



**Evergreen Commercial Development Project  
Initial Study/Mitigated Negative Declaration**

**Appendix E**

**Geotechnical Engineering Investigation With Geologic Hazard Study**

**Salem Engineering Group, Inc.**

**April 22, 2021**



**SALEM**  
engineering group, inc.

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# **GEOTECHNICAL ENGINEERING INVESTIGATION WITH GEOLOGIC HAZARD STUDY**

**PROPOSED COMMERCIAL DEVELOPMENT  
CENTRAL AVENUE AND CAMBERN AVENUE  
LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA**

**SALEM PROJECT NO. 3-221-0167  
APRIL 22, 2021**

***PREPARED FOR:***

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April 22, 2021

Project No. 3-221-0167

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**SUBJECT: GEOTECHNICAL ENGINEERING INVESTIGATION  
WITH GEOLOGIC HAZARD STUDY  
PROPOSED COMMERCIAL DEVELOPMENT  
CENTRAL AVENUE AND CAMBERN AVENUE  
LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA**

Dear Mr. Prystasz:

At your request and authorization, SALEM Engineering Group, Inc. (SALEM) has prepared this Geotechnical Engineering Investigation with Geologic Hazard Study report for the Proposed Commercial Development to be located at the subject site.

The accompanying report presents our findings, conclusions, and recommendations regarding the geotechnical aspects of designing and constructing the project as presently proposed. In our opinion, the proposed project is feasible from a geotechnical viewpoint provided our recommendations are incorporated into the design and construction of the project.

We appreciate the opportunity to assist you with this project. Should you have questions regarding this report or need additional information, please contact the undersigned at (909) 980-6455.

Respectfully Submitted,

**SALEM ENGINEERING GROUP, INC.**

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### **APPENDIX A – FIELD INVESTIGATION**

Figures A-1 through A-24, Logs of Exploratory Soil Borings B-1 through B-24
Percolation Test Results, P-1 and P-2
Liquefaction Analysis Report

### **APPENDIX B – LABORATORY TESTING**

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Direct Shear Test Results
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**GEOTECHNICAL ENGINEERING INVESTIGATION  
WITH GEOLOGIC HAZARD STUDY  
PROPOSED COMMERCIAL DEVELOPMENT  
CENTRAL AVENUE AND CAMBERN AVENUE  
LAKE ELSINORE, RIVERSIDE COUNTY, CALIFORNIA**

**1. PURPOSE AND SCOPE**

This report presents the results of our Geotechnical Engineering Investigation with Geologic Hazard Study for the proposed Commercial Development to be located at the east corner of Central Avenue and Cambern Avenue in the City of Lake Elsinore, County of Riverside, California (see Figure 1, Vicinity Map).

The purpose of our geotechnical engineering investigation was to observe and sample the subsurface conditions encountered at the site, and provide conclusions and recommendations relative to the geotechnical aspects of constructing the project as presently proposed.

The scope of this investigation included a field exploration, percolation testing, laboratory testing, engineering analysis and the preparation of this report. Our field exploration was performed on March 30 and 31, 2021 and included the drilling of twenty-four (24) small-diameter soil borings to a maximum depth of 41½ feet below existing grade at the site. Additionally, two (2) percolation tests were performed at depths of approximately 6 feet below existing grade for determination of the infiltration rate. The locations of the soil borings and percolation tests are depicted on Figure 2, Site Plan. A detailed discussion of our field investigation, exploratory boring logs and percolation test results are presented in Appendix A.

Laboratory tests were performed on selected soil samples obtained during the investigation to evaluate pertinent physical properties for engineering analyses. Appendix B presents the laboratory test results in tabular and graphic format. The recommendations presented herein are based on analysis of the data obtained during the investigation and our experience with similar soil and geologic conditions. If project details vary significantly from those described herein, SALEM should be contacted to determine the necessity for review and possible revision of this report. Earthwork and Pavement Specifications are presented in Appendix C. If text of the report conflict with the specifications in Appendix C, the recommendations in the text of the report have precedence.

**2. PROJECT DESCRIPTION**

Based on the Site Plan provided to us, we understand that the site will include construction of a commercial development in two potential phases on an approximately 8.3 acres of vacant land. Phase 1 (3.7 acres) will include a gas station, a 4,088 square-foot Convenience Store, a 3,000 square-foot QSR, and a 120-foot carwash tunnel. Phase 2 (4.6 acres) will include a 43,000 square-foot Grocery Building and a 3,000 square-foot QSR Building. On-site parking and landscaping are planned to be associated with the development.

Maximum wall load is expected to be on the order of 5 kips per linear foot. Maximum column load is expected to be on the order of 100 kips. Floor slab soil bearing pressure is expected to be on the order of 150 psf.

A site grading plan was not available at the time of preparation of this report. As the existing project area is essentially level, we anticipate that cuts and fills during the earthwork will be minimal to moderate and limited to providing level building pads and positive site drainage. In the event that changes occur in the nature or design of the project, the conclusions and recommendations contained in this report will not be considered valid unless the changes are reviewed and the conclusions of our report are modified.

### **3. GENERAL SITE INFORMATION**

#### **3.1 Site Location and Description**

The site is near-square in shape and encompasses approximately 8.3 acres. The site is located on the east corner of Central Avenue and Cambern Avenue in the unincorporated Lake Elsinore area of the County of Riverside, California (see Vicinity Map, Figure 1). The northwest portion of the site is the proposed Phase 1 development and encompasses approximately 3.7 acres. The southeast portion of the site is the proposed Phase 2 development and encompasses approximately 4.6 acres.

The site is currently vacant with weeds and large trees. Dense large trees and weeds are present within the eastern portion of the site where a natural drainage course flows through that area. Scattered large eucalyptus trees are present within the western boundary and west-central portion of the site. A ground relief was observed on the eastern end of the site. The site is gently sloping to the south with elevations ranging from 1,333 to 1,313 feet above mean sea level based on Google Earth imagery.

#### **3.2 Site History**

Based on review of historical aerial photographs and topographic maps, between at least 1949 and 1974, the northwestern portion of the site appears to have been occupied by a rectangular-shaped pit that is deeper in the center and slopes out on each side. During this time period, the northern/northwestern portion of the site appears to be associated with the clay pit mining operations located adjoining to the northwest across Central Avenue. By 1978, the pit had been backfilled and the site appeared to have been graded.

Between at least 1985 and at least 1990, the northwestern portion of the site appears to have been occupied by a mobile home sales facility. By 1994, it appears that the sales facility had been removed and that the northwestern portion of the site appeared to have been graded. The site appears to remain mostly unchanged since 1994.

### **4. FIELD EXPLORATION**

Our field exploration consisted of site surface reconnaissance and subsurface exploration. The exploratory test borings (B-1 through B-24) were drilled on March 30 and 31, 2021 in the areas shown on the Site Plan, Figure 2. The test borings were advanced with 4-inch diameter solid flight augers and 6.5-inch diameter hollow stem augers rotated by a truck-mounted CME 45C drill rig. Test borings B-23 and B-24 were advanced using a 4-inch diameter hand auger. The test borings were extended to a maximum

depth of 41½ feet below existing grade. Drilling was limited due to auger refusal on dense soil/weathered bedrock formations.

The materials encountered in the test borings were visually classified in the field, and logs were recorded by a field engineer and stratification lines were approximated on the basis of observations made at the time of drilling. Visual classification of the materials encountered in the test borings were generally made in accordance with the Unified Soil Classification System (ASTM D2488). A soil classification chart and key to sampling is presented on the Unified Soil Classification Chart, in Appendix "A." The logs of the test borings are presented in Appendix "A." The Boring Logs include the soil type, color, moisture content, dry density, and the applicable Unified Soil Classification System symbol.

The location of the test borings were determined by measuring from features shown on the Site Plan, provided to us. Hence, accuracy can be implied only to the degree that this method warrants. The actual boundaries between different soil types may be gradual and soil conditions may vary. For a more detailed description of the materials encountered, the Boring Logs in Appendix "A" should be consulted.

Soil samples were obtained from the test borings at the depths shown on the logs of borings. The MCS samples were recovered and capped at both ends to preserve the samples at their natural moisture content; SPT samples were recovered and placed in a sealed bag to preserve their natural moisture content. The borings were backfilled with soil cuttings after completion of the drilling.

## **5. LABORATORY TESTING**

Laboratory tests were performed on selected soil samples to evaluate their physical characteristics and engineering properties. The laboratory-testing program was formulated with emphasis on the evaluation of natural moisture, in-situ density, shear strength, consolidation potential, expansion index, maximum density and optimum moisture determination, and gradation of the materials encountered.

In addition, chemical tests were performed to evaluate the corrosivity of the soils to buried concrete and metal. Details of the laboratory test program and the results of laboratory test are summarized in Appendix "B." This information, along with the field observations, was used to prepare the final boring logs in Appendix "A."

## **6. GEOLOGIC SETTING**

The subject site is located within the northern part of the Peninsular Ranges Geomorphic Province of California. The province varies in width from approximately 30 miles to 100 miles in width. In general, the province consists of rugged mountains underlain by Jurassic metavolcanic and metasedimentary rocks and Cretaceous igneous rocks of the Southern California batholith. The Peninsular Ranges Province is divided into three northwest-trending fault-bounded structural blocks – from west to east – the Santa Ana Mountains, Perris, and San Jacinto Mountains (Morton and Miller, 2006). The Santa Ana Mountains block (west of the subject site) extends from the coast to the Elsinore Fault zone. The western margin of the Perris structural block underlies the subject site.

Paleocene to Pliocene sedimentary rocks underlie the western portion of the Santa Ana Mountains structural block. The eastern portion, a highly faulted structural anticline, is cored by a basement assemblage of Mesozoic metasedimentary and Cretaceous batholithic and volcanic rocks. A thick section



of primarily upper Cretaceous marine and Paleogene marine and nonmarine rocks overly this basement. The Perris structural block is a large mass of granitic rock generally bounded by the San Jacinto Fault, the Elsinore Fault, the Santa Ana River and a non-defined southeast boundary. The Perris Block has had a history of vertical land movements of several thousand feet due to shifts in the Elsinore and San Jacinto Faults.

## **6.1 Local Geologic Setting**

The subject site lies near the southeast face of the Santa Ana Mountains in the Perris structural block. The site is in an area of relatively low relief between the Santa Jacinto Mountains to the northeast, the Santa Ana Mountains to the southwest. The Perris block is underlain by lithologically diverse prebatholithic metasedimentary rocks intruded by plutons of the Cretaceous Peninsular Ranges batholith. Supra-batholithic volcanic rocks are preserved in the western part of the block. Several erosional and depositional surfaces are developed on the Perris block and thin to relatively thick sections of nonmarine, mainly Quaternary sediments discontinuously cover the basement.

Surficial deposits in the vicinity of the subject site are indicated on regional geologic maps (Morton and Bovard, 2003) to be comprised predominately of Quaternary alluvium. Specifically, formational materials mapped at the subject site are young alluvial fan deposits (Qyf<sub>a</sub>) and Silverado Formation (Tsi) on the Regional Geologic Map, Figure 3A). The alluvial fan deposits is composed of fluvial deposits along the valley floors and consists of unconsolidated sand, silt, and clay-bearing alluvium. The Silverado Formation is described as nonmarine and marine sandstone, siltstone, and conglomerate. Deposits encountered on the subject site during exploratory drilling are consistent with those mapped in the area. For approximate depths and more detailed descriptions, please refer to the enclosed logs of soil borings (Appendix A). The materials were visually classified in accordance with the Unified Soils Classification System.

## **7. GEOLOGIC HAZARDS**

### **7.1 Faulting and Seismicity**

Based on the proximity of several dominant active faults and seismogenic structures, as well as the historic seismic record, the area of the subject site is considered subject to relatively high seismicity. The seismic hazard most likely to impact the site is ground-shaking due to a large earthquake on one of the major active regional faults. Moderate to large earthquakes have affected the area of the subject site within historic time.

There are no known active fault traces in the project vicinity. The project area is not within an Alquist-Priolo Earthquake Fault (Special Studies) Zone and will not require a special site investigation by an Engineering Geologist. Soils on site are classified as Site Class D in accordance with Chapter 16 of the California Building Code. The proposed structures are determined to be in Seismic Design Category D.

To determine the distance of known active faults within 100 miles of the site, we used the United States Geological Survey (USGS) web-based application *2008 National Seismic Hazard Maps - Fault Parameters*. Site latitude is 33.6951° North; site longitude is 117.3315° West. The ten closest active faults are summarized below in Table 7.1.

**TABLE 7.1**  
**REGIONAL FAULT SUMMARY**

<b>Fault Name</b>	<b>Distance to Site (miles)</b>	<b>Maximum Earthquake Magnitude, <math>M_w</math></b>
Elsinore; W+GI	2.0	7.3
Elsinore; W+GI+T+J+CM	2.2	7.9
Elsinore; T+J+CM	3.3	7.6
Chino, alt 2	16.2	6.8
Elsinore; W	17.6	7.0
San Jacinto; A+CC+B+SM	18.6	7.6
Chino, alt 1	18.8	6.7
San Jacinto; SBV+SJV+A+CC+B+SM	19.9	7.9
San Jacinto; SBV+SJV	20.0	7.4
San Joaquin Hills	20.9	7.1

*The faults tabulated above and numerous other faults in the region are sources of potential ground motion. However, earthquakes that might occur on other faults throughout California are also potential generators of significant ground motion and could subject the site to intense ground shaking.*

## **7.2 Surface Fault Rupture**

The site is not within a currently established State of California Earthquake Fault Zone for surface fault rupture hazards (Figure 4, Fault Map). No active faults with the potential for surface fault rupture are known to pass directly beneath the site. Therefore, the potential for surface rupture due to faulting occurring beneath the site during the design life of the proposed development is considered low. Site reconnaissance on March 30, 2021 did not reveal evidence of active faulting at the subject site.

## **7.3 Ground Shaking**

Seismic coefficients and spectral response acceleration values were developed based on the 2019 California Building Code (CBC). The CBC methodology for determining design ground motion values is based on the Office of Statewide Health Planning and Development (OSHPD) Seismic Design Maps, which incorporate both probabilistic and deterministic seismic ground motion.

Based on the 2019 CBC, a Site Class D represents the on-site soil conditions with standard penetration resistance, N-values, averaging greater than 15 blow per foot but less than 50 blows per foot in the upper 100 feet below site grade. A table providing the recommended design acceleration parameters for the project site, based on a Site Class D designation, is included in Section 9.2.1 of this report.

Based on the Office of Statewide Health Planning and Development (OSHPD) Seismic Design Maps, the estimated design peak ground acceleration adjusted for site class effects ( $PGA_M$ ) was determined to be 0.952g (based on both probabilistic and deterministic seismic ground motion).

## **7.4 Liquefaction**

Soil liquefaction is a state of soil particles suspension caused by a complete loss of strength when the effective stress drops to zero. Liquefaction normally occurs under saturated conditions in soils such as sand in which the strength is purely frictional. Primary factors that trigger liquefaction are: moderate to strong ground shaking (seismic source), relatively clean, loose granular soils (primarily poorly graded sands and silty sands), and saturated soil conditions (shallow groundwater). Due to the increasing overburden pressure with depth, liquefaction of granular soils is generally limited to the upper 50 feet of a soil profile. However, liquefaction has occurred in soils other than clean sand.

The soils encountered within the depth of 41½ feet on the project site consisted predominately of medium dense to very dense silty sand with various amounts of clay and gravel; stiff to hard sandy silt with various amounts of clay, and hard weathered siltstone/claystone.

Groundwater was encountered at a depth of approximately 29 feet below ground surface during this investigation. The historically highest groundwater is estimated to be at a depth of 20 feet below ground surface based on the County of Riverside Geologic Hazards Map (2004) and regional groundwater data. The Riverside County Office of Information Technology GIS website shows the subject site to be in a very high liquefaction potential area (Figure 5, Liquefaction Potential Map).

Low to very low cohesion strength is commonly associated with the sandy soil profile at the site. A seismic hazard, which could cause damage to the proposed development during seismic shaking, is the post-liquefaction settlement of liquefied sands. The site was evaluated for liquefaction potential.

The potential for soil liquefaction during a seismic event was evaluated using LiqIT computer program (version 4.7.5) developed by GeoLogismiki of Greece. For the analysis, a maximum earthquake magnitude of 7.9  $M_w$ , a peak horizontal ground surface acceleration of 0.95g ( $PGA_M$ ) and a groundwater depth of 20 feet were considered appropriate for the liquefaction analysis. The analysis indicated that the on-site soils had a moderate potential for liquefaction and that the total liquefaction-induced settlement was calculated to be 1.42 inches. Differential settlement is estimated to be 0.71 inches over a horizontal distance of 40 feet. The liquefaction analysis is included in Appendix A.

## **7.5 Lateral Spreading**

Lateral spreading is a phenomenon in which soils move laterally during seismic shaking and is often associated with liquefaction. The amount of movement depends on the soil strength, duration and intensity of seismic shaking, topography, and free face geometry. Due to the relatively flat site/ slightly sloping topography, we judge the likelihood of lateral spreading to be low.

## **7.6 Subsidence**

The Riverside County Office of Information Technology GIS website shows the subject site to be in a susceptible subsidence potential area (Figure 7, Subsidence Potential Map). Based on the existence of medium dense to very dense silty sand with various amounts of clay and gravel, stiff to hard sandy silt with various amounts of clay, and hard weathered siltstone/claystone, subsidence potential is considered minimal.

## **7.7 Collapsible/Expansive or Hydroconsolidatable Soils**

Test data in this geotechnical report show that soil samples consolidated from approximately 4 to 12 percent after a maximum 12.8 ksf load. Hydroconsolidation (collapse upon wetting) at a load of 1.6 ksf was approximately 2.5 to 3 percent for two of the samples at a load of 1.6 ksf, one sample expanded approximately 0.4 percent. The potential for collapse should be considered moderate. Soil samples collected from surface to the proposed foundation depths are considered to have a very low to low expansion potential, and the sample tested returned an Expansion Index value of 15. The proposed site preparation methods recommended on our geotechnical report should address these geotechnical issues.

## **7.8 Flood and Dam Inundation**

The County of Riverside GIS website shows the subject site is partially located in a flood zone (Figure 6, Flood Zone Map). The Flood Zones Map shows the subject site to be in a 100-year flood zone as determined by approximate methods. The subject site is not located in areas of Riverside County Integrated Project map S-10, "Dam Failure Inundation Zones".

## **7.9 Landslides/Slope Instability/Debris Flow**

The subject site is on a gently (<5%) sloping grade, over 3/4 mile from the nearest significant topographic change. As such, landslide/slope instability/rock fall issues pose a very low risk. Due to the site's distance from significant topography, topography-related debris flows are a low risk.

## **7.10 Wind and Water Erosion**

Based on SALEM's soil boring logs for the subject site, surface soils consist predominantly of medium dense to very dense silty sand with various amounts of clay and gravel, stiff to hard sandy silt with various amounts of clay, and hard weathered siltstone/claystone. Soils of this consistency have been shown to possess good resistance to wind and water erosion. The site is essentially flat/slightly sloping, minimizing the potential for water erosion. The site will be completely covered by buildings, pavement or landscaping after development, minimizing long-term wind erosion potential.

## **7.11 Tsunamis and Seiches**

The site is not located within a coastal area. Therefore, tsunamis (seismic sea waves) are not considered a significant hazard at the site. Seiches are large waves generated in enclosed bodies of water in response to ground shaking. No major water-retaining structures are located immediately up gradient from the project site. Flooding from a seismically-induced seiche is considered unlikely.

# **8. SOIL AND GROUNDWATER CONDITIONS**

## **8.1 Subsurface Conditions**

The subsurface conditions encountered appear typical of those found in the geologic region of the site. In general, the soils within the depth of exploration consisted of alluvium deposits of medium dense to very dense silty sand with various amounts of clay and gravel, stiff to hard sandy silt with various amounts of clay, and hard weathered siltstone/claystone.

No significant or obvious fill material was encountered in our borings. "Potential Fill" is noted on boring B-10 and B-13 where the former clay pit was located.

Fill materials are anticipated to be present onsite between our boring locations since the northwest portion of the site was formerly excavated for use as a clay pit and regraded to its current condition.

Undocumented fill materials are not suitable to support any future structures and should be replaced with Engineered Fill. The extent and consistency of the fills should be verified during site construction. Prior to fill placement, Salem Engineering Group, Inc. should inspect the bottom of the excavation to verify the fill condition.

The soils were classified in the field during the drilling and sampling operations. The stratification lines were approximated by the field engineer on the basis of observations made at the time of drilling. The actual boundaries between different soil types may be gradual and soil conditions may vary. For a more detailed description of the materials encountered, the Boring Logs in Appendix "A" should be consulted.

The Boring Logs include the soil type, color, moisture content, dry density, and the applicable Unified Soil Classification System symbol. The locations of the test borings were determined by measuring from feature shown on the Site Plan, provided to us. Hence, accuracy can be implied only to the degree that this method warrants.

## **8.2 Groundwater**

The test boring locations were checked for the presence of groundwater during and after the drilling operations. Free groundwater was encountered at a depth of approximately 29 feet below ground surface during this time of investigation. The historically highest groundwater is estimated to be at a depth of approximately 20 feet below ground surface according to the County of Riverside Geologic Hazards Map (2004) and regional groundwater well data.

It should be recognized that water table elevations may fluctuate with time, being dependent upon seasonal precipitation, irrigation, land use, localized pumping, and climatic conditions as well as other factors. Therefore, water level observations at the time of the field investigation may vary from those encountered during the construction phase of the project. The evaluation of such factors is beyond the scope of this report.

## **8.3 Soil Corrosion Screening**

Excessive sulfate in either the soil or native water may result in an adverse reaction between the cement in concrete and the soil. The 2014 Edition of ACI 318 (ACI 318) has established criteria for evaluation of sulfate and chloride levels and how they relate to cement reactivity with soil and/or water.

A soil sample was obtained from the project site and was tested for the evaluation of the potential for concrete deterioration or steel corrosion due to attack by soil-borne soluble salts and soluble chloride.

The water-soluble sulfate concentration in the saturation extract from the soil sample was detected to be 230 mg/kg. ACI 318 Tables 19.3.1.1 and 19.3.2.1 outline exposure categories, classes, and concrete requirements by exposure class. ACI 318 requirements for site concrete based upon soluble sulfate are summarized in Table 8.3 on the next page.

**TABLE 8.3**  
**WATER SOLUBLE SULFATE EXPOSURE REQUIREMENTS**

Water Soluble Sulfate (SO <sub>4</sub> ) in Soil, Percentage by Weight	Exposure Severity	Exposure Class	Maximum w/cm Ratio	Minimum Concrete Compressive Strength	Cementations Materials Type
0.0230	Not Severe	S0	N/A	2,500 psi	II

The water-soluble chloride concentration detected in saturation extract from the soil samples was 195 mg/kg. This level of chloride concentration is considered to be mildly corrosive.

It is recommended that a qualified corrosion engineer be consulted regarding protection of buried steel or ductile iron piping and conduit or, at a minimum, applicable manufacturer's recommendations for corrosion protection of buried metal pipe be closely followed.

#### **8.4 Percolation Testing**

Two (2) percolation tests (P-1 and P-2) were performed within assumed infiltration areas and were conducted in accordance with the guidelines established by the County of Riverside. The approximate locations of the percolation tests are shown on the attached Site Plan, Figure 2.

Two boreholes were advanced to the depths shown on the percolation test worksheets. The holes were pre-saturated before percolation testing commenced. Percolation rates were measured by filling the test holes with clean water and measuring the water drops at a certain time interval.

The percolation rate data are presented in tabular format at the end of this Report. The difference in the percolation rates are reflected by the varied type of soil materials at the bottom of the test holes. The test results are shown on the table below.

**PERCOLATION TEST RESULTS**

Test No.	Depth (feet)	Measured Percolation Rate (min/inch)	Infiltration Rate* (inch/hour)	Soil Type**
P-1	6¼	35.7	<b>0.16</b>	Silty SAND (SM)
P-2	6	83.3	<b>0.07</b>	Silty SAND (SM)

\* Tested infiltration Rate =  $(\Delta H / 60 \text{ r}) / (\Delta t(r + 2H_{avg}))$

\*\* At bottom of drilled holes

Based on the soil condition and percolation test results, the site is considered to be technically **infeasible** to attain an infiltration rate necessary to achieve reliable performance of infiltration or bioretention BMPs in retaining the stormwater quality design volume (SWQDv) on site.

The soil infiltration or percolation rates are based on tests conducted with clear water. The infiltration/percolation rates may vary with time as a result of soil clogging from water impurities. The infiltration/percolation rates will deteriorate over time due to the soil conditions and an appropriate factor of safety (FS) may be applied. The owner or civil engineer may elect to use a lower FS for the design; however, more frequent maintenance will be expected. The soils may also become less permeable to impermeable if the soil is compacted. Thus, periodic maintenance consisting of clearing the bottom of the drainage system of clogged soils should be expected.

The infiltration/percolation rate may become slower if the surrounding soil is wet or saturated due to prolonged rainfalls. Additional percolation tests may be conducted at bottom of the drainage system during construction to verify the infiltration/percolation rate. Groundwater, if closer to the bottom of the drainage system, will also reduce the infiltration/percolation rate.

The scope of our services did not include a groundwater study and was limited to the performance of percolation testing and soil profile description, and the submitted data only. Our services did not include those associated with septic system design. Neither did services include an Environmental Site Assessment for the presence or absence of hazardous and/or toxic materials in the soil, groundwater, or atmosphere; or the presence of wetlands.

Any statements, or absence of statements, in this report or on any boring logs regarding odors, unusual or suspicious items, or conditions observed, are strictly for descriptive purposes and are not intended to convey engineering judgment regarding potential hazardous and/or toxic assessment. The geotechnical engineering information presented herein is based upon professional interpretation utilizing standard engineering practices. The work conducted through the course of this investigation, including the preparation of this report, has been performed in accordance with the generally accepted standards of geotechnical engineering practice, which existed in the geographic area at the time the report was written. No other warranty, express or implied, is made.

Please be advised that when performing percolation testing services in relatively small diameter borings, that the testing may not fully model the actual full scale long term performance of a given site. This is particularly true where percolation test data is to be used in the design of large infiltration system such as may be proposed for the site.

The measured percolation rate includes dispersion of the water at the sidewalls of the boring as well as into the underlying soils. Subsurface conditions, including percolation rates, can change over time as fine-grained soils migrate. It is not warranted that such information and interpretation cannot be superseded by future geotechnical engineering developments. We emphasize that this report is valid for the project outlined above and should not be used for any other sites.



## 9. CONCLUSIONS AND RECOMMENDATIONS

### 9.1 General

- 9.1.1 Based upon the data collected during this investigation, and from a geotechnical engineering standpoint, it is our opinion that the site is suitable for the proposed construction of improvements at the site as planned, provided the recommendations contained in this report are incorporated into the project design and construction. Conclusions and recommendations provided in this report are based on our review of available literature, analysis of data obtained from our field exploration and laboratory testing program, and our understanding of the proposed development at this time.
- 9.1.2 The primary geotechnical constraints identified in our investigation is the presence of potential fill soils, and potentially compressible (collapsible) soils at the site. Recommendations to mitigate the effects of these soils are provided in this report.
- 9.1.3 No significant or obvious fill material was encountered in our borings. Fill materials are anticipated to be present onsite between our boring locations since the northwest portion of the site was formerly excavated for use as a clay pit and regraded to its current condition. Undocumented fill materials are not suitable to support any future structures and should be excavated and recompacted in accordance with section 9.5 of this report. The extent and consistency of the fills should be verified during site construction. Prior to fill placement, Salem Engineering Group, Inc. should inspect the bottom of the excavation to verify the fill condition.
- 9.1.4 A geophysical survey has been recently performed to locate the former clay pit. However, the geophysical report is not available at the time of preparing this report. It's recommended the geophysical report be consulted to determine the depth and extent of the former clay pit. In addition, the extent and fill consistency of the clay pit should also be verified during site grading/construction.
- 9.1.5 Site demolition activities shall include removal of all surface obstructions not intended to be incorporated into final site design. In addition, underground buried structures and/or utility lines encountered during demolition and construction should be properly removed and the resulting excavations backfilled with Engineered Fill. It is suspected that possible demolition activities of the existing structures may disturb the upper soils. After demolition activities, it is recommended that disturbed soils be removed and/or recompacted.
- 9.1.6 Surface vegetation consisting of grasses and other similar vegetation should be removed by stripping to a sufficient depth to remove organic-rich topsoil. The upper 6 to 10 inches of the soils containing, vegetation, roots and other objectionable organic matter encountered at the time of grading should be stripped and removed from the surface. Deeper stripping may be required in localized areas. The stripped vegetation, will not be suitable for use as Engineered Fill or within 5 feet of building pads or within pavement areas. However, stripped topsoil may be stockpiled and reused in landscape or non-structural areas or exported from the site.



- 9.1.7 Tree root systems in proposed improvement areas should be removed to a minimum depth of 3 feet and to such an extent which would permit removal of all roots greater than ½ inch in diameter. Tree roots removed in parking areas may be limited to the upper 2 feet of the ground surface. Backfill of tree root excavations is not permitted until all exposed surfaces have been inspected and the Soils Engineer is present for the proper control of backfill placement and compaction. Burning in areas which are to receive fill materials shall not be permitted.
- 9.1.8 The near-surface onsite soils are moisture-sensitive and are moderately compressible (collapsible soil) under saturated conditions. Excessive post-construction settlement may be experienced by proposed structures if the foundation soils become near saturated. The collapsible or weak soils should be removed and re-compacted according to the recommendations in the Grading section of this report (Section 9.5).
- 9.1.9 In order to reduce differential settlement due to cut/fill transition zones, additional cut is required for cut/fill transition zones greater than 5 feet. All structures that are in cut/fill transition zones greater than 5 feet should be cut one-half the thickness of the fill placed on the “fill” portion to a maximum depth of 5 feet
- 9.1.10 Based on the subsurface conditions at the site and the anticipated structural loading, we anticipate that the proposed buildings may be supported using conventional shallow foundations provided that the recommendations presented herein are incorporated in the design and construction of the project.
- 9.1.11 Provided the site is graded in accordance with the recommendations of this report and foundations constructed as described herein, we estimate that total settlement due to static and seismic loads utilizing conventional shallow foundations for the proposed building will be within 1 inch and corresponding differential settlement will be less than ½ inch over 20 feet.
- 9.1.12 All references to relative compaction and optimum moisture content in this report are based on ASTM D 1557 (latest edition).
- 9.1.13 SALEM shall review the project grading and foundation plans prior to final design submittal to assess whether our recommendations have been properly implemented and evaluate if additional analysis and/or recommendations are required. If SALEM is not provided plans and specifications for review, we cannot assume any responsibility for the future performance of the project.
- 9.1.14 SALEM shall be present at the site during site demolition and preparation to observe site clearing/demolition, preparation of exposed surfaces after clearing, and placement, treatment and compaction of fill material.
- 9.1.15 SALEM's observations should be supplemented with periodic compaction tests to establish substantial conformance with these recommendations. Moisture content of footings and slab subgrade should be tested immediately prior to concrete placement. SALEM should observe foundation excavations prior to placement of reinforcing steel or concrete to assess whether the actual bearing conditions are compatible with the conditions anticipated during the preparation of this report.

## 9.2 Seismic Design Criteria

- 9.2.1 For seismic design of the structures, and in accordance with the seismic provisions of the 2016 CBC, our recommended parameters are shown below. These parameters are based on Probabilistic Ground Motion of 2% Probability of Exceedance in 50 years. The Site Class was determined based on the results of our field exploration.

**TABLE 9.2.1  
SEISMIC DESIGN PARAMETERS**

Seismic Item	Symbol	Value	ASCE 7-16 or 2019 CBC Reference
Site Coordinates (Datum = NAD 83)		33.6951 Lat -117.3315 Lon	
Site Class	--	D	ASCE 7 Table 20.3-1
Soil Profile Name	--	Stiff Soil	ASCE 7 Table 20.3-1
Risk Category	--	II	Table 1604.5
Site Coefficient for PGA	$F_{PGA}$	1.1	ASCE 7 Table 11.8-1
Peak Ground Acceleration (adjusted for Site Class effects)	$PGA_M$	0.952 g	ASCE 7 Equation 11.8-1
Seismic Design Category	SDC	D	Table 1613.2.5
Mapped Spectral Acceleration (Short period - 0.2 sec)	$S_s$	2.033 g	Figure 1613.2.1(1-8)
Mapped Spectral Acceleration (1.0 sec. period)	$S_1$	0.729 g	Figure 1613.2.1(1-8)
Site Class Modified Site Coefficient	$F_a$	1.0	Table 1613.2.3(1)
Site Class Modified Site Coefficient	$F_v$	1.7*	Table 1613.2.3(2)
MCE Spectral Response Acceleration (Short period - 0.2 sec) $S_{MS} = F_a S_s$	$S_{MS}$	2.033 g	Equation 16-36
MCE Spectral Response Acceleration (1.0 sec. period) $S_{M1} = F_v S_1$	$S_{M1}$	1.239 g*	Equation 16-37
Design Spectral Response Acceleration $S_{DS} = \frac{2}{3} S_{MS}$ (short period - 0.2 sec)	$S_{DS}$	1.355 g	Equation 16-38
Design Spectral Response Acceleration $S_{D1} = \frac{2}{3} S_{M1}$ (1.0 sec. period)	$S_{D1}$	0.826 g*	Equation 16-39
Short Term Transition Period ( $S_{D1}/S_{DS}$ ), Seconds	$T_s$	0.610	ASCE 7-16, Section 11.4.6
Long Period Transition Period (seconds)	$T_L$	8	ASCE 7-16, Figure 22-14

\* Determined per ASCE Table 11.4-2 for use in calculating  $T_s$  only.

- 9.2.2 Site Specific Ground Motion Analysis was not included in the scope of this investigation. Per ASCE 11.4.8, structures on Site Class D with  $S_1$  greater than or equal to 0.2 may require Site Specific Ground Motion Analysis. However, a site specific motion analysis may not be required based on Exceptions listed in ASCE 11.4.8. The Structural Engineer should verify whether

Exception No. 2 of ASCE 7-16, Section 11.4.8, is valid for the site. In the event that a site specific ground motion analysis is required, SALEM should be contacted for these services.

- 9.2.3 Conformance to the criteria in the above table for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a large earthquake occurs. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

### **9.3 Soil and Excavation Characteristics**

- 9.3.1 Based on the soil conditions encountered in our soil borings, the onsite soils can be excavated with moderate to laborious effort using conventional heavy-duty earthmoving equipment.
- 9.3.2 It is the responsibility of the contractor to ensure that all excavations and trenches are properly shored and maintained in accordance with applicable Occupational Safety and Health Administration (OSHA) rules and regulations to maintain safety and maintain the stability of adjacent existing improvements.
- 9.3.3 The upper soils are moisture-sensitive and moderately collapsible under saturated conditions. These soils, in their present condition, possess moderate risk to construction in terms of possible post-construction movement of the foundations and floor systems if no mitigation measures are employed. Accordingly, measures are considered necessary to reduce anticipated collapse potential. As recommended in Section 9.5, the collapsible soils should be overexcavated and recompacted. Mitigation measures will not eliminate post-construction soil movement, but will reduce the soil movement. Success of the mitigation measures will depend on the thoroughness of the contractor in dealing with the soil conditions.
- 9.3.4 The near surface soils identified as part of our investigation are, generally, slightly moist to very moist due to the absorption characteristics of the soil. Earthwork operations may encounter very moist unstable soils which may require removal to a stable bottom. Exposed native soils exposed as part of site grading operations shall not be allowed to dry out and should be kept continuously moist prior to placement of subsequent fill.

### **9.4 Materials for Fill**

- 9.4.1 Excavated soils generated from cut operations at the site are suitable for use as general Engineered Fill in structural areas provided they do exhibit an Expansion Index greater than 20 ( $EI > 20$ ) and do not contain deleterious matter, organic material, or rock material larger than 3 inches in maximum dimension.
- 9.4.2 Any soil with an Expansion Index greater than 20 and below 50 ( $20 < EI < 50$ ) should not be placed within the upper 12 inches within the building pad or exterior flatwork areas.
- 9.4.3 The preferred materials specified for Engineered Fill are suitable for most applications with the exception of exposure to erosion. Project site winterization and protection of exposed soils during the construction phase should be the sole responsibility of the Contractor, since they have complete control of the project site.

- 9.4.4 Import soil intended for use as Non-Expansive Engineered Fill soil shall be well-graded, slightly cohesive silty fine sand or sandy silt, with relatively impervious characteristics when compacted. A clean sand or very sandy soil is not acceptable for this purpose. This material should be approved by the Engineer prior to use and should typically possess the soil characteristics summarized below in Table 9.4.4.

**TABLE 9.4.4**  
**IMPORT FILL REQUIREMENTS**

Minimum Percent Passing No. 200 Sieve	20
Maximum Percent Passing No. 200 Sieve	50
Minimum Percent Passing No. 4 Sieve	80
Maximum Particle Size	3"
Maximum Plasticity Index	12
Maximum CBC Expansion Index	20

- 9.4.5 Environmental characteristics and corrosion potential of import soil materials should also be considered.
- 9.4.6 Proposed import materials should be sampled, tested, and approved by SALEM prior to its transportation to the site.

## **9.5 Grading**

- 9.5.1 A representative of our firm should be present during all site clearing and grading operations to test and observe earthwork construction. This testing and observation is an integral part of our service as acceptance of earthwork construction is dependent upon compaction of the material and the stability of the material. The Geotechnical Engineer may reject any material that does not meet compaction and stability requirements. Further recommendations of this report are predicated upon the assumption that earthwork construction will conform to recommendations set forth in this section as well as other portions of this report.
- 9.5.2 A preconstruction conference should be held at the site prior to the beginning of grading operations with the owner, contractor, civil engineer and geotechnical engineer in attendance.
- 9.5.3 Site preparation should begin with removal of existing surface/subsurface structures, underground utilities (as required), any existing uncertified fill, and debris. Excavations or depressions resulting from site clearing operations, or other existing excavations or depressions, should be restored with Engineered Fill in accordance with the recommendations of this report.
- 9.5.4 Surface vegetation consisting of grasses and other similar vegetation should be removed by stripping to a sufficient depth to remove organic-rich topsoil. The upper 6 to 10 inches of the soils containing, vegetation, roots and other objectionable organic matter encountered at the time of grading should be stripped and removed from the surface. Deeper stripping may be required in

localized areas. The stripped vegetation, will not be suitable for use as Engineered Fill or within 5 feet of building pads or within pavement areas. However, stripped topsoil may be stockpiled and reused in landscape or non-structural areas or exported from the site.

- 9.5.5 Tree root systems in proposed improvement areas should be removed to a minimum depth of 3 feet and to such an extent which would permit removal of all roots greater than ½ inch in diameter. Tree roots removed in parking areas may be limited to the upper 1½ feet of the ground surface. Backfill of tree root excavations is not permitted until all exposed surfaces have been inspected and the Soils Engineer is present for the proper control of backfill placement and compaction. Burning in areas which are to receive fill materials shall not be permitted.
- 9.5.6 Fill materials are anticipated to be present onsite between our boring locations since the northwest portion of the site was formerly excavated for use as a clay pit and regraded to its current condition. Any undocumented and uncompacted fill materials encountered during grading should be removed and replaced with Engineered Fill. The actual depth of the overexcavation and recompaction should be determined by our field representative during construction.
- 9.5.7 Structural building pad areas should be considered as areas extending a minimum of 5 feet horizontally beyond the outside dimensions of building, including footings and non-cantilevered overhangs carrying structural loads.
- 9.5.8 To minimize post-construction soil movement and provide uniform support for the proposed buildings, overexcavation and recompaction within the proposed building areas should be performed to a minimum depth of **three (3) feet** below existing grade or **two (2) feet** below proposed footing bottom, **or to a depth below all undocumented fill materials**, whichever is deeper. The extent of the overexcavation and recompaction should be verified during site grading. The overexcavation and recompaction should also extend laterally to a minimum of 5 feet beyond the outside dimensions of building.
- 9.5.9 Deeper overexcavation and recompaction are also anticipated within the current dense tree areas (i.e. eastern portion of the proposed grocery building) to remove all stream sediments, loose soil, wet soil, oversized rocks, or unsuitable materials.
- 9.5.10 Within pavement, it is recommended overexcavation and recompaction be performed to a minimum depth of **two (2) feet** below existing grade or **two (2) feet** below proposed grade, whichever is deeper. The overexcavation and recompaction should also extend laterally to a minimum of 2 feet beyond the pavement.
- 9.5.11 Prior to placement of fill soils, the upper 10 to 12 inches of native subgrade soils should be scarified, moisture-conditioned to no less than the optimum moisture content and recompacted to a minimum of 95 percent of the maximum dry density based on ASTM D1557-07 Test Method.
- 9.5.12 All Engineered Fill (including scarified ground surfaces and backfill) should be placed in thin lifts to allow for adequate bonding and compaction (typically 6 to 8 inches in loose thickness).

- 9.5.13 Engineered Fill soils should be placed, moisture conditioned to near optimum moisture content, and compacted to at least 95% relative compaction.
- 9.5.14 An integral part of satisfactory fill placement is the stability of the placed lift of soil. If placed materials exhibit excessive instability as determined by a SALEM field representative, the lift will be considered unacceptable and shall be remedied prior to placement of additional fill material. Additional lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable.
- 9.5.15 Final pavement subgrade should be finished to a smooth, unyielding surface. We further recommend proof-rolling the subgrade with a loaded water truck (or similar equipment with high contact pressure) to verify the stability of the subgrade prior to placing aggregate base.
- 9.5.16 The most effective site preparation alternatives will depend on site conditions prior to grading. We should evaluate site conditions and provide supplemental recommendations immediately prior to grading, if necessary.
- 9.5.17 We do not anticipate groundwater or seepage to adversely affect construction if conducted during the drier months of the year (typically summer and fall). However, groundwater and soil moisture conditions could be significantly different during the wet season (typically winter and spring) as surface soil becomes wet; perched groundwater conditions may develop. Grading during this time period will likely encounter wet materials resulting in possible excavation and fill placement difficulties. Project site winterization consisting of placement of aggregate base and protecting exposed soils during construction should be performed. If the construction schedule requires grading operations during the wet season, we can provide additional recommendations as conditions warrant.
- 9.5.18 Wet soils may become non conducive to site grading as the upper soils yield under the weight of the construction equipment. Therefore, mitigation measures should be performed for stabilization.

Typical remedial measures include: discing and aerating the soil during dry weather; mixing the soil with dryer materials; removing and replacing the soil with an approved fill material or placement of slurry, crushed rocks or aggregate base material; or mixing the soil with an approved lime or cement product. The most common remedial measure of stabilizing the bottom of the excavation due to wet soil condition is to reduce the moisture of the soil to near the optimum moisture content by having the subgrade soils scarified and aerated or mixed with drier soils prior to compacting. However, the drying process may require an extended period of time and delay the construction operation.

To expedite the stabilizing process, slurry or crushed rock may be utilized for stabilization provided this method is approved by the owner for the cost purpose. If the use of slurry, crushed rock is considered, it is recommended that the upper soft and wet soils be replaced by 6 to 24 inches of 2-sack slurry or ¾-inch to 1-inch crushed rocks. The thickness of the slurry or rock layer depends on the severity of the soil instability. The recommended 6 to 24 inches of crushed rock material will provide a stable platform.

It is further recommended that lighter compaction equipment be utilized for compacting the crushed rock. A layer of geofabric is recommended to be placed on top of the compacted crushed rock to minimize migration of soil particles into the voids of the crushed rock, resulting in soil movement. Although it is not required, the use of geogrid (e.g. Tensar TX7) below the slurry or crushed rock will enhance stability and reduce the required thickness of crushed rock necessary for stabilization. Our firm should be consulted prior to implementing remedial measures to provide appropriate recommendations.

## **9.6 Shallow Foundations**

9.6.1 The site is suitable for use of conventional shallow foundations consisting of continuous footings and isolated pad footings bearing in properly compacted Engineered Fill.

9.6.2 The bearing wall footings considered for the structures should be continuous with a minimum width of 15 inches and extend to a minimum depth of 18 inches below the lowest adjacent grade. Isolated column footings should have a minimum width of 24 inches and extend a minimum depth of 18 inches below the lowest adjacent grade. The bottom of footing excavations should be maintained free of loose and disturbed soil. Footing concrete should be placed into a neat excavation.

9.6.3 For design purposes, total settlement due to static and seismic loadings on the order of 2 inches may be assumed for shallow footings. Differential settlement due to static and seismic loadings, along a 40-foot exterior wall footing or between adjoining column footings, should be 1 inch, producing an angular distortion of 0.002. Most of the settlement is expected to occur during construction as the loads are applied. However, additional post-construction settlement may occur if the foundation soils are flooded or saturated. The footing excavations should not be allowed to dry out any time prior to pouring concrete.

9.6.4 Footings proportioned as recommended above may be designed for the maximum allowable soil bearing pressures shown in the table below.

<b>Loading Condition</b>	<b>Allowable Bearing</b>
Dead Load Only	2,000 psf
Dead-Plus-Live Load	2,500 psf
Total Load, Including Wind or Seismic Loads	3,325 psf

9.6.5 Resistance to lateral footing displacement can be computed using an allowable coefficient of friction factor of 0.40 acting between the base of foundations and the supporting native subgrade.

9.6.6 Lateral resistance for footings can alternatively be developed using an allowable equivalent fluid passive pressure of 350 pounds per cubic foot acting against the appropriate vertical native footing faces. The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance. An increase of one-third is permitted when using the alternate load combination in CBC that includes wind or earthquake loads.



- 9.6.7 Underground utilities running parallel to footings should not be constructed in the zone of influence of footings. The zone of influence may be taken to be the area beneath the footing and within a 1:1 plane extending out and down from the bottom edge of the footing.
- 9.6.8 The foundation subgrade should be sprinkled as necessary to maintain a moist condition without significant shrinkage cracks as would be expected in any concrete placement. Prior to placing rebar reinforcement, foundation excavations should be evaluated by a representative of SALEM for appropriate support characteristics and moisture content. Moisture conditioning may be required for the materials exposed at footing bottom, particularly if foundation excavations are left open for an extended period.

## **9.7 Caisson Foundations for Canopy Structures**

- 9.7.1 It is recommended that the caisson foundation should have a minimum diameter of 24 inches and a minimum depth of 7 feet below the lowest adjacent grade.
- 9.7.2 The caissons may be designed using an allowable sidewall friction of 250 psf. This value is for dead-plus-live loads. An allowable end bearing capacity of 3,000 psf may be used provided that the bottom of the caisson is cleaned with the use of a clean-out bucket or equivalent and inspected by our representative prior to placement of reinforcement and concrete. An increase of one-third is permitted when using the alternate load combination that includes wind or earthquake loads.
- 9.7.3 Uplift loads can be resisted by caissons using an allowable sidewall friction of 200 psf of the surface area and the weight of the caisson.
- 9.7.4 The total static settlement of the caisson footing is not expected to exceed 1 inch. Differential static settlement should be less than ½ inch. Most of the settlement is expected to occur during construction as the loads are applied.
- 9.7.5 The drilled caissons may be designed for a lateral capacity of 350 pounds per square foot per foot of depth below the lowest adjacent grade to a maximum of 5,250 psf.
- 9.7.6 The top one-foot of adjacent subgrade should be deleted from the passive pressure computation.
- 9.7.7 Sandy soils were encountered at the site. Casing of the drilled caisson will be required if caving is encountered or the drilled hole has to be left open for an extended period of time.

## **9.8 Concrete Slabs-on-Grade**

- 9.8.1 Slab thickness and reinforcement should be determined by the structural engineer based on the anticipated loading. We recommend that non-structural slabs-on-grade be at least 4 inches thick and underlain by six (6) inches of compacted clean granular aggregate subbase material compacted to at least 95% relative compaction.
- 9.8.2 Granular aggregate subbase material shall conform to ASTM D-2940, Latest Edition (Table 1, bases) with at least 95 percent passing a 1½-inch sieve and not more than 8% passing a No. 200 sieve or clean Crushed Aggregate Base (CAB) to prevent capillary moisture rise. Crushed



Miscellaneous Base (CMB) is not acceptable to be used as subbase material within the building pad area.

- 9.8.3 We recommend reinforcing slabs, at a minimum, with No. 3 reinforcing bars placed 18 inches on center, each way.
- 9.8.4 Slabs subject to structural loading may be designed utilizing a modulus of subgrade reaction K of 150 pounds per square inch per inch. The K value was approximated based on inter-relationship of soil classification and bearing values (Portland Cement Association, Rocky Mountain Northwest).
- 9.8.5 The spacing of crack control joints should be designed by the project structural engineer. In order to regulate cracking of the slabs, we recommend that construction joints or control joints be provided at a maximum spacing of 15 feet in each direction for 5-inch thick slabs and 12 feet for 4-inch thick slabs.
- 9.8.6 Crack control joints should extend a minimum depth of one-fourth the slab thickness and should be constructed using saw-cuts or other methods as soon as practical after concrete placement. The exterior floors should be poured separately in order to act independently of the walls and foundation system.
- 9.8.7 It is recommended that the utility trenches within the structures be compacted, as specified in our report, to minimize the transmission of moisture through the utility trench backfill. Special attention to the immediate drainage and irrigation around the structures is recommended.
- 9.8.8 Moisture within the structures may be derived from water vapors, which were transformed from the moisture within the soils. This moisture vapor penetration can affect floor coverings and produce mold and mildew in the structures. To minimize moisture vapor intrusion, it is recommended that a vapor retarder be installed in accordance with manufacturer's recommendations and/or ASTM guidelines, whichever is more stringent. In addition, ventilation of the structures is recommended to reduce the accumulation of interior moisture.
- 9.8.9 In areas where it is desired to reduce floor dampness where moisture-sensitive coverings are anticipated, construction should have a suitable waterproof vapor retarder (a minimum of 15 mils thick polyethylene vapor retarder sheeting, Raven Industries "VaporBlock 15, Stego Industries 15 mil "StegoWrap" or W.R. Meadows Sealtight 15 mil "Perminator") incorporated into the floor slab design. The water vapor retarder should be decay resistant material complying with ASTM E96 not exceeding 0.04 perms, ASTM E154 and ASTM E1745 Class A. The vapor barrier should be placed between the concrete slab and the compacted granular aggregate subbase material. The water vapor retarder (vapor barrier) should be installed in accordance with ASTM Specification E 1643-94.
- 9.8.10 The concrete maybe placed directly on vapor retarder. The vapor retarder should be inspected prior to concrete placement. Cut or punctured retarder should be repaired using vapor retarder material lapped 6 inches beyond damaged areas and taped.

- 9.8.11 The recommendations of this report are intended to reduce the potential for cracking of slabs due to soil movement. However, even with the incorporation of the recommendations presented herein, foundations, stucco walls, and slabs-on-grade may exhibit some cracking due to soil movement. This is common for project areas that contain expansive soils since designing to eliminate potential soil movement is cost prohibitive. The occurrence of concrete shrinkage cracks is independent of the supporting soil characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, proper concrete placement and curing, and by the placement of crack control joints at periodic intervals, in particular, where re-entrant slab corners occur.
- 9.8.12 Proper finishing and curing should be performed in accordance with the latest guidelines provided by the American Concrete Institute, Portland Cement Association, and ASTM.

## 9.9 Lateral Earth Pressures and Frictional Resistance

- 9.9.1 Active, at-rest and passive unit lateral earth pressures against footings and walls are summarized in the table below:

<b>Lateral Pressure Drained and Level Backfill Conditions</b>	<b>Equivalent Fluid Pressure, pcf</b>
Active Pressure	40
At-Rest Pressure	60
Passive Pressure	350
<b>Related Parameters</b>	
Allowable Coefficient of Friction	0.40
In-Place Soil Density (lbs/ft <sup>3</sup> )	120

- 9.9.2 Active pressure applies to walls, which are free to rotate. At-rest pressure applies to walls, which are restrained against rotation. The preceding lateral earth pressures assume sufficient drainage behind retaining walls to prevent the build-up of hydrostatic pressure.
- 9.9.3 The top one-foot of adjacent subgrade should be deleted from the passive pressure computation.
- 9.9.4 A safety factor consistent with the design conditions should be included in the usage of the values presented in the above table.
- 9.9.5 For stability against lateral sliding, which is resisted solely by the passive pressure, we recommend a minimum safety factor of 1.5.
- 9.9.6 For stability against lateral sliding, which is resisted by the combined passive and frictional resistance, a minimum safety factor of 2.0 is recommended.

- 9.9.7 For lateral stability against seismic loading conditions, we recommend a minimum safety factor of 1.1.
- 9.9.8 For dynamic seismic lateral loading the following equation shall be used:

Dynamic Seismic Lateral Loading Equation
Dynamic Seismic Lateral Load = $\frac{3}{8}\gamma K_h H^2$
Where: $\gamma$ = In-Place Soil Density
$K_h$ = Horizontal Acceleration = $\frac{2}{3}PGA_M$
H = Wall Height

## 9.10 Retaining Walls

- 9.10.1 Retaining and/or below grade walls should be drained with either perforated pipe encased in free-draining gravel or a prefabricated drainage system. The gravel zone should have a minimum width of 12 inches wide and should extend upward to within 12 inches of the top of the wall. The upper 12 inches of backfill should consist of native soils, concrete, asphaltic-concrete or other suitable backfill to minimize surface drainage into the wall drain system. The gravel should conform to Class II permeable materials graded in accordance with the current CalTrans Standard Specifications.
- 9.10.2 Prefabricated drainage systems, such as Miradrain®, Enkadrain®, or an equivalent substitute, are acceptable alternatives in lieu of gravel provided they are installed in accordance with the manufacturer's recommendations. If a prefabricated drainage system is proposed, our firm should review the system for final acceptance prior to installation.
- 9.10.3 Drainage pipes should be placed with perforations down and should discharge in a non-erosive manner away from foundations and other improvements. The top of the perforated pipe should be placed at or below the bottom of the adjacent floor slab or pavements. The pipe should be placed in the center line of the drainage blanket and should have a minimum diameter of 4 inches. Slots should be no wider than 1/8-inch in diameter, while perforations should be no more than 1/4-inch in diameter.
- 9.10.4 If retaining walls are less than 5 feet in height, the perforated pipe may be omitted in lieu of weep holes on 4 feet maximum spacing. The weep holes should consist of 2-inch minimum diameter holes (concrete walls) or unmortared head joints (masonry walls) and placed no higher than 18 inches above the lowest adjacent grade. Two 8-inch square overlapping patches of geotextile fabric (conforming to the CalTrans Standard Specifications for "edge drains") should be affixed to the rear wall opening of each weep hole to retard soil piping.
- 9.10.5 During grading and backfilling operations adjacent to any walls, heavy equipment should not be allowed to operate within a lateral distance of 5 feet from the wall, or within a lateral distance equal to the wall height, whichever is greater, to avoid developing excessive lateral pressures.

Within this zone, only hand operated equipment ("whackers," vibratory plates, or pneumatic compactors) should be used to compact the backfill soils.

## **9.11 Temporary Excavations**

- 9.11.1 We anticipate that the majority of the sandy site soils will be classified as Cal-OSHA "Type C" soil when encountered in excavations during site development and construction. Excavation sloping, benching, the use of trench shields, and the placement of trench spoils should conform to the latest applicable Cal-OSHA standards. The contractor should have a Cal-OSHA-approved "competent person" onsite during excavation to evaluate trench conditions and make appropriate recommendations where necessary.
- 9.11.2 It is the contractor's responsibility to provide sufficient and safe excavation support as well as protecting nearby utilities, structures, and other improvements which may be damaged by earth movements. All onsite excavations must be conducted in such a manner that potential surcharges from existing structures, construction equipment, and vehicle loads are resisted. The surcharge area may be defined by a 1:1 projection down and away from the bottom of an existing foundation or vehicle load.
- 9.11.3 Temporary excavations and slope faces should be protected from rainfall and erosion. Surface runoff should be directed away from excavations and slopes.
- 9.11.4 Open, unbraced excavations in undisturbed soils should be made according to the slopes presented in the following table:

**RECOMMENDED EXCAVATION SLOPES**

<b>Depth of Excavation (ft)</b>	<b>Slope (Horizontal : Vertical)</b>
0-5	1:1
5-10	2:1

- 9.11.5 If, due to space limitation, excavations near property lines or existing structures are performed in a vertical position, slot cuts, braced shorings or shields may be used for supporting vertical excavations. Therefore, in order to comply with the local and state safety regulations, a properly designed and installed shoring system would be required to accomplish planned excavations and installation. A Specialty Shoring Contractor should be responsible for the design and installation of such a shoring system during construction.
- 9.11.6 Braced shorings should be designed for a maximum pressure distribution of 30H, (where H is the depth of the excavation in feet). The foregoing does not include excess hydrostatic pressure or surcharge loading. Fifty percent of any surcharge load, such as construction equipment weight, should be added to the lateral load given herein. Equipment traffic should concurrently be limited to an area at least 3 feet from the shoring face or edge of the slope.

- 9.11.7 The excavation and shoring recommendations provided herein are based on soil characteristics derived from the borings within the area. Variations in soil conditions will likely be encountered during the excavations. SALEM Engineering Group, Inc. should be afforded the opportunity to provide field review to evaluate the actual conditions and account for field condition variations not otherwise anticipated in the preparation of this recommendation. Slope height, slope inclination, or excavation depth should in no case exceed those specified in local, state, or federal safety regulation, (e.g. OSHA) standards for excavations, 29 CFR part 1926, or Assessor's regulations.

## **9.12 Underground Utilities**

- 9.12.1 Underground utility trenches should be backfilled with properly compacted material. The material excavated from the trenches should be adequate for use as backfill provided it does not contain deleterious matter, vegetation or rock larger than 3 inches in maximum dimension. Trench backfill should be placed in loose lifts not exceeding 8 inches and compacted to at least 95% relative compaction at no less than the optimum moisture content.
- 9.12.2 Bedding and pipe zone backfill typically extends from the bottom of the trench excavations to approximately 6 to 12 inches above the crown of the pipe. Pipe bedding and backfill material should conform to the requirements of the governing utility agency.
- 9.12.3 It is suggested that underground utilities crossing beneath new or existing structures be plugged at entry and exit locations to the buildings or structures to prevent water migration. Trench plugs can consist of on-site clay soils, if available, or sand cement slurry. The trench plugs should extend 2 feet beyond each side of individual perimeter foundations.
- 9.12.4 The contractor is responsible for removing all water-sensitive soils from the trench regardless of the backfill location and compaction requirements. The contractor should use appropriate equipment and methods to avoid damage to the utilities and/or structures during fill placement and compaction.

## **9.13 Surface Drainage**

- 9.13.1 Proper surface drainage is critical to the future performance of the project. Uncontrolled infiltration of irrigation excess and storm runoff into the soils can adversely affect the performance of the planned improvements. Saturation of a soil can cause it to lose internal shear strength and increase its compressibility, resulting in a change to important engineering properties. Proper drainage should be maintained at all times.
- 9.13.2 The ground immediately adjacent to the foundation shall be sloped away from the building at a slope of not less than 5 percent for a minimum distance of 10 feet.
- 9.13.3 Impervious surfaces within 10 feet of the building foundation shall be sloped a minimum of 2 percent away from the building and drainage gradients maintained to carry all surface water to collection facilities and off site. These grades should be maintained for the life of the project. Ponding of water should not be allowed adjacent to the structure. Over-irrigation within landscaped areas adjacent to the structure should not be performed.

- 9.13.4 Roof drains should be installed with appropriate downspout extensions out-falling on splash blocks so as to direct water a minimum of 5 feet away from the structures or be connected to the storm drain system for the development.

#### **9.14 Pavement Design**

- 9.14.1 Based on site soil conditions, an R-value of 30 was used for the preliminary flexible asphaltic concrete pavement design. The R-value may be verified during grading of the pavement areas.
- 9.14.2 The asphaltic concrete (flexible pavement) is based on a 20-year pavement life for traffic indexes of 5.0 and 6.5. If higher traffic loading is anticipated, SALEM should be contacted to provide revised pavement thickness recommendations.

**TABLE 9.14.2  
ASPHALT CONCRETE PAVEMENT**

<b>Traffic Index</b>	<b>Asphaltic Concrete</b>	<b>Clean Crushed Aggregate Base*</b>	<b>Compacted Subgrade*</b>
5.0 (Parking and Vehicle Drive Areas)	3.0"	5.0"	24.0"
6.5 (Heavy Truck Areas)	4.0"	7.5"	24.0"

*\*95% compaction based on ASTM D1557 Test Method*

- 9.14.3 The following recommendations are for light-duty and heavy-duty Portland Cement Concrete pavement sections.

**TABLE 9.14.3  
PORTLAND CEMENT CONCRETE PAVEMENT**

<b>Traffic Index</b>	<b>Portland Cement Concrete*</b>	<b>Clean Crushed Aggregate Base**</b>	<b>Compacted Subgrade**</b>
5.0 (Light Duty)	5.0"	4.0"	24.0"
6.5 (Heavy Duty)	7.0"	4.0"	24.0"

*\* Min. Compressive Strength of 4,000 psi, Min. Reinforcement of No. 4 bars at 18 inches o.c. each way*

*\*\* 95% compaction based on ASTM D1557 Test Method*

## **10. PLAN REVIEW, CONSTRUCTION OBSERVATION AND TESTING**

### **10.1 Plan and Specification Review**

- 10.1.1 SALEM should review the project grading and foundation plans and specifications prior to final design submittal to assess whether our recommendations have been properly implemented and evaluate if additional analysis and/or recommendations are required.

## **10.2 Construction Observation and Testing Services**

- 10.2.1 The recommendations provided in this report are based on the assumption that we will continue as Geotechnical Engineer of Record throughout the construction phase. It is important to maintain continuity of geotechnical interpretation and confirm that field conditions encountered are similar to those anticipated during design. If we are not retained for these services, we cannot assume any responsibility for others interpretation of our recommendations, and therefore the future performance of the project.
- 10.2.2 SALEM should be present at the site during site preparation to observe site clearing, preparation of exposed surfaces after clearing, and placement, treatment and compaction of fill material.
- 10.2.3 SALEM's observations should be supplemented with periodic compaction tests to establish substantial conformance with these recommendations. Moisture content of footings and slab subgrade should be tested immediately prior to concrete placement. SALEM should observe foundation excavations prior to placement of reinforcing steel or concrete to assess whether the actual bearing conditions are compatible with the conditions anticipated during the preparation of this report.

## **11. LIMITATIONS AND CHANGED CONDITIONS**

The analyses and recommendations submitted in this report are based upon the data obtained from the test borings drilled at the approximate locations shown on the Site Plan, Figure 1. The report does not reflect variations which may occur between borings. The nature and extent of such variations may not become evident until construction is initiated.

If variations then appear, a re-evaluation of the recommendations of this report will be necessary after performing on-site observations during the excavation period and noting the characteristics of such variations. The findings and recommendations presented in this report are valid as of the present and for the proposed construction. If site conditions change due to natural processes or human intervention on the property or adjacent to the site, or changes occur in the nature or design of the project, or if there is a substantial time lapse between the submission of this report and the start of the work at the site, the conclusions and recommendations contained in our report will not be considered valid unless the changes are reviewed by SALEM and the conclusions of our report are modified or verified in writing.

The validity of the recommendations contained in this report is also dependent upon an adequate testing and observations program during the construction phase. Our firm assumes no responsibility for construction compliance with the design concepts or recommendations unless we have been retained to perform the on-site testing and review during construction. SALEM has prepared this report for the exclusive use of the owner and project design consultants.

SALEM does not practice in the field of corrosion engineering. It is recommended that a qualified corrosion engineer be consulted regarding protection of buried steel or ductile iron piping and conduit or, at a minimum, that manufacturer's recommendations for corrosion protection be closely followed. Further, a corrosion engineer may be needed to incorporate the necessary precautions to avoid premature corrosion of concrete slabs and foundations in direct contact with native soil.



The importation of soil and or aggregate materials to the site should be screened to determine the potential for corrosion to concrete and buried metal piping. The report has been prepared in accordance with generally accepted geotechnical engineering practices in the area. No other warranties, either express or implied, are made as to the professional advice provided under the terms of our agreement and included in this report.

If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (909) 980-6455.

Respectfully Submitted,

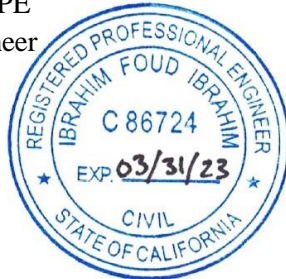
**SALEM ENGINEERING GROUP, INC.**



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<<http://www.water.ca.gov/waterdatalibrary/>>.
- California State Water Resources Control Board [SWRCB]; Geotracker database web page; Availability:  
<http://geotracker.swrcb.ca.gov>
- Hart, E.W. (1974) Fault-rupture hazard zones in California: California Department of Conservation, Division of Mines and Geology Special Publication 42, 38 p. (Revised periodically; information on state law and zoning program for regulating development near hazardous faults.)
- Morton, D.M. and F.K. Miller (2006) Geologic map of the San Bernardino and Santa Ana 30' x 60' quadrangles, California: U.S. Geological Survey Open-File Report 2006-1217, scale 1:100,000
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- Riverside County General Plan (2003) Chapter 6: Safety Element; Transportation and Land Management Agency (<http://www.rctlma.org/genplan/content/gp/chapter06.html>)
- Lake Elsinore General Plan–Certified Recirculated Program Environmental Impact Report: Section 3.11–Geology and Soils ([https:// http://www.lake-elsinore.org/city-hall/city-departments/community-development/planning/lake-elsinore-general-plan/general-plan-certified-eir](https://http://www.lake-elsinore.org/city-hall/city-departments/community-development/planning/lake-elsinore-general-plan/general-plan-certified-eir))
- OSHPD Seismic Design Maps applet tool to determine site-specific accelerations (available at <http://seismicmaps.org/>).
- Riverside County Information Technology (RCIT), Map My County (ver. 10) website:  
[https://gis1.countyofriverside.us/Html5Viewer/index.html?viewer=MMC\\_Public](https://gis1.countyofriverside.us/Html5Viewer/index.html?viewer=MMC_Public)
- Wills, C.J., Weldon, R.J., II, and Bryant, W.A. (2008) California fault parameters for the National Seismic Hazard Maps and Working Group on California Earthquake Probabilities, *Appendix A in The Uniform California Earthquake Rupture Forecast, version 2 (UCERF 2)*: U.S. Geological Survey Open-File Report 2007-1437A, and California Geological Survey Special Report 203A, 48 p. [<http://pubs.usgs.gov/of/2007/1437/a/>].



Source Image: U.S. Geological Survey, Lake Elsinore, California, <https://ngmdb.usgs.gov/topoview> (2018)



**VICINITY MAP**  
**GEOTECHNICAL ENGINEERING INVESTIGATION**  
**Proposed Commercial Development**  
**Central Avenue & Cambern Avenue**  
**Lake Elsinore, California**

SCALE:  
 NOT TO SCALE

DRAWN BY:  
 JC

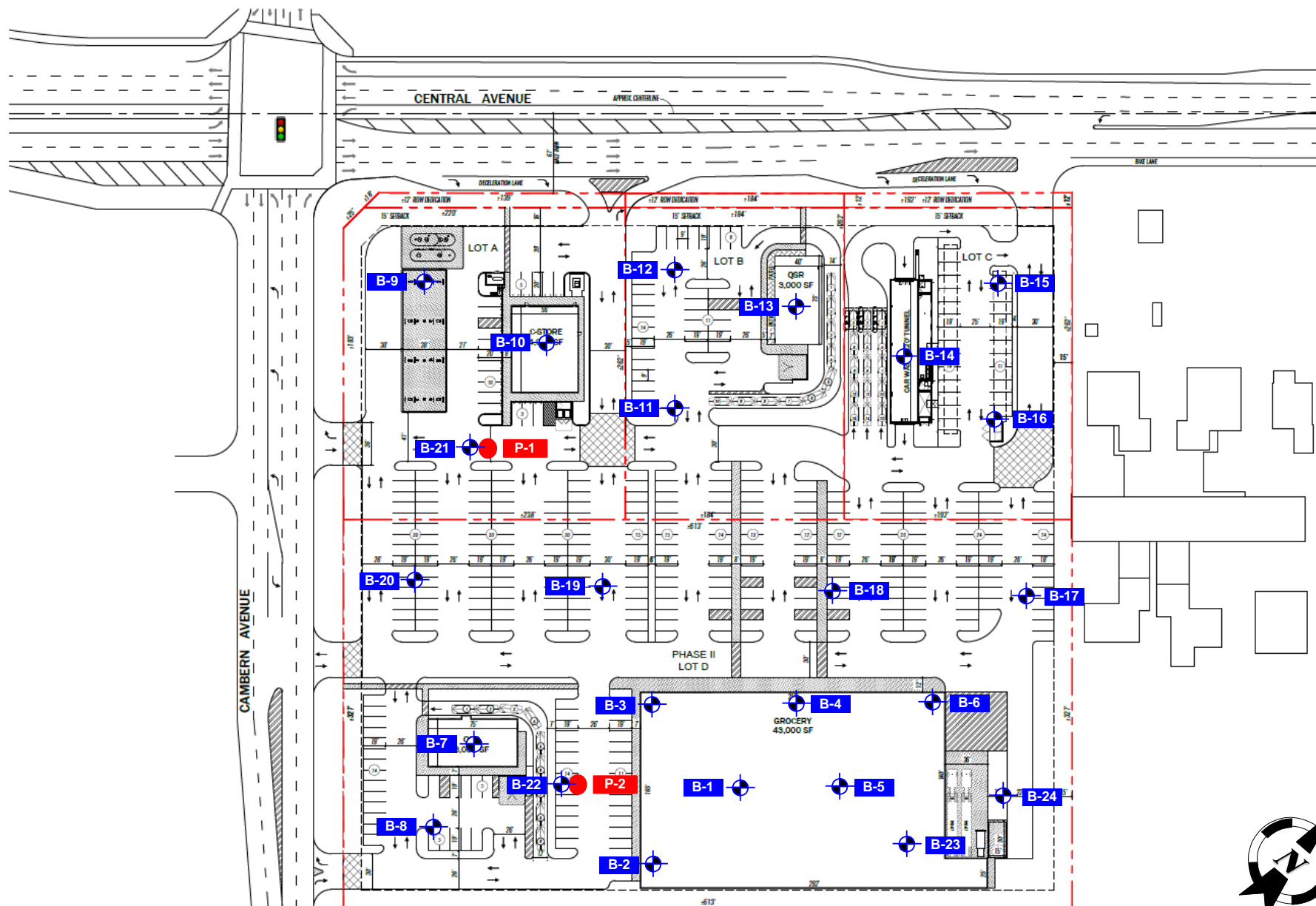
PROJECT NO.  
 3-221-0167

DATE:  
 04/2021

APPROVED BY:  
 CJ

FIGURE NO.  
 1

**SALEM**  
 engineering group, inc.



## SITE PLAN

**GEOTECHNICAL ENGINEERING INVESTIGATION**  
**Proposed Commercial Development**  
**Central Avenue & Cambern Avenue**  
**Lake Elsinore, California**

SCALE:  
 NOT TO SCALE

DRAWN BY:  
 JC

PROJECT NO.  
 3-221-0167

DATE:  
 04/2021

APPROVED BY:  
 CJ

FIGURE NO.  
 2

### LEGEND:

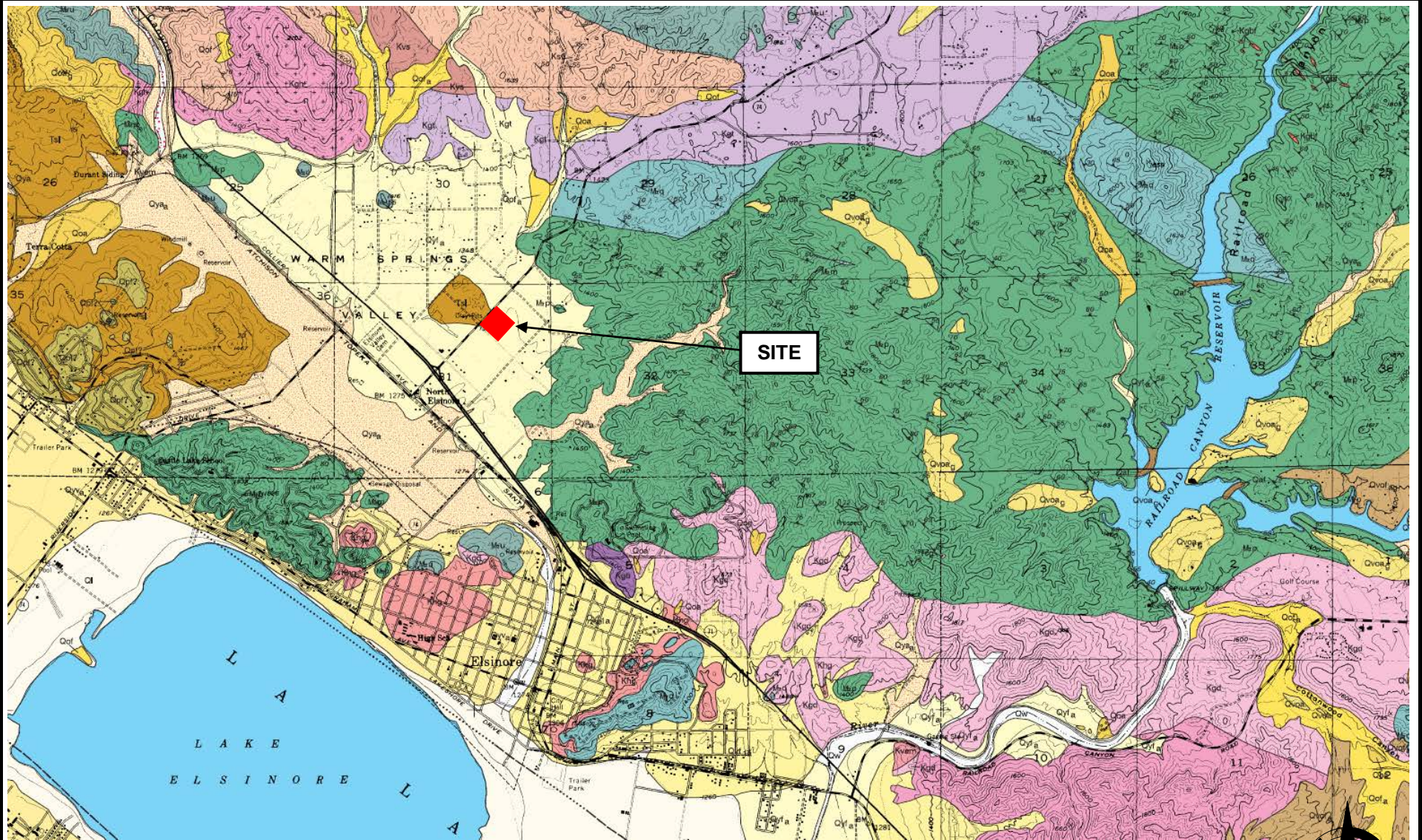


**B-1** Soil Boring Locations  
**P-1** Percolation Locations

All Locations Approximate







Morton, D.M (1978, 1998) and Weber, Jr., F. H. (1973-77) Preliminary Geologic Map of the Elsinore 7.5' Quadrangle, Riverside County, California: U.S. Geological Survey Open-File Report 03-281 Scale 1:24,000.



**Regional Geologic Map**  
**GEOTECHNICAL ENGINEERING INVESTIGATION**  
**Proposed Commercial Development**  
**Central Avenue & Cambern Avenue**  
**Lake Elsinore, Riverside County, California**

SCALE:  
NOT TO SCALE

DRAWN BY:  
JC

PROJECT NO.  
3-221-0167

DATE:  
04/2019

APPROVED BY:  
CJ

FIGURE NO.  
3A

**SALEM**  
engineering group, inc.



	<b>VERY YOUNG ALLUVIAL DEPOSITS</b> —Sediment recently transported and deposited in channels and meanders, vs. surfaces of alluvial fans and alluvial plains, and on hillslopes. Soil-profile development is non-existent.
Qaf	<b>Artificial fill (late Holocene)</b> —Deposits of fill resulting from human construction, mining, or quarrying activities; includes compacted engineered and non-compact non-engineered fill. Most large deposits are mapped, but in some areas, small deposits are not shown
Qw	<b>Very young wash deposits (late Holocene)</b> —Unconsolidated bedrock to sandy alluvium of active and recently active washes
Ql	<b>Very young alluvial-fan deposits (late Holocene)</b> —Active and recently active alluvial fans. Consists of unconsolidated, bouldery, cobbly, gravelly, sandy, or silty alluvial-fan deposits, and headward channel parts of alluvial fans. Provenance is local. These deposits may contain greater percentage of coarse-grained sediment than a distal part
Ql	<b>Very young lacustrine deposits (late Holocene)</b> —Dominantly gray, clayey, silty, and fine grained sandy lacustrine deposits
	<b>YOUNG SURFICIAL DEPOSITS</b> —Sedimentary units that are slightly consolidated to cemented and slightly to moderately dissected. Alluvial fan deposits (Qf) series typically have high cone-silt/clast ratios. Young surficial units have upper surfaces that are capped by silt to moderately developed pedogenic soils (AABB/Cx profiles and A/C to A/CBx/Cx profiles)
Qye	<b>Young alluvial-wash deposits (Holocene and late Pleistocene)</b> —Unconsolidated bedrock to sandy alluvium marginal to active and recently active washes
Qyf	<b>Young alluvial-fan deposits (Holocene and late Pleistocene)</b> —Unconsolidated deposits of alluvial fans and headward drainages of fans. Consists predominantly of gravel, sand, and silt. Trunk drainages and proximal parts of fans contain higher percentage of coarse-grained sediment than distal parts. Includes:
Qyf1	<b>Young alluvial-fan deposits (late Holocene, Holocene and late Pleistocene)</b> —Unconsolidated alluvial fans. Consists of gravel, sand, and silt; old part of Qyf. In part distinguished on basis of relative terrace levels
Qys	<b>Young alluvial-channel deposits (Holocene and late Pleistocene)</b> —Fluvial deposits along canyon floors. Consists of unconsolidated sand, silt, and clay-bearing alluvium
Qyv	<b>Young alluvial-valley deposits (Holocene and late Pleistocene)</b> —Alluvial deposits along valley floors. Consists of unconsolidated sand, silt, and clay-bearing alluvium
	<b>OLD SURFICIAL DEPOSITS</b> —Sedimentary units that are moderately consolidated to slightly to moderately dissected. Older alluvial deposits have upper surfaces that are capped by moderately to well-developed pedogenic soils (AABB/Cx profiles and Bt horizons as much as 1 to 2 m thick and maximum hues in the range of 10YR 5/4 and 6/4 through 7.5YR 6/4 to 4/4 and mature Bt horizons reaching 5YR 5/6)
Qol	<b>Old alluvial-fan deposits (late to middle Pleistocene)</b> —Reddish-brown, silty, and silty, alluvial-fan deposits, commonly slightly dissected. In places includes thin alluvial-fan deposits of Holocene age. Includes:
Qol1	<b>Old alluvial-fan deposits, Unit 1 (middle Pleistocene)</b> —Indurated, gravelly alluvial-fan deposits. Most are slightly to moderately dissected, reddish brown. Some deposits include thin, discontinuous surface layer of Holocene alluvial-fan material
Qol2	<b>Old alluvial-channel deposits (late to middle Pleistocene)</b> —Fluvial sediments deposited on canyon floors, but much of unit now elevated. Consists of moderately indurated, commonly slightly dissected gravel, sand, silt, and clay-bearing alluvium. Locally capped by thin, discontinuous alluvial deposits
	<b>VERY OLD SURFICIAL DEPOSITS</b> —Sediments that are slightly to well consolidated to indurated, and moderately to well dissected. Upper surfaces are capped by thin to moderately well developed pedogenic soils (AABB/Cx profiles having Bt horizons as much as 2 to 3 m thick and maximum hues in the range 7.5YR 6/4 and 4/4 to 2.5YR 5/8)
Qold	<b>Very old alluvial-fan deposits (ancient to early Pleistocene)</b> —Modestly well-dissected, well-indurated, reddish-brown alluvial-fan deposits. Grain












range 75R/54A and 44A (2.5R/58).  
Very old alluvial fan deposits (middle to early Pleistocene).—Mostly well-dissected, well-indurated, reddish-brown alluvial-fan deposits. Gravels coarse chiefly sand and gravel.  
Very old alluvial fan deposits (middle to early Pleistocene).—Gravels and sandstone deposited on canyon floors. Cores of moderately to well-indurated, reddish-brown, mostly very dissected gravel, sand, silt, and clay-bearing alluvium. In places, includes thin, discontinuous alluvial deposits of Holocene age. Deposits in Quail Valley and Railroad Canyon areas contain banded cobble.  
Pleistocene.—Silts, sandstone, and conglomerate.  
Named by Mann (1955) for exposures in Rancho Pabua area about 3.2 km southeast of Temecula. Vertebrate fauna from Pabua Formation and of late Irvington and early Rancholabrean ages (Reynolds and Reynolds, 1990a, 1990b). In type area, subdivided into two members; only the sandstone member is exposed in the quadrangle.  
Serrano—Berrero.—Berrero.—Berrero.—Well-indurated, cross-bedded sandstone containing sparse cobble to boulder-conglomerate beds. Restricted to Rose Hill area southeast of Lake Elsinore.  
Conglomerate (Paleocene?).—Mottled cobble conglomerate. Underlies a very small area (about 100m wide) on ridge crest 1.8 km west of the mouth of the San Jacinto River. Conglomerate is composed of metamorphic rock. Conglomerate is composed of exotic welded tuff clasts, some of which contain piemontic, characteristic mineral in welded tuff clasts in conglomerates of Poway Group (Woodford and others, 1968) (Kennedy, 1977). Welded tuff clasts appear identical to those in the early Pleistocene Serrano Formation. Conglomerate is a conglomerate of Eocene Poway Group. Welded tuff clasts occur in older alluvial deposits bordering Railroad Canyon Reservoir (Owens) and in northern part of the quadrangle (Owens) in Goodhope area. Distribution of reworked clasts within Elsinore quadrangle and quadrangles to north suggests occurrence here is small remnant of a very old conglomerate.  
Siverda Formation (Paleocene).—Nonmarine and marine sandstone, siltstone, and conglomerate. Dickerson (1914) first recognized Siverda rocks in Santa Ana Mountains to west, and based on faunal similarities, correlated strata with Martinez Formation of central California. Reeking (1936) named the Siverda Formation. Reeking named it Siverda Formation. Formation was deposited on deeply weathered erosional surface. Rocks underlying Siverda are characteristically spilitic. Siverda Formation consists of basal conglomerate overlain by relatively thin sequence of sandstone and siltstone. Distinctive Claymont clay bed overlies sandstone and siltstone. Claymont clay bed overlies sandstone and siltstone. Claymont clay bed includes second clay bed, the Serrano clay bed. Basal conglomerate is thoroughly weathered, 20- to 25-m-thick, massive, purple to reddish-brown, pebble conglomerate. Very locally is boulder conglomerate. Overlying this conglomerate is sandstone and siltstone. Claymont clay bed is 1- to 3-m-thick, brown, green, and gray clay with the weathers to distinctive brownish-red. Bed is mostly clay, and partly siltstone and has scattered quartz grains in it. Locally, supports large-scale clay operation. Upper part of unit above Claymont clay bed is diverse section of marine and nonmarine sandstone, siltstone, and conglomerate, and includes a clay bed. Clay bed is 1- to 3-m-thick, brown, green, and gray clay and composed of nearly equal amounts plastic clay and quartz. In addition to clay, upper part of section contains carbonaceous shale and lignite beds. Thinner lignite beds were locally mined for fuel. Upper part of unit also contains abundant marine mollusks. Some eastern extension of formation contains distinctive and diagnostic Paleocene Tertiary paleosols.  
Tertiary paleosols.

## Rocks of the Peninsular Ranges batholith

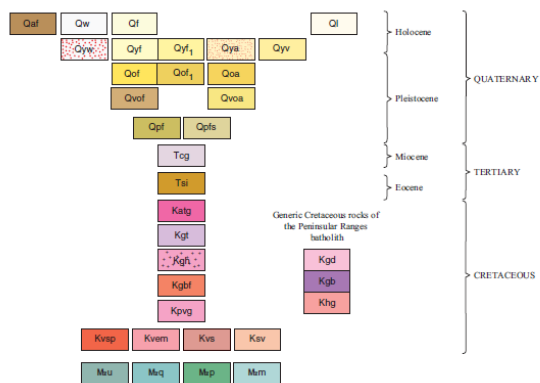
Katz	<p><b>Granodiorite of Arroyo del Toro pluton (Crataecus)</b>—Light gray, medium-grained, massive, very homogeneous and inclusion-free biotite-hornblende granodiorite. Some of the rock in the western part of the pluton is slightly porphyric. Informally named for Arroyo del Toro, located in center of pluton (Morton, 1999). Tinned Seale Valley granodiorite by Dudley (1953) and Railroad Canyon (1948) within Woodson Mountain granodiorite. Near circular Arroyo del Toro is located in center of Gavilan ring complex, but apparently is not part of complex. Zircon ages of the pluton are 108.6 Mag and 111 Mag, 40Ar/39Ar biotite age is 104.3 Ma and potassium feldspar 98.5 Ma.</p>
Katz	<p><b>Gavilan ring complex (Crataecus)</b>—Composite ring structure consisting of a variety of granitic rocks that range from monzogranite to tonalite. Informally named for Gavilan, located in the center of the quadrangle, western part of complex was termed Easlee quartz diorite and eastern part was included in Peritt quartz diorite by Dudley (1953). Western part of complex was termed Easlee tonalite and eastern part was included within Bonsall tonalite by Larsen (1948). Hypersthene is characteristic mineral of many rocks in complex. Based on texture, degree of erosion is greater in the western part of complex in western part. Rocks on west side of complex commonly have a hypabyssal texture and appear to grade into volcanic textured rock. Several gold mines (e.g., Good Hope, Gavilan, and Santa Rosa mines), which constituted Pinnacite mining district (Sampson, 1935), are located within complex in this quadrangle and the Seale Peak quadrangle. Gold apparently occurred in arsenopyrite bearing quartz veins. Located in center of ring complex, but not part of it, is near-circular Arroyo del Toro pluton. Includes:</p>
Katz	<p><b>Massive textured tonalite</b>—Brown-weathering, massive, relatively heterogeneous, hypersthene-bearing biotite-hornblende tonalite. Most abundant rock type in complex. Equant-shaped mesocratic to melanocratic inclusions are common. Zircon age is 112.9 Mag and 113 Mag.</p>
Katz	<p><b>Hypabyssal tonalite</b>—Massive, hypabyssal-textured tonalite and lesser granodiorite in southwestern part of complex. Contains small, equant shaped mesocratic inclusions.</p>
Katz	<p><b>Fine-grained hornblende gabbro, Railroad Canyon area (Crataecus)</b>—Fine-grained hornblende gabbro constituting dikes, veins, and small isolated plutons. Located in Railroad Canyon area.</p>
Katz	<p><b>Paloma Valley Ring Complex (Crataecus)</b>—Composite ring-dike intrusion. Named and described by Morton and Badt (1976) for exposures in Paloma Valley area. Included within Woodson Mountain granodiorite and San Marcos gabbro by Larsen (1948). Ring complex consists of older, elliptical in plan, single-ring-dike and two subsidiary short-arc dikes. A younger set of thin dikes is largely within older dikes. Older dikes are composed of granophyre with granitic with vertical walls emplaced into gabbro by ring fracturing and magmatic stoping of gabbro. Younger ring-dike consists of hundreds of granitic pegmatite dikes. Most pegmatite dikes are 30 cm to over 1 m in thickness, and define a donut ring-dike geometry in which other dikes are moderately to steeply outward dipping and pass inward to near vertical dikes in center. Some of granophyre with younger ring-dike in center of complex, is bounded by granophyre that contains strings of granitic pegmatite. Younger dikes are interpreted as products of volatilenriched magma that filled a donut set of fractures resulting from caldron subsidence. Granophyre is interpreted as a product of pressure quenching of pegmatite magma and attendant loss of volatiles. Zircon ages of rock from atypical hornblende-bearing granodiorite from western part of older dike near south of San Jacinto River is 121 Mag, 118 Mag, and 118.5 Ma, 40Ar/39Ar age of hornblende 117.7 Ma and biotite and</p>

**Monzogranite to granodiorite**—Pale gray, massive, medium-grained, hypidionomphic-granular biotite monzogranite, and less abundant hornblende-biotite granodiorite forming older ring dike. Plagioclase is An<sub>20</sub> to An<sub>35</sub>, subhedral, tabular crystals. Contains inclusions of small to large sized blocks of gabbro.

Generic Cretaceous granitic rocks of the Peninsular Ranges batholith

	<b>Granulite (Cretaceous)</b> —Blastic and hornblende-blastic granulite, undifferentiated. Most is massive and medium grained
	<b>Gabbro (Cretaceous)</b> —Mainly hornblende gabbro. Includes Virginian quartzite and gabbro of Dudley (1935), and San Marcos gabbro of Laren (1948). Typically trivertic, interstitial, medium-to-fine coarse-grained hornblende gabbro, very large blocky hornblende crystals are common, and very locally gabbro is pegmatitic. Much is quite heterogeneous in composition and texture. Includes some dioritic composition rocks
	<b>Heterogeneous granitic rocks (Cretaceous)</b> —Includes wide variety of heterogeneous granitic rocks. Some heterogeneous augenites include large proportions of schist and gneiss. Textural composition rocks is mostly hornblende rock type
	<b>Santafo Peak Volcanics (Cretaceous)</b> —Basaltic andesite, dacite, rhyolite, volcaniclastic breccias, welded tuff, and epilitic rocks (Herrig, 1991). Originally named Black Mountain volcanics by Hanna (1926), but name was preoccupied. Laren (1948) renamed unit Santafo Peak Volcanics for exposures in vicinity of Santafo Peak, northern Santa Ana Mountains. Rocks are very heterogeneous, discontinuous, and poorly exposed. Most of unit is hydrothermally altered, alteration was contemporaneous with volcanism. Zircon ages of Santafo Peak Volcanics range from 123 to 134 Ma (Anderson, 1993), making it coeval with older part of Peninsular and Range batholith
	<b>Estate Mountain volcanics of Herrig (1991)</b> —Heterogeneous mixture of rhyolite flows, shallow intrusive necks, and volcanoclastic breccias is rare. Informally named by Herrig (1991) for exposures in vicinity of Estate Mountain, Lake Mathews 7.5° quadrangle. These rocks were termed Temescal dacite-porphyry by Dudley (1935) and Temescal Wash quartz tuff porphyry by Laren (1948). Zircon age of rock from unit collected west of Lake Mathews, Lake Mathews 7.5° quadrangle, is 123.5 Ma (Anderson, 1991)
	<b>Intermitted Estate Mountain volcanics of Herrig (1991) and Cretaceous)</b> —Includes volcanic rocks (Cretaceous)—Completely intermitted volcanic and sedimentary rocks, which appear to be coeval; sedimentary rocks predominate
	<b>Intermitted Estate Mountain volcanics of Herrig (1991) and Mesozoic-sedimentary rocks (Mesozoic)</b> —Completely intermitted volcanic and sedimentary rocks; volcanic rocks predominate. West of Lake Mathews much of sedimentary rocks produces volcanic rocks. In Elmore quadrangle, much of sedimentary rocks appear coeval with volcanics
	<b>Metasedimentary rocks, undifferentiated (Mesozoic)</b> —Wide variety of low to high metamorphic grade metamorphic rocks. Most occurrences include biotite schist
	<b>Quartz-rich rocks (Mesozoic)</b> —Quartzite and quartzitic meta-andesite
	<b>Phyllite (Mesozoic)</b> —Fossils lack phyllite. Commonly has been produced by very fine-grained white mica on surface, locally contains small elongate prisms of fine-grained white mica, which may be pseudomorphs after chalcitole
	<b>Marble (Mesozoic)</b> —Pod-like masses and elongic layers of relatively fine-grained, affable to gray marble and calcareous rocks. Commonly contains massive radiating marble of white metamorphic. In the Kern and Mendocino to the east, small mass of fine-grained dark gray to black marble and calcareous rock in hills east of San City contains deformed and poorly preserved pelopods and crinoids

### Map Units and Symbol Explanation



On some SCAMP geologic map plots, including the Ekinore 7.5' quadrangle, characteristic grain size information is displayed using subscripted alpha characters (e.g. Qy<sub>f</sub>, Qv<sub>a</sub>), where the characters conform to the following definitions:

a - arenaceous (very coarse sand through very fine sand)  
b - boulder gravel (>25mm)  
g - gravel (cobble through granule gravel)  
s - silty  
c - clayey

Morton, D.M. (1978, 1998) and Weber, Jr., F.H. (1973-77) Preliminary Geologic Map of the Elsinore 7.5' Quadrangle, Riverside County, California: U.S. Geological Survey Open-File Report 03-281 Scale 1:24,000.

## Regional Geologic Map

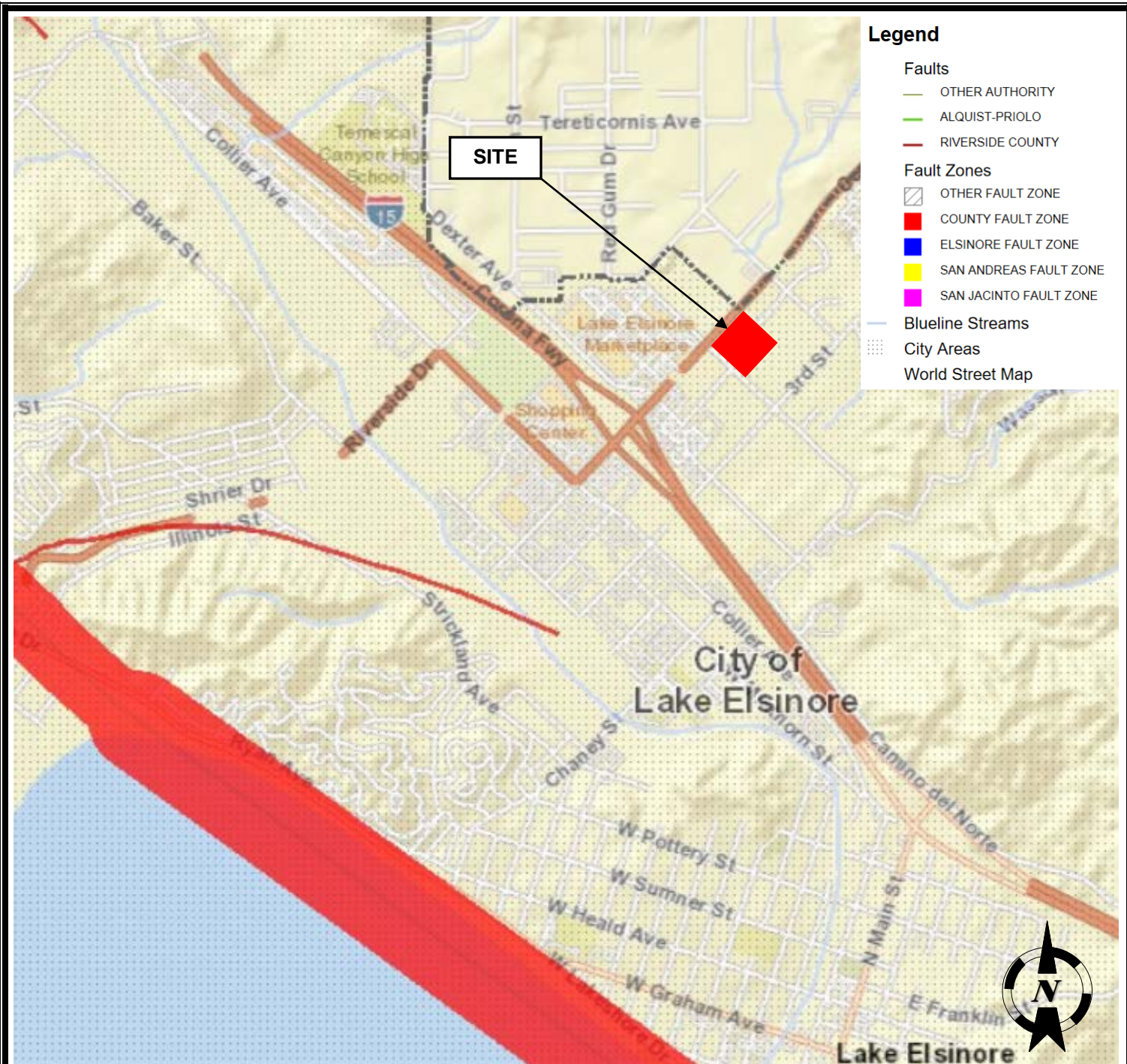
**GEOTECHNICAL ENGINEERING INVESTIGATION**  
**Proposed Commercial Development**  
**Central Avenue & Cambern Avenue**  
**Lake Elsinore, Riverside County, California**

SCALE: <b>NOT TO SCALE</b>	DATE: <b>04/2021</b>
DRAWN BY: <b>JC</b>	APPROVED BY: <b>CJ</b>
PROJECT NO. <b>3-221-0167</b>	FIGURE NO. <b>3B</b>



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engineering group, inc.






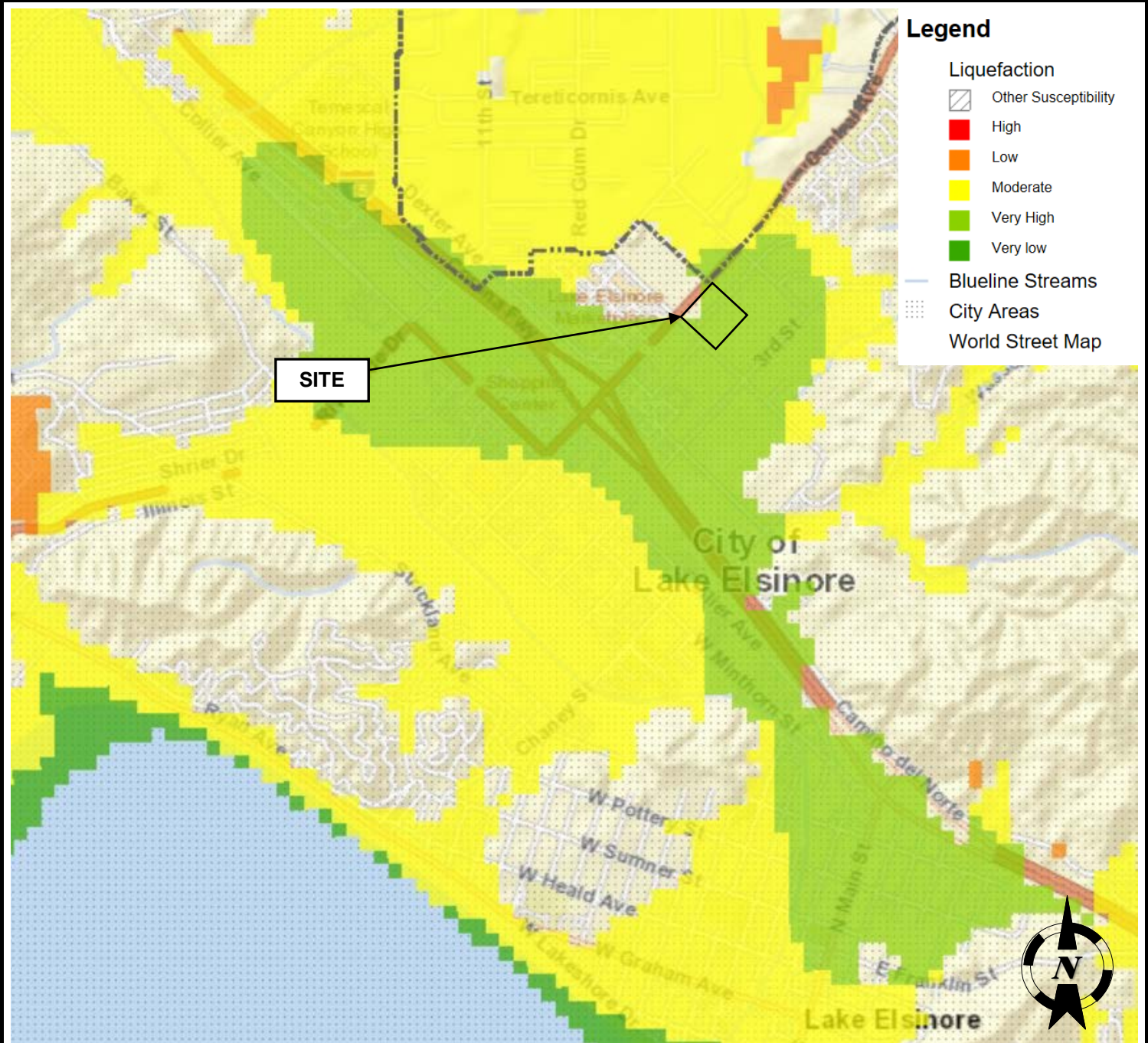
**\*IMPORTANT\*** Maps and data are to be used for reference purposes only. Map features are approximate, and are not necessarily accurate to surveying or engineering standards. The County of Riverside makes no warranty or guarantee as to the content (the source is often third party), accuracy, timeliness, or completeness of any of the data provided, and assumes no legal responsibility for the information contained on this map. Any use of this product with respect to accuracy and precision shall be the sole responsibility of the user.

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<b>Fault Map</b>  <b>GEOTECHNICAL ENGINEERING INVESTIGATION</b> <b>Proposed Commercial Development</b> <b>Central Avenue &amp; Cambern Avenue</b> <b>Lake Elsinore, Riverside County, California</b>	SCALE:	DATE:	
	NOT TO SCALE	04/2021	
	DRAWN BY:	APPROVED BY:	
	JC	CJ	
	PROJECT NO.	FIGURE NO.	
	3-221-0167	4	





**\*IMPORTANT\*** Maps and data are to be used for reference purposes only. Map features are approximate, and are not necessarily accurate to surveying or engineering standards. The County of Riverside makes no warranty or guarantee as to the content (the source is often third party), accuracy, timeliness, or completeness of any of the data provided, and assumes no legal responsibility for the information contained on this map. Any use of this product with respect to accuracy and precision shall be the sole responsibility of the user.

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**Liquefaction Potential Zone Map**  
**GEOTECHNICAL ENGINEERING INVESTIGATION**  
**Proposed Commercial Development**  
**Central Avenue & Cambern Avenue**  
**Lake Elsinore, Riverside County, California**

SCALE: NOT TO SCALE	DATE: 04/2021
DRAWN BY: JC	APPROVED BY: CJ
PROJECT NO. 3-221-0167	FIGURE NO. 5

**SALEM**  
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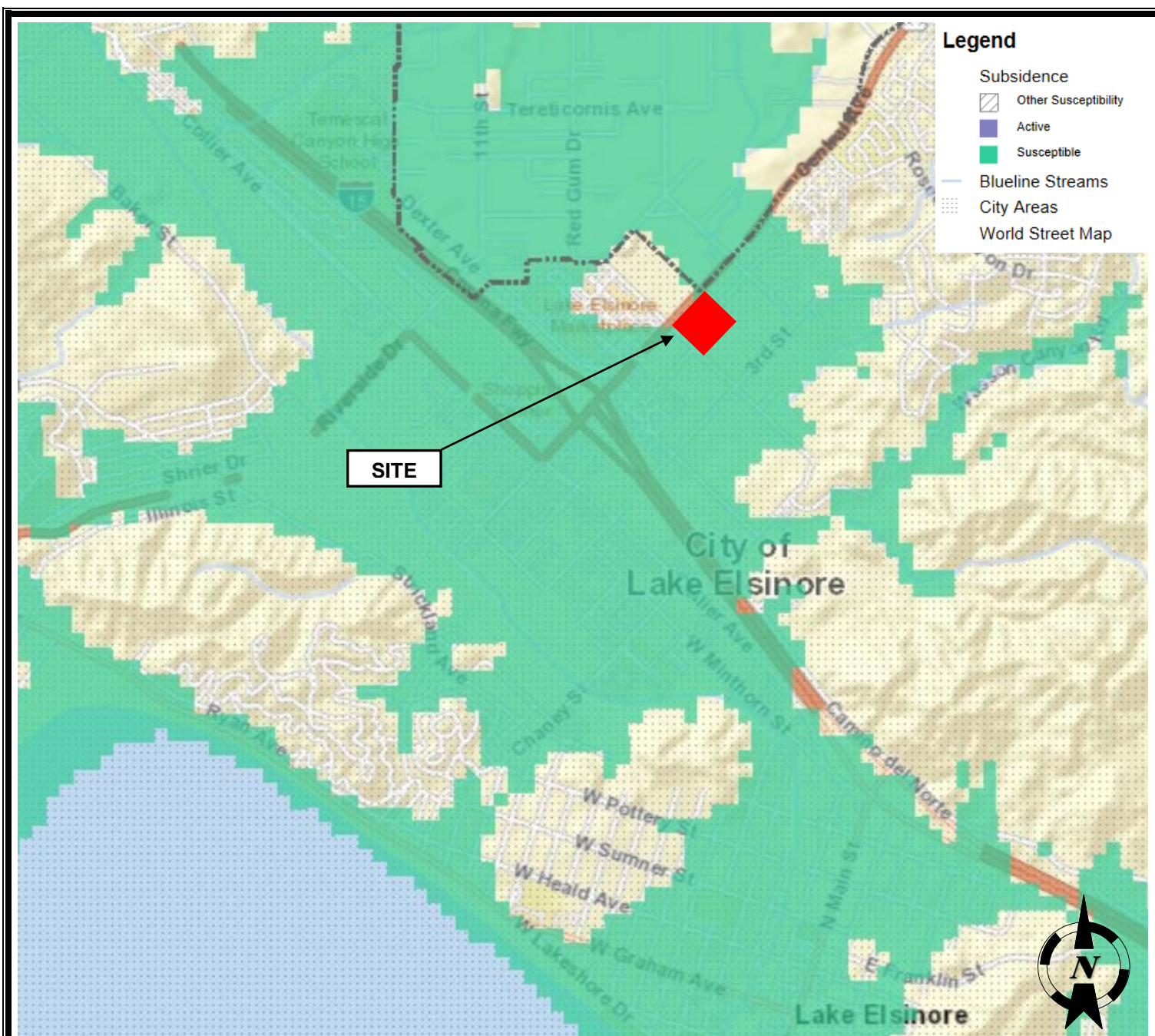
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<b>Flood Zone Map</b> <b>GEOTECHNICAL ENGINEERING INVESTIGATION</b> <b>Proposed Commercial Development</b> <b>Central Avenue &amp; Cambern Avenue</b> <b>Lake Elsinore, Riverside County, California</b>	SCALE: NOT TO SCALE	DATE: 04/2021	
	DRAWN BY: JC	APPROVED BY: CJ	
	PROJECT NO. 3-221-0167	FIGURE NO. 6	





**\*IMPORTANT\*** Maps and data are to be used for reference purposes only. Map features are approximate, and are not necessarily accurate to surveying or engineering standards. The County of Riverside makes no warranty or guarantee as to the content (the source is often third party), accuracy, timeliness, or completeness of any of the data provided, and assumes no legal responsibility for the information contained on this map. Any use of this product with respect to accuracy and precision shall be the sole responsibility of the user.

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### Subsidence Zone Map

**GEOTECHNICAL ENGINEERING INVESTIGATION**  
**Proposed Commercial Development**  
**Central Avenue & Cambern Avenue**  
**Lake Elsinore, Riverside County, California**

SCALE: NOT TO SCALE	DATE: 04/2021
DRAWN BY: JC	APPROVED BY: CJ
PROJECT NO. 3-221-0167	FIGURE NO. 7

**SALEM**  
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# A



## **APPENDIX A**

### **FIELD EXPLORATION**

Fieldwork for our investigation (drilling) was conducted on March 30 and 31, 2021 and included a site visit, subsurface exploration, percolation testing, and soil sampling. The percolation tests were performed on March 31, 2021. The locations of the exploratory borings and percolation tests are shown on the Site Plan, Figure 2. Boring logs for our exploration are presented in figures following the text in this appendix. Percolation data tables are presented in this appendix as well. Borings were located in the field using existing reference points. Therefore, actual boring locations may deviate slightly.

In general, our borings were performed using a truck-mounted CME 45C drill rig equipped with 4-inch diameter solid flight augers and 6.5-inch diameter hollow stem augers. Two (2) borings were drilled using a 4-inch diameter hand auger. Sampling in the borings was accomplished using a hydraulic 140-pound hammer with a 30-inch drop. Samples were obtained with a 3-inch outside-diameter (OD), split spoon (California Modified) sampler, and a 2-inch OD, Standard Penetration Test (SPT) sampler. The number of blows required to drive the sampler the last 12 inches (or fraction thereof) of the 18-inch sampling interval were recorded on the boring logs. The blow counts shown on the boring logs should not be interpreted as standard SPT “N” values; corrections have not been applied. Upon completion, the borings were backfilled with drill cuttings.

Subsurface conditions encountered in the exploratory borings were visually examined, classified and logged in general accordance with the American Society for Testing and Materials (ASTM) Practice for Description and Identification of Soils (Visual-Manual Procedure D2488). This system uses the Unified Soil Classification System (USCS) for soil designations. The logs depict soil and geologic conditions encountered and depths at which samples were obtained. The logs also include our interpretation of the conditions between sampling intervals. Therefore, the logs contain both observed and interpreted data. We determined the lines designating the interface between soil materials on the logs using visual observations, drill rig penetration rates, excavation characteristics and other factors. The transition between materials may be abrupt or gradual. Where applicable, the field logs were revised based on subsequent laboratory testing.



**SALEM**  
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**Test Boring: B-1**

**Page 1 Of: 2**

**Project Number: 3-221-0167**

**Date: 03/31/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1318'

**Auger Type:** 6.5 in. Hollow Stem Auger

**Initial Depth to Groundwater:** 33'

**Hammer Type:** Automatic Trip - 140 lb/30 in

**Final Depth to Groundwater:** 29'

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0		ML	Sandy SILT Hard; moist; reddish brown; fine to medium grain sand; with trace clay.	60	8.3	124.2	
1315	15/6 27/6 33/6						
5	11/6 20/6 34/6	SM	Grades as above.	54	10.5	111.8	
1310							
10	3/6 5/6 6/6		Silty SAND Medium dense; moist; brown; fine to coarse grain sand; trace gravel.	11	8.0	-	
1305							
15	4/6 6/6 6/6		Grades as above; dark brown.	12	7.6	-	
1300		SM	Grades as above; very moist.	19	12.2	-	
20	5/6 10/6 9/6						
1295							
25	13/6 22/6 26/6		Grades as above; dense; slightly moist; mottled brown/blueish gray; with fine to coarse gravel.	48	5.0	-	
1290							

**Notes:**

**Figure Number A-1**



**SALEM**  
engineering group, inc.

**Project Number:** 3-221-0167

**Date:** 03/31/2021

**Test Boring:** B-1

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
30	5/6 5/6 6/6		Grades as above; medium dense; very moist; dark brown; fine to coarse grain sand; with fine to coarse gravel.	11	16.5	-	
1285							
35	7/6 12/6 13/6	ML	Sandy SILT Very stiff; wet; tan/light red; fine to medium grain sand.	25	28.1	-	
1280							
40	12/6 17/6 40/6 50/6		Grades as above; hard; saturated.	57	19.9	-	
1275		ROCK	Weathered Siltstone/Claystone Hard; dry; mottled white/yellow/red. Auger refusal at 41.5 feet BSG due to hard drilling/ weathered bedrock.	50/6"	25.8	-	
45							
1270							
50							
1265							
55							
1260							
60							
1255							

**Notes:**

**Figure Number A-1**





**SALEM**  
engineering group, inc.

**Test Boring: B-2**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/30/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C


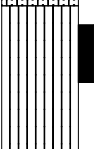



**Elevation:** 1320'

**Auger Type:** 6.5 in. Hollow Stem Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in

**Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
1320 0		SM	Silty SAND Dense; slightly moist; light brown; fine to coarse grain sand; with gravel; with trace clay.	36	6.1	-	
1315 5		ML	Sandy SILT Very stiff; moist; brown; fine to medium grain sand; with trace clay; with roots.	38	9.7	125.5	
1310 10		SM	Silty SAND Medium dense; moist; brown; fine to coarse grain sand; trace gravel.	11	5.6	-	
1305 15			Grades as above; dark brown.	13	5.8	-	
1300 20			Grades as above; slightly moist; mottled dark gray/reddish brown; fine to coarse grain sand; with gravel.	30	4.9	-	
1295 25			End of boring at 21.5 feet BSG.				

**Notes:**

**Figure Number A-2**



**SALEM**  
engineering group, inc.

**Test Boring: B-3**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/30/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1320'

**Auger Type:** 6.5 in. Hollow Stem Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in

**Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
1320 0		SM	Silty SAND Ver dense; slightly moist; light brown; fine to medium grain sand.	61	4.2	106.5	
1315 5			Grades as above; moist; brown.	62	6.1	116.4	
1310 10			Grades as above; medium dense.	29	10.6	-	
1305 15			Grades as above.	16	7.1	-	
1300 20			Grades as above; fine to coarse grain sand.	19	6.1	-	
1295 25			End of boring at 21.5 feet BSG.				

**Notes:**

**Figure Number A-3**





**SALEM**  
engineering group, inc.

**Test Boring: B-4**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/30/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1320'

**Auger Type:** 6.5 in. Hollow Stem Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in

**Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
1320 0		SM	Silty SAND Very dense; slightly moist; light brown; fine to medium grain sand.	50/2"	4.8	104.1	
1315 5			Grades as above; dense; brown; with roots.	44	5.2	130.7	
1310 10		ML	Sandy SILT Hard; moist; brown; fine grain sand; with trace clay.	46	12.1	-	
1305 15			Grades as above; very stiff.	21	.8	-	
1300 20			Grades as above; stiff.	11	15.1	-	
1295 25			End of boring at 21.5 feet BSG.				

**Notes:**

**Figure Number A-4**



**SALEM**  
engineering group, inc.

**Test Boring: B-5**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/30/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1318'

**Auger Type:** 6.5 in. Hollow Stem Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in

**Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0		SM	Silty SAND Dense; moist; mottled brown/gray; fine to medium grain sand.	64	7.4	121.8	
1315	22/6 28/6 36/6						
5	9/6 15/6 25/6		Grades as above; light brown.	40	7.6	-	
1310							
10	9/6 19/6 20/6		Grades as above; brown.	39	9.2	-	
1305							
15	5/6 9/6 10/6		Grades as above; medium dense; very moist; reddish brown; fine grain sand.	19	14.6	-	
1300							
20	9/6 9/6 10/6		Grades as above; moist; mottled dark brown/gray; fine to medium grain sand.	19	6.1	-	
1295			End of boring at 21.5 feet BSG.				
25							
1290							

**Notes:**

**Figure Number A-5**



**SALEM**  
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**Test Boring: B-6**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/30/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1321'

**Auger Type:** 6.5 in. Hollow Stem Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in

**Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0							
1320		SM	Silty SAND Dense; moist; light brown; fine to medium grain sand; with clay.	44	7.8	122.7	
5			Grades as above.	44	5.9	127.0	
1315							
10		ML	Sandy SILT Very stiff; moist; light brown; fine grain sand; with trace clay.	29	10.8	-	
1310							
15			Grades as above; brown.	21	10.0	-	
1305							
20			Grades as above; stiff; fine to medium grain sand; trace gravel.	15	10.5	-	
1300			End of boring at 21.5 feet BSG.				
25							
1295							

**Notes:**

**Figure Number A-6**



**SALEM**  
engineering group, inc.

**Test Boring: B-7**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/30/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1316'

**Auger Type:** 6.5 in. Hollow Stem Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in

**Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0							
1315		SM	Silty SAND Very dense; moist; light brown; fine to medium grain sand.	80	4.9	110.6	
5							
1310			Grades as above; dense; mottled light brown/light gray; fine to coarse grain sand; with gravel.	46	6.1	-	Disturbed sample.
10		ML	Sandy SILT Very stiff; moist; brown; fine grain sand.	18	14.2	-	
1305							
15			Grades as above; fine to medium grain sand.	17	10.6	-	
1300							
20		SM	Silty SAND Medium dense; moist; brown; fine to medium grain sand.	28	7.7	-	
1295							
25			End of boring at 21.5 feet BSG.				
1290							

**Notes:**

**Figure Number A-7**



**SALEM**  
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**Test Boring: B-8**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/30/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1317'

**Auger Type:** 6.5 in. Hollow Stem Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in

**Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0		SM	Silty SAND				
1315	32/6 38/6 47/6		Very dense; moist; light brown; fine to medium grain sand; with trace caly.	85	5.4	108.5	
5	10/6 20/6 22/6		Grades as above; dense; moist; fine grain sand.	42	7.5	-	
1310							
10	8/6 9/6 14/6		Grades as above; medium dense; very moist; reddish brown.	23	13.6	-	
1305			End of boring at 11.5 feet BSG.				
15							
1300							
20							
1295							
25							
1290							

**Notes:**

**Figure Number A-8**



**SALEM**  
engineering group, inc.

**Test Boring: B-9**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/31/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

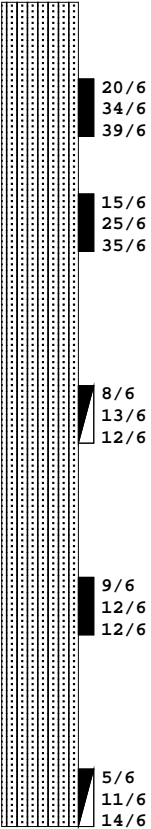
**Elevation:** 1323'

**Auger Type:** 6.5 in. Hollow Stem Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in

**Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0		SM	Silty SAND Very dense; slightly moist; brown; fine to medium grain sand.	73	4.3	110.1	Disturbed sample.
1320							
5			Grades as above; fine to coarse grain sand.	60	4.0	-	
1315							
10			Grades as above; moist; fine to medium grain sand.	25	5.7	-	
1310							
15		Grades as above.	24	5.8	117.0		
1305							
20		Grades as above.	25	6.9	-		
1300				End of boring at 21.5 feet BSG.			
25							
1295							

**Notes:**

**Figure Number A-9**



**SALEM**  
engineering group, inc.

**Test Boring: B-10**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/31/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1323'

**Auger Type:** 4 in. Solid Flight Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in **Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0		SM	<u>POTENTIAL FILL</u>				
			Silty SAND				
1320	20/6 35/6 40/6		Very dense; slightly moist; brown; fine to coarse grain sand.	75	4.0	115.0	
5	35/6 50/4 -		Grades as above.	50/4"	4.3	106.3	
1315							
10	8/6 10/6 11/6		Grades as above; medium dense; with gravel.	21	4.8	-	
1310							
15	6/6 10/6 14/6		Grades as above; fine to medium grain sand; no gravel.	24	4.6	-	
1305							
20	5/6 5/6 10/6		Grades as above; fine grain sand.	15	5.3	-	
1300			End of boring at 21.5 feet BSG.				
25							
1295							

**Notes:**

**Figure Number A-10**





**SALEM**  
engineering group, inc.

**Test Boring: B-11**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/31/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1323'

**Auger Type:** 4 in. Solid Flight Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in **Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0		SM	Silty SAND Very dense; slightly moist; brown; fine grain sand.	70	4.3	111.8	
1320	11/6 30/6 40/6						
5	8/6 24/6 30/6						
1315			Grades as above; dense; moist; fine to coarse grain sand; trace gravel.	54	6.0	-	
10	6/6 10/6 13/6		Grades as above; medium dense; reddish brown.	23	9.7	-	
1310			End of boring at 11.5 feet BSG.				
15							
1305							
20							
1300							
25							
1295							

**Notes:**

**Figure Number A-11**



**SALEM**  
engineering group, inc.

**Test Boring: B-12**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/31/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1323

**Auger Type:** 4 in. Solid Flight Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in **Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0		SM	Silty SAND Very dense; damp; brown; fine to medium grain sand.	81	2.5	113.1	
1320			Grades as above; medium dense; slightly moist.	13	4.9	-	
5			Grades as above; fine grain sand.	15	4.4	-	
1315			End of boring at 11.5 feet BSG.				
10							
1310							
15							
1305							
20							
1300							
25							
1295							

**Notes:**

**Figure Number A-12**



**SALEM**  
engineering group, inc.

**Test Boring: B-13**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/31/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1326'

**Auger Type:** 4 in. Solid Flight Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in

**Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0		SM	<u>POTENTIAL FILL</u>				
1325			Silty SAND Very dense; slightly moist; light brown; fine grain sand.	50/6"	4.0	106.0	
5			Grades as above.	89	4.4	117.0	
1320							
10			Grades as above; dense; moist.	35	7.3	-	
1315							
15			Grades as above; medium dense; slightly moist; fine to coarse grain sand; trace gravel.	20	3.6	-	
1310							
20			Grades as above; moist; brown; fine grain sand.	20	8.7	-	
1305			End of boring at 21.5 feet BSG.				
25							
1300							

**Notes:**

**Figure Number A-13**



**SALEM**  
engineering group, inc.

**Test Boring: B-14**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/31/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1329'

**Auger Type:** 4 in. Solid Flight Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in

**Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0		SM	Silty SAND Very dense; slightly moist; light brown; fine to coarse grain sand; trace gravel.	50/4"	3.7	120.2	
1325	35/6 50/4 -						
5	50/5 -		Grades as above; fine to medium grain sand; no gravel.	50/5"	4.4	103.7	
1320							
10	10/6 14/6 30/6		Grades as above; dense; moist; brown.	44	7.6	-	
1315			Grades as above; slightly moist; reddish brown; fine to coarse grain sand; with gravel.	31	3.4	-	
15	13/6 15/6 16/6						
1310			Grades as above; no gravel.	24	4.5	-	
20	8/6 8/6 16/6		End of boring at 21.5 feet BSG.				
1305							
25							

**Notes:**

**Figure Number A-14**



**SALEM**  
engineering group, inc.

**Test Boring: B-15**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/31/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1330'

**Auger Type:** 4 in. Solid Flight Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in **Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
1330 0		SM	Silty SAND Very dense; slightly moist; light brown; fine to medium grain sand.	50/5"	3.7	111.6	
1325 5			Grades as above; dense.	45	5.5	-	
1320 10			Grades as above; medium dense; moist; brown.	24	9.6	-	
1315 15			End of boring at 11.5 feet BSG.				
1310 20							
1305 25							

**Notes:**

**Figure Number A-15**



**SALEM**  
engineering group, inc.

**Test Boring: B-16**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/31/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1328'

**Auger Type:** 4 in. Solid Flight Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in **Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0		SM	Silty SAND Dense; slightly moist; brown; fine to medium grain sand.	46	3.0	105.9	
1325	11/6 17/6 29/6						
5	8/6 15/6 27/6						
1320			Grades as above; light brown; fine to coarse grain sand.	42	4.1	-	
10	11/6 30/6 40/6		Grades as above; very dense; moist; with trace clay.	70	8.5	-	
1315			End of boring at 11.5 feet BSG.				
15							
1310							
20							
1305							
25							
1300							

**Notes:**

**Figure Number A-16**



**SALEM**  
engineering group, inc.

**Test Boring: B-17**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/30/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1324'

**Auger Type:** 6.5 in. Hollow Stem Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in

**Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0		SM	Silty SAND Very dense; moist; brown; fine to medium grain sand; with trace clay.	77/7"	6.9	132.9	
1320			Grades as above; slightly moist; light brown.	50/2"	4.4	-	
5			Grades as above; moist; fine grain sand.	20	8.0	-	
10			End of boring at 21.5 feet BSG.				
1310							
15							
1305							
20							
1300							
25							

**Notes:**

**Figure Number A-17**





**SALEM**  
engineering group, inc.

**Test Boring: B-18**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/30/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1327'

**Auger Type:** 6.5 in. Hollow Stem Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in

**Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0		SM	Silty SAND				
1325	23/6 50/5 -		Very dense; slightly moist; light brown; fine to medium grain sand; with roots.	50/5"	3.3	110.6	
5	13/6 15/6 15/6		Grades as above; medium dense; moist; no roots.	30	6.6	-	
1320							
10	13/6 20/6 18/6		Grades as above; dense; brown.	38	8.9	-	
1315			End of boring at 11.5 feet BSG.				
15							
1310							
20							
1305							
25							
1300							

**Notes:**

**Figure Number A-18**



**SALEM**  
engineering group, inc.

**Test Boring: B-19**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/31/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1319'

**Auger Type:** 6.5 in. Hollow Stem Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in

**Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0		SM	Silty SAND Very dense; slightly moist; light brown; fine to medium grain sand; with trace clay.	50/6"	3.2	109.2	
1315			Grades as above; medium dense; moist; fine to coarse grain sand.	30	6.1	-	
5			Grades as above; reddish brown; fine to medium grain sand.	29	7.0	-	
1310			End of boring at 11.5 feet BSG.				
10							
1305							
15							
1300							
20							
1295							
25							

**Notes:**

**Figure Number A-19**



**SALEM**  
engineering group, inc.

**Test Boring: B-20**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/31/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1323'

**Auger Type:** 6.5 in. Hollow Stem Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in

**Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0		SM	Silty SAND Dense; slightly moist; brown; fine to medium grain sand.	46	5.1	116.7	
1320	12/6 20/6 26/6						
5	13/6 14/6 15/6		Grades as above; medium dense; fine to coarse grain sand; trace gravel.	29	5.9	-	Limited recovery.
1315							
10	6/6 10/6 10/6		Grades as above; moist; reddish brown; fine to medium grain sand; no gravel.	20	12.0	-	
1310			End of boring at 11.5 feet BSG.				
15							
1305							
20							
1300							
25							
1295							

**Notes:**

**Figure Number A-20**



**SALEM**  
engineering group, inc.

**Test Boring:** B-21

**Page 1 Of: 1**

**Project Number:** 3-221-0167

**Date:** 03/30/2021

**Client:** Evergreen Devco

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1323'

**Auger Type:** 6.5 in. Hollow Stem Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in

**Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0		SM	Silty SAND Very dense; damp; light brown; fine to medium grain sand.	76	2.8	105.2	
1320							
5			Grades as above; slightly moist.	69	3.8	-	
1315			End of boring at 6 feet BSG.				
10							
1310							
15							
1305							
20							
1300							
25							
1295							

**Notes:**

**Figure Number A-21**



**SALEM**  
engineering group, inc.

**Test Boring: B-22**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/30/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

**Elevation:** 1318'

**Auger Type:** 6.5 in. Hollow Stem Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** Automatic Trip - 140 lb/30 in

**Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0		SM	Silty SAND Medium dense; slightly moist; light brown; fine to medium grain sand.	36	4.8	110.4	
1315			Grades as above; moist; mottled light brown/reddish brown/gray; trace gravel.	25	7.3	-	
5			End of boring at 6 feet BSG.				
1310							
10							
1305							
15							
1300							
20							
1295							
25							
1290							

**Notes:**

**Figure Number A-22**





**SALEM**  
engineering group, inc.

**Test Boring: B-23**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/30/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

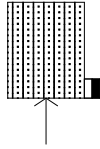
**Elevation:** 1324'

**Auger Type:** 4 in. Hand Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** N/A

**Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
0		SM	Silty SAND Moist; dark grayish brown; fine to coarse grain sand; with gravel.		5.9	-	
1320			Refusal at 2.5 feet due to gravel.				
5							
1315							
10							
1310							
15							
1305							
20							
1300							
25							

**Notes:**

**Figure Number A-23**



**SALEM**  
engineering group, inc.

**Test Boring: B-24**

**Page 1 Of: 1**

**Project Number: 3-221-0167**

**Date: 03/30/2021**

**Client: Evergreen Devco**

**Project:** Proposed Commercial Development

**Location:** Central Avenue and Cambern Avenue, Lake Elsinore, California

**Drilled By:** SALEM

**Logged By:** JC

**Drill Type:** CME 45C

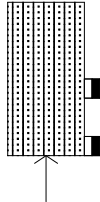
**Elevation:** 1325'

**Auger Type:** 4 in. Hand Auger

**Initial Depth to Groundwater:** N/A

**Hammer Type:** N/A

**Final Depth to Groundwater:** N/A

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Soil Description	N-Values blows/ft.	Moisture Content %	Dry Density, PCF	Remarks
1325 0		SM	Silty SAND Moist; brown; fine grain sand.		5.5	-	
			Grades as above; dark brown; with gravel.		4.5	-	
1320 5			Refusal at 4 feet due to gravel.				
1315 10							
1310 15							
1305 20							
1300 25							

**Notes:**

**Figure Number A-24**

# KEY TO SYMBOLS

## Symbol Description

### Strata symbols



Silt



Silty sand



Bedrock

### Misc. Symbols



Drill rejection



Boring continues



Water table during  
drilling

### Soil Samplers



California sampler



Standard penetration test



Auger

### Notes:

#### Granular Soils

Blows Per Foot (Uncorrected)

	MCS	SPT
Very loose	<5	<4
Loose	5-15	4-10
Medium dense	16-40	11-30
Dense	41-65	31-50
Very dense	>65	>50

#### Cohesive Soils

Blows Per Foot (Uncorrected)

	MCS	SPT
Very soft	<3	<2
Soft	3-5	2-4
Firm	6-10	5-8
Stiff	11-20	9-15
Very Stiff	21-40	16-30
Hard	>40	>30

MCS = Modified California Sampler

SPT = Standard Penetration Test Sampler

## Percolation Test Worksheet

**Project: Proposed Commercial Development**  
**Central Ave. & Cambern Ave.**  
**Lake Elsinore, California**

**Job No.: 3-221-0167**  
**Date Drilled: 3/30/2021**  
**Soil Classification: Silty SAND (SM)**

Hole Radius: 4 in.

Pipe Dia.: 3 in.

Total Depth of Hole: 75 in.

**Test Hole No.: P-1**

**Presoaking Date: 3/30/2021**

**Tested by: JC**

**Test Date: 3/31/2021**

**Drilled Hole Depth: 6.25 ft.**

**Pipe Stick up: 0.5 ft.**

Time Start	Time Finish	Depth of Test Hole (ft) <sup>#</sup>	Refill- Yes or No	Elapsed Time (hrs:min)	Initial Water Level <sup>#</sup> (ft)	Final Water Level <sup>#</sup> (ft)	Δ Water Level (in.)	Δ Min.	Meas. Perc Rate (min/in)	Initial Height of Water (in)	Final Height of Water (in)	Average Height of Water (in)	Infiltration Rate, It (in/hr)
10:40	11:10	6.75	Y	0:30	4.02	4.22	2.40	30	12.5	32.8	30.4	31.6	0.29
11:10	11:40	6.75	N	0:30	4.22	4.39	2.04	30	14.7	30.4	28.3	29.3	0.26
11:40	12:10	6.75	N	0:30	4.39	4.54	1.80	30	16.7	28.3	26.5	27.4	0.24
12:10	12:40	6.75	N	0:30	4.54	4.67	1.56	30	19.2	26.5	25.0	25.7	0.22
12:40	13:10	6.75	N	0:30	4.67	4.78	1.32	30	22.7	25.0	23.6	24.3	0.20
13:10	13:40	6.75	N	0:30	4.78	4.88	1.20	30	25.0	23.6	22.4	23.0	0.19
13:40	14:10	6.75	N	0:30	4.88	4.97	1.08	30	27.8	22.4	21.4	21.9	0.18
14:10	14:40	6.75	N	0:30	4.97	5.05	0.96	30	31.3	21.4	20.4	20.9	0.17
14:40	15:10	6.75	N	0:30	5.05	5.13	0.96	30	31.3	20.4	19.4	19.9	0.18
15:10	15:40	6.75	N	0:30	5.13	5.20	0.84	30	35.7	19.4	18.6	19.0	0.16
15:40	16:10	6.75	N	0:30	5.20	5.27	0.84	30	35.7	18.6	17.8	18.2	0.17
16:10	16:40	6.75	N	0:30	5.27	5.34	0.84	30	35.7	17.8	16.9	17.3	0.17
<b>Recommended for Design:</b>										<b>Infiltration Rate</b>		<b>0.16</b>	

## Percolation Test Worksheet

**Project:** Proposed Commercial Development  
Central Ave. & Cambern Ave.  
Lake Elsinore, California

**Job No.:** 3-221-0167  
**Date Drilled:** 3/30/2021  
**Soil Classification:** Silty SAND (SM)

Hole Radius: 4 in.

Pipe Dia.: 3 in.

Total Depth of Hole: 72 in.

**Test Hole No.:** P-2

**Presoaking Date:** 3/30/2021

**Tested by:** JC

**Test Date:** 3/31/2021

**Drilled Hole Depth:** 6.0 ft.

Pipe Stick up: 0.25 ft.

Time Start	Time Finish	Depth of Test Hole (ft) <sup>#</sup>	Refill- Yes or No	Elapsed Time (hrs:min)	Initial Water Level <sup>#</sup> (ft)	Final Water Level <sup>#</sup> (ft)	Δ Water Level (in.)	Δ Min.	Meas. Perc Rate (min/in)	Initial Height of Water (in)	Final Height of Water (in)	Average Height of Water (in)	Infiltration Rate, It (in/hr)
7:17	7:47	6.25	Y	0:30	4.24	4.33	1.08	30	27.8	24.1	23.0	23.6	0.17
7:47	8:17	6.25	N	0:30	4.33	4.40	0.84	30	35.7	23.0	22.2	22.6	0.14
8:17	8:47	6.25	N	0:30	4.40	4.47	0.84	30	35.7	22.2	21.4	21.8	0.14
8:47	9:17	6.25	N	0:30	4.47	4.53	0.72	30	41.7	21.4	20.6	21.0	0.13
9:17	9:47	6.25	N	0:30	4.53	4.58	0.60	30	50.0	20.6	20.0	20.3	0.11
9:47	10:17	6.25	N	0:30	4.58	4.63	0.60	30	50.0	20.0	19.4	19.7	0.11
10:17	10:47	6.25	N	0:30	4.63	4.67	0.48	30	62.5	19.4	19.0	19.2	0.09
10:47	11:17	6.25	N	0:30	4.67	4.71	0.48	30	62.5	19.0	18.5	18.7	0.09
11:17	11:47	6.25	N	0:30	4.71	4.75	0.48	30	62.5	18.5	18.0	18.2	0.09
11:47	12:17	6.25	N	0:30	4.75	4.78	0.36	30	83.3	18.0	17.6	17.8	0.07
12:17	12:47	6.25	N	0:30	4.78	4.81	0.36	30	83.3	17.6	17.3	17.5	0.07
12:47	13:17	6.25	N	0:30	4.81	4.84	0.36	30	83.3	17.3	16.9	17.1	0.08
<b>Recommended for Design:</b>										<b>Infiltration Rate</b>		<b>0.07</b>	



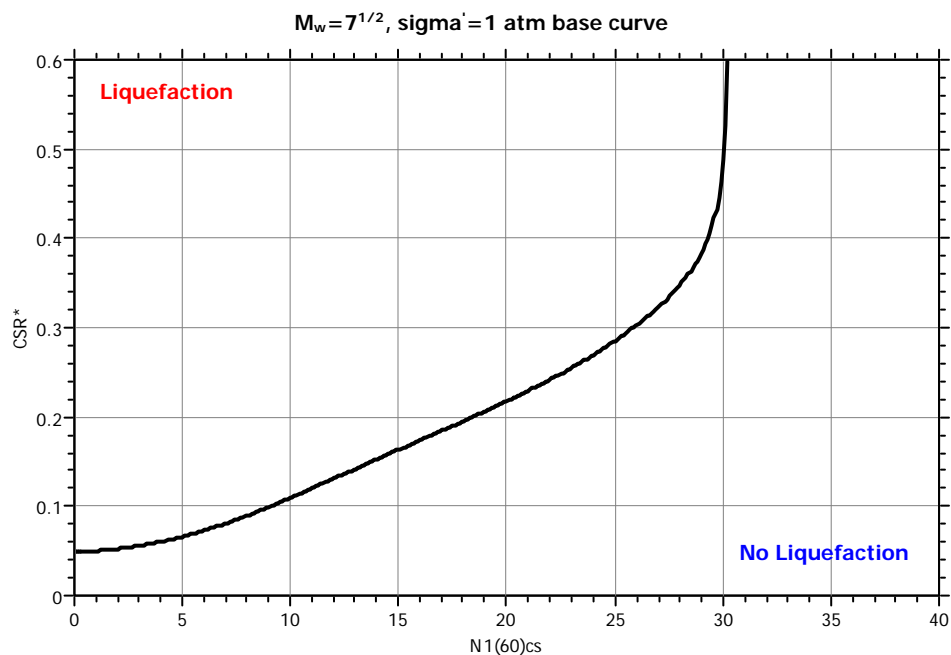
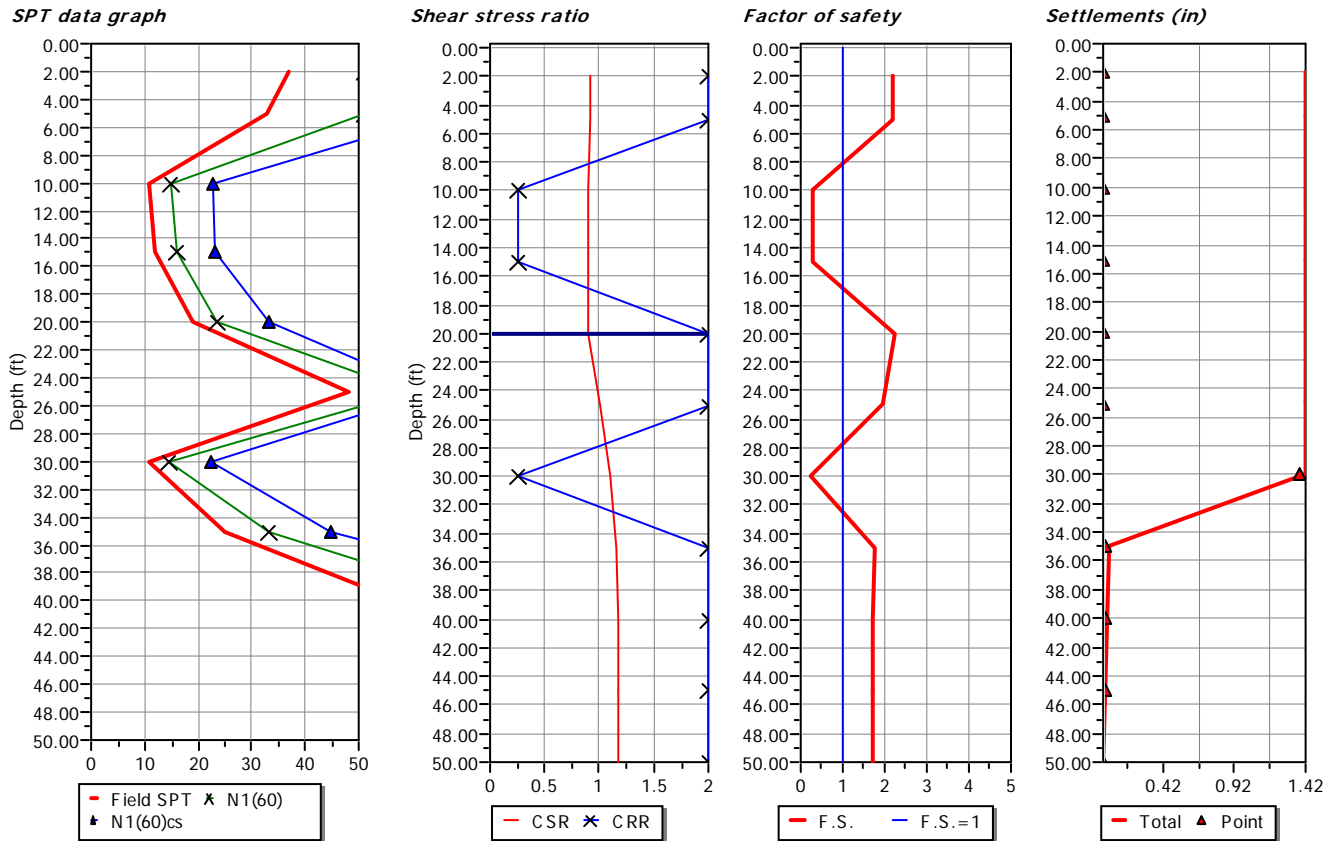
## LIQUEFACTION ANALYSIS REPORT

**Project title : 3-221-0167**

**Project subtitle : Lake Elsinore**

### Input parameters and analysis data

In-situ data type:	Standard Penetration Test	Depth to water table:	20.00 ft
Analysis type:	Deterministic	Earthquake magnitude $M_w$ :	7.90
Analysis method:	NCEER 1998	Peak ground acceleration:	0.95 g
Fines correction method:	Idriss & Seed	User defined F.S.:	1.30



**:: Field input data ::**

Point ID	Depth (ft)	Field $N_{SPT}$ (blows/feet)	Unit weight (pcf)	Fines content (%)
1	2.00	37.00	120.00	63.00
2	5.00	33.00	120.00	60.00
3	10.00	11.00	120.00	34.00
4	15.00	12.00	120.00	30.00
5	20.00	19.00	120.00	40.00
6	25.00	48.00	120.00	13.00
7	30.00	11.00	120.00	39.00
8	35.00	25.00	120.00	65.00
9	40.00	57.00	120.00	67.00
10	45.00	60.00	120.00	65.00
11	50.00	60.00	120.00	65.00

Depth : Depth from free surface, at which SPT was performed (ft)  
Field SPT : SPT blows measured at field (blows/feet)  
Unit weight : Bulk unit weight of soil at test depth (pcf)  
Fines content : Percentage of fines in soil (%)

**:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::**

Point ID	Depth (ft)	Sigma (tsf)	u (tsf)	Sigma' (tsf)	$r_d$	CSR	MSF	$CSR_{eq,M=7.5}$	$K_{sigma}$	CSR*
1	2.00	0.12	0.00	0.12	1.00	0.61	0.88	0.70	1.00	0.70
2	5.00	0.30	0.00	0.30	0.99	0.61	0.88	0.70	1.00	0.70
3	10.00	0.60	0.00	0.60	0.98	0.60	0.88	0.69	1.00	0.69
4	15.00	0.90	0.00	0.90	0.97	0.60	0.88	0.68	1.00	0.68
5	20.00	1.20	0.00	1.20	0.95	0.59	0.88	0.67	0.97	0.69
6	25.00	1.50	0.16	1.34	0.94	0.65	0.88	0.74	0.95	0.78
7	30.00	1.80	0.31	1.49	0.93	0.69	0.88	0.79	0.93	0.85
8	35.00	2.10	0.47	1.63	0.89	0.71	0.88	0.81	0.91	0.88
9	40.00	2.40	0.62	1.78	0.85	0.71	0.88	0.81	0.90	0.90
10	45.00	2.70	0.78	1.92	0.81	0.70	0.88	0.80	0.89	0.91
11	50.00	3.00	0.94	2.06	0.77	0.69	0.88	0.79	0.87	0.90

Depth : Depth from free surface, at which SPT was performed (ft)  
Sigma : Total overburden pressure at test point, during earthquake (tsf)  
u : Water pressure at test point, during earthquake (tsf)  
Sigma' : Effective overburden pressure, during earthquake (tsf)  
 $r_d$  : Nonlinear shear mass factor  
CSR : Cyclic Stress Ratio  
MSF : Magnitude Scaling Factor  
 $CSR_{eq,M=7.5}$  : CSR adjusted for M=7.5  
 $K_{sigma}$  : Effective overburden stress factor  
CSR\* : CSR fully adjusted

**:: Cyclic Resistance Ratio calculation  $CRR_{7.5}$  ::**

Point ID	Field SPT	$C_n$	$C_e$	$C_b$	$C_r$	$C_s$	$N_{1(60)}$	DeltaN	$N_{1(60)cs}$	$CRR_{7.5}$
1	37.00	1.70	0.86	1.05	0.75	1.20	51.18	15.24	66.42	2.00
2	33.00	1.70	0.90	1.05	0.80	1.20	51.04	15.21	66.25	2.00
3	11.00	1.32	0.97	1.05	0.85	1.20	15.10	7.77	22.88	0.25
4	12.00	1.08	1.04	1.05	0.95	1.20	16.11	7.19	23.30	0.26
5	19.00	0.93	1.11	1.05	0.95	1.20	23.56	9.71	33.27	2.00
6	48.00	0.88	1.18	1.05	0.95	1.20	59.75	4.09	63.84	2.00
7	11.00	0.84	1.25	1.05	1.00	1.20	14.50	7.90	22.40	0.25
8	25.00	0.80	1.32	1.05	1.00	1.20	33.22	11.64	44.86	2.00
9	57.00	0.77	1.33	1.05	1.00	1.20	73.44	19.69	93.12	2.00
10	60.00	0.74	1.33	1.05	1.00	1.20	74.35	19.87	94.22	2.00
11	60.00	0.71	1.33	1.05	1.00	1.20	71.71	19.34	91.05	2.00

**:: Cyclic Resistance Ratio calculation  $CRR_{7.5}$  ::**

Point ID	Field SPT	$C_n$	$C_e$	$C_b$	$C_r$	$C_s$	$N_{1(60)}$	DeltaN	$N_{1(60)cs}$	$CRR_{7.5}$
<hr/>										
$C_n$ :	Overburden correction factor									
$C_e$ :	Energy correction factor									
$C_b$ :	Borehole diameter correction factor									
$C_r$ :	Rod length correction factor									
$C_s$ :	Liner correction factor									
$N_{1(60)}$ :	Corrected $N_{SPT}$									
DeltaN :	Addition to corrected $N_{SPT}$ value due to the presence of fines									
$N_{1(60)cs}$ :	Corrected $N_{1(60)}$ value for fines									
$CRR_{7.5}$ :	Cyclic resistance ratio for $M=7.5$									

**:: Settlements calculation for saturated sands ::**

Point ID	$N_{1(60)}$	$N_1$	$FS_L$	$e_v$ (%)	Settle. (in)
1	66.42	55.35	2.19	0.00	0.00
2	66.25	55.21	2.21	0.00	0.00
3	22.88	19.07	0.28	2.25	0.00
4	23.30	19.42	0.29	2.21	0.00
5	33.27	27.72	2.22	0.00	0.00
6	63.84	53.20	1.97	0.00	0.00
7	22.40	18.67	0.22	2.29	1.38
8	44.86	37.39	1.74	0.02	0.01
9	93.12	77.60	1.71	0.02	0.01
10	94.22	78.51	1.70	0.02	0.01
11	91.05	75.87	1.70	0.02	0.01

**Total settlement : 1.42**

$N_{1(60)}$ :	Stress normalized and corrected SPT blow count
$N_1$ :	Japanese equivalent corrected value
$FS_L$ :	Calculated factor of safety
$e_v$ :	Post-liquefaction volumetric strain (%)
Settle.:	Calculated settlement (in)

**:: Liquefaction potential according to Iwasaki ::**

Point ID	F	$w_z$	$I_L$
1	0.00	9.70	0.00
2	0.00	9.24	0.00
3	0.72	8.48	9.26
4	0.71	7.71	8.31
5	0.00	6.95	0.00
6	0.00	6.19	0.00
7	0.78	5.43	6.43
8	0.00	4.67	0.00
9	0.00	3.90	0.00
10	0.00	3.14	0.00
11	0.00	2.38	0.00

**Overall potential  $I_L$  : 24.01**

$I_L = 0.00$  - No liquefaction  
 $I_L$  between 0.00 and 5 - Liquefaction not probable  
 $I_L$  between 5 and 15 - Liquefaction probable  
 $I_L > 15$  - Liquefaction certain

APPENDIX

B



## **APPENDIX B**

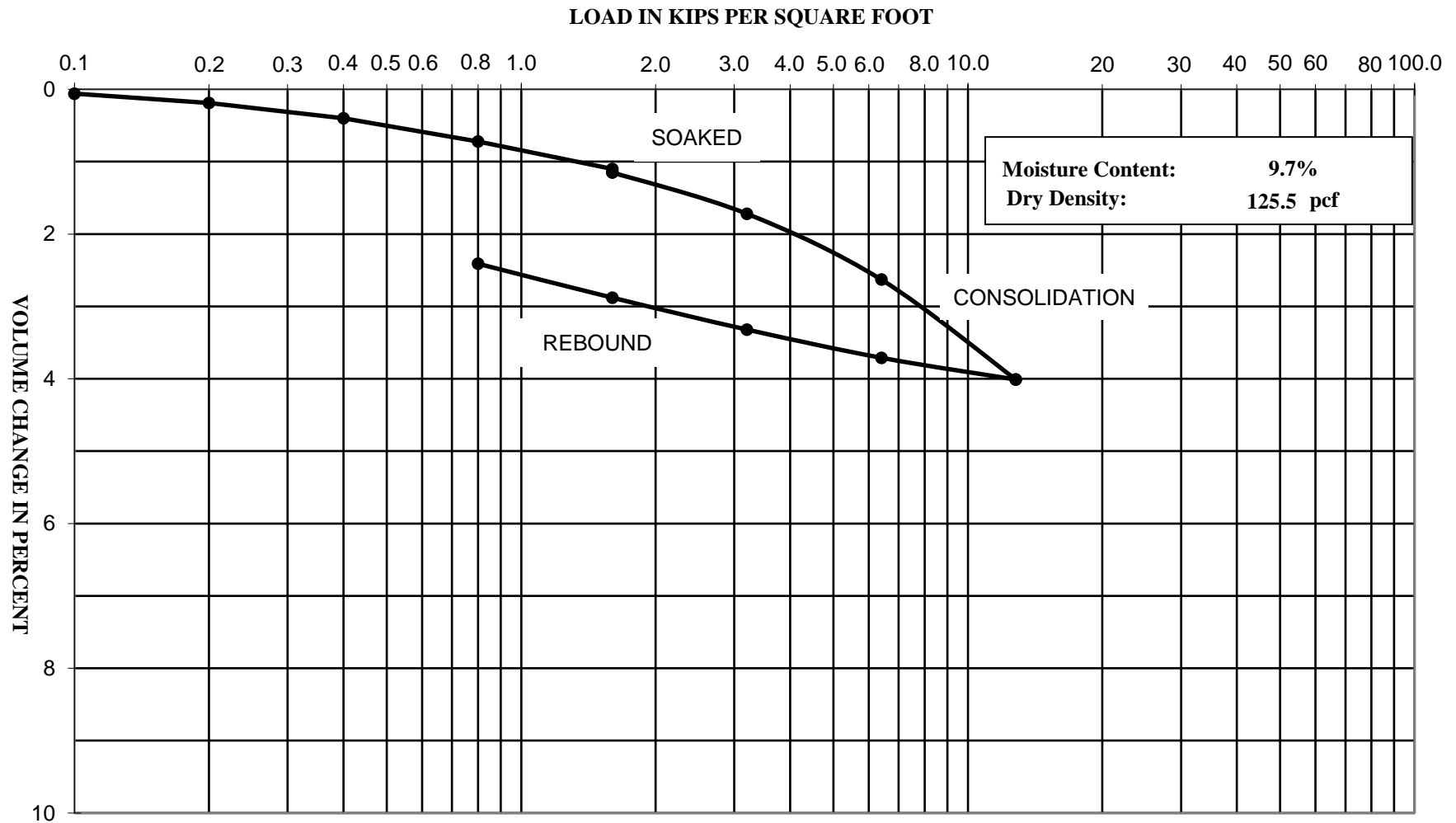
### **LABORATORY TESTING**

Laboratory tests were performed in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM), Caltrans, or other suggested procedures. Selected samples were tested for in-situ dry density and moisture content, corrosivity, consolidation, shear strength, expansion index, maximum dry density and optimum moisture content and grain size distribution. The results of the laboratory tests are summarized in the following figures.



# CONSOLIDATION - PRESSURE TEST DATA

## ASTM D2435



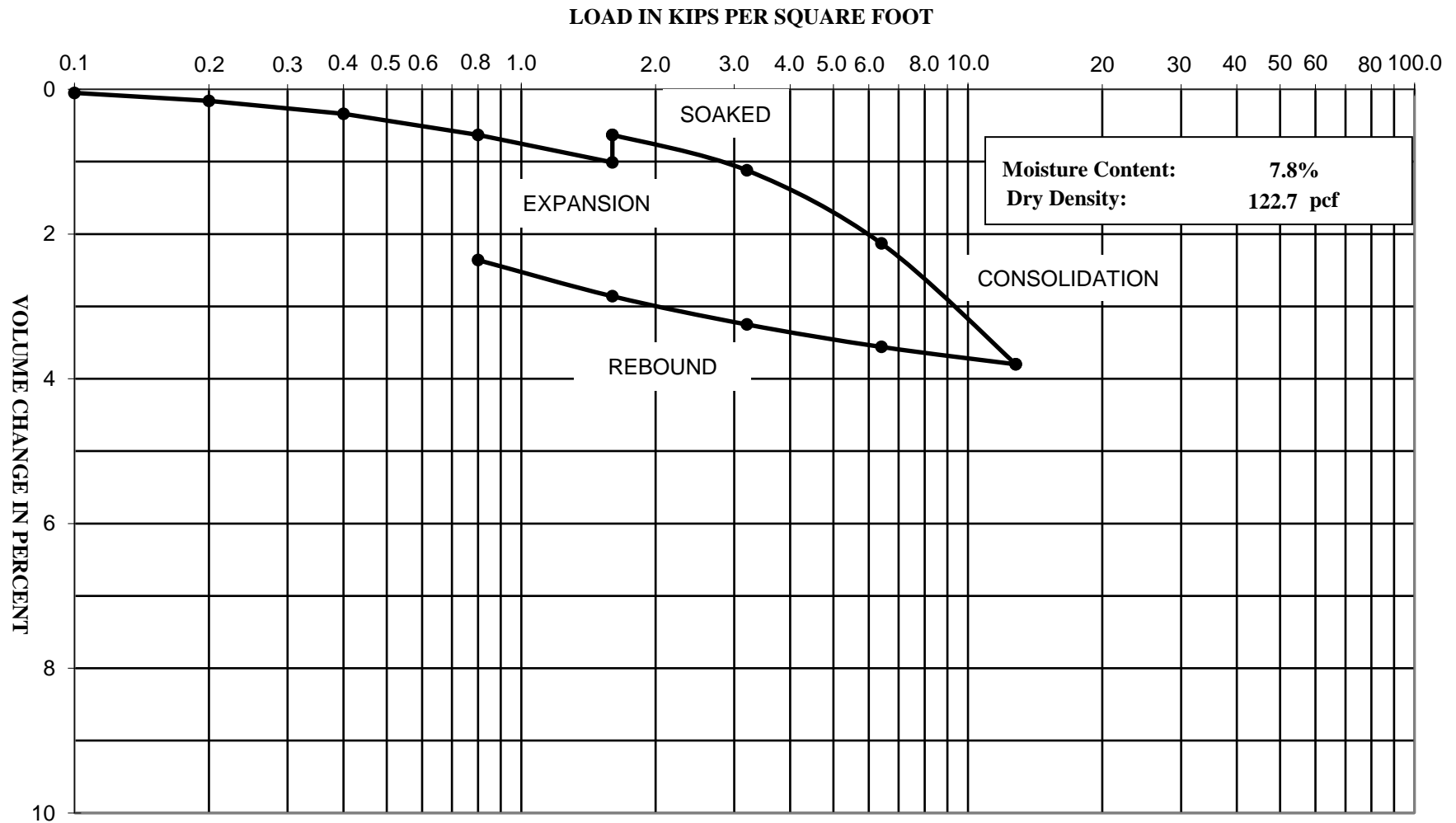
Project Name: Proposed Commercial Development - Lake Elsinore, CA

Project Number: 3-221-0167

Boring: B-2 @ 5'

# CONSOLIDATION - PRESSURE TEST DATA

## ASTM D2435

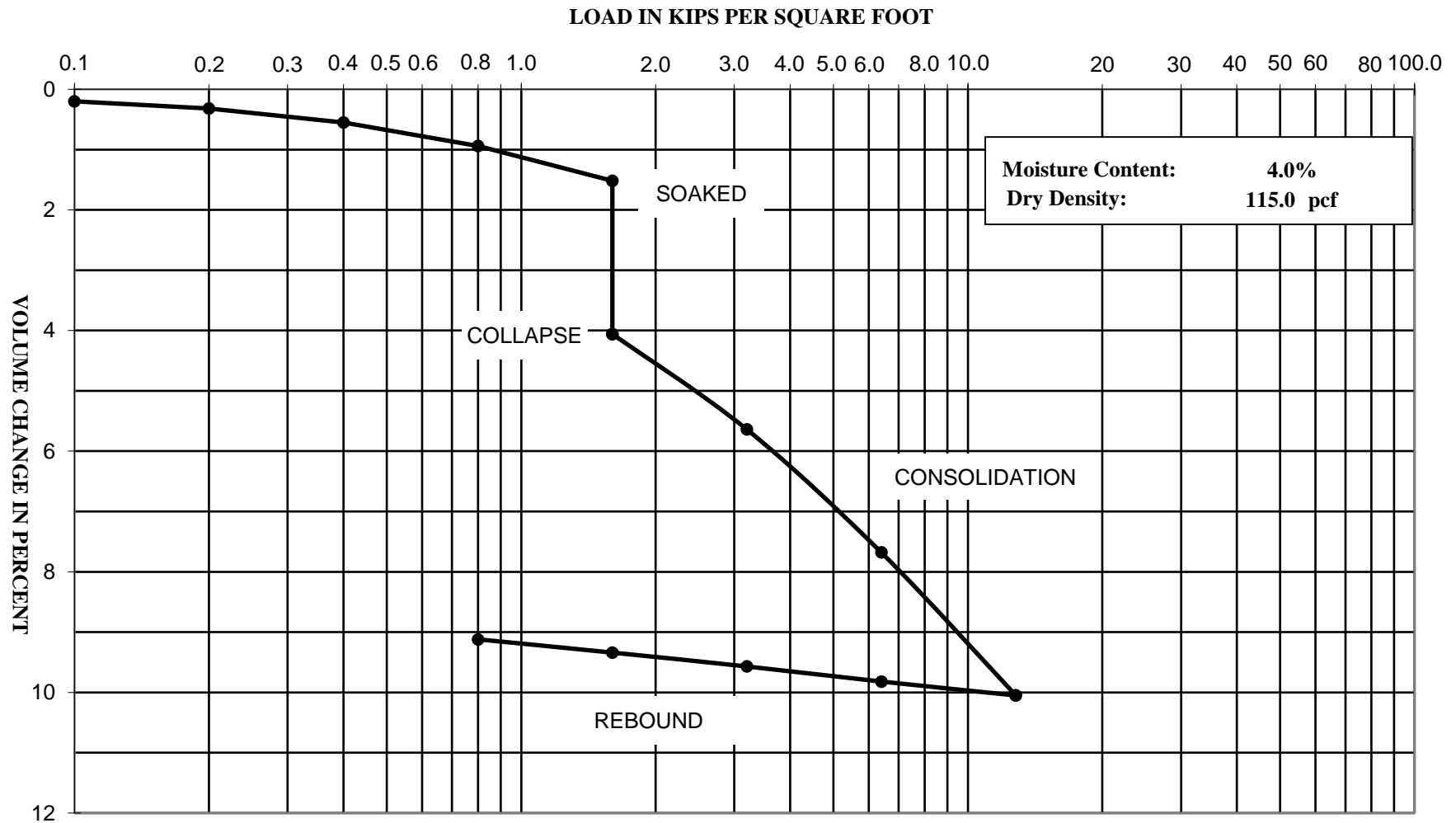


Project Name: Proposed Commercial Development - Lake Elsinore, CA

Project Number: 3-221-0167

Boring: B-6 @ 2'

# CONSOLIDATION - PRESSURE TEST DATA ASTM D2435

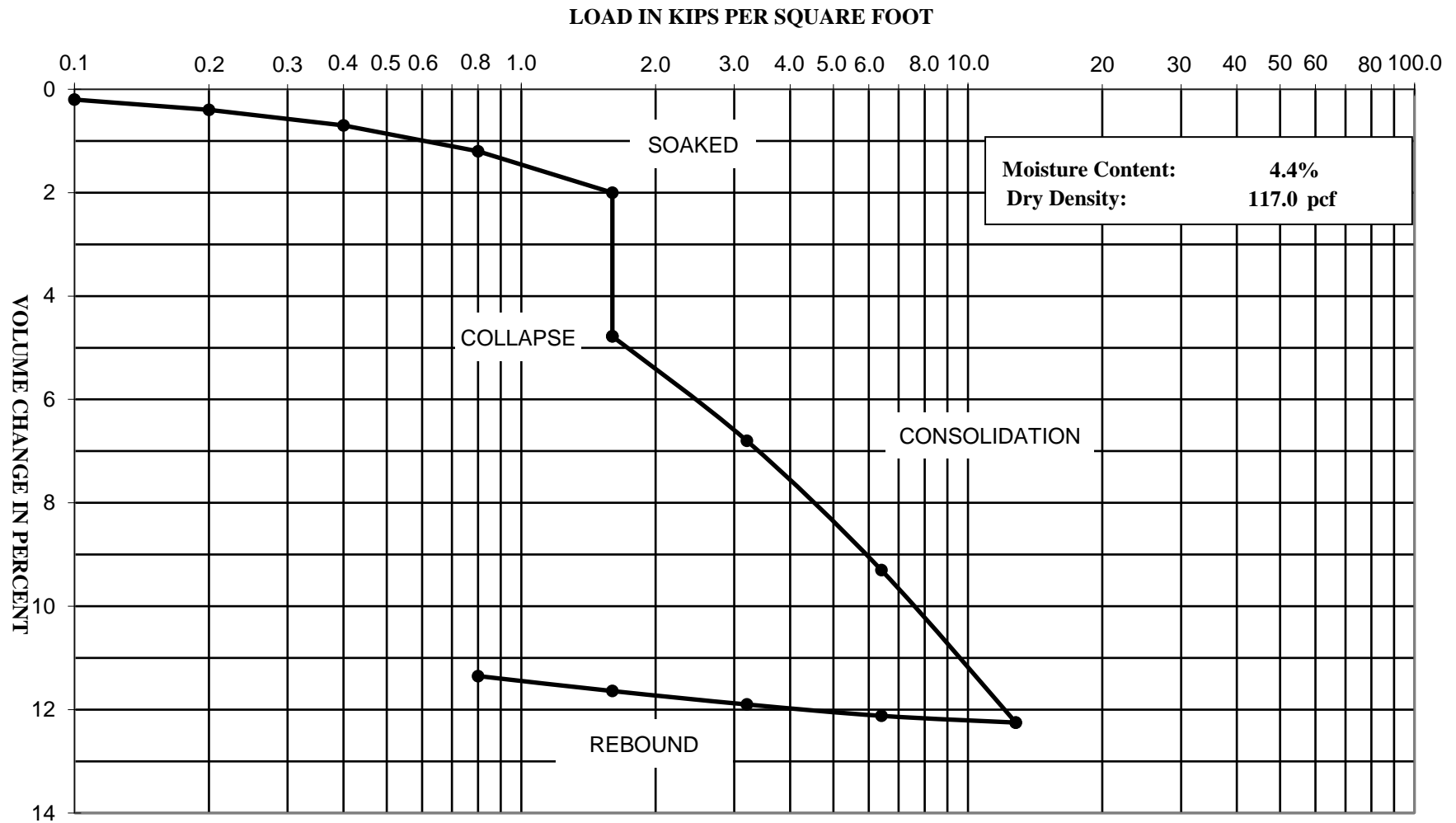


Project Name: Proposed Commercial Development - Lake Elsinore, CA

Project Number: 3-221-0167

Boring: B-10 @ 2'

# CONSOLIDATION - PRESSURE TEST DATA ASTM D2435



Project Name: Proposed Commercial Development - Lake Elsinore, CA

Project Number: 3-221-0167

Boring: B-13 @ 5'

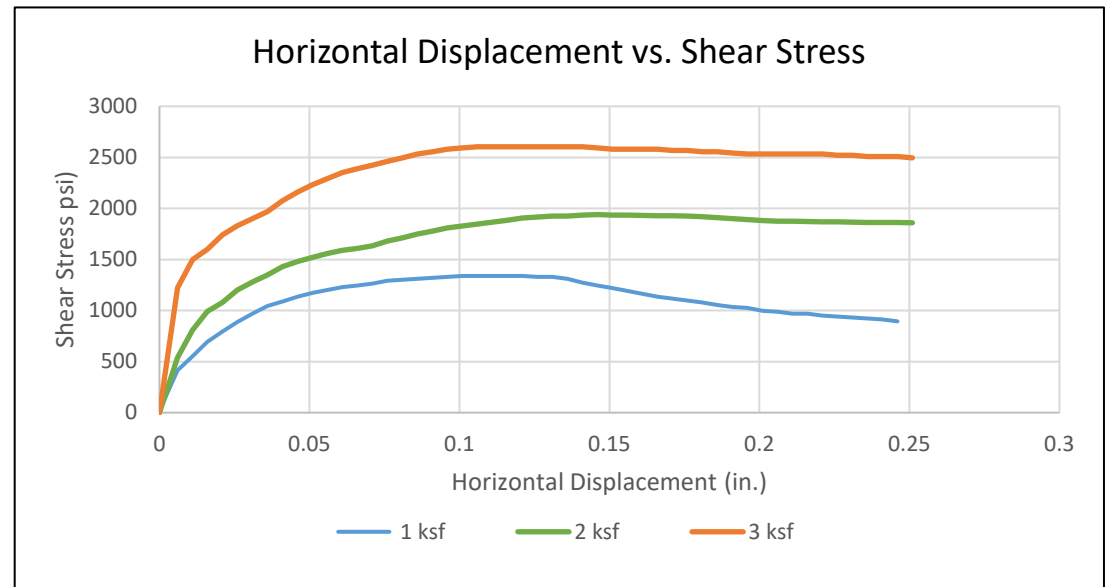
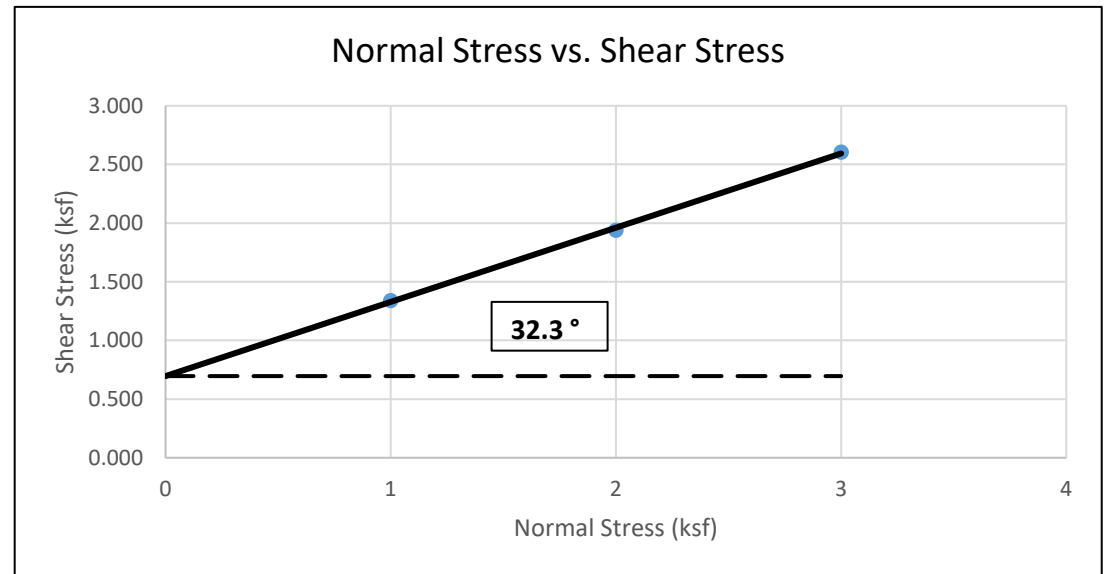
## Direct Shear Test (ASTM D3080)

Project Name: Proposed Commercial Development - Lake Elsinore, CA  
 Project Number: 3-221-0167  
 Client: Evergreen Devco  
 Sample Location: B-1 @ 2'  
 Sample Type: Undisturbed Ring  
 Soil Classification: Sandy SILT (ML)  
 Tested By: M. Noorzay  
 Reviewed By: CJ  
 Date: 4/8/2021  
 Equipment Used: Geomatic Direct Shear Machine

	Sample 1	Sample 2	Sample 3
Normal Stress (ksf)	1.000	2.000	3.000
Shear Rate (in/min)	0.004		
Peak Shear Stress (ksf)	1.339	1.940	2.604
Residual Shear Stress (ksf)	0.000	0.000	0.000

Initial Height of Sample (in)	1.000	1.000	1.000
Height of Sample before Shear (in.)	1	1	1
Diameter of Sample (in)	2.416	2.416	2.416
Initial Moisture Content (%)	8.0		
Final Moisture Content (%)	14.6	14.4	13.7
Dry Density (pcf)	124.0	123.4	119.4

Peak Shear Strength Values	
Slope	0.63
Friction Angle	32.3
Cohesion (psf)	696





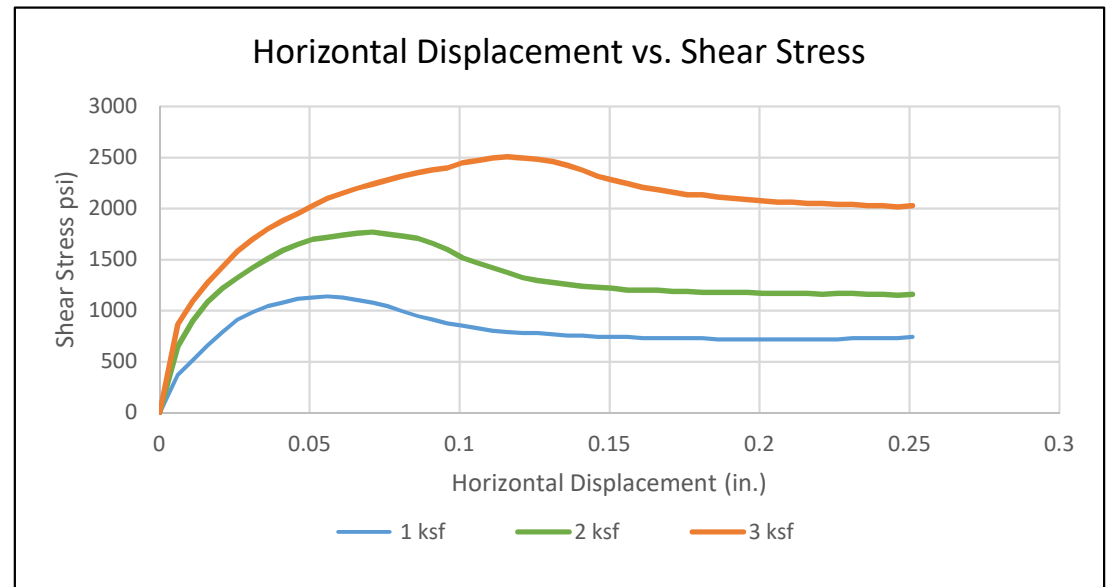
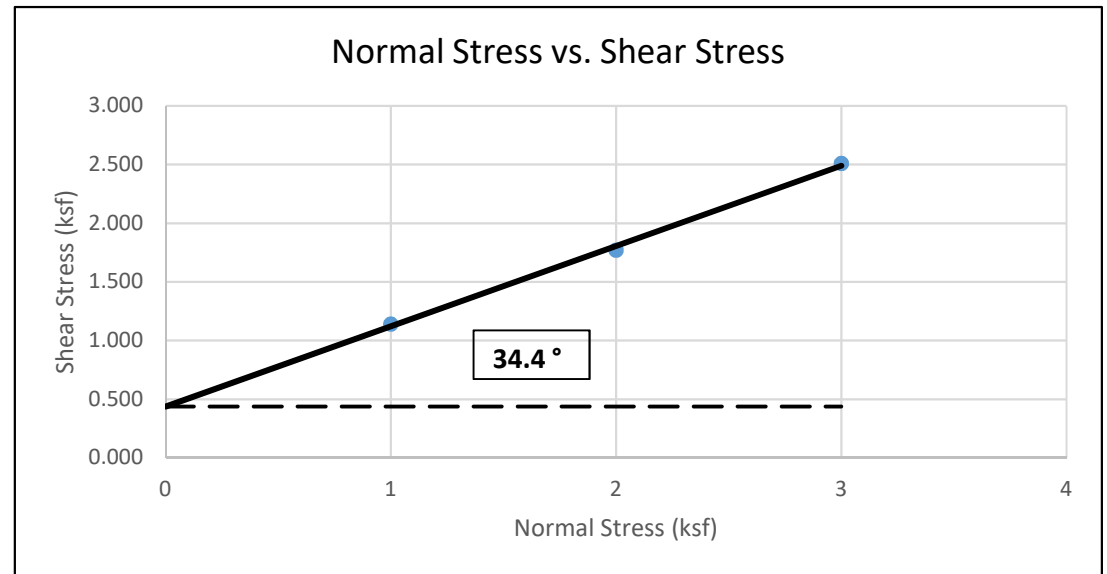
## Direct Shear Test (ASTM D3080)

Project Name: Proposed Commercial Development - Lake Elsinore, CA  
 Project Number: 3-221-0167  
 Client: Evergreen Devco  
 Sample Location: B-6 @ 5'  
 Sample Type: Undisturbed Ring  
 Soil Classification: Silty SAND (SM)  
 Tested By: M. Noorzay  
 Reviewed By: CJ  
 Date: 4/9/2021  
 Equipment Used: Geomatic Direct Shear Machine

	Sample 1	Sample 2	Sample 3
Normal Stress (ksf)	1.000	2.000	3.000
Shear Rate (in/min)	0.004		
Peak Shear Stress (ksf)	1.140	1.770	2.508
Residual Shear Stress (ksf)	0.000	0.000	0.000

Initial Height of Sample (in)	1.000	1.000	1.000
Height of Sample before Shear (in.)	1	1	1
Diameter of Sample (in)	2.416	2.416	2.416
Initial Moisture Content (%)	5.7		
Final Moisture Content (%)	14.9	13.9	15.0
Dry Density (pcf)	124.3	127.6	124.4

Peak Shear Strength Values	
Slope	0.68
Friction Angle	34.4
Cohesion (psf)	438



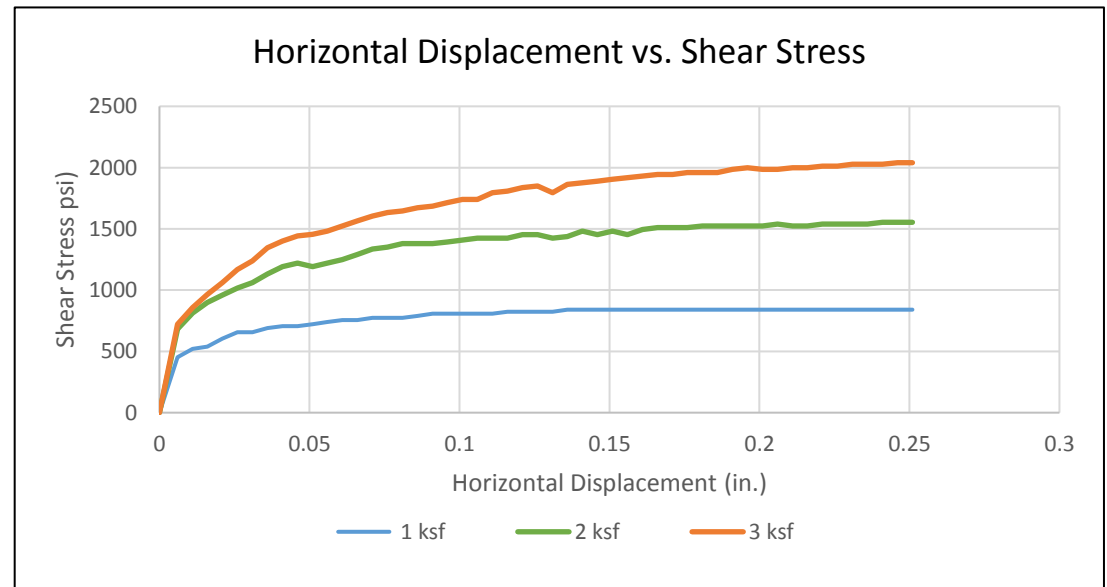
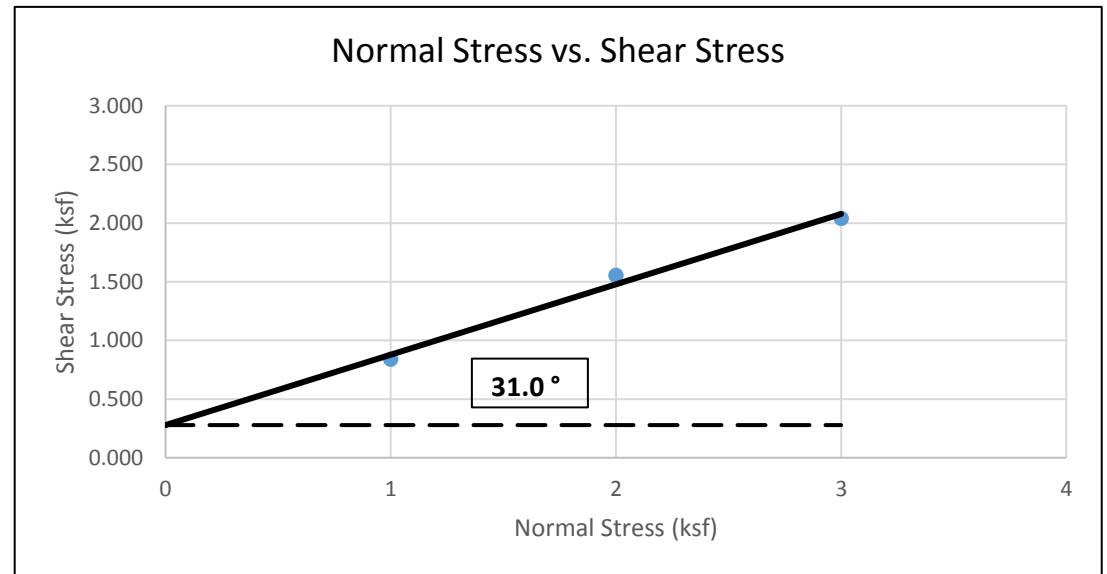
# Direct Shear Test (ASTM D3080)

Project Name: Proposed Commercial Development - Lake Elsinore, CA  
 Project Number: 3-221-0167  
 Client: Evergreen Devco  
 Sample Location: B-10 @ 5'  
 Sample Type: Undisturbed Ring  
 Soil Classification: Silty SAND (SM)  
 Tested By: M. Noorzay  
 Reviewed By: CJ  
 Date: 4/12/2021  
 Equipment Used: Geomatic Direct Shear Machine

	Sample 1	Sample 2	Sample 3
Normal Stress (ksf)	1.000	2.000	3.000
Shear Rate (in/min)	0.004		
Peak Shear Stress (ksf)	0.840	1.554	2.040
Residual Shear Stress (ksf)	0.000	0.000	0.000

Initial Height of Sample (in)	1.000	1.000	1.000
Height of Sample before Shear (in.)	1	1	1
Diameter of Sample (in)	2.416	2.416	2.416
Initial Moisture Content (%)	4.2		
Final Moisture Content (%)	17.5	15.7	14.7
Dry Density (pcf)	104.6	106.2	106.7

Peak Shear Strength Values	
Slope	0.60
Friction Angle	31.0
Cohesion (psf)	278



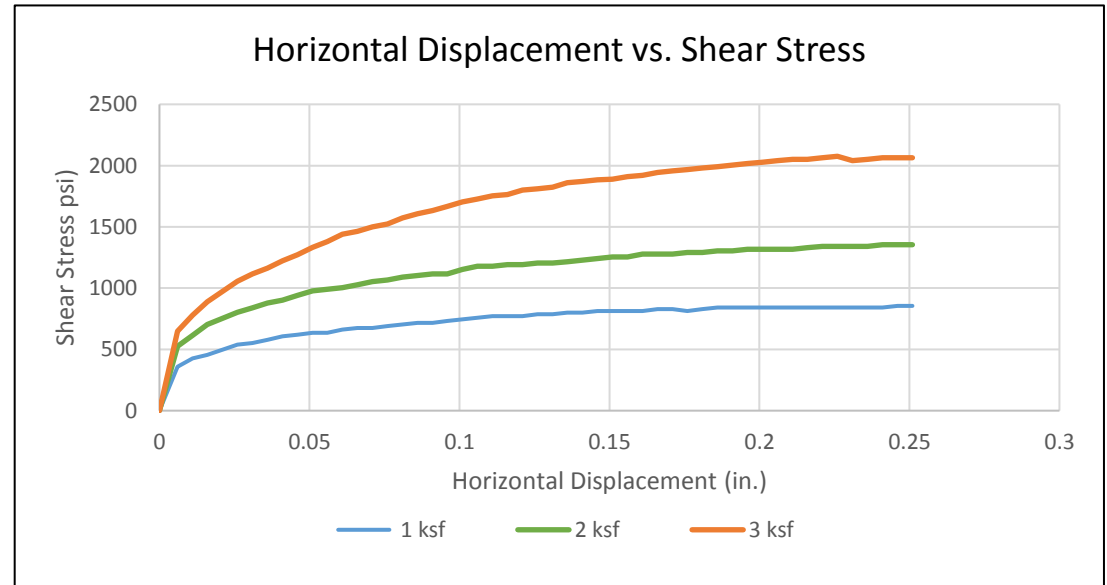
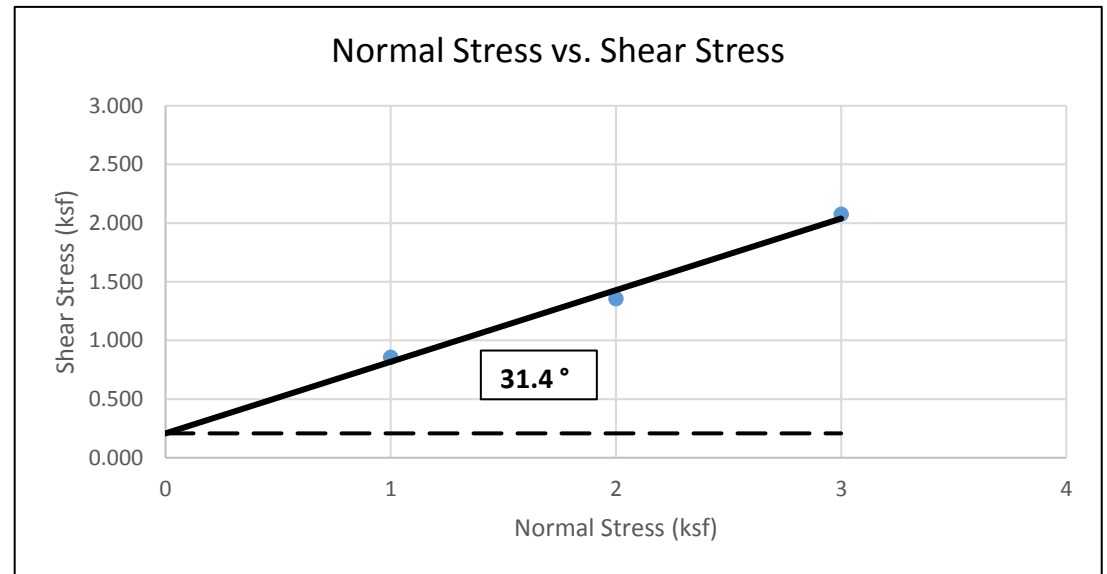
## Direct Shear Test (ASTM D3080)

Project Name: Proposed Commercial Development - Lake Elsinore, CA  
 Project Number: 3-221-0167  
 Client: Evergreen Devco  
 Sample Location: B-13 @ 2'  
 Sample Type: Undisturbed Ring  
 Soil Classification: Silty SAND (SM)  
 Tested By: M. Noorzay  
 Reviewed By: CJ  
 Date: 4/13/2021  
 Equipment Used: Geomatic Direct Shear Machine

	Sample 1	Sample 2	Sample 3
Normal Stress (ksf)	1.000	2.000	3.000
Shear Rate (in/min)	0.004		
Peak Shear Stress (ksf)	0.855	1.354	2.076
Residual Shear Stress (ksf)	0.000	0.000	0.000

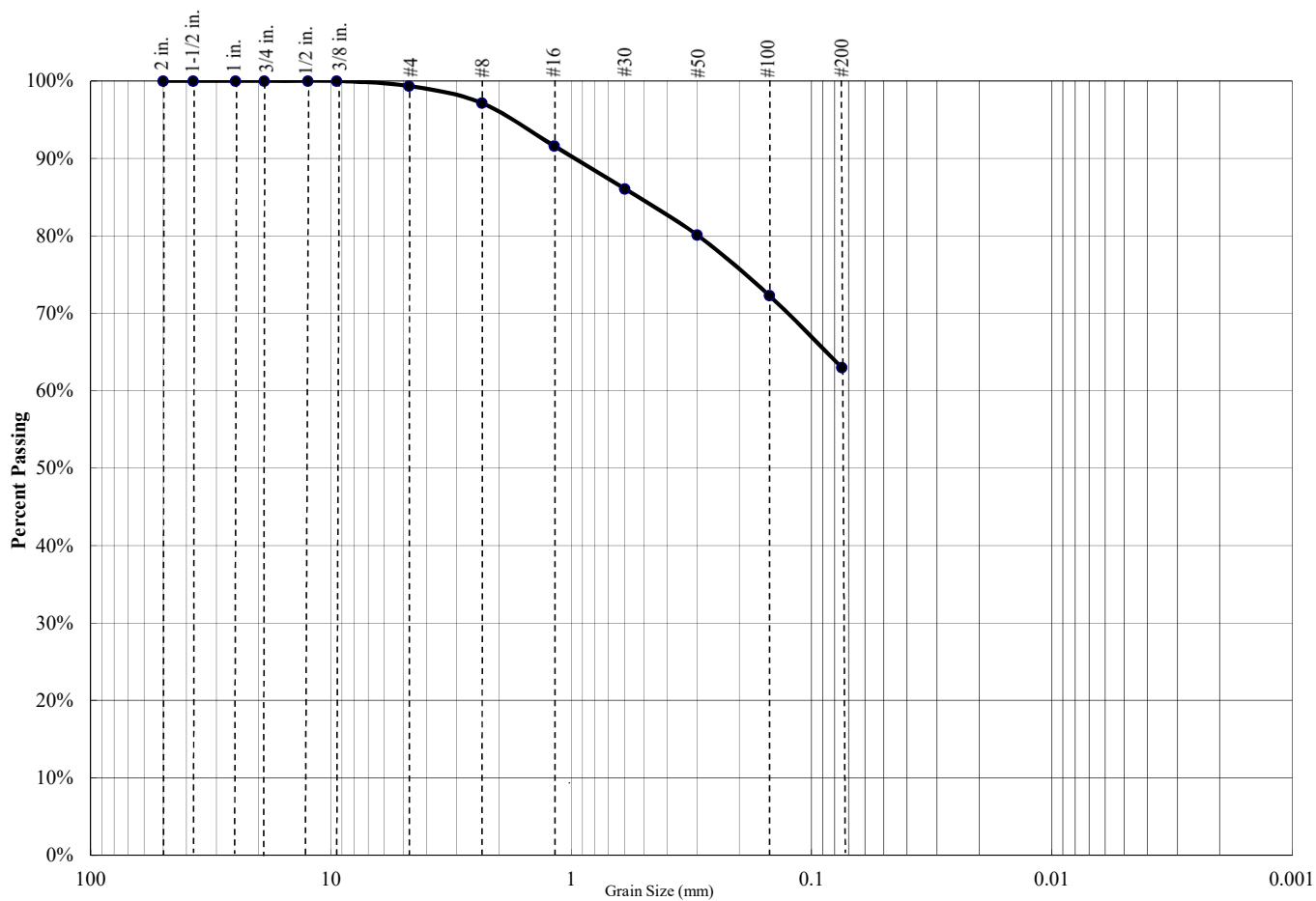
Initial Height of Sample (in)	1.000	1.000	1.000
Height of Sample before Shear (in.)	1	1	1
Diameter of Sample (in)	2.416	2.416	2.416
Initial Moisture Content (%)	3.8		
Final Moisture Content (%)	15.3	14.3	14.5
Dry Density (pcf)	109.6	99.4	100.9

Peak Shear Strength Values	
Slope	0.61
Friction Angle	31.4
Cohesion (psf)	208



## PARTICLE SIZE DISTRIBUTION DIAGRAM

### GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
1%	36%	63%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	100.0%
#4	99.4%
#8	97.1%
#16	91.6%
#30	86.1%
#50	80.1%
#100	72.3%
#200	63.0%

Atterberg Limits		
PL=	LL=	PI=

Coefficients		
D85=	D60=	D50=
D30=	D15=	D10=
C <sub>u</sub> =	N/A	C <sub>c</sub> = N/A

USCS CLASSIFICATION
Sandy SILT (ML)

**Project Name: Proposed Commercial Development - Lake Elsinore, CA**

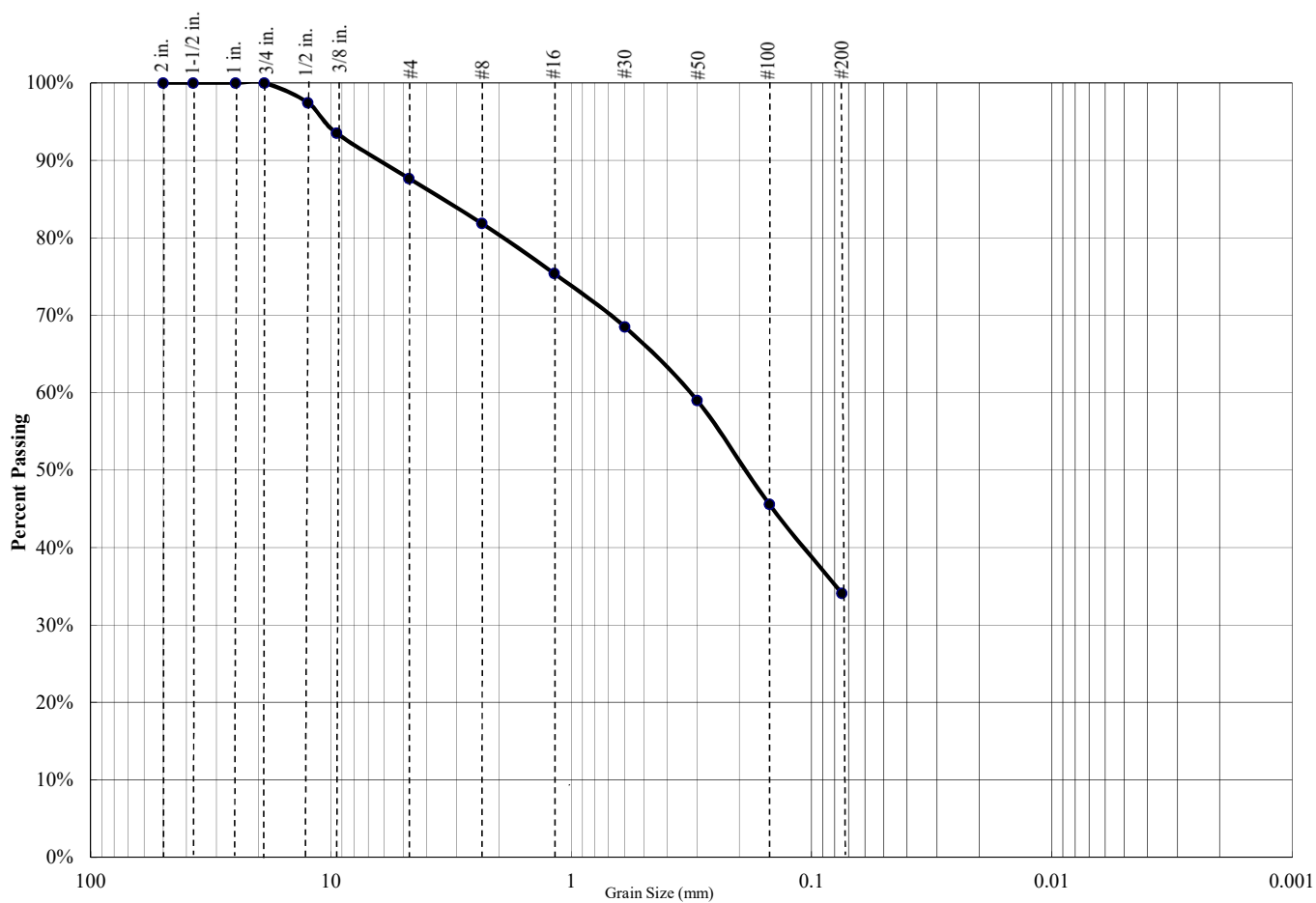
**Project Number: 3-221-0167**

**Boring: B-1 @ 2'**



## PARTICLE SIZE DISTRIBUTION DIAGRAM

### GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
12%	54%	34%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	97.5%
3/8 inch	93.5%
#4	87.7%
#8	81.9%
#16	75.4%
#30	68.5%
#50	59.0%
#100	45.6%
#200	34.1%

Atterberg Limits		
PL=	LL=	PI=

Coefficients		
D85=	D60=	D50=
D30=	D15=	D10=
C <sub>u</sub> =	N/A	C <sub>c</sub> = N/A

USCS CLASSIFICATION
Silty SAND (SM)

**Project Name: Proposed Commercial Development - Lake Elsinore, CA**

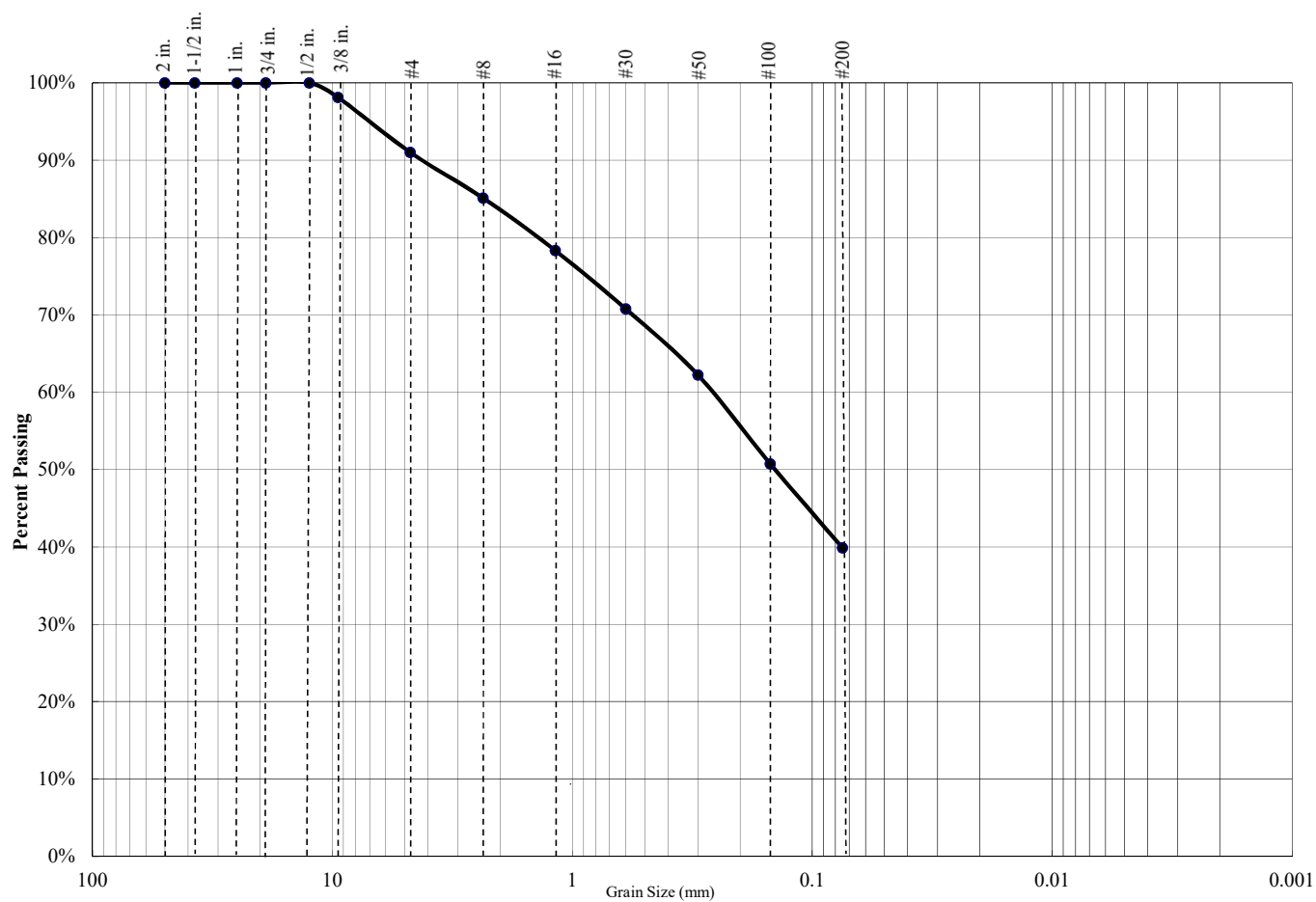
**Project Number: 3-221-0167**

**Boring: B-1 @ 10'**



## PARTICLE SIZE DISTRIBUTION DIAGRAM

### GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
9%	51%	40%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	98.1%
#4	91.0%
#8	85.1%
#16	78.3%
#30	70.8%
#50	62.2%
#100	50.8%
#200	39.9%

Atterberg Limits		
PL=	LL=	PI=

Coefficients		
D85=	D60=	D50=
D30=	D15=	D10=
C <sub>u</sub> =	N/A	C <sub>c</sub> = N/A

USCS CLASSIFICATION
Silty SAND (SM)

**Project Name: Proposed Commercial Development - Lake Elsinore, CA**

**Project Number: 3-221-0167**

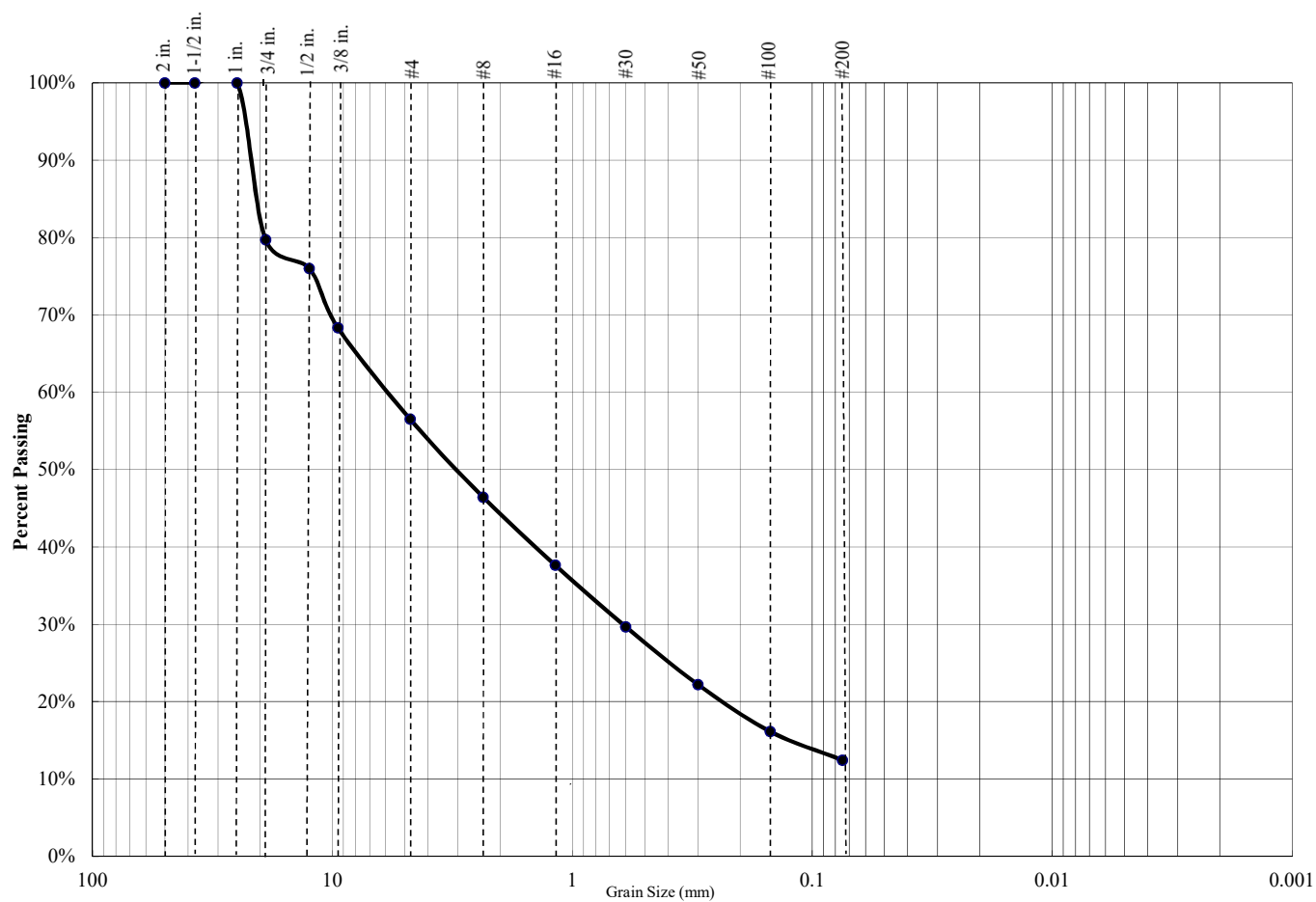
**Boring: B-1 @ 20'**





## PARTICLE SIZE DISTRIBUTION DIAGRAM

### GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
43%	44%	12%

Sieve Size	Percent Passing
3/4 inch	79.7%
1/2 inch	76.0%
3/8 inch	68.3%
#4	56.5%
#8	46.5%
#16	37.7%
#30	29.7%
#50	22.2%
#100	16.1%
#200	12.5%

Atterberg Limits		
PL=	LL=	PI=

Coefficients		
D85=	D60=	D50=
D30=	D15=	D10=
C <sub>u</sub> =	N/A	C <sub>c</sub> = N/A

USCS CLASSIFICATION
Silty SAND (SM)

**Project Name: Proposed Commercial Development - Lake Elsinore, CA**

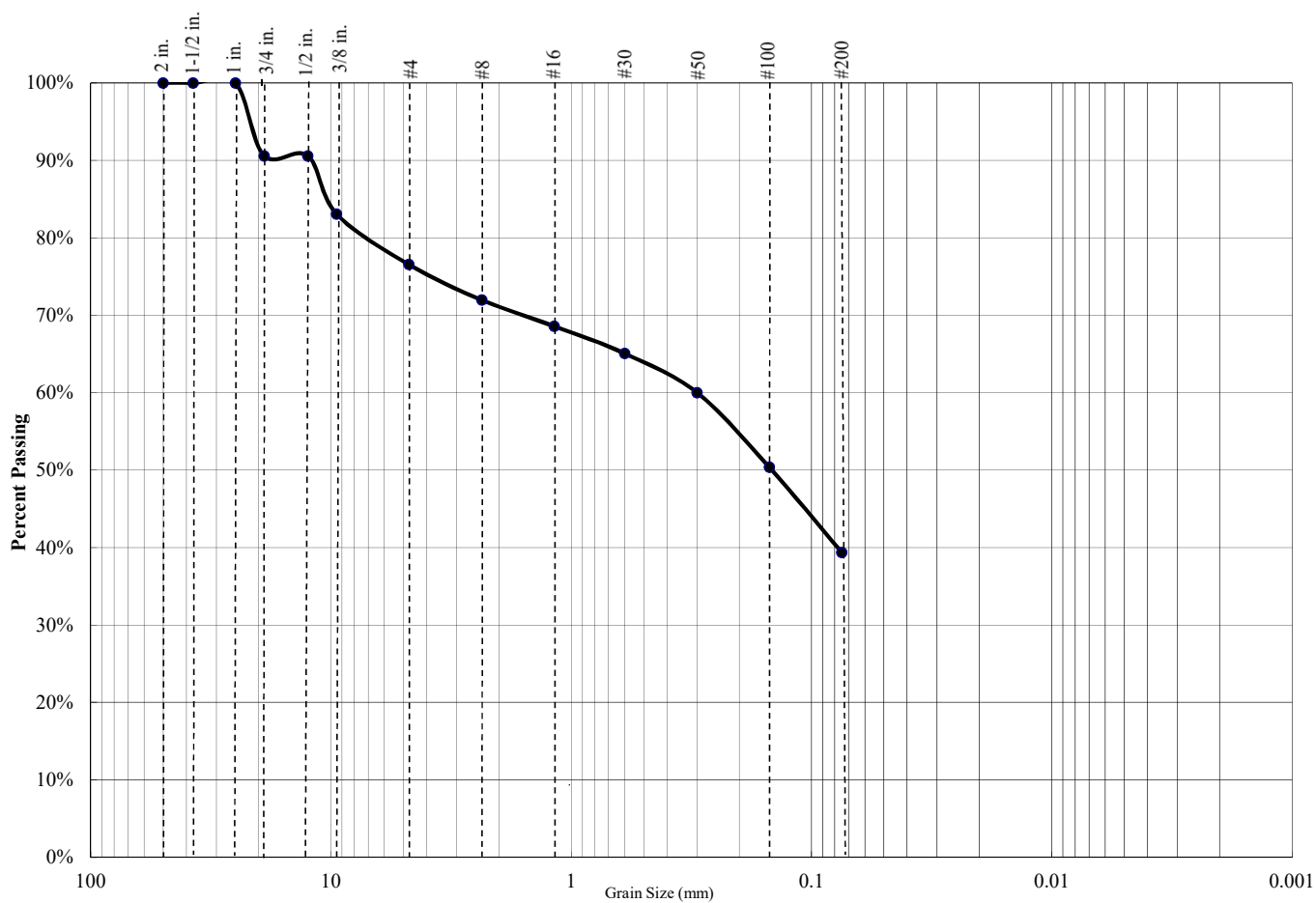
**Project Number: 3-221-0167**

**Boring: B-1 @ 25'**



## PARTICLE SIZE DISTRIBUTION DIAGRAM

### GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
23%	37%	39%

Sieve Size	Percent Passing
3/4 inch	90.6%
1/2 inch	90.6%
3/8 inch	83.1%
#4	76.6%
#8	72.0%
#16	68.6%
#30	65.1%
#50	60.0%
#100	50.4%
#200	39.4%

Atterberg Limits		
PL=	LL=	PI=

Coefficients		
D85=	D60=	D50=
D30=	D15=	D10=
C <sub>u</sub> =	N/A	C <sub>c</sub> = N/A

USCS CLASSIFICATION
Silty SAND (SM)

**Project Name: Proposed Commercial Development - Lake Elsinore, CA**

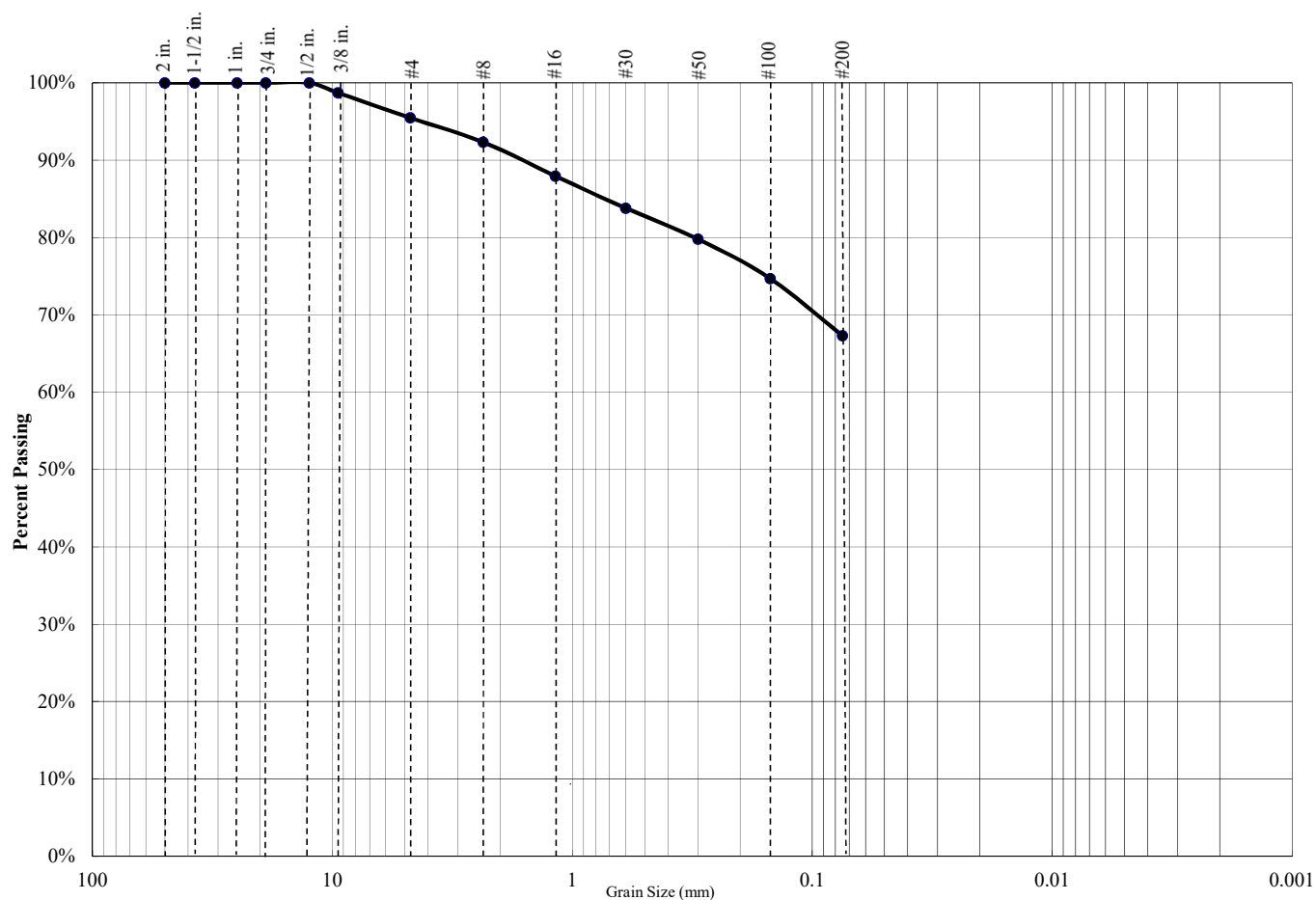
**Project Number: 3-221-0167**

**Boring: B-1 @ 30'**



## PARTICLE SIZE DISTRIBUTION DIAGRAM

### GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
5%	28%	67%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	98.7%
#4	95.5%
#8	92.3%
#16	87.9%
#30	83.8%
#50	79.8%
#100	74.7%
#200	67.3%

Atterberg Limits		
PL=	LL=	PI=

Coefficients		
D85=	D60=	D50=
D30=	D15=	D10=
C <sub>u</sub> =	N/A	C <sub>c</sub> = N/A

USCS CLASSIFICATION
Sandy SILT (ML)

**Project Name: Proposed Commercial Development - Lake Elsinore, CA**

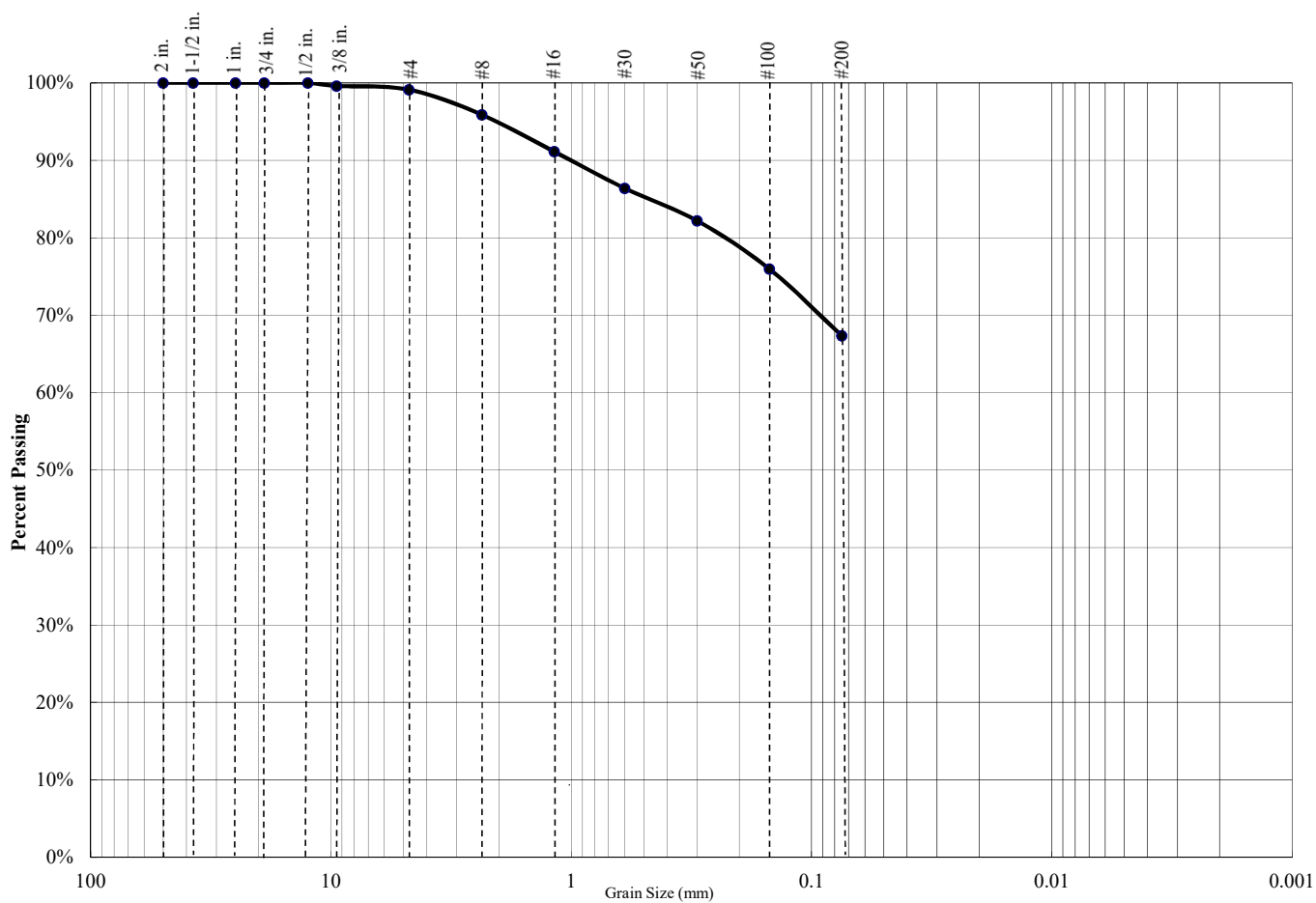
**Project Number: 3-221-0167**

**Boring: B-1 @ 40'**



## PARTICLE SIZE DISTRIBUTION DIAGRAM

### GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
1%	32%	67%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	99.6%
#4	99.1%
#8	95.9%
#16	91.1%
#30	86.4%
#50	82.2%
#100	76.0%
#200	67.4%

Atterberg Limits		
PL=	LL=	PI=

Coefficients		
D85=	D60=	D50=
D30=	D15=	D10=
C <sub>u</sub> =	N/A	C <sub>c</sub> = N/A

USCS CLASSIFICATION
Sandy SILT (ML)

**Project Name: Proposed Commercial Development - Lake Elsinore, CA**

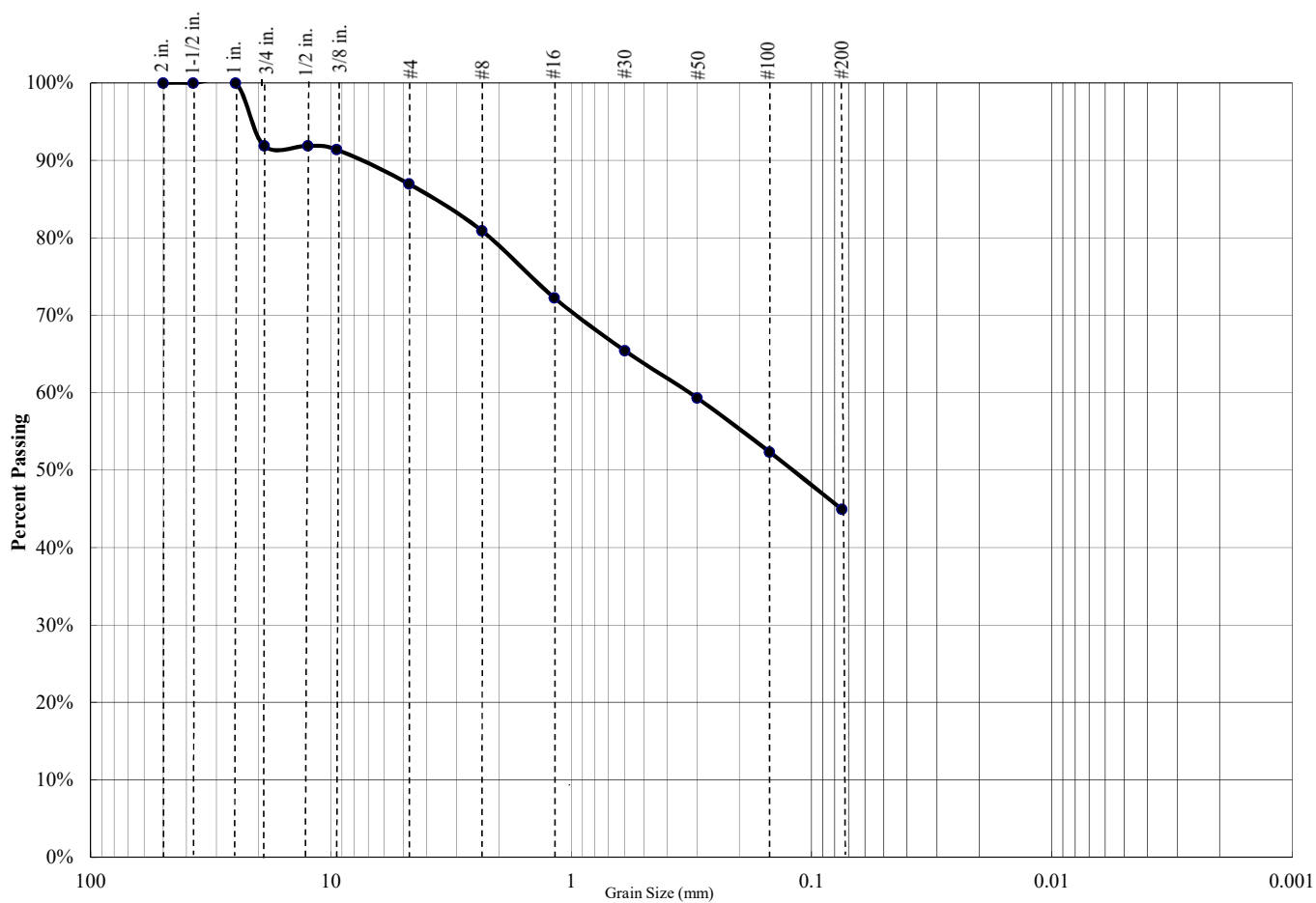
**Project Number: 3-221-0167**

**Boring: B-2 @ 5'**



# PARTICLE SIZE DISTRIBUTION DIAGRAM

## GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
13%	42%	45%

Sieve Size	Percent Passing
3/4 inch	91.9%
1/2 inch	91.9%
3/8 inch	91.4%
#4	87.0%
#8	80.9%
#16	72.3%
#30	65.4%
#50	59.3%
#100	52.4%
#200	45.0%

Atterberg Limits		
PL=	LL=	PI=

Coefficients		
D85=	D60=	D50=
D30=	D15=	D10=
C <sub>u</sub> =	N/A	C <sub>c</sub> = N/A

USCS CLASSIFICATION
Silty SAND (SM)

Project Name: Proposed Commercial Development - Lake Elsinore, CA

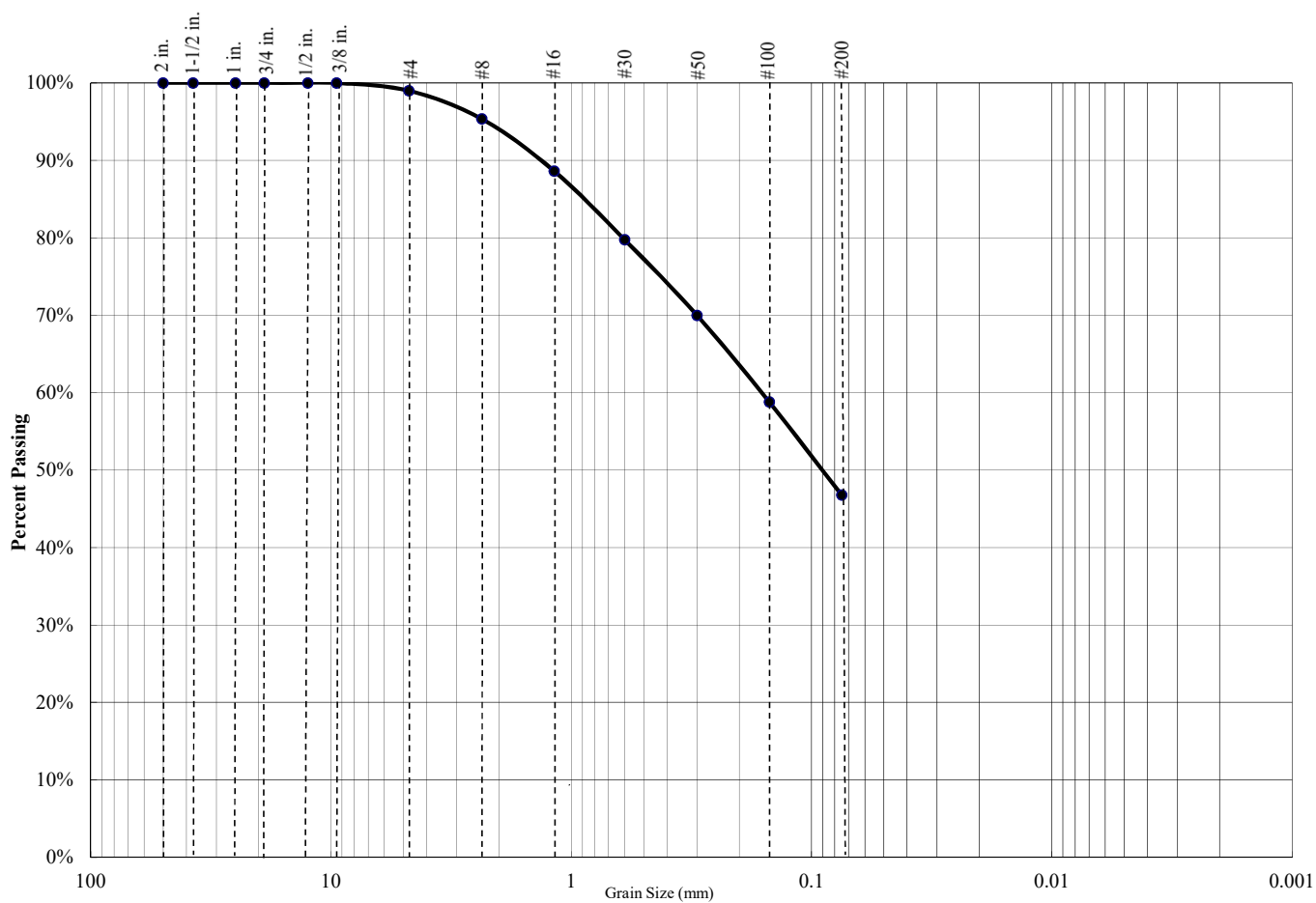
Project Number: 3-221-0167

Boring: B-6 @ 2'



## PARTICLE SIZE DISTRIBUTION DIAGRAM

### GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
1%	52%	47%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	100.0%
#4	99.0%
#8	95.4%
#16	88.6%
#30	79.8%
#50	70.0%
#100	58.8%
#200	46.8%

Atterberg Limits		
PL=	LL=	PI=

Coefficients		
D85=	D60=	D50=
D30=	D15=	D10=
C <sub>u</sub> =	N/A	C <sub>c</sub> = N/A

USCS CLASSIFICATION
Silty SAND (SM)

**Project Name: Proposed Commercial Development - Lake Elsinore, CA**

**Project Number: 3-221-0167**

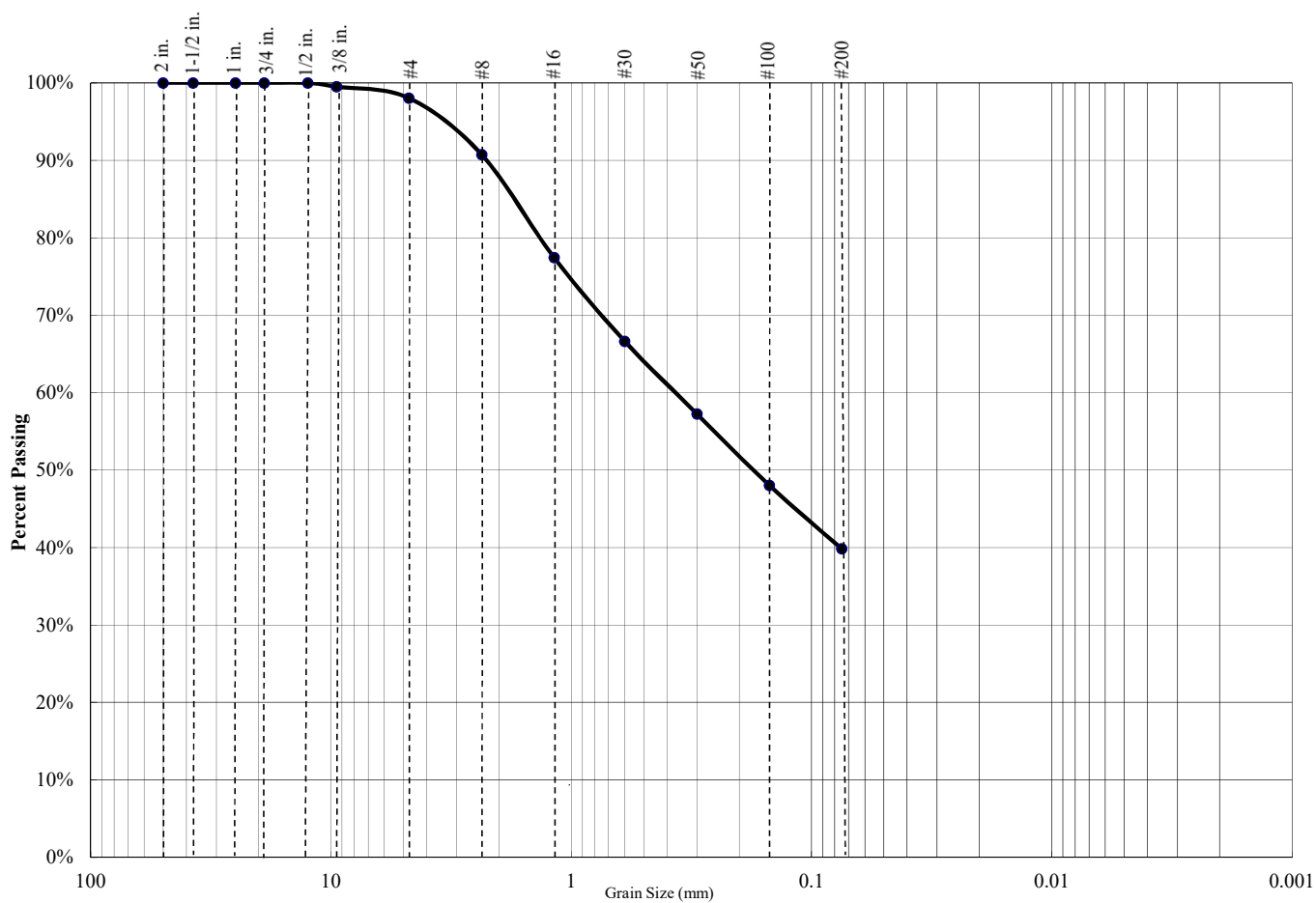
**Boring: B-6 @ 5'**





## PARTICLE SIZE DISTRIBUTION DIAGRAM

### GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
2%	58%	40%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	99.5%
#4	98.0%
#8	90.7%
#16	77.4%
#30	66.6%
#50	57.2%
#100	48.0%
#200	39.8%

Atterberg Limits		
PL=	LL=	PI=

Coefficients		
D85=	D60=	D50=
D30=	D15=	D10=
C <sub>u</sub> =	N/A	C <sub>c</sub> = N/A

USCS CLASSIFICATION
Silty SAND (SM)

**Project Name: Proposed Commercial Development - Lake Elsinore, CA**

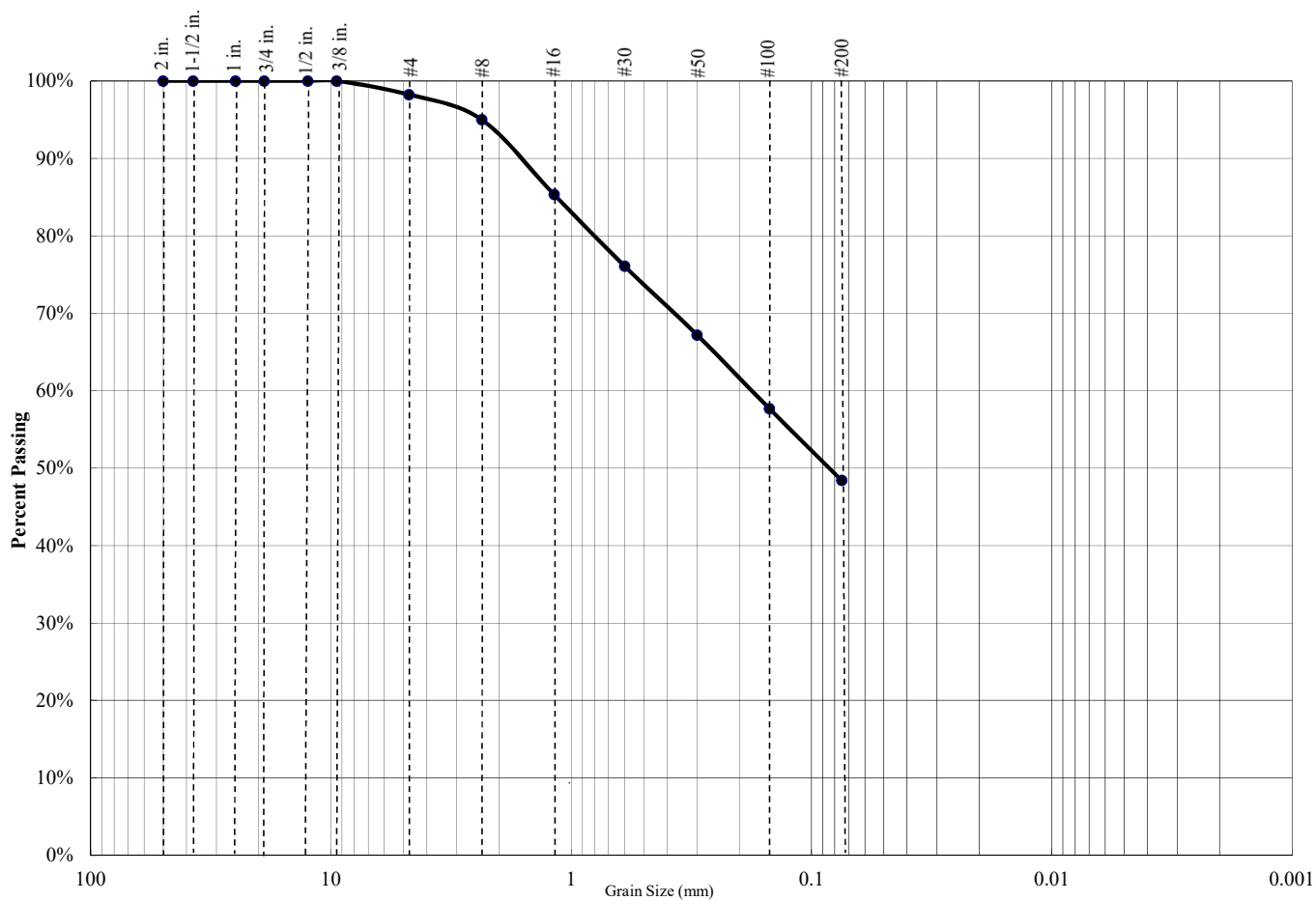
**Project Number: 3-221-0167**

**Boring: B-10 @ 2'**



## PARTICLE SIZE DISTRIBUTION DIAGRAM

### GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
2%	50%	48%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	100.0%
#4	98.3%
#8	95.0%
#16	85.3%
#30	76.1%
#50	67.2%
#100	57.7%
#200	48.4%

Atterberg Limits		
PL=	LL=	PI=

Coefficients		
D85=	D60=	D50=
D30=	D15=	D10=
C <sub>u</sub> =	N/A	C <sub>c</sub> = N/A

USCS CLASSIFICATION
Silty SAND (SM)

**Project Name: Proposed Commercial Development - Lake Elsinore, CA**

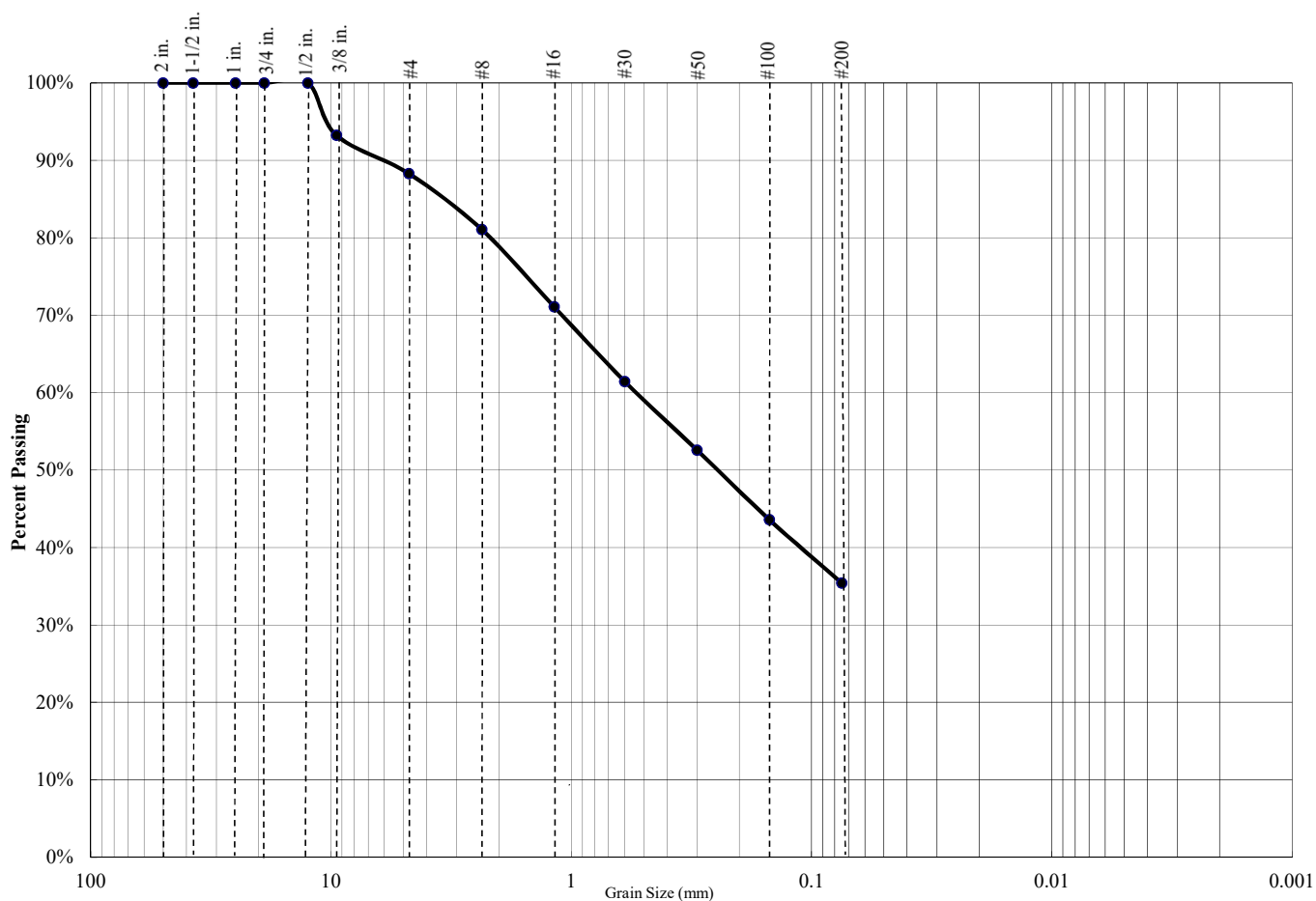
**Project Number: 3-221-0167**

**Boring: B-10 @ 5'**



# PARTICLE SIZE DISTRIBUTION DIAGRAM

## GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
12%	53%	35%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	93.2%
#4	88.3%
#8	81.1%
#16	71.1%
#30	61.5%
#50	52.6%
#100	43.6%
#200	35.4%

Atterberg Limits		
PL=	LL=	PI=

Coefficients		
D85=	D60=	D50=
D30=	D15=	D10=
C <sub>u</sub> =	N/A	C <sub>c</sub> = N/A

USCS CLASSIFICATION
Silty SAND (SM)

Project Name: Proposed Commercial Development - Lake Elsinore, CA

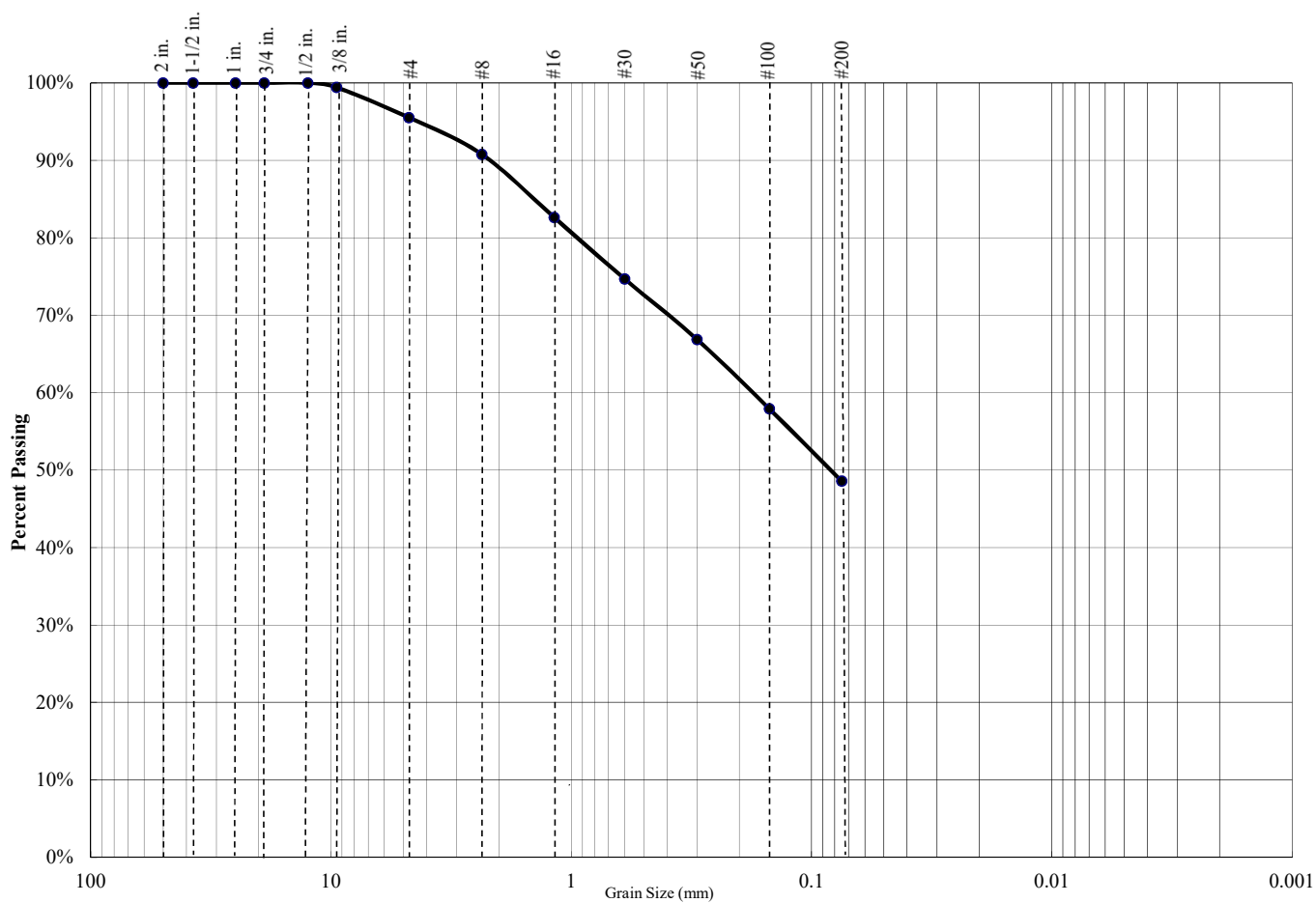
Project Number: 3-221-0167

Boring: B-13 @ 2'



## PARTICLE SIZE DISTRIBUTION DIAGRAM

### GRADATION TEST - ASTM C136



Percent Gravel	Percent Sand	Percent Silt/Clay
4%	47%	49%

Sieve Size	Percent Passing
3/4 inch	100.0%
1/2 inch	100.0%
3/8 inch	99.4%
#4	95.5%
#8	90.8%
#16	82.7%
#30	74.7%
#50	66.9%
#100	57.9%
#200	48.6%

Atterberg Limits		
PL=	LL=	PI=

Coefficients		
D85=	D60=	D50=
D30=	D15=	D10=
C <sub>u</sub> =	N/A	C <sub>c</sub> = N/A

USCS CLASSIFICATION
Silty SAND (SM)

**Project Name: Proposed Commercial Development - Lake Elsinore, CA**

**Project Number: 3-221-0167**

**Boring: B-13 @ 5'**



# EXPANSION INDEX TEST

## ASTM D4829

Project Name: Proposed Commercial Development - Lake Elsinore, CA

Project Number: 3-221-0167

Date Sampled: 3/30/2021- 3/31/2021

Date Tested: 4/12/2021

Sampled By: JC

Tested By: Mobin Noorzay

Sample Location: B-10 @ 0'-4'

Soil Description: Reddish Brown Sandy SILT (ML) with trace clay

Trial #	1	2	3
Weight of Soil & Mold, g.	798.1		
Weight of Mold, g.	368.4		
Weight of Soil, g.	429.7		
Wet Density, pcf	129.6		
Weight of Moisture Sample (Wet), g.	324.5		
Weight of Moisture Sample (Dry), g.	301.8		
Moisture Content, %	7.5		
Dry Density, pcf	120.5		
Specific Gravity of Soil	2.7		
Degree of Saturation, %	51.0		

Time	Initial	30 min	1 hr	6 hrs	12 hrs	24 hrs
Dial Reading	0	0.012	0.015	--	--	0.015

Expansion Index<sub>measured</sub> = 15

Expansion Index<sub>50</sub> = 15.5

**Expansion Index =**

**15**

Expansion Potential Table	
Exp. Index	Potential Exp.
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
>130	Very High

## CHEMICAL ANALYSIS

### SO<sub>4</sub> - Modified CTM 417 & Cl - Modified CTM 417/422

Project Name: Proposed Commercial Development - Lake Elsinore, CA

Project Number: 3-221-0167

Date Sampled: 3/30/2021- 3/31/2021

Date Tested: 4/13/2021

Sampled By: JC

Tested By: Mass Noorzay

Soil Description: Reddish Brown Sandy SILT (ML) with trace clay

Sample Number	Sample Location	Soluble Sulfate SO <sub>4</sub> -S	Soluble Chloride Cl	pH
1a.	B-1 @ 0'-4'	230 mg/kg	196 mg/kg	7.9
1b.	B-1 @ 0'-4'	230 mg/kg	195 mg/kg	7.9
1c.	B-1 @ 0'-4'	230 mg/kg	195 mg/kg	7.9
<b>Average:</b>		<b>230 mg/kg</b>	<b>195 mg/kg</b>	<b>7.9</b>



# Laboratory Compaction Curve ASTM D1557

Project Name: Proposed Commercial Development - Lake Elsinore, CA

Project Number: 3-221-0167

Date Sampled: 3/30/2021- 3/31/2021

Date Tested: 4/11/2021

Sampled By: JC

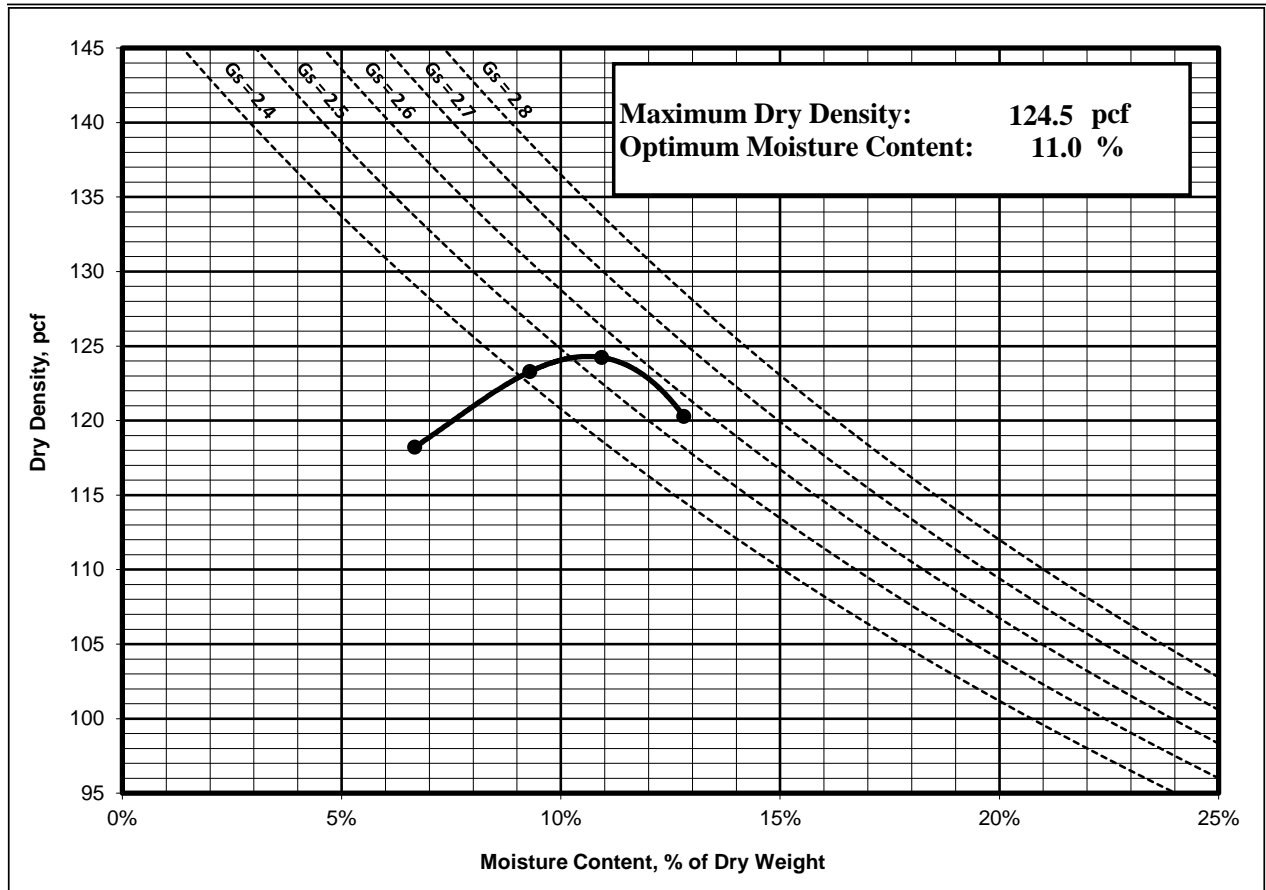
Tested By: Mobin Noorzay

Sample Location: B-1 @ 0'-4'

Soil Description: Reddish Brown Sandy SILT (ML) with trace clay

Test Method: Method B

	1	2	3	4
Weight of Moist Specimen & Mold, (g)	6197.5	6328.0	6374.6	6342.5
Weight of Compaction Mold, (g)	4290.9	4290.9	4290.9	4290.9
Weight of Moist Specimen, (g)	1906.6	2037.1	2083.7	2051.6
Volume of Mold, (ft <sup>3</sup> )	0.0333	0.0333	0.0333	0.0333
Wet Density, (pcf)	126.1	134.7	137.8	135.7
Weight of Wet (Moisture) Sample, (g)	200.0	200.0	200.0	200.0
Weight of Dry (Moisture) Sample, (g)	187.5	183.0	180.3	177.3
Moisture Content, (%)	6.7%	9.3%	10.9%	12.8%
Dry Density, (pcf)	118.2	123.3	124.2	120.3



APPENDIX

C



## APPENDIX C

### GENERAL EARTHWORK AND PAVEMENT SPECIFICATIONS

When the text of the report conflicts with the general specifications in this appendix, the recommendations in the report have precedence.

**1.0 SCOPE OF WORK:** These specifications and applicable plans pertain to and include all earthwork associated with the site rough grading, including, but not limited to, the furnishing of all labor, tools and equipment necessary for site clearing and grubbing, stripping, preparation of foundation materials for receiving fill, excavation, processing, placement and compaction of fill and backfill materials to the lines and grades shown on the project grading plans and disposal of excess materials.

**2.0 PERFORMANCE:** The Contractor shall be responsible for the satisfactory completion of all earthwork in accordance with the project plans and specifications. This work shall be inspected and tested by a representative of SALEM Engineering Group, Incorporated, hereinafter referred to as the Soils Engineer and/or Testing Agency. Attainment of design grades, when achieved, shall be certified by the project Civil Engineer. Both the Soils Engineer and the Civil Engineer are the Owner's representatives. If the Contractor should fail to meet the technical or design requirements embodied in this document and on the applicable plans, he shall make the necessary adjustments until all work is deemed satisfactory as determined by both the Soils Engineer and the Civil Engineer. No deviation from these specifications shall be made except upon written approval of the Soils Engineer, Civil Engineer, or project Architect.

No earthwork shall be performed without the physical presence or approval of the Soils Engineer. The Contractor shall notify the Soils Engineer at least 2 working days prior to the commencement of any aspect of the site earthwork.

The Contractor shall assume sole and complete responsibility for job site conditions during the course of construction of this project, including safety of all persons and property; that this requirement shall apply continuously and not be limited to normal working hours; and that the Contractor shall defend, indemnify and hold the Owner and the Engineers harmless from any and all liability, real or alleged, in connection with the performance of work on this project, except for liability arising from the sole negligence of the Owner or the Engineers.

**3.0 TECHNICAL REQUIREMENTS:** All compacted materials shall be densified to no less than 95 percent relative compaction based on ASTM D1557 Test Method (latest edition), UBC or CAL-216, or as specified in the technical portion of the Soil Engineer's report. The location and frequency of field density tests shall be determined by the Soils Engineer. The results of these tests and compliance with these specifications shall be the basis upon which satisfactory completion of work will be judged by the Soils Engineer.

**4.0 SOILS AND FOUNDATION CONDITIONS:** The Contractor is presumed to have visited the site and to have familiarized himself with existing site conditions and the contents of the data presented in the Geotechnical Engineering Report. The Contractor shall make his own interpretation of the data contained in the Geotechnical Engineering Report and the Contractor shall not be relieved of liability for any loss sustained as a result of any variance between conditions indicated by or deduced from said report and the actual conditions encountered during the progress of the work.

**5.0 DUST CONTROL:** The work includes dust control as required for the alleviation or prevention of any dust nuisance on or about the site or the borrow area, or off-site if caused by the Contractor's operation either during the performance of the earthwork or resulting from the conditions in which the Contractor leaves the site. The Contractor shall assume all liability, including court costs of codefendants, for all claims related to dust or wind-blown materials attributable to his work. Site preparation shall consist of site clearing and grubbing and preparation of foundation materials for receiving fill.

**6.0 CLEARING AND GRUBBING:** The Contractor shall accept the site in this present condition and shall demolish and/or remove from the area of designated project earthwork all structures, both surface and subsurface, trees, brush, roots, debris, organic matter and all other matter determined by the Soils Engineer to be deleterious. Such materials shall become the property of the Contractor and shall be removed from the site.

Tree root systems in proposed improvement areas should be removed to a minimum depth of 3 feet and to such an extent which would permit removal of all roots greater than 1 inch in diameter. Tree roots removed in parking areas may be limited to the upper 1½ feet of the ground surface. Backfill of tree root excavations is not permitted until all exposed surfaces have been inspected and the Soils Engineer is present for the proper control of backfill placement and compaction. Burning in areas which are to receive fill materials shall not be permitted.

**7.0 SUBGRADE PREPARATION:** Surfaces to receive Engineered Fill and/or building or slab loads shall be prepared as outlined above, scarified to a minimum of 12 inches, moisture-conditioned as necessary, and recompact to 95 percent relative compaction.

Loose soil areas and/or areas of disturbed soil shall be moisture-conditioned as necessary and recompact to 95 percent relative compaction. All ruts, hummocks, or other uneven surface features shall be removed by surface grading prior to placement of any fill materials. All areas which are to receive fill materials shall be approved by the Soils Engineer prior to the placement of any fill material.

**8.0 EXCAVATION:** All excavation shall be accomplished to the tolerance normally defined by the Civil Engineer as shown on the project grading plans. All over-excavation below the grades specified shall be backfilled at the Contractor's expense and shall be compacted in accordance with the applicable technical requirements.

**9.0 FILL AND BACKFILL MATERIAL:** No material shall be moved or compacted without the presence or approval of the Soils Engineer. Material from the required site excavation may be utilized for construction site fills, provided prior approval is given by the Soils Engineer. All materials utilized for constructing site fills shall be free from vegetation or other deleterious matter as determined by the Soils Engineer.

**10.0 PLACEMENT, SPREADING AND COMPACTION:** The placement and spreading of approved fill materials and the processing and compaction of approved fill and native materials shall be the responsibility of the Contractor. Compaction of fill materials by flooding, ponding, or jetting shall not be permitted unless specifically approved by local code, as well as the Soils Engineer. Both cut and fill shall be surface-compacted to the satisfaction of the Soils Engineer prior to final acceptance.

**11.0 SEASONAL LIMITS:** No fill material shall be placed, spread, or rolled while it is frozen or thawing, or during unfavorable wet weather conditions. When the work is interrupted by heavy rains, fill

operations shall not be resumed until the Soils Engineer indicates that the moisture content and density of previously placed fill is as specified.

**12.0 DEFINITIONS** - The term "pavement" shall include asphaltic concrete surfacing, untreated aggregate base, and aggregate subbase. The term "subgrade" is that portion of the area on which surfacing, base, or subbase is to be placed. The term "Standard Specifications": hereinafter referred to, is the most recent edition of the Standard Specifications of the State of California, Department of Transportation. The term "relative compaction" refers to the field density expressed as a percentage of the maximum laboratory density as determined by ASTM D1557 Test Method (latest edition) or California Test Method 216 (CAL-216), as applicable.

**13.0 PREPARATION OF THE SUBGRADE** - The Contractor shall prepare the surface of the various subgrades receiving subsequent pavement courses to the lines, grades, and dimensions given on the plans. The upper 12 inches of the soil subgrade beneath the pavement section shall be compacted to a minimum relative compaction of 95 percent relative compaction based upon ASTM D1557. The finished subgrades shall be tested and approved by the Soils Engineer prior to the placement of additional pavement courses.

**14.0 AGGREGATE BASE** - The aggregate base material shall be spread and compacted on the prepared subgrade in conformity with the lines, grades, and dimensions shown on the plans. The aggregate base material shall conform to the requirements of Section 26 of the Standard Specifications for Class II material, ¾-inch or 1½-inches maximum size. The aggregate base material shall be compacted to a minimum relative compaction of 95 percent based upon CAL-216. The aggregate base material shall be spread in layers not exceeding 6 inches and each layer of aggregate material course shall be tested and approved by the Soils Engineer prior to the placement of successive layers.

**15.0 AGGREGATE SUBBASE** - The aggregate subbase shall be spread and compacted on the prepared subgrade in conformity with the lines, grades, and dimensions shown on the plans. The aggregate subbase material shall conform to the requirements of Section 25 of the Standard Specifications for Class II Subbase material. The aggregate subbase material shall be compacted to a minimum relative compaction of 95 percent based upon CAL-216, and it shall be spread and compacted in accordance with the Standard Specifications. Each layer of aggregate subbase shall be tested and approved by the Soils Engineer prior to the placement of successive layers.

**16.0 ASPHALTIC CONCRETE SURFACING** - Asphaltic concrete surfacing shall consist of a mixture of mineral aggregate and paving grade asphalt, mixed at a central mixing plant and spread and compacted on a prepared base in conformity with the lines, grades, and dimensions shown on the plans. The viscosity grade of the asphalt shall be PG 64-10, unless otherwise stipulated or local conditions warrant more stringent grade. The mineral aggregate shall be Type A or B, ½ inch maximum size, medium grading, and shall conform to the requirements set forth in Section 39 of the Standard Specifications. The drying, proportioning, and mixing of the materials shall conform to Section 39. The prime coat, spreading and compacting equipment, and spreading and compacting the mixture shall conform to the applicable chapters of Section 39, with the exception that no surface course shall be placed when the atmospheric temperature is below 50 degrees F. The surfacing shall be rolled with a combination steel-wheel and pneumatic rollers, as described in the Standard Specifications. The surface course shall be placed with an approved self-propelled mechanical spreading and finishing machine.