City of Industry BESS and Substation

Revised Geotechnical Engineering Report

December 5, 2023 | Terracon Project No. LA235125

Prepared for:

AYPA City of Industry BESS
11801 Domain Development, Suite 450
Austin, Texas 78758

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December 5, 2023

AYPA City of Industry BESS
11801 Domain Development, Suite 450
Austin, Texas 78758

Attn: Mr. Matthew McCaffrey, Senior Director of Development
P: (415) 990-6611
E: mmccaffrey@aypa.com

Re: Revised Geotechnical Engineering Report
City of Industry BESS and Substation
16253 Gale Ave
City of Industry, Los Angeles County, California 91745
Terracon Project No. LA235125

Dear Mr. McCaffrey:

We have completed the scope of Revised Geotechnical Engineering services for the above referenced project in general accordance with Terracon Proposal No. PLA235125 dated September 8, 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 Battery Energy Storage Systems (BESS) and 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

Janna Valdez, E.I.T.
Staff Engineer

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

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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 Revised Geotechnical Engineering services performed for the proposed BESS and substation facility to be located at 16253 Gale Ave, City of Industry, Los Angeles County, California 91745. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Seismic site classification per CBC
- Site preparation and earthwork
- Foundation design and construction
- Lateral earth pressure
- Roadway Design and construction

The geotechnical engineering Scope of Services for this project included the advancement of test borings, electrical resistivity testing, 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 approximately 26.5 feet below ground surface (bgs) in the proposed BESS areas
- One (1) soil test boring to approximately 51.5 feet bgs in the proposed substation area
- Corrosion testing on soil samples obtained from one (1) location
- Lab thermal resistivity 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	An email request for proposal was provided by Priyanka Bist on August 8, 2023. The request included an image of the bounded area of the proposed site. Terracon prepared a proposal on August 16, 2023 with a Scope of Services for the proposed BESS. However, based on comments from the client, a geotechnical analysis is also requested for a proposed substation. As such, Terracon submitted a revised proposal on September 11, 2023 to include the substation in our geotechnical analysis.
Project Description	The project includes a new BESS facility. In addition, a small project substation will be developed southeast of the proposed project boundary and adjacent to the existing Walnut substation.
Proposed Structure	We anticipate that the facility will consist of battery storage units supported by grade beams or mat foundations and other appurtenant electrical equipment supported on drilled shaft foundations. We anticipate that the proposed substation will include transformers, turning poles and bus supports and other ancillary structures are anticipated to be supported on spread footings, mat foundations, or drilled shafts.
Maximum Loads	Structural loads were not provided, but have been estimated based on our experience ▪ BESS enclosure pads: 1,000 to 1,200 psf contact pressure ▪ BESS Axial Load: 75 kips ▪ BESS Shear Load: 5 kips ▪ Transformers: 500 – 1,000 psf contact pressure
Grading/Slopes	We assume that the field grade will follow the existing site grades with minimum grading required to bring the site to finish grade.

Item	Description
Access Roadways	We understand that the access road cross sections used for construction of the project will be the responsibility of AYPA. We anticipate low-volume access roads that will have a maximum vehicle load of 10,000 lbs. and will travel over the access roads only once per week.

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 16253 Gale Ave, City of Industry, Los Angeles County, California 91745. The project site encompasses a total area of approximately 6.54 acres. The coordinates of the approximate center of the site are 34.009°N, 117.951°W. See **Site Location**
Existing Improvements	Developments on site include a commercial building used for multiple businesses with associated landscaping, parking and drive areas. Adjacent to the site is Walnut substation. It is our understanding that the existing structure will be demolished and replaced with a BESS and substation facility.
Current Ground Cover	The majority of the site is covered in asphalt. Portions of the building connects to a concrete apron.
Existing Topography	The project site is generally flat with south to north elevations ranging from 348 to 354 feet.

Geotechnical Characterization

Subsurface Conditions

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.

Model Layer	Layer Name	Consistency/Density
1	**Sandy Lean Clay / Clayey Sand**	Medium stiff to hard
2	**Silty Sand / Poorly Graded Sand with Silt**	Medium dense to very dense
3	**Clayey Sand / Silty-Clayey Sand**	Medium dense to very dense

The geotechnical characterization forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. As noted in **General Comments**, the characterization is based upon widely spaced exploration points across the site, and variations are likely.

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 medium plasticity. A consolidation test indicated that the clayey soils encountered at an approximate depth of 2.5 feet bgs have a negligible collapse/swell potential when saturated under normal footing loads of 2,000 psf. Direct shear testing on clayey soils encountered at 5 feet indicate soils have an effective friction angle of approximately 26 degrees with apparent cohesion value of 190 psf. Maximum density/optimum moisture content testing conducted in accordance with ASTM D1557 (Modified Proctor) indicate that near surface soils tested have maximum dry densities of 123.8 pounds per cubic feet (pcf) and optimum water contents ranging from 12.1 percent. Expansion index testing on clayey soils encountered at the near surface soils indicate soils have an approximate expansion index value of 37.

Groundwater

Groundwater was observed in boring B-1, B-2 and B-5 at approximate depths of 21 to 26 feet bgs. In clayey soils with low permeability, the accurate determination of groundwater level may not be possible without long term observation. Long term observation after drilling could not be performed as borings were backfilled immediately upon completion due to safety concerns. Groundwater conditions may be different at the time of construction. Groundwater levels can best be determined by implementation of a groundwater monitoring plan.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident 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.

According to data collected from the Los Angeles County Public Works Water Data Livrart for the State of California from a nearby well 3048E, located approximately 2,200 feet northwest of the site, historic groundwater elevation level on October 30, 2023 were recorded at approximately 14 feet below ground surface.[1]

Based on our review of available historical topographic and aerial maps, the San Jose Creek Diversion Channel is located approximately 450 feet north and parallel from the project site. The approximate depth of the channel estimated based on Google Earth Imagery is approximately 10 to 15 feet.[2] This groundwater data corresponds to condition observed on-site.

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

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[1] Los Angeles Public Works. https://dpw.lacounty.gov/general/wells/#

[2] Historical Aerials. https://www.historicaerials.com/viewer

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)	34.009
Site Longitude (°W)	117.951
S_s Spectral Acceleration for a 0.2-Second Period	1.801
S_1 Spectral Acceleration for a 1-Second Period	0.641
F_a Site Coefficient for a 0.2-Second Period	1.0
F_v Site Coefficient for a 1-Second Period	1.7

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.

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

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 Whittier Alt 1, which is considered to have the most significant effect at the site from a design standpoint, has a maximum credible earthquake magnitude of 6.56 and is located approximately 4.90 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 0.852g. Furthermore, the site is not located within an Alquist-Priolo Earthquake Fault Zone based on our review of the State Fault Hazard Maps.[3]

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 exist below groundwater. The California Geological Survey (CGS) has designated certain areas 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 has been mapped and is located within a liquefaction hazard zone as designated by the California Geological Survey (CGS).

Seismic Settlement

Our explorations indicate the native soils encountered in exploratory borings generally consisted of medium stiff to hard sandy lean clay and medium dense to very dense silty/clayey sand a maximum exploration depth of 51½ feet bgs.

The proposed structures are considered Group U occupancy or having no human occupancy. To evaluate the presence of liquefiable soils and determine the amount of

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

settlement of saturated/unsaturated soils during seismic shaking, we performed liquefaction analysis in accordance with the Los Angeles County guidelines.

Groundwater was encountered in borings B-1, B-2 and B-5 at depths ranging from 21 to 26 feet bgs while drilling. Historic high groundwater levels were recorded at approximately 14 feet bgs.

We utilized the software "LiquefyPro" by CivilTech Software, using soil dated from boring B-5. A Peak Ground Acceleration (PGA_M) of 0.852g and assumed a magnitude of 6.78 for the 2% chance of exceedance over 50 years for the project site were used. Settlement analysis used the Tokimatsu, M-correction method. The fines percentage were corrected for liquefaction using the Modify Stark/Olson method. For this analysis a groundwater depth of 14 feet has been utilized.

Based on the calculation results, the seismically induced settlement is estimated to be on the order of ½ inch. Differential settlement is anticipated to be in the order of ¼ inch.

Results and calculations for the liquefaction analysis are included in the **Supporting Documents** section of this report.

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)	Soluble Sulfate (%)	Sulfides (ppm)	Chloride (mg/kg)	Red-Ox Potential (mV)	Electrical Resistivity (Ω-cm)	Total Salts (ppm)	pH
B-3	0-2.5	0.02	Nil	250	+720	1,416	938	8.11

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 one test array at one (1) location in the proposed project site. The approximate location of the test is 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. The test in the proposed locations included perpendicular arrays with "a" spacings 1, 2, 3, 6, 10, 18, 30, 40, 50, 70 and 100 feet. Spacings 150 and 200 feet were also proposed. However, these spacings were omitted due to site constraints from pedestrian and vehicle traffic. 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**.

Thermal Resistivity Testing

Terracon subcontracted Geotherm USA to perform laboratory thermal resistivity testing. Testing was conducted on two (1) bulk sample at the project site from a depth of 1 to 5 feets bgs within the proposed BESS area. The tests were conducted on soil samples remolded to 85% and 95% (as determined by ASTM D1557) of the material's maximum dry density for a total of two (2) tests. Dry out curves targeted the higher of either the in-situ moisture content of the optimum moisture content as determined by ASTM D1557, totally dry condition, and two intermediate points. The results are in the **Exploration Results** section of this report.

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.

The subsurface materials generally consisted of clay with varying amounts of sand and gravel, layered by sand with varying amount of clay and gravel extending to the maximum depth of the borings. Groundwater was not encountered in borings B-1, B-2 and B-5 at approximately 21 to 26 feet bgs.

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

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 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.

Expansion Index testing indicates these near surface lean clay soils exhibit EI values equal to 37, which is considered medium expansion potential. Due to the expansion potential and anticipated seismic settlement of the near surface soils, spread footings bearing on engineered fill are recommended for support of the proposed BESS/substation. Engineered fill should extend to a minimum depth of 3 feet below the bottom of foundations, depth of disturbed material from demolition of the existing building, or 5 feet below existing grades, whichever is greater. Grading for the proposed BESS/substation should incorporate the limits of the overexcavation plus a lateral distance of 3 feet beyond the outside edge of perimeter footings. Beyond site preparation and removal of disturbed soils associated with the demolition of the existing building, 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% 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.

Based on the findings summarized in this report, it is our professional opinion that the proposed construction will not be subjected to a hazard from settlement, slippage, or landslide, provided the recommendations of our report are incorporated into the proposed construction. It is also our opinion that the proposed construction will not adversely affect the geologic stability of the site or adjacent properties provided the recommendations contained in our report are incorporated into the proposed construction.

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.

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 pavement, debris, and other deleterious materials should be removed from proposed foundation and roadway 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.

Demolition of the existing building should include complete removal of all foundation systems and remaining underground utilities within the proposed construction area. This should include removal of any loose backfill found adjacent to existing foundations. All materials derived from the demolition of existing structures and pavements should be removed from the site and not be allowed for use as on-site fill, unless processed in accordance with the fill requirements included in this report.

In the event the contractor desires to crush on-site pavements and concrete and use these materials as engineered fill, the crushed materials should be evaluated and tested for compliance with the requirements and specifications of the State of California Department of Transportation, or other approved local governing specifications.

Although no evidence of fills, utilities, or underground facilities such as septic tanks, cesspools, basements, and utilities was observed during the site reconnaissance, such features could be encountered during construction. If unexpected fills, utilities, 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 structures may be supported by a shallow concrete foundation system bear on engineered fill, or drilled shafts.

Due to the expansion potential and seismic settlement of the near surface soils, spread footings bearing on engineered fill are recommended for support of the proposed BESS/substation equipment pads. Engineered fill should extend to a minimum depth of 3 feet below the bottom of foundations, to the depth of disturbed zone associated with demolition of the existing building, or 5 feet below existing grades, whichever is greater. Grading for the proposed BESS/substation should incorporate the limits of the overexcavation plus a lateral distance of 3 feet beyond the outside edge of perimeter footings. Beyond site preparation and removal of disturbed soils associated with the demolition of the existing building, overexcavation and replacement is not required for support of drilled shaft foundations.

Subgrade soils beneath proposed exterior slabs and roadways should be scarified to a minimum depth of 12 inches, moisture conditioned, and compacted. The moisture content and compaction of subgrade soils should be maintained until slab or pavement 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. 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 or pavement 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.

Prior to the construction phase of the project, additional evaluation of groundwater and fluctuations in groundwater levels should be performed. Depending upon the depth of excavation and seasonal conditions, groundwater may be encountered within the excavations planned on the site.

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 and Placement

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

Due to the on-site soil's expansion potential, they are not recommended for use as engineered fill within 12 inches of the bottom of lightly loaded (less than 500 psf contact pressure) equipment slab foundations. Such soils may be used as fill materials for engineered structural fill, general site grading and roadway areas. Imported low volume change soils should be used as engineered fill within 12 inches below lightly loaded slabs.

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(max)

- 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 on-site or imported fill soils:			
Beneath foundations:	90%	0%	+4%
Utility trenches (pavement and structural areas)[1]:	90%	0%	+4%
Fill greater than 5 feet in depth:	95%	0%	+4%
Exterior Slabs:	90%	0%	+4%
Miscellaneous backfill:	90%	0%	+4%
Aggregate base:	95%	0%	+4%

1. Upper 12 inches should be compacted to 95% within pavement and structural areas. Low-volume change imported soils should be used in lightly loaded equipment areas.

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.

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.

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. Imported low volume change soils should be used for trench backfill in structural areas.

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

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

Backfill against footings and in utility and sprinkler line trenches should be well compacted and structure of all construction debris to reduce the possibility of moisture infiltration.

We recommend a minimum horizontal setback distance of 10 feet from the perimeter of any structure and the high-water elevation of the nearest storm-water retention basin.

Roof drainage should discharge into splash blocks or extensions when the ground surface beneath such features is not protected by exterior slabs or paving. Sprinkler systems and landscaped irrigation should not be installed within 5 feet of foundation walls.

Exterior Slab Design and Construction

Exterior slabs-on-grade, exterior architectural features, and utilities founded on, or in backfill may experience some movement due to the volume change of the backfill. 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 of roadways. 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 roadway 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.

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.

The individual contractor(s) is responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. Excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current Occupational Safety and Health Administration (OSHA) excavation and trench safety standards.

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.

Shallow Foundations

We anticipate that the proposed BESS/substation equipment will be supported on either spread footings, mat foundation or drilled shafts.

Recommendations for foundation 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
Maximum Net Allowable Bearing Pressure [1, 2]	3,000 psf up to 4 feet wide 2,000 psf up to 7 feet wide

Item	Description
	1,000 psf up to 15 feet wide
Required Bearing Stratum [3]	Engineered fill extending to a minimum of 3 feet below the bottom of foundations, or 5 feet below existing grade, or the depth of undocumented fill/disturbed soils associated with demolition of the existing building, whichever is greater.
Design Modulus of Subgrade Reaction, k[3]	200 pounds per square inch per inch (psi/in) The modulus was obtained on estimates obtained from NAVFAC 7.1 design charts. This value is for a small-loaded area (1 sq.ft. or less) such as for forklift wheel loads or point loads and should be adjusted for larger loaded areas.
Modulus Correction Factor[3]	$k_c = k/B^2$
Minimum Embedment Below Finished Grade	18 inches
Minimum Dimensions	Square footings and mats: 24 inches Strip footings: 18 inches
Estimated Total Settlement from Structural Loads	About 1 inch
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**.
3. k values should be reduced to account for dimensional effects of largely loaded areas. Where kc is the corrected or design modulus value and B is the mat width in feet.

Settlement calculations were performed utilizing Westergaard and Hough's methods[4] to estimate the static settlement for various foundations widths with an allowable settlement of 1-inch.

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 foundation concrete below grade may be neglected in dead load computations.

Foundation should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement. Foundation excavations should be observed by the geotechnical engineer. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendation will be required.

Lateral Earth Pressures

Design Parameters

For engineered fill comprised of on-site soils or imported low volume change materials above any free water surface, recommended equivalent fluid pressure of unrestrained foundation elements are:

Item	Recommended Value
Active Case	40 psf/ft
Passive Case	330 psf/ft
At-Rest Case	65 psf/ft
Ultimate Coefficient of Sliding Friction	0.36

1. The values are based on engineered fill materials used as backfill.
2. Uniform, horizontal backfill, compacted to at least 90% of the ASTM D 1557 maximum dry density, rendering a maximum
3. Use of passive earth pressures require the sides of the excavation for the foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the

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

foundation forms be removed and compacted engineered fill be placed against the vertical foundation face
4. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Should be neglected for foundations subject to net uplift conditions.
5. Passive pressure and sliding friction may be combined to resist sliding provided that either the passive pressure or frictional resistance is reduced by 50 percent.

The lateral earth pressures herein do not include any factor of safety and are not applicable for submerged soils/hydrostatic loading. Additional recommendations may be necessary if such conditions are to be included in the design.

Fill against foundation walls should be compacted to densities specified in the Earthwork section of this report. Compaction of each lift adjacent to walls should be accomplished with hand-operated tampers of other lightweight compactors.

Deep Foundations

Drilled Shaft Design Recommendations

Proposed structures may be supported on drilled shafts. Total required embedment of the drilled shaft should be determined by the structural engineer based on structural loading and parameters provided in this report.

Drilled Shaft Axial Loading

Due to the presence of liquefiable soils between depths of about 29 feet and 32 feet below existing ground surface, drilled piers should not rely on end bearing or skin friction within this zone.

Allowable skin friction and total capacity charts are attached to our **Supporting Information** section at the end of this report. The values presented for allowable side friction and end bearing include a factor of safety of 2.5.

Drilled piers 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 piers in a group versus the capacity calculated using the perimeter and base of the pier group acting as a unit. The lesser of the two capacities should be used in design.

The allowable uplift capacities should only be based on the side 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. Tensile reinforcement should extend to the bottom of shafts subjected to uplift loading.

Drilled Shaft Lateral Loading

Based on our review of the subsurface conditions in the area of the BESS/substation, our laboratory testing, 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 for disturbance within the upper soils around the shaft, lateral and axial capacity of soils within the upper 2 feet should be neglected.

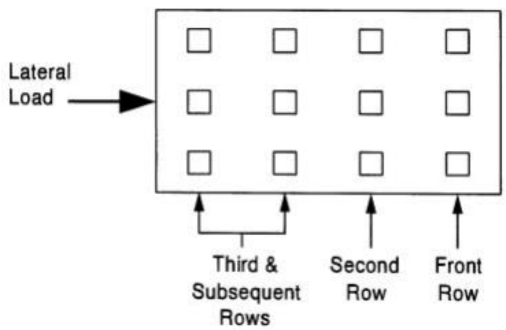
Recommended geotechnical parameters for lateral load analyses by others of drilled shaft foundations have been developed for use in the LPILE computer program. The following table summarizes input values for use in LPILE analyses. LPILE estimated values of k_h may be used. Since deflection or a service limit criterion will most likely control lateral capacity design, no safety/resistance factor is included with the parameters. **γ' (pcf)[2]**

Stratigraphy[1]		L-Pile Soil Model	ϕ[2]	Cohesion (psf)	γ' (pcf)[2]
Layer	Depth Below Finished Grade (feet)				
1	2 14	Stiff Clay w/o Water	--	900	120
2	14 20	Stiff Clay w/o Water	--	1,200	60
3	20 29	Sand	33	--	60
4	29 32	Sand	5[4]	--	60
5	32 40	Sand	33	--	60
6	40 50	Sand	36	--	60

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.
4. Low friction angle should be used for this zone to account for loss of strength associated with liquefaction occurring.

The load capacities provided herein are based on the stresses induced in the supporting soil strata. The structural capacity of the shafts/piles should be checked to assure they can safely accommodate the combined stresses induced by axial and lateral forces. Lateral deflections of shafts/piles should be evaluated using an appropriate analysis method, and will depend upon the pile's diameter, length, configuration, stiffness and "fixed head" or "free head" condition. We can provide additional analyses and estimates of lateral deflections for specific loading conditions upon request. The load-carrying capacity of shafts/piles may be increased by increasing the diameter and/or length.

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



1. Front row: Pm = 0.8
2. Second row: Pm = 0.4
3. Third and subsequent row: Pm= 0.3

For the case of a single row of piers supporting a laterally loaded grade beam, group action for lateral resistance of piers would need to be considered when spacing is less than five pier diameters (measured center-to-center). However, spacing closer than 3D (where D is the diameter of the pier) is not recommended due to the potential for the installation of a new pier disturbing an adjacent installed pier, likely resulting in axial capacity reduction.

Drilled Shaft Construction Considerations

Drilling to design depths should be possible with conventional single flight power augers. Due to sandy lean clay soils, temporary casing is not anticipated to be required during shaft excavation to approximate depth of 10 feet bgs. Temporary steel casing will likely be required to depths greater than 10 feet bgs to properly drill and clean shafts prior to concrete placement. If shafts extend below the depth of groundwater, a tremie should be used for concrete placement.

Drilled shaft foundation concrete should be placed immediately after completion of drilling and cleaning. 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 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.

Drilled pier end bearing surfaces must be thoroughly cleaned prior to concrete placement. A representative of the Geotechnical Engineer should inspect the bearing surface and foundation pier configuration. If the subsurface soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

The contractor should check for gas and/or oxygen deficiency before any workers enter the excavation for observation and manual cleanup. All necessary monitoring and safety precautions as required by OSHA, State or local codes should be strictly enforced.

Access Roadways

Compacted Native Soils Access Road Design Recommendations

Based upon the soil conditions encountered in the test borings, the use of on-site soils for construction of on-site roads is considered acceptable. Without the use of asphalt concrete or other hardened material to surface the roadways, there is an increased potential for erosion and rutting of the roadway to occur.

If high traffic loading is anticipated during wet seasons or when the upper soils are in saturated conditions, the proposed compacted soils road may experience wheel path rutting and depression on the order of 3 inches deep.

Construction of the un-surfaced roadways should consist of a minimum 12-inches of compacted on-site soils. More specifically, the upper ten inches of subgrade soils beneath existing grade, and any fill required to raise site grades should be moisture conditioned and compacted in accordance with **Fill Compaction Requirements**. The upper 12 inches beneath finish native soils road grade should also be compacted in accordance with **Fill Compaction Requirements**.

Positive drainage should be provided during construction and maintained throughout the life of the roadways. Proposed roadway design should maintain the integrity of the road and eliminate ponding. The un-surfaced roads are expected to function with periodic maintenance.

Aggregate Surface Roadway Design Recommendations

It is our understanding that aggregate surfaced roads will be utilized during the construction of this project.

Aggregate surface roadway design was conducted in general accordance with the Army Corps of Engineers (ACOE) Technical Manual TM-5-822, Design of Aggregate Surface Roads and Airfields (1990). The design was based on Category III, traffic containing as much as 15% trucks, but with not more than 1% of the total traffic composed of trucks having three or more axles (Group 3 vehicles), and Road Class G (Under 70 vehicles per day). Based on the Category and Road Class, a Design Index of 1 was utilized along with an estimated CBR of 3. Terracon should be contacted if significant changes in traffic loads or in the characteristics described are anticipated.

As a minimum, the aggregate surface course should have a minimum thickness of 6 inches and should be constructed over a minimum of 12 inches of scarified, moisture conditioned, and compacted native soils to 95% of the maximum dry density using ASTM D1557. The recommended thicknesses should be measured after full compaction. The width of the roadway should extend a minimum distance of 1 foot on each side of the desired surface width.

Aggregate materials should conform to the specifications of Class II aggregate base in accordance with the requirements and specifications of the State of California Department of Transportation (Caltrans), or other approved local governing specifications.

Positive drainage should be provided during construction and maintained throughout the life of the roadways. Proposed roadway design should maintain the integrity of the road and eliminate ponding.

Roadway Design and Construction Considerations

Regardless of the design, un-surfaced roadways will display varying levels of wear and deterioration. We recommend an implementation of a site inspection program at a frequency of at least once per year to verify the adequacy of the roadways. Preventative measures should be applied as needed for erosion control and re-grading. An initial site inspection should be completed approximately three months following construction.

Preventative maintenance should be planned and provided for through an on-going management program to enhance future roadway performance. Preventative maintenance activities are intended to slow the rate of deterioration, and to preserve the roadway investment.

Surfacing materials should not be placed when the surface is wet. Surface drainage should be provided away from the edge of roadways to reduce lateral moisture transmission into the subgrade.

If rut depths become excessive as construction work progresses, re-grading and re-compaction should be performed as necessary. Care should be taken to reduce or eliminate trafficking of the unpaved access road when the subgrade is wet as this will result in accelerated rutting conditions. Scarification, moisture treatment as necessary, and re-compaction of the roadways will likely be necessary as the roadways deteriorate.

Materials and construction of roadways for the project should be in accordance with the requirements and specifications of the California Department of Transportation or the applicable local governing body.

Maintenance

Periodic maintenance extends the service life of the aggregate-surfaced roadways and parking areas and should include re-grading and replacement of aggregate base course in any deteriorated areas. Thicker aggregate base course sections could be used to reduce the required maintenance and extend the service life of the aggregate-surfaced roadways. Design alternatives which could reduce the risk of subgrade saturation and improve long-term performance include installing surface drains next to any areas where surface water could pond. Properly designed and constructed subsurface drainage will reduce the time subgrade soils are saturated and can also improve subgrade strength and performance.

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.

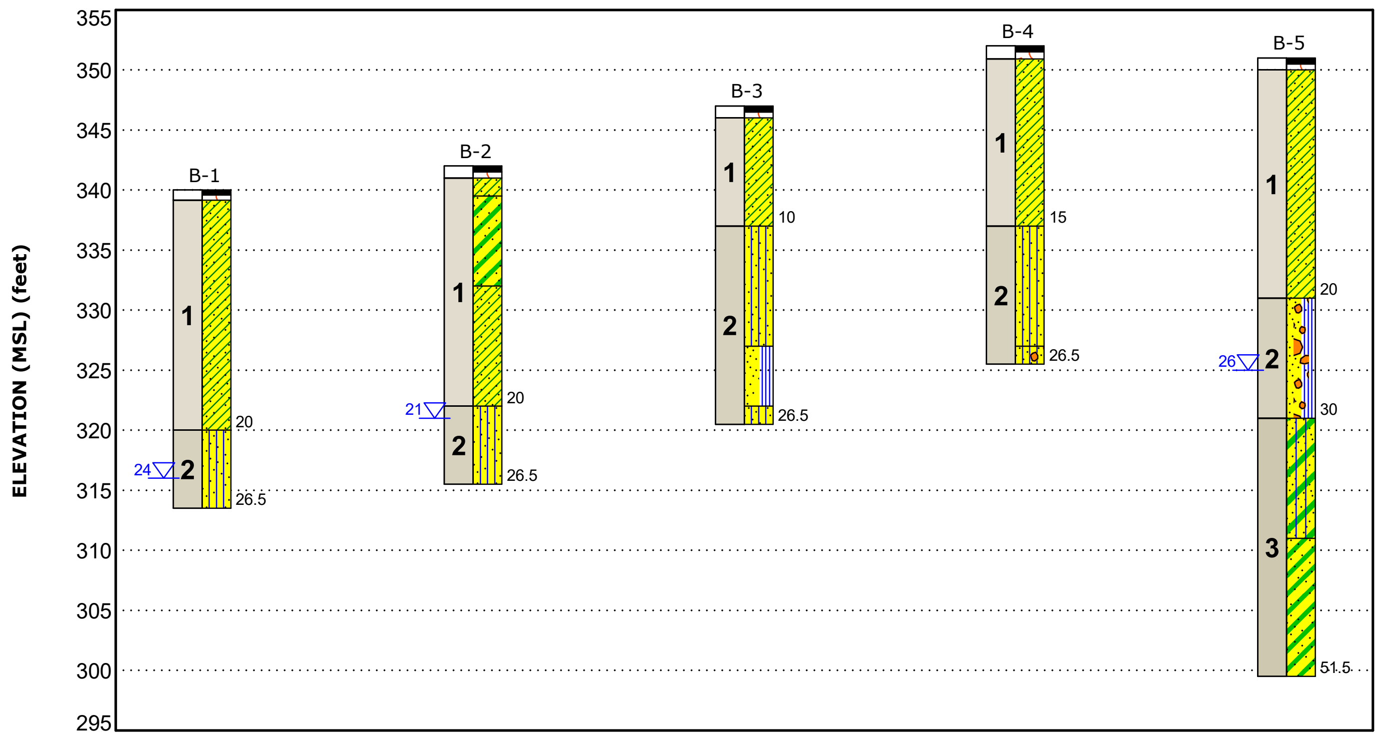
Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly effect excavation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

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	CL/SC	Sandy Lean Clay/Clayey Sand
2	SM/SP-SM	Silty Sand or Poorly Graded Sand with Silt
3	SC/SC-SM	Clayey Sand or Silty Clayey Sand

Legend

- Asphalt
- Aggregate Base Course
- Sandy Lean Clay
- Silty Sand
- Clayey Sand
- Poorly-graded Sand with Silt
- Silty Sand with Gravel
- Poorly-graded Sand with Silt and Gravel
- Silty Clayey Sand

First Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time.
Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

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. Numbers adjacent to soil column indicate depth below ground surface.

Attachments

Exploration and Testing Procedures

Field Exploration

Number of Borings	Approximate Boring Depth (feet)	Location
4	26.5 or auger refusal	Proposed BESS Area
1	51.5 or auger refusal	Proposed Substation Area

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 after their completion.

We also observed the boreholes while drilling and at the completion of drilling for the presence of groundwater. Groundwater was encountered in borings B-1, B-2 and B-5.

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 the 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
1	1, 2, 3, 6, 10, 18, 30, 40, 50, 70 and 100 feet	Proposed BESS and Substation Areas

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
- Compaction
- Swell Consolidation Test
- Direct Shear
- Corrosivity
- Thermal Resistivity

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

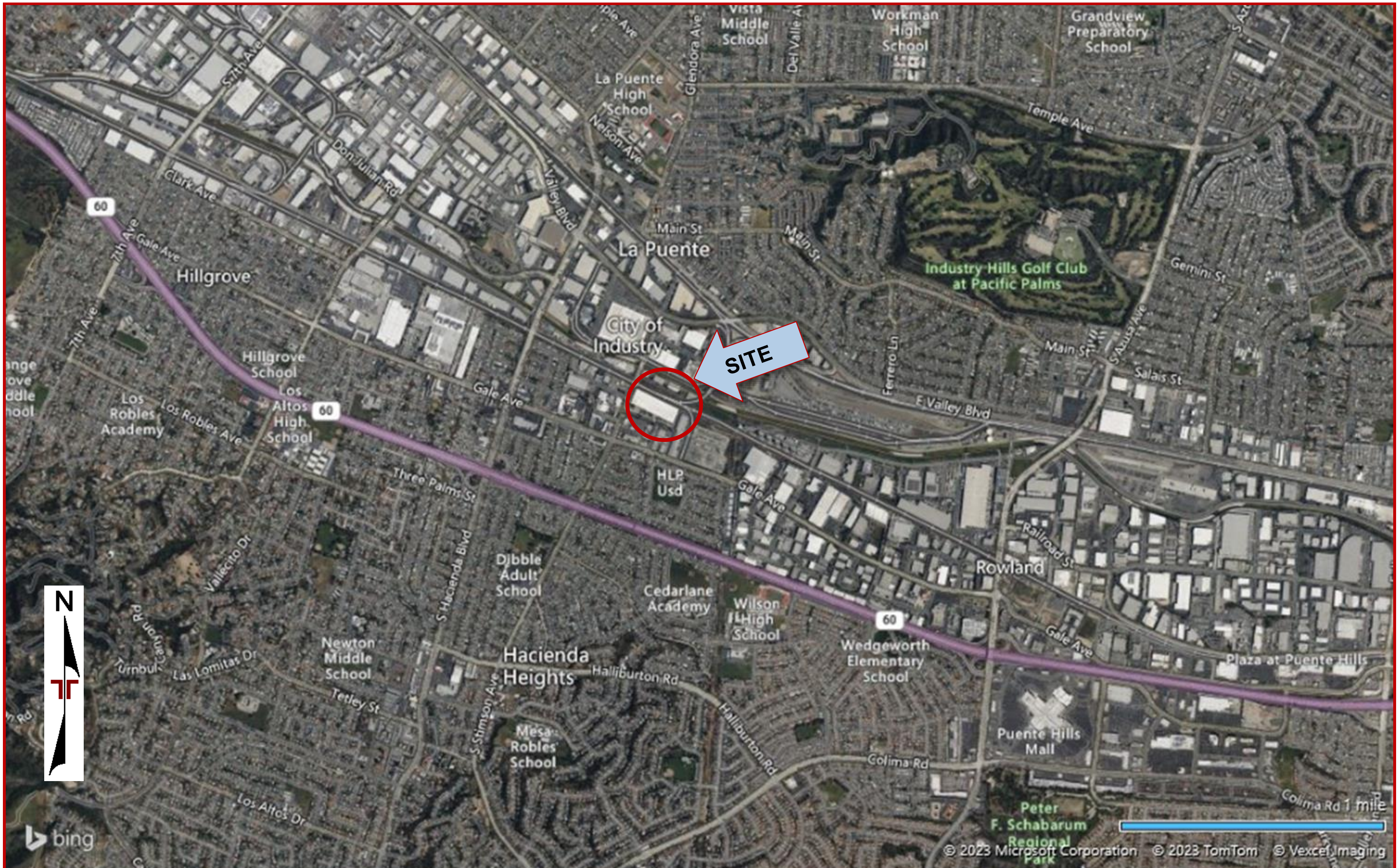


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

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.

Terracon
145 W Walnut St
Carson, CA

Boring Log No. B-1

Location: See Exploration Plan

Latitude: 34.0102° Longitude: -117.9515°

Model Layer	Depth (Ft.)	Material Description	Water Level Observations	Sample Depth (Ft.)	Field Test Results	Expansion Index	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	0.4	**ASPHALT**, 5'' thickness								
	0.8	**AGGREGATE BASE COURSE**, 5'' thickness								
1		**SANDY LEAN CLAY (CL)**, dark brown				37				
		stiff			5-6-8		19.3	99	37-11-26	
				5	4-4-5 N=9					
		very stiff			8-10-14		17.6	112		
		stiff		10	12-4-5 N=9					62
				15	7-8-8		20.2	101		
	20.0									
2		**SILTY SAND (SM)**, trace gravel, brown, medium dense		20	5-6-7 N=13					
			▽							
	26.5			25	13-14-18		12.7	116		
		Boring Terminated at 26.5 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
▽ While drilling

Notes

Advancement Method
8'' Hollow Stem Auger

Abandonment Method
Boring backfilled with bentonite grout upon completion

Drill Rig
D-70 Turbo

Hammer Type
Automatic

Driller
24/7 Drilling

Logged by
TA

Boring Started
10-26-2023

Boring Completed
10-26-2023

Boring Log No. B-2

Location: See Exploration Plan

Latitude: 34.0096° Longitude: -117.9510°

Model Layer	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
	0.5	**ASPHALT**, 6'' thickness								
	1.0	**AGGREGATE BASE COURSE**, 6'' thickness								
1	2.5	**SANDY LEAN CLAY (CL)**, brown			Grab					
1		**CLAYEY SAND (SC)**, brown, medium dense			SPT	4-5-5 N=10				
1			5		Ring	10-13-16	12.1	116		38
1	10.0				SPT	5-6-8 N=14				
1		**SANDY LEAN CLAY (CL)**, brown, very stiff	10		Ring	11-17-19	21.5	101	46-18-28	
1	20.0	hard	15		SPT	15-20-21 N=41				
2		**SILTY SAND (SM)**, trace gravel, brown, medium dense	20	▽	Ring	12-15-17	8.2	114		
2	26.5		25		SPT	9-9-10 N=19				

Boring Terminated at 26.5 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
▽ While drilling

Advancement Method
8'' Hollow Stem Auger

Abandonment Method
Boring backfilled with bentonite grout upon completion

Drill Rig
D-70 Turbo

Hammer Type
Automatic

Driller
24/7 Drilling

Logged by
TA

Boring Started
10-27-2023

Boring Completed
10-27-2023

AYPA - City of Industry BESS
16253 Gale Ave | City of Industry, CA
Terracon Project No. LA235125

Terracon
145 W Walnut St
Carson, CA

Boring Log No. B-3

Location: See Exploration Plan

Latitude: 34.0091° Longitude: -117.9519°

Model Layer	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
	0.5	**ASPHALT**, 6'' thickness									
	1.0	**AGGREGATE BASE COURSE**, 6'' thickness									
1		**SANDY LEAN CLAY (CL)**, trace gravel, brown			Grab						
1		very stiff			Ring	22-17-18		9.6	114		
1		stiff	5		SPT	5-6-7 N=13					
1	10.0	hard			Ring	15-20-28		8.7	117		
2		**SILTY SAND (SM)**, brown, medium dense	10		SPT	10-11-12 N=23					29
2	20.0		15		Ring	16-21-22		9.5	111		
2	25.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown, very dense	20		SPT	18-27-29 N=56					
2	26.5	**SILTY SAND (SM)**, brown, dense	25		Ring	17-35-37		6.8	114		
		Boring Terminated at 26.5 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
8'' Hollow Stem Auger

Abandonment Method
Boring backfilled with bentonite grout upon completion

Drill Rig
D-70 Turbo

Hammer Type
Automatic

Driller
24/7 Drilling

Logged by
TA

Boring Started
10-26-2023

Boring Completed
10-26-2023

Terracon
145 W Walnut St
Carson, CA

Boring Log No. B-4

Location: See Exploration Plan

Latitude: 34.0083° Longitude: -117.9522°

Model Layer	Depth (Ft.) / Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Expansion Index	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	0.5 **ASPHALT**, 6'' thickness									
	1.1 **AGGREGATE BASE COURSE**, 7'' thickness									
1	**SANDY LEAN CLAY (CL)**, dark brown									
1	medium stiff				2-3-4 N=7					71
1	very stiff	5			6-9-11		15.8	113		
1	stiff				3-4-6 N=10				35-12-23	
1	brown, very stiff	10			10-11-14		12.0	113		
1	15.0									
2	**SILTY SAND (SM)**, dark brown, medium dense	15			5-5-7 N=12					
2	dense	20			25-35-38		11.2	119		
2	25.0									
2	**SILTY SAND WITH GRAVEL (SM)**, brown, very dense	25			17-24-28 N=52					
2	26.5									
	Boring Terminated at 26.5 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
8'' Hollow Stem Auger

Abandonment Method
Boring backfilled with bentonite grout upon completion

Drill Rig
D-70 Turbo

Hammer Type
Automatic

Driller
24/7 Drilling

Logged by
TA

Boring Started
10-26-2023

Boring Completed
10-26-2023

Terracon
145 W Walnut St
Carson, CA

Boring Log No. B-5

Location: See Exploration Plan

Latitude: 34.0077° Longitude: -117.9518°

Model Layer	Depth (Ft.)	Material Description	Sample Depth (Ft.)	Water Level Observations	Field Test Results	Expansion Index	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	0.5	**ASPHALT**, 6'' thickness								
	1.0	**AGGREGATE BASE COURSE**, 6'' thickness								
1		**SANDY LEAN CLAY (CL)**, dark brown								
		very stiff	2.5–4		10-12-15		17.1	111		
		medium stiff	5–6.5		3-4-4 N=8				35-13-22	
		very stiff	7.5–9		9-9-10		15.3	115		
			10–11.5		6-8-10 N=18					50
			15–16.5		11-14-16		15.7	109		
	20.0									
2		**POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)**, brown, dense	20–21.5		12-18-18 N=36					12
		medium dense	25–26.5	▽	10-25-31		6.8	95		
	30.0									

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
▽ While drilling

Advancement Method
8'' Hollow Stem Auger

Abandonment Method
Boring backfilled with bentonite grout upon completion

Drill Rig
D-70 Turbo

Hammer Type
Automatic

Driller
24/7 Drilling

Logged by
TA

Boring Started
10-27-2023

Boring Completed
10-27-2023

Terracon
145 W Walnut St
Carson, CA

Boring Log No. B-5

Location: See Exploration Plan

Latitude: 34.0077° Longitude: -117.9518°

Model Layer	Graphic Log	Depth (Ft.)	Material Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Expansion Index	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
3			**SILTY CLAYEY SAND (SC-SM)**, brown, medium dense				4-7-7 N=14					20
				35			10-11-12 N=23					
		40.0	**CLAYEY SAND (SC)**, brown, dense	40			15-20-21 N=41					
			very dense	45			13-22-40 N=62					
				50			15-35-30 N=65					
		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
While drilling

Advancement Method
8" Hollow Stem Auger

Abandonment Method
Boring backfilled with bentonite grout upon completion

Drill Rig
D-70 Turbo

Hammer Type
Automatic

Driller
24/7 Drilling

Logged by
TA

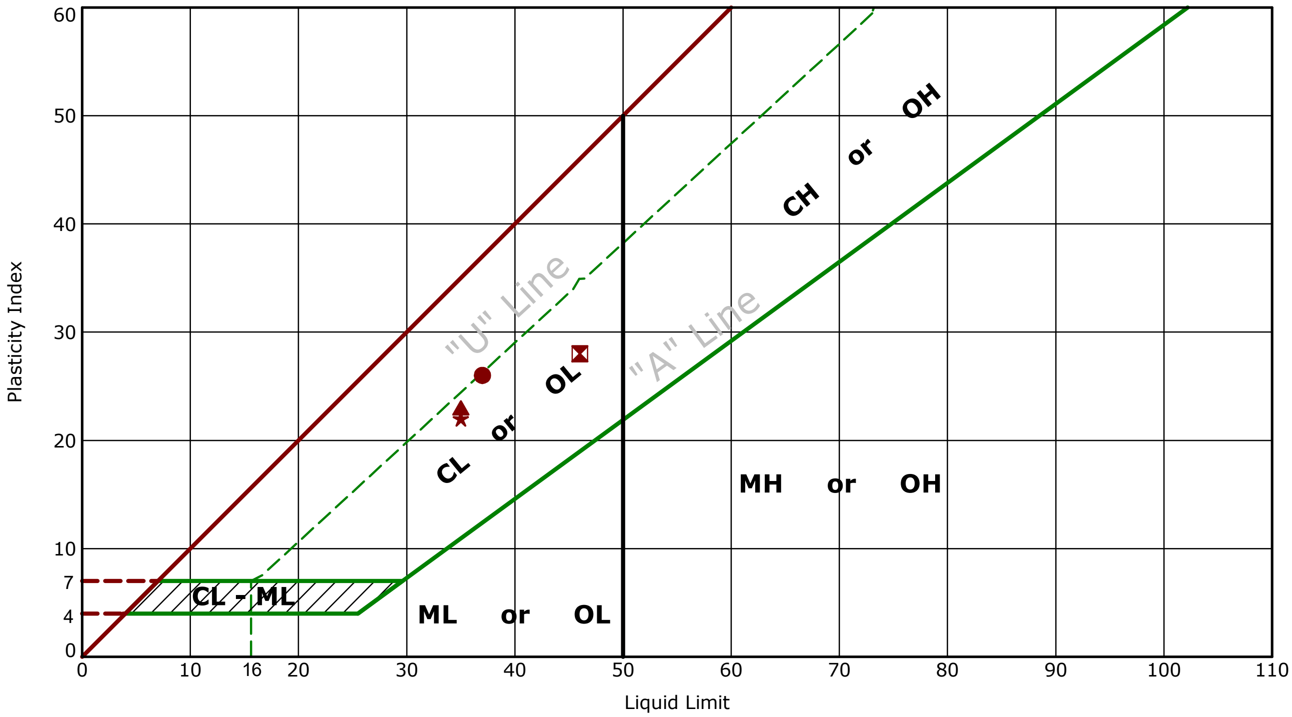
Boring Started
10-27-2023

Boring Completed
10-27-2023

145 W Walnut St
Carson, CA

Atterberg Limit Results

ASTM D4318

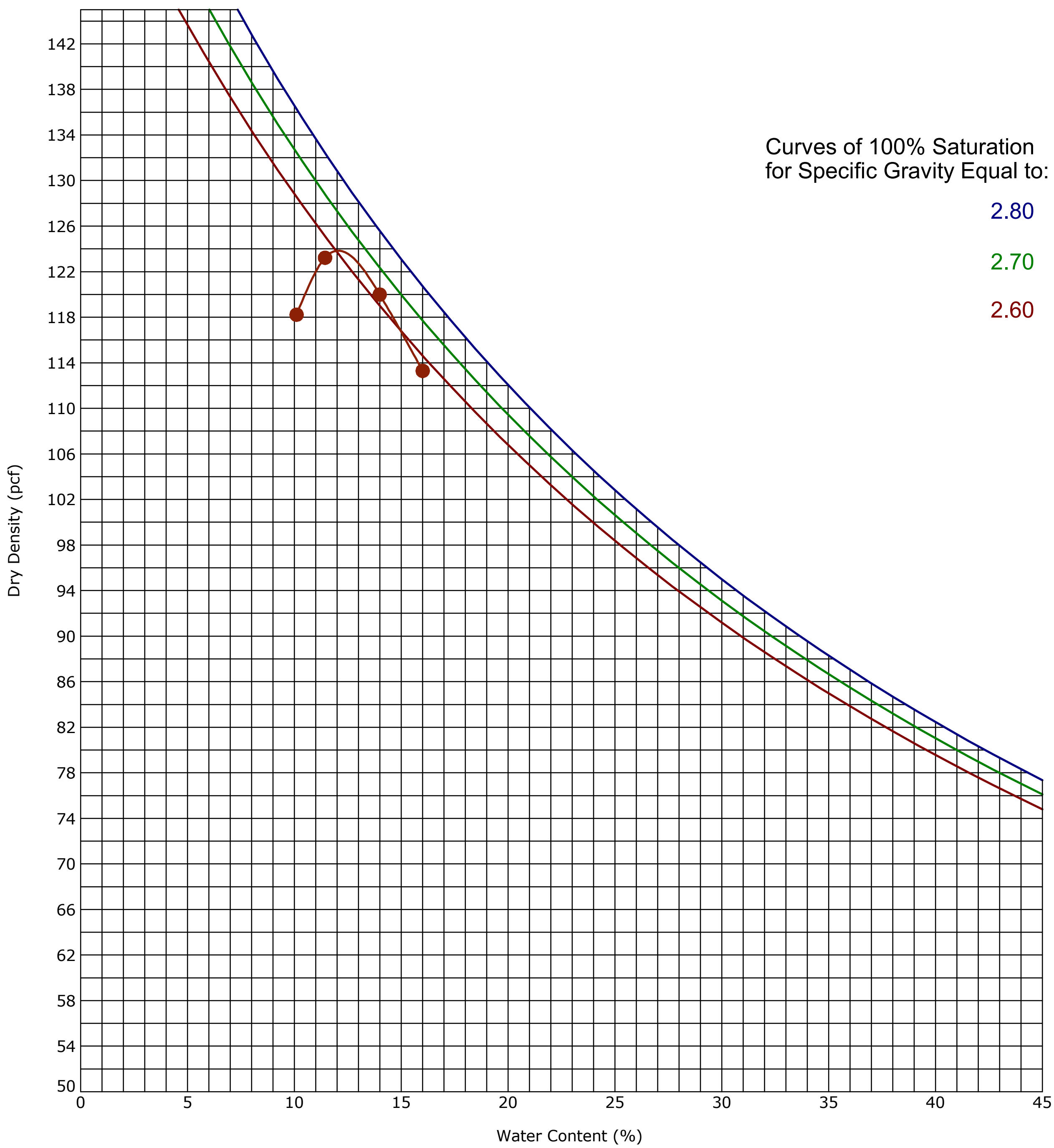


	Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	B-1	2.5 - 4	37	11	26		CL	SANDY LEAN CLAY
⊠	B-2	10 - 11.5	46	18	28		CL	SANDY LEAN CLAY
▲	B-4	7.5 - 9	35	12	23		CL	SANDY LEAN CLAY
★	B-5	5 - 6.5	35	13	22		CL	SANDY LEAN CLAY

145 W Walnut St
Carson, CA

Moisture-Density Relationship

ASTM D1557-Method A



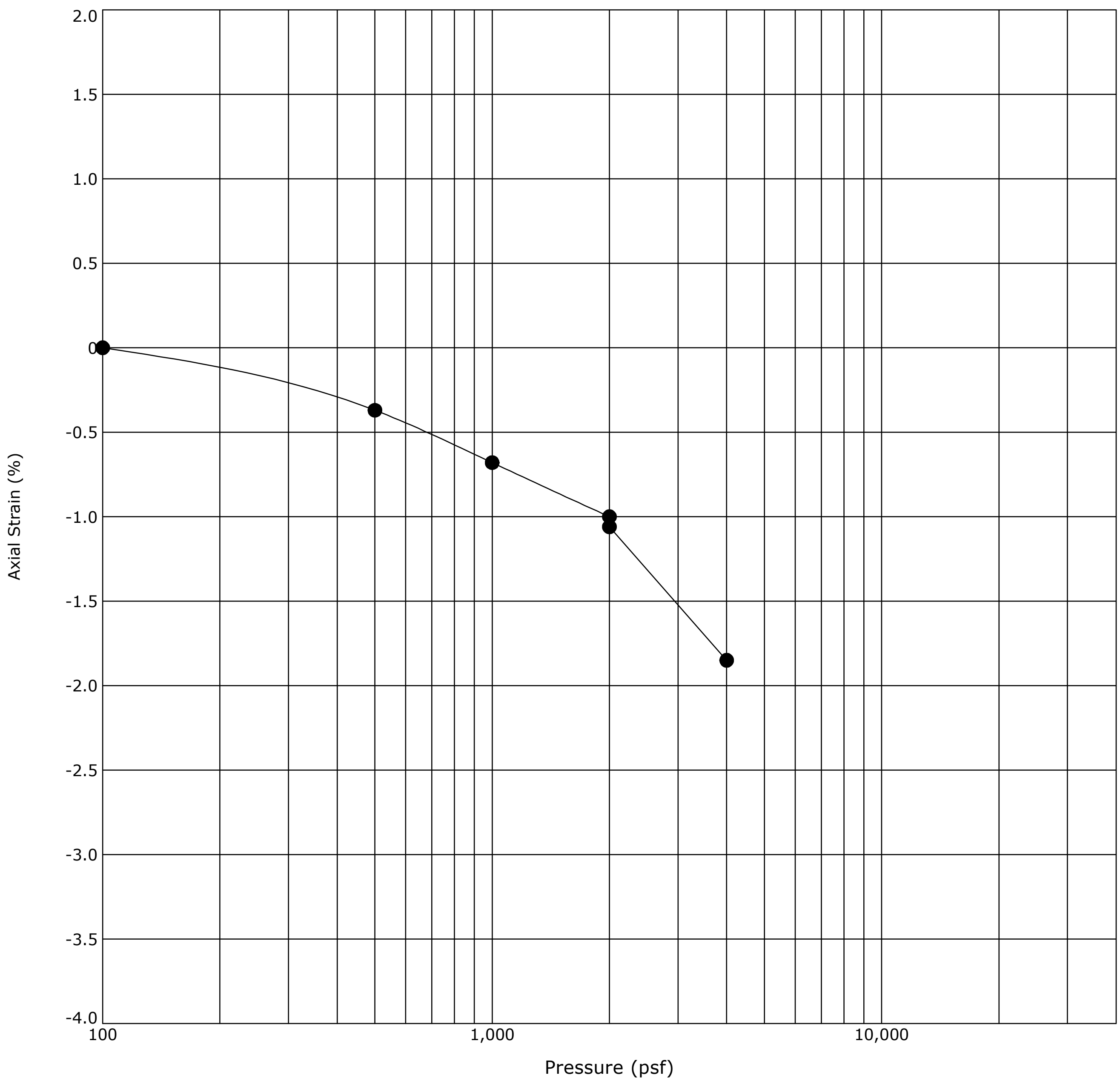
Boring ID	Depth (Ft)	Description of Materials
B-4	0 - 5	SANDY LEAN CLAY

Fines (%)	Fraction > mm size	LL	PL	PI	Test Method	Maximum Dry Density (pcf)	Optimum Water Content (%)
					ASTM D1557-Method A	123.8	12.1

145 W Walnut St
Carson, CA

Swell Consolidation Test

ASTM D2435



	Boring ID	Depth (Ft)	Description	USCS	γ_d(pcf)	WC (%)
●	B-3	2.5 - 4	SANDY LEAN CLAY	CL	114	9.6

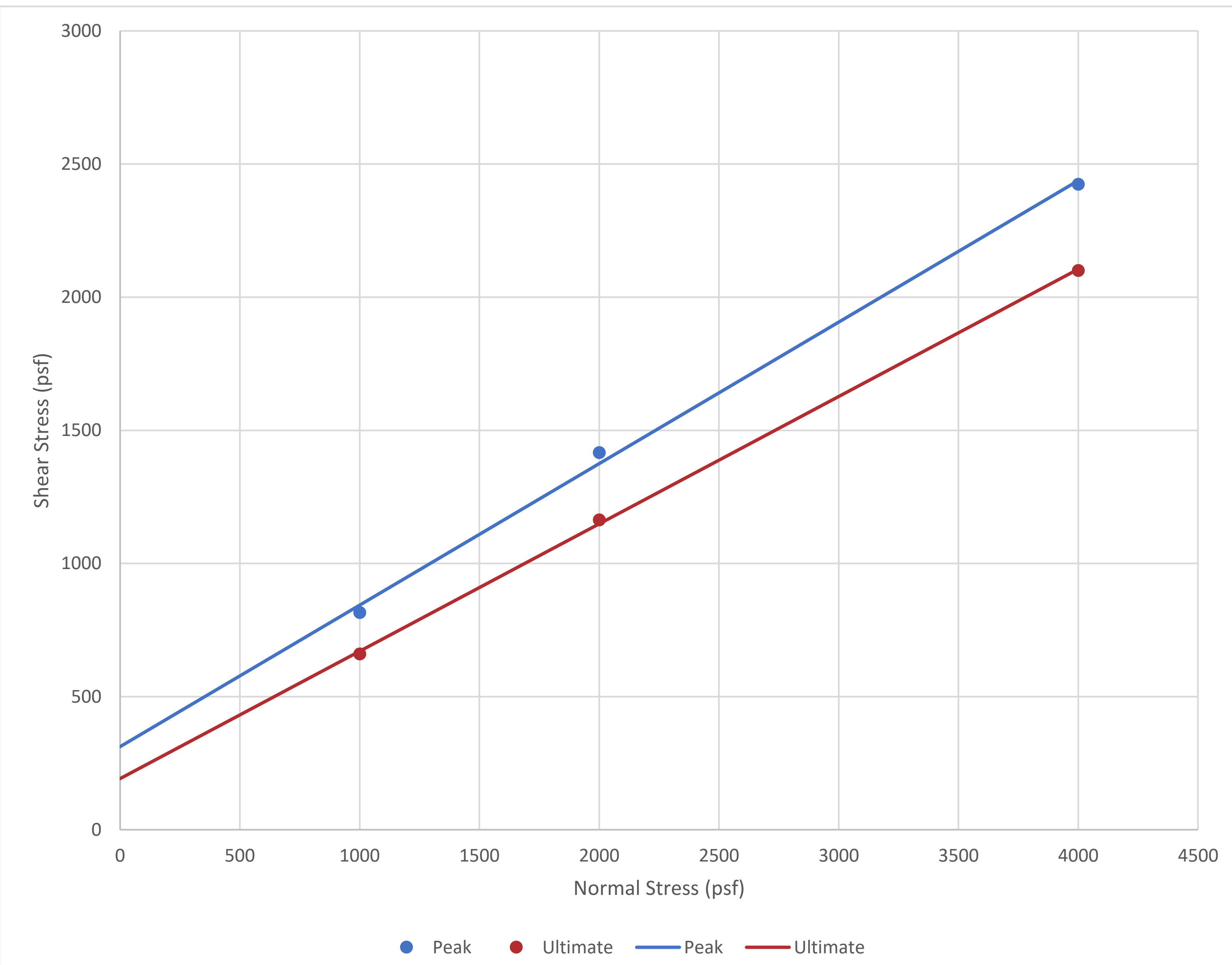
Notes: water added at 2000 psf

145 W Walnut St.
Gardena, CA

Direct Shear Test
ASTM D3080

Boring ID	Depth (ft)	Description	USCS	γ_d (pcf)	W(%)
B-4	5	Sandy Lean Clay	CL	113	15.8

Normal Stress (psf)	Peak Shear Stress (psf)	Ultimate Shear Stress (psf)	Peak		Ultimate	
			φ°	C (psf)	φ°	C (psf)
1000	816	660	**28.0**	**310**	**26.0**	**190**
2000	1416	1164				
4000	2424	2100				



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

Client
Aypa Power LLC

Project
AYPA - City of Industry BESS

Sample Submitted By: Terracon (LA) **Date Received:** 11/5/2023 **Lab No.: 23-0586**

Results of Corrosion Analysis

Sample Number	--
Sample Location	B-3
Sample Depth (ft.)	0.0-2.5
pH Analysis, ASTM G51	8.11
Water Soluble Sulfate (SO4), ASTM C 1580 (Percent %)	0.02
Sulfides, AWWA 4500-S D, (mg/Kg)	Nil
Chlorides, ASTM D512, (mg/kg)	250
Red-Ox, ASTM G200, (mV)	+720
Total Salts, AWWA 2520 B, (mg/Kg)	1416
Saturated Minimum Resistivity, ASTM G-187, (ohm-cm)	938

Analyzed By N. Campo
Nathan Campo
Laboratory Coordinator

21239 FM529 Rd., Bldg. F
Cypress, TX 77433
Tel: 281-985-9344
Fax: 832-427-1752
info@geothermusa.com
http://www.geothermusa.com

November 28, 2023

Terracon
145 W. Walnut Street
Carson, CA 90248
Attn: Janna Alexia Valdez, E.I.T.

Re: Thermal Analysis of Native Soil Sample
AYPA City of Industry BESS – City of Industry, CA (Project No. LA235125)

The following is the report of thermal dryout characterization tests conducted on one (1) native soil sample from the referenced project sent to our laboratory.

Thermal Resistivity Tests: The sample was tested at either "optimum" or at "in-situ" moisture content whichever is higher and at 85% and 95% of the standard Proctor dry density ***provided by Terracon***. The tests were conducted in accordance with the **IEEE standard 442-2017**. The results are tabulated below and the thermal dryout curves are presented in **Figure 1.**

Sample ID, Description, Thermal Resistivity, Moisture Content and Density

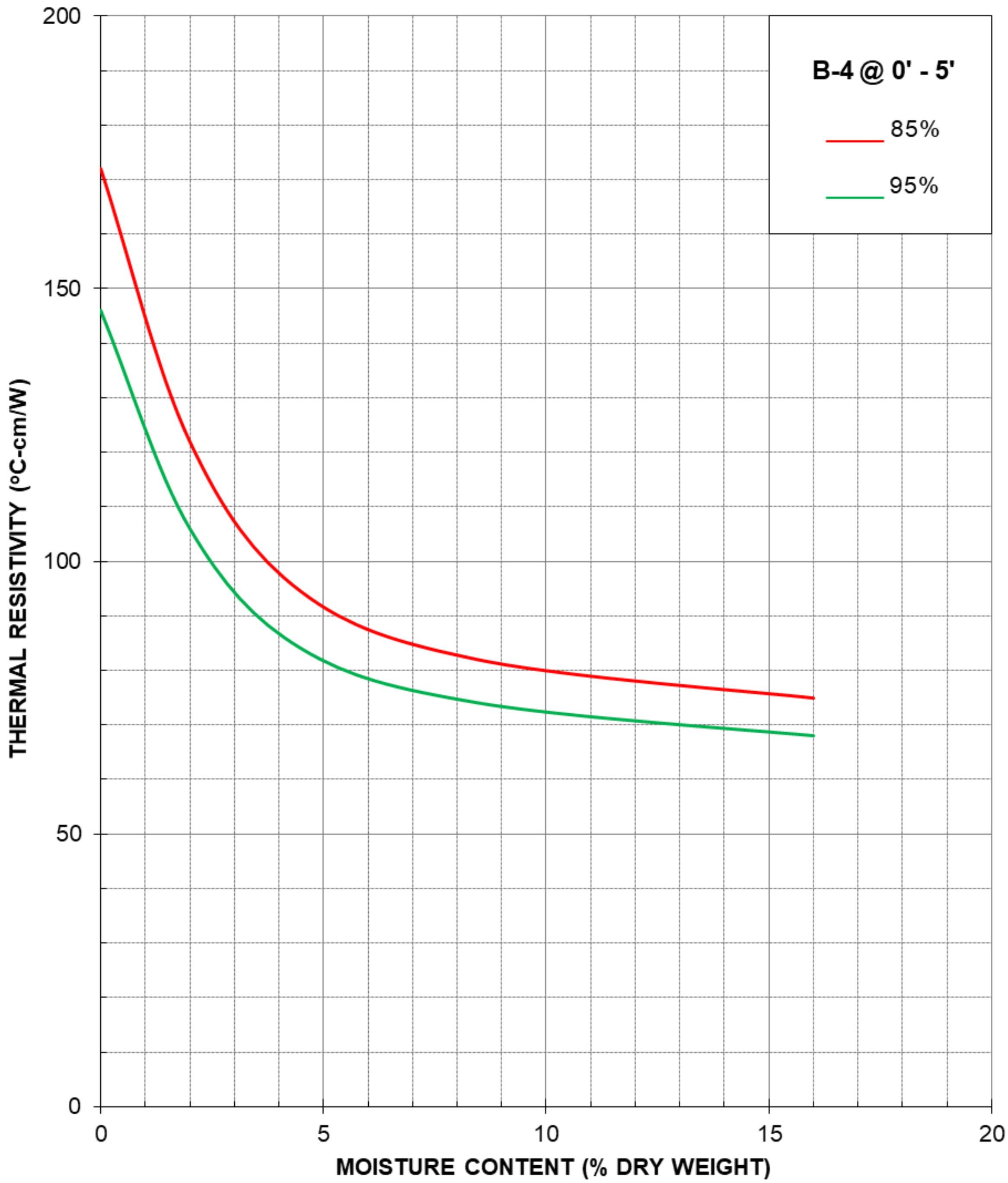
Sample ID	Depth (ft)	Effort (%)	Description (Terracon)	Thermal Resistivity (°C-cm/W)		Moisture Content (%)	Dry Density (lb/ft^3)
				Wet	Dry		
B-4	0 – 5	85	Silty Sandy Clay, Dark Brown	75	172	16	96
B-4	0 – 5	95	Silty Sandy Clay, Dark Brown	68	146	16	107

Please contact us if you have any questions or if we can be of further assistance.

Geotherm USA

Nimesh Patel

THERMAL DRYOUT CURVES



Terracon (Project No. LA235125)

AYPA City of Industry BESS – City of Industry, CA

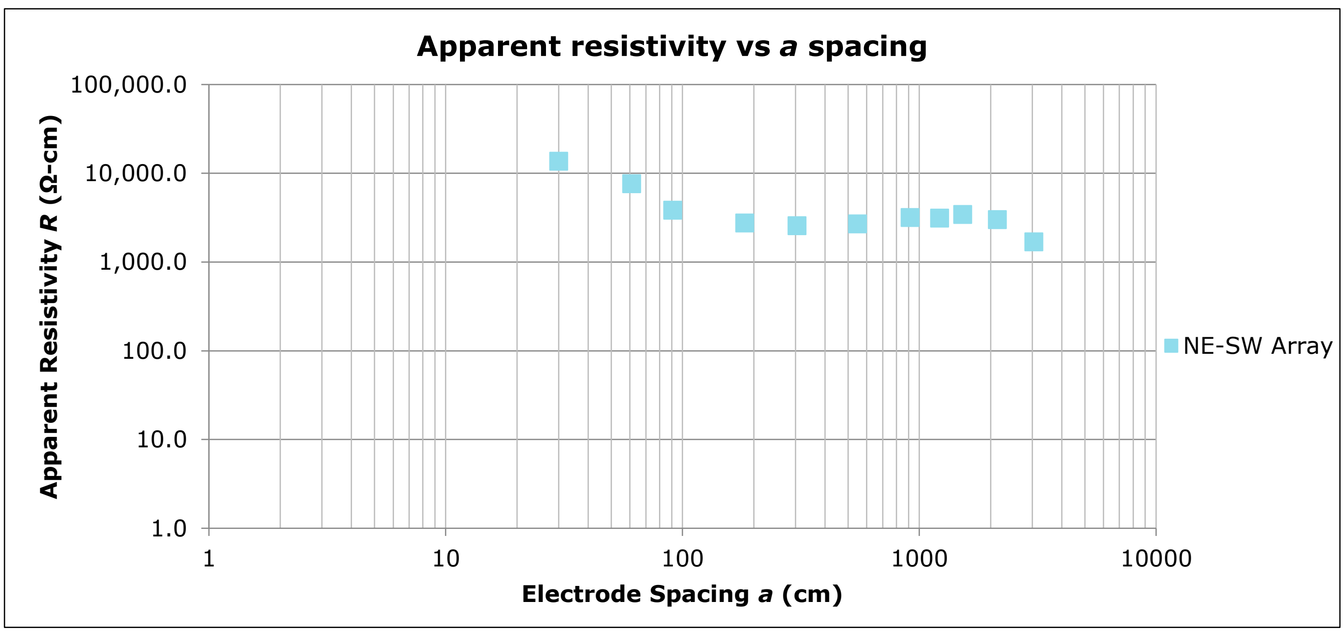
Thermal Analysis of Native Soil Sample

November 2023 **Figure 1**

Array Loc.	ER-1 (34.0003, -117.9531)		
Instrument	MiniSting	**Weather**	Sunny
Serial #	S2107129	**Ground Cond.**	Exposed Soils
Cal. Check	July 14, 2021	**Tested By**	DM/AC
Test Date	October 20, 2023	**Method**	Wenner 4-pin (ASTM G57-06 (2012); IEEE 81-2012)
Notes & Conflicts	Due to site constraints from pedestrian and vehicle traffic, spacings 150 and 200 feet were omitted		

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***		**NE-SW Test**	
(feet)	(centimeters)	(inches)	(centimeters)	Measured Resistance *R* Ω	Apparent Resistivity *ρ* (Ω-cm)
1	30	1	3	71	13640
2	61	1.5	4	20	7610
3	91	2	5	6.6	3810
6	183	3	8	2.4	2750
10	305	6	15	1.3	2550
18	549	9	23	0.8	2690
30	914	12	30	0.5	3160
40	1219	12	30	0.4	3120
50	1524	12	30	0.4	3420
70	2134	12	30	0.2	2990
100	3048	12	30	0.1	1680



Supporting Information

Contents:

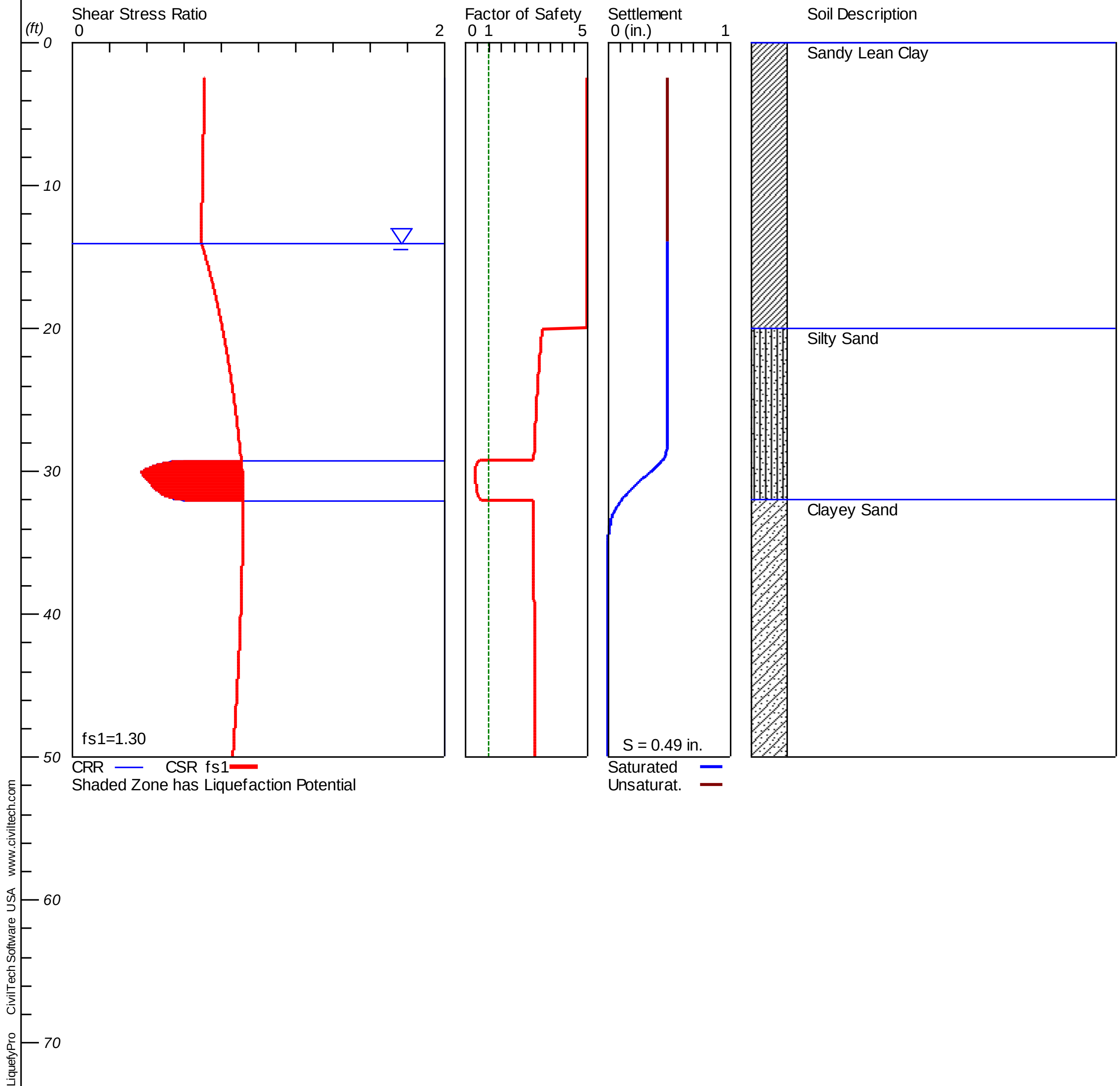
Note: All attachments are one page unless noted above.

LIQUEFACTION ANALYSIS

LA235125

Hole No.=B-5 Water Depth=14 ft Surface Elev.=351

Magnitude=6.78
Acceleration=0.852g



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LIQUEFACTION ANALYSIS SUMMARY

****
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Font: Courier New, Regular, Size 8 is recommended for this report.
Licensed to ,   11/14/2023   12:44:28 PM

Input File Name: C:\Users\sdhital\OneDrive - Terracon Consultants Inc\Desktop\4Janna\B-5.liq
Title: LA235125
Subtitle: AYPA City of Industry BESS

Surface Elev.=351
Hole No.=B-5
Depth of Hole= 50.00 ft
Water Table during Earthquake= 14.00 ft
Water Table during In-Situ Testing= 14.00 ft
Max. Acceleration= 0.85 g
Earthquake Magnitude= 6.78

Input Data:
Surface Elev.=351
Hole No.=B-5
Depth of Hole=50.00 ft
Water Table during Earthquake= 14.00 ft
Water Table during In-Situ Testing= 14.00 ft
Max. Acceleration=0.85 g
Earthquake Magnitude=6.78
No-Liquefiable Soils: CL, OL are Non-Liq. Soil

1. SPT or BPT Calculation.
2. Settlement Analysis Method: Tokimatsu, M-correction
3. Fines Correction for Liquefaction: Modify Stark/Olson
4. Fine Correction for Settlement: During Liquefaction*
5. Settlement Calculation in: All zones*
6. Hammer Energy Ratio,   Ce = 1.25
7. Borehole Diameter,   Cb= 1.15
8. Sampling Method,   Cs= 1.2
9. User request factor of safety (apply to CSR) ,   User= 1.3
   Plot one CSR curve (fs1=User)
10. Use Curve Smoothing: Yes*
* Recommended Options

In-Situ Test Data:

Depth ft	SPT	gamma pcf	Fines %
2.50	14.00	120.00	NoLiq
5.00	8.00	120.00	NoLiq
7.50	9.00	120.00	NoLiq
10.00	18.00	120.00	NoLiq
15.00	15.00	125.00	NoLiq
20.00	36.00	125.00	12.00
25.00	36.00	125.00	12.00
30.00	14.00	125.00	20.00
35.00	23.00	125.00	20.00
40.00	41.00	125.00	20.00
45.00	62.00	125.00	20.00
50.00	65.00	125.00	20.00

Output Results:

Settlement of Saturated Sands=0.49 in.
Settlement of Unsaturated Sands=0.00 in.
Total Settlement of Saturated and Unsaturated Sands=0.49 in.
Differential Settlement=0.244 to 0.323 in.

Depth ft	CRRm	CSRfs	F.S.	S_sat. in.	S_dry in.	S_all in.
2.50	2.00	0.72	5.00	0.49	0.00	0.49
3.00	2.00	0.71	5.00	0.49	0.00	0.49
3.50	2.00	0.71	5.00	0.49	0.00	0.49
4.00	2.00	0.71	5.00	0.49	0.00	0.49
4.50	2.00	0.71	5.00	0.49	0.00	0.49
5.00	2.00	0.71	5.00	0.49	0.00	0.49
5.50	2.00	0.71	5.00	0.49	0.00	0.49
6.00	2.00	0.71	5.00	0.49	0.00	0.49
6.50	2.00	0.71	5.00	0.49	0.00	0.49
7.00	2.00	0.71	5.00	0.49	0.00	0.49
7.50	2.00	0.71	5.00	0.49	0.00	0.49
8.00	2.00	0.71	5.00	0.49	0.00	0.49
8.50	2.00	0.71	5.00	0.49	0.00	0.49
9.00	2.00	0.70	5.00	0.49	0.00	0.49
9.50	2.00	0.70	5.00	0.49	0.00	0.49
10.00	2.00	0.70	5.00	0.49	0.00	0.49
10.50	2.00	0.70	5.00	0.49	0.00	0.49
11.00	2.00	0.70	5.00	0.49	0.00	0.49
11.50	2.00	0.70	5.00	0.49	0.00	0.49
12.00	2.00	0.70	5.00	0.49	0.00	0.49
12.50	2.00	0.70	5.00	0.49	0.00	0.49
13.00	2.00	0.70	5.00	0.49	0.00	0.49
13.50	2.00	0.70	5.00	0.49	0.00	0.49

14.00	2.00	0.70	5.00	0.49	0.00	0.49
14.50	2.00	0.71	5.00	0.49	0.00	0.49
15.00	2.00	0.72	5.00	0.49	0.00	0.49
15.50	2.00	0.73	5.00	0.49	0.00	0.49
16.00	2.00	0.74	5.00	0.49	0.00	0.49
16.50	2.00	0.75	5.00	0.49	0.00	0.49
17.00	2.00	0.76	5.00	0.49	0.00	0.49
17.50	2.00	0.77	5.00	0.49	0.00	0.49
18.00	2.00	0.78	5.00	0.49	0.00	0.49
18.50	2.00	0.79	5.00	0.49	0.00	0.49
19.00	2.00	0.80	5.00	0.49	0.00	0.49
19.50	2.00	0.80	5.00	0.49	0.00	0.49
20.00	2.00	0.81	5.00	0.49	0.00	0.49
20.50	2.59	0.82	3.16	0.49	0.00	0.49
21.00	2.59	0.83	3.14	0.49	0.00	0.49
21.50	2.59	0.83	3.11	0.49	0.00	0.49
22.00	2.59	0.84	3.09	0.49	0.00	0.49
22.50	2.59	0.85	3.06	0.49	0.00	0.49
23.00	2.59	0.85	3.04	0.49	0.00	0.49
23.50	2.59	0.86	3.02	0.49	0.00	0.49
24.00	2.59	0.86	3.00	0.49	0.00	0.49
24.50	2.59	0.87	2.98	0.49	0.00	0.49
25.00	2.59	0.87	2.96	0.49	0.00	0.49
25.50	2.59	0.88	2.95	0.49	0.00	0.49
26.00	2.59	0.88	2.93	0.49	0.00	0.49
26.50	2.59	0.89	2.91	0.49	0.00	0.49
27.00	2.59	0.89	2.90	0.49	0.00	0.49
27.50	2.59	0.90	2.88	0.49	0.00	0.49
28.00	2.59	0.90	2.87	0.49	0.00	0.49
28.50	2.59	0.91	2.86	0.49	0.00	0.49
29.00	2.59	0.91	2.84	0.47	0.00	0.47
29.50	0.46	0.91	0.50*	0.43	0.00	0.43
30.00	0.37	0.92	0.40*	0.36	0.00	0.36
30.50	0.39	0.92	0.43*	0.29	0.00	0.29
31.00	0.43	0.92	0.47*	0.23	0.00	0.23
31.50	0.47	0.92	0.51*	0.17	0.00	0.17
32.00	0.58	0.92	0.62*	0.12	0.00	0.12
32.50	2.59	0.92	2.81	0.08	0.00	0.08
33.00	2.59	0.92	2.81	0.05	0.00	0.05
33.50	2.59	0.92	2.81	0.03	0.00	0.03
34.00	2.59	0.92	2.81	0.01	0.00	0.01
34.50	2.59	0.92	2.81	0.01	0.00	0.01
35.00	2.59	0.92	2.82	0.00	0.00	0.00
35.50	2.59	0.92	2.82	0.00	0.00	0.00
36.00	2.59	0.92	2.82	0.00	0.00	0.00
36.50	2.59	0.92	2.82	0.00	0.00	0.00
37.00	2.59	0.92	2.82	0.00	0.00	0.00
37.50	2.59	0.92	2.83	0.00	0.00	0.00
38.00	2.59	0.91	2.83	0.00	0.00	0.00
38.50	2.59	0.91	2.83	0.00	0.00	0.00

39.00	2.59	0.91	2.84	0.00	0.00	0.00
39.50	2.60	0.91	2.85	0.00	0.00	0.00
40.00	2.60	0.91	2.85	0.00	0.00	0.00
40.50	2.59	0.91	2.85	0.00	0.00	0.00
41.00	2.59	0.91	2.86	0.00	0.00	0.00
41.50	2.59	0.91	2.86	0.00	0.00	0.00
42.00	2.58	0.90	2.86	0.00	0.00	0.00
42.50	2.58	0.90	2.86	0.00	0.00	0.00
43.00	2.57	0.90	2.86	0.00	0.00	0.00
43.50	2.57	0.90	2.86	0.00	0.00	0.00
44.00	2.57	0.90	2.86	0.00	0.00	0.00
44.50	2.56	0.89	2.87	0.00	0.00	0.00
45.00	2.56	0.89	2.87	0.00	0.00	0.00
45.50	2.55	0.89	2.87	0.00	0.00	0.00
46.00	2.55	0.89	2.87	0.00	0.00	0.00
46.50	2.55	0.88	2.88	0.00	0.00	0.00
47.00	2.54	0.88	2.88	0.00	0.00	0.00
47.50	2.54	0.88	2.89	0.00	0.00	0.00
48.00	2.54	0.88	2.89	0.00	0.00	0.00
48.50	2.53	0.88	2.89	0.00	0.00	0.00
49.00	2.53	0.87	2.90	0.00	0.00	0.00
49.50	2.52	0.87	2.90	0.00	0.00	0.00
50.00	2.52	0.87	2.91	0.00	0.00	0.00

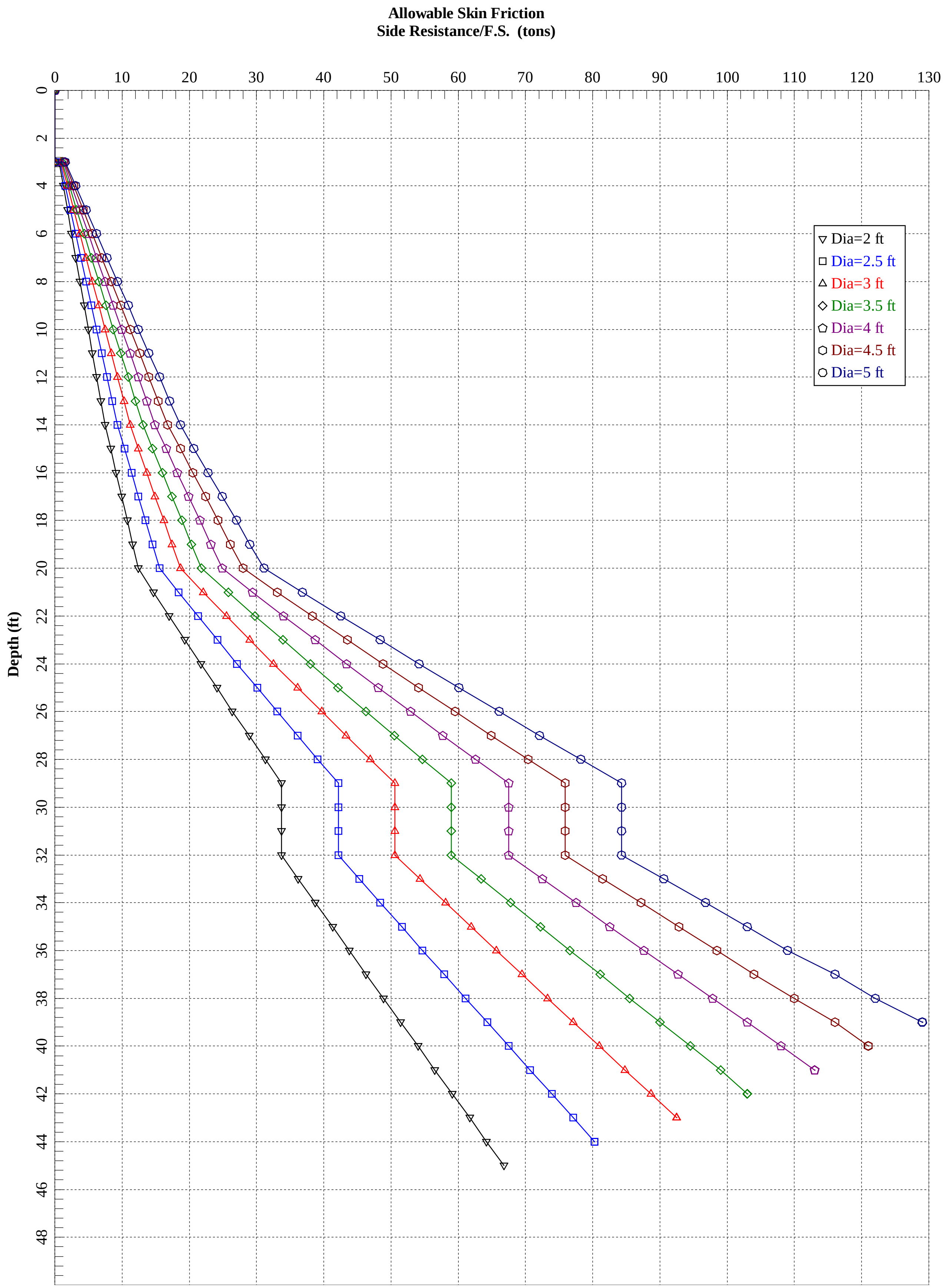
* F.S.<1, Liquefaction Potential Zone
(F.S. is limited to 5, CRR is limited to 2, CSR is limited to 2)

Units: Unit: qc, fs, Stress or Pressure = atm (1.0581tsf); Unit Weight = pcf; Depth = ft; Settlement = in.

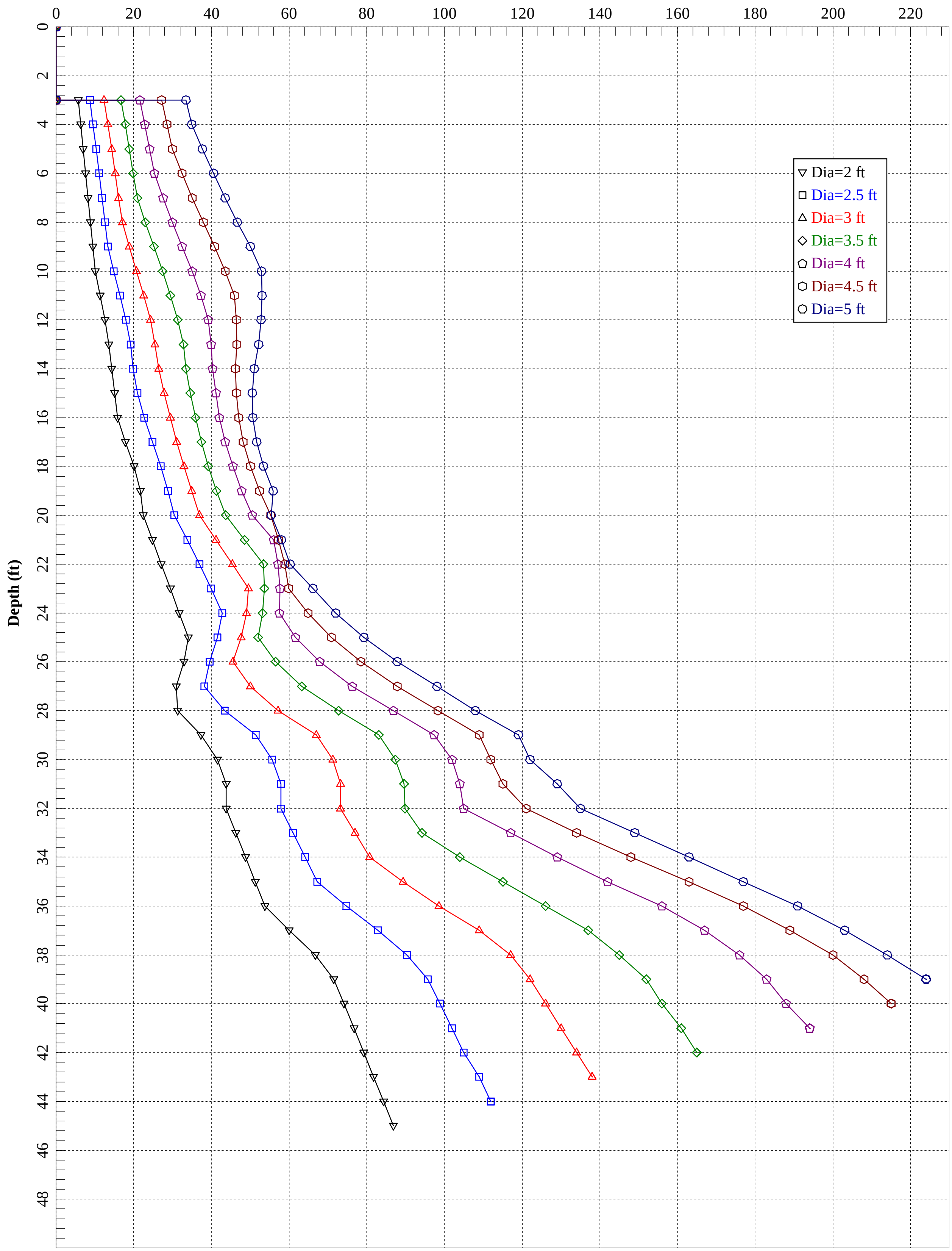
---

1 atm (atmosphere) = 1 tsf (ton/ft2)

CRRm	Cyclic resistance ratio from soils
CSRsf	Cyclic stress ratio induced by a given earthquake (with user request factor of safety)
F.S.	Factor of Safety against liquefaction, F.S.=CRRm/CSRsf
S_sat	Settlement from saturated sands
S_dry	Settlement from Unsaturated Sands
S_all	Total Settlement from Saturated and Unsaturated Sands
NoLiq	No-Liquefy Soils


Allowable Skin Friction
Side Resistance/F.S. (tons)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
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)



Terracon
145 W Walnut St
Carson, CA

General Notes

Sampling	Water Level	Field Tests
Auger Cuttings	Water Initially Encountered	N — Standard Penetration Test Resistance (Blows/Ft.)
Modified Dames & Moore Ring Sampler	Water Level After a Specified Period of Time	(HP) — Hand Penetrometer
Grab Sample	Water Level After a Specified Period of Time	(T) — Torvane
Standard Penetration Test	Cave In Encountered	(DCP) — Dynamic Cone Penetrometer
	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.	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] $Cu = D_{60}/D_{10}$ $\quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[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.