(1)	Site Coefficient, F_a	1.184
	Table 1613.2.3(2)	Site Coefficient, F_v	1.991
	Equation 16-36	Adjusted MCE Spectral Response Parameters, $S_{MS} = F_a S_S$	0.935g
	Equation 16-37	Adjusted MCE Spectral Response Parameters, $S_{M1} = F_v S_1$	0.615g
	Equation 16-38	Design Spectral Acceleration Parameters, $S_{DS} = \frac{2}{3} S_{MS}$	0.623g
	Equation 16-39	Design Spectral Acceleration Parameters, $S_{D1} = \frac{2}{3} S_{M1}$	0.410g
	Table 1613.2.5(1)	Seismic Design Category (Short Period), Occupancy I to IV	D
	Table 1613.2.5(2)	Seismic Design Category (1-Sec Period), Occupancy I to IV	D

*Based on the online calculator available at <https://earthquake.usgs.gov/ws/designmaps/>

Earthquake Induced Liquefaction, Settlement, and Surface Rupture Potential

Liquefaction is the sudden loss of soil shear strength and sudden increase in porewater pressure caused by shear strains, as could result from an earthquake. Research has shown that saturated, loose to medium-dense sands with a silt content less than about 25 percent and located within the top 40 feet are most susceptible to liquefaction and surface rupture/lateral spreading. Typically, recent alluvial deposits such as those present on site are more susceptible to liquefaction. Lateral displacement was not considered since the site is relatively flat.

Earthquake induced settlement associated with liquefaction could be separated into free-field settlements (i.e., settlement of the ground surface), building settlement (i.e., settlement of the building relative to the ground surface), and ejecta (e.g., sand boils). The total settlement of the buildings is the combination of the free-field settlement, liquefaction induced building settlement, and ejecta.

Free-Field Settlement

An analysis of the liquefaction potential for these layers was performed using the computer-based program CLiq v.3.5.2.22 developed by Geologismiki, Inc. The methods used include those

described by Robertson (2009) with settlement calculations based on methods presented by Zhang, et al. (2002) and incorporate thin layer correction. We used a design earthquake moment magnitude of 6.51 and a peak ground acceleration of 0.42g based on the USGS disaggregation tool and ASCE 7-16, respectively. The groundwater elevation was set to a depth of 7½ feet based on the groundwater conditions section of this report.

Based upon the CPT findings collected during our recent exploration of the upper 50 feet of site materials, a liquefaction/seismic settlement of about 0.55 inches was calculated. These results appear to be in general agreement with parametric reviews using Idriss & Boulanger (2008) and Robertson (NCEER 2001). These methods utilize summation method throughout a soil profile. Although possible that liquefaction could occur at depth, the potential for manifestation of the entire calculated settlement at the ground surface becomes less with increasing depth.

Liquefaction Potential Index (Iwasaki, 1978)

We considered other methods of evaluation by using the liquefaction potential index (LPI) developed by Iwasaki, et al., 1978. This method considers depth and thickness of the liquefiable layer in respect to the surface effects of liquefaction. Based on this evaluation, the LPI is calculated to be approximately 1, depending on triggering method which is considered to have a low potential for liquefaction for the selected method.

Liquefaction Severity Number

We considered other manifestations method of evaluation using the liquefaction severity number (LSN). This method considers depth to liquefiable layers in respect to potential damage to surface layers. Based on this evaluation, the LSN is calculated to be approximately 4, depending on triggering method which is considered to have little to no expression of liquefaction for the selected method.

Ejecta

The ejection of sands or materials from the ground surface following a seismic event is referred to as ejecta. Based on the thickness of the overlying clay layer, ejecta is not anticipated.

Lateral Displacement

The project site and the surrounding area are relatively flat; therefore, the potential for lateral displacement was not considered to have a potential impact for this project.

Mitigation for Liquefaction

Based on information presented above, the potential for seismically induced damage due to liquefaction, surface ruptures, and settlement is considered low. Therefore, mitigation for these potential hazards is not considered necessary for the development of this project.

Static and Seismically Induced Slope Instability

The existing slopes within the agricultural canal were observed to be steeper than 2H:1V (Horizontal:Vertical) with erosion along the edges. The remaining slopes at the site were observed to have adequate vegetation on the slope face, appropriate drainage away from the slope face, and no apparent tension cracks or slump blocks in the slope face or at the head of the slope. No other indications of slope instability such as seeps or springs were observed. Therefore, the potential for seismically induced slope instability for the existing slopes beyond the canal is considered low.

Questionable Soils (Existing Fills)

As previously mentioned, the existing access road between the fields south of the channel may be constructed of undocumented fills over a possible drainage area. The access road is similar elevations with the southern adjacent field, and the slope down from the road to the northern field is shallow, so the fills may be relatively shallow. Additionally, the southern two fields had been tilled on the order of 1 foot deep, and the northern two fields contained furrows and ridges with vertical differences on the order of one foot. These undocumented fills are not considered suitable for reuse in their current condition. Considering the historical farming use, other undocumented fills may be found during grading operations.

5.0 DISCUSSION AND CONCLUSIONS

Based upon the results of our field explorations, findings, and analysis described above, it is our opinion that construction of the proposed improvements is feasible from a geotechnical standpoint, provided the recommendations contained in this report are incorporated into the design plans, specifications, and implemented during construction. The native soils, once processed and compacted as recommended below, may be considered “engineered” and suitable for support of the planned improvements.

Geotechnical Considerations for Development

The project site is generally comprised of stiff clays which is considered suitable for support of the proposed improvements. Generally, issues associated with development on sites with these conditions include the presence of expansive soils, the presence of loose/soft soils/undocumented fills, and drainage associated with low-permeable materials.

Considering that expansive soils are present in the development area, we have prepared this report to include recommendations for design and construction within these materials. For foundations on expansive soils, we have provided recommendations for foundations with increased reinforcement. For slabs-on-grade on expansive soils, we have provided recommendations for increased reinforcement. For pavements, we have provided recommendations for lime treatment for increased support and shrink/swell mitigation.

The access roads may be constructed of undocumented fills, and the fields have been repeatedly tilled. The access road fills are anticipated to be relatively shallow, and till depths on the order of 12 inches were encountered in our recent test pits. These materials are expected to be able to be processed with surficial methods. Potholes may be conducted across the site prior to grading to more precisely plan the necessary depths of grading. These materials should be processed and recompacted as discussed in Section 6.0.

Basin and utility excavation will encounter fat clays which are more expansive than the surface clays. Consideration should be given to suitable placement areas. We recommend conducting a clay survey after the mass grading operations are completed in order to identify any areas that may require location specific treatment methods and prepare any supplemental foundation design and construction recommendations as the observed conditions dictate.

6.0 SITE GRADING AND EARTHWORK IMPROVEMENTS

Excavation Characteristics

The uppermost site soils are anticipated to be excavatable with conventional earthwork equipment, such as a backhoe or mini-excavator. Mass grading operations have generally been performed with scrapers and motor graders in combination with CAT 815 compactors.

Based on our understanding of the project, we anticipate that the majority or all of the project could be completed using open excavations. Open excavation is the typical excavation approach performed on utility installations. This approach utilizes excavation equipment such as excavators or backhoes to remove soils to a specified depth. Based on the test pits performed as part of our report and local experience, we expect that the site soils can be excavated using conventional excavating equipment, such as a medium sized excavator (i.e., CAT 320) for trench excavations. It is the responsibility of the contractor to appropriately apply construction methods to execute the proposed task

Soil Moisture Considerations

The compaction of soil to a desired relative compaction is dependent on conditioning the soil to a target range of moisture content. Moisture contents that are excessively dry or wet could limit the ability of the contractor to compact soils to the requirements for engineered fill. When dry, moisture should be added to the soil and the soils blended to improve consistency. Wet soil will need to be dried to become compactable. Generally, this includes blending and working the soil to avoid trapping moisture below a dryer surficial crust. Other options are available to reduce the time involved but typically have higher costs and require more evaluation prior to implementation.

The largest contributor to excessive soil moisture is generally precipitation and seepage during the rainy season. In recognition of this, we suggest that consideration be given to the seasonal limitations and costs of winter grading operations on the site. Special attention should be given regarding the drainage of the project site. If the project is expected to work through the wet season, the contractor should install appropriate temporary drainage systems at the construction site and should minimize traffic over exposed subgrades due to the moisture-sensitive nature of the on-site soils. During wet weather operations, the soil should be graded to drain and should be sealed by rubber tire rolling to minimize water infiltration.

Due to the surficial clay soils, grading operations can become difficult during the winter season. This is particularly of interest for preparing the subgrade for pavements. It has been our experience that preparing subgrade and aggregate base rock to receive pavements during the winter and spring seasons can be difficult and likely require the use of alternative support methods such as geogrid reinforcement or chemical stabilization.

Site Preparation

Preparation of the project site should involve demolition, site drainage controls, dust control, clearing and stripping, overexcavation and recompaction of loose/soft native soils, and exposed grade compaction, and expansive soil mitigation considerations. The following paragraphs state our geotechnical comments and recommendations concerning site preparation.

Demolition

As part of the demolition operation, any unwanted foundation, structural improvement, or site improvement elements (including underground utilities) should be exhumed and removed from the site. In addition, any underground storage tanks, abandoned wells or other utilities not intended for reuse should be removed or backfilled in accordance with the appropriate regulations.

Concrete and asphalt separated from the other debris, and adequately broken down in particle size, may be mixed thoroughly with soil and placed as engineered fill as described below. If this option is exercised, a representative from our firm should be contacted to observe the adequacy of grading operations associated with the breaking and mixing of these elements.

Site Drainage Controls

We recommend that initial site preparation involve intercepting and diverting any potential sources of surface or near-surface water within the construction zones. Because the selection of an appropriate drainage system will depend on the water quantity, season, weather conditions, construction sequence, and methods used by the contractor, final decisions regarding drainage systems are best made in the field at the time of construction. All drainage and/or water diversion performed for the site should be in accordance with the Clean Water Act and applicable Storm Water Pollution Prevention Plan.

Dust Control

Dust control provisions should be provided for as required by the local jurisdiction's grading ordinance (i.e. water truck or other adequate water supply during grading). Dust control is the purview of the grading contractor.

Clearing and Stripping of Organic Materials

Clearing and stripping operations should include the removal of all organic laden materials including trees, bushes, root balls, root systems, and any soft or loose soil generated by the removal operations. Short or mowed dry grasses may be pulverized and lost within fill materials provided no concentrated pockets of organics result. It is the responsibility of the grading contractor to remove excess organics from the fill materials. **No more than 2 percent of organic material, by weight, should be allowed within the fill materials at any given location.** Preserved trees may require tree root protection which should be addressed on an individual basis by a qualified arborist.

Our recommendations are based on limited windows into the surface and interpretations thereof; therefore, a representative of our firm should be present during site clearing operations to identify the location and depth of potential fills or loose soils, some of which may not have been found during our evaluation. We should also be present to observe removal of deleterious materials, and to identify any existing site conditions which may require mitigation or further recommendations prior to site development.

Overexcavation and Recomposition of Loose Native Soils

Following general site clearing, all existing loose or saturated native soils within the development footprint should be overexcavated down to firm native materials and backfilled with engineered fill as detailed in the engineered fill section below. Any depressions extending below final grade resulting from the removal of fill materials or other deleterious materials should be properly prepared as discussed below and backfilled with engineered fill.

Overexcavation and Recomposition of Farmed Areas

Following general site clearing, all tilled areas (i.e., fields) within the development footprint should be overexcavated down to firm native materials and backfilled with engineered fill as detailed in the engineered fill section below. Any depressions extending below final grade resulting from the removal of fill materials or other deleterious materials should be properly prepared as discussed below and backfilled with engineered fill.

Overexcavation and Recomposition of Existing Fills

Following general site clearing, all existing fills within the development footprint should be overexcavated down to firm native materials and backfilled with engineered fill as detailed in the engineered fill section below. Any depressions extending below final grade resulting from the removal of fill materials or other deleterious materials should be properly prepared as discussed below and backfilled with engineered fill.

Exposed Grade Compaction

Exposed soil grades following initial site preparation activities and overexcavation operations should be scarified to a minimum depth of 8 inches and compacted to the requirements for engineered fill. Grades developed by cutting into native soils should also be scarified and recompacted in the same manner.

Prior to placing fill, the exposed grades should be in a firm and unyielding state. Any localized zones of soft or pumping soils observed within the exposed grade should either be scarified and recompacted or be overexcavated and replaced with engineered fill as detailed in the engineered fill section below.

Expansive Soil Mitigation

Expansive soils were encountered throughout the exploration program for this study. The expansive soils appeared as clay soils present across the site with lenses of intermittent sandy/silty soils below the surface soils. As such, the site grading operations should be performed to address placement and compaction of expansive materials.

Engineered Fill Criteria

All materials placed as fills on the site should be placed as "Engineered Fill" which is observed, tested, and compacted as described in the following paragraphs.

Suitability of Onsite Materials

We expect that soil generated from excavations on the site, excluding deleterious material, may be used as engineered fill. Any expansive soils should be thoroughly blended with non-expansive material prior to use as engineered fill. Asphalt concrete and concrete materials may also be mixed into the engineered fills provided they are reduced to not greater than 8 inches in maximum dimension and placed in low concentration to prevent nesting and allow for conventional testing of relative compaction.

Fill Placement and Compaction

Engineered fills should be placed in thin horizontal lifts not to exceed 12 inches in uncompacted thickness. Clay soils with similar properties to the native materials encountered during the recent subsurface exploration should be compacted with a padded drum compactor (e.g., Caterpillar 815 or equivalent). Lightweight compaction equipment may require thinner lifts to achieve the recommended relative compaction. Fills should have a maximum particle size of 8 inches unless approved by our firm.

Table 4: Recommended Relative Compaction

Fill Materials	Relative Compaction	Method
Engineered Fill (Expansive Soils)	90 to 95 percent +4% optimum moisture	ASTM D1557
Engineered Fill (Non-expansive Soils)	≥ 90 percent	ASTM D1557
Base of Overexcavation	90 percent	ASTM D1557
Utility Trench Backfill*	90 percent	ASTM D1557
Subgrade	95 percent 0 to +3% optimum moisture	ASTM D1557
Aggregate Baserock Grade	95 percent	ASTM D1557
Asphalt Concrete Pavement	92 to 96 percent	ASTM D2041 or CTM 309

*Unless otherwise noted by the governing agency.

Depending on the moisture condition of the soils, the engineered fills may require moisture conditioning to be within a suitable compaction range

Fill soil compaction should be evaluated by means of in-place density tests performed during fill placement so that the adequacy of soil compaction efforts may be determined as earthwork progresses.

Import Materials

The recommendations presented in this report are based on the assumption that the import materials will be similar to the materials present at the project site. High quality materials are preferred for import; however, these materials can be more dependent on source availability. Import material should be approved by our firm prior to transporting it to the project site.

Material for this project should consist of a material with the geotechnical characteristics presented below. If these requirements are not met, additional testing and evaluation may be necessary to determine the appropriate design parameters for foundations, pavement, and other improvements.

Table 5: Select Import Criteria

Behavior Property	Reference Document	Recommendation
Direct Shear Strength	ASTM D3080	$\geq 30^\circ$ when compacted
Plasticity Index	ASTM D4318	≤ 12
Expansion Index	ASTM D4829	≤ 20
Sieve Analysis	ASTM D1140	Not more than 30% Passing the No. 200 sieve
Maximum Aggregate Size	ASTM D1140	≤ 3 inches
R-Value	CTM 301	≥ 5

Underground Improvements

Trench Excavation

Trenches or excavations in soil should be shored or sloped back in accordance with current Cal/OSHA regulations prior to persons entering them. The potential use of a shield to protect workers cannot be precluded. Refer to the Excavation Characteristics section of Site Grading and Improvements of this report for anticipated excavation conditions.

Backfill Materials

Backfill materials for utilities should conform to the requirements of the local jurisdiction. It should be realized that permeable backfill materials will likely carry water at some time in the future.

When backfilling within structural footprints, compacted low permeability materials are recommended to be used a minimum of 5 feet beyond the structural footprint to minimize moisture intrusion.

Backfill Compaction

Backfill compaction should conform to the requirements of the local jurisdiction or to the recommendations of this report, whichever is greater. Where backfill compaction is not specified by the local jurisdiction, the backfill should be compacted to achieve the minimum relative compactions specified in Table 6 of this report.

continuous footing foundations be reinforced four No. 4 reinforcing bars, two located near the bottom of the footing and two near the top of the stem wall.

Foundation Influence Line and Slope Setback

All footings should be founded below an imaginary 2H:1V plane projected up from the bottoms of adjacent footings and/or parallel utility trenches, or to a depth that achieves a minimum horizontal clearance of 6 feet from the outside toe of the footings to the slope face, whichever requires a deeper excavation.

Subgrade Conditions

Footings should never be cast atop soft, loose, organic, slough, debris, nor atop subgrades covered by ice or standing water. A representative of our firm should be retained to observe all subgrades during footing excavations and prior to concrete placement so that a determination as to the adequacy of subgrade preparation can be made.

Shallow Footing / Stemwall Backfill

All footing/stemwall backfill soil should be compacted to the criteria for engineered fill as recommended in Section 6.0 of this report.

Pre-Saturation and Desiccation Cracks

We recommend the foundation excavations be pre-saturated to a moisture condition that is above optimum to a depth of about 12 inches from the exposed soil surface and exhibits no desiccation cracks. These conditions should be observed by our representative prior to the placement of the vapor retarder materials. The time between inspection and the placement of concrete should be limited to avoid excessive drying..

Slab-on-Grade Construction for Conventional Foundations

It is our opinion that soil-supported slab-on-grade floors could be used for the main floor of structures over conventional foundations, contingent on proper subgrade preparation. Often the geotechnical issues regarding the use of slab-on-grade floors include proper soil support and subgrade preparation, proper transfer of loads through the slab underlayment materials to the subgrade soils, and the anticipated presence or absence of moisture at or above the subgrade level. We offer the following comments and recommendations concerning support of slab-on-grade floors. The slab design (concrete mix design, curing procedures, reinforcement, joint spacing, moisture protection, and underlayment materials) is the purview of the project Structural Engineer.

Slab Subgrade Preparation

All subgrades proposed to support slab-on-grade floors should be prepared and compacted to the requirements of engineered fill as discussed in Section 6.0 of this report.

Slab Underlayment

As a minimum for slab support conditions, the slab should be underlain by a minimum 4-inch-thick crushed rock layer that is covered by a minimum 10-mil thick moisture retarding plastic membrane. The membrane may only be functional when it is above the vapor sources. The bottom of the crushed rock layer should be above the exterior grade to act as a capillary break and not a reservoir, unless it is provided with an underdrain system. The slab design and underlayment should be in accordance with ASTM E1643 and E1745.

An optional 1-inch blotter sand layer placed above the plastic membrane, is sometimes used to aid in curing of the concrete. Although historically common, this blotter layer is not currently included in slabs designed according to the 2022 Green Building Code. When omitted, special

wet curing procedures will be necessary. If installed, the blotter layer can become a reservoir for excessive moisture if inclement weather occurs prior to pouring the slab, excessive water collects in it from the concrete pour, or an external source of water enters above or bypasses the membrane.

Our experience has shown that vapor transmission through concrete is controlled through proper concrete mix design. As such, proper control of moisture vapor transmission should be considered in the design of the slab as provided by the project architect, structural or civil engineer. It should be noted that placement of the recommended plastic membrane, proper mix design, and proper slab underlayment and detailing per ASTM E1643 and E1745 will not provide a waterproof condition. If a waterproof condition is desired, we recommend that a waterproofing expert be consulted for slab design.

Slab Thickness and Reinforcement

Geotechnical reports have historically provided minimums for slab thickness and reinforcement for general crack control. The concrete mix design and construction practices can additionally have a large impact on concrete crack control. All concrete should be anticipated to crack. As such, these minimums should not be considered to be standalone items to address crack control, but are suggested to be considered in the slab design methodology.

In order to help control the growth of cracks in interior concrete from becoming significant, we suggest the following minimums. Interior concrete slabs-on-grade not subject to heavy loads, should be a minimum of 5-inches thick and reinforced. A minimum of No. 4 deformed reinforcing bars placed at 18 inches on center both ways, at the center of the structural section is suggested. Joint spacing should be provided by the structural engineer. Troweled joints recovered with paste during finishing or "wet sawn" joints should be considered every 10 feet on center. Expansion joint felt should be provided to separate floating slabs from foundations and at least at every third joint. Cracks will tend to occur at recurrent corners, curved or triangular areas and at points of fixity. Trim bars can be utilized at right angle to the predicted crack extending 40 bar diameters past the predicted crack on each side.

Pre-Saturation and Desiccation Cracks

We recommend the slab-on-grade surface be pre-saturated to a moisture condition that is above optimum to a depth of about 12 inches from the exposed soil surface and exhibits no desiccation cracks. These conditions should be observed by our representative prior to the placement of the vapor retarder materials. The time between inspection and the placement of concrete should be limited to avoid excessive drying.

Non-Expansive Soil Surface

A non-expansive soil surface could be provided below the slab in lieu of some special design measures. For this condition, the slab should be underlain by a minimum of 12 inches of non-expansive material. Open graded gravels should not be utilized for this purpose due to their ability to capture or store water. Where this 12-inch layer is provided, the slab thickness may be reduced to not less than 4 inches, reinforcement spacing increased to 24 inches on-center, and pre-saturation not performed.

Vertical Deflections

Soil-supported slab-on-grade floors can deflect downward when vertical loads are applied, due to elastic compression of the subgrade. For preliminary design of concrete floors, a modulus of subgrade reaction of $k = 100$ psi per inch would be applicable for engineered fills.

Exterior Flatwork

Exterior concrete flatwork is recommended to have a 4-inch-thick rock cushion. This could consist of vibroplate compacted crushed rock or compacted $\frac{3}{4}$ -inch aggregate baserock. If exterior flatwork concrete is against the floor slab edge without a moisture separator it may transfer moisture to the floor slab. Expansion joint felt should be provided to separate exterior flatwork from foundations and at least at every third joint. Contraction / groove joints should be provided to a depth of at least $\frac{1}{4}$ of the slab thickness and at a spacing of less than 30 times the slab thickness for unreinforced flatwork, dividing the slab into nearly square sections. Cracks will tend to occur at recurrent corners, curved or triangular areas and at points of fixity. Trim bars can be utilized at right angle to the predicted crack extending 40 bar diameters past the predicted crack on each side.

Due to the presence of expansive soils, consideration should be given to; 1) moisture conditioning the subgrade soils to above optimum moisture content, 2) underlaying the flatwork with 12 inches of non-expansive material, 3) providing thickened slab edges and installing No. 3 reinforcing bars at a spacing not greater than 18 inches on-center both ways, and/or lime-treating the flatwork areas. The methods described above are intended to reduce the potential for expansive soil damage, and the decision to utilize any or all of the methods described above is ultimately left to others.

Retaining Walls

Our design recommendations and comments regarding retaining walls for the project site are discussed below. *Retaining wall foundations should be designed in accordance with the Shallow Conventional Foundations section above.*

Retaining Wall Lateral Pressures

Based on our observations and testing, the retaining wall should be designed to resist lateral pressure exerted from a soil media having an equivalent fluid weight provided in the table below. The values presented below are not factored and are for conditions when firm native soil or engineered fill is used within the zone behind the wall defined as twice the height of the retaining wall. Additionally, the values do not account for the friction of the backfill on the retaining wall which may or may not be present depending on the wall materials and construction. **No expansive soil should be placed within the parameter “H” of the back of the walls, where “H” is the total height of the wall including the footing but excluding any key.**

The lateral pressures presented in the table below include recommendations for earthquake loading which is required for structures to be designed in Seismic Design Categories D, E, or F per Section 1803.5.12.1 of the 2022 California Building Code. The lateral pressures presented have been calculated using the Mononobe-Okabe Method derived from Wood (1973) and modified by Whitman et al. (1991). The values are intended to be used as the multiplier for uniformly distributed loads and the parameter “H”, if used.

Table 9: Retaining Wall Pressures

Wall Type	Wall Slope Configuration	Equivalent Fluid Weight (pcf)	Lateral Pressure Coefficient	Earthquake Loading (plf)	
Free Cantilever	Flat	42	0.35	7H ²	Applied 0.6H above the base of the wall
Restrained*	Flat	62	0.52	25H ²	

* Restrained conditions shall be defined as walls which are structurally connected to prevent flexible yielding, or rigid wall configurations (i.e., walls with numerous turning points) which prevent the yielding necessary to reduce the driving pressures from an at-rest state to an active state.

Design Values for Dry Stacked Walls

Dry stacked walls do not generally use the equivalent fluid weight method presented above; instead, they use design soil properties for a given soil condition such as the internal friction angle, cohesion, and bulk unit weight. Where walls are constructed, expansive soils should not be used within the total height of the wall including the footing, "H", of the wall.

The walls could include keyed or interlocking non-mortared walls such as segmental block (Basalite, Keystone, Allan Block, etc.), rockery walls, or specialty designs for proprietary systems. When this occurs, the following soil parameters would be applicable for design with the onsite native materials in a firm condition or for engineered fills. The seismic coefficient is considered to be ½ of the adjusted peak ground acceleration for the site conditions is given in Section 4.0 of this report. Some software allows for the extension of the Mononobe-Okabe Method beyond the conventional limitations and, if the method is applied, could calculate seismic values significantly higher than those provided by the multiplier method provided above.

Table 10: Generalized Design Parameters

Internal Angle of Friction	Cohesion	Bulk Unit Weight	Seismic Coefficient, Kh
29°	0 psf	120 pcf	0.211g

Wall Drainage

The criteria presented above is based on fully drained conditions as detailed in the attached Figure C-2, Appendix C. For these conditions, we recommend that a blanket of filter material be placed behind all proposed walls. Permeable materials are specified in Section 68 of the California Department of Transportation Standard Specifications, current edition. The filter material should conform to Class 1, Type B permeable material in combination with a filter fabric to separate the open graded gravel/rock from the surrounding soils. Generally, a clean ¾ inch crushed rock should be acceptable. Consistent with Caltrans Standards, when Class 2 permeable materials are used, the filter fabric may be omitted unless otherwise designed.

The blanket of filter material should be a minimum of 12-inches thick and should extend from the bottom of the wall to within 12 inches of the ground surface. The top 12 inches of wall backfill should consist of a compacted soil cap. A filter fabric having specifications equal to or greater than those for Mirafi 140N should be placed between the gravel filter material and the surrounding soils to reduce the potential for infiltration of soil into the gravel. A 4-inch diameter drain pipe should be installed near the bottom of the filter blanket with perforations facing down. The drainpipe should be underlain by at least 4 inches of filter-type material. An adequate gradient should be provided along the top of the foundation to discharge water that collects behind the retaining wall to a controlled discharge system.

The configuration of a long retaining wall generally does not allow for a positive drainage gradient within the perforated drain pipe behind the wall since the wall footing is generally flat with no

gradient for drainage. Where this condition is present, to maintain a positive drainage behind the walls, we recommend that the wall drains be provided with a discharge to an appropriate non-erosive outlet a maximum of 50 feet on center. **In addition, if the wall drain outlets are temporarily stubbed out in front of the walls for future connection during building construction, it is imperative that the outlets be routed into the tight pipe area drainage system and not buried and rendered ineffective.**

Asphalt Concrete Pavement Design

We understand that asphalt pavements will be used for the associated roadways. The following comments and recommendations are given for pavement design and construction purposes. All pavement construction and materials used should conform to applicable sections of the latest edition of the California Department of Transportation Standard Specifications.

Relative Compaction

The asphalt concrete pavement section should be constructed to achieve the minimum relative compactions specified in Section 6.0 of this report. Deviation from the following values should be reviewed by the governing agency when the pavements are to be constructed within their right-of-way.

Subgrade Stability

All subgrades and aggregate base should be proof-rolled with a full water truck or equivalent immediately before paving, in order to evaluate their condition. If unstable subgrade conditions are observed, these areas should be overexcavated down to firm materials and the resulting excavation backfilled with suitable materials for compaction (i.e., drier native soils or aggregate base). Areas displaying significant instability may require geotextile stabilization fabric within the overexcavated area, followed by placement of aggregate base. Final determination of any required overexcavation depth and stabilization fabric should be based on the conditions observed during subgrade preparation.

Subgrade Resistance Value

Critical features that govern the durability of a pavement section include the stability of the subgrade; the presence or absence of moisture, free water, and organics; the fines content of the subgrade soils; the traffic volume; and the frequency of use by heavy vehicles. Soil conditions can be defined by a soil resistance value, or "R-Value," and traffic conditions can be defined by a Traffic Index (TI).

Laboratory testing was performed on bulk samples considered to be representative of the materials expected to be exposed at subgrade, which resulted in R-Values ranging from less than 5 to 20. Considering the low values and expansive clays, an R-Value of 5 has been used for the pavement sections this report. Following the rough grading operations, the subgrade conditions should be evaluated to determine whether adjustments to the design R-value are warranted.

Design values provided are based upon properly drained subgrade conditions. Although the R-Value design to some degree accounts for wet soil conditions, proper surface and landscape drainage design is integral in performance of adjacent street sections with respect to stability and degradation of the asphalt. If clay soils are encountered and cannot be sufficiently blended with non-expansive soils, we should review pavement subgrades to determine the appropriateness of the provided sections, and provide additional pavement design recommendations as field conditions dictate. Even minor clay constituents will greatly reduce the design R-Value.

Lime Treatment

Chemical treatment operations with lime is anticipated to provide reduced pavement sections to address low-strength subgrade conditions related to clays within subgrade soils. Site specific testing has not been performed for the subject site, and the following recommendations are based on our experience.

If chemical treatment is performed, the upper 12 inches of subgrade soils under pavement sections should be treated and compacted to a minimum relative compaction of 95 percent based on the ASTM 1557 test method at a moisture content at least 2 percent above the optimum. It has been our experience that 5 percent lime by mass has been suitable for treatment at other projects in the vicinity. Additional evaluation should be performed to study the percentage required to achieve a pH of 12.4 or greater and an unconfined compressive strength of 300 psi or greater. For estimation purposes, the unit weight of the soil may be assumed to be 110 pcf; however, the unit weight should be verified prior to implementation. Prior to the final compaction of the subgrade soils, the lime-soil mixture should be treated and allowed to rest for a period of 18 hours then scarified to the depth of the lime-treatment and should be completed within 72 hours from the start of placement. Treatment should be performed using a mixer by a specialty stabilization contractor. Any subsequent repairs to subgrade after treatment should be completed with slurry.

Chemical treatment can affect stormwater quality. The contractor should discuss the impacts to stormwater quality with their stormwater specialist and implement adequate measures to reduce the associated risks.

Section Thickness

The recommended design thicknesses presented in the following table were calculated in accordance with the methods presented in the Sixth Edition of the California Department of Transportation Highway Design Manual. A varying range of traffic indices are provided for use by the project Civil Engineer for roadway design.

Table 11: Asphalt Pavement Section Recommendations (Untreated, R-Value = 5)

Design Traffic Indices	Alternative Pavement Sections (Inches)	
	Asphalt Concrete *	Aggregate Base **
5.0	3.0	10.0
5.5	3.0	12.0
	3.5	11.0
6.0	3.0	14.0
	3.5	13.0
7.0	4.0	15.5
	4.5	14.5
8.0	4.5	18.5
	5.0	17.5
9.0	5.5	20.5
	6.0	20.0
10.0	5.0	25.5
	6.0	23.5
	7.0	21.5

* Asphalt Concrete: must meet specifications for Caltrans Hot Mix Asphalt Concrete

** Aggregate Base: must meet specifications for Caltrans Class II Aggregate Base (R-Value = minimum 78)

Table 12: Asphalt Pavement Section Recommendations (Lime-Treated, R-Value = 40)

Design Traffic Indices	Alternative Pavement Sections (Inches)	
	Asphalt Concrete *	Aggregate Base **
5.0	3.0	4.0
5.5	3.0	4.0
6.0	3.0	4.0
7.0	3.5	4.0
8.0	4.5	4.0
9.0	5.5 6.0	7.5 6.5
10.0	5.0 6.0 7.0	12.0 10.5 8.5

* Asphalt Concrete: must meet specifications for Caltrans Hot Mix Asphalt Concrete

** Aggregate Base: must meet specifications for Caltrans Class II Aggregate Base (R-Value = minimum 78)

Drainage

In order to maintain the engineering strength characteristics of the soil presented for use in this report, maintenance of the site will need to be performed. This maintenance generally includes, but is not limited to, proper drainage and control of surface and subsurface water which could affect structural support and fill integrity. A difficulty exists in determining which areas are prone to the negative impacts resulting from high moisture conditions due to the diverse nature of potential sources of water; some of which are outlined in the paragraph below. We suggest that measures be installed to minimize exposure to the adverse effects of moisture, but this will not guarantee that excessive moisture conditions will not affect the structure.

Some of the diverse sources of moisture could include water from landscape irrigation, annual rainfall, offsite construction activities, runoff from impermeable surfaces, collected and channeled water, and water perched in the subsurface soils. Some of these sources can be controlled through drainage features installed either by the owner or contractor. Others may not become evident until they, or the effects of the presence of excessive moisture, are visually observed on the property.

Some measures that can be employed to minimize the buildup of moisture include, but are not limited to proper backfill materials and compaction of utility trenches within the footprint of the proposed structures; grout plugs at foundation penetrations; collection and channeling of drained water from impermeable surfaces (i.e. roofs, concrete or asphalt paved areas); installation of subdrain/cut-off drain provisions; utilization of low flow irrigation systems; education to the proposed owners of proper design and maintenance of landscaping and drainage facilities that they or their landscaper installs.

Drainage Adjacent to Buildings

All grades should provide rapid removal of surface water runoff; ponding water should not be allowed on building pads or adjacent to foundations or other structural improvements (during and following construction). All soils placed against foundations during finish grading should be compacted to minimize water infiltration. Finish and landscape grading should include positive drainage away from all foundations. Section 1808.7.4 of the 2022 California Building Code (CBC)

Depending on the moisture condition of the soils, the engineered fills may require moisture conditioning to be within a suitable compaction range

Fill soil compaction should be evaluated by means of in-place density tests performed during fill placement so that the adequacy of soil compaction efforts may be determined as earthwork progresses.

Import Materials

The recommendations presented in this report are based on the assumption that the import materials will be similar to the materials present at the project site. High quality materials are preferred for import; however, these materials can be more dependent on source availability. Import material should be approved by our firm prior to transporting it to the project site.

Material for this project should consist of a material with the geotechnical characteristics presented below. If these requirements are not met, additional testing and evaluation may be necessary to determine the appropriate design parameters for foundations, pavement, and other improvements.

Table 5: Select Import Criteria

Behavior Property	Reference Document	Recommendation
Direct Shear Strength	ASTM D3080	$\geq 30^\circ$ when compacted
Plasticity Index	ASTM D4318	≤ 12
Expansion Index	ASTM D4829	≤ 20
Sieve Analysis	ASTM D1140	Not more than 30% Passing the No. 200 sieve
Maximum Aggregate Size	ASTM D1140	≤ 3 inches
R-Value	CTM 301	≥ 5

Underground Improvements

Trench Excavation

Trenches or excavations in soil should be shored or sloped back in accordance with current Cal/OSHA regulations prior to persons entering them. The potential use of a shield to protect workers cannot be precluded. Refer to the Excavation Characteristics section of Site Grading and Improvements of this report for anticipated excavation conditions.

Backfill Materials

Backfill materials for utilities should conform to the requirements of the local jurisdiction. It should be realized that permeable backfill materials will likely carry water at some time in the future.

When backfilling within structural footprints, compacted low permeability materials are recommended to be used a minimum of 5 feet beyond the structural footprint to minimize moisture intrusion.

Backfill Compaction

Backfill compaction should conform to the requirements of the local jurisdiction or to the recommendations of this report, whichever is greater. Where backfill compaction is not specified by the local jurisdiction, the backfill should be compacted to achieve the minimum relative compactions specified in Table 6 of this report.

Drainage Considerations

On projects with the potential for a perched groundwater condition (i.e., low permeable soils), underground utilities can become collection points for subsurface water. This is particularly true within the utility penetrations of infiltration areas such as basins. As a result, we recommend that slurry plug be installed where storm drain utilities enter and exit these areas (if present). The plugs should consist of a sand/cement slurry mixture, containing a minimum of 2 sacks of cement per cubic yard. The plugs should extend a minimum of 2 feet below bottom of the trenches and should be cut a minimum of 2 feet into the sides of the trenches and at least 5 feet long. The top of the plug should extend upward to finish grade elevation. Or 12 inches above the freeboard elevation.

Slope Configuration and Grading

Generally, a cut slope orientation of 2H:1V (Horizontal:Vertical) is considered stable with the material types encountered on the site provided the slope is less than 10 feet in height. A fill slope constructed at the same orientation is considered stable if compacted to the engineered fill recommendations as stated in the recommendations section of this report and less than 10 feet in height. Slopes 10 feet or greater in height should not exceed 3H:1V unless we are further consulted to evaluate the slope stability. All slopes should have appropriate drainage and vegetation measures to minimize erosion of slope soils.

Placement of Fills on Slopes

The site is comprised of rolling terrain. Depending on the final grading configuration, fill placement could occur within sloping ground conditions. Where this occurs, placement of fill material on natural slopes should be stabilized by means of keyways and benches. Where the slope of the original ground equals or exceeds 5H:1V, a keyway should be constructed at the base of the fill. The keyway should consist of a trench excavated to a depth of at least 2 feet into firm, competent materials. The keyway should consist of a trench excavated to a depth of at least 2 feet into firm, competent materials for fill slopes up to 10 vertical feet tall, at least 3 feet deep for fill slopes higher than 10 vertical feet, or as designated by our firm based on the conditions at the time of construction. Benches should be cut into the original slope as the filling operation proceeds. Each bench should consist of a level surface excavated at least 6 feet horizontally into firm soils. The rise between successive benches should not exceed 36 inches. Preliminarily, subdrain installation should be anticipated within benches where the fills exceed 10 feet in height. The need for additional subdrainage should be evaluated at the time of construction.

Slope Face Compaction

All slope fills should be laterally overbuilt and cut back such that the required compaction is achieved at the proposed finish slope face. As a less preferable alternative, the slope face could be track walked or compacted with a wheel. If this second alternative is used, additional slope maintenance may be necessary.

Setbacks

In order to reduce damage to future improvements caused by slope erosion or slumping, appropriate slope setbacks should be used for the project. We recommend setbacks be established by a 3H:1V (Horizontal:Vertical) plane projected up from the toe of slopes upward toward improvements. Where the projected line intersects the finished ground surface, we recommend that improvements be setback at least 5 feet from the intersection or at least 5 feet from the top of slope, whichever is greater. Homes should be at least 10 feet from the intersection or at least 10 feet from the top of slope, whichever is greater.

Slope Drainage

Surface drainage should not be allowed to flow uncontrolled over any slope face. Adequate surface drainage control should be designed by the project civil engineer in accordance with the latest applicable edition of the CBC. All slopes should have appropriate drainage and vegetation measures to minimize erosion of slope soils.

7.0 DESIGN RECOMMENDATIONS

The contents of this section include recommendations for foundations, slabs-on-grade, retaining walls, pavements, and drainage.

Post Tension Slab-on-Grade (Option 1)

It is our opinion that soil-supported post tension slab-on-grade floors could be used for the main floor of the proposed structures and will be constructed on the existing native soils or recompacted soils consisting of expansive materials as described in the Engineered Fills, Section 6.0 of this report. We offer the following comments and recommendations concerning support of slab-on-grade floors. The slab design (concrete mix, reinforcement, moisture protection, and underlayment materials) is the purview of the project Structural Engineer.

The post-tensioned slab design parameters below are considered applicable to the project site soils. Post-tensioned slabs will be subject to a higher degree of movement related to expansive soil shrinkage and swelling due to their lighter soil contact pressures as compared to deepened conventional foundations. The slab design (concrete mix, reinforcement, moisture protection, and underlayment materials) is the purview of the project Structural Engineer.

Post Tension Slab-on-Grade Bearing Capacities

A localized allowable dead plus live load bearing pressure of 1,500 psf may be used for design of a post-tension slab-on-grade based on firm native soils or engineered fills. The ratio of total load to soil contact area in the horizontal plane should not exceed 750 psf for the entire slab without further review. The allowable pressures are for support of dead plus live loads and may be increased by 1/3 for short-term wind and seismic loads.

Post Tension Slab-on-Grade Lateral Capacities

The allowable lateral soil capacities are presented in the table below. The bearing capacity is for support of dead plus live loads based on the foundation configuration presented in this report. The allowable capacity may be increased by 1/3 for short-term wind and seismic loads. Lateral forces on structures may be resisted by passive pressure acting against the sides of shallow footings and/or friction between the foundation bearing material and the bottom of the footing. Section 1806.3 of the 2022 CBC allows for the combination of the friction factor and passive resistance value to lateral resistance. Consideration should be given to ignoring passive resistance where soils could be disturbed later or within 6 feet horizontally of the slope face.

Table 6: Foundation Lateral Soil Capacities

Soil Type	Design Condition	Design Value	Minimum Applied Factor of Safety
Engineered Fill or Firm Native Soil	Allowable Friction Factor*	0.35	1.5
	Allowable Passive Resistance	230 psf/ft	1.5

* Friction Factor is calculated as $\tan(\phi)$

Post-Tensioned Slab Section

Based on our experience with post tensioned slabs in the area, we anticipate that the slab may be on the order of 8 to 10 inches thick with reinforcing cables spaced at about 30 inches. Our firm does not perform calculations for structural design of this type of slab/foundation and these values should not be misconstrued as design minimums or requirements. Design for thickness and reinforcement is the purview of the structural engineer.

Geotechnical Design Parameters

A post-tension slab-on-grade foundation for expansive soil conditions may be used for support of the proposed structures. Based on the results of our laboratory testing and the methodology described in the Standard Requirements for Design and Analysis of Shallow Post-Tensioned Concrete Foundations on Expansive and Stable Soils, PTI DC10.5-19, prepared by the Post-Tensioning Institute, we anticipate the following design parameters are suitable for use in designing the post-tension slab.

Table 7: Expansive Soil Parameters for Post Tension Slabs

Parameter		Design Value	
Thornthwaite Index		-21	
Wettest Suction		3.0 pF	
Driest Suction		4.5 pF	
Equilibrium Suction		3.92 pF	
Lift Criteria	Edge Lift	Edge Drop (Center Lift)	
e_m	2.9 feet	5.5 feet	
y_m	2.31 inches	0.83 inches	

Edge Moisture Protection

The local practice generally uses a uniform slab thickness as opposed to the conventional ribbed foundation. While this method is intended to maintain the stiffness of the conventional system, it is more susceptible to edge moisture fluctuations which results in foundation tilt (localized expansion of the soil) or gaps between the soils and the edge of the slab foundation (localized contraction of the soil). It has been our experience that this risk increases for soils with moderate-high to high expansion potential. To reduce the risks associated with this condition, we recommend a moisture barrier around the perimeter of the foundation. The moisture barrier should extend to a minimum of 18 inches below the lowest adjacent soil grade and be under or at the perimeter edge. This edge protection should consist of concrete materials used for this purpose and should be a minimum of 8 inches wide.

Pre-Saturation and Desiccation Cracks

We recommend the slab-on-grade surface be pre-saturated to a moisture condition that is above optimum to a depth of about 12 inches from the exposed soil surface and exhibits no desiccation cracks. These conditions should be observed by our representative prior to the placement of the vapor retarder materials. The time between inspection and the placement of concrete should be limited to avoid excessive drying.

Post-Tensioned Slab Underlayment and Vertical Moisture Protection

Due to the potential for landscape to be present directly adjacent to the slab edge/foundation or for drainage to be altered following our involvement with the project, varying levels of moisture below, at, or above the pad subgrade level should be anticipated. The slab designer should consider the potential for moisture vapor transmission when designing the slab. Our experience has shown that vapor transmission through concrete is controlled through slab thickness as well as proper concrete mix design. It should be noted that placement of the recommended plastic

membrane, proper mix design, and proper slab underlayment and detailing per ASTM E1643 and E1745 will not provide a waterproof condition. If a waterproof condition is desired, we recommend that a waterproofing expert be consulted for slab design.

The 2022 California Green Building Standards Code addresses the use of capillary breaks in Section 4.505.2.1 and allows for the installation of a conventional aggregate capillary break, other methods approved by the enforcing agency, or when the slab is designed by a licensed design professional and refers to ACI PRC 302.2-22 for additional information.

Based on our experience with post-tensioned slabs on grade, it is conventional practice to construct post-tensioned slabs without a conventional capillary break. When the conventional capillary break has been eliminated, a vapor retarder with a significantly reduced permeance has been incorporated into the design to reduce the potential for vapor transmission through the slab (i.e. a permeance of 0.01 perms or lower). The current minimum standard for vapor retarders is presented in ASTM E1745 and indicates that the maximum requirement for a vapor retarder is 0.1 perms. The structural designer of the slab should consider the impacts of the permeance in the proposed design.

Moisture Maintenance

Maintaining uniformity in moisture content for the life of the structure is considered paramount to minimizing the potential of for shrinkage and swell of the near-surface soil and for optimum foundation and slab performance. In landscaping areas adjacent to the foundation and other improvements, it is suggested that the homeowner establish landscaping with an automated watering system around the foundation in order to reduce the fluctuation in moisture content of the foundation soils caused by wet and dry weather cycles. Some features that could be incorporated to promote a constant moisture condition included the use of 4 to 6 inches of bark with planter areas and the avoidance of rock-lined swales and groundcover which tend to bake out moisture in high temperature seasons. Overwatering of landscape must be avoided. Additionally, planters should be constructed to slope to abundant area drainage inlets which should be installed flush to the adjacent grade.

It has been our experience that trees planted near foundation and flatwork elements contribute to moisture-related issues, especially during periods of drought. The trees tend to require significant amounts of water which are drawn from the local soils. The Post-Tension Institute recognized the effects of tree drying in the 3rd Edition of the PTI Design Manual and has provided limited recommendations for counteracting the effects. We recommend working with the landscape contractor to avoid the condition.

Shallow Conventional Foundations (Option 2)

Shallow conventional foundation systems are considered suitable for construction of the planned improvements, provided that the site is prepared in accordance with the recommendations discussed in Section 6.0 of this report.

The provided values do not constitute a structural design of foundations which should be performed by the structural engineer. In addition to the provided recommendations, foundation design and construction should conform to applicable sections of the 2022 California Building Code.

Foundation Capacities

The foundation bearing and lateral capacities are presented in the table below. The allowable bearing capacity is for support of dead plus live loads based on the foundation configuration

presented in this report. The allowable capacity may be increased by 1/3 for short-term wind and seismic loads. Lateral forces on structures may be resisted by passive pressure acting against the sides of shallow footings and/or friction between the foundation bearing material and the bottom of the footing. Section 1806.3 of the 2022 CBC allows for the combination of the friction factor and passive resistance value to lateral resistance. Consideration should be given to ignoring passive resistance where soils could be disturbed later or within 6 feet horizontally of the slope face.

Table 8: Foundation Capacities

Soil Type	Design Condition	Design Value	Minimum Applied Factor of Safety
Engineered Fill or Firm Native Soil	Allowable Bearing Capacity	2,000 psf	3.0
	Allowable Friction Factor*	0.35	1.5
	Allowable Passive Resistance	230 psf/ft	1.5

* Friction Factor is calculated as $\tan(\phi)$

Foundation Settlement

A total settlement of less than 1 inch is anticipated; a differential settlement of 0.5 inches in 25 feet is anticipated where foundations are bearing on like materials. The settlement criteria are based upon the assumption that foundations will be sized and loaded in accordance with the recommendations in this report.

Foundation Configuration for Residential Structures

Conventional shallow foundations for residential structures should be a minimum of 12 inches wide and founded a minimum of 24 inches below the lowest adjacent soil grade for one- and two-story slab-on-grade residences. Continuous foundations should be terminated into other continuous foundations to produce a grid-like pattern. ***Isolated pad footings should not be used. The intent of this is to minimize independent movement of foundations with respect to each other due to the expansive soil conditions.***

Foundation reinforcement should be provided by the structural engineer. The reinforcement schedule should account for typical construction issues such as load consideration, concrete cracking, and the presence of isolated irregularities. At a minimum, we recommend that continuous footing foundations be reinforced four No. 4 reinforcing bars, two located near the bottom of the footing and two near the top of the stem wall.

Foundation Configuration for Retaining Wall Structures

Conventional shallow foundations for retaining wall structures should be a minimum of 24 inches wide and founded a minimum of 24 inches below the lowest adjacent soil grade. Foundation reinforcement should be provided by the structural engineer.

Foundation Configuration for Perimeter Wall Structures

Conventional shallow foundations for sound wall structures should be a minimum of 8 inches wide and founded a minimum of 30 inches below the lowest adjacent soil grade. Since perimeter walls are subject to wind loading, additional depth may be required by the structural engineer. The pilasters should be founded a minimum of 24 inches below the lowest adjacent soil grade.

Foundation reinforcement should be provided by the structural engineer. The reinforcement schedule should account for typical construction issues such as load consideration, concrete cracking, and the presence of isolated irregularities. At a minimum, we recommend that

continuous footing foundations be reinforced four No. 4 reinforcing bars, two located near the bottom of the footing and two near the top of the stem wall.

Foundation Influence Line and Slope Setback

All footings should be founded below an imaginary 2H:1V plane projected up from the bottoms of adjacent footings and/or parallel utility trenches, or to a depth that achieves a minimum horizontal clearance of 6 feet from the outside toe of the footings to the slope face, whichever requires a deeper excavation.

Subgrade Conditions

Footings should never be cast atop soft, loose, organic, slough, debris, nor atop subgrades covered by ice or standing water. A representative of our firm should be retained to observe all subgrades during footing excavations and prior to concrete placement so that a determination as to the adequacy of subgrade preparation can be made.

Shallow Footing / Stemwall Backfill

All footing/stemwall backfill soil should be compacted to the criteria for engineered fill as recommended in Section 6.0 of this report.

Pre-Saturation and Desiccation Cracks

We recommend the foundation excavations be pre-saturated to a moisture condition that is above optimum to a depth of about 12 inches from the exposed soil surface and exhibits no desiccation cracks. These conditions should be observed by our representative prior to the placement of the vapor retarder materials. The time between inspection and the placement of concrete should be limited to avoid excessive drying..

Slab-on-Grade Construction for Conventional Foundations

It is our opinion that soil-supported slab-on-grade floors could be used for the main floor of structures over conventional foundations, contingent on proper subgrade preparation. Often the geotechnical issues regarding the use of slab-on-grade floors include proper soil support and subgrade preparation, proper transfer of loads through the slab underlayment materials to the subgrade soils, and the anticipated presence or absence of moisture at or above the subgrade level. We offer the following comments and recommendations concerning support of slab-on-grade floors. The slab design (concrete mix design, curing procedures, reinforcement, joint spacing, moisture protection, and underlayment materials) is the purview of the project Structural Engineer.

Slab Subgrade Preparation

All subgrades proposed to support slab-on-grade floors should be prepared and compacted to the requirements of engineered fill as discussed in Section 6.0 of this report.

Slab Underlayment

As a minimum for slab support conditions, the slab should be underlain by a minimum 4-inch-thick crushed rock layer that is covered by a minimum 10-mil thick moisture retarding plastic membrane. The membrane may only be functional when it is above the vapor sources. The bottom of the crushed rock layer should be above the exterior grade to act as a capillary break and not a reservoir, unless it is provided with an underdrain system. The slab design and underlayment should be in accordance with ASTM E1643 and E1745.

An optional 1-inch blotter sand layer placed above the plastic membrane, is sometimes used to aid in curing of the concrete. Although historically common, this blotter layer is not currently included in slabs designed according to the 2022 Green Building Code. When omitted, special

wet curing procedures will be necessary. If installed, the blotter layer can become a reservoir for excessive moisture if inclement weather occurs prior to pouring the slab, excessive water collects in it from the concrete pour, or an external source of water enters above or bypasses the membrane.

Our experience has shown that vapor transmission through concrete is controlled through proper concrete mix design. As such, proper control of moisture vapor transmission should be considered in the design of the slab as provided by the project architect, structural or civil engineer. It should be noted that placement of the recommended plastic membrane, proper mix design, and proper slab underlayment and detailing per ASTM E1643 and E1745 will not provide a waterproof condition. If a waterproof condition is desired, we recommend that a waterproofing expert be consulted for slab design.

Slab Thickness and Reinforcement

Geotechnical reports have historically provided minimums for slab thickness and reinforcement for general crack control. The concrete mix design and construction practices can additionally have a large impact on concrete crack control. All concrete should be anticipated to crack. As such, these minimums should not be considered to be standalone items to address crack control, but are suggested to be considered in the slab design methodology.

In order to help control the growth of cracks in interior concrete from becoming significant, we suggest the following minimums. Interior concrete slabs-on-grade not subject to heavy loads, should be a minimum of 5-inches thick and reinforced. A minimum of No. 4 deformed reinforcing bars placed at 18 inches on center both ways, at the center of the structural section is suggested. Joint spacing should be provided by the structural engineer. Troweled joints recovered with paste during finishing or "wet sawn" joints should be considered every 10 feet on center. Expansion joint felt should be provided to separate floating slabs from foundations and at least at every third joint. Cracks will tend to occur at recurrent corners, curved or triangular areas and at points of fixity. Trim bars can be utilized at right angle to the predicted crack extending 40 bar diameters past the predicted crack on each side.

Pre-Saturation and Desiccation Cracks

We recommend the slab-on-grade surface be pre-saturated to a moisture condition that is above optimum to a depth of about 12 inches from the exposed soil surface and exhibits no desiccation cracks. These conditions should be observed by our representative prior to the placement of the vapor retarder materials. The time between inspection and the placement of concrete should be limited to avoid excessive drying.

Non-Expansive Soil Surface

A non-expansive soil surface could be provided below the slab in lieu of some special design measures. For this condition, the slab should be underlain by a minimum of 12 inches of non-expansive material. Open graded gravels should not be utilized for this purpose due to their ability to capture or store water. Where this 12-inch layer is provided, the slab thickness may be reduced to not less than 4 inches, reinforcement spacing increased to 24 inches on-center, and pre-saturation not performed.

Vertical Deflections

Soil-supported slab-on-grade floors can deflect downward when vertical loads are applied, due to elastic compression of the subgrade. For preliminary design of concrete floors, a modulus of subgrade reaction of $k = 100$ psi per inch would be applicable for engineered fills.

Exterior Flatwork

Exterior concrete flatwork is recommended to have a 4-inch-thick rock cushion. This could consist of vibroplate compacted crushed rock or compacted $\frac{3}{4}$ -inch aggregate baserock. If exterior flatwork concrete is against the floor slab edge without a moisture separator it may transfer moisture to the floor slab. Expansion joint felt should be provided to separate exterior flatwork from foundations and at least at every third joint. Contraction / groove joints should be provided to a depth of at least $\frac{1}{4}$ of the slab thickness and at a spacing of less than 30 times the slab thickness for unreinforced flatwork, dividing the slab into nearly square sections. Cracks will tend to occur at recurrent corners, curved or triangular areas and at points of fixity. Trim bars can be utilized at right angle to the predicted crack extending 40 bar diameters past the predicted crack on each side.

Due to the presence of expansive soils, consideration should be given to; 1) moisture conditioning the subgrade soils to above optimum moisture content, 2) underlaying the flatwork with 12 inches of non-expansive material, 3) providing thickened slab edges and installing No. 3 reinforcing bars at a spacing not greater than 18 inches on-center both ways, and/or lime-treating the flatwork areas. The methods described above are intended to reduce the potential for expansive soil damage, and the decision to utilize any or all of the methods described above is ultimately left to others.

Retaining Walls

Our design recommendations and comments regarding retaining walls for the project site are discussed below. *Retaining wall foundations should be designed in accordance with the Shallow Conventional Foundations section above.*

Retaining Wall Lateral Pressures

Based on our observations and testing, the retaining wall should be designed to resist lateral pressure exerted from a soil media having an equivalent fluid weight provided in the table below. The values presented below are not factored and are for conditions when firm native soil or engineered fill is used within the zone behind the wall defined as twice the height of the retaining wall. Additionally, the values do not account for the friction of the backfill on the retaining wall which may or may not be present depending on the wall materials and construction. **No expansive soil should be placed within the parameter “H” of the back of the walls, where “H” is the total height of the wall including the footing but excluding any key.**

The lateral pressures presented in the table below include recommendations for earthquake loading which is required for structures to be designed in Seismic Design Categories D, E, or F per Section 1803.5.12.1 of the 2022 California Building Code. The lateral pressures presented have been calculated using the Mononobe-Okabe Method derived from Wood (1973) and modified by Whitman et al. (1991). The values are intended to be used as the multiplier for uniformly distributed loads and the parameter “H”, if used.

Table 9: Retaining Wall Pressures

Wall Type	Wall Slope Configuration	Equivalent Fluid Weight (pcf)	Lateral Pressure Coefficient	Earthquake Loading (plf)	
Free Cantilever	Flat	42	0.35	7H ²	Applied 0.6H above the base of the wall
Restrained*	Flat	62	0.52	25H ²	

* Restrained conditions shall be defined as walls which are structurally connected to prevent flexible yielding, or rigid wall configurations (i.e., walls with numerous turning points) which prevent the yielding necessary to reduce the driving pressures from an at-rest state to an active state.

Design Values for Dry Stacked Walls

Dry stacked walls do not generally use the equivalent fluid weight method presented above; instead, they use design soil properties for a given soil condition such as the internal friction angle, cohesion, and bulk unit weight. Where walls are constructed, expansive soils should not be used within the total height of the wall including the footing, "H", of the wall.

The walls could include keyed or interlocking non-mortared walls such as segmental block (Basalite, Keystone, Allan Block, etc.), rockery walls, or specialty designs for proprietary systems. When this occurs, the following soil parameters would be applicable for design with the onsite native materials in a firm condition or for engineered fills. The seismic coefficient is considered to be ½ of the adjusted peak ground acceleration for the site conditions is given in Section 4.0 of this report. Some software allows for the extension of the Mononobe-Okabe Method beyond the conventional limitations and, if the method is applied, could calculate seismic values significantly higher than those provided by the multiplier method provided above.

Table 10: Generalized Design Parameters

Internal Angle of Friction	Cohesion	Bulk Unit Weight	Seismic Coefficient, K _h
29°	0 psf	120 pcf	0.211g

Wall Drainage

The criteria presented above is based on fully drained conditions as detailed in the attached Figure C-2, Appendix C. For these conditions, we recommend that a blanket of filter material be placed behind all proposed walls. Permeable materials are specified in Section 68 of the California Department of Transportation Standard Specifications, current edition. The filter material should conform to Class 1, Type B permeable material in combination with a filter fabric to separate the open graded gravel/rock from the surrounding soils. Generally, a clean ¾ inch crushed rock should be acceptable. Consistent with Caltrans Standards, when Class 2 permeable materials are used, the filter fabric may be omitted unless otherwise designed.

The blanket of filter material should be a minimum of 12-inches thick and should extend from the bottom of the wall to within 12 inches of the ground surface. The top 12 inches of wall backfill should consist of a compacted soil cap. A filter fabric having specifications equal to or greater than those for Mirafi 140N should be placed between the gravel filter material and the surrounding soils to reduce the potential for infiltration of soil into the gravel. A 4-inch diameter drain pipe should be installed near the bottom of the filter blanket with perforations facing down. The drainpipe should be underlain by at least 4 inches of filter-type material. An adequate gradient should be provided along the top of the foundation to discharge water that collects behind the retaining wall to a controlled discharge system.

The configuration of a long retaining wall generally does not allow for a positive drainage gradient within the perforated drain pipe behind the wall since the wall footing is generally flat with no

gradient for drainage. Where this condition is present, to maintain a positive drainage behind the walls, we recommend that the wall drains be provided with a discharge to an appropriate non-erosive outlet a maximum of 50 feet on center. **In addition, if the wall drain outlets are temporarily stubbed out in front of the walls for future connection during building construction, it is imperative that the outlets be routed into the tight pipe area drainage system and not buried and rendered ineffective.**

Asphalt Concrete Pavement Design

We understand that asphalt pavements will be used for the associated roadways. The following comments and recommendations are given for pavement design and construction purposes. All pavement construction and materials used should conform to applicable sections of the latest edition of the California Department of Transportation Standard Specifications.

Relative Compaction

The asphalt concrete pavement section should be constructed to achieve the minimum relative compactions specified in Section 6.0 of this report. Deviation from the following values should be reviewed by the governing agency when the pavements are to be constructed within their right-of-way.

Subgrade Stability

All subgrades and aggregate base should be proof-rolled with a full water truck or equivalent immediately before paving, in order to evaluate their condition. If unstable subgrade conditions are observed, these areas should be overexcavated down to firm materials and the resulting excavation backfilled with suitable materials for compaction (i.e., drier native soils or aggregate base). Areas displaying significant instability may require geotextile stabilization fabric within the overexcavated area, followed by placement of aggregate base. Final determination of any required overexcavation depth and stabilization fabric should be based on the conditions observed during subgrade preparation.

Subgrade Resistance Value

Critical features that govern the durability of a pavement section include the stability of the subgrade; the presence or absence of moisture, free water, and organics; the fines content of the subgrade soils; the traffic volume; and the frequency of use by heavy vehicles. Soil conditions can be defined by a soil resistance value, or "R-Value," and traffic conditions can be defined by a Traffic Index (TI).

Laboratory testing was performed on bulk samples considered to be representative of the materials expected to be exposed at subgrade, which resulted in R-Values ranging from less than 5 to 20. Considering the low values and expansive clays, an R-Value of 5 has been used for the pavement sections this report. Following the rough grading operations, the subgrade conditions should be evaluated to determine whether adjustments to the design R-value are warranted.

Design values provided are based upon properly drained subgrade conditions. Although the R-Value design to some degree accounts for wet soil conditions, proper surface and landscape drainage design is integral in performance of adjacent street sections with respect to stability and degradation of the asphalt. If clay soils are encountered and cannot be sufficiently blended with non-expansive soils, we should review pavement subgrades to determine the appropriateness of the provided sections, and provide additional pavement design recommendations as field conditions dictate. Even minor clay constituents will greatly reduce the design R-Value.

Lime Treatment

Chemical treatment operations with lime is anticipated to provide reduced pavement sections to address low-strength subgrade conditions related to clays within subgrade soils. Site specific testing has not been performed for the subject site, and the following recommendations are based on our experience.

If chemical treatment is performed, the upper 12 inches of subgrade soils under pavement sections should be treated and compacted to a minimum relative compaction of 95 percent based on the ASTM 1557 test method at a moisture content at least 2 percent above the optimum. It has been our experience that 5 percent lime by mass has been suitable for treatment at other projects in the vicinity. Additional evaluation should be performed to study the percentage required to achieve a pH of 12.4 or greater and an unconfined compressive strength of 300 psi or greater. For estimation purposes, the unit weight of the soil may be assumed to be 110 pcf; however, the unit weight should be verified prior to implementation. Prior to the final compaction of the subgrade soils, the lime-soil mixture should be treated and allowed to rest for a period of 18 hours then scarified to the depth of the lime-treatment and should be completed within 72 hours from the start of placement. Treatment should be performed using a mixer by a specialty stabilization contractor. Any subsequent repairs to subgrade after treatment should be completed with slurry.

Chemical treatment can affect stormwater quality. The contractor should discuss the impacts to stormwater quality with their stormwater specialist and implement adequate measures to reduce the associated risks.

Section Thickness

The recommended design thicknesses presented in the following table were calculated in accordance with the methods presented in the Sixth Edition of the California Department of Transportation Highway Design Manual. A varying range of traffic indices are provided for use by the project Civil Engineer for roadway design.

Table 11: Asphalt Pavement Section Recommendations (Untreated, R-Value = 5)

Design Traffic Indices	Alternative Pavement Sections (Inches)	
	Asphalt Concrete *	Aggregate Base **
5.0	3.0	10.0
5.5	3.0	12.0
	3.5	11.0
6.0	3.0	14.0
	3.5	13.0
7.0	4.0	15.5
	4.5	14.5
8.0	4.5	18.5
	5.0	17.5
9.0	5.5	20.5
	6.0	20.0
10.0	5.0	25.5
	6.0	23.5
	7.0	21.5

* Asphalt Concrete: must meet specifications for Caltrans Hot Mix Asphalt Concrete

** Aggregate Base: must meet specifications for Caltrans Class II Aggregate Base (R-Value = minimum 78)

Table 12: Asphalt Pavement Section Recommendations (Lime-Treated, R-Value = 40)

Design Traffic Indices	Alternative Pavement Sections (Inches)	
	Asphalt Concrete *	Aggregate Base **
5.0	3.0	4.0
5.5	3.0	4.0
6.0	3.0	4.0
7.0	3.5	4.0
8.0	4.5	4.0
9.0	5.5 6.0	7.5 6.5
10.0	5.0 6.0 7.0	12.0 10.5 8.5

* Asphalt Concrete: must meet specifications for Caltrans Hot Mix Asphalt Concrete

** Aggregate Base: must meet specifications for Caltrans Class II Aggregate Base (R-Value = minimum 78)

Drainage

In order to maintain the engineering strength characteristics of the soil presented for use in this report, maintenance of the site will need to be performed. This maintenance generally includes, but is not limited to, proper drainage and control of surface and subsurface water which could affect structural support and fill integrity. A difficulty exists in determining which areas are prone to the negative impacts resulting from high moisture conditions due to the diverse nature of potential sources of water; some of which are outlined in the paragraph below. We suggest that measures be installed to minimize exposure to the adverse effects of moisture, but this will not guarantee that excessive moisture conditions will not affect the structure.

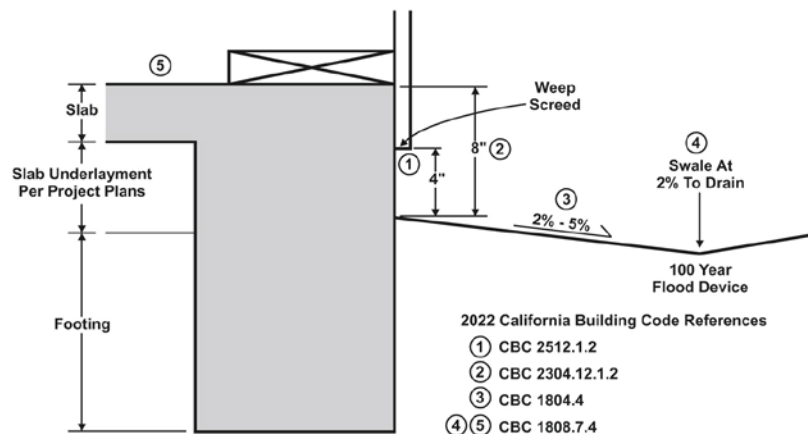
Some of the diverse sources of moisture could include water from landscape irrigation, annual rainfall, offsite construction activities, runoff from impermeable surfaces, collected and channeled water, and water perched in the subsurface soils. Some of these sources can be controlled through drainage features installed either by the owner or contractor. Others may not become evident until they, or the effects of the presence of excessive moisture, are visually observed on the property.

Some measures that can be employed to minimize the buildup of moisture include, but are not limited to proper backfill materials and compaction of utility trenches within the footprint of the proposed structures; grout plugs at foundation penetrations; collection and channeling of drained water from impermeable surfaces (i.e. roofs, concrete or asphalt paved areas); installation of subdrain/cut-off drain provisions; utilization of low flow irrigation systems; education to the proposed owners of proper design and maintenance of landscaping and drainage facilities that they or their landscaper installs.

Drainage Adjacent to Buildings

All grades should provide rapid removal of surface water runoff; ponding water should not be allowed on building pads or adjacent to foundations or other structural improvements (during and following construction). All soils placed against foundations during finish grading should be compacted to minimize water infiltration. Finish and landscape grading should include positive drainage away from all foundations. Section 1808.7.4 of the 2022 California Building Code (CBC)

states that for graded soil sites, the top of any exterior foundation shall extend above the elevation of the street gutter at the point of discharge or the inlet of an approved drainage device a minimum of 12 inches plus 2 percent. If overland flow is not achieved adjacent to buildings, the drainage device should be designed to accept flows from a 100-year event. Grades directly adjacent to foundations should be no closer than 8 inches from the top of the slab (CBC 2304.12.1.2), and weep screeds are to be placed a minimum of 4 inches clear of soil grades and 2 inches clear of concrete or other hard surfacing (CBC 2512.1.2). From this point, surface grades should slope a minimum of 2 percent away from all foundations for at least 5 feet but preferably 10 feet, and then 2 percent along a drainage swale to the outlet (CBC 1804.4). Downspouts should be tight piped via an area drain network and discharged to an appropriate non-erosive outlet away from all foundations.



**Typical 2022 California Building Code
Drainage Requirements**

The above referenced elements pertaining to drainage of the proposed structures is provided as general acknowledgement of the California Building Code requirements, restated and graphically illustrated for ease of understanding. Surface drainage design is the purview of the Project Architect/Civil Engineer. Review of drainage design and implementation adjacent to the building envelopes is recommended as performance of these improvements is crucial to the performance of the foundation and construction of rigid improvements.

Subdrainage

Reduction of potential moisture related issues could be addressed by the construction of subdrains in addition to the drainage provisions provided in the 2022 CBC. Considering that this site is down sloping from the road, a subdrain should be considered along the front of the residence to collect and redirect unwanted water from the structure.

Typical subdrain construction would include a 3 feet deep trench (or depth required to intercept the bottom of utility trenches) constructed as detailed on Figure C-3, Appendix C. The water collected in the subdrain pipe would be directed to an appropriate non-erosive outlet. We recommend that a representative from our firm be present during the subdrain installation procedures to document that the drain is installed in accordance with the observed field conditions, as well as to provide additional consultation as the conditions dictate.

As noted in the previous discussions, the moisture conditions may not manifest until after the site is developed. As such, any recommendations for the subdrain orientation and location to mitigate the moisture conditions can be provided on an as requested basis as the conditions arise.

ADA Compliance and Drainage

It should be noted that due to the Americans with Disabilities Act (ADA) requirements, design and construction of alternative site drainage configurations may be necessary, particularly for multi-family and commercial developments. In this case, design and construction of adequate drainage adjacent to foundations and slabs are essential to preserving foundation support and reducing the potential for wet slab related issues. A typical example of this condition occurs in commercial developments where the landscape grades are situated at the same elevation as the parking areas so as to not create a drop off between the grades. This condition subsequently results in flat grades between the building, landscape area, and parking lot which do not meet building code requirements and may require more substantial drain inlets.

Subsurface Water within Street Utilities

In sites developed on low permeable soil formations, water can collect in the utility trench backfill materials. Sometimes these materials are select permeable materials which allow transmission of water in the trench network. Heavy inundation of water in trenches can surpass the ability of engineered fill to maintain the strength qualities that they are designed to. In addition, if prolonged inundation occurs, the stability of subgrades can also be impacted. Planning of water storage in interim construction conditions either on street subgrades or adjacent to street subgrades should consider these impacts.

Following site development, additional water sources (i.e. landscape watering, downspouts) are generally present. The presence of low permeability materials can prohibit rapid dispersion of surface and subsurface water drainage.

Roadway or Parking Area Landscaping Drainage

Prolonged water seepage into pavement sections can result in softening of subgrade soils and subsequent pavement distress. It is anticipated that heavy landscape watering could enter and pond within the street aggregate base section as it permeates through the aggregate base under the sidewalks and/or curbs. Prolonged seepage within the pavement section could cause distress to pavements in heavy traffic areas. Some measures that can be employed to minimize the saturation of the subgrade and aggregate base materials include, but are not limited to, construction of cut-off drains or moisture barriers alongside the roadway adjacent to the roadway interface, construction of subdrains within landscape medians and installation of plug and drain systems within utility trenches. Due to the elusive and discontinuous nature of drainage related issues, a risk-based approach should be determined by the developer based on consultation and discussions with the design professionals and the amount of protection of facilities that the developer may want to provide against potential moisture related issues.

Post Construction

All drainage related issues may not become known until after construction and landscaping are complete. Therefore, some mitigation measures may be necessary following site development. Landscape watering is typically the largest source of water infiltration into the subgrade. Given the soil conditions on site, excessive or even normal landscape watering could contribute to moisture related problems and/or cause distress to foundations and slabs, pavements, and underground utilities, as well as creating a nuisance where seepage occurs.

Low Impact Development Standards

Low Impact Development or LID standards have become a consideration for many projects in the region. LID standards are intended to address and mitigate urban storm water quality concerns. These methods include the use of Source Controls, Run-off Reduction and Treatment Controls.

For the purpose of this report use of Run-off Reduction measures and some Treatment Controls may impact geotechnical recommendations for the project.

Youngdahl Consulting Group, Inc. performed the Reference 5 infiltration testing for the site as part of the Geotechnical Investigation which encountered fat clays with very low infiltration rates. A review of soil survey and the data collected from test pits and borings indicate that soils within the project are Hydrologic Soil Group D (very low permeability). Based on this condition, use of infiltration type LID methods (infiltration trenches, dry wells, infiltration basins, permeable pavements, etc.) should not be considered without addressing applicable geotechnical considerations/implications. As such, use of any LID measure that would require infiltration of discharge water to surfaces adjacent to structures/pavement or include infiltration type measures should be reviewed by Youngdahl Consulting Group, Inc. during the design process.

Infiltration and Retention Basin Offset from Buildings

The introduction of water to soils adjacent to structures could increase the potential for undesirable effects such as expansion and/or settlement and high floor moisture. For this reason, we recommend that infiltration trenches and basins are kept a minimum of 15 feet from the proposed structures. If the infiltration system must be within 15 feet from a proposed structure, they should be lined with a 30-mil HDPE membrane to prevent the concentration of water into the subsurface soils at the structure.

8.0 DESIGN REVIEW AND CONSTRUCTION MONITORING

Geotechnical engineering can be affected by natural variability of soils and, as with many projects, the contents of this report could be used and interpreted by many design professionals for the application and development of their plans. For these reasons, we recommend that our firm provide support through plan reviews and construction monitoring to aid in the production of a successful project.

Plan Review

The design plans and specifications should be reviewed and accepted by Youngdahl Consulting Group, Inc. prior to contract bidding. A review should be performed to determine whether the recommendations contained within this report are still applicable and/or are properly interpreted and incorporated into the project plans and specifications. Modifications to the recommendations provided in this report or to the design may be necessary at the time of our review based on the proposed plans.

Construction Monitoring

Construction monitoring is a continuation of geotechnical engineering to confirm or enhance the findings and recommendations provided in this report. It is essential that our representative be involved with all grading activities in order for us to provide supplemental recommendations as field conditions dictate. Youngdahl Consulting Group, Inc. should be notified at least two working days before site clearing or grading operations commence, and should observe the stripping of deleterious material, overexcavation of soft soils and existing fills (if present), and provide consultation, observation, and testing services to the grading contractor in the field. At a minimum, Youngdahl Consulting Group, Inc. should be retained to provide services listed in Table 13 below.

The recommendations included in this report have been based in part on assumptions about strata variations that may be tested only during earthwork. Accordingly, these recommendations should not be applied in the field unless Youngdahl Consulting Group, Inc. is retained to perform construction observation and thereby provide a complete professional geotechnical engineering service through the observational method. Youngdahl Consulting Group, Inc. cannot assume

responsibility or liability for the adequacy of its recommendations when they are used in the field without Youngdahl Consulting Group, Inc. being retained to observe construction.

Post Construction Drainage Monitoring

Due to the elusive nature of subsurface water, the alteration of water features for development, and the introduction of new water sources, all drainage related issues may not become known until after construction and landscaping are complete. Youngdahl Consulting Group, Inc. can provide consultation services upon request that relate to proper design and installation of drainage features during and following site development.

9.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. This report has been prepared for the exclusive use of the addressee of this report for specific application to this project. The addressee may provide their consultants authorized use of this report. Youngdahl Consulting Group, Inc. has endeavored to comply with generally accepted geotechnical engineering practice common to the local area. Youngdahl Consulting Group, Inc. makes no other warranty, expressed or implied.
2. As of the present date, the findings of this report are valid for the property studied. With the passage of time, changes in the conditions of a property can occur whether they be due to natural processes or to the works of man on this or adjacent properties. Legislation or the broadening of knowledge may result in changes in applicable standards. Changes outside of our control may cause this report to be invalid, wholly or partially. Therefore, this report should not be relied upon after a period of three years without our review nor should it be used or is it applicable for any properties other than those studied.
3. Section [A] 107.3.4 of the 2022 California Building Code states that, in regard to the design professional in responsible charge, the building official shall be notified in writing by the owner if the registered design professional in responsible charge is changed or is unable to continue to perform the duties.

WARNING: Do not apply any of this report's conclusions or recommendations if the nature, design, or location of the facilities is changed. If changes are contemplated, Youngdahl Consulting Group, Inc. must review them to assess their impact on this report's applicability. Also note that Youngdahl Consulting Group, Inc. is not responsible for any claims, damages, or liability associated with any other party's interpretation of this report's subsurface data or reuse of this report's subsurface data or engineering analyses without the express written authorization of Youngdahl Consulting Group, Inc.

4. The analyses and recommendations contained in this report are based on limited windows into the subsurface conditions and data obtained from subsurface exploration. The methods used indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Samples cannot be relied on to accurately reflect the strata variations that usually exist between sampling locations. Should any variations or undesirable conditions be encountered during the development of the site, Youngdahl Consulting Group, Inc. will provide supplemental recommendations as dictated by the field conditions.

Table 13: Checklist of Recommended Services

Item Description		Recommended	Not Anticipated
1	Provide foundation design parameters	Included	
2	Review grading plans and specifications	✓	
3	Review foundation plans and specifications	✓	
4	Observe and provide recommendations regarding demolition	✓	
5	Observe and provide recommendations regarding site stripping	✓	
6	Observe and provide recommendations on moisture conditioning removal, and/or recompaction of unsuitable existing soils	✓	
7	Observe and provide recommendations on the installation of subdrain facilities	✓	
8	Observe and provide testing services on fill areas and/or imported fill materials	✓	
9	Review as-graded plans and provide additional foundation recommendations, if necessary	✓	
10	Observe and provide compaction tests on storm drains, water lines and utility trenches	✓	
11	Observe foundation excavations and provide supplemental recommendations, if necessary, prior to placing concrete	✓	
12	Observe and provide moisture conditioning recommendations for foundation areas and slab-on-grade areas prior to placing concrete	✓	
13	Provide design parameters for retaining walls	Included	
14	Observe the installation of retaining wall drains	✓	
15	Provide finish grading and drainage recommendations	Included	
16	Provide geologic observations and recommendations for keyway excavations and cut slopes during grading		✓
17	Excavate and recompact all test pits within structural areas	✓	

APPENDIX A

Field Study

Vicinity Map

Site Plan

Logs of Exploratory Borings and Test Pits

Soil Classification Chart and Log Explanation

Logs of CPT Soundings

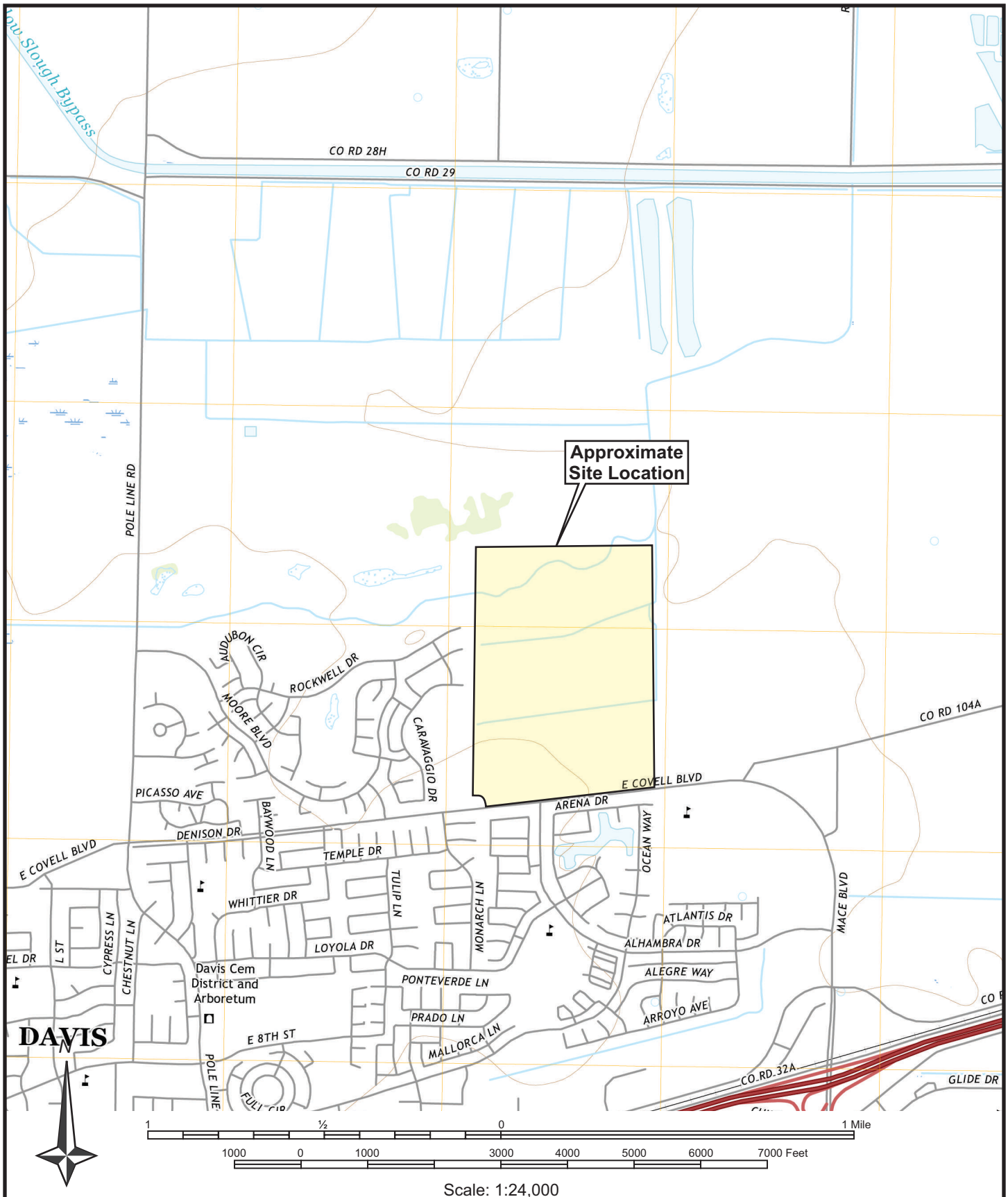
Introduction

The contents of this appendix shall be integrated with the Geotechnical Engineering Study of which it is a part. They shall not be used in whole or in part as a sole source for information or recommendations regarding the subject site.

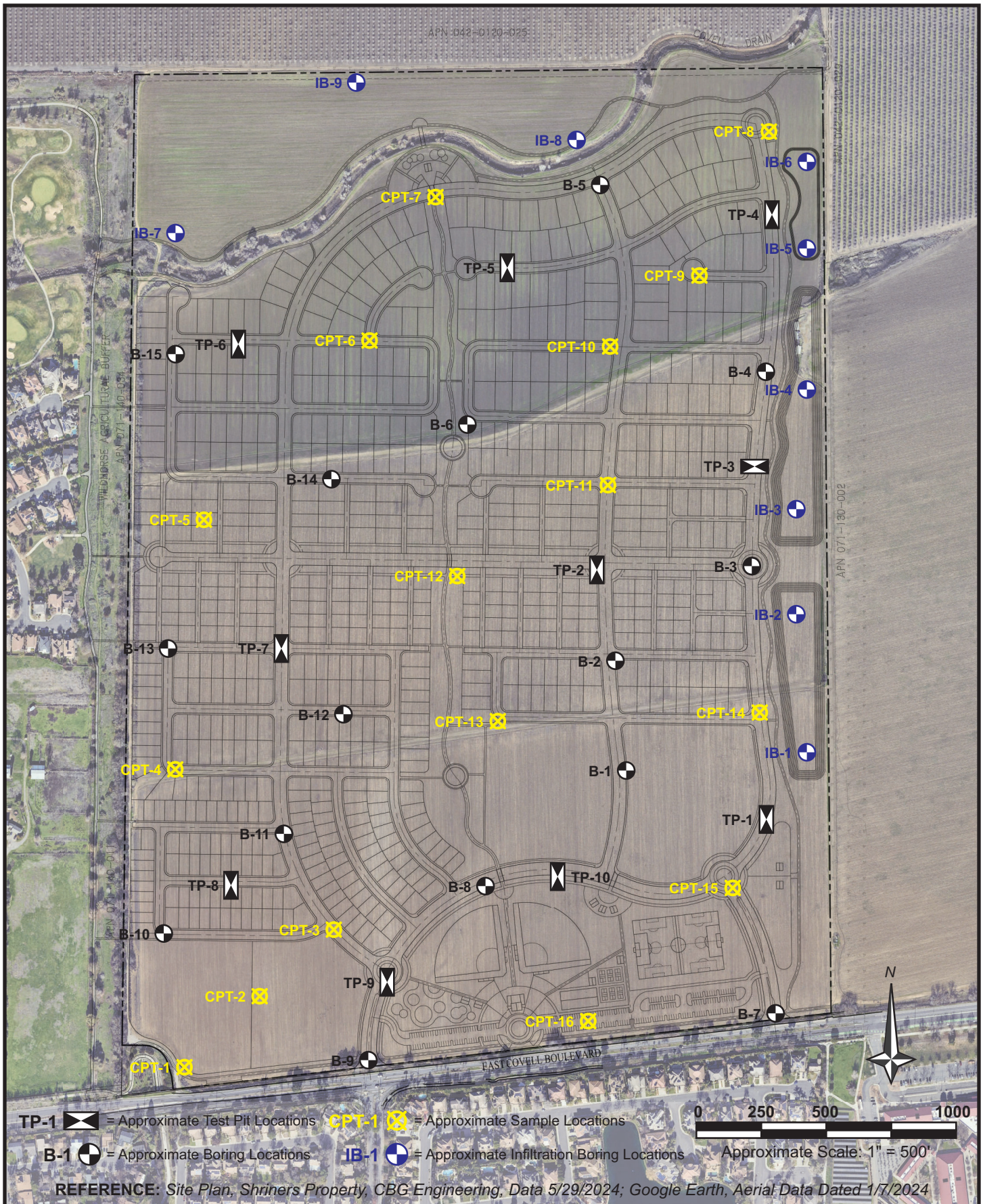
Our field study included a site reconnaissance by a Youngdahl Consulting Group, Inc. representative followed by a subsurface exploration program conducted on 11 September through 17 September 2024, which included the excavation of 10 test pits and advancement of 15 borings and 16 cone penetration test (CPT) soundings under his direction at the approximate locations shown on Figure A-2, this Appendix. Excavation of the test pits was accomplished with a John Deere 410G rubber tire-mounted backhoe equipped with a 24-inch-wide bucket. Drilling of the exploratory borings was accomplished with a CME 55 truck mounted drill rig.

Throughout the drilling operation, soil samples were obtained at 5-foot depth intervals by means of a Modified California Sampler. This testing and sampling procedure consists of driving the steel sampler 18 inches into the soil with a 140-pound hammer free-falling 30 inches. The number of blows required to drive the sampler through each 6-inch interval is counted, and the total number of blows struck during the final 12 inches is recorded. If a total of 50 blows are struck within any 6-inch interval, the driving is stopped and the blow count is recorded as 50 blows for the actual penetration distance.

The soils encountered were logged during drilling and excavations and provide the basis for the "Boring Logs" and "Test Pit Logs," Figures A-3 through A-27, this Appendix. The enclosed Boring Logs describe the vertical sequence of soils and materials encountered, based primarily on our field classifications and supported by our subsequent laboratory examination and testing. Where a soil contact was observed to be gradational, our logs indicate the average contact depth. Where a soil type changed between sample intervals, we inferred the contact depth. Our logs also graphically indicate the blow count, sample type, sample number, and approximate depth of each soil sample obtained from the borings, as well as any laboratory tests performed on these soil samples. If any groundwater was encountered in a borehole, the approximate groundwater depth is depicted on the boring log. Groundwater depth estimates are typically based on the moisture content of soil samples, the wetted height on the drilling rods, and the water level measured in the borehole after the auger has been extracted.



BASE MAP REFERENCE: U.S.G.S. 7.5 Minute Topographic Series, Davis Quadrangle, Dated 2021



Logged By: ITK		Date: 11 September 2024	Lat / Lon: N 38.566950° / W 121.704195°		Pit No. TP-1
Equipment: John Deere 410G with 24" Bucket		Pit Orientation: 180°		Elevation: ~	
Depth (Feet)	Geotechnical Description & Unified Soil Classification		Sample	Tests & Comments	
@ 0' - 5'	Yellow brown sandy CLAY (CL) , medium stiff to stiff, moist		 TP-1 @ 1-2'  TP-1 @ 7'		
@ 5' - 14.5'	Olive brown CLAY (CH) , stiff, moist				
	Test pit terminated at 14.5' No free groundwater encountered No caving noted				

0

2'

4'

6'

8'

10'

12'

14'

16'

18'

20'

22'

24'

26'

28'

2'

4'

6'

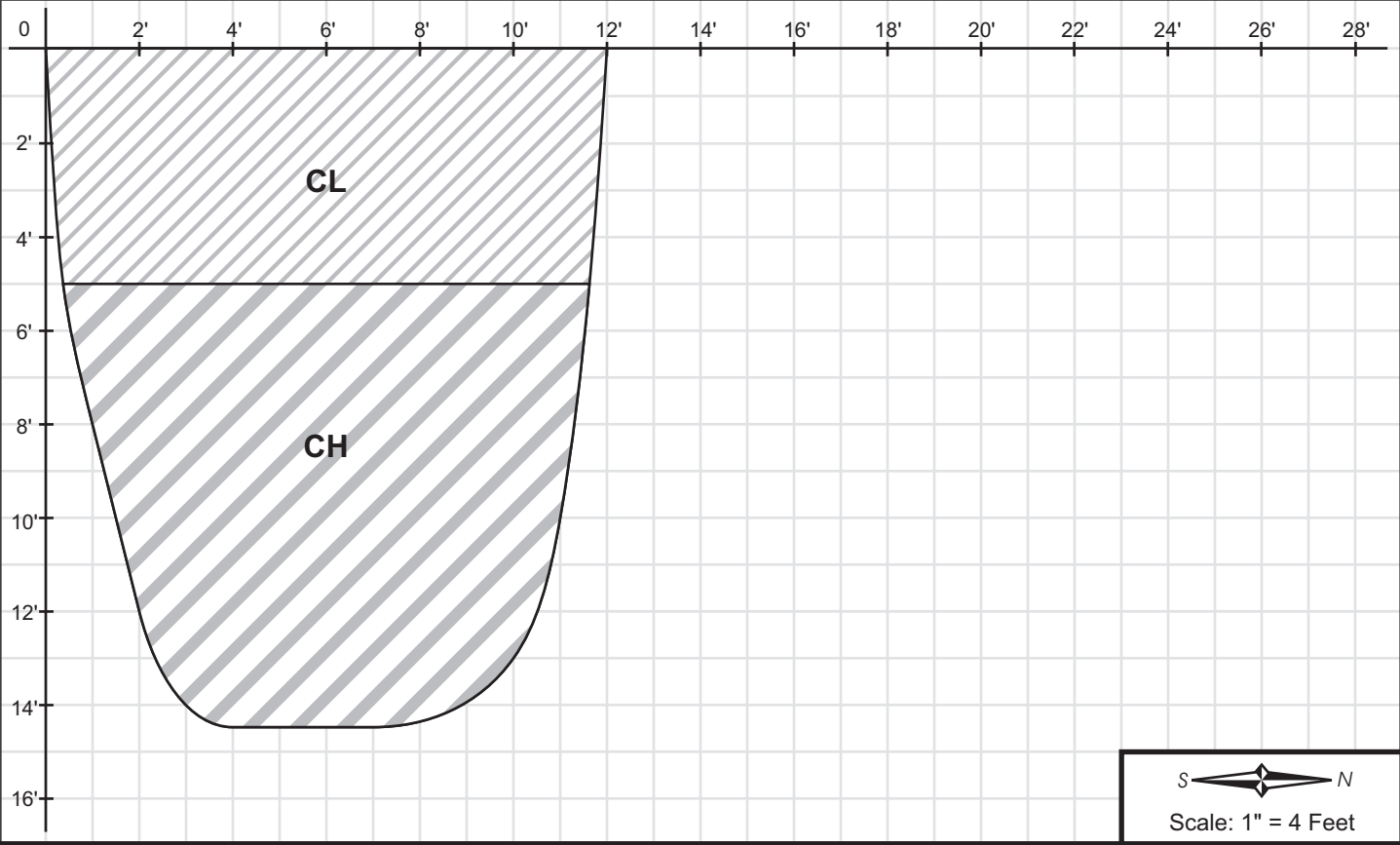
8'

10'

12'

14'

16'

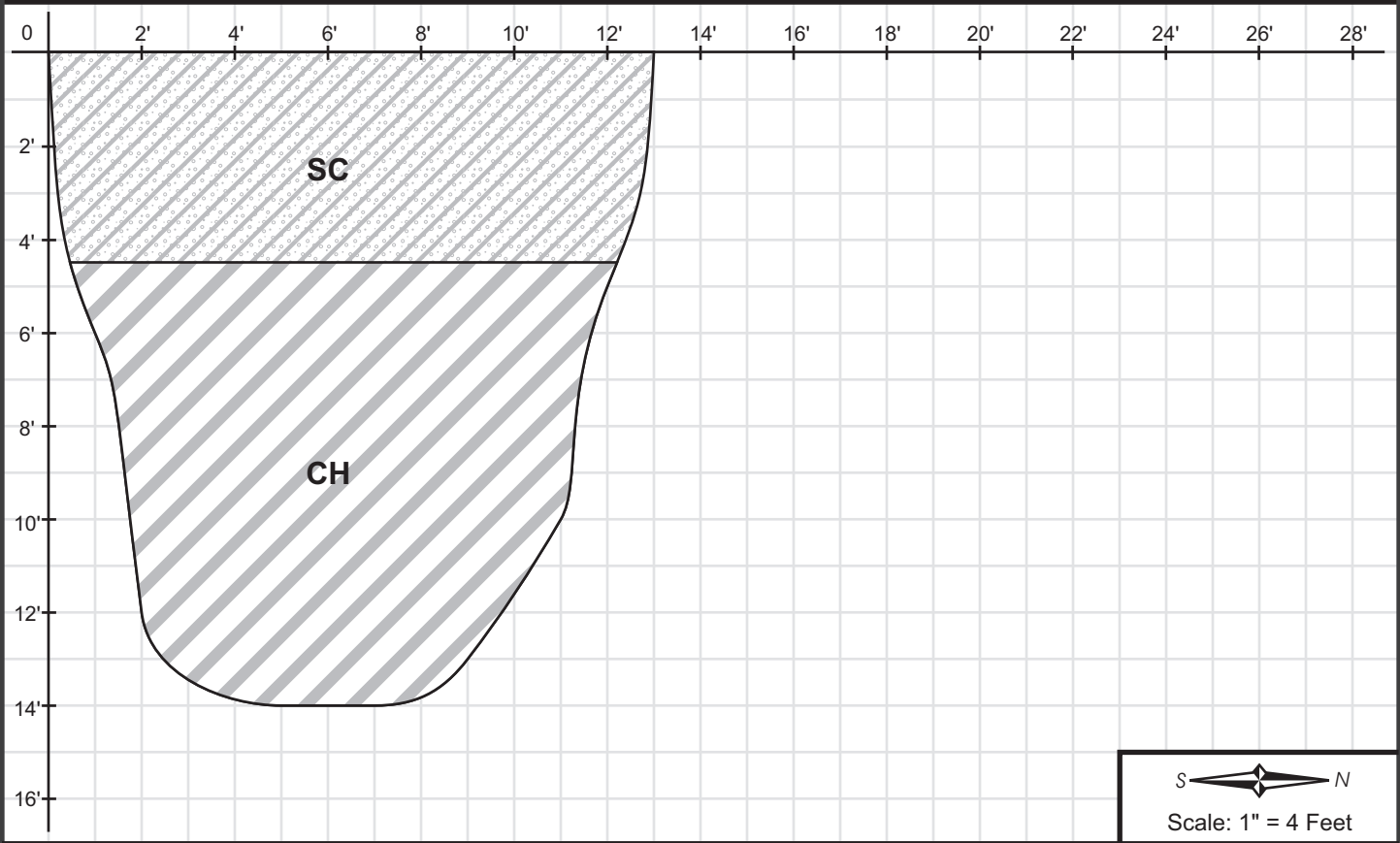


Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

 YOUNGDAHL CONSULTING GROUP, INC. Celebrating 40 Years of Service	Project No.: E24278.000	EXPLORATORY TEST PIT LOG	FIGURE A-3
	November 2024		

Logged By: ITK	Date: 11 September 2024	Lat / Lon: N 38.569581° / W 121.706589°	Pit No. TP-2
Equipment: John Deere 410G with 24" Bucket	Pit Orientation: 180°	Elevation: ~	

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0' - 4.5'	Brown clayey SAND (SC) , medium dense, moist		
@ 4.5' - 14'	Olive brown CLAY (CH) , stiff, moist		
	Test pit terminated at 14' No free groundwater encountered No caving noted		



Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

Logged By: ITK		Date: 11 September 2024	Lat / Lon: N 38.570563° / W 121.704364°		Pit No. TP-3
Equipment: John Deere 410G with 24" Bucket			Pit Orientation: 180°	Elevation: ~	
Depth (Feet)	Geotechnical Description & Unified Soil Classification		Sample	Tests & Comments	
@ 0' - 5'	Blue and olive grey CLAY (CL) , medium stiff to stiff, moist		 TP-3 @ 3-4'  TP-3 @ 5-6'	TP-3 @ 3-4' EI = 88 (medium)	
@ 5' - 14'	Olive grey CLAY (CH) , stiff to very stiff, moist			TP-3 @ 5-6' EI = 118 (high)	
	Test pit terminated at 14' No free groundwater encountered No caving noted				

0

2'

4'

6'

8'

10'

12'

14'

16'

18'

20'

22'

24'

26'

28'

2'

4'

6'

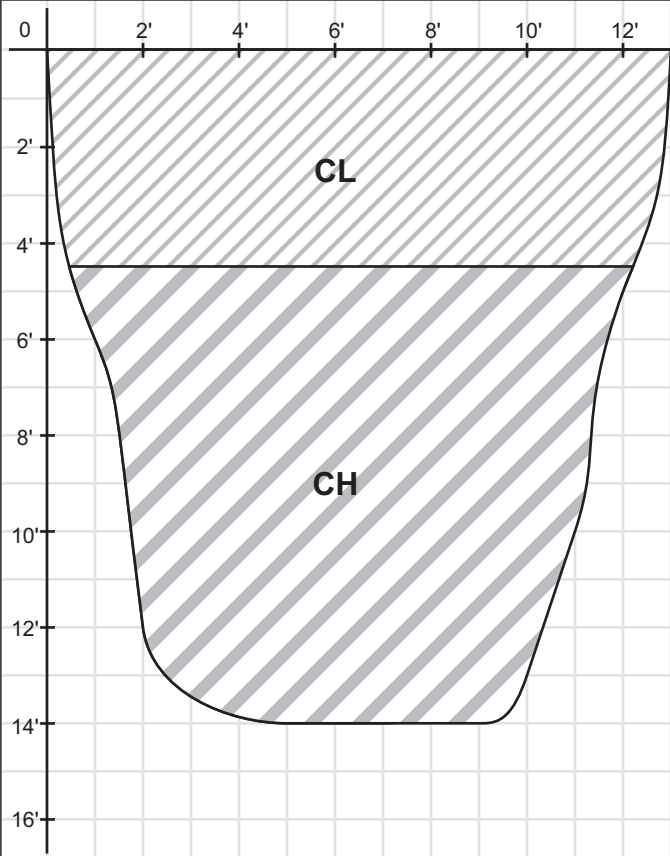
8'

10'

12'

14'

16'



S

N

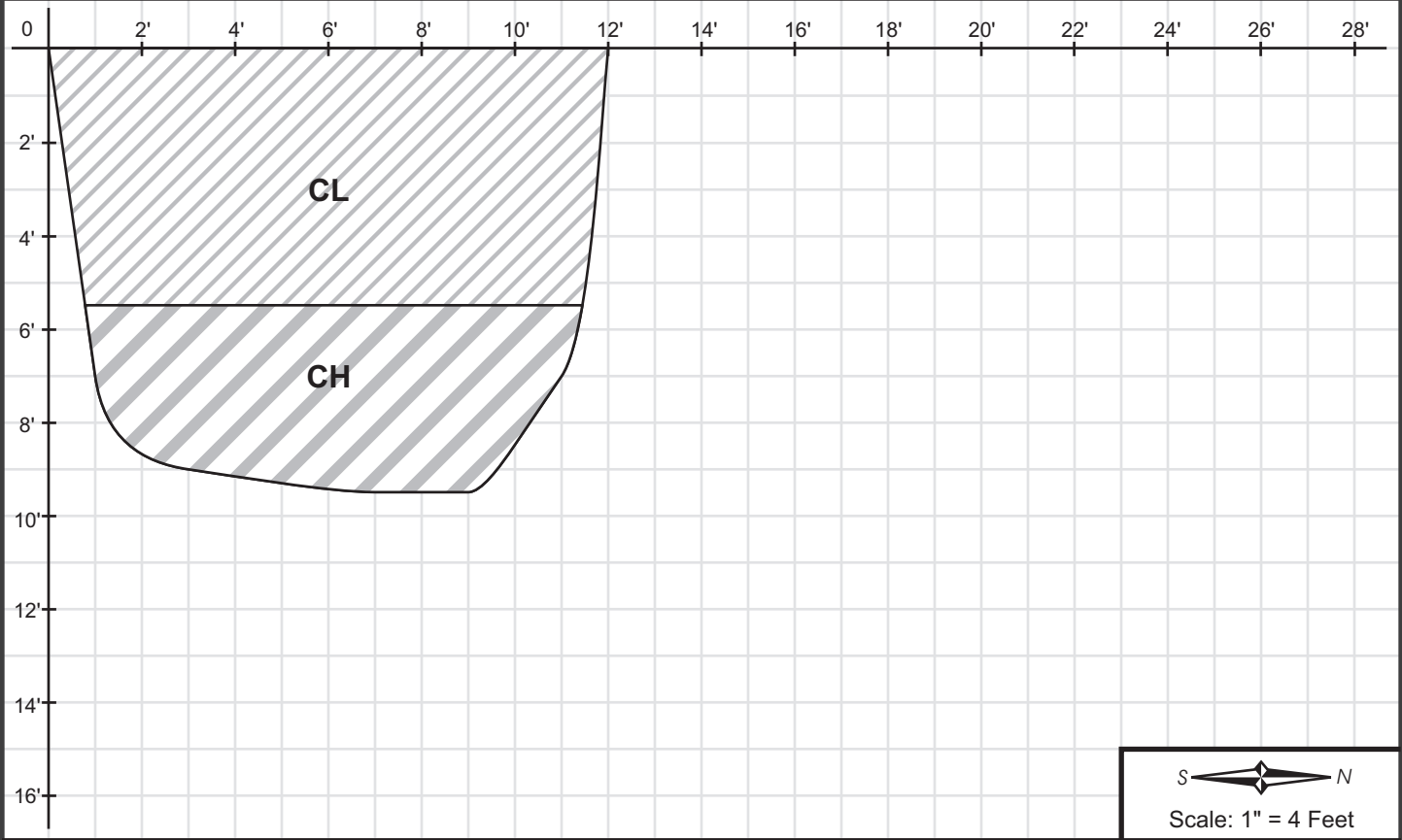
Scale: 1" = 4 Feet

Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

 YOUNGDAHL CONSULTING GROUP, INC. Celebrating 40 Years of Service	Project No.: E24278.000	EXPLORATORY TEST PIT LOG	FIGURE A-5
	November 2024		
		Shriner Property Davis, California	

Logged By: ITK	Date: 11 September 2024	Lat / Lon: N 38.573305° / W 121.704110°	Pit No. TP-4
Equipment: John Deere 410G with 24" Bucket	Pit Orientation: 180°	Elevation: ~	

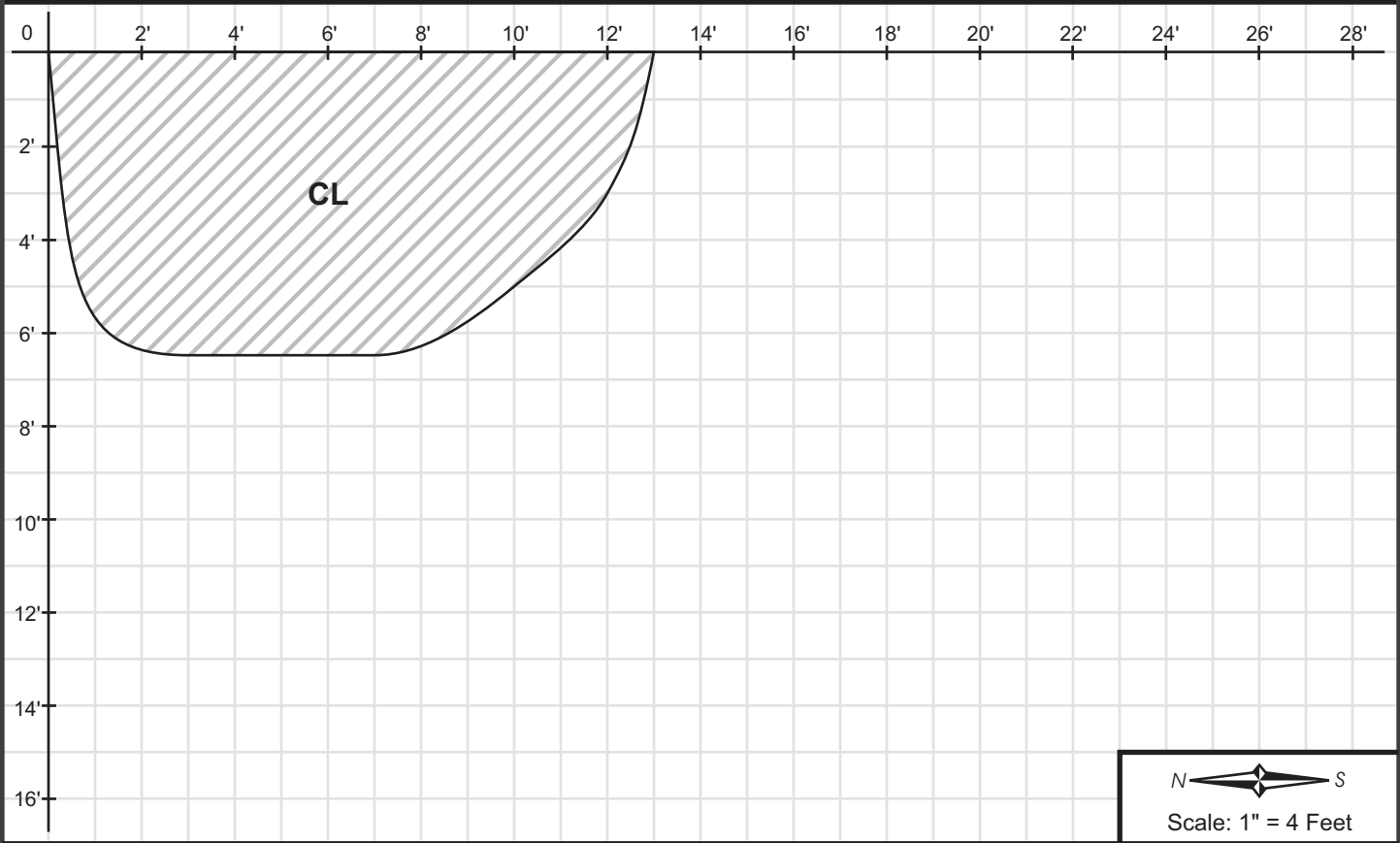
Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0' - 5.5'	Yellow brown CLAY (CL) , medium stiff to stiff, moist	 TP-4 @ 1-2'	TP-4 @ 1-2' Corrosivity Suite
@ 5.5' - 8'	Olive brown CLAY (CH) , stiff to very stiff, moist		
@ 8' - 9.5'	<i>Grades very stiff</i>		
	Test pit terminated at 9.5' (practical refusal) No free groundwater encountered No caving noted		



Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

Logged By: ITK	Date: 11 September 2024	Lat / Lon: N 38.572716° / W 121.707687°	Pit No. TP-5
Equipment: John Deere 410G with 24" Bucket	Pit Orientation: 180°	Elevation: ~	

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0' - 2'	Brown CLAY (CL) , medium stiff to stiff, moist		
@ 2' - 6.5'	<i>Grades very stiff</i>		
	Test pit terminated at 6.5' (practical refusal) No free groundwater encountered No caving noted		



Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

Logged By: ITK		Date: 11 September 2024	Lat / Lon: N 38.571877° / W 121.711301°		Pit No. TP-6
Equipment: John Deere 410G with 24" Bucket			Pit Orientation: 180°	Elevation: ~	
Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments		
@ 0' - 6'	Brown CLAY (CL) with trace sand, medium stiff to stiff, moist	 TP-6 @ 10-11'			
@ 6' - 15'	Olive brown CLAY (CH) , stiff, moist				
	Test pit terminated at 6.5' No free groundwater encountered No caving noted				

0'2'4'6'8'10'12'14'16'18'20'22'24'26'28'

2'

4'

6'

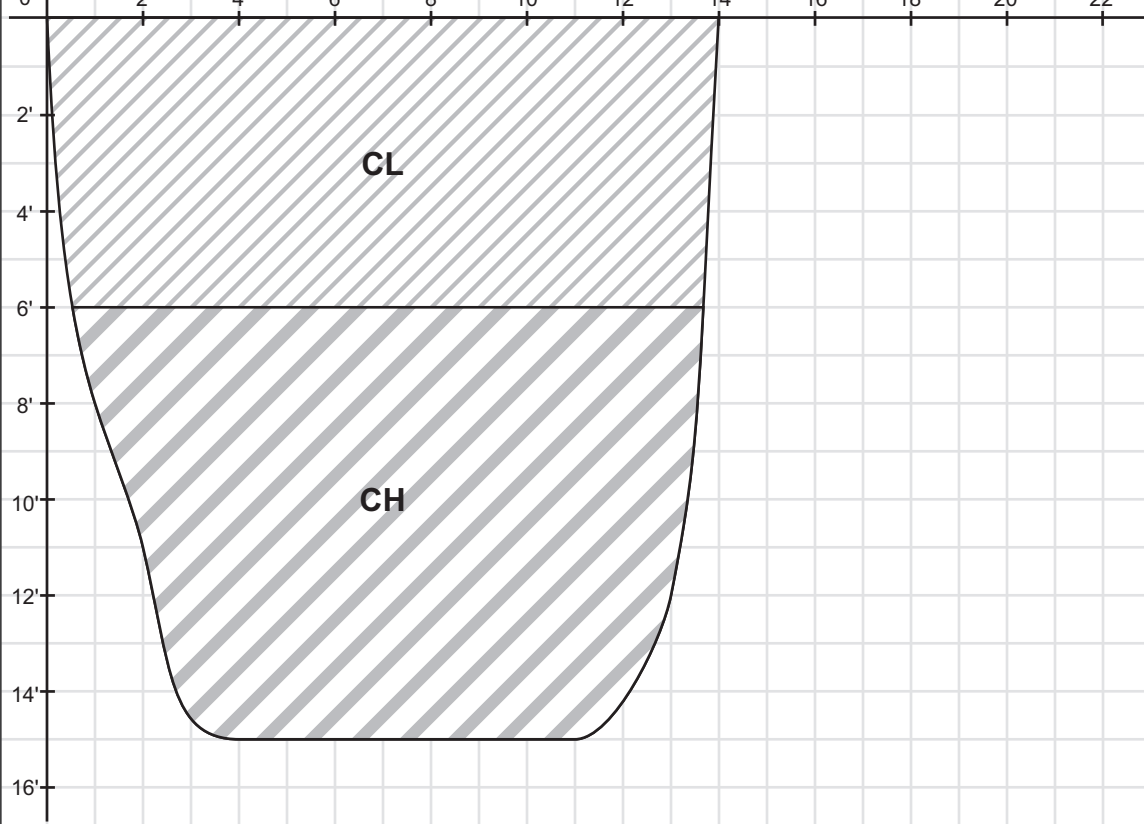
8'

10'

12'

14'

16'



N

S

Scale: 1" = 4 Feet

Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

4

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YOUNGDAHL
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Celebrating 40 Years of Service

Project No.:
E24278.000

November 2024

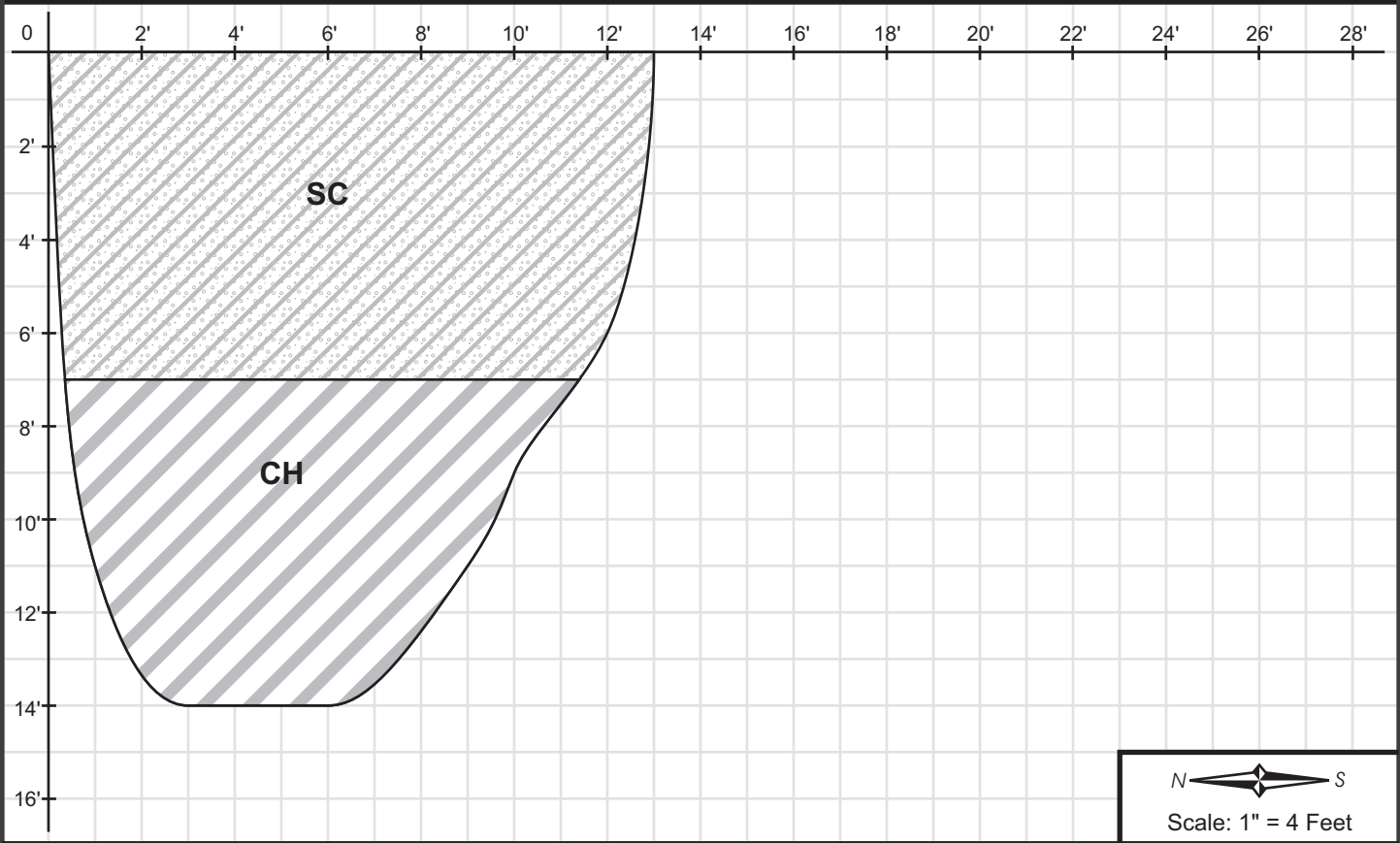
EXPLORATORY TEST PIT LOG

Shriner Property
Davis, California

FIGURE
A-8

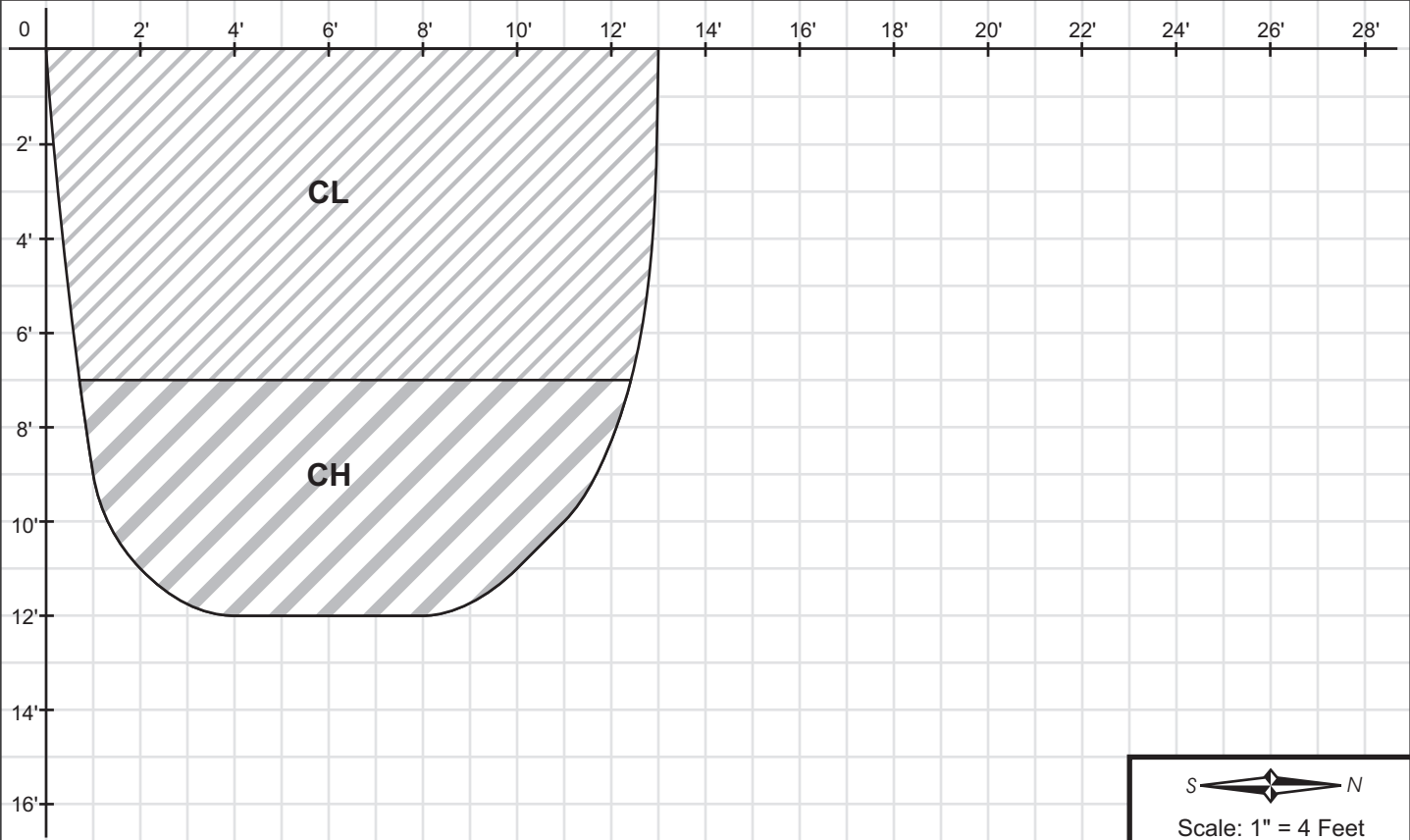
Logged By: ITK	Date: 11 September 2024	Lat / Lon: N 38.568636° / W 121.710715°	Pit No. TP-7
Equipment: John Deere 410G with 24" Bucket	Pit Orientation: 180°	Elevation: ~	

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0' - 7'	Brown clayey SAND (SC) , medium dense, moist	 TP-7 @ 1-2'	
@ 7' - 14'	Olive brown CLAY (CH) , stiff, moist		
	Test pit terminated at 14' No free groundwater encountered No caving noted		



Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

Logged By: ITK		Date: 11 September 2024	Lat / Lon: N 38.566190° / W 121.711432°		Pit No. TP-8
Equipment: John Deere 410G with 24" Bucket			Pit Orientation: 180°	Elevation: ~	
Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments		
@ 0' - 7'	Olive brown CLAY (CL) , medium stiff to stiff, moist	 TP-8 @ 1-2'  TP-8 @ 8'	TP-8 @ 1-2' φ = 33.6°, c = 40 psf DDmax = 114.9 pcf MCopt = 14.4% EI = 51 (medium) 87.5% < No. 200 TP-8 @ 8' EI = 114 (high)		
@ 7' - 12'	Olive brown CLAY (CH) , stiff to very stiff, moist				
	Test pit terminated at 12' (practical refusal) No free groundwater encountered No caving noted				

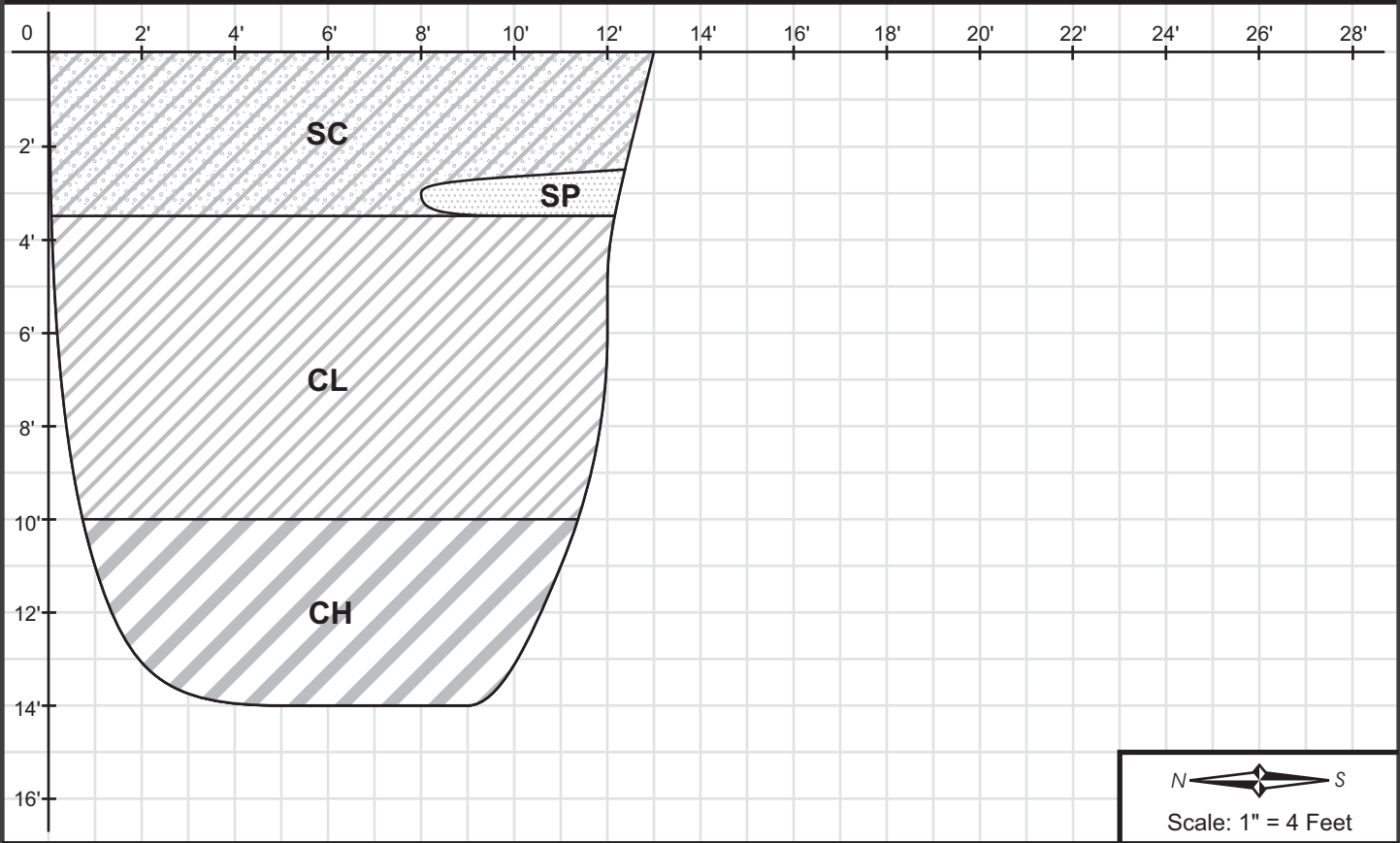



Scale: 1" = 4 Feet

Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

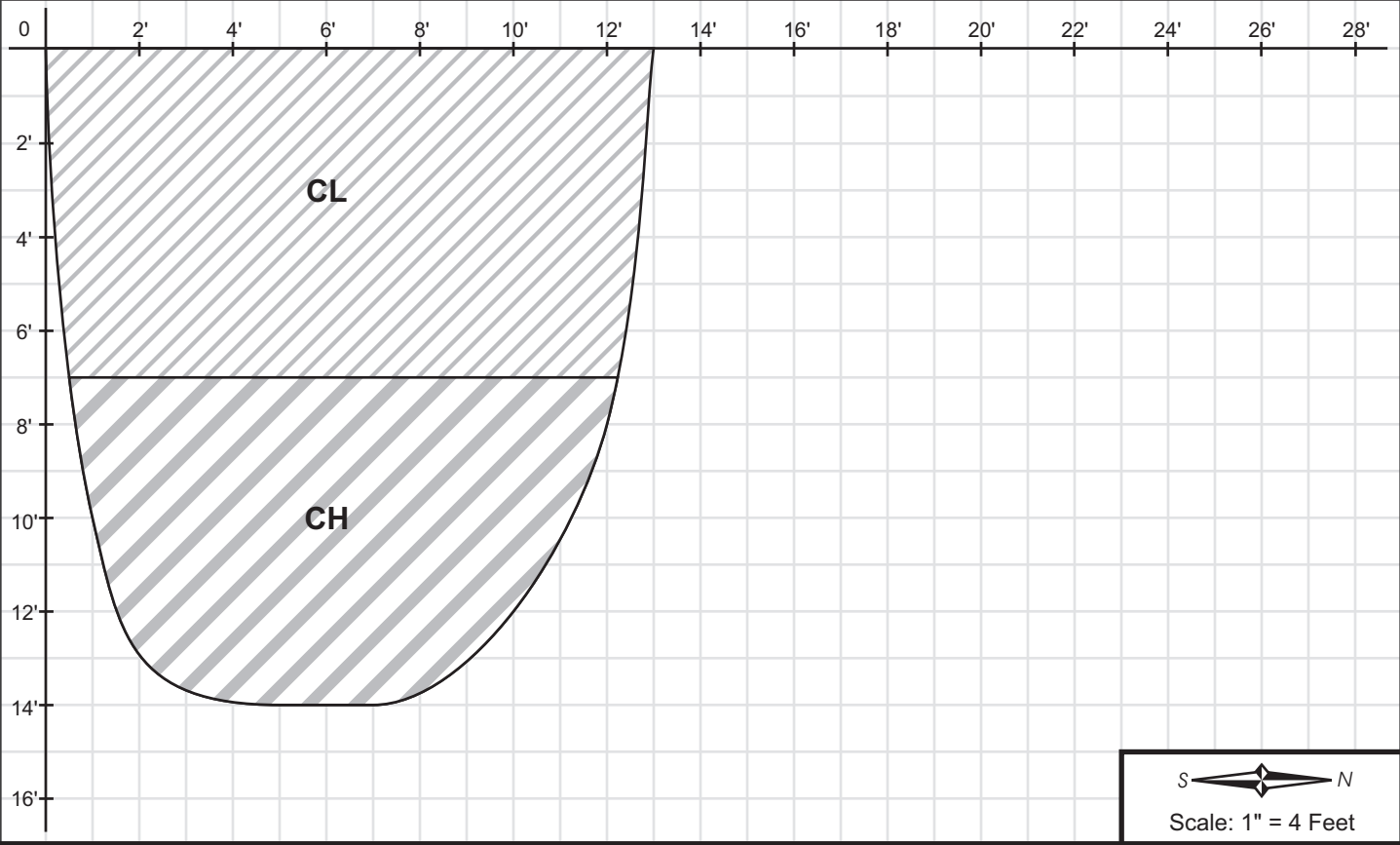
 YOUNGDAHL CONSULTING GROUP, INC. Celebrating 40 Years of Service	Project No.: E24278.000	EXPLORATORY TEST PIT LOG	FIGURE A-10
	November 2024		
		Shriner Property Davis, California	

Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments
@ 0' - 2.5'	Yellow brown clayey SAND (SC) , medium dense, moist		
@ 2.5' - 3.5'	Grey gravelly SAND (SP) , medium dense, moist		
@ 3.5' - 7'	Yellow brown CLAY (CL) , stiff, moist		
@ 7' - 10'	<i>Grades olive brown</i>		
@ 10' - 14'	Olive brown CLAY (CH) , very stiff, moist		
	Test pit terminated at 14' No free groundwater encountered No caving noted		



Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

Logged By: ITK		Date: 11 September 2024	Lat / Lon: N 38.566361° / W 121.707125°		Pit No. TP-10
Equipment: John Deere 410G with 24" Bucket			Pit Orientation: 180°	Elevation: ~	
Depth (Feet)	Geotechnical Description & Unified Soil Classification	Sample	Tests & Comments		
@ 0' - 7'	Dark brown sandy CLAY (CL) , medium stiff to stiff, moist	 TP-10 @ 1-2'  TP-10 @ 7-8'	TP-10 @ 1-2' LL = 39, PI = 20 (CL) R-Value = 20 Corrosivity Suite		
@ 7' - 14'	Olive brown CLAY (CH) , stiff, moist				
	Test pit terminated at 14' No free groundwater encountered No caving noted				



Note: The test pit log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

 YOUNGDAHL CONSULTING GROUP, INC. Celebrating 40 Years of Service	Project No.: E24278.000	EXPLORATORY TEST PIT LOG	FIGURE A-12
	November 2024		
		Shriner Property Davis, California	

Logged By: ITK		Date: 16 September 2024		Lat / Lon: N 38.567209° / W 121.706104°		Boring No. B-1				
Equipment: Diedrich D120 Truck Rig - 4" Solid Stem Auger				Elevation: ~						
Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments	
1			Brown CLAY (CL) , medium stiff to stiff, dry						UCS = 5,700 psf Su = 2,850 psf	
2			<i>Grades moist</i>							
3										
4			<i>Grades trace sand</i>		7					
5										
6					6					
7				Dark grey CLAY (CH) , stiff, moist						
8										
9										
10						22	2.75	99.3		23.7
11										
12										
13										
14										
15										
16					20	2.5				
17										
18										
19										
20										
21					18	2.0				
22										
23										
24										
25				Boring Continued on Figure A-13b						

Note: The boring log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

 YOUNGDAHL CONSULTING GROUP, INC. Celebrating 40 Years of Service	Project No.: E24278.000	EXPLORATORY BORING LOG Shriner Property Davis, California	FIGURE A-13a
	November 2024		

Logged By: ITK			Date: 16 September 2024		Lat / Lon: N 38.567209° / W 121.706104°			Boring No. B-1			
Equipment: Diedrich D120 Truck Rig - 4" Solid Stem Auger					Elevation: ~						
Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments		
26			Grades light olive brown, with sand		24	3.5	99.7	25.2	UCS = 5,700 psf Su = 2,850 psf		
27											
28											
29											
30											
31							17	2.0			
32											
33											
34											
35					Grades very stiff						
36					38	4.5 4.0	105.7	23.0			
37											
38											
39											
40					Grades without sand, stiff						
41							21	1.75		105.7	22.9
42											
43											
44											
45											
46			Olive grey clayey fine SAND (SC), dense, wet		41				0 % > No. 4 49.0% < No. 200		
47											
48					Yellow brown CLAY (CH), very stiff, moist						
49											
50											
51					31	3.25	102.8	24.0			
Boring terminated at 51.5' Groundwater encountered at 40'											
Note: The boring log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.											
				Project No.: E24278.000		EXPLORATORY BORING LOG Shriner Property Davis, California			FIGURE A-13b		
				November 2024							

Logged By: ITK		Date: 16 September 2024		Lat / Lon: N 38.569539° / W 121.704418°		Boring No. B-3				
Equipment: Diedrich D120 Truck Rig - 4" Solid Stem Auger				Elevation: ~						
Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments	
1			Dark grey CLAY (CL) , medium stiff to stiff, dry							
2			<i>Grades moist</i>							
3										
4						9	1.25	86.6	30.0	
5				Olive brown CLAY (CH) , stiff, moist						
6						19	2.5			
7										
8										
9										
10				<i>Grades stiff to very stiff</i>						
11						28	3.5			
12										
13										
14										
15										
16						25	3.0			
17			Boring terminated at 16.5'							
18			No groundwater encountered							
19										
20										
21										
22										
23										
24										
25										

Note: The boring log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

 YOUNGDAHL CONSULTING GROUP, INC. Celebrating 40 Years of Service	Project No.: E24278.000	EXPLORATORY BORING LOG Shriner Property Davis, California	FIGURE A-15
	November 2024		

Logged By: ITK		Date: 16 September 2024		Lat / Lon: N 38.571575° / W 121.704249°		Boring No. B-4			
Equipment: Diedrich D120 Truck Rig - 4" Solid Stem Auger					Elevation: ~				
Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments
1			Brown CLAY (CL) , medium stiff to stiff, dry						Corrosivity Suite UCS = 11,180 psf Su = 5,590 psf
2			<i>Grades moist</i>						
3									
4			Dark olive brown CLAY (CH) , stiff to very stiff, slightly moist		29	4.5+	105.0	20.7	
5			<i>Grades moist</i>						
6					23	3.75			
7									
8									
9									
10			<i>Grades stiff</i>						
11					15	1.75			
12									
13									
14									
15			<i>Grades yellow brown, with trace sand, very stiff</i>						
16					34				
17			Boring terminated at 16.5'						
18			No groundwater encountered						
19									
20									
21									
22									
23									
24									
25									

Note: The boring log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

 YOUNGDAHL CONSULTING GROUP, INC. Celebrating 40 Years of Service	Project No.: E24278.000	EXPLORATORY BORING LOG Shriner Property Davis, California	FIGURE A-16
	November 2024		

Logged By: ITK		Date: 16 September 2024		Lat / Lon: N 38.571050° / W 121.708324°		Boring No. B-6				
Equipment: Diedrich D120 Truck Rig - 4" Solid Stem Auger				Elevation: ~						
Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments	
1			Grey CLAY (CL) with sand, medium stiff to stiff, dry						Bulk B-6 @ 0' - 5' φ = 29.8°, c = 98 psf DDmax = 116.9 pcf MCopt = 13.7% R-Value < 5 35.4% < No. 200	
2			<i>Grades stiff to very stiff</i>							
3										
4			Olive brown CLAY (CH) , stiff to very stiff, slightly moist		26					
5			<i>Grades stiff, moist</i>							
6						18				
7										
8										
9										
10										
11						14	1.75			
12										
13										
14										
15				<i>Grades yellow brown</i>						
16						22	3.25			
17			Boring terminated at 16.5'							
18			No groundwater encountered							
19										
20										
21										
22										
23										
24										
25										

Note: The boring log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

 YOUNGDAHL CONSULTING GROUP, INC. Celebrating 40 Years of Service	Project No.: E24278.000	EXPLORATORY BORING LOG Shriner Property Davis, California	FIGURE A-18
	November 2024		

Logged By: ITK		Date: 17 September 2024		Lat / Lon: N 38.564910° / W 121.704100°		Boring No. B-7				
Equipment: Diedrich D120 Truck Rig - 4" Solid Stem Auger					Elevation: ~					
Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments	
1			Brown CLAY (CL) , medium stiff to stiff, dry							
2										
3										
4				Grades olive brown		13				
5				Grades olive grey, with sand						
6										
7						10	2.25	86.1		27.5
8				Olive brown CLAY (CH) , stiff, moist						
9										
10										
11						19	2.5			
12										
13										
14										
15				Grades stiff to very stiff						
16						25	3.25 2.75			
17			Boring terminated at 16.5'							
18			No groundwater encountered							
19										
20										
21										
22										
23										
24										
25										

Note: The boring log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

 YOUNGDAHL CONSULTING GROUP, INC. Celebrating 40 Years of Service	Project No.: E24278.000	EXPLORATORY BORING LOG Shriner Property Davis, California	FIGURE A-19
	November 2024		

Logged By: ITK		Date: 17 September 2024		Lat / Lon: N 38.566204° / W 121.708046°		Boring No. B-8			
Equipment: Diedrich D120 Truck Rig - 4" Solid Stem Auger				Elevation: ~					
Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments
1			Brown CLAY (CL) , medium stiff to stiff, dry						
2									
3									
4						9			
5				Grades with trace sand, slightly moist					
6									
7						7			
8				Olive brown CLAY (CH) , stiff, moist					
9									
10									
11						21	2.5		
12							2.5		
13									
14									
15				Grades stiff to very stiff					
16						24	3.25		
17			Boring terminated at 16.5'						
18			No groundwater encountered						
19									
20									
21									
22									
23									
24									
25									

Note: The boring log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

 YOUNGDAHL CONSULTING GROUP, INC. Celebrating 40 Years of Service	Project No.: E24278.000	EXPLORATORY BORING LOG Shriner Property Davis, California	FIGURE A-20
	November 2024		

Logged By: ITK		Date: 17 September 2024	Lat / Lon: N 38.564420° / W 121.709582°		Boring No. B-9				
Equipment: Diedrich D120 Truck Rig - 4" Solid Stem Auger				Elevation: ~					
Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments
1			Brown CLAY (CL) , medium stiff to stiff, dry						
2									
3			Grades sandy						
4					10				
5			Grades moist						
6					10				
7			Olive brown CLAY (CH) , stiff, moist						
8									
9									
10									
11					17	1.75			
12									
13									
14									
15			Grades stiff to very stiff						
16					26	3.25			
17			Boring terminated at 16.5'						
18		No groundwater encountered							
19									
20									
21									
22									
23									
24									
25									
Note: The boring log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.									
 YOUNGDAHL CONSULTING GROUP, INC. Celebrating 40 Years of Service			Project No.: E24278.000 November 2024		EXPLORATORY BORING LOG Shriner Property Davis, California			FIGURE A-21	

Logged By: ITK		Date: 16 September 2024		Lat / Lon: N 38.565721° / W 121.702342°		Boring No. B-10				
Equipment: Diedrich D120 Truck Rig - 4" Solid Stem Auger				Elevation: ~						
Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments	
1			Brown CLAY (CL) , medium stiff to stiff, dry							
2										
3			<i>Grades stiff</i>							
4						17				
5			<i>Grades slight moist</i>							
6										
7						16				
8				Olive brown CLAY (CH) , stiff, moist						
9										
10										
11						18				
12										
13										
14										
15				<i>Grades stiff to very stiff</i>						
16						25	3.75			
17			Boring terminated at 16.5'							
18			No groundwater encountered							
19										
20										
21										
22										
23										
24										
25										

Note: The boring log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

 YOUNGDAHL CONSULTING GROUP, INC. Celebrating 40 Years of Service	Project No.: E24278.000	EXPLORATORY BORING LOG Shriner Property Davis, California	FIGURE A-22
	November 2024		

Logged By: ITK		Date: 16 September 2024		Lat / Lon: N 38.566718° / W 121.710700°		Boring No. B-11				
Equipment: Diedrich D120 Truck Rig - 4" Solid Stem Auger				Elevation: ~						
Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments	
1			Brown CLAY (CL) , medium stiff to stiff, dry						Bulk B-11 @ 0' - 5'	
2			<i>Grades moist</i>							
3			<i>Grades light olive brown, slight moist</i>							
4					13		86.4	14.4		
5										
6						12				
7										
8				Olive brown CLAY (CH) , stiff to very stiff, moist						Corrosivity Suite
9										
10										
11						25	3.5			
12										
13										
14										
15				<i>Grades stiff</i>						
16						20	2.5			
17			Boring terminated at 16.5'							
18			No groundwater encountered							
19										
20										
21										
22										
23										
24										
25										

Note: The boring log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

YOUNGDAHL CONSULTING GROUP, INC. Celebrating 40 Years of Service	Project No.: E24278.000	EXPLORATORY BORING LOG Shriner Property Davis, California	FIGURE A-23
	November 2024		

Logged By: ITK		Date: 17 September 2024		Lat / Lon: N 38.568725° / W 121.712296°		Boring No. B-13				
Equipment: Diedrich D120 Truck Rig - 4" Solid Stem Auger				Elevation: ~						
Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments	
1			Brown CLAY (CL) , medium stiff to stiff, dry <i>Grades moist</i>							
2										
3										
4						11				
5										
6										
7						12				
8				Olive brown CLAY (CH) , stiff, moist						
9										
10										
11						13	1.25			
12										
13										
14										
15										
16						19	2.25			
17			Boring terminated at 16.5'							
18			No groundwater encountered							
19										
20										
21										
22										
23										
24										
25										

Note: The boring log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

 YOUNGDAHL CONSULTING GROUP, INC. Celebrating 40 Years of Service	Project No.: E24278.000	EXPLORATORY BORING LOG Shriner Property Davis, California	FIGURE A-25
	November 2024		

Logged By: ITK		Date: 17 September 2024		Lat / Lon: N 38.570514° / W 121.710021°		Boring No. B-14			
Equipment: Diedrich D120 Truck Rig - 4" Solid Stem Auger					Elevation: ~				
Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments
1			Brown CLAY (CL) , medium stiff to stiff, dry						 Bulk B-14 @ 0' - 5'
2									
3			Olive brown CLAY (CH) , very stiff, slightly moist						
4			<i>Grades stiff to very stiff, moist</i>		31	4.5+			
5									
6					23	4.5+	102.8	20.7	
7									
8									
9									
10			<i>Grades stiff</i>						
11					20	3.0			
12									
13									
14									
15			<i>Grades yellow brown</i>						
16					21	3.0			
17			Boring terminated at 16.5'						
18			No groundwater encountered						
19									
20									
21									
22									
23									
24									
25									

Note: The boring log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

 YOUNGDAHL CONSULTING GROUP, INC. Celebrating 40 Years of Service	Project No.: E24278.000	EXPLORATORY BORING LOG Shriner Property Davis, California	FIGURE A-26
	November 2024		

Logged By: ITK		Date: 17 September 2024		Lat / Lon: N 38.571827° / W 121.712141°		Boring No. B-15			
Equipment: Diedrich D120 Truck Rig - 4" Solid Stem Auger					Elevation: ~				
Depth (Feet)	Graphic Log	Ground Water	Geotechnical Description & Unified Soil Classification	Sample	Blow Counts	Pocket Pen (tsf)	Dry Density (pcf)	Moisture Content (%)	Tests & Comments
1			Brown sandy CLAY (CL) , stiff, dry						Bulk B-15 @ 0' - 5'
2									
3			Light yellow brown clayey SAND (SC) , medium dense, slightly moist		24				
4									
5			Grades yellow brown						
6					22		102.5	7.6	
7			Olive brown CLAY (CH) , stiff, moist						
8									
9									
10									
11					20				
12									
13									
14									
15									
16					26	3.75			
17			Boring terminated at 16.5'						
18			No groundwater encountered						
19									
20									
21									
22									
23									
24									
25									

Note: The boring log indicates subsurface conditions only at the specific location and time noted. Subsurface conditions, including groundwater levels, at other locations of the subject site may differ significantly from conditions which, in the opinion of Youngdahl Consulting Group, Inc., exist at the sampling locations. Note, too, that the passage of time may affect conditions at the sampling locations.

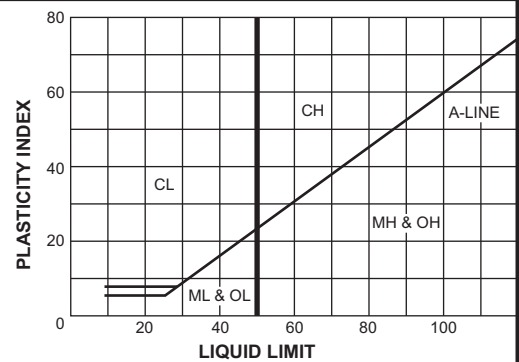
YOUNGDAHL CONSULTING GROUP, INC. Celebrating 40 Years of Service	Project No.: E24278.000	EXPLORATORY BORING LOG Shriner Property Davis, California	FIGURE A-27
	November 2024		

UNIFIED SOIL CLASSIFICATION SYSTEMS

MAJOR DIVISION		SYMBOLS		TYPICAL NAMES	
COARSE GRAINED SOILS Over 50% > #200 sieve	GRAVELS Over 50% > #4 sieve	Clean GRAVELS With Little Or No Fines	GW		Well graded GRAVELS, GRAVEL-SAND mixtures
			GP		Poorly graded GRAVELS, GRAVEL-SAND mixtures
		GRAVELS With Over 12% Fines	GM		Silty GRAVELS, poorly graded GRAVEL-SAND-SILT mixtures
			GC		Clayey GRAVELS, poorly graded GRAVEL-SAND-CLAY mixtures
	SANDS Over 50% < #4 sieve	Clean SANDS With Little Or No Fines	SW		Well graded SANDS, gravelly SANDS
			SP		Poorly graded SANDS, gravelly SANDS
		SANDS With Over 12% Fines	SM		Silty SANDS, poorly graded SAND-SILT mixtures
			SC		Clayey SANDS, poorly graded SAND-CLAY mixtures
FINE GRAINED SOILS Over 50% < #200 sieve	SILTS & CLAYS Liquid Limit < 50	ML		Inorganic SILTS, silty or clayey fine SANDS, or clayey SILTS with plasticity	
		CL		Inorganic CLAYS of low to medium plasticity, gravelly, sandy, or silty CLAYS, lean CLAYS	
		OL		Organic CLAYS and organic silty CLAYS of low plasticity	
	SILTS & CLAYS Liquid Limit > 50	MH		Inorganic SILTS, micaceous or diamaceous fine sandy or silty soils, elastic SILTS	
		CH		Inorganic CLAYS of high plasticity, fat CLAYS	
		OH		Organic CLAYS of medium to high plasticity, organic SILTS	
HIGHLY ORGANIC CLAYS		PT		PEAT & other highly organic soils	

PLASTICITY CHART

USED FOR CLASSIFICATION OF FINE GRAINED SOILS



SAMPLE DRIVING RECORD

BLOWS PER FOOT	DESCRIPTION
25	25 Blows drove sampler 12 inches, after initial 6 inches of seating
50/7"	50 Blows drove sampler 7 inches, after initial 6 inches of seating
50/3"	50 Blows drove sampler 3 inches during or after initial 6 inches of seating

Note: To avoid damage to sampling tools, driving is limited to 50 blows per 6 inches during or after seating interval.

SOIL GRAIN SIZE

U.S. STANDARD SIEVE	6"	3"	¾"	4	10	40	200		
SOIL GRAIN SIZE IN MILLIMETERS	150	75	GRAVEL		SAND			SILT	CLAY
			COARSE	FINE	COARSE	MEDIUM	FINE		
			19	4.75	2.0	.425	0.075	0.002	

KEY TO PIT & BORING SYMBOLS

	Standard Penetration test
	2.5" O.D. Modified California Sampler
	3" O.D. Modified California Sampler
	Shelby Tube Sampler
	2.5" Hand Driven Liner
	Bulk Sample
	Water Level At Time Of Drilling
	Water Level After Time Of Drilling
	Perched Water

KEY TO PIT & BORING SYMBOLS

	Joint
	Foliation
	Water Seepage
NFWE	No Free Water Encountered
FWE	Free Water Encountered
REF	Sampling Refusal
DD	Dry Density (pcf)
MC	Moisture Content (%)
LL	Liquid Limit
PI	Plasticity Index
PP	Pocket Penetrometer
UCC	Unconfined Compression (ASTM D2166)
TVS	Pocket Torvane Shear
EI	Expansion Index (ASTM D4829)
Su	Undrained Shear Strength

Project: Shriner Property

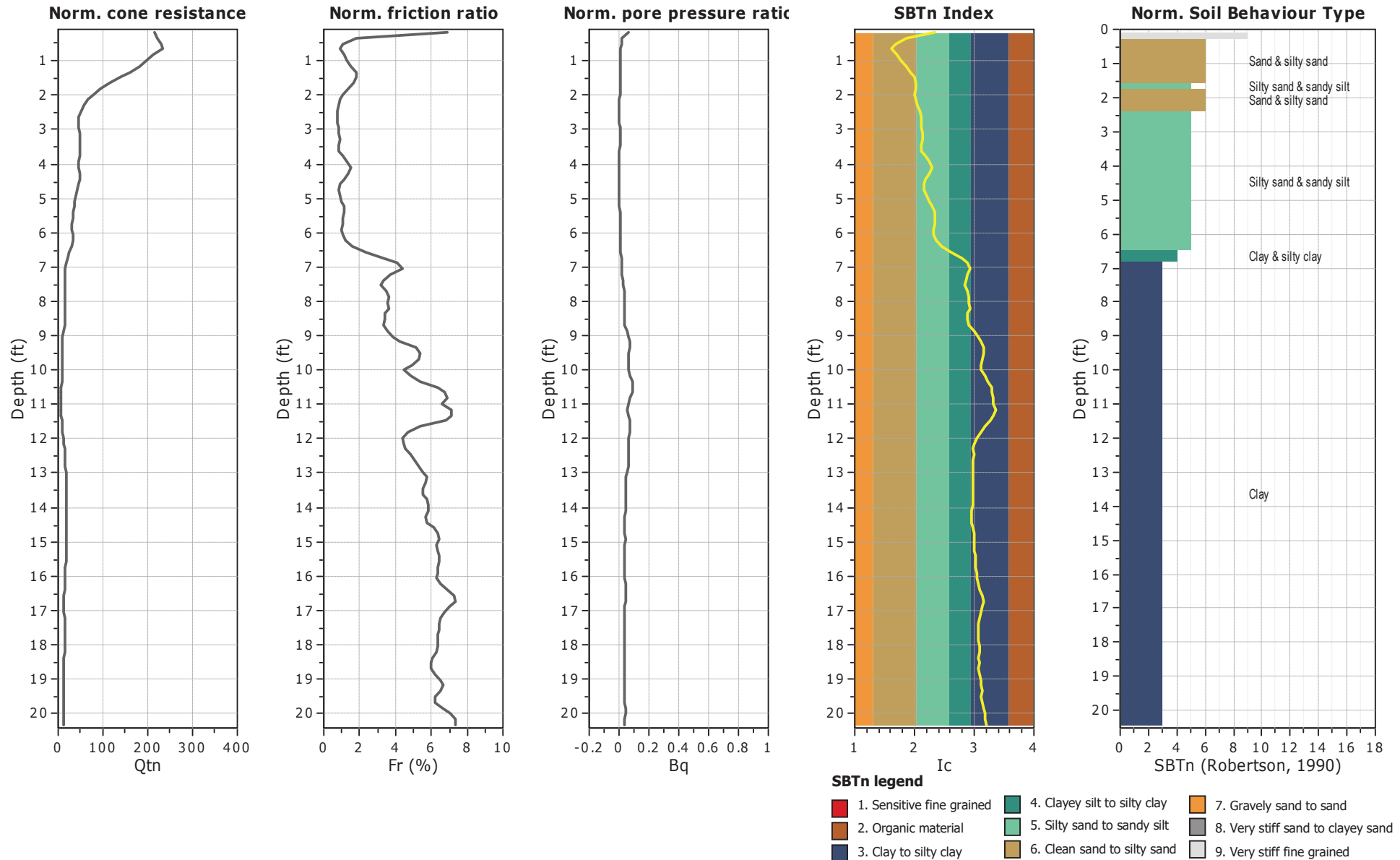
Location: East Covell Boulevard, Davis, CA

CPT: CPT 1

Total depth: 20.34 ft, Date: 9/12/2024

Coords: lat 0° lon 0°

Cone Operator:



Project: Shriner Property

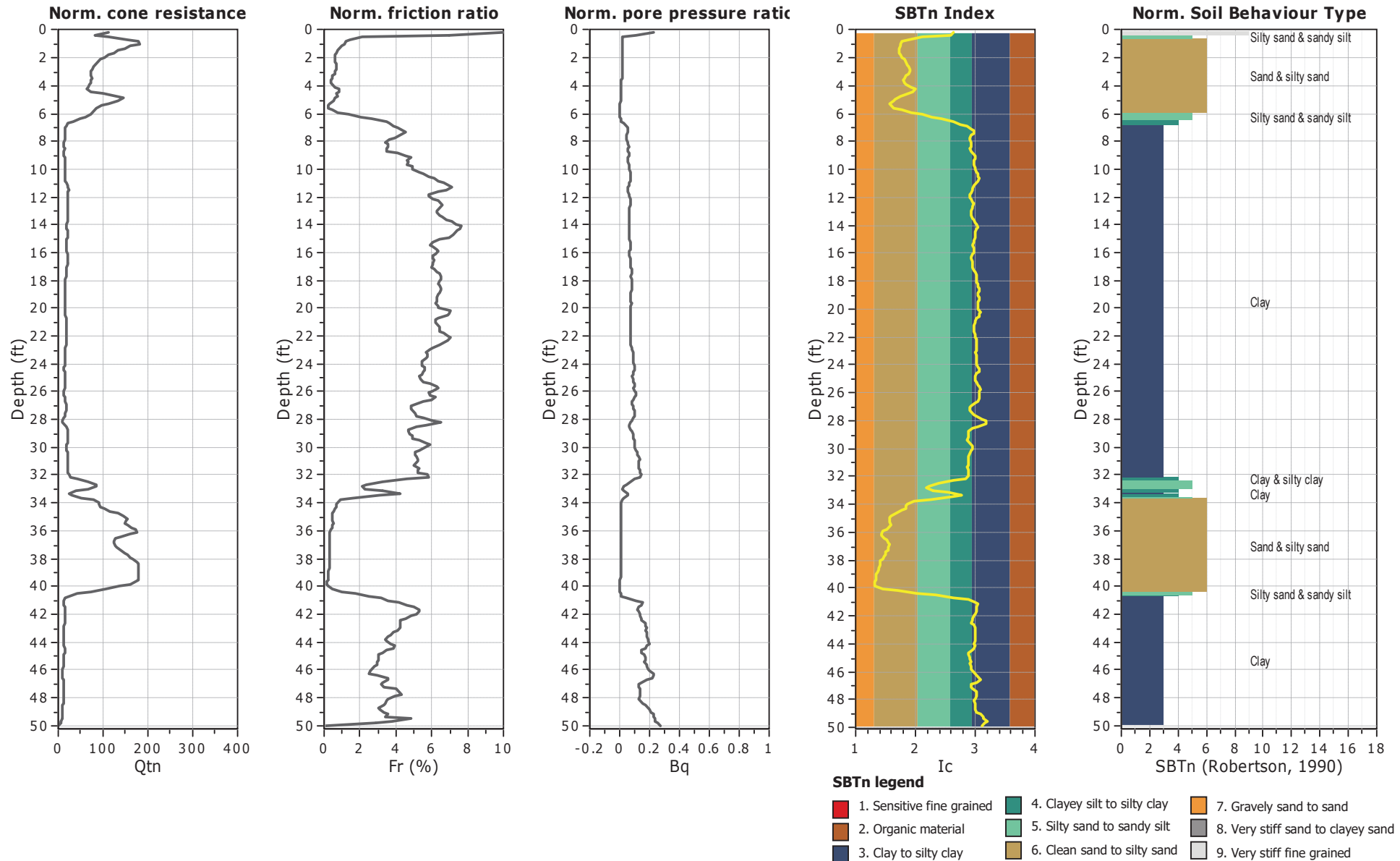
Location: East Covell Boulevard, Davis, CA

CPT: CPT 2

Total depth: 50.03 ft, Date: 9/12/2024

Coords: lat 0° lon 0°

Cone Operator:



Project: Shriner Property

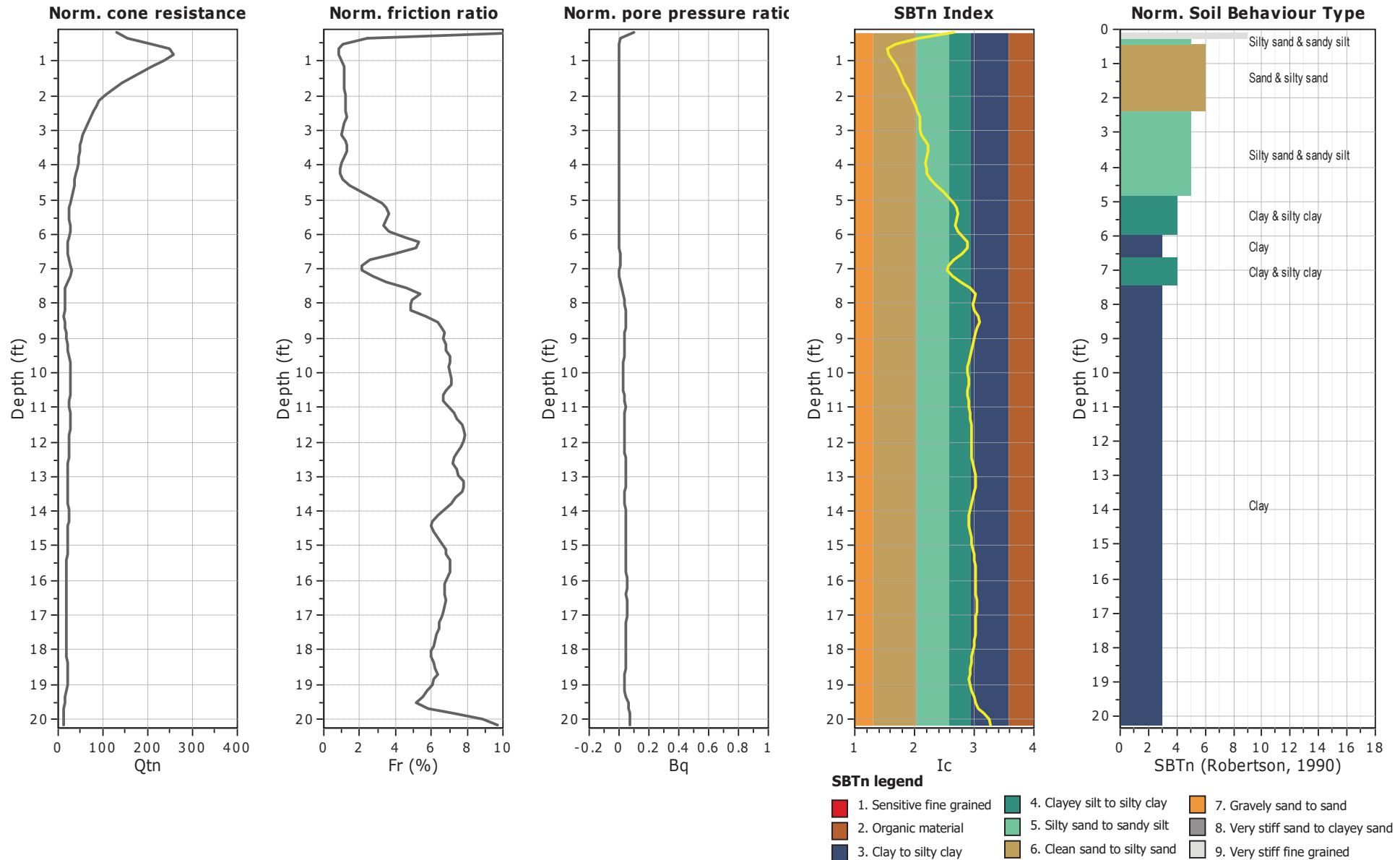
Location: East Covell Boulevard, Davis, CA

CPT: CPT 3

Total depth: 20.18 ft, Date: 9/12/2024

Coords: lat 0° lon 0°

Cone Operator:



Project: Shriner Property

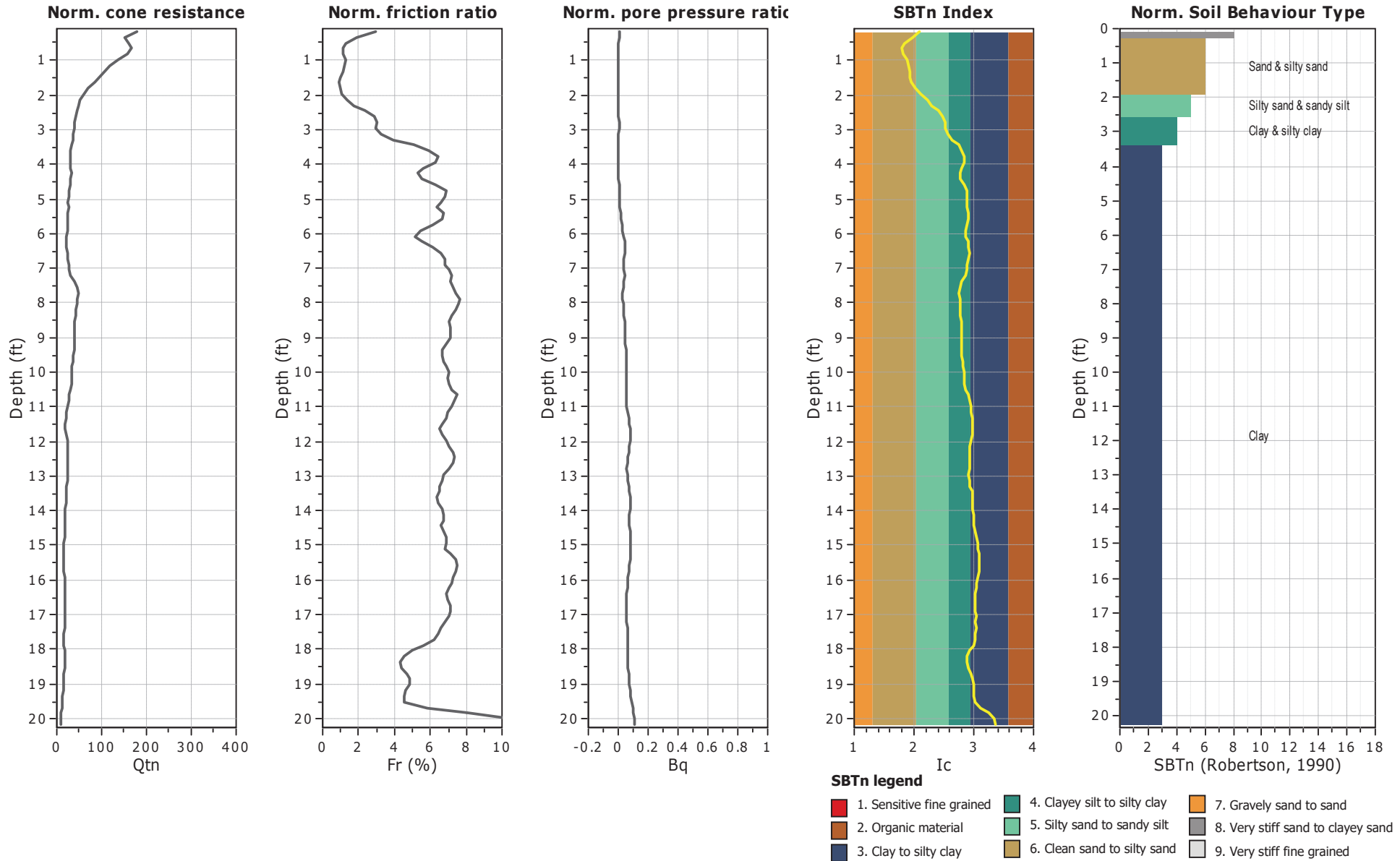
Location: East Covell Boulevard, Davis, CA

CPT: CPT 4

Total depth: 20.18 ft, Date: 9/12/2024

Coords: lat 0° lon 0°

Cone Operator:



Project: Shriner Property

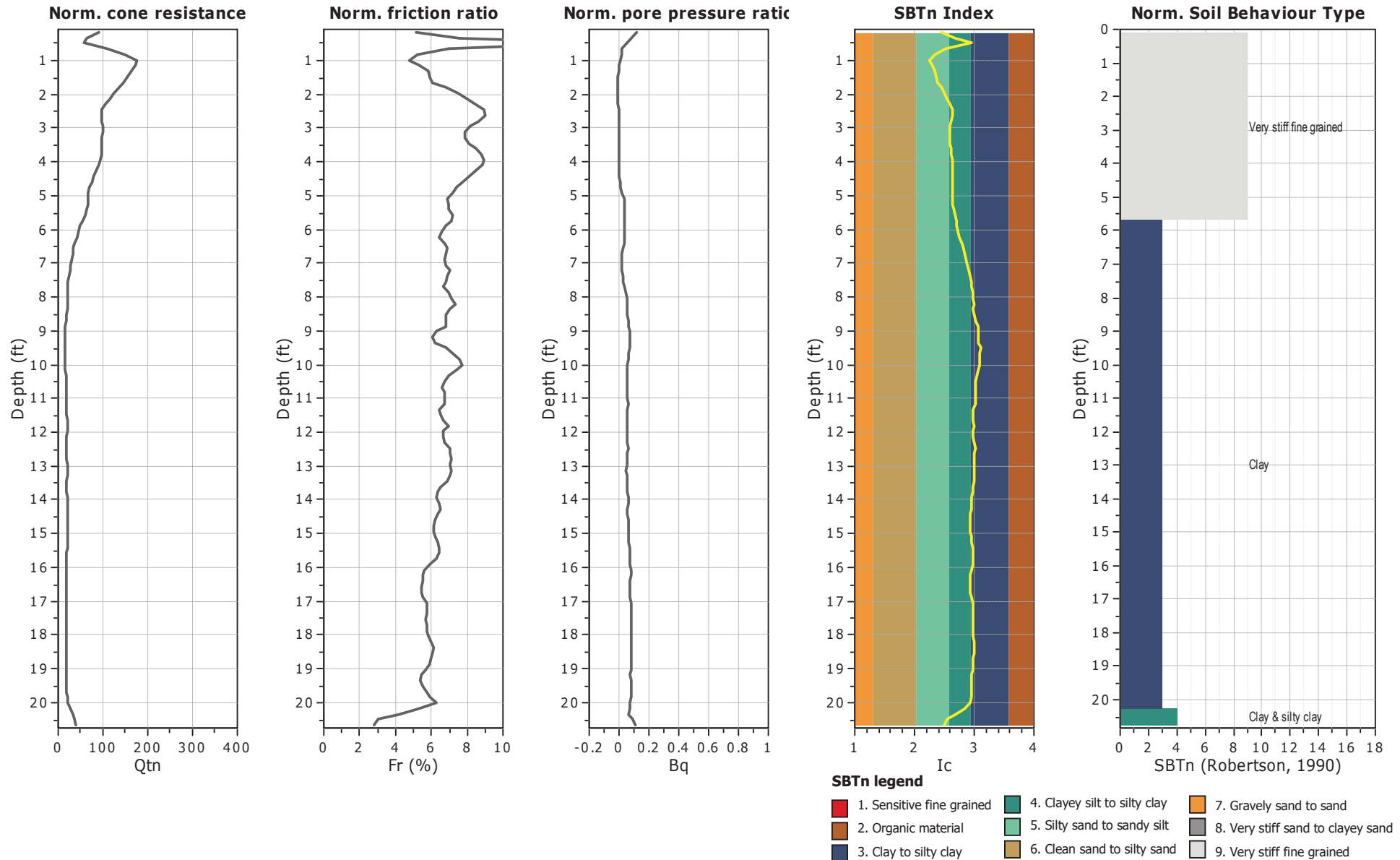
Location: East Covell Boulevard, Davis, CA

CPT: CPT 5

Total depth: 20.67 ft, Date: 9/12/2024

Coords: lat 0° lon 0°

Cone Operator:



Project: Shriner Property

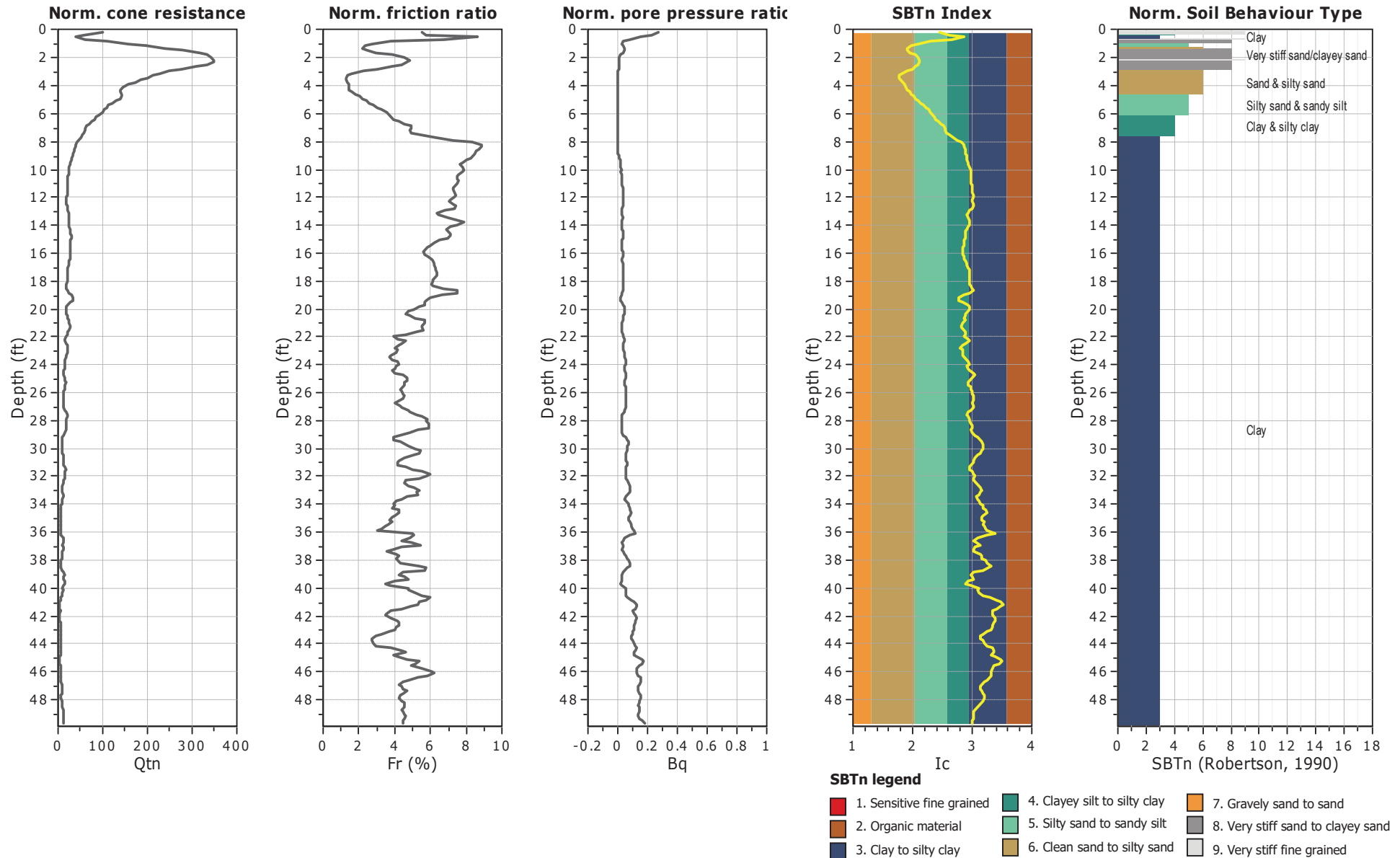
Location: East Covell Boulevard, Davis, CA

CPT: CPT 6

Total depth: 49.70 ft, Date: 9/12/2024

Coords: lat 0° lon 0°

Cone Operator:



Project: Shriner Property

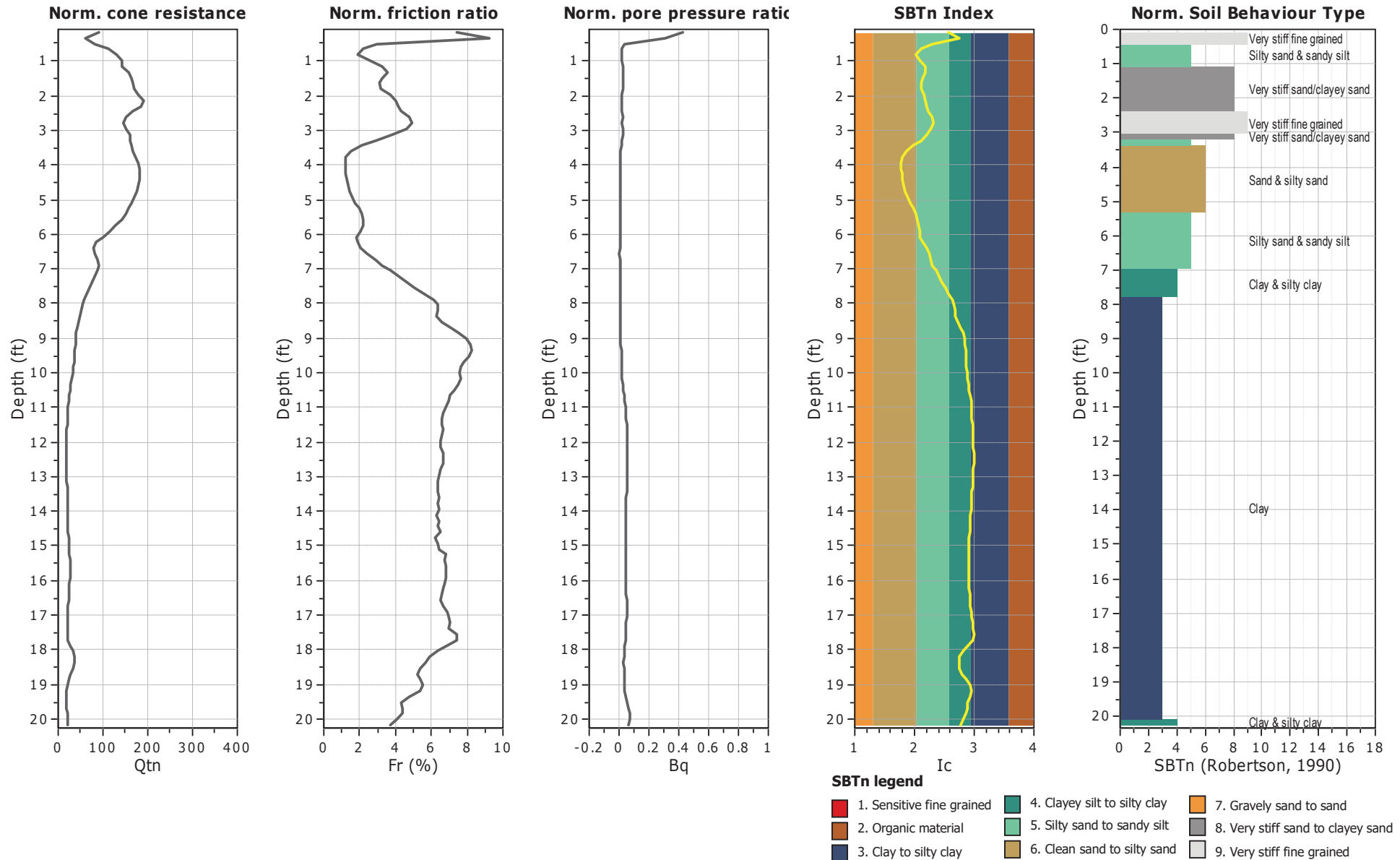
Location: East Covell Boulevard, Davis, CA

CPT: CPT 7

Total depth: 20.18 ft, Date: 9/12/2024

Coords: lat 0° lon 0°

Cone Operator:



Project: Shriner Property

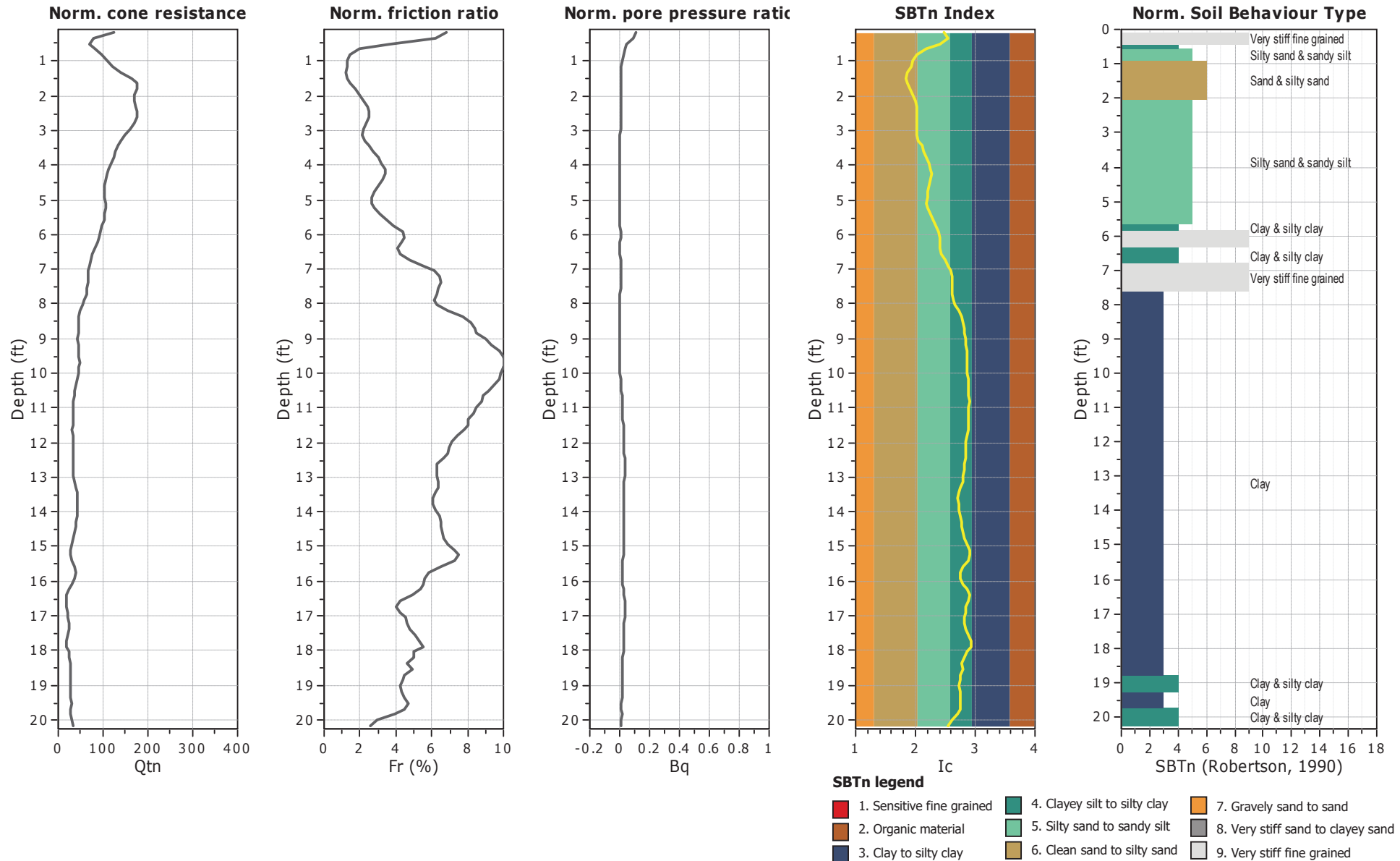
Location: East Covell Boulevard, Davis, CA

CPT: CPT 8

Total depth: 20.18 ft, Date: 9/12/2024

Coords: lat 0° lon 0°

Cone Operator:



Project: Shriner Property

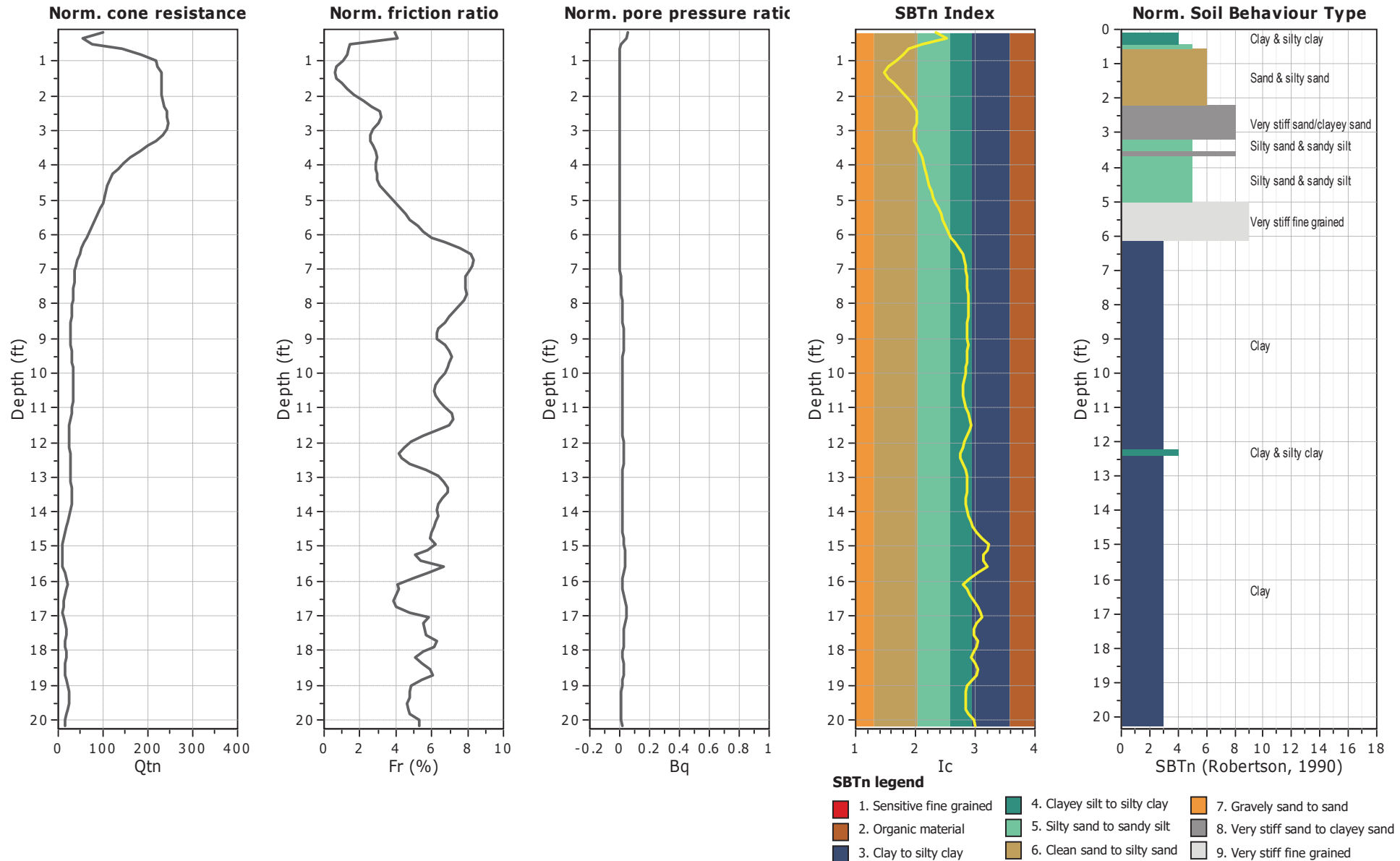
Location: East Covell Boulevard, Davis, CA

CPT: CPT 9

Total depth: 20.18 ft, Date: 9/12/2024

Coords: lat 0° lon 0°

Cone Operator:



Project: Shriner Property

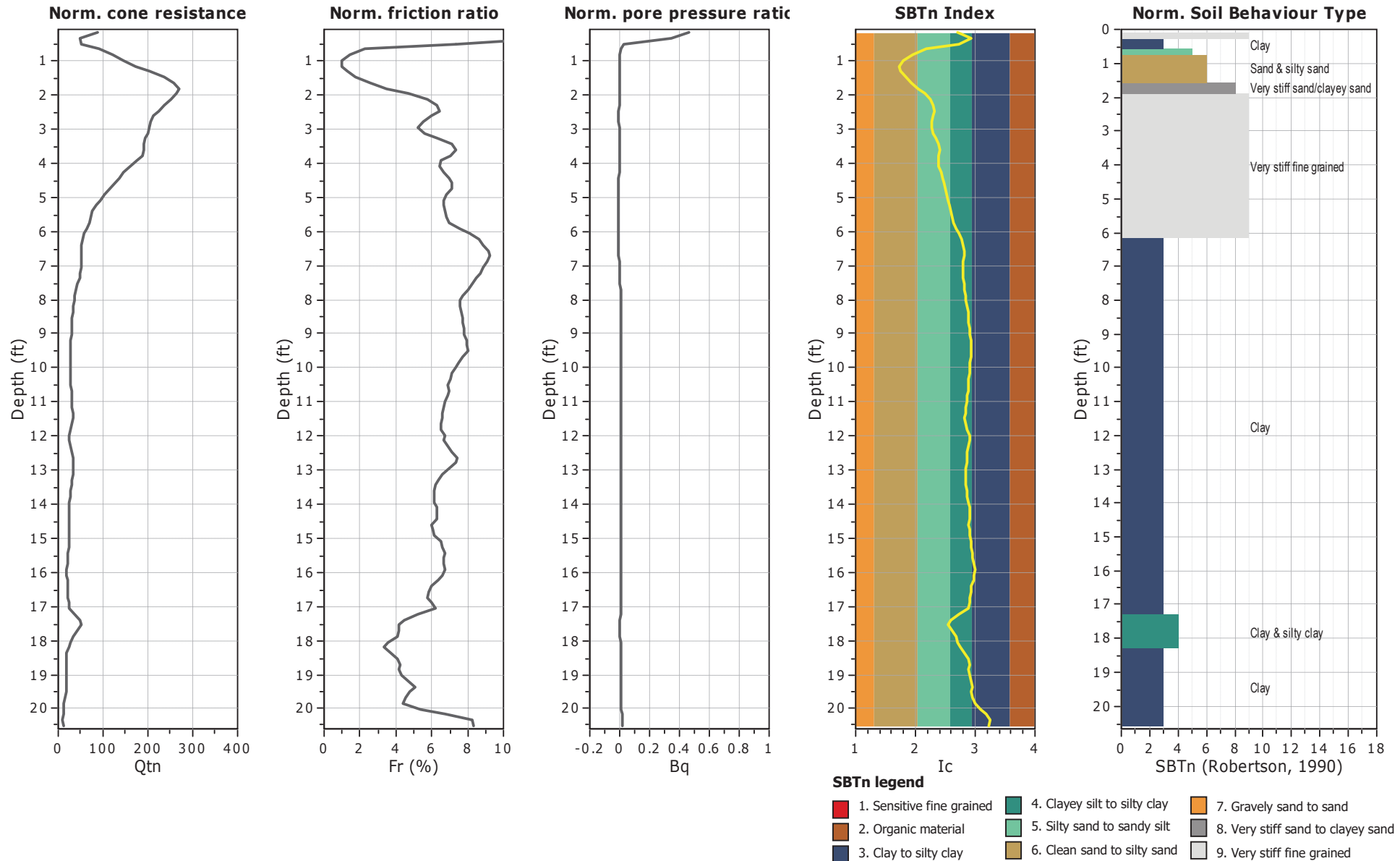
Location: East Covell Boulevard, Davis, CA

CPT: CPT 10

Total depth: 20.50 ft, Date: 9/12/2024

Coords: lat 0° lon 0°

Cone Operator:



Project: Shriner Property

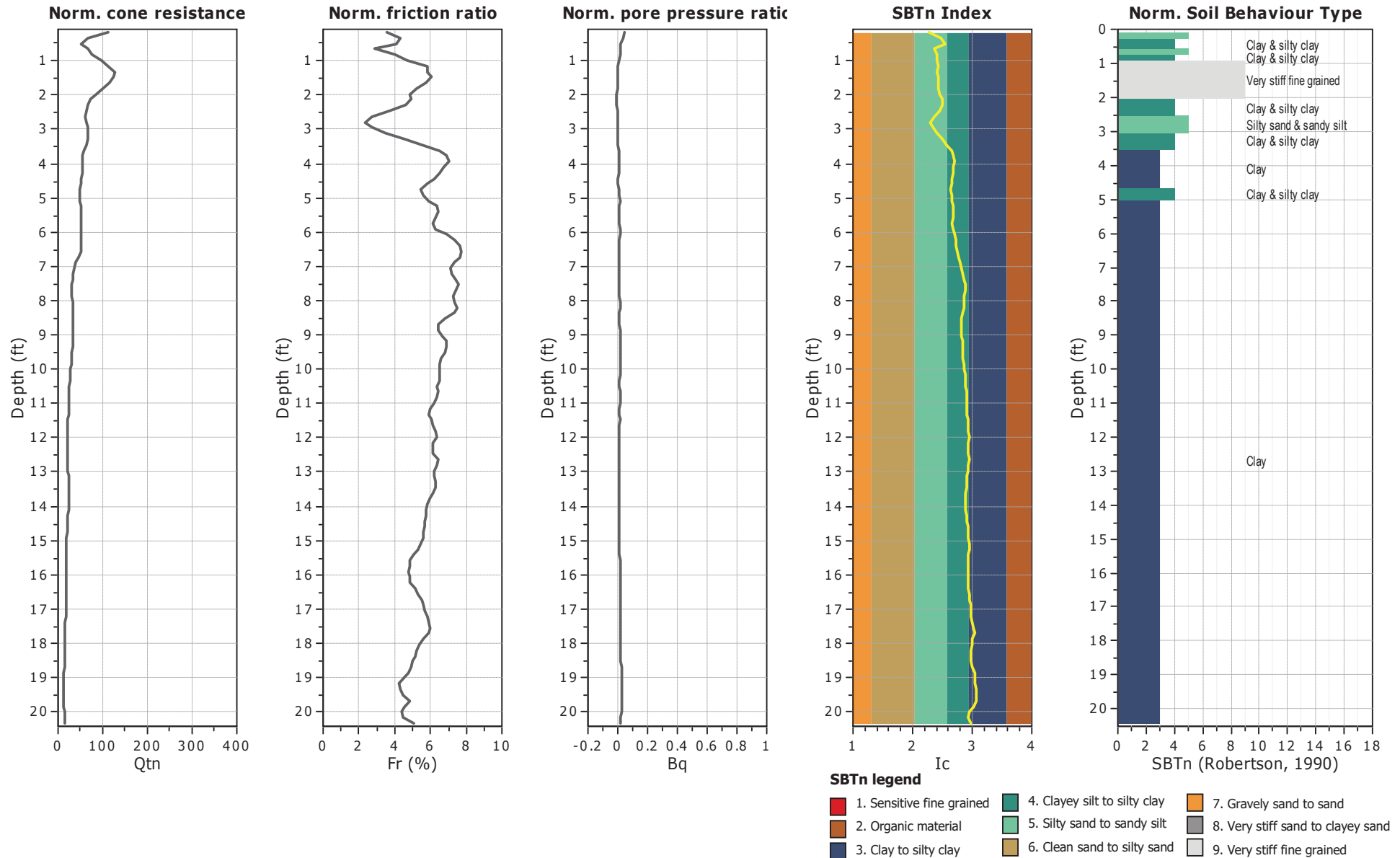
Location: East Covell Boulevard, Davis, CA

CPT: CPT 11

Total depth: 20.34 ft, Date: 9/12/2024

Coords: lat 0° lon 0°

Cone Operator:



Project: Shriner Property

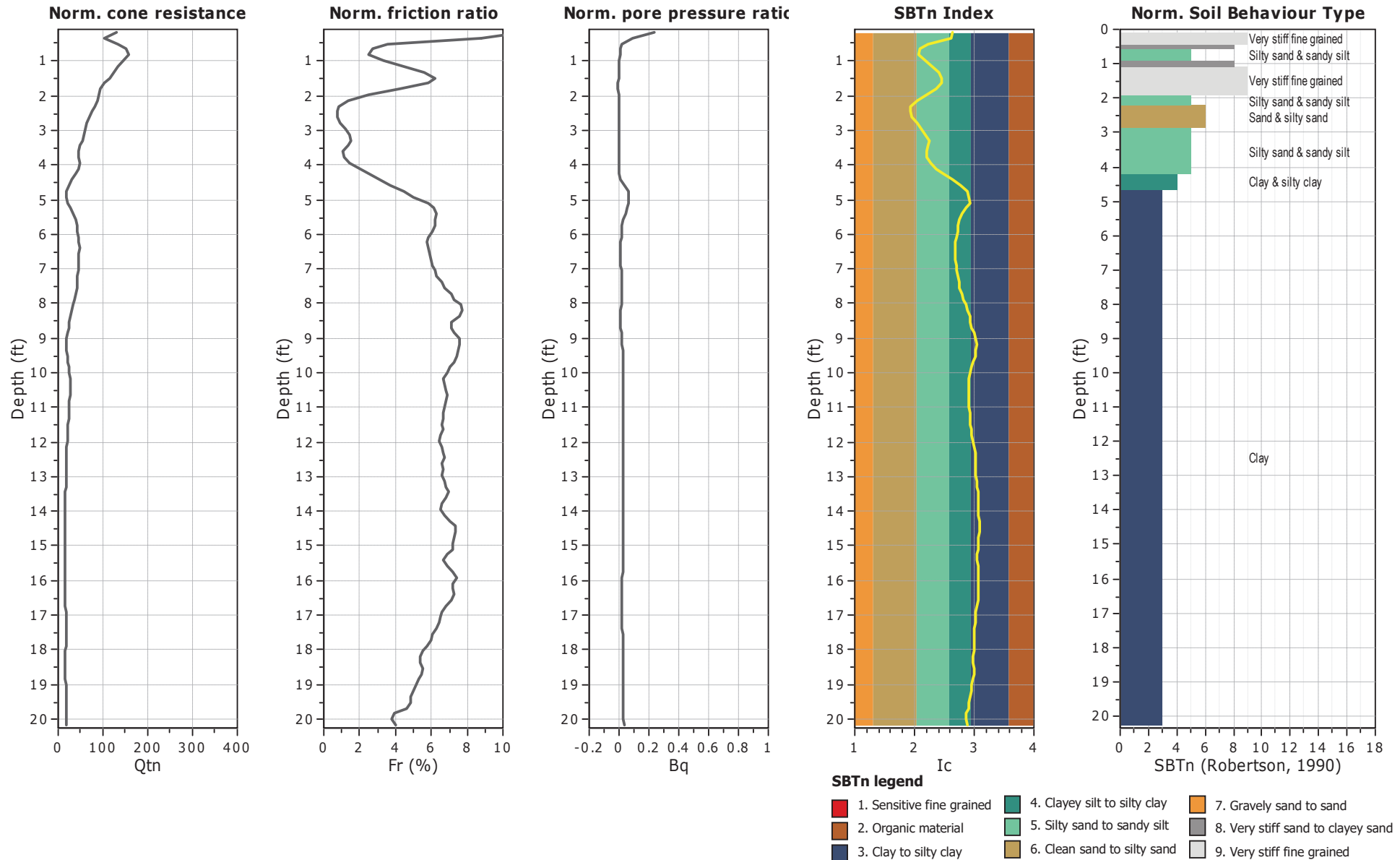
Location: East Covell Boulevard, Davis, CA

CPT: CPT 12

Total depth: 20.18 ft, Date: 9/12/2024

Coords: lat 0° lon 0°

Cone Operator:



Project: Shriner Property

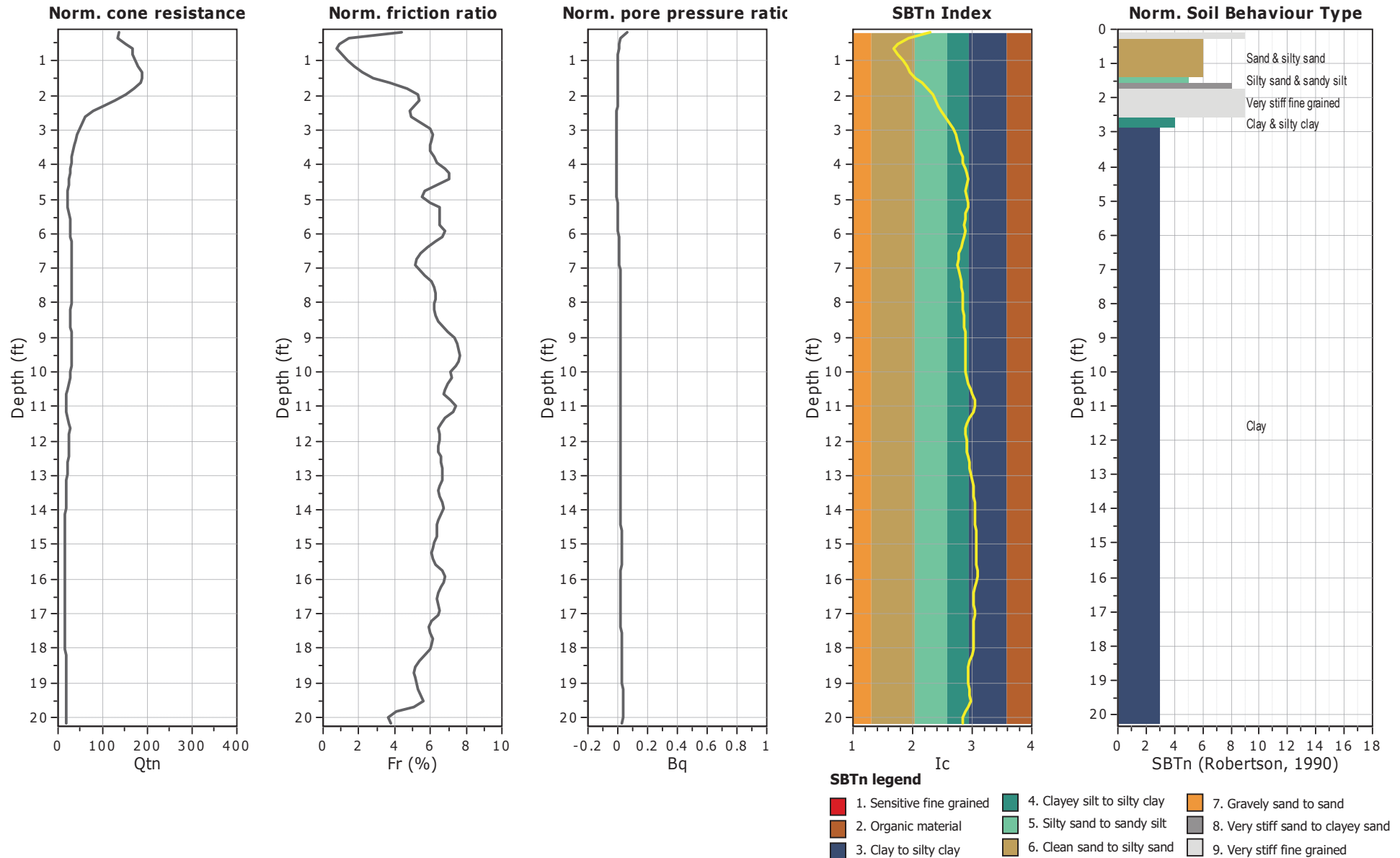
Location: East Covell Boulevard, Davis, CA

CPT: CPT 13

Total depth: 20.18 ft, Date: 9/12/2024

Coords: lat 0° lon 0°

Cone Operator:



Project: Shriner Property

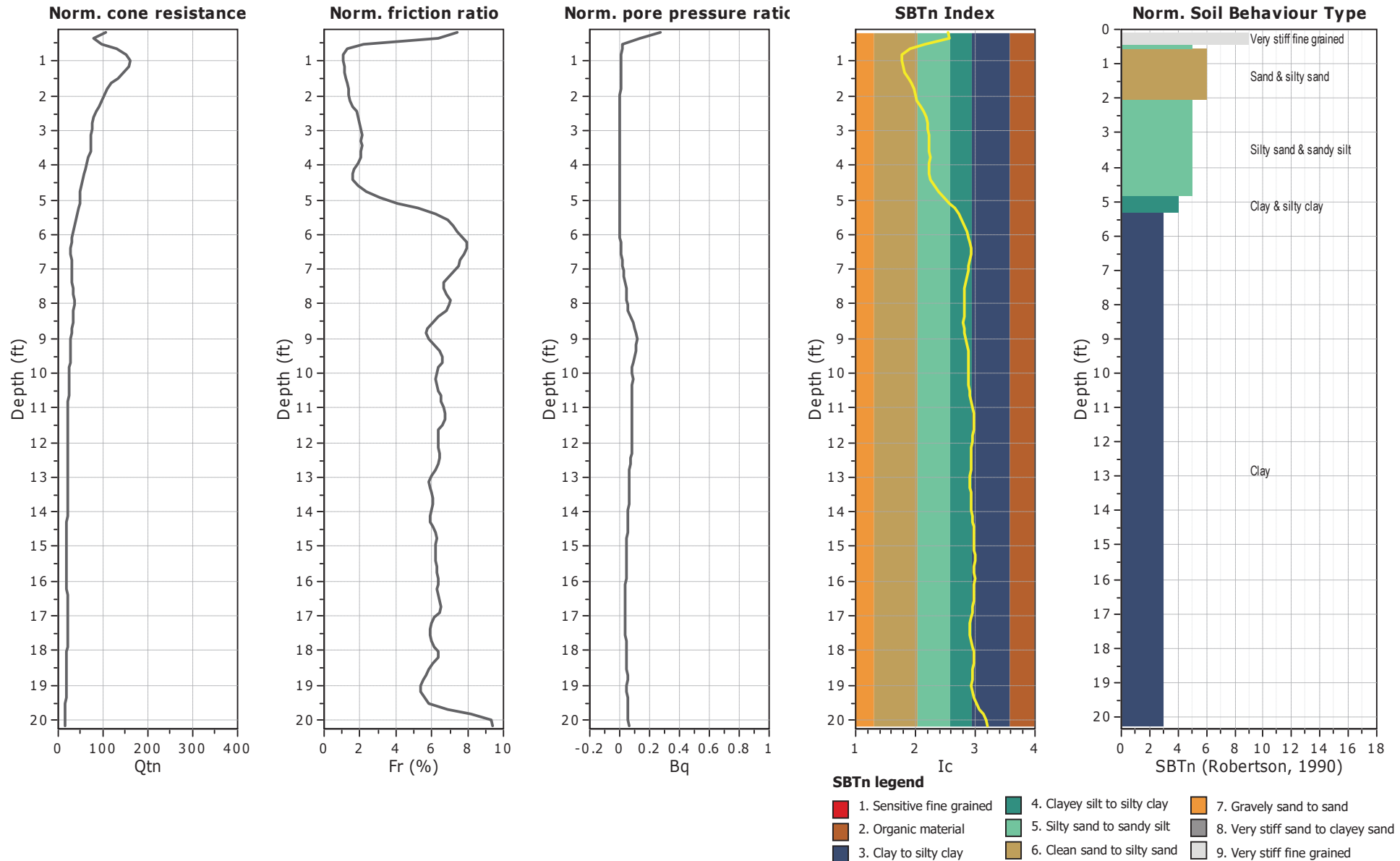
Location: East Covell Boulevard, Davis, CA

CPT: CPT 15

Total depth: 20.18 ft, Date: 9/12/2024

Coords: lat 0° lon 0°

Cone Operator:



Project: Shriner Property

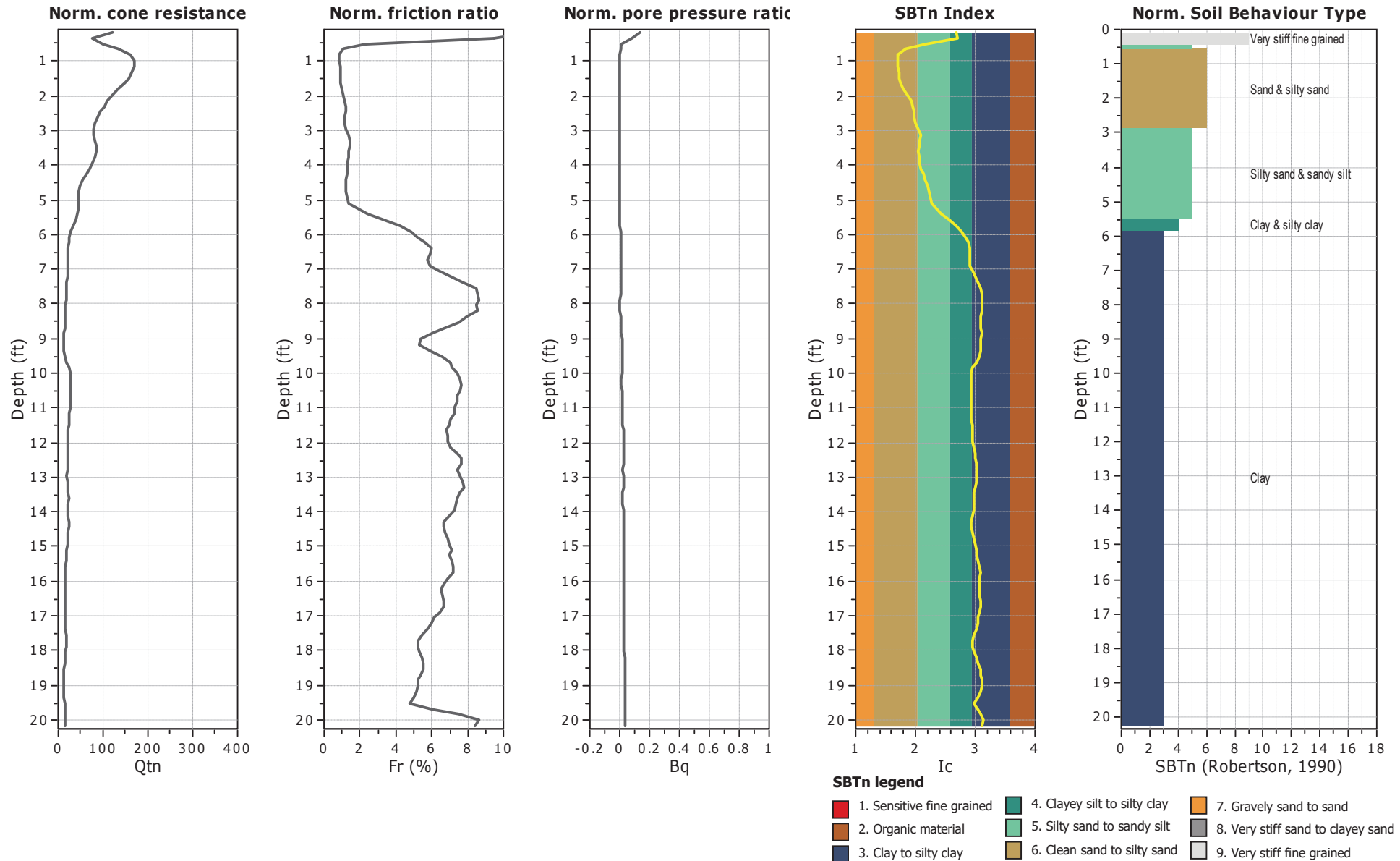
Location: East Covell Boulevard, Davis, CA

CPT: CPT 16

Total depth: 20.18 ft, Date: 9/12/2024

Coords: lat 0° lon 0°

Cone Operator:



Project: Shriner Property

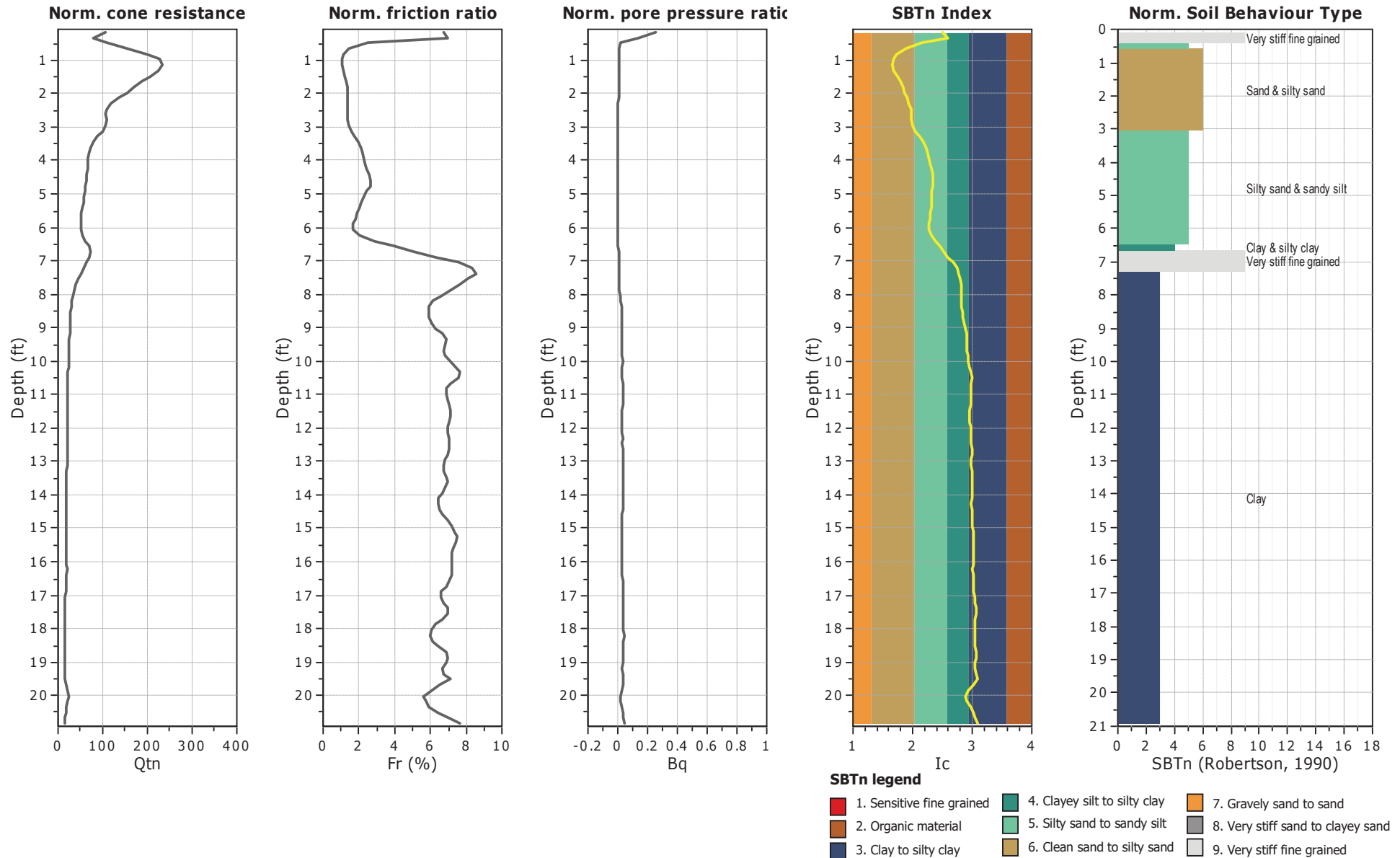
Location: East Covell Boulevard, Davis, CA

CPT: CPT 14

Total depth: 20.83 ft, Date: 9/12/2024

Coords: lat 0° lon 0°

Cone Operator:

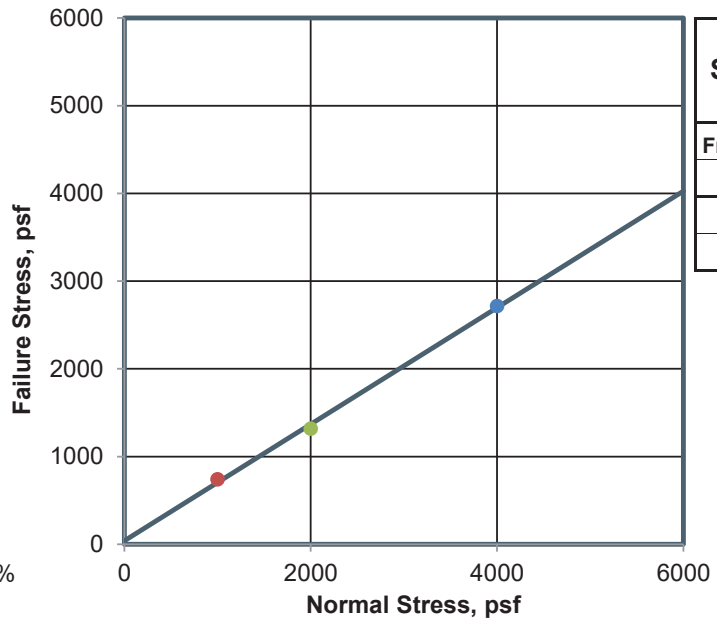
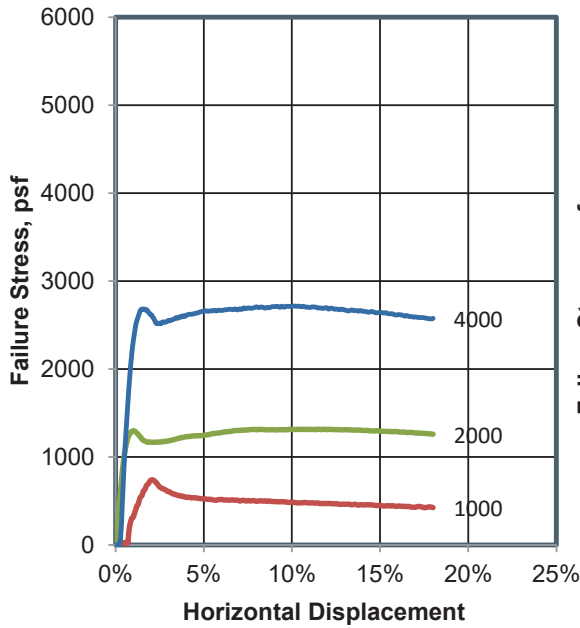


APPENDIX B

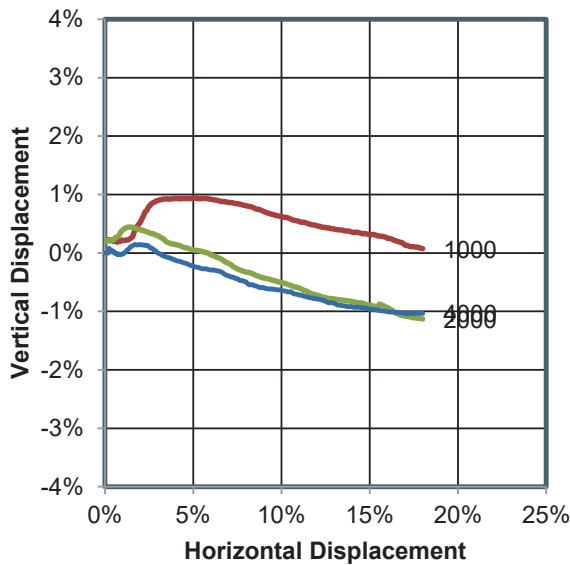
Laboratory Testing

Direct Shear Tests
Modified Proctor Tests
Resistance Value Tests
Expansion Index Tests
Atterberg Limit Tests
Sieve Analysis Test
Sieve Analysis with Hydrometer Test
Amount Finer Than No. 200 Tests
Moisture Content and Dry Density Tests
Corrosivity Tests

Direct Shear Test of Soils Under Consolidated Drained Conditions, ASTM D3080



Direct Shearbox Results	
Friction Angle	33.6°
Cohesion	40 psf



Test No.		1	2	3
Initial	Wet Density, pcf	118.3	118.3	118.3
	Dry Density, pcf	103.4	103.4	103.4
	Moisture Content, %	14.4	14.4	14.4
	Diameter, in	2.50	2.50	2.50
	Height, in	1.00	1.00	1.00
Pre Shear	Wet Density, pcf	130.4	129.9	128.9
	Dry Density, pcf	102.6	103.3	104.2
	Moisture Content, %*	27.0	25.7	23.7
	Diameter, in	2.50	2.50	2.50
	Height, in	1.01	1.00	0.99
Normal Stress, psf		1000	2000	4000
Failure Stress, psf		740	1316	2715
Failure Strain, %		2.04	11.47	10.16
Rate, in/min		0.001		

*Based on post shear moisture content

Sample Type: Remolded to 90% RC

Material Description: Olive Brown CLAY

Source:

Notes: Gravel removed from test sample

Sample No./Depth:	TP-8 @ 1-2'	USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled:	9/11/2024	Date Test Started:	10/5/2024		0	87.5

Project: Shriners Property

Project No.: E24278.000

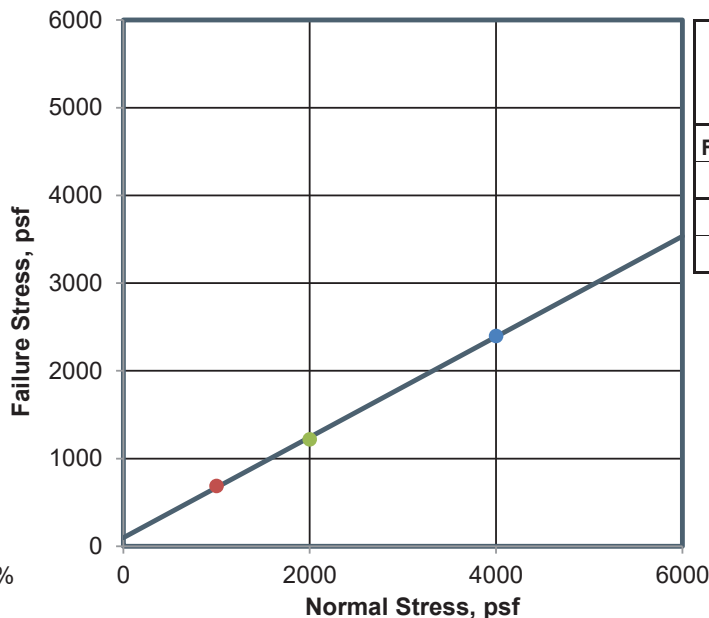
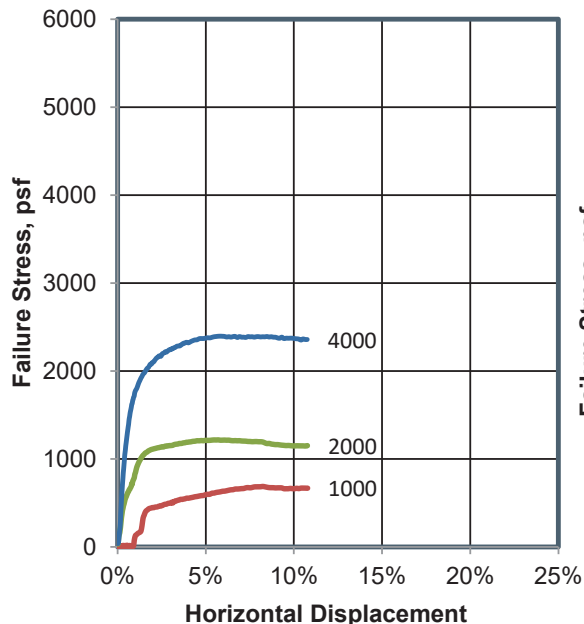
Reviewed By: DN

Date: 10/8/2024

Figure

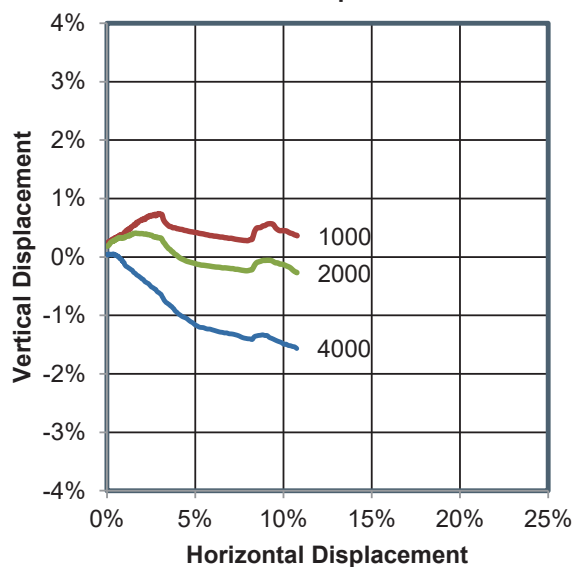
B-1

Direct Shear Test of Soils Under Consolidated Drained Conditions, ASTM D3080



Direct Shearbox Results

Friction Angle
29.8°
Cohesion
98 psf



Test No.		1	2	3
Initial	Wet Density, pcf	119.6	119.6	119.6
	Dry Density, pcf	105.2	105.2	105.2
	Moisture Content, %	13.7	13.7	13.7
	Diameter, in	2.50	2.50	2.50
	Height, in	1.00	1.00	1.00
Pre Shear	Wet Density, pcf	127.1	129.2	128.9
	Dry Density, pcf	102.2	104.6	106.1
	Moisture Content, %*	24.3	23.5	21.5
	Diameter, in	2.50	2.50	2.50
	Height, in	1.03	1.01	0.99
Normal Stress, psf		1000	2000	4000
Failure Stress, psf		688	1217	2396
Failure Strain, %		8.23	5.71	5.83
Rate, in/min		0.00015		

*Based on post shear moisture content

Sample Type: Remolded to 90% RC

Material Description: Gray CLAY with Sand

Source:

Notes: Gravel removed from test sample.

Sample No./Depth: B-6 @ 0-5'

USCS Class.

Liquid Limit

Plasticity Index

% Greater than No. 4

% Less than No. 200

Date Sampled: 9/16/2024

Date Test Started: 10/9/2024

0



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Project: Shriners Property

Project No.: E24278.000

Figure

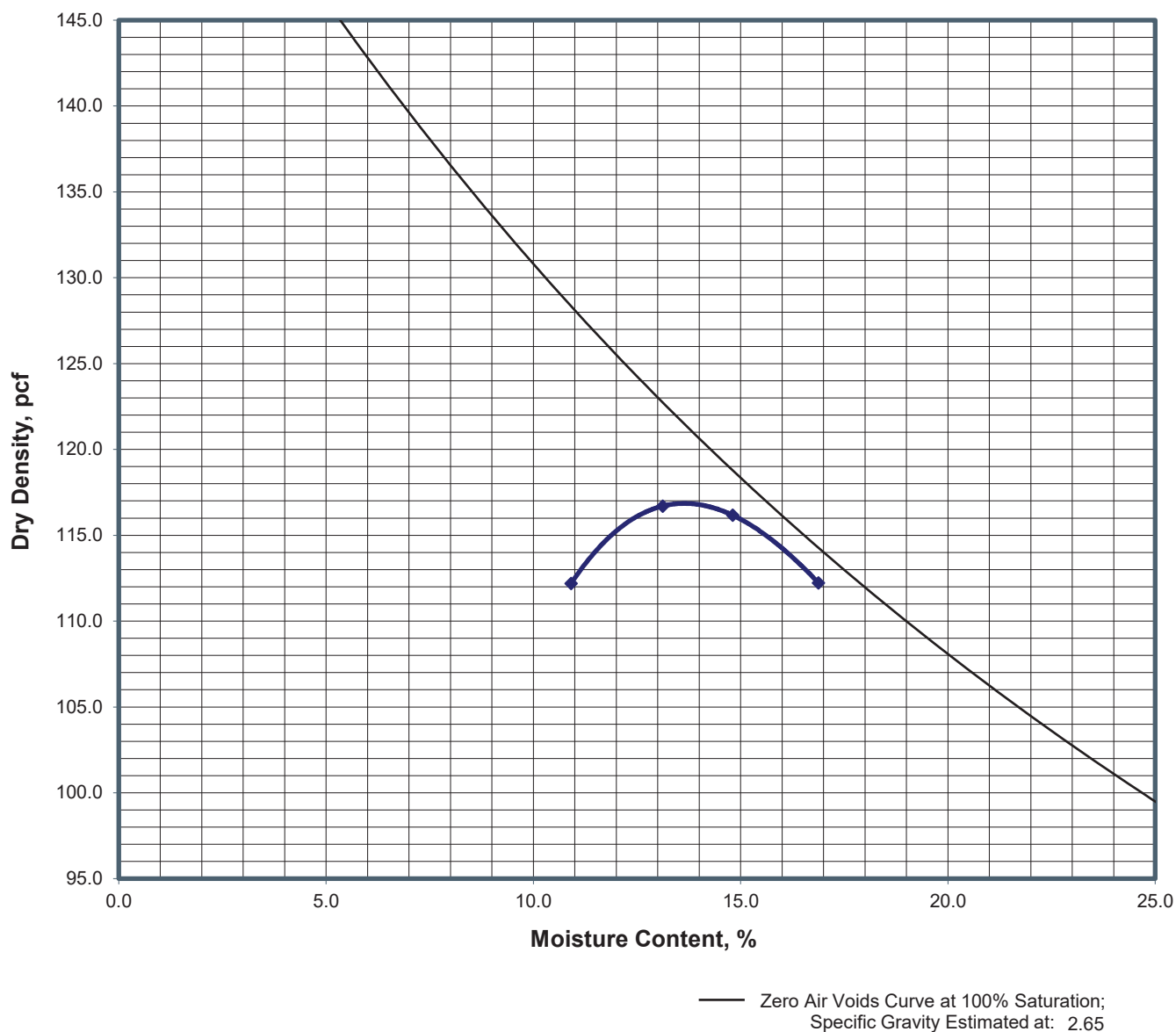
Reviewed By: DN

Date: 10/14/2024

B-2

Laboratory Compaction Characteristics of Soil

Using Modified Effort (56,000 lbf/ft³), ASTM D1557, Method A



Maximum Dry Density, pcf: 116.9	Optimum Moisture Content, %: 13.7
--	--

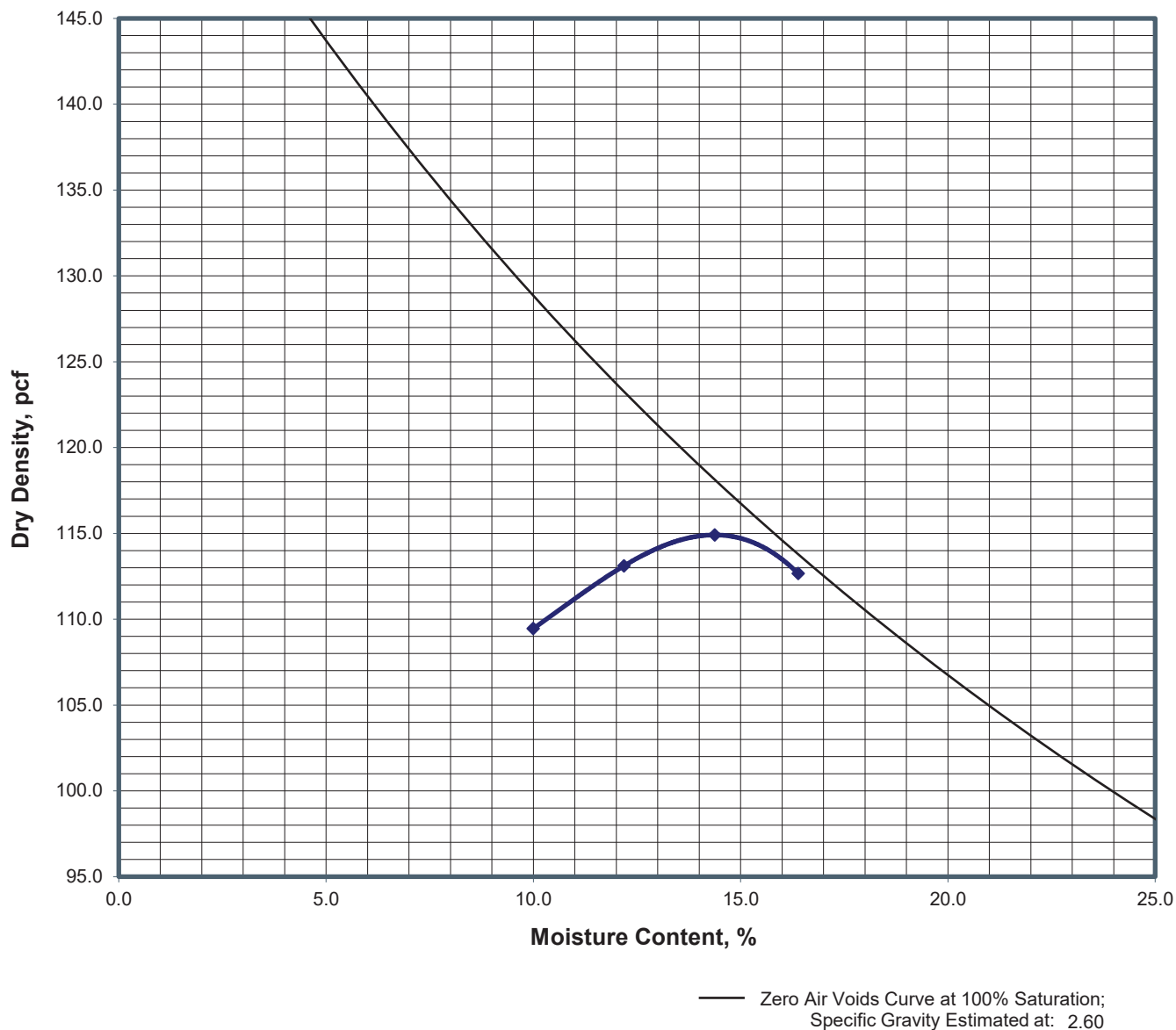
Material Description: **Gray CLAY with Sand**

Source: **B-6 @ 0-5'**

Notes:

Sample No./Depth: Curve 1	USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4 :	% Less than No. 200
Date Sampled: 9/16/2024 Date Test Started: 10/8/2024				0	

Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 lbf/ft³), ASTM D1557, Method A



Maximum Dry Density, pcf: 114.9	Optimum Moisture Content, %: 14.4
--	--

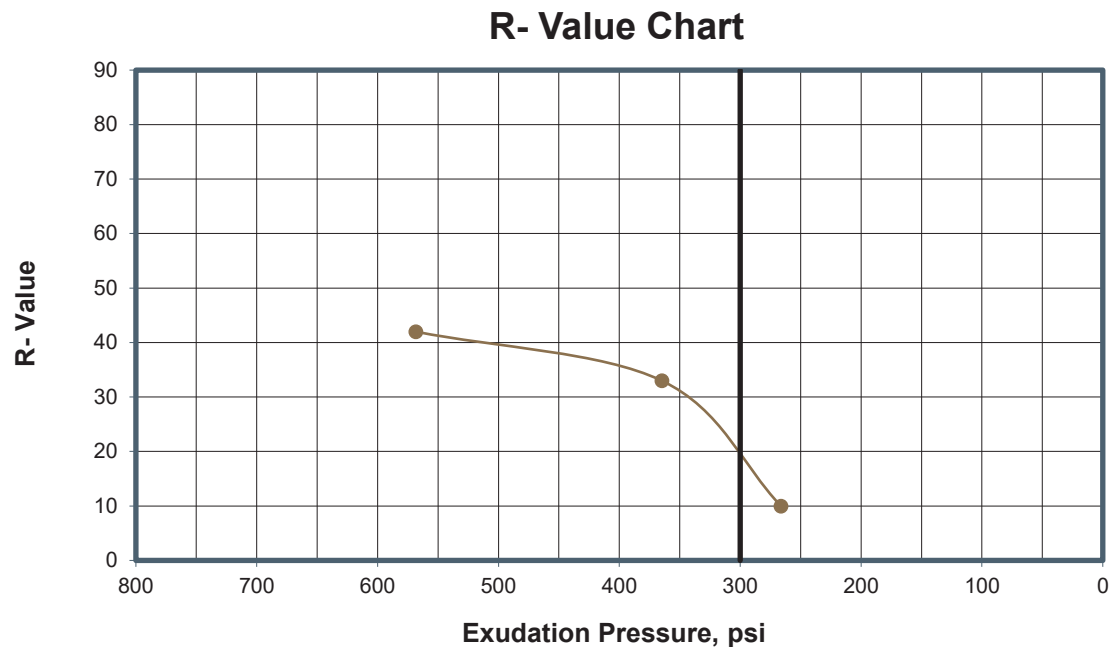
Material Description: **Olive Brown CLAY**

Source: **TP-8 @ 1-2'**

Notes:

Sample No./Depth:	Curve 2	USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4 :	% Less than No. 200
Date Sampled:	9/11/2024	Date Test Started:	10/3/2024		0	87.5

Resistance "R" Value of Soil and Soil-Aggregate Mixtures, CTM 301



Test Specimen No.:	1	2	3
Moisture Content at Test, %	17.3	18.4	20.7
Dry Density at Test, pcf	112.2	109.0	104.0
Expansion Pressure, psf	312	121	0
Exudation Pressure, psi	569	365	266
Resistance "R" Value	42	33	10
"R" Value at 300 psi Exudation Pressure	20		

Material Description: **Dark Olive Brown Sandy Lean CLAY**

Source: TP-10 @ 1-2'

Notes:

Sample No./Depth: RV-1	USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled: 9/11/2024 Date Test Started: 9/25/2024	CL	39	20	0	

Project: **Shriner Property**

Project No.: **E24278.000**

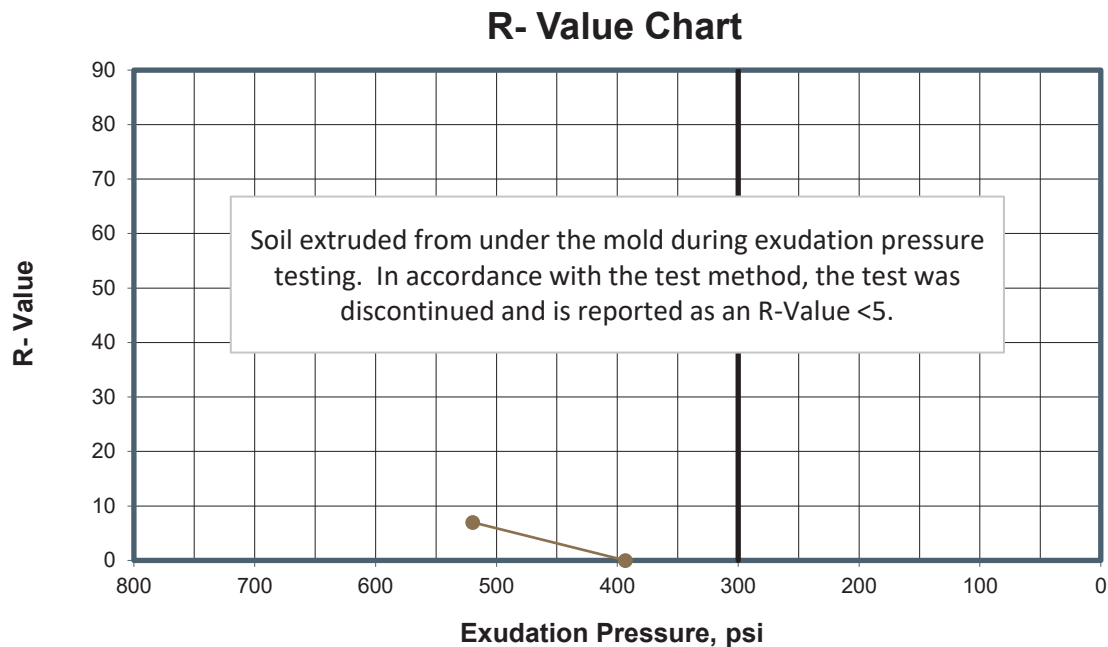
Reviewed By: JLC

Date: 9/26/2024

Figure

B-5

Resistance "R" Value of Soil and Soil-Aggregate Mixtures, CTM 301



Test Specimen No.:	1	2	3
Moisture Content at Test, %	21.5	23.7	
Dry Density at Test, pcf	105.6	99.8	
Expansion Pressure, psf	169	95	
Exudation Pressure, psi	520	393	
Resistance "R" Value	7	0	
"R" Value at 300 psi Exudation Pressure	<5		

Material Description: **Gray CLAY with Sand**

Source: **B-6 @ 0-5'**

Notes:

Sample No./Depth: RV-2	USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled: 9/16/2024	Date Test Started: 10/7/2024			0	

Project: **Shriners Property**

Project No.: **E24278.000**

Reviewed By: **JLC**

Date: **10/9/2024**

Figure

B-6

Expansion Index of Soils, ASTM D4829

Test Results

Expansion Index	88
Dry Density, as molded, pcf	90.8
Moisture Content, as molded, %	16.0
Final Moisture Content, %	32.7
Initial Saturation, as molded, %	51
Final Degree of Saturation, %	88

Classification of Potentially Expansive Soil

Expansion Index, EI	Potential Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
Above 130	Very High

Material Description: **Olive/Olive Gray CLAY**

Source:

Notes:

Sample No./Depth: TP-3 @ 3-4'	USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled: 9/11/2024 Date Test Started: 9/30/2024				0	



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Figure

B-7

Expansion Index of Soils, ASTM D4829

Test Results

Expansion Index	118
Dry Density, as molded, pcf	91.0
Moisture Content, as molded, %	15.2
Final Moisture Content, %	36.5
Initial Saturation, as molded, %	49
Final Degree of Saturation, %	92

Classification of Potentially Expansive Soil

Expansion Index, EI	Potential Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
Above 130	Very High

Material Description: **Olive Gray CLAY**

Source:

Notes:

Sample No./Depth: TP-3 @ 5-6'	USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled: 9/11/2024 Date Test Started: 9/20/2024				0	



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Figure

B-8

Expansion Index of Soils, ASTM D4829

Test Results

Expansion Index	51
Dry Density, as molded, pcf	98.0
Moisture Content, as molded, %	13.3
Final Moisture Content, %	28.4
Initial Saturation, as molded, %	50
Final Degree of Saturation, %	94

Classification of Potentially Expansive Soil

Expansion Index, EI	Potential Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
Above 130	Very High

Material Description: **Olive Brown CLAY**

Source:

Notes:

Sample No./Depth:	TP-8 @ 1-2'	USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled:	9/11/2024	Date Test Started:	10/3/2024		0	87.5



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Figure

B-9

Expansion Index of Soils, ASTM D4829

Test Results

Expansion Index	114
Dry Density, as molded, pcf	91.7
Moisture Content, as molded, %	15.0
Final Moisture Content, %	37.8
Initial Saturation, as molded, %	49
Final Degree of Saturation, %	97

Classification of Potentially Expansive Soil

Expansion Index, EI	Potential Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
Above 130	Very High

Material Description: **Olive/Light Olive Brown CLAY**

Source:

Notes:

Sample No./Depth: TP-8 @ 8'	USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled: 9/11/2024 Date Test Started: 9/20/2024				0	



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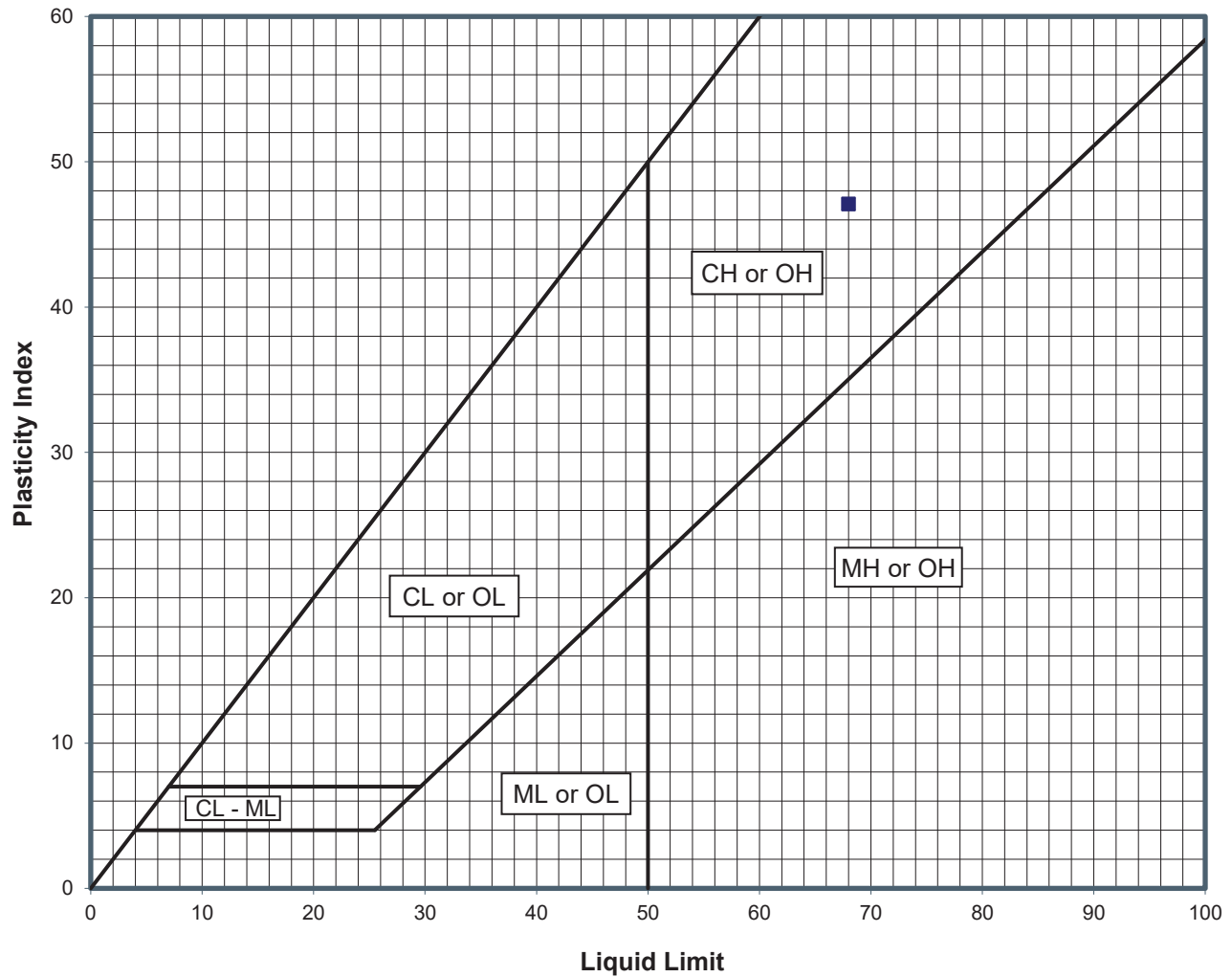
Reviewed By: DN

Date: 9/25/2024

Figure

B-10

Liquid Limit, Plastic Limit, and Plasticity Index of Soils, ASTM D4318, Method A



Liquid Limit	Plastic Limit	Plasticity Index	Unified Soil Classification, ASTM D2487
68	21	47	CH

Material Description: **Olive Gray Fat CLAY**

Source:

Notes:

Sample No./Depth: B-2 @ 6-6.5'				USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled:	9/16/2024	Date Test Started:	9/23/2024	CH	68	47	0	98.0

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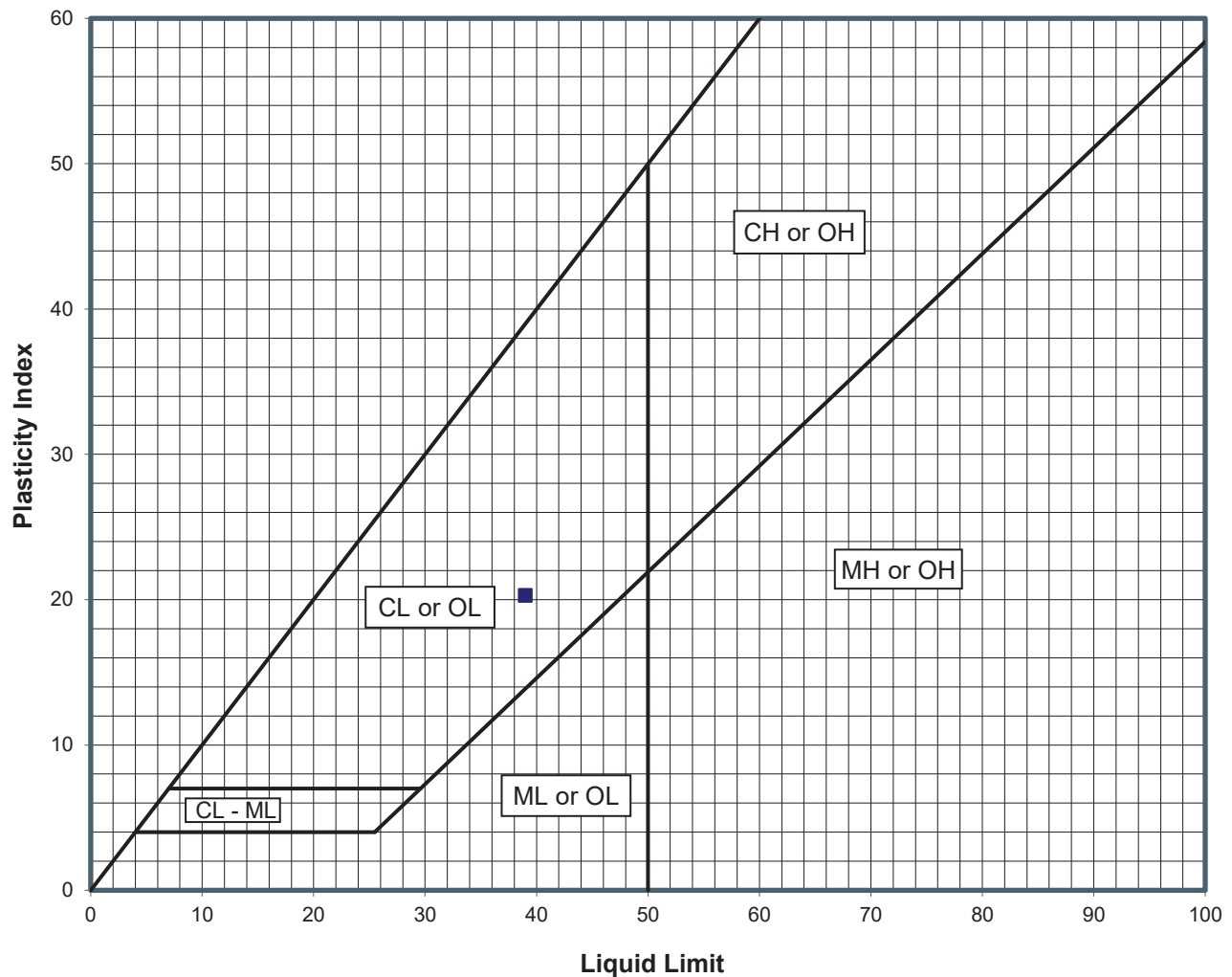
Reviewed By: DN

Date: 9/25/2024

Figure

B-11

Liquid Limit, Plastic Limit, and Plasticity Index of Soils, ASTM D4318, Method A



Liquid Limit	Plastic Limit	Plasticity Index	Unified Soil Classification, ASTM D2487
39	19	20	CL

Material Description: **Dark Olive Brown Sandy Lean CLAY**

Source:

Notes:

Sample No./Depth: TP-10 @ 1-2'				USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled:	9/11/2024	Date Test Started:	9/26/2024	CL	39	20	0	

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Reviewed By: DN

Date: 10/2/2024

Figure

B-12

Unconfined Compressive Strength of Cohesive Soil, ASTM D2166

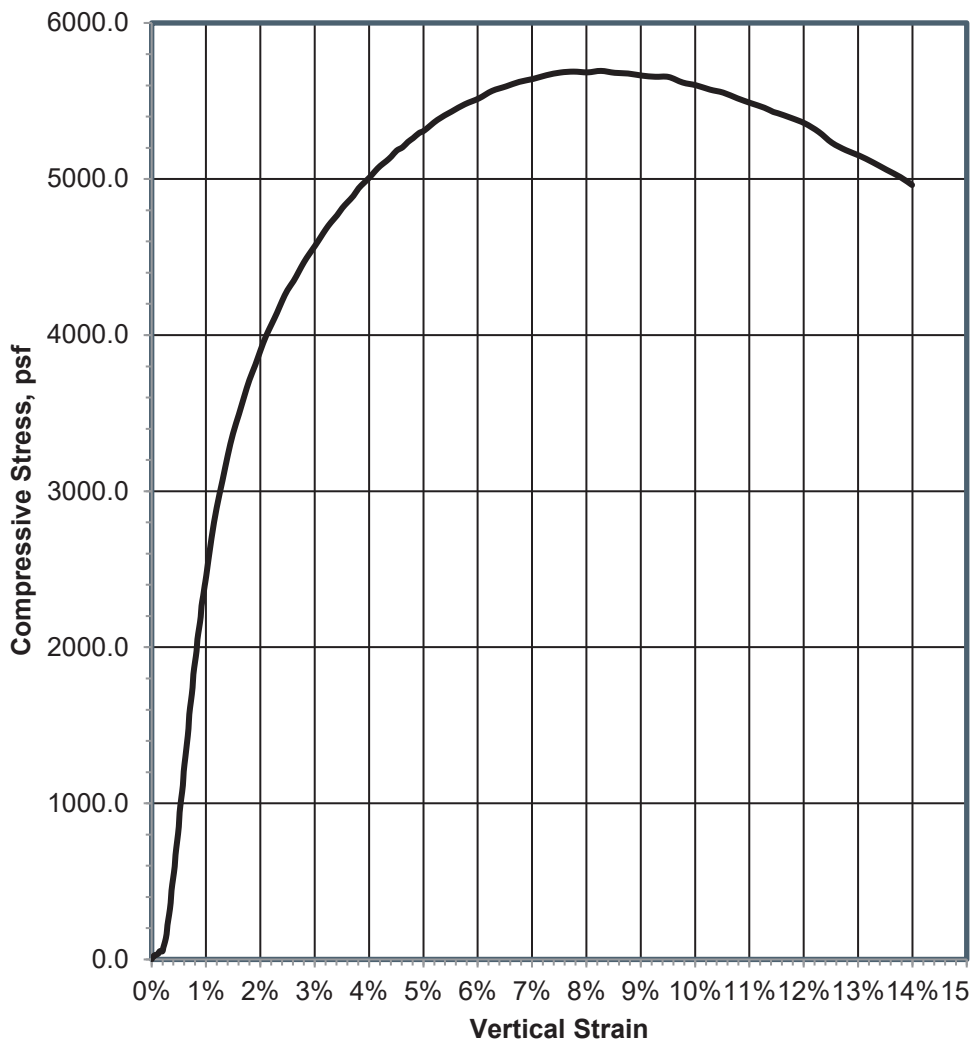


**Image of
Failed Specimen**



Unconfined Compression Results	Compression Strength	5700 psf	Specimen Parameters	Wet Density, pcf	122.8	Diameter, in	2.40
	Shear Strength	2850 psf		Dry Density, pcf	99.3	Height/Diameter	2.4
	Failure Strain, %	8.3 %		Moisture Content, %	23.7	Strain Rate, %/min	1.5
				Saturation, %	Not Evaluated	Sensitivity:	Not Evaluated
				Void Ratio	76.2	Specimen Type:	Insitu
				Height, in	5.79		

Material Description: **Dark Gray Brown CLAY**

Source:

Notes: *Moisture content based on after test sample.

Sample No./Depth:	B-1 @ 11-11.5'	USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled:	9/16/2024	Date Test Started:	9/23/2024			



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Figure

B-13

Unconfined Compressive Strength of Cohesive Soil, ASTM D2166

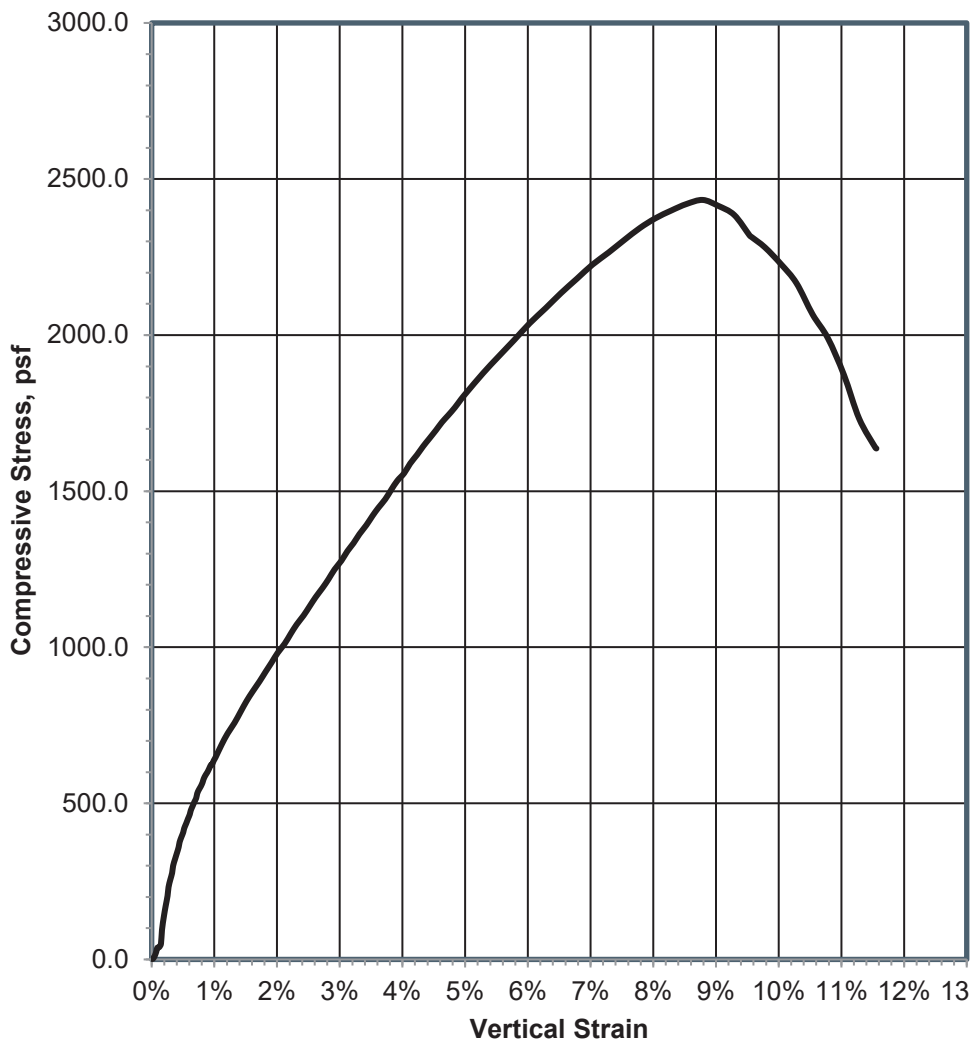


**Image of
Failed Specimen**



Unconfined Compression Results	Compression Strength	2440 psf	Specimen Parameters	Wet Density, pcf	124.9	Diameter, in	2.40
	Shear Strength	1220 psf		Dry Density, pcf	99.7	Height/Diameter	2.4
	Failure Strain, %	8.8 %		Moisture Content, %	25.2	Strain Rate, %/min	1.5
				Saturation, %	Not Evaluated	Sensitivity:	Not Evaluated
				Void Ratio	77.2	Specimen Type:	Insitu
				Height, in	5.65		

Material Description: **Light Olive Brown CLAY with Sand**

Source:

Notes: *Moisture content based on after test sample.

Sample No./Depth:	B-1 @ 26-26.5'	USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled:	9/16/2024	Date Test Started:	9/23/2024			



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Figure

B-14

Unconfined Compressive Strength of Cohesive Soil, ASTM D2166

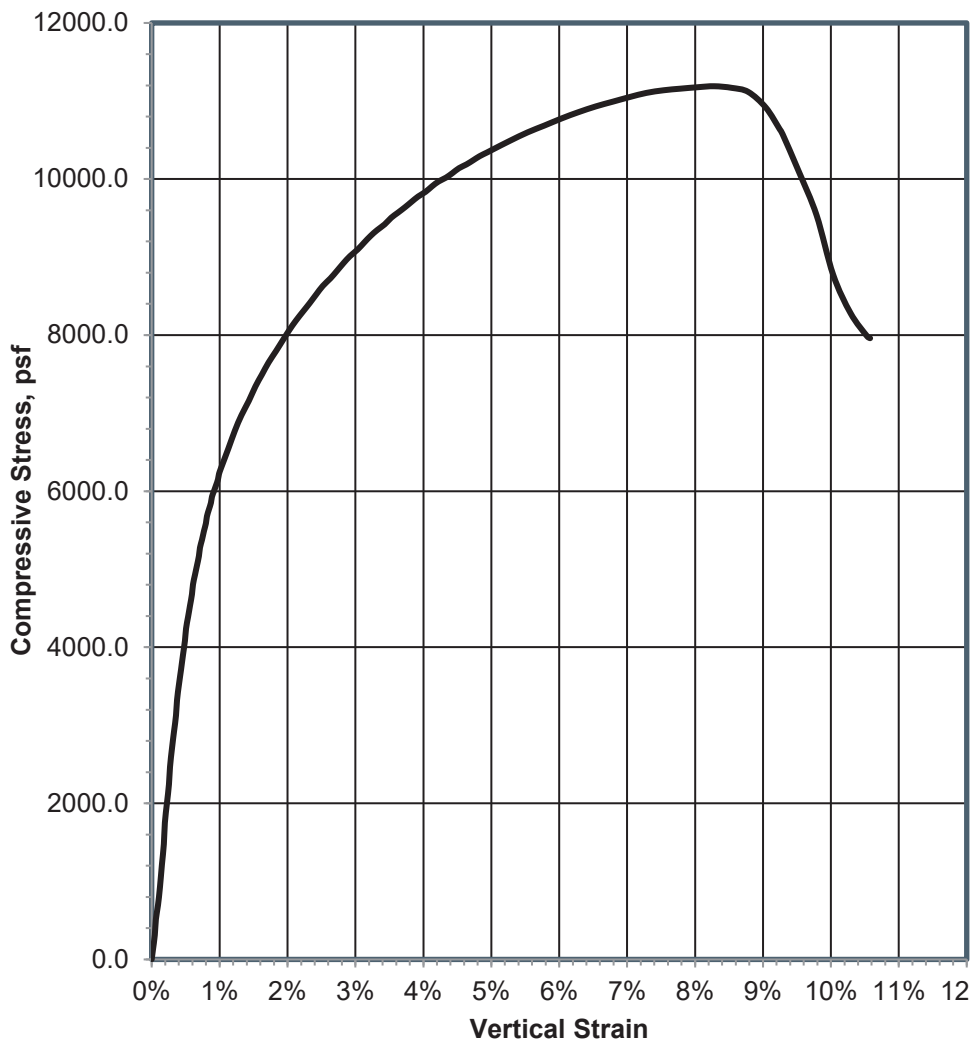


**Image of
Failed Specimen**



Unconfined Compression Results	Compression Strength	11180 psf	Specimen Parameters	Wet Density, pcf	126.7	Diameter, in	2.39
	Shear Strength	5590 psf		Dry Density, pcf	105.0	Height/Diameter	2.5
	Failure Strain, %	8.3 %		Moisture Content, %	20.7	Strain Rate, %/min	1.5
				Saturation, %	Not Evaluated	Sensitivity:	Not Evaluated
				Void Ratio	74.3	Specimen Type:	Insitu
				Height, in	5.88		

Material Description: **Dark Olive Gray CLAY**

Source:

Notes: *Moisture content based on after test sample.

Sample No./Depth:	B-4 @ 3.5-4'	USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled:	9/16/2024	Date Test Started:	9/23/2024			



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Figure

B-15

Unconfined Compressive Strength of Cohesive Soil, ASTM D2166

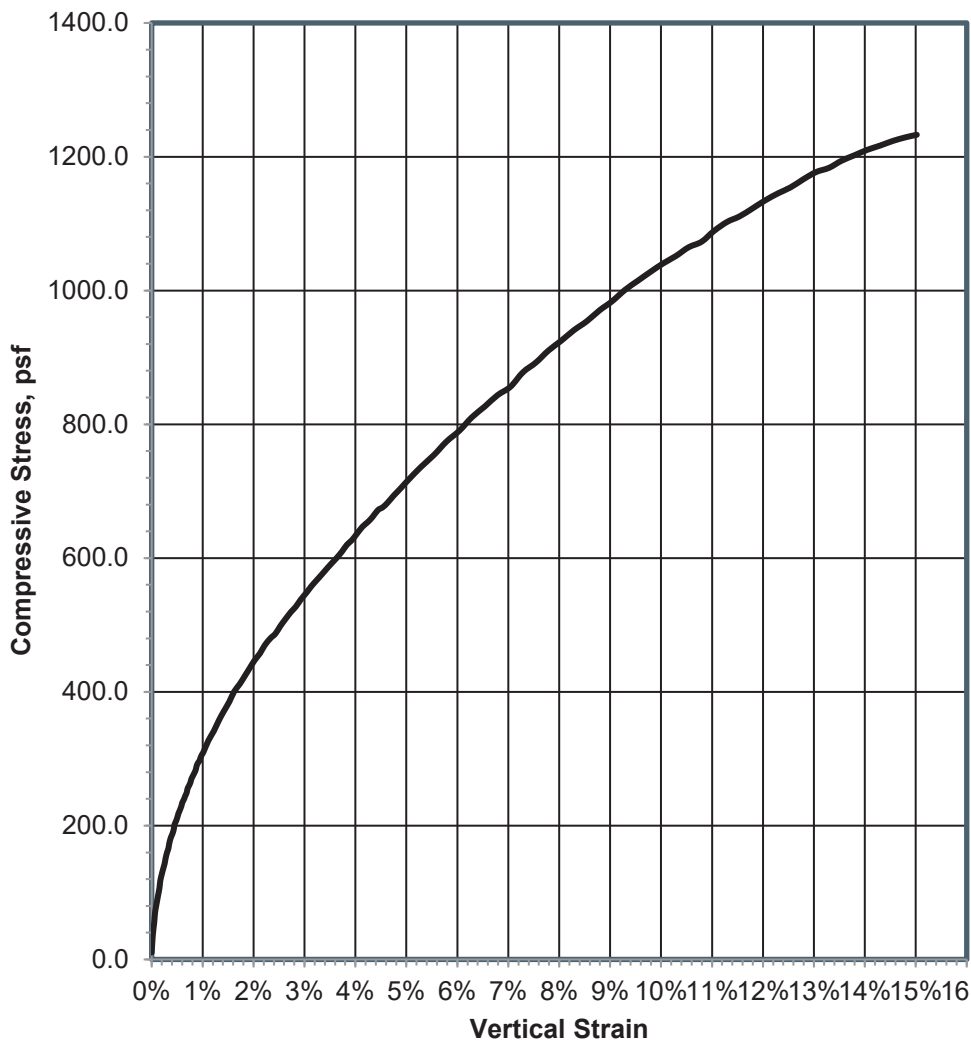


**Image of
Failed Specimen**



Unconfined Compression Results	Compression Strength	1240 psf	Specimen Parameters	Wet Density, pcf	116.9	Diameter, in	2.39
	Shear Strength	620 psf		Dry Density, pcf	91.2	Height/Diameter	2.3
	Failure Strain, %	15.0 %		Moisture Content, %	28.2	Strain Rate, %/min	1.5
				Saturation, %	Not Evaluated	Sensitivity:	Not Evaluated
				Void Ratio	79.0	Specimen Type:	Insitu
				Height, in	5.49		

Material Description: **Olive Gray CLAY**

Source:

Notes: *Moisture content based on after test sample.

Sample No./Depth:	B-12 @ 6-6.5'	USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled:	9/17/2024	Date Test Started:	9/23/2024			



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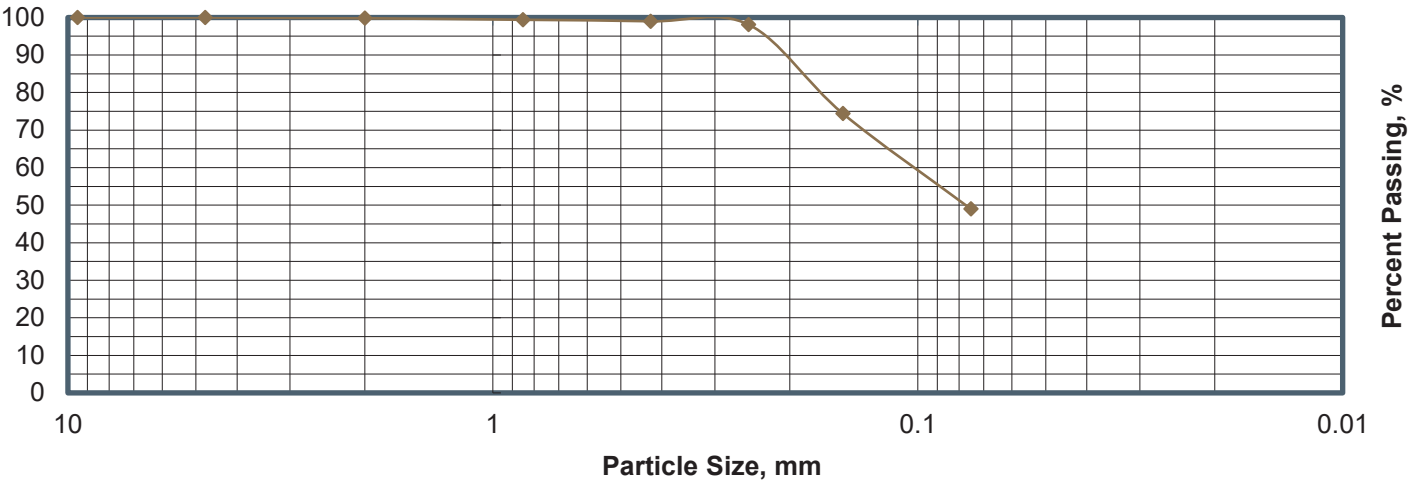
Reviewed By: DN

Date: 9/25/2024

Figure

B-16

Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis, ASTM D6913, Method A



U.S. Standard Sieve Size	Combined % Passing
3/8 Inch (9.5 mm)	100
No. 4 (4.75 mm)	100
No. 10 (2 mm)	100
No. 20 (850 μm)	99
No. 40 (425 μm)	99
No. 60 (250 μm)	98
No.100 (150 μm)	74
No. 200 (75 μm)	49.0

Material Description: B-1 @ 46-46.5'

Source:

Notes:

Sample No./Depth:	Olive Gray Clayey SAND	USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled:	9/16/2024	Date Test Started:	9/23/2024		0	49.0

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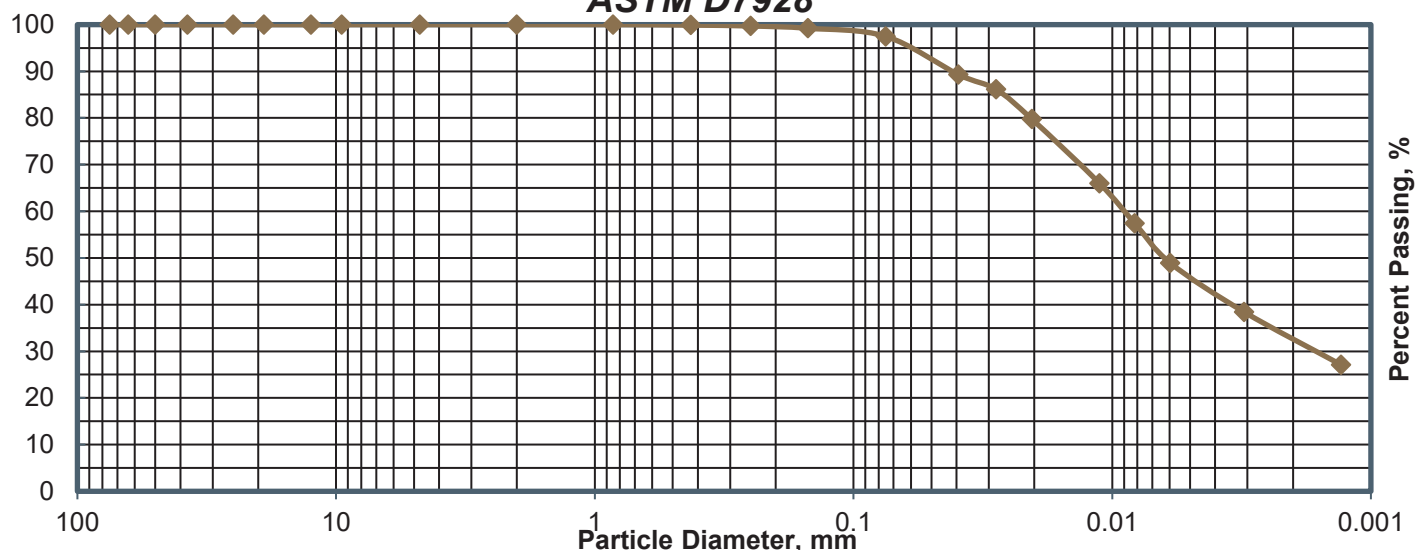
Project No.: E24278.000

Reviewed By: DN

Figure B-17

Date: 9/23/2024

Particle-Size Distribution of Fine-Grained Soils Using the Sedimentation Analysis, ASTM D7928



Sieve Analysis	
US Standard Sieve Size	Percent Passing
3 Inch (75 mm)	100
2 1/2 Inch (63.5 mm)	100
2 Inch (50 mm)	100
1 1/2 Inch (37.5 mm)	100
1 Inch (25 mm)	100
3/4 Inch (19 mm)	100
1/2 Inch (12.5 mm)	100
3/8 Inch (9.5 mm)	100
No. 4 (4.75 mm)	100
No. 10 (2 mm)	100
No. 20 (850 µm)	100
No. 40 (425 µm)	100
No. 60 (250 µm)	100
No. 100 (150 µm)	99
No. 200 (75 µm)	97.5

Hydrometer Analysis	
Particle Diameter, mm	Percent Passing
0.039	89.3
0.028	86.1
0.020	79.8
0.011	72.8
0.011	66.0
0.008	57.4
0.006	48.9
0.003	38.4
0.001	27.1

Material Description: **Olive Brown CLAY**

Source:

Notes:

Sample No./Depth: B-2 @ 3.5-4'	USCS Class.	Liquid Limit	Plasticity Index	% Greater than No. 4	% Less than No. 200
Date Sampled: 9/16/2024 Date Test Started: 10/1/2024				0	97.5



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Date: 10/2/2024

Figure

B-18

**Amount of Material Finer than No. 200 (75- μ m) Sieve in Soils by
Washing, ASTM D1140, Method A**

Sample No.	Depth	Sample Description	Material Finer than No. 200 Sieve, %
B-2	6-6.5'	Olive Gray Fat CLAY	98.0
B-5	3.5-4'	Light Yellow Brown CLAY	86.6
B-6	3.5-4'	Dark Grayish Brown CLAY	88.0
B-15	3.5-4'	Light Yellow Brown Clayey SAND	35.4
TP-8	1-2'	Olive Brown CLAY	87.5

Notes:

Date Sampled: 9/11/2024, 9/16/2024, & 9/17/2024	Date Test Started: 9/20/2024
--	---------------------------------

Project: **Shriners Property**

Project No.: **E24278.000**

Reviewed By: DN Date: 9/23/2024

Figure

B-19

**Moisture Content & Dry Density of Soil, ASTM D2216, Method B & D7263,
Method B**

Sample No.	B-1	B-1	B-1	B-3	B-5	B-7	B-11	B-14
Depth	36-36.5'	41-41.5'	51-51.5'	3.5-4'	3.5-4'	6-6.5'	3.5-4'	6-6.5'
Diameter, in	2.39	2.40	2.39	2.39	2.40	2.39	2.40	2.40
Height, in	6.00	6.00	6.10	5.95	5.70	5.80	5.90	6.05
Moisture Content, %	23.0	22.9	24.0	30.0	9.8	27.5	14.4	20.7
Dry Density, pcf	105.7	105.1	102.8	86.6	92.8	86.1	86.4	102.8
Soil Description	Olive Brown CLAY with Sand	Olive Brown CLAY	Olive Brown CLAY	Dark Grayish Brown CLAY	Light Yellowish Brown CLAY	Olive Gray CLAY with Sand	Light Olive Brown CLAY	Dark Grayish Brown CLAY

Notes:

Date Sampled: 9/11/2024, 9/16/2024, 9/17/2024

Date Test Started: 9/19/2024



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Project: **Shriners Property**

Project No.: **E24278.000**

Figure

Reviewed By: DN

Date: 9/23/2024

B-20

**Moisture Content & Dry Density of Soil, ASTM D2216, Method B & D7263,
Method B**

Sample No.	B-15							
Depth	3.5-4'							
Diameter, in	2.39							
Height, in	5.70							
Moisture Content, %	7.6							
Dry Density, pcf	102.5							
Soil Description	Light Yellow Brown Clayey SAND							

Notes:

Date Sampled: 9/17/2024

Date Test Started: 9/19/2024



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Project: **Shriners Property**

Project No.: **E24278.000**

Figure

Reviewed By: DN

Date: 9/23/2024

B-21



Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

RECEIVED OCT 03 2024

Date Reported 09/27/2024
Date Submitted 09/23/2024

To: Jeffry Cannon
Youngdahl Consulting Group
1234 Glenhaven Ct.
El Dorado Hills, CA 95630

From: Gene Oliphant, Ph.D. \ Ty Bui
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : E24278.000 Site ID : TP-4@1-2FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 93159-192878.

EVALUATION FOR SOIL CORROSION

Soil pH	7.49		
Minimum Resistivity	1.13 ohm-cm (x1000)		
Chloride	4.8 ppm	00.00048	%
Sulfate	14.0 ppm	00.00140	%

METHODS

pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m



Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

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To: Jeffry Cannon
Youngdahl Consulting Group
1234 Glenhaven Ct.
El Dorado Hills, CA 95630

From: Gene Oliphant, Ph.D. \ Ty Bui 
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : E24278.000 Site ID : TP-10@1-2FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 93159-192879.

EVALUATION FOR SOIL CORROSION

Soil pH	7.00		
Minimum Resistivity	1.50 ohm-cm (x1000)		
Chloride	7.0 ppm	00.00070	%
Sulfate	17.3 ppm	00.00173	%

METHODS

pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m



Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

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Youngdahl Consulting Group
1234 Glenhaven Ct.
El Dorado Hills, CA 95630

From: Gene Oliphant, Ph.D. \ Ty Bui
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : E24278.000 Site ID : B-4@3-3.5FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 93159-192880.

EVALUATION FOR SOIL CORROSION

Soil pH	7.01		
Minimum Resistivity	0.80 ohm-cm (x1000)		
Chloride	61.4 ppm	00.00614	%
Sulfate	74.3 ppm	00.00743	%

METHODS

pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m



Sunland Analytical

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1234 Glenhaven Ct.
El Dorado Hills, CA 95630

From: Gene Oliphant, Ph.D. \ Ty Bui 
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : E24278.000 Site ID : B-11@6-6.5FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 93159-192881.

EVALUATION FOR SOIL CORROSION

Soil pH	7.65		
Minimum Resistivity	1.15 ohm-cm (x1000)		
Chloride	19.5 ppm	00.00195	%
Sulfate	61.8 ppm	00.00618	%

METHODS

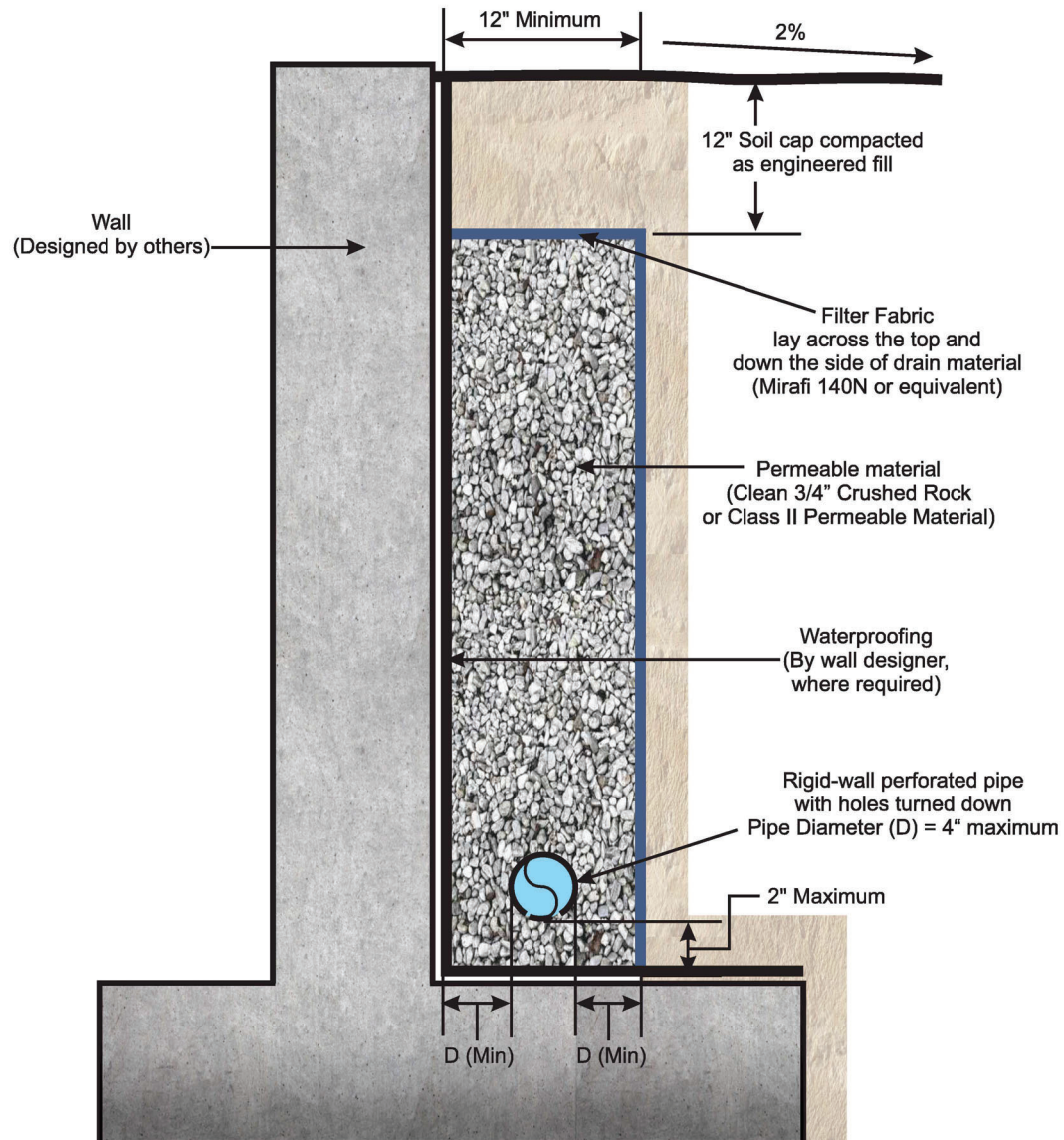
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

APPENDIX C

Details

Site Wall Drainage
Sub-Drain

Site Retaining Wall With Perforated Pipe Backdrain (Typical Cross Section)

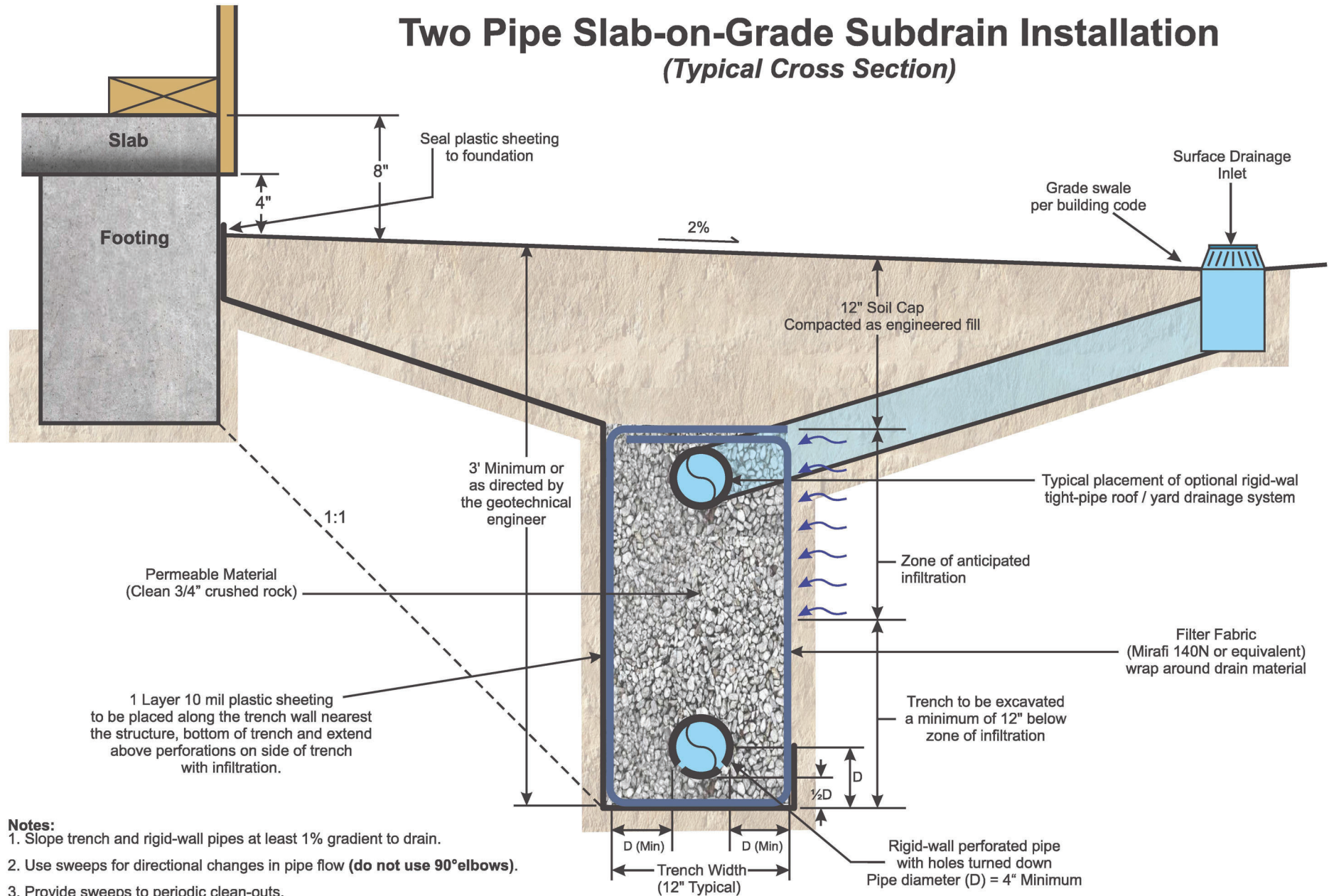


Notes:

1. Slope trench and rigid-wall pipes at least 1% gradient to drain to an appropriate outfall area away from residence.
2. Use sweeps for directional changes in pipe flow (**do not use 90° elbows**).
3. Provide periodic clean-outs.
4. If Class II Permeable Material is used, installation of filter fabric may be waived.

Not to Scale

Two Pipe Slab-on-Grade Subdrain Installation (Typical Cross Section)



Notes:

1. Slope trench and rigid-wall pipes at least 1% gradient to drain.
2. Use sweeps for directional changes in pipe flow (**do not use 90° elbows**).
3. Provide sweeps to periodic clean-outs.

Not to Scale