DOCKETED	
Docket Number:	23-OPT-02
Project Title:	Darden Clean Energy Project
TN #:	254677
Document Title:	Data Response Set 1 Appendix A - Geotechnical Report Utility Switchyard
Description:	Geotechnical report for the utility switchyard, provided in response to DR GEO-1 as part of Appendix A of Response Set 1.
Filer:	Evelyn Langsdale
Organization:	Rincon Consultants
Submitter Role:	Applicant Consultant
Submission Date:	2/23/2024 5:09:26 PM
Docketed Date:	2/26/2024

Data Response Set 1 - Appendix A

DR GEO-1 Geotechnical Engineering Report - Utility Switchyard

804650A 500 Kv Darden Interconnection

Geotechnical Engineering Report

October 12, 2023 | Terracon Project No. LA235112

Prepared for:

Dashiell Corporation
12301 Kurland Drive, Suite 400
Houston, Texas 77304

Terracon

145 W Walnut St.
Gardena, CA 90248
P (949) 261-0051
Terracon.com

October 12, 2023

Dashiell Corporation
12301 Kurland Drive, Suite 400
Houston, Texas 77304

Attn: Mr. Blaise Trahan
P: (281) 406-9538
E: James.Trahan@dashiell.com

Re: Geotechnical Engineering Report
804650A 500 Kv Darden Interconnection
Mendota, Fresno County, CA
Terracon Project No. LA235112

Dear Mr. Trahan:

We have completed the scope of Geotechnical Engineering services for the above referenced project in general accordance with Terracon Proposal No. PLA235112 dated August 2, 2023. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of access roads and foundations for the proposed substation facility.

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

REGISTERED PROFESSIONAL ENGINEER JOSHUA R. MORGAN C 86032 CIVIL STATE OF CALIFORNIA

Janna Valdez, E.I.T.
Staff Engineer

Joshua R. Morgan, P.E.
Regional Geotechnical Manager

Table of Contents

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.

Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed substation yard to be located at Mendota, Fresno County, CA. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil (and rock) conditions
- Groundwater conditions
- Seismic site classification per CBC
- Site preparation and earthwork
- Foundation design and construction

The geotechnical engineering Scope of Services for this project included the advancement of test borings, laboratory testing, engineering analysis, and preparation of this report. The geotechnical engineering Scope of Services for our current scope of work included the following:

- Four (4) soil test borings to depths of approximately 50 feet below ground surface (bgs)
- Corrosion testing on soil samples obtained from one (1) location
- Field electrical resistivity at one (1) location

Drawings showing the site and boring and electrical resistivity 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 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	The following documents were provided by Dashiell via email on July 19, 2023: ▪ Document No. 804650A-DE0-03000 ▪ Document No. 804650A-DC0-70099 ▪ Document No. 804650A-DC0-04310 ▪ Document No. 840650A-DE0-19401
Project Description	The project includes a new substation yard encompassing an approximate footprint of 50 acres.
Proposed Structure	We anticipate the substation will be developed and supported by slab on grade and/or mat foundations one foot below final grade. Drilled piers will be used to support turning poles and other substation equipment.
Maximum Loads	According to document No. 804650A-DC0-04310, two sets of bearing capacities are being requested: ▪ Less than one inch of settlement ▪ Two inches of settlement Pad mounted foundations are anticipated to have contact pressures of 1 to 2 ksf. Dead end structures are anticipated to have loads on the order of: ▪ 700 to 1,000 kip-ft Moment ▪ 10-to-20-kip Shear ▪ 10-to-15-kip Axial
Grading/Slopes	Grading plans were not provided at this stage of the project. However, it is our assumption that proposed grades will follow existing levels with minimum earthwork at less than 2 feet cut/fill.

Terracon should be notified if any of the above 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 Mendota, Fresno County, CA. The project site encompasses a total area of approximately 50 acres. The coordinates of the approximate center of the site are 36.4239°N, 120.4083°W. See **Site Location**
Existing Improvements	Based on our review of recent aerial photographs and our exploration, the site is being utilized as agricultural land. Multiple rows of Orchard trees are planted on the site. Additionally, riser towers with overhead powerlines are also located nearby the site.
Current Ground Cover	Exposed soil with Orchard trees
Existing Topography	The site location is relatively flat and have an approximate elevation ranging from 600 to 620 feet, according to Google Earth.

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 the **Exploration 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.

Stratum	Layer Name	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
1	Sandy Lean Clay	5 to 7.5	Clay with varying amount of silt, sand and gravel	Very stiff

Stratum	Layer Name	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
2	Clayey/Silty Sand	20 to 30	Sand with varying amount of silt, clay and gravel	Loose to very dense
3	Sandy Lean Clay	30 to 35	Clay with varying amount of silt, sand and gravel	Stiff to hard
4	Poorly Graded Sand	30 to 45	Sand with varying amounts of silt, clay and gravel	Medium dense to very dense
5	Lean Clay	45	Clay with varying amount of silt, sand and gravel	Very Stiff
6	Poorly Graded Sand with Gravel	51.5	Sand with varying amounts of silt, clay and gravel	Dense to very dense

Lab Results

Laboratory tests were conducted on selected soil samples and the test results are presented in the **Exploration Results** section and on the boring logs. Atterberg limit test results indicate that the on-site soils generally have a medium plasticity. A consolidation test indicates that the clayey soils encountered at an approximate depth of 2.5 feet bgs have a negligible collapse potential when saturated under normal footing loads of 2,000 psf, respectively. Direct shear testing on sandy soils encountered at 5 and 7.5 feet indicate soils have an effective friction angle of approximately 26 to 29 degrees with apparent cohesion value of 0 to 400 psf. Undrained shear strengths from unconfined compression testing on clayey soils are shown in the table below.

Boring ID	Layer Name	Undrained Shear Strength (ksf)
SB-1 at 25'	Poorly Graded Sand with Clay	1.79
SB-2 at 2.5'	Sandy Lean Clay	2.78
SB-2 at 20'	Sandy Lean Clay	7.98
SB-3 at 35'	Lean Clay	2.91

Groundwater

The borings were advanced using a hollow-stem-auger technique that allow short term groundwater observations to be made while drilling. Groundwater seepage was not encountered within the maximum allowed drilling depth at the time of our field exploration. Groundwater conditions may be different at the time of construction. According to data collected from the Water Data Library for the State of California from a nearby well, located 1.4 miles away from the site with approximate coordinates of 36.4224°N, 120.3811°W State Well Number 17S15E30G002M, historic groundwater levels between December 6, 2017, and November 7, 2019 is greater than 100 feet bgs.[1]

Seismic Site Class

The 2022 California Building Code (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_S value greater than or equal 0.2.

However, Section 11.4.8 of ASCE 7-16 includes an exception from such analysis for specific structures on Site Class D sites. The commentary for Section 11 of ASCE 7-16 (Page 534 of Section C11 of ASCE 7-16) states that "In general, this exception effectively limits the requirements for site-specific hazard analysis to very tall and or flexible structures at Site Class D sites." Based on our understanding of the proposed structures, it is our assumption that the exception in Section 11.4.8 applies to the proposed structure. However, the structural engineer should verify the applicability of this exception.

Based on this exception, the spectral response accelerations presented below were determined using the site coefficients (Fa and Fv) from Tables 1613.2.3(1) and 1613.2.3(2) presented in Section 16.4.4 of the 2022 CBC.

Description	Value
2022 California Building Code Site Classification (CBC)[1]	D[2]
Site Latitude (°N)	36.4239°

[1] *California Department of Water Resources. https://wdl.water.ca.gov/WaterDataLibrary/GroundWaterLevel.aspx?StateWellNumber=17S15E30G002M&SiteCode=364224N1203811W001*

Description	Value
Site Longitude (°W)	120.4083°
S_s Spectral Acceleration for a 0.2-Second Period	1.52
S_1 Spectral Acceleration for a 1-Second Period	0.525
F_a Site Coefficient for a 0.2-Second Period	1
F_v Site Coefficient for a 1-Second Period	1.776

1. Seismic site classification in general accordance with the *2022 California Building Code*.
2. The 2022 California Building Code (CBC) requires a site soil profile determination extending to a depth of 100 feet for seismic site classification. The current scope does not include the 100-foot soil profile determination. Borings were extended to a maximum depth of 51½ feet, and this seismic site class definition considers that similar or denser soils continue below the maximum depth of the subsurface exploration. Additional exploration to deeper depths would be required to confirm the conditions below the current depth of exploration.

Faulting and Estimated Ground Motions

The site is located in the southern California, which is a seismically active area. 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. As calculated using the USGS Unified Hazard Tool, the fault with approximate coordinates -120.408°N, 36.446°W, which is considered to have the most significant effect at the site from a design standpoint, has a maximum credible earthquake magnitude of 5.57 and is located approximately 5.67 kilometers from the site.

Based on the USGS Design Maps Summary Report, using the American Society of Civil Engineers (ASCE 7-16) standard, the peak ground acceleration (PGA_M) at the project site is expected to be 0.675 g. Based on the USGS Unified Hazard Tool, the project site has a mean magnitude of 6.41. Furthermore, the site is not located within an Alquist-Priolo Earthquake Fault Zone based on our review of the State Fault Hazard Maps.[2]

[2] *California Geological Survey. https://maps.conservation.ca.gov/cgs/informationwarehouse.*

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 the condition of loose sandy soils exists below groundwater. The California Geological Survey (CGS) has designated certain areas as potential liquefaction hazard zones. However, CGS has not mapped the site for liquefaction hazard potential. Based on the anticipated depth to groundwater at the site, it is our opinion that the liquefaction hazard potential is low. Other geologic hazards related to liquefaction, such as lateral spreading, are therefore also considered low.

Corrosivity

The table below 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 (mg/kg)	Electrical Resistivity (Ω-cm)	pH
SB-2	0.8-5	Sandy Lean Clay	<0.01	50	970	9.19

Results of soluble sulfate testing indicate samples of the on-site soils tested possess negligible sulfate concentrations when classified in accordance with Table 19.3.1.1 of the ACI Design Manual. Concrete should be designed in accordance with the exposure class S0 provisions of the ACI Design Manual, Section 318, Chapter 19.

Electrical Resistivity Testing

Terracon performed field measurements of soil electrical resistivity for the support of grounding design. Soil resistivity data was obtained from two perpendicular arrays at one (1) location in the proposed substation yard. The approximate location of the tests are shown in the **Exploration Plan**. The testing was performed in general accordance with Wenner Array (4-pin) method per ASTM G57. This method was performed in with IEEE Standard 81, IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Ground System. Each test in the proposed locations included perpendicular arrays with "a" spacings 0.5,1,1.5, 2, 3, 5, 7, 10, 20, 30, 45, 70, 100, 150, 200 and 300. The "a" spacing is generally considered to be the depth of influence of the test. The electrical resistivity test results are presented in **Exploration Results**.

Geotechnical Overview

The site appears suitable for the proposed construction based upon geotechnical conditions encountered in the test borings, provided that the recommendations provided in this report are implemented in the design and construction phases of this project.

We anticipate that the proposed substation pads will be supported by a shallow foundation system bearing on engineered fill, or mat foundations and other appurtenant electrical equipment and turning poles will be supported on drilled shaft foundations.

The subsurface materials generally consisted of lean clay with varying amounts of sand and gravel, interbedded with sand with varying amounts of silt, clay and gravel to the maximum depth of the borings. Groundwater was not encountered within the maximum depths of exploration during or at the completion of drilling.

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 cosmetic damage such as uneven floor slabs will probably increase if any modification of the site results in excessive wetting or drying of the expansive soils. Eliminating the risk of movement and cosmetic 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. We would be pleased to discuss other construction alternatives with you upon request.

Based on the geotechnical engineering analyses, subsurface exploration, and laboratory test results, we recommend that the proposed substation may be supported on a spread footing foundation system. Due to the potential for expansion and anticipated depth of vegetation and tree removal, spread footings bearing on engineered fill are recommended for support of the proposed shallow foundations. Engineered fill should extend to a minimum depth of 3 feet below the bottom of foundations, or 5 feet below existing grades, whichever is greater. Grading for the proposed substation should incorporate the limits of the overexcavation plus a lateral distance of 2 feet beyond the outside edge of perimeter footings. Overexcavation and replacement is not required for support of drilled shaft foundations.

Estimated movements described in this report are based on effective drainage for the life of the structure and cannot be relied upon if effective drainage is not maintained. Exposed ground, extending at least 10 feet from the perimeter, should be sloped a minimum of 5% away from the building to provide positive drainage away from the structure. Grades around the structure should be periodically inspected and adjusted as part of the structure's maintenance program.

Geotechnical engineering recommendations for foundation systems and other earth connected phases of the project are outlined below. The recommendations contained in this report are based upon the results of field and laboratory testing (presented in the **Exploration Results**), engineering analyses, and our current understanding of the proposed project. The **General Comments** section provides an understanding of the report limitations.

Earthwork

The following presents recommendations for site preparation, excavation, subgrade preparation, and placement of engineered fills on the project. The recommendations presented for the design and construction of foundations are contingent upon following the recommendations outlined in this section. All grading for substation structures, except for those supported on drilled piers, should incorporate the limits of the proposed structure plus a minimum lateral distance of 2 feet beyond the edges.

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundation of bearing soils, and other geotechnical conditions exposed during construction of the project.

Site Preparation

Prior to placing fill, existing vegetation, debris, topsoil, root mats, and other deleterious materials should be removed from proposed development areas. Complete stripping of the topsoil should be performed in the proposed substation areas. Exposed surfaces within these areas should be free of mounds and depressions which could prevent uniform compaction. The site should be initially graded to create a relatively level surface to receive fill and provide for a relatively uniform thickness of fill beneath proposed structures.

We recommend stripping topsoil to depths that expose soils with less than 3 percent organics and no roots having a diameter greater than 1/8 inch. While the depth of the unsuitable soils should be expected to vary, the thickness of the top soil layer may be estimated to range between 6 and 12 inches for construction budgeting purposes. The thickness of the top soil layer was not determined during our field exploration.

Therefore, the actual depth of stripping should be verified by engineering observations made during the grading operations at the project. Exposed surfaces should be free of mounds and depressions which could prevent uniform compaction.

Stripped materials consisting of vegetation and organic materials should be wasted from the site or used to revegetate landscaped areas or exposed slopes after completion of grading operations. If it is necessary to dispose of organic materials on site, they should be placed in non-structural areas, and in fill sections not exceeding 5 feet in height.

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

The proposed substation may be supported by a shallow concrete foundation system bearing on engineered fill or drilled shafts.

Due to the potential for expansion and anticipated depth of vegetation and tree removal, spread footings bearing on engineered fill are recommended for support of the proposed shallow foundations. Engineered fill should extend to a minimum depth of 3 feet below the bottom of foundations, or 5 feet below existing grades, whichever is greater. Grading for the proposed substation should incorporate the limits of the overexcavation plus a lateral distance of 2 feet beyond the outside edge of perimeter footings.

Subsequent to the surface clearing and grubbing efforts, the exposed subgrade soils which will support engineered fill constructed at grade, should be prepared to a minimum depth of 10 inches. Subgrade preparation should generally include scarification, moisture conditioning, and compaction. The moisture content and compaction of subgrade soils should be maintained until construction.

All exposed areas which will receive fill, once properly cleared and benched where necessary, should be scarified to a minimum depth of 10 inches, moisture conditioned as necessary, and compacted per the compaction requirements in this report.

Structures supported on either drilled shafts may be constructed without the above recommended remedial grading.

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.

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.

Fill Material Types

All fill materials should be inorganic soils free of vegetation, debris, and fragments larger than six inches in size. Pea gravel or other similar non-cementatious, poorly-graded materials should not be used as fill or backfill without the prior approval of the geotechnical engineer.

Due to the on-site clayey soil's expansion potential, they are not recommended for use as engineered fill beneath foundations and lightly loaded slabs. Such soils may be used as fill materials for site grading only.

Imported soils for use as fill material within proposed structure areas should conform to low volume change materials as indicated in the following specifications:

Gradation	**Percent Finer by Weight (ASTM C 136)**
3″	100
No. 4 Sieve	50-100
No. 200 Sieve	40

- Liquid Limit .... 30 (max)
- Plasticity Index .... 10 (max)
- Maximum Expansion Index* .... 20 (max)

*ASTM D4829

The contractor shall notify the Geotechnical Engineer of import sources sufficiently ahead of their use so that the sources can be observed and approved as to the physical characteristic of the import material. For all import material, the contractor shall also 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 job.

Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. Fill lifts should not exceed 10 inches loose thickness.

Compaction Requirements

Recommended compaction and moisture content criteria for engineered fill materials are as follows:

Material Type and Location	Per the Modified Proctor Test (ASTM D 1557)		
	Minimum Compaction Requirement	Range of Moisture Contents for Compaction Above Optimum	
		Minimum	Maximum
Approved imported fill soils:			
Beneath foundations:	90%	0%	+4%
On-site native soils:			
Miscellaneous backfill:	90%	+2%	+5%
Bottom of excavation receiving fill:	90%	+2%	+5%

Utility Trench Backfill

We anticipate that the on-site soils will provide suitable support for underground utilities and piping that may be installed. Any soft and/or unsuitable material encountered at the bottom of excavations should be removed and be replaced with an adequate bedding material.

A non-expansive granular material with a sand equivalent greater than 30 should be used for bedding and shading of utilities, unless allowed or specified otherwise by the utility manufacturer.

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.

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. Where trenches are placed beneath footings, the backfill should satisfy the gradation and expansion index requirements of engineered fill discussed in this report. Flooding or jetting for placement and compaction of backfill is not recommended.

Grading and Drainage

Positive drainage should be provided during construction and maintained throughout the life of the development. Infiltration of water into utility trenches or foundation excavations should be prevented during construction. Backfill against footings, exterior walls, and in utility and sprinkler line trenches should be well compacted and free of all construction debris to reduce the possibility of moisture infiltration.

Exterior Slab Design and Construction

Compacted subgrade composed of on-site clayey soils will expand with increasing moisture content; therefore, exterior concrete slabs may heave, resulting in cracking or vertical offsets. The potential for damage would be greatest where exterior slabs are constructed adjacent to the building or other structural elements. To reduce the potential for damage caused by movement, we recommend:

- exterior slabs should be supported directly on subgrade fill (not ABC) with no, or very low expansion potential;
- strict moisture-density control during placement of subgrade fills;
- maintain proper subgrade moisture until placement of slabs;
- placement of effective control joints on relatively close centers and isolation joints between slabs and other structural elements;
- provision for adequate drainage in areas adjoining the slabs;
- use of designs which allow vertical movement between the exterior slabs and adjoining structural elements.

Earthwork Construction Considerations

Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction. 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 desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to construction.

On-site clay soils may pump and unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. The use of light construction equipment would aid in reducing subgrade disturbance. The use of remotely operated equipment, such as a backhoe, would be beneficial to perform cuts and reduce subgrade disturbance.

Should unstable subgrade conditions develop stabilization measures will need to be employed. Stabilization measures may include placement of aggregate base and multi-axial geogrid. Use of lime, fly ash, kiln dust or cement could also be considered as a stabilization technique. Laboratory evaluation is recommended to determine the effect of chemical stabilization on subgrade soils 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 mitigative measures beyond that which would be expected during the drier summer and fall months. This could include 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.

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.

Construction Observation and Testing

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation, proof-rolling, placement and compaction of controlled compacted fills, backfilling of excavations to the completed subgrade.

The exposed subgrade and 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 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement 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. This testing frequency criteria may be adjusted during construction as specified by the geotechnical engineer of record.

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.

Foundations

Substation equipment and self-contained structures may be supported on slab on grade and/or mat foundations bearing on engineered fill. Substation elements including turning poles, bus supports, and shield wire poles may be supported on drilled piers. Recommendations for foundations for the proposed structures and related structural elements are presented in the following paragraphs.

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

Shallow Foundation Design Recommendations

Item	Description
Foundation System	Spread footings, mat foundation, grade beams
Maximum Net Allowable Bearing Pressure (for a total static settlement of 1 inch) [1, 2]	3,000 psf up to 7 feet wide 2,000 psf up to 11 feet wide 1,000 psf up to 20 feet wide
Maximum Net Allowable Bearing Pressure (for a total static settlement of 2 inch) [1, 2]	5,000 psf up to 7 feet wide 4,000 psf up to 11 feet wide 3,000 psf up to 20 feet wide
Required Bearing Stratum	Engineered fill extending to a minimum of 3 foot below the bottom of foundations, or 5 feet below existing grade, whichever is greater.
Minimum Embedment Below Finished Grade	12 inches
Minimum Dimensions	Square footings and mats: 24 inches Strip footings: 18 inches
Estimated Differential Settlement	About 1/2 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. Unsuitable or soft soils should be overexcavated and replaced per the recommendations presented in **Earthwork**.

Settlement calculations were performed utilizing Westergaard and Hough's methods[3] to estimate the static settlement for various foundations widths with an allowable settlement of 1-inch and 2-inch as notes in the table above.

Since there are several factors that will control the design of mat foundations besides vertical load, Terracon should be consulted when the final foundation depth and width are determined to assist the structural designer in the evaluation of anticipated settlement.

For structural design of mat foundations, a modulus of subgrade reaction (Kv_1) of 200 pounds per cubic inch (pci) may be used. Other details including treatment of loose foundation soils, superstructure reinforcement and observation of foundation excavations as outlined in the Earthwork section of this report are applicable for the design and construction of a mat foundation at the site.

The subgrade modulus (K_v) for the mat is affected by the size of the mat foundation and would vary according the following equation:

$$K_v = K_{v1}/B$$

Where: K_v is the modulus for the size footing being analyzed
B is the width of the mat foundation.

Shallow Foundation Design Considerations

Finished grade is defined as the lowest adjacent grade within five feet of the foundation for perimeter (or exterior) footings.

The allowable foundation bearing pressure applies to dead loads plus design live load conditions. The design bearing pressure may be increased by one-third when considering total loads that include wind or seismic conditions. The weight of the foundation concrete below grade may be neglected in dead load computations.

Foundations should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement. The use of joints at openings or other discontinuities in masonry walls is recommended.

[3] *FHWA Geotechnical Engineering Circular No. 6 – Shallow Foundations, FHWA – SA-02-054*

Foundation excavations should be observed by the geotechnical engineer. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

Drilled Shaft Design Recommendations

The proposed substation towers, poles, and bus supports can be supported on drilled shafts. Total required embedment of the drilled shafts should be determined by the structural engineer based on structural loading and parameters provided in this report.

The allowable end bearing, and side friction components of resistance were evaluated and are presented in the tables and graphs provided in the **Supporting Documents** section of this report. The allowable axial compressive capacities are based on a minimum factor of safety of 2.5 for skin friction and 3.0 for end bearing. Uplift capacities should be based on two-thirds of the allowable skin friction of the shaft, however the weight of the foundation should be added to these values to obtain the actual allowable uplift capacities for drilled shafts. Depth-capacity graphs are provided in the attachments of this report.

Recommended geotechnical parameters for lateral load analyses of drilled shaft foundations have been developed for use in the L-PILE computer program. Based on our review of the subsurface conditions within the outline of the substation and the Standard Penetration Test (SPT) results, engineering properties have been estimated for the soils conditions as shown in the following table. Due to potential disturbance within the upper soils around the shaft, lateral and axial capacity of soils within the upper 2 feet should be neglected. In the event disturbance is expected in a deeper depth, such depth should be neglected. We recommend that Terracon review the final drilled shaft design to verify that sufficient embedment is achieved.

Substation				
Top Depth / **Bottom Depth**	**Effective Unit Weight (pcf)**	**LPILE/ GROUP Soil Type**	**Internal Friction (degrees)ϕ**	**Cohesion (psf)**
2 / **5**	100	Stiff Clay without Free Water	--	1,800
5 / **20**	100	Sand	31	--
20 / **25**	100	Stiff Clay without Free Water	--	1,800
25 / **40**	100	Sand	31	--
40 / **50**	100	Sand	41	--

1. See Subsurface Profile in **Geotechnical Characterization** for more details on Stratigraphy.
2. Definition of Terms:
   ϕ: Internal friction angle
   γ': Effective unit weight
3. Default K and E_{50} values may be utilized.

The depth below ground surface indicated in the table above is referenced from the existing site surface at the time of the field exploration. If fill is placed to raise the site grades, the depths shown in the charts and table above must be increased by the thickness of fill placed. The required depths of shaft embedment should also be determined for design lateral loads and overturning moments to determine the most critical design condition.

Lateral load design parameters are valid within the elastic range of the soil. The coefficient of subgrade reaction are ultimate values; therefore, appropriate factors of safety should be applied in the shaft design or deflection limits should be applied to the design.

It should be noted that the loaded capacities provided herein are based on the stresses induced in the supporting soils. The structural capacity of the shafts should be checked to assure that they can safely accommodate the combined stresses induced by axial and lateral forces. Furthermore, the response of the drilled shaft foundations to lateral loads is dependent upon the soil/structure interaction as well as the shaft’s actual diameter, length, stiffness and “fixity” (fixed or freehead condition).

Drilled Shaft Construction Considerations

Drilling to design depths should be possible with conventional single flight power augers. Due to lean clay soils, temporary casing is not anticipated to be required during shaft excavation. We do not anticipate drilled shafts to extend below the depth of groundwater. However, if foundation concrete cannot be placed in dry conditions, a tremie should be used for concrete placement.

Drilled shaft foundation concrete should be placed immediately after completion of drilling and cleaning. If foundation concrete cannot be placed in dry conditions, a tremie should be used for concrete placement. Due to potential sloughing and raveling, foundation concrete quantities may exceed calculated geometric volumes.

In the event drilled hole walls slough during drilling, temporary steel casing may be required to properly drilled shafts prior to concrete placement. We recommend the use of slurry drilling methods with polymers method to keep the solids in suspension during the drilling. Drilled shaft foundation concrete should be placed within 6 inches of the shaft base of the slurry-filled excavation immediately after completion of drilling and cleaning. The tremie should remain inserted several feet into the fresh concrete as it displaces the slurry upward and until placement is complete. The slurry should have a sand content no greater than 1% at the time concrete placement commences. The maximum unit weight of the slurry should be established in consultation with Terracon.

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.

Formation of mushrooms or enlargements at the tops of shafts should be avoided during shaft drilling. If mushrooms develop at the tops of the shafts during drilling, sono-tubes should be placed at the shaft tops to help isolate the shafts.

Free-fall concrete placement in drilled shafts 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.

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. Natural 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 or collaboration through this system 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.

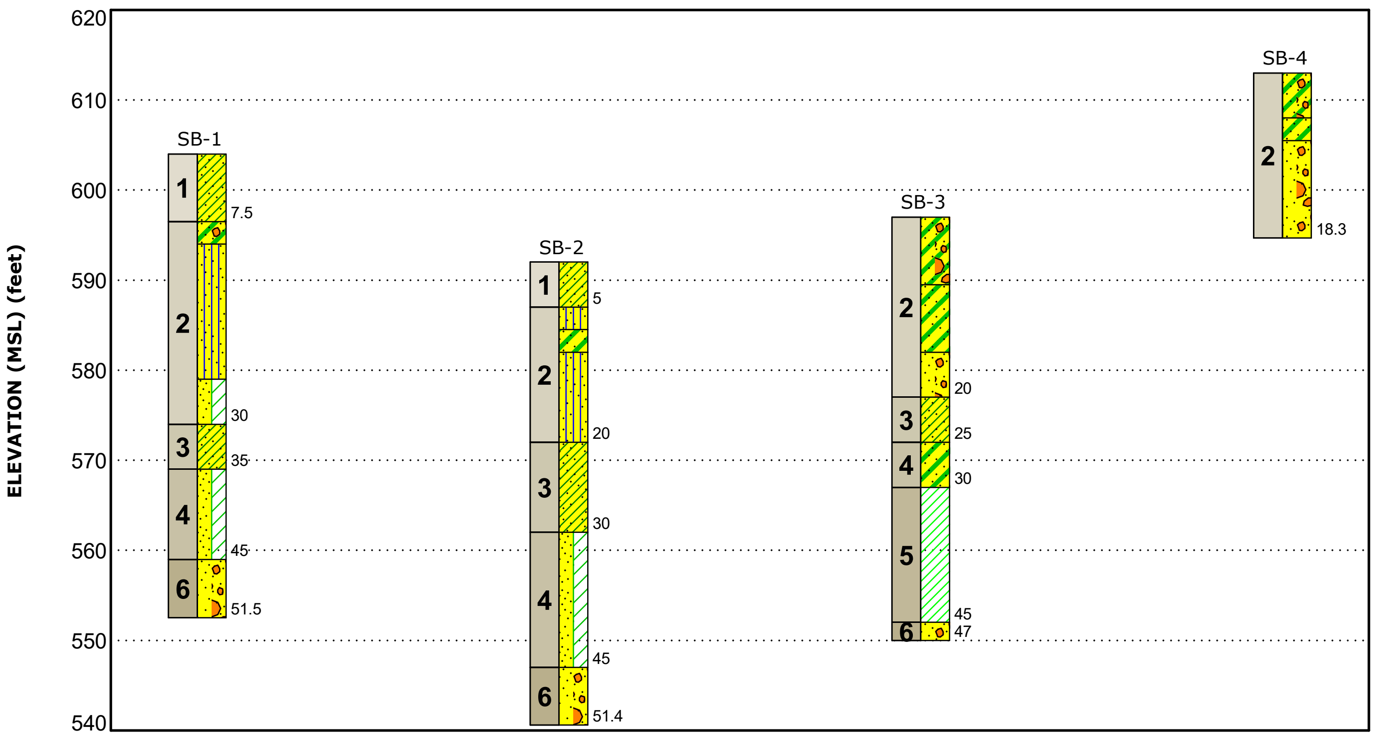
Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation 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. 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.

Figures

Contents:

145 W Walnut St
Carson, CA

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	**Sandy Lean Clay**	Clay with varying amounts of silt, sand and gravel
2	**Clayey/Silty Sand**	Sand with varying amounts of clay, silt and gravel
3	**Lean Clay**	Clay with varying amount of sand, silt and gravel
4	**Poorly Graded Sand**	Sand with varying amount of silt, clay and gravel
5	**Lean Clay**	Clay with varying amount of sand, silt and gravel
6	**Poorly Graded Sand with Gravel**	Sand with varying amount of silt, clay and gravel

Legend

- Sandy Lean Clay
- Clayey Sand with Gravel
- Silty Sand
- Poorly-graded Sand with Clay
- Poorly-graded Sand with Gravel
- Clayey Sand
- Lean Clay

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.

Attachments

Exploration and Testing Procedures

Field Exploration

Number of Borings	Approximate Boring Depth (feet)	Location
4	51.5 or auger refusal	Proposed substation yard

Boring Layout and Elevations: Terracon personnel provided the boring layout using handheld GPS equipment (estimated horizontal accuracy of about ±10 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 borings be surveyed.

Subsurface Exploration Procedures: We advanced the borings with a truck-mounted drill rig using continuous hollow stem flight. Four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. Test samples were collected during drilling in general accordance with the appropriate ASTM methods using Standard Penetration Testing (SPT) and sampling using either standard split-spoon or Modified California samplers. A 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 was recorded as the Standard Penetration Test (SPT) resistance value, also referred to as N-values. The N-values are indicated on the boring logs at the test depths. The samples were placed in appropriate containers, taken to our soil laboratory for testing, and classified by a geotechnical engineer.

For safety purposes, all borings were backfilled with auger cuttings and grout after their completion. We also observed the boreholes while drilling and at the completion of drilling for the presence of groundwater. Groundwater was not encountered during the course of our exploration.

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.

Electrical Resistivity Testing: Soil electrical resistivity data was be obtained in accordance with ASTM G57 Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method. At each test location, two near perpendicular lines was tested. Electrode "a" spacings are summarized in the following table. Electrode spacing was adjusted to conform to site conditions.

No. of Test Locations	Electrode "a" Spacing (feet) [1]	Planned Location
2	0.5, 1, 1.5, 2, 3, 5, 7, 10, 20, 30, 45, 70, 100, 150, 200, and 300' feet	Proposed substation yard

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
- Atterberg Limits
- Swell Consolidation Test
- Unconfined compression
- Direct Shear
- 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 noted above.

Site Location

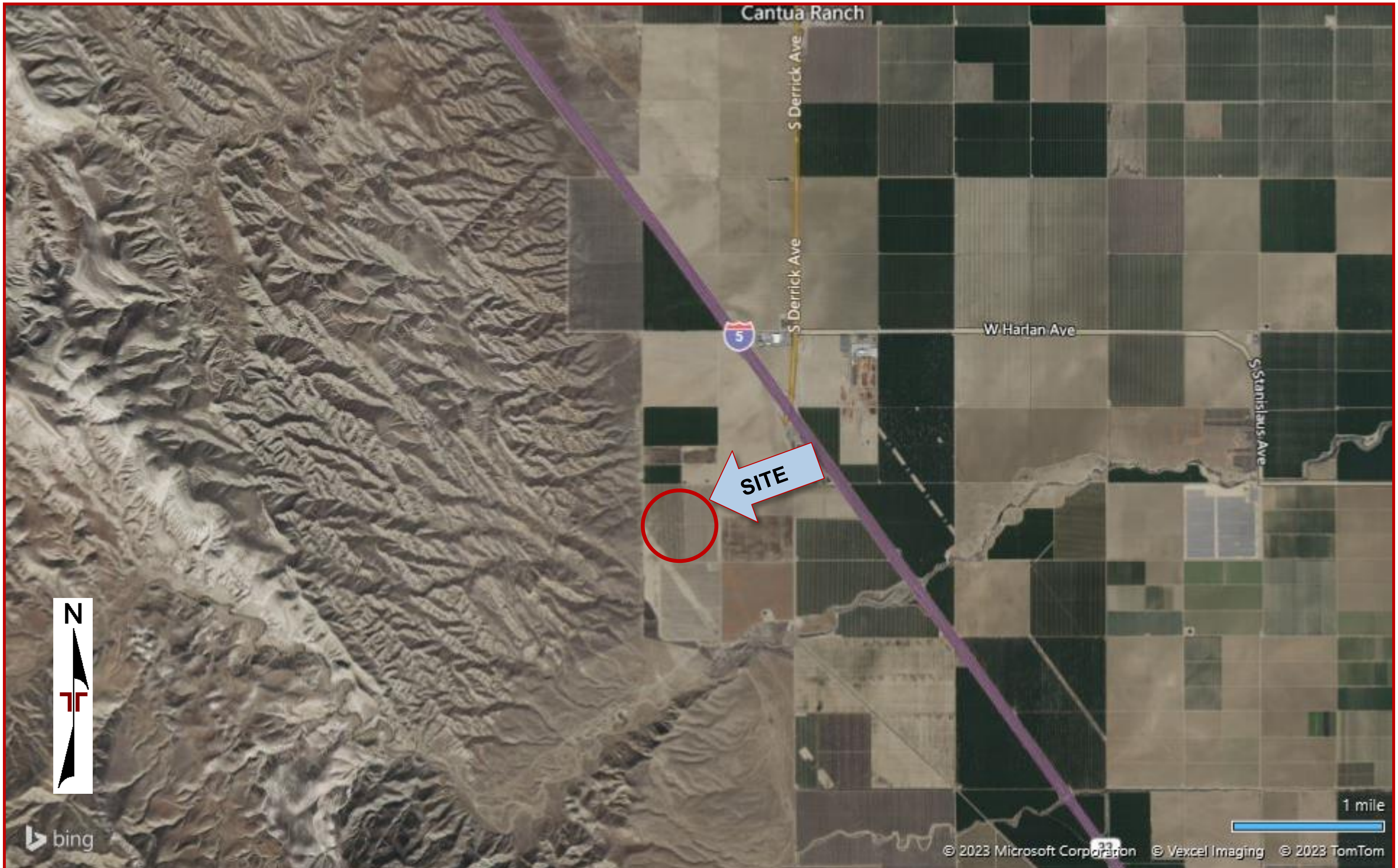


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan

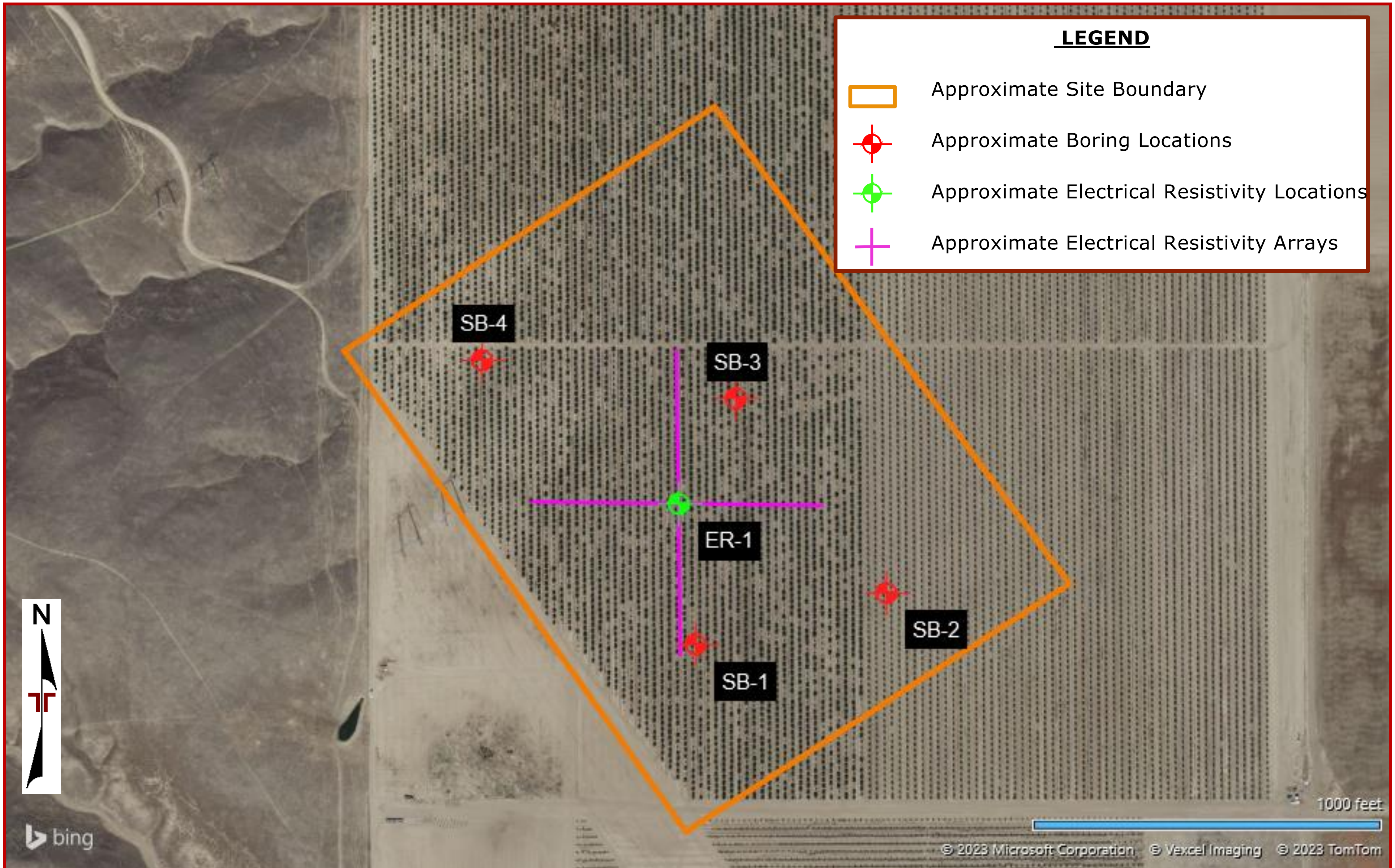


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration and Laboratory Results

Contents:

Note: All attachments are one page unless noted above.

804650A 500 Kv Darden Interconnection
Mendota | Fresno County, CA
Terracon Project No. LA235112

Terracon
145 W Walnut St
Carson, CA

Boring Log No. SB-1

Location: See Exploration Plan

Latitude: 36.4226° Longitude: -120.4077°

Model Layer	Depth (Ft.)	Description
1	0.0–7.5	**SANDY LEAN CLAY (CL)**, light brown or light brown; very stiff
2	7.5–10.0	**CLAYEY SAND WITH GRAVEL (SC)**, light brown, medium dense
2	10.0–25.0	**SILTY SAND (SM)**, light brown, medium dense; light bluish gray to light brown; loose
2	25.0–30.0	**POORLY GRADED SAND WITH CLAY (SP-SC)**, light brown, medium dense

Depth (Ft.)	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
0–5						52
2.5–4	Ring sample	7-10-13	8.0	87		
5–6.5	SPT	7-12-15 N=27			47-18-29	55
7.5–9	Ring sample	8-16-21	8.7	87		
10–11.5	SPT	4-7-17 N=24				
15–16.5	Ring sample	3-12-23	6.2	97		
20–21.5	SPT	4-2-4 N=6				37
25–26.5	Ring sample	10-10-12	10.0	105		

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

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Drill Rig
Diedrich D-50

Hammer Type
Automatic

Driller
Terracon

Logged by
GM

Boring Started
09-06-2023

Boring Completed
09-06-2023

Terracon
145 W Walnut St
Carson, CA

Boring Log No. SB-1

Location: See Exploration Plan

Latitude: 36.4226° Longitude: -120.4077°

Model Layer	Graphic Log	Depth (Ft.)	Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
3			**SANDY LEAN CLAY (CL)**, brown, very stiff				6-8-12 N=20				
		35.0		35							
4			**POORLY GRADED SAND WITH CLAY (SP-SC)**, trace gravel, light brown, medium dense				10-16-30	11.0	104		
			brown, very dense	40			12-23-32 N=55				
		45.0		45							
6			**POORLY GRADED SAND WITH GRAVEL (SP)**, trace clay, light brown, very dense				12-50/4"	11.4	103		
				50			12-26-32 N=58				
		51.5	***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

Water Level Observations
Groundwater not encountered

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Drill Rig
Diedrich D-50

Hammer Type
Automatic

Driller
Terracon

Logged by
GM

Boring Started
09-06-2023

Boring Completed
09-06-2023

Terracon
145 W Walnut St
Carson, CA

Boring Log No. SB-2

Location: See Exploration Plan

Latitude: 36.4229° Longitude: -120.4055°

Model Layer	Depth (Ft.)	Description	Depth (Ft.)	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1		**SANDY LEAN CLAY (CL)**, light brown						
		very stiff		6-12-13	11.2	91	37-20-17	62
	5.0		5					
2		**SILTY SAND (SM)**, light brown, medium dense		3-9-15	15.1	80		
	7.5	**CLAYEY SAND (SC)**, trace gravel, light brown, medium dense		5-6-7 N=13			35-17-18	
	10.0	**SILTY SAND (SM)**, light brown, medium dense	10	9-12-16	7.1	99		
		brown or gray, dense	15	12-14-21 N=35				
3	20.0	**SANDY LEAN CLAY (CL)**, brown, very stiff	20	6-11-13	15.6	108		
		hard	25	9-13-21 N=34			28-16-12	54
	30.0		30					

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

Water Level Observations
Groundwater not encountered

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Drill Rig
Diedrich D-50

Hammer Type
Automatic

Driller
Terracon

Logged by
GM

Boring Started
09-06-2023

Boring Completed
09-06-2023

Terracon
145 W Walnut St
Carson, CA

Boring Log No. SB-2

Location: See Exploration Plan

Latitude: 36.4229° Longitude: -120.4055°

Model Layer	Depth (Ft.)	Material Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
4		**POORLY GRADED SAND WITH CLAY (SP-SC)**, brown, medium dense				5-8-12	8.8	106		
		dense	35			12-18-23 N=41				
		medium dense	40			18-18-16	10.9	104		
6	45.0	**POORLY GRADED SAND WITH GRAVEL (SP)**, trace silt, brown, very dense	45			18-18-50/5"				
			50			36-10-50/5"	4.1			
	51.4	***Boring Terminated at 51.4 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

Water Level Observations
Groundwater not encountered

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Drill Rig
Diedrich D-50

Hammer Type
Automatic

Driller
Terracon

Logged by
GM

Boring Started
09-06-2023

Boring Completed
09-06-2023

Terracon
145 W Walnut St
Carson, CA

Boring Log No. SB-3

Location: See Exploration Plan

Latitude: 36.4244° Longitude: -120.4072°

Model Layer	Depth (Ft.)	Material Description	Sample Depth (Ft.)	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
2	0.0–7.5	**CLAYEY SAND WITH GRAVEL (SC)**, trace silt, brown medium dense	2.5–4.0	16-10-15	7.9	88	43-22-21	43
			5.0–6.5	8-8-9 N=17				
2	7.5–15.0	**CLAYEY SAND (SC)**, trace gravel, brown, medium dense very dense	7.5–9.0	9-10-18	9.1	107		
			10.0–11.5	10-37-23 N=60				
2	15.0–20.0	**POORLY GRADED SAND WITH GRAVEL (SP)**, trace silt, light brown, very dense	15.0–16.5	12-23-35	5.4	108		
3	20.0–25.0	**SANDY LEAN CLAY (CL)**, light brown, stiff	20.0–21.5	4-6-10 N=16				
4	25.0–30.0	**CLAYEY SAND (SC)**, light brown, medium dense	25.0–26.5	8-12-17	12.2	106		

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

Water Level Observations
Groundwater not encountered

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Drill Rig
Diedrich D-50

Hammer Type
Automatic

Driller
Terracon

Logged by
GM

Boring Started
09-06-2023

Boring Completed
09-06-2023

Terracon
145 W Walnut St
Carson, CA

Boring Log No. SB-3

Location: See Exploration Plan

Latitude: 36.4244° Longitude: -120.4072°

Model Layer	Graphic Log	Depth (Ft.)	Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
5			**LEAN CLAY (CL)**, trace sand, brown, very stiff				6-9-23 N=32			49-17-32	86
				35			3-8-13	15.3	105		
				40			8-10-11	26.6	89		
		45.0									
6			**POORLY GRADED SAND WITH GRAVEL (SP)**, tan, dense	45			7-17-24 N=41				
		47.0									
			Boring Refusal at 47 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

Water Level Observations
Groundwater not encountered

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Drill Rig
Diedrich D-50

Hammer Type
Automatic

Driller
Terracon

Logged by
GM

Boring Started
09-06-2023

Boring Completed
09-06-2023

804650A 500 Kv Darden Interconnection
Mendota | Fresno County, CA
Terracon Project No. LA235112

145 W Walnut St
Carson, CA

Boring Log No. SB-4

Location: See Exploration Plan

Latitude: 36.4247° Longitude: -120.4100°

Model Layer	Depth (Ft.)	Description	Sample Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
2		**CLAYEY SAND WITH GRAVEL (SC)**, trace silt, brown								
		dense	2.5			6-15-23 N=38			34-20-14	39
	5.0	**CLAYEY SAND (SC)**, light brown, medium dense	5			10-15-16	7.8	96		
	7.5	**POORLY GRADED SAND WITH GRAVEL (SP)**, trace silt, brown, dense	7.5			8-16-23 N=39				
		very dense	10			20-32-50/5"	6.3			
		tan	15			17-21-50/5"				
	18.3		18			50/4"				

Boring Refusal at 18.3 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

Water Level Observations
Groundwater not encountered

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with Auger Cuttings and/or Bentonite

Drill Rig
Diedrich D-50

Hammer Type
Automatic

Driller
Terracon

Logged by
GM

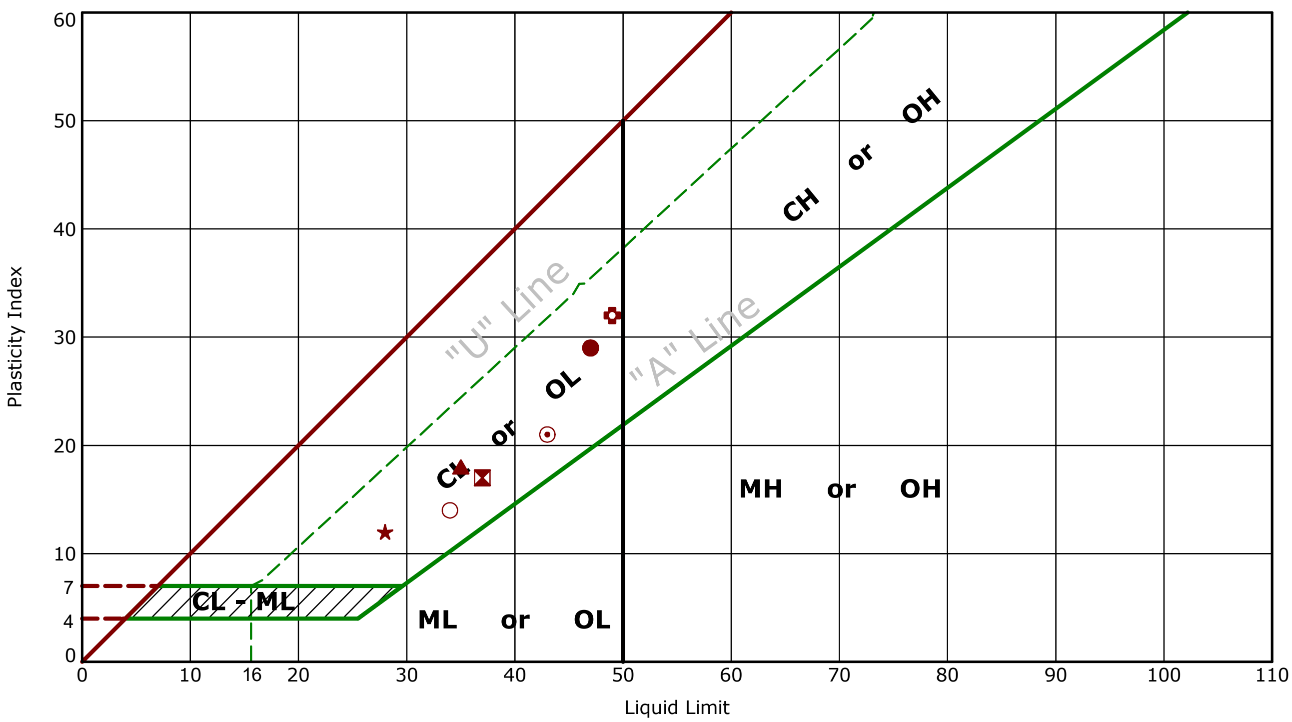
Boring Started
09-06-2023

Boring Completed
09-06-2023

145 W Walnut St
Carson, CA

Atterberg Limit Results

ASTM D4318

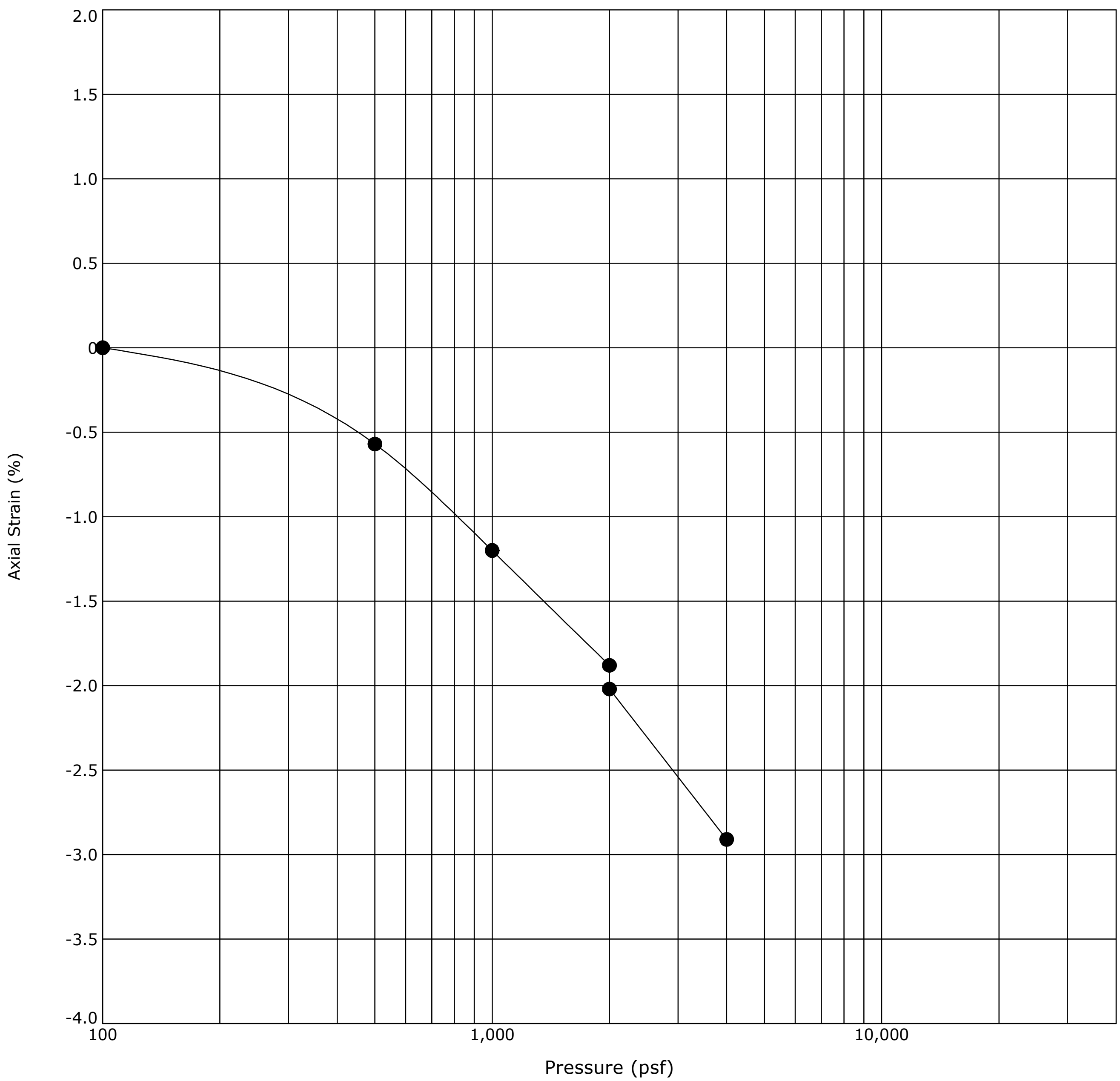


	Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	SB-1	5 - 6.5	47	18	29	55.1	CL	SANDY LEAN CLAY
⊠	SB-2	0 - 5	37	20	17	62.5	CL	SANDY LEAN CLAY
▲	SB-2	7.5 - 9	35	17	18		SC	CLAYEY SAND
★	SB-2	25 - 26.5	28	16	12	53.7	CL	SANDY LEAN CLAY
⊙	SB-3	0 - 5	43	22	21	43.1	SC	CLAYEY SAND WITH GRAVEL
✤	SB-3	30 - 31.5	49	17	32	86.1	CL	LEAN CLAY TRACE SAND
○	SB-4	0 - 5	34	20	14	38.6	SC	CLAYEY SAND WITH GRAVEL

Terracon
145 W Walnut St
Carson, CA

Swell Consolidation Test

ASTM D2435



	Boring ID	Depth (Ft)	Description	USCS	γ_d(pcf)	WC (%)
●	SB-1	2.5 - 4	SANDY LEAN CLAY	CL	87	8.0

Notes: Water added at 2,000psf

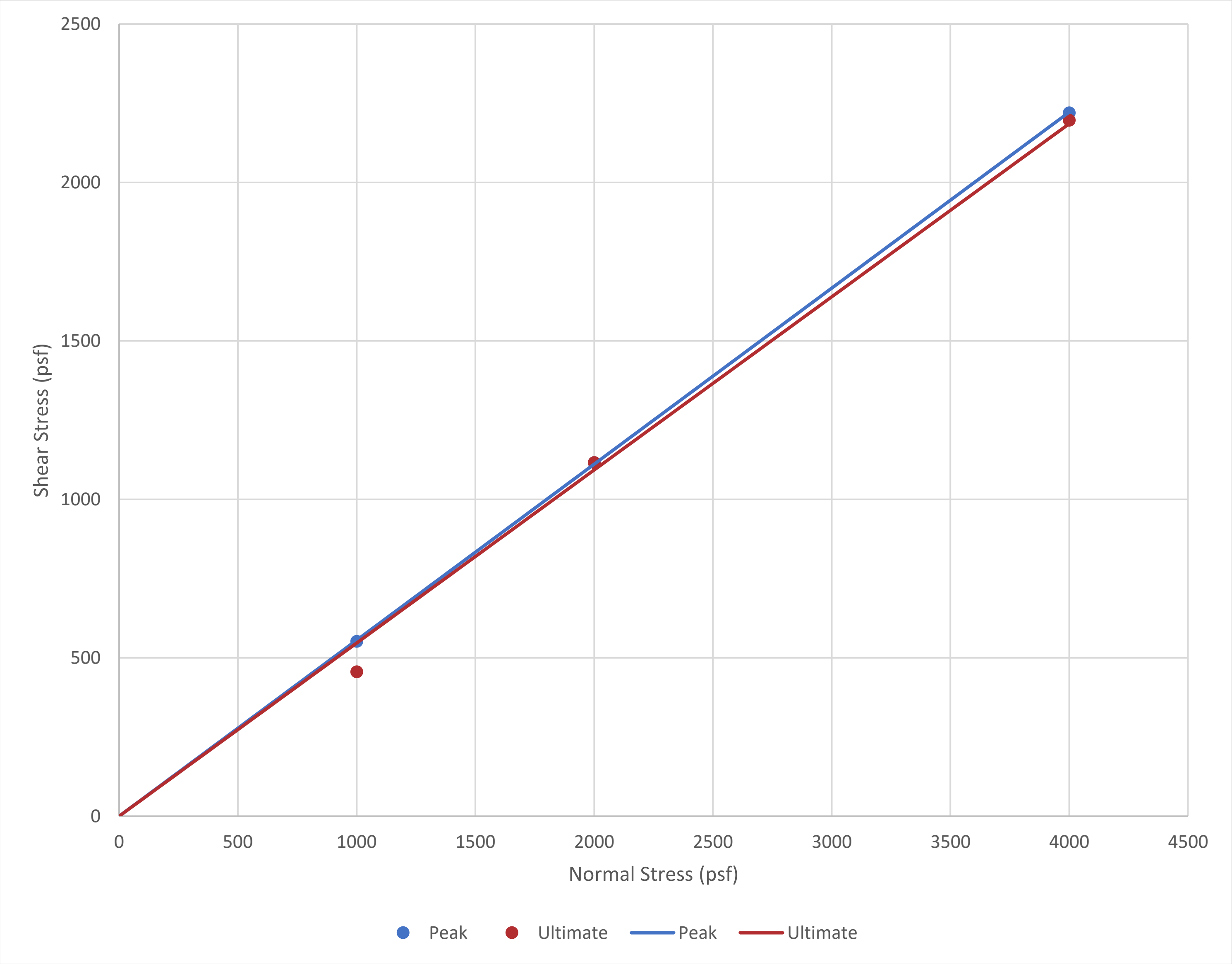
Terracon
145 W Walnut St.
Gardena, CA

Direct Shear Test

ASTM D3080

Boring ID	Depth (ft)	Description	USCS	γ_d (pcf)	W(%)
SB-2	5	Silty Sand	SM	107	9.1

Normal Stress (psf)	Peak Shear Stress (psf)	Ultimate Shear Stress (psf)	Peak		Ultimate	
			φ°	C (psf)	φ°	C (psf)
1000	552	456	29.0	0	30.0	0
2000	1116	1116				
4000	2220	2196				



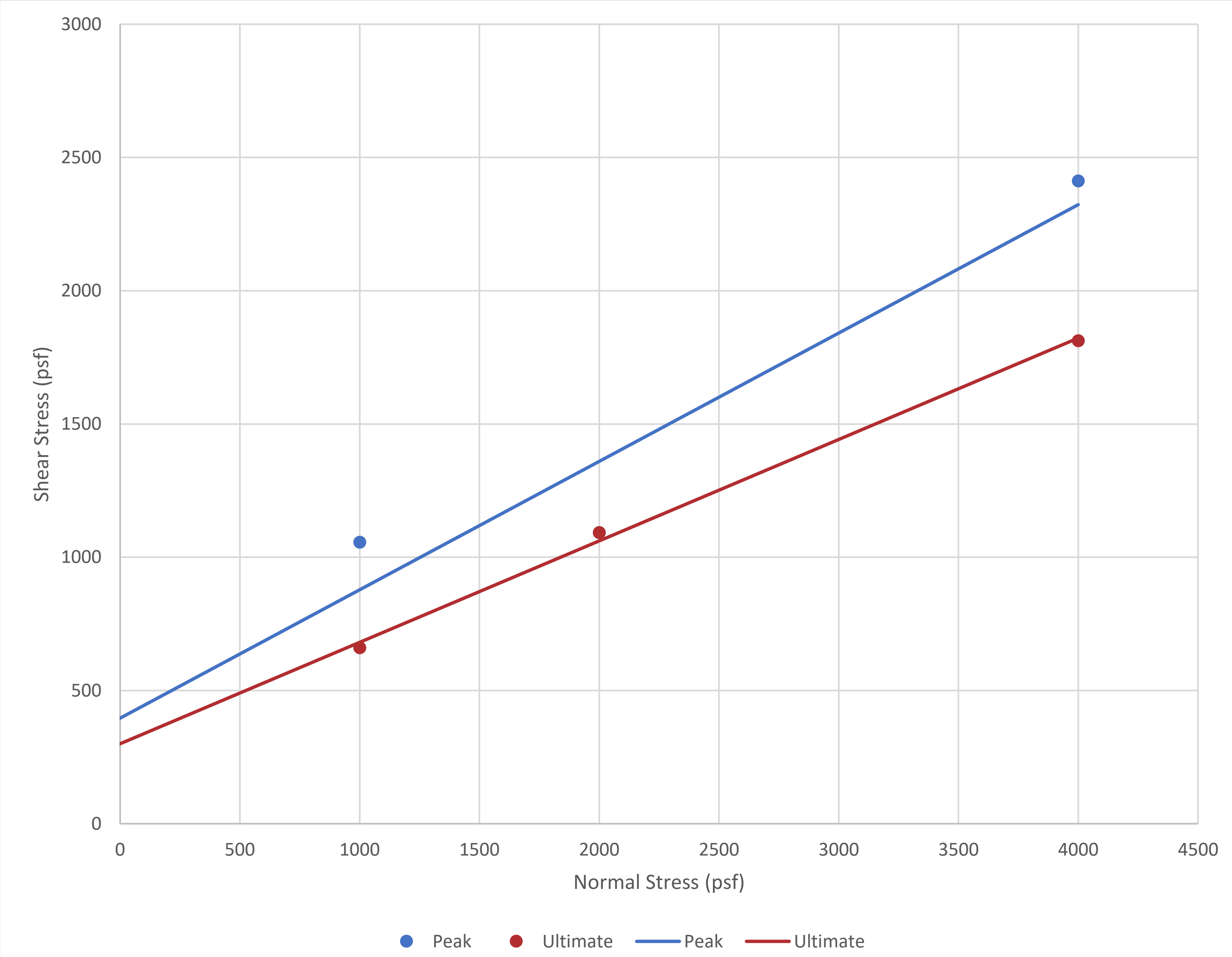
Terracon
145 W Walnut St.
Gardena, CA

Direct Shear Test

ASTM D3080

Boring ID	Depth (ft)	Description	USCS	γ_d (pcf)	W(%)
SB-3	7.5	Clayey Sand	SC	107	9.1

Normal Stress (psf)	Peak Shear Stress (psf)	Ultimate Shear Stress (psf)	Peak		Ultimate	
			φ°	C (psf)	φ°	C (psf)
1000	1056	660	**26.0**	**400**	**21.0**	**300**
2000	1092	1092				
4000	2412	1812				



AP Engineering and Testing, Inc.
DBE|MBE|SBE
2607 Pomona Boulevard | Pomona, CA 91768
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com

MOISTURE AND DENSITY TEST RESULTS

ASTM D2216 and ASTM D7263 (Method B)

Client: Terracon
Project Name: 804650A 500 Kv Darden Interconnection
Project No.: LA235112

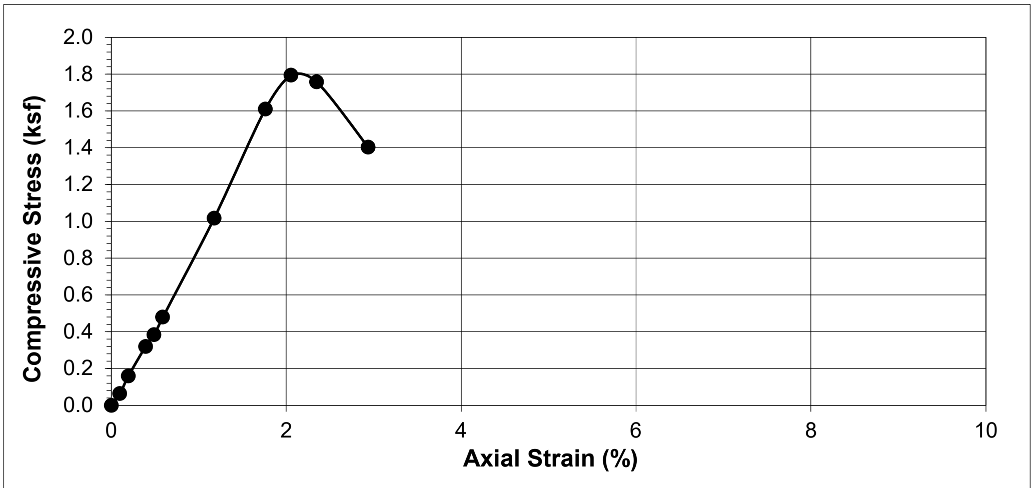
AP Lab No.: 23-0950
Test Date: 09/27/23

Boring No.	Sample No.	Sample Depth (ft.)	Moisture Content (%)	Dry Density (pcf)
SB-1	-	25	10.0	104.9
SB-2	-	2.5	11.2	90.9
SB-2	-	20	15.6	108.3
SB-3	-	35	15.3	104.6

AP Engineering and Testing, Inc.
DBE|MBE|SBE
2607 Pomona Boulevard | Pomona, CA 91768
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com

UNCONFINED COMPRESSION TEST RESULTS
ASTM D 2166

Project Name:	804650A 500 Kv Darden Interconnection	Sample Type:	Mod Cal
Project No.:	LA235112	Soil Description	Clayey Sand
Boring No.:	SB-1	Dry Density (pcf):	102.2
Sample No.:	-	Moisture Content (%)	11.8
Depth (feet):	25	Test Date:	09/26/23
Sample Diameter (inch):	2.389	Wt. Wet Soil+Container(gms)	835.5
Sample Height (inch):	5.110	Wt. Dry Soil+Container(gms)	763.31
Sample Weight (gms):	686.99	Wt. Container (gms)	149.82



After Test

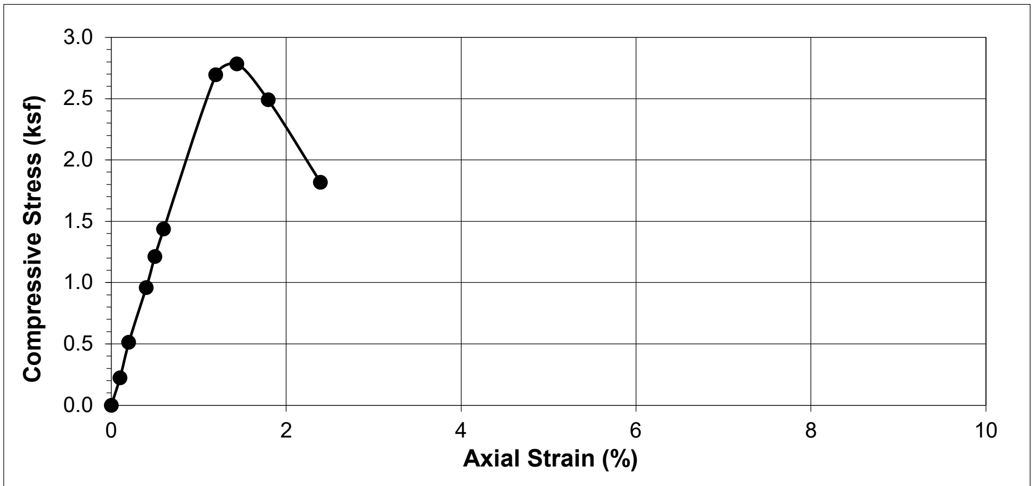
Load (lbs)	Deformation (inch)	Area (sq.in)	Compressive Stress (ksf)	Axial Strain (%)
0	0.000	4.48	0.00	0.00
2	0.005	4.49	0.06	0.10
5	0.010	4.49	0.16	0.20
10	0.020	4.50	0.32	0.39
12	0.025	4.50	0.38	0.49
15	0.030	4.51	0.48	0.59
32	0.060	4.53	1.02	1.17
51	0.090	4.56	1.61	1.76
57	0.105	4.58	1.79	2.05
56	0.120	4.59	1.76	2.35
45	0.150	4.62	1.40	2.94

Unconfined Compressive Strength (ksf) = **1.79**

AP Engineering and Testing, Inc.
DBE|MBE|SBE
2607 Pomona Boulevard | Pomona, CA 91768
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com

UNCONFINED COMPRESSION TEST RESULTS
ASTM D 2166

Project Name:	804650A 500 Kv Darden Interconnection	Sample Type:	Mod Cal
Project No.:	LA235112	Soil Description	Silt
Boring No.:	SB-2	Dry Density (pcf):	91.4
Sample No.:	-	Moisture Content (%)	13.3
Depth (feet):	2.5	Test Date:	09/26/23
Sample Diameter (inch):	2.390	Wt. Wet Soil+Container(gms)	792.4
Sample Height (inch):	5.018	Wt. Dry Soil+Container(gms)	720.42
Sample Weight (gms):	612.25	Wt. Container (gms)	180.94



After Test

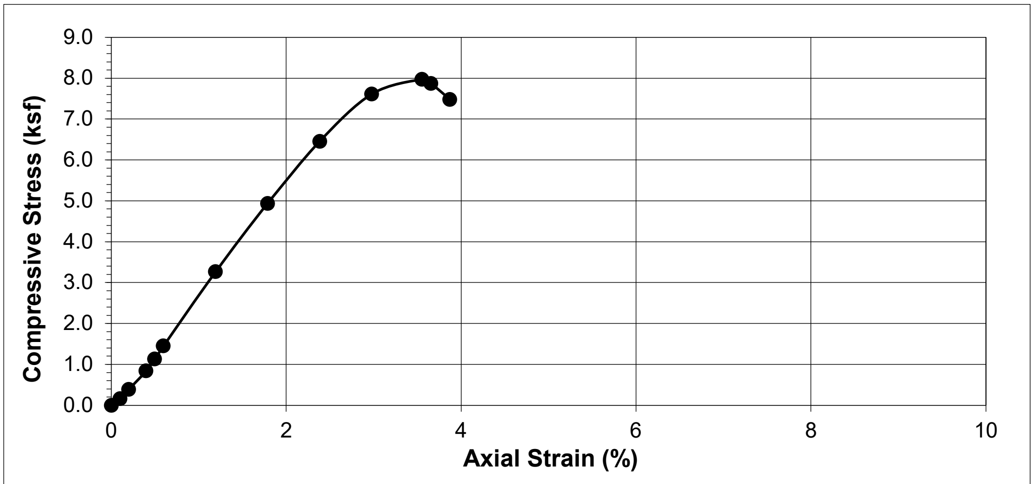
Load (lbs)	Deformation (inch)	Area (sq.in)	Compressive Stress (ksf)	Axial Strain (%)
0	0.000	4.49	0.00	0.00
7	0.005	4.49	0.22	0.10
16	0.010	4.50	0.51	0.20
30	0.020	4.50	0.96	0.40
38	0.025	4.51	1.21	0.50
45	0.030	4.51	1.44	0.60
85	0.060	4.54	2.70	1.20
88	0.072	4.55	2.78	1.43
79	0.090	4.57	2.49	1.79
58	0.120	4.60	1.82	2.39

Unconfined Compressive Strength (ksf) = **2.78**

AP Engineering and Testing, Inc.
DBE|MBE|SBE
2607 Pomona Boulevard | Pomona, CA 91768
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com

UNCONFINED COMPRESSION TEST RESULTS
ASTM D 2166

Project Name:	804650A 500 Kv Darden Interconnection	Sample Type:	Mod Cal
Project No.:	LA235112	Soil Description	Clayey Sand
Boring No.:	SB-2	Dry Density (pcf):	110.4
Sample No.:	-	Moisture Content (%)	16.0
Depth (feet):	20	Test Date:	09/27/23
Sample Diameter (inch):	2.378	Wt. Wet Soil+Container(gms)	898.87
Sample Height (inch):	5.038	Wt. Dry Soil+Container(gms)	795.39
Sample Weight (gms):	752.05	Wt. Container (gms)	148.15



After Test

Load (lbs)	Deformation (inch)	Area (sq.in)	Compressive Stress (ksf)	Axial Strain (%)
0	0.000	4.44	0.00	0.00
5	0.005	4.44	0.16	0.10
12	0.010	4.45	0.39	0.20
26	0.020	4.46	0.84	0.40
35	0.025	4.46	1.13	0.50
45	0.030	4.47	1.45	0.60
102	0.060	4.49	3.27	1.19
155	0.090	4.52	4.94	1.79
204	0.120	4.55	6.46	2.38
242	0.150	4.58	7.61	2.98
255	0.179	4.60	7.98	3.55
252	0.184	4.61	7.87	3.65
240	0.195	4.62	7.48	3.87

Unconfined Compressive Strength (ksf) = **7.98**

AP Engineering and Testing, Inc.
DBE|MBE|SBE
2607 Pomona Boulevard | Pomona, CA 91768
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com

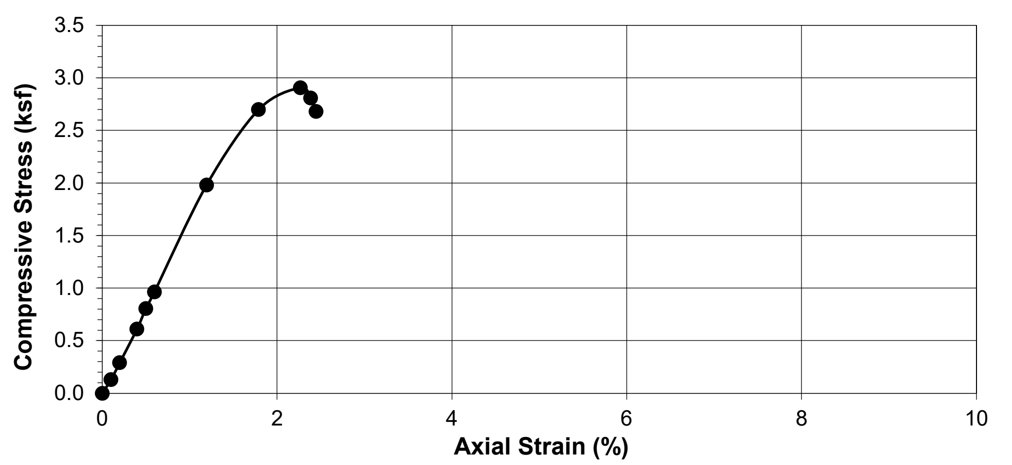
UNCONFINED COMPRESSION TEST RESULTS
ASTM D 2166

Project Name: 804650A 500 Kv Darden Interconnection
Project No.: LA235112
Boring No.: SB-3
Sample No.: -
Depth (feet): 35

Sample Type: Mod Cal
Soil Description: Clayey Sand
Dry Density (pcf): 105.2
Moisture Content (%): 15.7
Test Date: 09/27/23

Sample Diameter (inch): 2.381
Sample Height (inch): 5.031
Sample Weight (gms): 716.03

Wt. Wet Soil+Container(gms): 862.77
Wt. Dry Soil+Container(gms): 765.85
Wt. Container (gms): 148.19



After Test

Load (lbs)	Deformation (inch)	Area (sq.in)	Compressive Stress (ksf)	Axial Strain (%)
0	0.000	4.45	0.00	0.00
4	0.005	4.46	0.13	0.10
9	0.010	4.46	0.29	0.20
19	0.020	4.47	0.61	0.40
25	0.025	4.48	0.80	0.50
30	0.030	4.48	0.96	0.60
62	0.060	4.51	1.98	1.19
85	0.090	4.53	2.70	1.79
92	0.114	4.56	2.91	2.27
89	0.120	4.56	2.81	2.39
85	0.123	4.57	2.68	2.44

Unconfined Compressive Strength (ksf) = **2.91**

750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client
Dashiell Corporation

Project
804650A 500Kv Darden Interconnection

Sample Submitted By: Terracon (LA) **Date Received:** 9/21/2023 **Lab No.: 23-0524**

Results of Corrosion Analysis

Sample Number	--
Sample Location	SB-2
Sample Depth (ft.)	0.0-5.0
pH Analysis, ASTM G51	9.19
Water Soluble Sulfate (SO4), ASTM C 1580 (Percent %)	<0.01
Sulfides, AWWA 4500-S D, (mg/Kg)	Nil
Chlorides, ASTM D512, (mg/kg)	50
Red-Ox, ASTM G200, (mV)	+730
Total Salts, AWWA 2520 B, (mg/Kg)	471
Saturated Minimum Resistivity, ASTM G-57, (ohm-cm)	970

Analyzed By N. Campo
Nathan Campo
Engineering Technician III

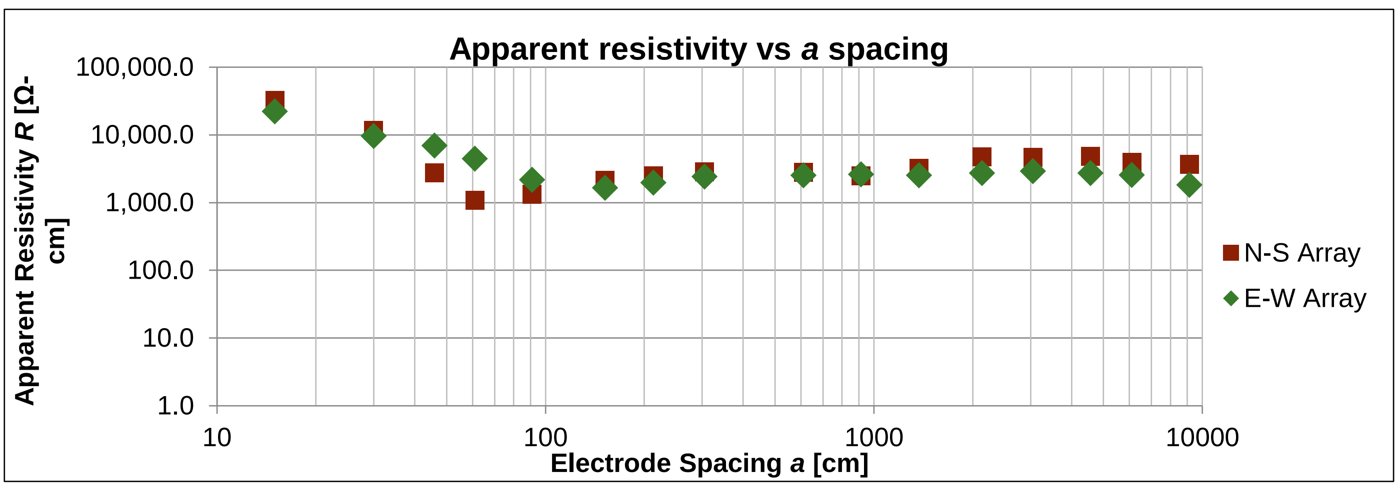
The tests were performed in general accordance with applicable ASTM and AWWA test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

Field Soil Electrical Resistivity Test Data

Array Loc.	ER-1 (36.423608°, -120.408223°)		
Instrument	CRI	**Weather**	Sunny 96°
Serial #	#201	**Ground Cond.**	Clayey Sand
Cal. Check		**Tested By**	Greg Mancini
Test Date	September 8, 2023	**Method**	Wenner 4-pin (ASTM G57-06 (2012); IEEE 81-2012)
Notes & Conflicts			

Apparent resistivity ρ is calculated as : $\rho = \dfrac{4\pi a R}{1 + \dfrac{2a}{\sqrt{a^2 + 4b^2}} - \dfrac{a}{\sqrt{a^2 + b^2}}}$

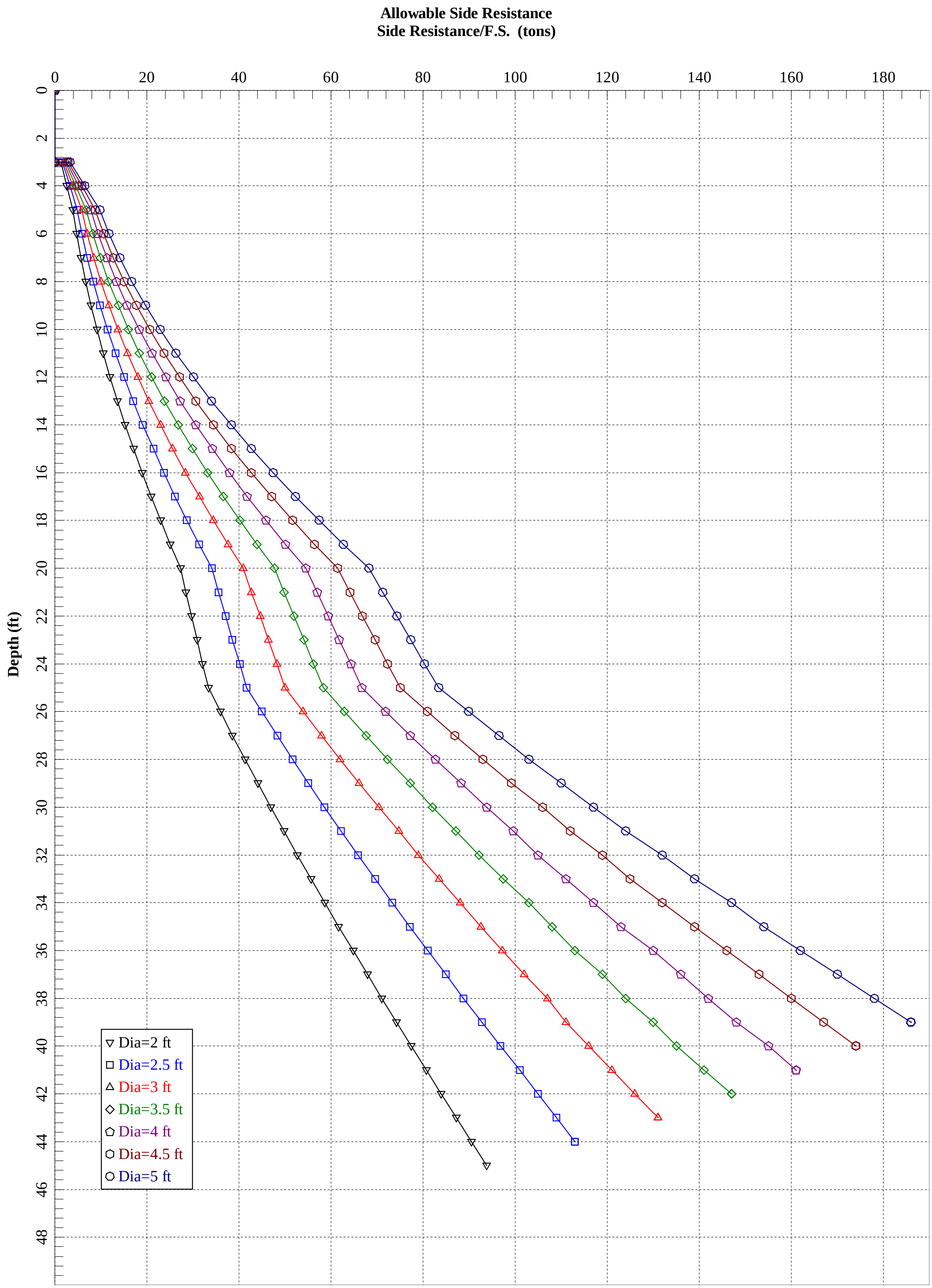
Electrode Spacing *a*		Electrode Depth *b*		N-S Test		E-W Test	
[feet]	[centimeters]	[inches]	[centimeters]	Measured Resistance *R* Ω	Apparent Resistivity ρ [Ω-cm]	Measured Resistance *R* Ω	Apparent Resistivity ρ [Ω-cm]
0.5	15	0.3	1	345	32750	234	22230
1	30	0.6	2	61.7	11720	50.7	9630
1.5	46	1.2	3	9.5	2770	23.9	6960
2	61	3.0	8	2.77	1090	11.28	4450
3	91	6.0	15	2.20	1320	3.63	2170
5	152	9.0	23	2.15	2130	1.67	1660
7	213	12.0	30	1.81	2510	1.42	1970
10	305	12.0	30	1.46	2850	1.25	2440
20	610	12.0	30	0.74	2840	0.66	2530
30	914	12.0	30	0.43	2500	0.45	2610
45	1372	12.0	30	0.37	3230	0.30	2550
70	2134	12.0	30	0.35	4710	0.20	2740
100	3048	12.0	30	0.24	4640	0.15	2930
150	4572	12.0	30	0.17	4800	0.10	2730
200	6096	12.0	30	0.10	3980	0.07	2570
300	9144	12.0	30	0.07	3730	0.03	1840

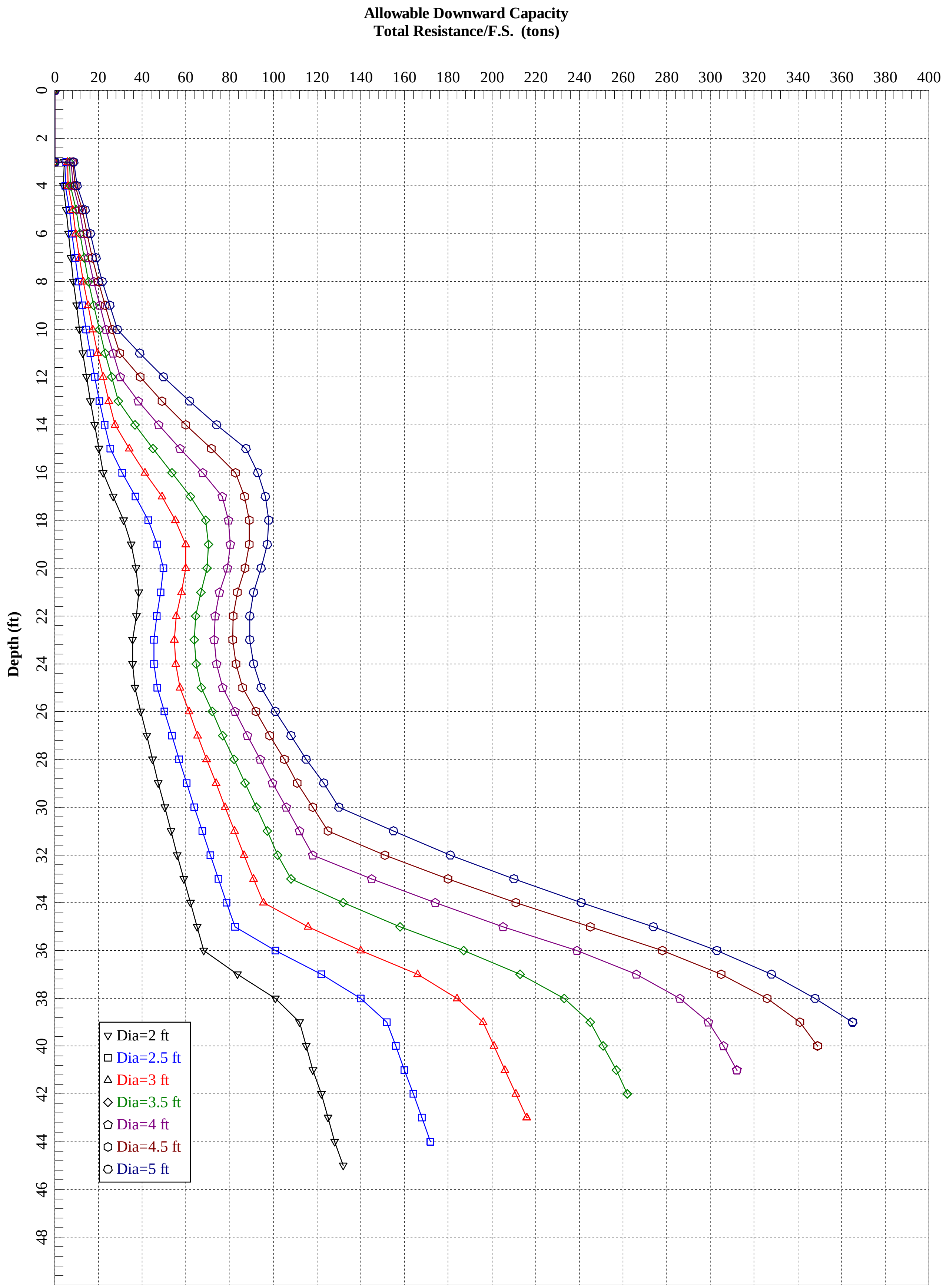


Supporting Information

Contents:

Note: All attachments are one page unless noted above.


Allowable Side Resistance
Side Resistance/F.S. (tons)
0
20
40
60
80
100
120
140
160
180
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=2 ft
Dia=2.5 ft
Dia=3 ft
Dia=3.5 ft
Dia=4 ft
Dia=4.5 ft
Dia=5 ft



Allowable Downward Capacity
Total Resistance/F.S. (tons)
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400
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=2 ft
Dia=2.5 ft
Dia=3 ft
Dia=3.5 ft
Dia=4 ft
Dia=4.5 ft
Dia=5 ft

Terracon
145 W Walnut St
Carson, CA

General Notes

Sampling	Water Level	Field Tests
Auger Cuttings Modified Dames & Moore Ring Sampler Standard Penetration Test	Water Initially Encountered Water Level After a Specified Period of Time Water Level After a Specified Period of Time Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N — Standard Penetration Test Resistance (Blows/Ft.) (HP) — Hand Penetrometer (T) — Torvane (DCP) — Dynamic Cone Penetrometer UC — Unconfined Compressive Strength (PID) — Photo-Ionization Detector (OVA) — Organic Vapor Analyzer

Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms

Relative Density of Coarse-Grained Soils (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance			**Consistency of Fine-Grained Soils** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Relative Density	**Standard Penetration or N-Value (Blows/Ft.)**	**Ring Sampler (Blows/Ft.)**	**Consistency**	**Unconfined Compressive Strength Qu (tsf)**	**Standard Penetration or N-Value (Blows/Ft.)**	**Ring Sampler (Blows/Ft.)**
Very Loose	0 - 3	0 - 6	Very Soft	less than 0.25	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	0.25 to 0.50	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium Stiff	0.50 to 1.00	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	1.00 to 2.00	8 - 15	10 - 18
Very Dense	> 50	> 99	Very Stiff	2.00 to 4.00	15 - 30	19 - 42
			Hard	> 4.00	> 30	> 42

Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

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.