



SALEM
engineering group, inc.

GEOTECHNICAL ENGINEERING INVESTIGATION

**PROPOSED CENTRAL PLAZA
SEC COLLIER AVENUE AND CENTRAL AVENUE
LAKE ELSINORE, CALIFORNIA**

**SALEM PROJECT NO. 3-216-0112
FEBRUARY 29, 2016**

PREPARED FOR:

**MR. GREG LUKOSKY
PENINSULA RETAIL PARTNERS
417 29TH STREET
NEWPORT BEACH, CA 92663**

PREPARED BY:

**SALEM ENGINEERING GROUP, INC.
11650 MISSION PARK DR., #108
RANCHO CUCAMONGA, CA 91730
P: (909) 980-6455
F: (909) 980-6435
www.salemeng.com**

February 29, 2016

Project No. 3-216-0112

Mr. Greg Lukosky
Peninsula Retail Partners
417 29th Street
Newport Beach, CA 92663

**SUBJECT: GEOTECHNICAL ENGINEERING INVESTIGATION
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Dear Mr. Lukosky:

At your request and authorization, SALEM Engineering Group, Inc. (SALEM) has prepared this Geotechnical Engineering Investigation report for the Proposed Central Plaza 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.



Clarence Jiang, GE
Senior Geotechnical Engineer
RGE 2477



R. Sammy Salem, MS, PE, GE
Principal Engineer
RCE 52762 / RGE 2549



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**GEOTECHNICAL ENGINEERING INVESTIGATION
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1. PURPOSE AND SCOPE

This report presents the results of our Geotechnical Engineering Investigation for the Proposed Central Plaza to be located at the southeast corner of the intersection of Collier Avenue and Central Avenue in Lake Elsinore, 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, laboratory testing, engineering analysis and the preparation of this report. Our field exploration was performed on February 16, 2016 and included the drilling of sixteen (16) small-diameter soil borings to a maximum depth of 41 feet at the site. The locations of the soil borings are depicted on Figure 2, Site Plan. A detailed discussion of our field investigation and exploratory boring logs 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

We understand that the development of the site will include construction of a total of seven (7) buildings on an approximately 7.25 acre land. The proposed buildings will include 21,070 square-foot Marshals (Major A), a 9,998 square-foot Ultra Beauty (Major B), a 25,012 square-foot Ross (Major C), a 4,304 square-foot Drive-Thru Restaurant (Pad 1), a 3,220 square-foot Retail (Pad 2), a 2,700 square-foot Drive-Thru Restaurant (Pad 3), and a 2,588 square-foot Drive-Thru Restaurant (Pad 4). Maximum wall load is

expected to be on the order of 3.5 kips per linear foot. Maximum column load is expected to be on the order of 70 kips. Floor slab bearing pressure is expected to be on the order of 150 psf.

Concrete and asphaltic concrete pavement for parking area, customers travel lanes, and truck lane are to be designed for standard duty and heavy-duty traffic loading based on an Equivalent Single Axle Load (ESAL) of 18 kips, a maximum load of 60,000 ESAL and a design life of 20 years. The pavement design recommendations provided herein are based on the State of California Department (CALTRANS) design manual.

A site grading plan was not available at the time of preparation of this report. Based on the current site conditions, slight to moderate cuts and fills may be required during the earthwork construction to provided 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. The site configuration and locations of proposed improvements are shown on the Site Plan, Figure 2.

3. SITE LOCATION AND DESCRIPTION

The subject site is located on the southeast corner of the intersection of Collier Avenue and Central Avenue in Lake Elsinore, California (see Vicinity Map, Figure 1). The site is rectangular in shape and encompasses approximately 7.25 acres. The site is bounded by Central Avenue to the North, Interstate I-15 ramp to the east, vacant land to the south, and Collier Avenue to the west.

The site is currently mostly undeveloped land, covered with medium to large trees and seasonal grasses on localized area. The west-northwest portion of the site is currently occupied by a single-family residence. The site is gently sloping to the south with elevations ranging between 1,280 feet to 1,271 feet above mean sea level based on google earth imagery. The site is flat to rolling hill terrain with land relief of up to ± 5 feet in some areas on the southern portion of the property.

4. FIELD EXPLORATION

Our field exploration consisted of site surface reconnaissance and subsurface exploration. The exploratory test borings (B-1 through B-16) were drilled on February 16, 2016 in the area shown on the Site Plan, Figure 2. The test borings were advanced with a 4-inch diameter solid flight auger rotated by a truck-mounted CME-45C drill rig. The test borings were extended to a maximum depth of 41 feet below existing grade. The test boring depth was limited due to auger refusal on dense soils.

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 D2487).

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, 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 Peninsular Range Geomorphic Province, an area characterized by active northeast trending strike slip faults, including the San Jacinto to the northwest, and the Elsinore to the southwest. The project site is situated between the Santa Rosa Mountains and the San Jacinto Mountains to the east; and Santa Ana Mountains to the west and south. The near-surface deposits in the vicinity of the subject site are comprised of recent alluvium consisting of unconsolidated sands, silt, and clays derived from erosion of local mountain ranges. Deposits encountered on the subject site during exploratory drilling are discussed in detail in this report.

7. GEOLOGIC HAZARDS

7.1 Faulting and Seismicity

The Peninsular Range has historically been a province of relatively high seismic activity. The nearest faults to the project site are associated with the Elsinore Fault system located approximately 1.5 miles from the site. There are no known active fault traces in the project vicinity. Based on mapping and historical seismicity, the seismicity of the Peninsular Range has been generally considered high by the scientific community.

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 E.

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 33.6901° North; site longitude is 117.3380° West. The ten closest active faults are summarized below in Table 7.1.

**TABLE 7.1
REGIONAL FAULT SUMMARY**

Fault Name	Distance to Site (miles)	Maximum Earthquake Magnitude, M_w
Elsinore; W+GI	1.5	7.3
Elsinore; W+GI+T+J+CM	1.7	7.9
Elsinore; T+J+CM	2.9	7.6
Chino, alt 2	16.1	6.8
Elsinore; W	17.4	7.0
Chino, alt 1	18.7	6.7
San Jacinto; A+CC+B+SM	19.1	7.6
San Jacinto; SBV+SJV+A+CC+B+SM	20.4	7.9
San Jacinto; SBV+SJV	20.5	7.4
San Jacinto; SBV	23.3	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. 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.

7.3 Ground Shaking

We used the USGS web-based application *US Seismic Design Maps* to estimate the peak ground acceleration adjusted for site class effects (PGA_M). Because of the proximity to the subject site and the maximum probable events for these faults, it appears that a maximum probable event along the fault zones could produce a peak horizontal acceleration of approximately 0.887g (2% probability of being exceeded in 50 years). While listing PGA is useful for comparison of potential effects of fault activity in a region, other considerations are important in seismic design, including frequency and duration of motion and soil conditions underlying the site.

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 41 feet on the project site consisted predominately of sandy silt with varying amounts of clay, silty sand/sandy silt with varying amounts of clay, clayey sand, silty sand with varying amounts of clay and gravel; and sand with varying amounts of gravel. The historically highest groundwater is estimated to be at a depth of 10 feet below ground surface according to County of Riverside Geologic Hazards Map (2004) and regional groundwater well data. Low to very low cohesion strength is associated with the sandy soil. A seismic hazard, which could cause damage to the proposed development during seismic shaking, is the post-liquefaction settlement of the liquefied sands.

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 and a peak horizontal ground surface acceleration of 0.89g (with a 2 percent probability of exceedance in 50 years) and a groundwater depth of 10 feet were considered appropriate for the liquefaction analysis. The liquefaction analysis indicated that the site soils had a moderate potential for liquefaction under seismic conditions and the total liquefaction-induced settlement was calculated to be 2.12 inches. The differential settlement is estimated to be 1.4 inches.

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 topography and low liquefaction potential, we judge the likelihood of lateral spreading to be low.

7.6 Landslides

There are no known landslides at the site, nor is the site in the path of any known or potential landslides. We do not consider the potential for a landslide to be a hazard to this project.

7.7 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 firm to hard medium dense to very dense sandy silt with varying amounts of clay, silty sand/sandy silt with varying amounts

of clay, loose clayey sand, loose to very dense silty sand with varying amounts of clay and gravel; and loose to medium dense sand with varying amounts of gravel

No significant fill was encountered in our borings. Fill soils may be present onsite between our test boring locations. Verification of the extent of fill should be determined during site grading. Field and laboratory tests suggest that the deeper native soils are moderately strong and slightly compressible. These soils extended to the termination depth of our borings.

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 during this investigation at a depths approximately between 14 to 17 feet below existing grades. The historically highest groundwater is estimated to be at a depth of 10 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 2011 Edition of ACI 318 has established criteria for evaluation of sulfate and chloride levels and how they relate to cement reactivity with soil and/or water.

Three soil samples were obtained from the project site and were 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 concentrations in the saturation extract from the soil samples were detected to between 260 to 1,967 mg/kg. ACI 318 Tables 4.2.1 and 4.3.1 outline exposure categories, classes, and concrete requirements by exposure class. ACI 318 requirements for site concrete based upon the three different soil samples soluble sulfate are summarized in Table 8.3 below.

TABLE 8.3
WATER SOLUBLE SULFATE EXPOSURE REQUIREMENTS

Water-Soluble Sulfate (SO₄) in Soil, % by Weight	Exposure Severity	Exposure Class	Maximum w/cm Ratio	Minimum Concrete Compressive Strength	Cementitious Materials Type
0.0260	Not Applicable	S0	N/A	2,500 psi	No Restriction
0.1967	Severe	S2	0.45	4,500 psi	V
0.0337	Not Applicable	S0	N/A	2,500 psi	No Restriction

Additional corrosivity testing may be performed to verify the sulfate concentrations during construction or the concrete can be designed based on the severe sulfate exposure.

The water-soluble chloride concentrations detected in saturation extract from the soil samples were 34 to 131 mg/kg. This level of chloride concentration is not considered to be severely 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.

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 potentially compressible and potentially liquefiable material at the site. Recommendations to mitigate the effects of these soils are provided in this report.
- 9.1.3 Fill materials may be present on site between boring locations. Undocumented fill materials are not suitable to support any future structures and should be excavated and replaced with Engineered Fill. Prior to fill placement, SALEM should inspect the bottom of the excavation to verify the bottom condition.
- 9.1.4 The site is currently compromised of an undeveloped land that is covered by small to medium sized trees and native grasses in localized areas. 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 4 to 6 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.

- 9.1.5 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.
- 9.1.6 The site west-northwest portion of the site is currently occupied by a single family residential. 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.
- 9.1.7 The majority of the upper soils within the project site are identified primarily as silty sand/sandy silt with varying with clay, clayey sand, and silty sand with varying amounts of clay. The clayey soils exhibit a low to moderate swell potential (EI=41) and are subject to volumetric changes if moisture contents vary. The clayey soil, in its present condition, possess minor to moderate hazards to construction in terms of possible post-construction movement of the foundations and floor systems if no mitigation measures are employed. The estimated swell pressures of the clayey material may cause movement affecting slabs and brittle exterior finishes. Accordingly, measures are considered necessary to reduce anticipated soil movement. To minimize the potential soil movement due to expansive soil conditions, it is recommended that the upper 12 inches of soil beneath the required granular aggregate subbase within slab on grade and exterior flatwork areas be removed and replaced with Non-Expansive Engineered Fill meeting the requirements of section 9.4. The soils with an EI greater than 20 (EI>20) may be placed below a depth of 12 inches within the building pad and exterior flatwork areas or in the parking and non-structural areas.
- 9.1.8 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
- 9.1.9 Loose sandy soils were encountered within the soil borings at the project site. A seismic hazard, which could cause damage to the proposed development during seismic shaking, is the post-liquefaction settlement of liquefied sands. Liquefaction potential at the site was evaluated using the “LiqIT” computer program. Based on our evaluation, the potential for

liquefaction at the site is moderate. Mitigation measures are recommended to minimize structural damage due to the liquefaction. The potential for structural damage at the site can be minimized by using geogrid (see Section 9.6), a structural slab system (see Section 9.7), stone columns, or supporting the building on a deep foundation system.

- 9.1.10 Geogrid is a commonly and economically method to reduce structural damage due to liquefaction. This method has been accepted by cities and counties throughout California, and implemented into design and construction of many retail buildings. However, this method may not be accepted by some local jurisdictions. We have no control for the acceptance of this method for this project. To use the geogrid method, it's recommended the proposed buildings be designed and the structural drawings be prepared **after this report is approved by the City of Lake Elsinore.**
- 9.1.11 Recommendations for the geogrid system (option 1) are provided herein. As an alternative to the use of geogrid, the proposed structure may be supported by a structural slab system. A structural slab system will help reduce structural damage caused by liquefaction. Recommendations for a structural slab system (option 2) are provided in the Foundation's section of this report.
- 9.1.12 In lieu of the geogrid reinforcement method or the structural slab system, the buildings may be supported on deep foundations or by utilizing stone columns. Recommendations for a deep foundation system or the stone column method may be provided to the client by Salem Engineering Group, Inc. upon request.
- 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 2013 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
2013 CBC SEISMIC DESIGN PARAMETERS

Seismic Item	Symbol	Value	2010 ASCE 7 or 2013 CBC Reference
Site Coordinates (Datum = NAD 83)		33.6901 Lat -117.3380 Lon	
Site Class	--	D	ASCE 7 Table 20.3
Soil Profile Name	--	Stiff Soil	ASCE 7 Table 20.3
Risk Category	--	II	CBC Table 1604.5
Site Coefficient for PGA	F_{PGA}	1.000	ASCE 7 Table 11.8-1
Peak Ground Acceleration (adjusted for Site Class effects)	PGA_M	0.887	ASCE 7 Equation 11.8-1
Seismic Design Category	SDC	E	ASCE 7 Table 11.6-1 & 2
Mapped Spectral Acceleration (Short period - 0.2 sec)	S_S	2.273 g	CBC Figure 1613.3.1(1-6)
Mapped Spectral Acceleration (1.0 sec. period)	S_1	0.906 g	CBC Figure 1613.3.1(1-6)
Site Class Modified Site Coefficient	F_a	1.000	CBC Table 1613.3.3(1)
Site Class Modified Site Coefficient	F_v	1.500	CBC Table 1613.3.3(2)
MCE Spectral Response Acceleration (Short period - 0.2 sec) $S_{MS} = F_a S_S$	S_{MS}	2.273 g	CBC Equation 16-37
MCE Spectral Response Acceleration (1.0 sec. period) $S_{M1} = F_v S_1$	S_{M1}	1.359 g	CBC Equation 16-38
Design Spectral Response Acceleration $S_{DS} = \frac{2}{3} S_{MS}$ (short period - 0.2 sec)	S_{DS}	1.515 g	CBC Equation 16-39
Design Spectral Response Acceleration $S_{D1} = \frac{2}{3} S_{M1}$ (1.0 sec. period)	S_{D1}	0.906 g	CBC Equation 16-40

9.2.2 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 effort using conventional excavation 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 expansion and collapse potential. As recommended in Section 9.5, the upper 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 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 The upper on-site, native soils are predominately silty sand/sandy silt with clay, clayey sand, and sandy silt with varying amounts of clay. The test results indicate that the clayey soils have a low to moderate expansion potential (EI=41).
- 9.4.2 It is recommended that the upper 12 inches of soil within the building slab and exterior flatwork areas be replaced with “non-expansive” fill of silty sand or sandy silt with an Expansion Index equal to or less than 20. The replacement soils should extend 5 feet beyond the perimeter of the building. The soils with an EI greater than 20 (EI>20) may be placed below a depth of 12 inches within the building pad and exterior flatwork areas or in the parking and non-structural areas. The exposed native soils in the excavation should not be allowed to dry out and should be kept continuously moist prior to backfilling.
- 9.4.3 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. A sandy soil will allow the surface water to drain into the expansive clayey soils below, which may result in unacceptable swelling. This material should be approved by the Engineer prior to use and should typically possess the soil characteristics summarized below in Table 9.4.3.

**TABLE 9.4.3
IMPORT FILL REQUIREMENTS**

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

- 9.4.4 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.
- 9.4.5 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 The site is currently comprised of an undeveloped land that is covered by small to medium sized trees and native grasses in localized areas. 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 4 to 6 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 To minimize the potential soil movement due to expansive soil condition, it is recommended that the upper 12 inches of soil beneath the required granular aggregate subbase within slab on grade and exterior flatwork areas be removed and replaced with Non-Expansive Engineered Fill meeting the requirements of section 9.4. The soils with an EI greater than 20 (EI>20) may be placed below a depth of 12 inches within the building pad and exterior flatwork areas or in the parking and non-structural areas.
- 9.5.7 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.
- 9.5.8 Any 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.
- 9.5.9 Within pavement areas, it is recommended that overexcavation and recompaction be performed to a minimum depth of 12 inches below the existing grade or 12 inches below the proposed grade, whichever is deeper. Deeper overexcavation may be required in some local areas to removal all the unsuitable materials.
- 9.5.10 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 (90 percent for cohesive soils) of the maximum dry density based on ASTM D1557 Test Method.
- 9.5.11 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).
- 9.5.12 All Engineered Fill soils should be moisture conditioned to near optimum moisture content and compacted to at least 95% (90 % for cohesive soils) relative compaction.
- 9.5.13 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.
- 9.5.14 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 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.

- 9.5.16 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.
- 9.5.17 The 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 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, crushed rock may be utilized for stabilization provided this method is approved by the owner for the cost purpose. If the use of crushed rock is considered, it is recommended that the upper soft and wet soils be replaced by 6 to 24 inches of ¾-inch to 1-inch crushed rocks. The thickness of the 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 BX 1100 or TX 140) below the 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 Option 1 - Shallow Foundations with Geogrid

- 9.6.1 The site is suitable for use of conventional shallow foundations consisting of continuous strip footings in combination with isolated spread footings bearing on geogrid reinforced Engineered Fill.
- 9.6.2 Subsurface soils within the site are prone to liquefaction under high ground shaking acceleration during an earthquake. Our preliminary calculations indicated that the building areas, and at least **5 feet** beyond, should be over-excavated to a depth of **2 feet below existing**

grade or 2 feet below proposed footings, whichever is greater, and the resulting excavation should be backfilled with a layered system of Engineered Fill and geogrid reinforcing fabric.

Any undocumented and uncompacted fills encountered during grading should be removed and replaced with engineered fill. The depth of the over-excavation should be measured from existing ground or rough pad grade, whichever is greater. A preliminary design procedure is provided below. Final design will be provided by the geogrid manufacturer along with our office. Global seismic induced settlement of the site is still anticipated when liquefaction occurs.

Prior to placing the geogrid, the bottom of the subgrade should be scarified to a depth of 8 inches, moisture conditioned to near optimum moisture, and recompacted to a minimum of 95 percent (90% for cohesive soil) relative compaction based on ASTM D 1557 (Latest Edition).

The first layer of geogrid reinforcement will be placed directly on the prepared subgrade at a depth of 2 feet below existing grade or 2 feet below proposed footings, whichever is deeper. The geogrid material should be overlapped a minimum of 3 feet in all directions. The interlock between the geogrid and Engineered Fill will provide load transfer. No vehicles may traverse the geogrid prior to placement of the Engineered Fill cover.

The next layer of geogrid should be placed on top of the compacted Engineered Fill. This and subsequent layers need only be overlapped a minimum of 1 foot on all sides. The fill soils excavated from the area beneath the structure may be moisture conditioned and recompacted between geogrid layers as reinforced fill. The reinforced fill should be moisture conditioned to near optimum moisture content and recompacted to a minimum of 95 percent (90% for cohesive soil) of the maximum dry density based on ASTM D 1557 Test Method.

A total of two (2) geogrid layers, including the layer at the base of the excavation should be installed at vertical increments of 1 foot. The geogrid layers should extend to a minimum of 5 feet beyond the exterior footing perimeter of the structure. The geogrid reinforcement fabric should consist of Tensar® TX7 Geogrid. Any additional unstable soils within building areas should be excavated and backfilled with Engineered Fill.

It is recommended that the entire site be excavated at once, and soils be stockpiled on adjacent or nearby properties. The geogrid and excavated soil may then be placed and recompacted as recommended herein.

Alternatively, the contractor may elect to excavate the site in two stages, where excavated soil can be stockpiled over one-half of the site while the other half is mitigated. However, if the contractor elects the option of two stages over the preferred option of using one stage, a minimum of 5 feet of geogrid from the first half should overlap the second half. Furthermore, the overlapping geogrid should be protected from damages, which may be caused by operating equipment. It is further recommended that flexible utility connections be used for the project.

- 9.6.3 It is recommended that continuous bearing wall footings to be utilized for the building have a minimum width of 15 inches, and a minimum embedment depth of 18 inches below lowest

adjacent pad grade. Isolated column footings should have a minimum width of 24 inches, and a minimum embedment depth of 18 inches below lowest adjacent pad grade.

9.6.4 Footing concrete should be placed into neat excavation. The footing bottoms shall be maintained free of loose and disturbed soil.

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

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

9.6.6 For design purposes, total static settlement not exceeding 1 inch may be assumed for shallow foundations. Differential static settlement should not exceed ¼ inch (with geogrid) over 20 feet, 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. The total settlement due to severe seismic loads is expected to be on the order of 2.12 inches. With the geogrid reinforcement, the seismic induced differential settlement is expected to be reduced to approximately ½ inch over 20 feet.

9.6.7 Resistance to lateral footing displacement can be computed using an allowable coefficient of friction factor of 0.34 acting between the base of foundations and the supporting native subgrade.

9.6.8 Lateral resistance for footings can alternatively be developed using an equivalent fluid passive pressure of 320 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 Section 1605.3.2 of the 2012 IBC/2013 CBC that includes wind or earthquake loads.

9.6.9 Minimum reinforcement for continuous footings should consist of four No. 4 steel reinforcing bars; two placed near the top of the footing and two near the bottom. Reinforcement for spread footings should be designed by the project structural engineer.

9.6.10 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.

- 9.6.11 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 Option 2 – Structural Slabs

- 9.7.1 As an alternative to the geogrid method, the building may be supported on a reinforced structural slab foundation system (e.g. mat foundation, modified mat foundation, post-tensioned slab or stiffened footings with rigid grade beams) to resist damage due to seismic-induced differential settlement.
- 9.7.2 The foundation can be designed utilizing allowable bearing pressure of 1,500 pounds per square foot for dead-plus-live loads. This value may be increased by 1/3 for short duration loads such as wind or seismic. The thickness and reinforcement of the structural slab should be determined by the Structural Engineer.
- 9.7.3 The structural slab should have a minimum depth of 12 inches below the lowest adjacent exterior grade. The structural slab should be supported by at least 2 feet of Engineered Fill. Any undocumented and uncompacted fills encountered during grading should be removed and replaced with engineered fill.
- 9.7.4 The total settlement due to foundation loads (static) is not expected to exceed 1 inch. Differential settlement due to static loads should be less than ½ inch over 20 feet. 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.
- 9.7.5 The seismic-induced total and differential settlements are expected to be on the order of 2.12 inches and 1.4 inches over 20 feet, respectively. It is further recommended that flexible utility connectors be used for this project.
- 9.7.6 Resistance to lateral footing displacement can be computed using an allowable friction factor of 0.34 acting between the base of foundations and the supporting subgrade. Lateral resistance for footings can alternatively be developed using an equivalent fluid passive pressure of 320 pounds per cubic foot acting against the appropriate vertical slab faces. The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance.

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 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 its approved equivalents to prevent capillary moisture rise.
- 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 120 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 full depth 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:

Lateral Pressure Conditions	Equivalent Fluid Pressure, pcf
Active Pressure, Drained	45
At-Rest Pressure, Drained	65
Passive Pressure	320
Related Parameters	
Allowable Coefficient of Friction	0.34
In-Place Soil Density (lbs/ft ³)	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. The top one-foot of adjacent subgrade should be deleted from the passive pressure computation.
- 9.9.3 A safety factor consistent with the design conditions should be included in their usage.
- 9.9.4 For stability against lateral sliding, which is resisted solely by the passive pressure, we recommend a minimum safety factor of 1.5.
- 9.9.5 For stability against lateral sliding, which is resisted by the combined passive and frictional resistance, a minimum safety factor of 2.0 is recommended.
- 9.9.6 For lateral stability against seismic loading conditions, we recommend a minimum safety factor of 1.1.

9.9.7 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: γ = 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

Depth of Excavation (ft)	Slope (Horizontal : Vertical)
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% (90 % for cohesive soils) relative compaction at or above 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 Site drainage should be collected and transferred away from improvements in non-erosive drainage devices. Drainage should not be allowed to pond anywhere on the site, and especially not against any foundations or retaining walls. Drainage should not be allowed to flow uncontrolled over any descending slope. The proposed structures should be provided with roof gutters.
- 9.13.3 Discharge from downspouts, roof drains and scuppers are not permitted onto unprotected soils within five feet of the buildings perimeters. Planters which are located adjacent to foundations should be sealed or properly drained to prevent moisture intrusion into the materials providing foundation support. Landscape irrigation within 5 feet of the buildings perimeter footings should be kept to a minimum to just support vegetative life.

9.13.4 The ground immediately adjacent to the foundation shall be sloped away from buildings at a slope of not less than 5 percent for a minimum distance of 10 feet. Impervious surfaces within 10 feet of building's foundations shall be sloped a minimum of 2 percent away from buildings 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.

9.14 Pavement Design

9.14.1 Based on site soil conditions, an R-value of 25 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 pavement design recommendations provided herein are based on the State of California Department of Transportation (CALTRANS) design manual. The asphaltic concrete (flexible pavement) is based on a 20-year pavement life utilizing 1200 passenger vehicles, 10 single unit trucks, and 2 multi-unit trucks. The following table shows the recommended pavement sections for various traffic indices.

**TABLE 9.14.2
ASPHALT CONCRETE PAVEMENT THICKNESSES**

Traffic Index	Asphaltic Concrete	Class II Aggregate Base*	Compacted Subgrade**
5.0 (Parking and Vehicle Drive Areas)	3.0"	6.0"	12.0"
6.0 (Heavy Truck Areas)	3.0"	9.5"	12.0"

**95% compaction based on ASTM D1557 Test Method
 ***95% (90% for cohesive soils) 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 THICKNESSES**

Traffic Index	Portland Cement Concrete*	Class II Aggregate Base**	Compacted Subgrade***
5.0 (Light Duty)	5.0"	5.0"	12.0"
6.0 (Heavy Duty)	6.5"	7.0"	12.0"

* Minimum Compressive Strength of 4,500 psi
 ** 95% compaction based on ASTM D1557 Test Method
 ***95% (90% for cohesive soils) 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 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.



Ibrahim Ibrahim, MS, EIT
Geotechnical Staff Engineer

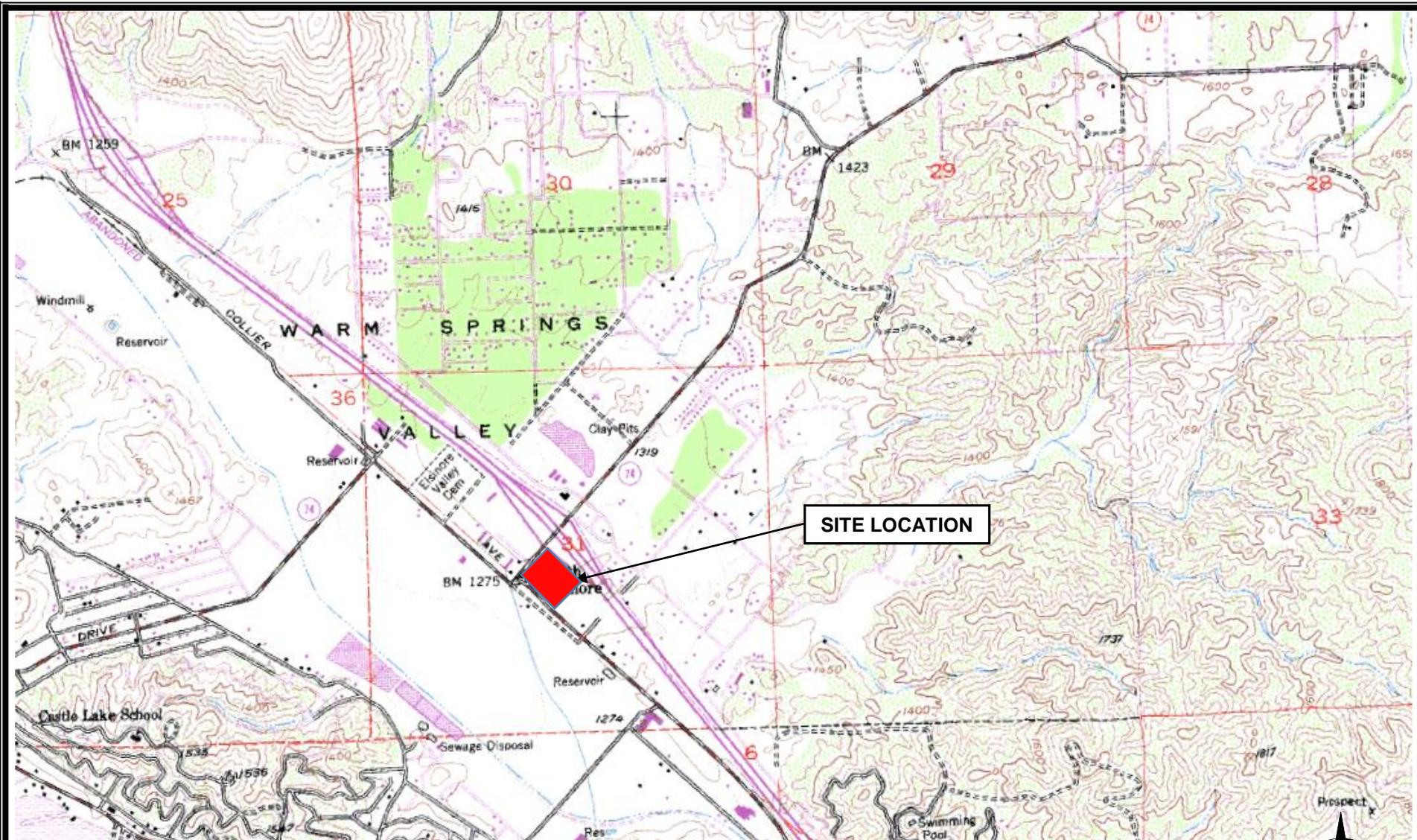


Clarence Jiang, GE
Senior Geotechnical Engineer
RGE 2477



R. Sammy Salem, MS, PE, GE
Principal Engineer
RCE 52762 / RGE 2549





Source Image: U.S. Geological Survey Lake Elsinore, California 1953, (Photorevised 1988)

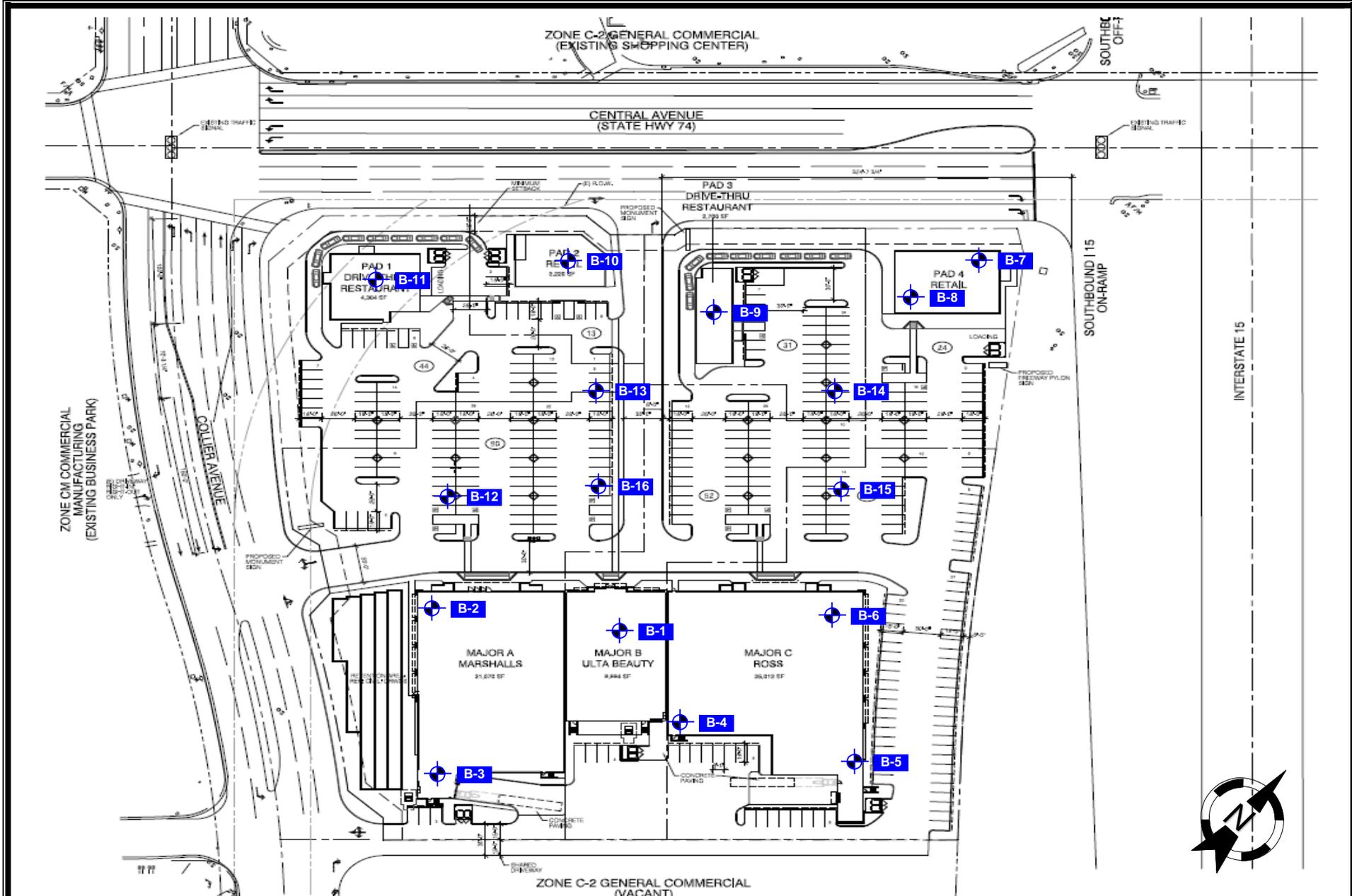


SVICINITY MAP
GEOTECHNICAL ENGINEERING INVESTIGATION
Proposed Central Plaza
SEC Collier Avenue & Central Avenue
Lake Elsinore, California

SCALE:
 NOT TO SCALE
 DRAWN BY:
 AA
 PROJECT NO.
 3-216-0112

DATE:
 02/2016
 APPROVED BY:
 CJ
 FIGURE NO.
 1





SITE PLAN

GEOTECHNICAL ENGINEERING INVESTIGATION
Proposed Central Plaza
SEC Collier Avenue & Central Avenue
Lake Elsinore, California

SCALE: NOT TO SCALE	DATE: 02/2016
DRAWN BY: AA	APPROVED BY: CJ
PROJECT NO. 3-216-0112	FIGURE NO. 2

LEGEND:
 **B-1** Soil Boring Locations
 All Locations Approximate



LIQUEFACTION ANALYSIS REPORT

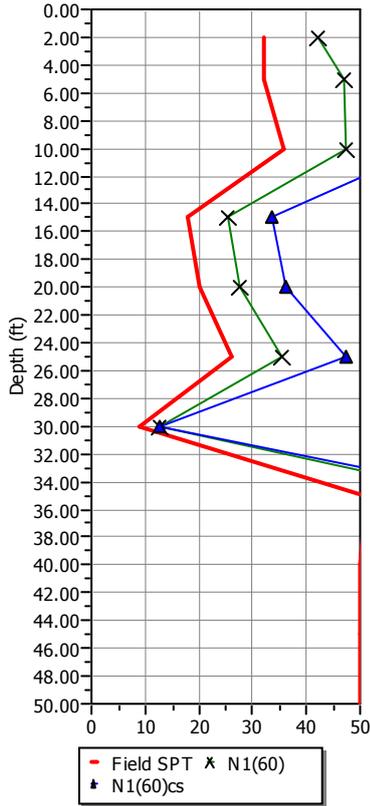
Project title : 3-216-0112

Project subtitle : Proposed Central Plaza

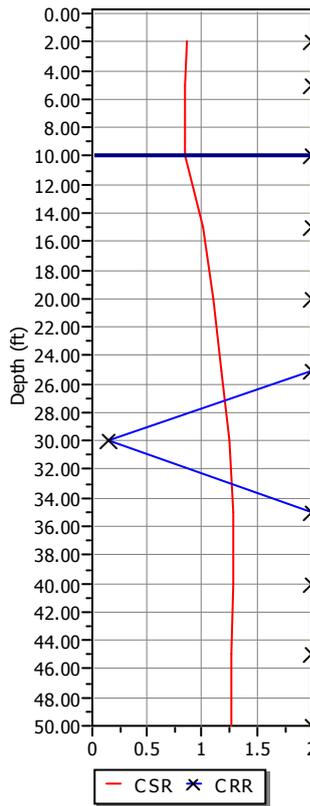
Input parameters and analysis data

In-situ data type:	Standard Penetration Test	Depth to water table:	10.00 ft
Analysis type:	Deterministic	Earthquake magnitude M_w :	7.90
Analysis method:	NCEER 1998	Peak ground acceleration:	0.89 g
Fines correction method:	Idriss & Seed	User defined F.S.:	1.30

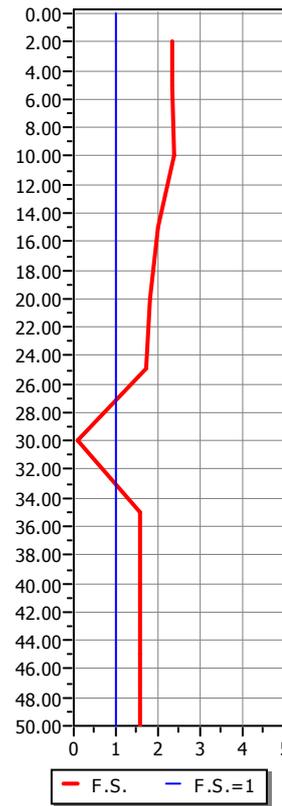
SPT data graph



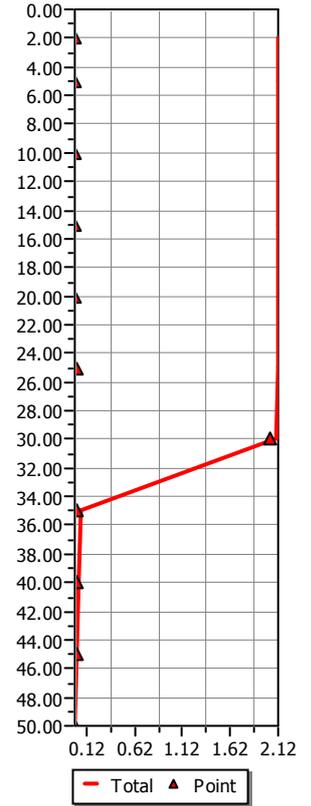
Shear stress ratio



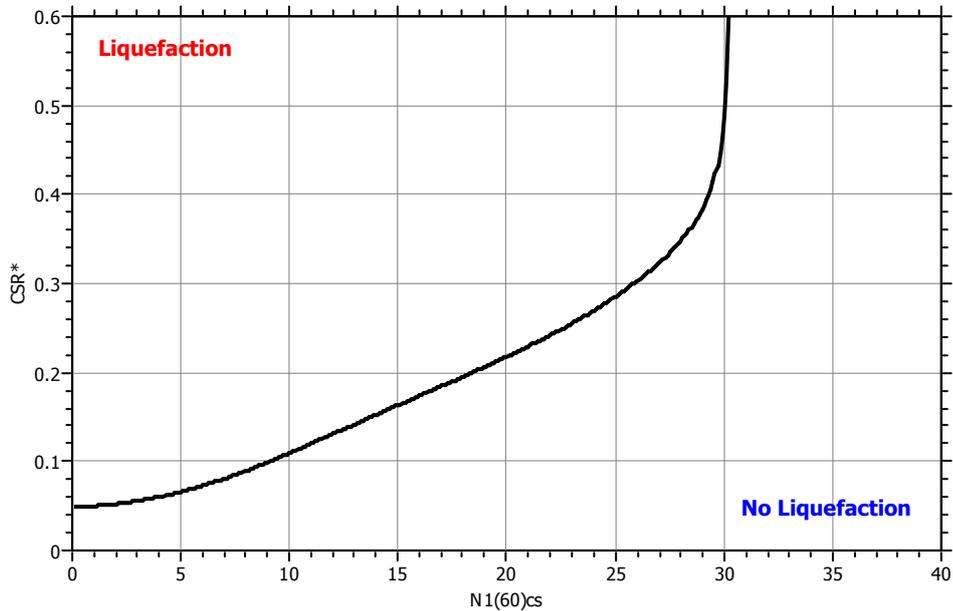
Factor of safety



Settlements (in)



$M_w=7^{1/2}$, $\sigma_v=1$ atm base curve



:: Field input data ::

Point ID	Depth (ft)	Field N _{SPT} (blows/feet)	Unit weight (pcf)	Fines content (%)
1	2.00	32.00	116.00	53.90
2	5.00	32.00	117.00	44.40
3	10.00	36.00	120.00	46.20
4	15.00	18.00	120.00	28.20
5	20.00	20.00	120.00	28.20
6	25.00	26.00	120.00	52.00
7	30.00	9.00	120.00	4.00
8	35.00	51.00	120.00	13.70
9	40.00	50.00	120.00	13.70
10	45.00	50.00	120.00	13.70
11	50.00	50.00	120.00	13.70

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	0.58	0.88	0.66	1.00	0.66
2	5.00	0.29	0.00	0.29	0.99	0.57	0.88	0.65	1.00	0.65
3	10.00	0.59	0.00	0.59	0.98	0.57	0.88	0.65	1.00	0.65
4	15.00	0.89	0.16	0.74	0.97	0.68	0.88	0.77	1.00	0.77
5	20.00	1.19	0.31	0.88	0.95	0.75	0.88	0.85	1.00	0.85
6	25.00	1.49	0.47	1.02	0.94	0.79	0.88	0.91	1.00	0.91
7	30.00	1.79	0.62	1.17	0.93	0.83	0.88	0.94	0.98	0.96
8	35.00	2.09	0.78	1.31	0.89	0.82	0.88	0.94	0.96	0.98
9	40.00	2.39	0.94	1.45	0.85	0.81	0.88	0.92	0.94	0.99
10	45.00	2.69	1.09	1.60	0.81	0.79	0.88	0.90	0.92	0.98
11	50.00	2.99	1.25	1.74	0.77	0.76	0.88	0.87	0.90	0.97

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	32.00	1.70	0.86	1.00	0.75	1.20	42.16	13.43	55.59	2.00
2	32.00	1.70	0.90	1.00	0.80	1.20	47.14	14.43	61.57	2.00
3	36.00	1.33	0.97	1.00	0.85	1.20	47.42	14.48	61.90	2.00
4	18.00	1.19	1.04	1.00	0.95	1.20	25.46	8.13	33.59	2.00
5	20.00	1.09	1.11	1.00	0.95	1.20	27.59	8.43	36.02	2.00
6	26.00	1.01	1.18	1.00	0.95	1.20	35.32	12.06	47.39	2.00
7	9.00	0.95	1.25	1.00	1.00	1.20	12.76	0.00	12.76	0.14
8	51.00	0.89	1.32	1.00	1.00	1.20	72.00	5.04	77.05	2.00
9	50.00	0.85	1.33	1.00	1.00	1.20	67.78	4.87	72.65	2.00
10	50.00	0.81	1.33	1.00	1.00	1.20	64.65	4.74	69.40	2.00
11	50.00	0.77	1.33	1.00	1.00	1.20	61.93	4.63	66.56	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}
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	55.59	46.32	2.34	0.00	0.00
2	61.57	51.30	2.35	0.00	0.00
3	61.90	51.58	2.38	0.00	0.00
4	33.59	27.99	1.99	0.00	0.00
5	36.02	30.02	1.80	0.01	0.01
6	47.39	39.49	1.70	0.02	0.01
7	12.76	10.63	0.11	3.39	2.03
8	77.05	64.20	1.57	0.03	0.02
9	72.65	60.54	1.56	0.03	0.02
10	69.40	57.83	1.57	0.03	0.02
11	66.56	55.47	1.59	0.03	0.01

Total settlement : 2.12

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	0.00	8.48	0.00
4	0.00	7.71	0.00
5	0.00	6.95	0.00
6	0.00	6.19	0.00
7	0.89	5.43	7.35
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 : 7.35

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

A



APPENDIX A FIELD EXPLORATION

Fieldwork for our investigation (drilling) was conducted on February 16, 2016 and included a site visit, subsurface exploration, and soil sampling. The locations of the exploratory borings and are shown on the Site Plan, Figure 2. Boring logs for our exploration are presented in figures following the text in this appendix. 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 solid flight 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.

Unified Soil Classification System

Major Divisions			Letter	Symbol	Description	
Coarse-grained Soils More than 1/2 retained on the No. 200 Sieve	Gravels More than 1/2 coarse fraction retained on the No. 4 sieve	Clean Gravels	GW		Well-graded gravels and gravel-sand mixtures, little or no fines.	
		Gravels	GP		Poorly-graded gravels and gravel-sand mixtures, little or no fines.	
		Gravels With Fines	GM		Silty gravels, gravel-sand-silt mixtures.	
			GC		Clayey gravels, gravel-sand-clay mixtures.	
	Sands More than 1/2 passing through the No. 4 sieve	Clean Sands	SW		Well-graded sands and gravelly sands, little or no fines.	
			SP		Poorly-graded sands and gravelly sands, little or no fines.	
		Sands With Fines	SM		Silty sands, sand-silt mixtures	
			SC		Clayey sands, sandy-clay mixtures.	
	Fine-grained Soils More than 1/2 passing through the No. 200 Sieve	Silts and Clays Liquid Limit less than 50%		ML		Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.
				CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
OL					Organic clays of medium to high plasticity.	
Silts and Clays Liquid Limit greater than 50%		MH		Inorganic silts, micaceous or diatomaceous fines sands or silts, elastic silts.		
		CH		Inorganic clays of high plasticity, fat clays.		
		OH		Organic clays of medium to high plasticity.		
Highly Organic Soils			PT		Peat, muck, and other highly organic soils.	
Consistency Classification						
<i>Granular Soils</i>			<i>Cohesive Soils</i>			
Description - Blows Per Foot (Corrected)			Description - Blows Per Foot (Corrected)			
Very loose	<u>MCS</u> <5	<u>SPT</u> <4	Very soft	<u>MCS</u> <3	<u>SPT</u> <2	
Loose	5 - 15	4 - 10	Soft	3 - 5	2 - 4	
Medium dense	16 - 40	11 - 30	Firm	6 - 10	5 - 8	
Dense	41 - 65	31 - 50	Stiff	11 - 20	9 - 15	
Very dense	>65	>50	Very Stiff	21 - 40	16 - 30	
			Hard	>40	>30	
MCS = Modified California Sampler			SPT = Standard Penetration Test Sampler			

Boring No. B-1

Project: Proposed Central Plaza

Client: Peninsula Retail Partners

Location: SEC Collier Avenue & Central Avenue, Lake Elsinore, California

Grnd. Surf. Elev. (Ft. MSL) N/A

Project No: 3-216-0112

Figure No.: A-1

Logged By: JRM

Initial: 17 feet

Depth to Water>

At Completion: 17 feet

SUBSURFACE PROFILE			SAMPLE					Penetration Test				Water Level
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count					
0		Ground Surface						20	40	60	80	
		Silty SAND/Sandy SILT (SM/ML) Dense; slightly moist; brown; fine-medium grained; with clay.	116.9	3.6	MCS		52					
5		Silty SAND (SM) Dense; moist; brown; fine-medium grained; with clay.	117.2	5.0	MCS		52					
		Silty SAND/Sandy SILT (SM/ML) Medium dense; moist; brown; fine-medium grained; with clay.	-	13.4	MCS		36					
10		Grades as above.										
		Silty SAND (SM) Medium dense; moist; brown; fine-medium grained.	-	11.4	SPT		18					
15		Sandy SILT (ML) Very stiff; saturated; brown; fine-medium grained; with trace clay.	-	17.6	SPT		20					
		Clayey Sandy SILT (ML) Very stiff; saturated; brown; fine-medium grained.	-	18.9	SPT		26					
20												
25												

Drill Method: Solid Flight Auger
Drill Rig: CME 45C
Driller: Salem Engineering Group, Inc.
Sheet: 1 of 2

Drill Date: 02/16/2016
Borehole Size: 4 inches
Hammer Type: Auto Trip.
Weight & Drop: 140 lbs./30 in.



Boring No. B-1

Project: Proposed Central Plaza

Client: Peninsula Retail Partners

Location: SEC Collier Avenue & Central Avenue, Lake Elsinore, California

Grnd. Surf. Elev. (Ft. MSL) N/A

Project No.: 3-216-0112

Figure No.: A-1

Logged By: JRM

Initial: 17 feet

Depth to Water>

At Completion: 17 feet

SUBSURFACE PROFILE			SAMPLE					Penetration Test	Water Level
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count		
	[Symbol]	Grades as above.						20 40 60 80	
30	[Symbol]	SAND (SP) Loose; saturated; light gray; fine-medium grained.	-	13.8	SPT		9		
35	[Symbol]	Silty SAND (SM) Very dense; saturated; mottled; fine-medium grained.	-	16.9	SPT		51		
40	[Symbol]	Grades as above.	-	10.0	SPT		50		
	[Symbol]	Auger refusal at 41 feet due to very dense soils.							
45	[Symbol]								
50	[Symbol]								

Drill Method: Solid Flight Auger
Drill Rig: CME 45C
Driller: Salem Engineering Group, Inc.
Sheet: 2 of 2

Drill Date: 02/16/2016
Borehole Size: 4 inches
Hammer Type: Auto Trip.
Weight & Drop: 140 lbs./30 in.



Boring No. B-2

Project: Proposed Central Plaza

Client: Peninsula Retail Partners

Location: SEC Collier Avenue & Central Avenue, Lake Elsinore, California

Grnd. Surf. Elev. (Ft. MSL) N/A

Project No.: 3-216-0112

Figure No.: A-2

Logged By: JRM

Initial: None

Depth to Water>

At Completion: None

SUBSURFACE PROFILE			SAMPLE					Penetration Test				Water Level	
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count						
0		Ground Surface											
	[Symbol]	Silty SAND/Sandy SILT (SM/ML) Very dense; moist; brown; fine-medium grained; with clay.	102.7	12.4	MCS	█	75						
5		Sandy SILT (ML) Hard; moist; brown; fine-medium grained; with clay.	120.8	10.7	MCS	█	42						
10		Grades as above.	-	16.9	SPT	█	11						
15		Silty SAND (SM) Medium dense; moist; dark brown; fine-coarse grained; with clay.	-	13.3	SPT	█	21						
20		Grades as above.											
		End of Borehole											
25													

Drill Method: Solid Flight Auger
Drill Rig: CME 45C
Driller: Salem Engineering Group, Inc.
Sheet: 1 of 1

Drill Date: 02/16/2016
Borehole Size: 4 inches
Hammer Type: Auto Trip.
Weight & Drop: 140 lbs./30 in.



Boring No. B-3

Project: Proposed Central Plaza

Client: Peninsula Retail Partners

Location: SEC Collier Avenue & Central Avenue, Lake Elsinore, California

Grnd. Surf. Elev. (Ft. MSL) N/A

Project No.: 3-216-0112

Figure No.: A-3

Logged By: JRM

Initial: 14 feet

Depth to Water>

At Completion: 14 feet

SUBSURFACE PROFILE			SAMPLE					Penetration Test				Water Level
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count	20	40	60	80	
0		Ground Surface										
		<b style="color: red;">Clayey SAND (SC) Loose; moist; darkbrown; fine-medium grained.	116.6	14.3	MCS		7					
5		<b style="color: red;">Sandy SILT(ML) Stiff; moist; dark brown; fine-medium grained; with clay.	117.0	14.8	MCS		15					
10		Grades as above; firm.	-	23.6	SPT		6					
15		<b style="color: red;">Silty SAND (SM) Loose; saturated; dark brown; fine-medium grained; with clay.	-	16.3	SPT		8					
20		Grades as above.										
		End of Borehole										
25												

Drill Method: Solid Flight Auger
Drill Rig: CME 45C
Driller: Salem Engineering Group, Inc.
Sheet: 1 of 1

Drill Date: 02/16/2016
Borehole Size: 4 inches
Hammer Type: Auto Trip.
Weight & Drop: 140 lbs./30 in.



Boring No. B-4

Project: Proposed Central Plaza

Client: Peninsula Retail Partners

Location: SEC Collier Avenue & Central Avenue, Lake Elsinore, California

Grnd. Surf. Elev. (Ft. MSL) N/A

Project No.: 3-216-0112

Figure No.: A-4

Logged By: JRM

Initial: None

Depth to Water>

At Completion: None

SUBSURFACE PROFILE			SAMPLE					Penetration Test	Water Level
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count		
0		Ground Surface						20 40 60 80	
		Silty SAND (SM) Dense; moist; brown; fine-medium grained; with clay.	120.8	13.5	MCS		53		
5		Grades as above; very dense.	126.5	11.3	MCS		50		
10		Grades as above; medium dense; with trace gravel.	-	8.0	SPT		18		
		Grades as above.							
15		Silty SAND/Sandy SILT (SM/ML) Medium dense; very moist; brown; fine-medium grained; with clay.	-	17.3	SPT		21		
20		Grades as above.							
		End of Borehole							
25									

Drill Method: Solid Flight Auger
Drill Rig: CME 45C
Driller: Salem Engineering Group, Inc.
Sheet: 1 of 1

Drill Date: 2/16/2016
Borehole Size: 4 inches
Hammer Type: Auto Trip.
Weight & Drop: 140 lbs./ 30in.



Boring No. B-5

Project: Proposed Central Plaza

Client: Peninsula Retail Partners

Location: SEC Collier Avenue & Central Avenue, Lake Elsinore, California

Grnd. Surf. Elev. (Ft. MSL) N/A

Project No.: 3-216-0112

Figure No.: A-5

Logged By: JRM

Initial: None

At Completion: None

Depth to Water >

SUBSURFACE PROFILE			SAMPLE					Penetration Test				Water Level	
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count						
0		Ground Surface											
		Silty SAND (SM) Dense; slightly moist; light brown; fine-coarse grained; with gravel.	116.7	3.7	MCS		42						
5		Grades as above; medium dense; fine-medium grained..	117.2	5.0	MCS		37						
10		Grades as above; medium dense; dark brown; with clay.	-	13.3	SPT		11						
15		Grades as above.	-	14.0	SPT		15						
20		Grades as above.											
		End of Borehole											
25													

Drill Method: Solid Flight Auger
Drill Rig: CME 45C
Driller: Salem Engineering Group, Inc.
Sheet: 1 of 1

Drill Date: 02/16/2016
Borehole Size: 4 inches
Hammer Type: Auto Trip.
Weight & Drop: 140 lbs./30 in.



Boring No. B-6

Project: Proposed Central Plaza

Client: Peninsula Retail Partners

Location: SEC Collier Avenue & Central Avenue, Lake Elsinore, California

Grnd. Surf. Elev. (Ft. MSL) N/A

Project No.: 3-216-0112

Figure No.: A-6

Logged By: JRM

Initial: 14 feet

Depth to Water>

At Completion: 14 feet

SUBSURFACE PROFILE			SAMPLE					Penetration Test				Water Level	
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count						
0		Ground Surface						20 40 60 80					
		Clayey SAND (SC) Loose; moist; dark brown; fine-coarse grained.	114.6	9.0	MCS		11						
5		Sandy SILT (ML) Stiff; moist; dark brown; fine-medium grained; with clay.	123.4	11.5	MCS		13						
10		Grades as above; saturated.		16.8	SPT		9						
15		Grades as above.		19.5	SPT		12						
20		Grades as above.											
		End of Borehole											
25													

Drill Method: Solid Flight Auger
Drill Rig: CME 45C
Driller: Salem Engineering Group, Inc.
Sheet: 1 of 1

Drill Date: 02/16/2016
Borehole Size: 4 inches
Hammer Type: Auto Trip.
Weight & Drop: 140 lbs./30 in.



Boring No. B-7

Project: Proposed Central Plaza
Client: Peninsula Retail Partners
Location: SEC Collier Avenue & Central Avenue, Lake Elsinore, California
Grnd. Surf. Elev. (Ft. MSL) N/A

Project No.: 3-216-0112
Figure No.: A-7
Logged By: JRM
Initial: None
At Completion: None

Depth to Water >

SUBSURFACE PROFILE			SAMPLE					Penetration Test 20 40 60 80	Water Level
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count		
0		Ground Surface							
	[Symbol]	<b style="color: red;">Silty SAND (SM) Very dense; slightly moist; light brown; fine-coarse grained; with trace gravel.	124.3	5.1	MCS	█	60	●	
5		<b style="color: red;">Silty SAND/Sandy SILT (SM/ML) Very dense; moist; brown; fine-medium grained.	120.8	12.7	MCS	█	54	●	
10		<b style="color: red;">Sandy SILT (ML) Firm; moist; dark brown; fine-medium grained; with trace clay.	-	16.1	SPT	█	6	●	
15		Grades as above.							
		End of Borehole							
20									
25									

Drill Method: Solid Flight Auger
Drill Rig: CME 45C
Driller: Salem Engineering Group, Inc.
Sheet: 1 of 1

Drill Date: 2/16/16
Borehole Size: 4 inches
Hammer Type: Auto Trip.
Weight & Drop: 140 lbs./30 in.



Boring No. B-8

Project: Proposed Central Plaza

Client: Peninsula Retail Partners

Location: SEC Collier Avenue & Central Avenue, Lake Elsinore, California

Grnd. Surf. Elev. (Ft. MSL) N/A

Project No.: 3-216-0112

Figure No.: A-8

Logged By: JRM

Initial: None

At Completion: None

Depth to Water >

SUBSURFACE PROFILE			SAMPLE					Penetration Test 20 40 60 80	Water Level
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count		
0		Ground Surface							
	[Symbol]	<b style="color: red;">Silty SAND (SM) Dense; moist; gray brown; fine-coarse grained; with gravel and clay.	122.4	6.1	MCS		53	●	
5		Grades as above.	127.7	10.9	MCS		59	●	
10	[Symbol]	<b style="color: red;">SAND (SP) Medium dense; slightly moist; light brown; fine-coarse grained; with trace gravel.	-	3.1	SPT		19	●	
15	[Symbol]	<b style="color: red;">Silty SAND (SM) Loose; moist; dark brown; fine-coarse grained; with trace gravel and clay.	-	7.3	SPT		10	●	
20		Grades as above.							
		End of Borehole							
25									

Drill Method: Solid Flight Auger
Drill Rig: CME 45C
Driller: Salem Engineering Group, Inc.
Sheet: 1 of 1

Drill Date: 02/16/2016
Borehole Size: 4 inches
Hammer Type: Auto Trip.
Weight & Drop: 140 lbs./30 in.



Boring No. B-9

Project: Proposed Central Plaza

Client: Peninsula Retail Partners

Location: SEC Collier Avenue & Central Avenue, Lake Elsinore, California

Grnd. Surf. Elev. (Ft. MSL) N/A

Project No.: 3-216-0112

Figure No.: A-9

Logged By: JRM

Initial: None

At Completion: None

Depth to Water >

SUBSURFACE PROFILE			SAMPLE					Penetration Test				Water Level	
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count						
0		Ground Surface											
	[Symbol]	<p style="color: red; margin: 0;">Silty SAND (SM)</p> <p style="margin: 0;">Medium dense; moist; brown; fine-medium grained; with clay.</p>	112.4	5.4	MCS		30						
5		Grades as above; very dense; moist.	116.4	12.9	MCS		51						
10		Grades as above; medium dense; with trace gravel.	-	3.2	SPT		22						
		Grades as above.											
15	[Symbol]	<p style="color: red; margin: 0;">Silty SAND/Sandy SILT (SM/ML)</p> <p style="margin: 0;">Medium dense; very moist; brown; fine-medium grained; with clay.</p>	-	13.1	SPT		16						
20		Grades as above.											
		End of Borehole											
25													

Drill Method: Solid Flight Auger
Drill Rig: CME 45C
Driller: Salem Engineering Group, Inc.
Sheet: 1 of 1

Drill Date: 02/16/2016
Borehole Size: 4 inches
Hammer Type: Auto Trip.
Weight & Drop: 140 lbs./30 in.



Boring No. B-10

Project: Proposed Central Plaza

Client: Peninsula Retail Partners

Location: SEC Collier Avenue & Central Avenue, Lake Elsinore, California

Grnd. Surf. Elev. (Ft. MSL) N/A

Project No.: 3-216-0112

Figure No.: A-10

Logged By: JRM

Initial: None

Depth to Water>

At Completion: None

SUBSURFACE PROFILE			SAMPLE					Penetration Test	Water Level
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count		
0		Ground Surface						20 40 60 80	
		Silty SAND (SM) Very dense; moist; brown; fine-coarse grained; with clay and trace gravel.	123.1	4.0	MCS		56		
5		Grades as above.	128.9	6.2	MCS		80		
10		Silty SAND/Sandy SILT (SM/ML) Medium dense; slightly moist; brown; fine-medium grained; with trace clay.	-	5.2	SPT		15		
15		Grades as above.							
		End of Borehole							
20									
25									

Drill Method: Solid Flight Auger
Drill Rig: CME 45C
Driller: Salem Engineering Group, Inc.
Sheet: 1 of 1

Drill Date: 02/16/2016
Borehole Size: 4 inches
Hammer Type: Auto Trip.
Weight & Drop: 140 lbs./30 in.



Boring No. B-11

Project: Proposed Central Plaza

Client: Peninsula Retail Partners

Location: SEC Collier Avenue & Central Avenue, Lake Elsinore, California

Grnd. Surf. Elev. (Ft. MSL) N/A

Project No.: 3-216-0112

Figure No.: A-11

Logged By: JRM

Initial: None

At Completion: None

Depth to Water >

SUBSURFACE PROFILE			SAMPLE					Penetration Test				Water Level	
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count						
0		Ground Surface											
	[Symbol]	<b style="color: red;">Silty SAND (SM) Very dense; moist; light brown; fine-medium grained.	125.1	8.2	MCS	█	81						
5		Grades as above; medium dense.	112.0	5.8	MCS	█	38						
10		Grades as above; with clay.	-	13.4	SPT	█	15						
15		<b style="color: red;">Sandy SILT (ML) Stiff; very moist; brown; fine-medium grained; with clay.	-	17.2	SPT	█	14						
20		Grades as above.											
		End of Borehole											
25													

Drill Method: Solid Flight Auger
Drill Rig: CME 45C
Driller: Salem Engineering Group, Inc.
Sheet: 1 of 1

Drill Date: 2/16/16
Borehole Size: 4 inches
Hammer Type: Auto Trip.
Weight & Drop: 140lbs./30in.



Boring No. B-12

Project: Proposed Central Plaza

Client: Peninsula Retail Partners

Location: SEC Collier Avenue & Central Avenue, Lake Elsinore, California

Grnd. Surf. Elev. (Ft. MSL) N/A

Project No: 3-216-0112

Figure No.: A-12

Logged By: JRM

Initial: None

At Completion: None

Depth to Water >

SUBSURFACE PROFILE			SAMPLE					Penetration Test	Water Level
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count		
0		Ground Surface						20 40 60 80	
		Silty SAND (SM)							
		Medium dense; moist; brown; fine-medium grained; with clay.	104.2	13.4	MCS		35	●	
5		Grades as above.	-	10.5	SPT		69	●	
10		Grades as above.							
		End of Borehole							
15									
20									
25									

Drill Method: Solid Flight Auger
Drill Rig: CME 45C
Driller: Salem Engineering Group, Inc.
Sheet: 1 of 1

Drill Date: 2/16/16
Borehole Size: 4 inches
Hammer Type: Auto Trip.
Weight & Drop: 140 lbs./30 in.



Boring No. B-13

Project: Proposed Central Plaza

Client: Peninsula Retail Partners

Location: SEC Collier Avenue & Central Avenue, Lake Elsinore, California

Grnd. Surf. Elev. (Ft. MSL) N/A

Project No.: 3-216-0112

Figure No.: A-13

Logged By: JRM

Initial: None

At Completion: None

Depth to Water >

SUBSURFACE PROFILE			SAMPLE					Penetration Test	Water Level
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count		
0		Ground Surface						20 40 60 80	
		Silty SAND (SM)							
		Dense; moist; light brown; fine-medium grained; with clay.	118.3	9.0	MCS		48		
5		Grades as above; medium dense.	-	10.5	SPT		20		
10		Grades as above.							
		End of Borehole							
15									
20									
25									

Drill Method: Solid Flight Auger
Drill Rig: CME 45C
Driller: Salem Engineering Group, Inc.
Sheet: 1 of 1

Drill Date: 2/16/16
Borehole Size: 4 inches
Hammer Type: Auto Trip.
Weight & Drop: 140 lbs./30 in.



Boring No. B-14

Project: Proposed Central Plaza

Client: Peninsula Retail Partners

Location: SEC Collier Avenue & Central Avenue, Lake Elsinore, California

Grnd. Surf. Elev. (Ft. MSL) N/A

Project No: 3-216-0112

Figure No.: A-14

Logged By: JRM

Initial: None

At Completion: None

Depth to Water >

SUBSURFACE PROFILE			SAMPLE					Penetration Test				Water Level	
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count						
0		Ground Surface											
	[Symbol]	<b style="color: red;">Silty SAND (SM) Dense; moist; light brown; fine-medium grained; with clay and trace gravel.	120.2	6.4	MCS		45						
5		Grades as above; with no gravel.	-	11.9	SPT		43						
10		Grades as above.											
		End of Borehole											
15													
20													
25													

Drill Method: Solid Flight Auger
Drill Rig: CME 45C
Driller: Salem Engineering Group, Inc.
Sheet: 1 of 1

Drill Date: 02/16/2016
Borehole Size: 4 inches
Hammer Type: Auto Trip.
Weight & Drop: 140 lbs./30 in.



Boring No. B-15

Project: Proposed Central Plaza

Client: Peninsula Retail Partners

Location: SEC Collier Avenue & Central Avenue, Lake Elsinore, California

Grnd. Surf. Elev. (Ft. MSL) N/A

Project No.: 3-216-0112

Figure No.: A-15

Logged By: JRM

Initial: None

At Completion: None

Depth to Water >

SUBSURFACE PROFILE			SAMPLE					Penetration Test 20 40 60 80	Water Level
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count		
0		Ground Surface							
		Silty SAND (SM) Dense; moist; light brown; fine-medium grained; with clay and trace gravel.	115.4	5.8	MCS		41		
5		Grades as above; with no gravel.	-	10.2	SPT		48		
10		Grades as above.							
		End of Borehole							
15									
20									
25									

Drill Method: Solid Flight Auger
Drill Rig: CME 45C
Driller: Salem Engineering Group, Inc.
Sheet: 1 of 1

Drill Date: 02/16/2016
Borehole Size: 4 inches
Hammer Type: Auto Trip.
Weight & Drop: 140 lbs./30 in.



Boring No. B-16

Project: Proposed Central Plaza

Client: Peninsula Retail Partners

Location: SEC Collier Avenue & Central Avenue, Lake Elsinore, California

Grnd. Surf. Elev. (Ft. MSL) N/A

Project No.: 3-216-0112

Figure No.: A-16

Logged By: JRM

Initial: None

At Completion: None

Depth to Water >

SUBSURFACE PROFILE			SAMPLE					Penetration Test 20 40 60 80	Water Level
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture Content (%)	Sampler Type	Penetration	Blow Count		
0		Ground Surface							
		Silty SAND (SM)							
		Medium dense; moist; light brown; fine-medium grained; with clay.	114.2	9.6	MCS		38		
5		Grades as above.	-	11.2	SPT		24		
10		Grades as above.							
		End of Borehole							
15									
20									
25									

Drill Method: Solid Flight Auger
Drill Rig: CME 45C
Driller: Salem Engineering Group, Inc.
Sheet: 1 of 1

Drill Date: 2/16/16
Borehole Size: 4 inches
Hammer Type: Auto Trip.
Weight & Drop: 140 lbs./30 in.



APPENDIX

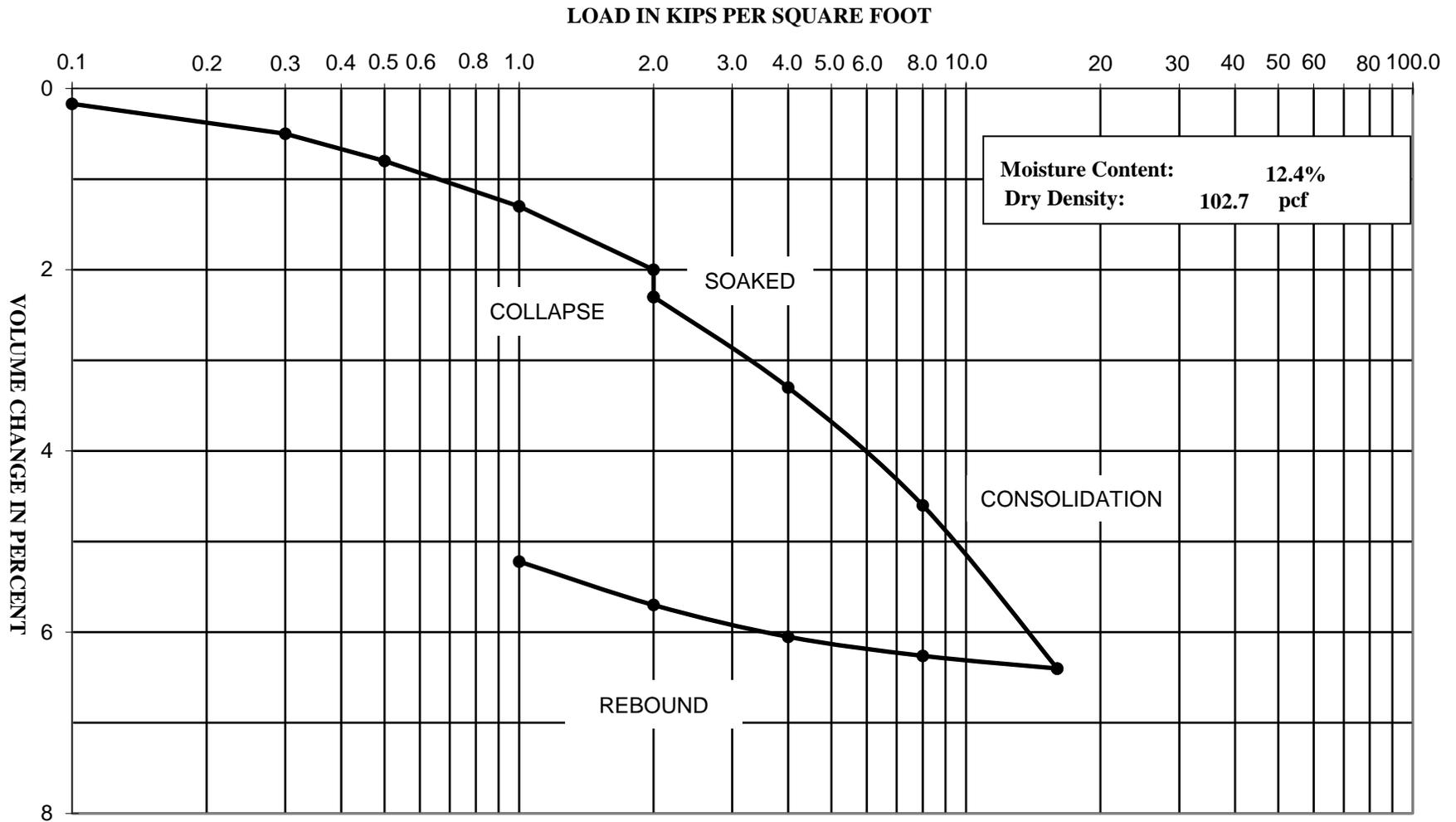
B



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 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 D 2435



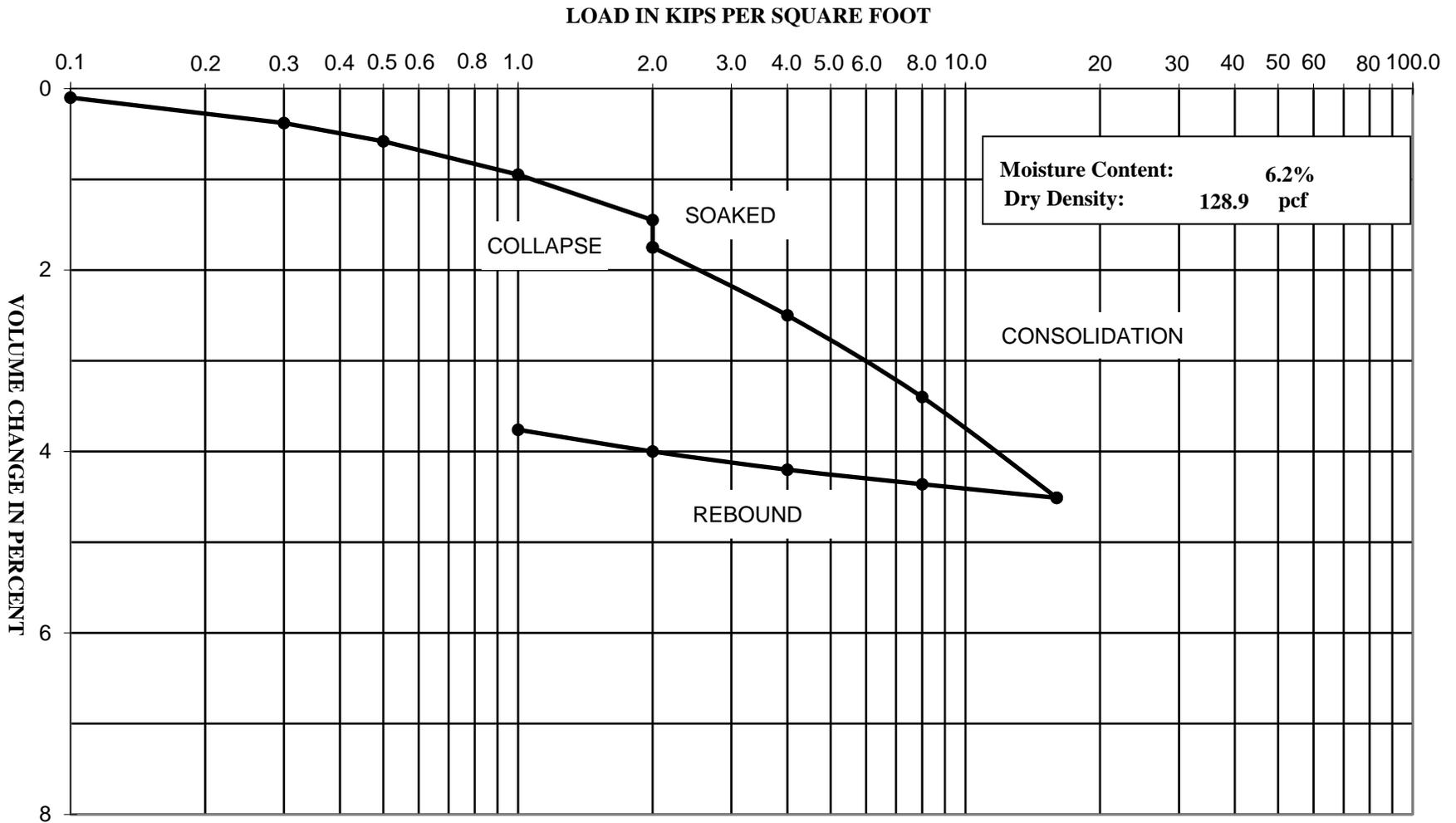
Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-2 @ 2'



CONSOLIDATION - PRESSURE TEST DATA ASTM D 2435



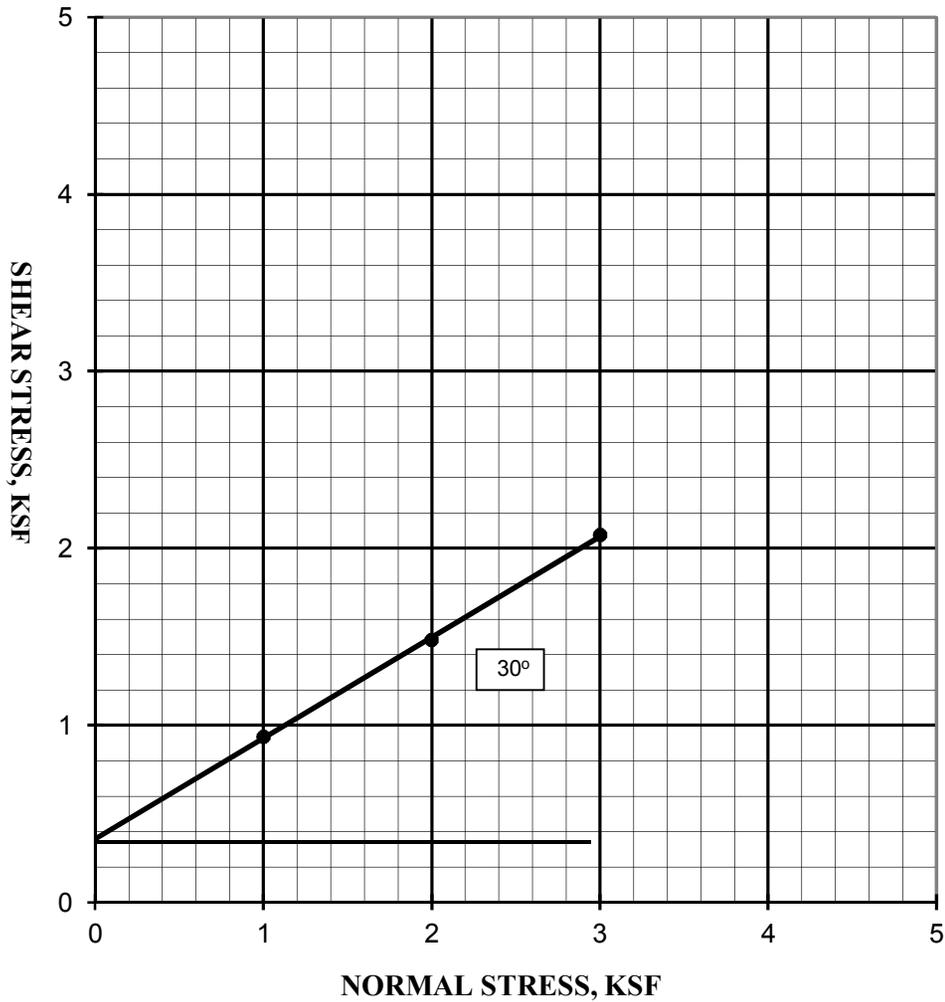
Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-10 @ 5'



**SHEAR STRENGTH DIAGRAM
(DIRECT SHEAR)
ASTM D - 3080**



**Proposed Central Plaza, SEC Collier Avenue &
Central Avenue, Lake Elsinore, CA**

Project Number: 3-216-0112

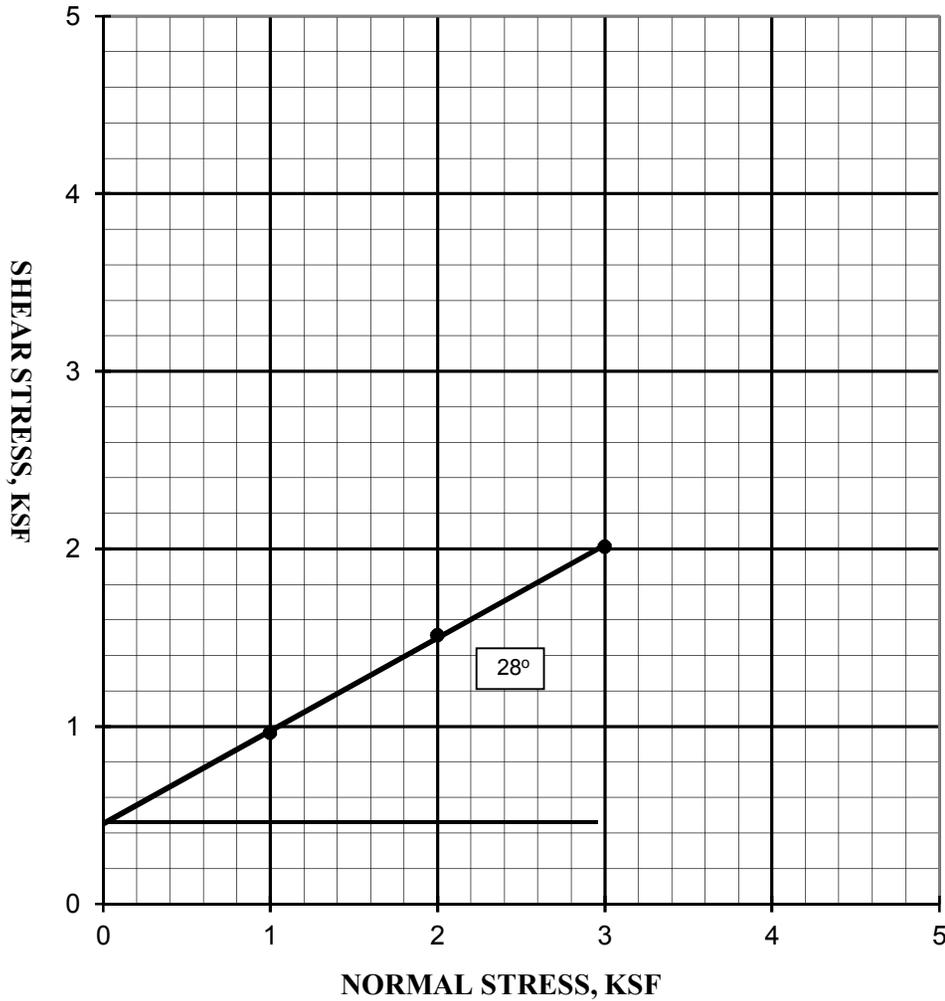
Boring: B-1 @ 5'
**Soil Type: Silty SAND/Sandy SILT
(SM/ML) with clay**

Friction Angle: 30 degrees
Cohesion: 355 psf

Moisture Content 3.6%
Dry Density 116.9 pcf



**SHEAR STRENGTH DIAGRAM
(DIRECT SHEAR)
ASTM D - 3080**



**Proposed Central Plaza, SEC Collier Avenue &
Central Avenue, Lake Elsinore, CA**

Project Number: 3-216-0112

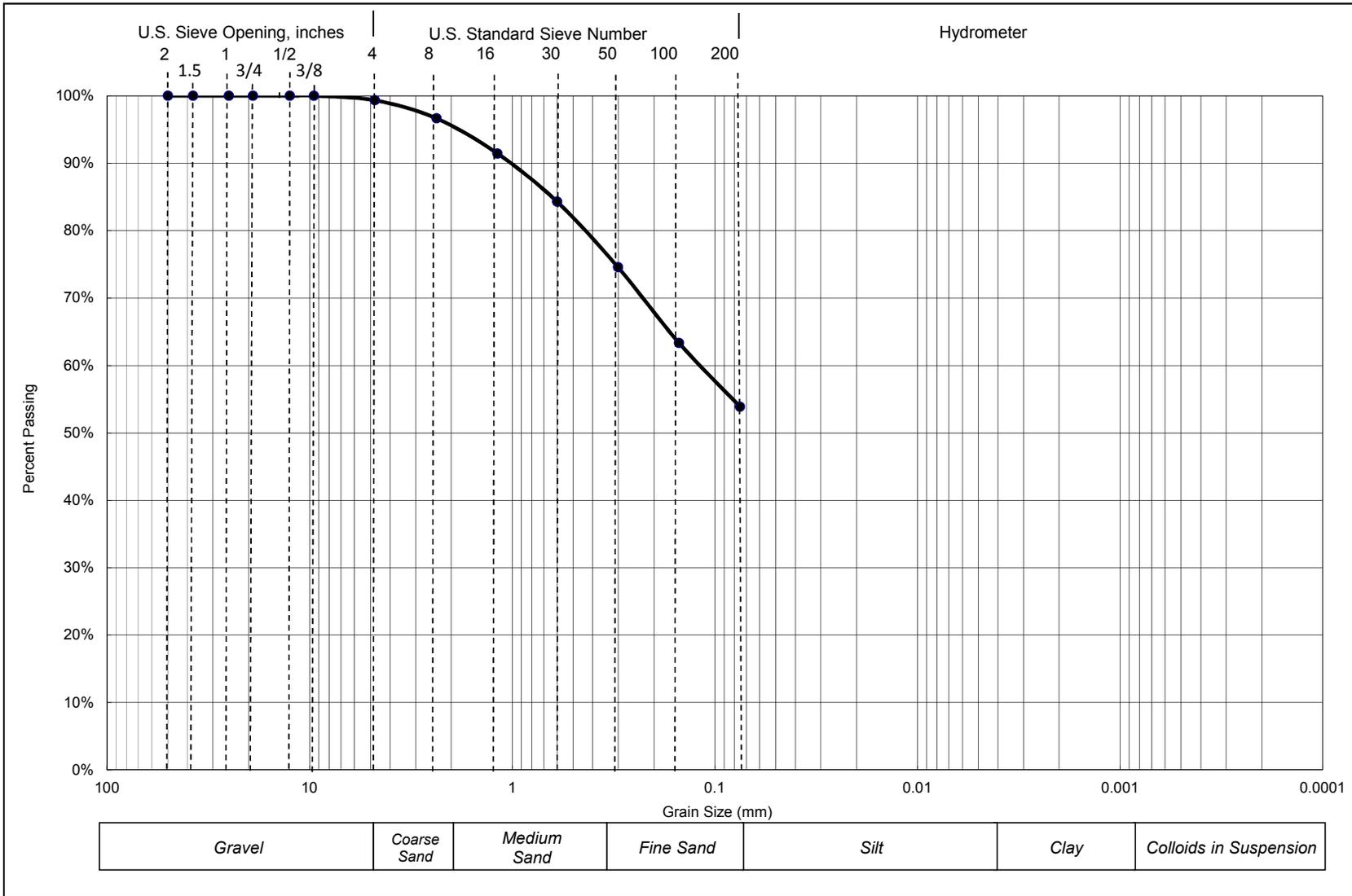
Boring: B-2 @ 2'
**Soil Type: Silty SAND/Sandy SILT
(SM/ML) with clay**

Friction Angle: 28 degrees
Cohesion: 450 psf

Moisture Content 12.4%
Dry Density 102.7 pcf



PARTICLE SIZE DISTRIBUTION DIAGRAM
GRADATION TEST - ASTM D 422



Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-1 @ 2'



DRY SIEVE ANALYSIS (ASTM D422 without Hydrometer)

Sieve Size	Particle Size, mm	Percent Passing
1 1/2-in.	37.5	100.0%
1-in.	25	100.0%
3/4-in.	19	100.0%
1/2-in.	12.5	100.0%
3/8-in.	9.5	100.0%
No. 4	4.75	99.3%
No. 8	2.36	96.6%
No. 16	1.18	91.4%
No. 30	0.6	84.3%
No. 50	0.3	74.6%
No. 100	0.15	63.3%
No. 200	0.075	53.9%

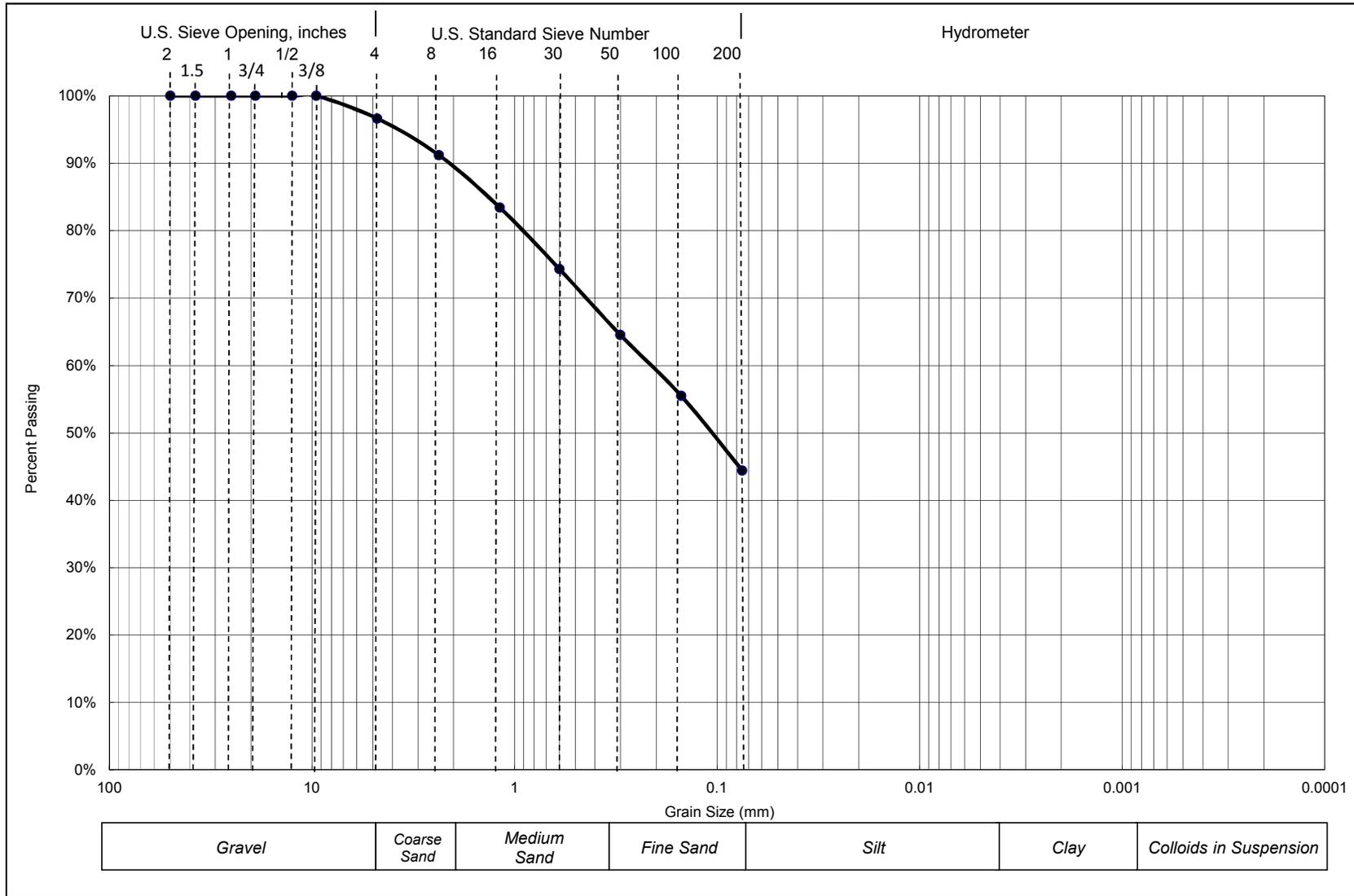
Proposed Retail Building, SWC E. Alostia Avenue & N. Citrus Avenue, Azusa, CA

Project Number: 3-216-0112

Boring: B-1 @ 2'



PARTICLE SIZE DISTRIBUTION DIAGRAM
GRADATION TEST - ASTM D 422



Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-1 @ 5'



DRY SIEVE ANALYSIS (ASTM D422 without Hydrometer)

Sieve Size	Particle Size, mm	Percent Passing
1 1/2-in.	37.5	100.0%
1-in.	25	100.0%
3/4-in.	19	100.0%
1/2-in.	12.5	100.0%
3/8-in.	9.5	100.0%
No. 4	4.75	96.6%
No. 8	2.36	91.2%
No. 16	1.18	83.4%
No. 30	0.6	74.3%
No. 50	0.3	64.5%
No. 100	0.15	55.5%
No. 200	0.075	44.4%

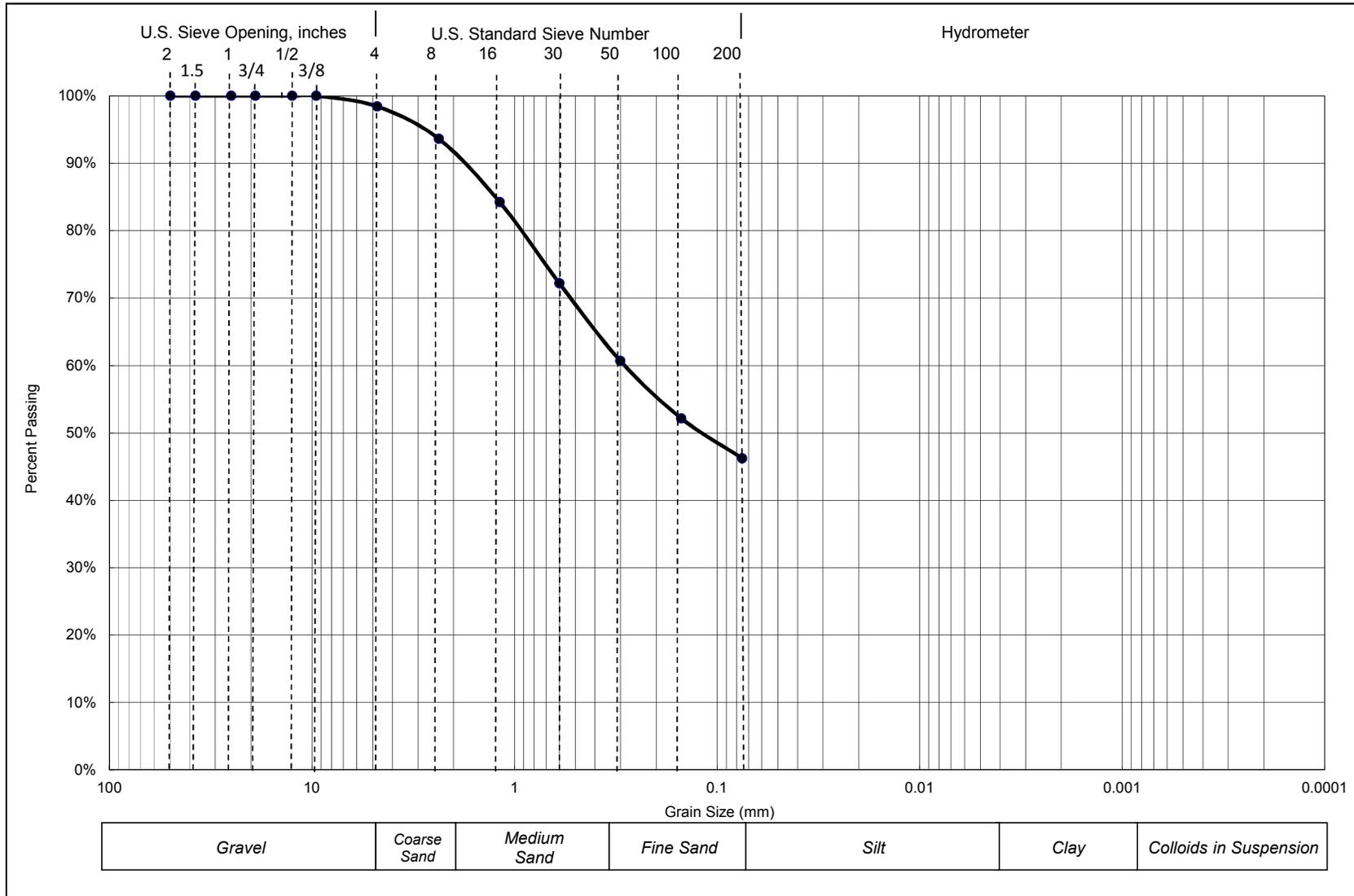
Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-1 @ 5'



**PARTICLE SIZE DISTRIBUTION DIAGRAM
GRADATION TEST - ASTM D 422**



Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-1 @ 10'



DRY SIEVE ANALYSIS (ASTM D422 without Hydrometer)

Sieve Size	Particle Size, mm	Percent Passing
1 1/2-in.	37.5	100.0%
1-in.	25	100.0%
3/4-in.	19	100.0%
1/2-in.	12.5	100.0%
3/8-in.	9.5	100.0%
No. 4	4.75	98.4%
No. 8	2.36	93.6%
No. 16	1.18	84.2%
No. 30	0.6	72.2%
No. 50	0.3	60.7%
No. 100	0.15	52.2%
No. 200	0.075	46.2%

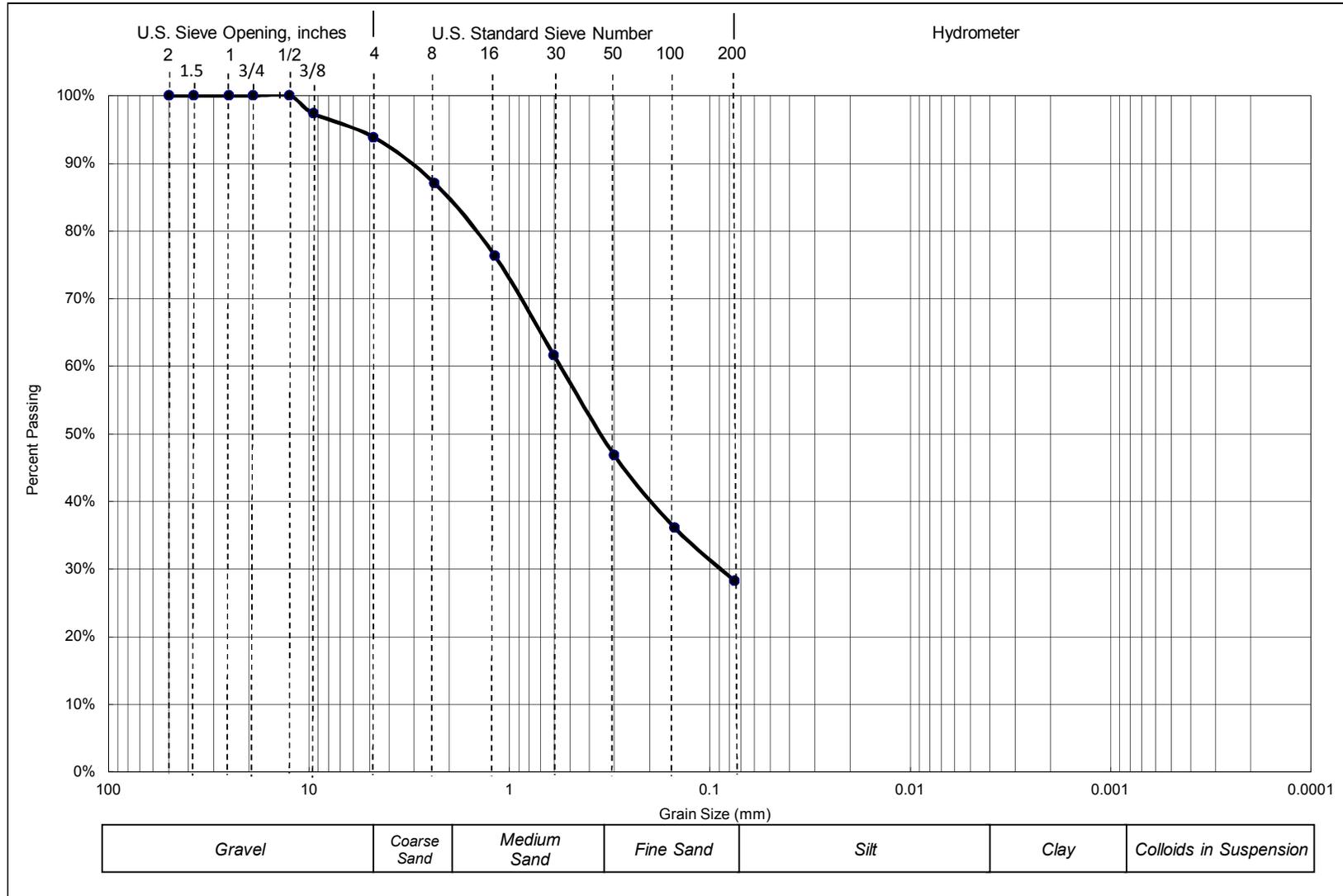
Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-1 @ 10'



PARTICLE SIZE DISTRIBUTION DIAGRAM
GRADATION TEST - ASTM D 422



Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-1 @ 15'



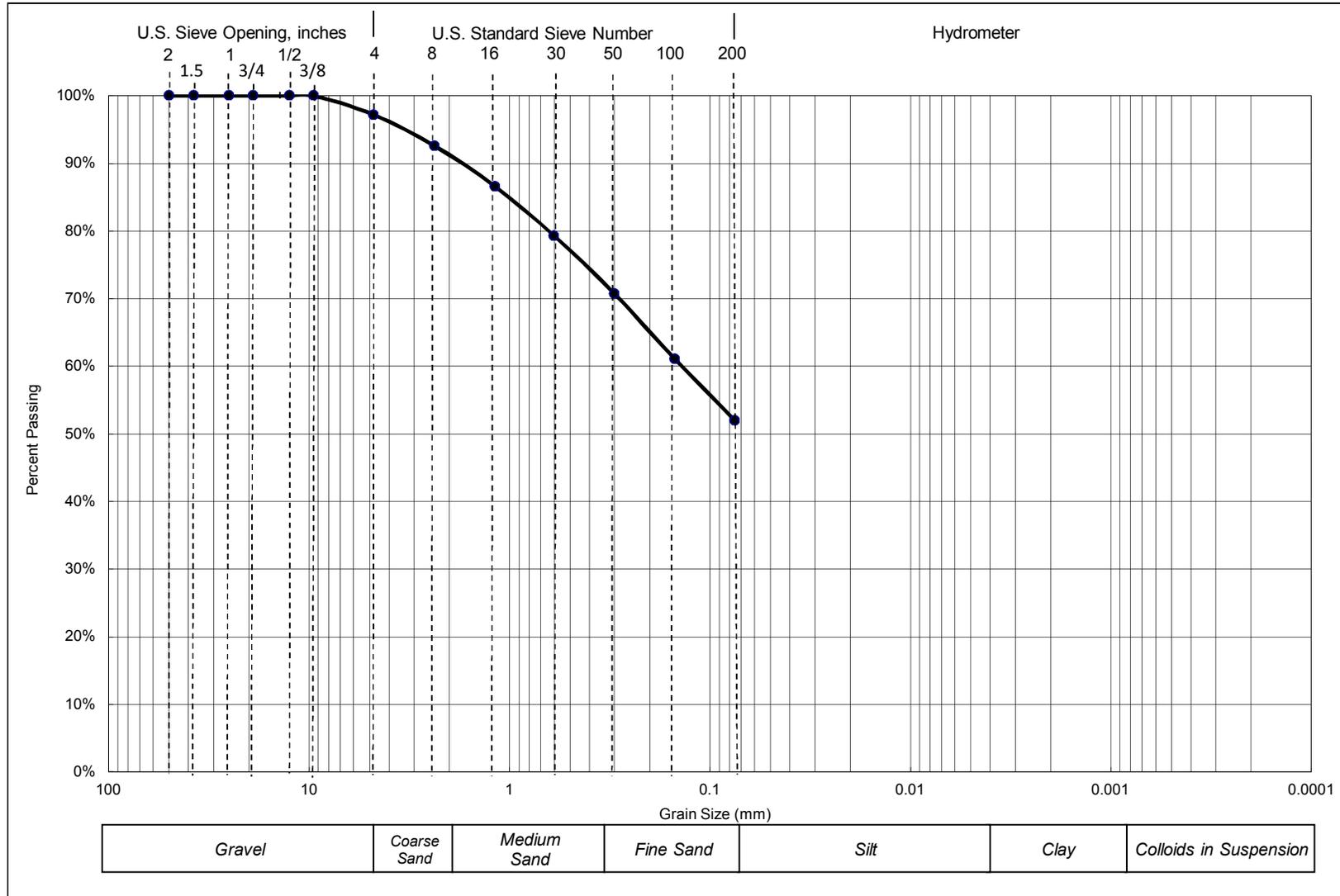
DRY SIEVE ANALYSIS
ASTM D422 (without Hydrometer)

Sieve Size	Particle Size, mm	Percent Passing
1 1/2-in.	37.5	100.0%
1-in.	25	100.0%
3/4-in.	19	100.0%
1/2-in.	12.5	100.0%
3/8-in.	9.5	97.4%
No. 4	4.75	93.8%
No. 8	2.36	87.0%
No. 16	1.18	76.3%
No. 30	0.6	61.6%
No. 50	0.3	46.9%
No. 100	0.15	36.1%
No. 200	0.075	28.2%

Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA
Project Number: 3-216-0112
Boring: B-1 @ 15'



**PARTICLE SIZE DISTRIBUTION DIAGRAM
GRADATION TEST - ASTM D 422**



Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-1 @ 25'



DRY SIEVE ANALYSIS

ASTM D422 (without Hydrometer)

Sieve Size	Particle Size, mm	Percent Passing
1 1/2-in.	37.5	100.0%
1-in.	25	100.0%
3/4-in.	19	100.0%
1/2-in.	12.5	100.0%
3/8-in.	9.5	100.0%
No. 4	4.75	97.2%
No. 8	2.36	92.6%
No. 16	1.18	86.6%
No. 30	0.6	79.3%
No. 50	0.3	70.7%
No. 100	0.15	61.1%
No. 200	0.075	52.0%

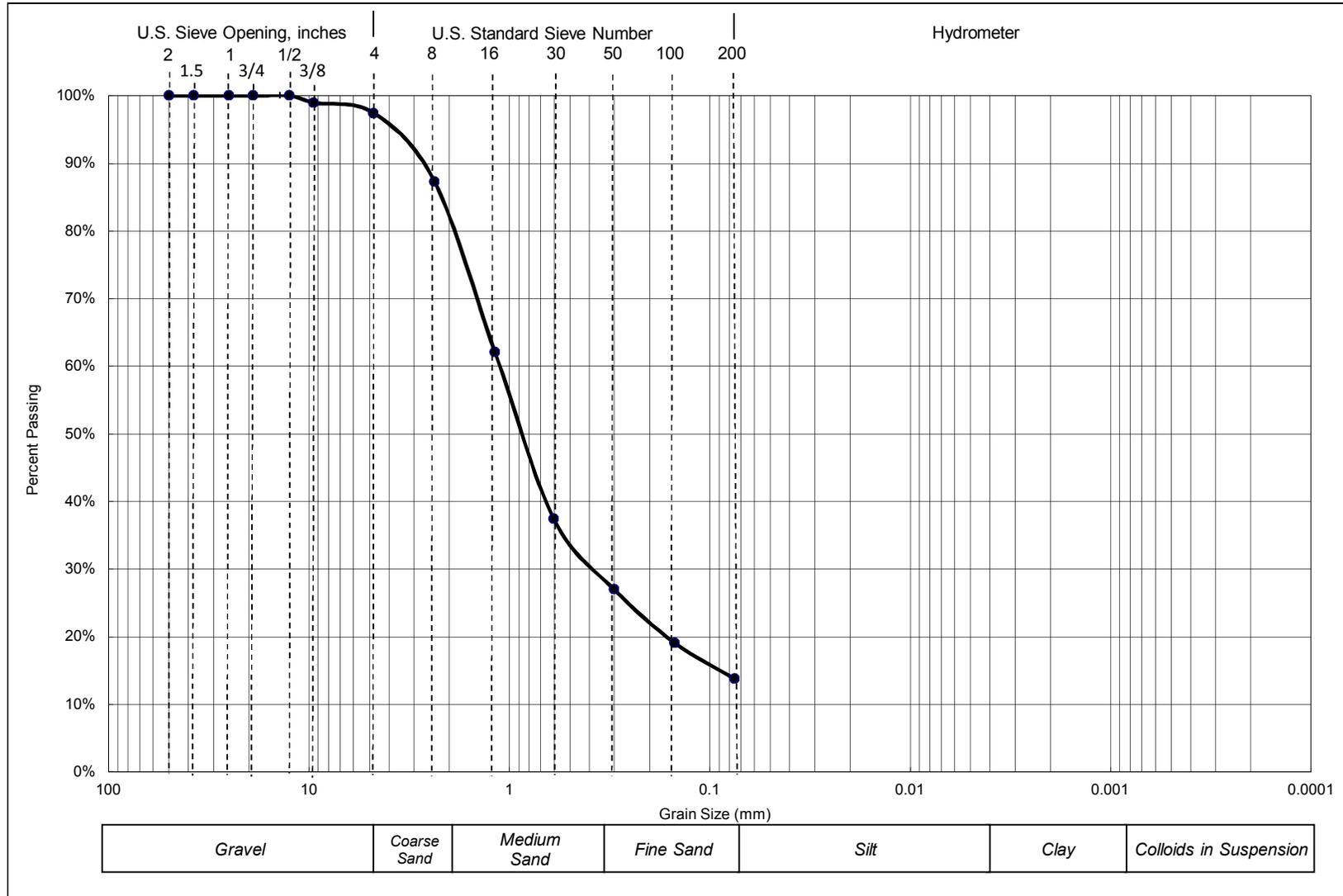
Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-1 @ 25'



**PARTICLE SIZE DISTRIBUTION DIAGRAM
GRADATION TEST - ASTM D 422**



Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-1 @ 35'



DRY SIEVE ANALYSIS

ASTM D422 (without Hydrometer)

Sieve Size	Particle Size, mm	Percent Passing
1 1/2-in.	37.5	100.0%
1-in.	25	100.0%
3/4-in.	19	100.0%
1/2-in.	12.5	100.0%
3/8-in.	9.5	99.0%
No. 4	4.75	97.4%
No. 8	2.36	87.2%
No. 16	1.18	62.1%
No. 30	0.6	37.4%
No. 50	0.3	27.0%
No. 100	0.15	19.1%
No. 200	0.075	13.7%

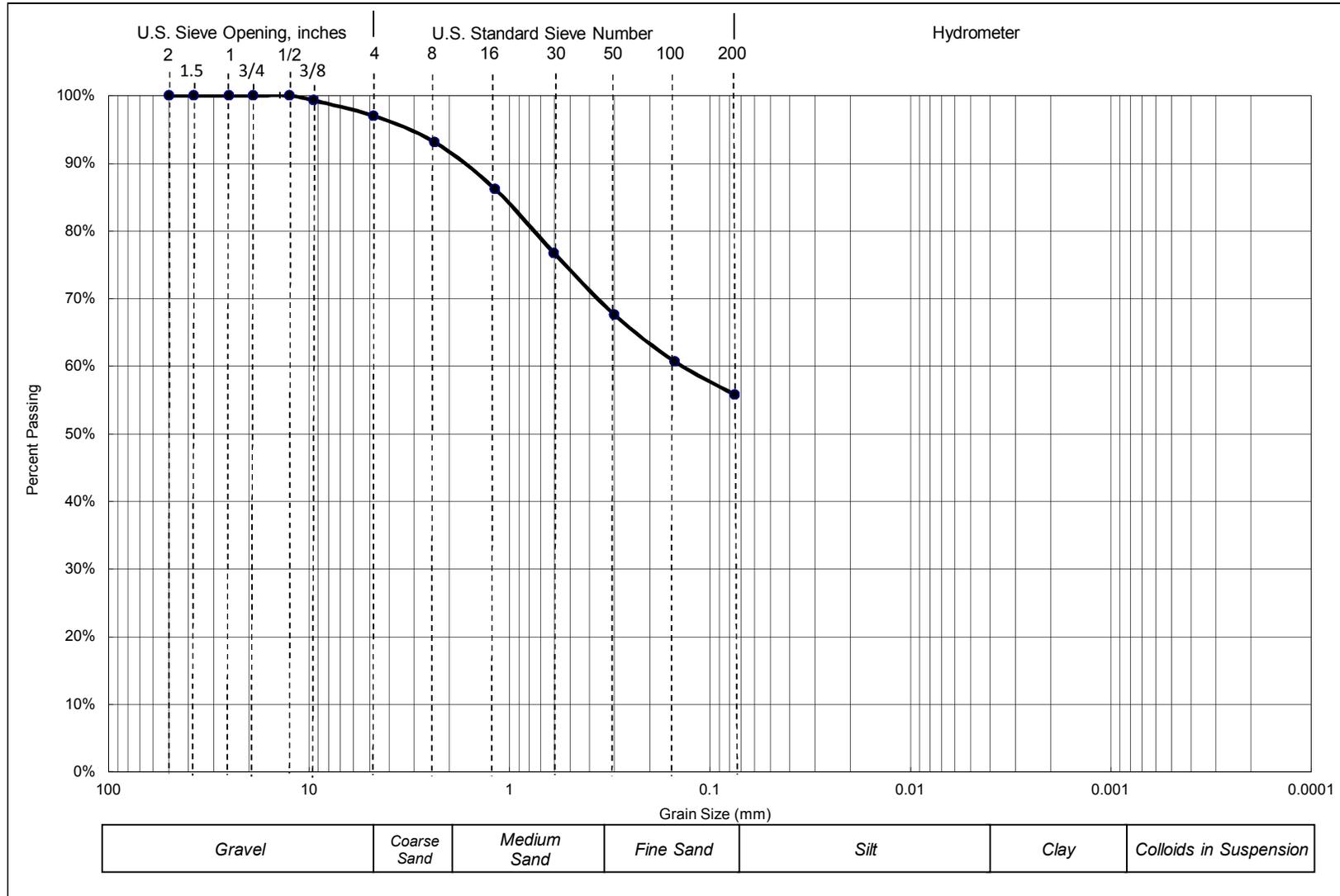
Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-1 @ 35'



**PARTICLE SIZE DISTRIBUTION DIAGRAM
GRADATION TEST - ASTM D 422**



Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-2 @ 2'



DRY SIEVE ANALYSIS

ASTM D422 (without Hydrometer)

Sieve Size	Particle Size, mm	Percent Passing
1 1/2-in.	37.5	100.0%
1-in.	25	100.0%
3/4-in.	19	100.0%
1/2-in.	12.5	100.0%
3/8-in.	9.5	99.3%
No. 4	4.75	97.0%
No. 8	2.36	93.1%
No. 16	1.18	86.2%
No. 30	0.6	76.7%
No. 50	0.3	67.6%
No. 100	0.15	60.7%
No. 200	0.075	55.7%

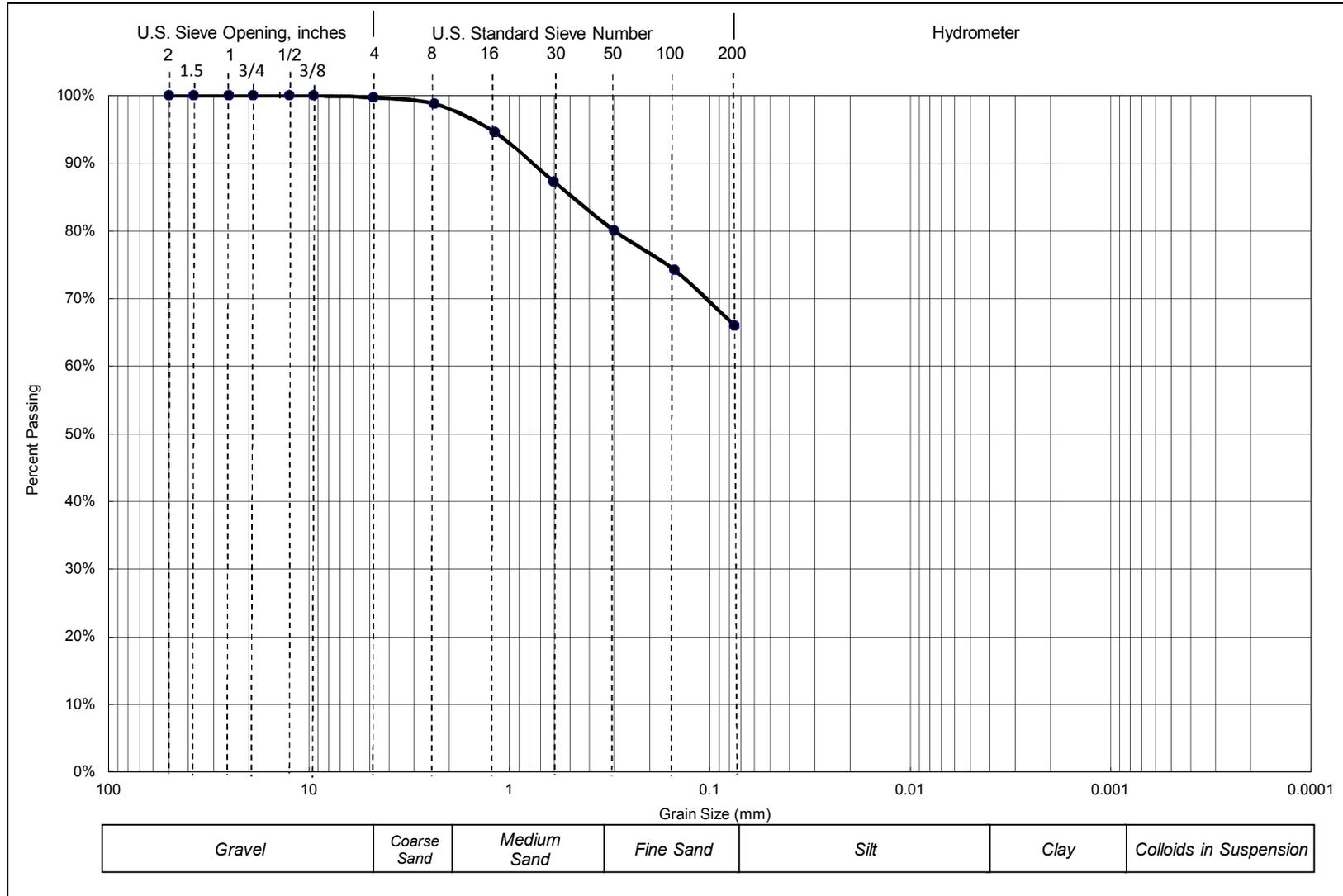
Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-2 @ 2'



**PARTICLE SIZE DISTRIBUTION DIAGRAM
GRADATION TEST - ASTM D 422**



Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-2 @ 5'



DRY SIEVE ANALYSIS

ASTM D422 (without Hydrometer)

Sieve Size	Particle Size, mm	Percent Passing
1 1/2-in.	37.5	100.0%
1-in.	25	100.0%
3/4-in.	19	100.0%
1/2-in.	12.5	100.0%
3/8-in.	9.5	100.0%
No. 4	4.75	99.7%
No. 8	2.36	98.8%
No. 16	1.18	94.6%
No. 30	0.6	87.3%
No. 50	0.3	80.0%
No. 100	0.15	74.2%
No. 200	0.075	66.0%

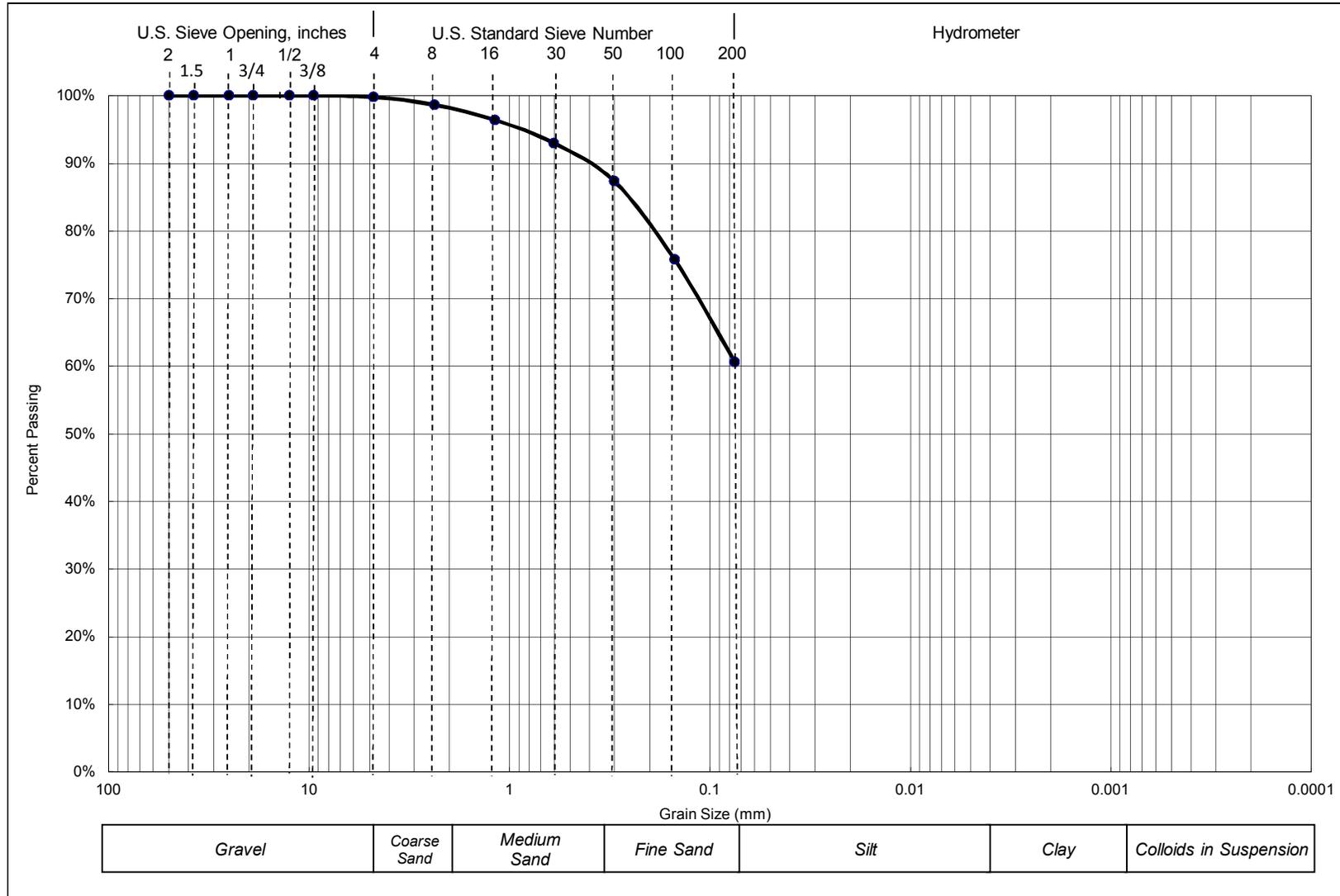
Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-2 @ 5'



**PARTICLE SIZE DISTRIBUTION DIAGRAM
GRADATION TEST - ASTM D 422**



Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-2 @ 10'



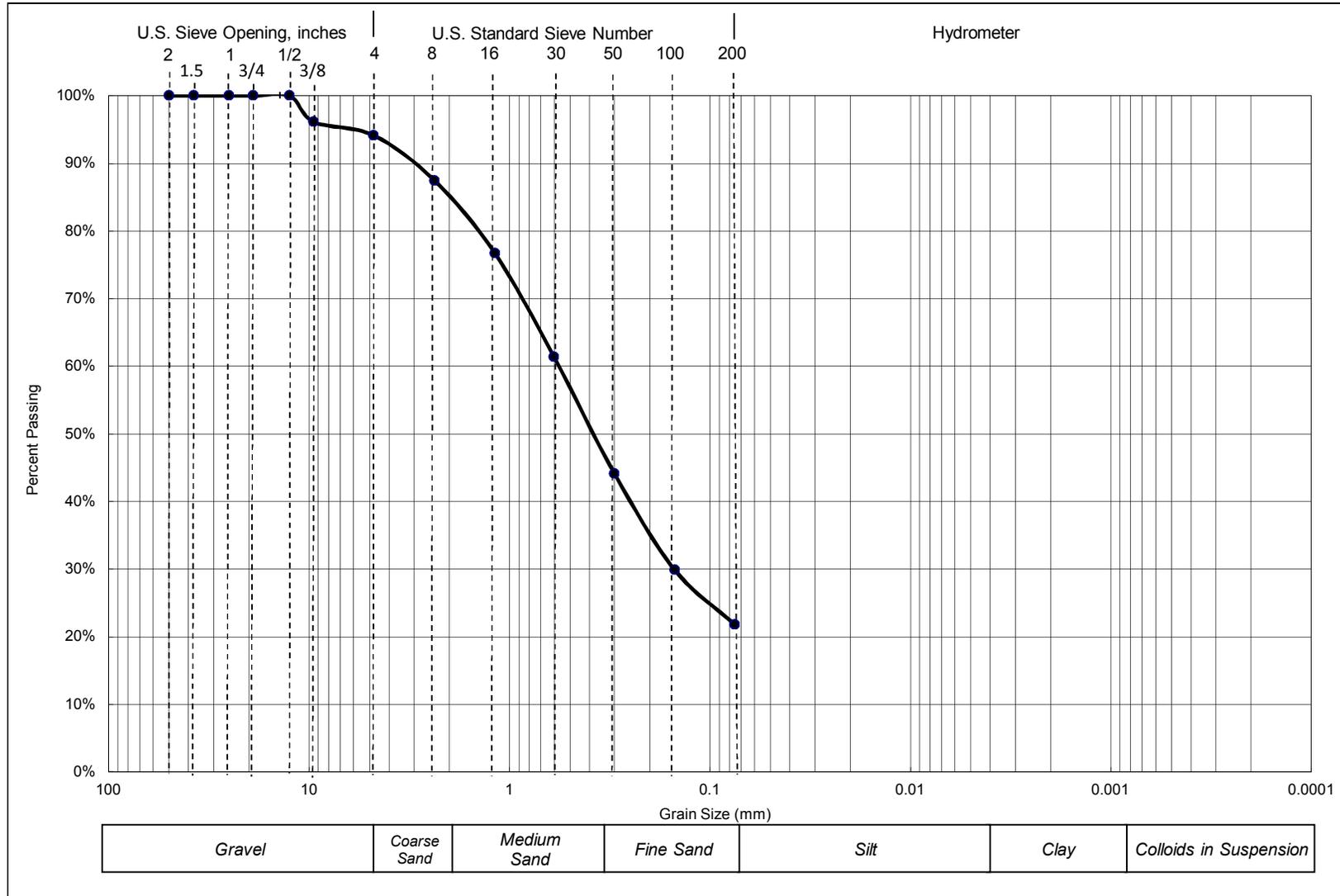
DRY SIEVE ANALYSIS
ASTM D422 (without Hydrometer)

Sieve Size	Particle Size, mm	Percent Passing
1 1/2-in.	37.5	100.0%
1-in.	25	100.0%
3/4-in.	19	100.0%
1/2-in.	12.5	100.0%
3/8-in.	9.5	100.0%
No. 4	4.75	99.8%
No. 8	2.36	98.6%
No. 16	1.18	96.4%
No. 30	0.6	93.0%
No. 50	0.3	87.3%
No. 100	0.15	75.8%
No. 200	0.075	60.6%

Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA
Project Number: 3-216-0112
Boring: B-2 @ 10'



PARTICLE SIZE DISTRIBUTION DIAGRAM
GRADATION TEST - ASTM D 422



Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-2 @ 15'



DRY SIEVE ANALYSIS

ASTM D422 (without Hydrometer)

Sieve Size	Particle Size, mm	Percent Passing
1 1/2-in.	37.5	100.0%
1-in.	25	100.0%
3/4-in.	19	100.0%
1/2-in.	12.5	100.0%
3/8-in.	9.5	96.1%
No. 4	4.75	94.1%
No. 8	2.36	87.4%
No. 16	1.18	76.7%
No. 30	0.6	61.4%
No. 50	0.3	44.1%
No. 100	0.15	29.9%
No. 200	0.075	21.8%

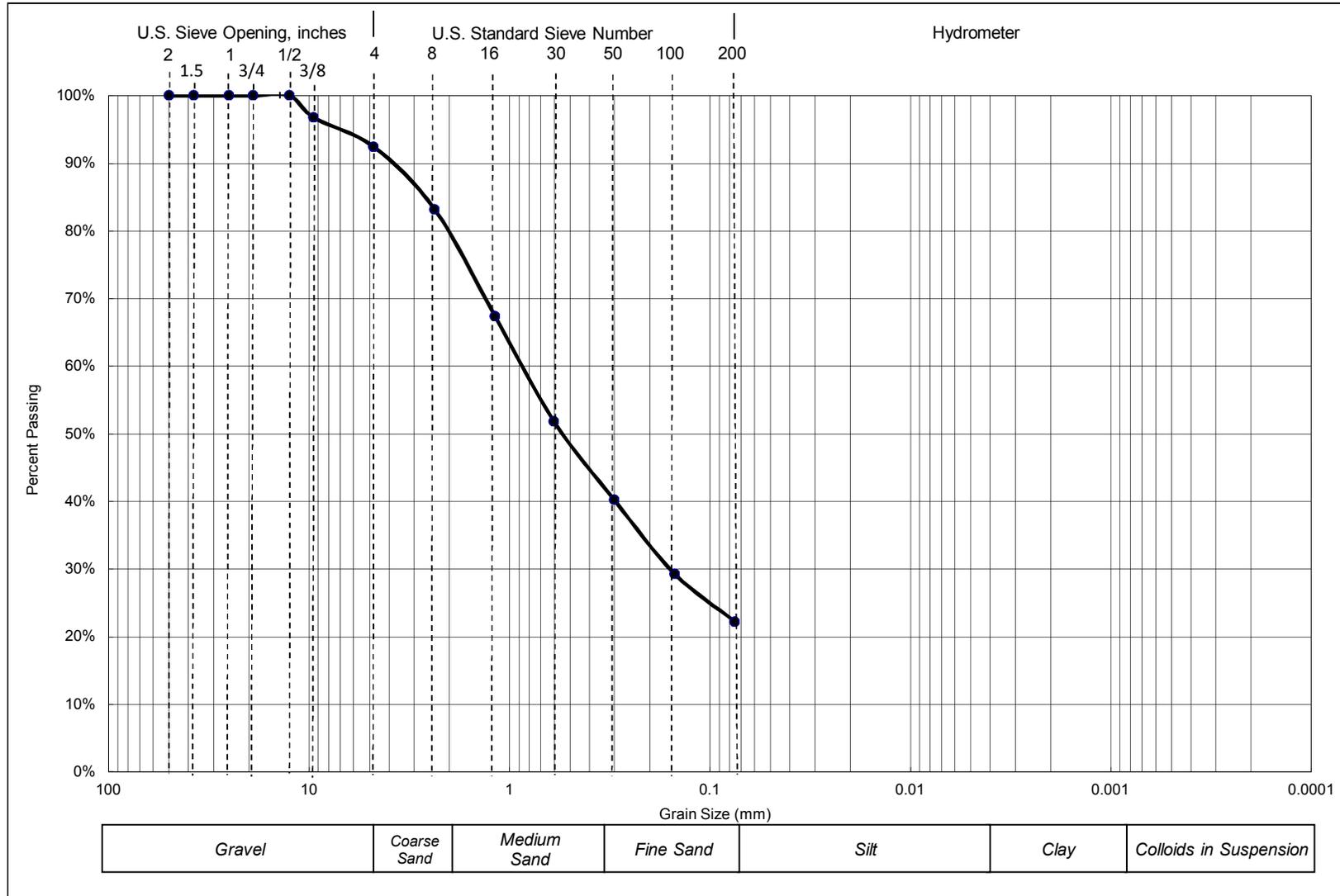
Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-2 @ 15'



**PARTICLE SIZE DISTRIBUTION DIAGRAM
GRADATION TEST - ASTM D 422**



Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-10 @ 5'



DRY SIEVE ANALYSIS

ASTM D422 (without Hydrometer)

Sieve Size	Particle Size, mm	Percent Passing
1 1/2-in.	37.5	100.0%
1-in.	25	100.0%
3/4-in.	19	100.0%
1/2-in.	12.5	100.0%
3/8-in.	9.5	96.8%
No. 4	4.75	92.4%
No. 8	2.36	83.2%
No. 16	1.18	67.4%
No. 30	0.6	51.8%
No. 50	0.3	40.2%
No. 100	0.15	29.3%
No. 200	0.075	22.2%

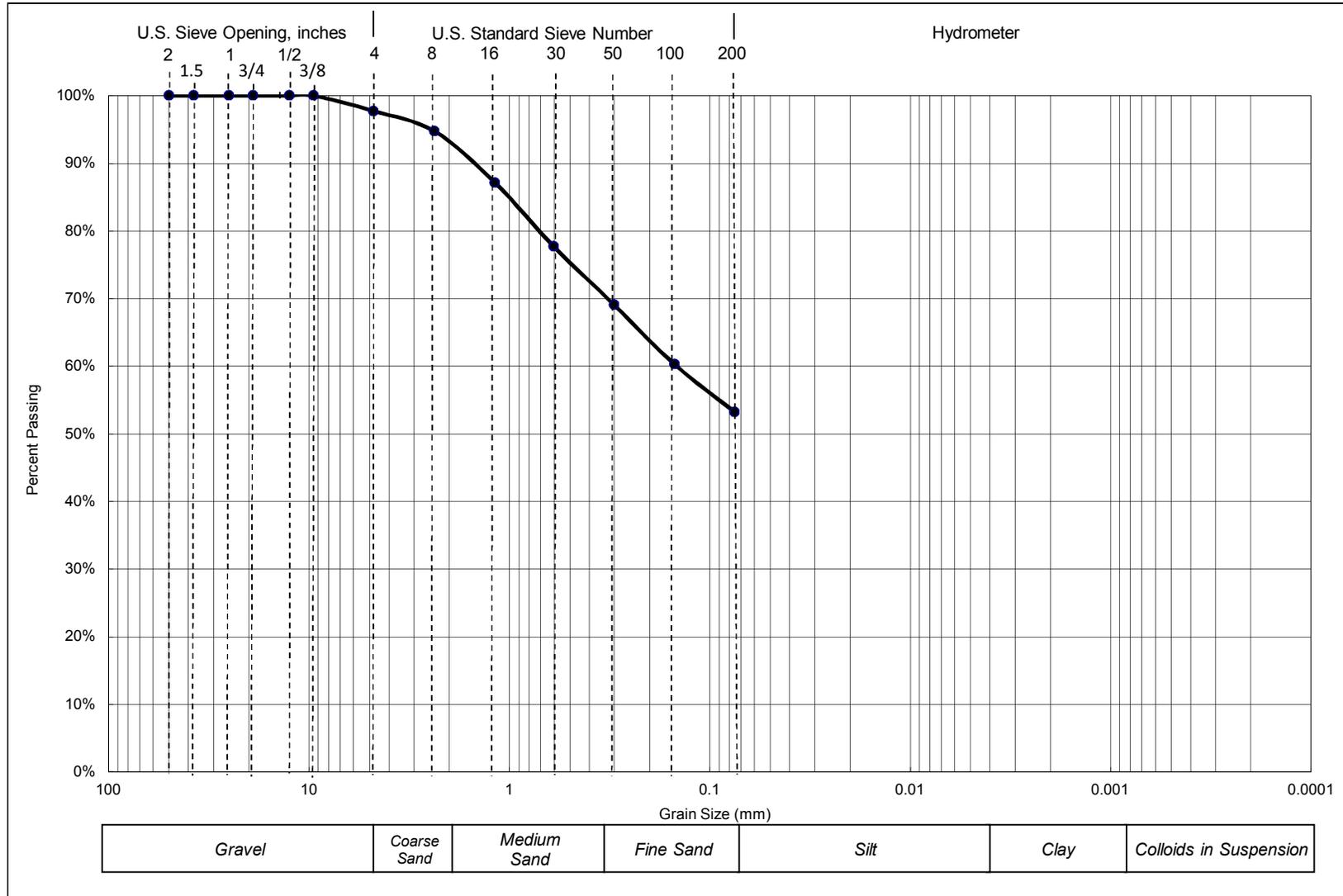
Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-10 @ 5'



**PARTICLE SIZE DISTRIBUTION DIAGRAM
GRADATION TEST - ASTM D 422**



Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-10 @ 10'



DRY SIEVE ANALYSIS

ASTM D422 (without Hydrometer)

Sieve Size	Particle Size, mm	Percent Passing
1 1/2-in.	37.5	100.0%
1-in.	25	100.0%
3/4-in.	19	100.0%
1/2-in.	12.5	100.0%
3/8-in.	9.5	100.0%
No. 4	4.75	97.7%
No. 8	2.36	94.7%
No. 16	1.18	87.1%
No. 30	0.6	77.7%
No. 50	0.3	69.0%
No. 100	0.15	60.3%
No. 200	0.075	53.2%

Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Boring: B-10 @ 10'



EXPANSION INDEX TEST

ASTM D 4829 / UBC Std. 29-2

Project Number: 3-216-0112

Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Date: 2/23/16

Sample location/ Depth: B-1 @ 0' - 3'

Sample Number: 1

Soil Classification: Silty SAND (SM) with trace clay

Trial #	1	2	3
Weight of Soil & Mold, gms	607.5		
Weight of Mold, gms	186.7		
Weight of Soil, gms	420.8		
Wet Density, Lbs/cu.ft.	126.9		
Weight of Moisture Sample (Wet), gms	300.0		
Weight of Moisture Sample (Dry), gms	278.3		
Moisture Content, %	7.8		
Dry Density, Lbs/cu.ft.	117.7		
Specific Gravity of Soil	2.7		
Degree of Saturation, %	48.8		

Time	Initial	30 min	1 hr	6 hrs	12 hrs	24 hrs
Dial Reading	0	--	--	--	--	0.042

Expansion Index_{measured} = 42

Expansion Index₅₀ = 41.3

Expansion Index = 41

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

SO₄ - Modified Caltrans 417 & Cl - Modified Caltrans 417/422

Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Date: 2/25/16

Soil Classification: Silty SAND (SM) with trace clay

Sample Number	Sample Location	Soluble Sulfate SO ₄ -S	Soluble Chloride Cl	pH
1a.	B-1 @ 0' - 3'	259 mg/Kg	130 mg/Kg	8.0
1b.	B-1 @ 0' - 3'	259 mg/Kg	131 mg/Kg	8.0
1c.	B-1 @ 0' - 3'	261 mg/Kg	131 mg/Kg	8.0
Average:		260 mg/Kg	131 mg/Kg	8.0

CHEMICAL ANALYSIS

SO₄ - Modified Caltrans 417 & Cl - Modified Caltrans 417/422

Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Date: 2/25/16

Soil Classification: Silty SAND (SM) with trace clay

Sample Number	Sample Location	Soluble Sulfate SO ₄ -S	Soluble Chloride Cl	pH
1a.	B-2 @ 2'	2100 mg/Kg	104 mg/Kg	7.9
1b.	B-2 @ 2'	1900 mg/Kg	104 mg/Kg	7.9
1c.	B-2 @ 2'	1900 mg/Kg	104 mg/Kg	7.9
Average:		1967 mg/Kg	104 mg/Kg	7.9

CHEMICAL ANALYSIS

SO₄ - Modified Caltrans 417 & Cl - Modified Caltrans 417/422

Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Date: 2/20/16

Soil Classification: Silty SAND (SM) with trace clay

Sample Number	Sample Location	Soluble Sulfate SO ₄ -S	Soluble Chloride Cl	pH
1a.	B-10 @ 5'	340 mg/Kg	34 mg/Kg	7.5
1b.	B-10 @ 5'	340 mg/Kg	34 mg/Kg	7.5
1c.	B-10 @ 5'	330 mg/Kg	34 mg/Kg	7.5
Average:		337 mg/Kg	34 mg/Kg	7.5

LABORATORY COMPACTION CURVE

ASTM - D1557, D698

Proposed Central Plaza, SEC Collier Avenue & Central Avenue, Lake Elsinore, CA

Project Number: 3-216-0112

Date Tested: 2/23/16

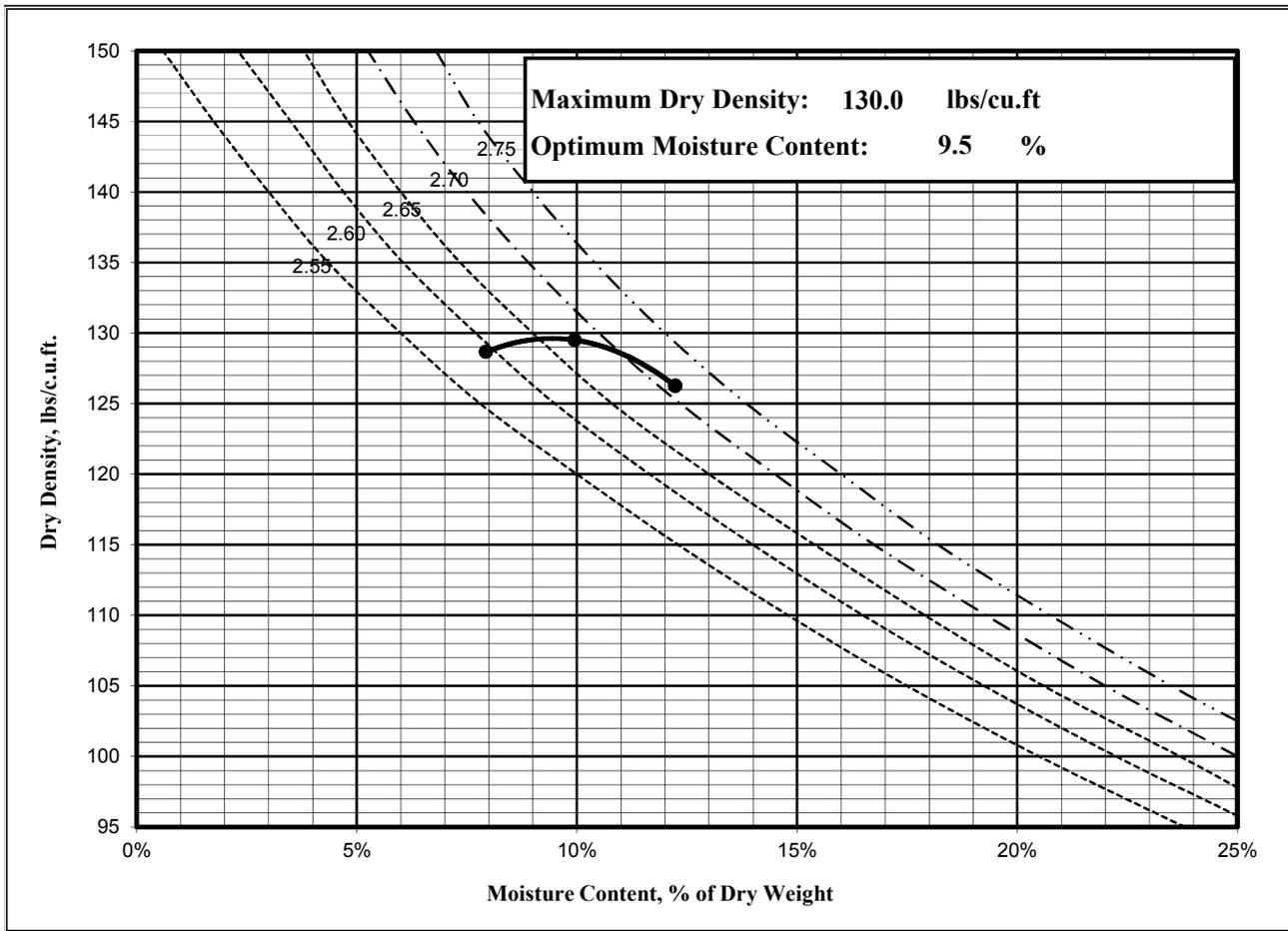
Sample Location: B-1 @ 0'-3'

Soil Classification: Silty SAND (SM) with trace clay

Sample/Curve Number: 1

Test Method: 1557 A

	1	2	3
Weight of Moist Specimen & Mold, gm	4355.8	4409.1	4398.6
Weight of Compaction Mold, gm	2258.2	2258.2	2258.2
Weight of Moist Specimen, gm	2097.6	2150.9	2140.4
Volume of mold, cu. ft.	0.0333	0.0333	0.0333
Wet Density, lbs/cu.ft.	138.9	142.4	141.7
Weight of Wet (Moisture) Sample, gm	200.0	200.0	200.0
Weight of Dry (Moisture) Sample, gm	185.3	181.9	178.2
Moisture Content, %	7.9%	10.0%	12.2%
Dry Density, lbs/cu.ft.	128.7	129.5	126.3



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 of relative compaction (90 percent for cohesive soils) 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 recompacted to 95 percent relative compaction (90 percent for cohesive soils). Loose soil areas and/or areas of disturbed soil shall be moisture-conditioned as necessary and recompacted to 95 percent relative compaction (90 percent for cohesive soils). 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 (90 percent for cohesive soils) 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.