Appendix F
Geotechnical Evaluations

ESA

F-1 Geotechnical Investigation

GEOTECHNICAL INVESTIGATION
PROPOSED D2 AIR CARGO COMPATIBLE DEVELOPMENT

SE Terminus of Van Buren Boulevard,
Between I-215 and MARB
Moreno Valley, California
For Hillwood

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

December 16, 2015

Hillwood
901 Via Piemonte, Suite 175
Ontario, California 91764

Attention: Mr. Ned Sciortino

Project No.: **15G204-1**

Subject: **Geotechnical Investigation**
Proposed D2 Air Cargo Compatible Development
SE Terminus of Van Buren Boulevard
Between I-215 and MARB
Moreno Valley, California

Gentlemen:

In accordance with your request, we have conducted a geotechnical investigation at the subject site. We are pleased to present this report summarizing the conclusions and recommendations developed from our investigation.

We sincerely appreciate the opportunity to be of service on this project. We look forward to providing additional consulting services during the course of the project. If we may be of further assistance in any manner, please contact our office.

Respectfully Submitted,

SOUTHERN CALIFORNIA GEOTECHNICAL, INC.

Daniel W. Nielsen, RCE 77915
Project Engineer

REGISTERED PROFESSIONAL ENGINEER
DANIEL W. NIELSEN
No. 77915
CIVIL
STATE OF CALIFORNIA

John A. Seminara, CEG 2125
Principal Geologist

PROFESSIONAL GEOLOGIST
JOHN A. SEMINARA
No. 2125
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Distribution: (2) Addressee

22885 Savi Ranch Parkway ▾ Suite E ▾ Yorba Linda ▾ California ▾ 92887
voice: (714) 685-1115 ▾ fax: (714) 685-1118 ▾ www.socalgeo.com

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY

Presented below is a brief summary of the conclusions and recommendations of this investigation. Since this summary is not all inclusive, it should be read in complete context with the entire report.

Site Preparation

- Initial site preparation should include stripping of the surficial vegetation including existing moderate to dense native grass and weed growth, trees and any organic soils. These materials should be properly disposed of off-site.
- Concrete slabs and foundations from a previously demolished structure are present in the northeast portion of the site. Manholes are present throughout the central portion of the site, indicating that utilities are present in the central portion of the site. Initial site preparation should also include demolition of any remnants of former development which will not be reused with the proposed development including pavements, floor slabs, foundations, utilities, septic systems, and any other improvements that will not remain in place with the new development. Concrete and asphalt debris may be re-used within the compacted fills, provided they are pulverized and the maximum particle size is less than 2 inches.
- The near surface soils encountered at most of the borings consist of high strength older alluvium. However, some of the borings encountered moderate strength younger alluvial soils within the upper 1½ to 5½± feet.
- Although the soils generally possess moderate to high strengths, the near surface soils vary somewhat in composition and density and also possess moisture contents lower than the optimum moisture content. Therefore, remedial grading is considered warranted within the new building and retaining wall areas in order to remove a portion of the near-surface soils and replace them as compacted structural fill.
- The existing soils within the building area should be overexcavated to a depth of at least 2 feet below existing grade and to a depth of at least 2 feet below proposed pad grade. The soils within the proposed foundation influence zones should be overexcavated to a depth of at least 2 feet below proposed foundation bearing grades. The overexcavation should also extend to a sufficient depth to remove any soils disturbed during demolition and any artificial fill soils, if encountered.
- After the recommended overexcavation has been completed, the resulting subgrade soils should be evaluated by the geotechnical engineer to identify any additional soils that should be overexcavated. The resulting subgrade should then be scarified to a depth of 12 inches and thoroughly moisture conditioned to 2 to 4 percent above optimum moisture content. The resulting subgrade should then be recompacted to at least 90 percent of the ASTM D-1557 maximum dry density. The previously excavated soils may then be replaced as compacted structural fill.
- The new parking area subgrade soils are recommended to be scarified to a depth of 12± inches, moisture conditioned to 2 to 4 percent above optimum, and recompacted to at least 90 percent of the ASTM D-1557 maximum dry density.

Building Foundations

- Conventional shallow foundations, supported in newly placed compacted fill.

- 3,000 lbs/ft^2 maximum allowable soil bearing pressure.
- Reinforcement consisting of at least four (4) No. 5 rebars (2 top and 2 bottom) in strip footings due to the low expansion potential of the on-site soils. Additional reinforcement may be necessary for structural considerations.

Building Floor Slabs

- Conventional Slab-on-Grade, 6 inches thick.
- Modulus of Subgrade Reaction: k = 125 psi/in
- Minimum slab reinforcement: No. 3 bars at 18 inches on center in both directions due to the presence of low expansive soils. The actual floor slab reinforcement should be determined by the structural engineer, based on the imposed loading.

Pavements

ASPHALT PAVEMENTS (R = 30)					
Materials	**Thickness (inches)**				
	Auto Parking and Auto Drive Lanes (TI = 4.0 to 5.0)	Truck Traffic			
		TI = 6.0	TI = 7.0	TI = 8.0	TI = 9.0
Asphalt Concrete	3	3½	4	5	5½
Aggregate Base	6	8	10	11	13
Compacted Subgrade	12	12	12	12	12

PORTLAND CEMENT CONCRETE PAVEMENTS				
Materials	**Thickness (inches)**			
	Autos and Light Truck Traffic (TI = 6.0)	Truck Traffic		
		TI = 7.0	TI = 8.0	TI = 9.0
PCC	5	6½	8	9
Compacted Subgrade (95% minimum compaction)	12	12	12	12

2.0 SCOPE OF SERVICES

The scope of services performed for this project was in accordance with our Proposal No. 15P395R, dated October 12, 2015. The scope of services included a visual site reconnaissance, subsurface exploration, field and laboratory testing, and geotechnical engineering analysis to provide criteria for preparing the design of the building foundations, building floor slab, and parking lot pavements along with site preparation recommendations and construction considerations for the proposed development. Based on the location of the subject site, this investigation also included a site specific liquefaction evaluation. The evaluation of the environmental aspects of this site was beyond the scope of services for this geotechnical investigation.

3.0 SITE AND PROJECT DESCRIPTION

3.1 Site Conditions

The subject site is located at the southeast terminus of Van Buren Boulevard in Moreno Valley, California. The site is bounded to the north by the March Air Field Museum, to the east by the March Air Reserve Base (MARB) flight line, to the south by vacant land, and to the west by the Escondido Freeway (Interstate 215). The general location of the site is illustrated on the Site Location Map, included as Plate 1 in Appendix A of this report.

The site consists of four (4) irregular shaped parcels, which total 155± acres in size. The site is presently vacant and undeveloped, except for several small footings and slabs, from a previously demolished structure in the northeastern area of the site. Ground surface cover throughout the majority of the site consists of moderate to heavy native grass and weed growth with areas of exposed soil. A soil stockpile, approximately 100± feet long, 32± feet wide, and 10± feet high, is present in the northwest area of the site. Occasional trees of various sizes were observed throughout the site.

A drainage channel trends from the northwest corner of the site to the southeast corner of the site. The channel has a trapezoidal shaped cross-section and appears to be of artificial construction. This channel is approximately 15± feet wide and 7± feet deep. Limited portions of the channel, near the northern and southern property lines, are lined with concrete and limited portions of the channel are lined with small boulders. Two drainage courses are present in the northern portion of the site. These drainage courses are present at the western property line and terminate at the aforementioned channel. The depths of both of the drainage courses range between 2 and 4± feet.

Topographic information for the subject site was obtained from a topographic plan provided by the client. Based on this plan, the existing site grades range from a maximum elevation of 1524.0± feet mean sea level (msl) in the northwest corner of the site to a minimum elevation of 1500.0± feet msl in the southeast corner of the subject site. There is approximately 24 feet of elevation differential across the site. Site topography on the west side of the channel generally slopes downward to the southeast at a gradient of approximately 1 percent. On the east side of the channel, site topography generally slopes downward to the south at a gradient between 0.5 and 1 percent.

3.2 Proposed Development

A master site plan, prepared by RGA, was provided to our office. Based on this plan, the site will be developed with three (3) distribution/logistics buildings. These buildings will be constructed to be convertible to accommodate air cargo facilities. The buildings, identified as Buildings A through C, will possess footprint areas of 985,998± ft^2, 557,653± ft^2, 846,019± ft^2, respectively.

The buildings will be surrounded by asphaltic concrete and/or Portland cement concrete pavements with limited landscape planter areas.

Detailed structural information has not been provided. It is assumed that the new buildings will be single-story structures of tilt-up concrete construction, typically supported on a conventional shallow foundation system with a concrete slab-on-grade floor. Based on the assumed construction, maximum column and wall loads are expected to be on the order of 100 kips and 3 to 5 kips per linear foot, respectively.

No significant amounts of below grade construction, such as basements or crawl spaces, are expected to be included in the proposed development. Based on the assumed topography, cuts and fills of 6 to 10± feet are expected to be necessary to achieve the proposed site grades. Deeper fills are expected to be necessary in the area of the existing drainage channel which is present within the footprint of Buildings A and B and in the proposed pavement areas on the east side of Buildings B and C.

4.0 SUBSURFACE EXPLORATION

4.1 Scope of Exploration/Sampling Methods

The subsurface exploration conducted for this project consisted of twenty-three (23) borings advanced to depths of 5 to 50± feet below existing site grades. Eight (8) of the borings were drilled to depths of 50± feet as part of the liquefaction evaluation. Eleven (11) additional borings were drilled within the building footprint areas to depths of 15 to 20± feet. Four (4) borings were drilled to depths of 5± feet within the proposed surrounding pavement areas. All of the borings were logged during drilling by a member of our staff.

The borings were advanced with hollow-stem augers, by a conventional truck-mounted drilling rig. Representative bulk and relatively undisturbed soil samples were taken during drilling. Relatively undisturbed samples were taken with a split barrel "California Sampler" containing a series of one inch long, 2.416± inch diameter brass rings. This sampling method is described in ASTM Test Method D-3550. Samples were also taken using a 1.4± inch inside diameter split spoon sampler, in general accordance with ASTM D-1586. Both of these samplers are driven into the ground with successive blows of a 140-pound weight falling 30 inches. The blow counts obtained during driving are recorded for further analysis. Bulk samples were collected in plastic bags to retain their original moisture content. The relatively undisturbed ring samples were placed in molded plastic sleeves that were then sealed and transported to our laboratory.

The approximate locations of the borings are indicated on the Boring Location Plan, included as Plate 2 in Appendix A of this report. The Boring Logs, which illustrate the conditions encountered at the boring locations, as well as the results of some of the laboratory testing, are included in Appendix B.

4.2 Geotechnical Conditions

Younger Alluvium

The majority of the borings encountered older native alluvium at the ground surface. However, seven of the twenty-three borings encountered younger alluvial soils at the ground surface, extending to depths of 1½ to 5½± feet. These younger alluvial soils generally consist of medium dense silty fine sands with varying quantities of medium to coarse sands and occasional medium dense clayey fine sands.

Older Alluvium

Older alluvium was encountered at all of the borings, either at the ground surface, or beneath the younger alluvium, except at Boring No. B-22, which was terminated in younger alluvium at a depth of 5± feet. The near surface older alluvium generally consists of medium dense to very dense clayey sands and silty sands and very stiff to hard fine sandy clays with varying amounts of medium to coarse sand, silt, and fine gravel. Occasional strata of well graded, dense to very dense sands were encountered at a depth greater than 20± feet. Older alluvial soils extend to at least the maximum depth explored of 50± feet at the boring locations.

Groundwater

Free water was encountered during drilling at eight of the borings at the subject site. Boring Nos. B-1, B-4, B-8, B-9, B-13, B-14, B-17 and B-19 encountered free water at depths ranging from 22± feet to 36± feet. Based on the water level measurements and the moisture contents of the recovered soil samples, the static groundwater table is considered to have existed at depths of 22 to 36± feet below the existing site grades at the time of subsurface exploration.

As part of our research, we reviewed available groundwater data in order to determine the historic high groundwater level for the site. The primary reference used to determine the groundwater depths in this area is a monitoring well located approximately 1.6 miles north of the subject site. In this well, the groundwater level is 17± feet (September 2015) below the ground surface.

5.0 LABORATORY TESTING

The soil samples recovered from the subsurface exploration program were returned to our laboratory for further testing to determine selected physical and engineering properties of the soils. The tests are briefly discussed below. It should be noted that the test results are specific to the actual samples tested, and variations could be expected at other locations and depths.

Classification

All recovered soil samples were classified using the Unified Soil Classification System (USCS), in accordance with ASTM D-2488. Field identifications were then supplemented with additional visual classifications and/or by laboratory testing. The USCS classifications are shown on the Boring Logs and are periodically referenced throughout this report.

Density and Moisture Content

The density has been determined for selected relatively undisturbed ring samples. These densities were determined in general accordance with the method presented in ASTM D-2937. The results are recorded as dry unit weight in pounds per cubic foot. The moisture contents are determined in accordance with ASTM D-2216, and are expressed as a percentage of the dry weight. These test results are presented on the Boring Logs.

Soluble Sulfates

Representative samples of the near-surface soils were submitted to a subcontracted analytical laboratory for determination of soluble sulfate content. Soluble sulfates are naturally present in soils, and if the concentration is high enough, can result in degradation of concrete which comes into contact with these soils. The result of the soluble sulfate testing is presented below, and is discussed further in a subsequent section of this report.

Sample Identification	**Soluble Sulfates (%)**	**ACI 318 Classification**
B-2 @ 0 to 5 feet	0.002	Negligible
B-3 @ 0 to 5 feet	0.002	Negligible
B-19 @ 0 to 5 feet	0.001	Negligible

Consolidation

Selected soil samples have been tested to determine their consolidation potential, in accordance with ASTM D-2435. The testing apparatus is designed to accept either natural or remolded samples in a one-inch high ring, approximately 2.416 inches in diameter. Each sample is then loaded incrementally in a geometric progression and the resulting deflection is recorded at selected time intervals. Porous stones are in contact with the top and bottom of the sample to permit the addition or release of pore water. The samples are typically inundated with water at an intermediate load to determine their potential for collapse or heave. The results of the consolidation testing are plotted on Plates C-1 through C-12 in Appendix C of this report.

Maximum Dry Density and Optimum Moisture Content

Representative bulk samples were tested to determine their maximum dry density and optimum moisture content. The results were obtained using the Modified Proctor procedure, per ASTM D-1557. These test results are enclosed in presented on Plates C-13 through C-16 in Appendix C of this report. This test is generally used to compare the in-situ densities of undisturbed field samples, and for later compaction testing. Additional testing of other soil types or soil mixes may be necessary at a later date.

Expansion Index

The expansion potential of the on-site soils was determined in general accordance with ASTM D-4829. The testing apparatus is designed to accept a 4-inch diameter, 1-in high, remolded sample. The sample is initially remolded to 50± 1 percent saturation and then loaded with a surcharge equivalent to 144 pounds per square foot. The sample is then inundated with water, and allowed to swell against the surcharge. The resultant swell or consolidation is recorded after a 24-hour period. The results of the EI testing are as follows:

Sample Identification	**Expansion Index**	**Expansion Potential**
B-3 @ 0 to 5 feet	22	Low
B-4 @ 0 to 5 feet	15	Very Low
B-9 @ 0 to 5 feet	38	Low
B-13 @ 0 to 5 feet	33	Low
B-14 @ 0 to 5 feet	21	Low

California Bearing Ratio (CBR)

One representative bulk sample was submitted to a subcontracted laboratory and tested to determine its CBR values at three different densities. The resulting CBR values are plotted on a chart of CBR versus Dry density. The samples were tested in accordance with ASTM D-1883, Standard Test Method for CBR of Laboratory Compacted Soils. The results of the CBR testing are presented below. The CBR laboratory data sheets are included in Appendix C.

Boring No. B-20 @ 0-5 feet	
Material	**CBR-Value**
Subgrade Compacted to 84% Relative Compaction	1
Subgrade Compacted to 92% Relative Compaction	7
Subgrade Compacted to 98% Relative Compaction	21

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our review, field exploration, laboratory testing and geotechnical analysis, the proposed development is considered feasible from a geotechnical standpoint. The recommendations contained in this report should be taken into the design, construction, and grading considerations. The recommendations are contingent upon all grading and foundation construction activities being monitored by the geotechnical engineer of record. The Grading Guide Specifications, included as Appendix D, should be considered part of this report, and should be incorporated into the project specifications. The contractor and/or owner of the development should bring to the attention of the geotechnical engineer any conditions that differ from those stated in this report, or which may be detrimental for the development.

6.1 Seismic Design Considerations

The subject site is located in an area which is subject to strong ground motions due to earthquakes. The performance of a site specific seismic hazards analysis was beyond the scope of this investigation. However, numerous faults capable of producing significant ground motions are located near the subject site. Due to economic considerations, it is not generally considered reasonable to design a structure that is not susceptible to earthquake damage. Therefore, significant damage to structures may be unavoidable during large earthquakes. The proposed structures should, however, be designed to resist structural collapse and thereby provide reasonable protection from serious injury, catastrophic property damage and loss of life.

Faulting and Seismicity

Research of available maps indicates that the subject site is not located within an Alquist-Priolo Earthquake Fault Zone. Therefore, the possibility of significant fault rupture on the site is considered to be low.

Seismic Design Parameters

Based on standards in place at the time of this report, the proposed development must be designed in accordance with the requirements of the 2013 edition of the California Building Code (CBC). The CBC provides procedures for earthquake resistant structural design that include considerations for on-site soil conditions, occupancy, and the configuration of the structure including the structural system and height. The seismic design parameters presented below are based on the soil profile and the proximity of known faults with respect to the subject site.

The 2013 CBC Seismic Design Parameters have been generated using U.S. Seismic Design Maps, a web-based software application developed by the United States Geological Survey. This software application, available at the USGS web site, calculates seismic design parameters in accordance with the 2013 CBC, utilizing a database of deterministic site accelerations at 0.01 degree intervals. The table below is a compilation of the data provided by the USGS application. A copy of the output generated from this program is included in Appendix E of this report. A copy of the Design Response Spectrum, as generated by the USGS application is also included in Appendix E. Based on this output, the following parameters may be utilized for the subject site:

2013 CBC SEISMIC DESIGN PARAMETERS

Parameter		Value
Mapped Spectral Acceleration at 0.2 sec Period	S_S	1.500
Mapped Spectral Acceleration at 1.0 sec Period	S_1	0.600
Site Class	---	D
Site Modified Spectral Acceleration at 0.2 sec Period	S_{MS}	1.500
Site Modified Spectral Acceleration at 1.0 sec Period	S_{M1}	0.900
Design Spectral Acceleration at 0.2 sec Period	S_{DS}	1.000
Design Spectral Acceleration at 1.0 sec Period	S_{D1}	0.600

Ground Motion Parameters

The liquefaction evaluation was performed using a site acceleration consistent with maximum considered earthquake ground motions, as required by the 2013 CBC. The peak ground acceleration (PGA) was determined in accordance with Section 11.8.3 of ASCE 7-10. The parameter PGA_M is the maximum considered earthquake geometric mean (MCE_G) PGA, multiplied by the appropriate site coefficient from Table 11.8-1 of ASCE 7-10. The web-based software application U.S. Seismic Design Maps (described in the previous section) was used to determine PGA_M, which is 0.50g. A portion of the program output is included as Plate 2 of this report. An associated earthquake magnitude was obtained from the 2008 USGS Interactive Deaggregation application available on the USGS website. The deaggregated modal magnitude is 7.58, based on the peak ground acceleration and NEHRP soil classification D.

Liquefaction

The Riverside County Land Information System indicates that the subject site is located within a zone of moderate high liquefaction susceptibility. Based on this mapping, the scope of this geotechnical investigation included a site-specific liquefaction evaluation.

Liquefaction is the loss of strength in generally cohesionless, saturated soils when the pore-water pressure induced in the soil by a seismic event becomes equal to or exceeds the overburden pressure. The primary factors which influence the potential for liquefaction include groundwater table elevation, soil type and plasticity characteristics, relative density of the soil, initial confining pressure, and intensity and duration of ground shaking. The depth within which the occurrence of liquefaction may impact surface improvements is generally identified as the upper 50 feet below the existing ground surface. Liquefaction potential is greater in saturated, loose, poorly graded fine sands with a mean (d_{50}) grain size in the range of 0.075 to 0.2 mm (Seed and Idriss, 1971). Non-sensitive clayey (cohesive) soils which possess a plasticity index of at least 18 (Bray and Sancio, 2006) are generally not considered to be susceptible to liquefaction, nor are those soils which are above the historic static groundwater table.

The liquefaction analysis was conducted in accordance with the requirements of Special Publication 117A (CDMG, 2008), and currently accepted practice (SCEC, 1997). The liquefaction potential of the subject site was evaluated using the empirical method developed by Boulanger and Idriss (Boulanger and Idriss, 2008). This method predicts the earthquake-induced liquefaction potential of the site based on a given design earthquake magnitude and peak ground acceleration at the subject site. This procedure essentially compares the cyclic resistance ratio (CRR) [the cyclic stress ratio required to induce liquefaction for a cohesionless soil stratum at a given depth] with the earthquake-induced cyclic stress ratio (CSR) at that depth from a specified design earthquake (defined by a peak ground surface acceleration and an associated earthquake moment magnitude). CRR is determined as a function of the corrected SPT N-value $(N_1)_{60\text{-}cs}$, adjusted for fines content. The factor of safety against liquefaction is defined as CRR/CSR. Based on Special Publication 117A, a factor of safety of at least 1.3 is required in order to demonstrate that a given soil stratum is non-liquefiable. Additionally, in accordance with Special Publication 117A, clayey soils which do not meet the criteria for liquefiable soils defined by Bray and Sancio (2006), loose soils with a plasticity index (PI) less than 12 and moisture content greater than 85% of the liquid limit, are considered to be insusceptible to liquefaction. Non-sensitive soils with a PI greater than 18 are also considered to be non-liquefiable.

As part of the liquefaction evaluation, Boring Nos. B-1, B-4, B-8, B-9, B-13, B-14, B-17 and B-19 were extended to depths of 50± feet. The liquefaction analysis procedure is tabulated on the spreadsheet forms included in Appendix F of this report, using the data obtained from these borings. The liquefaction potential of the site was analyzed utilizing a PGA_M of 0.5g for a magnitude 7.58 seismic event.

The historic high groundwater depth is assumed to be approximately 17 feet based on readily available monitoring well data from the internet. It should be noted that the closest well was located approximately 1.6 miles north of the site.

If liquefiable soils are identified, the potential settlements that could occur as a result of liquefaction are determined using the equation for volumetric strain due to post-cyclic reconsolidation (Yoshimine et. al, 2006). This procedure uses an empirical relationship between the induced cyclic shear strain and the corrected N-value to determine the expected volumetric strain of saturated sands subjected to earthquake shaking. This analysis is also documented on the spreadsheets included in Appendix F.

Conclusions and Recommendations

The results of the liquefaction analysis did not identify potentially liquefiable soils at the site. Soils which are located above the historic groundwater table, or possess factors of safety in excess of 1.3 are considered non-liquefiable. Some silty clay and sandy clay strata are also considered non-liquefiable due to their cohesive characteristics and the results of the Atterberg limits testing with respect to the criteria of Bray and Sancio (2006). Based on the results of this analysis, liquefaction is not considered to be a design concern for this project.

6.2 Geotechnical Design Considerations

General

Most of the borings encountered high strength older alluvium at or near the ground surface. Some of the borings encountered moderate strength, lower density younger alluvium within the upper 1½ to 5½± feet below the ground surface. The results of consolidation/collapse testing indicate that the near surface younger and older alluvial soils possess favorable consolidation characteristics. Although the majority of the soils possess relatively high strengths, the soils present in the building pad areas possess variable compositions and densities and have moisture contents below the optimum moisture content. Based on these considerations, some remedial grading is considered to be warranted within the proposed building areas in order to provide uniform support characteristics by removing and replacing a portion of the near-surface older and younger alluvium and replacing these soils as compacted structural fill.

Additional overexcavation may be necessary within the existing drainage course and channel areas due to the presence of low-density sediments which may be present in the channel and/or drainage courses. The extent and presence of such materials is presently unknown, because these areas were not accessible to the drill rig during subsurface exploration.

Settlement

The recommended remedial grading will remove the upper portion of the older and younger alluvial soils, and replace these materials as compacted structural fill. The native soils that will remain in place below the depth of recommended overexcavation possess favorable consolidation/collapse characteristics. Therefore, following completion of the recommended grading, post-construction settlements are expected to be within tolerable limits.

Expansion

The near surface soils at this site generally consist of silty and clayey sands. Laboratory testing indicates that these materials possess very low to low expansion potentials (EIs between 15 and 38). The foundation and floor slab design recommendations contained within this report are made in consideration of the expansion index test results. It is recommended that additional expansion index testing be conducted at the completion of rough grading to verify the expansion potential of the as-graded building pad.

Soluble Sulfates

The results of the soluble sulfate testing indicate that the selected samples of the on-site soils contain negligible concentrations of soluble sulfates, in accordance with American Concrete Institute (ACI) guidelines. Therefore, specialized concrete mix designs are not considered to be necessary, with regard to sulfate protection purposes. It is, recommended that additional soluble sulfate testing be conducted at the completion of rough grading to verify the soluble sulfate concentrations of the soils which are present at pad grade within the building area.

Shrinkage/Subsidence

Based on the results of the laboratory testing, removal and recompaction of the younger alluvial soils is estimated to result in an average shrinkage of 8 to 12 percent. Shrinkage on the order of 4 to 8 percent is expected during the removal and recompaction of the near surface older alluvium. Minor ground subsidence is expected to occur in the soils below the zone of removal, due to settlement and machinery working. The subsidence is estimated to be 0.1± feet. This estimate may be used for grading in areas that are underlain by native alluvial soils.

These estimates are based on previous experience and the subsurface conditions encountered at the boring locations. The actual amount of subsidence is expected to be variable and will be dependent on the type of machinery used, repetitions of use, and dynamic effects, all of which are difficult to assess precisely.

Grading and Foundation Plan Review

No grading and foundation plans were available at the time of this report. It is therefore recommended that we be provided with copies of the preliminary plans, when they become available, for review with regard to the conclusions, recommendations, and assumptions contained within this report.

6.3 Site Grading Recommendations

The grading recommendations presented below are based on the subsurface conditions encountered at the boring locations and our understanding of the proposed development. We recommend that all grading activities be completed in accordance with the Grading Guide Specifications included as Appendix D of this report, unless superseded by site-specific recommendations presented below.

Site Stripping and Demolition

Initial site preparation should include stripping of any topsoil, vegetation and organic debris on the site. Based on conditions observed at the time of the subsurface exploration, this will include localized areas of shrubs, grasses and trees. These materials should be disposed of off-site. The actual extent of stripping should be determined in the field by a representative of the geotechnical engineer, based on the organic content and the stability of the encountered materials.

Remnants of previous development, including concrete slabs and footings were observed in the northeastern portion of the property. Additionally, a few manholes are present in the central portion of the site, indicating the presence of buried utility lines. Initial site preparation should include demolition of any remnants of former development, including any floor slabs, foundations, utilities, septic systems, and any other improvements that will not remain in place with the new development. Concrete and asphalt debris may be re-used within the compacted fills, provided they are pulverized and the maximum particle size is less than 2 inches.

Treatment of Existing Soils: Building Pads

Remedial grading should be performed within the proposed building areas in order to provide uniform support characteristics for the proposed building foundations and floor slabs. Any soils disturbed during site stripping and demolition of the remnants of previous development should be removed and replaced as structural fill. It is recommended that the existing soils within the proposed building areas be overexcavated to depths of at least 2 feet below proposed building pad subgrade elevation and to a depth of at least 2 feet below existing grade, whichever is greater.

Additional overexcavation should be performed within the influence zones of the new foundations, to provide for a new layer of compacted structural fill extending to a depth of 2 feet below proposed bearing grade.

The overexcavation areas should extend at least 5 feet beyond the building perimeter and foundations, and to an extent equal to the depth of fill below the new foundations. If the proposed structure incorporates any exterior columns (such as for a canopy or overhang) the overexcavation should also encompass these areas.

Following completion of the overexcavation, the subgrade soils within the building areas should be evaluated by the geotechnical engineer to verify their suitability to serve as the structural fill subgrades, as well as to support the foundation loads of the new structures. This evaluation should include proofrolling and probing to identify any soft, loose or otherwise unstable soils that must be removed. Some localized areas of deeper excavation may be required if undocumented fill materials or loose, porous, or low density native soils are encountered at the base of the overexcavation. As discussed in the previous section of this report, deeper overexcavation may be necessary to remove low-density sediments in the existing channel and drainage courses, which are present with the proposed Building A footprint area. As discussed above, the actual presence and depth of such sediments are unknown.

After a suitable overexcavation subgrade has been achieved, the exposed soils should be scarified to a depth of at least 12 inches, moisture treated to 2 to 4 percent above optimum moisture content. The subgrade soils should then be recompacted to at least 90 percent of the ASTM D-1557 maximum dry density. The previously excavated soils may then be replaced as compacted structural fill.

Treatment of Existing Soils: Retaining Walls and Site Walls

The existing soils within the areas of any proposed retaining and site walls should be overexcavated to a depth of 2 feet below foundation bearing grade and replaced as compacted structural fill as discussed above for the proposed building pad. Any undocumented fill soils within any of these foundation areas should be removed in their entirety. The overexcavation subgrade soils should be evaluated by the geotechnical engineer prior to scarifying, moisture conditioning, and recompacting the upper 12 inches of exposed subgrade soils, as discussed for the building areas. The previously excavated soils may then be replaced as compacted structural fill.

Treatment of Existing Soils: Parking and Drive Areas

Based on economic considerations, overexcavation of the existing soils in the new parking and drive areas is not considered warranted, with the exception of areas where lower strength, or unstable, soils are identified by the geotechnical engineer during grading. Subgrade preparation in the new parking and drive areas should initially consist of removal of all soils disturbed during stripping and demolition operations.

The geotechnical engineer should then evaluate the subgrade to identify any areas of additional unsuitable soils. Any such materials should be removed to a level of firm and unyielding soil. The exposed subgrade soils should then be scarified to a depth of 12± inches, moisture conditioned to at least 2 to 4 percent above optimum, and recompacted to at least 90 percent of the ASTM D-1557 maximum dry density. Based on the presence of variable strength surficial soils throughout the site, it is expected that some isolated areas of additional overexcavation may be required to remove zones of lower strength, unsuitable soils.

The grading recommendations presented above for the proposed parking and drive areas assume that the owner and/or developer can tolerate minor amounts of settlement within the proposed parking and drive areas. The grading recommendations presented above do not completely mitigate the extent of variable density and low expansive soils within proposed parking and drive areas. As such, settlement and associated pavement distress could occur. Typically, repair of such distressed areas involves significantly lower costs than completely mitigating these soils at the time of construction. If the owner cannot tolerate the risk of such settlements, the parking area should be graded in a manner similar to that described for the building area.

Fill Placement

- Fill soils should be placed in thin (6± inches), near-horizontal lifts, moisture conditioned to 2 to 4 percent above the optimum moisture content, and compacted.
- On-site soils may be used for fill provided they are cleaned of any debris to the satisfaction of the geotechnical engineer.
- All grading and fill placement activities should be completed in accordance with the requirements of the 2013 CBC and the grading code of the City of Moreno Valley.
- All fill soils should be compacted to at least 90 percent of the ASTM D-1557 maximum dry density. Fill soils should be well mixed.
- Compaction tests should be performed periodically by the geotechnical engineer as random verification of compaction and moisture content. These tests are intended to aid the contractor. Since the tests are taken at discrete locations and depths, they may not be indicative of the entire fill and therefore should not relieve the contractor of his responsibility to meet the job specifications.

Imported Structural Fill

All imported structural fill should consist of very low expansive (EI < 20), well graded soils possessing at least 10 percent fines (that portion of the sample passing the No. 200 sieve). Additional specifications for structural fill are presented in the Grading Guide Specifications, included as Appendix D.

Utility Trench Backfill

In general, all utility trench backfill soils should be compacted to at least 90 percent of the ASTM D-1557 maximum dry density. It is recommended that materials in excess of 3 inches in size not be used for utility trench backfill. Compacted trench backfill should conform to the requirements of the local grading code, and more restrictive requirements may be indicated by City of Moreno Valley. All utility trench backfills should be witnessed by the geotechnical engineer. The trench backfill soils should be compaction tested where possible; probed and visually evaluated elsewhere.

Utility trenches which parallel a footing, and extending below a 1h:1v plane projected from the outside edge of the footing should be backfilled with structural fill soils, compacted to at least 90 percent of the ASTM D-1557 standard. Pea gravel backfill should not be used for these trenches.

6.4 Construction Considerations

Excavation Considerations

The near-surface soils generally consist of silty sands and clayey sands. Some of these materials may be subject to minor caving within shallow excavations. Where caving does occur, flattened excavation slopes may be sufficient to provide excavation stability. On a preliminary basis, the inclination of temporary slopes should not exceed 1.5h:1v. Deeper excavations may require some form of external stabilization such as shoring or bracing. Maintaining adequate moisture content within the near-surface soils will improve excavation stability. All excavation activities on this site should be conducted in accordance with Cal-OSHA regulations.

Moisture Sensitive Subgrade Soils

Most of the near surface soils possess appreciable silt and clay content and may become unstable if exposed to significant moisture infiltration or disturbance by construction traffic. In addition, based on their granular content, some of the on-site soils will also be susceptible to erosion. The site should, therefore, be graded to prevent ponding of surface water and to prevent water from running into excavations.

Expansive Soils

The near surface on-site soils have been determined to possess a low expansion potential. Therefore, care should be given to proper moisture conditioning of all building pad subgrade soils to a moisture content of 2 to 4 percent above the Modified Proctor optimum during site grading. All imported fill soils should have very low expansive (EI < 20) characteristics. In addition to adequately moisture conditioning the subgrade soils and fill soils during grading, special care must be taken to maintain moisture content of these soils at 2 to 4 percent above the Modified Proctor optimum. This will require the contractor to frequently moisture condition these soils throughout the grading process, unless grading occurs during a period of relatively wet weather.

Groundwater

The static groundwater table at this site was present at depths between 22 and 36± feet below the existing site grades. Therefore, groundwater is not expected to impact grading or foundation construction activities.

6.5 Foundation Design and Construction

Based on the preceding grading recommendations, it is assumed that the new building pads will be underlain by structural fill soils used to replace variable strength, variable composition, dry of optimum, near surface alluvium. These new structural fill soils are expected to extend to depths of at least 2 feet below proposed foundation bearing grade, underlain by 1± foot of additional soil that has been scarified, moisture conditioned, and recompacted. Based on this subsurface profile, the proposed structure may be supported on conventional shallow foundations.

Foundation Design Parameters

New square and rectangular footings may be designed as follows:

- Maximum, net allowable soil bearing pressure: 3,000 lbs/ft^2.
- Minimum wall/column footing width: 14 inches/24 inches.
- Minimum longitudinal steel reinforcement within strip footings: Four (4) No. 5 rebars (2 top and 2 bottom) due to the presence of low expansive soils. Additional reinforcement may be necessary for structural considerations.
- Minimum foundation embedment: 12 inches into suitable structural fill soils, and at least 24 inches below adjacent exterior grade. Interior column footings may be placed immediately beneath the floor slab.
- It is recommended that the perimeter building foundations be continuous across all exterior doorways. Any flatwork adjacent to the exterior doors should be doweled into the perimeter foundations in a manner determined by the structural engineer.

The allowable bearing pressures presented above may be increased by 1/3 when considering short duration wind or seismic loads. The minimum steel reinforcement recommended above is based on geotechnical considerations; additional reinforcement may be necessary for structural considerations. The actual design of the foundations should be determined by the structural engineer.

Foundation Construction

The foundation subgrade soils should be evaluated at the time of overexcavation, as discussed in Section 6.3 of this report. It is further recommended that the foundation subgrade soils be evaluated by the geotechnical engineer immediately prior to steel or concrete placement. Soils suitable for direct foundation support should consist of newly placed structural fill, compacted to at least 90 percent of the ASTM D-1557 maximum dry density. Any unsuitable materials should be removed to a depth of suitable bearing compacted structural fill, with the resulting excavations backfilled with compacted fill soils. As an alternative, lean concrete slurry (500 to 1,500 psi) may be used to backfill such isolated overexcavations.

The foundation subgrade soils should also be properly moisture conditioned to at least 2 to 4 percent of the Modified Proctor optimum, to a depth of at least 12 inches below bearing grade. **Since it is typically not feasible to increase the moisture content of the floor slab and foundation subgrade soils once rough grading has been completed, care should be taken to maintain the moisture content of the building pad subgrade soils throughout the construction process.**

Estimated Foundation Settlements

Post-construction total and differential settlements of shallow foundations designed and constructed in accordance with the previously presented recommendations are estimated to be less than 1.0 and 0.5 inches, respectively. Differential movements are expected to occur over a 30-foot span, thereby resulting in an angular distortion of less than 0.002 inches per inch.

Lateral Load Resistance

Lateral load resistance will be developed by a combination of friction acting at the base of foundations and slabs and the passive earth pressure developed by footings below grade. The following friction and passive pressure may be used to resist lateral forces:

- Passive Earth Pressure: 300 lbs/ft^3
- Friction Coefficient: 0.30

These are allowable values, and include a factor of safety. When combining friction and passive resistance, the passive pressure component should be reduced by one-third. These values assume that footings will be poured directly against compacted structural fill. The maximum allowable passive pressure is 3000 lbs/ft^2.

6.6 Floor Slab Design and Construction

Subgrades which will support new floor slabs should be prepared in accordance with the recommendations contained in the ***Site Grading Recommendations*** section of this report. Based on the anticipated grading which will occur at this site, the floors of the new structures may be constructed as conventional slabs-on-grade supported on newly placed structural fill, extending to a depth of at least 2 feet below the proposed building pad grade. Based on geotechnical considerations, the floor slab may be designed as follows:

- Minimum slab thickness: 6 inches.

- Minimum slab reinforcement: No. 3 bars at 18 inches on center in both directions due to the presence of low expansive soils. The actual floor slab reinforcement should be determined by the structural engineer, based on the imposed loading.

- Modulus of Subgrade Reaction: k = 125 psi/in.

- Slab underlayment: If moisture sensitive floor coverings will be used then minimum slab underlayment should consist of a moisture vapor barrier constructed below the entire area of the proposed slab where such moisture sensitive floor coverings are expected. The moisture vapor barrier should meet or exceed the Class A rating as defined by ASTM E 1745-97 and have a permeance rating less than 0.01 perms as described in ASTM E 96-95 and ASTM E 154-88. A polyolefin material such as Stego® Wrap Vapor Barrier or equivalent will meet these specifications. The moisture vapor barrier should be properly constructed in accordance with all applicable manufacturer specifications. Given that a rock free subgrade is anticipated and that a capillary break is not required, sand below the barrier is not required. The need for sand and/or the amount of sand above the moisture vapor barrier should be specified by the structural engineer or concrete contractor. The selection of sand above the barrier is not a geotechnical engineering issue and hence outside our purview. Where moisture sensitive floor coverings are not anticipated, the vapor barrier may be eliminated.
- Moisture condition the floor slab subgrade soils to 2 to 4 percent above the Modified Proctor optimum moisture content, to a depth of 12 inches. The moisture content of the floor slab subgrade soils should be verified by the geotechnical engineer within 24 hours prior to concrete placement.
- Proper concrete curing techniques should be utilized to reduce the potential for slab curling or the formation of excessive shrinkage cracks.

The actual design of the floor slabs should be completed by the structural engineer to verify adequate thickness and reinforcement.

6.7 Retaining Wall Design and Construction

Although not indicated on the site plan, some small retaining walls (less than 3 to 4 feet in height) may be required to facilitate the new site grades. The parameters recommended for use in the design of these walls are presented below.

Retaining Wall Design Parameters

Based on the soil conditions encountered at the boring locations, the following parameters may be used in the design of new retaining walls for this site. We have provided parameters assuming the use of on-site soils for retaining wall backfill. The near surface soils generally consist of clayey sands and silty sands with occasional clays. Based on their classifications, these soils are expected to possess a friction angle of at least 30 degrees when compacted to 90 percent of the ASTM-1557 maximum dry density.

If desired, SCG could provide design parameters for an alternative select backfill material behind the retaining walls. The use of select backfill material could result in lower lateral earth pressures. In order to use the design parameters for the imported select fill, this material must be placed within the entire active failure wedge. This wedge is defined as extending from the heel of the retaining wall upwards at an angle of approximately 60° from horizontal. If select backfill material behind the retaining wall is desired, SCG should be contacted for supplementary recommendations.

RETAINING WALL DESIGN PARAMETERS

Design Parameter		Soil Type: On-Site Clayey Sands and Silty Sands
Internal Friction Angle (ϕ)		30°
Unit Weight		130 lbs/ft^3
Equivalent Fluid Pressure:	Active Condition (level backfill)	42 lbs/ft^3
	Active Condition (2h:1v backfill)	67 lbs/ft^3
	At-Rest Condition (level backfill)	63 lbs/ft^3

Regardless of the backfill type, the walls should be designed using a soil-footing coefficient of friction of 0.30 and an equivalent passive pressure of 300 lbs/ft^3. The structural engineer should incorporate appropriate factors of safety in the design of the retaining walls.

The active earth pressure may be used for the design of retaining walls that do not directly support structures or support soils that in turn support structures and which will be allowed to deflect. The at-rest earth pressure should be used for walls that will not be allowed to deflect such as those which will support foundation bearing soils, or which will support foundation loads directly.

Where the soils on the toe side of the retaining wall are not covered by a "hard" surface such as a structure or pavement, the upper 1 foot of soil should be neglected when calculating passive resistance due to the potential for the material to become disturbed or degraded during the life of the structure.

Seismic Lateral Earth Pressures

In accordance with the 2013 CBC, any retaining walls more than 6 feet in height must be designed for seismic lateral earth pressures. If walls 6 feet or more are required for this site, the geotechnical engineer should be contacted for supplementary seismic lateral earth pressure recommendations.

Retaining Wall Foundation Design

The retaining wall foundations should be supported within newly placed compacted structural fill, extending to a depth of at least 2 feet below the proposed bearing grade. Foundations to support new retaining walls should be designed in accordance with the general Foundation Design Parameters presented in a previous section of this report.

Backfill Material

On-site soils may be used to backfill the retaining walls. However, all backfill material placed within 3 feet of the back wall face should have a particle size no greater than 3 inches. The retaining wall backfill materials should be well graded.

It is recommended that a a properly installed prefabricated drainage composite such as the MiraDRAIN 6000XL (or approved equivalent), which is specifically designed for use behind retaining walls be used. If the drainage composite material is not covered by an impermeable surface, such as a structure or pavement, a 12-inch thick layer of a low permeability soil should be placed over the backfill to reduce surface water migration to the underlying soils. The drainage composite should be separated from the backfill soils by a suitable geotextile, approved by the geotechnical engineer.

All retaining wall backfill should be placed and compacted under engineering controlled conditions in the necessary layer thicknesses to ensure an in-place density between 90 and 93 percent of the maximum dry density as determined by the Modified Proctor test (ASTM D1557). Care should be taken to avoid over-compaction of the soils behind the retaining walls, and the use of heavy compaction equipment should be avoided.

Subsurface Drainage

As previously indicated, the retaining wall design parameters are based upon drained backfill conditions. Consequently, some form of permanent drainage system will be necessary in conjunction with the appropriate backfill material. Subsurface drainage may consist of either:

- A weep hole drainage system typically consisting of a series of 4-inch diameter holes in the wall situated slightly above the ground surface elevation on the exposed side of the wall and at an approximate 8-foot on-center spacing. The weep holes should include a 2 cubic foot pocket of open graded gravel, surrounded by an approved geotextile fabric, at each weep hole location.

- A 4-inch diameter perforated pipe surrounded by 2 cubic feet of gravel per linear foot of drain placed behind the wall, above the retaining wall footing. The gravel layer should be wrapped in a suitable geotextile fabric to reduce the potential for migration of fines. The footing drain should be extended to daylight or tied into a storm drainage system.

6.8 Pavement Design Parameters

Site preparation in the pavement area should be completed as previously recommended in the ***Site Grading Recommendations*** section of this report. The subsequent pavement recommendations assume proper drainage and construction monitoring, and are based on either PCA or CALTRANS design parameters for a twenty (20) year design period. However, these designs also assume a routine pavement maintenance program to obtain the anticipated 20-year pavement service life.

The following pavement designs are provided for truck and automobile traffic. However, we understand that the new pavements on the east sides of the proposed building may also be subjected to traffic from aircraft. Based on conversations with the client and the project civil engineer, information regarding the volume of airplane traffic and types of airplanes is presently not available. Therefore, the following pavement designs do not include airplane traffic. SCG will provide an addendum pavement design report after additional information regarding airplane traffic has been provided.

Pavement Subgrades

It is anticipated that the new pavements will be supported on a layer of existing soils which have been scarified, thoroughly moisture conditioned and recompacted. The near surface soils generally consist of silty and clayey sands and possess an R-value of 30, based on a correlation with the results of the CBR testing. Any fill material imported to the site should have support characteristics equal to or greater than that of the on-site soils and be placed and compacted under engineering controlled conditions. It is recommended that R-value and/or CBR testing be performed after completion of rough grading. Depending upon the results of this testing, it may be feasible to use thinner pavement sections in some areas of the site.

Asphaltic Concrete

Presented below are the recommended thicknesses for new flexible pavement structures consisting of asphaltic concrete over a granular base. The pavement designs are based on the traffic indices (TI's) indicated. The client and/or civil engineer should verify that these TI's are representative of the anticipated traffic volumes. If the client and/or civil engineer determine that the expected traffic volume will exceed the applicable traffic index, we should be contacted for supplementary recommendations. The design traffic indices equate to the following approximate daily traffic volumes over a 20 year design life, assuming six operational traffic days per week.

Traffic Index	No. of Heavy Trucks per Day
4.0	0
5.0	1
6.0	3
7.0	11
8.0	35
9.0	93

For the purpose of the traffic volumes indicated above, a truck is defined as a 5-axle tractor trailer unit with one 8-kip axle and two 32-kip tandem axles. All of the traffic indices allow for 1,000 automobiles per day.

ASPHALT PAVEMENTS (R=30)					
Materials	**Thickness (inches)**				
	Auto Parking and Auto Drive Lanes (TI = 4.0 to 5.0)	Truck Traffic			
		TI = 6.0	TI = 7.0	TI = 8.0	TI = 9.0
Asphalt Concrete	3	3½	4	5	5½
Aggregate Base	6	8	10	11	13
Compacted Subgrade	12	12	12	12	12

The aggregate base course should be compacted to at least 95 percent of the ASTM D-1557 maximum dry density. The asphaltic concrete should be compacted to at least 95 percent of the Marshall maximum density, as determined by ASTM D-2726. The aggregate base course may consist of crushed aggregate base (CAB) or crushed miscellaneous base (CMB), which is a recycled gravel, asphalt and concrete material. The gradation, R-Value, Sand Equivalent, and Percentage Wear of the CAB or CMB should comply with appropriate specifications contained in the current edition of the "Greenbook" Standard Specifications for Public Works Construction.

Portland Cement Concrete

The preparation of the subgrade soils within concrete pavement areas should be performed as previously described for proposed asphalt pavement areas. The minimum recommended thicknesses for the Portland Cement Concrete pavement sections are as follows:

PORTLAND CEMENT CONCRETE PAVEMENTS				
Materials	**Thickness (inches)**			
	Autos and Light Truck Traffic (TI = 6.0)	Truck Traffic		
		TI = 7.0	TI = 8.0	TI = 9.0
PCC	5	6½	8	9
Compacted Subgrade (95% minimum compaction)	12	12	12	12

The concrete should have a 28-day compressive strength of at least 3,000 psi. The maximum joint spacing within all of the PCC pavements is recommended to be equal to or less than 30 times the pavement thickness. The actual joint spacing and reinforcing of the Portland cement concrete pavements should be determined by the structural engineer.

7.0 GENERAL COMMENTS

This report has been prepared as an instrument of service for use by the client, in order to aid in the evaluation of this property and to assist the architects and engineers in the design and preparation of the project plans and specifications. This report may be provided to the contractor(s) and other design consultants to disclose information relative to the project. However, this report is not intended to be utilized as a specification in and of itself, without appropriate interpretation by the project architect, civil engineer, and/or structural engineer. The reproduction and distribution of this report must be authorized by the client and Southern California Geotechnical, Inc. Furthermore, any reliance on this report by an unauthorized third party is at such party's sole risk, and we accept no responsibility for damage or loss which may occur. The client(s)' reliance upon this report is subject to the Engineering Services Agreement, incorporated into our proposal for this project.

The analysis of this site was based on a subsurface profile interpolated from limited discrete soil samples. While the materials encountered in the project area are considered to be representative of the total area, some variations should be expected between boring locations and sample depths. If the conditions encountered during construction vary significantly from those detailed herein, we should be contacted immediately to determine if the conditions alter the recommendations contained herein.

This report has been based on assumed or provided characteristics of the proposed development. It is recommended that the owner, client, architect, structural engineer, and civil engineer carefully review these assumptions to ensure that they are consistent with the characteristics of the proposed development. If discrepancies exist, they should be brought to our attention to verify that they do not affect the conclusions and recommendations contained herein. We also recommend that the project plans and specifications be submitted to our office for review to verify that our recommendations have been correctly interpreted.

The analysis, conclusions, and recommendations contained within this report have been promulgated in accordance with generally accepted professional geotechnical engineering practice. No other warranty is implied or expressed.

8.0 REFERENCES

Blake, Thomas F., *FRISKSP, A Computer Program for the Probabilistic Estimation of Peak Acceleration and Uniform Hazard Spectra Using 3-D Faults as Earthquake Sources*, Version 4.00, 2000.

California Division of Mines and Geology (CDMG), "Guidelines for Evaluating and Mitigating Seismic Hazards in California," State of California, Department of Conservation, Division of Mines and Geology, Special Publication 117, 1997.

National Research Council (NRC), "Liquefaction of Soils During Earthquakes," Committee on Earthquake Engineering, National Research Council, Washington D. C., Report No. CETS-EE-001, 1985.

Seed, H. B., and Idriss, I. M., "Simplified Procedure for Evaluating Soil Liquefaction Potential using field Performance Data," Journal of the Soil Mechanics and Foundations Division, American Society of Civil Engineers, September 1971, pp. 1249-1273.

Sadigh, K., Chang, C. –Y., Egan, J. A., Makdisi. F., Youngs, R. R., "*Attenuation Relationships for Shallow Crustal Earthquakes Based on California Strong Motion Data"*, Seismological Research Letters, Seismological Society of America, Volume 68, Number 1, January/ February 1997, pp. 180-189.

Southern California Earthquake Center (SCEC), University of Southern California, "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California," Committee formed 1997.

Tokimatsu K., and Seed, H. B., "Evaluation of Settlements in Sands Due to Earthquake Shaking," Journal of the Geotechnical Engineering Division, American society of Civil Engineers, Volume 113, No. 8, August 1987, pp. 861-878.

Tokimatsu, K. and Yoshimi, Y., "*Empirical Correlations of Soil Liquefaction Based on SPT N-value and Fines Content,"* Seismological Research Letters, Eastern Section Seismological Society Of America, Volume 63, Number 1, p. 73.

Youd, T. L. and Idriss, I. M. (Editors), "Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils," Salt Lake City, UT, January 5-6 1996, NCEER Technical Report NCEER-97-0022, Buffalo, NY.

APPENDIX A

SOURCE: RIVERSIDE COUNTY THOMAS GUIDE, 2013

SITE LOCATION MAP

D2 AIR CARGO COMPATIBLE DEVELOPMENT

MORENO VALLEY, CALIFORNIA

SCALE: 1" = 2400'

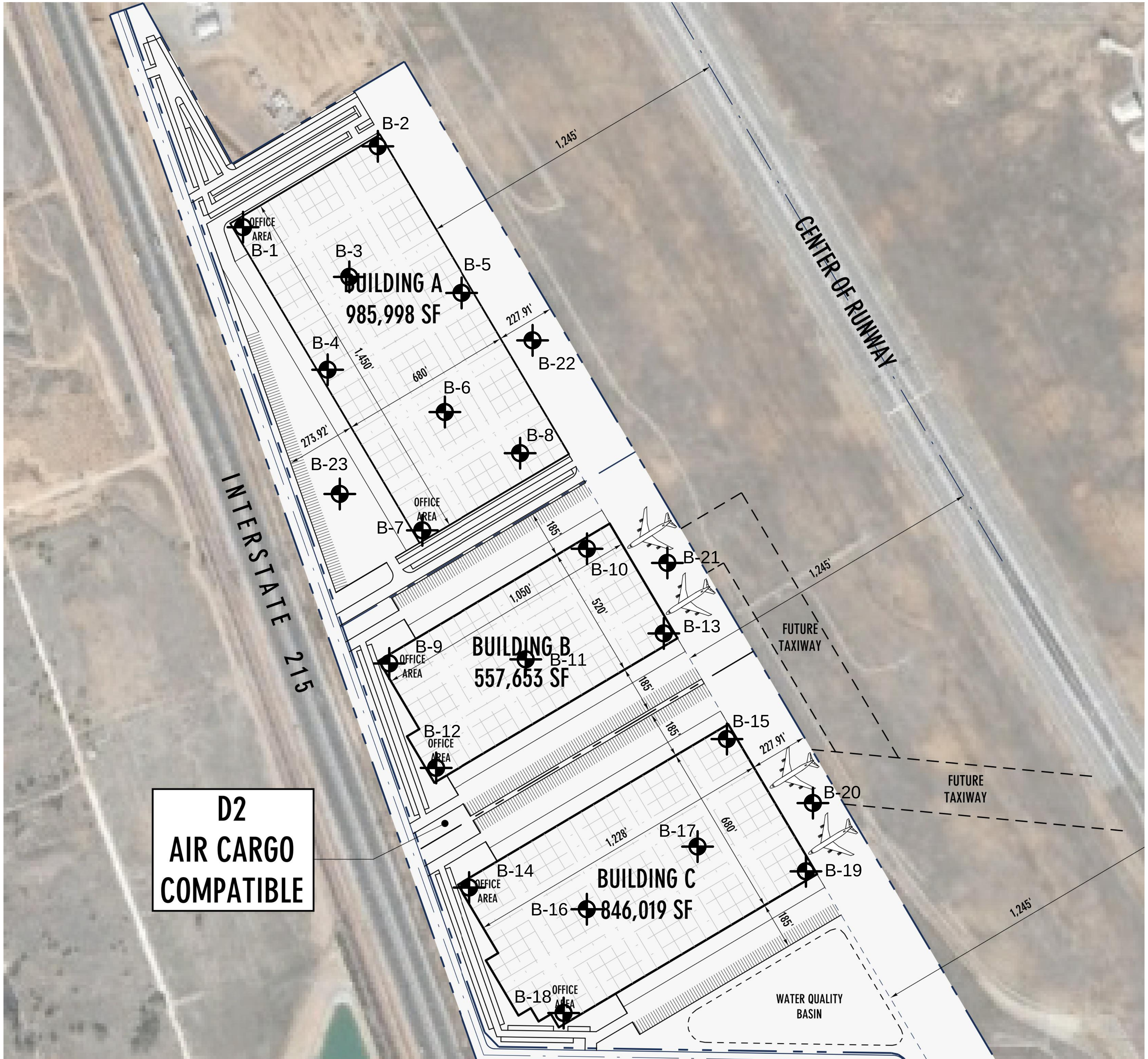
DRAWN: MRM
CHKD: JAS

SCG PROJECT
15G204-1

PLATE 1

SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL



GEOTECHNICAL LEGEND

APPROXIMATE BORING LOCATION

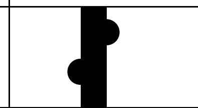
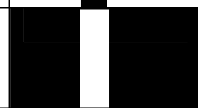
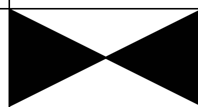
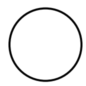
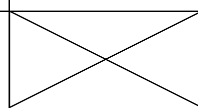
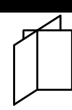
NOTE: SITE MAP PROVIDED BY RGA ARCHITECTS

BORING LOCATION PLAN
D2 AIR CARGO COMPATIBLE DEVELOPMENT
MORENO VALLEY, CALIFORNIA

SCALE: 1" = 400'	SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: MRM CHKD: JAS	
SCG PROJECT 15G204-1	
PLATE 2	

APPENDIX B

BORING LOG LEGEND

SAMPLE TYPE	GRAPHICAL SYMBOL	SAMPLE DESCRIPTION
AUGER		SAMPLE COLLECTED FROM AUGER CUTTINGS, NO FIELD MEASUREMENT OF SOIL STRENGTH. (DISTURBED)
CORE		ROCK CORE SAMPLE: TYPICALLY TAKEN WITH A DIAMOND-TIPPED CORE BARREL. TYPICALLY USED ONLY IN HIGHLY CONSOLIDATED BEDROCK.
GRAB		SOIL SAMPLE TAKEN WITH NO SPECIALIZED EQUIPMENT, SUCH AS FROM A STOCKPILE OR THE GROUND SURFACE. (DISTURBED)
CS		CALIFORNIA SAMPLER: 2-1/2 INCH I.D. SPLIT BARREL SAMPLER, LINED WITH 1-INCH HIGH BRASS RINGS. DRIVEN WITH SPT HAMMER. (RELATIVELY UNDISTURBED)
NSR		NO RECOVERY: THE SAMPLING ATTEMPT DID NOT RESULT IN RECOVERY OF ANY SIGNIFICANT SOIL OR ROCK MATERIAL.
SPT		STANDARD PENETRATION TEST: SAMPLER IS A 1.4 INCH INSIDE DIAMETER SPLIT BARREL, DRIVEN 18 INCHES WITH THE SPT HAMMER. (DISTURBED)
SH		SHELBY TUBE: TAKEN WITH A THIN WALL SAMPLE TUBE, PUSHED INTO THE SOIL AND THEN EXTRACTED. (UNDISTURBED)
VANE		VANE SHEAR TEST: SOIL STRENGTH OBTAINED USING A 4 BLADED SHEAR DEVICE. TYPICALLY USED IN SOFT CLAYS-NO SAMPLE RECOVERED.

COLUMN DESCRIPTIONS

DEPTH: Distance in feet below the ground surface.

SAMPLE: Sample Type as depicted above.

BLOW COUNT: Number of blows required to advance the sampler 12 inches using a 140 lb hammer with a 30-inch drop. 50/3” indicates penetration refusal (>50 blows) at 3 inches. WH indicates that the weight of the hammer was sufficient to push the sampler 6 inches or more.

POCKET PEN.: Approximate shear strength of a cohesive soil sample as measured by pocket penetrometer.

GRAPHIC LOG: Graphic Soil Symbol as depicted on the following page.

DRY DENSITY: Dry density of an undisturbed or relatively undisturbed sample in lbs/ft^3.

MOISTURE CONTENT: Moisture content of a soil sample, expressed as a percentage of the dry weight.

LIQUID LIMIT: The moisture content above which a soil behaves as a liquid.

PLASTIC LIMIT: The moisture content above which a soil behaves as a plastic.

PASSING #200 SIEVE: The percentage of the sample finer than the #200 standard sieve.

UNCONFINED SHEAR: The shear strength of a cohesive soil sample, as measured in the unconfined state.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-1

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/28/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: 23 feet
CAVE DEPTH: 36 feet
READING TAKEN: At Completion

DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
	X	23			YOUNGER ALLUVIUM: Light Brown Silty fine Sand, trace medium to coarse Sand, trace Clay, medium dense-damp		3					
	X	29			OLDER ALLUVIUM: Gray Brown Clayey fine to coarse Sand, trace Silt, trace fine Gravel, medium dense-damp to moist		7					
5												
	X	30					6					
			4.5+		Brown fine to medium Sandy Clay, hard-damp to moist		9					
	X	35			Red Brown Clayey fine to coarse Sand, trace fine Gravel, trace to little Silt, dense-damp to moist		6					
10												
					Brown Clayey fine Sand, trace to little Silt, trace medium Sand, trace Iron oxide staining, medium dense-moist							
	X	21					13					
15												
					Gray Brown Clayey fine to coarse Sand, little Silt, medium dense-moist							
	X	17					13			18		
20												
					Groundwater encountered at 23 feet during drilling							
	X	33					13					
25					Brown Silty fine Sand, trace to little Clay, trace Iron oxide staining, dense-wet		16			33		
					OLDER ALLUVIUM: Red Brown Clayey fine to coarse Sand, trace Silt, trace fine Gravel, dense-wet							
	X	26					16					
30												
	X	35					15					

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

TEST BORING LOG

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-1

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/28/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: 23 feet
CAVE DEPTH: 36 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION (Continued)	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					OLDER ALLUVIUM: Red Brown Clayey fine to coarse Sand, trace Silt, trace fine Gravel, dense-wet							
40	X	38					17					
45	X	41					14					
50	X	56					14					
					Boring Terminated at 50'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-2

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/28/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: Dry
CAVE DEPTH: 13 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					YOUNGER ALLUVIUM: Light Brown Silty fine Sand, trace Clay, trace medium Sand, trace fine root fibers, slightly porous, medium dense-damp							
	X	32				101	3					
					OLDER ALLUVIUM: Brown fine Sandy Clay, trace Silt, trace medium to coarse Sand, slightly porous, hard-damp							
	X	52	4.0			116	6					
					Brown Clayey fine to medium Sand, trace Silt, trace coarse Sand, dense-damp							
5	X	59				121	5					
					Brown Silty fine Sand, trace medium to coarse Sand, trace to little Clay, dense to very dense-moist							
	X	85/10				127	9					
	X	53	4.5+		Brown Clayey fine Sand to fine Sandy Clay, trace medium to coarse Sand, trace Silt, trace calcareous veining, dense to hard-moist	114	11					
10												
					Brown fine Sandy Silt, trace Clay, medium dense-very moist							
	X	15					18					
15												
					Light Gray Brown Silty fine to medium Sand, trace coarse Sand, medium dense-damp							
	X	19					6					
20												
					Boring Terminated at 20'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

TEST BORING LOG

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-3

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/28/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: Dry
CAVE DEPTH: 12 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
	X	52			OLDER ALLUVIUM: Light Brown Silty fine Sand, trace medium to coarse Sand, trace Clay, very dense-damp		5					EI = 22 @ 0 to 5'
	X	54			Gray Brown Clayey fine to medium Sand, very dense-damp		5					
5	X	39			Light Brown Clayey fine Sand, litle Silt, trace medium Sand, trace calcareous veining, dense-moist		8					
	X	40	4.5		Gray Brown fine Sandy Clay, trace Silt, trace medium to coarse Sand, trace Iron oxide staining, dense to hard-moist		10					
10												
	X	20	2.0		@13½ to 15 feet, Brown, trace medium Sand, moist to very moist		15					
15					Boring Terminated at 15'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

TEST BORING LOG

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-4

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/28/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: 23 feet
CAVE DEPTH: 37 feet
READING TAKEN: At Completion

SURFACE ELEVATION: --- MSL

DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
	X	44	4.5+		OLDER ALLUVIUM: Brown Clayey fine Sand to fine Sandy Clay, trace medium to coarse Sand, trace to little Silt, slightly porous, dense-damp		5					EI = 15 @ 0 to 5'
	X	64			Light Red Brown Clayey fine Sand, trace medium to coarse Sand, little Silt, trace Iron oxide staining, very dense-moist		9					
5												
	X	26	4.5+		Brown fine to medium Sandy Clay, trace coarse Sand, little Silt, trace calcareous veining, very stiff-moist		11					
	X	21					9					
10												
	X	18	3.5		Brown Clayey fine Sand to fine Sandy Clay, trace to little Silt, trace medium Sand, trace Iron oxide staining, medium dense to very stiff-moist to very moist		14					
15												
	X	26			Light Gray Brown Silty fine to coarse Sand, trace Clay, trace calcareous veining, medium dense-moist		10			25		
20												
	X	19			Light Brown Clayey fine to coarse Sand, trace Silt, trace fine Gravel, medium dense to very dense-wet Groundwater encountered at 23 feet during drilling		16			14		
25												
	X	34					15					
30												
	X	52					14					

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

TEST BORING LOG

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-4

JOB NO.: 15G204	DRILLING DATE: 10/28/15	WATER DEPTH: 23 feet
PROJECT: D2 Air Cargo Compatible Dev.	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 37 feet
LOCATION: Moreno Valley, California	LOGGED BY: Matt Manni	READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION (Continued)	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					Light Brown Clayey fine to coarse Sand, trace Silt, trace fine Gravel, medium dense to very dense-wet							
					Red Brown to Gray Brown Clayey fine to coarse Sand, trace fine Gravel, trace Silt, dense to very dense-wet							
	X	67					16					
40												
	X	47					15					
45												
	X	52					16					
50												
					Boring Terminated at 50'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-5

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/28/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: Dry
CAVE DEPTH: 14 feet
READING TAKEN: At Completion

SURFACE ELEVATION: --- MSL

DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					OLDER ALLUVIUM: Brown to Dark Brown Clayey fine to medium Sand, trace coarse Sand, trace Silt, trace fine root fibers, slightly porous, dense-damp							
	X	35				99	3					
	X	45				118	7					
					Light Brown Silty fine Sand, trace medium Sand, trace Clay, dense-damp to moist							
5	X	50/6"					5					Disturbed Sample
	X	50				109	9					
					Gray Brown Silty fine to medium Sand, little coarse Sand, trace fine Gravel, medium dense-damp							
	X	15				112	4					
10												
					Gray Brown fine Sandy Silt, trace to little Clay, trace Iron oxide staining, medium dense-very moist							
	X	19					16					
15												
					Gray Brown Clayey fine Sand, little Silt, trace medium Sand, trace Iron oxide staining, medium dense-very moist							
	X	18					16					
20												
					Boring Terminated at 20'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-6

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/28/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: Dry
CAVE DEPTH: 18 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					OLDER ALLUVIUM: Light Brown Silty fine Sand, trace medium Sand, trace Clay, very dense-damp							
	X	62					6					
					Brown Clayey fine Sand to fine Sandy Clay, trace medium to coarse Sand, little Silt, dense-damp to moist							
	X	33					7					
5												
	X	22	4.5		@ 6 to 10 feet, trace Iron oxide staining, trace calcareous veining, medium dense		11					
	X	24					11					
10												
					Brown fine to medium Sandy Clay, trace Silt, dense-damp to moist							
	X	31	4.5				8					
15												
					Gray Brown Silty fine to medium Sand, trace coarse Sand, trace Clay, medium dense-damp							
	X	23					6					
20												
					Boring Terminated at 20'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-7

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/29/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: Dry
CAVE DEPTH: 14 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					OLDER ALLUVIUM: Light Brown Silty fine Sand, trace medium Sand, trace Clay, dense-damp							
		48				109	5					
					Dark Brown Clayey fine to medium Sand, trace coarse Sand, trace Silt, slightly porous, dense-damp to moist							
		50/4"					7					Disturbed Sample
5		50/6"				102	7					
					Brown Clayey fine Sand to fine Sandy Clay, little Silt, trace medium Sand, medium dense to very stiff-moist to very moist							
		28	4.5+			119	13					
		20	4.5+			114	11					
10												
		25	3.0				26					
15												
					Boring Terminated at 15'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

TEST BORING LOG

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-8

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/29/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: 22 feet
CAVE DEPTH: 36 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					ALLUVIUM: Light Brown Silty fine Sand, trace medium Sand, trace Clay, medium dense-very moist							
	X	21					13					
					OLDER ALLUVIUM: Brown fine to medium Sandy Clay, trace coarse Sand, trace Silt, hard-moist							
	X	57	2.0				8					
5												
	X	38	4.5+				10					
					Light Brown Silty fine Sand, trace medium Sand, trace Clay, dense-very moist		18					
					Brown Clayey fine Sand, trace medium Sand, trace Silt, medium dense-damp to moist							
	X	20					8					
10												
					Red Brown Clayey fine to medium Sand, trace Silt, medium dense-very moist							
	X	22					13					
15												
					Brown Clayey fine Sand, trace medium to coarse Sand, trace Silt, trace calcareous veining, medium dense-very moist to wet							
	X	16					16			38		
20												
					Gray Brown fine to coarse Sand, little Clay, trace fine Gravel, medium dense-wet Groundwater encountered at 22 feet during drilling							
	X	22					15			13		
25												
	X	73					17					
					Gray Brown Clayey fine to coarse Sand, trace Silt, well cemented, very dense-wet		14					
30												
					Orange Brown Clayey fine to coarse Sand, trace Silt, trace fine Gravel, moderately cemented, dense-wet							
	X	41					14					

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-8

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/29/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: 22 feet
CAVE DEPTH: 36 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION (Continued)	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					Orange Brown Clayey fine to coarse Sand, trace Silt, trace fine Gravel, moderately cemented, dense-wet							
					Light Gray Brown Clayey fine to coarse Sand, trace Silt, trace fine Gravel, medium dense to dense-wet							
40	X	42					15					
45	X	29					15			19		
50	X	41					15					
					Boring Terminated at 50'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SOCALGEO SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-9

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/29/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: 36 feet
CAVE DEPTH: 40 feet
READING TAKEN: At Completion

SURFACE ELEVATION: --- MSL

DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
	X	45	4.5+	OLDER ALLUVIUM: Gray Brown Clayey fine to medium Sand, trace coarse Sand, trace fine Gravel, trace Silt, dense-damp		6					EI = 38 @ 0 to 5'
5	X	64		Light Brown Clayey fine Sand, little Silt, trace medium to coarse Sand, very dense-moist		9					
	X	27	4.0	Brown fine to medium Sandy Clay, trace coarse Sand, trace Silt, medium dense to very stiff-moist		11					
10	X	24	3.0			13					
15	X	33	4.5+	Red Brown Clayey fine Sand to fine Sandy Clay, trace medium to coarse Sand, trace to little Silt, trace calcareous veining, dense to hard-moist		11					
20	X	24		Light Gray Silty fine to medium Sand, trace coarse Sand, trace to little Clay, medium dense-damp to moist		7			17		
25	X	24		Light Gray Clayey fine to coarse Sand, trace Silt, medium dense to dense-damp to moist		6			13		
30	X	33		@ 28½ to 30 feet, trace fine Gravel		11					
	X	47		Gray Brown fine to coarse Sand, little Clay, trace fine Gravel, dense-moist to very moist		14					

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-9

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/29/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: 36 feet
CAVE DEPTH: 40 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION (Continued)	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					Gray Brown fine to coarse Sand, little Clay, trace fine Gravel, dense-moist to very moist Groundwater encountered at 36 feet during drilling							
					Red Brown Clayey fine Sand, trace Silt, trace fine Gravel, dense to very dense-wet							
	X	37					21					
40												
	X	47					16					
45												
	X	50					16					
50												
					Boring Terminated at 50'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

TEST BORING LOG

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-10

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/29/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: Dry
CAVE DEPTH: 16 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
	X	36	4.5		OLDER ALLUVIUM: Brown Clayey fine to medium Sand to fine to medium Sandy Clay, trace Silt, dense to hard-damp to moist		7					
	X	48			Light Brown Silty fine Sand, little Clay, trace medium to corase Sand, dense-damp to moist		7					
5	X	41	4.5+		Brown fine Sandy Clay, trace medium to coarse Sand, trace Silt, hard-moist		12					
	X	34	3.75				11					
10												
	X	24			Gray Brown Silty fine to medium Sand, trace coarse Sand, trace Clay, medium dense-damp		5					
15					Gray Brown Clayey fine Sand, trace medium Sand, trace Silt, medium dense-damp		5					
	X	22	4.5+		Brown fine Sandy Clay, trace medium Sand, trace Silt, trace Iron oxide staining, very stiff-moist to very moist		13					
20					Boring Terminated at 20'							

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-11

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/29/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: Dry
CAVE DEPTH: 11 feet
READING TAKEN: At Completion

SURFACE ELEVATION: --- MSL

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					OLDER ALLUVIUM: Brown Clayey fine to medium Sand, trace coarse Sand, trace Silt, dense-damp							
	X	33					6					
					Red Brown fine to medium Sandy Clay, trace coarse Sand, trace Silt, medium dense to very stiff-moist							
	X	20	4.5+				11					
5												
					Brown Clayey fine to medium Sand to fine to medium Sandy Clay, trace coarse Sand, dense to hard-moist							
	X	35	3.5				8					
	X	41	4.5+				7					
10												
					Brown fine Sandy Clay, little Silt, trace medium to coarse Sand, very stiff-moist							
	X	29	2.0				10					
15												

Boring Terminated at 15'

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

TEST BORING LOG

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-12

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/29/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: Dry
CAVE DEPTH: 17 feet
READING TAKEN: At Completion

FIELD RESULTS					DESCRIPTION	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	
		15			YOUNGER ALLUVIUM: Brown Silty fine to medium Sand, trace Clay, slightly porous, medium dense-damp	101	3					
		17			Brown Clayey fine to medium Sand, trace coarse Sand, trace fine Gravel, trace Silt, medium dense to dense-damp	107	3					
5		47				110	8					
		31	4.5		OLDER ALLUVIUM: Light Brown Clayey fine Sand, trace medium Sand, trace Silt, trace Iron oxide staining, dense-moist	114	8					
		41	4.5+		Red Brown Clayey fine to medium Sand to fine to medium Sandy Clay, trace Silt, medium dense to very stiff-moist to very moist	117	14					
10												
		19	4.5				12					
15												
					Gray Brown Clayey fine to coarse Sand, little Silt, trace fine Gravel, medium dense-damp							
		25					6					
20												
					Boring Terminated at 20'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-13

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/30/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: 36 feet
CAVE DEPTH: 38 feet
READING TAKEN: At Completion

SURFACE ELEVATION: --- MSL

DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					OLDER ALLUVIUM: Brown Clayey fine to medium Sand, trace Silt, dense-damp							
	X	46					5					EI = 33 @ 0 to 5'
					Light Brown Silty fine Sand, trace medium Sand, trace to little Clay, very dense-damp							
5	X	50/6"					6					
					Brown Clayey fine Sand, trace medium to coarse Sand, little Silt, trace calcareous veining, medium dense to dense-moist							
	X	32					8					
10	X	22					12					
					Brown Clayey fine to medium Sand, trace coarse Sand, medium dense-damp to moist							
15	X	16					7					
					Gray Brown fine to coarse Sand, little Clay, trace Silt, trace fine Gravel, medium dense-damp							
20	X	18					5			18		
					Gray Brown to Red Brown Clayey fine to coarse Sand, trace medium Sand, trace Silt, medium dense-moist to very moist							
25	X	22					17			37		
30	X	19					13			27		
					Red Brown Clayey fine to coarse Sand, little Silt, dense to very dense-very moist to wet							
	X	42					12					

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-13

JOB NO.: 15G204	DRILLING DATE: 10/30/15	WATER DEPTH: 36 feet
PROJECT: D2 Air Cargo Compatible Dev.	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 38 feet
LOCATION: Moreno Valley, California	LOGGED BY: Matt Manni	READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION (Continued)	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					Red Brown Clayey fine to coarse Sand, little Silt, dense to very dense-very moist to wet Groundwater encountered at 36 feet during drilling							
40	X	50					14					
45	X	43					14					
50	X	79/11"					14					
					Boring Terminated at 50'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-14

JOB NO.: 15G204	DRILLING DATE: 10/30/15	WATER DEPTH: 36 feet
PROJECT: D2 Air Cargo Compatible Dev.	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 41 feet
LOCATION: Moreno Valley, California	LOGGED BY: Matt Manni	READING TAKEN: At Completion

SURFACE ELEVATION: --- MSL

DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
	X	26			OLDER ALLUVIUM: Brown Clayey fine to medium Sand, trace to little coarse Sand, trace Silt, trace fine Gravel, medium dense-damp		4					EI = 21 @ 0 to 5'
	X	32	4.5		@ 3½ to 35 feet, Clayey fine to medium Sand to fine to medium Sandy Clay, dense-hard		6					
5												
	X	69			Red Brown Clayey fine Sand, little medium to coarse Sand, trace Silt, very dense-damp to moist		6					
	X	68					12					
10												
					Light Brown Silty fine to medium Sand, trace coarse Sand, medium dense-damp							
	X	15					4					
15												
					Light Gray Brown Silty fine to medium Sand, trace coarse Sand, trace Clay, trace calcareous veining, dense to very dense-moist							
	X	80					10					
20												
	X	37					8			20		
25												
					Light Red Brown Clayey fine to coarse Sand, little Silt, trace fine Gravel, dense to very dense-moist to wet							
	X	59					11					
30												
	X	42					13					

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-14

JOB NO.: 15G204	DRILLING DATE: 10/30/15	WATER DEPTH: 36 feet
PROJECT: D2 Air Cargo Compatible Dev.	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 41 feet
LOCATION: Moreno Valley, California	LOGGED BY: Matt Manni	READING TAKEN: At Completion

FIELD RESULTS					DESCRIPTION (Continued)	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG		DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	
					Light Red Brown Clayey fine to coarse Sand, little Silt, trace fine Gravel, dense to very dense-moist to wet. Groundwater encountered at 36 feet during drilling							
	X	47					15					
40												
	X	60					15					
45												
	X	68					16					
50					Boring Terminated at 50'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-15

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/30/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: Dry
CAVE DEPTH: 18 feet
READING TAKEN: At Completion

SURFACE ELEVATION: --- MSL

FIELD RESULTS: DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	LABORATORY RESULTS: DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
		20			ALLUVIUM: Brown Silty fine to medium Sand, trace coarse Sand, trace Clay, trace fine root fibers, very porous, medium dense-damp	101	3					
		48			OLDER ALLUVIUM: Brown Clayey fine to medium Sand, trace coarse Sand, trace to little Silt, trace fine root fibers, slightly porous, dense-damp	110	4					
5		47				112	4					
		49	2.5		Orange Brown Clayey fine Sand to fine Sandy Clay, trace medium to coarse Sand, trace Silt, trace Iron oxide staining, dense to hard-damp to moist	116	6					
10		55	3.5			102	12					
15		26	4.0		Brown to Gray Brown fine Sandy Clay, trace Silt, trace medium to coarse Sand, trace calcareous nodules, very stiff-very moist		19					
20		24	4.0				16					
					Boring Terminated at 20'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-16

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/30/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: Dry
CAVE DEPTH: 14 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
	X	42			OLDER ALLUVIUM: Brown Clayey fine to medium Sand, trace coarse Sand, trace Silt, trace calcareous veining, dense-damp		4					
	X	18	4.5+		@ 3½ to 8 feet, Clayey fine to medium Sand to fine to medium Sandy Clay, medium dense to very stiff-damp to moist		5					
5												
	X	29	4.5				10					
	X	22	4.5		Red Brown fine to medium Sandy Clay, trace coarse Sand, trace Silt, very stiff-moist		11					
10												
					Brown Clayey fine to medium Sand, trace coarse Sand, trace Silt, medium dense-moist							
	X	25					10					
15												
					Boring Terminated at 15'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-17

JOB NO.: 15G204	DRILLING DATE: 10/30/15	WATER DEPTH: 31 feet
PROJECT: D2 Air Cargo Compatible Dev.	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 39 feet
LOCATION: Moreno Valley, California	LOGGED BY: Matt Manni	READING TAKEN: At Completion

DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					OLDER ALLUVIUM: Brown Clayey fine to medium Sand, trace coarse Sand, trace Silt, slightly porous, trace fine Gravel, medium dense-damp							
	X	26					5					
	X	23					6					
5												
					Brown Clayey fine Sand to fine Sandy Clay, trace medium to coarse Sand, slightly porous, trace Iron oxide staining, dense to hard-moist							
	X	32	4.5+				12					
					Red Brown Clayey fine to medium Sand to fine to medium Sandy Clay, trace coarse Sand, trace Silt, trace fine Gravel, trace Iron oxide staining, medium dense to dense to hard-moist							
	X	32	4.0				10					
10												
	X	18	4.5				11					
15												
					Light Brown Silty fine Sand, trace medium to coarse Sand, trace fine Gravel, trace calcareous veining, very dense-moist							
	X	84					9					
20												
					Light Gray Brown to Red Brown Clayey fine to coarse Sand, trace fine Gravel, dense-very moist							
	X	31					14					
25												
	X	37					19					
30												
					Groundwater encountered at 31 feet during drilling							
	X	47					16					

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

TEST BORING LOG

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-17

JOB NO.: 15G204	DRILLING DATE: 10/30/15	WATER DEPTH: 31 feet
PROJECT: D2 Air Cargo Compatible Dev.	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 39 feet
LOCATION: Moreno Valley, California	LOGGED BY: Matt Manni	READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION (Continued)	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					Light Gray Brown to Red Brown Clayey fine to coarse Sand, trace fine Gravel, dense-very moist							
	X	53					15					
40												
					Brown Silty fine Sand, trace Clay, trace medium to coarse Sand, dense-wet							
	X	37					19					
45												
	X	47					23					
50												
					Boring Terminated at 50'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

TEST BORING LOG

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-18

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 10/30/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: Dry
CAVE DEPTH: 16 feet
READING TAKEN: At Completion

FIELD RESULTS					DESCRIPTION	LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					YOUNGER ALLUVIUM: Light Brown Silty fine Sand, trace medium Sand, trace Clay, trace fine root fibers, slightly porous, medium dense-damp							
	X	25				105	3					
					OLDER ALLUVIUM: Brown Clayey fine to medium Sand, little coarse Sand, trace Silt, medium dense to dense-damp							
	X	40				129	5					
5	X	63				105	4					
					Light Brown Clayey fine Sand, little Silt, trace medium Sand, medium dense-damp							
	X	32				97	4					
					Red Brown fine to coarse Sand, trace Clay, trace to little Silt, trace fine Gravel, medium dense-damp							
					Brown Clayey fine Sand to fine Sandy Clay, trace medium to coarse Sand, trace Silt, slightly porous, trace Iron oxide staining, medium dense to dense to very stiff to hard-damp to moist							
10	X	32	4.5			107	6					
15	X	32	4.0				14					
					Light Gray Brown fine Sandy Silt, trace Clay, trace medium Sand, trace calcareous veining, dense-moist							
20	X	40					11					
					Boring Terminated at 20'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SOUTHERN CALIFORNIA GEOTECHNICAL

A California Corporation

BORING NO. B-19

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 11/3/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: 33 feet
CAVE DEPTH: 39 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					OLDER ALLUVIUM: Brown Clayey fine Sand, trace medium to coarse Sand, trace Silt, trace fine root fibers, medium dense to very dense-damp to moist							
	X	25					7					
	X	53					5					
5												
	X	63/11"			@ 6 to 7½ feet, Red Brown		7					
					Brown Clayey fine Sand to fine Sandy Clay, trace Silt, trace medium Sand, medium dense to very stiff-very moist							
	X	22					13					
10												
					Brown Clayey fine to medium Sand, trace Silt, trace calcareous veining, well cemented, very dense-moist							
	X	54					11					
15												
					Brown fine to coarse Sand, little Clay, little Silt, dense-moist							
	X	39					12					
20												
					Gray Brown Clayey fine to coarse Sand, trace Silt, trace fine Gravel, well cemented, very dense-damp to moist							
	X	52					9					
25												
					Brown to Red Brown Clayey fine to coarse Sand, trace fine Gravel, trace Silt, dense-moist to wet							
	X	47					9					
30												
					Groundwater encountered at 33 feet during drilling							
	X	45					14					

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-19

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 11/3/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: 33 feet
CAVE DEPTH: 39 feet
READING TAKEN: At Completion

DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION (Continued)	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					Brown to Red Brown Clayey fine to coarse Sand, trace fine Gravel, trace Silt, dense-moist to wet							
	X	39					15					
40												
					Red Brown Silty fine to coarse Sand, trace to little Clay, trace fine Gravel, very dense-wet							
	X	51					13					
45												
	X	65					15					
50												
					Boring Terminated at 50'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

TEST BORING LOG

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-20

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 11/3/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: Dry
CAVE DEPTH: 3 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					OLDER ALLUVIUM: Brown Clayey fine Sand, trace medium to coarse Sand, trace fine root fibers, slightly porous, dense-damp							
	X	32					5					
	X	30					6					
5												
					Boring Terminated at 5'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-21

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 11/3/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: Dry
CAVE DEPTH: 3 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
	X	27			OLDER ALLUVIUM: Brown Clayey fine Sand, trace medium Sand, trace fine root fibers, medium dense-damp		3					
5	X	55			Light Gray Brown Clayey fine to medium Sand, trace coarse Sand, trace Silt, very dense-damp		5					
					Boring Terminated at 5'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-22

JOB NO.: 15G204
PROJECT: D2 Air Cargo Compatible Dev.
LOCATION: Moreno Valley, California

DRILLING DATE: 11/3/15
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Matt Manni

WATER DEPTH: Dry
CAVE DEPTH: 3 feet
READING TAKEN: At Completion

SURFACE ELEVATION: --- MSL

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					YOUNGER ALLUVIUM: Light Brown Silty fine Sand, trace medium to coarse Sand, trace Clay, medium dense-damp							
	X	12					3					
	X	11					4					
5												
					Boring Terminated at 5'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

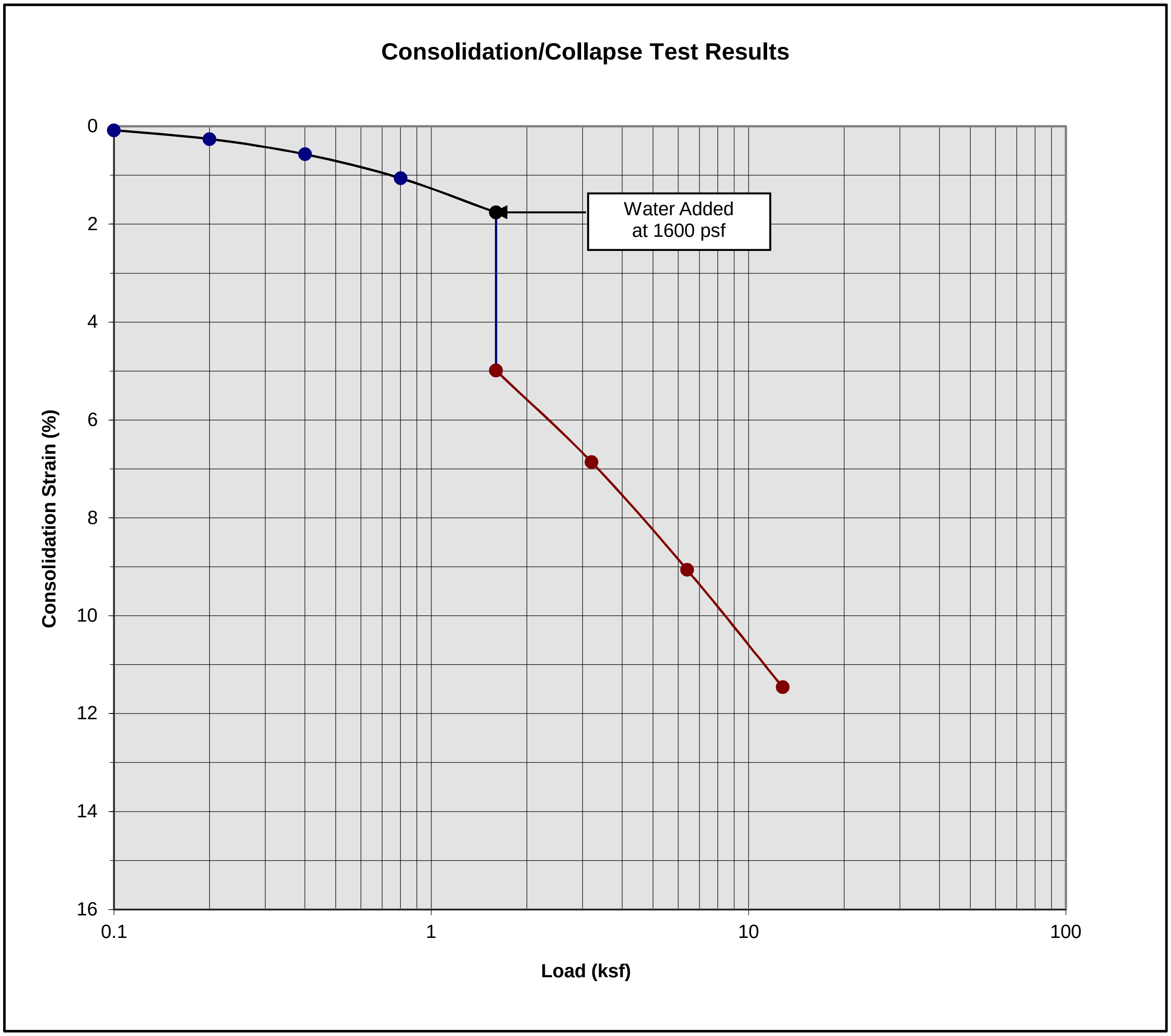
BORING NO. B-23

JOB NO.: 15G204	DRILLING DATE: 11/3/15	WATER DEPTH: Dry
PROJECT: D2 Air Cargo Compatible Dev.	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 3 feet
LOCATION: Moreno Valley, California	LOGGED BY: Matt Manni	READING TAKEN: At Completion

FIELD RESULTS					DESCRIPTION	LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	SURFACE ELEVATION: --- MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
	X	27			OLDER ALLUVIUM: Light Brown Clayey fine Sand, trace medium to coarse Sand, little Silt, medium dense-damp		4					
	X	37			Gray Brown Clayey fine to medium Sand, trace coarse Sand, trace Silt, dense-damp		6					
5					Boring Terminated at 5'							

TBL 15G204.GPJ SOCALGEO.GDT 12/17/15

APPENDIX C

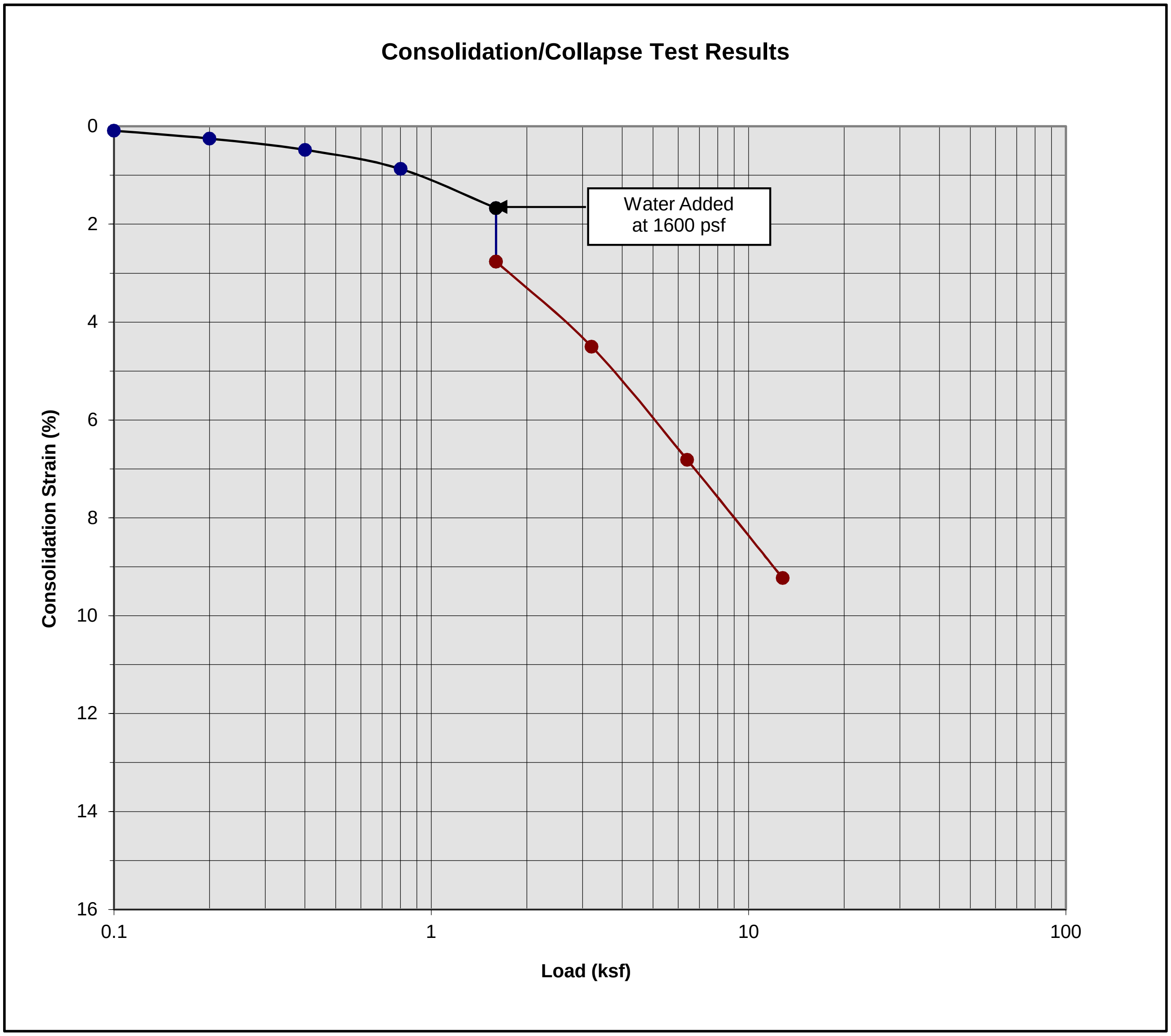


Classification: Brown Clayey fine to medium Sand, trace coarse Sand

Boring Number:	B-12	Initial Moisture Content (%)	3
Sample Number:	---	Final Moisture Content (%)	13
Depth (ft)	3 to 4	Initial Dry Density (pcf)	107.5
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	120.3
Specimen Thickness (in)	1.0	Percent Collapse (%)	3.23

D2 Air Cargo Compatible Development
Moreno Valley, California
Project No. 15G204
PLATE C- 1

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation



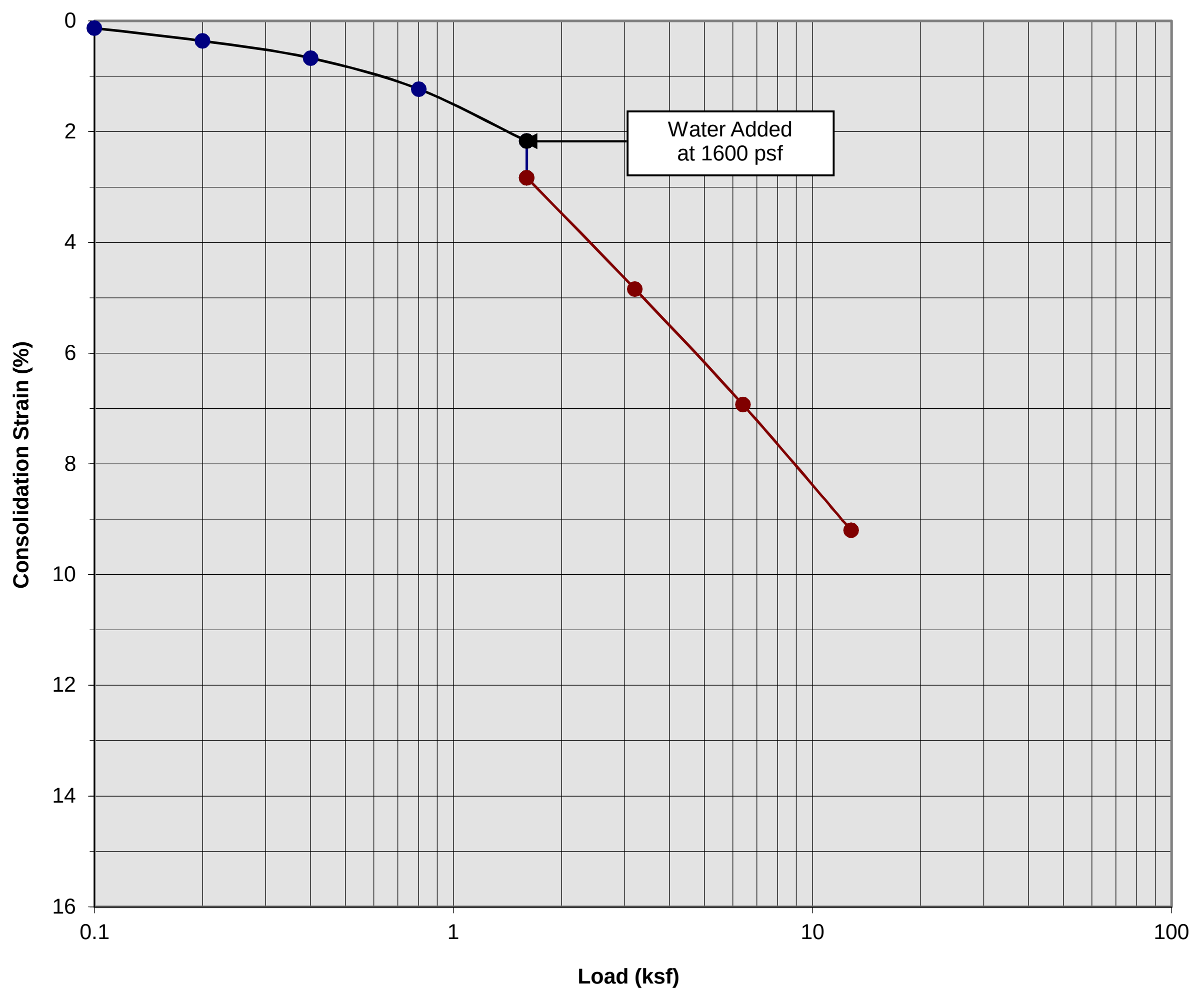
Classification: Light Brown Clayey fine Sand, trace medium Sand, trace Silt

Boring Number:	B-12	Initial Moisture Content (%)	8
Sample Number:	---	Final Moisture Content (%)	19
Depth (ft)	5 to 6	Initial Dry Density (pcf)	109.4
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	115.9
Specimen Thickness (in)	1.0	Percent Collapse (%)	1.09

D2 Air Cargo Compatible Development
Moreno Valley, California
Project No. 15G204
PLATE C- 2

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results



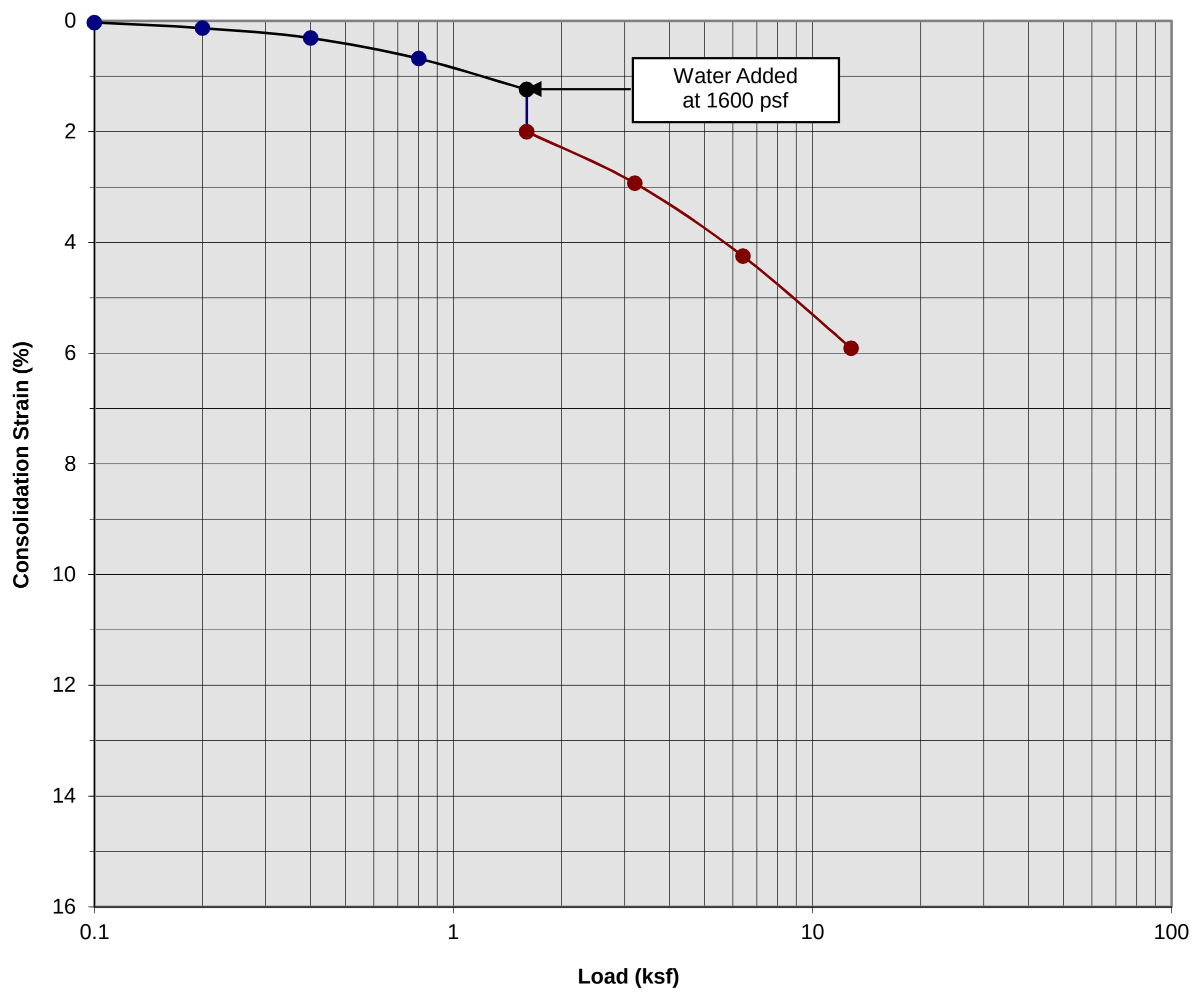
Classification: Red Brown Clayey fine to medium Sand, trace coarse Sand, trace Silt

Boring Number:	B-12	Initial Moisture Content (%)	8
Sample Number:	---	Final Moisture Content (%)	13
Depth (ft)	7 to 8	Initial Dry Density (pcf)	113.9
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	125.4
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.66

D2 Air Cargo Compatible Development
Moreno Valley, California
Project No. 15G204
PLATE C- 3

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results



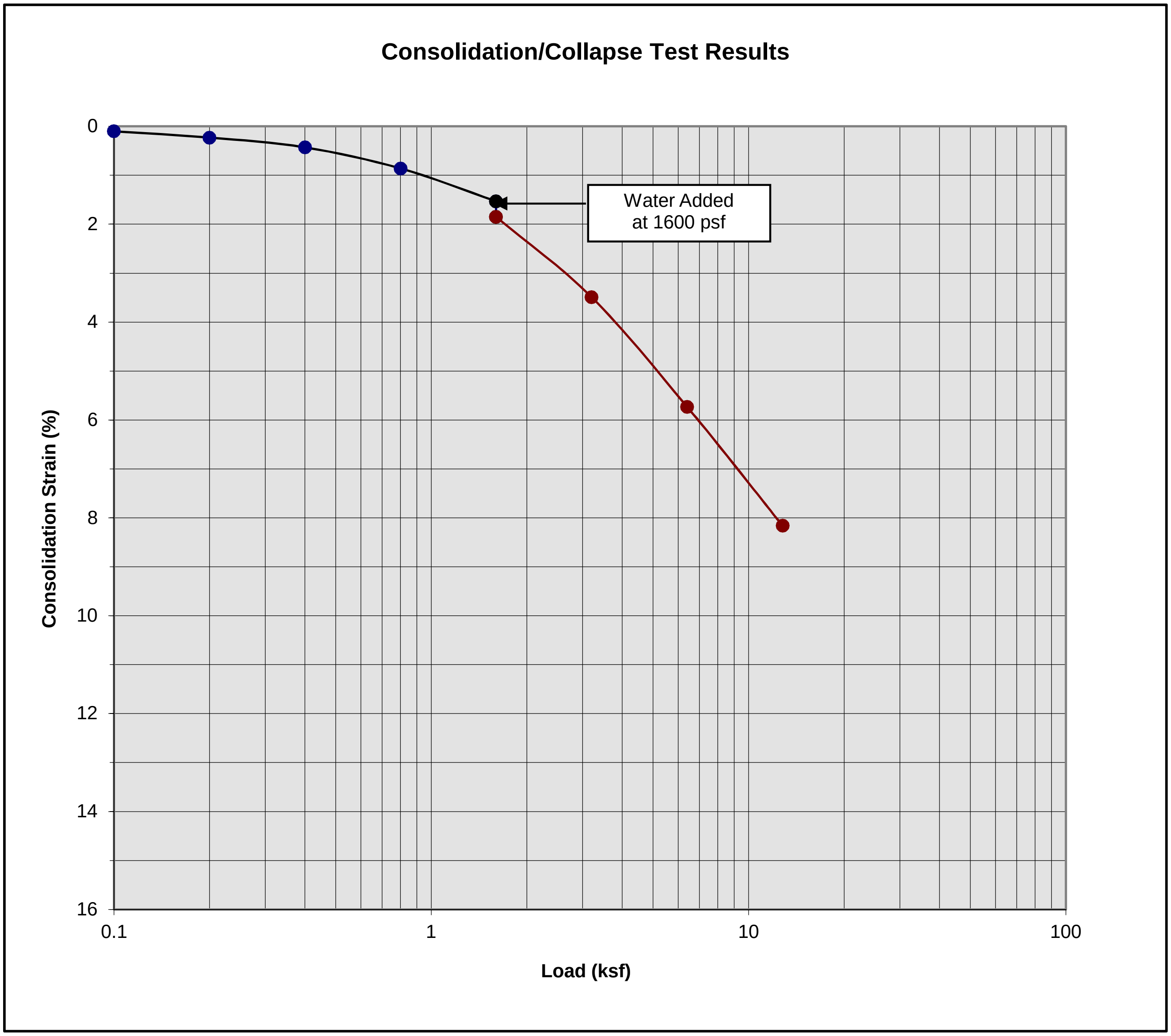
Classification: Brown Clayey fine Sand, trace medium Sand, trace to little Silt

Boring Number:	B-12	Initial Moisture Content (%)	14
Sample Number:	---	Final Moisture Content (%)	16
Depth (ft)	9 to 10	Initial Dry Density (pcf)	117.6
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	124.4
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.76

D2 Air Cargo Compatible Development
Moreno Valley, California
Project No. 15G204

PLATE C- 4

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation



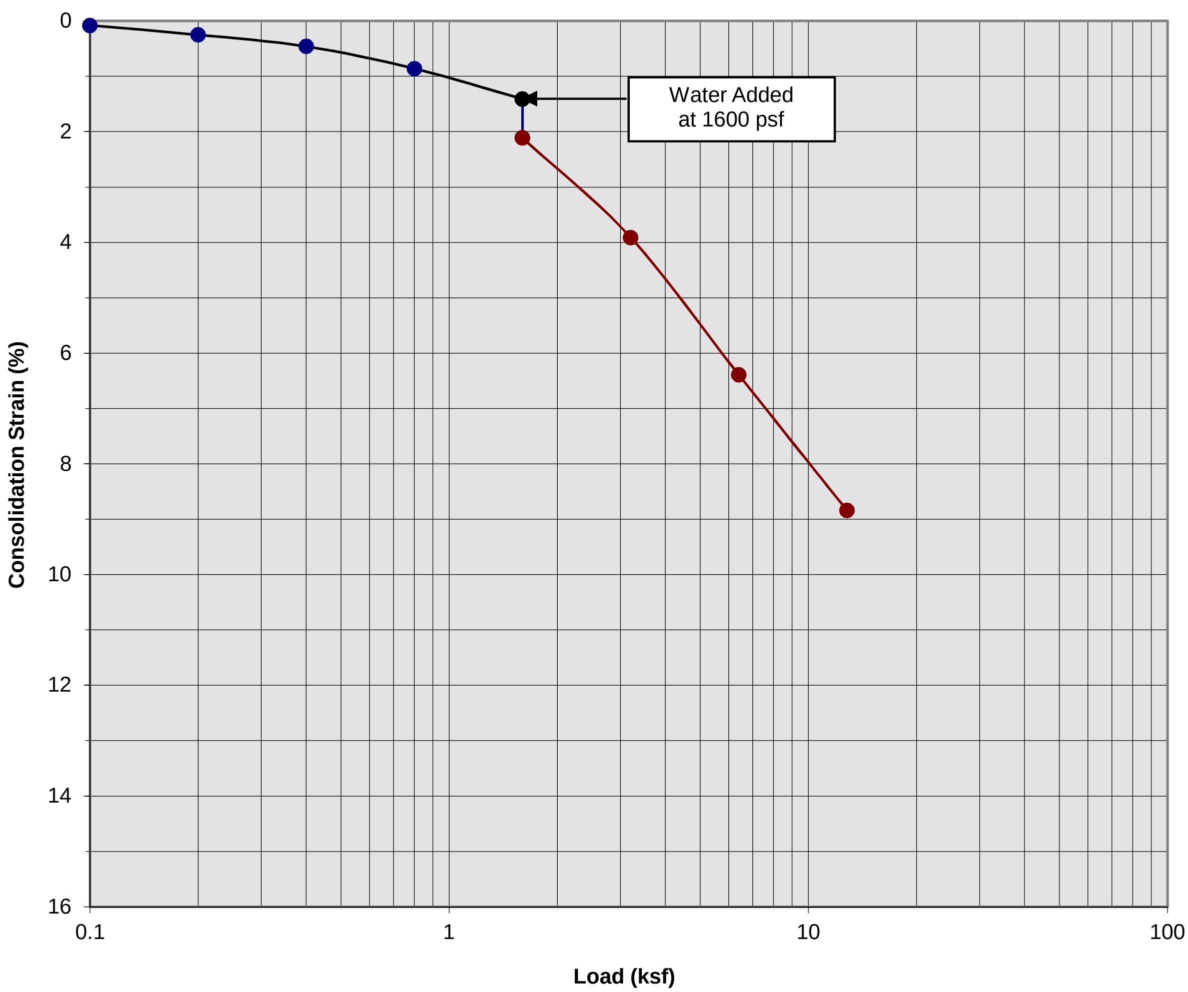
Classification: Brown Clayey fine to medium Sand, trace coarse Sand, trace to little Silt

Boring Number:	B-15	Initial Moisture Content (%)	4
Sample Number:	---	Final Moisture Content (%)	12
Depth (ft)	3 to 4	Initial Dry Density (pcf)	110.2
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	119.6
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.32

D2 Air Cargo Compatible Development
Moreno Valley, California
Project No. 15G204
PLATE C- 5

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

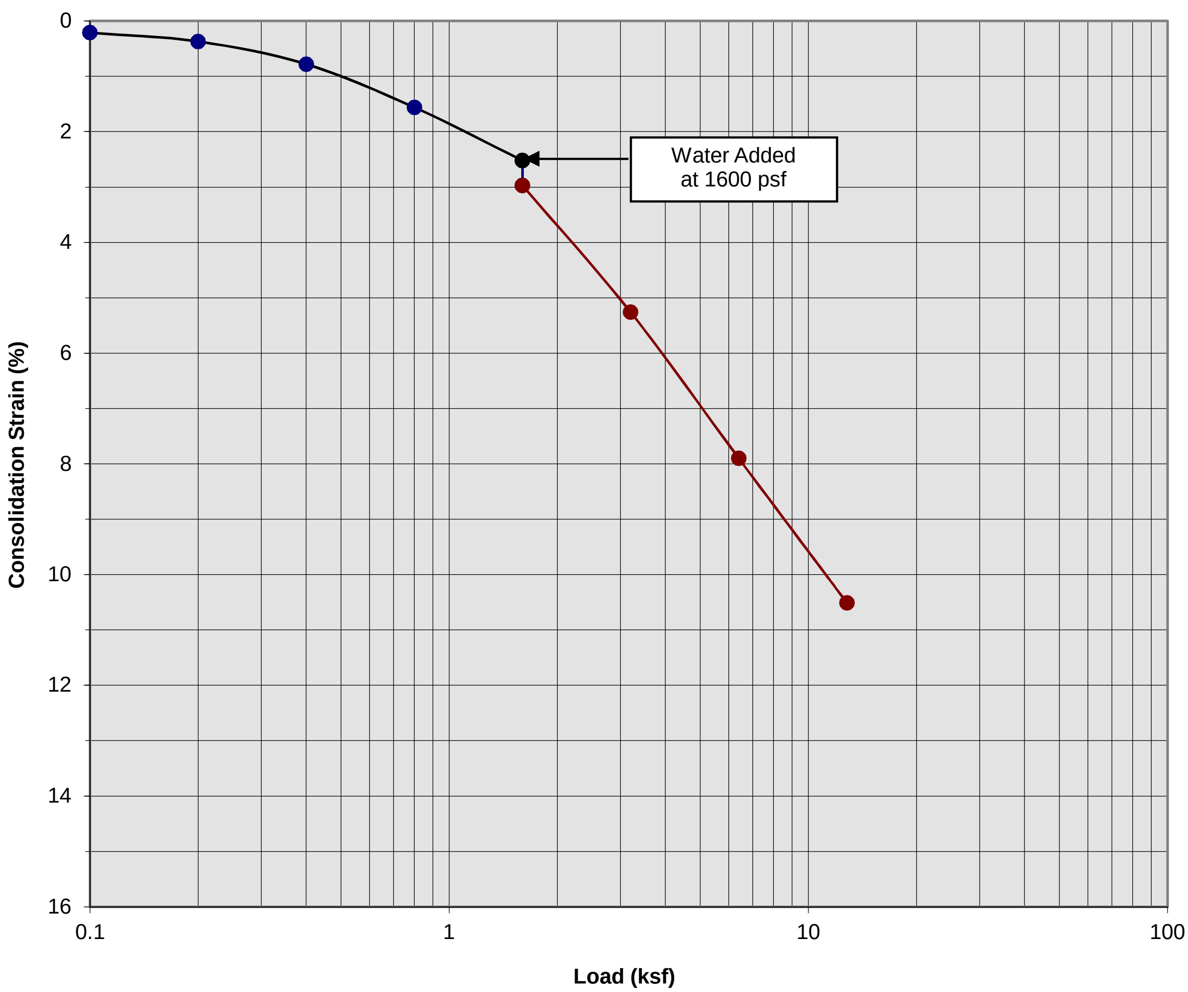
Consolidation/Collapse Test Results



Classification: Brown Clayey fine to medium Sand, trace coarse Sand, trace to little Silt

Boring Number:	B-15	Initial Moisture Content (%)	4
Sample Number:	---	Final Moisture Content (%)	12
Depth (ft)	5 to 6	Initial Dry Density (pcf)	112.8
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	124.1
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.70

Consolidation/Collapse Test Results



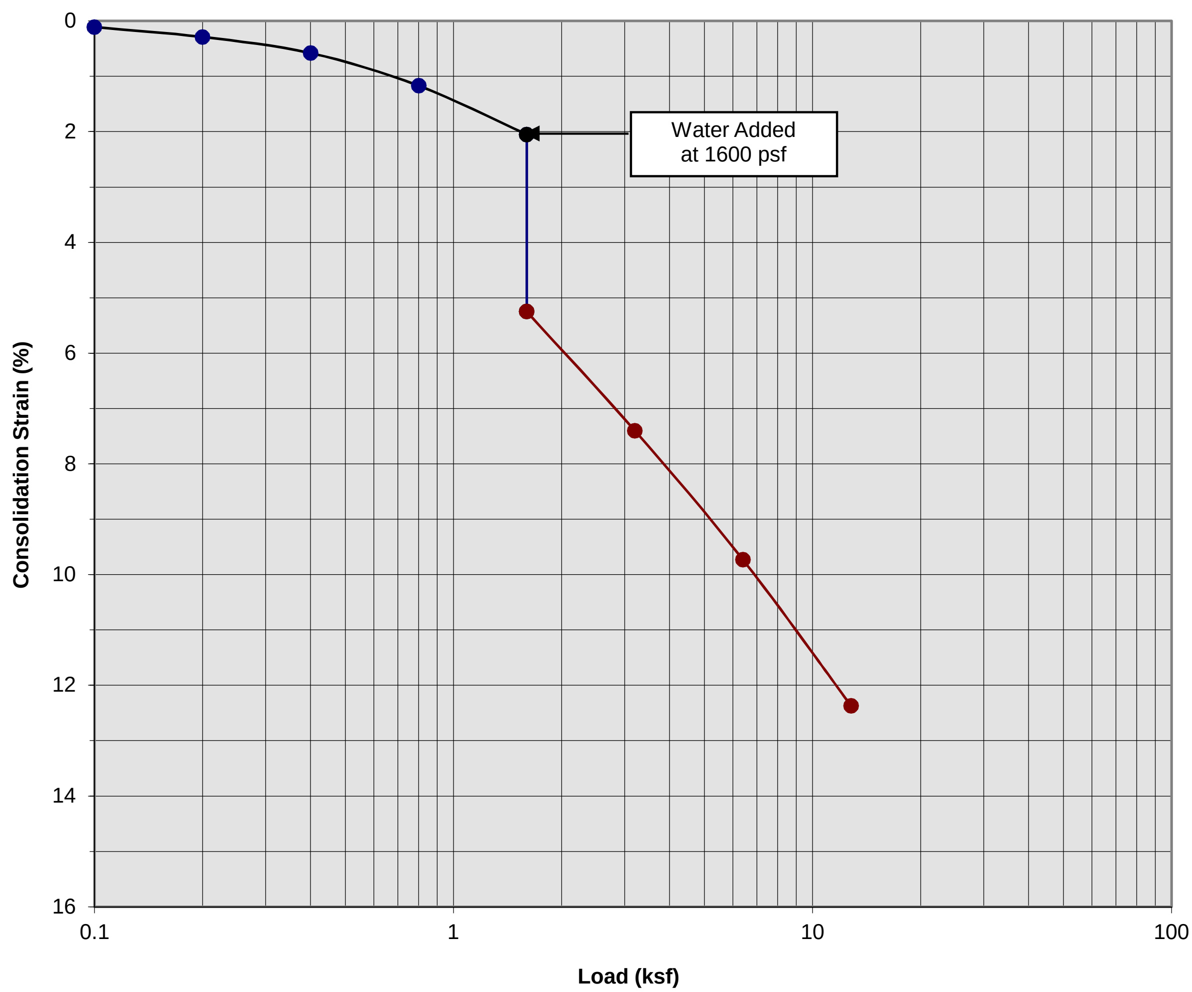
Classification: Orange Brown Clayey fine Sand, trace medium to coarse Sand, trace Silt

Boring Number:	B-15	Initial Moisture Content (%)	6
Sample Number:	---	Final Moisture Content (%)	14
Depth (ft)	7 to 8	Initial Dry Density (pcf)	116.0
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	129.6
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.45

D2 Air Cargo Compatible Development
Moreno Valley, California
Project No. 15G204
PLATE C- 7

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results

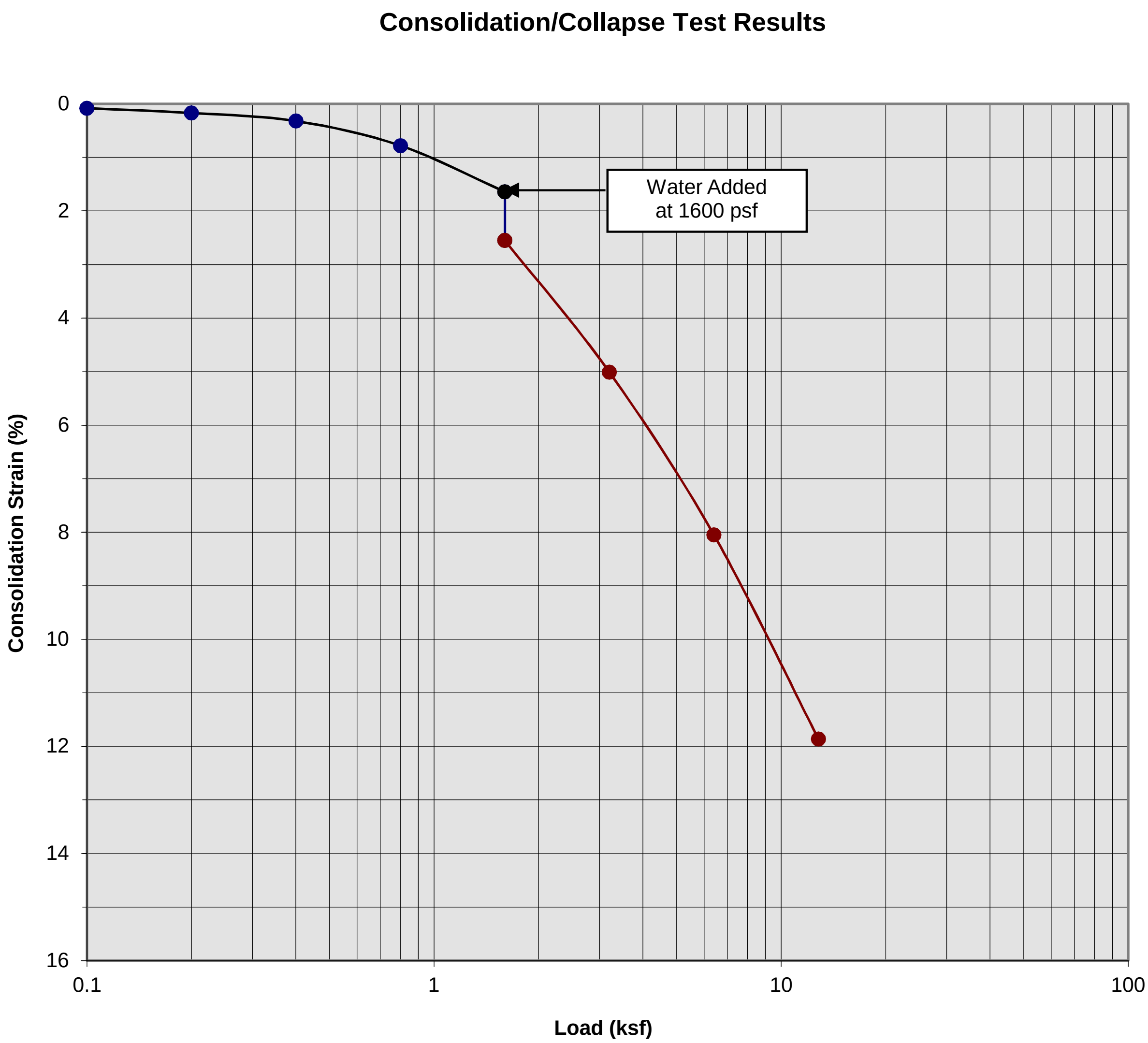


Classification: Orange Brown Clayey fine Sand, trace medium to coarse Sand, trace Silt

Boring Number:	B-15	Initial Moisture Content (%)	12
Sample Number:	---	Final Moisture Content (%)	18
Depth (ft)	9 to 10	Initial Dry Density (pcf)	102.0
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	116.4
Specimen Thickness (in)	1.0	Percent Collapse (%)	3.20

D2 Air Cargo Compatible Development
Moreno Valley, California
Project No. 15G204
PLATE C- 8

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

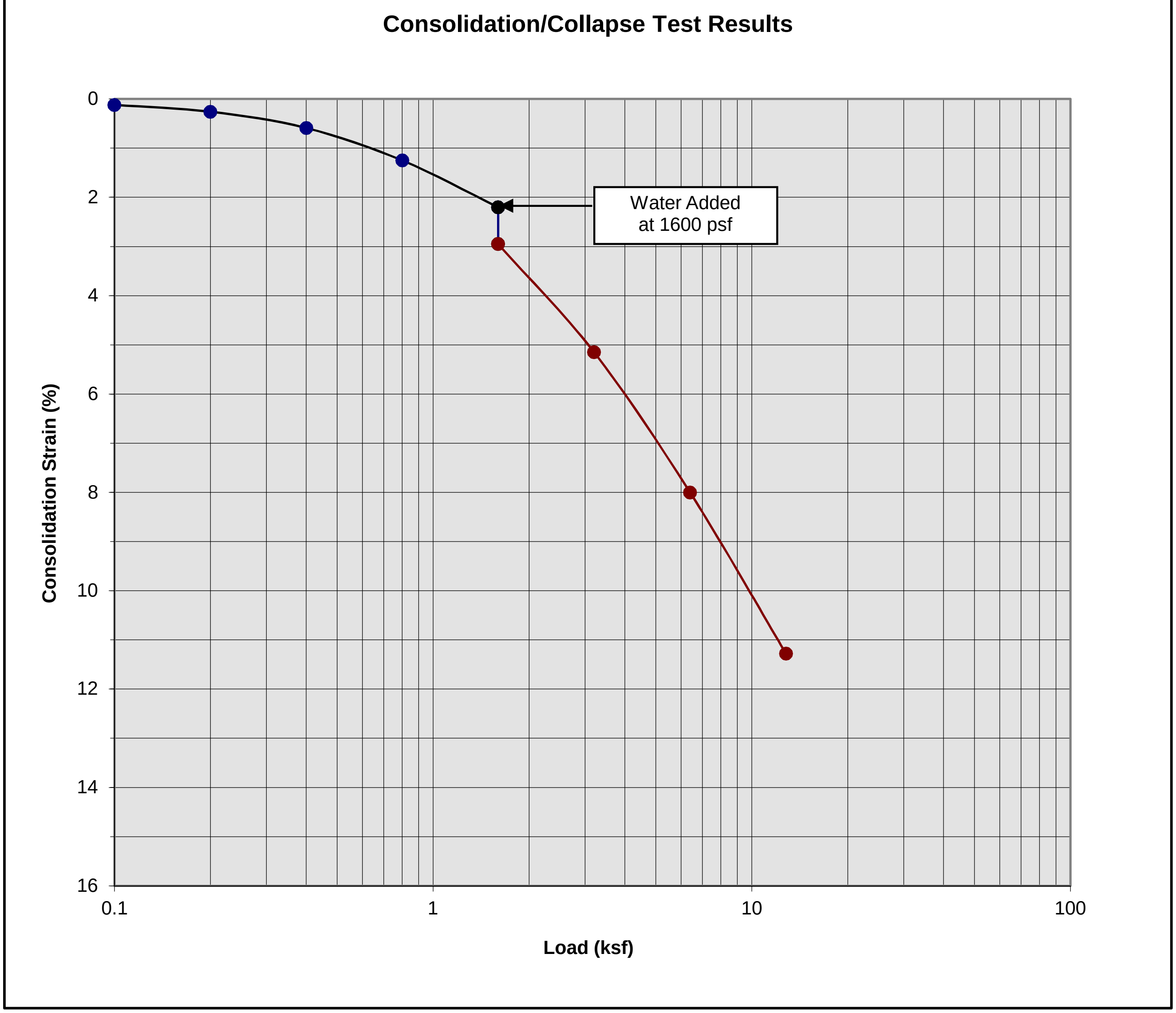


Classification: Light Brown Silty fine Sand, trace medium Sand, trace Clay

Boring Number:	B-18	Initial Moisture Content (%)	3
Sample Number:	---	Final Moisture Content (%)	13
Depth (ft)	1 to 2	Initial Dry Density (pcf)	105.5
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	119.2
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.91

D2 Air Cargo Compatible Development
Moreno Valley, California
Project No. 15G204
PLATE C- 9

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

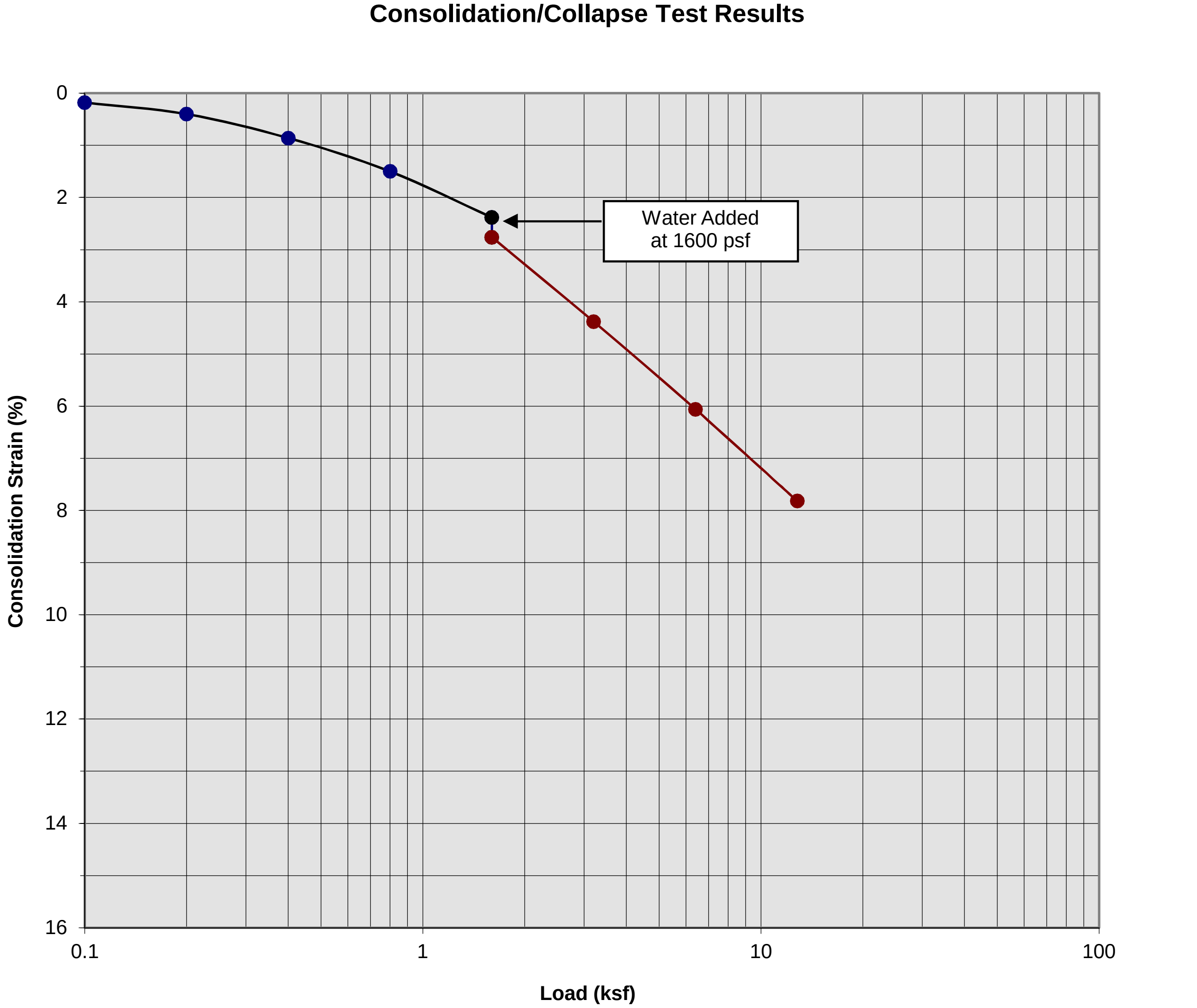


Classification: Brown Clayey fine to medium Sand, little coarse Sand, trace Silt

Boring Number:	B-18	Initial Moisture Content (%)	4
Sample Number:	---	Final Moisture Content (%)	12
Depth (ft)	5 to 6	Initial Dry Density (pcf)	104.7
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	118.3
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.75

D2 Air Cargo Compatible Development
Moreno Valley, California
Project No. 15G204
PLATE C- 10

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL *A California Corporation*



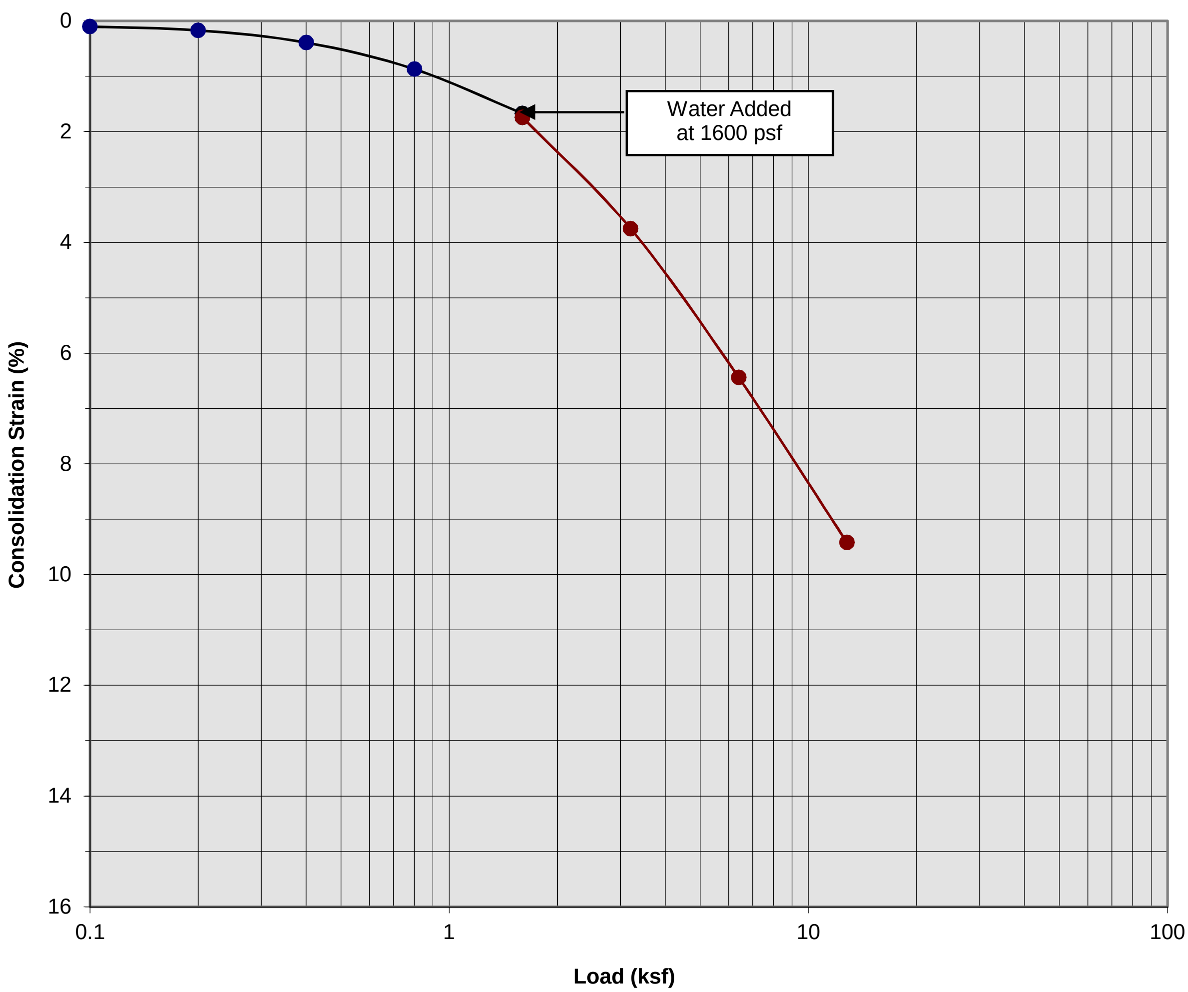
Classification: Red Brown fine to coarse Sand, trace Clay, trace to little Silt, trace fine Gravel

Boring Number:	B-18	Initial Moisture Content (%)	4
Sample Number:	---	Final Moisture Content (%)	15
Depth (ft)	7 to 8	Initial Dry Density (pcf)	97.4
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	105.7
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.38

D2 Air Cargo Compatible Development
Moreno Valley, California
Project No. 15G204
PLATE C- 11

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results

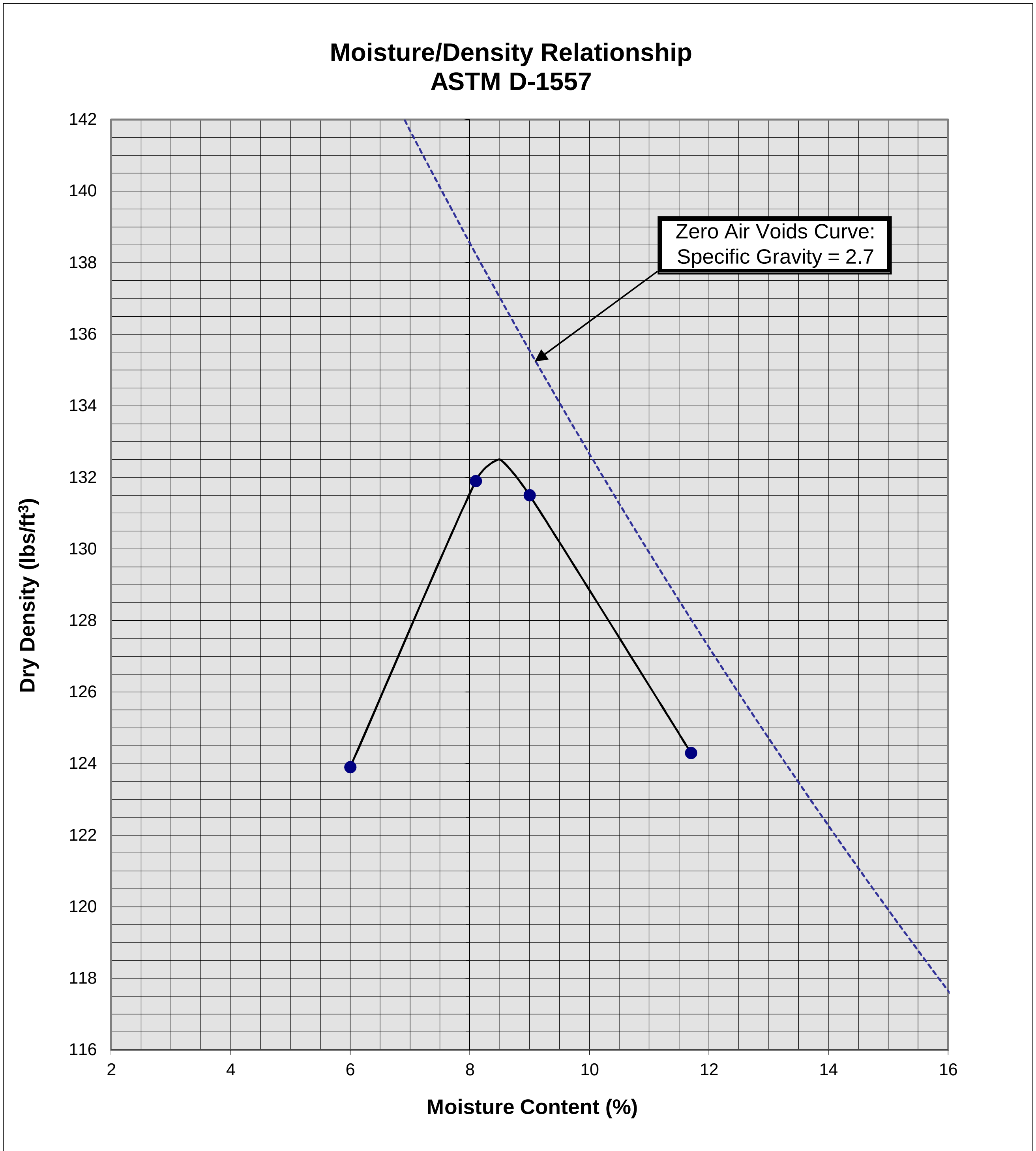


Classification: Brown Clayey fine Sand to fine Sandy Clay, trace medium to coarse Sand

Boring Number:	B-18	Initial Moisture Content (%)	6
Sample Number:	---	Final Moisture Content (%)	13
Depth (ft)	9 to 10	Initial Dry Density (pcf)	105.8
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	116.2
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.07

D2 Air Cargo Compatible Development
Moreno Valley, California
Project No. 15G204
PLATE C- 12

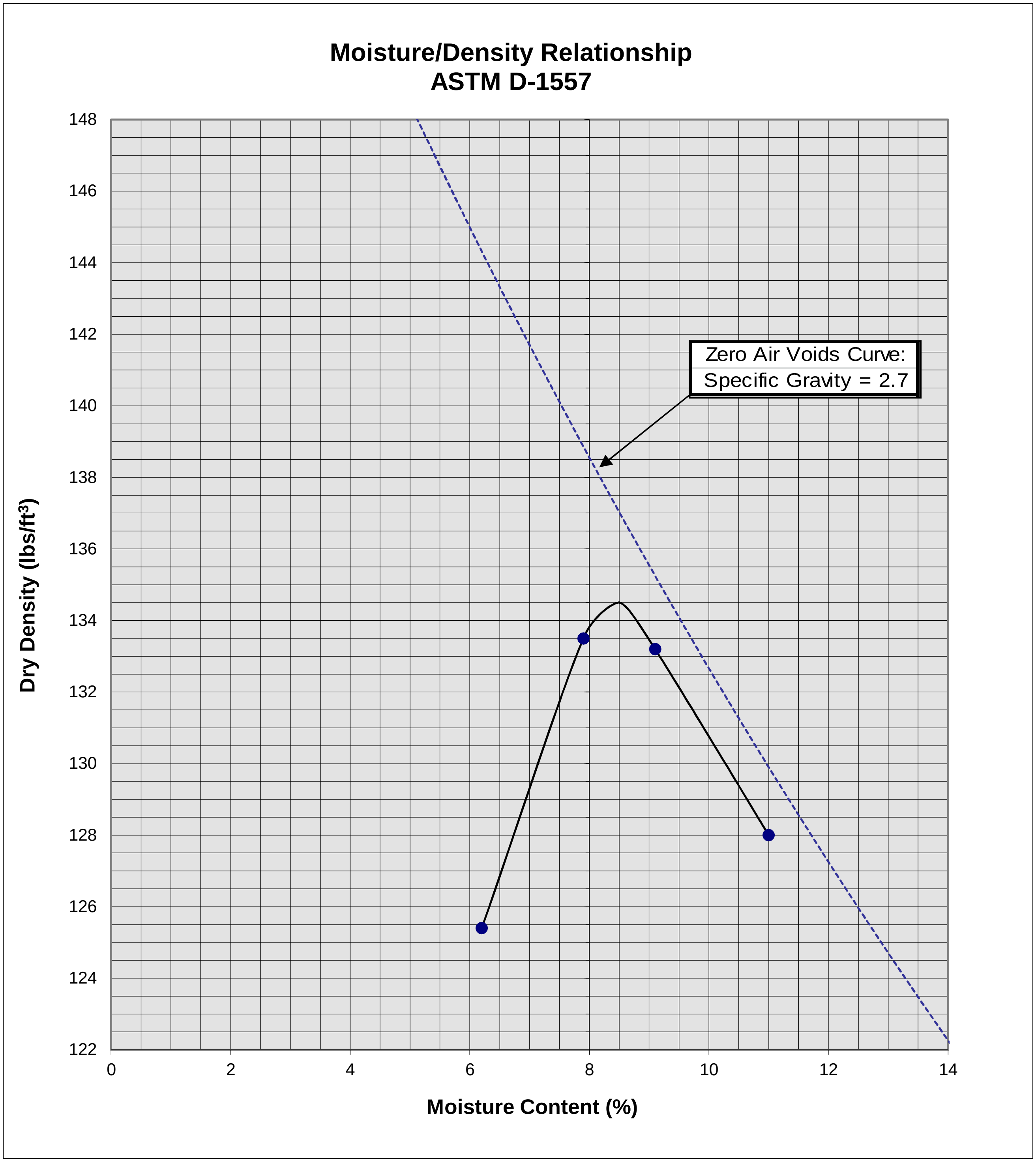
SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation



Soil ID Number	B-4 @ 0 to 5'
Optimum Moisture (%)	8.5
Maximum Dry Density (pcf)	132.5
Soil Classification	Light Red Brown Clayey fine Sand

D2 Air Cargo Compatible Dev.
Moreno Valley, California
Project No. 15G204
PLATE C-13

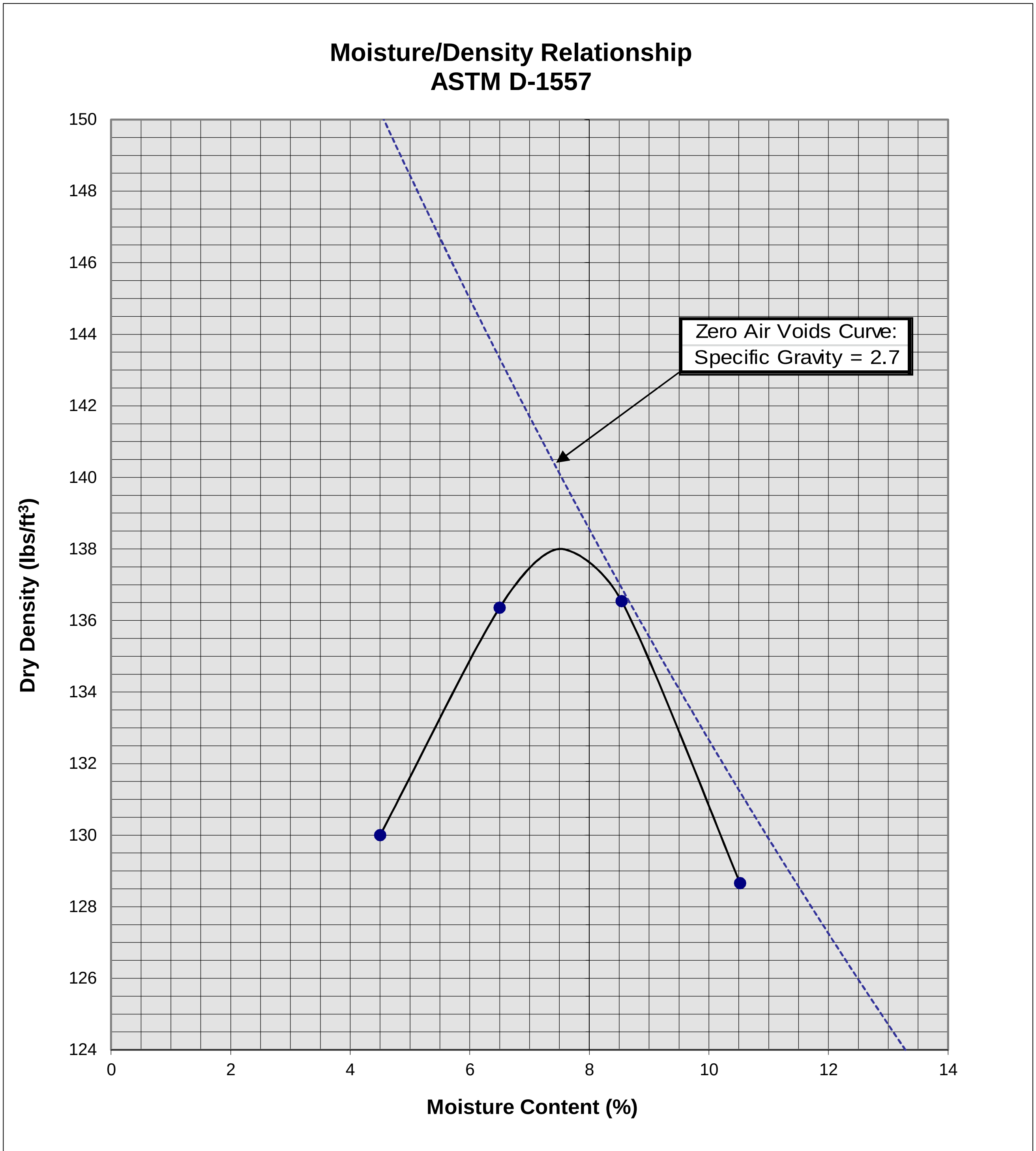
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation



Soil ID Number	B-13 @ 0 to 5'
Optimum Moisture (%)	8.5
Maximum Dry Density (pcf)	134.5
Soil Classification	Red Brown Clayey fine to medium Sand

D2 Air Cargo Compatible Dev.
Moreno Valley, California
Project No. 15G204
PLATE C-14

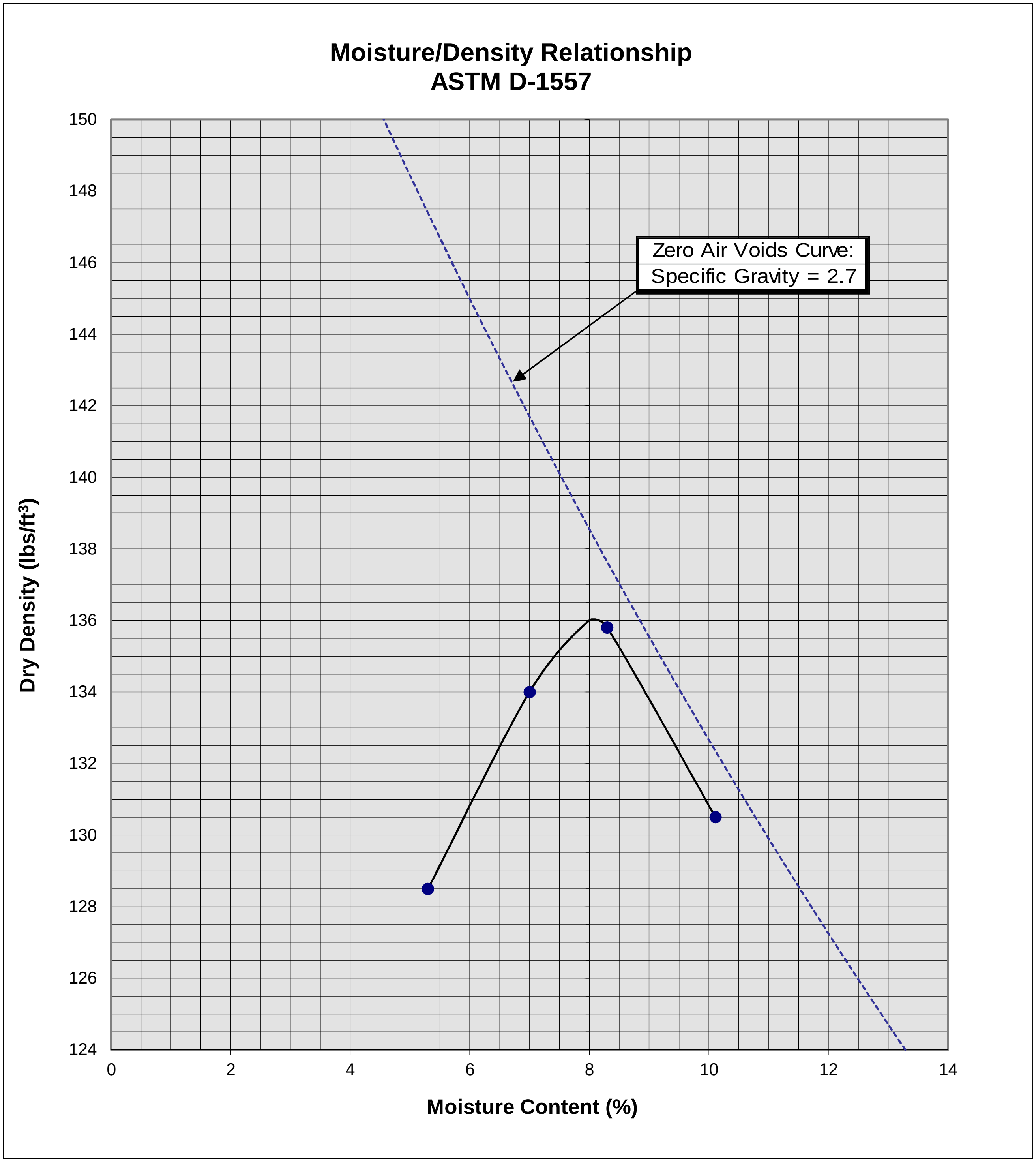
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation



Soil ID Number	B-14 @ 0 to 5'
Optimum Moisture (%)	7.5
Maximum Dry Density (pcf)	138
Soil Classification	Dark Brown Clayey fine to medium Sand, trace Silt & fine Gravel

D2 Air Cargo Compatible Dev.
Moreno Valley, California
Project No. 15G204
PLATE C-15

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation



Soil ID Number	B-20 @ 0 to 5'
Optimum Moisture (%)	8
Maximum Dry Density (pcf)	135.5
Soil Classification	Brown Silty fine Sand

D2 Air Cargo Compatible Dev.
Moreno Valley, California
Project No. 15G204
PLATE C-16

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

APPENDIX D

GRADING GUIDE SPECIFICATIONS

These grading guide specifications are intended to provide typical procedures for grading operations. They are intended to supplement the recommendations contained in the geotechnical investigation report for this project. Should the recommendations in the geotechnical investigation report conflict with the grading guide specifications, the more site specific recommendations in the geotechnical investigation report will govern.

General

- The Earthwork Contractor is responsible for the satisfactory completion of all earthwork in accordance with the plans and geotechnical reports, and in accordance with city, county, and applicable building codes.

- The Geotechnical Engineer is the representative of the Owner/Builder for the purpose of implementing the report recommendations and guidelines. These duties are not intended to relieve the Earthwork Contractor of any responsibility to perform in a workman-like manner, nor is the Geotechnical Engineer to direct the grading equipment or personnel employed by the Contractor.

- The Earthwork Contractor is required to notify the Geotechnical Engineer of the anticipated work and schedule so that testing and inspections can be provided. If necessary, work may be stopped and redone if personnel have not been scheduled in advance.

- The Earthwork Contractor is required to have suitable and sufficient equipment on the job-site to process, moisture condition, mix and compact the amount of fill being placed to the approved compaction. In addition, suitable support equipment should be available to conform with recommendations and guidelines in this report.

- Canyon cleanouts, overexcavation areas, processed ground to receive fill, key excavations, subdrains and benches should be observed by the Geotechnical Engineer prior to placement of any fill. It is the Earthwork Contractor's responsibility to notify the Geotechnical Engineer of areas that are ready for inspection.

- Excavation, filling, and subgrade preparation should be performed in a manner and sequence that will provide drainage at all times and proper control of erosion. Precipitation, springs, and seepage water encountered shall be pumped or drained to provide a suitable working surface. The Geotechnical Engineer must be informed of springs or water seepage encountered during grading or foundation construction for possible revision to the recommended construction procedures and/or installation of subdrains.

Site Preparation

- The Earthwork Contractor is responsible for all clearing, grubbing, stripping and site preparation for the project in accordance with the recommendations of the Geotechnical Engineer.

- If any materials or areas are encountered by the Earthwork Contractor which are suspected of having toxic or environmentally sensitive contamination, the Geotechnical Engineer and Owner/Builder should be notified immediately.

- Major vegetation should be stripped and disposed of off-site. This includes trees, brush, heavy grasses and any materials considered unsuitable by the Geotechnical Engineer.

- Underground structures such as basements, cesspools or septic disposal systems, mining shafts, tunnels, wells and pipelines should be removed under the inspection of the Geotechnical Engineer and recommendations provided by the Geotechnical Engineer and/or city, county or state agencies. If such structures are known or found, the Geotechnical Engineer should be notified as soon as possible so that recommendations can be formulated.

- Any topsoil, slopewash, colluvium, alluvium and rock materials which are considered unsuitable by the Geotechnical Engineer should be removed prior to fill placement.

- Remaining voids created during site clearing caused by removal of trees, foundations basements, irrigation facilities, etc., should be excavated and filled with compacted fill.

- Subsequent to clearing and removals, areas to receive fill should be scarified to a depth of 10 to 12 inches, moisture conditioned and compacted

- The moisture condition of the processed ground should be at or slightly above the optimum moisture content as determined by the Geotechnical Engineer. Depending upon field conditions, this may require air drying or watering together with mixing and/or discing.

<u>Compacted Fills</u>

- Soil materials imported to or excavated on the property may be utilized in the fill, provided each material has been determined to be suitable in the opinion of the Geotechnical Engineer. Unless otherwise approved by the Geotechnical Engineer, all fill materials shall be free of deleterious, organic, or frozen matter, shall contain no chemicals that may result in the material being classified as “contaminated,” and shall be very low to non-expansive with a maximum expansion index (EI) of 50. The top 12 inches of the compacted fill should have a maximum particle size of 3 inches, and all underlying compacted fill material a maximum 6-inch particle size, except as noted below.

- All soils should be evaluated and tested by the Geotechnical Engineer. Materials with high expansion potential, low strength, poor gradation or containing organic materials may require removal from the site or selective placement and/or mixing to the satisfaction of the Geotechnical Engineer.

- Rock fragments or rocks less than 6 inches in their largest dimensions, or as otherwise determined by the Geotechnical Engineer, may be used in compacted fill, provided the distribution and placement is satisfactory in the opinion of the Geotechnical Engineer.

- Rock fragments or rocks greater than 12 inches should be taken off-site or placed in accordance with recommendations and in areas designated as suitable by the Geotechnical Engineer. These materials should be placed in accordance with Plate D-8 of these Grading Guide Specifications and in accordance with the following recommendations:

  - Rocks 12 inches or more in diameter should be placed in rows at least 15 feet apart, 15 feet from the edge of the fill, and 10 feet or more below subgrade. Spaces should be left between each rock fragment to provide for placement and compaction of soil around the fragments.

  - Fill materials consisting of soil meeting the minimum moisture content requirements and free of oversize material should be placed between and over the rows of rock or concrete. Ample water and compactive effort should be applied to the fill materials as they are placed in order that all of the voids between each of the fragments are filled and compacted to the specified density.

- Subsequent rows of rocks should be placed such that they are not directly above a row placed in the previous lift of fill. A minimum 5-foot offset between rows is recommended.

- To facilitate future trenching, oversized material should not be placed within the range of foundation excavations, future utilities or other underground construction unless specifically approved by the soil engineer and the developer/owner representative.

- Fill materials approved by the Geotechnical Engineer should be placed in areas previously prepared to receive fill and in evenly placed, near horizontal layers at about 6 to 8 inches in loose thickness, or as otherwise determined by the Geotechnical Engineer for the project.

- Each layer should be moisture conditioned to optimum moisture content, or slightly above, as directed by the Geotechnical Engineer. After proper mixing and/or drying, to evenly distribute the moisture, the layers should be compacted to at least 90 percent of the maximum dry density in compliance with ASTM D-1557-78 unless otherwise indicated.

- Density and moisture content testing should be performed by the Geotechnical Engineer at random intervals and locations as determined by the Geotechnical Engineer. These tests are intended as an aid to the Earthwork Contractor, so he can evaluate his workmanship, equipment effectiveness and site conditions. The Earthwork Contractor is responsible for compaction as required by the Geotechnical Report(s) and governmental agencies.

- Fill areas unused for a period of time may require moisture conditioning, processing and recompaction prior to the start of additional filling. The Earthwork Contractor should notify the Geotechnical Engineer of his intent so that an evaluation can be made.

- Fill placed on ground sloping at a 5-to-1 inclination (horizontal-to-vertical) or steeper should be benched into bedrock or other suitable materials, as directed by the Geotechnical Engineer. Typical details of benching are illustrated on Plates D-2, D-4, and D-5.

- Cut/fill transition lots should have the cut portion overexcavated to a depth of at least 3 feet and rebuilt with fill (see Plate D-1), as determined by the Geotechnical Engineer.

- All cut lots should be inspected by the Geotechnical Engineer for fracturing and other bedrock conditions. If necessary, the pads should be overexcavated to a depth of 3 feet and rebuilt with a uniform, more cohesive soil type to impede moisture penetration.

- Cut portions of pad areas above buttresses or stabilizations should be overexcavated to a depth of 3 feet and rebuilt with uniform, more cohesive compacted fill to impede moisture penetration.

- Non-structural fill adjacent to structural fill should typically be placed in unison to provide lateral support. Backfill along walls must be placed and compacted with care to ensure that excessive unbalanced lateral pressures do not develop. The type of fill material placed adjacent to below grade walls must be properly tested and approved by the Geotechnical Engineer with consideration of the lateral earth pressure used in the design.

Foundations

- The foundation influence zone is defined as extending one foot horizontally from the outside edge of a footing, and proceeding downward at a ½ horizontal to 1 vertical (0.5:1) inclination.
- Where overexcavation beneath a footing subgrade is necessary, it should be conducted so as to encompass the entire foundation influence zone, as described above.
- Compacted fill adjacent to exterior footings should extend at least 12 inches above foundation bearing grade. Compacted fill within the interior of structures should extend to the floor subgrade elevation.

Fill Slopes

- The placement and compaction of fill described above applies to all fill slopes. Slope compaction should be accomplished by overfilling the slope, adequately compacting the fill in even layers, including the overfilled zone and cutting the slope back to expose the compacted core
- Slope compaction may also be achieved by backrolling the slope adequately every 2 to 4 vertical feet during the filling process as well as requiring the earth moving and compaction equipment to work close to the top of the slope. Upon completion of slope construction, the slope face should be compacted with a sheepsfoot connected to a sideboom and then grid rolled. This method of slope compaction should only be used if approved by the Geotechnical Engineer.
- Sandy soils lacking in adequate cohesion may be unstable for a finished slope condition and therefore should not be placed within 15 horizontal feet of the slope face.
- All fill slopes should be keyed into bedrock or other suitable material. Fill keys should be at least 15 feet wide and inclined at 2 percent into the slope. For slopes higher than 30 feet, the fill key width should be equal to one-half the height of the slope (see Plate D-5).
- All fill keys should be cleared of loose slough material prior to geotechnical inspection and should be approved by the Geotechnical Engineer and governmental agencies prior to filling.
- The cut portion of fill over cut slopes should be made first and inspected by the Geotechnical Engineer for possible stabilization requirements. The fill portion should be adequately keyed through all surficial soils and into bedrock or suitable material. Soils should be removed from the transition zone between the cut and fill portions (see Plate D-2).

Cut Slopes

- All cut slopes should be inspected by the Geotechnical Engineer to determine the need for stabilization. The Earthwork Contractor should notify the Geotechnical Engineer when slope cutting is in progress at intervals of 10 vertical feet. Failure to notify may result in a delay in recommendations.
- Cut slopes exposing loose, cohesionless sands should be reported to the Geotechnical Engineer for possible stabilization recommendations.
- All stabilization excavations should be cleared of loose slough material prior to geotechnical inspection. Stakes should be provided by the Civil Engineer to verify the location and dimensions of the key. A typical stabilization fill detail is shown on Plate D-5.

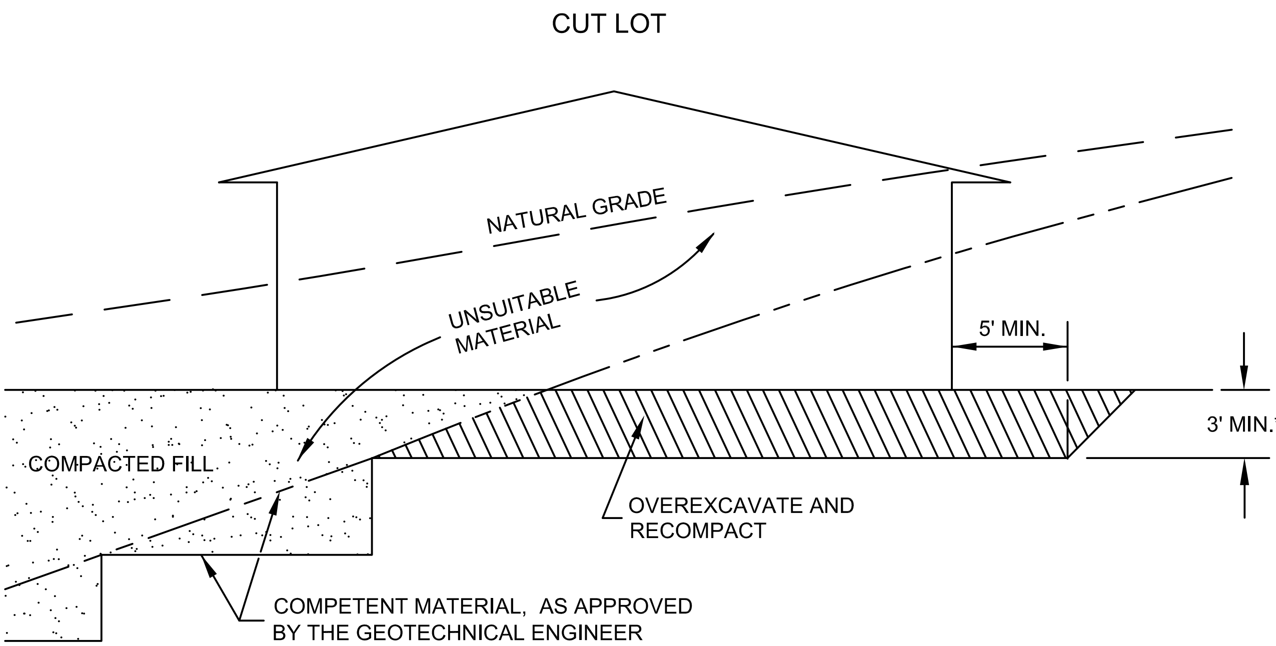
- Stabilization key excavations should be provided with subdrains. Typical subdrain details are shown on Plates D-6.

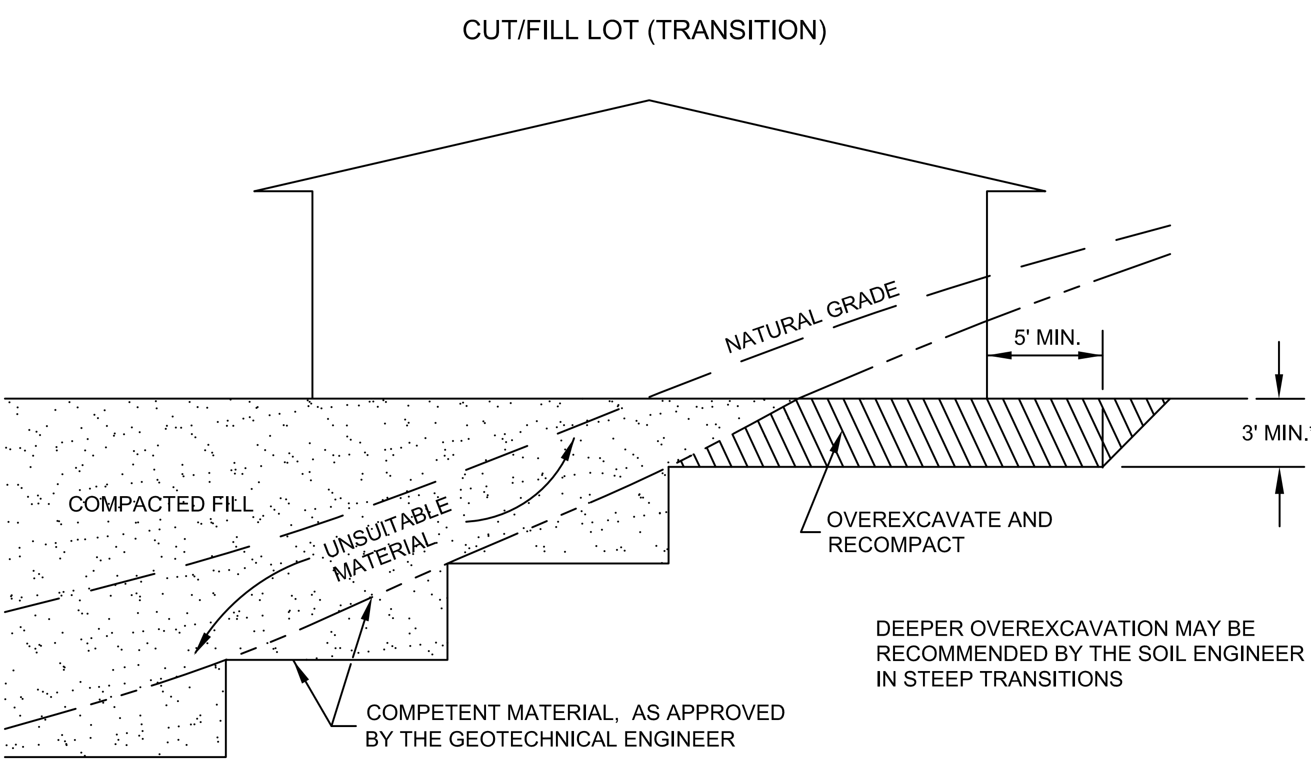
Subdrains

- Subdrains may be required in canyons and swales where fill placement is proposed. Typical subdrain details for canyons are shown on Plate D-3. Subdrains should be installed after approval of removals and before filling, as determined by the Soils Engineer.

- Plastic pipe may be used for subdrains provided it is Schedule 40 or SDR 35 or equivalent. Pipe should be protected against breakage, typically by placement in a square-cut (backhoe) trench or as recommended by the manufacturer.

- Filter material for subdrains should conform to CALTRANS Specification 68-1.025 or as approved by the Geotechnical Engineer for the specific site conditions. Clean ¾-inch crushed rock may be used provided it is wrapped in an acceptable filter cloth and approved by the Geotechnical Engineer. Pipe diameters should be 6 inches for runs up to 500 feet and 8 inches for the downstream continuations of longer runs. Four-inch diameter pipe may be used in buttress and stabilization fills.





DEEPER OVEREXCAVATION MAY BE RECOMMENDED BY THE SOIL ENGINEER IN STEEP TRANSITIONS

*SEE TEXT OF REPORT FOR SPECIFIC RECOMMENDATION. ACTUAL DEPTH OF OVEREXCAVATION MAY BE GREATER.

TRANSITION LOT DETAIL

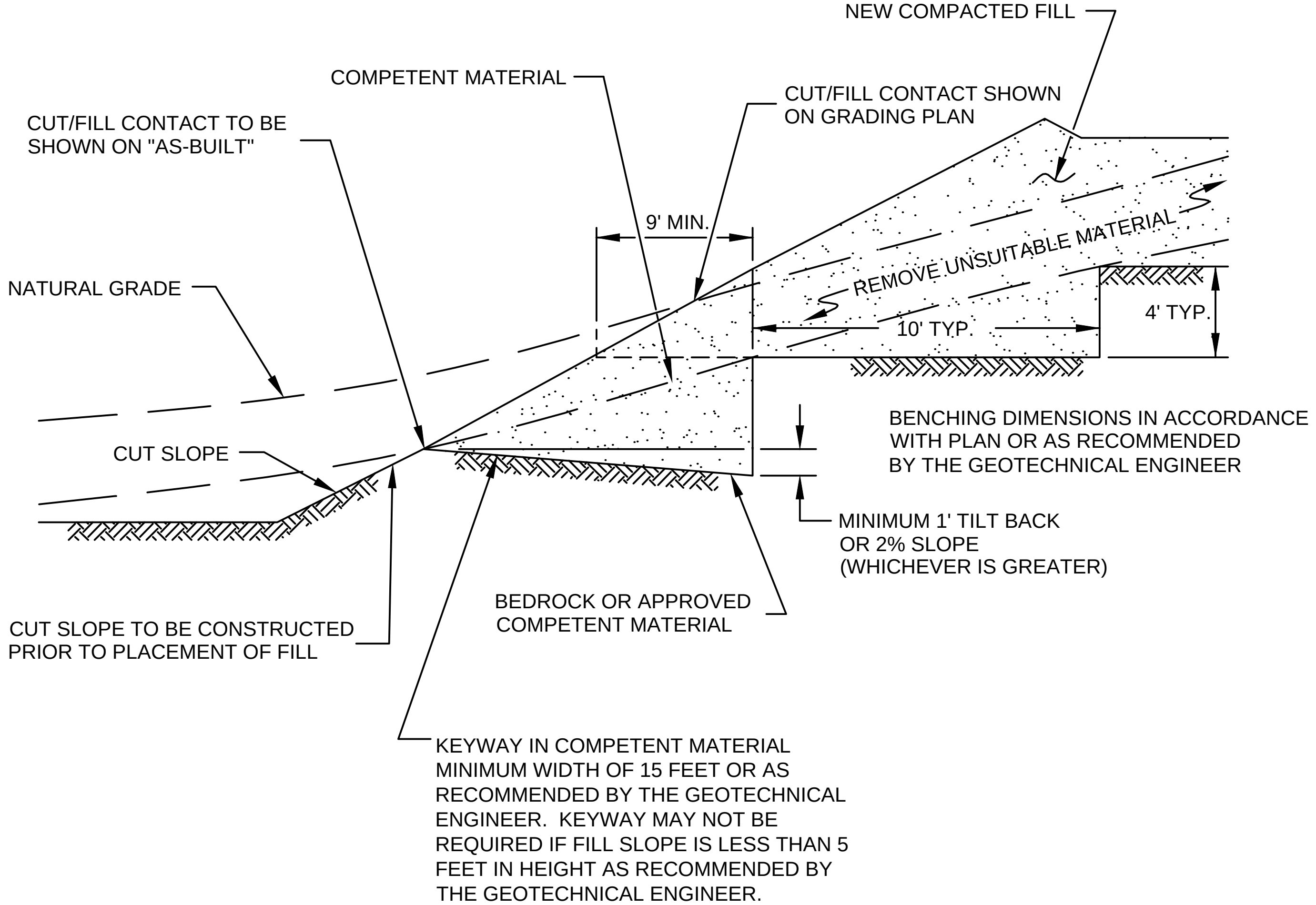
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

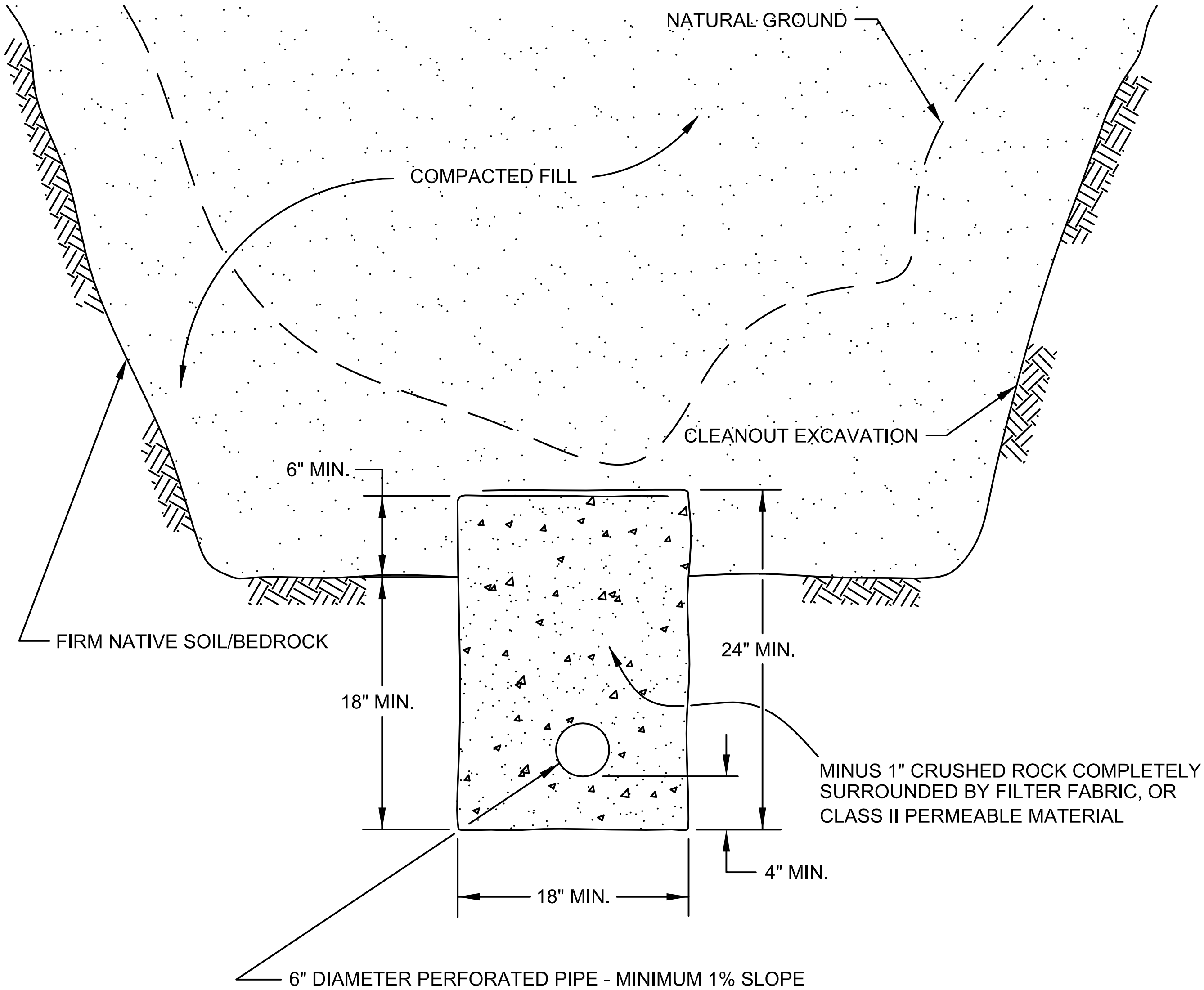
DRAWN: JAS
CHKD: GKM

PLATE D-1

SOUTHERN CALIFORNIA GEOTECHNICAL



FILL ABOVE CUT SLOPE DETAIL	
GRADING GUIDE SPECIFICATIONS	
NOT TO SCALE	SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: JAS CHKD: GKM	
PLATE D-2	



PIPE MATERIAL	DEPTH OF FILL OVER SUBDRAIN
ADS (CORRUGATED POLETHYLENE)	8
TRANSITE UNDERDRAIN	20
PVC OR ABS: SDR 35	35
SDR 21	100

SCHEMATIC ONLY
NOT TO SCALE

CANYON SUBDRAIN DETAIL

GRADING GUIDE SPECIFICATIONS

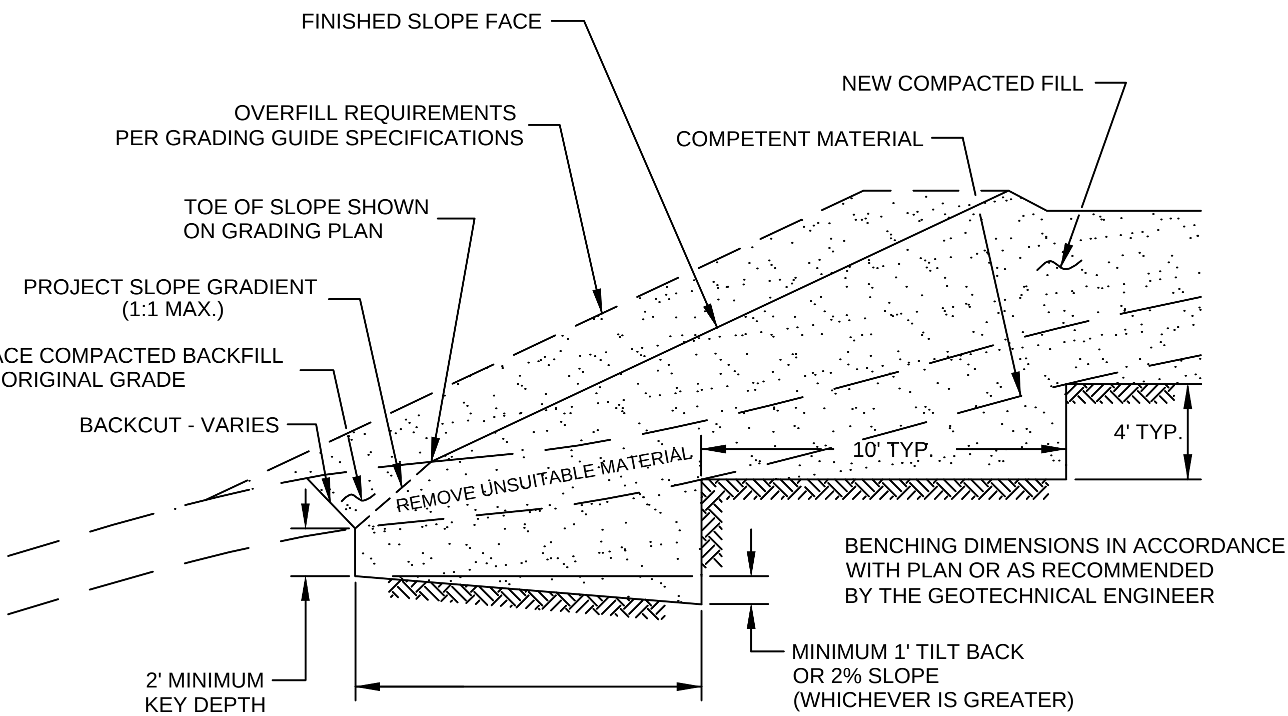
NOT TO SCALE

DRAWN: JAS
CHKD: GKM

PLATE D-3

SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL



BENCHING DIMENSIONS IN ACCORDANCE WITH PLAN OR AS RECOMMENDED BY THE GEOTECHNICAL ENGINEER

KEYWAY IN COMPETENT MATERIAL. MINIMUM WIDTH OF 15 FEET OR AS RECOMMENDED BY THE GEOTECHNIAL ENGINEER. KEYWAY MAY NOT BE REQUIRED IF FILL SLOPE IS LESS THAN 5' IN HEIGHT AS RECOMMENDED BY THE GEOTECHNICAL ENGINEER.

NOTE:
BENCHING SHALL BE REQUIRED WHEN NATURAL SLOPES ARE EQUAL TO OR STEEPER THAN 5:1 OR WHEN RECOMMENDED BY THE GEOTECHNICAL ENGINEER.

FILL ABOVE NATURAL SLOPE DETAIL

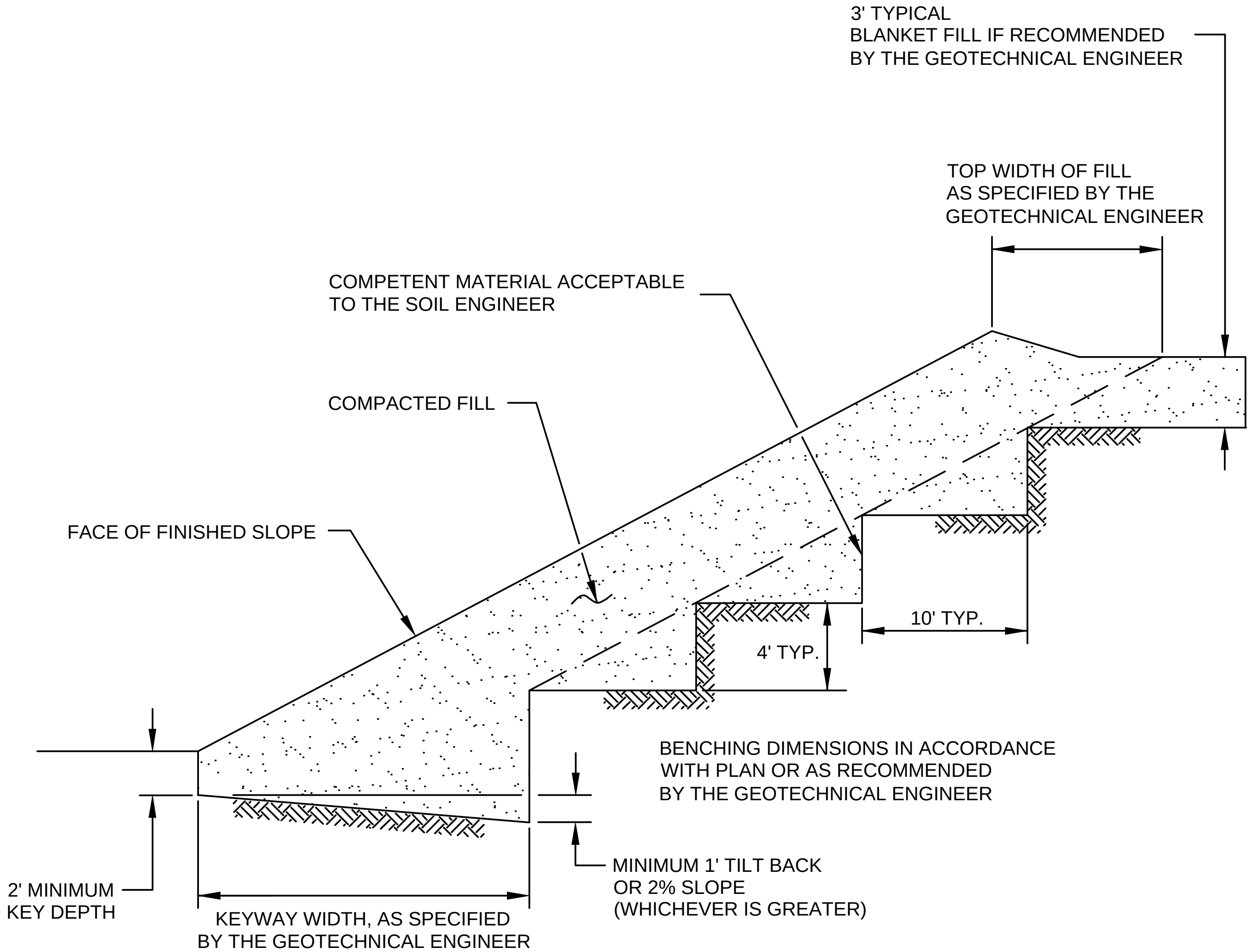
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

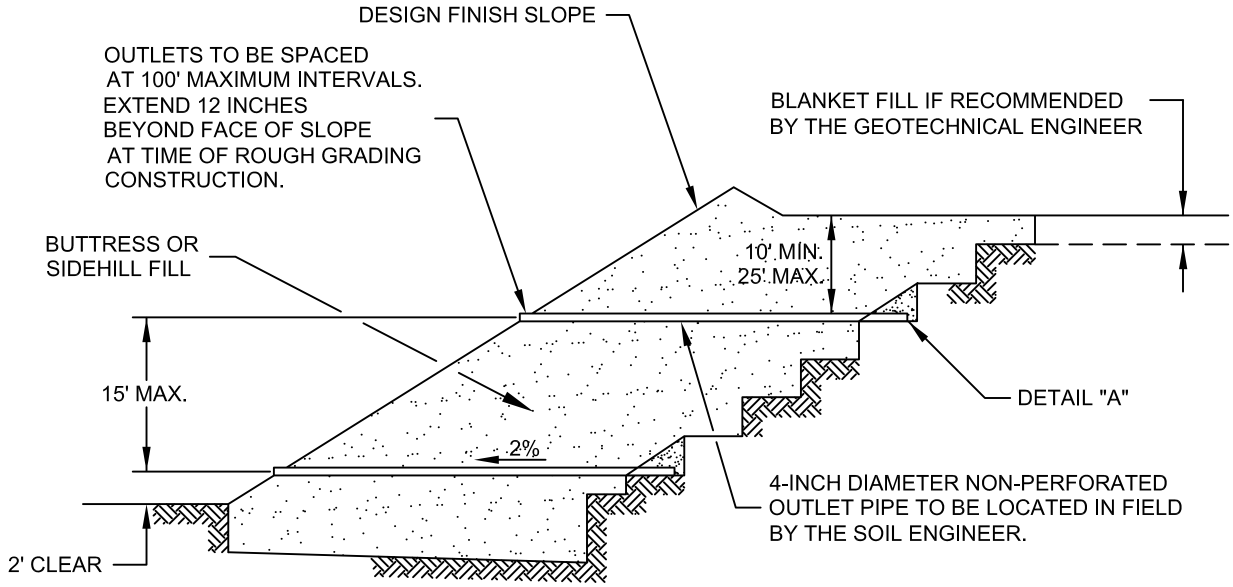
DRAWN: JAS
CHKD: GKM

PLATE D-4

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL



STABILIZATION FILL DETAIL	
GRADING GUIDE SPECIFICATIONS	
NOT TO SCALE	SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: JAS CHKD: GKM	
PLATE D-5	



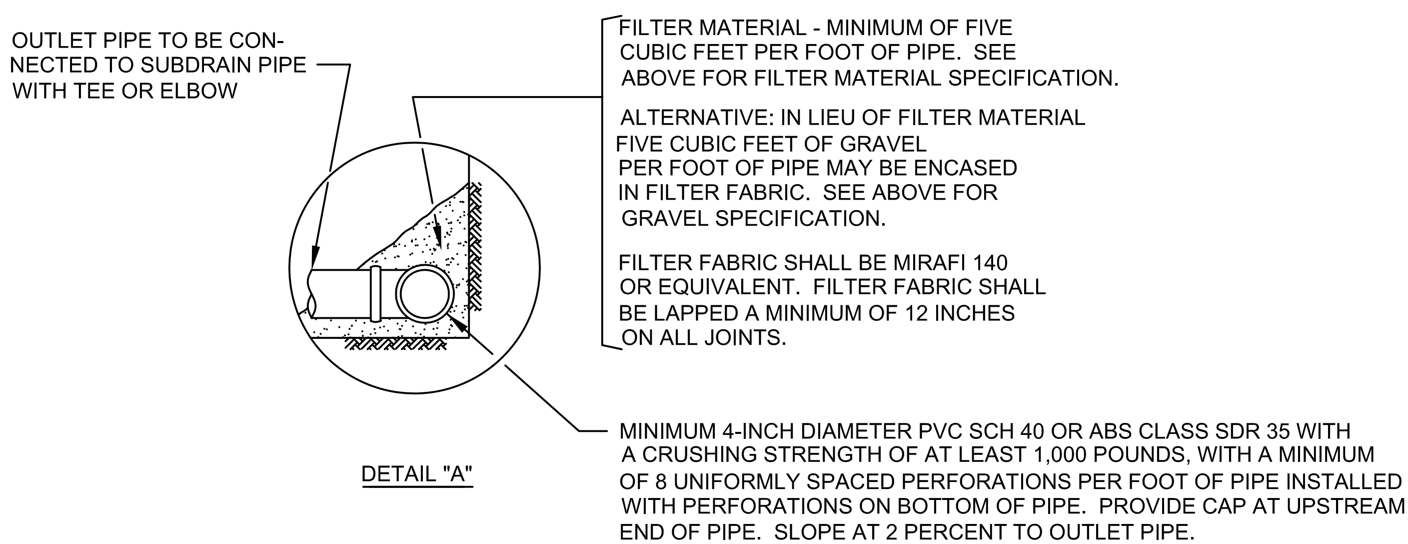
"FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT: (CONFORMS TO EMA STD. PLAN 323)

SIEVE SIZE	PERCENTAGE PASSING
1"	100
3/4"	90-100
3/8"	40-100
NO. 4	25-40
NO. 8	18-33
NO. 30	5-15
NO. 50	0-7
NO. 200	0-3

"GRAVEL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT:

SIEVE SIZE	MAXIMUM PERCENTAGE PASSING
1 1/2"	100
NO. 4	50
NO. 200	8

SAND EQUIVALENT = MINIMUM OF 50



DETAIL "A"

NOTES:
1. TRENCH FOR OUTLET PIPES TO BE BACKFILLED WITH ON-SITE SOIL.

SLOPE FILL SUBDRAINS

GRADING GUIDE SPECIFICATIONS

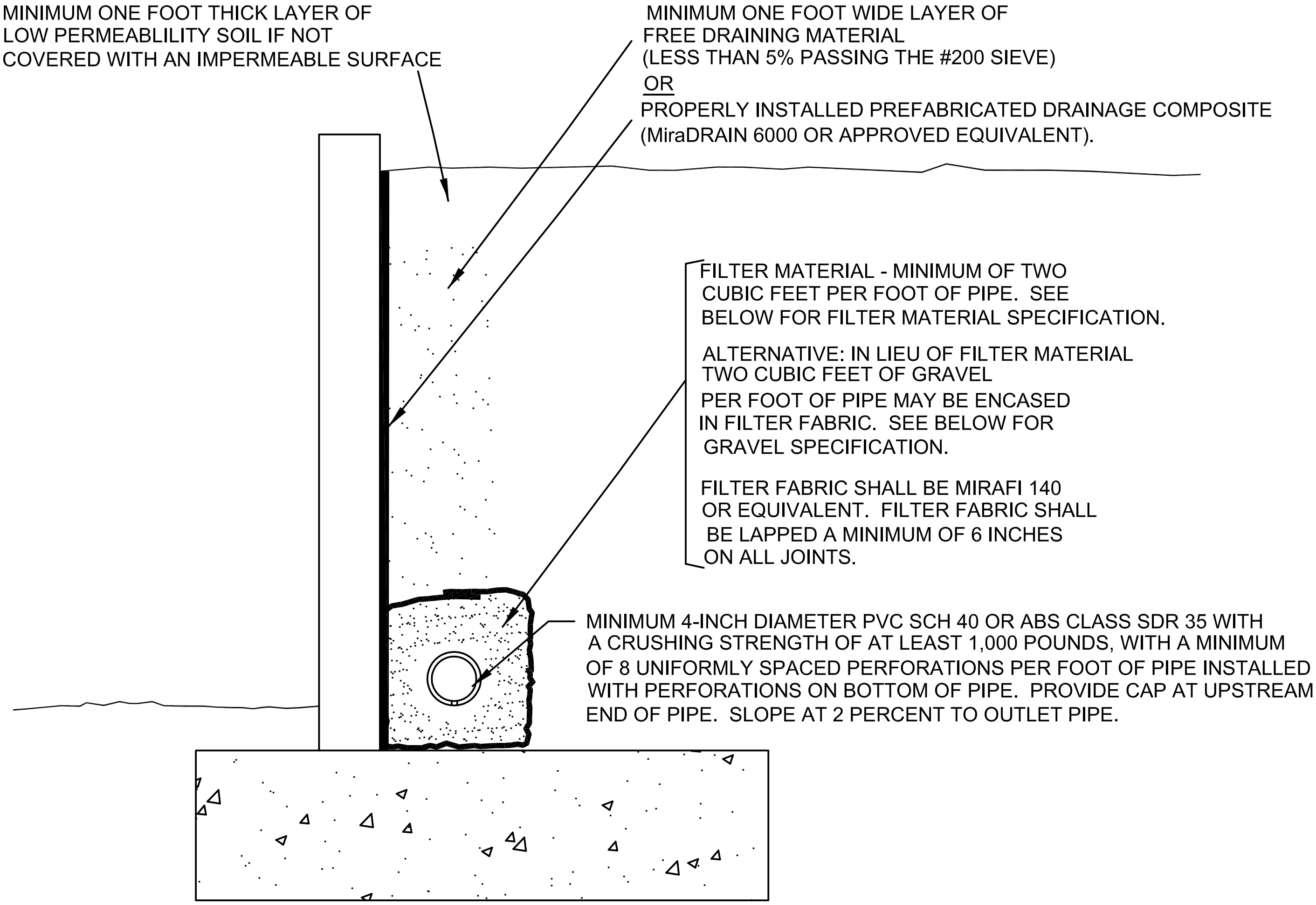
NOT TO SCALE

DRAWN: JAS
CHKD: GKM

PLATE D-6

SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL



"FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT: (CONFORMS TO EMA STD. PLAN 323)

SIEVE SIZE	PERCENTAGE PASSING
1"	100
3/4"	90-100
3/8"	40-100
NO. 4	25-40
NO. 8	18-33
NO. 30	5-15
NO. 50	0-7
NO. 200	0-3

"GRAVEL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT:

SIEVE SIZE	MAXIMUM PERCENTAGE PASSING
1 1/2"	100
NO. 4	50
NO. 200	8

SAND EQUIVALENT = MINIMUM OF 50

RETAINING WALL BACKDRAINS

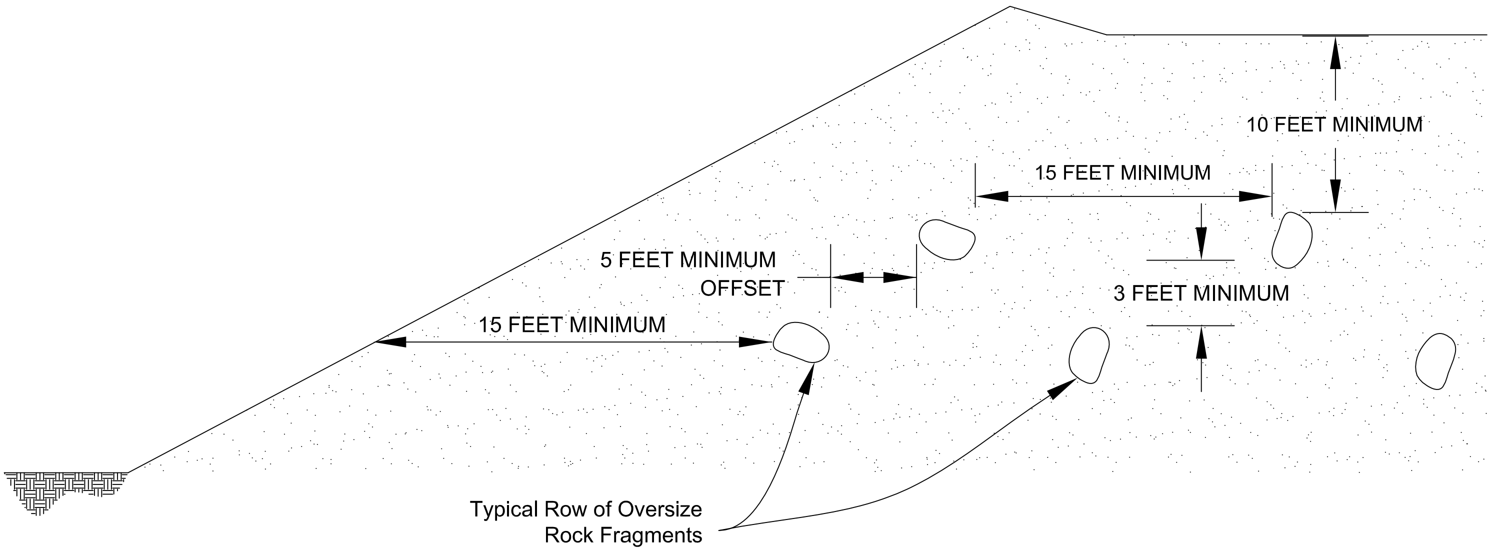
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

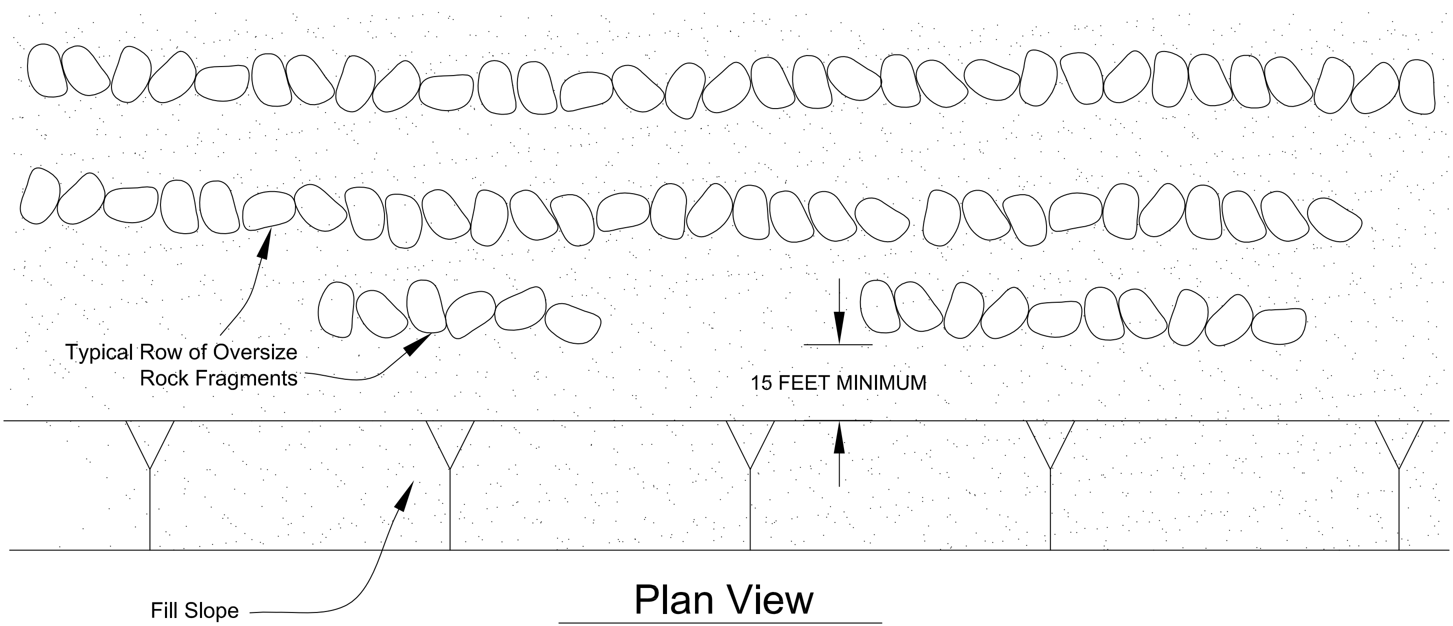
DRAWN: JAS
CHKD: GKM

PLATE D-7

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL



Section View



Plan View

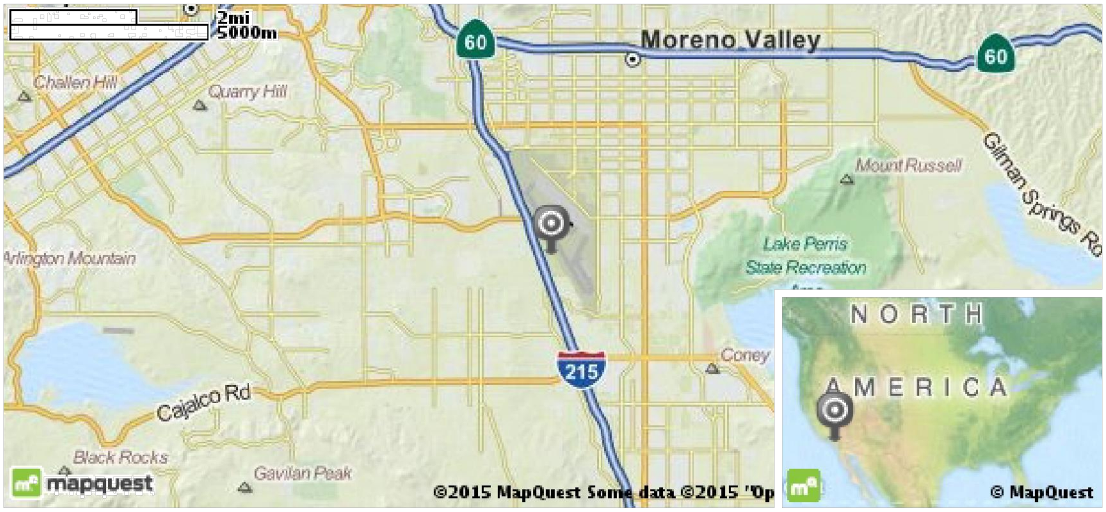
PLACEMENT OF OVERSIZED MATERIAL	
GRADING GUIDE SPECIFICATIONS	
NOT TO SCALE	SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: PM CHKD: GKM	
PLATE D-8	

APPENDIX E

USGS Design Maps Summary Report

User–Specified Input

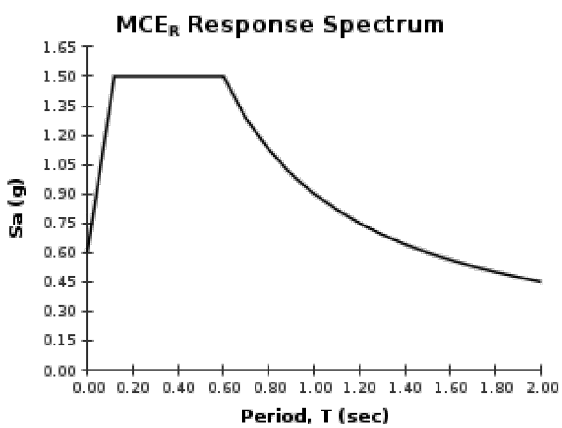
Report Title	D2 Air Cargo Compatible Development Wed November 18, 2015 23:19:47 UTC
Building Code Reference Document	ASCE 7-10 Standard (which utilizes USGS hazard data available in 2008)
Site Coordinates	33.87653°N, 117.26065°W
Site Soil Classification	Site Class D – "Stiff Soil"
Risk Category	I/II/III

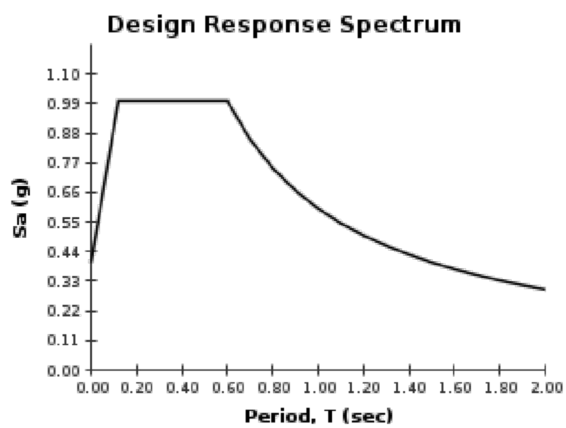


USGS–Provided Output

S_S = 1.500 g	S_{MS} = 1.500 g	S_{DS} = 1.000 g
S_1 = 0.600 g	S_{M1} = 0.900 g	S_{D1} = 0.600 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.





SOURCE: U.S. GEOLOGICAL SURVEY (USGS)
<http://geohazards.usgs.gov/designmaps/us/application.php>

SEISMIC DESIGN PARAMETERS

D2 AIR CARGO COMPATIBLE DEVELOPMENT

MORENO VALLEY, CALIFORNIA

DRAWN: MRM
CHKD: JAS

SCG PROJECT
15G204-1

PLATE E-1

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL

Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4]	PGA = 0.500
Equation (11.8–1):	$PGA_M = F_{PGA}PGA = 1.000 \times 0.500 = 0.5$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of PGA

For Site Class = D and PGA = 0.500 g, F_{PGA} = 1.000

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5]	C_{RS} = 1.071
From Figure 22-18 [6]	C_{R1} = 1.038

SOURCE: U.S. GEOLOGICAL SURVEY (USGS)
<http://geohazards.usgs.gov/designmaps/us/application.php>

MCE PEAK GROUND ACCELERATION

D2 AIR CARGO COMPATIBLE DEVELOPMENT

MORENO VALLEY, CALIFORNIA

DRAWN: MRM
CHKD: JAS

SCG PROJECT
15G204-1

PLATE E-2

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL

APPENDIX F

LIQUEFACTION EVALUATION

Project Name	D2 Air Cargo Compatible Cev	MCE_G Design Acceleration	0.500 (g)
Project Location	Moreno Valley	Design Magnitude	7.58
Project Number	15G204	Historic High Depth to Groundwater	17 (ft)
Engineer	DWN	Depth to Groundwater at Time of Drilling	23 (ft)
		Borehole Diameter	6 (in)
Boring No.	B-1		

Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	Uncorrected SPT N-Value	Unit Weight of Soil (pcf)	Fines Content (%)	Energy Correction	C_B	C_S	C_N	Rod Length Correction	$(N_1)_{60}$	$(N_1)_{60CS}$	Overburden Stress (σ_o) (psf)	Eff. Overburden Stress (Hist. Water) (σ_o') (psf)	Eff. Overburden Stress (Curr. Water) (σ_o') (psf)	Stress Reduction Coefficient (r_d)	MSF	Ks	Cyclic Resistance Ratio (M=7.5)	Cyclic Resistance Ratio (M=7.58)	Cyclic Stress Ratio Induced by Design Earthquake	Factor of Safety	Comments
							(1)	(2)	(3)	(4)	(5)	(6)	(7)				(8)	(9)	(10)	(11)	(12)	(13)		
7	0	17	8.5	9	120		1.3	1.05	1.15	1.43	0.75	15.1	15.1	1020	1020	1020	0.99	0.99	1.08	0.16	0.17	N/A	N/A	Above Water Table
19.5	17	22	19.5	17	120	18	1.3	1.05	1.27	0.96	0.95	27.0	31.1	2340	2184	2340	0.95	0.97	0.99	0.56	0.54	0.33	1.64	Non-Liquefiable
24.5	22	24.5	23.3	33	120		1.3	1.05	1.3	0.94	0.95	52.3	52.3	2790	2400	2774	0.94	0.97	0.96	2.00	1.86	0.35	5.24	Non-Liquefiable
24.5	24.5	27	25.8	33	120	33	1.3	1.05	1.3	0.94	0.95	52.1	57.6	3090	2544	2918	0.93	0.97	0.94	2.00	1.83	0.37	4.98	Non-Liquefiable
29.5	27	32	29.5	26	120		1.3	1.05	1.3	0.89	0.95	38.9	38.9	3540	2760	3134	0.92	0.97	0.92	2.00	1.78	0.38	4.67	Non-Liquefiable
34.5	32	37	34.5	35	120		1.3	1.05	1.3	0.90	1	56.2	56.2	4140	3048	3422	0.90	0.97	0.89	2.00	1.72	0.40	4.36	Non-Liquefiable
39.5	37	42	39.5	38	120		1.3	1.05	1.3	0.90	1	60.8	60.8	4740	3336	3710	0.87	0.97	0.86	2.00	1.67	0.40	4.14	Non-Liquefiable
44.5	42	47	44.5	41	120		1.3	1.05	1.3	0.90	1	65.6	65.6	5340	3624	3998	0.85	0.97	0.84	2.00	1.63	0.41	3.98	Non-Liquefiable
49.5	47	50	48.5	56	120		1.3	1.05	1.3	0.98	1	97.7	97.7	5820	3854	4229	0.83	0.97	0.82	2.00	1.59	0.41	3.88	Non-Liquefiable

Notes:

(1) Energy Correction for N_{90} of automatic hammer to standard N_{60}

(2) Borehole Diameter Correction (Skempton, 1986)

(3) Correction for split-spoon sampler with room for liners, but liners are absent, (Seed et al., 1984, 2001)

(4) Overburden Correction, Caluclated by Eq. 39 (Boulanger and Idriss, 2008)

(5) Rod Length Correction for Samples <10 m in depth

(6) N-value corrected for energy, borehole diameter, sampler with absent liners, rod length, and overburden

(7) N-value corrected for fines content per Eqs. 75 and 76 (Boulanger and Idriss, 2008)

(8) Stress Reduction Coefficient calculated by Eq. 22 (Boulanger and Idriss, 2008)

(9) Magnitude Scaling Factor calculated by Eqns. A.8 & A.10 (Boulanger and Idriss, 2014)

(10) Overburden Correction Factor calcuated by Eq. 54 (Boulanger and Idriss, 2008)

(11) Calcuated by Eq. 70 (Boulanger and Idriss, 2008)

(12) Calcuated by Eq. 72 (Boulanger and Idriss, 2008)

(13) Calcuated by Eq. 25 (Boulanger and Idriss, 2008)

LIQUEFACTION INDUCED SETTLEMENTS

Project Name	D2 Air Cargo Compatible Cev
Project Location	Moreno Valley
Project Number	15G204
Engineer	DWN

Boring No. B-1

Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	$(N_1)_{60}$	DN for fines content	$(N_1)_{60-CS}$	Liquefaction Factor of Safety	Limiting Shear Strain γ_{min}	Parameter Fα	Maximum Shear Strain γ_{max}	Height of Layer		Vertical Reconsolidation Strain ε_v		Total Deformation of Layer (in)	Comments
				(1)	(2)	(3)	(4)	(5)	(6)	(7)			(8)			
7	0	17	8.5	15.1	0.0	15.1	N/A	0.27	0.75	0.00	17.00		0.000		0.00	Above Water Table
19.5	17	22	19.5	27.0	4.1	31.1	1.64	0.04	-0.16	0.01	5.00		0.000		0.00	Non-Liquefiable
24.5	22	24.5	23.3	52.3	0.0	52.3	5.24	0.00	-1.78	0.00	2.50		0.000		0.00	Non-Liquefiable
24.5	24.5	27	25.8	52.1	5.5	57.6	4.98	0.00	-2.22	0.00	2.50		0.000		0.00	Non-Liquefiable
29.5	27	32	29.5	38.9	0.0	38.9	4.67	0.01	-0.72	0.00	5.00		0.000		0.00	Non-Liquefiable
34.5	32	37	34.5	56.2	0.0	56.2	4.36	0.00	-2.10	0.00	5.00		0.000		0.00	Non-Liquefiable
39.5	37	42	39.5	60.8	0.0	60.8	4.14	0.00	-2.49	0.00	5.00		0.000		0.00	Non-Liquefiable
44.5	42	47	44.5	65.6	0.0	65.6	3.98	0.00	-2.91	0.00	5.00		0.000		0.00	Non-Liquefiable
49.5	47	50	48.5	97.7	0.0	97.7	3.88	0.00	-5.85	0.00	3.00		0.000		0.00	Non-Liquefiable
											Total Deformation (in)				0.00	

Notes:

(1) $(N_1)_{60}$ calculated previously for the individual layer

(2) Correction for fines content per Equation 76 (Boulanger and Idriss, 2008)

(3) Corrected $(N_1)_{60}$ for fines content

(4) Factor of Safety against Liquefaction, calculated previously for the individual layer

(5) Calcuated by Eq. 86 (Boulanger and Idriss, 2008)

(6) Calcuated by Eq. 89 (Boulanger and Idriss, 2008)

(7) Calcuated by Eqs. 90, 91, and 92 (Boulanger and Idriss, 2008)

(8) Voumetric Strain Induced in a Liquefiable Layer, Calcuated by Eq. 96 (Boulanger and Idriss, 2008)
(Strain N/A if Factor of Safety against Liquefaction > 1.3)

LIQUEFACTION EVALUATION

Project Name	D2 Air Cargo Compatible Cev	MCE$_G$ Design Acceleration	0.500	(g)
Project Location	Moreno Valley	Design Magnitude	7.58	
Project Number	15G204	Historic High Depth to Groundwater	17	(ft)
Engineer	DWN	Depth to Groundwater at Time of Drilling	23	(ft)
		Borehole Diameter	6	(in)
Boring No.	B-4			

Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	Uncorrected SPT N-Value	Unit Weight of Soil (pcf)	Fines Content (%)	Energy Correction	C_B	C_S	C_N	Rod Length Correction	$(N_1)_{60}$	$(N_1)_{60CS}$	Overburden Stress (σ_o) (psf)	Eff. Overburden Stress (Hist. Water) (σ_o') (psf)	Eff. Overburden Stress (Curr. Water) (σ_o') (psf)	Stress Reduction Coefficient (r_d)	MSF	Ks	Cyclic Resistance Ratio (M=7.5)	Cyclic Resistance Ratio (M=7.58)	Cyclic Stress Ratio Induced by Design Earthquake	Factor of Safety	Comments
							(1)	(2)	(3)	(4)	(5)	(6)	(7)				(8)	(9)	(10)	(11)	(12)	(13)		
7	0	17	8.5	9	120		1.3	1.05	1.15	1.43	0.75	15.1	15.1	1020	1020	1020	0.99	0.99	1.08	0.16	0.17	N/A	N/A	Above Water Table
19.5	17	22	19.5	26	120	25	1.3	1.05	1.3	0.97	0.95	42.7	47.8	2340	2184	2340	0.95	0.97	0.99	2.00	1.91	0.33	5.77	Non-Liquefiable
24.5	22	27	24.5	19	120	14	1.3	1.05	1.29	0.90	0.95	28.5	31.4	2940	2472	2846	0.93	0.97	0.96	0.59	0.55	0.36	1.53	Non-Liquefiable
29.5	27	32	29.5	34	120		1.3	1.05	1.3	0.91	0.95	52.4	52.4	3540	2760	3134	0.92	0.97	0.92	2.00	1.78	0.38	4.67	Non-Liquefiable
34.5	32	37	34.5	52	120		1.3	1.05	1.3	0.97	1	89.8	89.8	4140	3048	3422	0.90	0.97	0.89	2.00	1.72	0.40	4.36	Non-Liquefiable
39.5	37	42	39.5	67	120		1.3	1.05	1.3	1.04	1	123.7	123.7	4740	3336	3710	0.87	0.97	0.86	2.00	1.67	0.40	4.14	Non-Liquefiable
44.5	42	47	44.5	47	120		1.3	1.05	1.3	0.93	1	78.0	78.0	5340	3624	3998	0.85	0.97	0.84	2.00	1.63	0.41	3.98	Non-Liquefiable
49.5	47	50	48.5	52	120		1.3	1.05	1.3	0.96	1	88.4	88.4	5820	3854	4229	0.83	0.97	0.82	2.00	1.59	0.41	3.88	Non-Liquefiable

Notes:

(1) Energy Correction for N_{90} of automatic hammer to standard N_{60}

(2) Borehole Diameter Correction (Skempton, 1986)

(3) Correction for split-spoon sampler with room for liners, but liners are absent, (Seed et al., 1984, 2001)

(4) Overburden Correction, Caluclated by Eq. 39 (Boulanger and Idriss, 2008)

(5) Rod Length Correction for Samples <10 m in depth

(6) N-value corrected for energy, borehole diameter, sampler with absent liners, rod length, and overburden

(7) N-value corrected for fines content per Eqs. 75 and 76 (Boulanger and Idriss, 2008)

(8) Stress Reduction Coefficient calculated by Eq. 22 (Boulanger and Idriss, 2008)

(9) Magnitude Scaling Factor calculated by Eqns. A.8 & A.10 (Boulanger and Idriss, 2014)

(10) Overburden Correction Factor calcuated by Eq. 54 (Boulanger and Idriss, 2008)

(11) Calcuated by Eq. 70 (Boulanger and Idriss, 2008)

(12) Calcuated by Eq. 72 (Boulanger and Idriss, 2008)

(13) Calcuated by Eq. 25 (Boulanger and Idriss, 2008)

LIQUEFACTION INDUCED SETTLEMENTS

Project Name	D2 Air Cargo Compatible Cev
Project Location	Moreno Valley
Project Number	15G204
Engineer	DWN

Boring No. B-4

Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	$(N_1)_{60}$	DN for fines content	$(N_1)_{60\text{-CS}}$	Liquefaction Factor of Safety	Limiting Shear Strain γ_{min}	Parameter Fα	Maximum Shear Strain γ_{max}	Height of Layer		Vertical Reconsolidation Strain ε_v		Total Deformation of Layer (in)	Comments
				(1)	(2)	(3)	(4)	(5)	(6)	(7)			(8)			
7	0	17	8.5	15.1	0.0	15.1	N/A	0.27	0.75	0.00	17.00		0.000		0.00	Above Water Table
19.5	17	22	19.5	42.7	5.1	47.8	5.77	0.00	-1.41	0.00	5.00		0.000		0.00	Non-Liquefiable
24.5	22	27	24.5	28.5	2.9	31.4	1.53	0.04	-0.18	0.01	5.00		0.000		0.00	Non-Liquefiable
29.5	27	32	29.5	52.4	0.0	52.4	4.67	0.00	-1.79	0.00	5.00		0.000		0.00	Non-Liquefiable
34.5	32	37	34.5	89.8	0.0	89.8	4.36	0.00	-5.10	0.00	5.00		0.000		0.00	Non-Liquefiable
39.5	37	42	39.5	123.7	0.0	123.7	4.14	0.00	-8.37	0.00	5.00		0.000		0.00	Non-Liquefiable
44.5	42	47	44.5	78.0	0.0	78.0	3.98	0.00	-4.01	0.00	5.00		0.000		0.00	Non-Liquefiable
49.5	47	50	48.5	88.4	0.0	88.4	3.88	0.00	-4.97	0.00	3.00		0.000		0.00	Non-Liquefiable
											Total Deformation (in)				0.00	

Notes:

(1) $(N_1)_{60}$ calculated previously for the individual layer

(2) Correction for fines content per Equation 76 (Boulanger and Idriss, 2008)

(3) Corrected $(N_1)_{60}$ for fines content

(4) Factor of Safety against Liquefaction, calculated previously for the individual layer

(5) Calcuated by Eq. 86 (Boulanger and Idriss, 2008)

(6) Calcuated by Eq. 89 (Boulanger and Idriss, 2008)

(7) Calcuated by Eqs. 90, 91, and 92 (Boulanger and Idriss, 2008)

(8) Voumetric Strain Induced in a Liquefiable Layer, Calcuated by Eq. 96 (Boulanger and Idriss, 2008)
(Strain N/A if Factor of Safety against Liquefaction > 1.3)

LIQUEFACTION EVALUATION

Project Name	D2 Air Cargo Compatible Cev	MCE_G Design Acceleration	0.500 (g)
Project Location	Moreno Valley	Design Magnitude	7.58
Project Number	15G204	Historic High Depth to Groundwater	17 (ft)
Engineer	DWN	Depth to Groundwater at Time of Drilling	22 (ft)
		Borehole Diameter	6 (in)
Boring No.	B-8		

Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	Uncorrected SPT N-Value	Unit Weight of Soil (pcf)	Fines Content (%)	Energy Correction	C_B	C_S	C_N	Rod Length Correction	$(N_1)_{60}$	$(N_1)_{60CS}$	Overburden Stress (σ_o) (psf)	Eff. Overburden Stress (Hist. Water) (σ_o') (psf)	Eff. Overburden Stress (Curr. Water) (σ_o') (psf)	Stress Reduction Coefficient (r_d)	MSF	Ks	Cyclic Resistance Ratio (M=7.5)	Cyclic Resistance Ratio (M=7.58)	Cyclic Stress Ratio Induced by Design Earthquake	Factor of Safety	Comments
							(1)	(2)	(3)	(4)	(5)	(6)	(7)				(8)	(9)	(10)	(11)	(12)	(13)		
7	0	17	8.5	22	120		1.3	1.05	1.3	1.26	0.75	36.9	36.9	1020	1020	1020	0.99	0.97	1.1	1.71	1.82	N/A	N/A	Above Water Table
19.5	17	22	19.5	16	120	38	1.3	1.05	1.25	0.96	0.95	25.0	30.6	2340	2184	2340	0.95	0.97	0.99	0.52	0.50	0.33	1.52	Non-Liquefiable
24.5	22	27	24.5	22	120	13	1.3	1.05	1.3	0.92	0.95	34.0	36.5	2940	2472	2784	0.93	0.97	0.95	1.54	1.42	0.36	3.93	Non-Liquefiable
29.5	27	32	29.5	73	120		1.3	1.05	1.3	1.03	0.95	126.8	126.8	3540	2760	3072	0.92	0.97	0.92	2.00	1.78	0.38	4.67	Non-Liquefiable
34.5	32	37	34.5	41	120		1.3	1.05	1.3	0.93	1	67.8	67.8	4140	3048	3360	0.90	0.97	0.89	2.00	1.72	0.40	4.36	Non-Liquefiable
39.5	37	42	39.5	42	120		1.3	1.05	1.3	0.92	1	68.8	68.8	4740	3336	3648	0.87	0.97	0.86	2.00	1.67	0.40	4.14	Non-Liquefiable
44.5	42	47	44.5	29	120	19	1.3	1.05	1.3	0.86	1	44.1	48.4	5340	3624	3936	0.85	0.97	0.84	2.00	1.63	0.41	3.98	Non-Liquefiable
49.5	47	50	48.5	41	120		1.3	1.05	1.3	0.89	1	65.1	65.1	5820	3854	4166	0.83	0.97	0.82	2.00	1.59	0.41	3.88	Non-Liquefiable

Notes:

(1) Energy Correction for N_{90} of automatic hammer to standard N_{60}

(2) Borehole Diameter Correction (Skempton, 1986)

(3) Correction for split-spoon sampler with room for liners, but liners are absent, (Seed et al., 1984, 2001)

(4) Overburden Correction, Caluclated by Eq. 39 (Boulanger and Idriss, 2008)

(5) Rod Length Correction for Samples <10 m in depth

(6) N-value corrected for energy, borehole diameter, sampler with absent liners, rod length, and overburden

(7) N-value corrected for fines content per Eqs. 75 and 76 (Boulanger and Idriss, 2008)

(8) Stress Reduction Coefficient calculated by Eq. 22 (Boulanger and Idriss, 2008)

(9) Magnitude Scaling Factor calculated by Eqns. A.8 & A.10 (Boulanger and Idriss, 2014)

(10) Overburden Correction Factor calcuated by Eq. 54 (Boulanger and Idriss, 2008)

(11) Calcuated by Eq. 70 (Boulanger and Idriss, 2008)

(12) Calcuated by Eq. 72 (Boulanger and Idriss, 2008)

(13) Calcuated by Eq. 25 (Boulanger and Idriss, 2008)

LIQUEFACTION INDUCED SETTLEMENTS

Project Name	D2 Air Cargo Compatible Cev
Project Location	Moreno Valley
Project Number	15G204
Engineer	DWN

Boring No. B-8

Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	$(N_1)_{60}$	DN for fines content	$(N_1)_{60\text{-}CS}$	Liquefaction Factor of Safety	Limiting Shear Strain γ_{min}	Parameter Fα	Maximum Shear Strain γ_{max}	Height of Layer		Vertical Reconsolidation Strain ε_v		Total Deformation of Layer (in)	Comments
				(1)	(2)	(3)	(4)	(5)	(6)	(7)			(8)			
7	0	17	8.5	36.9	0.0	36.9	N/A	0.02	-0.57	0.00	17.00		0.000		0.00	Above Water Table
19.5	17	22	19.5	25.0	5.6	30.6	1.52	0.04	-0.13	0.01	5.00		0.000		0.00	Non-Liquefiable
24.5	22	27	24.5	34.0	2.5	36.5	3.93	0.02	-0.54	0.00	5.00		0.000		0.00	Non-Liquefiable
29.5	27	32	29.5	126.8	0.0	126.8	4.67	0.00	-8.69	0.00	5.00		0.000		0.00	Non-Liquefiable
34.5	32	37	34.5	67.8	0.0	67.8	4.36	0.00	-3.10	0.00	5.00		0.000		0.00	Non-Liquefiable
39.5	37	42	39.5	68.8	0.0	68.8	4.14	0.00	-3.19	0.00	5.00		0.000		0.00	Non-Liquefiable
44.5	42	47	44.5	44.1	4.3	48.4	3.98	0.00	-1.46	0.00	5.00		0.000		0.00	Non-Liquefiable
49.5	47	50	48.5	65.1	0.0	65.1	3.88	0.00	-2.86	0.00	3.00		0.000		0.00	Non-Liquefiable
											Total Deformation (in)				0.00	

Notes:

(1) $(N_1)_{60}$ calculated previously for the individual layer

(2) Correction for fines content per Equation 76 (Boulanger and Idriss, 2008)

(3) Corrected $(N_1)_{60}$ for fines content

(4) Factor of Safety against Liquefaction, calculated previously for the individual layer

(5) Calcuated by Eq. 86 (Boulanger and Idriss, 2008)

(6) Calcuated by Eq. 89 (Boulanger and Idriss, 2008)

(7) Calcuated by Eqs. 90, 91, and 92 (Boulanger and Idriss, 2008)

(8) Voumetric Strain Induced in a Liquefiable Layer, Calcuated by Eq. 96 (Boulanger and Idriss, 2008)
(Strain N/A if Factor of Safety against Liquefaction > 1.3)

LIQUEFACTION EVALUATION

Project Name	D2 Air Cargo Compatible Cev
Project Location	Moreno Valley
Project Number	15G204
Engineer	DWN
Boring No.	B-9

MCE_G Design Acceleration	0.500	(g)
Design Magnitude	7.58	
Historic High Depth to Groundwater	17	(ft)
Depth to Groundwater at Time of Drilling	36	(ft)
Borehole Diameter	6	(in)

Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	Uncorrected SPT N-Value	Unit Weight of Soil (pcf)	Fines Content (%)	Energy Correction	C_B	C_S	C_N	Rod Length Correction	$(N_1)_{60}$	$(N_1)_{60CS}$	Overburden Stress (σ_o) (psf)	Eff. Overburden Stress (Hist. Water) (σ_o') (psf)	Eff. Overburden Stress (Curr. Water) (σ_o') (psf)	Stress Reduction Coefficient (r_d)	MSF	Ks	Cyclic Resistance Ratio (M=7.5)	Cyclic Resistance Ratio (M=7.58)	Cyclic Stress Ratio Induced by Design Earthquake	Factor of Safety	Comments
							(1)	(2)	(3)	(4)	(5)	(6)	(7)				(8)	(9)	(10)	(11)	(12)	(13)		
7	0	17	8.5	33	120		1.3	1.05	1.3	1.18	0.75	52.0	52.0	1020	1020	1020	0.99	0.97	1.1	2.00	2.00	N/A	N/A	Above Water Table
19.5	17	22	19.5	24	120	17	1.3	1.05	1.3	0.97	0.95	39.3	43.2	2340	2184	2340	0.95	0.97	0.99	2.00	1.91	0.33	5.77	Non-Liquefiable
24.5	22	27	24.5	24	120	23	1.3	1.05	1.3	0.91	0.95	36.8	41.7	2940	2472	2940	0.93	0.97	0.95	2.00	1.84	0.36	5.10	Non-Liquefiable
29.5	27	32	29.5	33	120		1.3	1.05	1.3	0.88	0.95	49.0	49.0	3540	2760	3540	0.92	0.97	0.92	2.00	1.78	0.38	4.67	Non-Liquefiable
34.5	32	37	34.5	47	120		1.3	1.05	1.3	0.93	1	77.6	77.6	4140	3048	4140	0.90	0.97	0.89	2.00	1.72	0.40	4.36	Non-Liquefiable
39.5	37	42	39.5	37	120		1.3	1.05	1.3	0.85	1	56.0	56.0	4740	3336	4522	0.87	0.97	0.86	2.00	1.67	0.40	4.14	Non-Liquefiable
44.5	42	47	44.5	47	120		1.3	1.05	1.3	0.91	1	75.9	75.9	5340	3624	4810	0.85	0.97	0.84	2.00	1.63	0.41	3.98	Non-Liquefiable
49.5	47	50	48.5	50	120		1.3	1.05	1.3	0.93	1	82.2	82.2	5820	3854	5040	0.83	0.97	0.82	2.00	1.59	0.41	3.88	Non-Liquefiable

Notes:

(1) Energy Correction for N_{90} of automatic hammer to standard N_{60}

(2) Borehole Diameter Correction (Skempton, 1986)

(3) Correction for split-spoon sampler with room for liners, but liners are absent, (Seed et al., 1984, 2001)

(4) Overburden Correction, Caluclated by Eq. 39 (Boulanger and Idriss, 2008)

(5) Rod Length Correction for Samples <10 m in depth

(6) N-value corrected for energy, borehole diameter, sampler with absent liners, rod length, and overburden

(7) N-value corrected for fines content per Eqs. 75 and 76 (Boulanger and Idriss, 2008)

(8) Stress Reduction Coefficient calculated by Eq. 22 (Boulanger and Idriss, 2008)

(9) Magnitude Scaling Factor calculated by Eqns. A.8 & A.10 (Boulanger and Idriss, 2014)

(10) Overburden Correction Factor calcuated by Eq. 54 (Boulanger and Idriss, 2008)

(11) Calcuated by Eq. 70 (Boulanger and Idriss, 2008)

(12) Calcuated by Eq. 72 (Boulanger and Idriss, 2008)

(13) Calcuated by Eq. 25 (Boulanger and Idriss, 2008)

LIQUEFACTION INDUCED SETTLEMENTS

Project Name	D2 Air Cargo Compatible Cev
Project Location	Moreno Valley
Project Number	15G204
Engineer	DWN

Boring No. B-9

Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	$(N_1)_{60}$	DN for fines content	$(N_1)_{60-CS}$	Liquefaction Factor of Safety	Limiting Shear Strain γ_{min}	Parameter Fα	Maximum Shear Strain γ_{max}	Height of Layer		Vertical Reconsolidation Strain ε_v		Total Deformation of Layer (in)	Comments
				(1)	(2)	(3)	(4)	(5)	(6)	(7)			(8)			
7	0	17	8.5	52.0	0.0	52.0	N/A	0.00	-1.75	0.00	17.00		0.000		0.00	Above Water Table
19.5	17	22	19.5	39.3	3.9	43.2	5.77	0.00	-1.05	0.00	5.00		0.000		0.00	Non-Liquefiable
24.5	22	27	24.5	36.8	4.9	41.7	5.10	0.01	-0.93	0.00	5.00		0.000		0.00	Non-Liquefiable
29.5	27	32	29.5	49.0	0.0	49.0	4.67	0.00	-1.51	0.00	5.00		0.000		0.00	Non-Liquefiable
34.5	32	37	34.5	77.6	0.0	77.6	4.36	0.00	-3.98	0.00	5.00		0.000		0.00	Non-Liquefiable
39.5	37	42	39.5	56.0	0.0	56.0	4.14	0.00	-2.09	0.00	5.00		0.000		0.00	Non-Liquefiable
44.5	42	47	44.5	75.9	0.0	75.9	3.98	0.00	-3.82	0.00	5.00		0.000		0.00	Non-Liquefiable
49.5	47	50	48.5	82.2	0.0	82.2	3.88	0.00	-4.40	0.00	3.00		0.000		0.00	Non-Liquefiable
											Total Deformation (in)				0.00	

Notes:

(1) $(N_1)_{60}$ calculated previously for the individual layer

(2) Correction for fines content per Equation 76 (Boulanger and Idriss, 2008)

(3) Corrected $(N_1)_{60}$ for fines content

(4) Factor of Safety against Liquefaction, calculated previously for the individual layer

(5) Calcuated by Eq. 86 (Boulanger and Idriss, 2008)

(6) Calcuated by Eq. 89 (Boulanger and Idriss, 2008)

(7) Calcuated by Eqs. 90, 91, and 92 (Boulanger and Idriss, 2008)

(8) Voumetric Strain Induced in a Liquefiable Layer, Calcuated by Eq. 96 (Boulanger and Idriss, 2008)
(Strain N/A if Factor of Safety against Liquefaction > 1.3)

LIQUEFACTION EVALUATION

Project Name	D2 Air Cargo Compatible Cev	MCE_G Design Acceleration	0.500 (g)
Project Location	Moreno Valley	Design Magnitude	7.58
Project Number	15G204	Historic High Depth to Groundwater	17 (ft)
Engineer	DWN	Depth to Groundwater at Time of Drilling	23 (ft)
		Borehole Diameter	6 (in)
Boring No.	B-13		

Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	Uncorrected SPT N-Value	Unit Weight of Soil (pcf)	Fines Content (%)	Energy Correction	C_B	C_S	C_N	Rod Length Correction	$(N_1)_{60}$	$(N_1)_{60CS}$	Overburden Stress (σ_o) (psf)	Eff. Overburden Stress (Hist. Water) (σ_o') (psf)	Eff. Overburden Stress (Curr. Water) (σ_o') (psf)	Stress Reduction Coefficient (r_d)	MSF	Ks	Cyclic Resistance Ratio (M=7.5)	Cyclic Resistance Ratio (M=7.58)	Cyclic Stress Ratio Induced by Design Earthquake	Factor of Safety	Comments
							(1)	(2)	(3)	(4)	(5)	(6)	(7)				(8)	(9)	(10)	(11)	(12)	(13)		
7	0	17	8.5	22	120		1.3	1.05	1.3	1.26	0.75	36.9	36.9	1020	1020	1020	0.99	0.97	1.1	1.71	1.82	N/A	N/A	Above Water Table
19.5	17	22	19.5	18	120	18	1.3	1.05	1.291	0.97	0.95	29.1	33.2	2340	2184	2340	0.95	0.97	0.99	0.79	0.76	0.33	2.28	Non-Liquefiable
24.5	22	27	24.5	22	120	37	1.3	1.05	1.3	0.91	0.95	33.9	39.5	2940	2472	2846	0.93	0.97	0.95	2.00	1.84	0.36	5.10	Non-Liquefiable
29.5	27	32	29.5	19	120	27	1.3	1.05	1.274	0.87	0.95	27.4	32.6	3540	2760	3134	0.92	0.97	0.94	0.71	0.65	0.38	1.69	Non-Liquefiable
34.5	32	37	34.5	42	120		1.3	1.05	1.3	0.93	1	69.6	69.6	4140	3048	3422	0.90	0.97	0.89	2.00	1.72	0.40	4.36	Non-Liquefiable
39.5	37	42	39.5	50	120		1.3	1.05	1.3	0.96	1	85.0	85.0	4740	3336	3710	0.87	0.97	0.86	2.00	1.67	0.40	4.14	Non-Liquefiable
44.5	42	47	44.5	43	120		1.3	1.05	1.3	0.91	1	69.7	69.7	5340	3624	3998	0.85	0.97	0.84	2.00	1.63	0.41	3.98	Non-Liquefiable
49.5	47	50	48.5	79	120		1.3	1.05	1.3	1.14	1	159.4	159.4	5820	3854	4229	0.83	0.97	0.82	2.00	1.59	0.41	3.88	Non-Liquefiable

Notes:

(1) Energy Correction for N_{90} of automatic hammer to standard N_{60}

(2) Borehole Diameter Correction (Skempton, 1986)

(3) Correction for split-spoon sampler with room for liners, but liners are absent, (Seed et al., 1984, 2001)

(4) Overburden Correction, Caluclated by Eq. 39 (Boulanger and Idriss, 2008)

(5) Rod Length Correction for Samples <10 m in depth

(6) N-value corrected for energy, borehole diameter, sampler with absent liners, rod length, and overburden

(7) N-value corrected for fines content per Eqs. 75 and 76 (Boulanger and Idriss, 2008)

(8) Stress Reduction Coefficient calculated by Eq. 22 (Boulanger and Idriss, 2008)

(9) Magnitude Scaling Factor calculated by Eqns. A.8 & A.10 (Boulanger and Idriss, 2014)

(10) Overburden Correction Factor calcuated by Eq. 54 (Boulanger and Idriss, 2008)

(11) Calcuated by Eq. 70 (Boulanger and Idriss, 2008)

(12) Calcuated by Eq. 72 (Boulanger and Idriss, 2008)

(13) Calcuated by Eq. 25 (Boulanger and Idriss, 2008)

LIQUEFACTION INDUCED SETTLEMENTS

Project Name	D2 Air Cargo Compatible Cev
Project Location	Moreno Valley
Project Number	15G204
Engineer	DWN

Boring No. B-13

Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	$(N_1)_{60}$	DN for fines content	$(N_1)_{60\text{-CS}}$	Liquefaction Factor of Safety	Limiting Shear Strain γ_{min}	Parameter Fα	Maximum Shear Strain γ_{max}	Height of Layer		Vertical Reconsolidation Strain ε_v		Total Deformation of Layer (in)	Comments
				(1)	(2)	(3)	(4)	(5)	(6)	(7)			(8)			
7	0	17	8.5	36.9	0.0	36.9	N/A	0.02	-0.57	0.00	17.00		0.000		0.00	Above Water Table
19.5	17	22	19.5	29.1	4.1	33.2	2.28	0.03	-0.31	0.00	5.00		0.000		0.00	Non-Liquefiable
24.5	22	27	24.5	33.9	5.5	39.5	5.10	0.01	-0.76	0.00	5.00		0.000		0.00	Non-Liquefiable
29.5	27	32	29.5	27.4	5.2	32.6	1.69	0.03	-0.27	0.01	5.00		0.000		0.00	Non-Liquefiable
34.5	32	37	34.5	69.6	0.0	69.6	4.36	0.00	-3.26	0.00	5.00		0.000		0.00	Non-Liquefiable
39.5	37	42	39.5	85.0	0.0	85.0	4.14	0.00	-4.66	0.00	5.00		0.000		0.00	Non-Liquefiable
44.5	42	47	44.5	69.7	0.0	69.7	3.98	0.00	-3.27	0.00	5.00		0.000		0.00	Non-Liquefiable
49.5	47	50	48.5	159.4	0.0	159.4	3.88	0.00	-11.98	0.00	3.00		0.000		0.00	Non-Liquefiable
											Total Deformation (in)				0.00	

Notes:

(1) $(N_1)_{60}$ calculated previously for the individual layer

(2) Correction for fines content per Equation 76 (Boulanger and Idriss, 2008)

(3) Corrected $(N_1)_{60}$ for fines content

(4) Factor of Safety against Liquefaction, calculated previously for the individual layer

(5) Calcuated by Eq. 86 (Boulanger and Idriss, 2008)

(6) Calcuated by Eq. 89 (Boulanger and Idriss, 2008)

(7) Calcuated by Eqs. 90, 91, and 92 (Boulanger and Idriss, 2008)

(8) Voumetric Strain Induced in a Liquefiable Layer, Calcuated by Eq. 96 (Boulanger and Idriss, 2008)
(Strain N/A if Factor of Safety against Liquefaction > 1.3)

LIQUEFACTION EVALUATION

Project Name	D2 Air Cargo Compatible Cev	MCE_G Design Acceleration	0.500 (g)
Project Location	Moreno Valley	Design Magnitude	7.58
Project Number	15G204	Historic High Depth to Groundwater	17 (ft)
Engineer	DWN	Depth to Groundwater at Time of Drilling	23 (ft)
		Borehole Diameter	6 (in)
Boring No.	B-14		

Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	Uncorrected SPT N-Value	Unit Weight of Soil (pcf)	Fines Content (%)	Energy Correction	C_B	C_S	C_N	Rod Length Correction	$(N_1)_{60}$	$(N_1)_{60CS}$	Overburden Stress (σ_o) (psf)	Eff. Overburden Stress (Hist. Water) (σ_o') (psf)	Eff. Overburden Stress (Curr. Water) (σ_o') (psf)	Stress Reduction Coefficient (r_d)	MSF	Ks	Cyclic Resistance Ratio (M=7.5)	Cyclic Resistance Ratio (M=7.58)	Cyclic Stress Ratio Induced by Design Earthquake	Factor of Safety	Comments
							(1)	(2)	(3)	(4)	(5)	(6)	(7)				(8)	(9)	(10)	(11)	(12)	(13)		
7	0	17	8.5	15	120		1.3	1.05	1.26	1.33	0.75	25.7	25.7	1020	1020	1020	0.99	0.98	1.1	0.31	0.33	N/A	N/A	Above Water Table
19.5	17	22	19.5	80	120		1.3	1.05	1.3	1.01	0.95	136.4	136.4	2340	2184	2340	0.95	0.97	0.99	2.00	1.91	0.33	5.77	Non-Liquefiable
24.5	22	27	24.5	37	120	20	1.3	1.05	1.3	0.95	0.95	59.3	63.8	2940	2472	2846	0.93	0.97	0.95	2.00	1.84	0.36	5.10	Non-Liquefiable
29.5	27	32	29.5	59	120		1.3	1.05	1.3	0.99	0.95	98.6	98.6	3540	2760	3134	0.92	0.97	0.92	2.00	1.78	0.38	4.67	Non-Liquefiable
34.5	32	37	34.5	42	120		1.3	1.05	1.3	0.93	1	69.6	69.6	4140	3048	3422	0.90	0.97	0.89	2.00	1.72	0.40	4.36	Non-Liquefiable
39.5	37	42	39.5	47	120		1.3	1.05	1.3	0.94	1	78.7	78.7	4740	3336	3710	0.87	0.97	0.86	2.00	1.67	0.40	4.14	Non-Liquefiable
44.5	42	47	44.5	60	120		1.3	1.05	1.3	1.01	1	107.2	107.2	5340	3624	3998	0.85	0.97	0.84	2.00	1.63	0.41	3.98	Non-Liquefiable
49.5	47	50	48.5	68	120		1.3	1.05	1.3	1.06	1	128.0	128.0	5820	3854	4229	0.83	0.97	0.82	2.00	1.59	0.41	3.88	Non-Liquefiable

Notes:

(1) Energy Correction for N_{90} of automatic hammer to standard N_{60}

(2) Borehole Diameter Correction (Skempton, 1986)

(3) Correction for split-spoon sampler with room for liners, but liners are absent, (Seed et al., 1984, 2001)

(4) Overburden Correction, Caluclated by Eq. 39 (Boulanger and Idriss, 2008)

(5) Rod Length Correction for Samples <10 m in depth

(6) N-value corrected for energy, borehole diameter, sampler with absent liners, rod length, and overburden

(7) N-value corrected for fines content per Eqs. 75 and 76 (Boulanger and Idriss, 2008)

(8) Stress Reduction Coefficient calculated by Eq. 22 (Boulanger and Idriss, 2008)

(9) Magnitude Scaling Factor calculated by Eqns. A.8 & A.10 (Boulanger and Idriss, 2014)

(10) Overburden Correction Factor calcuated by Eq. 54 (Boulanger and Idriss, 2008)

(11) Calcuated by Eq. 70 (Boulanger and Idriss, 2008)

(12) Calcuated by Eq. 72 (Boulanger and Idriss, 2008)

(13) Calcuated by Eq. 25 (Boulanger and Idriss, 2008)

LIQUEFACTION INDUCED SETTLEMENTS

Project Name	D2 Air Cargo Compatible Cev
Project Location	Moreno Valley
Project Number	15G204
Engineer	DWN

Boring No. B-14

Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	$(N_1)_{60}$	DN for fines content	$(N_1)_{60\text{-}CS}$	Liquefaction Factor of Safety	Limiting Shear Strain γ_{min}	Parameter Fα	Maximum Shear Strain γ_{max}	Height of Layer		Vertical Reconsolidation Strain ε_v		Total Deformation of Layer (in)	Comments
				(1)	(2)	(3)	(4)	(5)	(6)	(7)			(8)			
7	0	17	8.5	25.7	0.0	25.7	N/A	0.08	0.19	0.00	17.00		0.000		0.00	Above Water Table
19.5	17	22	19.5	136.4	0.0	136.4	5.77	0.00	-9.64	0.00	5.00		0.000		0.00	Non-Liquefiable
24.5	22	27	24.5	59.3	4.5	63.8	5.10	0.00	-2.75	0.00	5.00		0.000		0.00	Non-Liquefiable
29.5	27	32	29.5	98.6	0.0	98.6	4.67	0.00	-5.94	0.00	5.00		0.000		0.00	Non-Liquefiable
34.5	32	37	34.5	69.6	0.0	69.6	4.36	0.00	-3.26	0.00	5.00		0.000		0.00	Non-Liquefiable
39.5	37	42	39.5	78.7	0.0	78.7	4.14	0.00	-4.08	0.00	5.00		0.000		0.00	Non-Liquefiable
44.5	42	47	44.5	107.2	0.0	107.2	3.98	0.00	-6.76	0.00	5.00		0.000		0.00	Non-Liquefiable
49.5	47	50	48.5	128.0	0.0	128.0	3.88	0.00	-8.80	0.00	3.00		0.000		0.00	Non-Liquefiable
											Total Deformation (in)				0.00	

Notes:

(1) $(N_1)_{60}$ calculated previously for the individual layer

(2) Correction for fines content per Equation 76 (Boulanger and Idriss, 2008)

(3) Corrected $(N_1)_{60}$ for fines content

(4) Factor of Safety against Liquefaction, calculated previously for the individual layer

(5) Calcuated by Eq. 86 (Boulanger and Idriss, 2008)

(6) Calcuated by Eq. 89 (Boulanger and Idriss, 2008)

(7) Calcuated by Eqs. 90, 91, and 92 (Boulanger and Idriss, 2008)

(8) Voumetric Strain Induced in a Liquefiable Layer, Calcuated by Eq. 96 (Boulanger and Idriss, 2008)
(Strain N/A if Factor of Safety against Liquefaction > 1.3)

LIQUEFACTION EVALUATION

Project Name	D2 Air Cargo Compatible Cev	MCE_G Design Acceleration	0.500 (g)
Project Location	Moreno Valley	Design Magnitude	7.58
Project Number	15G204	Historic High Depth to Groundwater	17 (ft)
Engineer	DWN	Depth to Groundwater at Time of Drilling	31 (ft)
		Borehole Diameter	6 (in)
Boring No.	B-17		

Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	Uncorrected SPT N-Value	Unit Weight of Soil (pcf)	Fines Content (%)	Energy Correction	C_B	C_S	C_N	Rod Length Correction	$(N_1)_{60}$	$(N_1)_{60CS}$	Overburden Stress (σ_o) (psf)	Eff. Overburden Stress (Hist. Water) (σ_o') (psf)	Eff. Overburden Stress (Curr. Water) (σ_o') (psf)	Stress Reduction Coefficient (r_d)	MSF	Ks	Cyclic Resistance Ratio (M=7.5)	Cyclic Resistance Ratio (M=7.58)	Cyclic Stress Ratio Induced by Design Earthquake	Factor of Safety	Comments
							(1)	(2)	(3)	(4)	(5)	(6)	(7)				(8)	(9)	(10)	(11)	(12)	(13)		
7	0	17	8.5	18	120		1.3	1.05	1.3	1.30	0.75	31.1	31.1	1020	1020	1020	0.99	0.97	1.1	0.56	0.60	N/A	N/A	Above Water Table
19.5	17	22	19.5	84	120		1.3	1.05	1.3	1.01	0.95	143.6	143.6	2340	2184	2340	0.95	0.97	0.99	2.00	1.91	0.33	5.77	Non-Liquefiable
24.5	22	27	24.5	31	120		1.3	1.05	1.3	0.92	0.95	48.1	48.1	2940	2472	2940	0.93	0.97	0.95	2.00	1.84	0.36	5.10	Non-Liquefiable
29.5	27	32	29.5	37	120		1.3	1.05	1.3	0.90	0.95	56.0	56.0	3540	2760	3540	0.92	0.97	0.92	2.00	1.78	0.38	4.67	Non-Liquefiable
34.5	32	37	34.5	47	120		1.3	1.05	1.3	0.94	1	78.2	78.2	4140	3048	3922	0.90	0.97	0.89	2.00	1.72	0.40	4.36	Non-Liquefiable
39.5	37	42	39.5	53	120		1.3	1.05	1.3	0.96	1	90.7	90.7	4740	3336	4210	0.87	0.97	0.86	2.00	1.67	0.40	4.14	Non-Liquefiable
44.5	42	47	44.5	37	120		1.3	1.05	1.3	0.85	1	56.1	56.1	5340	3624	4498	0.85	0.97	0.84	2.00	1.63	0.41	3.98	Non-Liquefiable
49.5	47	50	48.5	47	120		1.3	1.05	1.3	0.91	1	76.1	76.1	5820	3854	4728	0.83	0.97	0.82	2.00	1.59	0.41	3.88	Non-Liquefiable

Notes:

(1) Energy Correction for N_{90} of automatic hammer to standard N_{60}

(2) Borehole Diameter Correction (Skempton, 1986)

(3) Correction for split-spoon sampler with room for liners, but liners are absent, (Seed et al., 1984, 2001)

(4) Overburden Correction, Caluclated by Eq. 39 (Boulanger and Idriss, 2008)

(5) Rod Length Correction for Samples <10 m in depth

(6) N-value corrected for energy, borehole diameter, sampler with absent liners, rod length, and overburden

(7) N-value corrected for fines content per Eqs. 75 and 76 (Boulanger and Idriss, 2008)

(8) Stress Reduction Coefficient calculated by Eq. 22 (Boulanger and Idriss, 2008)

(9) Magnitude Scaling Factor calculated by Eqns. A.8 & A.10 (Boulanger and Idriss, 2014)

(10) Overburden Correction Factor calcuated by Eq. 54 (Boulanger and Idriss, 2008)

(11) Calcuated by Eq. 70 (Boulanger and Idriss, 2008)

(12) Calcuated by Eq. 72 (Boulanger and Idriss, 2008)

(13) Calcuated by Eq. 25 (Boulanger and Idriss, 2008)

LIQUEFACTION INDUCED SETTLEMENTS

Project Name	D2 Air Cargo Compatible Cev
Project Location	Moreno Valley
Project Number	15G204
Engineer	DWN

Boring No.	B-17

Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	$(N_1)_{60}$	DN for fines content	$(N_1)_{60\text{-}CS}$	Liquefaction Factor of Safety	Limiting Shear Strain γ_{min}	Parameter Fα	Maximum Shear Strain γ_{max}	Height of Layer		Vertical Reconsolidation Strain ε_v		Total Deformation of Layer (in)	Comments
				(1)	(2)	(3)	(4)	(5)	(6)	(7)			(8)			
7	0	17	8.5	31.1	0.0	31.1	N/A	0.04	-0.16	0.00	17.00		0.000		0.00	Above Water Table
19.5	17	22	19.5	143.6	0.0	143.6	5.77	0.00	####	0.00	5.00		0.000		0.00	Non-Liquefiable
24.5	22	27	24.5	48.1	0.0	48.1	5.10	0.00	-1.44	0.00	5.00		0.000		0.00	Non-Liquefiable
29.5	27	32	29.5	56.0	0.0	56.0	4.67	0.00	-2.09	0.00	5.00		0.000		0.00	Non-Liquefiable
34.5	32	37	34.5	78.2	0.0	78.2	4.36	0.00	-4.03	0.00	5.00		0.000		0.00	Non-Liquefiable
39.5	37	42	39.5	90.7	0.0	90.7	4.14	0.00	-5.19	0.00	5.00		0.000		0.00	Non-Liquefiable
44.5	42	47	44.5	56.1	0.0	56.1	3.98	0.00	-2.09	0.00	5.00		0.000		0.00	Non-Liquefiable
49.5	47	50	48.5	76.1	0.0	76.1	3.88	0.00	-3.84	0.00	3.00		0.000		0.00	Non-Liquefiable
											Total Deformation (in)				0.00	

Notes:

(1) $(N_1)_{60}$ calculated previously for the individual layer

(2) Correction for fines content per Equation 76 (Boulanger and Idriss, 2008)

(3) Corrected $(N_1)_{60}$ for fines content

(4) Factor of Safety against Liquefaction, calculated previously for the individual layer

(5) Calcuated by Eq. 86 (Boulanger and Idriss, 2008)

(6) Calcuated by Eq. 89 (Boulanger and Idriss, 2008)

(7) Calcuated by Eqs. 90, 91, and 92 (Boulanger and Idriss, 2008)

(8) Voumetric Strain Induced in a Liquefiable Layer, Calcuated by Eq. 96 (Boulanger and Idriss, 2008)
(Strain N/A if Factor of Safety against Liquefaction > 1.3)

LIQUEFACTION EVALUATION

Project Name	D2 Air Cargo Compatible Cev	MCE$_G$ Design Acceleration	0.500 (g)
Project Location	Moreno Valley	Design Magnitude	7.58
Project Number	15G204	Historic High Depth to Groundwater	17 (ft)
Engineer	DWN	Depth to Groundwater at Time of Drilling	33 (ft)
		Borehole Diameter	6 (in)
Boring No.	B-19		

Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	Uncorrected SPT N-Value	Unit Weight of Soil (pcf)	Fines Content (%)	Energy Correction	C_B	C_S	C_N	Rod Length Correction	$(N_1)_{60}$	$(N_1)_{60CS}$	Overburden Stress (σ_o) (psf)	Eff. Overburden Stress (Hist. Water) (σ_o') (psf)	Eff. Overburden Stress (Curr. Water) (σ_o') (psf)	Stress Reduction Coefficient (r_d)	MSF	Ks	Cyclic Resistance Ratio (M=7.5)	Cyclic Resistance Ratio (M=7.58)	Cyclic Stress Ratio Induced by Design Earthquake	Factor of Safety	Comments
							(1)	(2)	(3)	(4)	(5)	(6)	(7)				(8)	(9)	(10)	(11)	(12)	(13)		
7	0	17	8.5	54	120		1.3	1.05	1.3	1.08	0.75	77.7	77.7	1020	1020	1020	0.99	0.97	1.1	2.00	2.00	N/A	N/A	Above Water Table
19.5	17	22	19.5	39	120		1.3	1.05	1.3	0.98	0.95	64.7	64.7	2340	2184	2340	0.95	0.97	0.99	2.00	1.91	0.33	5.77	Non-Liquefiable
24.5	22	27	24.5	52	120		1.3	1.05	1.3	0.98	0.95	85.6	85.6	2940	2472	2940	0.93	0.97	0.95	2.00	1.84	0.36	5.10	Non-Liquefiable
29.5	27	32	29.5	47	120		1.3	1.05	1.3	0.94	0.95	74.4	74.4	3540	2760	3540	0.92	0.97	0.92	2.00	1.78	0.38	4.67	Non-Liquefiable
34.5	32	37	34.5	45	120		1.3	1.05	1.3	0.92	1	73.6	73.6	4140	3048	4046	0.90	0.97	0.89	2.00	1.72	0.40	4.36	Non-Liquefiable
39.5	37	42	39.5	39	120		1.3	1.05	1.3	0.87	1	60.5	60.5	4740	3336	4334	0.87	0.97	0.86	2.00	1.67	0.40	4.14	Non-Liquefiable
44.5	42	47	44.5	51	120		1.3	1.05	1.3	0.94	1	85.4	85.4	5340	3624	4622	0.85	0.97	0.84	2.00	1.63	0.41	3.98	Non-Liquefiable
49.5	47	50	48.5	65	120		1.3	1.05	1.3	1.05	1	121.5	121.5	5820	3854	4853	0.83	0.97	0.82	2.00	1.59	0.41	3.88	Non-Liquefiable

Notes:

(1) Energy Correction for N_{90} of automatic hammer to standard N_{60}

(2) Borehole Diameter Correction (Skempton, 1986)

(3) Correction for split-spoon sampler with room for liners, but liners are absent, (Seed et al., 1984, 2001)

(4) Overburden Correction, Caluclated by Eq. 39 (Boulanger and Idriss, 2008)

(5) Rod Length Correction for Samples <10 m in depth

(6) N-value corrected for energy, borehole diameter, sampler with absent liners, rod length, and overburden

(7) N-value corrected for fines content per Eqs. 75 and 76 (Boulanger and Idriss, 2008)

(8) Stress Reduction Coefficient calculated by Eq. 22 (Boulanger and Idriss, 2008)

(9) Magnitude Scaling Factor calculated by Eqns. A.8 & A.10 (Boulanger and Idriss, 2014)

(10) Overburden Correction Factor calcuated by Eq. 54 (Boulanger and Idriss, 2008)

(11) Calcuated by Eq. 70 (Boulanger and Idriss, 2008)

(12) Calcuated by Eq. 72 (Boulanger and Idriss, 2008)

(13) Calcuated by Eq. 25 (Boulanger and Idriss, 2008)

LIQUEFACTION INDUCED SETTLEMENTS

Project Name	D2 Air Cargo Compatible Cev
Project Location	Moreno Valley
Project Number	15G204
Engineer	DWN

Boring No. B-19

Sample Depth (ft)	Depth to Top of Layer (ft)	Depth to Bottom of Layer (ft)	Depth to Midpoint (ft)	$(N_1)_{60}$	DN for fines content	$(N_1)_{60\text{-}CS}$	Liquefaction Factor of Safety	Limiting Shear Strain γ_{min}	Parameter Fα	Maximum Shear Strain γ_{max}	Height of Layer		Vertical Reconsolidation Strain ε_v		Total Deformation of Layer (in)	Comments
				(1)	(2)	(3)	(4)	(5)	(6)	(7)			(8)			
7	0	17	8.5	77.7	0.0	77.7	N/A	0.00	-3.99	0.00	17.00		0.000		0.00	Above Water Table
19.5	17	22	19.5	64.7	0.0	64.7	5.77	0.00	-2.82	0.00	5.00		0.000		0.00	Non-Liquefiable
24.5	22	27	24.5	85.6	0.0	85.6	5.10	0.00	-4.71	0.00	5.00		0.000		0.00	Non-Liquefiable
29.5	27	32	29.5	74.4	0.0	74.4	4.67	0.00	-3.69	0.00	5.00		0.000		0.00	Non-Liquefiable
34.5	32	37	34.5	73.6	0.0	73.6	4.36	0.00	-3.62	0.00	5.00		0.000		0.00	Non-Liquefiable
39.5	37	42	39.5	60.5	0.0	60.5	4.14	0.00	-2.47	0.00	5.00		0.000		0.00	Non-Liquefiable
44.5	42	47	44.5	85.4	0.0	85.4	3.98	0.00	-4.69	0.00	5.00		0.000		0.00	Non-Liquefiable
49.5	47	50	48.5	121.5	0.0	121.5	3.88	0.00	-8.16	0.00	3.00		0.000		0.00	Non-Liquefiable
											Total Deformation (in)				0.00	

Notes:

(1) $(N_1)_{60}$ calculated previously for the individual layer

(2) Correction for fines content per Equation 76 (Boulanger and Idriss, 2008)

(3) Corrected $(N_1)_{60}$ for fines content

(4) Factor of Safety against Liquefaction, calculated previously for the individual layer

(5) Calcuated by Eq. 86 (Boulanger and Idriss, 2008)

(6) Calcuated by Eq. 89 (Boulanger and Idriss, 2008)

(7) Calcuated by Eqs. 90, 91, and 92 (Boulanger and Idriss, 2008)

(8) Voumetric Strain Induced in a Liquefiable Layer, Calcuated by Eq. 96 (Boulanger and Idriss, 2008)
(Strain N/A if Factor of Safety against Liquefaction > 1.3)

F-2 Storm Water Infiltration

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

February 23, 2016

Hillwood
901 Via Piemonte, Suite 175
Ontario, California 91764

Attention: Mr. Kathy Hoffer

Project No.: **15G204-3**

Subject: **Storm Water Infiltration**
Proposed D2 Air Cargo Compatible Development
SE Terminus of Van Buren Boulevard
Between I-215 and MARB
Moreno Valley, California

Reference: Geotechnical Investigation, D2 Air Cargo Compatible Development, SE Terminus of Van Buren Boulevard, Between I-215 and MARB, Moreno Valley, California, prepared for Hillwood by Southern California Geotechnical, Inc. (SCG), SCG Project No. 15G204-1, dated December 16, 2015.

Gentlemen:

In accordance your request, we have prepared this letter in order to comment on the infiltration characteristics of the on-site soils. The near surface soils generally consist of medium dense to very dense silty sands and clayey sands and stiff to hard silty clays and sandy clays. In general, these soils possess high densities and are weakly to moderately cemented. These soils are considered relatively impermeable with respect to storm water infiltration.

Based on the relatively high densities, cementation, and the silt and clay content of the near surface soils, no significant storm water infiltration should be expected within the near surface soils at the subject site.

Respectfully Submitted,

SOUTHERN CALIFORNIA GEOTECHNICAL, INC.

Daniel W. Nielsen, RCE 77915
Project Engineer

REGISTERED PROFESSIONAL ENGINEER
DANIEL W. NIELSEN
No. 77915
CIVIL
STATE OF CALIFORNIA

Distribution: (1) Addressee
(1) Huitt-Zollars, Attention: Mr. Johnny Murad

22885 Savi Ranch Parkway ▾ Suite E ▾ Yorba Linda ▾ California ▾ 92887
voice: (714) 685-1115 ▾ fax: (714) 685-1118 ▾ www.socalgeo.com

F-3 Updated Geotechnical Report and Site Plan Review

March 23, 2017

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Hillwood
901 Via Piemonte, Suite 175
Ontario, California 91764

Attention: Ms. Kathy Hofer

Project No.: **15G204-4**

Subject: **Update of Geotechnical Report and Site Plan Review**
Proposed Veterans Industrial Park 215
SE Terminus of Van Buren Boulevard
Between I-215 and MARB
Moreno Valley, California

Reference: Geotechnical Investigation, Proposed Geotechnical Investigation, D2 Air Cargo Compatible Development, SE Terminus of Van Buren Boulevard, Between I-215 and MARB, Moreno Valley, California, prepared for Hillwood by Southern California Geotechnical, Inc. (SCG), SCG Project No. 15G204-1, dated December 16, 2015.

Dear Ms. Hofer:

In accordance with your request, we have reviewed the most recent site plan for the proposed development and have prepared this letter to address the differences between the currently proposed development and the conceptual site plan provided at the time of the geotechnical report. The client has also provided ground water data obtained from a well located on site. In addition to reviewing the site plan, the client has asked us to comment on the groundwater well data and to provide additional information regarding the location of the site with respect to nearby earthquake faults. This letter will also serve as an update to the above referenced report.

Previous Study

Southern California Geotechnical, Inc., (SCG) previously performed a geotechnical investigation for this site, the results of which were presented in the above referenced geotechnical report. As part of this study, twenty-three (23) borings were advanced to depths of 5 to 50± feet below previously existing grades. Eight (8) of the borings were drilled within the proposed building areas to depths of 50± feet as part of a site-specific liquefaction evaluation. The remaining borings were drilled within the proposed building footprint and exterior pavement areas to depths of 5 to 20± feet.

The majority of the borings encountered older native alluvium at the ground surface. Seven of the borings encountered younger alluvium which extended to depths of 1 to 5½± feet and consisted of medium dense silty fine sands with varying quantities of medium to coarse sands and occasional medium dense clayey fine sands. The younger alluvial soils were underlain be older alluvium.

22885 Savi Ranch Parkway ▾ Suite E ▾ Yorba Linda ▾ California ▾ 92887
voice: (714) 685-1115 ▾ fax: (714) 685-1118 ▾ www.socalgeo.com

The older alluvium encountered at the ground surface or beneath the younger alluvium generally consisted of medium dense to very dense clayey sands and silty sands and very stiff to hard fine sandy clays. Occasional strata of well graded, dense to very dense sands were encountered at depths greater than 20± feet. Older alluvial soils extended to at least the maximum depth explored of 50± feet at the boring locations.

Remedial grading was recommended in the proposed building areas in order to remove a portion of the near surface soils, in order to replace them as compacted structural fill. The recommendation for remedial grading was primarily based on the fact that the near surface soils possess variable densities and were generally dry of the ASTM D-1557 optimum moisture content.

The liquefaction evaluation was performed using data obtained at all eight of the 50-foot deep borings. The results of the liquefaction evaluation did not identify any liquefiable soils. Therefore, liquefaction was not considered to be a design concern for this project.

Updated Project Description and Site Plan Review

A master site plan, prepared by RGA, was provided to our office. The plan is dated November 29, 2016. Based on this plan, the site will be developed with two (2) new distribution/logistics buildings. The buildings, identified as Buildings 1 and 2, will possess footprint areas of 1,014,822± ft^2 and 1,170,796± ft^2, respectively. The buildings will be surrounded by asphaltic concrete and/or Portland cement concrete pavements and limited landscape planter areas. A bio-retention pond will be constructed in the southeast portion of the site. A slope with an inclination of 7h:1v will be constructed along the east property line. The slope will possess a height of about 9± feet.

Plan Review Comments

The master site plan indicates that two new structures will be built at the site. At the time of the referenced report, the proposed development for the subject site was to consist of three structures. The locations, orientations, and structure type of the two new buildings are generally similar to the previously proposed development.

Based on our review of the current site plan, the recommendations contained within the referenced geotechnical report are considered to be applicable to the currently proposed development. If the new structures will be designed in accordance with the 2016 California Building Code (CBC), references to the now-obsolete 2013 CBC in the report should be considered to refer to the current to the 2016 CBC.

Updated Project Description and Site Plan Review

Based on information provided by the client, we understand that a well is present on the subject property. SCG was not aware of this well at the time of the referenced geotechnical report. The well is identified as RBEMW05. The well data provided by the client indicates that the well is 368 feet in depth and was constructed with 5 screened stages located at various depths. Water level data for this well was provided for depth readings taken between the June 30, 2000 and November 18, 2016.

As discussed in the referenced geotechnical report, the historic high groundwater level for the site was assumed to be approximately 17 feet below the existing ground surface, based on data obtained for a well located offsite on the state water data library website. The liquefaction evaluation for the subject site was based on a historic high groundwater level of 17 feet.

The data provided for Well RBEMW0 indicates groundwater levels ranging between 22 and 43 feet below the ground surface at readings taken between the dates provided above. Based on this data, the assumed historic high groundwater level of 17 feet is considered to be more conservative for the actual well data from the site. Therefore, no changes to the liquefaction evaluation are considered to be warranted based on the water level data provided by the client. Furthermore, no additional construction or design considerations due to groundwater are considered to be of concern for this site.

Site Seismicity

Based on e-mail correspondence with the client, we understand that one of the parties reviewing project documents and information, ESA, has posed two questions regarding site seismicity. Firstly, ESA asked that we document known faults in the vicinity of the project site, and secondly, to confirm that a magnitude 7.58 earthquake is the estimated probable seismic event that could impact the proposed structures.

The subject site is not located within a mapped state, county, or city fault zone. Research of the United States Geological Survey (USGS) Quaternary Fault and Fold Database of the United States indicates that the nearest fault zone to the subject site is the San Jacinto Fault Zone. This fault zone is located at least 8 miles away from the proposed structures at the subject site.

As discussed in the referenced report, the earthquake magnitude used for the liquefaction evaluation was obtained from the 2008 USGS Interactive Deaggregation application available on the USGS website. The deaggregated magnitude was based on a probabilistic analysis for a seismic event with a probability of exceedance of 2 percent in 50 years, which is equal to a return period of approximately 2,475 years. The deaggregated modal magnitude was 7.58, based on the peak ground acceleration and NEHRP soil classification D. A portion of the program output indicating the deaggregated magnitude is included as an enclosure to this letter.

Geotechnical Report Update

This letter may serve as an update to the original geotechnical report. Provided that the updated recommendations contained within this letter are implemented, the previous geotechnical report is considered valid for the currently proposed improvements.

Closure

We sincerely appreciate the opportunity to be of continued service on this project. We look forward to providing additional consulting services during the course of the project. If we may be of further assistance in any manner, please contact our office.

Respectfully Submitted,

SOUTHERN CALIFORNIA GEOTECHNICAL, INC.

REGISTERED PROFESSIONAL ENGINEER
DANIEL W. NIELSEN
No. 77915
CIVIL
STATE OF CALIFORNIA

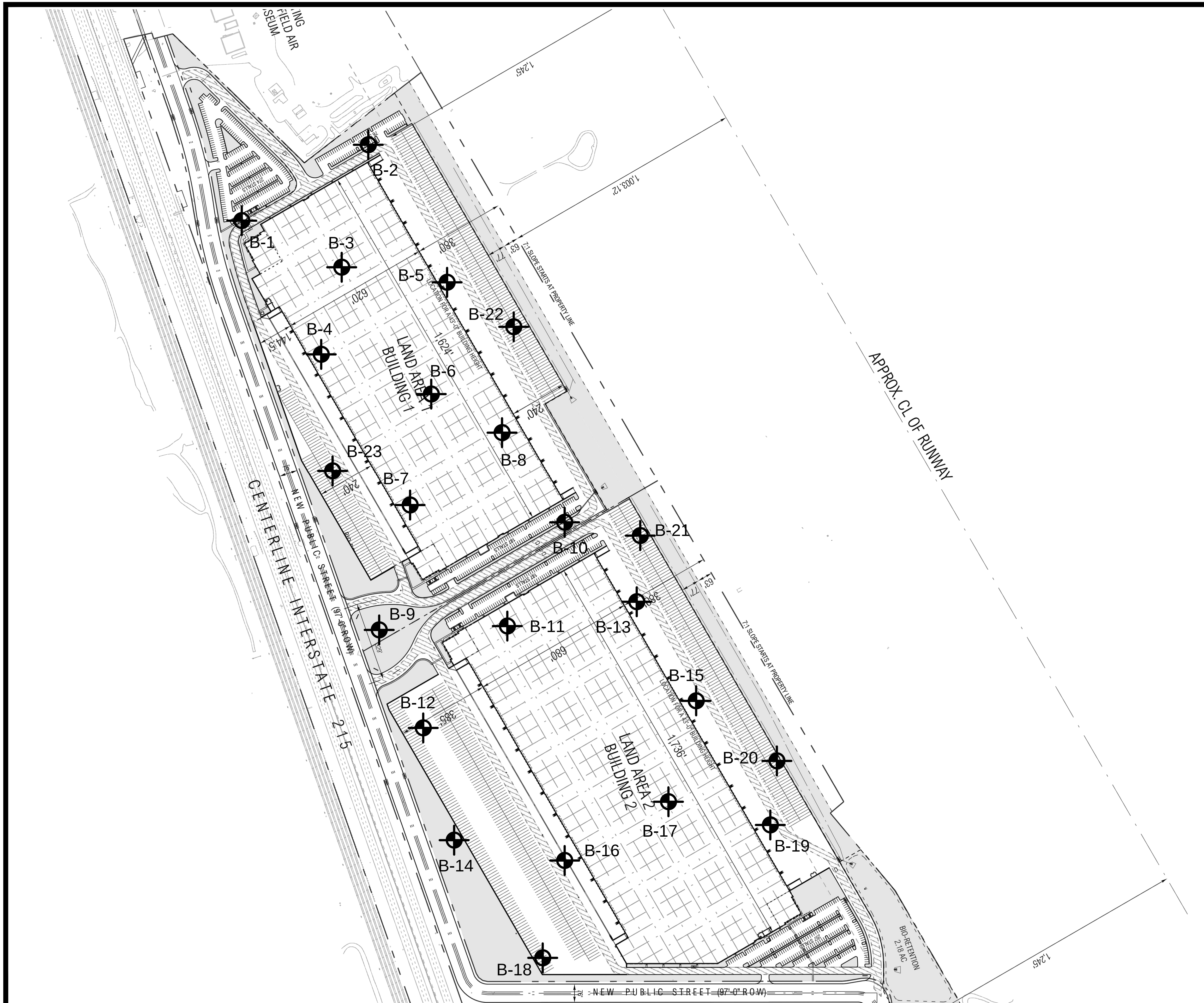
Daniel W. Nielsen, RCE 77915
Project Engineer

REGISTERED PROFESSIONAL ENGINEER
ROBERT TRAZO
No. 2655
GEOTECHNICAL
STATE OF CALIFORNIA

Robert G. Trazo, M.Sc., GE 2655
Principal Engineer

Enclosures: Plate 1: Revised Boring Location Plan
2008 Interactive Deaggregations Program Output

Distribution: (1) Addressee

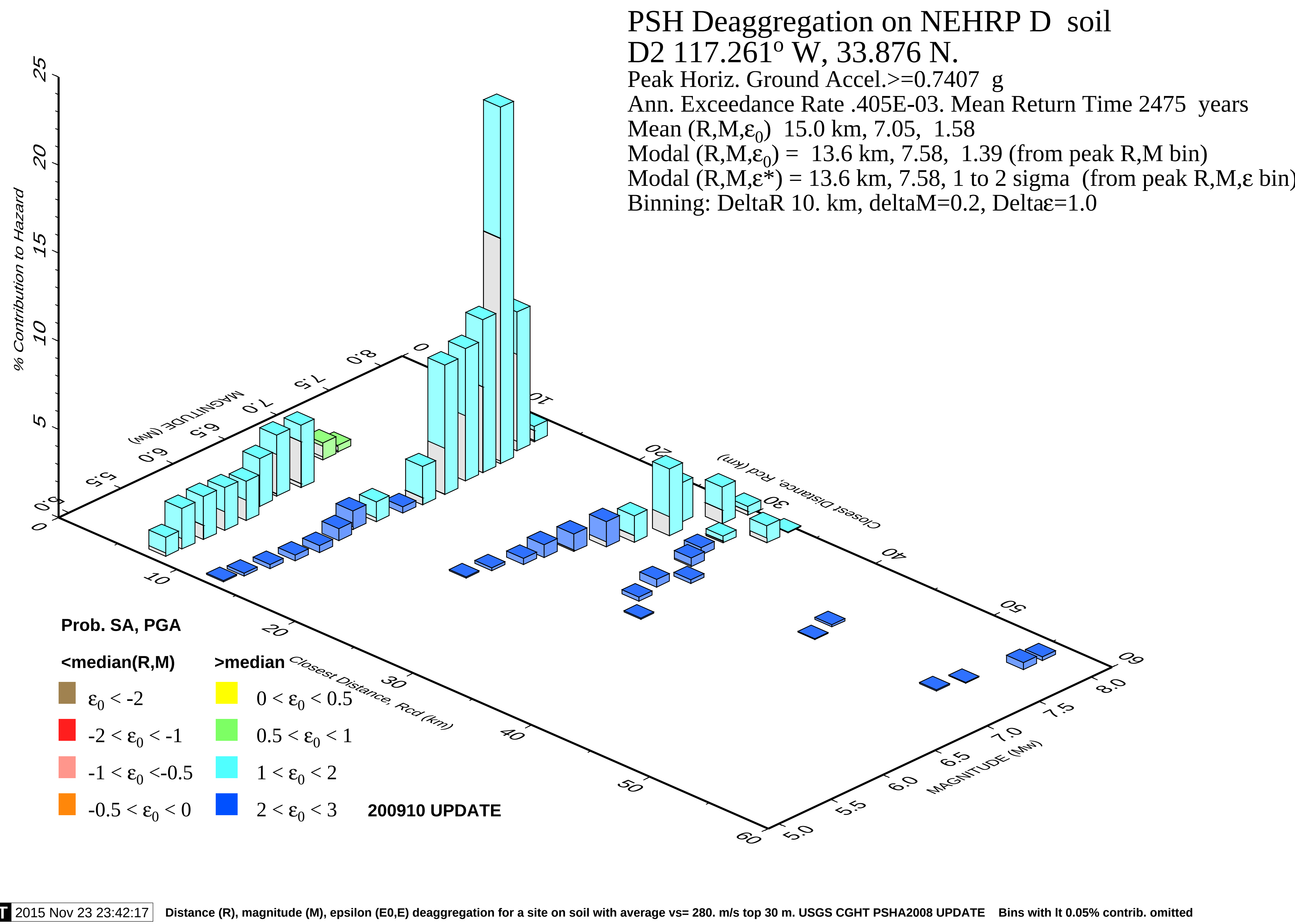


GEOTECHNICAL LEGEND

⌖ APPROXIMATE BORING LOCATION

NOTE: SITE MAP PROVIDED BY RGA ARCHITECTS

UPDATED BORING LOCATION PLAN	
PROPOSED VETERANS INDUSTRIAL PARK 215	
MORENO VALLEY, CALIFORNIA	
SCALE: 1" = 400'	SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: MRM CHKD: JAS	
SCG PROJECT 15G204-4	
PLATE 1	


PSH Deaggregation on NEHRP D soil
D2 117.261° W, 33.876 N.
Peak Horiz. Ground Accel.>=0.7407 g
Ann. Exceedance Rate .405E-03. Mean Return Time 2475 years
Mean (R,M,ε0) 15.0 km, 7.05, 1.58
Modal (R,M,ε0) = 13.6 km, 7.58, 1.39 (from peak R,M bin)
Modal (R,M,ε*) = 13.6 km, 7.58, 1 to 2 sigma (from peak R,M,ε bin)
Binning: DeltaR 10. km, deltaM=0.2, Deltaε=1.0
% Contribution to Hazard
0
5
10
15
20
25
MAGNITUDE (Mw)
5.0
5.5
6.0
6.5
7.0
7.5
8.0
Closest Distance, Rcd (km)
0
10
20
30
40
50
60
Prob. SA, PGA
<median(R,M)
>median
ε0 < -2
-2 < ε0 < -1
-1 < ε0 <-0.5
-0.5 < ε0 < 0
0 < ε0 < 0.5
0.5 < ε0 < 1
1 < ε0 < 2
2 < ε0 < 3
200910 UPDATE
GMT 2015 Nov 23 23:42:17
Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on soil with average vs= 280. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

F-4 Geotechnical Hazards Review, Proposed Van Buren Boulevard Extension

September 28, 2018

Hillwood
901 Via Piemonte, Suite 175
Ontario, California 91764

Attention: Ms. Kathy Hoffer
Development Director

Project No.: **15G204-5**

Subject: **Geotechnical Hazards Review**
Proposed Van Buren Boulevard Extension
Van Buren Boulevard, South of Escondido Freeway Van Buren Boulevard Off-Ramp
Moreno Valley, California

Dear Ms. Hoffer:

In accordance with your request, this report presents the geotechnical hazards review for the proposed development. In order to prepare this report, we have conducted geotechnical and geologic research of available sources. This report does not include any field or laboratory testing. A comprehensive geotechnical study may be required prior to developing this site.

Site Location and Proposed Development

The subject site consists of a portion of Van Buren Boulevard extending from approximately 750 feet south of the northbound Escondido Freeway (Interstate 215) Van Buren Boulevard off-ramp to the north boundary of March Air Reserve Base (MARB). The general location of the site is illustrated on the Site Location Map, enclosed as Plate 1 of this report.

Based on electronic mail conversations with the client, we understand that the proposed development will consist of a four lane extension of Van Buren Boulevard. It is assumed that the new pavements will consist of asphaltic concrete.

Regional Geology

The subject site is located within the Peninsular Ranges province. The Peninsular Ranges province consists of several northwesterly-trending ranges in the southwestern California. The province is truncated to the north by the east-west trending Transverse Ranges. Prior to the mid-Mesozoic, the region was covered by seas and thick marine sedimentary and volcanic sequences were deposited. The bedrock geology that dominates the elevated areas of the Peninsular Ranges consists of high-grade metamorphic rocks intruded by Mesozoic plutons. During the Cretaceous, extensive mountain building occurred during the emplacement of the southern California batholith. The Peninsular Ranges have been significantly disrupted by Tertiary and Quaternary strike-slip faulting along the Elsinore and San Jacinto faults. This tectonic activity has resulted in the present terrain.

Geologic Conditions

The geologic conditions of the subject site were determined by research of the Geologic Map of for the Riverside East 7.5' Quadrangle, Riverside County, California, published by the United States Geological Survey (USGS) in corporation with the California Division of Mines and Geology currently known as California Geological Survey (CGS) and the United States Air Force (USAF). A portion of this map is presented as Plate 2 of this report. As shown on Plate 2, the subject site is underlain by early Pleistocene age very old alluvial fan deposits (Map Symbol Qvof). The old alluvial fan deposits are described as mostly well-dissected, well-induated, reddish-brown sand deposits.

Fault Rupture Hazard

Currently, there is no published Alquist-Priolo Earthquake Fault Zone Map for the Riverside East Quadrangle. Therefore, the CGS has not mapped any active or potentially active faults with potential surface fault rupture in the Riverside East Quadrangle. In addition, the Riverside County Information Technology (RCIT) Map My County at https://gis.countyofriverside.us does not depict any fault zones near the subject site. A portion of this map is presented as Plate 4 of this report.

The nearest fault zone is the San Jacinto Fault Zone (SJFZ) located 8± miles northeast of the subject site. The SJFZ is a right-lateral strike-slip fault with minor right-reverse. The SJFZ has a total length of 210 km with a slip rate ranging between 7 and 17 mm/yr. The interval between surface ruptures ranges between 100 and 300 years with a probable magnitude of M_w 6.5 to 7.5 (SCEC).

Based on research of the RCIT website and the referenced geologic map, the subject site is not located within a fault zone. Therefore, the possibility of significant fault rupture on the site is considered to be low.

Liquefaction

Liquefaction is the loss of strength in generally cohesionless, saturated soils when the pore-water pressure induced in the soil by a seismic event becomes equal to or exceeds the overburden pressure. The primary factors which influence the potential for liquefaction include groundwater table elevation, soil type and grain size characteristics, relative density of the soil, initial confining pressure, and intensity and duration of ground shaking. The depth within which the occurrence of liquefaction may impact surface improvements is generally identified as the upper 50 feet below the existing ground surface. Liquefaction potential is greater in saturated, loose, poorly graded fine sands with a mean (d_{50}) grain size in the range of 0.075 to 0.2 mm (Seed and Idriss, 1971). Clayey (cohesive) soils or soils which possess clay particles ($d<0.005$mm) in excess of 20 percent (Seed and Idriss, 1982) are generally not considered to be susceptible to liquefaction, nor are those soils which are above the historic static groundwater table.

The site is depicted as being located within a high liquefaction potential zone as mapped by the RCIT website. A portion of this map is presented as Plate 3 of this report. Although the subject site is located within a zone of high liquefaction potential, there are no structures proposed as part of this project. Therefore, liquefaction is not considered to be a design concern for this project.

Other Secondary Seismic Hazards

Secondary seismic hazards include lateral spreading, seismic settlement of dry soils and landsliding. Based on the proximity to the SJFZ and a relatively flat topography, there is little to no potential for lateral spreading and seismic settlements of dry sands or risk of landsliding. In addition, the subject site is not located near any large body of water, therefore, risk of seiches is considered to be low.

Closure

We sincerely appreciate the opportunity to be of service on this project. We look forward to providing additional consulting services during the course of the project. If we may be of further assistance in any manner, please contact our office.

Respectfully Submitted,

SOUTHERN CALIFORNIA GEOTECHNICAL, INC.

Daryl Kas, CEG 2467
Project Geologist

Robert G. Trazo, GE 2655
Principal Engineer

Enclosure: Plate 1: Site Location Map
Plate 2: Geologic Map
Plate 3: Riverside County Seismic Hazards Map
Plate 4: Riverside County Fault Map

SOURCE: RIVERSIDE COUNTY
THOMAS GUIDE, 2013

SITE LOCATION MAP

VAN BUREN EXTENTION

MORENO VALLEY, CALIFORNIA

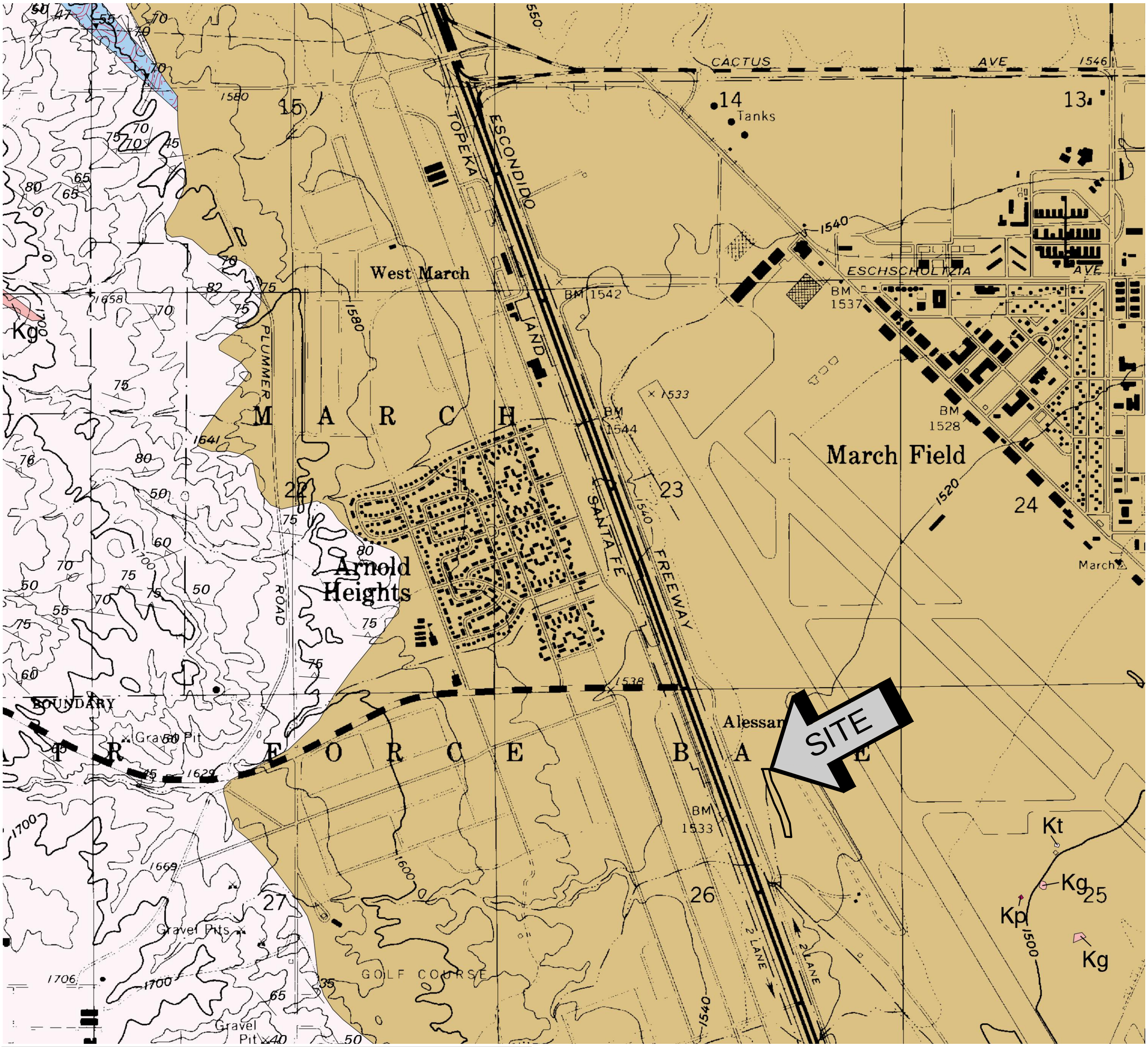
SCALE: 1" = 2400'

DRAWN: DRK
CHKD: RGT

SCG PROJECT
15G204-5

PLATE 1

SoCalGeo
SOUTHERN
CALIFORNIA
GEOTECHNICAL



DESCRIPTION OF MAP UNITS

Qvof	**Very old alluvial fan deposits (early Pleistocene)—**Mostly well-dissected, well-indurated, reddish-brown sand deposits. Commonly contains duripans and locally silcretes. Forms large area in southeastern part of quadrangle in area of March Air Force Base, and numerous smaller areas in northern part of quadrangle. Derived chiefly from rocks of southern California batholith
Kvt	**Val Verde tonalite—**Gray-weathering, relatively homogeneous, massive- to well-foliated, medium- to coarse-grained, hypautomorphic-granular biotite-hornblende tonalite; principal rock type of Val Verde pluton. Contains subequal biotite and hornblende, quartz and plagioclase. Potassium feldspar generally less than two percent of rock. Where present, foliation typically strikes northwest and dips moderately to steeply northeast. Northern part of pluton contains younger, intermittently developed, northeast-striking foliation. In central part of pluton, tonalite is mostly massive, and contains few segregational masses of mesocratic to melanocratic tonalite. Elliptical- to pancake-shaped, meso-to melanocratic inclusions are common.
KgPz	**Intermixed Paleozoic(?) schist and gneiss and Cretaceous granitic rocks (Cretaceous and Paleozoic?)—**Intermixed Paleozoic(?) schist and gneiss and Cretaceous granitic rocks, mostly tonalite and granodiorite. Forms elongate mass within Val Verde tonalite (Kvt) west of Sycamore Canyon and small mass south of Tequesquite Arroyo

SOURCE: "GEOLOGIC MAP OF THE RIVERSIDE EAST 7.5' QUADRANGLE, RIVERSIDE COUNTY, CALIFORNIA" MORTON AND COX, 1997

GEOLOGIC MAP

VAN BUREN EXTENTION

MORENO VALLEY, CALIFORNIA

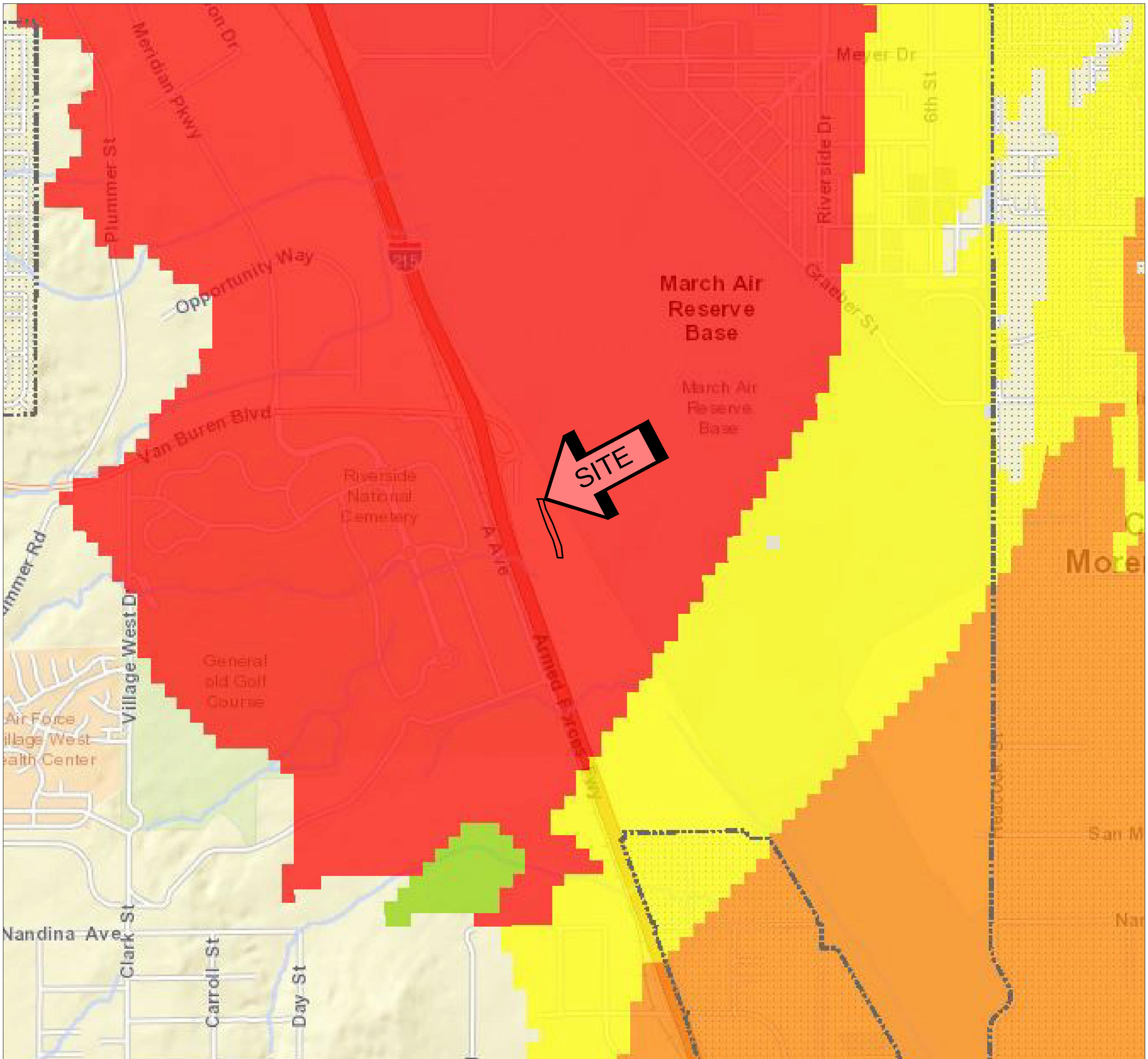
SCALE: 1" = 2000'

DRAWN: DRK
CHKD: RGT

SCG PROJECT
15G204-5

PLATE 2

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL



Legend

Geographic Layers

Liquefaction

- Other Susceptibility
- High
- Low
- Moderate
- Very High
- Very low

SOURCE: RIVERSIDE COUNTY
MAP MY COUNTY GIS

RIVERSIDE COUNTY SEISMIC HAZARDS MAP

VAN BUREN EXTENTION

MORENO VALLEY, CALIFORNIA

SCALE: 1" = 2400'	SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: DRK CHKD: RGT	
SCG PROJECT 15G204-5	
PLATE 3	

Legend

- Geographic Layers
  - Faults
    - OTHER AUTHORITY
    - ALQUIST-PRIOLO
    - RIVERSIDE COUNTY
  - Fault Zones
    - OTHER FAULT ZONE
    - COUNTY FAULT ZONE
    - ELSINORE FAULT ZONE
    - SAN ANDREAS FAULT ZONE
    - SAN JACINTO FAULT ZONE

SOURCE: RIVERSIDE COUNTY
MAP MY COUNTY GIS

RIVERSIDE COUNTY FAULT MAP

VAN BUREN EXTENTION

MORENO VALLEY, CALIFORNIA

SCALE: 1" = 2400'

DRAWN: DRK
CHKD: RGT

SCG PROJECT
15G204-5

PLATE 4

SOUTHERN CALIFORNIA GEOTECHNICAL

F-5 Geotechnical Hazards Review, Proposed Western Way Extension – North

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

October 2, 2018

Hillwood
901 Via Piemonte, Suite 175
Ontario, California 91764

Attention: Ms. Kathy Hoffer
Development Director

Project No.: **15G204-6**

Subject: **Geotechnical Hazards Review**
Proposed Western Way Extension - North
Western Way between March Air Reserve Base and Nandina Avenue
Perris, California

Dear Ms. Hoffer:

In accordance with your request, this report presents the geotechnical hazards review for the proposed development. In order to prepare this report, we have conducted geotechnical and geologic research of available sources. This report does not include any field or laboratory testing. A comprehensive geotechnical study may be required prior to developing this site.

Site Location and Proposed Development

The subject site consists of a portion of Western Way extending from March Air Reserve Base (MARB) south to Nandina Avenue in Perris, California. The general location of the site is illustrated on the Site Location Map, enclosed as Plate 1 of this report.

Based on electronic mail conversations with the client and other members of the design team, we understand that the proposed development will consist of a new street and an 18-inch-diameter Eastern Municipal Water District (EMWD) pipeline to be constructed along the portion of Western Way between the project site, located at the southeast terminus of Van Buren Boulevard between I-215 and the March Air Reserve Base, and Nandina Avenue. It is assumed that the new pavements will consist of asphaltic concrete.

Regional Geology

The subject site is located within the Peninsular Ranges province. The Peninsular Ranges province consists of several northwesterly-trending ranges in the southwestern California. The province is truncated to the north by the east-west trending Transverse Ranges. Prior to the mid-Mesozoic, the region was covered by seas and thick marine sedimentary and volcanic sequences were deposited. The bedrock geology that dominates the elevated areas of the Peninsular Ranges consists of high-grade metamorphic rocks intruded by Mesozoic plutons. During the Cretaceous, extensive mountain building occurred during the emplacement of the southern California batholith. The Peninsular Ranges have been significantly disrupted by Tertiary and Quaternary strike-slip faulting along the Elsinore and San Jacinto faults. This tectonic activity has resulted in the present terrain.

Geologic Conditions

The geologic conditions of the subject site were determined by research of the Geologic Map of for the Steel Peak 7.5' Quadrangle, Riverside County, California, published by the United States Geological Survey (USGS) in corporation with the California Division of Mines and Geology currently known as California Geological Survey (CGS) and the United States Air Force (USAF). A portion of this map is presented as Plate 2 of this report. As shown on Plate 2, the subject site is underlain by early Pleistocene age very old alluvial fan deposits (Map Symbol Qvof). The old alluvial fan deposits are described as mostly well-dissected, well-induated, reddish-brown sand deposits.

Fault Rupture Hazard

Currently, there is no published Alquist-Priolo Earthquake Fault Zone Map for the Riverside East Quadrangle. Therefore, the CGS has not mapped any active or potentially active faults with potential surface fault rupture in the Riverside East Quadrangle. In addition, the Riverside County Information Technology (RCIT) Map My County at https://gis.countyofriverside.us does not depict any fault zones near the subject site. A portion of this map is presented as Plate 4 of this report.

The nearest fault zone is the San Jacinto Fault Zone (SJFZ) located 8.5± miles northeast of the subject site. The SJFZ is a right-lateral strike-slip fault with minor right-reverse. The SJFZ has a total length of 210 km with a slip rate ranging between 7 and 17 mm/yr. The interval between surface ruptures ranges between 100 and 300 years with a probable magnitude of M_w 6.5 to 7.5 (SCEC).

Based on research of the RCIT website and the referenced geologic map, the subject site is not located within a fault zone. Therefore, the possibility of significant fault rupture on the site is considered to be low.

Liquefaction

Liquefaction is the loss of strength in generally cohesionless, saturated soils when the pore-water pressure induced in the soil by a seismic event becomes equal to or exceeds the overburden pressure. The primary factors which influence the potential for liquefaction include groundwater table elevation, soil type and grain size characteristics, relative density of the soil, initial confining pressure, and intensity and duration of ground shaking. The depth within which the occurrence of liquefaction may impact surface improvements is generally identified as the upper 50 feet below the existing ground surface. Liquefaction potential is greater in saturated, loose, poorly graded fine sands with a mean (d_{50}) grain size in the range of 0.075 to 0.2 mm (Seed and Idriss, 1971). Clayey (cohesive) soils or soils which possess clay particles ($d<0.005$mm) in excess of 20 percent (Seed and Idriss, 1982) are generally not considered to be susceptible to liquefaction, nor are those soils which are above the historic static groundwater table.

The site is depicted as being located within a low to moderate liquefaction potential zone as mapped by the RCIT website. A portion of this map is presented as Plate 3 of this report. Although the subject site is located within a zone of low to moderate liquefaction potential, there are no structures proposed as part of this project. Therefore, liquefaction is not considered to be a design concern for this project.

Other Secondary Seismic Hazards

Secondary seismic hazards include lateral spreading, seismic settlement of dry soils and landsliding. Based on the proximity to the SJFZ and a relatively flat topography, there is little to no potential for lateral spreading and seismic settlements of dry sands or risk of landsliding. In addition, the subject site is not located near any large body of water, therefore, risk of seiches is considered to be low.

Closure

We sincerely appreciate the opportunity to be of service on this project. We look forward to providing additional consulting services during the course of the project. If we may be of further assistance in any manner, please contact our office.

Respectfully Submitted,

SOUTHERN CALIFORNIA GEOTECHNICAL, INC.

Daryl Kas, CEG 2467
Project Geologist

Robert G. Trazo, GE 2655
Principal Engineer

Enclosure: Plate 1: Site Location Map
Plate 2: Geologic Map
Plate 3: Riverside County Seismic Hazards Map
Plate 4: Riverside County Fault Map

SOURCE: RIVERSIDE COUNTY
THOMAS GUIDE, 2013

SITE LOCATION MAP

WESTERN WAY EXTENTION - NORTH

PERRIS, CALIFORNIA

SCALE: 1" = 2400'

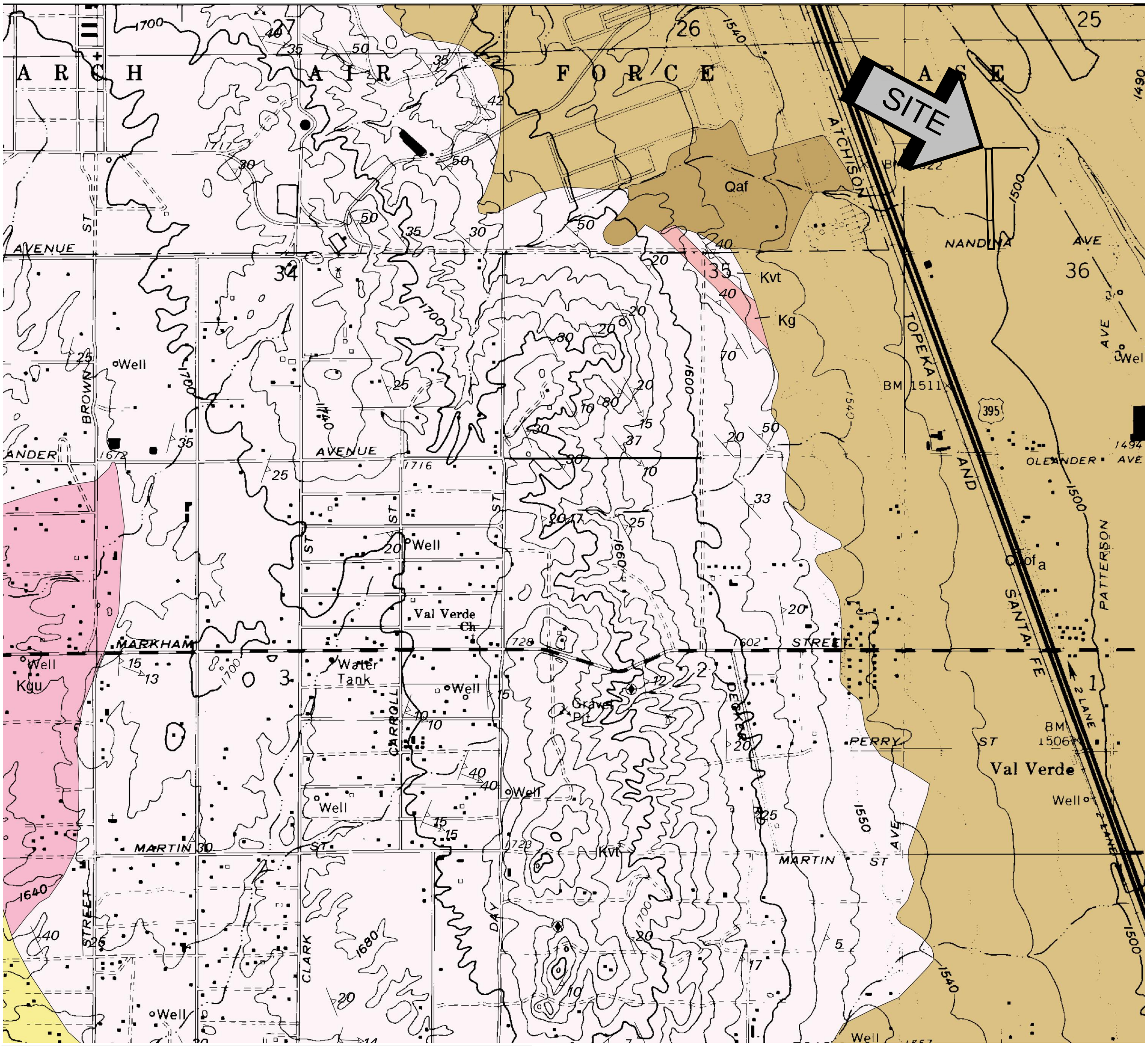
DRAWN: DRK
CHKD: RGT

SCG PROJECT
15G204-6

PLATE 1

SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL



DESCRIPTION OF MAP UNITS

Qaf	**Artificial fill (late Holocene)—**Deposits of fill resulting from human construction; restricted to construction activities on March Air Force Base in northeastern part of quadrangle and Colorado River aqueduct construction near Cajalco Road.
Qvof	**Very old alluvial fan deposits (early Pleistocene)—**Mostly well-dissected, well-indurated, reddish-brown sand deposits. Commonly contains duripans and locally silcretes. Covers large areas adjacent to U.S. Highway 215 in northeastern part of quadrangle and flanking drainage followed by Cajalco Road
Kvt	**Val Verde tonalite—**Gray-weathering, relatively homogeneous, massive- to well-foliated, medium- to coarse-grained, hypautomorphic-granular biotite-hornblende tonalite; principal rock type of Val Verde pluton. Contains subequal biotite and hornblende, quartz and plagioclase. Potassium feldspar generally less than two percent of rock. Where present, foliation typically strikes northwest and dips moderately to steeply northeast. Northern part of pluton contains younger, intermittently developed, northeast-striking foliation. In central part of pluton, tonalite is mostly massive, and contains few segregational masses of mesocratic to melanocratic tonalite. Elliptical- to pancake-shaped, meso-to melanocratic inclusions are common

SOURCE: "GEOLOGIC MAP OF THE STEEL PEAK' QUADRANGLE, RIVERSIDE COUNTY, CALIFORNIA" MORTON, 2001

GEOLOGIC MAP

WESTERN WAY EXTENSION - NORTH

PERRIS, CALIFORNIA

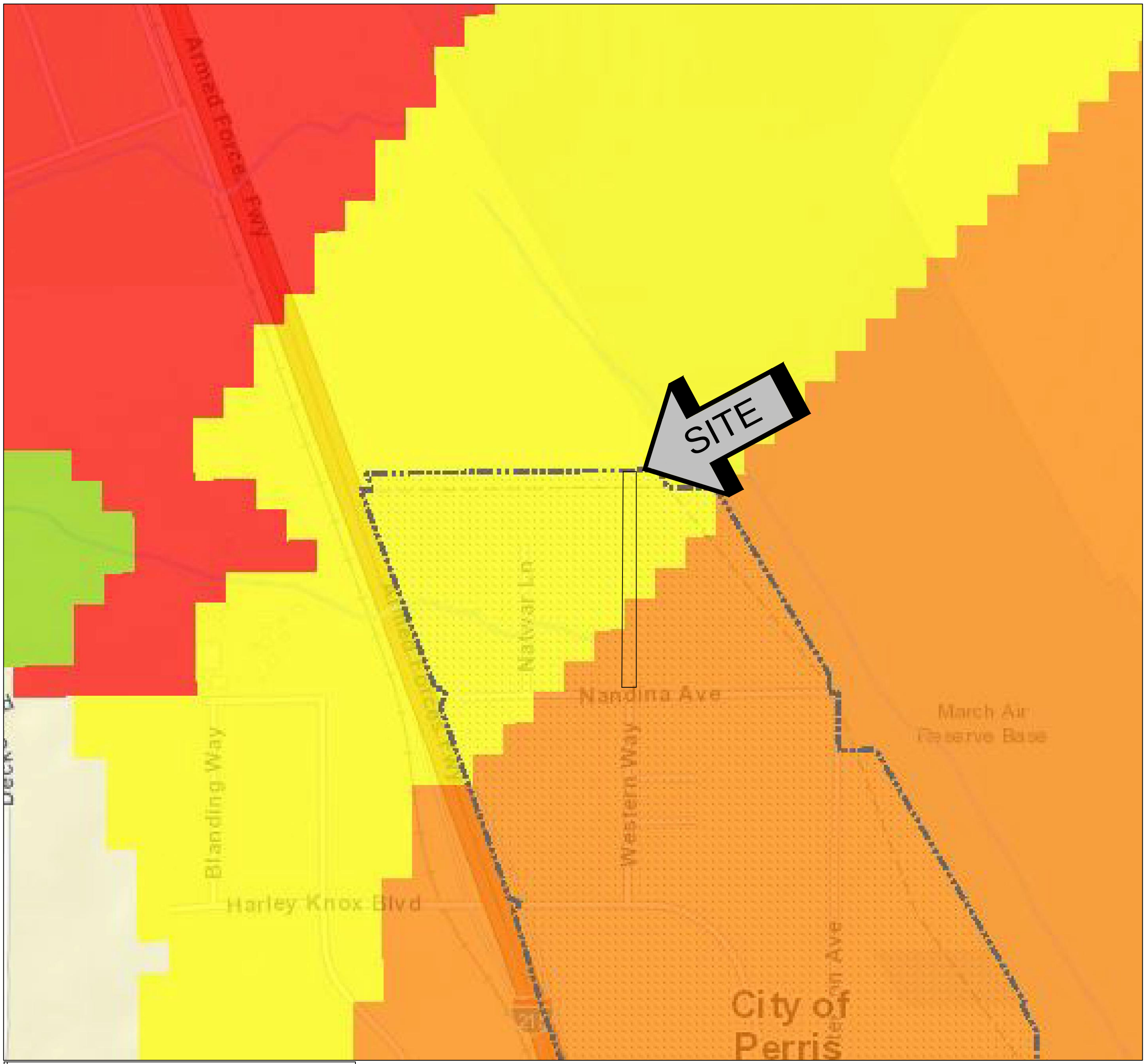
SCALE: 1" = 2000'

DRAWN: DRK
CHKD: RGT

SCG PROJECT
15G204-6

PLATE 2

SOUTHERN CALIFORNIA GEOTECHNICAL



Legend

- Geographic Layers
  - Liquefaction
    - Other Susceptibility
    - High
    - Low
    - Moderate
    - Very High
    - Very low

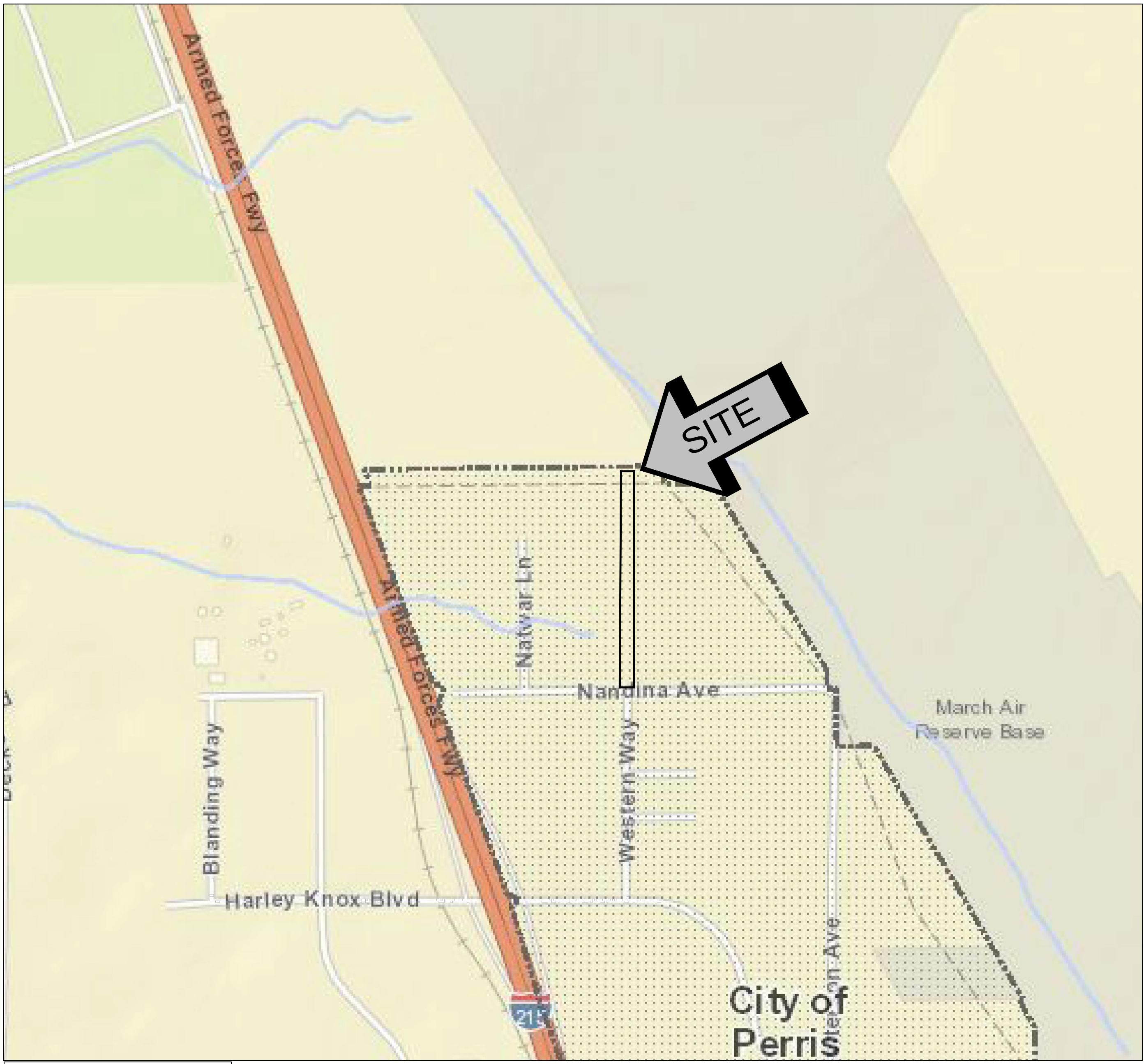
SOURCE: RIVERSIDE COUNTY
MAP MY COUNTY GIS

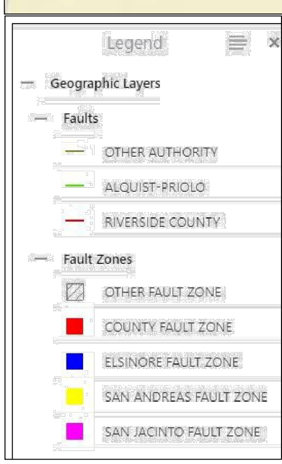
RIVERSIDE COUNTY SEISMIC HAZARDS MAP

WESTERN WAY EXTENTION - NORTH

PERRIS, CALIFORNIA

SCALE: 1" = 1000'	SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: DRK CHKD: RGT	
SCG PROJECT 15G204-6	
PLATE 3	





SOURCE: RIVERSIDE COUNTY
MAP MY COUNTY GIS

RIVERSIDE COUNTY FAULT MAP

WESTERN WAY EXTENTION - NORTH

PERRIS, CALIFORNIA

SCALE: 1" = 1000'

DRAWN: DRK
CHKD: RGT

SCG PROJECT
15G204-6

PLATE 4

SoCalGeo
SOUTHERN
CALIFORNIA
GEOTECHNICAL

F-6 Geotechnical Hazards Review, Proposed Western Way Extension – South

September 28, 2018

Hillwood
901 Via Piemonte, Suite 175
Ontario, California 91764

Attention: Ms. Kathy Hoffer
Development Director

Project No.: **15G204-7**

Subject: **Geotechnical Hazards Review**
Proposed Western Way Extension - South
Western Way between Nandina Avenue and Harley Knox Boulevard
Perris, California

Dear Ms. Hoffer:

In accordance with your request, this report presents the geotechnical hazards review for the proposed development. In order to prepare this report, we have conducted geotechnical and geologic research of available sources. This report does not include any field or laboratory testing. A comprehensive geotechnical study may be required prior to developing this site.

Site Location and Proposed Development

The subject site consists of a portion of Western Way extending from Nandina Avenue south to Harley Knox Boulevard in Perris, California. The general location of the site is illustrated on the Site Location Map, enclosed as Plate 1 of this report.

Based on electronic mail conversations with the client, we understand that the proposed development will consist of a new 18-inch Eastern Municipal Water District (EMWD) pipeline.

Regional Geology

The subject site is located within the Peninsular Ranges province. The Peninsular Ranges province consists of several northwesterly-trending ranges in the southwestern California. The province is truncated to the north by the east-west trending Transverse Ranges. Prior to the mid-Mesozoic, the region was covered by seas and thick marine sedimentary and volcanic sequences were deposited. The bedrock geology that dominates the elevated areas of the Peninsular Ranges consists of high-grade metamorphic rocks intruded by Mesozoic plutons. During the Cretaceous, extensive mountain building occurred during the emplacement of the southern California batholith. The Peninsular Ranges have been significantly disrupted by Tertiary and Quaternary strike-slip faulting along the Elsinore and San Jacinto faults. This tectonic activity has resulted in the present terrain.

Geologic Conditions

The geologic conditions of the subject site were determined by research of the Geologic Map of for the Steel Peak 7.5′ Quadrangle, Riverside County, California, published by the United States Geological Survey (USGS) in corporation with the California Division of Mines and Geology currently known as California Geological Survey (CGS) and the United States Air Force (USAF). A portion of this map is presented as Plate 2 of this report. As shown on Plate 2, the subject site is underlain by early Pleistocene age very old alluvial fan deposits (Map Symbol Qvof). The old alluvial fan deposits are described as mostly well-dissected, well-induated, reddish-brown sand deposits.

Fault Rupture Hazard

Currently, there is no published Alquist-Priolo Earthquake Fault Zone Map for the Riverside East Quadrangle. Therefore, the CGS has not mapped any active or potentially active faults with potential surface fault rupture in the Riverside East Quadrangle. In addition, the Riverside County Information Technology (RCIT) Map My County at https://gis.countyofriverside.us does not depict any fault zones near the subject site. A portion of this map is presented as Plate 4 of this report.

The nearest fault zone is the San Jacinto Fault Zone (SJFZ) located 8.5± miles northeast of the subject site. The SJFZ is a right-lateral strike-slip fault with minor right-reverse. The SJFZ has a total length of 210 km with a slip rate ranging between 7 and 17 mm/yr. The interval between surface ruptures ranges between 100 and 300 years with a probable magnitude of M_w 6.5 to 7.5 (SCEC).

Based on research of the RCIT website and the referenced geologic map, the subject site is not located within a fault zone. Therefore, the possibility of significant fault rupture on the site is considered to be low.

Liquefaction

Liquefaction is the loss of strength in generally cohesionless, saturated soils when the pore-water pressure induced in the soil by a seismic event becomes equal to or exceeds the overburden pressure. The primary factors which influence the potential for liquefaction include groundwater table elevation, soil type and grain size characteristics, relative density of the soil, initial confining pressure, and intensity and duration of ground shaking. The depth within which the occurrence of liquefaction may impact surface improvements is generally identified as the upper 50 feet below the existing ground surface. Liquefaction potential is greater in saturated, loose, poorly graded fine sands with a mean (d_{50}) grain size in the range of 0.075 to 0.2 mm (Seed and Idriss, 1971). Clayey (cohesive) soils or soils which possess clay particles ($d<0.005$mm) in excess of 20 percent (Seed and Idriss, 1982) are generally not considered to be susceptible to liquefaction, nor are those soils which are above the historic static groundwater table.

The site is depicted as being located within a low liquefaction potential zone as mapped by the RCIT website. A portion of this map is presented as Plate 3 of this report. Therefore, liquefaction is not considered to be a design concern for this project.

Other Secondary Seismic Hazards

Secondary seismic hazards include lateral spreading, seismic settlement of dry soils and landsliding. Based on the proximity to the SJFZ and a relatively flat topography, there is little to no potential for lateral spreading and seismic settlements of dry sands or risk of landsliding. In addition, the subject site is not located near any large body of water, therefore, risk of seiches is considered to be low.

Closure

We sincerely appreciate the opportunity to be of service on this project. We look forward to providing additional consulting services during the course of the project. If we may be of further assistance in any manner, please contact our office.

Respectfully Submitted,

SOUTHERN CALIFORNIA GEOTECHNICAL, INC.

Daryl Kas, CEG 2467
Project Geologist

Robert G. Trazo, GE 2655
Principal Engineer

Enclosure: Plate 1: Site Location Map
Plate 2: Geologic Map
Plate 3: Riverside County Seismic Hazards Map
Plate 4: Riverside County Fault Map

SOURCE: RIVERSIDE COUNTY
THOMAS GUIDE, 2013

SITE LOCATION MAP

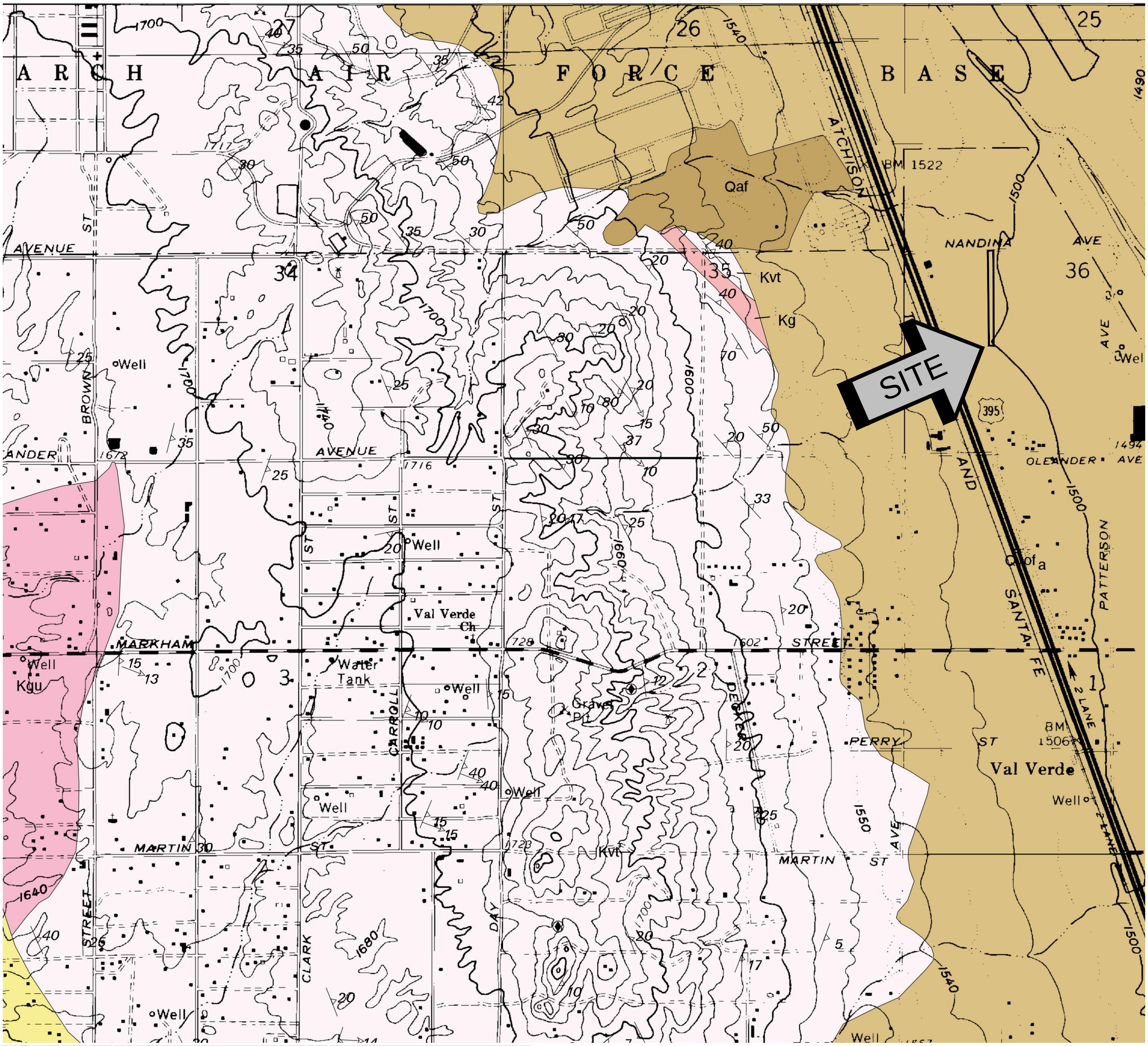
WESTERN WAY EXTENTION - SOUTH

PERRIS, CALIFORNIA

SCALE: 1" = 2400'	
DRAWN: DRK CHKD: RGT	
SCG PROJECT 15G204-7	
PLATE 1	

SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL



DESCRIPTION OF MAP UNITS

Qaf — **Artificial fill (late Holocene)—**Deposits of fill resulting from human construction; restricted to construction activities on March Air Force Base in northeastern part of quadrangle and Colorado River aqueduct construction near Cajalco Road.

Qvof — **Very old alluvial fan deposits (early Pleistocene)—**Mostly well-dissected, well-indurated, reddish-brown sand deposits. Commonly contains duripans and locally silcretes. Covers large areas adjacent to U.S. Highway 215 in northeastern part of quadrangle and flanking drainage followed by Cajalco Road

Kvt — **Val Verde tonalite—**Gray-weathering, relatively homogeneous, massive- to well-foliated, medium- to coarse-grained, hypautomorphic-granular biotite-hornblende tonalite; principal rock type of Val Verde pluton. Contains subequal biotite and hornblende, quartz and plagioclase. Potassium feldspar generally less than two percent of rock. Where present, foliation typically strikes northwest and dips moderately to steeply northeast. Northern part of pluton contains younger, intermittently developed, northeast-striking foliation. In central part of pluton, tonalite is mostly massive, and contains few segregational masses of mesocratic to melanocratic tonalite. Elliptical- to pancake-shaped, meso-to melanocratic inclusions are common

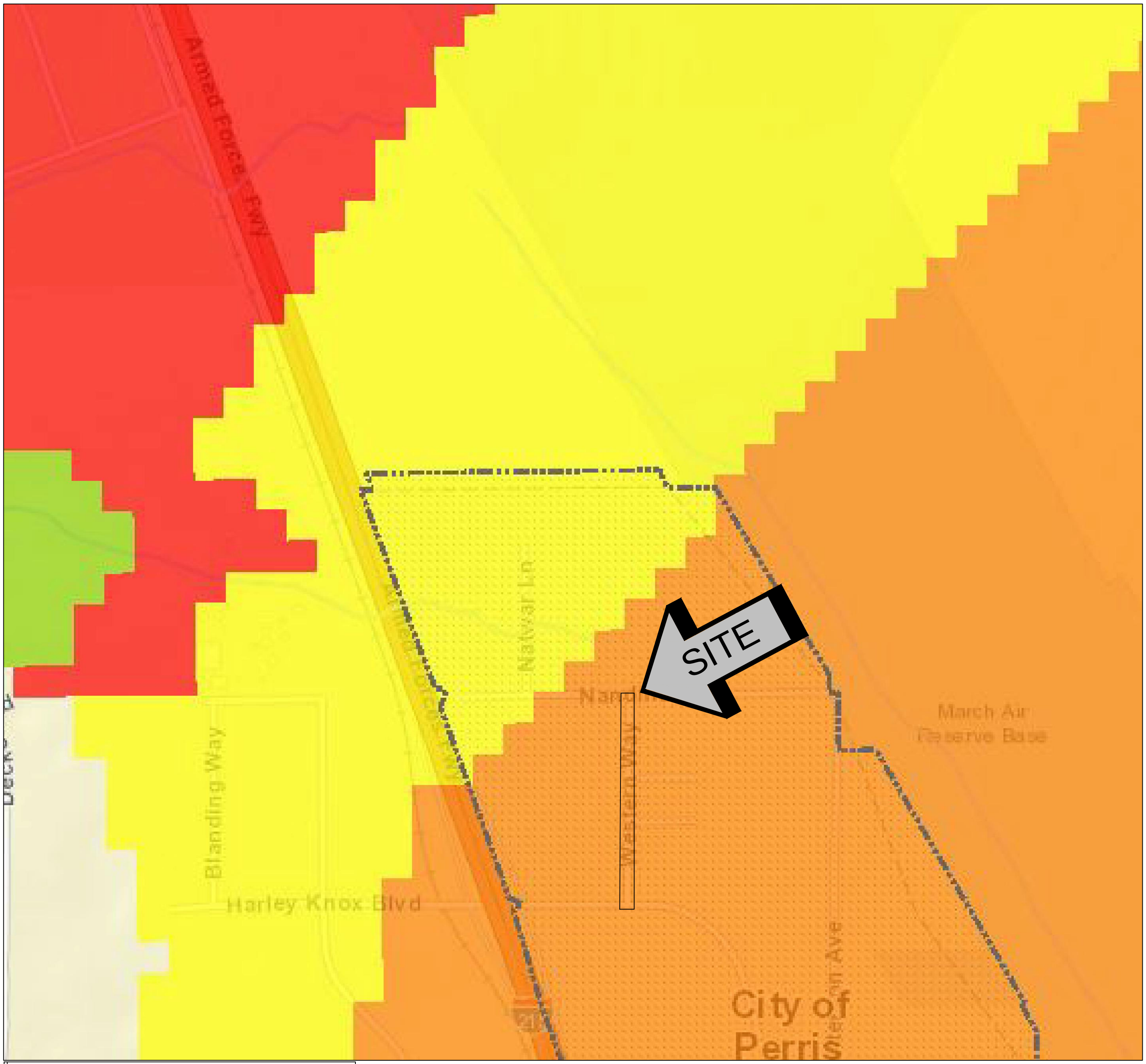
SOURCE: "GEOLOGIC MAP OF THE STEEL PEAK' QUADRANGLE, RIVERSIDE COUNTY, CALIFORNIA" MORTON, 2001

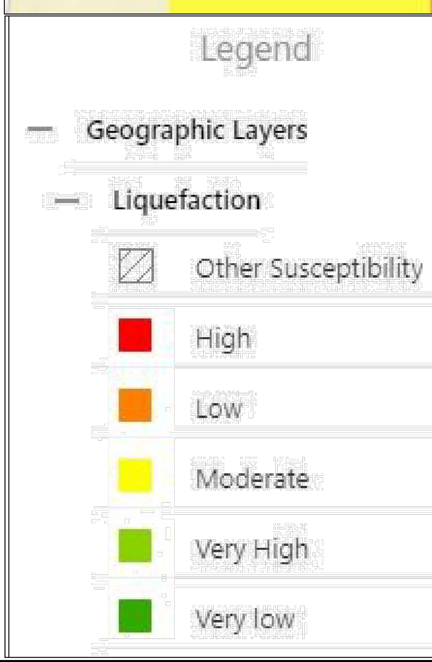
GEOLOGIC MAP

WESTERN WAY EXTENSION - SOUTH

PERRIS, CALIFORNIA

SCALE: 1" = 2000'	SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: DRK CHKD: RGT	
SCG PROJECT 15G204-7	
PLATE 2	





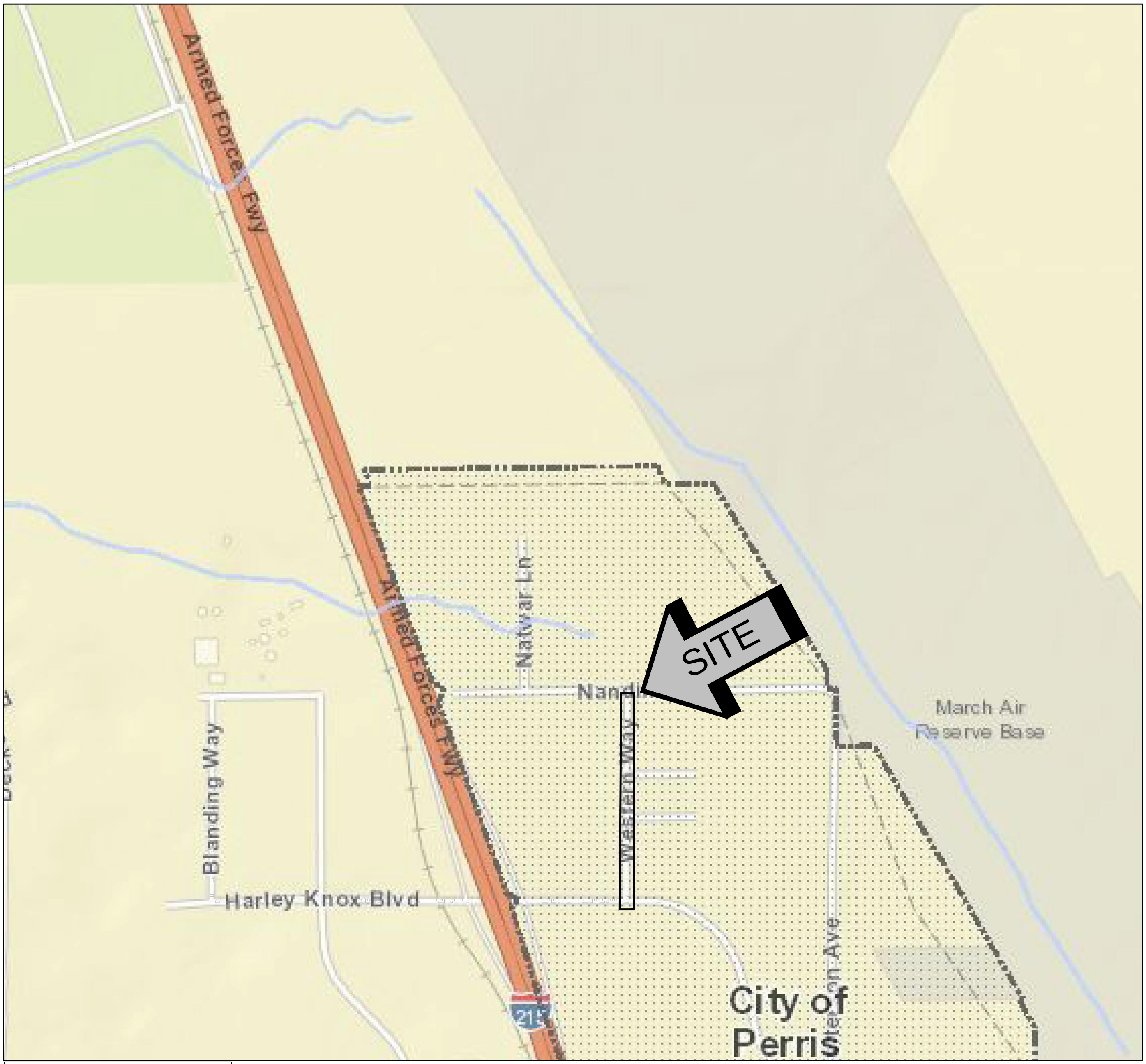
SOURCE: RIVERSIDE COUNTY
MAP MY COUNTY GIS

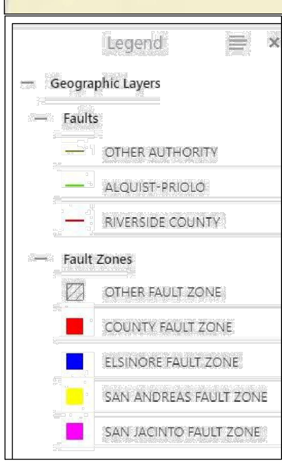
RIVERSIDE COUNTY SEISMIC HAZARDS MAP

WESTERN WAY EXTENTION - SOUTH

PERRIS, CALIFORNIA

SCALE: 1" = 1000'	SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: DRK CHKD: RGT	
SCG PROJECT 15G204-7	
PLATE 3	





SOURCE: RIVERSIDE COUNTY
MAP MY COUNTY GIS

RIVERSIDE COUNTY FAULT MAP

WESTERN WAY EXTENTION - SOUTH

PERRIS, CALIFORNIA

SCALE: 1" = 1000'

DRAWN: DRK
CHKD: RGT

SCG PROJECT
15G204-7

PLATE 4

SoCalGeo
SOUTHERN
CALIFORNIA
GEOTECHNICAL