500 kV Collinsville Substation

Geotechnical Engineering Report

Collinsville, Solano County, California

June 27, 2025 | Terracon Project No. NA245123

Prepared for:

EPC Solutions Inc
2115 N 30th St Ste 203
Tacoma, WA 98403

Nationwide

Terracon.com

- Facilities
- Environmental
- Geotechnical
- Materials

902 Industrial Way
Lodi, CA 92540
P (209) 367-3701
Terracon.com

June 27, 2025

EPC Solutions Inc
2115 N 30th St Ste 203
Tacoma, WA 98403

Attn: Terry Ryan
P: (253) 312-8479
E: TerryRyan@EPCS.com

Re: Geotechnical Engineering Report
500 kV Collinsville Substation
Stratton Lane
Collinsville, Solano County, California
Terracon Project No. NA245123

Dear Mr. Ryan:

We have completed the scope of Geotechnical Engineering services for the referenced project in general accordance with Terracon Proposal No. PNA245123 dated October 1, 2024. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon

DRAFT **DRAFT**

Christopher B. Congrave, PE 92512
Senior Engineer

Robert Fosse, GE 2380
Senior Engineering Consultant

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Figures

Attachments

Note: This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the Terracon logo will bring you back to this page. For more interactive features, please view your project online at **client.terracon.com**.

Refer to each individual Attachment for a listing of contents.

Report Summary

Topic [1]	Overview Statement [2]
Project Description	Facilities planned for the Collinsville Substation include electrical structures supported by either shallow spread footing or drilled cast-in-place shaft foundations of adequate size and depth for supporting the anticipated loads. Drilled shaft foundations are preferred for the substation where soil conditions will allow. The substation will also include large oil filled equipment which is anticipated to be placed on mat slab foundations. A stormwater bio-retention area will also be located on the south end of the substation.
Geotechnical Characterization	Near surface soils encountered in our borings generally consisted of stiff to hard fat or lean clay to the maximum boring depth of 51½ feet below the existing ground surface (bgs). Some of the borings encountered minimal layers of medium dense silty sand. Groundwater was observed in seven of the ten test borings at depths as shallow as 19½ feet bgs at the time of our exploration.
Earthwork	Preliminary grading plans were not available for review at the time this report was prepared. We have assumed tha final site grades will generally remain the same as existing grades. Existing on-site lean clays can be used for general site grading. Grading should be conducted in accordance with the Earthwork section of this report.
Shallow Foundations	Shallow foundations are recommended for improvements supported on shallow mat slabs or spread footings. Expected settlements: < 1-inch total, < ½-inch differential
Deep Foundations	Deep foundation systems are recommended for the substation elements of the site. Drilled cast-in-place reinforced concrete shafts are a common foundation type in this region and can be used to support the structural loads through skin friction in the overburden soils using parameters provided herein.
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. If the reader is reviewing this report as a pdf, the topics in the table can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed substation to be located at Stratton Lane in Collinsville, Solano County, California. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Seismic site classification per the 2022 California Building Code (CBC)
- Site preparation and earthwork
- Foundation design and construction
- Access road design and construction
- Stormwater detention considerations

The geotechnical engineering Scope of Services for this project included the advancement of test borings, laboratory testing, engineering analysis, and preparation of this report.

Drawings showing the site and boring locations are shown on the **Site Location** and **Exploration Plan**, respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the boring logs and/or as separate graphs in the **Exploration and Laboratory Results** section.

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	An email request for proposal was initially provided by Terry Ryan on August 23, 2024, for the Collinsville substation. The request included the following: • Collinsville Geotechnical Specification_Rev0_08-23-2024.docx (provided August 23, 2024) • Soil Resistivity Data Sheets.pdf (provided August 23, 2024)

Item	Description
Project Description	Facilities planned for the Collinsville Substation are anticipated to include electrical structures supported with either shallow spread footing or drilled cast-in-place shaft foundations. The substation will also include large oil filled equipment which is anticipated to be placed on mat slab foundations. A stormwater bio-retention area will also be located on the east end of the substation.
Finished Elevation	Not provided; We have assumed the finished elevation is not more than 3 feet below/above existing grade
Maximum Loads	Anticipated structural loads were provided by EPC. ▪ Axial: 460 kips (oil filled equipment) ▪ Overturning: 175 foot-kips ▪ Shear: 16 kips
Grading	A preliminary grading plan was not available for review at the time this report was prepared. We have assumed approximately 3 feet of cut and 3 feet of fill will be required to develop final grade, excluding remedial grading requirements.
Access Roads	Unpaved access roads and parking areas are planned for the site as described below: ▪ Access roads are to support post-construction traffic which we understand will be primarily light maintenance vehicles. The roads will be required to support a maximum vehicle load of 80,000 pounds for fire truck access. Additionally, the substation access road should be able to support heavy vehicle delivery (HS-20 loading) up to two times per year throughout the design life. We understand it is acceptable for the access roads to require ongoing maintenance throughout their design life.
Building Code	2022 CBC

Terracon should be notified if any of this information is inconsistent with the planned construction, especially the grading limits, as modifications to our recommendations may be necessary.

Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located at Stratton Lane in Collinsville, Solano County, California. APN: 009-012-030-0 Latitude/Longitude (approximate): 38.0806°N, 121.8355°W See **Site Location**
Existing Improvements	The site appears to have been used for agricultural grasses.
Current Ground Cover	The current ground cover consists of agricultural grasses.
Existing Topography	A topographic survey of the project site is currently unavailable. Based on our review of Google Earth, the majority of the project site has an elevation difference of about 10 feet with the southern portion of the site being lower than the northern portion.

Geotechnical Characterization

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting, and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in **Exploration and Laboratory Results** and the GeoModel can be found in the **Figures** attachment of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	**Fat Clay**	Stiff to hard fat clay with various amounts of sand
2	**Lean Clay**	Stiff to hard lean clay with various amounts of sand

3	**Sand**	Medium dense silty sand

Additional borings, CPTs, auger probes, test pits, or geophysical testing could be performed to obtain more specific subgrade information.

Groundwater Conditions

The borings were advanced using hollow stem auger drilling technique that allow short term groundwater observations to be made while drilling. The boreholes were observed while drilling and after completion for the presence and level of groundwater. The water levels observed in the boreholes can be found on the boring logs in **Exploration and Laboratory Results** section of this report and are summarized in the following table.

Boring Number	Approximate Depth to Groundwater immediately after Drilling [1] (feet)	Approximate Depth to Groundwater 24 hours after Drilling [1] (feet)
B1	19½	--
B2	24½	--
B3	25½	33½
B4	Not Encountered	--
B5	Not Encountered	--
B6	Not Encountered	--
B7	28½	--
B8	30	--
B9	45½	--
B10	49½	--

1. Below ground surface.

Since the borings were backfilled relatively soon after completion, the water levels summarized in the table for the borings are not stable groundwater levels. Due to the low permeability of soils encountered in the borings, a relatively long period may be necessary for a groundwater level to develop and stabilize in a borehole. Long term observations in piezometers or observation wells sealed from the influence of surface water are often required to define groundwater levels in materials of this type. Long-term groundwater monitoring was outside the scope of services for this project. Terracon is experienced in installing groundwater monitoring wells/piezometers to provide more groundwater data prior to construction if required.

Groundwater conditions may change because of seasonal variations in rainfall, runoff, and other conditions not apparent at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

Geologic Setting

Geologic maps indicate subsurface conditions at the site consist of both[1] Older Alluvium (Qoal) and Montezuma Formation (Qm) consisting of sand, silt, and clay. The subgrade soils encountered in our borings were generally consistent with mapped geology.

Geologic Hazards

Faulting and Estimated Ground Motions

The site is located in the Bay Area of California, which is a relatively high seismicity region. The type and magnitude of seismic hazards affecting the site are dependent on the distance to causative faults, the intensity, and the magnitude of the seismic event. The following table indicates the distance of the fault zones and the associated maximum credible earthquake that can be produced by nearby seismic events, as calculated using the USGS Earthquake Hazard Toolbox. Segments of the Great Valley 5 Fault, which is located approximately 5½ kilometers from the site, are considered to have the most significant effect at the site from a design standpoint.

[1] Sims, J.D., Fox, K.F., Bartow, J.A., and Helley, E.J., 1973, Preliminary geologic map of Solano County and parts of Napa, Contra Costa, Marin, and Yolo Counties, California, U.S. Geological Survey, Miscellaneous Field Studies Map MF-484, 1:62,500

Fault Name	Approximate Contribution (%)	Approximate Distance to Site (kilometers)	Maximum Credible Earthquake (MCE) Magnitude
WUS Branch Average: Great Valley 5 (Pittsburg – Kirby Hills) (3)	31.37	5.46	6.89

Based on the ASCE 7-16 Standard, the peak ground acceleration (PGA_M) at the subject site is approximately 0.780g. Based on the USGS Earthquake Hazard Toolbox and the USGS NSHM Conterminous U.S. 2023 interactive disaggregations, the PGA at the subject site for a 2% probability of exceedance in 50 years (return period of 2475 years) is expected to be about 0.758g. The site is not located within an Alquist-Priolo Earthquake Fault Zone based on our review of the State Fault Hazard Maps.[1]

Liquefaction

Liquefaction is a mode of ground failure that results from the generation of high pore water pressures during earthquake ground shaking, causing loss of shear strength. Liquefaction is typically a hazard where loose sandy soils or low plasticity fine grained soils exist below groundwater. The California Geological Survey (CGS) has designated certain areas within California as potential liquefaction hazard zones. These are areas considered at a risk of liquefaction-related ground failure during a seismic event, based upon mapped surficial deposits and the presence of a relatively shallow water table. The project site is not located within a mapped liquefaction hazard zone. The Association of Bay Area Governments maps the site within an area of "Very Low" liquefaction susceptibility.[2] As a result, we have not included a liquefaction evaluation as part of our scope of work covered under this proposal.

[1] California Geological Survey (CGS), *"California Earthquakes Hazards Zone Application (EQ Zapp)"*, 2024, **https://maps.conservation.ca.gov/cgs/informationwarehouse/eqzapp/**

[2] Association of Bay Area Governments (ABAG), *"Hazard Viewer"*, March 2020 **https://abag.ca.gov/our-work/resilience/data-research/hazard-viewer**

Flooding

Based on a review of the Federal Emergency Management Agency (FEMA) National Flood Layer (NFHL), the project site is in an area with a FEMA Flood Zone X designation specified as an area of minimal flood hazard.

Seismic Considerations

The 2022 CBC Seismic Design Parameters have been generated using the SEAOC/OSHPD Seismic Design Maps Tool. This web-based software application calculates seismic design parameters in accordance with ASCE 7-16, and 2022 CBC. The 2022 CBC requires that a site-specific ground motion study be performed in accordance with Section 11.4.8 of ASCE 7-16 for Site Class D sites with a mapped S_1 value greater than or equal 0.2. Therefore, the project is subject to a requirement for site-specific ground motion hazard analysis in accordance with ASCE 7-16, 21.2.

However, an exception to this requirement is included in Supplement 3 to ASCE 7-16 that states: "A ground motion hazard analysis is not required where the value of the parameter S_{M1} determined by Eq. (11.4-2) is increased by 50% for all applications of S_{M1} in this standard. The resulting value of the parameter S_{D1} determined by Eq. (11.4-4) shall be used for all applications of S_{D1} in the Standard."

Based on this exception, the spectral response accelerations presented in the following table were calculated using the site coefficients (F_a and F_v) from Tables 1613.2.3(1) and 1613.2.3(2) presented in Section 1613 of the 2022 CBC.

Description	Value
2022 CBC Site Class[1]	D[2]
Risk Category	III
Site Latitude[3]	38.0806ºN
Site Longitude[3]	121.8355ºW
S_S, Spectral Acceleration for a Short Period[4]	1.673
S_1, Spectral Acceleration for a 1-Second Period[4]	0.554
Fa, Site Coefficient	1.0
Fv, Site Coefficient (1-Second Period)	1.846

Description	Value
S_{DS}, Spectral Acceleration for a Short Period	1.115
S_{D1}, Spectral Acceleration for a 1-Second Period	1.023[5]

1. Seismic site soil class in general accordance with the 2022 CBC, which refers to ASCE 7-16. Site Classification is required to determine the Seismic Design Category for a structure.
2. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7-16 and the 2022 CBC. Subsurface explorations at this site were extended to a maximum depth of approximately 51½ feet bgs. The site properties below the maximum exploration depth to 100 feet bgs were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper exploration or geophysical testing may be performed to confirm the conditions below the current maximum depth of exploration.
3. Provided coordinates represent a point located at the general center of the site.
4. These values were obtained using online seismic design maps and tools provided by ASCE Hazard Tool (**https://ascehazardtool.org/**).
5. The value of S_{D1} has been increased by 50% for structural design in accordance with Item 1 Exception in ASCE 7-16 Supplement 3, Section 11.4.8.

Typically, a site-specific ground motion study may reduce construction costs. We recommend consulting with a structural engineer to evaluate the need for such a study and its potential impact on construction costs. Terracon should be contacted if a site-specific ground motion study is desired.

Percolation/Infiltration

We performed one percolation test within the proposed site development for use by the project Civil Engineer in the design of the storm water retention system. The percolation test was performed using Boring B8 drilled to a depth of about 10 feet bgs as requested by EPC Services Company. The approximate locations of the test holes are shown on the **Exploration Plan**.

After drilling the test hole, we placed approximately 2 inches of gravel in the bottom, then placed a slotted PVC pipe in the hole, and filled the annular space around the pipe with gravel. The test hole was filled with water and left to saturate overnight. We then filled the shallow hole with water to depths ranging from about 5 to 7½ feet and measured the drop-in water surface over a period of approximately 2 hours.

The measured percolation rates and calculated infiltration rates are summarized in the following table. Due to the limited access of the project site during our exploration program, additional percolation testing within the location of the storm water retention system is strongly recommended prior to the final design of the system.

Perc. Test Location	Depth (ft)	Avg. Head (ft)	Perc. Rate (min/inch)	Perc. Rate (inch/hr)	Infiltration Rate (inch/hr)
Boring B8	10	6	10	6	0.10

Since we used a test boring to perform percolation testing, we have used the Porchet formula (aka Inverse Borehole Formula) to calculate the infiltration rate which takes into account sidewall area of the bore hole. Storm water runoff may likely contain materials such as silt, leaves, oil residues, and other matter that may reduce the percolation characteristics of the soil. We therefore recommend that a filtration system be implemented into the design and installed. An appropriate safety factor should be applied to the measured infiltration rates by the designer for use in design and be based on the amount of filtration designed into the system, at a minimum a Safety Factor of 2 shall be utilized. The values presented in the table are clear water rates and do not have a safety factor applied. In addition, we recommend a regular maintenance program be implemented to monitor the storm drainage/filtration system prior to the beginning of each wet weather season.

We have provided the following considerations for the design and construction of the retention/detention facilities. Planned retention/detention facilities should be located no closer than 10 feet to structural site improvements.

The long-term infiltration rates will depend on many factors, and can vary or be reduced if the following conditions are present:

- Fill placement,
- Variability of site soils,
- Fine layering of soils, or
- Maintenance and pre-treatment (filtration) of the influent are not performed regularly

Fill Placement: We have assumed earthwork required to develop the site may consist of cuts and fills of 3 feet or less. It is unknown whether final grades will consist of native material or imported fill. As a result, the percolation tests performed may not be representative of the final soil conditions depending on the blend of soils utilized as structural fill and native soils exposed where cuts and fills are made. Additional percolation testing may be warranted following rough grading to confirm the values utilized in design are appropriate.

Subsurface Soil Variation: Variations in subsurface soil conditions and the presence of fine layering can affect the infiltration rate of the receptor soils. Due to variation in thickness of the upper surface fine grained soils, infiltration rates may vary across the site.

Construction Considerations: The infiltration rate of the receptor soils will be reduced in the event that fine sediment, organic materials, and/or oil residue are allowed to accumulate in the retention facilities. The use of a filtration system is highly recommended as well as a maintenance program.

Operation of heavy equipment during construction may densify the receptor soils below the infiltration facility. The soils exposed in the bottom of the infiltration facility should not be compacted and should remain in their native condition. This may require scarification of the soils prior to construction.

Maintenance of Facilities: Satisfactory long-term performance of an infiltration facility will require some degree of maintenance. Accumulations of sediment, organic materials, or other material that serve to reduce their permeability of the receptor soils should be removed from the filtration system on a regular basis so as not to enter the retention system. The filtration system shall have a rigorous maintenance program, debris from the filtration maintenance should be disposed of at an approved facility in accordance with applicable regulations.

Corrosivity

The following table lists the results of laboratory soluble sulfate, soluble chloride, electrical resistivity, and pH testing. The values may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction.

Corrosivity Test Results Summary

Boring	Sample Depth (feet)	Soil Description	Soluble Sulfate (%)	Soluble Chloride (%)	Electrical Resistivity (Ω-cm)	pH
B1	2½	Fat Clay with Sand	0.003	0.007	840	7.42
B7	1	Lean Clay with Sand	0.020	0.005	600	8.08
B9	2½	Fat Clay	0.026	0.021	490	8.11

Results of soluble sulfate testing can be classified in accordance with ACI 318 – Building Code Requirements for Structural Concrete. Numerous sources are available to characterize corrosion potential to buried metals using the parameters presented in the previous table. ANSI/AWWA is commonly used for ductile iron, while threshold values for evaluating the effect on steel can be specific to the buried feature (e.g., piling, culverts, welded wire reinforcement, etc.) or agency for which the work is performed. Imported fill materials may have significantly different properties than the site materials noted in the table and should be evaluated if expected to be in contact with metals used for construction. Consultation with a NACE certified corrosion professional is recommended for buried metals on the site.

Mapping by the NRCS includes qualitative severity of corrosion to concrete and steel. This source rates the near-surface materials as "Low to Moderate" for corrosion to concrete and "High" for corrosion of steel.

Field Electrical Resistivity

In-situ electrical resistivity testing was performed during our field exploration in general accordance with ASTM G57, utilizing the Wenner Four-Electrode Method. The testing consisted of two arrays oriented N-S and E-W with a common midpoint. Within the test array, potential electrodes are created on a transverse line between the current electrodes. An equal "A" spacing between electrodes is maintained. Individual in-situ electrical resistivity values at various "A" spacings along each array are summarized in the table provided in the results. Field Electrical Resistivity Test Data Sheets (Project No. NS245221, Dated April 22, 2025) presenting the field test results and approximate test locations are presented in the **Exploration and Laboratory Results** section of this report.

Geotechnical Overview

The subject site has geotechnical considerations that will affect the construction and performance of the proposed improvements that are discussed in this report. The primary geotechnical consideration that has been identified at the subject site that will affect development is the following:

- Expansive soils

Expansive Soils

Expansive soils are present on this site. This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and (at least minor) cracking in the structure should be anticipated. The severity of cracking and other damage such as uneven slabs will probably increase if modification of the site results in excessive wetting or drying of the expansive soils. Eliminating the risk of movement and distress may not be feasible, but it may be possible to further reduce the risk of movement if significantly more expensive measures are used during construction. Some of these options are discussed in this report such as complete replacement of expansive soils or supporting the improvements on **Deep Foundations**.

The near surface, stiff to hard medium plasticity lean clay and high plasticity fat clay could become unstable with typical earthwork and construction traffic, especially after precipitation events. The effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential issues. If possible, the grading should be performed during the warmer and drier times of the year. If grading is performed during the winter months, an increased risk for possible undercutting and replacement of unstable subgrade will persist. Additional site preparation recommendations, including subgrade improvement and fill placement, are provided in the **Earthwork** section.

The soils which form the bearing stratum for shallow foundations are plastic and exhibit potential for shrink-swell movements with changes in moisture. Additional areas of localized highly plastic soils are likely present where borings were not performed. Maintaining above optimum moisture conditions in the bearing soils and a minimum dead load pressure on footings should reduce the anticipated swell movements to tolerable levels. The **Shallow Foundations** section addresses support of the structural improvements directly bearing on native very stiff to hard lean/fat clay.

The recommendations contained in this report are based upon the results of field and laboratory testing (presented in the **Exploration and Laboratory Results** section), engineering analyses, and our current understanding of the proposed project. The **General Comments** section provides an understanding of the report limitations.

Earthwork

We have assumed grading may consist of cuts and fills on the order of 3 feet or less and that site grades will be within 3 feet of existing ground elevation. <u>Specific site grading information was unavailable at the time this report was prepared. If elevation and site grading differ from our stated assumptions, Terracon should be contacted to determine if additional earthwork recommendations are warranted.</u>

Earthwork is anticipated to include clearing and grubbing, excavations, and engineered fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, slabs, and access roads.

Site Preparation

Prior to placing fill, existing vegetation, topsoil, and root mats should be removed. Complete stripping of the topsoil should be performed in the proposed building and parking/driveway areas. Stripping should extend laterally a minimum of 5 feet beyond the limits of proposed improvements.

Although no evidence of fill or underground facilities (such as septic tanks, cesspools, basements, and utilities) was observed during the exploration and site reconnaissance, such features could be encountered during construction. If unexpected fills or underground facilities are encountered, such features should be removed, and the excavation thoroughly cleaned prior to backfill placement and/or construction.

Subgrade Preparation

After clearing, any required cuts and overexcavation should be made.

Subgrade soils beneath proposed mat slabs should be removed to a depth of 24 inches beneath proposed slab section, or existing grade, whichever is greater. Structural fill placed beneath the entire footprint of the mat slab should extend horizontally a minimum distance of 5 feet beyond the outside edge of slab. On-site soils are expansive and are not suitable for use as structural fill.

Where fill is placed on existing slopes steeper than 5H:1V (Horizontal:Vertical), benches should be cut into the existing slopes prior to fill placement. The benches should have a minimum vertical face height of 1 foot and a maximum vertical face height of 3 feet and should be cut wide enough to accommodate the compaction equipment. This benching will help provide a positive bond between the fill and natural soils and reduce the possibility of failure along the fill/natural soil interface.

Excavated material may be stockpiled for use as fill provided it is cleaned of organic material, debris, and any other deleterious material and meets the criteria for general or structural fill specified in the ***Fill Material Types*** section of this report.

Once cuts and over-excavation operations are complete, the resulting subgrade should be proofrolled with an adequately loaded vehicle such as a fully-loaded tandem-axle dump truck. The proofrolling should be performed under the observation of the Geotechnical Engineer or their representative. Areas excessively deflecting under the proofroll should be delineated and subsequently addressed by the Geotechnical Engineer. Such areas should either be removed or modified by stabilizing as noted in the

Soil Stabilization section of this report. Excessively wet or dry material should either be removed, or moisture conditioned and recompacted.

The depth of scarification of subgrade soils and moisture conditioning of the subgrade is highly dependent upon the time of year of construction and the site conditions that exist immediately prior to construction. If construction occurs during the winter or spring, when the subgrade soils are typically already in a moist condition, scarification and compaction may only be 8 inches. If construction occurs during the summer or fall when the subgrade soils have been allowed to dry out deeper, the depth of scarification and moisture conditioning may be as much as 18 inches or more. A representative from Terracon should be present during earthwork to observe the exposed subgrade and confirm the depth of scarification and moisture conditioning required.

Following scarification, moisture conditioning, and compaction of the subgrade soils, compacted structural fill soils should then be placed to the proposed design grade and the moisture content and compaction of subgrade soils should be maintained until foundation construction.

Based upon the subsurface conditions determined from the geotechnical exploration, subgrade soils exposed during construction are anticipated to be relatively workable; however, the workability of the subgrade may be affected by precipitation, repetitive construction traffic or other factors. If unworkable conditions develop, workability may be improved by scarifying and drying.

Excavation

We anticipate that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. The bottom of excavations should be thoroughly cleaned of loose soils and disturbed materials prior to backfill placement and/or construction.

The bottom of excavations should be thoroughly cleaned of loose soils and disturbed materials prior to backfill placement and/or construction.

Individual contractors are responsible for designing and constructing stable, temporary excavations. Excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

Soil Stabilization

Methods of subgrade stabilization, as described in this section, could include scarification, moisture conditioning and recompaction, removal of unstable materials and replacement with granular fill (with or without geosynthetics), and chemical stabilization.

The appropriate method of improvement, if required, would be dependent on factors such as schedule, weather, the size of area to be stabilized, and the nature of the instability. More detailed recommendations can be provided during construction as the need for subgrade stabilization occurs. Performing site grading operations during warm seasons and dry periods would help reduce the amount of subgrade stabilization required.

If the exposed subgrade is unstable during proofrolling operations, it could be stabilized using one of the following methods:

- **Scarification and Recompaction** - It may be feasible to scarify, dry, and recompact the exposed soils. The success of this procedure would depend primarily upon favorable weather and sufficient time to dry the soils. Stable subgrades likely would not be achievable if the thickness of the unstable soil is greater than about 1 foot, if the unstable soil is at or near groundwater levels, or if construction is performed during a period of wet or cool weather when drying is difficult.
- **Aggregate Base** - The use of Caltrans Class II aggregate base is a common procedure to improve subgrade stability. Typical undercut depths would be expected to range from about 6 inches to 18 inches below finished subgrade elevation. The use of high modulus geosynthetics (i.e., engineering fabric or geogrid) could also be considered after underground work such as utility construction is completed. Prior to placing the fabric or geogrid, we recommend that all below grade construction, such as utility line installation, be completed to avoid damaging the fabric or geogrid. Equipment should not be operated above the fabric or geogrid until one full lift of aggregate base is placed above it. The maximum particle size of granular material placed over geotextile fabric or geogrid should meet the manufacturer's specifications.
- **Chemical Stabilization** - Improvement of subgrades with Portland cement or quicklime could be considered for improving unstable soils. Chemical stabilization should be performed by a pre-qualified contractor having experience with successfully stabilizing subgrades in the project area on similar sized projects with similar soil conditions. The hazards of chemicals blowing across the site or onto adjacent property should also be considered. Additional testing would be needed to develop specific recommendations to improve subgrade stability by blending chemicals with the site soils. Additional testing could include, but not be limited to, determining the most suitable stabilizing agent, the optimum amounts required, and the presence of sulfates in the soil. <u>If this method is chosen to stabilize subgrade soils the actual amount of high calcium quicklime/Portland cement to be used should be determined by Terracon and by laboratory testing **at least three weeks prior** to the start of grading operations</u>.

Further evaluation of the need and recommendations for subgrade stabilization can be provided during construction as the geotechnical conditions are exposed.

Fill Material Types

Fill required to achieve design grade should be classified as structural fill and general fill. Structural fill is material used below, or within 5 feet of structures. General fill is material used to achieve grade outside of these areas.

Reuse of On-Site Soil: Excavated on-site soil is not suitable for reuse as Structural Fill and should not be placed beneath settlement sensitive structures. Material property requirements for on-site soil for use as general fill and structural fill are noted in the following table:

Property	Structural Fill	General Fill
Composition	Free of deleterious material	Free of deleterious material
Maximum particle size	3 inches	6 inches (or 2/3 of the lift thickness)
Fines content	Less than 60% Passing No. 200 sieve	Not limited
Plasticity	Maximum liquid limit of 30 Maximum plasticity index of 10 Expansion Index less than 20	Not limited
GeoModel Layer Expected to be Suitable[1]	3	1, 2, 3

1. Based on subsurface exploration. Actual material suitability should be determined in the field at time of construction.

Imported Fill Materials: Imported fill materials should meet the following material property requirements. Regardless of its source, compacted fill should consist of approved materials that are free of organic matter and debris. For all import material, the contractor shall submit current verified reports from a recognized analytical laboratory indicating that the import has a "not applicable" (Class S0) potential for sulfate attack based upon current ACI criteria and is "mildly corrosive" to ferrous metal and copper. The reports shall be accompanied by a written statement from the contractor that the laboratory test results are representative of all import material that will be brought to the project.

Soil Type [1]	USCS Classification	Acceptable Parameters (for Structural Fill)
Low Plasticity	CL, SC	Liquid Limit less than 30 Plasticity index less than 10 Expansion index less than 20 Less than 70% passing No. 200 sieve
Granular[2]	GW, GM, GC, SW, SM	Less than 40% passing No. 200 sieve

1. Structural and general fill should consist of approved materials free of organic matter and debris and should contain no material larger than 3 inches and 6 inches in greatest dimension, respectively. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation at least two weeks prior to use on this site. Additional geotechnical consultation should be provided prior to use of uniformly graded gravel on the site.
2. Caltrans Class II aggregate base may be used for this material. Recycled aggregate base should not be used without prior approval by the Geotechnical Engineer.

Fill Placement and Compaction Requirements

Compacted native soil and structural and general fill should meet the following compaction requirements.

Item	Structural Fill	General Fill
Maximum Lift Thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used	Same as structural fill
Minimum Compaction Requirements [1,2]	95% of max. within 1 foot of finished access road subgrade, for aggregate base and chemically treated soil, and for fills deeper than 5 feet 90% of max. for all other locations	90% of max.

Item	Structural Fill	General Fill
Water Content Range [1]	Low plasticity cohesive: +1% to +3% above optimum Medium plasticity cohesive: +2% to +4% above optimum High plasticity cohesive: +3% to +5% above optimum Granular: -2% to +2% of optimum	As required to achieve min. compaction requirements

1. Maximum density and optimum water content as determined by the Modified Proctor test (ASTM D 1557).
2. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 70% relative density (ASTM D 4253 and D 4254). Materials not amenable to density testing should be placed and compacted to a stable condition observed full time by the Geotechnical Engineer or representative.

Utility Trench Backfill

Any soft or unsuitable materials encountered at the bottom of utility trench excavations should be removed and replaced with structural fill or bedding material in accordance with public works specifications for the utility be supported. This recommendation is particularly applicable to utility work requiring grade control and/or in areas where subsequent grade raising could cause settlement in the subgrade supporting the utility. Trench excavation should not be conducted below a downward 1:1 projection from existing foundations without engineering review of shoring requirements and geotechnical observation during construction.

On-site materials are considered suitable for backfill of utility and pipe trenches from 1 foot above the top of the pipe to the final ground surface, provided the material is free of organic matter and deleterious substances. Where trenches are placed beneath slabs or footings, the backfill should satisfy the gradation and Atterberg limit requirements for structural fill discussed in this report.

Trench backfill should be mechanically placed and compacted as discussed earlier in this report. Compaction of initial lifts should be accomplished with hand-operated tampers or other lightweight compactors. Flooding or jetting for placement and compaction of backfill is not recommended.

All trench excavations should be made with sufficient working space to permit construction including backfill placement and compaction. If utility trenches are backfilled with relatively clean granular material, they should be capped with at least 18 inches of cementitious flowable fill or cohesive fill in non-pavement areas to reduce the infiltration and conveyance of surface water through the trench backfill. Attempts should also be made to limit the amount of fines migration into the clean granular material. Fines migration into clean granular fill may result in unanticipated localized settlements over a period of time. To help limit the amount of fines migration, Terracon recommends the use of a geotextile fabric that is designed to prevent fines migration in areas of contact between clean granular material and fine-grained soils. Terracon also recommends that clean granular fill be tracked or tamped in place where possible to limit the amount of future densification which may cause localized settlements over time.

For low permeability subgrades, utility trenches are a common source of water infiltration and migration. Utility trenches penetrating beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches, which could migrate below the building. The trench should provide an effective trench plug that extends at least 5 feet from the face of the building exterior. The plug material should consist of cementitious flowable fill or low permeability clay. The trench plug material should be placed to surround the utility line. If used, the clay trench plug material should be placed and compacted to comply with the water content and compaction recommendations for structural fill stated previously in this report.

If chemical treatment of subgrade soils occurs before utility construction, Controlled Low Strength Material (CLSM) or sand/cement slurry should be used as backfill material to cap utility trenches in all areas where trenches have cut through the treated subgrade. The thickness of the CLSM or slurry should be at least the thickness or depth of chemically treated subgrade. Below that depth, imported structural fill or moisture conditioned native clay may be used for backfill. Such areas trenched through chemically treated soil should not be backfilled with aggregate base, native soil, or disturbed chemically treated soil.

Post construction trenching through geogrid reinforced pavement areas shall be accomplished with conventional trenching equipment. Repairs to the trenched section shall be accomplished using a full structural replacement of the displaced materials or with a repaired section that is identical to the original section. If the trench section is repaired to match the original, the trench backfill must be compacted to the same or higher density and the geogrid must be over-lapped a minimum 3-inches at the proper geogrid elevation.

Grading and Drainage

All grades must provide effective drainage away from the improvements during and after construction and should be maintained throughout the life of the structures. Water retained next to the improvements can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential slab and/or foundation movements and cracked slabs.

Exposed ground should be sloped and maintained at a minimum 5 percent away from the structures for at least 10 feet beyond the perimeter of the structure. If a minimum 5 percent slope cannot be achieved due to site grades, a minimum 2½ percent slope could be used provided pavement or hardscape surrounds and extends to the structure, or a subdrain could be installed around the perimeter of the foundations that carries water away from the structure. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Any planters and/or bio-swales located within 10 feet of the building should be self-contained or lined with an impermeable membrane to prevent water from accessing subgrade soils below the building. Sprinkler mains and spray heads should be located a minimum of 5 feet away from the foundation lines.

No vegetation over 6 feet in height shall be planted within 20 feet of the structural improvements perimeter unless a root barrier is provided between the structure and tree to limit roots within 10 feet of the building. Roots can draw additional moisture from the soils and cause excessive volume changes in the soil resulting in movement.

Implementation of adequate drainage for this project can affect the surrounding developments. Consequently, in addition to designing and constructing drainage for this project, the effects of site drainage should be taken into consideration for the planned structures on this property, the undeveloped portions of this property, and surrounding sites. Extra care should be taken to ensure irrigation and drainage from adjacent areas do not drain onto the project site or saturate the construction area.

Earthwork Construction Considerations

Shallow excavations for the proposed structures are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of grade-supported improvements. Construction traffic over the completed subgrades should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade should become desiccated, saturated, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to construction.

We recommend that the earthwork portion of this project be completed during extended periods of dry weather if possible. If earthwork is completed during the wet season (typically November through April) it may be necessary to take extra precautionary measures to protect subgrade soils. Wet season earthwork operations may require additional mitigation measures beyond that which would be expected during the drier summer and fall months. This could include ground stabilization utilizing chemical treatment of the subgrade, diversion of surface runoff around exposed soils, and draining of ponded water on the site. Once subgrades are established, it may be necessary to protect the exposed subgrade soils from construction traffic.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local and/or state regulations. Stockpiles of soil, construction materials, and construction equipment should not be placed near trenches or excavations. ***The Contractor is responsible for maintaining the stability of adjacent structures during construction.***

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied nor inferred.

Excavations or other activities resulting in ground disturbance have the potential to affect adjoining properties and structures. Our scope of services does not include review of available final grading information or consider potential temporary grading performed by the contractor for potential effects such as ground movement beyond the project limits. A preconstruction/precondition survey should be conducted to document nearby property/infrastructure prior to any site development activity. Excavation or ground disturbance activities adjacent or near property lines should be monitored or instrumented for potential ground movements that could negatively affect adjoining property and/or structures.

Construction Observation and Testing

The earthwork efforts should be observed by the Geotechnical Engineer (or others under their direction). Observation should include documentation of adequate removal of surficial materials (vegetation, topsoil, debris, and pavements), evaluation and remediation of existing fill materials, as well as proofrolling and mitigation of unsuitable areas delineated by the proofroll.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, as recommended by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 1,500 square feet of compacted fill in the building areas and 2,500 square feet in access road areas. Where not specified by local ordinance, one density and water content test should be performed for every 50 linear feet of compacted utility trench backfill and a minimum of one test performed for every 12 vertical inches of compacted backfill. The frequency of the testing may be adjusted during construction under the direction of the geotechnical engineer.

In areas of foundation excavations, the bearing subgrade should be evaluated by the Geotechnical Engineer. If unanticipated conditions are observed, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

Shallow Foundations

The proposed improvements may be supported by spread footings. If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

Mat Foundation Design Parameters – Compressive Loads (Foundation Pad Option)

Item	Description
Maximum Net Allowable Bearing Pressure [1, 2]	2,800 psf up to 5 feet wide 1,600 psf up to 10 feet wide 1,000 psf up to 20 feet wide
Required Bearing Stratum [3]	24 inches non-expansive structural fill
Design Modulus of Subgrade Reaction, k[3]	For 2,800 psf bearing pressure: 19.4 pounds per square inch per inch (psi/in) for maximum foundation widths stated above For 1,600 psf bearing pressure: 11.1 psi/in for maximum foundation widths stated above For 1,000 psf bearing pressure: 6.9 psi/in for maximum foundation widths stated above

Item	Description
Minimum Embedment Below Finished Grade	24 inches
Estimated Total Settlement from Structural Loads [2]	Less than about 1 inch
Estimated Differential Settlement	About ½ of total settlement over a horizontal distance of 40 feet

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. An appropriate factor of safety has been applied. These bearing pressures can be increased by 1/3 for transient loads unless those loads have been factored to account for transient conditions.
2. Maximum allowable pressure is based on both calculated bearing capacities and allowable settlements.
3. Unsuitable or soft soils should be overexcavated and replaced per the recommendations presented in Earthwork.

Spread Footing Design Parameters – Compressive Loads (Foundation Pad Option)

Item	Description
Maximum Net Allowable Bearing Pressure [1, 2]	2,000 psf
Required Bearing Stratum [3]	Firm native soil
Minimum Foundation Dimensions	Per CBC 1809.7
Maximum Foundation Dimensions	Columns: 10 feet Continuous: 5 feet
Passive Resistance[4, 8] (equivalent fluid pressures)	350 pcf
Sliding Resistance [5, 8]	0.30 allowable coefficient of friction
Minimum Embedment below Finished Subgrade [6]	24 inches
Estimated Total Settlement from Structural Loads [2]	Less than about 1 inch
Estimated Differential Settlement [2, 7]	About ½ of total settlement

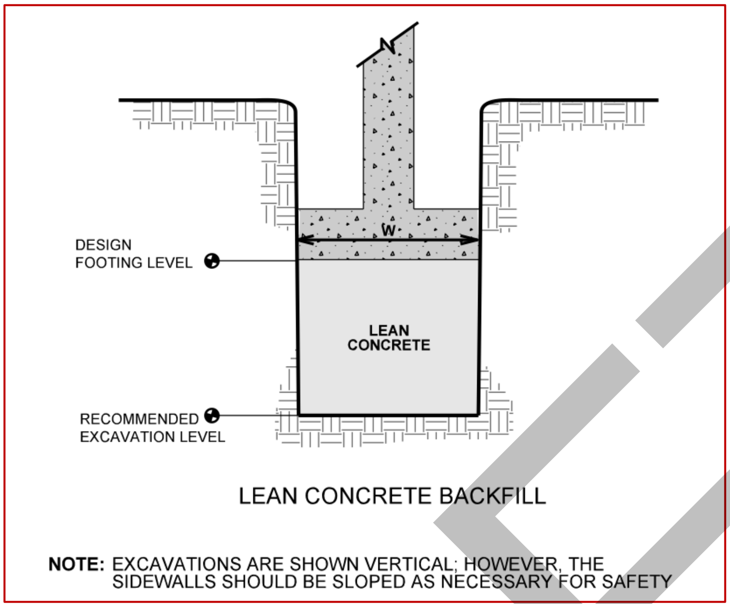
1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. This

Item	Description
	bearing pressure can be increased by 1/3 for transient loads unless those loads have been factored to account for transient conditions. Values assume that exterior grades are no steeper than 20% within 10 feet of structure. 2. Values provided are for maximum loads noted in **Project Description**. Additional geotechnical consultation will be necessary if higher loads are anticipated. 3. Unsuitable or soft soils should be overexcavated and replaced per the recommendations presented in **Earthwork**. 4. Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed and compacted structural fill be placed against the vertical footing face. Assumes no hydrostatic pressure. 5. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Frictional resistance for granular materials is dependent on the bearing pressure which may vary due to load combinations. 6. Embedment necessary to minimize the effects of seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior subgrade within 5 horizontal feet of the structure. 7. Differential settlements are noted for equivalent-loaded foundations and bearing elevation as measured over a span of 40 feet. 8. Passive Resistance and Sliding Resistance may be combined to resist sliding provided the Passive Resistance is reduced by 50 percent.

Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be evaluated under the observation of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

If unsuitable bearing soils are observed at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. The lean concrete replacement zone is illustrated on the following sketch.



To ensure foundations have adequate support, special care should be taken when footings are located adjacent to trenches. The bottom of such footings should be at least 1 foot below an imaginary plane with an inclination of 1.5 horizontal to 1.0 vertical extending upward from the nearest edge of the adjacent trench.

Deep Foundations

Preliminary Drilled Shaft Design Parameters

The proposed substation structures may be supported by a deep foundation system consisting of drilled cast-in-place reinforced concrete shafts. The design shaft capacities and lengths should be determined by the Geotechnical and Structural Engineers during final design.

An Shaft Capacity versus Depth chart is provided in the **Figures** section of this report for shaft diameters ranging from 1.5 feet to 6 feet for project planning. A factor of safety of 2.5 was used for allowable skin friction values. Terracon should be consulted if additional shaft diameters are required.

We recommend that the deep foundation system be designed to develop axial compression through skin friction only, and end-bearing should be neglected. Shaft uplift capacity should also be derived from skin friction only. Shaft uplift capacity should be considered as 2/3 of the compressive capacity due to skin friction. The effective weight of the shaft can be added to the uplift load resistance to the extent permitted by the 2022 CBC. Design parameters for a drilled shaft foundation system are presented in the following table.

Drilled Shaft Design Summary

Description	Recommendations
Foundation Type	Drilled shaft
Shaft Dimension (minimum)	18-inch diameter
Minimum Shaft Embedment for Axial Design	20 feet below the existing ground surface

1. Preliminary design capacity is dependent upon the method of installation, and quality control parameters, and should be evaluated further during final design.
2. Drilled shaft embedment depths should be evaluated further with the design team when structural loading information and final grading plans are available. The upper 2 feet of soil has been neglected in providing support to drilled shaft.
3. Our current scope of work included extending test borings to a maximum depth of 51½ feet bgs. Deeper borings shall be utilized for confirmation of subgrade conditions if drilled shafts deeper than 51½ feet bgs are required.
4. The drilled shafts may be subject to uplift as a result of wind and seismic loading. The shafts must contain sufficient continuous vertical reinforcing and embedment depth to resist the net tensile load.

Shafts should be adequately reinforced as designed by the Structural Engineer for both tension and shear to sufficient depths.

The shaft foundation should be designed to distribute the weight of the structure solely on the shafts. All shafts should be connected with a reinforced slab or continuous grade beams which rely on the shafts for full support where multiple shafts are supporting a structure. Slab or grade beam reinforcement should be designed by the structural engineer so as to distribute the structural loads to the shafts. Grade beams should extend a minimum of 12 inches below the lowest surrounding grade.

Drilled shafts should have a minimum (center-to-center) spacing of three diameters. Closer spacing may require a reduction in axial load capacity. Axial capacity reduction can be determined by comparing the allowable axial capacity determined from the sum of individual shafts in a group versus the capacity calculated using the perimeter and base of the shaft group acting as a unit. The lesser of the two capacities should be used in design.

Post-construction settlements of drilled shafts designed and constructed as described in this report are estimated to range from about ½ to ¾ inch. Differential settlement between individual shafts is expected to be ½ to ⅔ of the total settlement. Actual settlements should be evaluated for the actual foundation system geometry and structural loading conditions during final design.

Preliminary Drilled Shaft Lateral Loading

The following table lists input values for use in LPILE analyses. Modern versions of LPILE provide estimated default values of k_h and E_{50} based on strength and are recommended for the project. Since deflection or a service limit criterion will most likely control lateral capacity design, no safety/resistance factor is included with the parameters.

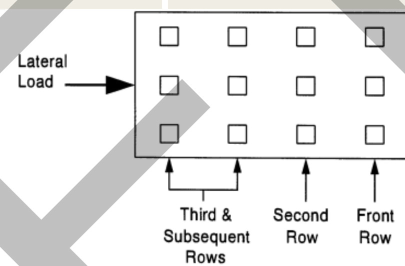
Stratigraphy[1]		L-Pile Soil Model	S_u (psf)[2]	ϕ[2]	γ' (pcf)[2]	ε_{50}	K (pci)	
Depth	Material						Static	Cyclic
2-19[3]	Fat/Lean Clay	Stiff Clay without Free Water (Reese)	2,300	---	120	Use Default Value		
19-30	Lean Clay	Stiff Clay with Free Water (Reese)	2,100	---	58	Use Default Value		
30-51½	Fat/Lean Clay	Stiff Clay with Free Water (Reese)	4,400	---	58	Use Default Value		

1. See Subsurface Profile in **Geotechnical Characterization** for more details on Stratigraphy.
2. Definition of Terms:
   S_u: Undrained shear strength
   ϕ: Internal friction angle
   γ': Effective unit weight
3. The upper 2 feet of the drilled shaft should be neglected from design.
4. Our current scope of work included extending test borings to a maximum depth of 51½ feet bgs. Deeper borings shall be utilized for confirmation of subgrade conditions if drilled shafts deeper than 51½ feet bgs are required.

When shafts are used in groups, the lateral capacities of the shafts in the second, third, and subsequent rows of the group should be reduced as compared to the capacity of a single, independent shaft. Guidance for applying p-multiplier factors to the p values in the p-y curves for each row of shaft foundations within a shaft group are as follows:

Center to Center Shaft Spacing [1,2]	P-Multiplier, P_m [3]		
	Front Row	Second Row	Third and Subsequent Rows
3B	0.8	0.4	0.3
4B	0.9	0.65	0.5
5B	1.0	0.85	0.7
6B	1.0	1.0	1.0

1. Spacing in the direction of loading. B = shaft diameter
2. For the case of a single row of shafts supporting a laterally loaded grade beam, group action for lateral resistance of shafts would need be considered when spacing is less than three shaft diameters (measured center-to-center).
3. See adjacent figure for definition of front, second and third rows.



Spacing closer than 3D (where D is the diameter of the shaft) is not recommended without additional geotechnical consultation due to potential for the installation of a new shaft disturbing an adjacent installed shaft likely resulting in axial capacity reduction.

Drilled Shaft Construction Considerations

The drilling contractor should be experienced in the subsurface conditions observed at the site, and the excavations should be performed with equipment capable of providing a clean bearing surface free of any loose material. The drilled straight-shaft foundation system should be installed in general accordance with the procedures presented in "Standard Specification for the Construction of Drilled Piers", ACI Publication No. 336.1-01.

Subsurface water was encountered in boring during the drilling activities and should be considered for installation of the drilled shaft. Subsurface water levels are influenced by seasonal and climatic conditions, which result in fluctuations in subsurface water elevations. Additionally, it is common for water to be present after periods of significant rainfall.

The drilling contractor should remove all soft and disturbed soils from the base of the drilled shaft prior to placing concrete. The drilled shaft installation process should be performed under the observation of the Geotechnical Engineer. The Geotechnical

Engineer should document the shaft installation process including soil and groundwater conditions observed, consistency with expected conditions, and details of the installed shaft.

If casing is used for drilled shaft construction, it should be withdrawn in a slow continuous manner maintaining a sufficient head of concrete to prevent infiltration of water or the creation of voids in shaft concrete. Shaft concrete should have a relatively high fluidity when placed in cased shaft holes or through a tremie. Shaft concrete with slump in the range of 6 to 8 inches is recommended.

Foundation concrete should be placed immediately after completion of drilling and cleaning. Closely spaced shafts should be drilled and filled alternatively, allowing the concrete to set at least eight hours before drilling the adjacent shaft. All excavations should be filled with concrete as soon after drilling as possible. In no event should shaft holes be left open overnight.

Free-fall concrete placement in drilled piers will only be acceptable if provisions are taken to avoid striking the concrete on the sides of the hole or reinforcing steel. The use of a bottom-dump hopper, or an "elephant's trunk" discharging near the bottom of the hole where concrete segregation will be minimized, is recommended.

We recommend that all drilled shaft installations be observed on a full-time basis by an experienced geotechnical engineer in order to evaluate that the soils encountered are consistent with the recommended design parameters. If the subsurface soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required. The Geotechnical Engineer should observe the installation of drilled piers to verify the soil conditions and the diameter and depth of piers. Drilled piers should be constructed true and plumb.

Gravel-Surfaced Drives and Parking

Recommendations are pending additional laboratory testing.

General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials, or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly affect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing. This report should not be used after 3 years without written authorization from Terracon.

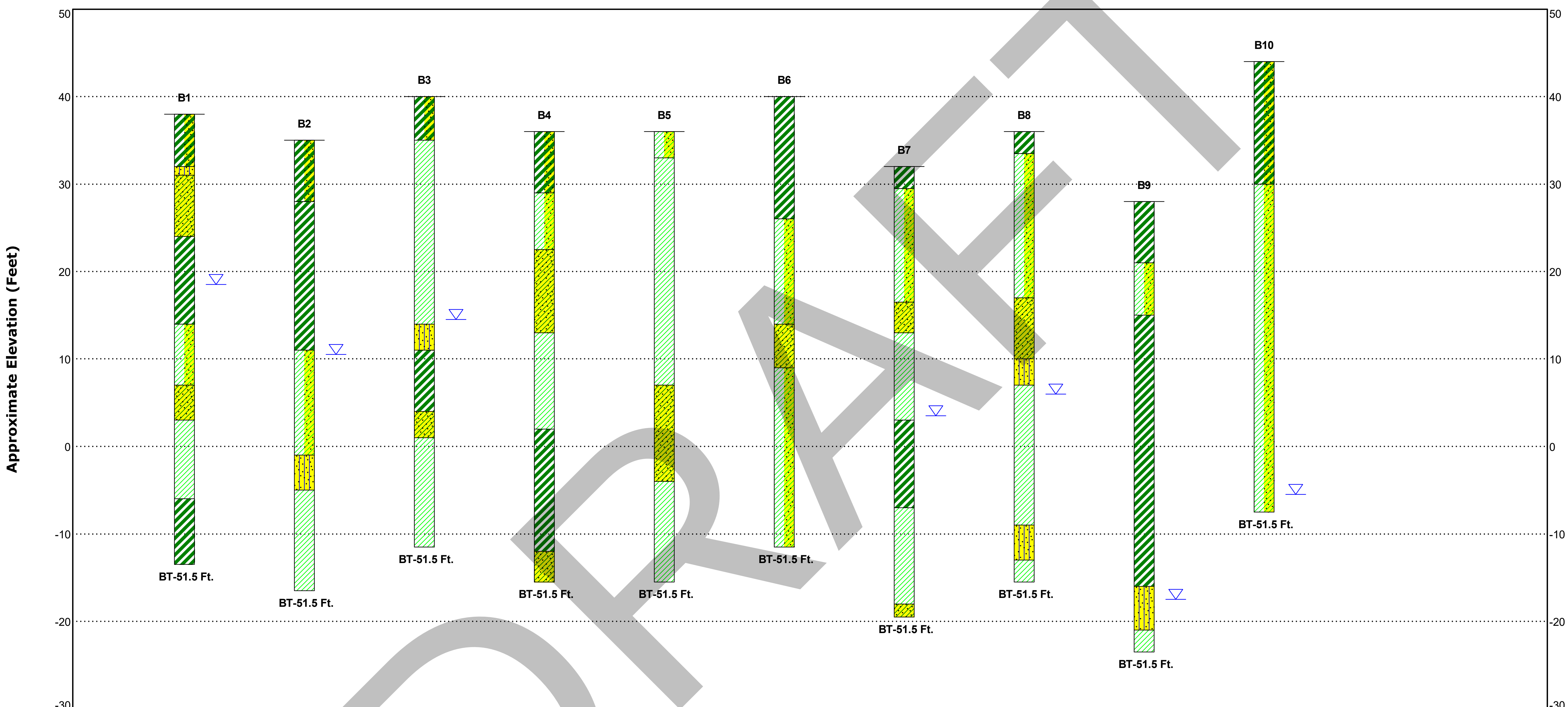
Figures

Contents:

Terracon
902 Industrial Way
Lodi, CA

Subsurface Profile

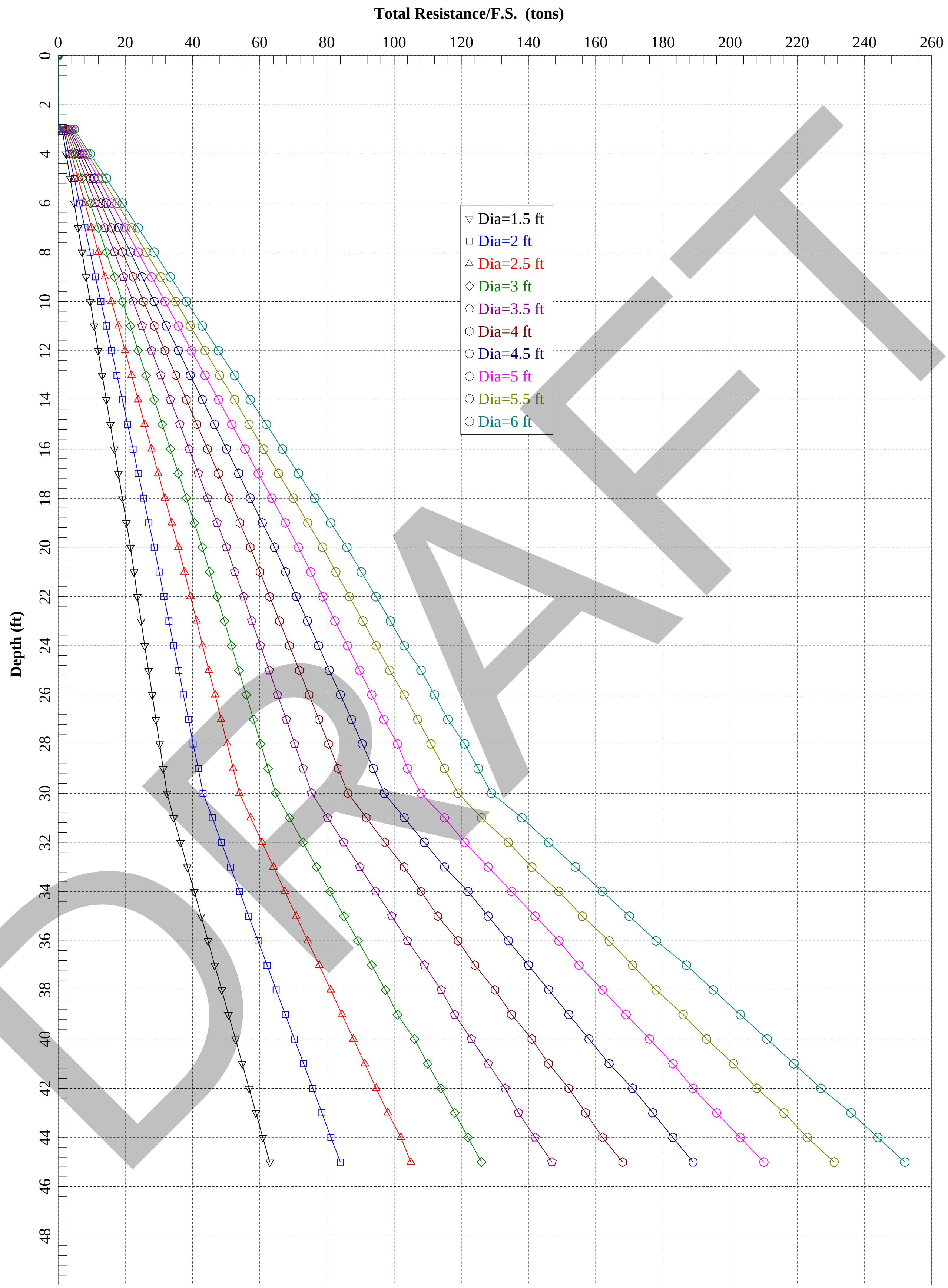
Geomodel



Notes	Water Level Observations	Explanation
See Exploration Plan for orientation of soil profile. See General Notes in Supporting Information for symbols and soil classifications. Soils profile provided for illustration purposes only. Soils between borings may differ AR - Auger Refusal BT - Boring Termination	Water Level Reading at time of drilling. Water Level Reading after drilling.	B1 — Borehole Number Moisture Content — %w LL PL — Liquid and Plastic Limits Sampling (See General Notes) Borehole Lithology AR BT — Borehole Termination Type

Material Legend

- Fat Clay with Sand
- Silty Sand
- Sandy Lean Clay
- Fat Clay
- Lean Clay with Sand
- Lean Clay



Total Resistance/F.S. (tons)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
Dia=1.5 ft
Dia=2 ft
Dia=2.5 ft
Dia=3 ft
Dia=3.5 ft
Dia=4 ft
Dia=4.5 ft
Dia=5 ft
Dia=5.5 ft
Dia=6 ft

Attachments

Exploration and Testing Procedures

Field Exploration

Number of Borings	Approximate Boring Depth (feet)	Location
10	51½	Substation area

Boring Layout and Elevations: Terracon personnel provided the boring layout using handheld GPS equipment (estimated horizontal accuracy of about ±15 feet) and referencing existing site features. Approximate ground surface elevations were estimated using Google Earth. If elevations and a more precise boring layout are desired, we recommend the exploration locations be surveyed.

Subsurface Exploration Procedures: We advanced the borings with an ATV-mounted rotary drill rig using continuous flight hollow stem augers. Four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. A 3-inch O.D. split-barrel sampling spoon with 2.5-inch I.D. tube lined sampler was used for sampling. Tube-lined, split-barrel sampling procedures are similar to standard split spoon sampling procedure; however, blow counts are typically recorded for 6-inch intervals for a total of 12 inches of penetration. We observed and recorded groundwater levels during drilling and sampling. The groundwater levels are shown on the attached boring logs. For safety purposes, all borings were backfilled with cement-grout after their completion.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials observed during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests. The laboratory testing program included the following types of tests:

- Moisture Content
- Dry Unit Weight
- Unconfined Compression
- Atterberg Limits
- No. 200 Wash
- California Bearing Ratio (CBR)
- Corrosivity

The laboratory testing program often included examination of soil samples by an engineer. Based on the results of our field and laboratory programs, we described and classified the soil samples in accordance with the Unified Soil Classification System.

Site Location and Exploration Plans

Contents:

Note: All attachments are one page unless otherwise noted.

Site Location

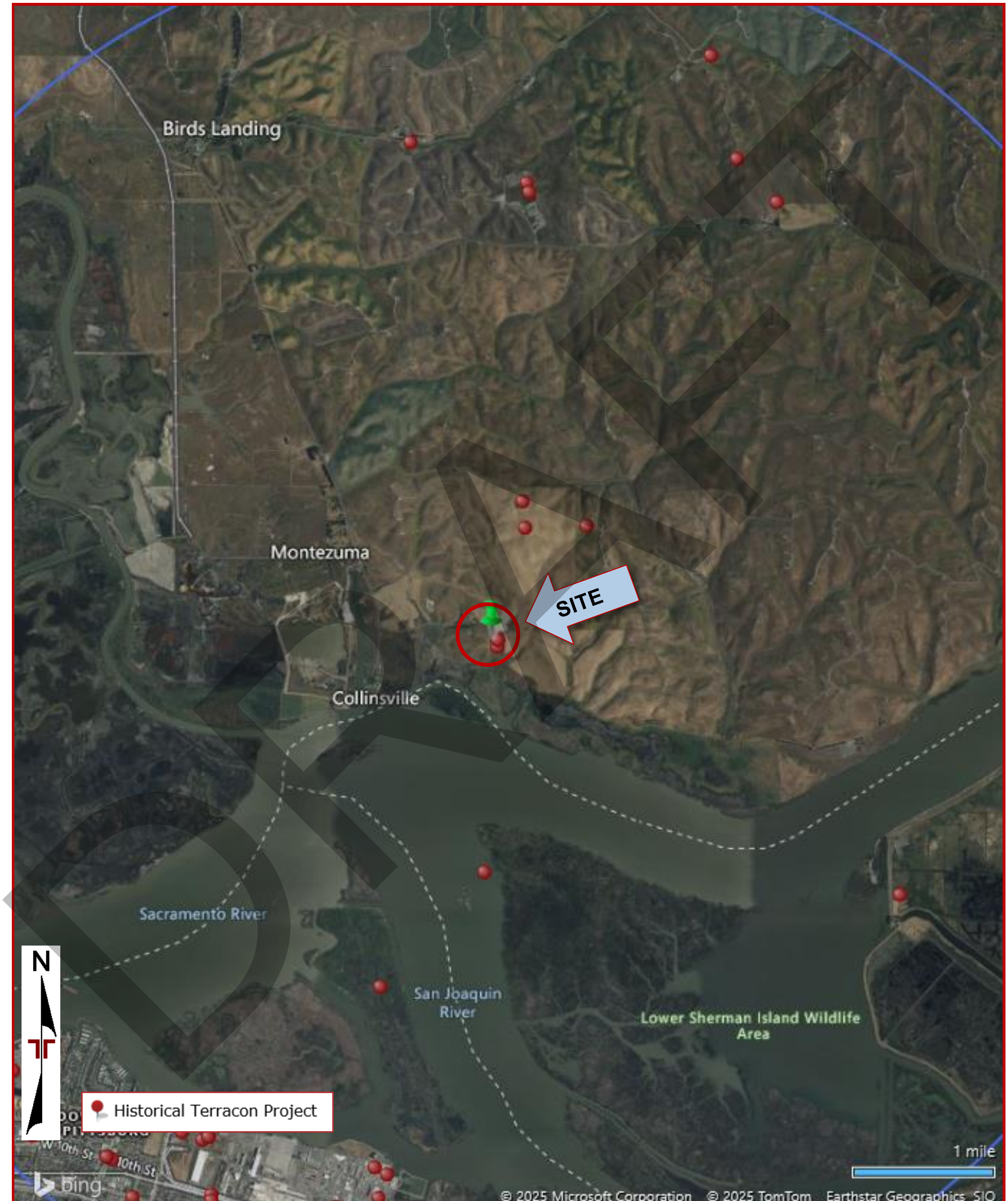


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan

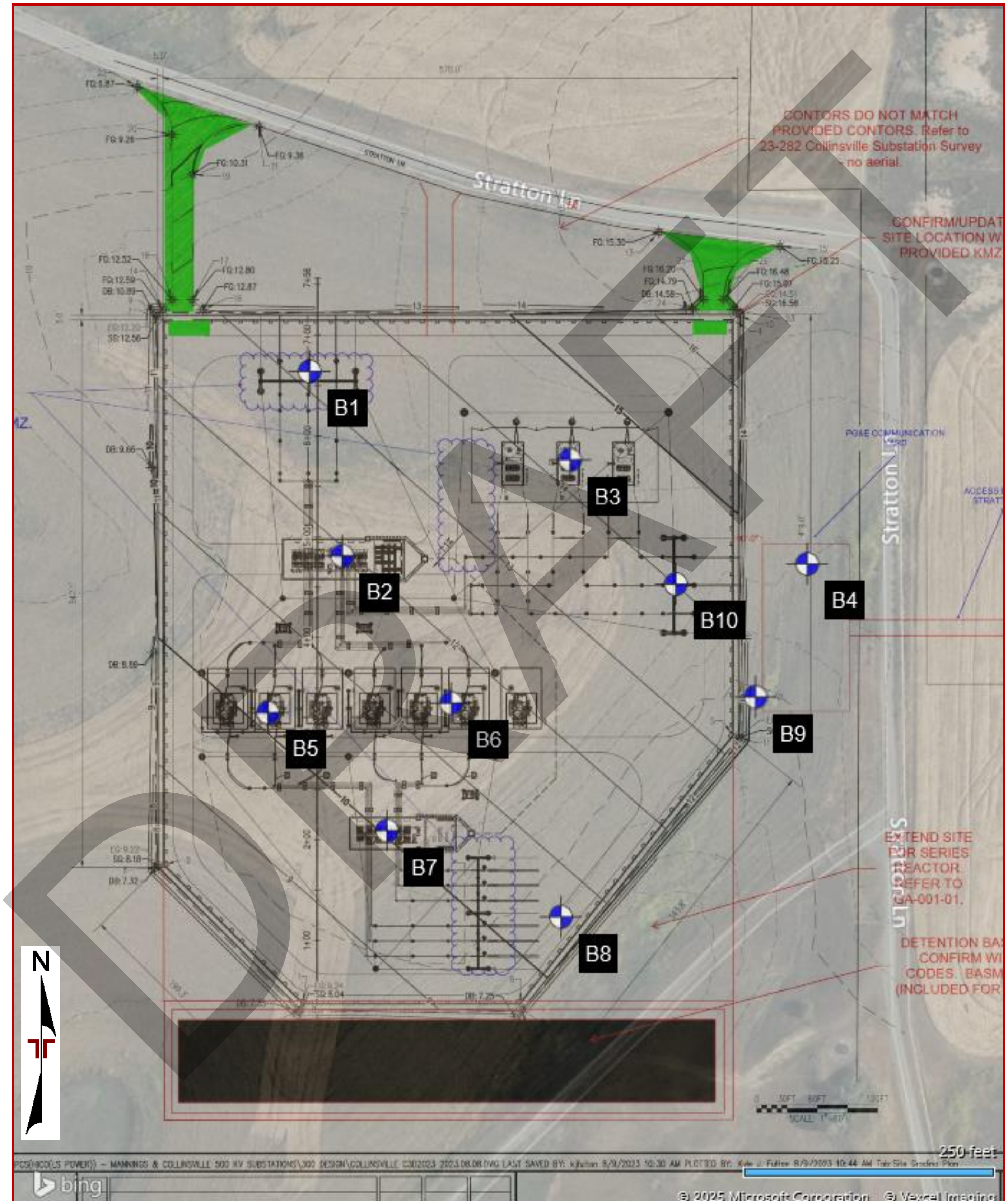


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES   MAP PROVIDED BY MICROSOFT BING MAPS

Exploration and Laboratory Results

Contents:

Boring Logs (B1 through B10)
Atterberg Limits
Field Electrical Resistivity
Unconfined Compressive Strength
CBR (pending)
Corrosivity

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B1

Location: See Exploration Plan

Latitude: 38.0814° Longitude: -121.8359°

Depth (Ft.) Elevation: 38 (Ft.) +/-

Model Layer	Depth (Ft.) / Elev.	Description	Water Level Observations	Sample Type	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1	0.0–6.0 / 32	**FAT CLAY WITH SAND (CH)**, dark gray to black, very stiff									
				Split spoon	6-10-18			19.7	101	54-20-34	79
		hard		Split spoon	11-37-17			19.1	104		
				Split spoon	7-17-20			9.6	103		
3	6.0–7.0 / 31	**SILTY SAND (SM)**, fine grained, light brown, medium dense									
2	7.0–14.0 / 24	**SANDY LEAN CLAY (CL)**, brown, hard									
				Split spoon	5-10-19		5.16	17.9	115	48-15-33	68
				Split spoon	10-19-25			19.6	113		
1	14.0–24.0 / 14	**FAT CLAY (CH)**, brown, very stiff									
				Split spoon	5-12-19			30.3	93		
			▽ (approx. 19 ft)								
		hard		Split spoon	6-14-20		4.11	26.0	100	60-21-39	97
2	24.0–	**LEAN CLAY WITH SAND (CL)**, medium plasticity, brown to gray, very stiff									
				Split spoon	9-13-21			25.8	104		

Depth scale (Ft.): 5, 10, 15, 20, 25

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
▽ At completion of drilling

Notes
Elevation Reference: Elevations were estimated using Google Earth

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

Boring Started
04-14-2025

Boring Completed
04-14-2025

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B1

Location: See Exploration Plan

Latitude: 38.0814° Longitude: -121.8359°

Model Layer	Graphic Log	Depth (Ft.) / Description / Elevation: 38 (Ft.) +/-	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
2		**LEAN CLAY WITH SAND (CL)**, medium plasticity, brown to gray, very stiff *(continued)*	30			8-18-20			29.8	97		
		31.0 — Elev. 7										
		SANDY LEAN CLAY (CL), grayish brown, very stiff										
		35.0 — Elev. 3	35			5-11-27			21.7	109		
		LEAN CLAY (CL), medium plasticity, grayish brown, very stiff										
		hard	40			9-20-25			25.4	102		
		44.0 — Elev. -6										
1		**FAT CLAY (CH)**, grayish brown, very stiff	45			11-12-19		3.56	29.8	97	50-21-29	96
			50			3-19-21			35.5	93		
		51.5 — Elev. -13.5										
		Boring Terminated at 51.5 Feet										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes

Elevation Reference: Elevations were estimated using Google Earth

Water Level Observations

At completion of drilling

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

Boring Started
04-14-2025

Boring Completed
04-14-2025

500 kV Collinsville Substation
Stratton Lane | Collinsville, CA
Terracon Project No. NA245123

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B2

Location: See Exploration Plan

Latitude: 38.0809° Longitude: -121.8358°

Elevation: 35 (Ft.) +/-

Model Layer	Depth (Ft.) / Elevation	Description	Depth (Ft.)	Water Level Observations	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1		**FAT CLAY WITH SAND (CH)**, dark gray to black, very stiff			6-10-19			21.5	103		
1					12-15-26			14.8	105		
1			5		7-10-15			16.4	100	53-15-38	84
1	7.0 / 28	**FAT CLAY (CH)**, brownish gray, very stiff			6-7-12			22.7	101		
1		stiff	10		4-6-11			28.5	99		
1		hard	15		5-7-15		4.76	27.0	100	72-21-51	95
1			20		5-9-14			28.4	96		
2	24.0 / 11	**LEAN CLAY WITH SAND (CL)**, brown, stiff		▽							
2			25		4-6-11		1.27	24.0	102	40-20-20	72

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
▽ At completion of drilling

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

Boring Started
04-11-2025

Boring Completed
04-11-2025

Notes
Elevation Reference: Elevations were estimated using Google Earth

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B2

Location: See Exploration Plan

Latitude: 38.0809° Longitude: -121.8358°

Depth (Ft.) Elevation: 35 (Ft.) +/-

Model Layer	Graphic Log	Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
2		**LEAN CLAY WITH SAND (CL)**, brown, stiff *(continued)*										
		very stiff	30			4-10-22			14.9	115		
		brownish gray										
			35			6-14-28			22.7	103		
		36.0 (Elev. -1)										
3		**SILTY SAND (SM)**, fine to medium grained, dark brown, medium dense										
		40.0 (Elev. -5)	40			6-13-21			24.3	104		
2		**LEAN CLAY (CL)**, medium plasticity, brownish gray, very stiff										
			45			6-15-21			24.0	103		
		hard	50			7-20-26			19.1	90		
		51.5 (Elev. -16.5)										
		Boring Terminated at 51.5 Feet										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
At completion of drilling

Notes
Elevation Reference: Elevations were estimated using Google Earth

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Trilte

Boring Started
04-11-2025

Boring Completed
04-11-2025

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B3

Location: See Exploration Plan

Latitude: 38.0812° Longitude: -121.8350°

Model Layer	Depth (Ft.)	Material Description (Elevation: 40 (Ft.) +/-)	Sample Depth (Ft.)	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1	0.0–5.0 (Elev. 35)	**FAT CLAY WITH SAND (CH)**, dark gray to black, stiff	1.0–2.5	3-7-6	2.75 (HP)		21.5	101		
			2.5–4.0	6-6-12			20.3	109	55-19-36	78
2	5.0–26.0 (Elev. 14)	**LEAN CLAY (CL)**, brown to light brown, stiff	5.0–6.5	9-9-6			22.0	83		
		very stiff	7.5–9.0	12-20-21			23.4	93		
			10.0–11.5	11-12-28		3.81	23.3	108		
			15.0–16.5	10-19-22			20.5	109		
			20.0–21.5	10-14-25			21.6	108	33-17-16	60
			25.0–26.5	14-26-25			24.1	107		
3	26.0–	**SILTY SAND (SM)**, fine grained, brown, medium dense								

Water level observed at approximately 25 ft (at completion of drilling).

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
- ▽ At completion of drilling
- ▽ After 24 hours

Notes
Elevation Reference: Elevations were estimated using Google Earth

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

Boring Started
04-14-2025

Boring Completed
04-14-2025

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B3

Location: See Exploration Plan

Latitude: 38.0812° Longitude: -121.8350°

Depth (Ft.) Elevation: 40 (Ft.) +/-

Model Layer	Graphic Log	Depth (Ft.) / Material Description	Elevation	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
3		**SILTY SAND (SM)**, fine grained, brown, medium dense *(continued)*											
		29.0	11										
1		**FAT CLAY (CH)**, brown, very stiff		30			12-18-21		5.44	23.6	107	50-19-31	98
					▽								
				35			8-10-21			25.3	104		
		36.0	4										
2		**SANDY LEAN CLAY (CL)**, medium plasticity, brown, very stiff											
		39.0	1										
		LEAN CLAY (CL), medium plasticity, brown, very stiff		40			9-19-22			32.7	94		
				45			5-13-26			22.4	106		
				50			14-13-26			25.3	102		
		51.5	-11.5										
		Boring Terminated at 51.5 Feet											

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
▽ At completion of drilling
▽ After 24 hours

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

Boring Started
04-14-2025

Boring Completed
04-14-2025

Notes
Elevation Reference: Elevations were estimated using Google Earth

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B4

Location: See Exploration Plan

Latitude: 38.0809° Longitude: -121.8341°

Model Layer	Depth (Ft.) / Description / Elevation: 36 (Ft.) +/-	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1	**FAT CLAY WITH SAND (CH)**, dark gray to black, stiff				3-5-8	2.5 (HP)		27.1	97		
	very stiff				4-8-12		2.30	24.1	100	61-20-41	83
		5			8-16-19			23.2	101		
	7.0 — Elev. 29										
2	**LEAN CLAY WITH SAND (CL)**, brown, stiff				6-7-10			16.7	104	31-14-17	75
	very stiff	10			7-11-13	4.0 (HP)		16.7	110		
	13.5 — Elev. 22.5										
	SANDY LEAN CLAY (CL), brownish gray, very stiff	15			4-8-15			20.6	107	34-19-15	59
		20			7-11-19			25.8	102		
	23.0 — Elev. 13										
	LEAN CLAY (CL), brown, very stiff	25			5-9-16		2.17	23.0	98	37-17-20	89

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
Groundwater not encountered

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

Boring Started
04-08-2025

Boring Completed
04-08-2025

Notes
Elevation Reference: Elevations were estimated using Google Earth

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B4

Location: See Exploration Plan

Latitude: 38.0809° Longitude: -121.8341°

Depth (Ft.) Elevation: 36 (Ft.) +/-

Model Layer	Graphic Log	Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
2		**LEAN CLAY (CL)**, brown, very stiff *(continued)*	30			4-8-17			26.6	101		
		34.0 — 2										
1		**FAT CLAY (CH)**, brownish gray, very stiff	35			4-9-13		4.41	25.9	100	67-18-49	94
			40			5-12-22			20.3	111		
			45			5-12-15			24.0	103		
		48.0 — -12										
2		**SANDY LEAN CLAY (CL)**, medium plasticity, brown, very stiff	50			5-11-19			24.9	100		
		51.5 — -15.5										
		Boring Terminated at 51.5 Feet										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
Groundwater not encountered

Notes
Elevation Reference: Elevations were estimated using Google Earth

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

Boring Started
04-08-2025

Boring Completed
04-08-2025

500 kV Collinsville Substation
Stratton Lane | Collinsville, CA
Terracon Project No. NA245123

902 Industrial Way
Lodi, CA

Boring Log No. B5

Location: See Exploration Plan

Latitude: 38.0805° Longitude: -121.8360°

Depth (Ft.) Elevation: 36 (Ft.) +/-

Model Layer	Graphic Log	Material Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
2		**LEAN CLAY WITH SAND (CL)**, dark gray, very stiff				10-12-15			17.8	111	42-16-26	76
		3.0 33				7-9-15			21.7	100		
		LEAN CLAY (CL), brown, very stiff	5			5-13-17		4.43	22.2	103		
						4-7-13			22.7	104		
			10			7-16-22			19.8	105		
			15			6-12-19		4.73	23.7	101	46-20-26	93
			20			6-13-17			27.9	95		
			25			5-13-19			28.1	97		

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
Groundwater not encountered

Notes
Elevation Reference: Elevations were estimated using Google Earth

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

Boring Started
04-10-2025

Boring Completed
04-10-2025

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B5

Location: See Exploration Plan

Latitude: 38.0805° Longitude: -121.8360°

Depth (Ft.) Elevation: 36 (Ft.) +/-

Model Layer	Graphic Log	Material Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
2		**LEAN CLAY (CL)**, brown, very stiff *(continued)*										
		29.0 — 7										
		SANDY LEAN CLAY (CL), brownish gray, very stiff	30			5-17-18			21.2	107	36-15-21	61
			35			4-10-13			25.5	101		
		40.0 — -4										
		LEAN CLAY (CL), medium plasticity, brownish gray, very stiff	40			9-14-23			27.0	95		
			45			5-12-22			28.3	98		
		hard	50			3-20-29			34.8	90		
		51.5 — -15.5										
		Boring Terminated at 51.5 Feet										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes

Elevation Reference: Elevations were estimated using Google Earth

Water Level Observations
Groundwater not encountered

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

Boring Started
04-10-2025

Boring Completed
04-10-2025

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B6

Location: See Exploration Plan

Latitude: 38.0805° Longitude: -121.8354°

Depth (Ft.) Elevation: 40 (Ft.) +/-

Model Layer	Depth (Ft.) / Elevation	Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1		**FAT CLAY (CH)**, dark gray to black, very stiff										
						3-8-13	4.0 (HP)		22.7	98		
						4-9-12			22.9	97		
			5			10-15-17			22.0	105		
						5-4-15		4.72	20.7	106	59-22-37	93
			10			5-11-13			24.4	102		
	14.0 / 26											
2		**LEAN CLAY WITH SAND (CL)**, brown, very stiff										
			15			6-10-18			25.2	103		
			20			5-12-18		5.49	21.4	106	48-19-29	81
			25			9-25-27			19.0	108		
	26.0 / 14											
		SANDY LEAN CLAY (CL), medium plasticity, brownish gray, hard										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
Groundwater not encountered

Notes
Elevation Reference: Elevations were estimated using Google Earth

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

Boring Started
04-10-2025

Boring Completed
04-10-2025

500 kV Collinsville Substation
Stratton Lane | Collinsville, CA
Terracon Project No. NA245123

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B6

Location: See Exploration Plan

Latitude: 38.0805° Longitude: -121.8354°

Depth (Ft.) — Elevation: 40 (Ft.) +/-

Model Layer	Graphic Log	Depth (Ft.) / Description / Elevation	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
2		**SANDY LEAN CLAY (CL)**, medium plasticity, brownish gray, hard *(continued)*										
			30			9-17-25			24.0	100		
		31.0 — 9										
		LEAN CLAY WITH SAND (CL), brownish gray, hard										
		very stiff	35			6-11-24		4.59	20.1	107	41-19-22	84
			40			6-13-18			23.4	105		
		hard	45			6-19-25			27.0	98		
		very stiff	50			9-20-20			23.6	103		
		51.5 — -11.5										
		Boring Terminated at 51.5 Feet										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
Groundwater not encountered

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

Boring Started
04-10-2025

Boring Completed
04-10-2025

Notes
Elevation Reference: Elevations were estimated using Google Earth

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B7

Location: See Exploration Plan

Latitude: 38.0801° Longitude: -121.8356°

Depth (Ft.) — Elevation: 32 (Ft.) +/-

Model Layer	Depth (Ft.)	Elevation	Material Description	Sample Depth (Ft.)	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1			**FAT CLAY (CH)**, high plasticity, dark gray to black, very stiff								
				1	6-11-15			22.8	100		
	2.5	29.5									
2			**LEAN CLAY WITH SAND (CL)**, brown, very stiff	2.5	10-15-21			19.1	106		
				5	9-16-22			12.7	111		
				7.5	9-17-19			20.7	109		
				10	5-10-16		2.60	25.2	103	43-23-20	81
	15.5	16.5									
			SANDY LEAN CLAY (CL), medium plasticity, brown, very stiff	15	4-9-16			20.2	104		
	19.0	13									
			LEAN CLAY (CL), brownish gray, very stiff	20	8-15-19		2.98	22.6	97	43-22-21	88
				25	6-18-22			27.4	100		

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes

Elevation Reference: Elevations were estimated using Google Earth

Water Level Observations

▽ At completion of drilling

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

Boring Started
04-09-2025

Boring Completed
04-09-2025

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B7

Location: See Exploration Plan

Latitude: 38.0801° Longitude: -121.8356°

Model Layer	Graphic Log	Depth (Ft.) / Description / Elevation: 32 (Ft.) +/-	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
2		**LEAN CLAY (CL)**, brownish gray, very stiff *(continued)*		▽								
		29.0 — 3										
1		**FAT CLAY (CH)**, brownish gray, very stiff	30			5-12-20		6.40	23.8	104	51-22-29	97
			35			8-15-21			22.6	108		
		39.0 — -7										
2		**LEAN CLAY (CL)**, medium plasticity, brown, very stiff	40			6-11-21			28.5	96		
			45			9-17-23			30.8	97		
		50.0 — -18										
		SANDY LEAN CLAY (CL), brown, hard	50			11-26-29			24.9	103		
		51.5 — -19.5										
		Boring Terminated at 51.5 Feet										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
▽ At completion of drilling

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

Boring Started
04-09-2025

Boring Completed
04-09-2025

Notes
Elevation Reference: Elevations were estimated using Google Earth

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B8

Location: See Exploration Plan

Latitude: 38.0799° Longitude: -121.8350°

Model Layer	Depth (Ft.) / Description (Elevation: 36 (Ft.) +/-)	Depth (Ft.)	Sample Type	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1	**FAT CLAY (CH)**, dark gray to black, very stiff									
		1–2.5	Sample		2.5 (HP)		24.2	90	59-18-41	85
	2.5 (Elev. 33.5)									
2	**LEAN CLAY WITH SAND (CL)**, brown, very stiff	2.5–4	Sample				26.3	100		
		5–6.5	Sample				16.5	114		
		7.5–9	Sample			3.90	17.0	105	34-17-17	72
		10–11.5	Sample				13.4	111		
		15–16.5	Sample	10-12-16			19.9	109		
	19.0 (Elev. 17)									
	SANDY LEAN CLAY (CL), brown, very stiff	20–21.5	Sample	12-16-18		3.79	24.4	108	37-18-19	53
		25–26.5	Sample	10-14-28			30.8	91		
	26.0 (Elev. 10)									
3	**SILTY SAND (SM)**, fine to medium grained, brown, medium dense									

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes

Elevation Reference: Elevations were estimated using Google Earth

Water Level Observations

At completion of drilling

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

Boring Started
04-14-2025

Boring Completed
04-15-2025

500 kV Collinsville Substation
Stratton Lane | Collinsville, CA
Terracon Project No. NA245123

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B8

Location: See Exploration Plan

Latitude: 38.0799° Longitude: -121.8350°

Elevation: 36 (Ft.) +/-

Model Layer	Depth (Ft.)	Material Description	Elevation	Sample Depth (Ft.)	Water Level Observations	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
3	29.0	**SILTY SAND (SM)**, fine to medium grained, brown, medium dense *(continued)*	7									
2		**LEAN CLAY (CL)**, brown, hard		30	▽	12-31-40			17.1	122		
		very stiff		35		9-15-20		2.30	22.7	106	32-19-13	91
	45.0	hard	-9	40		10-20-25	4.0 (HP)		26.8	97		
3	49.0	**SILTY SAND (SM)**, fine to medium grained, brown, medium dense	-13	45		16-17-20			23.8	107		19
2	51.5	**LEAN CLAY (CL)**, medium plasticity, brown, hard	-15.5	50		17-21-25			25.7	98		

Boring Terminated at 51.5 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
▽ At completion of drilling

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

Boring Started
04-14-2025

Boring Completed
04-15-2025

Notes
Elevation Reference: Elevations were estimated using Google Earth

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B9

Location: See Exploration Plan

Latitude: 38.0805° Longitude: -121.8343°

Depth (Ft.) Elevation: 28 (Ft.) +/-

Model Layer	Graphic Log	Material Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1		**FAT CLAY (CH)**, high plasticity, dark gray to black, stiff				4-6-10			18.7	110		
		very stiff				8-14-17			18.3	107		
			5			8-12-17			18.6	111		
		7.0 (Elevation 21)										
2		**LEAN CLAY WITH SAND (CL)**, brown, very stiff				5-9-14		3.46	18.2	107	45-14-31	72
			10			5-9-15			18.2	113		
		13.0 (Elevation 15)										
1		**FAT CLAY (CH)**, brownish gray, very stiff	15			7-14-19			22.5	108		
			20			5-7-12		2.68	34.3	89	67-26-41	100
			25			6-10-11			21.6	104		

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes

Elevation Reference: Elevations were estimated using Google Earth

Water Level Observations

At completion of drilling

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

Boring Started
04-08-2025

Boring Completed
04-08-2025

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B9

Location: See Exploration Plan

Latitude: 38.0805° Longitude: -121.8343°

Depth (Ft.) Elevation: 28 (Ft.) +/-

Model Layer	Graphic Log	Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1		**FAT CLAY (CH)**, brownish gray, very stiff *(continued)*										
			30			4-7-14			29.0	91		
			35			4-10-12		4.10	26.5	91	65-24-41	97
		hard	40			6-18-29			21.8	102		
		44.0 ... -16										
3		**SILTY SAND (SM)**, fine to medium grained, brownish gray, medium dense	45	▽		4-10-18			23.9	106		22
		49.0 ... -21										
2		**LEAN CLAY (CL)**, medium plasticity, gray, very stiff	50			9-13-16			28.4	90		
		51.5 ... -23.5										
		Boring Terminated at 51.5 Feet										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes

Elevation Reference: Elevations were estimated using Google Earth

Water Level Observations

▽ At completion of drilling

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

Boring Started
04-08-2025

Boring Completed
04-08-2025

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B10

Location: See Exploration Plan

Latitude: 38.0808° Longitude: -121.8346°

Depth (Ft.) Elevation: 44 (Ft.) +/-

Model Layer 1

FAT CLAY WITH SAND (CH), dark gray, stiff

very stiff

brown

14.0 — 30

Model Layer 2

LEAN CLAY WITH SAND (CL), brown to dark brown, very stiff

grayish brown

brown, hard

Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
			3-6-9			23.3	94		
			4-8-8			19.1	87		
5			6-8-14		3.17	35.5	83	58-20-38	81
			5-9-14			22.6	98		
10			6-15-19			26.9	92		
15			5-13-19			24.0	100		
20			5-9-12		3.12	21.7	94	45-20-25	75
25			10-15-28			21.8	108		

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
At completion of drilling

Notes
Elevation Reference: Elevations were estimated using Google Earth

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

Boring Started
04-09-2025

Boring Completed
04-09-2025

Terracon
902 Industrial Way
Lodi, CA

Boring Log No. B10

Location: See Exploration Plan

Latitude: 38.0808° Longitude: -121.8346°

Model Layer	Depth (Ft.)	Material Description	Elevation: 44 (Ft.) +/-	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	HP (tsf)	Unconfined Compressive Strength (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
2		**LEAN CLAY WITH SAND (CL)**, brown to dark brown, very stiff *(continued)*											
		very stiff		30			6-12-19			26.6	102		
				35			5-13-15			26.8	103		
				40			9-13-21		5.16	25.0	99	45-20-25	100
				45			7-15-21			25.7	97		
				50	▽		8-13-21			25.4	104		
	51.5		-7.5										

Boring Terminated at 51.5 Feet

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations
▽ At completion of drilling

Notes
Elevation Reference: Elevations were estimated using Google Earth

Advancement Method
6 inch Hollow Stem Auger

Abandonment Method
Boring backfilled with cement-bentonite grout upon completion.

Drill Rig
CME 750

Hammer Type
Automatic

Driller
Terracon

Logged by
Austin Tritle

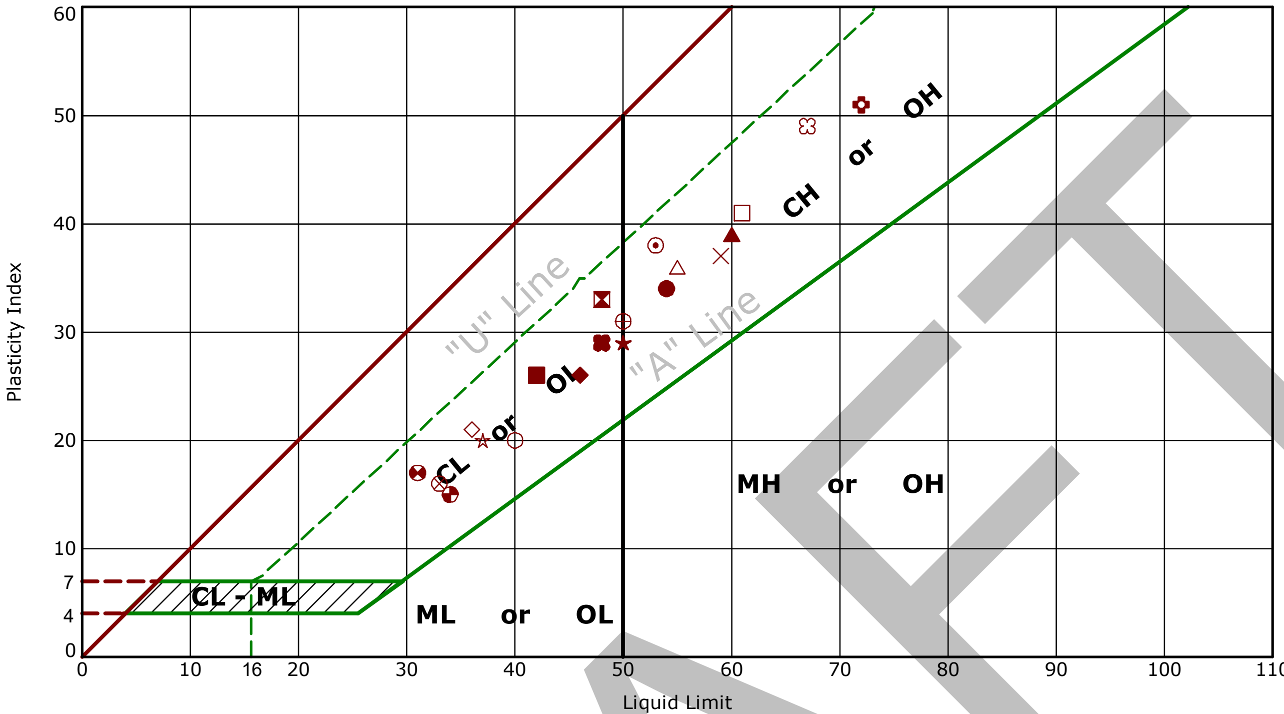
Boring Started
04-09-2025

Boring Completed
04-09-2025

Terracon
902 Industrial Way
Lodi, CA

Atterberg Limit Results

ASTM D4318



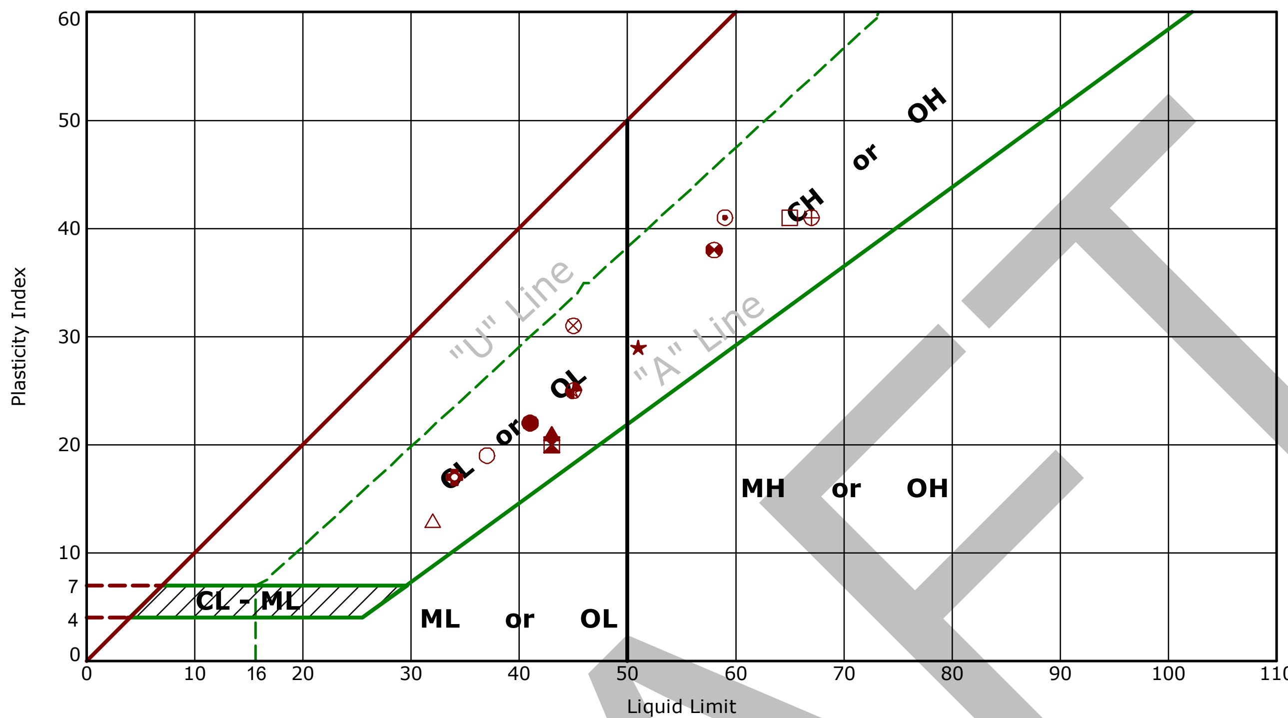
	Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	B1	1 - 2.5	54	20	34	78.6	CH	FAT CLAY with SAND
⊠	B1	7.5 - 9	48	15	33	68.5	CL	SANDY LEAN CLAY
▲	B1	20 - 21.5	60	21	39	96.7	CH	FAT CLAY
★	B1	45 - 46.5	50	21	29	96.3	CH	FAT CLAY
⊙	B2	5 - 6.5	53	15	38	84.2	CH	FAT CLAY with SAND
✿	B2	15 - 16.5	72	21	51	95.1	CH	FAT CLAY
○	B2	25 - 26.5	40	20	20	71.9	CL	LEAN CLAY with SAND
△	B3	2.5 - 4	55	19	36	78.1	CH	FAT CLAY with SAND
⊗	B3	20 - 21.5	33	17	16	60.5	CL	SANDY LEAN CLAY
⊕	B3	30 - 31.5	50	19	31	97.8	CH	FAT CLAY
□	B4	2.5 - 4	61	20	41	83.5	CH	FAT CLAY with SAND
⊗	B4	7.5 - 9	31	14	17	75.1	CL	LEAN CLAY with SAND
⊕	B4	15 - 16.5	34	19	15	58.9	CL	SANDY LEAN CLAY
☆	B4	25 - 26.5	37	17	20	88.9	CL	LEAN CLAY
✿	B4	35 - 36.5	67	18	49	93.9	CH	FAT CLAY
■	B5	1 - 2.5	42	16	26	76.0	CL	LEAN CLAY with SAND
◆	B5	15 - 16.5	46	20	26	93.1	CL	LEAN CLAY
◇	B5	30 - 31.5	36	15	21	61.2	CL	SANDY LEAN CLAY
×	B6	7.5 - 9	59	22	37	93.1	CH	FAT CLAY
✿	B6	20 - 21.5	48	19	29	80.7	CL	LEAN CLAY with SAND

500 kV Collinsville Substation
Stratton Lane | Collinsville, CA
Terracon Project No. NA245123

Terracon
902 Industrial Way
Lodi, CA

Atterberg Limit Results

ASTM D4318



	Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	B6	35 - 36.5	41	19	22	84.0	CL	LEAN CLAY with SAND
⊠	B7	10 - 11.5	43	23	20	81.0	CL	LEAN CLAY with SAND
▲	B7	20 - 21.5	43	22	21	87.5	CL	LEAN CLAY
★	B7	30 - 31.5	51	22	29	97.3	CH	FAT CLAY
⊙	B8	1 - 2.5	59	18	41	85.1	CH	FAT CLAY
✜	B8	7.5 - 9	34	17	17	72.4	CL	LEAN CLAY with SAND
○	B8	20 - 21.5	37	18	19	52.9	CL	SANDY LEAN CLAY
△	B8	35 - 36.5	32	19	13	91.2	CL	LEAN CLAY
⊗	B9	7.5 - 9	45	14	31	72.1	CL	LEAN CLAY with SAND
⊕	B9	20 - 21.5	67	26	41	99.9	CH	FAT CLAY
□	B9	35 - 36.5	65	24	41	96.5	CH	FAT CLAY
⊗	B10	5 - 6.5	58	20	38	81.5	CH	FAT CLAY with SAND
◕	B10	20 - 21.5	45	20	25	74.9	CL	LEAN CLAY with SAND
☆	B10	40 - 41.5	45	20	25	99.8	CL	LEAN CLAY

FIELD ELECTRICAL RESISTIVITY TEST DATA
EPC Solutions Substation ERS | Collinsville, Solano County, California
April 22, 2025 | Terracon Project No. NS245221

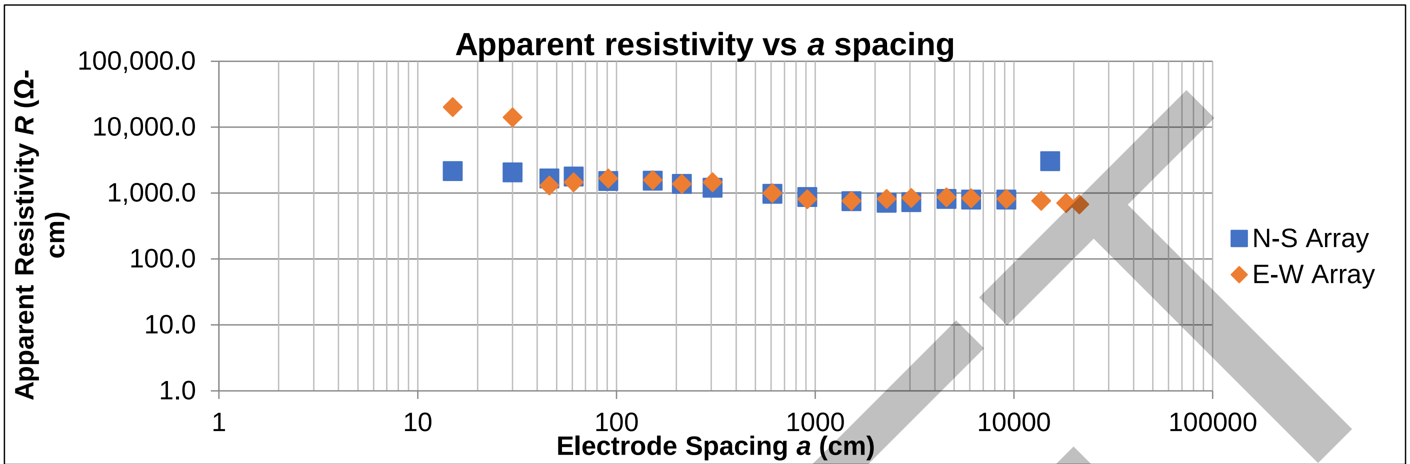
Sounding	VES-1		
Array Loc.	38.080607747°N , 121.837862381°W		
Instrument	AGI SuperSting R1	**Weather**	Overcast, high of 59°F
Serial #	SP0303161	**Ground Cond.**	Tilled AG field
Cal. Check	June 12, 2024	**Tested By**	T. Black
Test Date	April, 17 2025	**Method**	Wenner 4-pin (ASTM G57-06 (2020); IEEE 81-2012)
Notes & Conflicts	Arrays share a common midpoint and are oriented N-S and W-E		

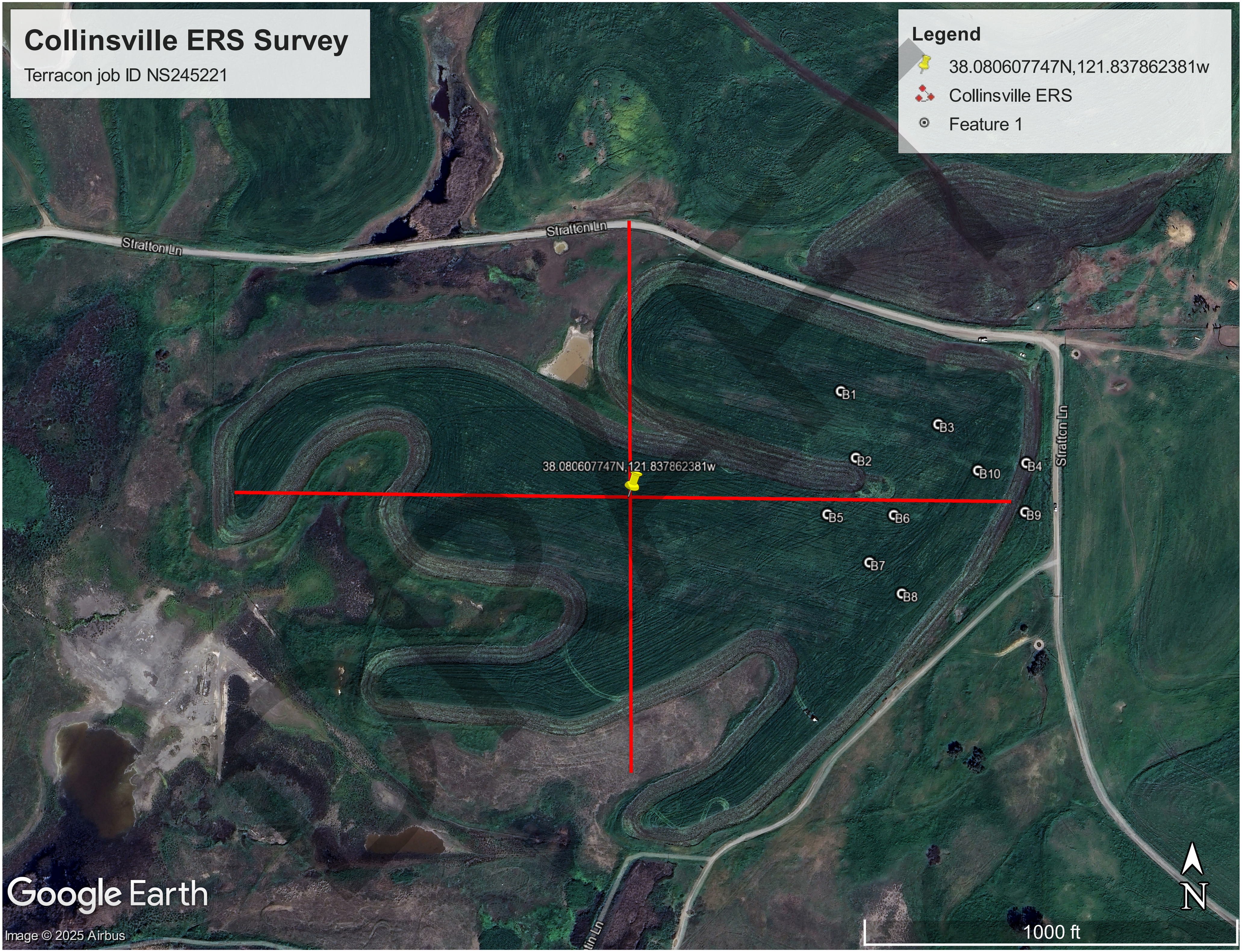
Apparent resistivity ρ is calculated as :

$$\rho = \frac{4\pi a R}{1 + \frac{2a}{\sqrt{a^2 + 4b^2}} - \frac{a}{\sqrt{a^2 + b^2}}}$$

Electrode Spacing *a*		**Electrode Depth *b***		**N-S Test**		**E-W Test**	
(feet)	(centimeters)	(inches)	(centimeters)	Measured Resistance *R* Ω	Apparent Resistivity *ρ* (Ω-cm)	Measured Resistance *R* Ω	Apparent Resistivity *ρ* (Ω-cm)
0.5	15	1	0.4	22.84	2160	214.6	20250
1	30	1	0.4	11.04	2080	75.65	14260
1.5	46	2	0.8	5.797	1680	4.538	1310
2	61	2	0.8	4.688	1800	3.801	1460
3	91	3	1.2	2.668	1530	2.938	1680
5	152	6	2.4	1.624	1550	1.651	1580
7	213	8	3.1	1.028	1380	1.034	1380
10	305	12	4.7	0.6369	1220	0.7592	1460
20	610	12	4.7	0.2548	980	0.26	1000
30	914	12	4.7	0.1533	880	0.1414	810
50	1524	12	4.7	0.0796	760	0.0809	770
75	2286	12	4.7	0.05	720	0.0571	820
100	3048	12	4.7	0.0379	730	0.0444	850
150	4572	12	4.7	0.0284	820	0.0302	870
200	6096	12	4.7	0.021	800	0.022	840
300	9144	12	4.7	0.014	800	0.0143	820
450	13716	12	4.7	-	-	0.0089	770
500	15240	12	4.7	0.0321	3070	-	-
600	18288	12	4.7	-	-	0.0062	710
700	21336	12	4.7	-	-	0.0051	680

FIELD ELECTRICAL RESISTIVITY TEST DATA
EPC Solutions Substation ERS | Collinsville, Solano County, California
April 22, 2025 | Terracon Project No. NS245221




Collinsville ERS Survey
Terracon job ID NS245221
Legend
38.080607747N,121.837862381w
Collinsville ERS
Feature 1
Stratton Ln
Stratton Ln
Stratton Ln
38.080607747N,121.837862381w
B1
B2
B3
B4
B5
B6
B7
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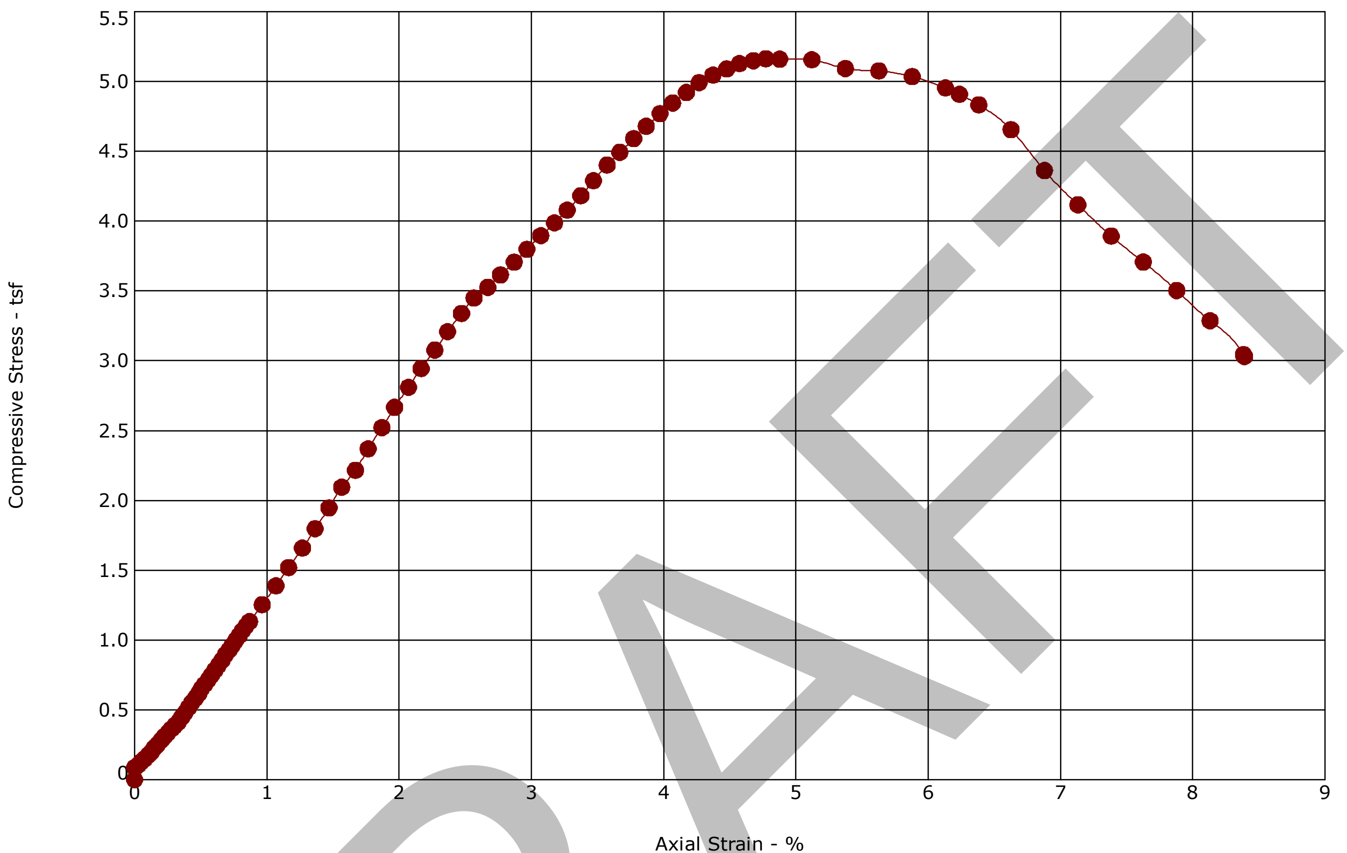
Google Earth
Image © 2025 Airbus
1000 ft
N

Terracon
902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B1	7.5 - 9	DMRS	48	15	33	68.5	SANDY LEAN CLAY(CL)

Specimen Failure Mode

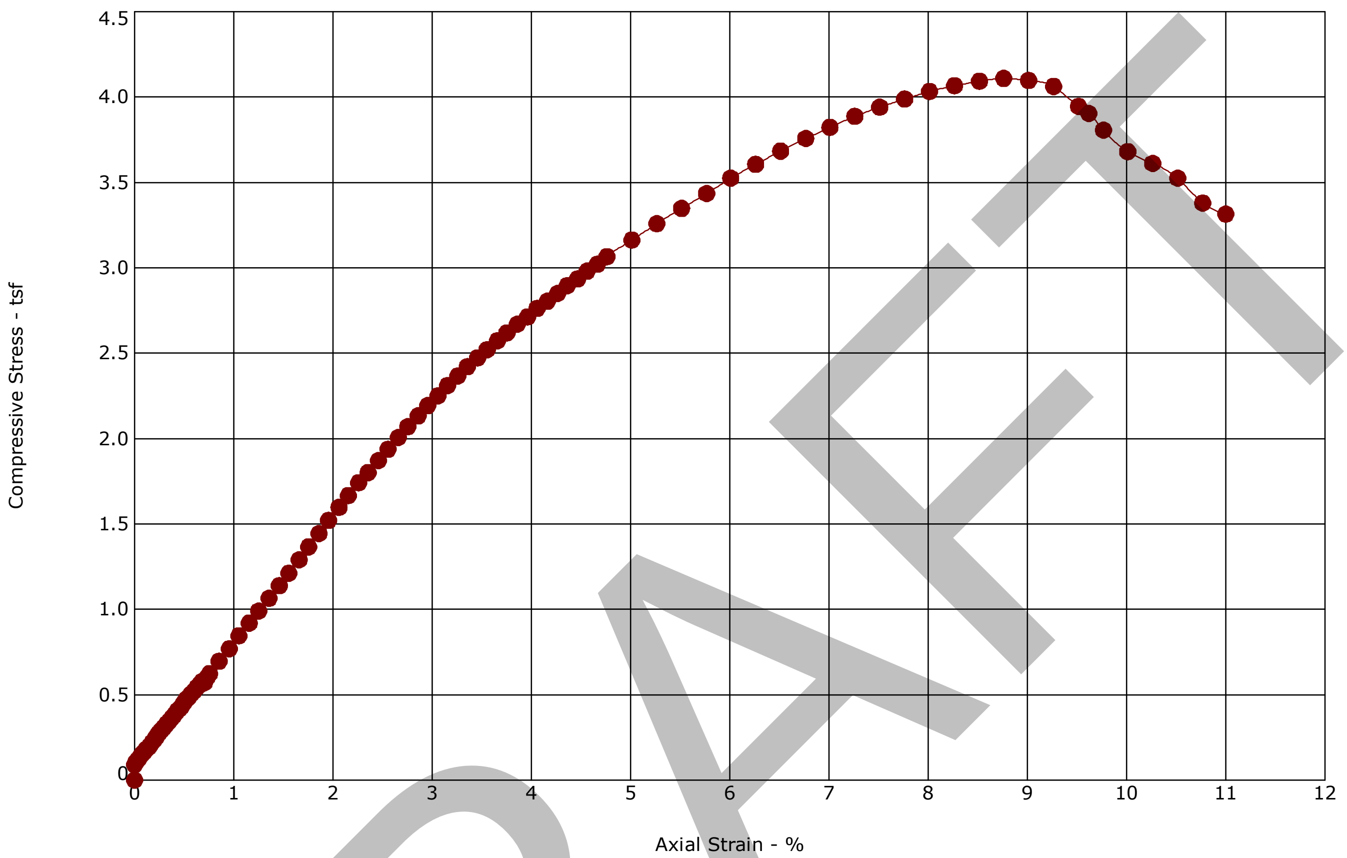
Specimen Test Data

Moisture Content (%):	17.7
Dry Density (pcf):	112
Diameter (in.):	2.39
Height (in.):	4.79
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	104.70
Calculated Void Ratio:	0.46
Assumed Specific Gravity:	2.7
Failure Strain (%):	4.77
Unconfined Compressive Strength (tsf):	5.16
Undrained Shear Strength (tsf):	2.58
Strain Rate (in/min):	0.0478
Remarks:	

Terracon
902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B1	20 - 21.5	DMRS	60	21	39	96.7	FAT CLAY(CH)

Specimen Failure Mode

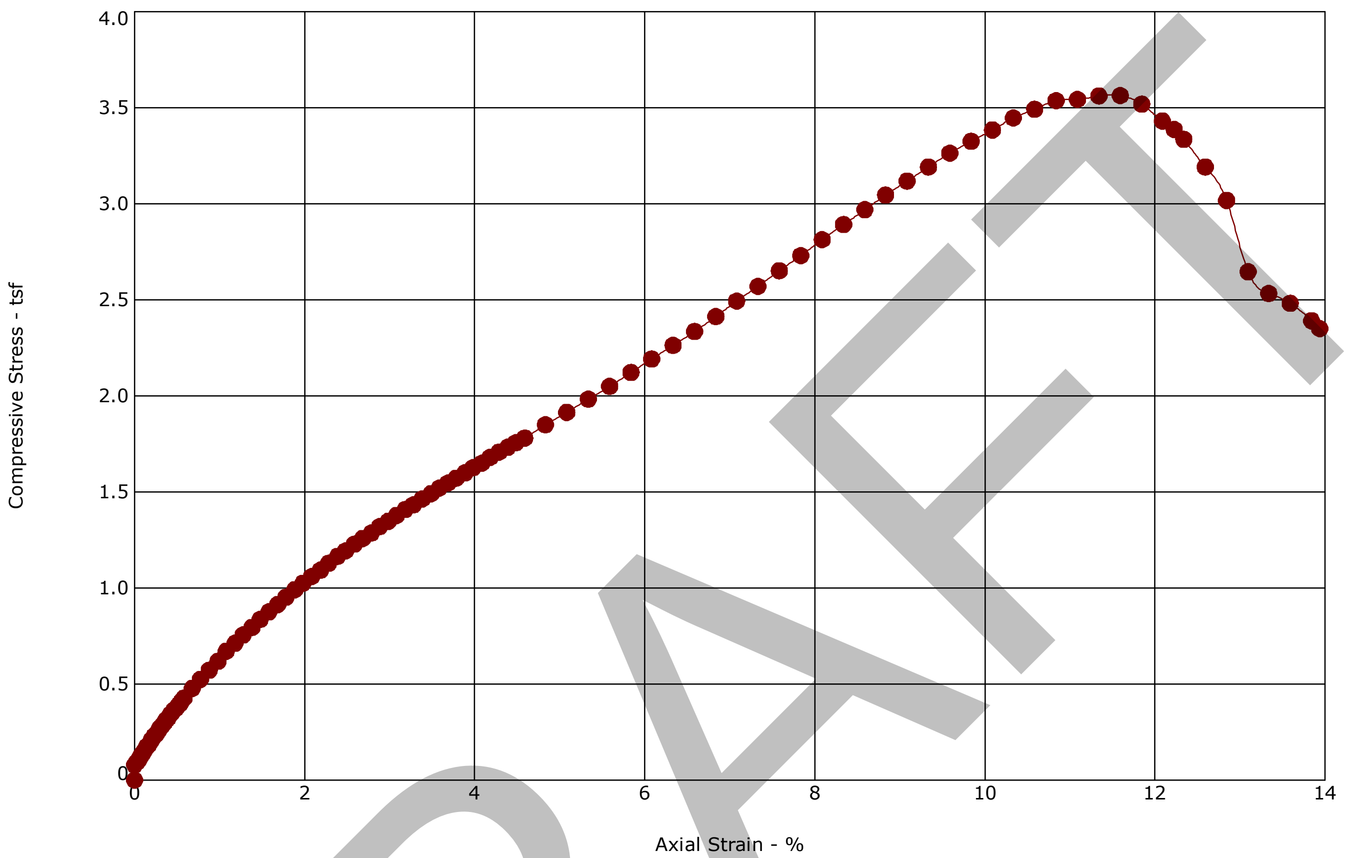
Specimen Test Data

Moisture Content (%):	29.0
Dry Density (pcf):	96
Diameter (in.):	2.39
Height (in.):	4.78
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	102.00
Calculated Void Ratio:	0.69
Assumed Specific Gravity:	2.7
Failure Strain (%):	8.76
Unconfined Compressive Strength (tsf):	4.11
Undrained Shear Strength (tsf):	2.05
Strain Rate (in/min):	0.0478
Remarks:	

Terracon
902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B1	45 - 46.5	DMRS	50	21	29	96.3	FAT CLAY(CH)

Specimen Failure Mode

Specimen Test Data

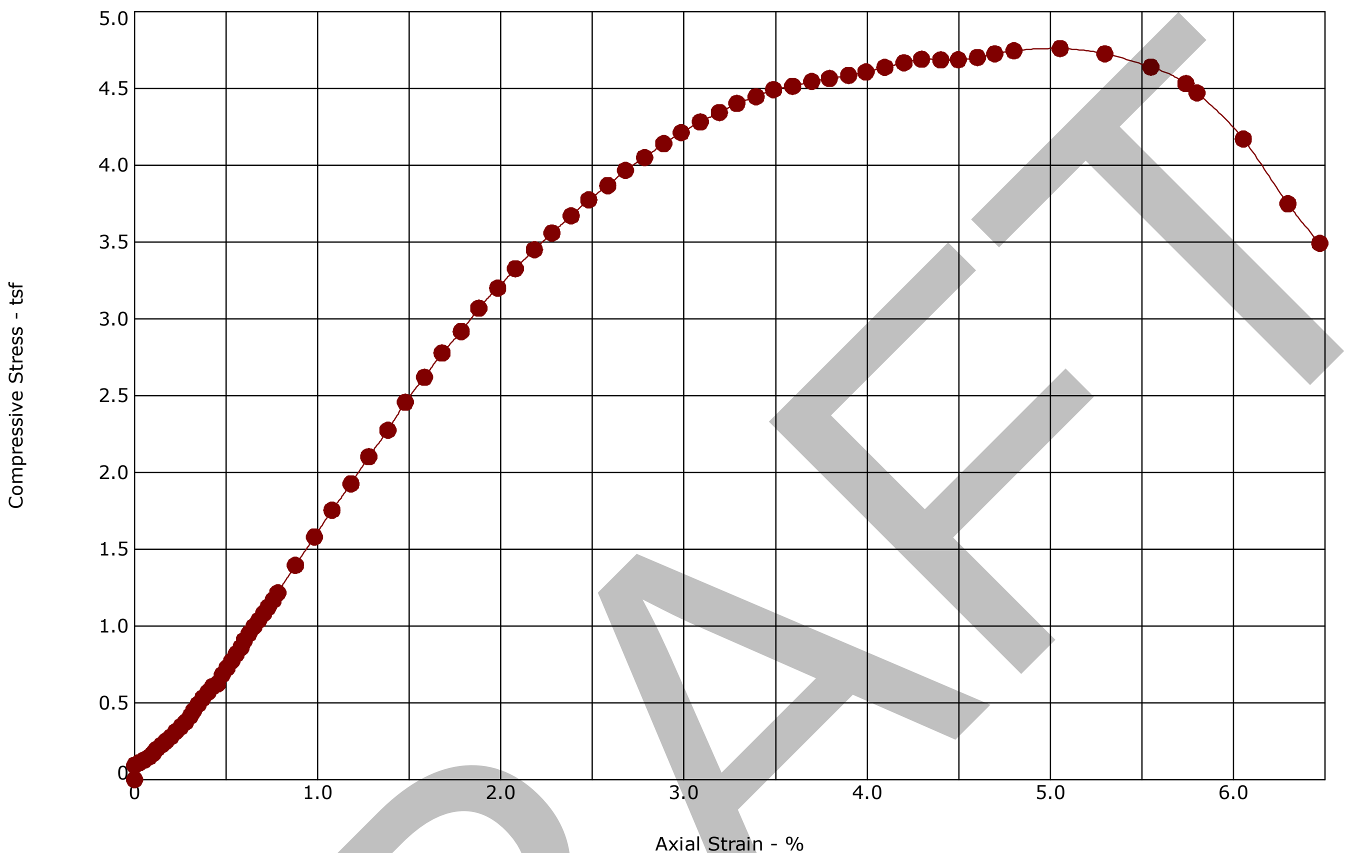
Moisture Content (%):	29.7
Dry Density (pcf):	96
Diameter (in.):	2.39
Height (in.):	4.80
Height / Diameter Ratio:	2.01
Calculated Saturation (%):	107.90
Calculated Void Ratio:	0.75
Assumed Specific Gravity:	2.7
Failure Strain (%):	11.59
Unconfined Compressive Strength (tsf):	3.56
Undrained Shear Strength (tsf):	1.78
Strain Rate (in/min):	0.0479
Remarks:	

500 kV Collinsville Substation
Stratton Lane | Collinsville, CA
Terracon Project No. NA245123

Terracon
902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B2	15 - 16.5	DMRS	72	21	51	95.1	FAT CLAY(CH)

Specimen Failure Mode

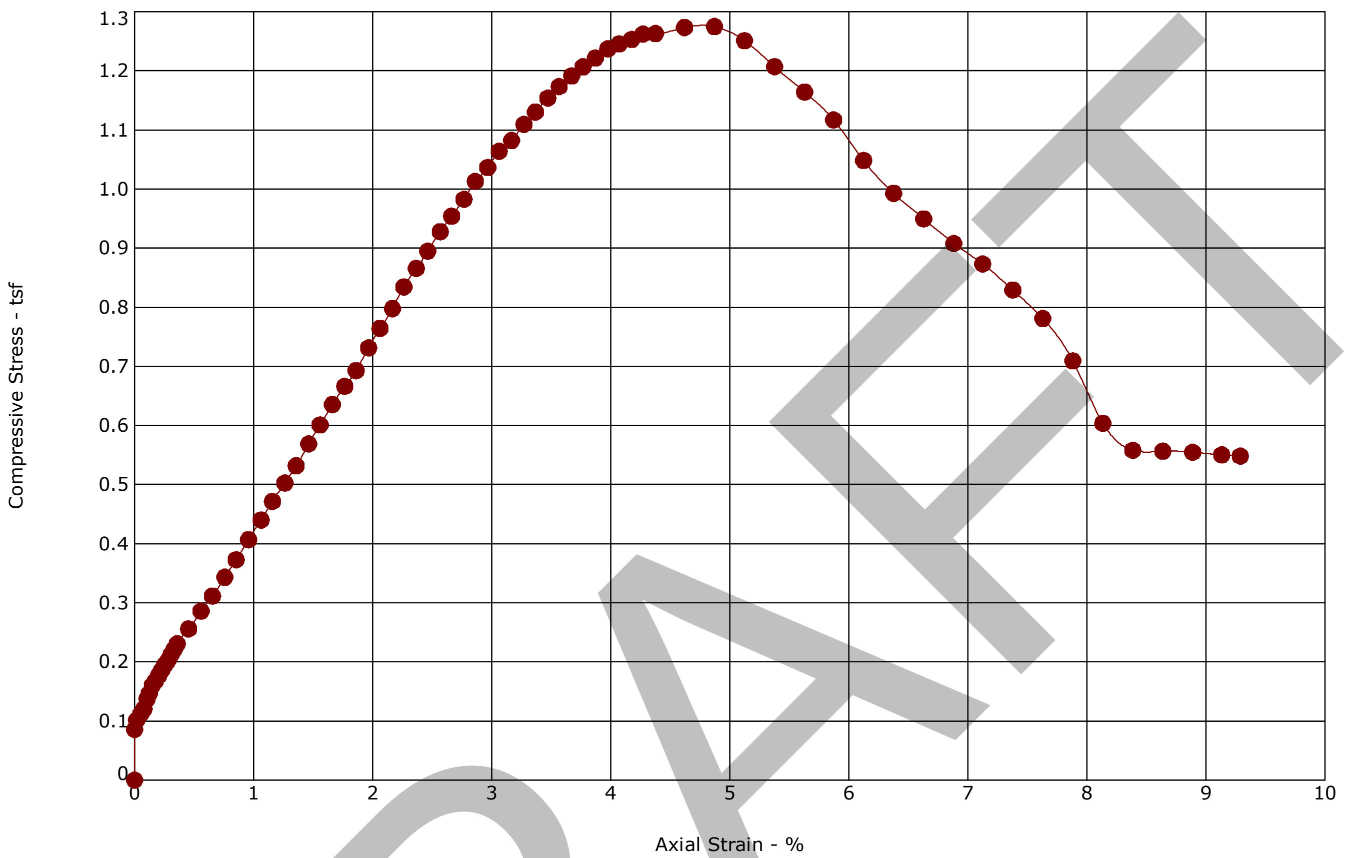
Specimen Test Data

Moisture Content (%):	27.7
Dry Density (pcf):	98
Diameter (in.):	2.40
Height (in.):	4.81
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	107.33
Calculated Void Ratio:	0.68
Assumed Specific Gravity:	2.7
Failure Strain (%):	5.05
Unconfined Compressive Strength (tsf):	4.76
Undrained Shear Strength (tsf):	2.38
Strain Rate (in/min):	0.0481
Remarks:	

902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B2	25 - 26.5	DMRS	40	20	20	71.9	LEAN CLAY with SAND(CL)

Specimen Failure Mode

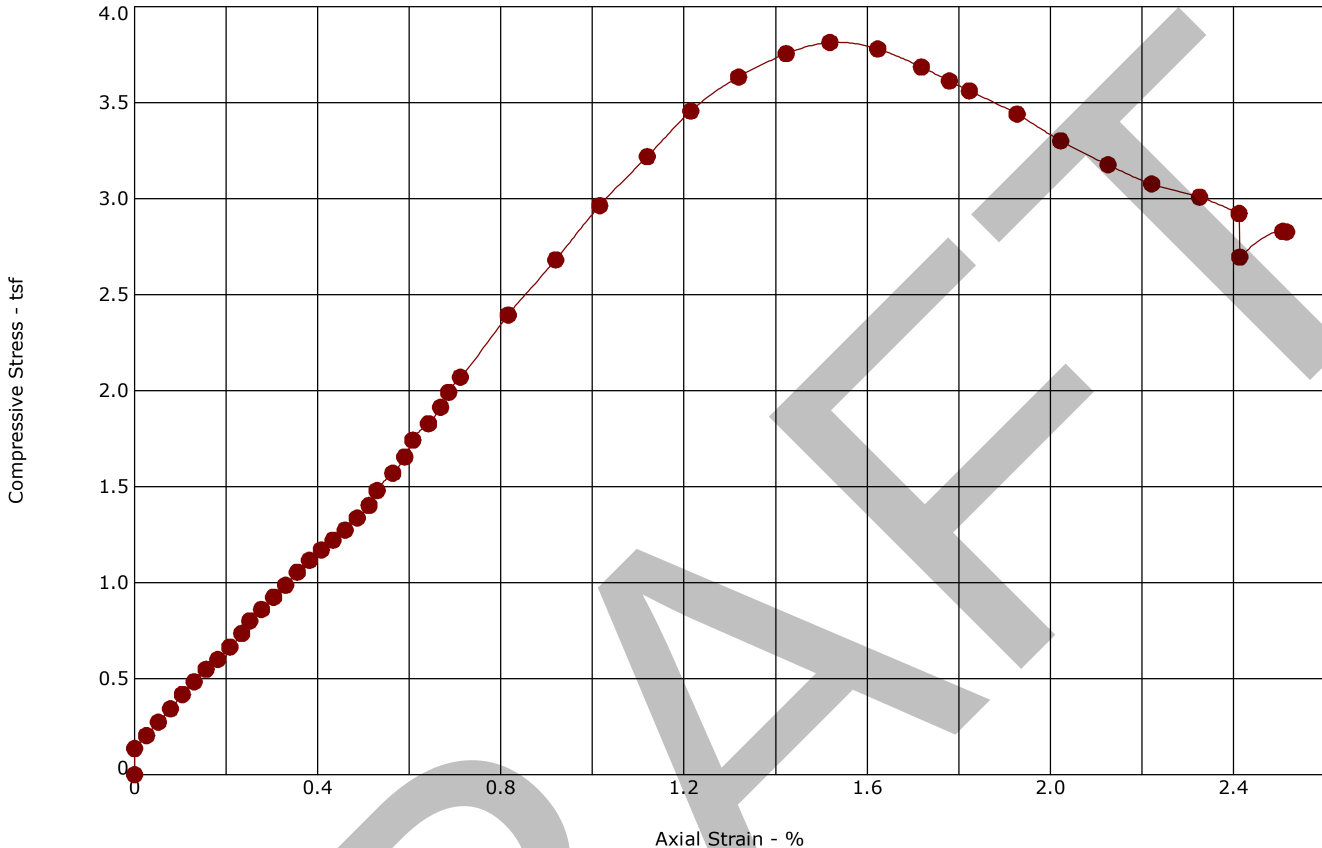
Specimen Test Data

Moisture Content (%):	24.9
Dry Density (pcf):	100
Diameter (in.):	2.39
Height (in.):	4.78
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	98.43
Calculated Void Ratio:	0.66
Assumed Specific Gravity:	2.7
Failure Strain (%):	4.87
Unconfined Compressive Strength (tsf):	1.27
Undrained Shear Strength (tsf):	0.64
Strain Rate (in/min):	0.0478
Remarks:	

902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B3	10 - 11.5	DMRS					

Specimen Failure Mode

Specimen Test Data

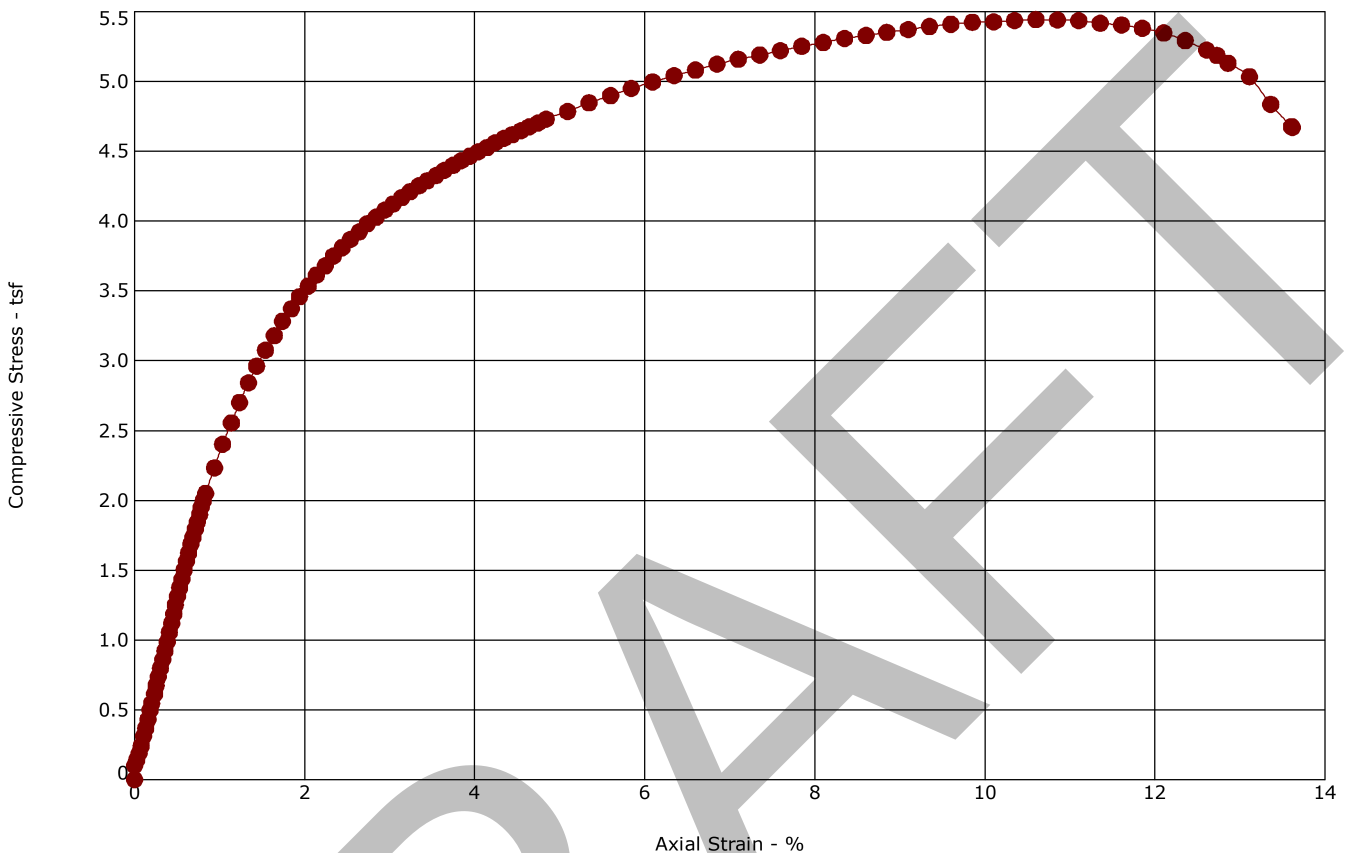
Moisture Content (%):	23.7
Dry Density (pcf):	103
Diameter (in.):	2.40
Height (in.):	4.81
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	110.96
Calculated Void Ratio:	0.57
Assumed Specific Gravity:	2.7
Failure Strain (%):	1.52
Unconfined Compressive Strength (tsf):	3.81
Undrained Shear Strength (tsf):	1.91
Strain Rate (in/min):	0.0463
Remarks:	

500 kV Collinsville Substation
Stratton Lane | Collinsville, CA
Terracon Project No. NA245123

Terracon
902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B3	30 - 31.5	DMRS	50	19	31	97.8	FAT CLAY(CH)

Specimen Failure Mode

Specimen Test Data

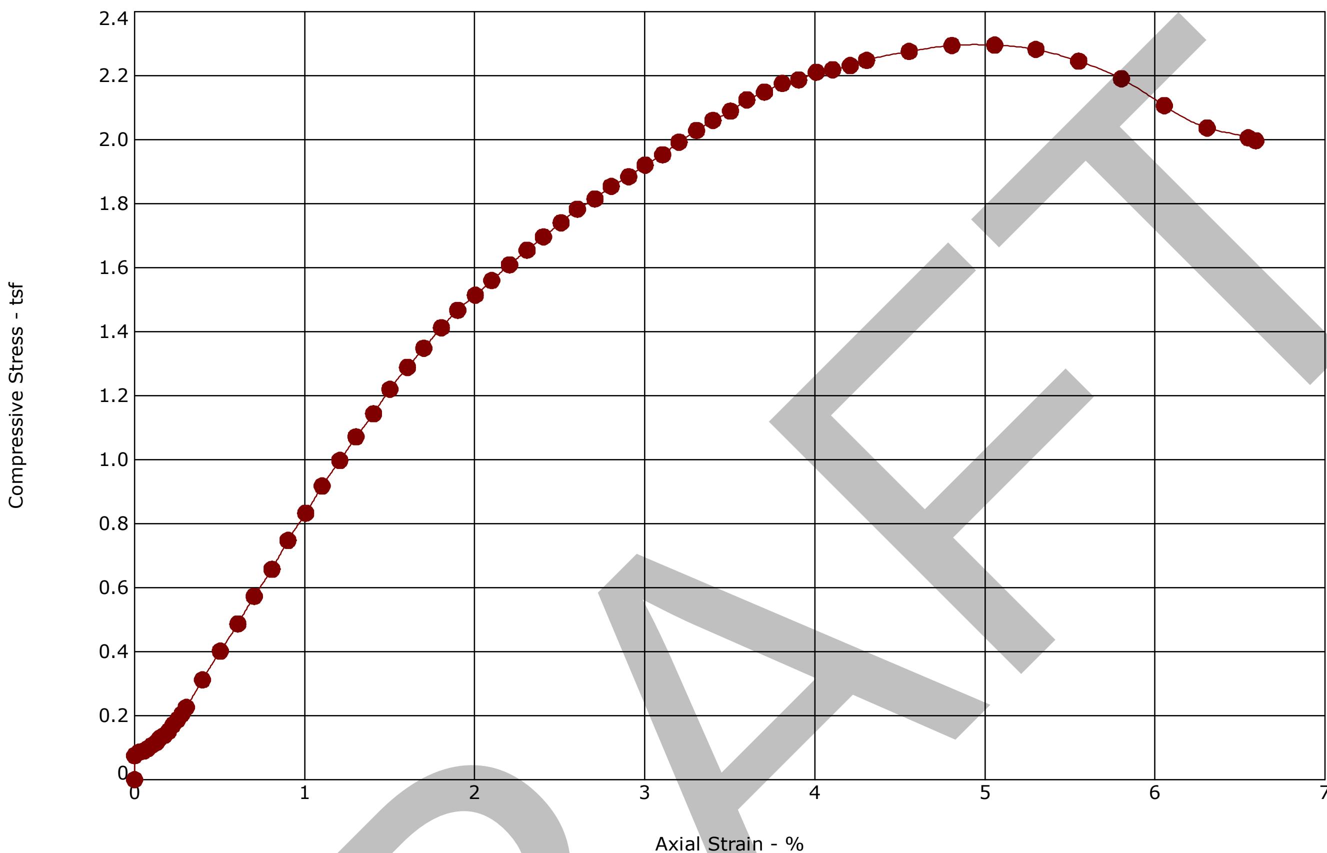
Moisture Content (%):	23.4
Dry Density (pcf):	105
Diameter (in.):	2.40
Height (in.):	4.80
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	110.84
Calculated Void Ratio:	0.57
Assumed Specific Gravity:	2.7
Failure Strain (%):	10.60
Unconfined Compressive Strength (tsf):	5.44
Undrained Shear Strength (tsf):	2.72
Strain Rate (in/min):	0.0480
Remarks:	

500 kV Collinsville Substation
Stratton Lane | Collinsville, CA
Terracon Project No. NA245123

Terracon
902 Industrial Way
Lodi, CA

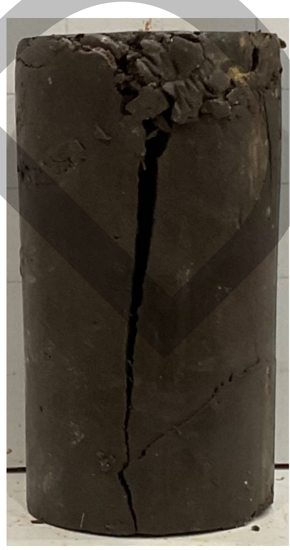
Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B4	2.5 - 4	DMRS	61	20	41	83.5	FAT CLAY with SAND(CH)

Specimen Failure Mode



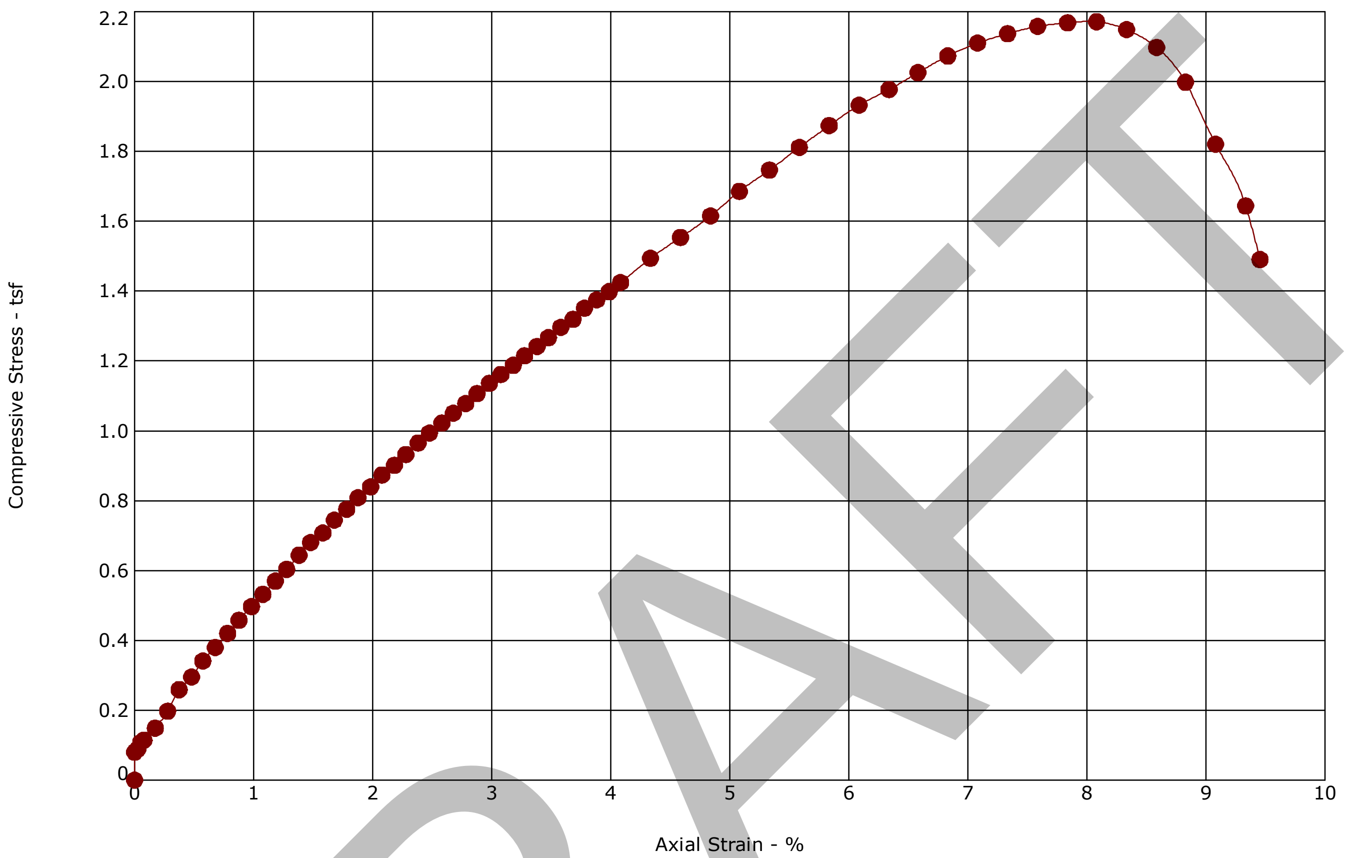
Specimen Test Data

Moisture Content (%):	24.1
Dry Density (pcf):	98
Diameter (in.):	2.40
Height (in.):	4.81
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	94.79
Calculated Void Ratio:	0.69
Assumed Specific Gravity:	2.7
Failure Strain (%):	5.06
Unconfined Compressive Strength (tsf):	2.30
Undrained Shear Strength (tsf):	1.15
Strain Rate (in/min):	0.0480
Remarks:	

902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B4	25 - 26.5	DMRS	37	17	20	88.9	LEAN CLAY(CL)

Specimen Failure Mode

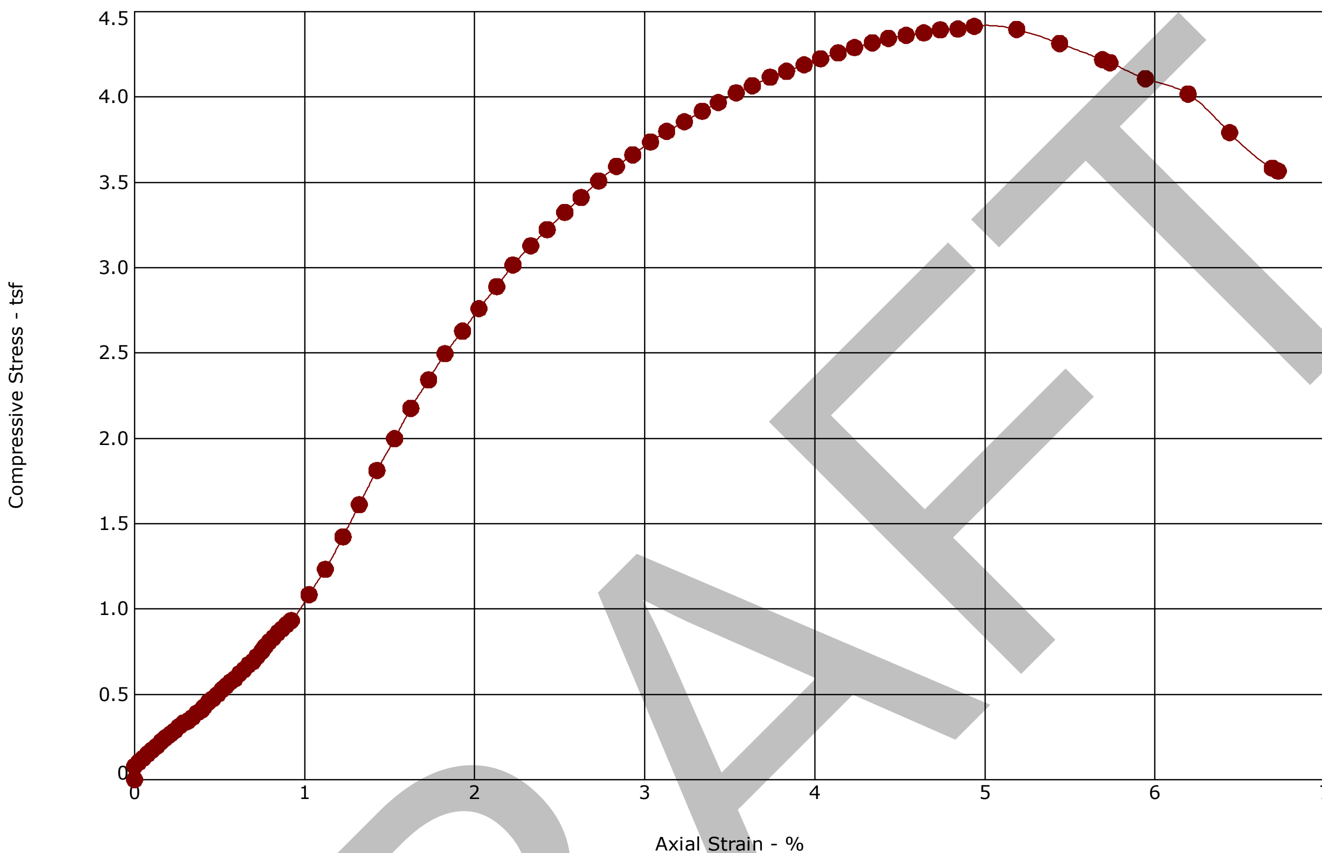
Specimen Test Data

Moisture Content (%):	22.0
Dry Density (pcf):	104
Diameter (in.):	2.40
Height (in.):	4.80
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	86.71
Calculated Void Ratio:	0.72
Assumed Specific Gravity:	2.7
Failure Strain (%):	8.08
Unconfined Compressive Strength (tsf):	2.17
Undrained Shear Strength (tsf):	1.09
Strain Rate (in/min):	0.0480
Remarks:	

Terracon
902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B4	35 - 36.5	DMRS	67	18	49	93.9	FAT CLAY(CH)

Specimen Failure Mode

Specimen Test Data

Moisture Content (%):	25.8
Dry Density (pcf):	100
Diameter (in.):	2.38
Height (in.):	4.78
Height / Diameter Ratio:	2.01
Calculated Saturation (%):	101.53
Calculated Void Ratio:	0.69
Assumed Specific Gravity:	2.7
Failure Strain (%):	4.94
Unconfined Compressive Strength (tsf):	4.41
Undrained Shear Strength (tsf):	2.21
Strain Rate (in/min):	0.0477
Remarks:	

Terracon
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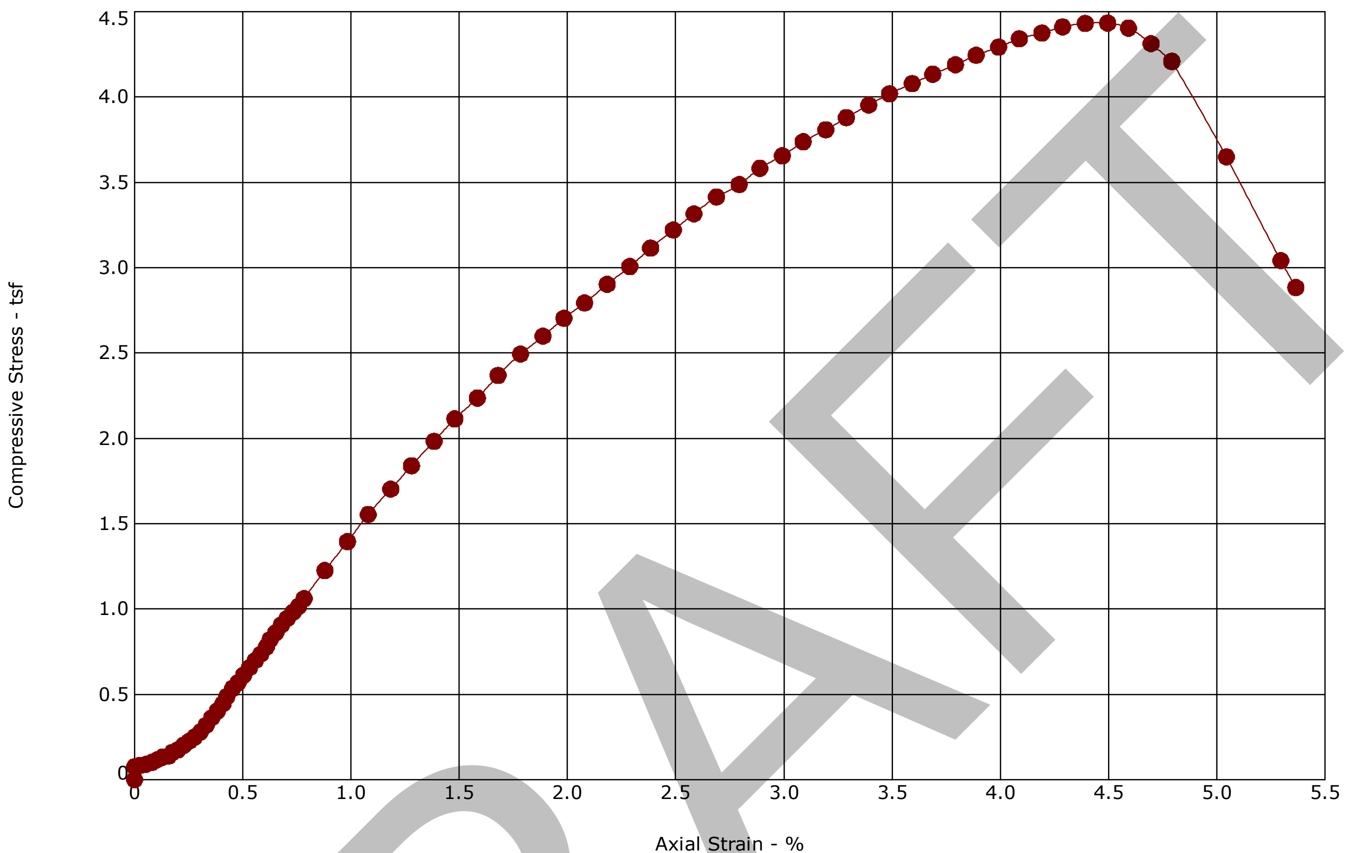
Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B5	5 - 6.5	DMRS					LEAN CLAY(CL)

Specimen Failure Mode

Specimen Test Data	
Moisture Content (%):	23.2
Dry Density (pcf):	101
Diameter (in.):	2.40
Height (in.):	4.80
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	94.64
Calculated Void Ratio:	0.63
Assumed Specific Gravity:	2.7
Failure Strain (%):	4.50
Unconfined Compressive Strength (tsf):	4.43
Undrained Shear Strength (tsf):	2.22
Strain Rate (in/min):	0.0479
Remarks:	

Terracon
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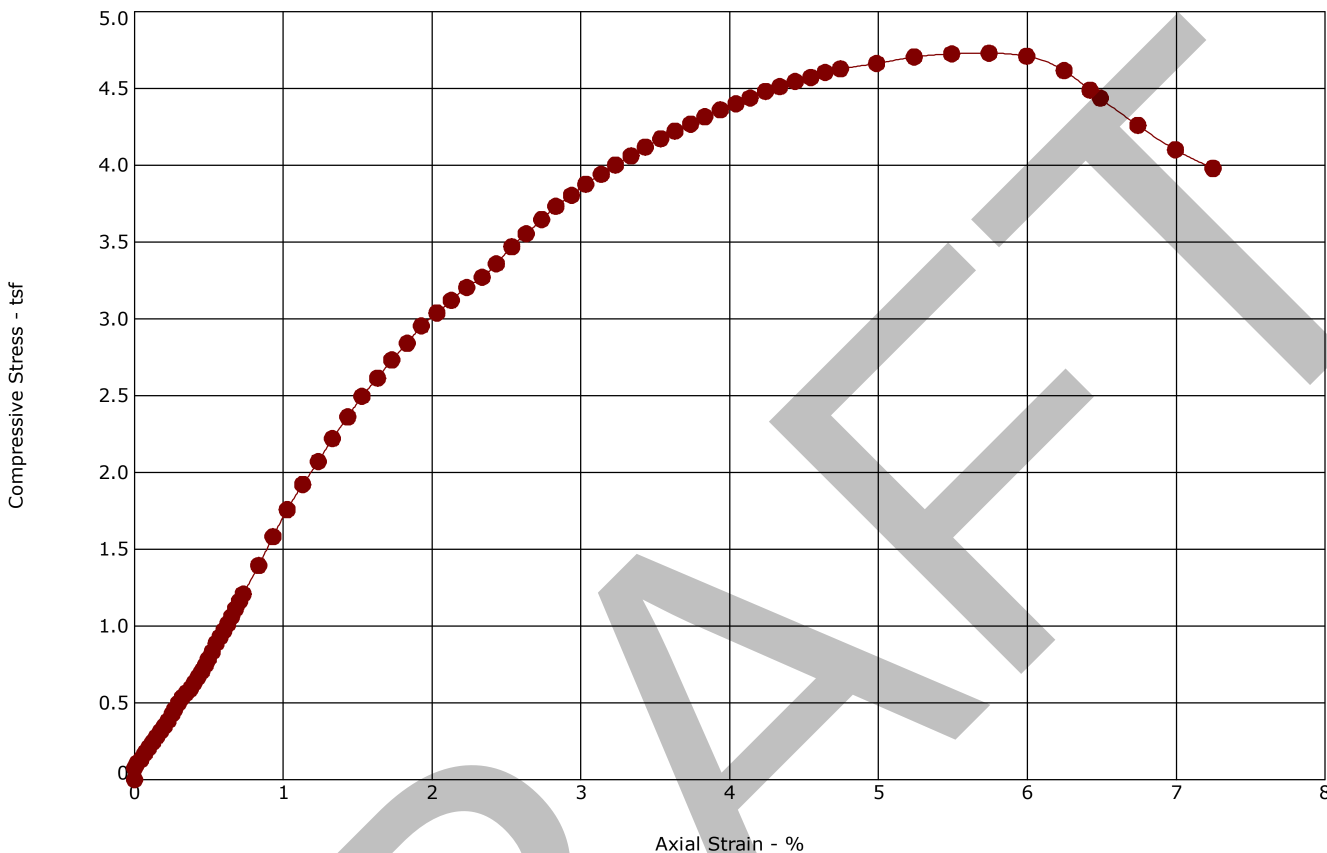
Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B5	15 - 16.5	DMRS	46	20	26	93.1	LEAN CLAY(CL)

Specimen Failure Mode

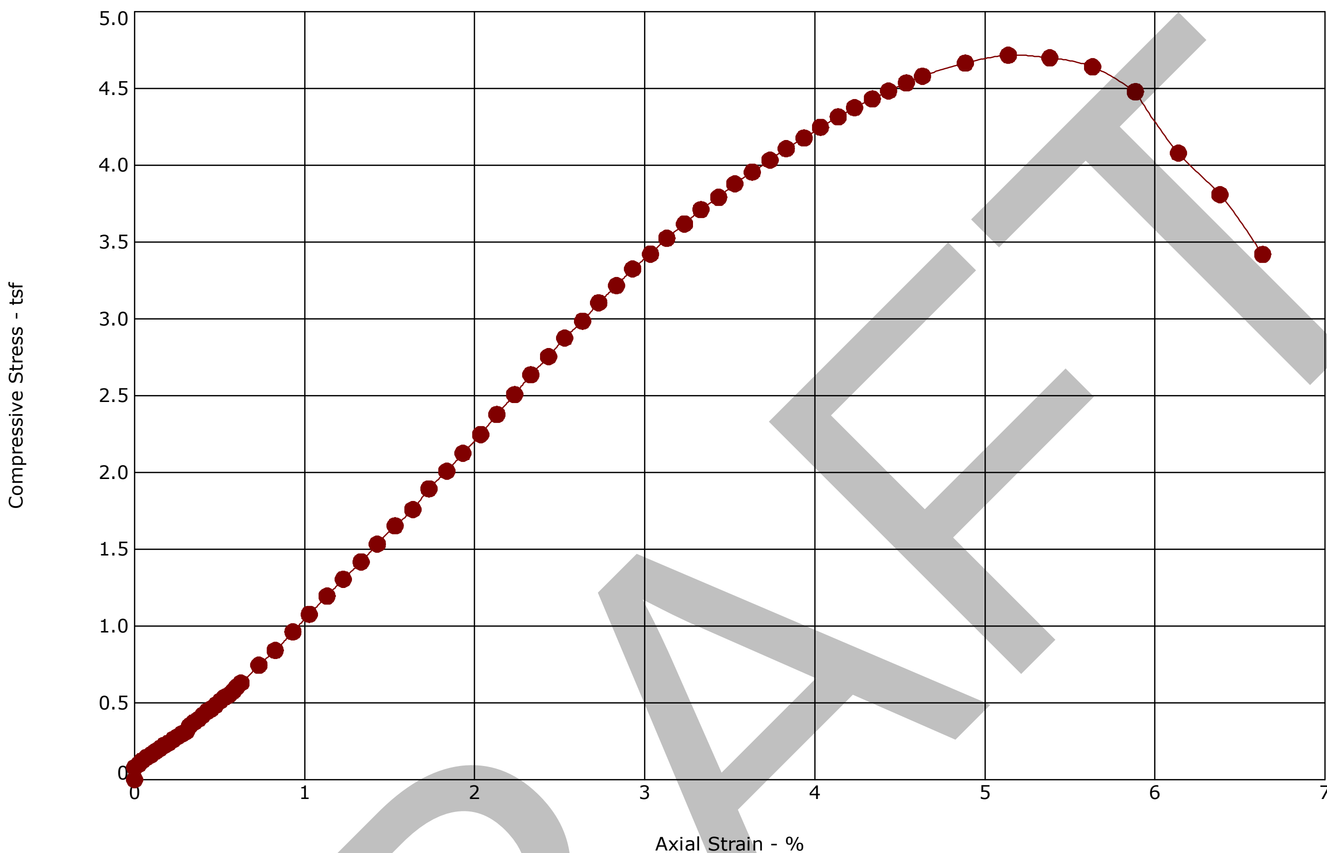
Specimen Test Data	
Moisture Content (%):	23.2
Dry Density (pcf):	104
Diameter (in.):	2.40
Height (in.):	4.80
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	95.69
Calculated Void Ratio:	0.67
Assumed Specific Gravity:	2.7
Failure Strain (%):	5.74
Unconfined Compressive Strength (tsf):	4.73
Undrained Shear Strength (tsf):	2.36
Strain Rate (in/min):	0.0480
Remarks:	

500 kV Collinsville Substation
Stratton Lane | Collinsville, CA
Terracon Project No. NA245123

Terracon
902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B6	7.5 - 9	DMRS	59	22	37	93.1	FAT CLAY(CH)

Specimen Failure Mode

Specimen Test Data

Moisture Content (%):	21.6
Dry Density (pcf):	104
Diameter (in.):	2.39
Height (in.):	4.79
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	95.62
Calculated Void Ratio:	0.58
Assumed Specific Gravity:	2.7
Failure Strain (%):	5.14
Unconfined Compressive Strength (tsf):	4.72
Undrained Shear Strength (tsf):	2.36
Strain Rate (in/min):	0.0479
Remarks:	

Terracon
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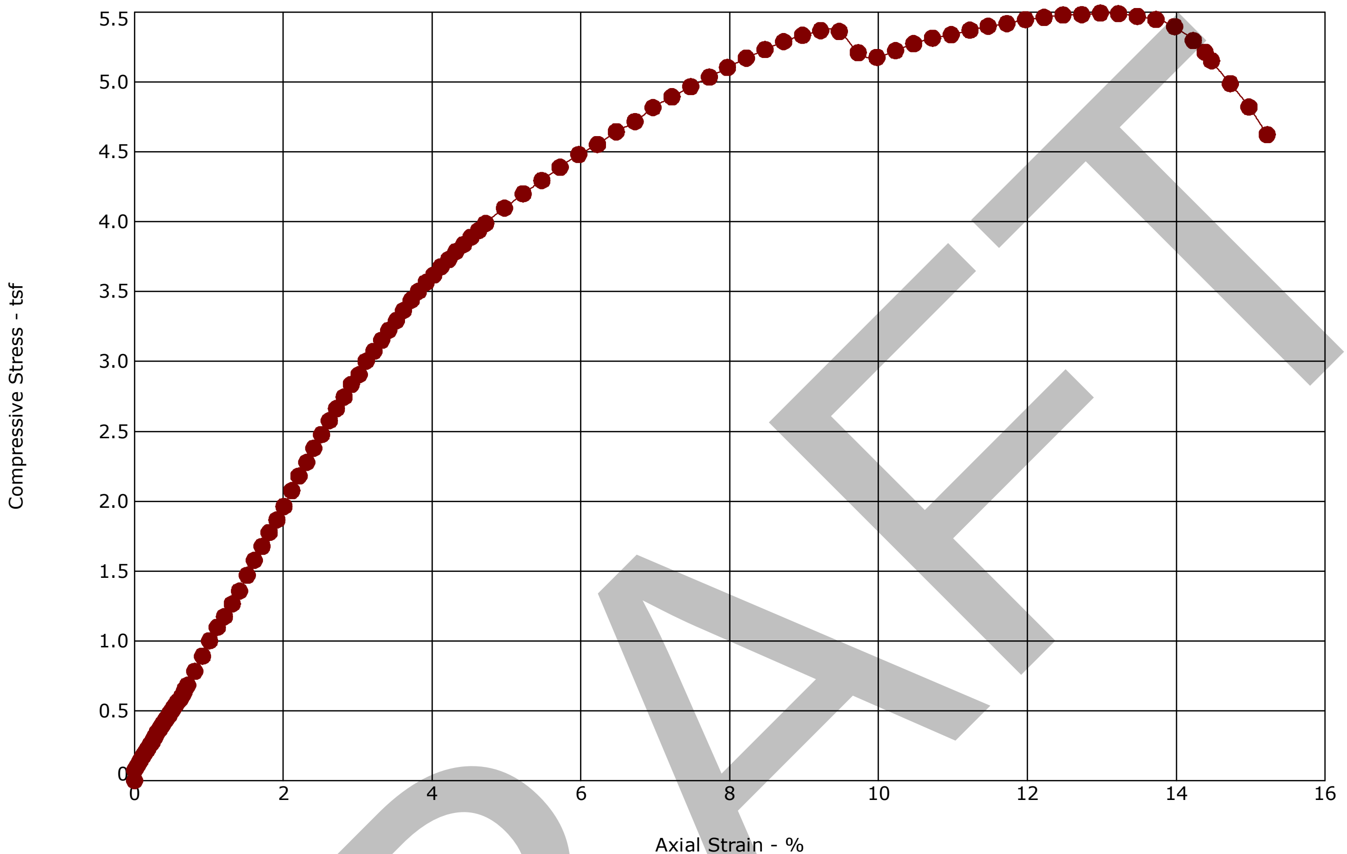
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B6	20 - 21.5	DMRS	48	19	29	80.7	LEAN CLAY with SAND(CL)

Specimen Failure Mode

Specimen Test Data

Moisture Content (%):	20.9
Dry Density (pcf):	108
Diameter (in.):	2.38
Height (in.):	4.77
Height / Diameter Ratio:	2.01
Calculated Saturation (%):	96.95
Calculated Void Ratio:	0.59
Assumed Specific Gravity:	2.7
Failure Strain (%):	12.98
Unconfined Compressive Strength (tsf):	5.49
Undrained Shear Strength (tsf):	2.75
Strain Rate (in/min):	0.0477
Remarks:	

Terracon
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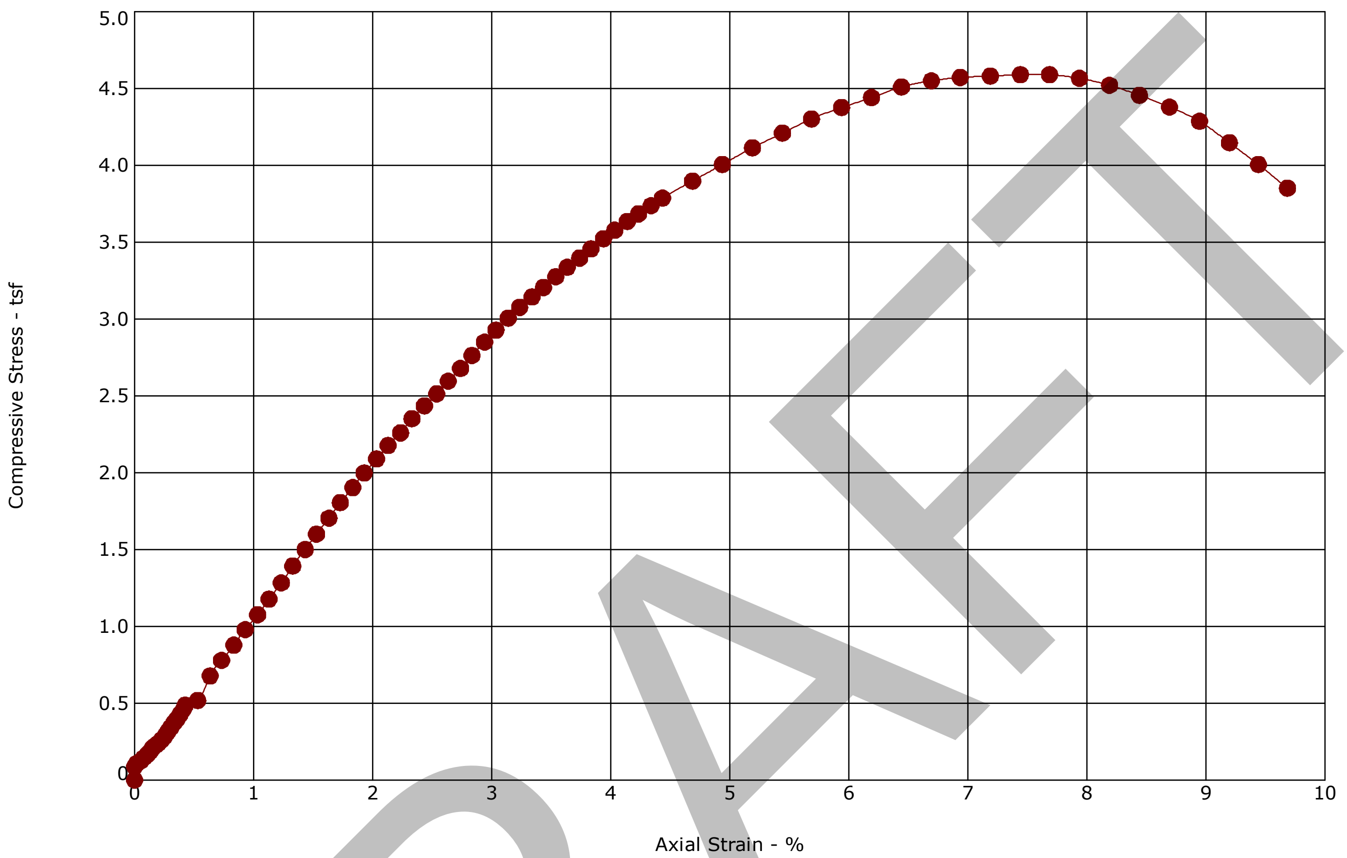
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B6	35 - 36.5	DMRS	41	19	22	84.0	LEAN CLAY with SAND(CL)

Specimen Failure Mode

Specimen Test Data

Moisture Content (%):	19.3
Dry Density (pcf):	111
Diameter (in.):	2.40
Height (in.):	4.80
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	93.89
Calculated Void Ratio:	0.58
Assumed Specific Gravity:	2.7
Failure Strain (%):	7.44
Unconfined Compressive Strength (tsf):	4.59
Undrained Shear Strength (tsf):	2.30
Strain Rate (in/min):	0.0480
Remarks:	

500 kV Collinsville Substation
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Terracon
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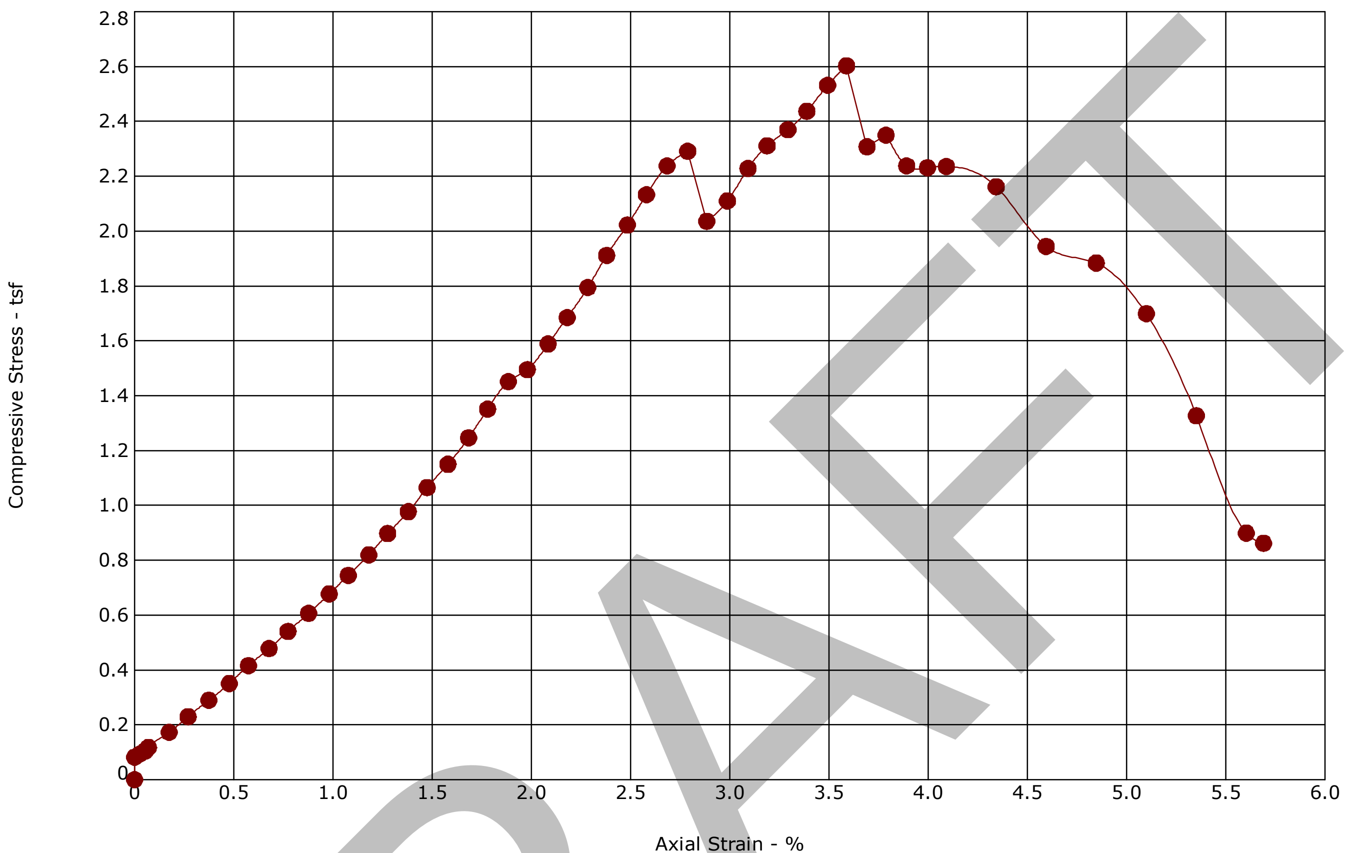
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B7	10 - 11.5	DMRS	43	23	20	81.0	LEAN CLAY with SAND(CL)

Specimen Failure Mode

Specimen Test Data

Moisture Content (%):	23.8
Dry Density (pcf):	100
Diameter (in.):	2.38
Height (in.):	4.78
Height / Diameter Ratio:	2.01
Calculated Saturation (%):	106.72
Calculated Void Ratio:	0.64
Assumed Specific Gravity:	2.7
Failure Strain (%):	3.59
Unconfined Compressive Strength (tsf):	2.60
Undrained Shear Strength (tsf):	1.30
Strain Rate (in/min):	0.0477
Remarks:	

Terracon
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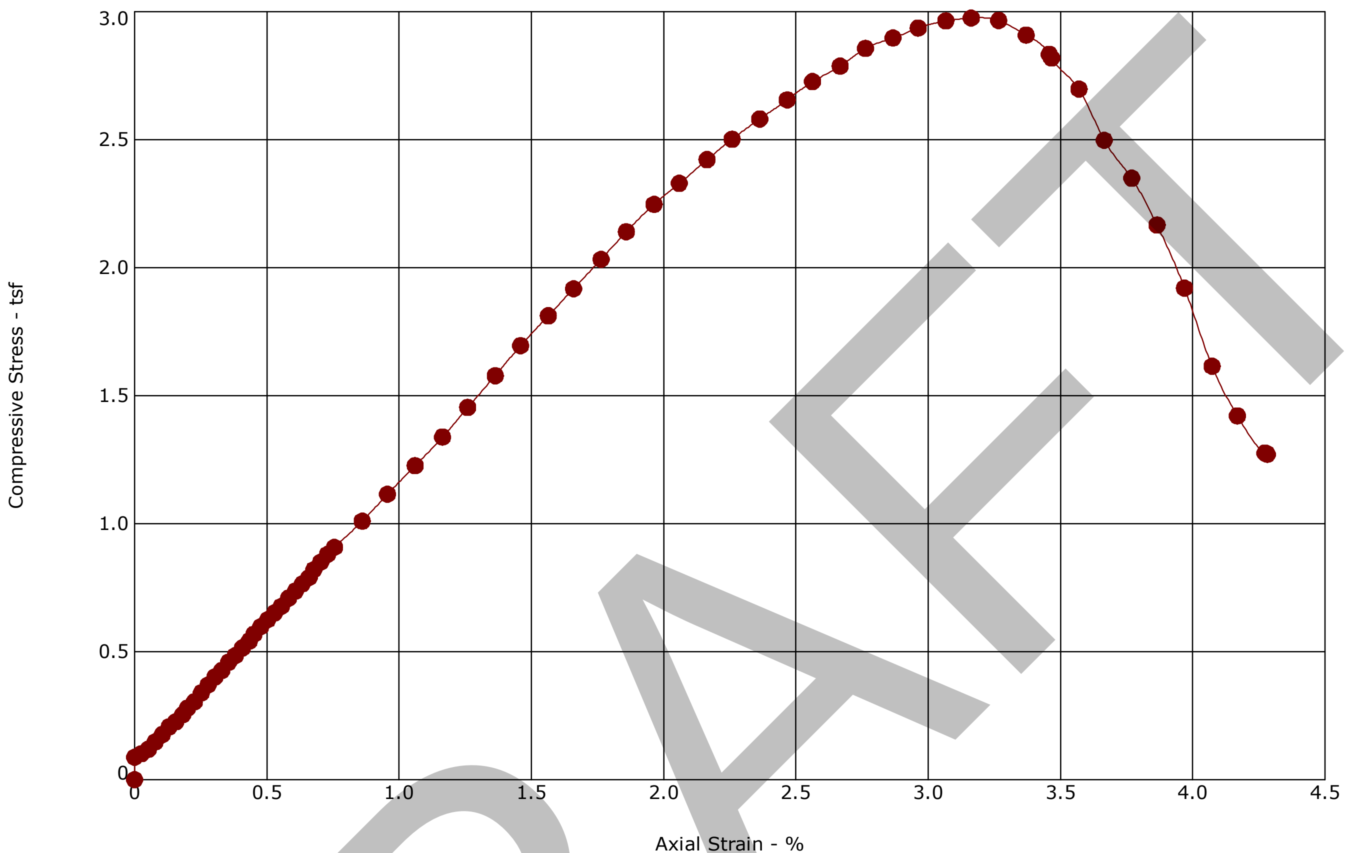
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B7	20 - 21.5	DMRS	43	22	21	87.5	LEAN CLAY(CL)

Specimen Failure Mode

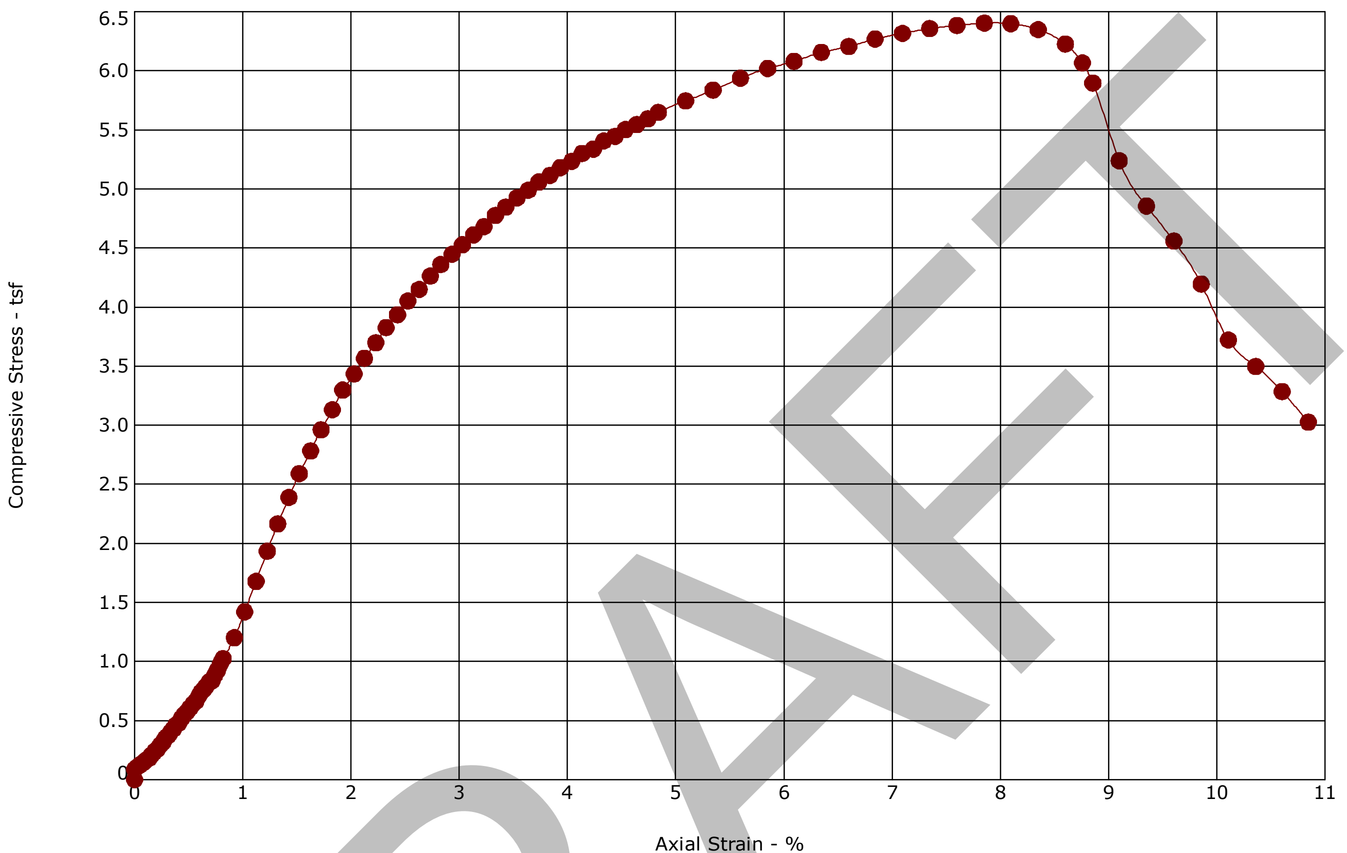
Specimen Test Data

Moisture Content (%):	27.9
Dry Density (pcf):	95
Diameter (in.):	2.39
Height (in.):	4.85
Height / Diameter Ratio:	2.03
Calculated Saturation (%):	82.48
Calculated Void Ratio:	0.74
Assumed Specific Gravity:	2.7
Failure Strain (%):	3.16
Unconfined Compressive Strength (tsf):	2.98
Undrained Shear Strength (tsf):	1.49
Strain Rate (in/min):	0.0487
Remarks:	

902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B7	30 - 31.5	DMRS	51	22	29	97.3	FAT CLAY(CH)

Specimen Failure Mode

Specimen Test Data

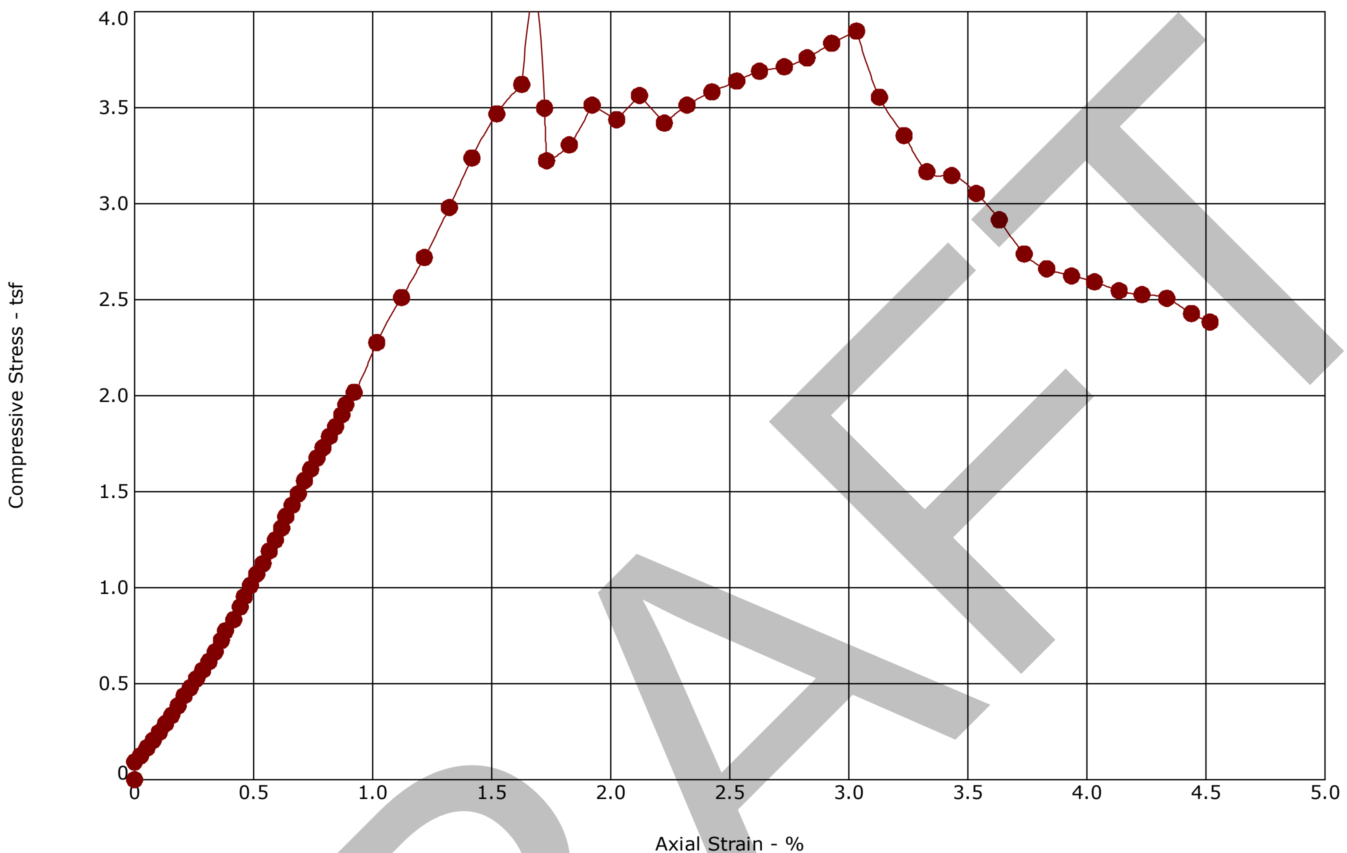
Moisture Content (%):	23.8
Dry Density (pcf):	104
Diameter (in.):	2.40
Height (in.):	4.81
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	104.07
Calculated Void Ratio:	0.62
Assumed Specific Gravity:	2.7
Failure Strain (%):	7.85
Unconfined Compressive Strength (tsf):	6.40
Undrained Shear Strength (tsf):	3.20
Strain Rate (in/min):	0.0481
Remarks:	

500 kV Collinsville Substation
Stratton Lane | Collinsville, CA
Terracon Project No. NA245123

Terracon
902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B8	7.5 - 9	DMRS	34	17	17	72.4	LEAN CLAY with SAND(CL)

Specimen Failure Mode

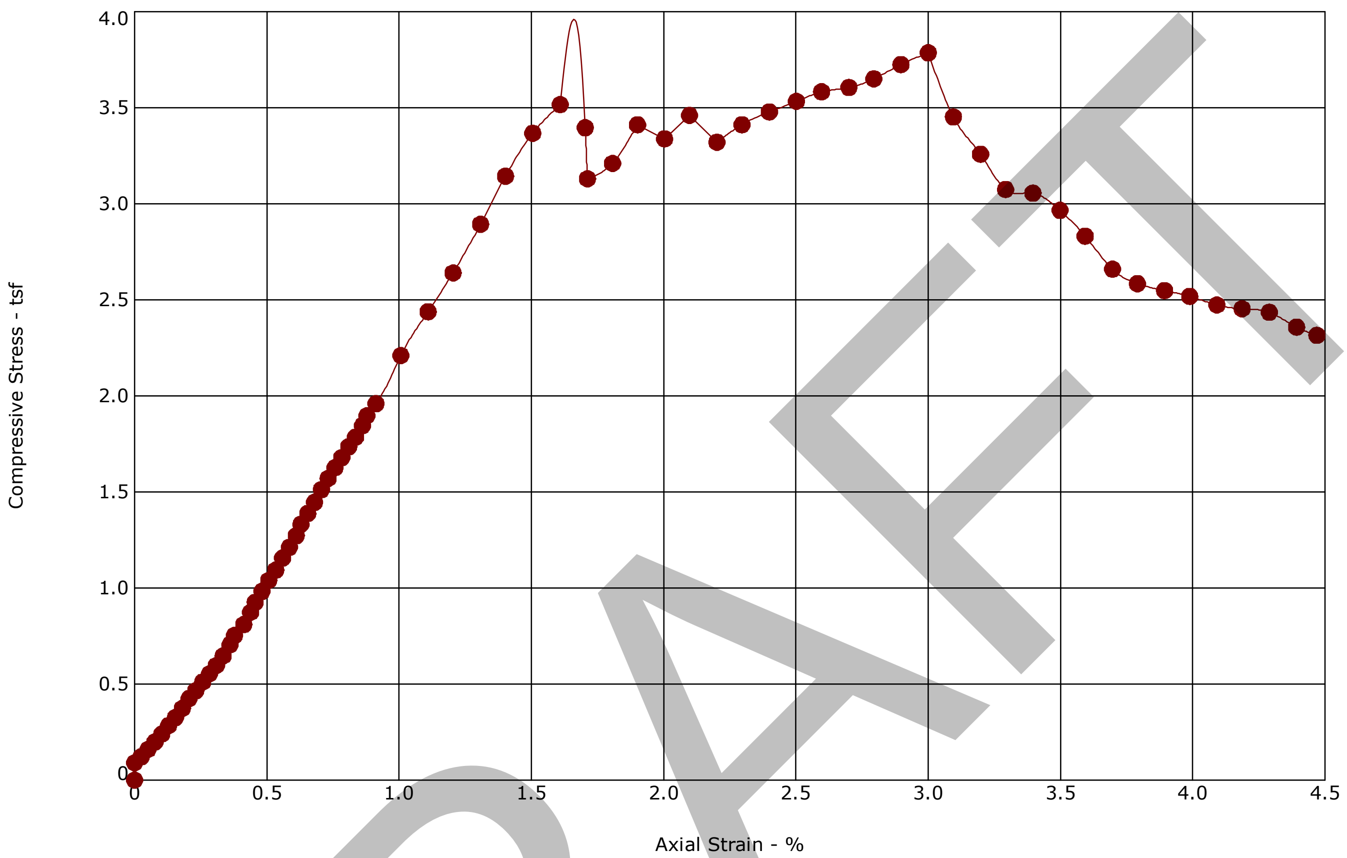
Specimen Test Data

Moisture Content (%):	12.9
Dry Density (pcf):	115
Diameter (in.):	2.37
Height (in.):	4.78
Height / Diameter Ratio:	2.01
Calculated Saturation (%):	75.58
Calculated Void Ratio:	0.61
Assumed Specific Gravity:	2.7
Failure Strain (%):	3.03
Unconfined Compressive Strength (tsf):	3.90
Undrained Shear Strength (tsf):	1.95
Strain Rate (in/min):	0.0478
Remarks:	

902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B8	20 - 21.5	DMRS	37	18	19	52.9	SANDY LEAN CLAY(CL)

Specimen Failure Mode

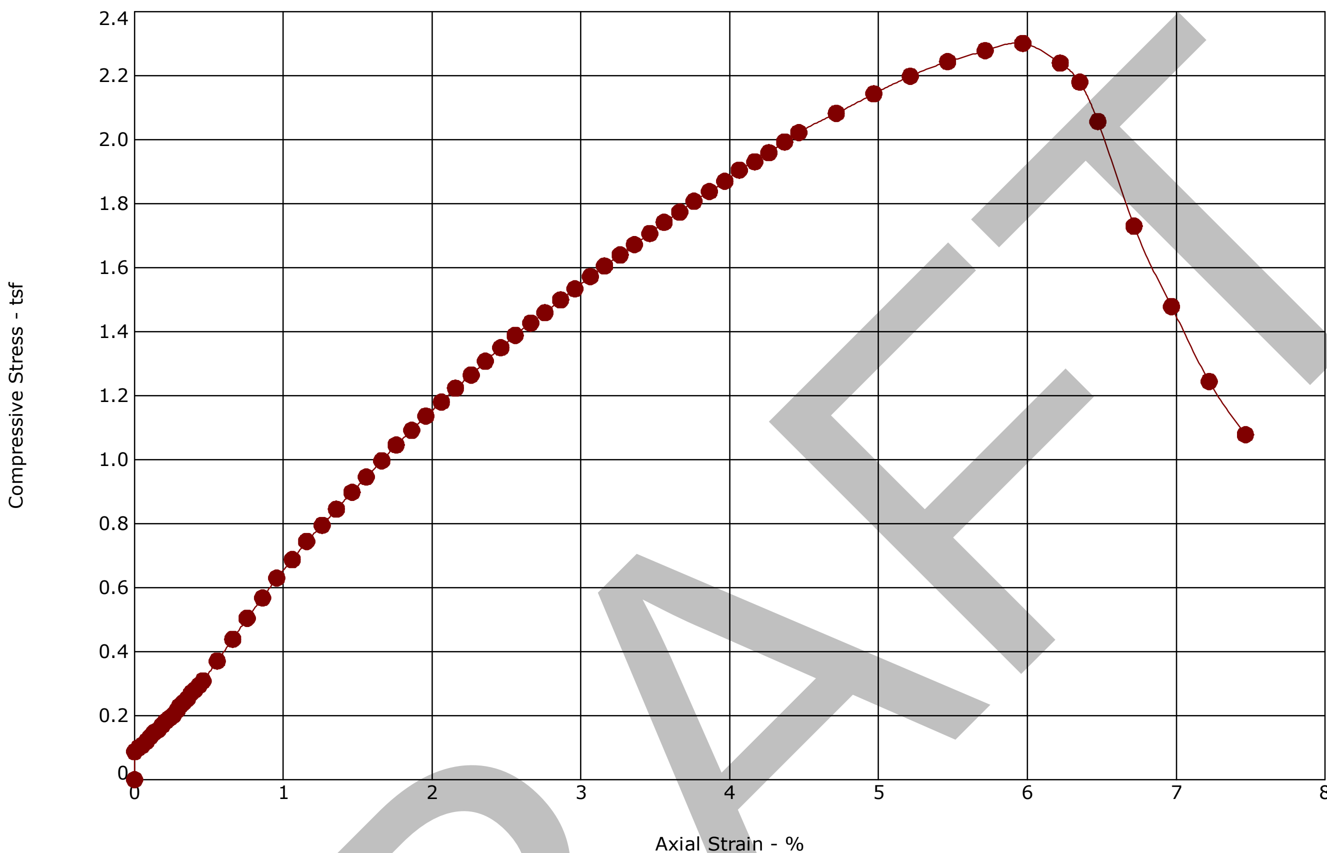
Specimen Test Data

Moisture Content (%):	17.7
Dry Density (pcf):	111
Diameter (in.):	2.41
Height (in.):	4.83
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	117.47
Calculated Void Ratio:	0.56
Assumed Specific Gravity:	2.7
Failure Strain (%):	3.00
Unconfined Compressive Strength (tsf):	3.79
Undrained Shear Strength (tsf):	1.89
Strain Rate (in/min):	0.0478
Remarks:	

Terracon
902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B8	35 - 36.5	DMRS	32	19	13	91.2	LEAN CLAY(CL)

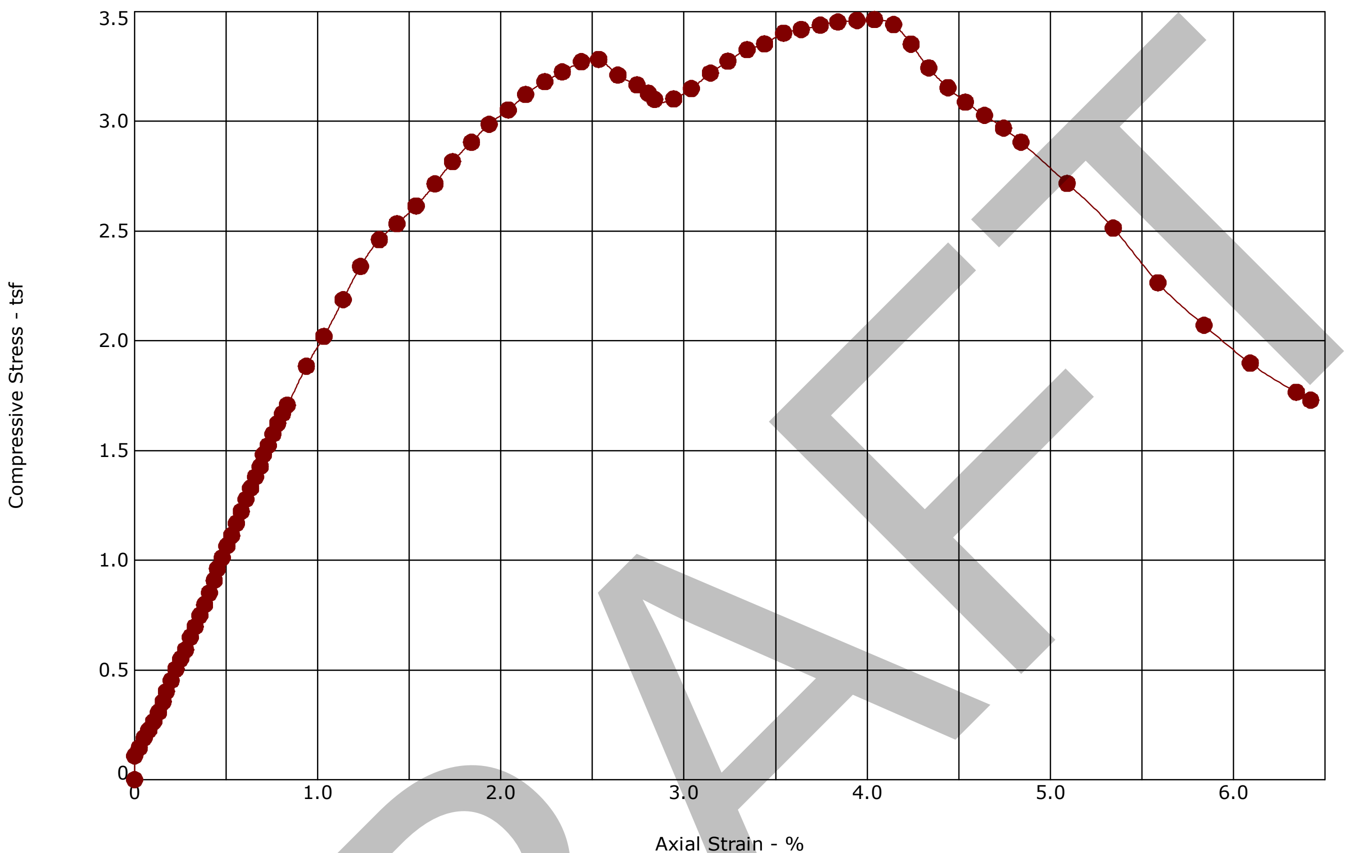
Specimen Failure Mode

Specimen Test Data	
Moisture Content (%):	23.9
Dry Density (pcf):	105
Diameter (in.):	2.39
Height (in.):	4.80
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	104.00
Calculated Void Ratio:	0.59
Assumed Specific Gravity:	2.7
Failure Strain (%):	5.97
Unconfined Compressive Strength (tsf):	2.30
Undrained Shear Strength (tsf):	1.15
Strain Rate (in/min):	0.0480
Remarks:	

902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B9	7.5 - 9	DMRS	45	14	31	72.1	LEAN CLAY with SAND(CL)

Specimen Failure Mode

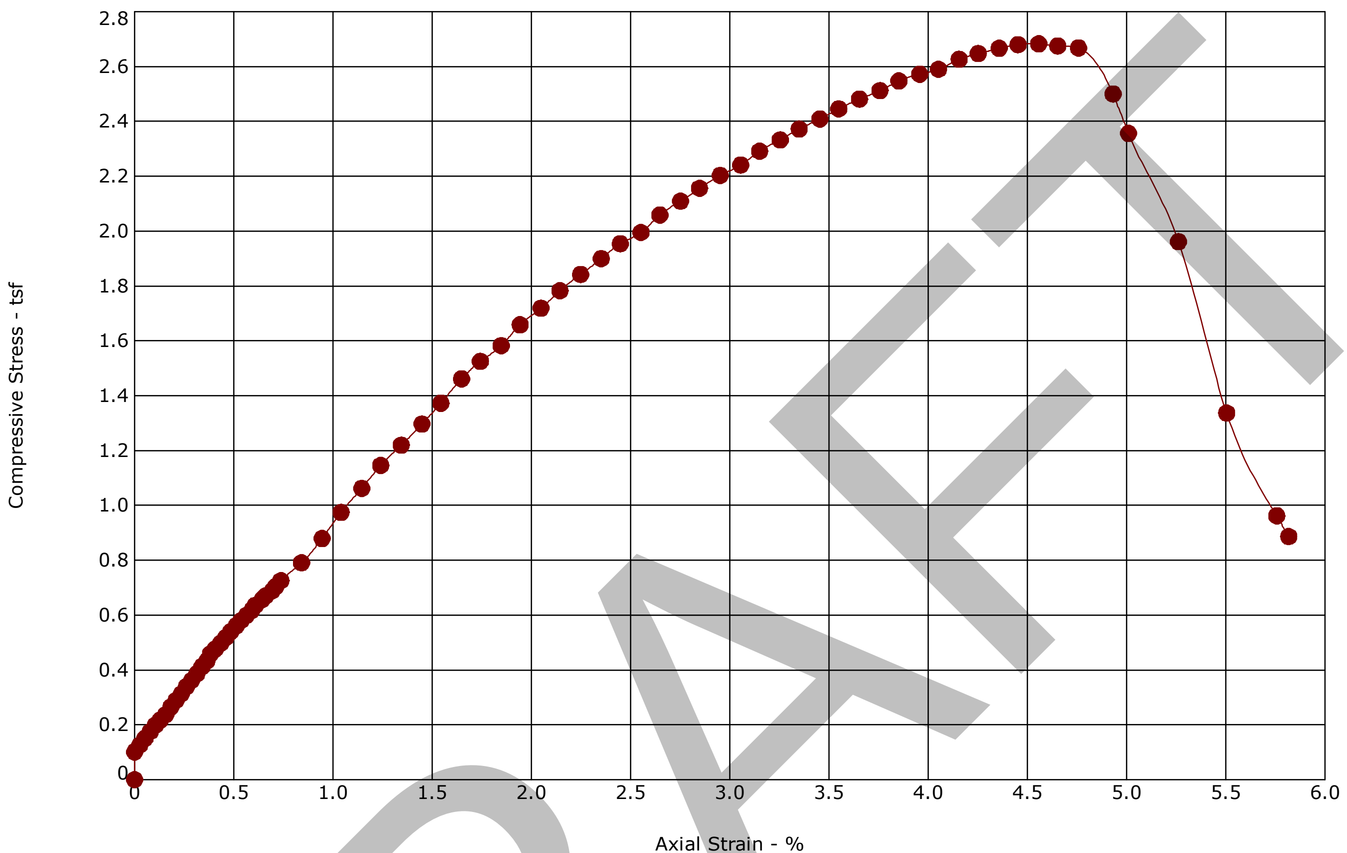
Specimen Test Data

Moisture Content (%):	17.8
Dry Density (pcf):	109
Diameter (in.):	2.40
Height (in.):	4.80
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	85.86
Calculated Void Ratio:	0.57
Assumed Specific Gravity:	2.7
Failure Strain (%):	4.04
Unconfined Compressive Strength (tsf):	3.46
Undrained Shear Strength (tsf):	1.73
Strain Rate (in/min):	0.0481
Remarks:	

Terracon
902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B9	20 - 21.5	DMRS	67	26	41	99.9	FAT CLAY(CH)

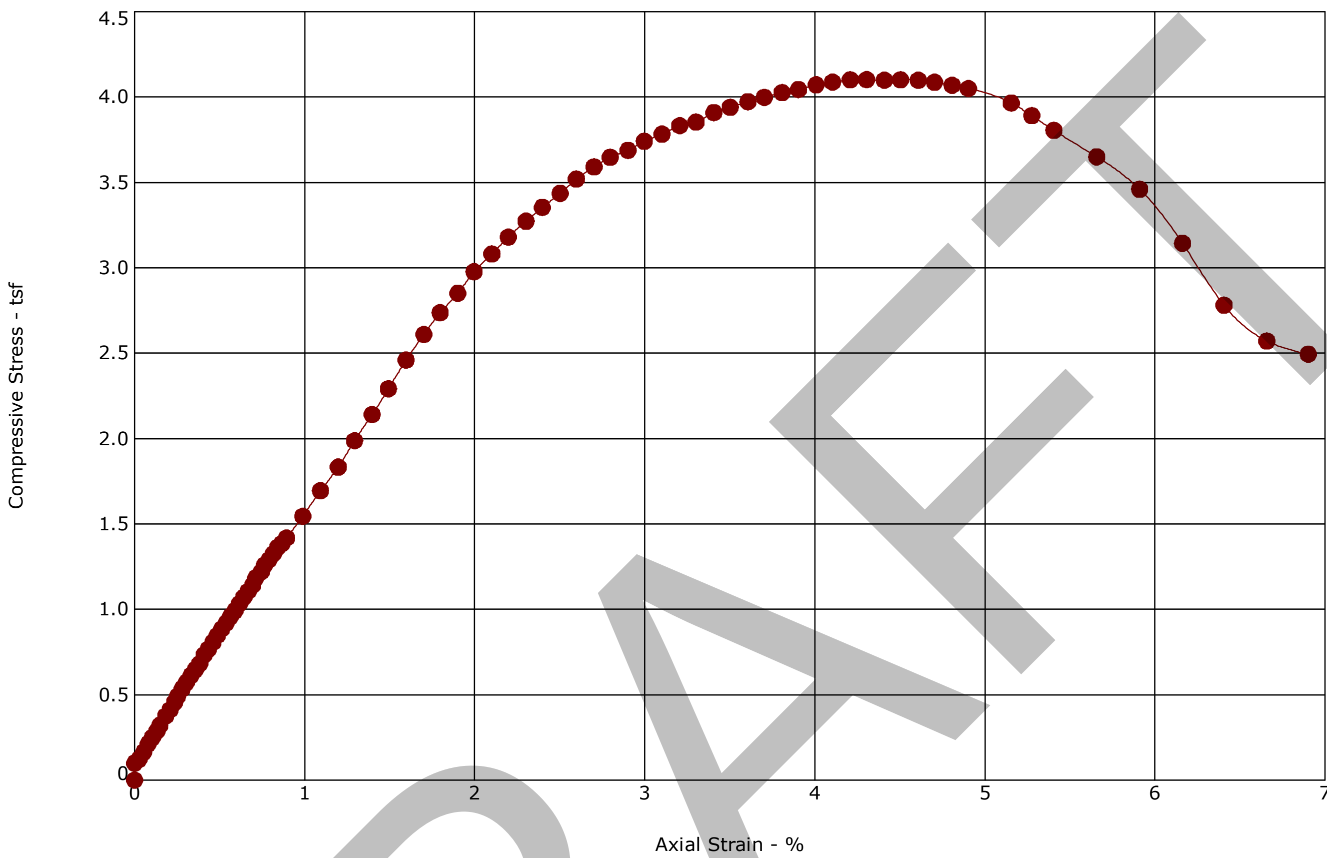
Specimen Failure Mode

Specimen Test Data	
Moisture Content (%):	33.5
Dry Density (pcf):	90
Diameter (in.):	2.40
Height (in.):	4.81
Height / Diameter Ratio:	2.01
Calculated Saturation (%):	102.76
Calculated Void Ratio:	0.90
Assumed Specific Gravity:	2.7
Failure Strain (%):	4.56
Unconfined Compressive Strength (tsf):	2.68
Undrained Shear Strength (tsf):	1.34
Strain Rate (in/min):	0.0481
Remarks:	

902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B9	35 - 36.5	DMRS	65	24	41	96.5	FAT CLAY(CH)

Specimen Failure Mode

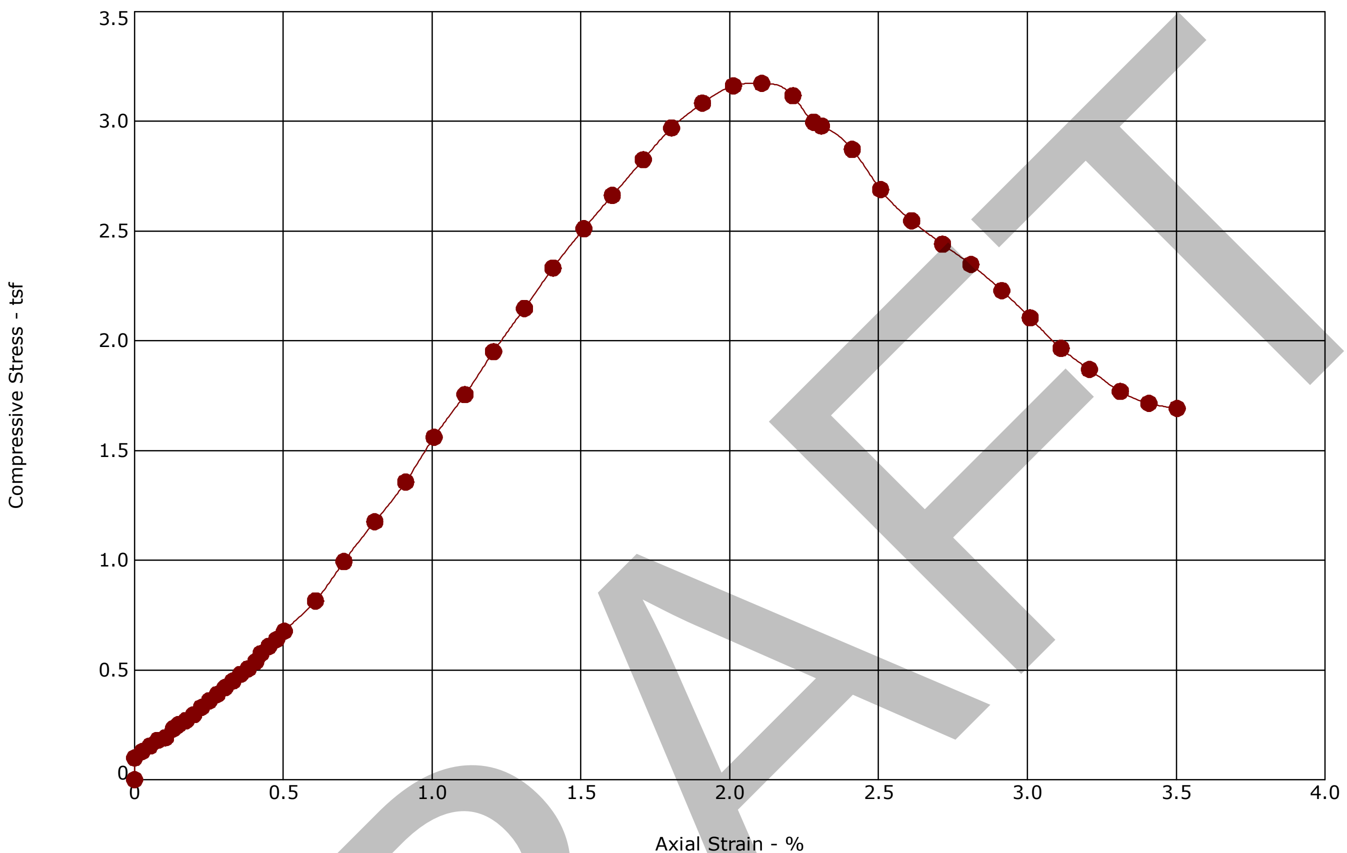
Specimen Test Data

Moisture Content (%):	25.1
Dry Density (pcf):	100
Diameter (in.):	2.40
Height (in.):	4.80
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	84.59
Calculated Void Ratio:	0.85
Assumed Specific Gravity:	2.7
Failure Strain (%):	4.30
Unconfined Compressive Strength (tsf):	4.10
Undrained Shear Strength (tsf):	2.05
Strain Rate (in/min):	0.0481
Remarks:	

Terracon
902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B10	5 - 6.5	DMRS	58	20	38	81.5	FAT CLAY with SAND(CH)

Specimen Failure Mode

Specimen Test Data

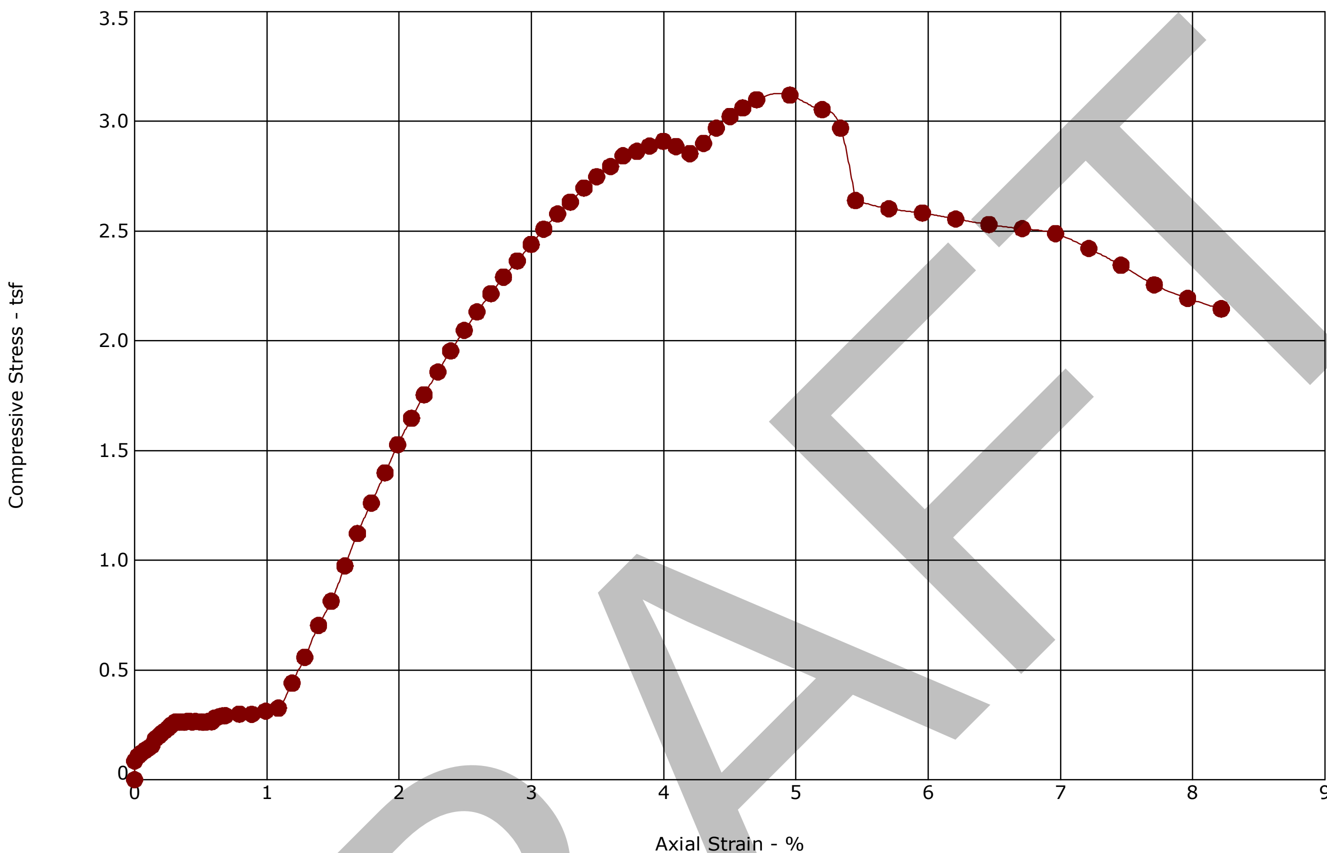
Moisture Content (%):	28.1
Dry Density (pcf):	91
Diameter (in.):	2.39
Height (in.):	4.83
Height / Diameter Ratio:	2.02
Calculated Saturation (%):	92.67
Calculated Void Ratio:	1.03
Assumed Specific Gravity:	2.7
Failure Strain (%):	2.11
Unconfined Compressive Strength (tsf):	3.17
Undrained Shear Strength (tsf):	1.59
Strain Rate (in/min):	0.0482
Remarks:	

500 kV Collinsville Substation
Stratton Lane | Collinsville, CA
Terracon Project No. NA245123

Terracon
902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B10	20 - 21.5	DMRS	45	20	25	74.9	LEAN CLAY with SAND(CL)

Specimen Failure Mode

Specimen Test Data

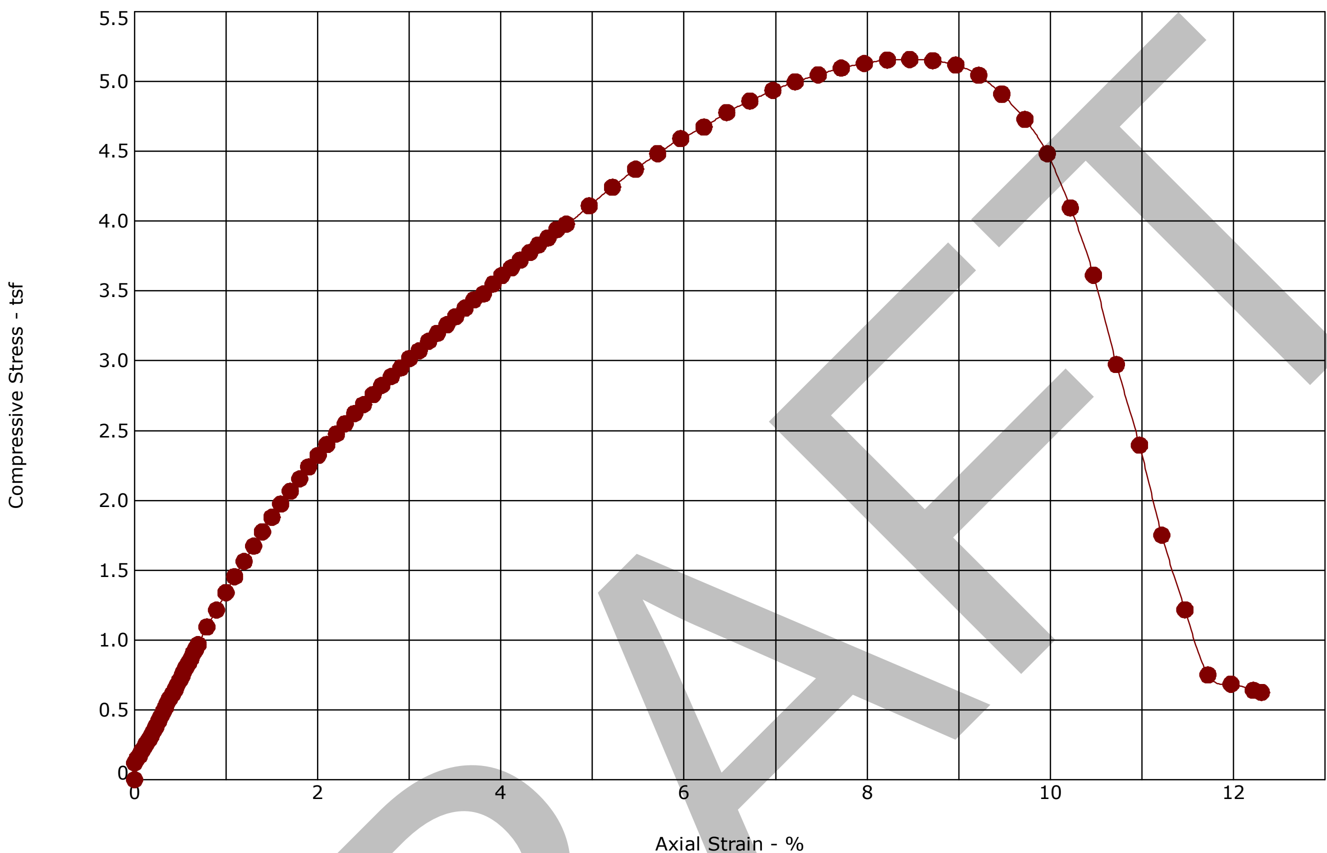
Specimen Test Data	
Moisture Content (%):	22.7
Dry Density (pcf):	100
Diameter (in.):	2.39
Height (in.):	4.78
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	73.74
Calculated Void Ratio:	0.80
Assumed Specific Gravity:	2.7
Failure Strain (%):	4.95
Unconfined Compressive Strength (tsf):	3.12
Undrained Shear Strength (tsf):	1.56
Strain Rate (in/min):	0.0478
Remarks:	

500 kV Collinsville Substation
Stratton Lane | Collinsville, CA
Terracon Project No. NA245123

Terracon
902 Industrial Way
Lodi, CA

Unconfined Compression Test

ASTM D2166



Boring ID	Depth (Ft)	Sample type	LL	PL	PI	Fines (%)	Description
B10	40 - 41.5	DMRS	45	20	25	99.8	LEAN CLAY(CL)

Specimen Failure Mode

Specimen Test Data

Moisture Content (%):	24.7
Dry Density (pcf):	102
Diameter (in.):	2.40
Height (in.):	4.80
Height / Diameter Ratio:	2.00
Calculated Saturation (%):	97.06
Calculated Void Ratio:	0.70
Assumed Specific Gravity:	2.7
Failure Strain (%):	8.47
Unconfined Compressive Strength (tsf):	5.16
Undrained Shear Strength (tsf):	2.58
Strain Rate (in/min):	0.0480
Remarks:	

902 Industrial Way
Lodi, California 95240
(209) 367-3701

Terracon
Explore with us

Client

EPC Solutions Inc

Project

500 kV Collinsville Substation

Sample Submitted By: Terracon (NA) **Date Received:** 5/9/2025 **Project Number:** NA245123

Results of Corrosion Analysis

Sample Type	CARS	CARS	CARS
Sample Location	B1-2	B7-1	B9-2
Sample Depth (ft.)	2.5	1.0	2.5
pH Analysis, ASTM G 51	7.42	8.08	8.11
Water Soluble Sulfate (SO4), ASTM D516 (%)	0.003	0.020	0.026
Sulfides, AWWA 4500-S^{2-} D, (ppm)	<0.001	<0.001	<0.001
Chlorides, AWWA 4500-CL^{-} E, (%)	0.007	0.005	0.021
Red-Ox, ASTM G 200, (mV)	+109	+96	+93
Total Salts, AWWA 2520 B, (mg/kg)	393	770	1040
Saturated Minimum Resistivity, ASTM G 57, (ohm-cm)	840	600	490

Reviewed By: Stella Oliveira

Stella Oliveira
Staff Geologist

Supporting Information

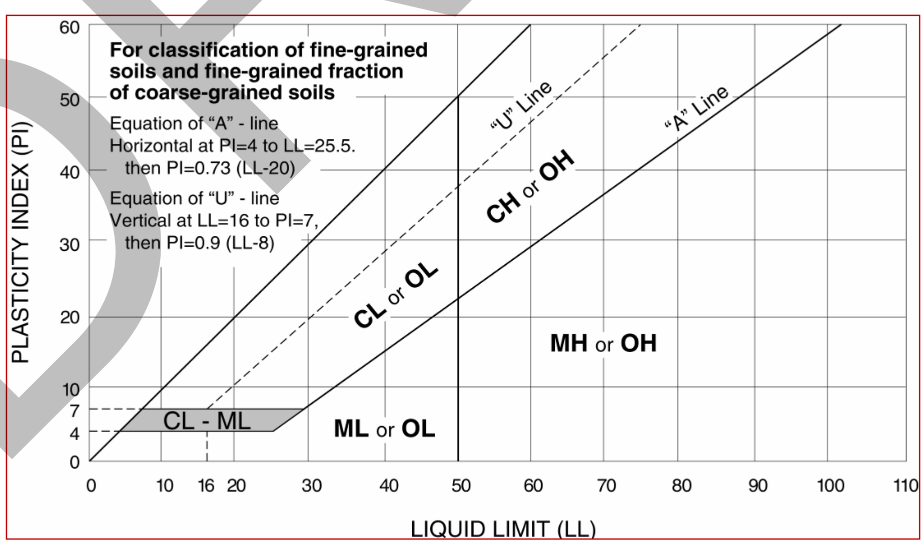
Contents:

Note: All attachments are one page unless otherwise noted.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	**Group Name** [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu≥4 and 1≤Cc≤3 [E]	GW	Well-graded gravel [F]
			Cu<4 and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu≥6 and 1≤Cc≤3 [E]	SW	Well-graded sand [I]
			Cu<6 and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.
[E] $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.



Rock Classification Notes

WEATHERING	
Term	**Description**
Fresh	Mineral crystals appear bright; show no discoloration. Features show little or no staining on surfaces. Discoloration does not extend into intact rock.
Slightly weathered	Rock generally fresh except along fractures. Some fractures stained and discoloration may extend <0.5 inches into rock.
Moderately weathered	Significant portions of rock are dull and discolored. Rock may be significantly weaker than in fresh state near fractures. Soil zones of limited extent may occur along some fractures.
Highly weathered	Rock dull and discolored throughout. Majority of rock mass is significantly weaker and has decomposed and/or disintegrated; isolated zones of stronger rock and/or soil may occur throughout.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The rock mass or fabric is still evident and largely intact. Isolated zones of stronger rock may occur locally.

STRENGTH OR HARDNESS		
Description	**Field Identification**	**Uniaxial Compressive Strength, psi**
Extremely strong	Can only be chipped with geological hammer. Rock rings on hammer blows. Cannot be scratched with a sharp pick. Hand specimens require several hard hammer blows to break.	>36,000
Very strong	Several blows of a geological hammer to fracture. Cannot be scratched with a 20d common steel nail. Can be scratched with a geologist's pick only with difficulty.	15,000-36,000
Strong	More than one blow of a geological hammer needed to fracture. Can be scratched with a 20d nail or geologist's pick. Gouges or grooves to ¼ inch deep can be excavated by a hard blow of a geologist's pick. Hand specimens can be detached by a moderate blow.	7,500-15,000
Medium strong	One blow of geological hammer needed to fracture. Can be distinctly scratched with 20d nail. Can be grooved or gouged 1/16 in. deep by firm pressure with a geologist's pick point. Can be fractured with single firm blow of geological hammer. Can be excavated in small chips (about 1-in. maximum size) by hard blows of the point of a geologist's pick;	3,500-7,500
Weak	Shallow indent by firm blow with geological hammer point. Can be gouged or grooved readily with geologist's pick point. Can be excavated in pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.	700-3,500
Very weak	Crumbles under firm blow with geological hammer point. Can be excavated readily with the point of a geologist's pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.	150-700

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		**Bedding Spacing (May Include Foliation or Banding)**	
Description	**Spacing**	**Description**	**Spacing**
Intensely fractured	< 2.5 inches	**Laminated**	< ½-inch
Highly fractured	2.5 – 8 inches	**Very thin**	½ – 2 inches
Moderately fractured	8 inches to 2 feet	**Thin**	2 inches – 1 foot
Slightly fractured	2 to 6.5 feet	**Medium**	1 – 3 feet
Very slightly fractured	> 6.5 feet	**Thick**	3 – 10 feet
		Massive	> 10 feet

ROCK QUALITY DESIGNATION (RQD) [1]	
Description	**RQD Value (%)**
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.