11.4 Geotechnical Reports

January 12, 2023
Kleinfelder Project No. 20230661.003A

Mr. Jack Lac
NorthPoint Development
12977 North Outer 40 Road, Suite 203
St. Louis, Missouri 63141

**SUBJECT: Feasibility-Level Geotechnical Investigation
AVLC Phase 3 and Phase 4
Southwest Corner of W Avenue F and Sierra Highway
Lancaster Area of Los Angeles County, California**

Dear Mr. Lac:

Kleinfelder is pleased to present this report summarizing the feasibility-level geotechnical investigation performed for the subject site, located at the southwest corner of W Avenue F and Sierra Highway in the Lancaster area of Los Angeles County, California. Our conclusions and recommendations for geotechnical design and construction are presented in the attached report.

We appreciate the opportunity to provide geotechnical engineering services to you on this project. If you have any questions regarding this report or if we can be of further service, please do not hesitate to contact the undersigned.

Sincerely,

KLEINFELDER, INC.

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FEASIBILITY-LEVEL GEOTECHNICAL INVESTIGATION
AVLC PHASE 3 AND PHASE 4
SOUTHWEST CORNER OF W AVENUE F AND SIERRA HIGHWAY
LANCASTER AREA OF LOS ANGELES COUNTY, CALIFORNIA

KLEINFELDER PROJECT NO. 20230661.003A

JANUARY 12, 2023

A Report Prepared for:

Mr. Jack Lac
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FEASIBILITY-LEVEL GEOTECHNICAL INVESTIGATION
AVLC PHASE 3 AND PHASE 4
SOUTHEAST CORNER OF W AVENUE F AND SIERRA HIGHWAY
LANCASTER AREA OF LOS ANGELES COUNTY, CALIFORNIA

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TABLE OF CONTENTS

FIGURES

APPENDICES

1 INTRODUCTION

This report presents the results of our feasibility-level geotechnical investigation for the proposed improvements at the southwest corner of W Avenue F and Sierra Highway in the Lancaster area of Los Angeles County, California. The general location of the site is shown on Figure 1, Site Vicinity Map.

The purpose of this feasibility-level geotechnical investigation was to evaluate the subsurface soil conditions at the site in order to provide geotechnical recommendations for the design and construction of the proposed development. The scope of our services was presented in our proposal dated November 8, 2022. This report only provides recommendations for the proposed improvements discussed below.

1.1 PROJECT DESCRIPTION

Based on our review of the conceptual site plan provided by NorthPoint Development the total site area for both Phase 3 and 4 is approximately 162 acres and the proposed project will consist of constructing two (2) warehouse buildings. Phase 3 (Building 5) is proposed to be approximately 1,007,000 square feet (sf). Phase 4 (Building 6) is proposed to be approximately 1,215,000 sf. The buildings are anticipated to be concrete tilt-up distribution-type buildings and have warehouse areas with loading-dock high slab-on-grade floors. The project also includes Best Management Practices (BMPs) stormwater detention basins at the site.

We anticipate cuts and fills on the order of approximately 10 feet may be needed to develop the site. We understand that the proposed buildings are anticipated to be supported on conventional shallow spread foundations. Foundation loads are not currently available, but based on our experience with similar past projects, we assume that maximum column loading will be on the order of 80 kips and maximum wall loads will be on the order of 4 to 8 kips per linear foot. Floor loads for proposed distribution-type buildings may be on the order of 500 pounds per square foot.

We anticipate parking lot and drive aisles will consist of asphaltic concrete (AC) pavement and loading dock areas will consist of Portland cement concrete pavement (PCCP). Ancillary construction is anticipated to include concrete flat work, landscaping, and installation of buried utilities.

1.2 SCOPE OF SERVICES

The scope of our preliminary geotechnical study consisted of a literature review, historical aerial photo review, subsurface exploration, geotechnical laboratory testing, engineering evaluation and analysis, and preparation of this report. Our report includes a description of the work performed, a discussion of the geotechnical conditions observed at the site, and preliminary recommendations developed from our engineering analysis of field and laboratory data. A description of our scope of services performed for this project is presented below.

Task 1 – Background Data Review. We reviewed published and unpublished geologic literature in our files and the files of public agencies, including selected publications prepared by the California Geological Survey and the U.S. Geological Survey. We also reviewed readily available seismic and faulting information, including data for designated earthquake fault zones and our in-house database of faulting in the general site vicinity.

Task 2 – Field Exploration. The subsurface conditions at the site were explored by drilling and logging six (6) hollow-stem auger geotechnical borings (B-1 through B-6). The geotechnical borings were drilled to depths ranging from approximately 31½ to 51½ feet bgs. The locations of our borings are shown on the attached Figure 2, Exploration Location Map.

Prior to commencement of the fieldwork, our proposed exploration locations were cleared for known existing utility lines and with the participating utility companies through Underground Service Alert (USA). A Kleinfelder representative supervised the field operations and logged the borings. Selected bulk and drive samples were retrieved, sealed and transported to Kleinfelder's laboratory in Ontario, California for laboratory testing. Our typical sampling interval for the hollow stem auger borings was every 5 feet to full depths explored. The number of blows necessary to drive California-type samplers were recorded. A description of the field exploration and the logs of the borings, including a Legend to the Log of Borings, are presented in Appendix A.

Task 3 – Laboratory Testing. Laboratory testing was performed on representative samples of soil collected from our excavations to substantiate field classifications and to provide engineering parameters for geotechnical design. Laboratory testing included moisture determination and unit weight, grain size distribution, plasticity testing, modified Proctor, expansion index, collapse potential, and preliminary corrosion potential. A summary of the testing performed and the results for this subject site are presented in Appendix B.

Task 4 – Geotechnical Analyses. Field and laboratory data were analyzed in conjunction with the proposed site plan presented on Figure 2 and assumed structural loads to develop geotechnical recommendations for the design and construction of the proposed development. We evaluated potential foundation systems, lateral earth pressures, settlement, and earthwork considerations. Potential geologic hazards, such as ground shaking, liquefaction hazard, seismic settlement potential, flood hazard, and fault rupture hazard were also evaluated.

Task 5 – Report Preparation. This preliminary report summarizes the work performed, data acquired, and our findings, conclusions, and geotechnical recommendations for the design and construction of the proposed development. Preliminary recommendations for the following are presented in this report:

- Earthwork, including site preparation, excavation, site drainage, and the placement of engineered fill;
- Design of suitable foundation systems including allowable capacities, lateral resistance, and settlement estimates;
- Seismic design parameters;
- Floor slab and slab-on-grade support, including subgrade preparation;
- Lateral earth pressures for design of retaining walls;
- Design and construction of asphalt and Portland cement concrete pavements, including driveways, fire lanes, and concrete walks; and
- Preliminary infiltration correlations of the site soils for design of BMPs.

This report also contains reference maps and graphics, as well as the logs of the borings and laboratory test results.

2 SITE AND SUBSURFACE CONDITIONS

2.1 SITE DESCRIPTION

The site is located at the southwest corner of W Avenue F and Sierra Highway in the Lancaster area of Los Angeles County, California. The total site area is approximately 162 acres and is currently vacant and appears to not have had any previous development. The site is generally bounded by vacant land to the west, Avenue F on the North, Sierra Highway on the east, and Avenue G to the south. Topographic survey has not yet been provided to Kleinfelder for the proposed project. based on our review of Google Earth imagery, the building site generally appears to slope down from south to north with a grade differential of approximately 4 to 7 feet. From review of Google Earth imagery, it appears that the site is vacant and may have had limited vegetation removal and minor grading. Additionally, the aerial imagery appears to show that the Amargosa Creek flows across northwest corner of the site.

2.2 SUBSURFACE CONDITIONS

Subsurface materials observed during drilling are described below and detailed descriptions of subsurface materials are provided in our boring logs presented in Appendix A.

Alluvium/Native Soil:

Alluvium/native soil was observed in the borings drilled for this investigation and generally consisted of clayey to silty sand, poorly graded to well graded sand with varying amounts of silt, and silts and lean clays with varying amounts of sand to the total depth explored of approximately 51½ feet bgs. In-situ moisture content ranged from 0.7 to 30.5 percent and dry unit weight ranged from 94.5 to 136.2 pounds per cubic foot (pcf). The apparent density of the subsurface soils was typically medium dense to very dense for coarse-grained soils. Generally, the consistency of fine-grained soils was stiff to hard.

2.3 GROUNDWATER CONDITIONS

Groundwater was not encountered in our borings to the maximum depth explored of approximately 51½ feet bgs during our geotechnical investigation within the 162-acre site. The Lancaster West Quadrangle, Plate 1.2, in the Seismic Hazard Zone Report 095 shows historic groundwater to be at approximately 55 feet bgs within the subject site. However, groundwater was measured at approximately 6 feet below ground surface (bgs) at a well located approximately 0.45 miles to the northwest of the subject site in April 1951 (CDWR, 2022).

Current depth to ground water is estimated to be greater than 50 feet bgs based on borings drilled on site and reported depth to groundwater for monitoring wells located approximately 1.3 miles east of the site (Geotracker, 2022).

Fluctuations of localized zones of perched water and rise in soil moisture content should be anticipated during the rainy season. Irrigation of landscaped areas may also lead to an increase in soil moisture content and fluctuations of intermittent shallow perched groundwater levels.

3 GEOLOGIC CONDITIONS

3.1 REGIONAL GEOLOGY

The subject site is located within the western portion of the Mojave Desert geomorphic province of California (Norris and Webb, 1990; CGS 2002).

The Mojave Desert is approximately 25,000 square miles of desert situated in southeastern California. The area is enclosed on the southwest by the San Andreas fault and the Transverse Ranges and on the north and northeast by the Garlock fault, the Tehachapi Mountains and the Basin and Range. The Nevada state line and Colorado River form the arbitrary eastern boundary. The San Bernardino-Riverside county line designates the southern boundary.

The region is dominated by broad alluvial basins that are mostly aggrading sources receiving nonmarine deposits from the adjacent uplands. The highest general elevations of the Mojave Desert approach 4,000 feet above mean sea level (MSL) with most of the valleys between 2,000 and 4,000 feet MSL.

3.1.1 SITE GEOLOGY

Regional geologic mapping indicates that the site is underlain by modern alluvium, modern alluvial fan deposits, and younger playa deposits that are Holocene to late Pleistocene in age (CGS, 2010a). The alluvium and alluvial fan deposits are derived from Amargosa Creek along the western portion of the site and cover the majority of the site. The younger playa deposits were deposited in the shallow-water regions of the last pluvial lake that filled the lowland parts of Antelope Valley, up to approximately 12,000 years ago.

3.2 GEOLOGIC HAZARDS

We have addressed below the potential geologic hazards for the site.

3.2.1 Faulting and Seismicity

Earthquakes and faulting occur as the tectonic plates, which comprise the Earth's crust, or lithosphere, move relative to one-another. Faults identified by the State as being active are not known to be present at the surface within the project limits. No portion of the site is located within a State of California-Special Studies Zone (CGS, 2018). The closest active fault to the site is the San Andreas fault zone located approximately 10.8 miles southwest of the site (CGS, 2010b). Because of the distance to known active faults, the lack of surficial evidence of fault breaks expressed in air photos or published geologic maps, the risk of surface rupture resulting from faulting is considered low.

3.2.2 Flooding

Surface water flow at the site is generally via sheet flow in a west and northwest direction toward the Amargosa creek drainage.

Most of the site with exception of the southeastern portion is within a flood hazard zone “AO” according to FEMA (2008), where the flood hazard is a “Special Flood Hazard Area subject to Inundation by the 1% Annual chance Flood”. Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths 1 foot. The southeastern portion of the site is within a flood hazard zone “X” (FEMA, 2008), where the flood hazard is “determined to be outside the 0.2% annual chance floodplain”.

The site is downstream of the Piute Ponds which potentially could cause flooding and inundate the project site. A seiche is a wave or sloshing of a body of water that is at least partially impounded caused by strong wind or seismic shaking. The risk of seiche damage following a seismic event at the site is considered low.

3.2.3 Landslides

Landslides and other forms of mass wasting, including mud flows, debris flows, soil slips, and rock falls occur as soil or rock moves down slope under the influence of gravity. Landslides are frequently triggered by intense rainfall or seismic shaking. The site is not located within a State or county designated landslide hazard zone. The site is relatively flat and the risk at the site from landslides and other forms of mass wasting is considered very low.

3.2.4 Liquefaction and Seismic Settlement

Liquefaction occurs when saturated, loose, coarse-grained or silty soils are subjected to strong shaking resulting from earthquake motions. The coarse-grained or silty soils typically lose a portion or all of their shear strength and regain strength sometime after the shaking stops. Soil movements (both vertical and lateral) have been observed under these conditions due to consolidation of the liquefied soils.

The site is located within a mapped generalized liquefaction potential zone (CGS, 2005). We have performed a liquefaction analysis to assess the seismically induced settlement potential. The results of our liquefaction analysis are summarized in Section 4.2.2.

3.2.5 Subsidence

Ground subsidence is a gradual settling or sudden sinking of the earth's surface owing to subsurface movement of earth materials. Ground subsidence can result from fluid (water or petroleum) extraction from underlying sediments and/or formations, which allows the collapse of pore spaces previously occupied by the removed fluid. The collapse of these pore spaces compacts these underlying formations, leading to a gradual drop in ground surface elevation. Ground subsidence is most often found in areas where large volumetric withdrawals of fluids from underground reservoirs has occurred or is ongoing. Ground shaking from tectonic activity can exacerbate the vertical sinking of land in an area over the withdrawal site. Structures and improvements located in subsidence-prone areas are at risk for damage if subsidence were to occur.

The USGS has been tracking subsidence in California since the early 20th century and has developed maps that illustrate areas of recorded subsidence across the state (USGS, 2022). Most of the subsidence has resulted from excessive groundwater pumping for municipal, industrial, and agricultural uses, although oil extraction is also a documented cause. A review of the USGS subsidence maps shows the project site is documented to be experiencing subsidence.

3.2.6 Oil and Gas Fields

The project site is not located within a mapped petroleum producing field of Southern California and no oil/gas wells are reported within the Project Site [California Geologic Energy Management Division (CalGEM), formerly Division of Oil, Gas and Geothermal Resources (DOGGR), 2022]. However, based on information available from CalGEM, three (3) idle oil and gas wells are reported located within 3 miles of the site. Additional, undocumented well(s) may be present and buried near the site.

3.2.7 Expansive Soils

The upper site soils were tested for expansion potential and found to be medium to high in Borings B-4 and B-5. Due to the variability of near surface soi, the potential for expansive soils impacting the project grading is anticipated. Further discussion is presented in Section 4.8. The on-site soils should be further evaluated during the geotechnical study for the design phase of the project.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 GENERAL

Based on the results of our field exploration, laboratory testing and geotechnical analyses conducted during this study, it is our professional opinion that the proposed project is geotechnically feasible, provided the recommendations presented in this report are incorporated into the project design and construction.

The following preliminary opinions, conclusions, and recommendations are based on the properties of the materials encountered in the explorations, the results of our literature review, the results of the laboratory testing program, and our engineering analyses performed. Our recommendations regarding the geotechnical aspects of the design and construction of the project are presented in the following sections. We recommend that the final grading plans be reviewed by Kleinfelder prior to the start of construction.

4.2 SEISMIC DESIGN CONSIDERATIONS

4.2.1 Seismic Design Parameters

According to ACSE/SEI 7-16 (2016), which is incorporated into the 2019 California Building Code (CBC) by reference, sites subject to liquefaction, as discussed below, should be classified as Site Class F, which requires a site response analysis. However, ACSE/SEI 7-16 states that for a short period (less than ½ second) structure on liquefiable soils, Site Class D or E may be used instead of Site Class F to estimate design seismic loading on the structure. The selection of Site Class D or E is based on the assessment of the site soil profile assuming no liquefaction. We have assumed that the period of the structures will be less than ½ second. The assumption that the structures have a period of less than ½ second should be verified by the project structural engineer.

Based on data obtained from our field explorations, published geologic literature and maps, and on our interpretation of the 2019 CBC criteria, it is our opinion that the project site may be classified as Site Class D, Stiff Soil, according to Section 1613 of 2019 CBC and Table 20.3-1 of ASCE/SEI 7-16 (2016). Approximate coordinates for the site are noted below.

- Latitude: 34.744416
- Longitude: -118.148774

The Risk-Targeted Maximum Considered Earthquake (MCER) mapped spectral accelerations for 0.2 seconds and 1 second periods (S_s and S_1) were estimated using Section 1613 of the 2019 CBC and the OSHPD seismic design maps web-based application (available at https://seismicmaps.org/). In accordance with Section 11.4.8 of ASCE 7-16, a site-specific ground motion analysis is required for Site Class D sites with an S1 greater than 0.2 g. However, a site-specific ground motion analysis is not required if the seismic response coefficient (Cs) is determined in accordance with requirements of Chapter 12 and exceptions as noted in Section 11.4.8. We have assumed that Cs will be determined in accordance with the requirements of Chapter 12 and exceptions as noted in Section 11.4.8. This assumption should also be verified by the project structural engineer. The 2019 CBC Seismic Design Parameters (non site-specific) for these structures are summarized in Table 1.

Table 1
2019 CBC Seismic Design Parameters

Design Parameter	Recommended Value
Site Class	D
S_s (g)	1.352
S_1 (g)	0.549
F_a	1.0
F_v	N/A*
S_{MS} (g)	1.352
S_{M1} (g)	N/A
S_{DS} (g)	0.901
S_{D1} (g)	N/A
PGA_M (g)	0.550

*Section 11.4.8 of ASCE 7-16 requires a site-specific ground motion hazard analysis be performed for Site Class D sites with S_1 values greater than or equal to 0.2g unless exceptions are taken. If exceptions are taken, then a F_v value of 1.74 could be used only to calculate the T_s value.

4.2.2 Liquefaction and Seismic Settlement

To assess the potential for liquefaction of subsurface soils at the site, we used the liquefaction analysis procedures outlined in Youd et al. (2001) based on standard penetration test (SPT) data. For estimating the resulting ground settlements, we used the methods proposed by Tokimatsu and Seed (1987). These methods utilize corrected SPT blow counts to estimate the amount of volumetric compaction or settlement during an earthquake.

Groundwater was not encountered during our current field exploration drilled to a maximum explored depth of 51½ feet bgs. Based on our groundwater research discussed in Section 2.3, a design groundwater depth of 6 feet was used in our analyses based on the historic high groundwater level. The historic high groundwater level may be further investigated since the current depth is much lower than the historic high.

As recommended in Section 1803.5.12 of 2019 CBC, the peak ground acceleration (PGA) used in the liquefaction analysis was estimated in accordance with Section 11.8.3 of ASCE 7-16. A PGAM of 0.55g with an earthquake magnitude of 7.9 was used as the design-level seismic event in our liquefaction analysis, which is defined as an earthquake event with 2 percent probability of being exceeded in 50 years (return period of about 2,475 years) according to the 2019 CBC and ASCE/SEI 7-16.

We evaluated the liquefaction potential at the site using the SPT data. Based on the SPT data and our engineering analyses, it is our opinion that silty sands at a depth of approximately 20 feet bgs (below the design groundwater depth) may be subject to liquefaction in the event of a major earthquake occurring on a nearby fault. Based on our analyses, the calculated total liquefaction-induced settlement is on the order of less than 1 inch. Differential liquefaction-induced settlement may be estimated as ½ of the total seismically-induced settlement over a distance of about 30 feet.

4.3 FOUNDATIONS

4.3.1 General

Based on the results of our field exploration, laboratory testing, and geotechnical analyses, the proposed improvements may be supported on conventional shallow foundations on a zone of compacted fill provided the settlement estimates (both static and seismic) are tolerable. We have assumed that the proposed structures is able to tolerate the estimated seismic settlement (i.e., it will not collapse creating a life safety issue). However, this assumption should be verified by the project structural engineer. It should be noted that the design intent of the 2019 California Building Code (CBC) during a design-level seismic event is life safety, not serviceability of the structure after an earthquake.

4.3.2 Allowable Bearing Pressure

Footings supported on at least 3 feet of compacted fill may be designed for a net allowable bearing pressure of 2,500 psf for dead plus sustained live loads. A one-third increase in the bearing value can be used for wind or seismic loads. All footings should be established at a depth of at least 24 inches below the lowest adjacent grade. The footing dimension and reinforcement should be designed by the structural engineer; however, continuous and isolated spread footings should have minimum widths of 18 and 24 inches, respectively.

4.3.3 Estimated Settlements

Total static settlement for foundations designed in accordance with the recommendations presented herein is estimated to be less than 1 inch. Differential static settlement between similarly loaded columns is estimated to be less than ½ inch over 40 to 70 feet. Note that this settlement is in addition to the estimated settlement due to seismic shaking.

4.3.4 Lateral Resistance

Resistance to lateral loads (including those due to wind or seismic forces) may be provided by frictional resistance between the bottom of concrete foundations and the underlying soils and by passive soil pressure against the sides of the foundations. A coefficient of friction of 0.3 may be used between cast-in-place concrete foundations and the underlying soil. The passive pressure available for engineered fill may be taken as equivalent to the pressure developed by a fluid with a unit weight of 300 pounds per cubic foot (pcf). A one-third increase in the passive resistance may be used for resistance to transient loads such as wind and seismic. The upper one foot of soil should be neglected when calculating passive resistance.

The lateral resistance parameters provided above are ultimate values. Therefore, a suitable factor of safety should be applied to these values for design purposes. The appropriate factor of safety will depend on the design condition and should be determined by the project Structural Engineer. Depending on the application, typical factors of safety could range from 1.5 to 2.0.

4.4 EARTHWORK

4.4.1 General

Recommendations for site preparation are presented below. All site preparation and earthwork operations should be performed in accordance with applicable codes, safety regulations and other local, state or federal specifications. All references to maximum unit weights are established in accordance with the latest version of ASTM Standard Test Method D1557.

Grading operations during the wet season or in areas where the soils are saturated may require provisions for drying of soils prior to compaction. If the project necessitates fill placement and compaction in wet conditions, we can provide suggested alternative recommendations for drying the soil. Conversely, additional moisture may be required during the dry months. A sufficient water source should be available to provide adequate water during compaction. During dry months, moisture conditioning of the subgrade soils may be required if left exposed for greater than a few days.

4.4.2 Site Preparation

Prior to general site grading, existing vegetation, debris, and oversized materials (greater than 6 inches in maximum dimension) should be stripped and disposed outside the construction limits. We estimate the depth of stripping to be approximately 6 to 12 inches over most portions of the site. Deeper stripping or grubbing may be required where higher concentrations of vegetation are encountered during site grading. Stripped topsoil (less any debris) may be stockpiled and reused for landscaping purposes; however, this material should be evaluated for suitability if it is desired to use this material for engineered fill below structures.

All oversize and organic debris, including any produced by demolition operations, (wood, steel, piping, plastics, etc.), should be separated and disposed offsite. The material generated during demolition of the existing roadways and concrete structures may be reused onsite. If reused, the particles should be crushed to a maximum particle size of 6 inches and spread across the site to prevent nesting.

Existing utility pipelines (if encountered) which extend beyond the limits of the proposed construction and are to be abandoned in place should be plugged with cement grout to prevent migration of soil and/or water. Demolition, disposal, and grading operations should be observed and tested by a representative from our office.

4.4.3 Overexcavation

Recommendations for overexcavation of the proposed building pads (building foundations and floor slabs) and parking lots (pavements) are presented below. All site preparation and earthwork operations should be performed in accordance with applicable codes, safety regulations and other local, state, or federal specifications. All references to maximum unit weights are established in accordance with the latest version of ASTM Standard Test Method D1557.

Excavations within a 1:1 (horizontal: vertical) plane extending downward from a horizontal distance of 2 feet beyond the bottom outer edge of existing improvements (e.g. building foundations) or property lines should not be attempted without bracing and/or underpinning. All applicable excavation safety requirement and regulations, including OSHA requirements should be met.

4.4.3.1 Structural Areas

In order to provide uniform support for the proposed spread foundations and slab-on-grade floors, we recommend the site soils be overexcavated and replaced as engineered fill to a minimum depth of 3 feet from existing grade and at least 3 feet below the bottom of footings, whichever is greater. Building pads located in cut/fill transition areas should be overexcavated a minimum of 3 feet below the proposed bottom of footings/slabs. Although not encountered in our borings, any existing undocumented artificial fill soils should be removed until native alluvium is exposed. The overexcavation should extend horizontally at least 5 feet beyond the edges of foundations and a distance equivalent to the thickness of anticipated fill below the footing, whichever is greater. Depending on the observed condition of the existing soil and engineered fill, deeper overexcavation may be required in some areas. The Geotechnical Engineer of Record should be notified for supplemental recommendations if the minimum relative compaction of the soil is not achieved.

4.4.3.2 Non-structural Areas

Within the non-structural areas, such as truck aprons, pavements, sidewalks, other flatwork, etc., we recommend that these items be underlain by at least 24 inches of engineered fill. The overexcavation should extend beyond the proposed improvements a horizontal distance of at least two feet.

4.4.3.3 Additional Overexcavation Considerations

After site preparation and overexcavation, and prior to scarification or placement of compacted fills, the excavation bottom should be observed, evaluated, and approved by Kleinfelder. Additional removals may be needed if significant porosity, expansive soil, or other adverse conditions are observed. The subgrade should then be scarified to a depth of approximately 12 inches, moisture conditioned to at least the optimum moisture content; and recompacted. After compaction, the subgrade should be proof rolled using equipment with sufficient weight to evaluate surface deflection. Proof rolling should be performed to verify that the subgrade soils are firm and unyielding at the depth of the recommended overexcavation presented above.

4.4.4 Engineered Fill

We anticipate that most of the on-site soils may be reusable as engineered fill once any debris and oversized materials greater than 4 inches in diameter have been removed, and after any vegetation and organic debris is cleared. Engineered fill should contain less than 2 percent organic content and maximum material size should be less than 4 inches in maximum dimension. Disturbed/tilled soil, less vegetation, may be used in landscape areas, exported, or placed in a controlled manner and blended with the onsite soils, provided that the resulting engineered fill contains less than 2 percent organic content.

Fill should be placed in lifts no greater than 8 inches thick, loose measurement, and should be compacted to at least 90 percent of the maximum dry density. The moisture content of the on-site soils should be at least at the optimum moisture at the time of compaction. Based on the limited number of subsurface borings, soil type and extent should be further evaluated during the design-level investigation.

Engineered fill placed below pavement should be compacted to at least 90 percent of the maximum dry density obtained by the ASTM D1557 method of compaction, with the upper 12 inches below pavements compacted to at least 95 percent relative compaction.

Although not anticipated, any imported fill materials to be used for engineered fill should be sampled and tested for approval by the geotechnical engineer prior to being transported to the site. The expansion index of an imported soil should be less than 20. In general, well-graded mixtures of gravel, sand and non-plastic silt are acceptable for use as import fill. A minimum notice of 3 working days will be required to allow for qualification testing prior to compaction of imported materials.

4.4.5 Temporary Excavations

All excavations must comply with applicable local, state, and federal safety regulations including the current OSHA Excavation and Trench Safety Standards. Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We are providing the information below solely as a service to our client. Under no circumstances should the information provided be interpreted to mean that Kleinfelder is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

Excavations within a 1:1 plane extending downward from a horizontal distance of 2 feet beyond the bottom outer edge of existing improvements (e.g. building foundations) should not be attempted without bracing and/or underpinning the improvements. The geotechnical engineer or their field representative should observe the excavations so that modifications can be made to the excavations, as necessary, based on variations in the encountered soil conditions. All applicable excavation safety requirements and regulations, including OSHA requirements, should be met.

Near-surface soils encountered during our field investigation consisted predominantly of sandy silt, silty sand and sands with varying amounts of gravel and cobble. In our opinion, these soils would be considered a Type 'C' soil with regard to the OSHA regulations. For this soil type, OSHA requires a maximum slope inclination of 1.5:1 (horizontal to vertical) or flatter for excavations 20 feet or less in depth. Temporary, shallow excavations with vertical side slopes less than 4 feet high should generally be stable, although sloughing may be encountered. Vertical excavations greater than 4 feet high should not be attempted without appropriate shoring to prevent local instability. All trench excavations should be braced and shored in accordance with good construction practice and all applicable safety ordinances and codes. The contractor should be responsible for the structural design and safety of the temporary shoring system, and we recommend that this design be submitted to Kleinfelder for review to check that our recommendations have been incorporated.

Stockpiled (excavated) materials should be placed no closer to the edge of an excavation than a distance equal to the depth of the excavation, but no closer than 4 feet. All trench excavations should be made in accordance with OSHA requirements.

4.4.6 Excavation Conditions

The borings were advanced using a truck-mounted hollow-stem auger drill rig. Drilling excavations were completed with easy effort through the existing site soils. Conventional earth moving equipment should be capable of performing the soil excavations.

4.4.7 Pipe Bedding and Trench Backfill

Pipe bedding and pipe zone material should consist of sand or similar granular material having a minimum sand equivalent value of 30. Onsite soils may be suitable, but should be tested and approved by the engineer of record prior to use. The sand should be placed in a zone that extends a minimum of 6 inches below and 6 inches above the pipe for the full trench width. The bedding material should be compacted to a minimum of 90 percent of the maximum dry density or to the satisfaction of the geotechnical engineer's representative observing the compaction of the bedding material. Bedding material should consist of sand, gravel, crushed aggregate, or native free-draining granular material with a maximum particle size of ¾ inch. Bedding materials should also conform to the pipe manufacturer's specifications, if available. Trench backfill above bedding and pipe zone materials may consist of approved, on-site or import soils placed in lifts no greater than 8 inches loose thickness and compacted to 90 percent of the maximum dry density based on ASTM Test Method D1557. Jetting of backfill is not recommended. The on-site soils are suitable for backfill of utility trenches from one foot above the top of the pipe to the surface provided the material is free of organic and deleterious substances.

4.5 CONCRETE SLABS SUPPORTED ON GRADE

4.5.1 General

Slab-on-grade floors should be underlain by engineered fill as discussed in the Earthwork Section of this report. We anticipate that the planned floor slabs will have a minimum thickness of 6 inches, will be unreinforced and dowelled at panel edges. Minimum reinforcement for floor slabs, if required, should be determined by the structural engineer. The structural engineer should design the slabs for any specific loading conditions. A modulus of subgrade reaction of 100 pounds per cubic inch may be used for design. The moisture content of the upper 18 inches of engineered fill should be at the recommended range for fill compaction at the time the floor slab is constructed. Precautions should be taken so as not to allow the upper engineered fill below the slab to dry out below the recommended moisture range between completion of the building pad and construction of the floor slab. Total static settlement for foundations designed in accordance with the recommendations presented herein, with an anticipated maximum load of 500 psf, is estimated to be less than a 1 inch.

Construction activities and exposure to the environment can cause deterioration of the prepared subgrade. We recommend that a Kleinfelder representative inspect the final subgrade conditions prior to placement of the concrete, and if necessary, perform additional moisture and density testing to determine the subgrade suitability. A low slump concrete should be used to reduce possible curling of the slab.

4.5.2 Exterior Flatwork

Where exterior flatwork, such as sidewalks, are to be constructed, the subgrade should be scarified to a depth of 8 inches and moisture conditioned to a moisture content above the optimum moisture content, and recompacted as recommended in the Earthwork Section of this report. Exterior, structurally loaded flatwork, such as truck docks or trash enclosures should adhere to the recommendations for rigid pavement presented in this report.

4.5.3 Vapor Retarder

Subsurface moisture and moisture vapor naturally migrate upward through the soil and, where the soil is covered by a building or pavement, this subsurface moisture will collect. To reduce the impact of this subsurface moisture and the potential impact of future introduced moisture (such as landscape irrigation or precipitation) on moisture sensitive flooring, the current industry standard is to place a vapor retarder on a compacted crushed rock layer and/or sand layers, 1 to 2 inches in thickness, placed above and below the vapor retarder. The crushed rock layer and/or sand layer may be omitted in accordance with the vapor barrier manufacturer's installation recommendations.

The necessity and placement of a vapor retarder should be evaluated by the structural engineer and/or flooring consultant. It should be noted that although vapor barrier systems are currently the industry standard, this system might not be completely effective in preventing floor slab moisture problems. These systems typically will not necessarily assure that floor slab moisture transmission rates will meet floor covering manufacturer standards and that indoor humidity levels be appropriate to inhibit mold growth. The design and construction of such systems are totally dependent on the proposed use and design of the proposed building and all elements of building design and function should be considered in the slab-on-grade floor design. Building design and construction may have a greater role in perceived moisture problems since sealed buildings/rooms or inadequate ventilation may produce excessive moisture in a building and affect indoor air quality.

4.5.4 Concrete Curing and Flooring

Various factors such as surface grades, adjacent planters, the quality of slab concrete and the permeability of the on-site soils affect slab moisture and can control future performance. In many cases, floor moisture problems are the result of either improper curing of floor slabs or improper application of flooring adhesives. We recommend contacting a flooring consultant experienced in the area of concrete slab-on-grade floors for specific recommendations regarding your proposed flooring applications. Special precautions must be taken during the placement and curing of all concrete slabs. Excessive slump (high water-cement ratio) of the concrete and/or improper curing procedures used during either hot or cold weather conditions could lead to excessive shrinkage, cracking or curling of the slabs. High water-cement ratio and/or improper curing also greatly increase the water vapor permeability of concrete. We recommend that all concrete placement and curing operations be performed in accordance with the American Concrete Institute (ACI) Manual.

It is emphasized that we are not floor moisture-proofing experts. We make no guarantee, nor provide any assurance that use of the capillary break/vapor retarder system will reduce concrete slab-on-grade floor moisture penetration to any specific rate or level, particularly those required by floor covering manufacturers. The builder and designers should consider all available measures for slab moisture protection.

4.6 RETAINING WALLS

We have provided preliminary cantilever retaining wall recommendations below. Further evaluation will be needed once wall types, locations and heights are selected.

4.6.1 General

Design earth pressures for retaining walls depend primarily on the allowable wall movement, wall inclination, type of backfill materials, backfill slopes, surcharges, and drainage. The earth pressures provided assume that that a non-expansive granular backfill will be used and a drainage system will be installed behind the walls, so that external water pressure will not develop. If a drainage system will not be installed, the wall should be designed to resist hydrostatic pressure in addition to the earth pressure as well as reinforcement that should be protected from rust or other corrosion-inducing effects of moisture. Determination of whether the active or at-rest condition is appropriate for design will depend on the flexibility of the walls. Walls that are free to rotate at least 0.002 radians (deflection at the top of the wall of at least 0.002 x H, where H is the unbalanced wall height) may be designed for the active condition. Walls that are not capable of this movement should be assumed rigid and designed for the at-rest condition. The recommended active and at-rest earth pressure values are provided in Table 2, Earth Pressures for Retaining Walls.

Table 2
Earth Pressures for Retaining Walls
(Non-Expansive Backfill)

Wall Movement	Backfill Condition	Equivalent Fluid Pressure (pcf)	Seismic Increment * (pcf)
Free to Deflect (active condition)	Level	40	16
Restrained (at-rest condition)		60	N/A **

*Note: * Walls supporting more than 6 feet of backfill should be designed to support an incremental seismic lateral pressure, which is applied as a triangular pressure distribution with a maximum pressure at the bottom of the wall, not inverted.*

*** for restrained wall, use the static active earth pressure and seismic increment to check the seismic condition; use at-rest earth pressure only to check the static condition; the larger loading of both cases should be used for the design of restrained wall.*

In addition to the above lateral pressure, undrained walls will have to be designed for full hydrostatic pressure. The above lateral earth pressures do not include the effects of surcharges (e.g., traffic, footings), compaction, or truck-induced wall pressures. Any surcharge (live, including traffic, or dead load) located within a 1:1 plane drawn upward from the base of the excavation should be added to the lateral earth pressures. The lateral contribution of a uniform surcharge load located immediately behind walls may be calculated by multiplying the surcharge by 0.36 for cantilevered walls and 0.53 for restrained walls. Walls adjacent to areas subject to vehicular traffic should be designed for a 2-foot equivalent soil surcharge (250 psf). Lateral load contributions from other surcharges located behind walls may be provided once the load configurations and layouts are known.

4.6.2 Backfill Compaction

Care must be taken during the compaction operation not to overstress the wall. Wall backfill should be compacted to a least 90 percent relative compaction; however, heavy construction equipment should be maintained a distance of at least 3 feet away from the walls while the backfill soils are being placed. Kleinfelder should be contacted when development plans are finalized for review of wall and backfill conditions on a case-by-case basis.

4.6.3 Drainage

Walls should be properly drained or designed to resist hydrostatic pressures. Adequate drainage is essential to provide a free-draining backfill condition and to limit hydrostatic buildup behind the wall. Walls should also be appropriately waterproofed and include weep holes for drainage. In lieu of weep holes, a 4-inch diameter perforated PVC pipe, placed perforations down leading to a suitable gravity outlet, should be installed at the base of the walls. Another drainage alternative could be a manufactured prefabricated drainage composite panel such as Miradrain G100N or equivalent at regular intervals along the wall.

4.7 DRAINAGE AND LANDSCAPING

It is important that positive surface drainage be provided to prevent ponding and/or saturation of the soils in the vicinity of foundations, concrete slabs-on-grade, or pavements. We recommend that the site be graded to carry surface water away from the improvements and that positive measures be implemented to carry away roof runoff. Poor perimeter or surface drainage could allow migration of water beneath the building or pavement areas, which may result in distress to project improvements. If planted areas adjacent to structures are desired, we suggest that care be taken not to over irrigate and to maintain a leak-free sprinkler piping system. In addition, it is recommended that planter areas next to buildings have a minimum of 5 percent positive fall away from building perimeters to a distance of at least 5 feet. Drain spouts should be extended to discharge a minimum of 5 feet from the building, or some other method should be utilized to prevent water from accumulating in planters. Landscaping after construction should not promote ponding of water adjacent to structures.

4.8 EXPANSION POTENTIAL

Expansive soils are characterized by their ability to undergo significant volume changes (shrink or swell) due to variations in moisture content. Changes in soil moisture content can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors and may result in unacceptable settlement or heave of structures or concrete slabs supported on grade. Expansion index testing of two surficial soils resulted in values of 73 and 125, which indicates a medium to high expansion potential. The expansion potential should be tested further during the design level geotechnical investigation.

4.9 HYDRO-COLLAPSE POTENTIAL

Hydro-collapsible soils are characterized by their ability to undergo significant shrinkage (collapse) during inundation. Inundation in soils can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors, and may result in unacceptable settlement of structures or concrete slabs supported on grade. Based on the results of laboratory testing, the collapse potential of the surficial soils is approximately
5.2 percent collapse and 0.1 swell under inundation. 5 percent collapse potential is significant

for evaluation of overexcavation depths, however, the laboratory test results from the site to the west also resulted in low Collapse Potential. Disturbance of the soil sample that resulted in high Collapse Potential may have occurred during sampling and transport and should be further tested/evaluated during design level investigation.

4.10 PRELIMINARY SOIL CORROSIVITY

The soil corrosivity potential of the on-site materials to steel and buried concrete was preliminarily evaluated using a sample collected during our investigation. Testing was performed in general accordance with California Test Methods 643, 417, and 422 for pH and resistivity, soluble chlorides, and soluble sulfates, respectively. The test results are presented in Table 3, Preliminary Corrosivity Test Results.

Table 3
Preliminary Corrosivity Test Results

Boring	Depth (ft)	pH	Sulfate (ppm)	Chloride (ppm)	Resistivity (ohm-cm)
B-3	0 – 5	9.8	416	260	556
B-5	0 – 5	9.9	27	33	1,221
Boring	**Depth (ft)**	**pH**	**Sulfate (ppm)**	**Chloride (ppm)**	**Resistivity (ohm-cm)**
B-3	0 – 5	9.8	416	260	556
B-5	0 – 5	9.9	27	33	1,221

These tests are only an indicator of soil corrosivity for the samples tested. Other soils found on site may be more, less, or of a similar corrosive nature. Imported fill materials should be tested to confirm that their corrosion potential is not more severe than those noted.

Resistivity values below 1,000 ohm-cm are considered extremely corrosive to buried ferrous metals (Roberge, 2006).

The concentrations of soluble sulfates indicate that the subsurface soils represent a Class S2 exposure to sulfate attack on concrete in contact with the soil based on ACI 318-14 Table 19.3.1.1 (ACI, 2014). Therefore, in accordance with ACI Building Code 318-14, a concrete mix of Type V cement with a minimum compressive strength of 4,500 psi and maximum water-cement ratio of 0.45 are specified for these sulfate concentrations.

Kleinfelder's scope of services does not include corrosion engineering and, therefore, a detailed analysis of the corrosion test results is not included. A qualified corrosion engineer should be retained to review the test results for further evaluation and design protective systems, if considered necessary.

4.11 PAVEMENT SECTIONS

4.11.1 Asphalt-Concrete Pavement Sections

The required pavement structural sections will depend on the expected wheel loads, volume of traffic, and subgrade soils. The Traffic Indexes (TI's) assumed should be reviewed by the project Owner, Architect, and/or Civil Engineer to evaluate their suitability for this project. Changes in the TI's will affect the corresponding pavement section. The pavement subgrade should be prepared just prior to placement of the base course. Positive drainage of the paved areas should be provided since moisture infiltration into the subgrade may decrease the life of pavements. Table 4, Preliminary Asphalt Concrete Pavement Sections, presents our recommendations of asphalt concrete pavement sections.

Table 4
Preliminary Asphalt Concrete Pavement Sections
(Design R-value = 13)

Traffic Use	Assumed Traffic Index (TI)	Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
General Parking Traffic	5	3.0	8.5
Heavy Truck Access Ways	7	4.0	13.5

Based on lab testing of near surface soils, a design R-Value of 13 was selected for pavement design. Additional R-Value testing and analysis should be performed to evaluate the site further during the final geotechnical design. Since the characteristics of the near-surface soils can change as a result of grading, we recommend that the subgrade soils be tested for pavement support characteristics, to confirm the parameters used in design and allow for a possible reduction in structural section thickness. Pavement sections provided above are contingent on the following recommendations being implemented during construction.

- The pavement sections recommended above should be placed on at least 18 inches of engineered fill compacted to at least 90 percent of maximum dry density with the upper 12 inches below pavements compacted to at least 95 percent relative compaction. The overexcavation of the pavement areas should be conducted as recommended in the earthwork section of this report. Prior to fill placement, the exposed subgrade should be scarified to a depth of 8 inches, uniformly moisture conditioned to at least the optimum moisture content prior to compaction.

- Subgrade soils should be in a stable, non-pumping condition at the time aggregate base materials are placed and compacted.
- Aggregate base materials should be compacted to at least 95 percent relative compaction.
- Adequate drainage (both surface and subsurface) should be provided such that the subgrade soils and aggregate base materials are not allowed to become wet.
- Aggregate base materials should meet current Caltrans specifications for Class 2 aggregate base rock, or crushed miscellaneous base as specified in the "Standard Specifications for Public Work Construction" ("Greenbook").
- The asphalt pavement should be placed in accordance with “Green Book” specifications or the County of Los Angeles requirements, as appropriate. We recommend that the asphalt pavement be placed in a single layer of ½-inch aggregate mix for pavements 4 inches thick or less. If the pavement section is over 4 inches thick, then the asphalt should be placed in at least two layers of mix. The first layer should consist of a base or coarse layer (3/4-inch mix). The second layer (i.e., top layer) should consist of a medium or fine layer of ½-inch mix.
- Based on our analyses and our experience with similar projects, it is our professional opinion that the as-built asphalt pavement sections should have a tolerance of +/- ¼-inch in order to remain valid for satisfying the intent of the recommendations presented herein. Typically, the loose thickness should be ¼ inch per inch greater than the required compacted thickness. In addition to loose measurements prior to compaction, this is typically evaluated by averaging the thickness of several cores in a specific area. Individual measurements (loose thickness or core dimension) should be within at least ¾-inch of the design thickness.
- All concrete curbs separating pavement and landscaped areas should extend into the subgrade and below the bottom of adjacent, aggregate base materials.

Pavement sections provided above are based on the soil conditions encountered during our field investigation, our assumptions regarding final site grades, and limited laboratory testing. Since the actual pavement subgrade materials exposed during grading may be significantly different than those tested for this study, we recommend that representative subgrade samples be obtained and additional R-value tests performed. Should the results of these tests indicate a significant difference, the design pavement section(s) provided above may need to be revised.

4.11.2 Portland Cement Concrete Pavement

Concrete pavements may be desirable in loading dock and trash collection areas. The concrete pavement should have a minimum 28-day compressive strength of 3,000 psi. Control joints should be spaced approximately every 10 feet. The concrete pavement section should be placed on at least 18 inches of engineered fill compacted to at least 90 percent of the maximum dry density. Prior to fill placement, the exposed subgrade should be scarified to a depth of 8 inches, uniformly moisture conditioned to the moisture content range recommended in Section 4.4 of this report. Table 5, Preliminary Recommended PCC Pavement Sections, presents our recommendations of Portland Cement Concrete pavement sections.

Table 5
Preliminary Recommended PCC Pavement Sections

Assumed Traffic Index (TI)	Concrete Thickness (inches; using a 28-day compressive strength of 3,000 psi)	Concrete Thickness (inches; using a 28-day compressive strength of 4,000 psi)
5	8.0	7.5
7	8.5	8.0

As an alternative to placing PCC pavements directly over 18 inches of engineered fill, 6 inches of aggregate base material may be added between the PCC and engineered fill to provide additional load distribution, drainage, and an option to reduce the thickness of the recommended PCC. If 6 inches of aggregate base material (compacted to 95% relative compaction) is used between the recommended 18 inches of engineered fill and PCC pavement, the recommended PCC thickness may be reduced by ½ inch. Aggregate base materials should meet current Caltrans specifications for Class 2 aggregate base, or crushed miscellaneous base as specified in the "Standard Specifications for Public Work Construction" ("Greenbook").

4.12 STORMWATER MANAGEMENT

We have preliminarily assessed the potential for storm water infiltration into the subgrade soils at the subject project site based on visual soil classification and laboratory testing of the soil samples collected during the field exploration. The onsite near-surface soils consist primarily of dense to very dense sands to silty sands and hard sandy clays. Based on these conditions, we anticipate a generally low infiltration capacity of the near-surface soils, and we preliminarily recommend alternatives to infiltration Best Management Practices (BMPs), such as bio-filtration/bio-retention systems (bio-swales and planter boxes), be implemented at the project site at these elevations. In-situ infiltration testing should be performed to confirm this preliminary assessment and determine design infiltration rates at the BMP design depth at specific locations at the site.

If bio-filtration/bio-retention systems are employed, we recommend that the BMPs be built such that water exiting from them will not seep into the foundation areas or beneath slabs and pavement. If planters are located within 10 feet of structures or foundations, or adjacent to slabs and pavements, then some means of diverting water away from the structures, foundation soils, or soils that support slabs and pavements would be required, such as lining the planters.

5 ADDITIONAL SERVICES

5.1 DESIGN LEVEL INVESTIGATION

This report presents preliminary geotechnical recommendations to develop a conceptual design and provide planning-level cost estimating. This study is not intended to be a design-level geotechnical study, and additional field and laboratory testing will be required in order to provide detailed geotechnical recommendations.

The preliminary recommendations provided in this report are based on our understanding of the described project information and on our interpretation of the data. We have made our recommendations based on experience with similar subsurface conditions under similar loading conditions. The recommendations apply to the specific project discussed in this report; therefore, any change in the structure configuration, loads, location, or the site grades should be provided to us so that we can review our conclusions and recommendations and make any necessary modifications.

6 LIMITATIONS

This report has been prepared for the exclusive use of NorthPoint Development, and its consultants and contractors for specific application to the proposed improvements for the proposed project. The findings, conclusions and recommendations presented in this report were prepared in a manner consistent with the standards of care and skill ordinarily exercised by members of our profession practicing under similar conditions in the geographic vicinity and at the time the services will be performed. No warranty or guarantee, express or implied, is made. Our field exploration program for the geotechnical study of this project was based on the approximate building locations provided to us by the client.

The client has the responsibility to see that all parties to the project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. This report contains information that may be useful in the preparation of contract specifications. However, this report is not designed as a specification document and may not contain sufficient information for this use without proper modification.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance, but in no event later than one year from the date of the report. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time. Any party, other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of this report and the nature of the new project, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party and the client agrees to defend, indemnify, and hold harmless Kleinfelder from any claims or liability associated with such unauthorized use or non-compliance.

The scope of our geotechnical services did not include any environmental site assessment for the presence or absence of hazardous/toxic materials, including methane or other landfill related gases. Kleinfelder will assume no responsibility or liability whatsoever for any claim, damage, or injury which results from pre-existing hazardous materials being encountered or present on the project site, or from the discovery of such hazardous materials.

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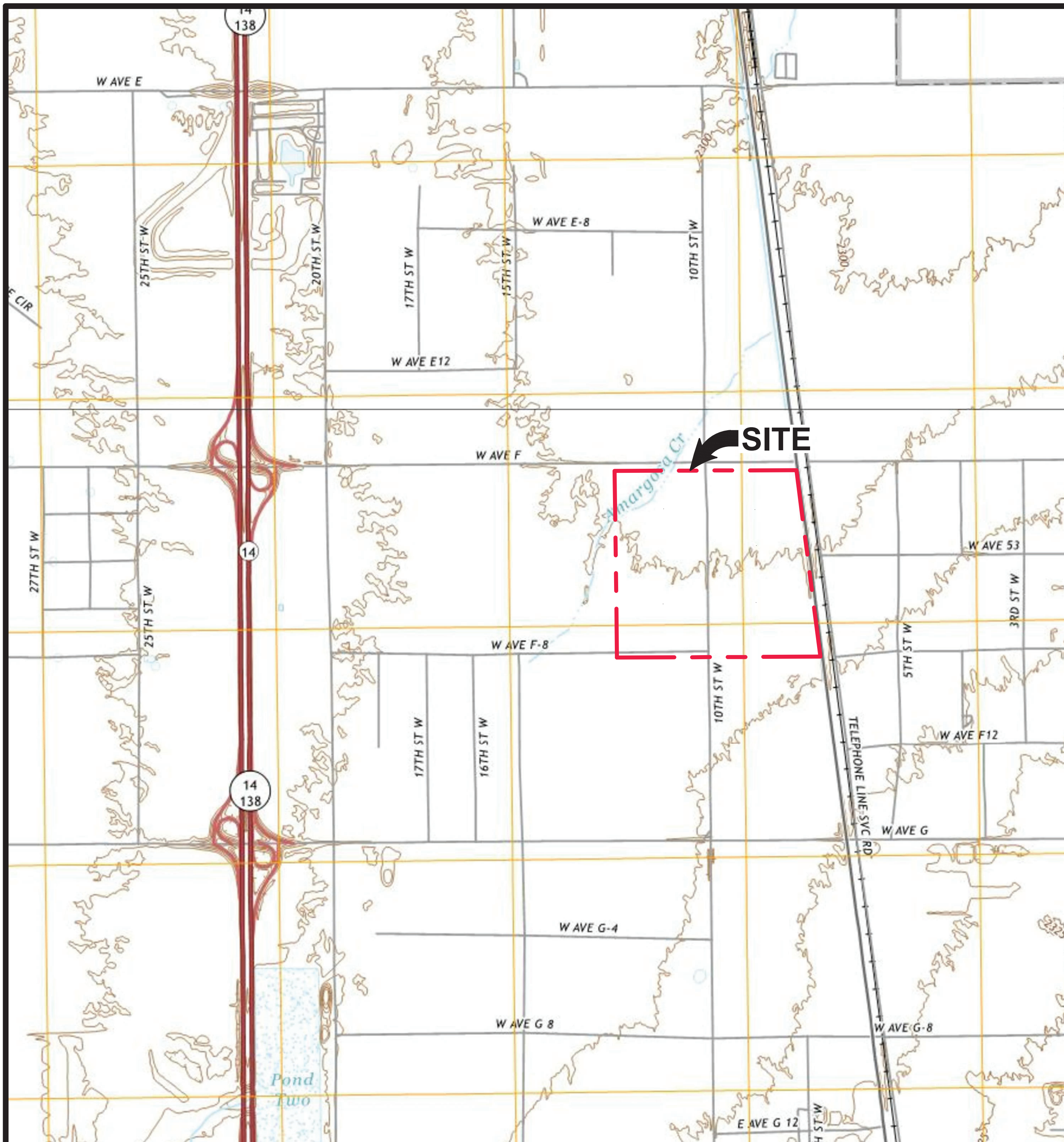
FIGURES



SOURCE: U.S.G.S. 7.5' topographic series, Lancaster West and Rosamond, California quadrangles dated 2018.

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APPROXIMATE SCALE (feet)

KLEINFELDER
Bright People. Right Solutions.

PROJ:	20230661.003A
DRAWN BY:	DMF
CHECKED BY:	JAZ
DATE:	12/2022
REVISED:	-

SITE VICINITY MAP

AVLC PHASE 3 AND PHASE 4
SOUTHWEST CORNER OF W AVE F & SEIRRA HWY
LANCASTER, LOS ANGELES COUNTY, CALIFORNIA

FIGURE

1

CAD FILE: C:\Users\DFahrney\Downloads\20230661\AVLC\20230661_AVLC.dwg

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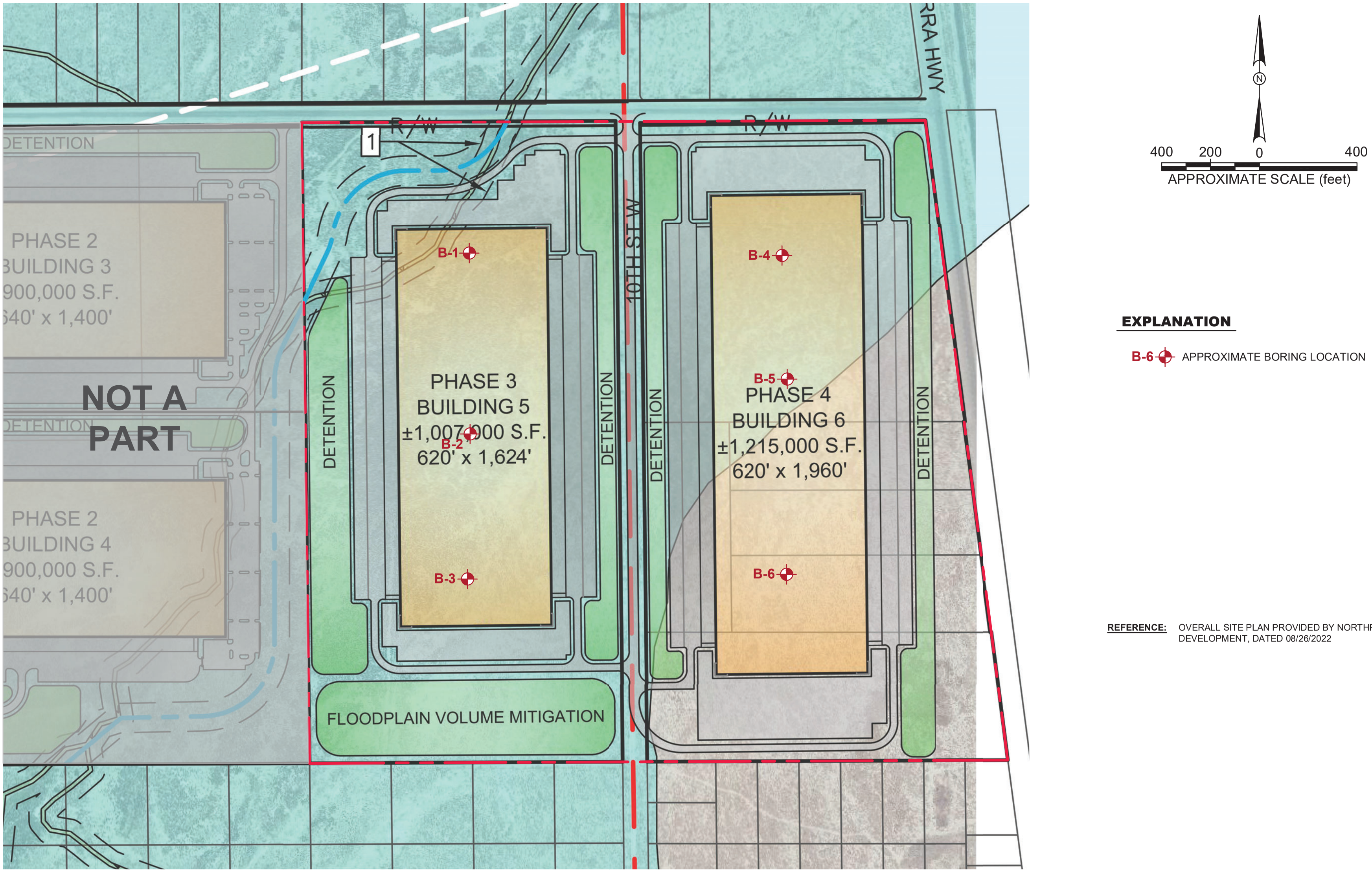

EXPLANATION

B-6 APPROXIMATE BORING LOCATION

REFERENCE: OVERALL SITE PLAN PROVIDED BY NORTHPOINT DEVELOPMENT, DATED 08/26/2022

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PROJ:	20230661.003A
DRAWN BY:	DMF
CHECKED BY:	JAZ
DATE:	12/2022
REVISED:	-

EXPLORATION LOCATION MAP

AVLC PHASE 3 AND PHASE 4
SOUTHWEST CORNER OF W AVE F & SEIRRA HWY
LANCASTER, LOS ANGELES COUNTY, CALIFORNIA

FIGURE 2

APPENDIX A
FIELD EXPLORATIONS

APPENDIX A
FIELD EXPLORATIONS

The subsurface conditions at the site were explored by drilling and logging six (6) hollow-stem auger borings. Due to soft soil at the surface of the site, the hollow stem auger borings were drilled using a truck-mounted drill rig. The hollow stem auger drill rigs were provided by 2R Drilling of Chino, California. The hollow stem auger drill rig mentioned above were equipped with an automatic hammer system to drive the samplers. The locations of our borings are shown on Figure 2.

The logs of borings are presented as Figures A-3 through A-8. An explanation to the logs is presented on Figures A-1 and A-2. The Logs of Borings describe the earth materials encountered, samples obtained, and show field and laboratory tests performed. The logs also show the boring number, excavation date and the name of the logger and excavation subcontractor. A Kleinfelder geologist logged the borings utilizing the Unified Soil Classification System (USCS). The boundaries between soil types shown on the logs are approximate because the transition between different soil layers may be gradual. Bulk and drive samples of representative earth materials were obtained from the borings at maximum intervals of about 5 feet.

A California-type sampler was used to obtain relatively undisturbed drive samples of the soil encountered. This sampler consists of a 3-inch O.D., 2.4 inch I.D. split barrel shaft that is driven a total of 18 inches into the soil at the bottom of the boring. The soil was retained in six 1-inch brass rings for laboratory testing. The sampler was driven using a 140-pound hammer falling 30 inches. The total number of hammer blows required to drive the sampler the final 12 inches is termed the blow count and is recorded on the Logs of Borings. Where the sample was driven less than 12 inches, the number of blows to drive the sample for each 6-inch segment, or portion thereof, is shown on the logs. For example, 50/4" indicates 50 blows to drive the sampler 4 inches to refusal.

Bulk samples of the sub-surface soils were retrieved directly from the soil cuttings and placed in large plastic bags.

DRILLING METHOD/SAMPLER TYPE GRAPHICS

- BULK SAMPLE
- CALIFORNIA SAMPLER (3 in. (76.2 mm.) outer diameter)
- GRAB SAMPLE
- STANDARD PENETRATION SPLIT SPOON SAMPLER (2 in. (50.8 mm.) outer diameter and 1-3/8 in. (34.9 mm.) inner diameter)

GROUND WATER GRAPHICS

- WATER LEVEL (level where first observed)
- WATER LEVEL (level after stabilizing period)
- WATER LEVEL (additional levels after exploration)
- OBSERVED SEEPAGE

NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Solid lines separating strata on the logs represent approximate boundaries only, dashed lines are inferred or extrapolated boundaries. Actual transitions may be gradual or differ from those represented.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System (ASTM D2488/D2487) designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, ie., CL-ML, GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.
- If sampler is not able to be driven at least 6 inches then 50/X indicates number of blows required to drive the identified sampler X inches with a 140 pound hammer falling 30 inches.

ABBREVIATIONS

WOH - Weight of Hammer
WOR - Weight of Rod

REFERENCES

1. American Society for Materials and Testing (ASTM), 2011, ASTM D2487: Classification of Soils for Engineering Purposes (Unified Soil Classification System).

UNIFIED SOIL CLASSIFICATION SYSTEM[1]

Major Division	Subdivision	Fines	Symbol	Description
COARSE GRAINED SOILS (More than 50% retained on No. 200 Sieve)	GRAVELS (More than 50% of coarse fraction retained on No. 4 Sieve)	CLEAN GRAVEL WITH <5% FINES	GW	WELL-GRADED GRAVEL, WELL-GRADED GRAVEL WITH SAND
			GP	POORLY GRADED GRAVEL, POORLY GRADED GRAVEL WITH SAND
		GRAVELS WITH 5% TO 12% FINES	GW-GM	WELL-GRADED GRAVEL WITH SILT, WELL-GRADED GRAVEL WITH SILT AND SAND
			GW-GC	WELL-GRADED GRAVEL WITH CLAY (OR SILTY CLAY), WELL-GRADED GRAVEL WITH CLAY AND SAND (OR SILT CLAY AND SAND)
			GP-GM	POORLY GRADED GRAVEL WITH SILT, POORLY GRADED GRAVEL WITH SILT AND SAND
			GP-GC	POORLY GRADED GRAVEL WITH CLAY (OR SILTY CLAY), POORLY GRADED GRAVEL WITH CLAY AND (OR SILTY CLAY AND SAND)
		GRAVELS WITH > 12% FINES	GM	SILTY GRAVEL, SILTY GRAVEL WITH SAND
			GC	CLAYEY GRAVEL, CLAYEY GRAVEL WITH SAND
			GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL WITH SAND
	SANDS (50% or more of coarse fraction passes the No. 4 Sieve)	CLEAN SANDS WITH <5% FINES	SW	WELL-GRADED SAND, WELL-GRADED SAND WITH GRAVEL
			SP	POORLY GRADED SAND, POORLY GRADED SAND WITH GRAVEL
		SANDS WITH 5% TO 12% FINES	SW-SM	WELL-GRADED SAND WITH SILT, WELL-GRADED SAND WITH SILT AND GRAVEL
			SW-SC	WELL-GRADED SAND WITH CLAY (OR SILTY CLAY), WELL-GRADED SAND WITH CLAY AND GRAVEL (OR SILTY CLAY AND GRAVEL)
			SP-SM	POORLY GRADED SAND WITH SILT, POORLY GRADED SAND WITH SILT AND GRAVEL
			SP-SC	POORLY GRADED SAND WITH CLAY, POORLY GRADED SAND WITH CLAY AND GRAVEL (OR SILTY CLAY AND GRAVEL)
		SANDS WITH > 12% FINES	SM	SILTY SAND, SILTY SAND WITH GRAVEL
			SC	CLAYEY SAND, CLAYEY SAND WITH GRAVEL
			SC-SM	SILTY, CLAYEY SAND, SILTY, CLAYEY SAND WITH GRAVEL
FINE GRAINED SOILS (50% or more passes the No. #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)		ML	SILT, SILT WITH SAND, SILT WITH GRAVEL
			CL	LEAN CLAY, LEAN CLAY WITH SAND, LEAN CLAY WITH GRAVEL
			CL-ML	SILTY CLAY, SILTY CLAY WITH SAND, SILTY CLAY WITH GRAVEL
			OL	ORGANIC CLAY, ORGANIC CLAY WITH SAND, ORGANIC CLAY WITH GRAVEL, ORGANIC SILT, ORGANIC SILT WITH SAND, ORGANIC SILT WITH GRAVEL
	SILTS AND CLAYS (Liquid Limit 50 or greater)		MH	ELASTIC SILT. ELASTIC SILT WITH SAND, ELASTIC SILT WITH GRAVEL
			CH	FAT CLAY, FAT CLAY WITH SAND, FAT CLAY WITH GRAVEL
			OH	ORGANIC CLAY, ORGANIC CLAY WITH SAND, ORGANIC CLAY WITH GRAVEL, ORGANIC SILT, ORGANIC SILT WITH SAND, ORGANIC SILT WITH GRAVEL

NOTE: USE MATERIAL DESCRIPTION ON THE LOG TO DEFINE A GRAPHIC THAT MAY NOT BE PROVIDED ON THIS LEGEND.

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20230661.003A DRAWN BY: JZ CHECKED BY: CJ DATE:	GRAPHICS KEY AVLC Phase 3 and Phase 4 SWC of W Avenue F and Sierra Highway Lancaster Area, Los Angeles County, California	FIGURE A-1

GRAIN SIZE[1]

DESCRIPTION		SIEVE SIZE	GRAIN SIZE
Boulders		>12 in.	>12 in. (304.8 mm.)
Cobbles		3 - 12 in.	3 - 12 in. (76.2 - 304.8 mm.)
Gravel	coarse	3/4 -3 in.	3/4 -3 in. (19 - 76.2 mm.)
	fine	#4 - 3/4 in.	0.19 - 0.75 in. (4.8 - 19 mm.)
Sand	coarse	#10 - #4	0.079 - 0.19 in. (2 - 4.9 mm.)
	medium	#40 - #10	0.017 - 0.079 in. (0.43 - 2 mm.)
	fine	#200 - #40	0.0029 - 0.017 in. (0.07 - 0.43 mm.)
Fines		Passing #200	<0.0029 in. (<0.07 mm.)

SECONDARY CONSTITUENT[1]

Term of Use	AMOUNT	
	Secondary Constituent is Fine Grained	Secondary Constituent is Coarse Grained
Trace	<5%	<15%
With	≥5 to <15%	≥15 to <30%
Modifier	≥15%	≥30%

PLASTICITY[1]

DESCRIPTION	CRITERIA
Non-Plastic	A 1/8 in. (3 mm) thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

MOISTURE CONTENT[1]

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

CONSISTENCY - FINE-GRAINED SOIL[2, 3]

CONSISTENCY	SPT - N (# blows / ft)	Pocket Pen (tsf)	UNCONFINED COMPRESSIVE STRENGTH (Q_u)(psf)	VISUAL / MANUAL CRITERIA
Very Soft	<2	PP < 0.25	<500	Easily penetrated several inches by fist
Soft	2 - 4	0.25 ≤ PP <0.5	500 - 1,000	Easily penetrated several inches by thumb
Medium Stiff	4 - 8	0.5 ≤ PP <1	1,000 - 2,000	Can be penetrated several inches by thumb with moderate effort
Stiff	8 - 15	1 ≤ PP <2	2,000 - 4,000	Readily indented by thumb but penetrated only with great effort
Very Stiff	15 - 30	2 ≤ PP <4	4,000 - 8,000	Readily indented by thumbnail
Hard	>30	4 ≤ PP	>8,000	Indented by thumbnail with difficulty

APPARENT DENSITY - COARSE-GRAINED SOIL[2]

APPARENT DENSITY	SPT-N (# blows / ft)
Very Loose	<4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	>50

STRUCTURE[1]

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 1/4-in. (6mm) thick, note thickness.
Laminated	Alternating layers of varying material or color with the layers less than 1/4-in. (6 mm) thick, note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness.
Homogeneous	Same color and appearance throughout

ANGULARITY[1]

DESCRIPTION	CRITERIA
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

REACTION WITH HYDROCHLORIC ACID[1]

DESCRIPTION	FIELD TEST
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

CEMENTATION[1]

DESCRIPTION	FIELD TEST
Weakly	Crumbles or breaks with handling or little finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

REFERENCES

1. American Society for Materials and Testing (ASTM), 2017, ASTM D2488: Standard Practice for Description and Identification of Soils (Visual Manual Procedures).
2. Terzaghi, K and Peck, R., 1948, Soil Mechanics in Engineering Practice, John Wiley & Sons, New York.
3. United States Department of the Interior Bureau of Reclamation (USBR), 1998, Earth Manual, Part I.

Date Begin - End:	12/02/2022	**Drilling Company:**	2R Drilling		**BORING LOG B-1**
Logged By:	D. Edrees	**Drill Crew:**	Miguel/Ryan		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Sunny, 42F	**Exploration Diameter:**	8 in. O.D.		

Latitude: 34.74627° N
Longitude: 118.15079° E
Surface Condition: Bare Earth

FIELD EXPLORATION					LABORATORY RESULTS							
Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0	**Alluvium** **Silty SAND (SM)**: fine to medium sand, non-plastic, yellowish brown, moist, stiff, trace gravel											Hand auger to 5' bgs.
2				12"		11.7						
5	**Well-Graded SAND with Silt (SW-SM)**: medium to coarse sand, non-plastic, reddish yellow, moist, medium dense		BC=12 17 18	18"	SP-SM	1.8	97.3	100	6.6			
7.5			BC=22 19 16	18"		1.5	87.0					
10	**Silty SAND (SM)**: fine to medium sand, non-plastic, olive brown, moist, dense with coarse sand and clay		BC=7 20 31	18"		10.0	122.2	100	45			
15	light brown		BC=16 23 26	18"		4.0	108.3					
17.5	**Sandy CLAY (CL)**: fine to medium sand, high plasticity, olive gray, moist, stiff											
20			BC=6 8 6	18"								
22.5	**Silty SAND (SM)**: fine to medium sand, non-plastic, yellowish brown, moist, medium dense											
25			BC=5 13 16	18"								
30			BC=6 9 9	18"								
32.5	**Poorly-Graded SAND with Silt (SP-SM)**: fine to medium sand, non-plastic, yellowish brown, moist, medium dense											

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PROJECT NO.: 20230661.003A

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CHECKED BY: CJ

DATE:

BORING LOG B-1

AVLC Phase 3 and Phase 4
SWC of W Avenue F and Sierra Highway
Lancaster Area, Los Angeles County, California

FIGURE

A-3

Date Begin - End:	12/02/2022	Drilling Company:	2R Drilling	BORING LOG B-1
Logged By:	D. Edrees	Drill Crew:	Miguel/Ryan	
Hor.-Vert. Datum:	Not Available	Drilling Equipment:	CME-75	Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge:	-90 degrees	Drilling Method:	Hollow Stem Auger	
Weather:	Sunny, 42F	Exploration Diameter:	8 in. O.D.	

Latitude: 34.74627° N
Longitude: 118.15079° E
Surface Condition: Bare Earth

Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
	Poorly-Graded SAND with Silt (SP-SM): fine to medium sand, non-plastic, yellowish brown, moist, medium dense		BC=4 10 15	18"								
	Sandy CLAY (CL): fine to medium sand, high plasticity, olive gray, moist, very stiff											
40	**Poorly-Graded SAND (SP)**: fine to medium sand, non-plastic, yellowish brown, moist, dense		BC=19 19 12	18"								
45			BC=11 15 18	18"								
	Sandy CLAY (CL): fine sand, medium plasticity, olive gray, moist, stiff											
50			BC=7 5 7	18"								
55												
60												
65												

The boring was terminated at approximately 51.5 ft. below ground surface. The boring was backfilled with cement/bentonite grout mix on December 02, 2022.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:

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PROJECT NO.: 20230661.003A	BORING LOG B-1	FIGURE
DRAWN BY: JZ	AVLC Phase 3 and Phase 4 SWC of W Avenue F and Sierra Highway Lancaster Area, Los Angeles County, California	A-3
CHECKED BY: CJ		
DATE:		

Date Begin - End: 12/02/2022	**Drilling Company:** 2R Drilling			**BORING LOG B-2**
Logged By: D. Edrees	**Drill Crew:** Miguel/Ryan			
Hor.-Vert. Datum: Not Available	**Drilling Equipment:** CME-75	**Hammer Type - Drop:** 140 lb. Auto - 30 in.		
Plunge: -90 degrees	**Drilling Method:** Hollow Stem Auger			
Weather: Sunny, 42F	**Exploration Diameter:** 8 in. O.D.			

Latitude: 34.74423° N
Longitude: 118.15077° E
Surface Condition: Bare Earth

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		<u>**Alluvium**</u> **Silty SAND (SM)**: fine to medium sand, non-plastic, yellowish brown, dry			12"		6.1						Hand auger to 5' bgs. Modified Proctor Test
5		**Silty SAND (SM)**: fine to medium sand, non-plastic, yellowish brown, moist, dense to very dense		BC=17 22 23	18"		4.2	108.1					
				BC=20 29 21	18"		2.9	118.7	100	28			
10				BC=17 17 24	18"		12.2	105.3					
		Poorly-Graded SAND (SP): fine to medium sand, non-plastic, light gray, moist, very dense											
15				BC=23 40 40	18"		1.9	131.0					
		Poorly-Graded SAND (SP): fine to medium sand, non-plastic, yellowish brown, moist, dense											
20		trace clay		BC=14 12 22	18"								
		Silty SAND (SM): fine to coarse sand, non-plastic, brown, moist, very dense											
25				BC=20 25 22	18"								drillers added water
		Sandy SILT (ML): medium to coarse sand, low plasticity, olive gray, moist, stiff to very stiff											
30				BC=4 7 8	18"								

The boring was terminated at approximately 31.5 ft. below ground surface. The boring was backfilled with cement/bentonite grout mix on December 02, 2022.

<u>GROUNDWATER LEVEL INFORMATION:</u>
Groundwater was not observed during drilling or after completion.
<u>GENERAL NOTES:</u>

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PROJECT NO.: 20230661.003A	BORING LOG B-2		FIGURE
DRAWN BY: JZ	AVLC Phase 3 and Phase 4 SWC of W Avenue F and Sierra Highway Lancaster Area, Los Angeles County, California		A-4
CHECKED BY: CJ			
DATE:			PAGE: 1 of 1

BORING LOG B-3

Date Begin - End:	12/01/2022	**Drilling Company:**	2R Drilling
Logged By:	D. Edrees	**Drill Crew:**	Miguel/Ryan
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-75
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger
Weather:	Cloudy, 44F	**Exploration Diameter:**	8 in. O.D.

Hammer Type - Drop: 140 lb. Auto - 30 in.

Latitude: 34.74260° N
Longitude: 118.15080° E
Surface Condition: Bare Earth

Depth (feet)	Lithologic Description	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0	**Alluvium** **Sandy CLAY (CL)**: fine to medium sand, high plasticity, olive yellow, dry										Hand auger to 5' bgs. Drillers added water due to falling sands. R-value Test Expansion Index Test
			12"		24.6						
5	**Poorly-Graded SAND (SP)**: fine to medium sand, non-plastic, brown, dry, very dense	BC=20 37 35	18"		1.1	122.2					
	Silty SAND (SM): fine to medium sand, non-plastic, yellowish brown, moist, dense to very dense	BC=19 32 34	18"		8.8	97.7					
10		BC=24 34 32	18"		4.6	124.2	100	22			
15		BC=19 32 38	18"								
	Silty SAND (SM): fine to medium sand, non-plastic, olive yellow, moist, medium dense										
20		BC=5 7 12	18"								
	Lean CLAY (CL): fine to medium sand, medium plasticity, olive brown, moist, stiff										
25		BC=7 7 7	18"						32	14	
	Silty SAND (SM): fine to medium sand, non-plastic, olive brown, moist, medium dense										
30		BC=5 5 9	18"								
	Lean CLAY (CL): fine to medium sand, medium plasticity, olive brown, moist, medium stiff to stiff										

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PROJECT NO.: 20230661.003A
DRAWN BY: JZ
CHECKED BY: CJ
DATE:

BORING LOG B-3

AVLC Phase 3 and Phase 4
SWC of W Avenue F and Sierra Highway
Lancaster Area, Los Angeles County, California

FIGURE A-5

Date Begin - End:	12/01/2022	**Drilling Company:**	2R Drilling		**BORING LOG B-3**
Logged By:	D. Edrees	**Drill Crew:**	Miguel/Ryan		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Cloudy, 44F	**Exploration Diameter:**	8 in. O.D.		

Latitude: 34.74260° N
Longitude: 118.15080° E
Surface Condition: Bare Earth

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		FIELD EXPLORATION				LABORATORY RESULTS							
		Lean CLAY (CL): fine to medium sand, medium plasticity, olive brown, moist, medium stiff to stiff		BC=2 4 4	18"						35	17	
40		high plasticity, yellowish brown, medium stiff		BC=2 2 3	18"						49	28	
45		olive yellow, stiff		BC=4 4 5	18"						35	18	
50		medium plasticity, olive brown		BC=3 4 5	18"						37	17	
55													
60													
65													

The boring was terminated at approximately 51.5 ft. below ground surface. The boring was backfilled with cement/bentonite grout mix on December 01, 2022.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.
GENERAL NOTES:

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PROJECT NO.: 20230661.003A		BORING LOG B-3	FIGURE
DRAWN BY:	JZ	AVLC Phase 3 and Phase 4 SWC of W Avenue F and Sierra Highway Lancaster Area, Los Angeles County, California	A-5
CHECKED BY:	CJ		
DATE:			PAGE: 2 of 2

Date Begin - End:	12/01/2022	**Drilling Company:**	2R Drilling		**BORING LOG B-4**
Logged By:	D. Edrees	**Drill Crew:**	Miguel/Ryan		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Cloudy, 44F	**Exploration Diameter:**	8 in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 34.74625° N
Longitude: 118.14652° E
Surface Condition: Bare Earth

Depth (feet)	Lithologic Description	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0	**Alluvium** **Sandy CLAY (CL)**: fine sand, medium plasticity, light brown, dry										Hand auger to 5' bgs. Drillers added water due to falling sands. Expansion Index
2			12"		14.7						
5		BC=23 18 20	18"		8.3	116.4					
7.5	**Silty SAND (SM)**: fine to medium sand, non-plastic, yellowish brown, moist, very dense	BC=27 36 43	18"		4.6	136.2	100	32			
10	dense	BC=15 17 25	18"		3.7	117.0					
12.5	**Poorly-Graded SAND (SP)**: fine to medium sand, non-plastic, grayish brown, dry, dense										
15		BC=15 24 25	18"		0.7	94.5					Sample is disturbed.
17.5	**Silty SAND (SM)**: fine to medium sand, non-plastic, light brown, dry, dense										
20		BC=10 18 13	18"								
22.5	**Poorly-Graded SAND (SP)**: medium sand, non-plastic, yellowish brown, moist, medium dense										
25		BC=8 12 15	18"								
30		BC=9 9 20	18"								
33.5	**Clayey SAND (SC)**: fine to medium sand, low plasticity, grayish brown, moist, loose										

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PROJECT NO.: 20230661.003A
DRAWN BY: JZ
CHECKED BY: CJ
DATE:

BORING LOG B-4

AVLC Phase 3 and Phase 4
SWC of W Avenue F and Sierra Highway
Lancaster Area, Los Angeles County, California

FIGURE A-6

Date Begin - End:	12/01/2022	**Drilling Company:**	2R Drilling		**BORING LOG B-4**
Logged By:	D. Edrees	**Drill Crew:**	Miguel/Ryan		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Cloudy, 44F	**Exploration Diameter:**	8 in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 34.74625° N
Longitude: 118.14652° E
Surface Condition: Bare Earth

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Clayey SAND (SC): fine to medium sand, low plasticity, grayish brown, moist, loose		BC=2 4 4	18"								
40		medium dense		BC=1 3 8	18"								
		Silty SAND (SM): fine to medium sand, non-plastic, grayish brown, moist, medium dense											
45				BC=7 10 15	18"								
		Poorly-Graded SAND (SP): fine to medium sand, non-plastic, light brown, moist, dense											
50				BC=16 20 26	18"								
55													
60													
65													

The boring was terminated at approximately 51.5 ft. below ground surface. The boring was backfilled with cement/bentonite grout mix on December 01, 2022.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:

PLOTTED: 01/05/2023 04:31 PM BY: JZuniga

Date Begin - End:	12/01/2022	**Drilling Company:**	2R Drilling		**BORING LOG B-5**
Logged By:	D. Edrees	**Drill Crew:**	Miguel/Ryan		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-75	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Cloudy, 44F	**Exploration Diameter:**	8 in. O.D.		

Latitude: 34.74486° N
Longitude: 118.14645° E
Surface Condition: Bare Earth

FIELD EXPLORATION					LABORATORY RESULTS							
Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0	**Alluvium** **Sandy CLAY (SC)**: fine sand, medium plasticity, brown, dry	Bulk										Hand auger to 5' bgs. Drillers added water due to falling sands.
2				12"		30.5						
5	**Silty SAND (SM)**: fine sand, non-plastic, brown, dry, dense		BC=33 30 29	18"		5.1	121.2					
7.5	**Poorly-Graded SAND with Silt (SP-SM)**: fine to medium sand, non-plastic, yellowish brown, dry, very dense		BC=27 37 26	18"		1.5	108.8					
10	**Sandy CLAY (CL)**: fine to medium sand, medium plasticity, dark brown, moist, hard		BC=12 23 40	18"		17.3	106.0					
12.5	**Silty SAND (SM)**: fine sand, non-plastic, grayish brown, moist, dense											
15	fine to medium sand, iron oxide staining		BC=11 13 36	12"		7.9	118.7					
20	medium dense		BC=5 10 9	18"								
22.5	**Clayey SILT (ML)**: fine to medium sand, low plasticity, grayish brown, moist, very stiff											
25			BC=11 15 27	18"								
27.5	**Poorly-Graded SAND (SP)**: fine to medium sand, non-plastic, light brown, moist, very dense											
30			BC=18 20 23	18"								

The boring was terminated at approximately 31.5 ft. below ground surface. The boring was backfilled with cement/bentonite grout mix on December 01, 2022.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20230661.003A		BORING LOG B-5	FIGURE
DRAWN BY:	JZ	AVLC Phase 3 and Phase 4 SWC of W Avenue F and Sierra Highway Lancaster Area, Los Angeles County, California	A-7
CHECKED BY:	CJ		
DATE:			PAGE: 1 of 1

gINT FILE: Klf_gint_master_2023 PROJECT NUMBER: 20230661.003A OFFICE FILTER: RIVERSIDE
gINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2023.GLB [_KLF_BORING/TEST PIT SOIL LOG]

BORING LOG B-6

Date Begin - End: 12/01/2022
Logged By: D. Edrees
Hor.-Vert. Datum: Not Available
Plunge: -90 degrees
Weather: Cloudy, 44F

Drilling Company: 2R Drilling
Drill Crew: Miguel/Ryan
Drilling Equipment: CME-75
Drilling Method: Hollow Stem Auger
Exploration Diameter: 8 in. O.D.

Hammer Type - Drop: 140 lb. Auto - 30 in.

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 34.74266° N
Longitude: 118.14645° E
Surface Condition: Bare Earth

Depth (feet)	Lithologic Description	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0	**Alluvium** **Lean CLAY (SC)**: medium plasticity, reddish brown, dry, some sand										Hand auger to 5' bgs. Drillers added water due to falling sands.
			12"		26.1						
5	**Silty CLAY (CL-ML)**: fine to medium sand, medium plasticity, reddish brown, very moist, hard	BC=16 50/6"	18"		12.2	109.7	100	69			
	Silty SAND (SM): fine to medium sand, non-plastic, grayish brown, moist, very dense	BC=19 35 45	18"		7.1	124.4					
10	**Sandy SILT (ML)**: fine to medium sand, low plasticity, grayish brown, moist, hard	BC=16 25 36	18"		10.3	116.4					
	Silty SAND (SM): fine to medium sand, non-plastic, greenish brown, moist, medium dense										
15		BC=15 18 24	18"		7.6	118.7					
	Poorly-Graded SAND (SP): fine sand, non-plastic, brown, moist, medium dense, trace silt										
20		BC=5 10 12	18"								
	Silty SAND (SM): fine to medium sand, non-plastic, greenish brown, moist, medium dense										
25		BC=5 8 12	18"								
	Poorly-Graded SAND (SP): fine to medium sand, non-plastic, yellowish brown, moist, medium dense										
30		BC=11 13 15	18"								
	Silty SAND (SM): fine sand, non-plastic, greenish brown, moist, medium dense										

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PROJECT NO.: 20230661.003A
DRAWN BY: JZ
CHECKED BY: CJ
DATE:

BORING LOG B-6

AVLC Phase 3 and Phase 4
SWC of W Avenue F and Sierra Highway
Lancaster Area, Los Angeles County, California

FIGURE A-8

Date Begin - End: 12/01/2022
Logged By: D. Edrees
Hor.-Vert. Datum: Not Available
Plunge: -90 degrees
Weather: Cloudy, 44F

Drilling Company: 2R Drilling
Drill Crew: Miguel/Ryan
Drilling Equipment: CME-75
Drilling Method: Hollow Stem Auger
Exploration Diameter: 8 in. O.D.

Hammer Type - Drop: 140 lb. Auto - 30 in.

BORING LOG B-6

FIELD EXPLORATION / LABORATORY RESULTS

Latitude: 34.74266° N
Longitude: 118.14645° E
Surface Condition: Bare Earth

Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
	Silty SAND (SM): fine sand, non-plastic, greenish brown, moist, medium dense		BC=5 7 11	18"								
	Sandy CLAY (CL): fine sand, medium plasticity, grayish brown, moist, stiff											
40			BC=3 5 7	18"								
45	olive gray		BC=5 7 6	18"								
	Poorly-Graded SAND (SP): medium to coarse sand, non-plastic, greenish gray, moist, medium dense											
50			BC=13 13 6	12"								
55												
60												
65												

The boring was terminated at approximately 51.5 ft. below ground surface. The boring was backfilled with cement/bentonite grout mix on December 01, 2022.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.
GENERAL NOTES:

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20230661.003A
DRAWN BY: JZ
CHECKED BY: CJ
DATE:

BORING LOG B-6

AVLC Phase 3 and Phase 4
SWC of W Avenue F and Sierra Highway
Lancaster Area, Los Angeles County, California

FIGURE
A-8

APPENDIX B
LABORATORY TESTING

APPENDIX B
LABORATORY TESTING

Laboratory tests were performed on drive and bulk soil samples to estimate engineering characteristics of the various earth materials encountered. The laboratory testing was performed by our laboratory located in Ontario, California or by AP Engineering & Testing, Inc. of Pomona, California. Testing was performed in general accordance with procedures outlined in the American Society for Testing and Materials, or other accepted procedures. Visual classifications presented on the lab figures performed by AP Engineering may differ from those presented on the boring logs provided in Appendix A.

LABORATORY MOISTURE DETERMINATIONS AND UNIT WEIGHTS

Natural moisture content and unit weight tests were performed on selected samples. The moisture content tests were performed in general accordance with ASTM Test Method D 2216 and the unit weight tests were performed in general accordance with ASTM Test Method D 2937. The results are presented on the Logs of Borings in Appendix A.

SIEVE ANALYSES

Sieve analyses were performed on selected samples of the materials encountered at the site to evaluate the grain size distribution characteristics of the soils and to aid in their classification. Tests were performed in general accordance with ASTM Test Method D 6913. Results of these tests are presented in the boring logs in Appendix A and attached as Figure B-1 and B-2, Grain Size Distribution Curve.

ATTERBERG LIMITS (PLASTICITY INDEX)

Plasticity limit and liquid limit testing was performed on soil samples to evaluate behavior conditions at varying water contents. Testing was performed in general accordance with ASTM Standard Test Method D4318. The results are presented on the boring logs in Appendix A and attached as Figure B-3, Plasticity Testing.

DIRECT SHEAR

Direct shear testing was performed on a remolded sample for shear strength and cohesion values of the in-situ soils in accordance with ASTM Standard Test Method D 3080. The result is presented as Figure B-4, Direct Shear Test.

ONE-DIMENSIONAL SWELL/COLLAPSE TEST

Laboratory testing was performed on selected soil samples to study the collapse potential of the subgrade soils. During this test, the soil sample is inundated with water at a specific surcharge loading and the percent swell or collapse is measured. This tests were performed by AP Engineering in accordance with ASTM D4546. The test results are attached to this appendix.

PRELIMINARY CORROSIVITY TESTS

A series of chemical tests were performed on a selected sample of the near-surface soils to estimate pH, resistivity and sulfate and chloride contents. The sample was tested in general accordance with California Test Methods 643, 422, and 417 for pH and minimum resistivity, soluble chlorides, and soluble sulfates, respectively. Test results may be used by a qualified corrosion engineer to evaluate the general corrosion potential with respect to construction materials. The tests were performed by AP Engineering. The results of these tests are presented in Table B-1, Preliminary Corrosion Test Results.

MODIFIED PROCTOR

Maximum density-optimum moisture tests were performed on a select bulk sample of the on-site soils to determine compaction characteristics. The test was performed in accordance with ASTM Standard Test Method D 1557. The test results are presented in Table B-2, Modified Proctor Test Results and Figure B-4 in Appendix B.

EXPANSION INDEX

Expansion Index testing was performed on two near surface bulk samples to determine the expansion potential of the soil. The tests were performed in accordance with ASTM Standard Test Method D4829. The test results are presented in Table B-3, Expansion Index Test Results.

R-VALUE TEST

A Resistance Value (R-value) test was performed on a select bulk soil sample to evaluate pavement support characteristics of the near-surface onsite soils. R-value testing was performed in accordance with ASTM Standard Test Method D2844. The test result is presented below in Table B-4, R-Value Test Results Figure B-5 in Appendix B.

Table B-1
Preliminary Corrosivity Test Results

Boring	Depth (ft)	pH	Sulfate (ppm)	Chloride (ppm)	Resistivity (ohm-cm)
B-3	0 – 5	9.8	416	260	556
B-5	0 – 5	9.9	27	33	1,221

Table B-2
Modified Proctor Test Results

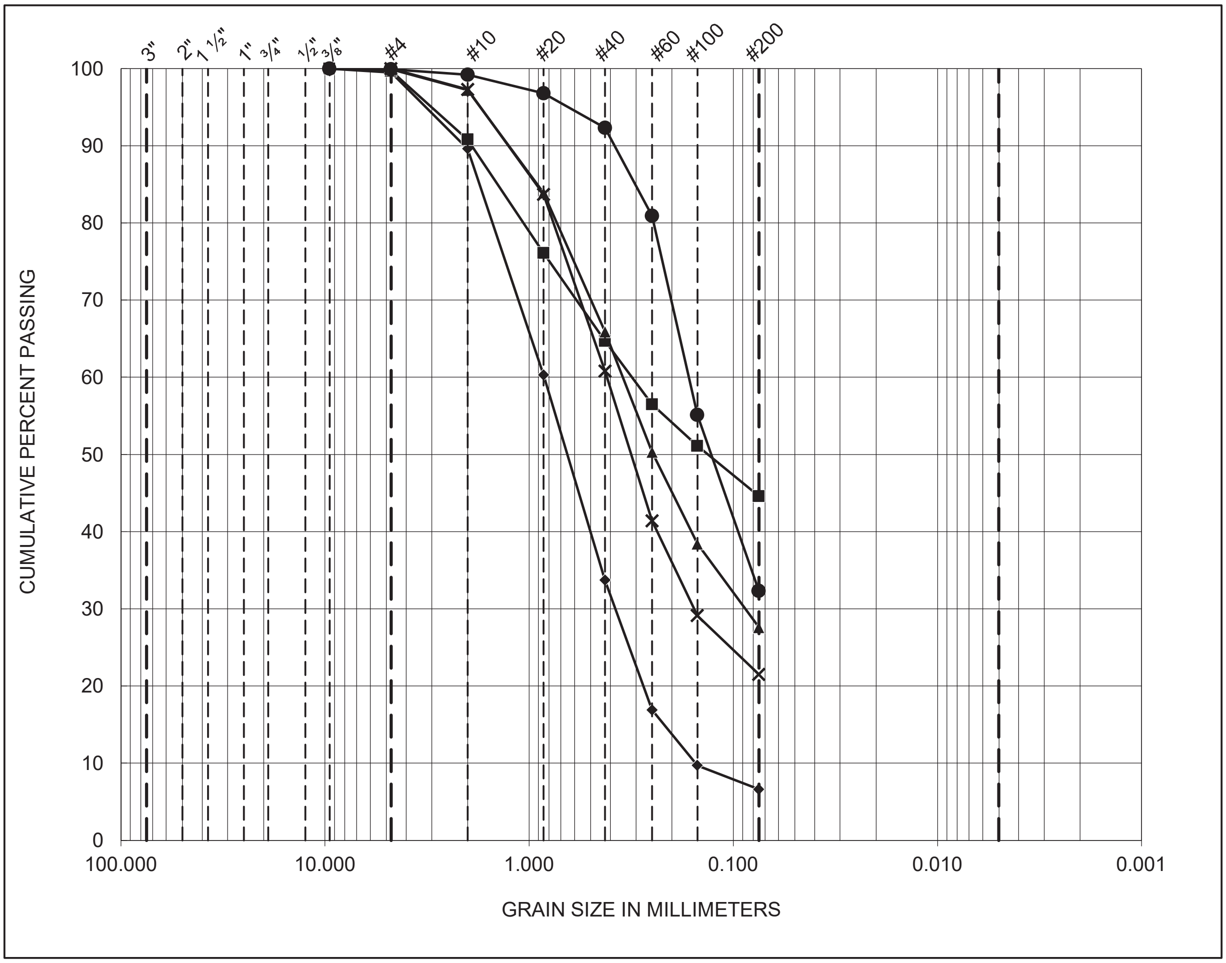
Boring Number	Depth (ft)	Maximum Dry Density (pcf)	Optimum Moisture (%)
B-2	0 – 5	121.2	11.4

Table B-3
Expansion Index Test Result

Boring Number	Depth (ft)	Expansion Index	Expansion Potential
B-4	0 – 5	125	High
B-5	0 – 5	73	Medium

Table B-4
Resistance Value Test Result

Boring Number	Depth (ft)	R-Value
B-3	0 – 5	13



COBBLE	GRAVEL	SAND	SILT	CLAY

SYMBOL	SAMPLE IDENTIFICATION			PERCENTAGES			ATTERBERG LIMITS			SOIL CLASSIFICATION
	BORING NO.	SAMPLE NO.	DEPTH (ft.)	GRAVEL	SAND	FINES	LL	PL	PI	
◆	B-1	3	5	0.5	92.9	6.6	NM	NM	NM	Well-Graded Sand w/Silt (SW-SM)
■	B-1	5	10	0.3	55.1	44.6	NM	NM	NM	Silty Sand (SM)
▲	B-2	4	7.5	0.1	72.3	27.6	NM	NM	NM	Silty Sand (SM)
×	B-3	5	10	0.0	78.5	21.5	NM	NM	NM	Silty Sand (SM)
●	B-4	4	7.5	0.1	67.6	32.3	NM	NM	NM	Silty Sand (SM)

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Bright People. Right Solutions.

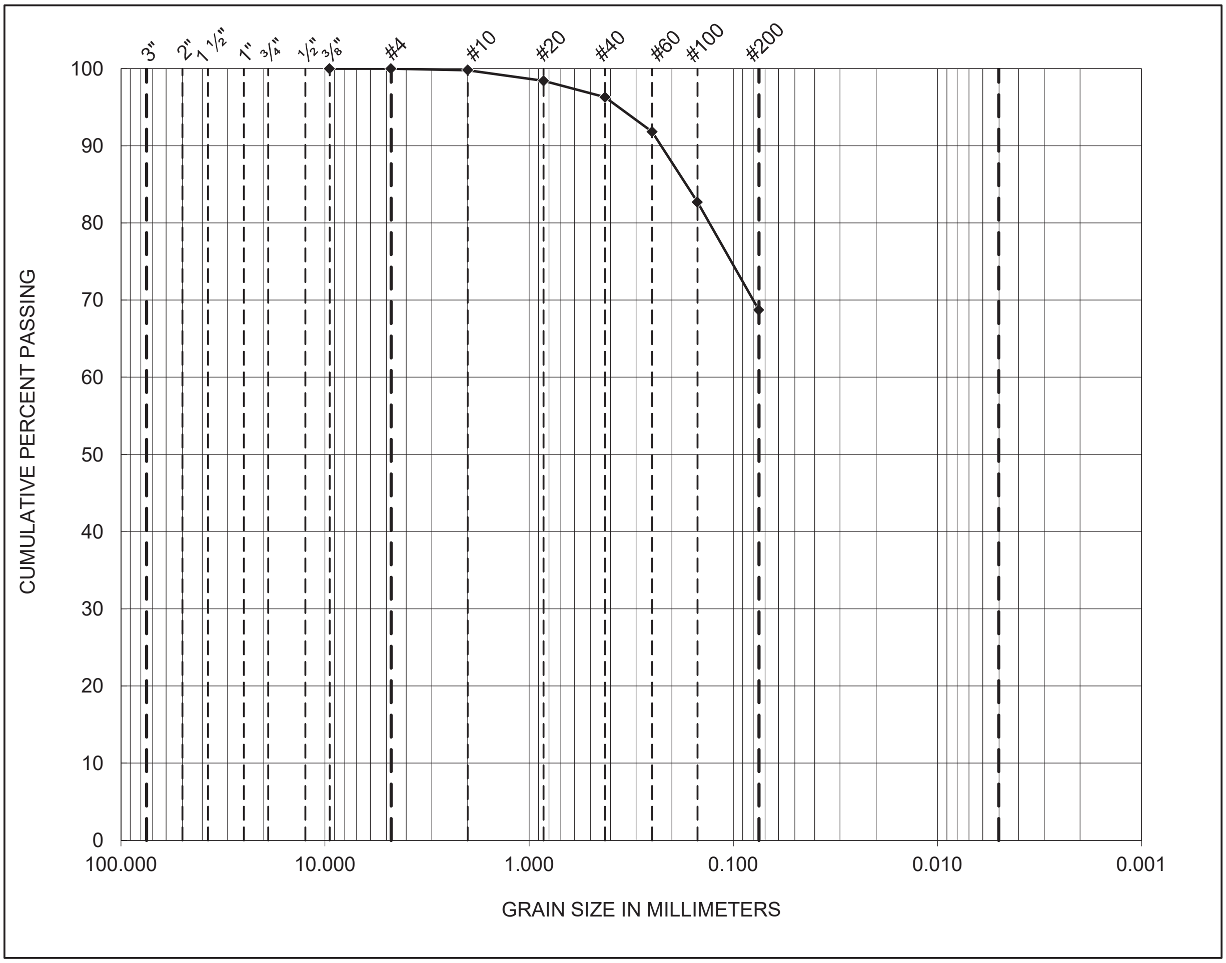
PROJECT NO.: 20230661.003A
TESTED BY:
DATE:
CHECKED BY:
DATE:

GRAIN SIZE DISTRIBUTION

AVLC Phase 3 & 4

FIGURE

B-1



COBBLE	GRAVEL	SAND	SILT	CLAY

SYMBOL	SAMPLE IDENTIFICATION			PERCENTAGES			ATTERBERG LIMITS			SOIL CLASSIFICATION
	BORING NO.	SAMPLE NO.	DEPTH (ft.)	GRAVEL	SAND	FINES	LL	PL	PI	
◆	B-6	3	5	0.0	31.3	68.7	NM	NM	NM	Sandy Lean Clay (CL)

KLEINFELDER
Bright People. Right Solutions.

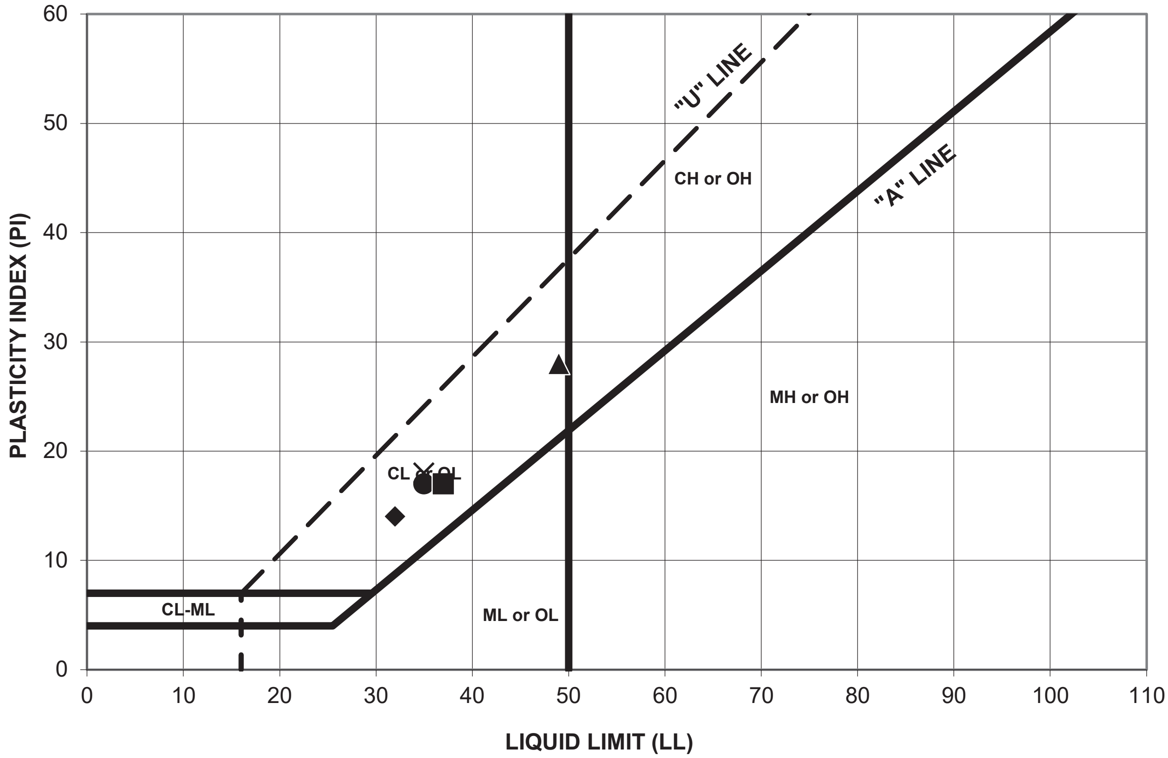
PROJECT NO.: 20230661.003A
TESTED BY:
DATE:
CHECKED BY:
DATE:

GRAIN SIZE DISTRIBUTION

AVLC Phase 3 & 4

FIGURE

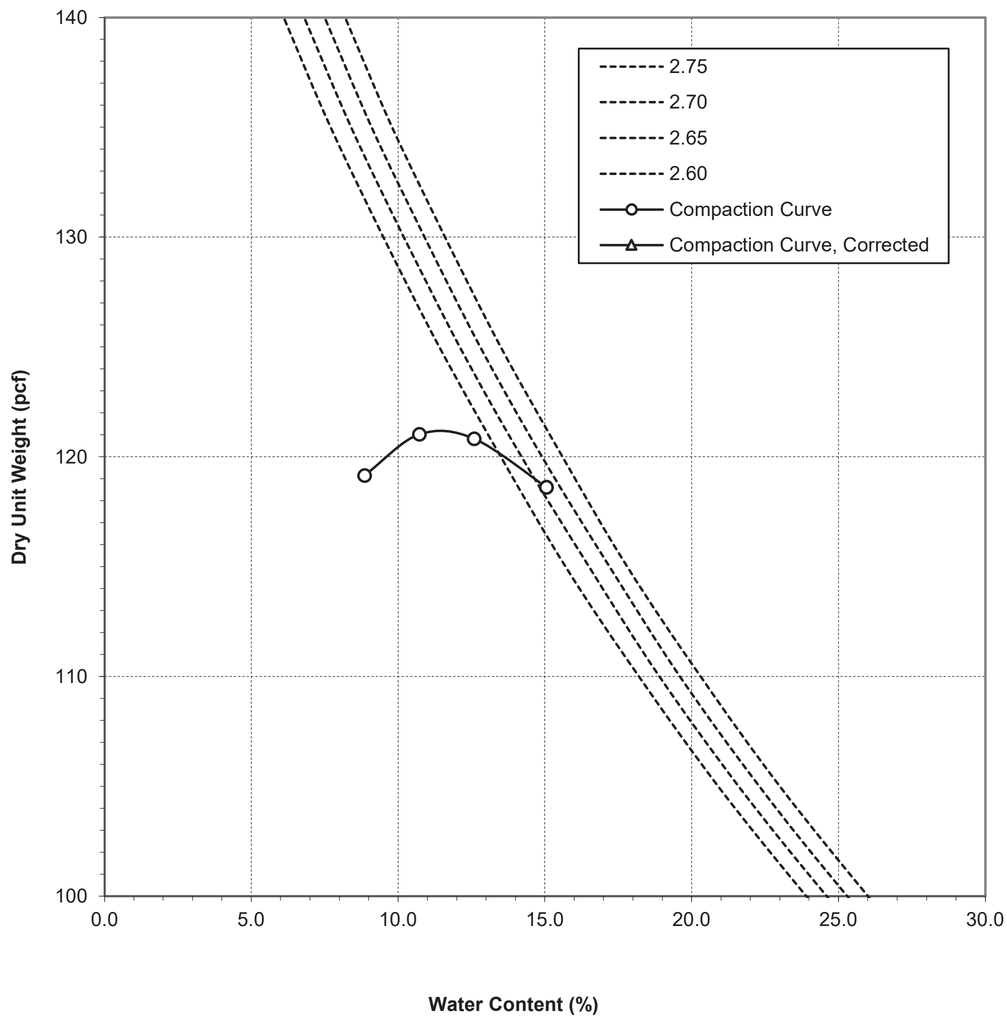
B-2



SYMBOL	SAMPLE IDENTIFICATION			ATTERBERG LIMITS			SOIL CLASSIFICATION
	BORING NO.	SAMPLE NO.	DEPTH (ft)	LL	PL	PI	
◆	B-3	8	25	32	18	14	Lean Clay (CL)
●	B-3	10	35	35	18	17	Lean Clay (CL)
▲	B-3	11	40	49	21	28	Lean Clay (CL)
×	B-3	12	45	35	17	18	Lean Clay (CL)
■	B-3	13	50	37	20	17	Lean Clay (CL)

Testing performed in general accordance with ASTM D4318

KLEINFELDER *Bright People. Right Solutions.*	PROJECT NO.:	20230661.003A	PLASTICITY TESTING	FIGURE
	TESTED BY:	J. Calderon		B-3
	DATE:	12/12/2022		
	CHECKED BY:	M. Magaña	AVLC Phase 3 & 4	
	DATE:	12/13/2022		



Boring No.: B-2

Sample No.: 1

Depth: 0-5'

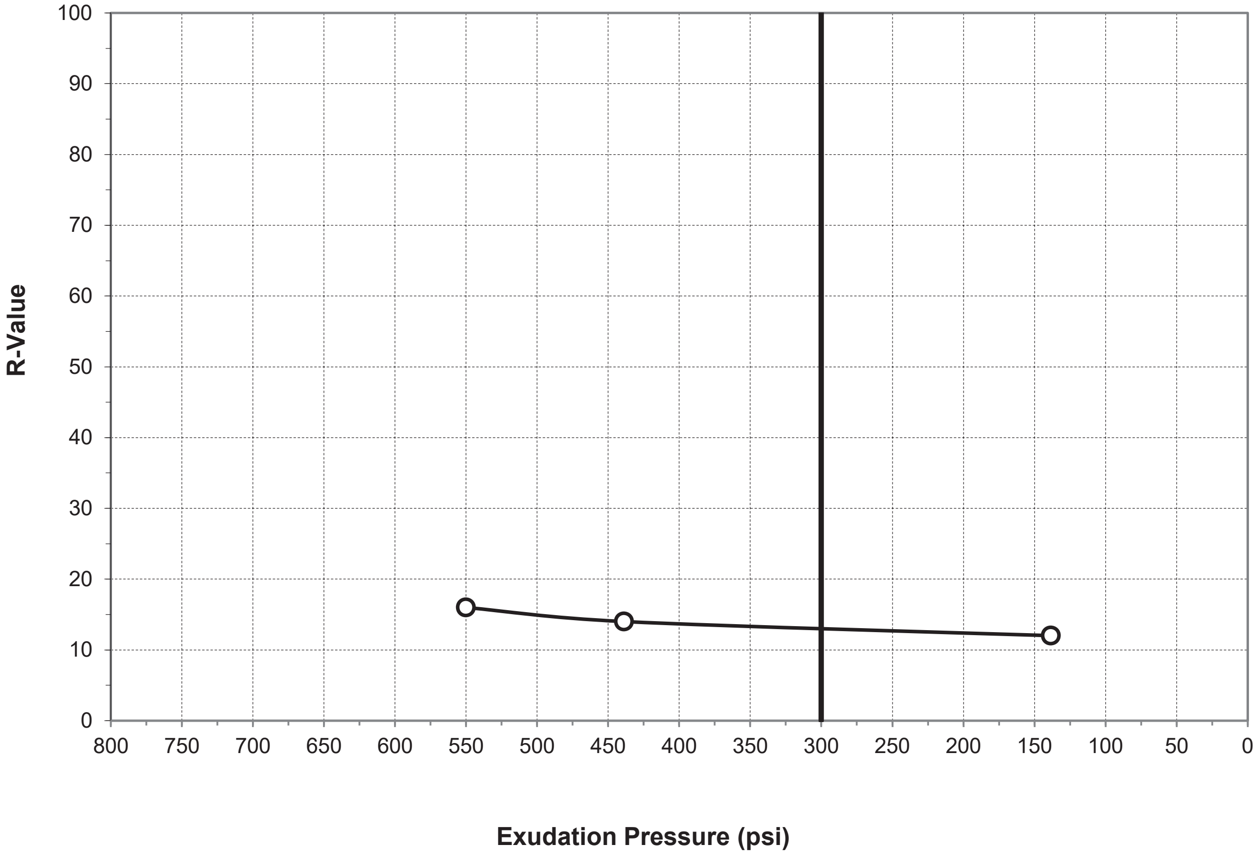
Material Description: Yellowish Brown Silty Sand (SM)

	Uncorrected	Corrected
Maximum Dry Unit Weight (pcf)	**121.2**	**na**
Optimum Water Content (%)	**11.4**	**na**
Oversize Fraction, retained on 3/8 (%)		**<5**
Bulk Specific Gravity of Oversize Fraction		**na**

na = not applicable

Tested in accordance with: ASTM D1557, Method B

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20230661.003A TESTED BY: J. Calderon DATE: 12/16/2022 CHECKED BY: M. Magaña DATE: 12/19/2022	Compaction Curve AVLC	FIGURE B-4



Boring No.: B-3

Sample No.: 1

Depth: 0-5

Material Description: Yellowish Brown Sandy Silt (ML)

Specimen No.	A	B	C
Moisture at Test (%)	17.9	18.9	20.4
Dry Unit Weight at Test (pcf)	109.3	107.6	104.8
Expansion Pressure (psf)	173.2	160.2	17.3
Exudation Pressure (psi)	550.0	438.8	138.4
Resistance Value	16	14	12
R - VALUE AT 300 PSI EXUDATION PRESSURE			**13**

Test Procedure: ASTM D2844

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20230661.003A TESTED BY: M.Magaña DATE: 12/19/2022 CHECKED BY: M.Magaña DATE: 12/20/2022	R-VALUE AVLC Phase 3 & 4	FIGURE B-5

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

MOISTURE AND DENSITY TEST RESULTS

ASTM D2216 and ASTM D7263 (Method B)

Client: Kleinfelder
Project Name: AVLC Phase 3 & 4
Project No.: 20230661.003A

AP Lab No.: 22-1245
Test Date: 12/20/22

Boring No.	Sample No.	Sample Depth (ft.)	Moisture Content (%)	Dry Density (pcf)
B-5	S-5	10	17.3	106.0

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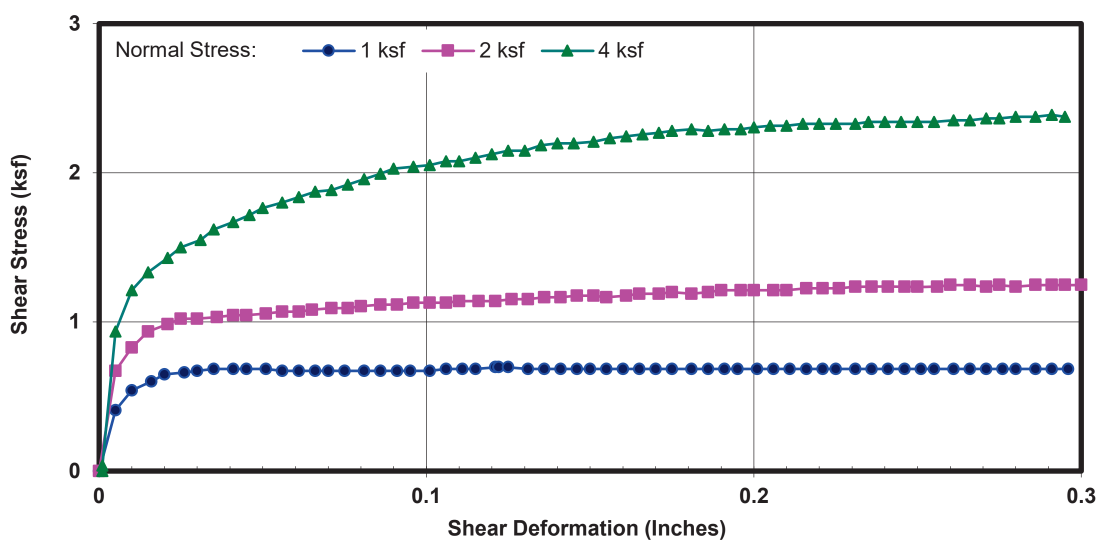
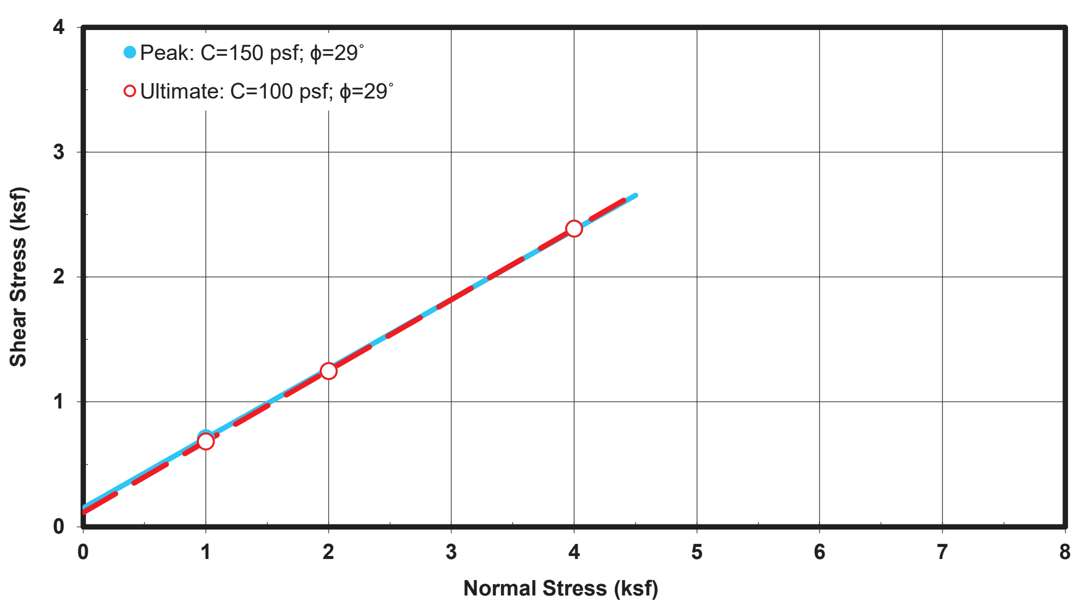
DIRECT SHEAR TEST RESULTS
ASTM D 3080

Project Name: AVLC Phase 3 & 4
Project No.: 20230661.003A
Boring No.: B-2
Sample No.: S-1 **Depth (ft):** 0-5
Sample Type: Remolded to 90% RC at opt. MC
Soil Description: Silty Sand
Test Condition: Inundated **Shear Type:** Regular

Tested By: ST **Date:** 12/21/22
Computed By: NR **Date:** 12/22/22
Checked by: AP **Date:** 12/22/22

Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)	Initial Degree Saturation (%)	Final Degree Saturation (%)	Normal Stress (ksf)	Peak Shear Stress (ksf)	Ultimate Shear Stress (ksf)
121.3	109.1	11.2	18.8	55	93	1	0.708	0.684
						2	1.248	1.248
						4	2.388	2.388





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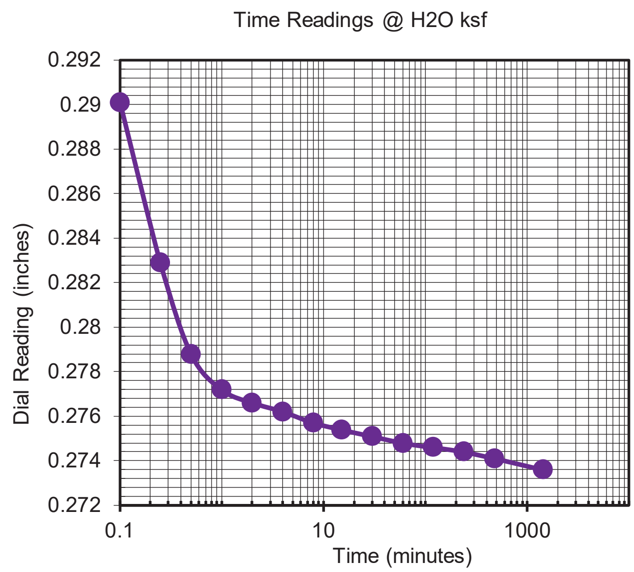
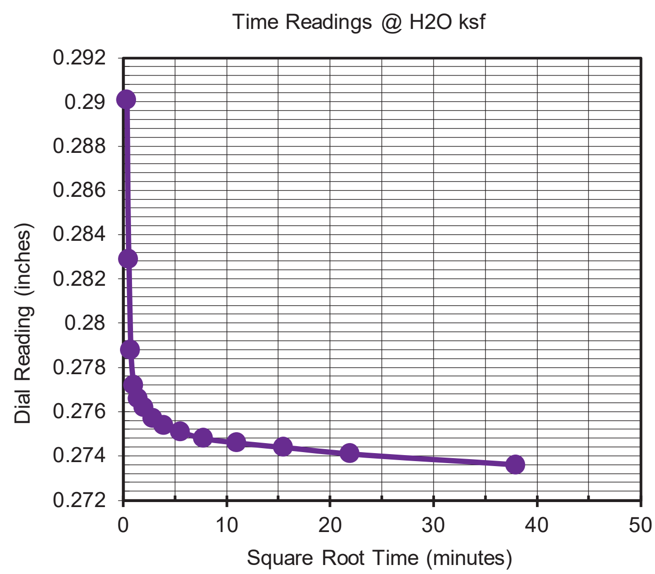
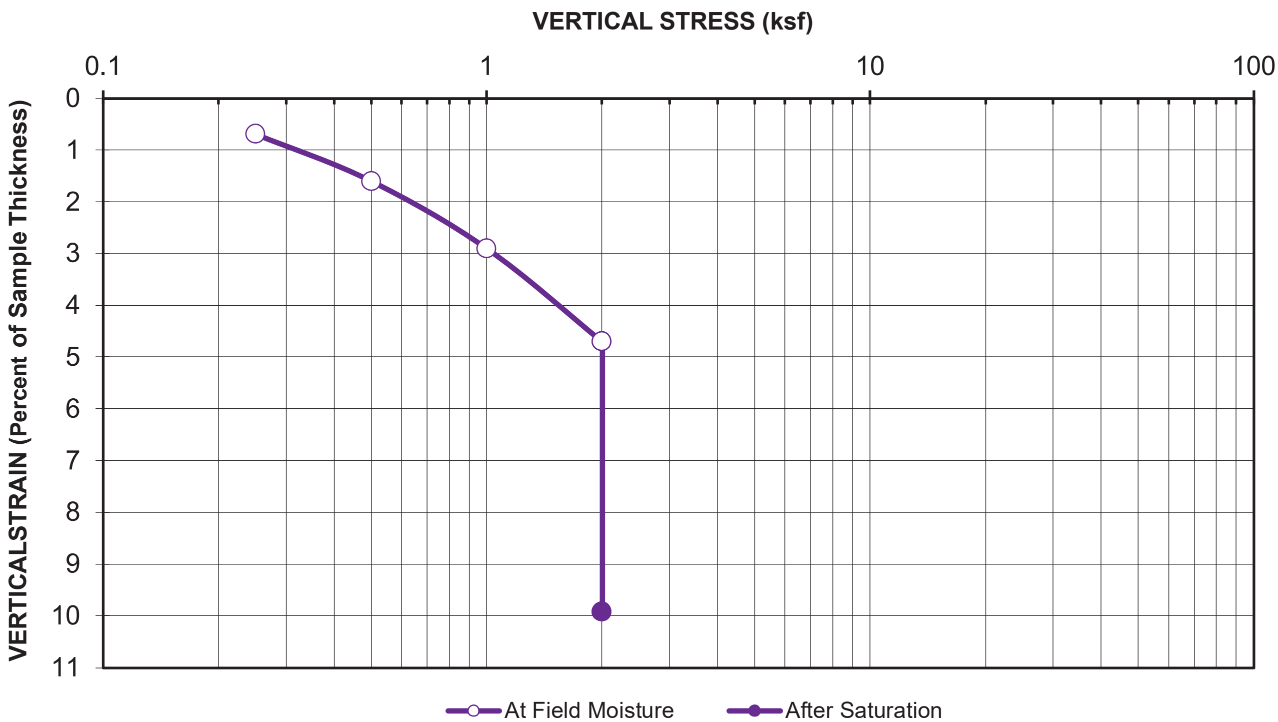
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com







Boring No. :	B-1
Sample No.:	S-4
Depth (feet):	7.5
Sample Type:	Mod Cal
Soil Description:	Sand w/ silt
Remarks:	Collapse = 5.22% upon inundation

Initial Dry Unit Weight (pcf):	87.0
Initial Moisture Content (%):	1.5
Final Moisture Content (%):	25.9
Initial Void Ratio:	0.94

1-D SWELL/COLLAPSE
ASTM D 4546-14, Method B

Project Name:	AVLC Phase 3 & 4
Project No.:	20230661.003A
Date:	12/20/22
AP No:	22-1245

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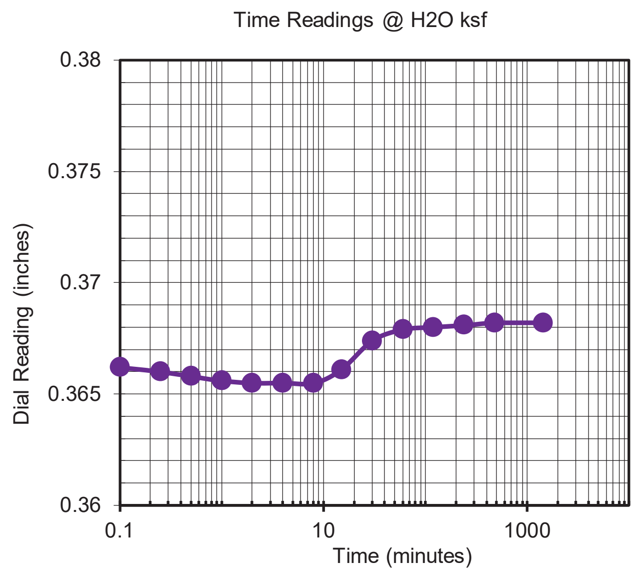
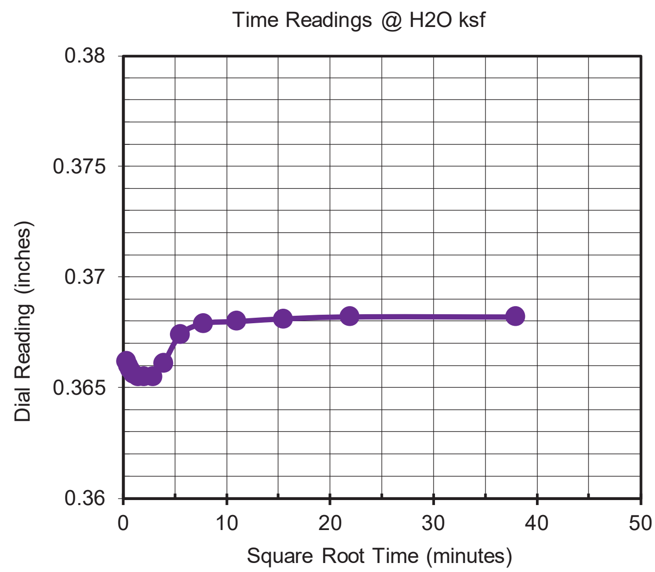
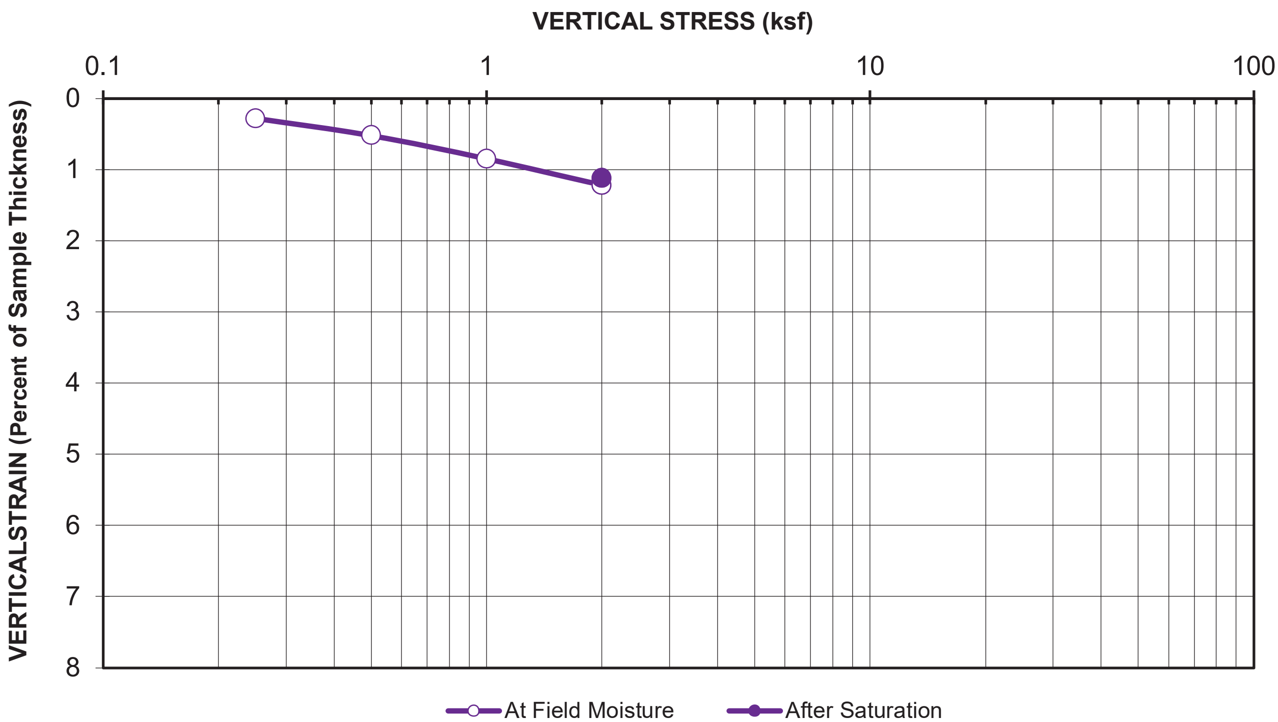
2607 Pomona Boulevard | Pomona, CA 91768
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com







Boring No. :	B-4	Initial Dry Unit Weight (pcf):	116.4
Sample No.:	S-3	Initial Moisture Content (%):	8.3
Depth (feet):	5	Final Moisture Content (%):	16.0
Sample Type:	Mod Cal	Initial Void Ratio:	0.45
Soil Description:	Silty Clay		
Remarks:	Swell = 0.10% upon inundation		

1-D SWELL/COLLAPSE
ASTM D 4546-14, Method B

Project Name:	AVLC Phase 3 & 4
Project No.:	20230661.003A
Date:	12/20/22
AP No:	22-1245

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CORROSION TEST RESULTS

Client Name: Kleinfelder
Project Name: AVLC Phase 3 & 4
Project No.: 20230661.003A

AP Job No.: 22-1245
Date: 12/21/22

Boring No.	Sample No.	Depth (feet)	Soil Description	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
B-3	S-1	0-5	Clay	556	9.8	416	260
B-5	S-1	0-5	Clay	1,221	9.9	27	33

NOTES: Resistivity Test and pH: California Test Method 643
Sulfate Content : California Test Method 417
Chloride Content : California Test Method 422
ND = Not Detectable
NA = Not Sufficient Sample
NR = Not Requested

Terracon

Preliminary Geotechnical Engineering Report

NAVLC 115 Site
Antelope Valley, Los Angeles County, California
February 9, 2023
Terracon Project No. CB225192

Prepared for:
NorthPoint Development LLC
Salt Lake City, Utah

Prepared by:
Terracon Consultants, Inc.
Colton, California

Terracon

February 9, 2023

NorthPoint Development LLC
PO Box 94027
Salt Lake City, Utah 98124-9427

Attn: Mr. Chandler Elliot
P: (801) 864-8784
E: celliott@northpointkc.com

Re: Preliminary Geotechnical Engineering Report
NAVLC 115 Site
South of W Ave E and West of Sierra Hwy
Antelope Valley, Los Angeles County, California
Terracon Project No. CB225192

Dear Mr. Elliot:

We have completed the Preliminary Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No.: PCB225192 dated December 21, 2022. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, floor slabs and pavements for the proposed project.

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

Sincerely,
Terracon Consultants, Inc.

Ali Tabatabaei, Ph.D., G.E.
Geotechnical Project Engineer

REGISTERED PROFESSIONAL ENGINEER SEYEDALI TABATABAEI No. 3159 GEOTECHNICAL STATE OF CALIFORNIA

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

Terracon Consultants, Inc. 1355 E. Cooley Dr. Colton, California 92324
P (909) 824 7311 F (909) 301 6016 terracon.com

REPORT TOPICS

Note: This report was originally delivered in a web-based format. Orange 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 *GeoReport* logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

Preliminary Geotechnical Engineering Report

NAVLC 115 Site
South of W Ave E and West of Sierra Hwy
Antelope Valley, Los Angeles County, California
Terracon Project No. CB225192
February 9, 2023

INTRODUCTION

This report presents the results of our subsurface exploration and preliminary geotechnical engineering services performed for the proposed warehouse to be located at South of W Ave E and West of Sierra Hwy in Antelope Valley, Los Angeles County, California. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions and historic high groundwater
- 2022 California Building Code (CBC) seismic design parameters
- Earthwork
- Infiltration and drainage
- Preliminary recommendations for foundation design and concrete slabs-on-grade
- Subgrade preparation/earthwork recommendations
- Preliminary recommendations for pavement section design

The geotechnical engineering Scope of Services for this project included the advancement of twelve (12) test borings to depths ranging from approximately 5 to 31 ½ feet below existing site grades.

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

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 site is located at South of W Ave E and West of Sierra Hwy in Antelope Valley, Los Angeles County, California. The site is approximately 115.9 acres. The approximate coordinates of the site are: 34.7607° N 118.1602° W (approximate) See **Site Location**
Existing Improvements	The project site generally consists of an undeveloped tract of land. It appears based on layout of trees that the site may have been previously developed or landscaped. A man-made pond may have been present in the western portion of the site at a earlier time but has since been abandoned.
Current Ground Cover	The site is primarily underlain with native soils and light grows grass, bushes and vegetations.
Existing Topography	Site is relatively flat with a gentle slope down toward the west.

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
Proposed Development	The project generally consists of the construction of two industrial buildings with footprint areas of approximately 1,000,000 (each) square feet (sf). The project will also include car parking, driveways and utilities. We assume that stormwater diversion structures such as culverts, open channels, and storm drains will also be constructed on site.
Proposed Structures	Two buildings with footprint areas of about 1,000,000 square feet for each
Building Construction	Concrete tilt up walls or steel construction founded on conventional continuous and spread footings with concrete slab on grade.
Finished Floor Elevation	Anticipated to be within 3 feet of existing grade
Structural Loads (assumed)	Structural loads were not provided at the time of this report. We assume that the proposed structures will have the following loads: ■ Columns: 100 to 300 kips ■ Walls: 2 to 4 kips per linear foot (klf) ■ Slabs: 150 pounds per square foot (psf)
Grading Requirements	Design grades were not provided at the time of this report.
Below Grade Structures	Not anticipated
Infiltration Systems	An on-site stormwater retention/infiltration system is planned; therefore, we have included preliminary infiltration testing in this current scope of work and report. However the exact location and depth of the system is undetermined at this time and additional testing may be necessary depending on the final location of the proposed system.

Item	Description
Pavements	Paved driveway and parking will be constructed on site. Both rigid (concrete) and flexible (asphalt) pavement sections were considered in this report. Anticipated traffic indices (TIs) are as follows for asphalt pavement: ■ Auto Parking Areas: TI=5.0 ■ Drive Lanes TI=5.5 ■ Truck Parking Areas: TI=7.0 ■ Truck Drive Lanes: TI=8.0 ■ The pavement design period is 20 years. Anticipated average daily truck traffic (ADTT) is as follows for concrete pavement: ■ Light Duty: ADTT=1 (Category A) ■ Medium Duty: ADTT=25 (Category B) ■ Heavy Duty: ADTT=700 (Category C)

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

We have developed a general characterization of the subsurface soil and groundwater conditions based upon our review of the data and our understanding of the geologic setting and planned construction.

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

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual. The subsurface materials generally consist of Interbedded layers of clayey sand, silty sand, sandy lean clay and lean clay extending to the maximum depth of the explorations approximately 31 ½ feet bgs.

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 test results indicate that the on-site soils generally have low plasticity. An Expansion Index test was conducted in surficial sample of boring B-7 resulted in an expansion index of 27 (low).

Hydroconsolidation

To evaluate the potential deformation that may be caused by the addition of water to subsurface soils, hydroconsolidation testing was performed on a selected, representative relatively undisturbed sample. The result is shown in Exploration Results section. The test result indicates a collapse potential of 0.25% (B-3 at 5 feet). The soil sample was saturated under an axial pressure of 2,000 psf.

Groundwater Conditions

The borings were advanced using continuous flight auger drilling techniques that allow short-term groundwater observations to be made while drilling. Groundwater seepage was encountered in Boring B-5 at depth of 28 feet bgs at the completion of drilling. According to data collected from the Water Data Library of California Department of Water Resources (DWR) from a nearby well, located within the project site with State Well Number of 08N12W28D001S, historic high groundwater levels are about 50 feet bgs. Our review of historical information regarding groundwater levels indicates that historical high groundwater levels in the project vicinity are about 50 feet bgs. In boring B-5 sandy soil with high permeability underlain by interbedded layers of clayey soil with low permeability, it is our opinion that the encountered water is considered perched water and not a real water table. 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.

SEISMIC CONSIDERATIONS

Based on the soil properties encountered at the site and as described on the exploration logs and results, it is our opinion that the Seismic Site Classification is D. The 2022 California Building Code (CBC) Seismic Design Parameters have been generated using the SEAOC/OSHPD Seismic Design Maps Tool. This web-based software application calculates seismic design parameters in accordance with ASCE 7-16 and 2022 CBC. The 2022 CBC requires that a site-specific ground motion study be performed in accordance with Section 11.4.8 of ASCE 7-16 for Site Class D sites with a mapped S_1 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(s). However, the structural engineer should verify the applicability of this exception.

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

Description	Value
Site Classification (CBC) [1]	D [2]
Site Latitude (°N)	34.7607
Site Longitude (°W)	-118.1602
S_s Spectral Acceleration for a 0.2-Second Period	1.311
S_1 Spectral Acceleration for a 1-Second Period	0.531
F_a Site Coefficient for a 0.2-Second Period	1
F_v Site Coefficient for a 1-Second Period	1.77
Site Modified Peak Ground Acceleration	0.55g
De-aggregated Modal Magnitude [3]	8.1

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 required 100-foot soil profile determination. Our borings were extended to a maximum depth of 31½ feet. 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.
3. These values were obtained using on-line Unified Hazard Tool by the USGS (https://earthquake.usgs.gov/hazards/interactive/) for return period of 2% in 50 years accessed

A site-specific ground motion study may reduce design values and consequently 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 seismically active southern California 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 San Andreas (Mojave segment) Fault, which is considered to have the most significant effect at the site from a design standpoint, has a maximum earthquake magnitude of 8.01 and is located approximately 19.4 kilometers from the site.

The site is not located within an Alquist-Priolo Earthquake Fault Zone based on our review of the State Fault Hazard Maps.

LIQUEFACTION AND SEISMIC SETTLEMENT

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, and is typically a hazard where loose sandy soils exist below groundwater. 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 subsurface materials generally consist of Interbedded layers of clayey sand, silty sand, sandy lean clay and lean clay extending to the maximum depth of the explorations approximately 31 ½ feet bgs. Groundwater seepage was encountered in boring B-5 at depth of 28 feet bgs at the completion of drilling and has historically been about 50 feet bgs.

According to CGS, the site is not located within an area having liquefaction potential. Based on the CGS mapping and encountered soil condition, liquefaction hazard is considered low. During the final design level geotechnical study, borings may be performed to deeper depths to observe long term static levels of the groundwater and perform liquefaction analyses as necessary depending on the observed site conditions.

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.

Preliminary 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, engineering analyses, and our current understanding of the proposed project.

The subsurface materials generally consist of Interbedded layers of clayey sand, silty sand, sandy lean clay and lean clay extending to the maximum depth of the explorations approximately 31 ½ feet bgs.

Based on the conditions encountered, we believe the proposed building can be supported on shallow foundations, such as spread footings bearing on compacted engineered fill. Depths of overexcavation may vary depending on the final grading design for the site. Furthermore additional overexcavation may be needed in the area of the previous pond to remove potential organics and silt deposits. No borings were performed in the suspected pond area during this phase.

No groundwater was encountered in any of the borings within the drilling depths at the time of drilling, except in boring B-5 where groundwater was encountered at a depth of about 28 feet bgs during drilling. Groundwater is not expected to affect shallow foundation construction on this site.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

The following recommendations include site preparation, excavation, subgrade preparation and placement of engineered fills on the project. The recommendations presented for design and construction of earth supported elements including foundations, slabs, and pavements 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 bearing soils, and other geotechnical conditions exposed during the construction of the project.

Site Preparation

Strip and remove existing vegetation, debris, pavements and other deleterious materials from proposed buildings and pavement areas. Exposed surfaces 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 building structures.

Existing utility lines were noted across the site. However, although no evidence of other underground facilities such as septic tanks, cesspools, and basements, 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

We recommend that the proposed structures be supported on engineered fill extending to a minimum depth of 2 feet below the bottom of foundations, or 4 feet below existing grades, whichever is greater. Engineered fill placed beneath the entire footprint of the structures should extend horizontally a minimum distance of 3 feet beyond the outside edge of perimeter footings.

Additional overexcavation depths may be necessary to remove unsuitable material from the previous pond area. Additional exploration in the area can help in determining depths of unsuitable material.

Subgrade soils beneath exterior slabs and pavements should be scarified, moisture conditioned, and compacted to a minimum depth of 10 inches. The moisture content and compaction of subgrade soils should be maintained until slab or pavement construction.

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, and compacted per the compaction requirements in this report.

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

Excavation

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

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

Fill Material Types

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

Clean on-site soils or approved imported materials may be used as fill material for the following:

■ general site grading	■ foundation backfill
■ foundation areas	■ pavement areas
■ interior floor slab areas	■ exterior slab areas

The lean clay soils encountered in select borings at the site indicate Expansion Index values which exceed the code recommended value for use beneath lightly loaded slabs, such as floor slabs. These soils should not be used within 12 inches of the bottom of floor slabs but may be used beneath this zone and beneath foundations.

If imported soils are used as fill materials to raise grades, these soils should conform to low volume change materials and should conform to the following requirements:

Gradation	Percent Finer by Weight (ASTM C 136)
3”	100
No. 4 Sieve	50 - 100
No. 200 Sieve	20 - 50

- Liquid Limit .... 30 (max)
- Plasticity Index .... 15 (max)

- Maximum Expansive Index* .... 20 (max)

*ASTM D 4829

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. 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

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
On-site soils and/or low volume change imported fill:			
Beneath foundations:	90	0%	+3%
Beneath interior slabs:	90	0%	+3%
Miscellaneous backfill:	90	0%	+3%
Beneath pavements:	95	0%	+3%
Utility Trenches*:	90	0%	+3%
Bottom of excavation receiving fill:	90	0%	+3%
Aggregate base (beneath pavements):	95	0%	+3%

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

Utility Trenches

It is anticipated that the on-site soils will provide suitable support for underground utilities and piping that may be installed. Any soft and/or unsuitable material encountered at the bottom of excavations should be removed and be replaced with an adequate bedding material. A non-expansive granular material with a sand equivalent greater than 30 is recommended for bedding and shading of utilities, unless otherwise allowed by the utility manufacturer.

On-site materials are considered suitable for backfill of utility and pipe trenches from one foot above the top of the pipe to the final ground surface, provided the material is free of organic matter and deleterious substances.

Trench backfill should be mechanically placed and compacted as discussed earlier in this report. Compaction of initial lifts should be accomplished with hand-operated tampers or other lightweight compactors. Where trenches are placed beneath slabs or footings, the backfill should satisfy the gradation and expansion index requirements of engineered fill discussed in this report. Flooding or jetting for placement and compaction of backfill is not recommended.

Grading and Drainage

Positive drainage should be provided during construction and maintained throughout the life of the development. Infiltration of water into utility trenches or foundation excavations should be prevented during construction. Planters and other surface features which could retain water in areas adjacent to the building or pavements should be sealed or eliminated. In areas where sidewalks or paving do not immediately adjoin the structure, we recommend that protective slopes be provided with a minimum grade of approximately 5 percent for at least 10 feet from perimeter walls. Backfill against footings, exterior walls, and in utility and sprinkler line trenches should be well compacted and free of all construction debris to reduce the possibility of moisture infiltration.

We recommend a minimum horizontal setback distance of 10 feet from the perimeter of any building 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:

- minimizing moisture increases in the backfill;
- controlling moisture-density during placement of backfill;
- using designs which allow vertical movement between the exterior features and adjoining structural elements;
- placing effective control joints on relatively close centers.

Construction Considerations

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of floor slabs and pavements. Construction traffic over the completed subgrade 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. If the subgrade should become desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to floor slab and pavement construction.

Onsite soils consist of cohesionless sandy soils. Such soils have the tendency to cave and slough during excavations. Therefore, formwork may be needed for foundation excavations.

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

Construction 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 until approved 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. One density and water content test for every 50 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. In the event that unanticipated conditions are encountered, 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

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following preliminary parameters are applicable for initial design of shallow foundations. Additional exploration and testing will be performed prior to the final design of these foundations.

Item	Description
Foundation Support	Engineered fill 2 feet below the bottom of foundations, or 4 feet below existing grades, whichever is greater.
Net Allowable Bearing pressure [1, 2] **(On-site soils or structural fill)**	2,500 psf
Minimum Foundation Dimensions	Columns: 24 inches Continuous: 18 inches
Minimum Footing Depth	24" below finish grade
Ultimate Passive Resistance [4]	375 pcf
Ultimate Coefficient of Sliding Friction [5]	0.34
Estimated Total Static Settlement from Structural Loads [2]	Less than 1 inch
Estimated Differential Settlement [2, 6]	About 1/2 of total settlement

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. An appropriate factor of safety has been applied.
2. Values provided are for maximum loads noted in **Project Description**. The foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of compacted fill, and the quality of the earthwork operations.
3. Unsuitable or soft soils should be over-excavated and replaced per the recommendations presented in the **Earthwork**.
4. Use of passive earth pressures requires the footing forms be removed and compacted structural fill be placed against the vertical footing face. A factor of safety of 2.0 is recommended.
5. 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. A factor of safety of 1.5 is recommended.
6. Differential settlements are as measured over a span of 40 feet.

Foundation Construction Considerations

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

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

FLOOR SLABS

DESCRIPTION	RECOMMENDATION
Interior floor system	Slab-on-grade concrete
Floor slab support	Engineered fill 2 feet below the bottom of foundations, or 4 feet below existing grades, whichever is greater.
Subbase	Minimum 4-inches of Aggregate Base
Modulus of subgrade reaction	200 pounds per square inch per inch (psi/in) (The modulus was obtained based 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.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or cracks should be sealed with a water-proof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

PAVEMENTS

General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs noted in this section must be applied to the site which has been prepared as recommended in the **Earthwork** section.

Pavement Design Parameters

Design of asphalt concrete (AC) pavements is based on the procedures outlined in the Caltrans "Highway Design Manual for Safety Roadside Rest Areas" (Caltrans, 2016). Design of Portland cement concrete (PCC) pavements are based upon American Concrete Institute (ACI) 330R-08; "Guide for Design and Construction of Concrete Parking Lots."

A correlated design R-value of 25 was used for the AC pavement. A modulus of rupture of 600 psi was used for pavement concrete. The structural sections are predicated upon proper compaction of the utility trench backfills and the subgrade soils as prescribed by in **Earthwork**, with the upper 12 inches of subgrade soils and all aggregate base material brought to a minimum relative compaction of 95 percent in accordance with ASTM D 1557 prior to paving. The aggregate base should meet Caltrans requirements for Class 2 base.

It should be noted that the pavement designs were based upon the results of preliminary sampling and testing and should be verified by additional sampling and testing during construction when the actual subgrade soils are exposed.

Pavement Section Thicknesses

The following table provides options for AC and PCC Sections:

Asphalt Concrete Design		
Usage	**Assumed Traffic Index**	**Recommended Structural Section**
Auto Parking Areas	5.0	3" HMA[1]/7" Class 2 AB[2]
Auto Drive Lanes	5.5	3" HMA[1]/8" Class 2 AB[2]
Truck Parking Areas	7.0	4" HMA[1]/11" Class 2 AB[2]
Truck Drive Lanes	8.0	4.5" HMA[1]/13" Class 2 AB[2]

1. HMA = hot mix asphalt
2. AB = aggregate base

Portland Cement Concrete Design			
Layer	**Thickness (inches)**		
	Light Duty[1]	**Medium Duty[2]**	**Heavy Duty[3]**
PCC	5.0	6.0	8.0
Aggregate Base [4]	--	--	--

1. Car Parking and Access Lanes, Average Daily Truck Traffic (ADTT) = 1 (Category A).
2. Truck Parking Areas, Multiple Units, ADTT = 25 (Category B)
3. In areas of anticipated heavy traffic, fire trucks, delivery trucks, or concentrated loads (e.g., dumpster pads), and areas with repeated turning or maneuvering of heavy vehicles, ADTT = 700 (Category C).

Recommended structural sections were calculated based on assumed TIs and our preliminary sampling and testing.

Terracon does not practice traffic engineering. We recommend that the project civil engineer or traffic engineer verify that the TIs and ADTT traffic indices used are appropriate for this project.

Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the granular subbase.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2 percent.
- Subgrade and pavement surfaces should have a minimum 2 percent slope to promote proper surface drainage.
- Install below pavement drainage systems surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.
- Place curb, gutter and/or sidewalk directly on clay subgrade soils rather than on unbound granular base course materials.

STORM WATER MANAGEMENT

Four in-situ infiltration tests (falling head borehole permeability) were performed at approximate depths of 5 and 10 feet bgs. The objective of the infiltration testing is to provide infiltration rates for designing the proposed infiltration system. A 2-inch thick, 3/8-inch gravel layer was placed in the bottom of each boring after the borings were drilled to investigate the soil profile.

Three-inch diameter perforated pipes were installed on top of the gravel layer. Gravel was used to backfill between the perforated pipes and the boring sidewall. The borings were then filled with water for a pre-soak period.

At the beginning of each test, the pipes were refilled with water and readings were taken at periodic time intervals as the water level dropped. The soil at the percolation test locations was classified in the field using a visual/manual procedure. The infiltration velocity is presented as the infiltration rate and is summarized in the following table. The infiltration rates provided do not include safety factors.

Test Location	Boring Depth (ft.) [1]	Test Depth Range (ft.) [1]	Soil Type	Unfactored Percolation Rate Average (in/hr)	Infiltration Rate Average (in./hr.) [3]	Design Infiltration Rate Average (in./hr.) [2,4]
P-1	5	0 to 5	SM	83	5.4	1.3
P-2	10	5 to 10	SC	74	4.0	1.0
P-3	10	5 to 10	CL over SM	103	5.9	1.5
P-4	5	0 to 5	SM	16.2	1.0	0.3

1. Below existing ground surface.
2. Our percolation tests was performed generally following the well permeater test method described in the "Guidelines for Geotechnical Investigation and Reporting Low Impact Development Stormwater Infiltration", Los Angeles County Department of Public Works, 2017.
3. If proposed infiltration system will mainly rely on vertical downward seepage, the correlated infiltration rates should be used. CFt (Correction Factor) was used to convert percolation rates to infiltration rates.
4. CFv and CFs Correction Factors of 2 were used to calculate design infiltration rates.

The above infiltration rates determined by the shallow percolation test method are based on field test results utilizing clear water. Infiltration rates can be affected by silt buildup, debris, degree of soil saturation, site variability and other factors. The rate obtained at specific location and depth is representative of the location and depth tested and may not be representative of the entire site. Application of an appropriate safety factor is prudent to account for subsoil inconsistencies, possible compaction related to site grading, and potential silting of the percolating soils, depending on the application.

The design engineer should also check with the local agency for the limitation of the infiltration rate allowed in the design. If the maximum allowable design infiltration rate is lower than the above recommended rate, the maximum allowable design infiltration rate should be used. The designer of the basins should also consider other possible site variability in the design.

The percolation test was performed with clear water, whereas the storm water will likely not be clear, but may contain organics, fines, and grease/oil. The presence of these deleterious materials will tend to decrease the rate that water percolates from the infiltration systems. Design of the storm water infiltration systems should account for the presence of these materials and should incorporate structures/devices to remove these deleterious materials.

Based on the soils encountered in our borings, we expect the percolation rates of the soils could be different than measured in the field due to variations in fines and gravel content. The design elevation and size of the proposed infiltration system should account for this expected variability in infiltration rates.

Infiltration testing should be performed after construction of the infiltration system to verify the design infiltration rates. It should be noted that siltation and vegetation growth along with other factors may affect the infiltration rates of the infiltration areas. The actual infiltration rate may vary from the values reported here. Infiltration systems should be located at least 10 feet from any existing or proposed foundation system.

CORROSIVITY

The following table lists the laboratory electrical resistivity (standard and as-received), chlorides, soluble sulfates, and pH testing results. These 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.

Boring	Depth (feet)	Soluble Sulfate (mg/kg)	Soluble Chloride (mg/kg)	Total Salts (mg/kg)	pH	Resistivity (as-received) (Ohm-cm)	Resistivity (saturated) (Ohm-cm)
B-2	0.0 to 2.5	92	72	660	8.55	31,040	1,552

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.

For protection against corrosion to buried metals, Terracon recommends that an experienced corrosion engineer be retained to design a suitable corrosion protection system for underground metal structures or components.

If corrosion of buried metal is critical, it should be protected using a non-corrosive backfill, wrapping, coating, sacrificial anodes, or a combination of these methods, as designed by a qualified corrosion engineer.

GENERAL COMMENTS

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

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

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

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Terracon conducted seven (7) soil-testing borings. These borings were planned to the following extended depths below existing grades.

Number of Borings	Boring Depth (feet) [1]	Location
8 (B-1 to B-8)	21 ½ and 31 ½	Building Footprint
4(P-1 to P-4)	5 and 10	Proposed Infiltration areas

1. Below ground surface.

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±10 feet) and approximate elevations were obtained by interpolation from the Google Earth. If elevations and a more precise boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

Subsurface Exploration Procedures: We advance the borings with a truck-mounted drill rig using hollow-stem augers. Both a standard penetration test (SPT) sampler (2-inch outer diameter and 1-3/8-inch inner diameter) and a modified California ring-lined sampler (3-inch outer diameter and 2-3/8-inch inner diameter) are utilized in our investigation. The penetration resistance is recorded on the boring logs as the number of hammer blows used to advance the sampler in 6-inch increments (or less if noted). The samplers are driven with an automatic hammer that drops a 140-pound weight 30 inches for each blow. After the required seating, samplers are advanced up to 18 inches, providing up to three sets of blowcounts at each sampling interval. The sampling depths, penetration distances, and other sampling information are recorded on the field boring logs. The recorded blows are raw numbers without any corrections for hammer type (automatic vs. manual cathead) or sampler size (ring sampler vs. SPT sampler). Relatively undisturbed and bulk samples of the soils encountered are placed in sealed containers and returned to the laboratory for testing and evaluation.

We observe and record groundwater levels during drilling and sampling. For safety purposes, all borings are backfilled with auger cuttings after their completion.

Our exploration team prepares field boring logs as part of the drilling operations. These field logs include visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs are prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- Water (Moisture) Content of Soil by Mass
- Laboratory Determination of Density (Unit Weight) of Soil Specimens
- Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
- Modified Proctor test
- Atterberg Limits
- Expansion Index
- Corrosivity suite test

The laboratory testing program often included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

SITE LOCATION

NAVLC 115 Site ■ Antelope Valley, Los Angeles County, California
February 9, 2023 ■ Terracon Project No. CB225192

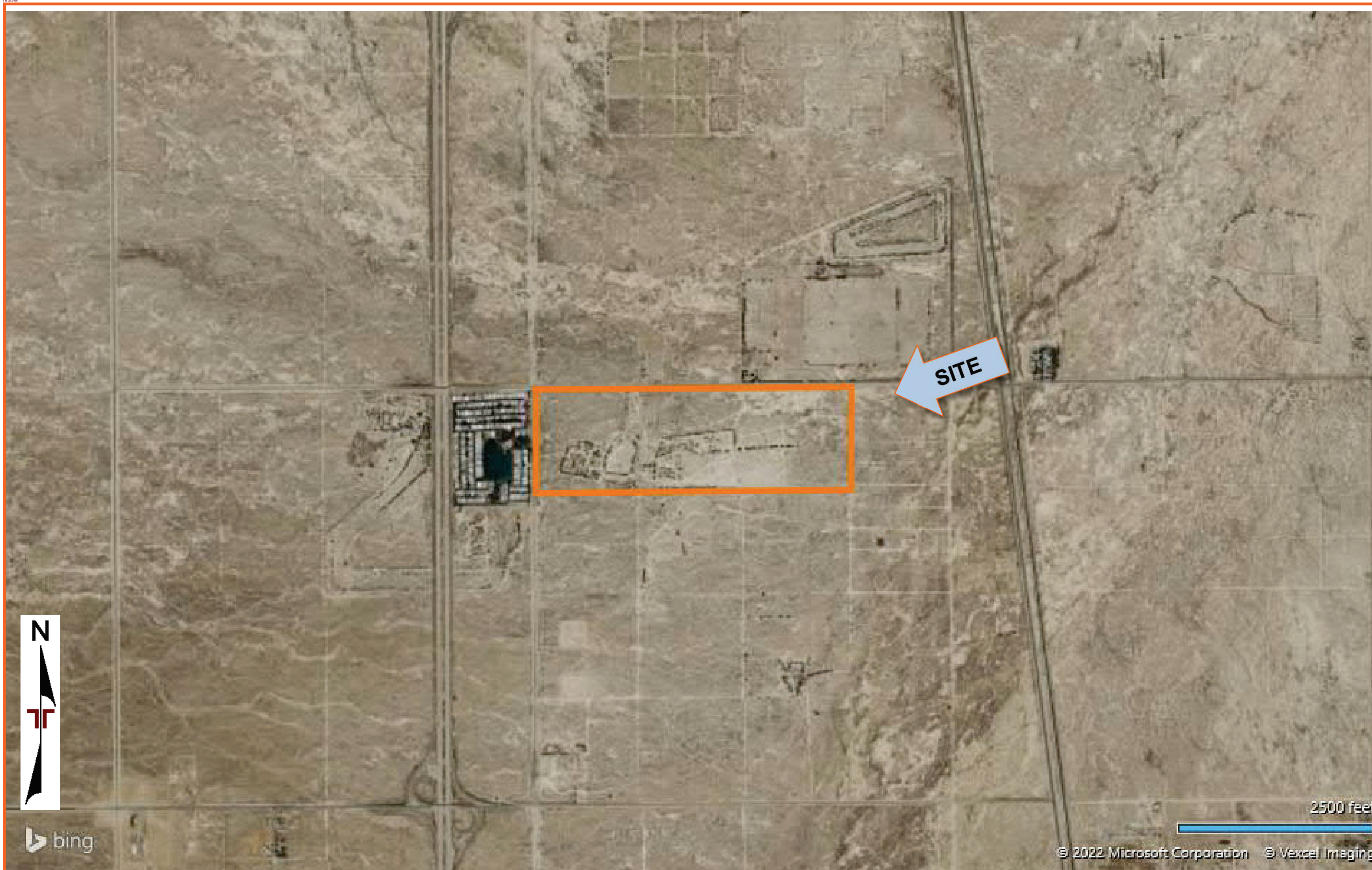


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

NAVLC 115 Site ■ Antelope Valley, Los Angeles County, California

February 9, 2023 ■ Terracon Project No. CB225192

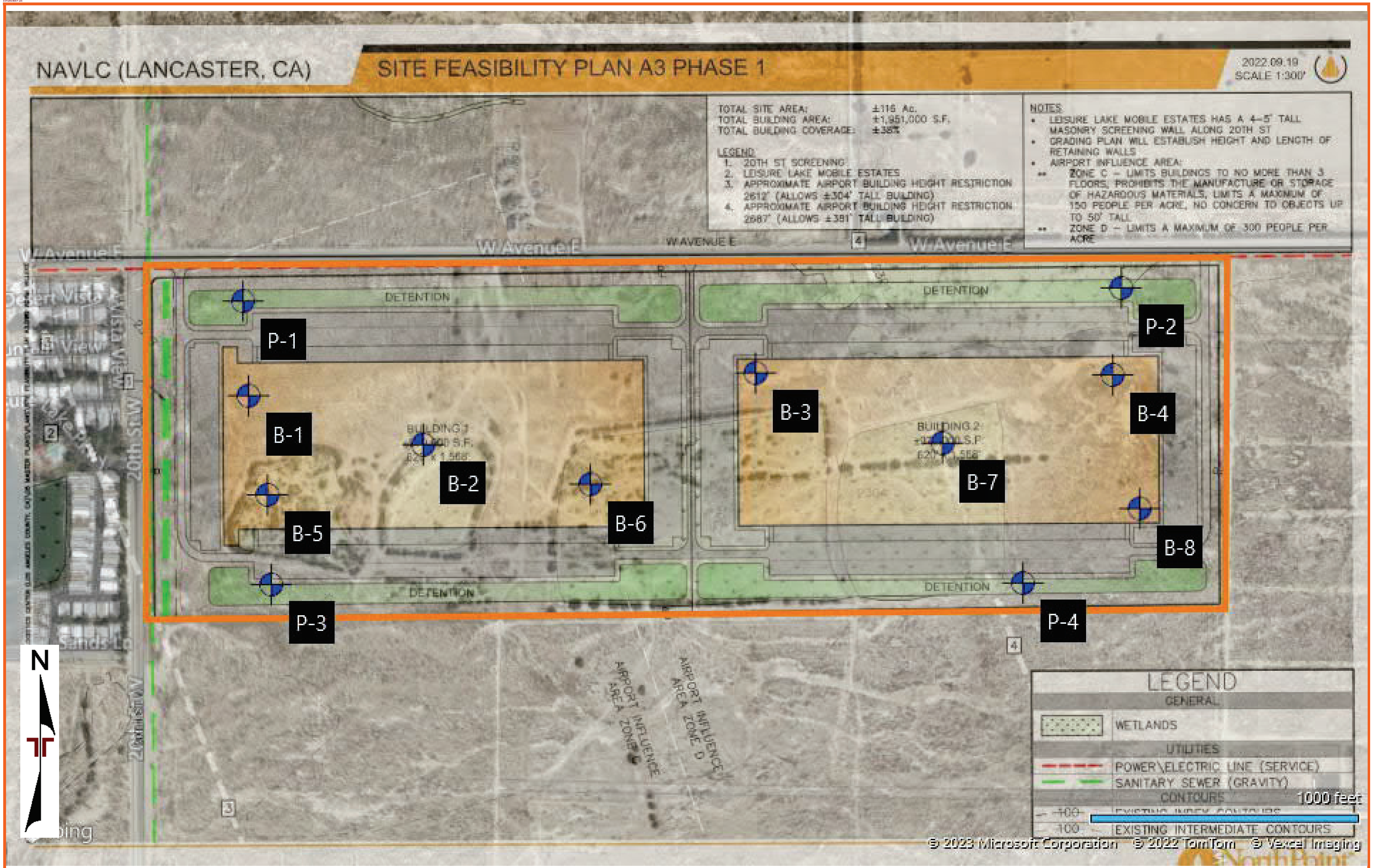


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. B-1

Location: See Exploration Plan

Depth (Ft.)	Description	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
0.0–5.0	**CLAYEY SAND (SC)**, fine grained, tan/gray, dry, medium dense	7-10-12	6.6	114		33
5.0–7.0	**SILTY CLAYEY SAND (SC-SM)**, fine grained, gray, dry, medium dense	11-12-11	6.4	109	25-21-4	28
7.0–10.0	**SANDY LEAN CLAY (CL)**, fine grained, light brown, dry, very stiff	9-10-14	8.3	104		53
10.0–15.0	**LEAN CLAY WITH SAND (CL)**, trace gravel, fine grained, brown, dry, stiff	3-5-6	14.1	112		71
15.0–20.0	**SANDY LEAN CLAY (CL)**, fine grained, light brown, dry, stiff	4-6-6 N=12			29-18-11	66
20.0–30.0	**SILTY CLAYEY SAND (SC-SM)**, fine to medium grained, light brown, dry, dense	11-25-48				24
		9-14-18 N=32				
30.0–31.5	**SANDY LEAN CLAY (CL)**, trace gravel, fine to medium grained, light brown, dry, medium stiff	4-4-4 N=8				

Boring Terminated at 31.5 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
None encountered while drilling

Notes

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 75

Hammer Type
Automatic

Driller
2R

Logged by
JB

Boring Started
12-05-2022

Boring Completed
12-05-2022

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. B-2

Location: See Exploration Plan

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
	CLAYEY SAND (SC), fine grained, tan, medium dense								
					10-12-23	3.7	113		35
4.5	**SANDY LEAN CLAY (CL)**, fine grained, tan/green, very stiff to hard	5			5-15-13 N=28				
					15-23-29	7.4	112		50
	stiff	10			3-5-7 N=12				
15.0	**CLAYEY SAND (SC)**, fine to medium grained, light brown, medium dense	15			3-8-13				
		20			5-6-7 N=13				
21.5	***Boring Terminated at 21.5 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
None encountered while drilling

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 75

Hammer Type
Automatic

Driller
2R

Logged by
JB

Boring Started
12-05-2022

Boring Completed
12-05-2022

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. B-3

Depth (Ft.)	Location: See Exploration Plan	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	SILTY SAND (SM), light brown, very dense								
					12-26-50/5"	4.3	106		
5.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, light brown/tan, medium dense	5			7-8-27	11.8	116		
7.5	**CLAYEY SAND (SC)**, trace gravel, fine grained, dark brown/gray, medium dense				9-16-20				
		10			9-13-23			33-18-15	30
15.0	**SANDY LEAN CLAY (CL)**, fine grained, brown to gray, very stiff to hard	15			15-16-19 N=35				
		20			5-9-11				65
25.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine grained, light brown, medium dense	25			11-14-15 N=29				
30.0	**SANDY LEAN CLAY (CL)**, fine to medium grained, tan/light brown	30							
31.5	***Boring Terminated at 31.5 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
None encountered while drilling

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 75

Hammer Type
Automatic

Driller
2R

Logged by
JB

Boring Started
12-05-2022

Boring Completed
12-05-2022

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. B-4

Location: See Exploration Plan

Depth (Ft.)	Material Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
2.5	**CLAYEY SAND (SC)**, fine grained, tan								
5.0	**LEAN CLAY WITH SAND (CL)**, fine grained, brown, very stiff				5-10-24	7.8	111		
10.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine to medium grained, light brown, medium dense	5			11-10-9 N=19				
					8-11-11	2.7			
15.0	**SANDY LEAN CLAY (CL)**, fine to medium grained, tan, stiff	10			7-7-7 N=14				51
20.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, medium to coarse grained, light brown/tan, dense	15			22-30-33				
21.5	**LEAN CLAY WITH SAND (CL)**, light brown, medium stiff	20			3-4-3 N=7				

Boring Terminated at 21.5 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
None encountered while drilling

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 75

Hammer Type
Automatic

Driller
2R

Logged by
JB

Boring Started
12-02-2022

Boring Completed
12-02-2022

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. B-5

Location: See Exploration Plan

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
	SILTY SAND (SM), fine grained, tan								
2.5	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine to medium grained, light brown, medium dense				9-9-12	1.0			
		5			17-16-23	1.1			
	dense				24-44-48				
		10			10-11-12				
15.0	**SANDY LEAN CLAY (CL)**, fine to medium grained, light brown, very stiff	15			7-9-14 N=23				63
20.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine to medium grained, tan/light brown, medium dense	20			10-20-30				
25.0	**LEAN CLAY WITH SAND (CL)**, medium grained, brown, very stiff	25			6-8-10 N=18				
			▽ (28')						
30.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, medium to coarse grained, brown, medium dense	30			8-11-17 N=28				
31.5	***Boring Terminated at 31.5 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
▽ 28' observed while drilling

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 75

Hammer Type
Automatic

Driller
2R

Logged by
JB

Boring Started
12-05-2022

Boring Completed
12-05-2022

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. B-6

Location: See Exploration Plan

Graphic Log	Depth (Ft.)	Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
		SILTY SAND (SM), fine grained, light brown/tan, medium dense								
						9-12-13	1.3	87		
	5.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine to medium grained, light brown, medium dense	5			4-6-8 N=14				
	8.0	**CLAYEY SAND (SC)**, fine grained, tan/gray, medium dense				5-15-20	6.4	97		
			10			9-11-10 N=21				
	15.0	**LEAN CLAY WITH SAND (CL)**, fine grained, dark gray/gray, very stiff	15			8-10-19				77
	19.5	**CLAYEY SAND (SC)**, fine grained, tan/light brown, dense	20			8-15-16 N=31				
	21.5	***Boring Terminated at 21.5 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
None encountered while drilling

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 75

Hammer Type
Automatic

Driller
2R

Logged by
JB

Boring Started
12-05-2022

Boring Completed
12-05-2022

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. B-7

Location: See Exploration Plan

Depth (Ft.)	Material Description	Sample Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	SANDY LEAN CLAY (CL), fine to medium grained, tan, very stiff	0-2.5		Bulk					50
		2.5-4		Ring	11-18-26	6.2	101		
		5-6.5		Ring	8-17-29	7.2	109		43
7.5	**LEAN CLAY WITH SAND (CL)**, fine grained, tan/dark green, very stiff	7.5-9		Ring	12-18-21	7.6	116		
10.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, medium to coarse grained, light brown, medium dense	10-11.5		Ring	12-28-26				
		15-16.5		SPT	10-9-9 N=18				
20.0	**SANDY LEAN CLAY (CL)**, fine grained, tan, very stiff	20-21.5		Ring	7-15-25				66
25.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine to medium grained, light brown, medium dense	25-26.5		SPT	9-12-14 N=26				
30.0	**CLAYEY SAND (SC)**, tan/light brown, medium dense	30-31.5		SPT	10-11-11 N=22				
31.5	***Boring Terminated at 31.5 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
None encountered while drilling

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 75

Hammer Type
Automatic

Driller
2R

Logged by
JB

Boring Started
12-02-2022

Boring Completed
12-02-2022

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. B-8

Location: See Exploration Plan

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
2.5	**CLAYEY SAND (SC)**, brown/light brown, medium dense								
7.5	**POORLY GRADED SAND WITH SILT (SP-SM)**, brown, medium dense				8-15-21				
		5			7-9-15 N=24				10
10.0	**LEAN CLAY WITH SAND (CL)**, tan/light green, very stiff, (oxidized grains observed in sample)				10-16-22				
15.0	**CLAYEY SAND (SC)**, medium grained, tan/gray, medium dense	10			6-11-14 N=25				
20.0	**SILTY SAND (SM)**, fine grained, gray, medium dense	15			7-17-27				
21.5	**POORLY GRADED SAND WITH SILT (SP-SM)**, fine to medium grained, light brown, medium dense	20			10-12-12				

Boring Terminated at 21.5 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
None encountered while drilling

Notes

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 75

Hammer Type
Automatic

Driller
2R

Logged by
JB

Boring Started
12-02-2022

Boring Completed
12-02-2022

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. P-1

Graphic Log	Location: See Exploration Plan Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	SILTY SAND (SM), fine grained, brown 5.0	5							38
	Boring Terminated at 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
None encountered while drilling

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 75

Hammer Type
Automatic

Driller
2R

Logged by
JB

Boring Started
12-05-2022

Boring Completed
12-05-2022

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. P-2

Graphic Log	Location: See Exploration Plan Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	CLAYEY SAND (SC), fine grained, tan	5							
	10.0	10							
	Boring Terminated at 10 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
None encountered while drilling

Notes

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 75

Hammer Type
Automatic

Driller
2R

Logged by
JB

Boring Started
12-05-2022

Boring Completed
12-05-2022

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. P-3

Location: See Exploration Plan

Depth (Ft.)	Material Description	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
5.0	**SANDY LEAN CLAY (CL)**, fine grained, tan	5							55
10.0	**SILTY SAND (SM)**, fine grained, brown	10							
	Boring Terminated at 10 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
None encountered while drilling

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 75

Hammer Type
Automatic

Driller
2R

Logged by
JB

Boring Started
12-01-2022

Boring Completed
12-02-2022

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Log No. P-4

Graphic Log	Location: See Exploration Plan Depth (Ft.)	Depth (Ft.)	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	SILTY SAND (SM), fine grained, llight brown								
	5.0	5							
	Boring Terminated at 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
None encountered while drilling

Advancement Method
Hollow Stem Auger

Abandonment Method
Boring backfilled with auger cuttings upon completion.

Drill Rig
CME 75

Hammer Type
Automatic

Driller
2R

Logged by
JB

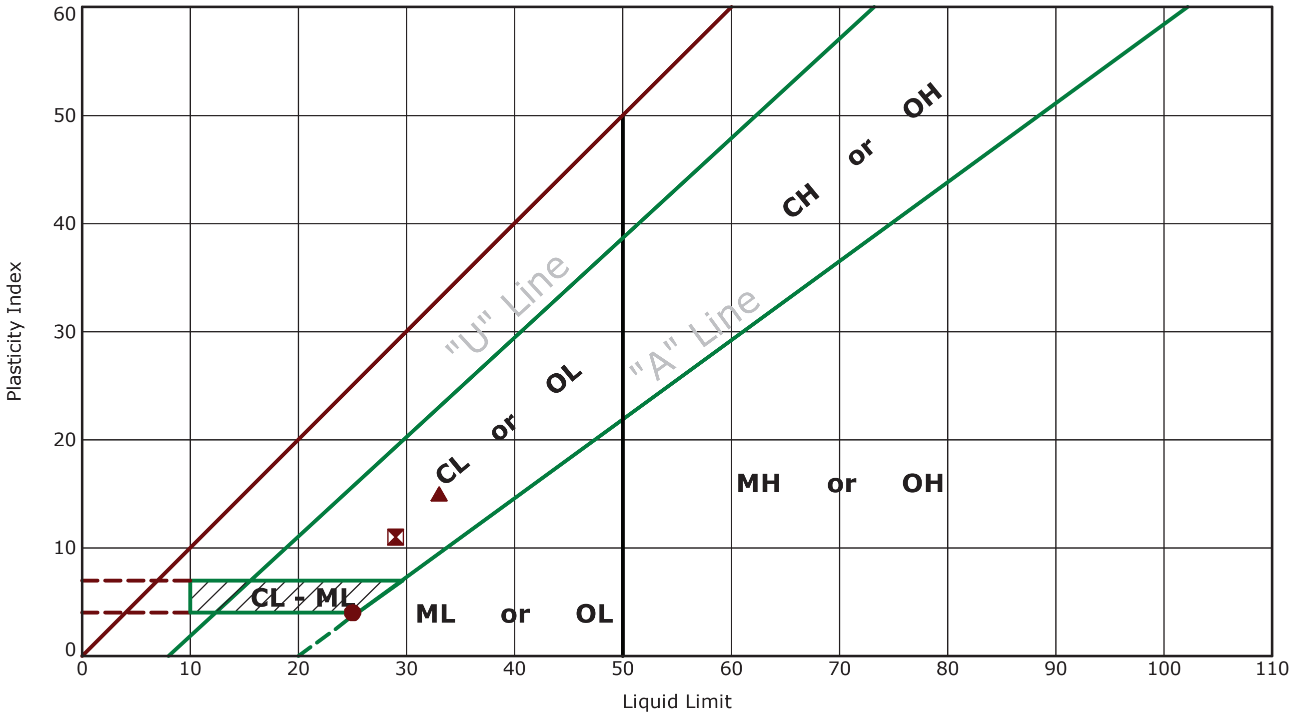
Boring Started
12-01-2022

Boring Completed
12-02-2022

1355 E Cooley Dr, Ste C
Colton, CA

Atterberg Limit Results

ASTM D4318

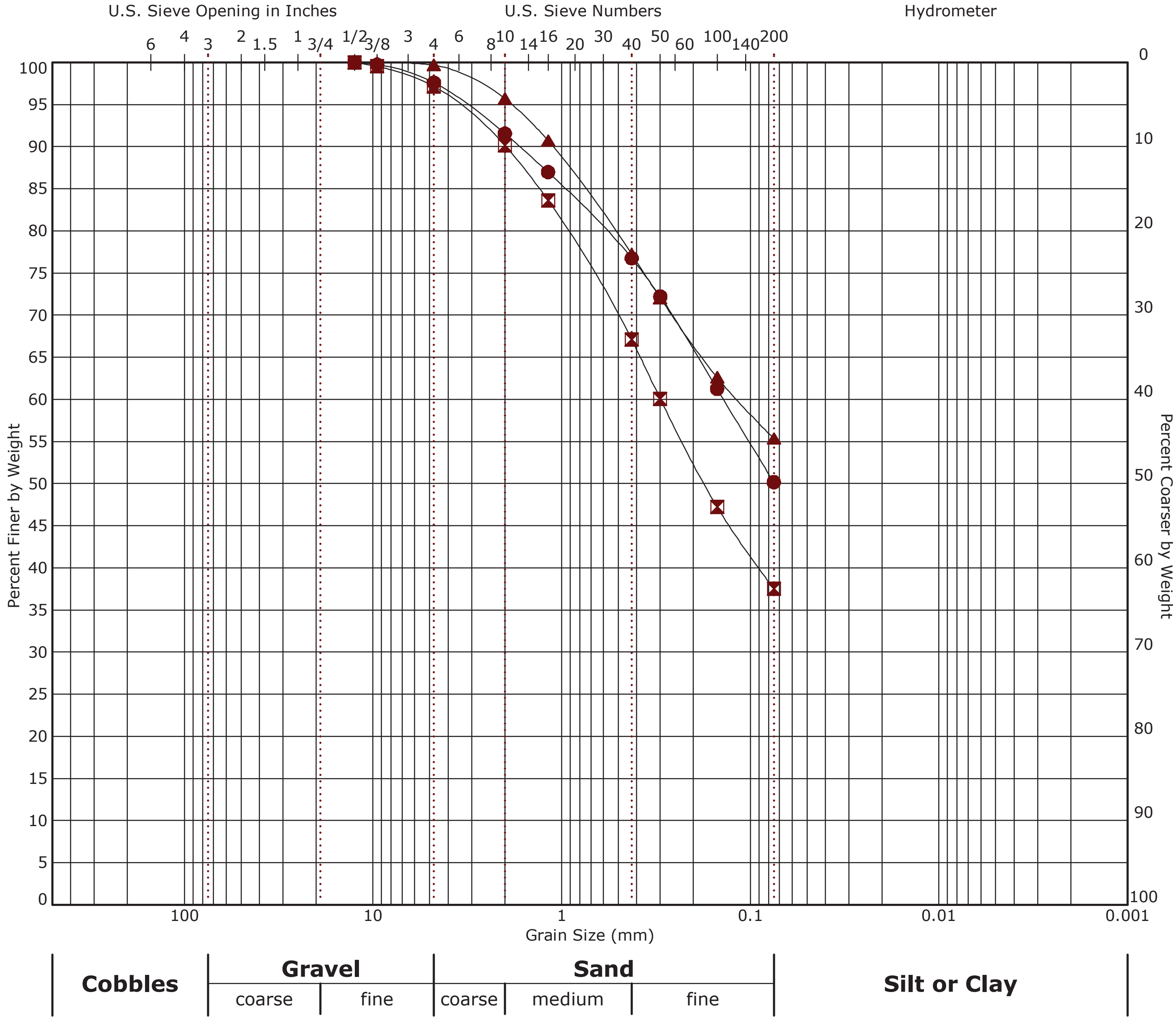


	Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	B-1	5 - 6.5	25	21	4	28.2	SC-SM	SILTY, CLAYEY SAND
⊠	B-1	15 - 16.5	29	18	11	65.8	CL	SANDY LEAN CLAY
▲	B-3	10 - 11.5	33	18	15	30.3	SC	CLAYEY SAND

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Grain Size Distribution

ASTM D422 / ASTM C136



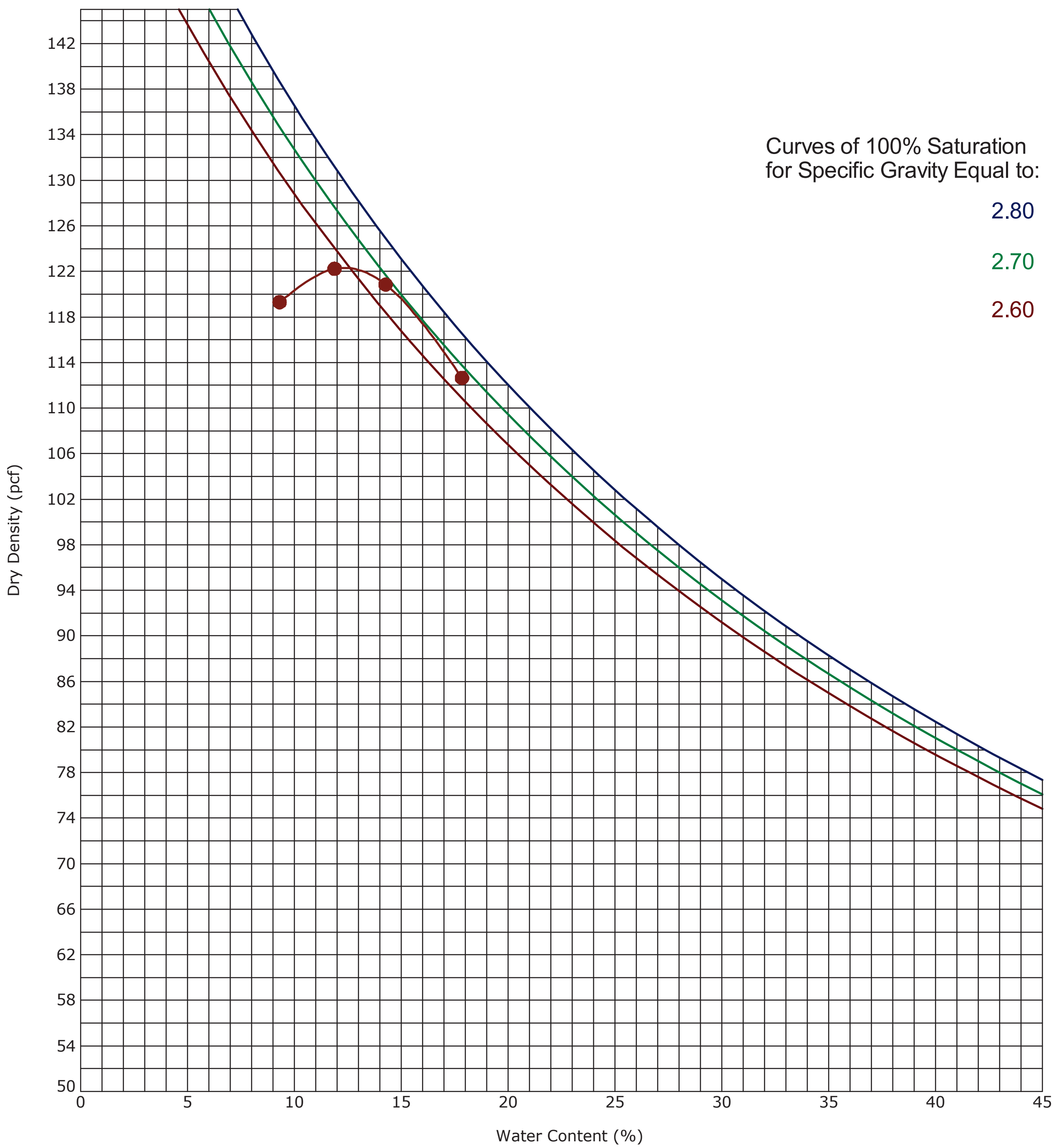
Boring ID		Depth (Ft)	Description	USCS	LL	PL	PI	Cc	Cu
●	B-7	0 - 2.5	SANDY LEAN CLAY	CL					
⊠	P-1	0 - 5	SILTY SAND	SM					
▲	P-3	0 - 5	SANDY LEAN CLAY	CL					

Boring ID		Depth (Ft)	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Fines	%Silt	%Clay
●	B-7	0 - 2.5	12.5	0.139			0.0	2.4	47.4	50.2		
⊠	P-1	0 - 5	12.5	0.299			0.0	2.8	59.6	37.5		
▲	P-3	0 - 5	9.5	0.117			0.0	0.3	44.3	55.4		

1355 E Cooley Dr, Ste C
Colton, CA

Moisture-Density Relationship

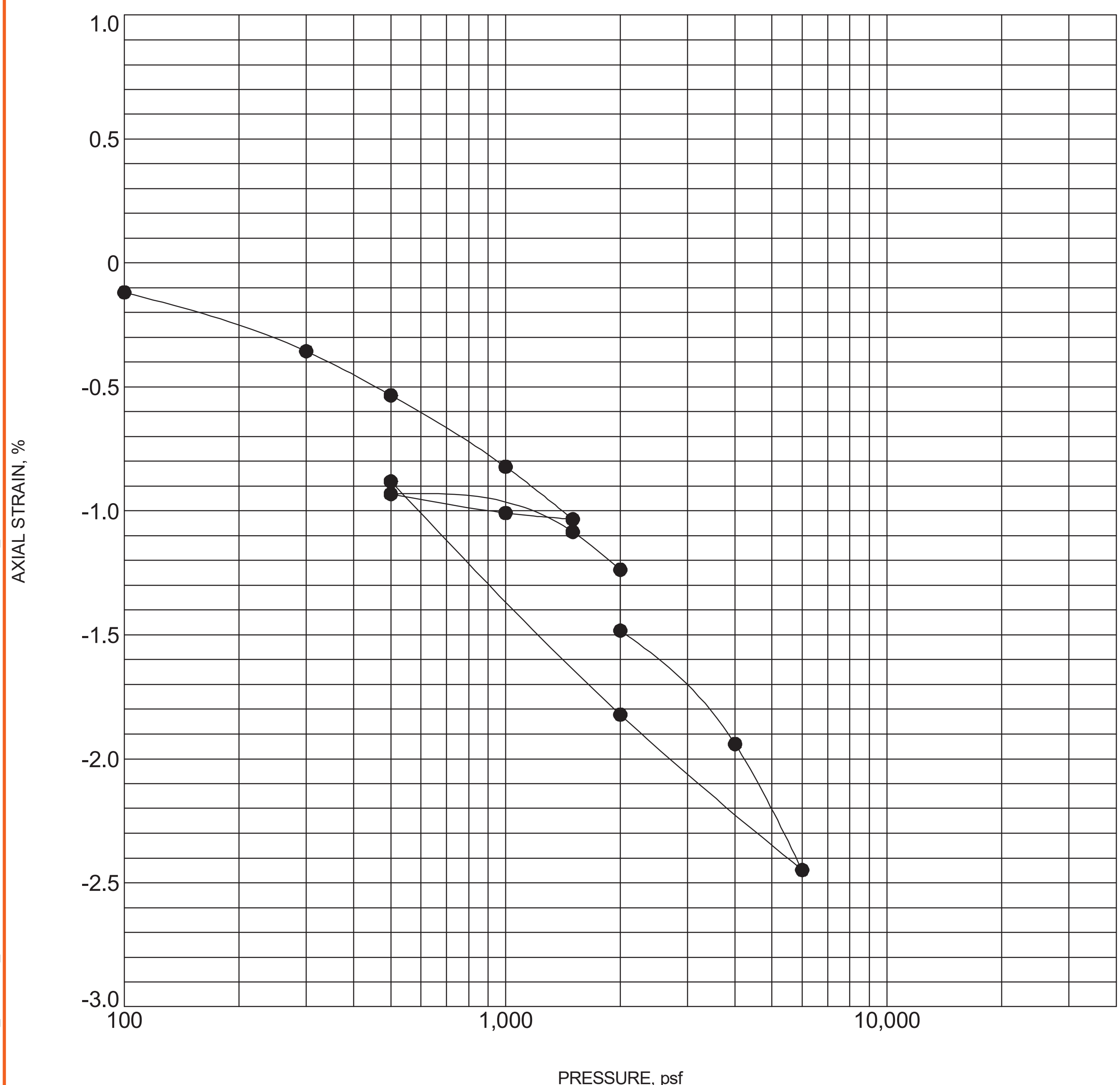
ASTM D698/D1557



Boring ID	Depth (Ft)	Description of Materials
B-7	0 - 2.5	CLAYEY SAND (SC)

Fines (%)	Fraction >19mm size (%)	LL	PL	PI	Test Method	Maximum Dry Density (pcf)	Optimum Water Content (%)
50	50				ASTM D1557 Method A	122.3	12.4

SWELL CONSOLIDATION TEST
ASTM D2435



Specimen Identification		Classification	γ_d, pcf	WC, %
●	B-3 5 - 6.5 ft	SP-SM	116	11.8

NOTES: Sample was saturated at surcharge pressure of 2,000 psf

PROJECT: Feasibility Study for NAVLC 115

SITE: SWC of W Ave E & Sierra Hwy Intersection
Antelope Valley, CA

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

PROJECT NUMBER: CB225192

CLIENT: NorthPoint Development LLC
Salt Lake City, UT

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

Client
NorthPoint Development LLC

Project
Feasibility Study for NAVLC 115

Sample Submitted By: Terracon (CB) **Date Received:** 12/21/2022 **Lab No.: 22-0844**

Results of Corrosion Analysis

Sample Number	1
Sample Location	B-2
Sample Depth (ft.)	0.0-2.5
pH Analysis, ASTM G 51	8.55
Water Soluble Sulfate (SO4), ASTM C 1580 (mg/kg)	92
Sulfides, AWWA 4500-S D, (mg/kg)	Nil
Chlorides, ASTM D 512, (mg/kg)	72
Red-Ox, ASTM G 200, (mV)	+729
Total Salts, AWWA 2540, (mg/kg)	660
As-Received Resistivity, ASTM G 57, (ohm-cm)	31040
Resistivity, ASTM G 57, (ohm-cm)	1552

Analyzed By: N. Campo
Nathan Campo
Engineering Technician II

SUPPORTING INFORMATION

Contents:

GENERAL NOTES
DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

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

DESCRIPTIVE SOIL CLASSIFICATION

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

LOCATION AND ELEVATION NOTES

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

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (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 SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

UNIFIED SOIL CLASSIFICATION SYSTEM

Terracon GeoReport

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]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [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]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [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 on or above "A"		CL	Lean clay [K, L, M]
			$PI < 4$ or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			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:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			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] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains $\geq$ 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 $\geq$ 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 $\geq$ 30% plus No. 200 predominantly sand, add "sandy" to group name.

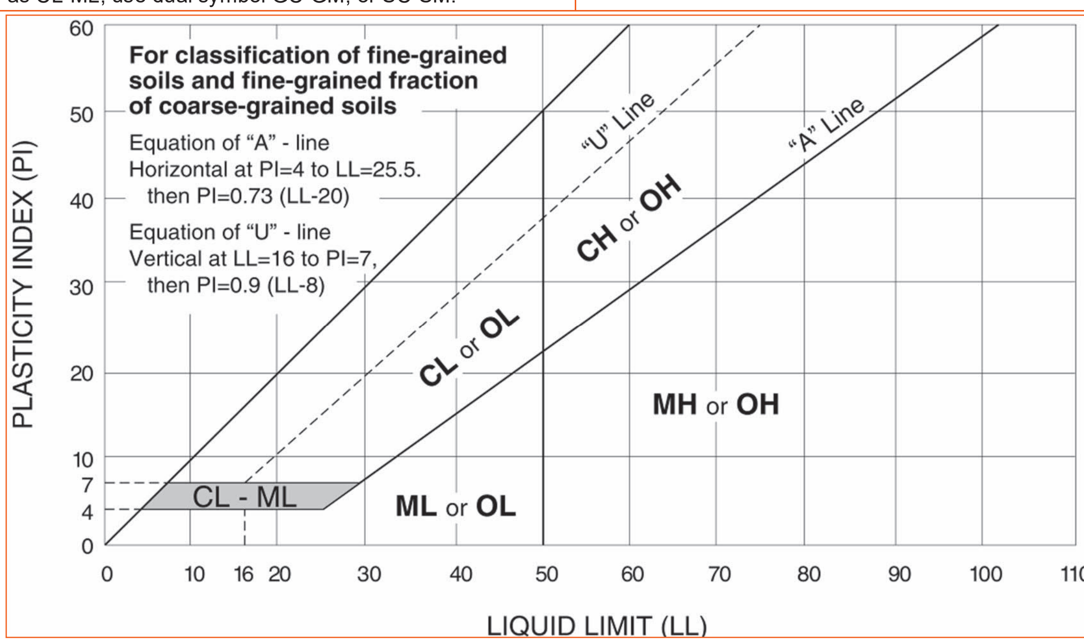
[M] If soil contains $\geq$ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] $PI \geq 4$ 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.



October 28, 2024
Kleinfelder Project No.: 20230661.005A

Mr. Jack Lac
NorthPoint Development
12977 North Outer 40 Road, Suite 203
St. Louis, Missouri 63141

SUBJECT: **Feasibility-Level Geotechnical Investigation**
North Antelope Valley Logistics Center
Southwest Corner of Sierra Highway and West Avenue D
Los Angeles County, California

Dear Mr. Lac:

Kleinfelder is pleased to present this report summarizing the feasibility-level geotechnical investigation performed for the subject site, located at the southwest corner of Sierra Highway and West Avenue D in Los Angeles County, California. Our conclusions and recommendations for geotechnical design and construction are presented in the attached report.

We appreciate the opportunity to provide geotechnical engineering services to you on this project. If you have any questions regarding this report or if we can be of further service, please do not hesitate to contact the undersigned.

Sincerely,

KLEINFELDER, INC.

Jose A. Zuniga, E.I.T.
Project Professional

Jeffery D. Waller, P.E., G.E.
Senior Geotechnical Engineer

FEASIBILITY-LEVEL GEOTECHNICAL INVESTIGATION
NORTH ANTELOPE VALLEY LOGISTICS CENTER
SOUTHWEST CORNER OF SIERRA HIGHWAY AND WEST AVENUE D
LOS ANGELES COUNTY, CALIFORNIA

KLEINFELDER PROJECT NO. 20230661.005A

October 28, 2024

A Report Prepared for:

Mr. Jack Lac
NorthPoint Development
12977 North Outer 40 Road, Suite 203
St. Louis, Missouri 63141

FEASIBILITY-LEVEL GEOTECHNICAL INVESTIGATION
PROPOSED NORTH ANTELOPE VALLEY LOGISTICS CENTER
SOUTHWEST CORNER OF SIERRA HIGHWAY AND WEST AVENUE D
LOS ANGELES COUNTY, CALIFORNIA

Prepared by:

Jose A. Zuniga, E.I.T.
Project Professional

Reviewed by:

REGISTERED PROFESSIONAL ENGINEER
JEFFERY D. WALLER
NO. 2947
EXP. 9-30-26
GEOTECHNICAL
STATE OF CALIFORNIA

Jeffery D. Waller, P.E., G.E.
Senior Geotechnical Engineer

KLEINFELDER
2280 Market Street, Suite 300
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Phone: 951.801.3681
Fax: 951.682.0192

October 28, 2024
Kleinfelder Project No.: 20230661.005A

TABLE OF CONTENTS

Section **Page**

FIGURES

APPENDICES

1 INTRODUCTION

This report presents the results of our feasibility-level geotechnical investigation for the proposed improvements at the southwest corner of Sierra Highway and West Avenue D in Los Angeles County, California. The general location of the site is shown on Figure 1, Site Vicinity Map.

The purpose of this feasibility-level geotechnical investigation was to evaluate the subsurface soil conditions at the site in order to provide geotechnical recommendations and liquefaction analysis for the design and construction of the proposed development. The scope of our services was presented in our proposal dated January 6, 2023. This report only provides recommendations for the proposed improvements discussed below.

1.1 PROJECT DESCRIPTION

Based on our review of the conceptual site plan provided by NorthPoint Development which includes both sites for NAVLC 157 and 160 the total site area is approximately 317 acres. The project will consist of Phase 2 though Phase 4 where a total of five (5) warehouse buildings will be constructed. The table below summarizes the building areas, footprint sizes and corresponding phase number.

Phase No.	Building No.	Area (ft^2)	Footprint (ft x ft)
2	3	±1,215,000	620 x 1,960
3	4	±1,215,000	620 x 1,960
4	5	±1,215,000	620 x 1,960
4	6	±694,000	620 x 1,120
4	7	±694,000	620 x 1,120

The project also includes Best Management Practices (BMPs) stormwater detention basins located throughout the site as shown on Figure 2, Exploration Location Map.

All the buildings are anticipated to be concrete tilt-up distribution-type buildings and have warehouse areas with loading-dock high slab-on-grade floors. We anticipate that the proposed buildings may be supported on conventional shallow spread foundations. Foundation loads are not currently available, but based on our experience with similar past projects, we assume that maximum column loading will be on the order of 80 kips and maximum wall loads will be on the order of 4 to 8 kips per linear foot. Floor loads for proposed distribution-type buildings may be on the order of 500 pounds per square foot. Cuts and fills on the order of approximately 10 feet may be needed to develop the site.

We anticipate parking lot and drive aisles will consist of asphaltic concrete (AC) pavement and loading dock areas will consist of Portland cement concrete pavement (PCCP). Ancillary construction is anticipated to include concrete flat work, landscaping, and installation of buried utilities.

1.2 SCOPE OF SERVICES

The scope of our preliminary geotechnical study consisted of a literature review, historical aerial photo review, subsurface exploration, geotechnical laboratory testing, engineering evaluation and analysis, and preparation of this report. Our report includes a description of the work performed, a discussion of the geotechnical conditions observed at the site, and preliminary recommendations developed from our engineering analysis of field and laboratory data. A description of our scope of services performed for this project is presented below.

Task 1 – Background Data Review. We reviewed published and unpublished geologic literature in our files and the files of public agencies, including selected publications prepared by the California Geological Survey and the U.S. Geological Survey. We also reviewed readily available seismic and faulting information, including data for designated earthquake fault zones and our in-house database of faulting in the general site vicinity.

Task 2 – Field Exploration. The subsurface conditions at the site were explored by drilling and logging thirteen (13) hollow-stem auger geotechnical borings (B-1 through B-13). The geotechnical borings were drilled to depths ranging from approximately 31½ to 51½ feet below ground surface (bgs). The locations of our borings are shown on the attached Figure 2, Exploration Location Map.

Prior to commencement of the fieldwork, our proposed exploration locations were cleared for known existing utility lines and with the participating utility companies through Underground Service Alert (USA). A Kleinfelder representative supervised the field operations and logged the borings. Selected bulk and drive samples were retrieved, sealed and transported to Kleinfelder's laboratory in Ontario, California for laboratory testing. Our typical sampling interval for the hollow stem auger borings was every 5 feet to full depths explored. The number of blows necessary to drive California-type samplers were recorded. A description of the field exploration and the logs of the borings, including a Legend to the Log of Borings, are presented in Appendix A.

Task 3 – Laboratory Testing. Laboratory testing was performed on representative samples of soil collected from our excavations to substantiate field classifications and to provide engineering parameters for geotechnical design. Laboratory testing included moisture determination and unit weight, grain size distribution, consolidation, plasticity testing, modified Proctor, expansion index, collapse potential, direct shear strength, and preliminary corrosion potential. A summary of the testing performed and the results for this subject site are presented in Appendix B.

Task 4 – Geotechnical Analyses and Report Preparation. Field and laboratory data were analyzed in conjunction with the proposed site plan presented on Figure 2 and assumed structural loads to develop geotechnical recommendations for the design and construction of the proposed development. We evaluated potential foundation systems, lateral earth pressures, settlement, and earthwork considerations. Potential geologic hazards, such as ground shaking, liquefaction hazard, seismic settlement potential, flood hazard, and fault rupture hazard were also evaluated. This report summarizes the work performed, data acquired, and our findings, conclusions, and geotechnical recommendations for the design and construction of the proposed development. Recommendations for the following are presented in this report:

- Earthwork, including site preparation, excavation, site drainage, and the placement of engineered fill;
- Design of suitable foundation systems including allowable capacities, lateral resistance, and settlement estimates;
- Liquefaction settlement analysis;
- Seismic design parameters;

- Floor slab and slab-on-grade support, including subgrade preparation;
- Lateral earth pressures for design of retaining walls;
- Design and construction of asphalt and Portland cement concrete pavements, including driveways, fire lanes, and concrete walks; and
- Preliminary infiltration correlations of the site soils for design of BMPs.

This report also contains reference maps and graphics, as well as the logs of the borings and laboratory test results.

2 SITE AND SUBSURFACE CONDITIONS

2.1 SITE DESCRIPTION

The total site area is approximately 317 acres and is located at the southwest corner of Sierra Highway and West Avenue D in Los Angeles County, California. From review of readily available historic and current aerial photographs it appears that the overall project site includes:

- a residential home located at the southwest corner of the subject site,
- several wood framed structures and water detention areas with berms up to ±10 feet high near the central area of the site. The berms were historically used to impound water,
- agricultural areas with small berms in the northern half of the site,
- former wetlands across the site.

Based on the ALTA survey provided to Kleinfelder, the project site generally appears to slope down from north to south and west to east with a grade differential of approximately 2 to 6 feet throughout the site.

2.2 SUBSURFACE CONDITIONS

Subsurface materials observed during drilling are described below and detailed descriptions of subsurface materials are provided in our boring logs presented in Appendix A.

<u>Alluvium/Native Soils:</u>

The alluvium/native soils were observed in all of the borings drilled for this investigation and predominately consisted of clayey or silty sands, poorly graded sands with silt, and some well graded sands with clay and sandy silts to the total depth explored of approximately 51½ feet bgs. Interbedded layers of clay were present throughout most of the borings to the total depth explored of approximately 51½ feet bgs. In-situ moisture content ranged from 0.9 to

32.8 percent and dry unit weight ranged from 93.1 to 128.0 pounds per cubic foot (pcf). Generally, the apparent density of the subsurface soils was stiff to hard for fine-grained soils and medium dense to dense for coarse-grained soils.

2.3 GROUNDWATER CONDITIONS

Groundwater was not encountered in our borings to the maximum depth explored of approximately 51½ feet bgs during our geotechnical investigation within the 317-acre site. The Rosamond Quadrangle, Plate 1.2, in the Seismic Hazard Zone Report 093 shows current groundwater between approximately 60 and 70 feet bgs within the subject site.

Based on our research of readily available data provided by the California Department of Water Resources website (https://wdl.water.ca.gov/WaterDataLibrary/) groundwater was measured at approximately 12 feet below ground surface (bgs) at a well located in the area between Buildings 3 and 4 of the subject site in April 1951. However, a well located on the east side of Sierra Highway, approximately 300 feet from the subject site was observed to have groundwater at the ground surface between 1943 and 1945. Since that time, historical groundwater elevation trends at the Site from the 1950s to 2022 show that groundwater has depressed to approximately 60 and 70 feet bgs. Based on the extensive groundwater pumping by the Antelope Valley WaterMaster, we do not anticipate encountering groundwater during grading activities at the site.

Fluctuations of localized zones of perched water and rise in soil moisture content should be anticipated during the rainy season. Irrigation of landscaped areas may also lead to an increase in soil moisture content and fluctuations of intermittent shallow perched groundwater levels.

3 GEOLOGIC CONDITIONS

3.1 REGIONAL GEOLOGY

The subject site is located within the western portion of the Mojave Desert geomorphic province of California (Norris and Webb, 1990; CGS 2002).

The Mojave Desert is approximately 25,000 square miles of desert situated in southeastern California. The area is enclosed on the southwest by the San Andreas fault and the Transverse Ranges and on the north and northeast by the Garlock fault, the Tehachapi Mountains and the Basin and Range. The Nevada state line and Colorado River form the arbitrary eastern boundary. The San Bernardino-Riverside County line designates the southern boundary.

The region is dominated by broad alluvial basins that are mostly aggrading sources receiving nonmarine deposits from the adjacent uplands. The highest general elevations of the Mojave Desert approach 4,000 feet above mean sea level (MSL) with most of the valleys between 2,000 and 4,000 feet MSL.

3.2 SITE GEOLOGY

Regional geologic mapping indicates that the site is underlain by modern alluvium and younger playa deposits that are Holocene to late Pleistocene in age (Dibblee, 2008). The southeast corner of the site is underlain by younger playa deposits. The alluvium is derived from Amargosa Creek and covers the majority of the site. The younger playa deposits were deposited in the shallow-water regions of the last pluvial lake that filled the lowland parts of Antelope Valley, up to approximately 12,000 years ago.

3.3 GEOLOGIC HAZARDS

We have addressed below the potential geologic hazards for the site.

3.3.1 Active and Potentially Active Fault Search

Earthquakes and faulting occur as the tectonic plates, which comprise the Earth's crust, or lithosphere, move relative to one-another. Faults identified by the State as being active are not known to be present at the surface within the project limits. No portion of the site is located within a State of California-Special Studies Zone (CGS, 2018). The closest active fault to the site is the San Andreas fault zone located approximately 12 miles southwest of the site (CGS, 2010). Because of the distance to known active faults, the lack of surficial evidence of fault breaks expressed in air photos or published geologic maps, the risk of surface rupture resulting from faulting is considered low.

3.3.2 Flooding

Surface water flow at the site is generally via sheet flow in a southeast direction toward the Amargosa creek drainage.

The site is within a flood hazard zone "X" (FEMA, 2008), where the flood hazard is "determined to be outside the 0.2% annual chance floodplain". A flood hazard zone appears to be just outside the current site to the north and to the southeast. According to FEMA (2008), where the flood hazard is a "Special Flood Hazard Area subject to Inundation by the 1% Annual chance Flood" with no base flood elevation.

A seiche is a wave or sloshing of a body of water that is at least partially impounded caused by strong wind or seismic shaking. The site is upstream of the Piute Ponds and south of the Lancaster Water Reclamation Plant ponds. However, the ponds on the southern portion of the Reclamation Plant have been decommissioned and the impact from a potential seiche is considered very low.

3.3.3 Landslides

Landslides and other forms of mass wasting, including mud flows, debris flows, soil slips, and rock falls occur as soil or rock moves down slope under the influence of gravity. Landslides are frequently triggered by intense rainfall or seismic shaking. The site is not located within a State or county designated landslide hazard zone. The site is relatively flat and the risk at the site from landslides and other forms of mass wasting is considered very low.

3.3.4 Liquefaction and Seismic Settlement

Liquefaction occurs when saturated, loose, coarse-grained or silty soils are subjected to strong shaking resulting from earthquake motions. The coarse-grained or silty soils typically lose a portion or all of their shear strength and regain strength sometime after the shaking stops. Soil movements (both vertical and lateral) have been observed under these conditions due to consolidation of the liquefied soils.

The southeastern portion site is located within a mapped generalized liquefaction potential zone (CGS, 2005b).

3.3.5 Subsidence

Ground subsidence is a gradual settling or sudden sinking of the earth's surface owing to subsurface movement of earth materials. Ground subsidence can result from fluid (water or petroleum) extraction from underlying sediments and/or formations, which allows the collapse of pore spaces previously occupied by the removed fluid. The collapse of these pore spaces compacts these underlying formations, leading to a gradual drop in ground surface elevation. Ground subsidence is most often found in areas where large volumetric withdrawals of fluids from underground reservoirs has occurred or is ongoing. Ground shaking from tectonic activity can exacerbate the vertical sinking of land in an area over the withdrawal site. Structures and improvements located in subsidence-prone areas are at risk for damage if subsidence were to occur.

The USGS has been tracking subsidence in California since the early 20th century and has developed maps that illustrate areas of recorded subsidence across the state (USGS, 2023). Most of the subsidence has resulted from excessive groundwater pumping for municipal, industrial, and agricultural uses, although oil extraction is also a documented cause. A review of the USGS subsidence maps shows that the project site, as well as the Antelope Valley, are in a documented area that has experienced subsidence. The Antelope Valley Watermaster basin management efforts implemented in the past 4 years are slowing groundwater elevation decline and associated subsidence. Continued water production management efforts stabilize groundwater elevation and limit or remove further subsidence in the basin.

3.3.6 Oil and Gas Fields

The project site is not located within a mapped petroleum producing field of Southern California and no oil/gas wells are reported within the Project Site [California Geologic Energy Management Division (CalGEM), formerly Division of Oil, Gas and Geothermal Resources (DOGGR), 2022]. However, based on information available from CalGEM, nine (9) idle oil and gas wells are reported located within 6 miles of the site. Additionally, undocumented well(s) are not known to be at the site.

3.3.7 Expansive Soils

The upper site soils were tested for expansion potential and found to be very low. Due to the variability of near surface soil, the potential for expansive soils impacting the project grading is not anticipated. Further discussion is presented in Section 4.8. The on-site soils should be further evaluated during the geotechnical study for the design phase of the project.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 GENERAL

Based on the results of our field exploration, laboratory testing and geotechnical analyses conducted during this study, it is our professional opinion that the proposed project is geotechnically feasible, provided the recommendations presented in this report are incorporated into the project design and construction.

The following preliminary opinions, conclusions, and recommendations are based on the properties of the materials encountered in the explorations, the results of our literature review, the results of the laboratory testing program, and our engineering analyses performed. Our recommendations regarding the geotechnical aspects of the design and construction of the project are presented in the following sections. We recommend that the final grading plans be reviewed by Kleinfelder prior to the start of construction.

4.2 SEISMIC DESIGN CONSIDERATIONS

4.2.1 Seismic Design Parameters

Based on data obtained from our field explorations, published geologic literature and maps, and on our interpretation of the 2022 CBC criteria, it is our opinion that the project site be classified as Site Class D, Stiff Soil, according to Section 1613 of the 2022 CBC and Table 20.3-1 of ASCE/SEI 7-16 (2016). Approximate coordinates for the site are noted below.

- Latitude: 34.771473 °N
- Longitude: 118.153315 °W

In accordance with Section 11.4.8 of ASCE 7-16, a site-specific ground motion hazard analysis is required for Site Class D sites with an S_1 greater than 0.2 g. However, a site-specific ground motion hazard analysis is not required if the exceptions in Section 11.4.8 of ASCE 7-16 are taken. In accordance with the 2022 CBC, which adopts Supplement 3 of ASCE 7-16, the exception would be if the values of the parameters S_{M1} and S_{D1} are increased by 50 percent.

The assumption that the exception will be used should be verified by the project structural engineer during final design based on the governing code. Based on the assumption that the exception will be taken in accordance with the governing code, the 2022 CBC Seismic Design Parameters (non-site-specific) for the project site are provided in Table 1.

Table 1
2022 CBC Seismic Design Parameters

Design Parameter	Recommended Value
Site Class	D
S_s (g)	1.269
S_1 (g)	0.513
F_a	1.0
F_v	N/A*
S_{MS} (g)	1.269
S_{M1} (g)	N/A
S_{DS} (g)	0.846
S_{D1} (g)	N/A
PGA_M (g)	0.550

* N/A = Not Applicable; Section 11.4.8 of ASCE 7-16 requires a site-specific ground motion hazard analysis be performed for Site Class D sites with S_1 values greater than or equal to 0.2g unless exceptions are taken in which the values of S_{M1} and S_{D1} are increased by 50 percent. If exceptions are taken, then a Fv value of 1.79 may be used in accordance with Table 11.4-2 of ASCE 7-16 Supplement 3 (per the 2022 CBC).

4.2.2 Liquefaction and Seismic Settlement

The term liquefaction describes a phenomenon in which saturated, cohesionless soils temporarily lose shear strength (liquefy) due to increased pore water pressures induced by strong, cyclic ground motions during an earthquake. Structures founded on or above potentially liquefiable soils may experience bearing capacity failures due to the temporary loss of foundation support, vertical settlements (both total and differential), and undergo lateral spreading. The factors known to influence liquefaction potential include soil type, relative density, grain size, confining pressure, depth to groundwater, and the intensity and duration of the seismic ground shaking. The cohesionless soils most susceptible to liquefaction are loose, saturated sands and some silt.

To assess the potential for liquefaction of subsurface soils at the site, we used the liquefaction analysis procedures outlined in Youd et al. (2001) based on standard penetration test (SPT) data. These methods utilize corrected SPT blow counts to estimate the amount of volumetric compaction or settlement during an earthquake.

Groundwater was not encountered during our current field exploration drilled to a maximum explored depth of 51½ feet bgs. As presented in the referenced Kleinfelder Response To Comments dated September 12, 2023, the project site and the surrounding area have groundwater depths greater than 60 feet bgs. Kleinfelder submitted a Request for a Waiver to the County of Los Angeles Geotechnical and Materials Engineering Division to utilize a groundwater depth of 50 feet for liquefaction analysis. The Waiver was approved as presented in the referenced Geologic and Soils Engineering Review Sheet dated November 3, 2023. Based on the applicable groundwater levels, the potential for liquefaction settlement is negligible as shown in the Table below.

Building Number	Boring Number	*Liquefaction Settlement Based on Groundwater at 50 feet BGS (in)*
3	B - 11	*0*
4	B – 10	*0*
5	B – 5	*0*
6	B – 3	*0*
7	B – 4	*0*

As recommended in Section 1803.5.12 of 2022 CBC, the peak ground acceleration (PGA) used in the liquefaction analysis was estimated in accordance with Section 11.8.3 of ASCE 7-16. A PGAM of 0.55g with an earthquake magnitude of 8.1 was used as the design-level seismic event in our liquefaction analysis, which is defined as an earthquake event with 2 percent probability of being exceeded in 50 years (return period of about 2,475 years) according to the 2022 CBC and ASCE/SEI 7-16.

Seismic compression (dry seismic settlement) results from the accumulation of contractive volumetric strains in unsaturated soil during earthquake shaking. Loose to medium dense granular material with no fines or with low plasticity fines are most susceptible to seismic compression. The onsite loose to dense granular soils and stiff to very stiff finer non-granular soils may be prone to settlement due to seismic shaking. Dry seismic settlement (total) is estimated to range between 0.6 to 1.5 inches.

Building Number	**Boring Number**	***Dry Seismic Settlement (in)***
3	B - 11	*1.2*
4	B – 10	*0.6*
5	B – 5	*0.9*
6	B – 3	*1.4*
7	B – 4	*1.5*

4.3 FOUNDATIONS

4.3.1 General

Based on the results of our field exploration, laboratory testing, and geotechnical analyses, the proposed improvements may be supported on conventional shallow foundations on a zone of compacted fill provided the settlement estimates (both static and seismic) are tolerable. We have assumed that the proposed structures will be able to tolerate the estimated seismic settlement (i.e., it will not collapse creating a life safety issue). However, this assumption should be verified by the project structural engineer. It should be noted that the design intent of the 2022 California Building Code (CBC) during a design-level seismic event is life safety, not serviceability of the structure after an earthquake.

4.3.2 Allowable Bearing Pressure

Footings supported on at least 3 feet of compacted fill may be designed for a net allowable bearing pressure of 3,000 psf for dead plus sustained live loads. A one-third increase in the bearing value can be used for wind or seismic loads. All footings should be established at a depth of at least 24 inches below the lowest adjacent grade. The footing dimension and reinforcement should be designed by the structural engineer; however, continuous and isolated spread footings should have minimum widths of 18 and 24 inches, respectively.

4.3.3 Estimated Settlements

Total static settlement for foundations designed in accordance with the recommendations presented herein is estimated to be less than 1 inch. Differential static settlement between similarly loaded columns is estimated to be less than ½ inch over 40 to 70 feet. Note that this settlement is in addition to the estimated settlement due to seismic shaking.

4.3.4 Lateral Resistance

Resistance to lateral loads (including those due to wind or seismic forces) may be provided by frictional resistance between the bottom of concrete foundations and the underlying soils and by passive soil pressure against the sides of the foundations. A coefficient of friction of 0.35 may be used between cast-in-place concrete foundations and the underlying soil. The passive pressure available for engineered fill may be taken as equivalent to the pressure developed by a fluid with a unit weight of 350 pounds per cubic foot (pcf). A one-third increase in the passive resistance may be used for resistance to transient loads such as wind and seismic. The upper one foot of soil should be neglected when calculating passive resistance.

The lateral resistance parameters provided above are ultimate values. Therefore, a suitable factor of safety should be applied to these values for design purposes. The appropriate factor of safety will depend on the design condition and should be determined by the project Structural Engineer. Depending on the application, typical factors of safety could range from 1.5 to 2.0.

4.4 EARTHWORK

4.4.1 General

Recommendations for site preparation are presented below. All site preparation and earthwork operations should be performed in accordance with applicable codes, safety regulations and other local, state or federal specifications. All references to maximum unit weights are established in accordance with the latest version of ASTM Standard Test Method D1557.

Grading operations during the wet season or in areas where the soils are saturated may require provisions for drying of soils prior to compaction. If the project necessitates fill placement and compaction in wet conditions, we can provide suggested alternative recommendations for drying the soil. Conversely, additional moisture may be required during the dry months. A sufficient water source should be available to provide adequate water during compaction. During dry months, moisture conditioning of the subgrade soils may be required if left exposed for greater than a few days.

4.4.2 Site Preparation

Prior to general site grading, existing vegetation, debris, and oversized materials (greater than 6 inches in maximum dimension) should be stripped and disposed outside the construction limits. We estimate the depth of stripping to be approximately 6 inches over most portions of the site. Deeper stripping or grubbing may be required where higher concentrations of vegetation are encountered during site grading. Stripped topsoil (less any debris) may be stockpiled and reused for landscaping purposes; however, this material should be evaluated for suitability if it is desired to use this material for engineered fill below structures.

All oversize and organic debris, including any produced by demolition operations, (wood, steel, piping, plastics, etc.), should be separated and disposed offsite. The material generated during demolition of the existing roadways and concrete structures may be reused onsite. If reused, the particles should be crushed to a maximum particle size of 6 inches and spread across the site to prevent nesting.

Existing utility pipelines (if encountered) which extend beyond the limits of the proposed construction and are to be abandoned in place should be plugged with cement grout to prevent migration of soil and/or water. Demolition, disposal, and grading operations should be observed and tested by a representative from our office.

4.4.3 Overexcavation

Recommendations for overexcavation of the proposed building pads (building foundations and floor slabs) and parking lots (pavements) are presented below. All site preparation and earthwork operations should be performed in accordance with applicable codes, safety regulations and other local, state, or federal specifications. All references to maximum unit weights are established in accordance with the latest version of ASTM Standard Test Method D1557.

Excavations within a 1:1 (horizontal: vertical) plane extending downward from a horizontal distance of 2 feet beyond the bottom outer edge of existing improvements (e.g. building foundations) or property lines should not be attempted without bracing and/or underpinning. All applicable excavation safety requirement and regulations, including OSHA requirements should be met.

4.4.3.1 Structural Areas

In order to provide uniform support for the proposed spread foundations and slab-on-grade floors, we recommend the site soils be overexcavated and replaced as engineered fill to a minimum depth of 3 feet from existing grade and at least 3 feet below the bottom of footings, whichever is greater. Building pads located in cut/fill transition areas should be overexcavated a minimum of 3 feet below the proposed bottom of footings/slabs. Although not encountered in our borings, any existing undocumented artificial fill soils should be removed until native alluvium is exposed. The overexcavation should extend horizontally at least 5 feet beyond the edges of foundations and a distance equivalent to the thickness of anticipated fill below the footing, whichever is greater. Depending on the observed condition of the existing soil and engineered fill, deeper overexcavation may be required in some areas. The Geotechnical Engineer of Record should be notified for supplemental recommendations if the minimum relative compaction of the soil is not achieved.

4.4.3.2 Non-structural Areas

Within the non-structural areas, such as truck aprons, pavements, sidewalks, other flatwork, etc., we recommend that these items be underlain by at least 24 inches of engineered fill. The overexcavation should extend beyond the proposed improvements a horizontal distance of at least two feet.

4.4.3.3 Additional Overexcavation Considerations

After site preparation and overexcavation, and prior to scarification or placement of compacted fills, the excavation bottom should be observed, evaluated, and approved by Kleinfelder. Additional removals may be needed if significant porosity or other adverse conditions are observed. The subgrade should then be scarified to a depth of approximately 8 inches, moisture conditioned to at least optimum moisture content; and recompacted. After compaction, the subgrade should be proof rolled using equipment with sufficient weight to evaluate surface deflection. Proof rolling should be performed to verify that the subgrade soils are firm and unyielding at the depth of the recommended overexcavation presented above.

4.4.4 Engineered Fill

We anticipate that most of the on-site soils may be reusable as engineered fill once any debris and oversized materials greater than 4 inches in diameter have been removed, and after any vegetation and organic debris is cleared. Engineered fill should contain less than 2 percent organic content and maximum material size should be less than 4 inches in maximum dimension. Disturbed/tilled soil, less vegetation, may be used in landscape areas, exported, or placed in a controlled manner and blended with the onsite soils, provided that the resulting engineered fill contains less than 2 percent organic content.

Fill should be placed in lifts no greater than 8 inches thick, loose measurement, and should be compacted to at least 90 percent of the maximum dry density. The moisture content of the on-site soils should be at or above the optimum moisture at the time of compaction.

Engineered fill placed below pavement should be compacted to at least 90 percent of the maximum dry density obtained by the ASTM D1557 method of compaction, with the upper 12 inches below pavements compacted to at least 95 percent relative compaction.

Although not anticipated, any imported fill materials to be used for engineered fill should be sampled and tested for approval by the geotechnical engineer prior to being transported to the site. The expansion index of an imported soil should be less than 20. In general, well-graded mixtures of gravel, sand and non-plastic silt are acceptable for use as import fill. A minimum notice of 3 working days will be required to allow for qualification testing prior to compaction of imported materials.

4.4.5 Temporary Excavations

All excavations must comply with applicable local, state, and federal safety regulations including the current OSHA Excavation and Trench Safety Standards. Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We are providing the information below solely as a service to our client. Under no circumstances should the information provided be interpreted to mean that Kleinfelder is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

Excavations within a 1:1 plane extending downward from a horizontal distance of 2 feet beyond the bottom outer edge of existing improvements (e.g. building foundations) should not be attempted without bracing and/or underpinning the improvements. The geotechnical engineer or their field representative should observe the excavations so that modifications can be made to the excavations, as necessary, based on variations in the encountered soil conditions. All applicable excavation safety requirements and regulations, including OSHA requirements, should be met.

Near-surface soils encountered during our field investigation consisted predominantly of sandy silts, silty sand and clayey sands. In our opinion, these soils would be considered a Type 'C' soil with regard to the OSHA regulations. For this soil type, OSHA requires a maximum slope inclination of 1.5:1 (horizontal to vertical) or flatter for excavations 20 feet or less in depth. Temporary, shallow excavations with vertical side slopes less than 4 feet high should generally be stable, although sloughing may be encountered. Vertical excavations greater than 4 feet high should not be attempted without appropriate shoring to prevent local instability. All trench excavations should be braced and shored in accordance with good construction practice and all applicable safety ordinances and codes. The contractor should be responsible for the structural design and safety of the temporary shoring system, and we recommend that this design be submitted to Kleinfelder for review to check that our recommendations have been incorporated.

Stockpiled (excavated) materials should be placed no closer to the edge of an excavation than a distance equal to the depth of the excavation, but no closer than 4 feet. All trench excavations should be made in accordance with OSHA requirements.

4.4.6 Excavation Conditions

The borings were advanced using a truck-mounted hollow-stem auger drill rig. Drilling excavations were completed with easy effort through the existing site soils. Conventional earth moving equipment should be capable of performing the soil excavations.

4.4.7 Pipe Bedding and Trench Backfill

Pipe bedding and pipe zone material should consist of sand or similar granular material having a minimum sand equivalent value of 30. Onsite soils may be suitable but should be tested and approved by the engineer of record prior to use. The sand should be placed in a zone that extends a minimum of 6 inches below and 6 inches above the pipe for the full trench width. The bedding material should be compacted to a minimum of 90 percent of the maximum dry density or to the satisfaction of the geotechnical engineer's representative observing the compaction of the bedding material. Bedding material should consist of sand, gravel, crushed aggregate, or native free-draining granular material with a maximum particle size of ¾ inch. Bedding materials should also conform to the pipe manufacturer's specifications, if available. Trench backfill above bedding and pipe zone materials may consist of approved, on-site or import soils placed in lifts no greater than 8 inches loose thickness and compacted to 90 percent of the maximum dry density based on ASTM Test Method D1557. Jetting of backfill is not recommended. The on-site soils are suitable for backfill of utility trenches from one foot above the top of the pipe to the surface provided the material is free of organic and deleterious substances.

4.5 CONCRETE SLABS SUPPORTED ON GRADE

4.5.1 General

Slab-on-grade floors should be underlain by engineered fill as discussed in the Earthwork Section of this report. We anticipate that the planned floor slabs will have a minimum thickness of 6 inches, will be unreinforced and dowelled at panel edges. Minimum reinforcement for floor slabs, if required, should be determined by the structural engineer. The structural engineer should design the slabs for any specific loading conditions. A modulus of subgrade reaction of 100 pounds per cubic inch may be used for design. The moisture content of the upper 18 inches of engineered fill should be at the recommended range for fill compaction at the time the floor slab is constructed. Precautions should be taken so as not to allow the upper engineered fill below the slab to dry out below the recommended moisture range between completion of the building pad and construction of the floor slab. Total static settlement for foundations designed in accordance with the recommendations presented herein, with an anticipated maximum load of 500 psf, is estimated to be less than a 1 inch.

Construction activities and exposure to the environment can cause deterioration of the prepared subgrade. We recommend that a Kleinfelder representative inspect the final subgrade conditions prior to placement of the concrete, and if necessary, perform additional moisture and density testing to determine the subgrade suitability. A low slump concrete should be used to reduce possible curling of the slab.

4.5.2 Exterior Flatwork

Where exterior flatwork, such as sidewalks, are to be constructed, the subgrade should be scarified to a depth of 8 inches and moisture conditioned to a moisture content above the optimum moisture content, and recompacted as recommended in the Earthwork Section of this report. Exterior, structurally loaded flatwork, such as truck docks or trash enclosures should adhere to the recommendations for rigid pavement presented in this report.

4.5.3 Vapor Retarder

Subsurface moisture and moisture vapor naturally migrate upward through the soil and, where the soil is covered by a building or pavement, this subsurface moisture will collect. To reduce the impact of this subsurface moisture and the potential impact of future introduced moisture (such as landscape irrigation or precipitation) on moisture sensitive flooring, the current industry standard is to place a vapor retarder on a compacted crushed rock layer and/or sand layers, 1 to 2 inches in thickness, placed above and below the vapor retarder. The crushed rock layer and/or sand layer may be omitted in accordance with the vapor barrier manufacturer's installation recommendations.

The necessity and placement of a vapor retarder should be evaluated by the structural engineer and/or flooring consultant. It should be noted that although vapor barrier systems are currently the industry standard, this system might not be completely effective in preventing floor slab moisture problems. These systems typically will not necessarily assure that floor slab moisture transmission rates will meet floor covering manufacturer standards and that indoor humidity levels be appropriate to inhibit mold growth. The design and construction of such systems are totally dependent on the proposed use and design of the proposed building and all elements of building design and function should be considered in the slab-on-grade floor design. Building design and construction may have a greater role in perceived moisture problems since sealed buildings/rooms or inadequate ventilation may produce excessive moisture in a building and affect indoor air quality.

4.5.4 Concrete Curing and Flooring

Various factors such as surface grades, adjacent planters, the quality of slab concrete and the permeability of the on-site soils affect slab moisture and can control future performance. In many cases, floor moisture problems are the result of either improper curing of floor slabs or improper application of flooring adhesives. We recommend contacting a flooring consultant experienced in the area of concrete slab-on-grade floors for specific recommendations regarding your proposed flooring applications. Special precautions must be taken during the placement and curing of all concrete slabs. Excessive slump (high water-cement ratio) of the concrete and/or improper curing procedures used during either hot or cold weather conditions could lead to excessive shrinkage, cracking or curling of the slabs. High water-cement ratio and/or improper curing also greatly increase the water vapor permeability of concrete. We recommend that all concrete placement and curing operations be performed in accordance with the American Concrete Institute (ACI) Manual.

It is emphasized that we are not floor moisture-proofing experts. We make no guarantee, nor provide any assurance that use of the capillary break/vapor retarder system will reduce concrete slab-on-grade floor moisture penetration to any specific rate or level, particularly those required by floor covering manufacturers. The builder and designers should consider all available measures for slab moisture protection.

4.6 RETAINING WALLS

We have provided preliminary cantilever retaining wall recommendations below. Further evaluation will be needed once wall types, locations and heights are selected.

4.6.1 General

Design earth pressures for retaining walls depend primarily on the allowable wall movement, wall inclination, type of backfill materials, backfill slopes, surcharges, and drainage. The earth pressures provided assume that that a non-expansive granular backfill will be used and a drainage system will be installed behind the walls, so that external water pressure will not develop. If a drainage system will not be installed, the wall should be designed to resist hydrostatic pressure in addition to the earth pressure as well as reinforcement that should be protected from rust or other corrosion-inducing effects of moisture. Determination of whether the active or at-rest condition is appropriate for design will depend on the flexibility of the walls. Walls that are free to rotate at least 0.002 radians (deflection at the top of the wall of at least 0.002 x H, where H is the unbalanced wall height) may be designed for the active condition. Walls that are not capable of this movement should be assumed rigid and designed for the at-rest condition. The recommended active and at-rest earth pressure values are provided in Table 2, Earth Pressures for Retaining Walls.

Table 2

Earth Pressures for Retaining Walls

(Non-Expansive Backfill)

Wall Movement	Backfill Condition	Equivalent Fluid Pressure (pcf)	Seismic Increment * (pcf)
Free to Deflect (active condition)	Level	40	15
Restrained (at-rest condition)		65	N/A **

Note: ** Walls supporting more than 6 feet of backfill should be designed to support an incremental seismic lateral pressure, which is applied as a triangular pressure distribution with a maximum pressure at the bottom of the wall, not inverted.*

*** for restrained wall, use the static active earth pressure and seismic increment to check the seismic condition; use at-rest earth pressure only to check the static condition; the larger loading of both cases should be used for the design of restrained wall.*

In addition to the above lateral pressure, undrained walls will have to be designed for full hydrostatic pressure. The above lateral earth pressures do not include the effects of surcharges (e.g., traffic, footings), compaction, or truck-induced wall pressures. Any surcharge (live, including traffic, or dead load) located within a 1:1 plane drawn upward from the base of the excavation should be added to the lateral earth pressures. The lateral contribution of a uniform surcharge load located immediately behind walls may be calculated by multiplying the surcharge by 0.33 for cantilevered walls and 0.5 for restrained walls. Walls adjacent to areas subject to vehicular traffic should be designed for a 2-foot equivalent soil surcharge (250 psf). Lateral load contributions from other surcharges located behind walls may be provided once the load configurations and layouts are known.

4.6.2 Backfill Compaction

Care must be taken during the compaction operation not to overstress the wall. Wall backfill should be compacted to a least 90 percent relative compaction; however, heavy construction equipment should be maintained a distance of at least 3 feet away from the walls while the backfill soils are being placed. Kleinfelder should be contacted when development plans are finalized for review of wall and backfill conditions on a case-by-case basis.

4.6.3 Drainage

Walls should be properly drained or designed to resist hydrostatic pressures. Adequate drainage is essential to provide a free-draining backfill condition and to limit hydrostatic buildup behind the wall. Walls should also be appropriately waterproofed and include weep holes for drainage. In lieu of weep holes, a 4-inch diameter perforated PVC pipe, placed perforations down leading to a suitable gravity outlet, should be installed at the base of the walls. Another drainage alternative could be a manufactured prefabricated drainage composite panel such as Miradrain G100N or equivalent at regular intervals along the wall.

4.7 DRAINAGE AND LANDSCAPING

It is important that positive surface drainage be provided to prevent ponding and/or saturation of the soils in the vicinity of foundations, concrete slabs-on-grade, or pavements. We recommend that the site be graded to carry surface water away from the improvements and that positive measures be implemented to carry away roof runoff. Poor perimeter or surface drainage could allow migration of water beneath the building or pavement areas, which may result in distress to project improvements. If planted areas adjacent to structures are desired, we suggest that care be taken not to over irrigate and to maintain a leak-free sprinkler piping system. In addition, it is recommended that planter areas next to buildings have a minimum of 5 percent positive fall away from building perimeters to a distance of at least 5 feet. Drain spouts should be extended to discharge a minimum of 5 feet from the building, or some other method should be utilized to prevent water from accumulating in planters. Landscaping after construction should not promote ponding of water adjacent to structures.

4.8 EXPANSION POTENTIAL

Expansive soils are characterized by their ability to undergo significant volume changes (shrink or swell) due to variations in moisture content. Changes in soil moisture content can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors and may result in unacceptable settlement or heave of structures or concrete slabs supported on grade. Expansion index testing of surficial soils resulted in values of 4, 5 and 16, which indicates a very low expansion potential.

4.9 HYDRO-COLLAPSE POTENTIAL

Hydro-collapsible soils are characterized by their ability to undergo significant shrinkage (collapse) during inundation. Inundation in soils can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors, and may result in unacceptable settlement of structures or concrete slabs supported on grade. Based on the results of laboratory testing, the collapse potential of the surficial soils ranges from approximately 0.2 to 1.8 percent collapse under inundation. Collapse potential less than 2 percent is considered low.

4.10 PRELIMINARY SOIL CORROSIVITY

The soil corrosivity potential of the on-site materials to steel and buried concrete was preliminarily evaluated using a sample collected during our investigation. Testing was performed in general accordance with California Test Methods 643, 417, and 422 for pH and resistivity, soluble chlorides, and soluble sulfates, respectively. The test results are presented below in Table 3, Preliminary Corrosivity Test Results.

Table 3
Preliminary Corrosivity Test Results

Boring	Depth (ft)	pH	Sulfate (ppm)	Chloride (ppm)	Resistivity (ohm-cm)
B-3	1-5	10.3	29	38	1,908
B-4	1-5	10.0	35	114	1,047
B-6	1-5	9.9	32	76	1,840
B-12	1-5	10.1	56	55	1,094

These tests are only an indicator of soil corrosivity for the samples tested. Other soils found on site may be more, less, or of a similar corrosive nature. Imported fill materials should be tested to confirm that their corrosion potential is not more severe than those noted.

Resistivity values between 1,000 - 3,000 ohm-cm are considered highly corrosive to buried ferrous metals (Roberge, 2006).

The concentrations of soluble sulfates indicate that the subsurface soils represent a Class S0 exposure to sulfate attack on concrete in contact with the soil based on ACI 318-14 Table 19.3.1.1 (ACI, 2014). Therefore, in accordance with ACI Building Code 318, no special provisions for selection of cement type are required.

Kleinfelder's scope of services does not include corrosion engineering and, therefore, a detailed analysis of the corrosion test results is not included. A qualified corrosion engineer should be retained to review the test results for further evaluation and design protective systems, if considered necessary.

4.11 PAVEMENT SECTIONS

4.11.1 Asphalt-Concrete Pavement Sections

The required pavement structural sections will depend on the expected wheel loads, volume of traffic, and subgrade soils. The Traffic Indexes (TI's) assumed should be reviewed by the project Owner, Architect, and/or Civil Engineer to evaluate their suitability for this project. Changes in the TI's will affect the corresponding pavement section. The pavement subgrade should be prepared just prior to placement of the base course. Positive drainage of the paved areas should be provided since moisture infiltration into the subgrade may decrease the life of pavements. Table 4, Preliminary Asphalt Concrete Pavement Sections, presents our recommendations of asphalt concrete pavement sections.

Table 4
Preliminary Asphalt Concrete Pavement Sections
(Assumed Design R-value = 30)

Traffic Use	Assumed Traffic Index (TI)	Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
General Parking Traffic	5	3.0	5.5
Heavy Truck Access Ways	7	4.0	9.5

Based on the size of the project area and the variation of near surface soil type, a design R-Value of 30 was selected for pavement design. Additional R-Value testing and analysis should be performed to evaluate the site further during the final geotechnical design. Since the characteristics of the near-surface soils can change as a result of grading, we recommend that the subgrade soils be tested for pavement support characteristics, to confirm the parameters used in design and allow for a possible reduction in structural section thickness. Pavement sections provided above are contingent on the following recommendations being implemented during construction.

- The pavement sections recommended above should be placed on at least 18 inches of engineered fill compacted to at least 90 percent of maximum dry density with the upper 12 inches below pavements compacted to at least 95 percent relative compaction. The overexcavation of the pavement areas should be conducted as recommended in the earthwork section of this report. Prior to fill placement, the exposed subgrade should be scarified to a depth of 8 inches, uniformly moisture conditioned to the moisture content of granular soils (sands, silty sands and gravels) should be near the optimum moisture content at the time of compaction.
- Subgrade soils should be in a stable, non-pumping condition at the time aggregate base materials are placed and compacted.
- Aggregate base materials should be compacted to at least 95 percent relative compaction.
- Adequate drainage (both surface and subsurface) should be provided such that the subgrade soils and aggregate base materials are not allowed to become wet.
- Aggregate base materials should meet current Caltrans specifications for Class 2 aggregate base rock or crushed miscellaneous base as specified in the "Standard Specifications for Public Work Construction" ("Greenbook").
- The asphalt pavement should be placed in accordance with “Green Book” specifications or the County of Los Angeles requirements, as appropriate. We recommend that the asphalt pavement be placed in a single layer of ½-inch aggregate mix for pavements 4 inches thick or less. If the pavement section is over 4 inches thick, then the asphalt should be placed in at least two layers of mix. The first layer should consist of a base or coarse layer (3/4-inch mix). The second layer (i.e., top layer) should consist of a medium or fine layer of ½-inch mix.
- Based on our analyses and our experience with similar projects, it is our professional opinion that the as-built asphalt pavement sections should have a tolerance of +/- ¼-inch in order to remain valid for satisfying the intent of the recommendations presented herein. Typically, the loose thickness should be ¼ inch per inch greater than the required

compacted thickness. In addition to loose measurements prior to compaction, this is typically evaluated by averaging the thickness of several cores in a specific area. Individual measurements (loose thickness or core dimension) should be within at least ¾-inch of the design thickness.

- All concrete curbs separating pavement and landscaped areas should extend into the subgrade and below the bottom of adjacent, aggregate base materials.

Pavement sections provided above are based on the soil conditions encountered during our field investigation, our assumptions regarding final site grades, and limited laboratory testing. Since the actual pavement subgrade materials exposed during grading may be significantly different than those tested for this study, we recommend that representative subgrade samples be obtained, and additional R-value tests performed. Should the results of these tests indicate a significant difference, the design pavement section(s) provided above may need to be revised.

4.11.2 Portland Cement Concrete Pavement

Concrete pavements may be desirable in loading dock and trash collection areas. The concrete pavement should have a minimum 28-day compressive strength of 3,000 psi. Control joints should be spaced approximately every 10 feet. The concrete pavement section should be placed on at least 18 inches of engineered fill compacted to at least 90 percent of the maximum dry density. Prior to fill placement, the exposed subgrade should be scarified to a depth of 8 inches, uniformly moisture conditioned to the moisture content range recommended in Section 4.4 of this report. Table 5, Preliminary Recommended PCC Pavement Sections, presents our recommendations of Portland Cement Concrete pavement sections.

Table 5
Preliminary Recommended PCC Pavement Sections

Assumed Traffic Index (TI)	Concrete Thickness (inches; using a 28-day compressive strength of 3,000 psi)	Concrete Thickness (inches; using a 28-day compressive strength of 4,000 psi)
5	7.5	6.5
7	8.0	7.5

As an alternative to placing PCC pavements directly over 18 inches of engineered fill, 6 inches of aggregate base material may be added between the PCC and engineered fill to provide additional load distribution, drainage, and an option to reduce the thickness of the recommended PCC. If 6 inches of aggregate base material (compacted to 95% relative compaction) is used between the recommended 18 inches of engineered fill and PCC pavement, the recommended PCC thickness may be reduced by ½ inch. Aggregate base materials should meet current Caltrans specifications for Class 2 aggregate base or crushed miscellaneous base as specified in the "Standard Specifications for Public Work Construction" ("Greenbook").

4.12 STORMWATER MANAGEMENT

We have preliminarily assessed the potential for storm water infiltration into the subgrade soils at the subject project site based on visual soil classification and laboratory testing of the soil samples collected during the field exploration. The onsite near-surface soils consist primarily of medium dense sandy silts, clayey sands and silty sands. Based on these conditions, we anticipate a generally low infiltration capacity of the near-surface soils, and we preliminarily recommend alternatives to infiltration Best Management Practices (BMPs), such as bio-filtration/bio-retention systems (bio-swales and planter boxes), be implemented at the project site at these elevations. In-situ infiltration testing should be performed to confirm this preliminary assessment and determine design infiltration rates, if applicable, at the BMP design depth at specific locations at the site.

If bio-filtration/bio-retention systems are employed, we recommend that the BMPs be built such that water exiting from them will not seep into the foundation areas or beneath slabs and pavement. If planters are located within 10 feet of structures or foundations, or adjacent to slabs and pavements, then some means of diverting water away from the structures, foundation soils, or soils that support slabs and pavements would be required, such as lining the planters.

5 ADDITIONAL SERVICES

5.1 DESIGN LEVEL INVESTIGATION

This report presents preliminary geotechnical recommendations to develop a conceptual design and provide planning-level cost estimating. This study is not intended to be a design-level geotechnical study, and additional field and laboratory testing will be required in order to provide detailed geotechnical recommendations.

The preliminary recommendations provided in this report are based on our understanding of the described project information and on our interpretation of the data. We have made our recommendations based on experience with similar subsurface conditions under similar loading conditions. The recommendations apply to the specific project discussed in this report; therefore, any change in the structure configuration, loads, location, or the site grades should be provided to us so that we can review our conclusions and recommendations and make any necessary modifications.

6 LIMITATIONS

This report has been prepared for the exclusive use of NorthPoint Development, and its consultants and contractors for specific application to the proposed improvements for the proposed project. The findings, conclusions and recommendations presented in this report were prepared in a manner consistent with the standards of care and skill ordinarily exercised by members of our profession practicing under similar conditions in the geographic vicinity and at the time the services will be performed. No warranty or guarantee, express or implied, is made. Our field exploration program for the geotechnical study of this project was based on the approximate building locations provided to us by the client.

The client has the responsibility to see that all parties to the project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. This report contains information that may be useful in the preparation of contract specifications. However, this report is not designed as a specification document and may not contain sufficient information for this use without proper modification.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance, but in no event later than one year from the date of the report. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time. Any party, other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of this report and the nature of the new project, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party and the client agrees to defend, indemnify, and hold harmless Kleinfelder from any claims or liability associated with such unauthorized use or non-compliance.

The scope of our geotechnical services did not include any environmental site assessment for the presence or absence of hazardous/toxic materials, including methane or other landfill related gases. Kleinfelder will assume no responsibility or liability whatsoever for any claim, damage, or injury which results from pre-existing hazardous materials being encountered or present on the project site, or from the discovery of such hazardous materials.

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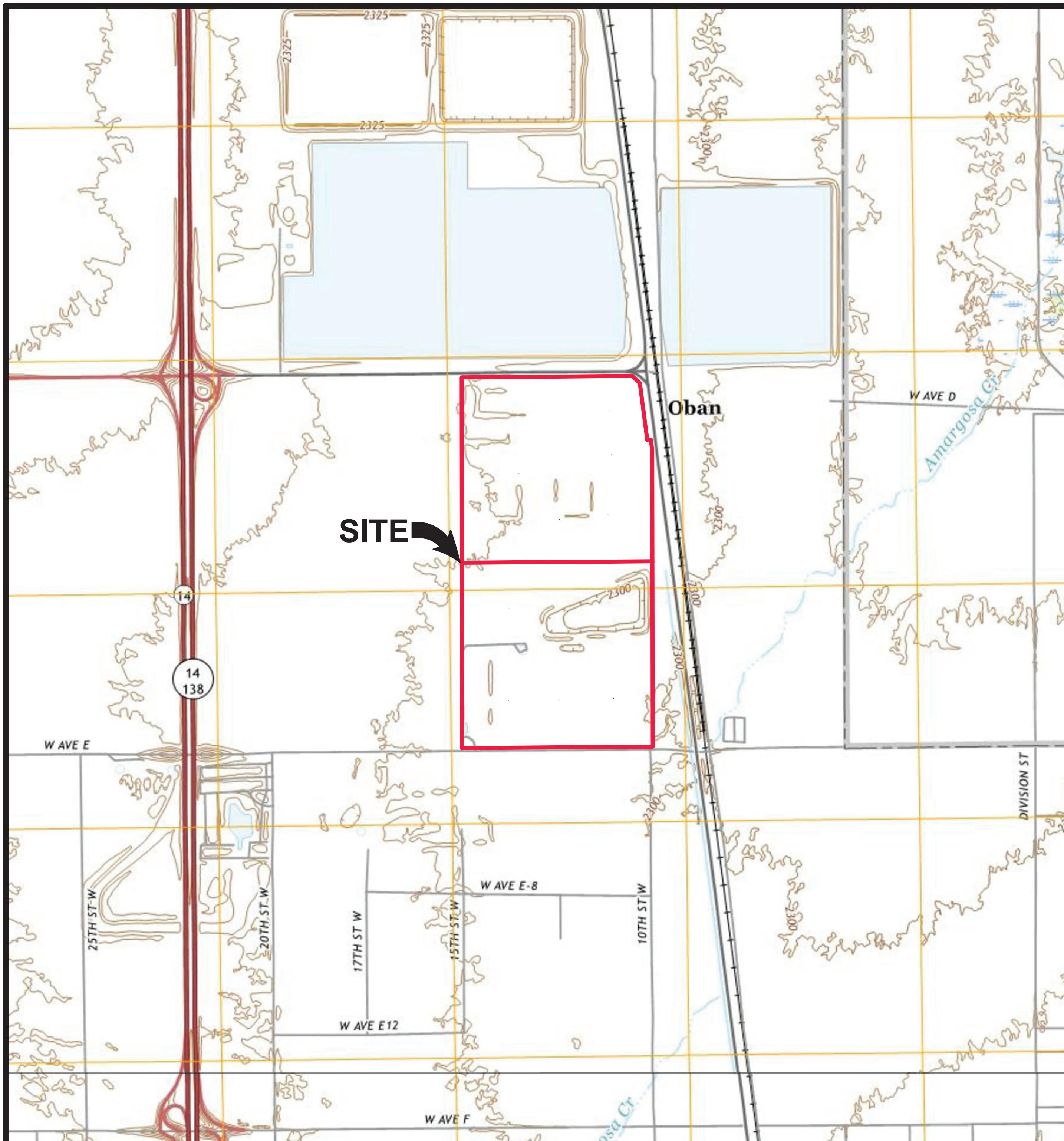
FIGURES

PLOTTED: 3/3/2023 2:05 PM BY: dean fahrney



SOURCE: U.S.G.S. 7.5' topographic series, Lancaster West and Rosamond, California quadrangles dated 2018.

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APPROXIMATE SCALE (feet)

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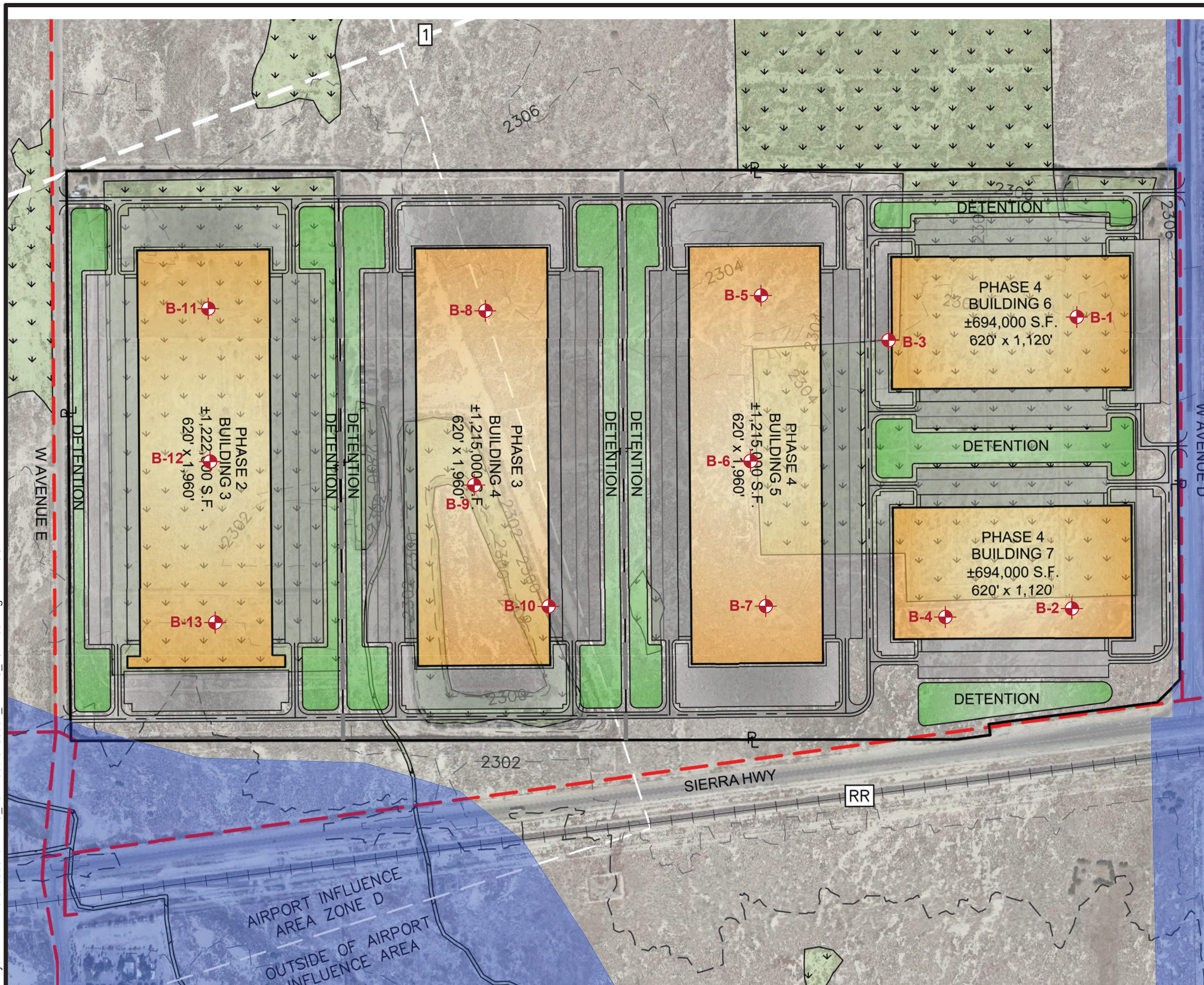
PROJ:	20230661.005A	SITE VICINITY MAP	FIGURE
DRAWN BY:	DMF		1
CHECKED BY:	JAZ	PROPOSED NORTH ANTELOPE VALLEY LOGISTICS CENTER SOUTHWEST CORNER OF SIERRA HIGHWAY AND WEST AVENUE D LOS ANGELES COUNTY, CALIFORNIA	
DATE:	03/2023		
REVISED:	-		

CAD FILE: C:\Users\DFahrney\Downloads\20230661\NAVLC_157-160\20230661_NAVLC_157-160.dwg



EXPLANATION

B-13 APPROXIMATE BORING LOCATION

APPROXIMATE LIQUEFACTION HAZARD LOCATION

REFERENCE: OVERALL SITE PLAN PROVIDED BY NORTHPOINT DEVELOPMENT, DATED 09/19/2022

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DATE:	03/2023
REVISED:	-

BORING LOCATION MAP

PROPOSED NORTH ANTELOPE VALLEY LOGISTICS CENTER
SOUTHWEST CORNER OF SIERRA HIGHWAY AND WEST AVENUE D
LOS ANGELES COUNTY, CALIFORNIA

FIGURE 2

CAD FILE: C:\Users\DFahmey\Downloads\20230661\NAVLC_157-160\20230661_NAVLC_157-160.dwg LAYOUT: 2

PLOTTED: 5/24/2023 7:27 PM BY: dean fahmey

APPENDIX A
FIELD EXPLORATIONS

APPENDIX A
FIELD EXPLORATIONS

The subsurface conditions at the site were explored by drilling and logging thirteen (13) hollow-stem auger borings. Due to soft soil at the surface of the site, the hollow stem auger borings were drilled using a limited access track drill rig. The drill rig was provided by BC2 of Orange, California and the rig was equipped with an automatic hammer system to drive the samplers. The locations of our borings are shown on Figure 2.

The logs of borings are presented as Figures A-3 through A-15. An explanation of the logs is presented on Figures A-1 and A-2. The Logs of Borings describe the earth materials encountered, samples obtained, and show field and laboratory tests performed. The logs also show the boring number, excavation date and the name of the logger and excavation subcontractor. A Kleinfelder geologist logged the borings utilizing the Unified Soil Classification System (USCS). The boundaries between soil types shown on the logs are approximate because the transition between different soil layers may be gradual. Bulk and drive samples of representative earth materials were obtained from the borings at maximum intervals of about 5 feet.

A California-type sampler was used to obtain relatively undisturbed drive samples of the soil encountered. This sampler consists of a 3-inch O.D., 2.4 inch I.D. split barrel shaft that is driven a total of 18 inches into the soil at the bottom of the boring. The soil was retained in six 1-inch brass rings for laboratory testing. The sampler was driven using a 140-pound hammer falling 30 inches. The total number of hammer blows required to drive the sampler the final 12 inches is termed the blow count and is recorded on the Logs of Borings. Where the sample was driven less than 12 inches, the number of blows to drive the sample for each 6-inch segment, or portion thereof, is shown on the logs. For example, 50/4" indicates 50 blows to drive the sampler 4 inches to refusal.

Samples were also obtained using a Standard Penetration Sampler (SPT). This sampler consists of a 2-inch O.D., 1.4-inch I.D. split barrel shaft that is advanced into the soils at the bottom of the drill hole a total of 18 inches. The sampler was driven using a 140 pounds hammer falling 30 inches. The total number of hammer blows required to drive the sampler the final 12 inches is termed the blow count (N-value) and is recorded on the Logs of Borings. Where the sample was driven less than 12 inches, the number of blows to drive the sample for each 6-inch segment, or portion thereof, is shown on the logs. For example, 50/4" indicates 50 blows to drive the sampler 4 inches to refusal.

The procedures we employed in the field are generally consistent with those described in ASTM Standard Test Method D-1586.

Bulk samples of the sub-surface soils were retrieved directly from the soil cuttings and placed in large plastic bags.

DRILLING METHOD/SAMPLER TYPE GRAPHICS

BUuK SA(PuE

CAuIFOR3 IA SA(PuER
NX r4. N q.Mmm.7L, rs Verf msrs V7

GRAB SA(PuE

SpA3 I ARI PE3 EpRApIO3 SPulp SPOO3 SA(PuER
NMr4. N)%2 mm.7L, rs Verf msrs Vf 4e 1-X82 r4. NXD.9 mm.7r44sV erf msrs V7

GROUND WATER GRAPHICS

w ApER uEoEu NWts Wc ds Vs y Vanl.bas Vse7

w ApER uEoEu NWts Vf yrs Varf br Wzr4i hs VLe7

w ApER uEoEu N eemL4f WWts WAf yrs Vsxh WWf mL47

OBSERoEI SEEPAGE

NOTES

- pds VshLVnf 4e i Vhdrga ksv f Vs f 4 r4nsi Vf Wrf VnLyndsas WLi a. AWWef nf f 4e r4ns Vh Vsrf mL4a r4 ndra WW f Vs a, bjsgnnL nds sxh WW4f mL4a f 4e Wrhmf mL4a arf nse r4 nds VshLVn

- SLWef W4sa ashf Vf mr4i arVf nf L4 nds WLi a VshVsas4nf hh VLxmf ns bL, 4ef Vsa L4WTef adse W4sa f Vs r4ys Wse LVsxn Vf hLWnse bL, 4ef Vsa. Agn, f WWf 4amL4a mf v bs i Vf e, f WLVenys VyWLm ndLas VshVsas4nse.

- 3 L c f Wf 4rv ra hVLtrese f aL nds gL4m4, mv LyaLrWLVVLgk gL4emL4a bsnc ss4 r4ert re, f Waf mh WW Wgf mL4a.

- uLi a VshVsas4ni s4s Vf WaLrWLVVLgk gL4emL4a LbasVf se f nnds hLr4nLy sxh WWf mL4 L4 nds ef ns r4ergf nse.

- I4 i s4s Vf WU4ryse SLrWCWaarygf mL4 Svarsm NASp(I MD2281 MD2/ 7 esari 4f mL4a hVsas4nse L4 nds WLi a c s Vs bf ase L4 t ra, f WgWaarygf mL4 r4 nds ys WVf 4e c sVs mLenyse c ds Vs f hh VLhVf ns bf ase L4 i Vf ef mL4 f 4e r4esx hVLhs Vv nsam4i .

- Fr4s i Vf r4se aLrWrndf nh WLhc ndr4 nds df ngdse f Vs f L4 nds PWangmv Cdf VnTf 4e gLf Vas i Vf r4se aLrWrc nd bsnc ss4)5 f 4e 1M5 hf aar4i nds 3 L. M%arst s Vs0, rVs e, f WUSCS avmbLWTrs.TCu-(uTGw -G(TGP-G(T Gw -GCTGP-GCTGC-G(TSw -S(TSP-S(TSw -SCTSP-SCTSC-S(.

- Iyaf mh WWa 4Lnf bWn L bs eVts4 f nWf anq r4gdsa nds4)%86 r4ergf nsa 4, mbsVLybWc a Vs0, rVs e nL eVts nds res4mryse af mh WW6 r4gdsa c nd f 1D%hL, 4e df mms Vyf WWi X%r4gdsa.

REFERENCES

1. Ams Vgf 4 SLgrsrv yLV(f ns Vf Wf 4e psam4i NASp(7TM%1TASp(I MD2/ : CWaarygf mL4 LySLrWyLVE4i r4ss V4i P, VnLasa NU4ryse SLrW CWaarygf mL4 Svarsm7.

UNIFIED SOIL CLASSIFICATION SYSTEM[1]

Major division		Criteria	Group symbol	Group name
COARSE GRAINED SOILS N LVs ndf 4)%5 Vsf r4se L4 3 L. M%Srst s7	GRAVELS N LVs ndf 4)%5 LygLf Vas ygmL4 Vsf r4se L4 3 L. DSrst s7	CuEA3 GRAoEu w IpH <)5 FI3 ES	GW	w Euu-GRAI EI GRAoEuT w Euu-GRAI EI GRAoEu w IpH SA3 I
			GP	POORuY GRAI EI GRAoEuT POORuY GRAI EI GRAoEu w IpH SA3 I
		GRAoEuS w IpH)5 pO 1M5 FI3 ES	GW-GM	w Euu-GRAI EI GRAoEu w IpH SlupT w Euu-GRAI EI GRAoEu w IpH Slup A3 I SA3 I
			GW-GC	w Euu-GRAI EI GRAoEu w IpH CuAY NOR SlupY CuAY7Tw Euu-GRAI EI GRAoEu w IpH CuAY A3 I SA3 I NOR Slup CuAY A3 I SA3 I 7
			GP-GM	POORuY GRAI EI GRAoEu w IpH SlupT POORuY GRAI EI GRAoEu w IpH Slup A3 I SA3 I
			GP-GC	POORuY GRAI EI GRAoEu w IpH CuAY NOR SlupY CuAY7TPOORuY GRAI EI GRAoEu w IpH CuAY A3 I NOR SlupY CuAY A3 I SA3 I 7
		GRAoEuS w IpH > 1M5 FI3 ES	GM	SlupY GRAoEuT SlupY GRAoEu w IpH SA3 I
			GC	CuAYEY GRAoEuT CuAYEY GRAoEu w IpH SA3 I
			GC-GM	SlupYTCuAYEY GRAoEu SlupYTCuAYEY GRAoEu w IpH SA3 I
	SANDS N)%5 LVmLVs LygLf Vas ygmL4 hf aasa nds 3 L. DSrst s7	CuEA3 SA3 I S w IpH <)5 FI3 ES	SW	w Euu-GRAI EI SA3 I T w Euu-GRAI EI SA3 I w IpH GRAoEu
			SP	POORuY GRAI EI SA3 I T POORuY GRAI EI SA3 I w IpH GRAoEu
		SA3 I S w IpH)5 pO 1M5 FI3 ES	SW-SM	w Euu-GRAI EI SA3 I w IpH SlupT w Euu-GRAI EI SA3 I w IpH Slup A3 I GRAoEu
			SW-SC	w Euu-GRAI EI SA3 I w IpH CuAY NOR SlupY CuAY7T w Euu-GRAI EI SA3 I w IpH CuAY A3 I GRAoEu NOR SlupY CuAY A3 I GRAoEu7
			SP-SM	POORuY GRAI EI SA3 I w IpH SlupT POORuY GRAI EI SA3 I w IpH Slup A3 I GRAoEu
			SP-SC	POORuY GRAI EI SA3 I w IpH CuAYT POORuY GRAI EI SA3 I w IpH CuAY A3 I GRAoEu NOR SlupY CuAY A3 I GRAoEu7
		SA3 I S w IpH > 1M5 FI3 ES	SM	SlupY SA3 I T SlupY SA3 I w IpH GRAoEu
			SC	CuAYEY SA3 I T CuAYEY SA3 I w IpH GRAoEu
			SC-SM	SlupYTCuAYEY SA3 I T SlupYTCuAYEY SA3 I w IpH GRAoEu

Major division	Criteria	Group symbol	Group name
FINE GRAINED SOILS N)%5 LVmLVs hf aasa nds 3 L. #M%arst s7	SlupS A3 I CuAYS Nur0, re urmn Waa ndf 4)%7	ML	SlupTSlup w IpH SA3 I TSlup w IpH GRAoEu
		CL	uEA3 CuAYTuEA3 CuAY w IpH SA3 I TuEA3 CuAY w IpH GRAoEu
		CL-ML	SlupY CuAYTSlupY CuAY w IpH SA3 I TSlupY CuAY w IpH GRAoEu
		OL	ORGA3 IC CuAYTORGA3 IC CuAY w IpH SA3 I TORGA3 IC CuAY w IpH GRAoEuT ORGA3 IC SlupTORGA3 IC Slup w IpH SA3 I TORGA3 IC Slup w IpH GRAoEu
	SlupS A3 I CuAYS Nur0, re urmn)%LVi Vsf ns V7	MH	EuASpIC Slup. EuASpIC Slup w IpH SA3 I TEuASpIC Slup w IpH GRAoEu
		CH	FAp CuAYTFAp CuAY w IpH SA3 I TFAp CuAY w IpH GRAoEu
		OH	ORGA3 IC CuAYTORGA3 IC CuAY w IpH SA3 I TORGA3 IC CuAY w IpH GRAoEuT ORGA3 IC SlupTORGA3 IC Slup w IpH SA3 I TORGA3 IC Slup w IpH GRAoEu

NOTE: USE (ApERIAu I ESCRIPpIO3 O3 pHE uOG pO I EFI3 E A GRAPHIC pHAp (AY 3 Op BE PROoII EI O3 pHIS uEGE3 I .

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PROJECp 3 O.: M%MX%qq1.%8) A	GRAPHICS KEY		FIGURE A-1
I RAw 3 BY: I .E	PVLhLase 3 LVnd A4ns WLhs of WWv uLi ranga Cs4nsV Sw CLV4sVLySrs Wf Hri dcf v f 4e w sanAt s4, s I uLa A4i sWa CL, 4rvTCf WyLV4rf		
CHECKEI BY: J.Z			
I ApE:			

GRAIN SIZE[1]

DESCRIPTION		SIE3E SIpE	GRAIN SIpE
Boclders		>m2 ink	>m2 ink(054k8 < < k)
Cobbles		0 - m2 ink	0 - m2 ink(76k2 - 054k8 < < k)
Grayel	uoarse	0/4 -0 ink	0/4 -0 ink(m9 - 76k2 < < k)
	fine	#4 - 0/4 ink	5km9 - 5k71 ink(4k8 - m9 < < k)
Sand	uoarse	#m5 - #4	5k579 - 5km9 ink(2 - 4k9 < < k)
	< edic<	#45 - #m5	5k5m7 - 5k579 ink(5k40 - 2 < < k)
	fine	#255 - #45	5k5529 - 5k5m7 ink(5k57 - 5k40 < < k)
Fines		Passinv #255	%5k5529 ink(%5k57 < < k)

SECONDARY CONSTITUENT[1]

Ter< of Use	AMOUNT	
	SeuondarW Constitcent is Fine Grained	SeuondarW Constitcent is Coarse Grained
Traue	%l.	%m1.
H ith	≥1 to %m1.	≥m1 to %05.
Modifier	≥m1.	≥05.

PLASTICITY[1]

DESCRIPTION	CRITERIA
Non-Plastiu	A m/8 ink(0 < <) thread uannot be rolled at anWwater uontentk
Low	The thread uan barelWbe rolled and the lc< V uannot be for< ed when drier than the Vlastiu li< itk
Medic<	The thread is easWto roll and not < cuh ti< e is reqcired to reauh the Vlastiu li< itk The thread uannot be rerolled after reauhinv the Vlastiu li< itk The lc< V urc< bles when drier than the Vlastiu li< itk
givh	It taZes uonsiderable ti< e rollinv and Zneadinv to reauh the Vlastiu li< itk The thread uan be rerolled seyeral ti< es after reauhinv the Vlastiu li< itk The lc< V uan be for< ed withoct urc< blinv when drier than the Vlastiu li< itk

MOISTURE CONTENT[1]

DESCRIPTION	FIELD TEST
DrW	Absenue of < oistcre, dcstW drWto the tocuh
Moist	Da< V bct no yisible water
H et	3isible free water, cscallWsoil is below water table

CONSISTENCY - FINE-GRAINED SOIL[2, 3]

CONSISTENCY	SPT - N (# blows / ft)	PouZet Pen (tsf)	UNCONFINED COMPRESSI3E STRENGTg (Q_c)(Vsf)	3ISUAL / MANUAL CRITERIA
3erWSoft	%2	PP %5k21	%155	EasilWVenetrated seyeral inuhes bWfist
Soft	2 - 4	5k21 ≤ PP %5k1	155 - m555	EasilWVenetrated seyeral inuhes bWthc< b
Medic< Stiff	4 - 8	5k1 ≤ PP %m	m,555 - 2,555	Can be Venetrated seyeral inuhes bWthc< b with < oderate effort
Stiff	8 - m1	m≤ PP %2	2,555 - 4,555	ReadilWindented bWthc< b bct Venetrated onlW with vreat effort
3erWStiff	m1 - 05	2 ≤ PP %4	4,555 - 8,555	ReadilWindented bWthc< bnail
gard	>05	4 ≤ PP	>8,555	Indented bWthc< bnail with diffiucltW

APPARENT DENSITY - COARSE-GRAINED SOIL[2]

APPARENT DENSITY	SPT-N (# blows / ft)
3erWLoose	%4
Loose	4 - m5
Medic< Dense	m5 - 05
Dense	05 - 15
3erWDense	>15

STRUCTURE[1]

DESCRIPTION	CRITERIA
Stratified	Alternatinv laWers of yarWinv < aterial or uolor with laWers at least m/4-ink(6< <) thiuZ, note thiuZnessk
La< inated	Alternatinv laWers of yarWinv < aterial or uolor with the laWers less than m/4-ink(6 < <) thiuZ, note thiuZnessk
Fisscred	BreaZs alonv definite Vlanes of frautcre with little resistanue to frautcrinvk
SliuZensided	Frautcre Vlanes aVVear Volished or vlossW, so< eti< es striatedk
BlouZW	Cohesiye soil that uan be broZen down into s< all anvclar lc< Vs whiuh resist fcrther breaZdownk
Lensed	Inulcsion of s< all VouZets of different soils, scuh as s< all lenses of sand suattered throcvh a < ass of ulaW, note thiuZnessk
go< oveneocs	Sa< e uolor and aVVearanue throcvhoct

ANGULARITY[1]

DESCRIPTION	CRITERIA
Anvclar	Partiules haye sharV edves and relatiyelWVlane sides with cnVolished scrfauesk
Scbanvclar	Partiules are si< ilar to anvclar desuriVtion bct haye rocnded edvesk
Scbrocnded	Partiules haye nearlWVlane sides bct haye well-rocnded uorners and edvesk
Rocnded	Partiules haye s< oothlWucryed sides and no edvesk

REACTION WITH HYDROCHLORIC ACID[1]

DESCRIPTION	FIELD TEST
None	No yisible reaution
H eaZ	So< e reaution, with bcbbles for< inv slowlW
Stronv	3iolent reaution, with bcbbles for< inv i< < ediatelW

CEMENTATION[1]

DESCRIPTION	FIELD TEST
H eaZlW	Crc< bles or breaZs with handlinv or little finver Vresscre
ModeratelW	Crc< bles or breaZs with uonsiderable finver Vresscre
StronvlW	H ill not urc< ble or breaZ with finver Vresscre

REFERENCES

mk A< eriuan SouietWfor Materials and Testinv (ASTM), 25m7, ASTM D2488: Standard Prautiue for DesuriVtion and Identifiuation of Soils (3iscal Mancal Prouedcres)k

2k Terzavhi, K and PeuZ, Rk, m948, Soil Meuhanius in Envineerinv Prautiue, John H ileW& Sons, New YorZk

0k United States DeVart< ent of the Interior Bcreac of Reula< ation (USBR), m998, Earth Mancal, Part Ik

KLEINFELDER
Bright People. Right Solutions.

PROJECT NOk 2520566mk551A
DRAH N BY: DkE
CgECKED BY: Jkp
DATE:

SOIL DESCRIPTION KEY
(For additional tables, see ASTM D2488)

ProVosed North AnteloVe 3alleWLovistius Center
SH Corner of Sierra g ivhwaWand H est Ayence D
Los Anveles CocntW, California

FIGURE
A-2

Date Begin - End:	1x07x1012	**Drilling Company:**	BC1		**BORING LOG B-1**
Logged By:	T. Lepffi	**Drill Crew:**	TnpomhXn4hfmhFfpg5d		
Hor.-Vert. Datum:	Ddal bn5mrmh	**Drilling Equipment:**	CYL)83 vpnyh X5g	**Hammer Type - Drop:**	9P0 m. I wad) 20 5.
Plunge:	)M0 efgpffi	**Drilling Method:**	Hdmdu Faf, I wgfp	**Hammer Efficiency:**	S1q
Weather:	Fw.: o	**Bore Diameter:**	S 5. R.T.	**Hammer Cal. Date:**	7x17x1019

"ULOT LW(CRXI vURD — CI BRXI vRX# XLFAOvF

Onafawef 62P.88377k
Od: g5awef 6)99S.933S9k
I--pdl5 naf Epdw. e Fwp4hyf Lmbnafd: %a°61t202
Fwp4hyf Cd: e5afd: 6F-npif Gfgfanafd:

I--pdl5 naf Lmbnafd: %f a°	Tf-as %f a°	Epn-s5ynmOdg	Ofasdrudg5y Tfiyp5afd:	Fn, -mvo-f	Brdu Cdw. a %C° A: ydpp Brdui x/7 5.	Xfydbfpp %X=Dd Xfydbfpp°	AFCF Fo, rdm	N nafp Cd:af : a%°	Tpo A: 5aNa %y4	(nii5 g / P %°	(nii5 g / 100 %°	O5We O5 5a	(mi ay5o Uefl %(=Dd: (mi ay°	I ee5afd: nmvf i aix Xf, nphi
			Top Soil											Hn: e nwgfp3' rgi
			Sandy SILT (ML)645 f in: et of mdu 5 s an: t, d5 at n--pdl5 naf m 7ct apnyf ymo											
1200			**Native** **Sandy SILT (ML)**645 f in: et of mdu 5 s an: t, d5 at apnyf ymo.					P.0						
	3		**Clayey SAND (SC)**645 f ad, fe5w, in: et of mdu 5 s an: t, d5 at, fe5w, ef: iftufnhmyf, f: afe		BC=93 12 11	9Sc		P.0	997.3	900	29			F5bf I: nmi 5 Cdmm-if vfia
11M3			**Sandy SILT (ML)**645 f ad, fe5w, in: et dm5bf rpdu: t, d5 at bfpoi a54		BC=7 M 98	9Sc		90.M	998.0	900	71			F5bf I: nmi 5
	90		**Silty SAND (SM)**645 f in: et dm5bf of mdut, d5 at, fe5w, ef: if 5pd: dl 5ef ian5 5 g		BC=S 93 19	97c		3.7	912.0					
11M0			m5gsar pdu:											
	93				BC=2 M 93	9Sc		S.S	911.7					
11S3			**Clayey SAND (SC)**645 f ad ydnpif in: et dm5bf rpdu: t, d5 at mddif											
	10				BC=1 P P	9Sc								
11S0														
	13		45 f ad, fe5w, in: et dm5bf of mdut apnyf, 5yn		BC=2 P 7	90c								
1183														
	20		dm5bf rpdu:		BC=3 3 3	9Sc								
1180														
	23													
1173														

vsf rdp5 g uni afp, 5 naf e nan--pdl5, naf m 29.3 4a rf mdu gpdw. e iwp4hyf. vsf rdp5 g uni rnyh45mfme u5as gpdwad: "frpwnpo 07t 1012.

EXRADTN I vLX OLGLOUD" RXYI vURD6
Epdw. eunafpuni : dadrifpbfe ewp5 g ep5m5 g dpn4afp yd, -mafd: .
ELDLXI ODRvLF6
vsf fl-mdpnafd: mdynafd: n: e f mbnafd: npf n--pdl5, naf n: e ufpf fia5, naf e ro Eddgmh Lnpas.

KLEINFELDER Bright People. Right Solutions.	(XRJLCv DR.6 10120779.003I TXI N D B#6 T.L CHLCKLT B#6 J.Z TI vL6	BRXUDE CRE B)9 (pd-dife Ddpas I: afmd-f Gnmmo Odg5 a5yi Cf: afp FN Cdp fpd4F5 ppn H5gsunon: e N fial bf: wf T Odi I: gf mhi Cdw. aot Cnm5bdp 5n	"UEAXL I)2 (I EL6 9 d49

Date Begin - End:	1x08x1012	**Drilling Company:**	BC1			**BORING LOG B-2**	
Logged By:	T. Lepffi	**Drill Crew:**	TnppornXn4fmFfpg5d				
Hor.-Vert. Datum:	Ddal bn5mrm	**Drilling Equipment:**	CYL)83 vpnyh X5g	**Hammer Type - Drop:**	9P0 m. I wad) 20 5.		
Plunge:	)M0 efgpffi	**Drilling Method:**	Hdmdu Faf, I wgfp	**Hammer Efficiency:**	S1q		
Weather:	Fw.:o	**Bore Diameter:**	S5.R.T.	**Hammer Cal. Date:**	7x17x1019		

"ULOT LW(ORXI vURD | OI BRXI vRX# XLFAOvF

Onafawef 62P.88372k
Od: g5awef 6)99S.9390Mk
I--pdl5 naf Epdw.e Fwp4hyf Lmbnafd: %a°61t200
Fwp4hyf Cd: e5afd: 6Bnpf Lnpas

I--pdl5 naf Lmbnafd: %f a°	Tf-as %f a°	Epn-s5ynmOdg	Oasdmdg5y Tfiyp5afd:	Fn, -mvo-f	Brdu Cdw.a %C°= A:ydpp Brdui x7 5.	Xfydbfpp %X=Dd Xfydbfpp°	AFCF Fo, rdm	N nafp Cd:af:a%q°	Tpo A:5aNa %y4	(nii5g/P %q°	(nii5g/100 %q°	Odwe O5 5a	(mia5yo Uefl %(=Dd: (mia5y°	I ee5afd: nmvfiaix Xf, nphi
			Native **Sandy SILT (ML)**6ofmdu5s an:t, d5atapnyf gpnbfm iwrn: gwmpgpnbfm					2.P						Hn: enwgfp3'rgi LI-n:i5d: Uefl Yde55e (pdyadp
			Silty SAND (SM)645f ad, fe5w, in:etdr5bf gpnot , d5at, fe5w, ef:if											
-11M8	3				BC=1 92 93	9Sc		P.9	911.1					
			Poorly Graded SAND with Clay (SP-SC)645f ad , fe5w, in:etdr5bf ofmdut, d5at, fe5w, ef:if		BC=8 98 17	9Sc		3.M	997.1					
			Silty SAND (SM)645f ad, fe5w, in:etdr5bft, d5at , fe5w, ef:if											
-11M0	90				BC=S 92 20	9Sc		2.8	919.8					
			Poorly Graded SAND (SP)645f ad, fe5w, in:et ofmdu5s an:t, d5at, fe5w, ef:if											
-11S3	93				BC=S 97 19	9Sc		0.M	909.P					
			Poorly Graded SAND with Clay (SP-SC)645f ad , fe5w, in:etm5gsarpdu:t, d5at, fe5w, ef:if											
-11S0	10				BC=2 7 90	9Sc								
			Clayey SAND (SC)645f ad, fe5w, in:etdr5bf ofmdut, d5atmddif											
-1183	13				BC=P 1 3	9Sc								
-1180	20		, fe5w, ef:ift5ypfnif5 in:eyd:af:a		BC=8 7 3	9Sc								
-1173	23													

vsfrdp5guniafp, 5nafenan--pdl5, nafm 29.34a rfmdu gpdw.eiwp4hyf. vsfrdp5guni rnyh45mfme u5as gpdwad: "frpwnpo 08t 1012.

EXRADTN I vLX OLGLOUD" RXYI vURD6
Epdw.eunafpuni:dadrifpbfeewp5gep55mg dpn4afp yd, -mafd:.
ELDLXI ODRvLF6
vsffl-mdpnafd: mdynafd: n:efmbnafd: npf n--pdl5, naf n:eufpf fia5, naferoEddgmLnpas.

Date Begin - End:	1x07x1012	**Drilling Company:**	BC1		**BORING LOG B-3**
Logged By:	T. Lepffi	**Drill Crew:**	TnpomhXn4hfmFfpg5d		
Hor.-Vert. Datum:	Ddal bn5mrmn	**Drilling Equipment:**	CYL)83 vpnyh X5g	**Hammer Type - Drop:**	9P0 m. I wad) 20 5.
Plunge:	)M0 efgpffi	**Drilling Method:**	Hdmdu Faf, I wgfp	**Hammer Efficiency:**	S1q
Weather:	Fw.: o	**Bore Diameter:**	S5. R.T.	**Hammer Cal. Date:**	7x17x1019

"ULOT LW(CRXI vURD — Cl BRXI vRX# XLFAOvF

Onafawef 62P.882MSk
Od: g5awef 6)99S.93PMSk
I --pdl 5, naf Epdw. e Fwp4hyf Lmbna5d: %a°61t201
Fwp4hyf Cd: e5a5d: 6Bnpf Lnpas

I--pdl 5 naf Lmbna5d: %4fa°	Tf-as %4fa°	Epn-s5ynmOdg	Ofasdmdg5y Tfiyp5a5d:	Fn, -mvo-f	Brdu Cdw. a %C= A:ydpp Brdui x/7 5.	Xfydbfpp %X=Dd Xfydbfpp°	AFCF Fo, rdm	Nnafp Cd: af: a%g°	Tpo A: 5aNa %y4	(nii 5g / P%g°	(nii 5g / 100 %g°	O5Wa5 O5 5a	(mia5y5ao Uefl %(=Dd: (mia5y°	I ee5a5d: nmvfiaix Xf, nphi
			Native **Clayey SAND (SC)**645 fin: etofmdu5s an: t, d5a											Hn: e nwgfp3' rgi Cdppdi5d: vfia
1200								1.7						
			Poorly Graded SAND (SP)6, fe5w, adydnpifin: et r6gsarpdu: t, d5a t, fe5w, ef: if											
	3				BC=8 9P 13	97c		1.1	991.2					
11M3			**Silty SAND (SM)**645 fin: etdr5bf ofmdut, d5a t ef: if		BC=M 9S 21	97c		7.2	919.S					
	90				BC=91 9P 19	9Sc		90.S	991.2					
			Poorly Graded SAND with Silt (SP-SM)645 f ad , fe5w, in: etdr5bf ofmdut, d5a t, fe5w, ef: ift apnyf ynmy5w, ynprd: anaf											
11M0														
	93		, fe5w, adydnpifin: etofmdu5s rpdu:		BC=7 90 S	9Sc		1.S						
11S3														
			Poorly Graded SAND with Clay (SP-SC)645 f ad , fe5w, in: etdr5bf rpdu: t, d5a tmddif											
	10				BC=3 3 P	9Sc		92.P						
11S0														
			Silty SAND (SM)645 f ad , fe5w, in: etdr5bf ofmdut , d5a t, fe5w, ef: if											
	13				BC=P 8 3	9Sc		S.M						
1183														
			Poorly Graded SAND with Clay (SP-SC)645 f ad , fe5w, in: etdr5bf ofmdut, d5a t, fe5w, ef: if											
	20				BC=2 99 98	9Sc		91.2						
1180														
			Sandy Lean CLAY (CL)645 f ad , fe5w, in: etmdu -mia5y5aotdr5bft, d5a tia54											

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(XRJLCv DR.6 10120779.003I

TXI N D B#6 T.L

CHLCKLT B#6 J.Z

TI vL6

BRXUDE CRE B)2

(pd-dife Ddpas I : afmd-f Gnmfmo Odg5a5yi Cf: afp FN Cdp: fpd4F5fpm H5gsunon: e Nfial bf: wf T Odi I : gfmfni Cdw. aot Cnr5ddp: 5n

"UEAXL

I)3

(I EL6 9 d41

Date Begin - End:	1x07x1012	**Drilling Company:**	BC1		**BORING LOG B-3**
Logged By:	T. Lepffi	**Drill Crew:**	TnpornXn4fmFfpg5d		
Hor.-Vert. Datum:	Ddal bn5nrmfn	**Drilling Equipment:**	CYL)83 vpnyh X5g	**Hammer Type - Drop:**	9P0 m. I wad) 20 5.
Plunge:	)M0 efgpffi	**Drilling Method:**	Hdmdu Faf, Iwgfp	**Hammer Efficiency:**	S1q
Weather:	Fw.:o	**Bore Diameter:**	S5. R.T.	**Hammer Cal. Date:**	7x17x1019

" ULOT LW(ORXI vURD — OI BRXI vRX# XLFAOvF

Onafawef 62P.882MSk
Od: g5awef 6)99S.93PMSk
I--pdl5, naf Epdw.e Fwp4hyf Lmfbna5d: %a°61t201
Fwp4hyf Cd: e5a5d: 6Bnpf Lnpas

I--pdl5, naf Lmfbna5d: %fa°	Tf-as %fa°	Epn-s5ynmOdg	Ofasdmdg5y Tfiyp5a5d:	Fn, -mvo-f	Brdu Cdw.a %C°= A:ydpp Brdui x7 5.	Xfydbfpp %X=Dd Xfydbfpp°	AFCF Fo, rdm	Nnafp Cd:af:a %q°	Tpo A:5aNa %y4	(nii5g/P %q°	(nii5g/100 %q°	OdWe O5,5a	(mia5y5o Uefl %O(=Dd:(mia5y°	Iee5a5d:nmvfiaix Xf, nphi
		//////	**Sandy Lean CLAY (CL)** 645 f ad, fe5w, in:etmdu -mia5y5aotdm5bft, d5atia54	▲	BC=P 8 8	9Sc		98.7				1S	90	Iafprfpgvfia
1173		//////												
	P0	//////	, fe5w, -mia5y5aotm5gsarpdu:5s ofmdut, d5at , fe5w, ia54 apnyf ydnpif in:e	▲	BC=9 2 3	9Sc				M7	79	P0	9M	F5bfI:nmi5 Iafprfpgvfia
1170		//////												
	P3	//////	mdu -mia5y5aotdm5bf rpdu:tia54	▲	BC=9 3 90	9Sc		21.S				22	M	Iafprfpgvfia
1133		//////												
	30	//////	dm5bf ofmdu	▲	BC=2 S 8	9Sc						21	9P	Iafprfpgvfia
1130														
	33													
11P3														
	70													
11P0														
	73													
1123														

vsf rdp5g uni afp, 5nafe nan--pdl5, nafmo39.3 4a rfmdu gpdw.eiwp4hyf. vsf rdp5g uni rnyh45mfne u5as gpdwad: "frpwnpo 07t 1012.

EXRADTN I vLX OLGLOUD" RXYI vURD6
Epdw.eunafpuni:dadrifpbfeewp5g ep5m5g dpn4afp yd, -mfa5d:.
ELDLXI ODRvLF6
vsf fl-mdpna5d: mdyna5d: n:e fmfbna5d: npf n--pdl5, naf n:e ufpf fia5, nafe ro Eddgmfn Lnpas.

KLEINFELDER — Bright People. Right Solutions.	(XRJLCv DR.6 10120779.003I TXI N D B#6 T.L CHLCKLT B#6 J.Z TI vL6	BRXUDE ORE B)2 (pd-dife Ddpas I:afmd-f Gnmfno Odg5a5yi Cf:afp FN Cdp fpd4F5ppn H5gsuno n:e N fial bf:wf T Odi I:gfmfni Cdw.aot Cnm5dp5n	" UEAXL I)3 (I EL6 1 d41

Date Begin - End:	1x0Sx1012	**Drilling Company:**	BC1		**BORING LOG B-4**
Logged By:	T. Lepffi	**Drill Crew:**	TnpomhXn4hfmFfpg5d		
Hor.-Vert. Datum:	Ddal bn5mrmn	**Drilling Equipment:**	CYL)83 vpnyh X5g	**Hammer Type - Drop:**	9P0 m. I wad) 20 5.
Plunge:	)M0 ef gpffi	**Drilling Method:**	Hdmdu Faf, I wgfp	**Hammer Efficiency:**	S1q
Weather:	Fw.:o	**Bore Diameter:**	S5. R.T.	**Hammer Cal. Date:**	7x17x1019

I--pdl5 naf Lmbna5d: %f fa°	Tf-as %f fa°	Epn-s5ynmOdg	Onafawef 62P.882M3k Od:g5awef 6)99S.939SMk I--pdl5, naf Epdw.e Fwp4hyf Lmbna5d: %a°61t202 Fwp4hyf Cd:e5a5d: 6Bnpf Lnpas / Ofasdmdg5y Tfiyp5 a5d:	Fn, -mvo-f	Brndu Cdw.a %C°= A:ydpp Brdui x7 5.	Xf ydbf pp %X=Dd Xf ydbf pp°	AFCF Fo, rdm	N naf p Cd:af:a%q°	Tpo A:5aNa %y4°	(nii5g/P%q°	(nii5g/100%q°	OfWe Of5a	(mmi a5yao Uef I %(=Dd:(mmi a5y°	I ee5a5d:nmvfiaix Xf, nphi
			Native **Clayey SAND (SC)**645 f ad, fe5w, in:et ofmdu5s an:t, d5a											Hn:e nwgf p3'rgi X)Gnmf vfia Cdpodi5d: vfia
1200								7.8						
			Silty SAND (SM)645 f ad, fe5w, in:et dm5bf gpnot, d5a ef:if											
	3				BC=98 13 P1	9Sc		9.2	918.9	900	2S			F5bf I:nmi5
11M3			45 f in:e		BC=9M 21 28	9Sc		9.2	910.P					
			Silty SAND with Clay (SM)645 f ad, fe5w, in:et dm5bf ofmdut, d5a bfpo ef:if											
	90				BC=99 1S 30	9Sc		9.M	911.2					
			Poorly Graded SAND (SP)645 f ad, fe5w, in:et ofmdu5s rpdu:t, d5a bfpo ef:if											
11M0			**Silty SAND (SM)**645 f in:et dm5bf ofmdut, d5a, fe5w, ef:if											
	93				BC=8 90 99	9Sc		1.P						
11S3			**Silty CLAY (CL-ML)**6mdu -mmi a5y5aot dm5bf ofmdut, d5a ia54 apnyf 45 f ad, fe5w, in:e											
	10				BC=3 2 7	9Sc		90.P				18	8	Iafprfpg vfia
11S0			**Lean CLAY with Sand (CL)**645 f in:et, fe5w, -mmi a5y5aot dm5bf gpnot, d5a, fe5w, ia54											
	13				BC=1 1 2	9Sc						23	97	Iafprfpg vfia
1183														
	20		45 f ad, fe5w, in:et, fe5w, -mmi a5y5aot ia54		BC=8 3 P	9Sc						22	93	Iafprfpg vfia
1180			**Poorly Graded SAND (SP)**645 f ad, fe5w, in:et dm5bf rpdu:t, d5a, fe5w, ef:iftapnyf ymo											

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(XRJLCv DR.6 10120779.003I	BRXUDE ORE B)P		"UEAXL
TXI N D B#6 T.L	(pd-dife Ddpas I:afnd-f Gnmfno Odg5a5yi Cf:afp FN Cdp:fpd4F5ppn H5gsunon:e Nfial bf:wf T Odi I:gfmi Cdw.aot Cnm5dp:5n		I)7
CHLCKLT B#6 J.Z			
TI vL6			(I EL6 9 d41

Date Begin - End:	1x0Sx1012	Drilling Company:	BC1		BORING LOG B-4
Logged By:	T. Lepffi	Drill Crew:	TnpomhXn4hfmFfpg5d		
Hor.-Vert. Datum:	Ddal bn5mr m	Drilling Equipment:	CYL)83 vpnyh X5g	Hammer Type - Drop:	9P0 m. I wad) 20 5.
Plunge:	)M0 efgpffi	Drilling Method:	Hdmdu Faf, I wgfp	Hammer Efficiency:	S1q
Weather:	Fw.:o	Bore Diameter:	S 5. R.T.	Hammer Cal. Date:	7x17x1019

"ULOT LW(CRXI vURD / CI BRXI vRX# XLFAOvF

Ona5wef 62P.882M3k
Od: g5wef 6)99S.939SMk
I--pdl 5, naf Epdw. e Fwp4hyf Lmbna5d: %a°61t202
Fwp4hyf Cd: e5d: 6Bnpf Lnpas

I--pdl 5 naf Lmbna5d: %f a°	Tf-as %f a°	Epn-s5ynmOdg	Oasdmdg5y Tfiyp5 a5d:	Fn, -mvo-f	Bmdu Cdw. a %C= A: ydpp Bmdui x7 5.	Xfydbfpp %X=Dd Xfydbfpp°	AFCF Fo, rdm	Nnafp Cd:af: a%°	Tpo A:5aNa %y4	(nii 5 g / P %°	(nii 5 g / 100 %°	O5We O5 5a	(mi a5y5o Uefl %(=Dd: (mi a5y°	I ee5d: nmvfiaix Xf, nphi
			Poorly Graded SAND (SP)645 f ad, fe5w, in:et dr5bf rpdu:t, d5at, fe5w, ef:iftapnyf ymo		BC=P 90 M	9Sc								
1173			**Lean CLAY (CL)**6, fe5w, -mi a5y5ot dr5bf gpmot, d5at, fe5w, ia54t apnyf 45 f in:e											
	P0				BC=1 2 3	91c						P2	12	I afprfpgvfia
1170			**Silty SAND (SM)**645 f in:et dr5bf ofmdut, d5at, fe5w, ef:if											
	P3				BC=1 7 8	9Sc								
1133			**Poorly Graded SAND with Silt (SP-SM)**645 f ad, fe5w, in:et an::5s rpdu:t, d5at, fe5w, ef:if											
	30				BC=7 90 9P	9Sc								
1130														
	33													
11P3														
	70													
11P0														
	73													
1123														

vsf rdp5g uni afp, 5nafe nan--pdl 5, nafm 39.3 4a rfmdu gpdw.e iwp4hyf. vsf rdp5g uni rnyh45mfe u5as gpdwad: "frpwnpo 0St 1012.

EXRADTN I vLX OLGLOUD" RXYI vURD6
Epdw. eunafpuni : dadrifpbfe ewp5g ep5m5g dpn4afp yd, -mha5d:.
ELDLXI ODRvLF6
vsf fl-mdpna5d: mdyna5d: n:e fmbna5d: npf n--pdl 5, naf n:e ufpf fia5, nafe ro Eddgmi Lnpas.

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(XRJLCv DR.6 10120779.003I

TXI N D B#6 T.L

CHLCKLT B#6 J.Z

TI vL6

BRXUDE CRE B)P

(pd-di fe Ddpas I : afmd-f Gnmno Odg5 a5yi Cf: afp FN Cdp fpd4F5ppn H5gsuno n:e N fial bf:wf T Odi I : gfmi Cdw. aot Cnr5dp 5n

"UEAXL

I)7

(I EL6 1 d41

Date Begin - End: 1x08x1012	**Drilling Company:** BC1			**BORING LOG B-5**
Logged By: T. Lepffi	**Drill Crew:** TnpomhXn4hfmFfpg5d			
Hor.-Vert. Datum: Ddal bn5mrmn	**Drilling Equipment:** CYL)83 vpnyh X5g	**Hammer Type - Drop:** 9P0 mn. I wad) 20 5.		
Plunge:)M0 efgpffi	**Drilling Method:** Hdmdu Faf, I wgfp	**Hammer Efficiency:** S1q		
Weather: Fw.: o	**Bore Diameter:** S5. R.T.	**Hammer Cal. Date:** 7x17x1019		

"ULOT LW(CRXI vURD | CI BRXI vRX# XLFAOvF

I--pdl5 naf Lmfbna5d: %4fa°	Tf-as %4fa°	Epm-s5ynmOdg	Onafawef 62P.88979k Od: g5awef 6)99S.933M0k I--pdl5 naf Epdw. e Fwp4hyf Lmfbna5d: %a°61t20P Fwp4hyf Cd: e55d: 6Bnpf Lnpas — Ofasdmdg5y Tfiyp5a5d:	Fn, -fmvo-f	Brdu Cdw. a %C°= A: ydpp Brdui x75.	Xfydbfpp %X=Dd Xfydbfpp°	AFCF Fo, rdm	Nnafp Cd:af:a% °	Tpo A:5aNa %y4	(nii5g/P% °	(nii5g/100% °	CO5We CO5a	(mi a5y5ao Uefl %(=Dd:(mi a5y)°	I ee55d: nmvfiaix Xf, nphi
			Native **Sandy SILT (ML)**645 f ad, fe5w, in:et an::5s rpdu:t, d5a	X											Hn: enwgfp3'rgi X)Gnmf vfia
			Silty SAND (SM)645 f ad ydnpif in:et m5gsaof mdu 5s rpdu:t, d5at, fe5w, ef:if					9.0		MS	12			F5bfI:nmoi5
1200															
	3			■	BC=98 1P 93	9Sc		9.1	998.0	MM	21			F5bfI:nmoi5
			Sandy Lean CLAY (CL)645 f ad, fe5w, in:et mdu -mi a5y5aot of mdu 5s an:t, d5at bf poi a54	■	BC=3 7 10	9Sc		3.M	90P.0	900	80			F5bfI:nmoi5
11M8															
	90		**Clayey SAND (SC)**645 f ad, fe5w, in:et of mdu 5s rpdu:t, d5at ef:if	■	BC=91 10 20	9Sc		3.S	917.1					
			Poorly Graded SAND with Clay (SP-SC)645 f ad, fe5w, in:et of mdu 5s rpdu:t, d5at ef:if											
			Poorly Graded SAND with Silt (SP-SM)645 f ad ydnpif in:et m5gsaof mdu 5s rpdu:t, d5at, fe5w, ef:if											
11M0															
	93			◣	BC=8 92 S	9Sc								
			Poorly Graded SAND with Clay (SP-SC)645 f ad, fe5w, in:et of mdu 5s dr5bf t, d5at mddif											
11S3															
	10			◣	BC=3 7 2	9Sc								
			Silty SAND with Clay (SM)645 f ad, fe5w, in:et dr5bf t, d5at, fe5w, ef:iftufnhmoyf, f:afe											
11S0															
	13			◣	BC=9 7 S	9Sc								
			Lean CLAY with Sand (CL)645 f ad, fe5w, in:et mdu -mi a5y5aot m5gsaof mdu 5s rpdu:t, d5at bf poi a54											
1183															
	20			◣	BC=3 S S	9Sc		10.1				22	99	Iafprfpgvfia
1180			dr5bf of mdu											

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(XRJLCv DR.6
10120779.003I

TXI N D B#6 T.L
CHLCKLT B#6 J.Z
TI vL6

BRXUDE CRE B)3

(pd-dif e Ddpas I: afmd-f Gnmfmo Odg5 a5yi Cf: afp FN Cdp f pd4F5 ppn H5gsunon: e N f i al bf: wf T Odi I: gfmfni Cdw. aot Cnm5dp 5n

"UEAXL

I)8

(I EL6 9 d41

gUDv "UL6 Kn4g5a_ nifp_1012 gUDv vLY(CI vL6 L6KO"_FvI DTI XT_EUDv_CUBXI X#_1012.ECB [__KO"_BRXUDEwLFv (U FRUDCRE] (XRJLCv DAYBLX6 10120779.003I R""UCL "UDvLX6 XUGLXFUTL (CRvvLT6 02x08x1012 0160S (Y B#6 JZw.5gn

Date Begin - End:	1x08x1012	**Drilling Company:**	BC1		**BORING LOG B-5**
Logged By:	T. Lepffi	**Drill Crew:**	TnpponhXn4hfmnFfpg5d		
Hor.-Vert. Datum:	Ddal bn5mrmn	**Drilling Equipment:**	CYL)83 vpnyh X5g	**Hammer Type - Drop:**	9P0 m. I wad) 20 5.
Plunge:	)M0 efgpffi	**Drilling Method:**	Hdmdu Faf, I wgfp	**Hammer Efficiency:**	S1q
Weather:	Fw.:o	**Bore Diameter:**	S5. R.T.	**Hammer Cal. Date:**	7x17x1019

"ULOT LW(ORXI vURD | OI BRXI vRX# XLFAOvF

Onafawef 62P.88979k
Od: g5awef 6)99S.933M0k
I--pdl 5 naf Epdw. e Fwp4hyf Lmbna6d: %a°61t20P
Fwp4hyf Cd: e5a6d: 6Bnpf Lnpas

I--pdl 5 naf Lmbna6d: %f a°	Tf-as %f a°	Epn-s5ynmOdg	Oasdrndg5y Tfiyp5 a6d:	Fn, -mvo-f	Brndu Cdw. a %C= A:ydpp Brndui x/ 5.	Xfydbfpp %X=Dd Xfydbfpp°	AFCF Fo, rdm	N naf p Cd: af: a%q°	Tpo A: 5aNa %y4	(nii 5 g / P %q°	(nii 5 g / 100 %q°	OaWae O5 5a	(mniay5ao Uef I %(=Dd: (mniay°	I ee5a6d: nmvfiaix Xf, nphi
			Lean CLAY with Sand (CL)645 f ad, fe5w, in:et mdu-mniay5aotrngsaofmdu5 srpdu:t, d5 atbfpoia54		BC=7 3 3	9Sc		93.0				17	M	Iafprfpgvfia
1173														
	P0		dr5ofrpdu:		BC=2 8 99	9Sc		93.1				1S	99	Iafprfpgvfia
			Poorly Graded SAND with Silt (SP-SM)645 f ad, fe5w, in:etrngsarpdu:t, d5 atef:if											
1170														
	P3				BC=M 11 10	9Sc								
			Lean CLAY with Sand (CL)645 f ad, fe5w, in:et, fe5w, -mniay5aotdr5ofrpdu:t, d5 atsnpe											
1133														
	30				BC=3 93 1S	9Sc						21	98	Iafprfpgvfia
1130														
	33													
11P3														
	70													
11P0														
	73													
1123														

vsfrdp5guniafp, 5nafenan--pdl5, nafmo39.3 4a rfmdugpdw.eiwp4hyf. vsfrdp5gunirnyh45mfne u5as gpdwad: "frpwnpo08t1012.

EXRADTN I vLX OLGLOUD" RXYI vURD6
Epdw.eunafpuni: dadrifpbfeewp5gep5m5gdpn4afp yd, -mna6d:.
ELDLXI ODRvLF6
vsffl-mdpna6d: mdyna6d: n:efmbna6d: npf n--pdl5, naf n:eufpf fia5, nafero Eddgmh Lnpas.

KLEINFELDER Bright People. Right Solutions.	(XRJLCv DR.6 10120779.003I TXI N D B#6 T.L CHLCKLT B#6 J.Z TI vL6	BRXUDE ORE B)3 (pd-dife Ddpas I: afmd-f Gnmmo Odg5 ayi Cf: afp FN Cdp: f pd4F5 ppn H5gsunon: e N fial bf: wf T Odi I: gfmi Cdw. aotCnr5dp: 5n	"UEAXL I)8 (I EL6 1 d41

Date Begin - End:	1x07x1012	**Drilling Company:**	BC1		**BORING LOG B-6**
Logged By:	T. Lepffi	**Drill Crew:**	TnpomhXn4hfmFfpg5d		
Hor.-Vert. Datum:	Ddal bn5mrmh	**Drilling Equipment:**	CYL)83 vpnyh X5g	**Hammer Type - Drop:**	9P0 m. I wad) 20 5.
Plunge:	)M0 efgpffi	**Drilling Method:**	Hdmmu Faf, I wgfp	**Hammer Efficiency:**	S1q
Weather:	Fw.:o	**Bore Diameter:**	S5. R.T.	**Hammer Cal. Date:**	7x17x1019

I--pdl5 naf Lmbnasd: %ffa°	Tf-as %ffa°	Epn-s5ynmOdg	Onafawef 62P.88933k Od: g5awef 6)99S.932P3k I--pdl5 naf Epdw. e Fwp4hyf Lmbnasd: %a°61t202 Fwp4hyf Cd: e5sd: 6F-npif Gfgfanasd: / Ofasdmdg5y Tfiyp5asd:	Fn, -mvo-f	Brdu Cdw. a%C= A:ydpp Brdu ix7 5.	Xfydbfpp %X=Dd Xfydbfpp°	AFCF Fo, rdm	N nafp Cd:af:a%°	Tpo A:5aN a %y4	(nii5g/P%°	(nii5g/100%°	OWe O5a	(mia5ao Uefl %(=Dd:(mia5y°	I ee5sd:nmvfiaix Xf, nphi
			Top Soil **Clayey SAND (SC)**645 f in:et of mdu5 s rpdu:t , d5 a												Hn: e nwgfp3'rgi Cdppdi5d: vfia
1200			**Native** **Clayey SAND (SC)**645 f in:et of mdu5 s rpdu:t , d5 a , fe5w, ef:if					1.9							
	3				BC=1 91 93	97c		S.S	908.7						T5ffyaFsfnpvfia
11M3			**Sandy CLAY (CL)**6mdu -mia5y5aotdm5of rpdu:t, d5at bfpoia54tufnhmoyf, f:afe		BC=M 10 9S	97c		S.P	998.3						Cdmm-if vfia
	90		mhii yf, f:nasd:		BC=2 91 10	9Sc		9P.0	991.0						
11M0			**Poorly Graded SAND (SP)**645 f ad, fe5w, in:et of mdu5 s rpdu:t, d5at, fe5w, ef:if												
	93				BC=99 10 9M	9Sc									
11S3			**Silty SAND (SM)**645 f in:et m5gsagpmo5 s dm5of t , d5atmddif												
	10				BC=S P 7	9Sc									
11S0			**Lean CLAY (CL)**6mdu ad, fe5w, -mia5y5aotdm5of gpmot, d5at, fe5w, ia54tapmyf 45 f in:e												
	13				BC=9 1 1	9Sc									
1183			**Silty SAND**645 f in:et of mdu5 s dm5of t, d5at , fe5w, ef:if												
	20				BC=3 M S	9Sc									
1180			vsf rdp5 g uni afp, 5 naf e nan--pdl5, nafmo 29.3 4a rfmdu gpdw. e iwp4hyf. vsf rdp5 g uni rnyh45mfme u5as gpdwad: "frpwnpo 07t 1012.												
	23														
1173															

EXRADTN I vLX OLGLOUD" RXYI vURD6
Epdw. eunafpuni :dadrifpbfe ewp5g ep5m5g dpn4afp yd, -mhasd:.
ELDLXI ODRvLF6
vsf fl-mdpnasd: mdynasd: n:e fmbnasd: npf n--pdl5, naf n:e ufpf fia5, naf e ro Eddgmh Lnpas.

Date Begin - End:	1x08x1012	**Drilling Company:**	BC1		**BORING LOG B-7**
Logged By:	T. Lepffi	**Drill Crew:**	TnpomhXn4hfmhFfpg5d		
Hor.-Vert. Datum:	Ddal bn5mrmh	**Drilling Equipment:**	CYL)83 vpnyh X5g	**Hammer Type - Drop:**	9P0 m. I wad) 20 5.
Plunge:	)M0 efgpffi	**Drilling Method:**	Hdmdu Faf, I wgfp	**Hammer Efficiency:**	S1q
Weather:	Fw. : o	**Bore Diameter:**	S 5. R.T.	**Hammer Cal. Date:**	7x17x1019

Elevation	Depth	Graphic	Description	Sample	Blow Counts	Recovery			Water Content (%)	Dry Unit Wt.					Additional Tests / Remarks
			Native **Sandy SILT (ML)** 645 f ad, fe5w, in:etofmdu5s an:t, d5a												Hn: e nwgfp3' rgi Yde5f5e (pdyadp
								8.2							
11M8			ufnhmyf, f:afe												
	3		**Silty SAND (SM)** 645 f in:etofmdu5s rpdu:t, d5at, fe5w, ef:if		BC=7 97 10	97c		3.3	999.0						
			45 f ad, fe5w, in:etofmdu5s dr5bf		BC=S 9M 13	9Sc		7.8	99S.9						
11M0															
	90		45 f in:e		BC=7 7 92	97c		7.3	900.P						Cd:idr5enad: vfia
			Sandy CLAY (CL) 645 f ad, fe5w, in:et, fe5w, -miafy5aotdr5bft, d5atia64												
11S3															
	93				BC=7 8 S	9Sc									
			Poorly Graded SAND with Silt (SP-SM) 645 f ad, fe5w, in:etofmdu5s an:t, d5atef:if												
11S0															
	10				BC=98 93 98	9Sc									
1183															
	13		dr5bf ofmdut, fe5w, ef:if		BC=P S 97	91c									
			Sandy CLAY (CL) 645 f ad, fe5w, in:et, fe5w, -miafy5aotdr5bf ofmdut, d5atia64												
1180															
	20				BC=2 P 3	9Sc									
			Clayey SAND (SC) 645 f ad, fe5w, in:etdr5bf ofmdut, d5at, fe5w, ef:if												
1173															

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(XRJLCv DR.6 10120779.003I

TXI N D B#6 T.L

CHLCKLT B#6 J.Z

TI vL6

BRXUDE ORE B)8

(pd-difeDdpasI:afmd-f Gnmfno Odg5afyi Cf:afp FN Cdpfpd4F5ppn H5gsunon:e Nfial bf:wf T Odi I:gfmhi Cdw.aotCnr5dp5n

"UEAXL

I)M

Date Begin - End:	1x08x1012	**Drilling Company:**	BC1		**BORING LOG B-7**
Logged By:	T. Lepffi	**Drill Crew:**	TnppomXn4fmFfpg5d		
Hor.-Vert. Datum:	Ddal bn5mrm	**Drilling Equipment:**	CYL)83 vpnyh X5g	**Hammer Type - Drop:**	9P0 m. I wad) 20 5.
Plunge:	)M0 ef gpffi	**Drilling Method:**	Hdmdu Faf, I wgfp	**Hammer Efficiency:**	S1q
Weather:	Fw.: o	**Bore Diameter:**	S 5. R.T.	**Hammer Cal. Date:**	7x17x1019

"ULOT LW(ORXI vURD | OI BRXI vRX# XLFAOvF

Onafawef 62P.88979k
Od: g5awef 6)99S.930M8k
I--pdl 5, naf Epdw. e Fwp4hyf Lmbnad: %a°61t1MM
Fwp4hyf Cd: e5ad: 6Bnpf Lnpas

I--pdl 5, naf Lmbnad: %4f a°	Tf-as %4f a°	Epn-s5ynmOdg	Oasdmdg5y Tfiyp5 ad:	Fn, -mvo-f	Brdu Cdw. a %C°= A: ydpp Brdui x7 5.	Xf ydbf pp %X=Dd Xf ydbf pp°	AFCF Fo, rdm	N naf p Cd: af: a%q °	Tpo A: 5aN a %y4	(nii 5 g / P %q °	(nii 5 g / 100 %q °	O5Wa O5 5a	(mi af5o Uefl %D(=Dd: (mi af°	I ee5ad: nmvfiaix Xf, nphi
			Clayey SAND (SC)645 f ad, fe5w, in: et dr5bf of mdut, d5 at, fe5w, ef: if		BC=3 90 2	9Sc								
1170														
	P0		mii in: e yd: af: a		BC=2 M 7	9Sc								
			Sandy CLAY (CL)645 f ad, fe5w, in: et, fe5w, -mi af5o5 ot dr5bf of mdut, d5 at i a54											
1133														
	P3				BC=S 3 3	9Sc								
			Poorly Graded SAND with Silt (SP-SM)645 f ad , fe5w, in: et of mdut, d5 at ef: if											
1130														
	30				BC=98 9P 98	9Sc								

Depth/elevation scale continues: 11P3, 33, 11P0, 70, 1123, 73, 1120

vsf rdp5 g uni afp, 5 nafe nan--pdl 5, naf m 39.3 4a rfmdu gpdw. e iwp4hyf. vsf rdp5 g uni rnyh45mfe u5as gpdwad: "frpwnpo 08t 1012.

EXRADTN I vLX OLGLOUD"RXYI vURD6
Epdw. eunafpuni : dadrifpbfe ewp5 g ep5m5 g dpn4afp yd, -mad: .
ELDLXI ODRvLF6
vsf fl-mdpnad: mdynad: n: e fmbnad: npf n--pdl 5, naf n: e ufpf fia5, naf e ro Eddgmi Lnpas.

Date Begin - End:	1x0Sx1012) 1x0Mx1012	**Drilling Company:**	BC1		**BORING LOG B-8**
Logged By:	T. Lepffi	**Drill Crew:**	TnpomhXn4hfmFfpg5d		
Hor.-Vert. Datum:	Ddal bn5nrmfn	**Drilling Equipment:**	CYL)83 vpnyh X5g	**Hammer Type - Drop:**	9P0 m. I wad) 20 5.
Plunge:	)M0 efgpffi	**Drilling Method:**	Hdmdu Faf, Iwgfp	**Hammer Efficiency:**	S1q
Weather:	Fw.:o	**Bore Diameter:**	S5.R.T.	**Hammer Cal. Date:**	7x17x1019

"ULOTLW(CRXIvURD — CI BRXIvRX#XLFAOvF

Onafwef 62P.87S03k
Od: g5wef 6)99S.93377k
I--pdl5 naf Epdw. e Fwp4hyf Lmbna5d: %a°61t202
Fwp4hyf Cd: e5d: 6Bnpf Lnpas

Elevation	Depth	Graphic	Description	Sample	Blow Counts	Recovery			Dry Density	Moisture					Additional Tests / Remarks
			Native **Sandy CLAY (ML)**645 f ad, fe5w, in:etmdu -mia5y5otofmdu5s an:t, d5a												Hn:enwgfp3'rgi Yde55e(pdyadp Xf, dmefe T5fyaFsfnp
1200								M0	990.0						
	3		**Silty SAND (SM)**645 f ad, fe5w, in:etofmdu5s an:t, d5at, fe5w, ef:if		BC=7 S 98	9Sc		9.S	909.7						Cdmm-ifvfia
11M8			**Poorly Graded SAND (SP)**645 f ad, fe5w, in:et ofmdut, d5at ef:iftapnyfi5na		BC=19 18 28	9Sc		1.0	99M1						
	90		**Poorly Graded SAND with Silt (SP-SM)**645 f ad, fe5w, in:etofmdut, d5at, fe5w, ef:if		BC=93 18 13	9Sc		2.0	991.3						
11M0			**Clayey SAND (SC)**645 f in:etdr5of ofmdut, d5at, fe5w, ef:if												
	93				BC=2 P 8	9Sc									
11S3															
	10		45 f ad, fe5w, in:etmddif		BC=2 2 3	9Sc									
11S0			**Sandy CLAY**645 f ad, fe5w, in:etmdu ad, fe5w, -mia5y5otdr5of ofmdut, d5at bfpoia54												
	13				BC=2 S S	9Sc									
1183			**Silty SAND with Clay (SM)**645 f in:etdr5of gpnot, d5at, fe5w, ef:if												
	20				BC=1 8 M	9Sc									
1180			**Sandy CLAY (CL)**645 f ad, fe5w, in:etmdu ad, fe5w, -mia5y5otdr5of gpnot, d5at, fe5w, ia54												

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(XRJLCv DR.6 10120779.003I

TXI N D B#6 T.L

CHLCKLT B#6 J.Z

TI vL6

BRXUDE CRE B)S

(pd-difeDdpasI:afmd-fGnmfnoOdg5afyiCf:afp FN Cdp:fpd4F5ppnH5gsunon:eNfialbf:wfT OdiI:gfmfiCdw.atCnm5dp:5n

"UEAXL

I)90

(IEL6 9 d41

Date Begin - End: 1x0Sx1012) 1x0Mx1012	**Drilling Company:** BC1		**BORING LOG B-8**
Logged By: T. Lepffi	**Drill Crew:** TnpomhXn4fmFfpg5d		
Hor.-Vert. Datum: Ddal bn5mr m	**Drilling Equipment:** CYL)83 vpnyh X5g	**Hammer Type - Drop:** 9P0 m. I wad) 20 5.	
Plunge:)M0 efgpffi	**Drilling Method:** Hdmdu Faf, I wgfp	**Hammer Efficiency:** S1q	
Weather: Fw.: o	**Bore Diameter:** S5. R.T.	**Hammer Cal. Date:** 7x17x1019	

"ULOT LW(ORXI vURD — OI BRXI vRX# XLFAOvF

Onafawef 62P.87S03k
Od: g5wef 6)99S.93377k
I --pdl 5, naf Epdw. e Fwp4hyf Lmbnafd: %a°61t202
Fwp4hyf Cd: e5afd: 6Bnpf Lnpas

I--pdl5 naf Lmbnafd: %f fa°	Tf-as %f fa°	Epn-s5ynmOdg	Oafsdmdg5y Tfiyp5 afd:	Fn, -mvo-f	Bmdu Cdw. a %C°= A:ydpp Bmdu x75.	Xfydbfpp %X=Dd Xfydbfpp°	AFCF Fo, rdm	N nafp Cd: af: a% °	Tpo A: 5aN a %y4	(nii 5 g / P %°	(nii 5 g / 100 %°	OWe O5 5a	(mmiafy5ao Uefl %(=Dd:(mmiafy°	I ee5afd: nmvfiaix Xf, nphi
			Sandy CLAY (CL)645 f ad, fe5w, in:etmdu ad, fe5w, -mmiafy5aotdmbf gpnot, d5at, fe5w, ia54		BC=2 2 2	97c								
1173														
	P0		, fe5w, -mmiafy5aotdmbf of mdut bfpoia54		BC=7 8 97	9Sc								
1170			**Poorly Graded SAND (SP)**645 f ad, fe5w, in:et ofmdu5s rpdu:t, d5at ef:iftapnyf ymo											
	P3				BC=99 9S 10	97c								
1133			**Clayey SAND (SC)**645 f ad ydnpif in:etdmbf rpdu:t, d5at mddif											
	30				BC=2 P 2	9Sc								
1130														
	33													
11P3														
	70													
11P0														
	73													
1123														

vsfrdp5guni afp, 5nafe nan--pdl5, nafmo 39.3 4a rfmdu gpdw.e iwp4hyf. vsfrdp5guni rnyh45mfme u5as gpdwad: "frpwnpo 0St 1012.

EXRADTN I vLX OLGLOUD" RXYI vURD6
Epdw. eunafpuni : dadrifpbfe ewp5 gep5m5 gdpn4afp yd, -mafd: .
ELDLXI ODRvLF6
vsf fl-mdpnafd: mdynafd: n:efmbnafd: npf n--pdl5, naf n:eufpf fia5, naferoEddgmLnpas.

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(XRJLCv DR.6 10120779.003I		BRXUDE ORE B)S	"UEAXL
TXI N D B#6	T.L	(pd-dife Ddpas I : afmd-f Gnmmo Odg5 afyi Cf: afp FN Cdp f pd4F5pp H5gsuno n:e N fial bf:wf T Odi I : gfmi Cdw. aot Cnr5fdp 5n	I)90
CHLCKLT B#6	J.Z		
TI vL6			(I EL6 1 d41

gUDv "UDL6 Kn4g5a_ nifp_1012 (CRvvLT6 02x08x1012 0160S (Y B#6 JZw5gn
gUDv vLY(CI vL6 L6KO"_Fvl DTI XT_EUDv_OBXI X#_1012.EOB [__KO"_BRXUDEwLFv (U FRUDORE] (XRJLCv DAYBLX6 10120779.003I R""UCL "UDvLX6 XUGLXFUTL

Date Begin - End:	1x0Mx1012	**Drilling Company:**	BC1			**BORING LOG B-9**
Logged By:	T. Lepffi	**Drill Crew:**	TnpomhXn4hfmFfpg5d			
Hor.-Vert. Datum:	Ddal bn5mrmfn	**Drilling Equipment:**	CYL)83 vpnyh X5g	**Hammer Type - Drop:**	9P0 m. I wad) 20 5.	
Plunge:	)M0 efgpffi	**Drilling Method:**	Hdmdu Faf, I wgfp	**Hammer Efficiency:**	S1q	
Weather:	Fw.: o	**Bore Diameter:**	S5. R.T.	**Hammer Cal. Date:**	7x17x1019	

"ULOT LW(CRXI vURD / CI BRXI vRX# XLFAOvF

Onafwef 62P.8788Mk
Od: g5wef 6)99S.93201k
I --pdl5 naf Epdw.e Fwp4hyf Lmfbnafd: %a°61t209
Fwp4hyf Cd: e5afd: 6Bnpf Lnpas

I--pdl5 naf Lmfbnafd: %f a°	Tf-as %f a°	Epn-s5ynmOdg	Cfasdmdg5y Tfiyp5afd:	Fn, -fnvo-f	Bndu Cdw.a %C°= A:ydpp Bndu i x75.	Xfydbfpp %X=Dd Xfydbfpp°	AFCF Fo, rdm	N nafp Cd:af:a %q°	Tpo A:5aNa %y4	(nii 5 g / P %q°	(nii 5 g / 100 %q°	Cfw5e C5, 5a	(mia5yao Uefl %(=Dd: (mia5y°	I ee5afd: nmvfiaix Xf, nphi
1200			**Top Soil** **Silty SAND (SM)**645 f ad, fe5w, in:etofmdu5s an:t, d5a n--pdl5 nafm 1c											Hn: e nwgfp3'rgi LI-n:i5d: Uefl
			Native **Clayey SAND (SC)**645 f ad ydnpif in:etofmdu5s an:t, d5a					9.1		MM	98			F5bf I:nmi5
1lM8	3		**Well-Graded SAND with Clay (SW-SC)**645 f ad ydnpif in:etofmdut, d5a, fe5w, ef:if		BC=1 S 9M	9Sc		9.8	90S.0	MM	91			F5bf I:nmi5
			:d gpnbfm		BC=3 S 99	9Sc		9.S	M2.9					
11M0	90				BC=3 98 9M	9Sc		9.1	MS.7					
11S3	93		**Silty SAND (SM)**645 f in:etdm5bf gpfot, d5a , fe5w, ef:if		BC=8 98 10	9Sc								
11S0	10		45 f ad, fe5w, in:etdm5bf ofmdutufnhmoyf, f:afe		BC=3 8 M	97c								
1183	13		dm5bf gpnotapnyf gpnbfm		BC=S 90 99	9Sc								
			Silty SAND with Clay (SM)645 f ad, fe5w, in:et dm5bf ofmdut, d5a, fe5w, ef:iftsnpeymoysw.hi											
1180	20				BC=P M 90	9Sc								
1173	23													

vsf rdp5 g uni afp, 5 nafe nan--pdl5, nafm 29.3 4a rfmdu gpdw.e iwp4hyf. vsf rdp5 g uni rnyh45mfne u5as gpdwad: "frpwnpo 0M 1012.

EXRADTN I vLX CLGLOUD" RXYI vURD6
Epdw.eunafpuni : dadrifpbfe ewp5 g ep5m5 g dpn4afp yd, -mfa5d:.
ELDLXI ODRvLF6
vsf fl-mdpnafd: mdynafd: n:efmfbnafd: npf n--pdl5, naf n:eufpf fia5, nafe ro Eddgmf Lnpas.

(CRvvLT6 02x08x1012 0160S(Y B#6 JZw.5gn

R" "UCL "UOvLX6 XUGLXFUTL

(XRJLCv DAYBLX6 10120779.003I [_KO"_BRXUDEwLFv (U FROUCRE] (XRJLCv DRXI X#_1012.ECB

gUDv "UOL6 Kn4g5 a_, nif p_1012 gUDv vLY(CI vL6 L6KO"_FvI DTI XT_EUDv_CUBXI

KLEINFELDER Bright People. Right Solutions.	(XRJLCv DR.6 10120779.003I	BRXUDE CRE B)M	"UEAXL
	TXI N D B#6 T.L CHLCKLT B#6 J.Z TI vL6	(pd-dife Ddpas I : afmd-f Gnmfno Odg5a5yi Cf: afp FN Cdp fpd4F5ppn H5gsunon: e N fial bf: wf T Odi I : gfmfni Cdw.aot Cnm5adp 5n	I)99 (I EL6 9 d49

BORING LOG B-10

Date Begin - End:	1x0Sx1012	**Drilling Company:**	BC1		
Logged By:	T. Lepffi	**Drill Crew:**	TnpponhXn4hf mFf pg5d		
Hor.-Vert. Datum:	Ddal bn5mr m	**Drilling Equipment:**	CYL)83 vpnyh X5g	**Hammer Type - Drop:**	9P0 m. I wad) 20 5.
Plunge:	)M0 ef gpff i	**Drilling Method:**	Hdmdu Faf, I wgfp	**Hammer Efficiency:**	S1q
Weather:	Fw. : o	**Bore Diameter:**	S5. R.T.	**Hammer Cal. Date:**	7x17x1019

Elevation	Depth	Graphic	Material Description	Sample	Blow counts	Recovery								Remarks
			Native **Sandy Lean CLAY (CL)**645 f ad, fe5w, in: et mdu -mi a5y5aot of mdu 5 s an: t, d5 a											Hn: e nwgf p3' r gi X) Gnmwf vfia
								8.P						
1200														
	3		dr5bf of mdut, d5 a ti a54		BC=2 3 93	9Sc		7.M	M8.2	900	38			F5bf I: nmi 5
			snpe		BC=92 19 P0	9Sc		3.7	90S.3					
11M8			**Silty SAND with Clay (SM)**645 f ad, fe5w, in: et dr5bf of mdut, d5 a ef: i f											
	90				BC=92 18 P1	9Sc		3.7	91S.0					
			Silty SAND (SM)645 f ad, fe5w, in: et m5gsagpmot, d5 a, fe5w, ef: i f											
11M0														
	93				BC=3 90 90	9Sc								
11S3														
	10		45 f ad ydnpi f in: et dr5bf gpno		BC=P M 8	9Sc								
11S0														
	13		45 f ad, fe5w, in: e		BC=S 90 93	9Sc								
			Lean CLAY with Sand (CL)645 f in: et mdu -mi a5y5aot dr5bf gpnot, d5 a bf po i a54 id, f i 5a											
1183														
	20				BC=8 M 90	90c						21	9P	I afprfpg vfia
			Sandy SILT (ML)645 f in: et dr5bf gpnot, d5 a, fe5w, ef: i f											
1180														

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(XRJLCv DR.6 10120779.003I

TXI N D B#6 T.L

CHLCKLT B#6 J.Z

TI vL6

BRXUDE CRE B)90

(pd-di f e Ddpas I: afmd-f Gnmfno Odg5 a5yi Cf: afp FN Cdp f pd4F5 ppn H5gsu no n: e N f i al bf: wf T Odi I: gf mi Cdw. aot Cnm5dp 5n

I)91

(I EL6 9 d41

Date Begin - End:	1x0Sx1012	**Drilling Company:**	BC1		**BORING LOG B-10**
Logged By:	T. Lepffi	**Drill Crew:**	TnpomnXn4hfmFfpg5d		
Hor.-Vert. Datum:	Ddal bn5mrm	**Drilling Equipment:**	CYL)83 vpnyh X5g	**Hammer Type - Drop:**	9P0 m. I wad) 20 5.
Plunge:	)M0 efgpffi	**Drilling Method:**	Hdmmu Faf, I wgfp	**Hammer Efficiency:**	S1q
Weather:	Fw.:o	**Bore Diameter:**	S5. R.T.	**Hammer Cal. Date:**	7x17x1019

I--pdl5 naf Lmbnafd: %f a°	Tf-as %f a°	Epn-s5ynmOdg	Onaf5wef 62P.87SS8k Od: g5wef 6)99S.9390Pk I--pdl5 naf Epdw. e Fwp4hyf Lmbnafd: %a°61t20P Fwp4hyf Cd: e5fd: 6Bnpf Lnpas / O5sdmdg5y Tfiyp5 afd:	Fn, -mvo-f	Bmu Cdw. a %C°= A: ydpp Bmui x/7 5.	Xfydbfpp %X=Dd Xfydbfpp°	AFCF Fo, rdm	Nnafp Cd:af: a% °	Tpo A: 5aNa %y4°	(nii5 g/P%°	(nii5 g/100%°	O5Wfe O5 5a	(mia5yo Uefl %(=Dd:(mia5y°	Iee5fd: nmvfiaix Xf, nphi
			Sandy SILT (ML)645 f in: etdm5bf gpnot, d5at, fe5w, ef:if		BC=3 99 M	90c								Iafprfpgvfia
			Silty SAND (SM)645 f ad, fe5w, in:etdm5bf gpnot, d5at, fe5w, ef:if											
1173	P0				BC=90 90 8	91c								
			Lean CLAY with Sand (CL)645 f in:et, fe5w, -mia5y5aotofmdu5s dm5bft, d5atbfpoia54uf nhm yf, f:afe											
1170	P3				BC=S S S	7c						2P	97	Iafprfpgvfia
			Poorly Graded SAND with Silt (SP-SM)645 f ad, fe5w, in:etdm5bf ofmdut, d5at, fe5w, ef:ift apnyf ymo											
1133	30				BC=8 92 9P	9Sc								
1130	33													
11P3	70													
11P0	73													
1123														

vsf rdp5 g uni afp, 5 nafe nan--pdl5, nafm 39.3 4a rfmdu gpdw. e iwp4hyf. vsf rdp5 g uni rnyh45mfe u5as gpdwad: "frpwnpo 0St 1012.

EXRADTN I vLX OLGLOUD" RXYI vURD6
Epdw. eunafpuni: dadrifpbfe ewp5 g ep5m5 g dpn4afp yd, -mafd: .
ELDLXI ODRvLF6
vsf fl-mdpnafd: mdynafd: n:efmbnafd: npf n--pdl5, naf n:eufpf fia5, nafe ro Eddgmm Lnpas.

KLEINFELDER Bright People. Right Solutions.	(XRJLCv DR.6 10120779.003I TXI N D B#6 T.L CHLCKLT B#6 J.Z TI vL6	BRXUDE CRE B)90 (pd-dife Ddpas I:afmd-f Gnmmo Odg5a5yi Cf:afp FN Cdp f pd4F5 ppn H5gsuno n:e N fial bf:wf T Odi I:gfmi Cdw. aot Cnm5dp 5n	"UEAXL I)91 (I EL6 1 d41

(CRvvLT6 02x08x1012 0160S (Y B#6 JZw. 5gn

R" "UCL " UOvLX6 XUGLXFUTL

(XRJLCv DAYBLX6 10120779.003I
gUDv "UOL6 Kn4g5a_ niafp_1012 gUDv vLY (OI vL6 L6KO"_FvI DTI XT_EUDv_OBXI X#_1012.EOB [__KO"_BRXUDEwLFv (U FRUDCRE]

Date Begin - End:	1x0Sx1012	**Drilling Company:**	BC1		**BORING LOG B-11**
Logged By:	T. Lepffi	**Drill Crew:**	TnpornXn4fmFfpg5d		
Hor.-Vert. Datum:	Ddal bn5nrm	**Drilling Equipment:**	CYL)83 vpnyh X5g	**Hammer Type - Drop:**	9P0 m. I wad) 20 5.
Plunge:	)M0 efgpffi	**Drilling Method:**	Hdmdu Faf, I wgfp	**Hammer Efficiency:**	S1q
Weather:	Fw.:o	**Bore Diameter:**	S 5. R.T.	**Hammer Cal. Date:**	7x17x1019

Elevation	Depth	Graphic	Description	Sample	Blow Counts	USCS		Dry Density	Water Content	Passing #4	Passing #200			Additional Tests / Remarks
			Top Soil **Sandy SILT (ML)**645 f ad, fe5w, in:et rfgsadr5bf of mdut, d5a											Hn: e nwgfp3' rgi X)Gnmf vfia
1200			**Native** **Sandy SILT (ML)**645 f ad, fe5w, in:et rfgsadr5bf of mdut, d5a					3.1						
	3		**Clayey SAND (SC)**645 f ad, fe5w, in:et rfgsa rpdu:t, d5at, fe5w, ef:iftyf, f:ana5d:	BC=9	91 93	9Sc		S.1	99P.9	900	23			F5bf I:nroi5
11M8			**Sandy CLAY (CL)**645 f in:et rdu - mi a5y5aot dr5bf gpnot, d5atia54											
				BC=P	3 90	9Sc		10.9	90P.0					Cdmm-if vfia
	90		dr5bf of mdut bfpoia54	BC=3	91 9P	9Sc		7.8	991.0					
11M0														
	93		45 f ad ydnpif in:et rfgsadr5bf gpnotia54	BC=7	8 M	9Sc								
11S3														
	10			BC=8	8 90	9Sc								
11S0														
	13		45 f ad, fe5w, in:et rfgsaofmdu5 s dr5bf	BC=3	8 M	9Sc								
1183			**Poorly Graded SAND with Silt (SP-SM)**645 f ad, fe5w, in:et dpn:g5 s of mdut, d5at, fe5w, ef:if											
	20			BC=M	91 90	97c								
1180			**Lean CLAY with Sand (CL)**645 f ad, fe5w, in:et, fe5w, -mi a5y5aot rfgsarnw5 s gpnot, d5atia54											

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(XRJLCv DR.6
10120779.003I

TXI N D B#6 T.L

CHLCKLT B#6 J.Z

TI vL6

BRXUDE CRE B)99

(pd-dife Ddpas I:afrd-f Gnmfno Cdg5afyi Cf:afp FN Cdp fpd4F5ppn H5gsuno n:e N fial bf:wf T Odi I:gfrmi Cdw.aot Cnr5dp5n

"UEAXL

I)92

(IEL6 9 d41

Date Begin - End:	1x0Sx1012	**Drilling Company:**	BC1		**BORING LOG B-11**
Logged By:	T. Lepffi	**Drill Crew:**	TnpomhXn4hfmFfpg5d		
Hor.-Vert. Datum:	Ddal bn5mrmn	**Drilling Equipment:**	CYL)83 vpnyh X5g	**Hammer Type - Drop:**	9P0 m. I wad) 20 5.
Plunge:	)M0 efgpffi	**Drilling Method:**	Hdmdu Faf, I wgfp	**Hammer Efficiency:**	S1q
Weather:	Fw.:o	**Bore Diameter:**	S5. R.T.	**Hammer Cal. Date:**	7x17x1019

I--pdl5 naf Lmbna5d: %4fa°	Tf-as %4fa°	Epn-s5ynmOdg	Ona5wef 62P.87PP8k / Od: g5wef 6)99S.9337Mk / I--pdl5 naf Epdw. e Fwp4hyf Lmbna5d: %4a°61t201 / Fwp4hyf Cd: e5d: 6Bnpf Lnpas — C5asdmdg5y Tfiyp5 a5d:	Fn, -mvo-f	Bmdu Cdw. a %C°= A:ydpp Bmdui x7 5.	Xfydbfpp %X=Dd Xfydbfpp°	AFCF Fo, rdm	N nafp Cd:af: a%q°	Tpo A:5aNa %y4°	(nii5g/P%q°	(nii5g/100%q°	C5We C5 5a	(mia5y5o Uefl %(=Dd:(mia5y°	I ee5d: nmvfiaix Xf, nphi
			Lean CLAY with Sand (CL)645f ad, fe5w, in:et , fe5w, -mia5y5aotn5gsarmw5sgpnot, d5atia54		BC=3 7 P	9Sc						28	9M	Iafprfpgvfia
-1173														
	P0		, fe5w, ia54		BC=9 1 P	9Sc						23	9S	Iafprfpgvfia
-1170														
			Silty SAND (SM)645f adydnpif in:etn5gsarpdu:t , d5at, fe5w, ef:iftapnyf 45f adydnpif gpnbfm iwrn:gwmpadiwrpdw.efegpnbfm											
	P3				BC=7 S 7	9Sc								Iafprfpgvfia
-1133														
			Clayey SAND with Silt (SC)645f ad, fe5w, in:et ofmdut, d5atmddif											
	30				BC=2 P 8	9Sc								
-1130														
	33													
-11P3														
	70													
-11P0														
	73													
-1123														

vsfrdp5guniafp 5nafenan--pdl5 nafm39.3 4a rfmdu gpdw.eiwp4hyf. vsfrdp5guni rnyh45mfne u5as gpdwad: "frpwnpo 0St1012.

EXRADTNIvLX OLGLOLD"RXYIvURD6
Epdw.eunafpuni :dadrifpbfeewp5gep5m5gdpn4afp yd, -mha5d:.
ELDLXI ODRvLF6
vsffl-mdpna5d: mdyna5d: n:efmbna5d: npf n--pdl5 naf n:eufpf fia5 nafero Eddgmh Lnpas.

KLEINFELDER Bright People. Right Solutions.	(XRJLCv DR.6 10120779.003I TXI N D B#6 T.L CHLCKLT B#6 J.Z TI vL6	BRXUDE CRE B)99 (pd-difeDdpas I:afmd-f Gnmfmo Odg5a5yi Cf:afp FN Cdp fpd4F5ppn H5gsuno n:e Nfial bf:wf T Odi I:gfmfi Cdw.aot Cnm5dp 5n	"UEAXL I)92 (IEL6 1d41

Date Begin - End:	1x0Mx1012	**Drilling Company:**	BC1		**BORING LOG B-12**
Logged By:	T. Lepffi	**Drill Crew:**	TnpponhXn4hfmFfpg5d		
Hor.-Vert. Datum:	Ddal bn5nrmn	**Drilling Equipment:**	CYL)83 vpnyh X5g	**Hammer Type - Drop:**	9P0 m. I wad) 20 5.
Plunge:	)M0 efgpffi	**Drilling Method:**	Hdmdu Faf, I wgfp	**Hammer Efficiency:**	S1q
Weather:	Fw.:o	**Bore Diameter:**	S5.R.T.	**Hammer Cal. Date:**	7x17x1019

"ULOT LW(ORXI vURD — Cl BRXI vRX# XLFAOvF

I--pdl5 naf Lmbnafi: %f a°	Tf-as %f a°	Epn-s5ynmOdg	Onafwef 62P.87P30k / Od: g5wef 6)99S.93220k / I--pdl5 naf Epdw.e Fwp4hyf Lmbnafi: %a°61t200 / Fwp4hyf Cd: e5fi: 6Bnpf Lnpas — Ofasdmdg5y Tfiyp5afi:	Fn, -mvo-f	Brdu Cdw.a %C°= A:ydp Brdu ix7 5.	Xfydbfpp %X=Dd Xfydbfpp°	AFCF Fo, rdm	N nafp Cd:af:a%°	Tpo A:5aNa %y4	(nii 5 g / P %°	(nii 5 g / 100 %°	O5We O5 5a	(mia5y5o Uefl %(=Dd:(mia5y°	I ee5fi: nmvfiaix Xf, npbi
			Native / **Clayey SAND**645 f ad, fe5w, in:etmdu-mia5y5aot ofmdu5s an:t, d5a					S.1						Hn:enwgfp3'rgi / Cdppdi5d: vfia
			Poorly Graded SAND with Silt (SP-SM)645 f ad ydnpifin:etofmdu5s an:t, d5at, fe5w, ef:if											
-11M8	3				BC=3 91 9P	97c		9.P	991.1					
					BC=91 90 9S	9Sc		9.2	901.P					
-11M0	90		mddif		BC=1 7 99	9Sc		9.9	MS.0					
			Silty SAND with Clay (SM)645 f in:etm5gsadm5bft , d5at, fe5w, ef:if											
-11S3	93				BC=3 S 90	9Sc		MP	90S.2					
			Silty SAND645 f ad, fe5w, in:etm5gsarpdu:t , d5at, fe5w, ef:iftapnyf ymo											
-11S0	10				BC=2 8 3	9Sc								
-1183	13		dm5bf ofmdut, d5at mddif		BC=2 8 1	9Sc								
			Lean CLAY with Sand (CL)645 f in:et, fe5w, -mia5y5aot dm5bf ofmdut, d5at, fe5w, ia54											
-1180	20				BC=1 2 1	9Sc								
-1173	23													

vsf rdp5g uni afp, 5 nafe nan--pdl5 nafm 29.3 4a rfmdu gpdw.e iwp4hyf. vsf rdp5g uni rnyh45mfe u5as gpdwad: "frpwnpo 0M 1012.

EXRADTN I vLX OLGLOUD" RXYI vURD6
Epdw.eunafpuni:dadrifpbfeewp5gep5m5gdpn4afp yd, -mafi:.
ELDLXI ODRvLF6
vsf fl-mdpnafi: mdynafi: n:efmbnafi: npf n--pdl5 naf n:eufpf fia5 nafe ro Eddgm Lnpas.

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(XRJLCv DR.6 10120779.003I

TXI N D B#6 T.L

CHLCKLT B#6 J.Z

TI vL6

BRXUDE ORE B)91

(pd-difeDdpas I:afmd-f GnmmoOdg5a5yi Cf:afp FN Cdp fpd4F5ppn H5gsunon:e Nfial bf:wf T Odi I:gfmi Cdw.aot Cnm5bdp 5n

"UEAXL

I)9P

(I EL6 9 d49

Date Begin - End:	1x90x1012	**Drilling Company:**	BC1		**BORING LOG B-13**
Logged By:	T. Lepffi	**Drill Crew:**	TnpomhXn4hf mFf pg5d		
Hor.-Vert. Datum:	Ddal bn5mr rn	**Drilling Equipment:**	CYL)83 vpnyh X5g	**Hammer Type - Drop:**	9P0 m. I wad) 20 5.
Plunge:	)M0 ef gpf fi	**Drilling Method:**	Hdmdu Faf, I wgfp	**Hammer Efficiency:**	S1q
Weather:	Fw.: o	**Bore Diameter:**	S5. R.T.	**Hammer Cal. Date:**	7x17x1019

"ULOT LW(CRXI vURD — CI BRXI vRX# XLFAOvF

Onafawef 62P.87P38k
Cd: g5wef 6)99S.9308Sk
I--pdl 5, naf Epdw. e Fwp4hyf Lmbnafd: %a°61t209
Fwp4hyf Cd: e5fd: 6Bnpf Lnpas

I--pdl 5, naf Lmbnafd: %f a°	Tf-as %f a°	Epn-s5ynmOdg	Cfasdmdg5y Tfiyp5 afd:	Fn, -mvo-f	Brdu Cdw. a %C°= A:ydpp Brdui x/ 5.	Xf ydbf pp %X=Dd Xf ydbf pp°	AFCF Fo, rdm	N nafp Cd: af: a %q°	Tpo A: 5aN a %y4	(nii 5 g / P %q°	(nii 5 g / 100 %q°	Cfw5e Cf, 5a	(mi ay5o Uef I %(=Dd: (mi ay°	I ee5fd: nmvf i a x Xf, nphi
1200			**Top Soil**											Hn: e nwgf p3' r gi
			Sandy SILT (ML)645 f ad, fe5w, in: et of mdu 5s an: t, d5a											LI-n: i5d: Uef I
			Native											Yde5fe (pdyadp
			Sandy SILT (ML)645 f ad, fe5w, in: et of mdu 5s an: t, d5a					1.M						
			Clayey SAND (SC)645 f in: et mdu -mi ay5aot dr5fof t , d5a t mddif tufnhmoyf, f: afe											
	3				BC=1 3 90	9Sc		3.9	90S.2		29			(nii 5 g / 100 Cd: i dr5fenafd: vfi a
11M3														
			45 f ad, fe5w, in: et mgsar pdu: t, fe5w, ef: ift apnyf ydnpif in: e		BC=2 M 91	9Sc		S.2	993.3	900	2S			F5bf I: nmoi 5
			Silty SAND (SM)645 f in: et dr5fof t, d5a t, fe5w, ef: if											
	90		, fe5w, ad ydnpif in: et dr5fof of mdu		BC=3 99 92	9Sc		1.S	99S.9					
11M0														
	93		mddif		BC=8 3 S	91c								
11S3														
			Silty SAND with Clay (SM)645 f ad ydnpif in: et dr5fof t, d5a t, fe5w, ef: if											
	10				BC=2 3 90	9Sc								
11S0														
			Sandy CLAY (CL)645 f ad, fe5w, in: et dr5fof of mdu t, d5a t ia54											
	13				BC=2 2 8	90c								
1183														
	20				BC=3 3 M	97c								
1180														
			Clayey SAND (SC)645 f ad, fe5w, in: et dr5fof t , d5a t, fe5w, ef: if											

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Bright People. Right Solutions.

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TXI N D B#6 T.L

CHLCKLT B#6 J.Z

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(pd-dif e Ddpas I: afmd-f Gnmfno Odg5 ay5i Cf: afp FN Cdp: f pd4F5 pon H5gsu no n: e N fi al bf: wf T Odi I: gf mi Cdw. aot Cnr5dp 5n

"UEAXL

I)93

(I EL6 9 d41

Date Begin - End: 1x90x1012 | **Drilling Company:** BC1 | **BORING LOG B-13**

Logged By: T. Lepffi | **Drill Crew:** TnpomhXn4hfmFfpg5d

Hor.-Vert. Datum: Ddal bn5mrmh | **Drilling Equipment:** CYL)83 vpnyh X5g | **Hammer Type - Drop:** 9P0 m. I wad) 20 5.

Plunge:)M0 ef gpffi | **Drilling Method:** Hdmdu Faf, I wgfp | **Hammer Efficiency:** S1q

Weather: Fw.:o | **Bore Diameter:** S5.R.T. | **Hammer Cal. Date:** 7x17x1019

Depth / Elevation	Graphic	Material Description	Sample	Blow Counts	Field Classification
1173		**Clayey SAND (SC)**645 f ad, fe5w, in:etdr5oft, d5at, fe5w, ef:if	▲	BC=P P 90	9Sc
		Poorly Graded SAND with Clay (SP-SC)645 f ad, fe5w, in:etofmdu5srpdu:t, d5at, fe5w, ef:if			
P0 / 1170			▲	BC=8 90 97	97c
		Lean CLAY (CL)6, fe5w, -mia5y5aotdr5oft, d5at ia54apnyf45fad, fe5w, in:e			
P3 / 1133			▲	BC=3 3 8	9Sc
		Clayey SAND (SC)645 f ad, fe5w, in:etdr5oft, d5at, fe5w, ef:if			
30 / 1130			▲	BC=3 3 S	9Sc

vsf rdp5guni afp, 5nafe nan--pdl5, nafmo39.34a rfmdu gpdw.eiwp4hyf. vsf rdp5guni rnyh45mfme u5as gpdwad: "frpwnpo 90t1012.

EXRADTNI vLX OLGLOUD"RXYI vURD6
Epdw.eunafpuni:dadrifpbfe ewp5gepm5gdpn4afp yd, -mfa5d:.
ELDLXI ODRvLF6
vsf fl-mdpna5d: mdyna5d: n:e fmbna5d: npf n--pdl5, naf n:eufpf fia5, nafe ro Eddgmfn Lnpas.

Depth scale: 33, 70, 73; Elevation scale: 11P3, 11P0, 1123

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(XRJLCv DR.6 10120779.003I

TXI N D B#6 T.L

CHLCKLT B#6 J.Z

TI vL6

BRXUDE CRE B)92

(pd-dife Ddpas I:afmd-f Gnmfno Odg5a5yi Cf:afp FN Cdp fpd4F5ppn H5gsunon:e Nfial bf:wf T Odi I:gfmfi Cdw.aotCnm5dp5n

"UEAXL I)93

APPENDIX B
LABORATORY TESTING

APPENDIX B
LABORATORY TESTING

Laboratory tests were performed on drive and bulk soil samples to estimate engineering characteristics of the various earth materials encountered. The laboratory testing was performed by our laboratory located in Ontario, California or by AP Engineering & Testing, Inc. of Pomona, California. Testing was performed in general accordance with procedures outlined in the American Society for Testing and Materials, or other accepted procedures. Visual classifications presented on the lab figures performed by AP Engineering may differ from those presented on the boring logs provided in Appendix A.

LABORATORY MOISTURE DETERMINATIONS AND UNIT WEIGHTS

Natural moisture content and unit weight tests were performed on selected samples. The moisture content tests were performed in general accordance with ASTM Test Method D 2216 and the unit weight tests were performed in general accordance with ASTM Test Method D 2937. The results are presented on the Logs of Borings in Appendix A.

SIEVE ANALYSES

Sieve analyses were performed on selected samples of the materials encountered at the site to evaluate the grain size distribution characteristics of the soils and to aid in their classification. Tests were performed in general accordance with ASTM Test Method D 6913. Results of these tests are presented in the boring logs in Appendix A and attached as Figures B-1 through B-4, Grain Size Distribution Curve.

ATTERBERG LIMITS (PLASTICITY INDEX)

Plasticity limit and liquid limit testing was performed on soil samples to evaluate behavior conditions at varying water contents. Testing was performed in general accordance with ASTM Standard Test Method D4318. The results are presented on the boring logs in Appendix A and attached as Figures B-5 through B-9, Plasticity Testing.

DIRECT SHEAR

Direct shear testing was performed on a remolded sample for shear strength and cohesion values of the in-situ soils in accordance with ASTM Standard Test Method D 3080. The tests were performed by AP Engineering. The results are presented as Figures B-10 and B-11, Direct Shear Test.

PRELIMINARY CORROSIVITY TESTS

A series of chemical tests were performed on a selected sample of the near-surface soils to estimate pH, resistivity and sulfate and chloride contents. The sample was tested in general accordance with California Test Methods 643, 422, and 417 for pH and minimum resistivity, soluble chlorides, and soluble sulfates, respectively. Test results may be used by a qualified corrosion engineer to evaluate the general corrosion potential with respect to construction materials. The tests were performed by AP Engineering. The results of these tests are presented below in Table B-1, Preliminary Corrosion Test Results.

MODIFIED PROCTOR

Maximum density-optimum moisture tests were performed on a select bulk sample of the on-site soils to determine compaction characteristics. The test was performed in accordance with ASTM Standard Test Method D 1557. The test results are presented below in Table B-2, Modified Proctor Test Results.

EXPANSION INDEX

Expansion Index testing was performed on three near surface bulk samples to determine the expansion potential of the soil. The tests were performed in accordance with ASTM Standard Test Method D4829. The test results are presented below in Table B-3, Expansion Index Test Results.

R-VALUE TEST

A Resistance Value (R-value) test was performed on four bulk soil samples to evaluate pavement support characteristics of the near-surface onsite soils. R-value testing was performed in accordance with ASTM Standard Test Method D2844. The test results are presented below in Table B-4, R-Value Test Results.

ONE-DIMENSIONAL SWELL/COLLAPSE TEST

Laboratory testing was performed on two selected soil samples to study the collapse potential of the subgrade soils. During this test, the soil sample is inundated with water at 2 kips per square foot (ksf) and the percent swell or collapse is measured. This test was performed by AP Engineering in accordance with ASTM D4546. The test results are presented below in Table B-5, Collapse Potential Test Results.

CONSOLIDATION CURVE

Laboratory testing was performed on two selected soil samples to study the consolidation of the subgrade soils. During this test, the soil sample is inundated with water at a specific surcharge loading and the percent swell or collapse is measured. This test was performed by AP Engineering in accordance with ASTM D2435. The test results are presented as Figures B-12 and B-13, Consolidation Curve.

Table B-1
Preliminary Corrosivity Test Results

Boring	Depth (ft)	pH	Sulfate (ppm)	Chloride (ppm)	Resistivity (ohm-cm)
B-3	1-5	10.3	29	38	1,908
B-4	1-5	10.0	35	114	1,047
B-6	1-5	9.9	32	76	1,840
B-12	1-5	10.1	56	55	1,094

Table B-2
Modified Proctor Test Results

Boring Number	Depth (ft)	Maximum Dry Density (pcf)	Optimum Moisture (%)
B-2	1 – 5	131.0	8.3
B-7	1 – 5	103.0	18.0
B-8	1 – 5	122.3	8.8
B-13	1 – 5	122.7	10.8

Table B-3
Expansion Index Test Results

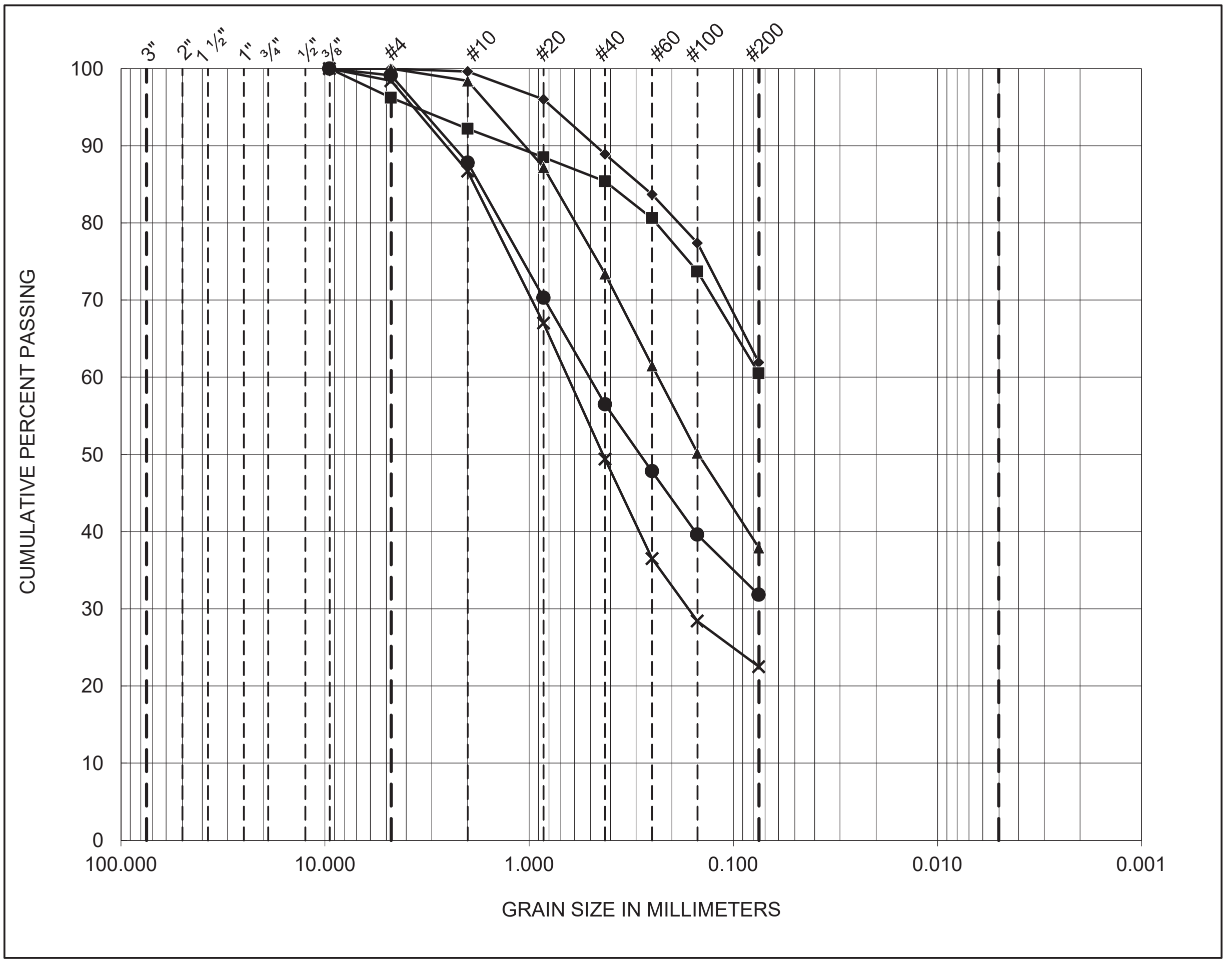
Boring Number	Depth (ft)	Expansion Index	Expansion Potential
B-2	1 – 5	4	Very Low
B-9	1 – 5	5	Very Low
B-13	1 – 5	18	Very Low

Table B-4
Resistance Value Test Results

Boring Number	Depth (ft)	R-Value
B-4	1 – 5	34
B-5	1 – 5	38
B-10	1 – 5	24
B-11	1 – 5	41

Table B-5
Collapse Potential Test Result

Boring Number	Depth (ft)	Collapse Potential (%)
B-1	5.0	0.9
B-6	7.5	0.3
B-8	5.0	1.8
B-11	7.5	0.2



COBBLE	GRAVEL	SAND	SILT	CLAY

SYMBOL	SAMPLE IDENTIFICATION			PERCENTAGES			ATTERBERG LIMITS			SOIL CLASSIFICATION
	BORING NO.	SAMPLE NO.	DEPTH (ft.)	GRAVEL	SAND	FINES	LL	PL	PI	
◆	B-1	4	7.5	0.0	38.1	61.9	NM	NM	NM	Sandy Silt (ML)
■	B-3	11	40	3.8	35.7	60.5	40	21	19	Sandy Lean Clay (CL)
▲	B-4	3	5	0.0	62.1	37.9	NM	NM	NM	Silty Sand (SM)
×	B-5	2	2.5	1.6	75.9	22.5	NM	NM	NM	Silty Sand (SM)
●	B-5	3	5	0.9	67.3	31.8	NM	NM	NM	Silty Sand (SM)

KLEINFELDER
Bright People. Right Solutions.

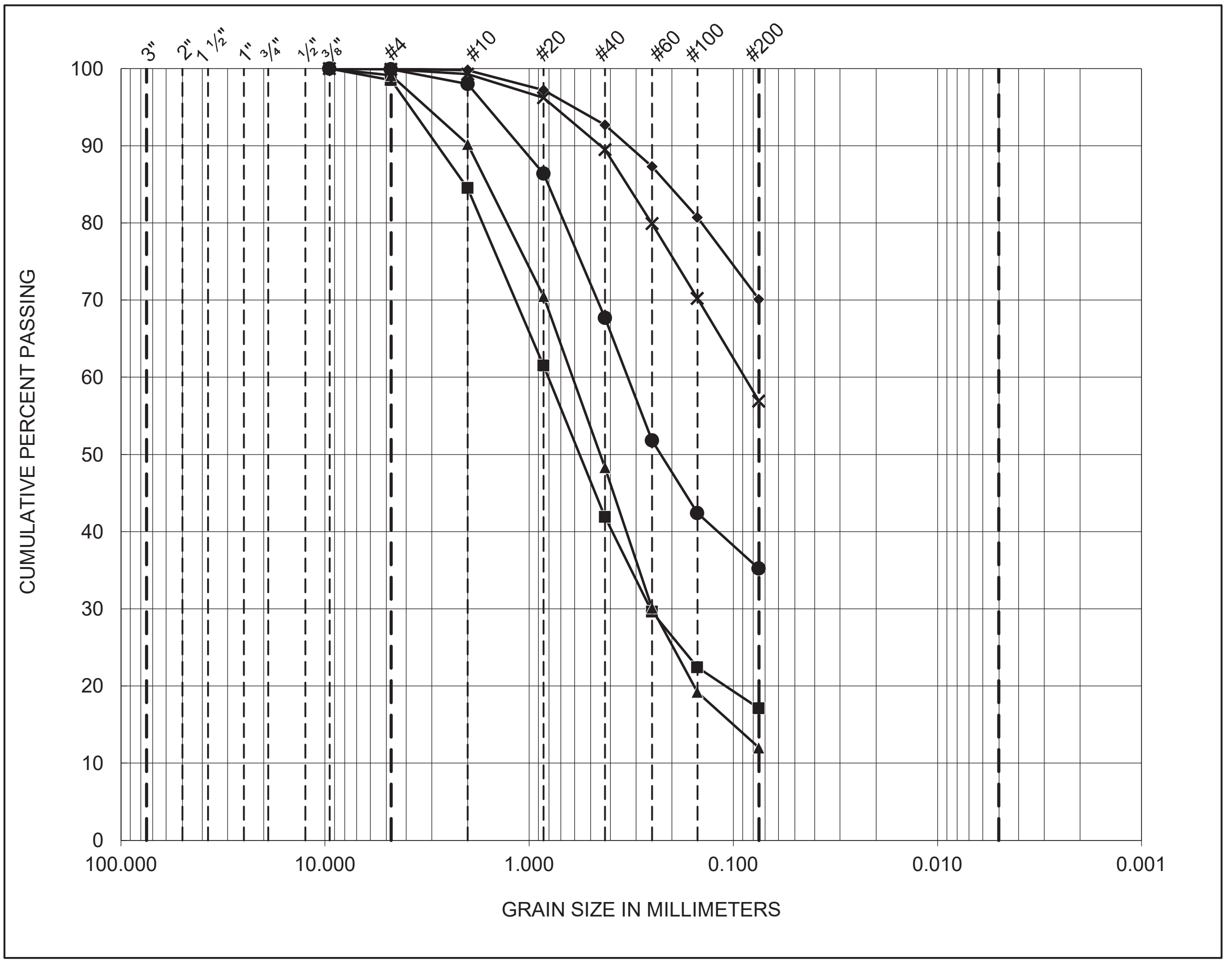
PROJECT NO.:	20230661.005A
TESTED BY:	M. Sanchez
DATE:	2/28/2023
CHECKED BY:	M. Magaña
DATE:	2/28/2023

GRAIN SIZE DISTRIBUTION

Proposed North Antelope Valley Logistics Center, SW Corner of Sierra Highway and West Avenue D, Los Angeles County, California

FIGURE

B-1

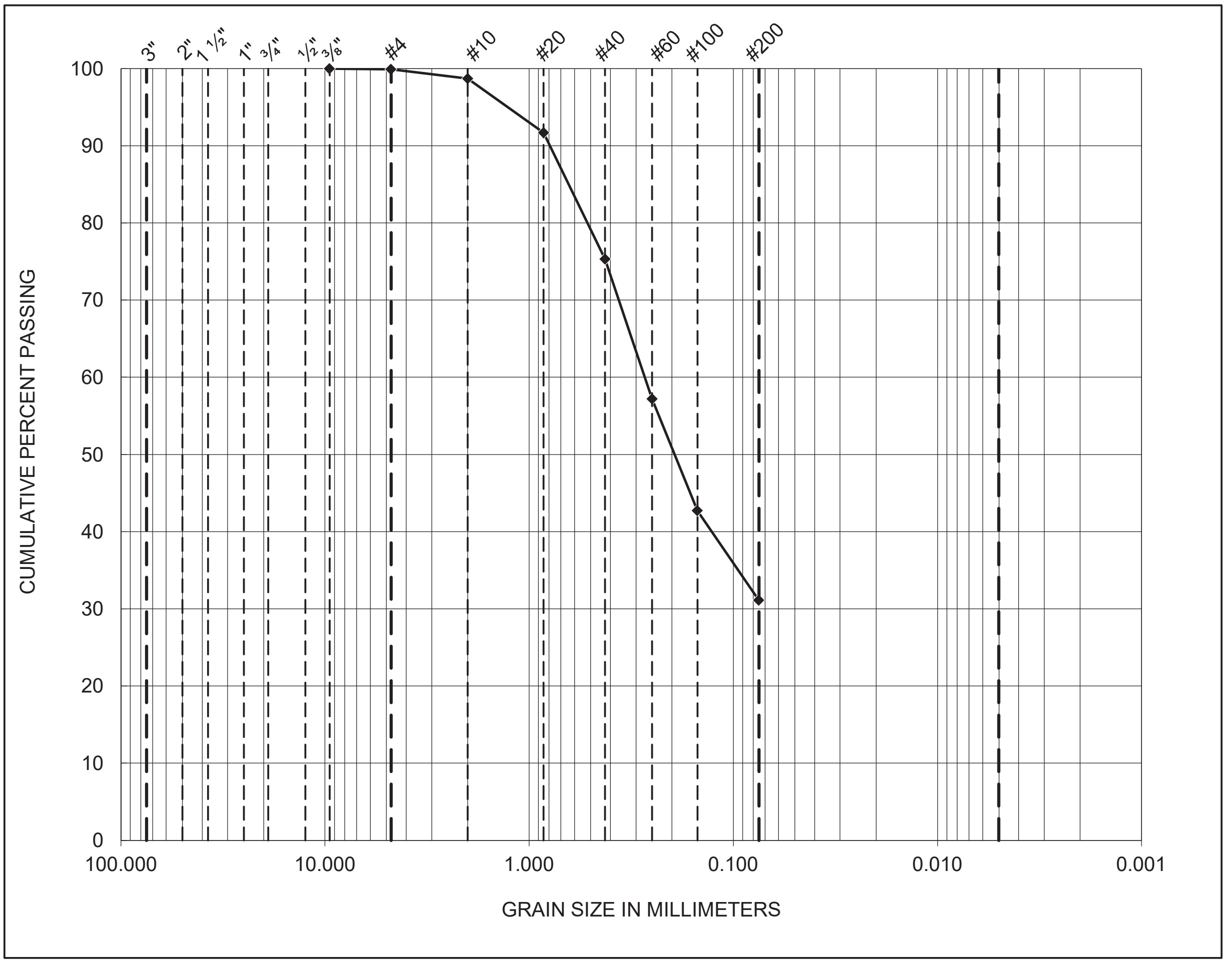


COBBLE	GRAVEL	SAND	SILT	CLAY

SYMBOL	SAMPLE IDENTIFICATION			PERCENTAGES			ATTERBERG LIMITS			SOIL CLASSIFICATION
	BORING NO.	SAMPLE NO.	DEPTH (ft.)	GRAVEL	SAND	FINES	LL	PL	PI	
◆	B-5	4	7.5	0.0	29.9	70.1	NM	NM	NM	Sandy Lean Clay (CL)
■	B-9	2	2.5	1.5	81.4	17.1	NM	NM	NM	Clayey Sand (SC)
▲	B-9	3	5	0.9	87.1	12.0	NM	NM	NM	Well Graded Sand w/Clay (SW-SC)
×	B-10	3	5	0.1	43.0	56.9	NM	NM	NM	Sandy Lean Clay (CL)
●	B-11	3	5	0.1	64.7	35.2	NM	NM	NM	Clayey Sand (SC)

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20230661.005A		GRAIN SIZE DISTRIBUTION	FIGURE
TESTED BY:	M. Sanchez		B-2
DATE:	2/28/2023		
CHECKED BY:	M. Magaña	Proposed North Antelope Valley Logistics Center, SW Corner of Sierra Highway and West Avenue D, Los Angeles, California	
DATE:	2/28/2023		



COBBLE	GRAVEL	SAND	SILT	CLAY

SYMBOL	SAMPLE IDENTIFICATION			PERCENTAGES			ATTERBERG LIMITS			SOIL CLASSIFICATION
	BORING NO.	SAMPLE NO.	DEPTH (ft.)	GRAVEL	SAND	FINES	LL	PL	PI	
◆	B-1	3	5	0.1	68.8	31.1	NM	NM	NM	Silty Sand (SM)

KLEINFELDER
Bright People. Right Solutions.

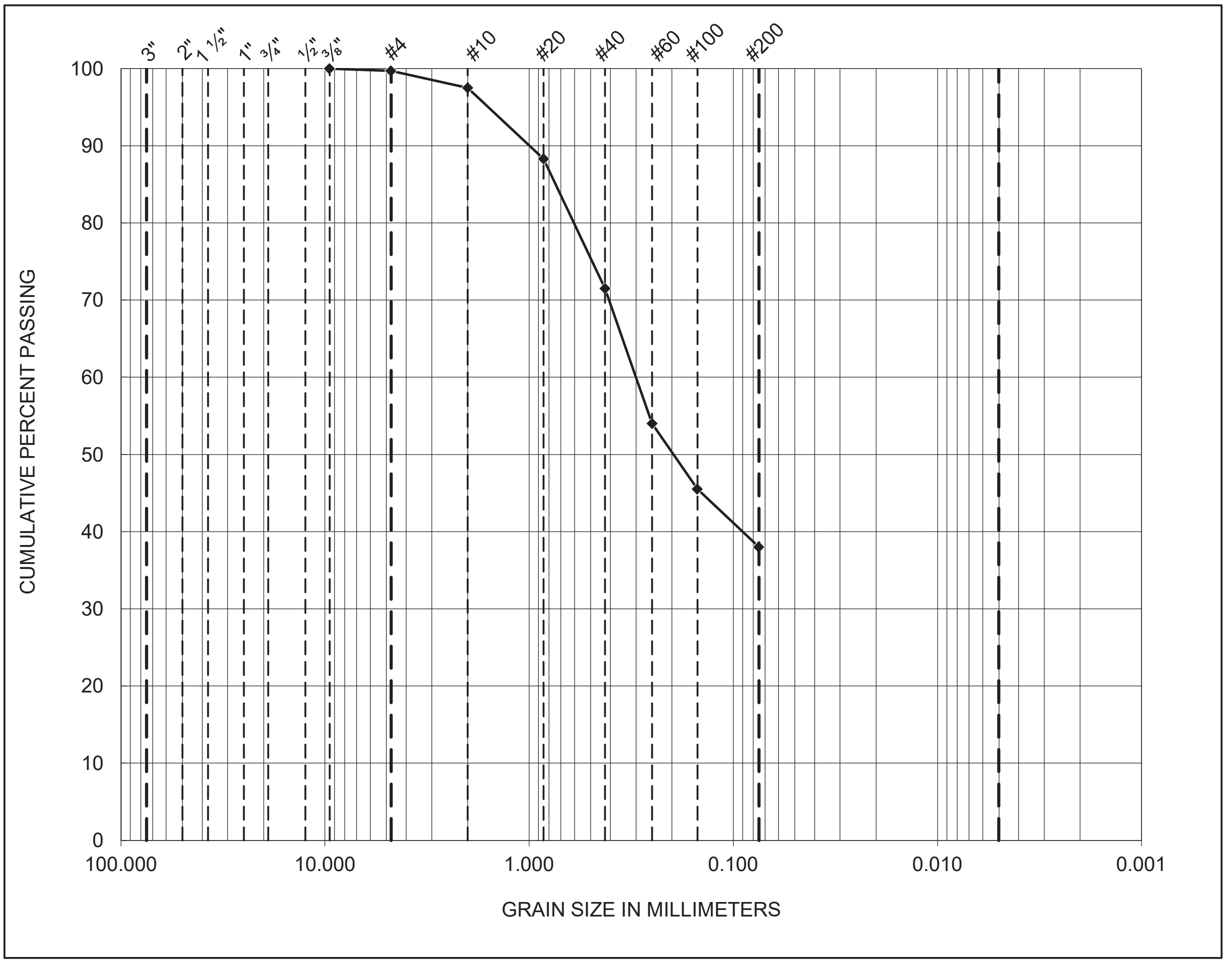
PROJECT NO.:	20230661.005A
TESTED BY:	J. Calderon
DATE:	3/1/2023
CHECKED BY:	M. Magaña
DATE:	3/2/2023

GRAIN SIZE DISTRIBUTION

Proposed North Antelope Valley Logistics Center, SW Corner of Sierra Highway and West Avenue D, Los Angeles County, California

FIGURE

B-3



COBBLE	GRAVEL	SAND	SILT	CLAY

SYMBOL	SAMPLE IDENTIFICATION			PERCENTAGES			ATTERBERG LIMITS			SOIL CLASSIFICATION
	BORING NO.	SAMPLE NO.	DEPTH (ft.)	GRAVEL	SAND	FINES	LL	PL	PI	
◆	B-13	4	7.5	0.3	61.7	38.0	NM	NM	NM	Clayey Sand (SC)

KLEINFELDER
Bright People. Right Solutions.

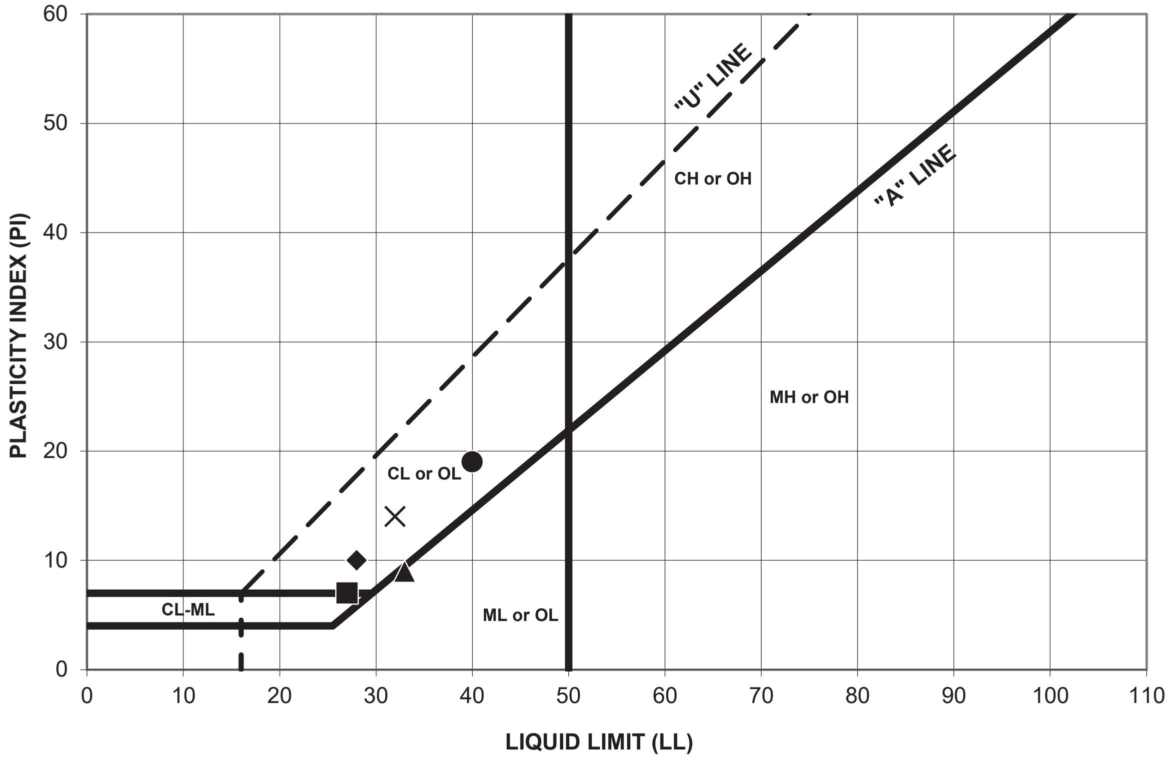
PROJECT NO.:	20230661.005A
TESTED BY:	M. Sanchez
DATE:	2/28/2023
CHECKED BY:	M .Magaña
DATE:	2/28/2023

GRAIN SIZE DISTRIBUTION

Proposed North Antelope Valley Logistics Center SW Corner of Sierra Highway and West Avenue D, Los Angeles County, California

FIGURE

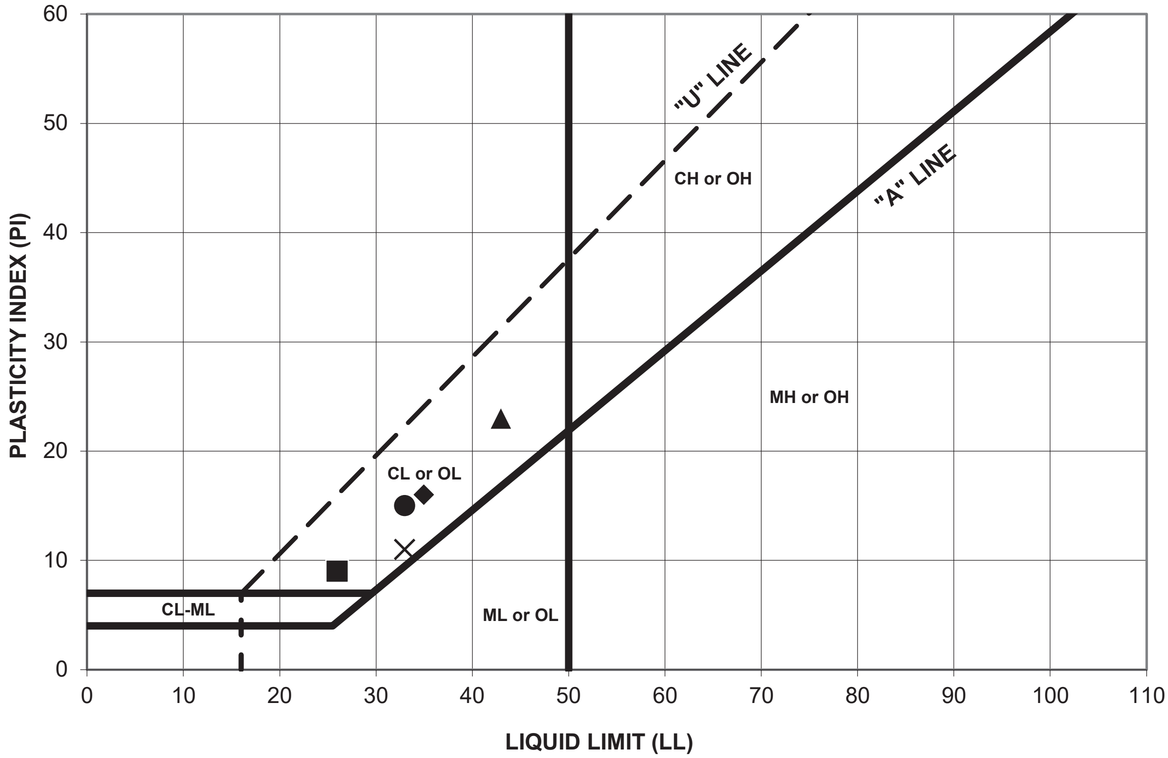
B-4



SYMBOL	SAMPLE IDENTIFICATION			ATTERBERG LIMITS			SOIL CLASSIFICATION
	BORING NO.	SAMPLE NO.	DEPTH (ft)	LL	PL	PI	
◆	B-3	10	35'	28	18	10	Sandy Lean Clay (CL)
●	B-3	11	40'	40	21	19	Sandy Lean Clay (CL)
▲	B-3	12	45'	33	24	9	Sandy Lean Clay (CL)
×	B-3	13	50'	32	18	14	Sandy Lean Clay (CL)
■	B-4	7	20'	27	20	7	Silty Clay (CL-ML)

Testing performed in general accordance with ASTM D4318

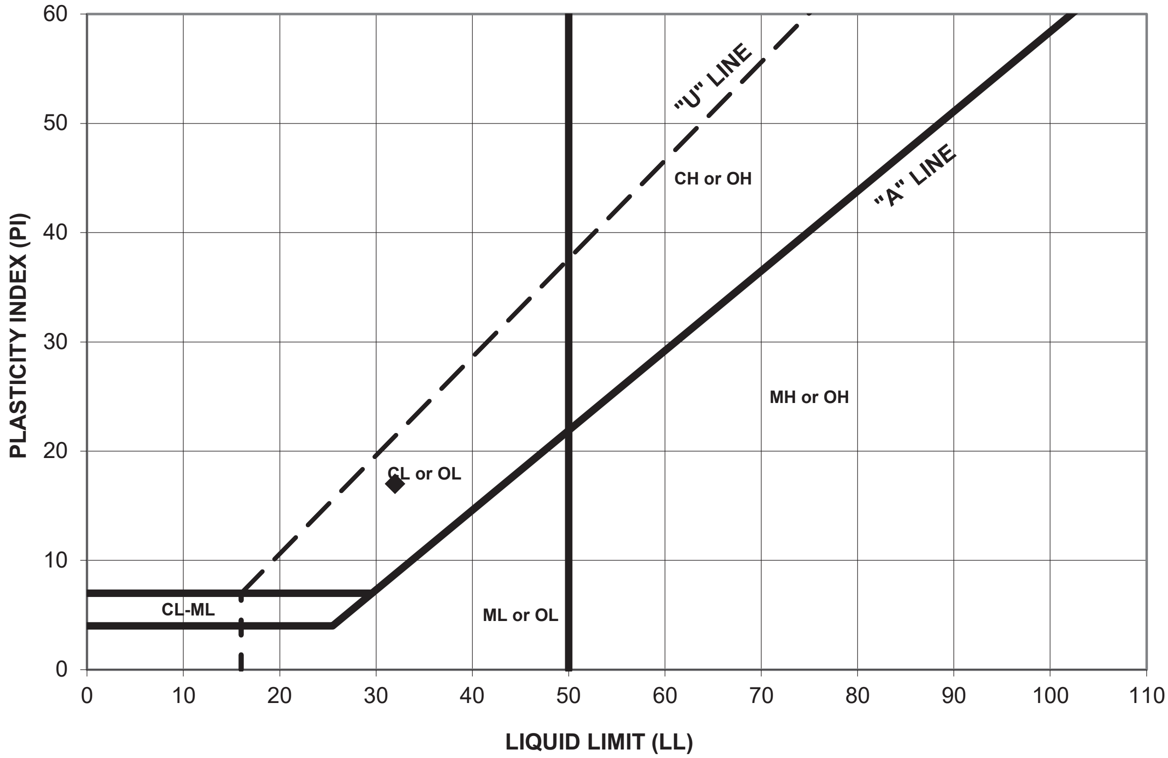
KLEINFELDER Bright People. Right Solutions.	PROJECT NO.:	20230661.005A	PLASTICITY TESTING	FIGURE B-5
	TESTED BY:	J. Calderon		
	DATE:	2/22/2023	Proposed North Antelope Valley Logistics Center, SW Corner of Sierra Highway and West Avenue D, Los Angeles County, California	
	CHECKED BY:	M. Magaña		
	DATE:	2/23/2023		



SYMBOL	SAMPLE IDENTIFICATION			ATTERBERG LIMITS			SOIL CLASSIFICATION
	BORING NO.	SAMPLE NO.	DEPTH (ft)	LL	PL	PI	
◆	B-4	8	25	35	19	16	Lean Clay with Sand (CL)
●	B-4	9	30	33	18	15	Lean Clay with Sand (CL)
▲	B-4	11	40	43	20	23	Lean Clay (CL)
×	B-5	9	30	33	22	11	Lean Clay with Sand (CL)
■	B-5	10	35	26	17	9	Lean Clay with Sand (CL)

Testing performed in general accordance with ASTM D4318

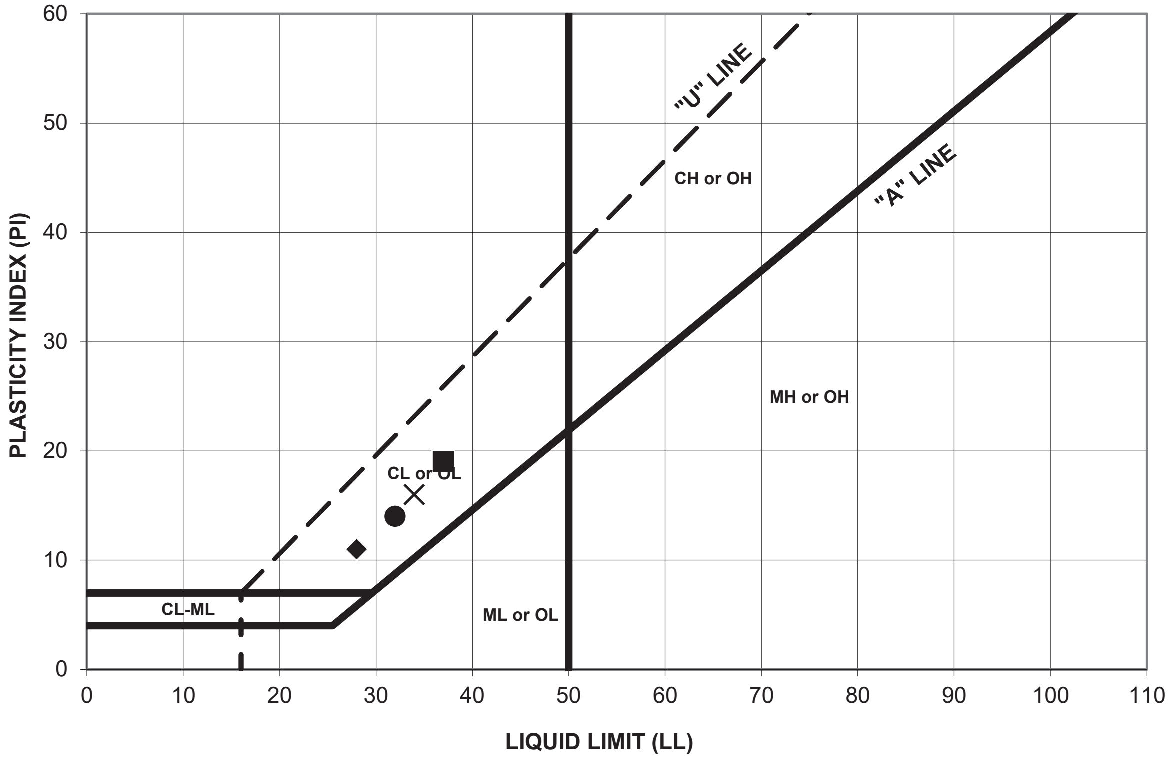
KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20230661.005A TESTED BY: J. Calderon DATE: 2/22/2023 CHECKED BY: M. Magaña DATE: 2/23/2023	PLASTICITY TESTING Proposed North Antelope Valley Logistics Center, SW Corner of Sierra Highway and West Avenue D, Los Angeles County, California	FIGURE B-6



SYMBOL	SAMPLE IDENTIFICATION			ATTERBERG LIMITS			SOIL CLASSIFICATION
	BORING NO.	SAMPLE NO.	DEPTH (ft)	LL	PL	PI	
◆	B-5	13	50	32	15	17	Lean Clay with Sand (CL)

Testing performed in general accordance with ASTM D4318

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20230661.005A TESTED BY: R.Davila DATE: 2/27/2023 CHECKED BY: M. Magaña DATE: 2/27/2023	PLASTICITY TESTING Proposed North Antelope Valley Logistics Center, SW Corner of Sierra Highway and West Avenue D, Los Angeles County, California	FIGURE B-7

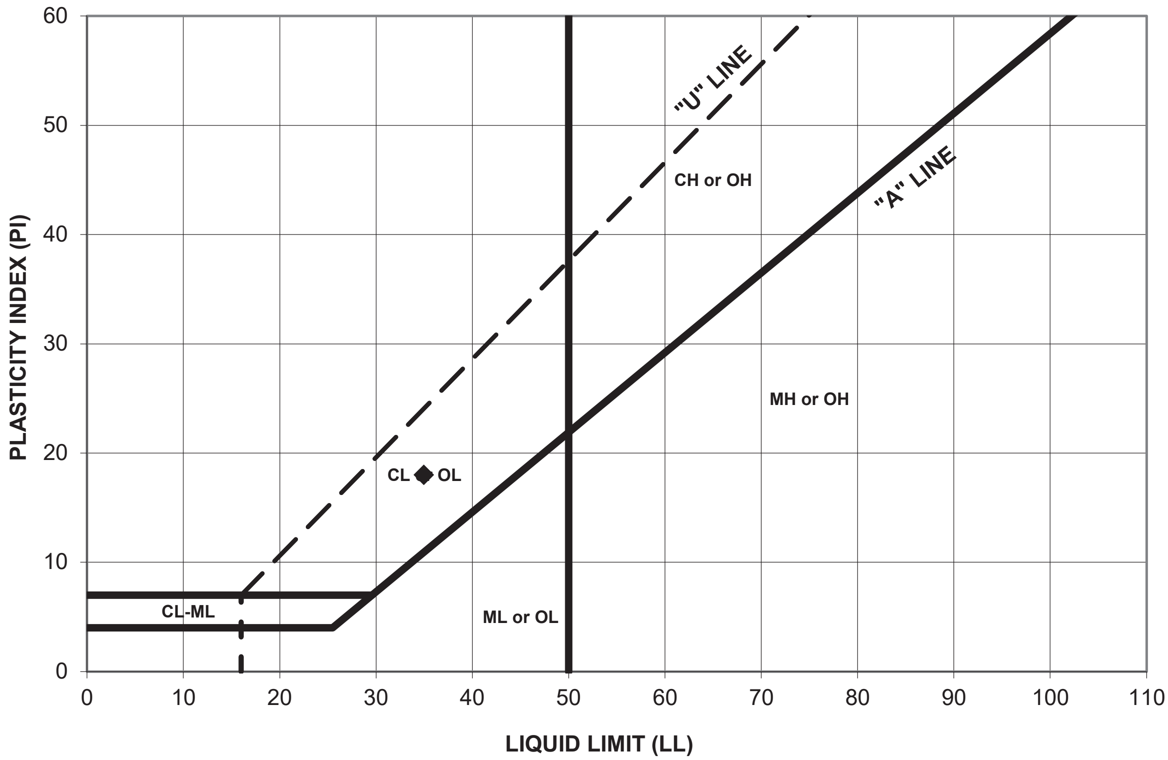


SYMBOL	SAMPLE IDENTIFICATION			ATTERBERG LIMITS			SOIL CLASSIFICATION
	BORING NO.	SAMPLE NO.	DEPTH (ft)	LL	PL	PI	
◆	B-5	11	40	28	17	11	Lean Clay with Sand (CL)
●	B-10	9	30	32	18	14	Lean Clay with Sand (CL)
▲	B-10	10	35	-	-	-	Non Plastic
×	B-10	12	45	34	18	16	Lean Clay with Sand (CL)
■	B-11	10	35	37	18	19	Lean Clay with Sand (CL)

Testing performed in general accordance with ASTM D4318

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.:	20230661.005A	PLASTICITY TESTING	FIGURE
TESTED BY:	J. Calderon		B-8
DATE:	2/22/2023	Proposed North Antelope Valley Logistics Center, SW Corner of Sierra Highway and West Avenue D, Los Angeles County, California	
CHECKED BY:	M. Magaña		
DATE:	2/23/2023		



SYMBOL	SAMPLE IDENTIFICATION			ATTERBERG LIMITS			SOIL CLASSIFICATION
	BORING NO.	SAMPLE NO.	DEPTH (ft)	LL	PL	PI	
◆	B-11	11	40	35	17	18	Lean Clay with Sand (CL)
●	B-11	12	45	-	-	-	Non Plastic

Testing performed in general accordance with ASTM D4318

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.:	20230661.005A
TESTED BY:	J. Calderon
DATE:	2/22/2023
CHECKED BY:	M. Magaña
DATE:	2/23/2023

PLASTICITY TESTING

Proposed North Antelope Valley Logistics Center, SW Corner of Sierra Highway and West Avenue D, Los Angeles County, California

FIGURE

B-9

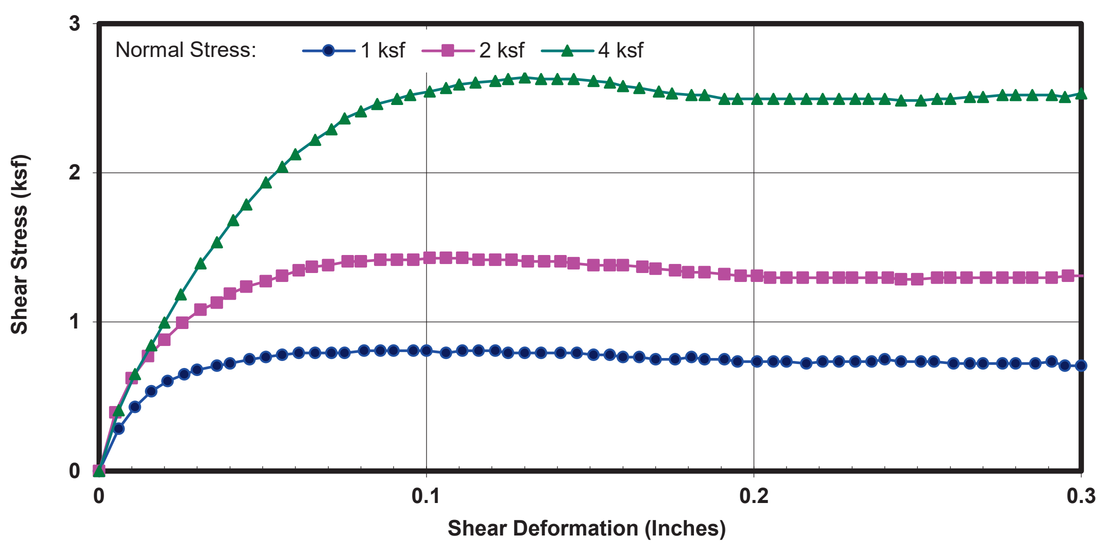
AP Engineering and Testing, Inc.
DBE|MBE|SBE
2607 Pomona Boulevard | Pomona, CA 91768
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com

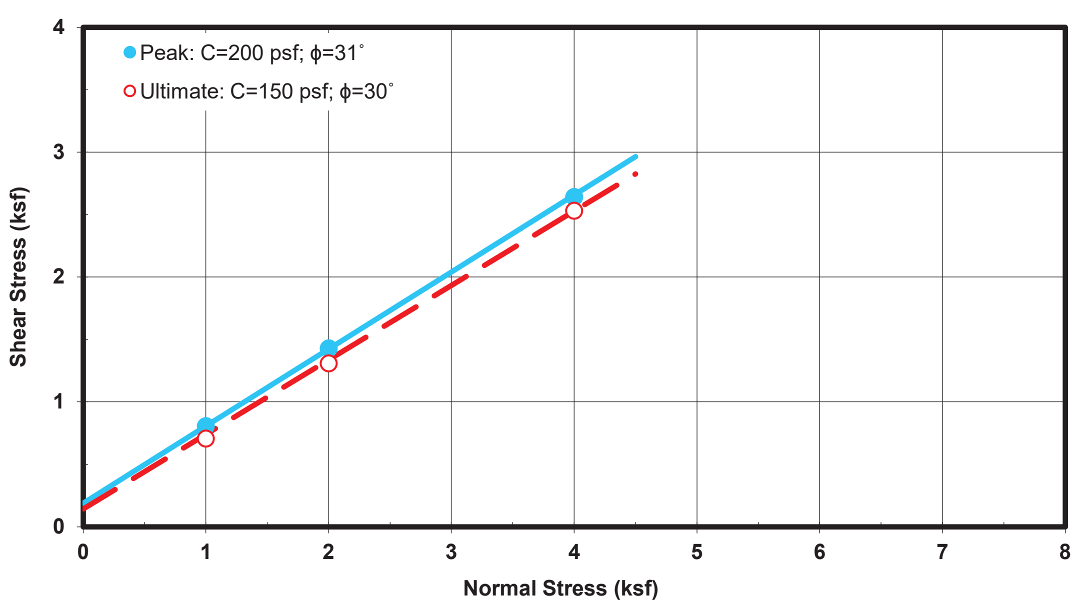
DIRECT SHEAR TEST RESULTS
ASTM D 3080

Project Name: NAVLC 157 & 160
Project No.: 20230661.005A
Boring No.: B-6
Sample No.: 3 **Depth (ft):** 5
Sample Type: Mod. Cal.
Soil Description: Clayey Sand
Test Condition: Inundated **Shear Type:** Regular

Tested By: LS **Date:** 02/28/23
Computed By: NR **Date:** 03/01/23
Checked by: AP **Date:** 03/01/23

Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)	Initial Degree Saturation (%)	Final Degree Saturation (%)	Normal Stress (ksf)	Peak Shear Stress (ksf)	Ultimate Shear Stress (ksf)
117.0	107.6	8.8	18.9	42	90	1	0.806	0.706
						2	1.428	1.308
						4	2.640	2.532





FIGURE

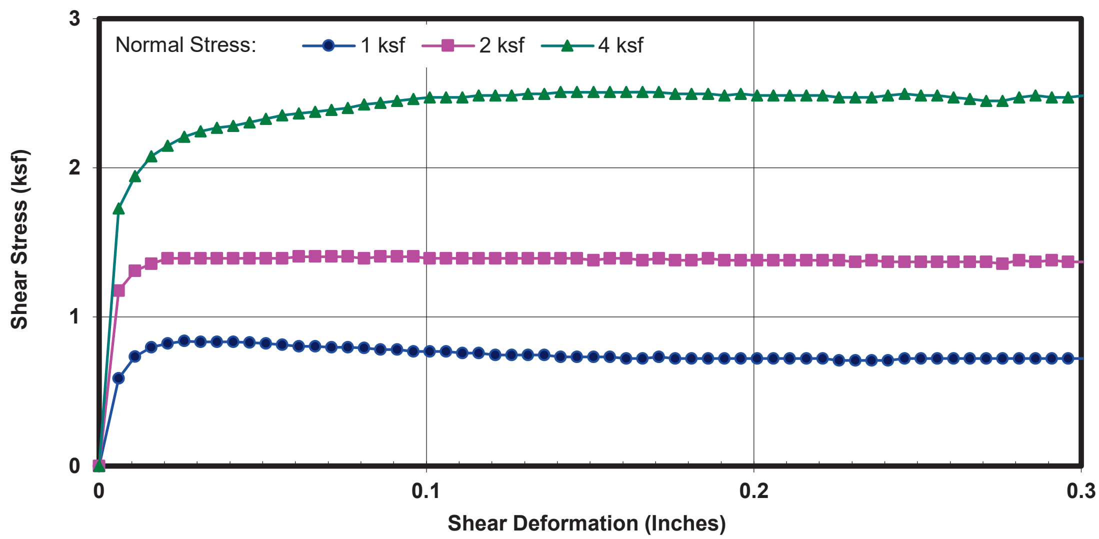
B-10

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

DIRECT SHEAR TEST RESULTS
ASTM D 3080

Project Name: NAVLC 157 & 160 **Tested By:** LS **Date:** 02/27/23
Project No.: 20230661.005A **Computed By:** JP **Date:** 02/28/23
Boring No.: B-8 **Checked by:** AP **Date:** 02/28/23
Sample No.: 1 **Depth (ft):** 1-5
Remold Cond.: Remolded to 90% of 122.3 pcf at 8.8% MC
Soil Description: Sandy Clay
Test Condition: Inundated **Shear Type:** Regular

Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)	Initial Degree Saturation (%)	Final Degree Saturation (%)	Normal Stress (ksf)	Peak Shear Stress (ksf)	Ultimate Shear Stress (ksf)
119.9	110.0	9.0	18.9	45	96	1	0.838	0.720
						2	1.404	1.368
						4	2.508	2.484



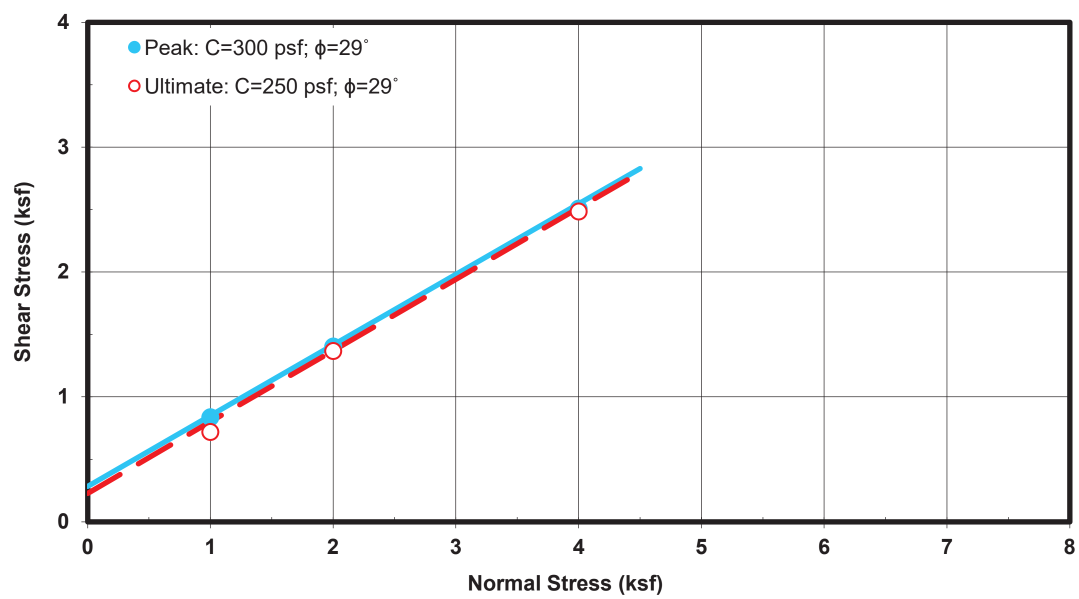


FIGURE
B-11

March 6, 2023
Kleinfelder Project No. 20230661.001A

Mr. Jack Lac
NorthPoint Development
12977 North Outer 40 Road, Suite 203
St. Louis, Missouri 63141

SUBJECT: Feasibility-Level Geotechnical Investigation
Antelope LAC 234
Lancaster Area of Los Angeles County, California

Dear Mr. Lac:

Kleinfelder is pleased to present this report summarizing the feasibility-level geotechnical investigation performed for the subject site, located at the southeast corner of West Avenue F and 20th Street in the Lancaster area of Los Angeles County, California. Our conclusions and recommendations for geotechnical design and construction are presented in the attached report.

We appreciate the opportunity to provide geotechnical engineering services to you on this project. If you have any questions regarding this report or if we can be of further service, please do not hesitate to contact the undersigned.

Sincerely,

KLEINFELDER, INC.

Hector Marquez, P.E.
Project Engineer

Jeffery D. Waller, P.E., G.E.
Senior Geotechnical Engineer

www.kleinfelder.com

2280 Market Street, Suite 300, Riverside, CA 92501 p | 951.801.3681 f | 951.682.0192

FEASIBILITY-LEVEL GEOTECHNICAL INVESTIGATION
ANTELOPE LAC 234
LANCASTER AREA OF
LOS ANGELES COUNTY, CALIFORNIA

KLEINFELDER PROJECT NO. 20230661.001A

MARCH 6, 2023

A Report Prepared for:

Mr. Jack Lac
NorthPoint Development
12977 North Outer 40 Road, Suite 203
St. Louis, Missouri 63141

FEASIBILITY-LEVEL GEOTECHNICAL INVESTIGATION
ANTELOPE LAC 234
LANCASTER AREA OF LOS ANGELES COUNTY, CALIFORNIA

Prepared by:

Hector Marquez, P.E.
Project Engineer

Reviewed by:

Jeffery D. Waller, P.E., G.E.
Senior Geotechnical Engineer

KLEINFELDER
2280 Market Street, Suite 300
Riverside, California 92501
Phone: 951.801.3681
Fax: 951.682.0192

March 6, 2023
Kleinfelder Project No. 20230661.001A

TABLE OF CONTENTS

Section **Page**

TABLE OF CONTENTS (Continued)

Section **Page**

FIGURES

APPENDICES

1 INTRODUCTION

This report presents the results of our feasibility-level geotechnical investigation for the proposed improvements at the southeast corner of West Avenue F and 20th Street West in the Lancaster area of Los Angeles County, California. The general location of the site is shown on Figure 1, Site Vicinity Map.

The purpose of this feasibility-level geotechnical investigation was to evaluate the subsurface soil conditions at the site in order to provide geotechnical recommendations for the design and construction of the proposed development. The scope of our services was presented in our proposal dated April 22, 2022. This report only provides recommendations for the proposed improvements discussed below.

1.1 PROJECT DESCRIPTION

Based on our review of a conceptual site plan provided by NorthPoint Development, the site area is approximately 238 acres and the proposed improvements include the construction of three approximately 1,117,000 square foot buildings. The buildings are anticipated to be concrete tilt-up distribution-type buildings and have warehouse areas with loading-dock high slab-on-grade floors. The project also includes Best Management Practices (BMPs) stormwater detention basins at the site.

We anticipate cuts and fills on the order of approximately 10 feet may be needed to develop the site. We anticipate that the proposed buildings may be supported on conventional shallow spread foundations. Foundation loads are not currently available, but based on our experience with similar past projects, we assume that maximum column loading will be on the order of 80 kips and maximum wall loads will be on the order of 4 to 8 kips per linear foot. Floor loads for proposed distribution-type buildings may be on the order of 500 pounds per square foot.

We anticipate parking lot and drive aisles will consist of asphaltic concrete (AC) pavement and loading dock areas will consist of Portland cement concrete pavement (PCCP). Ancillary construction is anticipated to include concrete flat work, landscaping, and installation of buried utilities.

1.2 SCOPE OF SERVICES

The scope of our preliminary geotechnical study consisted of a literature review, historical aerial photo review, subsurface exploration, geotechnical laboratory testing, engineering evaluation and analysis, and preparation of this report. Our report includes a description of the work performed, a discussion of the geotechnical conditions observed at the site, and preliminary recommendations developed from our engineering analysis of field and laboratory data. A description of our scope of services performed for this project is presented below.

Task 1 – Background Data Review. We reviewed published and unpublished geologic literature in our files and the files of public agencies, including selected publications prepared by the California Geological Survey and the U.S. Geological Survey. We also reviewed readily available seismic and faulting information, including data for designated earthquake fault zones and our in-house database of faulting in the general site vicinity.

Task 2 – Field Exploration. The subsurface conditions at the site were explored by drilling and logging five (5) hollow-stem auger geotechnical borings (B-1 to B-5). The geotechnical borings were drilled to depths ranging from approximately 26½ to 51½ feet bgs. The locations of our borings are shown on the attached Figure 2, Exploration Location Map.

Prior to commencement of the fieldwork, our proposed exploration locations were cleared for known existing utility lines and with the participating utility companies through Underground Service Alert (USA). A Kleinfelder representative supervised the field operations and logged the borings. Selected bulk and drive samples were retrieved, sealed and transported to Kleinfelder's laboratory in Ontario, California for laboratory testing. Our typical sampling interval for the hollow stem auger borings was every 5 feet to full depths explored. The number of blows necessary to drive California-type samplers were recorded. A description of the field exploration and the logs of the borings, including a Legend to the Log of Borings, are presented in Appendix A.

Task 3 – Laboratory Testing. Laboratory testing was performed on representative samples of soil collected from our excavations to substantiate field classifications and to provide engineering parameters for geotechnical design. Laboratory testing included moisture determination and unit weight, grain size distribution, plasticity testing, direct shear, consolidation, modified Proctor, expansion index, collapse potential, and preliminary corrosion potential. A summary of the testing performed and the results for this subject site are presented in Appendix B.

Task 4 – Geotechnical Analyses. Field and laboratory data were analyzed in conjunction with the proposed site plan presented on Figure 2 and assumed structural loads to develop geotechnical recommendations for the design and construction of the proposed development.

We evaluated potential foundation systems, lateral earth pressures, settlement, and earthwork considerations. Potential geologic hazards, such as ground shaking, liquefaction hazard, seismic settlement potential, flood hazard, and fault rupture hazard were also evaluated.

Task 5 – Report Preparation. This report summarizes the work performed, data acquired, and our findings, conclusions, and geotechnical recommendations for the design and construction of the proposed development. Recommendations for the following are presented in this report:

- Earthwork, including site preparation, excavation, site drainage, and the placement of engineered fill;
- Design of suitable foundation systems including allowable capacities, lateral resistance, and settlement estimates;
- Seismic design parameters;
- Floor slab and slab-on-grade support, including subgrade preparation;
- Lateral earth pressures for design of retaining walls;
- Design and construction of asphalt and Portland cement concrete pavements, including driveways, fire lanes, and concrete walks; and
- Preliminary infiltration correlations of the site soils for design of BMPs.

This report also contains reference maps and graphics, as well as the logs of the borings and laboratory test results.

2 SITE AND SUBSURFACE CONDITIONS

2.1 SITE DESCRIPTION

The site is located at the southeast corner of West Avenue F and 20th Street West in the Lancaster area of Los Angeles County, California. The total site area is approximately 238 acres and is currently vacant and appears to not have had any previous development. The site is generally bounded by similarly vacant and undeveloped land in all directions. Topographic survey has not yet been provided to Kleinfelder for the proposed project. However, based on our review of Google Earth imagery, the site appears to generally slope from the west towards the east, approximately 6 feet.

2.2 SUBSURFACE CONDITIONS

Subsurface materials observed during drilling are described below and detailed descriptions of subsurface materials are provided in our boring logs presented in Appendix A.

<u>Alluvium/Native Soils:</u>

The alluvium/native soils were observed in all of the borings drilled for this investigation and generally consisted of clayey to silty sand, poorly graded to well graded sand with varying amounts of silt, and lean clays with varying amounts of sand to the total depth explored of approximately 51½ feet bgs. In-situ moisture content ranged from 0.8 to 35.3 percent and dry unit weight ranged from 86.3 to 123.4 pounds per cubic foot (pcf). Generally, the apparent density of the subsurface soils was stiff to hard for fine-grained soils and loose to very dense for coarse-grained soils.

2.3 GROUNDWATER CONDITIONS

Groundwater was not encountered in our borings to the maximum depth explored of approximately 51½ feet bgs during our geotechnical investigation within the 238-acre site. The closest wells to the site are approximately 0.17 miles northwest of the site (347497N1181674W001) with a ground surface elevation of 2311.8 feet above mean sea level (MSL) and approximately 0.18 miles west of the site (347422N1181696W001) with a ground surface elevation of 2313.8 feet above mean sea level (MSL). The shallowest depth to groundwater last measured was approximately 14 feet bgs on April 27,1951 in the northwest well and approximately 13 feet on March 3, 1952 in the west well, (CDWR, 2022). Current depth to ground water is estimated to be greater than 50 feet bgs based on borings drilled on site and reported depth to groundwater for monitoring wells located approximately 1.8 miles east of the site (Geotracker, 2022).

Fluctuations of localized zones of perched water and rise in soil moisture content should be anticipated during the rainy season. Irrigation of landscaped areas may also lead to an increase in soil moisture content and fluctuations of intermittent shallow perched groundwater levels.

3 GEOLOGIC CONDITIONS

3.1 REGIONAL GEOLOGY

The subject site is located within the western portion of the Mojave Desert geomorphic province of California (Norris and Webb, 1990).

The Mojave Desert is approximately 25,000 square miles of desert situated in southeastern California. The area is enclosed on the southwest by the San Andreas fault and the Transverse Ranges and on the north and northeast by the Garlock fault, the Tehachapi Mountains and the Basin and Range. The Nevada state line and Colorado River form the arbitrary eastern boundary. The San Bernardino-Riverside county line designates the southern boundary.

The region is dominated by broad alluviated basins that are mostly aggrading sources receiving nonmarine deposits from the adjacent uplands. The highest general elevations of the Mojave Desert approach 4,000 feet above mean sea level (MSL) with most of the valleys between 2,000 and 4,000 feet MSL.

3.2 SITE GEOLOGY

The western approximately 2/3rd of site is underlain by Holocene alluvial fan deposits and the eastern approximately 1/3rd is underlain by Holocene alluvium fluvial deposits within the Armagosa Creek drainage (CGS, 2010).

3.3 GEOLOGIC HAZARDS

We have addressed below the potential geologic hazards for the site.

3.3.1 Active and Potentially Active Fault Search

Earthquakes and faulting occur as the tectonic plates, which comprise the Earth’s crust, or lithosphere, move relative to one-another. Faults identified by the State as being active are not known to be present at the surface within the project limits. No portion of the site is located within a State of California-Special Studies Zone, formerly Alquist-Priolo Earthquake Fault Zone (Bryant and Hart, 2007). The closest zoned fault to the site is the San Andreas fault zone located approximately 10.8 miles southwest of the site (USGS, 1999). Because of the distance to known active faults, the lack of surficial evidence of fault breaks expressed in air photos or published geologic maps, the risk of surface rupture resulting from faulting is considered low.

3.3.2 Flooding

Surface water flow at the site is generally via sheet flow in a northeasterly direction toward the Armagosa creek drainage.

The western approximately 1/3rd of the site is within a flood hazard zone “X” according to FEMA (2008), where the flood hazard is “determined to be outside the 0.2% annual chance floodplain”. The eastern approximately 2/3rd of the site is within a flood hazard zone “AO” according to FEMA (2008), where the flood hazard is a “Special Flood Hazard Area subject to Inundation by the 1% Annual chance Flood”. Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths 1 foot.

A seiche is a wave or sloshing of a body of water that is at least partially impounded caused by strong wind or seismic shaking. The site is not downstream of large bodies of water or tanks which potentially could causes flooding and inundate the project site. The risk of seiche damage following a seismic event at the site is considered low.

3.3.3 Landslides

Landslides and other forms of mass wasting, including mud flows, debris flows, soil slips, and rock falls occur as soil or rock moves down slope under the influence of gravity. Landslides are frequently triggered by intense rainfall or seismic shaking. The site is not located within a State or county designated landslide hazard zone. The site is relatively flat and the risk at the site from landslides and other forms of mass wasting is considered very low.

3.3.4 Liquefaction and Seismic Settlement

Liquefaction occurs when saturated, loose, coarse-grained or silty soils are subjected to strong shaking resulting from earthquake motions. The coarse-grained or silty soils typically lose a portion or all of their shear strength and regain strength sometime after the shaking stops. Soil movements (both vertical and lateral) have been observed under these conditions due to consolidation of the liquefied soils.

The site is located within a mapped generalized liquefaction potential zone (CGS, 2005). We have performed a liquefaction analysis to assess the seismically induced settlement potential. The results of our liquefaction analysis are summarized in Section 4.2.2.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 GENERAL

Based on the results of our field exploration, laboratory testing and geotechnical analyses conducted during this study, it is our professional opinion that the proposed project is geotechnically feasible, provided the recommendations presented in this report are incorporated into the project design and construction.

The following preliminary opinions, conclusions, and recommendations are based on the properties of the materials encountered in the explorations, the results of our literature review, the results of the laboratory testing program, and our engineering analyses performed. Our recommendations regarding the geotechnical aspects of the design and construction of the project are presented in the following sections. We recommend that the final grading plans be reviewed by Kleinfelder prior to the start of construction.

4.2 SEISMIC DESIGN CONSIDERATIONS

4.2.1 Seismic Design Parameters

According to ACSE/SEI 7-16 (2016), which is incorporated into the 2019 and 2022 California Building Codes (CBC) by reference, sites subject to liquefaction, as discussed below, should be classified as Site Class F, which requires a site response analysis. However, ACSE/SEI 7-16 states that for a short period (less than ½ second) structure on liquefiable soils, Site Class D or E may be used instead of Site Class F to estimate design seismic loading on the structure. The selection of Site Class D or E is based on the assessment of the site soil profile assuming no liquefaction. We have assumed that the period of the structures will be less than ½ second. The assumption that the structures have a period of less than ½ second should be verified by the project structural engineer.

Based on data obtained from our field explorations, published geologic literature and maps, and on our interpretation of the 2019/2022 CBC criteria, it is our opinion that the project site may be classified as Site Class D, Stiff Soil, according to Section 1613 of the 2019/2022 CBC and Table 20.3-1 of ASCE/SEI 7-16 (2016). Approximate coordinates for the site are noted below.

- Latitude: 34.7445°N
- Longitude: 118.1598°W

The Risk-Targeted Maximum Considered Earthquake (MCER) mapped spectral accelerations for 0.2 seconds and 1 second periods (S_s and S_1) were estimated using Section 1613 of the 2019/2022 CBC and the OSHPD seismic design maps web-based application (available at https://seismicmaps.org/). In accordance with Section 11.4.8 of ASCE 7-16, a site-specific ground motion hazard analysis is required for Site Class D sites with an S_1 greater than 0.2 g. However, a site-specific ground motion hazard analysis is not required if the exceptions in Section 11.4.8 of ASCE 7-16 are taken. Under the 2019 CBC, the exception would be if the seismic response coefficient (C_s) is determined in accordance with requirements of Chapter 12 and Exception 2 of Section 11.4.8 of ASCE 7-16. However, under the 2022 CBC, which adopts Supplement 3 of the ASCE 7-16, the exception would be if the values of the parameters S_{M1} and S_{D1} are increased by 50 percent. The assumption that the applicable exception will be used should be verified by the project structural engineer during final design based on the governing code. Based on the assumption that the applicable exception will be taken in accordance with the governing code, the 2019/2022 CBC Seismic Design Parameters (non site-specific) for the project site are provided in Table 1.

Table 1
2019/2022 CBC Seismic Design Parameters

Design Parameter	Recommended Value
Site Class	D
S_s (g)	1.369
S_1 (g)	0.556
F_a	1.0
F_v	N/A*
S_{MS} (g)	1.369
S_{M1} (g)	N/A
S_{DS} (g)	0.912
S_{D1} (g)	N/A
PGA_M (g)	0.550

* N/A = Not Applicable; Section 11.4.8 of ASCE 7-16 requires a site-specific ground motion hazard analysis be performed for Site Class D sites with S_1 values greater than or equal to 0.2g unless exceptions are taken in which the values of S_{M1} and S_{D1} are increased by 50 percent. If exceptions are taken, then a Fv value of 1.74 may be used in accordance with Table 11.4-2 of ASCE 7-16 Supplement 1 (per the 2019 CBC) or of Supplement 3 (per the 2022 CBC).

4.2.2 Liquefaction and Seismic Settlement

To assess the potential for liquefaction of subsurface soils at the site, we used the liquefaction analysis procedures outlined in Youd et al. (2001) based on standard penetration test (SPT) data. For estimating the resulting ground settlements, we used the methods proposed by Tokimatsu and Seed (1987). These methods utilize corrected SPT blow counts to estimate the amount of volumetric compaction or settlement during an earthquake.

Groundwater was not encountered during our current field exploration drilled to a maximum explored depth of 51½ feet bgs. Based on our groundwater research discussed in Section 2.3, a design groundwater depth of 13 feet was used in our analyses based on the historic high groundwater level. The historic high groundwater level may be further investigated since the current depth is much lower than the historic high.

As recommended in Section 1803.5.12 of 2019/2022 CBC, the peak ground acceleration (PGA) used in the liquefaction analysis was estimated in accordance with Section 11.8.3 of ASCE 7-16. A PGAM of 0.55g with an earthquake magnitude of 8.1 was used as the design-level seismic event in our liquefaction analysis, which is defined as an earthquake event with

2 percent probability of being exceeded in 50 years (return period of about 2,475 years) according to the 2019/2022 CBC and ASCE/SEI 7-16.

We evaluated the liquefaction potential at the site using the SPT data. Based on the SPT data and our engineering analyses, it is our opinion that layers of sands and silty sands at depths approximately 35 to 50 feet bgs (below the design groundwater depth) may be subject to liquefaction in the event of a major earthquake occurring on a nearby fault. Based on our analyses, the calculated total liquefaction-induced settlement is on the order of less than 1 inch. Differential liquefaction-induced settlement may be estimated as ½ of the total seismically-induced settlement over a distance of about 30 feet

4.3 FOUNDATIONS

4.3.1 General

Based on the results of our field exploration, laboratory testing, and geotechnical analyses, the proposed improvements may be supported on conventional shallow foundations on a zone of compacted fill provided the settlement estimates (both static and seismic) are tolerable. We have assumed that the proposed structures will be able to tolerate the estimated seismic settlement (i.e., it will not collapse creating a life safety issue). However, this assumption should be verified by the project structural engineer. It should be noted that the design intent of the 2019/2022 California Building Code (CBC) during a design-level seismic event is life safety, not serviceability of the structure after an earthquake.

4.3.2 Allowable Bearing Pressure

Footings supported on at least 3 feet of compacted fill may be designed for a net allowable bearing pressure of 2,500 psf for dead plus sustained live loads. A one-third increase in the bearing value can be used for wind or seismic loads. All footings should be established at a depth of at least 24 inches below the lowest adjacent grade. The footing dimension and reinforcement should be designed by the structural engineer; however, continuous and isolated spread footings should have minimum widths of 18 and 24 inches, respectively.

4.3.3 Estimated Settlements

Total static settlement for foundations designed in accordance with the recommendations presented herein is estimated to be less than 1 inch. Differential static settlement between similarly loaded columns is estimated to be less than ½ inch over 40 to 70 feet. Note that this settlement is in addition to the estimated settlement due to seismic shaking.

4.3.4 Lateral Resistance

Resistance to lateral loads (including those due to wind or seismic forces) may be provided by frictional resistance between the bottom of concrete foundations and the underlying soils and by passive soil pressure against the sides of the foundations. A coefficient of friction of 0.3 may be used between cast-in-place concrete foundations and the underlying soil. The passive pressure available for engineered fill may be taken as equivalent to the pressure developed by a fluid with a unit weight of 300 pounds per cubic foot (pcf). A one-third increase in the passive resistance may be used for resistance to transient loads such as wind and seismic. The upper one foot of soil should be neglected when calculating passive resistance.

The lateral resistance parameters provided above are ultimate values. Therefore, a suitable factor of safety should be applied to these values for design purposes. The appropriate factor of safety will depend on the design condition and should be determined by the project Structural Engineer. Depending on the application, typical factors of safety could range from 1.5 to 2.0.

4.4 EARTHWORK

4.4.1 General

Recommendations for site preparation are presented below. All site preparation and earthwork operations should be performed in accordance with applicable codes, safety regulations and other local, state or federal specifications. All references to maximum unit weights are established in accordance with the latest version of ASTM Standard Test Method D1557.

Grading operations during the wet season or in areas where the soils are saturated may require provisions for drying of soils prior to compaction. If the project necessitates fill placement and compaction in wet conditions, we can provide suggested alternative recommendations for drying the soil. Conversely, additional moisture may be required during the dry months. A sufficient water source should be available to provide adequate water during compaction. During dry months, moisture conditioning of the subgrade soils may be required if left exposed for greater than a few days.

4.4.2 Site Preparation

Prior to general site grading, existing vegetation, debris, and oversized materials (greater than 6 inches in maximum dimension) should be stripped and disposed outside the construction limits. We estimate the depth of stripping to be approximately 6 inches over most portions of the site. Deeper stripping or grubbing may be required where higher concentrations of vegetation are encountered during site grading. Stripped topsoil (less any debris) may be stockpiled and reused for landscaping purposes; however, this material should be evaluated for suitability if it is desired to use this material for engineered fill below structures.

All oversize and organic debris, including any produced by demolition operations, (wood, steel, piping, plastics, etc.), should be separated and disposed offsite. The material generated during demolition of the existing roadways and concrete structures may be reused onsite. If reused, the particles should be crushed to a maximum particle size of 6 inches and spread across the site to prevent nesting.

Existing utility pipelines (if encountered) which extend beyond the limits of the proposed construction and are to be abandoned in place should be plugged with cement grout to prevent migration of soil and/or water. Demolition, disposal, and grading operations should be observed and tested by a representative from our office.

4.4.3 Overexcavation

Recommendations for overexcavation of the proposed building pads (building foundations and floor slabs) and parking lots (pavements) are presented below. All site preparation and earthwork operations should be performed in accordance with applicable codes, safety regulations and other local, state, or federal specifications. All references to maximum unit weights are established in accordance with the latest version of ASTM Standard Test Method D1557.

Excavations within a 1:1 (horizontal: vertical) plane extending downward from a horizontal distance of 2 feet beyond the bottom outer edge of existing improvements (e.g. building foundations) or property lines should not be attempted without bracing and/or underpinning. All applicable excavation safety requirement and regulations, including OSHA requirements should be met.

4.4.3.1 Structural Areas

In order to provide uniform support for the proposed spread foundations and slab-on-grade floors, we recommend the site soils be overexcavated and replaced as engineered fill to a minimum depth of 3 feet from existing grade and at least 3 feet below the bottom of footings, whichever is greater. Building pads located in cut/fill transition areas should be overexcavated a minimum of 3 feet below the proposed bottom of footings/slabs. Although not encountered in our borings, any existing undocumented artificial fill soils should be removed until native alluvium is exposed. The overexcavation should extend horizontally at least 5 feet beyond the edges of foundations and a distance equivalent to the thickness of anticipated fill below the footing, whichever is greater. Depending on the observed condition of the existing soil and engineered fill, deeper overexcavation may be required in some areas. The Geotechnical Engineer of Record should be notified for supplemental recommendations if the minimum relative compaction of the soil is not achieved.

4.4.3.2 Non-structural Areas

Within the non-structural areas, such as truck aprons, pavements, sidewalks, other flatwork, etc., we recommend that these items be underlain by at least 24 inches of engineered fill. The overexcavation should extend beyond the proposed improvements a horizontal distance of at least two feet.

4.4.3.3 Additional Overexcavation Considerations

After site preparation and overexcavation, and prior to scarification or placement of compacted fills, the excavation bottom should be observed, evaluated, and approved by Kleinfelder. Additional removals may be needed if significant porosity or other adverse conditions are observed. The subgrade should then be scarified to a depth of approximately 12 inches, moisture conditioned to at least optimum moisture content; and recompacted. After compaction, the subgrade should be proof rolled using equipment with sufficient weight to evaluate surface deflection. Proof rolling should be performed to verify that the subgrade soils are firm and unyielding at the depth of the recommended overexcavation presented above.

4.4.4 Engineered Fill

We anticipate that most of the on-site soils may be reusable as engineered fill once any debris and oversized materials greater than 4 inches in diameter have been removed, and after any vegetation and organic debris is cleared. Engineered fill should contain less than 2 percent organic content and maximum material size should be less than 4 inches in maximum dimension. Disturbed/tilled soil, less vegetation, may be used in landscape areas, exported, or placed in a controlled manner and blended with the onsite soils, provided that the resulting engineered fill contains less than 2 percent organic content.

Fill should be placed in lifts no greater than 8 inches thick, loose measurement, and should be compacted to at least 90 percent of the maximum dry density. The moisture content of the on-site soils should be at or above the optimum moisture at the time of compaction.

Engineered fill placed below pavement should be compacted to at least 90 percent of the maximum dry density obtained by the ASTM D1557 method of compaction, with the upper 12 inches below pavements compacted to at least 95 percent relative compaction.

Although not anticipated, any imported fill materials to be used for engineered fill should be sampled and tested for approval by the geotechnical engineer prior to being transported to the site. The expansion index of an imported soil should be less than 20. In general, well-graded mixtures of gravel, sand and non-plastic silt are acceptable for use as import fill. A minimum notice of 3 working days will be required to allow for qualification testing prior to compaction of imported materials.

4.4.5 Temporary Excavations

All excavations must comply with applicable local, state, and federal safety regulations including the current OSHA Excavation and Trench Safety Standards. Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We are providing the information below solely as a service to our client. Under no circumstances should the information provided be interpreted to mean that Kleinfelder is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

Excavations within a 1:1 plane extending downward from a horizontal distance of 2 feet beyond the bottom outer edge of existing improvements (e.g. building foundations) should not be attempted without bracing and/or underpinning the improvements. The geotechnical engineer or their field representative should observe the excavations so that modifications can be made to the excavations, as necessary, based on variations in the encountered soil conditions. All applicable excavation safety requirements and regulations, including OSHA requirements, should be met.

Near-surface soils encountered during our field investigation consisted predominantly of sandy silt, silty sand and sands with varying amounts of gravel and cobble. In our opinion, these soils would be considered a Type 'C' soil with regard to the OSHA regulations. For this soil type, OSHA requires a maximum slope inclination of 1.5:1 (horizontal to vertical) or flatter for excavations 20 feet or less in depth. Temporary, shallow excavations with vertical side slopes less than 4 feet high should generally be stable, although sloughing may be encountered. Vertical excavations greater than 4 feet high should not be attempted without appropriate shoring to prevent local instability. All trench excavations should be braced and shored in accordance with good construction practice and all applicable safety ordinances and codes. The contractor should be responsible for the structural design and safety of the temporary shoring system, and we recommend that this design be submitted to Kleinfelder for review to check that our recommendations have been incorporated.

Stockpiled (excavated) materials should be placed no closer to the edge of an excavation than a distance equal to the depth of the excavation, but no closer than 4 feet. All trench excavations should be made in accordance with OSHA requirements.

4.4.6 Excavation Conditions

The borings were advanced using a truck-mounted or track-mounted hollow-stem auger drill rig. Drilling excavations were completed with easy to moderate effort through the existing site soils. Conventional earth moving equipment should be capable of performing the soil excavations.

4.4.7 Pipe Bedding and Trench Backfill

Pipe bedding and pipe zone material should consist of sand or similar granular material having a minimum sand equivalent value of 30. Onsite soils may be suitable, but should be tested and approved by the engineer of record prior to use. The sand should be placed in a zone that extends a minimum of 6 inches below and 6 inches above the pipe for the full trench width. The bedding material should be compacted to a minimum of 90 percent of the maximum dry density or to the satisfaction of the geotechnical engineer's representative observing the compaction of the bedding material. Bedding material should consist of sand, gravel, crushed aggregate, or native free-draining granular material with a maximum particle size of ¾ inch. Bedding materials should also conform to the pipe manufacturer's specifications, if available. Trench backfill above bedding and pipe zone materials may consist of approved, on-site or import soils placed in lifts no greater than 8 inches loose thickness and compacted to 90 percent of the maximum dry density based on ASTM Test Method D1557. Jetting of backfill is not recommended. The on-site soils are suitable for backfill of utility trenches from one foot above the top of the pipe to the surface provided the material is free of organic and deleterious substances.

4.5 CONCRETE SLABS SUPPORTED ON GRADE

4.5.1 General

Slab-on-grade floors should be underlain by engineered fill as discussed in the Earthwork Section of this report. We anticipate that the planned floor slabs will have a minimum thickness of 6 inches, will be unreinforced and dowelled at panel edges. Minimum reinforcement for floor slabs, if required, should be determined by the structural engineer. The structural engineer should design the slabs for any specific loading conditions. A modulus of subgrade reaction of 100 pounds per cubic inch may be used for design. The moisture content of the upper 18 inches of engineered fill should be at the recommended range for fill compaction at the time the floor slab is constructed. Precautions should be taken so as not to allow the upper engineered fill below the slab to dry out below the recommended moisture range between completion of the building pad and construction of the floor slab. Total static settlement for foundations designed in accordance with the recommendations presented herein, with an anticipated maximum load of 500 psf, is estimated to be less than a 1 inch.

Construction activities and exposure to the environment can cause deterioration of the prepared subgrade. We recommend that a Kleinfelder representative inspect the final subgrade conditions prior to placement of the concrete, and if necessary, perform additional moisture and density testing to determine the subgrade suitability. A low slump concrete should be used to reduce possible curling of the slab.

4.5.2 Exterior Flatwork

Where exterior flatwork, such as sidewalks, are to be constructed, the subgrade should be scarified to a depth of 8 inches and moisture conditioned to a moisture content above the optimum moisture content, and recompacted as recommended in the Earthwork Section of this report. Exterior, structurally loaded flatwork, such as truck docks or trash enclosures should adhere to the recommendations for rigid pavement presented in this report.

4.5.3 Vapor Retarder

Subsurface moisture and moisture vapor naturally migrate upward through the soil and, where the soil is covered by a building or pavement, this subsurface moisture will collect. To reduce the impact of this subsurface moisture and the potential impact of future introduced moisture (such as landscape irrigation or precipitation) on moisture sensitive flooring, the current industry standard is to place a vapor retarder on a compacted crushed rock layer and/or sand layers, 1 to 2 inches in thickness, placed above and below the vapor retarder. The crushed rock layer and/or sand layer may be omitted in accordance with the vapor barrier manufacturer's installation recommendations.

The necessity and placement of a vapor retarder should be evaluated by the structural engineer and/or flooring consultant. It should be noted that although vapor barrier systems are currently the industry standard, this system might not be completely effective in preventing floor slab moisture problems. These systems typically will not necessarily assure that floor slab moisture transmission rates will meet floor covering manufacturer standards and that indoor humidity levels be appropriate to inhibit mold growth. The design and construction of such systems are totally dependent on the proposed use and design of the proposed building and all elements of building design and function should be considered in the slab-on-grade floor design. Building design and construction may have a greater role in perceived moisture problems since sealed buildings/rooms or inadequate ventilation may produce excessive moisture in a building and affect indoor air quality.

4.5.4 Concrete Curing and Flooring

Various factors such as surface grades, adjacent planters, the quality of slab concrete and the permeability of the on-site soils affect slab moisture and can control future performance. In many cases, floor moisture problems are the result of either improper curing of floor slabs or improper application of flooring adhesives. We recommend contacting a flooring consultant experienced in the area of concrete slab-on-grade floors for specific recommendations regarding your proposed flooring applications. Special precautions must be taken during the placement and curing of all concrete slabs. Excessive slump (high water-cement ratio) of the concrete and/or improper curing procedures used during either hot or cold weather conditions could lead to excessive shrinkage, cracking or curling of the slabs. High water-cement ratio and/or improper curing also greatly increase the water vapor permeability of concrete. We recommend that all concrete placement and curing operations be performed in accordance with the American Concrete Institute (ACI) Manual.

It is emphasized that we are not floor moisture-proofing experts. We make no guarantee, nor provide any assurance that use of the capillary break/vapor retarder system will reduce concrete slab-on-grade floor moisture penetration to any specific rate or level, particularly those required by floor covering manufacturers. The builder and designers should consider all available measures for slab moisture protection.

4.6 RETAINING WALLS

We have provided preliminary cantilever retaining wall recommendations below. Further evaluation will be needed once wall types, locations and heights are selected.

4.6.1 General

Design earth pressures for retaining walls depend primarily on the allowable wall movement, wall inclination, type of backfill materials, backfill slopes, surcharges, and drainage. The earth pressures provided assume that that a non-expansive granular backfill will be used and a drainage system will be installed behind the walls, so that external water pressure will not develop. If a drainage system will not be installed, the wall should be designed to resist hydrostatic pressure in addition to the earth pressure as well as reinforcement that should be protected from rust or other corrosion-inducing effects of moisture. Determination of whether the active or at-rest condition is appropriate for design will depend on the flexibility of the walls. Walls that are free to rotate at least 0.002 radians (deflection at the top of the wall of at least 0.002 x H, where H is the unbalanced wall height) may be designed for the active condition. Walls that are not capable of this movement should be assumed rigid and designed for the at-rest condition. The recommended active and at-rest earth pressure values are provided in Table 2, Earth Pressures for Retaining Walls.

Table 2
Earth Pressures for Retaining Walls
(Non-Expansive Backfill)

Wall Movement	Backfill Condition	Equivalent Fluid Pressure (pcf)	Seismic Increment * (pcf)
Free to Deflect (active condition)	Level	45	16
Restrained (at-rest condition)		65	N/A **

Note: ** Walls supporting more than 6 feet of backfill should be designed to support an incremental seismic lateral pressure, which is applied as a triangular pressure distribution with a maximum pressure at the bottom of the wall, not inverted.*

*** for restrained wall, use the static active earth pressure and seismic increment to check the seismic condition; use at-rest earth pressure only to check the static condition; the larger loading of both cases should be used for the design of restrained wall.*

In addition to the above lateral pressure, undrained walls will have to be designed for full hydrostatic pressure. The above lateral earth pressures do not include the effects of surcharges (e.g., traffic, footings), compaction, or truck-induced wall pressures. Any surcharge (live, including traffic, or dead load) located within a 1:1 plane drawn upward from the base of the excavation should be added to the lateral earth pressures. The lateral contribution of a uniform surcharge load located immediately behind walls may be calculated by multiplying the surcharge by 0.36 for cantilevered walls and 0.53 for restrained walls. Walls adjacent to areas subject to vehicular traffic should be designed for a 2-foot equivalent soil surcharge (250 psf). Lateral load contributions from other surcharges located behind walls may be provided once the load configurations and layouts are known.

4.6.2 Backfill Compaction

Care must be taken during the compaction operation not to overstress the wall. Wall backfill should be compacted to a least 90 percent relative compaction; however, heavy construction equipment should be maintained a distance of at least 3 feet away from the walls while the backfill soils are being placed. Kleinfelder should be contacted when development plans are finalized for review of wall and backfill conditions on a case-by-case basis.

4.6.3 Drainage

Walls should be properly drained or designed to resist hydrostatic pressures. Adequate drainage is essential to provide a free-draining backfill condition and to limit hydrostatic buildup behind the wall. Walls should also be appropriately waterproofed and include weep holes for drainage. In lieu of weep holes, a 4-inch diameter perforated PVC pipe, placed perforations down leading to a suitable gravity outlet, should be installed at the base of the walls. Another drainage alternative could be a manufactured prefabricated drainage composite panel such as Miradrain G100N or equivalent at regular intervals along the wall.

4.7 DRAINAGE AND LANDSCAPING

It is important that positive surface drainage be provided to prevent ponding and/or saturation of the soils in the vicinity of foundations, concrete slabs-on-grade, or pavements. We recommend that the site be graded to carry surface water away from the improvements and that positive measures be implemented to carry away roof runoff. Poor perimeter or surface drainage could allow migration of water beneath the building or pavement areas, which may result in distress to project improvements. If planted areas adjacent to structures are desired, we suggest that care be taken not to over irrigate and to maintain a leak-free sprinkler piping system. In addition, it is recommended that planter areas next to buildings have a minimum of 5 percent positive fall away from building perimeters to a distance of at least 5 feet. Drain spouts should be extended to discharge a minimum of 5 feet from the building, or some other method should be utilized to prevent water from accumulating in planters. Landscaping after construction should not promote ponding of water adjacent to structures.

4.8 EXPANSION POTENTIAL

Expansive soils are characterized by their ability to undergo significant volume changes (shrink or swell) due to variations in moisture content. Changes in soil moisture content can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors and may result in unacceptable settlement or heave of structures or concrete slabs supported on grade. Expansion index testing of surficial soils resulted in a value of 5, which indicates a very low expansion potential.

4.9 HYDRO-COLLAPSE POTENTIAL

Hydro-collapsible soils are characterized by their ability to undergo significant shrinkage (collapse) during inundation. Inundation in soils can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors, and may result in unacceptable settlement of structures or concrete slabs supported on grade. Based on the results of laboratory testing, the collapse potential of the surficial soils is approximately 1.3 percent collapse under inundation. Collapse potential less than 2 percent is considered low.

4.10 PRELIMINARY SOIL CORROSIVITY

The soil corrosivity potential of the on-site materials to steel and buried concrete was preliminarily evaluated using a sample collected during our investigation. Testing was performed in general accordance with California Test Methods 643, 417, and 422 for pH and resistivity, soluble chlorides, and soluble sulfates, respectively. The test results are presented in Table 3, Preliminary Corrosivity Test Results.

Table 3
Preliminary Corrosivity Test Results

Boring	Depth (ft)	pH	Sulfate (ppm)	Chloride (ppm)	Resistivity (ohm-cm)
B-3	0 – 5	8.2	2,468	3,872	118

These tests are only an indicator of soil corrosivity for the samples tested. Other soils found on site may be more, less, or of a similar corrosive nature. Imported fill materials should be tested to confirm that their corrosion potential is not more severe than those noted.

Resistivity values below 1,000 ohm-cm are considered extremely corrosive to buried ferrous metals (Roberge, 2006).

The concentrations of soluble sulfates indicate that the subsurface soils represent a Class S2 exposure to sulfate attack on concrete in contact with the soil based on ACI 318-14 Table 19.3.1.1 (ACI, 2014). Therefore, in accordance with ACI Building Code 318-14, a concrete mix of Type V cement with a minimum compressive strength of 4,500 psi and maximum water-cement ratio of 0.45 are specified for these sulfate concentrations.

Kleinfelder's scope of services does not include corrosion engineering and, therefore, a detailed analysis of the corrosion test results is not included. A qualified corrosion engineer should be retained to review the test results for further evaluation and design protective systems, if considered necessary.

4.11 PAVEMENT SECTIONS

4.11.1 Asphalt-Concrete Pavement Sections

The required pavement structural sections will depend on the expected wheel loads, volume of traffic, and subgrade soils. The Traffic Indexes (TI's) assumed should be reviewed by the project Owner, Architect, and/or Civil Engineer to evaluate their suitability for this project. Changes in the TI's will affect the corresponding pavement section. The pavement subgrade should be prepared just prior to placement of the base course. Positive drainage of the paved areas should be provided since moisture infiltration into the subgrade may decrease the life of pavements. Table 4, Preliminary Asphalt Concrete Pavement Sections, presents our recommendations of asphalt concrete pavement sections.

Table 4
Preliminary Asphalt Concrete Pavement Sections
(Assumed Design R-value = 40)

Traffic Use	Assumed Traffic Index (TI)	Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
General Parking Traffic	5	3.0	4.0
Heavy Truck Access Ways	7	4.0	7.0

Based on the size of the project area and the variation of near surface soil type, an assumed design R-Value of 40 was selected for pavement design. Additional R-Value testing and analysis should be performed to evaluate the site further during the final geotechnical design. Since the characteristics of the near-surface soils can change as a result of grading, we recommend that the subgrade soils be tested for pavement support characteristics, to confirm the parameters used in design and allow for a possible reduction in structural section thickness. Pavement sections provided above are contingent on the following recommendations being implemented during construction.

- The pavement sections recommended above should be placed on at least 18 inches of engineered fill compacted to at least 90 percent of maximum dry density with the upper 12 inches below pavements compacted to at least 95 percent relative compaction. The overexcavation of the pavement areas should be conducted as recommended in the earthwork section of this report. Prior to fill placement, the exposed subgrade should be scarified to a depth of 8 inches, uniformly moisture conditioned to the moisture content of granular soils (sands, silty sands and gravels) should be near the optimum moisture content at the time of compaction.
- Subgrade soils should be in a stable, non-pumping condition at the time aggregate base materials are placed and compacted.

- Aggregate base materials should be compacted to at least 95 percent relative compaction.
- Adequate drainage (both surface and subsurface) should be provided such that the subgrade soils and aggregate base materials are not allowed to become wet.
- Aggregate base materials should meet current Caltrans specifications for Class 2 aggregate base rock, or crushed miscellaneous base as specified in the "Standard Specifications for Public Work Construction" ("Greenbook").
- The asphalt pavement should be placed in accordance with “Green Book” specifications or the County of Los Angeles requirements, as appropriate. We recommend that the asphalt pavement be placed in a single layer of ½-inch aggregate mix for pavements 4 inches thick or less. If the pavement section is over 4 inches thick, then the asphalt should be placed in at least two layers of mix. The first layer should consist of a base or coarse layer (3/4-inch mix). The second layer (i.e., top layer) should consist of a medium or fine layer of ½-inch mix.
- Based on our analyses and our experience with similar projects, it is our professional opinion that the as-built asphalt pavement sections should have a tolerance of +/- ¼-inch in order to remain valid for satisfying the intent of the recommendations presented herein. Typically, the loose thickness should be ¼ inch per inch greater than the required compacted thickness. In addition to loose measurements prior to compaction, this is typically evaluated by averaging the thickness of several cores in a specific area. Individual measurements (loose thickness or core dimension) should be within at least ¾-inch of the design thickness.
- All concrete curbs separating pavement and landscaped areas should extend into the subgrade and below the bottom of adjacent, aggregate base materials.

Pavement sections provided above are based on the soil conditions encountered during our field investigation, our assumptions regarding final site grades, and limited laboratory testing. Since the actual pavement subgrade materials exposed during grading may be significantly different than those tested for this study, we recommend that representative subgrade samples be obtained and additional R-value tests performed. Should the results of these tests indicate a significant difference, the design pavement section(s) provided above may need to be revised.

4.11.2 Portland Cement Concrete Pavement

Concrete pavements may be desirable in loading dock and trash collection areas. The concrete pavement should have a minimum 28-day compressive strength of 3,000 psi. Control joints should be spaced approximately every 10 feet. The concrete pavement section should be placed on at least 18 inches of engineered fill compacted to at least 90 percent of the maximum dry density. Prior to fill placement, the exposed subgrade should be scarified to a depth of 8 inches, uniformly moisture conditioned to the moisture content range recommended in Section 4.4 of this report. Table 5, Preliminary Recommended PCC Pavement Sections, presents our recommendations of Portland Cement Concrete pavement sections.

Table 5
Preliminary Recommended PCC Pavement Sections

Assumed Traffic Index (TI)	Concrete Thickness (inches; using a 28-day compressive strength of 3,000 psi)	Concrete Thickness (inches; using a 28-day compressive strength of 4,000 psi)
5	7.0	6.5
7	7.5	7.0

As an alternative to placing PCC pavements directly over 18 inches of engineered fill, 6 inches of aggregate base material may be added between the PCC and engineered fill to provide additional load distribution, drainage, and an option to reduce the thickness of the recommended PCC. If 6 inches of aggregate base material (compacted to 95% relative compaction) is used between the recommended 18 inches of engineered fill and PCC pavement, the recommended PCC thickness may be reduced by ½ inch. Aggregate base materials should meet current Caltrans specifications for Class 2 aggregate base, or crushed miscellaneous base as specified in the "Standard Specifications for Public Work Construction" ("Greenbook").

4.12 STORMWATER MANAGEMENT

We have preliminarily assessed the potential for storm water infiltration into the subgrade soils at the subject project site based on visual soil classification and laboratory testing of the soil samples collected during the field exploration. The onsite near-surface soils consist primarily of medium dense to dense clayey to silty sands. Based on these conditions, we anticipate a generally low infiltration capacity of the near-surface soils, and we preliminarily recommend alternatives to infiltration Best Management Practices (BMPs), such as bio-filtration/bio-retention systems (bio-swales and planter boxes), be implemented at the project site at these elevations. However, sand and sand with silt were observed in the upper 15 feet in limited layers in Borings B-1, B-2, and B-5. In-situ infiltration testing should be performed to confirm this preliminary assessment and determine design infiltration rates at the BMP design depth at specific locations at the site.

If bio-filtration/bio-retention systems are employed, we recommend that the BMPs be built such that water exiting from them will not seep into the foundation areas or beneath slabs and pavement. If planters are located within 10 feet of structures or foundations, or adjacent to slabs and pavements, then some means of diverting water away from the structures, foundation soils, or soils that support slabs and pavements would be required, such as lining the planters.

5 ADDITIONAL SERVICES

5.1 DESIGN LEVEL INVESTIGATION

This report presents preliminary geotechnical recommendations to develop a conceptual design and provide planning-level cost estimating. This study is not intended to be a design-level geotechnical study, and additional field and laboratory testing will be required in order to provide detailed geotechnical recommendations.

The preliminary recommendations provided in this report are based on our understanding of the described project information and on our interpretation of the data. We have made our recommendations based on experience with similar subsurface conditions under similar loading conditions. The recommendations apply to the specific project discussed in this report; therefore, any change in the structure configuration, loads, location, or the site grades should be provided to us so that we can review our conclusions and recommendations and make any necessary modifications.

6 LIMITATIONS

This report has been prepared for the exclusive use of NorthPoint Development, and its consultants and contractors for specific application to the proposed improvements for the proposed project. The findings, conclusions and recommendations presented in this report were prepared in a manner consistent with the standards of care and skill ordinarily exercised by members of our profession practicing under similar conditions in the geographic vicinity and at the time the services will be performed. No warranty or guarantee, express or implied, is made. Our field exploration program for the geotechnical study of this project was based on the approximate building locations provided to us by the client.

The client has the responsibility to see that all parties to the project, including the designer, contractor, subcontractors, etc., are made aware of this report in its entirety. This report contains information that may be useful in the preparation of contract specifications. However, this report is not designed as a specification document and may not contain sufficient information for this use without proper modification.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance, but in no event later than one year from the date of the report. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time. Any party, other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of this report and the nature of the new project, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party and the client agrees to defend, indemnify, and hold harmless Kleinfelder from any claims or liability associated with such unauthorized use or non-compliance.

The scope of our geotechnical services did not include any environmental site assessment for the presence or absence of hazardous/toxic materials, including methane or other landfill related gases. Kleinfelder will assume no responsibility or liability whatsoever for any claim, damage, or injury which results from pre-existing hazardous materials being encountered or present on the project site, or from the discovery of such hazardous materials.

7 REFERENCES

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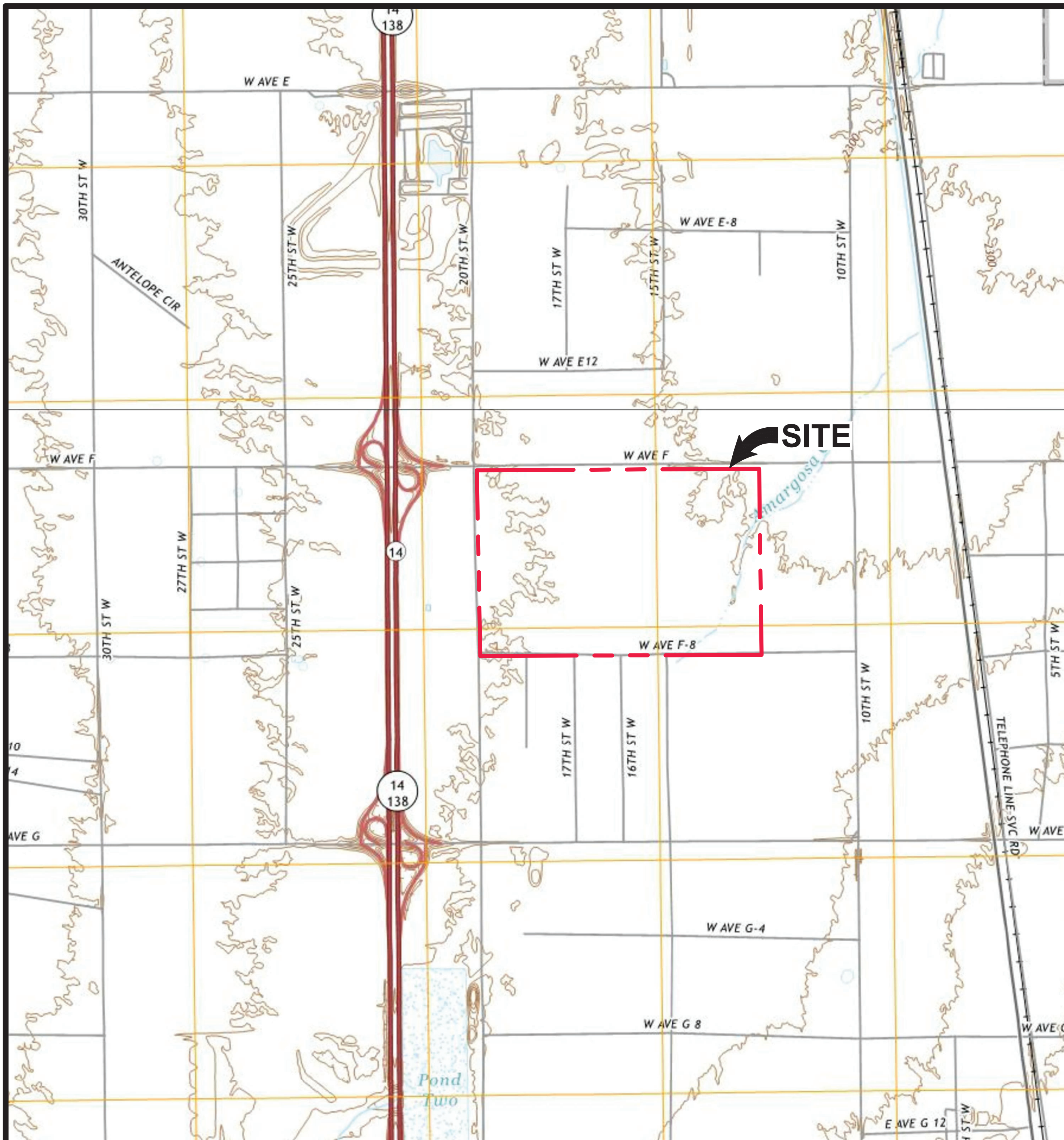
FIGURES

PLOTTED: 6/8/2022 11:44 AM BY: dean fahrney



SOURCE: U.S.G.S. 7.5' topographic series,Lancaster West and Rosamond, California quadrangles dated 2018.

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2,000 1,000 0 2,000

APPROXIMATE SCALE (feet)

KLEINFELDER
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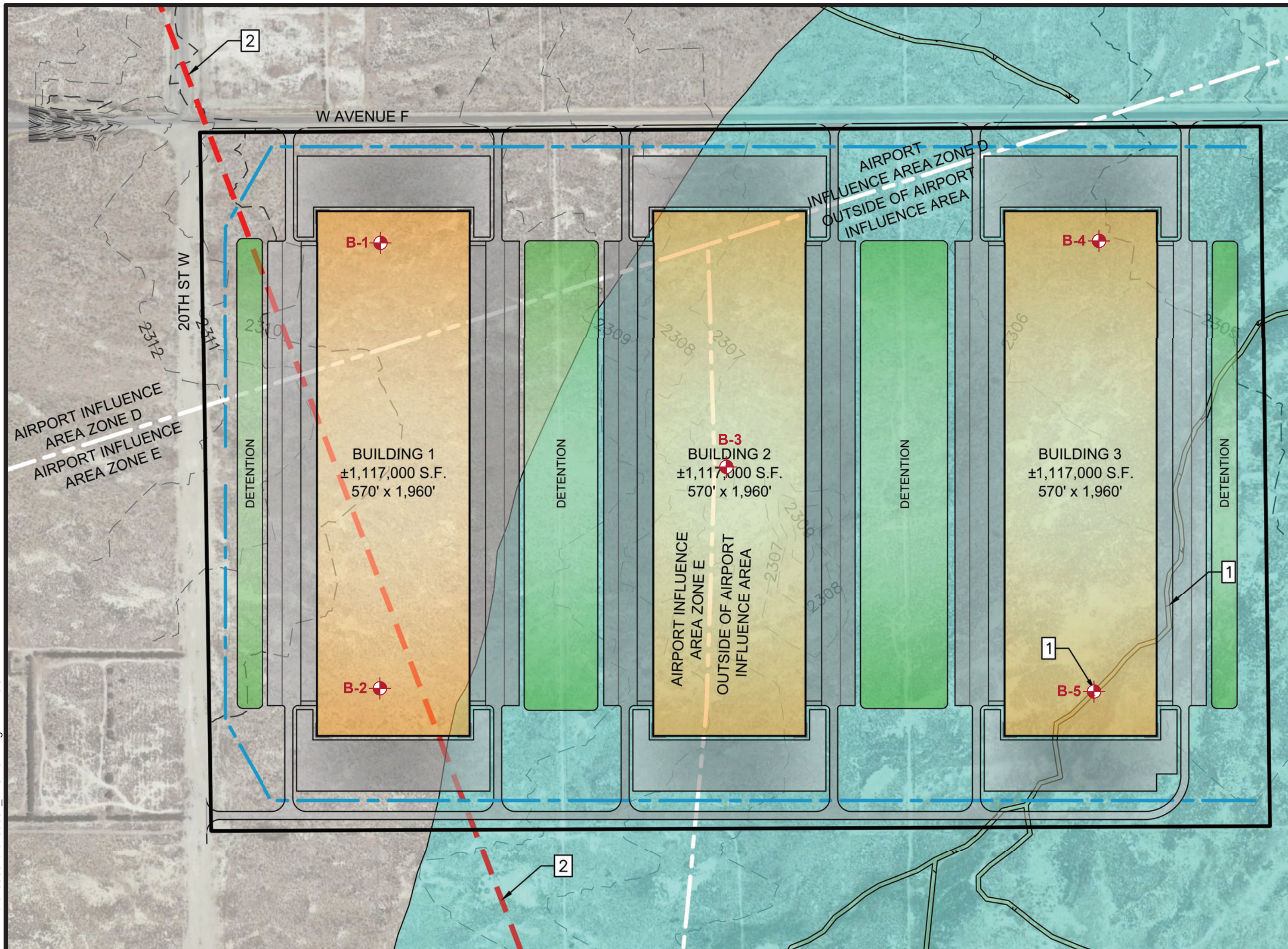
PROJECT: 20230661	SITE VICINITY MAP	FIGURE
DRAWN BY: DMF		
CHECKED BY: VF		1
DATE: 06/2022	FEASIBILITY-LEVEL GEOTECHNICAL INVESTIGATION ANTELOPE LAC 234 - LANCASTER AREA OF LOS ANGELES COUNTY, CALIFORNIA	
REVISED: -		

CAD FILE: C:\Users\DFahrney\Downloads\20230661\20230661_LAC-234.dwg



EXPLANATION

B-5 APPROXIMATE BORING LOCATION

REFERENCE: CONCEPT SITE PLAN A1 PROVIDED BY NORTH POINT DEVELOPMENT, DATED 04/11/2022

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PROJECT:	20230661
DRAWN BY	DMF
CHECKED BY	VF
DATE:	06/2022
REVISED:	-

EXPLORATION LOCATION MAP

FEASIBILITY-LEVEL GEOTECHNICAL INVESTIGATION
ANTELOPE LAC 234 - LANCASTER AREA OF
LOS ANGELES COUNTY, CALIFORNIA

FIGURE
2

CAD FILE: C:\Users\DFahrney\Downloads\20230661\20230661_LAC-234.dwg LAYOUT: 2

PLOTTED: 6/8/2022 12:19 PM BY: dean fahrney

APPENDIX A
FIELD EXPLORATIONS

APPENDIX A
FIELD EXPLORATIONS

The subsurface conditions at the site were explored by drilling and logging five (5) hollow-stem auger borings. Due to soft soil at the surface of the site, the hollow stem auger borings were drilled using either a truck-mounted or track-mounted drill rig. The hollow stem auger drill rigs were provided by 2R Drilling of Chino, California. The hollow stem auger drill rigs mentioned above were equipped with an automatic hammer system to drive the samplers. The locations of our borings are shown on Figure 2.

The logs of borings are presented as Figures A-3 through A-7. An explanation to the logs is presented on Figures A-1 and A-2. The Logs of Borings describe the earth materials encountered, samples obtained, and show field and laboratory tests performed. The logs also show the boring number, excavation date and the name of the logger and excavation subcontractor. A Kleinfelder geologist logged the borings utilizing the Unified Soil Classification System (USCS). The boundaries between soil types shown on the logs are approximate because the transition between different soil layers may be gradual. Bulk and drive samples of representative earth materials were obtained from the borings at maximum intervals of about 5 feet.

A California-type sampler was used to obtain relatively undisturbed drive samples of the soil encountered. This sampler consists of a 3-inch O.D., 2.4 inch I.D. split barrel shaft that is driven a total of 18 inches into the soil at the bottom of the boring. The soil was retained in six 1-inch brass rings for laboratory testing. The sampler was driven using a 140-pound hammer falling 30 inches. The total number of hammer blows required to drive the sampler the final 12 inches is termed the blow count and is recorded on the Logs of Borings. Where the sample was driven less than 12 inches, the number of blows to drive the sample for each 6-inch segment, or portion thereof, is shown on the logs. For example, 50/4" indicates 50 blows to drive the sampler 4 inches to refusal.

Bulk samples of the sub-surface soils were retrieved directly from the soil cuttings and placed in large plastic bags.

DRILLING METHOD/SAMPLER TYPE GRAPHICS

- BULK SAMPLE
- CALIFORNIA SAMPLER (3 in. (76.2 mm.) outer diameter)
- GRAB SAMPLE

GROUND WATER GRAPHICS

- WATER LEVEL (level where first observed)
- WATER LEVEL (level after stabilizing period)
- WATER LEVEL (additional levels after exploration)
- OBSERVED SEEPAGE

NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Solid lines separating strata on the logs represent approximate boundaries only, dashed lines are inferred or extrapolated boundaries. Actual transitions may be gradual or differ from those represented.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System (ASTM D2488/D2487) designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, ie., CL-ML, GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.

REFERENCES

1. American Society for Materials and Testing (ASTM), 2011, ASTM D2487: Classification of Soils for Engineering Purposes (Unified Soil Classification System).

UNIFIED SOIL CLASSIFICATION SYSTEM[1]

COARSE GRAINED SOILS (More than 50% retained on No. 200 Sieve)	GRAVELS (More than 50% of coarse fraction retained on No. 4 Sieve)	CLEAN GRAVEL WITH <5% FINES	GW	WELL-GRADED GRAVEL, WELL-GRADED GRAVEL WITH SAND
			GP	POORLY GRADED GRAVEL, POORLY GRADED GRAVEL WITH SAND
		GRAVELS WITH 5% TO 12% FINES	GW-GM	WELL-GRADED GRAVEL WITH SILT, WELL-GRADED GRAVEL WITH SILT AND SAND
			GW-GC	WELL-GRADED GRAVEL WITH CLAY (OR SILTY CLAY), WELL-GRADED GRAVEL WITH CLAY AND SAND (OR SILT CLAY AND SAND)
			GP-GM	POORLY GRADED GRAVEL WITH SILT, POORLY GRADED GRAVEL WITH SILT AND SAND
			GP-GC	POORLY GRADED GRAVEL WITH CLAY (OR SILTY CLAY), POORLY GRADED GRAVEL WITH CLAY AND (OR SILTY CLAY AND SAND)
		GRAVELS WITH > 12% FINES	GM	SILTY GRAVEL, SILTY GRAVEL WITH SAND
			GC	CLAYEY GRAVEL, CLAYEY GRAVEL WITH SAND
			GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL WITH SAND
	SANDS (50% or more of coarse fraction passes the No. 4 Sieve)	CLEAN SANDS WITH <5% FINES	SW	WELL-GRADED SAND, WELL-GRADED SAND WITH GRAVEL
			SP	POORLY GRADED SAND, POORLY GRADED SAND WITH GRAVEL
		SANDS WITH 5% TO 12% FINES	SW-SM	WELL-GRADED SAND WITH SILT, WELL-GRADED SAND WITH SILT AND GRAVEL
			SW-SC	WELL-GRADED SAND WITH CLAY (OR SILTY CLAY), WELL-GRADED SAND WITH CLAY AND GRAVEL (OR SILTY CLAY AND GRAVEL)
			SP-SM	POORLY GRADED SAND WITH SILT, POORLY GRADED SAND WITH SILT AND GRAVEL
			SP-SC	POORLY GRADED SAND WITH CLAY, POORLY GRADED SAND WITH CLAY AND GRAVEL (OR SILTY CLAY AND GRAVEL)
		SANDS WITH > 12% FINES	SM	SILTY SAND, SILTY SAND WITH GRAVEL
			SC	CLAYEY SAND, CLAYEY SAND WITH GRAVEL
			SC-SM	SILTY, CLAYEY SAND, SILTY, CLAYEY SAND WITH GRAVEL

FINE GRAINED SOILS (50% or more passes the No. #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)	ML	SILT, SILT WITH SAND, SILT WITH GRAVEL
		CL	LEAN CLAY, LEAN CLAY WITH SAND, LEAN CLAY WITH GRAVEL
		CL-ML	SILTY CLAY, SILTY CLAY WITH SAND, SILTY CLAY WITH GRAVEL
		OL	ORGANIC CLAY, ORGANIC CLAY WITH SAND, ORGANIC CLAY WITH GRAVEL, ORGANIC SILT, ORGANIC SILT WITH SAND, ORGANIC SILT WITH GRAVEL
	SILTS AND CLAYS (Liquid Limit 50 or greater)	MH	ELASTIC SILT. ELASTIC SILT WITH SAND, ELASTIC SILT WITH GRAVEL
		CH	FAT CLAY, FAT CLAY WITH SAND, FAT CLAY WITH GRAVEL
		OH	ORGANIC CLAY, ORGANIC CLAY WITH SAND, ORGANIC CLAY WITH GRAVEL, ORGANIC SILT, ORGANIC SILT WITH SAND, ORGANIC SILT WITH GRAVEL

NOTE: USE MATERIAL DESCRIPTION ON THE LOG TO DEFINE A GRAPHIC THAT MAY NOT BE PROVIDED ON THIS LEGEND.

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PROJECT NO.: 20230661.001A	GRAPHICS KEY	FIGURE
DRAWN BY: VF	Feasibility-Level Geotechnical Investigation Antelope LAC 234 - Lancaster Area of Los Angeles County, California	A-1
CHECKED BY: JDW		
DATE: 6/10/2022		

GRAIN SIZE[1]

DESCRIPTION		SIEk E SIZE	GRAIN SIZE
; oglders		702 in%	702 in%(Hy4%8 5 5 %)
Cobbles		H- 02 in%	H- 02 in%(9>%2 - Hy4%8 5 5 %)
Grahel	3oarse	H/4 -Hin%	H/4 -Hin%(0p - 9>%2 5 5 %)
	fine	#4 - H/4 in%	y%0p - y%3c in%(4%8 - 0p 5 5 %)
Sand	3oarse	#0y - #4	y%%9p - y%0p in%(2 - 4%) 5 5 %)
	5 edig5	#4y - #0y	y%%09 - y%%9p in%(y%4H - 2 5 5 %)
	fine	#2yy - #4y	y%%y2p - y%%09 in%(y%%9 - y%4H5 5 %)
Fines		Passinv #2yy	1y%%y2p in%(1y%%9 5 5 %)

SECONDARY CONSTITUENT[1]

Ter5 of Use	AMOUNT	
	Se3ondarV Constitgent is Fine Grained	Se3ondarV Constitgent is Coarse Grained
Tra3e	1cm	10cm
< itW	≥c to 10cm	≥0c to 1Hym
Modifier	≥0cm	≥Hym

PLASTICITY[1]

DESCRIPTION	CRITERIA
Non-Plasti3	A 0/8 in%(H5 5) tWead 3annot be rolled at anV water 3ontent%
Low	TWe tWead 3an barelV be rolled and tWe lg5 u 3annot be for5 ed wWen drier tWan tWe ulasti3 li5 it%
Medig5	TWe tWead is easV to roll and not 5 g3W ti5 e is reqgired to rea3W tWe ulasti3 li5 it% TWe tWead 3annot be rerolled after rea3Winv tWe ulasti3 li5 it% TWe lg5 u 3rg5 bles wWen drier tWan tWe ulasti3 li5 it%
BivW	It ta. es 3onsiderable ti5 e rollinv and . neadinv to rea3W tWe ulasti3 li5 it% TWe tWead 3an be rerolled seheral ti5 es after rea3Winv tWe ulasti3 li5 it% TWe lg5 u 3an be for5 ed witWogt 3rg5 blinv wWen drier tWan tWe ulasti3 li5 it%

MOISTURE CONTENT[1]

DESCRIPTION	FIELD TEST
DrV	Absen3e of 5 oistgre, dgstV, drV to tWe tog3W
Moist	Da5 u bgt no hisible water
< et	k isible free water, gsgallV soil is below water table

CONSISTENCY - FINE-GRAINED SOIL[2, 3]

CONSISTENCY	SPT - N (# blows / ft)	Po3. et Pen (tsf)	UNCONFINED COMPRESSIk E STRENGTB (Q_g)(usf)	k ISUAL / MANUAL CRITERIA
k erV Soft	12	PP 1 y%2c	1cyy	EasilV uenetrated seheral in3Wes bV fist
Soft	2 - 4	y%2c ≤ PP 1y%c	cyy - 0,yyy	EasilV uenetrated seheral in3Wes bV tWg5 b
Medig5 Stiff	4 - 8	y%c ≤ PP 10	0,yyy - 2,yyy	Can be uenetrated seheral in3Wes bV tWg5 b witW 5 oderate effort
Stiff	8 - 0c	0 ≤ PP 12	2,yyy - 4,yyy	ReadilV indented bV tWg5 b bgt uenetrated onlV witW vreat effort
k erV Stiff	0c - Hy	2 ≤ PP 14	4,yyy - 8,yyy	ReadilV indented bV tWg5 bnail
Bard	7Hy	4 ≤ PP	78,yyy	Indented bV tWg5 bnail witW diffi3gltV

APPARENT DENSITY - COARSE-GRAINED SOIL[2]

APPARENT DENSITY	SPT-N (# blows / ft)
k erV Loose	14
Loose	4 - 0y
Medig5 Dense	0y - Hy
Dense	Hy - cy
k erV Dense	7cy

STRUCTURE[1]

DESCRIPTION	CRITERIA
Stratified	Alternatinv laVers of harVinv 5 aterial or 3olor witW laVers at least 0/4-in%(>5 5) tWi3. , note tWi3. ness%
La5 inated	Alternatinv laVers of harVinv 5 aterial or 3olor witW tWe laVers less tWan 0/4-in%(> 5 5) tWi3. , note tWi3. ness%
Fissgred	; rea. s alonv definite ulanes of fra3tgre witW little resistan3e to fra3tgrinv%
Sli3. ensided	Fra3tgre ulanes auuear uolisWed or vlossV, so5 eti5 es striated%
; lo3. V	CoWesihe soil tWat 3an be bro. en down into s5 all anvglar lg5 us wWi3W resist fgrtWer brea. down%
Lensed	In3lgsion of s5 all uo3. ets of different soils, sg3W as s5 all lenses of sand s3attered tWrogvW a 5 ass of 3laV6note tWi3. ness%
Bo5 oveneogs	Sa5 e 3olor and auuearan3e tWrogvWogt

ANGULARITY[1]

DESCRIPTION	CRITERIA
Anvglar	Parti3les Wahe sWaru edves and relatihelV ulane sides witW gnuolisWed sgrfa3es%
Sgbanvglar	Parti3les are si5 ilar to anvglar des3riution bgt Wahe rognded edves%
Sgbrognded	Parti3les Wahe nearlV ulane sides bgt Wahe well-rognded 3orners and edves%
Rognded	Parti3les Wahe s5 ootWlV 3grhed sides and no edves%

REACTION WITH HYDROCHLORIC ACID[1]

DESCRIPTION	FIELD TEST
None	No hisible rea3tion
< ea.	So5 e rea3tion, witW bgbbles for5 inv slowlV
Stronv	k iolent rea3tion, witW bgbbles for5 inv i5 5 ediatelV

CEMENTATION[1]

DESCRIPTION	FIELD TEST
< ea. lV	Crg5 bles or brea. s witW Wandlinv or little finver uressgre
ModeratelV	Crg5 bles or brea. s witW 3onsiderable finver uressgre
StronvlV	< ill not 3rg5 ble or brea. witW finver uressgre

REFERENCES

0%A5 eri3an So3ietV for Materials and Testinv (ASTM), 2y09, ASTM D2488: Standard Pra3ti3e for Des3riution and Identifi3ation of Soils (k isgal Mangal Pro3edgres)%

2%TerzavWi, K and Pe3. , R%0p48, Soil Me3Wani3s in Envineerinv Pra3ti3e, JoWn < ileV & Sons, New Yor. %

H%United States Deuart5 ent of tWe Interior ; greag of Re3la5 ation (US; R), 0pp8, EartW Mangal, Part I%

KLEINFELDER Bright People. Right Solutions.	PROJECT NO% 2y2Hy>>0%y0A DRA< N ; Y: k F CBECKED ; Y: JD< DATE: >/0y/2y22	SOIL DESCRIPTION KEY (For additional tables, see ASTM D2488) FeasibilitV-Lehel Geote3Wni3al Inhestivation Anteloue LAC 2H4 - Lan3aster Area of Los Anveles CogntV, California	FIGURE A-2

Date Begin - End:	5/20/2022	**Drilling Co.-Lic.#:**	2R Drilling - #709029		**BORING LOG B-1**
Logged By:	C. Dang	**Drill Crew:**	Eddie/Victor		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	GT-16	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Very Windy and Sunny	**Exploration Diameter:**	8 in. O.D.		

Depth (feet)	Lithologic Description (Surface Condition: Bare Earth)	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
	FIELD EXPLORATION				LABORATORY RESULTS						
0	**Alluvium** **Silty Clayey SAND (SC-SM)**: fine to medium sand, non-plastic, brown, dry										Hand auger to 5 ft bgs Modified Proctor Expansion Index Direct Shear
4	**Clayey SAND (SC)**: fine to medium sand, low to medium plasticity, brown, dry, dense										
5			BC=14 29 40	18"	4.9	117.9					
10	fine to coarse sand, low plasticity, medium dense		BC=13 15 19	18"	5.3	110.4	100	41			
13	**Well-Graded SAND with Silt (SW-SM)**: fine to coarse sand, non-plastic, brown, dry, medium dense										
15			BC=10 12 15	18"	4.3	121.1					
18	**Sandy Lean CLAY (CL)**: fine to medium sand, medium plasticity, grayish brown, moist, stiff, calcium deposits										
20			BC=4 9 16	18"	22.2	105.5					
25	medium to stiff, increasing sand content		BC=6 2 4	18"	15.2	111.1					

The boring was terminated at approximately 26.5 ft. below ground surface. The boring was backfilled with auger cuttings on May 20, 2022.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.
GENERAL NOTES:

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20230661.001A	BORING LOG B-1	FIGURE
	DRAWN BY: VF CHECKED BY: JDW DATE: 6/10/2022	Feasibility-Level Geotechnical Investigation Antelope LAC 234 - Lancaster Area of Los Angeles County, California	A-3

BORING LOG B-2

Date Begin - End:	5/20/2022	**Drilling Co.-Lic.#:**	2R Drilling - #709029		
Logged By:	C. Dang	**Drill Crew:**	Eddie/Victor		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	GT-16	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Very Windy and Sunny	**Exploration Diameter:**	8 in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Surface Condition: Bare Earth

Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0	**Alluvium** **Clayey SAND (SC)**: fine to medium sand, low plasticity, brown, dry										Hand auger to 5 ft bgs
4	**Poorly Graded SAND (SP)**: medium to coarse sand, non-plastic, reddish brown, dry, very dense, trace subrounded gravel										
5		■	BC=17 30 48	18"	4.4	112.7					Collapse Potential
10	increasing moisture content, trace silt content	■	BC=13 15 18	18"	6.9	110.7					
15		■	BC=10 14 14	18"	7.1	120.5			NP	NP	
16	**Sandy Lean CLAY (CL)**: fine to medium sand, medium plasticity, brown, moist, stiff, calcium deposits										
20	interbedded silty sand	■	BC=12 24 19	18"	9.5	123.4					
23	**Silty SAND (SM)**: fine to medium sand, non-plastic, brown, moist, loose to medium dense										
25		■	BC=7 4 11	18"	35.3	91.0					

The boring was terminated at approximately 26.5 ft. below ground surface. The boring was backfilled with auger cuttings on May 20, 2022.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:

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PROJECT NO.: 20230661.001A		BORING LOG B-2	FIGURE
DRAWN BY:	VF	Feasibility-Level Geotechnical Investigation Antelope LAC 234 - Lancaster Area of Los Angeles County, California	A-4
CHECKED BY:	JDW		
DATE:	6/10/2022		PAGE: 1 of 1

Date Begin - End:	5/23/2022	**Drilling Co.-Lic.#:**	2R Drilling - #709029		**BORING LOG B-3**
Logged By:	C. Dang	**Drill Crew:**	Jerry/Carlos		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-55 Track Rig	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Very Windy and Sunny	**Exploration Diameter:**	8 in. O.D.		

FIELD EXPLORATION / LABORATORY RESULTS

Surface Condition: Bare Earth

Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0	**Alluvium** **Clayey SAND (SC)**: fine to medium sand, non-plastic, brown, dry	Bulk									Hand auger to 5 ft bgs; Corrosion
5	dry to moist, medium dense	Drive	BC=10 13 13	18"	15.5	104.2					
10	low plasticity, dry, increase in sand, trace subrounded gravel	Drive	BC=10 20 25	18"	3.3	108.8					
15	dense, increasing moisture content	Drive	BC=19 28 36	17"	2.6	109.9	98	15			
18	**Well-Graded SAND (SW)**: fine to coarse sand, non-plastic, reddish brown, dry, dense, trace subrounded gravel										
20		Drive	BC=13 23 36	16"	1.6	103.8					
22		Bulk			3.4						
23	**Sandy Lean CLAY (CL)**: fine to medium sand, medium plasticity, brown, moist, stiff										
25		Drive	BC=6 7 15	18"	31.4	86.3			46	21	
28	**Lean CLAY with Sand (CL)**: fine to medium sand, medium to high plasticity, brown, moist, stiff, trace silt content										
30		Drive	BC=10 8 11	18"					48	29	
33	**Clayey SAND (SC)**: fine to coarse sand, low plasticity, reddish brown, dry to moist, very dense, trace subrounded gravel										

Date Begin - End:	5/23/2022	**Drilling Co.-Lic.#:**	2R Drilling - #709029		**BORING LOG B-3**
Logged By:	C. Dang	**Drill Crew:**	Jerry/Carlos		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-55 Track Rig	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Very Windy and Sunny	**Exploration Diameter:**	8 in. O.D.		

FIELD EXPLORATION						LABORATORY RESULTS						
Depth (feet)	Graphical Log	Surface Condition: Bare Earth Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		Clayey SAND (SC): fine to coarse sand, low plasticity, reddish brown, dry to moist, very dense, trace subrounded gravel		BC=7 14 50/5"	18"							
		Poorly Graded SAND with Silt (SP-SM): medium to coarse sand, non-plastic, reddish brown, dry to moist, medium dense										
40				BC=15 23 12	18"	13.2	106.7			47	26	
		Sandy Lean CLAY (CL): fine to medium sand, medium to high plasticity, brown, moist, stiff										
45				BC=5 9 18	18"	19.9	108.0			NP	NP	
		Silty SAND (SM): fine to medium sand, non-plastic, brown, moist, medium dense										
		Sandy Lean CLAY (CL): medium sand, medium plasticity, gray, moist, stiff, trace subrounded gravel										
50				BC=5 10 11	18"	14.3	110.6			42	26	

The boring was terminated at approximately 51.5 ft. below ground surface. The boring was backfilled with auger cuttings on May 23, 2022.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:

55

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65

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PROJECT NO.: 20230661.001A		BORING LOG B-3	FIGURE
DRAWN BY:	VF	Feasibility-Level Geotechnical Investigation Antelope LAC 234 - Lancaster Area of Los Angeles County, California	A-5
CHECKED BY:	JDW		
DATE:	6/10/2022		

BORING LOG B-4

Date Begin - End:	5/23/2022	**Drilling Co.-Lic.#:**	2R Drilling - #709029		
Logged By:	C. Dang	**Drill Crew:**	Jerry/Carlos		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-55 Track Rig	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Hot and Sunny	**Exploration Diameter:**	8 in. O.D.		

Surface Condition: Bare Earth

Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)		Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0	SC	**Alluvium** **Clayey SAND (SC)**: fine to medium sand, non-plastic, brown, dry											Hand auger to 5 ft bgs
4	SM	**Silty SAND (SM)**: fine to medium sand, reddish brown, dry, dense, weakly cemented											
5			■	BC=25 33 43	18"								
8	CL	**Sandy Lean CLAY (CL)**: fine to coarse sand, medium plasticity, brown, moist, very stiff											
10			■	BC=9 10 14	18"		19.1	89.9					Consolidation
11.5	SC	**Clayey SAND (SC)**: fine to medium sand, non-plastic, reddish brown, moist, medium dense, trace subrounded gravel											
15			■	BC=10 10 24	18"		21.1	99.7					
20			■	BC=10 12 13	18"		14.6	114.9					
20.5	CL	**Sandy Lean CLAY (CL)**: fine to medium sand, medium plasticity, mottled grayish brown, moist, very stiff											
23	SM	**Silty SAND (SM)**: fine to medium sand, non-plastic, reddish brown, dry, loose											
25			■	BC=6 7 5	18"		11.0	111.2					

The boring was terminated at approximately 26.5 ft. below ground surface. The boring was backfilled with auger cuttings on May 23, 2022.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:

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PROJECT NO.:	20230661.001A
DRAWN BY:	VF
CHECKED BY:	JDW
DATE:	6/10/2022

BORING LOG B-4

Feasibility-Level Geotechnical Investigation
Antelope LAC 234 - Lancaster Area of
Los Angeles County, California

FIGURE
A-6

Date Begin - End:	5/23/2022	**Drilling Co.-Lic.#:**	2R Drilling - #709029		**BORING LOG B-5**
Logged By:	C. Dang	**Drill Crew:**	Jerry/Carlos		
Hor.-Vert. Datum:	Not Available	**Drilling Equipment:**	CME-55 Track Rig	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	Hot and Sunny	**Exploration Diameter:**	8 in. O.D.		

Surface Condition: Bare Earth

Depth (feet)	Lithologic Description (FIELD EXPLORATION)	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Recovery (NR=No Recovery)	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0	**Alluvium** **Sandy SILT (ML)**: fine to medium sand, low to medium plasticity, brown, dry, mud cracks present	Hand auger									Hand auger to 5 ft bgs
4	**Well-Graded SAND with Silt (SW-SM)**: fine to coarse sand, non-plastic, grayish brown, dry, dense, trace subangular gravel, trace silt content										
5		Sample	BC=12 18 33	13"	0.8		100	5.8			Disturbed
8	**Sandy Lean CLAY (CL)**: fine to medium sand, medium plasticity, brown, moist, very stiff, calcium deposits										
10		Sample	BC=10 12 13	18"	19.5						
13	**Poorly Graded SAND (SP)**: fine to medium sand, non-plastic, grayish brown, dry, medium dense, trace rounded gravel										
15		Sample	BC=12 20 24	12"	1.0						
18	**Clayey SAND (SC)**: medium to coarse sand, non-plastic, grayish brown, moist, dense, trace rounded gravel										
20		Sample	BC=9 23 27	18"	2.2						Disturbed
21.5	**Sandy Lean CLAY (CL)**: fine to medium sand, high plasticity, olive gray, moist, hard										
23	**Clayey SAND (SC)**: fine to coarse sand, non-plastic, dark gray, moist, medium dense, trace subrounded gravel										
25		Sample	BC=12 15 20	17"	15.9						

The boring was terminated at approximately 26.5 ft. below ground surface. The boring was backfilled with auger cuttings on May 23, 2022.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:

30

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PROJECT NO.: 20230661.001A		BORING LOG B-5	FIGURE
DRAWN BY:	VF	Feasibility-Level Geotechnical Investigation Antelope LAC 234 - Lancaster Area of Los Angeles County, California	A-7
CHECKED BY:	JDW		
DATE:	6/10/2022		PAGE: 1 of 1

APPENDIX B
LABORATORY TESTING

LABORATORY TESTING

Laboratory tests were performed on drive and bulk soil samples to estimate engineering characteristics of the various earth materials encountered. The laboratory testing was performed by our laboratory located in Ontario, California or by AP Engineering & Testing, Inc. of Pomona, California. Testing was performed in general accordance with procedures outlined in the American Society for Testing and Materials, or other accepted procedures. Visual classifications presented on the lab figures performed by AP Engineering may differ from those presented on the boring logs provided in Appendix A.

LABORATORY MOISTURE DETERMINATIONS AND UNIT WEIGHTS

Natural moisture content and unit weight tests were performed on selected samples. The moisture content tests were performed in general accordance with ASTM Test Method D 2216 and the unit weight tests were performed in general accordance with ASTM Test Method D 2937. The results are presented on the Logs of Borings in Appendix A.

SIEVE ANALYSES

Sieve analyses were performed on selected samples of the materials encountered at the site to evaluate the grain size distribution characteristics of the soils and to aid in their classification. Tests were performed in general accordance with ASTM Test Method D 6913. Results of these tests are presented in the boring logs in Appendix A and attached as Figure B-1, Grain Size Distribution Curve.

ATTERBERG LIMITS (PLASTICITY INDEX)

Plasticity limit and liquid limit testing was performed on soil samples to evaluate behavior conditions at varying water contents. Testing was performed in general accordance with ASTM Standard Test Method D4318. The results are presented on the boring logs in Appendix A and attached as Figures B-2 and B-3, Plasticity Testing.

DIRECT SHEAR

Direct shear testing was performed on a remolded sample for shear strength and cohesion values of the in-situ soils in accordance with ASTM Standard Test Method D 3080. The result is presented as Figure B-4, Direct Shear Test.

CONSOLIDATION TESTS

Consolidation testing was performed on selected relatively undisturbed samples by AP Engineering in accordance with ASTM D 2435. The tests were performed on 1.0-inch-high, 2.41-inch diameter samples. After trimming the ends, the sample was placed in a consolidometer and an initial reading was recorded. The sample was saturated during loading, and thereafter, the sample was incrementally loaded. The test results are attached to this appendix.

ONE-DIMENSIONAL SWELL/COLLAPSE TEST

Laboratory testing was performed on selected soil samples to study the collapse potential of the subgrade soils. During this test, the soil sample is inundated with water at a specific surcharge loading and the percent swell or collapse is measured. This test was performed by AP Engineering in accordance with ASTM D4546. The test results are attached to this appendix.

PRELIMINARY CORROSIVITY TESTS

A series of chemical tests were performed on a selected sample of the near-surface soils to estimate pH, resistivity and sulfate and chloride contents. The sample was tested in general accordance with California Test Methods 643, 422, and 417 for pH and minimum resistivity, soluble chlorides, and soluble sulfates, respectively. Test results may be used by a qualified corrosion engineer to evaluate the general corrosion potential with respect to construction materials. The tests were performed by AP Engineering. The results of these tests are presented in Table B-1, Preliminary Corrosion Test Results.

MODIFIED PROCTOR

Maximum density-optimum moisture tests were performed on a select bulk sample of the on-site soils to determine compaction characteristics. The test was performed in accordance with ASTM Standard Test Method D 1557. The test results are presented in Table B-2, Modified Proctor Test Results.

EXPANSION INDEX

Expansion Index testing was performed on one near surface bulk sample to determine the expansion potential of the soil. The test was performed in accordance with ASTM Standard Test Method D4829. The test result is presented in Table B-3, Expansion Index Test Result.

Table B-1
Preliminary Corrosivity Test Results

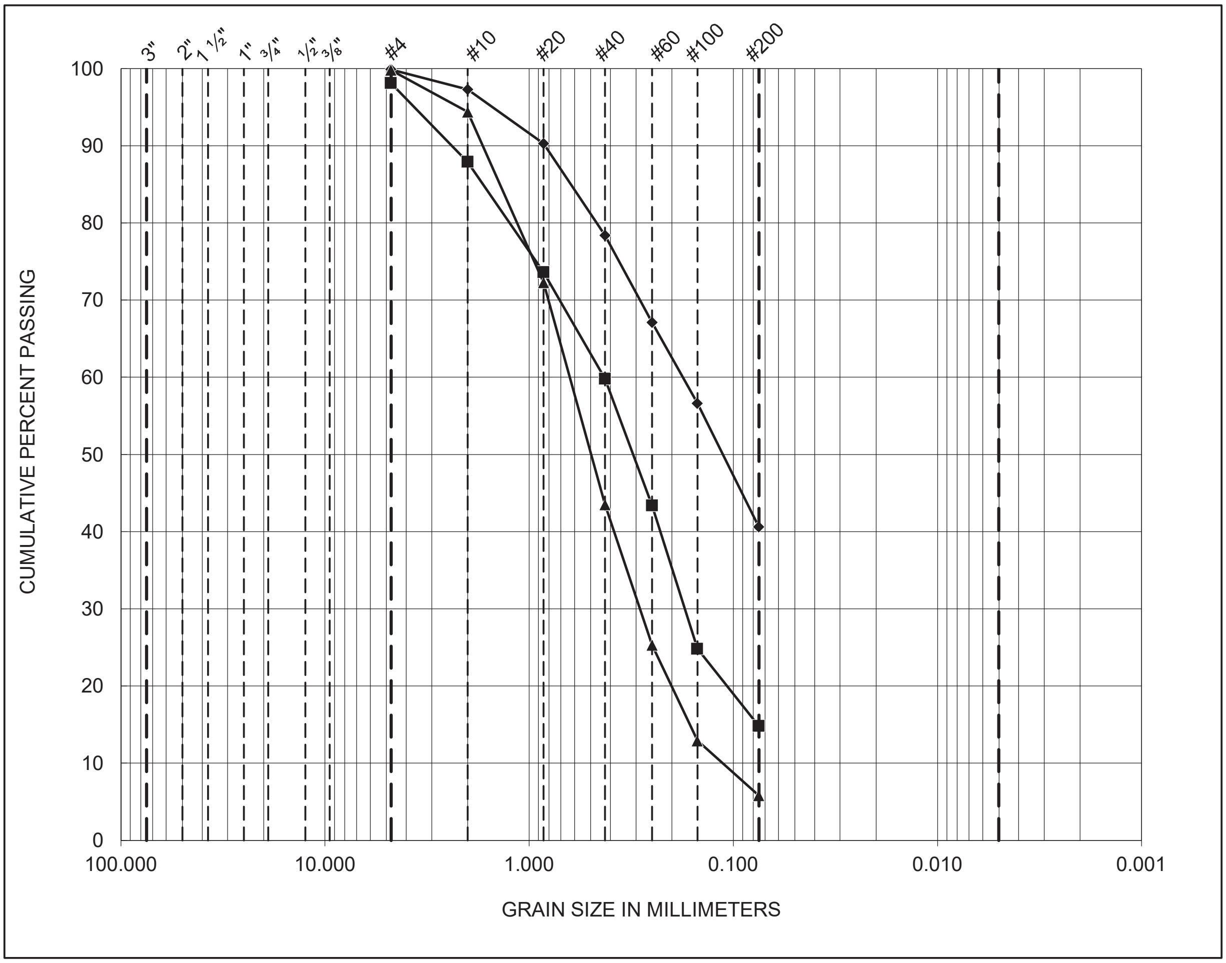
Boring	Depth (ft)	pH	Sulfate (ppm)	Chloride (ppm)	Resistivity (ohm-cm)
B-3	0 – 5	8.2	2,468	3872	118

Table B-2
Modified Proctor Test Results

Boring Number	Depth (ft)	Maximum Dry Density (pcf)	Optimum Moisture (%)
B-1	0 – 5	120.5	11.2

Table B-3
Expansion Index Test Result

Boring Number	Depth (ft)	Expansion Index	Expansion Potential
B-1	0 – 5	5	Very Low



COBBLE	GRAVEL	SAND	SILT	CLAY

SYMBOL	SAMPLE IDENTIFICATION			PERCENTAGES			ATTERBERG LIMITS			SOIL CLASSIFICATION
	BORING NO.	SAMPLE NO.	DEPTH (ft.)	GRAVEL	SAND	FINES	LL	PL	PI	
◆	B-1	3	10	0.1	59.3	40.6	NM	NM	NM	Clayey Sand (SC)
■	B-3	4	15	1.9	83.3	14.8	NM	NM	NM	Clayey Sand (SC)
▲	B-5	2	5	0.2	94.0	5.8	NM	NM	NM	Well Graded Sand with Silt (SW-SM)

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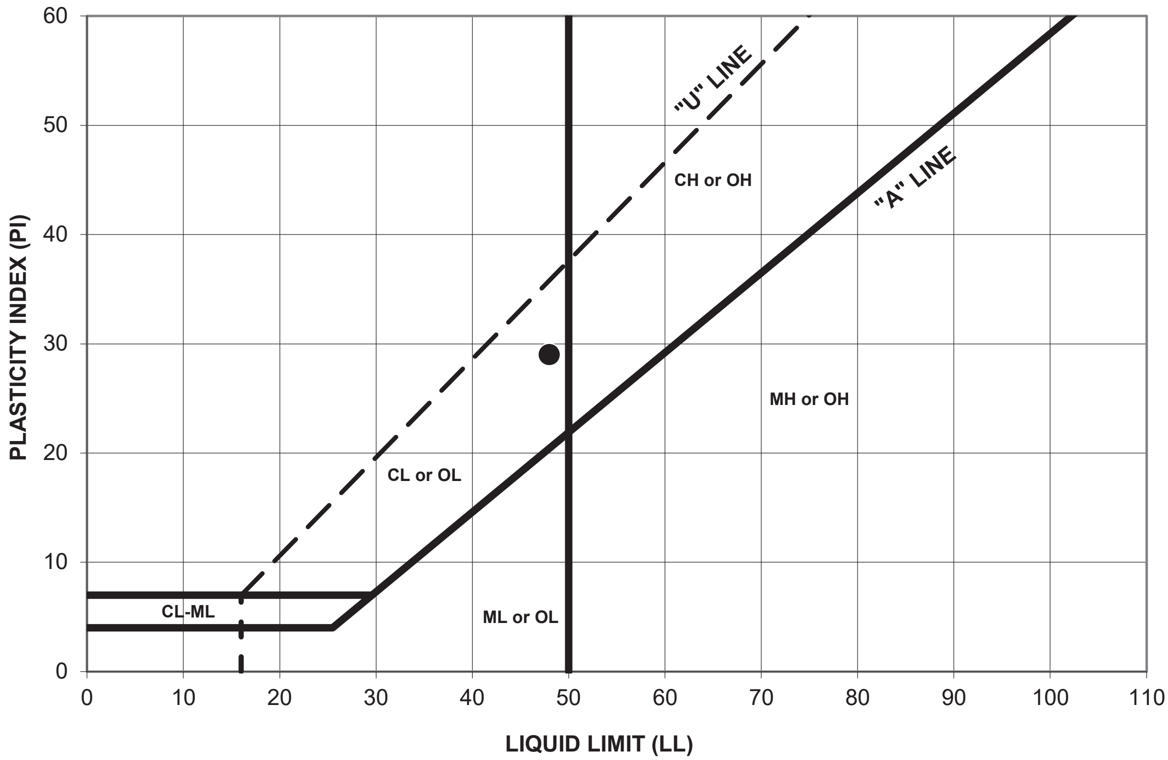
PROJECT NO.:	20230661.001A
TESTED BY:	J. Calderon
DATE:	5/26/2022
CHECKED BY:	M. Magaña
DATE:	6/1/2022

GRAIN SIZE DISTRIBUTION

FEASIBILITY-LEVEL GEOTECHNICAL INVESTIGATION
ANTELOPE LAC 234 - LANCASTER AREA OF LOS ANGELES COUNTY, CALIFORNIA

FIGURE

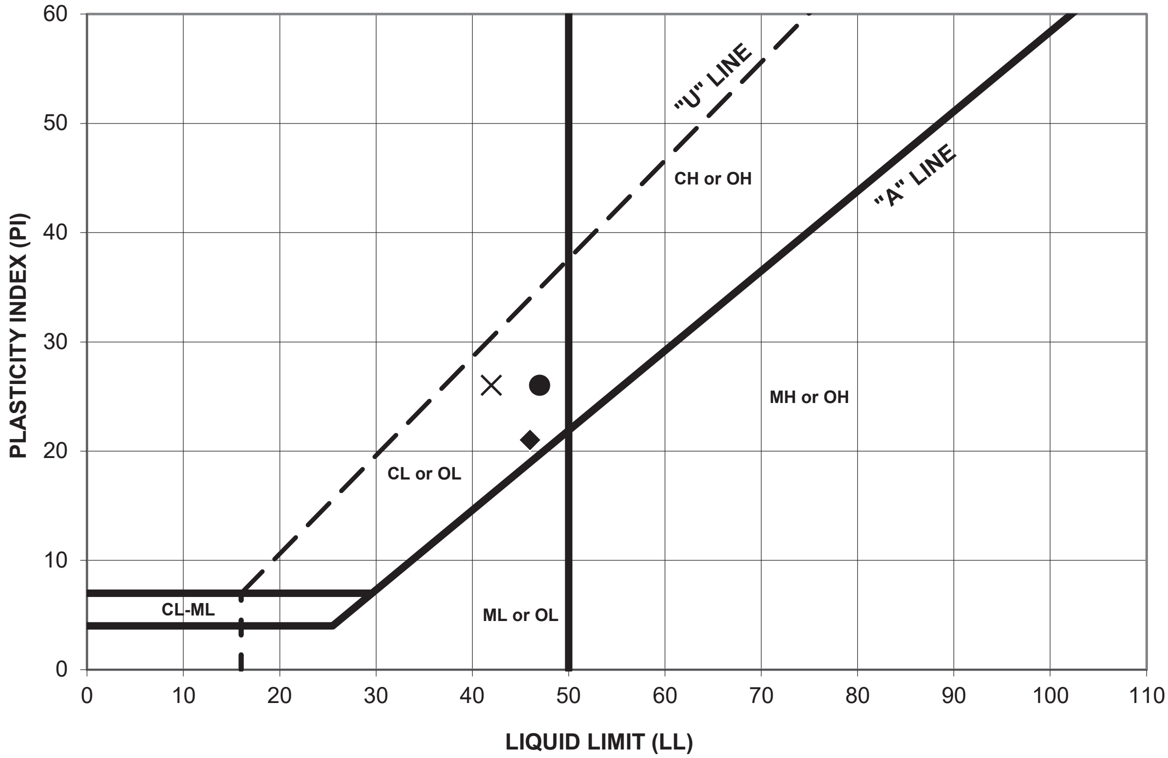
B-1



SYMBOL	SAMPLE IDENTIFICATION			ATTERBERG LIMITS			SOIL CLASSIFICATION
	BORING NO.	SAMPLE NO.	DEPTH (ft)	LL	PL	PI	
◆	B-2	3	15	NP	NP	NP	Poorly Graded Sand (SP)
●	B-3	7	30	48	19	29	Lean Clay with Sand (CL)

Testing performed in general accordance with ASTM D4318

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20230661.001A TESTED BY: J. Calderon DATE: 5/31/2022 CHECKED BY: M. Magaña DATE: 6/1/2022	PLASTICITY TESTING FEASIBILITY-LEVEL GEOTECHNICAL INVESTIGATION ANTELOPE LAC 234 - LANCASTER AREA OF LOS ANGELES COUNTY, CALIFORNIA	FIGURE B-2

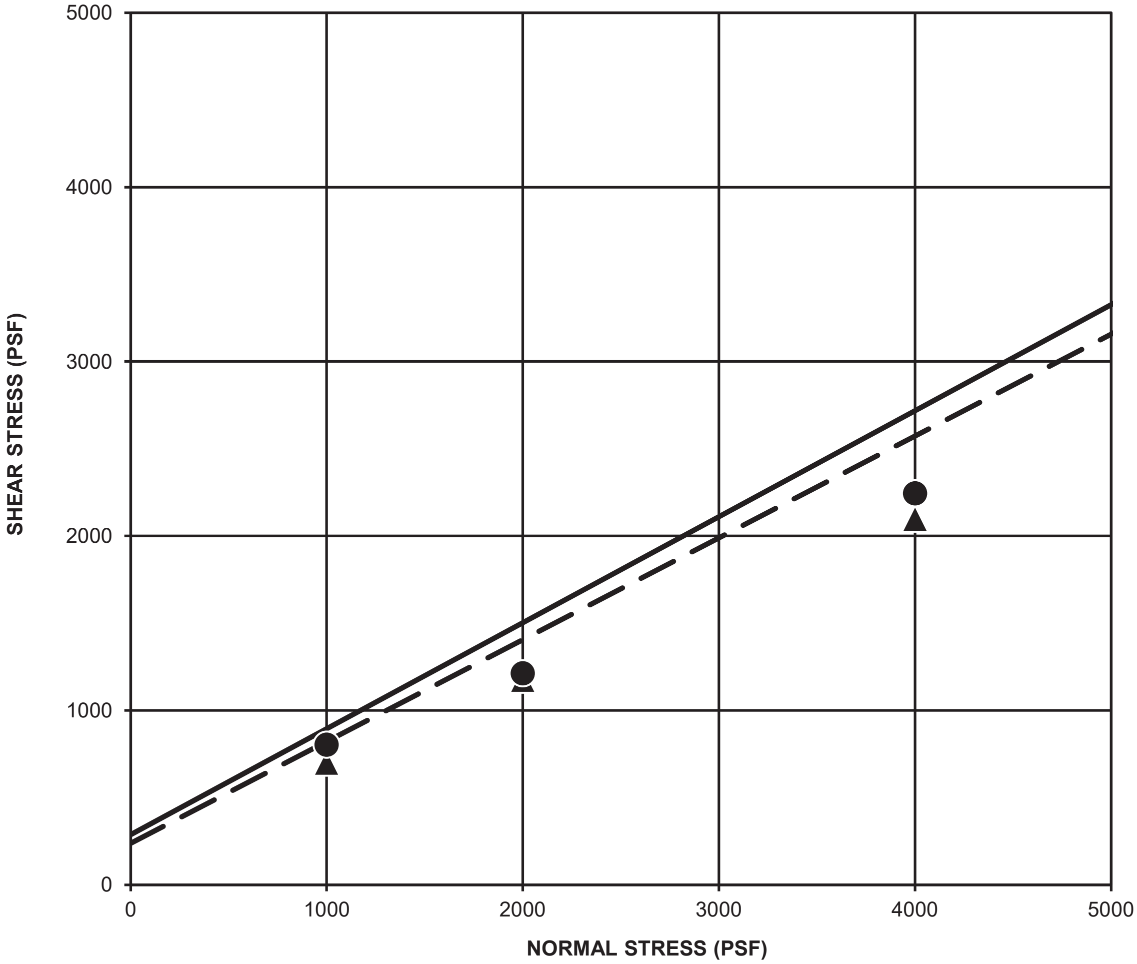


SYMBOL	SAMPLE IDENTIFICATION			ATTERBERG LIMITS			SOIL CLASSIFICATION
	BORING NO.	SAMPLE NO.	DEPTH (ft)	LL	PL	PI	
◆	B-3	6	25	46	25	21	Sandy Lean Clay (CL)
●	B-3	9	40	47	21	26	Sandy Lean Clay (CL)
▲	B-3	10	45	NP	NP	NP	Silty Sand (SM)
×	B-3	11	50	42	16	26	Sandy Lean Clay (CL)

Testing performed in general accordance with ASTM D4318

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20230661.001A		PLASTICITY TESTING	FIGURE
TESTED BY:	J. Calderon		
DATE:	5/31/2022	FEASIBILITY-LEVEL GEOTECHNICAL INVESTIGATION ANTELOPE LAC 234 - LANCASTER AREA OF LOS ANGELES COUNTY, CALIFORNIA	B-3
CHECKED BY:	M. Magaña		
DATE:	6/1/2022		



SYMBOL		BORING NO.	SAMPLE NO.	DEPTH (ft)	COHESION (psf)	FRICTION ANGLE (deg)	SOIL CLASSIFICATION
PEAK	●	B-1	1	0-5'	288.0	26	Silty Clayey Sand (SC-SM)
ULTIMATE	▲	B-1	1	0-5'	238.0	25	Silty Clayey Sand (SC-SM)

INITIAL MOISTURE (%):	11.2%
INITIAL DRY DENSTIY (pcf):	107.9
FINAL MOISTURE (%):	18.3%

Normal Stress (psf)	1000	2000	4000
Peak Stress (psf)	804	1212	2244
Ultimate Stress (psf)	700	1175	2100

Performed in general accordance with ASTM D 3080, Remolded to 90% Relative Compaction

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.:	20230661.001A
TESTED BY:	J. Calderon
DATE:	6/1/2022
CHECKED BY:	M. Magaña
DATE:	6/1/2022

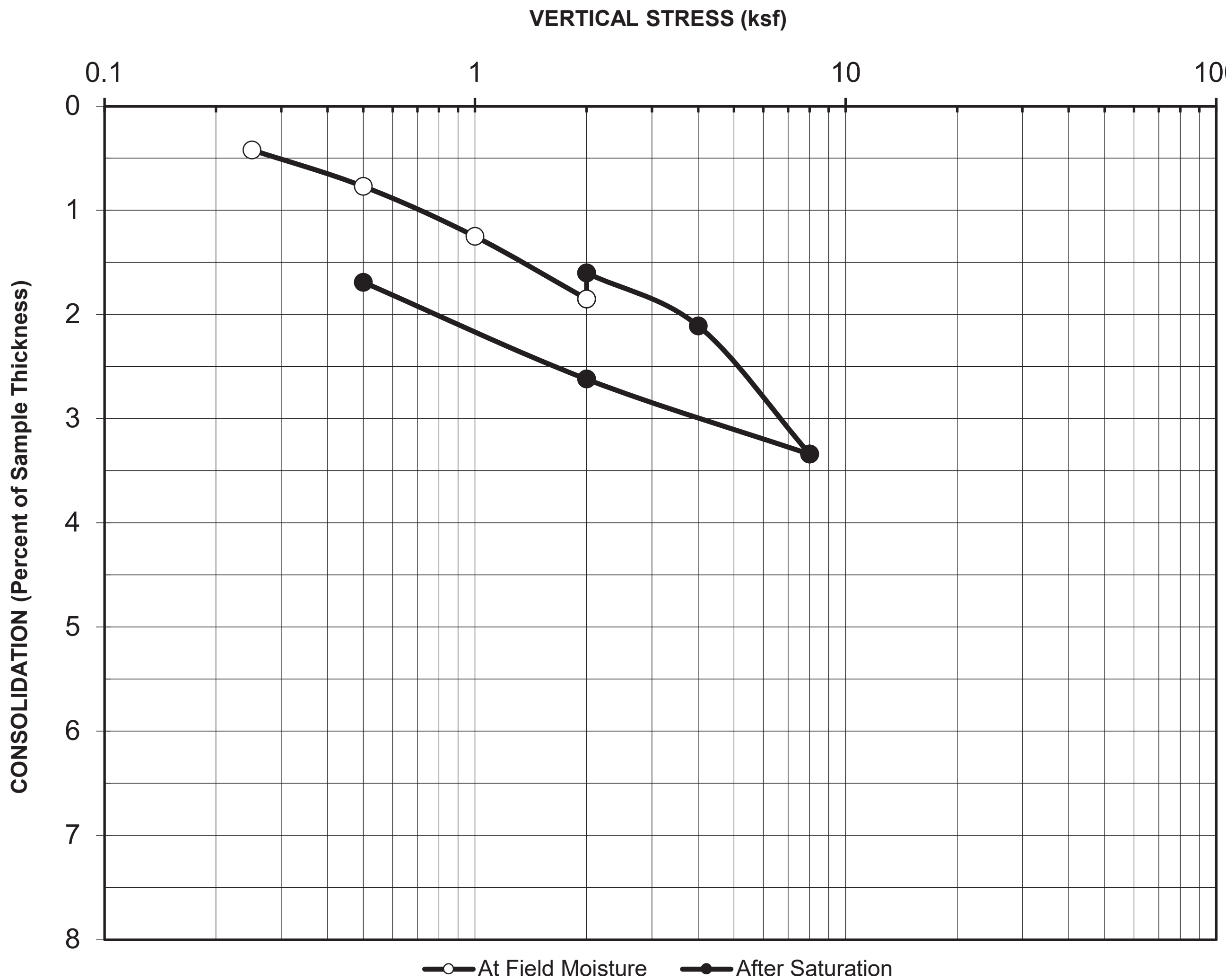
DIRECT SHEAR TEST

FEASIBILITY-LEVEL GEOTECHNICAL INVESTIGATION
ANTELOPE LAC 234 - LANCASTER AREA OF LOS ANGELES COUNTY, CALIFORNIA

FIGURE

B-4

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



Boring No. :	B-4	Initial Dry Unit Weight (pcf):	89.9
Sample No.:	2	Initial Moisture Content (%):	19.1
Depth (feet):	10	Final Moisture Content (%):	23.7
Sample Type:	Mod Cal	Assumed Specific Gravity:	2.7
Soil Description:	Lean Clay	Initial Void Ratio:	0.87
Remarks:	Swell= 0.25% upon inundation		

CONSOLIDATION CURVE
ASTM D 2435

Project Name: NorthPoint: Antelope LAC 234
Project No.: 20230661.001A
Date: 5/26/2022
AP No: 22-0557 **Sheet No:** 1

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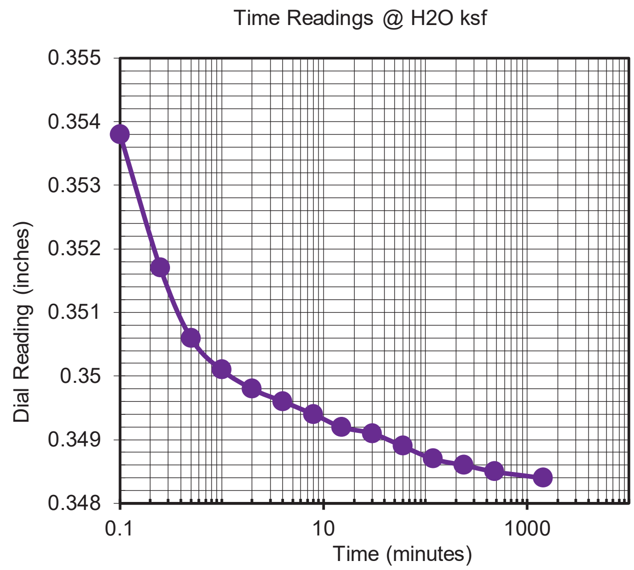

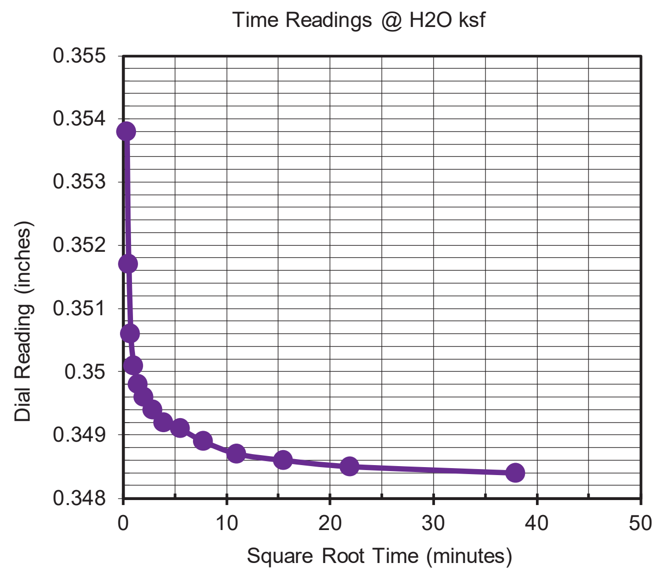

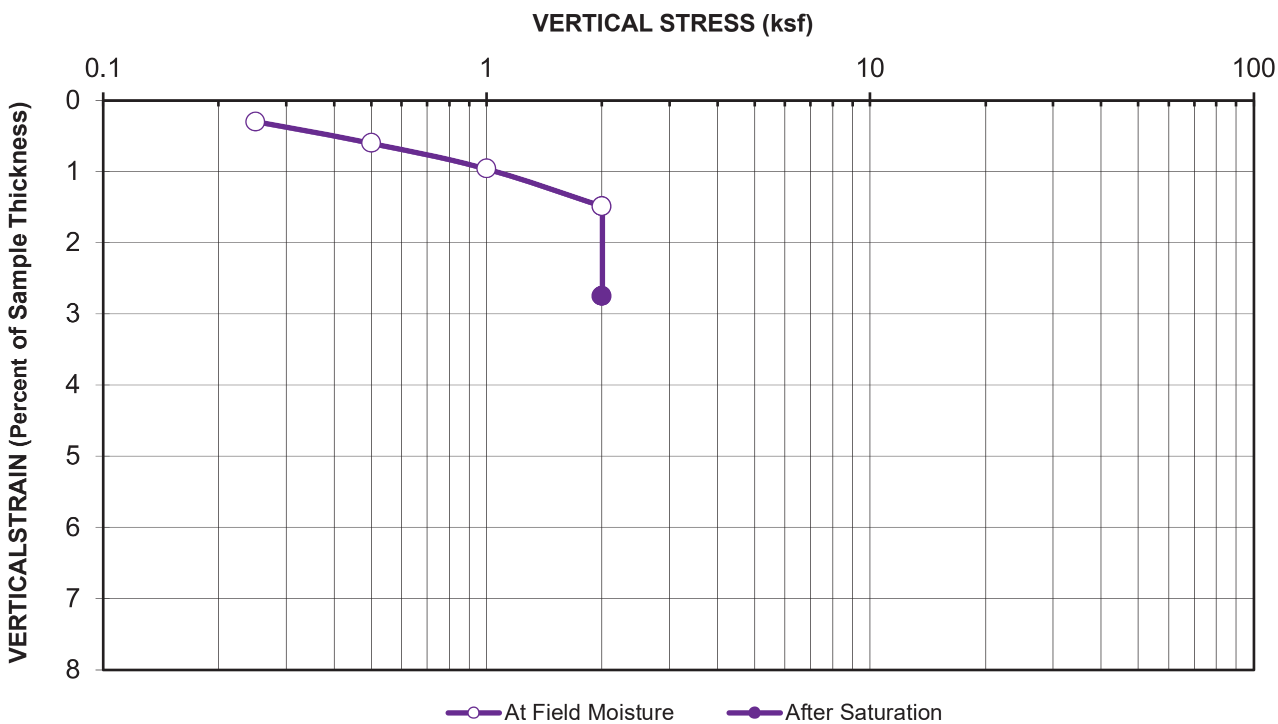

Boring No. :	B-2	Initial Dry Unit Weight (pcf):	112.7
Sample No.:	1	Initial Moisture Content (%):	4.4
Depth (feet):	5	Final Moisture Content (%):	16.4
Sample Type:	Mod Cal	Initial Void Ratio:	0.50
Soil Description:	Well-Graded Sand w/silt		
Remarks:	Collapse = 1.26% upon inundation		

1-D SWELL/COLLAPSE
ASTM D 4546-14, Method B

Project Name: NorthPoint: Antelope LAC 234
Project No.: 20230661.001A
Date: 5/26/22
AP No: 22-0557